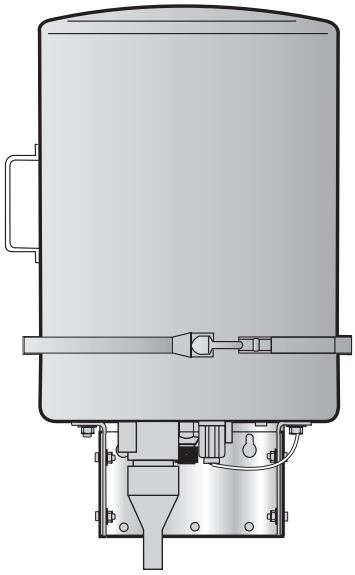
USER MANUAL



HRE-454 Remote Enclosure

Model	List Number	Part Number	CLEI Code
HRE-454	1A	150-1122-11	
HRE-454	2A	150-1122-21	T1RHM2W4
HRE-454	1B	150-1122-12	T1RHMCV4
HRE-454	2B	150-1122-22	T1RHMCW4
HRE-454	3	150-1122-03	N/A
HRE-454	4	150-1122-04	N/A
HRE-454	5	150-1122-05	N/A
HRE-454	6	150-1122-06	N/A

Revision History of This Manual

To order copies of this manual, use document catalog number 150-454-111-06.

Issue	Release Date	Revisions Made
04	June 12, 1998	Updated the following: • HRE-454 List 5 and List 6 Applications section. • Figure 17, Figure 20, and Table 11.
05	February 25, 2000	• Changed from plastic to all-metal control valves. • Wired pin 27 to chassis ground. • Removed optional security cover.
06	August 9, 2002	• ADC rebranding only

USING THIS MANUAL

The following conventions are used in this manual:

- `Monospace type` indicates screen text.
- Keys you press are indicated by small icons such as Y or ENTER. Key combinations to be pressed simultaneously are indicated with a plus sign as follows: CTRL + ESC.
- Items you select are in **bold**.
- Three types of messages, identified by icons, appear in text.

Notes contain information about special circumstances.

Cautions indicate the possibility of personal injury or equipment damage.

The Electrostatic Discharge (ESD) symbol indicates that a device or assembly is susceptible to damage from electrostatic discharge.

For a list of abbreviations used in this document, refer to "Appendix D - Glossary" on page 64.

INSPECTING SHIPMENT

Upon receipt of the equipment:

- Unpack each container and 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 DSL Systems, Inc. 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 DSL Systems, Inc. as described in "Appendix C - Product Support" on page 63. If you must store the equipment for a prolonged period, store the equipment in its original container.

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LIST OF FIGURES

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OVERVIEW

This document describes the ADC® HiGain® weatherproof enclosures HRE-454 List 1A, List 1B, List 3 and List 5 (gel-filled), and the HRE-454 List 2A, List 2B, List 4, and List 6 (air-filled). Information on installing these enclosures is also included. The HRE-454 is part of a HiGain system and used to house the HiGain remote line or doubler units.

FEATURES

The following features are included on the HRE-454 HiGain weatherproof enclosures:

- Four single-width slots
- 30-foot (9.144 M) gel- or air-filled 28-pair cable stub
- 100-foot gel- or air-filled 28-pair cable stub (List 1B and List 2B only)
- Flat surface, rack, or pole mount
- Primary surge protection
- Seamless stainless steel cover
- Single stub access
- Tilt forward mounting

APPLICATIONS

The primary application of the HRE-454 remote enclosure is to house HiGain remote or doubler units in a HiGain repeaterless T1 transmission system. The HRE-454 is an outdoor enclosure with four single-width 400 mechanical slots. It has a single gel-filled stub (List 1A, List 1B, List 3, and List 5) or air-filled stub (List 2A, List 2B, List 4, and List 6).

The air-filled unit can be pressurized locally or from the main feeder cable through an air core stub. This air core stub protects the air-filled unit from flooding with water when it is mounted in underground manholes. The gel-filled unit is intended for above ground pole mounting applications.

Figure 2 on page 5 shows the gel-filled HRE-454 and Figure 3 on page 6 shows the air-filled HRE-454. The gel-filled version comes with a combination air stem/air intake T-valve while the air-filled version comes with an air stem. The T-valve provides the option of pressurizing the gel-filled unit locally. Another noticeable difference is that, in the gel-filled unit, the pressure relief valve is replaced by a breather vent valve. However, both units have primary gas tube surge protection on all signal ports.

For a front and rear view of the internal portion of the HRE-454, see Figure 12 on page 26. The interior four-slot card cage is also shown. Remote or doubler units are installed in these slots.

HRE-454 List 3 and List 4

The number of spare pairs in the enclosure has been reduced from eleven to four. The reduction was implemented to reduce the antenna effect which produces excessive Electromagnetic Interference (EMI) when too many spare pairs are installed in one enclosure. The four remaining spare pairs are:

- Group 1
  - Red and Slate
  - Black and Blue
  - Black and Orange
- Group 2
  - Red and Brown

The four remaining spare pairs and all signal pairs are routed through ferrite coils. The coils are embedded in the bottom of the enclosure and prevent EMI energy from escaping the pairs. In addition, the green ground wire that previously connected the stub shield to the enclosure card cage (List 2A) has been replaced by a short copper braided wire (see Figure 12 on page 26 for more information). The braided wire helps to reduce the high frequency noise in the ground plane.

The HRE-454 List 3 and List 4 enclosures have been modified to comply with the following European Union Conformité Européene (CE) Mark requirements:

- EMI compliance: EN 55022, Class B and IEC-950
- Electrostatic Discharge (ESD) compliance and fast transients: ENC 5082-1, IEC-801-2, and 801-4
- Safety: EN 60950 and IEC 950

HRE-454 List 5 and List 6

The HRE-454 List 5 and List 6 are mainly used for housing HLU-431and HLU-432 line units. The line units have the same 400/200 mechanics as the doubler and remote units and are used for extending T1 services over distribution pairs that connect fiber-fed hubs to remote locations. However, instead of being line-powered over the HDSL pairs, like doubler and remote units, the HLU-431 or HLU-432 is powered from -48 Vdc at its edge connector on pins 17 (+) and 35 (-). The HRE-454 List 5 and List 6 are located adjacent to the hub and gain access to the T1 payloads and -48 Vdc power over the cable stub that connects the two units. The system alarm relay contacts from each of the four slots are also brought out through the stub. See Table 12 on page 51 and Figure 24 on page 43 for wiring information.

Figure 1 on page 3 shows a typical HRE-454 List 5 application where it is used to extend T1 service from a Nortel© DMS-1 Urban S100E Digital Loop Carrier (DLC) fiber-fed hub to a remote Nortel Access Node. Nortel provides a HiGain compatible remote unit that has been integrated into the Access Node shelf precluding the need for an externally located remote unit.

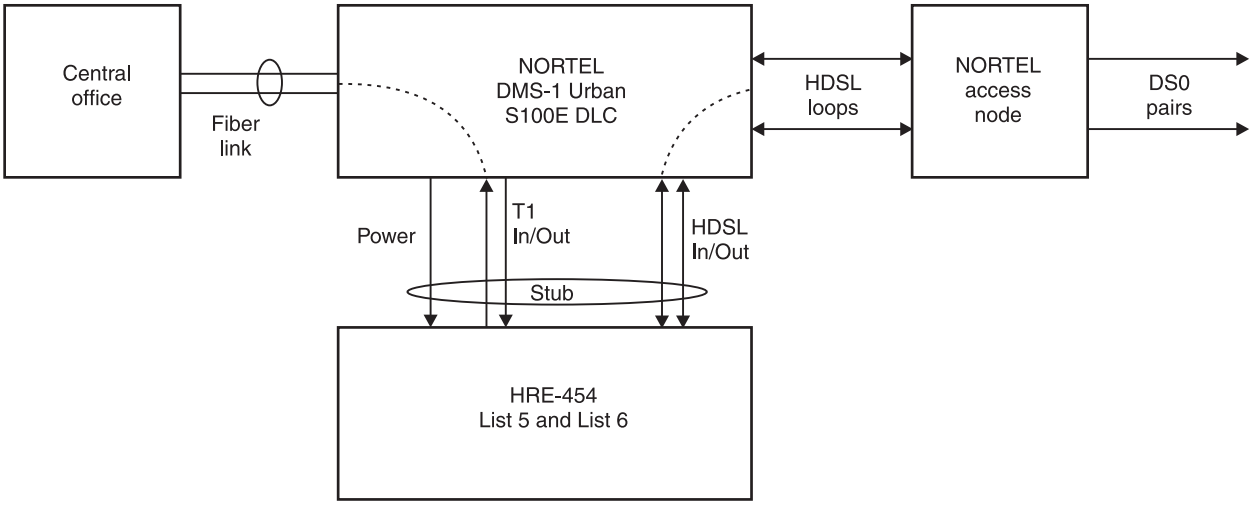


Figure 1. *Typical HRE-454 List 5 and List 6 Application*

Doubler, Line, and Remote Unit

All HRE-454 list numbers use the following doubler, line, and remote units. See the respective figure number listed in the table next to the unit to view pinout assignments for that unit. Refer to "HRE-454 Wiring" on page 33 for HiGain pair assignments and Figure 24 on page 43 for a diagram listing all the HRE-454 wiring interfaces.

Table 1. *Doubler, Line, and Remote Unit Pin Assignment Figure Numbers*

Unit	Figure and Page Number	Description	Wire List
HRU-412	Figure 16 on page 35	Remote module for 2 pair (HDSL), T1 (1.544 Mbps) service.	Table 8 on page 44
ERU-412 List 2	Figure 17 on page 36	Remote module for 2 pair (HDSL), E1 (2.048 Mbps) service, G.703, 120Ω balanced.	Table 9 on page 46
HRU-512	Figure 18 on page 37	Remote module for 1 pair (HDSL), T1 fractional (128 to 786 kbps) service.	Table 10 on page 47
HRU-612	Figure 19 on page 38	Remote module for 1 pair (HDSL), T1 (1.544 Mbps) service.	Table 10 on page 47
HDU-451, HDU-404, and EDU-451	Figure 20 on page 39	Doubler module for 2 pair (HDSL), T1 (HDU-451, HDU-404) or E1 (EDU-451) service.	Table 11 on page 49
HLU-431 List 1D, HLU-432	Figure 21 on page 40	Line Unit Module for 2 pair (HDSL) T1 (1.546 Mbps) service.	Table 12 on page 51
HRU-402	Figure 22 on page 41	Remote unit for 2 pair (HDSL), T1 (1.544 Mbps) service.	Table 8 on page 44
H2TU-R-402	Figure 23 on page 42	Remote unit for 1 pair (HDSL2), T1 (1.544 Mbps) service.	Table 10 on page 47

Only the HRE-454 List 5 and List 6 units are wired to provide -48 Vdc power to their four slots.

Doubler Applications

The HRE-454 houses the following HiGain doubler units:

- HDU-404 T1 (1.544 Mbps)
- HDU-451 T1 (1.544 Mbps)
- EDU-451 E1 (2.048 Mbps)

All three units have identical pin assignments as shown in Figure 20 on page 39. The wire list for each doubler appears in Table 11 on page 49. Figure 24 on page 43 summarizes all the HRE-454 interfaces.

FUNCTIONAL DESCRIPTION

The following section discusses the function of each component on the HRE-454.

The HRE-454 consists of a metal alloy card cage with space for up to four remote or doubler units, a stainless steel composite baseplate, and a stainless steel cover which maintains weather-tight integrity. Figure 2 on page 5 and Figure 3 on page 6 show the details for each unit.

Gel-filled Stub Units

The gel-filled unit comes equipped with three metal valves installed in the base section, as shown in Figure 2 on page 5. The gel-filled, screened, 28-pair, 24 American Wire Gauge (AWG) cable stub on the gel-filled unit is equivalent to an ALP FTS-PIC filled core telephone cable. (Refer to Table 7 on page 33 for a complete description of the cable stub.) The unit has foam skin insulation with a single-filled jacket. This insulation allows the cable stub on the gel-filled unit to be used in buried, aerial, and duct applications. Standard color codes are used for pair identification with color compounds chosen for electrical balance and permanency. The outer jacket provides a flexible protective covering that withstands exposure to sunlight, atmospheric temperatures, ground chemicals, and stresses expected in standard installations. The outside diameter of the cable is 0.64 inches (16.25 mm).

The cable complies with the requirements of the American National Standards Institute (ANSI) and the Insulated Cable Engineers Association (ICEA) S-84-608-1994 and REA PE-89, respectively.

The gel-filled unit is similar to the air-filled unit (Figure 3 on page 6), except that the gel-filled unit has a breather vent valve instead of a pressure relief valve. The breather vent valve allows the circulation of outside air through the gel-filled enclosure. Circulating outside air through the gel-filled enclosure prevents the buildup of excessive moisture and other damaging contaminants within the enclosure.

A combined Schrader air stem/external air input T-valve is also included with the gel units. The Schrader air stem valve can be used to connect to an external air source or to release the internal pressure whenever the dome is to be removed. Opposite the Schrader valve, the external air input valve accepts tubing for connection to an external air source. The pressure cutoff valve allows the external source of air to be cut off when the dome is to be opened.

An optional pressure relief valve is included in the shipping kit for the gel units. The kit comes in a small plastic bag that is attached to the shrink tab on one of the spare pairs. Use the valve in place of the breather vent valve when the get unit is to be locally pressurized.

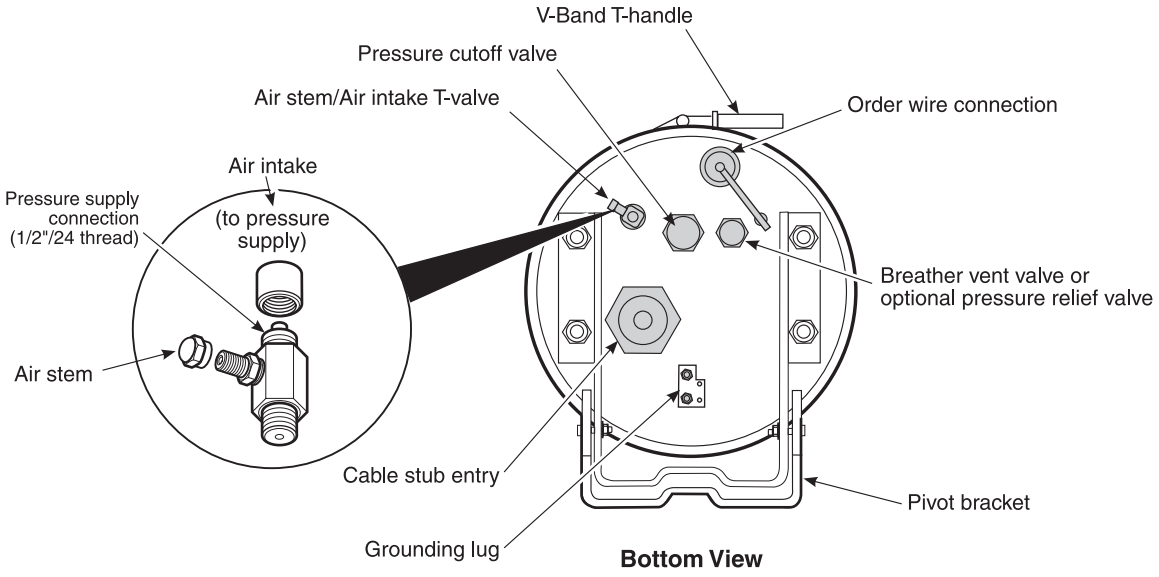


Figure 2. *HRE-454 Gel-filled Remote Enclosure*

Air-filled Stub Units

The air-filled, screened, 28-pair, 24 AWG cable stub on the air-filled unit (Figure 3 on page 6) is equivalent to an ALP FTS-PIC air-filled telephone cable. The unit comes with three metal valves: an air-pressure cutoff valve, a Schrader air stem valve, and a pressure relief valve. The air cutoff valve is used to shut off the inlet air supply that is pumped from the main feeder cable through the 30-foot (9.144 M) stub into the HRE-454 enclosure. The cable stub is intended for buried, aerial, and duct applications. Standard color codes are used for pair identification. A jacket protects the core and provides improved mechanical and electrical characteristics. The outer jacket provides a flexible protective covering that withstands exposure to sunlight, atmospheric temperatures, ground chemicals, and stresses expected in standard installations. The outside diameter of the cable is 0.64 inches (16.25 mm). Refer to Table 7 on page 33 for a complete description of the cable stub.

The cable complies with the requirements of ANSI/ICEA S-85-625-1996 and REA PE-22.

The HRE-454 cable sealing, O-ring, and V-Band seal have been safety tested to 36 pounds per square inch (PSI). Most cables become ruptured or damaged at this pressure level. However, the HRE-454 cable sealing is designed to handle this amount of pressure.

Avoid using pressures above 36 PSI. Such pressures could force the V-Band away from the flange and, in effect, impel the dome away from the housing. This could cause damage or injury.

The common pressure supplied through the cable is approximately 9 PSI. This is sufficient to prevent water from entering the cable or housing. ADC recommends pressurizing the enclosure to a maximum of 12 PSI.

To avoid pressure buildup, the pressure relief valve is set to release air at a maximum pressure of 15 PSI. Due to manufacturing tolerances of the springs, this maximum pressure has a tolerance of +/- 3 PSI. This pressure and tolerance is well within the safety concerns that may apply to the housing, personnel, or cable.

The pressure relief valve is not intended for controlling the air pressure that is being applied to the housing cable.

PRESSURIZED APPLICATIONS

For pressurized applications on the HRE-454, the Schrader air stem valve is used. A pressure gauge is attached to the valve for the purpose of measuring the internal pressure of the enclosure. This valve is also used to relieve the internal pressure prior to opening and removing the dome cover. This can be done by depressing the center pin on the valve (see Figure 3 on page 6 and Figure 4 on page 7 for air stem valve and pin locations).

Depressurizing must be performed every time the cover is removed from the List 2A, List 2B, List 4, and List 6 equipment. Failure to do so may cause personal injury or damage to the equipment. This also applies to a gel-filled unit that is being locally pressurized.

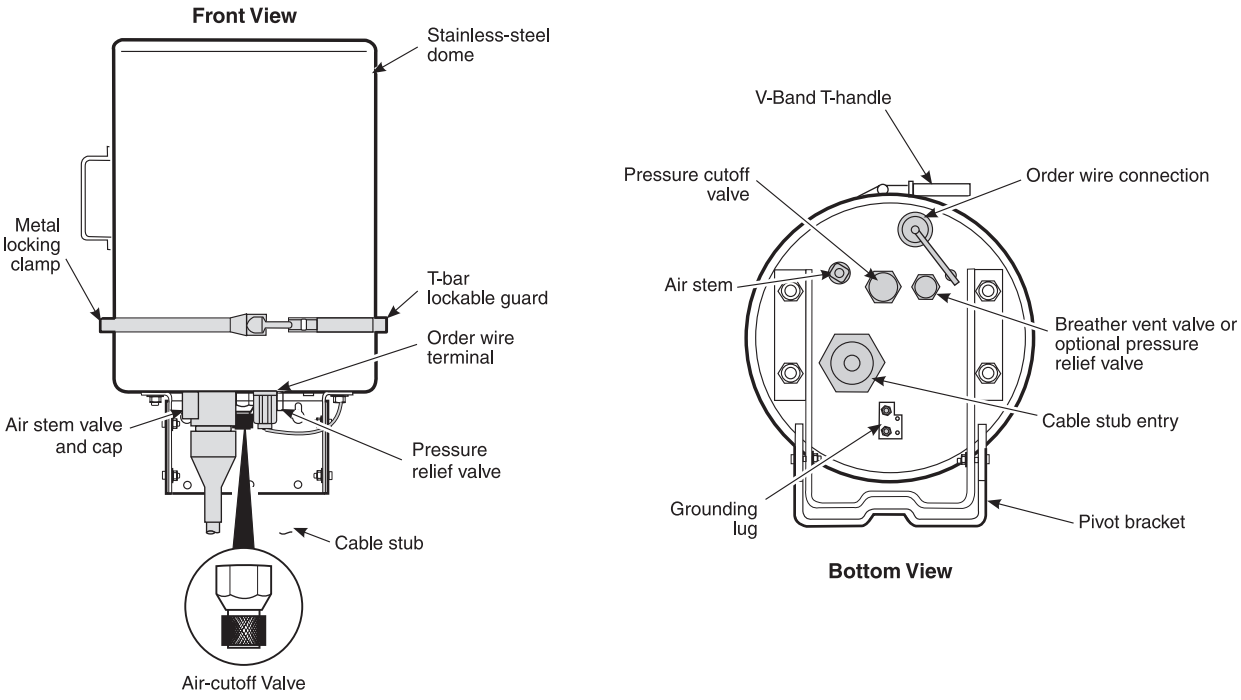


Figure 3. *HRE-454 Air-filled Remote Enclosure*

A breather vent valve is enclosed in an air-filled shipping kit. The kit is a small plastic bag attached to a red and brown colored spare pairs shrink tube. The breather vent valve replaces the pressure relief valve if the air-filled unit is not pressurized. The assembly allows the enclosure to breathe and keeps the internal atmosphere free of harmful contaminants. The five metal valves are shown in Figure 4.

Unlike the gel-filled unit, the pressure cutoff valve in the air-filled unit cannot be used to cut off an external air source that is applied to the Schrader air stem valve. The air-filled unit pressure cutoff valve can only control the air source that is applied to the enclosure through the air core stub.

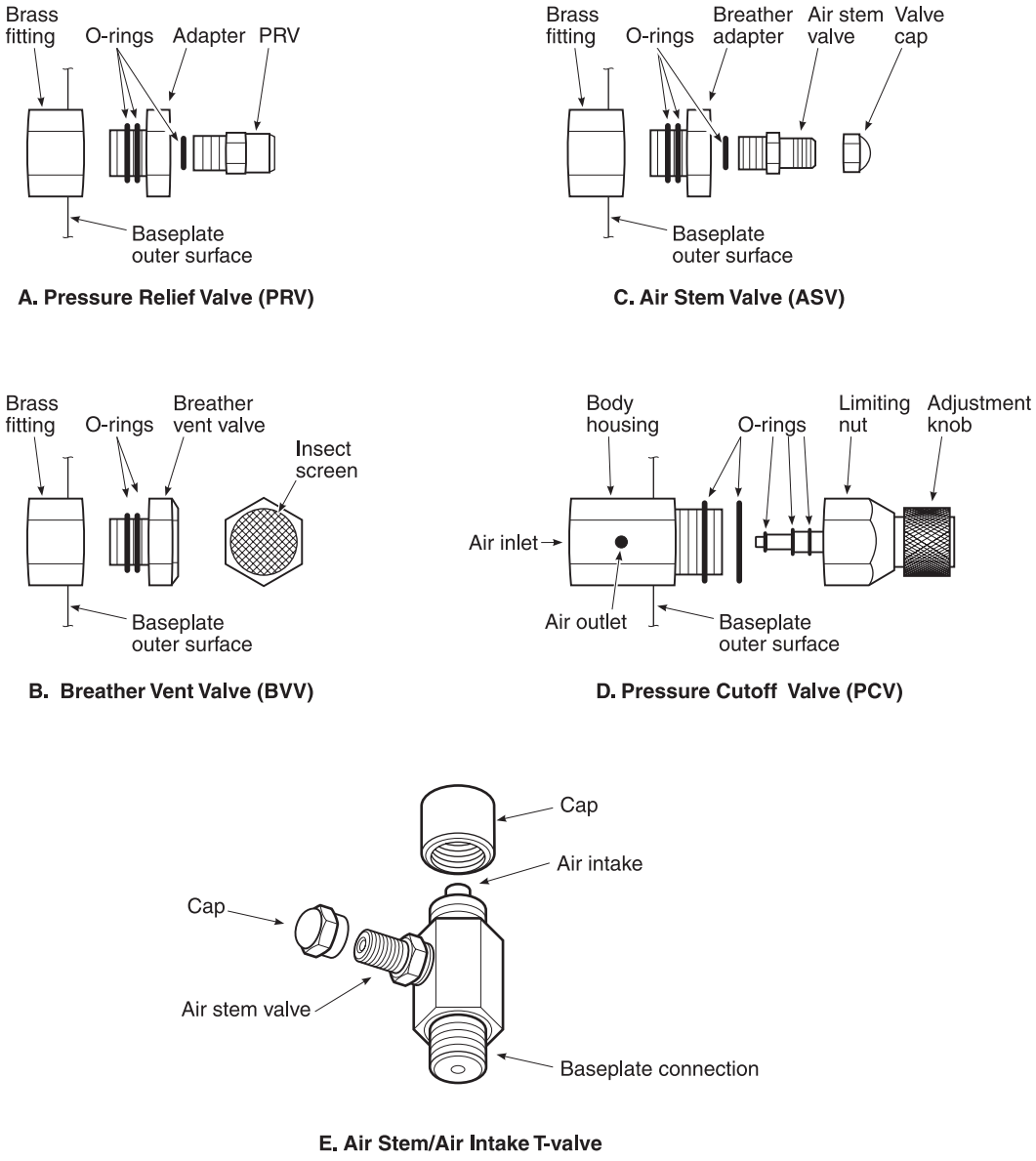


Figure 4. *Metal Valves*

INSTALLATION

UNPACKING AND INSPECTING YOUR SHIPMENT

When you receive the equipment, inspect it for signs of damage. If damage has occurred, immediately report the extent of damage to the transportation company and to ADC Telecommunications, Inc. (see "Appendix C - Product Support" on page 63 for more information).

Your shipment should consist of:

- One HRE-454
- One HTC-400 test card
- HiGain Remote Enclosure HRE-454 List 1A, List 2A, List 1B, List 2B, List 3, List 4, List 5, and List 6 Technical Practice

Before installing the HRE-454, unpack and inspect it for missing components and physical damage that may have occurred during shipping. To unpack the enclosure:

1 Remove the HRE-454 from its shipping carton.

2 Perform an inventory to verify that all equipment listed on the packing list is present.

3 Inspect the enclosure for shipping damage.

4 Check the card cage for any sign of breakage.

5 Check the O-ring for any sign of damage.

6 Find and loosen the retaining screws at the rear base of the card cage.

7 Tilt the card cage on its hinge.

8 Lower the card cage to its level position and tighten the screws to lock it in position. ADC recommends always keeping the card cage in a level, locked position.

9 Report any damage to the carrier immediately.

If you must store the equipment for a prolonged period of time, store it in the container shipped with your equipment.

An HTC-400 test card is included with every HRE-454. This unit is found in a separate box inside the HRE-454 shipping carton. The test card provides an easy-to-use way of accessing and testing the four cable pairs connected to every HRE-454 slot. The test card is provided free of charge for your convenience.

MOUNTING

The HRE-454 may be mounted on a pole, a pedestal, a flat surface, or in a rack (Figure 5). Various methods for mounting the HRE-454 are detailed in the following sections. The mounting details for the various methods are as follows:

Table 2. *Mounting Details*

Mounting	Page
Pole mounting with a pole diameter of less than 7 inches (17.78 cm)	9
Pole mounting with a pole diameter greater than 7 inches (17.78 cm)	10
Flat surface mounting	11
Rack mounting	12

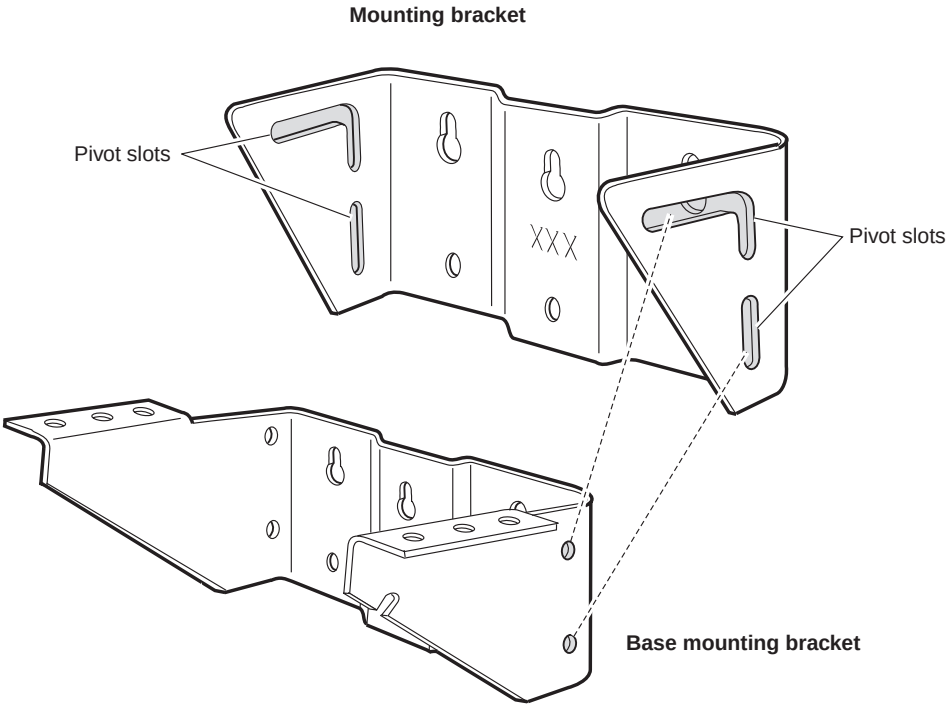


Figure 5. *HRE-454 Pivot-mounting Bracket*

Small Pole or Pedestal Mounting

Use the procedure below to mount the enclosure on a pole or pedestal where the pole is less than 7 inches (17.78 cm) in diameter. The overall enclosure dimensions are shown in Figure 8 on page 17. For details on mounting the pivot bracket, refer to Figure 5.

Have the following equipment ready before you begin:

- Two $^{3}/_{8}$-inch (0.952 cm) lug bolts, 4 inches (10.16 cm) long (minimum)

- Two $^{3}/_{8}$-inch (0.952 cm) washers
- One wrench
- One drill with a $^{1}/_{4}$-inch (0.635 cm) bit

Because of the weight and size of the enclosure, you may want to remove the dome before mounting. The enclosure may be mounted horizontally, vertically, or any orientation desired. A vertical orientation is preferred because it reduces the thermal stress on the installed plugs. A shady location is also preferred for the same reason. Refer to Table 5 on page 30 and Table 6 on page 31 for temperature specifications.

While mounting the enclosure, hold the enclosure securely to prevent personal injury or damage to the enclosure.

1. Select a convenient mounting location on the pole or pedestal.
2. Remove the enclosure base mounting bracket from the mounting bracket by removing the four bolts that connect each side plate (see Figure 5 on page 9).
3. Position the mounting bracket against the pole or pedestal (stub down) and mark the location of the center mounting lug bolt holes. Use the two middle mounting holes for this application.
4. Place the mounting bracket out-of-the-way.
5. Drill two $^{1}/_{4}$-inch (0.635 cm) diameter holes 3-inches (7.62 cm) deep at the locations marked in Step 3.
6. Start a lug bolt in the top center mounting hole and screw the bolt into the pole or pedestal approximately two-thirds of an inch of its length.
7. Insert a lug bolt into the center bottom hole of the mounting bracket and screw the bolt into the bottom mounting hole.
8. Secure the enclosure bracket to the pole or pedestal by tightening the lug bolts.
9. Reattach the enclosure to the mounting bracket and torque the mounting bracket bolts between 30 and 40 inch-pounds.
10. If the cable stub connects to an underground cable, dress the cable down the pole or pedestal to the splice case. If the cable stub connects to an aerial cable, form a drip loop in the cable and dress it up the pole or pedestal to the splice case.

Large Pole or Pedestal Mounting

Use the procedure below to mount the enclosure on a pole or pedestal where the pole is greater than 7 inches (17.78 cm) in diameter. The overall enclosure dimensions are shown in Figure 8 on page 17. Figure 5 on page 9 details the mounting pivot bracket. Have the following equipment ready before you begin:

- Four $^{3}/_{8}$-inch (0.952 cm) lug bolts, 4 inches (10.16 cm) long (minimum)
- Four $^{3}/_{8}$-inch (0.952 cm) washers
- One wrench
- One pencil
- One drill with a $^{1}/_{4}$-inch (0.635 cm) bit

While mounting the enclosure, hold the enclosure securely to prevent personal injury or damage to the enclosure.

1. Select a convenient mounting location on the pole or pedestal.
2. Unscrew the four bolts that connect the mounting bracket side plates to the enclosure base. Remove the mounting bracket from the enclosure.
3. Position the mounting bracket against the pole or pedestal (stub down) and mark the location of the four mounting holes. Use the four corner mounting holes for this application.
4. Place the mounting bracket out-of-the-way.
5. Drill four holes $^1/_4$-inch (0.635 cm) in diameter by 3 inches (7.62 cm) deep at the locations marked in Step 3.
6. Start an anchor bolt in each of the two top matched bolt mounting slots and tighten the bolts into the wall approximately two-thirds of an inch of the bolt length.
7. Rest the mounting bracket top outside holes over the two bolts.
8. Insert the lug bolts into the two bottom outside holes of the mounting bracket and start bolts.
9. Secure the enclosure bracket to the pole or pedestal by tightening all lug bolts until snug.
10. Using the four sideplate bolts, reattach the enclosure's base mounting bracket to the mounting bracket. Torque the mounting bracket bolts between 30 and 40 inch-pounds.
11. If the cable stub connects to an underground cable, dress the cable stub down the pole or pedestal to the splice case. If the cable stub connects to an aerial cable, form a drip loop in the stub and dress the stub up the pole or pedestal to the splice case.

Flat Surface Mounting

Use the procedure below to mount the enclosure on a flat surface in a manhole. You must allow for enough top clearance to remove the cover (see Figure 8 on page 17). Allow at least 3 inches (7.62 cm) of clearance above the dome if the 31° tilt feature is used and allow at least 10 inches (25.4 cm) of clearance if the tilt feature is not used.

Have the following equipment ready before you begin:

- Four $^3/_8$-inch (0.952 cm), 16 NC anchor bolts, $2^1/_2$ inches (6.35 cm) long for wall mounting
- Four $^3/_8$-inch (0.952 cm) washers
- One Wrench
- One Drill with a $^1/_4$-inch (0.635 cm) bit

The desiccant bags shipped with the List 2A, List 2B, List 4, and List 6 units must be activated prior to closing the lid. Do this by removing the bags from their plastic container and placing them inside the enclosure.

While mounting the enclosure, hold it securely to prevent personal injury or damage.

To mount the enclosure on a flat surface:

1 Select a convenient mounting location on a wall.

2 Remove the enclosure base mounting bracket from the mounting bracket by removing the four bolts that connect each side plate (see Figure 5 on page 9).

3 Position the mounting bracket against the wall and mark the location of the four outside mounting holes. Place the mounting bracket out-of-the-way.

4 Drill four $^{1}/_{4}$-inch (0.635 cm) diameter holes $2^{1}/_{2}$-inches (6.35 cm) deep at the locations marked in Step 3.

5 Start an anchor bolt in each of the two top matched bolt mounting slots and tighten the bolts into the wall approximately two-thirds of an inch of the bolt length.

6 Insert the anchor bolts into the two bottom holes located on the outside of the mounting bracket and tighten the bolts into the bottom two holes of the mounting bracket.

7 Secure the enclosure bracket to the wall by tightening all anchor bolts.

8 Reattach the enclosure base mounting brackets to the mounting bracket with the four sideplate bolts and torque the mounting bracket bolts between 30 and 40 inch-pounds.

9 If the cable stub connects to an underground cable, dress the cable down the wall to the splice case. If the cable stub connects to an aerial cable, form a drip loop in the cable and dress it up the wall to the splice case.

Rack Mounting

Use the procedure below when mounting the enclosure in a rack. Have the following equipment ready before you begin:

- Four $^{3}/_{8}$-inch thru-bolts for rack mounting
- Four $^{3}/_{8}$-inch nonmetallic washers. Nonmetallic washers are required to avoid a ground loop that may result if both the rack and the enclosure are grounded. ADC does not recommend using the rack ground for the enclosure ground since its integrity is not one-hundred percent reliable.
- One wrench

Because of the weight and size of the enclosure, you may want to remove the dome before mounting the enclosure. The enclosure must be mounted vertically. A shady location is also preferred to minimize thermal stress. Refer to Table 5 on page 30 and Table 6 on page 31 for thermal load capacity information.

While mounting the enclosure, hold it securely to prevent personal injury or damage to the enclosure.

1 Select a convenient location on the cable rack.

2 Position the enclosure so that the outside slots and holes in the mounting bracket align with the mounting holes in the cable rack.

3 Slide the thru-bolts with nonmetallic washers on them through the outside slots and holes of the mounting bracket. Begin tightening the bolts into the mounting holes.

4 Secure the enclosure to the rack by tightening the thru-bolts.

The desiccant bags shipped with the unit must be activated prior to closing the lid. Do this by removing the bags from their plastic container and placing them inside the enclosure.

GROUNDING

Use the standard grounding procedure in "Grounding a Pole Mounted Enclosure" on page 13 or use existing local grounding practices to ground the enclosure. The HRE-454 requires a resistance of 25 Ω or less to ground as measured with a megger-type Ohmmeter.

The 8 MIL aluminum shield on the stub is connected to the card cage mounting brackets by a braided shield ground wire shown in Figure 12 on page 26. This wire connects the shield to the enclosure ground lug. The wire may need to be temporarily removed from the enclosure ground lug when troubleshooting ground faults. The wire can be removed by unscrewing the screws that secure the braided shield ground wire to the card cage mounting bracket.

Have the following equipment ready before you begin:

- One bullet bond
- One ground rod for pole or pedestal mounted enclosures (may require more than one rod)
- One megger-type Ohmmeter
- 6 American Wire Gauge (AWG) cable

The braided shield ground wire should be reconnected to the card cage bracket after completing the ground fault test. This insures that the stub's shield is properly grounded which is required to reduce the possibility of shield corrosion and lightning damage.

The screen divider on the stub is an insulated floating divider separating the Group 1 and Group 2 pair. DO NOT GROUND THIS SCREEN DIVIDER. Doing so could result in degraded performance.

Grounding a Pole Mounted Enclosure

Use the following procedure to ground a pole-or pedestal-mounted enclosure (See Figure 6 on page 15):

1 Bond the main cable shield through the splice case using bullet bond.

2 Drive the ground rod into the ground near the enclosure location.

Make sure you ground the HRE-454 before splicing the cable stub into the main cable. This grounding method (or an accepted local grounding method) must be in effect at all times to safeguard personnel.

If the HRE-454 is improperly grounded, the LPU surge arrestors will not work and the enclosure will be unprotected.

3 Using a megger-type Ohmmeter, measure the resistance between enclosure ground and the ground rod. The resistance must be 25 Ω or less.

4 If the requirement is met, proceed to Step 5. If the requirement is not met, follow the procedure normally used for the enclosure you are mounting to lower the resistance to ground to comply with the requirement before proceeding to Step 5.

5 Using 6 AWG cable, connect the grounding lug on the enclosure to the ground rod. Torque the grounding lug between 18 and 22 inch-pounds.

6 Using 6 AWG cable, connect the main cable shield to the ground rod.

If the main feeder cable's shield is bonded to the stub's shield, the green insulated or bonded stub shield wire, shown in Figure 12 on page 26, should be disconnected from the metal card cage base. This is recommended to reduce service affecting noise from being injected into the doubler circuits from circulating ground loop currents, and to help inhibit corrosion.

7 If commercial power ground exists, bond telephone ground to power ground as a safety measure.

8 Using a megger-type Ohmmeter, measure the main cable shield resistance to ground rods. The resistance must be 5 Ω or less.

9 If the resistance requirement is not met, ground the main cable shield every 2,000 ft.

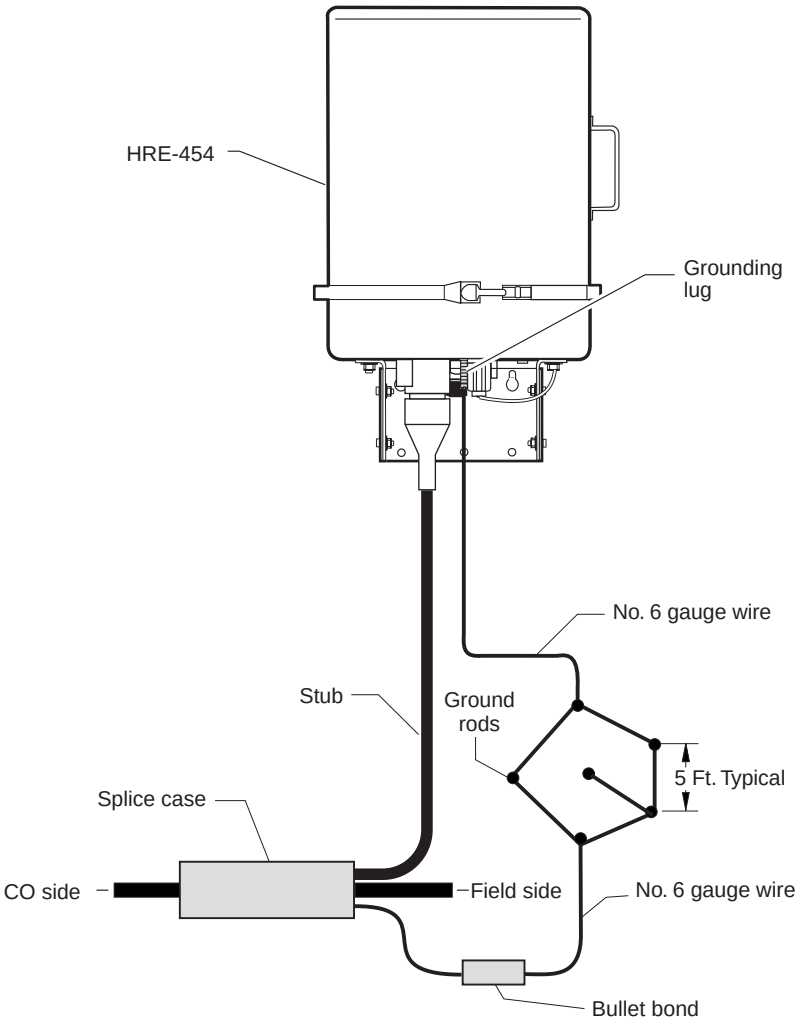


Figure 6. *Grounding For Pole Mounted Unit*

Grounding a Flat Surface Mounted Enclosure

1 Bond the main cable shield through the splice case using bullet bond (see Figure 7 on page 16).

2 Using a megger-type Ohmmeter, measure the resistance between enclosure ground and the ground connection point in the manhole. The resistance must be 25 Ω or less.

Make sure you ground the HRE-454 before splicing the cable stub into the main cable. This grounding method (or an accepted local grounding method) must be in effect at all times to safeguard personnel. If the HRE-454 is improperly grounded, the LPU surge arrestors will not work and the enclosure will be unprotected.

3 If the requirement is met, proceed to Step 4. If the requirement is not met, follow the procedure normally used for mounting the enclosure to lower the resistance to ground to comply with the requirement in Step 2, then proceed to Step 4.

4 Using 6 AWG cable, connect the ground lug on the HRE-454 to the ground connection in the manhole. Torque the grounding lug between 18 and 22 inch-pounds.

5 Using 6 AWG cable, connect the main cable shield to the ground connection in the manhole.

If the main feeder cable's shield is bonded to the stub's shield, the green insulated or bonded stub shield wire, shown in Figure 12 on page 26, should be disconnected from the metal card cage base. This is recommended to reduce service affecting noise from being injected into the doubler circuits from circulating ground loop currents, and to help inhibit corrosion.

6 Using a megger-type Ohmmeter, measure the main cable shield resistance to manhole ground. The resistance must be 5 Ω or less.

7 If the Ohm requirement is not met, ground the main cable shield every 2,000 ft.

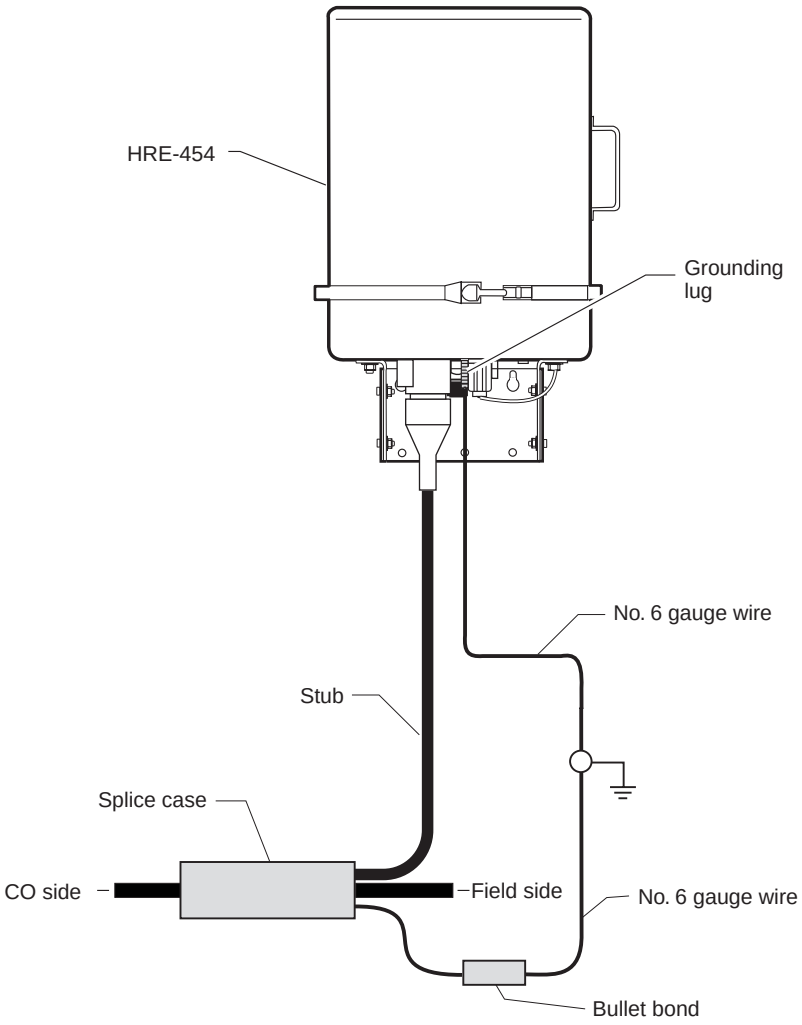


Figure 7. *Grounding for Flat Surface Mounted Unit.*

SLOT CHASSIS GROUND CONNECTIONS

Each of the four slots in the enclosure has both pins 1 and 27 connected to chassis ground. This allows them to support 400/200 mechanics plugs which use either pins 1 or 27 for their chassis ground connection.

DETACHING THE DOME FROM THE BASEPLATE

Perform the following steps to detach the dome from the enclosure baseplate (Figure 8):

1 Release the internal pressure.

2 Unclamp the dome from the baseplate.

3 Lift the dome up and away from the baseplate.

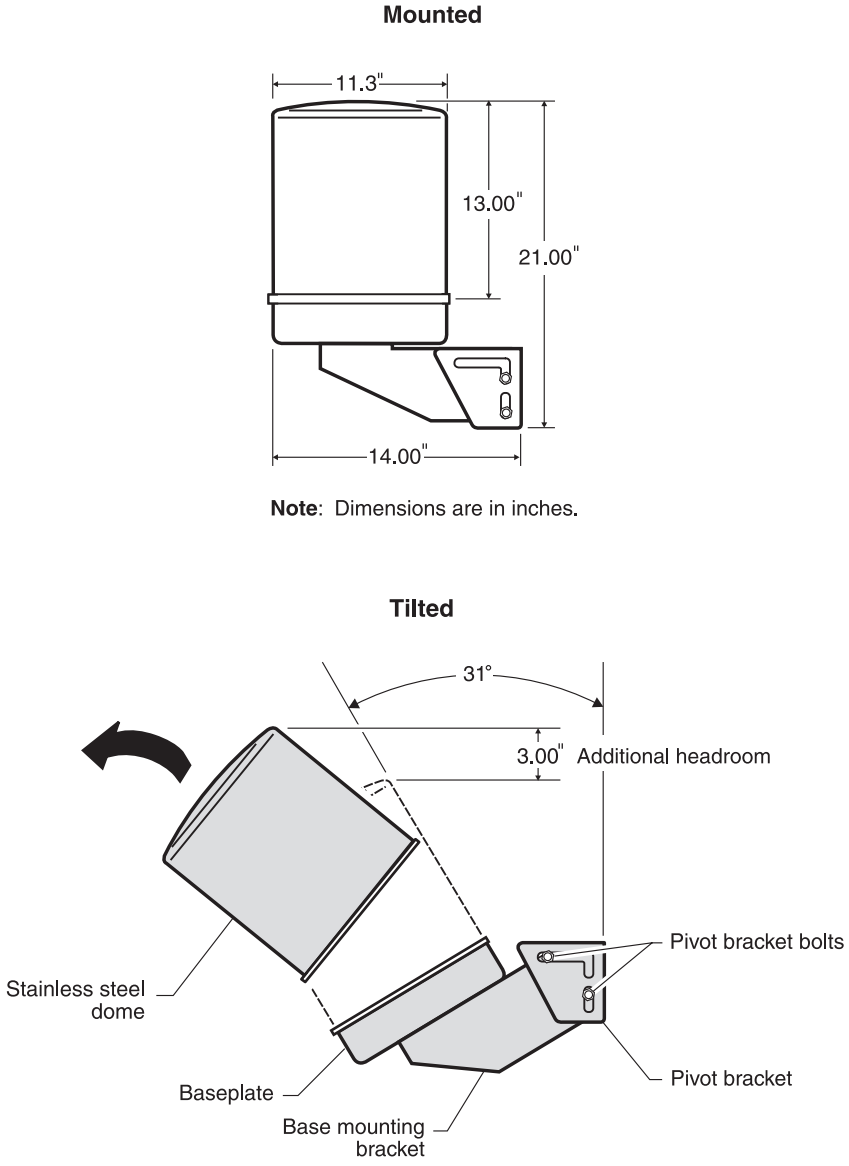


Figure 8. *HRE-454 Enclosure*

OPENING THE HRE-454 ENCLOSURE

When handling any enclosures, always assume they are pressurized. Failure to relieve the pressure before removing the cover could result in serious personal injury.

To open the HRE-454, do the following:

1 To open a gel-filled List 1A, List 1B, List 3, or List 5 enclosure, which **is not** being pressurized, go to Step 7. To open a gel-filled List 1A, List 1B, List 3, or List 5 enclosure, which **is** being pressurized, go to Step 3.

2 To open an air filled List 2A, List 2B, List 3, or List 5 enclosure, go to Step 5. Steps 3 and 4 relate to the pressurized List 1A, List 1B, List 3, and List 5 enclosures.

3 Turn off the external pressure supply, if possible. Locate the pressure cutoff valve as shown in Figure 2 on page 5. If the external pressure supply is off verify that the pressure cutoff valve is in the open position (rotated counterclockwise), which is the normal position when operating a gel filled enclosure in a pressurized application. If you were **able** to turn the external pressure supply off go to Step 6. If you were **unable** to turn the external pressure supply off close the pressure cutoff valve by rotating clockwise one (1) full turn, blocking the pressure from the external source. Go to step 4.

4 Unlock the enclosure. Gently push the dome cover back and forth while loosening the cover clamp until the seal is broken and the pressure is released. The seal should break well before the cover clamp is loosened enough to allow the cover to separate from the enclosure. Go to step 9.

5 Locate the pressure cutoff valve as shown in figure 3 on page 6. Close the pressure cutoff valve by rotating clockwise one (1) full turn, blocking the pressure from the main cable.

6 Depress the center pin of the air stem to release the remaining pressure within the enclosure.

7 Unlock the enclosure.

8 Loosen cover clamp and twist the stainless steel dome slightly to break seal.

9 Remove the cover clamp.

10 Remove the stainless steel dome from the enclosure.

Exercise care when removing and handling the stainless steel dome. A damaged stainless steel dome may not seal properly when replaced.

CLOSING THE HRE-454 ENCLOSURE

To close the HRE-454 enclosure, do the following:

1 Inspect the enclosure cover for dirt, moisture, or mechanical damage especially around the baseplate flange and O-ring. Remove any accumulation of dirt or moisture from the cover and replace any damaged components.

2 Inspect the baseplate for dirt, moisture, or mechanical damage especially around the baseplate flange. Remove any accumulation of dirt or moisture from the baseplate.

3 Remove the two desiccant bags from the plastic storage bag and place them in the enclosure.

4 Fasten the slot retainer bracket in place.

5 Slide the stainless steel dome over the card cage and position it on the O-ring and baseplate.

6 Lubricate the threads of the cover clamp T-bolt with an antiseize compound.

7 Position the cover clamp around the base of the cover and the baseplate flange. Handtighten the T-bolt securely, then torque the T-bolt between 10 and 15 inch-pounds.

8 If you are pressurizing the enclosure from a portable pressure bottle, continue from Step 9. If you are pressurizing the enclosure from the main cable, continue from Step 11. If the enclosure is mounted above ground and you are not pressurizing the enclosure, continue from Step 13.

9 For the List 2A, List 2B, List 4, and List 6 air-filled stubs, block the cable stub in the splice case by placing an air dam in the stub according to the normal procedures used to prevent pressure leakage back into the main cable. Also, make sure that the air cutoff valve is off (fully clockwise).

10 Use a portable pressure bottle and standard tire gauge at the external air stem valve to pressurize the enclosure to a maximum of 15 PSI (there is no minimum requirement as long as a slight positive pressure is applied). Replace the air stem cap. Continue from Step 12.

11 Open the air inlet tube by turning the air valve one (1) full turn counterclockwise. Allow the enclosure to pressurize from the main cable through the enclosure stub.

12 Check the O-ring and enclosure for leaks by painting the enclosure with a pressure-testing solution such as soap and water. If you detect a leak, tighten the T-bolt and tap lightly around the cover clamp. Repeat as necessary until the cover is sealed.

13 Secure the HRE-454 with a padlock. This step is not required for manhole-mounted enclosures; however, a locking assembly is provided.

PIVOTING THE ENCLOSURE

To pivot the enclosure out from its vertical position:

1 Loosen the four bolts that connect the pivot bracket to the enclosure baseplate.

2 Lift the housing up slightly and pull it out until the top bolts rest against the end of the two pivot bracket slots.

HIGAIN TEST CARD (HTC-400) INSTALLATION

Every HRE-454 comes equipped with the HTC-400 test card (Figure 9). The test card provides access to all assigned cable pairs of the HRE-454. The card is used to test cable pairs and to check Central Office (CO) and field circuits by performing loopback, loop-through, short, and open testing of all cable pairs. A four-position slide switch on the test card enables technicians to select the type of test to perform. The number of each test point corresponds to the edge connector pin of the circuit under test (see "Test Connections" on page 21 for detailed information). The test card can be inserted into any HRE-454 slot and does not need to be secured by the retaining bar.

The following features are included on the test card:

- Switch-selectable loopback, loop-through, short, and open testing of Transmit (XMT) and Receive (RCV) Tip and Ring pairs on CO and field circuits.
- Test point access to Tip and Ring XMT and RCV circuits (CO and field), circuit ground, frame ground, and -48 Vdc power (if available).

A 47k Ω resistor connected between the -48 Vdc source and the test point limits current in case of accidental shorting.

Circuit Testing

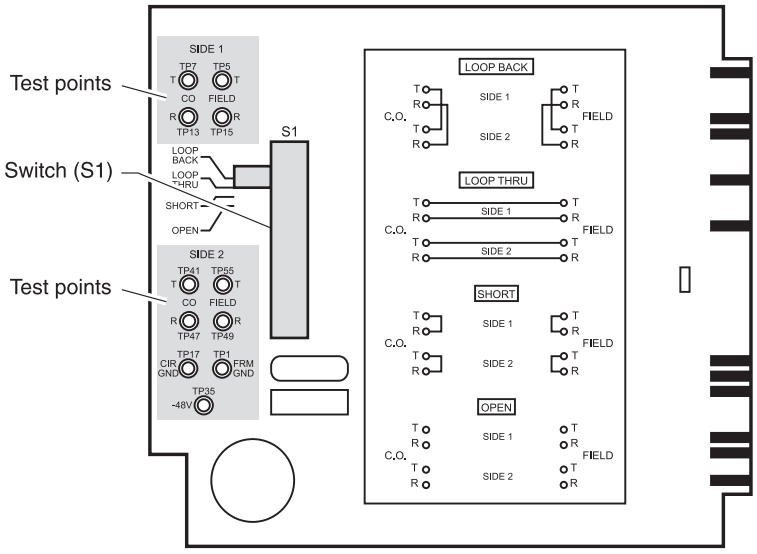


Figure 9. *HTC-400 List 1 Test Card*

To test circuits on the HTC-400 test card, perform the following steps:

1 Plug the test card into the shelf slot that contains the circuits you want to test.

2 Set test switch S1 (Figure 9) on the card to the type of test you want to perform (LOOP BACK, LOOP THRU, SHORT, or OPEN). Figure 10 on page 21 illustrates the connection of Tip and Ring pairs of CO and field circuits for each setting of the test switch. Pin numbers correspond to edge connector pins for each circuit.

3 Perform the selected test. Monitor the circuits at the corresponding test points on the card.

4 Repeat Steps 2 and 3 as required.

Test Connections

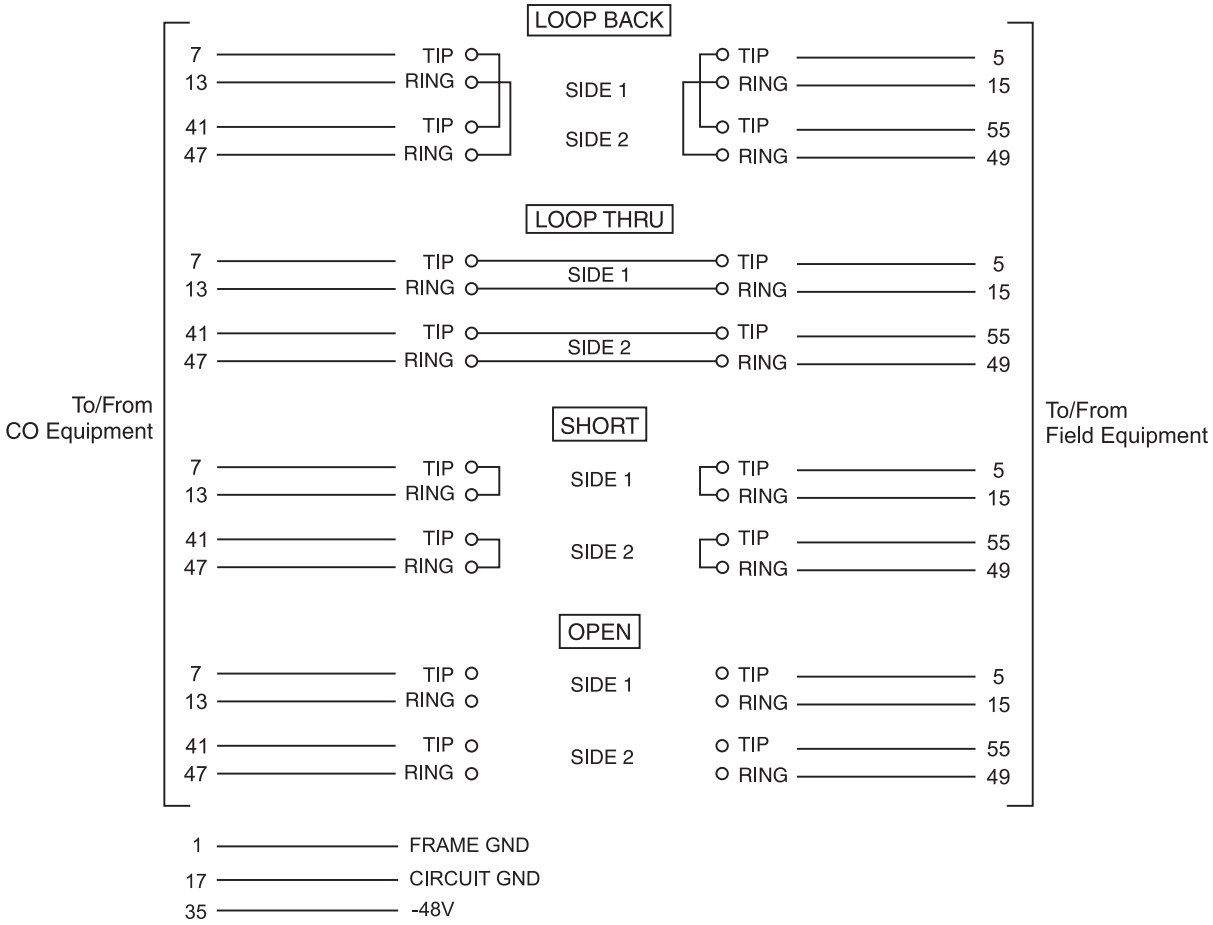


Figure 10. *HTC-400 Test Card Test Connections*

Test Capabilities

The HTC-400 test card enables technicians to perform the following tests on CO and field circuits by using switch 1 (S1) to select the appropriate test:

Table 3. Test Connections

Test Capabilities					
LOOP BACK - This switch position connects the following circuits:					
	CO Tip	Pin # 7	to	CO Tip	Pin # 41
	CO Ring	Pin # 13	to	CO Ring	Pin # 47
	Field Tip	Pin # 5	to	Field Tip	Pin # 55
	Field Ring	Pin # 15	to	Field Ring	Pin # 49
LOOP THRU - This switch position connects the following circuits:					
	CO Tip	Pin # 7	to	Field Tip	Pin # 5
	CO Ring	Pin # 13	to	Field Ring	Pin # 15
	CO Tip	Pin # 41	to	Field Tip	Pin # 55

Table 3. Test Connections (Cont.)

Test Capabilities					
	CO Ring	Pin # 47	to	Field Ring	Pin # 49
SHORT - This switch position connects the following circuits:					
	CO Tip	Pin # 7	to	CO Ring	Pin # 13
	CO Tip	Pin # 41	to	CO Ring	Pin # 47
	Field Tip	Pin # 5	to	Field Ring	Pin # 15
	Field Tip	Pin # 55	to	Field Ring	Pin # 49
OPEN - This switch position removes all connection between the circuits.					

The HTC-400 extends beyond the front plane of the shelf or enclosure into which it is inserted. This permits easy access to the test points. However, this limited extension is such that the HTC-400 could be inserted into the HRE-454 outdoor enclosure with the card cage retaining/locking bar in place. This allows the HTC-400 to be permanently installed in any slot where it provides loop-through of the cable pairs. This allows end-to-end metallic cut-through access to Sides 1 and 2 cable pairs without the need to rewire the shelf slots.

APPENDIX A - SPECIFICATIONS

Environment

Operating Temperature:	-40° F to +150° F (-40° C to +65° C)
Operating Humidity:	5% to 95% (without pressurization) 100% (when pressurized)
Altitude:	14,000 ft. (4,300 m)
Mounting:	400 mechanics

Dimensions

Height:	21.0 in. (53.8 cm)
Diameter:	11.3 in. (28.9 cm)
Depth:	14.0 in. (35.7 cm)
Volume:	0.75 $ft.^3$ (.021 m^3)

Weight

HRE-454, List 1A, List 3, and List 5 (GF):	38 lb. (17.2 kg) [(a)]
HRE-454, List 2A, List 4, and List 6 (AF):	36 lb. (16.3 kg) [(a)]
HRE-454, List 1B (GF)	51 lb. (23.1 kg) [(a)]
HRE-454, List 2B (AF)	49 lb. (22.2 kg) [(a)]

(a) Shipping weights include stubs and packaging.

APPENDIX B - TECHNICAL REFERENCE

Appendix B contains additional technical information about the HRE-454.

CLEI CODE AND P1 LABELS

Figure 11 shows the location on the HRE-454 for the bar code and warranty control number. Table 4 gives a brief description of each label.

Front view
(HRE-454 shown with cover removed)

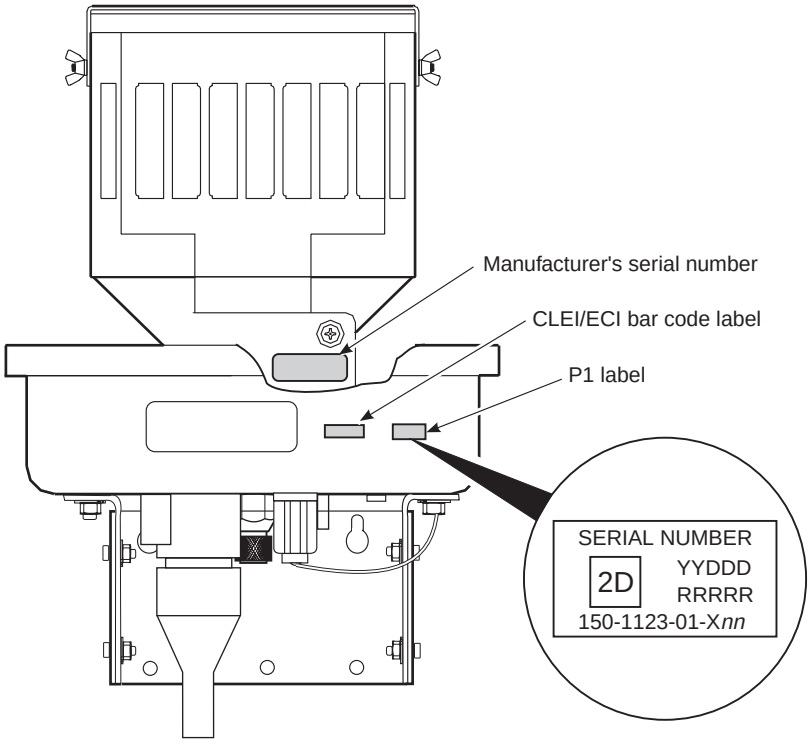


Figure 11. *HRE-454 Bar Code and P1 Label Locations*

Table 4. *HRE-454 Bar Code and P1 Label Information*

Number	Components
CLEI/ECI Bar Code Label	Contains human-readable Common Language Equipment Identifier (CLEI) code number and Equipment Catalog Item (ECI) bar code number.
P1 Label Date Code	YY = Last two digits of shipment year. DDD = Julian day
P1 CFG	X*nn* = Configuration

HRE-454 ENCLOSURE INFORMATION

All HRE-454 units have access to an order wire pair shown in Figure 2 on page 5 and Figure 3 on page 6. The enclosure mounting plate allows the unit to be tilted 31° from its vertical position (see Figure 8 on page 17). This reduces the headroom required in manhole installations from10 inches to 3 inches and the amount of valuable air space required for such underground applications.

To pivot the enclosure out from its vertical position, perform the following steps:

1 Loosen the four bolts that connect the pivot bracket to the enclosure baseplate and loosen the housing up slightly.

2 Pull the housing out until the top two pivot bracket bolts rest against the end of the two pivot bracket slots.

Stainless Steel Dome

A stainless steel dome cover fits over the card cage and protects the enclosure from heat and other harmful environmental effects. The dome seals the inner assembly when clamped to the baseplate, providing a seamless, corrosion-resistant, easily-removed protective cover. The stainless steel cover V-retainer, equipped with a T-bolt, is used to tighten the dome firmly against the O-ring on the baseplate. The purpose of the O-ring is to create a pressure-tight seal between the dome and the baseplate. There is also a locking cover over the T-handle which prevents unauthorized access to the enclosure. This cover accepts a padlock with a maximum shackle diameter of 0.3-inch (0.76 cm). The V-retainer T-bolt should be torqued between 10 and 15 inch-pounds for proper sealing.

Card Cage

The card cage (Figure 12 on page 26) inside the enclosure has four mounting positions which hold up to four doubler or remote units. There is also a retainer bar on top of the card cage that extends the width of the cage. The retainer bar is used for:

- Writing down the circuit ID number on the label attached to the bar.
- Preventing the doubler or remote units from disconnecting when the enclosure is subjected to severe vibrations or mounted in non-vertical planes.
- Accessing the doubler or remote units by loosening the side wingnuts and rotating the retainer bar forward.

The enclosure has a mechanism that enables the card cage to tilt up approximately 45°. This provides easy access to the rear of the card cage for servicing the Line Protection Unit (LPU) board. Two knobbed retainer screws at the base of the card cage (one on each side) lock the card cage in its normal level position. This helps prevent it from tilting during severe vibrations. The cable stubs shield is grounded through a braided shield ground wire which is connected to the card cage base (see Figure 12 for wire location). The card cage itself is grounded through a ribbon ground connected between the card cage base and the side.

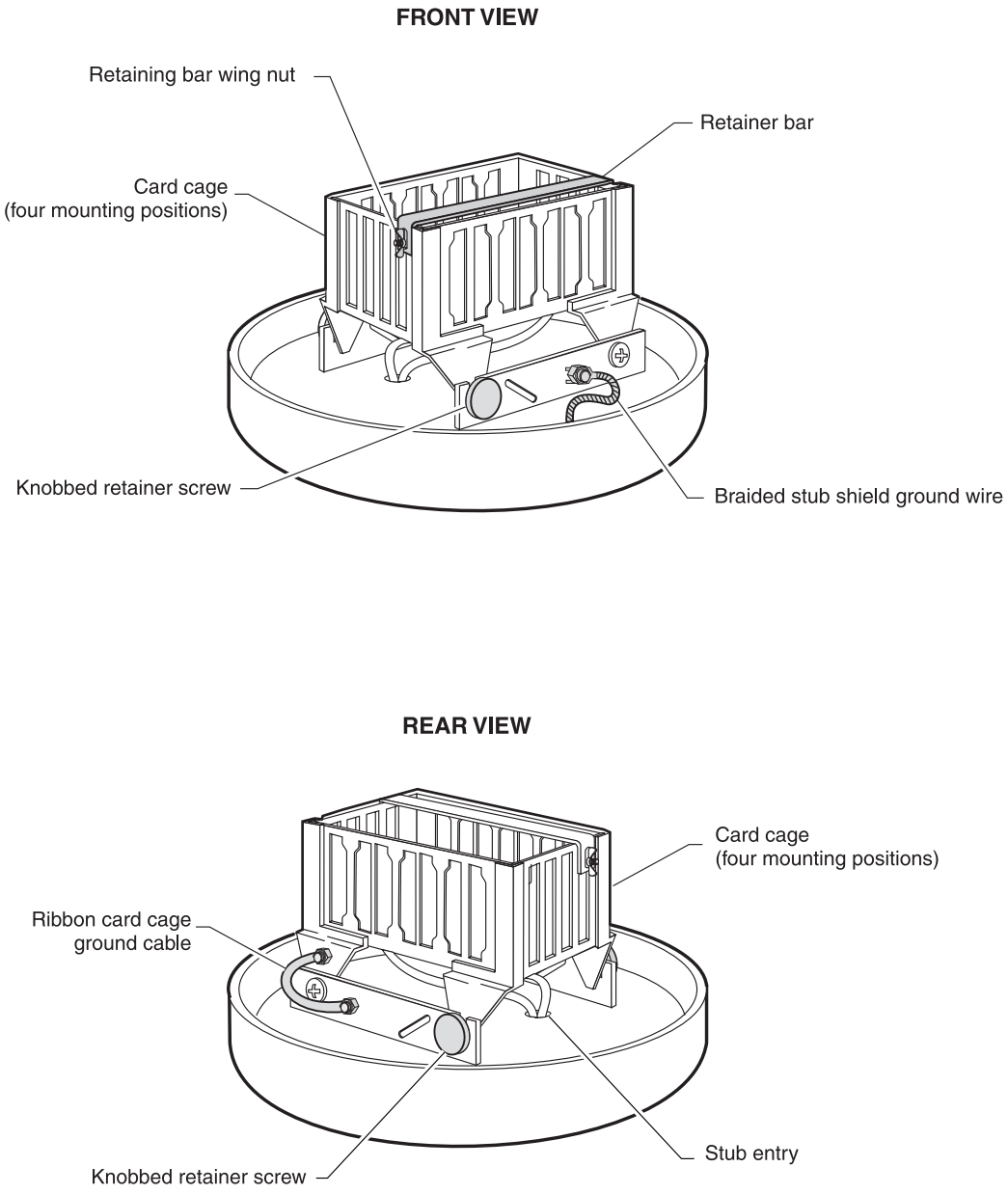


Figure 12. *HRE-454 with Cover Removed*

Lightning Protection Unit (LPU)

The LPU, shown in Figure 13 on page 27, is a printed circuit board assembly that attaches to the card-edge connector of each slot and provides primary lightning protection for the HDSL loops and customer T1 circuits.

All HRE-454 units come equipped with four LPUs. Each LPU contains four gas tubes which provide the surge protection to each of the four parts. These tubes also have three leads which provide protection from Tip and Ring to ground. The ground pin is connected to pin 1 of each slot. These slots are connected to the enclosure ground plane.

Although the individual gas tubes are field replaceable components, ADC recommends replacing the entire LPU when any of its protector tubes are suspect. See "Replacement Parts" on page 57 for details on replacing an LPU.

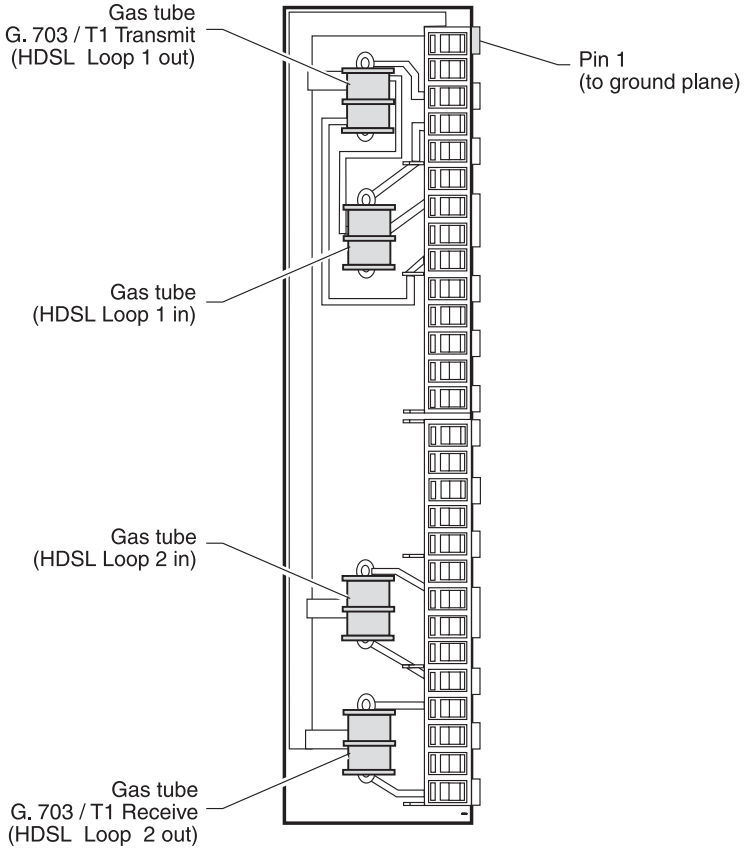


Figure 13. *Lightning Protection Unit (LPU)*

The gas tube parameters are equivalent to a TTI 47 BT. The Vdc breakdown ranges from 300 to 500 volts. The tube can withstand at least 400, 10/1000, or 500 amp discharges. (Amp discharges are quantities of discharges that occur before system degradation.)

Cable Stub and Pressurization

Every HRE-454 is equipped with a single-screened cable stub. Refer to Table 7 on page 33 for a complete description of the cable stub. The stub is available as a gel- or air-filled unit. It is secured to the enclosure plate by a cable strain relief adapter. The cable stub is spliced out and encapsulated in the polyurethane that is poured into the enclosure base. This provides an airtight seal at the cable entry point.

The pressurized enclosure has an air inlet tube that accompanies the air-filled stub. The tube connects the inside of the enclosure to the main feeder cable which enables dry air or dry nitrogen to flow from the main cable to the cable stub through the air cutoff valve. The air cutoff valve controls the dry air or nitrogen flow through the air inlet tube as described in "Air-filled Stub Units" on page 5.

The maximum pressure for an air-filled enclosure is 12 PSI.

Vented-to-Pressurized Conversion Procedure

The following instructions are for converting the HRE-454 gel-filled vented enclosures to external pressurized enclosures.

The HRE-454 enclosure can be converted to a pressurized housing that uses a continuous, local, air pressure source. The conversion requires replacing the breather vent valve with an optional pressure relief valve. The breather vent valve, located in the base pan, allows the internal pressure to equalize with the outside pressure. The optional pressure relief valve, included in the shipping kit, replaces the breather vent valve and prevents over-pressurization when pressurized from the external air source. The HRE-454 comes with a gel-filled cable, which precludes pressurizing through the cable stub.

Static pressurization requires monitoring and maintenance as the pressure decreases over time.

Use the following instructions, along with Figure 2 on page 5, to convert the HRE-454 enclosure from a vented housing to a pressurized one:

1 Locate the breather vent valve on the bottom of the housing (see Figure 4 on page 7). It is a metal valve located on the far side away from the cable stub inlet.

2 Remove the valve by unscrewing it in a counterclockwise direction.

3 Save the vent or store it inside the housing for future conversions.

4 Check the threaded hole for debris and clean it, if necessary.

5 Remove the pressure relief valve from the plastic bag. Verify that an O-ring is installed on the threaded end of the valve.

6 Carefully place the threaded end of the pressure relief valve into the threaded brass fitting from which the breather vent valve was removed.

7 Hold the valve straight and push it into the hole. Turn the valve clockwise to screw it in place.

If there are any signs of resistance while screwing the valve into place, you could be crossthreading the part. Remove the valve and restart.

8 Handtighten the valve until it is secure against the gasket material.

The housing is now ready to be pressurized through either the Schrader air stem valve, which accepts a standard tire valve chuck, or the air intake stem of the T-valve, as shown in Figure 2 on page 5 and Figure 4 on page 7. A desiccant bag is also included in the HRE-454 along with the pressure relief valve. Remove this bag and place it in the HRE-454 prior to pressurization.

1 Attach a plastic tube, $^{1}/_{4}$-inch (.64 cm) inner diameter (ID) by $^{3}/_{8}$-inch(.83 cm) outer diameter (OD), from the external air source to the $^{1}/_{4}$-inch (.64 cm) air intake protrusion of the T-valve. (The plastic tube is not included.)

2 Secure the tube to the valve with the hex bolt and ferrule.

The tube, hex bolt, and ferrule fitting assembly is also called an Express Air Connection Fitting. These parts are not supplied by ADC.

Spare Connections

Each HRE-454 stub (with the exception of the List 3 and List 4 models) has 11 spare pairs. The HRE-454 List 3 and List 4 models provide access only to four spare pairs. On the List 3 and List 4 units, the 28 pairs have been grouped into seven, 4-pair groups. Each of these groups passes through a ferrite coil. This design was created to minimize the leakage of EMI energy through the stub pairs and to reduce the antenna effect that occurs when too many spare pairs are installed in one enclosure. The red/brown pair in Group 1 is used to access the order wire pair. The other spare pairs in both groups are folded back for easy access, if needed.

Order Wire Connections

The external order wire access port is connected to its protector by the white/black ground wire. The red/brown spare pair also terminates on the order wire protector. This permits access to the order wire without opening the enclosure. Simply unscrew the order wire protective cap (see Figure 3 on page 6) to expose the order wire terminals.

General Deployment Rules

The HRE-454 is an airtight enclosure. The breather vent valve on gel-filled units and the pressure relief valve on air-filled units allow minimum ventilation to the atmosphere. This environment traps the heat generated by the installed plugs and, in effect, causes the heat temperature to significantly rise inside the enclosure. The number of doubler or remote units that can be housed in the HRE-454 is dependent upon the:

- Plug type
- Doubler version (the list number of the doubler version will also affect the number of doubler units housed in the HRE-454)
- Solar exposure
- Unit orientation

Table 5 on page 30 lists the HRE-454 deployment rules for doubler and remote unit applications. Table 6 on page 31 lists the HRE-454 deployment rules for the HLU 431 and HLU 432 applications.

The orientation column in Table 5 and Table 6 refer to the position of four card slots as shown in Figure 14 on page 32. The horizontal orientations cause more thermal stress on the upper slots due to the chimney effect. The chimney effect forces the heat from the lower slots to move up through the upper slots.

Even if the deployment rules are followed correctly, the metal surfaces of the installed units can feel hot when removed from an HRE-454 that is operating in elevated ambient temperatures. This is a normal condition for the plugs when operating in these circumstances. The plugs were designed to withstand these elevated temperatures.

When less than four slots are used, always try to leave empty slots between adjacent units. This reduces the hot spot temperature. Also, always use the last column deployment rules when mixing units from both columns in the same enclosure.

Table 5. *HRE-454 Deployment Rules for Doublers and Remote Units*

Orientation	Occupied Slots	Solar Load [a]	EDU-451, HDU-451 List 3 & List 4 Max. Ambient Temp [b]	HDU-451 List 1 & List 2 All HRU Units Max. Ambient Temp [b]	HDU-404 All list numbers Max. Ambient Temp [b]
Vertical	4	Full	115 °F 46 °C	100 °F 38 °C	125 °F 52 °C
Vertical	4	None	125 °F 52 °C	110 °F 43 °C	135 °F 57 °C
Vertical	3	Full	125 °F 52 °C	110 °F 43 °C	135 °F 57 °C
Vertical	3	None	135 °F 57 °C	120 °F 49 °C	145 °F 63 °C
Vertical	2	Full	135 °F 57 °C	120 °F 49 °C	145 °F 63 °C
Vertical	2	None	145 °F 63 °C	130 °F 54 °C	155 °F 68 °C
Vertical	1	Full	145 °F 63 °C	130 °F 54 °C	155 °F 68 °C
Vertical	1	None	155 °F 68 °C	140 °F 60 °C	165 °F 74 °C
Horizontal	4	Full	105 °F 40 °C	90 °F 32 °C	125 °F 52 °C
Horizontal	4	None	115 °F 46 °C	100 °F 38 °C	135 °F 57 °C
Horizontal	3	Full	115 °F 46 °C	100 °F 38 °C	135 °F 57 °C
Horizontal	3	None	125 °F 50 °C	110 °F 43 °C	145 °F 63 °C
Horizontal	2	Full	125 °F 50°C	110 °F 43 °C	145 °F 63 °C
Horizontal	2	None	135 °F 57 °C	120 °F 49 °C	155 °F 68 °C
Horizontal	1	Full	135 °F 57 °C	120 °F 49 °C	155 °F 68 °C
Horizontal	1	None	145 °F 63 °C	130 °F 56 °C	165 °F 74 °C

(a) Solar Load: Full = maximum sunlight exposure per TR-TSY-000057.
Solar Load: None = indoor or fully shaded.

(b) All maximum ambient temperatures of 115 °F (46 °C) or more comply with the outside deployment requirements of Section 10.2.1.3 in TA-NWT-001210.

Table 6 lists the deployment rules for the HRE-454 List 5 and List 6 enclosures for HLU-431 and HLU-432 applications. These rules are shown as a function of the type of doubler that is used in HLU-431 circuits. The HDU-409 mini-doubler requires less power and thus reduces the heat dissipated by the HLU-431 when the doublers (listed in column four) are used.

Table 6. *HRE-454 Deployment Rules for HLU-431/ 432 Applications vs. Type of Doubler Used*

Orientation	Occupied Slots	Solar Load [a]	HDU 404, HDU-409, HDU-407 Max. Ambient Temp [b]	HDU-439, 437 List 1 and List 1B HDU-431 List 3, List 3B, List 4 and List 4B Max. Ambient Temp [b]
Vertical	4	Full	115°F 46°C	105°F 40°C
Vertical	4	None	125°F 52°C	115°F 46°C
Vertical	3	Full	125°F 52°C	115°F 46°C
Vertical	3	None	135°F 57°C	125°F 52°C
Vertical	2	Full	135°F 57°C	125°F 52°C
Vertical	2	None	145°F 63°C	135°F 57°C
Vertical	1	Full	145°F 63°C	135°F 57°C
Vertical	1	None	155°F 68°C	145°F 63°C
Horizontal	4	Full	105°F 40°C	95°F 35°C
Horizontal	4	None	115°F 46°C	105°F 40°C
Horizontal	3	Full	115°F 46°C	105°F 40°C
Horizontal	3	None	125°F 50°C	115°F 46°C
Horizontal	2	Full	125°F 50°C	115°F 46°C
Horizontal	2	None	135°F 57°C	125°F 52°C
Horizontal	1	Full	135°F 57°C	125°F 52°C
Horizontal	1	None	145°F 63°C	135°F 57°C

(a) Solar Load: Full = maximum sunlight exposure per TR-TSY-000057.
Solar Load: None = indoor or fully shaded.

(b) All maximum ambient temperatures of 115 °F (46 °C) or more comply with the outside deployment requirements of Section 10.2.1.3 in TA-NWT-001210.

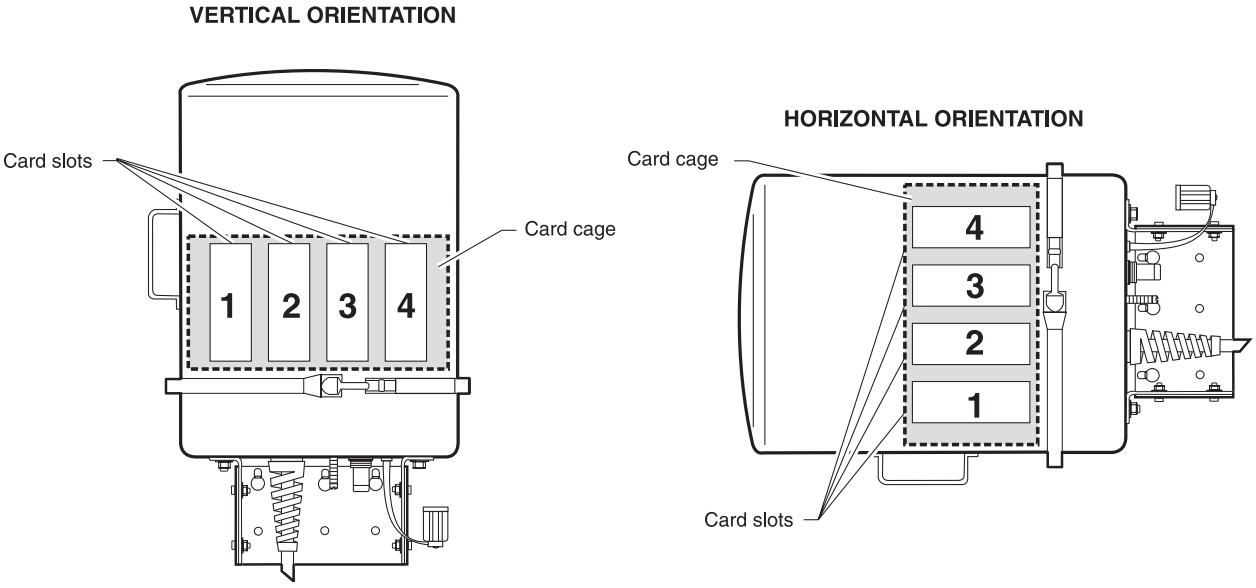


Figure 14. *HRE-454 Vertical And Horizontal Mounting Orientation*

Deployment considerations determine the physical location of the HRE-454 doubler enclosures, which are:

1 The first and most important rule is to place each enclosure span to the electrical limits of 35 dB. This will place the first doubler at the 35 dB location and the second at 70 dB. Such electrical setting allows the maximum range of 105 dB if the third span to the remote unit is also 35 dB.

2 If the first rule is not applicable, then make all the spans the same electrical length (same 196 kHz loss). This minimizes span loss and maximizes operating margin which will result in optimum transmission performances. If specific application constraints preclude using Rule 2, or two different circuit layout choices have the same maximum span loss, then use Rule 3.

3 The third rule minimizes the power consumption and dissipation of the line unit that powers the doubler or remote units. Rule 3 requires Span 1 to be a minimum and Span 3 to be a maximum. This choice minimizes the I^2R loss in the cable pairs and reduces the thermal stress on the line unit.

HRE-454 WIRING

A single cable stub, shown in Figure 6 on page 15 and Figure 7 on page 16, provides access from the HRE-454 to the main cable. The stub is a 28-pair, 24-gauge, T-screened cable with two 14-pair binder groups.

Both 14-pair groups have the same color coding. The first twelve pairs are assigned the White/Blue through White/Orange codes. Each group also has two pairs identified as Spare (SP)1 (White/Red) and SP2 (White/Black). Group 1 is identified by a Blue group thread. Group 2 is identified by an Orange group thread.

Table 7. *HRE-454 28-pair Cable Stub Wire Pair Assignment for Doubler and Remote Units*

HRE 454 Slot No.	Direction	Side	Group [a]	Color Tip	Color Ring	Pair Number
1	In	1	1	White	Blue	1
2	In	1	1	White	Orange	2
3	In	1	1	White	Green	3
4	In	1	1	White	Brown	4
1	In	2	1	White	Slate	5
2	In	2	1	Red	Blue	6
3	In	2	1	Red	Orange	7
4	In	2	1	Red	Green	8
Order Wire			1	Red	Brown	9
Spare [b]			1	Red	Slate	10
Spare [b]			1	Black	Blue	11
Spare [b]			1	Black	Orange	12
Spare			1	White	Red	SP1
Spare			1	White	Black	SP2
1	Out	1	2	White	Blue	1
2	Out	1	2	White	Orange	2
3	Out	1	2	White	Green	3
4	Out	1	2	White	Brown	4
1	Out	2	2	White	Slate	5
2	Out	2	2	Red	Blue	6
3	Out	2	2	Red	Orange	7
4	Out	2	2	Red	Green	8
Spare [b]			2	Red	Brown	9
Spare			2	Red	Slate	10
Spare			2	Black	Blue	11
Spare			2	Black	Orange	12
Spare			2	White	Red	SP1
Spare			2	White	Black	SP2

(a) * Group #1 = Blue Thread, Group #2 = Orange Thread
(b) These are the only available spares in the List 3 and List 4 models.

The first eight pairs in each group connect to the four shelf slots as shown in Figure 15. The HRE-454 is shown as being wired in a typical mini-repeater fashion, using Sides 1 and 2 terminology. This adheres to conventional T1 terminology which describes a unidirectional (simplex) service. HDSL is, in fact, a bidirectional (duplex)

service and could be shown with bidirectional doubler header arrows. The brown/red pair in Group 1 is used to access the order wire pair as described in "Grounding" on page 13.

Table 12 on page 51 shows how the two spare red and white pairs in both groups are used in the HRE-454 List 5 and List 6 enclosures to power the four slots for HLU-431 List 1B applications. The four spare pairs used to access the HLU-431 system relay alarm controls are also shown.

Each power pair must be fused at 1.5 amps to prevent the 48 Vdc power source from current overloads.
Group 1 pair powers slots 1 and 2 while Group 2 pair powers slots 3 and 4. This configuration splits the current load between the two pairs.

The wiring from the cable stub entry to the card cage connectors and to the order wire connector is factory installed.

The wiring diagram (Figure 15) is located on the inside of the stainless steel dome for easy reference.

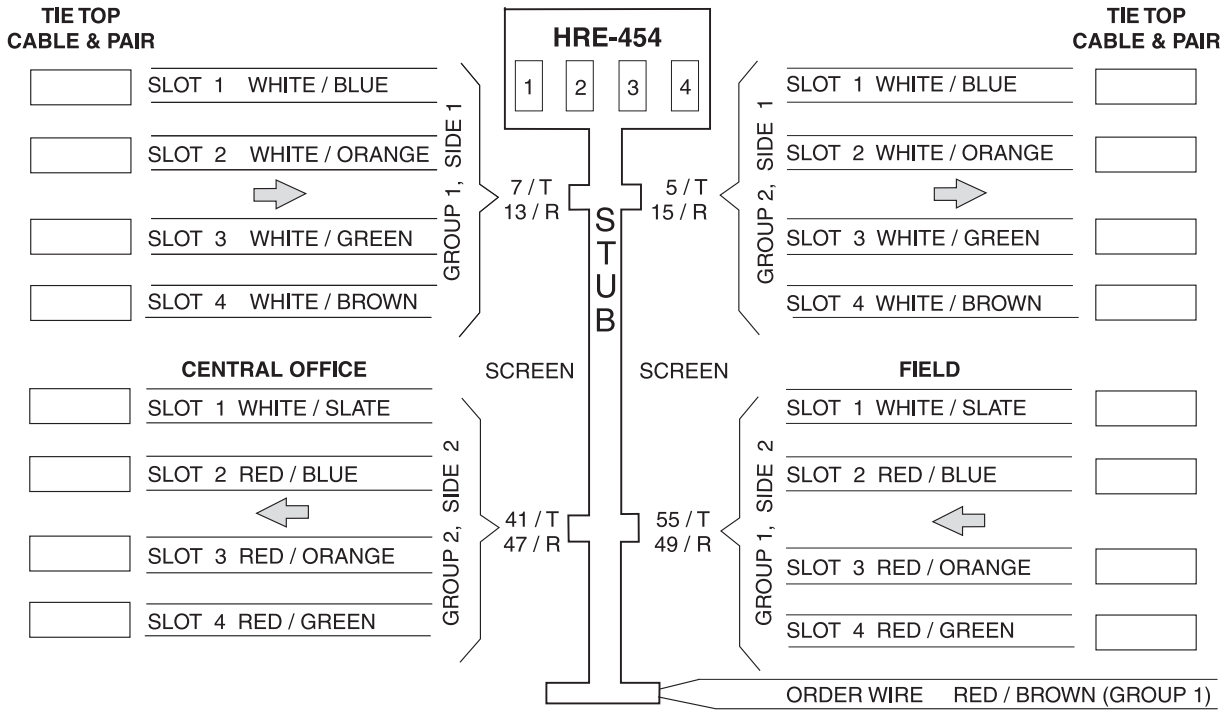


Figure 15. *HRE-454 Interface Wiring Diagram and Cable Assignment Drawing.*

Pinout Information

To use a specific shelf slot on the HRE-454, a remote, line, or doubler unit must be inserted. Insert the units into the desired shelf slot by lining up the gold fingers on each unit with the slot connector. Active pins are highlighted in black.

The HTC-400 test card can be inserted into a slot to make a through connection (see"Test Capabilities" on page 21 for more information).

This HRE-454 is not compatible with T1 repeaters.

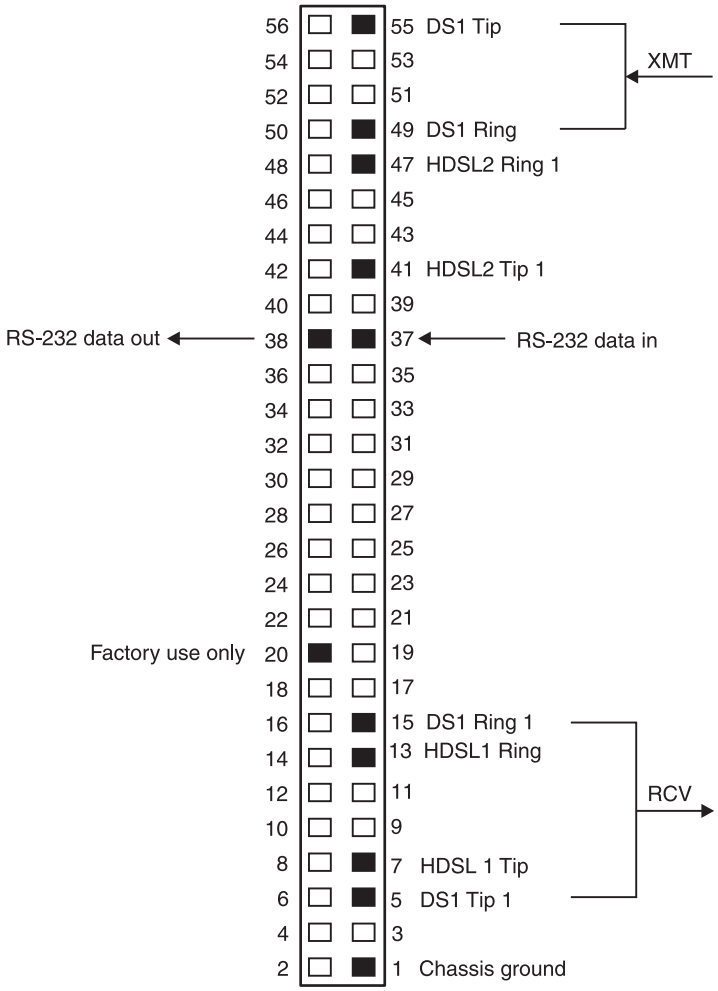


Figure 16. *HRU-412 Pin Assignments*

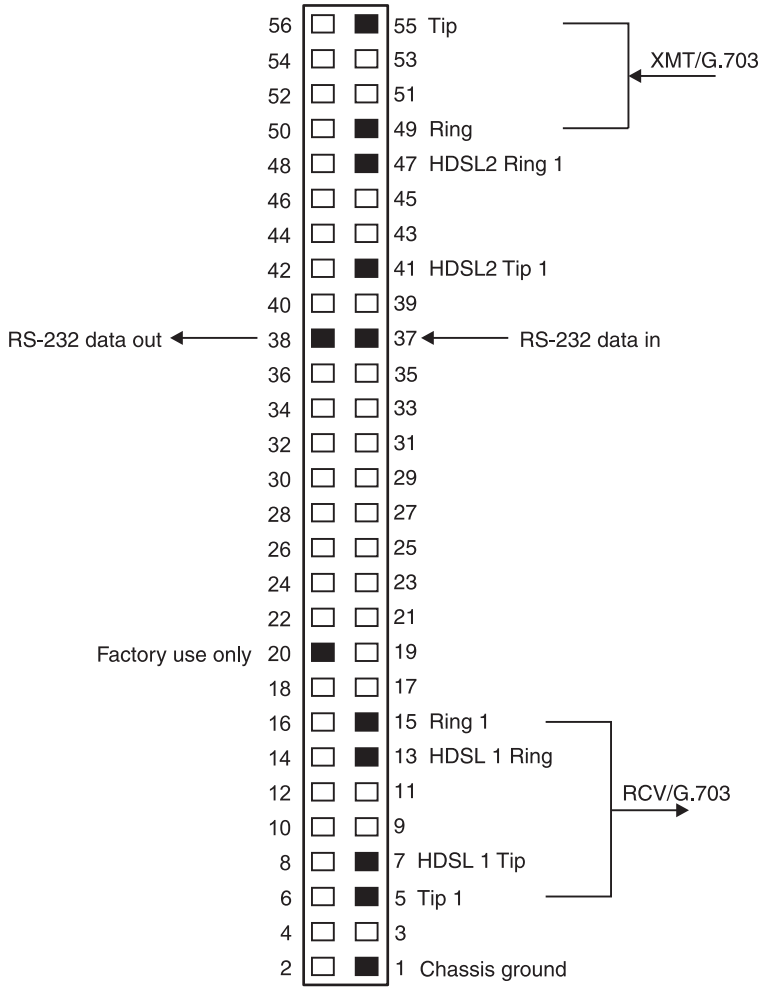


Figure 17. *ERU-412 List 2 Pin Assignments*

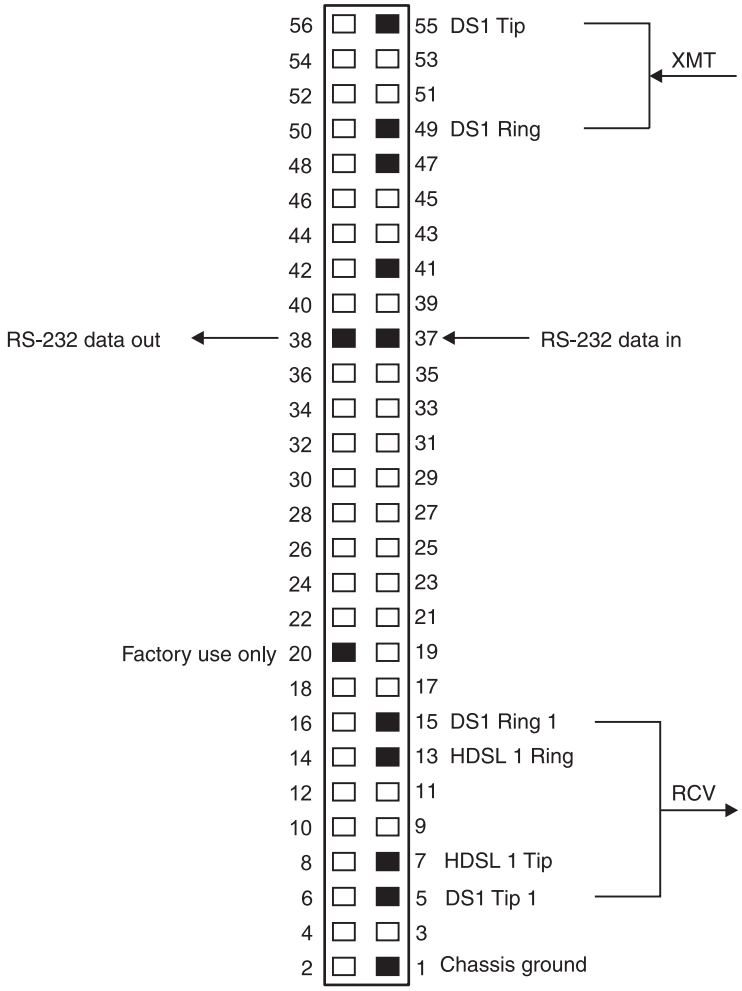


Figure 18. *HRU-512 Pin Assignments*

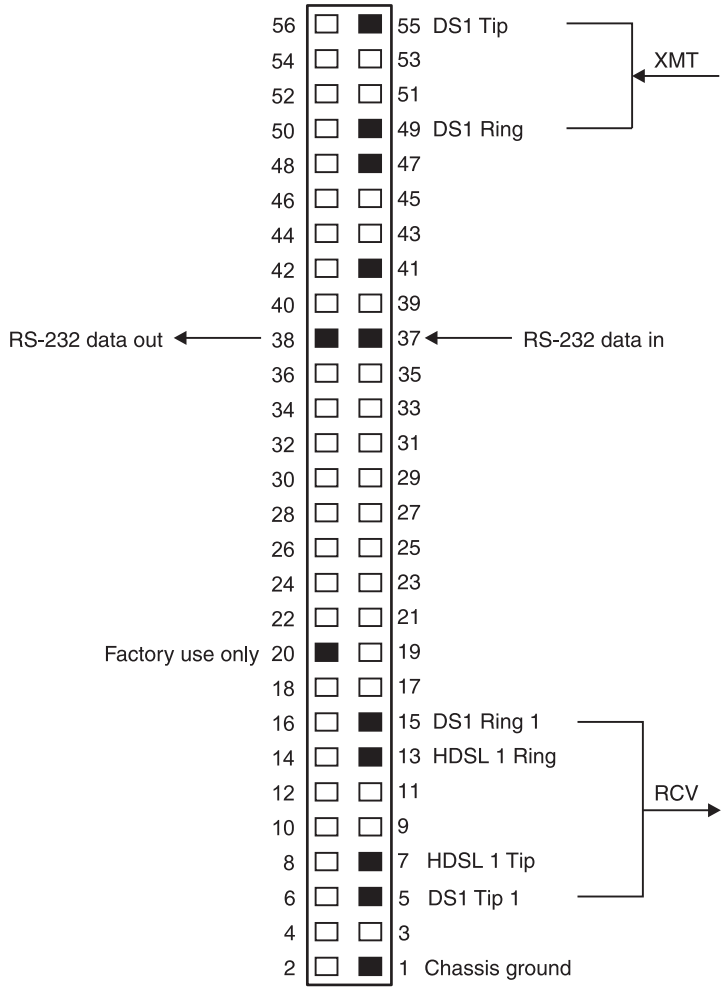


Figure 19. *HRU-612 Pin Assignments*

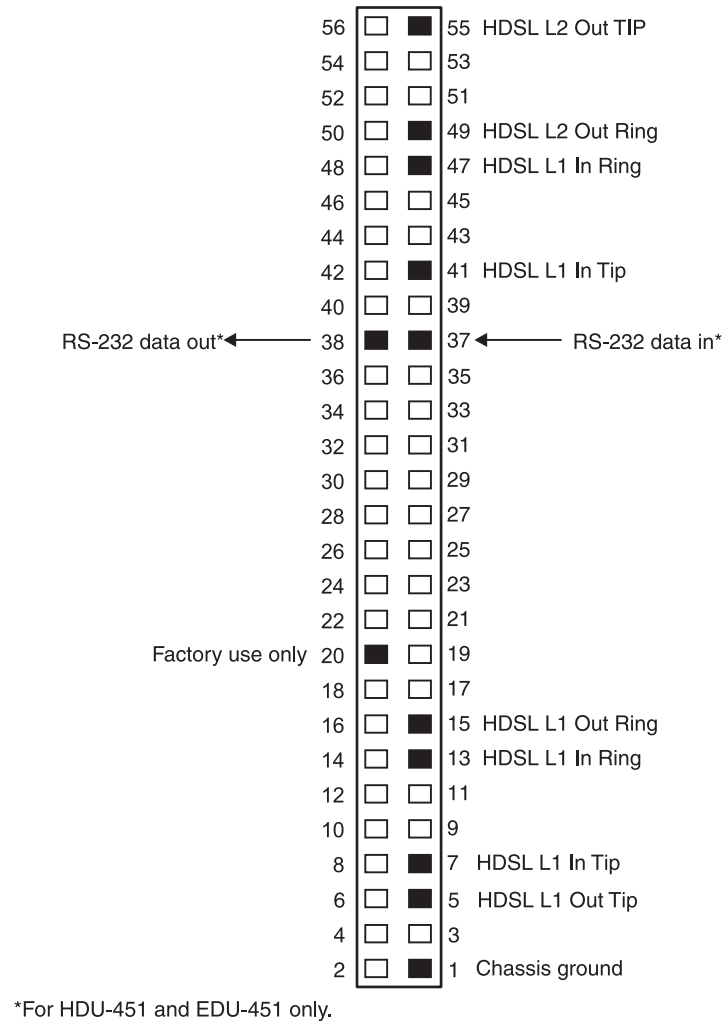


Figure 20. *HDU-451, HDU-404, and EDU-451 Pin Assignments*

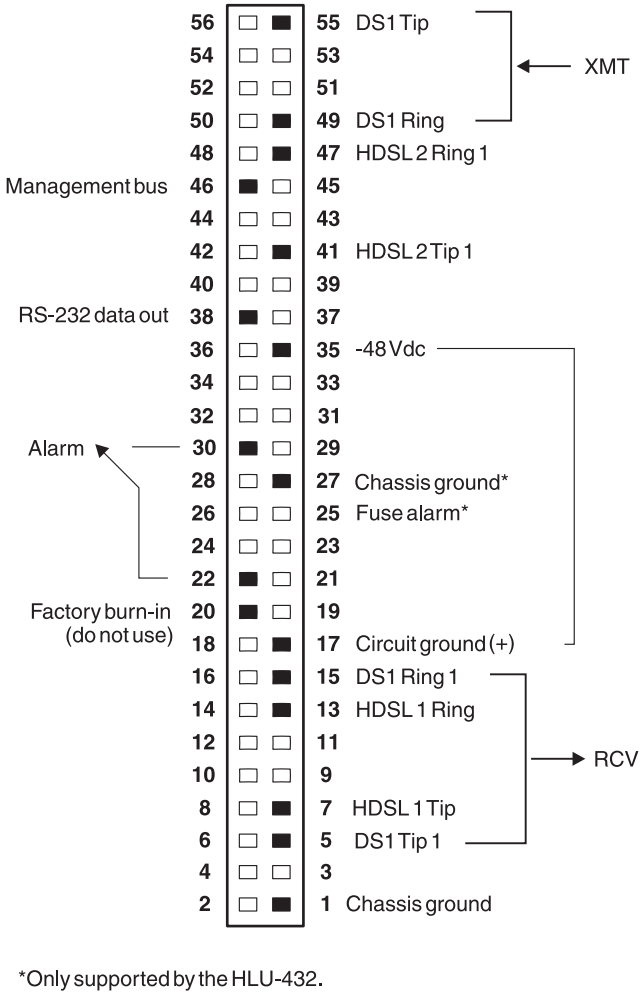
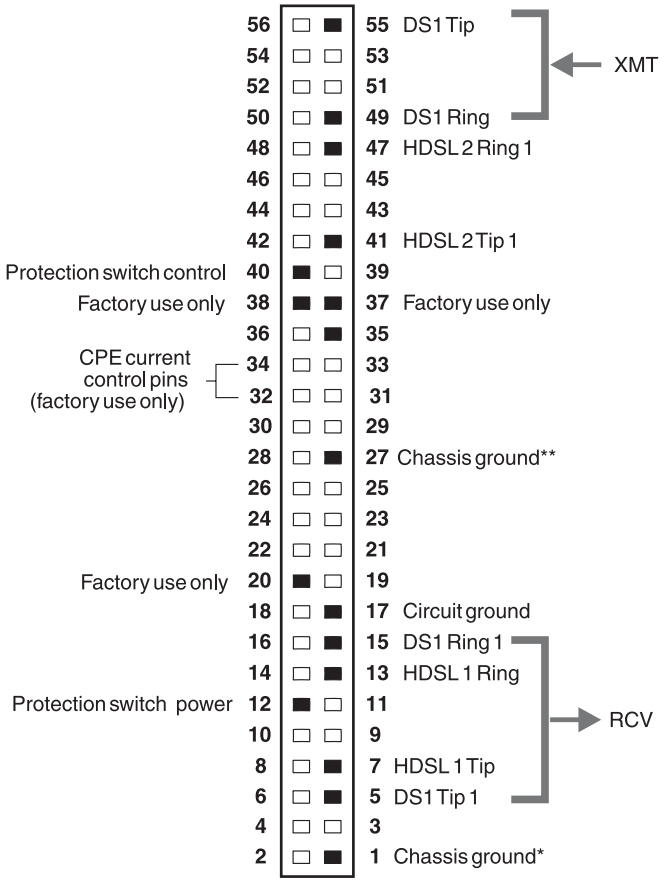
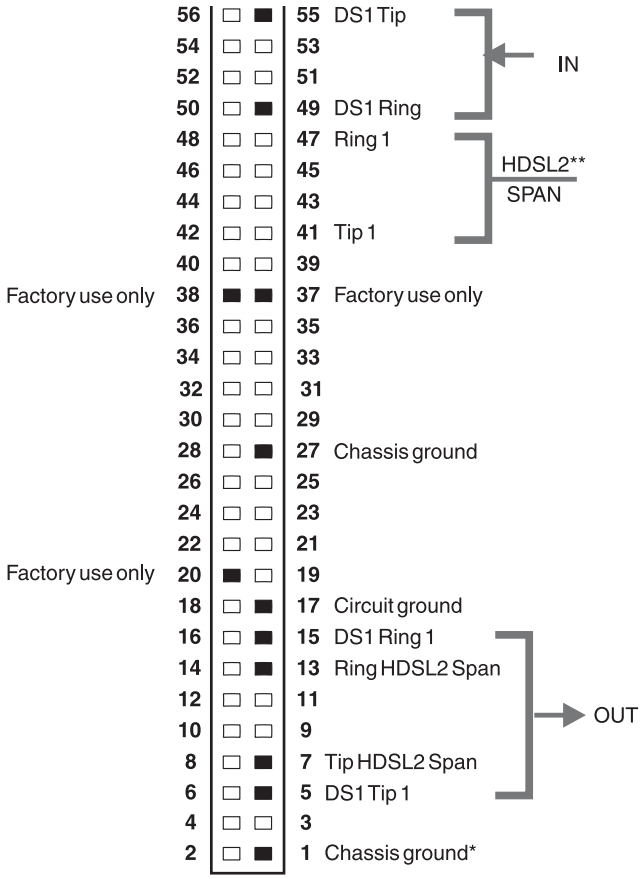


Figure 21. *HLU-431 and HLU-432 Pin Assignments Supported by HRE-454 List 5 and List 6*



* Not supported by the HRU-402 List 4 unit.
** Only supported by the HRU-402 List 4 unit.

Figure 22. *HRU-402 Pin Assignments*



* Not supported by the H2TU-R-402 List 4 units.
**Applies to the H2TU-R-402, List 1D and List 3D only.

Figure 23. *H2TU-R-402 Pin Assignments*

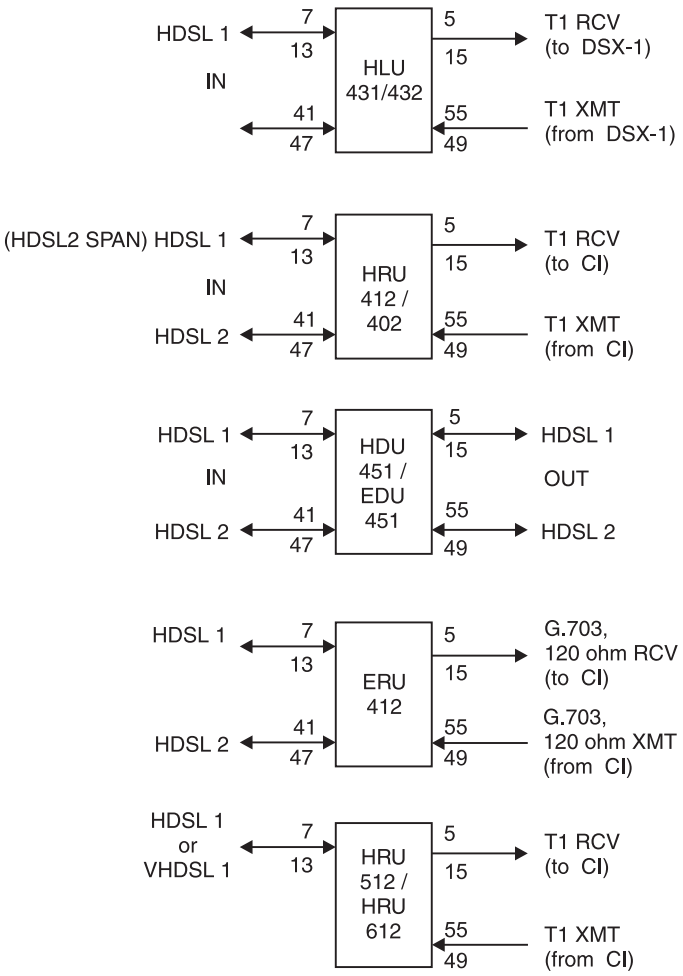


Figure 24. *HRE-454 Wiring Interfaces*

Wire List Information

The following tables provide information on different wiring configurations between the HRE-454 and doubler, line, and remote units. This list shows the interface between the HRU-412 pairs and the HRE-454 slots. Connectors J1, J2, J3, and J4 are the card-edge connectors at the rear of each HRE-454 slot. The slots are numbered 1 through 4, from left to right, facing the front of the card cage.

1 The red and brown order wire access pair terminates on the order wire protector terminals. The protector connects to order the wire terminals via a black/white jumper pair.

2 Pin number 1 on each connector is connected to chassis ground.

3 -48 Vdc power pair must be fused at 1.5 amps.

Table 8. *HRE-454, HRU-412, and HRU-402 Wire List*

HRE 454 Slot No.	Signal	Side	Group [a]	Color	Connector	Pair #
1	HDSL 1 Tip	1	1	White	J1 Pin 7	1
1	HDSL 1 Ring	1	1	Blue	J1 Pin 13	
1	HDSL 2 Tip	2	2	White	J1 Pin 41	5
1	HDSL 2 Ring	2	2	Slate	J1 Pin 47	
1	DS1 TX Tip	2	1	White	J1 Pin 55	5
1	DS1 TX Ring	2	1	Slate	J1 Pin 49	
1	DS1 RX Tip	1	2	White	J1 Pin 5	1
1	DS1 RX Ring	1	2	Blue	J1 Pin 15	
2	HDSL 1 Tip	1	1	White	J2 Pin 7	2
2	HDSL 1 Ring	1	1	Orange	J2 Pin 13	
2	HDSL 2 Tip	2	2	Red	J2 Pin 41	6
2	HDSL 2 Ring	2	2	Blue	J2 Pin 47	
2	DS1 TX Tip	2	1	Red	J2 Pin 55	6
2	DS1 TX Ring	2	1	Blue	J2 Pin 49	
2	DS1 RX Tip	1	2	White	J2 Pin 5	2
2	DS1 RX Ring	1	2	Orange	J2 Pin 15	
3	HDSL 1 Tip	1	1	White	J3 Pin 7	3
3	HDSL 1 Ring	1	1	Green	J3 Pin 13	
3	HDSL 2 Tip	2	2	Red	J3 Pin 41	7
3	HDSL 2 Ring	2	2	Orange	J3 Pin 47	
3	DS1 TX Tip	2	1	Red	J3 Pin 55	7
3	DS1 TX Ring	2	1	Orange	J3 Pin 49	
3	DS1 RX Tip	1	2	White	J3 Pin 5	3
3	DS1 RX Ring	1	2	Green	J3 Pin 15	

Table 8. *HRE-454, HRU-412, and HRU-402 Wire List (Cont.)*

HRE 454 Slot No.	Signal	Side	Group [a]	Color	Connector	Pair #
4	HDSL 1 Tip	1	1	White	J4 PIN 7	4
4	HDSL 1 Ring	1	1	Brown	J4 Pin 13	
4	HDSL 2 Tip	2	2	Red	J4 Pin 41	8
4	HDSL 2 Ring	2	2	Green	J4 Pin 47	
4	DS1 TX Tip	2	1	Red	J4 Pin 55	8
4	DS1 TX Ring	2	1	Green	J4 Pin 49	
4	DS1 RX Tip	1	2	White	J4 Pin 5	4
4	DS1 RX Ring	1	2	Brown	J4 Pin 15	
	Order wire Tip		1	Red	Order Wire Term	9
	Order wire Ring		1	Brown	Order Wire Term	
	Spare Tip [b]		2	Red		9
	Spare Ring [b]		2	Brown		
	Spare Tip		2	Red		10
	Spare Ring		2	Slate		
	Spare Tip [b]		1	Red		10
	Spare Ring [b]		1	Slate		
	Spare		2	Black		11
	Spare		2	Blue		
	Spare [b]		1	Black		11
	Spare [b]		1	Blue		
	Spare		2	Black		12
	Spare		2	Orange		
	Spare [b]		1	Black		12
	Spare [b]		1	Orange		
	Spare		2	White		SP1
	Spare		2	Red		
	Spare		1	White		SP1
	Spare		1	Red		
	Spare		2	White		SP2
	Spare		2	Black		
	Spare		1	White		SP2
	Spare		1	Black		

(a) Group #1 = Blue Thread, Group #2 = Orange Thread
(b) These are the only available spares in the List 3 and List 4 units.

Table 9 is the wire list for HRE-454 List 1A, List 2B and List 4, and the ERU-412 List 2, 120Ω applications. The HRE-454 Slots are numbered 1 through 4 from left to right as viewed from the front. The red and brown order wire access pair terminates on order wire protector terminals. Protector connects to order wire terminals via the black and white jumper pair. Pin number 1 on each connector must be grounded at J1-1, J2-1, J3-1, and J4-1.

Table 9. *HRE-454 and ERU-412 List 2 Wire List*

HRE 454 Slot No.	Signal	Side	Group*	Color	Connector	Pair #
1	HDSL 1 Tip	1	1	White	J1 Pin 7	1
1	HDSL 1 Ring	1	1	Blue	J1 Pin 13	
1	HDSL 2 Tip	2	2	White	J1 Pin 41	5
1	HDSL 2 Ring	2	2	Slate	J1 Pin 47	
1	G.703/120Ω TX Tip	2	1	White	J1 Pin 55	5
1	G.703/120Ω TX Ring	2	1	Slate	J1 Pin 49	
1	G.703/120Ω RX Tip	1	2	White	J1 Pin 5	1
1	G.703/120Ω RX Ring	1	2	Blue	J1 Pin 15	
2	HDSL 1 Tip	1	1	White	J2 Pin 7	2
2	HDSL 1 Ring	1	1	Orange	J2 Pin 13	
2	HDSL 2 Tip	2	2	Red	J2 Pin 41	6
2	HDSL 2 Ring	2	2	Blue	J2 Pin 47	
2	G.703/120Ω TX Tip	2	1	Red	J2 Pin 55	6
2	G.703/120Ω TX Ring	2	1	Blue	J2 Pin 49	
2	G.703/120Ω RX Tip	1	2	White	J2 Pin 5	2
2	G.703/120Ω RX Ring	1	2	Orange	J2 Pin 15	
3	HDSL 1 Tip	1	1	White	J3 Pin 7	3
3	HDSL 1 Ring	1	1	Green	J3 Pin 13	
3	HDSL 2 Tip	2	2	Red	J3 Pin 41	7
3	HDSL 2 Ring	2	2	Orange	J3 Pin 47	
3	G.703/120Ω TX Tip	2	1	Red	J3 Pin 55	7
3	G.703/120Ω TX Ring	2	1	Orange	J3 Pin 49	
3	G.703/120Ω RX Tip	1	2	White	J3 Pin 5	3
3	G.703/120Ω RX Ring	1	2	Green	J3 Pin 15	
4	HDSL 1 Tip	1	1	White	J4 Pin 7	4
4	HDSL 1 Ring	1	1	Brown	J4 Pin 13	
4	HDSL 2 Tip	2	2	Red	J4 Pin 41	8
4	HDSL 2 Ring	2	2	Green	J4 Pin 47	
4	G.703/120Ω TX Tip	2	1	Red	J4 Pin 55	8
4	G.703/120Ω TX Ring	2	1	Green	J4 Pin 49	
4	G.703/120Ω RX Tip	1	2	White	J4 Pin 5	4
4	G.703/120Ω RX Ring	1	2	Brown	J4 Pin 15	
	Order wire Tip	2	1	Red	Order Wire Term	9
	Order wire Ring	2	1	Brown	Order Wire Term	
	Spare Tip		2	Red		9
	Spare Ring		2	Brown		
	Spare Tip		2	Red		10
	Spare Ring		2	Slate		
	Spare Tip		1	Red		10
	Spare Ring		1	Slate		
	Spare		2	Black		11

Table 9. *HRE-454 and ERU-412 List 2 Wire List (Cont.)*

HRE 454 Slot No.	Signal	Side	Group*	Color	Connector	Pair #
	Spare		2	Blue		
	Spare		1	Black		11
	Spare		1	Blue		
	Spare		2	Black		12
	Spare		2	Orange		
	Spare		1	Black		12
	Spare		1	Orange		
	Spare		2	White		SP1
	Spare		2	Red		
	Spare		1	White		SP1
	Spare		1	Red		
	Spare		2	White		SP2
	Spare		2	Black		
	Spare		1	White		SP2
	Spare		1	Black		

*Group #1 = Blue Thread, Group #2 = Orange Thread

Table 10 is the wire list for the single HDSL pair HRU-512 and HRU-612 applications. Only the Side 1, Group 1 HDSL pairs are used. The Side 2, Group 2 pairs are not used.

Table 10. *HRE-454 (HRU-512, HRU-612, and H2TU-R-402) Wire List*

HRE 454 Slot No.	Signal	Side	Group *	Color	Connector	Pair #
1	HDSL2 Tip	1	1	White	J1 Pin 7	1
1	HDSL2 Ring	1	1	Blue	J1 Pin 13	
1	Not Used	2	2	White	J1 Pin 41	5
1	Not Used	2	2	Slate	J1 Pin 47	
1	DS1 TX Tip	2	1	White	J1 Pin 55	5
1	DS1 TX Ring	2	1	Slate	J1 Pin 49	
1	DS1 RX Tip	1	2	White	J1 Pin 5	1
1	DS1 RX Ring	1	2	Blue	J1 Pin 15	
2	HDSL 2 Tip	1	1	White	J2 Pin 7	2
2	HDSL 2 Ring	1	1	Orange	J2 Pin 13	
2	Not Used	2	2	Red	J2 Pin 41	6
2	Not Used	2	2	Blue	J2 Pin 47	
2	DS1 TX Tip	2	1	Red	J2 Pin 55	6
2	DS1 TX Ring	2	1	Blue	J2 Pin 49	
2	DS1 RX Tip	1	2	White	J2 Pin 5	2
2	DS1 RX Ring	1	2	Orange	J2 Pin 15	
3	HDSL 2 Tip	1	1	White	J3 Pin 7	3
3	HDSL 2 Ring	1	1	Green	J3 Pin 13	

Table 10. *HRE-454 (HRU-512, HRU-612, and H2TU-R-402) Wire List (Cont.)*

HRE 454 Slot No.	Signal	Side	Group *	Color	Connector	Pair #
3	Not Used	2	2	Red	J3 Pin 41	7
3	Not Used	2	2	Orange	J3 Pin 47	
3	DS1 TX Tip	2	1	Red	J3 Pin 55	7
3	DS1 TX Ring	2	1	Orange	J3 Pin 49	
3	DS1 RX Tip	1	2	White	J3 Pin 5	3
3	DS1 RX Ring	1	2	Green	J3 Pin 15	
4	HDSL 2 In Tip	1	1	White	J4 Pin 7	4
4	HDSL 2 In Ring	1	1	Brown	J4 Pin 13	
4	Not Used	2	2	Red	J4 Pin 41	8
4	Not Used	2	2	Green	J4 Pin 47	
4	DS1 TX Tip	2	1	Red	J4 Pin 55	8
4	DS1 TX Ring	2	1	Green	J4 Pin 49	
4	DS1 RX Tip	1	2	White	J4 Pin 5	4
4	DS1 RX Ring	1	2	Brown	J4 Pin 15	
	Order wire Tip	2	1	Red	Order Wire Term	9
	Order wire Ring	2	1	Brown	Order Wire Term	
	Spare Tip		2	Red		9
	Spare Ring		2	Brown		
	Spare Tip		2	Red		10
	Spare Ring		2	Slate		
	Spare Tip		1	Red		10
	Spare Ring		1	Slate		
	Spare		2	Black		11
	Spare		2	Blue		
	Spare		1	Black		11
	Spare		1	Blue		
	Spare		2	Black		12
	Spare		2	Orange		
	Spare		1	Black		12
	Spare		1	Orange		
	Spare		2	White		SP1
	Spare		2	Red		
	Spare		1	White		SP1
	Spare		1	Red		
	Spare		2	White		SP2
	Spare		2	Black		
	Spare		1	White		SP2
	Spare		1	Black		

*Group #1 = Blue Thread, Group #2 = Orange Thread

Table 11 is the wire list for HRE-454 (HDU-451, HDU-404, and EDU-451) applications.

Table 11. *HRE-454 (HDU-451, HDU-404, and EDU-451) Wire List*

HRE 454 Slot No.	Signal	Side	Group*	Color	Connector	Pair #
1	HDSL 1 In Tip	1	1	White	J1 Pin 7	1
1	HDSL 1 In Ring	1	1	Blue	J1 Pin 13	
1	HDSL 2 In Tip	2	2	White	J1 Pin 41	5
1	HDSL 2 In Ring	2	2	Slate	J1 Pin 47	
1	HDSL 2 Out Tip	2	1	White	J1 Pin 55	5
1	HDSL 2 Out Ring	2	1	Slate	J1 Pin 49	
1	HDSL 1 Out Tip	1	2	White	J1 Pin 5	1
1	HDSL 1 Out Ring	1	2	Blue	J1 Pin 15	
2	HDSL 1 In Tip	1	1	White	J2 Pin 7	2
2	HDSL 1 In Ring	1	1	Orange	J2 Pin 13	
2	HDSL 2 In Tip	2	2	Red	J2 Pin 41	6
2	HDSL 2 In Ring	2	2	Blue	J2 Pin 47	
2	HDSL 2 Out Tip	2	1	Red	J2 Pin 55	6
2	HDSL 2 Out Ring	2	1	Blue	J2 Pin 49	
2	HDSL 1 Out Tip	1	2	White	J2 Pin 5	2
2	HDSL 1 Out Ring	1	2	Orange	J2 Pin 15	
3	HDSL 1 in Tip	1	1	White	J3 Pin 7	3
3	HDSL 1 In Ring	1	1	Green	J3 Pin 13	
3	HDSL 2 In Tip	2	2	Red	J3 Pin 41	7
3	HDSL 2 In Ring	2	2	Orange	J3 Pin 47	
3	HDSL 2 Out Tip	2	1	Red	J3 Pin 55	7
3	HDSL 2 Out Ring	2	1	Orange	J3 Pin 49	
3	HDSL 1 Out Tip	1	2	White	J3 Pin 5	3
3	HDSL 1 Out Ring	1	2	Green	J3 Pin 15	
4	HDSL 1 In Tip	1	1	White	J4 PIN 7	4
4	HDSL 1 In Ring	1	1	Brown	J4 Pin 13	
4	HDSL 2 In Tip	2	2	Red	J4 Pin 41	8
4	HDSL 2 In Ring	2	2	Green	J4 Pin 47	
4	HDSL 2 Out Tip	2	1	Red	J4 Pin 55	8
4	HDSL 2 Out Ring	2	1	Green	J4 Pin 49	
4	HDSL 1 Out Tip	1	2	White	J4 Pin 5	4
4	HDSL 1 Out Ring	1	2	Brown	J4 Pin 15	
	Order wire Tip	2	1	Red	Order Wire Term	9
	Order wire Ring	2	1	Brown	Order Wire Term	
	Spare Tip		2	Red		9
	Spare Ring		2	Brown		
	Spare Tip		2	Red		10
	Spare Ring		2	Slate		

Table 11. *HRE-454 (HDU-451, HDU-404, and EDU-451) Wire List (Cont.)*

HRE 454 Slot No.	Signal	Side	Group*	Color	Connector	Pair #
	Spare		2	Black		11
	Spare		2	Blue		
	Spare		1	Black		11
	Spare		1	Blue		
	Spare		2	Black		12
	Spare		2	Orange		
	Spare		1	Black		12
	Spare		1	Orange		
	Spare		2	White		SP1
	Spare		2	Red		
	Spare		1	White		SP1
	Spare		1	Red		
	Spare		2	White		SP2
	Spare		2	Black		
	Spare		1	White		SP2
	Spare		1	Black		

*Group #1 = Blue Thread, Group #2 = Orange Thread

Table 12 is the wire list for HRE-454 List 5 and List 6 units in the HLU-431 and HLU-432 applications.

Table 12. *HRE-454 List 5 and List 6 (HLU-431 and HLU-432) Wire List*

HRE 454 Slot No.	Signal	Side	Group [a]	Color	Connector	Pair #
1	HDSL 1 Tip	1	1	White	J1 Pin 7	1
1	HDSL 1 Ring	1	1	Blue	J1 Pin 13	
1	HDSL 2 Tip	2	2	White	J1 Pin 41	5
1	HDSL 2 Ring	2	2	Slate	J1 Pin 47	
1	DS1 TX Tip	2	1	White	J1 Pin 55	5
1	DS1 TX Ring	2	1	Slate	J1 Pin 49	
1	DS1 RX Tip	1	2	White	J1 Pin 5	1
1	DS1 RX Ring	1	2	Blue	J1 Pin 15	
2	HDSL 1 Tip	1	1	White	J2 Pin 7	2
2	HDSL 1 Ring	1	1	Orange	J2 Pin 13	
2	HDSL 2 Tip	2	2	Red	J2 Pin 41	6
2	HDSL 2 Ring	2	2	Blue	J2 Pin 47	
2	DS1 TX Tip	2	1	Red	J2 Pin 55	6
2	DS1 TX Ring	2	1	Blue	J2 Pin 49	
2	DS1 RX Tip	1	2	White	J2 Pin 5	2
2	DS1 RX Ring	1	2	Orange	J2 Pin 15	
3	HDSL 1 Tip	1	1	White	J3 Pin 7	3
3	HDSL 1 Ring	1	1	Green	J3 Pin 13	
3	HDSL 2 Tip	2	2	Red	J3 Pin 41	7
3	HDSL 2 Ring	2	2	Orange	J3 Pin 47	
3	DS1 TX Tip	2	1	Red	J3 Pin 55	7
3	DS1 TX Ring	2	1	Orange	J3 Pin 49	
3	DS1 RX Tip	1	2	White	J3 Pin 5	3
3	DS1 RX Ring	1	2	Green	J3 Pin 15	
4	HDSL 1 Tip	1	1	White	J4 Pin 7	4
4	HDSL 1 Ring	1	1	Brown	J4 Pin 13	
4	HDSL 2 Tip	2	2	Red	J4 Pin 41	8
4	HDSL 2 Ring	2	2	Green	J4 Pin 47	
4	DS1 TX Tip	2	1	Red	J4 Pin 55	8
4	DS1 TX Ring	2	1	Green	J4 Pin 49	
4	DS1 RX Tip	1	2	White	J4 Pin 5	4
4	DS1 RX Ring	1	2	Brown	J4 Pin 15	
	Order wire Tip		1	Red	Order Wire Term	9
	Order wire Ring		1	Brown	Order Wire Term	
	Spare Tip		2	Red		9
	Spare Ring		2	Brown		
	Spare Tip		2	Red		10
	Spare Ring		2	Slate		
	Spare Tip		1	Red		10
	Spare Ring		1	Slate		

Table 12. *HRE-454 List 5 and List 6 (HLU-431 and HLU-432) Wire List (Cont.)*

HRE 454 Slot No.	Signal	Side	Group [a]	Color	Connector	Pair #
4	System Alarm Relay (Normally open)		2	Black	J4 Pin 30	11
4	System Alarm Relay (Wiper)		2	Blue	J4 Pin 22	
2	System Alarm Relay (Normally open)		1	Black	J2 Pin 30	11
2	System Alarm Relay (Wiper)		1	Blue	J2 Pin 22	
3	System Alarm Relay (Normally open)		2	Black	J3 Pin 30	12
3	System Alarm Relay (Wiper)		2	Orange	J3 Pin 22	
1	System Alarm Relay (Normally open)		1	Black	J1 Pin 30	12
1	System Alarm Relay (Wiper)		1	Orange	J1 Pin 22	
3	+ (48 Vdc)		2	White	J3 Pin 17	+48 Vdc Power (GND)
4	+ (48 Vdc)		2	White	J4 Pin 17	
3	- (48 Vdc)		2	Red	J3 Pin 35	-48 Vdc Power
4	- (48 Vdc)		2	Red	J4 Pin 35	
1	+ (48 Vdc)		1	White	J1 Pin 17	+48 Vdc Power (GND)
2	+ (48 Vdc)		1	White	J2 Pin 17	
1	- (48 Vdc)		1	Red	J1 Pin 35	-48 Vdc Power
2	- (48 Vdc)		1	Red	J2 Pin 35	
	Spare		2	White		SP2
	Spare		2	Black		
	Spare		1	White		SP2
	Spare		1	Black		

(a) Group #1 = Blue Thread, Group #2 = Orange Thread

HRE-454 MAINTENANCE

This section covers various maintenance procedures for the HRE-454.

Splicing

Splicing consists of connecting the wire pairs of the HRE-454 cable stub to the main cable within the splice case. "Pre-splicing Procedure" on page 53, "Splicing Procedure" on page 55, and "Post-splicing Procedure" on page 56 contain step-by-step procedures for preparing the stubs, which include:

- Splicing into the main cable (pre-splice procedure)
- Splicing the stubs into the main cable (splicing procedure)
- Dressing and taping the final splice in the splice case (post-splice procedure)

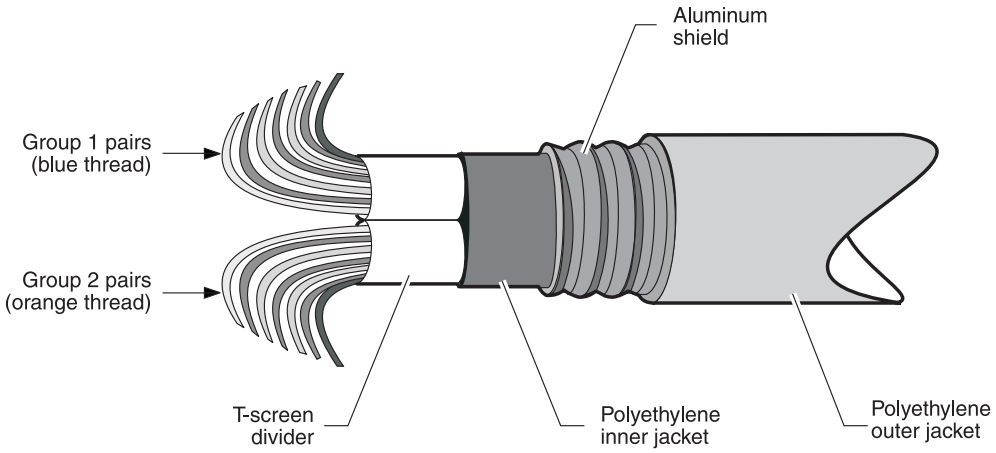


Figure 25. *Cable Stub Construction*

While performing these three splicing procedures, maintain cable pair integrity when splicing stub pairs into the main cable. The T1 lines must have correct cable pair connection. However, the HDSL units will compensate if cable pairs are reversed, but may give false indications when trouble occurs. Follow normal procedures as required.

Pre-splicing Procedure

Perform the following to pre-splice the enclosure cable stub:

1 Strip a sufficient length of the outer jacket, aluminum shield, and mylar sheath from the cable stub.

Make sure you ground the HRE-454 enclosure before splicing the cable stubs into the main cable. The grounding method in "Grounding" on page 13 (or an accepted local grounding method) must be in effect at all times to safeguard personnel.

The HRE-454 comes with a screened cable stub that is pre-cut and capped. Refer to Figure 25 on page 53 for a view of the screened cable stub construction.

The cable butt is considered to be the end of the cable stub most distant from the enclosure.

2 Strip the main cable as required by the cable manufacturer.

3 Install shield bonding connectors in accordance with standard practices.

4 To avoid split pairs, tie or band the ends of the Group 1 and Group 2 pairs. Cut off the pair ends and cable butt to aid in the removal of grease.

5 Separate pairs between the tied ends and the cable butt to aid in the removal of grease.

6 Remove grease by wiping the tied ends and the cable butt with a clean cloth or paper towel.

When the air temperature is low, warm the cable pairs to aid in removing grease by cleaning the stub in a heated enclosure or by using a heat gun to apply warm air to the pairs. Avoid applying excessive heat, which could deform the insulation on the pairs.

7 Keep cable pairs dry. Cover the exposed splice to protect it from the elements if it is left unattended prior to completion.

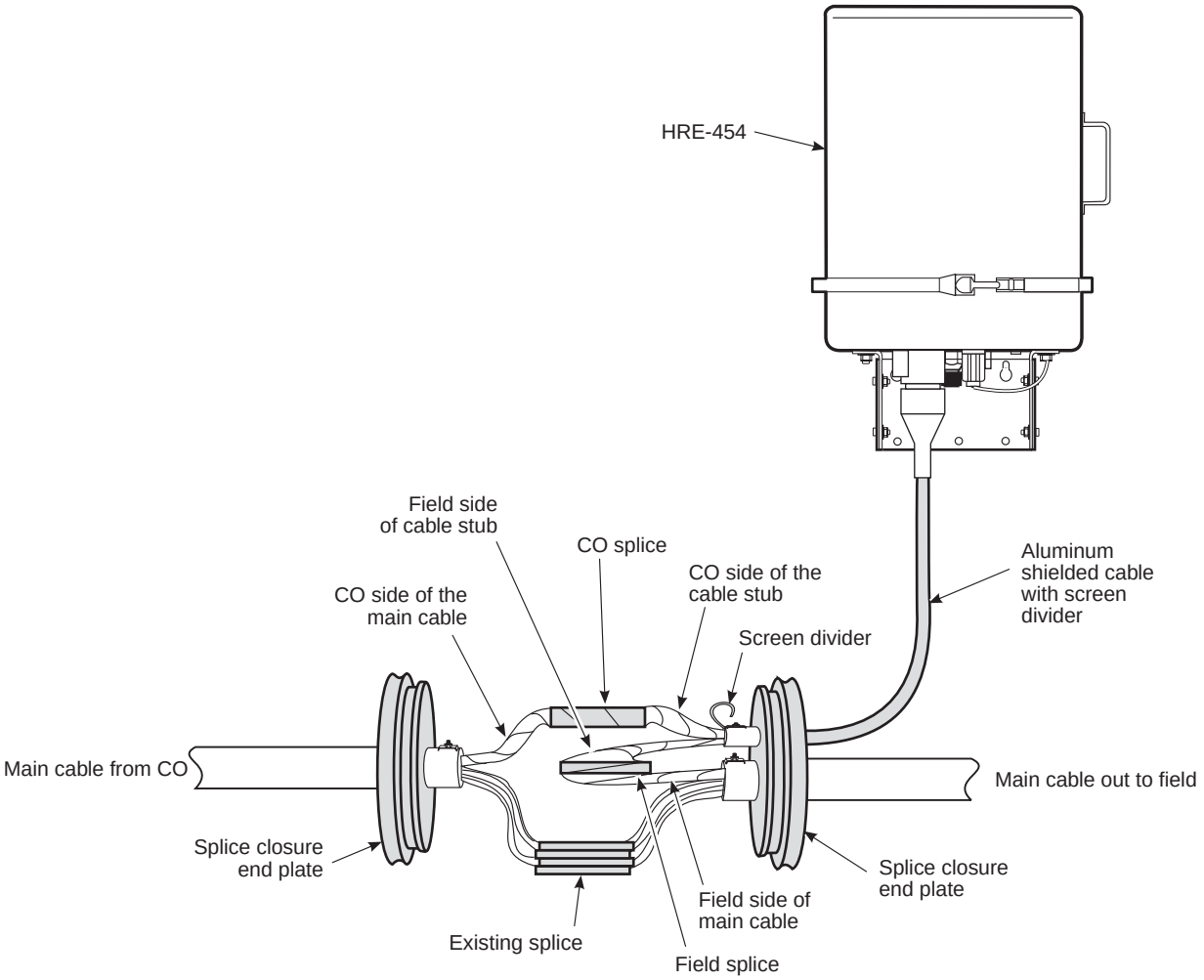


Figure 26. *Dress Splice in Splice Case*

Splicing Procedure

Certain applications involve splicing the cables on the HRE-454. The following section describes splicing procedures and wire list information.

1 Splice the cable stub to the main cable using the diagram in Figure 26 and the wire identification information in:

- Table 8, “HRE-454, HRU-412, and HRU-402 Wire List,” on page 44
- Table 9, “HRE-454 and ERU-412 List 2 Wire List,” on page 46
- Table 10, “HRE-454 (HRU-512, HRU-612, and H2TU-R-402) Wire List,” on page 47
- Table 11, “HRE-454 (HDU-451, HDU-404, and EDU-451) Wire List,” on page 49
- Table 12, “HRE-454 List 5 and List 6 (HLU-431 and HLU-432) Wire List,” on page 51

2 Visually inspect each splice for split pairs, opens, and shorts.

Maintenance personnel sometimes cross-splice defective pairs between units. These pairs are referred to as wandering pairs and may cause problems.

3 Connect the CO side of the main cable to the CO side of the cable stub with a straight splice.

4 Once the cables are connected, wrap the CO splice with aluminum tape or dress out the splice according to local procedures.

5 Connect the field side of the cable stub to the field side of the main cable with a straight splice.

6 Once the cables are connected, wrap the field splice with aluminum tape as shown in or dress out the splice according to local procedures.

7 Repair or correct defective or wandering pairs before closing the splice; otherwise, the color code sequence of the cable stub in relation to the pair count or the main cable will no longer be valid.

8 Roll back and tape the screen divider from the cable stub.

9 Perform any cable tests required by local practice.

ADC highly recommends that you maintain cable pair integrity on the HDSL and T1/G.703 sides.

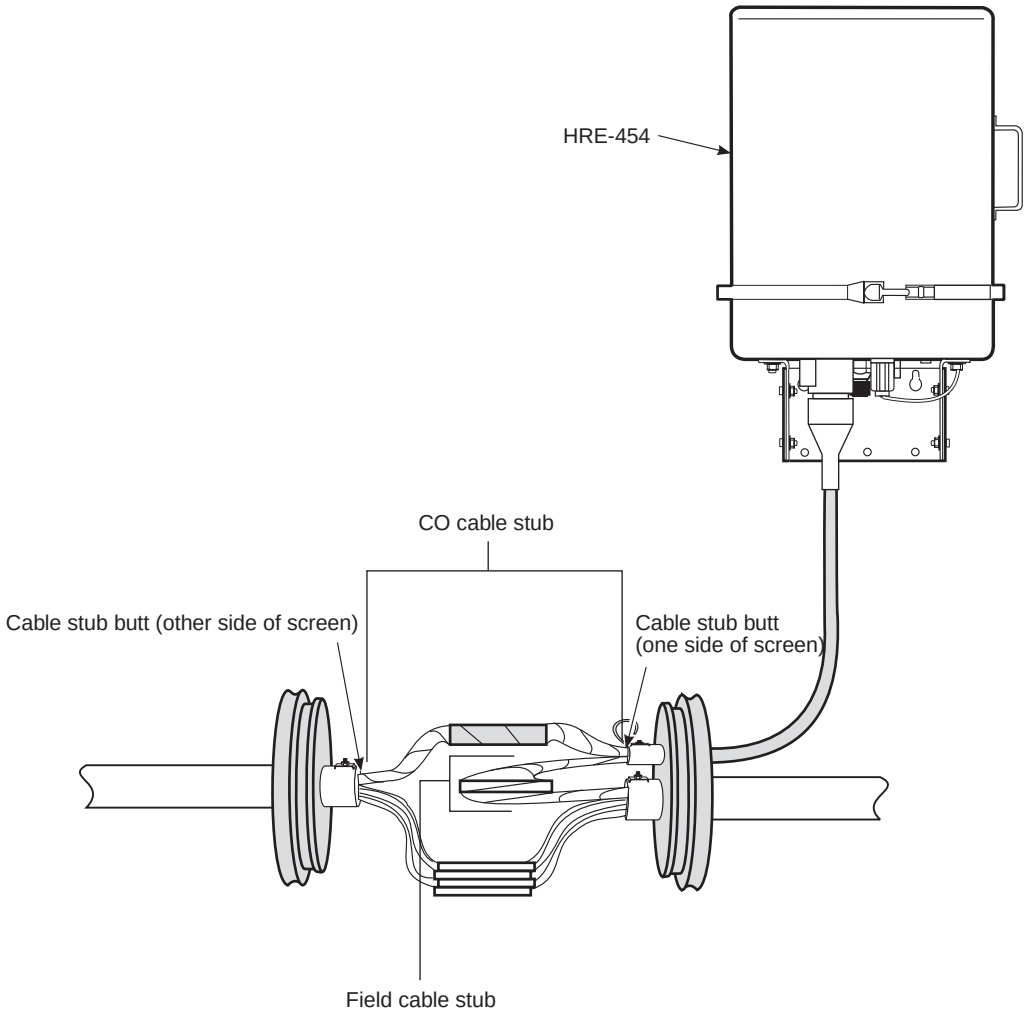


Figure 27. *Post-splicing Procedure*

Post-splicing Procedure

The post-splice procedure involves the following steps:

1 Starting at the cable stub butt of the CO cable stub, wrap the pairs on one side of the screen with $^{3}/_{4}$-inch self-bonding rubber tape. Overlap the tape by one-half its width (see Figure 27 on page 56).

2 Repeat Step 1, wrapping the pairs on the other side of the screen of the CO cable stub in the same way.

3 Starting at the cable-stub butt, wrap the pairs on one side of the screen with 2-inch, pressure sensitive, aluminum tape. Overlay the tape by one-half its width and form the tape in place. Aluminum tape provides electrical isolation from outside EMI sources. For these applications, dress out the splice per local practices.

Aluminum tape may present a potential shorting hazard when splicing paper pulp insulated cables.

4 Repeat Step 3 wrapping the pairs on the other side of the screen in the same way.

5 Starting at the cable-stub butt of the field cable stub, wrap the pairs on one side of the screen with two layers of $^{3}/_{4}$-inch vinyl tape. Overlap the tape by one-half its width.

6 Repeat Step 5 wrapping the pairs on the other side of the field cable stub screen in the same way.

The screen divider is an insulated floating divider that isolates Group 1 (blue thread, side 1 in) and Group 2 (green thread, side 2 in) from Group 3 (orange thread, side 1 out) and Group 4 (brown thread, side 2 out) in the cable stub.

Do not ground the divider or connect it to the screen divider of the main cable. This may result in poor performance. The aluminum tape used to wrap the input and output pairs provides the necessary isolation.

7 Cut the cable stub screen divider approximately 6 inches from the cable stub butt.

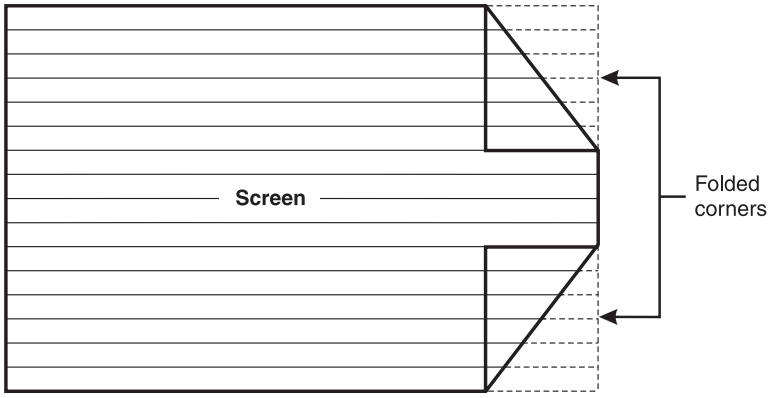


Figure 28. *Screen Folding Diagram*

8 Fold each corner at a 45° angle to the center of the screen.

9 Fold the screen divider back on itself several times and tape it to prevent it from unfolding.

10 Position the folded and taped screen divider between the spliced and taped Groups 1 and 2 pairs.

11 Seal and close the splice case according to the splice case instructions.

REPLACEMENT PARTS

There are seven replacement or accessory kits that are available for the HRE-454 enclosures. Table 13 on page 59 lists these kits. Following are the topics regarding replacement parts:

- Replacing the Stainless Steel Dome Cover
- Replacing LPU Arrestor Boards

Kits 132-1010, -1011, -1013, -1014; 132-1038-01; and 132-1030-01 are available for damaged components. Kit 132-1916-01 contains a typical set of nuts and bolts mounting hardware.

The HRE-454 contains replaceable LPU surge arrestors. (See "Replacing LPU Arrestor Boards" on page 58 for instructions on replacing the LPU surge arrestors.) Additionally, ADC recommends that the O-ring be closely examined whenever the housing is opened for maintenance. Be sure to replace the O-ring if it becomes damaged.

The cover, clamp, O-ring, and LPU surge arrestors may be replaced in the field if they become damaged. See Table 13 on page 59 for replacement kits.

Replacing the Stainless Steel Dome Cover

It is necessary to replace the following items: stainless steel dome cover, metal locking clamp, and O-ring. It is recommended that the desiccant bags be replaced when the enclosure is opened. Use Davison Chemical Corp. *Proteck-Sorb-121* or equivalent desiccant.

Replacing LPU Arrestor Boards

If any of the enclosure plugs experience severe lightning stress, ADC recommends replacing the LPU board for that plug. To replace LPU arrestor boards, perform the following steps:

1 Clean the dome cover and clamp of dust and debris.

2 Remove the clamp and dome cover as described in "Replacement Parts" on page 57.

3 Remove the defective LPU board.

4 Insert a new LPU board in the vacant position.

5 Replace other defective LPU boards in the same manner. Note that the LPU board must be reattached so that pin 1 of the board is connected to the edge connector pin which, in turn, is connected to the green or braided shield ground wire. If the LPU board is attached in any other way, protection will not be provided.

6 Replace O-ring if damaged.

7 Replace the cover and clamp and repressurize the housing if required (see "Closing the HRE-454 Enclosure" on page 18 for more information).

Table 13. *Replacement Part Kits*

Number	Components
132-1010-01	**Dome Cover and Accessories**
Qty 1	Dome Cover
Qty 1	O-Ring
Qty 1	V-Band Metal Locking Clamp
Qty 1 Bag	Desiccant (2 units)
132-1011-01	**O-Ring**
Qty 1	O-Ring
Qty 1 Bag	Desiccant (2 units)
132-1012-01	**LPU Surge Arrestor Assembly**
Qty 1	Single Slot, 4 Port Plug-on, Lightning (LPU) Unit
Qty 1 Bag	Desiccant (2 units)
132-1013-01	**List 2A, List 2B, List 4 and List 6 Security Cover**
Qty 1	Security Cover
132-1014-01	**V-Band and Accessories**
Qty 1	O-Ring
Qty 1	V-Band Metal Locking Clamp
Qty 1 Bag	Desiccant (2 units)
132-1038-01	**Valve Kit (Metal)**
Qty 2	Breather Vent Valves (BVV)
Qty 2	Pressure Relief Valves (PRV)
Qty 2	Air Stem Valve and Caps (ASV)
Qty 2	Pressure Cutoff Valves (PCV)
Qty 2	Air Intake T-Valve Caps
Qty 2 Bag	Desiccant (2 units)
132-1016-01	**Installation Hardware**
Qty 4	3/8-16 x 1-inch Stainless Steel Hex Head Bolts
Qty 4	3/8-16 x 1-inch Stainless Steel Hex Nut Bolts
Qty 4	3/8-16 x 1-inch Stainless Steel Split Lock Washers
Qty 4	3/8-10x4-inch Stainless Steel Lug Bolts
Qty 2	Desiccant (2-unit bag)
132-1030-01	**Protector Tube Kit**
Qty 25	47BT Gas Tube Protectors or equivalent

VALVE REPLACEMENT PROCEDURES

All but the Air Stem/Air Intake T-valve shown in Figure 4 on page 7 can be replaced, if needed. Order the valve replacement kit #132-1038-01 listed in Table 13 on page 59 to obtain new valves. Use the following procedures when replacing any of the four replaceable valves.

Pressure Relief Valve

The pressure relief valve (PRV) is part of an all metal, nickel-plated brass assembly as shown in Figure 4 on page 7**.** The valve acts as a guard against over-pressurizing the enclosure and releases the internal pressure when it exceeds a nominal level of 15 PSI. The assembly consists of an adapter that screws into a brass fitting located in the bottom of the baseplate and the PRV valve itself which screws into this adapter. The adapter has two O-rings that are required to create an airtight seal. One is located on its outer threaded stem that connects to the brass fitting; the other is located at the base of its inner well where it seals the PRV to the adapter.

To remove and replace the PRV, proceed as follows:

1 Grip the adapter nut with a $^{3}/_{4}$-inch wrench and the PRV with a $^{1}/_{2}$-inch wrench.

2 While holding the adapter nut steady (it should not be moved), loosen the PRV by turning it counterclockwise, then remove it by hand. If the adapter nut becomes loose, tighten it to a torque of 60 inch-pounds.

3 Check that the O-ring in the adapter's inner well has remained in place. If not, reseat it.

4 Thread the new PRV into the adapter. Do not crossthread.

5 Again grip the adapter nut with a $^{3}/_{4}$-inch wrench and the PRV with a $^{1}/_{2}$-inch wrench. Tighten the PRV to 120 inch-pounds of torque.

Do not overtighten. Excessive torque does not improve the seal and may damage the PRV.

6 Pressurize the chamber and check the entire assembly for leaks.

Breather Vent Valve

The breather vent valve (BVV) is an all metal, nickel-plated brass unit as shown in Figure 4 on page 7**.** It allows air to circulate into the enclosure so it can breathe and avoid the buildup of excessive moisture and other contaminants. It has a hollow-threaded stem that screws into a brass fitting located on the bottom of the base. An O-ring is located on its outer threaded stem that connects to the brass fitting. The hollow stem contains a piece of plastic screen to prevent insects from migrating into the enclosure.

To remove and replace the breather vent, proceed as follows:

1 Grip the BVV with a $^{3}/_{4}$-inch wrench and loosen by turning it counterclockwise, then remove it by hand.

2 Check that the new BVV came equipped with its O-ring.

3 Thread the new BVV into the brass fitting. Do not crossthread.

4 Again grip the BVV with a $^{3}/_{4}$-inch wrench and tighten to 60 inch-pounds of torque.

Do not overtighten. Excessive torque does not improve the seal and may damage the BVV.

Air Stem Valve

The air stem valve (ASV) is part of an all-metal, nickel-plated brass assembly as shown in Figure 4 on page 7. It is used to pressurize the enclosure from an external air supply or to release the internal pressure. The assembly consists of an adapter that screws into a brass fitting located in the bottom of the base. The ASV itself screws into this adapter and the cap screws on to the top of the ASV. The adapter has two O-rings that are required to create an airtight seal. One is located on its outer threaded stem that connects to the brass fitting. The other is located at the base of its inner well where it seals the ASV to the adapter.

To remove and replace the ASV, proceed as follows:

1 Grip the adapter nut with a $^{3}/_{4}$-inch wrench and the ASV with a $^{7}/_{16}$-inch wrench.

2 While holding the adapter nut steady (it should not be moved), loosen the ASV by turning it counterclockwise, then remove it by hand. If the adapter nut becomes loose, tighten it to a torque of 60 inch-pounds.

3 Check that the O-ring in the adapter's inner well has remained in place. If not, reseat it.

4 Thread the new ASV into the adapter. Do not crossthread.

5 Again grip the adapter nut with a $^{3}/_{4}$-inch wrench and the PRV with a $^{7}/_{16}$-inch wrench and tighten the PRV to 120 inch-pounds of torque.

Do not overtighten. Excessive torque does not improve the seal and may damage the ASV.

6 Pressurize the chamber and check the entire assembly for leaks.

Pressure Cutoff Valve

The pressure cutoff valve (PCV) is part of an all metal, nickel-plated assembly as shown in Figure 4 on page 7**.** The valve controls the flow of air from the air core stub (air-filled unit) or the external air inlet valve ((gel-filled unit) into the enclosure. The assembly consists of an adjusting knob with stem that is inner-locked to a limiting nut. The outer limiting nut screws into the outer threads of the body housing connected to the enclosure's baseplate. The stem screws into the inner threads of the housing. The stem's tip has three O-rings that work to open and close the air flow through the base of the body housing. When the adjusting nut is fully clockwise, the airflow is OFF. When it is rotated one turn clockwise, the airflow is ON. The body housing also has an O-ring on its threads to create an airtight seal when the limiting nut is tightened down upon it.

To remove and replace the PCV, proceed as follows:

1 Grip the limiting nut with a 1-inch wrench and loosen it by turning one-half turn counterclockwise.

2 Since the valve stem is internally threaded to the body housing, both the limiting nut and adjustment knob must next be turned together counterclockwise until both are fully unthreaded from the body housing.

3 Pull the adjusting knob and limiting nut subassembly away from the body housing until it is completely disengaged. Some resistance will be noticed as the stem's O-rings rub against the walls of the body housing as the stem is withdrawn.

4 Check that the O-ring remains attached to the threaded tip of the body housing.

5 The replacement PCV assembly comes as a unit. It includes the limiting nut, adjustment knob, and all O-rings. Do not attempt to disassemble it.

6 Insert the valve stem into the body housing's threaded tip as far as it will go. Some resistance will be encountered as the O-rings contact the inner housing threads.

7 Rotate the limiting nut one-half turn clockwise.

8 Grasp both the limiting nut and the adjustment knob. Screw this subassembly into the housing until the adjusting nut tightens the O-ring against the body housing. Do not crossthread.

9 Turn the adjusting knob clockwise until contact is felt between the stem's O-rings and the inner threads of the body housing.

10 Use the 1-inch wrench to torque the limiting nut to 200 inch-pounds.

Do not overtighten. Excessive torque does not improve the seal and may damage the PCV.

11 Check that the adjusting knob has at least one and one-half turns of free movement in and out.

12 If any binding occurs, loosen the limiting nut and turn the adjustment knob until it moves freely. Retighten the limiting nut.

13 Rotate the adjustment knob a full turn counterclockwise from its full clockwise position. This should turn the pressure ON.

14 Pressurize the chamber and check the entire assembly for leaks.

15 Rotate the adjustment knob back and forth and determine that it does turn the airflow OFF when fully clockwise and back ON when backed off one turn counterclockwise.

APPENDIX C - PRODUCT SUPPORT

ADC Customer Service Group provides expert pre-sales and post-sales support and training for all its products.

Technical support is available 24 hours a day, 7 days a week by contacting the ADC Technical Assistance Center (TAC).

Sales Assistance 800.366.3891 extension 73000 (USA and Canada) 952.917.3000 Fax: 952.917.3237	• Quotation Proposals • Ordering and Delivery • General Product Information
Systems Integration 800.366.3891, extension 73000 (USA and Canada) 952.917.3000	• Complete Solutions (from concept to installation) • Network Design and Integration Testing • System Turn-Up and Testing • Network Monitoring (upstream or downstream) • Power Monitoring and Remote Surveillance • Service/Maintenance Agreements • Systems Operation
ADC Technical Assistance Center 800.638.0031 714.730.3222 Fax: 714.730.2400 Email: wsd_support@adc.com	• Technical Information • System/Network Configuration • Product Specification and Application • Training (product-specific) • Installation and Operation Assistance • Troubleshooting and Repair/Field Assistance
Online Technical Support	• www.adc.com/Knowledge_Base/index.jsp
Online Technical Publications	• www.adc.com/library1/
Product Return Department 800.366.3891 ext. 73748 or 952.917.3748 Fax: 952.917.3237 Email: repair&return@adc.com	• ADC Return Material Authorization (RMA) number and instructions must be obtained before returning products.

All telephone numbers with an 800 prefix are toll-free in the USA and Canada.

APPENDIX D - GLOSSARY

The following abbreviations are used throughout this technical practice.

Amp	Amperes
ANSI	American National Standards Institute
ASV	Air Stem Valve and Cap
AWG	American Wire Gauge
BT	Burst Tolerance
BVV	Breather Vent Valve
CLEI	Common Language Equipment Identified
cm	Centimeter
CO	Central Office
dB	Decibel
DDS	Digital Data System
ECI	Equipment Catalog Item
EMI	Electromagnetic Interference
HDSL	High bit-rate Digital Subscriber Line
HDU	HiGain Doubler Unit
HLU	HiGain Line Unit
HRE	HiGain Remote Enclosure
HTC	HiGain Test Card
ICEA	Insulated Cable Engineers Association
IS	Inner Statial
ISDN	Integrated Services Digital Network
kHz	Kilohertz
k Ω	Kilohm
LPU	Lightning Protection Unit
MIL	1/1000 of an inch
mm	millimeter

Ohms	Measures of resistance
PCV	Pressure Cutoff Valve
PE	Processing Element
PRV	Pressure Relief Valve
PSI	Pounds per Square Inch
REA	Rural Electrification Administration
RMA	Return Material Authorization

CERTIFICATION AND WARRANTY

FCC CERTIFICATION

The HRE-454 does not have any clocking source and is a passive device per FCC guidelines. When used in conjunction with any clocking devices, this combined system may radiate radio frequency energy that causes harmful interference to radio communications. Operating such a system 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.

LIMITED WARRANTY

ADC DSL Systems, Incorporated (“ADC”) warrants that, for a period of sixty (60) months from the date of shipment, the hardware portion of its products will be free of material defects and faulty workmanship under normal use. ADC's obligation, under this warranty, is limited to replacing or repairing, at ADC's option, any such hardware product which is returned during the 60-month warranty period per ADC's instructions and which product is confirmed by ADC not to comply with the foregoing warranty.

ADC 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 ADC published specifications and documentation for such software. ADC’s entire liability for software that does not comply with the foregoing warranty and is reported to ADC during the 90-day warranty period is, at ADC’s option, either (a) return of the price paid or (b) repair or replace of the software. ADC 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. ADC will replace defective media at no charge if it is returned to ADC during the 30-day warranty period along with proof of the date of shipment.

The transportation charges for shipment of returned products to ADC will be prepaid by the Buyer. ADC 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.

ADC 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 ADC or in ADC'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.

ADC 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, ADC 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.

MODIFICATIONS

Any changes or modifications made to this device that are not expressly approved by ADC DSL Systems, Inc. voids the user's warranty.

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

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