Teleline™

3-card Shelf HVI Backboard (751980/05) and Cabinet (751980/15) With Power Supply Housing Description and Installation Guide

925W751058-02E

POSITRON

Positron Inc.

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Chapter 1

General Information

1.1 Publication Information

Teleline 3-card Shelf HVI Backboard (751980/05) and Cabinet (751980/15) With Power Supply Housing Description and Installation Guide
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1.2 About this Guide

This guide introduces you to the Teleline 3-card Shelf HVI Backboard (751980/05) and Cabinet (751980/15) With Power Supply Housing and how to install them. This guide was designed to be read from beginning to end.

1.2.1 Related Documentation

For any other technical document relating to this system installation or applications cards and shelves, please refer to the Positron Web site: www.PositronPower.com.

1.2.2 Positron Products and Services

Positron engineers and manufactures high voltage isolation products to protect personnel and telecommunications circuits in high voltage areas that are susceptible to the effects of Ground Potential Rise (GPR).

Positron is the leader in isolation technology with its Teleline wireline products and TeleLite optical fiber wireline isolation/protection product families. Positron provides total flexibility in product configuration – from standalone units protecting a single circuit to high-capacity, multi-shelf HVI preconfigured systems.

Positron also provides a wide range of consulting, analysis and training services for communications companies and electrical utilities.

Full details and contact information are available at: www.PositronPower.com

1.3 Service and Support

1.3.1 Positron Contact Information

General information:	Positron Inc. 5101 Buchan Street, Suite 220 Montreal, Quebec, Canada H4P 2R9 US and Canada: 1-888-577-5254 International: 1-514-345-2220 Fax: 514-345-2271 E-mail: info@positronpower.com Website: www.positronpower.com
Customer Service and Repairs:	US and Canada: 1-888-577-5254 International: 1-514-345-2220 E-mail: customerservice@positronpower.com

1.3.2 Technical Customer Support

Positron is committed to providing excellent ongoing technical support to its customers. A team of specialists is always available for telephone consultations or for on-site visits to assist in the maintenance and troubleshooting of Positron equipment.

For pricing information or assistance in the planning, configuration and implementation of the installation of equipment, contact Technical Customer Service.

1.3.3 Customer Training

Full customer training courses on High Voltage Interface (HVI) are also available. For more information, contact Positron.

1.3.4 Repair Service

All warranty repairs are performed at no cost. Positron reserves the right to repair or replace any equipment that has been found to be defective.

For information about out-of-warranty repairs, contact Positron's Repair Department. Due to the varied nature of repairs, no specific turnaround can be guaranteed, but average turnaround time is 20 working days from date of receipt. In emergency situations, special arrangements can be made. All repaired items are warranted for a period of 90 days.

Before returning any items to Positron for repair, warranty repair or replacement, call the Repair department to obtain a Return Material Authorization (RMA) number. Parts returned without RMA numbers cannot be accepted. The RMA number must always be clearly marked on all boxes, crates, and shipping documents. Bulk repairs (more than five items) will require additional processing time, so please take this into consideration when requesting an RMA number.

To accelerate the repair process, whenever possible, include a report detailing the reason for return with the unit(s). Also, please include the name and phone number of a person who can be contacted should our Repair department need further information.

When packing items being returned for repair, please ensure they are properly packed to avoid further damage. Plug-in cards should never be shipped while installed in a shelf; this will cause damage that can extend the repair period.

1.4 Teleline Warranty

Subject to the provisions of this paragraph, Positron warrants that the equipment shall perform in accordance with Positron's specifications. The warranty remains valid for five (5) years from the date of shipment. The warranty fully covers workmanship, materials and labor. Positron shall, at its sole discretion, repair or replace the problem unit.

Freight costs to ship defective equipment to Positron are borne by the Customer, with return of replaced or repaired equipment to be at Positron's expense.

1.4.1 Limitation of Liability

Subject to anything to the contrary contained herein, Positron's sole obligation and liability and the customer's sole remedy for Positron's negligence, breach of warranty, breach of contract or for any other liability in any way connected with or arising out of, the equipment or any services performed by Positron shall be as follows:

- In all situations involving performance or non-performance of the equipment or any component thereof, the customer's sole remedy shall be, at Positron's option, the repair or replacement of the equipment or said component.
- For any other claim in any other way related to the subject matter of any order under, the customer shall be entitled to recover actual and direct damages; provided that Positron's liability for damages for any cause whatsoever, and regardless of the form of the action, whether in contract or in tort (including negligence), shall be limited to the value of the order.

Positron shall not be obligated to repair or replace any item of the equipment which has been repaired by others, abused or improperly handled, improperly stored, altered or used with third party material or equipment, which material, or equipment may be defective, of poor quality or incompatible with the equipment supplied by Positron, and Positron shall not be obligated to repair or replace any component of the equipment which has not been installed according to Positron specifications.

IN NO EVENT SHALL POSITRON BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SIMILAR OR ADDITIONAL DAMAGES INCURRED OR SUFFERED INCLUDING

LOSS OF PROFITS, LOSS OF REVENUES, LOSS OF DATA, LOSS OF BUSINESS INFORMATION, LOSS OF GOODWILL, LOSS OF EXPECTED SAVINGS OR BUSINESS INTERRUPTION ARISING OUT OF OR IN CONNECTION WITH THE EQUIPMENT, A PURCHASE ORDER, SUPPLIES, MAINTENANCE SERVICES OR OTHER SERVICES FURNISHED HEREUNDER, EVEN IF POSITRON HAS BEEN ADVISED OR IS AWARE OF THE POSSIBILITY OF SUCH DAMAGES.

EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, POSITRON DISCLAIMS ANY FURTHER CONDITIONS, REPRESENTATIONS OR WARRANTIES, WHETHER WRITTEN OR ORAL, EXPRESSED OR IMPLIED, INCLUDING THE CONDITIONS AND WARRANTIES OF MERCHANTABILITY, MERCHANTABLE QUALITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, PERFORMANCE AND THOSE ARISING FROM STATUTE, TO THE EXTENT PERMITTED BY LAW. POSITRON DOES NOT WARRANT THAT THE SYSTEM WILL OPERATE WITHOUT INTERRUPTION OR THAT IT WILL BE ERROR FREE.

1.4.2 Cancellation and Rescheduling Charges

Should the customer cancel, prior to shipment, any part of an order, the customer agrees to pay to Positron cancellation charges, not as a penalty, which shall total all expenses, including labor expenses, incurred by Positron prior to said cancellation. Equipment that has been specially developed for the customer's specific applications shall not be subject to cancellation. Cancellation or rescheduling is not permissible after shipment of the System.

Chapter 2

Overview and Planning

2.1 Introduction

The Teleline 3-card Shelf HVI Backboard (751980/05) and Cabinet (751980/15) With Power Supply Housing features:

- Teleline 3-card Shelf, model 751127
- Lightning arrestor
- Isolation jacks
- Frame ground
- Circuit ground
- Ground bar
- Station cable terminating blocks
- Power Supply Housing, model 750004
- Available room for a second Power Supply Housing, model 750004
- Available room for a 2-slot NIU terminating shelf (model DTM02 from Westell™)
- Five Cable entry holes (751980/15 only)

2.1.1 3-card Shelf, model 751127

The 3-card Shelf, model 751127 accommodates Teleline plug-in cards. The shelf is molded from specially treated high dielectric strength polyurethane, making it lightweight and flame retardant. The polyurethane body limits the possibility of many kinds of infiltration while providing reliable isolation from external ground potentials.

The shelf itself is compliant with CSA CAN/CSA-C22.2 No. 60950-1 for US and Canada.

2.1.2 Power Supply Housing 750004

While the 3-card shelf does not allow plug-in power supply modules as do the Teleline 5-card and 8-card shelves, a Power Supply Housing has been incorporated into the HVI Backboard and Cabinet to allow any of the Teleline Plug-in power supply modules and Battery Back-up to be used in the HVI. The Housing is pre-wired to the 3-card shelf power inputs.

2.1.3 3-card Shelf HVI Backboard (751980/05) and Cabinet (751980/15) with Power Supply Housing (750004)

The 3-card Shelf HVI Backboard (751980/05) and Cabinet (751980/15) with Power Supply Housing (750004) assemblies have the same functionalities and require the same connections and power input. The difference between them being that the HVI Cabinet (751980/15) assembly can be installed outdoors as well as indoors while the Backboard (751980/05) can only be installed indoors.

2.1.4 Placement Selection

The location selected for the HVI unit must take into account:

- Room for the HVI and related equipment.
- Location where the CO or dedicated cable enters building.
- Location and length of the grid ground connection.
- Elimination of all telephone equipment on the entrance cable.

This then ensures that the CO or dedicated cable enters onto or within the HVI assembly straight from the entrance conduit.

The placement of related equipment and wiring must be located so as to prevent an arcing condition from the CO cable.

The CO or dedicated cable must be installed to maintain a 15 cm (6 inch) air gap from the cable jacket to any grounded component or structure surface or member.

The CO cable can not cross or come within 15 cm (6”) of any equipment on the low voltage side of the HVI.

The station side or low voltage side equipment can not cross or come within 15 cm (6”) of the CO or dedicated cable, the top of the lightning arrestor, any other equipment that is attached to the CO cable shield, cable pairs, or the CO side of the Teleline Shelf or the CO side of any related equipment.

2.2 HVI Equipment Layout - Concept

All equipment that is subject to the effects of the remote ground aspect of the site is grouped and located on the High Voltage Side and the Low Voltage side of the HVI unit. With the equipment laid out in this manner it is easy to determine what potential is possible on all equipment at any time.

The CO cable cannot cross or come within 15 cm (6”) of any equipment on the low voltage side of the HVI. The station side or low voltage side equipment cannot cross or come within 15 cm (6”) of the CO Cable, the top of the lightning arrestor, any other equipment that is attached to the CO cable shield, cable pairs, or the CO side of the Teleline Shelf or the CO side of any related equipment.

2.2.1 High Voltage Side

The High Voltage side of the HVI contains equipment and wiring that is at remote ground potential. Therefore, if the installation is complete with the connection to the feeding cable that originates beyond the substation, it is not at a safe potential to touch, unless using rubber gloves and standing on a rubber safety mat. In other words, if a fault event occurs, this equipment and or wiring will be at a potential that is stable and not subject to the Ground Potential Rise effects of the substation grid. Therefore, if the individual is standing on the grid, the effects of the fault will make this equipment energized to an unsafe voltage level.

The equipment normally found on this side contains but may not be limited to, the CO cable, the cable attachment to the surge or lightning arrestor, the connection at the top of the surge or lightning arrestor, Isolation jacks if they are installed, and the CO side of the Teleline equipment.

The Teleline equipment is designed to isolate the personnel and equipment from the effects of the high and the low voltage condition of this site.

2.2.2 Low Voltage Side

The low voltage side of the HVI contains equipment and wiring that is essentially at substation ground potential. Therefore it is at a safe potential to touch. It is important to note that the circuit wires may be at an elevated potential in relation to the earthing or ground potential of the building or concrete floor that is being stood upon. Therefore care should be taken when handling circuit equipment and or wiring.

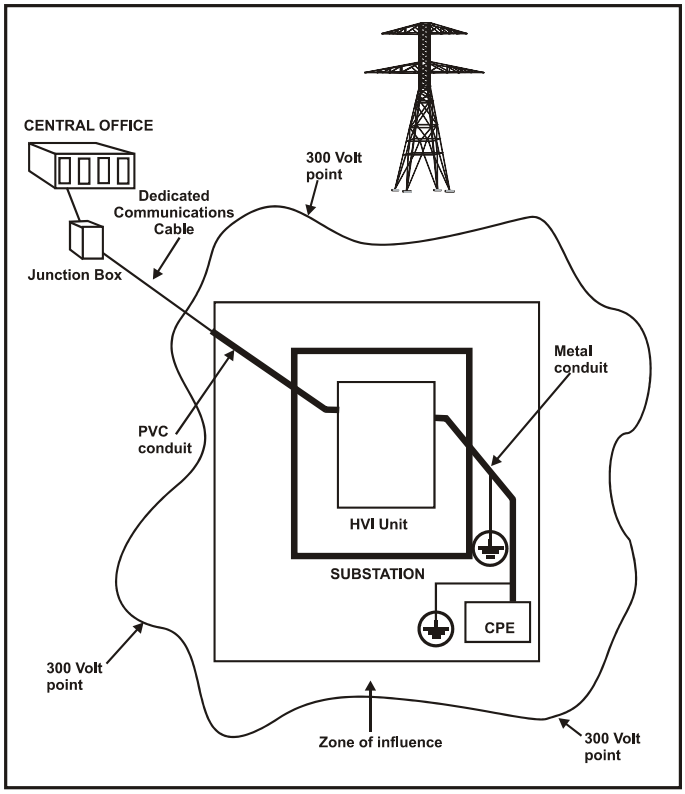
The Teleline equipment is designed to isolate the personnel and equipment from the effects of the high and the low voltage condition of this site.

2.3 300 Volt Point Location

2.3.1 Cable Shields

The 300 V point for an installation is defined by the electrical parameters of the substation. This is the point where the Ground Potential Rise of the site is reduced to 300 V or less. This is usually a new or existing cable closure.

Figure 1: 300V Point



There will be a minimum of two cables in the closure at this point. The cable that originates at the CO will be called the general use cable. The cable that originates

in this closure and routes into the substation switch room will be called the dedicated cable. Any other cables located in this closure will be referred to as other cable(s).

Splicing of the general use cable pairs to the dedicated cable pairs in this closure must follow the following rules:

- All pairs spliced from the general use cable to the dedicated cable must not be spliced using modular connectors. These pairs must be spliced using single conductor splice connectors. This is an electrical dielectric strength item.
- All pairs spliced from the general use cable to other cable(s) can be spliced using any normal splicing method.
- All cable shields should be bonded together at this point.

➤ **Grounding the 300 V point closure**

Grounding of the 300 V point closure can be accomplished utilizing a ground rod driven within a 1.8m (6') radius of the closure.

1. Attach a #6 AWG bare copper wire to this ground rod and route it to this same cable closure.
2. Attach this ground wire to the cable closure bond bar.
3. All cables within this closure are to be bonded to this cable bond bar, thereby effectively grounding them to a local ground.

NOTE

- Do not install a bond wire to any power system multi grounded neutral conductor or other power system apparatus at this closure.

2.3.2 Cable Routing CO Side Non-Metallic Conduit

As shown in Figure 1 on page 20, the CO Cable should be routed to the HVI utilizing a nonmetallic conduit. This increases the insulation of the cable shield from earth ground contact via the dielectric material of the conduit. This conduit should originate on the HVI backboard and extend to a distance of at least 3 m (10 feet) beyond the grounded perimeter fence. In addition the cable after it leaves the

nonmetallic conduit should not cross or come in contact with any grounded conductive surface.

2.3.3 Cable Routing Station Side Metallic Conduit

The station cable(s) that terminate on the HVI backboard should be routed to this backboard utilizing a metallic conduit. If the distance between origination point and the termination point of the HVI backboard is substantial, greater than 30 m (100 feet), then a #2 copper bonding conductor should be run with the station cables either exposed or in a metallic conduit of its own. This bonding conductor is then tied to ground at both ends and the equipment connected to the cable pairs is also bonded to this same ground point. This effectively puts both ends of the station cable(s) and the serving equipment at the same earthing potential.

2.3.4 Crossing Cables and Ground Wires

The CO cable, or any cable with the shield at remote ground potential should not cross or come in contact with any ground wire or conductive surface within the Zone of Influence of the substation.

The station cables are at local or substation potential. Therefore, they can be run adjacent to or may cross local ground wires or grounded conductive surfaces.

2.3.5 Sealing Current

Sealing current will be simplexed back to the Central Office source by the circuit cards when utilized. No provision is made for sealing current to work beyond this card. Therefore it is anticipated that the NCTE equipment will be operated close to the HVI backboard.

2.4 Electrical Power

2.4.1 Power Supply Housing

Because the 3-card Shelf, model 751127 does not accommodates Teleline Plug-in Power Supplies, a Power Supply Housing, model 750004 has been incorporated into the HVI Backboard and Cabinet.

The Housing is compatible with all Teleline Plug-in Power Supplies It is pre-wired to the 115 Vac/130 Vdc input terminal blocks, and will only accommodate the power supplies listed in Table 1below.

Table 1: Power supplies compatible with the 750004 Housing

Model #	Input Voltage	Output Voltage
751313MC	120 Vac or 130 Vdc	-24 Vdc / 2 A
751318MC	120 Vac or 130 Vdc	-48 Vdc / 1 A
751319MC	48 Vdc	-48 Vdc / 1A
751316	48 Vdc	-24 Vdc / 2A

2.4.2 Additional Power Supply Combinations

If battery back-up or power supply redundancy is required, space to locate an additional Power Supply Housing has been incorporated in the HVI under the 3-card shelf.

Please refer to the manual for the model 750004 for wiring of such installations.

Table 2 on page 24 shows the different power supply combinations available.

Table 2: Power supply combinations:

Input Voltage	Model(s)	Output Voltage(s)	Supply Current
120 Vac or 130 Vdc	Single 751313MC	-24 Vdc	2 A
	Dual 751313MC		4 A
120 Vac or 130 Vdc	Single 751318MC	-48 Vdc	1 A
	Dual 751318MC		2 A
120 Vac or 130 Vdc	Single 751313MC +	-24 Vdc & -48 Vdc	2A @ -24 Vdc
	Single 751318MC		1A @ -48 Vdc
120 Vac or 130 Vdc	Single 751313MC	-24 Vdc &	2A &
	Single 751312	Battery backup	2 Ahr. backup
48 Vdc	Single 751319MC	-48 Vdc	1 A
	Dual 751319MC		2 A
48 Vdc	Single 751316	-24 Vdc	2 A
	Dual 751316		4 A
48 Vdc	Single 751316 +	-24 Vdc	2A @ -24 Vdc
	Single 751319MC	-48 Vdc	1A @ -48 Vdc
The -24 Vdc and -48 Vdc above can be applied simultaneously to the shelf			

Either or both of these voltage(s) can be utilized to power external equipment to the shelf. However, power consumption calculations should be done to ensure that the various supply outputs are not exceeded. This of course assumes that the respective power supply is in and working in the Power Supply Housing and have been energized by the respective input voltage source(s).

Equipment powered this way could include a 2-slot NIU shelf installed in the HVI (location has been incorporated for such an option). When powering external equipment, power must be wired from the terminal block located above the Power Supply Housing and not from the Housing itself.

2.5 Environmental and Temperature Considerations

2.5.1 HVI Cabinet

The HVI Cabinet designs comply with Standard I.E.E.E. 487 recommendations. Compliance with this standard will insure a safe working environment for all personnel, while protecting the telecommunications network from hazardous voltages and currents.

The shelf enclosure is made of an insulating material, which under normal operating conditions (i.e., shelf closed) results in a higher temperature internally than externally (ambient room temperature). Therefore, special care must be taken to ensure that the internal temperature never exceeds the operating temperature of each card.

This section provides a procedure for the calculation of the temperature inside the shelf.

For a list of the thermal specifications for all Teleline cards designed for use within shelves, see Table 3 on page 26.

Table 3: Positron Plug-in Card Thermal Specifications

Notes	Model	Power Consumption	Power Dissipation	Operating Temperature Range	
1	7501-16B	8.4 W from -24 Vdc	8.5 W	**0º to 50ºC**	**32ºF to 122ºF**
1	7501-16C	6 W from -48 Vdc	6 W	**0º to 50ºC**	**32ºF to 122ºF**
	7501-24	N/A	N/A	-20º to 65ºC	-4ºF to 149ºF
	7501-72	N/A	< 200mW if loop current is < 80 mA	-20º to 65ºC	-4ºF to 149ºF
		N/A	< 5 W if loop current is > 80 mA	-20º to 65ºC	-4ºF to 149ºF
1	751312	270 mA (charging)	N/A	**0º to 50ºC**	**32ºF to 122ºF**
2	751313MC	N/A	**25% of output power**	-20º to 65ºC	-4ºF to 149ºF
2	751318MC	N/A	**25% of output power**	-20º to 65ºC	-4ºF to 149ºF
2	751319MC	N/A	**25% of output power**	-20º to 65ºC	-4ºF to 149ºF
2	751316	N/A	**25% of output power**	-20º to 65ºC	-4ºF to 149ºF
	751322	1.8 W at -24 Vdc 2.4 W at -48 Vdc	1 W at -24 Vdc 2 W at -48 Vdc	-20º to 65ºC	-4ºF to 149ºF
	751322 & 751322/1	2.6 W at -24 Vdc 3.6 W at -48 Vdc	2 W at -24 Vdc 3.5 W at -48 Vdc	-20º to 65ºC	-4ºF to 149ºF
	751322/2	2.6 W at -24 Vdc 3.6 W at -48 Vdc	2 W at -24 Vdc 3.5 W at -48 Vdc	-20º to 65ºC	-4ºF to 149ºF
	751323	1.7 W at -24 Vdc 2.4 W at -48 Vdc	1 W at -24 Vdc 2 W at -48 Vdc	-20º to 65ºC	-4ºF to 149ºF
	751325	1.8 W at -24 Vdc 2.4 W at -48 Vdc	1 W at -24 Vdc 2 W at -48 Vdc	-20º to 65ºC	-4ºF to 149ºF
	751329R2	N/A	0.75 W	-20º to 65ºC	-4ºF to 149ºF
	751329SP	3 W at -48 Vdc	2.5 W	-20º to 65ºC	-4ºF to 149ºF
	751333A	10.6 W at -24 Vdc 11 W at -48 Vdc	3 W at -24 Vdc 3.5 W at -48 Vdc	-20º to 65ºC	-4ºF to 149ºF
	751339R2	N/A	4 W	-20º to 65ºC	-4ºF to 149ºF
	751339SP	10 W at -48 Vdc	5 W	-20º to 65ºC	-4ºF to 149ºF
	751340R2	N/A	2 W	-20º to 65ºC	-4ºF to 149ºF
	751340SP	7 W at -48 Vdc	3 W	-20º to 65ºC	-4ºF to 149ºF
Note 1 : These cards are designed for indoor applications due to their operating temperature range.					
Note 2 : Power Supply Card					

2.5.2 Thermal Calculations

Use Table 3 on page 26 for calculations below.

2.5.3 Calculating the temperature inside the HVI Cabinet 751980/15

The 3-card Shelf model 751127 enclosure and the cabinet are made of an insulating material, which under normal operating conditions (i.e. shelf and cabinet closed) result in a higher temperature internally than externally (ambient temperature). Therefore, special care must be taken to ensure that the internal temperature never exceeds the operating temperature of each card plugged into the shelf.

This section provides a procedure for the calculation of the temperature inside the cabinet and the shelf. An example follows the procedure.

For a list of the thermal specifications for the Teleline cards, designed for use with the shelf, at the time of writing, refer to Table 3 on page 26.

Table 4: Temperature Calculation Worksheet

Slot No.	Model #	Power Consumption	Power Dissipation	Max. Operating Temperature
1				
2				
3				
Total Power Consumption in Shelf				
Total Power Dissipation in Shelf				
NIU				
Total Power Consumption in Cabinet				
-24 Vdc Cabinet Power Supply				
-48 Vdc Cabinet Power Supply			25% of Total Power Consumption =	
Total Power Dissipation in Cabinet				
Highest allowable Temperature				

➤ Calculating the temperature inside the cabinet and 3-card shelf

Photocopy and complete the worksheet in Table 4 on page 28.

NOTE

- If the power supply output in the Power Supply Housing is -48 Vdc, omit the following step:

1. Add the power consumption of all cards powered by -24 Vdc as shown in Table 3 on page 26. This value represents the “Shelf Total Power Consumption” at -24 Vdc. This value is required for the calculation of the power dissipation of the power supply in the cabinet.

NOTE

- If the power supply output in the Power Supply Housing is -24 Vdc, omit the following step.

2. Add the power consumption of all cards powered by -48 Vdc as shown in Table 3 on page 26. This value represents the “Shelf Total Power Consumption” at -48 Vdc. This value is required for the calculation of the power dissipation of the power supply in the cabinet. Add the power dissipation of all cards in the shelf, including the power supply. This value represents the “Total Power Dissipation.”
3. If NIUs are installed and they are locally powered by the -48 Vdc source, add their power consumption to the value obtained in step 2. If the NIUs are span powered through the Teleline cards, their power consumption has been calculated in the cards’ consumption already.

   If a Battery Backup Housing has been installed, add the battery current consumption to the calculations.

   The value obtained represents the “Cabinet Total Power Consumption. “
4. Add the power dissipation of all the cards in the shelf as shown in Table 3 on page 26. This value represents the “Shelf Total Power Dissipation.”
5. The “Maximum Operating Temperature” of a card represents the highest temperature at which a card is guaranteed to operate within specifications. At the bottom of the maximum operating temperature column, enter the lowest of the maximum operating temperatures. This temperature is referred to as the “Highest Allowable Temperature.”

6. Calculate the power dissipation of the power supply installed in the Power Supply Housing by dividing by four the “Cabinet Total Power Consumption” at -24 Vdc or -48 Vdc obtained in step 3 (or step 1 or 2 if no NIU is used).
7. Calculate the “Cabinet Total Power Dissipation” by adding the numbers obtained in step 4 and step 6 and the power dissipation of the NIUs (if installed).
8. The temperature rise inside the cabinet ($T_{RISE\_CABINET}$) is calculated using the following equation:

   $T_{RISE\_CABINET}$ = (Cabinet Total Power Dissipation) x (0.20º C/W or 0.36º F/W).

NOTE

- If the cabinet is installed outside without shade add another 10º C (18º F) to the temperature rise for the solar loading effect.

9. The temperature inside the cabinet ($T_{CABINET}$) is then calculated by adding the temperature rise calculated in step 8 to the room temperature where the cabinet is installed.

NOTE

- If the cabinet is installed outside, use 46º C (114.8º F) as the ambient temperature (maximum outside temperature in North America).

10. The temperature inside the shelf (T_{SHELF}) is then calculated using the following equation:
    T_{SHELF} = (Shelf Total Power Dissipation calculated in step 4) x (1.0º C/W or 1.8º F/W) + $T_{CABINET}$.
11. Compare the temperature inside the shelf (T_{SHELF}) with the “Highest Allowable Temperature”. T_{SHELF} should not exceed the “Highest Allowable Temperature”.

➤ **To reduce the temperature inside the shelf:**

1. Reduce the number of cards in the shelf by distributing the cards among other available cabinets.
2. Move the cards between shelves to replace a card that dissipates heat with one that does not, for example model 7501-24.
3. Lower the temperature of the room where the equipment is installed.
4. Replace SP cards by R2 cards (for example a 751339SP for a 751339R2). This will move some dissipation outside of the shelf. For this, the remote equipment will need to allow local powering instead of span powering.
5. If NIUs are installed in the cabinet, moving them out of the cabinet would reduce the power dissipation in the cabinet.
6. Alternatively replace the 3-card shelf HVI with a 5-card shelf HVI. For the same power dissipation, the 5-card shelf will have a lower inside temperature because of its lower thermal resistance.
7. For an outdoor installation, install a sun cover to shade the cabinet, which eliminates the 10º C (18º F) temperature rise caused by the solar loading.

2.5.4 Temperature Calculation Example for a 751980/15 Cabinet

Below is an example of a 3-card Shelf HVI Cabinet, model 751980/15, fully populated with three different cards. The cabinet in the example is installed outside and has a 751318MC power supply installed in the Power Supply Housing to power the 3-card Shelf. The cabinet also has an NIU housing with two H4TU-Rs that are span powered by the Teleline cards.

Table 5: Temperature Calculation Example for a 751980/15

Slot No.	Model #	Power Consumption	Power Dissipation	Max. Operating Temperature
1	751339SP	10 W	5 W	65°C (149°F)
2	751339SP	10 W	5 W	65°C (149°F)
3	751322	2.4 W	2 W	65°C (149°F)
Total Power Consumption in Shelf		22.4 W		
Total Power Dissipation in Shelf			12 W	
NIU		N/A (SP Cards)	3.8 W x 2	
Total Power Consumption in Cabinet		22.4 W		
-24 Vdc Cabinet Power Supply	N/A	N/A	N/A	N/A
-48 Vdc Cabinet Power Supply			25% of Total Power Consumption = 5.6 W	
Total Power Dissipation in Cabinet			25.2 W	
Highest Allowable Temperature				65°C (149°F)

1º Not applicable (-48 Vdc power supply).

2º Total power consumption of all cards in shelf = 22.4 W

3º Cabinet Total Power Consumption = 22.4 W

4º Total power dissipation in shelf = 12 W

5º Highest Allowable Temperature = 65°C or 149°F

6º Power supply dissipation = 22.4W ÷ 4 = 5.6 W

7º Cabinet Total Power Dissipation = 12 W + (2 x 3.8 W) + 5.6 W = 25.2 W

8º $T_{RISE\_CABINET}$ = 25.2 W x 0.20 ºC/W = 5.0°C
or $T_{RISE\_CABINET}$ = 25.2 W x 0.36ºF/W = 9.1°F.
Because it is installed outside, we have to add 10ºC (18ºF) to the temperature inside the cabinet because of the solar loading effect, which brings the temperature rise to 15.0°C or 27.1°F.

9º Because it is installed outside, an ambient temperature of 46ºC (114.8ºF) is used. Therefore the temperature inside the cabinet is:
46ºC + 15.0ºC = 61.0°C or
114.8ºF + 27.1ºF = 141.9°F.

10º T_{SHELF} = (12 W x 1.0ºC/W) + 61.0ºC = 73.0°C or
T_{SHELF} = (12 W x 1.8ºF/W) + 141.9ºF = 163.5°F.

11º Since the calculated temperature in the shelf is higher than the Highest Allowable Temperature (65°C or 149°F) found in step 4, this system is **NOT VIABLE**.
Note that if we had used 751339R2 cards instead, the procedure would have shown a shelf temperature of 65ºC (149ºF).
This system would have been at the limit of the operating range of the cards. In this case it would have been a good idea, if possible, to feed the cabinet from an outside -48V source, thereby reducing the shelf temperature to 64ºC (147ºF).
Another option is to build a sun cover above the cabinet, thereby reducing the shelf temperature to 60ºC (140ºF) by eliminating the solar loading.

2.5.5 Calculating the temperature inside the Teleline shelf of an HVI Backboard 751980/05

The 3-card Shelf model 751127 enclosure is made of an insulating material, which under normal operating conditions (i.e. shelf closed) results in a higher temperature internally than externally (room temperature). Therefore, special care must be taken to ensure that the internal temperature never exceeds the operating temperature of each card plugged-in the shelf.

This section provides a procedure for the calculation of the temperature inside the shelf. An example follows the procedure.

For a list of the thermal specifications for the Teleline cards, designed for use with the shelf, at the time of writing, refer to Table 3 on page 26.

➤ **To calculate the temperature inside the Teleline shelf**

Photocopy and complete the worksheet in Figure 7 on page 37 using the instructions below.

1. Add the power dissipation of all cards in the shelf. This value represents the "Total Power Dissipation."
2. The "Maximum Operating Temperature" of a card represents the highest temperature at which a card is guaranteed to operate within specifications. At the bottom of the Maximum Operating Temperature column, enter the lowest of the maximum operating temperatures. This temperature is referred to as the "Highest Allowable Temperature."
3. The temperature inside the shelf is calculated using the following equation:
4. T_{SHELF} = (Total Power Dissipation x Shelf Thermal Resistance) + Room Temperature (see note below)

NOTE

- When installed inside a room without air-conditioning, use 50ºC (122ºF) as the room temperature.

5. Shelf Thermal Resistance = 0.55° C/W (1.0°F/W)
6. Compare the "Calculated temperature inside the shelf" with the "Highest Allowable Temperature." The "Temperature inside the shelf" should not exceed the "Highest Allowable Temperature."

➤ **To reduce the temperature inside the shelf:**

1. Reduce the number of cards in the shelf by distributing the cards among other available shelves.
2. Move the cards between shelves to replace a card that dissipates heat with one that does not, for example, model 7501-24.
3. Lower the temperature of the room where the equipment is installed.
4. Replace an SP card by an R2 card (for example a 751339SP for a 751339R2). This will move some dissipation outside of the shelf. For this, the remote equipment will need to allow local powering instead of span powering.

5. If none of those options are available, the 3-card shelf HVI could be replaced with a 5-card shelf HVI. For the same power dissipation, the 5-card shelf will have a lower inside temperature because of its lower thermal resistance.

2.5.6 Temperature Calculation example for an HVI Backboard 751980/05

Below is an example of a 3-card Shelf HVI Backboard, model 751980/05, fully populated with three different cards. The Backboard in the example is powered from -48 Vdc and is installed in a room without air-conditioning, so the room temperature used is 50ºC (122ºF). In this example, the resulting temperature inside the shelf of 56.5ºC (134ºF) is lower than the Highest Allowable Temperature of 65ºC (149ºF) and is acceptable.

1º Total power dissipation of all cards in shelf = 12 W
2º Highest Allowable Temperature = 65°C or 149°F
3º T_{SHELF} = (12 W x 0.55ºC/W) + 50ºC = 56.5°C
or T_{SHELF} = (12 W x 1.0ºF/W) + 122ºF = 134°F.
4º Since the temperature in the shelf is lower than the temperature noted in step 2, this system is viable.

Table 6: Temperature Calculation Worksheet for an HVI Backboard model 751980/05

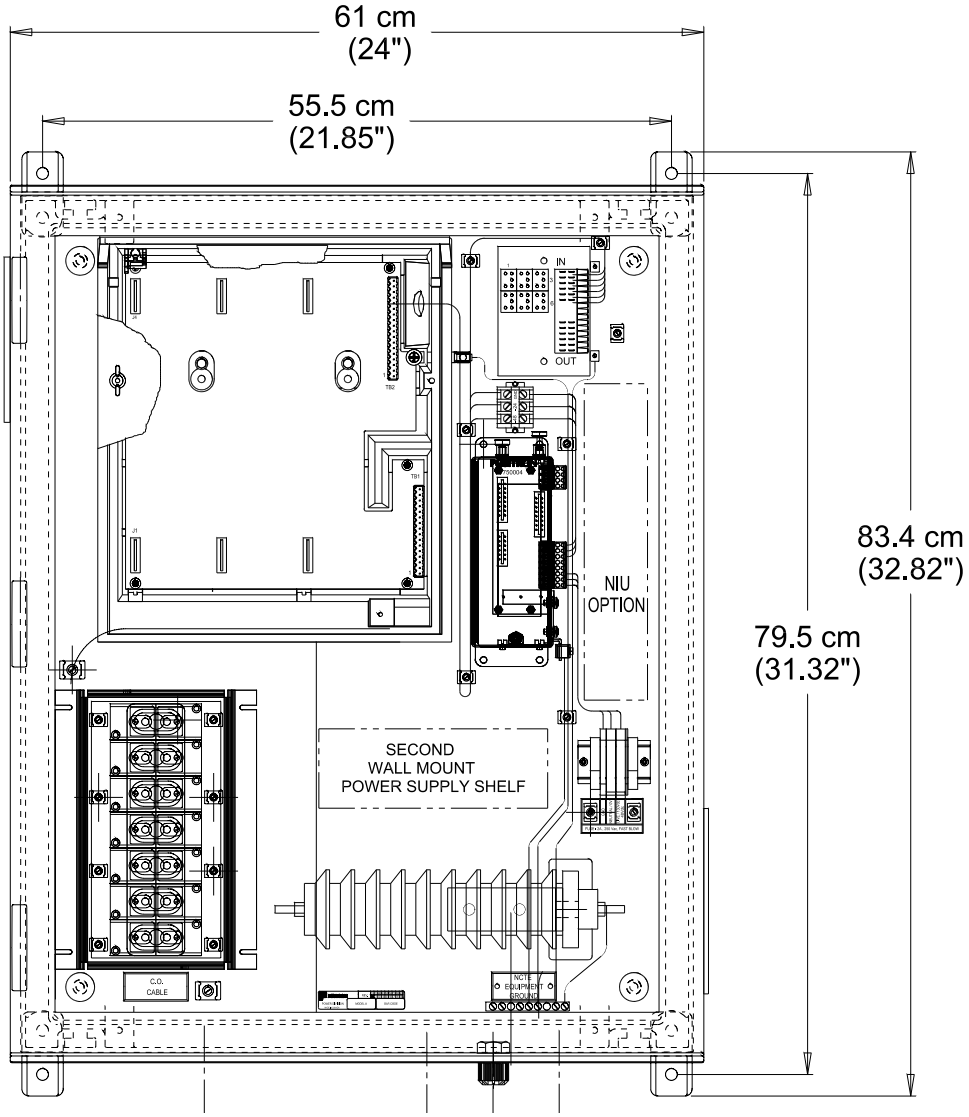
Slot No.	Model	Power Dissipation	Max. Operating Temperature
1	751322/2	3.5 W	65°C (149°F)
2	751339SP	5 W	65°C (149°F)
3	751333A	3.5 W	65°C (149°F)
Total Power Dissipation in shelf		12 W	
Highest Allowable Temperature			65°C (149°F)

Table 7: Temperature Calculation Worksheet for an HVI Backboard model 751980/05

Slot No.	Model	Power Dissipation	Max. Operating Temperature
1			
2			
3			
Total Power Dissipation in shelf			
Highest Allowable Temperature			

2.6 HVI Cabinet model 751980/15

Figure 2: HVI Cabinet Unit model (751980/15)



2.7 Specifications for 3- card HVI Cabinet model 751980/15

The HVI Cabinet design complies with Standard I.E.E.E. 487 recommendations.

Compliance with this standard will insure a safe working environment for all personnel, while protecting the telecommunications network from hazardous voltages and currents.

Table 8: Physical Specifications: 3-card HVI Cabinet model (751980/15)

Parameter	Specification
Height	79.6 cm (31.3”)
Width	61.2 cm (24.0”)
Depth	32.4 cm (12.8”)
Weight (see Note below)	34 kg (75 lbs)

NOTE

- Add the weight of the individual plug-in cards (including the power supply cards) as well as the second 750004, NIU shelf and their cards, if applicable.

Table 9: Operating Temperatures
(When using 65°C (149°F) Rated Cards)

Parameter	Specification
Inside installation	-20°C to 55°C (-4°F to 130°F)
Outside installation (with solar load)	-20°C to 46°C (-4°F to 115°F)

NOTE

- See Table 3 on page 26 for temperature ratings of Teleline plug-in cards.

2.8 HVI Backboard model 751980/05

Figure 3: HVI Backboard Unit model (751980/05)

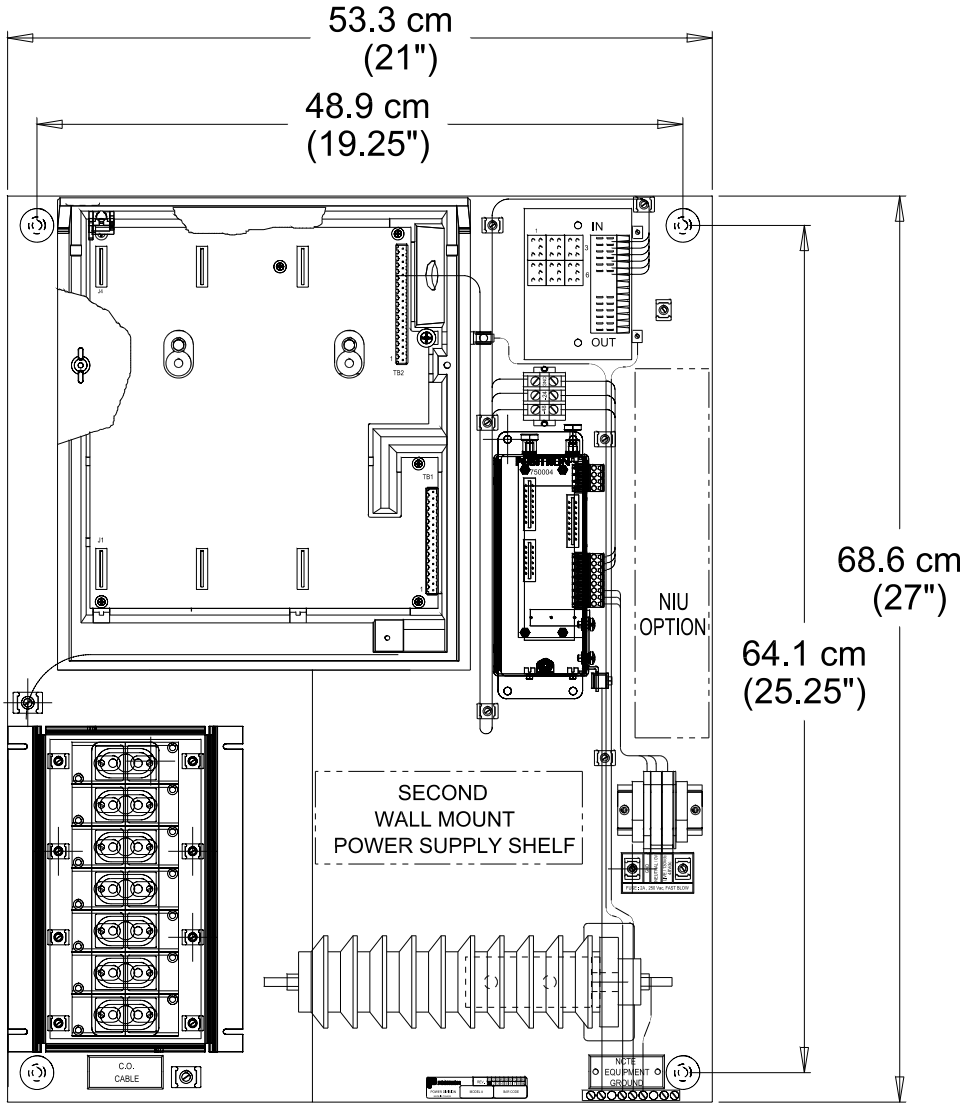


Table 10: Physical Specifications of Backboard model 751980/05:

Parameter	Specification
Height	68.6 cm (27.0”)
Width	53.3 cm (21.0”)
Depth	31.1 cm (12.3”)
Weight (see Note below)	15.9 kg (35 lbs)

NOTE

- Add the weight of the individual plug-in cards (including the power supply cards) as well as the second 750004, NIU shelf and their cards, if applicable.

Table 11: HVI Backboard model (751980/05) Operating Temperatures
(When using 65°C (149°F) Rated Cards)

Parameter	Specification
Inside installation	-20°C to 55°C (-4°F to 130°F)

NOTE

- See Table 3 on page 26 for temperature ratings of Teleline plug-in cards.

2.9 Power Connections

Although the HVI Backboard (751980/05) and HVI Cabinet (751980/15) can be powered by 115 Vac or 130 Vdc, the system is more reliable when powered from the station batteries 130 Vdc or through an inverted 115 Vac driven from the station batteries.

The Power Connections have been pre-wired in the HVI unit between the 3-card Shelf, the Power Supply Housing and the input Terminal Block for a single -48 Vdc supply and a 115 Vac or 130 Vdc input. If a different configuration is required (power supply redundancy, battery back-up, 48 Vdc input, multiple output voltages), the power will have to be re-wired by the installer.

2.9.1 115 Vac/130 Vdc Wiring to HVI Units

This HVI unit has provisions for 115 Vac or 130 Vdc power. Wiring to the HVI unit should be done via a metal conduit. There are three conductors needed to power the unit, as shown in Table 12 below.

Table 12: 115 Vac Power input connections

Conductor	Color
Phase (Live)	Black or Red Wire
Neutral	White Wire
GND	Green Wire

Table 13: 48 Vdc / 130 Vdc Power input connections

Conductor	Color
48 Vdc / 130 Vdc	White or Red Wire
Return (0 Vdc)	Black Wire
GND	Green Wire

The circuit feeding this HVI unit should be sized for a maximum load of 5A when powered from 130 Vdc or 15 A when powered from 120 Vac.

Actual connection to the serving power circuit is done through a fused terminal block in the lower right hand side of the backboard.

Chapter 3

Installation

3.1 HVI Installation

3.1.1 Preparation for Installation

Review the plan view drawing for the equipment to be installed. Any problems associated with the placement of this equipment must be addressed before work is commenced.

Confirm that:

- The supporting structure is adequate to support the cabinet.
- The installation space is adequate for the cabinet exterior size.
- The entrance cable location is as designed.
- The power source is the same as that identified on the drawing and in this document.
- The Substation Ground Grid connection is available and within 1.8m (6') of the cabinet.
- The safety considerations as outlined in "Safety Precautions" on page 45 have been taken.

3.1.2 Safety Precautions

CAUTION

When working on the equipment, the following safety issues should be noted:

- A rubber safety mat and rubber safety gloves must be available for use at the job site at all times. These gloves and mat should be tested for a 10,000 V exposure safe level.
- There is an extreme hazard in working on or coming in contact with the lightning arrestor during inclement weather. The lightning arrestor is connected to the cable shield so a lighting strike may at any time energize it.
- Direct contact with conductors and equipment while standing on a moist surface is hazardous. Ensure that the rubber safety mat does not allow water or any conducting material to come in contact with personnel.
- Precautions should be taken to ensure that moisture is prevented from entering or splashing on the unit.
- Communication pairs that leave the cabinet can be energized at any moment. Rubber gloves and mats should be utilized at any time when there is a potential for contact with an energized conductor.
- Do not install or work on these circuits or cables during a lightning storm. Power substations and their transmission systems attract lightning due to their designed aerial ground wires above the substation grid and support structure.

3.1.3 Additional Safety Precautions for Exterior Locations

CAUTION

- When necessary to work on the cabinet for long periods of time during wet weather conditions, a rainproof umbrella or tent should be used to keep the work area dry.
- If the craftsman standing area is wet or saturated, a raised platform for the mat may be required.

3.2 HVI Cabinet Installation

3.2.1 Additional Hardware Required

Table 14: Additional Hardware Required

Quantity	Description	Use
4	3/8” diameter studs or lag bolts	For mounting to the supporting surface
4	3/8” washers	For use with the mounting fasteners
1	Connector	For the Grid Ground wire to the #6 cabinet ground wire connection

➤ Unpacking the HVI Cabinet

1. Cut the packing straps holding the cabinet box to the pallet.
2. Open the cabinet and remove any packing material.
3. Remove any other loose items and set aside for later use.

➤ Mounting the Unit to the Supporting Structure

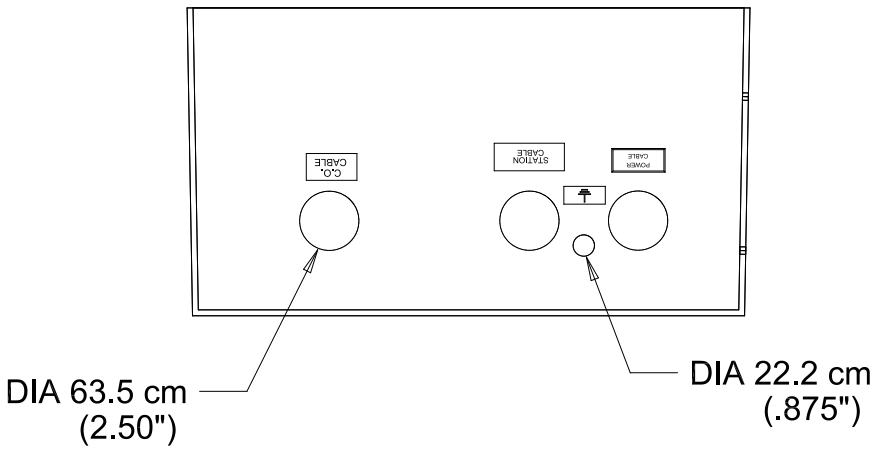
CAUTION

- The cabinet weight is substantial. Mounting should be accomplished by two or more persons.

1. Orient the brackets as needed to fit the installation surface on the supporting structure. The orientation shown in Figure 2 on page 38 is the only acceptable one.
2. Utilizing the dimensions as shown in Figure 2 on page 38, locate and drill the top two holes to mount the cabinet to the support surface. Refer to the plan view drawing of the cabinet.
3. Bolt the cabinet to the supporting structure using two studs or lag bolts and washers.

4. Drill and install the studs or lag bolts and washers for the bottom two mounting holes. Tighten the mounting hardware assemblies to secure the cabinet to the supporting structure.

Figure 4: Cable Entry Holes for HVI Cabinet



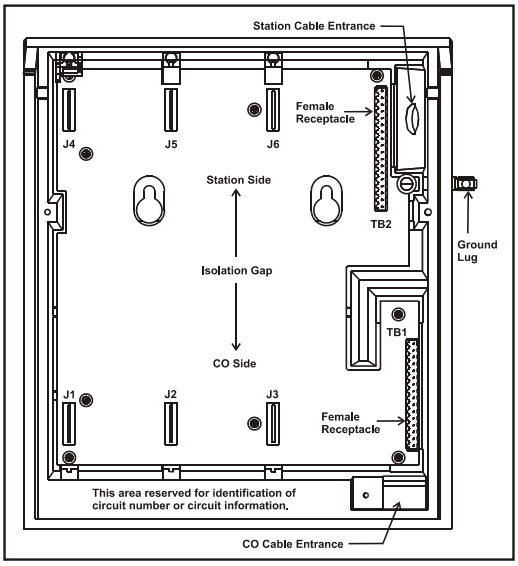
3.2.2 Installing the Power Service

1. Route the incoming -48 Vdc (or -24 Vdc) power cable through one of the holes at the bottom of the cabinet.
2. Inside the cabinet, route the power cable to the power terminal block at lower right hand side of the backboard, using platforms and cable ties.
3. Attach the power conductors onto the terminals of the terminal block as indicated on the label next to it.

The 3-card shelf is pre-wired to the power terminal block.

For any powering issues, please refer to the documentation provided for the 3-card Shelf, model 751127. Documentation is available on the Positron Power website at: www.PositronPower.com

Figure 5: 3-card Shelf, model 751127



3.3 HVI Backboard Installation

The HVI backboard should be located on the grid of the site. This installation location should also be located so as to provide easy access for maintenance. The equipment utilized in this manual is designed to isolate energies, that is, it does not shunt or route damaging energy to a grounding field.

3.3.1 Additional Hardware Required

The following customer-supplied hardware will be required to install the unit

Table 15: Additional hardware required:

Quantity	Article	Application
4	3/8” diameter studs or lag bolts	mounting to the supporting surface
4	3/8” washers	use with the above mounting fasteners
1	connector	connect Grid Ground wire to the #6 backboard ground wire connection

3.3.2 Safety Precautions

CAUTION

When working on the equipment, the following safety issues should be noted:

- A rubber safety mat and rubber safety gloves must be available for use at the job site at all times. These gloves and mat should be tested for a 10,000 V exposure safe level.
- There is an extreme hazard in working on or coming in contact with the lightning arrestor during inclement weather. The lightning arrestor is connected to the cable shield so a lighting strike may at any time energize it.
- Direct contact with conductors and equipment while standing on a moist surface is hazardous. Ensure that the rubber safety mat does not allow water or any conducting material to come in contact with personnel.
- Precautions should be taken to ensure that moisture is prevented from entering or splashing on the unit.
- Communication pairs that leave the cabinet can be energized at any moment. Rubber gloves and mats should be utilized at any time when there is a potential for contact with an energized conductor.
- Do not install or work on these circuits or cables during a lightning storm. Power substations and their transmission systems attract lightning due to their designed aerial ground wires above the substation grid and support structure.

➤ **To unpack the HVI backboard unit**

1. Cut any packing straps holding the backboard box to the pallet.
2. Open the box and remove the lag bolts holding the backboard to the pallet.
3. Examine the backboard and remove any packing material.
4. Remove any other loose items and set aside for later use.

3.3.3 Mounting to the Supporting Structure

CAUTION

- The backboard weight is substantial. Mounting should be accomplished by two or more persons.

➤ **To mount the backboard**

1. Orient the backboard as needed to fit the installation surface on the supporting structure. The orientation shown in Figure 3 on page 40 is the only one allowed.
2. Locate and drill the top two holes to mount the backboard to the support surface as indicated in Figure 3 on page 40.
3. Use two studs or lag bolts and washers to bolt the backboard to the supporting structure.
4. After the backboard is supported by the top fasteners, drill and install the studs or lag bolts and washers for the bottom two holes.
5. Secure the backboard to the supporting structure by tightening the mounting hardware assemblies.

The backboard is now ready for connection to the external wiring sources.

3.3.4 Installing the Power Service

1. The incoming power cables should be routed into a the cabinet using a metal conduit.
2. Route the incoming 48 Vdc, 130 Vdc or 115 Vac power cables through one of the holes at the bottom of the cabinet.
3. Inside the cabinet, route the power cable to the power terminal block at lower right hand side of the backboard, using platforms and cable ties.
4. Attach the power conductors onto the terminals of the terminal block as indicated on the label next to it.
5. The 3-card shelf is pre-wired to the power terminal block above the Power Supply Housing.
6. Insert the Power Supply card into the Power Supply Housing.

For any powering issues, please refer to the documentation provided for the 3-card Shelf, model 751127, the Power Supply card used (751318MC, 751313MC, 751319MC) or the Power Supply Housing model 750004.

Documentation is available on the Positron Power website at: www.PositronPower.com.

3.3.5 Optional Power Supply Housing

If battery back-up, power redundancy or multiple voltages are necessary, a second Power Supply Housing can be installed, as shown in Figure 3 on page 40. This Housing has to be purchased separately.

To wire the Housing, please refer to its user documentation.

3.3.6 Optional NIU Mounting

A location is provided for customers who need to install an NIU shelf into the Cabinet.

In such an installation, the technician would have to rewire the cable from the 3-card shelf, disconnecting it from the 5-pin protector block and wiring it instead to

the NIU mounting. The NIU mounting output would then be connected to the 5-pin protector block INput side, the OUTput feeding the end equipment.

The NIU cards can be span powered through the Teleline cards installed in the 3-card shelf but if local powering is desired, then power to the NIU shelf needs to be brought from the -48 Vdc terminal block located above the Power Supply Housing. Refer to Figure 3 on page 40 for a view of the different elements.

For more information on the installation and wiring of the NIU, refer to section section 3.8 on page 67.

3.4 Station Side Connections

3.4.1 Grounding the HVI

This HVI must be connected to the substation grid ground. Provisions have been made for connecting the backboard to ground via the provided ground bar located in the lower right area of the unit. See Figure 2 on page 38 and Figure 3 on page 40.

The lightning arrestor, 3-card Shelf, secondary protector block and Power Supply Housing are connected to this same ground bar.

If an additional Power Supply Housing and/or an NIU shelf are installed, they too must be connected to the ground bar (three spare locations are available for extra equipment ground), using a green jacketed #10 AWG or bigger wire.

➤ **To ground the HVI Unit**

1. Connect the bar to the grid with a minimum gauge #6 ground wire. The ground wire should be 2m (6 ft) or less external to the HVI.
2. Cut off all excess ground wire after the connection to the grid conductor is made.
3. Install a grounding clamp sized for the grid conductor and the cabinet grounding conductor. The use of a non oxidation compound is recommended. Exothermic welding of this connection would be acceptable.

3.4.2 Secondary Protector Modules

The station cable terminating block is a terminating block for the Teleline modules output pairs and the station service cable pairs. It also acts as a secondary protector block. The protector modules inserted into the 5-pin receptacles are Multi-Stage Protector modules for high switching speed and high current handling capability. These modules must be plugged into the protector block field for the circuit to function through the interface block. These modules are installed to prevent damage to the Teleline modules in the event that an unbalance voltage condition appears across the tip and ring conductors of a station cable pair.

In the event one of the protector modules fails, it will fail shorted to ground and should be replaced.

3.4.3 Terminated Teleline Shelf pairs on the 5-pin Protector Block

The Teleline 3-card Shelf pairs 1-6 have been pre-wired to the INput side of the 5-pin Protector Block. The station cable will be wired directly to the OUTput side of the 5-pin Protector Block.

Refer to Table 16 on page 55 for the wiring list.

3.4.4 3-card Shelf Station Cable Connections

The first six pairs of the shelf cable have been wired to the 5-pin protector block. The GND (pair 7), -24 Vdc (pair 9) and -48 Vdc (pair 11) have been pre-wired to the power terminal block above the Power Supply Housing.

The remaining pairs of the shelf station cable are left unconnected.

Table 16: 3-card Shelf Station Cable Connections for 751980/05 and 751980/15

Ring	Tip	Pair #	Shelf Slot #	Protector Block Pair # (input)	Power Terminal Block
Blue/White	White/Blue	1	1	1	
Orange/White	White/Orange	2	1	2	
Green/White	White/Green	3	2	3	
Brown/White	White/Brown	4	2	4	
Slate/White	White/Slate	5	3	5	
Blue/Red	Red/Blue	6	3	6	
Orange/Red	Ref/Orange	7	ALL	Not connected	GND
Green/Red	Red/Green	8	Not used		
Brown/Red	Red/Brown	9	ALL	Not connected	-24 Vdc
Slate/Red	Red/Slate	10	Not used		
Blue/Black	Black/Blue	11	ALL	Not connected	-48 Vdc
Orange/Black	Black/Orange	12	Not used		

3.4.5 Site Originating Station Circuit Cables

➤ **To Install the Station Circuit Cables**

1. Route the station cable(s) to the bottom of the HVI Unit.
2. Continue routing the cables up to the interface block located in the upper right-hand area of the HVI unit.
3. Prepare the cable by exposing the conductors.
4. Place the conductors on the bottom right side of the terminating block (marked “OUT”) and press them into place on the block. Press the conductors home on the block using a punch-down tool and cut off the excess with the cutter blade on the tool.
5. Match the Tip to Ring configuration to equal that of the upper portion of the block (marked “IN”). The cable pair count is vertical with the top pair being pair #1 and is associated with row #1 of that portion of the block.
6. Secure the cable or conductors to the backboard

3.5 CO Side Connections

3.5.1 Terminating the Dedicated CO Cable Pairs on the Isolation Jacks

The dedicated cable pairs are to be terminated onto screw terminals or wire-wrap isolation jacks. The tip of the jack is the 'Tip' conductor and the shorter or higher pin on the jack is the 'Ring' conductor location. The jacks are numbered from top to bottom, with the top jack being number 1.

NOTE

- Do not bond or ground the cable shield.

Table 17: Attachment sequence: Dedicated Cable Pairs

Ring	Tip	Cable Pair #	Jack Position
Blue/White	White/Blue	1	1
Orange/White	White/Orange	2	2
Green/White	White/Green	3	3
Brown/White	White/Brown	4	4
Slate/White	White/Slate	5	5
Blue/Red	Red/Blue	6	6
Slate/Violet	Violet/Slate	25	7

3.5.2 Dedicated CO Cable Pairs to Shelf Stub Color Code Assignments

The 3-card Shelf, model 751127 CO Cable Pairs are already connected within the shelf. The connection to the CO Cable must be done inside the HVI Unit utilizing the isolation jacks.

This splicing sequence will then marry sheath cable odd # pairs (1 to 5) to slots 1 through 3 for two wire circuits. It will also marry sheath cable even # pairs (2 to 6) to slots 1 through 3 for the second half of four wire circuits. This then results in the cable pair assignment for a series of four wire circuits shown in Table 18 on page 58.

See section 3.5.3 on page 59.

CAUTION

- Do not bond or ground the cable shield.

Table 18: Dedicated (CO) Cable Pairs to Shelf Stub Color Code Assignments

Dedicated (CO) Cable Pairs			Shelf CO Cable Stub		
Pair #	Ring	Tip	Pair #	Ring	Tip
1	Blue/White	White/Blue	1	Blue	White
2	Orange/White	White/Orange	2	Orange	White
3	Green/White	White/Green	3	Green	White
4	Brown/White	White/Brown	4	Brown	White
5	Slate/White	White/Slate	5	Slate	White
6	Blue/Red	Red/Blue	6	Blue	Red
25	Slate/Violet	Violet/Slate	11	Blue	Black

3.5.3 Attachment sequence: Dedicated Cable Pairs

This splicing sequence will then marry sheath cable pairs 1 & 2 through 5 & 6 to slots 1 through 3 for a 4-wire circuit.

Table 19: Cable pair assignment for a series of 4-wire circuits

Cable Pair	Shelf Slot Position List
1 & 2	1
3 & 4	2
5 & 6	3

3.5.4 Terminated Shelf Stub Cable Pairs on Isolation Jacks

The cable pairs are terminated onto the isolation jacks. The white conductor is the Tip conductor and the Blue conductor is the Ring conductor (for pair #1). This will insure that the circuits will appear in the shelf as expected, designed and listed in the Circuit Assignment List. The jacks are numbered from top to bottom, with the top jack being number 1.

NOTE

- Do not bond or ground the cable shield.

3.5.5 Remote Ground Shelf Pair

The remote ground pair of the shelf appears on CO pair #11 (Black/Blue) of the shelf stub. This cable pair should be used only if a remote ground connection is required. This is usually done with a 751323 card used to isolate a ground start PBX trunk or a coin phone circuit with ground signaling.

3.5.6 Teleline #751125 Lightning Arrestor

This unit has been installed and correctly wired to the ground bar as designed. The cabinet #6 ground wire must be connected to the grid ground connection as instructed in the item titled GROUND WIRE. The connection to the CO cable must be done as instructed in order for the unit to dissipate energy from the cable as designed. See the instructions in the section for the CO cable installation for correct connection procedures.

Additional information may be found in the documentation found in the envelope marked #751125 for this unit.

➤ Attaching the Lightning Arrestor to the Cable Shield

NOTE

- Please see Figure 6 on page 62.

1. The insulation around the cable sheath should be stripped only in an area of 10 cm (4 inches) where it is to be clamped to the lightning arrestor. Caution should be taken not to strip the insulation or cut the cable in any other area.
2. Using a sheath knife, make a 5 - 6 cm (2" to 2 1/2”) long slit longitudinally in the shield along the length of the cable. Be careful not to damage the inner poly wrap if the cable is so equipped.
3. Using a sheath knife, make a 4 cm (1-1/2”) long slit circumferential in the shield, perpendicular to the slit in step 1. DO NOT cut all the way around the cable. This cut would be approximately 2 cm (3/4”) long on each side of the longitudinal slit created in step 1.
4. Repeat at the opposite end of the slit. Be careful not to damage any inner poly wrap.
5. Carefully fold these created shield flaps back, sufficiently far to allow for the base of the cable bond clamp to be placed in the created void.
6. Place the cable clamp base into the created void. If there is no inner poly wrap on the cable in use, use two layers of vinyl tape to create an insulating blanket under the clamp.
7. Carefully bend the shield flaps back into place and on top of the bond clamp. This action captures the base of the bond clamp between the inner poly insulation and the shield material.

8. Place the outer bond clamp pressure plate and one nut on the stud of the bond clamp then tighten securely.
9. Apply four layers of vinyl tape over the exposed shield and bond clamp, working the tape layers from one end of the made sheath opening to the other. This will create a good physical bond to the material and an efficient coverage of a dielectric insulating wrap.

NOTE

- Do not tape over the nut on the stud.

10. Place a #6 bond strap or equivalent flex braid on the cable clamp stud. Use the second nut to secure.
11. Route the other end of the bond strap to the indicated lightning arrestor attach point. See Figure 2 on page 38 and Figure 3 on page 40 for a view of the lightning arrestor.

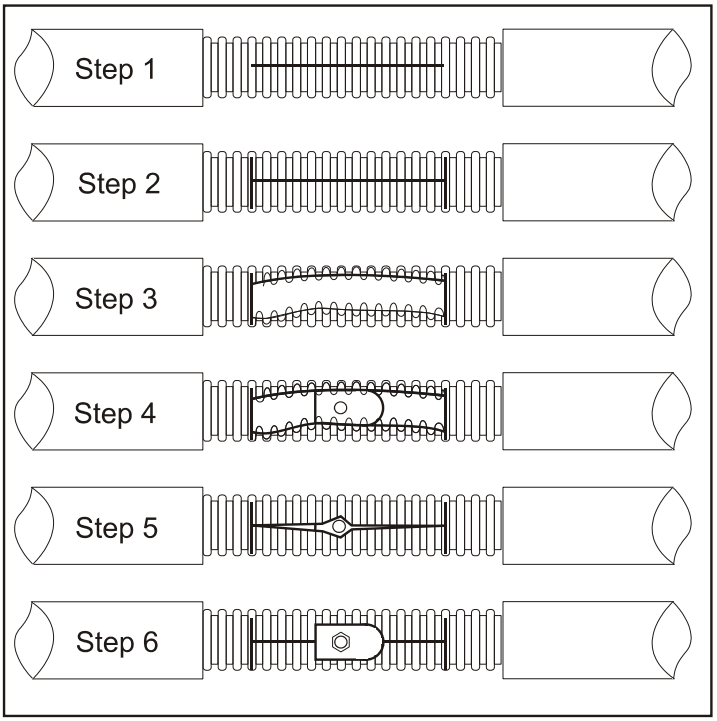
These actions have now resulted in a connection of the cable shield to the cable side of the lightning arrestor.

The ground side of the lightning arrestor has been secured to the cabinet ground wire and was identified in a previous section.

NOTE

- This ground connection must be a substation grid or equivalent connection to ensure proper arrestor operation and adequate energy dissipation.

Figure 6: Grounding the Cable Shield



3.6 Connecting an NIU shelf

A location is provided in the HVI Unit to install an NIU enclosure, model DTM02 from Westell™.

When an NIU is installed in the HVI Unit, wiring has to be changed in the following manner.

3.6.1 Powering the NIU shelf

➤ **To power the NIU enclosure, do the following:**

1. Connect the “GND” from the power terminal block (above the Power Supply Housing) to the NIU terminal block, pin “+” (the terminal block is located at the top of the enclosure).
2. Connect the “-48 Vdc” from the power terminal block to the NIU terminal block pin “- “.
3. Connect a wire of #10 AWG from the copper gnd lug at the bottom of the NIU enclosure to an available screw on the ground bar at the bottom of the backboard.

3.6.2 Connecting the telecom pairs to the NIU enclosure

To connect the telecom pairs, you must first disconnect the first four pairs of the 3-card shelf station cable from the protector block (if you use two NIUs, otherwise only the first two pairs) and move them to the NIU enclosure. The pairs will terminate on the facility terminal blocks (FAC) at the top of the NIU enclosure. Follow the connection sequence shown in Table 20 on page 64.

Table 20: Table 3-card Shelf Station Cable Connections to NIU enclosure CPE side

Shelf Station Cable				NIU Enclosure FAC Side Terminal Block	
Ring	Tip	Pair #	Shelf Slot #	CKT 1	CKT 2
Blue/White	White/Blue	1	1	R/T	
Orange/White	White/Orange	2	1	R1/T1	
Green/White	White/Green	3	2		R/T
Slate/White	White/Slate	4	2		R1/T1

Connect the CPE side of the NIU enclosure back to the protector block. The connections to the CPE side of the NIU enclosure are made through RJ48C using an RJ48C connectorized cable. The connections between the NIU enclosure and the protector block will follow the sequence shown in Table 21 below.

Table 21: NIU Enclosure CPE Connections to 5-pin Protector Block

INPUT of 5-pin Protector Block			NIU Enclosure CPE Side RJ48C	
Ring	**Tip**	**Pair #**	**J1**	**J2**
Blue/White	White/Blue	1	R1/T1 (pins1/2)	
Orange/White	White/Orange	2	R/T (pins 4/5)	
Green/White	White/Green	3		R1/T1 (pins 1/2)
Slate/White	White/Slate	4		R/T (pins 4/5)

This wiring will result on the first four pairs from the 3-card shelf going through the NIU card, then to the input of the 5-pin protector block. The output of the 5-pin protector block will then be connected to the Customer Premises Equipment (CPE), thereby protecting the NIU and 3-card shelf from surges coming from the CPE equipment.

The fifth and sixth pairs from the 3-card shelf will still be going directly to the 5-pin protector block input pairs #5 & #6. Those pairs could be used for normal telephone circuits.

3.7 Power Supply Card Insertion and Removal

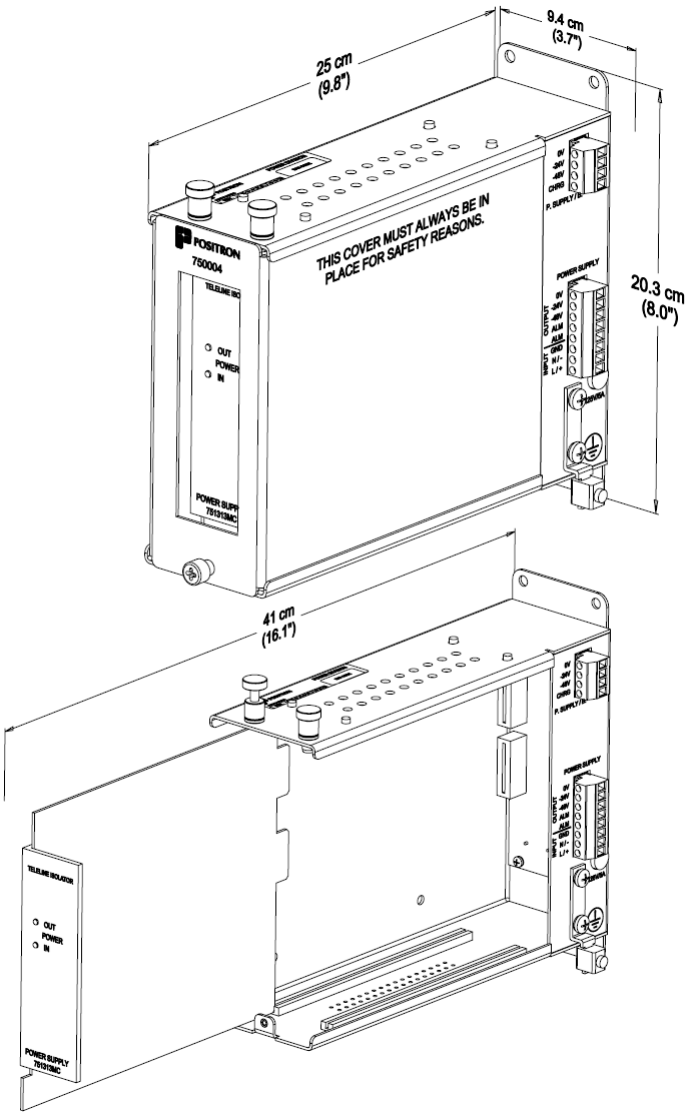
For information relevant to any of the Power Supply cards, refer to their respective documentation.

For a view of the Power Supply Housing, refer to Figure 7 on page 66.

➤ **Inserting plug-in Power Supply cards:**

1. To open the Power Supply Housing 750004, unscrew the thumb screw located at the bottom of the front panel, then slide out the sliding cover to gain access inside the housing.
2. Locate the Power Supply Housing slot into which the module will be plugged. In the case of a Power Supply Card (751318MC for example), it would be the left slot. For a battery backup module (751312), it would be the right slot. Refer to the Power Supply Housing, model 750004 for more details.
3. Pull up the spring loaded plunger aligned with the slot where the unit will plug in. The plunger is located on the front of the Power Supply Housing, on top o the housing. The plunger can be locked in the open position by rotating it slightly.
4. Insert the Power Supply Card, verifying that the face plate text is right side up.
5. Push the Unit in until you feel the edge connectors in the back sliding into the sockets.
6. Release the spring-loaded plunger to lock the card in.
7. Put the sliding cover back. First align it on the right, inside of the housing then slide it all the way in and tighten the thumb screw located at the bottom of the front panel.

Figure 7: Power Supply model 750004



3.8 Card Insertion and Removal

For information relevant to any of the cards, refer to their respective documentation.

➤ **Inserting plug-in cards:**

1. Push up on the yellow retaining clip slightly with one hand
2. Insert the cards with the other hand.
3. Close and secure the cover by fastening the wing nuts. To close the cover properly, you must first secure the bottom of the cover before joining the holes with their respective screws. This procedure is very important in order to prevent damage to the cover.

NOTE

- The yellow retaining clips prevent the dislodging of cards due to vibration when the shelf is mounted near mechanical equipment
- Two spare yellow retaining clips have been included with the installation kit to be used in the event that a clip becomes unusable.

DANGER

- The cover must be kept closed and secured at all times in order to protect personnel from potentially hazardous voltages, and to prevent damage to the cover.
- To prevent minor injury to your fingers when removing a card from the shelf, use your right hand only. Push up on the yellow retaining clip with your right thumb and then pull the card out.

3.8.1 Installing Plug-in Circuit Cards

CAUTION

- Make sure that the rubber mat is in place and rubber gloves are being utilized before starting work in this step.

➤ To install and test circuit cards

1. Place the circuit cards into the slots in the shelf.
2. Turn the circuits up for service.
3. Test each circuit to verify that the circuits are working through the equipment as expected. Sealing current will be simplexed back to the Central Office source by the circuit cards when utilized. No provision is made for sealing current to work beyond this card. Therefore it is anticipated that the NCTE equipment will be operated close to the HVI backboard.

3.9 Circuit Testing

➤ **To test CO Side of pairs**

CAUTION

Fault Exposure Hazard

- All work performed after this work sequence requires the use of a rubber mat and rubber safety gloves when working on or touching any cable pair on the CO side of the shelf.
- Use of the mat and gloves is also required when using the Test Card since this card brings contact with the cable pairs out to the edge of the card on the CO Pairs terminal pins.
- In the event of inclement weather obey the precautions listed in section 3.1.2 on page 45.

1. Insert the test card Model 751366 into a slot in the shelf.
2. Test the cable pairs from the shelf slot to the CO Main Distributing Frame or any other available test point that is at or beyond the 300 Volt point closure using appropriate test equipment.
3. Test all pairs for shorts, grounds and opens. This test is being done to insure that all connections are complete between the CO side of the shelf to the Central Office, thereby proving the reliability of the circuit.
4. If there are any problems with the pairs, open the Isolation jack plug and access the cable pair directly on the CO side of the jack field.
5. Repeat this test for all shelf slot positions.

➤ **To test substation side of pairs**

CAUTION

- Make sure that the rubber mat is in place and rubber gloves are being utilized before starting work in this step.

This test will confirm the presence of power in the shelf.

1. Insert the test card Model # 751366 into a slot in the shelf.
2. Repeat this test for all shelf slot positions.

3.9.1 Test Substation Side of Pairs with Test Card

CAUTION

- Use the rubber mat and rubber safety gloves when using the Test Card since this card presents the full fault-created voltage potential across the CO and Station cable pair pins on the test card.
- In the event of inclement weather, obey the precautions listed in section 3.1.2 on page 45.

1. Insert the test card Model # 751366 into a slot in the shelf.
2. Test the cable pairs from the substation side of the shelf to the 66 protection block on the protector block on the backboard using appropriate test equipment.
3. Repeat this test for all cable pairs in all shelf slot positions.

Appendix A

Acronyms

Acronyms

AC	Alternating Current
AWG	American Wire Gauge
CO	Central Office
CPE	Customer Premises Equipment
DC	Direct Current
FAC	Facility-Side
GND	Ground
GPR	Ground Potential Rise
HTU-R	HDSL Terminating Unit - Remote
HVI	High Voltage Interface
MD	Manufacture Discontinued
NIU	Network Interface Unit
PWR	Power
NCTE	Network Channel Terminating Equipment