Teleline™

Expandable, Add-on and Dual POTS Plug-in Cards (751322, 751322/1 and 751322/2) Description and Installation Guide

925W751020-07E

POSITRON

Positron Inc.

Contents

Acronyms

CO	Central Office
CMOS	Complimentary Metal Oxide Semiconductor
CPLD	Complex Programmable Logic Device
CSA	Canadian Standards Association
DC	Direct Current
DIP	Dual In-line Package
ESD	Electro-Static Discharge
FCC	Federal Communications Commission
GND	Ground
GPR	Ground Potential Rise
HVI	High-Voltage Interface
LED	Light-emitting Diode
PBX	Private Branch Exchange
POTS	Plain Old Telephone Service
REN	Ringer Equivalent Number
SLIC	Subscriber Line Interface Circuit
UL	Underwriters Laboratories

Chapter 1

General Information

1.1 Publication Information

Teleline Expandable, Add-on and Dual POTS Plug-in Cards (751322, 751322/1 and 751322/2), Description and Installation Guide
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1.2 About this Guide

This guide introduces you to the Expandable Add-on and Dual POTS Plug-in Cards (751322, 751322/1 and 751322/2), their features and applications, and describes how to install them in a Teleline shelf. This guide was designed to be read from beginning to end.

1.2.1 Related Documentation

For any other technical document relating 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, public safety and security organizations and electrical utilities.

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

1.3 Compliance Information

1.3.1 FCC Part 15

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

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

1.3.2 FCC Part 68

This equipment complies with Part 68 of the FCC rules and the requirements adopted by the ACTA (Administrative Council on Terminal Attachments). On the back of this equipment is a label that contains, among other information, a product identifier in the format US:AAAEQ##TXXXX. If requested, this number must be provided to the telephone company.

You are required to request service from the telephone company before you connect the unit to a network. When you request service, provide the telephone company with the following information:

Table 1: Request Service Information

Product Identifier:	751322
Facility Interface Code (FIC):	02LS2
Service Order Code (SOC):	9.0Y
Universal Service Order Code (USOC) jack:	RJ-11C
Network Address Code:	E
Equipment Code:	CN
REN:	0.9B
Identification Numbers: US:	RP4CN09B751322

A plug and jack used to connect this equipment to the premises wiring and telephone network must comply with the applicable FCC Part 68 rules and requirements adopted by the ACTA. A compliant telephone cord and modular plug is provided with this product. It is designed to be connected to a compatible modular jack that is also compliant. For details, see installation instructions.

The REN is used to determine the number of devices that may be connected to a telephone line. Excessive RENs on a telephone line may result in the devices not ringing in response to an incoming call. In most but not all areas, the sum of RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to a line, as determined by the total RENs, contact the local telephone company. For products approved after July 23, 2001, the REN for this product is part of the product identifier that has the format US:AAAEQ##TXXXX. The digits represented by ## are the REN without a decimal point (for example, 03 is a REN of 0.3). For earlier products, the REN is separately shown on the label.

If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations or procedures that could affect the operation of the equipment. If this happens the telephone company will provide advance notice in order for you to make necessary modifications to maintain uninterrupted service.

If trouble is experienced with the Teleline product, please contact Positron for repair or warranty information. If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

Positron Inc. located at 5101 Buchan street, Montreal in Canada hereby certifies that the Teleline product bearing labeling identification numbers mentioned above complies with the Federal Communications Commission's (FCC) Rules and Regulations 47 CFR Part 68, and the Administrative Council on Terminal Attachments (ACTA)-adopted technical criteria TIA-968-A-2, Telecommunications - Telephone Terminal Equipment -Technical Requirements for Connection of Terminal Equipment To the Telephone Network, January 2004.

Chapter 2

Overview

2.1 Introduction to the Expandable, Add-on and Dual POTS Plug-in Cards

The Expandable POTS Plug-in card, model 751322, the POTS Add-on card, model 751322/1, and the Dual POTS Plug-in card, model 751322/2 provide high- voltage isolation between a telephone line and the drop side of one loop start telephone circuit (telephone, dial-up modem, fax, or loop start PBX):

- The Expandable POTS Plug-in card (model 751322), by itself, isolates one POTS circuit. It can be used with the old and the new generation Teleline Isolator 3-, 5- and 8-card shelves.
- The Add-on card (model 751322/1) can be installed, at any time, on the Expandable POTS Plug-in card (model 751322) to upgrade from a single-line isolator to a double-line isolator. When upgraded, the card will be compatible with every Teleline shelf EXCEPT the old 7501-27 (3-card shelf), 7501-09 (5-card shelf) and 7501-08/7501-CS8 (8-card shelves).
- The Dual POTS Plug-in card (model 751322/2) is made up of one Expandable POTS Plug-in card (model 751322) combined with one POTS Add-on card (model 751322/1). It isolates up to two POTS circuits and can be used with every Teleline shelf EXCEPT the old 7501-27 (3-card shelf), 7501-09 (5-card shelf) and 7501-08/7501-CS8 (8-card shelves).

NOTE

- Model 751322 is a direct replacement card for models 751321, 751311 and 7501-01, and is NOT COMPATIBLE with the old version of the Add-on card (model 751321/A).
- Model 751322/1 is a direct replacement card for models 751321/A, and is NOT COMPATIBLE with the old version of the Plug-in card (model 751321).
- Model 751322/2 is a direct replacement card for model 751321C.
- The old version of the Plug-in card (model 751321) cannot be used with a new version of the Add-on card (model 751322/1).
- The new version of the Plug-in card (model 751322) cannot be used with the old version of the Add-on card (751321/A).

Features for the 751322, 751322/1 and 751322/2 cards include the following:

- The cards operate from either -24 Vdc or -48 Vdc provided by the shelf's power supply or from a source external to the shelf.

NOTE

If both voltages are present in the shelf:

- Set W501 to "-48V" ("IN" on older versions) to power from -48V input. This is the factory setting.
- Set W501 to "-24V" ("OUT" on older versions) to power from -24V input.

- The Central Office (CO) side circuit components are powered from the line.
- The cards withstand 600 V power cross (as per CAN/CSA-C22.2 No. 60950-1-07) with automatic restoration of service.
- When the 751322 card is upgraded with the 751322/1 Add-on POTS card, the ringing generator can ring up to seven standard 500 type sets (REN of 7).
- The card ringing generator meets Telecordia GR-506-CORE Section 14 specifications. It provides a sinusoidal unbalanced ringing of 20 Hz.
- The card will reproduce OSI (Open Switching Interval) from the CO at the station side.

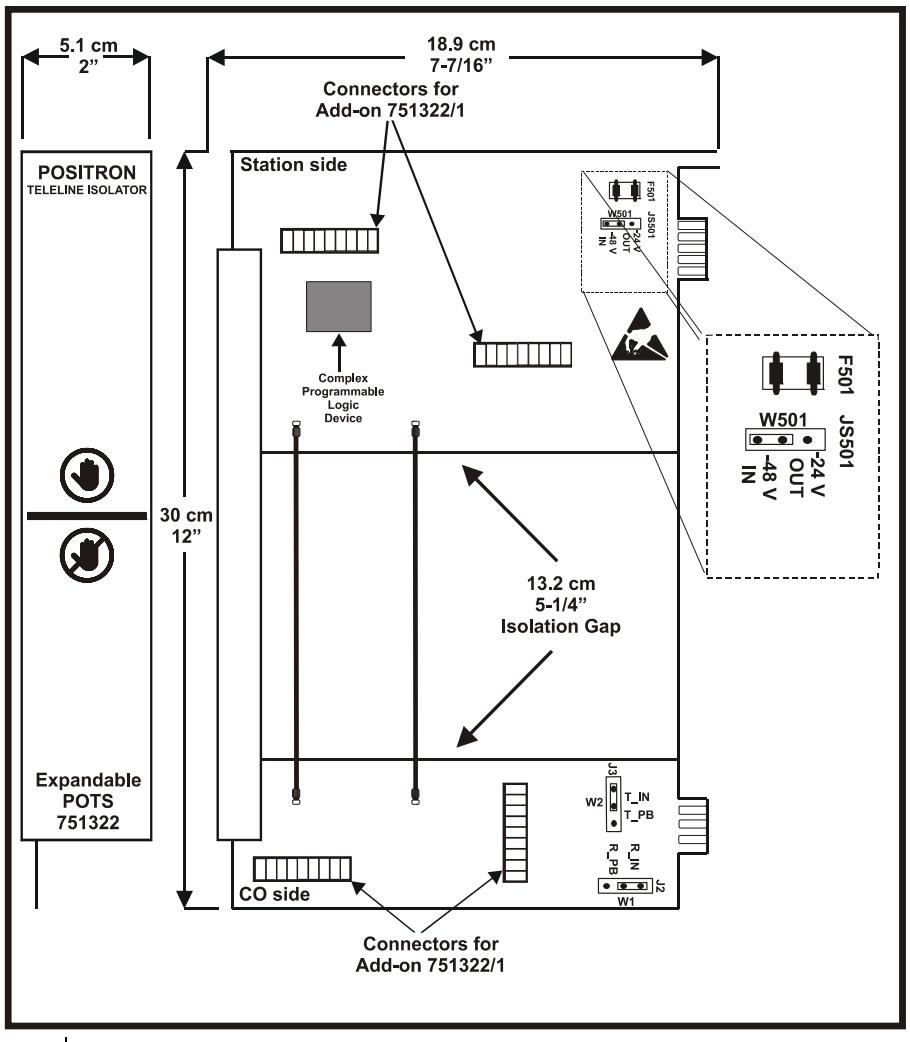
- The card will reproduce forward disconnect.

NOTE When interfacing with a PBX, fax or modem, it is recommended to power the cards from -48 Vdc. Some fax machines or modems have a “line-sharing” feature that will prevent them from picking up the line at -24 Vdc.

For an illustration of the Expandable POTS Plug-in card, see Figure 1 on page 11.

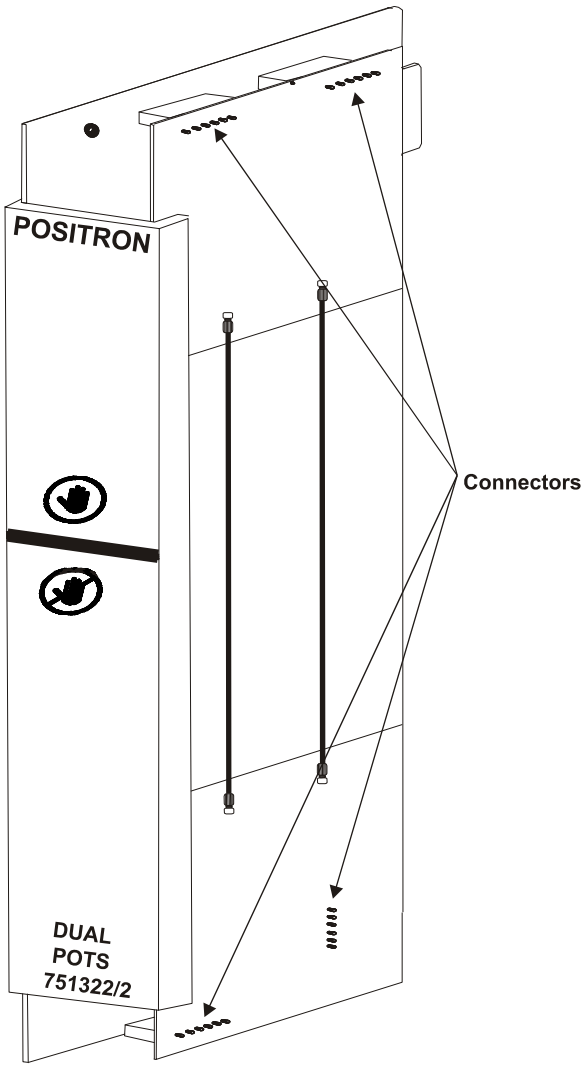
For an illustration of the Dual POTS Plug-in card, see Figure 2 on page 12.

Figure 1: Expandable POTS Plug-in Card Model 751322 Component Layout (only major components shown)



NOTE By default, W1 is set to R_IN, and W2 is set to T_IN and W501 is set to -48 V IN.

Figure 2: Dual POTS Plug-in Card Model 751322/2 Component Layout (only major components shown)

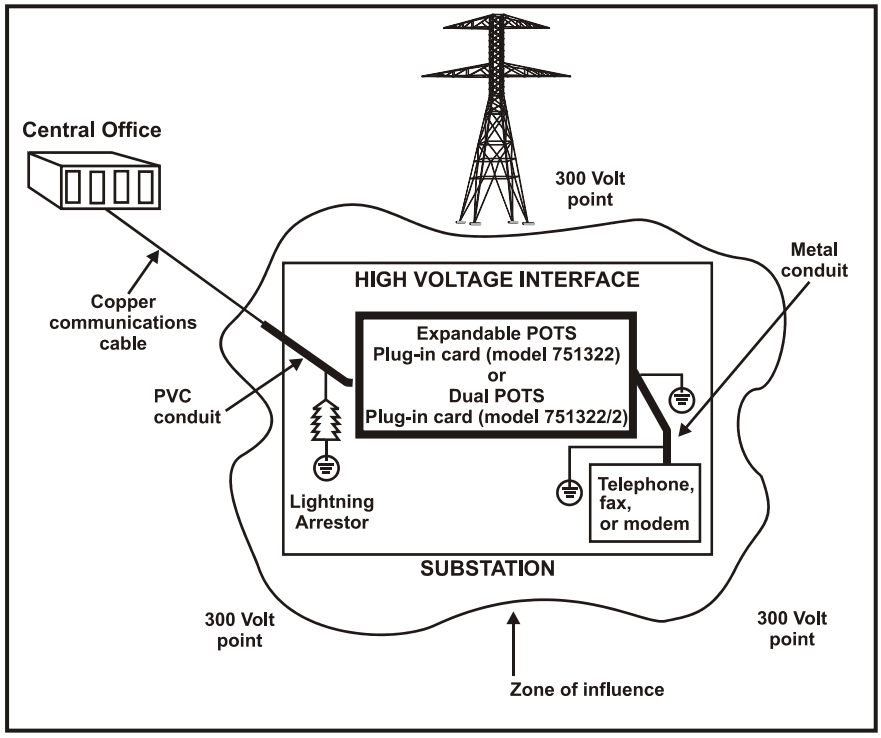


2.2 Applications

The applications of the Expandable and Dual POTS Plug-in cards include the following:

- Loop start telephone (POTS)
- Fax and dial-up “smart” modems (up to 56.6 kb/s modem)
- Loop start PBX
- Dial-up remote meter reading

Figure 3: High Voltage Interface Applications



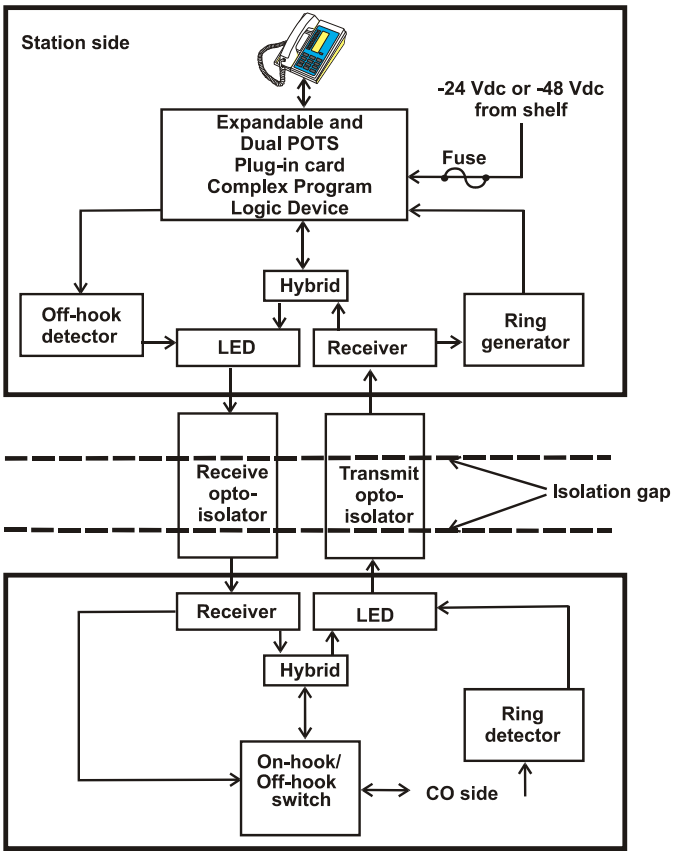
2.3 Hardware Description

The Expandable POTS Plug-in card and the Dual POTS Plug-in cards have two sides. With the cards facing you:

- The CO side is located on the lower portion of the card.
- The Station side is located on the upper portion of the card.

The CO side and Station side are separated by the opto-isolators, which create a 13 cm (5¼ inch) isolation gap.

Figure 4: Block Diagram



2.3.1 POTS Circuit

The Expandable POTS Plug-in card (model 751322) has a Complex Programmable Logic Device (CPLD) located on the Station side portion of the card; see Figure 1 on page 11.

The CPLD generates all the clocks used on both the CO and Station sides. It also controls the Subscriber Line Interface Circuit (SLIC).

The SLIC drives the telephone on the Station side and feeds the ringing signal for the phone.

The telephone line is driven using a transformer to provide good longitudinal balance and eliminate common mode noise on the line.

The Station side ringing generator provides 20 Hz for North American networks.

The card is registered for Part 68 of FCC. The CO circuit operates with line currents between 18 mA and 29 mA (the card limits current at 29 mA) allowing the card to operate on a line of up to 1,500 Ω (excluding card). The Station side SLIC will detect off-hook with currents as low as 16 mA and limits the phone current to 35 mA.

The audio signal is modulated and demodulated on both sides, in full duplex.

The CO side has a ringing detector that operates from 17 Hz to 50 Hz, as low as 40 V_{rms}.

2.4 Technical Specifications

2.4.1 751322 Expandable POTS Plug-in card

For 751322 electrical specifications, see Table 2.
For physical specifications, see Table 3 on page 16.

Table 2: Electrical Specifications for 751322 (measured at 25°C or 77°F, 50% R.H.)

	Parameter	Specification
Isolation Data:	Isolation Resistance	100,000 MΩ
	Metallic Surge	1.5 kV max
	Insulation Voltage	50 kV_{rms} (70 kV peak)
Input Voltage Requirement:		-24 Vdc (-21 V to -27 V) default to -48 Vdc (-42 V to -54 V)
Input Power Requirement (-48 Vdc input):	On-hook (idle)	45 mA max
	Off-hook	60 mA max
	Ringing 1 phone	90 mA max
	Ringing 5 REN	170 mA max
Input Power Requirement (-24 Vdc input):	On-hook (idle)	65 mA max
	Off-hook	105 mA max
	Ringing 1 Phone	125 mA max
	Ringing 5 REN	250 mA max
On-hook:	CO Side Input Ringing Detection	40 V to 105 V_{rms}, 17 to 50 Hz
	Terminal Resistance (CO side)	≥ 10 MΩ ± 100 Vdc, ≥ 10 MΩ at ± 200 Vdc
Off-hook:	Minimum Loop Current (CO)	18 mADC
	Maximum Loop Current (CO)	Current limiting at 29 mAdc
	Minimum Loop Current (Station)	Will detect off-hook down to 16 mAdc
	Maximum Loop Current (Station)	Current limiting at 36 mAdc
	Echo Return Loss	600 Ω ≥ 15 dB
	Singing Return Loss	600 Ω ≥ 9 dB
	Insertion Loss (both directions)	≤1dB @ 1kHz, 600 Ω
	Frequency response (both directions) (300 Hz - 3400 Hz)	≤ 3dB ref to 1kHz
		...continued
Ringing Generator Output (-48 Vdc input):	Maximum Output No Load	102 V_{rms} max
	Minimum Output (5 REN at the end of 400 Ω line)	55 V_{rms} min
Ringing Generator Output (-24 Vdc input):	Maximum Output No Load	103 V_{rms} max
	Minimum Output (5 REN at the end of 400 Ω line)	50 V_{rms} min

Table 3: Physical Specifications for 751322

Parameter	Specification
Operating Temperature Range	-40ºC to +85ºC (-40ºF to +185ºF)
Height	30.5 cm (12”)
Width	5.1 cm (2”)
Depth	18.9 cm (7-7/16”)
Weight	0.7 kg (1.5 lbs)

2.4.2 751322/1 POTS Add-on card

For 751322/1 electrical specifications, see Table 4 below.
For physical specifications, see Table 5.

Table 4: Electrical Specifications for 751322/1 (measured at 25°C or 77°F, 50% R.H.)

	Parameter	Specification
Isolation Data:	Isolation Resistance	100,000 MΩ
	Metallic Surge	1.5 kV max
	Insulation Voltage	50 kV_{rms} (70 kV peak)
On-hook:	CO Side Input Ringing Detection	40 V to 105 V_{rms}, 17 to 50 Hz
	Terminal Resistance (CO side)	≥ 10 MΩ ± 100 Vdc, ≥ 10 MΩ at ± 200 Vdc
Off-hook:	Minimum Loop Current (CO)	18 mADC
	Maximum Loop Current (CO)	Current limiting at 29 mAdc
	Minimum Loop Current (Station)	Will detect off-hook down to 16 mAdc
	Maximum Loop Current (Station)	Current limiting at 36 mAdc
	Echo Return Loss	600 Ω ≥ 15dB
	Singing Return Loss	600 Ω ≥ 9dB
	Insertion Loss (both directions)	≤1dB @ 1kHz, 600 Ω
	Frequency response (both directions) (300 Hz - 3400 Hz)	≤ 3dB ref to 1kHz
Ringing Generator Output (-48 Vdc input):	Maximum Output No Load	102 V_{rms} max
	Minimum Output (5 REN at the end of 400 Ω line)	55 V_{rms} min
Ringing Generator Output (-24 Vdc input):	Maximum Output No Load	103 V_{rms} max
	Minimum Output (5 REN at the end of 400 Ω line)	50 V_{rms} min

Table 5: Physical Specifications for 751322/1

Parameter	Specification
Operating Temperature Range	-40ºC to +85ºC (-40ºF to +185ºF)
Height	29.2 cm (11-1/2”)
Width	3.7 cm (1-7/16”)
Depth	15.4 cm (6-1/16”)
Weight	0.4 kg (0.9 lbs)

2.4.3 751322/2 Dual POTS Plug-in card

For 751322/2 electrical specifications, see Table 6 below.

For physical specifications, see Table 7 on page 18.

Table 6: Electrical Specifications for 751322/2 (measured at 25°C or 77°F, 50% R.H.)

	Parameter	Specification
Isolation Data:	Isolation Resistance	100,000 MΩ
	Metallic Surge	1.5 kV max
	Insulation Voltage	50 kV_{rms} (70 kV peak)
Input Voltage Requirement:		-24 Vdc (-21 V to -27 V) default to -48 Vdc (-42 V to -54 V)
Input Power Requirement (-48 Vdc input):	Both Lines On-hook (idle)	59 mA max
	Line 1 Off-hook	84 mA max
	Line 2 Off-hook	115 mA max
	Both Lines Off-hook	135 mA max
	Ringing 1 phone on 1 Line	96 mA max
	Ringing 5 REN on 2 Line	166 mA max
	Ringing 1 Phone on Both Lines	105 mA max
	Ringing 7 REN Total (max load)	180 mA max
Input Power Requirement (-24 Vdc input):	Both Lines On-hook (idle)	100 mA max
	Line 1 Off-hook	135 mA max
	Line 2 Off-hook	141 mA max
	Both Lines Off-hook	175 mA max
	Ringing 1 phone on 1 Line	145 mA max
	Ringing 5 REN on 2 Line	275 mA max
	Ringing 1 Phone on Both Lines	150 mA max
	Ringing 7 REN Total (max load)	285 mA max
On-hook:	CO Side Input Ringing Detection	40 V to 105 V_{rms}, 17 to 50 Hz
	Terminal Resistance (CO side)	$\geq$ 10 MΩ ± 100 Vdc, $\geq$ 10 MΩ at ± 200 Vdc
Off-hook:	Minimum Loop Current (CO)	18 mADC
	Maximum Loop Current (CO)	Current limiting at 29 mAdc
	Minimum Loop Current (Station)	Will detect off-hook down to 16 mAdc
	Maximum Loop Current (Station)	Current limiting at 36 mAdc
	Echo Return Loss	600 Ω $\geq$ 15dB
	Singing Return Loss	600 Ω $\geq$ 9dB
	Insertion Loss (both directions)	≤1dB @ 1kHz, 600 Ω
	Frequency response (both directions) (300 Hz - 3400 Hz)	≤ 3dB ref to 1kHz

	Parameter(Continued)	Specification
Ringing Generator Output (-48 Vdc input):	Maximum Output No Load	102 V_{rms} max
	Minimum Output (5 REN at the end of 400 Ω line)	55 V_{rms} min
Ringing Generator Output (-24 Vdc input):	Maximum Output No Load	103 V_{rms} max
	Minimum Output (5 REN at the end of 400 Ω line)	50 V_{rms} min

Table 7: Physical Specifications for 751322/2

Parameter	Specification
Operating Temperature Range	-40ºC to +85ºC (-40ºF to +185ºF)
Height	30.5 cm (12”)
Width	5.1 cm (2”)
Depth	18.9 cm (7-7/16”)
Weight	1.1 kg (2.4 lbs)

Chapter 3

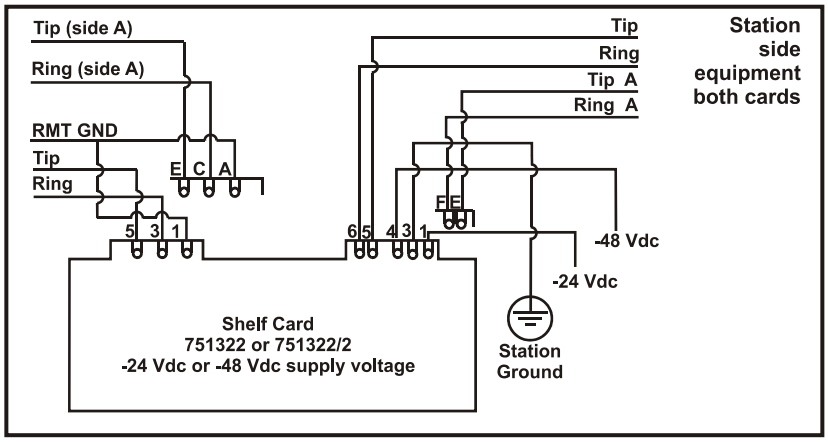
Installation

3.1 POTS Plug-in Card Models 751322 and 751322/2

The Expandable POTS card plugs into any slot of the any Teleline 3-, 5-, 8-card shelf. However, the Dual POTS card plugs into EVERY Teleline shelf EXCEPT the old 7501-27 (3-card shelf), 7501-09 (5-card shelf) and 7501-08/7501-CS8 (8-card shelves).

Each card must be installed into the slot of the shelf, which has been pre-wired according to the installation diagram of the specific shelf.

Figure 5: Expandable and Dual POTS Plug-in Cards, Models 751322 and 751322/2

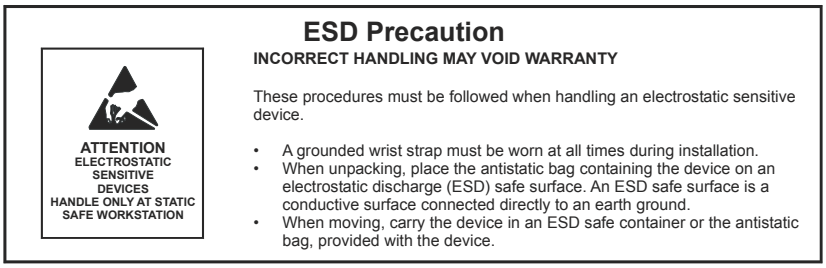


CAUTION

A jumper (W501) is located on the Station side of the cards to select either -24 Vdc or -48 Vdc operation.

- If the card is supplied with -24 Vdc, -21 Vdc is fed on the line.
- If the card is supplied with -48 Vdc, -45 Vdc is fed on the line.

3.1.1 Installing the Expandable POTS Plug-in card



➤To Install the Model 751322 and the Model 751322/2

CAUTION

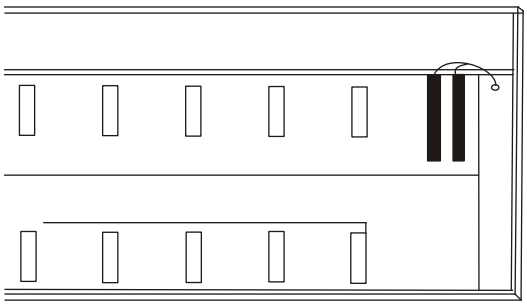
- Stand on a thick rubber mat and wear rubber gloves during the installation procedure. Perform these procedures on a clear dry day when a Ground Potential Rise (GPR) or transients are less likely to occur.
- Grounding of the card is done through the shelf. See the grounding section of the shelf's installation manual for more information.

1. Unpack the Expandable POTS Plug-in card from its protective box and shielded anti-static bag.
2. Confirm that the card is a Expandable POTS Plug-in card, model 751322 by identifying the name and model number on the front panel of the card.
3. Verify that the fuse F501 is intact. To view the location of the fuse, see Figure 1 on page 11.
4. Set W501 to "-48V" (IN) if there is no floating 48 Vdc or 130 Vdc fed through the station cable. This will let the card power itself from -48 Vdc if present in the shelf, otherwise it will select -24 Vdc automatically. See Figure 1 on page 11. By default, the card is set to "-48V" (IN). For switch settings, see section 3.3 on page 26.
5. Slide the card into its designated pre-wired shelf slot until the two card-edge connectors lock into the shelf and the retaining clip snaps into place.
6. Verify the installation by making and receiving a call.

NOTE

- If a fuse is blown, contact Positron Customer Support for a card replacement.
- The card must be inserted right-side up and may be plugged into the shelf with the power ON or OFF.
- If the Dual POTS Plug-in card (model 751322/2) has to be installed in slot 8 of the 8-card shelf or slot 5 of the 5-card shelf, be sure to push the station cable to the side. See Figure 6.

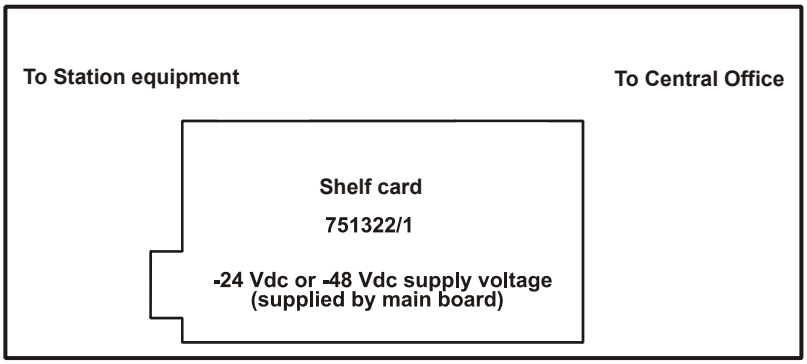
Figure 6: Last Slot of a 5- or 8-card Shelf



3.2 POTS Add-on Card Model 751322/1

The Add-on POTS card piggybacks onto the 751322 Expandable POTS Plug-in card. The cards combined plug into any slot of EVERY Teleline shelf EXCEPT the old 7501-27 (3-card shelf), 7501-09 (5-card shelf) and 7501-08/7501-CS8 (8-card shelves). However, the card must be installed into the slot which has been pre-wired according to the installation diagram of the specific shelf.

Figure 7: The Add-on card, Model 751322/1



NOTE

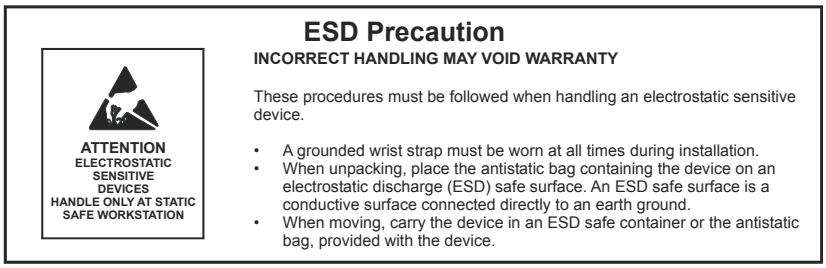
- You cannot upgrade with the 751322/1 Add-on POTS card if you have an old 7501-27 (3-card shelf), 7501-09 (5-card shelf) or 7501-08/7501-CS8 (8-card shelves).
- All circuits connected to this card are done from the 751322 motherboard card.

NOTE

This piggyback is powered from the same voltage as the mainboard (set through W501), which allows powering from -24 Vdc or -48 Vdc.

3.2.1 Installing the Add-on POTS Card

➤ To Install the Model 751322/1



CAUTION

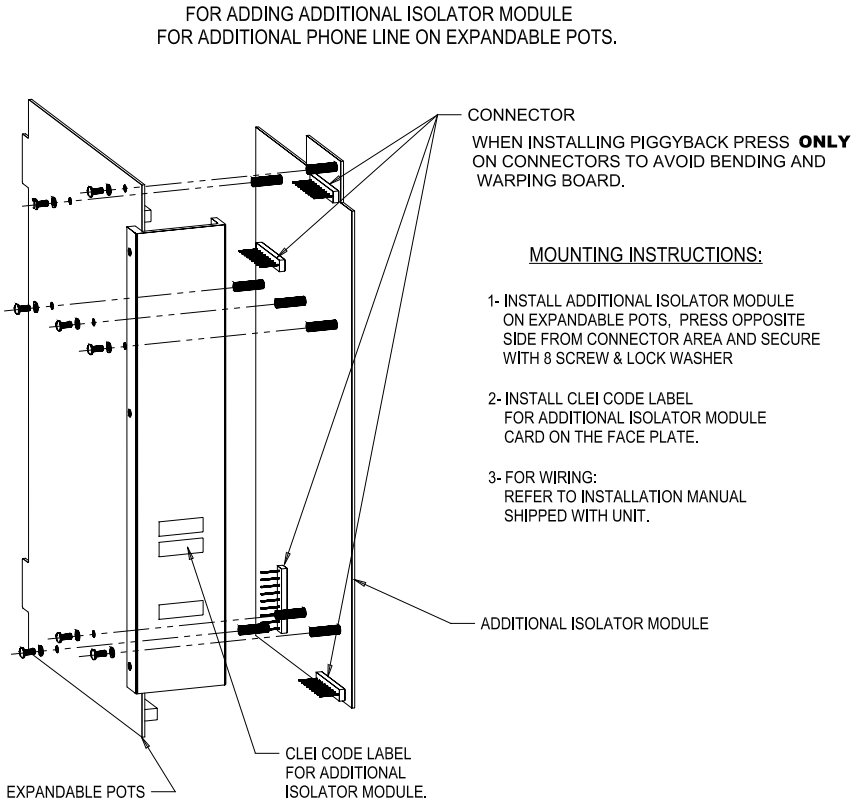
- Stand on a thick rubber mat and wear rubber gloves during the installation procedure. Perform these procedures on a clear dry day when a Ground Potential Rise (GPR) or transients are less likely to occur.
- Grounding of the card is done through the shelf. See the grounding section of the shelf's installation manual for more information.

1. Place the Add-on POTS card model 751322/1 on top of the Expandable POTS Plug-in card model 751322, as shown in Figure 8 on page 25.
2. Make sure all the pins of the four connectors are properly aligned with their female counterparts on the mainboard, then press ONLY where the connectors are located to avoid bending or warping the boards to fully insert the male connectors into the female connectors.
3. Secure the Add-on POTS card using the 8 screws and washers in kit #241-010344-401 included with the 751322/1.
4. Slide the card into its designated pre-wired shelf slot until the two card-edge connectors lock into the shelf and the retaining clip snaps into place.
5. Verify the installation by making and receiving a call on each of the two lines.

NOTE

- The card must be inserted right-side up, and may be plugged into the shelf with the power ON or OFF.
- There are no jumpers to set on the Add-on POTS card (model 751322/1). It is powered from the mainboard (model 751322).
- Model 751322/1 is a direct replacement card for model 751321/A, and is NOT COMPATIBLE with the old version of the Plug-in card (model 751321).
- If installing the 751322/1 on an older version of the 751322 mainboard, the nylon spacer will not align with a mounting hole. The spacer will not have a screw but will still provide support for the piggyback.

Figure 8: Expandable POTS Plug-in card Model 751322 and Add-on Model 751322/1



3.3 Settings

3.3.1 CO Side Switch Settings for 751322 and 751322/2

W1 and W2 are used to determine if the CO circuitry will take its signal from the line or the add-on (this feature will be used on future applications). For the 751322/2 unit, these jumpers are located on the main board.

- T_IN: Tip input (default)
- T_PB: Tip Piggyback
- R_IN: Ring input (default)
- R_PB: Ring Piggyback

NOTE By default, W1 is set to R_IN, and W2 is set to T_IN.

3.3.2 Station Side Switch Settings for 751322 and 751322/2

Jumper W501 is located on the main board station side. The card's -24 Vdc input is permanently connected and the -48 Vdc input is selectable through W501.

If W501 is set to "-24V" (OUT), the card can only be powered from -24 Vdc present in the shelf. If -24 Vdc is not present, the card will be unpowered.

"If W501 is set to "-48V" (IN), then both the -48 Vdc and -24 Vdc inputs can be used. If both voltages are present in the shelf, the card will power itself from the most negative voltage (i.e. -48 Vdc).

NOTE
- By default, W501 is set to -48 Vdc IN.

In legacy shelves that have floating 48 Vdc or floating 130 Vdc powering some cards, W501 must be set to "-24V" (OUT) to prevent grounding the station batteries and generating an alarm.

3.3.3 Switches for 751322/1

There are no switches or settings on the 751322/1.

3.4 Maintenance

NOTE
- Before maintenance, disconnect telecom lines on all cards being serviced in the CO splice case and on the station punch block. If not possible, stand on a thick rubber mat and wear gloves during maintenance. It is preferable to perform these procedures on a clear, dry day when a GPR (Ground Potential Rise) or transients are less likely to occur.

Appendix A

Service and Warranty

A 1 Service and Support

A 1.1 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

A 1.2 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.

A 1.3 Customer Training

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

A 1.4 Product Safety

This equipment is compliant with CSA CAN/CSA-C22.2 No. 60950-1-07.

A 1.5 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.

A 2 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.

A 2.1 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 STATUE, TO THE EXTENT PERMITTED BY LAW. POSITRON DOES NOT WARRANT THAT THE SYSTEM WILL OPERATE WITHOUT INTERRUPTION OR THAT IT WILL BE ERROR FREE.

A 2.2 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.