

# PAIRGAIN TECHNOLOGIES PG-2™ COT LINE UNIT MODEL LU-311 Issue 1

List 3, PairGain # 150-1021-03, CLEI Code: SIC1AA01AB

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**CAUTION**  
This product incorporates static sensitive components. Proper electrostatic discharge procedures must be followed.

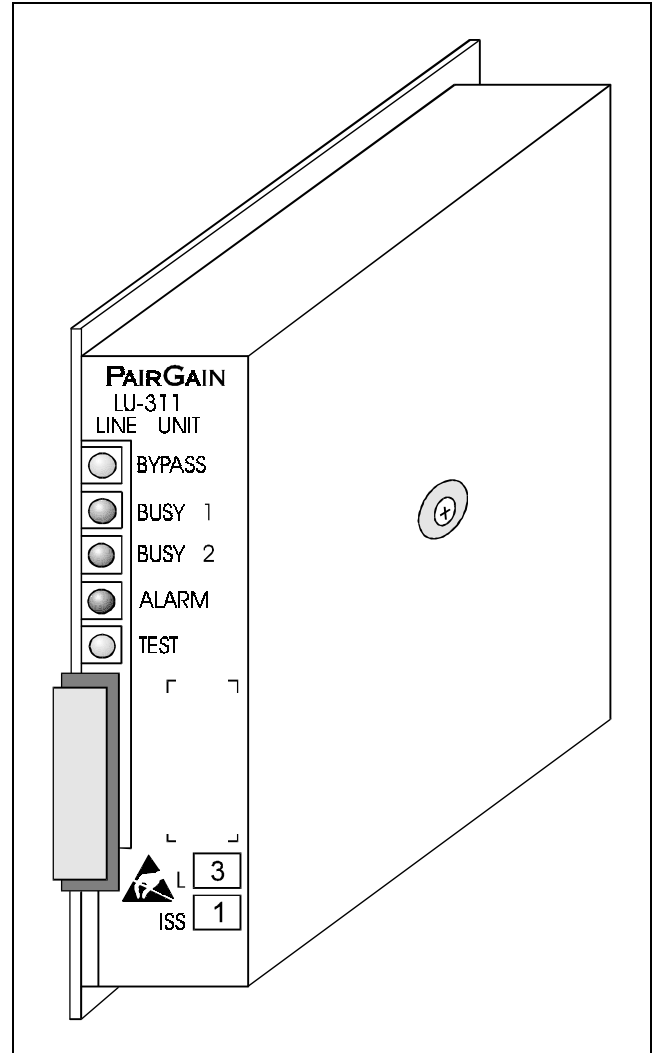


Figure 1. LU-311 COT Line Unit, List 3, Front Panel.  
The PairGain LU-311 is the Central Office end of a PG-2 DSL transmission system.

## A. PRODUCT OVERVIEW

### 1. DESCRIPTION AND FEATURES

**1.01** The LU-311 COT Line Unit, List 3, is the Central Office end of the PairGain PG-2 digital subscriber carrier system.

**1.02** The LU-311 meets the same electrical performance specifications as the PairGain LU-211 (PG-2 system) and operates with the same RT-212 digital remote unit used with the LU-211. The LU-311 differs from the LU-211 in that it installs directly into the single channel analog carrier shelves including: R-TEC AML, Seiscor SSC-1, and AT&T SLC-1. It also mounts into any metallic facilities terminal (MFT) shelf slot when used with the PairGain MFT-311 shelf adapter. The unit includes a built-in power supply. It is not compatible with the PairGain PG-2 CU-214 Common Unit.

**1.03** Revision History of this practice.

#### Revision 01— October 24, 1995

- a) Initial Release of 050-311-103 document.  
Replaces 100-311-003

**1.04 Unit Description.** The LU-311 COT Line Unit, List 3 is shown in Figure 2. The LU contains electronics that connect to two analog (POTS) tip and ring pairs and one Digital Subscriber Line (DSL) tip and ring pair. The LU-311 uses a 2.5 V DSL line driver and is compatible with RT-212 Remote Units.

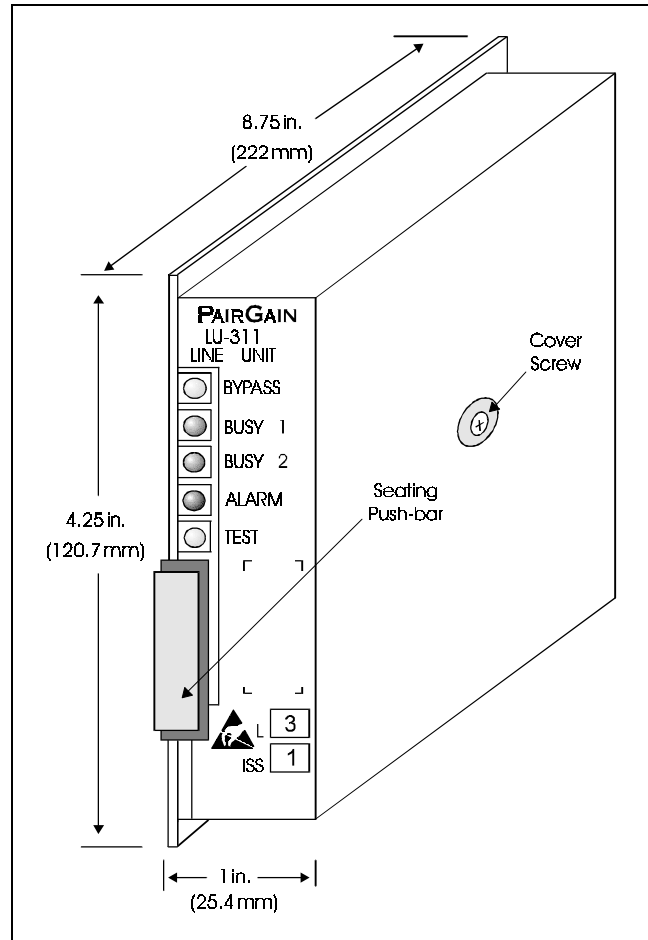
**1.05** Via  $\mu$ -Law PCM, the LU encodes two POTS channels into two 64 kbps channels. The LU then encodes the 64 kbps channels into the B channels of the LU's 2B1Q transceiver. LEDs indicate LU status.

**1.06** The RT decodes two POTS services from the DSL, and interfaces with the premises via POTS tips and rings.

**1.07 Line Power.** The LU provides power to the RT, over a DSL, up to 1300 ohms (AWG 26) in reach. During idle, off-hook and ringing silence states, the DSL tip is at 80 V above and the DSL ring is at 80 V below ground. During the ringing portion of the ring cycle, the DSL tip is at 130 V above and the DSL ring is at 130 V below ground. LU line power fully conforms to TR-057 Class A2 at all times.

**1.08 Electrical Protection.** The LU 311 COT Line

Unit, List 3 provides secondary surge and power cross protection on the DSL tip and ring.



**Figure 2. LU-311 COT Line Unit, List 3.** The unit's circuit board, containing the functional components, are housed within a removable, protective cover.

## 2. APPLICATIONS

**2.01 System Description.** PG-2 is a 2:1 pair gain. PG-2 transports two single party POTS channels over a single unloaded copper pair (2W) operating as a Digital Subscriber Line (DSL). Figure 3 is a block diagram of the PG-2 system. The Central Office Terminal (COT) contains the LU-311 plug-ins. Each LU multiplexes 2 POTS services onto the DSL. The Remote Terminal (RT) demultiplexes the DSL into two POTS services. The two POTS channels are independent of each other.

## 3. SPECIFICATIONS

### POWER:

**Shelf Power Supply Input Voltage**

-42 to -56 Vdc

**LU-311 Input Power Consumption**

6 Watts (maximum)

**LU-311 Power Supply Input Protection**

Fuse

**DSL Power Supply Output Voltage**

± 130 Vdc (maximum)

### DSL PERFORMANCE:

**Line Coding Format**

2B1Q per TR-393, ANSI T1.601-1988

**Bit Rate**

160 kbps

**COT/RT DSL Impedance**

135 ohms

**Signal Level**

11 dBm

**DSL Longitudinal Balance**

>60 dB

**Maximum 60 Hz Noise (Metallic)**

-47 dBm

**System Convergence Time**

<25 seconds

**Loop Maximum 40 kHz Loss**

>42 dB

**Line Powering Maximum Loop Resistance**

1300 ohms

### CO SIGNALING

**COT Off-hook Resistance**

1100 ohms

**COT Ringer (20 Hz) Impedance**

30 kohms

### ANALOG TRANSMISSION PERFORMANCE

**COT Impedance**

900 ohms

**RT Impedance**

600 ohms

**RT to COT Loss; 1004 Hz 0 dBm0 Input**

3.5 dB ± 0.5 dB

**COT to RT Loss; 1004 Hz 0 dBm0 Input**

3.5 dB ± 0.5 dB

**RT Echo Return Loss (ERL)**

>18 dB

**RT SRL-Lo, SRL-Hi**

>10 dB

**Idle Channel Noise**

<20 dBmnc

**On-hook Transmission Loss (either direction)**

<8 dB

**Channel Crosstalk Isolation**

@ 1004 Hz, 0 dBm0  
>65 dB

**Frequency Response (400 to 2800 Hz)**

+1, -0.5 dB

**Impulse Noise**

<15 counts in 15 minutes

**RT Longitudinal Balance**

200 to 1000 Hz  
>58 dB

3000 Hz  
>53 dB

**Amplitude Tracking**

+3 to -37 dBm0  
± 0.5 dB  
-37 to -50 dBm0  
± 1.0 dB

**Signal to Distortion Ratio**

0 to -30 dBm0  
>33 dB  
-30 to -40 dBm0  
>27 dB  
-40 to -45 dBm0  
>22 dB

ENVIRONMENTALS:

**Humidity (non-condensing)**

5% to 95%

**Operating Temperature**

-40° to +65° Celsius

**Operating Elevation**

200 feet (60 m) below sea level to 13,000

feet

(4,000 m) above sea level.

SIZE:

**Dimensions**

Height: 4.25 in. (120.7 cm)

Width: 1.00 in. (25.4 cm)

Depth: 8.75 in. (222.0 cm)

**Weight**

0.96 lbs. (0.43 kg)

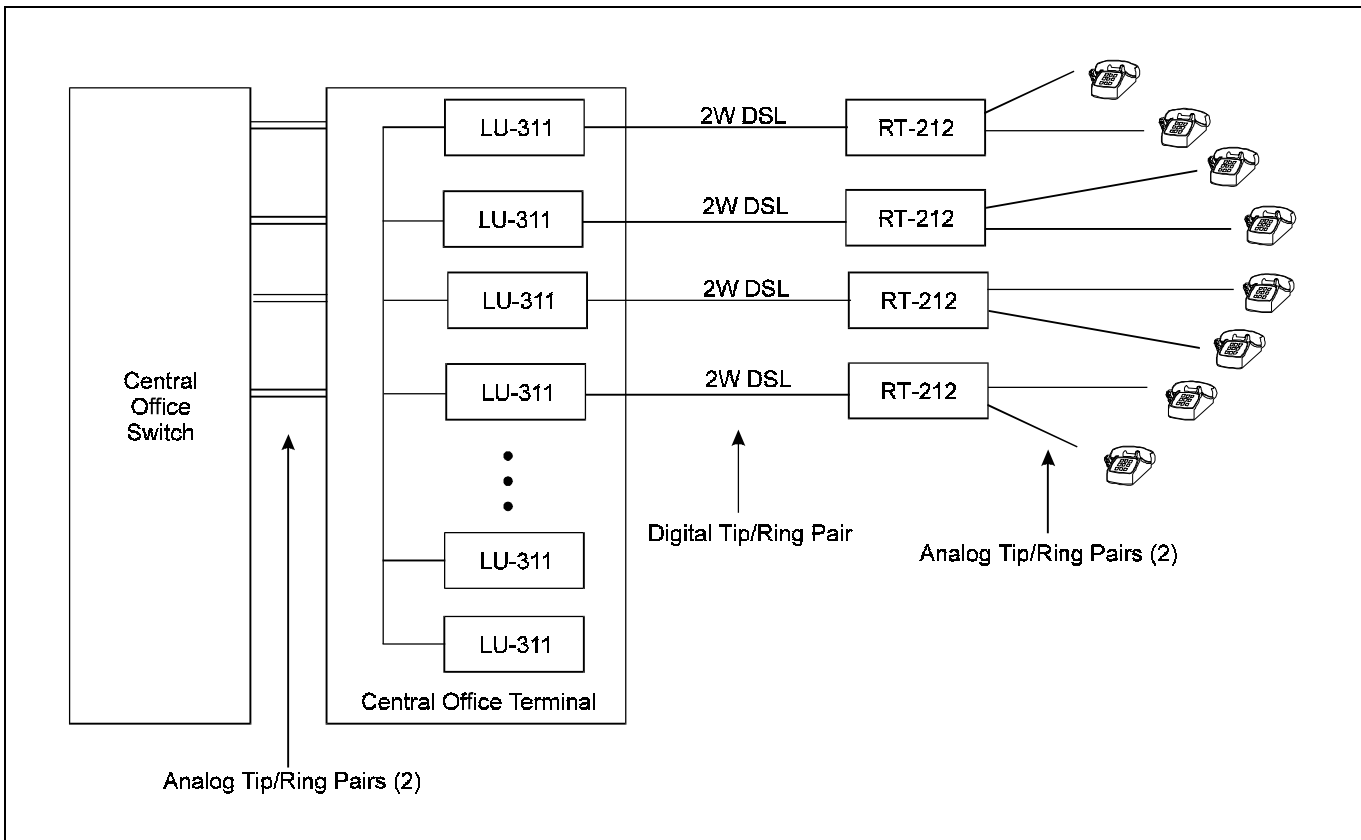


Figure 3. Block Diagram of the PG-2 System.

#### **4. CERTIFICATION**

**4.01 FCC Compliance.** The LU-311 COT Line Unit complies with the limits for Class A digital devices pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy, and, if not installed and used in accordance with the instruction manual, 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.

**4.02** Refer to the installation section of the appropriate practice for the unit being installed to get information on:

- Cabling
- Proper connections
- Grounding
- Line power

**4.03** All wiring external to the product(s) should follow the provisions of the current edition of the National Electrical Code.

#### **5. WARRANTY**

**5.01** PairGain Technologies warrants this product to be free of defects and to be fully functional for a period of 24 months from the date of original shipment, given proper customer installation and regular maintenance. During this warranty period, PairGain will repair or replace any unit, without cost, if the unit is found to be defective for any reason other than abuse or improper use or installation.

**5.02** This module should not be field repaired. If it fails, replace it with another unit and return the faulty unit to PairGain for repair. Any modifications of the unit by anyone other than an authorized PairGain representative will void the warranty.

**5.03** If a unit needs repair, call PairGain for a Return Material Authorization (RMA) number and return the defective unit, freight prepaid, along with a brief description of the problem, to:

**PairGain Technologies, Inc.**  
**14402 Franklin Avenue**  
**Tustin, CA 92780**  
**ATTN: Repair and Return Dept.**

**(800) 638-0031**  
**(714) 832-9922**

**5.04** PairGain will continue to repair faulty modules beyond the warranty program for a nominal charge. Contact your PairGain sales representative for details and pricing.

#### **6. TECHNICAL ASSISTANCE**

**6.01** PairGain Technical Assistance is available 24-hours-a-day, 7-days-a-week by contacting PairGain's Customer Service Engineering group at one of the following numbers:

**Telephone: (800) 638-0031**  
**(714) 832-9922**  
**Fax: (714) 832-9924**

During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday through Friday, excluding holidays), technical assistance calls are answered directly by a Customer Service Engineer. At other times, a request for technical assistance is handled by an on-duty Customer Service Engineer through a callback process. This process results in a callback within 30 minutes of initiating the request. In addition, PairGain maintains a computer bulletin board system for obtaining current information on PairGain products, product troubleshooting tips and aids, accessing helpful utilities, and posting requests or questions. This system is available 24-hours-a-day by calling (714) 730-3299. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1.

#### **B. FUNCTIONAL DESCRIPTION**

##### **7. OPERATIONAL CAPABILITIES**

**7.01** The LU-311 COT Line Unit provides the following functions:

- Internal Power Supply
- System Clock Circuit
- Front Panel Status Indicators

##### **8. FRONT PANEL**

**8.01** The front panel of the LU-311 COT Line Unit contains the following indicators (see Figures 1 and 2):

- **BYPASS** LED Indicator

*Yellow*—illuminated during turn-up and MLT testing, or during a bypass alarm condition.

*Off*—normal idle.

- **BUSY 1** LED Indicator  
*Green*—channel is busy.  
*Flashing Green*—channel is ringing.  
*Off*—normal idle.
- **BUSY 2** LED Indicator  
*Green*—channel is busy.  
*Flashing Green*—channel is ringing.  
*Off*—normal idle.
- **ALARM** LED Indicator  
*Red*—illuminated during self or MLT testing for 10 seconds, or indicates an alarm condition.  
*Off*—normal idle.
- **TEST** LED Indicator  
*Yellow*—illuminated during self or MLT testing.  
*Off*—normal idle.

## C. INSTALLATION AND TESTING

### 9. UNPACKING

**9.01** Upon receipt of the equipment, proceed as follows:

1. Unpack each container and visually inspect it for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to PairGain. Order replacement equipment if necessary.
2. Check the contents versus the packing list for a complete and accurate shipment. If the shipment is short or irregular, contact PairGain as described in Section 5. If you must store the equipment for a prolonged period, store the equipment in its original container.

### 10. INSTALLATION

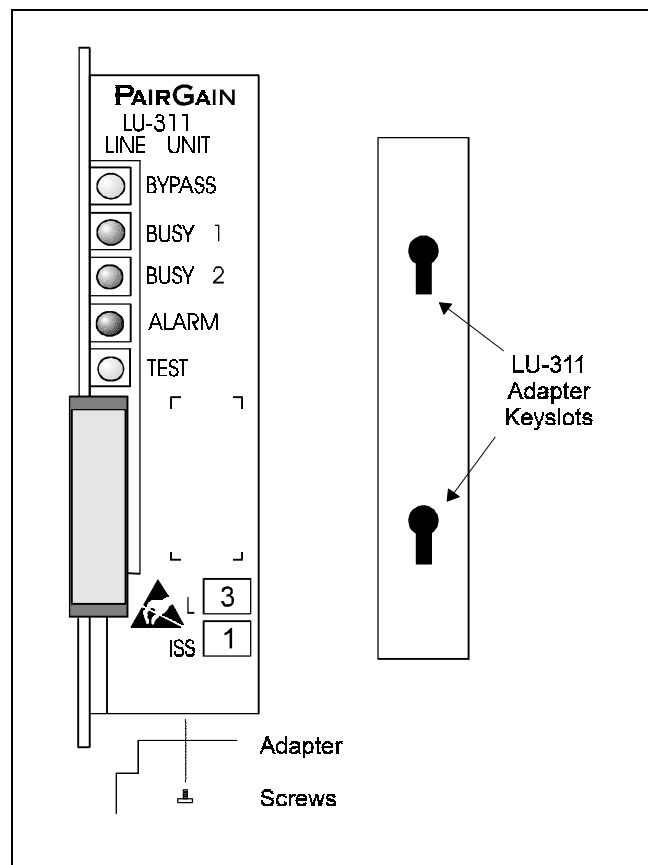
**10.01** The LU-311 shelf should be fused at 2.5 A.

**10.02 Insertion.** The LU can be inserted directly into any slot of a compatible shelf.

**10.03 Card Shelf Adapters.** An adapter for AML I, MFT or SSC-1 shelves is included with each LU (see Figure 4). This adapter should be removed if the LU is installed in other types of shelves, including AML II and SLC-1. Table 1 describes compatibility with a variety of card shelves.

**10.04 MFT Shelf Adapter.** If the LU is to be installed in a Metallic Facilities Terminal (MFT) shelf, a PairGain MFT-311 adapter, part number 150-1280-01 is required. See Technical Practice 050-311-300 for additional information.

**10.05 SLC-1 Shelf Adapter.** If the LU is to be installed in a SLC-1 shelf, a PairGain SLC-311 adapter, part number 150-1023-01 is required. See Technical Practice 050-311-200 for additional information.



**Figure 4. Adapter Bracket.** The standard LU-311 adapter bracket and mounting screws are included with the LU-311 COT Line Unit.

**Table 1. LU-311 COT Line Unit COT Shelf Compatibility**

Vendor	Shelf Type	Length	Part Number	Number of Line Unit Slots
Western Electric	MFT*	23 inches	N/A	?
	SLC-1***	23 inches	J98729B	12
R-Tec	AML I**	19 inches	71-110-05	10
		23 inches	71-110-06	12
	AML II****	19 inches	77-112-00	16
		23 inches	77-112-01	19
	AML III****	19 inches	77-112	16
		23 inches	77-112	19
Seiscor	SSC-1**	19 inches	9960-2210	10
		19 inches	9960-5748	12
		23 inches	9960-1603	12
		23 inches	9962-5745	14

**Notes for Table 1:**

\* Requires an MFT-311 Adapter, PairGain part number 150-1280-01 (ordered separately).

\*\* Use the standard metal adapter attached to the LU-311.

\*\*\* Requires a PG-2 SLC-311 Adapter, PairGain part number 150-1023-01 (ordered separately).

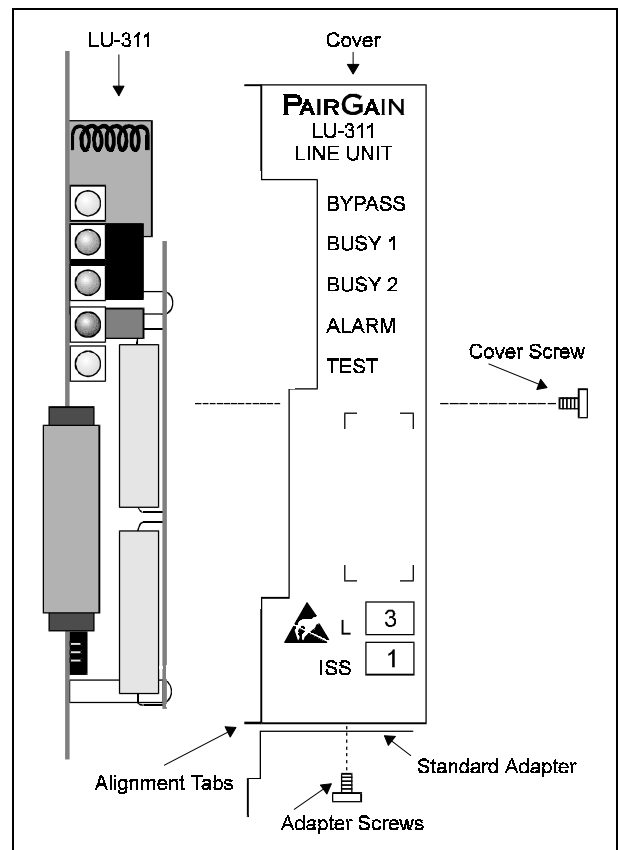
**10.06 AML II and AML III 19-inch Shelves.** This shelf is the manufacturer's part number 77-112-00. To install an LU-311 in the right-most slot, as seen from the front of the shelf, the metal cover on the LU-311 must be removed (see Figure 5). This cover provides electrical shielding for the circuit card to the right, and is therefore not required when the LU-311 is installed in the right-most card slot. The cover is held on with one screw. Remove the screw and cover, then replace the screw in its hole. The cover should be retained for future installation in another location, also, for the possibility of returning the unit to PairGain for repair.

**10.07 Shelf Pin-outs and Alarm Wiring.** Figure 6 shows the shelf connector pin-outs. A pair of normally open, minor alarm contacts is available. Loss of line sync closes this contact pair. The contacts are rated at:

- -125 Vac Switching @ 10 A
- -60 Vdc Switching (Resistive Load) @ 2 A
- -60 Vdc Switching (Inductive Load) @ 1 A

**10.08 Before Turn-up.** Verify CO wiring.

**10.09 After Turn-up.** Install RT-212 remote.



**Figure 5. LU-311 and cover (separated).**

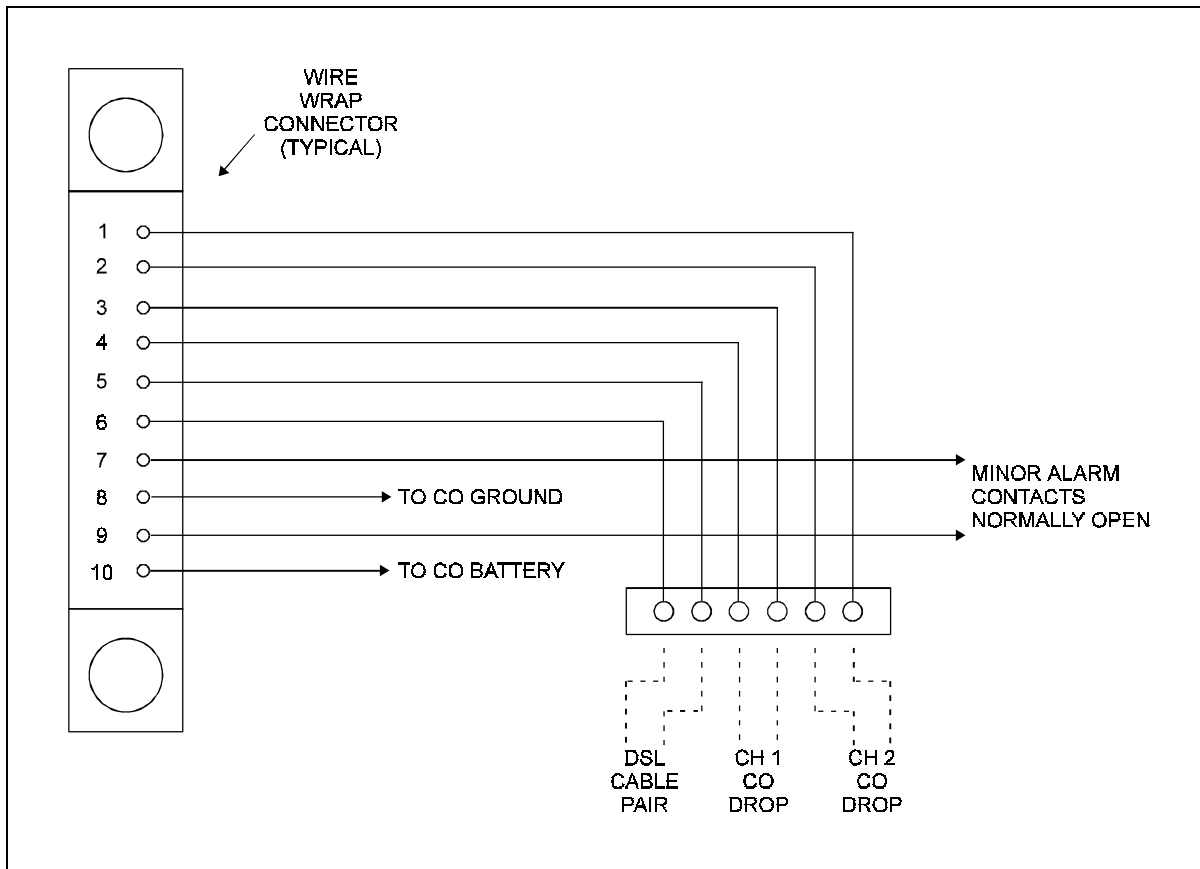


Figure 6. Shelf Connector and Pin-outs.

## 11. TURN-UP AND TESTING

**11.01 LED Indications.** During LU turn-up and operation, the LU provides LED indications. Table 2 provides step-by-step turn-up and test procedures for the LU-311 COT Line Unit.

**11.02 Initial Power On Indication.** When the LU is turned up, it indicates initial power on for less than one second, and then attempts to power the RT. During this start-up mode, the LU-311's BUSY LEDs *flash*. The LU and RT sync within about 30 seconds, leaving the LU-311 in its normal operational mode.

**11.03 Normal Idle Indication.** Normal idle indication is all LEDs *off*. This means both channels are operational and idle.

**11.04 Normal Busy Indication.** When a channel is busy, its BUSY LED is *on*. When a channel is ringing, its BUSY LED *flashes* in sync with the ringing frequency.

**11.05 Bypass Indication.** The BYPASS LED indicates that the LU has metallicly connected the switch tip and ring to the DSL cable tip and ring. Between LU installation and RT installation, bypass provides physical pair POTS service to channel 1. During the MLT test, bypass provides metallic test access to the DSL cable.

**Note:** The LU should be installed before the RT is installed in the field. This sequence assures service to channel 1 in the interval between LU installation and RT installation.

**Note:** Bypass is a normal condition in the interval between LU installation and RT installation.

## 12. TROUBLESHOOTING

**12.01** Table 3 provides troubleshooting procedures based on indications displayed by the front panel indicators of LU-311 COT Line Unit.

**TABLE 2. LU-311 COT LINE UNIT TURN-UP AND TESTING**

<b>CAUTION</b>			
<i>Observe normal electrostatic discharge precautions when handling electronic equipment. Do not hold electronic plug-ins by their edges. Take care not to touch components or circuitry.</i>			
<b>Step</b>	<b>Operation</b>	<b>Action</b>	<b>Note</b>
1	Initial Power On	Seat the LU-311 COT Line Unit by pressing on the seating push-bar until the LU is firmly in place.	All LEDs illuminate for less than one second, then the LU-311 proceeds to Cold Start.
2	Cold Start	Observe the BUSY LEDs.	The BUSY LEDs will flash for a period of approximately 30 seconds while the ALARM LED is <i>on</i> . The LU-311 then proceeds to one of the other indications.
3	LU Self-test	Observe the ALARM and TEST LEDs.	The ALARM and TEST LEDs will illuminate for less than ten seconds.
4	MLT Test	Observe the BYPASS, ALARM and TEST LEDs.	The BYPASS, ALARM and TEST LEDs are illuminated during this test.
5	Normal Idle	The system is functioning normally.	All LEDs are <i>off</i> .
6	Ringling	Observe the BUSY 1 and BUSY 2 LEDs.	When a channel is ringing, the appropriate BUSY LED will flash in sync with the ringing frequency.
7	Busy	Observe the BUSY 1 and BUSY 2 LEDs.	When a channel is busy, the appropriate BUSY LED will be illuminated.

**TABLE 3. LU-311 COT LINE UNIT TROUBLESHOOTING**

<b>Indication</b>	<b>Problem</b>	<b>Action</b>
BYPASS and ALARM LEDs are illuminated.	RT is installed but not responding.	<ol style="list-style-type: none"> <li>1. Replace the LU-311.</li> <li>2. Check for and correct DSL cable fault.</li> <li>3. Replace the RT.</li> </ol> <p style="text-align: center;"><b>Note:</b> This indication is normal if the RT is not yet installed.</p>
ALARM and TEST LEDs are illuminated.	The ALARM and TEST LEDs do not turn <i>off</i> after ten seconds during the LU Self-test, or, they come <i>on</i> at other times.	Replace the LU-311. See Section 5 of this document for return instructions, or Section 6 for Technical Assistance.