Westronic

Dual/Quad Modem Assembly

994-T035 Rev D Oct 2000

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Technical Manual

Technical Manual

NOTICE

WESTRONIC makes no warranties about this document. WESTRONIC reserves the right to make hard-ware and software changes to the product described within this document without prior notice and without obligation to notify any person of such revision or change.

REGULATORY INFORMATION

WARNING: This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the installation manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15, Subpart J of the FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of the equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

CAUTION: Changes or modifications not expressly approved by Westronic could void the user's authority to operate this equipment.

The FCC label can be found on the right side of the shelf assembly. The label includes the following information:

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

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Rev Level	Issue Date	Reason for Reissue
A	June, 1994	First Release
B	November, 1996	New Format
C	January, 2000	Logo Update; New Format, Error Correction
D	October, 2000	Logo Branding Update

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Section 1 Product Description

1.1 Overview

The Westronic dual-/quad-modem shelf is a single vertical unit (VU – 1.75-inch) enclosure with mounting positions for three plug-in units. The first mounting position plug-in unit is a power supply that provides +5 Vdc and ±12 Vdc from –20 Vdc through –60 Vdc input. The other two mounting positions are for dual eurocard-style modems. User connections to the modem boards and the power supply are through connectors on the modem shelf backplane.

The Westronic dual rate-adaption modem plugin provides two Bell 202T-compatible modems with optional data-rate adaption. The digital interface can be configured for RS-232, RS-422, or RS-485 interface operation.

The Westronic dual clock-recovery modem plugin provides two Bell 202T-compatible modems with a recovered clock signal that is synchronous with the received data. The digital interface can be configured for RS-232, RS-422, or RS-485 interface operation.

Figure 1-1 shows the modem shelf and modules for either modem type.

Figure 1-1 Dual/Quad Modem Front Panel

1.2 Shelf and Power Supply

The modem shelf, PN 534-T004, consists of a backplane and metal chassis with three plug-in slots. The left-hand slot is dedicated to a power supply (PN 521-T007); the remaining two slots are for modem plug-in units (PN 532-T009 or PN 532-T010). The shelf occupies 1 VU in a standard 19-inch rack. Adapters are available for mounting in a 23-inch rack.

The backplane provides all user connections. Compression-style terminal blocks provide all power supply and audio line connections, whereas 8-pin Methode connectors provide digital connections. Minijumpers on the backplane enable interface configuration settings. See Section 3 for pinout details.

The eurocard power supply, which provides +5 Vdc and ±12 Vdc from a power source of –20 Vdc through –60 Vdc, is equipped with a power switch and an On/Off LED indicator. Current-limited test points allow measurement of each output voltage. A trim potentiometer, which should be adjusted in a lab or factory environment only, enables adjustment of the +5 Vdc output. Figure 1-2 shows the potentiometer location.

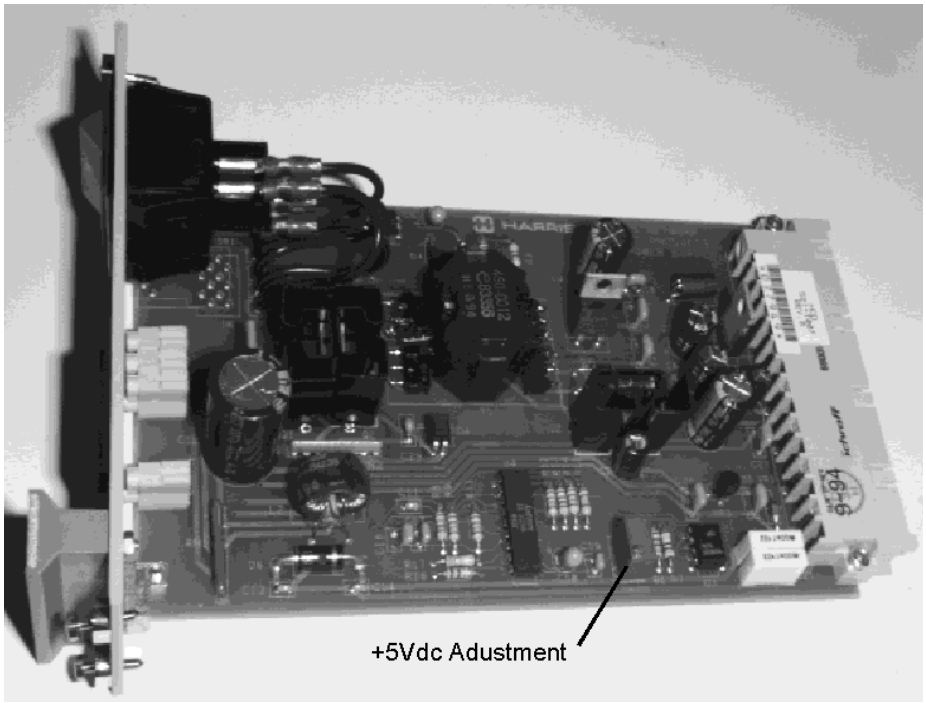

Figure 1-2 Power Supply +5 Vdc Adjustment Location

The dual rate-adaption and dual clock-recovery modems are single eurocard-sized modules, each containing two independent modems. Each modem supports Bell 202T specifications for use on 2- or 4-wire circuits with data rates of 1,200 bps.

1.3 Dual Rate-Adaption Modem

Each dual rate-adaption plug-in module contains two identical modems. The digital side of the modem operates at the 1,200-bps line data rate or at the optional rate with the adaption feature enabled. The adaption feature converts the data rate from 2,400 bps on the digital side to 1,200 bps on the analog line side. Any application having at least 10 milliseconds between successive characters can use the dual rate-adaption modem, initially intended for use in TBOS applications. (A character cannot contain more than one start bit, nine data bits, and two stop bits.) Each modem digital interface uses an RS-232, RS-422, or RS-485 interface with a Data Communication Equipment (DCE) configuration that supports the signals listed in Table 1-1.

Table 1-1 Rate-Adaption Modem Communication Modes (DCE)

Signal	Direction	RS-232	RS-422	RS-485
TX DATA	Input	Yes	Yes	Yes
RX DATA	Output	Yes	Yes	Yes
RTS	Input	Yes	Yes	Yes
CTS	Output	Yes	No	No
DCD	Output	Yes	No	No

For the period that data is output on an RS-485 signal pair, the transmit data driver is enabled only while valid data is detected. You can enable constant carrier by installing the following backplane straps:

- Z7: Modem 1, Channel 1
- Z8: Modem 1, Channel 2
- Z15: Modem 2, Channel 1
- Z16: Modem 2, Channel 2

The LED indicators on the front panel indicate TX Data, RX Data, RTS, and DCD activity for each modem.

Figure 1-3 illustrates a typical dual rate-adaption modem installation that uses Westronic WS1000, WS2000, and WS3000 Remote Telemetry Unit (RTU) equipment. Refer to the following technical manuals for more information on C1000, WS1000, WS2000, and WS3000 RTUs:

- C1000: 994-T028
- WS1000 TBOS: SPEC-0054
- WS1000 TABS: 994-T013
- WS2000 TBOS: SPEC-0016
- WS2000 MCS-11: SPEC-0049
- WS2000 TABS: 994-T017; 994-T027; 994-T057
- WS3000: 994-T022; 994-T054

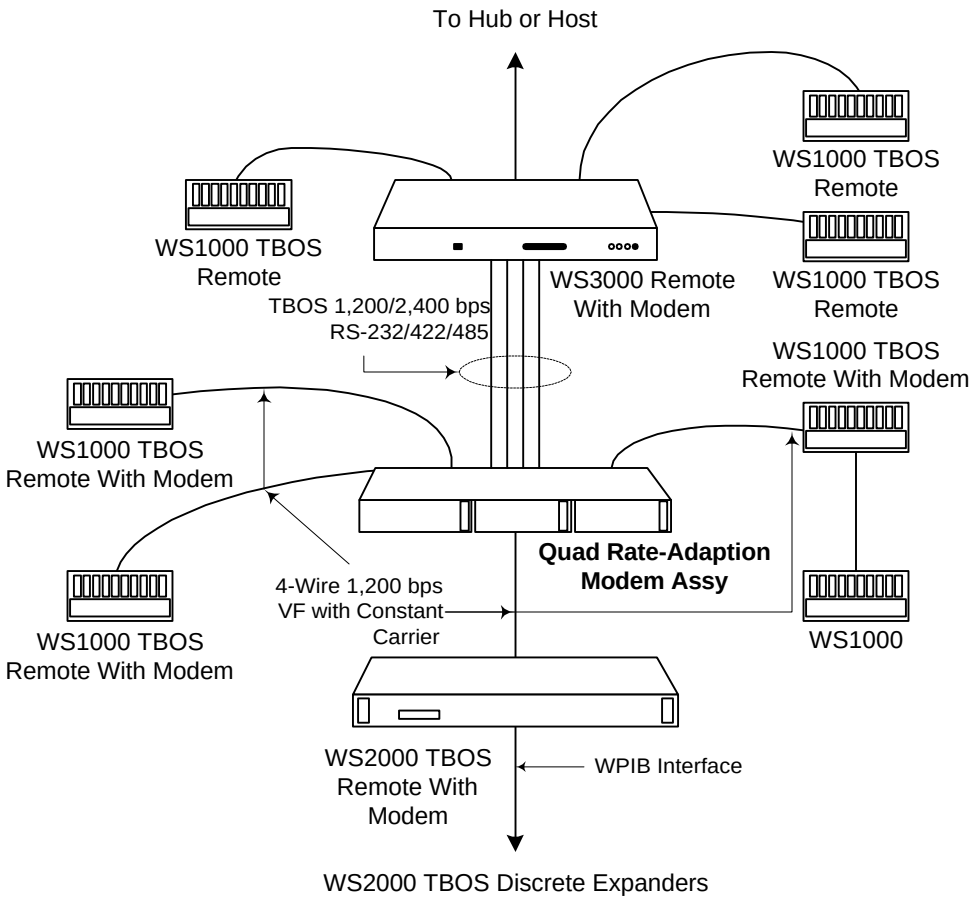

Figure 1-3 Typical Quad Rate-Adaption Modem Application

1.4 Dual Clock-Recovery Modem

The plug-in dual clock-recovery modem, containing two identical modems, is intended for use in MCS-11 applications, which require synchronous data clocks. Both sides of the modem, operating at 1,200 bps, are suitable for use in any 202T modem application without the recovered clocks. Each modem digital interface is usually an RS-485 interface with a DCE configuration that supports the signals listed in Table 1-2.

Table 1-2 Clock-Recovery Modem Communication Modes (DCE)

Signal	Direction	RS-232	RS-422	RS-485
TX DATA	Input	Yes	Yes	Yes
RX DATA	Output	Yes	Yes	Yes
RTS	Input	Yes	Yes	Yes
CTS	Output	Yes	No	No
DCD	Output	Yes	No	No
RX CLOCK	Output	Yes	Yes	Yes
TX CLOCK	Output	Yes	Yes	Yes

Enable constant transmit carrier/switched receive carrier by installing the following backplane straps:

- Z7: Modem 1, Channel 1
- Z8: Modem 1, Channel 2
- Z15: Modem 2, Channel 1
- Z16: Modem 2, Channel 2

The LED indicators on the front panel indicate TX Data, RX Data, RTS, and DCD activity for each modem.

Figure 1-4 illustrates a typical quad-clock recovery modem installation.

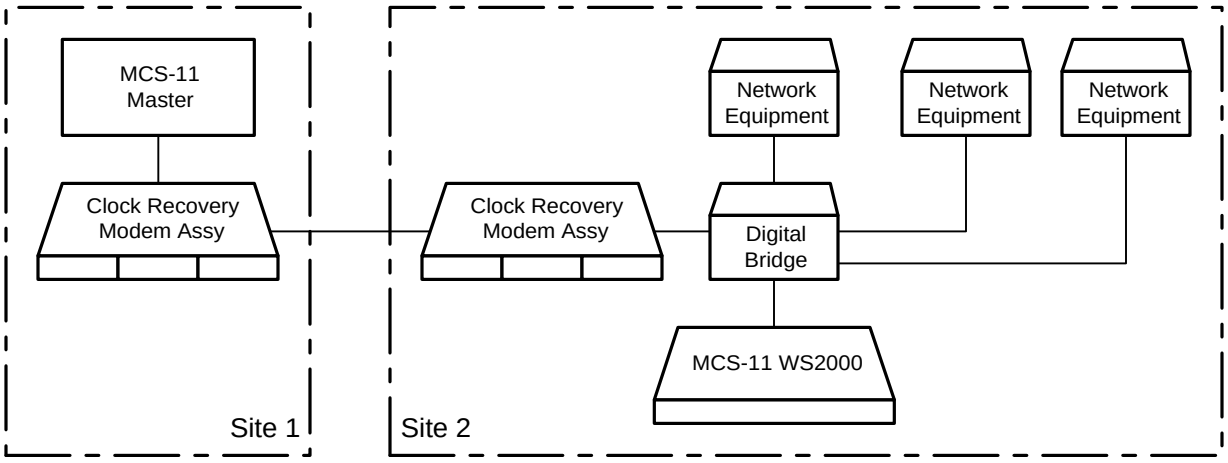

Figure 1-4 Typical Quad-Clock Recovery Modem Application

1.5 Specifications

1.5.1 Power Supply

The following specifications are subject to change without notice.

The plug-in power supply provides power for two dual-/quad-modem shelves (four dual-modem modules maximum). See Section 2 for connection details.

- Input voltage: –20 V dc to –72 Vdc
- Output voltage/current:
  +5 Vdc (4.90 Vdc to 5.20 Vdc) at 1.5 Amps maximum
  +12 Vdc (11.6 Vdc to 12.4 Vdc) at 400 mAmps maximum
  –12 Vdc (–12.4 Vdc to –11.6 Vdc) at 400 mAmps maximum
- Power rating: 15 Watts total
- Regulation:
  0.2% line
  2.0% load
- Recommended external fusing: 2.0 Amps (Type 70) or 2-1/2 Amps (GMT) at –48 Vdc

1.5.2 Modem Power Requirements

Power requirements for each module:
+5 Vdc at 225 mA
+12 Vdc at 10 mAmps
–12 Vdc at 40 mAmps

1.5.3 Environmental

Operating ambient temperature range: 0° C to +55° C

Humidity: <95% non-condensing

1.5.4 Interfaces for Dual Rate-Adaption Modem

Digital Serial Channels 1 Through 4

- Protocol:
  TBOS (eight data bits, odd parity, two stop bits)
  TABS (eight data bits, odd parity, one stop bit)
- Speed:
  TBOS (1,200/2,400 bps)
  TABS (1,200 bps)
- Communication type: RS-232, RS-422, or RS-485

- Protection: Sustain transient voltage to a maximum 2 kV
- Connectors: 8-pin Methode connector (Westronic PN 620-0077)

Analog Serial Channels 1 Through 4

- Type: 202T compliant 4-wire
- Speed: 1,200 bps
- Output amplification: +2.0 dBm (maximum)
- Input sensitivity: –6 dBm to –48 dBm (in 6-dBm steps)
- Connection: 3-position D/Level compression plug (Westronic PN 640-0105)

1.5.5 Interfaces for Dual Clock-Recovery Modem

Digital Serial Channels 1 Through 4

- Protocol: MCS-11
- Speed: 1,200 bps, external clock
- Communication type: RS-232, RS-422, or RS-485
- Protection: Sustain transient voltage to a maximum 2 kV
- Connection: 8-pin Methode connector (Westronic PN 620-0077)

Analog Serial Channels 1 Through 4

- Type: 202T compliant 4-wire
- Speed: 1,200 baud
- Output amplification: +2.0 dBm (maximum)
- Input sensitivity: –6 dBm to –48 dBm (in 6-dBm steps)
- Connection: 3-position D/Level compression plug (Westronic PN 640-0105)

1.5.6 Mechanical

The modem assembly (Figure 1-5) occupies one vertical rack unit (1.75 inches) in a standard 19-inch equipment rack. Adapters are available for mounting in 23-inch racks. The maximum weight of a fully populated modem assembly is 6.2 lbs or 2.8 kg. The power supply occupies the left slot. The On/Off switch, power On LED indicator, and voltage test points are accessible on the unit front panel. The center and right slots are for dual plug-in modems. The front panels

include transmit level adjustment access and LED data activity indicators for Tx Data, Rx Data, RTS, and DCD for each channel.

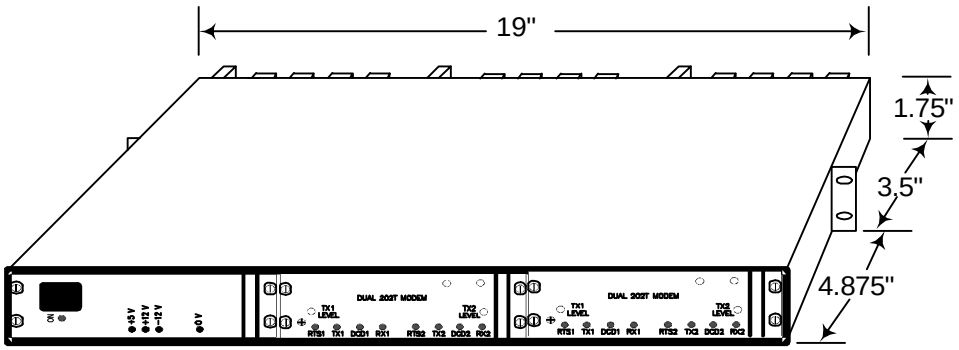

Figure 1-5 Installation Template

1.6 Unit Identification

Table 1-3 lists the major dual/quad modem components. Table 1-4 lists the top-level modem part numbers and major components for each.

Table 1-3 Major Components

Part Number	Description
534-T004	Modem Shelf
521-T007	15-Watt Power Supply
532-T009	Dual Rate-Adaption 202T Modem
532-T010	Dual Clock-Recovery 202T Modem

Table 1-4 Top Level Part Numbers and Components

Component Part Numbers	Part Numbers: 520-			
	T017	T018	T019	T020
534-T004 Modem Shelf	1	1	1	1
521-T007 15-Watt Power Supply	1	1	1	1
532-T009 Dual Rate-Adaption Modem	1	2	N/A	N/A
532-T010 Dual Clock-Recovery Modem	N/A	N/A	1	2
994-T035 Technical Manual	1	1	1	1

1.7 Other Products from Westronic

The following provides information about other Westronic products that are available to meet alarm system needs. Call **972-235-5292** to talk with a Westronic representative to learn more about these and other Westronic products.

1.7.1 C1000

The C1000 complements many operation support systems by providing an economical and flexible means of collecting small to large quantities (32 – 256 points) of discrete alarm and status data and converting them to simple, easy-to-handle TABS or TBOS interface.

Different versions of the C1000 allow communications with either a TABS or TBOS host. The C1000 can pass-through polls for other addresses, permitting daisy-chains of C1000 units in larger configurations and permitting the C1000 and local NE telemetry data to combine into a single channel. In some cases, data can combine through a single modem.

The C1000 requires only one vertical space (1.75 inches) in either a 19-inch or 23-inch equipment rack, allowing location as close as possible to the source of discrete interfaces. The result is a large reduction in the amount of wiring required to pick up alarm and status data. The reduction in wiring eliminates the possibility of losing data through unknown disconnected, moved, or cut wiring. Serial and discrete interface are through standard 9-pin subminiature and 50-pin connectors, making installation and replacement exceptionally fast and simple.

The C1000 is equipped with two serial ports:

- The first, a host port, serves as a TABS or TBOS host communications interface that can be equipped with an optional 1,200 bps Bell 202T-compatible internal modem, allowing the C1000 to be located beyond the range of standard RS-422/RS-485 interfaces.
- The second, an expansion port, serves as a TABS or TBOS data collection interface.

The housing accommodates a maximum of eight 50-pin discrete interface connectors. All the different configurations use this same housing.

1.7.2 WS1000

The WS1000 product line complements many operations and network management systems by providing an economical, flexible means of converting varying quantities of discrete (dry-contact) alarm, status, and control data to a simple, easy-to-handle TABS or TBOS interface.

Available configurations provide the flexibility to select the unit best suited for various applications. Choose from 64/128 discrete inputs with 8/16 discrete outputs.

Small size and flexible mounting requirements allow placement of the unit close to the source of discrete interfaces. WS1000 can mount in an equipment bay or on a distribution frame as the application demands. This flexibility results in considerable reduction in the amount of required wiring. The basic structure of a front-facing wire-wrap block, commonly found on distribution frames, provides a sturdy housing for the WS1000. Located on the easily removable module contained within the housing are all the active components. WS1000 is the ideal way to collect discrete alarms throughout a site or service area with feedback to a WS2000 or WS3000 hub.

1.7.3 WS2000

The WS2000 product line offers the data collection and reporting capabilities necessary to make small remote telemetry units more flexible and efficient. WS2000s combine compact design with the power to configure multiple serial and discrete interfaces in virtually any arrangement to best serve network needs. A single-rack-increment high unit fits within 19-inch or 23-inch racks. Other mountings are available.

A WS2000 can be equipped with the following:

- 4 or 8 serial ports supporting user-selectable RS-232, RS-422, and RS-485 interfaces at 1,200/2,400 bps
- 32 – 512 discrete alarm/status inputs and 8 – 128 discrete control outputs, expandable to 2,048 inputs and 512 outputs in some configurations
- 8 pulse accumulator inputs (optional)
- 8 analog inputs, expandable to 24 analog inputs (optional)
- Host port interface for RS-232, RS-422, and RS-485 at 1,200; 2,400 (most units); and 9,600 bps (some units). An optional internal modem is available.

To support a broad range of equipment, the WS2000 can incorporate many of the following interface types:

- Asynchronous/synchronous serial
- Discrete inputs and outputs
- Analog and pulse inputs

Some of the many types of available serial protocols include the following:

- E-Telemetry (E2A format)
- TABS
- TBOS
- MCS-11
- ASCII (HASP)

1.7.4 WS3000

The WS3000 is a powerful telemetry unit that combines the most useful functions of discrete and serial alarm collection, mediation, and access with a high-speed processor and large database capacity. WS3000 is the ideal bridge between today's telemetry networks and the advanced protocols now appearing. With Ethernet asynchronous connectivity and database capacity of 30,000 data points, WS3000 is the choice of quality telecommunications carriers. WS3000 features include the following:

- Optional ethernet interface
- Available solutions for remote alarm monitoring over TL1 ASCII TCP/IP ethernet, OSI ethernet, and asynchronous communications
- Data collection using TBOS, TABS, and Teltrac protocols
- 9 serial ports supporting user-selectable RS-232/RS-422/RS-485 interfaces from 1,200 – 9,600 bps
- 32 – 512 discrete alarm/status inputs and 8 – 128 discrete control outputs with capability to support a maximum of 30,000 alarm points
- Custom protocols are available on a special assembly basis

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Section 2 Installation

2.1 Handling Considerations And Precautions

Many Westronic products use modules that contain Complementary Metal Oxide Semiconductor (CMOS) and N-Channel Metal Oxide Semiconductor (NMOS) integrated circuits because these components help maximize noise immunity and promote lower power consumption. However, modules containing CMOS and NMOS integrated circuits require careful handling to avoid damage to the CMOS and NMOS integrated circuits resulting from high static voltage levels. The CMOS and NMOS devices come equipped with protection diodes, but incorrect handling that allows excessive static energy to enter the devices can still cause device failure that is not readily detectable and can lead to premature device failure. Packaging containing CMOS/NMOS components have a label similar to that shown in Figure 2-1.

Figure 2-1 Electrostatic Discharge (ESD) Logo

The following noteworthy points significantly reduce static damage on CMOS or NMOS components, thereby improving system reliability and keeping system downtime to a minimum:

- Always ground yourself using an ESD heel or wrist strap or touch a system rack that is earth grounded before removing or inserting modules to ensure that they are not carrying static charges.
- Always place an extracted module in an antistatic bag or covering for transportation and storage.
- Perform repair work on modules in an antistatic work station that uses personnel grounding protection, such as wrist straps and antistatic matting.

- Exercise extreme care when handling CMOS/NMOS components. Do not touch the pins and always place components in antistatic foam for storage and transportation.
- Ensure that desoldering tools have static reduction. Some desoldering tools can actually generate large static voltages that damage CMOS and NMOS devices.

The modem module is protected against 2-kV transients while installed in the modem shelf assembly through the shelf power ground.

2.2 Module Substitution

Keep the following important points in mind to assist board diagnosis when a module requires an upgrade, replacement, or substitution:

- Turn power off when removing or inserting modules. Although the boards are designed to withstand removal and insertion with power on, a recommended practice is to turn off system power when substituting modules.
- Make certain that the substitute board has identical configuration strap and switch arrangements as the board it is replacing. Without identical settings, the new module can operate improperly.
- Ensure that the module mates properly with the connector at the chassis rear when inserting the module. A firm push on the module front is usually all that is required to install the module. Never force a board into position because this can damage the module or the rear connector.

Only qualified personnel familiar with the type of electronic design used on the unit should perform module repair.

Describe the suspected problem or fault or operation symptoms observed before the failure occurred (what were the conditions just before the board failed? Can the board be made to fail because of some set of conditions?). This information can aid in reducing repair time.

2.3 Installation Procedures

2.3.1 Modem Shelf Assembly

1. Unpack the unit and inspect for any signs of damage.
2. Bolt the chassis into the rack.
3. Configure the modem terminations, as required, using the backplane minijumpers.
4. Connect the phone line and the digital interface cabling to the backplane connectors.

5. Verify that the power switch is in the Off position.
6. Connect the battery input feed and ground to TB1 on the backplane.
7. Turn on the system power and verify that the power supply LED lights. Check voltage levels at this time.
8. Turn power Off and install the modem modules.

2.3.2 Modem Module

1. Unpack the module and inspect for any signs of damage.
2. Configure the module as required (see *Configuration*).
3. Insert the module into the desired slot in the chassis.
4. When inserting the module, ensure that it mates properly with the rear chassis connector. A firm push on the module front is all that is required to install the module. Never force a board into position because this can damage the module or rear connector.

2.4 Configuration

Configuration occurs in the following areas:

- Dual-/Quad-Modem Modules
- Backplane
- Interface Connections

2.4.1 Dual/Quad Modem Modules

Minijumpers on the dual-modem board set operating parameters for each modem channel on a board. A 20k-ohm potentiometer adjusts the modem channel analog transmit level. Figure 2-2 shows the location of jumpers and potentiometers.

2.4.1.1 Plugin Jumper and Potentiometer Functions

The following describes the purpose of each jumper on the modem circuit board. See Figure 2-2 for jumper locations and pinouts.

Z1 Channel 1, equalization mode

Z2 Channel 1, 2-wire/4-wire operation

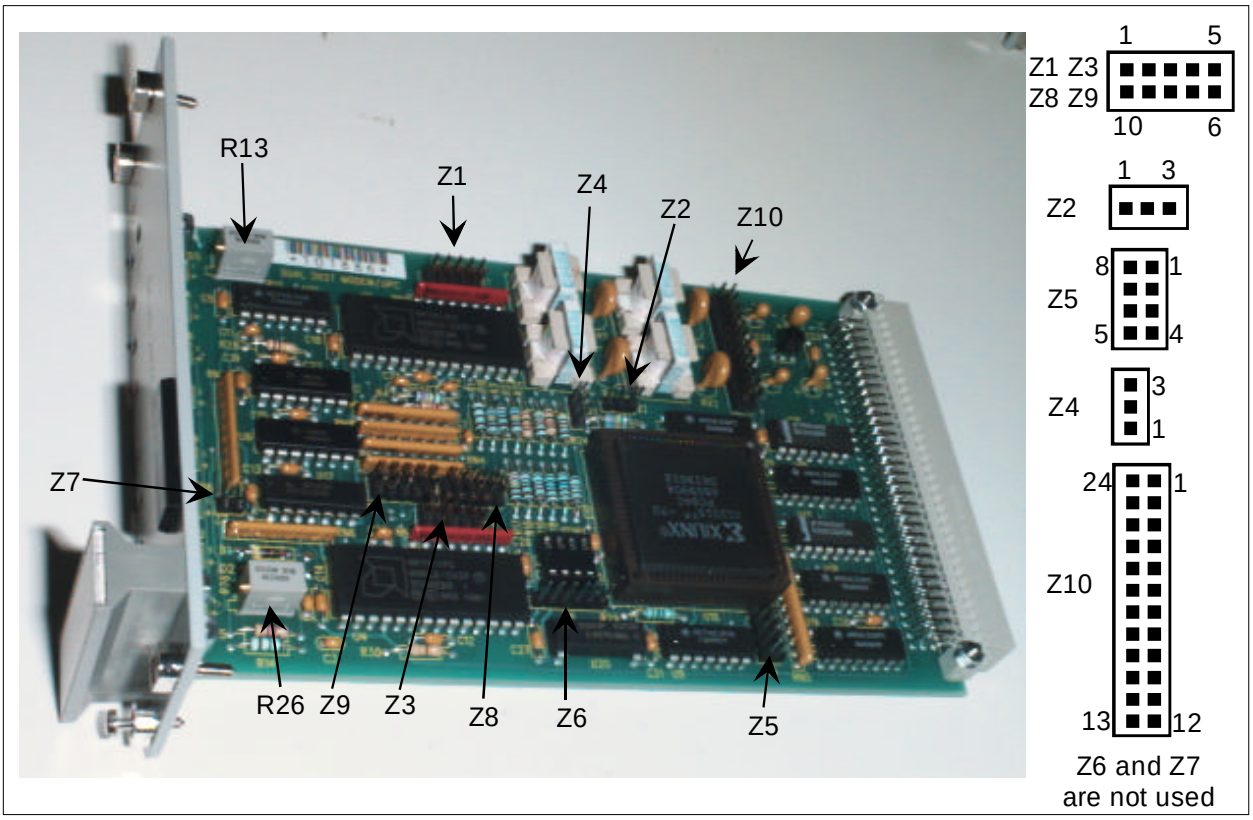

Figure 2-2 Dual/Quad Modem Jumper and Potentiometer Locations

Z3 Channel 2, equalization mode

Z4 Channel 2, 2-wire/4-wire operation

Z5 2,400-bps to 1,200-bps data rate adaption on each modem channel (applies only to dual rate-adaption modem – PN 532-T009)

Rx data output to clock on the falling/rising edge of the Rx clock (applies only to dual clock-recovery modem – PN 532-T010).

Z6 Factory alignment use only; does not apply to field applications

Z7 Factory alignment use only; does not apply to field applications

Z8 Channel 1 receive-level sensitivity

Z9 Channel 2 receive-level sensitivity

Z10 Interconnect analog signals and power from daughter module assemblies to the modem card

R13 Channel 1 transmit output trimpot adjustment. Counterclockwise rotation increases output level (+2 dBm maximum output). Adjust with constant carrier enabled (see *Jumper Functions*).

R26 Channel 2 transmit output trimpot adjustment. Counterclockwise rotation increases output level (+2 dBm maximum output). Adjust with constant carrier enabled (see *Jumper Functions*).

2.4.1.2 Dual/Quad Modem Default Settings

The factory installs the default option settings indicated in Table 2-1. Except for Z5 options, jumper settings for the rate-adaption and clock-recovery modems are the same.

Table 2-1 Dual/Quad Modem Default Settings

Channel	Block/Pins	Function
1	Z1: 2–9, 3–8, 5–6	202T Equalization Disabled
	Z2: 2–3	4-Wire Mode
	Z8: 1–10	Receive Sensitivity Level = –36 dBm
	R13	Output Transmit Level Set to –10 dBm
2	Z3: 2–9, 3–8, 5–6	202T Equalization Disabled
	Z4: 2–3	4-Wire Mode
	Z9: 1–10	Receive Sensitivity Level = –36 dBm
	R26	Output Transmit Level Set to –10 dBm
1, 2	Z5: 1–8 (1), 3–6 (2)	Rate Adaption Enabled for (channel) on Dual Rate-Adaption Modem
		Falling-Edge Rx Clock Recovery with Respect to Rx data for (channel) on Dual Clock-Recovery Modem
–	Z6, Z7	None required
	Z10	None required

2.4.1.3 Equalization Mode

The dual modem operates in Bell 202T-mode with/without equalization. Table 2-2 describes equalization option settings for Channels 1 (Z1) and 2 (Z3).

Table 2-2 Equalization Option Blocks (Z1 and Z3)

Chan/Block	Modem	1–10	2–9	3–8	4–7	5–6
1: Z1	202T EQ Enabled	Out	In	In	Out	Out
2: Z3	202T EQ Disabled	Out	In	In	Out	In

2.4.1.4 2-Wire/4-Wire Operation

Each modem operates on a 2-wire or 4-wire line. Table 2-3 identifies the 2-W/4-W option settings for Channels 1 (Z2) and 2 (Z4). See Backplane for the line connections.

Table 2-3 2-Wire/4-Wire Option Selection Jumpers (Z2 and Z4)

Chan/Block	Line Type	1–2	2–3
1: Z2	4-Wire	Out	In
2: Z4	2-Wire	In	Out

2.4.1.5 Rate Adaption (Dual Rate-Adaption Modem)

The following applies only to the dual rate-adaption modem board (PN 532-T009).

With rate adaption enabled, 1,200-bps data on the analog line converts to 2,400-bps data on the digital side and 2,400-bps data on the digital side converts to 1,200-bps data on the analog line. Data converted from 1,200 bps to 2,400 bps has a 10-millisecond delay.

With rate adaption disabled, data rates on the modem analog and digital sides are 1,200 bps. Data converted from 2,400 bps to 1,200 bps has a 5-millisecond delay. Table 2-4 lists the rate-adaption options for Channels 1 and 2.

Table 2-4 Rate Adaption Option Block (Z5)

Chan	Rate Adaption	1–8	2–7	3–6	4–5
1	Enabled	In	Out	N/A	Out
	Disabled	Out	Out	N/A	Out
2	Enabled	N/A	Out	In	Out
	Disabled	N/A	Out	Out	Out

2.4.1.6 Clock Recovery (Dual Clock-Recovery Modem)

The following applies only to the dual clock-recovery modem board (PN 532-T010).

The application using the dual clock-recovery modem board requires a clock signal for synchronous communication. The modem always provides an Rx clock that becomes synchronous to Rx data, thereby recovering a clock signal. You can choose whether the Rx data clocks with the falling or rising edge of the recovered Rx clock signal. Table 2-5 provides clock edge option settings for Channels 1 and 2.

Table 2-5 Clock Recovery Option Block (Z5)

Chan	Clock Edge Selection	1–8	2–7	3–6	4–5
1	Falling Edge Clock	In	Out	N/A	Out
	Rising Edge Clock	Out	Out	N/A	Out
2	Falling Edge Clock	N/A	Out	In	Out
	Rising Edge Clock	N/A	Out	Out	Out

2.4.1.7 4-Wire Receive Sensitivity

The dual-/quad-modem board provides seven receive sensitivity levels in 6-dBm increments. Table 2-6 shows the sensitivity level option jumper settings for Channels 1 (Z8) and 2 (Z9).

Table 2-6 4-Wire Receive Sensitivity Option Blocks (Z8 and Z9)

Chan/Block	Sensitivity	1–10	2–9	3–8	4–7	5–6
1: Z8 2: Z9	–6 dBm	In	In	In	In	In
	–12 dBm	Out	Out	Out	Out	In
	–18 dBm	Out	Out	Out	In	Out
	–24 dBm	Out	Out	In	Out	Out
	–30 dBm	Out	In	Out	Out	Out
	–36 dBm	In	Out	Out	Out	Out
	–42 dBm	Out	Out	Out	Out	Out

2.4.2 Backplane

The line termination and interface options for the two channels on each modem board type are configured through minijumpers on the backplane. Figure 2-3 shows the jumper and connector locations.

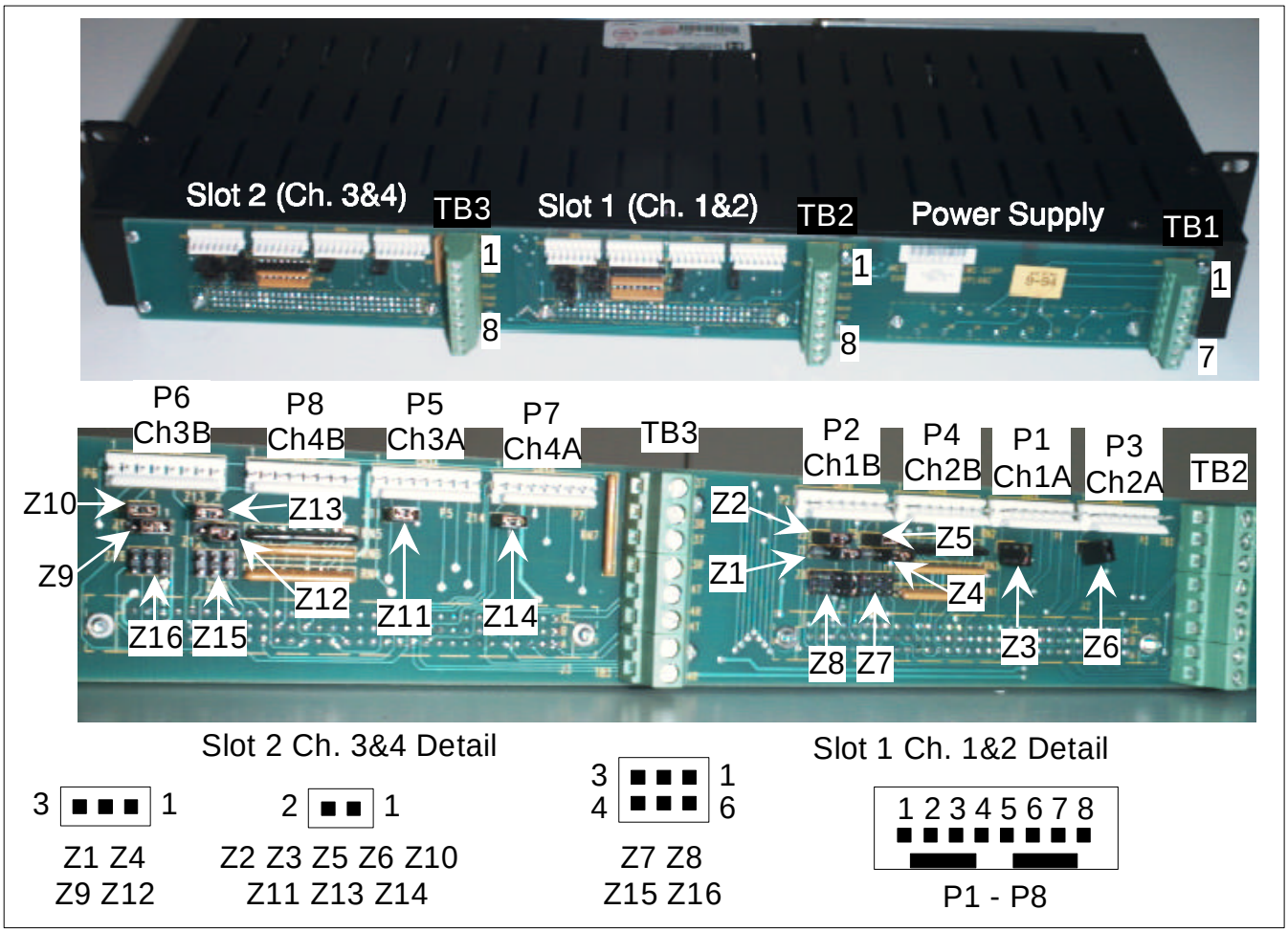

Figure 2-3 Backplane Connector and Jumper Locations

2.4.2.1 Jumper Functions

See Figure 2-3.

Z1 Sets RS-422/RS-485 or RS-232 on Channel 1, Modem Slot 1, in conjunction with Z7.

Z2 Terminates RTS line with 180-Ω resistor on Channel 1, Modem Slot 1.

Z3 Terminates Tx line with 180-Ω resistor on Channel 1, Modem Slot 1.

Z4 Sets RS-422/RS-485 or RS-232 on Channel 2, Modem Slot 1, in conjunction with Z8.

Z5 Terminates RTS line with 180-Ω resistor on Channel 2, Modem Slot 1.

Z6 Terminates Tx line with 180-Ω resistor on Channel 2, Modem Slot 1.

Z7 Sets RS-232 or RS-485 in conjunction with Z1; also sets constant/switched transmit carrier (digital side) and constant/switched receive carrier (analog side) on Channel 1, Modem Slot 1. Receive carrier options applicable to dual clock-recovery modem only.

Z8 Sets RS-232 or RS-485 in conjunction with Z4; also sets constant/switched transmit carrier (digital side) and constant/switched receive carrier (analog side) on Channel 2, Modem Slot 1. Receive carrier options applicable to dual clock-recovery modem only.

Z9 Sets RS-422/RS-485 or RS-232 on Channel 1, Modem Slot 2, in conjunction with Z15.

Z10 Terminates RTS line with 180-Ω resistor on, Channel 1, Modem Slot 2.

Z11 Terminates Tx line with 180-Ω resistor on, Channel 1, Modem Slot 2.

Z12 Sets RS-422/RS-485 or RS-232 on Channel 2, Modem Slot 2, in conjunction with Z16.

Z13 Terminates RTS line with 180-Ω resistor on Channel 2, Modem Slot 2.

Z14 Terminates Tx line with 180-Ω resistor on Channel 2, Modem Slot 2.

Z15 Sets RS-232 or RS-485 in conjunction with Z9; also sets constant/switched transmit carrier (digital side) and constant/switched receive carrier (analog side) on Channel 1, Modem Slot 2. Receive carrier options applicable to dual clock-recovery modem only.

Z16 Sets RS-232 or RS-485 in conjunction with Z12; also sets constant/switched transmit carrier (digital side) and constant/switched receive carrier (analog side) on Channel 2, Modem Slot 2. Receive carrier options applicable to dual clock-recovery modem only.

2.4.2.2 Backplane Default Settings

The factory installs the default option settings indicated in Table 2-7.

Table 2-7 Backplane Default Settings

Slot	Channel	Block/Pins	Function
1	1	Z1, 1–2	RS-422/RS-485
		Z2, 1–2	180-Ω Termination on RTS
		Z3, 1–2	180-Ω Termination on Tx
		Z7, 1–2	Constant Transmit Carrier
	2	Z4, 1–2	RS-422/RS-485
		Z5, 1–2	180-Ω Termination on RTS
		Z6, 1–2	180-Ω Termination on Tx
		Z8, 1–2	Constant Transmit Carrier
2	3	Z9, 1–2	RS-422/RS-485
		Z10, 1–2	180-Ω Termination on RTS
		Z11, 1–2	180-Ω Termination on Tx
		Z15, 1–2	Constant Transmit Carrier
	4	Z12, 1–2	RS-422/RS-485
		Z13, 1–2	180-Ω Termination on RTS
		Z14, 1–2	180-Ω Termination on Tx
		Z16, 1–2	Constant Transmit Carrier

2.4.2.3 Interface Standards

Each channel can operate with an RS-232 or an RS-422/RS-485 interface with switched or constant transmit carrier on the digital side. In addition, the receive carrier on the analog side (dual clock-recovery modems only) can be switched or constant.

Table 2-8 Interface Option Selections by Channel

Slot 1 Channel 1 ⇒ Z1 Channel 2 ⇒ Z4 Slot 2 Channel 3 ⇒ Z9 Channel 4 ⇒ Z12			Z7 Z8 Z15 Z16		
Interface	**1–2**	**2–3**	**1–6**	**2–5**	**3–4**
RS-232	Out	In	In (1)	Out	In
RS-422	In	Out	In (1)	Out	Out
RS-485	In	Out	In (1)	In (2)	Out

Notes:

5. Remove jumper to operate with Switched transmit carrier (digital side).

6. Position 2–5 selects RS-485 operation on a rate-adaption modem, but selects switched Rx carrier (analog side) on a dual clock-recovery modem.

2.4.2.4 Optional Modem Line Terminations

Optional terminating networks, for use in select RS-422 or RS-485 applications, are available through backplane jumpers, which install the networks across the differential receivers of a given line. Table 2-9 shows the details for installing the 180-ohm networks.

Table 2-9 RS-422/RS-485 Line Terminations

Slot	Channel	Signal	Block/Pin
1	1	RTS	Z2, 1–2
		Tx	Z3, 1–2
	2	RTS	Z5, 1–2
		Tx	Z6, 1–2
2	3	RTS	Z10, 1–2
		Tx	Z11, 1–2
	4	RTS	Z13, 1–2
		Tx	Z14, 1–2

2.4.2.5 Power Connections

Battery connections are for the –20 Vdc through –60 Vdc battery input to the power supply. Ground is for an earth ground connection and serves as reference for the power supply outputs.

Table 2-10 Input Power Connections

Voltage	Pin	Voltage	Pin
+Battery (Return)	TB1–1	+5 Vdc	TB1–5
–Battery (–48 Vdc Nominal)	TB1–2	+12 Vdc	TB1–6
Earth Ground	TB1–3, 4	–12 Vdc	TB1–7
Note: Normally TB1-3 through TB1-7 are not used. However, an external power supply can power the modem shelf if not equipped with a power supply in the left-most slot.			

2.5 Interface Connections

2.5.1 Modem Connectors and Cable

The following provides information regarding the type of connectors and cables to connect "the outside world" to the modems. Cables connecting to the dual/quad modem backplane must terminate in an 8-pin (straight) female connector, using either of the following assemblies:

- Westronic part numbers:
  - 8-pin connector: 620-0077
  - Connector insertion tool: 990-0150
- Methode part numbers:
  - Connector Body: 1300-108
  - Connector Pins: 1400-113
- Connector insertion tool: HC1001
- Cable:
  - RS-422 or RS-485: Standard 2-pair (4 wires), twisted, shielded (4,000 feet maximum) or unshielded (1,000 feet maximum), 24-AWG single- strand cable; synchronous connections can require 3-pair cable
  - RS-232: Standard 3-pair (6 wires), twisted, unshielded (50 feet maximum); 24-AWG single-strand cable

2.5.2 Dual Rate-Adaption Modem

Table 2-11 lists the backplane interface connections for the dual rate-adaption modem. Refer to Figure 2-3 for pin locations.

Note: Channels in RS-422/RS-485 applications have signals appearing across two plugs.

Table 2-11 Backplane Interface Connection for the Dual Rate-Adaption Modem, Slots 1 and 2

Slot	Chan	Plug	Intfc RS-	Methode Pin Number							
				1	2	3	4	5	6	7	8
1	1	P1	232	–	–	Gnd	Tx	RTS	Rx	DCD	CTS
			422/485	–	Tx+	–	Tx–	Rx+	Rx–	–	–
		P2	422/485	–	–	–	RTS+	–	–	RTS–	–
	2	P3	232	–	–	Gnd	Tx	RTS	Rx	DCD	CTS
			422/485	–	Tx+	–	Tx–	Rx+	Rx–	–	–
		P4	422/485	–	–	–	RTS+	–	–	RTS–	–
2	3	P5	232	–	–	Gnd	Tx	RTS	Rx	DCD	CTS
			422/485	–	Tx+	–	Tx–	Rx+	Rx–	–	–
		P6	422/485	–	–	–	RTS+	–	–	RTS–	–
	4	P7	232	–	–	Gnd	Tx	RTS	Rx	DCD	CTS
			422/485	–	Tx+	–	Tx–	Rx+	Rx–	–	–
		P4	422/485	–	–	–	RTS+	–	–	RTS–	–

2.5.3 Dual Clock-Recovery Modem

Table 2-12 lists the backplane interface connections for the dual clock-recovery modem. Refer to Figure 2-3 for pin locations.

Note: Dual clock-recovery channels in RS-232 or RS-422/RS-485 applications have signals appearing across two plugs.

Table 2-12 Backplane Interface Connections for the Dual Clock-Recovery Modem, Slots 1 and 2

Slot	Chan	Plug	Intfc RS-	Methode Pin Number							
				1	2	3	4	5	6	7	8
1	1	P1	232	–	–	Gnd	Tx	RTS	Rx	DCD	CTS
			422/485	–	Tx+	–	Tx–	Rx+	Rx–	–	–
		P2	232	–	TxC	–	–	–	RxC	–	–
			422/485	–	TxC+	TxC–	RTS+	RxC+	RxC–	RTS–	–
	2	P3	232	–	–	Gnd	Tx	RTS	Rx	DCD	CTS
			422/485	–	Tx+	–	Tx–	Rx+	Rx–	–	–
		P4	232	–	TxC	–	–	–	RxC	–	–
			422/485	–	TxC+	TxC–	RTS+	RxC+	RxC–	RTS–	–
2	3	P5	232	–	–	Gnd	Tx	RTS	Rx	DCD	CTS
			422/485	–	Tx+	–	Tx–	Rx+	Rx–	–	–
		P6	232	–	TxC	–	–	–	RxC	–	–
			422/485	–	TxC+	TxC–	RTS+	RxC+	RxC–	RTS–	–
	4	P7	232	–	–	Gnd	Tx	RTS	Rx	DCD	CTS
			422/485	–	Tx+	–	Tx–	Rx+	Rx–	–	–
		P8	232	–	TxC	–	–	–	RxC	–	–
			422/485	–	TxC+	TxC–	RTS+	RxC+	RxC–	RTS–	–

2.5.4 Modem Analog Line Backplane Connections

Table 2-13 Modem Line Backplane Connections

Signal	Slot 1		Slot 2	
	Chan 1	Chan 2	Chan 3	Chan 4
Rx+ (Tip)	TB2–1	TB2–5	TB3–1	TB3–5
Rx– (Ring)	TB2–2	TB2–6	TB3–2	TB3–6
Tx+ (Tip)	TB2–3	TB2–7	TB3–3	TB3–7
Tx– (Ring)	TB2–4	TB2–8	TB3–4	TB3–8

Note: Rx+/Rx– (Tip/Ring) are input signals and Tx+/Tx– (Tip/ Ring) are output signals. Two-wire connections use Tx+/Tx–.

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