Technical Manual
76.824462B-A
November 2, 1995

Practice Section 824462B
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4462B 4Wire 2Way Conference Bridge Module

CLEI code: BRGUTZ12*

Contents

1. General

1.1 The 4462B 4Wire 2Way Conference Bridge Module provides active bi-directional level control and impedance matching for two 4wire voice-frequency (VF) transmission facilities. When mounted in a Tellabs 24X Mounting Assembly, multiple 4462B modules establish a multi-port 4wire voice conference bridge.

1.2 When the module is used in a Tellabs 24X Mounting Assembly, incoming signals at the channel-1 receive in (RCV IN) port are cross-coupled to the channel-2 transmit out (XMT OUT) port, and those appearing at the channel-2 RCV IN port are cross-coupled to the channel-1 XMT OUT port. In addition, the VF signals appearing at the channel-1 and channel-2 receive ports are combined and coupled via the transmit right (TR) and transmit left (TL) pins of the 4462B to the voice conference bus of the 24X Assembly backplane. These conference buses transfer the combined VF signals to the receive right (RR) and receive left (RL) pins of the adjacent 4462B module used in the conference bridge. An option switch (or switches) disables the transfer of their combined VF signals to the left, right, or both, allowing for more than one discrete bridge to coexist within the same 24X Assembly.

1.3 For each 4wire channel of the 4462B, receive and transmit levels can be adjusted while the module is in place and operating. RCV IN levels from -23 to +7dBm can be set by means of front-panel rcv level controls without the use of a transmission measuring set (TMS). This is made possible by two front-panel LEDs that serve as overrange and underrange indicators. XMT OUT levels from -20 to +8dBm (based on internal bus levels) are set by means of front panel xmt level controls and are verified at the XMT OUT port. Front-panel bantam-type opening jacks facilitate alignment and maintenance procedures. Both channel-1 and channel-2 receive and transmit facility-side ports maintain constant input and output levels regardless of the terminating impedances selected. Sidetone at a typical -14.5dB level (re: internal bus level) can be introduced via switch option into each channel independently.

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1.4 Two types of amplitude equalization are available in the channel-1 and channel-2 receive paths for post-equalization of the incoming pairs. For loaded cable (LD), a compromise bump equalizer inserts a 3dB bump at 3200Hz (re: 1004Hz) and provides 1.5dB of roll-off at 404Hz (re:1004Hz). For nonloaded cable, an active prescription slope equalizer introduces from 0 to 7.5dB of gain at 2804Hz (re:1004Hz) in switch-selectable 0.5dB increments. Either or both equalizers can be inserted into a channel's receive signal path by means of front-panel switches. When both equalizers are used simultaneously, their effect upon the receive-path frequency response is additive. Because neither equalizer affects 1004Hz levels, equalization can be introduced not only before but after levels are set, with no interference between level and equalization adjustments.

1.5 The transformer-coupled transmit and receive facility-side ports in the module's two 4wire channels can be switched-optioned for balanced 1200, 600 or 150-ohm terminating impedance. For each channel, the given impedance switch setting provides the same terminating impedance for both of that channel's facility-side ports. All four transformers on the module are center-tapped to derive balanced simplex (SX) leads. As an alternative to normal SX-lead derivation, the module can be switch-optioned to apply 20mA of internally generated sealing current for both channel's facility-side ports independently. An integral "ZAP" feature provides a momentarily higher initial level of sealing current when the module is powered up. Front-panel LEDs light when the internal sealing-current option is selected. These are the same LEDs used to indicate receive levels when the front-panel test switch is set to ch1 or ch2 test.

1.6 An internally regulated power supply allows the 4462B to operate on filtered, ground-referenced -22 to -56VDC input power except when internally generated sealing current is selected for one or both channels, in which case input voltage must be -42 to -56VDC. Maximum current consumption at -48VDC is 40mA at idle, 75mA maximum without sealing current, and 117mA maximum with sealing current selected for both channels. The power supply features reverse-battery protection and transient-limiting circuitry, while a filter network minimizes noise and ripple.

1.7 The 4462B mounts in one position of a Tellabs 24X Mounting Assembly or in a Type 10 Mounting Shelf or apparatus case. The 24X Mounting Assembly is a pre-configured, connectorized printed circuit board (PCB) mounting shelf available in 19-inch and 23-inch versions. Type 10 shelves are available in several versions for relay rack and apparatus case installation. Up to 12 modules can be mounted across a 19-inch shelf or 24XA Assembly, while up to 14 modules can be mounted across a 23-inch shelf or 24XB Assembly. In either case, 6.125 inches of vertical rack space (e.g., 3.5 mounting spaces) is used.

Reason for Change

1.8 This practice is being reissued to delete all references to the 4462 module.

2. Applications

2.1 This module is designed for use on two 4wire VF transmission facilities, where it provides active bi-directional level control and impedance matching and establishes a common conference bridge arrangement when mounted in a Tellabs 24X Assembly. In addition, the 4462B also provides receive-path post-equalization for both 4wire facilities (channel-1 and channel-2). Within a 4462B module, the receive port of one 4wire channel is connected to the transmit port of the adjacent 4wire channel of the same module while maintaining minimum cross-coupling to the transmit port of its own associated 4wire channel. Therefore, each individual module establishes a dual 4wire conference bridge.

2.2 Multiple 4462B modules can be installed in a 24X or other Type 10 Mounting Assembly to provide voice-conferencing arrangements. Figure 2-1 shows a typical 4wire 6way voice-conferencing bridge configuration using three 4462B modules.

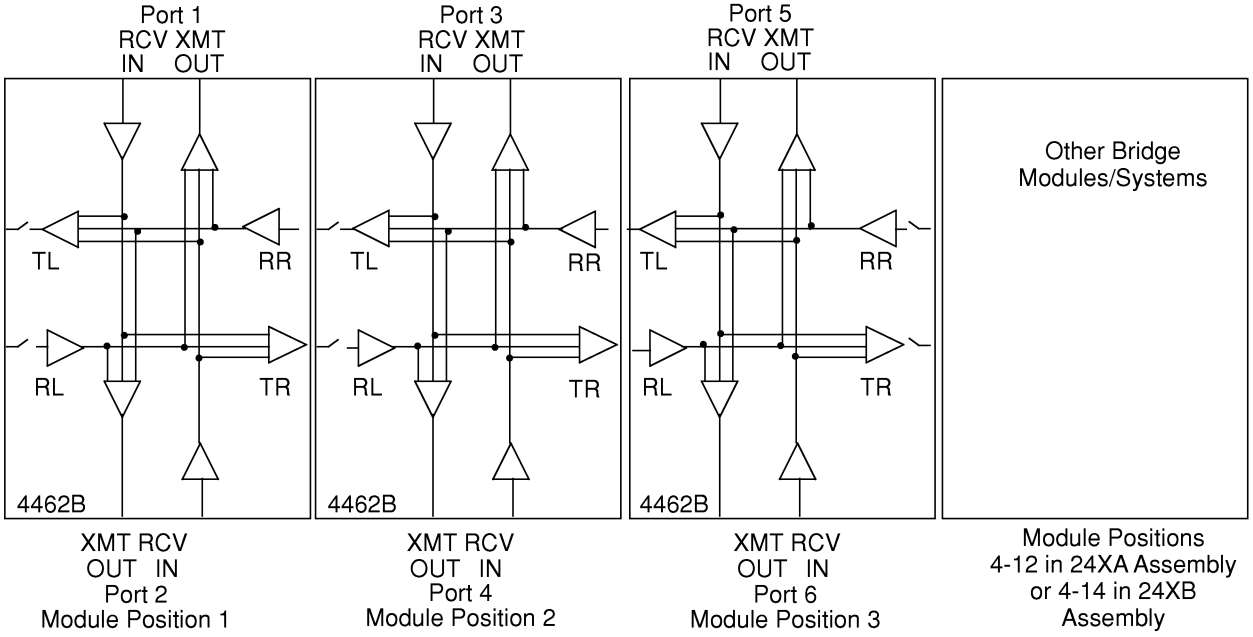


Figure 2-1 Typical 4Wire 6Way Conference Bridge Involving Three 4462B Modules in a Tellabs 24X Mounting Assembly

2.3 Levels at the receive and transmit ports of both 4wire channels are individually set via front-panel controls. The receive ports are arranged such that incoming VF signals, whose levels can range from -23 to +7dBm, are adjusted and transferred to the common conference buses at a predefined level. The transmit ports can be adjusted to provide transmission output levels of -20 to +8dBm. All ports are equipped with constant-power circuitry to ensure that input and output signal levels remain constant regardless of the selected terminating impedance. For example, levels that are set during alignment with 600 ohm module and test equipment settings will remain the same when the module's terminating impedance is changed to 150 or 1200 ohms.

2.4 Both the receive and transmit transmission levels, as well as the internal bus levels, can be quickly and easily adjusted with the 4462B module mounted in its normal operating position in the 24X Assembly or Type 10 Shelf. The only external test equipment required is a TMS at the distant end. The module's front-panel test switch, seal curr 1 and seal curr 2 LEDs and internal reference circuitry eliminate the need for local test equipment during level alignment. When the test switch is set to either the ch1 test or ch2 test position (for channel-1 or channel-2, respectively), the channel being aligned is removed from the bridge, and the seal curr 1 LED becomes an overrange indicator and seal curr 2 LED becomes the underrange indicator. The rcv level control is properly adjusted when both LEDs are off in channel-1 or channel-2 test mode. The transmit level is then adjusted to provide an appropriate level reading at the output port. After the levels for both channels are set, the test switch is reset to off, returning the module to normal service and reconfiguring the LEDs to serve their primary functions as sealing-current flow indicators.

Receive-Path Amplitude Equalization

2.5 Two switch-selectable modes of amplitude equalization are available for the receive path of each of the 4462B module's two 4wire channels. These modes are active prescription slope-type equalization for nonloaded cable and compromise bump-type equalization for loaded cable. Both equalization modes are described in detail as follows.

Note: Because the transmit path is generally used to coordinate levels rather than to reduce facility loss, no transmit equalization is available. Transmit equalization (i.e., pre-equalization) tends to amplify high-frequency signals to a level conducive to crosstalk. Receive equalization (i.e., post-equalization) not only eliminates this problem, but also expedites the equalization procedure because the circuit is easier to equalize at the receive end.

2.6 With active prescription slope equalization for nonloaded cable selected in a channel (front-panel channel-1 or channel-2 rcv eql ld switch set to out, i.e., away from ld), from 0 to 7.5dB of gain at 2804Hz (re:1004Hz) can be introduced in switch-selectable 0.5dB increments. Typical flatness achievable with the slope equalizer is ±0.3dB from 404 to 3200Hz (re:1004Hz). Typical frequency response of each channel's slope equalizer is shown in Figure 2-2 and in Table 2-1.

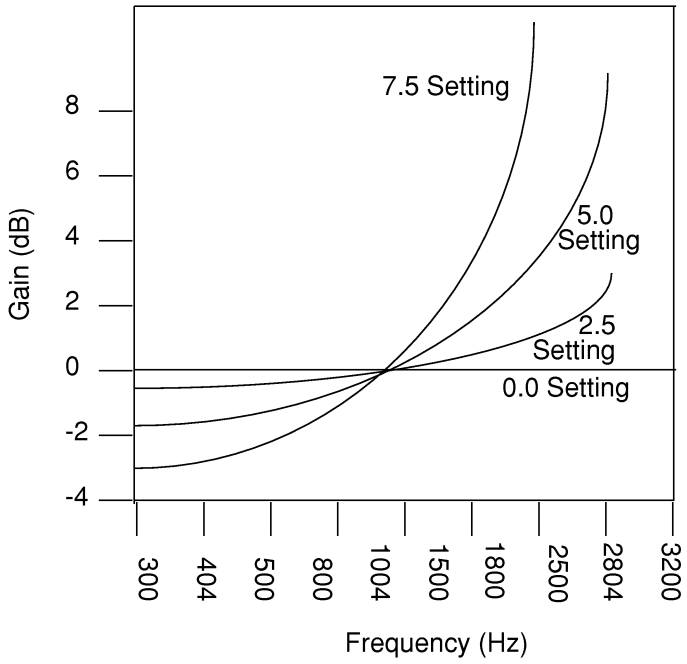


Figure 2-2 Typical 4462B Slope Equalization Response Curves

Slope Equalizer Switch Setting (dB), LD Switch Out	Equalization Gain (in dB) Introduced at Various Frequencies									
	300Hz	**404Hz**	**500Hz**	**800Hz**	**1004Hz**	**1500Hz**	**1800Hz**	**2500Hz**	**2804Hz**	**3200Hz**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5	-0.2	-0.2	-0.1	-0.1	0.0	+0.2	+0.3	+0.4	+0.5	+0.5
1.0	-0.3	-0.3	-0.3	-0.1	0.0	+0.4	+0.5	+0.9	+1.0	+1.1
1.5	-0.5	-0.5	-0.4	-0.2	0.0	+0.5	+0.8	+1.3	+1.5	+1.6
2.0	-0.7	-0.6	-0.5	-0.2	0.0	+0.7	+1.1	+1.8	+2.0	+2.2
2.5	-0.9	-0.8	-0.7	-0.3	0.0	+0.9	+1.4	+2.2	+2.5	+2.7
3.0	-1.1	-0.9	-0.8	-0.3	0.0	+1.1	+1.6	+2.7	+3.0	+3.3
3.5	-1.2	-1.1	-0.9	-0.4	0.0	+1.3	+1.9	+3.1	+3.5	+3.9
4.0	-1.5	-1.3	-1.2	-0.5	0.0	+1.3	+2.0	+3.4	+3.9	+4.4
4.5	-1.6	-1.5	-1.3	-0.5	0.0	+1.5	+2.3	+3.9	+4.4	+5.0
5.0	-1.8	-1.6	-1.4	-0.6	0.0	+1.6	+2.5	+4.3	+4.9	+5.6
5.5	-2.0	-1.8	-1.5	-0.6	0.0	+1.8	+2.8	+4.8	+5.5	+6.2
6.0	-2.2	-2.0	-1.7	-0.7	0.0	+1.9	+3.0	+5.2	+6.0	+6.9
6.5	-2.4	-2.1	-1.8	-0.8	0.0	+2.1	+3.2	+5.6	+6.5	+7.5
7.0	-2.6	-2.3	-2.0	-0.8	0.0	+2.2	+3.4	+6.0	+7.0	+8.2
7.5	-2.7	-2.5	-2.1	-0.9	0.0	+2.3	+3.6	+6.4	+7.5	+8.9

Table 2-1 Typical 4462B Slope Equalization Frequency Response

2.7 With compromise bump equalization for loaded cable selected in a channel (front-panel channel-1 or channel-2 rcv eql ld switch set to in, i.e., toward ld), a 3dB bump is inserted at 3200Hz (re:1004Hz) and 1.5dB of roll-off is provided at 404Hz (re:1004Hz). Typical frequency response of each channel's compromise bump equalizer is shown in graphic form in Figure 2-3 and in tabular form in Table 2-2.

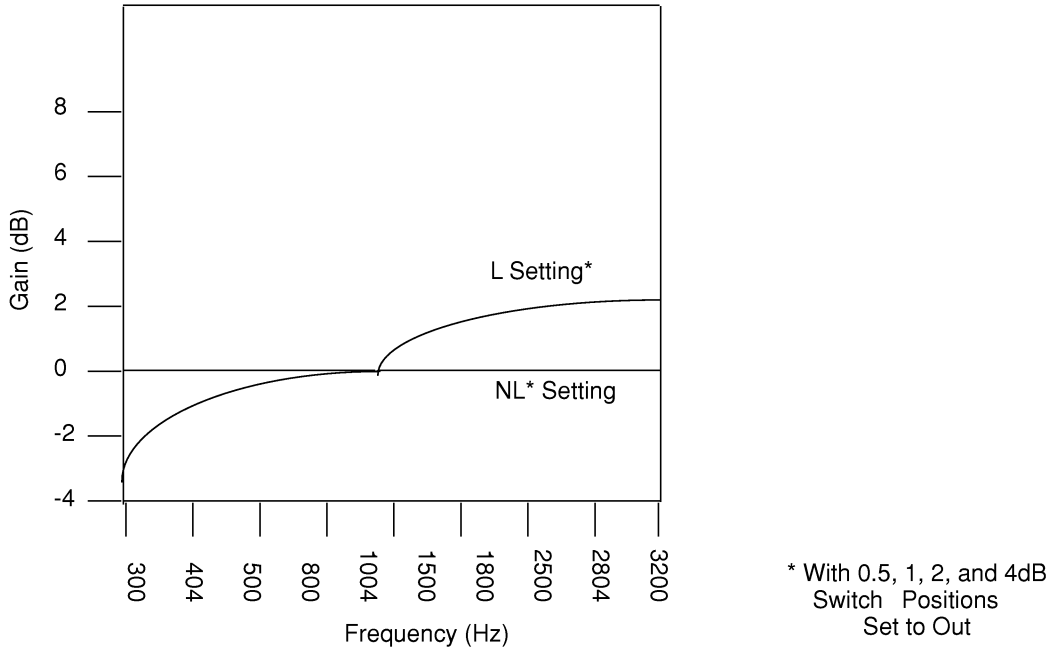


Figure 2-3 Typical 4462B Compromise Bump Equalization Response Curves

Front-Panel ld Switch Setting	Equalization Gain (in dB) Introduced at Various Frequencies									
	300Hz	404Hz	500Hz	800Hz	1004Hz	1500Hz	1800Hz	2500Hz	2804Hz	3200Hz
Out	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ld	-2.5	-1.5	-0.9	-0.2	0.0	+0.2	+0.3	+0.6	+1.1	+3.1

Table 2-2 Typical 4462B Compromise Bump Equalization Frequency Response

2.8 For each channel, the response curves of both the slope equalizer and the bump equalizer "pivot" at 1004Hz, as shown in Figure 2-2 and Figure 2-3. Therefore, neither equalizer has any effect on 1004Hz levels. As a result, equalization can be introduced not only before but also after receive levels are set, with no interference between level and equalization adjustments.

2.9 It is possible to introduce both modes of equalization into a channel simultaneously. If this is done, the resulting equalized gain at any frequency is the sum of the gain introduced by each equalizer at that frequency, as listed in Table 2-1 and Table 2-2. For example, if both equalizers are used and the slope equalizer is set for 3.5dB of gain at 2804Hz (re:1004Hz), the total amount of equalized gain at 800Hz is -0.6dB, which is the sum of -0.4dB (from Table 2-1) and -0.2dB (from Table 2-2). As a second example, with the same slope equalizer setting, the amount of equalized gain introduced by both equalizers at 1800Hz is +2.2dB, which is the sum of +1.9dB (from Table 2-1) and +0.3dB (from Table 2-2). Please note that even if both equalizers are used, there is no effect upon 1004Hz levels, as explained in paragraph 2.8).

Note: Tellabs recommends that if both equalizers in a channel are used simultaneously, only a small amount of slope equalization be introduced. Large amounts may cause instability in the form of ringing or oscillation.

Impedance Matching

2.10 The impedance-matching transformers at the facility-side receive and transmit ports of both 4wire channels of the 4462B can be switch-optioned for balanced 1200, 600, or 150 ohm terminating impedances. For each channel, this impedance selection is separate and independent. A given impedance setting, however, affects both facility-side ports of a channel. The 1200 ohm option is used for interface with loaded cable; the 600 ohm option for interface with nonloaded cable or carrier; and the 150 ohm option, to provide a small amount of slope equalization for long sections of nonloaded cable through the deliberate impedance mismatch. In addition, each of the four impedance-matching transformers is center-tapped to derive a balanced SX-lead.

Sealing Current

2.11 Option switches on the 4462B select either internally-generated sealing current or normal SX-lead derivation independently for each channel's facility-side ports. When internal sealing current is selected for a channel, 20mA of sealing current flows from that channel's XMT OUT ports and returns via the channel's RCV IN ports. A ZAP feature integral to the 4462B's sealing current supply provides a momentarily higher level of current to eliminate existing oxidation or corrosion when the sealing current option is initially activated. Front-panel LEDs function as sealing current flow indicators (seal curr 1 and seal curr 2; the same used in the level-alignment procedure).

Sidetone

2.12 Sidetone at a typical -14.5dB level (re: internal bus level) can be independently selected for each 4wire channel via switch option, if required.

3. Installation

Inspection

3.1 Visually inspect the 4462B module upon its arrival to detect any possible damage incurred during shipment. If damage is noted, immediately file a claim with the carrier. If the module is stored, reinspect both the module(s) and the mounting assembly prior to installation.

Mounting

3.2 The 4462B mounts in one position of a Tellabs 24X Mounting Assembly or in one position of a Type 10 Mounting Shelf or apparatus case. When a 24X Assembly is used, the bypass switch on the assembly backplane must be set to OFF at each module position containing a 4462B. A switch option on the 4462B enables or disables extension of the common conference bridge to the module positions to the left and right of the 4462B's own position in the 24X Assembly.

Installer Connections

3.3 If the 4462B module is to be installed in a 24X Assembly, no intermodule connections to the module need be made because the assembly is internally prewired to accommodate multiple 4462B modules without additional wiring. All external connections to the assembly itself are made quickly and easily via 25-pair male cables. Refer to the Tellabs 24X Mounting Assembly practice for details.

Note: At each 24X Assembly module position that houses a 4462B, the bypass switch at the rear of the module position must be set to OFF.

3.4 If the 4462B is to be installed in an unwired Type 10 Shelf, all required connections to the module must be made. Before doing so, ensure that power is off and modules are removed. The module should be put into place only after it is properly optioned and after wiring is completed.

3.5 Table 3-1 lists external connections to the 4462B. If the module is to be installed in a Type 10 Shelf, all connections are made via wire-wrapping to the 56-pin connector at the rear of the module's shelf position. Pin numbers are found on the body of the connector.

Connect:	To Pin:
CH1 RCV Tip	7
CH1 RCV Ring	13
CH1 RCV SX	44
CH1 XMT Tip	41
CH1XMT Ring	47
CH1 XMT SX	48
CH2 RCV Tip	9
CH2 RCV Ring	43
CH2 RCV SX	8
CH2 XMT Tip	45
CH2 XMT Ring	49
CH2 XMT SX	14
TR (Conference Bus XMT Right)	19
RR (Conference Bus RCV Right)	31
TL (Conference Bus XMT Left)	27
RL (Conference Bus RCV Left)	23
-BATT (-22 to -56VDC Without Sealing Current, -42 to -56VDC With Sealing Current)	35
GND (Ground)	17

Table 3-1 External Connections to 4462B

Optioning and Alignment

3.6 Optioning and alignment of the 4462B is comprised of the following for each of the module's two 4wire channels:

- Selecting the terminating impedance at the facility-side receive and transmit ports
- Adjusting the receive and transmit levels
- Enabling or disabling sidetone
- Selecting sealing current or SX leads
- Setting the bridge-expansion switch
- Adjusting the receive-channel equalization

3.7 Instructions for optioning and aligning the module are provided below. Locations of the option and alignment switches on the module are shown in Figure 3-1.

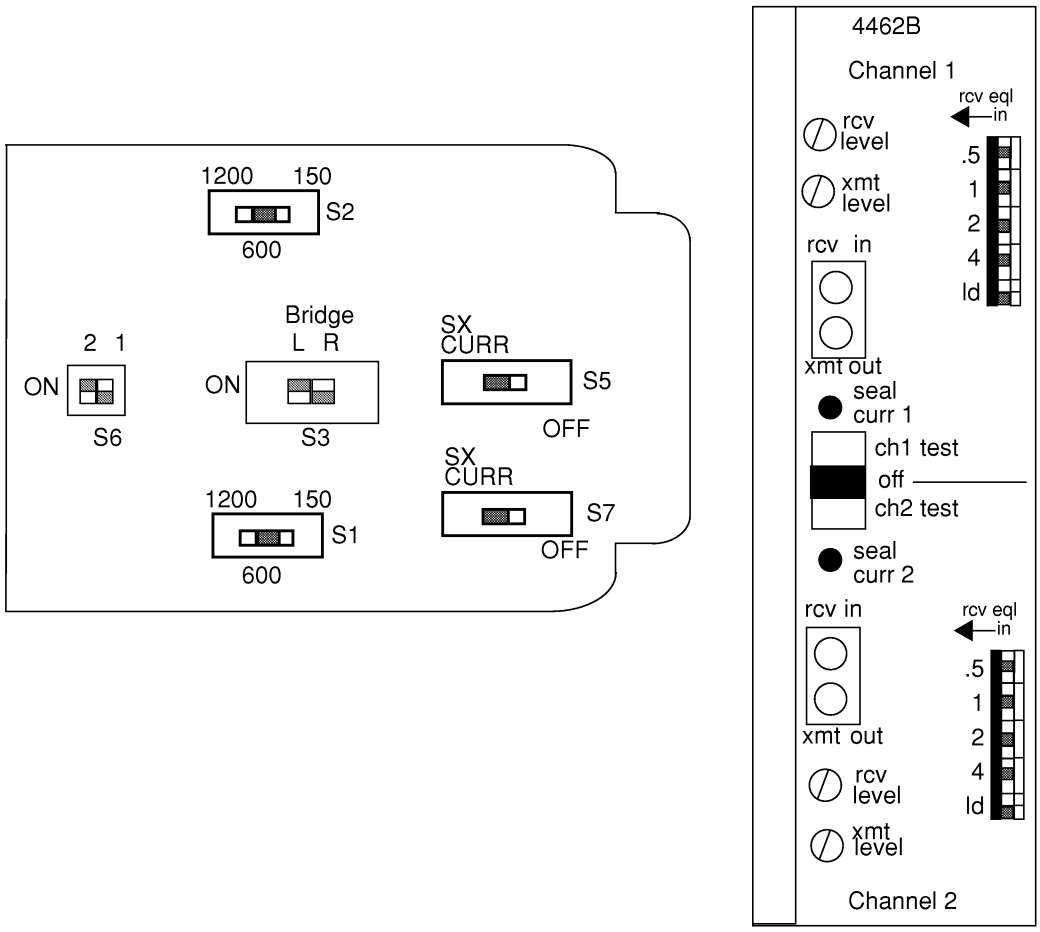


Figure 3-1 4462B Option Switch Locations and Front-Panel Switches and Controls

Terminating Impedances

3.8 Terminating impedances at the 4462B's channel-1 and channel-2 facility-side ports are selected via switches S2 and S1, respectively. While a choice of 1200, 600, or 150 ohms is available in channels 1 and 2 independently, the single impedance switch for each channel selects the same impedance at both facility-side ports (receive and transmit) in that channel. Set switches S2 (channel-1) and S1 (channel-2) as follows:

- For 1200 ohms, as is normally required for interface with loaded cable, set S2 and/or S1 to 1200.
- For 600 ohms, as is normally required for interface with nonloaded cable or carrier, set S2 and/or S1 to 600.

- For 150 ohms, which provides a small amount of slope equalization for nonloaded cable through the deliberate impedance mismatch, set S2 and/or S1 to 150.

Sidetone

3.9 Provision of sidetone is controlled by two-position DIP switch S6. Set this switch as follows:

- For sidetone in channel-1, set position 2 of S6 to ON. If sidetone is not required in channel-1, set S6-2 to OFF.
- For sidetone in channel-2, set position 1 of S6 to ON. If sidetone is not required in channel-2, set S6-1 to OFF.

Bridge Expansion

3.10 Although each 4462B by itself establishes a dual 4wire conference bridge, the bridge size in a 24X Assembly can be expanded as required to a maximum of all 4462B modules in the assembly. Bridge size is controlled by the two-position Bridge DIP switch, S3, on each 4462B in the assembly. Switch S3-1 determines whether or not the 4462B interfaces the module located directly to its left in the shelf (as viewed from the front). Setting the switch to ON enables the interface; OFF disables it. Switch S3-2 performs the same function but affects the module to the right. Thus, any number of the modules (up to 12 in a 19-inch assembly and up to 14 in a 23-inch assembly) can be used to form an expanded bridge. In addition, switch S3 allows a number of separate and independent conference bridges to coexist within the same 24X Assembly. For example, the 4wire 6way conference bridge shown in Figure 2-1 is arranged by using three 4462B modules with their Bridge switches arranged as follows:

- Module position A: S3-1 OFF, S3-2 ON for interface to the right only
- Module position B: S3-1 ON, S3-2 ON for interface to both the left and the right
- Module position C: S3-1 ON, S3-2 OFF for interface to the left only

3.11 In your particular application, option each 4462B module as required for its position as part of a bridge in the 24X Assembly.

Sealing Current/SX Leads

3.12 Switches S5 and S7 select, for channels 1 and 2 respectively, either SX leads or sealing current on the 4462B's facility side. Set these switches as follows:

- For 20mA of internally generated sealing current on the facility side of channel-1, set switch S5 to the SX CURR position. For access to channel-1's facility-side SX leads, or if sealing current is not required for channel-1, set S5 to OFF.
- For 20mA of internally generated sealing current on the facility side of channel-2, set switch S7 to the SX CURR position. For access to channel-2's facility-side SX leads, or if sealing current is not required for channel-2, set S7 to OFF.

Alignment: Level Adjustment

3.13 The receive ports of the 4462B can accept transmission input levels from -23 to +7dBm, and the transmit ports can provide transmission output levels from -20 to +8dBm. After ensuring that the module is properly optioned, install it in its mounting position, apply power, and adjust the receive and transmit levels as directed below. Although the following procedure covers only channel-1 alignment, it is equally applicable to channel-2 alignment.

Note: When aligning channel-2, the front-panel test switch must be set to the ch2 test position in Step 2.

1. Set all five positions of the channel-1 rcv eql DIP switch to out for no equalization at this time.
2. Set the front panel test switch to the ch1 test position.

3. Adjust the front-panel channel-1 rcv level and xmt level controls fully counterclockwise (CCW). The seal curr 2 LED should now be on.
4. Request personnel at the distant end of the channel-1 facility to send 1004Hz test tone at the output level specified on the circuit layout record (CLR) for that end. As an alternate method, the module's front-panel rcv in and xmt out jacks can be used in conjunction with local test equipment to insert tone and measure levels.
5. Adjust the rcv level control clockwise (CW) until the seal curr 2 LED goes off, but not far enough CW to cause the seal curr 1 LED to go on. The incoming signal is now properly adjusted to the predefined bus level.
6. Now adjust the xmt level control until the level of the signal returned to the distant end equals the CLR-specified input level for that end.

Alignment: Equalization Adjustment

3.14 To adjust the receive path equalization on the 4462B, proceed as directed below. Although the following procedure covers only channel-1 alignment, it is equally applicable to channel-2 alignment.

Note: When aligning channel-2, the front panel test switch must be set to the ch2 test position.

Loaded-Cable Equalization

1. If the channel-1 facility consists of loaded cable and compromise bump equalization is desired, set the ld position of the front panel channel-1 rcv eql DIP switch to in (toward ld). This provides the frequency response curve indicated in Table 2-2. If desired, this curve can be altered by setting one or more of the dB-value positions of the channel-1 rcv eql DIP switch to in. If no equalization is desired, set all five positions of the channel-1 rcv eql DIP switch to out.

Nonloaded-Cable Equalization

2. If the channel-1 facility consists of nonloaded cable, set the ld position of the front panel channel-1 rcv eql DIP switch to out (away from ld).
3. Arrange the receive portion of a TMS for 600 ohm terminated measurement and connect it to the module's front-panel channel-1 rcv in jack.
4. Request personnel at the distant end of the channel-1 facility to send 1004Hz tone and 2804Hz tone, both at the CLR specified output level for that end. Measure and record the level at which each tone is received.
5. Subtract the 2804Hz level measure in Step 4 from the 1004Hz level (also measured in Step 4).
6. If the difference calculated in Step 5 is 0.3dB or greater, set to in the proper combination of channel-1 rcv eql dB-value DIP-switch positions that most closely approximates this difference, as directed in Table 3-2. If no equalization is required, set all five positions of the channel-1 rcv eql DIP switch to out.

1004Hz-2804Hz Difference	Amount of Equalized Gain Required
0.0 to 0.2dB	0.0dB
0.3 to 0.7dB	0.5dB
0.8 to 1.2dB	1.0dB
1.3 to 1.7dB	1.5dB
1.8 to 2.2dB	2.0dB
2.3 to 2.7dB	2.5dB
2.8 to 3.2dB	3.0dB
3.3 to 3.7dB	3.5dB
3.8 to 4.2dB	4.0dB
4.3 to 4.7dB	4.5dB
4.8 to 5.2dB	5.0dB
5.3 to 5.7dB	5.5dB
5.8 to 6.2dB	6.0dB
6.3 to 6.7dB	6.5dB
6.8 to 7.2dB	7.0dB
7.3 to 7.7dB	7.5dB

Table 3-2 Receive Equalization Settings From Cable Loss Data

4. Circuit Description

4.1 This circuit description is intended to familiarize you with this module for engineering and application purposes only. Attempts to test or troubleshoot the 4462B internally are not recommended and may void your Tellabs warranty. Procedures for recommended testing in the field are limited to those described in Section 8. To help you follow this circuit description, refer to the block diagram in Section 5.

Overview

4.2 The 4462B contains circuitry to interface two 4wire VF facilities (channel-1 and channel-2). Level control and impedance matching are provided for the receive and transmit ports of each 4wire VF channel. Receive path post-equalization is available for loaded or nonloaded cable. The 4462B also contains test and level-detection circuitry, sidetone circuitry, summing and buffer amplifiers for busing, an internal sealing current source, and a power supply. Each of these is described throughout the remainder of this section.

Power Supply

4.3 The power supply in the 4462B is a series voltage regulator that uses a zener diode as a reference source. A series diode in the negative input lead protects the circuit against reversed power connections, and a metal-oxide varistor between input battery and ground limits high-level supply transients to a safe level.

Sealing Current and SX Leads

4.4 Switch S5 selects either internally-generated sealing current or balanced SX-lead derivation for channel-1. Switch S7 does the same for channel-2. When the internal sealing current supply is selected for a channel, current at 20mA (nominal) is fed to the external 4wire facility via the XMT OUT port and returns to the module via the RCV IN port. A ZAP feature provides a greater level of sealing current (34 to 51mA) for approximately 1 second when power is initially applied to the module. Sealing-current flow is indicated by two front-panel LEDs (one for each channel).

Receive Ports and Facility-Side Impedance Matching

4.5 The 4462B interfaces the 4wire facilities via channel-1 and channel-2 constant impedance transformers, each of which is center-tapped to derive a balanced SX-lead. A silicon transient suppressor is provided on the secondary of each transformer. Both facility-side transformers in each channel can be switch-optioned for balanced 1200, 600 or 150 ohm terminating impedance.

Receive Level Control

4.6 Operational-amplifier integrated circuits (op-amp ICs) provide voltage gain at the receive ports. Each channel's voltage-gain stage (volt amp) uses negative feedback to enhance amplifier stability and setability, and gain is adjusted by varying the negative feedback. This approach to gain control provides, in addition to optimum gain setability, optimum output signal-to-noise performance. Gain in each channel is adjusted via a front-panel control over a 30dB (-23 to +7dB) range. Either or both channels' receive paths can be optioned to provide sidetone at a typical -14.5dB level (re: internal bus level).

Receive Amplitude Equalization

4.7 On the 4462B module, the secondary windings at each receive port feed a series-connected equalization amplifier that offers switch-selectable compromise bump-type and/or active prescription slope-type amplitude equalization.

Transmit Ports

4.8 Like the receive ports, each of the 4462B's transmit ports uses a constant-power output transformer to interface the external facilities and to derive SX-leads.

Transmit Level Control

4.9 A voltage-gain amplifier (volt amp) similar to that at the receive ports is used to give each transmit port a 28dB (-20 to +8dB) output level range. This amplifier then drives a push-pull output driver that provides the increase in current required by the output transformer.

Summing and Buffer Amplifiers

4.10 Summing amplifiers (sum amps) are also provided on the 4462B. Signals from the receive ports are brought into these amplifiers and are passed to the conference buses and to the opposite channel transmit port. Signals from the conference buses also enter these amplifiers and are passed to the transmit ports. The summing amplifiers are op-amp ICs with the amplifier loop gain set to unity. The summing amplifiers, along with two buffer amplifiers (buffer amps), isolate the transmit-port and receive-port voltage-gain amplifiers (volt amps) from the conference buses.

Test and Level-Detection Circuitry

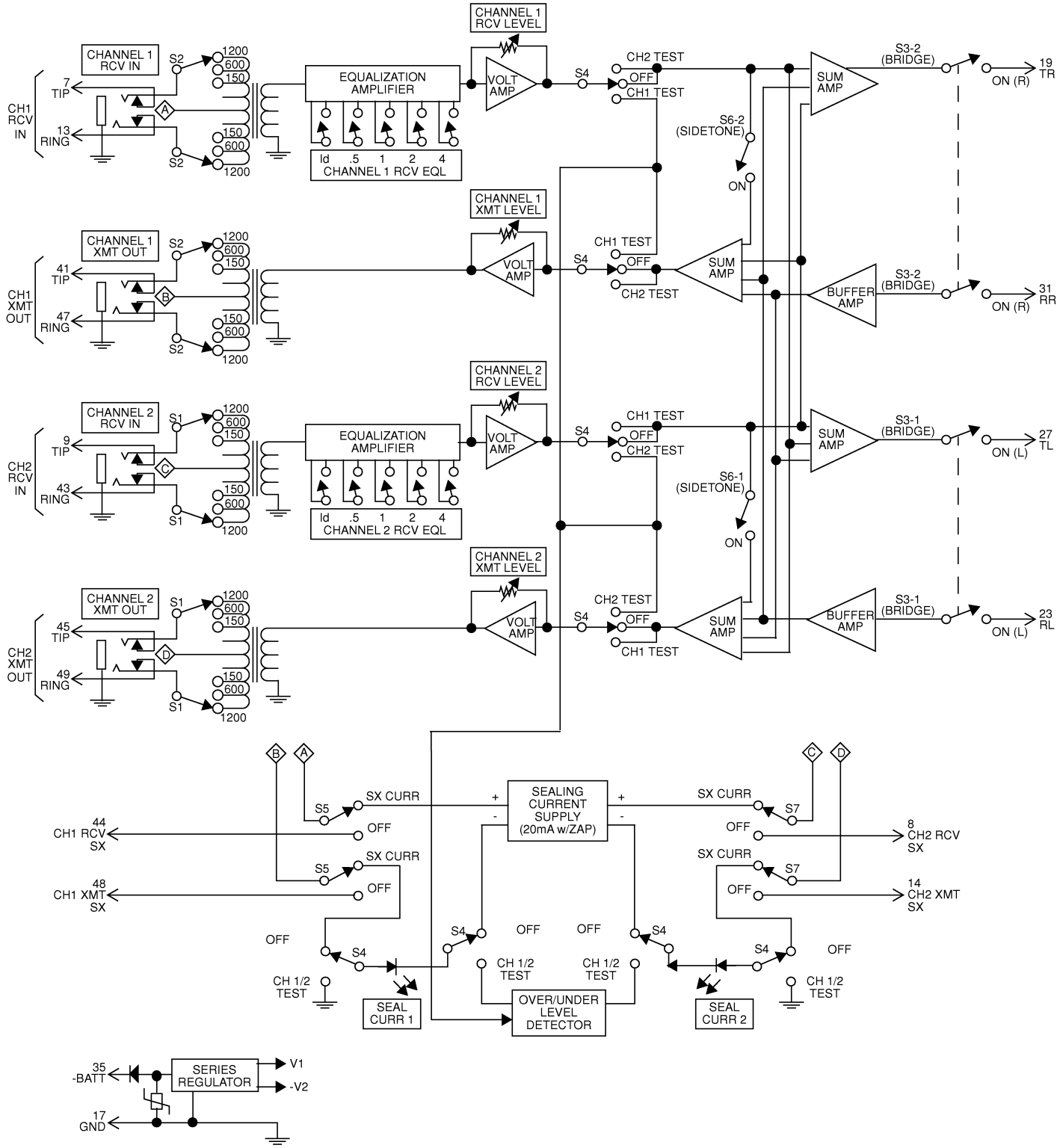
4.11 Level-detection circuitry (over/under level detector) is provided on the 4462B as an aid in circuit alignment and to maintain a constant conference bus level. When the front-panel test switch is set to either the ch1 test or ch2 test position, the level-detection circuit is active. This switch also isolates the selected channel from the conference and connects its receive and transmit ports to allow setting of gain and equalization. The same switch also conditions the sealing-current LEDs (seal curr 1 and 2) to function as part of the level-detection circuitry.

4.12 Two sections of a quad op-amp IC are used for the level-detection circuit. These amplifiers serve as voltage comparators with a window approximately 0.5dB wide at -13dBm. Each voltage comparator drives one of the sealing-current LEDs to give an overrange (seal curr 1) or underrange (seal curr 2) indication.

Test Jacks

4.13 Bantam-type opening jacks are provided at the facility-side ports (RCV IN and XMT OUT) of both 4wire channels. To facilitate testing and alignment, each of these jacks isolates the module from the facility when a plug is inserted into the jack.

5. Block Diagram



6. Specifications

Receive Port, Channel-1 and Channel-2

Input Impedance	• 1200 ohms ± 10%, 600 ohms ± 10%, or 150 ohms ± 15%, switch-selectable
SX Current (Sink)	• 120mA maximum, 5mA maximum unbalanced
Input Signal Range	• -23 to +7dBm
Sidetone Level	• Typical -14.5dB re: internal bus level, switch-selectable for either or both channels
Frequency Response (No Equalization)	• + 0.5dB, 300 to 4000Hz (re: 1004Hz)
Receive Equalization	• Prescription slope-type: 0.0 to 7.5dB of gain (in switch-selectable 0.5dB increments) at 2804Hz re: 1004Hz • Compromise bump-type: 3.0dB bump at 3400Hz re: 1004Hz and 1.5dB loss at 404Hz re: 1004Hz • Additive mode: If both equalizers are used simultaneously, the results are additive: at a given frequency, the amount of equalization provided is the sum of the amounts listed in Table 2-1 and Table 2-2

Transmit Port, Channel-1 and Channel-2

Output Impedance	• 1200 ohms ± 10%, 600 ohms ± 10%, or 150 ohms ± 15%, switch-selectable
SX Current (Sink)	• 120mA maximum, 5mA maximum unbalanced
Output Signal Range	• -20 to +8dBm (with internal bus aligned)
Frequency Response	• ± 0.5dB, 300 to 4000Hz (re:1004Hz)
Noise	• 20dBrnC maximum
Total Harmonic Distortion	• Less than 1% at +8dBm level
Crosstalk Loss Between Receive and Transmit Ports of Same 4Wire Channel	• Greater than 57dB at 1000Hz • Greater than 50dB at 3000Hz

Common

Internal Sealing Current Source	• 20 ± 6mA for loop resistances of 0 to 2500 ohms when module is powered by -48VDC, switch-selectable for either or both channels; integral ZAP feature provides momentarily higher current upon initial sealing-current activation.
Input Voltage	• Without internal sealing-current option activated: -22 to -56VDC, filtered, ground referenced • With internal sealing-current option activated: -42 to -56VDC, filtered, ground referenced
Maximum Input Current (at -48VDC)	• 40mA at idle, 75mA at maximum input and output levels (both channels active), with an additional 42mA required with sealing current flowing in both 4wire facilities
Operating Environment	• +32° to +122° F (0° to +50° C), humidity to 95% (no condensation)
Dimensions	• 5.58 inches (14.17cm) high • 1.42 inches (3.61cm) wide • 5.96 inches (15.14cm) deep
Weight	• 14 ounces (397 grams)
Mounting	• Relay rack via one position of a Tellabs 24X Mounting Assembly or one position of a Tellabs Type 10 Mounting Shelf

7. Acronyms

CLR	Circuit Layout Record
CCW	Counter Clockwise
CW	Clockwise
HZ	Hertz
IC	Integrated Circuit
LD	Loaded Cable
LED	Light-emitting Diode
PCB	Printed Circuit Board
RCV	Receive
RL	Receive Left
RR	Receive Right
SX	Simplex (Lead)
TL	Transmit Left
TMS	Transmission Measuring Set
TR	Transmit Right
VF	Voice Frequency
VOM	Volt-Ohm Meter
XMT	Transmit

8. Testing, Technical Assistance, Repair and Return

8.1 The following Testing Guide will assist in the installation, testing, or troubleshooting of the 4462B module and will aid in the localization of trouble to this specific equipment. If technical assistance is required, refer to paragraph 8.2. If the equipment seems to be defective, substitute new equipment (if possible) and conduct the test again. If the substitute operates correctly, the original should be considered defective and returned to Tellabs for repair or replacement (see paragraph 8.3). We strongly recommend that no internal (component-level) testing or repairs be attempted on the equipment; unauthorized testing or repairs may void its warranty.

Test	Test Procedure	Normal Result	If Normal Conditions are Not Met, Verify:
Receive Path (Bus Level Adjustment)	Set test switch to ch1 test or ch2 test for channel being tested. Arrange xmt portion of TMS for 1004Hz tone output at -10dBm and at facility-side port impedance selected on module. Connect this signal to rcv in jack of channel under test. Adjust rcv level control of channel under test until both seal curr LEDs are off.	As rcv level control is adjusted, both seal curr LEDs go off.	• Power • Wiring • Test switch properly set • Terminating impedance correct
Transmit Path Level Adjustment	Set test switch to ch1 test or ch2 test for channel being tested. Leave xmt portion of TMS arranged and connected as above. Arrange rcv portion of TMS for terminated measurement at facility-side port impedance selected on module, and connect it to xmt out jack of channel under test. Adjust xmt level control of channel under test fully CW and CCW. Observe TMS level readings at both control settings.	With xmt level control fully CW, xmt output level is greater than + 10dBm. With xmt level control fully CCW, xmt output level is below -20dBm.	• Power • Wiring • Test switch properly set • Terminating impedance correct • Rcv level control set as directed above
Receive Path Equalization, Bump-Type for Loaded Cable	Maintain all TMS connections as above. Set all rcv eql dB-value switches of channel under test to out. Set rcv eql ld switch of channel under test to in (toward ld). Arrange xmt portion of TMS for tone output of 404, 1004 and 2804Hz, all at 0dBm. Observe TMS level reading at all three frequencies.	TMS level readings should be as follows: • Approx. -1.5dBm at 404Hz • Approx. 0dBm at 1004Hz • Approx. +1.1dBm at 2804Hz	• Power • Wiring • Terminating impedances correct • Slide rcv eql dB-value and ld switches back and forth to clean contact surfaces • Impedance options correctly set • Input signal level (from TMS) constant over test range • Output level not exceeding +8dBm overload point

Continued on Next Page

Test	Test Procedure	Normal Result	If Normal Conditions are Not Met, Verify:
Continued			
Receive Path Equalization, Prescription Slope for Non-loaded Cable	Maintain all TMS connections as above. Set all rcv eql dB-value switches of channel under test to out. Set rcv eql ld switch of channel under test to out (away from ld). Arrange xmt portion of TMS for tone output of 404, 1004 and 2804Hz, all at 0dBm. Observe TMS level reading at all three frequencies.	TMS level readings should be as follows: • Approx. -2.7dBm at 404Hz. • Approx. 0dBm at 1004Hz • Approx. +7.3dBm at 2804Hz	• Same as above
Sealing Current	Set front panel test switch to off. Arrange Volt-Ohm Meter (VOM) to measure up to 50mA. With channel under test optioned for sealing current, connect VOM between that channel's xmt out and rcv in jacks.	VOM indicates approximately 20mA	• Switch S5 (channel-1) or S7 (channel-2) set to SX CURR • Test switch set to off • Replace module and retest

Technical Assistance

8.2 Contact Tellabs Technical Assistance as follows:

Location	Telephone	FAX
Tellabs International, Inc., Sucursal Buenos Aires, **Argentina**	+541.393.0764, .0892, or .0835	+541.393.0732
Tellabs Pty Ltd., Milsons Point NSW, Sydney, **Australia**	+61.2.9966.1043	+61.2.9966.1038
Tellabs Canada Ltd., Mississauga, Ontario, **Canada**	905/858-2058	905/858-0418
Tellabs International, Inc., Beijing, **China**	+86.10.501.1873	+86.10.501.1871
Tellabs International, Inc., **Dubai, U.A.E.**	+971.4.373250	+971.4.376526
Tellabs U.K. Ltd., Bucks, **England**	+44.1494.555800	+44.1494.555801
Martis Oy, Espoo, **Finland**	+358.0.502.771	+358.0.502.7815
Tellabs GmbH, Munich, **Germany**	+49.89.212133.0	+49.89.212133.20
Tellabs H.K. Ltd., **Hong Kong**	+852.2866.2983	+852.2866.2965
Tellabs GmbH Rep. Office, **Hungary**	+36.1.268.1220	+36.1.268.1222
Tellabs International, Inc., Bangalore, **India**	+91.80.6610826	+91.80.6615908
Tellabs, Ltd., County Clare, **Ireland**	+353.61.471433	+353.61.471000/472004
Tellabs de **Mexico**	525.282.1107, .1432, .1050, or .0981	525.282.0218
Tellabs Singapore Private, Ltd., **Singapore**	+65.736.2855	+65.736.1231
Tellabs International, Inc., Seoul, **South Korea**	+82.2.589.0667 or .0668	+82.2.589.0669
Tellabs Southern Europe s.a., Barcelona, **Spain**	+34.3.414.70.16	+34.3.414.69.25
Tellabs International, Inc., Stockholm, **Sweden**	+46.8.678.4040	+46.8.678.4041
Tellabs International, Inc., Bangkok, **Thailand**	+662.262.9065	+662.661.1141
USA and **Puerto Rico**	(800) 443-5555*	708/512-7097
*All other **Caribbean** and **South American** locations, or if the toll-free number is busy, telephone 708/969-8800		

Repair and Return

8.3 If equipment needs repair, contact Tellabs' Product Services Department with the equipment's model and issue numbers and warranty date code. You will be issued a Material Return Authorization (MRA) number and instructions on how and where to return the equipment.

Location	Telephone	FAX
Martis Oy, Espoo, **Finland**	+358.0.502.771	+358.0.502.7815
Tellabs Canada Ltd., Mississauga, Ontario, **Canada**	905/858-2058	905/858-0418
Tellabs, Ltd., County Clare, **Ireland**	+353.61.471433	+353.61.471000/472004
Tellabs Operations, Inc., **Lisle, IL USA**	(800) 443-5555 (USA and Puerto Rico only) 708/969-8800 (other International)	708/512-7097 (both)

8.4 Repair service includes an attempt to remove any permanent markings made by customers on Tellabs equipment. If equipment must be marked, it should be done with nonpermanent materials and in a manner consistent with the correct handling of electrostatically sensitive devices.