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GAI-TRONICS®

A HUBBELL COMPANY

Model LE300-IP
Page/Party® Line Extender

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General Information

The GAI-Tronics Model LE300-IP Line Extenders are used in pairs to connect two Page/Party®, SmartSeries or ICS Page/Party® cable segments over an IP Network using Fast Ethernet or Gigabit Ethernet access. Refer to Figure 1 for a typical block diagram.

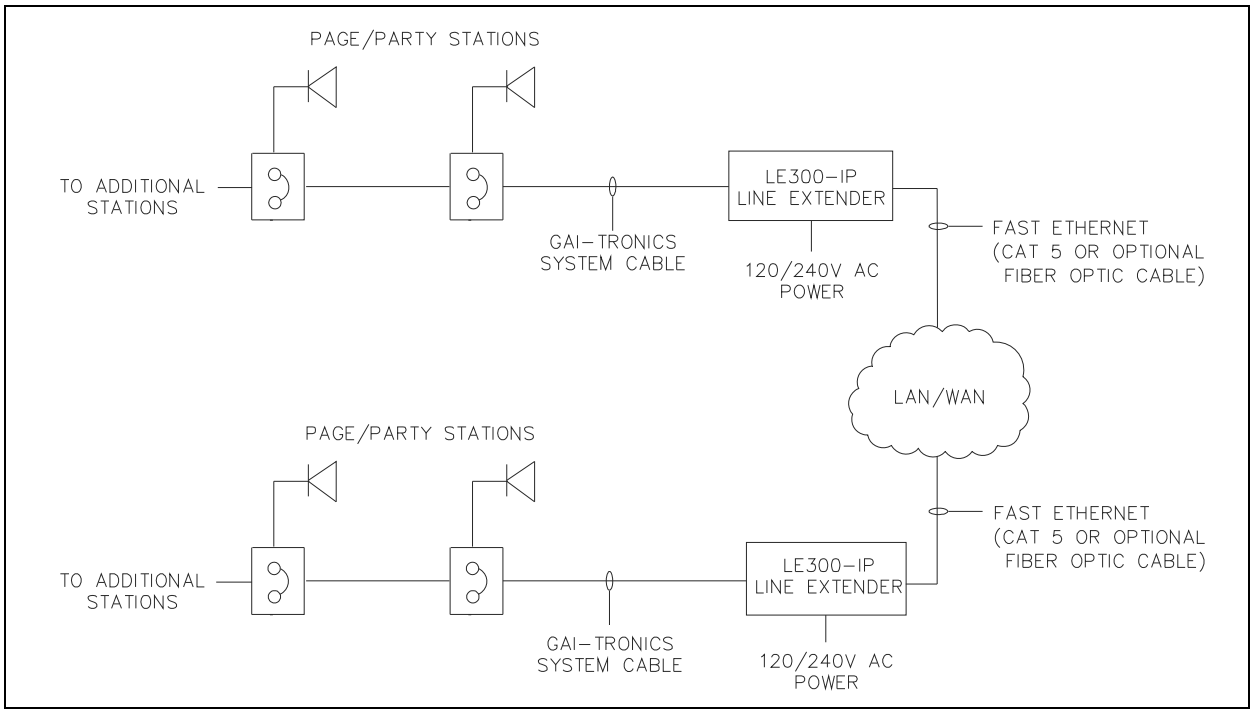


Figure 1. Typical System Block Diagram

Model LE300-IP Line Extender and Sub-Component Details

Refer to Figure 2 below for dimensional information and the sub-component layout of the Model LE300-IP Line Extender.

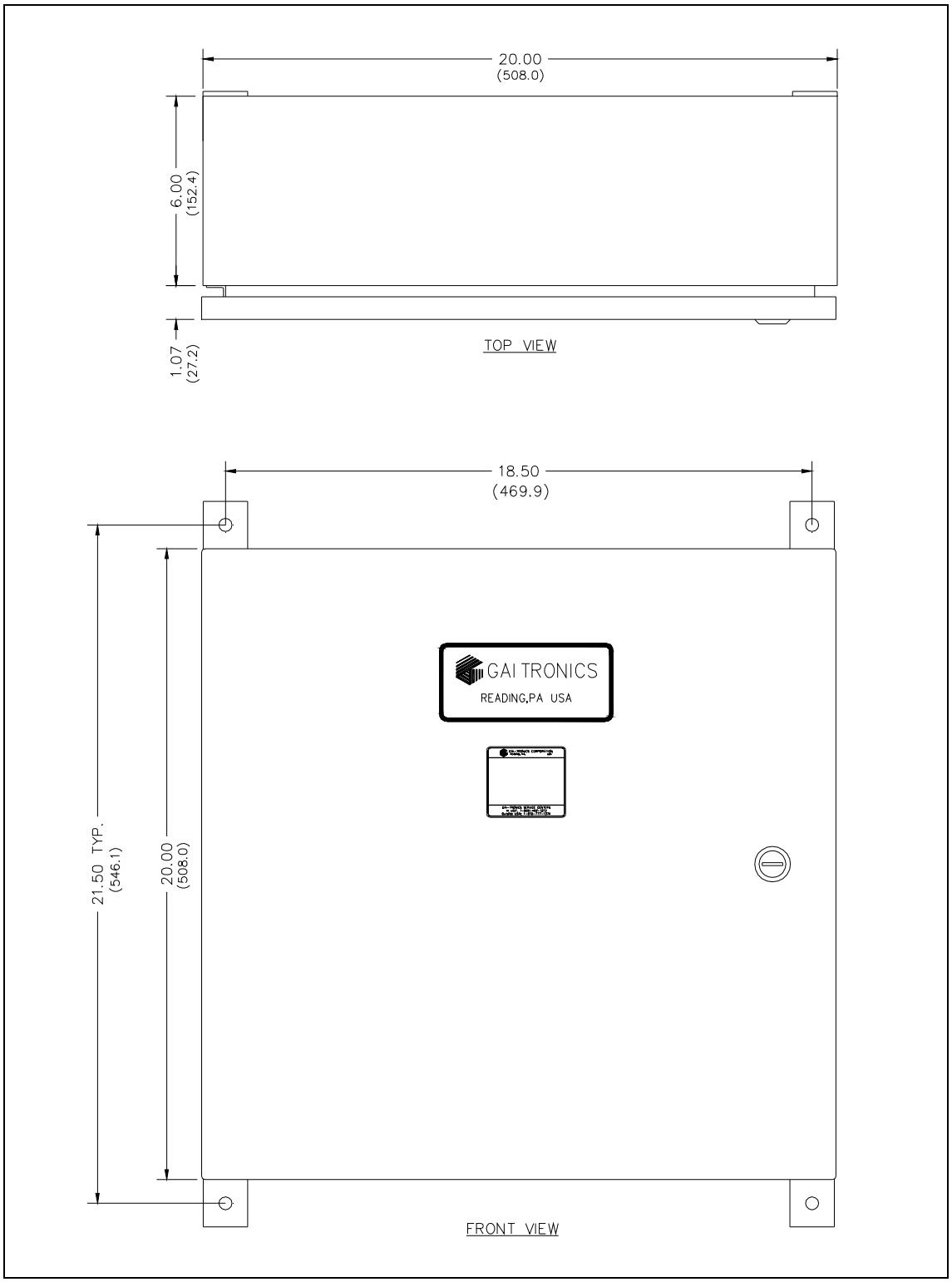


Figure 2. Model LE300-IP Line Extender Outline

Model LE300-IP Internal View

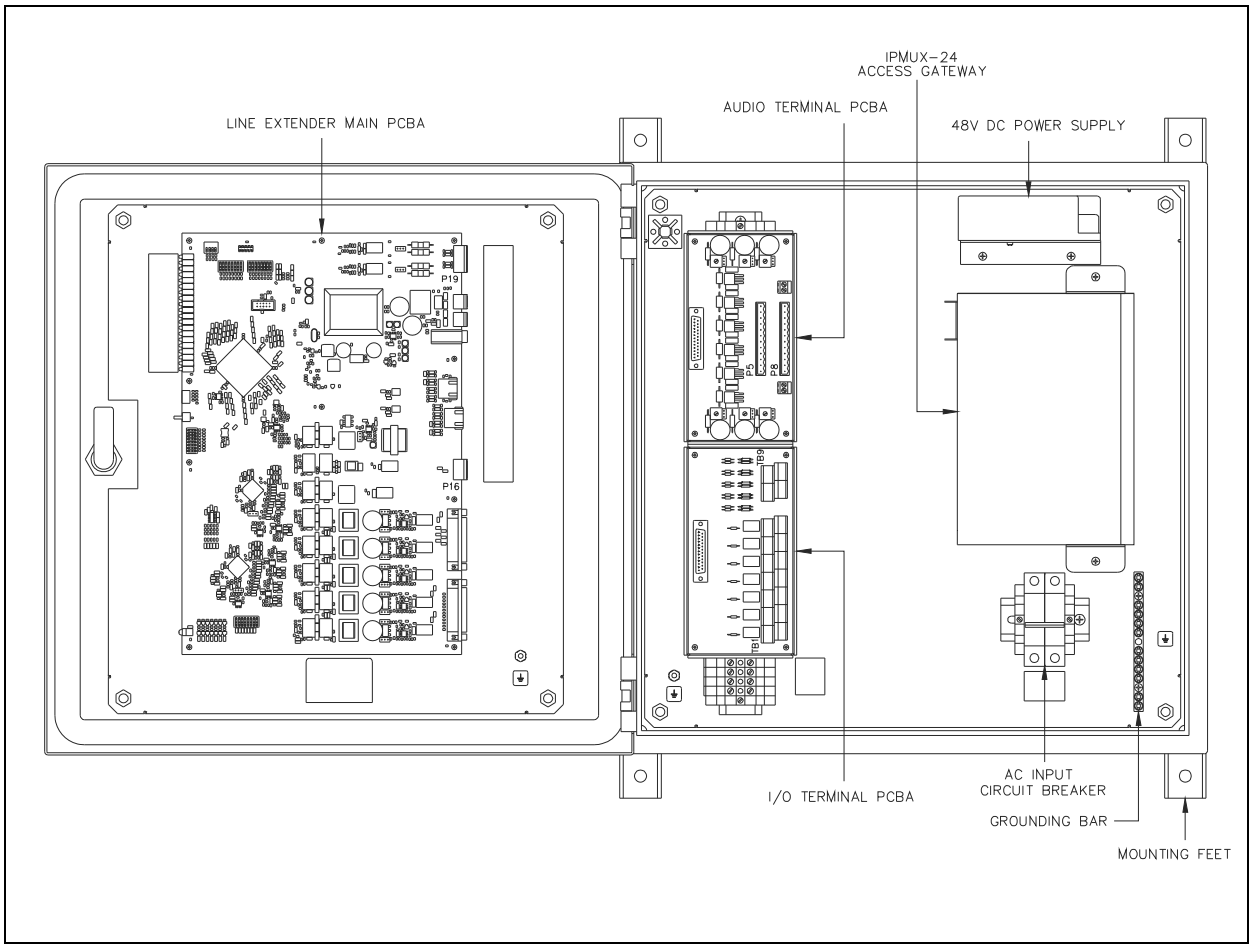


Figure 3. Interior View of Components - Model LE300-IP

Audio Termination Connection Module

The page line and party line 1–5 conductors of the Page/Party® system cable connect to the Audio Termination Connection Module. This module also can provide the 33-ohm line balance resistance needed for the audio lines. Audio line functions are described later in this manual.

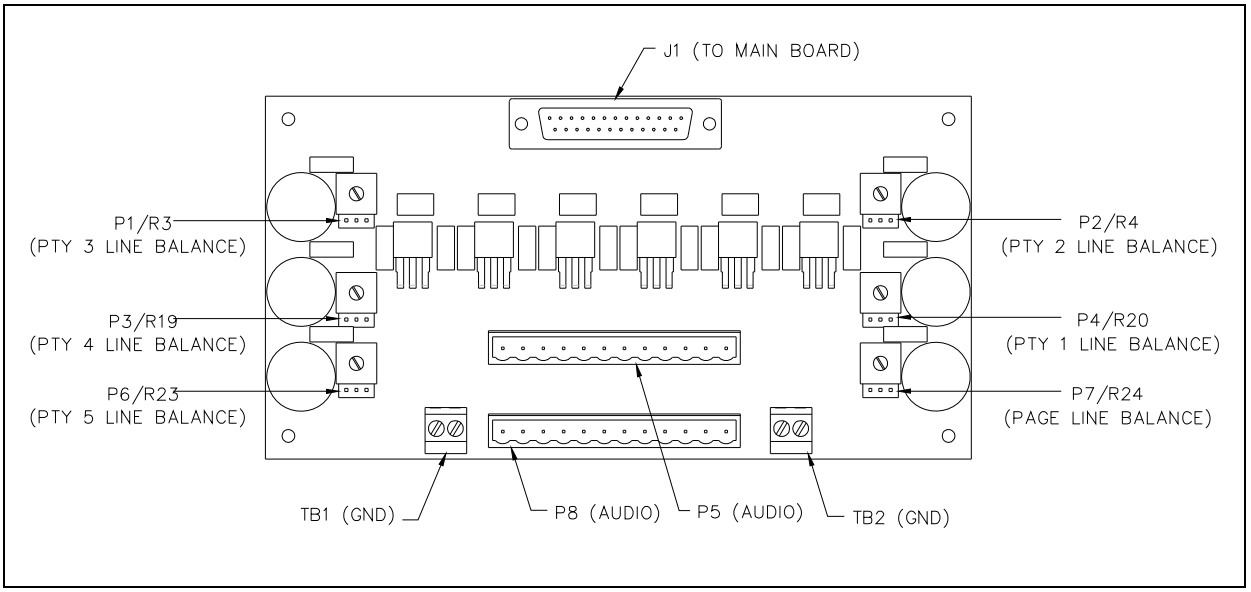


Figure 4. Audio Termination Connection Module

Input/Output (I/O) Termination Connection Module

The I/O Termination Connection Module connects the control wiring needed to send contact closures across the line extenders. I/O features and functions are described later in this manual.

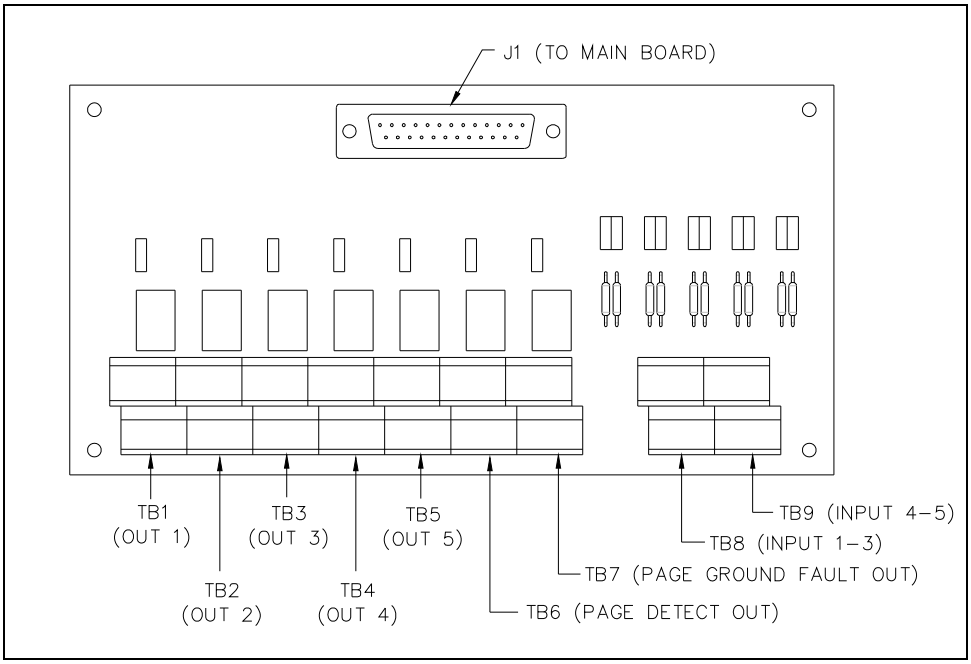


Figure 5. Input/ Output (I/O) Connection Module

Main PCBA

The Main PCBA contains all the central processing and line driver circuitry for the Model LE300-IP Line Extender. The board contains numerous connectors, switches and jumpers for setting the line extender operating parameters. Figure 6 below identifies the various components on the Main PCBA. Features and functions of each are described later in this manual.

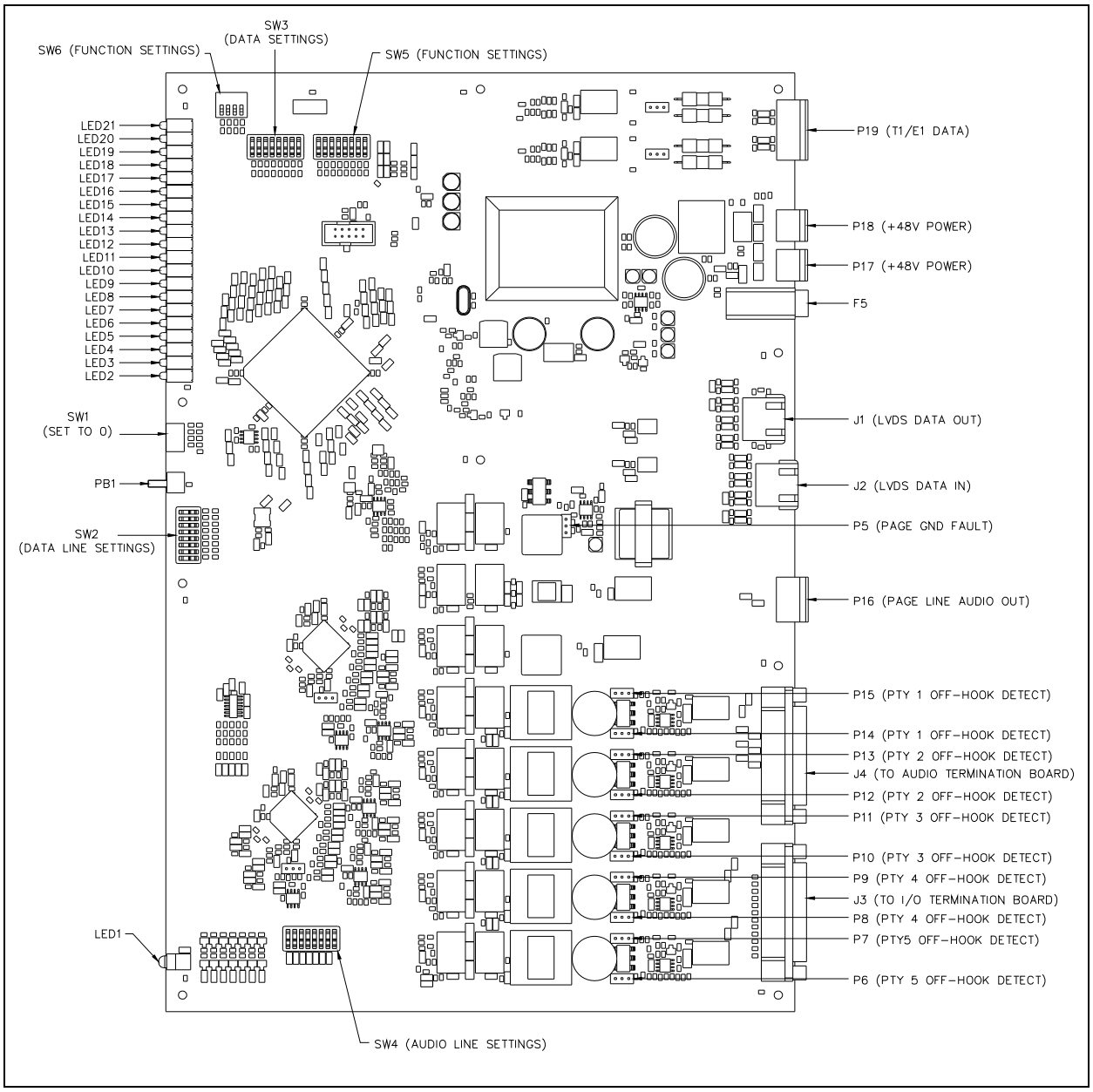


Figure 6. Main PCBA

Features and Functions

The Model LE300-IP Page/Party® Line Extender provides the following features between Page/Party® system cables.

Page Line Audio Transmission

A pair of Model LE300-IP Line Extenders provides page line audio transmission between two Page/Party® system cables. This transmission is half-duplex operation.

When the line extender detects a peak audio level equal or above a Peak Voltage Level Detection Threshold, it immediately switches audio "on" in that direction for the Transmission Direction Hold Time. Audio from the other direction is muted and ignored during that time. Audio is not switched "off" until it is continuously below the Peak Voltage Level Detection Threshold for the Transmission Direction Hold Time. The DIP switch SW2 positions 5–7, located on the Main PCBA, selects Peak Voltage Level Detection Threshold and Transmission Direction Hold Time. Refer to Figure 6 for the location of Switch SW2 on the Main PCBA and Table 1 and Table 2 below for setting options.

Table 1. Transmission Direction Hold Time Settings on Main PCBA

SW2-5	SW2-6	Transmission Direction Hold Time
Open*	Open *	1280 milliseconds
Closed	Open	640 milliseconds
Open	Closed	160 milliseconds
Closed	Closed	40 milliseconds

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Table 2. Peak Voltage Level Detection Threshold on Main PCBA

SW2-7	Peak Voltage Level Detection Threshold
Open*	−12 dB relative to nominal
Closed	−24 dB relative to nominal

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Page Line Audio Monitoring Output

The Model LE300-IP Line Extender provides a balanced 600-ohm audio output for monitoring audio on both the local and remote page lines. The LE300-IP mixes the local and remote page line audio and routes it to the 600-ohm audio output terminals. This audio can be sent to any external audio device (recorder, radio transmitter, amplifier, etc.) with an input impedance equal to or greater than 600 ohms. The audio output gain is adjustable using DIP switch SW3 positions 5–8 on the Main PCBA. Refer to Figure 6 for the location of Switch SW3 on the Main PCBA and the tables below for setting options.

Table 3. Page Line Monitor Output Gain Setting on Main PCBA

SW3-5	SW3-6	SW3-7	SW3-8	Monitor Output Gain
Open*	Open*	Open*	Open*	0 dB
Closed	Open	Open	Open	−30 dB
Open	Closed	Open	Open	−27 dB
Closed	Closed	Open	Open	−24 dB
Open	Open	Closed	Open	−21 dB
Closed	Open	Closed	Open	−18 dB
Open	Closed	Closed	Open	−15 dB
Closed	Closed	Closed	Open	−12 dB
Open	Open	Open	Closed	−9 dB
Closed	Open	Open	Closed	−6 dB
Open	Closed	Open	Closed	−3 dB
Closed	Closed	Open	Closed	0 dB
Open	Open	Closed	Closed	+3 dB
Closed	Open	Closed	Closed	+6 dB
Open	Closed	Closed	Closed	+9 dB
Closed	Closed	Closed	Closed	+12 dB

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Page Line Audio Detect Output Contact

The Model LE300-IP Line Extender provides a contact closure output that activates whenever audio is detected on the page line. The contact can be set to close when audio is detected at the local page line, the remote page line, or both. Typically this contact is used in conjunction with the Page Line Audio Monitoring Output to provide a control contact to external devices or systems when page line audio is present. The contact remains active for 1 second after the audio is no longer detected. DIP switch SW5 positions 6 and 7 enables or disables the output contact. Refer to Figure 6 for the location of switch SW5 on the Main PCBA and the tables below for setting options.

Table 4. Page Line Audio Detect Contact Main PCBA

SW5-6	SW5-7	Audio Detect Contact Operation
Closed	Closed	Disabled
Open	Closed	Local page line audio activates the contact
Closed	Open	Remote page line audio activates the contact
Open*	Open*	Both Local and Remote page line audio activates the contact

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Page Line FSK Data Transmission (SmartSeries Systems)

A pair of Model LE300-IP Line Extenders re-generates the FSK data transmission between two SmartSeries Page/Party® system cables. FSK data transmission occurs on the page line allowing SmartSeries Page/Party® stations to communicate with the ADVANCE system control cabinet. For proper operation, both line extenders must have this feature enabled by setting DIP switch SW5 position 1. Refer to Figure 6 for the location of switch SW5 on the Main PCBA and Table 5 below for setting options.

Table 5. Page Line FSK Transmission on Main PCBA

SW5-1	Page Line FSK Transmission
Open*	FSK data is disabled.
Closed	FSK data is enabled.

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

NOTE: FSK operation and VLC operation (described below) cannot be enabled at the same time. FSK operation is only used with SmartSeries systems.

VLC operation is only used within NON-SmartSeries systems. If both 50 kHz VLC and FSK are enabled at the same time, neither feature will function correctly.

Page Line 50 kHz VLC Transmission

A pair of Model LE300-IP Line Extenders re-generates the 50 kHz VLC control signal between two Page/Party® system cables. The 50 kHz VLC (Volume Level Control) signaling occurs on the page line and is typically used to alter the speaker volume of Page/Party® stations equipped VLC receivers. VLC signals may also be used for other on/off control functions on some Page/Party® systems. For proper operation, both line extenders must have this feature enabled by setting DIP switch SW5 position 2. Refer to Figure 6 for the location of switch SW5 on the Main PCBA and Table 6 below for setting options.

Table 6. Page Line 50 kHz VLC Transmission Setting on Main PCBA

SW5-2	Page Line 50 kHz VLC Transmission
Open*	50 kHz VLC is disabled.
Closed	50 kHz VLC is enabled.

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

NOTE: FSK operation and VLC operation (described above) cannot be enabled at the same time. FSK operation is only used with SmartSeries systems.

VLC operation is only used within NON-SmartSeries systems. If both 50 kHz VLC and FSK are enabled at the same time, neither feature will function correctly.

Page Line Ground Fault Detection

The Model LE300-IP Line Extenders provide page line ground fault detection on the local Page/Party® system cable. If multiple line extenders are connected to the same Page/Party® system cable segment, only one page line ground fault detector may be enabled. A shorting clip setting at header P5 on the Main PCBA enables the page line ground fault detection. Refer to Figure 6 for the location of header P5 on the Main PCBA and Table 7 below for setting options:

Table 7. Page Line Ground Fault Detection Setting on Main PCBA

P5 Shorting Clip	Page Line Ground Fault Detection
Pins 1–2*	Page line ground fault detection is disabled.
Pins 2–3	Page line ground fault detection is enabled.
Removed	Page line ground fault detection is disabled.

NOTES:

1. If connecting an LE300-IP Line Extender to the same system cable segment as an ADVANCE Page/Party® Interface (PPI) card, disable the LE300-IP page line ground fault detector. The PPI card contains the ground fault detector. If both ground fault circuits are enabled simultaneously, intermittent SmartSeries FSK data errors will occur between the PPI card and SmartSeries stations.
2. Changes to this parameter take effect without cycling power.
3. *Indicates default position.

Page Line Ground Fault Re-generation

When a ground fault is detected at a remote LE300-IP Line Extender, the ground fault can be duplicated on the local Page/Party® system cable. DIP switch SW5 position 3 enables regeneration of the ground fault. Refer to Figure 6 for the location of switch SW5 on the Main PCBA and Table 8 below for setting options.

Table 8. Page Line Ground Fault Regeneration Setting on Main PCBA

SW5-3	Page Line Ground Fault Regeneration
Open*	Disabled - Page line ground faults detected on the remote system cable are NOT regenerated on the local system cable.
Closed	Enabled - Page line ground faults detected on the remote system cable are regenerated on the local system cable.

NOTES:

1. The ground fault regeneration feature is used in SmartSeries systems to allow a ground fault on the remote cable segment to be detected by the system control cabinet. Disable this feature if the line extender is not installed in this type system.
2. Changes to this parameter take effect without cycling power.
3. *Indicates default position.

Page Line Ground Fault Output Contact

The Model LE300-IP provides a relay contact that activates whenever a ground fault is detected on the local page line, remote page line or both the page lines. The ground fault detection feature (described above) must be enabled. The contact output can be used to activate an external device or system that annunciates the fault condition. The DIP switch SW5 positions 4 and 5 configure which page line ground faults activate this contact. Refer to Figure 6 for the location of switch SW5 on the Main PCBA and Table 9 below for setting options.

Table 9. Page Line Ground Fault Contact Setting on Main PCBA

SW5-4	SW5-5	Page Line Ground Fault Contact
Closed	Closed	Disabled
Closed	Open	Remote page line ground fault activates the contact.
Open	Closed	Local page line ground fault activates the contact.
Open*	Open*	Both Local and Remote page line ground faults activate the contact.

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Party Line Audio Transmission

A pair of Model LE300-IP Line Extenders provides full duplex party line audio between two Page/Party® system cables, for party lines 1 through 5. During on-hook conditions of the party lines (meaning no handset stations are in use), the LE300-IP will mute the local party line analog circuits.

If it is necessary to have party line audio enabled even when no stations are off-hook, DIP switch SW6-3 may be closed to disable this muting feature. This switch affects the on-hook muting function of all five party lines simultaneously.

Refer to Figure 6 for the location of switch SW6 on the Main PCBA and Table 10 below for setting options.

Table 10. Party Line On-Hook Muting Setting on Main PCBA

SW6-3	Party Line On-Hook Muting
Open*	Enabled – local party lines are muted when no handset stations are in use.
Closed	Disabled – party line audio is never muted.

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Party Line Off-Hook Detection

The Model LE300-IP Line Extenders provide off-hook detection on the local Page/Party® system cable for party lines 1 through 5. An off-hook condition means a handset station is in use. If multiple line extenders are connected to the same Page/Party® system cable segment, only one off-hook detector can be enabled.

If connecting an LE300-IP to the same system cable segment as an ADVANCE Page/Party® Interface (PPI) card, disable the LE300-IP off-hook detection for party lines 1 and 2. The PPI card contains off-hook detection for party lines 1 and 2.

Several shorting clips (P6–P15) are used to enable the off-hook detection feature on party line 1 through 5. Two shorting clips are associated with each party line and must be set to the same position for proper operation. The party lines 1 through 5 are configured independently. Refer to Figure 6 for the location of P6–P15 on the Main PCBA and Table 11 below for setting options.

Table 11. Party Line Off-Hook Detection Setting on Main PCBA

Party Line	Headers	Shorting Clip	Off-Hook Detection
Party Line 1	P15, P14	Pins 1–2*	Disabled
		Pins 2–3	Enabled
		Removed	Disabled
Party Line 2	P13, P12	Pins 1–2*	Disabled
		Pins 2–3	Enabled
		Removed	Disabled
Party Line 3	P11, P10	Pins 1–2*	Disabled
		Pins 2–3	Enabled
		Removed	Disabled
Party Line 4	P9, P8	Pins 1–2*	Disabled
		Pins 2–3	Enabled
		Removed	Disabled
Party Line 5	P7, P6	Pins 1–2*	Disabled
		Pins 2–3	Enabled
		Removed	Disabled

NOTES:

1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Party Line Off-Hook Regeneration

When an off-hook handset station is detected, the LE300-IP can transmit the off-hook condition to remote line extenders so that it is duplicated on the remote Page/Party® system cable. Typically this feature is used in systems that contain a telephone interface device so that the caller is transferred to the party line when a handset station answers the call. DIP switch SW6 position 2 is used to enable this feature. This switch affects the off-hook regeneration function of all five party lines. Refer to Figure 6 for the location SW6 on the Main PCBA and Table 12 below for setting options.

Table 12. Off-Hook Regeneration on Main PCBA

SW6-2	Off-Hook Regeneration Setting
Open*	Enabled – an off hook condition on the local party line is regenerated at the remote line extender.
Closed	Disabled

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Audio Line Muting

In some line extender configurations using the LVDS data link, the Page/Party® system cable is not connected to the line extender. In this case, all audio lines (page and party lines 1 through 5) should be muted since they are not physically connected. DIP switch SW6 position 4 on the Main PCBA enables this feature. If this feature is enabled, it is unnecessary to disconnect the audio lines using the audio line relays (mentioned above). Refer to Figure 6 for the location of SW6 on the Main PCBA and Table 13 below for setting options.

Table 13. Audio Line Mute Setting on Main PCBA

SW6-4	Mute Analog Lines Setting
Open*	Disabled - Party lines 1–5 and page line are operational.
Closed	Enabled - Party lines 1–5 and page line are muted.

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Audio Line Connection Relays

The Model LE300-IP has relays that disconnect the page, party lines 1 through 5 and the page monitoring audio output connections from the Main PCBA. The disconnect feature is used for special applications such as connection of a single party line system, or other scenarios in which a particular audio line is not physically connected to the line extender. DIP switch SW4 is used to control the audio line disconnect feature. Refer to Figure 6 for the location of SW4 on the Main PCBA and Table 14 below for setting options.

Table 14. Audio Line Connection Relay Settings on Main PCBA

Audio Line	Switch SW4	Setting	Field Wiring
Party Line 5	SW4-1	Open	Disconnected
		Closed*	Connected
Party Line 4	SW4-2	Open	Disconnected
		Closed*	Connected
Party Line 3	SW4-3	Open	Disconnected
		Closed*	Connected
Party Line 2	SW4-4	Open	Disconnected
		Closed*	Connected
Party Line 1	SW4-5	Open	Disconnected
		Closed*	Connected
Page Line	SW4-6	Open	Disconnected
		Closed*	Connected
Page Monitor	SW4-7	Open	Disconnected
		Closed*	Connected
N/A	SW4-8	Open	Not used.
		Closed*	

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

Page/Party® Line Balance

For proper system operation, the page line and party lines 1 through 5 must be terminated with a resistance of approximately 33 ohms. The Model LE300-IP provides potentiometers to set the line balance resistance on the page line and five party lines. The line balance resistors are located on the Audio Termination Connection Module next to the page and party line terminal blocks. The line balance resistors are adjustable or can be disabled using shorting clips P1–P7.

If connecting an LE300-IP Line Extender to the same system cable segment as an ADVANCE Page/Party® Interface (PPI) card, disable the line balance for party lines 1, 2, and the page line. The PPI card provides the line balance resistors for these audio lines. Refer to Figure 3 for the location of the Audio Termination Connection Module. Refer to Figure 4 for the location of the jumpers and potentiometers on the Audio Termination Connection Module and Table 15 below for setting details.

Table 15. Page/Party® Line Balance Settings on Audio Termination Connection Module

Audio Line	Header	Shorting Clip	Line Balance	Adjustment Potentiometer
Party Line 5	P6	Pins 1–2*	Disabled	R23
		Pins 2–3	Enabled	
		Removed	Disabled	
Party Line 4	P3	Pins 1–2*	Disabled	R19
		Pins 2–3	Enabled	
		Removed	Disabled	
Party Line 3	P1	Pins 1–2*	Disabled	R3
		Pins 2–3	Enabled	
		Removed	Disabled	
Party Line 2	P2	Pins 1–2*	Disabled	R4
		Pins 2–3	Enabled	
		Removed	Disabled	
Party Line 1	P4	Pins 1–2*	Disabled	R20
		Pins 2–3	Enabled	
		Removed	Disabled	
Page Line	P7	Pins 1–2*	Disabled	R24
		Pins 2–3	Enabled	
		Removed	Disabled	

NOTES: *Indicates default position.

Contact Closure Inputs & Relay Outputs (I/O)

Five independent contact closures can be transmitted across a pair of line extenders, meaning that an active input contact on the local line extender results in the corresponding output relay contact energizing on the remote line extender. Contact closures are bi-directional between line extender pairs.

Example: Closing a switch contact across input #1 of the local line extender results in relay output #1 activating on the remote line extender and vice versa. When the input contact is removed the corresponding output relay de-activates. No switch or jumper setting is required on the Main PCBA for configuring the I/O feature.

NOTE: Any active output contacts will deactivate if the data link is broken between the line extenders.

Echo Cancellation

Line echo (also known as electric or hybrid echo) is created by the electrical circuitry connected to a two-wire (full duplex) audio system. Echo is inherent in all full-duplex audio systems and is affected by the audio line length and line impedance mismatches. The presence of audible echoes results in undesirable audio quality. This kind of quality degradation is inherent in network equipment and end-user telephone devices.

To minimize echo, the Model LE300-IP performs an echo cancellation sequence on party lines 1 through 5. The echo cancellation process takes approximately 15 seconds and is performed automatically one minute after power is applied to the LE300-IP. This delay allows all power levels to stabilize prior to performing echo cancellation.

NOTE: Signal impulses are transmitted onto the party lines during the echo cancellation process. Handset station users on a party line will hear the signals in the handset receiver. For troubleshooting purposes, the 1-minute delay may be disabled by closing DIP switch SW6 position 1. Refer to Figure 6 for the location of SW6 on the Main PCBA and Table 16 below for setting details.

Table 16. Echo Cancellation Power-On Delay Setting on Main PCBA

SW6-1	Echo Cancellation Power-On Delay
Open*	1 minute
Closed	No delay

NOTES: 1. Changes to this parameter take effect when cycling power.
2. *Indicates default position.

Manual Initiation of Echo Canceling

Echo cancellation can be manually initiated as described below.

Press and release push button PB1 on the Main PCBA three times. The push button must be pressed for at least 0.25 second and no more than 2 seconds each time. The timing requirement is meant to prevent accidental requests. If an error is made with the push-button timing, the sequence must be repeated from the beginning.

The LEDs on the Main PCBA will indicate the progress of the echo canceling sequence. One column of LEDs turns on after each push button and press release until the sequence is started. Once the sequence is started, those LEDs remain on, and a countdown timer is displayed on the remaining LEDs. The LEDs turn OFF after the echo cancellation training sequence is complete.

Data Links between Line Extenders

The Model LE300-IP Line Extender is equipped with two different data link types for connecting to another line extender. The two data link types are a T1/E1 link via the IP network and a Low Voltage Differential Signaling (LVDS) link. The type of data link(s) used is determined by the system architecture. It is possible to use both types at the same time to achieve complex system architectures. The data link type, their intended use, and the applicable switch settings are described below.

T1/E1 over an Ethernet IP Network

This data link is used to connect two Model LE300-IP Line Extenders using an IP Network. The Model LE300-IP contains an IPmux-24, which converts the data stream from its E1/T1 port into packets for transmission over the network. These packets are transmitted via the Ethernet network port to a remote LE300-IP device that receives the packets and converts them back to their original T1/E1 format.

The LE300-IP Line Extender should be connected to the closest Ethernet switch in the network. The distance between LE300-IP Line Extender and the Ethernet switch determines the type of cable connection needed. CAT5 or CAT6 cable can be used if the distance is <100 meters. The CAT5 or CAT6 cable should be terminated with RJ-45 plugs for connection to the LE300-IP Line Extender and the Ethernet switch.

For distances exceeding 100 meters, fiber optic cable must be used. When using fiber optic cable, a small form-factor pluggable (SFP) module must be purchased separately and plugged into the IPmux-24 to provide a termination point for the fiber cable inside the line extender. The optional SFP modules are available for use with multi-mode fiber optic or single mode fiber optic cable. The SFP modules contain LC-type fiber optic connector. Refer to the SFP data sheets for maximum cable distances.

Low Voltage Differential Signaling (LVDS) Data Link

The LVDS data link connection is used to connect two or more Model LE300-IP Line Extenders in a "daisy chain" fashion when the line extenders are located within 10 meters of each other. The LVDS data link requires a straight-through CAT5e cable between line extenders. Each line extender contains an LVDS data "in" port and an LVDS data "out" port. The "out" port of the first line extender connects to the "in" port of the next line extender. This connection scheme can be used to link up to a maximum of eight line extenders and is typically used when multiple line extenders are installed in a central location.

Configuring the Data Links

The T1/E1 and LVDS data link parameters between line extenders must be configured using multiple DIP switch settings on the Main PCBA. The following sections describe each parameter and the switch settings.

T1/E1 Data Format Selection

The LE300-IP supports both T1 and E1 data line connections between units. T1 is a digital circuit that uses the DS-1 (Digital Signaling level 1) signaling format to transmit voice/data at 1.544 Mbps. T1 can carry up to 24 digital channels for voice or data. E1 is the European equivalent which carries information at the rate of 2.048 Mbps. E1 is used to transmit 30 digital channels for voice or data plus one channel for signaling, and one channel for framing and maintenance.

In the case of LE300-IP, it is always be set to T1 (default setting). DIP switch SW5 position 8 on the Main PCBA selects the data link format for the digital audio transmission between line extenders. Both line extenders must be set to the same format. Refer to Figure 6 for the location of SW5 on the Main PCBA and Table 17 below for setting details.

Table 17. Data Format Setting on Main PCBA

SW5-8	Format
Open*	T1 Mode (1.544 Mbps, 24-channel)
Closed	E1 Mode (2.048 Mbps, 32-channel)

NOTES: 1. Changes to this parameter take effect *after cycling power*.
2. *Indicates default position.

T1 Line Build-out Settings

This option allows the user to control the wave shape being output by the transmitter. This helps to correct problems related to long copper cables. Improperly setting this switch will cause signal degradation. The proper setting refers to the cable distance between two LE300-IP Line Extenders. In the case of LE300-IP Line Extenders it should always be set to 0–133 feet (default setting). DIP switches SW2 positions 1–3 on the Main PCBA selects line-build out parameters. Refer to Figure 6 for the location of SW2 on the Main PCBA and Table 18 below for setting details.

Table 18. T1 Line Length Setting on Main PCBA

SW2-1	SW2-2	SW2-3	T1 Line Length
Open (up)*	Open (up)*	Open (up)*	0 to 133 feet
Closed (down)	Open (up)	Open (up)	133 to 266 feet
Open (up)	Closed (down)	Open (up)	266 to 399 feet
Closed (down)	Closed (down)	Open (up)	399 to 533 feet
Open (up)	Open (up)	Closed (down)	533 to 655 feet

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.
3. These switches have no effect in E1 mode.

T1/E1 Receiver Equalization Gain Limit

This option allows the user to compensate for diminishing signal intensity over the data line by adjusting the sensitivity of the receiver. By setting the Receive Equalizer Gain Limit, very long copper lines can be utilized. DIP switch SW2 position 4 on the Main PCBA selects the parameter. Refer to Figure 6 for the location of SW2 on the Main PCBA and Table 19 below for setting details.

Table 19. Receive Equalizer Gain Limit Setting on Main PCBA

SW2-4	Receive Equalization Gain Limit	
	T1 Mode	E1 Mode
Open (up)*	−36 dB (long haul)	−12 dB (short haul)
Closed (down)	−15 dB (limited long haul)	−43 dB (long haul)

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

T1/E1 Clock Source

In case of the LE300-IP, both Line Extenders should be set as the master clock source for proper operation with the IPmux-24. The slave unit receives the clock from the master. DIP switch SW3 positions 1 and 2 on the Main PCBA select T1/E1 clock parameters. Refer to Figure 6 for the location of SW3 on the Main PCBA and Table 20 below for setting details.

Table 20. Master Clock setting on Main PCBA

SW3-1	SW3-2	Clock Source
Open*	Open*	LE300-IP is the T1/E1 Master (generates the T1/E1 clock).
Closed	Closed	LE300-IP is the T1/E1 Slave (receives the T1/E1 clock from master).

NOTES: 1. Changes to this parameter take effect *after cycling power*.
2. *Indicates default position.

T1/E1 Data Line Grounding

T1/E1 data line can be floating or grounded. When floating, neither conductor of the data line cable pair is connected to ground. Headers P20 and P21 control the grounding of the T1/E1 lines. Grounding the T1/E1 lines may reduce emissions if it becomes an installation concern. Refer to Figure 6 for the location of P20 and P21 on the Main PCBA and Table 21 below for setting details.

Table 21. T1/E1 Data Line Grounding setting on Main PCBA

Header	Shorting Clip	Grounding Condition
P20	1–2*	T1/E1 Rx line floating
	2–3	T1/E1 Rx line grounded
	Removed	T1/E1 Rx line floating
P21	1–2*	T1/E1 Tx line floating
	2–3	T1/E1 Tx line grounded
	Removed	T1/E1 Tx line floating

*Indicates default position.

⚠ **NOTE** ⚠ Do not ground the T1/E1 lines at both ends. Doing so will create a ground loop.

LVDS Data Link Settings

The LVDS "in" port is disabled unless it is receiving a signal from LVDS "out" from another line extender. Switch SW3 position 3 enables the LVDS "in" port. Refer to Figure 6 for the location of SW3 on the Main PCBA and Table 22 below for setting details.

Table 22. LVDS "IN" Setting on Main PCBA

SW3-3	Enable/Disable LVDS "IN" Port
Open*	The LVDS "in" port is disabled (no cable connection from another LE300-IP.)
Closed	The LVDS "in" port is enabled (cable is connected to LVDS "out" cable connection from anther to LVDS.

NOTES: 1. Changes to this parameter take effect *after cycling power*.
2. *Indicates default position.

The LVDS "out" port is disabled unless the line extender is transmitting an LVDS signal to another line extender's LVDS "in" port. Switch SW3 position 4 enables the LVDS "out" port. Refer to Figure 6 for the location of SW3 on the Main PCBA and Table 23 below for setting details.

Table 23. LVDS "OUT" Setting on Main PCBA

SW3-4	Enable/Disable LVDS "OUT" Port
Open*	LVDS "out" is disabled.
Closed	LVDS "out" is enabled.

NOTES: 1. Changes to this parameter take effect without cycling power.
2. *Indicates default position.

⚠ **NOTE** ⚠ Do not connect LVDS "in" to LVDS "out" on the same LE300-IP Line Extender. Doing so creates a feedback path that usually results in (extremely loud) oscillations on the page line, all party lines, and possibly the contact outputs.

LVDS Port Indicators

Each LVDS port has two LEDs. The green LED is ON when the LE300-IP detects a signal connection from the other LE300-IPs connected to that port. The yellow/orange LED is ON when the LE300-IP detects page line data (SmartSeries FSK or 50 kHz VLC) on the LVDS port.

Typical Data Link Settings

The following section shows the most common line extender connection schemes and the expected T1/E1 and LVDS data line parameters for each. Consult the applicable tables to determine the correct switch settings. Consult GAI-Tronics for technical support of connection schemes not shown in this manual.

Point-to-Point Page/Party® System Connection

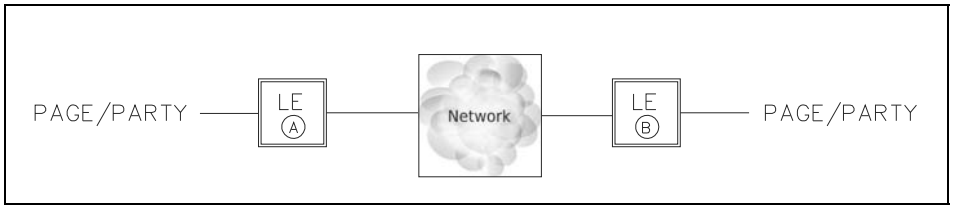


Figure 7. Point-to-Point Page/Party® System Connection

Table 24. Point-to-Point Page/Party® System Connection Table

Parameter	Switch	Configuration Description
T1/E1 Clock Source	SW3-1 SW3-2	Unit A & B is the master clock sources: SW3-1 (open) SW3-2 (open)
LVDS Clock Source	SW3-3 SW3-4	Not used - disable both LVDS "in" and "LVDS out": SW3-3 (open) SW3-4 (open)

Point to Multi-point Page/Party® System Connection

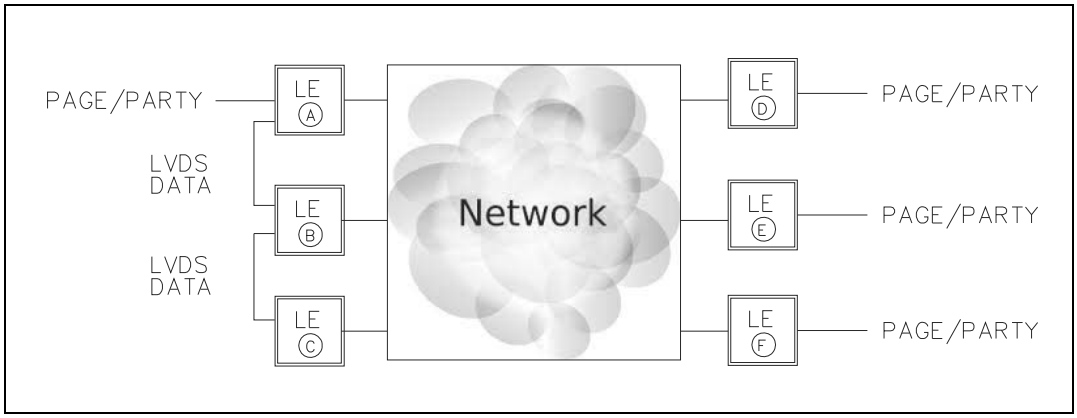


Figure 8. Point to Multi-point Page/Party® System Connection

Table 25. Point to Multi-point Page/Party® System Connection Table

Parameter	Switch	Configuration Description
T1/E1 Clock Source	SW3-1 SW3-2	Units A, B, C, D, E, & F are the master T1/E1 clock sources: SW3-1 (open) SW3-2 (open)
LVDS Data Line	SW3-3 SW3-4	LVDS data link is used between units A, B and C. • Unit A - "LVDS in" disabled, "LVDS out" enabled: SW3-3 (open) SW3-4 (closed) • Unit B - "LVDS in" enabled, "LVDS out" enabled: SW3-3 (closed) SW3-4 (closed) • Unit C - "LVDS in " enabled, "LVDS out" disabled: SW3-3 (closed) SW3-4 (open)
Mute Analog Lines	SW6-4	Units B and C have the page and party lines muted since there is not a Page/Party® cable connected: SW6-4 (closed)

Series Connection of Page/Party® System

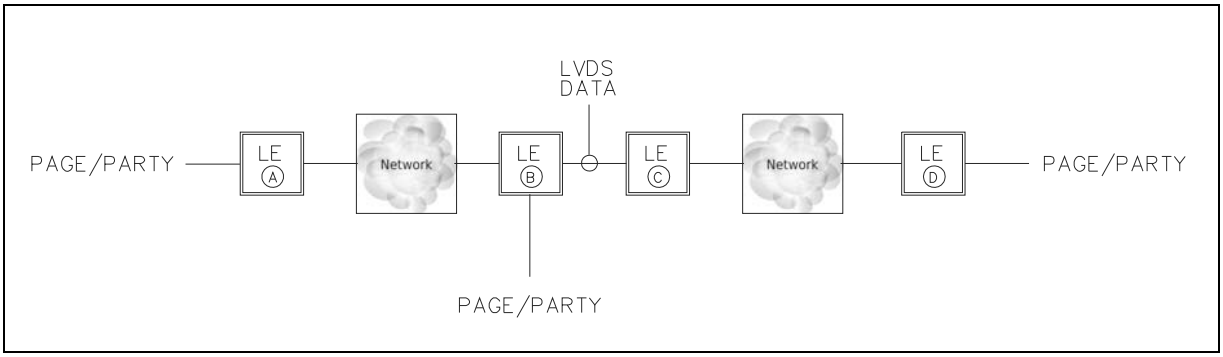


Figure 9. Series Connection of Page/Party® System

Table 26. Series Connection of Page/Party® System Table

Parameter	Switch	Configuration Description
T1/E1 Clock Source	SW3-1 SW3-2	• Units A, B, C, & D are the master T1/E1 clock sources: SW3-1 (open) SW3-2 (open)
LVDS Clock Source	SW3-3 SW3-4	LVDS clock is used between units B and C: • Unit B - "in" disabled, "out" enabled: SW3-3 (open) SW3-4 (closed) • Unit C - "in" enabled, "out" disabled: SW3-3 (closed) SW3-4 (open)
Mute Analog Lines	SW6-4	Unit C has the page and party lines muted since there is not a Page/Party® cable connected: SW6-4 (closed)

IP Bandwidth Requirements

Each pair of LE300-IP Line Extenders requires approximately 3 Mb of bandwidth on the network. Actual bandwidth usage can be adjusted via settings on the IPmux-24. Refer to the IPmux-24 user manual for details.

Rules for Interconnecting More than Two Model LE300-IPs

When connecting more than two Model LE300-IPs together, these rules must be followed.

- A maximum of two Model LE300-IP pairs can be connected in series when the series connections are made using Page/Party® cable as shown below.

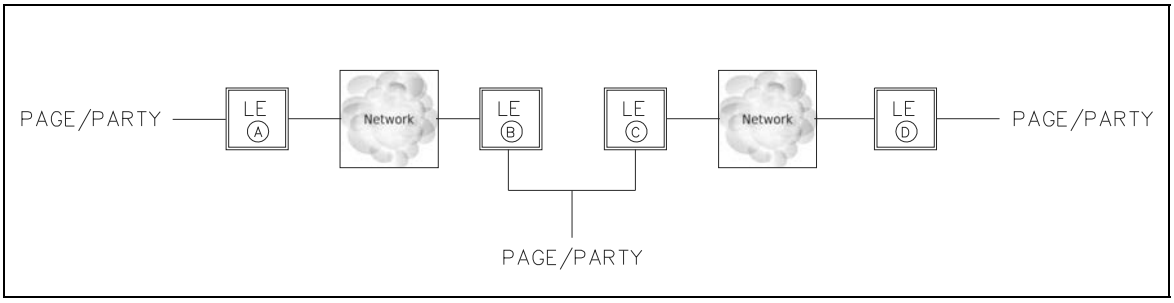


Figure 10. Maximum Series Connections

When Model LE300-IPs are connected in series, a problem can arise when training the echo cancellation. If more than one Model LE300-IP is training echo cancellation on a signal line at the same time, then none of them will train echo cancellation properly. To prevent this, power each line extender one at a time. Wait for the echo cancellation to complete on the first line extender before powering the second.

- A maximum of <u>eight</u> pairs of Model LE300-IPs can be connected in parallel. Parallel connections must be made using the LVDS as shown below.

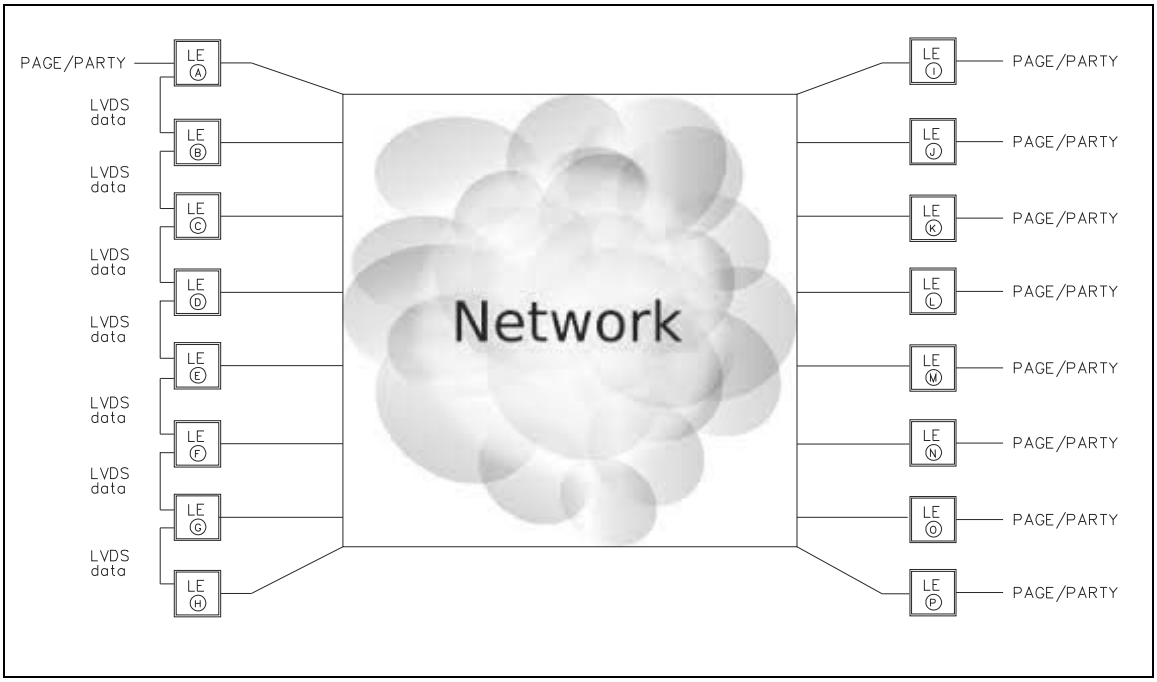


Figure 11. Maximum Parallel Connections

- A maximum of 16 Model LE300-IPs can be connected within a single zone or Page/Party® subsystem.
- Avoid having more than one Model LE300-IP connected to a particular Page/Party® cable. Instead, use the LVDS link whenever possible.
- Line extenders can NOT be wired in a loop architecture for redundant connections as shown below:

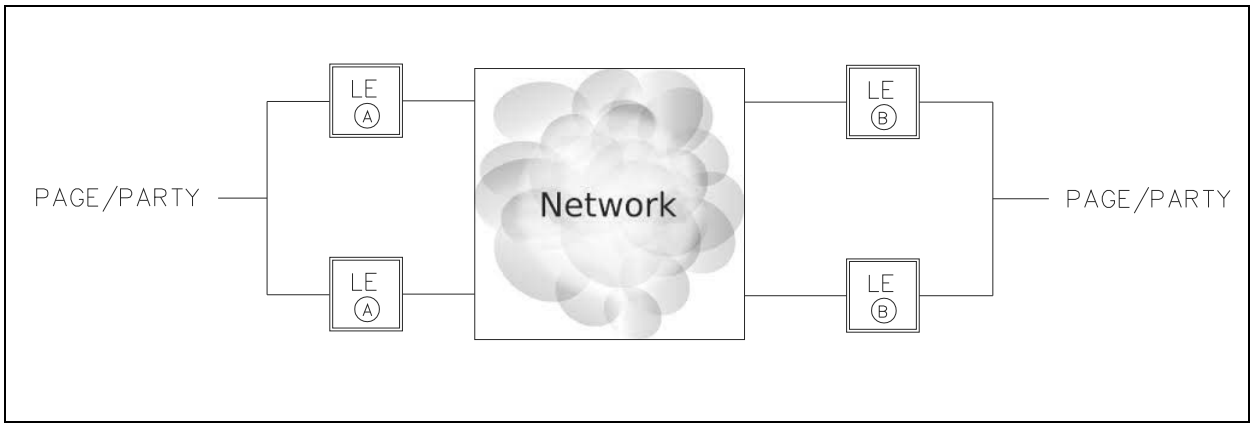


Figure 12. Invalid Loop Connection of Page/Party® Systems

- All contact input states are "Or"ed together to determine a contact output state.
- All remote page line audio detected states are "Or"ed together to determine the state of the page line audio detected relay contact output.
- All remote page line ground fault states are "Or"ed together to determine the state of the page line ground fault relay contact output.
- When enabled, 50 kHz VLC signal on any page line is transmitted to all page lines.
- SmartSeries FSK data on any page line is transmitted to all page lines.
- Manual retraining of echo cancellation at one Model LE300-IP also requests it at all LVDS interconnected Model LE300-IPs.

Installation

⚠ ATTENTION ⚠ Installation should be performed by qualified service personnel only in accordance with the National Electrical Code or applicable local codes.

Mounting

1. Unlock the front door of the enclosure using a screwdriver by rotating the lock a quarter turn counterclockwise, and open the front door.

2. Install the external mounting feet supplied with the enclosure prior to mounting the line extender to the wall or other mounting surface. To ensure proper sealing and enclosure protection rating, use the provided sealing washers. Install the sealing washers inside the enclosure with the tapered cone against the enclosure and then add the flat washers.

   NOTE: If removing rear component panel to install the mounting feet, disconnect the ribbon cables and the ground wire connections from the rear panel. Remove the four nuts that hold the panel in place, and set the panel assembly and the nuts aside in a safe location. Reinstall panel after the mounting feet are bolted to the enclosure.

3. Position the enclosure on the mounting surface and secure it with four 3/8-inch diameter bolts of the appropriate lengths for the mounting surface. See Figure 2 on page 2 for enclosure and mounting dimensions.

4. Drill or punch cable entries into the cabinet at the required locations. If installing the LE300-IP Line Extender outdoors or in an uncontrolled temperature/humidity area, bottom conduit/cable entry is recommended. Use conduit hubs or cable glands equipped with an O-ring to prevent entry of dust or moisture which can damage the internal components.

5. Pull the cables into the enclosure, and make connections per the wiring section of this manual.

6. Complete the installation by closing the front door and locking the enclosure.

Wiring

Pressure-type terminal blocks are provided inside the LE300-IP Line Extender for connecting the incoming field wiring. The terminal blocks can support a wire size of No. 24 AWG to No. 12 AWG. It is recommended that the installer crimp ferrules on the end of each wire before inserting the wire into the terminal block to ensure a reliable termination. Wiring connections to the LE300-IP are described below.

Power Connections

Connect input power of 120/240 V ac at 50/60 Hz to the double-pole circuit breaker. Connect the ground wire to the ground bar.

Page/Party® System Cable Connection

Connect the audio conductors (page line and party line 1–5) of the Page/Party® system cable to either P5 or P8 on the audio termination board. Each connection point is labeled next to the terminal block as shown below.

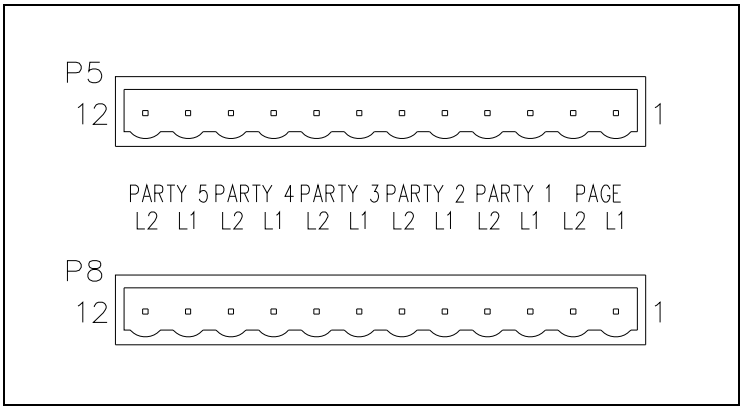


Figure 13. Page/Party® Cable Terminals

When using GAI-Tronics 60029 Series system cable, follow the wiring color code as shown in Table 27 below:

Table 27. Color Codes for GAI-Tronics 60029 Series System Cable

Terminal	Designator	GTC System Cable Color Code	Description
P5-1/P8-1	PAGE - L1	Red/Blue	Page Line audio
P5-2/P8-2	PAGE - L2	Blue/Red	
P5-3/P8-3	PARTY 1 - L1	Red	Party Line 1 audio
P5-4/P8-4	PARTY 1 - L2	Tan/red	
P5-5/P8-5	PARTY 2 - L1	Violet	Party Line 2 audio
P5-6/P8-6	PARTY 2 - L2	Tan/violet	
P5-7/P8-7	PARTY 3 - L1	Blue	Party Line 3 audio
P5-8/P8-8	PARTY 3 - L2	Tan/blue	
P5-9/P8-9	PARTY 4 - L1	Brown	Party Line 4 audio
P5-10/P8-10	PARTY 4 - L2	Tan/brown	
P5-11/P8-11	PARTY 5 - L1	Yellow	Party Line 5 audio
P5-12/P8-12	PARTY 5 - L2	Tan/yellow	

Contact Closure Input Connections

Contact inputs are typically connected to switches or mechanical relay contacts. Five inputs are available with each input requiring two conductors. Connect the normally open contact across the top and bottom. If using a solid state switch as the input device, observe polarity of the connection: (−) on bottom, and (+) on top. Each input cable connection point is labeled next to the terminal block TB8 and TB9 as shown below.

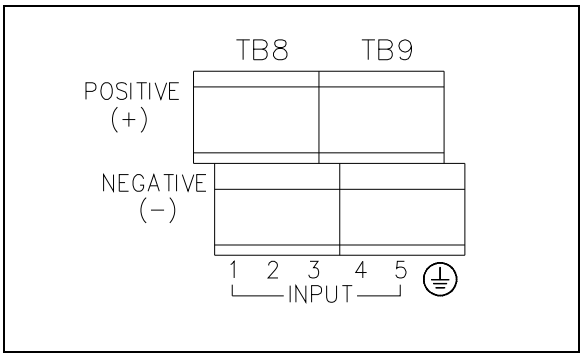


Figure 14. Input Contact Terminals

Table 28. TB8 and TB9

Terminal	Designator	Description
TB8	Input 1 (+)	Input contact 1
TB8	Input 1 (−)	
TB8	Input 2 (+)	Input contact 2
TB8	Input 2 (−)	
TB8	Input 3 (+)	Input contact 3
TB8	Input 3 (−)	
TB9	Input 4 (+)	Input contact 4
TB9	Input 4 (−)	
TB9	Input 5 (+)	Input contact 5
TB9	Input 5 (−)	

Contact Closure Output Connections

Seven relay outputs are provided. Each relay output provides two contact sets and each contact set consists of normally open (NO), common (C) and normally closed (NC) contacts. Outputs 1–5 are activated by inputs 1–5 on the companion LE300-IP. Output 6 is activated when page line audio is detected and output 7 is activated when a page line ground fault is detected. Terminals are provided for each relay contact and are labeled with the relay contact description next to the terminal block TB1-7 as shown in Figure 15 below.

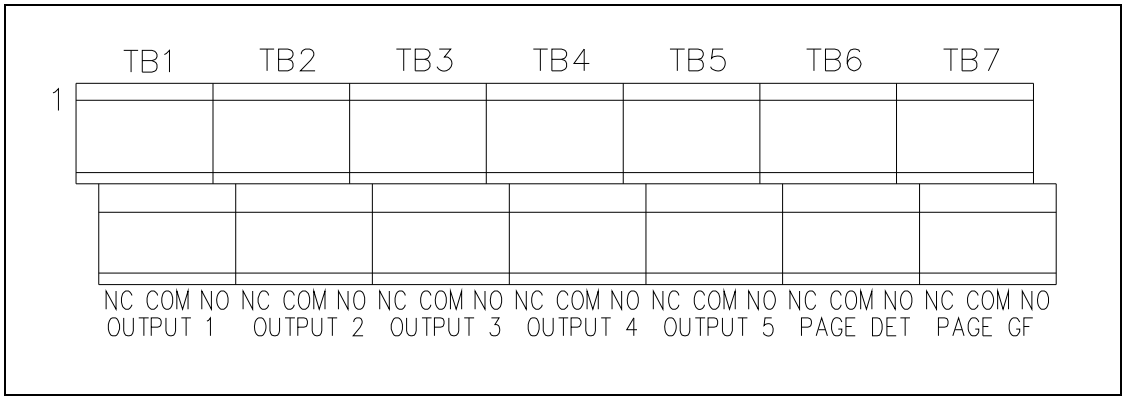


Figure 15. Relay Output Terminals

Table 29. Contact Closure Output Connections

Terminal	Designator	Description
TB1 (Top)	N.C.	Output 1 – contact #1
	COM	
	N.O.	
TB1 (Bottom)	N.C.	Output 1 – contact #2
	COM	
	N.O.	
TB2 (Top)	N.C.	Output 2 – contact #1
	COM	
	N.O.	
TB2 (Bottom)	N.C.	Output 2 – contact #2
	COM	
	N.O.	

Terminal	Designator	Description
TB3 (Top)	N.C.	Output 3 – contact #1
	COM	
	N.O.	
TB3 (Bottom)	N.C.	Output 3 – contact #2
	COM	
	N.O.	
TB4 (Top)	N.C.	Output 4 – contact #1
	COM	
	N.O.	
TB4 (Bottom)	N.C.	Output 4 – contact #2
	COM	
	N.O.	
TB5 (Top)	N.C.	Output 5 – contact #1
	COM	
	N.O.	
TB5 (Bottom)	N.C.	Output 5 – contact #2
	COM	
	N.O.	
TB6 (Top)	N.C.	Page Line Audio – contact #1
	COM	
	N.O.	
TB6 (Bottom)	N.C.	Page Line Audio – contact #2
	COM	
	N.O.	
TB7 (Top)	N.C.	Page Line Ground Fault – contact #1
	COM	
	N.O.	
TB7 (Bottom)	N.C.	Page Line Ground Fault – contact #2
	COM	
	N.O.	

Page Line Audio Monitoring Connections

The Model LE300-IP provides a balanced 600-ohm audio output for monitoring audio on both the local and remote page lines. Connect any external audio input device (audio recorder, radio transmitter, amplifier, etc.) to the audio line monitoring terminals using a twisted pair cable. The input impedance of the audio device should be 600 ohms or greater. Terminals are located at connector P16 on the Main PCBA and are labeled as shown in Table 30 below.

Table 30.

Terminal	Designator	Description
P16-1	PG MON L2	Page line monitor audio output (L2)
P16-2	–	No connection
P16-3	PG MON L1	Page line monitor audio output (L1)

Verifying the Proper Line Balance Resistance

For proper Line Extender operation, the line balance resistance, for both page and party lines, should be set close to 33 ohms. This can be done by enabling and adjusting the line balance potentiometers on the 69441-xxx terminal board using an ohmmeter.

When the line balance potentiometer is enabled, it is possible to measure the selected dc resistance directly. One side of the ohmmeter should connect to the exposed header pin on the header used to enable or disable the line balance potentiometer. The other side of the ohmmeter should connect to the side of the associated 15-ohm series resistor closest to the edge of the printed circuit board. Ensure the 15-ohm resistor is part of the measurement before adjusting the potentiometer for the correct resistance. All six circuits are symmetric and their signals have minimal overlap. If the incorrect series resistor is chosen, then the ohmmeter should read an open circuit.

Distributing Line Balance Resistance

As an increasing length of cable is added from the Line Extender the effects of cable resistance should be taken into consideration. The farther a Page/Party® station is connected to the system cable from the line balance resistance the greater the chance deficiencies in system behavior may occur. The station farthest away from the line balance will exhibit increased sidetone audio in the handset earpiece and will place higher than nominal levels of audio onto the system cable. Stations receiving this audio nearby will have louder than expected outputs. These same stations receiving audio from other stations near the line balance resistance will have lower than expected outputs due to the line loss of the cable resistance. A system showing these characteristics should have distributed line balancing.

For reference, if a line balance is installed at both ends of one mile of 18 gauge cable, then both line balances should be set to nominally 46.7 ohms. The one mile of cable provides approximately 33 ohms of resistance in each leg; the resulting series-parallel combination will result in the devices installed at both ends seeing a line impedance of approximately 33 ohms.

SmartSeries systems utilize FSK for communication on the page line between the stations and the Line Extender. Since FSK frequencies range between 31 kHz and 33 kHz instead of audio frequencies, the effects of longer cable lengths will present itself sooner. The higher frequency will lend to a greater probability that standing waves of the FSK signal will be present. The cable length, in addition to the number of cable branches present, will combine to determine the severity of these standing waves. Severe standing waves present on the line can cause a portion of the system devices to be unable to properly communicate with the Line Extender giving the need for distributing the line balance resistance.

Determining the cable resistance with any accuracy in installed systems is too difficult. Fortunately, the resistance values to be installed can be determined without using the cable resistance in the calculation, as precise accuracy is not necessary to achieve acceptable system functionality. The resistance values installed should always calculate to a nominal parallel resistance of 33 ohms. One of the line balance resistances can be the resistance included on the 69441-xxx terminal board, but it is not a requirement. It will provide a resistance up to 115 ohms determined by the position of the potentiometer. Examples of line balance resistances that could be installed are 51 ‖ 100 ohms, 68 ‖ 68 ohms or 100 ‖ 100 ‖ 100 ohms. It is best to install the line balance resistors as far apart from one another in cable distance as possible.

Network Connections

Ethernet network connection to the LE300-IP Line Extender can be made using CAT 5e or CAT 6 copper cable or fiber optic cable depending on the cable distance required. Each connection type is described below. Refer to Figure 16–18 for network connections to the IPmux-24, which is mounted inside the LE300-IP Line Extender.

Copper Cable Connections

Connect the LE300-IP Line Extender to the network Ethernet switch using CAT 5e or CAT 6 cable terminated with an RJ-45 plug. The cable should be straight pinned following the EIA/TIA industry standard for 568 A or B.

NOTE: Cable distance must be <100 meters.

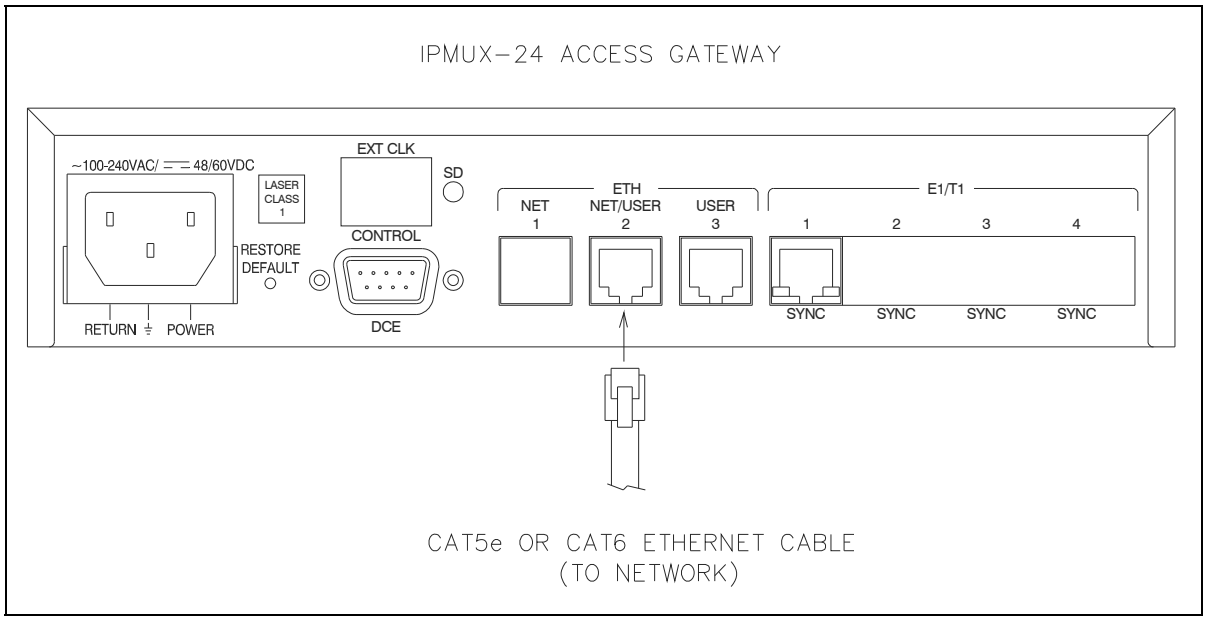


Figure 16. CAT5e or CAT 6 Cable Installation

Fiber Optic Cable Connections

IPmux-24 uses SFP modules with LC-type fiber optic connectors to provide a fiber optic cable connection to the network. Third-party SFP optical transceivers must be agency-approved, complying with the local laser safety regulations for Class 1 laser equipment.

To install the SFP module:

1. Lock the wire latch of each SFP module by lifting it up until it clicks into place as illustrated.

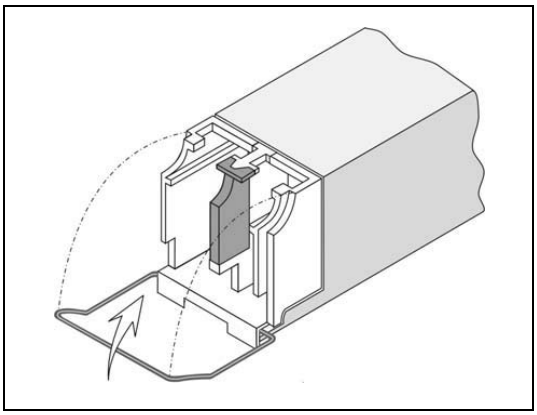


Figure 17. SFP Module Installation

NOTE: Some SFP models have a plastic door instead of a wire latch locking the SFP wire latch.

2. Carefully remove the dust covers from the SFP slot.

3. Insert the rear end of SFP into the socket labeled NET 1, and push slowly until the SFP clicks into place. If you feel resistance before the connectors are fully mated, retract the SFP using the latch wire as a pulling handle, and then repeat the procedure.

4. Remove the protective rubber caps from the SFP modules.

5. Insert the LC fiber optic connector into the SFP Module as shown in Figure 18 below.

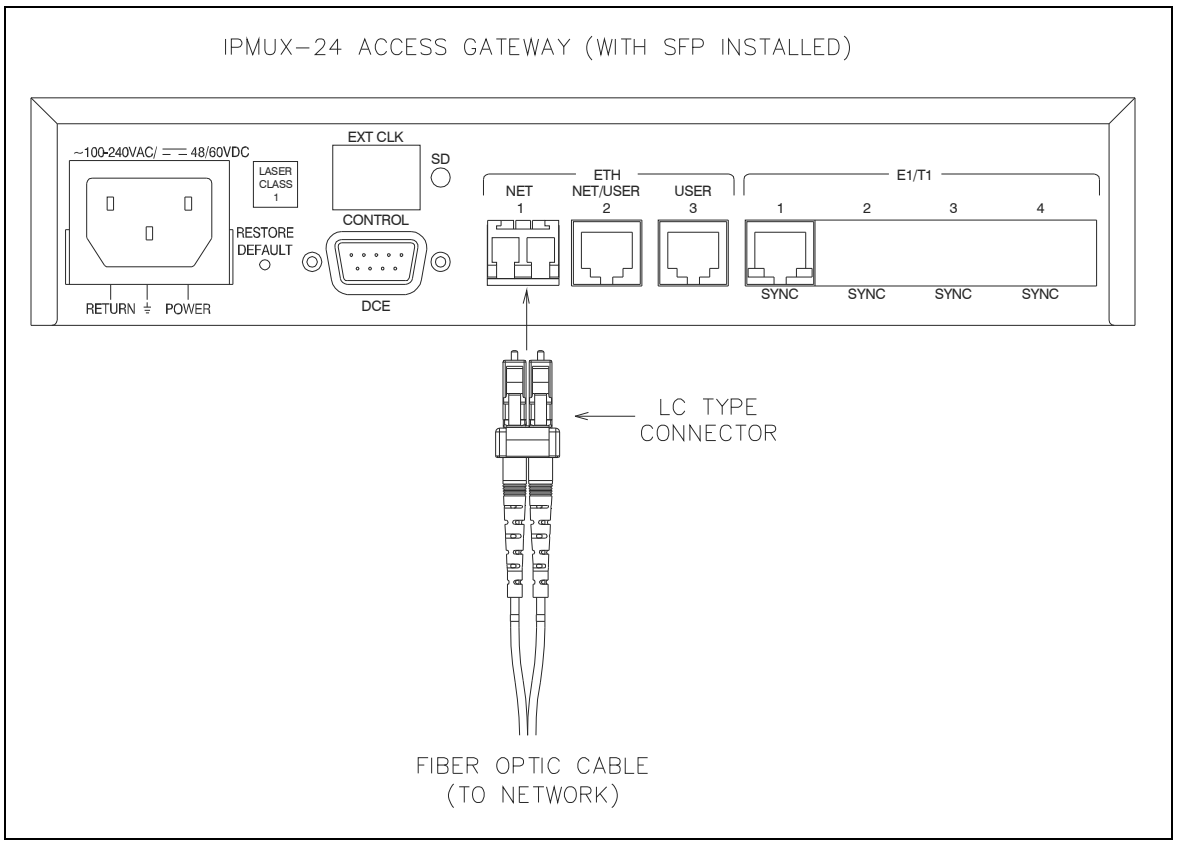


Figure 18. Fiber Optic Cable Installation

Removing the SFP Module

1. Disconnect the fiber optic cable from the SFP module.
2. Unlock the wire latch by lowering it downwards (as opposed to locking).
3. Hold the wire latch and pull the SFP module out of the Ethernet port.

Configuring the IPmux-24

NOTE: It is strongly recommended that you refer to the IPmux-24 manual, "IPmux-24 TDM Pseudowire Access Gateway Installation and Operation Manual", when configuring the LE300-IP Line Extender. All the configuration parameters are explained in the IPmux-24 manual. The information below is simply a quick start guide and includes only the basic operating parameters.

GAI-Tronics pre-configures the IPmux-24 to default management and operating parameters during testing of the LE300-IP Line Extender. The default settings allow the IPmux-24 to be managed using a PC running a Web browsing application connected to one of the user LAN ports. Refer to "Accessing the Web Page" section below.

If replacing an IPmux-24 with a new unit directly from the manufacturer (RAD), initial configuration of the management parameters must be performed using an ASCII terminal connected to the rear panel CONTROL port. Once the IPmux-24 host IP parameters are set, it is possible to access the unit via Telnet or a Web browsing application connected to one of the user LAN ports.

The following is a summary of the steps necessary to configure an IPmux-24 for management. Refer to the IPmux-24 manual for details.

1. Connect an ASCII terminal to the RS-232 control port of IPmux-24.

2. Log in as Superuser (su).

3. Enable or disable the IPmux-24 DHCP client.

4. Assign a Host IP address to the IPmux-24 for management of the device.

5. Assign a subnet mask and a default gateway.

6. Configure the SNMP communities.

Make sure that you save your settings at each configuration screen.

Note on Terminal Emulation Software: In Windows 7 you will no longer find the HyperTerminal program. There are several alternatives to HyperTerminal such as:

- **HyperTerminal Private Edition** – This is a commercial terminal emulation program that you can use to communicate with serial COM ports, dial-up modems, and TCP/IP networks.

- **Putty** – A free Telnet and SSH implementation for Windows. It also is an xterm terminal emulator.

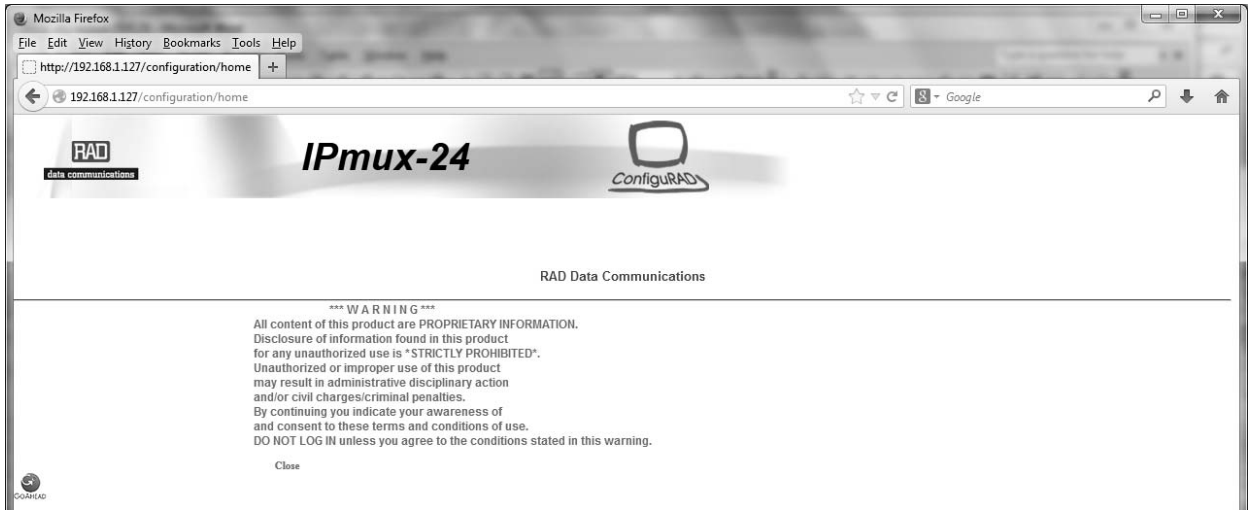
Accessing the IPmux-24 Webpage

1. Connect an Ethernet cable from a PC to the USER network port connector of IPmux-24.

2. Turn on the PC and IPmux-24.

3. Open a web browser on the PC and enter the management IP address of the IPmux-24.
   The GAI-Tronics factory default is **192.168.1.100**. This is the IP address which is programmed by GAI-Tronics during factory testing of the LE300-IP.

Initial Screen



Select CLOSE after reading message

Login Screen

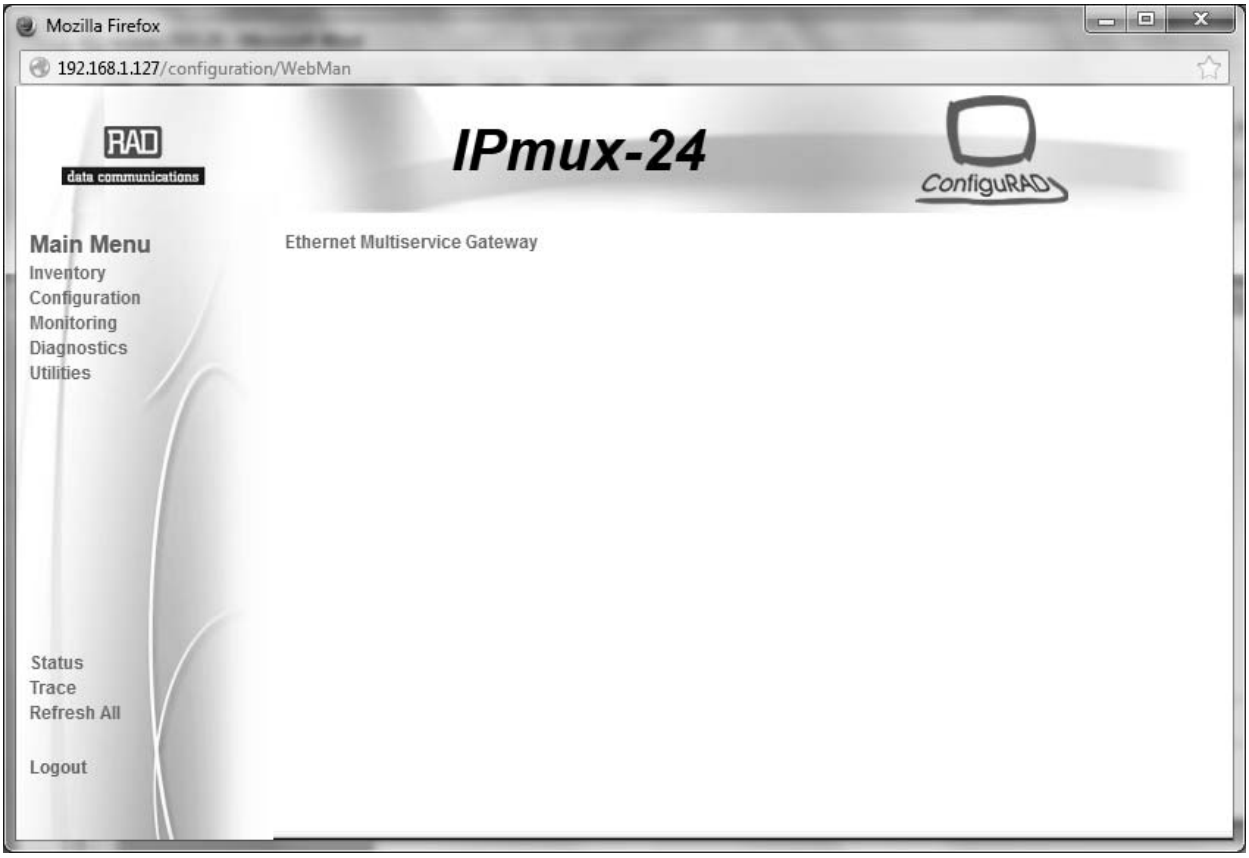
Enter User Name and Password and press SUBMIT button.

Default User Name: **su**

Default Password: **1234**

Home Screen

Upon successful log-in the Home Screen will appear:



Select the disired option under the Main Menu.

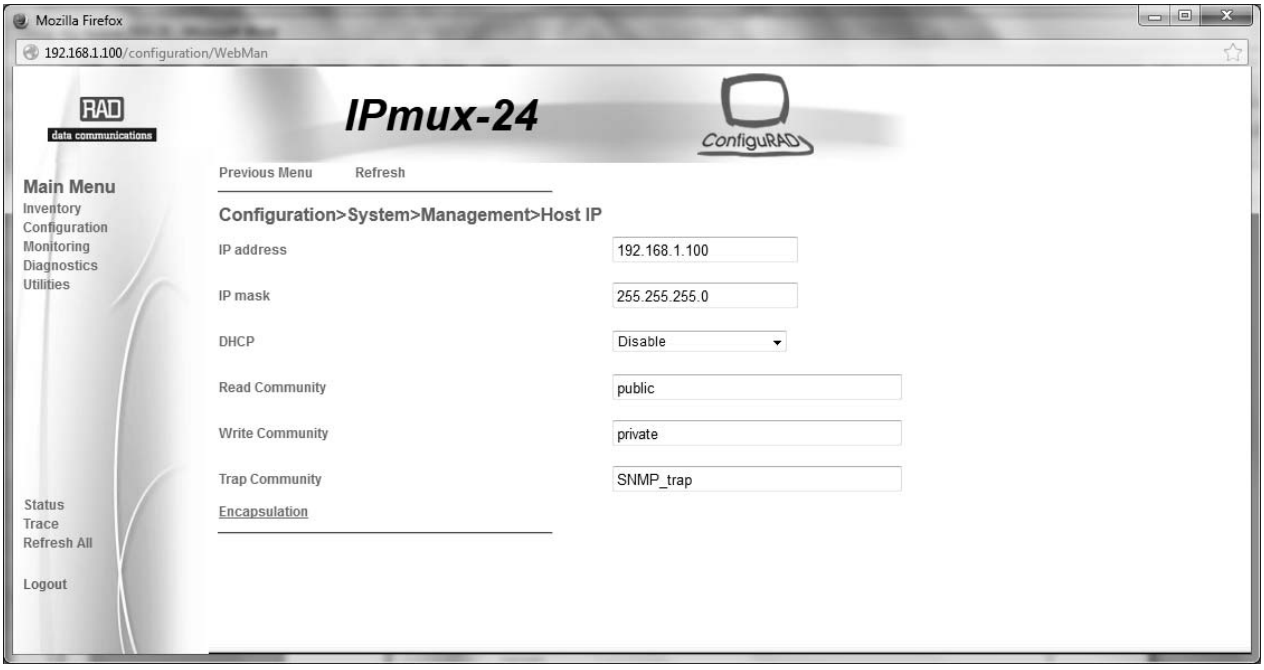
Configuring Management Access Permisions and Methods

It is recommended to change some of the default management settings of the IPmux-24. At minimum, the default Host IP address should be changed to allow operation on the end-user's network and the user password should be changed for security reasons.

Refer to the IPmux-24 user manual's "Configuring Management Access Permissions and Methods" section, which includes instructions on adding or deleting users, changing passwords, and controlling access.

Changing the Management Host IP Address

From the Main menu (Configuration > System > Management>Host IP), select a new IP address and IP mask.



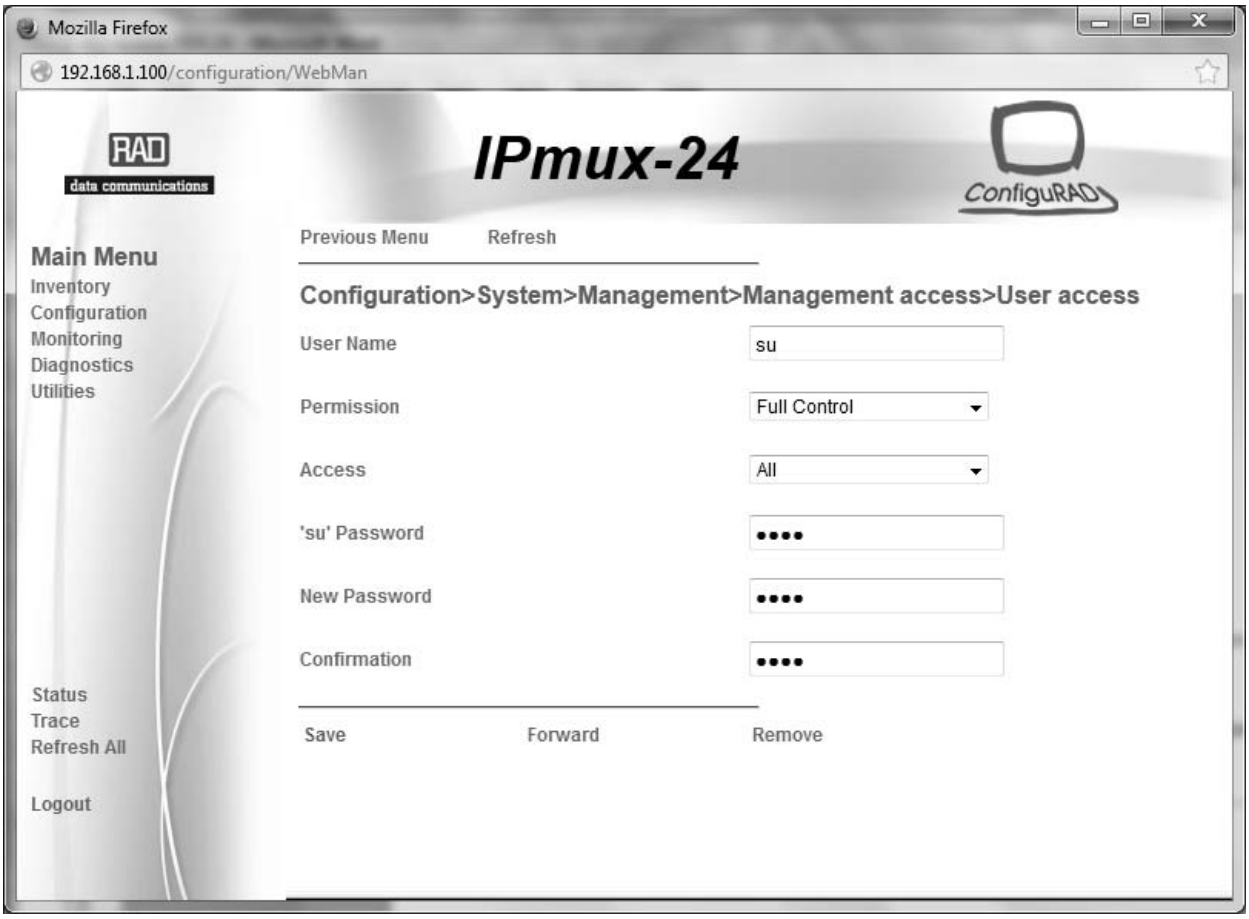
NOTE: Following the IP address change, a new web browser window must be opened using the new management IP address.

Make sure there are not multiple units with the same (Host) IP address connected to the network.

Changing the Default Password

From the Main menu (Configuration > System > Management> Management Access>User Access), enter the current super user (su) password. The factory default is **1234**.

Enter the new password and repeat the password in the Confirmation field.

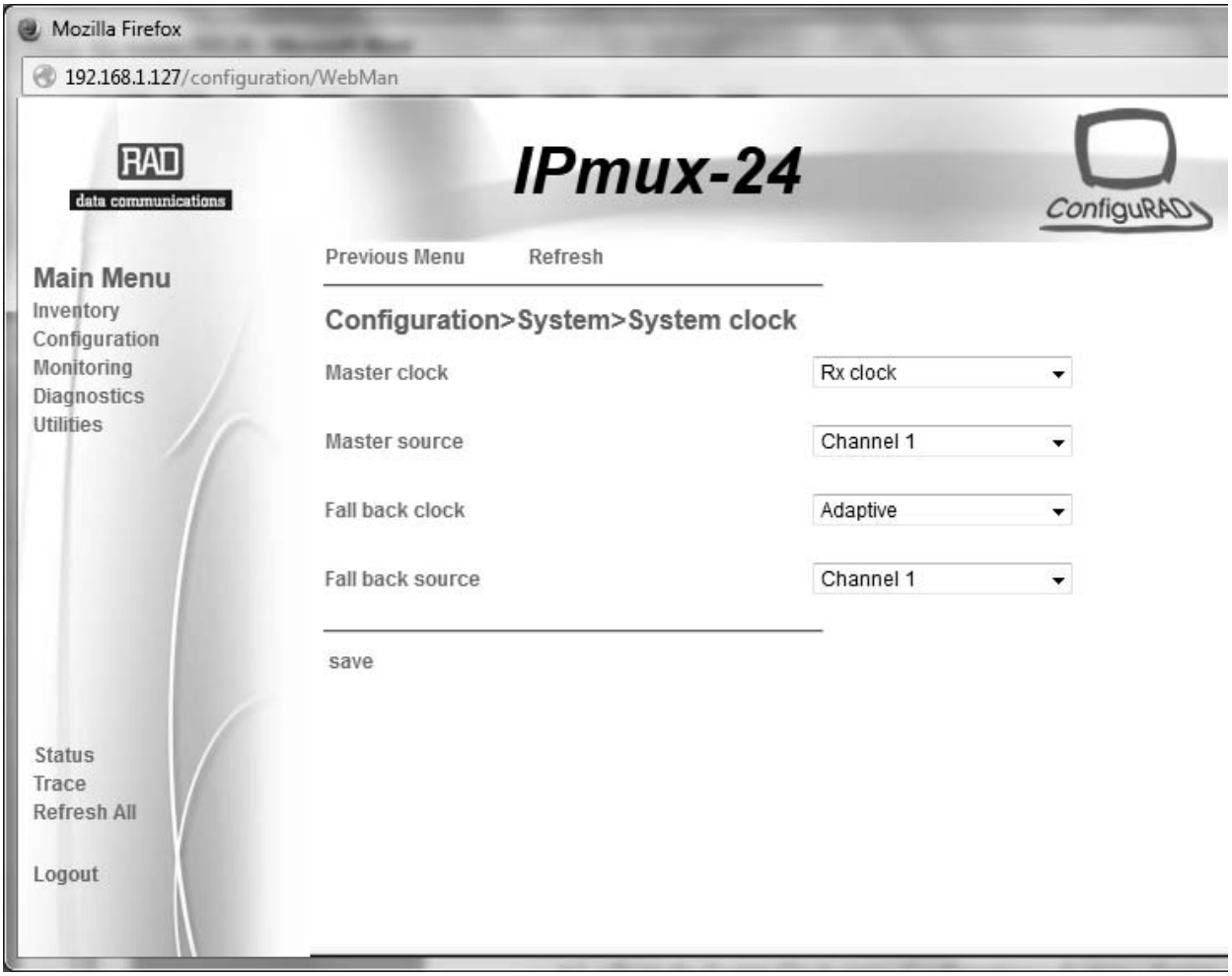


Select SAVE.

Configuring the System Clock

IPmux-24 system timing mechanism ensures a single clock source for all TDM links by providing the master and fallback clocks. To configure the system clock:

From the System Clock menu (Configuration > System > System clock), select the master and fallback timing reference for IPmux-24.



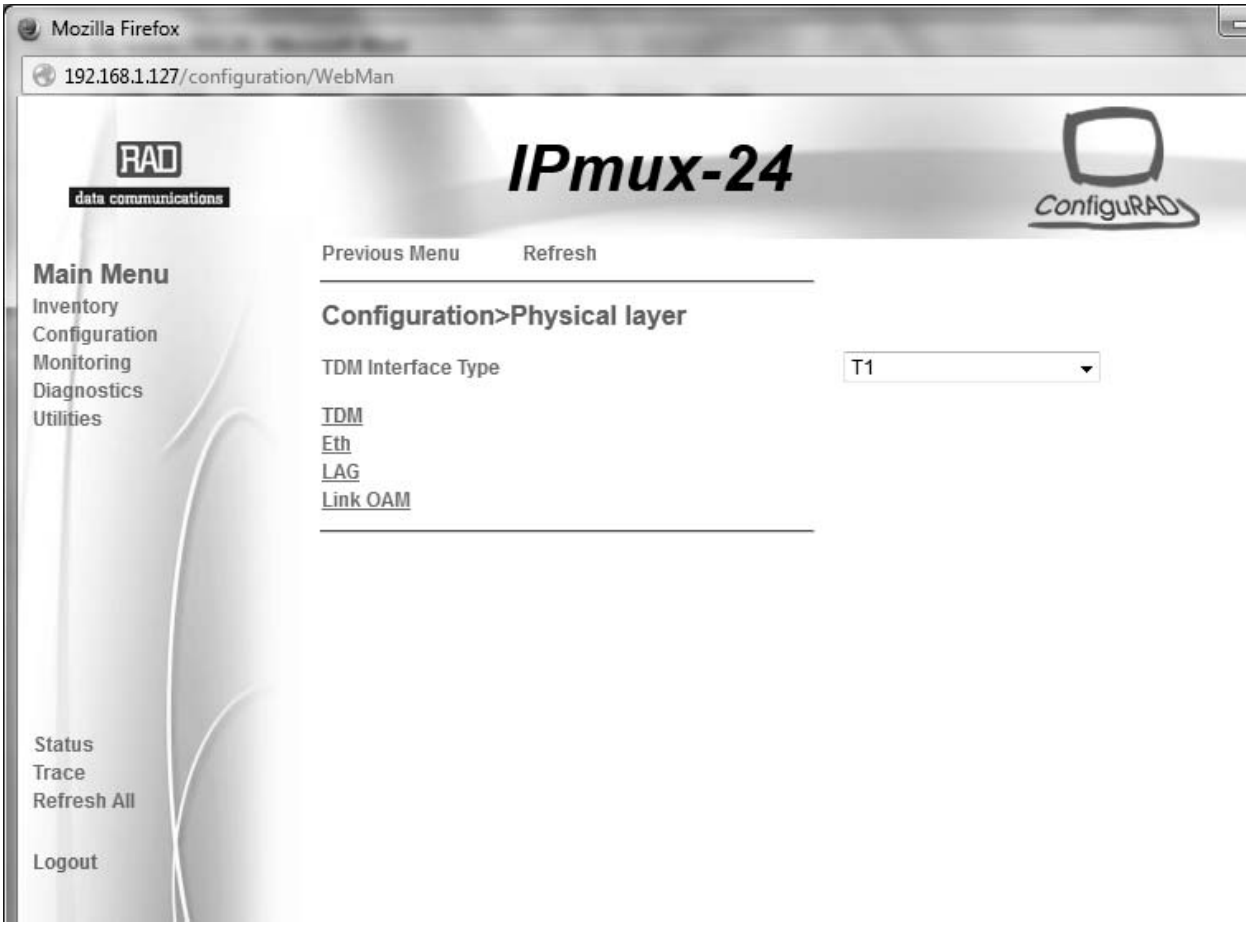
Default settings are shown above.

Select SAVE after entering the new settings.

Configuring E1 and T1 at the Physical Level

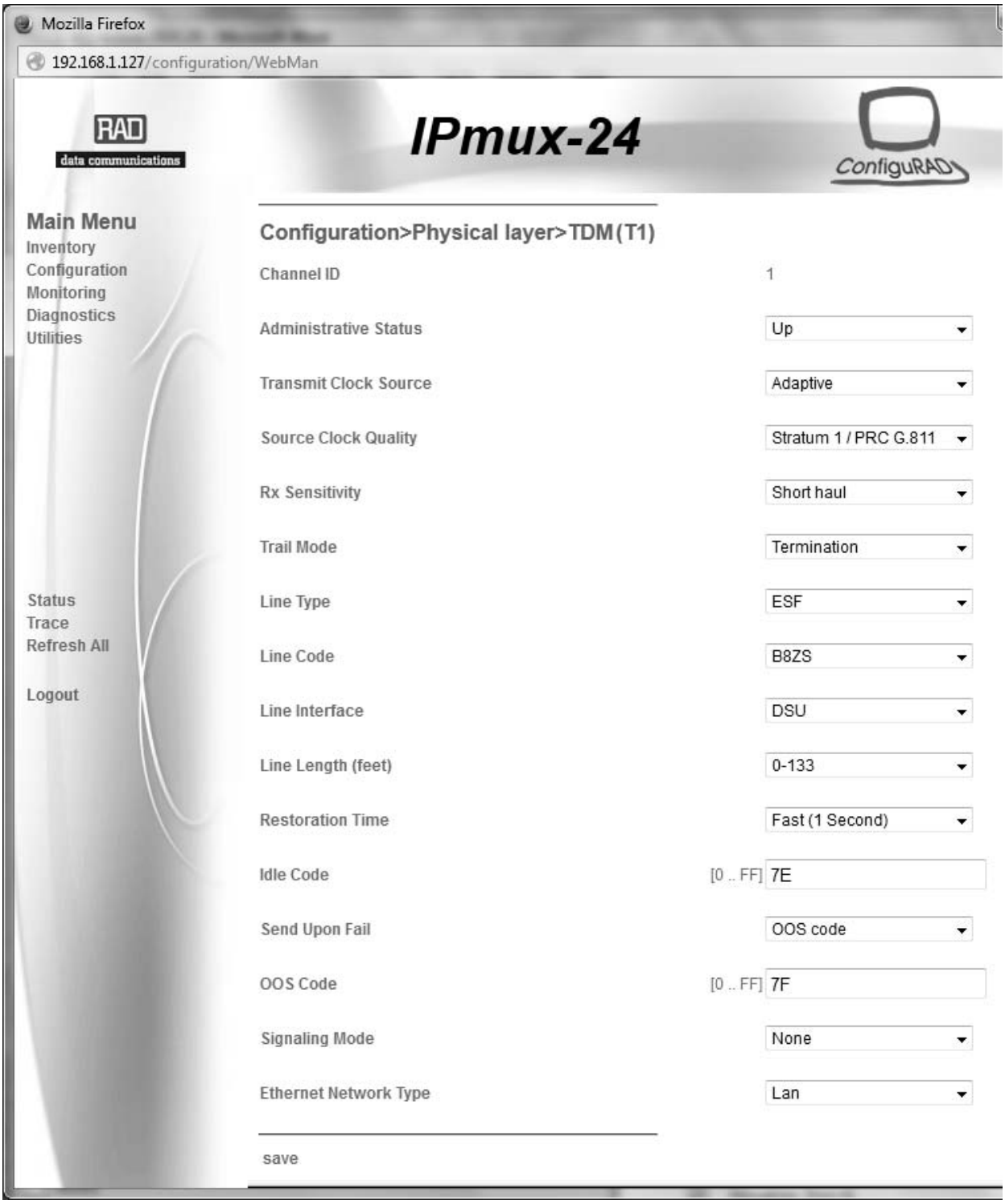
E1 and T1 interfaces must be configured at the physical level first. To configure E1 and T1 at the physical level:

From the TDM Interface Type menu (Configuration > Physical layer > TDM interface type), select the TDM interface type, E1 or T1.



The default TDM Interface Type is **T1**.

From the TDM Configuration menu (Configuration > Physical layer > TDM configuration), configure the necessary parameters of the T1 services.



The default T1 parameters are shown above.

Connecting Bundles between Line Extenders

The E1/T1 timeslots must be assigned to a bundle. IPmux-24 supports up to 16 bundles per E1/T1 link. Each bundle can include up to 31 E1 timeslots or up to 24 T1 timeslots. The bundle identification numbers are 1–16.

The bundle is then sent to the PW Host IP address of the IPmux-24 in the remote line extender. Any bundle can be connected to any bundle of the IPmux-24 in the remote line extender.

1. Assign Timeslots to a Bundle.

From the DS0 Bundle Configuration menu (Main > Configuration > Connection > DS0 bundle configuration), assign desired timeslots to a bundle by setting them to 1.

2. Configure a Pseudo Wire (PW) Host IP Address.

The PW Host IP address is used to send and receive pseudo wire traffic by the local LE300-IP Line Extender. This IP address will be the source IP address for all data transmissions to the remote LE300-IP Line Extender and must be the destination IP address for all data transmissions from the remote LE300-IP Line Extender.

Ensure that the Destination IP Address value at the remote LE300-IP is the same as the local PW Host IP address, and vice versa.

From the PW Host IP menu (Configuration > Connection > PW host IP), define IP parameters of PW host.

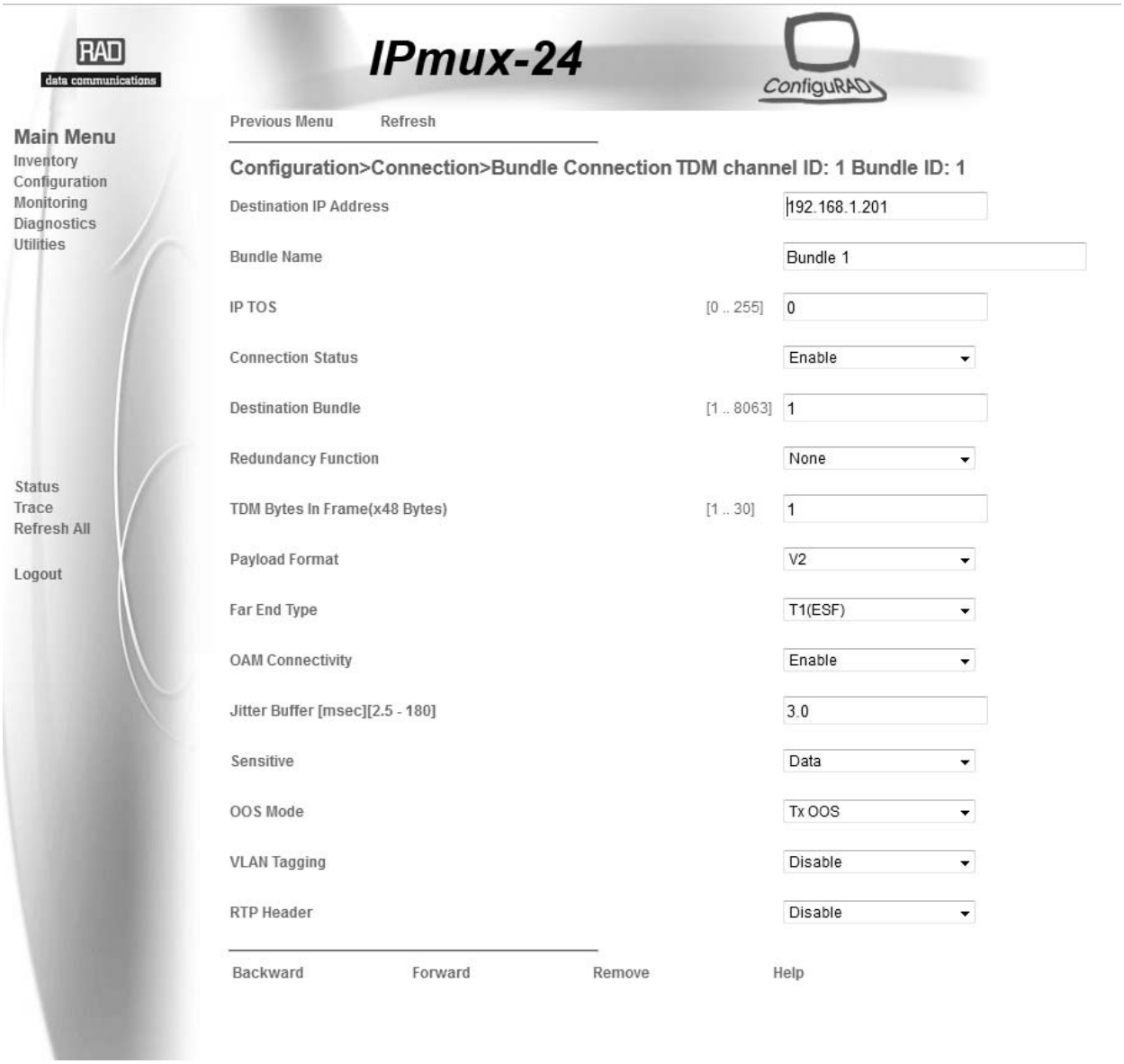
The default PW Host IP address and subnet IP mask are shown above.

NOTE: If "Loading. Please wait" message remains on the screen, select any of the Main Menu options. You will then be prompted to save settings.

3. Connecting the Bundle

Specify the destination IP address of the remote LE300-IP. Remember, this must be the same as the PW Host IP address of the IPmux-24 in the remote line extender. Also configure the necessary bundle connection parameters.

From the Bundle Connection Configuration menu (Main > Configuration > Connection > Bundle connection):



Default settings are shown above.

Summary of PC Board Connections and Settings

Table 31. Audio Line Termination Connection Module

Designator	Type	Function
J1	DB-25 connector	Connect to J4 on Main PCBA via ribbon cable.
P1	Jumper clip	Party line #3 line balance resistor (enabled/disabled)
P2	Jumper clip	Party line #2 line balance resistor (enabled/disabled)
P3	Jumper clip	Party line #4 line balance resistor (enabled/disabled)
P4	Jumper clip	Party line #1 line balance resistor (enabled/disabled)
P6	Jumper clip	Party line #5 line balance resistor (enabled/disabled
P7	Jumper clip	Page line balance resistor (enabled/disabled)
P5 & P8	Terminal block	Page Line - Terminals 1 and 2 Party Line 1 - Terminals 3 and 4 Party Line 2 - Terminals 5 and 6 Party Line 3 - Terminals 7 and 8 Party Line 4 - Terminals 9 and 10 Party Line 5 - Terminals 11 and 12
R3	Potentiometer	Party line #3 line balance resistance
R4	Potentiometer	Party line #2 line balance resistance
R19	Potentiometer	Party line #4 line balance resistance
R20	Potentiometer	Party line #1 line balance resistance
R23	Potentiometer	Party line #5 line balance resistance
R24	Potentiometer	Page line, line balance resistance
TB1	Terminal block	Chassis ground - Terminals 1 and 2
TB2	Terminal block	Chassis ground - Terminals 1 and 2

Table 32. Input/Output Termination Connection Module

Designator	Type	Function
J1	DB-25 connector	Connects to J3 on Main PCBA via ribbon cable.
TB1	Terminal block	Field connections for contact output #1 The board's silkscreen indicates the connections; the pin numbers are not labeled.
TB2	Terminal block	Field connections for contact output #2 The board's silkscreen indicates the connections; the pin numbers are not labeled.
TB3	Terminal block	Field connections for contact output #3 The board's silkscreen indicates the connections; the pin numbers are not labeled.
TB4	Terminal block	Field connections for contact output #4 The board's silkscreen indicates the connections; the pin numbers are not labeled.
TB5	Terminal block	Field connections for contact output #5 The board's silkscreen indicates the connections; the pin numbers are not labeled.
TB6	Terminal block	Field connections for page audio detected contact output The board's silkscreen indicates the connections; the pin numbers are not labeled.
TB7	Terminal block	Field connections for page ground fault contact output The board's silkscreen indicates the connections; the pin numbers are not labeled.
TB8	Terminal block	Field connections for contact inputs #1, #2, and #3 The board's silkscreen indicates the connections; the pin numbers are not labeled.
TB9	Terminal block	Field connections for contact inputs #4 and #5 Field connections for chassis ground The board's silkscreen indicates the connections; the pin numbers are not labeled.

Table 33. Main PCBA

Designator	Type	Function
J1	RJ-45 receptacle	LVDS data “out”
J2	RJ-45 receptacle	LVDS data “in”
J3	DB-25 connector	Connects to J1 on Input/Output Termination Connection Module via 25-pin ribbon cable.
J4	DB-25 connector	Connects to J1 on Page/Party® Termination Connection Module via 25-pin ribbon cable.
P1	N/A	Not installed
P2	Post header	No connection - used during production testing of PCBA
P3	N/A	Not installed
P4	Post header	No connection - used during production testing of PCBA
P5	Jumper clip	Page line ground fault detector (enabled/disabled)
P6, P7	Jumper clip	Party line #5 off-hook detector (enabled/disabled)
P8, P9	Jumper clip	Party line #4 off-hook detector (enabled/disabled)
P10, P11	Jumper clip	Party line #3 off-hook detector (enabled/disabled)
P12, P13	Jumper clip	Party line #2 off-hook detector (enabled/disabled)
P14, P15	Jumper clip	Party line #1 off-hook detector (enabled/disabled)
P16	Terminal block	Page line monitor output - Terminals 1 and 3 No connection - Terminal 2
P17, P18	Terminal block	Power 48 V dc (+) - Terminal 1 Power 48 V dc (−) - Terminal 2
P19	Terminal block	T1/E1 Data TX (ring) - Terminal 1 T1/E1 Data TX (tip) - Terminal 2 T1/E1 Data RX (ring) - Terminal 3 T1/E1 Data RX (tip) - Terminal 4
P20	Jumper clip	T1/E1 receive transformer center tap floating/grounded.
P21	Jumper clip	T1/E1 transmit transformer center tap floating/grounded.
PB1	Push-button switch	Used to retrain the echo cancellation circuit.
SW1	Rotary HEX switch	Used for diagnostic purposes. Set to 0 during normal operation.

Designator	Type	Function
SW2	8-position DIP switch	Position 1 - T1 line build out bit 0 Position 2 - T1 line build out bit 1 Position 3 - T1 line build out bit 2 Position 4 - T1/E1 receive equalizer gain limit Position 5 - Page audio hold time (bit 1) Test waveform select (bit 1) Position 6 - Page audio hold time (bit 2) Test waveform select (bit 2) Position 7 - Page audio detect threshold Test waveform select (bit 2) Position 8 - Test waveform enable
SW3	8-position DIP switch	Position 1 - T1/E1 clock source (master/slave) Position 2 - T1/E1 clock source (master/slave) Position 3 - LVDS “in” (enabled/disabled) Position 4 - LVDS “out” (enabled/disabled) Position 5 - 600-ohm audio monitor volume (bit 1) Position 6 - 600-ohm audio monitor volume (bit 2) Position 7 - 600-ohm audio monitor volume (bit 3) Position 8 - 600-ohm audio monitor volume (bit 4)
SW4	8-position DIP switch	Position 1 - Party Line 5 (connect/disconnect) Position 2 - Party Line 4(connect/disconnect) Position 3 - Party Line 3 (connect/disconnect) Position 4 - Party Line 2 (connect/disconnect) Position 5 - Party Line 1 (connect/disconnect) Position 6 - Page line (connect/disconnect) Position 7 - Page line monitor output (connect/disconnect) Position 8 - Not used
SW5	8-position DIP switch	Position 1 - SmartSeries Page Line FSK data (enable/disable) Position 2 - 50 kHz Page Line VLC signal (enable/disable) Position 3 - Regenerate page line ground fault (enable/disable) Position 4 - GND fault contact activates on local page line fault. Position 5 - GND fault contact activates on remote page line fault. Position 6 - Page audio contact activates on local page line audio. Position 7 - Page audio contact activates on remote page line audio. Position 8 - T1 or E1 mode selection
SW6	4-position DIP switch	Position 1 - One minute startup delay of echo cancellation training (enable/disable) Position 2 - Local party line off-hook regeneration (enable/disable) Position 3 - On-hook party line muting (enable/disable) Position 4 - Mute all audio lines (enable/disable)

Record of the Settings

The following tables have been included to document the "as installed" LE300-IP settings for future reference.

Table 34. Line Balance Resistor Enable on Audio Line Termination Connection Module

Header	Setting	Note
P1		Party Line #3
P2		Party Line #2
P3		Party Line #4
P4		Party Line #1
P6		Party Line #5
P7		Page Line

Table 35. Line Balance Resistance on Audio Line Termination Connection Module

Potentiometer	Setting	Note
R3		Party Line #3
R4		Party Line #2
R19		Party Line #4
R20		Party Line #1
R23		Party Line #5
R24		Page Line

Table 36. Off-hook and Ground Fault Detection on Main PCBA

Header	Setting	Note
P5		Page line ground fault detector
P6, P7		Party line #5 off-hook detector
P8, P9		Party line #4 off-hook detector
P10, P11		Party line #3 off-hook detector
P12, P13		Party line #2 off-hook detector
P14, P15		Party line #1 off-hook detector

Rotary Switch SW1 on Main PCBA

Set to "0" during normal operation.

Table 37. DIP Switch SW2 on Main PCBA

Switch	Setting	Function
SW2-1		T1 line length
SW2-2		
SW2-3		
SW2-4		T1/E1 receive equalizer gain limit
SW2-5		Page line transmission direction hold time
SW2-6		
SW2-7		Page line peak voltage level detection threshold
SW2-8	Open (Up)	Used during testing only.

Table 38. DIP Switch SW3 on Main PCBA

Switch	Setting	Function
SW3-1		T1/E1 master/slave
SW3-2		
SW3-3		Enable LVDS “in”
SW3-4		Enable LVDS “out”
SW3-5		Monitor volume
SW3-6		
SW3-7		
SW3-8		

Table 39. DIP Switch SW4 on Main PCBA

	Switch	Setting	Note
	SW4-1		Party line #5 connection to terminal board
	SW4-2		Party line #4 connection to terminal board
	SW4-3		Party line #3 connection to terminal board
	SW4-4		Party line #2 connection to terminal board
	SW4-5		Party line #1 connection to terminal board
	SW4-6		Page line connection to terminal board
	SW4-7		Monitor output connection to terminal block
	SW4-8	N/A	Not used

Table 40. DIP Switch SW5 on Main PCBA

	Switch	Setting	Note
	SW5-1		Enable FSK data for SmartSeries systems
	SW5-2		Enable 50 kHz VLC
	SW5-3		Regenerate page line ground fault
	SW5-4		Local ground fault activates output contact
	SW5-5		Remote ground fault activates output contact
	SW5-6		Local page audio activates output contact
	SW5-7		Remote page audio activates output contact
	SW5-8		Select T1 mode or E1 mode

Table 41. DIP Switch SW6 on Main PCBA

	Switch	Setting	Note
	SW6-1		Startup delay of echo cancellation training
	SW6-2		Local party line off-hook regeneration
	SW6-3		On-hook party line muting
	SW6-4		Mute analog circuits

Table 42. T1/E1 Line Grounding on Main PCBA

	Header	Setting	Note
	P20		T1/E1 Line receive
	P21		T1/E1 Line transmit

Testing and Troubleshooting

Generating Audio Test Signals

The Model LE300-IP Line Extender is capable of generating several testing waveforms onto the audio lines of the Page/Party® system to aid in system testing and troubleshooting. Rotary switch SW1 on the Main PCBA determines which Page/Party® audio line will receive the test waveform. DIP switch SW2 determines which testing waveform is generated. Closing DIP switch SW2-8 enables the test waveform. Switches SW2-5 through SW2-7 select a test waveform. Note that the frequency selections are different on the selected audio party line. Refer to tables below for valid switch settings.

Table 43.

SW1	Selected Page/Party® Line
1	Party Line #1
6	Page Line

Selected Tone	SW2-5	SW2-6	SW2-7	SW2-8
7 kHz (sine wave)	Open	Open	Open	Closed
4 kHz (sine wave)	Closed	Open	Open	Closed
2 kHz (sine wave)	Open	Closed	Open	Closed
1 kHz (sine wave)	Closed	Closed	Open	Closed
500 Hz (sine wave)	Open	Open	Closed	Closed
125 Hz (sine wave)	Closed	Open	Closed	Closed
1 kHz (saw tooth wave)	Open	Closed	Closed	Closed
31 Hz pulses	Closed	Closed	Closed	Closed

SW1	Selected Page/Party® Line
2	Party Line #2
3	Party Line #3
4	Party Line #4
5	Party Line #5

Selected Tone	SW2-5	SW2-6	SW2-7	SW2-8
3.5 kHz (sine wave)	Open	Open	Open	Closed
2.0 kHz (sine wave)	Closed	Open	Open	Closed
1.0 kHz (sine wave)	Open	Closed	Open	Closed
500 Hz (sine wave)	Closed	Closed	Open	Closed
250 Hz (sine wave)	Open	Open	Closed	Closed
125 Hz (sine wave)	Closed	Open	Closed	Closed
1 kHz (saw tooth wave)	Open	Closed	Closed	Closed
31 Hz Pulses	Closed	Closed	Closed	Closed

NOTE: Remember to restore SW1 to "0" and SW2 to its initial setting when no longer generating test signals.

Function Testing

The Model LE300-IP can manually activate some of the system "control" functions to aid in system troubleshooting or commissioning. Functions include relay contact outputs, party line off-hook generation, page line ground fault generation, and the LVDS connector LEDs. Similar to the audio test generation, rotary switch SW1 and DIP switch SW2 are used to activate the various functions. Refer to the tables below for valid switch settings.

Table 44. Generated Data Signaling on Page Line

SW1	Selected Data Signal	SW2-5	SW2-6	SW2-7	SW2-8
B	50.087 kHz sine wave (VLC tone)	Closed	Open	Open	Closed
	30.720 kHz sine wave (SmartSeries data 0)	Open	Closed	Open	Closed
	32.941 kHz sine wave (SmartSeries data 1)	Closed	Closed	Open	Closed
	SmartSeries data 1/0 pattern	Open	Open	Closed	Closed
	Random waveform containing all signals above.	Closed	Open	Closed	Closed

NOTE: Remember to restore SW1 to "0" and SW2 to its initial setting when no longer generating test signals.

Table 45. Activate Contact Closure Outputs

SW1	Selected Function	SW2	SW2-8
7	Activate Contact Output #1	SW2-1 Closed	Closed
	Activate Contact Output #2	SW2-2 Closed	Closed
	Activate Contact Output #3	SW2-3 Closed	Closed
	Activate Contact Output #4	SW2-4 Closed	Closed
	Activate Contact Output #5	SW2-5 Closed	Closed
	Activate Page Audio Detect Contact	SW2-6 Closed	Closed
	Activate Page Ground Fault Detect Contact	SW2-7 Closed	Closed

NOTE: Remember to restore SW1 to "0" and SW2 to its initial setting when no longer generating test signals.

Table 46. Generate Off-Hook & Ground Fault Conditions

SW1	Selected Function	SW2	SW2-8
7	Party Line #1 Off-hook	SW2-1 Closed	Closed
	Party Line #2 Off-hook	SW2-2 Closed	Closed
	Party Line #3 Off-hook	SW2-3 Closed	Closed
	Party Line #4 Off-hook	SW2-4 Closed	Closed
	Party Line #5 Off-Hook	SW2-5 Closed	Closed
	Page Line Ground Fault	SW2-6 Closed	Closed

NOTE: Remember to restore SW1 to "0" and SW2 to its initial setting when no longer generating test signals.

Performance Monitoring

The IPmux-24 provides performance monitoring tools, which consist of the following three levels:

1. E1/T1 statistics - Status of the physical E1/T1 parameters (signal, framing, etc.)

2. Ethernet statistics - Ethernet connection status (speed, duplex mode, bytes transmitted & received, etc.).

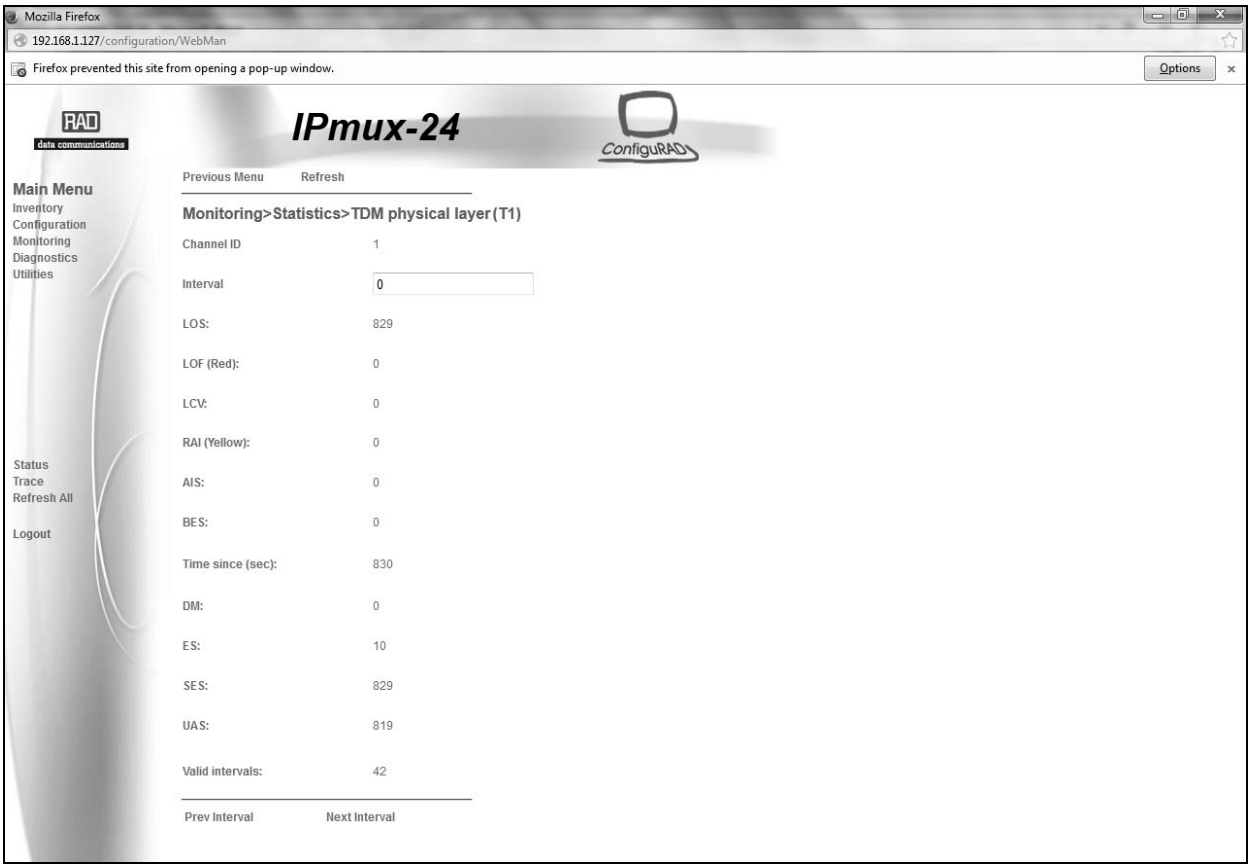
3. Bundle connection statistics - PW bundle connection status on the PSN level.

E1/T1 Statistics

E1/T1 statistics refer to the physical status of the E1/T1 traffic reaching IPmux-24 from the adjacent E1/T1 device. E1/T1 statistics are monitored and saved under consecutive intervals. Each interval is 15 minutes long. There are 96 intervals, which represent the last 24 hours. Whenever a new interval is started, the counters are reset to zero. The old interval shows the total of events that occurred during its 15-minute period.

The current active interval is always marked as interval 0 (you will see that the Time Since counter is running). The previous interval is marked as 1, and so on. The E1/T1 statistic counters cannot be reset manually.

From the Monitoring menu (Statistics> TDM Physical Layer> T1):

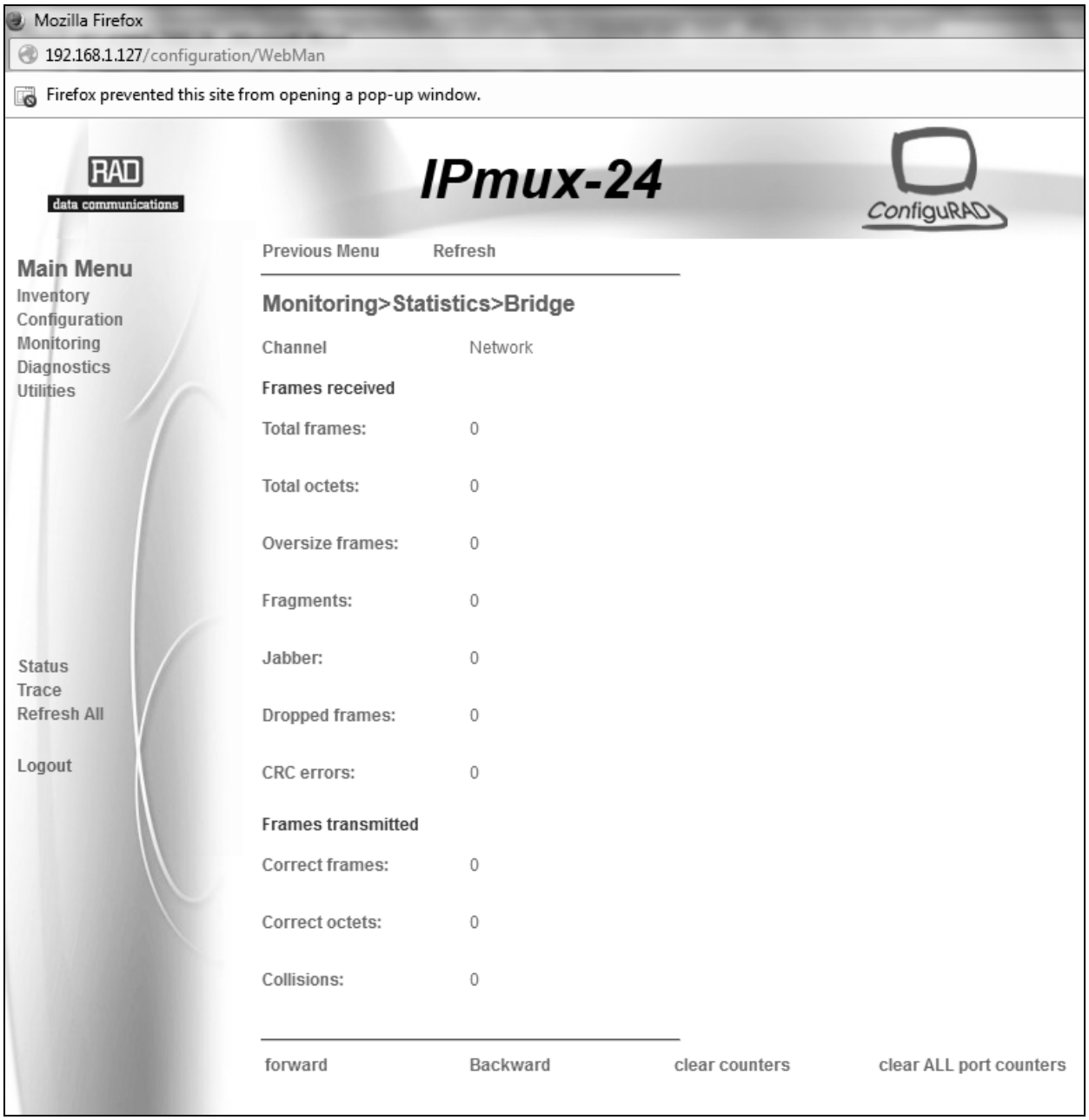


Enter the number of the interval whose statistics you wish to display, and press ENTER.

Ethernet Statistics

You can display statistic data for the network and user Ethernet ports.

From the Monitoring Menu (Statistics>Bridge):

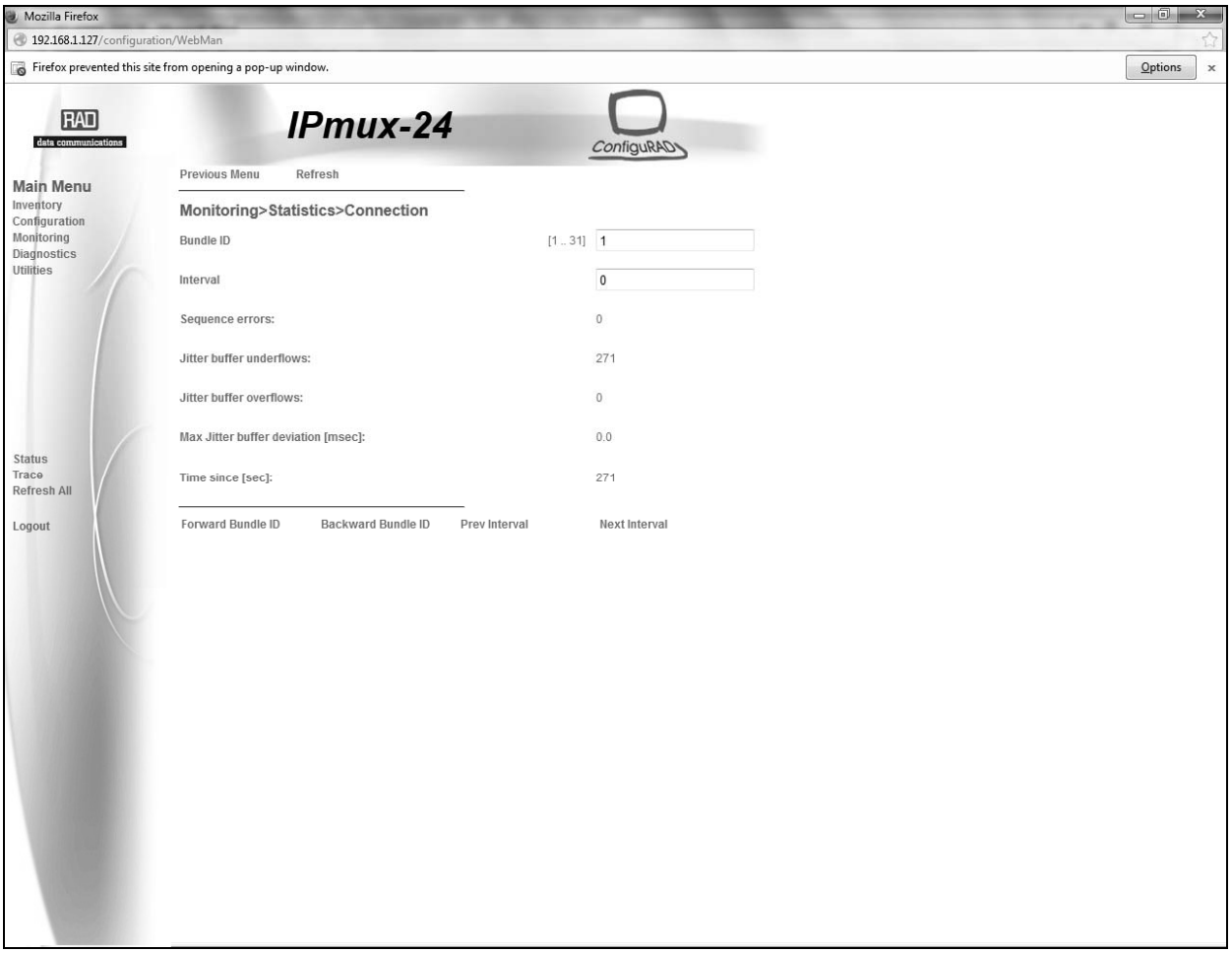


Use the FORWARD and BACKWARD buttons to view the various Ethernet ports. Press CLEAR COUNTERS to reset the port counters. Press CLEAR ALL PORT COUNTERS to reset the counters on all the Ethernet ports.

Bundle Connection Statistics

The Connection screen provides information about the integrity of the TDMoIP connection, including the status of the jitter buffer. Each bundle has its own independent jitter buffer.

From the Monitoring Menu (Statistics>Connection):



Select Bundle ID, enter the number of the bundle whose statistics you wish to display, and press ENTER.

Select Interval, enter the number of the interval whose statistics you wish to display, and press ENTER.

Specifications

Electrical

Supply Voltage

Input voltage ..... 120–240V ac, 50/60 Hz

Power consumption..... 33 watts (nominal)
82 watts (maximum)

Internal Power Supply

Voltage..... 48 V
Power ..... 75 watts maximum
DC operating current..... 250 mA (idle, nominal)
1000 mA (maximum)

T1 Parameters

Encoding ..... (Bipolar with 8 Zero Substitution) B8ZS
Framing..... (Extended Superframe) ESF

E1 Parameters

Encoding ..... (High Density Bipolar 3) HDB3
Framing..... (Cyclic Redundancy Check 4) CRC4
Signaling ..... (Common Channel Signaling) CCS

Copper Cabling

Type ..... CAT5e or CAT 6
Maximum cable length ..... 100 meters

Fiber Optic Cabling (Optional SFP Module Required)

The maximum data transmission distance archived over a fiber optic link depends on many factors, such as Transmit Power, Receiver Sensitivity /Saturation, splices and cable type. Prior to designing or installing a fiber optic system, a loss budget analysis is recommended to make certain the system will work over the proposed link. Both the passive and active components of the circuit have to be included in the budget loss calculation. Passive loss is made up of fiber loss, connector loss, splice loss, couplers or splitters in the link. Active components are system gain, wavelength, transmitter power, receiver sensitivity, and dynamic range. Prior to system turn up, test the circuit with a source and FO power meter to ensure that it is within the loss budget. The following distance information is approximate. Refer to the RAD website for specifications of SFP modules http://www.radusa.com/template.MEDIA_ITEM/6394_SFPs.pdf.
GAI-Tronics offers the following models but additional modules are available directly from RAD.

GTRFP6972-501 ..... Fast Ethernet/STM-1, 1310 nm, multimode, LED, 2 km (1.2 mi)
GTRFP6972-502 .....Fast Ethernet/STM-1, 1310 nm, single mode, laser, 15 km (9.3 mi)
GTRFP6972-503 .....Fast Ethernet/STM-1, 1310 nm, single mode, laser, 40 km (24.8 mi)
GTRFP6972-504 .....Fast Ethernet/STM-1, 1310 nm, single mode, laser, 80 km (49.7 mi)

Optical Port Type..... LC

LVDS Cabling

Type ..... Straight-through Shielded CAT 5e
Cable characteristic impedance..... 100 Ω (nominal)
Maximum cable length ..... 10 meters

Line Balance Characteristics

Coupling..... AC coupled
Adjustment range..... Disabled, 15 to 115 Ω adjustable (nominal)

Page Line or Party Line Maximum Peak Working Voltage

L1 to L2 ..... ±30 volts dc nominal
L1 or L2 to ground..... ±120 volts dc nominal

Page Line Data

VLC frequency..... 50,087 Hz nominal
FSK high frequency (start bit) ..... 32,914 Hz nominal
FSK low frequency (stop bit)..... 30,720 Hz nominal
FSK baud rate ..... 2400 bits per second
Page line data voltage transmit level..... 707 mVrms ±3 dB @ 33 Ω impedance
Output type..... Current source with 3.3 kΩ impedance, transformer coupled (nominal)
VLC frequency capture range ..... (within) inside 43,886 ≤ frequency ≤ 57,600 Hz nominal
VLC frequency release range..... (beyond) outside 40,070 ≤ frequency ≤ 65,829 Hz nominal
FSK high frequency capture range..... (within) inside 32,914 ≤ frequency ≤ 34,133 Hz nominal
FSK high frequency release range ..... (beyond) outside 31,779 ≤ frequency ≤ 36,864 Hz nominal
FSK low frequency capture range..... (within) inside 29,729 ≤ frequency ≤ 31,779 Hz nominal
FSK low frequency release range ..... (beyond) outside 27,106 ≤ frequency ≤ 31,779 Hz nominal
Page line data voltage detected range ..... ≥100 mVrms
Page line data voltage not detected range ..... ≤4.0 mVrms

Page Line Monitor Audio from Either Page Line

Frequency response..... 300 Hz to 7.0 kHz ±0.5 dB @ −10 dB
Reference voltage level..... 775 mVrms @ 600 Ω impedance (nominal)
Output type..... Voltage source with 600 Ω impedance, transformer coupled (nominal)
Gain error..... ±3 dB @ 1,020 Hz sine wave
0 dB ref. 775 mVrms @ 600 Ω impedance
Distortion + noise..... THD < 1.0% @ 1,020 Hz sine wave
0 dB ref. 775 mVrms @ 600 Ω impedance
Sampling rate ..... 16,000 samples per second ±32 ppm
Encoding ..... linear
Direction ..... output only
Gain adjustment range ..... −30 to +12 dB in 3 dB steps (nominal)
Maximum Peak Working Voltage L1 to L2 ..... ±15 volts dc nominal

Page Line Audio between Two LE300-IPs

Frequency response ..... 300 Hz to 7.0 kHz ±0.5 dB @ −10 dB
Reference voltage level ..... 1.5 Vrms @ 33 Ω impedance (nominal)
Output type ..... Current source with 3.3 kΩ impedance, transformer coupled (nominal)
Gain error ..... ±3 dB @ 1,020 Hz sine wave
0 dB ref. 1.5 Vrms @ 33 Ω impedance both ends
Distortion + noise ..... THD <1.0% @ 1,020 Hz sine wave
0 dB ref. 1.5 Vrms @ 33 Ω impedance both ends
Sampling rate ..... 16,000 samples per second ± 32 ppm
Encoding ..... Linear
Direction ..... Half duplex

NOTE: Refer to text for considerations when connecting LE300-IPs in series.

Party Line #1 Audio between Two LE300-IPs

Frequency response ..... 300 Hz to 7.0 kHz ±0.5 dB @ −10 dB
Reference voltage level ..... 1.5 Vrms @ 33 Ω impedance (nominal)
Output type ..... Current source with 3.3 kΩ impedance, transformer coupled (nominal)
Gain error ..... ±3 dB @ 1,020 Hz sine wave
0 dB ref. 1.5 Vrms @ 33 Ω impedance both ends
Distortion + noise ..... THD <1.0% @ 1,020 Hz sine wave
0 dB ref. 1.5 Vrms @ 33 Ω impedance both ends
Sampling rate ..... 16,000 samples per second ±32 ppm
Encoding ..... Linear
Direction ..... Full duplex

NOTE: Refer to text for considerations when connecting LE300-IPs in series.

Party Line #2 to #5 Audio between Two LE300-IPs

Frequency response ..... 300 Hz to 3.5 kHz ±0.5 dB @ −10 dB
Reference voltage level ..... 1.5 Vrms @ 33 Ω impedance (nominal)
Output type ..... Current source with 3.3 kΩ impedance, transformer coupled (nominal)
Gain error ..... ±3 dB @ 1,020 Hz sine wave
0 dB ref. 1.5 Vrms @ 33 Ω impedance both ends
Distortion + noise ..... THD <1.0% @ 1,020 Hz sine wave
0 dB ref. 1.5 Vrms @ 33 Ω impedance both ends
Sampling rate ..... 8,000 samples per second ±32 ppm
Encoding ..... Linear
Direction ..... Full duplex

NOTE: Refer to text for considerations when connecting LE300-IPs in series.

Page Line Audio Detection

Detection peak voltage threshold selections ..... −12 or −24 dB ref. nominal
Detection hold time selections ..... 40, 160, 640, 1280 milliseconds (nominal)
Hold time on audio detected relay output ..... 1 second (nominal)

Page Line Ground Fault Detection

DC resistance from either L1 or L2 to ground for fault ..... ≤5,000 Ω
DC resistance from either L1 or L2 to ground for no fault ..... ≥8,000 Ω
Minimum ground fault duration for detection ..... 10 seconds (nominal)
Minimum no ground fault duration for detection ..... 10 seconds (nominal)
No ground fault to ground fault propagation delay..... ≤20 seconds includes detection time
Ground fault to no ground fault propagation delay..... ≤20 seconds includes detection time

NOTE: Rapidly changing ground fault conditions may or may not be detected.

Page Line Ground Fault Generation

Resistance when generating ground fault ..... 3.3 kΩ (nominal)
Resistance when not generating ground fault ..... ≥1 MΩ

NOTE: The resistance is from the center tap of the page line coupling transformer to ground.

Party Line Off-hook detection

DC resistance between L1 and L2 for off-hook..... ≤300 Ω
DC resistance between L1 and L2 for on-hook ..... ≥30,000 Ω
Minimum off-hook duration for detection..... 50 milliseconds (nominal)
Minimum on-hook duration for detection..... 5 seconds (nominal)
On-hook to off-hook propagation delay..... ≤0.5 second includes detection time
Off-hook to on-hook propagation delay..... ≤10 seconds includes detection time

NOTE: Rapidly changing off-hook or on-hook conditions may or may not be detected.

Contact Outputs

Contact output type ..... DPDT miniature signal relay
Switching power ..... ≤30 W dc (resistive load)
≤62.5 VA ac (resistive load)
Switching voltage..... ≤110 V dc
≤125 V ac
Switching current ..... ≤1.0 A
Minimum switching capacity..... 10 μA, 10 mV dc (nominal)

NOTE: When neither the T1/E1 Link nor the LVDS link is detected, the contact outputs are de-energized.

Contact Inputs

Dry contact input open resistance ..... ≥20,000 Ω
Dry contact input closed resistance..... ≤200 Ω
Wet contact input open voltage..... 2.6 ≤ voltage ≤ +3.6 volts dc
Wet contact input closed voltage ..... 0.0 ≤ voltage ≤ 0.23 volts dc
Contact input allowed voltage ..... 0.0 ≤ voltage ≤ +3.6 volts dc
Contact input sink current..... ≤1.0 mA dc
Contact input state duration ..... ≥50 ms
Contact input to contact output delay ..... ≤50 ms
Contact input to contact output jitter..... ±10 ms
Contact input to contact output pulse width tolerance..... ±10 ms

NOTES:

1. Rapidly changing contact inputs may or may not be detected.
2. Contact input to contact output specifications does not include the effects of relay bounce.
3. The contact input's negative terminal is tied directly to the LE300-IP's signal ground.
4. Wet contact input voltages are measured at the input terminals on the I/O Connection Module.
5. The "wet contact input closed voltage" may be difficult to achieve when connecting a bipolar open collector output to a contact input.
6. A driving high wet contact input will source current to the LE300-IP when the LE300-IP is not powered. This current may or may not prevent the LE300-IP from powering up properly.
7. Be aware of the ground loop(s) formed when using wet contact inputs.

Mechanical

Enclosure Material..... Steel
Unit dimensions ..... 20.0 H × 20.0 W × 6.9 D inches (508 × 508 × 173 mm) nominal
Unit weight..... 40 lbs.
Enclosure Environmental Rating ..... NEMA 4

Environmental

Temperature range ..... 0° C to +50° C (+32° F to +122° F)
Relative humidity..... 10–85% non-condensing

Replacement Parts

Part Number	Description
51701-039	Circuit Breaker, 15 A
51809-008	Fuse, 2 A
13118-011	Audio Terminal Connection Module
13118-012	I/O Terminal Connection Module
61214-007	DB25 Ribbon Cable Assembly
69443-002	Line Extender Main PCBA
GTRFP6019-011	Power Supply, 48 V dc, 75 W
GTRFP6972-500	IPmux-24 TDM Pseudowire Access Gateway

Reference Material

Pub. 488-200-08/12, IPmux-24 TDM Pseudowire Access Gateway Installation and Operation Manual (Catalog No. 803781)

Available from:
RAD Data Communications Inc.
900 Corporate Drive
Mahwah, NJ 07430, USA
(800) 444-7234
www.radusa.com

Definitions and Acronyms

Term	Definition
Address	A coded representation of the origin or destination of date.
Attenuation	Signal power loss through equipment, lines or other transmission devices. Measured in decibels.
AWG	The American Wire Gauge system, which specifies wire width.
Balanced	A transmission line in which voltages on the two conductors are equal in magnitude, but opposite in polarity, with respect to ground.
Bandwidth	The range of frequencies passing through a given circuit. The greater the bandwidth, the more information can be sent through the circuit in a given amount of time.
Bipolar	Signaling method in E1/T1 representing a binary “1” by alternating positive and negative pulses, and a binary “0” by absence of pulses.

Term	Definition
Buffer	A storage device. Commonly used to compensate for differences in data rates or event timing when transmitting from one device to another. Also used to remove jitter.
Clock	A term for the source(s) of timing signals used in synchronous transmission.
Configuration	The arrangement of hardware in the system and the setting of various attributes and parameters used by the software to provide the desired features.
Destination	A destination determines where audio broadcasts.
Distributed Amplifier	An amplifier that resides in a zone. It amplifies broadcasts for certain loudspeakers (usually two or less) in the zone.
Dual PPI	Acronym for Dual Page/Party® Interface. A card in the ADVANCE control cabinet that allows two Page/Party® zones to be connected to the system.
E1	A digital transmission link with a capacity of 2.048 Mbps used in Europe. Is used to transmit 30 digital channels for voice or data plus one channel for signaling, and one channel for framing and maintenance.
EOL	Acronym for End-of-Line. An intelligent device located at the end of a wiring segment for the purpose of monitoring cable integrity.
Ethernet	A local area network (LAN) technology which has extended into the wide area networks. Ethernet operates at many speeds, including data rates of 10 Mbps (Ethernet), 100 Mbps (Fast Ethernet), 1,000 Mbps (Gigabit Ethernet), 10 Gbps, 40 Gbps, and 100 Gbps.
FSK	Acronym for Frequency Shift Keying.
Impedance	The combined effect of resistance, inductance, and capacitance on a transmitted signal, Impedance varies at different frequencies.
Interface	A shared boundary, defined by common physical interconnection characteristics, signal characteristics, and meanings of exchanged signals.
IP Address	Also known as an Internet address. A unique string of numbers that identifies a computer or device on a TCP/IP network. The format of an IP address is a 32-bit numeric address written a four numbers from) to 255, separated by periods (for example, 1.0.255.123)
Jitter	The deviation of a transmission signal in time or phase. It can introduce errors and loss of synchronization in high speed synchronous communications.
LED	Acronym for Light Emitting Diode. Used as a visual indicator (lamp) on equipment such as access panels and cards.
Loading	The addition of inductance to a line in order to minimize amplitude distortion. Used commonly on public telephone lines to improve voice quality, it can make the lines impassable to high speed data, and baseband modems.

Term	Definition
LVDS	Acronym for Low Voltage Differential Signaling.
Master Clock	The source of timing signals (or the signals themselves) that all network stations use for synchronization.
Muting	The act of silencing an audio broadcast.
NTP	The Network Time Protocol, a protocol for synchronizing the clocks of computer systems over packet-switched, variable-latency data networks. NTP uses UDP on port 123 as its transport layer.
Off-hook	A state where a handset is not in the cradle.
On-hook	The handset is in the cradle.
Page	A one-way audio announcement that is broadcast from loudspeakers.
Page/Party® Handset Station	A device that performs all of the following: amplifies audio broadcast in a Page/Party® zone, allows a user to initiate a page, and allows a user to conduct a 2-way party line conversation. A station contains a distributed amplifier.
Page/Party® Products	A family of products designed and manufactured by GAI-Tronics Corporation.
Page/Party® Speaker Amplifier Station	A device that amplifies audio broadcast in a Page/Party® zone.
Page/Party® Zone	The collection of Page/Party® and/or SmartSeries products connected to a common circuit.
Party Line Conversation	Full-duplex communication conducted by two or more users and/or operators. Conversation is not broadcast over speakers.
Port	The physical interface to a computer or multiplexer, for connection of terminals and modems.
PPI	Acronym for Page/Party® Interface. A card that allows one Page/Party® zone to be connected to an ADVANCE control cabinet.
Protocol	A formal set of conventions governing the formatting and relative timing of message exchange between two communicating systems.
Pseudowire	Point-to-point connections set up to emulate (typically Layer 2) native services like ATM, Frame Relay, Ethernet, TDM, or SoNET/SDH over an underlying common packet-switched network (Ethernet, MPLS or IP) core. Pseudowires are defined by the IETF PWE3 (pseudowire emulation edge-to-edge) working group.

Term	Definition
RTU	Acronym for Remote Terminal Unit. A SmartSeries handset or amplifier station that can receive inputs from initiating devices or provide outputs to indicating appliances. It provides input circuits and relay outputs.
SFP	Acronym for Small Form-factor Pluggable.
SmartSeries Amplifier Station	A device that includes a microprocessor and amplifies audio broadcast in a Page/Party® zone.
SmartSeries Handset Station	A device that includes a microprocessor. It amplifies audio broadcast in a Page/Party® zone, allows a user to initiate a page, and allows a user to conduct two-way party line conversation.
SmartSeries Products	SmartSeries products are a family of intelligent, microprocessor-based products designed and manufactured by GAI-Tronics Corporation.
SmartSeries Station RTU	See RTU.
Supervision	The ability of the system to determine whether a communication path is working properly.
T1	A digital transmission link with a capacity of 1.544 Mbps used in North America. Typically channelized into 24 DS0s, each capable of carrying a single voice conversation or data stream. Uses two pairs of twisted pair wires.
TDMoIP®	TDM over IP is a standards-based pseudowire transport technology that extends voice, video or data circuits across packet-switched networks simply, transparently and economically. TDMoIP supports the multiple signaling standards, OAM mechanisms and clock recovery features demanded by TDM networks for carrying voice-grade telephony.
Throughput	The amount of information transferred through the network between two users in a given period, usually measured in the number of packets per second (pps).
Time-out	The cancellation of a particular operational mode due to the expiration of a specified period of time.
VLC	Acronym for Volume Level Control.
Zone	A device or collection of devices connected by a common wire.

Warranty

Equipment. GAI-Tronics warrants for a period of one (1) year from the date of shipment, that any GAI-Tronics equipment supplied hereunder shall be free of defects in material and workmanship, shall comply with the then-current product specifications and product literature, and if applicable, shall be fit for the purpose specified in the agreed-upon quotation or proposal document. If (a) Seller's goods prove to be defective in workmanship and/or material under normal and proper usage, or unfit for the purpose specified and agreed upon, and (b) Buyer's claim is made within the warranty period set forth above, Buyer may return such goods to GAI-Tronics' nearest depot repair facility, freight prepaid, at which time they will be repaired or replaced, at Seller's option, without charge to Buyer. Repair or replacement shall be Buyer's sole and exclusive remedy. The warranty period on any repaired or replacement equipment shall be the greater of the ninety (90) day repair warranty or one (1) year from the date the original equipment was shipped. In no event shall GAI-Tronics warranty obligations with respect to equipment exceed 100% of the total cost of the equipment supplied hereunder. Buyer may also be entitled to the manufacturer's warranty on any third-party goods supplied by GAI-Tronics hereunder. The applicability of any such third-party warranty will be determined by GAI-Tronics.

Services. Any services GAI-Tronics provides hereunder, whether directly or through subcontractors, shall be performed in accordance with the standard of care with which such services are normally provided in the industry. If the services fail to meet the applicable industry standard, GAI-Tronics will re-perform such services at no cost to buyer to correct said deficiency to Company's satisfaction provided any and all issues are identified prior to the demobilization of the Contractor's personnel from the work site. Re-performance of services shall be Buyer's sole and exclusive remedy, and in no event shall GAI-Tronics warranty obligations with respect to services exceed 100% of the total cost of the services provided hereunder.

Warranty Periods. Every claim by Buyer alleging a defect in the goods and/or services provided hereunder shall be deemed waived unless such claim is made in writing within the applicable warranty periods as set forth above. Provided, however, that if the defect complained of is latent and not discoverable within the above warranty periods, every claim arising on account of such latent defect shall be deemed waived unless it is made in writing within a reasonable time after such latent defect is or should have been discovered by Buyer.

Limitations / Exclusions. The warranties herein shall not apply to, and GAI-Tronics shall not be responsible for, any damage to the goods or failure of the services supplied hereunder, to the extent caused by Buyer's neglect, failure to follow operational and maintenance procedures provided with the equipment, or the use of technicians not specifically authorized by GAI-Tronics to maintain or service the equipment. THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE IN LIEU OF AND EXCLUDE ALL OTHER WARRANTIES AND REMEDIES, WHETHER EXPRESS OR IMPLIED BY OPERATION OF LAW OR OTHERWISE, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Return Policy

If the equipment requires service, contact your Regional Service Center for a return authorization number (RA#). Equipment should be shipped prepaid to GAI-Tronics with a return authorization number and a purchase order number. If the equipment is under warranty, repairs or a replacement will be made in accordance with the warranty policy set forth above. Please include a written explanation of all defects to assist our technicians in their troubleshooting efforts.

Call 800-492-1212 (inside the USA) or 610-777-1374 (outside the USA) for help identifying the Regional Service Center closest to you.