LEX2000 Series™ ATSC Encoder / Mux User Manual

Linear Encoding Xponents™

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1. OVERVIEW

The LEX2000 multi-channel ATSC Encoder / Multiplexer supports ATSC cable / QAM and terrestrial / 8VSB broadcast applications, integrating a multitude of signal processing functions into a single, reliable, high performance, easy-to-use, low power product. The LEX2000 encodes up to 8 video and stereo audio programs, then combines the encoded media with program guide data to create an ATSC service multiplex, output as ASI, SMPTE-310 or IP data streams. The LEX2000 supports both analog and digital media inputs for maximum signal flexibility. Video encoder channels or optional functions may be added in the field through firmware updates and license upgrades, allowing broadcasters to grow their capabilities as their programming needs develop. The integrated statistical multiplexer, coupled with sophisticated MPEG-2 encoding and extensive IP networking enable broadcasters to deliver high quality video with the confidence that the LEX2000 supports their evolving needs for many years to come.

1.1. What's In the Box?

The following items are included in the shipping carton when new LEX2000 units are delivered.

- 1 – IEC power cord
- 1 – 10/100/1000Base-T Ethernet cable
- 1 – DVI-to-HDMI cable
- 4 – Mating audio connectors (Phoenix Contact P/N 1803659)
- 2 – Rack-mount bracket cover plates with adhesive

1.2. LEX2000 Firmware Version

This user manual describes functions implemented in LEX2000 firmware version 7.2.

LEX2000 units loaded with firmware versions released prior to this version may not have all of the functions described in this user manual. LEX2000 units with firmware versions released after this version may have functionality that is not described in this user manual.

1.3. Regulatory Compliance

This product is warranted to comply with the following industry standards and regulatory certifications.

- Safety: UL 60950, file number E308325, Model Number 102302.

- Electromagnetic Emissions: FCC part 15, class A

- Performance: ATSC A/53

1.4. Front Panel

Figure 1: LEX2000 Front Panel

The front panel provides essential status information for the power supply, encoder system, input signals and output signals. In general, LED illumination has the following meanings:

- G (green) – Normal operation
- Y (yellow) – Warning – User attention may be needed.
- R (red) – Error or Failure Detected – Corrective action may be needed.

The System, Input and Output LED's on the front panel are illuminated with different colors and styles to indicate the conditions listed in the tables, below.

Table 1: Front Panel LED Indicators - POWER

POWER	Meaning
G	Unit is powered on and the power supply is functioning properly.
OFF	Unit power is disconnected or switched off or the power input fuse is blown or the power supply has failed.

Table 2: Front Panel LED Indicators – Normal Broadcast Operations

SYSTEM	INPUT	OUTPUT	Meaning
G	G	G	Normal Operation
G	G – Y – G – Y…	Y – G – Y – G…	EAS Video Cutover Switch Activated
G	R – OFF – R – OFF…		Video Input or ASI Input Signal Loss Detected for an On-Air Service

Table 3: Front Panel LED Indicators – System Integrity and Status

SYSTEM	INPUT	OUTPUT	Meaning
OFF – fade – G – fade – OFF – fade – G … (all together)			System Booting / Starting-Up
Y – OFF – Y – OFF…			Non-catastrophic hardware failure. Check Event Log.
R – Y – R – Y … or R – G – R – G …			High Temperature Warning
R	R	R	High Temperature Error System has shut down
R	R	OFF	Invalid or Failed SFP Device Detected in IP-1 Socket
R	Y	OFF	Invalid or Failed SFP Device Detected in Socket IP-2, 3 or 4
R	OFF	OFF	Failure Detected in System Hardware, BIST or Boot-up. Check Event Log.

Table 4: Front Panel LED Indicators – System Reset Button Activation

SYSTEM	INPUT	OUTPUT	Meaning
G – OFF – G – OFF…	G – OFF – G – OFF…	G – OFF – G – OFF…	System Reset Button pressed for less than 5 seconds. Upon button release, encoder continues normal operation.
Y – OFF – Y – OFF…	Y – OFF – Y – OFF…	Y – OFF – Y – OFF…	System Reset Button pressed for 5 seconds. Upon button release, encoder reboots.
R – OFF – R – OFF…	R – OFF – R – OFF…	R – OFF – R – OFF…	System Reset Button pressed for 15 seconds. Upon button release, encoder IP address and password resets to default, encoder reboots.

Table 5: Front Panel LED Indicators – License File Update Sequence

SYSTEM	INPUT	OUTPUT	Meaning
Y	Y	OFF – G – OFF Flashes 5 times in 5 seconds	License File and/or Product Authorization Code has been Loaded and Validated
Y	Y	R for 5 seconds	Failure Detected during Load or Validation of License File or Product Authorization Code

Table 6: Front Panel LED Indicators – Normal Firmware Update Sequence

SYSTEM	INPUT	OUTPUT	Meaning
Y	G – OFF – G – OFF…	OFF	Loading Firmware Update File in Normal Update Mode
Y	OFF	G – OFF – G – OFF…	Validating Firmware Update in Normal Update Mode
Y	Steady G or OFF	Steady G or OFF	Unexpected or unknown failure during Normal Firmware Update Sequence. Waiting for power cycle.
Y	R – OFF – R – OFF…	OFF	No firmware file found on rear panel SD Card during Normal Firmware Update Sequence using SD Card update method. Waiting for power cycle.
Y	OFF	R – OFF – R – OFF…	Firmware load or validation failure detected during Normal Firmware Update Sequence. Waiting for power cycle.
G – OFF – G – OFF…	OFF	OFF	Firmware Update Completed. Waiting for power cycle.

Table 7: Front Panel LED Indicators – System Recovery Firmware Update Sequence

SYSTEM	INPUT	OUTPUT	Meaning
R	G – OFF – G – OFF…	OFF	Loading Firmware Update File in System Recovery Mode
R	OFF	G – OFF – G – OFF…	Validating Firmware Update in System Recovery Mode
R	Steady G or OFF	Steady G or OFF	Unexpected or unknown failure during System Recovery Firmware Update. Waiting for power cycle.
R	R – OFF – R – OFF…	OFF	No firmware found on rear panel SD Card while attempting System Recovery Firmware Update Sequence. Requires a power cycle with valid firmware on SD card in rear panel SD Card socket.
R	OFF	R – OFF – R – OFF…	Failure Detected during Firmware Load or Validation. Requires a power cycle with valid firmware on SD card in rear panel SD Card socket.
G – OFF – G – OFF…	OFF	OFF	Firmware Update Completed. Waiting for power cycle.

1.4.1. Rear Panel
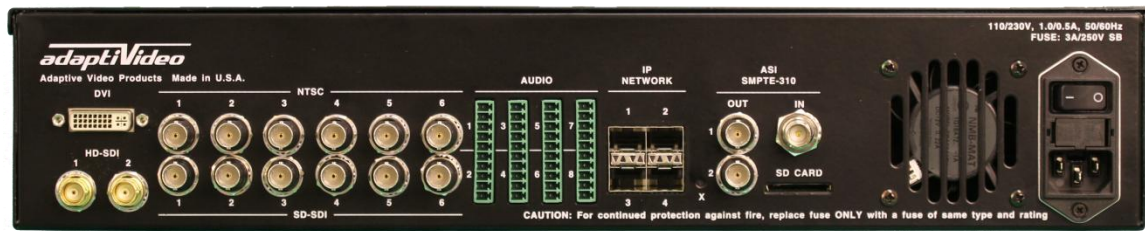
Figure 2: LEX2000 Rear Panel

The rear panel provides access to all signal input and output connectors, the SD card socket, exhaust fan, power input connector, power on-off switch, fuse and the system reset button. The rear panel signal connectors are summarized in Table 8, below.

Table 8: Rear Panel Signal Connectors

Connector	Description	Paragraph Number
DVI Output	System monitor output. Connect to DVI monitor or use a DVI-to-HDMI adapter cable to connect to HDMI monitor.	3.1
HD-SDI-1 HD-SDI-2 Inputs	Two SMPTE-292M digital video and embedded audio inputs for SD or HD video streams with up to 8 embedded stereo audio tracks per HD-SDI input.	3.2
NTSC-1 to NTSC-6 Inputs	Six NTSC analog composite video inputs.	3.2
SD-SDI-1 to SD-SDI-6 Inputs	Six SMPTE-259M digital video and embedded audio inputs, supporting SD video input streams with up to 8 embedded stereo audio tracks per SD-SDI input.	3.2
AUDIO-1/2 to AUDIO-7/8 Inputs and Contact I / O	Eight balanced analog audio inputs across four connectors. Connector AUDIO-5/6 may be configured to support contact closure I/O, and connector AUDIO-7/8 may be configured to support AES digital audio inputs.	3.3.1, 3.3.2.2, 3.4
IP NETWORK IP-1 to IP-4	Four SFP sockets provide a means to connect to multiple networks or point-to-point data links. IP-1 is the primary network interface for the unit and a Gigabit Ethernet port is installed in this socket as a part of the base product configuration. Additional SFP modules are provided with specific product upgrades.	2.3, 4.9
ASI-OUT-1 ASI-OUT-2	Two ASI outputs. Both ASI outputs carry the same transport stream, but each output may be independently configured to generate a SMPTE-310 or ASI signal.	3.6
ASI-IN	One ASI input is provided to receive multi-program transport streams, used for the ASI Remux (RX) Option as well as the ASI-to-IP function of the TG Option.	3.5

1.5. System Block Diagram

This simplified system block diagram shows the major elements of the LEX2000 system, as well as the flow of audio, video, meta-data and system control logic.
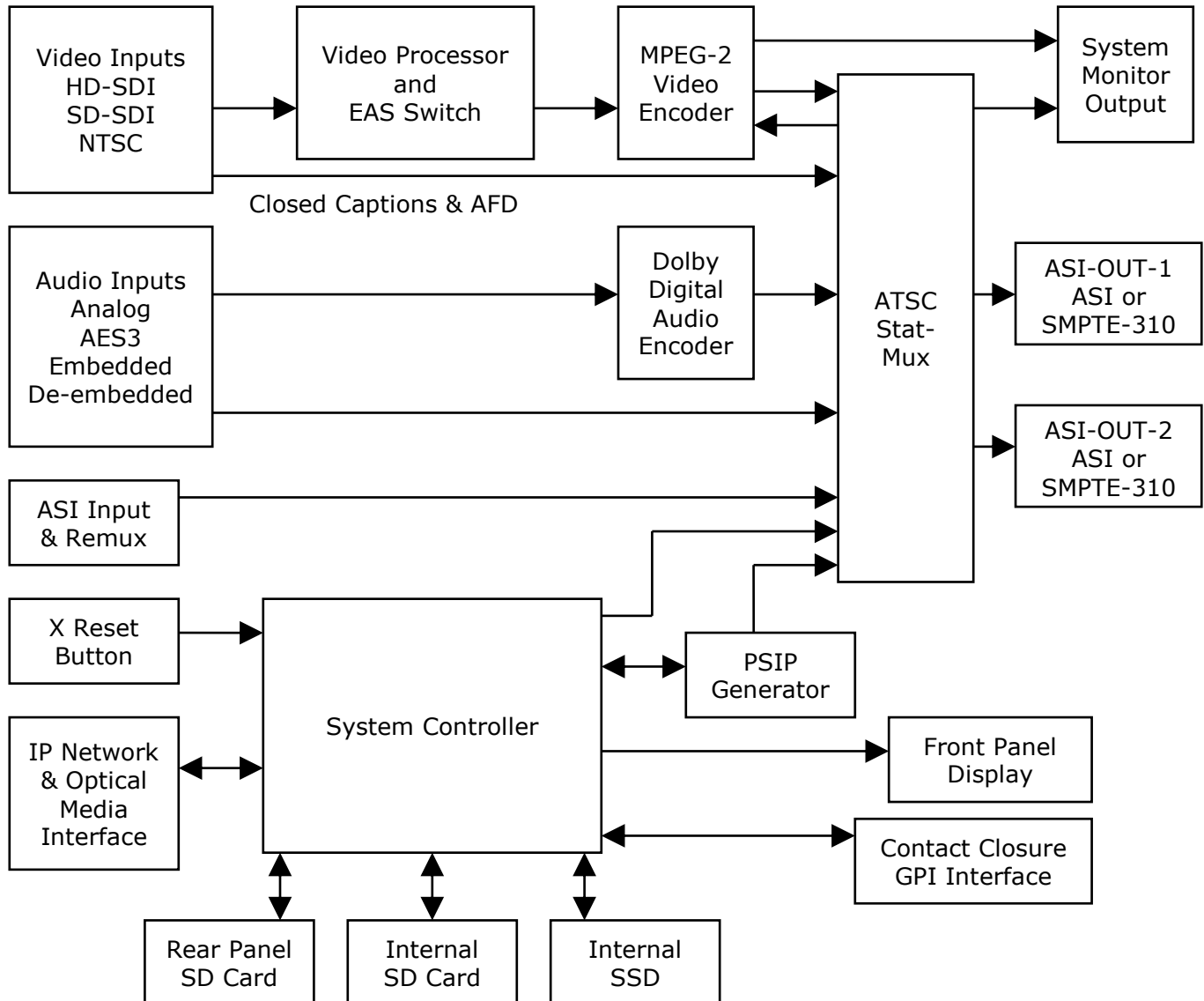
Figure 3: LEX2000 System Block Diagram

2. PRODUCT INSTALLATION

Configuration of the LEX2000 operational settings is performed by browsing the system configuration web pages, embedded within the unit. The user must first establish an IP network connection to the unit, and then log into the embedded web pages in order to make changes to system configuration settings.

Once it is configured, the LEX2000 unit operates without a network connection. However, there are numerous functions of the LEX2000 that make use of its network connection, such as uploading PSIP information, accessing a time server and installation of firmware updates. This section explains how to connect the LEX2000 to your network and configure the network communication settings.

2.1. Mechanical Installation

2.1.1. Rack Mounting

The LEX2000 is designed to be mounted in a standard 19-inch rack, occupying 2 rack units of vertical space. The front panel ears may not support the weight of the unit without additional support, so a shelf or shelf rails may be used to support the unit in the rack as needed.

2.1.2. Power Consumption & Air Flow

The LEX2000 consumes less than 90W, but air flow through the unit may still be required to avoid raising the internal chassis temperature to its thermal limit. Cool air flows in through the front panel vent. Warm air flows out through the vent in the rear panel as well as vent holes in the top of the case. It is recommended that the ambient temperature just outside the front panel be kept below 40C (104°F) to avoid excessively high internal temperatures. If the internal temperature of the LEX2000 unit rises to 65C (149°F), then the unit shuts down to prevent damage to its components.

2.1.3. Power Connection

The LEX2000 is designed to receive power from 120-240VAC sources, 50-60Hz. A universal IEC power input connector is provided on the rear panel. AC current levels vary with the provided AC voltage as well as the workload of the unit.

2.2. Quick-Start Product Installation Guide

The following checklist provides guidance on installing and configuring an LEX2000 ATSC encoder / multiplexer for the first time, as well as paragraph numbers and page numbers where additional information may be found.

Table 9: Installation Guide and Check List

Step	Installation and Configuration Task	Paragraph and Page Number
1	Prepare a suitable rack-mount location for the unit.	2.1.1, page 7
2	Check to make sure that the computer connected to the unit is communicating on the same Ethernet sub-net as the unit. If the unit's IP address is not specified in the delivered documentation, then use the factory default: 192.168.120.56.	2.3, page 10
3	Plug in the power cord and an Ethernet cable. Switch on the main power to the unit.	
4	Using a web browser, enter or browse to the IP address of the unit. If the unit's IP address is not specified in the delivered documentation, then use the factory default: 192.168.120.56.	2.3, page 10
5	On the NETWORK web page, configure the network communications parameters as needed.	2.3, page 10
6	On the USER ACCESS web page, change the system password to prevent unauthorized access to the unit.	2.4, page 11
7	On the DATE / TIME web page, review and set unit time and date as needed.	2.6, page 13
8	On the TRANSPORT web page, configure the ATSC services including major - minor channel numbers, call letters and extended text descriptions or tag lines for each station.	4.4, page 53
9	On the VIDEO web page, for each encoded video (EV) program: • Set the Maximum Format Size • Select the appropriate Video Input Source • Assign encoded video (EV) programs to ATSC services • Set the video encoder configuration parameters for each EV stream, including the target bit rate and stat-mux participation	4.2.5, page 43
10	Connect the video input cables to sources with video signals present. Refresh the VIDEO web page to see that video signals are detected on the video input connectors.	3.2, page 28 0, page 29
11	On the AUDIO web page, for each encoded audio (EA) program: • Select the appropriate Audio Input source • Assign encoded audio (EA) programs to ATSC services • Set the audio encoder and Dolby configuration parameters	4.1.3, page 37

Table 9: Installation Guide and Check List (continued)

Step	Installation and Configuration Task	Paragraph and Page Number
12	On the TRANSPORT web page, set the PID values for all program elements feeding active services.	4.4, page 53
13	On the PSIP web page, select the program guide data source. If the GN option is being used, enter the URL or IP address and login information for the program guide FTP server.	4.5, page 58
14	On the EAS web page, select the emergency broadcast alert cut-over switch trigger source and program source. Define the EAS alert response for each of the ATSC services.	4.6.2, page 70
15	Configuration of the encoder operation is now complete. The configuration settings may be saved to a file for future reference by clicking on the SAVE CONFIGURATION SETTINGS button, located near the upper right corner of each web page.	2.7, page 15

2.3. IP Network Connection

NETWORK CONNECTIONS

IP NETWORK DEVICE NUMBER	IP-1	IP-2	IP-3	IP-4
SFP Module MFR	Methode Elec.OEM	-	-	AAXEON
SFP Module Model	EX-SFP-1GE-T-OEM	-	-	SFP-C
SFP Module Status	Good	No Device	No Device	Good
MAC Address	00:1A:0A:05:00:0D	-	-	00:1A:0A:06:00:0D
Static IP	142.42.6.141	192.168.120.57	192.168.120.58	142.42.7.141
Subnet Mask	255.255.0.0	255.255.0.0	255.255.0.0	255.255.0.0
Gateway IP	142.42.6.252	192.168.120.1	192.168.120.1	192.168.0.120
DNS Server 1	8.8.8.8	-	-	-
DNS Server 2		-	-	-

Figure 4: NETWORK Configuration Web Page

The unit's primary network interface port is always located in the IP-1 socket, the top location nearest to connector AUDIO-7/8, regardless of how many SFP modules are installed in the other IP Network sockets.

- Connect the unit's primary network port to a computer or a control network using a 10/100/1000Base-T Ethernet cable.

- If the unit has been pre-configured prior to delivery, then the IP address, user name and password may have been set to different values than the factory defaults. If necessary, the system reset "X" button on the rear panel may be used to reset the primary network IP address, user name and password to their factory default values, as shown below. For more information on using the X button to reset system values to factory defaults, see paragraph 2.5.

- Access the unit's system configuration web pages by entering the following in your web browser: http://192.168.120.56 (factory default IP address for the primary network interface)

- Log into the system configuration web pages. The factory default password is:

  Password: ***pass***   *(case sensitive)*

- After logging into the system configuration web pages, navigate to the SYSTEM–NETWORK page and change the IP address for the primary network interface as needed.

  NOTE: Once the unit's IP address has been changed, the computer being used to view the internal web pages will not be able to communicate with the unit until the computer's own IP address is modified to match the first three fields of the unit's IP address.

2.4. User Logins and Access Control
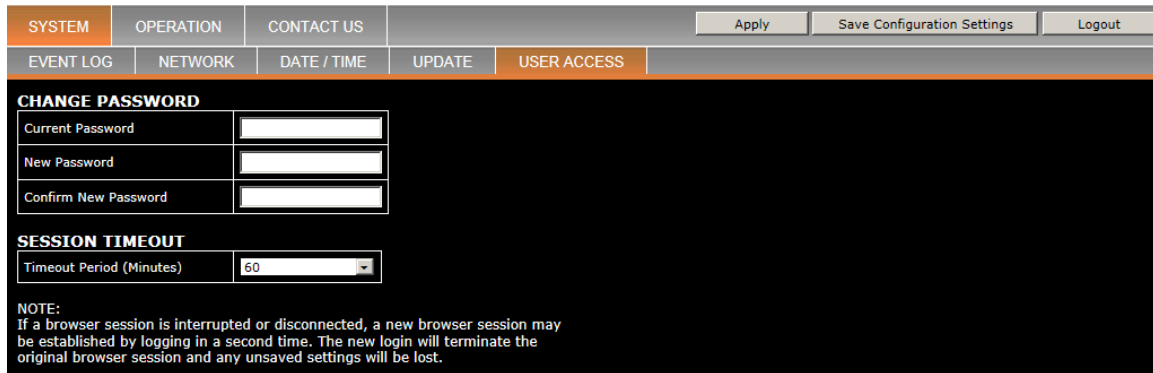
Figure 5: USER ACCESS Web Page

The LEX2000 encoder supports a single user login, with case-sensitive password for access control. In order to change any system configuration settings through the internal web pages, the user must be logged into the web pages with a valid password. Access to the LEX2000 system configuration settings is not secure until the default password is changed to a value that is not predictable or widely available.

The password may be changed on the SYSTEM – USER ACCESS web page. In the event that the password is lost or forgotten, the password may be reset to the factory default value by pressing the system reset "**X**" button on the rear panel, as described in paragraph 2.5. Please note that when the password is reset to its factory default value, the encoder unit's IP address is also reset to its factory default value.

The Session Timeout value determines the amount of time that the LEX2000 web interface allows to pass before it logs out the user closes the browser session.

2.5. <u>System Reset Button</u>

A system reset button is provided to reset the encoder system or to restore critical system communication parameters to known values in the event that these values are forgotten or in the event that network communications are not working properly.

The system reset button, marked with an "**X**," is located between IP-4 and ASI-OUT-2 connectors on the rear panel. The reset button may be gently pressed with a paper clip or small tool in order to cause the following actions in the unit.

Table 10: Rear Panel Reset Button Actions

Button Press Duration	Action Taken Upon Button Release	Front Panel LED Response
0 – 5 seconds	No action – continue operating normally.	G – OFF – G – OFF…
5 – 15 seconds	Reboot encoder system.	Y – OFF – Y – OFF…
More than 15 seconds	Reset IP address of primary network interface port to factory default: 192.168.120.56. Reset system configuration web pages password to its factory default value: Password: *pass*	R – OFF – R – OFF…

2.6. Setting and Maintaining System Date and Time

Figure 6: DATE / TIME Configuration Web Page

ATSC A/69 specifies that digital television broadcast system time table (STT) maintain correct time +/-1 second of the GPS atomic clock reference. The LEX2000 may be configured to connect to a Network Time Processor (NTP) on a regular basis to automatically ensure that the correct time is inserted into the output ASI stream. If an NTP is not available on the local network, the user may set the current date and time manually.

In order to set the system date and time or to configure the NTP communications, browse the system configuration web pages to the SYSTEM – DATE / TIME page. This web page provides a location for the user to enter the IP address of an NTP server for automatic time updates, or to set the date and time manually. Settings are also provided on this page to set the local broadcast time zone and to configure the start and stop dates and times for daylight savings time.

Use of an NTP server is strongly recommended in order to maintain compliance with ATSC time correctness specifications. Manually set times may not precisely match the GPS atomic clock time to the second and may drift over time. System times that are set manually should be checked and adjusted as needed at least once per week.

2.6.1. GPS Leap Seconds

Set the local broadcast time zone and GPS leap seconds offset in the Time Adjustments table. The Local Time Zone setting is used by the web page display to translate UTC time to the local time for the convenience of the user. Since all ATSC times in the transport stream are in UTC time, the local time zone setting has no effect on the transport stream output. Leap seconds are added to UTC time in order to derive GPS time or subtracted from GPS time to derive UTC time. As of July 1, 2012, the number of leaps seconds should be set to a value of 16. Changes to the leap second differential are evaluated from time to time and implemented on July 1 or January 1 if they are deemed necessary by the authorities who govern such things.

2.6.2. Daylight Saving Time

When the LEX2000 unit's local time is in an active Daylight Saving Time (DST) period, the unit's local time reflects the 1-hour DST time shift, the words "Daylight Time" are displayed in its web page banners and the DST flag is set in the unit's transport stream output.

The Daylight Saving Time table settings control when the LEX2000 unit switches between Daylight Saving Time and Standard Time. Set the DST Adjustment to "Automatic" in order to use the unit's internal calendar to automatically switch between DST and standard time through the year 2029. The next scheduled DST transition dates and times are identified in the two bottom rows of the table.

Set the DST Adjustment to Manual in order to enter DST start and stop dates that may be different than the unit's internal calendar.

If the broadcast location does not use Daylight Saving Time, then set the DST Adjustment to Off in order to disable DST switching.

IMPORTANT: The LEX2000 unit must have the Daylight Saving Time values set correctly in order to insert the proper DST flag into the transport stream output.

## 2.7. Saving and Restoring Encoder Configuration Settings
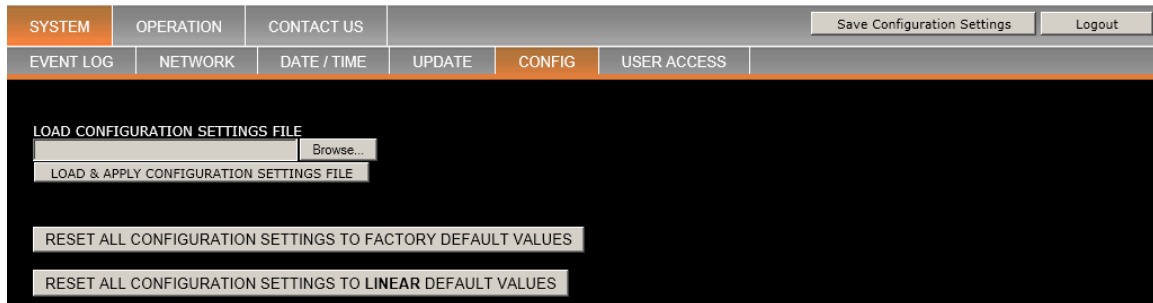
Figure 7: SYSTEM CONFIG Web Page

LEX2000 configuration (.CFG) files are human-readable ASCII text files that identify the current value of nearly all user-controlled configuration settings of the LEX2000 unit. LEX2000 configuration files written from one LEX2000 unit may be loaded into other LEX2000 units or reloaded into the same LEX2000 unit at a later time.

System configuration settings may be saved to a configuration (.CFG) file, located on the local computer or network by clicking on the SAVE CONFIGURATION SETTINGS button, located near the upper right corner of each LEX2000 web page. Upon clicking this button, a dialog box prompts the user for a file name and its storage location.

IMPORTANT: Do not manually edit or modify LEX2000 CFG files. Configuration settings files may only be written by LEX2000 units and may not be edited by the user. LEX2000 units **will not load** configuration settings files that have been modified by the user.

To load a configuration settings (.CFG) file into an LEX2000 unit, browse to the SYSTEM – CONFIG web page, shown in Figure 7, and locate the "LOAD CONFIGURATION SETTINGS FILE" box in the upper left area of the page.

- Click the browse button to pop up a dialog box that may be used to locate the CFG file on the local computer or local network.
- Select the file and OK the dialog box. The file pathname should appear in the gray box in the LOAD CONFIGURATION SETTINGS FILE area.
- Click the "LOAD & APPLY CONFIGURATION SETTINGS FILE" button to load the configuration settings from the file into the LEX2000 unit.

When configuration settings files are written from one LEX2000 unit and loaded into a different LEX2000 unit, the two encoders may have different numbers of video encoder channels enabled and/or different options installed. When the CFG file contains configuration settings values for features that are not present in the encoder loading the file, the excess settings values are ignored. If the CFG file is missing settings values for features present in the encoder loading the CFG file, then the encoder's configuration settings for those features are left unchanged when the CFG file is loaded.

Encoder network settings, such as its IP address, are not changed when loading CFG files in order to prevent the unintended loss of communication with the encoder unit, potentially caused by loading a configuration file containing an IP address that conflicts with the encoder's current network environment.

To reset all configuration settings in the encoder, except for network IP address, and restore the LEX2000 unit to its factory configuration, click on the button:

"RESET ALL CONFIGURATION SETTINGS TO FACTORY DEFAULT VALUES."

If customer default settings have been saved in the LEX2000 encoder unit, then a second button appears on the CONFIG web page:

"RESET ALL CONFIGURATION SETTINGS TO LINEAR DEFAULT VALUES."

Click this button to restore all configuration settings to their customer default values, except for network IP address. If this button is not present on the web page, then a customer default configuration has not been saved in the encoder.

2.8. Loading Firmware Updates

Figure 8: SYSTEM UPDATE Web Page

The specific functionality of each LEX2000 unit is controlled by its firmware and its authorization code, contained in a license file. LEX2000 units are loaded with the most up-to-date firmware before they are shipped from the factory. Firmware updates are released on a regular basis to enhance the performance and value of the LEX2000.

There are three methods available to load firmware updates into an LEX2000 unit:

1. Use the UPDATE web page to load a firmware update from a local computer or network file;

2. Use the UPDATE web page to load a firmware update from an SD card;

3. Use the power-up boot loader to load a firmware update from an SD card.

The special considerations and step-by-step procedures for each of these methods are detailed below.

WARNING: **When loading firmware updates, do not switch off the power until the update process has completed**. Loss of power during the update process may render the unit inoperable, requiring factory service to restore proper operation.

NOTE: When loading firmware updates, it is recommended that users back up their user settings and then reload them after the firmware update. To do this, click on the "Save Configuration Settings" button, located on the upper right area of any LEX2000 web page, and save all the user settings in a CFG file. After updating the unit's firmware, browse to the SYSTEM – CONFIG web page and load the configuration settings (CFG) file that was saved before the firmware update.

2.8.1. Updating Firmware from a Local Network File

This is the recommended method for updating LEX2000 firmware. Since the firmware update file is being selected manually by the user, the file may be changed and is not restricted to LEX2000_FW_xxyy.bin. Earlier (lower number) firmware versions may be loaded into an LEX2000 unit using this method, since the firmware update file is identified manually by the user from the local network or computer.

NOTE   Loading an earlier version of firmware is not recommended without consulting your LEX2000 technical support specialist.

IMPORTANT   These are general instructions for updating firmware. Please review the release notes and installation instruction files for the specific firmware version you are installing before beginning the update.

1. Log into the LEX2000 unit web pages

2. Click the "Save Configuration Settings" button on any of the unit's web pages to save the unit's user configuration settings to a CFG file.

3. Navigate to the SYSTEM – UPDATE page, shown in Figure 8, and find the LOAD FIRMWARE UPDATE table on the left side of the page.

4. Click on the "Browse" button in the LOAD FIRMWARE UPDATE area and use the file browser dialog box that pops up to select the firmware update file to be loaded. After clicking OK to close the file browser dialog box, the pathname of the selected file should appear in the gray box, alongside the Browse button.

5. Click on the "LOAD & APPLY FIRMWARE UPDATE" button.

    WARNING: **DO NOT TURN OFF POWER TO THE ENCODER DURING THE FIRMWARE UPDATE PROCESS.**

6. The LEX2000 unit initiates the firmware update process, which typically takes 20 to 30 minutes. The SYSTEM LED on the front panel glows Yellow and the INPUT and OUTPUT LED's blink to indicate the progression through the update process, as described in Table 6.

    Firmware update status messages are posted in the Firmware Update Status window on the SYSTEM – UPDATE web page. Click on the button: "REFRESH FIRMWARE UPDATE STATUS" and scroll to the bottom of the window to see the most recently posted progress messages. Firmware update status messages are also recorded in the Event Log, which may be viewed on the SYSTEM – EVENT LOG web page.

7. When the firmware update process is completed, a message is posted to the Firmware Update Status window and the Event Log, notifying the user that the firmware update has finished successfully and the SYSTEM LED on the front panel repeatedly blinks Green.
    In the unlikely event that the firmware update process does not complete successfully, the LEX2000 unit initiates a System Recovery Firmware Update Sequence, as defined in Table 7. The SYSTEM LED on the front panel glows RED and the INPUT and OUTPUT LED's blink to indicate progression through the firmware update process. Status messages are

posted to the Firmware Update Status window on the SYSTEM – UPDATE web page, as well as the Event Log.

If the System Recovery Firmware Update fails, the LEX2000 automatically re-starts the sequence again up to ten more times. If the firmware update is still unsuccessful after ten attempts, then the process stops and the unit should be serviced by the factory to restore it to proper working order.

8. When the SYSTEM LED on the front panel repeatedly blinks Green or the "System Update Complete" message is displayed in the Firmware Update Status window, the update process has been successfully completed.

   ONLY AFTER THE UPDATE PROCESS HAS COMPLETED,
   Click the REBOOT UNIT button on the UPDATE web page or switch the LEX2000's power switch off and then on to restart the encoder.

   NOTE: The LEX2000 unit continues to operate normally during the update process and does not change its functionality until the unit is re-booted.

9. After restarting the LEX2000 unit, access the unit's login web page to see the firmware version shown at the top of the page. A history of the update sequence may also be viewed on the SYSTEM – EVENT LOG web page.

10. Browse to the SYSTE – CONFIG web page and load the unit's CFG file that was saved before starting the firmware update process.

11. The process is complete and the encoder may be returned to service.

LINEAR

2.8.2. Guidelines for Updating Firmware from an SD Card

1. When loading firmware updates from an SD card, the firmware update files must be located at the root level of the SD card, not in a folder below the root level.

2. The firmware update files must be named LEX2000_FW_xxyy.bin, where xxyy indicates the firmware version contained in the update file. Do not change the name of the firmware update file received from the factory or it may not load properly.

3. When loading firmware updates from an SD card, the LEX2000 unit only loads firmware updates that are newer than the firmware version currently installed in the LEX2000 unit.

4. If multiple firmware update files are present on the SD card, then the LEX2000 unit identifies the firmware update file containing the highest firmware version number and load that update file.

5. If the LEX2000 finds that the firmware update file on the SD card with the highest version number contains the same version of firmware that is currently installed on the encoder, or is an earlier version, then the update file is ignored and the encoder continues with its normal boot process or terminate the firmware update, depending on which SD card method is being used.

2.8.3. Update Firmware from an SD Card using Web Page Button

This procedure may be used to load prior versions of LEX2000 firmware from the SD card, which are not loaded automatically when the LEX2000 unit is powered up.

1. Insert an SD card with the appropriate firmware update file into the SD Card socket in the rear panel of the LEX2000 unit.

2. Switch the LEX2000 power off and then on to restart the unit. The unit reports finding a firmware file on the SD card whose version is the same or order than the version already running in the unit and then terminates the update process.

3. Log into the system configuration web pages.

4. Navigate to the SYSTEM - UPDATE page.

5. Click on the button "LOAD FIRMWARE UPDATE FROM SD CARD"

   <u>WARNING</u>: **DO NOT TURN OFF POWER TO THE ENCODER DURING THE FIRMWARE UPDATE PROCESS.**

6. The LEX2000 unit searches for a firmware update file on the SD card. If no firmware update files are found, then the update process terminates. If one or more update files are found, but the update file with the highest version number contains the same version of firmware that is running in the encoder (or a prior version), the update process terminates.

7. If a suitable firmware update file is found, the LEX2000 unit initiates the firmware update process, which may take 20 to 30 minutes. The SYSTEM LED on the front panel changes to Yellow and the INPUT and OUTPUT LED's blinks to indicate the progression through the update process, as well as the failure or successful completion of the firmware update, as defined in Table 6.

8. When the SYSTEM LED on the front panel repeatedly blinks Green or the "System Update Complete" message is displayed in the Firmware Update Status window, the update process has been successfully completed.

   ONLY AFTER THE UPDATE PROCESS HAS COMPLETED,
   Click the REBOOT UNIT button on the UPDATE web page or switch the LEX2000's power switch off and then on to restart the encoder.

   <u>NOTE</u>: The LEX2000 unit continues to operate normally during the update process and does not change its functionality until the unit is re-started by switching its power off and then on.

9. After restarting the LEX2000 unit, access the unit's login web page to see the firmware version shown at the top of the page. A history of the update sequence may also be viewed on the SYSTEM – EVENT LOG web page.

10. Remove the SD card from the rear panel SD Card socket. The process is complete and the encoder may be returned to service.

2.8.4.   Update Firmware from an SD Card at Power-Up

1. Log into the LEX2000 unit's web pages and click the "Save Configuration Settings" button, located in the upper right area of any of the unit's web pages, to save the unit's user configuration settings to a CFG file.

2. Switch off power to the LEX2000 unit.

3. Insert an SD card with a firmware update file into the SD Card socket in the rear panel of the LEX2000 unit.

4. Switch on power to the LEX2000 unit.

5. During its power-on boot sequence, the LEX2000 unit searches for a firmware update file on the SD card inserted in the rear panel SD Card socket. If no firmware update files are found, then the encoder searches for a new license file on the SD card. If no firmware update and no license file is found, then the encoder proceeds to boot normally and does not start the firmware update process. If one or more firmware update files are found, but the update file with the highest version number contains the same version of firmware that is running in the encoder (or a prior version), the encoder boots up normally without loading the firmware update.

   If a suitable firmware update file is found, The LEX2000 unit initiates the firmware update process, which typically takes 20 to 30 minutes. The SYSTEM LED on the front panel glows Yellow and the INPUT and OUTPUT LED's blink to indicate the progression through the update process, as described in Table 6.

   Firmware update status messages are posted in the Firmware Update Status window on the SYSTEM – UPDATE web page. Click on the button: "REFRESH FIRMWARE UPDATE STATUS" and scroll to the bottom of the window to see the most recently posted progress messages. Firmware update status messages are also recorded in the Event Log, which may be viewed on the SYSTEM – EVENT LOG web page.

   <u>WARNING</u>:   DO NOT TURN OFF POWER TO THE ENCODER DURING THE FIRMWARE UPDATE PROCESS.

6. When the SYSTEM LED on the front panel repeatedly blinks Green or the "System Update Complete" message is displayed in the Firmware Update Status window, the update process has been successfully completed.

   ONLY AFTER THE UPDATE PROCESS HAS COMPLETED,
   Switch the LEX2000's power switch off and then on to restart the encoder.

   <u>NOTE</u>: The LEX2000 unit continues to operate normally during the update process and does not change its functionality until the unit is re-started by switching its power off and then on.

7. After restarting the LEX2000 unit, access the unit's login web page to see the firmware version shown at the top of the page. A history of the update sequence may also be viewed on the SYSTEM – EVENT LOG web page.

8. Browse to the SYSTE – CONFIG web page and load the unit's CFG file that was saved before starting the firmware update process.

9. Remove the SD card from the rear panel SD Card socket. The process is complete and the encoder may be returned to service.

2.9. Loading License Files

License files are human-readable, ASCII text files that contain the authorization code for a specific LEX2000 unit. Each license file and its authorization code control how many video encoder channels are enabled, how many of those video encoder channels are able to process HD video and which optional features are enabled in the LEX2000 unit. The video encoder channels and product features enabled by the authorization code are identified in the text of the license file.

Do not edit or modify the license file provided by the factory. Each license file and authorization code is designed to work with a specific LEX2000 unit, based on the unit's serial number. LEX2000 units ignore license files that have been modified and authorization codes that do not match the serial number of the LEX2000 unit.

License files may be loaded into the LEX2000 unit from the SYSTEM - UPDATE web page by browsing to the file on the local computer or network, or by loading the license file from an SD card inserted into the rear panel SD card socket.

License files provided by the factory are named: LEX2000_LIC_xxxx_yymmdd.dat, where xxxx is the 16-digit serial number of the LEX2000 unit and yymmdd is the date when the license file was created. If license files are loaded using an SD memory card, then the factory naming convention for the license file must be maintained in order for the files to be recognized as a license file.

2.9.1. Loading License File from the Local Network

1. Log into the system configuration web pages

2. Navigate to the SYSTEM - UPDATE page, shown in Figure 8, and find the LOAD LICENSE FILE table in the middle right area of the page.

3. Click on the "Browse" button in the LOAD LICENSE FILE area and use the file browser dialog box that pops up to select the license file to be loaded. After clicking OK to close the file browser dialog box, the pathname of the selected file should appear in the gray box, alongside the Browse button.

4. Click on the "LOAD & APPLY LICENSE FILE" button.

5. The LEX2000 unit loads and validates the license file, which takes less than a second. The SYSTEM and INPUT LED's on the front panel change to Yellow. The OUTPUT LED blinks Green five times over five seconds to indicate acceptance of the license file and its authorization code or glows Red for five seconds to indicate their rejection, as shown in Table 5.

6. The SYSTEM and INPUT LED's return to their normal Green condition, indicating the completion of the License File load process. The features enabled by the newly installed license file are listed in the LICENSE STATUS table on the SYSTEM - UPDATE web page.

7. The process is complete and the encoder may be returned to service.

2.9.2. Loading License File from an SD Card

1. Insert an SD card with the appropriate license file into the SD Card socket in the rear panel of the LEX2000 unit.

2. Switch the LEX2000 power off and then on to restart the unit.

3. Log into the system configuration web pages

4. Navigate to the SYSTEM – UPDATE page, shown in Figure 8, and find the LOAD LICENSE FILE table in the middle right area of the page.

5. Click on the "LOAD LICENSE FILE FROM SD CARD" button.

6. The LEX2000 unit searches for a license file on the SD card with a serial number in its file name that matches the serial number of the LEX2000 unit. If no matching license file is found, then the load process terminates. If multiple matching license files are found, then the license file with the most recent date code is selected for loading.

7. The LEX2000 unit loads and validates the license file, which takes less than a second. The SYSTEM and INPUT LED's on the front panel change to Yellow. The OUTPUT LED blinks Green five times over five seconds to indicate acceptance of the license file and its authorization code or glows Red for five seconds to indicate their rejection, as shown in Table 5.

8. The SYSTEM and INPUT LED's return to their normal Green condition, indicating the completion of the License File load process. The features enabled by the newly installed license file are listed in the LICENSE STATUS table on the SYSTEM - UPDATE web page.

9. Remove the SD card from the rear panel SD Card socket. The process is complete and the encoder may be returned to service.

2.10. Reviewing the Event Log

DATE / TIME	EVENT TYPE	EVENT SOURCE	DESCRIPTION
2012-Sep-6 13:09:40	NOTE	EIT	PSIP information found in flash. Generating tables from memory.
2012-Sep-6 13:09:38	NOTE	Update	No Firmware Update File Detected on Boot.
2012-Sep-6 12:57:14	NOTE	PSIP	Connection to remote source was successful. Login Successful.
2012-Sep-6 12:12:35	NOTE	Update	System Update Complete
2012-Sep-6 12:12:34	NOTE	Update	NANDFLASH Updated
2012-Sep-6 12:12:32	NOTE	Update	NANDFLASH Verified.
2012-Sep-6 12:12:22	NOTE	Update	Verifying NANDFLASH 90% complete
2012-Sep-6 12:12:11	NOTE	Update	Verifying NANDFLASH 80% complete
2012-Sep-6 12:12:01	NOTE	Update	Verifying NANDFLASH 70% complete
2012-Sep-6 12:11:51	NOTE	Update	Verifying NANDFLASH 60% complete
2012-Sep-6 12:11:40	NOTE	Update	Verifying NANDFLASH 50% complete
2012-Sep-6 12:11:30	NOTE	Update	Verifying NANDFLASH 40% complete
2012-Sep-6 12:11:20	NOTE	Update	Verifying NANDFLASH 30% complete
2012-Sep-6 12:11:09	NOTE	Update	Verifying NANDFLASH 20% complete
2012-Sep-6 12:10:59	NOTE	Update	Verifying NANDFLASH 10% complete
2012-Sep-6 12:10:49	NOTE	Update	Verifying NANDFLASH...
2012-Sep-6 12:10:49	NOTE	Update	Write Operation Complete.
2012-Sep-6 12:10:34	NOTE	Update	Writing NANDFLASH 90% complete
2012-Sep-6 12:10:20	NOTE	Update	Writing NANDFLASH 80% complete
2012-Sep-6 12:10:05	NOTE	Update	Writing NANDFLASH 70% complete
2012-Sep-6 12:09:51	NOTE	Update	Writing NANDFLASH 60% complete
2012-Sep-6 12:09:36	NOTE	Update	Writing NANDFLASH 50% complete
2012-Sep-6 12:09:22	NOTE	Update	Writing NANDFLASH 40% complete

Figure 9: EVENT LOG Web Page

The LEX2000 records system level events and messages to an Event Log in order to verify when specific activities occurred and to aid in detecting and trouble-shooting system level problems. To view the Event Log, log into the LEX2000 web pages and browse to the EVENT LOG page, as depicted in Figure 9.

The Event Log provides a chronological record of the events that have occurred in the recent past and is retained when the encoder power is switched off. Each event record contains the date and time that the event occurred, the type or importance level of the event, the encoder subsystem that generated the event message and a description of the event that occurred.

The Display Filter table allows the user to control which types of events are displayed on the web page, as well as the number of events to be displayed. The Display Filter only affects the presentation of events on the EVENT LOG web page and does not delete or clear any events from the Event Log.

- Click on each of the respective check boxes to show Errors, Warnings, Notes and/or Traces in the list of displayed events.

- Set the Date / Time Display to LOCAL or UTC to control the Date / Time display format for each event in the Event Log table. Changing the Date / Time Display only affects the time presented to the user. It does not affect the time recorded for the event.

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- Set the Max Number of Events to control the number of events displayed on the Event Log web page.

Be sure to click APPLY after making changes to the Display Filter check boxes in order to apply the new Display Filter settings and refresh the Event Log table.

The Event Type identifies the severity or urgency of the event or message.

"**Note**"   messages record the occurrence of normal events, such as the reception and loading of a new PSIP file.

"**Warning**"   messages record the occurrence of unexpected events or events that may lead to unexpected or incorrect system behavior. A warning may be issued for detection of high internal temperature or when the EAS switch is triggered.

"**Error**"   messages record the occurrence of events that likely caused incorrect system behavior. For example, error messages would be issued if the internal temperature triggered a thermal shut-down of the LEX2000 unit, or if the signal on a video input feeding an active ATSC service was lost.

"**Trace**"   messages are internal system messages that may be useful in troubleshooting complex system behaviors. Trace messages are helpful to the LEX2000 development staff, but may not be meaningful to users.

"**NTP**"   messages are recorded with the LEX2000 unit attempts to access the network time processor in order to update its internal clock. Since these events occur about every 20 minutes, the NTP event messages tend to fill up the event log display, hiding other event messages that might be more important.

The Event Source identifies the subsystem within the LEX2000 that generated the message. Typical event sources are: Update, PSIP, Video Encoder, Video Input, Audio Encoder, Transport Mux, System Monitor, etc.

The Description is the message sent by the encoder subsystem alerting the user.

The Event Log may be saved to a file by clicking on the SAVE EVENT LOG TO FILE button in the upper right area of the EVENT LOG web page. Upon clicking this button, the user is presented with a save file dialog box, so the user can browse to the appropriate folder and store the file. The default file name provided for the Event Log file is LEX2000_LOG_xxxx_yymmdd.log, where xxxx is the 16-digit serial number of the LEX2000 unit and yymmdd is the date the Event Log file was written.

An Event Log file is a tab-delimited text file, which may be viewed directly in a text editor or imported into a spreadsheet tool for further sorting or manipulation. A header in the file provides the serial number of the LEX2000 unit that saved the file as well as the date and time the file was saved. Both UTC and Local time are included for each event written to an Event Log file.

NOTE: The local time recorded for each event reflects the Local Time Zone setting when the event was recorded. Changing the Local Time Zone setting on the DATE / TIME web page does not change the local time for events already recorded in the Event Log.

The Event Log in the LEX2000 stores up to a few thousand event messages. After the event log reaches its capacity, new events replace the oldest events in the log, on a first-in first-out basis.

Click the CLEAR EVENT LOG button to erase all events from the unit's Event Log memory. The Event Log display will show "(Null)" values when there are fewer events in the Event Log than rows in the displayed Event Log table.

3. CONNECTING INPUT AND OUTPUT SIGNALS

3.1. DVI / HDMI Monitor Output

The DVI output may be connected directly to a DVI monitor or to an HDMI monitor using a DVI-to-HDMI adapter cable. The DVI monitor display provides a thumbnail view of the encoded video program assigned to each ATSC service, as well as the following status information for each service:

Video Input Source	Audio PID
Video PID	Audio Bit Rate
Video Bit Rate	PMT PID
Video Format	ASI Output Connector

Figure 10: System Monitor Display with Eight Active Channels

3.2. Video Input Connections

There are 6 analog NTSC composite video inputs, 6 SD-SDI digital video inputs and 2 HD-SDI digital video inputs. The LEX2000 uses two video encoder processing banks, and each video encoder bank is connected to specific video inputs on the rear panel, identified in Table 11.

Table 11: Video Input Signals for each Encoder Bank

Video Encoder Bank 1 Signal Inputs	Video Encoder Bank 2 Signal Inputs
HD-SDI-1	HD-SDI-2
SD-SDI-1, NTSC-1	SD-SDI-4, NTSC-4
SD-SDI-2, NTSC-2	SD-SDI-5, NTSC-5
SD-SDI-3, NTSC-3	SD-SDI-6, NTSC-6

NOTE: LEX2000 HD-SDI inputs accept either HD-SDI signals carrying HD video programs or SD-SDI signals carrying SD video programs.

Each of the two video encoder banks has a certain amount of available processing power. In order to optimize the broadcast video picture quality, the video processing workload should be evenly distributed across the two processing banks.

When broadcasting both high definition (HD) and standard definition (SD) channels, connect the HD video input to one bank and all of the SD video inputs to the other bank. When broadcasting SD video on all virtual channels in the broadcast multiplex, connect half of the video inputs to encoder bank 1 and half to encoder bank 2. Table 12 highlights recommended video input signal connections for achieving optimum broadcast picture quality in various broadcast channel scenarios.

Table 12: Video Signal Input Selection for Optimum Encoded Picture Quality

Virtual Channel Video Formats	Recommended Video Input Assignments
4 SD Channels	Connect two video signals to encoder bank 1 inputs: HD-SDI-1, SD-SDI-1, 2, 3 or NTSC-1, 2, 3; and two video signals to encoder bank 2 inputs: HD-SDI-2, SD-SDI-4, 5, 6 or NTSC-4, 5, 6.
6 SD Channels	Connect three video signals to encoder bank 1 inputs: HD-SDI-1, SD-SDI-1, 2, 3 or NTSC-1, 2, 3; and three video signals to encoder bank 2 inputs: HD-SDI-2, SD-SDI-4, 5, 6 or NTSC-4, 5, 6.
1 HD, 3 SD Channels	Connect the HD video signal to HD-SDI-1 and connect all of the SD video signals to encoder bank 2: HD-SDI-2, SD-SDI-4, 5, 6 or NTSC-4, 5, 6; OR Connect the HD video signal to HD-SDI-2 and connect all of the SD video signals to encoder bank 1: HD-SDI-1, SD-SDI-1, 2, 3 or NTSC-1, 2, 3.
2 HD	Connect one HD video signal to HD-SDI-1 and connect the other HD video signal to HD-SDI-2.
2 HD, 1 SD	This combination of video inputs is only supported if at least one HD video format is 720p30. Connect the SD video input and the 720p30 video input to the same video encoder bank. For example, connect a 1080i HD video signal to HD-SDI-1, a 720p30 HD video signal to HD-SDI-2 and an SD video signal to SD-SDI-4,5,6 or NTSC-4,5,6.

Use the following step-by-step process to select video input connections:

1. On the VIDEO web page, select the Maximum Format Size for each video program.

2. Select the Video Input Source for each HD encoded video (EV) stream. The web page only presents input sources that support the Maximum Format Size selected for each video stream.

3. Select the Video Input Source for each SD encoded video stream, being careful to balance the encoder bank usage, as show in Table 12, above.

4. Connect the video input cables to the connectors associated with each of the Video Input Source connections selected during the configuration process.

3.3. Audio Input Connections

The LEX2000 encoder is able to receive analog audio, digital audio embedded within SDI streams, AES digital audio, and pre-encoded pass-through audio programs through either embedded or de-embedded communication paths.

All audio programs must be synchronized with their associated video program upon arrival at the LEX2000 input connectors. The LEX2000 maintains time-base alignment of the audio and video programs from its audio and video inputs to its transport stream output. Minor adjustment of the audio delay are available on the AUDIO web page in order to compensate for any lip sync issues that may be present in the audio and video programs at the input to the LEX2000 unit.

3.3.1. Analog Audio Inputs

The LEX2000 may receive up to 8 stereo pairs of analog audio, using connectors AUDIO-1/2 through AUDIO-7/8. Each of the four AUDIO connectors supports a 10-contact mating connector, with screw terminals suitable for connecting shielded twisted pair audio cables. Each AUDIO connector provides two pro audio 600-ohm balanced stereo audio inputs, and should be connected as shown in Table 13. Analog audio signals are digitized to 24 bits at 48kHz, phase-locked to the transport stream master clock.

Table 13: Analog Audio Input Connector Pins

TOP

AUDIO Connector Contact Number	AUDIO-1/2 Connector Input Signals	AUDIO-3/4 Connector Input Signals	AUDIO-5/6 Connector Input Signals (Analog Audio Configuration)	AUDIO-7/8 Connector Input Signals (Analog Audio Configuration)
10	AUDIO-1_L(+)	AUDIO-3_L(+)	AUDIO-5_L(+)	AUDIO-7_L(+)
9	AUDIO-1_L(–)	AUDIO-3_L(–)	AUDIO-5_L(–)	AUDIO-7_L(–)
8	AUDIO-1_R(+)	AUDIO-3_R(+)	AUDIO-5_R(+)	AUDIO-7_R(+)
7	AUDIO-1_R(–)	AUDIO-3_R(–)	AUDIO-5_R(–)	AUDIO-7_R(–)
6	Chassis GND	Chassis GND	Chassis GND	Chassis GND
5	AUDIO-2_L(+)	AUDIO-4_L(+)	AUDIO-6_L(+)	AUDIO-8_L(+)
4	AUDIO-2_L(–)	AUDIO-4_L(–)	AUDIO-6_L(–)	AUDIO-8_L(–)
3	AUDIO-2_R(+)	AUDIO-4_R(+)	AUDIO-6_R(+)	AUDIO-8_R(+)
2	AUDIO-2_R(–)	AUDIO-4_R(–)	AUDIO-6_R(–)	AUDIO-8_R(–)
1	Chassis GND	Chassis GND	Chassis GND	Chassis GND

BOTTOM

The AUDIO input mating connector is shown to the left of the table, with screw terminals lined up with their respective contacts 1 through 10. When viewed in this orientation, wires are inserted on the left side of the connector. When this connector is inserted into the LEX2000 unit, contact number 10 will be on top and contact number 1 will be on the bottom.

3.3.2.   Digital Audio Inputs

The LEX2000 may receive digital audio formatted as AES monaural, AES stereo or may pass through audio that has been pre-encoded as Dolby Digital® (AC-3) or Dolby 5.1. Digital audio sample rates of 32kHz, 44.1kHz and 48kHz are supported by the audio encoder.

NOTE: ATSC specifications require that broadcast digital audio be sampled at 48kHz. Digital audio received by the LEX2000 is encoded to Dolby Digital at its native sample rate and is not resampled to 48kHz. Use of digital audio at non-compliant sample rates, such as 32kHz and 44.1kHz is not recommended.

3.3.2.1   Embedded Audio Inputs

Embedded digital audio may be received in the same SDI input stream that carries its associated video program. Stereo audio programs generally have their left channel assigned to track or group 1, 3 or 5, and their right channel to track 2, 4 or 6. Use the AUDIO web page, shown in Figure 12, to select the appropriate embedded audio track for each embedded audio program.

3.3.2.2   De-Embedded Digital Audio Inputs

The AUDIO-7/8 connector on each LEX2000 unit is configured at the factory to receive either analog audio or de-embedded AES digital audio. This configuration may be changed at any time by factory-authorized service personnel. When the LEX2000 unit is configured to receive digital audio on connector AUDIO-7/8, analog audio inputs 7 and 8 are not available for use. Conversely, when the LEX2000 is configured to receive analog audio on connector AUDIO-7/8, no de-embedded digital audio inputs are available. AUDIO-7/8 mating connector pin assignments are shown in Table 14, below.

De-embedded digital audio may be received on the AES digital audio inputs on connector AUDIO-7/8. Use the AUDIO web page, shown in Figure 12, to select the appropriate audio track for each de-embedded audio program.

3.3.3.   Pass-Through Audio Inputs

Digital audio that is already encoded as Dolby 5.1 or Dolby Digital and received by the LEX2000 is passed to the ATSC transport multiplex without further processing of the encoded audio program. Synchronization of the encoded audio program and its associated video program upon arrival at the LEX2000 input is maintained at the transport stream output.

The Pass-Through Audio table on the AUDIO web page, shown in Figure 12, may be used to select and receive pre-encoded audio programs on SDI and AES inputs and designate them as PA-1 through PA-8. Pre-encoded audio programs received on the ASI input by using the RX option are identified on the REMUX web page, shown in Figure 24, and are designated XA-1.1 through XA-4.3. After the audio program source is identified in the Pass-Through Audio table (AUDIO web page) or in the ASI Input Programs table (REMUX web page), the designation is available to be selected as an "Encoded Audio

Program" source in the ATSC Services table at the top of the AUDIO and REMUX web pages.

Pre-encoded audio programs may also be received on LEX2000 inputs selected as signal sources for audio encoder channels EA-1 through EA-8 in the Audio Encoder table on the AUDIO web page. Any Dolby 5.1 or Dolby Digital audio programs received on audio encoder inputs are passed directly to the ATSC transport multiplexer without further processing.

Table 14: AUDIO-7/8 Digital Audio Input Connector Pins

TOP

AUDIO Connector Contact Number	AUDIO-7/8 Connector Signals (Digital Audio Configuration) " D "
10	AES-1(+)
9	AES-1(–)
8	AES-2(+)
7	AES-2(–)
6	Chassis GND
5	AES-3(+)
4	AES-3(–)
3	AES-4(+)
2	AES-4(–)
1	Chassis GND

BOTTOM
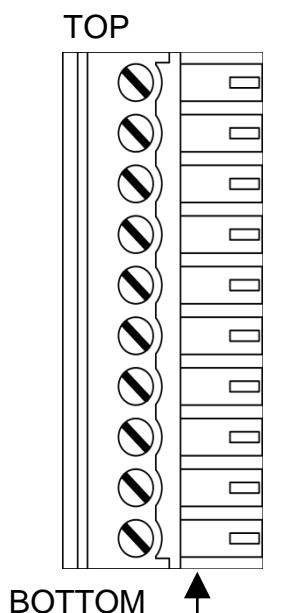
The AUDIO-7/8 mating connector is shown to the left of the table, with screw terminals lined up with their respective contacts 1 through 10. When viewed in this orientation, wires are inserted on the left side of the connector. When this connector is inserted into the LEX2000 unit, contact number 10 will be on top and contact number 1 will be on the bottom.

3.3.4. AUDIO Connector Configuration Label

LEX2000 units have a label applied to the rear panel at the factory to indicate the physical configuration of the four AUDIO connectors. Each AUDIO connectors supports two banks of signals and has two letters to designate the configuration of each bank, as follows:

"A" – stereo analog audio input

"C" – dry contact closure inputs and outputs (GPIO)

"D" – digital audio input (PCM / AES)

Figure 11: AUDIO Connector Configuration Label

3.4. Contact Closure Input / Output Connections

Each LEX2000 unit is configured at the factory for connector AUDIO-5/6 to either receive analog audio or to provide contact closure sense inputs and dry contact closure outputs. This configuration may be changed at any time by factory-authorized service personnel. When the LEX2000 unit is configured for contact closure I/O, analog audio inputs 5 and 6 are not available for use. Conversely, when the LEX2000 is configured to receive analog audio on connector AUDIO-5/6, no contact closure inputs or outputs are available. AUDIO-5/6 mating connector pin assignments for contact closure I/O are shown in Table 15, below.

The LEX2000 supports the use of contact closure inputs and outputs to perform a number of control functions, such as actuating the emergency broadcast cut-over switch, which is described in paragraph 4.6.2.

Table 15: AUDIO-5/6 Contact Closure Input / Output Connector Pins

AUDIO Connector Contact Number	AUDIO-5/6 Connector Signals (Contact Closure I/O Configuration)
10	RELAY1_B
9	RELAY1_A
8	VOUT_5V
7	SENSE_IN1
6	SIGNAL_GND
5	RELAY2_B
4	RELAY2_A
3	VOUT_12V
2	SENSE_IN2
1	SIGNAL_GND

TOP

BOTTOM

The AUDIO-5/6 mating connector is shown to the left of the table, with screw terminals lined up with their respective contacts 1 through 10. When viewed in this orientation, wires are inserted on the left side of the connector. When this connector is inserted into the LEX2000 unit, contact number 10 will be on top and contact number 1 will be on the bottom.

3.4.1. Contact Sense Inputs

The LEX2000 provides the ability to sense two external dry contact closures, through connection to the SENSE_IN1 and SENSE_IN2 signals, located on contacts 2 and 7 of the AUDIO-5/6 connector. When either one of the SENSE_IN signals is connected to SIGNAL_GND by an external switch or

relay, the LEX2000 unit receives the signal and takes the action defined by the system configuration web pages.

The external dry contact connected between SENSE_IN and SIGNAL_GND must have sufficient ratings to switch a 5VDC signal at 20mA of current. To ensure reliable activation of the SENSE_IN signals, and to avoid potential damage to the LEX2000 unit, the external switch or relay must only connect the SENSE_IN signals to the SIGNAL_GND contact on the AUDIO-5/6 connector.

WARNING: DO NOT connect either of the SENSE_IN contacts to a different system ground or to an external voltage source. Connecting the SENSE_IN contact to any signal other than SIGNAL_GND has unpredictable results and may potentially damage the LEX2000 unit.

3.4.2. Dry Contact Outputs

The LEX2000 provides two dry contact closure outputs, suitable for switching external loads. The signals RELAY_A and RELAY_B are connected to normally open relay contacts, which may be closed under firmware control as directed by settings on the ALERT web page.

The relays support a maximum load of 1A at 24V (AC or DC) and require a minimum current level of 10mA at 5VDC for reliable operation.

The RELAY_A and RELAY_B signals are not connected to the LEX2000 signal ground or internal power sources in any way, so they may be used to switch loads in nearby equipment that has different signal grounds than the LEX2000.

WARNING: DO NOT connect the RELAY_A or RELAY_B signals to long distance telecom circuits or to equipment whose ground voltage reference may vary from the LEX2000 SIGNAL_GND by more than 48V.

3.4.3. Power Sources for External Loads

The LEX2000 provides a 5VDC voltage source on AUDIO-5/6 contact 8 and a 12VDC voltage source on AUDIO-5/6 contact 3. These power sources are referenced to SIGNAL_GND on contacts 1 and 6, and may be used to drive external loads, such as relay coils. The voltage outputs are current-limited and are protected from short-circuits by a fold-back circuit.

Each of these two power sources may be turned on and off under firmware control, as directed by settings on the ALERT web page. The ratings of the two voltage sources are as follows:

Table 16: External Power Source Ratings

Power Source	Parameter	Min	Typ	Max	Units
VOUT_5V	Voltage		5		VDC
	Current			400	mA
VOUT_12V	Voltage		12		VDC
	Current			400	mA

3.5. ASI Input Connection

The ASI Input is used by the ASI Re-Multiplexer or Remux (RX) Option to receive encoded audio and video program streams from an ASI signal transport stream, generated by a satellite receiver or other ASI source, and integrate those streams with locally encoded content to form a new ATSC multiplex transport stream output. In order to use the ASI Remux function, the LEX2000 unit must have installed a version of firmware and a license file that supports the RX option. If the RX option is not activated, then the ASI Input connector has no function.

For more information on use of the ASI Remux function, see paragraph 4.10.

3.6. ASI and SMPTE-310 Output Connection

The LEX2000 includes two transport stream outputs to provide for connections to multiple pieces of equipment, such as an exciter, an ASI monitor, a feed to a cable distribution plant or a studio-transmitter link. The same ATSC multiplex data appears on both output signals, ASI-OUT-1 and ASI-OUT-2.

The protocol of the serial data output signal may be selected independently for each ASI-OUT-x signal as ASI or SMPTE-310 on the OPERATION - TRANSPORT web page. ASI protocol is the default and is highly recommended for new installations. SMPTE-310 is provided to support interfaces with modulator equipment that does not accept ASI signals.

NOTE: Throughout this user manual, the ASI / SMPTE-310 output signals are generally referred to as the ASI output for simplicity, even though they are able to support either ASI or SMPTE-310 data formats.

NOTE: The ASI output supports ATSC transport streams for terrestrial or cable broadcast, using data rates up to 38.8 Mbit/sec. If SMPTE-310 protocol is selected for one of the output connectors, then the data rate is forced to 19.39 Mbit/sec for both output signals.

3.7. Streaming IP Output Connection

The LEX2000 supports streaming IP output on a variety of physical media, including copper and fiber. A range of media types are supported by using different SFP (small form-factor pluggable) transceiver modules in the IP-4 socket on the rear panel.

The Streaming IP Gigabit Ethernet (TG) Option enables an LEX2000 unit to transmit its ATSC multiplex as a UDP or RTP data stream over Ethernet, using a Gigabit Ethernet transceiver with an RJ-45 connector. Connect a Cat-5, Cat-5e or Cat-6 Ethernet cable to the SFP transceiver RJ-45 connector in socket IP-4 to use the Streaming IP Output feature. If there is no RJ-45 connector and SFP transceiver installed in the IP-4 location, then the TG Option is not installed in the LEX2000 unit.

In order to use the Streaming IP Output Gigabit Ethernet option, a Gigabit Ethernet SFP transceiver must be installed in socket IP-4 and a license that enables the TG option must be loaded into the LEX2000 unit. For more information on use and configuration of the streaming IP output, see paragraph 4.9.

4. OPERATION

This section describes the LEX2000 functionality, including performance characteristics, usage recommendations and instructions for setting operational parameters using the system configuration web pages. A block diagram of the LEX2000 encoder / multiplexer, shown in Figure 3, provides a visual map of its internal functions, which are described in this section.

4.1. Audio Processing

The audio processing resources in the LEX2000 provide the ability to receive analog audio, uncompressed digital PCM audio and pre-encoded Dolby pass-through audio, digitize the analog audio and encode the uncompressed audio streams.

4.1.1. Analog Audio Digitizer

The LEX2000 digitizes up to 8 stereo (pairs) of analog audio signals, received through the AUDIO connectors. The 24-bit audio digitizers sample the analog audio at 48kHz.

4.1.2. Dolby Digital® Audio Encoder

The LEX2000 encodes up to 8 stereo audio programs to Dolby Digital. All 8 Dolby Digital audio encoder channels are active and available for use, regardless of how many video encoder channels are enabled or used. The Dolby Digital encoder and its control parameters conform to the rigid standards of Dolby Laboratories. Multiple settings are available for encoded audio bit rate, allowing broadcasters to trade-off bandwidth constraints and audio fidelity requirements for each audio program element.

4.1.3. Audio Configuration Settings

Audio encoder operation is configured using the AUDIO web page, shown in Figure 12 below.

The ATSC Services table allows encoded audio programs (EA-x) pre-encoded, pass-through audio programs (PA-x) and remux audio program (XA-1.1 to XA-4.3) to be assigned to each ATSC service in the output multiplex. Up to three audio program elements may be assigned to each ATSC service or virtual channel. A maximum of 8 unique audio programs may be integrated into the entire ATSC service multiplex.

Each EA, PA or XA stream may only be assigned to one Audio Program in one ATSC Service. EA, PA and XA streams may not be duplicated within the multiplex. In cases where an audio program stream needs to be delivered in two different ATSC services, use one audio signal as the input source for two or more EA or PA streams, providing the same audio program content on two different EA or PA streams. Each of these streams may then be used in different ATSC services.

The Audio Encoder table allows the user to define the audio signal source and encoding parameters for each encoded audio stream. If Dolby 5.1 or Dolby Digital data streams are detected on SDI or AES audio tracks that are selected as Audio Signal Sources in the Audio Encoder table, those pre-encoded data streams are passed through directly to the multiplexer, bypassing the Dolby Digital audio encoder.

Table 17, Table 18 and Table 19 explain the audio encoder configuration parameters available on the AUDIO web page. The ASI Bandwidth Management table at the bottom of the AUDIO web page provides bandwidth allocation guidance when selecting the encoded audio bit rate of audio programs in the Audio Encoder table. The ASI Bandwidth Management table appears on both the AUDIO and VIDEO web pages, and a detailed description is provided in Table 23, below.

SYSTEM	OPERATION	CONTACT US		Apply	Save Configuration Settings	Logout
TRANSPORT	VIDEO	AUDIO	PSIP	CAPTIONS	EAS	REMUX

ATSC SERVICES

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Service Status	Active	Active	Active	Active	Off Air	Off Air	Off Air	Off Air
Virtual Channel Name	WAAA-HD	WBBB	WCCC	WDDD				
Virtual Channel Number	12-1	12-2	12-3	12-4	12-5	12-6	12-7	12-8
Encoded Video Program	EV-1	EV-2	EV-3	EV-4	-	-	-	-
Video Input Source	HD-SDI-1	SD-SDI-4	NTSC-5	NTSC-6				
Encoded Audio Program 1	EA-1	EA-2	EA-3	EA-4				
Encoded Audio Program 2	EA-5	EA-6	EA-7	EA-8				
Encoded Audio Program 3								

AUDIO ENCODER

ENCODED AUDIO PROGRAM NUMBER:	EA-1	EA-2	EA-3	EA-4	EA-5	EA-6	EA-7	EA-8
Audio Signal Source	HD-SDI-1	SD-SDI-1	SD-SDI-2	AUDIO-3	AUDIO-4	AUDIO-7		
Left Channel Track	1	1	1	1	1	1	1	1
Right Channel Track	2	2	2	2	2	2	2	2
Detected Audio Sample Rate	-	-	-					
Audio Digitizer Sample Rate				48 kHz	48 kHz	48 kHz		
Audio Delay (ms)	0	0	0	0	0	0	0	0
Dialog Normalization	-27	-27	-27	-27	-27	-27	-27	-27
Dolby Coding Mode	2/0:L,R	2/0:L,R	2/0:L,R	2/0:L,R	2/0:L,R	2/0:L,R	2/0:L,R	2/0:L,R
Dolby Surround Mode	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified
Dolby DRC Line Mode	None	None	None	None	None	None	None	None
Dolby DRC RF Mode	None	None	None	None	None	None	None	None
Default Audio Language	ENG	ENG	ENG	ENG	SPA	SPA	SPA	SPA
Encoded Audio Bit Rate	192 kbps	192 kbps	192 kbps	96 kbps	96 kbps	96 kbps	96 kbps	96 kbps

PASS-THROUGH AUDIO

PASS-THROUGH AUDIO PROGRAM NUMBER:	PA-1	PA-2	PA-3	PA-4	PA-5	PA-6	PA-7	PA-8
Audio Signal Source	SD-SDI-1							
Audio Signal Track 1	5	1	1	1	1	1	1	1
Audio Signal Track 2	6	2	2	2	2	2	2	2
Audio Signal Status	-	-	-	-				
Detected Audio Bit Rate	-	-	-	-				
Expected Audio Bit Rate	384 kbps	96 kbps	96 kbps	96 kbps	96 kbps	96 kbps	96 kbps	96 kbps
Default Audio Language	ENG	ENG	ENG	ENG	ENG	ENG	ENG	ENG
Audio Delay (ms)	0	0	0	0	0	0	0	0

ATSC MULTIPLEX BANDWIDTH (Mbits/sec)

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Video Bit Rate Control	Stat-MUX	Stat-MUX	Stat-MUX	Stat-MUX	-	-	-	-
Video Bit Rate Target	9.000	3.000	2.900	2.200	-	-	-	-
Audio Program 1	0.384	0.192	0.128	0.096	-	-	-	-
Audio Program 2	0.096	0.096	0.096	0.096	-	-	-	-
Audio Program 3	-	-	-	-	-	-	-	-
AUDIO-VIDEO Subtotals	9.480	3.288	3.124	2.392	-	-	-	-

TOTAL AUDIO	1.184
TOTAL VIDEO	17.100
TOTAL AUDIO-VIDEO	18.284
RESERVED - MOBILE DTV	-
ATSC DATA	1.080
TOTAL MULTIPLEX	19.364
UNUSED BANDWIDTH	0.029
TOTAL MULTIPLEX BANDWIDTH LIMIT	19.393
TOTAL MAX BANDWIDTH ASI INPUT PROGRAMS USED	0.000

Figure 12: AUDIO Configuration Web Page

Table 17: AUDIO Web Page – ATSC Services Configuration

Parameter	Values
ATSC Service Number	Each ATSC service is identified as SR-x.
Service Status	Reports whether each virtual channel is Active or Off Air, as defined on the TRANSPORT web page.
Virtual Channel Name	Reports the short channel name (call letters) for each ATSC service, as defined on the TRANSPORT web page.
Virtual Channel Number	Reports the major and minor channel numbers for each ATSC service, as defined on the TRANSPORT web page.
Encoded Video Program	Reports the encoded video stream assigned to each ATSC service, as defined on the VIDEO web page.
Video Input Source	Reports the video input signal source to simplify selection of the correct Audio Signal Source for each EA-x stream.
Encoded Audio Program 1	Select one or more encoded audio program elements to use in each service. The LEX2000 supports up to three audio programs in each ATSC service.
Encoded Audio Program 2	
Encoded Audio Program 3	

Table 18: AUDIO Web Page – **AUDIO ENCODER** Configuration

Parameter	Values
Encoded Audio Program Number	Each encoded audio program is identified as EA-x.
Audio Signal Source	Select the input connector that receives the audio signal for this encoder channel: HD-SDI-x, SD-SDI-x, AUDIO-x, AES-x or blank if the encoder channel is not used.
Left Channel Track (1-16)	If the Audio Signal Source is HD-SDI or SD-SDI, then select the tracks that carry the left and right channels. These do not apply to analog or AES audio inputs and should be left blank.
Right Channel Track (1-16)	
Detected Audio Sample Rate	For digital audio inputs only, reports the sample rate of the audio signal carried by the serial data stream.
Audio Digitizer Sample Rate	For analog audio inputs only, received on AUDIO-x connectors, 48kHz is the only audio sample rate supported by the audio digitizer in the LEX2000. Dolby requires this item to be presented in the encoder configuration menu.
Audio Delay (ms)	Adjust from +300 to -300 ms to synchronize audio with a video program. Set this control to zero unless the audio and video are out of sync when received by the LEX2000 unit.
Dialog Normalization	This allows the broadcaster to normalize the dialog loudness across all the audio programs in the service multiplex. For each audio program, the dialog normalization value identifies the dB difference in loudness between maximum digital level and the level of the program dialog. When passed to the Dolby Digital decoder in the ATSC receiver, this value allows dynamic volume adjustment as the user switches audio programs. Default setting is -27.
Dolby Coding Mode	"2/0:L,R" is the only Dolby coding mode supported by the audio encoder within the LEX2000. Dolby requires this item to be presented in the encoder configuration menu.
Dolby Surround Mode	Supported values for the Dolby Surround Mode are Enabled, Disabled and Unspecified. The default value is "Unspecified."
Dolby DRC Line Mode	Dolby Dynamic Range Controls provide dynamic range information for the audio program being encoded, which allows the Dolby Digital decoder in the ATSC receiver to compress the dynamic range as needed to suit the listener preferences. Default values are "None."
Dolby DRC RF Mode	
Default Audio Language	The Dolby Digital audio descriptor for each program element includes a language designation. If the language is not identified in the dynamic PSIP data received, or if dynamic PSIP is not used, then the LEX2000 uses the default language selection for each respective EA stream in the ATSC multiplex.
Encoded Audio Bit Rate	Select a bit rate for the encoded audio stream from the list of supported bit rates. Higher bit rates use less compression for higher fidelity audio reproduction, while lower bit rates use less bandwidth, but may result in lower audio fidelity. The default encoded audio bit rate is 192 kbps.

Table 19: AUDIO Web Page – **PASS-THROUGH AUDIO** Configuration

Parameter	Values
Pass-Through Audio Program Number	Each pass-through audio program is identified as PA-x.
Audio Signal Source	Select the input connector that receives the pre-encoded audio signal for this Pass-Through Audio channel: HD-SDI-x, SD-SDI-x, AUDIO-x, AES-x or blank. Note: AES-x values are only presented as signal sources if the unit is configured to receive digital audio on connector AUDIO-7/8.
Audio Signal Track 1 (1-16)	If the Audio Signal Source is HD-SDI or SD-SDI, then select the tracks that carry the left and right channels. These do not apply to AES audio inputs and should be left blank.
Audio Signal Track 2 (1-16)	**IMPORTANT**: If pass-through audio is being received on only one track, then Audio Signal Track 1 and 2 must be set to the same value.
Audio Signal Status	Reports the type of encoded audio stream detected at the selected input.
Detected Audio Bit Rate	Reports the bit rate of the encoded audio stream detected at the selected input.
Expected Audio Bit Rate	Select the encoded audio bit rate expected for each PA channel. This value is used for bit rate calculations when the encoded audio input signal is not present.
Default Audio Language	Select the audio language setting to be used in the broadcast output stream when language data is not provided through dynamic PSIP for program using audio from this PA channel.
Audio Delay (ms)	Adjust from -300 ms to +300 ms to synchronize audio with a video program. Set this control to zero unless the audio and video are out of sync when received by the LEX2000 unit.

4.2. Video Processing

The video processing resources in the LEX2000 provide the ability to receive digital or analog video, digitize the analog video as needed, selectively apply spatial filtering of noise and sharpness, and then encode the video to MPEG-2 for ATSC broadcast.

4.2.1. NTSC Video Digitizer

The LEX2000 digitizes up to 6 analog NTSC video signals, received on the NTSC connectors. The 8-bit video digitizers sample the analog NTSC video at 27 MHz, phase-locked to the video signal being digitized. Chroma is sampled with 4:2:0 resolution, as required for ATSC broadcast.

4.2.2. Video Noise Filter

A two-dimensional statistical noise filter removes shot and speckle noise in the video images, while preserving the overall scene sharpness. The video noise filter removes artifacts that degrade the video encoding process, allowing more video encoding bits to be applied to video image details instead of useless noise. The video noise filter is particularly effective at improving the picture quality of video received on the analog NTSC video inputs. Filtering out even small amounts of noise in the video signal can dramatically improve encoder efficiency and the broadcast picture quality at a given bit rate.

The strength of the video noise filter may be selected independently for each encoded video stream, using the VIDEO web page. Set the video noise filter strength to MEDIUM or HEAVY for analog video inputs with noisy content and set the filter strength to OFF or LIGHT for digital video inputs, depending on its noise level. The video noise filter should be off for HD video inputs, unless speckle noise is apparent in the picture.

4.2.3. Video Smoothing Filter

A two-dimensional Gaussian smoothing filter allows the broadcaster to reduce the sharpness of video images, which reduces the bandwidth or bit-rate required by the encoded video program in the output multiplex. The strength of the video smoothing filter may be selected independently for each encoded video stream, using the VIDEO web page.

Video Smoothing Filter strength values of OFF, AUTO, LIGHT, MEDIUM and HEAVY provide a wide range of image filtering choices. When the Video Smoothing Filter is set to AUTO, the filter roll-off characteristics are adjusted automatically by the video encoder in order to maintain the desired bit rate for the encoded video while also maintaining image quality and avoiding artifacts.

4.2.4. MPEG-2 Video Encoder

The LEX2000 includes the *adaptiVideo™* variable bit rate video encoder, capable of encoding multiple HD and SD video programs to MPEG-2 format. Video program combinations supported by the video encoder are listed in Table 20, below. This table indicates the processing capacity of the video encoder and is not intended to provide guidance regarding encoded picture quality.

Picture quality depends on many factors, including the bit rate assigned to each video encoder channel and the type of video content being encoded. A 38.8Mbit/sec cable transport stream easily supports 8 SD video channels with great picture quality, but a 19.39Mbit/sec terrestrial broadcast transport stream provides much less bit rate per channel. For more information on optimizing the picture quality from an LEX2000 encoder, read the APN-2013-001application note on Picture Quality Optimization.

Table 20: Video Encoder HD / SD Stream Capacity

1080i or 720p60	720p30	480i or 480p30	Maximum Number of Video Programs
2			2
1	1	0 – 3	5
1		0 – 6	7
	2	0 – 6	8
	1	0 – 7	8
		1 – 8	8

The video encoder supports various frame rates, GOP styles and GOP sizes, allowing the broadcaster to tailor encoder performance to their video content and viewer preferences. The video encoder incorporates dynamic rate control, which works with the statistical multiplexer to optimize the allocation of transport stream bandwidth across the encoded video streams and maximize the picture quality across all of the video programs in the ATSC multiplex.

4.2.5. Video Configuration Settings

Video processor and encoder operations are configured using the VIDEO web page, shown in Figure 13.

The ATSC Services table at the top allows encoded video programs (EV-x) to be assigned to each ATSC service in the output multiplex. Each EV stream may be assigned to multiple ATSC services as needed. Table 21 defines each parameter of the ATSC Services table on the VIDEO web page.

The Video Encoder table allows the user to define the video input source and encoding parameters for each encoded video (EV) stream. One column of the table is presented for each EV stream authorized by the license file loaded into the LEX2000 unit. Table 22 explains the status and control settings presented in the Video Encoder table.

The ASI Bandwidth Management table is located below the Video Encoder table and provides bandwidth allocation guidance when selecting the encoded

video bit rate of each video program. Table 23 explains each of the parameters listed in the ASI Bandwidth Management table on the VIDEO web page.

SYSTEM	OPERATION	CONTACT US			Apply	Save Configuration Settings	Logout
TRANSPORT	VIDEO	AUDIO	PSIP	CAPTIONS	EAS	REMUX	

ATSC SERVICES

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Service Status	Active	Active	Active	Active	Off Air	Off Air	Off Air	Off Air
Virtual Channel Name	WAAA-HD	WBBB	WCCC	WDDD				
Virtual Channel Number	12-1	12-2	12-3	12-4	12-5	12-6	12-7	12-8
Encoded Video Program	EV-1	EV-2	EV-3	EV-4				
Encoded Audio Program 1	EA-1	EA-2	EA-3	EA-4	-	-	-	-
Encoded Audio Program 2	EA-5	EA-6	EA-7	EA-8	-	-	-	-
Encoded Audio Program 3	-	-	-	-	-	-	-	-

VIDEO ENCODER   Help with Video Input Source Selection

ENCODED VIDEO PROGRAM NUMBER:	EV-1 HD / SD	EV-2 HD / SD	EV-3 SD	EV-4 SD	EV-5 SD	EV-6 SD	EV-7 SD	EV-8 SD
Maximum Format Size	720p30	480i	480i	480i	480i	480i	480i	480i
Video Input Source	HD-SDI-1	SD-SDI-4	NTSC-5	NTSC-6				
Video Input Signal Status	No Signal	No Signal	No Signal	No Signal	No Signal	No Signal	No Signal	No Signal
Detected Video Format	-	-	-	-	-	-	-	-
Detected Closed Captions	-	-	-	-	-	-	-	-
Detected AFD Value	-	-	-	-	-	-	-	-
AFD Value Insertion	Force AFD	Auto AFD	Pass AFD	Auto AFD	Auto AFD	Auto AFD	Auto AFD	Auto AFD
Default Aspect Ratio SD	4:3 FULL	16:9 ANA	4:3 FULL	4:3 FULL	4:3 FULL	4:3 FULL	4:3 FULL	4:3 FULL
Default Aspect Ratio HD	16:9 FULL	16:9 FULL	-	-	-	-	-	-
Video Noise Filter	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Video Smoothing Filter	Off	Light	Medium	Heavy	Auto	Auto	Auto	Auto
Encoding Mode	Auto	Auto	Auto	Auto	Auto	Auto	Auto	Auto
GOP Structure	IPPPPPP	IPPPPPP	IPPPPPP	IPPPPPP	IPPPPPP	IPPPPPP	IPPPPPP	IPPPPPP
GOP Size	15	15	15	15	15	15	15	15
Video Bit Rate Control	Stat-MUX	Stat-MUX	Stat-MUX	Stat-MUX	Stat-MUX	Stat-MUX	Fixed - VBR	Fixed - VBR
Video Bit Rate Target	9.000	3.800	2.400	2.000	0.200	0.200	0.200	0.200

ATSC MULTIPLEX BANDWIDTH (Mbits/sec)

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Video Bit Rate Control	Stat-MUX	Stat-MUX	Stat-MUX	Stat-MUX	-	-	-	-
Video Bit Rate Target	9.000	3.800	2.400	2.000	-	-	-	-
Audio Program 1	0.192	0.192	0.192	0.096	-	-	-	-
Audio Program 2	0.096	0.096	0.096	0.096	-	-	-	-
Audio Program 3	-	-	-	-	-	-	-	-
AUDIO-VIDEO Subtotals	9.288	4.088	2.688	2.192	-	-	-	-

TOTAL AUDIO	1.056
TOTAL VIDEO	17.200
TOTAL AUDIO-VIDEO	18.256
RESERVED BANDWIDTH	-
TRANSPORT OVERHEAD	1.080
TOTAL MULTIPLEX	19.336
UNUSED BANDWIDTH	0.057
TOTAL MULTIPLEX BANDWIDTH LIMIT	19.393

Figure 13: VIDEO Configuration Web Page

Table 21: VIDEO Web Page – ATSC Services Configuration

Parameter	Values
ATSC Service Number	Identifies each ATSC service as SR-x.
Service Status	Reports whether each virtual channel is Active or Off Air, as defined on the TRANSPORT web page.
Virtual Channel Name	Reports the short channel name (call letters) for each ATSC service, as defined on the TRANSPORT web page.
Virtual Channel Number	Reports the major and minor virtual channel numbers for each ATSC service, as defined on the TRANSPORT web page.
Encoded Video Program	Select the encoded video program element to be used for each ATSC service or virtual channel. The same video program may be assigned to multiple virtual channels.
Encoded Audio Program 1	Reports the encoded audio streams assigned to each ATSC service, as defined on the AUDIO web page. Each audio program may only be assigned to a single virtual channel.
Encoded Audio Program 2	
Encoded Audio Program 3	

Table 22: VIDEO Web Page – Video Encoder Configuration

Parameter	Values		
Encoded Video Program Number	Identifies each encoded video program element as EV-x and the encoding capacity of each video encoder channel as HD/SD or SD.		
Maximum Format Size	Select the maximum format size that may be accepted into each video encoder channel: 1080i, 720p60, 720p30 or 480i. If the video format received requires substantially more bandwidth than indicated by the Maximum Format Size setting, the encoder switches to color bars, as outlined below.		
	Max Format Size Setting	Input Video Format Received	Video Encoder Action
	1080i or 720p60	Any	Encodes the video
	720p30	1080i	Error - displays color bars
		720p60	Encodes as 720p30 by dropping every other frame
		720p30, 480i	Encodes the video
	480i	Any HD Format	Error - displays color bars
		480p60	Encodes as 480p30 by dropping every other frame
		480i, 480p30	Encodes the video
Video Input Source	Select the input connector that receives the video signal for this encoder channel: HD-SDI-x, SD-SDI-x, NTSC-x or blank if encoder channel is not used.		
Video Input Signal Status	Reports status of signal detected on Video Input Source connector: Good Signal, No Signal, Signal Errors, Format Error		
Detected Video Format	Reports the video format and frame rate detected in the stream received at the selected input: 1080i, 720p60, 720p30, or 480i.		
Detected Closed Captions	Reports the closed caption format detected in video stream received from Video Input Source: 708, 608-CDP, 608-VA, 608-21, None		
Detected AFD Value	Reports the AFD value currently present in the video program as it is received by the LEX2000, including the binary value and its meaning.		
AFD Value Insertion	Select the mode of operation desired for setting AFD values in each encoded video stream: Pass AFD received with the video program, Force AFD to a specific value, or Auto AFD to insert an AFD value if one is not included in the received video program.		
Default Aspect Ratio SD	Select the aspect ratio value to be inserted into standard definition video programs that do not have an AFD value in their signal or stream.		
Default Aspect Ratio HD	Select the aspect ratio value to be inserted into high definition video programs that do not have an AFD value in their stream.		

Table 22: VIDEO Web Page – Video Encoder Configuration (continued)

Parameter (continued)	Values (continued)
Video Noise Filter	Select the noise filter level: Off, Light, Medium, Heavy. Medium or Heavy settings should be used with analog NTSC video sources, depending on the level of visible noise. Light or Off settings should be used with digital video sources. The video noise filter should be Off for high quality HD video sources.
Video Smoothing Filter	Select the smoothing filter strength: Off, Auto, Light, Medium, Heavy. Stronger filter values reduce image detail and soften sharp edges, but allow the video encoder to use a lower bit rate. The Auto setting allows the video encoder to change the amount of filtering, from Light to Heavy, depending on image characteristics in order to help maintain the user-specified bit rate for the encoded video output.
Encoding Mode	Select Frame mode to optimize quality of still images and Field mode to provide better picture quality during high motion sequences.
GOP Structure	Select the GOP structure for the encoded video: I or IPPPPPP. I-frame encoding provides independent frames and requires a higher bit rate than I-P encoding. I-P encoding uses motion estimation and predictive frames to reduce encoded video bit rate while maintaining good image quality.
GOP Size	Select a GOP size from the pull-down list provided. Larger GOP sizes reduce the bit rate required to get good image quality but lengthen the time required to begin display of a newly selected video channel at the ATSC receiver. Default GOP size is 15.
Video Bit Rate Control	Select "Fixed-VBR" to turn off dynamic rate control on this encoder channel and to reserve a fixed bandwidth for this video program in the ATSC service multiplex. Select "Stat-Mux" to turn on dynamic rate control and share a pool of multiplex bandwidth with other encoder channels that are also set to Stat-Mux.
Video Bit Rate Target	Fill in the amount of bandwidth to be allocated to this video program. When the Video Bit Rate Control setting is "Fixed-VBR" this setting identifies the specific amount of bandwidth to reserve in the ATSC service multiplex. When the Video Bit Rate Control setting is "Stat-Mux," the Video Bit Rate Target value identifies the bandwidth priority of this encoded video program relative to other encoded video programs sharing the Stat-Mux. In both cases the Video Bit Rate Target value is used to define the nominal bandwidth allocated to the encoded video program in the bandwidth calculations for entire ATSC multiplex.

Table 23: VIDEO Web Page – ATSC Multiplex Bandwidth

Parameter	Values
Video Bit Rate Control Video Bit Rate Target	Reports the video bit rate control and bit rate target for each encoded video stream used in the ATSC multiplex, as defined in the Video Encoder table on the VIDEO web page.
Audio Program 1, 2, 3	Reports the bandwidth assigned to each encoded audio program assigned to each ATSC service throughout the multiplex, as defined in the Audio Encoder table on the AUDIO web page.
AUDIO – VIDEO Subtotals	Reports the total bandwidth allocated to each ATSC service for encoded audio and encoded video data. This subtotal does not include PSIP, ATSC data or any encoded video streams that may be duplicated within the multiplex.
TOTAL AUDIO	Reports the total bandwidth allocated to all encoded audio programs within the ATSC service multiplex.
TOTAL VIDEO	Reports the total bandwidth allocated to all encoded video programs within the ATSC service multiplex. Video programs that are duplicated in multiple ATSC services only have a single stream in the multiplex and are only counted once in this value.
TOTAL AUDIO-VIDEO	Reports the total bandwidth allocated to all encoded audio and encoded video programs within the ATSC service multiplex.
RESERVED BANDWIDTH	Reports the multiplex bandwidth reserved for other applications, such as Mobile DTV, as defined on the TRANSPORT web page.
ATSC DATA	Reports the multiplex bandwidth allocated to PSIP, ATSC tables and other data that is not audio or video.
TOTAL MULTIPLEX	Reports the grand total allocation of multiplex bandwidth.
UNUSED BANDWIDTH	Reports the amount of multiplex bandwidth left unused (in green) or over-subscribed (in red) when all components of the ATSC service multiplex are combined.
MAX TS DATA RATE	Reports the maximum bandwidth of the ATSC multiplex data payload, as defined on the TRANSPORT web page. This value is normally 19.39 or 38.8 Mbits/sec, but may be manually set to any value between 10 and 80 Mbits/sec if the TG option is enabled in the unit.
MAX BANDWIDTH OF ASI INPUT PROGRAMS	For LEX2000 units with the RX Option enabled, reports the maximum bandwidth reserved for ASI Input programs in the transport stream output.
TOTAL DETECTED BANDWIDTH ASI INPUT PROGRAMS USED *(RX Option Only)*	For LEX2000 units with the RX Option enabled, reports the maximum bandwidth required by ASI Input programs in the transport stream output.

4.2.6. Active Format Description (AFD)

LEX2000 units apply multiple strategies to ensure that the correct aspect ratio information is provided to the broadcast viewer with each encoded video stream. The aspect ratio of the encoded video picture is defined by the Active Format Description (AFD) value, supplemented by Bar Data when necessary.

The Video Encoder table on the OPERATION - VIDEO web page provides the AFD control settings. Broadcasters are able to control the AFD behavior for each encoded video stream, EV-x, to accommodate a wide variety of video programming.

The Detected AFD Value reports the AFD value detected in the video input signal, if one is present. Both the binary data value and its meaning are displayed together, as shown in Table 24. Additional information embedded within the video input signal defines whether the original image is a 4:3 or 16:9 image and is necessary to properly interpret the meaning of the AFD value.

Table 24: Detected AFD Values in Video Input Signals

Detected AFD Value	AFD Reported for 4:3 Video	AFD Reported for 16:9 Video	Comments
0000	0000 UND	0000 UND	Undefined
0001	0001 RSVD	0001 RSVD	Reserved
0010	0010 16:9 LB	0010 16:9 FL	LB - Letterbox, FL - Full Screen
0011	0011 14:9 LB	0011 14:9 PB	LB - Letterbox, PB - Pillar Box
0100	0100 CIN LB	0100 CIN LB	Cinematic wide screen (> 16:9), displayed as a Letterbox
0101	0101 RSVD	0101 RSVD	Reserved
0110	0110 RSVD	0110 RSVD	Reserved
0111	0111 RSVD	0111 RSVD	Reserved
1000	1000 4:3 FL	1000 16:9 FL	FL - Full Screen
1001	1001 4:3 FL	1001 4:3 PB	FL - Full Screen, PB - Pillar Box
1010	1010 16:9 LB	1010 16:9 FL	LB - Letterbox, FL - Full Screen
1011	1011 14:9 LB	1011 14:9 PB	LB - Letterbox, PB - Pillar Box
1100	1100 RSVD	1100 RSVD	Reserved
1101	1101 4:3 FL	1101 4:3 PB	FL - Full Screen, PB - Pillar Box
1110	1110 16:9 LB	1110 16:9 FL	LB - Letterbox, FL - Full Screen
1111	1111 16:9 LB	1111 16:9 FL	LB - Letterbox, FL - Full Screen

4.2.6.1   AFD Insertion

The AFD Value Insertion control setting allows LEX2000 users to implement the AFD insertion behaviors outlined below for each encoded video stream.

Table 25: AFD Value Insertion Control Settings

AFD Value Insertion Setting	AFD Insertion Behavior	
	Video Input Signal Has AFD Value	Video Input Signal Has No AFD Value
Pass AFD	Input video AFD value is inserted into encoded video stream.	No AFD value is inserted into encoded video stream.
Auto AFD	Input video AFD value is inserted into encoded video stream.	An AFD value is created based on the input video format and the Default Aspect Ratio setting (HD or SD), and inserted into the encoded video stream.
Force AFD	Input video AFD value is ignored. An AFD value is created based on the input video format and the Default Aspect Ratio setting (HD or SD), and inserted into the encoded video stream.	

4.2.6.2   Default Aspect Ratio Settings

The LEX2000 inserts an AFD value into the encoded video stream when the AFD Value Insertion is set to "Force AFD" or when the AFD Value Insertion is set to "Auto AFD" and the input video does not have an AFD value. When the LEX2000 creates an AFD value for insertion into the encoded video stream, the value is based on the input video format (HD or SD) and the Default Aspect Ratio user setting for the respective video format.

The Default Aspect Ratio setting identifies the appearance of the input video images within 4:3 aspect ratio frames for SD video formats and 16:9 aspect ratio frames for HD video formats. Table 26 lists the Default Aspect Ratio settings available for SD video formats and Table 27 lists the settings available for HD formats. Users should set the Default Aspect Ratio to match the appearance of input video that is most common when AFD values are not present in the input video signal. Since HD / SD encoder channels may process both HD and SD video formats, Default Aspect Ratio settings should be provided for both HD and SD formats for HD / SD channels.

Table 26: Default Aspect Ratio Settings for 4:3 SD Video Formats

Default Aspect Ratio Setting	Description and Usage
4:3 FULL	Video contains 4:3 aspect ratio images that fill the 4:3 SD frame.
14:9 L-Box	Video contains 14:9 aspect ratio images that appear letterboxed within the 4:3 SD frame.
16:9 ANA	Video contains 16:9 aspect ratios images that use anamorphic, non-square pixels to fill a 4:3 SD frame. "Widescreen" SD content is usually produced in this format.
16:9 L-Box	Video contains 16:9 aspect ratio images that appear letterboxed within the 4:3 SD frame.
> 16:9 L-Box	Video contains images with aspect ratios larger than 16:9, such as wide screen cinema images, that appear letterboxed within the 4:3 SD frame.

Table 27: Default Aspect Ratio Settings for 16:9 HD Video Formats

Default Aspect Ratio Setting	Description and Usage
16:9 FULL	Video contains 16:9 aspect ratio images that fill the 16:9 HD frame.
4:3 P-Box	Video contains 4:3 aspect ratio images that appear pillar boxed within the 16:9 HD frame.
14:9 P-Box	Video contains 14:9 aspect ratio images that appear pillar boxed within the 16:9 HD frame.
> 16:9 L-Box	Video contains images with aspect ratios larger than 16:9, such as wide screen cinema images, that appear letterboxed within the 16:9 HD frame.

4.3. Statistical Video Multiplexer

The LEX2000 includes a statistical multiplexer (stat-mux) that manages the ATSC multiplex bandwidth allocated to each video program that participates in the stat-mux bandwidth pool in order to optimize video image quality across multiple video programs being delivered within the bandwidth constraints of the output transport stream.

4.3.1. Encoded Video Image Quality

The image quality of the encoded video depends on multiple factors, including the bandwidth (bit-rate) allocated to each encoded stream, the motion content in the video program, and the amount of detail in the video images. In order to broadcast high quality video images, more ATSC multiplex bandwidth should be allocated to HD programs, programs with high motion content or programs with high levels of detail in the images. Static images or video programs with limited motion (talking heads) require less bandwidth in the encoded video stream to produce high quality images.

4.3.2. Video Encoding Dynamic Rate Control

When combining more than 4 SD video programs into a single 19.39-Mbit transport stream or 8 SD programs into a 38.8-Mbit stream, maintaining high quality images on all broadcast channels may be challenging. Since bandwidth required for good picture quality on an encoded video stream increases and decreases momentarily with changes in the video content, setting the encoded video bandwidth to a constant bit rate may waste bandwidth during periods of no motion or lower detail levels, when less bandwidth is (fewer bits are) needed.

The *adaptiVideo* statistical multiplexer in the LEX2000 dynamically adjusts the bit rate for each encoded video stream, using predictive modeling and statistical techniques to allocate unused bits from one encoded video stream to be used on other video streams in the ATSC multiplex that require more bandwidth at that moment, optimizing the picture quality of high motion video or highly detailed video content.

4.3.3. Stat-Mux Configuration

Bit rate settings for encoded video programs are configured on the VIDEO web page, and bit rate settings for encoded audio programs are configured on the AUDIO web page.

The Video Bit Rate Control setting in the Video Encoder table defines which encoded video programs are managed by the Stat-Mux and which encoded video programs are set to a fixed bit rate. All encoded video programs included in the Stat-Mux share a block of available bandwidth within the ATSC multiplex. When bandwidth allocation conflicts arise from multiple video programs requiring higher bit rates at the same time, the LEX2000 statistical multiplexer prioritizes the allocation of available bandwidth to each Stat-Mux video program based on the video program's Video Bit Rate Target setting, compared to the other video programs that share the Stat-Mux, as well as video content dynamics. Video programs with a higher Video Bit Rate Target have higher bandwidth priority than Stat-Mux video programs with lower target bit rates.

Linear Encoding Xponents

4.4. ATSC Transport Multiplexer

The LEX2000 includes an ATSC transport multiplexer that assembles the encoded video programs, encoded audio programs, closed captions, PSIP data and ATSC control data to form the ATSC service multiplex, which is output as an ASI or SMPTE-310 serial data signal and / or streamed to an IP network port using the TG Option. The LEX2000 transport multiplexer supports up to eight ATSC services, containing up to eight total encoded video programs and up to sixteen total encoded audio programs.

The Transport Stream Protocol may be set to ATSC Cable or Terrestrial. The transport stream output data rate is set to 38.8 Mbits/sec for ATSC Cable and 19.39 Mbits/sec for ATSC Terrestrial. When the TG Option is enabled, the transport stream bit rate and data payload may be set to any data rate between 10 and 80 Mbits/sec.

| SYSTEM | OPERATION | CONTACT US | | | | Apply | Save Configuration Settings | Logout |

| TRANSPORT | VIDEO | AUDIO | PSIP | CAPTIONS | EAS | REMUX |

Transport Stream Protocol	ATSC Terrestrial							Reset PID Values to Factory Defaults
Transport Stream ID (TSID)	3074	0C02					
	DECIMAL	HEX					

ATSC SERVICES

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Service Status	Active	Active	Active	Active	Off Air	Off Air	Off Air	Off Air
Short Channel Name	WAAA-HD	WBBB	WCCC	WDDD				
Major Channel Number	12	12	12	12	12	12	12	12
Minor Channel Number	1	2	3	4	5	6	7	8
Encoded Video Program	EV-1	EV-2	EV-3	EV-4	-	-	-	-
Encoded Audio Program 1	EA-1	EA-2	EA-3	EA-4	-	-	-	-
Encoded Audio Program 2	EA-5	EA-6	EA-7	EA-8	-	-	-	-
Encoded Audio Program 3	-	-	-	-	-	-	-	-
Long Channel Name	Know it No	Reruns Gal	Local Motio	Weather T				

ATSC PIDS (Hexadecimal values)

Program Number	1	2	3	4	5	6	7	8
Video Program	31	41	51	61				
Audio Program 1	34	44	54	64	-	-	-	-
Audio Program 2	37	47	57	67	-	-	-	-
Audio Program 3	-	-	-	-	-	-	-	-
PMT	30	40	50	60	70	80	90	A0

ATSC MULTIPLEX BANDWIDTH (Mbits/sec)

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Video Bit Rate Control	Stat-MUX	Stat-MUX	Stat-MUX	Stat-MUX	-	-	-	-
Video Bit Rate Target	9.000	3.800	2.400	2.000	-	-	-	-
Audio Program 1	0.192	0.192	0.192	0.096	-	-	-	-
Audio Program 2	0.096	0.096	0.096	0.096	-	-	-	-
Audio Program 3	-	-	-	-	-	-	-	-
AUDIO-VIDEO Subtotals	9.288	4.088	2.688	2.192	-	-	-	-

TOTAL AUDIO	1.056
TOTAL VIDEO	17.200
TOTAL AUDIO-VIDEO	18.256
RESERVED BANDWIDTH	0.000
TRANSPORT OVERHEAD	1.080
TOTAL MULTIPLEX	19.336
UNUSED BANDWIDTH	0.054
MAX TS DATA RATE	19.390
MAX BANDWIDTH OF ASI INPUT PROGRAMS	0.000

EIT & ETT PIDS

	BASE PID	LAST PID
EIT PID Range (Hex)	1D01	1D80
EIT PID Range (Decimal)	7425	7552
ETT PID Range (Hex)	1E01	1E80
ETT PID Range (Decimal)	7681	7808

Note: All hex values between the BASE PID and the LAST PID, inclusive, are reserved for use as EIT and ETT PIDs.

MAX TS DATA RATE(Mbit/sec)

| Preset Values | Manual |
| Manual Value | 19.390000 |

ASI-OUT-1 CONNECTOR

| Transport Protocol | ATSC Terrestrial |
| Signal Protocol | SMPTE-310 |

ASI-OUT-2 CONNECTOR

| Transport Protocol | ATSC Terrestrial |
| Signal Protocol | ASI Mode 1 |

Figure 14: TRANSPORT Configuration Web Page

4.4.1. Transport Stream ID (TSID)

The TRANSPORT STREAM ID or TSID is the identification code issued to the broadcaster by their governing authority that uniquely labels their broadcast stream and must be entered in the box at the top of the TRANSPORT page.

IMPORTANT: TSID values are commonly provided using both decimal and hexadecimal (hex or base-16) numbering systems. Enter the decimal TSID value in the TRANSPORT web page. The LEX2000 reports the equivalent hex number value alongside the TSID entry box to confirm entry of the intended TSID value.

4.4.2. Static PSIP Configuration

The ATSC Services table on the TRANSPORT web page, shown in

Figure 14, allows the broadcaster to define the static PSIP data for each virtual channel, including its short channel name (station call letters), major and minor virtual channel numbers and long or extended channel name.

Each service or virtual channel in the multiplex is assigned a reference number, SR-1 to SR-8, to simplify the identification of control settings for specific services when communicating among system engineers.

Each virtual channel may be activated or taken off-air using the Service Status pull-down menu pick on the top row. This allows broadcasters to take services on air and off air while maintaining their configuration settings. Program elements from off-air services are not included in the ATSC multiplex output. However, any program guide information in the PSIP carousel associated with the off-air service continues to be present in the multiplex output until new PSIP data is received that does not include program data for the off-air service.

The major and minor channel numbers for each virtual channel are defined by entering an integer value in each of the boxes in the Major Channel Number and Minor Channel Number rows of the ATSC Services table. Major and minor channel numbers must be identified for all eight services, even if some of the services are not currently used.

The encoded video program and encoded audio program(s) assigned to each virtual channel are reported in this table for the convenience of the user. The encoded video program for each service is selected on the VIDEO web page, and the encoded audio programs assigned to each service are selected on the AUDIO web page.

The Long Channel Name provides the broadcaster with an opportunity to have a tag line or a brief position statement that describes the channel's program content. The Long Channel Name may be up to 64 characters long. To enter or edit the Long Channel Name for a specific virtual channel, click in the Long Channel Name box in the appropriate SR-x service columns. The complete value is displayed in the black bar below the fill-in box, and is updated as edits are made in the smaller, white fill-in box. When the edits are complete, click on APPLY in the upper right corner of the page to save the changes.

A summary of the ATSC Services table is provided at the top of the other OPERATION web pages to provide guidance on the transport stream definition when configuring other encoder operations.

4.4.3. ATSC PIDS Configuration

The ATSC PIDS table on the TRANSPORT page provides locations to enter the hexadecimal packet ID numbers for the program elements of each service, required to properly construct an ATSC service multiplex. ATSC packet ID (PID) values for the audio, video and program metadata components of each ATSC service allow the ATSC receiver to find and extract the information from the service multiplex as it is received over the air.

Encoded audio (EA) and encoded video (EV) streams must be assigned to each ATSC service on the AUDIO and VIDEO web pages before PIDs are assigned to them on the TRANSPORT web page. The ATSC PIDS table only provides PID value fill-in boxes for virtual channel program elements that have an EA or EV stream assigned to them on the AUDIO or VIDEO web pages.

PID values for each audio and video program element must be unique. If a program element, such as an EV stream, is assigned to multiple services within the multiplex, its PID value is referenced by both services, as only one instance of the program element is present in the ATSC service multiplex. In cases where video programs are duplicated within the multiplex, the lowest number SR service number using the duplicated EV stream (farthest left in the ATSC PIDS table) is used to set the video program PID value for that EV stream. Secondary services using the same EV stream use the same PID value set by the lowest number SR-x service number that uses the duplicated EV stream.

4.4.4. EIT & ETT PIDS

PID values for Event Information Tables and Extended Text Tables are identified in the EIT & ETT PIDS table on the TRANSPORT web page. One EIT PID value is required for each 3-hour event for each ATSC service in the multiplex. Since the LEX2000 supports broadcast of up to 16 days of future events, as many as 128 unique EIT PID values may be required for the transport stream. The same number of ETT PID values is also required.

The EIT & ETT PIDS table allows the broadcaster to enter the base PID value for the EIT and ETT. The LEX2000 reserves a block of consecutive PID values for the EIT and ETT, identifying the last PID value used in the Last PID column of the table. All PID values between the base PID and the last PID shown in this table are reserved and must not be used for any other packet data in the same transport stream.

4.4.5. Non-Compliant ATSC PID Values (XP Option)

All PID values entered on the TRANSPORT web page are checked for compliance with ATSC standards. If a user clicks on the APPLY button after entering PID values that do not comply with the ATSC standard, the TRANSPORT page will report an error and no changes will be saved.

The XP Option enables users to set the PMT PID to a value of 20 hex, which is normally not allowed for ATSC broadcast, but is required in some areas where older ATSC television receivers do not function properly within PMT PID values of 30 hex and above.

4.4.6.   Factory Default PID Values

A "Reset Transport Values to Factory Defaults" button is provided on the TRANSPORT web page to reset all of the entries on this page to their factory default values. Clicking on this button only affects the TRANSPORT web page and does not reset settings on other web pages. Although ATSC standards do not define the assignment of specific values for most PID's, industry conventions guide the use of specific PID values for each data type in the ATSC stream and are used as the basis for the factory default PID values.

4.4.7.   ATSC Multiplex Bandwidth Management

The ASI Bandwidth Management table, shown on the AUDIO, VIDEO and TRANSPORT web pages, allows the user to understand the total multiplex bandwidth allocated to each virtual channel as well as each of their service multiplex components, as bit rate adjustments are applied to each audio and video encoder channel.

If a portion of the transport stream multiplex is reserved for insertion of additional data later in the signal chain, such as a mobile DTV transport stream, enter the bandwidth to be reserved in the RESERVED BANDWIDTH field in this table. For example, if 2Mbps are reserved for insertion of a mobile DTV transport stream, then enter 2.0 in the RESERVED BANDWIDTH field, restricting the LEX2000 service multiplex output to be 17.39Mbps for terrestrial. Null packets are inserted in the transport stream output to fill the RESERVED BANDWIDTH allocation and maintain the specified data rate of the ATSC multiplex output.

The bottom portion of the ASI Bandwidth Management table combines the bandwidth required by all active services with any reserved bandwidth and ATSC metadata. Unused or unallocated bandwidth or the amount of any over-subscription of the service multiplex is identified in the UNUSED BANDWIDTH row. Only active services are included in the TOTAL calculations in the bottom portion table. ATSC services that are defined but are Off-Air are not included in the output multiplex nor in the TOTAL MULTIPLEX bandwidth calculation.

4.4.8.   Transport Stream Data Rate Adjustment

The MAX TS DATA RATE (Maximum Transport Stream Data Rate) is preset to 19.39 Mbits/sec for ATSC Terrestrial protocol and 38.8 Mbits/sec for ATSC Cable protocol. When the TG Option (Streaming IP Output on Gigabit Ethernet) is enabled, the MAX TS DATA RATE may be set to an arbitrary value between 10 and 80 Mbits/sec, regardless of the transport stream protocol.

The MAX TS DATA RATE table at the bottom of the TRANSPORT web page allows the user to select Preset Values of 19.39 or 38.8 Mbits/sec. Select the Preset Value of "Manual" to enter a specific value in the Manual Value field. Remember to "Apply" the web page in order to save the settings.

4.4.9. Transport Stream Protocol and Signal Configuration

The LEX2000 provides two ASI outputs, allowing one ASI signal to be sent to a QAM or 8VSB modulator and a second, duplicate ASI signal to feed a local monitor or a cable head end.

Figure 15: TRANSPORT Web Page – ATSC Terrestrial Protocol

The ASI-OUT-1 CONNECTOR table allows the user to select the Transport Protocol as ATSC Cable or ATSC Terrestrial. The same Transport Protocol is used for both transport stream signal outputs, as well as the streaming IP output if the GN option is enabled.

Figure 16: TRANSPORT Web Page – ATSC Cable Protocol

Signal Protocol values are set independently for each ASI-OUT-x CONNECTOR table. If the Transport Protocol is ATSC Terrestrial, then the Signal Protocol may be set to ASI Mode 1, ASI Mode 2 or SMPTE-310. If the Transport Stream Protocol is ATSC Cable, then the Signal Protocol may be set to ASI Mode 1 or ASI Mode 2.

Two ASI signal modes are available to accommodate interfaces with older equipment with smaller data buffers. ASI_Mode_2 is the default setting and should work with all compliant equipment. In the event that the exciter equipment has difficulty accepting the ASI data stream from the LEX2000, select ASI_Mode_1. If the problem persists, contact LEX2000 technical support for further instructions.

4.5. Dynamic PSIP

The LEX2000 supports reception, generation and distribution of dynamic PSIP data in the ATSC service multiplex in accordance with ATSC A/65, "Program and System Information Protocol for Terrestrial Broadcast and Cable (PSIP)."

Figure 17: Dynamic PSIP Configuration Web Page

The LEX2000 maintains dynamic PSIP data in a rotating memory structure or carousel and inserts PSIP data into the ATSC multiplex at intervals specified by A/65. The PSIP carousel stores up to 16 days of program guide information for up to eight ATSC services in the multiplex. Dynamic PSIP data is stored in non-volatile memory, allowing the LEX2000 to provide program guide information to the ATSC multiplex output

immediately after recovering from a power failure, provided that the power is restored before the date of the latest program stored in the PSIP carousel.

The LEX2000 supports multiple methods of receiving program guide and dynamic PSIP data, including manual, low-cost PSIP solutions for small broadcasters as well as more comprehensive, automated solutions for larger broadcast enterprises. The supported PSIP data delivery methods are outlined below.

1. Use the **EZ-PSIP software**, provided with the LEX2000 unit, to create a basic program guide and manually upload it to the LEX2000 unit.

2. Use an **external PSIP generator** from Triveni or DTV Innovations that automatically receives program guide data from supported program guide services, generates the dynamic PSIP data and uploads it to the LEX2000 unit.

3. Use the LEX2000 **GN option (program guide ingest)**, which includes a PSIP generator inside the LEX2000 unit, allowing the LEX2000 to automatically retrieve program guide files from supported program guide services or traffic systems and generate the dynamic PSIP data for its transport stream output.

When dynamic PSIP data is received from any external source, the LEX2000 replaces the entire carousel memory with the newly received PSIP data, clearing all the existing program data. Last minute changes to program schedules are easily supported, as long as any new program guide files or PSIP data updates delivered to the LEX2000 contain the entire set of program data that the broadcaster intends to include in the ATSC service multiplex.

When the PSIP Data Source is EZ-PSIP or an FTP File source, the contents of the PSIP carousel are displayed in the PSIP Events table. To view the PSIP events for each virtual channel, click the appropriate button under the PSIP DATA DISPLAY heading to reload the PSIP Events table. This tool provides a way to verify that PSIP Events data is being received properly by the encoder.

When the PSIP Data Source is set to an external PSIP generator from Triveni or DTV Innovations, the PSIP Events table does not appear.

NOTE: When loading new PSIP data from EZ-PSIP or from an FTP File, it may take a few minutes for the PSIP Events data to be updated with the newly ingested data. In order to see newly ingested PSIP data appear in the PSIP Events table, the user should wait for a few minutes and then click the respective virtual channel button "Show PSIP for" in order to refresh the PSIP Events table.

4.5.1. Dynamic PSIP Configuration

The PSIP configuration web page allows the user to select the dynamic PSIP data source and to configure the PSIP behavior of the LEX2000 unit.

The PSIP DATA SOURCE table allows the user to identify the intended source of the PSIP data and to see when the most recent PSIP data was received. The PSIP Data Source may be set to one of the values shown in Table 28, below, to identify the intended PSIP data source and delivery method. The bottom row of the PSIP Data Source table identifies the time and date when dynamic PSIP data was last received.

Table 28: PSIP Data Source Configuration

PSIP Data Source Setting	PSIP Data Delivery Method
OFF - No PSIP Data Ingest	No PSIP data communications are accepted from any source.
IP - EZ-PSIP	PSIP data are accepted from the EZ-PSIP tool over an IP network connection.
IP - DTV Innovations PSIP Pro	PSIP data are accepted from DTV Innovations PSIP Pro over an IP network connection.
IP - Triveni GuideBuilder	PSIP data are accepted from Triveni GuideBuilder over an IP network connection.
FTP File - BIM TitanTV *(GN Option Required)*	The LEX2000 retrieves BIM program guide files from an FTP server and generates dynamic PSIP tables.
FTP File - Myers ProTrack *(GN Option Required)*	The LEX2000 retrieves ProTrack-generated PMCP XML program guide files from an FTP server and generates dynamic PSIP tables.
FTP File - Tribune Media *(GN Option Required)*	The LEX2000 retrieves Tribune Media program guide files from an FTP server and generates dynamic PSIP tables.
FTP File - Wide Orbit *(GN Option Required)*	The LEX2000 retrieves Wide Orbit-generated PMCP XML program guide files from an FTP server and generates dynamic PSIP tables.

The **PSIP Broadcast Control table** allows a user to specify the amount of dynamic PSIP data to be inserted into the ATSC transport stream, ranging from one day to 16 days, the maximum amount permitted by ATSC standards.

A "**Clear Dynamic PSIP Data" button** is provided in the upper right area of the page to erase the PSIP data carousel in the event that incorrect data is delivered to the encoder unit and needs to be cleared immediately.

If the GN option is enabled in the LEX2000 unit, then the **Program Guide File** and **Daily File Download** tables are visible on its OPERATION - PSIP web page, allowing the user to set the FTP login parameters and the PSIP file download schedule from the FTP site. Detailed instructions for configuring the Program Guide Ingest function are found in paragraph 4.5.4, below.

4.5.2.   Dynamic PSIP using EZ-PSIP

EZ-PSIP is a software tool for creating and editing a program guide that provides small broadcasters with a simple, low-cost way to implement a basic program guide for a single broadcast station. The EZ-PSIP Java application runs on Windows computers and is included with the purchase of the LEX2000. EZ-PSIP allows the user to connect directly with an LEX2000 unit to upload dynamic PSIP data.

EZ-PSIP uses a tab-delimited text file to store the program guide data, which facilitates exchanging data with Microsoft Excel or other data management software, able to import and export files in a text format. Users may build their own simple program guide workflow, using EZ-PSIP to send the PSIP data to their LEX2000 unit.

EZ-PSIP does not support extended text messages (ETT) and does not directly integrate with traffic management systems or third party program guide information sources.

For more information on EZ-PSIP, see the EZ-PSIP User Manual.

4.5.3.   Dynamic PSIP using an External PSIP Generator

The LEX2000 is able to receive dynamic PSIP data from third party PSIP generators provided by Triveni and DTV Innovations, using an IP network (Ethernet) interface. These PSIP generators allow customers to manage their program schedules in a comprehensive manner and deliver the dynamic PSIP data to the LEX2000 in a carousel-ready format at regular intervals. PSIP data received from the PSIP generator is stored by the LEX2000 in its carousel memory. The LEX2000 injects the PSIP data into the transport stream at specific, ATSC-compliant intervals.

Although these PSIP generators also allow users to define static PSIP data, such as virtual channel numbers and PID values, the LEX2000 extracts only the dynamic PSIP or program guide data from external PSIP generators and ignores any static PSIP information received from the PSIP generator. Virtual channel definition and PID assignments for the LEX2000 may only be configured through the LEX2000 web pages.

Program guide information for each virtual channel listed in GuideBuilder or PSIP Pro is mapped to virtual channels in the LEX2000 by matching the Program Number value for each virtual channel. The user must ensure that Program Number values used in GuideBuilder or PSIP Pro match the Program Number values on the LEX2000 TRANSPORT web page for each virtual channel.

The LEX2000 receives the EIT and ETT data from the PSIP generator, which is the dynamic PSIP data related to PSIP events, and inserts them into the ATSC multiplex output.

4.5.3.1   Triveni GuideBuilder Interface

To receive dynamic PSIP data from Triveni's GuideBuilder PSIP generator, set the following user configuration values.

On the OPERATION - PSIP web page of the LEX2000 unit:

Set the PSIP Data Source to "IP - Triveni GuideBuilder"

In the GuideBuilder tool:

1. Set the multiplexer to Linear LEX2000. If the GuideBuilder version in use does not include the Linear LEX2000 among its multiplexer choices, then contact the Triveni equipment provider for either a software update or for guidance on multiplexer settings that may be used to communicate with the LEX2000 unit.

2. Set the multiplexer IP address to the appropriate address of the LEX2000 unit intended to receive the PSIP data.

3. If GuideBuilder allows the IP port number of the multiplexer IP address to be set by the user, then set the port number to 1327.

4.5.3.2   DTV Innovations PSIP Pro Interface

To receive dynamic PSIP data from DTV Innovations' PSIP Pro generator, set the following user configuration values.

On the OPERATION - PSIP web page of the LEX2000 unit:

Set the PSIP Data Source to "IP - DTV Innovations PSIP Pro"

In the PSIP Pro tool:

1. Find the Environment Setup screen.

2. Click the button to enable Section Carousel Protocol

3. Set the multiplexer IP address to the appropriate address of the LEX2000 unit intended to receive the PSIP data.

4. Set the IP port number to 1327.

4.5.4. Dynamic PSIP using Program Guide Ingest (GN Option)

When the optional Program Guide Ingest function is enabled and configured, the LEX2000 automatically ingests program guide files from third party sources and generates the dynamic PSIP data for insertion into the ATSC multiplex. LEX2000 units with the GN option enabled support ingest of program guide files from the following sources:

- BIM (PMCP XML format only)
  NOTE: BIM includes TitanTV, MediaStar and Decisionmark brands

- Myers ProTrack traffic system (PMCP XML format only)

- Tribune Media Services (proprietary Tribune format)

- Wide Orbit traffic system (PMCP XML format only)

The LEX2000 checks the FTP server for new program guide files on a schedule defined in the Daily File Download table on the PSIP web page. If any new files are found on the FTP server, based on their file name and save date, the LEX2000 downloads all of the files, generates the dynamic PSIP data and updates its PSIP event carousel memory.

The number of dynamic PSIP fields extracted from the program guide files for each PSIP event depends on the information available from the program guide service. As a minimum, the supported fields include start time and date, duration, language, rating, title and extended text message.

4.5.4.1 PMCP Key Matching Data

The LEX2000 PSIP generator uses the TSID, major and minor channel numbers to determine which PSIP events in the PMCP file are associated with each virtual channel in the ATSC multiplex. PSIP event elements in PMCP-format program guide files must contain a "channelNumber" attribute with a value of "M-N", where M-N is the major-minor channel number of a virtual channel in the multiplex output of the LEX2000. If a channelNumber attribute value does not match any virtual channel numbers used in the LEX2000 multiplex output, then the respective PSIP event is ignored. PSIP events without a channelNumber attribute are also ignored. If the PSIP event does not contain a TSID value, then the LEX2000 assumes that it is intended for its broadcast multiplex. If a TSID value is present in the PSIP event data, then it must match the LEX2000's TSID value, otherwise the PSIP event will be ignored.

4.5.4.2 Multi-Station PMCP Files

If PMCP-format program guide files contain program event data for multiple stations or transmission sites, then the TSID attribute identifies which events are associated with each site. When TSID attributes are present in event elements within the PMCP file, they must match the LEX2000 TSID value, as entered on its TRANSPORT web page. PSIP events with TSID attribute values that do not match the LEX2000's TSID value will be ignored.

4.5.4.3   Configuring Program Guide File Ingest from an FTP Server

LEX2000 units with the GN option enabled may ingest program guide files from FTP servers and generate the dynamic PSIP data required for its ATSC transport stream output. Presence of the GN option license may be confirmed in the License Status table on the UPDATE web page.

On the OPERATION - PSIP web page of the LEX2000 unit, set the PSIP Data Source pull-down to the intended PSIP data source. File-based data source values begin with "FTP File - ". If the PSIP Data Source list does not include any "FTP File - " choices, then the GN option may not be enabled in the LEX2000 unit.

The **Program Guide File** table on the PSIP web page only appears when the GN option is enabled. In the Program Guide File table, enter the FTP Server address / pathname of the FTP server where the LEX2000 logs in to access the program guide files. The FTP server address may be entered as a numeric IP address, such as "216.248.111.6", or may be entered as a URL, such as "ftp.tmstv.com" or "ftp.mediastar.proximitytv.com."

Upon logging into an FTP server, users are typically placed in a specific folder, based on their login identity. If the program guide files are located in a folder below the login folder on the FTP server, then append "/folder_name" to the numerical IP address or FTP site URL, where "folder_name" is the name of the folder holding the program guide files.

Numerical example: 192.168.33.42/PSIP_Folder
URL example: ftp.tmstv.com

NOTE: A valid DNS server address must be present on the NETWORK web page in order for the LEX2000 to resolve the URL address to a numerical IP address.

If the PSIP folder name includes spaces (white space characters), then each space must be replaced with the character sequence "%20". For example, if the folder name is "PSIP Files" instead of "PSIP_Files", then enter the FTP Server IP Address / Pathname as

                192.168.33.42/PSIP%20Files

Enter the user name and password for the FTP server login in the Program Guide File table. If the login does not require a password, then leave the password box blank. Be sure to use upper case or lower case letters as appropriate when entering your login name and password.

Click on the button, "**VERIFY FTP SERVER LOGIN**" to validate that the FTP server IP address, user name and password are correct. Upon clicking this button, a message appears in the status box to the right of the button. It may take a couple minutes to communicate with the FTP server, complete the login process and provide feedback to the user. Click the "**REFRESH STATUS**" button to update the web page and show the current status of the FTP login process. When the LEX2000 unit successfully logs into the FTP server, the following message is displayed to the right of the VERIFY FTP SERVER LOGIN button:

                Login Status: Login Successful

Click on the button, "**LOAD PROGRAM GUIDE FILE NOW**" to log into the FTP server and download program guide files. Click the " **REFRESH STATUS** " button to update the status of the load operation. When the LEX2000 unit successfully downloads a program guide file from the FTP server, the following message is displayed to the right of the LOAD PROGRAM GUIDE FILE NOW button:

Load Status: Successfully Downloaded Program Guide Data

Each time that the LEX2000 unit attempts to log into the FTP server and download program guide files, a success or failure message is posted to the Event Log, which may be reviewed on the SYSTEM – EVENT LOG web page. The Event Log also records successful download of PSIP data files and successful parsing of those files into PSIP carousel data.

4.5.4.4   Adjusting Program Start Times for PMCP Files

Use the **PSIP Event Time Adjustment** to change the effective time zone of all program start times in the PMCP file. This is useful in cases where the PMCP file received from a traffic system applies to a one time zone and the broadcast transmission site is in a different time zone. This adjustment applies only to PMCP files ingested from an FTP server and does not apply to PSIP data received from external PSIP generators, such as DTV PSIP Pro or Triveni GuideBuilder.

The PSIP Event Time Adjustment should be set to "0" (zero) for normal operation, when the program start times in the PMCP file are correct for the time zone at the broadcast transmission site.

Set the PSIP Event Time Adjustment to "+1 Hour" to move one time zone eastward, adjusting the PSIP Event start times one hour earlier than the start time listed in the PMCP file. For example, to adjust program start times in a PMCP file generated for the US central time zone (GMT-6:00) so that they are correct when broadcast from a site in the US eastern time zone (GMT-5:00), set the PSIP Event Time Adjustment to "+1 Hour."

Set the PSIP Event Time Adjustment to "-1 Hour" to move one time zone westward, adjusting the PSIP Event start times one hour later than the start time listed in the PMCP file. For example, to adjust program start times in a PMCP file generated for the US central time zone (GMT-6:00) so that they are correct when broadcast from a site in the US mountain time zone (GMT-7:00), set the PSIP Event Time Adjustment to "-1 Hour."

4.5.4.5   Configuring Program Guide Ingest Schedule

The LEX2000 checks the FTP server for new program guide files on a schedule defined in the **Daily File Download** table on the PSIP web page. If new files are found on the FTP server, based on their file name and save date, the LEX2000 downloads the files, regenerates the dynamic PSIP data and updates its PSIP event carousel memory.

In many applications program guide files are posted to the FTP server at specific times. The Daily File Download table allows the user to tailor the LEX2000's FTP download activity to the broadcaster's workflow and minimize unnecessary network traffic.

The "**Daily Start Time for Program File Download**" setting defines the time that the LEX2000 begins checking the FTP site for new program guide files, based on a 24-hour, local time setting.

The "**Time Interval Between Program File Download Attempts**" setting defines the amount of time to wait before checking the FTP site again after the FTP site is checked and no new files are found.

The "**Daily Stop Condition for Program File Download Attempts**" setting defines the criteria for the LEX2000 to stop FTP download attempts for the day. When the Daily Stop Condition is achieved, FTP download attempts will stop until the Daily Start Time on the next day. The Daily Stop Condition settings available include the following:

- Stop After New PSIP Data is Successfully Loaded
- Stop After Checking for New Program Files 5 Times
- Stop After Checking for New Program Files 10 Times
- Stop After Checking for New Program Files 20 Times
- Keep Checking for Program Files without Stopping

4.5.4.6   Configuring Tribune Media Service Station ID Values

When the PSIP Data Source is set to "FTP File – Tribune Media," the **Tribune Media – Unique Station ID** table is presented below the Daily File Download table.

Enter the **Unique Station ID** for each virtual channel in this table.

The Unique Station ID is the identification code used by Tribune Media Services to associate program listings with each specific broadcast channel. Tribune Media Service users should get the proper Unique Station ID values from their point of contact at Tribune Media.

When the PSIP Data Source is set to a value that is not Tribune Media, the Tribune Media – Unique Station ID table is not displayed on the PSIP web page.

4.5.4.7   Ingesting PMCP Format Program Guide Files

ATSC specification A/76 defines the Programming Metadata Communication Protocol, which includes an XML file schema to support PSIP data exchange. LEX2000 units with the GN option enabled are able to ingest PMCP-format XML files from multiple sources. Even though all PMCP files use the same XML schema, PMCP files from different sources may contain different amounts of event information or require different logic to match PSIP event information to specific virtual channels in the LEX2000 multiplex output.

The LEX2000 supports ingest of PMCP-format program guide files from multiple program guide service providers and traffic system sources. Each source may provide program guide files in a variety of formats, but only PMCP-format XML program guide files are supported by the LEX2000. If an XML file includes the following reference to the ATSC PMCP schema near the top of the file, then it is a PMCP-format XML file:

xmlns="http://www.atsc.org/XMLSchemas/pmcp/2007/3.1"

4.5.4.8 Workflow Recommendations for Program Guide Ingest

Here are some important considerations to keep in mind when integrating the LEX2000 with a traffic system or program guide service to provide accurate program guide PSIP data to the television receivers in your broadcast area.

- The number of days of program guide data seen by a television viewer in your broadcast area is determined primarily by the PSIP Broadcast Control table on the PSIP web page, provided that the program guide data for those future days are available in the program guide file that was last ingested by the LEX2000. For example, if ten days of program guide data are ingested once each week and the EIT / ETT Program Guide Days in Transport is set to 3, then the viewer always has three days of future program guide data available, even though program guide data may be downloaded only once per week.

- The FTP folder holding the PCMP XML file(s) should not have any other, non-PMCP files in the folder. The LEX2000 attempts to download all files in the folder and processing non-PMCP files delays ingest of the valid PMCP files.

- Use one FTP folder for each broadcast station. The LEX2000 downloads and parses all the files in the FTP folder. For best system performance, only files intended for the LEX2000 unit should be placed in the FTP folder.

- When the PSIP Data Source is set to FTP File – BIM / Titan TV, the LEX2000 only downloads and parses files that begin with "PMCP" (case sensitive) and end with ".XML" or ".xml" extension.

- Only one set of program guide files should be present in the FTP folder at any one time. When the program guide service or traffic system generates a new set of program guide files, the older files should be deleted. Otherwise, when the LEX2000 downloads the multiple file sets, unique PSIP events may be duplicated in the data set, which may cause undesirable system behaviors.

- Large program guide files may take a long time to ingest. Most PMCP XML files are 250kB or less. Files larger than 1MB are supported, but the PSIP data may not be available for viewing in the PSIP Data Display table for ten minutes or more. If low-latency updates of PSIP data is important in your application, then keep the PMCP XML file size to a minimum. When processing large PSIP files, make sure the Time Interval Between Program File Download Attempts is set to 30 minutes or more.

- Zipped files are supported for Tribune Media only. The LEX2000 downloads the files, unzips them and parses their content to generate the dynamic PSIP data for each virtual channel.

4.6. Closed Captions

The LEX2000 extracts CEA-708 and CEA-608 closed caption data from each video input signal or data stream that contains closed caption data and inserts the caption data into the output video elementary stream at the appropriate location, in accordance with CEA-708. CEA-708 closed captions received with the video are always passed to the output video stream. When input video streams contain closed captions in both 608 and 708 formats, both closed caption data packets are extracted and passed to their proper locations in the output video stream.

SYSTEM	OPERATION	CONTACT US					Apply	Save Configuration Settings	Logout
TRANSPORT	VIDEO	AUDIO	PSIP	CAPTIONS	EAS				

ATSC SERVICES

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Service Status	Active	Active	Active	Active	Off Air	Off Air	Off Air	Off Air
Virtual Channel Name	WAAA-HD	WBBB	WCCC	WDDD	WEEE	WZZZ		
Virtual Channel Number	12-1	12-2	12-3	12-4	12-5	12-6	12-7	12-8
Encoded Video Program	EV-1	EV-2	EV-3	EV-4	EV-5	EV-6	EV-7	EV-8

VIDEO INPUT STATUS

VIDEO ENCODER NUMBER:	EV-1	EV-2	EV-3	EV-4	EV-5	EV-6	EV-7	EV-8
Maximum Format Size	720p30	480i	480i	480i	480i	480i	480i	480i
Video Input Source	HD-SDI-1	SD-SDI-1	SD-SDI-2	NTSC-4	NTSC-5	NTSC-6		
Video Input Signal Status	No Signal	No Signal	No Signal	No Signal	No Signal	No Signal	No Signal	No Signal
Detected Video Format								
Detected Closed Captions								
Detected 608 CC-1								
Detected 608 CC-2								
Detected 608 CC-3								
Detected 608 CC-4								

608-TO-708 CONVERTER CONTROL

VIDEO ENCODER NUMBER:	EV-1	EV-2	EV-3	EV-4	EV-5	EV-6	EV-7	EV-8
608-TO-708 Mode	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	OFF	OFF
608-TO-708 Status	Standing By	Standing By	Standing By	Standing By	Standing By	Standing By	Off	Off
Text Font	Mon Srf	Mon Srf	Mon Srf	Mon Srf	Mon Srf	Mon Srf	Mon Srf	Mon Srf
Text Justify	Left	Left	Left	Left	Left	Left	Left	Left
Text Color	Red	White	White	White	White	White	White	White
Background Color	Black	Black	Black	Black	Black	Black	Black	Black
Background Opacity	Solid	Solid	Solid	Solid	Solid	Solid	Solid	Solid
Window Height (Lines)	3	2	2	2	2	2	2	2

Figure 18: Captions Web Page

The CAPTIONS web page shows detailed information about the caption content detected in each of the input video signals. The 608-To-708 Converter Control table is only displayed when the 67 Option is enabled within the LEX2000 unit.

4.6.1.   Processing CEA-608 Caption Data

When input video data streams are received that contain CEA-608 closed captions carried in multiple delivery locations, the LEX2000 extracts the caption data from one of the 608-format delivery locations and inserts it into the output video stream. CEA-608 captions that are received in caption data packets (CDP's) in accordance with SMPTE-334-2, have the highest priority and are always passed to the output video stream. CEA-608 captions received in VANC packets per SMPTE-334-1 are only extracted and passed to the output video stream if no 608 captions are present in the CDP's per SMPTE-334-2. 608 captions received on line 21 are extracted and passed to the output video stream only if no 608 captions are present in the CDP's per SMPTE-334-2 and no 608 captions are present in the VANC per SMPTE-334-1.

Table 29 highlights the closed caption delivery mechanisms supported by the LEX2000 and the extraction priority for 608 captions when they are presented in multiple locations within the input video data stream.

Table 29: Closed Caption Pass-Through Support

Caption Delivery Priority	Video Input Signal	Closed Caption Input Format
N / A	SMPTE-292M SMPTE-259M	CEA-708 carried in Caption Data Packets in Vertical ANC per SMPTE-334-2
1	SMPTE-292M SMPTE-259M	CEA-608 carried in Caption Data Packets in Vertical ANC per SMPTE-334-2
2	SMPTE-292M SMPTE-259M	CEA-608 carried in Vertical ANC Packets per SMPTE-334-1
3	SMPTE-259M NTSC Composite	CEA-608 on Line 21

4.6.2. Converting 608 Captions to 708 Captions (67 Option)

When the 67 Option (608-to-708 Closed Caption Converter) is enabled and configured, the LEX2000 is able to convert CEA-608 caption data received with each of its video input signals into CEA-708 caption data and insert the 708 caption data into the respective video program. The 608 caption data received with the video input signal is also passed to the encoded video output stream.

LEX2000 units with the 67 Option enabled provide the 608-To-708 Converter Control table on the OPERATION - CAPTIONS web page for configuration of the 608-to-708 caption converter. If the LEX2000 unit does not have the -To-708 Converter Control table, then it may not have a license for the 67 Option. Check the License Status table on the SYSTEM - UPDATE web page to confirm whether or not the 67 Option is enabled in the LEX2000 unit.

The ATSC Services table on the CAPTIONS web page identifies the current status of the virtual channels in the multiplex output and identifies which encoded video streams are assigned to each virtual channel.

The Video Input Status table on the CAPTIONS web page identifies the current status of all the input video signals in use, video formats being received and the caption data detected within each video input signal or stream. The Detected Closed Captions row identifies the presence of 708 captions, 608 captions and which of the three 608 caption data locations are being used, based on the priority defined in Table 29. Activity is reported for each of the four 608 caption data services. The caption data status reported in the Video Input Status table is based on caption data found in the video input signal when the CAPTIONS web page was activated. To refresh the status of the Video Input Status table, click on the CAPTIONS tab again or click the APPLY button on the CAPTIONS web page.

The 608-to-708 Converter Control table allows the user to control the behavior of the 608-to-708 closed caption conversion process, as defined in Table 30. The 608-to-708 caption converter is intended to be used in AUTO mode, creating 708 captions from 608 caption data when no 708 captions are present in the video input signal. If display directives are present in the received 608 captions, those directives are converted into appropriate display directives in the 708 captions in order to preserve the caption appearance and timing defined by the received 608 captions. If display directives are not included in the received 608 captions, then the LEX2000 applies the user settings from the 608-to-708 control table to the 708 captions that are created from the 608 caption data.

The 608 caption data are also passed to the encoded video stream as 608 captions without any alteration. Thus, when the 608-to-708 converter is operating and the video input has 608 captions and no 708 captions, the encoded video output has both 608 and 708 captions with identical information and similar appearance.

Table 30: CAPTIONS Web Page – 608-to-708 Converter Control

Parameter	Values
608-to-708 Mode	OFF No 608 captions are converted to 708 format. AUTO Whenever the video input signal includes 608 caption data and does not include 708 caption data, the 608 caption data are copied, converted to 708 format and added to the encoded video stream as 708 captions. FORCE When the video input signal includes 608 caption data, the 608 caption data are copied, converted to 708 format and added to the encoded video stream as 708 captions, regardless whether or not 708 captions are present in the video input signal.
608-to-708 Status	Reports the current activity of the 608-to-708 converter as: OFF The 608-to-708 caption converter is off. Active 608 captions received with the video input signal are being converted to 708 format. Standing By The 608-to-708 converter is active and ready. Since the video input signal has 708 captions or does not have 608 captions, no 608 captions are being converted to 708 format.
Text Font	When 608 captions include no font directive and are converted to 708 captions, the LEX2000 sets the 708 caption font to the user-selected value. Casual Cursive Monospace Sans Serif Monospace Serif Proportional Sans Serif Proportional Serif Small Cap
Text Justify	When 608 captions include no justification directive and are converted to 708 captions, the LEX2000 sets the 708 caption justification to Left, Center or Right justification, according to the user setting for each encoded video stream.
Text Color	When 608 captions have no designation of text color or background color and are converted to 708 captions, the LEX2000 sets the text and background colors to user-selected values for each EV-x stream.
Background Color	Black (background default) White (Text default) Red BR Red (bright red) Magenta Green BR Green (bright green) Yellow Blue BR Blue (bright blue) Cyan
Background Opacity	When 608 captions include no background opacity directive and are converted to 708 captions, the LEX2000 sets the 708 caption background opacity to Solid, Translucent or Clear (transparent), according to the user setting for each EV-x stream.
Window Height (Lines)	When 608 captions include no window size directive and are converted to 708 captions, the LEX2000 sets the 708 caption window size to 1, 2 or 3 lines, according to the user setting for each encoded video stream.

4.7. Emergency Alert System (EAS) Cut-Over Switch

The LEX2000 is equipped with an audio-video cut-over switch that cuts the audio and video program on one or more ATSC services to emergency alert programming, as configured by the EAS web page in the LEX2000 unit. The EAS switch may be triggered or activated by the emergency broadcast alert tones carried by one of the audio programs or by a dry contact closure. When the EAS switch is triggered, the selected virtual channels cut to the designated EAS audio and video program sources. The cut-over switch is deactivated with the closing audio tones or release of the dry contact closure. EAS activation is indicated on the front panel when both the INPUT and OUTPUT LED's are alternately flashing yellow - green - yellow - green.

The EAS switch mechanism provides a simple, integrated cut-over solution for applications where the EAS program content is presented as a full screen video replacement. This EAS switch replaces the entire audio and/or video content with the emergency alert program and is not intended to be used when the EAS video program is a partial screen text crawl or graphics that overlays the original program content. The EAS cut-over switch may be used effectively in applications where an EAS receiver is placed in line with the audio and video programs that feed one of the ATSC services or by feeding the EAS audio and video programs into unused inputs of the LEX2000.

NOTE: In order to trigger the EAS cut-over switch using a contact closure sense input, the LEX2000 unit must be configured at the factory for contact closure I/O. When contact closure I/O is enabled, analog audio inputs AUDIO-5 and AUDIO-6 are not available, since the AUDIO-5/6 connector is used for contact closure I/O signals. See paragraph 3.4 for more information on configuring the unit to support contact closure I/O.

4.7.1. EAS Audio Alert Tones

If EAS audio tones are used to trigger the EAS cut-over switch in the LEX2000, the tones must be provided from an un-encoded audio signal. The EAS switch cannot be activated from alert tones received within a pass-through or pre-encoded audio program.

EAS audio tones must be delivered to the LEX2000 on the **left channel** of the stereo audio input, regardless of whether the audio is analog, embedded digital or AES/EBU digital audio.

4.7.2. EAS Program Sources

The source for the EAS video program may be selected from any video input, including video inputs that are not used by active broadcast channels. The EAS video program that is switched into multiple services in the ATSC multiplex must be a standard definition format. When the EAS video program is switched into services carrying HD video programs, the service's video program format switches to SD during the EAS switch activation and returns to the original HD program when the EAS condition is finished.

4.7.3. EAS Configuration

The EAS trigger source, program sources and trigger response behavior are all configured on the EAS web page. The EAS Trigger Response table allows the broadcaster to select which of the virtual channels in the ATSC multiplex cuts to

the EAS programming when a trigger is received and which services do not change. Audio and video programs are selected independently to allow broadcasters the flexibility of cutting only the audio or the entire audio and video program to the sub-channels.

Figure 19: EAS Configuration Web Page

The EAS Trigger table allows the user to identify the trigger source. If the LEX2000 unit is configured to support contact closure I/O, then the EAS Trigger Source may be an Audio Tone or one of the two contact closure inputs. If the LEX2000 unit is not configured to support contact closure I/O, then the EAS Trigger Source may only be an audio tone. EAS audio tones must be present on the **left channel** of the stereo audio input in order for them to be detected. If the EAS Audio Tone Input is an SDI-embedded digital audio input, then the user must also specify the track on which the audio tones are present. If the EAS receiver provides an unbalanced audio output, for example on an RCA connector, then be sure to use a balun to convert the unbalanced signal to a balanced audio signal, suitable for connecting to the LEX2000 audio input.

The EAS Audio Program and EAS Video Program are the audio and video content that are cut into all selected virtual channel when the EAS cut-over switch is activated. Select the signal inputs for these programs using the EAS Audio Program and EAS Video Program tables in the lower right area of the EAS web page.

After configuration of the EAS program sources, the cut-over switch may be tested by clicking on the Trigger EAS Now button, below the EAS Video Program table.

4.7.4.   EAS Audio Tone Sensitivity Adjustments

The EAS audio signal consists of three identical alert header tones (modulated audio) that contain the FIPS codes for the affected areas, followed by an 8-second attention tone, the audio emergency message and finally three end-of-alert tone bursts.

The EAS cut-over switch is designed to engage as soon as the LEX2000 detects the three audio bursts of a valid EAS alert header. The EAS audio tone trigger filter is precisely tuned to the FCC-specified EAS tone frequencies and the specified tone burst duration in order to avoid falsely triggering the cut-over switch with normal program content that may have very similar audio patterns. Since EAS receivers that generate audio tones may have different levels of loudness or amplitude of their audio tones, the EAS web page allows the user to adjust the LEX2000 sensitivity to the EAS audio tone signals.

NOTE: Changing the EAS audio tone sensitivity is not normally required for proper operation. Before adjusting the sensitivity values, double check to make sure that the EAS audio tones are being fed to the EAS Trigger Source input on the **left channel**, that the analog audio signal source is using a balanced signal configuration (if applicable) and that the virtual channels that should cut to the EAS program are selected (checked) in the EAS Trigger Response table.

If necessary, use the EAS Adjustments table to adjust the sensitivity to the EAS alert and attention tones in the audio input. The sensitivity value for the EAS Alert and EAS Attention tones range from zero (off) to 100 (most sensitive). The default value for each setting is 70. The recommended procedure to make adjustments to these values is as follows. This procedure assumes that the EAS audio tones are not being detected by the LEX2000 unit when beginning the procedure.

1. Change the EAS Alert Sensitivity setting from the default of 70 to a value of 75.

2. Test the EAS trigger by applying the EAS audio tones and observing the response on the appropriate virtual channels.

3. Continue increasing the EAS Alert sensitivity by 5 and retesting until the EAS Alert value is set to 100, taking note of which setting values produce successful EAS triggers and which setting values do not.

4. If one or more of the EAS Alert values between 75 and 100 produce successful EAS triggers, then set the EAS Alert to a value in the middle of the range of EAS Alert values that produce successful triggers. The procedure is complete.

5. If no EAS Alert values between 70 and 100 result in a successful EAS trigger, then set the EAS Alert to 65 and test the EAS trigger as in step 2. Check Alert Sensitivity values of 65, 60, 55, etc. down to 0 and note the values that produce successful EAS triggers.

6. If one or more of the EAS Alert values between 65 and 0 produce successful EAS triggers, then set the EAS Alert to a value in the middle of the range of EAS Alert values that result in successful triggers. The procedure is complete.

7. If no EAS Alert values between 0 and 100 produce successful EAS triggers, then set the EAS Alert value to 70 and execute steps 1-6 on the EAS Attention Sensitivity value.

8. If no values of EAS Alert Sensitivity or EAS Attention Sensitivity produce a reliable, successful EAS trigger, then contact technical support for further guidance. In cases where the tones from a specific EAS receiver are not being properly detected, it may be more effective to use a contact closure for the EAS trigger.

The EAS Timeout setting in the EAS Adjustments table is the maximum length of time that the EAS cut-over switch remains engaged in the event that the end-of-alert tones are not detected to release the cut-over switch. The EAS Timeout value should be longer than the longest permissible EAS message duration.

4.7.5.   Dry Contact Status Monitor

When the LEX2000 unit is configured to enable contact closure I/O, the **Dry Contact Sense Status** table is displayed on the EAS web page, allowing the user to monitor the dry contact closure inputs, SENSE_IN1 and SENSE_IN2. When nothing is connected or the external dry contact is open, the status is "OPEN." When the SENSE_IN input is connected to a ground contact, as specified in paragraph 3.4.1, its status becomes "ACTIVE."

The EAS audio and video program sources are identified in the EAS Audio Program and EAS Video Program tables. If the audio program source is an SDI digital audio input, then the user must also specify the track on which the audio program is carried.

The EAS response may be tested by clicking on the TRIGGER EAS NOW button, which activates the EAS cut-over switch for 10 seconds.

4.8. Alert Signal Outputs

Figure 20: ALERT Signal Configuration Web Page

When configured for contact closure I/O, as described in section 3.4, the LEX2000 is able to generate alert signals through dry contact closures and firmware-controlled power sources. The Alerts web page provides tables to configure all four of these output signal sources.

The Dry Relay Contacts table allows the user to define the trigger condition and response action independently for the two available relay contacts, RELAY-1 and RELAY-2.

The Power Sources table allows the user to define trigger conditions and response behaviors for turning on a remotely controlled 5VDC source and a 12VDC source. The current-limited power sources are designed to drive small loads, such as external relays or opto-isolators. More information on the power sources may be found in paragraph 3.4.3.

Both tables provide the status of their respective signals in the bottom row of the table to assist with system integration and testing. When inspecting the status to verify correct operation, click the "Refresh Status" button to update the Contact Status and Power Source Status fields.

4.9. Streaming IP Output Gigabit Ethernet (TG Option)

The Streaming IP Output Gigabit Ethernet (TG) Option enables an LEX2000 unit to transmit an ATSC multiplex as a UDP or RTP data stream over Ethernet. When the TG option is installed in an LEX2000 unit, a Gigabit Ethernet transceiver with an RJ-45 connector is located in the IP-4 socket on the LEX2000 rear panel and the License Status table on the SYSTEM - UPDATE web page indicates that the TG option is "Active."

Before making use of the TG option, an Ethernet cable must be plugged into the IP-4 socket on the LEX2000 rear panel. Streaming IP outputs are not transmitted on the IP-1 port, which is used for connection to a primary control network. Even if the same network is used for control communication and streaming IP video from the LEX2000, separate connections must be made the IP-1 and IP-4 sockets, since IP-1 only supports access to the internal web pages, and IP-4 only supports the streaming IP output.

4.9.1. Using Forward Error Correction (FEC)

The LEX2000 streaming IP output supports the use of two-dimensional forward-error correction in accordance with SMPTE-2022-1.

Using FEC enhances the reliability of the streaming IP output by sending additional streams of packets to other IP ports at the receiver. If IP packets are lost in the primary transport stream, they can be recreated from the information provided in the FEC streams. The number of contiguous packets that may be lost and recreated effectively in the primary transport stream depends on the strength of the FEC applied and the ability of the receiving equipment to recreate the transport packets while managing the receive data buffers in order to reassemble the original IP transport stream.

FEC should be used when the IP output stream is being transmitted over an uncontrolled network or any network that exhibits unacceptable levels of packet loss between the LEX2000 unit and the receiving equipment.

The FEC data streams consume more network bandwidth than is required when FEC is not used, but the FEC data streams protect the primary IP output stream from a specific level of packet loss, as defined by the FEC-L and FEC-D parameter settings. Stronger levels of FEC, indicated by higher FEC-L and FEC-D parameter values, consume more network bandwidth than lower strength (smaller) values, but provide more robust packet-loss prevention.

In order to apply FEC to the IP output stream, set the Destination IP Port Number to an even-number value and set the IP Protocol to RTP. FEC data streams are generated with Destination IP Port Numbers 2 and 4 port above the primary transport IP output stream. For example, if the Destination IP Port Number is set to 50000, then FEC data streams will be transmitted with Destination IP Ports 50002 and 50004.

Null packets may be included or removed from the primary IP output stream, depending on the requirements of the receiving equipment. Removing null packets reduces the network bandwidth consumed by the primary output stream and also reduces the bandwidth required by the FEC streams, depending on the portion of null packets in the original transport stream.

4.9.2.   Configuring the Streaming IP Output

When the TG option is enabled, the SYSTEM - NETWORK web page provides the **IP-4 Streaming Output** table, which is used to configure the behavior of the LEX2000's streaming IP output. The streaming IP output generates an IP stream to a single destination, defined by the IP address and port number entered in the table for each IP stream.

NETWORK CONNECTIONS

IP NETWORK DEVICE NUMBER	IP-1	IP-2	IP-3	IP-4
SFP Module MFR	Methode Elec.OEM	-	-	AAXEON
SFP Module Model	EX-SFP-1GE-T-OEM	-	-	SFP-C
SFP Module Status	Good	No Device	No Device	Good
MAC Address	00:1A:0A:05:00:0D	-	-	00:1A:0A:06:00:0D
Static IP	142.42.6.141	192.168.120.57	192.168.120.58	142.42.7.141
Subnet Mask	255.255.0.0	255.255.0.0	255.255.0.0	255.255.0.0
Gateway IP	142.42.6.252	192.168.120.1	192.168.120.1	192.168.0.120
DNS Server 1	8.8.8.8	-	-	-
DNS Server 2		-	-	-

IP-4 STREAMING OUTPUT

IP STREAM NUMBER	IPT-4.1
Stream Content	None - Stream Off
Destination IP Address	192.168.100.42
Destination IP Port Number	50000
IP TTL	128
IP TOS	0
IP Protocol	RTP
Null Packet Treatment	Include Nulls
SMPTE-2022 FEC	FEC On
FEC L PARAMETER	1
FEC D PARAMETER	4
Link Status	Offline

Figure 21: Streaming IP Output Configuration

The **IP Stream Number** identifies each stream as IP-4.x, providing a unique identifier for each IP stream when multiple streams are generated from a single physical IP port. Each IP stream (IP-4.1, IP-4.2, ...) is presented in its own column in the IP-4 Streaming Output table and is configured independently from the other IP streams, as described below.

Set the **Stream Content** value to identify the data payload of the IP stream, such as TS-1, for Transport Stream 1.

Enter the **Destination IP Address**, using a four-field numerical format, such as xxx.xxx.xxx.xxx. Leading zeros in each of the four fields may be omitted. Do not use spaces.

Enter the **Destination Port number** as an integer between 1 and 65535. Generally, port numbers in the range of 49151 to 65530 are recommended in order to avoid interfering with port numbers commonly used by other applications. Consult your information technology professional to determine which port number is best for your application.

Set the **IP TTL** (packet time-to-live) value to 128 or an appropriate value provided by your network system administrator or IT professional. TTL is used to avoid flooding networks with ghost packets and defines the maximum number of times each packet can be processed by a network router before it expires and is no longer passed by the routers.

Set the **IP TOS** (type of service) to a value appropriate for the network application, as defined by an information technology professional. The TOS byte contains numerical information that may be used to prioritize media traffic handling by network routers and switches.

Select the **IP Protocol** to be used, based on the requirements of the equipment that is receiving the IP stream. UDP (user datagram protocol) is a simple method of sending data from one point to another point on an IP network. UDP has low overhead and low latency, but has limited error checking and no packet recovery mechanism. RTP (real time protocol) provides a more robust connection and consumes slightly more network bandwidth to transfer the same data payload as UDP protocol.

Select the **Null Packet Treatment** to either include null packets or remove null packets from the IP stream. Removing null packets reduces the network bandwidth consumed by the IP stream, but some receiving equipment may require that null packets be retained in the transport stream in order to fully reconstruct the original transport stream with the proper timing.

Set the **SMPTE-2022 FEC** to "FEC On." When set to "FEC Off," no FEC data streams are generated.

Set the **FEC L Parameter** to an integer value between 1 and 20, inclusive. Setting the L parameter to 1 implements a one-dimension FEC operation and generates only one FEC data stream. Setting the L parameter to a value greater than one implies a two-dimensional FEC operation, which generates two FEC data streams.

Set the **FEC D Parameter** to an integer value between 4 and 20, inclusive. Ensure that the values L x D are less than or equal to 100. For example, values of 8 and 15 are not allowed since 8 x 15 = 120 which is greater than 100.

The L and D parameters control the number of transport packets used in each dimension of FEC calculations. FEC data streams generated from a larger number of primary stream packets generally provide the ability to recover more lost packets of the primary IP stream than smaller values of L and D.

For more information on the use of FEC and effective values of L and D parameters to account for specific network conditions, consult SMPTE-2022-2 or an information technology professional.

The **Link Status** reports the status of the connection between the IP-4 Ethernet transceiver and the receiving equipment at the specified IP address and port number, as one of the following.

- Active - Communications are established between the two Ethernet ports.
- Off Line - The local Ethernet port in IP-4 is not ready to communicate.
- Failed Link - The LEX2000 IP-4 port has attempted to communicate, but has not received an acknowledgement from the receiving equipment. This may occur for a variety of reasons, such as an unplugged network cable, incorrect IP port designation, incorrect IP address, receiving equipment powered off, etc.

4.9.3. Setting the Transport Stream Bandwidth

When the TG Option is enabled, the ATSC multiplex output data rate may be adjusted by the user to a value other than the standard 19.39 or 38.8 Mbits/sec. The Max TS Data Rate value may be set by the user to rates ranging from 10 to 80 Mbits/sec in order to accommodate use in applications with limited-capacity data communication equipment, such as microwave links.

Figure 22: TRANSPORT Configuration Web Page

When the TG Option is enabled, the **Max TS Data Rate** table appears at the bottom of the TRANSPORT web page. To set the ASI output bandwidth to the standard values of 19.39 or 38.8 Mbits/sec, select the appropriate value from the pull-down pick list. To set a different ASI output bandwidth limit, select "Manual" in the pick list and enter a value in the Manual Value field, below. The transport stream data rate is the same for the ASI output and the streaming IP output, except for any additional bandwidth consumed by FEC data streams.

If the TRANSPORT page on the LEX2000 unit does not include the Total Multiplex Bandwidth Limit row at the bottom of the web page, then the unit may

not have the TG option enabled. Check the License Status table on the SYSTEM – UPDATE page to verify the TG option status.

4.9.4.   <u>ASI – to – IP Converter Using the TG Option</u>

When the TG Option is enabled, the LEX2000 can convert an externally generated ASI transport stream signal into an IP-based transport stream. This may be done independently of the other functions being performed by the LEX2000 unit. This is especially useful when looping the LEX2000 ASI output through other ASI processing equipment, such as a Nielsen box, and then generating an IP-based transport stream to send to a studio-transmitter link.
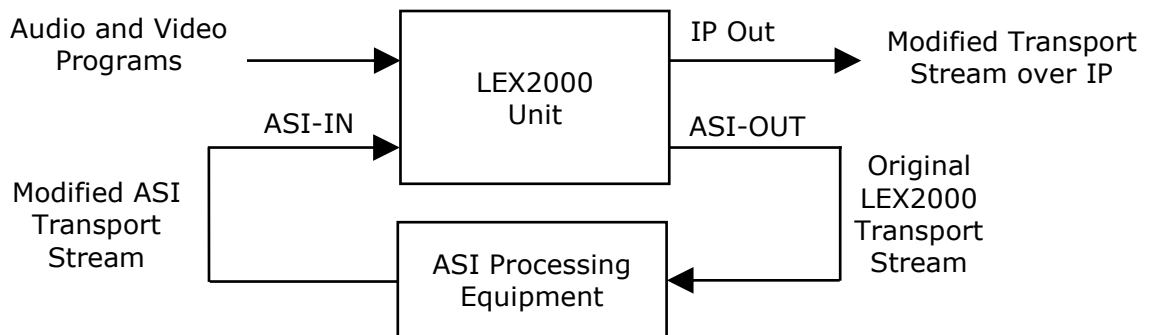
Figure 23: ASI-to-IP Loop-Through Application

To generate a TS-over-IP output from a transport stream received on the LEX2000 ASI input, set the **Stream Content** in the **IP-4 Streaming Output** table to ASI-IN.

4.9.5.   Streaming the IP Output to VLC Media Player

The LEX2000 may be configured to stream its transport stream output to a local network computer, running the VLC media player in order to verify proper operation of the LEX2000's Streaming IP Output. The following steps provide a guideline for implementing this functionality.

VLC media player may be downloaded for free at www.videolan.org. This procedure assumes that VLC is operating on a receiving computer.

Acquire the IP address of the receiving computer. This may be viewed by opening a command window and entering the "ipconfig" command.

Start the VLC media player and configure it to receive streaming media from the LEX2000, as follows.

1. Click on the menu, Media - Open Network Stream. VLC presents its Open Media dialog box with the Network tab selected.

2. Enter one the following in the network URL entry box:
    udp://@:1234 (if using UDP protocol) or
    rtp://@:1234   (if using RTP protocol)

    1234 is the default IP port number for VLC, but other port numbers, such as 50000 may also be used.

3. Click on Play. VLC looks for an IP stream to at the IP port number indicated, using the protocol specified in the URL entry.

Browse to the SYSTEM - NETWORK web page on the LEX2000 unit and enter the following information in the IP-4 Streaming Output table.

1. Set Stream Content to TS-1

2. Set Destination IP Address to the IP address of the receiving computer, which was acquired earlier using the ipconfig command.

3. Set the Destination IP Port Number to 1234. This is the default port number for VLC. A different port number may be used if desired, but the port number used must also be entered into VLC at a later step.

4. Set the IP Protocol to UDP or RTP to match the protocol expected by VLC, based on the VLC configuration step 2, above.

5. Set the Null Packet Treatment to Remove Nulls

6. Apply the page. Verify that the Link Status indicates "Active." It may be necessary to click the Apply button a second time after a 10 to 20 second delay in order to update the Link Status value.

The VLC window on the computer displays the video being streamed from the LEX2000 unit. If there are multiple virtual channels in the transport stream multiplex, VLC allows the user to select among them to play the audio and video from any of the virtual channels in the IP-based transport stream.

If VLC does not successfully show the IP-based transport stream, then double check each of the configuration parameters to ensure that they match, especially the Destination IP Address, Destination IP Port Number and IP Protocol used.

4.10. ASI Re-multiplexer (RX Option)

The ASI Re-multiplexer or Remux (RX) option enables an LEX2000 unit to receive encoded audio and video program streams from an ASI signal transport stream, generated by a satellite receiver or other ASI source, and integrate those program streams with locally encoded content to form a new ATSC multiplex transport stream output. The LEX2000 unit is able to extract up to 4 encoded video programs and up to 12 encoded audio programs from an ASI input stream.

NOTE: In order to use the ASI Remux function, the LEX2000 unit must loaded a version of firmware and a license file that supports the RX option.

The LEX2000 ASI Remux allows users to receive and integrate program content from a transport stream received on an ASI signal in three basic steps:

1. Identify the encoded audio and video program streams to be extracted from the transport stream received on the ASI input signal;

2. Allocate bandwidth for the ASI-based programs in the LEX2000 transport stream output, and select the appropriate action to take if the ASI-based program streams overflow their user-specified bandwidth allocation;

3. Assign the ASI-based audio and video program elements to ATSC broadcast services in the LEX2000 transport stream output.

4.10.1. Using ASI Input Signal to Configure ASI Remux

An ASI signal with the intended transport stream must be connected to the LEX2000 unit's ASI Input in order to configure its ASI Remux operation, allowing the LEX2000 to read the contents of the ASI input transport stream and use this information during the configuration process. Once the ASI Remux settings are saved, they are retained in the LEX2000 unit and the ASI signal may be removed.

To configure the ASI Remux in LEX2000 units that do not have access to an ASI signal when being configured, load a configuration file (.CFG) that was saved from an LEX2000 unit that was configured using the ASI input signal. All of the user settings stored in the CFG file, including the ASI Remux settings, are applied to the LEX2000 unit that loads the CFG file.

4.10.2. Identifying ASI Input Programs

Log into the LEX2000 unit's web pages and browse to the OPERATION – REMUX web page, shown in Figure 24, below. Find the ASI Input Programs table and its four sections with headings, "ASI Input Program Number:" Each section of the table is used to select one program from the ASI input stream, including its audio and video program elements.

Each program and program element received from the ASI-based transport stream is identified with a tag or designation, allowing these programs or program elements to be assigned to virtual channels on the TRANSPORT web page. The following designations are used:
XP-1 … XP-4   ASI Remux program 1 through 4
XV-1 … XV-4   ASI Remux video program 1 through 4
XA-1.1 … XA-4.3   ASI Remux audio program 1.1 through 4.3.

Since each program received on the ASI input transport stream may contain up to three audio programs, two digits are used to identify the Remux audio

program element. The first digit identifies the ASI Remux program associated with the audio program and the second digit indicates a specific audio program within the program set.

In the **ASI Input Programs** table, select a Program Number from the pull-down pick list under the heading PROGRAM XP-1. The program numbers listed in the Program Number pick list include all of the program numbers detected in the transport stream received on the unit's ASI Input. If an expected program number does not appear in the Program Number pick list, then the LEX2000 unit does not detect it in the ASI signal.

After a **Program Number** is selected, detailed information about the contents of the selected program are displayed in that section of the ASI Input Programs table, including PID values, current status and current detected bit rate for each audio and video element within the program.

IMPORTANT: The Video-Audio status row in each program section of the ASI Input Programs table identifies the encoding format of each audio and video program element. All program content extracted from the ASI Input signal and included in the LEX2000 unit's transport stream output must comply with ATSC requirements. Audio may be encoded as Dolby Digital (AC-3) or Dolby 5.1. Video must be encoded as MPEG-2.

4.10.3. Assigning ASI Input Programs to ATSC Broadcast Services

After XV and XA program elements are defined in the ASI Input Programs table on the REMUX web page, the XV-x and XA-x.y values appear in the pick list for the ATSC Services tables. The Encoded Video Program choices include EV (encoded video) as well as XV (remux video) programs. The Encoded Audio Program choices include EA (encoded audio), PA (pass-through audio) and XA (remux audio) programs that are defined in their respective tables.

4.10.4. Reassigning PID Values

The **ASI Input Programs** table displays the ASI Input PID value for each audio and video program element in the selected program, as well as the new PID value assigned to that element in the LEX2000's transport multiplexer. New PID Values are defined on the TRANSPORT web page for all program elements feeding active services or virtual channels in the transport stream output. If the ASI Input Programs table displays a "-" as the New PID Value for a Program Element, then either that element does not exist in the ASI input stream, it does not have a new PID value assigned on the TRANSPORT web page, or it is not assigned to an active virtual channel on the TRANSPORT web page.

4.10.5. <u>Allocating TS Bandwidth for ASI Input Programs</u>

The encoded audio and video programs that the LEX2000 receives on its ASI Input are fed directly to the transport multiplexer with no changes to the encoding or bit rate of the incoming program stream. A specific amount of transport stream bandwidth is reserved for each program stream received on the ASI input and used in the transport stream output. The remaining bandwidth in the transport stream output is available for use by locally encoded audio and video programs.

Enter a **MAX Bit Rate** for each XV video program defined in the ASI Input Programs table. This MAX Bit Rate should be the peak bit rate expected for the video program being received on the ASI Input. Contact your video program supplier to understand the maximum bit rate expected for the ASI video programs being received.

Select a **MAX Bit Rate** value for each XA audio program defined in the ASI Input Programs table. The audio program bit rates on the pick list correspond to ATSC standard bit rates for encoded audio, and the bit rate of the audio program being received on the ASI Input should match one of the listed values.

The LEX2000 unit reports the actual bit rate of each program element in the received transport stream in the Detected Bit Rate row, directly above the MAX Bit Rate setting for each XV or XA program element. The **Detected Bit Rate** displayed in this table is a momentary measurement and may change each time the web page is refreshed.

The **ATSC Multiplex Bandwidth** table at the bottom of the TRANSPORT, AUDIO, VIDEO and REMUX web pages, reports the transport stream bandwidth allocated to each program element of each virtual channel, as well as the total for each virtual channel. When XV programs are assigned to an ATSC service, the Video Bit Rate Control reports "ASI REMUX", meaning that the LEX2000 unit does not have control over the video bit rate of this program.

The MAX Bit Rate value for each XV and XA program element is reported as the target bit rate for each program element and is combined to form the TOTAL AUDIO and TOTAL VIDEO bit rates reported in the lower section of the table.

The "**Total Max Bandwidth ASI Input Programs Used**" is reported in the bottom section of this table and is the grand total bandwidth reserved for all program elements received on the ASI Input stream and used in the transport stream output. The "**Total Detected Bandwidth ASI Input Programs Used**" is reported directly below and is the grand total bandwidth actually used by the same ASI Input program elements, detected momentarily when the web page was last refreshed. The Total Detected Bandwidth is shown in red if it exceeds the Total Max Bandwidth that is reserved for use by programs from the ASI Input stream.

4.10.6. ASI Input Overflow Response

The LEX2000 video encoders and transport multiplexer work together to ensure that the transport stream output has correct timing, does not overflow and that the no audio or video programs are ever dropped from the stream. However, since audio and video programs received on the ASI Input are already encoded before being received by the LEX2000, and since the LEX2000 does not control their encoded bit rate, ASI Input program bit rates that exceed the bandwidth reserved for the program may cause the LEX2000 transport stream output to overflow unless programs are dropped from the stream.

LEX2000 units do accommodate minor variations in ASI program bit rates. However, if the total bit rate of the ASI Input programs used in the transport stream output exceeds the bandwidth reserved for these combined programs, an overflow condition may occur, causing the LEX2000 transport multiplexer to discard data in order to maintain the integrity of the transport stream output.

The **ASI Input Overflow Program** selection, near the bottom of the REMUX web page, allows the user to control the response of the LEX2000 unit when the ASI Input Programs exceed their total, combined reserved bandwidth and cause a transport stream overflow condition. Use the pull-down control to select one of the EV or XV encoded video programs to be dropped momentarily from the transport stream if a transport stream overflow condition occurs. Select XV-ALL to drop all of the XV video programs from the transport stream output upon detection of a transport stream overflow condition.

Encoded video programs that are dropped from the transport stream upon detection of an overflow condition are restored automatically, shortly after the overflow condition is resolved. When video programs are momentarily dropped from the transport stream, television receivers may exhibit a variety of behaviors, including freezing the last frame received or displaying a black screen until video is restored.

Encoded audio programs are always maintained in the transport stream and not dropped when a transport stream overflow condition is detected.

The **ASI Input Overflow Counter**, near the bottom of the REMUX web page, reports the number of times the selected video program was dropped from the transport stream output during the last hour, day, week and month. Increase the MAX Bit Rate of the XV and XA program elements to allocate more bandwidth in the transport stream output for the ASI Input programs in order reduce the frequency of transport stream overflows.

WARNING: If the actual bit rate of ASI Input programs assigned to active virtual channels is high enough to overflow the ATSC transport stream output, even after dropping the selected video program(s), then the entire transport stream is reset, affecting all audio and video programs in the broadcast multiplex.

SYSTEM	OPERATION	CONTACT US			Apply	Save Configuration Settings	Logout
TRANSPORT	VIDEO	AUDIO	PSIP	CAPTIONS	EAS	REMUX	ALERTS

ASI INPUT STATUS

Signal Lock	Locked	
Transport Stream ID (TSID)	1103	044F
	DECIMAL	HEX

REFRESH ASI INPUT STATUS

ATSC SERVICES

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Service Status	Active	Off Air	Off Air	Off Air	Off Air	Off Air	Off Air	Off Air
Virtual Channel Name	WAAA-HD	WBBB	WCCC	WDDD				
Virtual Channel Number	12-1	12-2	12-3	12-4	12-5	12-6	12-7	12-8
Encoded Video Program	XV-1	EV-3	EV-4					
Encoded Audio Program 1	XA-1.1	EA-2	EA-3	EA-4				
Encoded Audio Program 2	XA-1.2	EA-6	EA-7	EA-8				
Encoded Audio Program 3								

ASI INPUT PROGRAMS

ASI INPUT PROGRAM NUMBER:	PROGRAM XP-1	PROGRAM ELEMENT NUMBER:	VIDEO XV-1	AUDIO XA-1.1	AUDIO XA-1.2	AUDIO XA-1.3
Program Number (Hex)	3	ASI Input PID Value	31	34	-	-
PMT PID (Hex)	30	New PID Value	31	34	-	-
Program Status	Active	Video - Audio Status	MPEG-2	AC-3	-	-
Detected Bit Rate (Mbits/sec)	14.788	Detected Bit Rate	14.404	0.384	-	-
MAX Bit Rate (Mbits/sec)	15.384	MAX Bit Rate	15.000	384	192	96

ASI INPUT PROGRAM NUMBER:	PROGRAM XP-2	PROGRAM ELEMENT NUMBER:	VIDEO XV-2	AUDIO XA-2.1	AUDIO XA-2.2	AUDIO XA-2.3
Program Number (Hex)	4	ASI Input PID Value	41	44	-	-
PMT PID (Hex)	40	New PID Value	-	-	-	-
Program Status	Active	Video - Audio Status	MPEG-2	AC-3	-	-
Detected Bit Rate (Mbits/sec)	2.018	Detected Bit Rate	1.826	0.192	-	-
MAX Bit Rate (Mbits/sec)	2.892	MAX Bit Rate	2.700	192	96	96

ASI INPUT PROGRAM NUMBER:	PROGRAM XP-3	PROGRAM ELEMENT NUMBER:	VIDEO XV-3	AUDIO XA-3.1	AUDIO XA-3.2	AUDIO XA-3.3
Program Number (Hex)		ASI Input PID Value	-	-	-	-
PMT PID (Hex)	-	New PID Value	-	-	-	-
Program Status	-	Video - Audio Status	-	-	-	-
Detected Bit Rate (Mbits/sec)	-	Detected Bit Rate	-	-	-	-
MAX Bit Rate (Mbits/sec)	-	MAX Bit Rate	0.000	96	96	96

ASI INPUT PROGRAM NUMBER:	PROGRAM XP-4	PROGRAM ELEMENT NUMBER:	VIDEO XV-4	AUDIO XA-4.1	AUDIO XA-4.2	AUDIO XA-4.3
Program Number (Hex)		ASI Input PID Value	-	-	-	-
PMT PID (Hex)	-	New PID Value	-	-	-	-
Program Status	-	Video - Audio Status	-	-	-	-
Detected Bit Rate (Mbits/sec)	-	Detected Bit Rate	-	-	-	-
MAX Bit Rate (Mbits/sec)	-	MAX Bit Rate	0.000	96	96	96

ATSC MULTIPLEX BANDWIDTH (Mbits/sec)

ATSC SERVICE NUMBER:	SR-1	SR-2	SR-3	SR-4	SR-5	SR-6	SR-7	SR-8
Video Bit Rate Control	ASI REMUX	Stat-MUX	Stat-MUX	-	-	-	-	-
Video Bit Rate Target	15.000	2.400	2.000	-	-	-	-	-
Audio Program 1	0.384	0.192	0.192	0.096	-	-	-	-
Audio Program 2	0.192	0.096	0.096	0.096	-	-	-	-
Audio Program 3	-	-	-	-	-	-	-	-
AUDIO-VIDEO Subtotals	15.576	2.688	2.288	0.192	-	-	-	-

TOTAL AUDIO	0.576
TOTAL VIDEO	15.000
TOTAL AUDIO-VIDEO	15.576
RESERVED - MOBILE DTV	-
ATSC DATA	0.328
TOTAL MULTIPLEX	15.904
UNUSED BANDWIDTH	3.073
TOTAL MULTIPLEX BANDWIDTH LIMIT	19.390

TOTAL MAX BANDWIDTH ASI INPUT PROGRAMS USED	15.576
TOTAL DETECTED BANDWIDTH ASI INPUT PROGRAMS USED	14.788

ASI INPUT OVERFLOW PROGRAM

IF THE ACTUAL BIT RATE OF ASI INPUT PROGRAMS IN USE
EXCEEDS THE ASI INPUT RESERVED BANDWIDTH, THEN
THE SELECTED VIDEO PROGRAM WILL BE BLANKED MOMENTARILY: XV-ALL

ASI INPUT OVERFLOW COUNTER

NUMBER OF ASI OVERFLOW EVENTS	EVENT COUNT
DURING LAST HOUR	15
DURING LAST 24 HOURS	15
DURING LAST 7 DAYS	15
DURING LAST 30 DAYS	15
LAST TIME EVENT COUNTER CLEARED	

REFRESH OVERFLOW COUNTER DISPLAYS

CLEAR OVERFLOW EVENT COUNTERS

ASI INPUT OVERFLOW WARNING

IF THE ACTUAL BIT RATE OF ASI INPUT PROGRAMS ASSIGNED TO ACTIVE VIRTUAL
CHANNELS IS HIGH ENOUGH TO OVERFLOW THE ATSC TRANSPORT STREAM OUTPUT,
EVEN AFTER BLANKING THE SELECTED VIDEO PROGRAM, THEN THE ATSC TRANSPORT
STREAM OUTPUT WILL RESET.

Figure 24: ASI Remux Configuration Web Page

Table 31: ASI Remux Web Page – ASI Input Status

Parameter	Values
Signal Lock	Reports whether or not an ASI signal is being successfully received at the ASI Input connector.
Transport Stream ID (TSID)	Reports whether each virtual channel is Active or Off Air, as defined on the TRANSPORT web page.

Table 32: ASI Remux Web Page – ATSC Services Configuration

Parameter	Values
ATSC Service Number	Each ATSC service is identified as SR-x.
Service Status	Reports whether each virtual channel is Active or Off Air, as defined on the TRANSPORT web page.
Virtual Channel Name	Reports the short channel name (call letters) for each ATSC service, as defined on the TRANSPORT web page.
Virtual Channel Number	Reports the major and minor channel numbers for each ATSC service, as defined on the TRANSPORT web page.
Encoded Video Program	Select the encoded video program element to be used for each ATSC service or virtual channel. This selection may also be performed on the VIDEO web page.
Encoded Audio Program 1	Select one or more encoded audio program elements to use in each service. The LEX2000 supports up to three audio programs in each ATSC service. This selection may also be performed on the AUDIO web page.
Encoded Audio Program 2	
Encoded Audio Program 3	

Table 33: ASI Remux Web Page – ASI Input Programs Configuration

Program Parameter (Left Side)	Program Values (Left Side)
ASI Input Program Number	XP-1 to XP-4 designation identify each program in the ASI Input data stream that may be used as a source for audio or video program elements by the ATSC transport multiplexer.
Program Number (Hex)	Enter the program number of the program content to be extracted from the data stream on the ASI Input.
PMT PID (Hex)	Reports the PMT PID value of the program being received, whose program number matches the value entered above.
Program Status	Reports the status of the program being received, whose program number matches the value entered above. If no program is found that matches the program number entered above, the Program Status shows "-".
Detected Bit Rate	Reports the total bit rate detected in the data stream for the program elements associated with this program.
MAX Bit Rate	Reports the total bit rate reserved on this web page for the program elements associated with this program.
Program Element Parameter (Right Side)	Program Element Values (Right Side)
Program Element Number	XA-1.1 to XA-4.3 or XV-1 to XV-4 designations identify the audio or video program elements associated with the program received with the respective program number entered on the left side of the table. Audio program elements are designated with two digits, X.Y, since each program may contain multiple audio program elements.
ASI Input PID Value	Reports existing PID value in the received ASI data stream associated with the program element.
New PID Value	Reports the new PID value assigned to the program element on the TRANSPORT web page.
Video – Audio Status	Reports the video program format or audio encoding method detected for each respective program element.
Detected Bit Rate	Reports the actual bit rate being consumed by each respective program element. This value indicates the bit rate of the program element at the moment when it is sampled and is displayed in RED if it exceeds the MAX Bit Rate entered by the user in the field, below.
MAX Bit Rate	Enter the maximum allowed bit rate for each video program element and select a maximum bit rate setting for each audio program element. These values are used to calculate the amount of transport stream bandwidth that needs to be reserved for use by programs received on the ASI data stream.

Table 34: REMX Web Page – ATSC Multiplex Bandwidth

Parameter	Values
Video Bit Rate Control	Reports the video bit rate control and bit rate target for each encoded video stream used in the ATSC multiplex, as defined in the Video Encoder table on the VIDEO web page.
Video Bit Rate Target	Reports the video bit rate control and bit rate target for each encoded video stream used in the ATSC multiplex, as defined in the Video Encoder table on the VIDEO web page.
Audio Program 1, 2, 3	Reports the bandwidth assigned to each encoded audio program assigned to each ATSC service throughout the multiplex, as defined in the Audio Encoder table on the AUDIO web page.
AUDIO – VIDEO Subtotals	Reports the total bandwidth allocated to each ATSC service for encoded audio and encoded video data. This subtotal does not include PSIP or other ATSC data and does not account for encoded video streams that may be duplicated within the multiplex.
TOTAL AUDIO	Reports the total bandwidth allocated to all encoded audio programs within the ATSC service multiplex.
TOTAL VIDEO	Reports the total bandwidth allocated to all encoded video programs within the ATSC service multiplex. Video programs that are duplicated in multiple ATSC services only have a single stream in the multiplex and are counted only once in this total video value.
TOTAL AUDIO-VIDEO	Reports the total bandwidth allocated to all encoded audio and encoded video programs within the ATSC service multiplex.
RESERVED - MOBILE DTV	Reports the multiplex bandwidth reserved for other applications, such as Mobile DTV, as defined on the TRANSPORT web page.
ATSC Data	Reports the multiplex bandwidth allocated to PSIP and other ATSC data that is not audio or video.
TOTAL MULTIPLEX	Reports the grand total allocation of multiplex bandwidth.
UNUSED BANDWIDTH	Reports the amount of multiplex bandwidth left unused (in green) or over-subscribed (in red) when all components of the ATSC service multiplex are combined.
TOTAL MULTIPLEX BANDWIDTH LIMIT	Reports the maximum bandwidth of the ATSC multiplex data payload, as defined on the TRANSPORT web page.
TOTAL MAX BANDWIDTH ASI INPUT PROGRAMS USED	Reports the maximum bandwidth reserved for ASI Input programs in the transport stream output.
TOTAL **DETECTED** BANDWIDTH ASI INPUT PROGRAMS USED	Reports the maximum bandwidth required by ASI Input programs in the transport stream output.

Table 35: ASI Remux Web Page – ASI Input Overflow Control

Parameter	Values
ASI Input Overflow Control	Select a video program to be dropped from the transport stream output in the event that the combined ASI Input programs exceed the bandwidth reserved for them in the LEX2000's transport stream output and cause the transport stream output to overflow.

Table 36: ASI Remux Web Page – ASI Input Overflow Counter

Parameter	Values
During Last Hour	Reports the number of ASI Input overflow events that has occurred during each of the respective time periods.
During Last 24 Hours	
During Last 7 Days	
During Last 30 Days	
Last Time Event Counter Cleared	Reports the local time and date when the event counters were last cleared to zero.

Click the "REFRESH OVERFLOW COUNTER DISPLAYS" button to acquire and display new data on the static web page.

Click the "CLEAR OVERFLOW EVENT COUNTERS" button to reset the ASI Input Overflow counters to zero.

5. OPTIONAL FUNCTIONS

Optional functions extend the functionality of the base LEX2000 encoder / multiplexer system in order to meet the needs of specific applications. Optional functions may be purchased as factory options when ordering new LEX2000 units or purchased as field upgrades at a later date, as user needs evolve. Optional functions are activated by loading a license file into the LEX2000 unit. New options may also require installation of updated firmware in the LEX2000 unit.

The optional function content of each LEX2000 is indicated by fields appended to the Model SKU number of the LEX2000 unit. A complete list of available options and their status for the LEX2000 unit is shown in the License Status table on the SYSTEM - UPDATE web page of the unit. Table 37 identifies the functional options available, the earliest version of firmware required to support each option, and the section of this user manual that contains detailed information on the configuration and use of each option.

Table 37: LEX2000 Optional Functions

LEX2000 Option	Description	Initial Firmware Version	User Manual Section
GN	Program Guide Ingest	4.0	4.5.4
67	Closed Captions 608 - to - 708 Converter	4.6	4.6.2
TG	Streaming IP Output Gigabit Ethernet with SMPTE-2022 Forward Error Correction (FEC)	4.6	4.9
RX	ASI Re-Multiplexer	6.0	4.10
XP	Extended PID Range	6.5	4.4.5

6. <u>TECHNICAL SPECIFICATIONS</u>

Table 38: Electrical Specifications

Parameter	Min	Typ	Max	Units	Notes
HD-SDI (SMPTE-292M) Inputs					
Voltage	0.72	0.80	0.88	V_{P-P}	
Impedance		75		Ω	
SD-SDI (SMPTE-259M) Inputs					
Voltage	0.72	0.80	0.88	V_{P-P}	
Impedance		75		Ω	
NTSC Inputs					
Voltage		1.0		V_{P-P}	
Impedance		75		Ω	
Analog Audio Input – Balanced Pro Audio					
Voltage		3.44		V_{P-P}	
Impedance		600		Ω	
AES Digital Audio Input					
Voltage	1.0	1.5	3.3	V_{P-P}	
Impedance		75		Ω	
ASI / SMPTE-310 Output					
Voltage	0.72	0.80	0.88	V_{P-P}	
Impedance		75		Ω	
ASI / SMPTE-310 Input					
Voltage	0.72	0.80	0.88	V_{P-P}	
Impedance		75		Ω	

<u>NOTES:</u>

Table 39: Electrical Specifications (Continued)

Parameter	Min	Typ	Max	Units	Notes
Contact Closure RELAY_A, RELAY_B					
Voltage	5		30	VDC	
Current	10		1000	mA	
Contact Closure SENSE_IN					
Voltage	0		0.5	VDC	1
Current (opto-isolator activation)	6		15	mA	2
Contact Closure VOUT_5V					
Voltage	4.75	5.0	5.25	VDC	
Current	400	510	610	mA	
Contact Closure VOUT_12V					
Voltage	11.2	12.0	12.8	VDC	
Current	400	510	610	mA	

NOTES:

4. SENSE_IN inputs are intended to be connected to SIGNAL_GND through a switch or dry relay contacts. See paragraph for more details.

5. The external device connected to a SENSE_IN input must be capable of sinking the amount of current shown in order to activate the input.

Table 40: Mechanical & Environmental Specifications

Parameter	Min	Typ	Max	Units	Notes
Power Source Current (110VAC supply)			1.0	A	
Power Source Current (230VAC supply)			0.5	A	
Power Source Frequency	47		63	Hz	
Power Consumption		50	90	W	
Storage Temperature	-40 -40		70 158	C °F	
Operating Ambient Temperature	0 32		50 122	C °F	
Internal Temperature Shut-Down Limit			65 149	C °F	
Operating Humidity (non-condensing)			95%		
Cooling Mechanism	Integrated fans, air flows front to rear				
Electromagnetic Emissions Compliance	FCC part 15, Class A				
Safety Compliance	UL 60950				
Dimensions (Enclosure Only)	2RU – 19 W x 3.5 H x 18 D inches				
Weight	10 lb				
Shipping weight with packaging	17 lb				

NOTES:

7. CUSTOMER SERVICE

For technical assistance with installation, configuration or trouble-shooting an LEX2000 unit, please contact us at one of the following:

Table 41: LEX2000 Customer Service Contacts

Contact Purpose	Contact Information
Technical Support	847-428-5793
Purchase Upgrades	847-428-5793
Shipping address	Linear Industries, Inc. 2531 Technology Drive, Suite 310 Elgin, IL 60124

User Manual, LEX2000 Series ATSC Encoder / Multiplexer

Hitachi Kokusai Linear, USA, 2531 Technology Dr., Suite 310 Elgin, IL 60124 1.847.428.5793

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