



Model LA-5448

AC-3 Frame Synchronizer and Rate Shaper User's Guide





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Chapter 1: Introduction

The Linear Acoustic LA-5448 AC-3 Frame Synchronizer and Rate Shaper accepts three independent AC-3 streams and synchronizes them to a reference signal applied to the fourth input. This fourth input will accept 48kHz AES signals containing PCM or AC-3. If an AC-3 signal is applied, it will also be processed as a fourth program, but as it is also reference, it must be a stable 48kHz source (AC-3 data rate does not matter).

The Linear Acoustic LA-5448 has the following features:

- High density frame synchronization of AC-3 bitstreams
- Silent frame mode replaces errored or missing AC-3 frames with known good versions
- Rate shape mode allows output data rate to be fixed at 448 kbps while the input data rate can vary between 96 kbps and 448 kbps
- Features combine to allow artifact free, stable switching of pre-encoded content (i.e. commercial insertion) while maintaining critical AC-3 parameters
- Dual, redundant power supplies and hard-bypass for mission critical applications.

1.1 Principles of Operation

Figure 1-1 shows the internal audio path of the LA-5448.

It should be noted that this diagram is a general representation of signal flow. Please consult the appropriate section of this manual for specific functionality.

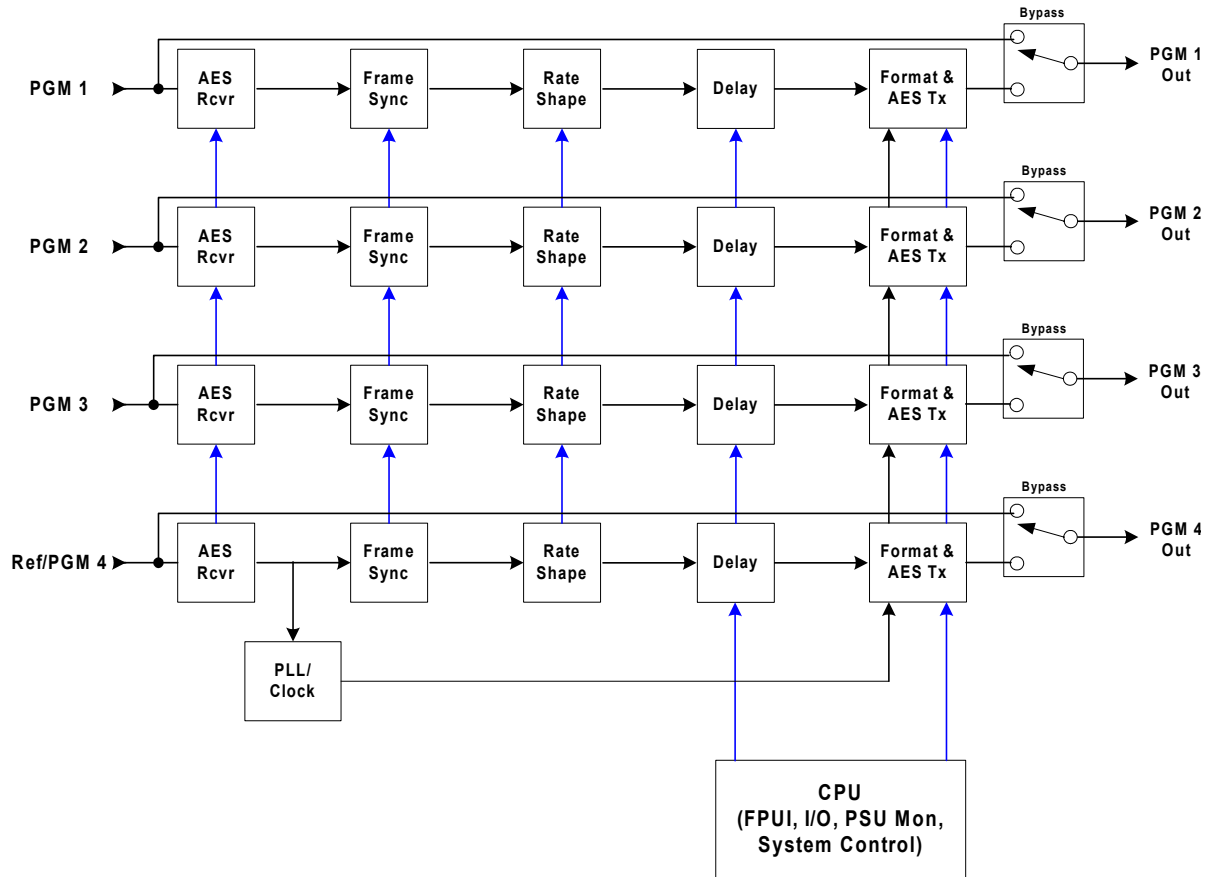


Figure 1-1 LA-5448 Frame Synchronizer/Rate Shaper Block Diagram

1.2 Location of LA-5448

The Linear Acoustic LA-5448 Demultiplexer/Splicer is best located near network satellite receivers or just prior to a multiplexer. In some cases, it may be located near AC-3 encoders such as a Dolby DP-569. As it will likely be in a transmission environment, dual redundant power supplies and hard relay bypass are provided for trouble free operation.

1.3 Future Updates

Software updates may become available in the future to add additional features and performance. Updates will utilize the serial port to accomplish the installation of upgraded software, and a loader application will be provided for this purpose.

1.4 Warranty and Feedback

Please take a moment to fill out the warranty card included with the unit and drop it in the mail. This will enable us to contact you if there are any software or documentation issues. Also, we are very interested in your feedback. This unit was designed based on feedback gathered from many broadcast engineers and it will evolve further thanks to ongoing suggestions and comments from users such as you.

We look forward to hearing from you!

Chapter 2: Connections

This chapter covers all required connections for the LA-5448.

2.1 Unpacking and Inspection

Before unpacking the unit, inspect the outer carton for shipping damage. If the carton shows damage, inspect the unit in those areas. Please save the carefully designed shipping carton and packing materials. In the unlikely event that the unit needs to be returned to the factory, alternate cartons or packing materials may not be adequate and can cause damage not covered by warranty.

The following essential items are provided with the unit:

- Two power cords (style to match shipping location).
- Small bag with replacement fuses and a handy permanent marker.
- This manual.
- Warranty information: Please fill out and return the warranty card to Linear Acoustic to ensure your software and documentation are kept up to date.

2.2 Installation

StreamStacker LA-5448 installation requires:

- One standard rack space units with ADEQUATE VENTILATION (the unit uses convection cooling via vents on the left and right sides of the unit);
- standard 75 Ω BNC cables for digital signal connections;

To connect to digital equipment with 110 Ω XLR connectors, we strongly recommend the use of impedance-matching transformers (baluns) which are available from Canare, Neutrik and other manufacturers. We know it is tempting to use shortcuts, and they will sometimes work just fine, however failure of such approaches are usually random and always seem to happen during the most expensive programming. We encourage the use of the inexpensive and widely available baluns, especially in a transmission environment.

2.3 Rear Panel

The rear panel of the Linear Acoustic LA-5448 contains all signal and power I/O.

WARNING: Replace fuses only with the same type and rating

2.3.1 Connection Ports

All of the LA-5448's connections are on the rear panel and are described in detail below. See Chapter 5: Specifications for specific pinouts.

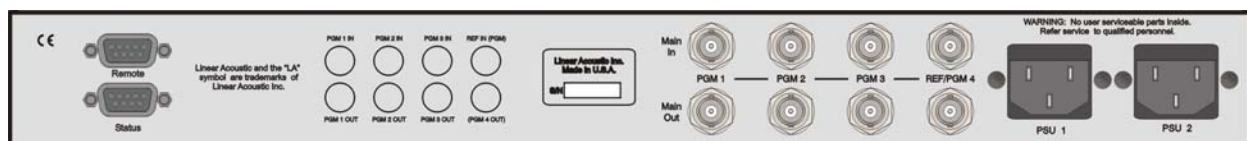


Figure 2-1 Rear Panel

- **Remote:** This RS232/485/422 port is used for software upgrades as well as serial remote control of the unit.
- **Status:** This is the GPI/O connection for parallel control of the unit. There are four GP Inputs and four GP Outputs whose function, polarity, and type (i.e. held or momentary) are adjustable via the front panel user interface. FUTURE
- **Main Inputs (PGM 1-PGM 3):** Connect the AC-3 signals that are to be processed to these connectors. During power on and in the unlikely event of failure, these inputs will be hard relay bypassed to the corresponding output connectors located below each of them.
- **REF/PGM 4:** Apply 48 kHz AES reference, either PCM or AC-3.

WARNING: A reference AC-3 signal MUST be connected to REF/PGM 4 at all times for proper operation. Plain AES reference can also be used.

- **Main Out Pgm 1-4:** Main AC-3 (Dolby Digital) programs one through four. During boot up or in the event of failure, the Main Input connector directly above each output will be hard relay bypassed to it.

NOTE: Front panel LEDs indicate input signal condition: Off = No Signal present, Orange = AES sync detected but no AC-3, Green = OK.

2.4 Quick Setup Notes

The LA-5448 requires only minimal setup to be up and running.

- Apply power to BOTH IEC AC power inlet modules.
- Note that once booted (~ 5 seconds), the front panel will display “No Reference” if no connections have been made to the rear panel.
- Connect a locally referenced 48kHz AC-3 signal (data rate or other parameters do not matter) or an AES reference to the REF/PGM4 input
- Verify that the front panel indicator shows either a Green (AC-3) or Amber (AES) signal has been detected on Input 4.
- Connect one or more AC-3 signals to be processed to the remaining PGM 1-PGM 3 connectors
- Frame synchronized, rate shaped (to 448kbps) versions of these programs will be produced at the corresponding Main Out Pgm 1-PGM 3 connectors.

Chapter 3: Applications

The LA-5448 is intended to be used in an emission (transmission) environment. This chapter shows several applications of the system as it is intended to be used. Of course other applications are possible:

- Frame synchronizer for multiple AC-3 streams, no rate shaping
- Frame synchronizer plus rate shaping for multiple AC-3 streams

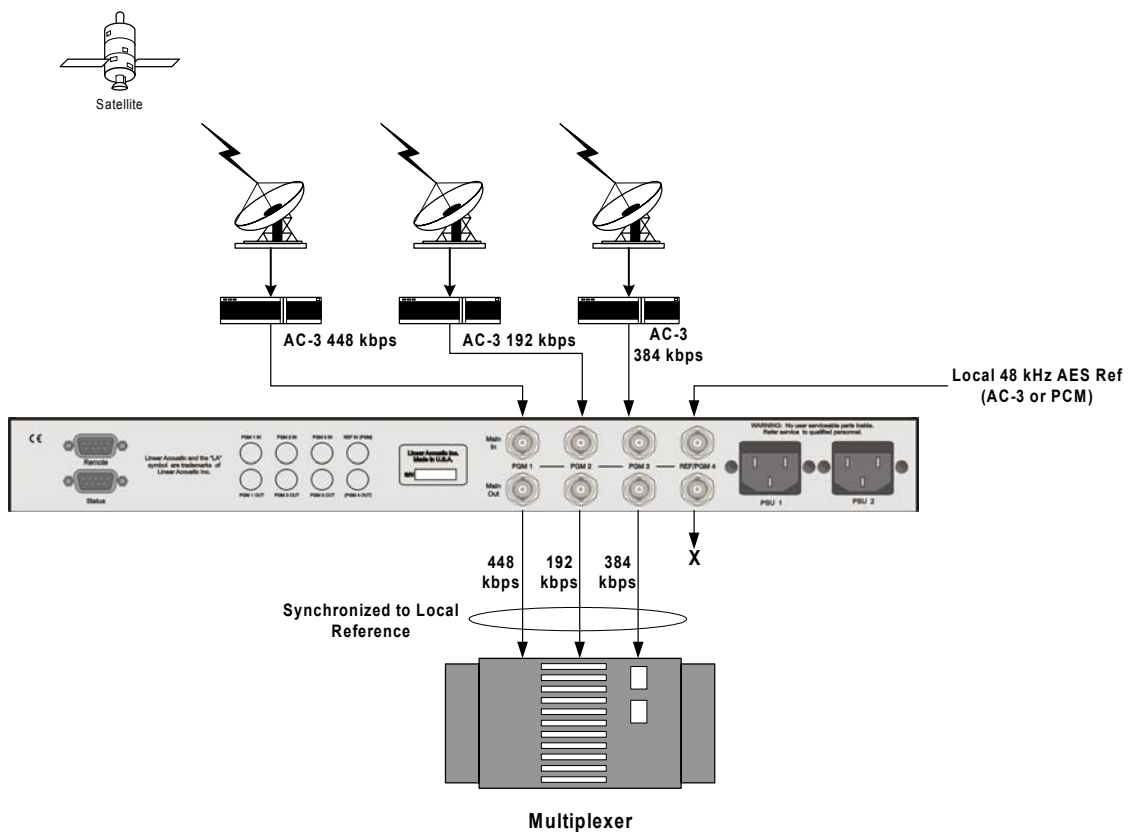


Figure 3-1 LA-5448 processing three individual AC-3 streams, rate shaping disabled

Figure 3-1 above shows three sources being frame synchronized to a local plant reference signal. Data rates at the output are unchanged, but errors can be mitigated by enabling Silent Frame mode.

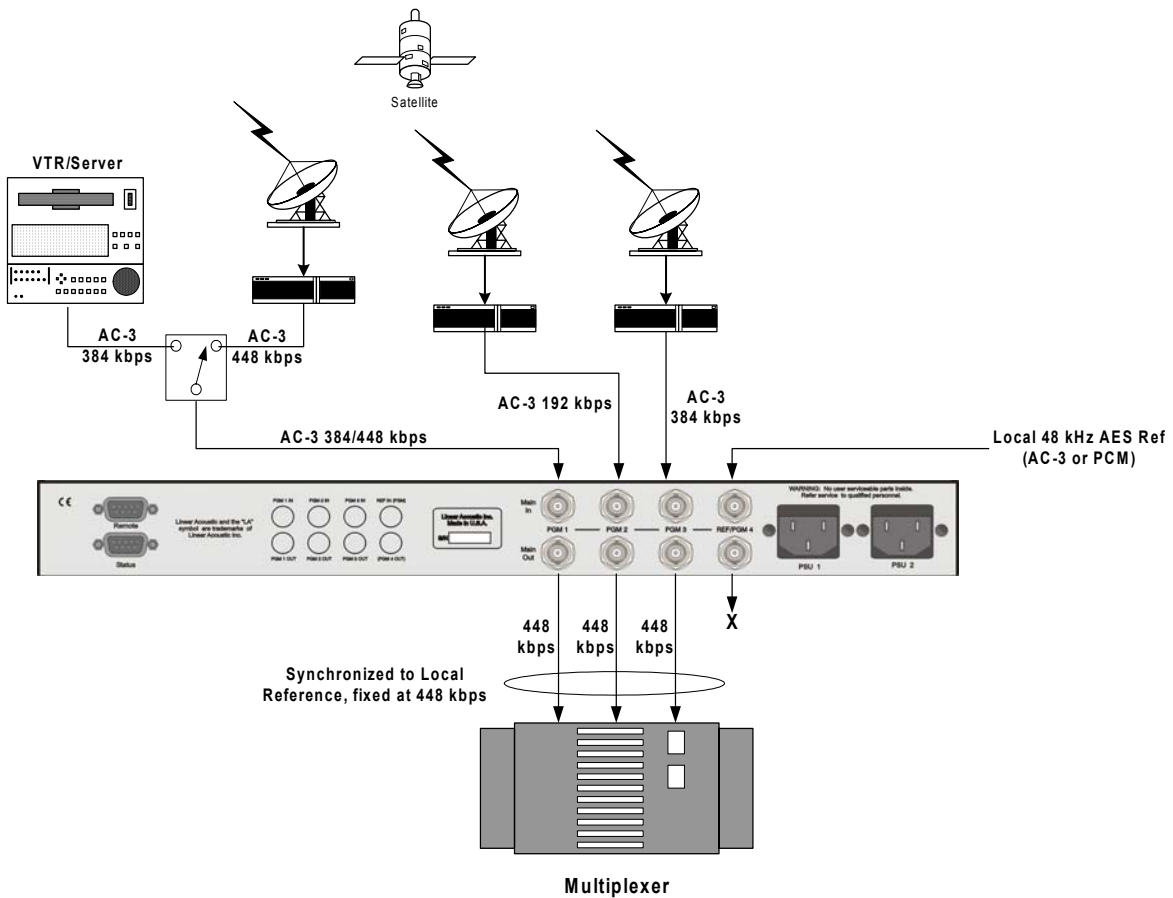


Figure 3-2 LA-5448 processing three separate streams, rate shaping enabled.

Figure 3.2 shows multiple AC-3 sources being frame synchronized to a local plant reference as well as being rate shaped to a constant 448 kbps output data rate. Also shown is a “crash switch” between two AC-3 sources that will be cleaned up and kept at a constant data rate by the LA-5448. This is useful for commercial insertion applications.

3.1 AC-3 (Dolby Digital) Notes

The maximum data rate that is supported by the LA-5448 is 448 kbps. Rates higher than this will be displayed as an error condition. When stream shaping is turned on, no changes are made to AC-3 content. All metadata and audio parameters are passed exactly as originally encoded with the exception that the data rate will now be fixed at 448 kbps.

Several additional parameters and configurations are described below.

3.1.1 Output Mode

Typical external AC-3 encoders (i.e. Dolby DP569) or other AC-3 sources may have several selections for output mode, which simply determines where inside an AES pair the relatively tiny AC-3 data packets are carried. It does not matter which selection is chosen as long as the LA-5448 and the encoder match. The default for the LA-5448 is Pro-32, the default for most known professional equipment that generates or passes AC-3. The result of mis-setting this is that the output audio will mute.

3.1.2 Multiplexer Timing Issues

Tandberg encoders supply an AES reference signal that may be in the form of a fifth wire with a BNC connector attached (later models), or it may be an XLR connector, possibly of the opposite sex (i.e. an XLR Female) requiring an AES balun. There also may be a menu setting to enable this reference output (automatically enabled in later models). This reference **MUST** be used to drive the local AC-3 encoder's reference input. It is **NOT** necessarily the same as plant reference as it is derived from the encoder's internal 27MHz clock. Save some headaches and lost sleep, and use this provided connection!

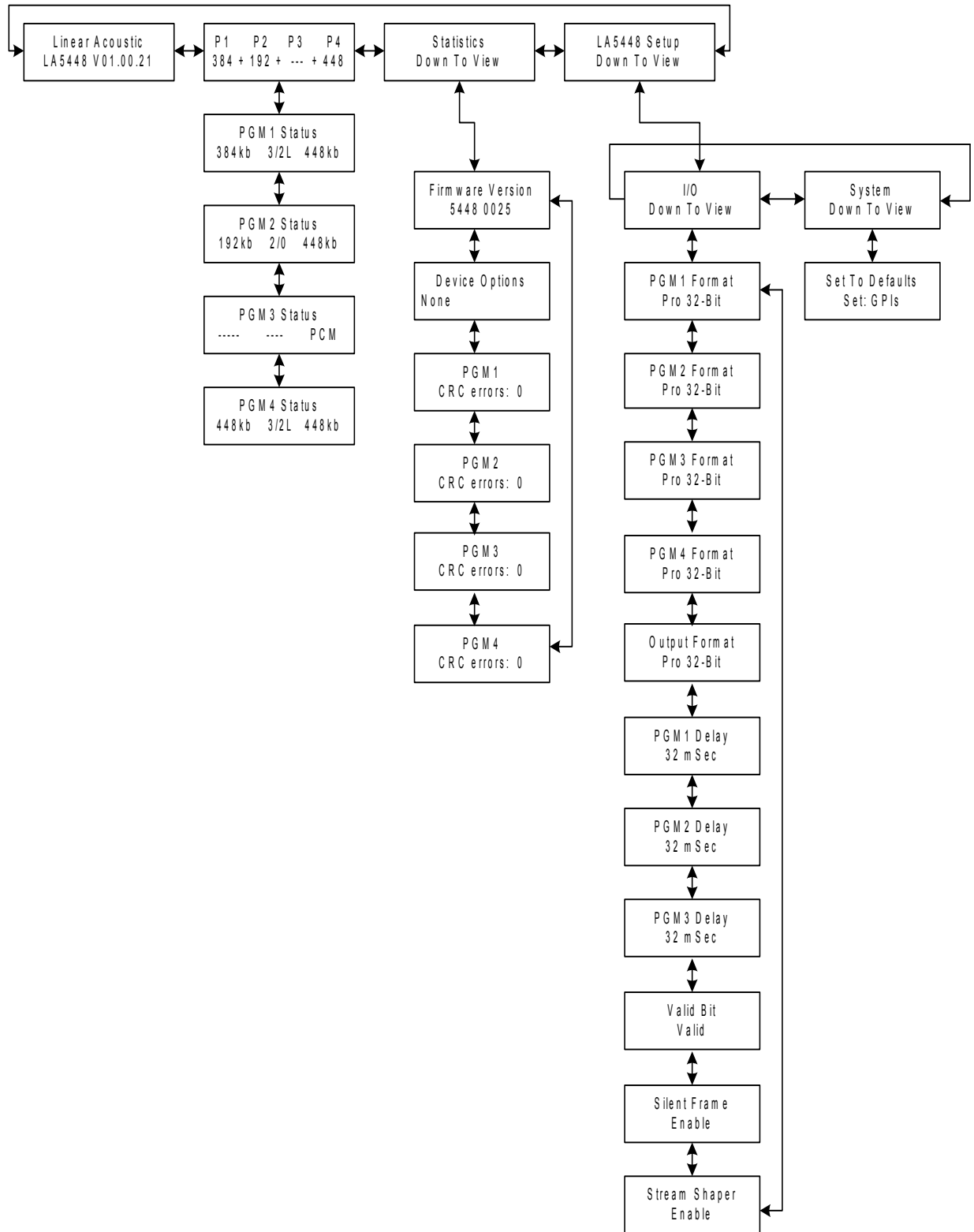
NOTE: *Tandberg encoders provide an external reference output which **MUST** be used to lock the local AC-3 encoder.*

Chapter 4: Menus

This chapter discusses how to use the front panel LED interface to access the menus. Most of it is rather obvious, and a bit of experimentation will quickly make you comfortable navigating through the submenus. The menus and submenus are structured to access more complex functionality as you go deeper into the hierarchy.

The following two pages show the menu structure for the LA5124. All up/down access is by the up/down front panel buttons, all left/right access is by the left/right (Prev/Next) front panel buttons, and parameter changes (where applicable) are by the use of the rotary encoder knob. When a parameter is changed, an asterisk (*) will be displayed next to the parameter denoting that it has changed and that in order for this change to be stored, the right (Next) front panel button must be pressed. To continue without storing the change, press the left (Prev) front panel button.

Like all of our products, when in doubt you can simply use the Left Arrow (Prev) to back out towards the Main menu level.



4.1 Main Menu Level

Referring to the menu tree on the preceding page, it can be seen that the Main Menu level can be scrolled through using either the left or right arrows. The choices are: Version, Status, Statistics, and Setup, each of which have sub menus (except the version screen). The submenus can be accessed by pressing the down arrow. Note that both the Status and Statistics screens are informational and have no adjustments.

4.1.1 Status Menu

Upon booting, the Version screen is briefly displayed then switched to the Status Menu. The Status Menu shows the data rate for the AC-3 signals applied to each of the four Main Inputs, and displays dashes (---) for programs that are not present.

Pressing the Down arrow will step through each of the four main input programs, showing the input data rate, followed by the audio coding mode (acmod) metadata parameter, followed by the output data rate. If Stream Shaping is disabled, the input and output data rates will match. If Stream Shaping is enabled, the output data rate will be fixed at 448 kbps.

4.1.2 Statistics Menu

The **Statistics** menu provides more detailed information about the health of each of the input signals applied to the LA-5448. The main status LEDs on the front panel give the first indication of trouble when illuminated red, while further details about the error condition can be found under this menu. Currently, the CRC of the AES carrier is counted and displayed and future revisions will expand this to show details of the AC-3 CRCs contained within each AES input.

As a general rule of thumb, the AES CRC indicates interface issues stemming from the corruption of the physical AES interface. These types of errors are most likely due to problems such as clocking, termination, or asynchronous switching. The AC-3 CRC is useful for determining upstream issues where the physical interface may be valid but clicking or popping might be heard after decode as the AC-3 packets are being damaged. The cause of an inner-interface issue such as this can stem from many things, but one likely suspect is a satellite receiver that is losing lock due to rainfade or other RF issues- the AES carrier may still be present as it is generated locally, but its AC-3 payload could be damaged or missing.

4.1.3 Setup Menu

This menu contains settings for the main digital audio I/O as well as a method to restore factory defaults. To adjust a particular parameter, simply rotate the rotary encoder knob until the desired value is displayed. An asterisk (*) is also displayed noting that the change will be made and stored to memory when the Right (Next) front panel button is pressed.

I/O Menu

The AES input formats of the LA5124 can be set to Professional 32-Bit, Consumer (also 32-bit with the Pro/Consumer mode bit set to Consumer), 16-Bit Channel 1, and 16-Bit channel 2. These can be independently adjusted on an input-by-input basis, and defaults to Pro 32-Bit. Note that most all gear is set to 32-bit mode, and only in rare cases does the pro/consumer bit matter.

The format of all of the outputs can be varied between Pro 32-Bit and Consumer. This is a single setting for all outputs and defaults to Pro 32-Bit. We have found that the Aastra/Harris Flexicoder requires this setting to be Consumer, but that is the only case of which we are aware.

Delays can be independently set for each of the inputs, and are adjustable in 32 msec (single AC-3 frame) increments up to about four seconds.

The AES output validity bit can also be set, and is defaulted to “Invalid” to indicate that the signals present in the AES stream are not suitable for direct conversion back to analog. As the interpretation of this bit varies by manufacturer, we have made it adjustable to match any situation.

Silent frame mode is enabled by default and has the function of keeping a continuous AC-3 stream flowing from each output of the LA-5448 in case of input error or loss. If a corrupt AC-3 frame is detected, the last good frame is repeated, then silent frames equal to the data rate and channel mode (acmod) of this last good frame are output until valid error free AC-3 frames return. Note that if Silent Frame mode is required and automatically enabled for Stream Shaping functionality.

Stream Shape mode is enabled by default and has the function of keeping the output data rate fixed at 448 kbps regardless of the input data rate. No audio or metadata is affected by this. When combined with frame synchronization and silent frame, it allows AC-3 streams of the same or different rates to be switched upstream via an AES router or other synchronous or asynchronous switch and a single-rate error-free will be output synchronized to plant reference.

System Menu

Under this menu, the LA5124 can have all of its parameters reset to factory defaults.

Chapter 5: Troubleshooting

The Linear Acoustic LA-5448 is a very stable and reliable unit, and most problems can be traced back either to mis-wiring causing incorrect signals to be applied to the unit or more than likely to mis-configuration. In an effort to speed troubleshooting, some common problems and their solutions are described below.

5.1 Problems and Possible Causes

Most problems can be traced back to the input signals applied to the LA-5448. Experience has shown many early high definition satellite IRDs used for the reception of network signals to be rather unreliable when presented with changing transport streams. The input status menus on the LA-5448 are very useful for tracking down data rate and audio coding mode discontinuities, as well as for monitoring CRC errors.

5.1.1 Status Lights are Green, but Display Shows Random Data

To recap, the LEDs have three states: Off = no signal applied, Red= AES carrier detected but AC-3 is not detected, Green = AES signal is present, correct data type marked. So how is it that with all green LEDs that data can still be wrong? There are multiple places where the contents of a typical AES signal are tagged with their identities. One is in the AES header itself (unreliable), one is before the actual data (called the IEC header), and one is in the data itself, in this case inside the AC-3 packets. Think of the LEDs detecting the first two: AES presence, and IEC header present, while the display shows the last: AC-3 present.

Once common cause of this is directly attributable to satellite IRDs which will output a blank AES stream with an IEC header that signifies AC-3, but with either a random or blank audio payload (i.e. no AC-3 data is actually present). This can be caused by the receiver being set to an invalid or missing PID, or by the PID disappearing.

5.1.2 Program 4/REF Input LED is Amber

The reference signal applied is PCM and not AC-3. This is a perfectly acceptable condition, and Amber is simply used to indicate that the input is valid, but is not AC-3 in nature. The LA-5448 locks to the frequency of the reference input, and the payload is ignored. However, if the reference input is fed with an AC-3 signal, in addition to it providing the frequency reference for the unit, the signal will also be frame synchronized, have silent frames inserted if necessary, and be rate shaped if desired.

5.1.3 Unit Produces 448 kbps Output, but it is Silent

Stream Shaper is enabled (and by requirement, so is silent frame), and the input for the channel in question is either missing, or errored.

Chapter 6: Specifications

Table 6-1 Electrical Specifications

Sampling Rate	48 kHz ($\pm 0.1\%$)
Output Delay	1.5 AC-3 frames, ± 0.5 frames (48 msec, ± 16 msec) minimum, can be increased in 32 msec steps to provide up to 4 seconds of delay to match external equipment.
Programs	Up to four separate AC-3 programs
Audio Resolution	AC-3 Codec dependent, LA-5448 is transparent
Main Input Program 1-3	75-Ohm BNC female connectors, per AES-3ID-1995/SMPTE 276M, internally terminated
Program 4/Ref Input	48 kHz AES input, PCM or AC-3, can be used as a fourth processing channel. 75-Ohm BNC female connector, per AES-3ID-1995/SMPTE 276M, internally terminated.
Main Outputs (Pgm 1-4)	Four 75-Ohm BNC female connectors per AES-3ID-1995/SMPTE 276M, with relay bypass from corresponding inputs
Processing	AC-3 frame synchronization, selectable silent frame insertion upon input error or loss, selectable rate shaping: any input rate up to 448 kbps will be output at a fixed 448 kbps
Remote (RS-232/485/422)	9-pin female D-connector
Status (GPIO) Port	TTL level, 9-pin female D-connector
Ethernet Port	RJ-45 female jack connector, 10/100 BASE-T
Boot Time	Less than 5 seconds

Table 6-2

Table 6-3 Mechanical Specifications

Dimensions	1.75 × 19 × 24 in (4.45 × 48.3 × 61 cm)
Net Weight	6 lb (12.6 kg) approx.
Shipping Weight	8 lb (15.75 kg) approx.
Power Requirements	115/220 VAC, auto ranging, 50–60 Hz, 2 supplies for redundancy
Power Consumption	35 W total maximum

Table 6-4 Environmental Specifications

Operating Temperature	0°C to 50°C, convection cooled
Non Operating Temperature (Storage)	-20°C to +70°C
Humidity	Up to 98% relative humidity, non-condensing
EMC Radiation Limits	FCC Part 15 Class A, ICES-003

RS485/422/232 Port

9-pin female D-connector with full-duplex RS-485 protocol running up to 115 kbps. Pinout is compatible with SMPTE 207M.

Table 6-5 RS-485/422/232 Input Port Pinout

Pin	Connection
1	Shield
2	TX A asynchronous data out -
3	RX B asynchronous data in +
4	Ground
5	NC
6	Ground
7	TX B asynchronous data out +
8	RX A asynchronous data in -
9	Shield

Status (GPI/O) Port

9-pin female D-connector, TTL compatible levels.

Table 6-6 Status (GPI/O) Port Pinout

Pin	Connection
1	GP Input 1
2	GP Input 2
3	GP Input 3
4	GP Input 4
5	Ground
6	GP Output 1
7	GP Output 2
8	GP Output 3
9	GP Output 4

Ethernet Port

The Ethernet port is a standard RJ-45 female connector that supports 10 or 100BASE-T. This connector is currently not active, but will be enabled in a future software release.