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Issue	Date	Changes
1.0	1/06/2000	Initial Draft Issue
1.1	13/10/2000	Corrections & s/w changes

1. INTRODUCTION

The LSC24 is combined two-channel analogue to digital converter (ADC), digital to analogue converter (DAC) and digital sample rate converter (SRC) intended for use in studio applications.

Section 2.2 of this manual details the function of the front panel controls and indicators whilst Section 3 summarises the four modes of operation of the LSC24 :-

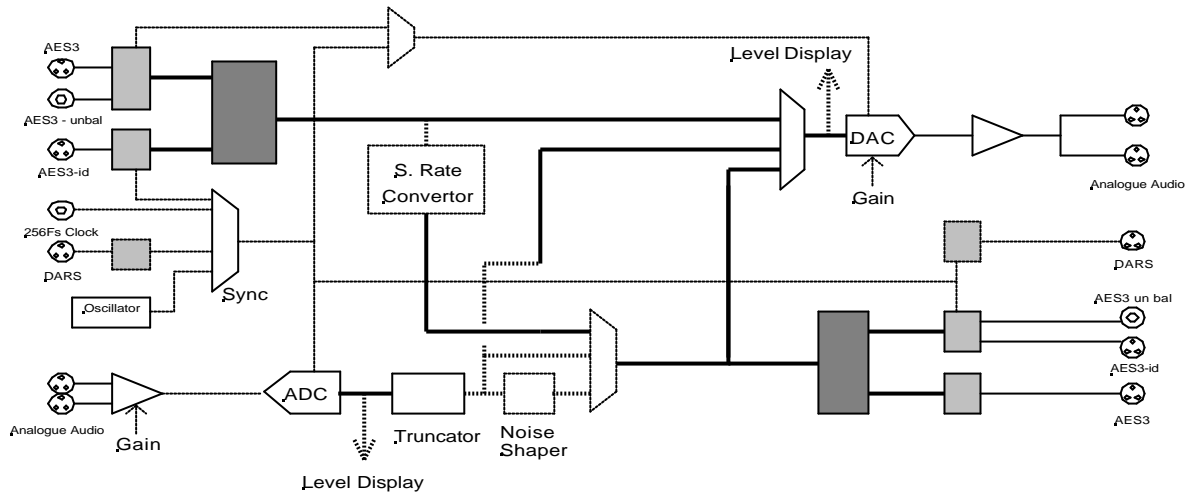
- Convert mode :- Digital to Digital Conversion for sample rate / word length conversion.
- Record mode :- Analogue to Digital Conversion with analogue output for the monitoring of the digital output.
- ADDA mode :- Independent Analogue to Digital and Digital to Analogue conversion.
- HQDA mode :- High Quality Digital to Analogue Conversion.

It is recommended that Section 2.2 is read first to obtain a full description of each control and their use.

This manual does not cover the operation of the LSC24 via the remote interface.

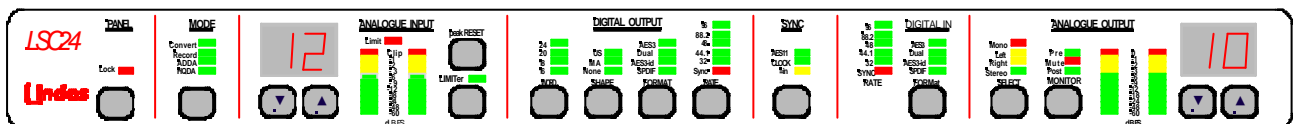
2. General Description

2.1 System Block Diagram



The above block diagram illustrates the major function blocks within the LSC24 and the interconnections between these blocks. The dotted lines represent the clocks, the fine lines the analogue signal flow and the thicker lines the digital signal paths.

2.2 Front Panel Controls and Display



All user interface is via front panel buttons and the current system operating configuration will be presented to the operator via the front panel LEDs. Dependant upon the mode of operation of the LSC24 some buttons and LEDs will not function. This is to prevent non valid configuration of the unit.

The unit will automatically power up in the same condition as last used. On power up the LSC24 will recall and configure the stored operating parameters and allow the converters to reach the correct operating temperature. During this time the firmware revision number is displayed on the two coding level displays.

The configuration for each of the four modes is also stored in Non Volatile memory (NVR) to simplify the setting up of the LSC24; these are all automatically recalled when changing between modes.

Please refer to Section 3 for the summary of operation for each of the four operating modes.

Each front panel group (ANALOGUE INPUT, SYNC etc.) is given a sub-section and then each control is detailed within the sub-section.

2.2.1 PANEL

LOCK

This toggles the panel LOCK function. When on, indicated by the red LED, all other panel controls are locked preventing accidental operation and changes to the LSC24.

2.2.2 MODE

Scrolls through the operating modes of the unit; CONVERT, RECORD, ADDA and HQDA.

2.2.3 ANALOGUE INPUT

LEVEL UP / DOWN

Sets the coding level of the analogue to digital conversion. Adjustable from +8dBu \equiv 0dB FS to +26dBu \equiv 0dB FS in 1dB steps. Either single key presses for 1dB steps or press and hold to quickly ramp through the levels.

LIMITER

This toggles the analogue input 'soft' LIMITER. When on, indicated by the green LED, the limiter circuitry will prevent the ADC from clipping when an large input signal is applied. This 'soft' limiter will begin to operate at – 3dB FS and the red LIMIT LED indicates that the limiter is in operation.

PEAK RESET

The peak input level display is automatically held until the PEAK RESET button is pressed. This will appear as a static LED with the LEDs below changing with the incoming signal.

2.2.4 DIGITAL OUTPUT

WORD

Selects the required digital output word lengths. 24,20,18 and 16 bit.

SHAPE

Selects the noise shaping filter when truncation of the digital audio is selected; 20,18 or 16 bit word length.

The options are :-

- NONE - no noise shaping – Triangular p.d.f. dither only
- MA - **Minimally Audible** shaping

US - UltraSonic shaping

The US shaper is only selectable with the 88.2kHz and 96kHz sample rates.

FORMAT

Selects the digital audio output format from the LSC24 unit. This applies to the two rear panel 3pin XLR connectors (A & B) and BNC output.

	Rear Panel Connector		
FORMAT	XLR 'A'	XLR 'B'	BNC
AES3	AES3	AES3	No Output
DUAL	½ rate AES3 – Right	½ rate AES3 – Left	No Output
AES3-id (Professional)	No Output	AES3	AES3-id
SPDIF (Consumer)	No Output	AES3	SPDIF

RATE

Selects the required output sample rate for the digital audio outputs. The 32kHz – 96kHz sample rates are derived from the internal crystal oscillator.

If SYNC is selected the adjacent SYNC control (see 2.2.5) is used to selected the source from one of the three external DARS inputs. The digital outputs are then locked to one of these external inputs.

2.2.5 SYNC

An external synchronisation signal can be selected from either the DARS (Digital Audio Reference Signal)/ AES11 input XLR, external CLOCK (256*FS) input, or the incoming audio data, =IN.

In HQDA mode this SYNC panel is used to select the sync source for the digital to analogue converters (DACs) [DARS/AES11 and =IN only]

2.2.6 DIGITAL IN

FORMAT

Selects the digital audio input format to the LSC24 unit. This applies to the two rear panel 3pin XLR connectors (A & B) and BNC input.

	Rear Panel Connector		
FORMAT	XLR 'A'	XLR 'B'	BNC
AES3	AES3	-	-
DUAL	½ rate AES3 – Right	½ rate AES3 – Left	-
AES3-id	-	-	AES3-id
SPDIF	-	-	SPDIF

RATE - display only, no control.

Shows the incoming sample rate of the selected source as defined by FORMAT. A flashing SYNC LED indicates no valid digital audio is connected or selected.

2.2.7 ANALOGUE OUT

SELECT

Used to configure the analogue outputs of the LSC24.

- STEREO - normal operation
- RIGHT- right channel only, left muted
- LEFT - left channel only, right muted
- MONO - left & right combined from both channels

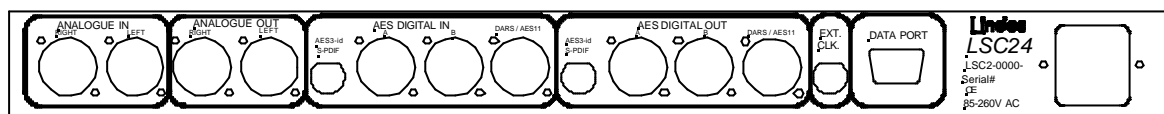
MONITOR

Selects the internal source for the input to the Digital to Analogue converter (DAC). This can be either PRE or POST the noise shaper (RECORD mode only). A MUTE function for all modes operating on both channels is also provided using this control.

OUTPUT LEVEL

Sets the analogue output level of the digital to analogue conversion. Adjustable from 0dBFS \equiv -9dBu to 0dB FS \equiv +26dBu in 1dB steps. Either single key presses for 1dB steps or press and hold to quickly ramp through the levels.

2.3 Rear Panel



The following sub sections detail each rear panel connector of the LSC24.

2.3.1 ANALOGUE IN

Two off (left and right channels) 3pin Female XLR connectors providing analogue inputs to the ADC.

10k Ω input impedance.

Maximum level +26dBu for 0dBFS (with limiter Off).

Pin	Function
1	Chassis
2	Audio + (Hot)
3	Audio – (Cold)

2.3.2 ANALOGUE OUT

Two off (left and right channels) analogue output from the DAC.

3pin Male XLR connectors

50 Ω output impedance.

Maximum level +26dBu.

Pin	Function
1	Chassis
2	Audio + (Hot)
3	Audio – (Cold)

2.3.3 AES3 DIGITAL IN

AES3-id (un-balanced AES3) and SPDIF input

Un balanced coaxial BNC connector.

AES3 Inputs

3pin Female XLR connectors, 'A' and 'B'.

AES3 digital audio data

DIGITAL IN FORMAT	XLR 'A'	XLR 'B'
AES3	AES3	-
DUAL (x2 AES3)	½ rate AES3 – Right	½ rate AES3 – Left

Pin	Function
1	Chassis
2	Audio + (Hot)
3	Audio – (Cold)

AES11 / DARS Input

3pin Female XLR connector.
AES11 Synchronisation

Pin	Function
1	Chassis
2	Audio + (Hot)
3	Audio – (Cold)

2.3.4 AES Digital OUT

AES3-id / SPDIF Output

Un-balanced BNC coaxial connector.

AES3-id (AES3 un-balanced) – Professional
S-PDIF - Consumer

DIGITAL OUTPUT FORMAT	BNC
AES3-id	AES3-id
SPDIF	SPDIF

AES3 Outputs

3pin Male XLR connector.

AES3 digital audio data for normal and Dual formats.

DIGITAL OUTPUT FORMAT	XLR 'A'	XLR 'B'
AES3	AES3	AES3
DUAL (x2 AES3)	½ rate AES3 – Right	½ rate AES3 – Left
AES3-id	-	AES3
SPDIF	-	AES3

Pin	Function
1	Chassis
2	Audio + (Hot)
3	Audio – (Cold)

AES11 / DARS Output

3pin Male XLR connector.

AES11

Pin	Function
1	Chassis
2	Audio + (Hot)
3	Audio – (Cold)

2.3.5 Ext. Clk

BNC connector.

256 x FS External Clock input. Single ended TTL input.

Example:

A clock frequency of 12.288MHz gives a sample rate of 48kHz

2.3.6 Data Port

RS232 / RS422 (internally switched) interface port for external control and monitoring.

9 pin Female 'D' type connector - DCE

Pin	Function – RS232	Function – RS422
1		
2	Tx Data (Output)	TxA
3	Rx Data (Input)	RxA
4		
5	0v RS232	
6		TxB
7		RxB
8		
9		

2.3.7 Mains Input

IEC inlet connector

85 – 264V AC 47-440 Hz or 110 – 370V DC

30W max.

3. LSC24 Operation

Record Mode

In this mode of operation the LSC24 behaves as an ADC with the DAC providing an analogue output for monitoring of either the pre- or post- noise shaper signal.

The Digital Input section is only used if RATE is set to SYNC and SYNC is set to =IN.

ADDA Mode

In this mode of operation the LSC24 behaves as separate ADC and DAC units. The ADC is synchronised to the internal oscillator, AES11 / DARS input, 256FS clock input or the digital audio input ('=in' mode).

The DAC is synchronised to the digital audio input.

HQDA Mode

In this mode the analogue input and digital output sections are disabled.

The DAC is synchronised to an external input (AES11/DARS or digital audio input) as selected by the SYNC function.

Convert Mode

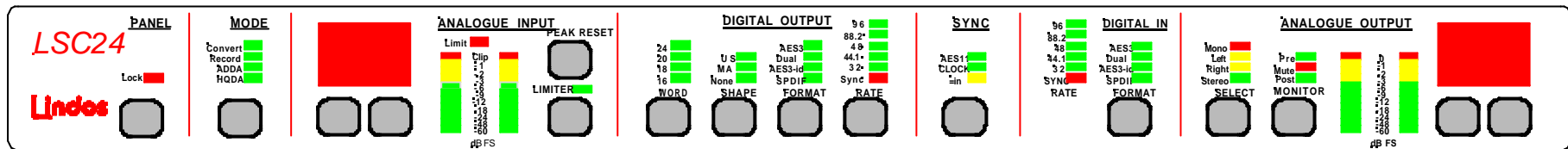
In this mode the ADC is disabled and the LSC24 behaves as a SRC with the DAC section used for monitoring.

This conversion is via the SRC unless '=in' SYNC mode is selected

3.1 Record Mode

In this mode of operation the LSC24 behaves as an ADC with the DAC providing an analogue output for monitoring of either the pre- or post- noise shaper signal.

The Digital Input section is only used if RATE is set to SYNC and SYNC is set to =IN or AES11



Coding Level
Up /Down controls.

Indicates the analogue input signal level for 0dB FS.

Peak Reset:
Used to reset last peak level

Limit:
Toggles 'soft' limiter, Green LED indicates on or off.

Limit LED:
Indicates when limiter is operating to prevent clipping of the ADC. Starts at -3dB.

Word:
Selects required output word length.

Shape:
Not valid for 24bit Word.
None: no shaping
MA: Minimally Audible
US: UltraSonic (only valid for 88.2 & 96KHz)

Format:
Selects output format and interface connectors.

Rate:
Selects required output sample rate or external sync.

Sync:
Only valid if Rate set to Sync.

Selects either AES11
CLOCK =IN (AES3) clock source.

Only valid if Sync set to =IN or AES11.

Rate
Incoming sample rate.
Format
Only valid if =IN.
Selects input format and interface connectors.

Select:
Configures output mode.

Monitor:
Selects input to DAC, either pre or post noise shaper. Also used to Mute both channels.

Level
Up /Down controls.

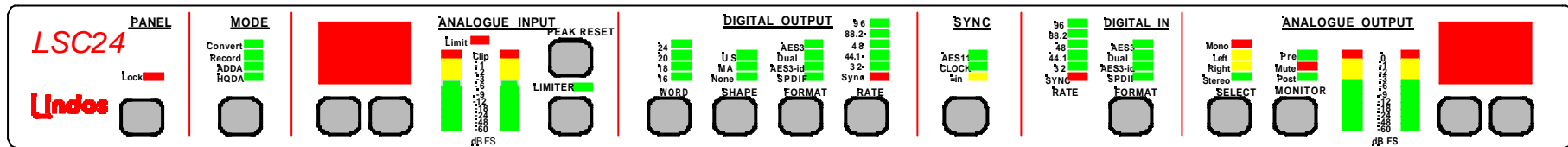
Indicates the analogue output signal level.

3.2 ADDA Mode

In this mode of operation the LSC24 behaves as separate ADC and DAC units.

The ADC is synchronised to the internal oscillator, AES11 / DARS input, 256FS clock input or the digital audio input (Sync '=in').

The DAC is synchronised to the digital audio input.



Coding Level
Up /Down controls.

Indicates the analogue input signal level for 0dB FS.

Peak Reset:
Used to reset last peak level

Limiter:
Toggles 'soft' limiter, Green LED indicates on or off.

Limit LED:
Indicates when limiter is operating to prevent clipping of the ADC. Starts at -3dB.

Word:
Selects required output word length.

Shape:
Not valid for 24bit Word.
None: no shaping
MA: Minimally Audible
US: UltraSonic (only valid for 88.2 & 96KHz)

Format:
Selects output format and interface connectors.

Rate:
Selects required output sample rate or external sync.

Sync:
Only valid if Rate set to Sync.

Selects either AES11 CLOCK =IN (AES3) clock source.

Rate:
Incoming sample rate.

Format:
Selects input format and interface connectors.

Select:
Configures output mode.

Monitor:
Selects either Mute or listen (Post) for both channels.

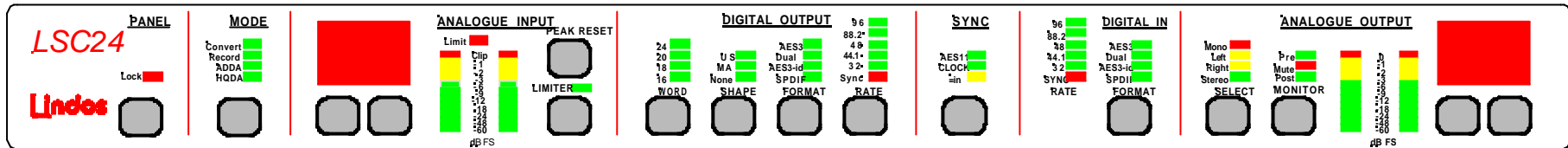
Level
Up /Down controls.

Indicates the analogue output signal level.

3.3 HQDA Mode

In this mode the analogue input and digital output sections are disabled.

The DAC is synchronised to an external input (AES11 or digital audio input) as selected by the SYNC function.



Sync:
Selects either AES11 or =IN (AES3) clock source.

Rate:
Incoming sample rate. Sync LED indicates SYNC mode.
Format
Selects input format and interface connectors.

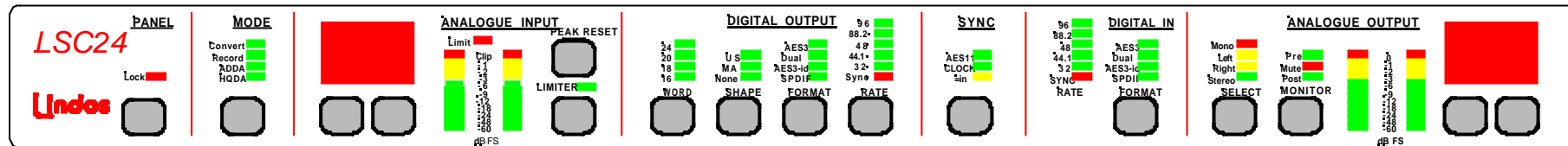
Select:
Configures output mode.
Monitor:
Selects either Mute or listen (Post) for both channels.

Level
Up /Down controls.
Level
Indicates the analogue output signal level.

3.4 Convert Mode

In this mode the ADC is disabled and the LSC24 acts as a SRC with the DAC section used for monitoring.

This conversion is via the SRC unless '=in' SYNC mode is selected



Word:

Selects required output word length. 16,20 or 24 bit. 18 bit is not valid.

Format:

Selects output format and interface connectors.

Rate:

Selects required output sample rate or external sync.

Sync:

Only valid if Rate set to Sync.

Select:

Selects input format and interface connectors.

Rate:

Incoming sample rate.

Format:

Selects input format and interface connectors.

Select:

Configures output mode.

Monitor:

Selects either Mute or listen (Pre) for both channels.

Level

Up /Down controls.

Indicates the analogue output signal level.

4. Technical Description

4.1 Specification

Analogue-Digital Section

Resolution	24 bits
Sample rates supported	Internal 32kHz, 44.1kHz, 48kHz, 88.2kHz, 96kHz External DARS (32kHz – 96kHz), Digital Audio Input, 256Fs clock
Word Length	24, 20, 18 & 16bits
Sample rate frequency accuracy	50ppm
Noise and distortion	At +18dBu=0dB FS coding level, Noise, RMS unweighted, 22-22kHz bandwidth Noise: < -108dB FS THD+N: < -102dB FS at -1dB below peak coding
Max. Analogue Input Level	+26dBu (with limiter off)

Digital-Analogue Section

Resolution	24 bits
Sample rates supported	Internal 32kHz, 44.1kHz, 48kHz, 88.2kHz, 96kHz External DARS (32kHz – 96kHz), Digital Audio Input, 256Fs clock
Noise and distortion	At +18dBu=0dB FS coding level, Noise, RMS unweighted, 22-22kHz bandwidth Noise: < -110dB FS THD+N: < -100dB FS
Max. Analogue Output Level	+26dBu

4.2 Dimensions

Width:-	483 mm (19" rack mount)
Height:-	44mm (1 ¾"- 1U)
Depth:-	335 mm (max)
Weight:-	3Kg

5. Declaration of Conformity

DECLARATION OF CONFORMITY

Manufacturers name address	Lindos Electronics Saddlemakers Lane Melton, Woodbridge Suffolk IP12 1PP U.K.
Telephone	+44 (0) 1394 380307
Fax	+44 (0) 1394 385156
email	info@lindos.co.uk
Product name	Lindos Studio Converter - LSC24
Part number	LSC2-RGUE-

**Complies with the requirements of the European Low Voltage Directive and
Electromagnetic Compatibility Regulations**


and

conforms to the following standards:-

Safety:	BS EN 61010-1:1993 and AMD 8691
EMC:	BS EN 50081-1: 1992 (Emissions) BS EN 50082-1: 1998 (Immunity) BS EN 60555-2: 1987 (Mains harmonics)

**Richard J Lincoln
Development Manager**

Date: 16 Oct 2000



**Patricia M. Skirrow
Proprietor**

Date: 16 Oct 2000