



SRC9624
High Definition Sample Rate Converter
User's Guide

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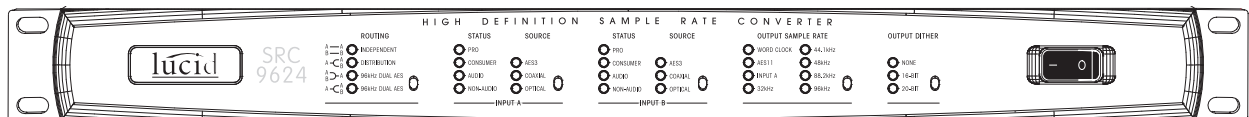
Web site: www.lucidaudio.com

The Lucid SRC9624 High Definition Sample Rate Converter is a two-channel digital audio sample rate converter intended for playback, mastering, post production, broadcast, or any application requiring an extremely adaptable sample rate converter of the highest possible quality.

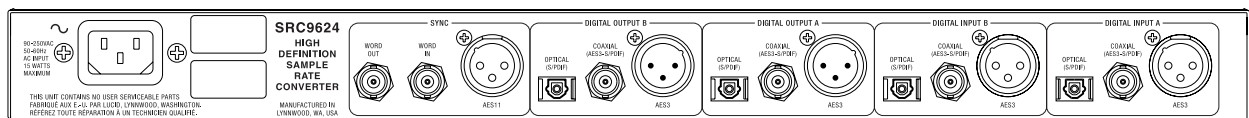
The SRC9624 supports a range of sample rates and 16-, 20-, and 24-bit word sizes. Using asynchronous conversion algorithms, it handles any input rate from 30 kHz to 100 kHz, including varispeed and common pull-up and pull-down rates. The SRC9624 also supports single- and dual-wire connections in 96 kHz (high-resolution) digital audio so you can interface gear using either format. It can also convert two single-wire stereo streams at rates up to 96 kHz to any standard common output rate, providing you with two sample rate converters in a single box. Finally, AES11 and word clock external sync capabilities, along with a wide range of industry-standard internally generated clocks, ensure easy synchronization between almost any digital audio equipment, whether it's professional or consumer.

We recommend that you read this manual from cover to cover. Somewhere between the confines of the two covers you should find the answers to most (98%) of your questions, both technical as well as musical. Please feel free to contact us if you have additional questions, comments, or suggestions.

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SRC9624 Front view.



SRC9624 Rear view.

Equipment Markings

The lightning flash with arrowhead symbol within an equilateral triangle is intended to alert the user of the presence of uninsulated “dangerous voltage” within the product’s enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.

The exclamation point within an equilateral triangle is intended to alert the user of the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product (i.e. this manual).

Caution *To prevent electric shock, do not use the polarized plug supplied with the unit with any extension cord, receptacle, or other outlet unless the blades can be fully inserted.*



WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE

AVIS: RISQUE DE CHOC ELECTRIQUE NE PAS OUVRIR

SEE OWNERS MANUAL. VOIR CAHIER D'INSTRUCTIONS.
 No user serviceable parts inside. Refer servicing to qualified service personnel.
 Il ne se trouve a l'interieur aucune piece pouvant etre reparaee l'usager.
 S'adresser a un reparateur competent.

Terms

The following are notational conventions used in this user guide:

- Note** Identifies information that needs extra emphasis. Supplies extra information to help you to better use the product.
- Caution** *Identifies information that, if unheeded, may cause damage to the Lucid product or other equipment in your system.*
- Warning** Identifies information that, if ignored, may be hazardous to your health or that of others.
- CAPITALS** Controls, switches, or other markings on the product’s chassis.

Important Safety Instructions

Please read and keep these instructions. Follow all warnings and instructions.

Mains Voltage Selection The Lucid SRC9624 uses an auto-sensing power supply and can operate from 90 to 250 VAC, at 50–60 Hz. Therefore, there is no need for the user to set the mains voltage prior to use.

Power Source This product is intended to operate from a power source that does not apply more than 250V rms between the power supply conductors or between either power supply conductor and ground. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

Grounding The chassis of this product is grounded through the grounding conductor of the power cord. To avoid electric shock, plug the power

cord into a properly wired receptacle before making any connections to the product. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation. **Do not defeat the safety purpose of the grounding plug.** The grounding plug has two blades and a third grounding prong. The third prong is provided for your safety. When the provided plug does not fit your outlet, consult an electrician for replacement of the outlet.

**Danger from
Loss of Ground**

If the protective ground connection is lost, all accessible conductive parts, including knobs and controls that may appear to be insulated, can render an electric shock.

Proper Power Cord

Use only the power cord and connector specified for the product and your operating locale. Use only a cord that is in good condition. **Protect the power cord** from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.

Operating Location

Do not operate this equipment under any of the following conditions: explosive atmospheres, in wet locations, in inclement weather, improper or unknown AC mains voltage, or if improperly fused. Do not install near any heat source such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat. Unplug this apparatus during lightning storms or when unused for long periods of time.

Stay Out of the Box

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed. Only use accessories specified by the manufacturer. Clean only with a damp cloth.

User-serviceable parts

There are no user serviceable parts inside the SRC9624. In case of failure, refer all servicing to the factory. Servicing is required when the SRC9624 has been damaged in any way, such as when a power supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

This section discusses getting signals in and out of the SRC9624 and using it.

Digital Input Connections

It is not necessary to connect all of these connectors at any given time. The connectors used or not used depend on your specific application. The INPUT SOURCE switches let you select the input source from the three connectors provided.

Connect the AES/EBU input connectors to AES/EBU digital audio sources. For long cable runs, you should use 110-ohm shielded twisted pair cable.

Connect the Coaxial (S/PDIF) connectors to consumer audio digital outputs. This connector floats from the chassis ground.

Use the Optical connector to connect to S/PDIF optical digital outputs.

Digital Output Connections

Like the digital inputs, it is not necessary to connect to all of these connectors at once. Use the ones you need; they are all active at once, and there is no interaction between them.

Connect the AES3 outputs to any AES/EBU receiver. For long cable runs, you should use 110-ohm shielded twisted pair cable.

Connect the Coaxial (S/PDIF) connectors to consumer audio digital inputs. This connector floats from the chassis ground.

Use the Optical connectors to connect to a S/PDIF optical digital input.

Sync Connections

The AES11 XLR connector accepts either sync signals or digital audio (of course, the audio is ignored). You enable this connector via the OUTPUT SAMPLE RATE selector switch. This input accepts both “black” AES signals (i.e., signals with AES clock info but no audio) as well as normal AES digital audio signals. In the latter case, the audio is stripped out of the signal, leaving the clock only. The input accepts sample rates from 30 kHz to 100 kHz.

The WORD IN BNC connector accepts word clock. This input does not terminate. If the SRC9624 is the last unit in a chain, you must use a tee connector at the input along with a 75-ohm terminator. The input accepts sample rates from 30 kHz to 100 kHz.

The WORD OUT BNC connector follows the sample rate of the outputs. It is NOT a thru connection of the WORD IN connector.

Mode Selection

Each portion of the SRC9624 uses three-position toggle switches to move the selection up or down. For the inputs, if the digital receiver does not achieve lock (no signal, or bad signal), the INPUT STATUS LEDs will not illuminate. Once the input locks, the status LEDs display the status information contained in the input signal.

The toggle switches and their associated LED stacks are designed to allow scrolling down or up through each user-controllable parameter.

Nonvolatile Memory

Approximately a half second after the last switch change, the LEDs will blink, indicating that the current configuration has been written to nonvolatile RAM. The next time the unit is powered up, it will remember its last state and initialize in that configuration.

Routing

The routing switch determines how the inputs connect to the outputs. Choose an appropriate setting for your application.

- | | |
|---------------------------------|---|
| Independent | The two inputs drive the two outputs. The signals remain separate. The output sample rate of both outputs depends on the setting of the OUTPUT SAMPLE RATE selector switch. |
| Distribution | The SRC9624 acts as a distribution amplifier, with Input A driving both outputs. |
| 96 kHz Dual AES Settings | These settings allow the SRC9624 to convert signals to or from the 96 kHz dual-wire AES format. |

The first Dual AES mode takes a stereo 96k signal which has been split into 2 mono signals running at a 48k frame rate, and converts it to 1 stereo signal on 1 wire, at any of the possible sample rates.

The second Dual AES mode does the opposite. It takes a single wire 96k signal and splits it into 2 wires—1 with left and 1 with right—both running at a 48k frame rate. The output sample rate should be set to the signal rate in this case (i.e., 96k). If you were to set the output rate to 48k, the signal will actually be sent at a 24 kHz frame rate, a format which is not generally used.

Input A Source

The INPUT A switch selects the desired source connection for INPUT A. The INPUT A STATUS LEDs monitor certain bits in the digital audio stream—pro or consumer, and audio

or non-audio (e.g., AC3). These bits are fed through the unit to the output. If the selected input is not present, the input A source LED flashes.

Input B Source

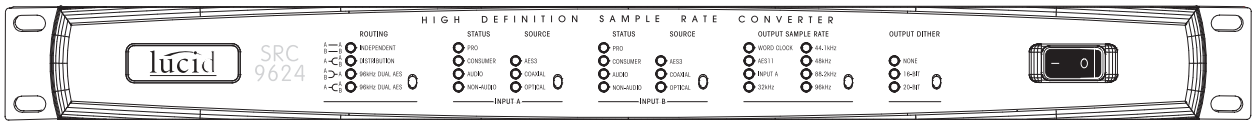
The INPUT B switch selects the desired source connection for Input B, either XLR, coaxial, or TOSLINK. The INPUT B STATUS LEDs will monitor certain bits in the digital audio stream—pro or consumer, and audio or non-audio (e.g., AC3). These bits are fed through the unit to the output. If the selected input is not present, the Input B source LED flashes.

Output Sample Rate

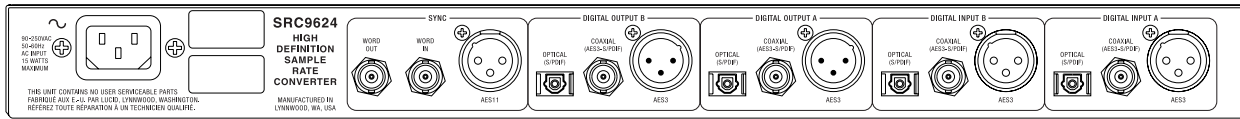
The OUTPUT SAMPLE RATE switch determines the sample rate of the digital audio output on both outputs A and B. For word clock input, AES11 Sync input and Input A input, the selected sync source's LED will flash if a valid clock signal is not present on that connector. For the internal clock frequencies, the selected sync source's LED illuminates.

Output Dither

This switch determines the word length of all outputs. None indicates no dithering. Settings of 20-bit or 16-bit indicate that the output signal has been dithered, using triangular PDF dithering, to these word lengths.



Feature	Description
ROUTING	<p>LEDs indicate the current signal routing. The toggle switch moves the selection up or down. There are four routing modes.</p> <p>Independent Input A drives Output A, Input B drives Output B.</p> <p>Distribution Input A drives Output A and Output B.</p> <p>96 kHz Dual AES (source) Inputs A and B receive two-wire AES signals at 96 kHz sample rate. The SRC9624 merges the two signals, and outputs at the selected sample rate in single-wire format via Output A.</p> <p>96 kHz Dual AES (receiver) Input A receives 96 kHz signal and the SRC9624 converts it to two-wire format. The outputs appear on Digital Output A and Digital Output B.</p>
INPUT A STATUS	LEDs indicate the settings of the status bits in the signal applied to Input A. The LEDs illuminate only when the input has locked on a valid signal.
INPUT A SOURCE	LEDs indicate the signal source for Input A. The toggle switch moves the selection up or down.
INPUT B STATUS	LEDs indicate the settings of the status bits in the signal applied to Input B. The LEDs illuminate only when the input has locked on a valid signal. The toggle switch moves the selection up or down.
INPUT B SOURCE	LEDs indicate the signal source for Input B. The toggle switch moves the selection up or down.
OUTPUT SAMPLE	LEDs indicate the output sample rate. The output sample rate can be derived from the sync inputs, Input A, or set to 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, or 96 kHz.
OUTPUT DITHER	LEDs indicate the output dither setting. The toggle switch moves the selection up or down. The SRC9624 uses triangular PDF function dithering. There is no noise shaping.
POWER SWITCH	Turns the unit on or off.



IEC POWER CONNECTOR

Accepts AC mains voltage. The SRC9624 uses a switching power supply that automatically adjusts to the applied voltage. Ensure that your AC mains voltage is between 90–250 VAC, 50–60 Hz.

Sync Connectors

WORD OUT

BNC connector. Supplies word clock signal at the same rate as the output sample rate. This is not a thru-connection to the WORD IN connector.

WORD IN

BNC connector. Accepts word clock signal from an external source. This is a bridging input (non-terminating). If the SRC9624 is the last unit connected to the word clock cable, the cable must be terminated. Use a tee connector and a 75-ohm terminator.

AES11

XLR-female connector. Accepts AES11 (AES/EBU) signals. This could be a sync-only signal or it could be a digital audio signal (the audio portion is ignored).

Digital Output A and B

The two sets of outputs are driven separately and there is no interaction between the connectors. Connect to any or all, as required by your application. Signals appearing at these outputs vary according to the setting of the ROUTING selector switch.

OPTICAL (S/PDIF)

TOSLINK connector. Carries S/PDIF signal.

COAXIAL (AES3-S/PDIF)

BNC* connector. Carries S/PDIF-AES3 signal.

AES3

XLR-male connector. Carries AES3 signal. Long cable runs require 110-ohm shielded twisted-pair cable.

Digital Input A and B

The digital inputs are all separate; any or all may be connected. The actual connector used as the signal source depends on the setting of the INPUT A SOURCE or INPUT B SOURCE selector switches. Input A may also be used as a sync or sample rate source.

OPTICAL (S/PDIF)

TOSLINK connector. Carries S/PDIF signal.

COAXIAL (AES3-S/PDIF)

BNC* connector. Carries S/PDIF-AES3 signal.

AES3

XLR-male connector. Carries AES3 signal. Long cable runs require 110-ohm shielded twisted-pair cable.

**BNC to RCA adapters are included with the SRC9624. Use these adapters if you are connecting to equipment with RCA/coaxial connectors.*

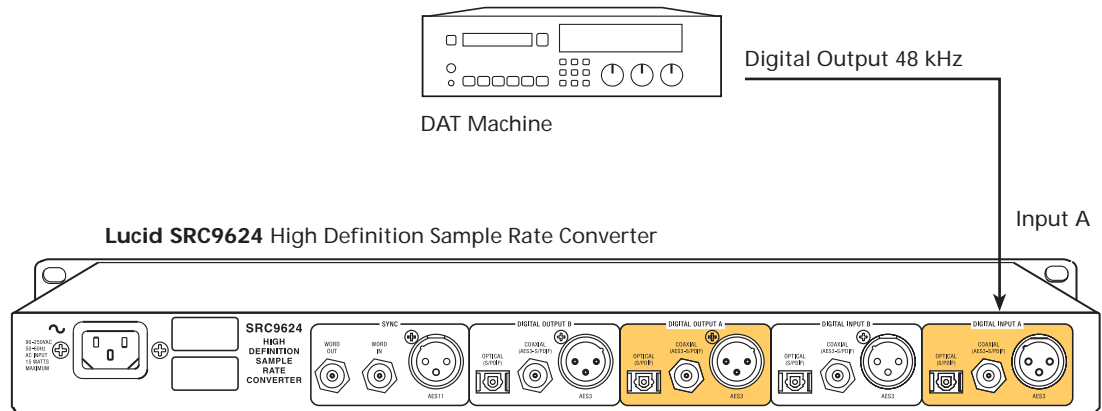
This chapter discusses operation of the SRC9624.

Applications

What You Can Do With the SRC9624

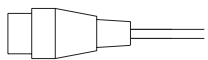


	Film and Video Post	Mastering	Multitrack Audio
Sample rate conversion	●	●	●
Routing	●	●	●
Drop Frame	●		
Dual-wire 96k		●	●
Resync	●		●
Format Conversion	●	●	●
Distribution Amp	●	●	●
Dithering	●		●

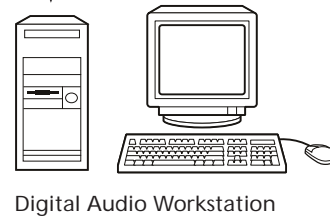
Setup Showing Sample Rate Conversion



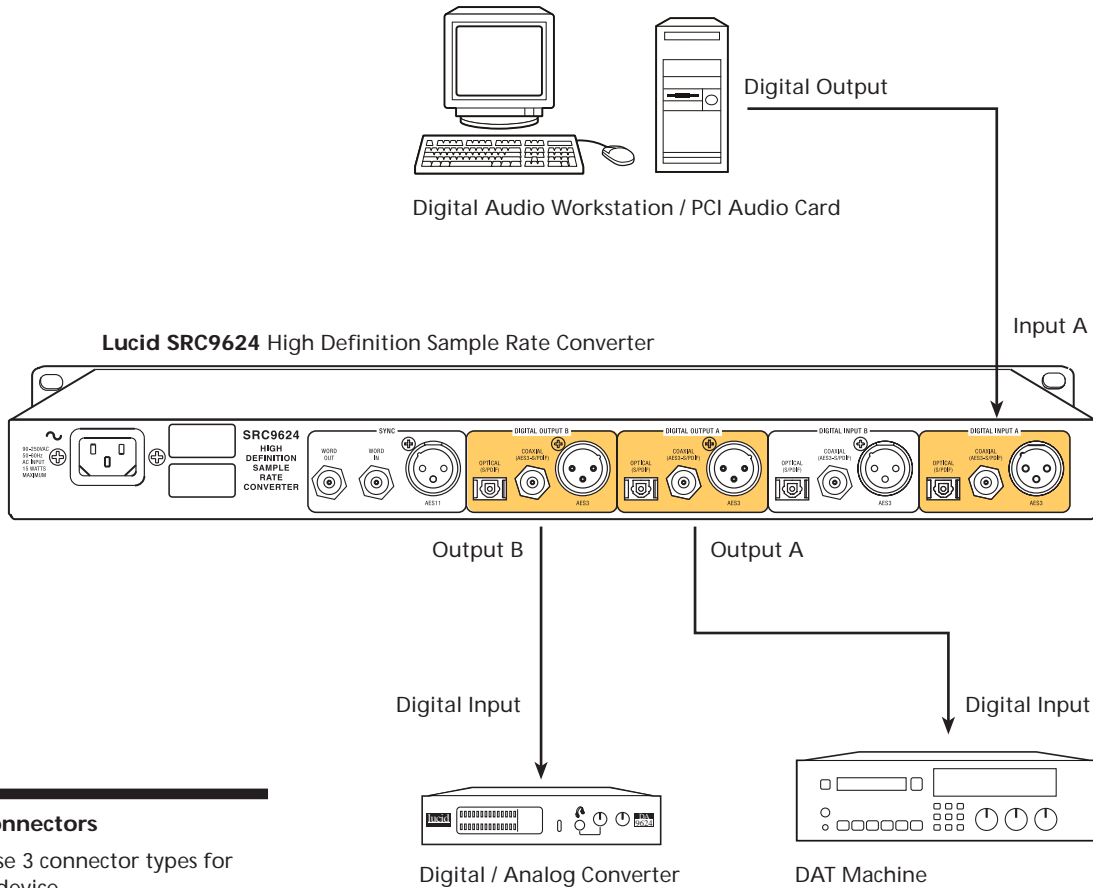
Rear Panel Connectors

Use one of these 3 connector types for each attached device.

-  XLR
-  TOSLINK (optical)
-  BNC/RCA

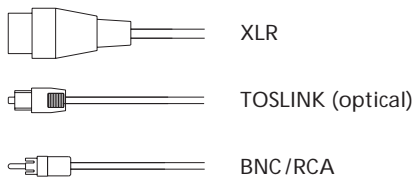


Setup Showing Distribution Mode



Rear Panel Connectors

Use one of these 3 connector types for each attached device.



Dither

Input signals arriving via the AES3 inputs are treated as 24-bit data. Signals less than 24-bit width should have been either converted at that bit width or truncated via an appropriate dither process. Serial (S/PDIF or TOSLINK) input signals are left-justified (the MSB of the input signal maps to the MSB of the SRC9624's 24-bit word).

On the output side, the SRC9624 applies flat triangular PDF dither that is not correlated between the left and right channels. This type of dithering is more or less equivalent to the standard dithering used in other devices. The advantage is that re-dithering is less of an issue

compared to re-dithering when using noise-shaped dither. If you're re-dithering the signal later, subjecting the signal to further downstream processing, or are dithering an already dithered signal, you're better off with flat dithering.

The downside of flat dithering over noise-shaped dither is the dithered noise gets spread across the audible spectrum (albeit at very low levels) rather than being pushed into less audible parts of the spectrum.

Input to Output Ratio

The sample rate converter chip used (Crystal Semiconductor CS8420) imposes a 3:1 or 1:3 conversion ratio limitation. When used at conversion ratios of 1.7:1 or less, the conversion process is relatively transparent. At high conversion ratios (> 1.7:1), the distortion performance degrades somewhat.

96 kHz Dual AES

The AES/EBU digital interface standard, formally known as AES3-1992, describes a serial transmission format for two-channel linearly represented digital audio data. Among the stated limitations are cable length, and a frame rate limitation of 50 kHz. Longer cables and higher frame rates may be used, but with the rapidly increasing requirement for care in cable selection, possible receiver equalization and/or the use of active repeaters would be required.

This standard was amended in 1999 (AES3-1992 Amendment 3-1999) to include several new encoded channel modes:

- Single channel double sampling frequency mode. This mode is mono.
- Single channel double sampling frequency mode—stereo mode left. This mode carries the left channel of a stereo pair. The channel mode bits reflect this condition.
- Single channel double sampling frequency mode—stereo mode right. This mode carries the right channel of a stereo pair. The channel mode bits reflect this condition.
- Multi-channel mode.

In addition, additional sampling frequencies were identified: 88.2 kHz, 96 kHz, 176.4 kHz, 192 kHz.

What does this mean to you? It means that there is a standard, defined method of transmitting high bit-rate digital audio signals down a piece of wire.

Simply stated, you can use the SRC9624 to convert digital audio signals to sample rates above 50 kHz, and transmit them via ordinary AES3 capable wiring, overcoming the distance limitation at high bit-rates. This practice requires two SRC9624s, one at each end of the cable, or the use of another dual-wire piece of equipment.

Pull Down and Pull Up Rates

The color NTSC video frame rate is 59.94 Hz. When recording digital audio on separate media using timecode, the sample rate is modified by the ratio 59.94/60 to 44.056 kHz. This makes the digital audio frames coincide with the video frames. Depending on which end of the conversion you are on, you may need to convert from the 44.056 kHz to 44.1 kHz or vice versa.

The SRC9624 does this with ease by making use of an external clock.

Resynching Signals

One aspect of multichannel digital audio recording that seems to never get enough attention is the need for sample rate synchronization between different sources. What this means is that the sample rate clock for each channel is phase locked to a master clock so that they change states at exactly the same instant in time.

When recording analog signals, either live or as overdubs, the recorder's A/D converters take care of this automatically. If you are using external converters, they must be synchronized to the recorder's word clock signal to accomplish the same thing. One way to do this would be to drive the A/D converter's word clock input from the recorder's word clock signal. But what if the A/D converter doesn't have a word clock (external sync) input? You use the SRC9624 to reclock the signals to the recorder's word clock.

With digital signals, since the audio is already in the digital domain, the SRC9624 provides a way to force these signals into sync with the recorder's clock.

To convert video frame rate signals to standard sample rates, drive the SRC9624's digital input with the video frame rate digital audio signal and select the output sample rate via the front panel switches.

To convert a standard sample rate to the video frame rate, drive the WORD CLOCK input with the video frame rate sync signal, select the external clock, and the output signal will conform to the sample rate of the external clock input.

Jitter Concerns

Jitter is phase variation in the clock signal of a digital audio bitstream. This is observable as frequency modulation of a stable waveform. If there is sufficient jitter, the receiving unit may not be able to lock to the signal.

A useful consequence of passing a digital audio signal through the SRC9624 is the attenuation of any jitter present on the input signal.

Using the Word Clock Inputs and Outputs

The word clock inputs and outputs are used to slave the conversion process to a master clock signal. The AES11-1997 standard describes the recommended practice. The signal used for word clock can be a Digital Audio Reference Signal (DARS) or a digital audio signal (the audio information is ignored).

The WORD IN and WORD OUT connectors are not paralleled. Only sometimes can the Word Out connection be considered a thru connection of the WORD IN connection.

The WORD OUT signal always reflects the sample rate of the output converters. If the Output Sample Rate switch is set to the WORD CLOCK position, then the WORD OUT is a thru connection from WORD IN.

Remember that WORD IN is a bridging connection; if the SRC9624 is the last unit in a chain, you must terminate the input with a 75-ohm resistor (use a tee-connector). If you need to chain multiple WORD IN connectors, use tee connectors and remember to terminate the last unit in the chain.

By design and definition, the AES11 Sync input terminates its source with 110-ohms. If you need a second AES11 sync source, you can use one of the digital outputs. In this usage, any audio present is ignored.

Cable Length Limitations

AES3-1992 states that the AES3 data format is intended for use with shielded twisted-pair cable of conventional design over distances of up to 100-meters at sample rates of up to 50 kHz. Beyond this length, special cable, equalization, or repeaters may be needed.

You can use the SRC9624's dual-AES connection to work around this limitation. At 44.1 kHz and 48 kHz this transmission format reduces the amount of data presented to each cable, which then allows you to violate the 100-meter limit using ordinary cables.

References

1. Principles of Digital Audio. Kenneth Pohlmann. ISBN 0-672-22634-0, copyright 1989, Howard W. Sams & Company.
2. Amendment 3 to AES Recommended practice for digital audio engineering - Serial transmission format for two-channel linearly represented digital data. AES3-1992 Amendment 3-1999. Journal of the Audio Engineering Society, V47N3, March 1999.
3. AES recommended practice for digital audio engineering—Serial transmission format for two-channel linearly represented digital data. AES3-1992 (ANSI S4.40-1992).
4. AES recommended practice for digital audio engineering—Synchronization of digital audio equipment in studio operations. AES11-1997.
5. CS8420 data sheet. Cirrus Logic, PO Box 17847, Austin TX 78760. 512-445-7222. Web site: <http://www.cirrus.com>
6. Application note AN22. Overview of Digital Audio Interface Data Structures. Clif Sanchez & Roger Taylor. Cirrus Logic, PO Box 17847, Austin TX 78760. 512-445-7222. Web site: <http://www.cirrus.com>

AES standards documents are available from the Audio Engineering Society, 60 E. 42nd Street, New York, NY 10165. 212-661-8528. Web site: <http://www.aes.org/publications>

Input/Output

Digital Inputs	XLR-female, TOSLINK (optical), BNC-female
Digital Outputs	XLR-female, TOSLINK(optical), BNC-female
Sync connections	BNC (word clock in, word clock out), XLR-male (AES11)
Digital Input Protocols	AES3 or S/PDIF (optical or copper)
Digital Audio Input Sample Rate Range	30–100 kHz
Digital Audio Output Sample Rate	Internal Sync: 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz External Sync: 30–100 kHz

Performance Data

Conversion Range Ratio (Fso/Fsi)	1:3 to 3:1
Input resolution	Up to 24-bits
Output resolution	24-bits
Signal-to-noise ratio	>120 dB minimum, 128 dB typical
Dynamic range	>120 dB minimum, 128 dB typical
THD+N	1 kHz, -1 dBFS, 0.33<Fso/Fsi<1.7: -117dB max
THD+N	1 kHz, -1 dbFS, 0.33<Fso/Fsi<3.0: -112dB max

Physical

Dimensions	1.72 (h) x 19 (w) x 6 (d) in / 4.37 x 48.26 x 15.24 cm
Weight	7.4 lbs / 3.36 kgs

Electrical

Power requirements	90–250 VAC, 50–60 Hz, 15 watts
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Temperature

Maximum operating ambient temperature	77° F / 25° C
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In the interest of continuous product improvement, Lucid reserves the right to alter, change, or modify these specifications without prior notice.

How to contact Lucid Tech Support

US callers should phone:	425.778.7728
International callers should phone:	(01) 425.778.7728
Phone hours:	8:00 am to 4:30 pm Pacific Time
Fax:	425.778.7727
E-mail:	tech@lucidaudio.com
Web site:	www.lucidaudio.com

Servicing your Lucid product

For US Customers:

If you have determined that your Lucid product requires repair services and you reside in the US, please contact our Customer Service Department for a return authorization (RA) number. Call 425.778.7728, Monday through Friday from 8 am to 4:30 pm Pacific Time.

If the warranty has expired, you'll be billed for all necessary parts, labor, packaging materials, and freight charges. Please remember, you must call for an RA number before sending the unit to Lucid.

For International Customers:

If you live outside of the United States, please contact your local Lucid dealer or distributor for instructions on how to obtain service.

Declaration of Conformity

We, **Lucid**, 6408 216th St. SW, Mountlake Terrace, Washington, USA,
declare under our sole responsibility that the products:

SRC9624 Sample Rate Converter

to which this declaration relates, are in conformity with the following standards:

EN 55103-1

**Electromagnetic compatibility - Generic emission standard
Part 1: Residential, commercial, and light industry.**

EN 55103-2

**Electromagnetic compatibility - Generic immunity standard
Part 1: Residential, commercial, and light industry.**

The technical construction file is maintained at:

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Mountlake Terrace WA 98043
USA

The authorized representative located within the European Community is:

World Marketing Associates
P.O. Box 100
St Austell, Cornwall, PL26 6YU, U.K.

Completion date: March 31, 2000

Place of issue: Mountlake Terrace, Washington, USA

Authorized signature:



Dane Butcher, President, **Lucid**



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Web site: www.lucidaudio.com