XHDI 02 Interface for Embedded Audio

16-Channel I/O Board for handling Audio Data Embedded in a Digital Serial Video Stream corresponding to SMPTE 259M (SD), SMPTE 292M (HD) and SMPTE 424M/425M (3G), and for embedding and de-embedding SMPTE 2020-Compliant Metadata

- I/O board for 16 audio channels
- De-embeds, embeds, replaces, and/or deletes audio compliant with SMPTE 272M-AC (SD), SMPTE 299M (HD), and SMPTE 424M/425M (3G)
- Provides de-embedding and embedding of 2 SMPTE 2020-1/-2-compliant metadata streams
- Direct link to XDED Dolby decoder and XDEE Dolby encoder for de-embedding and embedding asynchronous Dolby E audio signals
- Free channel assignment and routing on the NEXUS
- Internal DSP for audio processing
- Adjustable video delay: 0-15 frames (SD), 0-8 frames (HD/3G)
- Adjustable delay (0-170 ms @ 48 kHz) for audio and metadata send channels
- Down quantization of 20/24 bit source formats to 16 bit available, with dithering and noise shaping
- Built-in test-pattern video generator
- SMPTE RP165 (SD) compliant EDH check and insertion, CRC check and correction for HD/3G formats
- Bypass mode; can also be used for breakdown protection
- Configured with BNC or optical ports (LC, single mode)
- Optional XSRCA 02 SRC module for all audio channels
- Officially certified by Dolby® for Dolby E signal transmission

The XHDI 02 is the second-generation XHDI board. In addition to SD and HD video, it also supports HD-3G formats. The XHDI 02 enables the NEXUS system to receive, add, and process audio that is integrated in a digital serial video stream complying with either of the SMPTE 259M (SD), SMPTE 292M (HD), and SMPTE 424M/425M (3G) standards. It allows for embedding and de-embedding metadata streams which are used particularly in conjunction with the transport and processing of multi-channel audio. The board provides an adjustable video delay for compensating latencies between video and audio. Moreover, it features a video input and a video output. This allows any video to be forwarded simply and without modification, with no need for additional hardware components. If only audio data and or metadata are to be extracted from a video stream, the XHDI 02 can be used as an input board.

The XHDI 02 is designed as a universal SD and HD/3G interface. It offers a multiplicity of possibilities for reading audio from a video data stream, or adding it to a video data stream:

› **De-embedding** Any audio can be extracted from the video stream and be used and forwarded on the NEXUS audio network. Since the video stream remains unaffected, the output video signal's audio data is retained.

› **Embedding** Any audio signals present on the NEXUS system can be embedded into the video data stream. The data blocks and channels to be written in the SDI signal are selectable freely. Other blocks audio data, which were contained in the video stream previously, are retained. Channels from the same block can be carried over as they were.

› **Replacing** The replace mode allows individual audio streams to be replaced in non-standard data streams. In this mode, only the audio data is written to the existing data structure. This structure can be arranged in different ways.

› **Deletion** Audio blocks already contained in the video signal or marked for deletion can be deleted or overwritten entirely.

Metadata can be embedded and de-embedded. The board supports two metadata streams in each direction. Allocation and position is user definable. There is no replace mode for metadata – deletion of all metadata from a video stream is possible. Existing metadata can be overwritten.

A comprehensive software package enables all functions of the XHDI02 to be controlled from any PC.

High Flexible

The XHDI02 board handles signals compliant with the SMPTE 259M (4:2:2, Component, 270 Mbps), SMPTE 292M (4:2:2, Component, 1485/1483.5 Mbps), and SMPTE 425M (4:4:4 or 4:2:2 2970/2967 Mbps) standards. The standard format and any sub-formats under it are recognized automatically.

Supported video formats include:

Video Standard	Video-Format	SD/HD	Test-Tone Generator
SMPTE 425M 4:2:2	1920x1080 / 60p 1920x1080 / 50p	3G	yes
SMPTE 425M 4:4:4	1920x1080 / 60i 1920x1080 / 30p (PsF) 1920x1080 / 30p 1920x1080 / 50i 1920x1080 / 25p (PsF) 1920x1080 / 25p 1920x1080 / 24p 1280x720 / 60p 1280x720 / 50p 1280x720 / 25p 1280x720 / 24p		-
SMPTE 296M	1280x720 / 60p 1280x720 / 50p	HD	yes
	1280x720 / 30p 1280x720 / 25p 1280x720 / 24p		-
SMPTE 274M	1920x1080 / 60i 1920x1080 / 30p 1920x1080 / 50i 1920x1080 / 25p 1920x1080 / 24p		yes
	1920x1080 / 30p (PsF) 1920x1080 / 25p (PsF) 1920x1080 / 24p (PsF)		-
SMPTE 260M	1920x1035 / 60i		-
SMPTE 259M	1920x1080 / 50i		
SMPTE 125M	1440x487 / 60i (or x507) 1440x576 / 50i	SD	ja

PCM Audio Data

The SMPTE 272M-AC (SD) and SMPTE 299M (HD/3G) standards specify the transport of audio embedded in video streams. They define a maximum of four data blocks, each containing four 20/24-bit audio channels. Both standards are supported fully by the XHDI02. It de-embeds and/or embeds single or multiple channels into the data stream at the same time.

The SMPTE-272M-AC (SD) standard supports various types of embedding audio data into the video stream. This can lead to problems in long transmission lines and may make further incremental embedding of audio data impossible. Therefore, the XHDI02 board allows for existing data structures to be rearranged completely and, if necessary, to be rewritten, including the newly added audio data. According to SMPTE 299M (HD/3G), there are no restrictions regarding embedding. Therefore, no compatibility issues are to be expected as a consequence of different embedding algorithms.

A FIFO buffer is used to reconstruct the necessarily isochronous audio stream. The buffer size can be changed to suit the received signal in case of problems.

In HD/3G mode, the XHDI02 board can offer a special function: It tries to achieve an identical latency for all blocks in the Embedding and De-Embedding modes (but not in the Replace mode). This functionality is useful in multi-channel applications where the maximum number of 4 channels per audio block is exceeded. This functionality requires that the structure of the existing embedded audio be identical to the new audio. If the function is used only for embedding (without de-embedding existing audio), the XHDI02 can guarantee an identical latency for all audio blocks.

If the audio data to be processed is asynchronous to the NEXUS system, an SRC (sample-rate converter) module can be installed. The converter synchronizes the 16 send channels as well as the 16 receive channels to the NEXUS system clock.

All send channels feature an adjustable audio delay for compensating latencies between video and audio. In addition, the board enables the video to be delayed by up to 15 frames (or up to 8 frames with HD/3G signals).

The NEXUS system can be synchronized to the video signal and, with asynchronous audio, to the audio word clock encoded in the data stream. (only HD/3G)

The (AES-3 compliant) ancillary data contained in the audio stream is made available for software evaluation. On the sending side, the ancillary data can either be transparently adopted from AES-3 compliant signal sources or be regenerated by the XCPU board.

Compressed Audio, SDI Link

SDI signals may contain compressed audio (for example, in Dolby-D/E format). If the compressed audio is synchronous with the NEXUS system, it is de-embedded or embedded as normal and is then routed over the NEXUS bus to the encoders or decoders. However, if the SDI signals are not in sync with the NEXUS, the procedure is more complex. This is because the compressed data cannot be processed by an SRC. The XHDI02 provides a solution for this problem; a dedicated SDI link connecting the XHDI02 to the Dolby encoders and decoders. After the asynchronous compressed audio has been de-embedded, the XDED decoder board decodes it asynchronously. The signals which are now available separately can then be synchronised by the SRCs on the XDED to the NEXUS bus.

The XDEE Dolby-encoder board enables the video clock frequency to be shifted to reconcile latencies. This ensures that the signals comply with the strict Dolby E phase specifications. In combination, the audio

delay on the Dolby boards and the video delay provided by the XHDI 02 also support latency compensation and phase correction.

Thanks to these features, the XHDI 02 is the perfect solution for any application.

Signal Processor

The XHDI 02 board features DSP for level adjustment and signal processing without relying on other boards. The input and output levels can be adjusted separately. Reverse-polarity signals can be corrected using a phase-inversion function.

If audio is to be output in 20-bit or 16-bit format rather than with the NEXUS internal 24-bit resolution, the signal quality can be significantly improved by performing the down-quantizing function with dithering enabled. In addition, user selectable noise shaping can move the noise energy up to frequency ranges less perceptible by the human ear.

Note that the signal-processing functions are not available for compressed audio.

Metadata

The SMPTE 2020-1 and SMPTE 2020-2 standards support nine possible data streams per video signal. The XHDI 02 is capable of de-embedding two metadata streams and embedding two further streams at the same time. The user selects which data to work with. Metadata streams are assigned to stereo audio pairs. The user at the transmitting end makes this assignment; the receiver sees all available streams.

There are two ways of applying metadata to, or sending it from, the XHDI 02: as RS232 or RS422 signals using the optional XDEM interface module, or as an XTI signal. Combinations of these two modes are also supported. The major advantage of the XTI format is that metadata can be routed on the NEXUS just like audio. The XHDI 02 exchanges them either directly with the XDED and XDEE Dolby boards or with external devices using an XTI board.

As with the audio, the metadata send channels can be delayed.

Metadata must be synchronous with the video. Since there is no synchronicity with the NEXUS system clock, there is no need to employ SRCs: The metadata-signal path can always be the same regardless of the audio-sync status.

Error Detection

To achieve maximum reliability, the input-signal status and board status is checked regularly. The control software informs the user of any issues.

Two front-panel LEDs indicate the board status (sync errors, SD/HD/3G mode, test mode, and the status of the I/O PLL).

In the case of an input-signal failure, the board switches automatically to test-generator mode. (This feature can be disabled.) The output-signal format can be set using the control software.

In case of failure of a critical system component (e.g. the XCPU board), the board enters a bypass mode automatically, ensuring that the video stream is not interrupted. The NEXUS Base Devices feature redundant power-supply units to avoid power failure.

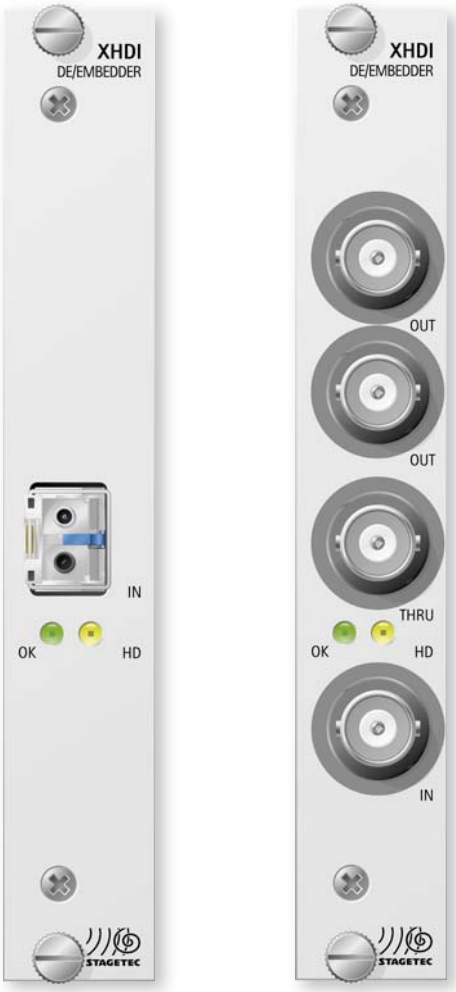
Ports

The XHDI 02 board is equipped with BNC or optical ports (LC, single mode).

The BNC version offers one BNC input, two parallel BNC outputs, and one BNC-through output, providing the re-clocked input signal.

Optical I/O ports are implemented as SFP modules providing LC terminals. The use of SFP modules enables the optical modules to be installed or replaced on site.

This makes adaptation for specific applications (distance, wavelength, etc.) simple.



XHDI 02 Specifications		
Data formats	SMPTE 259M (SD), SMPTE 292M (HD), and SMPTE 424M/425M (3G) compliant video; SMPTE 272M-AC (SD) and SMPTE 299M (HD/3G) compliant audio; SMPTE RP165 (SD) compliant EDH; SMPTE 2020-1/-2 compliant metadata	
Audio data	16/20/24-bit	
Audio channels	16 inputs, 16 outputs	
Sample rate	48 KHz (interface), 32 to 96 KHz (system)	
Metadata channels	2 inputs, 2 outputs	
Metadata rate	115.2 Kbps (nominal)	
Video rate	270/1,483.51/1,485 Mbps or 2,970/2,967 Mbps (nominal)	
Video latency	<200 pixels (no video delay set)	
BNC port	1 BNC	
	Reflection attenuation	>15 dB @ 5 MHz to 1.5 GHz (typ., SMPTE 424M) >10 dB @ 1.5 to 3 GHz (typ., SMPTE 424M)
	Cable length (recommended)	100m typ., 250m max. @ 270Mbps 100m typ., 230m max. @ 1,485Mbps 100m typ., 140m max. @ 2,970Mbps
	Impedance	75 ohm
BNC outputs	2 parallel BNC ports, 1 BNC through	
	Reflection attenuation	>15 dB @ 5MHz to 1.5 GHz (typ., SMPTE 424M) >10 dB @ 1.5 to 3 GHz (typ., SMPTE 424M)
	Output voltage	min. 750 mV_{PP}, typ. 800 mV_{PP}, max. 850 mV_{PP}
	Impedance	75 ohm
Optical input	1 LC port, single-mode, (max. rec. cable length: 10 km – example)	
	Optical power	-20 dBm @ 9/125 µm (min.)
	Overall attenuation	15 dBm (cable + connectors + splices/switches, etc., max.)
Optical output	1 LC port, single-mode, (max. rec. cable length: 10 km – example)	
	Center wavelength	1,310 µm (typ.)
	Optical power	-5 dBm @ 9/125 µm (min.)
Power supply	Voltage	+4.75 to 5.25 V
	Current	850 mA (BNC) 910 mA (optical)
Operating conditions	Temperature range	0 to 60 °C (between boards)
	Humidity	90 % (max.), non-condensing
Storage conditions	Temperature range	–35 to +60 °C
	Humidity	90 % (max.), non-condensing
Mechanical Data	General	Board for 19" module frame; 3U, 340 mm
	Front panel	4 HP (20.02 mm × 128.5 mm)
	Slot requirements	1
	Weight	BNC: 0.238 kg, SFP: 0.227 kg

Versions	
XHDI 02-BNC	BNC ports
XHDI 02-SFP	SFP module, single-mode (1,300µm), spanning distances of up to 2 km; LC, SM, DMI