Crystal Vision

TANDEM 320

3G/HD/SD dual channel audio embedder/de-embedder

Being dual channel makes the TANDEM 320 audio embedder/de-embedder perfect for those price-sensitive or space-sensitive applications.

Working with 3Gb/s, HD and SD sources, it provides economical embedding and de-embedding for two stereo pairs (four mono channels) of external analogue audio or four stereo pairs of AES per video channel, while fitting an amazing 24 channels of embedding or de-embedding in 2U.

TANDEM 320 can be configured in many different ways by fitting piggybacks, whether you want to use it as a dual channel embedder, a dual channel de-embedder or as a mixed embedder/de-embedder where you embed and de-embed at the same time. Additional features include audio routing, audio delays, audio processing and signal monitoring.

TANDEM 320 is ideal for engineers seeking straightforward embedding or de-embedding at a very low cost per channel, and who don't need all the features of the single channel TANDEM 310.

- Dual channel audio embedder/de-embedder, with two independent video channels
- Use it with a variety of sources: works with 3Gb/s, HD and SD video and both AES and analogue audio
- Designed for price-sensitive or space-sensitive applications – allows up to 24 channels of embedding and de-embedding in 2U
- Flexible embedding and de-embedding of external audio: use piggybacks to input and output up to four AES stereo pairs or two analogue audio stereo pairs (or four mono channels) per video channel
- Use it with four groups of internal audio on each video path
- Powerful audio routing: full channel shuffling and overwriting
- Compensate for system delays: with additional audio delay of up to 400ms
- Optimise the audio: with full audio processing including individual gain adjustments, stereo to mono conversion and channel muting and inversion
- Get peace of mind by knowing the status of your signal: easily monitor up to 35 video and audio alarms
- Save rack space: 100mm x 266mm module allows 12 TANDEM 320 in 2U (six in 1U and two in desk top box)
- Flexible control: select from front and remote panels, GPIs, SNMP, PC software and your web browser

WHY USE TANDEM 320?

TANDEM 320 is a dual channel audio embedder/de-embedder designed to save broadcast engineers money and rack space. With two independent video channels, it provides economical embedding and de-embedding for two stereo pairs (four mono channels) of external analogue audio or four stereo pairs of external AES per video channel, while allowing 24 channels of embedding or de-embedding to fit in 2U.

TANDEM 320 can be used with a variety of signals. It works with 3Gb/s, HD and SD video and with synchronous 48kHz AES, asynchronous 48kHz AES, synchronous Dolby E and analogue audio. When transporting Dolby E, any Dolby E stream is treated as a stereo pair and no audio processing applied to ensure integrity of the audio.

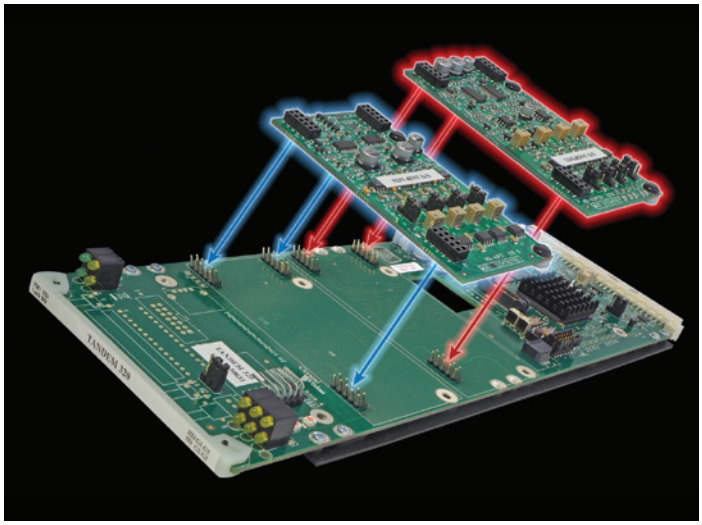
EMBED AND DE-EMBED ANALOGUE AND DIGITAL AUDIO

TANDEM 320 embeds and de-embeds external audio by fitting up to two audio piggybacks to the main board – with one piggyback used for each video channel. The front piggyback position is dedicated to video channel A and the rear position to video channel B.

Three different piggybacks are available. The 3G-AIP2 is used for inputting two stereo pairs or four mono channels of external analogue audio. The 3G-AOP2 is used for outputting two stereo pairs or four mono channels of analogue audio. The DIOP4 is used for inputting or outputting four stereo pairs of external digital audio; four bi-directional AES ports allow each stereo pair to be independently configured as input or output.

It is possible to fit two of the same piggybacks or to fit two different piggybacks to create the product required. For example, analogue and digital piggybacks can be mixed to create a hybrid system – ideal for those using analogue microphones with digital audio mixers in the studio. External digital audio can be both input and output on the same video channel; external analogue audio can be *either* input or output on a video channel.

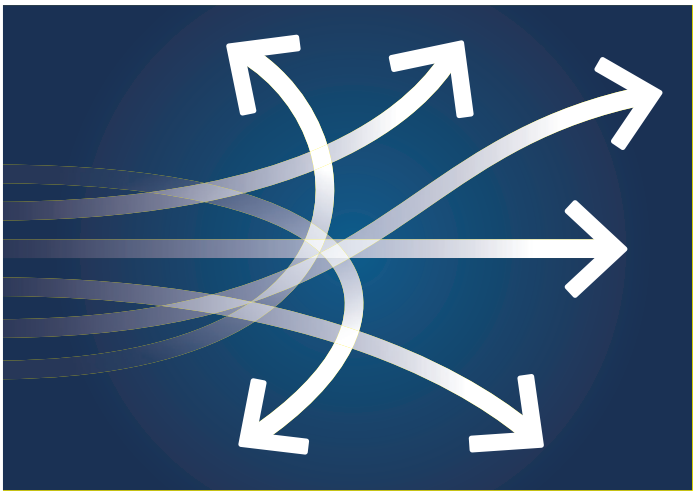
TANDEM 320 is aware of which piggybacks are fitted and adjusts the menus and audio routers to reflect the options available.



Which piggybacks can I fit?

These are the combination of piggybacks that can be fitted to TANDEM 320.

Front position (video channel A)	Rear position (video channel B)	Use TANDEM 320 as an audio shuffler and processor plus...	
		Channel A	Channel B
None	None		
DIOP4	None	Input and/or output four external AES stereo pairs (each stereo pair configured independently as input or output)	
3G-AIP2	None	Input two external analogue stereo pairs (or four mono channels)	
3G-AOP2	None	Output two analogue stereo pairs (or four mono channels) externally	
DIOP4	DIOP4	Input and/or output four external AES stereo pairs (each stereo pair configured independently as input or output)	Input and/or output four external AES stereo pairs (each stereo pair configured independently as input or output)
DIOP4	3G-AIP2	Input and/or output four external AES stereo pairs (each stereo pair configured independently as input or output)	Input two external analogue stereo pairs (or four mono channels)
DIOP4	3G-AOP2	Input and/or output four external AES stereo pairs (each stereo pair configured independently as input or output)	Output two analogue stereo pairs (or four mono channels) externally
3G-AIP2	3G-AIP2	Input two external analogue stereo pairs (or four mono channels)	Input two external analogue stereo pairs (or four mono channels)
3G-AIP2	3G-AOP2	Input two external analogue stereo pairs (or four mono channels)	Output two analogue stereo pairs (or four mono channels) externally
3G-AOP2	3G-AOP2	Output two analogue stereo pairs (or four mono channels) externally	Output two analogue stereo pairs (or four mono channels) externally



POWERFUL AUDIO ROUTING

TANDEM 320 includes flexible audio routing. It will pass through and route up to four groups of internal audio on each video path. Audio from an input piggyback can be added to any group as additional audio or can overwrite existing audio.

TANDEM 320 has two mono audio routing matrices on each video signal path. The first is the Embedder output router which is used to select which of up to 24 audio input channels (16 channels de-embedded from the input video along with up to eight audio channels from an input piggyback) should be embedded into up to four groups on the output video. This router will be will be configured as 24 x 16 if a DIOP4 is fitted, 20 x 16 if a 3G-AIP2 is fitted and 16 x 16 if a 3G-AOP2 is fitted. HANC cleaning removes the original version of old groups.

The second router is used to select which of the audio input channels should be output as external AES or analogue audio. Known as the Analogue output router if a 3G-AOP2 is fitted, it allows the 16 channels de-embedded from the input video to be routed to the four external analogue outputs. If a DIOP4 piggyback is fitted it is instead known as the AES output router and allows the 16 channels de-embedded from the input video plus optional external input channels from a DIOP4 to be routed to the external AES outputs. The number of external inputs and outputs available for routing depends on the I/O configuration of the DIOP4...

DIOP4 I/O configuration...	Routes...
1 in / 3 out	16 de-embedded channels plus one AES input pair to three external AES output pairs
2 in / 2 out	16 de-embedded channels plus two AES input pairs to two external AES output pairs
3 in / 1 out	16 de-embedded channels plus three AES input pairs to one external AES output pair

COMPENSATE FOR SYSTEM DELAYS

TANDEM 320 features short minimum delays for both the audio and video to help prevent system lip-sync complications.

An adjustable audio delay of up to 400ms (adjustable in 1ms steps) provides flexibility in compensating for video and audio delays elsewhere in the system.

OPTIMISE THE AUDIO

TANDEM 320 includes full audio processing of the linear AES. The audio levels can be increased or decreased to match the rest of your system, or even be muted to silence. Each gain control is independently adjustable between +18dB and -18dB in 0.1 steps.

The audio input channels can also be individually inverted – allowing you to correct for any reversed wiring of differential pairs. Stereo to mono conversion is available to help those broadcasting a multi-language service.

Audio resampling is set by default (except for Dolby E) and is used to seamlessly match the timing of audio signals when the user-controlled delay is altered.

SAVE RACK SPACE – WITH 24 CHANNELS OF EMBEDDING IN 2U

TANDEM 320 is a space-saving 100mm x 266mm module which is housed alongside any other Indigo product in the Indigo frames – available in 2U, 1U and desk top box sizes – with up to 12 boards (24 channels of embedding or de-embedding) fitting in 2U.

TANDEM 320 can be used with two different frame rear modules to access the inputs and outputs. Select the RM71 for 110 ohm AES or analogue audio applications and the RM72 for 75 ohm AES applications.

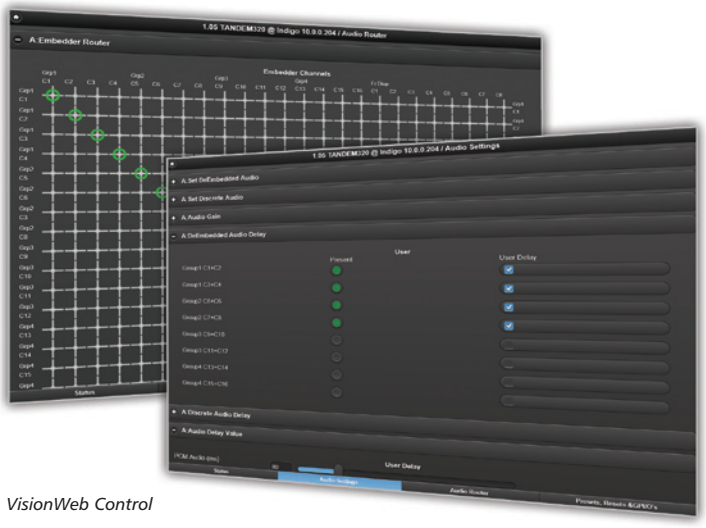
EASY AND FLEXIBLE CONTROL – AND SIGNAL MONITORING

TANDEM 320 is very straightforward to operate, with control options including an integrated control panel on the AE frame, the VisionPanel remote control panel, the SBB-4 smart button box, GPIs, SNMP, the Statesman Lite PC software and the VisionWeb Control web browser software.

Up to 16 user-defined presets, containing the board setup data, may be stored and recalled.

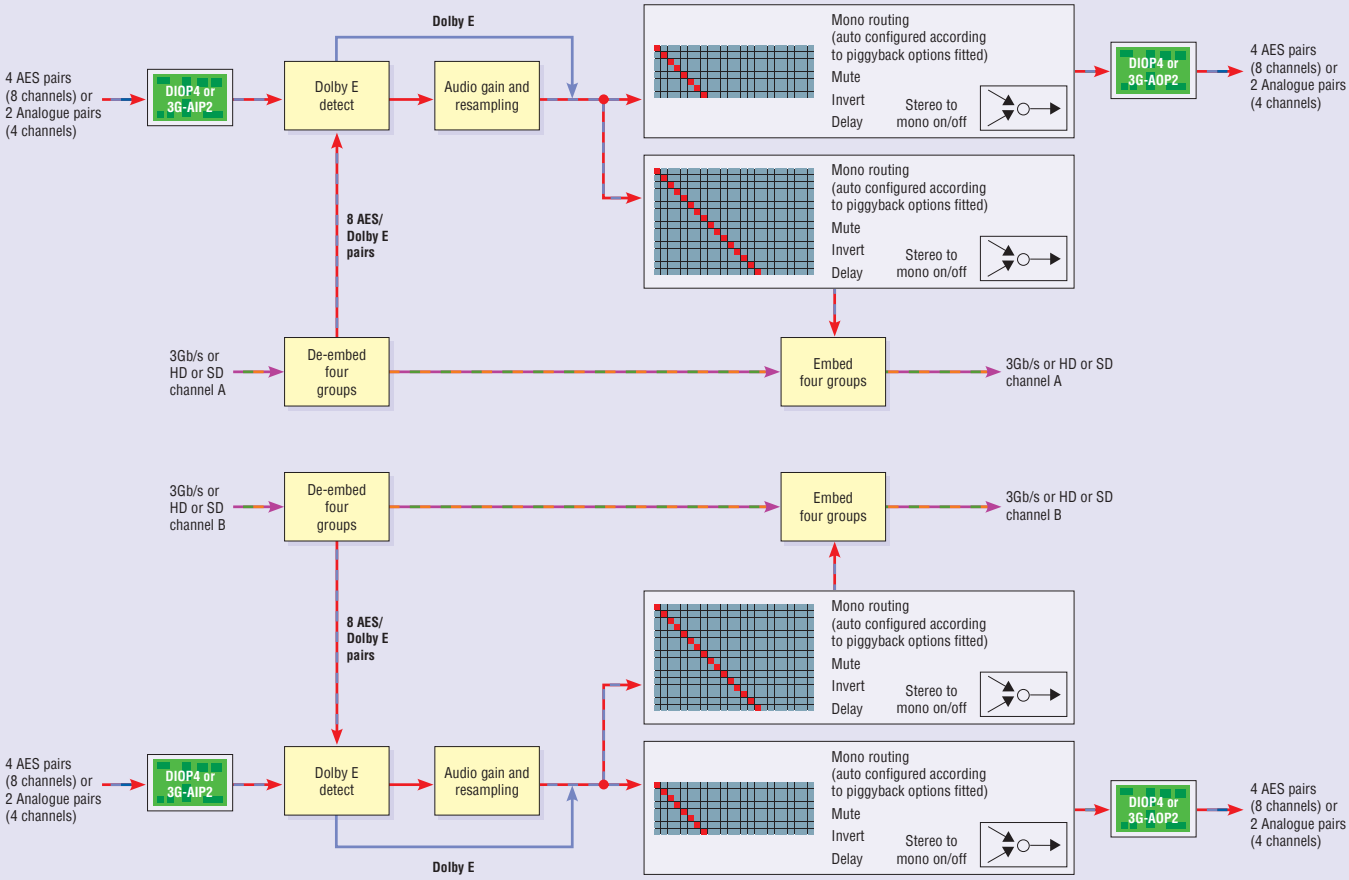
Two GPI outputs (one per video channel) are reserved for alarm indication and may be assigned any number of up to 35 video and audio alarms, allowing comprehensive signal monitoring. (See the SPECIFICATION for full list of alarms.) The silence alarms can be delayed before triggering to prevent false alarming during quiet periods in the audio.

VisionWeb



VisionWeb Control

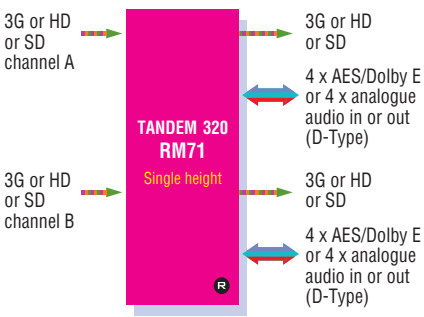
THE INPUTS AND OUTPUTS

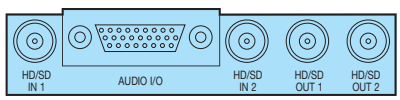


Note: Only one piggyback can be fitted per video channel. One DIOP4 can be used to both input and output AES

REAR MODULE CONNECTIONS

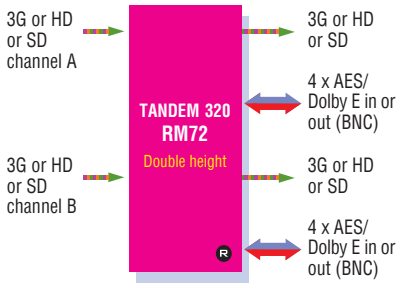
For applications using 110 ohm AES or analogue audio

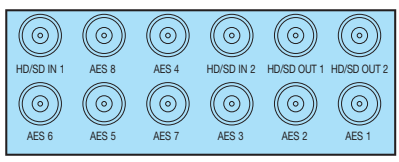




RM71

For applications using 75 ohm AES





RM72

TANDEM 320 MOTHERBOARD

MECHANICAL

Standard Crystal Vision module 266mm x 100mm
Weight: 200g
Power consumption: 9.3 Watts

VIDEO INPUTS

Two independent 3Gb/s or HD or SD inputs 270Mb/s or 1.5Gb/s or 3Gb/s serial compliant to SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A
The video formats supported are 625, 525, 720p50, 720p59.94, 1080PsF23.98, 1080PsF24, 1080i50, 1080i59.94, 1080p50 and 1080p59.94
3Gb/s cable equalisation up to 80m using Belden 1694A. HD cable equalisation up to 120m with Belden 1694A or equivalent (approx. 100m with Belden 8281). SD cable equalisation >200m Belden 8281 or equivalent
Input return loss: -15dB for 50MHz to 1.5GHz
Automatic de-embedding to SMPTE 272 or SMPTE 299-1

VIDEO OUTPUTS

One 3Gb/s, HD or SD output per channel using RM71 and RM72 frame rear modules
Serial output: 270Mb/s or 1.5Gb/s or 3Gb/s serial compliant to SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A. Output follows the input format
Audio is embedded to SMPTE 272 or SMPTE 299-1

AUDIO INPUTS AND OUTPUTS

Up to two piggybacks can be added to the main board, one per video channel. Each piggyback allows either input or output of four external AES stereo pairs or two external analogue stereo pairs (four mono channels). These channels can be routed to or from any of the four audio groups processed by TANDEM 320
Use 3G-AIP2 to input analogue audio. Up to two 3G-AIP2 can be fitted to TANDEM 320, one per video channel. Each piggyback allows two stereo pairs (four mono channels)
Use 3G-AOP2 to output analogue audio. Up to two 3G-AOP2 can be fitted to TANDEM 320, one per video channel. Each piggyback allows two stereo pairs (four mono channels)
Use bi-directional DIOP4 to input or output 75 ohm AES or 110 ohm AES audio. Up to two DIOP4 can be fitted to TANDEM 320, one per video channel. Each piggyback allows four stereo pairs (with each stereo pair configured independently as either 24 bit AES input or output)
Different piggybacks can be fitted, allowing embedding and de-embedding at same time and mixture of analogue and digital audio. There are rules regarding which piggybacks can be fitted in the front and rear positions (see tables on Page Two for full details). The front position is for video channel A; the rear position is for video channel B. It is possible to input and output AES on the same video channel. It is not possible to input and output analogue audio on the same video channel
TANDEM 320 can embed or de-embed analogue audio, synchronous 48kHz AES, asynchronous 48kHz AES and synchronous Dolby E. Linear AES can be resampled. Dolby E cannot be resampled. A manual resampler on/off control allows TANDEM 320 to embed synchronous compressed audio such as AC3

DELAY THROUGH BOARD

Minimum video in to out delay: 2 lines
Minimum embedding audio delay: <200us

AUDIO DELAY

Adjustable audio delay of up to 400ms on each stereo pair will compensate for any delay between the incoming video and audio signals. Delay is either on or off for any given stereo pair

AUDIO ROUTING

TANDEM 320 will pass through and route up to four groups of internal audio on each video path. Audio from an input piggyback can be added to any group as additional audio or can overwrite existing audio
TANDEM 320 has two input/output mono audio routing matrices per SDI signal path. These audio routers are auto configured according to the piggyback options fitted to the motherboard
The first matrix is the Embedder router, which will be configured as 24 x 16 if a DIOP4 is fitted, 20 x 16 if a 3G-AIP2 is fitted and 16 x 16 if a 3G-AOP2 is fitted. This router allows the 16 channels de-embedded from the input video along with up to eight audio channels from an input piggyback to be routed to any of the 16 embedded outputs
The second matrix is either the 16 x 4 Analogue output router (if a 3G-AOP2 piggyback is fitted) or the 24 x 8 AES output router (if a DIOP4 piggyback is fitted). The second router will not be shown if neither 3G-AOP2 nor DIOP4 piggybacks are fitted
The Analogue output router allows the 16 channels de-embedded from the input video to be routed to the four external analogue outputs
The AES output router allows the 16 channels de-embedded from the input video plus optional external input channels from a DIOP4 to be routed to the external AES outputs. The number of external inputs and outputs available depends on the I/O configuration of the DIOP4 – for example, if the DIOP4 is configured to provide two AES input pairs and two AES output pairs, then the AES output router can route the 16 de-embedded channels plus two AES input pairs to two external AES output pairs

AUDIO PROCESSING

Audio processing can be applied to linear AES only. It cannot be applied to Dolby E
Gain level adjustment on each channel between +18dB and -18dB in 0.1dB steps with 0dB calibration. There are a total of 24 audio gain controls, one for each of the 16 channels of audio de-embedded from the video and eight channels of external AES audio
Mute
Inversion
Stereo to mono conversion

ANCILLARY DATA

Ancillary data passed unless set to blank (by enabling VANC blanking)

LED INDICATION OF:

Power supplies on board
Video input HD/SD
Input audio groups present

PRESETS

The current board settings can be saved in one of 16 locations to be recalled as required

GPI INPUT LEVELS

Active pull to ground, pulled up to +5V through 10 kohm

GPI OUTPUT LEVELS

Electrically: Open collector transistors 30V, 270 ohm current limit resistors. Pulled up to +5V through 6800 ohm

GPI INPUTS

Four GPI inputs can be used to recall stored presets

GPI OUTPUTS

Two GPI outputs (GPI 5 and GPI 6) are reserved for alarm indication, with GPI 5 triggered by video channel A alarms and GPI 6 by video channel B alarms. They may be assigned any number of 35 video and audio alarms (some of these alarms are unavailable when a DIOP4 piggyback is not fitted):
Video missing
Video black
Video frozen
Input group 1 missing
Input group 2 missing
Input group 3 missing
Input group 4 missing
Silence group 1 channels 1 and 2
Silence group 1 channels 3 and 4
Silence group 2 channels 1 and 2
Silence group 2 channels 3 and 4
Silence group 3 channels 1 and 2
Silence group 3 channels 3 and 4
Silence group 4 channels 1 and 2
Silence group 4 channels 3 and 4
Missing AES 1
Missing AES 2
Missing AES 3
Missing AES 4
Silence AES 1
Silence AES 2
Silence AES 3
Silence AES 4
Dolby E on input group 1 channels 1 and 2
Dolby E on input group 1 channels 3 and 4
Dolby E on input group 2 channels 1 and 2
Dolby E on input group 2 channels 3 and 4
Dolby E on input group 3 channels 1 and 2
Dolby E on input group 3 channels 3 and 4
Dolby E on input group 4 channels 1 and 2
Dolby E on input group 4 channels 3 and 4
Dolby E on AES 1
Dolby E on AES 2
Dolby E on AES 3
Dolby E on AES 4
Video missing, video black, video frozen, input groups missing, AES channels missing and Dolby E present will all assert an alarm immediately. The silence alarms can be delayed by up to 127 seconds before an alarm is asserted to prevent false alarming during quiet audio periods

REMOTE CONTROL

Control from integrated control panel on Indigo 1AE-DP frame
Control from VisionPanel 3U remote panel
VisionWeb Control is available via the web server on the frame and allows operation using a standard web browser on a PC or tablet

CONTINUED OVERLEAF...

Statesman Lite allows control from any PC on a network
SBB-4 smart button box connects to the frame via Ethernet and provides four programmable LCD switches (which are configured for each order). The SBB-4 uses information from VisionWeb for settings. Uses Power over Ethernet so must be used with PoE enabled switch
SNMP monitoring and control available as a frame option
Control using ASCII and JSON protocols

3G-AIP2 DUAL ANALOGUE AUDIO INPUT PIGGYBACK

AUDIO INPUT
Two analogue stereo pairs or four mono channels. 24 bit quantising A to Ds. High input impedance (20 kohm) balanced

INPUT LEVEL RANGE
0dBFS = +28dBu max / 0dBFS = +12dBu min
Factory set default: 0dBFS = +18dBu or +24dBu by on board link

SIGNAL TO NOISE
99dB (+18dBu) rms., 22Hz to 22kHz typ.

TOTAL HARMONIC DISTORTION
0.004% THD+N rms., 22Hz to 22kHz typ.

INTERCHANNEL CROSSTALK
-110dB at 1kHz, -90dB at 20kHz, rms., typ.

3G-AOP2 DUAL ANALOGUE AUDIO OUTPUT PIGGYBACK

AUDIO OUTPUTS
Two analogue stereo pairs or four mono channels. 24 bit quantising D to As. Low output impedance (66 ohm) balanced

INPUT LEVEL RANGE
0dBFS = +28dBu max / 0dBFS = +12dBu min
Factory set default: 0dBFS = +18dBu or +24dBu by on board link

SIGNAL TO NOISE
99dB (+18dBu) rms., 22Hz to 22kHz typ.

TOTAL HARMONIC DISTORTION
0.002% THD+N rms., 22Hz to 22kHz typ.

INTERCHANNEL CROSSTALK
-110dB at 1kHz, -90dB at 20kHz, rms., typ.

DIOP4 QUAD DIGITAL AUDIO INPUT AND OUTPUT PIGGYBACK

AUDIO INPUTS AND OUTPUTS
Four 24 bit stereo pairs
Software selectable as 110 ohm AES/EBU balanced or 75 ohm AES3-id unbalanced on a per-DIOP4 basis (all four connections have the same impedance)
Individually configurable as inputs or outputs
Asynchronous audio to video 48kHz + or - 50ppm

TOTAL HARMONIC DISTORTION
With asynchronous inputs: < 0.0001% (-120dB)

ORDERING INFORMATION

TANDEM 320	3G/HD/SD dual channel audio embedder/de-embedder (allows fitting of one audio piggyback per video channel)
3G-AIP2	Analogue audio input piggyback (two stereo pairs or four mono)
3G-AOP2	Analogue audio output piggyback (two stereo pairs or four mono)
DIOP4	Digital audio input or output piggyback (four stereo pairs). Can be used to input and output AES at the same time
Indigo 2SE	2U frame with active front panel featuring smart CPU for up to 12 Crystal Vision modules
Indigo 1AE-DP	1U frame with active front panel featuring smart CPU and integrated control panel for up to six Crystal Vision modules, with included power supply redundancy
Indigo 1SE-DP	1U frame with active front panel featuring smart CPU for up to six Crystal Vision modules, with included power supply redundancy
Indigo DT	Desk top box with passive front panel for up to two Crystal Vision modules
Indigo DTSE	Desk top box with active front panel featuring smart CPU for up to two Crystal Vision modules
RM71	Single slot frame rear module. Allows maximum number of TANDEM 320 in frame (12 in 2U, six in 1U, two in desk top box). Suitable for 110 ohm AES or analogue audio. Gives access to two independent 3Gb/s, HD or SD inputs, one 3Gb/s, HD or SD output per channel and all audio inputs or outputs
RM72	Two slot frame rear module. Allows six TANDEM 320 in 2U, three in 1U and one in desk top box. Suitable for 75 ohm AES. Gives access to two independent 3Gb/s, HD or SD inputs, one 3Gb/s, HD or SD output per channel and all audio inputs or outputs
VisionPanel	3U Ethernet remote control panel with touch screen
SBB-4	Smart button box with four programmable LCD switches. It is powered by Power over Ethernet and therefore needs to be connected to a PoE enabled switch
VisionWeb Control	VisionWeb web browser control included within frame software
Statesman Lite	PC Control System
SNMP	SNMP monitoring and control

Crystal Vision

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