Crystal Vision

TANDEM 3G

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

TANDEM 3G is a single board solution providing a combined embedder and de-embedder for four groups of digital audio – with the ability to embed and de-embed at the same time. Working with 3Gb/s, HD and SD sources and including integrated fibre input or output connectivity while still only using a single slot in a frame, makes TANDEM 3G a powerful, economic and space-saving solution for a very wide range of applications.

With TANDEM 3G, the name TANDEM continues to be synonymous with high quality and flexible embedding and de-embedding.

- Combined embedder and de-embedder for up to four groups of digital audio
- Saves money: ideal for applications requiring both embedding and de-embedding at the same time, or for those who want to buy just one device to embed or de-embed as required
- Embed and de-embed any sources: works with 3Gb/s, HD and SD video and both 110 ohm and 75 ohm digital audio
- Complete freedom when embedding and de-embedding external audio: embed or de-embed up to eight AES at the same time and in any combination thanks to eight bi-directional digital audio connections on the board, individually configurable as either an AES input or AES output
- Optional integrated fibre input/output connectivity means you won't be limited by cable lengths
- Powerful audio routing: full shuffling and overwriting of the mono channels between all four audio groups using the two 32 x 16 audio routers
- Easy to match all your signals: compensate for any video processing with optional audio delay of up to 80ms
- Optimise the audio: with full audio processing including individual gain control of +/-18dB and stereo to mono conversion, and audio resampling of asynchronous AES
- Optimise the video: video proc-amp allows adjustment of video gain, black level and independent YUV gains
- Ideal for Dolby E users: allows embedding and de-embedding of synchronous Dolby E and a switchable one or two frames video delay to match Dolby E delays
- Get peace of mind by knowing the status of your signal: easily monitor 37 video and audio alarms
- Saves rack space: 100mm x 266mm module allows 12 TANDEM 3G in 2U (24 in 4U, six in 1U and two in desk top box)
- Flexible control: select from board edge, front and remote panels, GPIs, SNMP and PC software

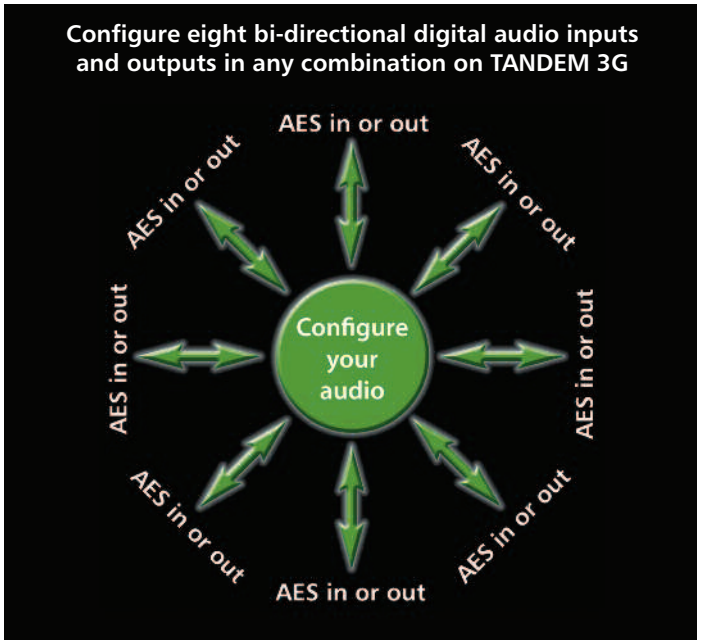
WHY USE TANDEM 3G?

TANDEM 3G is a very powerful audio embedder/de-embedder system.

One of its strengths is its ability to be used with a variety of signals: 3Gb/s, HD and SD video, along with either 110 ohm or 75 ohm digital audio. It can embed or de-embed synchronous 48kHz AES, asynchronous 48kHz AES and synchronous Dolby E. When transporting Dolby E, any Dolby E stream must be treated as a stereo pair and no audio processing applied to ensure integrity of the audio.

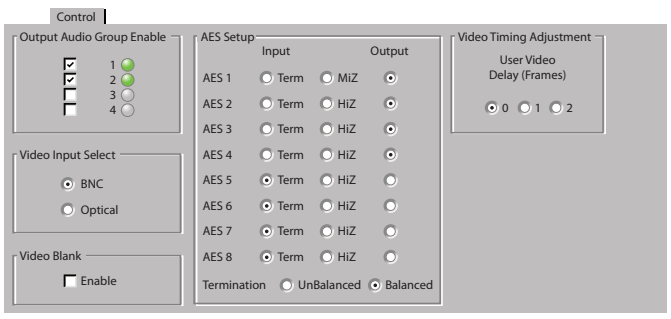
TANDEM 3G is ideal for applications requiring both embedding and de-embedding at the same time, while for those that just need to embed or de-embed there is no price premium to buy one device that can be used as both an embedder or de-embedder as required. Its ability to work with four audio groups allows broadcasters to have surround sound without Dolby E, and also makes it ideal for multi-language applications and for sports programming featuring both commentary and 'ground' effects.

EMBED AND DE-EMBED EXACTLY WHAT YOU WANT



TANDEM 3G offers complete freedom when embedding and de-embedding external audio, and can be used with up to four audio groups.

There are eight bi-directional digital audio connections on the board which can each be independently configured as either an AES input or AES output, allowing the embedding or de-embedding of up to eight AES stereo pairs at the same time and in any combination.

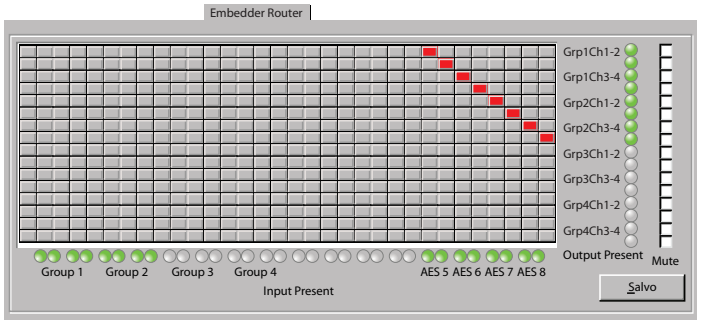


Typically used for embedding or de-embedding all eight AES channels, or for embedding four AES while de-embedding four AES at the same time, such is the flexibility of TANDEM 3G you could just as easily use it to, for example, embed three AES channels and de-embed five – or any other combination you choose.

The four output embedders can be individually enabled or disabled, allowing any other data already present on the input video to be retained for downstream use.

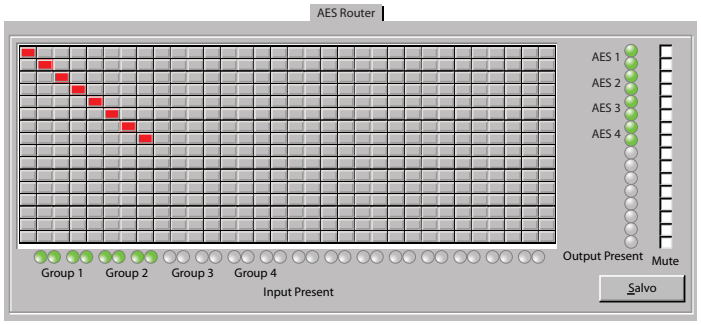
AUDIO ROUTING

TANDEM 3G includes powerful audio routing, allowing full shuffling and overwriting of the mono channels between all four groups.

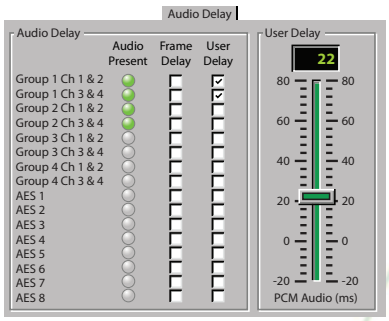


At the heart of TANDEM 3G are two 32 input/16 output mono audio routing matrices. One is the embedder output router, with the other the AES output router. These allow up to 32 possible audio input channels (16 embedded channels from up to four groups present on the input video, plus up to eight external stereo pair AES inputs) to be routed to 16 outputs for either embedding into up to four groups on the output video, or up to eight external stereo pair AES outputs.

HANC cleaning removes the original version of old groups.



EASY TO MATCH ALL YOUR SIGNALS – WITH AUDIO AND VIDEO DELAYS



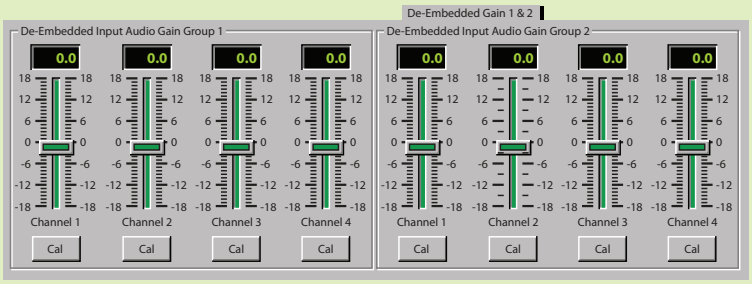
An adjustable audio delay of up to 80ms on each stereo pair of linear AES or Dolby E can be used to compensate for any small delay between the incoming video and audio signals caused by video processing. Each stereo pair can be selected to be either delayed or not delayed.

TANDEM 3G also provides a switchable one or two frames video delay, adjustable in whole frame steps, which is useful for matching Dolby E delays. Converting to or

from Dolby E delays the audio by one video frame and by incorporating the option of a one or two frame video delay within TANDEM 3G, the video and audio timing can be brought back into alignment at points where it matters (such as when switching signals or approaching a mixer) and therefore avoid lip-sync errors. By offering two frames of delay, TANDEM 3G can even compensate for the delays of 'both ways' Dolby E encoding and decoding.

OPTIMISE THE AUDIO AND VIDEO

TANDEM 3G includes full audio processing of the linear AES.

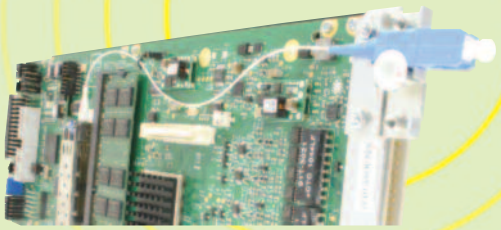


The audio levels can be increased or decreased to match the rest of your system, or even be muted to silence. There are a total of 32 individual audio gain controls, for the 16 channels of audio de-embedded from the video and 16 channels of external AES audio. Each gain control is independently adjustable between +18dB and -18dB in 0.1dB steps.

Stereo to mono conversion is available to help those broadcasting a multi-language service. Each of the 32 audio input channels can also be individually inverted – allowing you to correct for any reversed wiring of differential pairs. Forward error correction ensures audio quality is maintained, while asynchronous 48kHz AES can also be resampled.

It's not just the audio that can be improved. TANDEM 3G additionally includes a video proc-amp for picture optimisation, with adjustment of the video gain, black level and independent YUV gains by up to 200%.

FIBRE CONNECTIVITY – ON THE BOARD



If you need to embed and de-embed signals from beyond your local equipment bay, it's easy to give TANDEM 3G integrated fibre connectivity – and still only use a single frame slot. Just order either the FIP fibre input option, FOP fibre output option or FIO fibre input and output option. With a fibre option fitted you could easily, for example, take signals from another part of the building and de-embed audio into the audio mixer, or embed audio from the audio mixer and then send the signals to another area.

Designed for SMPTE 297-2006 short-haul applications, the FIP is used to receive an optical input and the FOP to transmit an optical output using a Class I laser. The FIO can do both – giving you simultaneous fibre input and output. With a FIP or FIO fitted you can select your video input source to be taken either from the input BNC or the optical input. Having the fibre integral to the board reduces the need to use up additional rack space for separate fibre optic transmitters and receivers – as well as saving you money.

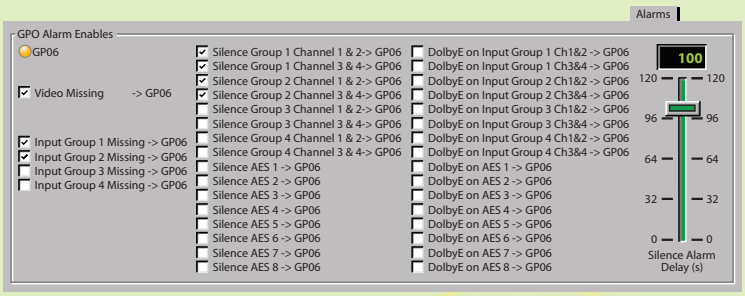
TANDEM 3G can also support CWDM lasers if required.

FRAMES AND CONTROL

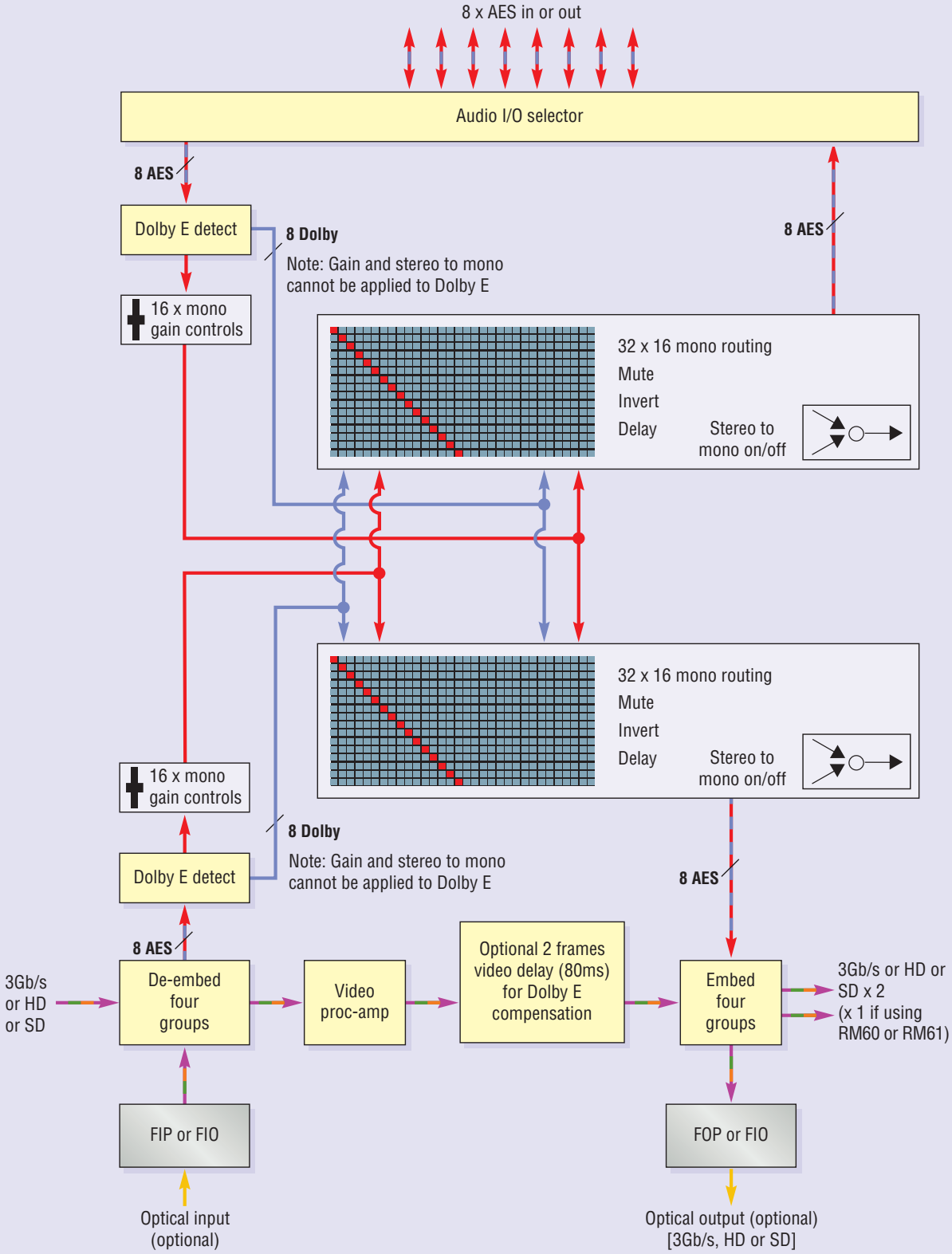
TANDEM 3G is a space-saving 100mm x 266mm module which is housed alongside any other product in the standard frames – available in 4U, 2U, 1U and desk top box sizes – with up to 12 boards fitting in 2U.

TANDEM 3G can be used with five different frame rear modules to access the inputs and outputs. Select from the RM47 (for standard 110 ohm applications), RM49 (for standard 75 ohm applications), RM60 (when using 110 ohm audio with a fibre input or output option fitted), RM61 (for 75 ohm fibre applications) and RM70 (when using 110 ohm audio with a fibre input and output fitted).

TANDEM 3G is very straightforward to operate, with control options including board edge switches, an active front panel on the frame, a remote control panel, GPIs, SNMP and the Statesman PC software. Up to 16 user-defined presets, containing the board setup data, may be stored and recalled. One GPI output is reserved for alarm indication and may be assigned any number of 37 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.



THE INPUTS AND OUTPUTS



SPECIFICATION

MECHANICAL

Standard Crystal Vision module 266mm x 100mm
Weight: 200g
Power consumption: 11.9 Watts; 0.6 Watts (FIP and FOP)

VIDEO INPUT

One 3Gb/s or HD or SD input
When using FIP fibre input option allows selection between one optical and one electrical input
270Mb/s or 1.5Gb/s or 3Gb/s serial compliant to EBU 3267-E, SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A
The video formats supported are 625, 525, 720p50, 720p59.94, 1080i50, 1080i59.94, 1080p50 and 1080p59.94
3Gb/s cable equalisation up to 80m using Belden 1694A. HD cable equalisation up to 140m with Belden 1694A or equivalent (approx. 100m with Belden 8281). SD cable equalisation >250m Belden 8281 or equivalent
Input return loss: -15dB for 50MHz to 1.5GHz and -10dB for 1.5GHz to 3GHz
Automatic de-embedding to SMPTE 272M or SMPTE 299M

VIDEO OUTPUTS

Using RM47 and RM49 rear modules: Two 3Gb/s, HD or SD outputs
Using RM60 and RM61 rear modules with FIP fibre input option: One 3Gb/s, HD or SD output
Using RM60 and RM61 rear modules with FOP fibre output option: Two 3Gb/s, HD or SD outputs (one on fibre and one on BNC)
Using RM70 rear module with FIP fibre input option: Two 3Gb/s, HD or SD outputs
Using RM70 rear module with FOP fibre output option or FIO fibre input and output option: Three 3Gb/s, HD or SD outputs (one on fibre and two on BNC)
Serial output: 270Mb/s or 1.5Gb/s or 3Gb/s serial compliant to EBU 3267-E, SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A. Output follows the input format
Audio is embedded to SMPTE 272M or SMPTE 299M

INTEGRATED FIBRE OPTIONS

TANDEM 3G can be given integrated fibre connectivity by fitting the FIP fibre input option, FOP fibre output option or FIO fibre input and output option. The chosen option should be fitted at the factory
To access the optical inputs or outputs an RM60 (for 110 ohm AES), RM61 (for 75 ohm AES) or RM70 (for 110 ohm AES) frame rear module must be used
When fitted with a FIP or FOP, TANDEM 3G can be housed in any frame slot position but due to its extra height it is not possible to place Standard Definition or audio boards directly above it when the TANDEM 3G is in even numbered slot positions. 3Gb/s and HD boards do not share this restriction.
FIP and FOP meet the SMPTE 297-2006 short-haul specification, allowing operation with single-mode and multi-mode fibre
Connector type: SC/PC
FIP:
Optical wavelength: 1260-1620nm
Input level maximum: 0dBm
Input level minimum: Typical -20dBm (-18dBm 3Gb/s pathological)
FOP:
Optical power: Max 0dBm, min -5.0dBm (typical -2.0dBm or 630uW)
Fibre pigtail: Single-mode 8/125uM
Optical wavelength: 1290-1330nm (1310 typical)
Extinction ratio: 7.5dB
Laser safety classification: Class 1 (EN 60825), Class I (21CFR1040.10)

AUDIO INPUTS AND OUTPUTS

Eight bi-directional digital audio I/O ports on the board can each be independently configured to be either an AES input or AES output 24 bit stereo pair. This allows the embedding or de-embedding of up to eight AES at the same time and in any combination
TANDEM 3G can embed or de-embed 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 3G to embed synchronous compressed audio such as AC3
110 ohm or HiZ (balanced) via D-Type, or AES3-id (unbalanced) via 75 ohm BNC
The four output embedders can be individually enabled or disabled, allowing any other data already present on the input video to be retained for downstream use

DELAY THROUGH BOARD

Minimum video in to out delay: 2 lines (HD) and 4 lines (SD)
Minimum embedding audio delay: 3ms

VIDEO DELAY

Optional one frame (33.3ms or 40ms) or two frames (66.6ms or 80ms) video delay allows compensation for Dolby E encoding and decoding

AUDIO DELAY

Adjustable audio delay of up to 80ms on each stereo pair of linear AES or Dolby E will compensate for any small delay between the incoming video and audio signals. Delay is either on or off for any given stereo pair

AUDIO REPLACE

TANDEM 3G has two 32 input/16 output mono audio routing matrices. One is the embedder output router, with the other the AES output router
These allow up to 32 audio channels (16 embedded channels from up to four groups present on the input video, plus up to eight external stereo pair AES inputs) to be routed to 16 outputs for either embedding into up to four groups on the output video, or up to eight external stereo pair AES outputs
HANC cleaning removes the original version of old groups

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 32 audio gain controls, for the 16 channels of audio de-embedded from the video and 16 channels of external AES audio
Mute
Inversion
Stereo to mono conversion

VIDEO PROCESSING

Video proc-amp for picture optimisation, with adjustment of the video gain, black level and independent YUV gains, with a maximum increase of 200%

AUXILIARY DATA

Auxiliary 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
Gains not calibrated
GPI output 6 active

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

One GPI output (GPI 6) is reserved for alarm indication. It may be assigned any number of 37 video and audio alarms:

- Video missing
- 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
- Silence AES 1
- Silence AES 2
- Silence AES 3
- Silence AES 4
- Silence AES 5
- Silence AES 6
- Silence AES 7
- Silence AES 8
- 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
- Dolby E on AES 5
- Dolby E on AES 6
- Dolby E on AES 7
- Dolby E on AES 8

The silence alarms can be delayed before an alarm is asserted to prevent false alarming during quiet audio periods

LOCAL CONTROL

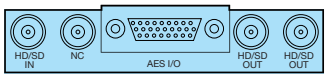
Intuitive board edge interface with two select buttons, shaft encoder and ten character alphanumeric display

REMOTE CONTROL

RS422/485
19200 baud, 8 bits, 1 stop no parity
Control from frame active front panel and remote panel
Statesman allows control from any PC on a network
SNMP monitoring and control available as a frame option

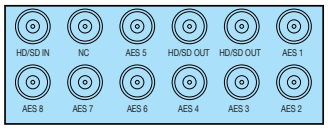
REAR MODULE CONNECTIONS

For standard applications using 110 ohm AES audio



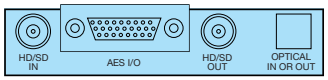
RM47

For standard applications using 75 ohm AES audio



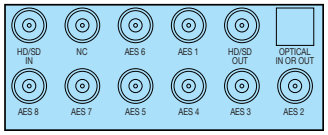
RM49

For fibre applications using 110 ohm AES audio



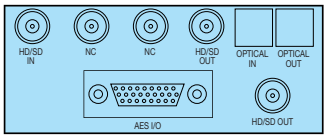
RM60

For fibre applications using 75 ohm AES audio

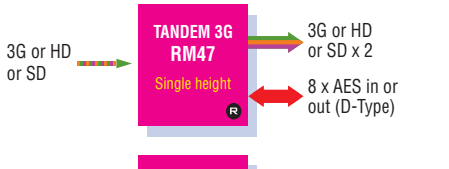


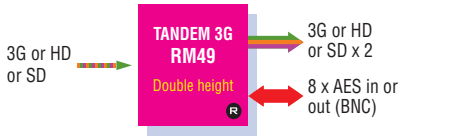
RM61

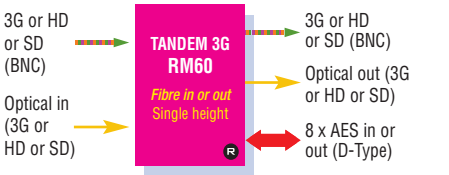
For fibre input and output applications using 110 ohm AES audio



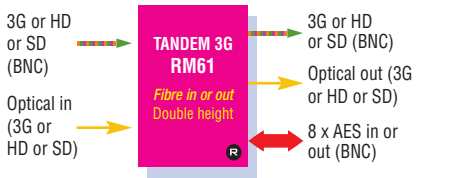
RM70







NB. Choose between fibre in or fibre out by selecting FIP or FOP option



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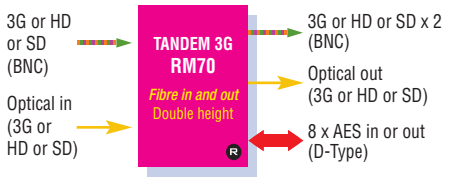

NB. Select FIP option for fibre in, FOP option for fibre out and FIO option for fibre in and out

ORDERING INFORMATION

TANDEM 3G	3G/HD/SD audio embedder/de-embedder for up to four groups of digital audio
FIP	Fibre input option for TANDEM 3G motherboard providing integrated fibre input connectivity
FOP	Fibre output option for TANDEM 3G motherboard providing integrated fibre output connectivity. For CWDM laser output options, please contact Crystal Vision
FIO	Fibre input and output option for TANDEM 3G motherboard providing both integrated fibre input and output connectivity
Indigo 4	4U frame with passive front panel for up to 24 Crystal Vision modules
Indigo 4SE	4U frame with passive front panel fitted with Statesman CPU for up to 24 Crystal Vision modules
Indigo 2	2U frame with passive front panel for up to 12 Crystal Vision modules
Indigo 2AE	2U frame with active front panel for up to 12 Crystal Vision modules
Indigo 2SE	2U frame with passive front panel fitted with Statesman CPU for up to 12 Crystal Vision modules
Indigo 1	1U frame with passive front panel for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1-DP
Indigo 1AE	1U frame with active front panel for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1AE-DP
Indigo 1SE	1U frame with passive front panel fitted with Statesman CPU for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1SE-DP
Indigo DT	Desk top box with passive front panel for up to two Crystal Vision modules
Indigo DTSE	Desk top box with passive front panel fitted with Statesman CPU for up to two Crystal Vision modules
RM47	Single slot frame rear module. Allows maximum number of boards in frame (24 in 4U, 12 in 2U, six in 1U, two in desk top box). Suitable for 110 ohm digital audio. Gives access to one 3Gb/s, HD or SD input, two 3Gb/s, HD or SD outputs and eight AES inputs or outputs
RM49	Two slot frame rear module. Allows 12 boards in 4U, six in 2U, three in 1U and one in desk top box. Suitable for 75 ohm digital audio. Gives access to one 3Gb/s, HD or SD input, two 3Gb/s, HD or SD outputs and eight AES inputs or outputs
RM60	Single slot frame rear module. Allows maximum number of boards in frame (24 in 4U, 12 in 2U, six in 1U, two in desk top box). Designed for applications using fibre inputs or outputs. Suitable for 110 ohm digital audio. **When using fibre input**, allows you to select between one fibre and one electrical 3Gb/s, HD or SD input, and gives out one 3Gb/s, HD or SD output and eight AES inputs or outputs. **When using fibre output**, gives access to one 3Gb/s, HD or SD input, two 3Gb/s, HD or SD outputs (one on fibre and one on BNC) and eight AES inputs or outputs
RM61	Two slot frame rear module. Allows 12 boards in 4U, six in 2U, three in 1U and one in desk top box. Designed for applications using fibre inputs or outputs. Suitable for 75 ohm digital audio. **When using fibre input**, allows you to select between one fibre and one electrical 3Gb/s, HD or SD input, and gives out one 3Gb/s, HD or SD output and eight AES inputs or outputs. **When using fibre output**, gives access to one 3Gb/s, HD or SD input, two 3Gb/s, HD or SD outputs (one on fibre and one on BNC) and eight AES inputs or outputs
RM70	Two slot frame rear module. Allows 12 boards in 4U, six in 2U, three in 1U and one in desk top box. Suitable for 110 ohm digital audio. Designed for applications using both fibre inputs and outputs. **When using fibre input**, allows you to select between one fibre and one electrical 3Gb/s, HD or SD input and gives out two 3Gb/s, HD or SD outputs and eight AES inputs or outputs. **When using fibre output**, gives access to one 3Gb/s, HD or SD input, three 3Gb/s, HD or SD outputs (one on fibre and two on BNC) and eight AES inputs or outputs. **When using both fibre input and output**, allows you to select between one fibre and one electrical 3Gb/s, HD or SD input and gives out three 3Gb/s, HD or SD outputs (one on fibre and two on BNC) and eight AES inputs or outputs
REMIND	19" remote control panel
REMIND-E	19" Ethernet remote control panel
Statesman	PC Control System
SNMP	SNMP monitoring and control

Crystal Vision

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