

# Crystal Vision



## TANDEM 310

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

TANDEM 310 is a very powerful embedding/de-embedding product: working with 3Gb/s, HD and SD sources and with the ability to embed and de-embed a mixture of up to four groups of AES and two groups of analogue audio at the same time. You can even use it as a Dolby decoder just by fitting a top board. Further functionality includes audio and video processing, integrated fibre connectivity and flexible delay compensation.

TANDEM 310 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. Alternatively, fitting a Dolby option makes it a convenient way to decode Dolby E signals that need to be de-embedded.

- ⦿ Combined audio embedder/de-embedder
- ⦿ Use it with any source: works with 3Gb/s, HD and SD video and both AES and analogue audio
- ⦿ Flexible embedding and de-embedding of external audio: use piggybacks to configure it as a two group analogue audio embedder/de-embedder or a four group AES embedder/de-embedder – or mix analogue and digital piggybacks
- ⦿ Powerful audio routing: full channel shuffling and overwriting
- ⦿ Easy to match all your signals: with additional 400ms of audio delay and additional ten frames of video delay
- ⦿ Use it as a Dolby decoder: simply fit a DBE-D Dolby decoder top board
- ⦿ Sophisticated audio metadata handling, including SMPTE 2020 embedding
- ⦿ Optimise the audio: with full audio processing including individual gain adjustments, stereo to mono conversion and channel muting and inversion
- ⦿ Optimise the video: video proc-amp including RGB and YUV lift and gain controls
- ⦿ Optional integrated fibre input/output connectivity means you won't be limited by cable lengths
- ⦿ Get peace of mind by knowing the status of your signal: easily monitor a large number of video and audio alarms
- ⦿ Save rack space: 100mm x 266mm module allows 12 TANDEM 310 in 2U (six in 1U and two in desk top box) – or if fitted with Dolby decoder option allows six TANDEM 310 in 2U (three in 1U and one in desk top box)
- ⦿ Flexible control: select from board edge, front and remote panels, GPIs, SNMP and PC software

# TANDEM 310

## WHY USE TANDEM 310?

TANDEM 310 is a very powerful and flexible audio embedder/de-embedder system. You can use it when you need to embed and de-embed at the same time or if you want a single product for use as an embedder or de-embedder as required.

TANDEM 310 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. TANDEM 310 can embed and de-embed a mixture of up to eight AES stereo pairs and four analogue stereo pairs (or eight mono channels) at the same time. It includes video and audio processing, delay compensation and integrated fibre input/output. It can even be used to decode Dolby E and to embed SMPTE 2020 audio metadata.

### EMBED AND DE-EMBED ANALOGUE OR DIGITAL AUDIO (OR BOTH)

TANDEM 310 embeds and de-embeds external audio by fitting up to two audio piggybacks to the main board. Three different piggybacks are available.

For analogue audio the 3G-AIP2 is used for embedding two stereo pairs or four mono channels and the 3G-AOP2 for de-embedding two stereo pairs or four mono channels. For digital audio the DIOP4 piggyback is used for embedding or de-embedding four stereo pairs, with four bi-directional AES ports available on each piggyback – giving you the option of embedding or de-embedding each stereo pair independently.

By fitting two of these piggybacks TANDEM 310 can be configured as a two group analogue audio embedder/de-embedder or a four group AES embedder/de-embedder. Alternatively 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. TANDEM 310 is aware of which piggyback/Dolby options are fitted and adjusts the menus and audio routers to reflect the options available.

### Which piggybacks can I fit?

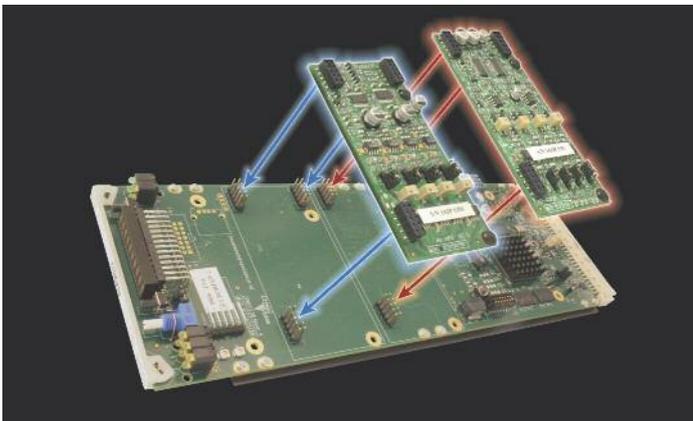
These are the combination of piggybacks that can be fitted to...

A standard TANDEM 310:

Front position	Rear position
None	None
DIOP4	None
3G-AIP2	None
3G-AOP2	None
DIOP4	DIOP4
DIOP4	3G-AIP2
DIOP4	3G-AOP2
3G-AIP2	3G-AIP2
3G-AIP2	3G-AOP2
3G-AOP2	3G-AOP2

A TANDEM 310 fitted with a DBE-D Dolby decoder:

Front position	Rear position
None	None
DIOP4	None
3G-AIP2	None
3G-AOP2	None
DIOP4	DIOP4 (output only)
DIOP4	3G-AOP2
3G-AIP2	3G-AOP2
3G-AOP2	3G-AOP2



### THE IDEAL EMBEDDER/DE-EMBEDDER FOR DOLBY E USERS

TANDEM 310 is ideal for Dolby E users. It allows the embedding and de-embedding of synchronous Dolby E, while TANDEM 310's additional video delay can be used to compensate for the one frame of audio delay introduced when converting to or from Dolby E.

TANDEM 310 can also be used as a Dolby decoder, simply by fitting a top board – making it a more convenient and space-saving way to decode Dolby E signals that need to be de-embedded than using a separate product for the task.

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.

### DECODE DOLBY E



TANDEM 310 fitted with DBE-D

TANDEM 310 can be fitted with a DBE-D Dolby decoder – a top board which connects directly to the main board through an expansion connector.

The DBE-D allows a Dolby E encoded signal to be decoded and then be either output as analogue or AES audio (using the appropriate piggybacks) or re-embedded into the output video. The DBE-D is perfect for those embedded audio applications where the audio within the Dolby E stream needs to be processed in some way, or where the Dolby E needs to be decoded before transmission.

The Dolby option router is used to select which Dolby E signal to send to the decoder. The Dolby E must be a pair and can be selected either from the embedded video input or from an external audio stream which is input via a DIOP4 piggyback. Only one audio input piggyback can be used if the DBE-D Dolby decoder is fitted.

The DBE-D decodes the Dolby E and outputs up to eight mono channels, which appear as inputs to the audio routers. Also provided are two stereo downmixes: Left total/Right total and Left only/Right only. These mix the multiple audio channels within the 5.1 surround sound down to a single stereo pair for easier monitoring. The Lt/Rt downmix includes encoding which allows regeneration of the original five channels. The Lo/Ro downmix gives a straight left/right version which is optimised for mono compatibility, and it also allows adjustment of how much of the stereo comes from each surround sound channel – ideal for those who wish to mimic the effect of a non-ideal listening set up with the surround sound.

Decoded audio metadata can be transported either via RS422 links (via the 9-way D-Type on the RM46 rear module or via the frame's GPI lines when using the RM74 rear module) or through SMPTE 2020 embedded data. The metadata status can be remotely read on the DBE-D using SNMP or Crystal Vision's PC control software, allowing you to check that the metadata is the value you want – particularly useful for parameters such as 'Dialnorm' where audio levels are set to a defined level for compliance with loudness requirements.

## SMPT E 2020 EMBEDDING

TANDEM 310 can embed SMPT E 2020, which is a way of carrying easily accessible audio metadata in the same data stream as the video and embedded audio.

The SMPT E 2020 embedding extracts the data from the RS422-format stream coming from the DBE-D Dolby decoder and puts it into the video stream as required by SMPT E 2020, supporting both the Method A and Method B embedding patterns.

## POWERFUL AUDIO ROUTING

TANDEM 310 includes powerful audio routing, allowing full shuffling and overwriting of the mono channels taken from the incoming video input, input piggybacks and Dolby decoder.

At the heart of TANDEM 310 are two mono audio routing matrices. The first is the Embedder router which is used to select which of up to 32 audio input channels should be embedded into up to four groups on the output video. HANC cleaning removes the original version of old groups. The second router is used to select which of up to 32 audio input channels should be output as external AES or analogue audio, and is known as the Analogue output router if a 3G-AOP2 piggyback is fitted and as the AES output router if a DIOP4 (and no 3G-AOP2) piggyback is fitted.

The configuration of the input and output channels changes depending on whether a Dolby decoder option is fitted.

### No Dolby option:

Select your audio from up to...	Route this audio to...
<ul style="list-style-type: none"><li>• 16 channels de-embedded from the input video</li><li>• 16 channels from two input piggybacks</li></ul>	<ul style="list-style-type: none"><li>• 16 channels for embedding into the output video</li><li>• Up to 16 channels for output as external AES or analogue audio via appropriate piggybacks</li></ul>

### With DBE-D fitted:

Select your audio from up to...	Route this audio to...
<ul style="list-style-type: none"><li>• 16 channels de-embedded from the input video</li><li>• Four channels from one input piggyback</li><li>• 12 channels from the Dolby decoder (up to eight channels of decoded audio, plus the two stereo downmixes)</li></ul>	<ul style="list-style-type: none"><li>• 16 channels for embedding into the output video</li><li>• 14 channels for output as external AES or analogue audio via appropriate piggybacks</li></ul> <p><i>NB. Two channels are used as audio sources for the Dolby decoder</i></p>

## EASY TO MATCH ALL YOUR SIGNALS

As well as featuring short minimum delays for both the audio and video to help prevent system lip-sync complications, TANDEM 310 makes it easy to compensate for any delay between the incoming video and audio and match all the signals.

An adjustable audio delay of up to 400ms (adjustable in 1ms steps) provides flexibility in compensating for any audio delays introduced by other equipment.

Up to ten frames of video delay (adjustable in one frame steps) can be used to match any big system delays, such as those created by Dolby E encoding and decoding or transcoding to AC3 and re-embedding. This allows the video and audio timing to 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.

## OPTIMISE THE AUDIO

TANDEM 310 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 32 audio gain controls, one for each of the available input channels. Each gain control is independently adjustable between +18dB and -18dB in 0.1dB steps.

Each of 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.

## OPTIMISE THE VIDEO

It's not just the audio that can be improved. TANDEM 310 additionally includes a video proc-amp for picture optimisation, with adjustment of the video gain, black level and independent RGB and YUV gains.

## 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 310 integrated fibre connectivity. 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 SMPT E 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 310 can also support a CWDM laser if required.

## SAVE RACK SPACE

TANDEM 310 is a space-saving 100mm x 266mm module which is housed in the Indigo frames – available in 2U, 1U and desk top box sizes – and with up to 12 boards fitting in 2U.

TANDEM 310 can be used with a variety of different frame rear modules to access the inputs and outputs. You select the rear module based on the type of audio you are using (75 ohm AES, 110 ohm AES or analogue audio), whether you are using fibre input or output (or both), and whether a Dolby decoder option is fitted.

See the REAR MODULE CONNECTIONS section on Page Five for full information on the rear modules available.

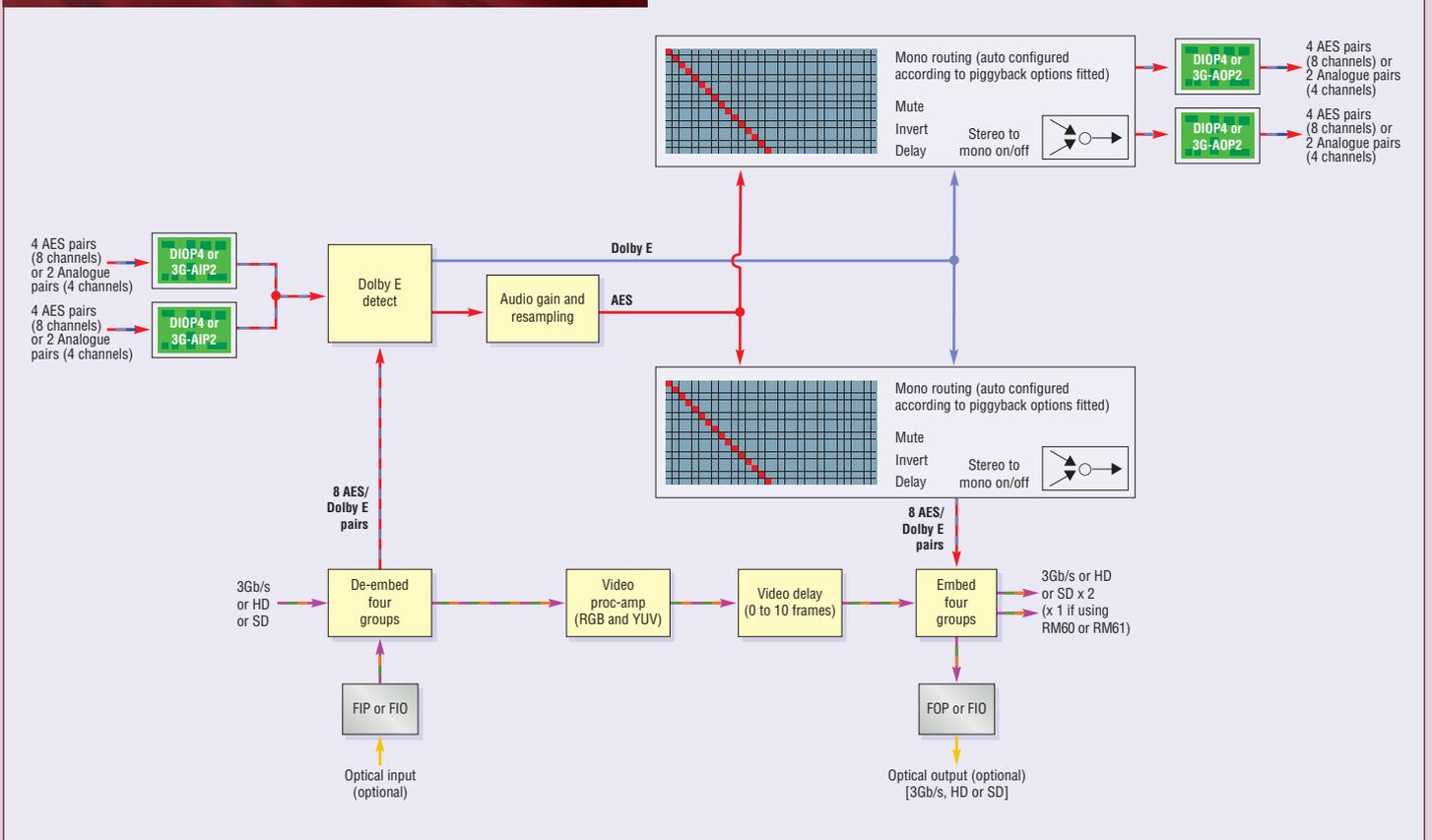
## EASY AND FLEXIBLE CONTROL – AND SIGNAL MONITORING

TANDEM 310 is very straightforward to operate, with control options including board edge switches, an integrated control panel on the AE frames, a remote control panel, GPIs, SNMP, the Statesman PC software and the VisionWeb Control web browser software.

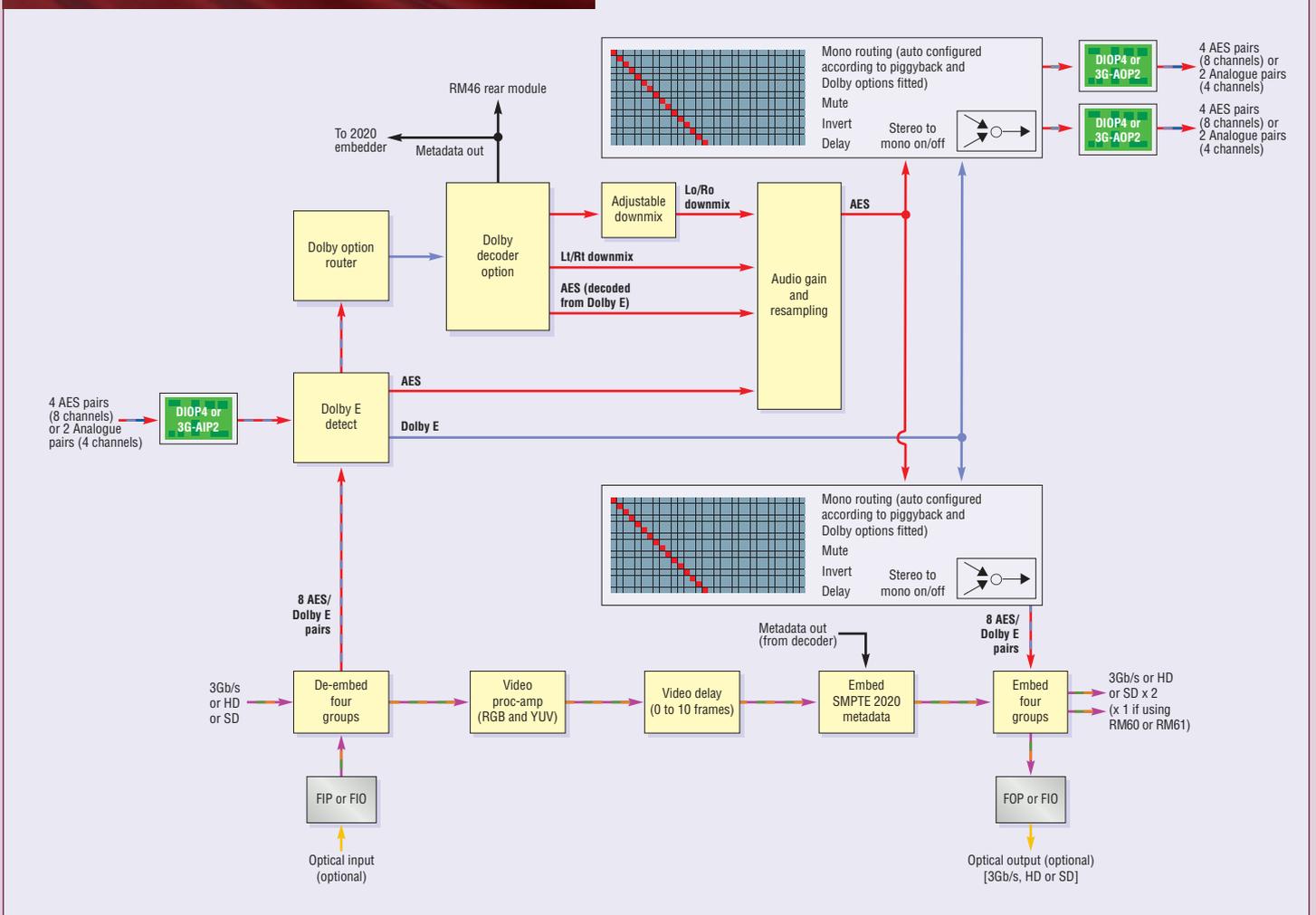
Up to 16 user-defined presets, containing the board setup data, may be stored and recalled. Two GPI outputs are reserved for alarm indication and may be assigned any number of video and audio alarms, allowing comprehensive signal monitoring. (See the SPECIFICATION for full list of 57 alarms, including which are available when different piggyback/Dolby options are fitted.) The silence alarms can be delayed before triggering to prevent false alarming during quiet periods in the audio.

# THE INPUTS AND OUTPUTS

## For straightforward embedding and de-embedding...



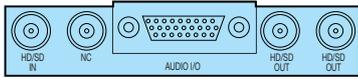
## For embedding and de-embedding with Dolby decoding...



# REAR MODULE CONNECTIONS

For straightforward embedding and de-embedding...

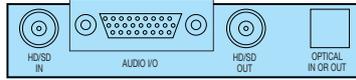
For standard applications using 110 ohm AES or analogue audio



RM47



For fibre input or output applications using 110 ohm AES or analogue audio

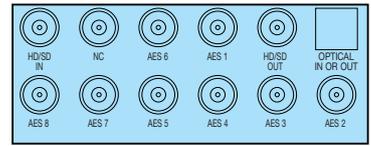


RM60



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

For fibre input or output applications using 75 ohm AES

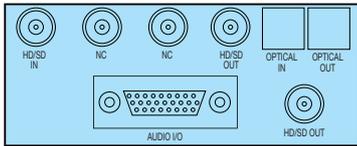


RM61



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

For fibre input and output applications using 110 ohm AES or analogue audio

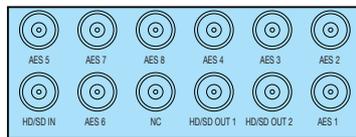


RM70



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

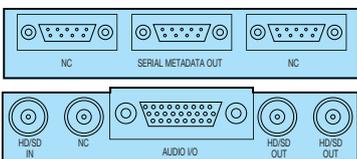
For standard applications using 75 ohm AES



RM74



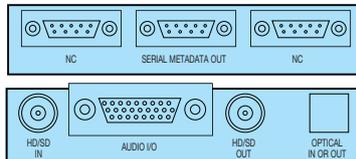
For Dolby decoding applications using 110 ohm AES or analogue audio



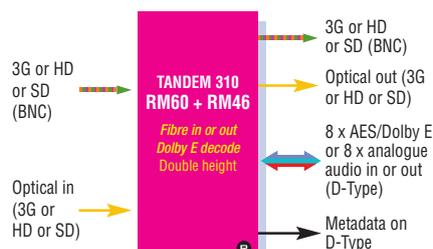
RM47 + RM46



For Dolby decoding applications using 110 ohm AES or analogue audio and fibre input or output

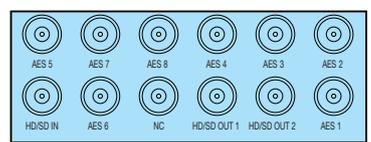


RM60 + RM46

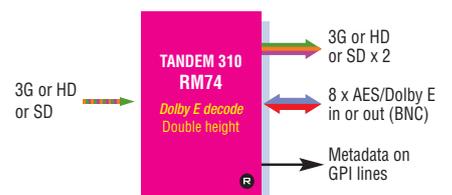


NB. Choose between fibre in or fibre out by selecting FIP or FOP option

For Dolby decoding applications using 75 ohm AES



RM74



**TANDEM 310 MOTHERBOARD****MECHANICAL**

Standard Crystal Vision module 266mm x 100mm

Weight: 200g

Power consumption: 9 Watts; 0.6 Watts (FIP and FOP); 1 Watt (FIO)

**VIDEO INPUT**

One 3Gb/s or HD or SD input

When using FIP or FIO fibre input options 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, 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 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

Automatic de-embedding to SMPTE 272M or SMPTE 299M

**VIDEO OUTPUTS**

Using RM47, RM47 + RM46 and RM74 rear modules: Two 3Gb/s, HD or SD outputs

Using RM60, RM60 + RM46 and RM61 rear modules with FIP fibre input option: One 3Gb/s, HD or SD output

Using RM60, RM60 + RM46 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 310 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 or analogue audio), RM61 (for 75 ohm AES) or RM70 (for 110 ohm AES or analogue audio) frame rear module must be used

When fitted with a FIP, FOP or FIO, TANDEM 310 can be housed in any frame slot position but due to its extra height it is not possible to place most Standard Definition or audio boards directly above it when the TANDEM 310 is in

even numbered slot positions. 3Gb/s and HD boards do not share this restriction

FIP, FOP and FIO meet the SMPTE 297-2006 short-haul specification, allowing operation with single-mode and multi-mode fibre

Connector type: SC/PC

FIP or FIO input:

Optical wavelength: 1260-1620nm

Input level maximum: -1dBm

Input level minimum: Typical -20dBm (-18dBm 3Gb/s pathological)

FOP or FIO output:

Optical power: Max -0.0dBm, 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)

CWDM laser can be fitted on request – please specify the wavelength required

**AUDIO INPUTS AND OUTPUTS**

Piggybacks can be added to the main board to enable either input or output of 4 x AES or 2 x analogue stereo pairs

Use 3G-AIP2 to input analogue audio. Fit one piggyback for one audio group or two piggybacks for two audio groups

Use 3G-AOP2 to output analogue audio. Fit one piggyback for one audio group or two piggybacks for two audio groups

Use bi-directional DIOP4 to input or output 75 ohm AES or 110 ohm AES audio. Each channel can be independently configured to be either an AES input or AES output 24 bit stereo pair. Fit one piggyback for two audio groups or two piggybacks for four audio groups

Different piggybacks can be used together, 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). If a DBE-D Dolby decoder is fitted, only one input piggyback can be used

TANDEM 310 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 310 to embed synchronous compressed audio such as AC3

**DELAY THROUGH BOARD**

Minimum video in to out delay: <1 line

Minimum embedding audio delay: <200us

**VIDEO DELAY**

Optional ten frames of video delay adjustable in one frame steps allows compensation for any big system delays such as Dolby E encoding and decoding and transcoding to AC3 and re-embedding

**AUDIO DELAY**

Adjustable audio delay of up to 400ms on each stereo pair adjustable in 1ms steps will compensate for any delay between the incoming video and audio signals. Delay is either on or off for any given stereo pair or can be set to follow the video frame delay

**DOLBY DECODING**

A DBE-D Dolby decoder top board can be optionally fitted to TANDEM 310

The DBE-D allows a Dolby E signal in the embedded video input or from an external audio stream (input via a DIOP4 piggyback) to be decoded and be either output as analogue or AES audio or re-embedded

Select which Dolby E signal to send to the decoder using the Dolby option router. The Dolby must be a stereo pair

Metadata can be output as RS422 and embedded to SMPTE 2020. The metadata status can be remotely read using SNMP or Crystal Vision's PC software

DBE-D includes two stereo downmixes (Lt/Rt and Lo/Ro), which mix the multiple audio channels within the 5.1 surround sound down to a single stereo pair for easier monitoring. The Lo/Ro downmix can adjust how much of the stereo comes from each surround sound channel

If a DBE-D is fitted, TANDEM 310 can be used with three different rear modules: either the RM47 + RM46 for standard 110 ohm applications, the RM74 for standard 75 ohm applications or the RM60 + RM46 for 110 ohm fibre applications

**AUDIO REPLACE**

TANDEM 310 has two input/output mono audio routing matrices. The first is the Embedder router; the second is either the Analogue output router (if a 3G-AOP2 piggyback is fitted) or the AES output router (if a DIOP4 piggyback is fitted and a 3G-AOP2 is not fitted). This second router will not be shown if neither 3G-AOP2 nor DIOP4 piggybacks are fitted

These audio routers are auto configured according to the piggyback and Dolby options fitted to the motherboard, to a maximum of 32 x 16 for each router

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 audio and 16 channels of external AES audio/Dolby option audio

Mute

Inversion

Stereo to mono conversion

**VIDEO PROCESSING**

Video proc-amp for picture optimisation, with adjustment for the video gain, black level and independent RGB and YUV gains

Video gain: Modify the gain of the whole video signal from 0 to +200%

RGB lift: Offset the colour component by +/- 10%

RGB gain: Modify the gain of the colour component from +80% to +120%

Y lift: Offset the luminance component by +/- 10%

Y gain: Modify the luminance gain from 0 to +200%

U/V lift: Offset the U or V component by +/- 10%

U/V gain: Modify the U or V component gain from 0 to +200%

#### 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

GPI output 5 active

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

Two GPI outputs (GPI 5 and GPI 6) are reserved for alarm indication. They may be assigned any number of video and audio alarms. 23 alarms are available as standard, with an additional 34 alarms available depending on the piggyback and Dolby options fitted to TANDEM 310. Video missing, video black, video frozen, input groups missing and AES channels missing 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

#### Standard alarms:

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

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

#### With front DIOP4 fitted:

Missing AES 1

Missing AES 2

Missing AES 3

Missing AES 4

Silence AES 1

Silence AES 2

Silence AES 3

Silence AES 4

#### With rear DIOP4 fitted:

Missing AES 5

Missing AES 6

Missing AES 7

Missing AES 8

Silence AES 5

Silence AES 6

Silence AES 7

Silence AES 8

#### With front 3G-AIP2 fitted:

Silence analogue audio channels 1 and 2

Silence analogue audio channels 3 and 4

#### With rear 3G-AIP2 fitted:

Silence analogue audio channels 9 and 10

Silence analogue audio channels 11 and 12

#### With DBE-D fitted:

Silence decoder ChA

Silence decoder ChB

Silence decoder ChC

Silence decoder ChD

Silence decoder Lo/Ro downmix

Silence decoder Lt/Rt downmix

#### LOCAL CONTROL

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

#### REMOTE CONTROL

Control from integrated control panel on AE frames and 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

Statesman allows control from any PC on a network

SNMP monitoring and control available as a frame option

### 3G-AIP2 DUAL ANALOGUE AUDIO INPUT PIGGYBACK

#### MECHANICAL

Power consumption: 1.6 Watts

#### AUDIO INPUTS

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

#### MECHANICAL

Power consumption: 1.5 Watts

#### 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

#### MECHANICAL

Power consumption: 0.9 Watts

#### 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 310	3G/HD/SD audio embedder/de-embedder for up to four groups of AES and two groups of analogue audio (allows fitting of up to two audio piggybacks)
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)
DBE-D	Dolby decoder top board which converts the channels encoded within an incoming Dolby E pair to discrete AES channels plus two stereo downmixes. If fitted, makes TANDEM 310 a 'double height' board which uses two frame slots
FIP	Fibre input option for TANDEM 310 motherboard
FOP	Fibre output option for TANDEM 310 motherboard. For CWDM laser options, contact Crystal Vision
FIO	Fibre input and output option for TANDEM 310 motherboard
Indigo 2AE	2U frame with active front panel featuring smart CPU and integrated control panel for up to 12 Crystal Vision modules
Indigo 2SE	2U frame with active front panel featuring smart CPU for up to 12 Crystal Vision modules
Indigo 1AE	1U frame with active front panel featuring smart CPU and integrated control panel for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1AE-DP
Indigo 1SE	1U frame with active front panel featuring smart 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 active front panel featuring smart CPU for up to two Crystal Vision modules
RM47	Single slot frame rear module. Allows maximum number of TANDEM 310 in frame (12 in 2U, six in 1U, two in desk top box). Suitable for 110 ohm AES or analogue audio. Gives access to one 3Gb/s, HD or SD input, two 3Gb/s, HD or SD outputs and all audio inputs or outputs
RM47 + RM46	Two single slot frame rear modules used together for when Dolby decoder top board is fitted. Allows six TANDEM 310 in 2U, three in 1U and one in desk top box. Suitable for 110 ohm AES or analogue audio. Gives access to one 3Gb/s, HD or SD input, two 3Gb/s, HD or SD outputs and all audio inputs or outputs including decoded Dolby E and metadata
RM60	Single slot frame rear module. Allows maximum number of TANDEM 310 in frame (12 in 2U, six in 1U, two in desk top box). Designed for applications using fibre inputs or outputs. Suitable for 110 ohm AES or analogue audio. <b>When using fibre input</b> , 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 all audio inputs or outputs. <b>When using fibre output</b> , 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 all audio inputs or outputs
RM60 + RM46	Two single slot frame rear modules used together for when Dolby decoder top board is fitted. Allows six TANDEM 310 in 2U, three in 1U and one in desk top box. Designed for applications using fibre inputs or outputs. Suitable for 110 ohm AES or analogue audio. <b>When using fibre input</b> , 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 all audio inputs or outputs including decoded Dolby E and metadata. <b>When using fibre output</b> , 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 all audio inputs or outputs including decoded Dolby E and metadata
RM61	Two slot frame rear module. Allows six TANDEM 310 in 2U, three in 1U and one in desk top box. Designed for applications using fibre inputs or outputs. Suitable for 75 ohm AES. <b>When using fibre input</b> , 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 all audio inputs or outputs. <b>When using fibre output</b> , 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 all audio inputs or outputs
RM70	Two slot frame rear module. Allows six TANDEM 310 in 2U, three in 1U and one in desk top box. Designed for applications using both fibre inputs and outputs. Suitable for 110 ohm AES or analogue audio. <b>When using fibre input</b> , 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 all audio inputs or outputs. <b>When using fibre output</b> , 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 all audio inputs or outputs. <b>When using both fibre input and output</b> , 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 (one on fibre and one on BNC) and all audio inputs or outputs
RM74	Two slot frame rear module. Allows six TANDEM 310 in 2U, three in 1U and one in desk top box. (Note that board sits in rear module bottom slot.) Suitable for 75 ohm AES. Can be used either with or without Dolby decoder top board. Gives access to one 3Gb/s, HD or SD input, two 3Gb/s, HD or SD outputs and all audio inputs or outputs including decoded Dolby E and metadata
VisionPanel	3U Ethernet remote control panel with touch screen
VisionWeb Control	VisionWeb web browser control included within frame software
Statesman	PC Control System
SNMP	SNMP monitoring and control

Performance and features are subject to change. Figures given are typical measured values. TANDEM3101115