TANDEM HD-20

HD/SD audio embedder/de-embedder

USER MANUAL

Crystal Vision

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Revision 2	Table on page 10, Sub PCB connection details RM33 changed to reflect Statesman
Revision 3	Manual formating corrected
Revision 4	Block diagram on page 4 corrected

1 Introduction

The TANDEM HD-20 is a High Definition video 24-bit two group audio analogue or digital embedder/de-embedder. It can be configured with two sub-PCB option cards to provide any of a number of possible functions at once, such as:

- De-embed, audio process, re-embed
- Embed digital or analogue audio into two groups
- De-embed and output digital or analogue audio from two groups
- Embed digital or analogue audio in one group whilst de-embedding and outputting digital or analogue audio from a second group

In addition to embedding and de-embedding two audio groups, TANDEM HD-20 incorporates a number of powerful features. For example, a built-in audio delay is provided to compensate for video processing, analogue monitoring can be used to preview sources and audio quality is ensured with forward error correction.

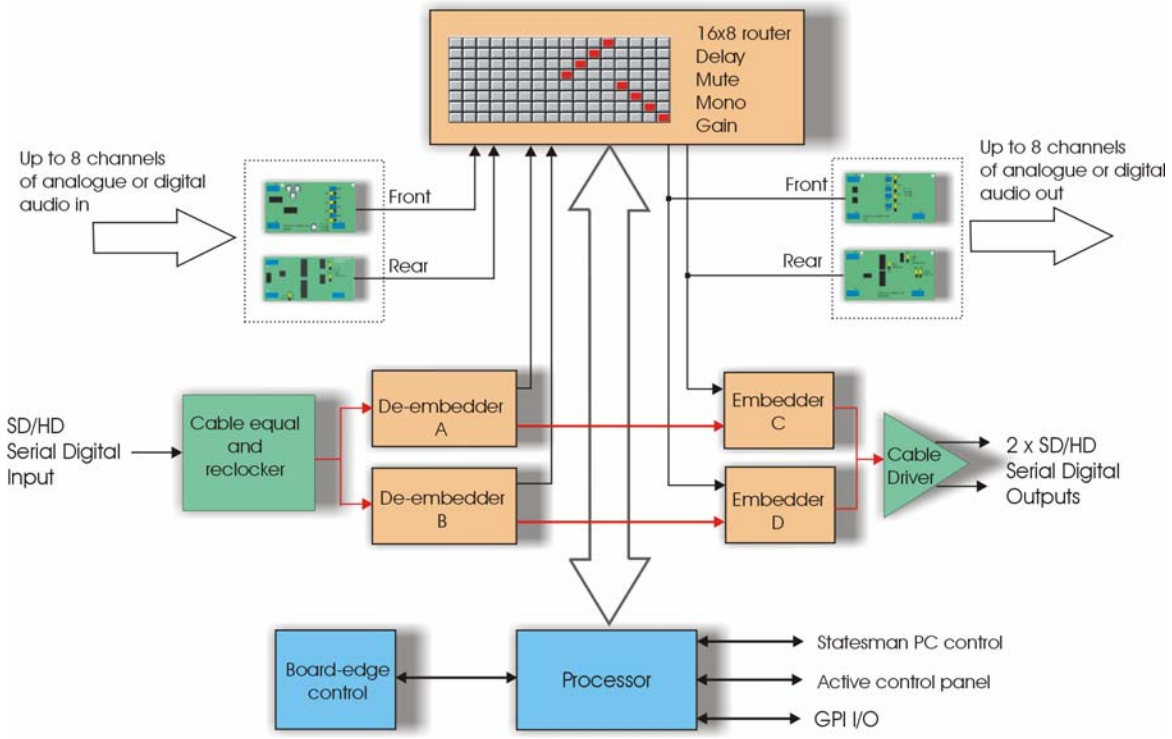
Control is available from the card edge, active control panels or by serial control from Statesman, a dedicated software application.

The main features are as follows:

- HD/SD capable
- De-embeds and re-embeds two audio groups
- Built-in multi-channel digital audio delay
- Independent audio gain controls
- HANC blanking option
- Audio source preview monitoring
- EDH insertion
- Audio replacement
- Channel swapping/shuffling
- Stereo to mono conversion
- Control and status monitoring via board edge or frame/remote control panel or Statesman
- Analogue and AES audio input / output sub-PCBs
- Audio forward error correction protection in de-embedders – handles untimed or asynchronous SDI with minimum corruption
- GPI control of configuration set-ups

TANDEM HD-20 has a single video signal path with two de-embedders and two embedders, which allow the extraction and insertion of up to two groups (eight channels) of audio. Additional sub-PCBs further increase the number of audio channels available for selection to re-embed to 16. Analogue, AES and Dolby E audio formats can be handled simultaneously, although care must be taken not to disrupt the integrity of any Dolby E data by inappropriate routing or gain manipulation.

TANDEM HD-20 automatically inserts EDH information on its SDI output. HANC blanking is also implemented either automatically or by selection.



TANDEM HD-20 block diagram

Functions include audio shuffling, video delay, gain compensation and audio replace.

The are two positions available on the TANDEM HD-20 for fitting optional sub-PCBs. The rear position 1 is associated with inputs 9-12 and outputs 1-4. The front position 2 with inputs 13-16 and outputs 5-8.

An 18-Volt regulator option card is also required when using analogue input or output cards.

The available option cards are:

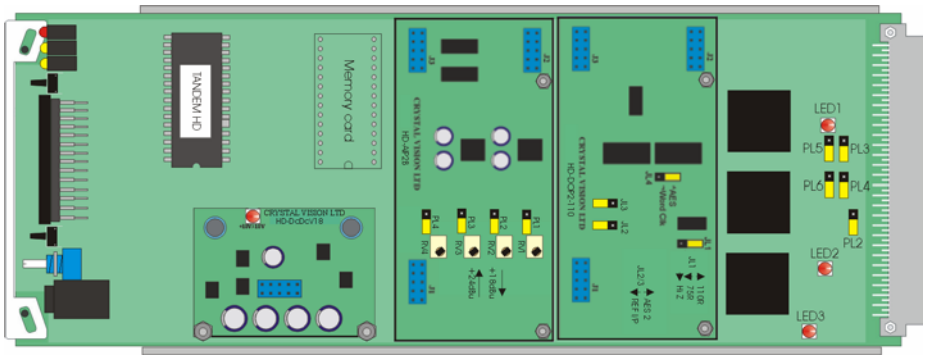
- HD-DIP2 – 2 x AES/EBU/Dolby E inputs for synchronous 48kHz audio, 75 Ohm, 110 Ohm, HiZ
- HD-DIP2-RS – 2 x AES/EBU inputs with re-sampler for asynchronous audio (30 to 108kHz), 75 Ohm, 110 Ohm, HiZ
- HD-DOP2-110 – 2 x AES/EBU/Dolby E outputs, 110 Ohm balanced
- HD-DOP2-75 – 2 x AES/EBU/Dolby E outputs, 75 Ohm unbalanced
- HD-AIP2 – Analogue dual stereo audio input
- HD-AOP2 – Analogue dual stereo audio output

2 Hardware installation

The TANDEM HD-20 single slot module uses the single height RM33 and dual height RM39 rear connectors that will fit into all Crystal Vision rack frames. All modules can be plugged in and removed while the frame is powered without damage.

2.1 Module configuration

The TANDEM HD-20 has positions available for mounting three sub-PCBs. Two of these can be any of the six available audio PCBs. The third position is for the ±18V regulator needed when any analogue sub-PCB is fitted.



DcDcV18 Front sub PCB Rear sub PCB

TANDEM HD-20

Link configuration and LEDs

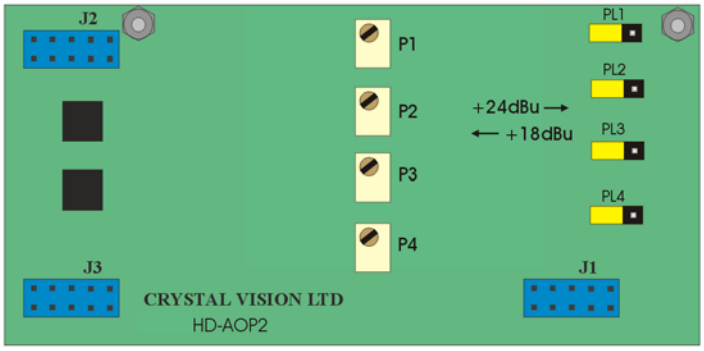
There are five jumper links and three surface-mounted LEDs on the TANDEM HD-20 motherboard. The surface-mounted LEDs are not viewable from the front of the frame and are included for diagnostic purposes.

Link	Function
PL2, PL3, PL4, PL5, PL6	No user configuration, factory set
LED1	Output serialiser locked
LED2	Input deserialiser locked
LED3	Input deserialiser carrier detect

2.2 Sub-module link settings

HD-AOP2

The analogue audio output module provides two stereo pairs or four mono outputs that may be used as destinations when routing de-embedded signals. Link jumpers are provided to allow 0dBFS to be set to +18dBu or +24dBu. The variable adjustments on the card are set at the factory and should not require re-adjustment. Set channel 1 with PL1/P1, channel 2 with PL2/P2, channel 3 with PL3/P3 and channel 4 with PL4/P4.

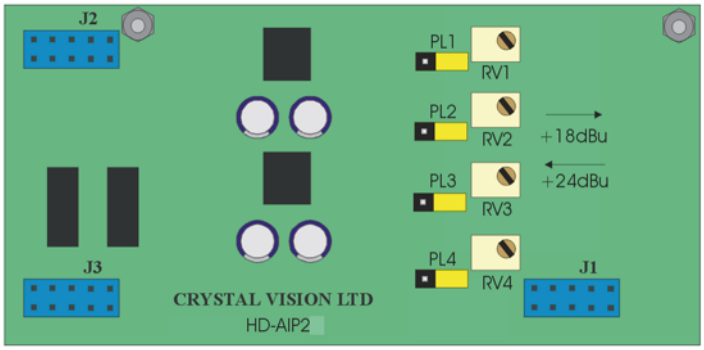


HD-AOP2

Selectable jumper links are provided to change input and reference terminations and pre-set levels, depending on sub-module features.

HD-AIP2

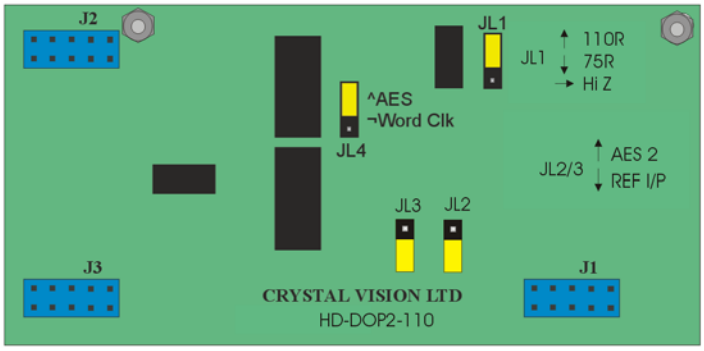
The analogue audio input module provides two stereo pairs or four mono signals that may be used as a source in subsequent embedding. Link jumpers are provided to allow 0dBFS to be set to +18dBu (rearwards, towards J1) or +24dBu (forwards, towards J2/3). The variable adjustments on the card are set at the factory and should not require re-adjustment. Set channel 1 with PL2/RV2, channel 2 with PL1/RV1, channel 3 with PL4/RV4 and channel 4 with PL3/RV3. *Take care to note the adjustment and channel numbering on this sub-board.*



HD-AIP2

HD-DOP2-110

This digital audio output module provides two 110 Ohm AES stereo pairs or four mono outputs that may be used as destinations when routing de-embedded signals.

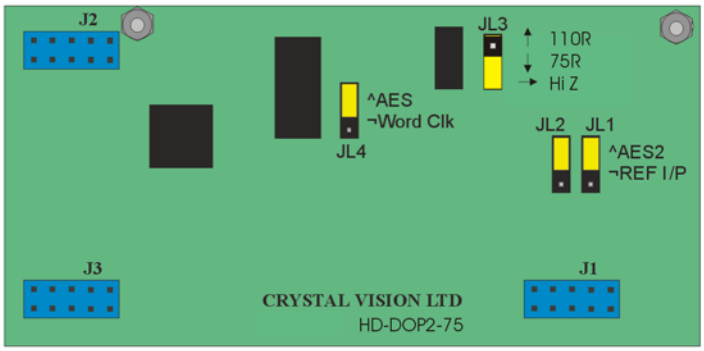


HD-DOP2-110

TANDEM HD-20 does not support an external reference. JL2 will normally be left in its upper position so giving the second AES2 output. JL3 and JL4 have no function.

HD-DOP2-75

This digital audio output module provides two 75 Ohm AES stereo pairs or four mono outputs that may be used as destinations when routing de-embedded signals.

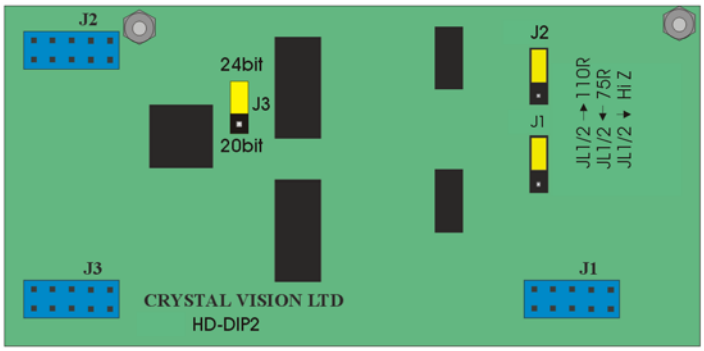


HD-DOP2-75

TANDEM HD-20 does not support an external reference. JL2 will normally be left in its upper position so giving the second AES2 output. JL3 and JL4 have no function.

HD-DIP2

This digital audio input module provides two AES stereo pairs or four mono channels that may be used as sources in subsequent embedding.

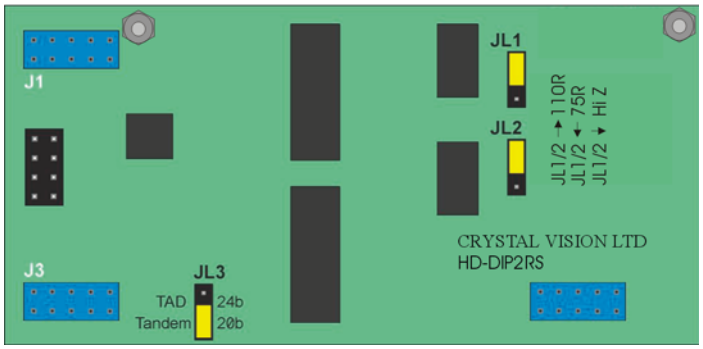


HD-DIP2

Link jumpers are provided to select between 110 Ohm (upper 2 pins), HiZ (balanced – centre pins only) or 75 Ohm (unbalanced – lower 2 pins). **J3 must be selected for 24-bit.**

HD-DIP2-RS

This digital audio input module provides two AES stereo pairs or four mono channels with an integral re-sampler for use when the AES input is either asynchronous, or at a sample rate other than 48kHz.



HD-DIP2-RS

The sample rate inputs can work with signals from less than 30kHz to 108kHz. It is particularly useful for asynchronous 48kHz inputs, and other sample rate inputs such as 44.1kHz and 96kHz.

The signal output from the HD-DIP2-RS to the TANDEM HD-20 is at 48kHz derived from the video content of the SDI signal into which it is to be embedded.

Because of the processing of the audio waveform, error words indicated by V-bit set high are ignored. Occasional errors marked by V-bit high such as would be the case with a noisy or too long AES input path, are masked out by the processing.

If the V-bit is consistently high, to indicate continuous error states, or to indicate non-audio data, then the processor will give a silent output. All other cards, except RS4, pass audio data unaltered even when V bit is set or held high.

Link jumpers are provided to select between 110 Ohm (upper two pins), HiZ (balanced – centre pins only) or 75 Ohm (unbalanced – lower two pins). For TANDEM HD-20 jumper JL3 must be in the 24-bit (TAD) position.

Notes: In general, balanced outputs require the use of rear modules with a D-Type connector and unbalanced outputs are for use with BNCs.
HiZ is achieved by removing termination jumpers – they can be parked for safe keeping by replacing them using only one pin.

2.3 Rear modules and signal I/O

The Indigo 4 4U frame will house up to 24 single height modules with up to three power supplies. The Indigo 2 2U frame will house up to 12 single height modules and dual power supplies. The Indigo 1 1U frame will house six single height modules and a single/dual power supply. The Indigo desk top box has a built-in power supply and will house up to two single height modules.

Note: For details of fitting rear connectors please refer to the appropriate frame manual.

RM33 rear module connections

The RM33 being a single height module will allow maximum packing density with the maximum number of outputs available.

RM33 rear module connector	Description
	**RM33** • 24 TANDEM HD-20 modules per Indigo 4 frame • 12 per Indigo 2 frame • Six per Indigo 1 frame • 2 per Indigo DT • All frame slots can be used

BNC	I/O assignment
HD SDI OUT	Serial digital output
HD SDI OUT	Serial digital output
NC	No user connection
HD SDI IN	Serial digital input

Input sub-PCBs

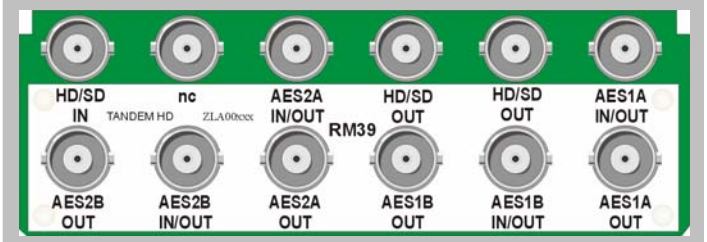
HD-AIP2		HD-DIP2		HD-DIP2-RS		pin-out
	GND		GND		GND	1
Input 9 (Rear 1)	1L+	Input 9-10 (Rear 1-2)	AES1+	Input 9-10 (Rear 1-2)	AES1+	2
	1L-		AES1-		AES1-	3
Input 10 (Rear 2)	1R+		AES1scrn		AES1scrn	4
	1R-		NC		NC	5
Input 11 (Rear 3)	2L+	Input 11-12 (Rear 3-4)	AES2+	Input 11-12 (Rear 3-4)	AES2+	6
	2L-		AES2-		AES2-	7
Input 12 (Rear 4)	2R+		AES2scrn		AES2scrn	8
	2R-		NC		NC	18
	GND		GND		GND	9
Input 13 (Front 1)	3L+	Input 13-14 (Front 1-2)	AES3+	Input 13-14 (Front 1-2)	AES3+	14
	3L-		AES3-		AES3-	15
Input 14 (Front 2)	3R+		AES1scrn		AES3scrn	10
	3R-		NC		NC	11
Input 15 (Front 3)	4L+	Input 15-16 (Front 3-4)	AES4+	Input 15-16 (Front 3-4)	AES4+	16
	4L-		AES4-		AES4-	17
Input 16 (Front 4)	4R+		AES4scrn		AES4scrn	12
	4R-		NC		NC	13
	GND					19, 20, 23, 24
	NC					21, 22, 25, 26

Output sub-PCBs

HD-A0P2		HD-DOP2-110		HD-DOP2-75		pin-out
GND		GND		GND		1
Input 9 (G1)	1L+	Output 1-2	AES1a+	Output 1-2	AES1a	2
	1L-		AES1a-		GND	3
Input 10 (G2)	1R+	Output 1-2 (duplicate)	AES1b+	Output 1-2 (duplicate)	AES1b	4
	1R-		AES1b-		GND	5
Input 11 (G3)	2L+	Output 3-4	AES2a+	Output 3-4	AES2a	6
	2L-		AES2a-		GND	7
Input 12 (G4)	2R+	Output 3-4 (duplicate)	AES2b+	Output 3-4 (duplicate)	AES2b	8
	2R-		AES2b-		GND	18
GND		GND		GND		9
Input 13 (H1)	3L+	Output 5-6	AES3a+	Output 5-6	AES3a	14
	3L-		AES3a-		GND	15
Input 14 (H2)	3R+	Output 5-6 (duplicate)	AES3b+	Output 5-6 (duplicate)	AES3b	10
	3R-		AES3b-		GND	11
Input 15 (H3)	4L+	Output 7-8	AES4a+	Output 7-8	AES4a	16
	4L-		AES4a-		GND	17
Output 1-2 (duplicate)	4R+	Output 7-8 (duplicate)	AES4b+	Output 7-8 (duplicate)	AES4b	12
	4R-		AES4b-		GND	13
GND						19, 20, 23, 24
NC						21, 22, 25, 26

RM39 rear module connections

The RM39 dual height rear module is designed for 75 Ohm unbalanced AES operation.
As this is a dual height module two frame slots are required with the TANDEM HD-20 fitted in the top slot position.

RM39 rear module connector	Description
	**RM39** • 12 TANDEM HD-20 modules per Indigo 4 frame • Six per Indigo 2 frame • Three per Indigo 1 frame • One per Indigo DT • Only top frame slots of each pair can be used

BNC	HD-DIP2	HD-DOP2-75
AES1A IN/OUT	AES1 input 9-10 (G1-2)	AES1 output 1-2
HD/SD OUT	HD/SD Serial digital output	HD/SD Serial digital output
HD/SD OUT	HD/SD Serial digital output	HD/SD Serial digital output
AES2A IN/OUT	AES2 input 11-12 (G3-4)	AES3 output 5-6
nc	no user connection	no user connection
HD SDI IN	HD/SD Serial digital input	HD/SD Serial digital input
AES1A OUT	no user connection	AES1 output 1-2 (duplicate)
AES1B IN/OUT	AES3 input 13-14 (G5-6)	AES2 output 3-4 (duplicate)
AES1B OUT	no user connection	AES2 output 3-4
AES2A OUT	no user connection	AES3 output 5-6 (duplicate)
AES2B IN/OUT	AES4 input 15-16 (G7-8)	AES4 output 7-8
AES2B OUT	no user connection	AES4 output 7-8 (duplicate)

2.4 General Purpose Interface (GPI)

Each frame slot has up to six connections 'a-f' for GPI control and monitoring. These connections are available at the rear of the frame on the 26-way D-Type remote connectors.

GPI			Low (<1V)	High (+5V)
0	'a'	Recall preset bit 1	See following table for user preset control	
1	'b'	Recall preset bit 2		
2	'c'	Recall preset bit 4		
3	'd'	Recall preset bit 8		
4	'e'	Video missing	Selected Alarms asserted	No alarm
5	'f'	Output channel silence (delayed alarm)	Selected Alarms asserted after set delay	No alarm

As supplied, each GPI output has a 270Ω resistor in series with its output. This allows for an external LED to be driven, connected to a DC voltage of +5V.

Each General Purpose Input (GPI) is fitted with a 6800Ω resistor connected to the internal +5V.

The 16 user preset configurations can be recalled using binary notation.

GPI / Preset	Bit 4	Bit 3	Bit 2	Bit 1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

4U frame GPI connections

GPI lines 'a' to 'f' of each card connect to two of eight rear remote connectors as follows:

Slot no.	'a' pin	'b' pin	'c' pin	'd' pin	'e' pin	'f' pin
1 (Upper)	8 (1)	9 (1)	18 (1)	26 (1)	19 (2)	20 (2)
2	7 (1)	16 (1)	17 (1)	25 (1)	10 (2)	11 (2)
3	8 (3)	9 (3)	18 (3)	26 (3)	19 (4)	20 (4)
4	7 (3)	16 (3)	17 (3)	25 (3)	10 (4)	11 (4)
5	5 (1)	6 (1)	15 (1)	24 (1)	1 (2)	2 (2)
6	4 (1)	14 (1)	13 (1)	23 (1)	3 (2)	4 (2)
7	5 (3)	6 (3)	15 (3)	24 (3)	1 (4)	2 (4)
8	4 (3)	14 (3)	13 (3)	23 (3)	3 (4)	4 (4)
9	3 (1)	12 (1)	22 (1)	21 (1)	12 (2)	13 (2)
10	10 (1)	11 (1)	19 (1)	20 (1)	21 (2)	22 (2)
11	3 (3)	12 (3)	22 (3)	21 (3)	12 (4)	13 (4)
12	10 (3)	11 (3)	19 (3)	20 (3)	21 (4)	22 (4)
Slot no.	**'a' pin**	**'b' pin**	**'c' pin**	**'d' pin**	**'e' pin**	**'f' pin**
1 (Lower)	8 (5)	9 (5)	18 (5)	26 (5)	19 (6)	20 (6)
2	7 (5)	16 (5)	17 (5)	25 (5)	10 (6)	11 (6)
3	8 (7)	9 (7)	18 (7)	26 (7)	19 (8)	20 (8)
4	7 (7)	16 (7)	17 (7)	25 (7)	10 (8)	11 (8)
5	5 (5)	6 (5)	15 (5)	24 (5)	1 (6)	2 (6)
6	4 (5)	14 (5)	13 (5)	23 (5)	3 (6)	4 (6)
7	5 (7)	6 (7)	15 (7)	24 (7)	1 (8)	2 (8)
8	4 (7)	14 (7)	13 (7)	23 (7)	3 (8)	4 (8)
9	3 (5)	12 (5)	22 (5)	21 (5)	12 (6)	13 (6)
10	10 (5)	11 (5)	19 (5)	20 (5)	21 (6)	22 (6)
11	3 (7)	12 (7)	22 (7)	21 (7)	12 (8)	13 (8)
12	10 (7)	11 (7)	19 (7)	20 (7)	21 (8)	22 (8)

Table shows pin number (remote number)

Note: Remote 1, Remote 3, Remote 5 and Remote 7 are 26-way high-density D-Type female sockets. Frame ground is pin 2 and +5V @500mA is pin 1 in each case.

Remote 2, Remote 4, Remote 6 and Remote 8 are 26-way high-density D-Type male plugs and frame ground is pin 6 in each case and +5V @500mA is pin 15 on Remote 2 and Remote 6.

Note. The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-4 to approximately 1A. Remotes 5-8 are similarly protected.

2U frame GPI connections

GPI lines 'a' to 'f' of each card connect to two of four rear remote connectors as follows:

Slot no.	'a' pin	'b' pin	'c' pin	'd' pin	'e' pin	'f' pin
1	8 (1)	9 (1)	18 (1)	26 (1)	19 (2)	20 (2)
2	7 (1)	16 (1)	17 (1)	25 (1)	10 (2)	11 (2)
3	8 (3)	9 (3)	18 (3)	26 (3)	19 (4)	20 (4)
4	7 (3)	16 (3)	17 (3)	25 (3)	10 (4)	11 (4)
5	5 (1)	6 (1)	15 (1)	24 (1)	1 (2)	2 (2)
6	4 (1)	14 (1)	13 (1)	23 (1)	3 (2)	4 (2)
7	5 (3)	6 (3)	15 (3)	24 (3)	1 (4)	2 (4)
8	4 (3)	14 (3)	13 (3)	23 (3)	3 (4)	4 (4)
9	3 (1)	12 (1)	22 (1)	21 (1)	12 (2)	13 (2)
10	10 (1)	11 (1)	19 (1)	20 (1)	21 (2)	22 (2)
11	3 (3)	12 (3)	22 (3)	21 (3)	12 (4)	13 (4)
12	10 (3)	11 (3)	19 (3)	20 (3)	21 (4)	22 (4)

Table shows pin number (remote number)

Note: Remote 1 and Remote 3 are 26-way high-density D-Type female sockets. Frame ground is pin 2 and +5V @500mA is pin 1 in each case.

Remote 2 and Remote 4 are 26-way high-density D-Type male plugs and frame ground is pin 6 in each case and +5V @500mA is pin 15 on Remote 2.

Note. The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-4 to approximately 1A.

1U frame GPI connections

GPI lines 'a' to 'f' of each card connect to the two rear remote connectors as follows:

Slot no.	'a' pin	'b' pin	'c' pin	'd' pin	'e' pin	'f' pin
1	8 (1)	9 (1)	18 (1)	26 (1)	19 (2)	20 (2)
2	7 (1)	16 (1)	17 (1)	25 (1)	10 (2)	11 (2)
3	5 (1)	6 (1)	15 (1)	24 (1)	1 (2)	2 (2)
4	4 (1)	14 (1)	13 (1)	23 (1)	3 (2)	4 (2)
5	3 (1)	12 (1)	22 (1)	21 (1)	12 (2)	13 (2)
6	10 (1)	11 (1)	19 (1)	20 (1)	21 (2)	22 (2)

Table shows pin number (remote number)

Note: Remote 1: 26-way high-density D-Type female socket. Frame ground is pin 2 and +5V @500mA is pin 1.

Remote 2: 26-way high-density D-Type male plugs and frame ground is pin 6 and +5V @500mA is pin 15.

Note. The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-2 to approximately 1A.

Indigo DT desk top box GPI connections

GPI lines ‘a’ to ‘f’ of each card connect to the two rear remote connectors as follows:

Slot no.	‘a’ pin	‘b’ pin	‘c’ pin	‘d’ pin	‘e’ pin	‘f’ pin
1	8 (1)	9 (1)	18 (1)	26 (1)	19 (2)	20 (2)
2	7 (1)	16 (1)	17 (1)	25 (1)	10 (2)	11 (2)

Table shows pin number (remote number)

Note: Remote 1: 26-way high-density D-Type female socket. Frame ground is pin 2 and +5V @500mA is pin 1.

Remote 2: 26-way high-density D-Type male plugs and frame ground is pin 6 and +5V @500mA is pin 15

Note. The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-2 to approximately 1A.

3 Card edge operation

3.1 Card edge controls

TANDEM HD-20 board edge

3.2 Card edge buttons

The two tactile push button switches allow the operator to navigate within the menu structure.

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Button	Function	Normal state Up, Action Down
⊏⊐	Up Menu	Push to jump up a menu level or cancel a selection
ENTER	Select/Action	Push to select a menu and to action and confirm a change

3.3 Card edge rotary control

The board edge rotary encoder is used to navigate through the menu categories and adjust parameter values.

Control	Function
SCROLL /ADJUST	Rotate SCROLL to identify a menu category. In combination with the ENTER button select and ADJUST to change the current level or select a further option.

Notes: The rotary control can access menus and parameter values by clockwise or anti-clockwise rotation.

3.4 Reading card edge LEDs

Card edge LEDs may be used in conjunction with status information from any connected remote status panel display or from Statesman if available.

Refer also to the trouble shooting chapter for more help with solving problems and monitoring status information.

The following table summarises the card edge LED functions and colours:

Name	LED Colour	Function when ON	Function when Off
HD	Yellow	Video input standard is HD (High Definition)	Input not present
SD	Yellow	Video input standard is SD (Standard Definition)	
Silent	Yellow	One or more flagged audio channel contains silence	All channels active or masked
PSU	Green	Good power supply (PSU) rails	One or more of the monitor supplies is out of specification
Error	Red	No video input present	
nCal	Yellow	One or more audio channel gains have been adjusted away from unity	All gains set to unity

3.5 Navigating card edge menus

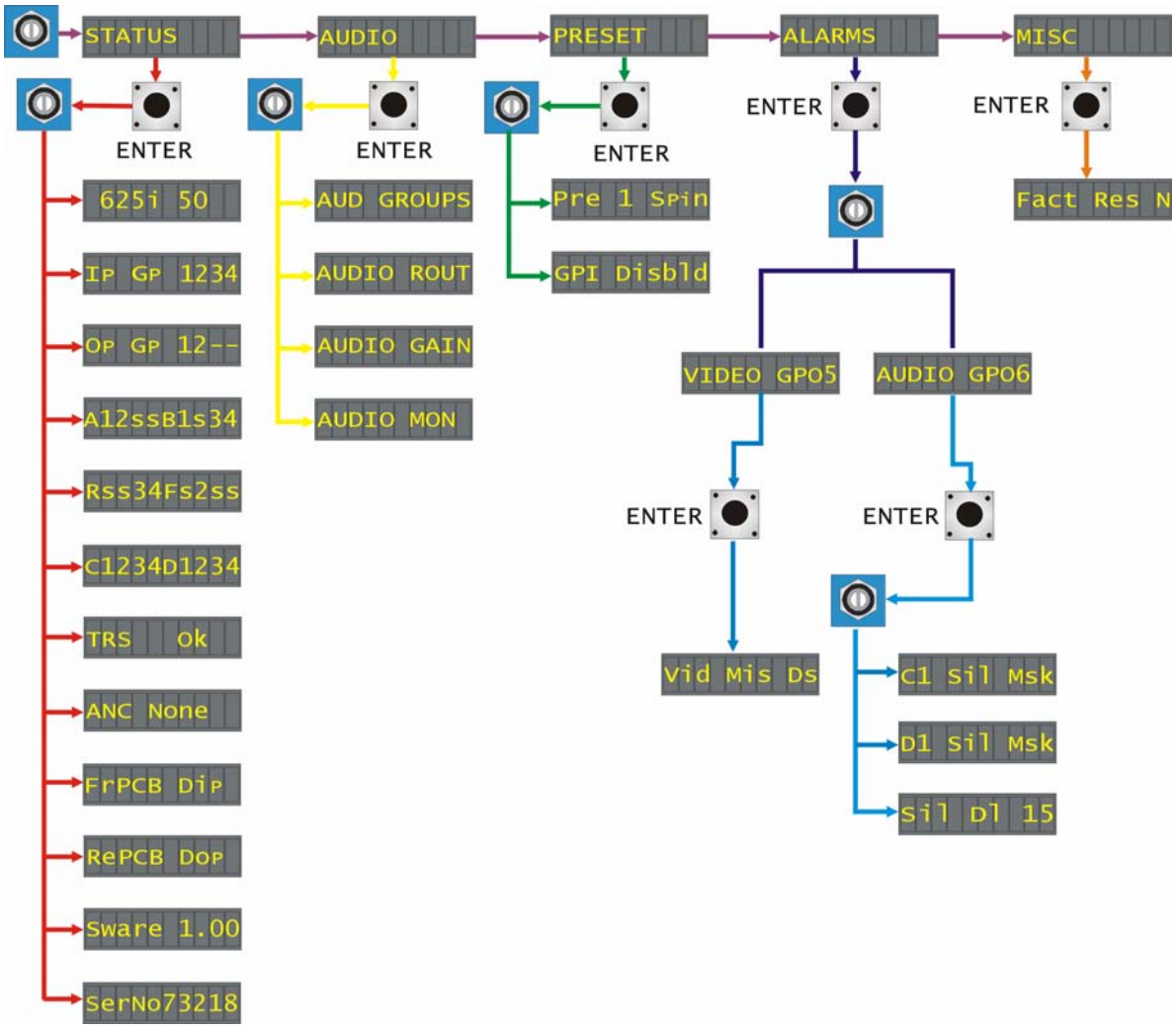
To access the card edge menu system proceed as follows:

- Press the up-arrow [⮌] until a top menu category is reached
- Rotate the SCROLL control until the desired menu category is found
- Push ENTER to enter the sub menus of that category
- Rotate SCROLL to select a sub menu
- Push ENTER to select the desired function. Selection will be indicated by the text being displayed in ***italic*** text
- Rotate ADJUST to make the desired change to the selected parameter. The display brightness will flash slowly to indicate that a change has been made and requires confirmation
- Push ENTER to action the change. The display will cease flashing
- Use the up-arrow [⮌] and SCROLL control to navigate to further menus

Note. The displayed menu brightness will flash slowly if confirmation of a change is required.

3.6 Card edge configuration

Menu Tree



Tip. To reach the top menu push the ⊏ button repeatedly until a top menu is reached. Rotate the SCROLL control anti-clockwise until the STATUS menu appears.

Card edge status

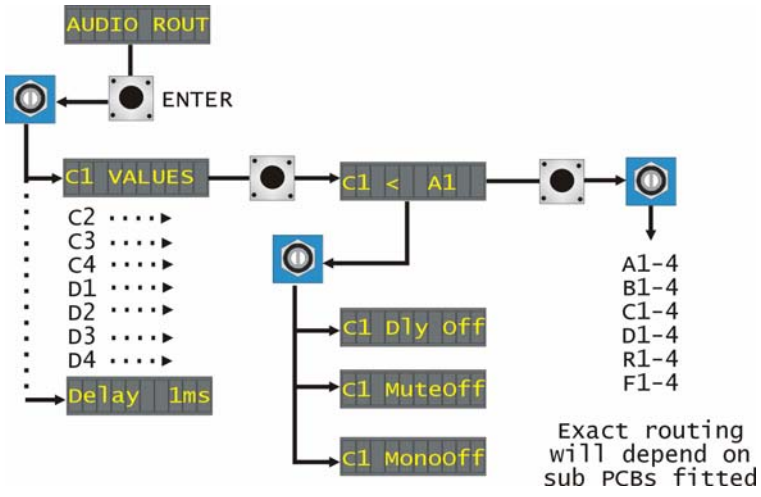
From the STATUS top menu press ENTER then SCROLL to access the status menu options.

Menu	Comment
STATUS	
625i	Input/Output line Standard	The Input video line standard is shown. ***625, 525i, 1080i 50/59.94/60, 1035 59.94/60, 720p 50/59.94/60***
IP GP 1234	Input audio groups present	Groups containing audio data present on the input video. ***1234*** groups contain audio. '-' no audio present.
OP GP 12--	Output audio groups present	Groups containing audio data present on the output video. ***1234*** groups contain audio. **'-'** no audio present.
A12ssB1s34	De-embedder channel status	Channel status of the input de-embedder A and de-embedder B. ***1234*** channels active. ***s*** channel silent.
Rss34Fs2ss	Sub-PCB channel status	Channel statuses of any fitted sub PCB. ***1234*** channels active. ***s*** channel silent, *Na* not fitted
C1234D1234	Embedder channel status	Channel status of the output embedder C and embedder C. ***1234*** channels active. ***s*** channel silent.
TRS Ok	Timing reference status	Four-word composite timing reference signal is present and correct. ***Ok, Err***
ANC None	Ancillary data presence	Ancillary data present or not within the video blanking intervals. ***Presn, None.***
FrPCB DiP	Front sub-PCB type	Type of sub PCB fitted in the forward position. ***Dip, DipR, Aip, Aop, Dop7, Dop1, None.***
RePCB DoP	Rear sub-PCB type	Type of sub PCB fitted in the rear position. ***Dip, DipR, Aip, Aop, Dop7, Dop1, None.***
Sware 1.00	Software version fitted	The version number of the currently installed software.
SerNo73218	PCB serial number	The electronically stored PCB serial number. This should correspond with the serial number label affixed to the PCB connector.

Audio menu

From the Audio top menu press ENTER then SCROLL to access the audio menu options.

AUDIO	Menu	Comment
AUD GROUPS	De-Embedder / Embedder group selection	The audio groups for de-embedding and embedding are selected here. Press ENTER to select this menu. Rotate SCROLL to find the required de-embedder / embedder. Press ENTER to select and SCROLL to select group. Hanc Blanking On/Off appears at the end of this menu. = Input group present. ***1,2,3,4 –*** none selected. Note: Embedders C and D cannot be made to embed to the same output group.
AUDIO ROUT	Channel routing for the embedders	Each channel of embedder C and D can be selected from any of the eight de-embedded channels plus four or eight audio inputs depending on fitted sub-PCBs. Delay, Mute and Mono can also be selected. **See table below for further details**. Note: The delay time globally affects all channels selected for delay.
AUDIO GAIN	Embedder channel gain controls	The gain of the four channels of embedder C and D can be independently varied by ± 3.0dB. ADJUST to increment value. Note: Any channel gain moved away from its cal position will be indicated by the board edge cal LED illuminating.
AUDIO MON	Card-edge stereo headphone routing	The monitoring outputs for the board edge headphone socket are selected in stereo pairs. ***A12, A34, B12, B34, R12, R34, F12, F34, C12, C34, D12 & D34*** Note: If output sub-PCBs are fitted B-F will copy C-D.



Audio routing sub menu

16x8 routing matrix

At the heart of TANDEM HD-20 is the sixteen input, eight output routing matrix. This will allow any of the sixteen possible inputs, eight embedded channels and up to eight analogue or digital audio inputs to be routed to any of the eight outputs for embedding or to be outputted via output sub-PCBs. The final configuration will depend on the number and type of sub-PCBs fitted.

Note: Front and Rear describes the position of the sub-PCB when fitted to the TANDEM HD-20. Front nearest the board edge controls and extraction handle. Rear nearest the board connector.

Note: If an output sub-PCB is fitted to the front position its output will always follow embedder C routing. Similarly a rear fitted output sub-PCB will always follow embedder D routing.

Stereo to Mono conversion

For the purposes of this discussion it is assumed that all inputs are stereo pairs and that each half of the stereo pair is on a consecutive input i.e. input 1 and input 2 are a stereo pair, input 3 and input 4 are a stereo pair, etc.

The action of converting a stereo pair to a mono output is simply a summing process followed by a gain correction. The gain correction is necessary because when the two components of a stereo signal are summed a 6dB increase in output level will result; this will then need to be corrected to maintain unity gain.

The action of selecting will cause that channel to output the mono sum of itself and its associated channel. The associated channel output will still output its unaltered programme. Either channel of a pair can be selected for stereo to mono conversion.

Example: Selecting channel 1 for mono conversion will result in channel 1 outputting the converted mono sum of channels 1 and 2. Channel 2 will remain outputting the original channel 2 programme. Similarly deselecting channel 1 and selecting channel 2 will cause channel 2 to output the converted mono programme and channel 1 the original channel 1 programme.

Delay control

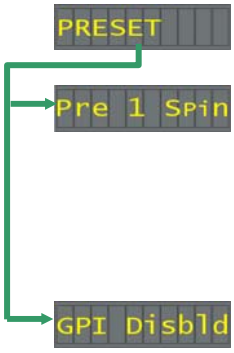
This control can be used to delay the audio with respect to the video by up to 64ms and compensate for any small delay between the incoming video and audio signals. The delay is applied at the output of the 16x8 router and is a single global control. The delay can be added individually to any output channel.

Individual channel can also be selected to mute.

Preset menu

Up to sixteen setups may be stored for the board and recalled either from the board control, active front panel, Statesman or through the use of external GPIs. Presets store board setup data including operating mode and option card status. If at any time a sub-PCB is changed for a different type, i.e. from an input type to output type, any previously saved preset configurations will become invalid. The presets are numbered 1-16.

Note: Care should be taken when storing presets that the desired configuration is not changed by any external input prior to saving.



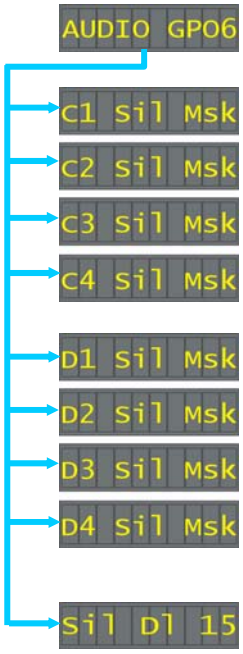
Menu	Comment
Save and recall Presets 1-16	To save a user configuration from the board edge. Press ENTER to select the preset menu. Rotate SCROLL to find the required preset location. Press ENTER to access the location and SCROLL to select save or recall. Press ENTER to action.
Enable GPI control of presets	Rotate SCROLL to select Enable Selecting Enable allows the recall of previously saved user configurations via GPI inputs 0-3.

Alarm menu

The alarm menu allows the user to customise the alarm reporting from the TANDEM HD-20 to suit their individual needs. TANDEM HD-20 has two alarm outputs, GPO5 and GPO6. These GPI outputs in their non-alarm condition are held to the internal +5V via a 6800Ohm resistor. An alarm condition will force the GPI output to less than 0.5V of frame 0V through a 270Ohm resistor. This makes the GPI outputs capable of driving an external LED or logic circuit as required. For ease the configurable alarms have been divided into two groups: the video alarms appear on GPO5 and the audio alarms on GPO6. The alarm option menus then allow the user to configure the alarm reporting by either flagging or masking individual alarms.

Menu	Comment
Video Alarms	Press ENTER to access the video alarms menu. SCROLL to view sub menus.
Audio Alarms	Press ENTER to access the video alarms menu. SCROLL to view sub menus.

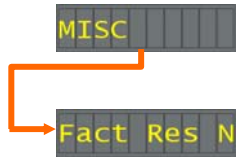
Menu	Comment
Video missing	Press ENTER to access menu. Rotate ADJUST to enable or disable reporting. Press ENTER to action command. ***Ds*** disable, ***En*** enable



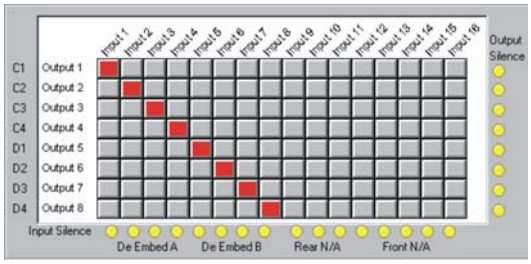
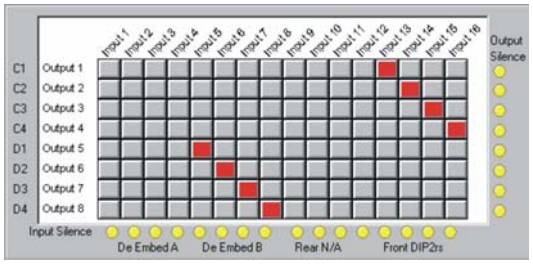
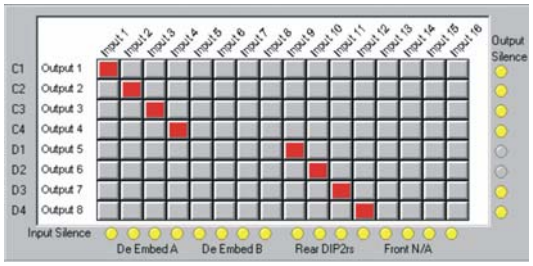
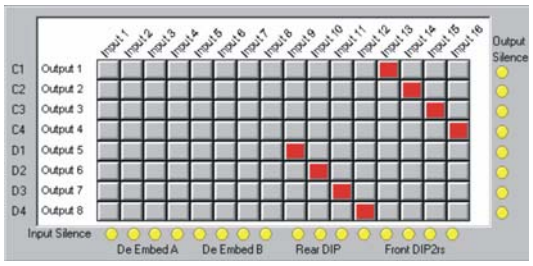
Menu	Comment
Embedder C silence detect	Each output channel can be monitored independently. Rotate SCROLL to find the channel silence alarm to be configured. Press ENTER to access the selected channel. Rotate ADJUST to flag or mask reporting. Press ENTER to action command. ***Msk*** disable, ***Flg*** enable
Embedder D silence detect	Rotate SCROLL to find the channel silence alarm to be configured. Press ENTER to access the selected channel. Rotate ADJUST to flag or mask reporting. Press ENTER to action command. ***Msk*** disable, ***Flg*** enable
Silence Delay	The delay before a silence alarm is reported can be varied from 1-120 seconds. Note this is a global control and will similarly affect all flagged channel silence alarms.

Miscellaneous menu (Factory Reset)

At present, the only control available in the miscellaneous menu is the Factory Reset. This control can be used to return the TANDEM HD-20 to its default condition. Note the default conditions will be dependent on any sub-PCBs fitted.



Menu	Comment
Factory Reset	Press ENTER to access factory-reset menu. SCROLL to select yes (Y). Press ENTER to assert.

Parameter	Default value
De-embedder A	Group 1
De-embedder B	Group 2
Embedder C	Group 1
Embedder D	Group 2
HANC blank	Set to Auto
No or Output Sub-PCBs fitted **(Statesman representation)**	
Input Sub-PCB in the front position **No or Output Sub-PCB fitted in the rear position** **(Statesman representation)**	
Input Sub-PCB in the rear position. **No or Output Sub-PCB fitted in the front position** **(Statesman representation)**	
Input Sub-PCBs fitted in both front and rear positions **(Statesman representation)**	
Delay, Mono, Mute	Unchecked
Audio Delay	Zero
Audio Gains	Unity
Selected Preset	Unchanged, contents of all saved presets are erased
GPI controls preset recall	Unchanged
Headphone monitoring	C1 and C2
GPO5 and GPO6	Unchecked
Silence Alarm delay	Zero delay

4 Using the front control panel

4.1 Module selected

This operational guide assumes that the panel has been set up according to the panel set up procedure described in the Crystal Vision Control Panel manual.

Note: It is **ESSENTIAL** that the panel set up procedure is followed and any old or unknown passwords cleared prior to using the panel for the first time.

At power up, the two line 20-character screen will display 'Crystal Vision' followed by the firmware version number for the control panel. All eight control panel keys LEDs will illuminate.

The Crystal Vision control panel start up display

'Control Panel' then briefly replaces the version number display.

If the control panel firmware has been updated for Statesman control (version 1.5.0 or higher), Statesman Mode will be entered and the message, 'Press CAL to Exit' will be displayed and the CAL LED will light.

Statesman mode is entered by default

To continue with control panel operation or configuration, press the CAL key once. A second press of the CAL key will return to Statesman control.

The control panel will display the name of the card that first responds to the polling request together with its location number.

The location number consists of the frame number plus the card position in the frame.

Navigating the display

The functions assigned to control panel keys are:

- DEVICE – enters Device menu to select a card or show cards available / enters panel set up when held down during power up / shows frame status when pressed from Statesman mode
- CAL – enters or leaves Statesman mode / enters panel diagnostics mode when held down during power up / updates the display
- Asterisk – enters board rename menu from the Device menu
- F1 to F4 – soft keys, function assigned within each menu
- HOME – moves the display to the home menu
- ENTER – accept current selection
- Upward arrow – used to move up the menu structure / enter lock panel menu from the Device menu
- Rotary control – shaft encoder used to select options or variable data

Note: Please refer to the Crystal Vision Control Panel manual for details of the Panel Setup, Lock Panel and Diagnostic menus.

Selecting TANDEM HD-20

To select a particular card in a frame, press the DEVICE key to go to the Device menu. Note there may be a delay whilst the frame is interrogated during which time the 'No cards Found' could be displayed.

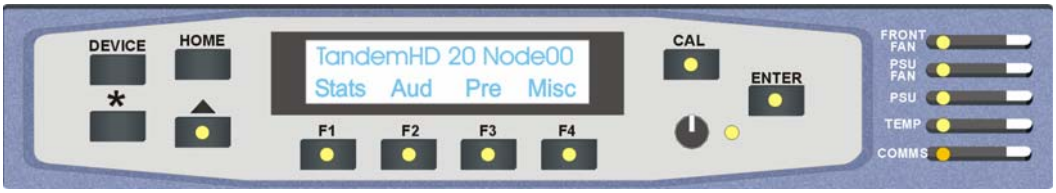
The top line of the display will show 'Available Cards X', where X is the number of cards that have responded so far to the polling request.

The available cards menu

Rotate the shaft encoder and the bottom row will display the successfully polled cards by name and location or slot number.

In the example above, the card displayed is located in the first frame in slot number 1.

When the desired card is selected press the ENTER key to access that card's HOME menu. The message shows that a TANDEM HD-20 has been selected.



The TANDEM HD-20 home menu

Updating the display

The values displayed on an active front panel are only updated when an adjustment is made and when changing menu level. If changes occur through the use of card edge controls or other remote control, the text displayed on the active front panel will not be updated immediately. If necessary, use the upward arrow to leave and then re-enter a menu to update the display.

4.2 The TANDEM HD-20 active panel menu structure

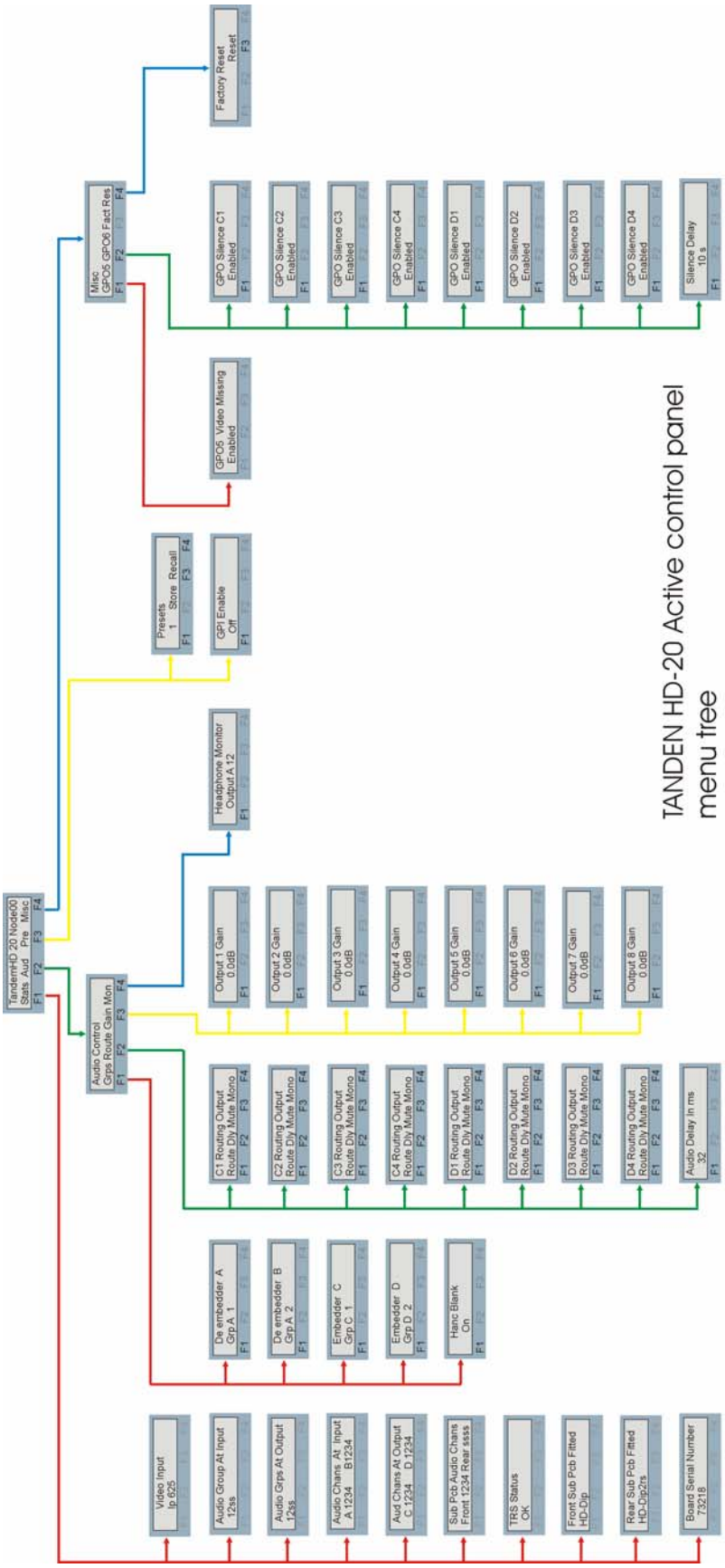
At any time the main top-level menu (Home) is obtained by pressing the HOME key. From the home menu further selections can be made. Active function keys are indicated by illuminated, integrated LEDs.

The main top-level menus for the TANDEM HD-20 are obtained by pressing the F1- F4 keys from the HOME menu. Menu keys are illuminated when active and when further menus are available. The top-level menus are:

- Status – Press F1 (Input Std, Input/Output groups present, Audio channels present, TRS status, sub PCBs fitted and board serial number)
- Audio controls – Press F2 (De-embedder/Embedder config, Audio channel routing, Audio output gains, Headphone monitoring router)
- Preset – Press F3 (User preset save/recall, GPI enable)
- Misc - Press F4 (GPO config, channel silence etc, factory reset)

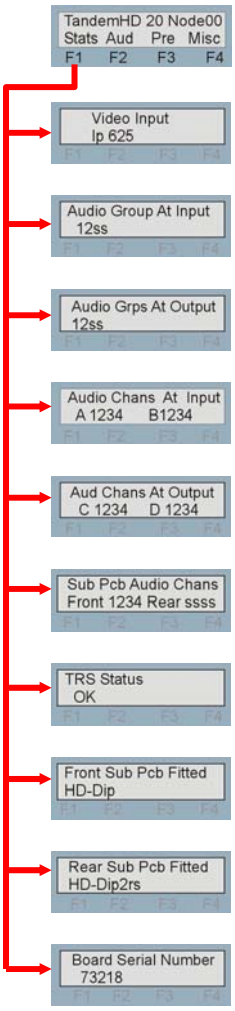
When a sub menu has been selected, further options may be obtained by using the Shaft control to scroll through them. Once the desired option has been located a selection or value change can be made by either toggling the appropriate function key or by selecting and using the shaft control to alter a numerical value. A configuration change or value will be activated as the shaft control is rotated or function button is toggled. The variable being adjusted will appear in brackets. Pressing Enter will fix the new value.

The following chart shows the available TANDEM HD-20 menus. The actual menus available may vary slightly as software is updated.


TANDEN HD-20 Active control panel
menu tree
Factory Reset
Reset
Misc
GPO5 GPO6 Fact Res
GPO Silence C1
GPO Silence C2
GPO Silence C3
GPO Silence C4
GPO Silence D1
GPO Silence D2
GPO Silence D3
GPO Silence D4
Silence Delay
10 s
GPO5 Video Missing
Enabled
Presets
Store
Recall
GPI Enable
Off
Headphone Monitor
Output A 12
TandemHD 20 Node60
Stats Aud Pre Misc
Audio Control
Grps Route Gain Mon
Output 1 Gain
0.0dB
Output 2 Gain
Output 3 Gain
Output 4 Gain
Output 5 Gain
Output 6 Gain
Output 7 Gain
Output 8 Gain
C1 Routing Output
Route Dly Mute Mono
C2 Routing Output
C3 Routing Output
C4 Routing Output
D1 Routing Output
D2 Routing Output
D3 Routing Output
D4 Routing Output
Audio Delay In ms
32
De embedder A
Grp A 1
De embedder B
Grp A 2
Embedder C
Grp C 1
Embedder D
Grp D 2
Hanc Blank
On
Video Input
Ip 625
Audio Group At Input
12ss
Audio Grps At Output
12ss
Audio Chans At Input
A 1234 B1234
Aud Chans At Output
C 1234 D 1234
Sub Pcb Audio Chans
Front 1234 Rear ssss
TRS Status
OK
Front Sub Pcb Fitted
HD-Dip
Rear Sub Pcb Fitted
HD-Dip2rs
Board Serial Number
73218

Card edge status

From the STATUS top menu press F1 then SCROLL to access the status menu options.



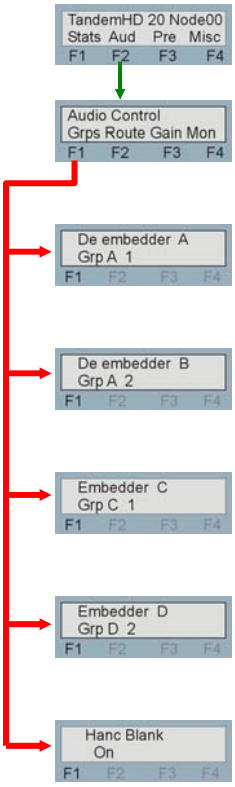
Menu	Comment
Input/Output line Standard	The Input video line standard is shown. ***625i, 525i, 1080i 50/59.94/60, 1035 59.94/60, 720p 50/59.94/60***
Input audio groups present	Groups containing audio data present on the input video. ***1234*** groups contain audio. 's' no audio present.
Output audio groups present	Groups containing audio data present on the output video. ***1234*** groups contain audio. 's' no audio present.
De-embedder channel status	Channel status of the input de-embedder A and de-embedder B. ***1234*** channels active. ***s*** channel silent.
Embedder channel status	Channel status of the output embedder C and embedder C. ***1234*** channels active. ***s*** channel silent.
Sub-PCB channel status	Channel statuses of any fitted sub-PCB. ***1234*** channels active. ***s*** channel silent, *Na* not fitted
Timing reference status	Four-word Composite timing reference signal is present and correct. ***Ok, Err***
Front sub-PCB type	Type of sub PCB fitted in the forward position. ***HD-Dip, HD-DipR, HD-Aip, HD-Aop, HD-Dop7, HD-Dop1, None***
Rear sub-PCB type	Type of sub PCB fitted in the rear position. ***HD-Dip, HD-DipR, HD-Aip, HD-Aop, HD-Dop7, HD-Dop1, None***
PCB serial number	The electronically stored PCB serial number. This should correspond with the serial number label affixed to the PCB connector.

Audio menu

From the Home menu press F2 to enter the Audio Control menu. F1-4 selects further options.

Groups

This menu gives control of both the de-embedder and embedder configurations.



Menu	Comment
De-Embedder / Embedder group selection	The audio groups for de-embedding and embedding are selected here. Press F1 to select this menu. Rotate SCROLL to find the required de-embedder / embedder. Press F1 to select.
De-embedder A group selection	To select a group to de-embed from the incoming video, press F1 and rotate SCROLL. ***1, 2, 3, 4 or - none***
De-embedder B group selection	To select a group to de-embed from the incoming video, press F1 and rotate SCROLL. ***1, 2, 3, 4 or - none***
Embedder C group selection	To select a group to embed to in the outgoing video, press F1 and rotate SCROLL. ***1, 2, 3, 4 or - none*** = denotes a current selected group
Embedder D group selection	To select a group to de-embed from the incoming video, press F1 and rotate SCROLL. ***1, 2, 3, 4 or - none*** = denotes a current selected group
HANC blanking control	Setting the HANC control to ON will cause automatic blanking of the HANC space before embedding

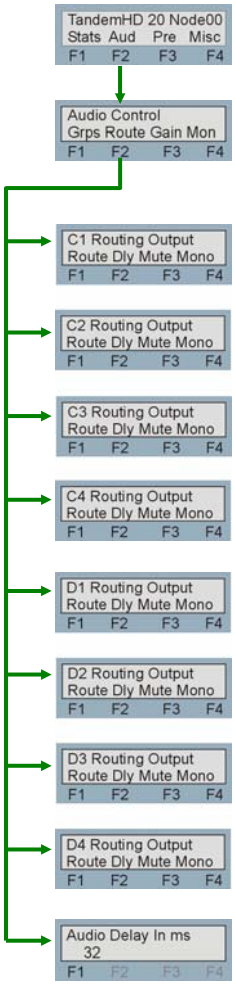
Note embedders C and D cannot be made to embed to the same output group.

Audio Routing

At the heart of TANDEM HD-20 is the sixteen input, eight output routing matrix. This will allow any of the sixteen possible inputs, eight embedded channels and up to eight analogue or digital audio inputs to be routed to any of the eight outputs for embedding or to be outputted via output sub-PCBs. The final configuration will depend on the number and type of sub PCBs fitted.

Note: Front and Rear describes the position of the sub-PCB when fitted to the TANDEM HD-20. Front nearest the board edge controls and extraction handle. Rear nearest the board connector.

Note: If an output sub-PCB is fitted to the front position its output will always follow embedder C routing. Similarly a rear fitted output sub-PCB will always follow embedder D routing.



Menu	Comment
Audio routing to output embedders	The audio channel routing for embedding onto the output video is selected here. Press F2 to select this menu. Rotate SCROLL to find the embedder channel to be routed. F1-4 give further options.
Embedder C channel selection	Press F1 to set routing. SCROLL to select. ***A1-4, B1-4, R1-4, F1-4 > C1 etc.*** Press F2 to select Audio delay. SCROLL to select. ***On, Off.*** Press F3 to select Mute. SCROLL to select. ***On, Off.*** Press F4 to select Mono conversion. SCROLL to select. ***On, Off.***
Embedder D channel selection	Press F1 to set routing. SCROLL to select. ***A1-4, B1-4, R1-4, F1-4 > D1 etc.*** Press F2 to select Audio delay. SCROLL to select. ***On, Off.*** Press F3 to select Mute. SCROLL to select. ***On, Off.*** Press F4 to select Mono conversion. SCROLL to select. ***On, Off.***
Audio Delay	This control can be used to delay the audio with respect to the video by up to 64ms and compensate for any small delay between the incoming video and audio signals. The delay is applied at the output of the 16x8 router and is a single global control. ***0-64ms.***

Stereo to Mono conversion

For the purposes of this discussion it is assumed that all inputs are stereo pairs and that each half of the stereo pair is on a consecutive input i.e. input 1 and input 2 are a stereo pair, input 3 and input 4 are a stereo pair etc.

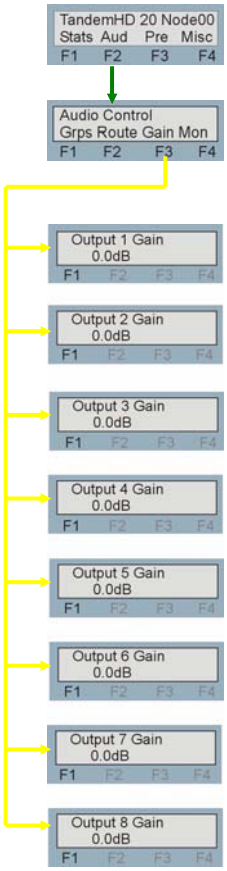
The action of converting a stereo pair to a mono output is simply a summing process followed by a gain correction. The gain correction is necessary because when the two components of a stereo signal are summed a 6dB increase in output level will result; this will then need to be corrected to maintain unity gain.

The action of selecting will cause that channel to output the mono sum of itself and its associated channel. The associated channel output will still output its unaltered programme. Either channel of a pair can be selected for stereo to mono conversion.

Example: Selecting channel 1 for mono conversion will result in channel 1 outputting the converted mono sum of channels 1 and 2. Channel 2 will remain outputting the original channel 2 programme. Similarly deselecting channel 1 and selecting channel 2 will cause channel 2 to output the converted mono programme and channel 1 the original channel 1 programme.

Output Channel gain adjustment

The eight audio channels from the router can have their gains varied by ± 3db from unity gain. This allows the user a certain amount of adjustment to compensate for variations between channels.



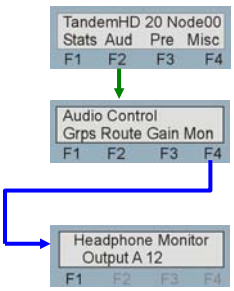
Menu	Comment
Output channel gains	Press F3 to enter the Gain menu. SCROLL to select output channel gain.
	Press F1 to select and SCROLL to adjust Outputs 1-8.

Headphone Monitoring

A powerful 12-source stereo monitoring bus provides audio monitoring at the card edge headphone socket.

Notes: Odd channel numbers will appear in the left headphone with the corresponding even channels appearing in the right.

F (front) and R (rear) indicate a sub-PCB and its location when fitted to the TANDEM HD-20 motherboard.

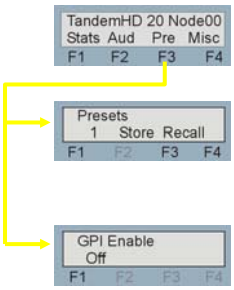


Menu	Comment
Monitoring menu	Press F4 to enter the Monitoring Headphone configuration menu.
Card edge stereo headphone routing	The monitoring outputs for the board edge headphone socket are selected in stereo pairs. ***A12, A34, B12, B34, R12, R34, F12, F34, C12, C34, D12 & D34*** Note: If output sub-PCBs are fitted B-F will copy C-D.

Preset menu

Up to sixteen setups may be stored for the board and recalled either from the board control, active front panel, Statesman or through the use of external GPIs. Presets store board setup data including operating mode and option card status. If at any time a sub-PCB is changed for a different type, i.e. from an input type to output type, any previously saved preset configurations will become invalid. The presets are numbered 1-16.

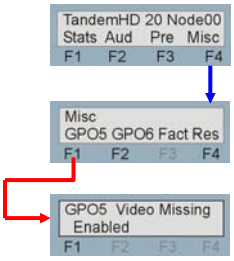
Note: Care should be taken when storing presets that the desired configuration is not changed by any external input prior to saving.



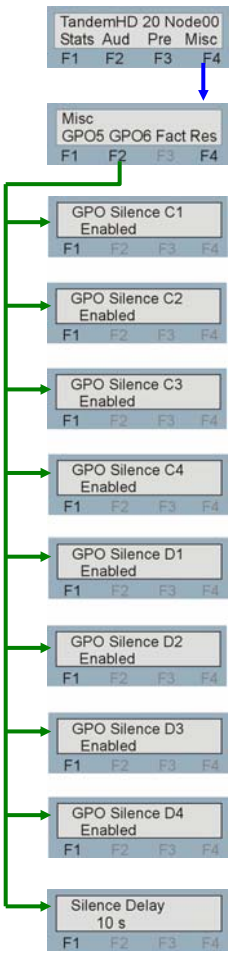
Menu	Comment
Save and recall Presets 1-16	To save a user configuration from the active control panel. From the Home menu Press F3 to select the preset menu. Press F1 and rotate SCROLL to find the required preset location.
Enable GPI control of presets	Selecting Enable allows the recall of previously saved user configurations via GPI inputs 0-3. To enable GPI control press F1 to toggle between On and Off. Press ENTER to select.

Miscellaneous menu

This menu allows the user to customise the alarm reporting from the TANDEM HD-20 to suit their individual needs. TANDEM HD-20 has two alarm outputs, GPO5 and GPO6. These GPI outputs in their non-alarm condition are held to the internal +5V via a 6800Ohm resistor. An alarm condition will force the GPI output to less than 0.5V through a series 270Ohm resistor. This makes the GPI outputs capable of driving an external LED or logic circuit as required. For ease the configurable alarms have been divided into two groups, the video alarms appear on GPO5 and the audio alarms on GPO6. This menu will then allow the user to configure the alarm reporting by either flagging or masking individual alarms. Access to the factory-reset function is also found here.



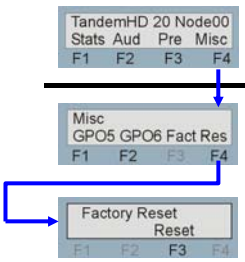
Menu	Comment
Misc menu	From the home menu press F4 to access the misc menu. Press F1 to select the GPO5 (video alarms) menu.
GPO5 (video alarm)	Press F1 to activate. SCROLL to enable or disable and press ENTER to accept.



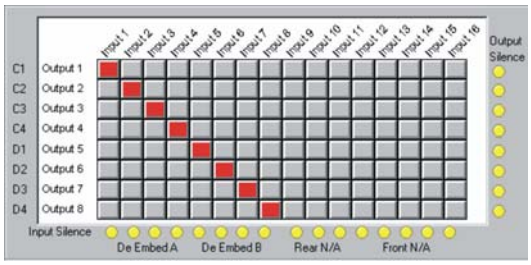
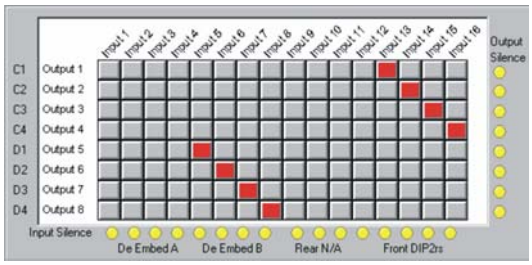
Menu	Comment
Misc menu	From the home menu press F4 to access the misc menu. Press F2 to select the GPO6 (audio alarms) menu.
Output channel silence detect (embedders C & D)	Rotate SCROLL to find the channel silence alarm to be configured. Press F1 to activate. SCROLL to enable or disable and press ENTER to accept.
Silence Delay	The delay before a silence alarm is reported can be varied from 1-120 seconds. Note this a global control.

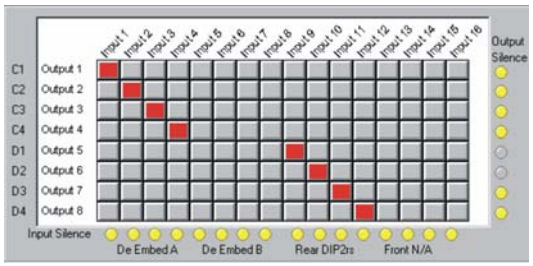
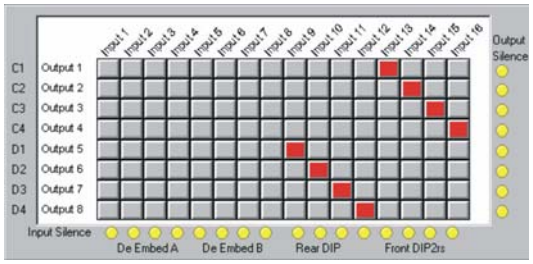
Factory Reset

The factory reset can be used to return the TANDEM HD-20 to it default condition. It should be noted that if a factory reset is carried out the final routing will depend on any sub-PCBs fitted and all preset configurations will be erased.



Menu	Comment
Misc menu	From the home menu press F4 to access the misc menu. Press F4 to select the factory reset menu.
Factory Reset	Press F3 to reset. The display will acknowledge that factory reset has been completed.

Parameter	Default value
De-embedder A	Group 1
De-embedder B	Group 2
Embedder C	Group 1
Embedder D	Group 2
HANC blank	Set to Auto
No or Output Sub-PCBs fitted **(Statesman representation)**	
Input Sub PCB in the front position. **No or Output Sub-PCB fitted in the rear position** **(Statesman representation)**	

Input Sub-PCB in the rear position. No or Output Sub-PCB fitted in the front position (Statesman representation)	
Input Sub-PCBs fitted in both front and rear positions (Statesman representation)	
Delay, Mono, Mute	Unchecked
Audio Delay	Zero
Audio Gains	Unity
Selected Preset	Unchanged, contents of all saved presets are erased
GPI controls preset recall	Unchanged
Headphone monitoring	C1 and C2
GPO5 and GPO6	Unchecked
Silence Alarm delay	Zero delay

5 Statesman

The Crystal Vision Statesman PC control software is designed to control a range of Crystal Vision modules via serial control from a PC. Statesman provides a user friendly means of configuring and operating the TANDEM HD-20 with the benefit of see-at-a-glance status monitoring.

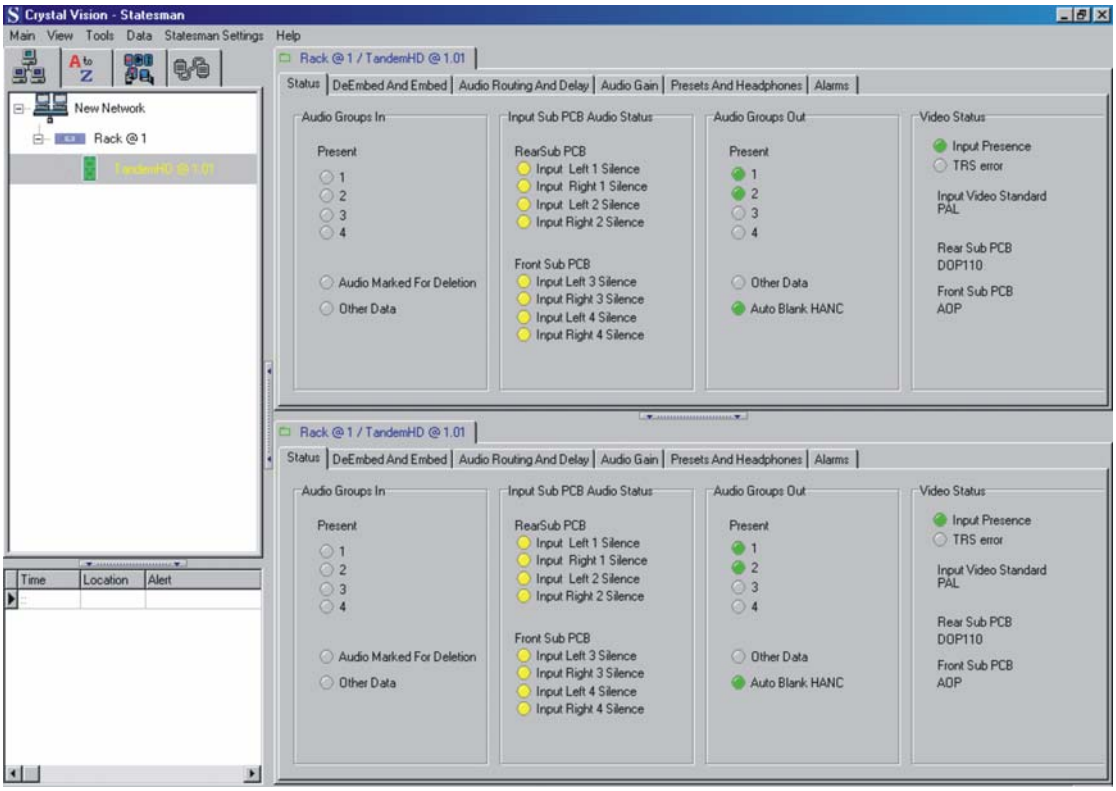
The main Statesman application communicates with each module in a frame through an active front panel. A frame or frame pair must have an active panel fitted to allow for Statesman control.

For details on installing Statesman on your PC refer to the Statesman installation manual.

5.1 Statesman operation

The initial view will show an Explorer style view of the connected frames and modules. Double-click on a module to display the main application control panes.

Initially two views of the first pane will be shown. Clicking any of the menu tabs will cause an alternate pane to appear.



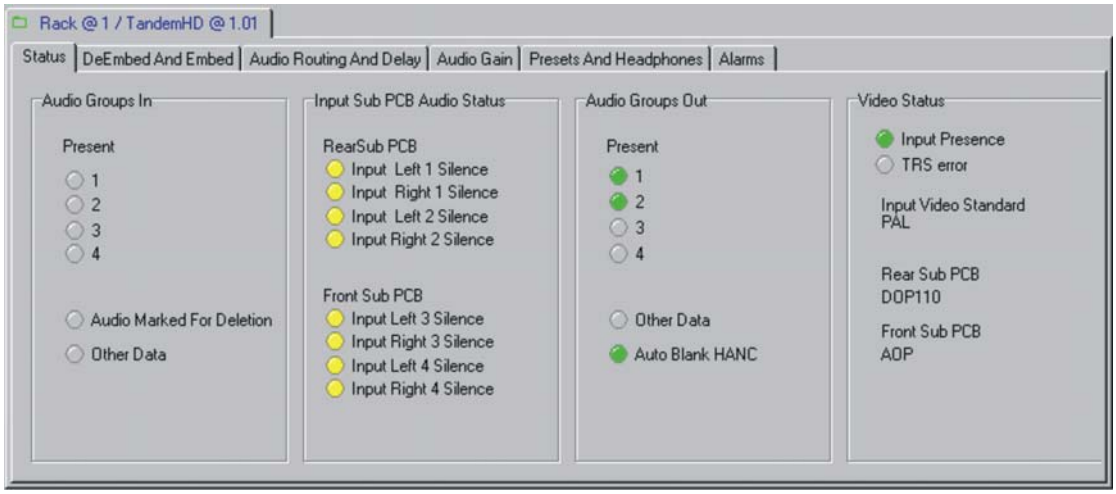
TANDEM HD-20 Statesman main application screen

The two large control panes shown in the upper and lower halves of the window may display different menus for the same card, or controls for different cards. Click on the horizontal button-bar between the two panes to close the lower pane or drag the button to vary the size of the panes.

TANDEM HD-20 has six Statesman menu tabs that provide: Status information, De-embedder and embedder configuration, Audio routing, Channel gain control, Presets controls as well as headphone routing and Alarm configurations.

Status

The Status menu pane is made up of four sub sections that have been reproduced from the other menus to give a general overview of TANDEM HD-20's configuration and signal monitoring.



TANDEM HD-20 Statesman Status menu

Audio Groups In

This pane will show which of the four available audio groups are present in the incoming serial video. It also indicates if any of the incoming audio has been marked for deletion or if any non-audio data is present.

Input Sub PCB Audio Status

If audio silence is detected on any of the sub-PCB channels for a length of time greater than that set by the Audio delay control (Audio Routing and Delay menu) it will be shown by the illumination of a simulated LED.

Audio Groups Out

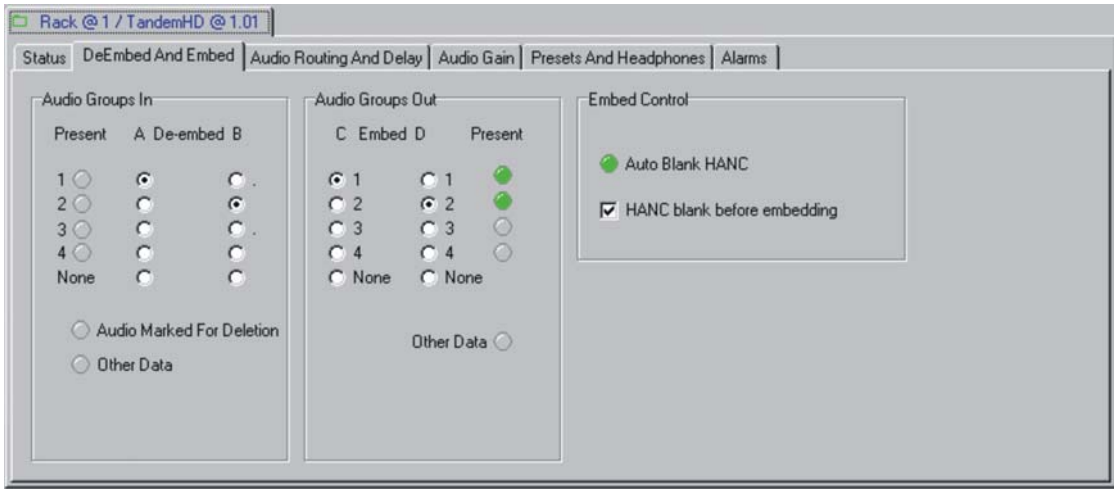
This pane indicates by simulated LED which two of the four available audio groups the C and D embedders are set to embed to. Indication is also given to whether the auto HANC blank has been set. Should the auto HANC blank not be set and there is non-audio data present on the input it will be passed to the output unimpeded and the Other data LED will indicate its presence.

Video Status

Indication of both video input present and its timing reference signal (TRS) being correct are given. The input video standard is also given along with the type of sub-PCB if fitted in both the forward and rear positions.

De-embed and Embed

The De-embed and Embed menu is where TANDEM HD-20's two de-embedders and two embedders are configured.



TANDEM HD-20 Statesman De-embedder and Embedder menu

Audio Groups In

Here the input groups for the A and B de-embedders are selected. Selection is by checking the appropriate radio button. This pane also shows which of the four available audio groups are present in the incoming serial video. It also indicates if any of the incoming audio has been marked for deletion or if any non-audio data is present.

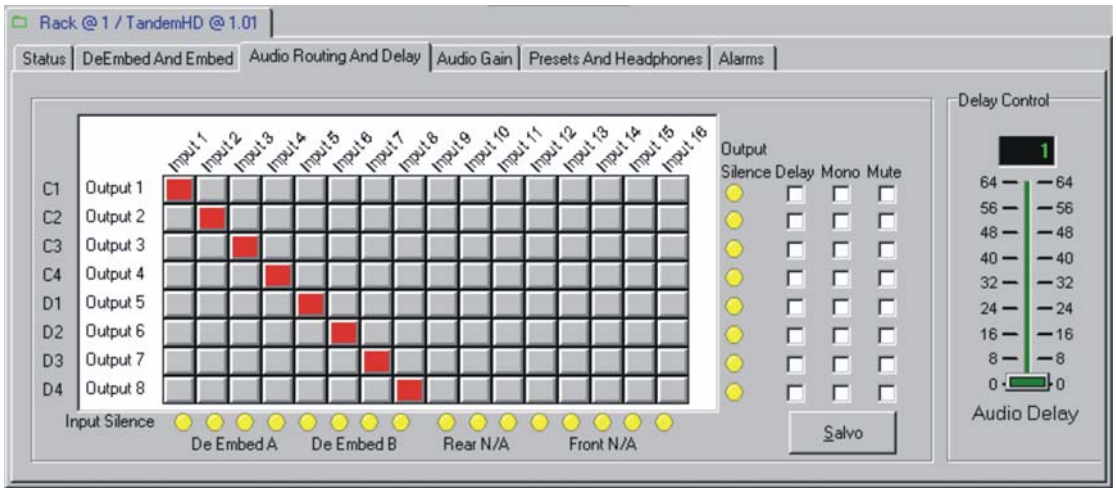
Audio Group Out

This pane is used to select which two of the four available audio groups you wish the C and D embedders to embed to. Selection is by checking the appropriate radio button. The presence of active output groups is also given and if any group contains non-audio data.

Embed control

HANC blanking is set here to automatically blank the HANC space by ticking the check box.

Audio routing and Delay



TANDEM HD-20 Statesman Audio routing and Delay menu

16x8 routing matrix

At the heart of TANDEM HD-20 is the 16 input, 8 output routing matrix. This will allow any of the sixteen possible inputs, eight embedded channels and up to eight analogue or digital audio inputs to be routed to any of the eight outputs for embedding or to be outputted via output sub-PCBs. The final configuration will depend on the number and type of sub-PCBs fitted.

An output may also be muted by ticking the appropriate tick box.

Note: Front and Rear describes the position of the sub-PCB when fitted to the TANDEM HD-20. Front nearest the board edge controls and extraction handle. Rear nearest the board connector.

Routing Selection

An input to output routing selection is applied by clicking on the crosspoint squares in the matrix. Any selections made will turn dark red. Invalid selections will be rejected and returned to the last valid selection. Once a routing selection is finished it will require the Salvo button to be pressed, until this point no changes to the original routing will have been made. Valid selections will turn bright red and new source-destination assignments will be loaded into the routing table.

Note: If an output sub-PCB is fitted to the front position its output will always follow embedder C routing. Similarly a rear fitted output sub-PCB will always follow embedder D routing.

Stereo to Mono conversion

For the purposes of this discussion, it is assumed that all inputs are stereo pairs and that each half of the stereo pair is on a consecutive input i.e. input 1 and input 2 are a stereo pair, input 3 and input 4 are a stereo pair, etc.

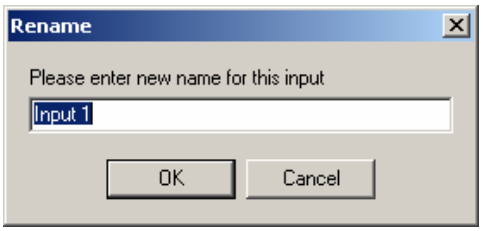
The action of converting a stereo pair to a mono output is simply a summing process followed by a gain correction. The gain correction is necessary because when the two components of a stereo signal are summed a 6dB increase in output level will result; this will then need to be corrected to maintain unity gain.

The action of ticking a check box will cause that channel to output the mono sum of itself and its associated channel. The associated channel will still output its unaltered programme. Either channel of a pair can be selected for stereo to mono conversion.

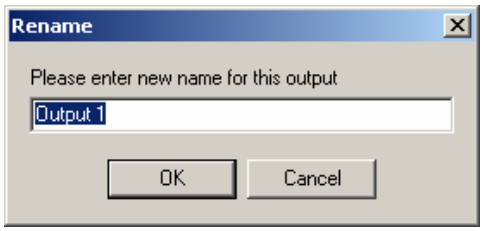
Example: Ticking channel 1 mono check box will result in channel 1 outputting the converted mono sum of channels 1 and 2. Channel 2 will remain outputting the original channel 2 programme. Similarly un-ticking channel 1 and ticking channel 2 will cause channel 2 to output the converted mono programme and channel 1 the original channel 1 programme.

Editing router input and output names

Each of the input and output names may be edited for both embed and output routers.



Changing router input name



Changing router output name

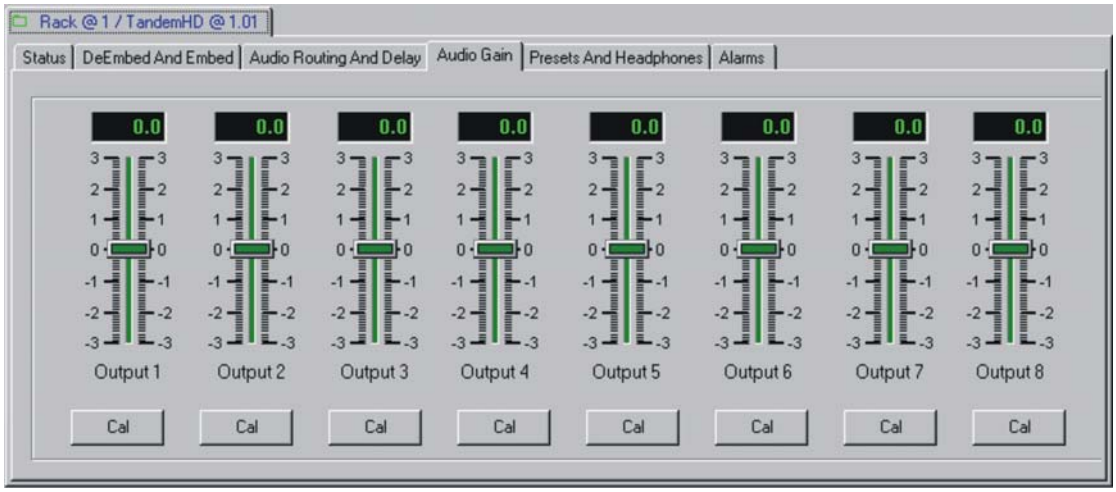
To edit a source or destination name click on the Input or Output text, and a Rename menu will appear. Enter the desired names in the box provided and click OK. The new name will be stored in the host PC, and appear each time Statesman is used.

Delay control

This control can be used to delay the audio with respect to the video by up to 64ms and compensate for any small delay between the incoming video and audio signals. The delay is applied at the output of the 16x8 router and is a single global control. To add a delay to any channels tick the adjacent check box.

Audio Gain

The gain of the eight audio output channels feeding the SDI output stream embedders can be varied from unity gain by ±3.0dB.



TANDEM HD-20 Statesman Audio Gain menu

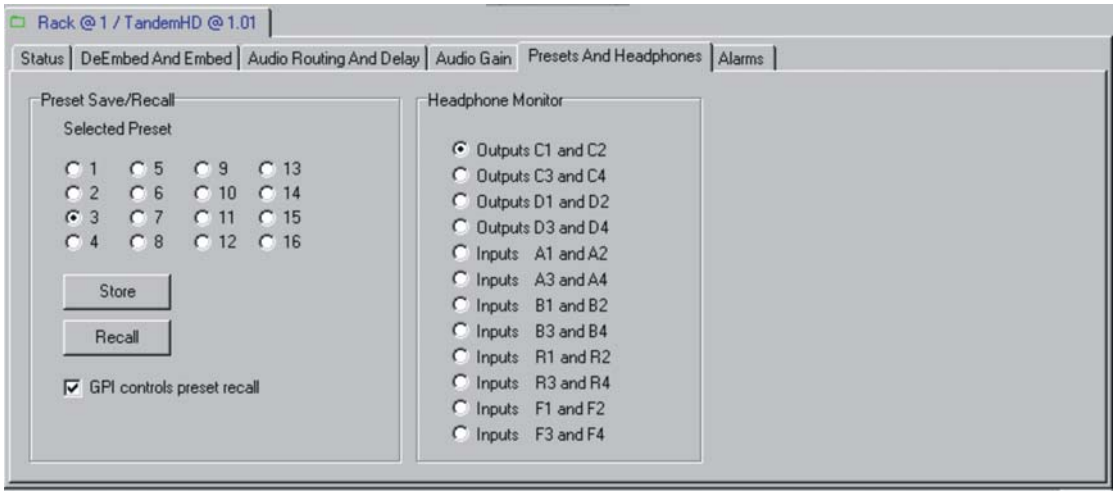
To adjust a channel gain click on the appropriate slider and drag it up or down whilst holding the left mouse button down. The gain applied will be shown in the read-out display above the slider. The readout may also be edited directly by clicking on to enter edit mode and pressing ↵ (Enter) to accept. To recalibrate a channel to exactly unity gain click on the CAL button beneath the appropriate slider or right click the slider and choose 'calibrate'.

To gang gain slider controls together to move them as one, right click on the slider chosen as the master with the CTRL key held down and then, whilst continuing to hold the CTRL key, right click on one or more further gain sliders to use as slaves.

To clear ganged gain controls and restore them to individual use, select 'Clear Ganged Controls' in the Tools menu.

Presets and Headphones

The Presets and Headphones tab gives access to the Preset save/recall and headphone monitor routing.



TANDEM HD-20 Statesman Presets and Headphones menu

Using Presets

Up to sixteen setups may be stored and recalled from Statesman, the card edge control or by external GPIs. Presets store board setup data including operating configurations and option card status. It is not possible to recall a preset if the option card configuration is different to that established when the preset was created. The presets are numbered 1-16.

To store a preset proceed as follows:

- Ensure ‘GPI controls preset recall’ is unchecked
- Select appropriate preset by checking the Preset Number radio button
- Click on ‘Store’ to save setup data into the selected preset

To recall a preset proceed as follows:

- Select appropriate preset by checking the Preset Number radio button
- Click on ‘Recall’ to recall setup data from the selected preset

‘GPI controls preset recall’ should not be checked whilst presets are being created or recalled by this menu to prevent inadvertent GPI operation. Enable ‘GPI controls preset recall’ when finished if required.

Headphone Monitoring

A powerful 12-source stereo monitoring bus provides audio monitoring at the card edge headphone socket. Select any valid stereo signal to be monitored by checking the appropriate radio button.

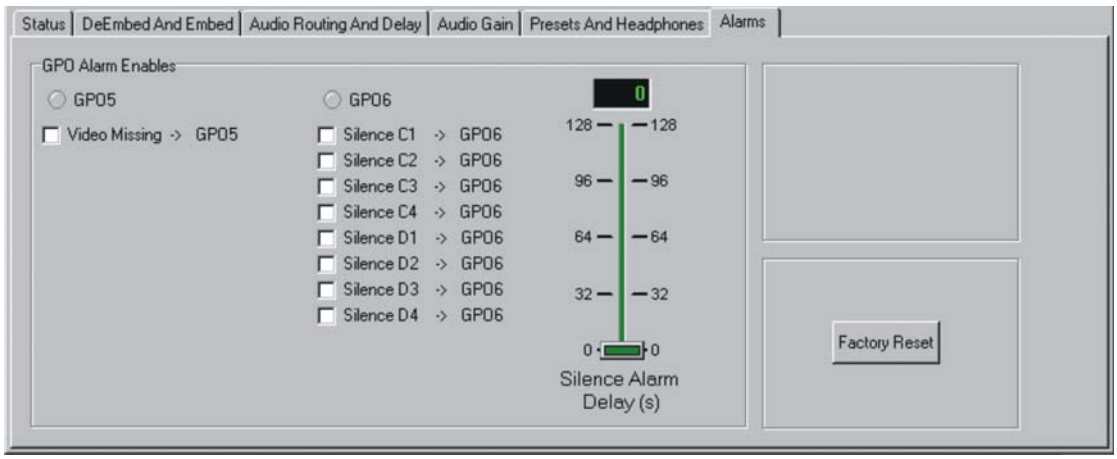
Notes:

Odd channel numbers will appear in the left headphone with the corresponding even channel appearing in the right.

F (front) and R (rear) indicate a sub-PCB and its location when fitted to the TANDEM HD-20 motherboard.

Alarms

The Alarms menu gives access to the GPO assignment, Silence alarm delay and Factory Reset.



TANDEM HD-20 Statesman Alarm menu

Using GPI outputs

There are two GPI outputs, GPO5 for video missing and GPO6, which may be assigned to the eight output silence alarms. If silence is sustained for more than the 'silence detect delay' the assigned GPO will be asserted low as an alarm when 'flag' is selected.

Visual indication of GPO5 and 6 status is also provided.

See Section 2.4 for further discussion of GPIs and pinout details.

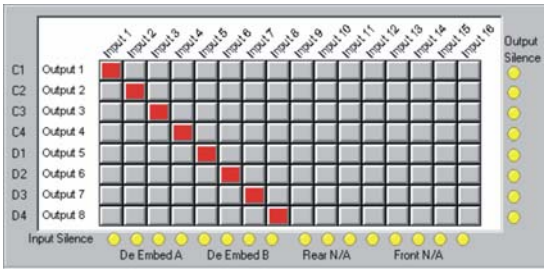
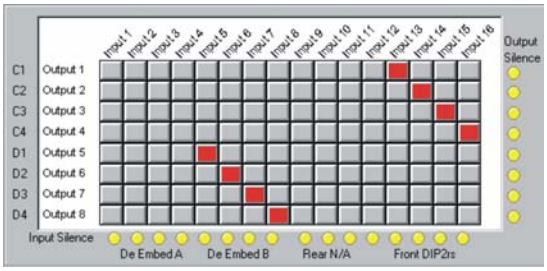
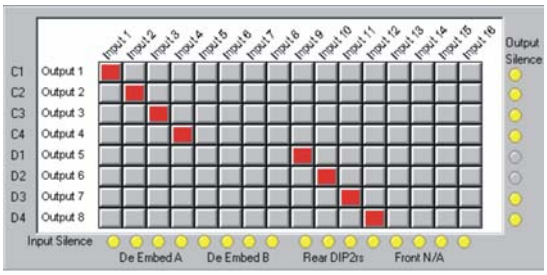
Silence detect delay

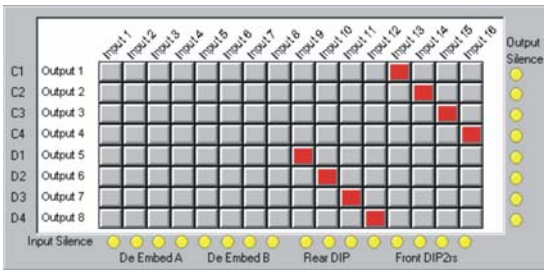
Silence detect or threshold delay can be set at the card edge or via Statesman. The control slider sets the silence detect delay from 0 to 128 seconds for the amount of time a signal is allowed to remain below -50dB with respect to Full Scale before a silence error is flagged. To prevent false alarms during quiet passages there is minimum delay period of approximately four seconds in which silence must be maintained before the delay timer is initiated.

Note: This minimum delay will become significant at short delay settings and it may be necessary to take it into consideration when using a short delay setting.

Factory Reset

The factory reset can be used to return the TANDEM HD-20 to it default condition. It should be noted that if a factory reset is carried out the final routing will depend on any sub-PCBs fitted and all preset configurations will be erased.

Parameter	Default value
De-embedder A	Group 1
De-embedder B	Group 2
Embedder C	Group 1
Embedder D	Group 2
HANC blank	Set to Auto
No or Output Sub-PCBs fitted	
Input Sub PCB in the front position. No or Output Sub-PCB fitted in the rear position	
Input Sub-PCB in the rear position. No or Output Sub-PCB fitted in the front position	

Input Sub-PCBs fitted in both front and rear positions	
Delay, Mono, Mute	Unchecked
Audio Delay	Zero
Audio Gains	Unity
Selected Preset	Unchanged, contents of all saved presets are erased
GPI controls preset recall	Unchanged
Headphone monitoring	C1 and C2
GPO5 and GPO6	Unchecked
Silence Alarm delay	Zero delay

6 Trouble shooting

Simple trouble shooting can be performed by using either the card edge or a remote status panel display.

Card edge monitoring

TANDEM HD-20's card edge LEDs will give a quick overview of current status.

Name	Led Colour	Function when ON	Function when Off
HD	Yellow	Video input standard is HD (High Definition)	Input not present
SD	Yellow	Video input standard is SD (Standard Definition)	
Silent	Yellow	One or more flagged audio channel contains silence	All channels active or masked
PSU	Green	Good power supply (PSU) rails	One or more of the monitor supplies is out of specification
Error	Red	No video input present	
nCal	Yellow	One or more audio channel gains have been adjusted away from unity	All gains set to unity

The board edge display may also give some useful information when trouble shooting.

Fault finding guide

The Power OK LEDs are not illuminated

Check that the frame PSU is functioning – refer to the appropriate frame manual for detailed information

There is no video output

Check that valid SDI inputs are present and that any cabling is intact

There are no audio outputs

Check for audio signals using headphones connected to the front PCB mini jack

Check that functioning analogue or digital audio output cards are fitted securely

Check that any audio cabling is intact

The digital audio output produces clicks and pops in downstream equipment

Check that the embedded audio is synchronous with the same source as the video content of the serial digital signals

Check that the downstream equipment is properly referenced to the system audio reference

The digital audio is not timed with the video (lip sync error)

TANDEM HD-20 can make some adjustment to the timing of the audio to the incoming video. See audio delay for details

Audio has been selected for embedding but fails to be inserted

Check that there is sufficient valid HANC space for the insertion to take place

The card no longer responds to Statesman/front panel control

Check that the card is seated correctly and that the Power OK LED is lit

Check that the Comms LED in an Indigo frame flashes when Statesman communication control is attempted

Check any active control panel/Statesman cabling

Check if the control panel/Statesman can control another card in the same rack

If necessary re-set the card

Statesman settings change unexpectedly

Active control panel or card edge control settings may have overridden Statesman settings if they were changed more recently

Card edge settings have changed unexpectedly

Statesman or active control panel settings may have overridden card edge control settings if they were changed more recently

Active control panel settings change unexpectedly

Statesman or card edge control settings may have overridden control panel settings if they were changed more recently

Re-setting the card

If required, the card may be reset by simply removing the card from the rack and re-inserting. It is safe to re-insert the card whilst the rack is powered.

Default settings may be re-loaded into the card if required – see Factory Reset.

7 Specification

TANDEM HD-20 motherboard

General

Dimensions	100mm x 266mm module with DIN 41612 connector
Weight	260g with two sub PCBs fitted
Power consumption	12W max, dependent on sub PCBs fitted

Processing

10-bit. Active picture only.

Inputs

Video	HD or SD SDI 270Mb/s to 1.485Gb/s serial digital compliant to EBU 3267-E, SMPTE 259M and SMPTE 292M
Cable equalisation	>200m Belden 8281 or equivalent (video)
	HD (1.485Gb/s) – 100 metres (Belden 1694 or equivalent up to 140m)
	SD (270Mb/s) >250 metres
Standard selection	625, 525, 1080i 50/59.94/60, 1035 59.94/60, 720p 50/59.94/60
	Automatic selection, output always follows input standard
Input return loss	-15dB for 5MHz to 1.5GHz
Audio inputs	SD embedded to SMPTE 272M
	HD embedded to SMPTE 299M
	Analogue or AES dependent on sub-modules fitted

Outputs

Video	Two HD or SD SDI 270Mb/s to 1.485Gb/s serial digital compliant to SMPTE 259M and SMPTE 292M with two buffered input loop-throughs.
Jitter	Typically SDI 0.2UI @ 1kHz, HD 0.2UI @ 100kHz
Audio	SD embedded to SMPTE 272M
	HD embedded to SMPTE 299M
	Analogue or AES dependent on sub-modules fitted
Embed/de-embed timing	Inter-channel: <1 clock cycle
	Audio to video: SD approx. 800us, HD approx. 90us

EDH	EDH insertion on SD output
Video/Audio Delay	Dual channel digital audio delay - OFF or pre-settable in 1ms steps from 1 - 64ms.
Delay through board	Less than one line

Audio processing

Audio	SD embedded to SMPTE 272M HD embedded to SMPTE 299M Analogue or AES dependent on sub-modules fitted
Audio gain	Gain level adjustment on each channel between +3dB and -3dB in 0.1dB steps. 0dB calibration.
Monitoring	1 x miniature front mounted audio jack and switch selects individual stereo audio analogue monitoring on both embedder and de-embedder
Audio Replace	Routing of input sub-PCB audio together with audio or Dolby E from up to two de-embedded groups present on video input to any channel of up to two output embedder groups
Silence detect delay	Silence detect delay for both sides is adjustable for the time a signal is allowed to remain below -50dB with respect to Full Scale before a silence error is flagged. Variable steps from 4 seconds plus 0-128 seconds
Dolby E	Dolby E signals can be processed and routed without corruption
Audio protection	Full support for data recovery using SMPTE 299M error correction codes

Set ups	Sixteen set-ups are available to store setup data. They may be recalled either from the board control or through the use of external GPIs
GPIs	Four GPIs are available for external recall of setups and two are available to provide alarm monitoring
Status monitoring	Front card edge visual monitoring with alphanumeric and LED indicators. Remote control panel and Statesman PC control also available Maskable GPI output of inputs present and silence

HD-AIP2: Dual analogue audio input sub-module

Audio input	2 analogue stereo pairs or 4 mono channels, 24 bit quantising A to Ds, High input impedance (20K Ohm) balanced
Level range	0dBFS = +28dBu max / 0dBFS = +12dBu max Default level: 0dBFS = +18dBu or +24dBu by on-board link
Signal to noise	-99dBu / -117 dBFS (+18dBu) rms., 22Hz to 22kHz typ.
Total harmonic distortion	0.004% THD+N rms. 22Hz to 22kHz typ.
Interchannel crosstalk	-110 dB @ 1kHz, -90 dB @ 20 kHz, rms. typ.

Synchronisation	Digitised output of analogue A to D is automatically locked to video

HD-AOP2: Dual analogue audio output sub-module

Audio output	2 analogue stereo pairs or 4 mono channels, 24 bit quantising A to Ds, Low output impedance (66 Ohm) balanced
Level range	0dBFS = +28dBu max / 0dBFS = +12dBu max Default level: 0dBFS = +18dBu or +24dBu by on-board link
Signal to noise	- 99dBu / -117 dBFS (+18 dBu) rms. 22Hz to 22kHz typ.
Total harmonic distortion	0.002% THD+N rms., 22Hz to 22kHz typ.
Interchannel crosstalk	-110 dB @ 1kHz, -90 dB @ 20 kHz, rms. typ.

HD-DIP2: Dual digital audio input sub-module

Audio input	2 x 24 bit stereo pairs. AES3 110 Ohm or HiZ (balanced) D Type, or AES3-id (unbalanced) 75 Ohm BNC. Set by on-board links
Synchronisation	Synchronous audio to video 48kHz

HD-DIP2-RS: Dual digital audio input re-sampler sub-module

Audio input	2 x 24 bit stereo pairs. AES3 110 Ohm or HiZ (balanced) D Type, or AES3-id (unbalanced) 75 Ohm BNC. Set by on-board links.
Synchronisation	Asynchronous audio to video 30kHz to 108kHz sample rates
Total harmonic distortion	0.0002% THD+N rms.

HD-DOP2-110 and HD-DOP2-75: Dual digital audio output sub-modules

Audio output	2 x 24 bit AES/EBU stereo pairs. HD-DOP2-110, 110 Ohm or HD-DOP2-75 (unbalanced) 75 Ohm BNC. Factory configuration only Each of the two AES signal outputs has a second buffered output, which may be available dependant on the RM module fitted.