



VISTEK V6402 **HD** FRAME
SYNCHRONISER,
V6404 **HD** DOWN CONVERTER,
V6406 **HD** UP CONVERTER,
V6408 **HD** CROSS CONVERTER and
V6418 **HD** CONVERTER
USER GUIDE

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V6402, V6404, V6406, V6408 and V6418 HD converters

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1 DESCRIPTION

The modules described in this manual form part of the Vistek 1600 range of interface products. Although they process High Definition (HD) video signals, they are fully compatible with all other products in the range in terms of their form factor, power supply requirements and control interface. Each is a 3U high card that can be fitted into a V1606 rack or a V6011 '1-Box', from which it obtains its power and control. A passive rear module is required for all signal interconnections.

This manual covers the following modules:

V6402	HD Frame Synchroniser
V6404	HD Down Converter
V6406	HD Up Converter
V6408	HD Cross Converter
V6418	HD Converter

These modules are based on a common platform, with a variety of Add-Ons available:

VP: **V**ideo **P**roc Amp
SY: **F**rame **S**ynchroniser (inherent for V6402)
FD: **F**ield/**F**rame **D**elay (requires the SY option to be enabled)
CP: **C**losed **C**aptioning
AH: **A**udio **H**andling

1.1 **General**

The **V6402 HD Frame Synchroniser** re-times an HD or SD SDI signal to an external reference signal and allows the operator to offset the output from the reference by a set amount both horizontally and vertically. The horizontal adjustment is in single clock steps over a whole line and the vertical adjustment is in lines with a range of ± 255 lines. The Frame Synchroniser will occasionally repeat a frame or drop a frame in order to keep pace with the external reference applied. Ancillary data in the horizontal and vertical blanking intervals - such as embedded Audio - remain unaltered, but can be also forced to be blanked. A built-in Test Pattern Generator (TPG) offers a choice of commonly used test patterns for system integrity tests. Without an external reference, the unit can operate as an adjustable delay module, allowing the operator to set the input to output delay pixel accurate from a minimum delay of roughly one video line up to an arbitrary number of fields/frames, provided that the Field/Frame Delay option is enabled. The unit automatically detects the input signal standard and operates accordingly. Available options for the V6402 are: VP and FD.

The **V6404 HD Down Converter** takes an HD input signal and converts it to a Standard Definition (SD) output at the same frame rate as the input. While the unit handles all the interlacing, filtering and scaling required, it does not change the frame rate. Therefore, both the input and output standards must have the same frame rate. The unit automatically detects the input signal standard and sets the output standard, i.e. 525 lines @ 59.94Hz or 625 lines @ 50Hz, accordingly. The operator can select between different aspect ratios (e.g. anamorphic, letterbox, centre-cutout). If the detected input standard is SD, the unit switches automatically into a bypass mode where it maintains the same processing delay that is normally introduced by the down-conversion process. If the module comes with the Audio Handling (AH) option fitted, embedded Audio information will be retained by de-embedding it in the HD domain and re-embedding it in the SD domain. Available options for the V6404 are: VP, SY, FD, CP and AH.



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The **V6406 HD Up Converter** takes an SD input signal and converts it to a High Definition (HD) output at the same frame rate as the input. The V6406's 3 dimensional, motion adaptive filtering offers far superior conversion compared with the V6408's 2 dimensional algorithm. While the unit handles all the interlacing, filtering and scaling required, it does not change the frame rate. Therefore, both the input and output standards must have the same frame rate. The operator can select between different aspect ratios (e.g. anamorphic, pillarbox, centre-cutout). If the module comes with the Audio Handling (AH) option fitted, embedded Audio information will be retained by de-embedding it in the SD domain, and re-embedding it in the HD domain. Available options for the V6406 are: VP, SY, FD, CP and AH.

The **V6408 HD Cross Converter** operates within the High Definition domain and in general converts between the interlaced and progressively scanned formats (720p ↔ 1080i). The unit automatically detects the input signal standard, but the operator must select the output standard from a list of supported standards. Furthermore, the V6408 can perform good quality up-conversions from SD to HD, with a choice of aspect ratios (e.g. anamorphic, pillarbox, centre-cutout). For superior performance, broadcast quality up-conversions, please consider using Vistek's V6406 HD Up Converter. For all up- and cross-conversions, embedded Audio information will be retained if the module comes with the Audio Handling (AH) option fitted. Available options for the V6408 are: VP, SY, FD, CP and AH.

The **V6418 HD Converter** integrates the functionality of the V6404 Down Converter and the V6408 Cross/Up Converter modules, with an additional Short Delay (< 1 ms) Down Conversion mode for monitoring purposes. The unit automatically detects the input signal standard, but the operator must select the output standard from a list of supported standards, or select the up/down operation mode. The V6418 performs the required up-, down- or cross-conversion according to the input/output standards combination. If the module comes with the Audio Handling (AH) option fitted, embedded Audio information will be retained by de-embedding it in the input domain, and re-embedding it in the output domain. Available options for the V6418 are: VP, SY, FD, CP and AH. When using Short Delay Down Conversion mode, only the VP, CP and AH options are available. Also the V6302/AP Advanced Audio Processor can not be utilised in Short Delay Down Conversion mode.

All units have two independent inputs, which can be selected either on the front panel or remotely via Vistek's control interface 'DART'. They also have a fully re-clocked and buffered output, which is after the input signal selection. Generally it is recommended to terminate unused input BNCs in order to improve the unit's noise susceptibility.

The reference input has two BNCs, so a passive loop-through is available. The reference can be either a conventional Black & Burst signal (sometimes known as bi-level sync) or a tri-level sync, which is a newer signal specifically for synchronising HD signals. The Frame Synchroniser (or any other module with the 'SY' option enabled) will automatically detect which type is being used and adapt accordingly. A 75Ω reference termination can be selected using a switch on the I/O Daughter Board.

Modules with a Frame Synchroniser, i.e. the V6402 or V6404/06/08/18 with the SY option fitted, come with a tracking delay output on a BNC which can be used in connection with a 3rd party Audio Processor. If a V64xx is used in combination with Vistek's V6302 Advanced Audio Processor and a dedicated double-width rear panel, the tracking delay information will be passed internally from the Frame Synchroniser to the Audio Processor.

Common for all modules are two (identical) Output BNCs, capable of driving either SD or HD SDI.

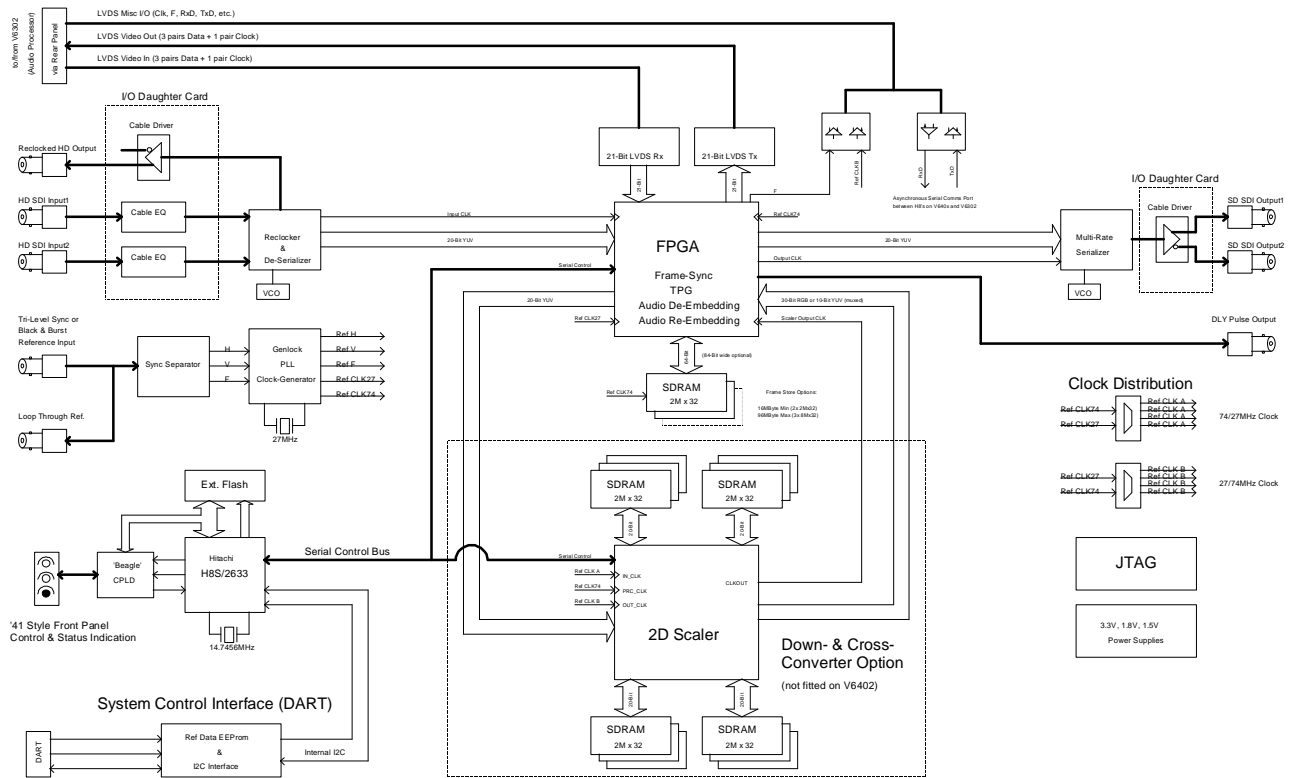
There is a versatile front panel with an alphanumeric display, which lets the operator set up a large number of parameters and read the internal status of the unit. The front panel operates in the same way as many of the more complex units in the range.

V6402, V6404, V6406, V6408 and V6418 HD converters



1.2 Block Diagram

V6402 / V6404 / V6408 / V6418





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1.3 Supported Video Standards

These units have been designed to operate using all the current Standard Definition and High Definition Standards based on field and frame rates of 23.98Hz, 24Hz, 25Hz, 29.97Hz, 30Hz, 50Hz, 59.94Hz and 60Hz. The Bit Serial Interface for all listed HD modes is in accordance with SMPTE specification 292M. For all SD modes, the Serial Digital Interface is in accordance with ANSI/SMPTE 259M.

1.3.1 V6402 HD Frame Synchroniser

Supported Video I/O Standards at the time of printing (FPGA Firmware Version V05.04)

Tektronix Definition	SMPTE	Colloquial
1920x1080/60/2:1	274M - 4	1080i60
1920x1080/59.94/2:1	274M - 5	1080i59
1920x1080/50/2:1	274M - 6	1080i50
1920x1080/30/1:1	274M - 7	1080p30
1920x1080/29.97/1:1	274M - 8	1080p29
1920x1080/25/1:1	274M - 9	1080p25
1920x1080/24/1:1	274M - 10	1080p24
1920x1080/23.98/1:1	274M - 11	1080p23
1920x1080/24/1:1SF	RP211 - 15	1080sf24
1920x1080/23.98/1:1SF	RP211 - 16	1080sf23
1280x720/60/1:1	296M	720p60
1280x720/59.94/1:1	296M	720p59
1280x720/50/1:1	296M	720p50
1280x720/30/1:1	296M	720p30
1280x720/29.97/1:1	296M	720p29
1280x720/25/1:1	296M	720p25
1280x720/24/1:1	296M	720p24
1280x720/23.98/1:1	296M	720p23
1920x1035/60/2:1	260M	1035i60
1920x1035/59.94/2:1	260M	1035i59
625/50/2:1	125/259M	625i50
525/59.94/2:1	125/259M	525i59

Note: The 'colloquial' label is how they are referred to in this manual.

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Supported Reference Standards

Standard	Sync Type	Compatible Video Input Frame- or Field Rates
1080i60	Tri-Level	30Hz, 60Hz
1080i59	Tri-Level	29.97Hz, 59.94Hz
1080i50	Tri-Level	25Hz, 50Hz
1080p30	Tri-Level	30Hz, 60Hz
1080p29	Tri-Level	29.97Hz, 59.94Hz
1080p25	Tri-Level	25Hz, 50Hz
1080p24	Tri-Level	24Hz
1080p23	Tri-Level	23.98Hz
1080sf24	Tri-Level	24Hz
1080sf23	Tri-Level	23.98Hz
720p60	Tri-Level	30Hz, 60Hz
720p59	Tri-Level	29.97Hz, 59.94Hz
720p50	Tri-Level	25Hz, 50Hz
720p30	Tri-Level	30Hz, 60Hz
720p29	Tri-Level	29.97Hz, 59.94Hz
720p25	Tri-Level	25Hz, 50Hz
720p24	Tri-Level	24Hz
720p23	Tri-Level	23.98Hz
1035i60	Tri-Level	30Hz, 60Hz
1035i59	Tri-Level	29.97Hz, 59.94Hz
625i50	Black & Burst	25Hz, 50Hz
525i59	Black & Burst	29.97Hz, 59.94Hz

The grey shaded rows highlight the most commonly used Reference Standards in today's Studio or Transmission environments.

It should be noted that the external Reference Input and the Video Input do not have to be of the same standard! It is however important that there is a match between the field- or frame-rates, since none of the V64xx modules performs field- or frame-rate conversions (e.g. 50Hz ↔ 59.94Hz conversion is not supported).



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1.3.2 V6404 HD Down Converter

Supported conversion modes at the time of printing (FPGA Firmware Version V05.04)

Input Standard	Output Standard	Aspect Ratios
1080i59	525i59	4:3 Anamorphic 16:9 Letterbox 14:9 Letterbox 4:3 Centre-Cutout
1035i59	525i59	
720p59	525i59	
1080i50	625i50	
720p50	625i50	
525i59	525i59	n.a.
625i50	625i50	n.a.

Furthermore, the V6404 HD Down Converter performs the colourspace conversion between the HD and the SD domain in accordance with the following standards:

ITU-R BT.709-5 (HD)

ITU-R BT.601-5 (SD)

F Things to remember:

The V6404 cannot perform field- or frame-rate conversions! When used in connection with the 'SY' option, the Reference's frame rate must either match the Video Input's field- or frame-rate or must be an integer fraction there from.

V6402, V6404, V6406, V6408 and V6418 HD converters



1.3.3 V6406 HD Up Converter

Supported conversion modes at the time of printing

Input Standard	Output Standard	Aspect Ratios
525i59	720p59	16:9 Anamorphic 4:3 Pillarbox
	1080i59	
625i50	720p50	14:9 Centre-Cutout
	1080i50	16:9 Centre-Cutout

Furthermore, the V6406 HD Up Converter performs the colourspace conversion between the SD and the HD domain in accordance with the following standards:

ITU-R BT.601-5 (SD)

ITU-R BT.709-5 (HD)

F Things to remember:

The V6406 cannot perform field- or frame-rate conversions! When used in connection with the 'SY' option, the Reference's frame rate must either match the Video Input's field- or frame-rate or must be an integer fraction there from.



V6402, V6404, V6406, V6408 and V6418 HD converters

1.3.4 V6408 HD Cross Converter

Supported conversion modes at the time of printing (FPGA Firmware Version V05.04)

Input Standard	Output Standard	Aspect Ratios
1080i59	720p59	all 16:9
1035i59	720p59	
720p59	720p59	
1080i60	720p60	
1035i60	720p60	
720p60	720p60	
1080i59	1080i59	
1035i59	1080i59	
720p59	1080i59	
1080i60	1080i60	
1035i60	1080i60	
720p60	1080i60	
1080i59	1035i59	
1035i59	1035i59	
720p59	1035i59	
1080i60	1035i60	
1035i60	1035i60	
720p60	1035i60	
1080i50	720p50	
720p50	1080i50	
1080i50	576p50 (on a 720p50 transport)	
720p50	576p50 (on a 720p50 transport)	
525i59	1080i59	16:9 Anamorphic 4:3 Pillarbox 14:9 Pillarbox 16:9 Centre-Cutout
525i59	1035i59	
525i59	720p59	
625i50	1080i50	
625i50	720p50	
625i50	576p50 (on a 720p50 transport)	

Furthermore, the V6408 HD Cross Converter performs the colourspace conversion between the SD and the HD domain when up-converting in accordance with the following standards:

ITU-R BT.709-5 (HD)
ITU-R BT.601-5 (SD)

F Things to remember:

The V6408 cannot perform field- or frame-rate conversions! When used in connection with the 'SY' option, the Reference's frame rate must either match the Video Input's field- or frame-rate or must be an integer fraction there from.

V6402, V6404, V6406, V6408 and V6418 HD converters



1.3.5 V6418 HD Converter

Supported conversion modes at the time of printing (FPGA Firmware Version V05.04)

Input Standard	Output Standard	Aspect Ratios
1080i59	720p59	all 16:9
1035i59	720p59	
720p59	720p59	
1080i60	720p60	
1035i60	720p60	
720p60	720p60	
1080i59	1080i59	
1035i59	1080i59	
720p59	1080i59	
1080i60	1080i60	
1035i60	1080i60	
720p60	1080i60	
1080i59	1035i59	
1035i59	1035i59	
720p59	1035i59	
1080i60	1035i60	
1035i60	1035i60	
720p60	1035i60	
1080i50	720p50	
720p50	1080i50	
1080i50	576p50 (on a 720p50 transport)	
720p50	576p50 (on a 720p50 transport)	
525i59	1080i59	16:9 Anamorphic 4:3 Pillarbox 14:9 Pillarbox 16:9 Centre-Cutout
525i59	1035i59	
525i59	720p59	
625i50	1080i50	
625i50	720p50	
625i50	576p50 (on a 720p50 transport)	
1080i59	525i59	4:3 Anamorphic 16:9 Letterbox ² 14:9 Letterbox ² 4:3 Centre-Cutout
1035i59 ¹	525i59	
720p59	525i59	
1080i50	625i50	
720p50	625i50	
525i59	525i59	n.a.
625i50	625i50	n.a.



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Notes:

1. 1035i59 Input Standard not supported in Short Delay Down Conversion mode.
2. 16:9 and 14:9 Letterbox Aspect Ratios not supported in Short Delay Down Conversion mode.

Furthermore, the V6418 HD Converter performs the colourspace conversion between the SD and the HD domains when up- or down-converting in accordance with the following standards:

ITU-R BT.709-5 (HD)
ITU-R BT.601-5 (SD)

F Things to remember:

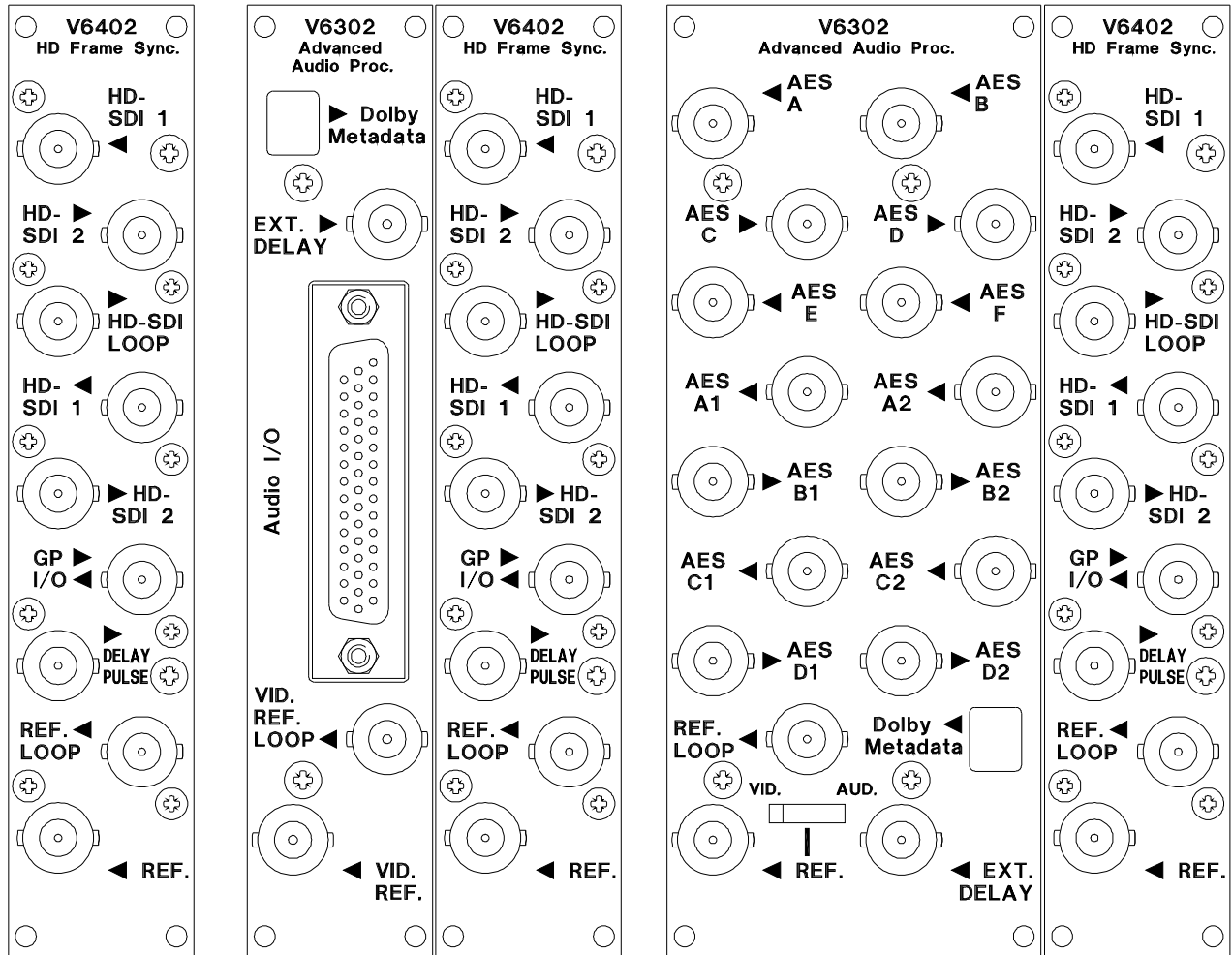
The V6418 cannot perform field- or frame-rate conversions! When used in connection with the 'SY' option, the Reference's frame rate must either match the Video Input's field- or frame-rate or must be an integer fraction there from.

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2 INSTALLATION

2.1 Rear Panels



For more details on the V6302 see the V6302 User Guide.



V6402, V6404, V6406, V6408 and V6418 HD converters

2.2 Connections

The following table shows the function of the rear panel BNCs:

Connector	Type	Function
▶ HD/SDI 1	BNC	HD/SDI Video Input 1
▶ HD/SDI 2	BNC	HD/SDI Video Input 2
◀ HD/SDI LOOP	BNC	HD/SDI Reclocked and Buffered Loop-through Output
◀ HD/SDI 1	BNC	HD/SDI Main Output 1
◀ HD/SDI 2	BNC	HD/SDI Main Output 2
▶ GPIO ◀	BNC	General Purpose Input or Output (bi-directional)
◀ DELAY PULSE	BNC	Delay Pulse Output.
◀ REF. LOOP	BNC	Reference Loop Output
▶ REF.	BNC	Reference Input. Switch selectable termination on board.

V6402, V6404, V6406, V6408 and V6418 HD converters



2.3 Module and Environmental Specifications

Parameter	Environmental Specification
Module Size	Standard V1600 range form factor; fits in V1606 3U rack or V6011 '1-Box'
Rear Panels	V16HR3C Single width rear V16HR3D Double width rear (for V6302 combo) V16HR3E Triple width rear (for V6302 combo)
Operating Voltage	+9..+18V
Power Consumption	V6402 +15V/0.35A (5.3W typ.) V6404 +15V/0.50A (7.5W typ.) V6406 +15V/1.10A (16.5W typ.) V6408 +15V/0.58A (8.7W typ.) V6418 +15V/0.58A (8.7W typ.)
Operating Temperature	0 to +60°C
Storage Temperature	-40°C to +85°C
Relative Humidity	95% non-condensing

2.4 Signal Specifications

Signal	Type	Comments
Video Inputs	75Ω BNC	Input Format: SMPTE259M or SMPTE292M Input Impedance: 75 Ohm Return Loss: > 15dB, 5MHz – 1.5GHz Equal. Cable Length: 0-250m @ 270Mbps 0-100m @ 1.5Gbps
Video Outputs	75Ω BNC	Output Format: SMPTE259M or SMPTE292M Output Impedance: 75 Ohm Return Loss: > 15dB, 5MHz – 1.5GHz Jitter Performance: < 0.2UI p-p (Timing @ 270Mbps) < 0.2UI p-p (Alignment @ 270Mbps) < 1UI p-p (Timing @ 1.485Gbps) < 0.2UI p-p (Alignment @ 1.485Gbps) Amplitude: 800mV p-p (terminated) Drive Capability: > 250m @ 270Mbps (Belden 8281) > 100m @ 1.5Gbps (Belden 1694A)
Video Reference Input	Bi-Level or Tri-Level	1V Composite video, but Black & Burst is recommended. Tri-Level sync as per SMPTE274M or 296M.
Tracking Delay Pulse	LVTTL with +/- 24mA drive capability	Positive pulse represents the video insertion delay. Repetition rate is 2 frames.
GP Input	0V to 5.5V with Schmitt-Trigger characteristic	Positive-going input threshold voltage: 1.75V typ. Negative-going input threshold voltage: 1.0V typ. Hysteresis Voltage: 0.77V typ.
GP Output	LVTTL with +/- 24mA drive capability	Short-circuit protected.



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2.5 Timing Adjustment Ranges

The following tables apply to the **V6402** and all other modules with the **'SY'** option enabled. The tables show the range of the timing adjustments possible relative to the external reference signal (Synchroniser mode) or the range of adjustable input-to-output delay (also known as insertion delay) if a module is being operated without an external reference, i.e. the incoming video signal itself is used as a 'reference' (Delay mode).

Note that overall insertion delay results from adding these timing adjustments to an intrinsic delay, which depends on the module (V6402, V6404, V6406, V6408 or V6418), the mode of operation and the type of conversion (progressive ↔ interlace, video mode ↔ film mode).

2.5.1 Synchroniser Mode

Standard	Horizontal	Vertical	Field/Frame Delay ('FD' option required)	
			24MB	96MB
1080i60	0 to 29.63µs in 13.46ns steps	-256 to +255 lines	4 fields	24 fields
1080i59	0 to 29.66µs in 13.48ns steps	-256 to +255 lines	4 fields	24 fields
1080i50	0 to 35.56µs in 13.46ns steps	-256 to +255 lines	2 fields	20 fields
1080p30	0 to 29.63µs in 13.46ns steps	-256 to +255 lines	2 frames	12 frames
1080p29	0 to 29.66µs in 13.48ns steps	-256 to +255 lines	2 frames	12 frames
1080p25	0 to 35.56µs in 13.46ns steps	-256 to +255 lines	1 frame	10 frames
1080p24	0 to 37.04µs in 13.46ns steps	-256 to +255 lines	1 frame	9 frames
1080p23	0 to 37.07µs in 13.48ns steps	-256 to +255 lines	1 frame	9 frames
1080sf24	0 to 37.04µs in 13.46ns steps	-256 to +255 lines	2 fields	18 fields
1080sf23	0 to 37.07µs in 13.48ns steps	-256 to +255 lines	2 fields	18 fields
720p60	0 to 22.22µs in 13.46ns steps	-256 to +255 lines	5 frames	25 frames
720p59	0 to 22.24µs in 13.48ns steps	-256 to +255 lines	5 frames	25 frames
720p50	0 to 26.67µs in 13.46ns steps	-256 to +255 lines	4 frames	21 frames
720p30	0 to 44.44µs in 13.46ns steps	-256 to +255 lines	2 frames	12 frames
720p29	0 to 44.49µs in 13.48ns steps	-256 to +255 lines	2 frames	12 frames
720p25	0 to 53.22µs in 13.46ns steps	-256 to +255 lines	1 frame	10 frames
720p24	0 to 55.56µs in 13.46ns steps	-256 to +255 lines	1 frame	9 frames
720p23	0 to 55.61µs in 13.48ns steps	-256 to +255 lines	1 frame	9 frames
1035i60	0 to 29.63µs in 13.46ns steps	-256 to +255 lines	4 fields	24 fields
1035i59	0 to 29.66µs in 13.48ns steps	-256 to +255 lines	4 fields	24 fields
625i50	0 to 64.00µs in 37ns steps	-256 to +255 lines	28 fields	58 fields
525i59	0 to 63.56µs in 37ns steps	-256 to +255 lines	34 fields	62 fields

Notes:

1. If the 'FD' option is not installed, the extra 'Field/Frame Delay' on top of any horizontal and/or vertical timing adjustments is automatically set to zero.
2. If a V6404, V6406, V6408 or V6418 is fitted with the Frame Synchroniser option ('SY') enabled, the hor. and vert. timing adjustments apply to the output video format. The Field/Frame Delay applies to the input video format. This means for the V6404 HD Down Converter for example that a maximum extra delay of just 24 Fields (and not 50!) can be imposed on top of the intrinsic delay when down-converting from 1080i59 to 525i59.

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2.5.2 Delay Mode

In the 'Delay Mode', i.e. if the reference is taken from the Input Video signal rather than an external reference, timing adjustments can be accomplished in three levels of accuracy: pixels, lines and fields (interlaced modes) or frames (progressive modes).

Standard	Horizontal	Vertical	Field/Frame Delay ('FD' option required)	
			24MB	96MB
1080i60	0 to 29.63µs in 13.46ns steps	0 to 562 lines	4 fields	24 fields
1080i59	0 to 29.66µs in 13.48ns steps	0 to 562 lines	4 fields	24 fields
1080i50	0 to 35.56µs in 13.46ns steps	0 to 562 lines	2 fields	20 fields
1080p30	0 to 29.63µs in 13.46ns steps	0 to 1124 lines	2 frames	12 frames
1080p29	0 to 29.66µs in 13.48ns steps	0 to 1124 lines	2 frames	12 frames
1080p25	0 to 35.56µs in 13.46ns steps	0 to 1124 lines	1 frame	10 frames
1080p24	0 to 37.04µs in 13.46ns steps	0 to 1124 lines	1 frame	9 frames
1080p23	0 to 37.07µs in 13.48ns steps	0 to 1124 lines	1 frame	9 frames
1080sf24	0 to 37.04µs in 13.46ns steps	0 to 562 lines	2 fields	18 fields
1080sf23	0 to 37.07µs in 13.48ns steps	0 to 562 lines	2 fields	18 fields
720p60	0 to 22.22µs in 13.46ns steps	0 to 749 lines	5 frames	25 frames
720p59	0 to 22.24µs in 13.48ns steps	0 to 749 lines	5 frames	25 frames
720p50	0 to 26.67µs in 13.46ns steps	0 to 749 lines	4 frames	21 frames
720p30	0 to 44.44µs in 13.46ns steps	0 to 749 lines	2 frames	12 frames
720p29	0 to 44.49µs in 13.48ns steps	0 to 749 lines	2 frames	12 frames
720p25	0 to 53.22µs in 13.46ns steps	0 to 749 lines	1 frame	10 frames
720p24	0 to 55.56µs in 13.46ns steps	0 to 749 lines	1 frame	9 frames
720p23	0 to 55.61µs in 13.48ns steps	0 to 749 lines	1 frame	9 frames
1035i60	0 to 29.63µs in 13.46ns steps	0 to 562 lines	4 fields	24 fields
1035i59	0 to 29.66µs in 13.48ns steps	0 to 562 lines	4 fields	24 fields
625i50	0 to 64.00µs in 37ns steps	0 to 311 lines	28 fields	58 fields
525i59	0 to 63.56µs in 37ns steps	0 to 261 lines	34 fields	62 fields

Notes:

If the 'FD' option is not installed, the extra 'Field/Frame Delay' on top of any horizontal and/or vertical timing adjustments is automatically set to zero.

If a V6404, V6406, V6408 or V6418 is fitted with the Frame Synchroniser option ('SY') enabled, the hor. and vert. timing adjustments apply to the output video format. The Field/Frame Delay applies to the input video format. This means for the V6404 HD Down Converter for example that a maximum extra delay of just 24 Fields (and not 50!) can be imposed on top of the intrinsic delay when down-converting from 1080i59 to 525i59.



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2.5.3 Minimum Delay (Intrinsic Delay)

Module	Standard/Conversion	Min. Delay Frame Sync mode	Min. Delay F-Delay mode
V6402	All modes	9.1µs (min) 24.4µs (max) Hysteresis: 15.3µs	1 line + 38 pixels ¹ (see Delay Mode table for mode dependent line lengths and pixel timing)
V6404	1080i59 to 525i59 (Down Conv.) 1035i59 to 525i59 (Down Conv.) 1080i50 to 625i50 (Down Conv.)	2 Input Fields + Hysteresis	2 Input Fields + 1 line + 38 pixels ¹
	720p59 to 525i59 (Down Conv.) 720p50 to 625i50 (Down Conv.)	2 Input Frames + Hysteresis	2 Input Frames + 1 line + 38 pixels ¹
	525i59 to 525i59 (Bypass) 625i50 to 625i50 (Bypass)	2 Input Fields + Hysteresis	2 Input Fields + 1 line + 38 pixels ¹
V6406	525i59 to 1080i59 (Up Conv.) 525i59 to 720p59 (Up Conv.) 625i50 to 1080i50 (Up Conv.) 625i50 to 720p50 (Up Conv.)	6 Input Fields + Hysteresis	6 Input Fields + 1 line + 38 pixels ¹
V6408	1080i59 to 720p59 (Cross Conv.) 1080i50 to 720p50 (Cross Conv.) 1035i59 to 720p59 (Cross Conv.)	2 Input Fields + Hysteresis	2 Input Fields + 1 line + 38 pixels ¹
	720p59 to 1080i59 (Cross Conv.) 720p50 to 1080i50 (Cross Conv.) 720p59 to 1035i59 (Cross Conv.)	2 Input Frames + Hysteresis	2 Input Frames + 1 line + 38 pixels ¹
	525i59 to 1080i59 (Up Conv.) 525i59 to 1035i59 (Up Conv.) 525i59 to 720p59 (Up Conv.) 625i50 to 1080i50 (Up Conv.) 625i50 to 720p50 (Up Conv.)	2 Input Fields + Hysteresis	2 Input Fields + 1 line + 38 pixels ¹
V6418 ²	1080i59 to 525i59 (Down Conv.) ² 1035i59 to 525i59 (Down Conv.) ² 1080i50 to 625i50 (Down Conv.) ²	2 Input Fields + Hysteresis	2 Input Fields + 1 line + 38 pixels ¹
	720p59 to 525i59 (Down Conv.) ² 720p50 to 625i50 (Down Conv.) ²	2 Input Frames + Hysteresis	2 Input Frames + 1 line + 38 pixels ¹
	525i59 to 525i59 (Bypass) ² 625i50 to 625i50 (Bypass) ²	2 Input Fields + Hysteresis	2 Input Fields + 1 line + 38 pixels ¹
	1080i59 to 720p59 (Cross Conv.) 1080i50 to 720p50 (Cross Conv.) 1035i59 to 720p59 (Cross Conv.)	2 Input Fields + Hysteresis	2 Input Fields + 1 line + 38 pixels ¹
	720p59 to 1080i59 (Cross Conv.) 720p50 to 1080i50 (Cross Conv.) 720p59 to 1035i59 (Cross Conv.)	2 Input Frames + Hysteresis	2 Input Frames + 1 line + 38 pixels ¹
	525i59 to 1080i59 (Up Conv.) 525i59 to 1035i59 (Up Conv.) 525i59 to 720p59 (Up Conv.) 625i50 to 1080i50 (Up Conv.) 625i50 to 720p50 (Up Conv.)	2 Input Fields + Hysteresis	2 Input Fields + 1 line + 38 pixels ¹

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Notes:

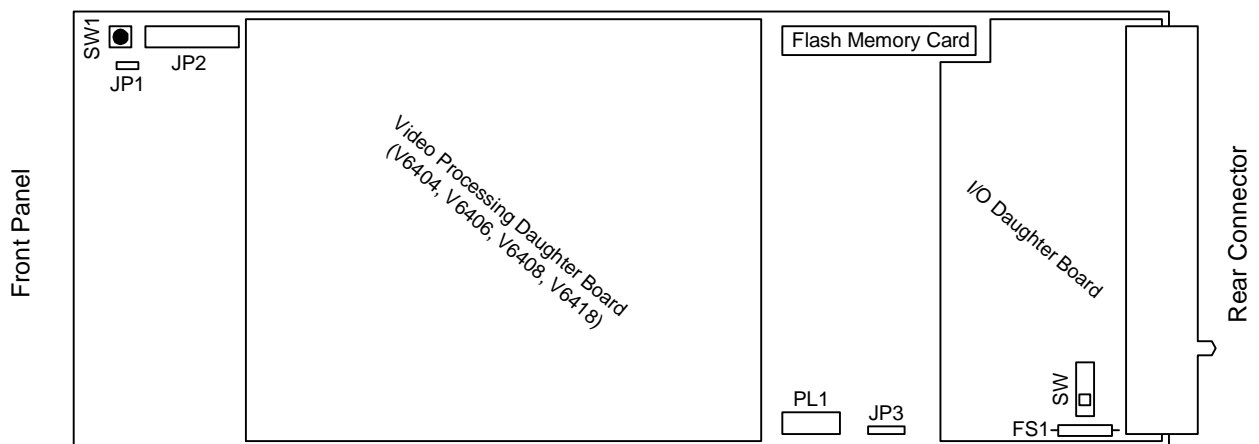
1. In this case, a pixel is a luminance sample.
2. When in Short Delay Down Conversion mode, these conversions have a maximum insertion delay of 1 ms.

2.6 Hardware

2.6.1 The PCB

This figure shows the construction of the PCB, along with some components of interest. Note that the main I/O connector is in fact mounted on a daughter board, which is held down by two screws. The Down and Cross Converters also have a large sub-board mounted on the centre of the board.

The main connector is a 220-way 2mm press-fit connector. When new there may be a substantial insertion force when mating with a rear module; this is normal. However, it is important that the module is not plugged into one of Vistek's conventional units with significant force. If so then it is possible to break off one of the locating lugs.



2.6.2 Links and Switches

The purposes of the links and switches are shown in the following table. Details of their operation are described in later sections.

ITEM	Title	Comments
SW1	RESET	Used to reset the internal microcontroller.
JP1	Debug	For development and test use only. (May not be fitted)
JP2	H8 Program	For development and test use only. (May not be fitted)
PL1	JTAG Port	Never used in operation. (May not be fitted)
JP3	JTAG Enable	For Test. Fit in 2-3 position.
SW	Video REF Term	Slider up – Terminated with 75Ω Slider down – Hi-Z (un-terminated)

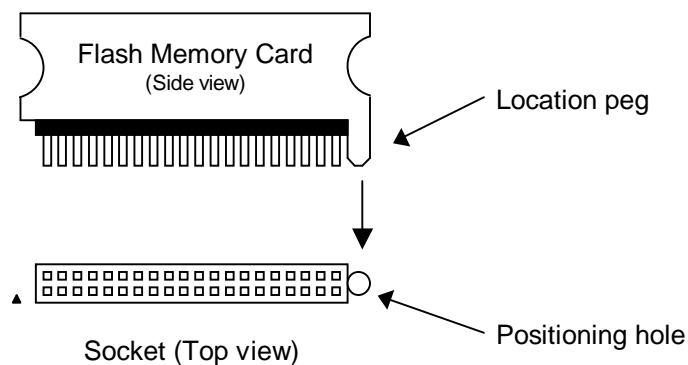
2.6.3 Fuse

There is only one fuse on these modules, which is in series with the main DC input.

FS1	Fuse 2 Amp Wire ended	In series with the +15V input to the module on the I/O daughter board.
-----	-----------------------	--

2.6.4 Flash Memory Card

The Flash Memory Card stores the firmware for the Microcontroller and the FPGA and is essential for the operation of the module. If this card is missing, the front panel display will come up with an error message (ERROR 10). The Flash Memory Card sits in a socket with a location peg to the right. In case of a firmware upgrade, one has to make sure that the replaced card sits firmly and straight in the socket with the location peg mating with the positioning hole on the baseboard.

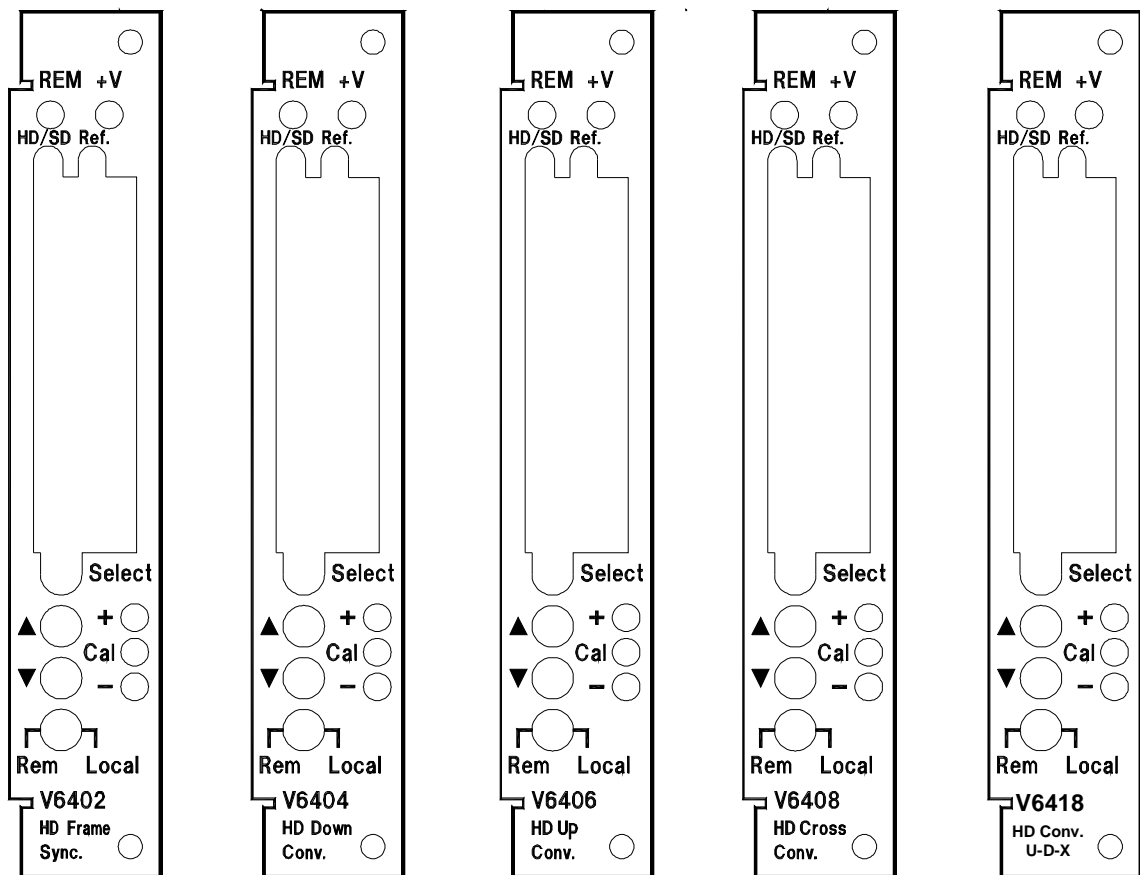


The Flash Memory Card is re-programmable. Customers are kindly asked not to throw it away after having upgraded a module with a newer firmware version. A Vistek service technician will collect it on his/her next visit or it can be put in an envelope and sent back to the postal address shown on the cover of this manual.

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2.7 Front Panel



The front panels are similar to other complex V1600 types. They provide the user with total control and monitoring of the unit without the need to consult manuals and read unlabelled indicators.

At first use the menu system may seem cumbersome but with only a small amount of practice it will become very easy to use.

2.7.1 Direct Indications

The four LEDs at the top of the panel provide these direct indications of the unit:

- REM Short blinks to indicate access by the DART controller, if fitted. It does **not** directly indicate that the unit is in remote control mode. If the rack frame does not have a Rack Controller fitted then this LED will not blink.
- +V Indicates that the main +3.3V is present on the board. This is derived from the +15V distributed through the rack. The modules do have many power rails, but only the main +3.3V is indicated here. It will, of course, be off if the fuse, FS1, were to have been blown.
- HD/SD Indicates that a valid SDI signal (either HD or SD) is being received.
- REF Indicates that a video reference signal is being present – either bi-level or tri-level.



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2.7.2 Display and Switches

The main display is an eight character LED matrix display. It has been set so that when fitted into a 3U rack (V1606) it can be read from the left, and when fitted into a '1-Box' (V6011) it is horizontal and the 'proper' way up. (At time of writing it is not possible to fit the V64xx HD products into the V1602 1U rack!)

The three action buttons are labelled **Select**, ▲ and ▼. The **Select** button is used to move down and up the menus. A short press will move down one level, while pressing and holding for about half a second will move up one level. If you continue to hold it will progressively move up a level every half second until it reaches the top level (**SLEEP**), or you let go, in which case it will stay where it is. When at any level the ▲ and ▼ buttons will move through the list of options, or if in an actual variable (such as Video Gain) they will change the values.

If the unit is in Local control then the display and switches are used to set up and show the operation the module. If in remote mode then they are still active for showing the status but cannot be used to actually change anything.

Beside the ▲ and ▼ buttons are three LEDs marked +, **CAL** and -. In general the **CAL** LED is used to show that a variable is set to its normalised value and if not then the others show in which direction it has been changed or that it is no longer on its CAL value.

2.7.3 Remote/Local Control

The lowest switch selects between Local control and Remote control over DART:

- | | |
|-------|---|
| Local | Control is from the front panel itself. |
| Rem | Control is from the DART system. This requires the use of an external controller running a suitable programme, which communicates with multiple racks using the Dartnet protocol. |

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3 SYSTEM OPERATION

3.1 Local Control

3.1.1 Start up

Local control and monitoring of the modules is done through the front panel with its eight character LED display and three control buttons **Select**, **▲** and **▼**. There are three LEDs which also contribute to the status indication; these are labelled **+**, **Cal** and **-**.

After power up and having successfully passed the power-on-self test, the display will start at the top level and show the unit type and any options that are included. The display will be one of these:

Unit type	Password protected Option(s)	Other options
V6402	VP, FD	
V6404	VP, SY, SV, FD, AH	CP
V6406	VP, SY, SV, FD, AH	CP
V6408	VP, SY, SV, FD, AH	CP
V6418	VP, SY, SV, FD, AH	CP

If the last character shown is a '+' (e.g. V6404SV+), this indicates that the unit has further options installed. To see what they are, use the **▼** button to navigate.

3.1.2 Option Abbreviations

Options are indicated by abbreviations. The following list illustrates their meanings:

Option	Meaning
VP	Video Proc Amp
SY	Frame Synchroniser (inherent on V6402)
SV	Frame Synchroniser + Video Proc Amp
FD	Field/Frame Delay (requires either SY or SV option)
AH	Audio Handling
CP	Closed Captioning



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3.1.3 Menu Control

The **Select**, **▲** and **▼** buttons are used to manoeuvre around the menu system. The menu structure has five levels and the **Select** button is used to go up and down the structure. The **▲** and **▼** buttons are used to move between selections or to adjust a parameter depending on which sort of menu is displayed. The five levels are as follows:

Sleep	Display is blank (except for Banner warnings).
Top Level	As above, e.g. V6402FD
Main Menu	The Main menu items, such as VIDEO , STATUS , ENG'ING etc. These items are all in Upper Case.
Sub Menu	Menu items under each main heading, such as source or A/R under the VIDEO main menu. These items are all in Sentence Case (generally lower case but with upper case first letters).
Parameter	The lowest level under the Sub Menu, and used to actually adjust a parameter. The display will depend on the actual parameter and may be a value such as +0.00dB for a gain or ON or OFF for a switch variable. There is usually a title to describe the variable and a small icon in the left hand character position, but 8 characters cannot provide for a detailed description.

To move down a level just press the **Select** button briefly; then press either the **Select** button again to go down another level or the **▲** and **▼** buttons to move around the options within a level.

To move up a level press and hold the **Select** button for about half a second which will move up one level. If you continue to hold the **Select** button then it will move up a level every half a second until it reaches the Sleep level (one above the Top Level).

A complete list of all the menus is given in Section 5.

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3.1.4 Menu Examples

This section has examples of how to manoeuvre through the menu system. The first one starts with the unit in its 'sleep' mode where the display is blank, and then proceeds to set the reference source to the processing input (*Vid I/P*).

Action	Display	Comments
Select	V6404SV	Top Level
Select	VIDEO	The Main Menu we want
Select	Source	The first Sub Menu in the list
▼	A/R	
▼	Ref Src	The Sub Menu we want
Select	Auto	The default setting
▲	Vid I/P	Set it as we want it

Now we shall select how the unit behaves when the input fails. The following steps should be taken from the current position (Select+Hold means that you should press and hold the select button for about half a second):

Action	Display	Comments
Select+Hold	Ref Src	UP to the Sub Menu level
▼	Anc Data	
▼	VFL Mode	The Sub Menu we want
Select	Black	The default setting
▲+ Hold	1 sec	Unit automatically counts up till it comes to...
	Freeze	or do you want it to go 'Black' after 14 sec?
▼	14 sec	Set it as we want it

3.1.5 Sleep

If the front panel is not used for a certain amount of time then the display will automatically go into a sleep mode when it will be blank. Pressing any of the buttons will cause it to 'wake up' back into the top level. The time delay before the unit slips into sleep mode can be set up using the **ENG' ING : sLeep** menu.

The brightness of the display can also be adjusted using the **ENG' ING : LEDLevel** menu.



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3.2 Common Features to all Units

3.2.1 SDI Inputs

V6402

V6404

V6406

V6408

V6418

The SDI inputs must conform to either the SMPTE292M or SMPTE259M standards, which describe the Bit Serial Digital Interface for HD and SD operation. If only one input is required then it should be connected to SDI 1. Unused inputs can be left open, it is however recommended to terminate unused inputs with a 75Ω Terminator to improve noise immunity. Signals of different frame-rates, resolutions or even a mixture of SD and HD standards can be connected to both Inputs at the same time, however only one of the two inputs can be selected at a time. Note that switching between different standards is neither instant nor glitch-free. This has to do with the necessity of the SDI de-serialiser hardware to lock to the newly detected standard. Furthermore, in case of an SD-to-HD switch over (or vice versa), the FPGA on the baseboard must be re-loaded. This process takes about 2 to 3 seconds.

The input selection is done on the **VIDEO : Source** menu.

3.2.2 SDI Reclocked & Buffered Output

This is always available, and is a relocked version of either SDI 1 or SDI 2, depending on the source selection. It is an unprocessed signal, i.e. neither synchronised nor converted.

3.2.3 SDI Main Outputs

The main synchronised/processed SDI output is available on two BNCs.

3.2.4 Video Reference

The external video reference is available for units with the Frame Synchroniser function; it can be either a standard composite black and burst video signal, or a new style tri-level sync. The unit will automatically detect which and extract the relevant timing information.

Note that on V6404, V6406, V6408 and V6418 units the SY function is optional. If it is not enabled, the Video Reference Input has no function.

The reference is looped on the rear module so it can be daisy chained along several modules. For accurate timing, this is not recommended. There is a termination on the I/O daughter module, which can be switched in at the end of the chain. Care should be taken to ensure that each reference has only one termination set.

The units can operate from either the external reference or use the selected SDI input. This is selected on the **VIDEO : Ref src** menu. When set to *Auto*, the external reference will be used if available; otherwise the selected SDI input will be used as the reference.

3.2.5 Standard Detection

The units detect and report back the detected video standard and frame-rate of the selected SDI input and that of the reference input. The detected standard can be seen in the **STATUS** menu under **I/P std** and **Ref std**.

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3.2.6 TRS Signals

The TRS signals are the digital equivalent of the analogue synchronising pulses. All modules described in this manual always regenerate the TRS signals on their output, so that any errors on the input signal will not be propagated through.

3.2.7 EDH (SD operation only)

EDH is a method of embedding data within the ancillary data space that carries a measurement of the integrity of video and other data. By regenerating the equivalent measurement at the receiving end it is possible to check that the data has been received correctly.

HD signals always have the EDH data in form of checksums embedded, but for SD signals it is optional. On the V6404 Down Converter or V6418 Converter, the EDH on the output can be disabled on the **ENG'ING : O/P EDH** menu. Care must be taken if the new EDH generation is disabled and the old EDH is being passed through because it will probably not correctly represent the data. In this case the Ancillary Data really ought to be blanked.

3.2.8 Illegal Codes

A function of these modules is to ensure that the SDI output always meets the relevant specification. In particular this means that the output is always legal in the sense of Line Length, Field Length and data values. In the main this works extremely well, but there are some circumstances where it fails:

1. If the output timing is being changed, there will be momentary errors.
2. If the input is noisy, such that erroneous data is received, then the ancillary data may get checksum errors. This obviously only applies if the Ancillary data is being passed. The video will be all right, since the EDH (SD operation), respectively the line numbers and CRC codes in accordance with SMPTE 292M (HD operation) are regenerated on the output.
3. If the reference is unstable or changing standards then the output will not be stable.

3.2.9 Horizontal and Vertical Blanking Interval Data (HANC and VANC)

V6402 and V6404/V6406/V6408/V6418 with SY option:

Any data embedded in the horizontal and vertical blanking intervals can be retained throughout the Frame Synchroniser stage. Ancillary Data can be passed unchanged (**VIDEO : Anc Data \bar{O} Anc Pass**) or it can be set to 'Black' (**VIDEO : Anc Data \bar{O} Anc Blnk**).

V6404/V6406/V6408/V6418 (with or without SY option):

Provided that the Down- or Cross-Converter unit is fitted with the Audio Handling (AH) option or the Closed Captioning option (CP), relevant chunks of Ancillary data, such as embedded Audio or Closed Captioning, can be transferred from the Input standard to the selected Output standard.



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3.2.10 SDI Input Fail

V6402 and V6404/V6406/V6408/V6418 with SY option:

If the selected SDI input fails, then the output picture will be either frozen, set to black or the selected input will switch from input 1 to input 2 (VIDEO : VFL Mode). If the Frame Delay option is not installed or set to zero, the output will resume after a full frame of undisrupted video has been received. On units with the Frame Delay option installed, resumption of the 'live' output will be delayed by the number of Frames set in the VIDEO : F Delay menu.

V6404/V6406/V6408/V6418 without SY option:

If the selected SDI input fails, then the output picture will be frozen. The output will continue after a full frame of video has been received.

V6418 in Short Delay Down Conversion mode:

When the V6418 is operating in Short Delay Down Conversion mode (ENG'ING : DownConv : ShortDel), if the selected SDI input fails, then the output will be set to black. The output will continue after a full frame of video has been received.

3.2.11 Video Reference Fail

V6402 and V6404/V6406/V6408/V6418 with SY option:

When there is no external reference signal present, the unit will use the selected SDI input as its timing reference if VIDEO : Ref Src is set to *Auto*. If VIDEO : Ref Src is set to *Ref I/P*, the module continues operating in a free-run mode if the external reference is invalid or absent.

Under the circumstances described above and depending on the setting of VIDEO : RFL Mode (Reference Fail Mode), the module then switches automatically into a minimum delay mode (*Min Dly*) or it maintains the delay set by the F-, V- and H- Delay controls (*Adj Dly*).

A module can be also forced to use the SDI input as its timing reference by setting VIDEO : Ref Src to *Vid I/P*. In this case, the current setting in VIDEO : RFL Mode will be ignored and the total insertion delay simply depends on the current settings in the F-, V- and H- Delay controls.

3.2.12 GPI Configuration

The modules have one GPI available at the rear with a BNC connection.

Connecting the input to 0v activates the GPI, leaving it open circuit de-activates it. The status is shown in the STATUS : GPI menu as **GPI -** or **GPI ⁻**, the former being active and the latter inactive (despite the fact that connecting it to 0v makes it active).

The GPI function can be set-up in the CONFIG : GPI menu to control the input selection, or switch the module's output to 75% bars generated internally. The 75% bars output option will only function with the **SY** option fitted.

Note that, if Video fail mode is set to "switch to I/P 2", the GPI can be used to set the source back to I/P 1 after the signal is restored. If the GPI is set to SDI1, it can be activated either permanently or momentarily. If it is set to SDI2, a momentary activation resets the source back to I/P 1.

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3.2.13 Video Reference Mismatch

When a mismatch between the Video Input's (Vid I/P) frame-rate and the Reference's frame-rate is being detected, the output can either follow the Vid I/P or the Reference, depending on the setting of **VIDEO : XStdMode** (also known as 'Cross-Reference' mode).

Available options are:

XStd Ref: Output frame-rate is set to Reference frame-rate, no matter what the Video Input frame-rate is.

XStd I/P: Output frame-rate is set to Video Input frame-rate

V6402 Example: Vid I/P is 720p @ 59.94Hz
XStdMode is set to *XStd Ref*
Ext. Reference changes from 59.94Hz to 50Hz

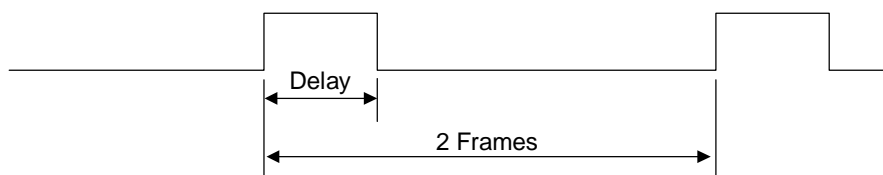
⊗ Output frame-rate instantly changes to the Reference frame-rate, i.e. the Output standard will be 720p @ 50Hz thereafter. The Output picture will look somehow corrupted - which is absolutely normal - but the Output video timing fully complies with the 720p50 standard. The reader should be reminded here that no member of the V64xx Series can perform frame-rate conversions (e.g. 59.94Hz to 50Hz).

The Frame Synchronizer will automatically resume normal operation as soon as a frame-rate match has been re-established.

3.2.14 Delay Signal

The Frame Synchroniser produces a signal that represents the variable delay being inserted into the video path. This delay information is passed on internally to the V6302 Advanced Audio Processor (if present) and used to provide a tracking delay to the audio. The signal is also available externally so it can be used by other audio tracking devices. Please note that the length of the tracking delay pulse is a measure for the variable delay between input and output only – it does not cover for any additional Field/Frame-Delay added on top of the variable delay.

The Delay signal has repetition rate of two frames and the positive pulse width represents the variable delay. This is shown in this diagram.



If the unit is not synchronising, such as loss of I/P or Freeze, then the delay output is blanked (static low). It is expected under these conditions that the audio processing will hold its current delay from the last valid measurement until a pulse re-appears.

The external Delay Pulse output is available on a BNC on the rear panel. The external pulse itself is nominally 3.3V with a sourcing/sinking capability of $\pm 24\text{mA}$.



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3.2.15 VCO Centre Frequency

Normally, the output is locked to the video reference - if present - and of the same standard as the video, or to the input video itself. If there is no signal or reference connected then the output will free run at the nominal centre frequency of the on board clock generator. This centre frequency can be adjusted under the **CALIB : CntrFreq** menu, but this should not normally be necessary in the field.

It is possible to force the unit into its free-run mode using the **ENG'ING : Free-run** menu. This is an unusual requirement and so is a setting that appears on the top level banner when set.

3.2.16 Version Numbers

Each module comprises various items of software/hardware and they all have separate version numbers. These can be read on the following read only menus:

STATUS	Soft Ver	XX.XX.XX	Microprocessor Code
STATUS	FPGA Ver	XX.XX	FPGA Code
STATUS	CPLD Ver	XX.XX	CPLD Code
STATUS	PCB Ver	XX.XX	The PCB revision, with Mod status
STATUS	Boot Ver	XX.XX.XX	Boot Loader

3.2.17 Memory Size

The amount of SDRAM fitted on the baseboard can be checked in the read only menu **STATUS : Mem size**. Some module functions, such as the Field/Frame Delay option, are memory size dependent. Currently, modules are available with two different memory configurations:

Memory Size	Supported Features
24MBytes	Basic - with limited Field/Frame Delay functionality
96MBytes	Required for full Field/Frame Delay support

3.2.18 Display Sleep

Since, for the vast majority of its life, a module will operate behind the front panel of a rack frame, the display on the local front panel will not be visible so it will go to sleep after a certain time. This timeout delay can be changed on the **ENG'ING : sleep** menu to be anything between 0 and 30 minutes; 0 minutes means that it will stay on indefinitely. The sleep timeout always counts from the last front panel button push. The default time is 5 minutes.

The panel can also be forced into its sleep mode by moving up a level from the Top Level menu, which displays the module type.

To get the display to come on again simply press one of the buttons and the menus will start again at the Top Level.

3.2.19 Display Brightness

The brightness of the front panel display can be adjusted on the **ENG'ING : LEDLevel** menu.

ENG'ING **LEDLevel** █ █ █ █

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3.3 Module Specific Functions

3.3.1 Manual Freeze

V6402

V6404SY

V6406SY

V6408SY

V6418SY

The output picture can be frozen manually using the **VIDEO : Freeze** menu.

With interlaced video input formats, such as 1080i59, the operator has the choice between *Field1 - Field2 - Frame*. Please note that when freezing a field, the selected field will be used for displaying both fields, resulting in a simple line-doubling effect. When freezing an interlaced input as 'Frame', the frozen image may appear very fuzzy or shaky, depending on the amount of motion between field1 and field2.

With progressively scanned input formats, the same choices are available, but a Frame-Freeze actually happens when selecting any of the three options (*Field1 - Field2 - Frame*).

When using the manual freeze function in connection with the Field/Frame Delay option, resumption of normal operation after a freeze will be delayed by the same number of frames (or fields) as set in the F-Delay menu.

The reason for that is that after having sent the *Run* command, the frame buffer must be filled first with n-frames in order to maintain the delay as set in the F-Delay menu.

At HD operation, this 'resumption-delay' is almost not noticeable, even if the frame-delay is set to a maximum. At SD operation however, the delay can be up to 2 seconds!

3.3.2 Timing & Delay Control

3.3.2.1 With External Reference (Ref I/P)

V6402

V6404SY

V6406SY

V6408SY

V6418SY

The delay imposed on the SDI data processed by a frame-synchronising module depends first of all on the Reference Source selection. If an external, analog Reference signal (e.g. Bi- or Tri-Level Sync) is present and the **Ref Src** selection control (**VIDEO : Ref Src**) is set to *Auto*, the V64xx will automatically operate as a Frame-Synchroniser, which means that its output will be frame-synchronous to the Reference signal applied.

In order to keep pace with the incoming SDI data, the Frame-Synchroniser will either repeat a frame or drop a frame once in a while, depending on a) which of the two clock domains (Input Video versus Reference signal) is the faster, and b) how far the two clock domains are apart (typically in the range of 0 to ± 150 ppm).

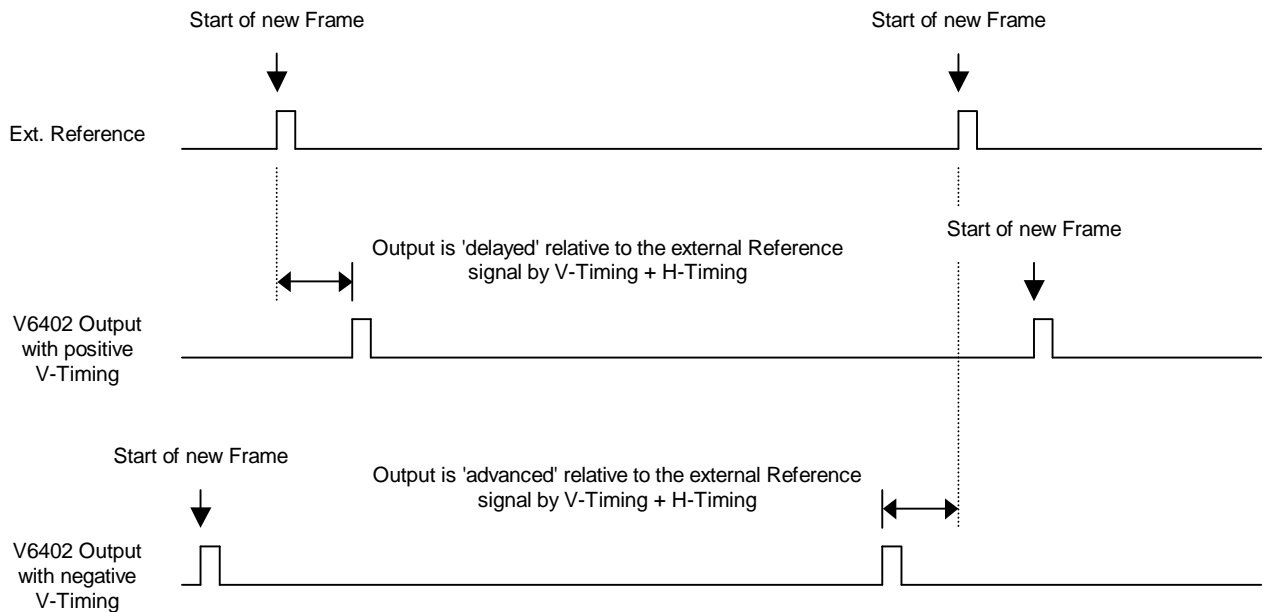
Between the events of two successive frame repeats, respectively two frame drops, the input-to-output delay will gradually increase (or decrease) from a variable minimum value (hysteresis) up to one frame (or vice versa). Hysteresis is essential in order to prevent a series of frame drops or repeats when approaching the 'roll-over' point.

As explained earlier, an extra n-field/frame delay can be introduced on top of this variable delay if the 'FD' option is enabled.

When operating the V64xx as a Frame-Synchroniser, two timing controls (V- & H-Timing) are available for adjusting the board's output timing relative to the external Reference signal. This works irrespective of the additional Field/Frame delay, which can be applied on top of the inherent variable delay.

VIDEO : V Timing: Purpose: For vertical adjustment (in number of lines)
Range: -256..+255 lines

VIDEO : H Timing: Purpose: For horizontal adjustment (in microseconds)
Range: from 0 μ s up to (duration of one line – one pixel)



This drawing illustrates the **Reference-to-Output** timing relationship when operating a V64xx in its Frame-Synchroniser mode.

Note that the Input-to-Output delay in a Frame-Synchroniser is variable and spans from a minimum delay up to a complete Frame. This timing variation can be monitored with a scope on the Delay Pulse BNC.

3.3.2.2 With Internal Reference (Vid I/P)

V6402

V6404SY

V6406SY

V6408SY

V6418SY

Alternatively, the V64xx can be used as a straightforward, adjustable Field/Frame Delay module, in applications where for example the incoming SDI signal is already frame-synchronous but requires an arbitrary delay in order to compensate latency accompanied with the encoding of specific Audio formats.

Disconnecting the external Reference signal (in case `VIDEO : Ref Src` is set to `Auto`) or forcing the unit to take its Video Input as the Reference signal (`VIDEO : Ref Src` is set to `Vid I/P`) will automatically disable the Frame Synchroniser function and put the board into a pure delay mode.

The V- and H-Timing controls change their meanings into V- and H-Delay. If the F-Delay option is enabled, an extra n-Field(s)/Frame(s) delay can be imposed on top of the V- and H-Delay.

F Important:

If `VIDEO : Ref Src` is set to `Auto` and no external Reference signal is present, the unit assumes that there is a persistent problem with the external Reference and the actual insertion delay is controlled by the setting in the `VIDEO : RFL Mode` menu:

If `RFL Mode` is set to `Min Dly`, all delay control settings will be forced to zero and the unit continues operating in a minimum delay (= intrinsic delay) mode.

If `RFL Mode` is set to `Adj Dly`, the insertion delay is the sum of the unit's intrinsic delay plus whatever is set in the F-, V- and H-Delay controls.

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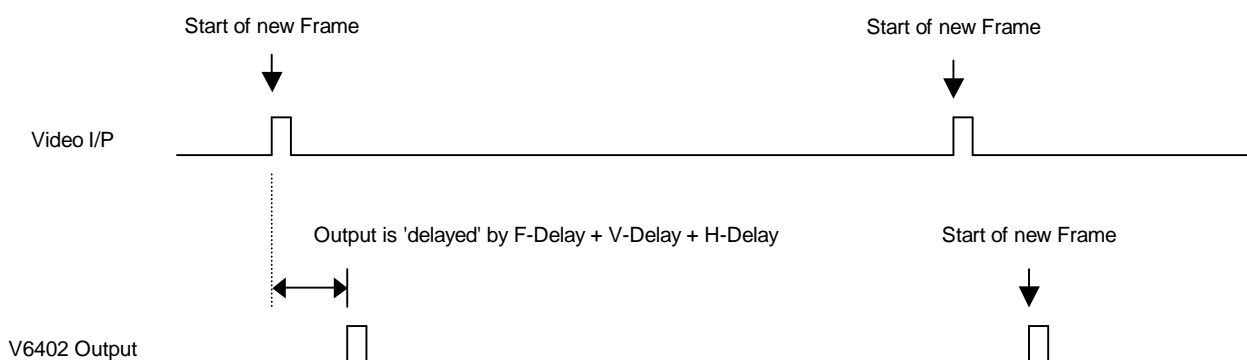


VIDEO : F Delay: Purpose: Coarse delay (in number of fields or frames)
 (Password enabled Option) Range: depends on baseboard configuration and
 Input Standard

FD

VIDEO : V Delay: Purpose: Fine delay (in number of lines)
 Range: 0 up to (number of total lines per field/frame – one line)

VIDEO : H Delay: Purpose: Super fine delay (in microseconds)
 Range: 0µs up to (duration of one line – one pixel)



3.3.2.3 Field/Frame Delay (FD) Option

V6402FD
V6404FD
V6406FD
V6408FD
V6418FD

To check whether a module is fitted with the 'FD' option, go into the **STATUS** menu and see under **Option** what options are fitted. If 'FD' is shown (might be shown together with other installed options), the board can be used as an adjustable Field/Frame Delay.

In addition to the variable delay, which is inherent when operating as a Frame Synchroniser, an extra n-Frame(s) (progressive input) or n-Field(s) (interlaced input) delay can be added on top of the variable delay.

When operating the module without an external reference, an extra n-Field(s)/Frame(s) delay can be added on top of the adjustable V- and H-Delay (see previous section for details).

The maximum amount of extra delay depends on the Baseboard's frame store size (24MB or 96MB) and the current Input Standard. To find out how much memory is fitted on the Baseboard, go into the **STATUS** menu and check under **Mem Size**.

The two available Baseboard configurations are: 24MBytes or 96MBytes.



V6402, V6404, V6406, V6408 and V6418 HD converters

The following table shows the upper limits of the Field/Frame Delay control (**VIDEO : F-Delay**). Please note that the actual numbers displayed in the menu **F-Delay** represent 'Fields' if the input standard is interlaced and 'Frames' if the input standard is progressive:

Input Standard	Maximum Delay ²	
	24MB Frame store	96MB Frame store
1080i60	4 fields	24 fields
1080i59	4 fields	24 fields
1080i50	2 fields	20 fields
1080p30	2 frames	12 frames
1080p29	2 frames	12 frames
1080p25	1 frame	10 frames
1080p24	1 frame	9 frames
1080p23	1 frame	9 frames
1080sf24	2 fields	18 fields
1080sf23	2 fields	18 fields
720p60	5 frames	25 frames
720p59	5 frames	25 frames
720p50	4 frames	21 frames
720p30	2 frames	12 frames
720p29	2 frames	12 frames
720p25	1 frame	10 frames
720p24	1 frame	9 frames
720p23	1 frame	9 frames
1035i60	4 fields	24 fields
1035i59	4 fields	24 fields
525i59	34 fields	68 fields ¹
625i50	28 fields	58 fields ¹

Note 1: An extra fixed delay of 1 second can be added on top of the 50/60 fields by setting the **DELAY** option in the **ENG'ING** menu to '1 Second'. This option is only available if the Baseboard is fitted with 96MBytes of memory.

Note 2: The **Maximum Delay** values specified in this table apply for video delay only, if the FD option is used in conjunction with the AH (Audio Handling) option, the following rules apply:

96MB FrameStore: In order to maintain the timing relationship between video and embedded audio, the maximum Field/Frame delay numbers listed are reduced by 2 in the case of the V6404/08/18, and by 6 in the case of the V6406.

24MB Frame Store: Audio delay compensation is not supported on 24MB boards.

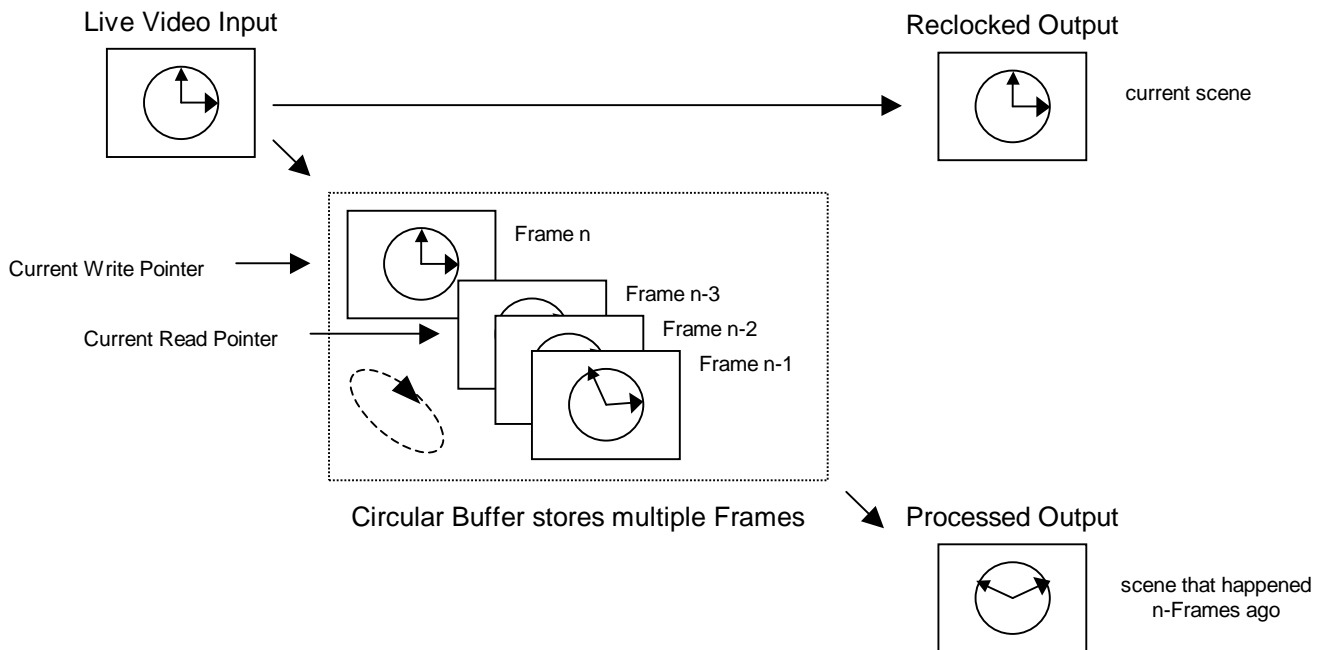
In terms of the actual delay imposed, same numbers imply the same delay in milliseconds, provided that the field/frame rate is the same. Example:

Input Std. is 720p59, F-Delay is set to 4 (frames): Output is delayed by 66.7ms (+ V-Delay + H-Delay)
 Input Std. is 1080i59, F-Delay is set to 4 (fields): Output is delayed by 66.7ms (+ V-Delay + H-Delay)

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The following illustration shows how the Field/Frame Delay works:



Live Video data gets written into a circular buffer (Frame-Store), which is $n+1$ frames deep (n is the number of frames the output gets delayed on top of the variable delay). The buffer's write-pointer lags exactly one frame behind the buffer's read pointer, which means that a frame that got written n -frames ago, will be read one frame prior to it gets overwritten by a new frame.

If the input standard is interlaced, the output can be delayed on a 'per-field' basis by shifting the output timing by one field (field1). The field order will remain intact.



V6402, V6404, V6406, V6408 and V6418 HD converters

3.3.3 Test Pattern Generator (TPG)

V6402

V6404SY

V6406SY

V6408SY

V6418SY

The V6402 and the V6404/06/08/18 with the SY option fitted come with a built-in Test Pattern Generator (TPG). The test patterns can be used to provide signals for system testing and even for testing other pieces of equipment. All test patterns are generated 'on-the-fly' and do not interfere with the current contents of the Frame Buffer. Clean switching between test patterns and the selected live video input is also provided.

On a V6402, the test patterns are being generated on the 'Output' side. It also means that they cannot be used as an internal confidence signal for proving the correct operation of the V6402 itself.

On the V6404/06/08/18, test patterns are being generated on the 'Input' side to the filtering and scaling processor, which means that they can be used to verify the conversion process.

The vertical interval is considered to be a part of the test pattern and is always synthesised as Black. This means that the vertical blanking interval is always blanked when Test Patterns have been selected. The same applies to Ancillary Data in the horizontal blanking interval.

The actual TPG selection menu can be found in the 'Engineering' Menu (**ENG'ING : Test Ptn**):

The default setting in the **Test Ptn** sub-menu is: *TPG Off*

From the remote control system they can be called up directly.

From here you have a choice of up to 7 built-in test patterns. Test pattern No.7 is a 'reserved' or a custom Test Pattern and might change between different firmware versions. At the time of printing, it is set to 'Black'. Note that the 100% and 75% colour bars have limited transition rates between adjacent bars.

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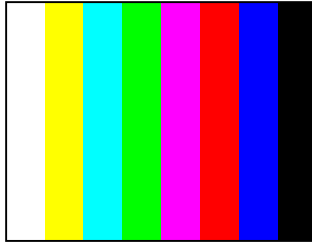


Stepping through the menu, the following Test Patterns will be generated:

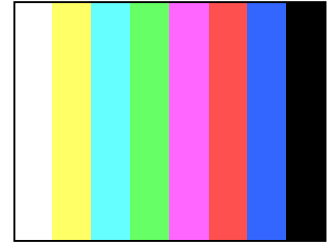
TPG Off (Live Video)



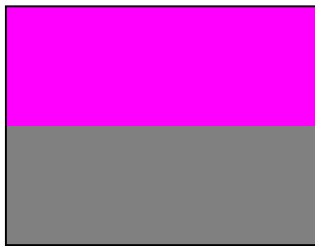
100 % Bars



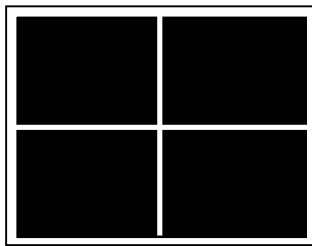
75 % Bars



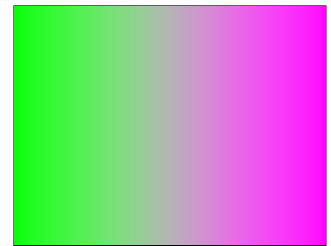
SDI Matrix
(Pathological signal)



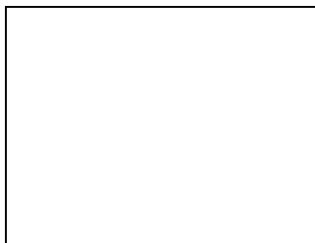
Cross Hair
(Timing)



Linear Ramp



Flat White



Custom
('Black' at the time of
printing)





V6402, V6404, V6406, V6408 and V6418 HD converters

The V6402 can be used as a simple stand-alone TPG, without the need for an Input signal or Reference signal being present. If the module powers up without an Input signal present, its output will automatically switch to the SD or HD Standard according to the selection made in the **CONFIG : Def std** menu.

The Output Standard can be changed 'on-the-fly' by stepping through the **Def std** menu. The Output Standard will instantly change to the selected mode without changing the selected test pattern. Please note that some Broadcast- or Professional-Monitors cannot cope with progressive standards with frame-rates of less than 50Hz, i.e. it is not surprising if no picture appears on the Monitor when selecting the 1080p25Hz or 1080p29Hz mode for example. A Waveform Monitor, such as Tektronix's WFM700 can be used instead for monitoring these standards.

As soon as a valid Video Input signal is present, the output will follow the detected Input Standard. The Output Standard can no longer be changed by flicking through the **Def std** menu thereafter. Even when the Input signal gets disconnected, the Output will remain in the 'last known good' mode. However, it can be overwritten by changing to a different Input Standard. Only a Hardware Reset (or re-powering the module) brings the Output Standard back to the Default Standard selected in the **Def std** menu, provided that no Input signal is present at the time of carrying out a manual Reset or re-powering the module.

If a test pattern is selected (**ENG'ING : Test Ptn : Bars 100** etc.) and the unit gets switch off, it will reboot next time with this last selected Test Pattern and the last selected Default Standard.

V6402, V6404, V6406, V6408 and V6418 HD converters



3.3.4 Conversion Modes

V6402

V6404

V6408

V6418

Input Modes:

By default, an auto-sensing mechanism switches the board between SD or HD input modes, depending on the Input standard applied to the board and the selected output standard.

Alternatively, the board can be 'forced' to work either in SD or HD input modes. In order to do this, go into the `CONFIG:SD/HD Op` menu. The three available options are: *Auto*, *HD* and *SD*:

'Auto', as the name implies, enables the auto-sensing mode. Changing the Input Standard from 525i59 to 720p59 for example will prompt the Microcontroller to re-load the FPGA automatically.

'HD' will force the board to permanent HD input operation.

'SD' will force the board to permanent SD input operation.

Permanent SD or HD operation might prove to be useful in installations where:

- the infrastructure is fixed to SD or HD anyway
- operation in 'noisy' environments
- a lot of Input Standard switching is going on (within one group of Standards)

Forcing the board's operational mode to either SD or HD will prevent it from unintentionally re-loading its FPGA code due to false interpretation of the detected Input Standard.

V6418

Output Modes:

In addition to forcing the input standard detection to a specific standard the conversion can be put into these two modes via the `CONFIG:OP Mode`.

'Normal' applies the necessary conversion to maintain the selected output standard.

'Up/Down' automatically up converts to the selected HD output standard when the input is SD, and down converts a HD input to SD, either 525 or 625 depending on the frame rate of the HD input.

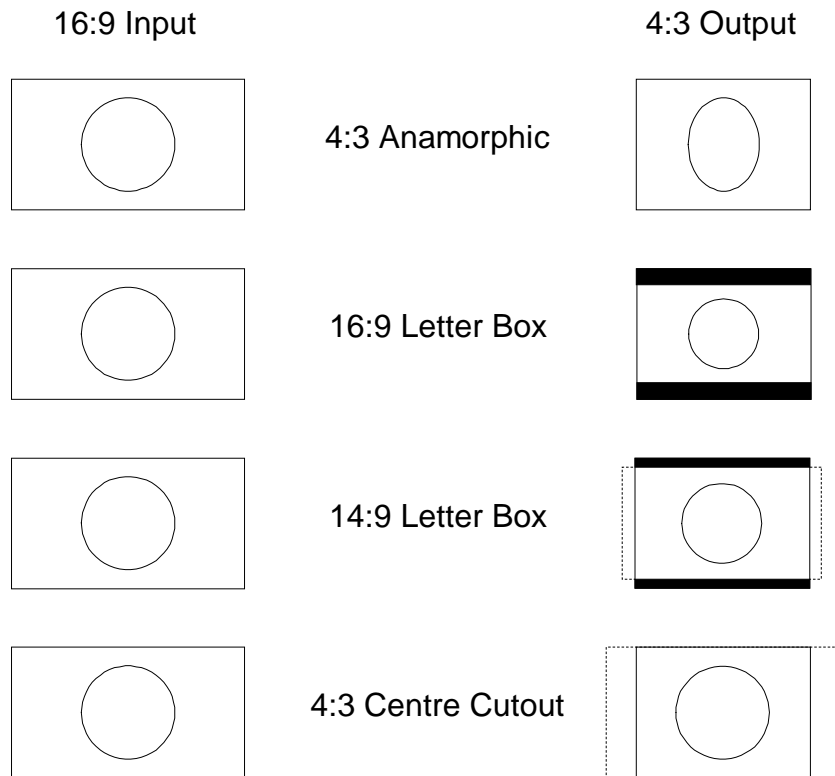
3.3.5 Down Converter Aspect Ratios

V6404

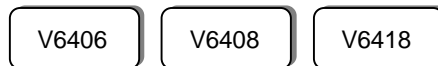
V6418

A Down-Converter always converts a 16:9 input picture to a 4:3 aspect ratio output. The V6404/18 gives four options in the **VIDEO : A/R** menu (**VIDEO : A/R Down** for V6418). They are shown diagrammatically below. Note that some conversion settings result in a loss of parts of the original picture (indicated by hatched areas).

If the V6418 is set in Short Delay Down Conversion mode (**ENG'ING : DownConv : ShortDel1**), only 4:3 Anamorphic and 4:3 Centre Cutout aspect ratios are available.



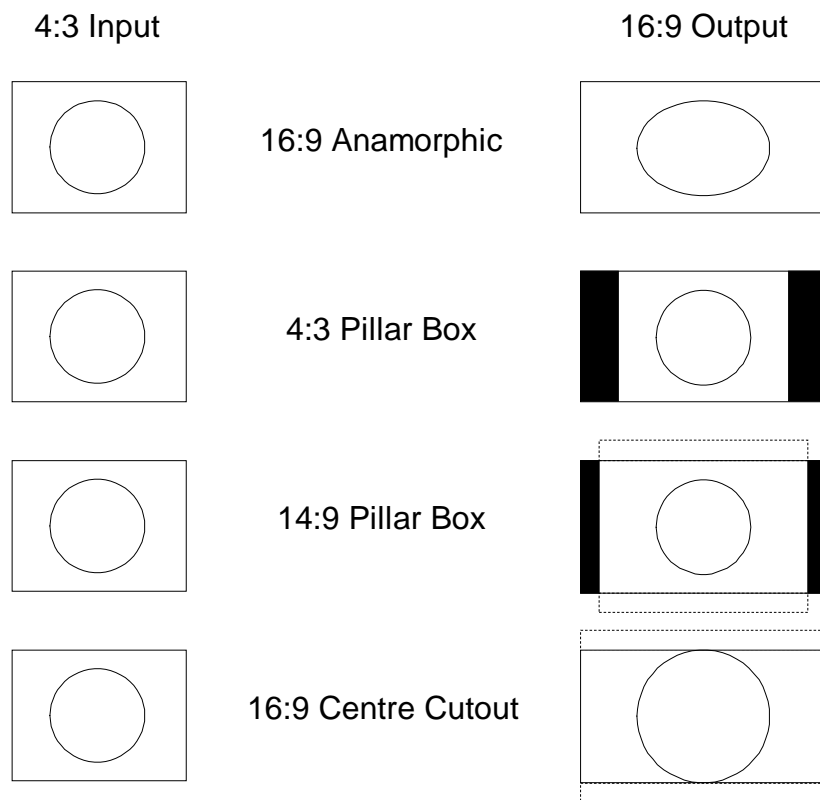
V6402, V6404, V6406, V6408 and V6418 HD converters



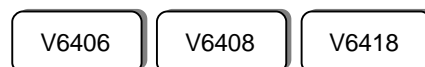
3.3.6 Up/Cross Converter Aspect Ratios

Since all of the currently supported HD standards have the same 16:9 aspect ratio, there is no need to perform an aspect ratio conversion when cross-converting between them.

If the V6406/08/18 is fed with an SD input, it will up-convert to the selected HD standard (provided they have the same frame-rate). The input picture will be scaled appropriately in order to accommodate the 16:9 HD video format. There are four options in the **VIDEO : A/R** menu (**VIDEO : A/R UP** for V6418). They are shown diagrammatically below. Note that some conversion settings result in a loss of parts of the original picture (indicated by hatched areas).



3.3.7 Cross- & Up-Converter Output Standard Selection



The desired HD output standard must be set manually on the V6406 / V6408 / V6418. This can be done in the menu **VIDEO: O/P Std.** Supported conversions are shown in section 1.3.

When stepping through the menu, the operator sees all implemented HD standards and not just frame-rate matching modes, so one must be careful that the selected output standard matches with its frame-rate with the input frame-rate for proper operation.



V6402, V6404, V6406, V6408 and V6418 HD converters

3.3.8 V6418 Short Delay Mode

The V6418 can be set in Short Delay Down Conversion mode in the menu: **ENG'ING : DownConv** : **shortDe1**. This mode applies only when the V6418 operates as a HD to SD down converter or a SD to SD bypass.

This is a limited feature operation mode, designed for monitoring purposes and not intended for broadcasting. Its main characteristic is a reduced input to output delay, compared to the standard down conversion or standard SD bypass modes. The image quality in the short delay down converter is slightly lower than in the standard down converter. In the short delay SD bypass there is no quality loss compared to the standard SD bypass.

When the short delay mode is selected, the input to output delay is < 1 ms for down conversion and < 10 us for SD bypass.

For down conversion, only 1080i50, 1080i59, 720p50 and 720p59 input standards are supported. In the same way, only anamorphic and centre cutout aspect ratio conversions are implemented. In SD bypass the aspect ratio cannot be changed.

For both short delay down conversion and short delay SD bypass modes, only Video Processor Amplifier (VP), Audio Handling (AH) and Closed Caption (CP) options are available. In case of input video failure, the output is switched to black.

V6402, V6404, V6406, V6408 and V6418 HD converters



3.4 Video Processing Amplifier

V6402VP

V6404VP

V6406VP

V6408VP

V6418VP

3.4.1 Video Gain

PROC AMP V Gain

The adjustment range is $\pm 6\text{dB}$ and it applies equally to the luminance and both of the chrominance channels (Cb and Cr). The gain is applied after the black level offset. The Video gain is applied simultaneously with the Chrominance gain so they can cancel one another out. For example $+3\text{dB}$ of Video gain along with -3dB of Chroma gain will result in the luminance being increased by $+3\text{dB}$ and the Cb and Cr channels being unchanged.

The output is limited to ensure that there is no numerical overflow as the output fits into the 10 bit D1 domain. There is no gamut legalisation function.

3.4.2 Chroma Gain

PROC AMP C Gain

The adjustment range is $\pm 6\text{dB}$ and it applies equally both the chrominance channels. The gain is applied along with the video gain and after the black level offset. The Chrominance gain is applied simultaneously with the Video gain so they can cancel one another out. For example $+3\text{dB}$ of Video gain along with -3dB of Chroma gain will result in the luminance being increased by $+3\text{dB}$ and the Cb and Cr channels being unchanged.

The output is limited to ensure that there is no numerical overflow as the output fits into the 10 bit D1 domain. There is no gamut legalisation function.

3.4.3 Black Level

PROC AMP Blk Lvl

The adjustment range is -127 and $+128$ D1 levels (equivalent to $-101/+102\text{mV}$). The black level adjustment is applied before the gain stages. This is considered the best arrangement since the unit is usually used to correct incoming errors.

3.4.4 Hue Shift

PROC AMP Hue

The adjustment range of the hue shift is $\pm 45^\circ$ in 0.35° steps.

3.4.5 Dynamic Rounding

PROC AMP Dyn Rnd

Since some quantising effects may be visible on the output of this unit when variable gains are applied, Dynamic Rounding has been applied. This Dynamic Rounding is only used to reduce the effects of the fractional bits of lower significance than the normal 10 bits; it does **not** reduce the resolution to 8 bits.

This can be disabled on the PROC AMP : Dyn Rnd menu.



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3.4.6 Limiting

PROC AMP Hrd Clip

Since gain can be applied to the D1 signal it is possible to generate levels outside the normal 10 bit gamut of D1 and so limiting is required. The V64xx Proc Amp normally applies a soft form of limiting that progressively reduces the gain of a signal as it approaches the limits, either overshoot or undershoot. If this is not required then it can be disabled on the **PROC AMP : Hrd Clip** menu.

The limiting that is applied is 'simple' in that it does not ensure that the output is correctly within the colour gamut, but only that each of the three components (Y, Cb, Cr) remains within the legal 10 bit range.

Certain test patterns, most notable the amplitude ramps, contain data that is within the overshoot and undershoot areas. If they are passed through the Proc Amp with its default soft clipping then they will be modified. This means that the EDH value on the output will be different to that on the input. If this is not wanted then the Hard Clipping can be turned ON, but this is not recommended for normal Proc Amp operation.

3.4.7 Fade to Black

PROC AMP Fade>Blk

V64xx modules with the VP option fitted include a fade to black facility. This enables the output to be cleanly attenuated to digital black on receipt of an internal command.

The rate of the fade is fixed at half a second.

Locally the fade can be initiated on the **PROC AMP : Fade>Blk** menu. This contains both an ON and OFF command.

The fade can also be initiated over the DART remote control network. The fade will start as soon as the command is sent.

The output will stay at black until any active control input is released, or the unit is reset. There is no direct indication on the front panel that the output is being forced to black except for the top level banner, if enabled.

V6402, V6404, V6406, V6408 and V6418 HD converters



3.5 Audio Handling



The V6404/06/08/18 provide some functionality for dealing with embedded audio. These functions are summed up in a group called 'AUDIO'.

The main task is to 'transfer' the embedded audio information between the different domains, i.e. from SD to HD or vice versa, whilst preserving its original digital content.

Audio is de-embedded before video processing, then re-embedded afterwards. The audio delay is automatically matched to the video processing delay to within 1ms.

3.5.1 Audio Group Selection

	V6404/06/08	V6404	V6406/V6408
AUDIO	Aud Grp1	20bit/24bit/Off	On/Off
	Aud Grp2	20bit/24bit/Off	On/Off
	Aud Grp3	20bit/24bit/Off	On/Off
	Aud Grp4	20bit/24bit/Off	On/Off
	V6418	V6418	
AUDIO	En Grp1	On/Off	
	En Grp2	On/Off	
	En Grp3	On/Off	
	En Grp4	On/Off	
	Grp1 Res	20bit/24bit	
	Grp2 Res	20bit/24bit	
	Grp3 Res	20bit/24bit	
	Grp4 Res	20bit/24bit	

Audio groups can be switched ON and OFF, but not shuffled. Channels within a group remain unchanged in their order. Locally the settings can be made on the AUDIO : Aud Grp# menu.

3.5.2 Audio Group Status

STATUS	Aud Grps	1 (2,3,4) indicates Group is present - indicates Group is absent
--------	----------	---

The presence/absence of Audio Groups can be checked in the STATUS : Aud Grps menu. Please note that if the V6404/06/08/18 comes with the Frame Synchroniser option fitted, any ancillary data will be blanked altogether if VIDEO : Anc Data is set to Anc Blnk.

3.6 Audio Processing

V6402AP

V6404AP

V6406AP

V6408AP

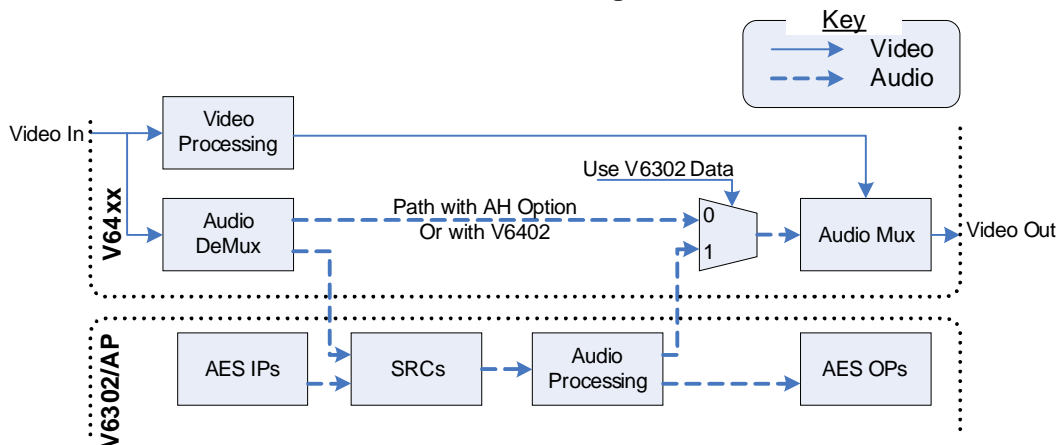
V6418AP

The audio processing capabilities of the V6302/AP Advanced Audio Processor module can be utilised by any of these modules by combining the V6302/AP module with the V64xx module in a V16HR3D Double width or V16HR3E Triple width rear module. No Option needs to be set, just combining any of these modules with a V6302/AP will automatically enable this functionality.

The V6302/AP has an all-digital Audio Processing Engine (APE) that provides synchronisation, gain, routing, fixed and tracking delay functions on the inputs and is intended for application in both Standard Definition and High Definition installations. It has six AES inputs and four AES outputs on the rear panel. An optional Dolby Decoder submodule has Dolby E[®] and Dolby Digital[®] decoding capability and provides a maximum of 8 decoded channels plus a single downmixed stereo pair, all of which are inputs to the Audio Processing Engine.

When combined the embedded audio is passed to the V6302/AP via the rear into the audio processor and processed audio is then passed back from the V6302/AP to the V64xx module for embedding. This essentially provides a further eight AES inputs and eight AES outputs to the V6302/AP APE. See the diagram below for an overview of the signal relationship between the V64xx and the V6302/AP modules.

V64xx & V6302/AP signal overview



The V6302/AP can optionally be put in the audio path or not by the V64xx menu control **VIDEO : 6302Data** setting **6302 ON** or **6302 OFF**. See the V6302 User Guide for more information.

3.6.1 Audio Insertion Delay

Audio Demux : 710 us

Audio Mux : 710 us

V6302/AP including SRC : 4 ms (Plus any manually added audio delay set in the V6302/AP)

3.6.2 Tracking Delay

One of the main advantages of pairing a V6302/AP module with the V64xx is that the V6302/AP can track the audio timing with the varying video delay when the frame synchroniser option is used. With just the SY option the V6302/AP will apply the variable tracking delay according to the video delay through the frame synchroniser. When the FD and SY options are used the V6302/AP will apply the tracking delay and also compensate for the 4 ms V6302/AP audio insertion delay if the video delay set on the V64xx is greater than 4 ms.

F Things to remember:

If the video delay set on the V64xx is less than the insertion delay of the V6302/AP the audio will incur the V6302/AP's insertion delay. The audio will always incur the audio mux and demux insertion delay when used.

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3.7 Closed Captions

V6404CP

V6406CP

V6408CP

V6418CP

The V6404/06/08/18 provide some functionality for dealing with closed caption data. These functions are summed up in a group call 'CCAPTION'.

The main task is to 'transcode' or transfer the closed caption information between the different domains, i.e. from SD to HD or vice versa, whilst preserving its original digital content.

The data is read from the input before video processing, then inserted afterwards.

Support is provided for CEA-608 and CEA-708 type captions using SMPTE-334M to carry the data in HD video formats.

Data can be transcoded or transferred in the following configurations:

Input

SD – CEA-608 : line 21

SD – CEA-608 : line 21

HD – CEA-708 : SMPTE 334M

HD – CEA-708 : (608 data) SMPTE 334M

Output

SD – CEA-608 : line 21

HD – CEA-708 : (608 data) SMPTE 334M

HD – CEA-708 : SMPTE 334M

SD – CEA-608 : line 21

3.7.1 SD Captions

Caption data is defined in CEA-608 is transported as an analogue waveform (typically on line 21) on the active picture of an SD frame. Data can be read from and inserted onto the SD video in the CEA-608 line 21 format.

In 525 Line 21 data can be present on line 21 to 25 and/or 284 to 289.

In 625 Line 21 data can be present on line 22 to 26 and/or 335 to 339.

Data is always inserted on line 21 and/or 284 of the 525 frame, and 22 and/or 335 of the 625 frame.

3.7.2 HD Captions

Caption data is carried in SMPTE 334M packets in the HD video standards. Packets will be read from any area in the VANC period of the input. In the output the SMPTE 334M packets can be inserted on a selected line which defaults to line 9 in all standards.

There are two controls for the line selection:

ANC1080i : sets the insertion line for the 1080i standard from line 1 to line 20.

ANC 720p : sets the insertion line for the 720p standard from line 1 to line 25.



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3.7.3 Output line selection on the V6418

The closed caption controls consist of an on/off control and line selection. Due to the complexity of the V6418 module the line selection control is a local only control available on the front panel of the module in remote and local modes.

3.7.4 Caption Status

If caption data is detected on the selected input this will be indicated in the STATUS menu as CEA608 ✓ or CEA708 ✓ .

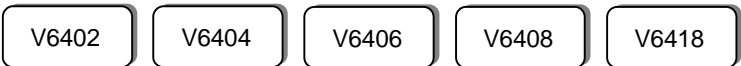
CEA608 ✓ indicates that SD caption data has been found on the input. CEA608 caption data can be present in HD or SD video.

CEA708 ✓ indicated that the HD input has a SMPTE 334M packet with CEA708 data embedded.

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4 CALIBRATION



This section describes how to calibrate the unit as it is done in the factory. The units do not contain any potentiometers, but like most equipment with analogue parts still needs to be calibrated. Normally this calibration is done in the factory and should not need to be repeated in the field but this section describes the procedure and is included for completeness.

High quality, calibrated test equipment should be used for this calibration. Note that it is not possible to return to the pre-calibration settings other than by making a note of the values and re-entering them.

4.1 Set-Up

There is a separate Main Level Menu for Calibration and this should be used throughout. The first sub-level menu is Cal Mode, which can be used to turn calibration ON:

```
CALIB      Cal Mode  Cal Off
                        Cal On
```

The calibration mode must be turned ON before any parameter can be adjusted. The calibration mode will be turned OFF in one of four ways:

1. Manually on the **CALIB : Cal Mode** menu
2. By going up to the Top Level Menu
3. By re-powering the unit.
4. By letting the display timeout and go to sleep mode.

When the calibration mode is ON then the unit will automatically set up the required conditions in the unit as you enter each sub-menu. For example, if you go into the CntrFreq sub-menu, the unit will automatically go into free run. For obvious reasons this should not be done on a unit that is being used On Air.

4.2 Free-Run Frequency

There is a voltage controlled crystal oscillator, which is usually locked to the external video reference or to the input video. However if there is no input or reference then it will free-run and this free running frequency should be set. The oscillator is not accurate enough to be used as a frequency reference, but nevertheless, should be set close to the ideal so that any succeeding SDI equipment will be able to lock to its output, and so that when in free run it will only drift slowly away from its starting reference.

To calibrate the frequency set the unit into Free Run by turning Cal Mode ON and selecting the CntrFreq sub-menu.

```
CALIB      Cal Mode  Cal On
```

Now compare the output picture movement on a monitor with an accurate external reference and adjust the frequency accordingly.

```
CALIB      CntrFreq      Range is -127 to +128
```

The setting is stored on the unit in non-volatile memory, and should not need regular adjustment..



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5 CONTROLS

These tables show a complete list of all the parameters that can be controlled locally for the various configurations. Unless otherwise shown they can also be controlled over the DART remote control system. Not all menus are available at any one time, since they depend on module configurations and sometimes on the operating conditions.

The tables also show the full range of the controls and their ranges and normalised value, if appropriate. The normalised value or setting is shown by the 'n'.

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5.1 Video Processing – VIDEO

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418	
VIDEO	Source	I/P 1	n		☐	☐	☐	☐	☐	
		I/P 2			☐	☐	☐	☐	☐	
		Black				☐	SY	SY	SY	SY
	O/P Std	720p59	n		Notes: 1. Grey shaded modes are supported by firmware versions released at the time of printing. 2. The frame-rate of the selected O/P Std must match with the frame-rate of the Video Input.				☐	☐
		720p60								
		720p29								
		720p30								
		720p50								
		720p25								
		720p23								
		720p24								
		1080i59								
		1080i60								
		1080p29								
		1080p30								
		1080i50								
		1080p25								
		1080p23								
		1080p24								
	1080sf23									
	1080sf24									
	O/P Std	720p59	n					ü		
		720p50								
		1080i59								
		1080i50								
	A/R	4:3 ANA	n	4:3 Anamorphic		ü				
		16:9 LB		16:9 Letter Box						
		14:9 LB		14:9 Letter Box						
		4:3 CC		4:3 Centre Cutout						
	A/R	16:9 ANA	n	16:9 Anamorphic			ü	ü		
		4:3 PB		4:3 Pillar Box						
		14:9 PB		14:9 Pillar Box						
		16:9 CC		16:9 Centre Cutout						
A/R Down	4:3 ANA	n	4:3 Anamorphic						ü	
	16:9 LB		16:9 Letter Box (see Note 1)							
	14:9 LB		14:9 Letter Box (see Note 1)							
	4:3 CC		4:3 Centre Cutout							



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Video Processing – VIDEO (cont.)

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418
VIDEO	A/R Up	16:9 ANA	n	16:9 Anamorphic					Ü
		4:3 PB		4:3 Pillar Box					
		14:9 PB		14:9 Pillar Box					
		16:9 CC		16:9 Centre Cutout					
	6302Data	6302 Off	n	Do not use the V6302	Ü	Ü	Ü	Ü	Ü
		6302 On		Use the V6302/AP					
	Ref Src	Auto	n	selects Ref I/P if present	Ü	SY	SY	SY	SY
		Vid I/P		selects Video Input					
		Ref I/P		selects Reference Input					
	Anc Data	Anc Blnk	n	Blank Anc Data (set to 'Black')	Ü	SY	SY	SY	SY
		Anc Pass		Pass Anc Data through					
	VFL Mode	Black	n	Instant Black on I/P Fail	Ü	SY	SY	SY	SY
		1 sec		from Black after 1 sec...					
		β		in increments of 1 sec					
		13 sec		...to Black after 13 sec					
		To I/P 2		Switch to input 2 on I/P Fail					
	RFL Mode	Freeze		Instant Freeze on I/P Fail					
		Min Dly	n		Ü	SY	SY	SY	SY
	XStdMode	Adj Dly							
		XStd Ref	n		Ü	SY	SY	SY	SY
	Freeze	XStd I/P							
		Run	n		Ü	SY	SY	SY	SY
		Field 1							
		Field 2							
	F Delay	Frame							
		0	n		FD	FD	FD	FD	FD
		β		The maximum delay depends on the baseboard configuration (24MB or 96MB) and the detected Input Standard. If the Input Standard is progressive, the number displayed means xx- 'Frames'. If the Input Standard is interlaced, the number displayed means xx- 'Fields'.					
	V Delay	xx							
		+0	n	With Vid I/P as reference	Ü	SY	SY	SY	SY
		β							
		+749		Range dependent on mode!					

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Video Processing – VIDEO (cont.)

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418
Video	H Delay	+0.00ms	n	With Vid I/P as reference	ü	SY	SY	SY	SY
		β		Range dependent on mode!					
		+22.23ms							
	V Timing	-256		With Ext. Reference	ü	SY	SY	SY	SY
		β							
		+0	n						
		β							
		+255							
	H Timing	+0.00ms	n	With Ext. Reference	ü	SY	SY	SY	SY
		β		Range dependent on mode!					
		+22.23ms							
	Norm		*****		ü	ü	ü	ü	ü

Note 1: 16:9 Letter Box and 14:9 Letter Box Aspect Ratios not available in Short Delay Down Conversion mode for V6418.



V6402, V6404, V6406, V6408 and V6418 HD converters

5.2 Operating Conditions – STATUS

Main Menu	Sub Menu	Value	Comment	V6402	V6404	V6406	V6408	V6418
STATUS	Variant	V6402	Frame Synchroniser	ü	ü	ü	ü	
		V6404	HD Down Converter					
		V6406	HD Up Converter					
		V6408	HD Cross Converter					
		V6418	HD Converter					
	Options	None	No extra option enabled	ü	ü	ü	ü	ü
		F Sync	Frame Synchroniser					
		FD	Frame Delay					
		AH	Audio Handling					
		CP	Closed Captioning					
	V6302	Attached	indicates presence of V6302 Advanced Audio Processor	ü	ü	ü	ü	ü
		None						
	Sub-Mod	Missing		ü	ü	ü	ü	ü
		Fitted						
	Source	I/P 1		ü	ü	ü	ü	ü
		I/P 2						
		Black						
	I/P std	720p59	Auto detected Input Standard	ü	ü	ü	ü	ü
		β						
		525i59						
		625i50						
		Unknown						
		No Input						
	I/P 1	I/P 1 ✓	present	ü	ü	ü	ü	ü
		I/P 1 x	absent					
	I/P 2	I/P 2 ✓	present	ü	ü	ü	ü	ü
		I/P 2 x	absent					
	Ref I/P	Ref ✓	present	ü	ü	ü	ü	ü
		Ref x	absent					
	Ref std	720p59	Auto detected Ref. Standard	ü	ü	ü	ü	ü
		β						
		525i59						
		625i50						
		Unknown						
		No Input						
	O/P std	720p59	Output Standard	ü	ü	ü	ü	ü
		β						
		525i59						
		625i50						
		Unknown						
No Input								

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Operating Conditions – STATUS (cont.)

Main Menu	Sub Menu	Value	Comment	V6402	V6404	V6406	V6408	V6418
STATUS	Aud Grps	None	Number indicates Grp present - indicates Grp absent	ü	AH	AH	AH	AH
		1 2 3 4						
		1 - - -						
STATUS	Mem Size	24MBytes	Amount of SDRAM fitted on Baseboard	ü	ü	ü	ü	ü
		96MBytes						
STATUS	VModule	ID 0..2	reserved	ü	ü	ü	ü	ü
		GF9320	fitted on V6404/08/18 units					
		ID 4..6	reserved					
		None						
	IOModule	ID 0	Standard I/O Daughter Board	ü	ü	ü	ü	ü
		ID 1	reserved					
		ID 2	reserved					
		None						
	Soft Ver	05.04.05		ü	ü	ü	ü	ü
	FPGA Ver	04.10		ü	ü	ü	ü	ü
	CPLD Ver	00.01		ü	ü	ü	ü	ü
	PCB Rev	03.02		ü	ü	ü	ü	ü
	Boot Ver	01.00.01		ü	ü	ü	ü	ü

Legend:

- ü Feature available on Standard version
- VP VP (Video Proc Amp) option required
- SY SY (Frame Synchroniser) option required
- FD FD (Field/Frame Delay) option required
- AH AH (Audio Handling) option required



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5.3 Engineering – ENG'ING

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418
ENG'ING	Ref Src	Auto	n	defaults to Ref I/P if present	ü	SY	SY	SY	SY
		Vid I/P		selects Video Input					
		Ref I/P		selects Reference Input					
	Test Ptn	TPG Off	n	Test Pattern 'Off'	ü	SY	SY	SY	SY
		Bars 100		100% Colour Bars					
		Bars 75		75% Colour Bars					
		SDI Mtrx		SDI Check Field (Pathologicals)					
		X-Hair		Cross Hair (Timing)					
		Ramp		Linear Ramp					
		Flat Wht		Flat White					
		Custom		t.b.d.					
	O/P EDH	EDH On	n	only when O/P standard is SD	ü	ü	ü	ü	ü
		EDH Off							
	DownConv	Standard	n	Standard Down Conversion					ü
		ShortDel		Short Delay Down Conversion					
	Delay (see Note 1)	0 Second	n	No extra delay	FD	FD	FD	FD	FD
		1 Second		Adds 1 second fixed delay on top of arbitrary Field Delay in 525i59 and 625i50 modes					
	Free-run	Free Off	n		ü	ü	ü	ü	ü
		Free On							
	Sleep	0 min		LED Display never falls asleep	ü	ü	ü	ü	ü
		β							
		5 min	n	Sleep after 5 minutes (default)					
		β							
	30 min		Sleep after 30 minutes						
LEDLevel		n	LED Display Intensity	ü	ü	ü	ü	ü	
Norm	*****			ü	ü	ü	ü	ü	

Note 1: Requires a baseboard with 96MByte Framestore

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5.4 Calibration – CALIB

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418
CALIB	Cal Mode	Cal Off	n		Ü	Ü	Ü	Ü	Ü
		Cal On		Must be set 'On' to enable calibration (CntrFreq setting)					
	CntrFreq	Frq=-128		Free-run Frequency	Ü	Ü	Ü	Ü	Ü
		Frq= +0	n						
		Frq=+127							
	Norm	*****			Ü	Ü	Ü	Ü	Ü

Legend:

- Ü Feature available on Standard version
- VP VP (Video Proc Amp) option required
- SY SY (Frame Synchroniser) option required
- FD FD (Field/Frame Delay) option required
- AH AH (Audio Handling) option required



V6402, V6404, V6406, V6408 and V6418 HD converters

5.5 Configuration – CONFIG

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418	
CONFIG	GPI	GPI OFF	n	GPI has no function	ü	ü	ü	ü	ü	
		GPI SDI1		Activate to select I/P 1						
		GPI SDI2		Activate to select I/P 2						
		GPI BARS		Activate to O/P Bars (SY)						
	Banner	On	n	This enables the Warning Msg. Banner.	ü	ü	ü	ü	ü	
		Off								
	Op Mode	Normal	n	Manual output std selection						ü
		Up/Down		Up/Down conversion only						
	Def Std		720p59	n	Default Standard This is the default O/P standard that will be selected when no valid Video Input signal is present. This is useful when the unit is used as a 'stand-alone' test pattern generator. It allows the operator to step through all supported modes (see list on the left), resulting in an instant change of the Output standard.	ü				
			720p60							
			720p29							
			720p30							
			720p50							
			720p25							
			720p23							
			720p24							
			1080i59							
			1080i60							
			1080p29							
			1080p30							
			1080i50							
			1080p25							
			1080p23							
			1080p24							
			1080sf23							
			1080sf24							
			1035i59							
			1035i60							
	DefIpStd		625i50	n	Default Standard This is the default I/P standard that will be selected when no valid Video Input signal is present.					ü
			729p59							
720p60										
720p29										
720p30										
720p50										
720p25										
720p23										

V6402, V6404, V6406, V6408 and V6418 HD converters



Configuration – CONFIG (cont.)

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418	
CONFIG		720p24								
		1080i59								
		1080i60								
		1080p29								
		1080p30								
		1080i50								
		1080p25								
		1080p23								
		1080p24								
		1080sf23								
		1080sf24								
		1035i59								
		1035i60								
		525i59								
		625i50								
	DefIpStd	525i59						ü		
		625i50								
	Password	0	n			ü	ü	ü	ü	ü
	Variant	V6402			Factory enabled option	ü	ü	ü	ü	
		V6404								
		V6406								
		V6408								
	F Sync	None			Factory enabled option		ü	ü	ü	ü
		Fitted								
	Vid Proc	None			Factory enabled option	ü	ü	ü	ü	ü
		Fitted								
	Fld Dely	None			Factory enabled option	ü	SY	SY	SY	SY
		Fitted								
	Aud Hndl	None			Factory enabled option		ü	ü	ü	ü
		Fitted								
	SD/HD Op	Auto	n		Auto-sensing of I/P standard	ü	ü	ü	ü	ü
		HD			I/P forced to HD operation					
		SD			I/P forced to SD operation					
	PCB Rev	0			Password protected	ü	ü	ü	ü	ü
		β								
		15								
	H/W Rev	0			Password protected	ü	ü	ü	ü	ü
		β								
		15								
	TestMode	Off	n			ü	ü	ü	ü	ü
On										
Mem Test	On	n		Execute SDRAM Test @Pwr-On	ü	ü	ü	ü	ü	
	Off									
Norm	*****				ü	ü	ü	ü	ü	



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Legend:

ü	Feature available on Standard version
VP	VP (Video Proc Amp) option required
SY	SY (Frame Synchroniser) option required
FD	FD (Field/Frame Delay) option required
AH	AH (Audio Handling) option required

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5.6 Video Proc Amp – PROC AMP

Note: This menu is only available on modules with the VP (Video Proc Amp) option enabled.

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418
PROC AMP	V Gain	-6.02dB		Video Gain Control	VP	VP	VP	VP	VP
		β							
		-0.00dB	n						
		β							
			+6.01dB						
	C Gain	-6.02dB		Chroma Gain Control	VP	VP	VP	VP	VP
		β							
		-0.00dB	n						
		β							
			+6.01dB						
	Blk Lvl	-128		Black Level Control	VP	VP	VP	VP	VP
		β							
		+0	n						
		β							
			+127						
	Hue	-45.00°		Hue Control	VP	VP	VP	VP	VP
		β							
		+0.00°	n						
		β							
			+44.65°						
	Bypass	Byp Off	n	Proc Amp Bypass Off	VP	VP	VP	VP	VP
		Byp On		Proc Amp Bypass On					
	Dyn Rdn	DR On	n	Dynamic Rounding On	VP	VP	VP	VP	VP
		DR Off		Dynamic Rounding Off					
Hrd Clip	HClp Off	n	Hard Clipping Off	VP	VP	VP	VP	VP	
	HClp On		Hard Clipping On						
Fade>Blk	F>B Off	n	Fade to Black Off	VP	VP	VP	VP	VP	
	F>B On		Fade to Black On						
Norm	*****			VP	VP	VP	VP	VP	

Legend:

- ü Feature available on Standard version
- VP VP (Video Proc Amp) option required
- SY SY (Frame Synchroniser) option required
- FD FD (Field/Frame Delay) option required
- AH AH (Audio Handling) option required



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5.7 Audio Handling – AUDIO

Note: This menu is only available on modules with the AH (Audio Handling) option enabled.

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418	
AUDIO	Aud Grp1	Grp1 20b	n			AH				
		Grp1 24b								
		Grp1 Off								
	Aud Grp2	Grp2 20b	n			AH				
		Grp2 24b								
		Grp2 Off								
	Aud Grp3	Grp3 20b	n			AH				
		Grp3 24b								
		Grp3 Off								
	Aud Grp4	Grp4 20b	n			AH				
		Grp4 24b								
		Grp4 Off								
	Aud Grp1	Grp1 On	n					AH	AH	
		Grp1 Off								
	Aud Grp2	Grp2 On	n					AH	AH	
		Grp2 Off								
	Aud Grp3	Grp3 On	n					AH	AH	
		Grp3 Off								
	Aud Grp4	Grp4 On	n					AH	AH	
		Grp4 Off								
	En Grp1	Grp1 On	n							AH
		Grp1 Off								
	En Grp2	Grp2 On	n							AH
		Grp2 Off								
En Grp3	Grp3 On	n							AH	
	Grp3 Off									
En Grp4	Grp4 On	n							AH	
	Grp4 Off									
Grp1 Res	Grp1 20b	n							AH	
	Grp1 24b									
Grp2 Res	Grp2 20b	n							AH	
	Grp2 24b									
	Grp3 Res	Grp3 20b	n		V6402	V6404	V6406	V6408	AH	
		Grp3 24b								
	Grp4 Res	Grp4 20b	n						AH	
		Grp4 24b								
	Norm	*****			AH	AH	AH	AH		

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Legend:

- ü Feature available on Standard version
- VP VP (Video Proc Amp) option required
- SY SY (Frame Synchroniser) option required
- FD FD (Field/Frame Delay) option required
- AH AH (Audio Handling) option required

5.8 Closed Captioning – CCAPTION

Note: This menu is only available on modules with the CP (CLOSED CAPTIONING) option enabled.

Main Menu	Sub Menu	Value		Comment	V6402	V6404	V6406	V6408	V6418
CCAPTION	O/P CC	CC On	n	Output captions if present		CP	CP	CP	CP
		CC Off		Disable caption output					
	ANC1080i	1		Set the output VANC line that the SMPTE 334M Packets will be embedded on when the output is 1080i.			CP	CP	CP
		↓							
		9	n						
		↓							
	ANC 720P	1		Set the output VANC line that the SMPTE 334M packets will be embedded on when the output is 720p			CP	CP	CP*
		↓							
		9	n						
		↓							
			*****			CP	CP	CP	CP

* Local only control on the V6418

Legend:

- ü Feature available on Standard version
- VP VP (Video Proc Amp) option required
- SY SY (Frame Synchroniser) option required
- FD FD (Field/Frame Delay) option required
- AH AH (Audio Handling) option required
- CP CP (Closed Caption) option required



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6 APPENDIX A

6.1 **Trouble Shooting Guide (Frequently Asked Questions)**

This section is to be a help in solving some common difficulties. If there is no control from the front panel first check that the Rem/Local switch is set to *Local*.

Q: My V64xx powers-up with a static test pattern or black output, although a valid SDI video signal is connected to one of its inputs.

- A:
1. Check whether the Front Panel HD/SD LED is lit. This indicates that a signal is being received.
 2. Check whether the Input selection is set correctly. VIDEO : Source : I/P 1 (or I/P 2)
 3. Check that the Test Pattern Generator is turned off. ENG'ING : Test Ptn : TPG Off
 4. Make sure that the mode of operation (SD/HD) matches with your Input Standard.
Set to 'Auto' sensing if in doubt. CONFIG : SD/HD Op : Auto

Q: My V64xx does not synchronise to the external reference.

- A:
1. Check whether the Front Panel Ref. LED is lit. This indicates the presence of an ext. reference.
 2. Check whether the ext. reference input is selected. VIDEO : Ref Src : Auto (or Ref IP)

Q: It seems that embedded Audio data does not get passed through the Frame Synchroniser (in fact, no Ancillary data whatsoever).

- A: Check whether the Anc Data enable control is set properly. VIDEO : Anc Data : Anc Pass

Q: I want to add a number of frames extra delay to the output, but I cannot find the associated menu item.

A: You need a V6402 (or a V6404/06/08/18SY) with the Field/Frame-Delay (FD) option enabled. This is a factory installed option and requires a password in order to enable it. If the option is enabled, you will find the corresponding control menu under VIDEO : F Delay.

Q: The output generated by my V6406/08/18 looks corrupt.

A: Make sure that the selected Output Standard has the same frame-rate as the Input signal.

Q: I want to use my V6402 as a stand-alone Test Pattern Generator, but I cannot see anything on the Monitor.

- A:
1. Make sure that the selected 'Default Standard' is compatible with your Monitor specification (CONFIG : Def std). Note that some Broadcast Monitors cannot cope with progressively scanned modes with frame-rates less than 50Hz.
 2. Check whether the TPG is turned on and that you have not deliberately selected a 'Black' test pattern (ENG'ING : TestPtn : Bars 100, Bars 75, etc.)

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Q: The Proc Amp does not work.

A: Check whether it is set to Bypass. **PROC AMP : Bypass : Byp Off**

Q: The display never goes to sleep.

A: Check whether the Sleep delay has been set to 0 Mins, which means stay awake.



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6.2 Initialization, Power On-Selftest & Error Messages

6.2.1 Board Initialization Sequence

Every time a board goes through a power-on cycle, either by re-seating the board in the rack or by triggering the manual reset, a sequence of initialisation and self-test events is being carried out by the on-board microcontroller.

If anything goes wrong, an error message is shown on the front panel display and program execution halts. The following table shows the error messages and their meaning:

Flash upgrading	ERROR 01	Flash erasing failed
	ERROR 02	Flash programming failed
	ERROR 03	Main program checksum error after programming
	ERROR 04	Bootloader checksum error after programming
	ERROR 05	No program loaded and no valid upgrade in Flash Stick
	ERROR 06	Bootloader upgrade required but no valid bootloader upgrade in Flash Stick
FPGA Load	ERROR 07	STATUS stayed low after CONFIG pulsed low
	ERROR 08	DONE stayed high after CONFIG pulsed low
	ERROR 09	STATUS went low during configuration
	ERROR 10	DONE stayed low after configuration
Local EEPROM	ERROR 11	Error writing to local EEPROM
	ERROR 12	Error reading from EEPROM
	ERROR 13	Initialising EEPROM to default data
	ERROR 14	Initialising parameters to default data
Debug Port	ERROR 15	Receive buffer overflow
	ERROR 16	Receive overrun
	ERROR 17	Receive framing error
	ERROR 18	Receive parity error

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6.2.2 SDRAM Test

An automatic SDRAM test is being carried out on the V64xx baseboard with firmware V02.00 (or higher) as part of the power-on self-test sequence. This is subject to the corresponding setting in the CONFIG Menu (**Mem Test ON/OFF**) - **Mem Test** is set to 'ON' by default.

In case of an error, the front panel display will show one of the following **SDRAM test exit codes**:

SDRAM Test	MEM ERR0	SDRAM Databus Bit(s) stuck @ 0
	MEM ERR1	SDRAM Databus Bit(s) stuck @ 1
	MEM ERR2	Neighbouring SDRAM Databus Bit(s) are shorted
	MEM ERR3	Neighbouring SDRAM Databus Bit(s) are shorted
	MEM ERR4	SDRAM Address lines (A10-A0) are shorted or open
	MEM ERR5	SDRAM Bank Select lines (BA0, BA1) are shorted or open
	MEM ERR6	Error whilst filling the SDRAM with 'black' pattern
	MEM ERR7	Timeout error (internal FPGA problem)

6.3 Menu Structures

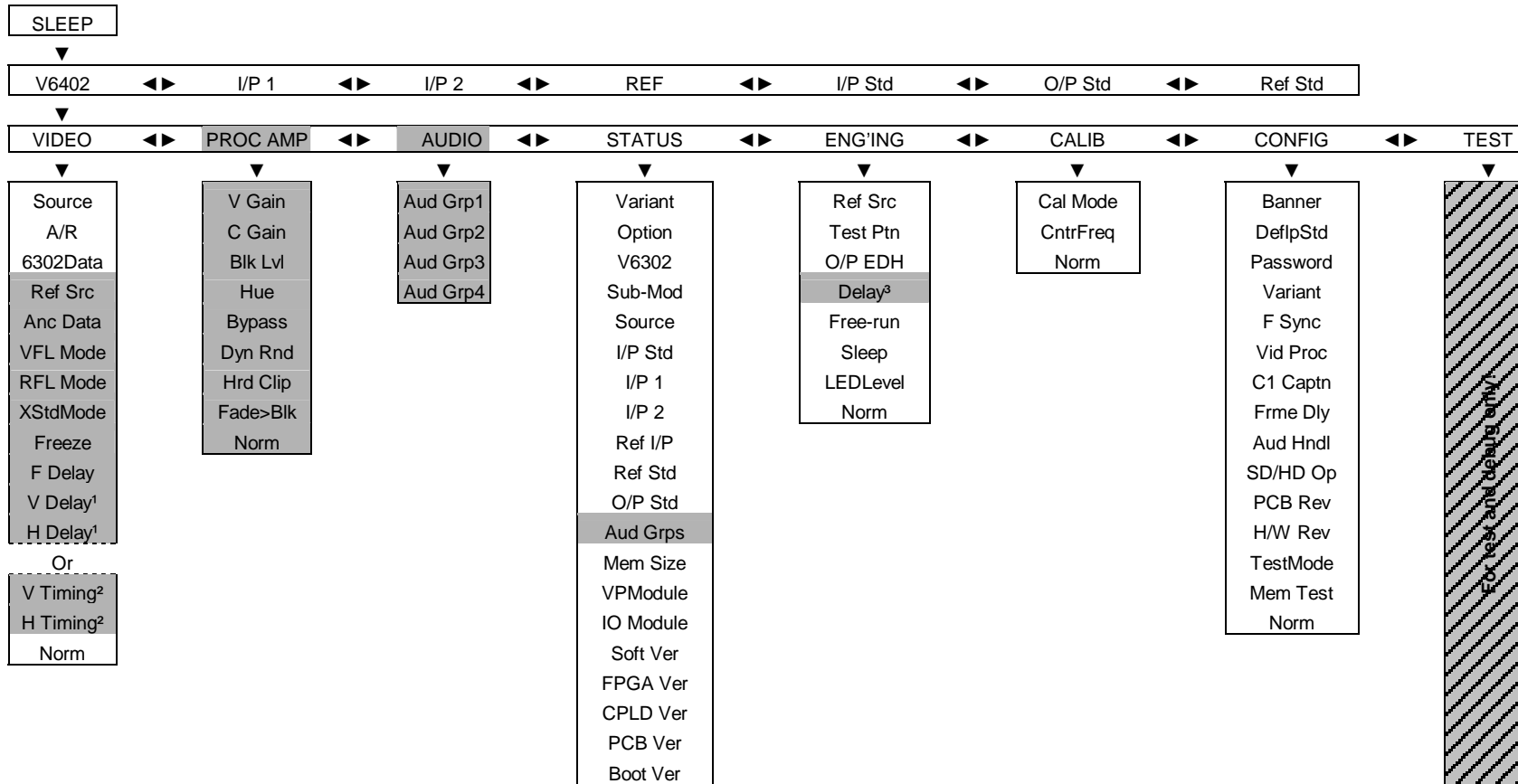
The following pages summarize the menu structures on all the modules.

Please note that the presence of some sub-menus depend on the factory configuration of your module. In other words, if an option is not fitted, the entire sub-menu belonging to it will not appear in the menu structure.

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6.3.1 V6402 HD Frame Synchroniser Menu Structure



Legend:

n Password enabled Option(s)

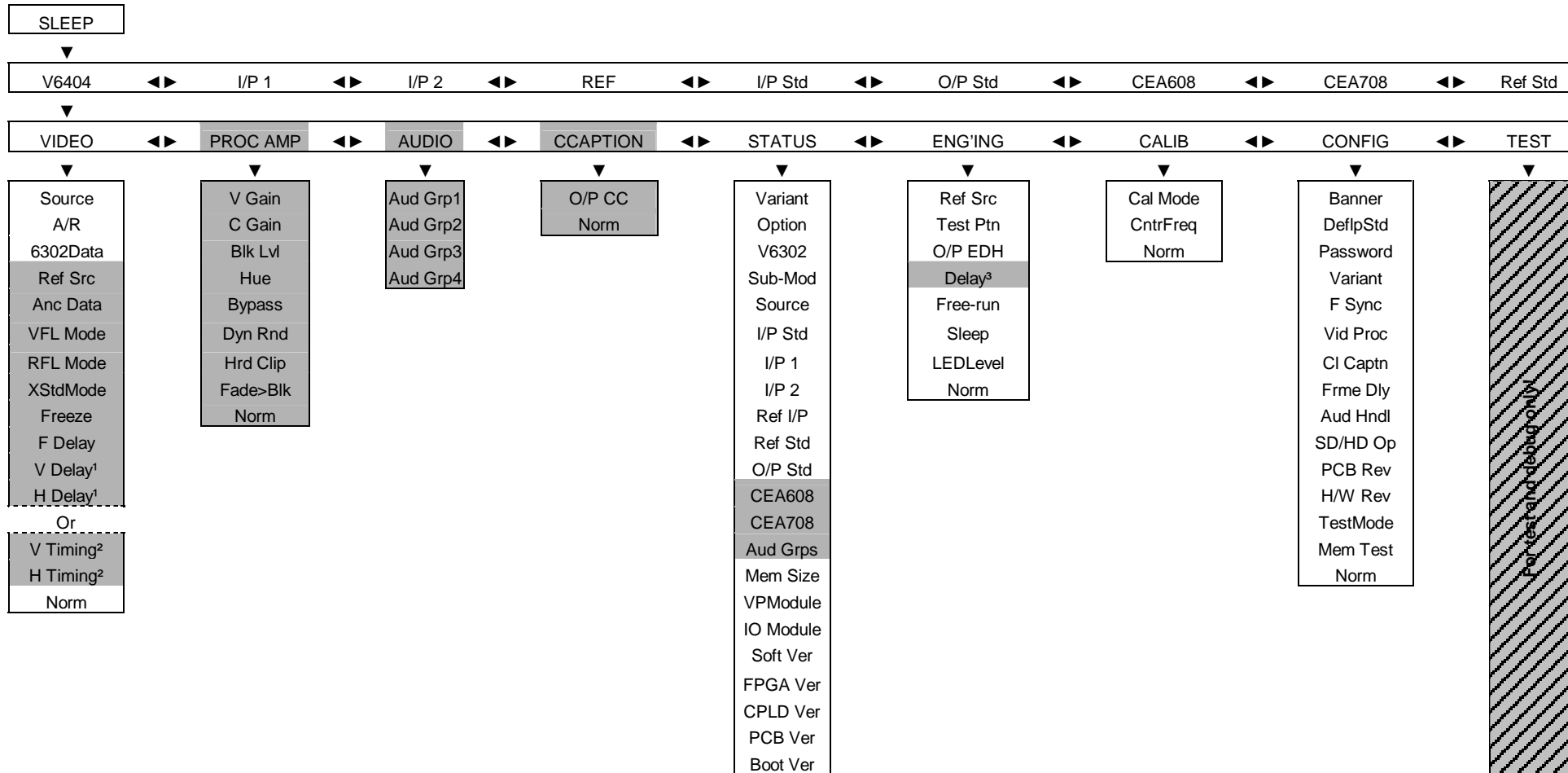
Notes:

1. Reference is Vid I/P
2. Reference is Ref I/P
3. Requires 'FD' option, only available with 525i59 and 625i50 Input Std.

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6.3.2 V6404 HD Down Converter Menu Structure

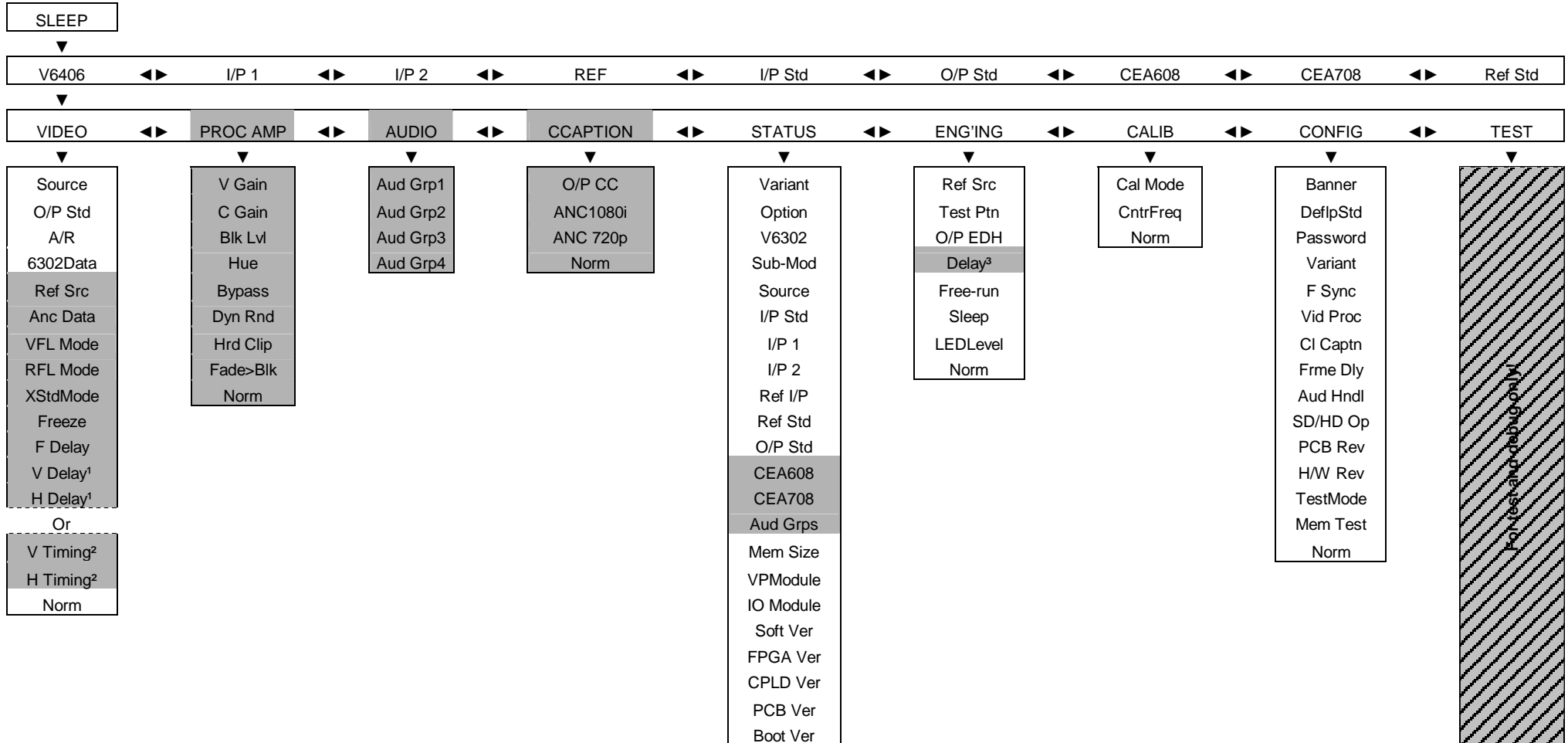


- Legend:** n Password enabled Option(s)
- Notes:**
1. Reference is Vid I/P
 2. Reference is Ref I/P
 3. Requires 'FD' option, only available with 525i59 and 625i50 Input Std.



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6.3.3 V6406 HD Up Converter Menu Structure



Legend:

n Password enabled Option(s)

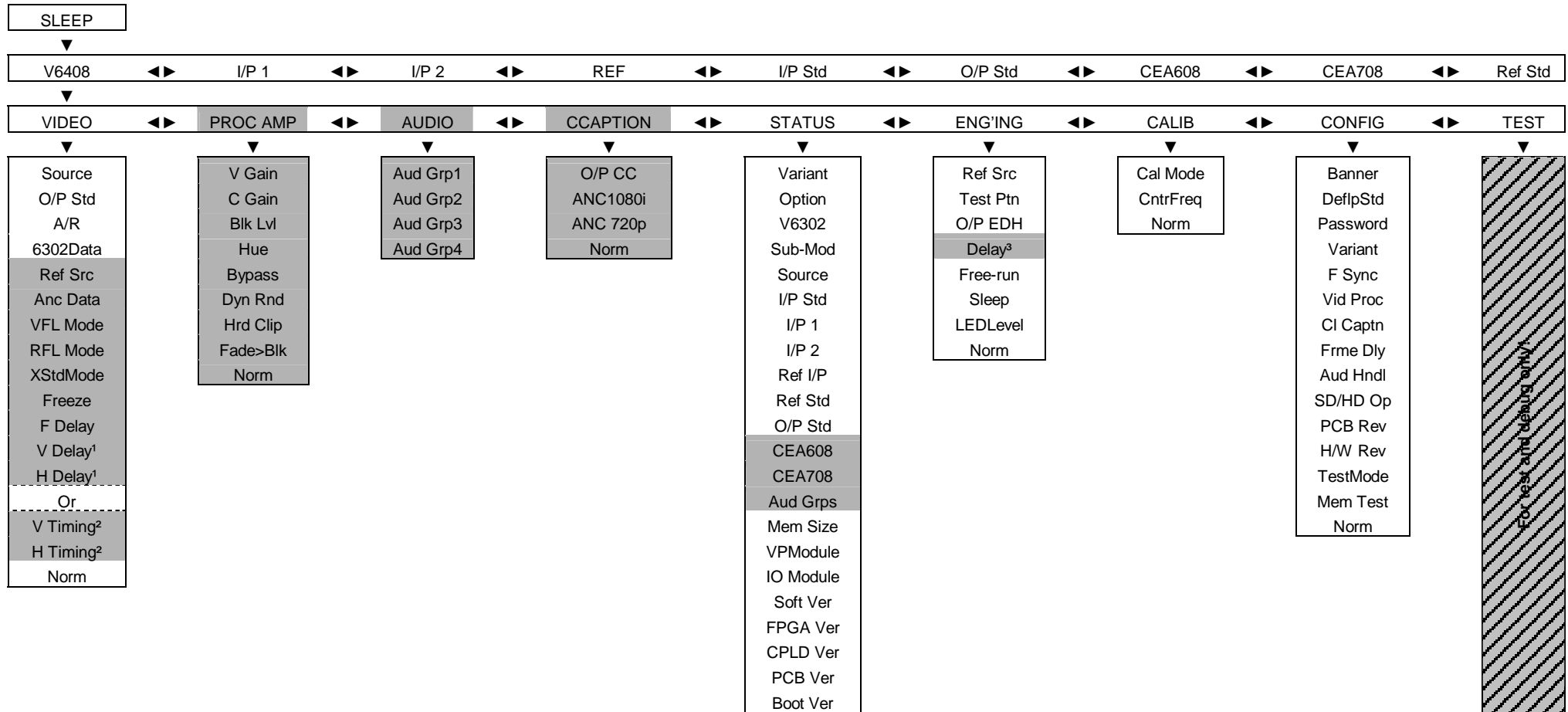
Notes:

1. Reference is Vid I/P
2. Reference is Ref I/P
3. Requires 'FD' option, only available with 525i59 and 625i50 Input Std

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6.3.4 V6408 HD Cross Converter Menu Structure



Legend:

n Password enabled Option(s)

Notes:

1. Reference is Vid I/P

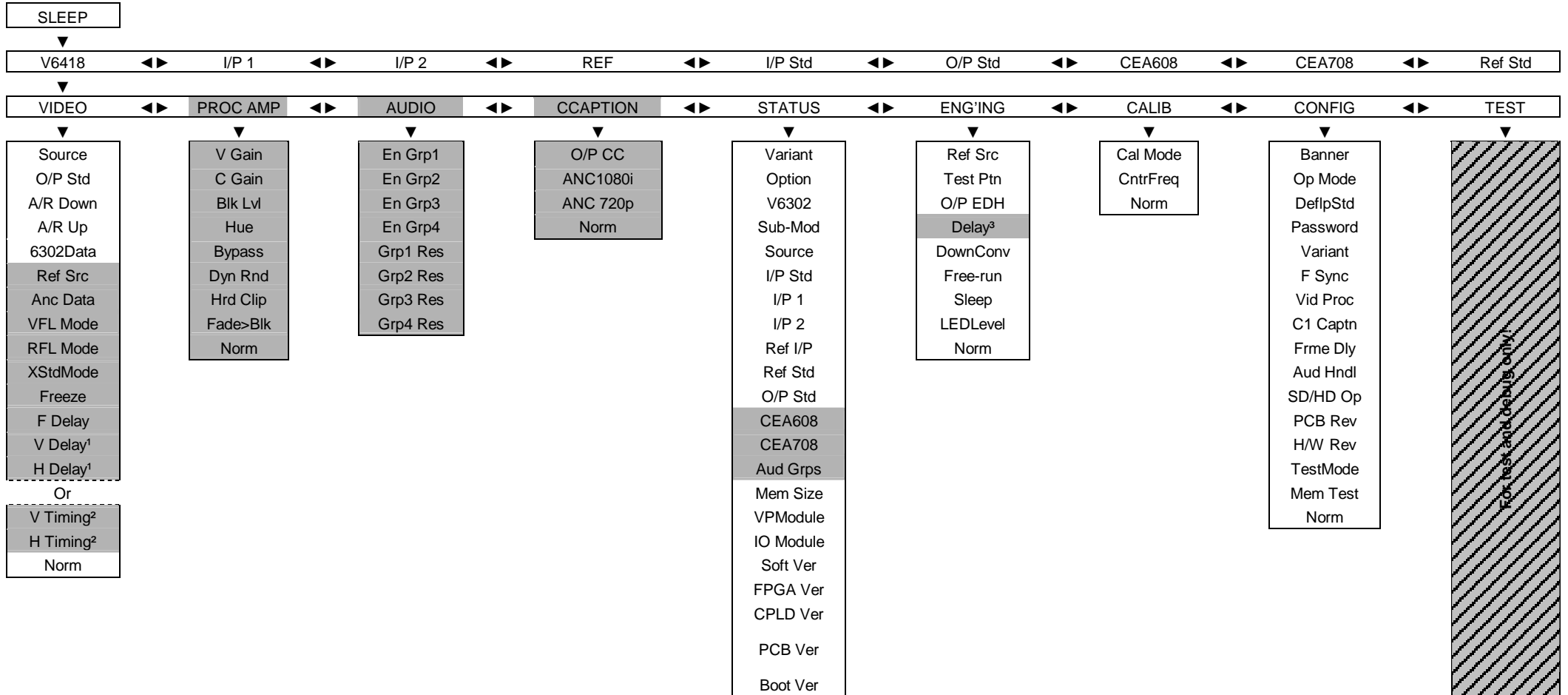
2. Reference is Ref I/P

3. Requires 'FD' option, only available with 525i59 and 625i50 Input Std



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6.3.5 V6418 HD Converter Menu Structure



Legend:
Notes:

- n Password enabled Option(s)
- 1. Reference is Vid I/P
- 2. Reference is Ref I/P
- 3. Requires 'FD' option, only available with 525i59 and 625i50 Input St