



V1662

SDV TO VIDEO ENCODER

INSTALLATION and OPERATION

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V1662 SDV to VIDEO ENCODER

INSTALLATION AND OPERATION

1. DESCRIPTION

The V1662 is a broadcast quality multi-standard encoder, which forms part of the Vistek V1600 range of interface products. It is a 3U high card which is fitted into either a V1601 or V1603 rack, from which it receives its power. A passive rear module, 130-0940, is required for all signal interconnections.

In its basic form, without any options fitted, the unit converts an SDI video signal to an analogue colour composite video in a variety of standards. It derives all its timing information from the D1 input signal.

Two synchroniser options are available. The Frame Synchroniser permits the output of the unit to be timed up to an external reference, with a programmable offset of up to ± 75 lines. The Short Range Synchroniser has a 10 line window, into which the input video should be timed. The output timing can still be adjusted from the reference by ± 75 lines, but if the input video falls outside the window then vertical shifting of the picture will occur.

The SDI input can be either 625/50 or 525/60 format, and the unit will automatically detect which and only allow operation in a standard compatible with that format. If the input signal fails then the unit will continue to operate in the current standard. The allowable standards for the two formats are:

625/50 PAL B/G/I, PAL N

525/60 NTSC, PAL M, NTSC, JAPAN, NTSC 443

An external reference input may be connected. In the basic unit without synchronisers then the reference is used to define the 4 or 8 field colour sequence of the output. When either of the synchronisers is fitted, then it is used as the primary output timing reference.

There are two active feed-throughs of the SDI input. These are fully re-generated.

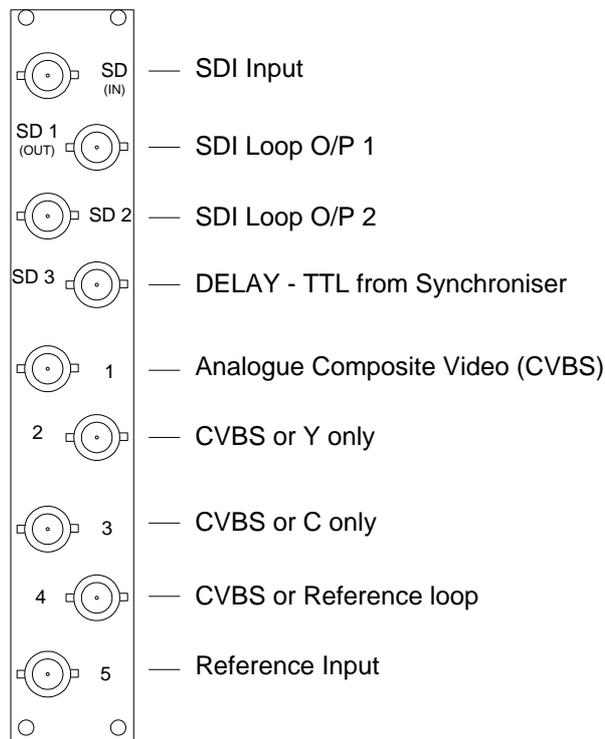
Four analogue outputs are provided; one is permanently colour composite video (CVBS), two are link selectable between CVBS and Y or C, and the fourth is link selectable between CVBS and the reference loop-through output.

Front panel controls allow the user to set up various operating parameters, and if a synchroniser option is fitted they are used to time the unit into an installation.

2. INSTALLATION

2.1 REAR PANEL CONNECTIONS

The rear panel is shown below:



SIGNAL	SOURCE	COMMENTS
POWER	The Rack	Basic Coder 9.5W
		Frame Synch. +1.5W
		Short Synch. +1.5W
SDI I/P	SD (IN)	Sourcing cable length up to 200m
SDI O/P 1	SD1 (OUT))	Driving cable length up to 200m
SDI O/P 2	SD2 (OUT))	Driving cable length up to 200m
REFERENCE I/P	BNC 5	High Impedance. Standard Level Black & Burst
REF Loop	BNC 4	LK 3 to "bc" (down)
Analogue Outputs	CVBS on BNC 1	
	CVBS on BNC 2	LK 2 to "ab" (right) as delivered
	CVBS on BNC 3	LK 1 to "ab" (right) as delivered
	CVBS on BNC 4	LK 3 to "ab" (up) * as delivered
	Y on BNC 2	LK 2 to "bc" (left)
	C on BNC 3	LK 1 to "bc" (left)
Ref Loop on BNC 4	LK 3 to "bc" (down) *	
DELAY	SD 3	TTL Delay from Frame Synchroniser

NOTE For reliable colour field sequencing the Reference must have an SC/H of $<\pm 30^\circ$. This applies whether or not a synchroniser module is fitted.

* These items were incorrectly indicated on early issues of this manual.

2.2 INSERTION DELAY

The insertion delay of the V1662 depends on whether a synchroniser option is fitted. With no synchroniser it is deterministic and fixed. With either synchroniser fitted there is a minimum delay from video to offset reference, which defines whether the picture will be either shifted (Short Range Synch.) or delayed by nearly a frame (Frame Synch.) In all cases the delay is measured from the output of the SDI deserialiser through to the analogue output.

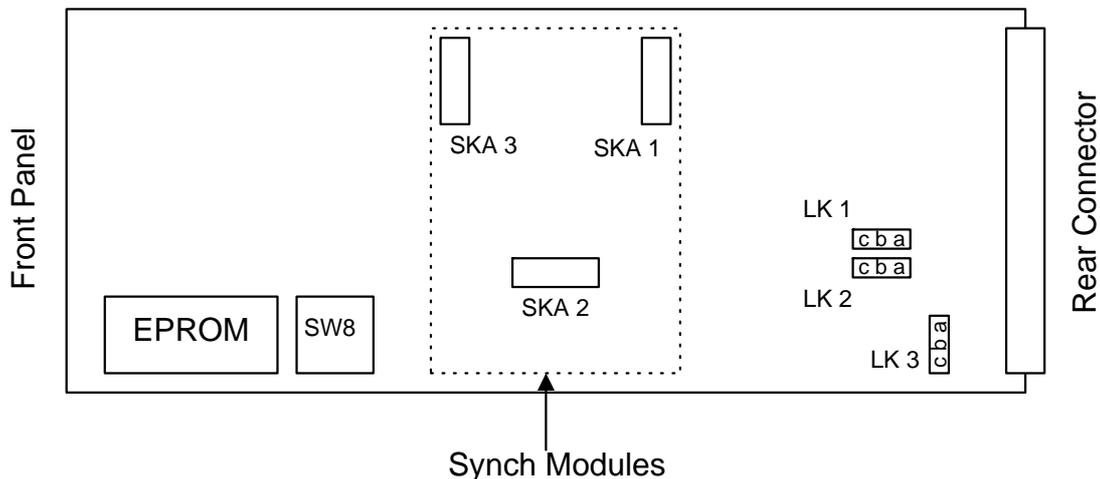
Condition	Delay
No Synchroniser	2.68 μ s
Short Range Synchroniser, Minimum	3.15 μ s
Short Range Synchroniser, Maximum	10 Lines + 2.76 μ s
Frame Synchroniser, Minimum	2.89 μ s

2.3 HARDWARE

The figure below shows diagrammatically the main board along with certain components of interest. In particular it shows the position and orientation of the links discussed above, and the location of the connectors for mounting either of the synchroniser options.

The EPROM locations is shown, as it is the component that would need to be changed as a result of any in-field software upgrade.

The position of SW 8 is shown as it may be used to implement a lockout of the front panel. How this is done is discussed later in section 3.7, but normally there is no component fitted in the SW 8 location.



2.4 SYNCHRONISER MODULES

The synchroniser modules are options which are not required for basic operation of the unit. Two types are available; a full Frame Synchroniser and a 10 line Short Range Synchroniser, but since they occupy the same position on the board only one can be fitted at a time.

Either module is easily fitted onto the board. They are both the same size and fit onto SKAs 1, 2 and 3. Once a module is fitted no further adjustments are required, since the system automatically adapts to their presence.

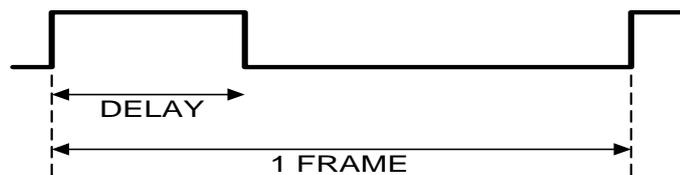
With a synchroniser fitted adjustments can be made to the output timing relative to the reference using the front panel. This is described in the Operation section 3.8.

If a synchroniser module is fitted but no reference is supplied, then the output will be locked to the incoming video, with a constant insertion delay.

2.5 FRAME SYNCHRONISER DELAY

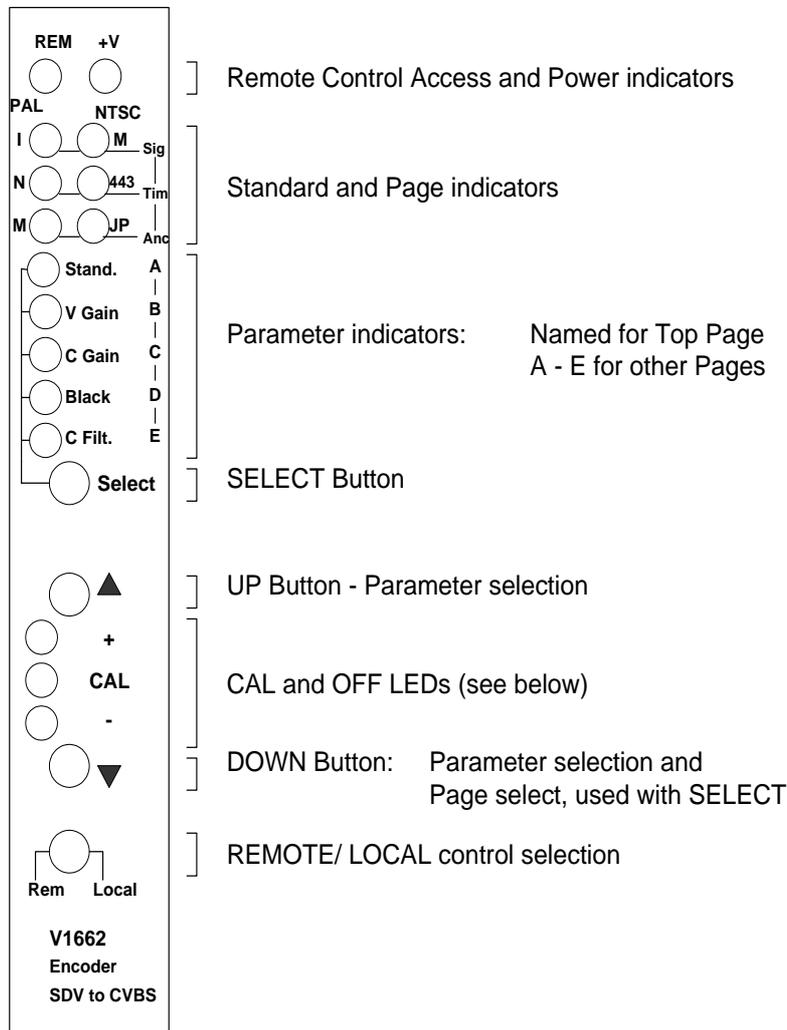
When the Frame Synchroniser delay option is fitted there is a TTL signal to indicate the amount of extra delay inserted above the minimum as specified for the unit. The signal has a constant period of one frame and a variable mark space ratio which depends on the amount of delay inserted. The HIGH portion of the signal indicates the delay.

A typical waveform is as shown below:



3. OPERATION

3.1 FRONT PANEL PRINCIPLES



The V1662 has a versatile front panel shown above. Commonly used controls are directly available, while the less used ones are protected from inadvertent use. It uses the concept of Pages and Parameters. There are five Pages and within each Page there are a maximum of 5 parameters, each of which is adjustable. Some have distinct settings, such as MONO or COLOUR, while others are true variables, such as VIDEO GAIN.

NOTE If the REM/LOCAL switch is in the REM position then the control panel buttons will be disabled.

There are five Pages in total starting with the Top Page. This is the page that the unit starts on after first being powered, and will always return to if no button is pressed for 5 minutes. It contains the standard selection and most commonly used functions, and is indicated by only one of the standard LEDs being ON.

To change Pages the SELECT button is used as a shift key along with the τ button. This means you should press and hold the SELECT button and press the τ button momentarily. The first time this key sequence is pressed the upper row of Standard LEDs will flash ON (they are also labelled SIG for 'signal processing'). On the next press the second row (TIM for 'timing') may FLASH, followed by the ANC (for 'ancillary') row. Finally the unit will return to a single standard LED showing it has returned to the Top Page.

NOTE The TIM page is for timing purposes and will only be available if one of the synchroniser options is fitted.

There is a special Engineering page, which is accessed by pressing the SELECT and τ buttons down for 5 seconds. Selection of the ENG page is indicated by all six standard LEDs turning ON.

Within each page there can be up to five parameters. On the Top Page these are directly labelled from STANDARD down to CHROMA FILTER, while on the other pages the codes **A** to **E** should be used with the following table. To select any parameter within a page use the SELECT button as many times as necessary until the required LED is ON. In the Top Page there is a 'special' sixth parameter for which none of the **A** to **E** LEDs is ON; this is a protected default condition where the σ and τ buttons have no effect.

In some configurations some parameters may have no effect. For example it is not possible to adjust the timing offsets if a synchroniser option has not been fitted. In these case it is not possible to select the relevant Page or parameter.

After a parameter has been selected it can be adjusted using the σ and τ buttons, and a measure of its setting can be made by reading the three CAL LEDs. With most parameters the LEDs give an indication of whether and in what direction a variable has been adjusted. Section 3.3 describes this in more detail.

The σ and τ buttons have a variable rate law on many parameters. This means that there is fine resolution when required, but it is also possible to make coarse adjustments quite rapidly. The coarse adjustment comes in when either button is held down longer than a second or two.

The toggle switch at the bottom of the panel selects whether control of the unit is from the front panel, as described here, or through remote control. If REM is selected then all other buttons on the panel are disabled. The REM LED at the top of the panel will flash only if remote control has been selected AND the unit is being accessed by a remote control system.

NOTE Having the REM/LOC switch in the REMOTE position is the most likely cause of a suspected control fault.

3.2 PARAMETER MAP

This table shows all the parameters in all the Pages. It may be convenient to keep a copy close to the equipment.

	Top Page	Page 1 (SIG)	Page 2 (TIM)	Page 3 (ANC)	ENG.
A	Standard	Mono	V Timing	Normalise	Bars/Ramps
B	Video Gain	Wide H Blank	H Timing		Pedestal
C	Chroma Gain	V Blank	Fine H		D2 O/P
D	Black	L23 Blank (625)	Synch Fail Mode		VCO Freq.
E	Chroma Filter	SC/H	Timing Reset		

3.3 CALIBRATION AND NORMALISATION

Some of the variable parameters have a predictable calibrated position; for example the VIDEO GAIN or BLACK level. If one of these parameters is changed, then one of the RED LEDs will turn ON, showing the direction of adjustment. At the same time the parameter LED will flash. If the operator now moves to another parameter, then the original parameter LED will continue to flash showing that it is OFF CAL. The RED LEDs will now reflect the state of the newly selected parameter so may not stay ON. This means that it is quite easy to see if any parameter on the current page is OFF CAL. Simply observe for any flashing parameter LEDs, select that parameter, and reset it to its CAL position. If any parameter apart from the currently selected one is OFF CAL and the current one is CAL then the red LEDs will blip. This is a warning of some OFF CAL condition.

Some parameters can be easily returned to their CAL position, simply by pressing σ or τ a few times until the CAL position is found, but others are not so easy. So any parameter that has a CAL position can be immediately reset by pressing the σ and τ buttons together as a special CAL operation.

Other parameters do not have a well defined CAL position. An example is the position of vertical blanking, where the user would set it as required, or the timing settings on the synchronisers. However it is useful to normalise all variables, so that at installation the starting point is known. Changing these settings requires some protection against accidental use, since they may upset the overall installation. The NORMALISE function is provided to return all variables to their CAL or normalised values and is done by selecting Page **3 A**, and then holding the σ and τ buttons down for 5 seconds. After being normalised in this way control will return automatically to the Top Page. This is how the unit is delivered from the factory.

As a special case of normalisation there is a TIMING RESET parameter on Page **2 E**, which resets all the synchroniser timing values to their normal settings. As with the NORMALISE operation TIMING RESET requires the σ and τ buttons to be held down for 5 seconds. The NORMALISE function also resets the timing values but affects other parameters as well.

3.4 SIGNAL FAIL

If the input signal fails the unit behaves differently depending on whether or not there is a synchroniser fitted. Without a synchroniser the unit will generate clean black and burst in the currently selected standard.

With the frame synchroniser fitted the unit may freeze the current picture or cut to black. If fail-to-freeze is selected then the unit will show the stored field during which the signal failure did not occur. Thus if the failure occurred during field 1 then field 2 will be displayed. The unit always freezes the failed picture so the selection can be changed between freeze and black even after the picture has disappeared. A further option is Freeze-3 s-Black where the picture will freeze for 3 seconds and then cut to black. The advantage of this is that a temporary interruption causes minimum disturbance to the output, but longer ones are detectable. In particular if Freeze were selected it would be hard to tell if a static test signal had failed.

With the short range synchroniser fitted the output goes to black, since there is not sufficient storage to enact a freeze.

If either synchroniser option is fitted and a reference is applied, then the output timing will continue to be locked to the reference if the input fails. Without a synchroniser the output will free run, continuing to generate a standard signal.

In the Top Page the operating standard LED will flash when the input signal fails, giving the warning while still showing the standard. This does not apply if the control panel is operating in another Page.

3.5 REFERENCE FAIL

The actions on a failure of the reference signal depend on the configuration. Without any synchroniser there will be no disturbance to the output and the colour field sequence will continue free-running from where it was.

If a synchroniser is fitted then the output will change its locking source from the reference to the input signal, and the colour field sequence will free run. There will be a disturbance to the output sync sequence.

There is no indication on the front panel that the Reference has failed.

3.6 TIME-OUT

If the front panel has not been touched for 5 minutes, then the control panel will automatically return to the Top Page with no parameter selected. This time-out is to avoid the accidental adjustment of any operating parameter.

3.7 PANEL LOCKOUT

In installations that require a high level of security it is possible to lockout the front panel so that it can only be used with the Top Page. This can be done on the PCB by fitting a 4 position DIL switch into SW 8 and closing switch 1. It is possible to put a wire link in place, but this is not recommended.

The REM/LOCAL switch provides a simple panel lockout by disabling all the buttons when in the REM position.

3.8 SYNCHRONISER TIMING

When either of the synchroniser options is fitted, either full frame or short range, the analogue video output can be locked to an external reference. The output timing can be offset from the reference by any amount up to ± 75 lines. The timing offset is done through the Timing Page, **PAGE 2**, using three separate variables, V Timing, H Timing and Fine H Timing.

The short range synchroniser has a 10 line window into which the input signal should fall. The window is defined relative to the output timing which is the reference plus any applied offset. If the input video falls outside the window then the output picture will be shifted vertically either up or down, depending on whether the video is early or late with respect to the offset reference.

To help in timing the system with the short range synchroniser fitted the two red UNCAL LEDs on the front panel are used to indicate the input video timing relative to the window. They indicate this status only when in the Timing Page and the Short Synchroniser is fitted. There is no such timing problem with the Frame Synchroniser since all input timings are correctly handled. This table shows how the LEDs indicate the timing state:

LED State	Meaning
Reds OFF	Input video inside Window
Upper Red ON	Input video late relative to offset reference
Lower Red ON	Input video early relative to offset reference
Green LED ON	All timing offsets at their Normalised value.

The green LED simply indicates that the timing offsets are at their normalised values; it does not reflect the relative timing of the input video in any way. Thus it is completely independent to the red LEDs.

3.9 LED INDICATIONS

The front panel LEDs convey a lot of information to the user that may not be immediately obvious. This table should help to explain them:

SYMPTOM	EXPLANATION
Single Standard LED Flashing (Top Page)	Input signal has failed
Parameter LED Flashing	Currently selected parameter is OFF CAL
Parameter LED Blipping	An unselected parameter on the current Page is OFF CAL
Both UNCAL red LEDs Blipping	Some currently unselected parameter is OFF CAL
One row of 2 Standard LEDs Flashing	Indicates the selection of Page 1, 2 or 3.
All 6 Standard LEDs Steady	ENG Page selected.
Green CAL LED ON	Current parameter is on its NORMALISED or CAL value
One or both red LEDs ON	a) Current parameter is OFF CAL b) Video outside window of Short Synch.

4. PARAMETER DESCRIPTIONS

The table in the Appendix shows all the controllable parameters and their pages. This section gives more detail on them. The CAL column shows which parameters can be calibrated, and the CAL value or setting. The NORM column shows which parameters can be normalised and their NORM value. All parameters that can be calibrated will also be normalised.

The LED column shows how the CAL LEDs operate. The 'standard' arrangement is that the green LED is ON when the parameter is on its CAL value, and one or other of the RED LEDs will be ON to show that it is OFF CAL, and in which direction.

4.1 STANDARD SELECT TOP PAGE A

Standards are only available for the current operating mode (625/50 or 525/60) so a correct input should be provided before changing the standard. It is only possible to select a standard that is compatible with the input format.

NTSC JAPAN is similar to NTSC M in all respects except that there is no Setup, and the gains are adjusted so that peak white level is the same.

CAL and NORMALISE have no affect on the standard selection.

4.2 VIDEO GAIN TOP PAGE B

This provides an overall adjustment of video level, both luminance and chrominance. The adjustment range is not symmetrical with respect to gain and loss due to the limited headroom of digital systems. At higher gain settings the U and V chrominance gains may limit independently, causing hue changes. The actual limits will be affected by the Chroma Gain setting.

The CAL LEDs are standard.

CAL and NORMALISE force the gain to 0dB.

4.3 CHROMA GAIN TOP PAGE C

This provides an adjustment of chrominance level. The adjustment range is not symmetrical with respect to gain and loss due to the limited headroom of digital systems. At higher gain settings the U and V chrominance gains may limit independently, causing hue changes. The actual limits will be affected by the Video Gain setting.

The CAL LEDs are standard.

CAL and NORMALISE force the gain to 0dB.

4.4 BLACK LEVEL TOP PAGE D

This provides an adjustment of the overall black level. The limit of $\pm 150\text{mV}$ applies with or without NTSC setup.

The CAL LEDs are standard.

CAL and NORMALISE force the black level to 0V or 54mV according to the current standard.

4.5 CHROMA FILTER TOP PAGE E

This selects the Gaussian chroma filter within the coder which ensures the output signal meets the published specifications. In some cases the signal may be known to have band limited chrominance signals, in which case the filter may be disabled. This function does not cycle, so the σ button is for ON and the τ button is for OFF.

There is no CAL position but the green CAL LED does indicate that the filter is enabled. The red LEDs are not used.

NORMALISE forces the chroma filter to be ON.

4.6 MONO PAGE 1 (SIG) A

This cycles through the various colour axis options: U Only, V Only, Full Colour and Mono.

The green CAL LED indicates that full colour is enabled. The red LEDs indicate that one or both of the colour axes is turned OFF.

NORMALISE forces full colour, as does CAL.

4.7 WIDE H BLANKING PAGE 1 (SIG) B

This selects between wide and narrow horizontal blanking. Wide blanking ensures that the output signal meets the published specifications, while narrow blanking allows the full CCIR Rec. 601 digital active line to pass. In the case of narrow blanking no shaping is applied to the edges of the video. This function does not cycle, so the σ button is for WIDE and the τ button is for NARROW.

There is no CAL position but the green CAL LED indicates that WIDE blanking is applied. The red LEDs are not used.

NORMALISE forces the blanking to WIDE.

4.8 V BLANKING PAGE 1 (SIG) C

This varies the amount of vertical blanking, by passing the lines in the vertical interval through the coder. The σ button widens the blanking and τ button narrows it to its limits. These are:

FORMAT	Field 1	Field 2
625/50	7 - 22	320 - 335
525/60	10 - 20	9 - 19

There is no CAL position but the green CAL LED indicates that the narrowest vertical blanking is applied thus passing all the vertical interval data.. The red LEDs are not used.

NORMALISE forces the blanking to NARROW.

4.9 L23 BLANK (625) PAGE 1 (SIG) D

This enables and disables the blanking on the first half of line 23 in 625/50 format only. If operating in 525/60, then this parameter is bypassed, and therefore not available.

In Europe the first half of line 23 has been allocated for signalling information to wide-screen receivers.

There is no CAL position but the green CAL LED indicates that Line 23 blanking is applied. The red LEDs are not used.

NORMALISE forces blanking of the first half of line 23.

4.10 SC/H**PAGE 1 (SIG) E**

This provides an adjustment of the SC/H relationship on the output signal. The adjustment is cyclic through the whole range of $\pm 180^\circ$.

The CAL LEDs are standard, but the variable is only considered to be out of CAL when $>10^\circ$. The upper red LED indicates an error up to $+180^\circ$ and the lower one down to -180° .

CAL and NORMALISE both force the SC/H to 0° .

4.11 V TIMING**PAGE 2 (TIM) A**

This applies the vertical timing offset to the output when either of the synchroniser options is fitted. The range is ± 75 lines. It is only available if a synchroniser module is fitted.

Using the σ button makes the output video earlier with respect to the reference.

Using the τ button makes the output video later with respect to the reference.

In addition to NORMALISE the timing parameters also have a TIMING RESET function (PAGE 2 E) which forces just the timing parameters back to their starting point.

There is no CAL position but the green CAL LED indicates that the vertical timing is in its normalised position.

NORMALISE and TIMING RESET force the vertical timing so that the output is coincident with the reference.

4.12 H TIMING**PAGE 2 (TIM) B**

This applies the horizontal timing offset to the output when either of the synchroniser options is fitted. The range is over a whole line but operates in steps of 37ns. It is only available if a synchroniser module is fitted.

Using the σ button makes the output video earlier with respect to the reference.

Using the τ button makes the output video later with respect to the reference.

In addition to NORMALISE the timing parameters also have a TIMING RESET function (PAGE 2 E) which forces just the timing parameters back to their starting point.

There is no CAL position but the green CAL LED indicates that the horizontal timing is in its normalised position.

NORMALISE and TIMING RESET force the horizontal timing so that the output is coincident with the reference.

4.13 FINE H TIMING

PAGE 2 (TIM) C

This applies the fine, sub-pixel, horizontal timing offset to the output when either of the synchroniser options is fitted. The range is approximately 50ns, but at least 37ns. It is only available if a synchroniser module is fitted.

In addition to NORMALISE the timing parameters also have a TIMING RESET function (PAGE 2 E) which forces just the timing parameters back to their starting point.

There is no CAL position but the green CAL LED indicates that the horizontal timing is in its normalised position.

NORMALISE and TIMING RESET force the fine horizontal timing to the centre of its adjustment range.

4.14 SYNCH FAIL MODE PAGE 2 (TIM) D

This selects one of three possible actions in the event of loss of input signal when the frame synchroniser is fitted. The options are to FREEZE, FREEZE for 3 seconds and then cut to BLACK, or cut directly to BLACK.

This control is not cyclic, so the σ button is for FREEZE and the τ button is for BLACK.

There is no CAL position but the green CAL LED indicates that FREEZE-3 secs-BLACK mode is selected. The red LEDs are not used.

NORMALISE forces the mode to FREEZE-3 secs-BLACK.

4.15 TIMING RESET

PAGE 2 (TIM) E

This forces all four of the timing parameters, PAGE 2 A to E, to their normalised values. It is enacted after pressing the σ and τ buttons together and holding down for 5 seconds. It should be used as the starting point before timing the unit into an installation. It is only available if a synchroniser module is fitted.

There is no CAL position but the green CAL LED indicates that all timing parameters are at their normalised values. The red LEDs are not used.

NORMALISE also resets the timing parameters so the green CAL LED will be lit afterwards until a timing parameter is varied.

4.16 NORMALISE

PAGE 3 (ANC) A

This forces all the parameters to their normalised values. There are a very small number of parameters which are not affected by NORMALISE, and these are identified in the Appendix. It is enacted by pressing the σ and τ buttons together and holding down for 5 seconds.

There is no CAL function associated with this parameter.

After NORMALISATION the front panel will return to **TOP PAGE**.

NOTE NORMALISE resets all the timing parameters as well as all the CAL parameters which may upset an already timed system.

4.17 SPARE

PAGE 3 (ANC) B-E

These not allocated to any function at present but are reserved for future use.

4.18 BARS/RAMPS **PAGE ENG A**

This parameter selects some test patterns internally generated on the coder chip. They are **NOT** broadcast quality, and should be used only with extreme caution. Their use has only been included for test purposes.

The parameter cycles through the test patterns as follows:

- Modulated RAMP
- I/P Signal
- 100% Colour Bars
- 75% Colour Bars.

CAL forces the unit to I/P Signal and the green CAL LED will reflect this. The red CAL LEDs are both ON to indicate that one of the test signals is selected.

NORMALISE forces the unit to the I/P Signal.

4.19 PEDESTAL (625) **PAGE ENG B**

This removes the pedestal (setup) from the 525/60 standards except for NTSC JAPAN which has none. It has no effect in the 625/50 standards.

The CAL LED indicates that the pedestal is correctly applied. The lower RED LED indicates that pedestal is removed.

NORMALISE forces the pedestal to be correctly applied.

4.20 D2 O/P **PAGE ENG C**

The unit can provide a parallel digital output for use on a neighbouring module to generate a D2/D3 signal. Until this facility is available the digital output has been disabled. This parameter is used to enable the D2 O/P to the rear connector.

Pressing the σ button enables the digital output.

Pressing the τ button disables the digital output.

CAL and NORMALISE do **NOT** affect this parameter.

There is no CAL indication.

4.21 VCO FREQUENCY **PAGE ENG D**

This is a parameter used in initial production test and alignment, to centralise the VCO Frequency used when there is no signal or reference. It should not be adjusted without reference to the Test Specification and suitable test equipment.

CAL and NORMALISE do **NOT** affect this parameter.

There is no CAL indication.

4.22 SPARE **PAGE ENG E**

This is not allocated to any function at present but is reserved for future use.

APPENDIX

PAGE		Parameter		RANGE	CAL	Norm	LEDs
TOP	A	Standard	σ τ σ τ	625/50 PAL B, G, I PAL N 525/60 NTSC PAL M NTSC 443 NTSC JAPAN			
	B	Video Gain	σ τ	-6dB to +1.6dB	0dB	0dB	Standard
	C	Chroma Gain	σ τ	-6dB to +5dB	0dB	0dB	Standard
	D	Black	σ τ	-150mV to +150mV	0mV	0mV	Standard
	E	Chroma Filter	σ τ	Filter ON Filter OFF		←	G None
1 (SIG)	A	Mono	σ τ	U only V only Colour Mono	←	←	LR UR G UR + LR
	B	Wide H Blank	σ τ	Wide Blanking Narrow Blanking		←	G None
	C	V Blanking	σ τ	Widening Narrowing		←	G = narrowest
	D	L23 Blank (625)	σ τ	Line 23 half blanked Line 23 Pass		←	G None
	E	SC/H	σ τ	-180° to +180°	0°	0°	Standard (<10°)
2 (TIM)	A	Vert. Timing	σ τ	Up to ±75 lines		←	G after re-time or NORM
	B	Horiz. Timing	σ τ	Full Line Width		←	G after re-time or NORM
	C	Fine Horiz.	σ τ	sub-pixel timing wrt Ref		←	G after re-time or NORM
	D	Synch Fail Mode	σ τ	Freeze Freeze-3s-Black Black		←	None G None
	E	Timing Reset	$\sigma+\tau$ 5secs	Reset Synch Timing			G after re-time or NORM
3 (ANC)	A	Normalise	$\sigma+\tau$ 5secs	NORM all functions			
ENG	A	Bars/Ramps	σ τ	Ramps Normal 100% Bars 75% Bars	←	←	UR+LR G UR+LR UR+LR
	B	Pedestal (525)	σ τ	Normal Removed	←	←	G LR
	C	D2 O/P	σ τ	Enabled Disabled			

	D	VCO Frequency	σ τ				
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