

SIERRA VIDEO SYSTEMS, INC.

TimeCache User's Guide

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Introduction

TimeCache is a solid state time delay product which accepts 270Mbps SMPTE 259M video signals and produces 270Mbps SMPTE 259M video signals. The time delay through the product is adjustable from a minimum value of roughly 1.5 microseconds to a maximum value of 0.232 seconds to 7.4 seconds; *depending on the option purchased*. The incoming signal is normally delayed without any alteration of the bit stream; no compression or ancillary data blanking occurs. Delay is adjustable in 37nsec. increments via rear panel controls, direct connection to a Windows computer, or a SmartLinx network control product. Additional features include a loop back mode which allows a user adjustable (in one frame increments) video sequence to be recorded and played back indefinitely as well as rear panel accessible contact closure signals which allow the user to blank the active video data (without affecting ancillary data) or mute all embedded audio signals (using a 4 millisecond fade-to-silence algorithm).

Peripheral Connections



The rear panel provides the following signal connections to the user:

- DIG. VID. IN** - This BNC connector serves as the 270Mbps SMPTE 259M signal input to the product. Signals applied here are fed to the time delay and to the clock generation circuitry for the module.
- DIG. VID. OUT** - These two BNC connectors provide 270Mbps SMPTE 259M signal outputs from the product. They are copies of one another and either may be used without affecting the other.
- MUTE CONNS.** - This is a 'Mini XLR' connector, the pins of which are assigned as follows:
 - AUD** - pin 1 of the connector has no effect if left unconnected. If connected to pin 2, pin 1 initiates a muting sequence which attenuates all embedded audio signals at the output of the time delay over a 4 millisecond period, culminating in digital 'silence' in the data segments of all provided audio packets. Removing the connection between pin 1 and pin 2 initiates a 4 millisecond sequence of gain progression, culminating in the restoration of unaltered audio data passing through the product.
 - GND** - pin 2 of the connector is wired to module ground.
 - VID** - pin 3 of the connector has no effect if left unconnected. If connected to pin 2, pin 3 replaces all active video pixels with 'digital black', starting with the next video field. Removing the connection between pin 1 and pin 2 restores original user data to the active pixel area of the outgoing video stream.

Video and audio can be simultaneously muted by connecting pins 1 and 3 to pin 2 simultaneously. This can be accomplished with a SPDT switch, or by connecting pins 1 and 3 to the anodes of two Germanium or Schottky diodes, the cathodes of which would be tied together to one side of a SPST switch leading to ground (pin 2).

Rear Panel Control

The delay values stored in the module can be entered and recalled via the two switches on the rear of the TimeCache module. This section describes the utilization of these switches.

SWA - Switch A is used to select the parameter to be adjusted by switch B. These are the parameters and their corresponding switch positions:

Table 1: SWA Positions and Their Functions

Sw. Pos.	Function Selected
0	Set least significant nibble of time delay.
1	Set 2nd least sig. nibble of time delay.
2	Set 3rd least sig. nibble of time delay.
3	Set 4th least sig. nibble of time delay.
4	Set 5th least sig. nibble of time delay.
5	Set 6th least sig. nibble of time delay.
6	Set 7th least sig. nibble of time delay.
7	Set most sig. nibble of time delay.
8-D	Unused.
E	Set EEPROM reg. in which to save delay.
F	Recall time delay from EEPROM register.

SWB - Switch B expresses the numeric value of the parameter pointed to by Switch A. If Switch A enters and leaves any mode without Switch B being changed, the parameter value stored in RAM for that mode will not be influenced by the switch value. If Switch B is changed, the parameter pointed at by Switch A will take on the value of Switch B until Switch A is changed to another setting. Here is an example of how to set the three most significant nibbles of the time delay to zero when Switch B is initially set to '0':

- 1) set switch A to position 7,
- 2) change switch B to any value other than zero,
- 3) set switch B to zero,
- 4) set switch A to position 6,
- 5) change switch B to any value other than zero,
- 6) set switch B to zero,
- 7) set switch A to position 5,
- 8) change switch B to any value other than zero,
- 9) set switch B to zero.

In other words, to tell the module you want to *change* a value you must *change* switch B.

During time delay nibble entries, Switch B's value expresses a hexadecimal number. This means switch position A indicates a value of 10, position B, a value of 11, position C, a value of 12, position D, a value of 13, position E, a value of 14, and position F indicates a value of 15.

Determining Time Delay Settings

The time delay settings are entered and stored as hexadecimal numbers which indicate the number of 27MHz clock cycles of delay which will be applied to the video input signal before that signal leaves the video output jack. The module has an intrinsic processing delay of 42 clock cycles, so entering delays of 0 through 42 will all result in delays of 42 clock cycles through the module. Otherwise, the switch values for the desired time delay can be calculated from an absolute time goal by

- 1) *Multiplying the desired delay time by 27,000,000,*
- 2) *rounding to the nearest whole number, and*
- 3) *expressing the result as a hexadecimal number.*

This last step is most easily realized with a calculator featuring a hexadecimal number notation mode. The resulting number is then entered into the module starting with the most significant nibble (SWA set to position 7), even if the value of this nibble is zero. If two adjacent nibbles require the same value to be entered, it is necessary to move SWB to another position and back again; otherwise, the module will think you don't want to change that register to something other than it's original value.

When using the module to 'fine tune' signal re-entry timings, it is often easier to monitor the time delay output relative to some 'correctly' timed signal and adjust the time delay nibbles until a satisfactory timing is achieved. Time delay settings beyond the maximum delay allowed by the installed memory option are automatically limited to the maximum delay available from the installed memory. The following indicates maximum values for each memory option.

Table 2: Memory Options and Resulting Maximum Delays

<u>Product Suffix</u>	<u>Memory Size(Mbytes)</u>	<u>Maximum Delay(secs)</u>	<u>Maximum Sw. Setting</u>
-00	8	0.233	005FFFFFF
-10	16	0.466	00BFFFFFF
-20	32	0.932	017FFFFFF
-30	64	1.86	02FFFFFFF
-40	128	3.73	05FFFFFFF
-50	256	7.46	0BFFFFFFF
-60	512	14.9	17FFFFFFF

It can be difficult to set delays which are more than a frame in duration by observation, since one test signal frame of video looks like any other(with static test signals, that is). The following table gives a few popular values for time delay settings expressed in the hexadecimal notation used by the rear panel switches. Note that 'second' value time delays are actually the nearest number of whole frames(at the line rate referred to) to the given number of seconds; allowing the video output to be 'in time' with the video input. The most significant digit in the 'Switch Settings in Hexadecimal' column would be entered while SWA is set to position 7, the second most significant digit entered with SWA set to position 6, etc.

Table 3: A Collection of Popular Time Delays and Their Corresponding Switch Settings

<u>Time Delay</u>	<u>Number of Clock Cycles</u>	<u>Switch Settings in Hexadecimal</u>
(1) '525' frame	900,900	000DBF24
(2) '525' frames	1,801,800	001B7E48(cont'd)
(3) '525' frames	2,702,700	00293D6C
(4) '525' frames	3,603,600	0036FC90
(5) '525' frames	4,504,500	0044BBB4
(1) second(525)	27,027,000	019C6638
(2) seconds(525)	54,054,000	0338CC70
(3) seconds(525)	81,081,000	04D532A8
(4) seconds(525)	108,108,000	067198E0
(5) seconds(525)	135,135,000	080DF18
(6) seconds(525)	189,189,000	09AA6550
(7) seconds(525)	216,216,000	0B46CB88
(1) '625' frame	1,080,000	00107AC0
(2) '625' frames	2,160,000	0020F580
(3) '625' frames	3,240,000	00317040
(4) '625' frames	4,320,000	0041EB00
(5) '625' frames	5,400,000	005265C0
(6) '625' frames	1,080,000	00107AC0
(1) second(625)	27,000,000	019BFCC0
(2) seconds(625)	54,000,000	0337F980
(3) seconds(625)	81,000,000	04D3F640
(4) seconds(625)	108,000,000	066FF300
(5) seconds(625)	135,000,000	080BEFC0
(6) seconds(625)	189,000,000	09A7EC80
(7) seconds(625)	216,000,000	0B43E940

Parameter Storage

The present operating delay value can be stored to one of nine EEPROM registers for the present video standard by setting SWA to position E and setting SWB to any value from 1 to 9. The storage to EEPROM occurs when SWA is then moved OUT of position E. If SWB is set to any value except 1-9, moving SWA out of position E will NOT result in parameter storage to EEPROM. Note that separate storage locations exist for 625 and 525 line parameters(9 for each). 9 locations are also reserved for 270Mbps streams which cannot be identified as 525 or 625 line signals(for compatibility with future 270Mbit streams).

Parameter Recall

The present operating delay value can be recalled from one of nine EEPROM registers for the present video standard by setting SWA to position F and setting SWB to any value from 1 to 9. As SWB is changed, the modules delay will reflect the parameters previously stored in the corresponding EEPROM register. Setting SWB to any value except 1-9 will result in a delay value of 42 clocks being loaded(the minimum delay). The module can automatically load any parameter set upon power application if SWA is moved OUT of position F after the desired parameter set has been selected with SWB.

Loop Back Mode

Loop back mode is not accessible via the rear panel controls as its use requires real time selection of play vs. record modes. Using a personal computer or a SmartLinx control panel, the following generalized guidelines apply.

Because this mode involves feeding the output of the time delay back to its input, there is no 'stop' mode; only 'record' and 'play'. When loop back mode is engaged, the time delay selections will always be whole multiples of a frame delay, since timing jumps at the end of the loop would otherwise occur. During 'record' mode, TimeCache acts like a time delay. When the user selects play, a video switch routes the time delay output to the time delay input during the next vertical blanking interval. Thus, the END of the recording is directly controlled by the play/record buttons; the beginning of the loop is INDIRECTLY defined by play button actuation time and the loop length setting. The resulting recordings produce fully compatible sync timings and video levels BUT full field and AP EDH checksums will be wrong for the first and last frames of the loop. In addition, ANC data is not guaranteed to be valid at the beginning of the loop nor at the end of the loop. A full featured RAM video recorder will be released as a separate product.

Audio Muting

The audio muting function acts on ANC packets with data ID (DID) values of 2FF, 1FD, 1FB, and 2F9. If each of these carries 4 channels of AES audio, 16 channels of audio would be muted. The hardware does not assume a limitation of 4 channels of AES audio per data packet. The hardware does not tamper with the extended data packet under any circumstances. All parity bits and checksums are recalculated in real time to avoid ANC checksum or AES parity errors during gain transitions or 'silence'. Audio fade up/fade down sequences are 4 milliseconds in duration each. Silence is digital two's complement zero. The ANC data streams are not altered in any way when muting is not in effect. No ANC data packets are moved relative to surrounding video or sync data at any time. All processing is performed in pipelined fashion without any buffering. The mute command is sampled once per field at the beginning of vertical blanking. This means the external muting signal must move from stable high/low to stable low/high in one field period or less.

Video Blanking

The video blanking function replaces only active picture pixels as defined by EAV and SAV signals provided by the incoming video signal. The substituted 'black' video signal consists of an alternating stream of '200h' and '040h' data words. The blanking control signal is sampled once per frame period at the falling edge of FID. This means the external muting signal must move from stable high/low to stable low/high in one frame period or less.

Specifications

Video Input Standard	SMPTE 259M
Video Input Connector	BNC female
Video Input Return Loss	>15dB @ 270MHz(75 Ohm referenced)
Video Input Range	Source must be within 200 meters of input when using Belden 8281 or equiv.
Video Output Standard	SMPTE 259M
Video Output Connector	BNC female
Video Output Jitter	<350 picoseconds peak-to-peak with 10 Hz high pass filter
Muting Control Conn.	Switchcraft Tini Q-G 3 pin receptacle(use Switchcraft TA3F for mate)
Muting Control 'high' level	>2.0 Volt
Muting Control 'low' level	<0.8 Volt
Muting Control Input Current	<-1mA with input connected to ground, 0 A with input@3.3V, <0.5mA with input connected to 5VDC
Muting Control Input Limits	30V>Vin>-30V 10mA>Iin>-10mA
Embedded Audio Standard	SMPTE 272M
Recognized Audio DID's	2FFh,1FDh,1FBh,2F9h
Muting Control Transition Rate	<16milliseconds from 0.8V to 2.0V or 2.0V to 0.8V
Minimum Time Delay	42 clock periods of incoming data(approx. 1.555usec.)
Maximum Time Delay	memory option dependent: 517135-00 0.233 seconds 517135-10 0.466 seconds 517135-20 0.932 seconds 517135-30 1.86 seconds 517135-40 3.73 seconds 517135-50 7.46 seconds 517135-60 14.9 seconds
Time Delay Adj. Resolution	37nsec.(one input clock cycle)
Power Consumption	5V, <1.5A 8V, <0.5A -8V, <0.15A
Operating Temperature Range	0 to 50 C, non-condensing
Operating Humidity Range	0 to 95% RH