Appendix E

ADAMS-SMITH ZETA THREE SLAVE TRANSPORT CONSTANTS
(Master Transport uses a subset of these)

Software Rev 3.70 (standard) and 3E70 (emulator)
Document revised Mar 5, 1992

Constant Number	Typ. Val.	Description
01	lsd x6	Number (0 thru F) of consecutive, contiguous frames during which offset errors greater than the "wide lock window" width (Constant 06 msd) must occur before re-synchronizing will begin, after lock has been achieved. Setting 01 lsd too low will cause unnecessary re-synchronizing when occasional bursts of corrupted time code occur (assuming this time code has passed all other tests).
01	msd 6x	Capstan FM frequency final divisor code. Used in conjunction with constants 03 (msd,lsd) and 04 (lsd only) to establish the capstan FM servo output center frequency. (See Constant 03 for formula). One special case (0x) specifies Constants 45 and 46 as the final divisor.

The following table shows the Final Divisor for each setting of this constant, as well as the final capstan frequencies ASSUMING THAT CONSTANTS 03 AND 04 CONTAIN x823:

Val.	Divisor	Frequency (hz)
0x	[Constants 45,46]	[38400/(Constants 45,46)]
1x	512	75
2x	32	1200
3x	16	2400
4x	16	2400
5x	8	4800
6x	4	9600
7x	2	19200

02	lsd	x5	Lock servo coefficient K2. Weights the running sum of offset errors to optimize damping while the slave is synchronizing. Set to the smallest value (0 thru F) which does not cause the slave transport to oscillate during final synchronization.
02	msd	3x	Lock servo coefficient K1. Weights present positional error of offset to optimize final synchronizing time. Set to the smallest value (0 thru F) which does not cause the slave transport to overshoot or oscillate about its lock position.
03	both	23	Used in conjunction with Constant 04 lsd to form the Main Divisor for the capstan center frequency. Typically, if this constant contains 23, and Constant 04 lsd contains x8, then the divisor value is 823 hexidecimal.

The formula for deriving the output capstan frequency (in hertz) is:

$$F = 80000000 / \text{Main Divisor} / \text{Final Divisor}$$

where the Final Divisor is established by Constant 01 msd.

| 04 | lsd | x8 | Part of the Main Divisor for the capstan center frequency (see Constant 03). |
| 04 | msd | 0x | Capstan relay switching mode: |

0x   Capstan Relay is ON (with the Zeta providing the Capstan frequency or voltage) only while the slave is enabled. This is the NORMAL capstan relay mode.

1x   ALWAYS ON - Otari MX-5050 mode.

2x   OFF if not PLAYing or not LOCKing.

4x   OFF after lock achieved - VCR mode.

[6x   Sony PCM-3324 mode.
       This is the combination of modes 2x and 4x.]

(See Constant 38 MSD).

05	lsd	x2	Limit for error contribution to lock speed change. Set to the highest value which adequately accomodates speed changes (varispeed) without incurring unacceptable overshoot.
05	msd	4x	Capstan speed control range. i.e. The percentage limit on capstan speed relative to the center frequency. The range is specified in 3% increments, so that, for example, 4x specifies +/-12%, Fx (hexadecimal for 15) specifies +/-45%, etc.
06	lsd	x3	"Narrow lock window" width. (Unit = .001 frame)
06	msd	1x	"Wide lock window" width. (Unit = .05 frame)

| 07 | lsd | x1 | x0 to x7 | Number of retries that will be attempted if Play-to-cue-point should fail. |
| | | | x8 to xF | Same as x0 to x7, but velocity projections will not be used in Play-to-cue stopping-window calculations. |

07	msd	0x		Play-to-cue-point. (Unit = 1 sec.)
			0x	No play-to-cue.
			1x to 7x	Play-to-cue enabled.
				When cueing, the transport will cue to a point which is the number of seconds specified here (0 thru 7) before the target cue point, stop, play up to the cue point, and stop.
				Useful if the transport tach or control track is unreliable.
			8x	Same as 0x.
			9x to Fx	Same as 1x to 7x, but a simpler stopping algorithm is used.

08	lsd	x2		Cue oscillation limit.
			x0 to x7	The number (0 thru 7) of oscillations around the cue point which are permitted while the synchronizer is attempting to stop or park at the cue point. If and when this count expires, the synchronizer "gives up" and issues a Stop command. Note: Movements across the cue point in the forward direction only are counted.
			x8 to 0F	Same as x0 to x7, but the synchronizer will never repeat a Fast Forward or Rewind command (good for transports which enter spooling mode when these commands are issued twice in a row).

08	msd	0x		Pause/Stop/Play command configurations for VCR's.
			0x	Normal non-VCR.
			1x	Pause:Pause instead of Stop:Play.
			2x	Pause:Play instead of Stop:Play.
			4x	Never repeat a Stop command (probably wired to the VCR's Pause input). This may be combined with 0x,1x,2x,9x,Ax making 4x,5x,6x,Dx,Ex respectively.
			9x or Ax	Same as 0x or 1x, but Stop command will not be issued before entering wind modes (avoids unlacing).

09	lsd	x0		Motion sense etc. (bits may be combined)
			x1	Wait for stop motion between commands.
			x2	Do not wait for stop motion before issuing Play.
			x4	Defeat time code reading over 2x play speed.
			x8	Do not use the presence of time code to indicate that a VCR is laced.

09	msd	0x		Cueing type (for cueing parameters see Constants 11-18).
			0x	Normal fast forward / rewind style cueing.
			Dx	Special Sony PCM-7030/7050 R-DAT cueing.
			Ex	Special JVC DS-DT900 R-DAT cueing.
			Fx	Special Fostex D-20 R-DAT cueing.

10   both   03   Cueing constant.
                        00 to 0F   Simple K factor for 'KV squared' cueing algorithm.
                                    The value here weights the influence of tape velocity on
                                    determination of the point at which the opposite direction
                                    command (i.e. Fast Forward or Rewind) is issued during
                                    cueing and parking.
                                    Set to the largest value which produces acceptably low
                                    transport overshoot.
                                    (Typical values are x1 thru x5).
                                    Note: Values xD, xE, xF are special "negative" range values,
                                    and can be thought of as -3, -2, and -1.

                        Serial cueing (via Control Port) [Overrides constant 09 msd]:
                        1x   Serial cueing is to be used during "chase" cueing operations
                                    in addition to "specific" cueing requests.
                        2x   Serial cueing is to be used during "locate to master position"
                                    cueing operations in addition to "specific" cueing requests.
                        4x   Enable serial cueing.
                                    Serial cueing to be used only during "specific" requests to
                                    cue the transport unless either/both of the previous are set.

                        80 to FF   Higher resolution K factor which may be used when the
                                    simple K factor is between F (-1) and 4, (overrides serial
                                    cueing (via Control Port). Correspondance between the two
                                    K scales is as follows:

Simple K	Hi-res K
4	81
3	82
2	84
1	88
0	90
F	9F

11-18   both   ??   Specific cueing parameters. Definitions will change according to the
                        setting of constant 09 msd (Cueing type).

                        Normal cueing [Constant 09 = 0x]:
                        11   both   00   Optional separate window specification for Play-
                                                to-cue (fast wind stopping window before
                                                entering play).
                                                If non-zero, and constant 12 is zero, then
                                                stopping window will be +/- this value (normally
                                                window is +/- the play-to-cue value).
                                                msd = seconds; lsd = seconds/16.
                        12   both   00   Optional separate negative window specification
                                                for Play-to-cue.
                                                If non-zero, and if constant 11 is also non-zero,
                                                then the Play-to-cue stopping window will be
                                                +(constant 11) / -(constant 12).
                                                msd = seconds; lsd = seconds/16.

Special Sony PCM-70X0 R-DAT cueing [Constant 09 = Dx]:
See Fostex R-DAT constants 11 thru 14.

Special JVC DS-DT900 R-DAT cueing [Constant 09 = Ex]:·
See Fostex R-DAT constants 11 thru 14.

Special Fostex D-20 R-DAT cueing [Constant 09 = Fx]:

11	both	10	Stopping allowance - ahead of cue point. msd = seconds; lsd = seconds/16.
12	both	20	Stopping allowance - behind cue point. msd = seconds; lsd = seconds/16.
13	both	15	Distance from cue point threshold for transition from slow to fast wind. msd = minutes; lsd = minutes/16.
14	both	0E	Distance from cue point threshold for transition from fast to slow wind. msd = minutes; lsd = minutes/16.
15	both	09	Delay before accepting new FF/REW/PLAY tallies (unit=seconds/120, range=00-FF).

19	both	00	Jog/Shuttle type:
		00	None supported.
		01	FF/Rew toggling.
		02	FM frequency speed control.
		03	DC speed control.
		0A	Special Panasonic VCR speeds.
		0B	Special Ampex VPR-2B DC speed control.
		0C	Serially controlled (via Control Port).
		F0	FF/Rew toggle Test mode.

20-32   both   ??   Multipurpose Jog/Shuttle parameters. Definitions will change according to the setting of constant 19 (Jog/Shuttle type).

FF/Rew Toggling [Constant 19 = 01]:

20	both	20	Period of FF/Rew oscillation. (Hexadecimal, unit=frames/16).
21	both	00	not used.
22	both	01	Minimum duty cycle; i.e. minimum time spent in either FF or Rewind. (Hexadecimal, unit=frames/16).
23	both	00	not used.
24	msd	0x	not used.
24	lsd	x6	Acceleration error clamp; lower values produce more clamping; more clamping may produce smoother but slower reaction to changes in acceleration.
25	msd	Cx	Parameter "M"; final multiplier/divisor for duty cycle adjustment (0=multiply by 1; 1 up thru 7 produce increasingly smaller adjustments; F down thru 8 produce increasingly larger adjustments).
25	lsd	x6	Parameter "K"; larger values increasingly damp the acceleration error contribution.
26	both	38	Maximum velocity of transport at full wind. (Hexadecimal, where 03h=playspeed).
27	both	0A	Start up boost value.

FM Frequency Speed Control [Constant 19 = 02]:

20	lsd	x0	Reverse flag:
			x1 FM jog/shuttle not available in reverse.
20	msd	6x	FM jog/shuttle operating flags; combine hexadecimal values as required:
			2x Hold capstan relay on during FM jog/shuttle.
			4x Switch to normal FF/Rew commands if requested jog/shuttle velocity is greater than the maximum available velocity (as specified in constants 27 and 28).
21,22	both	00,00	Minimum available jog/shuttle velocity low byte, high byte. (Hexadecimal, where 0300h=playspeed).

Example: values 23,01 would produce a
combined hexadecimal value of 0123h.

23,24	both	6A,08	Main center frequency divisor low byte, high byte (similar to constants 03 and 04).
25,26	both	06,00	Playspeed final hardware divisor low byte, high byte (similar to constants 45 and 46).
27,28	both	00,0C	Maximum available jog/shuttle velocity low byte, high byte. (Hexadecimal, where 0300h=playspeed).

DC Speed Control [Constant 19 = 03]:

20	lsd	x0	DC jog/shuttle Test Modes:
			x0 Test Mode off.
			x1 Set Span (Constants 23,24) to 0FFFh and adjust Offset (Constants 21,22) for zero velocity.
			x2 Adjust Span (Constants 23,24) to just attain maximum velocity; read and later set maximum velocity in Constants 27 and 28.
			x3 Adjust Constants 25,26 for playspeed jog/shuttle.
			x8 Use bipolar DC range.

20	msd	Cx	DC jog/shuttle operating flags; combine hexadecimal values as required:
			1x Hold capstan relay ON, during DC jog/shuttle. If this bit is not set, hold capstan relay OFF. (Only if 2x bit is set.)
			2x Override capstan relay during DC jog/shuttle.
			4x Switch to normal FF/Rew commands if requested jog/shuttle velocity is greater than the maximum available velocity (as specified in constants 27 and 28).
			8x Invert DC polarity.

21,22	both	4A,0A	DC Offset value for zero velocity - low byte, high byte. (Hexadecimal, range = 0000h-0FFFh).
23,24	both	C0,09	DC Span low byte, high byte (similar to Constants 98 and 99).
25,26	both	FB,02	DC Playspeed value low byte, high byte.
27,28	both	00,0F	Maximum available jog/shuttle velocity low byte, high byte. (Hexadecimal, where 0300h=playspeed).

Special Panasonic VCR Speeds [Constant 19 = 0A]:

20	both	24	Interface cable number.

Special Ampex VPR-2B DC Speed Control [Constant 19 = 0B]:

20	lsd	x8	DC jog/shuttle Test Modes:
			x0 Test Mode off.
			x1 Adjust Forward DC Offset (Constant 21) for onset of forward motion. Then, adjust Reverse DC Offset (Constant 22) for onset of reverse motion.
			x2 Adjust maximum available Forward and Reverse jog/shuttle velocity

			(constants 27 and 28) to just attain maximum velocity.
		x3	Adjust Constants 25,26 for playspeed jog/shuttle.
		x4	Inhibit capstan relay.
		x8	Use bipolar DC range.
20	msd	8x	DC jog/shuttle operating flags; combine hexadecimal values as required:
		1x	Hold capstan relay ON, during DC jog/shuttle. If this bit is not set, hold capstan relay OFF. (Only if 2x bit is set.)
		2x	Override capstan relay during DC jog/shuttle.
		4x	Switch to normal FF/Rew commands if requested jog/shuttle velocity is greater than the maximum available velocity (as specified in Constants 27 and 28).
		8x	Invert DC polarity.
21,22	both	4A,0C	Forward DC Offset value for the threshold of forward motion - low byte, high byte. (Hexadecimal, range = 0000h-0FFFh).
23,24	both	E0,0A	Reverse DC Offset value for the threshold of reverse motion - low byte, high byte. (Hexadecimal, range = 0000h-0FFFh).
25,26	both	4F,00	DC Playspeed value low byte, high byte.
27	both	B4	Maximum available Forward jog/shuttle velocity. (Hexadecimal, where 03h=playspeed).
28	both	FF	Maximum available Reverse jog/shuttle velocity. (Hexadecimal, where 03h=playspeed).

Serial Control (via Control Port) [Constant 19 = 0C]:
No Parameters used.

FF/Rew Toggle Test Mode [Constant 19 = F0]:

20	both	20	Period of FF/Rew oscillation. (Hexadecimal, unit=frames/16).
21	both	10	Test duty cycle (portion of period spent on FF).
22	both	01	Minimum duty cycle; i.e. minimum time spent in either FF or Rewind. (Hexadecimal, unit=frames/16).

29,30   [not used].

31,32   [not used].

33	lsd	x4	Time code reader bit length adjustment clamp.

x0 to x7   Amount of dampening of bit lenght calculation.
A value of x0 defeats dampening, bit length maesurement will instantly follow that of the incoming time code.
A value of x7 clamps the bit length measurment.

33	msd	0x	Subframe splice trap request.

0x   Normal.
1x to 3x   "Rough lock window" width.
The number of frames added to the "Wide lock window" (See Constant 06).
Used for transports that require a wider lock window than is possible with the "Wide lock window" (i.e. a "Wide lock window" greater than 0.75 frames).
4x   Subframe splice trap. In this mode, the synchronizer will allow the slave transport to run locked even when there is a "subframe" error (i.e. an error of less than a frame).
Mostly used for video decks whose time code sync word position on tape will typically be offset by a fraction of a frame from the reference video.
(Fx will still be used for Subframe splice trap.)

34	both	29	Lock routine exit error.

Determines the size of the lock error (unit = frames) which must occur before the synchronizer will switch from capstan speed control to Fast Forward / Rewind cueing in order to try to correct the error.

35	lsd	x6	Transport command pulse output duration. (Unit = 8.3 msec).

35	msd	6x	Transport command repeat count.

i.e. The number of times that the synchronizer is prepared to repeat a transport command until the desired action is achieved. If the transport has not responded after the last repeat, a Stop command is issued (except if 0x is entered).

36	lsd	x0	Determines percentage of playspeed above which changes in direction

will not be recognized. Typically used for direction sensing when a Rewind tally is used as a direction tally.
x0   No special direction sensing threshold.
x1   62%.
x2   50%.
x3   40%.
x4   32%.
x5   25%.
x6   20%.
x7   16%.

| 36 | msd | 0x | Stopping allowance for Play-to-cue (unit=frames, range=0-F). Not used during chase or locate cueing. |

| 37 | lsd | x0 | Smart-start defeat flags. |

- x0   Smart-Start routine enabled. (Normal).
- x1   Defeat Smart-start.
- x2   Use fixed Smart-start offset.
- x4   Smart-start may be adjusted to Master Tach or Control Track data i.e. not necessary to wait for time code.
- x8   Smart-start adjust to Slave Tach / Control Track is ok.

| 37 | msd | 2x | Park-ahead. |

i.e. The number of seconds (0 thru 7) that the slave will park ahead of a playing master when cueing up in order to synchronize to the already playing master.

| 38 | lsd | x0 | AUTO lock switchover delay (unit = secs). |

When LOCK MODE=AUTO, the synchronizer will initially lock the slave in ADDRESS mode, switching to FREEWHEEL mode the number of seconds specified here after lock occurs.
Note: Special value xF means "switch immediately after lock is achieved".

| 38 | msd | 0x | Special AUTO override modes (bits may be combined). |

- 8x   Override the LOCK MODE menu setting and force AUTO mode.
- 4x   The same as the 8x setting, but the CAPSTAN RELAY WILL BE DISABLED AFTER THE AUTO SWITCHOVER.
  Actually a variation of the Constant 04 msd capstan relay switching functions.

  Useful for digital dubbing where two digital recorders are "word-clock-locked" with the possibility that their time code tracks will "drift" relative to each other. This results of course from incorrect time code striping.
  To avoid such situations, both digital tapes must be striped with the same time code WHILE THEY ARE WORD-CLOCK-LOCKED.
- 1x   Inhibit slave resolve. When in resolve mode, the Zeta will normally try to resolve the slave transport whenever it is placed into play mode by itself (master disabled). This is unnecessary for a video slave which is referenced to the same video sync as the Zeta.

| 39 | lsd | x5 | Failure Sense play mode timeout (unit=frames). If the transport drops out of play mode for longer than this time period then the transport is judged to have failed. Failure Sense mode must first be invoked. |

39	msd	0x	Fast mode flag:

<table>
<tr><td></td><td></td><td>1x</td><td>Use only Fast Forward and Rewind pins when executing FF/Rew commands. In normal operation, Forward Hold, Reverse Hold and Search pins are also asserted. When controlling a VCR serially (via Control Port), causes the VCR to unlace and wind at maximum speed.</td></tr>
<tr><td></td><td></td><td>2x</td><td>Assert Forward Hold and Reverse Hold pins during Stop command. In normal operation, Forward Hold and Reverse Hold pins are not asserted.</td></tr>
</table>

40			[not used].

41	both	59	Park mode exit criterion (unit = frames).

If a slave transport fails to park within this programmed window after chasing a master, it will re-cue and attempt to re-park within the window, until the number of oscillations around the cue point (set by Constant 08 lsd) have occured.

42	both	05	Park-to-Play Compensation (unit = frames).

<table>
<tr><td></td><td></td><td>00 to FF</td><td>Defines the hexadecimal number of frames that the Zeta must compensate for the transport's start-up delay (i.e. the time from when the Zeta issues a play command to when the transport has actually achieved play speed). This value represents an initially-entered value, after going through several cue-park-lock cycles, the Zeta may optimize this value to one which is different from the initally-entered one. The newly "learned" value will be displayed.</td></tr>
</table>

43	both	01	Park-Ahead to Stopped Master (unit = 5 frames).

<table>
<tr><td></td><td></td><td>00 to 3F</td><td>Defines the minimum number of frames-multiplied-by-5 that the slave must position itself ahead of the parked master in order to insure correct play-up when the master goes into play. This value represents an initially-entered value, after going through several cue-park-lock cycles, the Zeta may optimize this value to one which is different from the initally-entered one. The newly "learned" value will be displayed.</td></tr>
<tr><td></td><td></td><td>4x</td><td>Forces Park-to-Play Compensation and Park-Ahead to Stopped Master (Constants 42 and 43) to be reset on power-up.</td></tr>
<tr><td></td><td></td><td>8x</td><td>Invert the sign of Park-to-Play Compensation (See Constant 42).</td></tr>
</table>

44	both	50	Varispeed limit (unit = percent of playspeed).

| 45 | both | 00 | Used in conjunction with Constant 46 lsd to form an alternative Final Divisor for the capstan center frequency. |

(Constants 45 and 46 are used ONLY IF Constant 01 msd = 0. See Constant 01.)
If this constant contains 23, and Constant 04 lsd contains x1, then the divisor value is 123 hexidecimal.

| 46 | lsd | x0 | Part of the alternative Final Divisor for the capstan center frequency (see Constant 45). |
| 46 | msd | 0x | [not used]. |

NOTE:
Constants 47 thru 81 contain hex values which map various functions to the command output pins of the Master/Slave transport connectors (plus the Slave capstan relay, and occasionally Aux Out tip/ring).

The connector pins are defined as follows . .

Map Value	Pin Name	Pin Number	Common Pin Number
01	Stop	3	19
02	FF	4	19
04	Rew	5	19
08	Play	6	19
10	GP1	7	20
20	GP2	8	21
40	GP3	9	22
80	Rec	10	19
F1	Event 1	(Aux out tip)	
F2	Event 2	(Aux out ring)	
F4	Capstan relay		

47	both	00	Connector command pins causing VCR to unlace.
48	both	00	Connector command pins causing VCR to lace and move.
49	both	00	Connector command pins causing VCR to lace and pause.

50	both	01	Stop function connector pin map.
51	both	00	Forward continuous (search only).
52	both	00	Reverse continuous (search only).
53	both	02	Fast forward.
54	both	04	Rewind.
55	both	08	Play.
56	both	00	Pause.
57	both	00	Search momentary.
58	both	00	Search Continuous.
59	both	00	Locked.
60	both	00	Lock momentary.

61	both	F4	Capstan.
62	both	00	Bump up.
63	both	00	Bump down.
64	both	20	Mute.
65	both	10	Lifter defeat.
66	both	00	Record out overlap.
67	both	08	Record out.
68	both	00	Record continuous.
69	both	88	Record in.
70	both	00	Rehearse out overlap.
71	both	00	Rehearse out.
72	both	40	Rehearse continuous.
73	both	00	Rehearse in.
74	both	00	Record armed.
75	both	00	Rehearse armed.
76			[not used].
77	both	00	Alternate capstan.
78	both	00	Parked (chase mode only).
79	both	00	Chase enabled.
80	both	00	Capstan momentary.
81	both	00	Standby (ready) command.

82	both	00	Transport connector invert mask - pins selected here will become active high, normally low.

83	lsd	x0	Invert mask for Capstan, Aux Out tip/ring.

        x1   Invert Aux out tip.
        x2   Invert Aux out ring.
        x4   Invert Capstan relay sense.

83	msd	4x	Time-Code-Only stop delay (unit = .133 sec).

        (i.e. when no tach is connected).
        0x   No special time-code-only delay.

84	lsd	x0	Audio mute disables.

        x0   Mute enabled.
        x1   Disable mute during initial lock.
        x2   Disable mute during high speed winding.
        x3   Disable all muting.

84	msd	0x	Delay from lifter release to un-mute.

        (unit = .133 sec).

85	lsd	x0	Tally flags.

        x1   Use Record tally.
        x2   Invert sense of Spare tally (i.e. active high).
        x4   Invert sense of Record tally.
        x8   Punch Out only if Record Tally is active; Punch In only if Record Tally is not active.

85   msd   0x   Use of Spare Tally.

           0x   Disabled.
           1x   Play tally.
           2x   Pause tally.
           3x   Eject tally.
           4x   Standby (ready) tally.
           Bx   Special Ampex VPR-2B tallies, where
                           Zeta spare tally = Ampex ready tally.
                           Zeta record tally = Ampex record tally.
                           Zeta direction input = Ampex direction tally.
           Cx   Serial (Control Port) tallies, where
                           Tallies are received serially from the transport.
           Dx   Special Sony PCM-7030/50 R-DAT tallies, where
                           Zeta spare tally = Sony fast forward tally.
                           Zeta record tally = Sony record tally.
                           Zeta direction input = Sony rewind tally.
           Ex   Special JVC DS-DT900 R-DAT tallies, where
                           Zeta spare tally = JVC fast forward tally.
                           Zeta direction input = JVC rewind tally.
           Fx   Special Fostex D-20 R-DAT tallies, where
                           Zeta spare tally = Fostex play tally.
                           Zeta record tally = Fostex fast forward tally.
                           Zeta direction input = Fostex rewind tally.

86   lsd   x0   Standby (ready) command type (Constant 81).

           x0   Pulse on only (no action for "off").
           x1   Pulse toggles standby on/off. Availability of a Standby tally (see
                        Constant 85 msd) will guarantee correct operation.
           x2   Continuous (output asserted when Standby = On).

86   msd   0x   Auto disarm / Rehearse flag.

           1x   Auto disarm Record/rehearse after punch out.
           2x   Rehearsal requires Transport to be playing.

87   both   00   Record in advance (0-99, unit = .25 frame).
88   both   00   Record out advance.
89   both   00   Rehearse in advance.
90   both   00   Rehearse out advance.

91   both   00   Tach rate - least significant hex byte.
92   both   00   Tach rate - most significant byte.
                           (for values greater than 255)
93   both   00   Tach rate - fraction byte (xx/256).

94	lsd	x1	Lifter operation and Control-Track/Tach overrides.

        x0   Lifters always defeated by Zeta.
        x1   Allow normal Zeta lifter defeat operation.
        x2   Zeta does not defeat lifters.
        x3   As x1, but also sample high speed code.
        x8   Control track rate override = 1 pulse per frame.
        xC   Control track rate override = 1 pulse per field.
        These last two are normally combined with x2:
        xA   No lifters, frame rate control track (tach).
        xE   No lifters, field rate control track (tach).

94	msd	2x	Reader flags.

        1x   Defeat time code 'Plus One' tests.
        2x   Learn tach and direction.   NOTE: ONLY Learns ONCE
        4x   Use serial (Control Port) time code if available -- SLAVE:ONLY
                 WHEN NOT LOCKING.
        8x   Invert sense of tach direction tally.

95	lsd	x0	Varispeed controls.

        x0   None.
        x1   Inhibit capstan during varispeed.
        x2   Inhibit "bump" outputs during varispeed.
        x3   Both x1 and x2.

95	msd	0x	Slave Capstan DC polarity.

        0x   Normal.
        8x   Invert polarity of capstan DC output.

96	both		Slave Capstan DC 'Offset'.
			(Least significant digits).
97	lsd		Slave Capstan DC 'Offset'.
			(Most significant digit).
97	msd		[not used].

98	both		Slave Capstan DC 'Span'.
			(Least significant digits).
99	lsd		Slave Capstan DC 'Span'.
			(Most significant digit).
99	msd		[not used].

A0	lsd	x2	Video Select/TSO Mode.

        x1   Video select.
        x2   Request serial time code during Field 2, if this bit is not set the
                 request is made during Field 1.
        x4   When locking, use program speed play command. If this bit is
                 not set, vari-forward command is used.
        x8   When in vari-speed, use program speed play command. If this
                 bit is not set, vari-forward command is used.

A0   msd   0x   Editor Mode.
                           0x   Insert edit mode.
                           1x   Assemble edit mode.
                           2x   Crash Record edit mode.
                           3x   All-safe (recording is inhibited).
                           8x   Enables the respective parallel port for operation in conjunction
                                    with the serial control port.

A1   both   Track Select (Control Port).
                           Analog audio/video transports:
                                    x1   Audio channel 1.
                                    x2   Audio channel 2.
                                    x4   Audio channel 3 (if supported).
                                    x8   Audio channel 4 (if supported).
                                    1x   Audio channel 5 (if supported).
                                    2x   Audio channel 6 (if supported).
                                    4x   Audio channel 7 (if supported).
                                    8x   Audio channel 8 (if supported).

                           Note: Bits may be combined. For example, a value of "03"
                           specifies analog channel 1 and 2 for analog audio/video
                           transports.

                           Digital audio/video transports:
                                    x1   Analog (cue) channel 1.
                                    x2   Analog (cue) channel 2 (if supported).
                                    x4   Time code channel.
                                    1x   Digital audio channel 1.
                                    2x   Digital audio channel 2.
                                    4x   Digital audio channel 3.
                                    5x   Digital audio channel 4.

                           Note: Bits may be combined. For example, a value of "31"
                           specifies analog (cue) channel 1 and digital audio channel 1 and
                           2 for digital audio/video transports.

Additional Constants for VTR Emulation (Zeta-Three^{em} only):

Constant Number	Typ. Val.	Description

CONSTANTS LOADED BY TRANSPORT SELECTION:

D6	lsd	x8	Emulation controls (may be combined to form hexadecimal values 0-F):

      x1   Use track selects to punch in/punch out during record and rehearse -- NOT used for Auto Modes during Sony emulation.

      x2   Use track selects to punch out during record and rehearse [SONY EMULATION ONLY].

      x4   The Zeta's transport will automaticly switch to E-E (input) mode after a Stop command is received.

      x8   Automatically issue a "Standby (ready) On" command whenever the Zeta's transport becomes enabled or when a Stop command is issued and the Zeta's transport is not "Standby (ready) On".

D6	msd	0x	Emulation controls (may be combined to form hexadecimal values 0-F):

      1x   No Field 2 adjustment for record.

      2x   No Field 2 adjustment for rehearse.

      4x   Use Aux 2 (Ring) for field select.

D7	lsd	x0	Use of Track Select Tallies.

      x0   Normal.

      xB   Ampex VPR-2B/80 Tallies, where
Tally B = Ampex remote/local tally.
Tally C = not used.
Tally D = Ampex servo lock tally.

D7	msd	0x	Invert Sense of Track Select Tallies.

      2x   Invert sense of Tally B (Master Spare Tally).

      4x   Invert sense of Tally C (Master Record Tally).

      8x   Invert sense of Tally D (Master Direction Tally).

D8	lsd	x0	Four audio channels at a time may be assigned to the Track Select (Master transport) connector:

Lower four outputs of Track Select:

x0   Analog channels 1 thru 4.
x1   Digital channels 1 thru 4 [SONY EMULATION ONLY].
x2   Digital channels 5 thru 8 [SONY EMULATION ONLY].

Upper four outputs of Track Select:
            Video.
            Full EE.
            Select EE (Rehearse).
            Preview [SONY EMULATION ONLY -- Auto Preview Only].

x4 thru x6 Same as x0 thru x2, but upper four outputs of Track Select connector are converted to:
            Video.
            Full EE.
            Insert.
            Assemble.

x8 thru xA Same as x0 thru x2, but upper four outputs of Track Select connector are converted to individual track E-E commands.

D8	msd	0x	Record Strobe and Ready Arming configurations:

1x   Record strobe required when adding new record tracks while recording.
2x   Rehearse strobe required when adding new rehearse tracks while rehearsing.
4x   Track record ready signals are used also as E-E (input) commands [AMPEX EMULATION ONLY].
8x   Transport requires advanced rehearse arming.
Note: Bits may be combined. For xample, a value of "5x" specifies that record strobe is required plus use record ready's as E-E (input) commands.

D9	lsd	x0	Jog/shuttle quality flags:

x1   Transport's jog/shuttle performance is not adequate for cueing (used in conjunction with constant E5 msd 4x bit).
x2   Lack of lifter defeat option makes low speed jog/shuttle inadequate for audition.

D9	msd	2x	Play-to-cue-point override. (Unit = 1 sec.)

This constant is almost identical to constant 07 msd, and is used only during emulation mode cueing.
0x to 7x   Play-to-cue override. The actual value used will be the larger of this and constant 07 msd.

CONSTANTS LOADED BY EDITOR / VTR SELECTION:

E0   both   ??   VTR device type (low byte).

E1   both   ??   VTR device type (high byte).
Note: During Sony emulation, if the Zeta is set up for 25 frame code time code, this byte will be modified to reflect PAL operation before being transmitted back to the Editor.

E2   lsd   x2   Number of analog tracks supported by target transport.

E2   msd   0x   Number of "digital" tracks supported by target transport.
If the Editor is capable of specifying digital channels, then it may be useful to assign all of the transport's tracks as "digital". When operating such an Editor in a mode where the Zeta's transport "chases" the Record VTR, analog channel inserts will then select VTR tracks, while digital channel inserts will select tracks on the Zeta's transport.
[SONY EMULATION ONLY].

E3   lsd   x6   Edit command delay (unit=frames):
Editing commands are typically operated with a fixed delay between receipt of the command and its execution. Commands affected are . .
Sony: Select EE On, EDIT Off, EDIT On, EDIT PRESET.
Ampex: Entry, Exit.

E3   msd   0x   Edit command start Field 1/Field 2:
0x   Execute all edit commands on Field 1 unless the editor has requested Field 2.
1x   Execute all edit commands on Field 2 unless the editor has requested Field 1.
2x   Excute all edit commands based on the timing of the edit commands received from the editor.
i.e. an edit command received during field 1 will produce an edit on field 2.
Unless, of course, the editor has assigned a specific starting field for the edit [SONY EMULATION ONLY].
4x   Forces edit commands to be executed on Field 1, regardless of which field the editor has assigned as the start field.

When combined with 1x, forces edit commands to be executed on Field 2.

When combined with 2x, forces execution of all edit commands to be based on the timing of the edit commands received from the editor [SONY EMULATION ONLY].

E4   both   0B   Capstan scale factor.
                        When the Editor requests varispeed play, this constant will cause the
                        deviation from playspeed to be either decreased or increased.
                        msd: 0=decrease (damp).
                                    1=increase.
                        lsd: amount of adjustment (unit=deviation/16).
                        For example, a setting of 01 will result in a 1/16th reduction in the
                        varispeed deviation from playspeed.

                        SONY EMULATION ONLY: Varispeed play is typically used during the
                        synchronization process. Both the value of Constant E4 and the setting
                        of the "Address Resolve" bit in Constant E5 will be critical in achieving
                        synchronization within a reasonable preroll time.

E5   lsd   x0   Emulation controls (may be combined to form hexadecimal values 0-F):
                x1   "Address Resolve" bit:
                            At the conclusion of the synchronization process, when the
                            Editor switches the Zeta from varispeed play to standard
                            play, setting this bit guarantees that the transport will resolve
                            at exactly the same frame offset that existed when the
                            standard play command was given. ,
                            If this bit is not set, then normal resolving will take place, with
                            the possiblity that the transport's inertia will carry it to another
                            frame. In this case, the Editor must account for this drift.
                            Generally, an Editor which is trying to be more "intelligent"
                            during synchronization may run better if this bit is not set.
                x2   Should the Editor request a re-cue after the transport has
                            already cued, then the re-cueing action will actually take
                            place. Normally, the Zeta will not bother to re-cue an already
                            cued transport, and this may be confusing to some Editors.
                x4   Inhibit smart start allowances during cueing [AMPEX
                            EMULATION ONLY].
                x8   Target Cue position bit:
                            At the end of a Target Cue operation, the Zeta will normally
                            inform the Editor that it has parked the transport precisely at
                            the requested cue point. Due the the difficulty of cueing an
                            audio transport to an exact time code frame, this may not
                            entirely be the case! If the transport's actual position were to
                            be reported, the danger is that the Editor may then request
                            an unnecessary and probably futile re-cue.
                            Entering an 8 in this constant will force the Zeta to "tell the
                            truth". Assuming that the Editor does not subsequently
                            re-cue the transport, then this setting may in fact lead to
                            shorter synchronization times.

E5	msd	0x	Emulation controls (may be combined to form hexadecimal values 0-F):

 1x   Force lifter defeat at all times (some Editors require a separate, continuous time code feed).

 2x   Inhibit Play-to-cue action during emulation. Not recommended while editing, but may be useful when simple machine control only is required. Will not inhibit the effect of constant 7 msd however.

 4x   Only "manual quality" jog/shuttle is required. If not set, and transport constant D9 lsd has its "x1" bit set, then jog/shuttle will be replaced by fast forward or rewind commands. This ensures that a poor quality jog/shuttle will not be invoked when an Editor uses these modes for cueing purposes.

 8x   Allow "direct" fast forward and rewind commands from the Editor to operate normally, even if this will cause an attached VCR to unlace. If not set, and if constant 47 specifies that unlacing will take place, then "direct" ff/rew commands will be converted to maximum speed shuttle.
[SONY EMULATION ONLY, Ampex has no "direct" ff/rew commands].

E6	lsd	x1	Global conversions to varispeed play (may be combined to form hexadecimal values 0-7):

VTR protocols typically support three different variable speed commands - Variable-play, Jog and Shuttle. An audio transport, on the other hand, may reliably implement only varispeed play, and that only within a narrow range.

 x1   Convert all forward direction VTR Variable-play commands to the transport's varispeed play mode (this bit is normally set, as Variable-play is most often used during synchronization).

 x2   Convert all forward direction VTR Jog commands to the transport's varispeed play mode.

 x4   Convert all forward direction VTR Shuttle commands to the transport's varispeed play mode.

E6   msd   0x   Specific VTR Variable-play controls (may be combined to form hexadecimal values 0-F):
<u>These bit definitions apply also to Constants E7 lsd (Jog) and E7 msd (Shuttle).</u>
The tape speed requested by the editor is classified as being in a Low, Mid or High speed range (see constants E8 thru F1). Unless overridden globally in constant E6 lsd, or "specifically" in this constant, the emulator section will always attempt to use whatever jog/shuttle functionality that the transport is capable of.
Many Editors use VTR variable speed commands (play/jog/shuttle) during the cueing process. The purpose of these controls (constants E6 msd, E7 lsd and msd), together with the threshold constants E8 thru F1, is primarily to intercept speed changes during the cue, and synthesize a play-to-cue-point at the end of the cue. For example, an Editor will typically request a fairly "Low" speed when approaching its cue point, and if variable play is enabled for the appropriate Low speed range (forward direction only), then a play-to-cue will be achieved.
These controls may secondarily be used to control manual jog/shuttle action, especially in the High speed range, where the choice is to hold the transport at its maximum jog/shuttle speed, or allow it to switch to full fast forward or rewind.

1x   Force variable play in the Low speed range.
2x   Allow "switch-back" from Mid and High speeds to variable play in the Low speed range (requires 1x also). If not set, then once the transport has switched to a higher speed mode (ff/rew/shuttle etc.), it will never switch back to variable play, even if the requested speed enters the Low range. Typically, this bit will be set if optimizing for cueing operations, and not set if optimizing for manual shuttling, where jumping in and out of play mode would be undesirable.
4x   Enable transport fast forward and/or rewind action when requested speed is in the High range. Otherwise, use jog/shuttle mode.
8x   Further allow fast forward and rewind commands in the High range, even if this will cause an attached VCR to unlace (requires 4x to be set). Setting the 4x bit and NOT setting this bit says "use ff/rew, but not if the deck will unlace".

E7   lsd   x0   Specific VTR Jog controls (may be combined to form hexadecimal values 0-F):
Same bit functions as constant E6 msd.

E7   msd   0x   Specific VTR Shuttle controls (may be combined to form hexadecimal values 0-F):
Same bit functions as constant E6 msd.

E8   both   05   Requested-tape-speed threshold, "Low" to "Mid" speed upward transition (hexadecimal, 03=playspeed, 05 represents 1.67 x play).

E9	both	03	Requested-tape-speed threshold, "Mid" to "Low" speed downward transition (hexadecimal, 03=playspeed).
F0	both	1E	Requested-tape-speed threshold, "Mid" to "High" speed upward transition (hexadecimal, 03=playspeed, 1E represents 10 x play).
F1	both	12	Requested-tape-speed threshold, "High" to "Mid" speed downward transition (hexadecimal, 03=playspeed, 12 represents 6 x play).

F2   lsd   x3   Delay between receipt of a ROLL command and actual execution.
0 thru 7   Delay in frames.
8 thru F   Negative delay (advance) of -8 thru -1 frames.
[AMPEX EMULATION ONLY].

F2   msd   0x   Delay between receipt of a TIMELINE RUN and actual execution.
0 thru 7   Delay in frames.
8 thru F   Negative delay (advance) of -8 thru -1 frames.
[AMPEX EMULATION ONLY].

F3   lsd   x0   Delay between receipt of a deferred edit command (Entry/Exit) and actual execution. (Rarely used.)
0 thru F   Delay in frames.
[AMPEX EMULATION ONLY].

F3   msd   0x   Various Ampex bits [AMPEX EMULATION ONLY]:
1x   Ignore parity errors on serial receive line.
2x   "Zero delay timeline run correction".
4x   Inhibit drop frame compensation of serial input data.
8x   Return only limited VPR-3 record/rehearse mode status.

F4   both   00   EDIT CHANNEL MASK.

When the slave transport is chasing a Record VTR, then it will normally punch in and out of record at the same time as the VTR. However, it will often be desirable to limit the transport's record activity such that, for example, it will only go into record when the edit calls for audio channels. This Constant specifies the channel or combination of channels which must be enabled before recording will take place:

		00	No channel restrictions for record (or rehearse).
lsd	x0	x1	Record/rehearse if Audio 1 enabled.
		x2	Record/rehearse if Audio 2 enabled.
		x4	Record/rehearse if Audio 3 enabled.
		x8	Record/rehearse if Audio 4 enabled.
msd	0x	1x	Record/rehearse if Video enabled.
		2x	Record/rehearse if Digital Audio 1 or 2 enabled.
		4x	Record/rehearse if Digital Audio 3 or 4 enabled.
		8x	Record/rehearse if Digital Audio 5,6,7 or 8 enabled.

Notes:

1.   Bits may be combined. For example, a value of "0F" specifies "any analog audio channel".

2.   Digital audio channels may apply during Sony emulation only, and then only if supported by the editor in use.

3.   Use of the EDIT CHANNEL MASK provides an alternative to the necessity of wiring the slave transport to the Zeta's track select connector. In most cases, the operator will manually select which channels are to be recorded on the slave deck, and the EDIT CHANNEL MASK will determine when those tracks are to be recorded.

4.   Correct operation will be maintained during split edits. For example, if the EDIT CHANNEL MASK specifies audio channels only, and if a split video/audio edit calls for audio to enter record at a certain time after the beginning of the edit, then the slave deck will not begin recording at all until the audio entry time is reached.

F5   lsd   x0   Servo Tally and other bits.

	x1	Use servo tally (if available).
	x2	Allow resolve inhibit.
	x4	Use local/remote tally (if available).

F5   msd   0x   [not used].