To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
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Subject: 07-297r1 SAS-2 CJTPAT usage

Revision history
Revision 0 (3 July 2007) First revision
Revision 1 (17 July 2007) Incorporated comments from July 2007 SAS physical WG

Related documents
sas2r10 - Serial Attached SCSI - 2 (SAS-2) revision 10

Overview
This addresses some questions about CJTPAT.

A sample CJTPAT pattern with fixed header values (and thus a fixed CRC value) is added to the standard, so test equipment doesn't have to worry about filling in those fields and calculating the correct CRC.

Discussion is added about what happens when a phy receives JTPAT or CJTPAT inside or outside of connections.

Based on SAS physical WG teleconference discussion on 28 June 2007 (see minutes in 07-296r0), CJTPAT will remain the sole pattern used for jitter testing (for compliance with the standard). JTPAT and other patterns may certainly be used, but they're not required for compliance.

Suggested changes

3.1.33 compliant jitter tolerance pattern (CJTPAT): A test pattern for jitter testing. See 5.3.5.4 and A.2.

3.1.121 jitter tolerance pattern (JTPAT): A test pattern for jitter testing. See 5.3.5.4 and A.1.

5.3.5.4 Receiver device jitter tolerance eye mask

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CJTPAT shall be used for all jitter testing unless otherwise specified. Annex A defines the required pattern on the physical link and provides information regarding special considerations for running disparity (see 6.2) and scrambling (see 7.6).

5.3.6.2 Transmitter device signal output characteristics as measured with the zero-length test load

Table 59 specifies the signal output characteristics for the transmitter device as measured with the zero-length test load (see 5.3.2.2) attached at a transmitter device compliance point (i.e., IT or CT). All specifications are based on differential measurements.

Table 59 — Transmitter device signal output characteristics as measured with the zero-length test load at transmitter device compliance points IT and CT

Signal characteristic [a]	Units	1,5 Gbps	3 Gbps
Maximum intra-pair skew [b]	ps	20	15
Maximum transmitter device off voltage [c]	mV(P-P)	50	
Maximum rise/fall time [d]	ps	273	137
Minimum rise/fall time [d]	ps	67	
Maximum transmitter output imbalance [e]	%	10	
OOB offset delta [f]	mV	± 25	
OOB common-mode delta [g]	mV	± 50	

[a] All tests in this table shall be performed with zero-length test load (see 5.3.2.2).
[b] The intra-pair skew measurement shall be made at the midpoint of the transition with a repeating 0101b pattern (see table 218 in 10.2.9.1) on the physical link. The same stable trigger, coherent to the data stream, shall be used for both the Tx+ and Tx- signals. Intra-pair skew is defined as the time difference between the means of the midpoint crossing times of the Tx+ signal and the Tx- signal.
[c] The transmitter device off voltage is the maximum A.C. voltage measured at compliance points IT and CT when the transmitter is unpowered or transmitting D.C. idle (e.g., during idle time of an OOB signal).
[d] Rise/fall times are measured from 20 % to 80 % of the transition with a repeating 0101b pattern (see table 218 in 10.2.9.1) on the physical link.
[e] The maximum difference between the V+ and V- A.C. RMS transmitter device amplitudes measured with CJTPAT (see A.2) into the zero-length test load shown in figure 105 (see 5.3.2.2), as a percentage of the average of the V+ and V- A.C. RMS amplitudes.
[f] The maximum difference in the average differential voltage (D.C. offset) component between the burst times and the idle times of an OOB signal.
[g] The maximum difference in the average of the common-mode voltage between the burst times and the idle times of an OOB signal.

Annex A
(normative)

Jitter tolerance patterns

A.1 Jitter tolerance pattern (JTPAT)

The jitter tolerance pattern (JTPAT) consists of:

1) a long run of low transition density pattern;
2) a long run of high transition density pattern; and
3) another short run of low transition density pattern.

The transitions between the pattern segments stress the receiver. The JTPAT is designed to contain the phase shift in both polarities, from 0 to 1 and from 1 to 0. The critical pattern sections with the phase shifts are underlined in table A.1 and table A.2.

Editor's Note 1: The blue underlines in this area are in the standard and are not proposed changes

Table A.1 shows the JTPAT when there is positive running disparity (RD+) (see 6.2) at the beginning of the pattern. The 8b and 10b values of each character are shown.

Table A.1 — JTPAT for RD+

Dword(s)	Beginning RD	First character	Second character	Third character	Fourth character	Ending RD
0 to 40	RD+	D30.3 (7Eh)	D30.3 (7Eh)	D30.3 (7Eh)	D30.3 (7Eh)	RD+
		1000011100b	0111100011b	1000011100b	0111100011b	
	The above dword of low transition density pattern is sent a total of 41 times					
41	RD+	D30.3 (7Eh)	D30.3 (7Eh)	D30.3 (7Eh)	D20.3 (74h)	RD-
		1000011100b	0111100011b	10000**11100**b	**00101**11100b	
	The above dword containing phase shift **11100001011**b is sent 1 time					
42	RD-	D30.3 (7Eh)	D11.5 (ABh)	D21.5 (B5h)	D21.5 (B5h)	RD+
		01111**00011**b	**110100**1010b	1010101010b	1010101010b	
	The above dword containing phase shift **00011110100**b is sent 1 time					
43 to 54	RD+	D21.5 (B5h)	D21.5 (B5h)	D21.5 (B5h)	D21.5 (B5h)	RD+
		1010101010b	1010101010b	1010101010b	1010101010b	
	The above dword of high transition density pattern is sent a total of 12 times					
55	RD+	D21.5 (B5h)	D30.2 (5Eh)	D10.2 (4Ah)	D30.3 (7Eh)	RD+
		1010101**010**b	**10000**10101b	0101010**101**b	**01111**00011b	
	The above dword containing phase shift **01010000**b and **10101111**b is sent 1 time					

If the same 8b characters specified in table A.1 are used when there is negative running disparity (RD-) at the beginning of the pattern, the resulting 10b pattern is different and does not provide the critical phase shifts. To achieve the same phase shift effects with RD-, a different 8b pattern is required. Table A.2 shows the JTPAT when there is negative running disparity (RD-) at the beginning of the pattern. The 8b and 10b values of each character are shown.

Table A.2 — JTPAT for RD-

Dword(s)	Beginning RD	First character	Second character	Third character	Fourth character	Ending RD
0 to 40	RD-	D30.3 (7Eh)	D30.3 (7Eh)	D30.3 (7Eh)	D30.3 (7Eh)	RD-
		0111100011b	1000011100b	0111100011b	1000011100b	
	The above dword of low transition density pattern is sent a total of 41 times					
41	RD-	D30.3 (7Eh)	D30.3 (7Eh)	D30.3 (7Eh)	D11.3 (6Bh)	RD+
		0111100011b	1000011100b	01111 00011b	110100 0011b	
	The above dword containing phase shift 00011110100b is sent 1 time					
42	RD+	D30.3 (7Eh)	D20.2 (54h)	D10.2 (4Ah)	D10.2 (4Ah)	RD-
		10000 11100b	001011 0101b	0101010101b	0101010101b	
	The above dword containing phase shift 11100001011b is sent 1 time					
43 to 54	RD-	D10.2 (4Ah)	D10.2 (4Ah)	D10.2 (4Ah)	D10.2 (4Ah)	RD-
		0101010101b	0101010101b	0101010101b	0101010101b	
	The above dword of high transition density pattern is sent a total of 12 times					
55	RD-	D10.2 (4Ah)	D30.5 (BEh)	D21.5 (B5h)	D30.3 (7Eh)	RD-
		0101010 101b	01111 01010b	1010101 010b	10000 11100b	
	The above dword containing phase shift 10101111b and 01010000b is sent 1 time					

Table A.3 shows a pattern containing both JTPAT for RD+ and JTPAT for RD-. The 10b pattern resulting from encoding the 8b pattern contains the desired bit sequences for the phase shifts with both starting running disparities.

Table A.3 — JTPAT for RD+ and RD-

Dword(s)	First character	Second character	Third character	Fourth character	Notes
0 to 40	D30.3(7Eh)	D30.3(7Eh)	D30.3(7Eh)	D30.3(7Eh)	This dword is sent a total of 41 times.
	...	...	...	...	
41	D30.3(7Eh)	D30.3(7Eh)	D30.3(7Eh)	D20.3(74h)	This dword is sent once.
42	D30.3(7Eh)	D11.5(ABh)	D21.5(B5h)	D21.5(B5h)	This dword is sent once.
43 to 54	D21.5(B5h)	D21.5(B5h)	D21.5(B5h)	D21.5(B5h)	This dword is sent a total of 12 times.
	...	...	...	...	
55	D21.5(B5h)	D30.2(5Eh)	D10.2(4Ah)	D30.3(7Eh)	This dword is sent once.
56 to 96	D30.3(7Eh)	D30.3(7Eh)	D30.3(7Eh)	D30.3(7Eh)	This dword is sent a total of 41 times.
	...	...	...	...	
97	D30.3(7Eh)	D30.3(7Eh)	D30.3(7Eh)	D11.3(6Bh)	This dword is sent once.
98	D30.3(7Eh)	D20.2(54h)	D10.2(4Ah)	D10.2(4Ah)	This dword is sent once.
99 to 110	D10.2(4Ah)	D10.2(4Ah)	D10.2(4Ah)	D10.2.(4Ah)	This dword is sent a total of 12 times.
	...	...	...	...	
111	D10.2(4Ah)	D30.5(BEh)	D21.5(B5h)	D30.3(7Eh)	This dword is sent once.

A.2 Compliant jitter tolerance pattern (CJTPAT)

The compliant jitter tolerance pattern (CJTPAT) is the JTPAT for RD+ and RD- (see table A.3 in A.1) included as the payload in an SSP DATA frame or an SMP frame~~or an SSP DATA frame modified to reduce the percentage of the transfer that is not the JTPAT~~. ~~The~~ CJTPAT is~~shall include at least~~:

1) SOF;
2) 6 data dwords containing either:
   A) an SSP DATA frame header; or
   B) an SMP frame header followed by 23 bytes;
3) 112 data dwords containing JTPAT for RD+ and RD-;
4) 1 data dword containing a CRC value; and
5) EOF.

~~Other SSP frame header information (see 9.2.1) may be included in the CJTPAT.~~ Deletable primitives may be included in the transmission of the CJTPAT, but the number of deletable primitives transmitted should be as small as possible so that the percentage of the transfer that is the JTPAT is as high as possible.

Because the SOF, EOF, and CRC are the same in SSP and SMP, CJTPAT complies with:

a) the SSP frame transmission format defined by the SSP link layer (see figure 173 in 7.16.3);
b) the SSP frame format defined by the SSP transport layer (see table 151 in 9.2.1);
c) the SMP frame transmission format defined by the SMP link layer (see figure 187 in 7.18.1); and
d) the SMP frame format defined by the SMP transport layer (see table 179 in 9.4.1).

When a phy transmits a frame, it XORs the 8b data provided by the application layer with the output of a scrambler before transmission (see 7.6). It does not modify primitives and it re-initializes the scrambler at the beginning of each frame (e.g., at SOF). If the application layer XORs the desired 8b pattern with the expected output of the scrambler prior to submitting it to the transmitter, then the transmitter transmits the desired pattern. The 8b data dwords are scrambled by XORing the pattern with the expected scrambler dword output, taking into account the position of the 8b data dwords within the frame.

Figure A.1 shows the effect of scrambling the input to the phy transmitter.

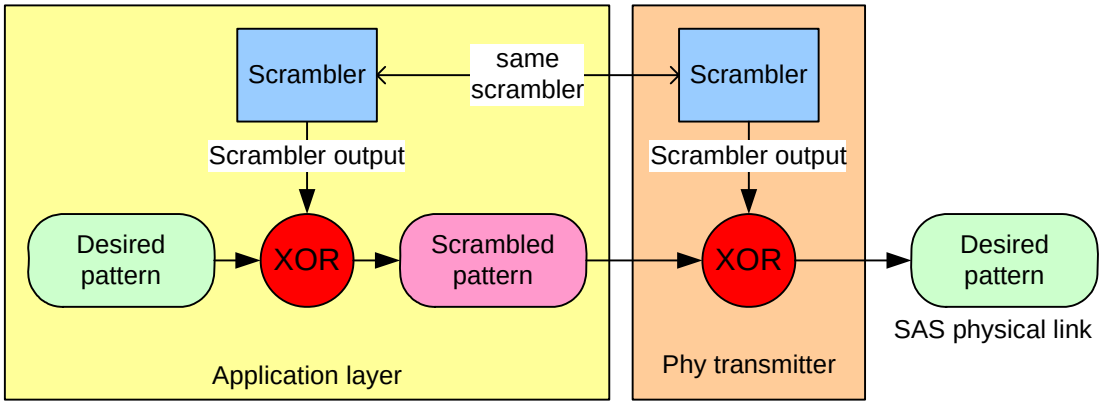

Figure A.1 — CJTPAT and scrambling

Table A.4 defines CJTPAT.~~shows an example of a CJTPAT where the JTPAT for RD+ and RD- is embedded in an SSP DATA frame (see 9.2.2.4). In this example, a 24-byte SSP DATA frame header is included after the SOF and before the JTPAT for RD+ and RD-.~~

The “SSP frame contents” column in table A.4 lists the interpretation of the frame if viewed as an SSP DATA frame.

The “SMP frame contents” column in table A.4 lists the interpretation of the frame if viewed as an SMP frame.

The ~~second column (~~“Desired pattern~~)~~” column in table A.4 lists the desired 8b data pattern.

The ~~third column (~~“Scrambler output~~)~~” column in table A.4 lists the scrambler output. The scrambler output is independent of the data pattern.

The ~~fourth column (~~“Scrambled pattern~~)~~” column in table A.4 shows the result of XORing the desired 8b data pattern with the scrambler output. ~~The data in this column, if~~If the data in this column is supplied to the transmitter scrambler, ~~results in~~ the desired pattern listed in the second column ~~being~~ is transmitted onto the physical link.

Editor’s Note 2: Note: in the table, “header dwords 0-7” was wrong; it should have been 0-5. This table is deleted; a replacement table follows.

~~Table A.4 — CJTPAT scrambled in an SSP DATA frame~~ ~~(part 1 of 5)~~

Frame contents	Desired pattern	Scrambler output	Scrambled pattern
SOF	<primitive>	<primitive>	<primitive>
SSP DATA frame header~~-~~(optional) (header dwords 0 - 7)	unknown	C2D2768Dh	unknown
	unknown	1F26B368h	unknown
	unknown	A508436Ch	unknown
	unknown	3452D354h	unknown
	unknown	8A559502h	unknown
	unknown	BB1ABE1Bh	unknown

~~Table A.4 — CJTPAT scrambled in an SSP DATA frame~~ ~~(part 2 of 5)~~

Frame contents	Desired pattern	Scrambler output	Scrambled pattern
SSP DATA frame INFORMATION UNIT field (part 1) (information unit dwords 0 - 7) or SMP frame dwords	7E7E7E7Eh	FA56B73Dh	8428C943h
	7E7E7E7Eh	53F60B1Bh	2D887565h
	7E7E7E7Eh	F0809C41h	8EFEE23Fh
	7E7E7E7Eh	747FC34Ah	0A01BD34h
	7E7E7E7Eh	BE865291h	C0F82CEFh
	7E7E7E7Eh	7A6FA7B6h	0411D9C8h
	7E7E7E7Eh	3163E6D6h	4F1D98A8h
	7E7E7E7Eh	F036FE0Ch	8E488072h
SSP DATA frame INFORMATION UNIT field (part 2) (information unit dwords 8-15)	7E7E7E7Eh	1EF3EA29h	608D9457h
	7E7E7E7Eh	EB342694h	954A58EAh
	7E7E7E7Eh	53853B17h	2DFB4569h
	7E7E7E7Eh	E94ADC4Dh	9734A233h
	7E7E7E7Eh	5D200E88h	235E70F6h
	7E7E7E7Eh	6901EDD0h	177F93AEh
	7E7E7E7Eh	FA9E38DEh	84E046A0h
	7E7E7E7Eh	68DB4B07h	16A53579h
SSP DATA frame INFORMATION UNIT field (part 3) (information unit dwords 16 - 23)	7E7E7E7Eh	450A437Bh	3B743D05h
	7E7E7E7Eh	960DD708h	E873A976h
	7E7E7E7Eh	3F35E698h	414B98E6h
	7E7E7E7Eh	FE7698A5h	8008E6DBh
	7E7E7E7Eh	C80EF715h	B670896Bh
	7E7E7E7Eh	666090AFh	181EEED1h
	7E7E7E7Eh	FAF0D5CBh	848EABB5h
	7E7E7E7Eh	2B82009Fh	55FC7EE1h
SSP DATA frame INFORMATION UNIT field (part 4) (information unit dwords 24 - 31)	7E7E7E7Eh	0E317491h	704F0AEFh
	7E7E7E7Eh	76F46A1Eh	088A1460h
	7E7E7E7Eh	F46D6948h	8A131736h
	7E7E7E7Eh	7BCD8A93h	05B3F4Edh
	7E7E7E7Eh	1513AD7Eh	6B6DD300h
	7E7E7E7Eh	1E72FEEEh	600C8090h
	7E7E7E7Eh	A014AA3Bh	DE6AD445h
	7E7E7E7Eh	23AAD4E7h	5DD4AA99h

~~Table A.4 — CJTPAT scrambled in an SSP DATA frame~~ ~~(part 3 of 5)~~

Frame contents	Desired pattern	Scrambler output	Scrambled pattern
SSP DATA frame INFORMATION UNIT field (part 5) (information unit dwords 32 - 39)	7E7E7E7Eh	B0DC9E67h	CEA2E019h
	7E7E7E7Eh	E0A573FBh	9EDB0D85h
	7E7E7E7Eh	06CA944Fh	78B4EA31h
	7E7E7E7Eh	63E29212h	1D9CEC6Ch
	7E7E7E7Eh	4578626Dh	3B061C13h
	7E7E7E7Eh	53260C93h	2D5872EDh
	7E7E7E7Eh	3E592202h	40275C7Ch
	7E7E7E7Eh	2B6ECA63h	5510B41Dh
SSP DATA frame INFORMATION UNIT field (part 6) (information unit dwords 40 - 47)	7E7E7E7Eh	636A1F1Fh	1D146161h
	7E7E7E74h	35B5A9EDh	4BCBD799h
	7EABB5B5h	4AA2A0FDh	34091548h
	B5B5B5B5h	71AFE196h	C41A5423h
	B5B5B5B5h	E1D57B62h	5460CED7h
	B5B5B5B5h	55A0568Ah	E015E33Fh
	B5B5B5B5h	82D18968h	37643CDDh
	B5B5B5B5h	234CB4FFh	96F9014Ah
SSP DATA frame INFORMATION UNIT field (part 7) (information unit dwords 48 - 55)	B5B5B5B5h	83481E7Fh	36FDABCAh
	B5B5B5B5h	B21AE87Fh	07AF5DCAh
	B5B5B5B5h	A9C5EACDh	1C705F78h
	B5B5B5B5h	6201ACC3h	D7B41976h
	B5B5B5B5h	F60939CEh	43BC8C7Bh
	B5B5B5B5h	395F767Dh	8CEAC3C8h
	B5B5B5B5h	2FA55841h	9A10EDF4h
	B55E4A7Eh	836D4A7Ah	36330004h
SSP DATA frame INFORMATION UNIT field (part 8) (information unit dwords 56 - 63)	7E7E7E7Eh	388D587Ah	46F32604h
	7E7E7E7Eh	773DFF5Ch	09438122h
	7E7E7E7Eh	3C239CB3h	425DE2CDh
	7E7E7E7Eh	564D91A0h	2833EFDEh
	7E7E7E7Eh	43ED0BE1h	3D93759Fh
	7E7E7E7Eh	987429A7h	E60A57D9h
	7E7E7E7Eh	E52DDBA2h	9B53A5DCh
	7E7E7E7Eh	E78DC87Fh	99F3B601h

~~Table A.4 — CJTPAT scrambled in an SSP DATA frame~~ ~~(part 4 of 5)~~

Frame contents	Desired pattern	Scrambler output	Scrambled pattern
SSP DATA frame INFORMATION UNIT field (part 9) (information unit dwords 64 - 71)	7E7E7E7Eh	0AB8C669h	74C6B817h
	7E7E7E7Eh	64D083C9h	1AAEFDB7h
	7E7E7E7Eh	053DF93Ah	7B438744h
	7E7E7E7Eh	EEE9D9Eah	9097A794h
	7E7E7E7Eh	44BD3B97h	3AC345E9h
	7E7E7E7Eh	0FE24B8Ch	719C35F2h
	7E7E7E7Eh	F28D5694h	8CF328EAh
	7E7E7E7Eh	6310B6D9h	1D6EC8A7h
SSP DATA frame INFORMATION UNIT field (part 10) (information unit dwords 72 - 79)	7E7E7E7Eh	1792AECEh	69ECD0B0h
	7E7E7E7Eh	0A562EA1h	742850DFh
	7E7E7E7Eh	B048DF69h	CE36A117h
	7E7E7E7Eh	161A2878h	68645606h
	7E7E7E7Eh	5519CB51h	2B67B52Fh
	7E7E7E7Eh	19F5BE56h	678BC028h
	7E7E7E7Eh	EFFFB4B6h	9181CAC8h
	7E7E7E7Eh	B3826E72h	CDFC100Ch
SSP DATA frame INFORMATION UNIT field (part 11) (information unit dwords 80 - 87)	7E7E7E7Eh	E4722DDAh	9A0C53A4h
	7E7E7E7Eh	60BF5129h	1EC12F57h
	7E7E7E7Eh	248D90F5h	5AF3EE8Bh
	7E7E7E7Eh	4D06D21Ch	3378AC62h
	7E7E7E7Eh	7E96166Ch	00E86812h
	7E7E7E7Eh	5FAFE3B4h	21D19DCAh
	7E7E7E7Eh	506CB855h	2E12C62Bh
	7E7E7E7Eh	5BF03098h	258E4EE6h
SSP DATA frame INFORMATION UNIT field (part 12) (information unit dwords 88 - 95)	7E7E7E7Eh	46D4B6B3h	38AAC8CDh
	7E7E7E7Eh	051B9E11h	7B65E06Fh
	7E7E7E7Eh	015CC556h	7F22BB28h
	7E7E7E7Eh	E21035EFh	9C6E4B91h
	7E7E7E7Eh	56604D75h	281E330Bh
	7E7E7E7Eh	2E76675Ch	50081922h
	7E7E7E7Eh	071476F0h	796A088Eh
	7E7E7E7Eh	AFF087EBh	D18EF995h

~~**Table A.4 — CJTPAT scrambled in an SSP DATA frame** (part 5 of 5)~~

Frame contents	Desired pattern	Scrambler output	Scrambled pattern
SSP DATA frame INFORMATION UNIT field (part 13) (information unit dwords 96 - 103)	7E7E7E7Eh	1B62DB01h	651CA57Fh
	7E7E7E6Bh	23661F6Ch	5D186107h
	7E544A4Ah	F877B027h	8623FA6Dh
	4A4A4A4Ah	F5E389A2h	BFA9C3E8h
	4A4A4A4Ah	EEC73611h	A48D7C5Bh
	4A4A4A4Ah	4C04FB93h	064EB1D9h
	4A4A4A4Ah	E8D70F32h	A29D4578h
	4A4A4A4Ah	BFF03C54h	F5BA761Eh
SSP DATA frame INFORMATION UNIT field (part 14) (information unit dwords 104 - 111)	4A4A4A4Ah	E3403C01h	A90A764Bh
	4A4A4A4Ah	20FACA7Eh	6AB08034h
	4A4A4A4Ah	9942458Ch	D3080FC6h
	4A4A4A4Ah	37E2CB89h	7DA881C3h
	4A4A4A4Ah	5A1A9783h	1050DDC9h
	4A4A4A4Ah	CE48AA3Fh	8402E075h
	4A4A4A4Ah	06C9A761h	4C83ED2Bh
	4ABEB57Eh	06C03EABh	4C7E8BD5h
SSP DATA frame CRC field	unknown; depends on contents of the frame header	9AFCB3DDh	unknown
EOF	<primitive>	<primitive>	<primitive>

Table A.5 — CJTPAT [replacement table] (part 1 of 5)

Data dword number	SSP frame contents	SMP frame contents	Desired pattern	Scrambler output	Scrambled pattern
Not applicable	SOF		SOF	Not applicable	SOF
0	SSP frame header	SMP frame header and 3 frame-type dependent bytes	unknown	C2D2768Dh	unknown
1		Frame-type dependent bytes	unknown	1F26B368h	unknown
2			unknown	A508436Ch	unknown
3			unknown	3452D354h	unknown
4			unknown	8A559502h	unknown
5			unknown	BB1ABE1Bh	unknown

Table A.5 — CJTPAT [replacement table] (part 2 of 5)

Data dword number	SSP frame contents	SMP frame contents	Desired pattern	Scrambler output	Scrambled pattern
6	INFORMATION UNIT field (dwords 0 - 7)	Frame-type dependent bytes	7E7E7E7Eh	FA56B73Dh	8428C943h
7			7E7E7E7Eh	53F60B1Bh	2D887565h
8			7E7E7E7Eh	F0809C41h	8EFEE23Fh
9			7E7E7E7Eh	747FC34Ah	0A01BD34h
10			7E7E7E7Eh	BE865291h	C0F82CEFh
11			7E7E7E7Eh	7A6FA7B6h	0411D9C8h
12			7E7E7E7Eh	3163E6D6h	4F1D98A8h
13			7E7E7E7Eh	F036FE0Ch	8E488072h
14	INFORMATION UNIT field (dwords 8-15)	Frame-type dependent bytes	7E7E7E7Eh	1EF3EA29h	608D9457h
15			7E7E7E7Eh	EB342694h	954A58EAh
16			7E7E7E7Eh	53853B17h	2DFB4569h
17			7E7E7E7Eh	E94ADC4Dh	9734A233h
18			7E7E7E7Eh	5D200E88h	235E70F6h
19			7E7E7E7Eh	6901EDD0h	177F93AEh
20			7E7E7E7Eh	FA9E38DEh	84E046A0h
21			7E7E7E7Eh	68DB4B07h	16A53579h
22	INFORMATION UNIT field (dwords 16 - 23)	Frame-type dependent bytes	7E7E7E7Eh	450A437Bh	3B743D05h
23			7E7E7E7Eh	960DD708h	E873A976h
24			7E7E7E7Eh	3F35E698h	414B98E6h
25			7E7E7E7Eh	FE7698A5h	8008E6DBh
26			7E7E7E7Eh	C80EF715h	B670896Bh
27			7E7E7E7Eh	666090AFh	181EEED1h
28			7E7E7E7Eh	FAF0D5CBh	848EABB5h
29			7E7E7E7Eh	2B82009Fh	55FC7EE1h
30	INFORMATION UNIT field (dwords 24 - 31)	Frame-type dependent bytes	7E7E7E7Eh	0E317491h	704F0AEFh
31			7E7E7E7Eh	76F46A1Eh	088A1460h
32			7E7E7E7Eh	F46D6948h	8A131736h
33			7E7E7E7Eh	7BCD8A93h	05B3F4Edh
34			7E7E7E7Eh	1513AD7Eh	6B6DD300h
35			7E7E7E7Eh	1E72FEEEh	600C8090h
36			7E7E7E7Eh	A014AA3Bh	DE6AD445h
37			7E7E7E7Eh	23AAD4E7h	5DD4AA99h

Table A.5 — CJTPAT [replacement table] (part 3 of 5)

Data dword number	SSP frame contents	SMP frame contents	Desired pattern	Scrambler output	Scrambled pattern
38	INFORMATION UNIT field (dwords 32 - 39)	Frame-type dependent bytes	7E7E7E7Eh	B0DC9E67h	CEA2E019h
39			7E7E7E7Eh	E0A573FBh	9EDB0D85h
40			7E7E7E7Eh	06CA944Fh	78B4EA31h
41			7E7E7E7Eh	63E29212h	1D9CEC6Ch
42			7E7E7E7Eh	4578626Dh	3B061C13h
43			7E7E7E7Eh	53260C93h	2D5872EDh
44			7E7E7E7Eh	3E592202h	40275C7Ch
45			7E7E7E7Eh	2B6ECA63h	5510B41Dh
46	INFORMATION UNIT field (dwords 40 - 47)	Frame-type dependent bytes	7E7E7E7Eh	636A1F1Fh	1D146161h
47			7E7E7E74h	35B5A9EDh	4BCBD799h
48			7EABB5B5h	4AA2A0FDh	34091548h
49			B5B5B5B5h	71AFE196h	C41A5423h
50			B5B5B5B5h	E1D57B62h	5460CED7h
51			B5B5B5B5h	55A0568Ah	E015E33Fh
52			B5B5B5B5h	82D18968h	37643CDDh
53			B5B5B5B5h	234CB4FFh	96F9014Ah
54	INFORMATION UNIT field (dwords 48 - 55)	Frame-type dependent bytes	B5B5B5B5h	83481E7Fh	36FDABCAh
55			B5B5B5B5h	B21AE87Fh	07AF5DCAh
56			B5B5B5B5h	A9C5EACDh	1C705F78h
57			B5B5B5B5h	6201ACC3h	D7B41976h
58			B5B5B5B5h	F60939CEh	43BC8C7Bh
59			B5B5B5B5h	395F767Dh	8CEAC3C8h
60			B5B5B5B5h	2FA55841h	9A10EDF4h
61			B55E4A7Eh	836D4A7Ah	36330004h
62	INFORMATION UNIT field (dwords 56 - 63)	Frame-type dependent bytes	7E7E7E7Eh	388D587Ah	46F32604h
63			7E7E7E7Eh	773DFF5Ch	09438122h
64			7E7E7E7Eh	3C239CB3h	425DE2CDh
65			7E7E7E7Eh	564D91A0h	2833EFDEh
66			7E7E7E7Eh	43ED0BE1h	3D93759Fh
67			7E7E7E7Eh	987429A7h	E60A57D9h
68			7E7E7E7Eh	E52DDBA2h	9B53A5DCh
69			7E7E7E7Eh	E78DC87Fh	99F3B601h

Table A.5 — CJTPAT [replacement table] (part 4 of 5)

Data dword number	SSP frame contents	SMP frame contents	Desired pattern	Scrambler output	Scrambled pattern
70	INFORMATION UNIT field (dwords 64 - 71)	Frame-type dependent bytes	7E7E7E7Eh	0AB8C669h	74C6B817h
71			7E7E7E7Eh	64D083C9h	1AAEFDB7h
72			7E7E7E7Eh	053DF93Ah	7B438744h
73			7E7E7E7Eh	EEE9D9Eah	9097A794h
74			7E7E7E7Eh	44BD3B97h	3AC345E9h
75			7E7E7E7Eh	0FE24B8Ch	719C35F2h
76			7E7E7E7Eh	F28D5694h	8CF328EAh
77			7E7E7E7Eh	6310B6D9h	1D6EC8A7h
78	INFORMATION UNIT field (dwords 72 - 79)	Frame-type dependent bytes	7E7E7E7Eh	1792AECEh	69ECD0B0h
79			7E7E7E7Eh	0A562EA1h	742850DFh
80			7E7E7E7Eh	B048DF69h	CE36A117h
81			7E7E7E7Eh	161A2878h	68645606h
82			7E7E7E7Eh	5519CB51h	2B67B52Fh
83			7E7E7E7Eh	19F5BE56h	678BC028h
84			7E7E7E7Eh	EFFFB4B6h	9181CAC8h
85			7E7E7E7Eh	B3826E72h	CDFC100Ch
86	INFORMATION UNIT field (dwords 80 - 87)	Frame-type dependent bytes	7E7E7E7Eh	E4722DDAh	9A0C53A4h
87			7E7E7E7Eh	60BF5129h	1EC12F57h
88			7E7E7E7Eh	248D90F5h	5AF3EE8Bh
89			7E7E7E7Eh	4D06D21Ch	3378AC62h
90			7E7E7E7Eh	7E96166Ch	00E86812h
91			7E7E7E7Eh	5FAFE3B4h	21D19DCAh
92			7E7E7E7Eh	506CB855h	2E12C62Bh
93			7E7E7E7Eh	5BF03098h	258E4EE6h
94	INFORMATION UNIT field (dwords 88 - 95)	Frame-type dependent bytes	7E7E7E7Eh	46D4B6B3h	38AAC8CDh
95			7E7E7E7Eh	051B9E11h	7B65E06Fh
96			7E7E7E7Eh	015CC556h	7F22BB28h
97			7E7E7E7Eh	E21035EFh	9C6E4B91h
98			7E7E7E7Eh	56604D75h	281E330Bh
99			7E7E7E7Eh	2E76675Ch	50081922h
100			7E7E7E7Eh	071476F0h	796A088Eh
101			7E7E7E7Eh	AFF087EBh	D18EF995h

Table A.5 — CJTPAT [replacement table] (part 5 of 5)

Data dword number	SSP frame contents	SMP frame contents	Desired pattern	Scrambler output	Scrambled pattern
102	INFORMATION UNIT field (dwords 96 - 103)	Frame-type dependent bytes	7E7E7E7Eh	1B62DB01h	651CA57Fh
103			7E7E7E6Bh	23661F6Ch	5D186107h
104			7E544A4Ah	F877B027h	8623FA6Dh
105			4A4A4A4Ah	F5E389A2h	BFA9C3E8h
106			4A4A4A4Ah	EEC73611h	A48D7C5Bh
107			4A4A4A4Ah	4C04FB93h	064EB1D9h
108			4A4A4A4Ah	E8D70F32h	A29D4578h
109			4A4A4A4Ah	BFF03C54h	F5BA761Eh
110	INFORMATION UNIT field (dwords 104 - 111)	Frame-type dependent bytes	4A4A4A4Ah	E3403C01h	A90A764Bh
111			4A4A4A4Ah	20FACA7Eh	6AB08034h
112			4A4A4A4Ah	9942458Ch	D3080FC6h
113			4A4A4A4Ah	37E2CB89h	7DA881C3h
114			4A4A4A4Ah	5A1A9783h	1050DDC9h
115			4A4A4A4Ah	CE48AA3Fh	8402E075h
116			4A4A4A4Ah	06C9A761h	4C83ED2Bh
117			4ABEB57Eh	06C03EABh	4C7E8BD5h
118	CRC field [a]		unknown; depends on contents of first 6 data dwords	9AFCB3DDh	unknown; depends on contents of first 6 data dwords
Not applicable	EOF		<primitive>	<primitive>	<primitive>

[a] The CRC field shall be set to a valid value for the frame.

A phy or test equipment transmitting CJTPAT outside connections may transmit it with fixed content as defined in table A.6.

Table A.6 shows CJTPAT with fixed content:

a) interpreted as an SSP frame, with the FRAME TYPE field in the frame header set to 01h (i.e., DATA), each other field in the frame header set to zero, the INFORMATION UNIT field containing JTPAT for RD+ and RD-, and the CRC field set to a fixed value; and

b) interpreted as an SMP frame, with the SMP FRAME TYPE field in the frame header set to 01h (i.e., reserved), the frame-type dependent bytes containing JTPAT for RD+ and RD-, and the CRC field set to a fixed value.

Table A.6 — CJTPAT with fixed content [new table]

Data dword number	SSP frame contents	SMP frame contents	Desired pattern	Scrambler output	Scrambled pattern
Not applicable	SOF		SOF	Not applicable	SOF
0	FRAME TYPE field set to 01h (i.e., DATA frame) and 23 subsequent bytes each set to 00h	SMP FRAME TYPE field set to 01h (i.e., reserved) and 23 subsequent frame-type dependent bytes each set to 00h	01000000h	C2D2768Dh	D2D2768Dh
1			00000000h	1F26B368h	1F26B368h
2			00000000h	A508436Ch	A508436Ch
3			00000000h	3452D354h	3452D354h
4			00000000h	8A559502h	8A559502h
5			00000000h	BB1ABE1Bh	BB1ABE1Bh
6	INFORMATION UNIT field	Frame-type dependent bytes	See the INFORMATION UNIT field in table A.4		
117					
118	CRC field		CBA0B26Ah	9AFCB3DDh	515C01B7h
Not applicable	EOF		EOF	Not applicable	EOF

A.3 Considerations for a phy transmitting JTPAT and CJTPAT

A phy may be configured to transmit JTPAT for RD+ and RD- (see A.2) by:

a) using the SMP PHY TEST FUNCTION function (see 10.4.3.27) or the Protocol-Specific diagnostic page (see 10.2.9.1) specifying the phy, with the PHY TEST FUNCTION field set to 01h (i.e., TRANSMIT_PATTERN), and the PHY TEST PATTERN field set to 01h (i.e., JTPAT); and
b) vendor-specific mechanisms.

A phy may be configured to transmit CJTPAT (see A.2) by:

a) using the SMP PHY TEST FUNCTION function (see 10.4.3.27) or the Protocol-Specific diagnostic page (see 10.2.9.1) specifying the phy, with the PHY TEST FUNCTION field set to 01h (i.e., TRANSMIT_PATTERN), and the PHY TEST PATTERN field set to 02h (i.e., CJTPAT);
b) including CJTPAT as a data pattern while perform SCSI commands (e.g., the WRITE BUFFER command if the phy is in an initiator port, or the a SCSI READ BUFFER command if the phy is in a target port). The frame length and scrambling need to be predictable to ensure the desired pattern is transmitted on the physical link; and
c) vendor-specific mechanisms.

A.4 Considerations for a phy receiving JTPAT and CJTPAT

If a phy receives JTPAT (see A.1) inside or outside a connection, it considers the data dwords to be idle dwords and ignores them.

If a phy receives CJTPAT (see A.2) outside a connection, the SL receiver (see 7.14.2) considers the SOF and EOF to be unexpected dwords and ignores them, and considers the data dwords to be idle dwords and ignores them.

Phy-layer based phy event information counters (e.g., invalid dword count, running disparity error count, loss of dword synchronization count, elasticity buffer overflow count, and received ERROR count) count events that occur while receiving idle dwords, so may be used to count events while receiving JTPAT or CTPAT.

If a phy receives CJTPAT (see A.2) inside an SSP connection, the phy expects it to have a valid frame header (e.g., valid frame type, source SAS address, etc.) and follow SSP frame transmission rules (e.g., RRDY credit, ACK or NAK exchange).

If a phy receives CJTPAT (see A.2) inside an SMP connection, the phy expects it to have a valid frame header (e.g., valid frame type) and follow SMP frame transmission rules (e.g., only one frame is transmitted in each direction per connection). Sending CJTPAT inside SMP connections is not recommended.

No standard mechanism is defined to configure a phy to expect to receive JTPAT or CJTPAT (e.g., to compare the incoming pattern to the expected pattern).