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To: T10 Technical Committee  
From: Bill Galloway  
Subj: SAS ALIGN Primitives

New ALIGN primitives.

Primitive	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup> (last)	Outside Connect	SSP	SMP	STP
ALIGN(1)	K28.5	D10.2	D10.2	D27.3	Y	Y	Y	Y
ALIGN(2)	K28.5	D07.0	D07.0	D07.0	Y	Y	Y	Y
ALIGN(3)	K28.5	D01.3	D01.3	D01.3	Y	Y	Y	Y
ALIGN(4)	K28.5	D27.3	D27.3	D27.3	Y	Y	Y	Y

**7.1.4.2 ALIGN(1), ALIGN(2), ALIGN(3), and ALIGN(4)**

ALIGN primitives are used for character and dword alignment during the reset sequence, and ~~is used to maintain dword alignment thereafter.~~ are used for rate matching and clock skew management thereafter.

~~ALIGN is the only K28.5 primitive defined by SATA, and is the only SATA primitive including the comma character used for character alignment. It has neutral disparity—disparity is the same after the ALIGN as it was before the ALIGN.~~

~~ALIGN(2), ALIGN(3), and ALIGN(4) may be used interchangeably with ALIGN after the reset sequence has completed. Rate matching requires the sender rotate through them to reduce EMI (see 7.12).~~

SAS ports shall be able to receive any ALIGN primitive after the reset sequence has completed.

SAS ports that are capable of sending ALIGN primitives with less than seven non-ALIGN dwords between them, shall transmit all of the ALIGN primitives. SAS ports that are capable of rate matching (see 7.12) shall transmit all of the ALIGN primitives.

SAS ports that are required to transmit all of the ALIGN primitives, shall transmit them in order ( ALIGN(1), ALIGN(2), ALIGN(3), ALIGN(4) ). SAS devices that are not required to transmit all of the ALIGN primitives shall transmit ALIGN(1) only.

See 7.2 for requirements for ALIGN insertion and other details on clock skew management.