



Maxtor Corporation
500 McCarthy Boulevard
Milpitas, CA 95035 USA

To: T10 SAS Protocol Working Group
Contact: Mark Evans
Phone: 408-894-5310
Email: mark_evans@maxtor.com
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Subject: SAS-1.1, additional LED behavior

Introduction

SAS defines one behavior for the LED signal. This is as a “ready” signal, that is, the signal is driven when the target device is in the active state but not processing a command. This proposal creates a new, optional, behavior for the LED as an “activity” signal, where the signal is not driven when the target device is in the active state and not processing a command (similar to how the analogous signal functions in parallel SCSI environments). In addition, this proposal clarifies the ready LED description in the draft standard. This proposal is based on SAS1r01.

1) Add the following to clause 10.2.6.2.2 Protocol-Specific Port mode page - short format:

Table 36 — Protocol-Specific Port mode page for SAS SSP - short format (proposed)

Byte\Bit	7	6	5	4	3	2	1	0
0	PS	SPF (0b)	PAGE CODE (19h)					
1	PAGE LENGTH (06H)							
2	Reserved			LED_ACT	PROTOCOL IDENTIFIER			
3	Reserved							
4	(MSB)	I_T NEXUS LOSS TIME						(LSB)
5								
6	(MSB)	INITIATOR RESPONSE TIMEOUT						(LSB)
7								

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[The LED activity bit \(LED_ACT\) indicates the behavior of the LED signal. See 10.4.1.](#)

2) Change clause 10.4.1 READY LED signal behavior to be as follows:

A SAS target device uses the READY LED signal to activate an externally visible LED that indicates the state of readiness and activity of the SAS target device. The READY LED signal electrical characteristics are described in 5.4. All SAS target devices using the SAS plug connector (see 5.2.3.2) shall support the READY LED signal.

The system is not required to generate any visual output when the READY LED signal is asserted. Additional vendor-specific flashing patterns may be used to signal vendor-specific conditions.

A-If the `LED_ACT` bit in the Protocol Specific Port mode page is set to zero (see 10.2.6.2.2), then the READY LED signal transmitted from a SAS target device containing an SSP target port shall ~~transmit the READY LED signal using the following patterns~~ have the following behavior:

- a) If the SAS target device is in the standby or stopped power condition state (see 10.2.8), then the device~~it~~ shall ~~negate~~ ~~assert~~ the READY LED signal continuously except when the device is~~while~~ processing a command. When processing a command, the SAS target device shall toggle the READY LED signal between the negated and asserted states in a vendor-specified manner (i.e., the LED is usually off, but flashes on and off when commands are being processed). The SAS target device may be removed with no danger of mechanical or electrical damage when the READY LED signal is negated~~in this state~~;
- b) If the SAS target device has rotating media and is in the process of performing a spin-up or spin-down, ~~it~~then the device shall ~~toggle assert and negate~~ the READY LED signal between the asserted and negated states with a $1\text{ s} \pm 0,1\text{ s}$ cycle using a $50\% \pm 10\%$ duty cycle (~~i.e.~~e.g., LED is on for 0,5 s and off for 0,5 s);
- c) If the SAS target device is in the active or idle power condition state (see 10.2.8), ~~it~~ then the device shall assert the READY LED signal continuously except when the ~~SAS target device~~ is processing a command. When processing a command, the SAS target device shall toggle the READY LED signal between the asserted and negated states in a vendor-specified manner (~~e.g.i.e.~~, the LED is usually on, but flashes on and is momentarily off when commands are processed); ~~or~~
- d) If the SAS target device is formatting the media, it shall toggle the READY LED signal between the asserted and negated states in a vendor-specified manner (e.g., with each cylinder change on a disk drive); and
- e) SAS target devices with rotating media shall transition from pattern c) to pattern b) during the spin-down process. When the SAS target device has reached a state stable enough for it to be removed without mechanical or electrical damage, it shall change from pattern b) to pattern a).

~~SAS target devices with rotating media transition from pattern c) to pattern b) during the spin-down process. When the SAS target device has reached a state stable enough for it to be removed without mechanical or electrical damage, it shall change from pattern b) to pattern a).~~

If the `led_act` bit in the Protocol Specific Port mode page is set to one (see 10.2.6.2.2), then the READY LED signal transmitted from a SAS target device containing an SSP target port shall have the following behavior:

- a) If the SAS target device is in the active, idle, standby, or stopped power condition state (see 10.2.8), then the device shall negate the READY LED signal continuously except when the device is processing a command. When processing a command, the SAS target device shall toggle the READY LED signal between the negated and asserted states in a vendor-specified manner (i.e., the LED is usually off, but flashes on and off when commands are processed). The SAS target device may be removed with no danger of mechanical or electrical damage when the READY LED signal is negated;
- b) If the SAS target device has rotating media and is in the process of performing a spin-up or spin-down, then the device shall toggle the READY LED signal between the asserted and negated states with a $1\text{ s} \pm 0,1\text{ s}$ cycle using a $50\% \pm 10\%$ duty cycle (e.g., LED is on for 0,5 s and off for 0,5 s); and
- c) If the SAS target device is formatting the media, it shall toggle the READY LED signal between the asserted and negated states in a vendor-specified manner (e.g., with each cylinder change on a disk drive.

Table <x> — LED signal behavior summary

<u>led_act\ power condition</u>	<u>Active</u>	<u>Idle</u>	<u>Standby</u>	<u>Stopped</u>	<u>Spin-up/ spin-down</u>	<u>Formatting media</u>
<u>led_act = 0</u>	a) assert when not processing commands b) when processing commands, toggle in vendor-specified manner		a) negate when not processing commands b) when processing commands, toggle in vendor-specified manner		toggle with 1 s ± 0.1 s cycle using a 50 % ± 10 % duty cycle	toggle in a vendor-specified manner
<u>led_act = 1</u>	a) negate when not processing commands b) when processing commands, toggle in vendor-specified manner					

SAS target devices without SSP target ports may transmit the READY LED signal using vendor-specific patterns.