SFF specifications are available at http://www.snia.org/sff/specifications
or ftp://ftp.seagate.com/sff

This specification was developed by the SFF Committee prior to it becoming the SFF TA (Technology Affiliate) TWG (Technical Working Group) of SNIA (Storage Networking Industry Association).

The information below should be used instead of the equivalent herein.

POINTS OF CONTACT:

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If you are interested in participating in the activities of the SFF TWG, the membership application can be found at:
http://www.snia.org/sff/join

The complete list of SFF Specifications which have been completed or are currently being worked on can be found at:
http://www.snia.org/sff/specifications/SFF-8000.TXT

The operations which complement the SNIA's TWG Policies & Procedures to guide the SFF TWG can be found at:
http://www.snia.org/sff/specifications/SFF-8032.PDF

Suggestions for improvement of this specification will be welcome, they should be submitted to:
http://www.snia.org/feedback

SFF Committee documentation may be purchased in electronic form.
SFF specifications are available at ftp://ftp.seagate.com/sff

SFF Committee

SFF-8489 Specification for

Serial GPIO IBPI (International Blinking Pattern Interpretation)

Rev 0.4 November 29, 2011

Secretariat: SFF Committee

Abstract: This specification defines an interpretation of the Serial GPIO (SGPIO) bits, the resulting state of the respective drive or slot, and the corresponding LED blinking pattern.

This document defines a proposed global standard between vendors of Host Bus Adapters (HBA), chip-sets, chassis and backplane vendors, and OEMs.

This specification provides a common reference for systems manufacturers, system integrators, and suppliers. This is an internal working specification of the SFF Committee, an industry ad hoc group.

This specification is made available for public review, and written comments are solicited from readers. Comments received by the members will be considered for inclusion in future revisions of this specification.

Support: This specification is supported by the identified member companies of the SFF Committee.

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EXPRESSION OF SUPPORT BY MANUFACTURERS

The following member companies of the SFF Committee voted in favor of this industry specification.

AMI
Hewlett Packard
Molex
Sandisk

The following member companies of the SFF Committee voted to abstain on this industry specification.

Dell Computer
EMC
Finisar
Foxconn
Hitachi GST
ICT-Lanto
Intel
JDS Uniphase
NetApp
Seagate
Siemon
TE Connectivity
Yamaichi

REVISION HISTORY

R.1 Revision 0.1 (5 August 2008)

Draft submitted as specification based on IBPI as described at http://en.wikipedia.org/wiki/IBPI

R.2 Revision 0.2 (1 September 2011)

Hotspare is no longer represented by LED blinking pattern. The state is identified by the backplane controller. The BMC can read it through SMBUS interface. Table 4 & Table 5 have been modified accordingly.

R.3 Revision 0.3 (1 September 2011)

Minor editorial and template style changes.

R.4 Revision 0.4 (November 2011)

Text changes made to identify this specification as one alternative, rather than the only one.

Foreword

The development work on this specification was done by the SFF Committee, an industry group. The membership of the committee since its formation in August 1990 has included a mix of companies which are leaders across the industry.

When 2 1/2" diameter disk drives were introduced, there was no commonality on external dimensions e.g. physical size, mounting locations, connector type, connector location, between vendors.

The first use of these disk drives was in specific applications such as laptop portable computers and system integrators worked individually with vendors to develop the packaging. The result was wide diversity, and incompatibility.

The problems faced by integrators, device suppliers, and component suppliers led to the formation of the SFF Committee as an industry ad hoc group to address the marketing and engineering considerations of the emerging new technology.

During the development of the form factor definitions, other activities were suggested because participants in the SFF Committee faced more problems than the physical form factors of disk drives. In November 1992, the charter was expanded to address any issues of general interest and concern to the storage industry. The SFF Committee became a forum for resolving industry issues that are either not addressed by the standards process or need an immediate solution.

Those companies which have agreed to support a specification are identified in the first pages of each SFF Specification. Industry consensus is not an essential requirement to publish an SFF Specification because it is recognized that in an emerging product area, there is room for more than one approach. By making the documentation on competing proposals available, an integrator can examine the alternatives available and select the product that is felt to be most suitable.

SFF Committee meetings are held during T10 weeks (see www.t10.org), and Specific Subject Working Groups are held at the convenience of the participants. Material presented at SFF Committee meetings becomes public domain, and there are no restrictions on the open mailing of material presented at committee meetings.

Most of the specifications developed by the SFF Committee have either been incorporated into standards or adopted as standards by EIA (Electronic Industries Association), ANSI (American National Standards Institute) and IEC (International Electro technical Commission).

If you are interested in participating or wish to follow the activities of the SFF Committee, the signup for membership and/or documentation can be found at:

www.sffcommittee.com/ie/join.html

The complete list of SFF Specifications which have been completed or are currently being worked on by the SFF Committee can be found at:

ftp://ftp.seagate.com/sff/SFF-8000.TXT

If you wish to know more about the SFF Committee, the principles which guide the activities can be found at:

ftp://ftp.seagate.com/sff/SFF-8032.TXT

Suggestions for improvement of this specification will be welcome. They should be sent to the SFF Committee, 14426 Black Walnut Ct, Saratoga, CA 95070.

SFF Committee

Serial GPIO IBPI (International Blinking Pattern Interpretation)

1. Scope

This specification defines how the steady and oscillating states of the Serial GPIO (SGPIO) bits can be interpreted into valid states for each drive slot represented. The SGPIO standard is defined in SFF-8485 by this same committee.

This specification defines the behavior of the LEDs for each slot.

The purpose of this specification is to offer a standard for the SGPIO and LED blinking patterns across vendors for the benefit of the consumer.

1.1 Description of Clauses

Clause 1 contains the Scope and Purpose.
Clause 2 contains Referenced and Related Standards and SFF Specifications.
Clause 3 contains the General Description.
Clause 4 contains the SGPIO Bit Definitions
Clause 5 contains the SDataOut Activity Interpretation According to SGPIO
Clause 6 contains the SDataOut Activity-Bit Interpretation According to IBPI
Clause 7 contains the SDataOut Locate- and Fail-bit Interpretation According to IBPI
Clause 8 contains the LED Blinking Patterns according to IBPI
Clause 9 contains the IBPI summary

2. References

The SFF Committee activities support the requirements of the storage industry, and it is involved with several standards.

2.1 Industry Documents

The following interface standards are relevant to many SFF Specifications.

- EIA/JEDEC JESD8-B Interface Standard for Nominal 3 V/3.3 V Supply Digital Integrated Circuits (LVTTL). See http://www.jedec.org.

- IISO/IEC 14776-150 Serial Attached SCSI (SAS) (ANSI INCITS 376-2003).
  See http://www.iso.int or http://www.ansi.org or http://www.incits.org
  Developed by T10 at http://www.t10.org

- ISO/IEC 14776-151 Serial Attached SCSI 1.1 (SAS-1.1) (ANSI INCITS 417-2006).
  See http://www.iso.int, http://www.ansi.org, or http://www.incits.org
  Developed by T10 at http://www.t10.org

- PCI Express ExpressModule Electromechanical Specification (PCI-EM) Revision 1.0
  See http://www.pcisig.com.

- Serial ATA (SATA) Revision 2.5.
  See http://www.sata-io.org.

- SFF-8485 Specification for Serial GPIO (SGPIO) Bus
  See ftp://ftp.seagate.com/sff

2.2 SFF Specifications

There are several projects active within the SFF Committee. The complete list of specifications which have been completed or are still being worked on are listed in the specification at ftp://ftp.seagate.com/sff/SFF-8000.TXT

2.3 Sources

Those who join the SFF Committee as an Observer or Member receive electronic copies

of the minutes and SFF specifications (http://www.sffcommittee.com/ie/join.html).

Copies of ANSI standards may be purchased from the InterNational Committee for Information Technology Standards (http://www.techstreet.com/incitsgate.tmpl).

2.4 Conventions

If there is a conflict between text and tables on a feature described as optional, the table shall be accepted as being correct.

A number of conditions, commands, sequence parameters, events, English text, states or similar terms are printed with the first letter of each word in uppercase and the rest lower-case; e.g., In, Out, Request Status. Any lower-case uses of these words have the normal American-English meaning.

The ISO convention of numbering is used i.e., the thousands and higher multiples are separated by a space and a period is used as the decimal point. This is equivalent to the English/American convention of a comma and a period.

American	French	ISO
0.6	0,6	0.6
1,000	1 000	1 000
1,323,462.9	1 323 462,9	1 323 462.9

2.5 Definitions

For the purpose of SFF Specifications, the following definitions apply:

2.5.1 Optional: This term describes features which are not required by the SFF Specification. However, if any feature defined by the SFF Specification is implemented, it shall be done in the same way as defined by the Specification.

2.5.2 Reserved: Where this term is used for bits, bytes, fields and code values; the bits, bytes, fields and code values are set aside for future standardization. The default value shall be zero. The originator is required to define a Reserved field or bit as zero, but the receiver should not check Reserved fields or bits for zero.

2.5.3 Vendor Specific: This term is used to describe bits, bytes, fields, pins, signals, code values and features which are not described in this SFF Specification, and may be used in a way that varies between vendors.

3. General Description

The environment for this SFF Specification includes any SAS or SATA disk cabinet.

The Serial General Purpose Input Output (SGPIO) protocol defined by SFF-8485 is an emerging standard for communicating slot and drive status information between an Initiator (such as a Host Bus Adapter (HBA)) and a target (such as a disk drive backplane controller).

Figure 1 depicts a typical system where SGPIO is used between a HBA and a Backplane.

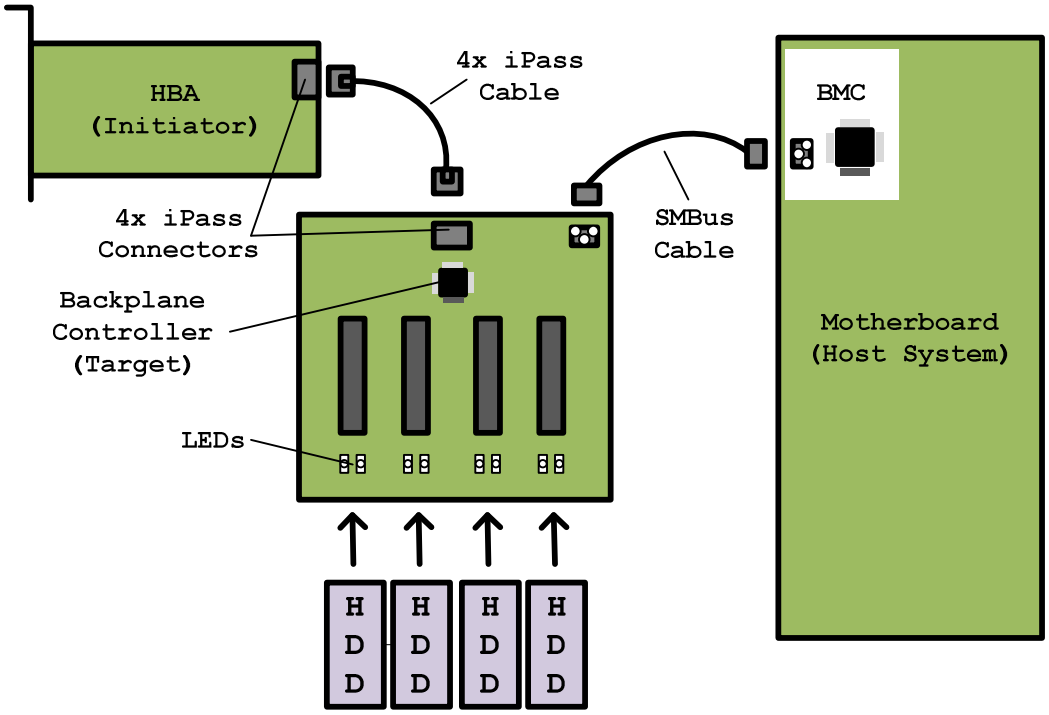

Figure 1 – Typical SGPIO Implementation

The secondary connection from the Backplane Controller (Target) to a Motherboard BMC is not required, but shown here for overall clarity.

4. SGPIO Bit Definitions

The SGPIO pattern as defined by SFF-8485 for a 4 slot implementation is shown in Figure 2 below.

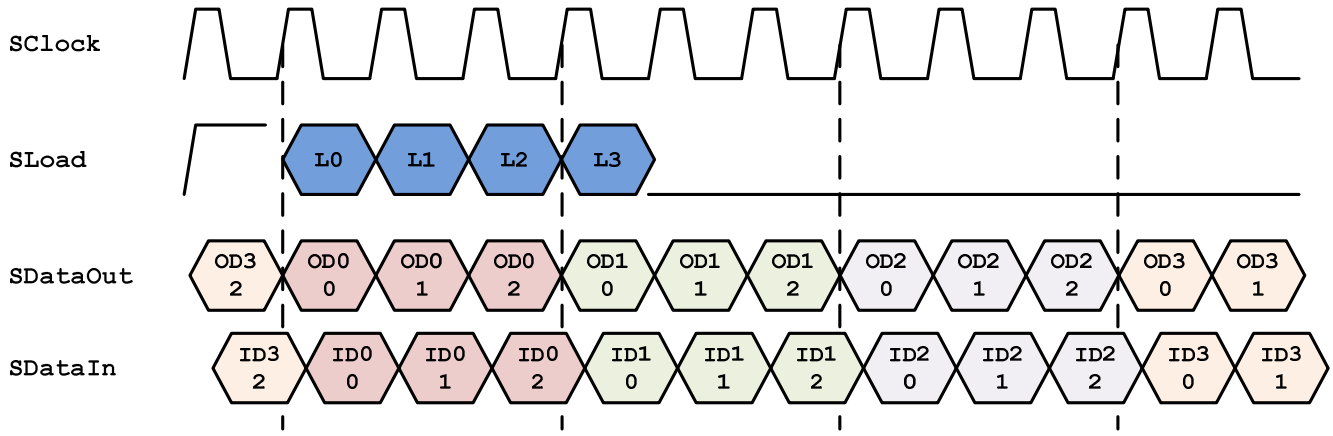

Figure 2 – SGPIO Stream for a 4 Slot Implementation

SGPIO Key Notes:

- The Initiator drives the SClock, SLoad, and SDataOut.
- The Target Drives only the SDataIn.
- SDataOut and SDataIn are both Active High (0=Disable, 1=Enable)
- The SGPIO stream must be minimum 12 SClock Cycles.
- The SGPIO stream can be substantially longer than 12 SClock cycles, but will always be a multiple of 3. (i.e. from a 24-drive expander there will be 72 SGPIO clocks.

5. SDataOut Activity, Locate and Fail Bit Interpretation According to SGPIO

The first bit (ODn.0) is exclusively used to represent Activity. The second and third bits; Locate (ODn.1) and Fail (ODn.2) are directly used to represent a locate and fail state of the drive.

NOTE that the interpretations of the Fail and Locate bits into specific states are not defined in the SGPIO specification, but Table 1 below describes how the industry has come to interpret these bits into slot states.

Table 1 – SGPIO SdataOut Bit Interpretation

ODn.0 Activity	**ODn.1** Locate	**ODn.2** Fail	**Interpretation**
1	X	X	Activity
0	X	X	No Activity
X	0	0	No Fail, Locate or Rebuild
X	1	0	Locate (Identify)
X	0	1	Fail
X	1	1	Rebuild

NOTE that IBPI is compatible with these states as described in Table 1.
IBPI simply defines additional states by oscillating the Fail and Locate bits inside the SGPIO SDataOut stream.

6. SDataOut Activity-Bit Interpretation According to IBPI

The first bit (ODn.0) is exclusively used to represent Activity. The second and third bits; Locate (ODn.1) and Fail (ODn.2) are directly used to represent locate and fail state of the drive.

Table 2 – IBPI SdataOut Activity Bit Interpretation

Condition	**SDataOut**	**SGPIO Interpretation**	
Drive Present	ODn.0 (Activity Bit)	State:	Description:
YES	0	No activity	
	1	activity	
NO	X	N/A	The Activity Bit is masked and not used in interpretation. Only the Locate and Fail bits remain valid for a slot with a drive that is not present
Legend: 0-Logical Low Signal (remaining low for 2 or more seconds) 1-Logical High Signal (remaining high for 2 or more seconds) n Hz – Signal toggles between 0 and 1 at the frequency of n Hz at a duty cycle of 50 % +/- 5 %. X-Don’t Care			

NOTE that this state is equivalent to the interpretation of the activity bit in standard SGPIO.

7. SDataOut Locate- and Fail-bit Interpretation According to IBPI

This section describes the core enhancements of IBPI over SGPIO. The first 3 states are equivalent of SGPIO. Additionally, IBPI defines 3 frequencies that the Fail and Locate bits can oscillate at: 1Hz, 2Hz and 4Hz.

Table 3 – IBPI SdataOut Locate and Fail Bit Interpretation

SGPIO-SDATAOUT bits:		**SGPIO Interpretation**	
ODn.1 (Locate)	ODn.2 (Fail)	State:	Description:
1	0	Locate (identify)	This state is used to identify a slot or drive
0	1	Fail	This state indicates a slot with a failed drive
1	1	Rebuild (preferred)	Because of legacy and cross-compatibility with SGPIO initiators, both interpretations of Rebuild should be supported
X	1 Hz	Rebuild (supported)	
X	2 Hz	PFA	Predicted Failure Analysis. The drive in this slot is still working but predicted to fail soon
X	4 Hz	Hotspare	This slot has a drive that is marked to be automatically rebuilt and used as a replacement for a failed drive
1 Hz	X	In A Critical Array	The array in which this slot is part of is degraded
2 Hz	X	In A Failed Array	The array in which this slot is part of is failed
4 Hz	X	(reserved)	(This case is not yet determined by the spec and remains available for future use)

Legend:
0-Logical Low Signal (remaining low for 2 or more seconds)
1-Logical High Signal (remaining high for 2 or more seconds)
n Hz – Signal toggles between 0 and 1 at the frequency of n Hz at a duty cycle of 50 % +/- 5 %
X-Don’t Care

8. LED Blinking Patterns according to IBPI

The IBPI standard defines interpretations for both 2 and 3 LED implementations as shown in Figure 3.

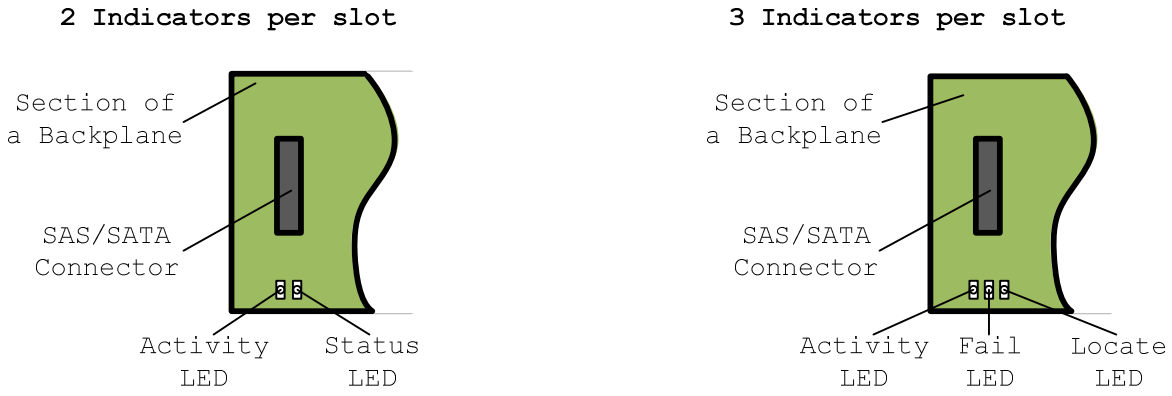

Figure 3 – Backplane Slot Status Indicators

Table 4 – IBPI SdataOut Locate and Fail Bit Interpretation

SGPIO-SDATAOUT bit:	2 LEDS/SLOT		3 LEDS/SLOT		
	Activity LED	Status LED	Activity LED	Locate LED	Fail LED
Description:					
Drive Not Present	OFF	X	OFF	X	X
Drive Present, No Activity	ON	X	ON	X	X
Drive Present, Activity	4Hz	X	4Hz	X	X
Locate (Identify)	4Hz	4Hz	X	4Hz	OFF
Fail	X	ON	X	OFF	ON
Rebuild	X	1Hz	X	OFF	1Hz
Rebuild	X	1Hz	X	OFF	1Hz
PFA	X	2 Fast Blinks at 4Hz & Pause for 0.5 sec	X	X	2 Fast Blinks at 4Hz & Pause for 0.5 sec
Hotspare	X	X	X	X	X
In A Critical Array	X	X	X	X	X
In A Failed Array	X	X	X	X	X
(undefined)	X	X	X	X	X

9. IBPI Summary

This table summarizes the implemented SGPIO interpretations and how these states are represented with 2 and 3 LED indicator implementations.

Table 5 – IBPI Summary Table

SGPIO-SDATAOUT bit:	**ODn.0 (Activity)**	**ODn.1 (Locate)**	**ODn.2 (Fail)**	**2 LEDS/SLOT**		**3 LEDS/SLOT**		
				Activity LED	Status LED	Activity LED	Locate LED	Fail LED
Description:								
Drive Not Present	X	X	X	OFF	X	OFF	X	X
Drive Present, No Activity	0	X	X	ON	X	ON	X	X
Drive Present, Activity	1	X	X	4Hz	X	4Hz	X	X
Locate (Identify)	X	1	0	4Hz	4Hz	X	4Hz	OFF
Fail	X	0	1	X	ON	X	OFF	ON
Rebuild	X	1	1	X	1Hz	X	OFF	1Hz
Rebuild	X	X	1Hz	X	1Hz	X	OFF	1Hz
PFA	X	X	2Hz	X	2 Fast Blinks at 4Hz & Pause for 0.5 sec	X	X	2 Fast Blinks at 4Hz & Pause for 0.5 sec
Hotspare	X	X	4Hz	X	X	X	X	X
In A Critical Array	X	1Hz	X	X	X	X	X	X
In A Failed Array	X	2Hz	X	X	X	X	X	X
(undefined)	X	4Hz	X	X	X	X	X	X