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Standard SCSI Wrapper/ Dock Design

Benjie Sun
Silicon Graphics Incorporated
2011 N. Shoreline Boulevard M/S 565
Mountain View, CA 94043
bsun@engr.sgi.com (650) 933-5573

The following document relates to the specification of the carrying device which allows a SCSI storage device to interface with its computer chassis. The initiative is being developed as part of the SCSI Harbor Project (www.scsita.org/harbor/) within the SCSI Trade Association. A reflector has been set up to facilitate this project as well (harbor@scsita.org).

1.0 Introduction

The purpose of this document is to specify a common hard drive wrapper and dock design. The document includes key mechanical and electrical design requirements and explains the presently envisioned solution for those requirements.

1.1 Objective

To standardize a storage container capable of being used in a broad variey of storage peripherals (priority being disk drives) in order to lower the cost and increase the opportunity for storage component suppliers. The storage container must take into account the issues of new disk power requirements, faster spindle speeds, and tighter track pitches.

1.2 Markets

The market spaces targeted for the standardized wrapper include:

- Standard High Volume Servers
- Mid Range Servers
- Entry level Servers
- Performance Workstations

1.3 Definition of Terms

Wrapper - The mechanical device to which a hard drive is fastened and which slides into a system chassis facilitating the proper electrical and mechanical connections between disk drive and backplane.

Dock - The slot, compartment,or receptacle cavity within the chassis which receives the wrapper and which provides connectivity for the device.

Enclosure - The chassis or cabinet that contains one or more docks.

Wrapped assembly - The hard drive sheathed within and fastened to its wrapper.

1.4 Related Documents

The following standards are relevant to many SFF specifications.

- SPI2
- SFF8300
- SFF8451
- IEA-700A0AE

2.0 Mechanical Specifications

This section defines the mechanical requirements for the product.

2.1 Wrapper

2.1.1 Wrapper Design Requirements

1. The drive shall be attached to the wrapper designed.

3. There should be minimal free play between the wrapper and cage during the insertion process with zero free play upon complete engagement/insertion.

4. Use commercially available damping materials if required.

5.

5. A spring leaf metal tab located near the front of the wrapper (near the handle) will be used to take up the tolerance between the wrapper and the dock. The tab will in effect jam the wrapper up against the side railing thus keeping the unit from experiencing excessive rotational vibration about its head actuation axis.

2.1.2 Form Factor

The wrapper shall accommodate 3.5 in. Winchester disk drives in both low profile (1 in.) and half (1.6 in.) heighth configurations.

The design of the wrapper and dock will be such that a quantity ten 3.5 in. full heighth (1.6 in.) drives can fit in a standard 19 in. rack.

2.1.3 Retention Mechanism

The wrapped assembly is held in place via three interfaces. The SCA-2 connector end holds its back end rigidly in place. The lever and hinge mechanism restricts motion along the length of the unit such that it cannot back itself out. The spring leaf metal tab restricts lateral motion along its width (both translational and rotational).

2.1.4 Assembly Tolerances

2.2 Dock

2.2.1 Dock Design

1. The dock should be evenly anchored so as not to allow motion is the plane of the drive.

2. Use of constrained layer damping may be required to quiet down significant modes or neighboring vibrations.

3. Additional vibration isolation may be needed if significant vibration transmission occurs from chassis to dock.

4. A removable PCB cover will protect the PCB and its components.

5. The bay must be keyed in such a way that the wrapped device cannot be inserted improperly.

2.2.2 Form Factor

The sheetmetal side-walls require some type of guide rails built-in whether they be cut and bent sheet metal or an independently fixtured railing system.

The dock also consists of the SCA-2 80-pin connector at the back face PCB.

2.3 Mechanical Insertion and Removal Sequence

The insertion/extraction mechanism consists of a lever arm (part of the wrapper) used to overcome the major forces of friction at the point of connector engagement/disengagement.

2.3.1 Insertion

The wrapped assembly should initially slide easily in the dock until the two halves of the SCA-2 connector (the hard drive half and the PCB half) are nearly mated. At this point the pivoting arm of the wrapper's handle should be used to cam the assembly fully into the dock.

As the lever arm is pushed in, it engages a hinge on the dock forcing the wrapper into the dock completely at the same time mating the SCA-2 connector halves.

2.3.2 Extraction:

To remove a given hard drive the major frictional forces between the wrapper and dock (between the SCA-2 connector halves) must again be overcome, this time by pulling the lever arm out. Again the lever arm engages a hinge on the dock (not necessarily the same hinge used for engagement) this time separating the SCA-2 connector halves and forcing the wrapper out of the dock.

At this point the wrapped assembly slides with less friction out of the dock.

2.4 Keying Mechanism

2.5 Locking Mechanism

2.6 EMI

Wrapper contains EMC shield.

The disk drive EMI emissions shall be no worse when sheathed in the wrapper as compared to its bare emissions.

2.7 ESD Management

The wrapped assembly should provide grounding between device and dock before the SCA-2 connector halves mate such that the electrostatic discharge does not occur through the connector. Metal tab spring fingers may be employed on the wrapper to make this initial contact with the system box.

Do not depend on screws, hinges, or rivets to provide grounding, there must be metal to metal contact.

2.8 Material Compatibility

2.9 Ground Contact Resistance

2.10 Shock and Vibration

All vibration and shock testing should occur with the drive mounted in the wrapper. For non-operating testing the wrapper assembly is then fixtured to the input device with the input power applied directly to the wrapper. For operating testing the wrapper is inserted into its dock and the enclosure is fixtured to the input device with the input power applied directly to the enclosure/chassis.

2.10.1 Operating Shock

The wrapped assembly meets the following criteria.

- No data loss with 10G 11ms half sine shock pulse
- No data loss with 65G 2msec half sine shock pulse

Ten shock pulses at each input level are applied in both the positive and negative directions of the three mutually perpendicular axes (one axis at a time) with a minimum of 30 seconds delay between shock pulses.

2.10.2 Non-Operating Shock

The wrapped assembly withstands the following half-sine shock pulses.

- No data loss with 75G 11msec
- No data loss with 175G 2msec

Ten shock pulses at each input level are applied in both the positive and negative directions of the three mutually perpendicular axes (one axis at a time) with a minimum of 30 seconds delay between shock pulses.

2.10.3 Tip over test

The wrapped assembly shall withstand the shock of being tipped over about its long axis without sustaining functional damage.

2.10.4 Non-operational Rotational Shock

The wrapped assembly withstands the following rotational shock.

- No data loss with 18,000 rad/sec^2 rotational shock applied around the axis of actuator pivot.

2.10.5 Operating Vibration

Random Vibration.

The wrapped assembly is designed to operate without unrecoverable errors while being subjected to the following vibration levels.

The Measurements are carried out during 30 minutes of random vibration using the power spectral density (PSD) levels as follows.

TABLE 1.

Random Vibration PSD Profile Breakpoints (Operating)									
Hz	5	17	45	48	62	65	150	200	500
Hoizontal vibration $x10^{-3}$ [G^2/Hz]	0.02	1.1	1.1	8.0	8.0	1.0	1.0	0.5	0.5
Vertical vibration $x10^{-3}$ [G^2/Hz]	0.02	1.1	1.1	8.0	8.0	1.0	1.0	0.5	0.5

Overall RMS (Root Mean Square) level of horizontal vibration is 0.67G.

Overall RMS (root mean square) level of vertical vibration is 0.56G.

Swept Sine Vibration.

The wrapped assembly will meet the criteria shown below while operating in respective conditions.

- No errors - 0.5G 0-peak, 5-300-5 Hz sine wave, 0.5 octaves/min sweep rate with 3 minute dwells at 2 major resonances.
- No data loss - 1.0G 0-peak, 5-300-5 Hz sine wave, 0.5 octaves/in sweep rate with 3 minute dwells at 2 major resonances.

2.10.6 Non-Operating Vibration

The drive does not sustain permanent damage or loss of recorded data after being subjected to the environment described below.

Random Vibration.

The test consists of a random vibration applied for each of three mutually perpendicular axes with the time duration of 10 minutes per axis. The PSD levels for the test simulates the shipping and relocation environments.

Random Vibration PSD Profile Breakpoints (Non-Operating)							
Hz	2	4	8	40	55	70	200
$x10^{-3}$ [G^2/Hz]	1	30	30	3	10	1.0	1

Overall RMS (Root Mean Square) level of vibration is 1.04G.

Swept Sine Vibration.

- 2 G (zero to peak), 5 to 500 to 5 Hz sine wave
- 0.5 octaves/min sweep rate
- 3 minutes dwell at two major resonances

2.10.7 Towards and from

2.10.8 Transfer function

2.10.9 Rotational Vibration

A major problem for the new generation of high performance hard disk drives (10krpm and up) occurs when the rotational vibration of one drive induces performance loss in neighboring drives. The faster drives with tighter track pitches and lower flying heads are more susceptible to in plane yaw rotation about the spindle axis.

A set of metrics must be developed to quantify the rotational vibration in the form of numerical targets for acceptable energy levels measured at the drive in the system environment.

There are two main sources of operational vibration problems for hard-mounted drives:

1. Seek-related rotational vibration caused by the voice coil motor rotating the head mechanism to the proper location above the disks. Random seeks will in turn cause random rotational oscillations with broad frequency content. The transmission path causes in-plane oscillation of the drive’s dock as well as the neighboring docks and drives.
2. Imbalance related rotational vibration from either a static or dynamic imbalance in the disk pack.

2.10.10 Wrapper/Dock Interaction

2.11 Thermal Management

The wrapped assembly must allow for cooling of the electronics and head and disk assembly (HDA). Forced convection via fans will pass air through holes in the backplane to facilitate the cooling of the unit. It is recommended that the air flow be directed front to back over the wrapped hard drive assemblies where the back is defined to be the connector end of the device.

The metal wrapper will act as a heatsink for the hard drive with conduction occurring along the four screws used to attach the hard drive to the wrapper. The thermal capacitance and increased surface area of the cast metal wrapper will help to alleviate the heat buildup.

2.11.1 Max Power

2.11.2 Peak Power

The operating conditions for the device are as follows:

Description	Value
Air Temperature	+5C to +35C up to 5000 ft
Air Temperature	+5C to +30C, 5000 ft to 10,000 ft
Humidity	10% to 95% non-condensing

The non-operating conditions for the device are as follows:

Description	Value
Temperature	-40C to +60C
Humidity	10% to 90% non-condensing
Altitude	-1,000 ft to +40,000 ft

2.11.3 Case Temperature

3.0 Connector Specifications

Reference SCA-2 (PAT M.)

4.0 Visual Status Indicators

4.1 LED's

There will be two LED indicator lights per drive for “Drive Activity” brought to the front of the Drive Carrier via light-pipes. The light pipes will be located in the dock. Current for the LED shall be supplied by the drive via the SCA as appropriate.

5.0 Hot Plugging

Reference SCA-2.