Connector Primer for Solid State Storage Devices

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As computing power and speed increase, solid-state storage device (SSD) drives are gaining traction in the marketplace against hard disk drives (HDD). Technological improvements, including connector advances, have helped mitigate many of the cost and capacity disadvantages associated with early iterations of SSD. Connector technology has also had to keep pace in supporting high performance as more design engineers turn to SSD for enhanced performance capabilities.

Connectors bridge the gap in circuit design by allowing current to flow seamlessly through the circuit to perform its intended function. High-level conceptualization and design strategies are needed for connectors to meet the mechanical and electrical performance demands of the SSD and datacom industry. Connector innovations and sound engineering principles can not only drive smarter design, but also help ensure that specified SSD-interconnect solutions deliver optimal performance as well as safety and long-term reliability of electronic circuitry.

Advent of Micro SAS

The advent of 1.8” drives led to the development of a small form-factor interconnect that has the performance headroom to meet requirements of mission-critical enterprise-storage interconnect needs for years to come. Micro SAS connectors are the storage industry’s smallest, next-generation, high-speed serial I/O solution for 1.8” drives that enable fast data rates of up to 6 Gbps.

Micro SAS architecture features a proven SCSI command set, advanced command queuing, and advanced verification/error correction. Micro SAS is also the ideal compact solution for high-speed, high-bandwidth SAS applications. In addition, Micro SAS connectors meet the SFF-8486 Specification, which defines the physical interface and general performance requirements for Micro SAS connectors used in high-speed serial interconnect applications including, but not limited to, SSD drives.

Dual Stack for Increasing Density and Performance

Dual stack, right-angle micro SATA/SAS connectors are used in 1.8” drives to increase density and provide sufficient electrical performance. A number of special features add to the SATA/SAS connector performance, including a common ground plane, staggered terminal pins, and terminal bends for increased performance.

The benefits of dual stack include increased drive density by stacking two 1.8” drives. Molex dual-stack drives provide much better electrical performance compared to the standard design. The addition of a stamped-type terminal acts as common ground between designated differential pairs to reduce coupling between them. This common-ground pin is used to connect both upper and lower-deck receptacles, as shown below. The common-ground pin is necessary for high-speed electrical performance and acts as a big plane that shields the coupling between the two high-speed differential pairs. Repeat iterations minimize the permanent set. This helps determine the optimal design of the dual-stack connector terminals.
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Electrical Performance

To do the job right as well as ensure reliability and optimal electrical performance over time, a connector’s electrical performance must meet or exceed the level at which a disk drive performs. New advances in connector features include reduced coupling between differential pairs and improvements of the coupling within the differential pair to improve transmission, signal integrity and electrical performance.

SSD connectors used in 1.8” drives vary somewhat from connectors for 2.5”/3.5” drives. The 1.8” drive connector has a smaller 25-pin count compared to a 29-pin count used in 2.5”/3.5” drives. The main difference is reflected in the power segment. The 2.5”/3.5” has 15 pins in the power segment, compared to 9 pins in the power segment of the 1.8” drive. Smaller SSD drives don’t require 12V, so they have a lower voltage requirement, hence the lower pin count.

Simulations Mitigate Connector Warpage

In solid-state device drives and all applications, connector warpage is a common problem. Simulations are performed during SSD connector design to reduce incidents of warpage while connector material can also mitigate warpage. Different mold compounds will have different mechanical and thermal properties, so mold compounds perform differently for a particular design. It’s important to choose a mold compound that performs optimally, with minimal warpage.

When the mold compound is injected into the mold cavities for the connector, the flow creates a filling pattern that reveals if the design of a connector and its tooling are correct. The purpose of closely analyzing the mold filling pattern is twofold: 1) To minimize any residual stresses that may be caused by injecting and cooling of the mold compound in the mold cavities; and, 2) to avoid short molds that may occur if the filling is not optimized, which would indicate that some part of the connector is not molded.

OEMs Benefit from Connector Technologies

A connector must ensure that the designer can tap the full functionality of an SSD drive. Speed, heat, data integrity, power integrity, and a host of application issues influence SSD connector design and selection. Gaining a clear understanding of all requirements early in the design phase and before specifying interconnect components can help ensure the right decisions and avoid costly missteps.

High-quality interconnect design and engineering enable electronic equipment and device manufacturers to maximize the performance, reliability and safety of their products—resulting in higher sales and customer satisfaction. Leading connector providers will work closely with OEMs and their design teams to match the connector selection to the specific application based on scientific testing and performance analysis under real-world application conditions. Today’s OEMs benefit from these and other technological developments as well as advances in connector technology that help drive the solid state storage industry.