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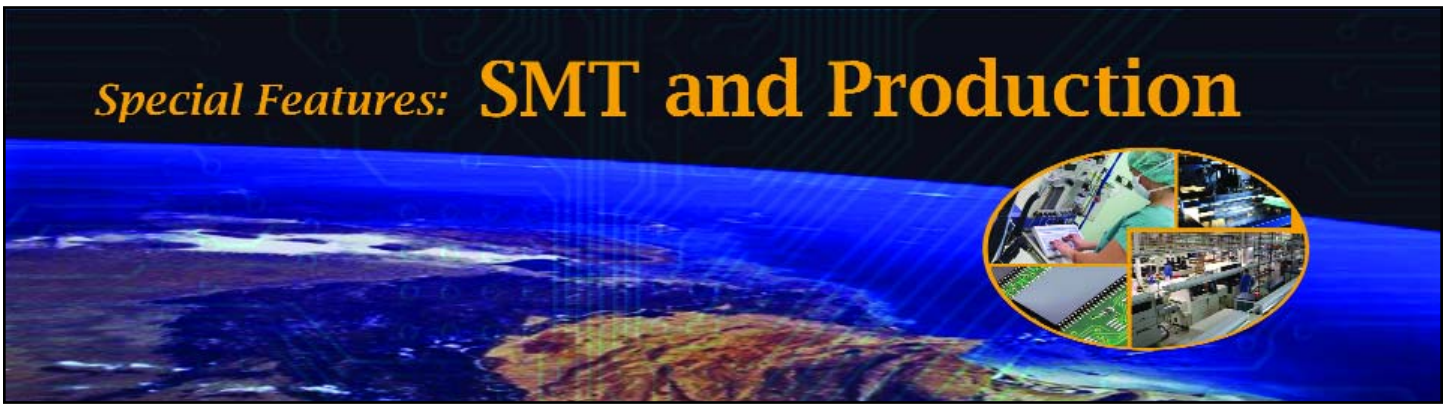


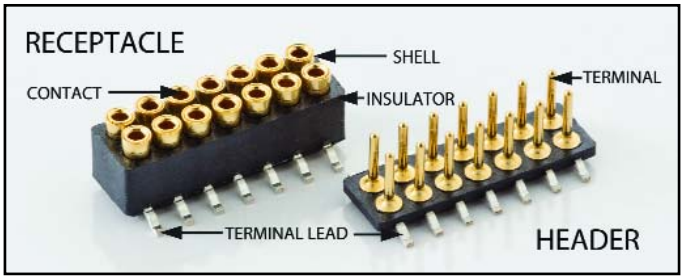
Reducing Stack Height with Low-Profile SMT Connectors

By Glenn Goodman, Senior Development Engineer, Advanced Interconnections Corp.

To fit more functionality into tighter spaces, multiple circuit boards are typically needed. These multiple boards require some form of board-to-board electrical interconnections to link the different functions of each board. Numerous choices are available for these board-to-board interconnections, each with its own mechanical and electrical properties. However, the size constraints of today's high-density, compact packages are driving a demand for lower-profile connectors.

PCB connectors are typically configured as two-piece interconnection systems, with a header and a receptacle or socket. Most are designed to provide paths for signals and power between boards, with configurations spanning from single contacts to large numbers of contacts for complex power/signal connections. One-piece PCB connectors are also available, with a connector mounted on one board making connections with a secondary board through compression of the contacts on the second board.

PCB connectors are specified by the number of positions or number of circuits that they can support. The contacts, also called terminals or pins, are defined by pitch — the distance from the center of one contact to the center of the next contact. The typical pitch for PCB connectors ranges from 0.5 to 1.27 mm (0.02 to 0.05 in.), with contacts arranged in one, two, three, or four rows. Engineers challenged with designing low-profile packages continually balance these mechanical design options with electrical and performance requirements.



Low-profile SMT connector system consisting of a receptacle (left) and a header (right), designed to mate with minimal force.

Stacking PCBs

Many connector systems provide secure interconnections between circuit boards, but also add size to the final assembly. One way to reduce the overall size of a multi-board circuit assembly is by stacking boards. In some cases, the final height of a board assembly can be critical because of limited available space in a particular system.

An example of such a limited-space requirement is an integral tunable laser assembly (ITLA) that is part of an optical transceiver for a telecommunications system. In this application, the layout requires either a micro cable-to-board or board-to-board solution to provide power to the laser without adding height to the small form-factor pluggable (SFP) transceiver module.

A connector system with special requirements is needed for the ITLA. Minimum stack height is important to allow the connector assembly to fit into the system design; off-the-shelf connector components did not meet the mechanical and electrical demands of such a tight-fitting circuit board assembly.

Because space is limited, a connector system with a fine pitch is required. However, the contacts also need to be robust, to meet the demands of a telecommunications system for long operating lifetime with minimal performance degradation.

The compact laser package only allowed for a connector with a length less than 8 mm (0.31 in.), a minimal

board stack height of 4 mm (0.16 in.) and compatibility with automated assembly equipment for attaching the connectors to circuit boards.

The costs and difficulty of assembling circuit boards with any connector system increase when special tooling or assembly equipment is required. Ideally, a connector system that enables stacking of circuit boards with reliable low-profile SMT interconnections can be supplied in tape-and-reel format in support of automated board assembly processes.

Connector Solution

To fulfill this assortment of challenging requirements for a robust interconnect for tightly-packed, stacked circuit boards, a connector system solution was developed using screw-machined terminals rather than conventional stamped-and-formed terminals. The connector system consists of a header and a receptacle.

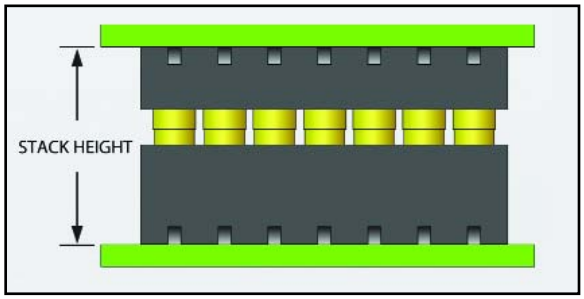
The header or male connector has a terminal (pin), an insulator and a stamped lead frame. The receptacle has a protective female shell with internal six-finger contact, an insulator, and a stamped lead frame.

Achieving the tolerances required for precision contacts to be set in a dense, 1 mm (0.04 in.) pitch calls for exceptional screw-machining capabilities. This approach is capable of yielding a high-performance connector system with fine features.

Combining the precision tolerances of screw-machined socket terminals and stamped multi-finger contacts contributes to securing long-term connections of mated connector halves. The screw-machined terminals with their multi-finger contacts account for the SMT connector system's long operating lifetimes for critical applications, such as in telecommunications systems.

This low-profile connector system, from Advanced Interconnections, is the Mezza-pede® SMT connector. It is a two-piece connector system with a header and a receptacle for mounting on circuit boards to be stacked and interconnected or used in a cable-to-board configuration.

The terminals are set on a 1 mm (0.04 in.) pitch in dual-row configurations with various pin counts. The connector system is characterized by a short stack height when compared with conventional connectors designed for stacking PCBs. With stack heights as low as 3.4 mm (0.13 in.), these low-profile connectors enable assembly of stacked PCBs for the tightest installation spaces.



The Mezza-pede SMT connector with 1 mm (0.04 in.) pitch contacts achieves a stack height as low as 3.4 mm (0.13 in.).

Low-Profile Interconnection

For any two-piece connector system designed for stacking circuit boards, the height of the mated connector halves will impact the z-axis, usually documented as the stack height of the mated PCBs with that connector system. This is essentially the distance from the bottom of the upper PCB to the top of the lower PCB.

A number of connector component issues contribute to the stack height achieved with a board-to-board connector system, including the length of the contact pins and the thickness of the insulator material used in the connectors.

For this new, low profile connector system design, the choice of insulator material was important not only for its contributions to the height of the mated connector but for its electrical characteristics. As an insulator, the material must provide suitable isolation between closely spaced connector contacts for minimal crosstalk.

But, it must do so with minimal contributions to the total height of a mated connector pair. The insulator material chosen for the new low-profile SMT connector system is a high-temperature liquid crystal polymer (LCP). It exhibits insulation resistance of greater than 1,000 MΩ, achieving high isolation between closely spaced, 1 mm (0.04 in.) pitch contacts.

Additional materials for the low profile SMT connectors were carefully selected to complement the high-temperature capabilities of the LCP insulator material for compliance with RoHS-2, lead-free soldering processes, including the use of matte tin plating. The connectors are usable at operating temperatures up to 125°C (257°F) and are tested for durability by 20-day mixed-flow-gas (MFG) testing.

In MFG tests, the ambient temperature, relative humidity, concentration of gaseous pollutants, and other environmental variables are controlled and monitored to simulate environmental phenomena related to corrosion and how the connectors will weather those conditions. The testing is meant to reproduce, at an accelerated rate, typical environmental conditions contributing to corrosion and equipment failures so that they can be minimized.

These SMT connectors with screw-machined terminals manage to achieve low stack heights without compromising performance, operating lifetime or reliability of connection. Available in tape-and-reel packaging for automated assembly, the connectors show that several manufacturing techniques, such as the use of screw-machined and stamped metal components, can be combined practically to create a connector system that meets demanding application requirements without sacrificing performance or ease of use.

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