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Orthogonally Hot Plug Enabled Blindmate Socket Connect

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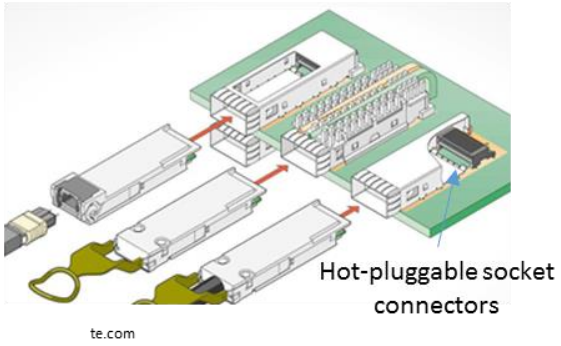
Problem Statement

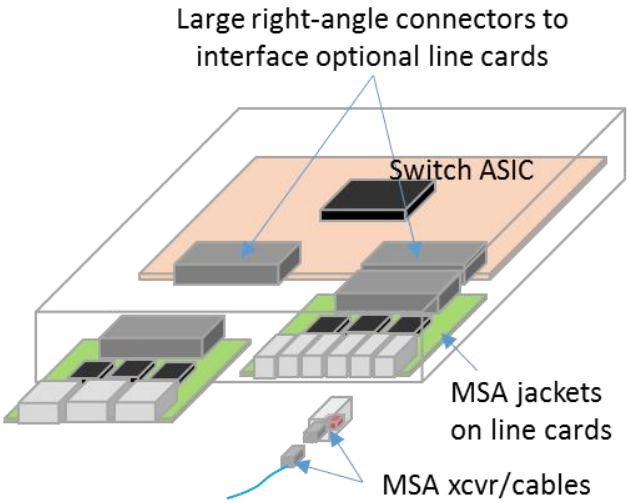
Supporting flexible transceiver types and high-density in servers and switches requires significant overhead in server and switch designs. Some switch systems use line cards to modularly implement different product options, such as fabric protocols and fabric interface signal lane counts. This requires large PCB and high lane-count right-angle electrical midplane connectors that are typically large, causing signal integrity and airflow blockage issues. Other implementations use hot-pluggable transceivers that are difficult to cool within metal cages (e.g., standard pluggable transceiver modules) and require right-angle connectors, while some designs use embedded mid-board optics transceivers that are not hot-pluggable or replaceable. Some hot-plug module examples are shown below:

Hot-Pluggable Optical Transceivers



Embedded Optical Transceiver

Line-card based traditional switch module



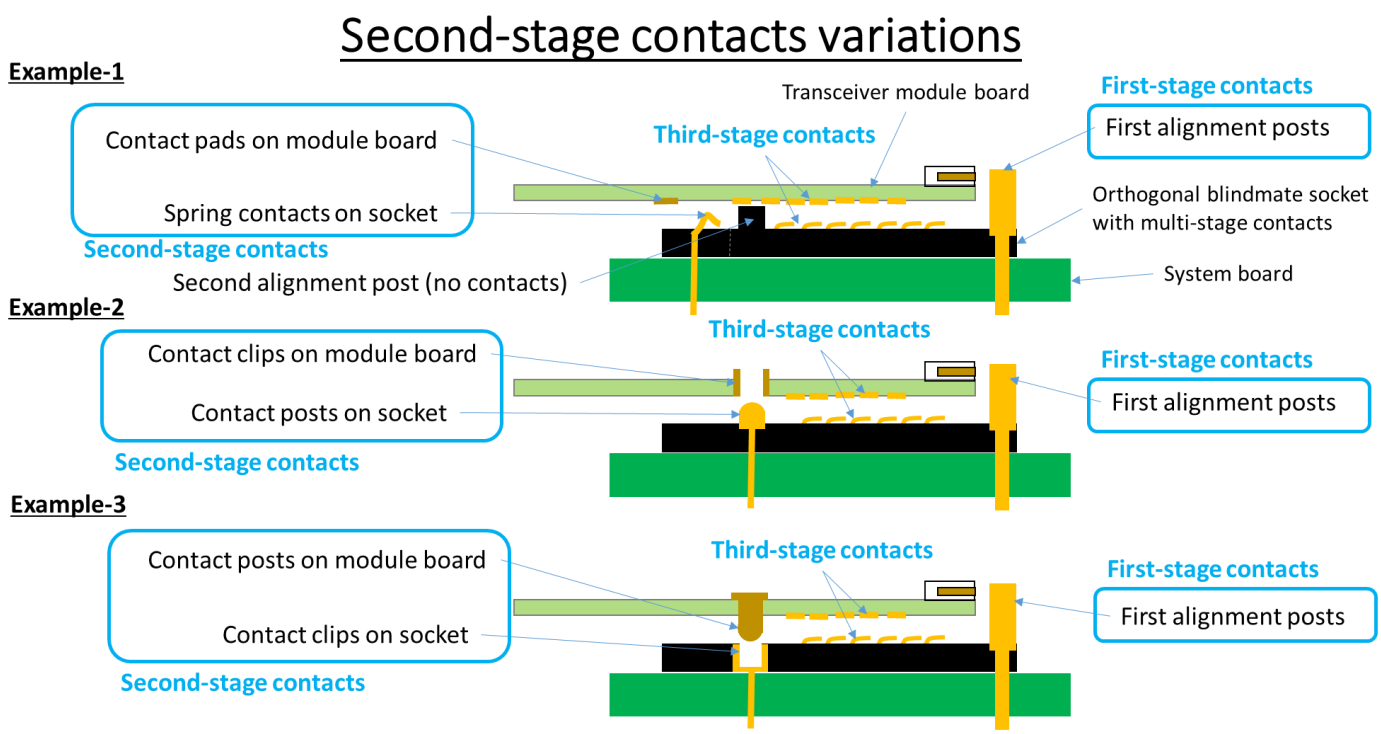
Solution

The following illustrations describe a variety of hot-plug enabled sockets that allow pluggable modules with multi-stage alignment features to overcome the challenges described above. A pluggable module and a socket have complementary features for mating alignment in three stages:

1) First-stage lateral alignment feature that also functions as first-mate and last-break power contacts
2) Second-stage vertical alignment feature that also functions as second-mate and second-break ground contacts
3) Third-stage vertical alignment feature that also functions as last-mate and first-break signal and ground contacts

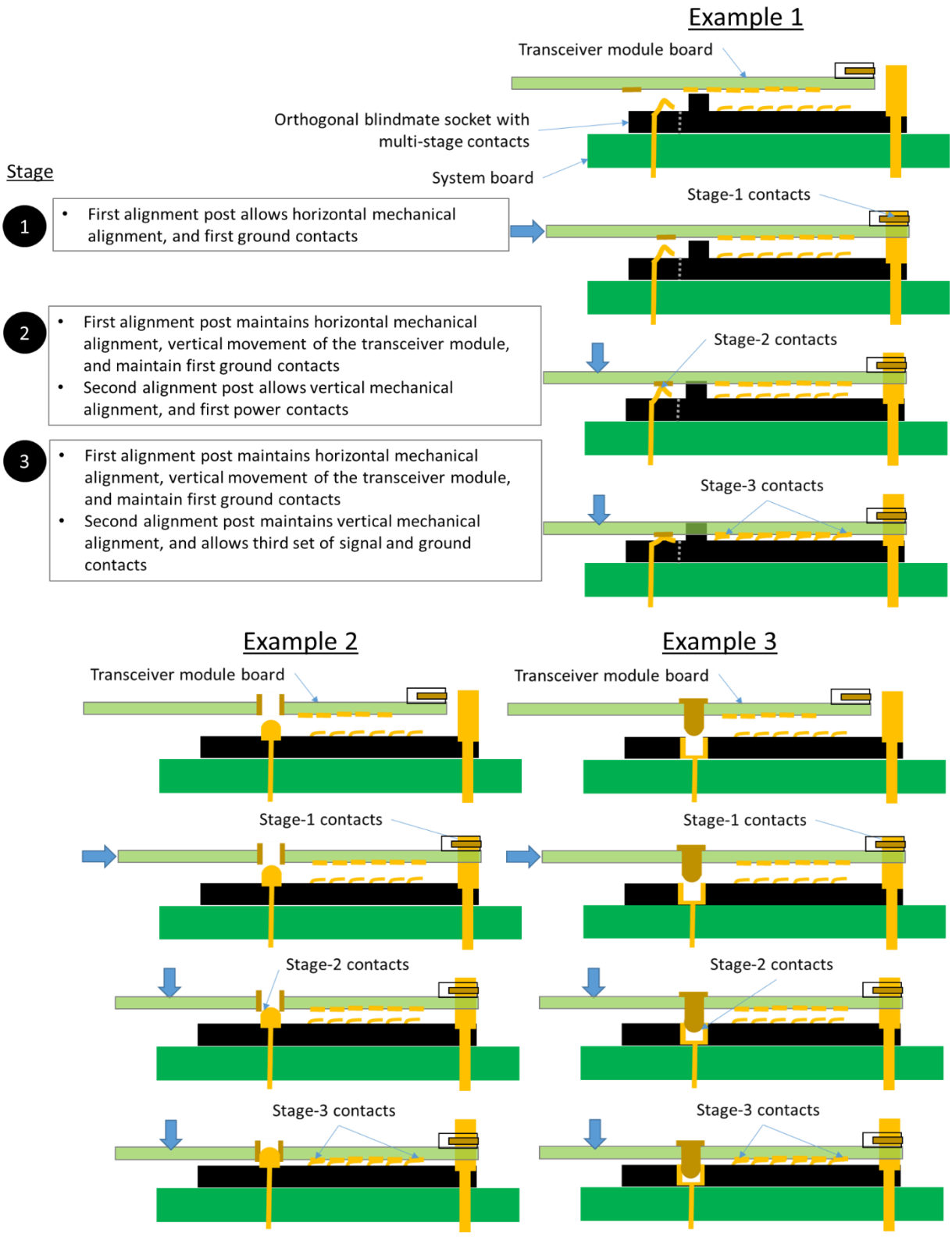
First-stage ground contacts are large, allowing coarse alignment and high current capabilities, eliminating the need to use large number of small contacts for power return. Second-stage power contacts are also large, allowing finer alignment and high current capabilities, eliminating the need to use large number of small contacts for power source. Large contacts also can be designed to minimize mating force. The first-mate last-break of ground then power contacts with respect to signals is necessary for hot-plugged electronic devices to properly function. After the second-stage alignment and contacts are engaged, the third-stage signal contacts are LGA type spring contacts are already aligned to be mated vertically. LGA contacts allow better signal integrity compared to right-angled contacts for high-speed signals because the contacts within the LGA socket are more consistently encased with dielectric material and have more consistent shorter contact geometries.

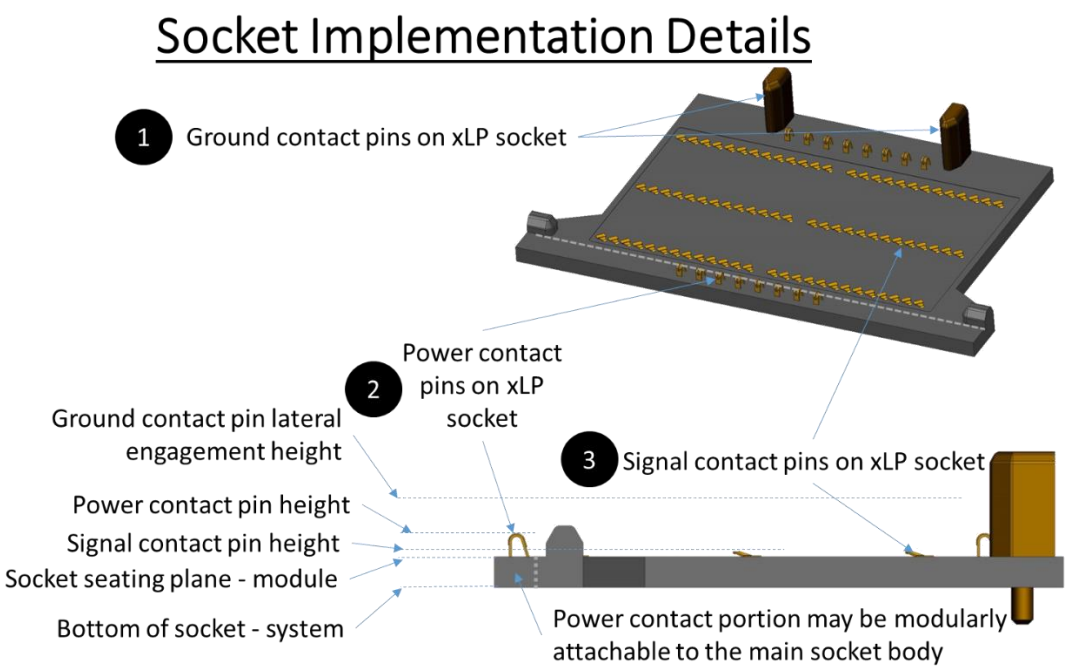
The following illustrations show examples of second-stage contacts:

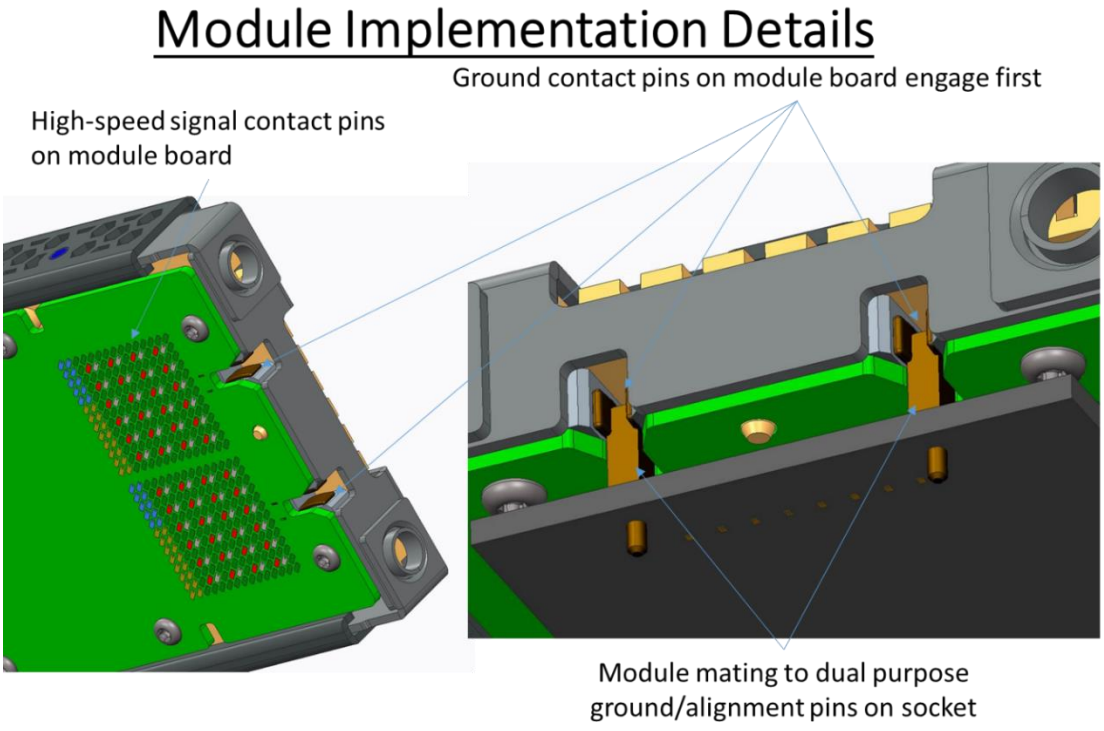


This design allows the large alignment posts for electrical contacts allows a larger surface area for electrical connection and enabling higher current applications. In addition, fewer spring contact required for power allows lower compression force, which in turns places less mechanical strain on the system and module board.

Mating Sequences




Socket Implementation Details
1
Ground contact pins on xLP socket
2
Power contact pins on xLP socket
Ground contact pin lateral engagement height
3
Signal contact pins on xLP socket
Power contact pin height
Signal contact pin height
Socket seating plane - module
Bottom of socket - system
Power contact portion may be modularly attachable to the main socket body


Module Implementation Details
Ground contact pins on module board engage first
High-speed signal contact pins on module board
Module mating to dual purpose ground/alignment pins on socket

Benefits

Hot-pluggability is achieved using multiple stages of contacts and alignment posts that also serve as first-mate last-break contacts. This allows the number of LGA pads on the module to be reduced which lowers cost and mechanical infrastructure needs. By allowing a hot-pluggable module with a vertical socket connection to the system, this design allows for better signal integrity performance, field servicing and configurable options for end users. Since all the high pin-count high-speed signals are at the bottom of the hot-plugged module, system board space is more efficiently used and no tall right-angle connectors that may block air flow, allowing better cooling environment. LGA contacts also allow large number of high-speed contacts to support modern devices such as SoC, GPU, FPGA and accelerators.

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