Optimizing Data Routing via Copper & Optical Interconnects in Scalable AI Hardware Architectures

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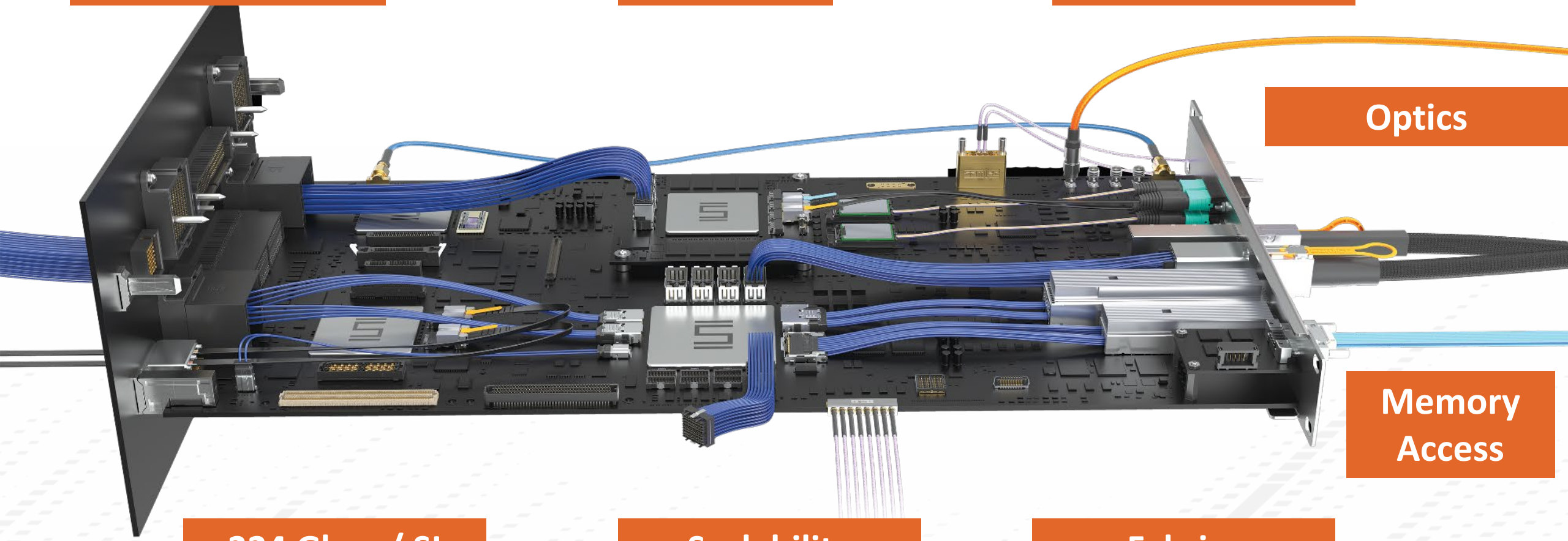
Optimized Data Routing - How???

Disaggregation

1.21 GW!

Thermal Relief



Optics

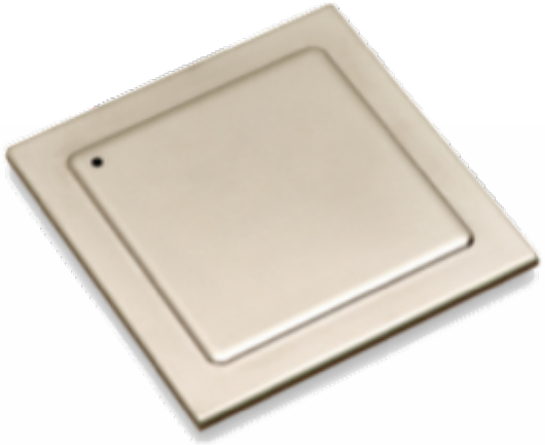
Memory Access

224 Gbps / SI

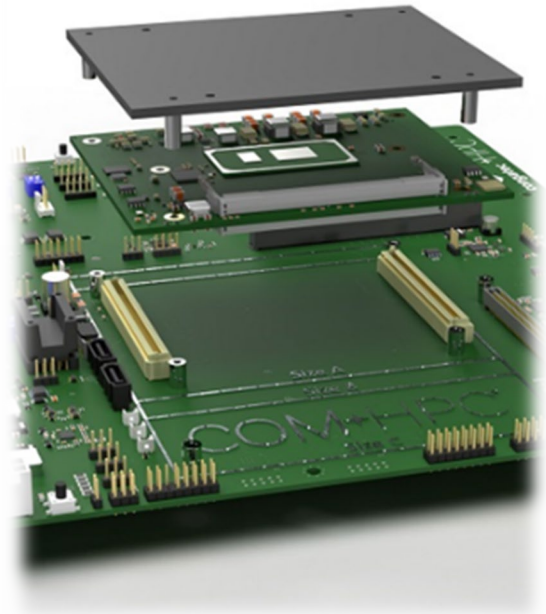
Scalability

Fabrics

Key AI Hardware Applications



CHIPSETS



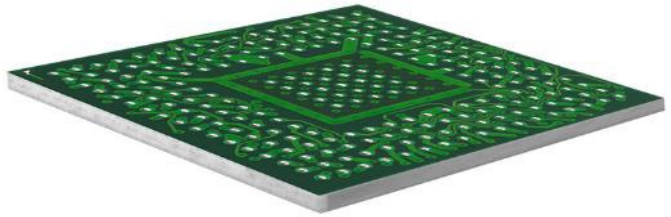
SoMs/CoMs

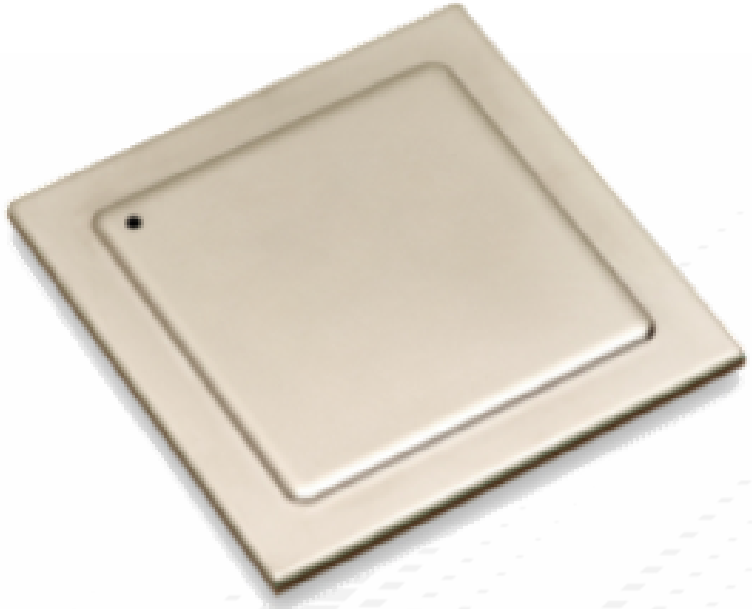
ACCELERATORS

DSAs

AI Chipsets/Characterization Platforms

- A number of emerging AI chipset options from a variety of suppliers
  - SoCs, CPU, GPU, TPU, Digital Compute, Analog Compute, etc.
- Fine-tuned for training or inference whether at edge or in the data center
- AI system development typically links AI chipset development boards mimicking end applications
- AI chipset I/O expansion opportunities abound



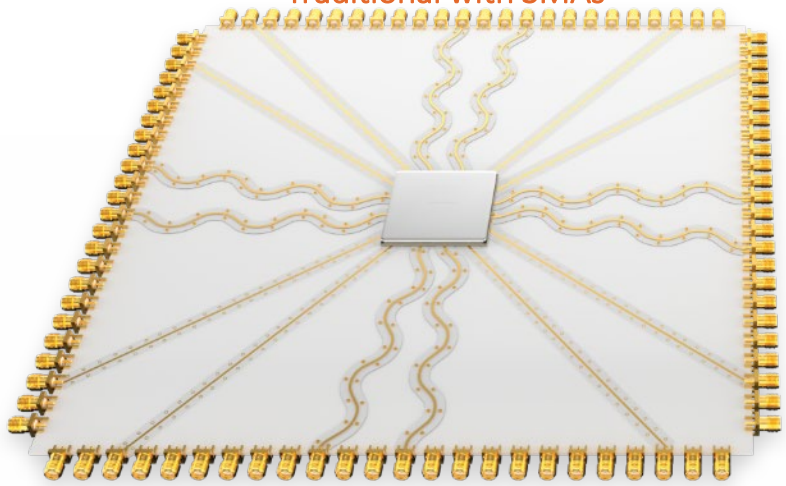


Samtec Bulls Eye® High-Performance Test

- The high-density array designs and advanced cabling solutions support T&M applications to 70 GHz
- 90 GHz solutions in development
- Compression interface provides easy mating/unmating and eliminates soldering costs
- High-density, space-saving design
- Enables smaller eval boards and shorter trace lengths
- Ideal for testing the latest AI chipsets capable of 224 Gbps PAM4

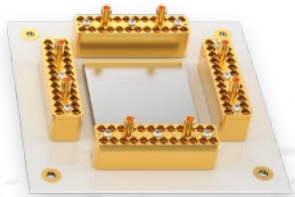
BULLSEYE® TEST POINT SYSTEM

Traditional with SMAs

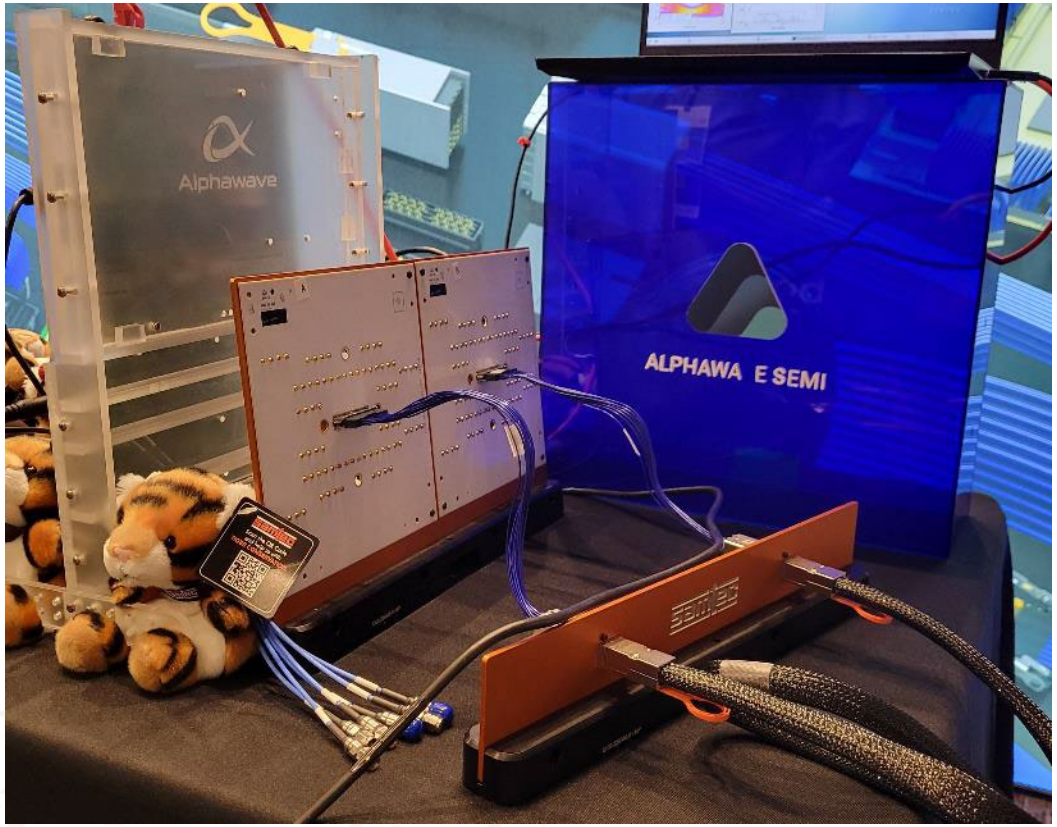


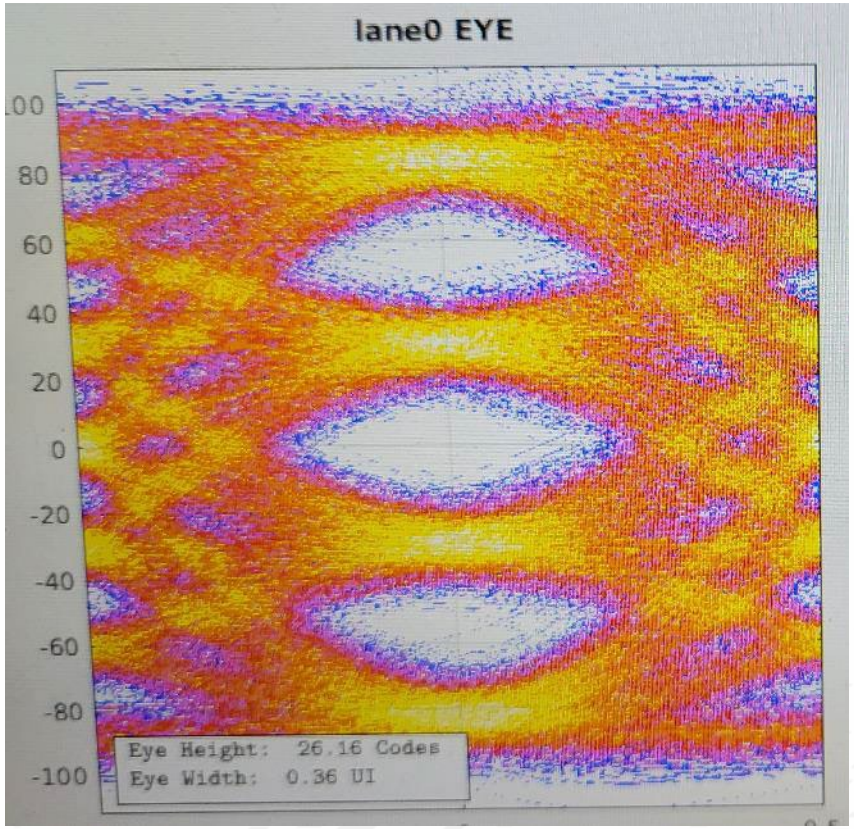
Enables smaller evaluation boards & shorter trace lengths

Bulls Eye®



Bulls Eye® Case Study





AI SoMs/CoMs

- Complete compute system on a single PCB
- ASIC, RAM, I/O, peripherals, etc.
- System I/O and peripherals routed via connectors to carrier board/baseboard
- Provides a path from prototype to production
- AI systems can consist of multiple SoMs/CoMs
- New SoMs/CoMs feature increased speed and density in small footprints

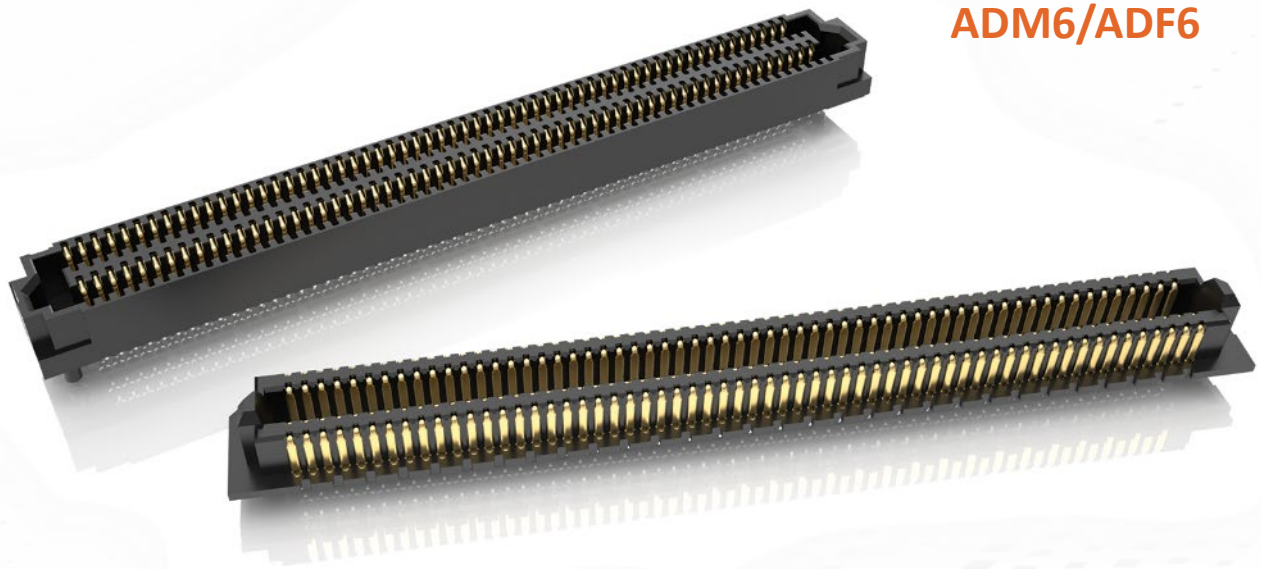
High-Density Slim Body Arrays

- Up to 400 I/Os in a 4-row, open-pin-field design
- 0.635 mm pitch Edge Rate® contacts
- Slim 5 mm body width
- 5 mm to 16 mm stack heights
- PCIe® 6.0/CXL® 3.1 capable
- Solder column termination for improved SI and ease of processing

ACCELERATE®HD

PAM4 64 Gbps

ADM6/ADF6

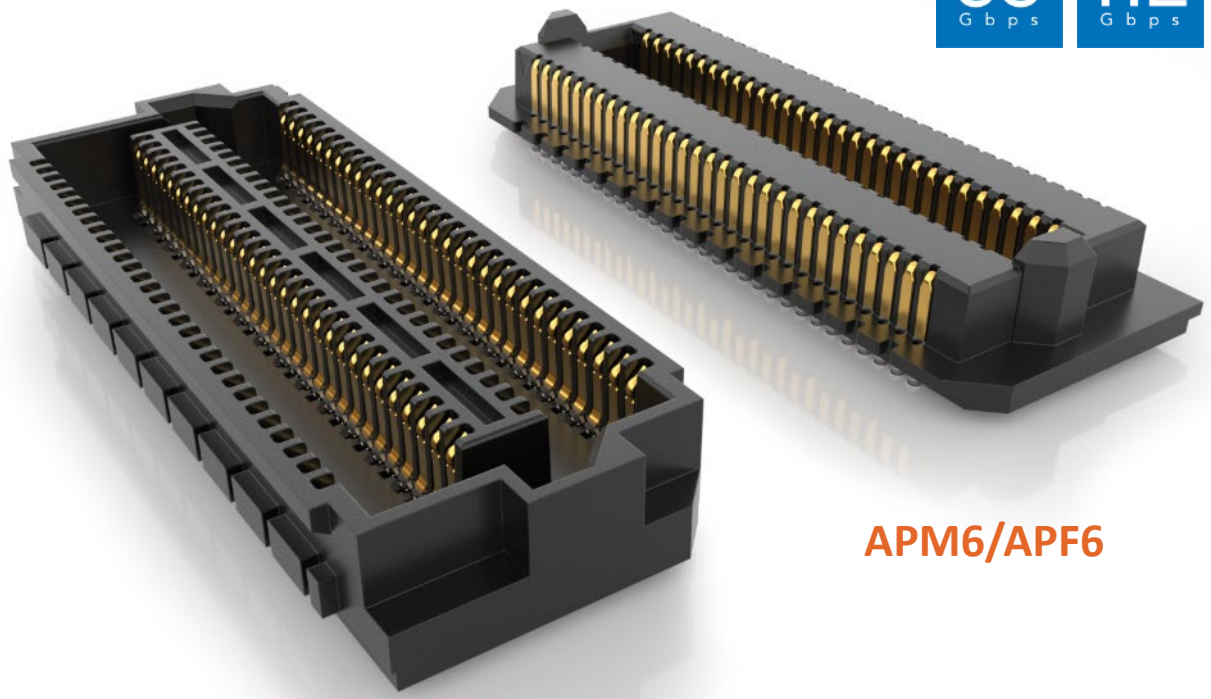


High-Performance Arrays

- Flexible open-pin-field and cost optimized, extreme performance solution
- 5 mm and 10 mm stack heights
- Right-angle socket available (APF6-RA)
- Four row design with up to 400 total pins on a 0.635 mm pitch
- Roadmap to 1,000+ pins
- Solder column termination for improved SI and ease of processing
- Data rate compatible with PCIe® 6.0/CXL® 3.1 and 100 GbE
- Additional row and pin counts in development

ACCELERATE®HP

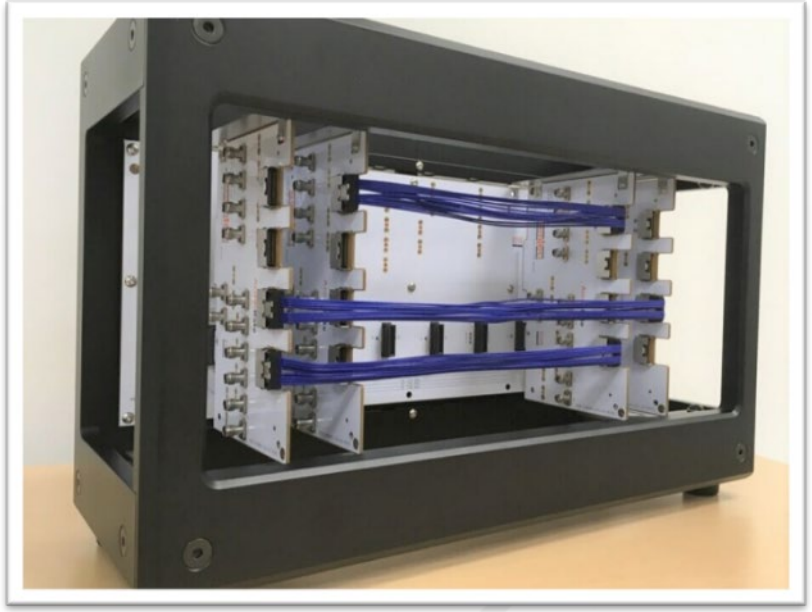
NRZ 56 Gbps | PAM4 112 Gbps



APM6/APF6

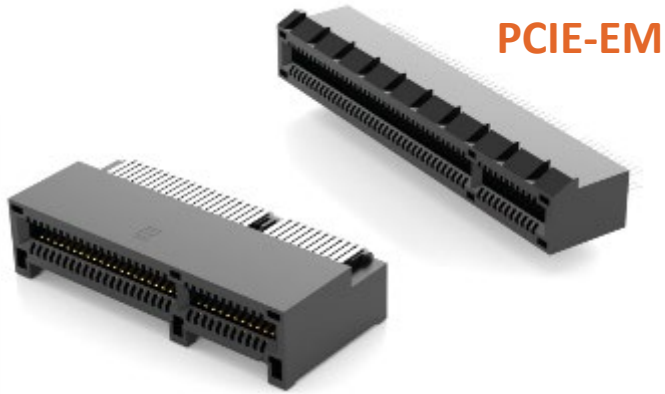
AI Accelerators

- Used to “Accelerate” parallel computing workloads common to AI/ML
- Industry-standard form factors
  - PCIe CEM AIC, PECFF, M.2, etc.
- AI chipset manufactures developing their own solutions
- Deliver dramatic acceleration across a broad set of applications
- Reconfigurable to provide an ideal fit for the changing workloads of the modern data center



PCI Express® Edge Card Systems

PCI Express® 3.0 Edge Card Connector



PCIE-EM

PCIE-RA

PCI EXPRESS®

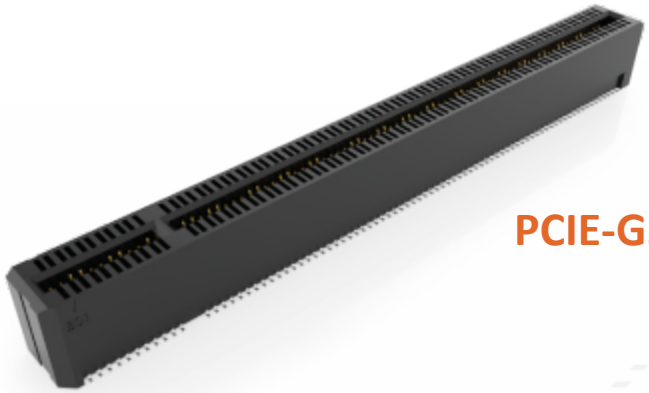
PCI Express® 4.0 Low Profile Edge Card Connector

PCIE-LP

PCI EXPRESS®

8 mm Low Profile Design vs. 11 mm Standard Height

PCI Express® 5.0 Edge Card Connector



PCIE-G5

In Development:
64 GT/s edge card system

PCI EXPRESS®

PCI Express® Jumper Cable Assemblies

- PCIe® 3.0/4.0/5.0 capable cable assembly
- PCIe® 6.0 under development
- Used for PCIe implementation, evaluation and development
- Configurable as a jumper or an extension cable
- Available in custom lengths to suit any application
- Standard 36, 64, 98 and 164 Positions
- Edge card or connector end options available
- Mates with Samtec's PCIE/PCIE-G4/PCIE-G5 series

PCIEC/PCIEC-G4/PCIEC-G5

Standard RF End 2 options also available

Generate™ High-Speed Edge Card System

- Compatible with SFF-TA-1002 (1C, 2C, 4C & 4C+)
- PCIe® 6.0/CXL® 3.1 capable
- Edge Rate® contacts optimized for signal integrity performance
- Vertical or right-angle cable launch
- Mates with Generate™ 0.60 mm pitch high-speed edge card socket (HSEC6)
- Rugged metal latching system

AcceleRate® Slim, Direct Attach System

- Slimmest cable assembly in the industry - 7.6 mm width
- 8, 16 and 24 DPs configurations in a high-density 2-row design
- 72 DPs in development

- PCIe® 6.0/CXL® 3.1 capable

- Contacts directly soldered to the twinax improves signal integrity by eliminating the transition board and its variability

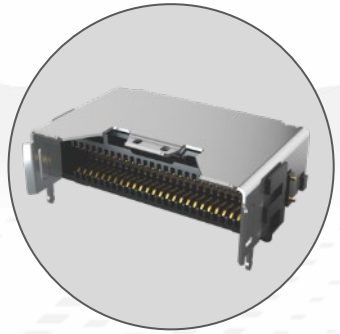
- Rugged metal latching and shielding

- “Reversed Polarity” pinout option for reduced FEXT

ACCELERATE®

ARC6/ARF6

PAM4 64 Gbps



Right-angle board mate available (ARF6-RA)

Domain Specific Architectures

- Evolving AI DSAs require more external cabling

- Reach requirements vary depending on use case
- 2m – Within the rack
- 7m – Rack-to-rack
- 10m+ - Larger clustering

- Several industry efforts underway to answer the challenge
- Passive DACs
- Re-timed AECs
- New PCI-SIG® CopprLink™ Cable Specification
- Optical Transceiver MSAs

- Is there another way?

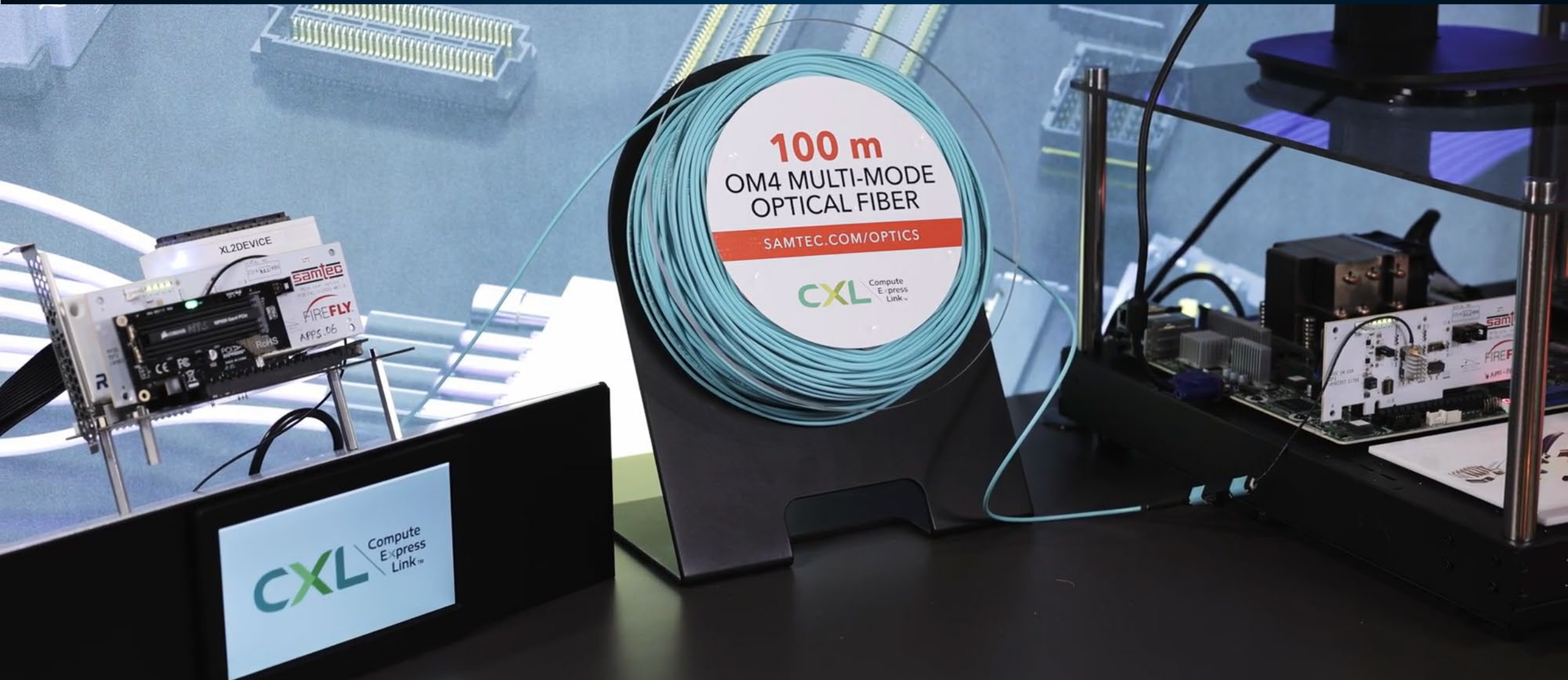
FireFly™ Optical Flyover® Technology

Data connection is taken "off board," simplifying board layout and enhancing signal integrity from IC to faceplate

FEATURES

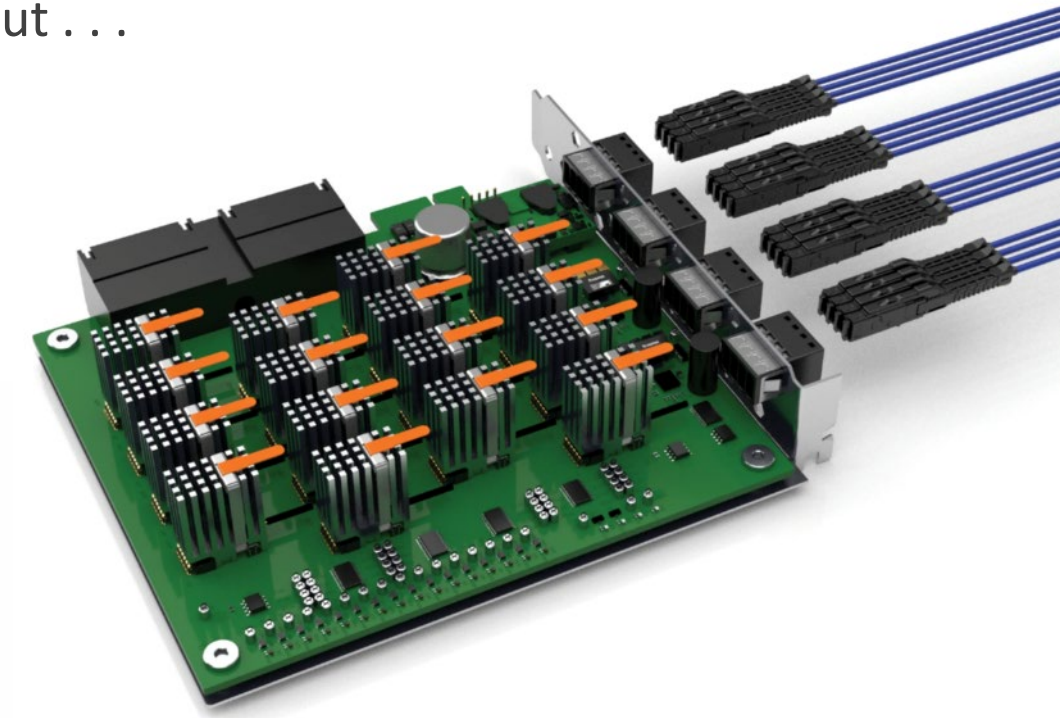
- Up to 28 Gbps per channel via optical cable for greater reach → 32 Gbps under development
- Industry leading miniature footprint allows for higher density close to the data source
- Protocol agnostic
- Simple to use system with easy insertion/removal and trace routing, no through-holes, and a surface mount connector system
- Supports data center, HPC and FPGA Protocols, including 10/40/100 GbE Ethernet, InfiniBand™, Fibre Channel, PCIe®, CXL™, and Aurora

Scalable AI Hardware Optical Solutions



Scalable AI Hardware Optical Solutions

- Mid-board optical transceivers are nice, but . . .
- Many AI HW systems leverage PCB-based interconnect
- Samtec FireFly™ OCP OAI EXP Module
- Features 16x FireFly Optical Transceivers
  - 25 Gbps x4 configuration
  - 400 Gbps aggregate throughput
- Live demonstration at 2024 OCP Global Summit

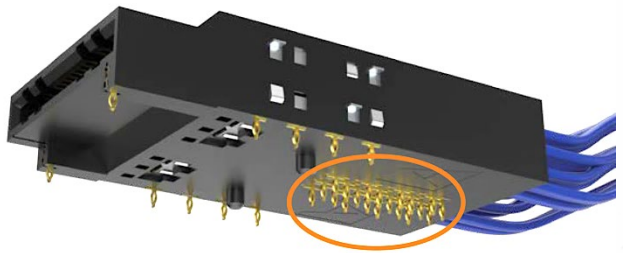


Flyover® QSFP Systems

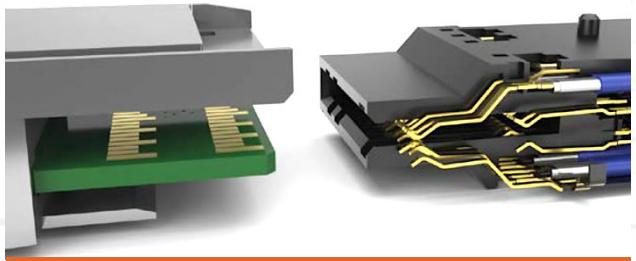
- Up to 800 Gbps PAM4 aggregate data rate
- Various configurations (x4/x8 bidirectional)
- Belly-to-belly mating available
- Multiple heat sink options for optimal dissipation
- Variety of end 2 options
- Additional front panel ports in development:
  - Flyover® SFP112/Flyover® OSFP 112 Gbps PAM4

FQSFP-D8

NRZ 56 Gbps | PAM4 112 Gbps



Sideband signals are routed through press-fit contacts for increased airflow



High-speed contacts directly soldered to Eye Speed® ultra low skew twinax

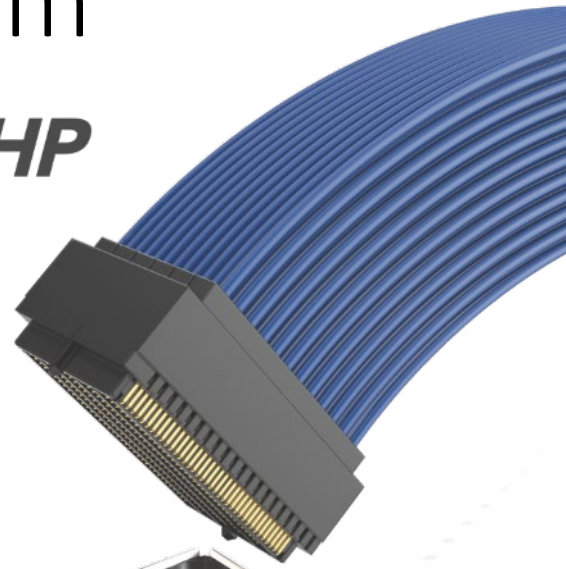
AcceleRate® HP Gen 2 On-Package System

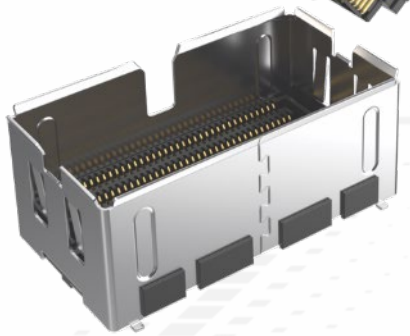
- First direct-to-chip package solution with the industry's highest density 112 Gbps PAM4 interconnect
- Double the density in same footprint → 144 DPs
- Vertical cable application provides the highest footprint density
- 2-piece system for high reliability and thermal performance required for co-packaged solutions

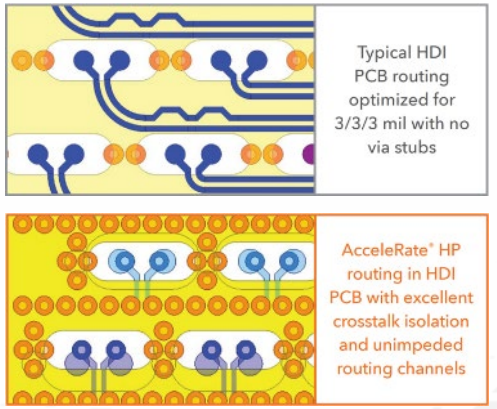
ACCELERATE®HP

NRZ 56 Gbps | PAM4 112 Gbps

ART6/ATF6





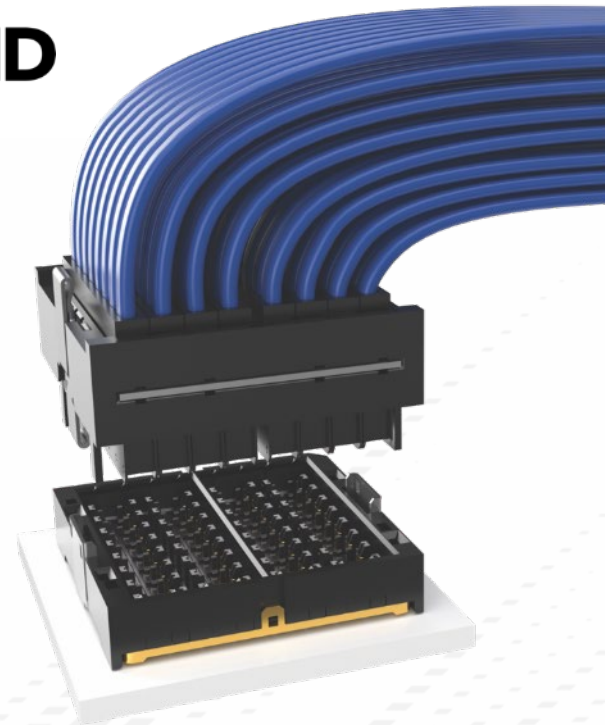


Si-Fly™ High-Density On-Package System

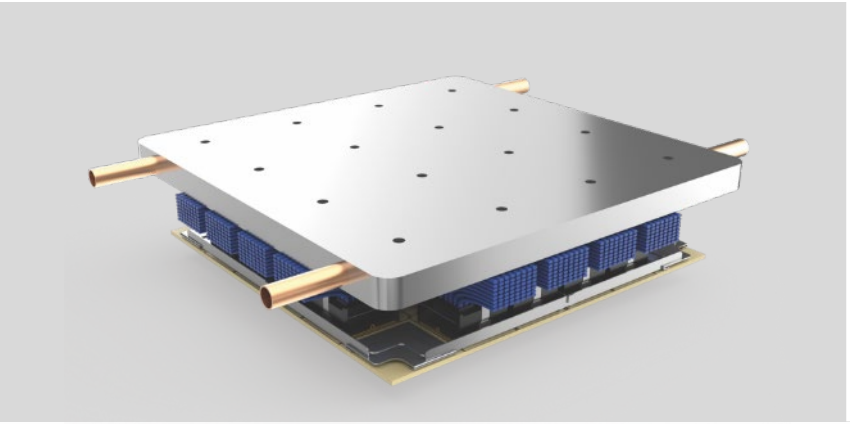
- Vertically launched cables for the highest density package
- 64 DPs in 14 mm x 14 mm footprint
- 0.53 mm (Signal-Ground) and 0.40 mm (Signal-Signal) contact pitch; 1.25 mm row-to-row pitch
- Designed for High Density Interconnect (HDI) and package substrates
- Eye Speed® AIR™ foamed twinax cable for significantly improved signal integrity and even lower intra-pair skew

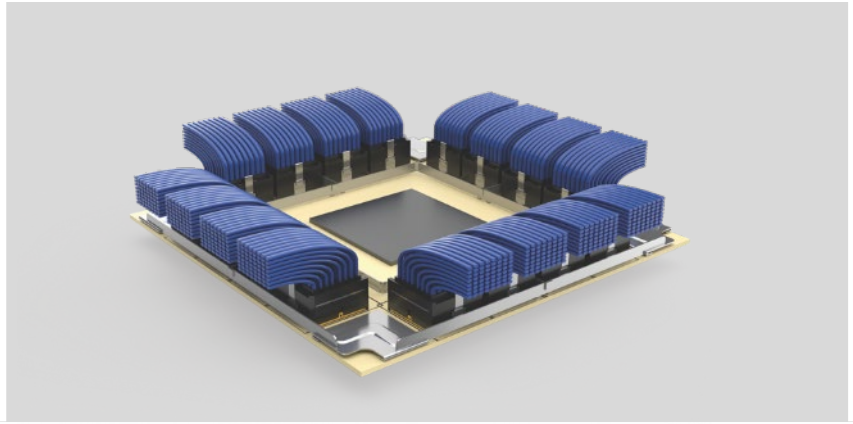
SI-FLY™ HD

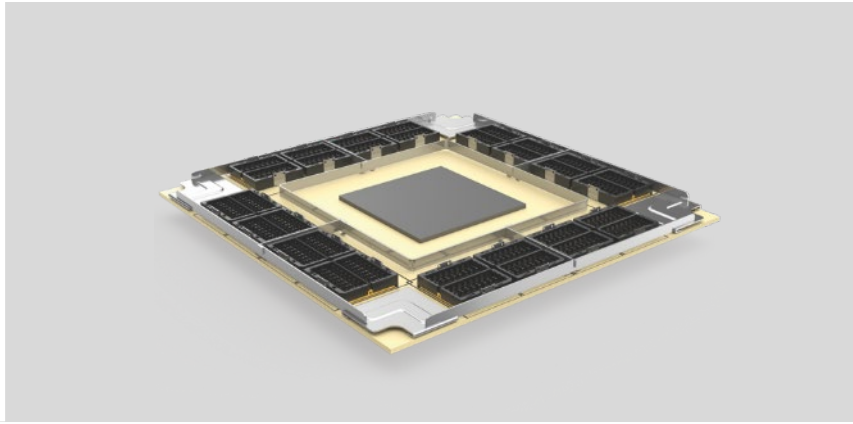
PAM4 224 Gbps



Si-Fly™ High-Density On-Package System







Ultra-high-density solution for co-packaged applications.

GLOBAL CABLE FACILITIES

Samtec's global cable manufacturing and assembly facilities are dedicated to R&D and manufacture of precision extruded twinax and micro coax cable, as well as high-frequency RF cable. Samtec has developed multiple proprietary ultra-high performance cable technologies that have been engineered to address the challenges of next generation system designs.

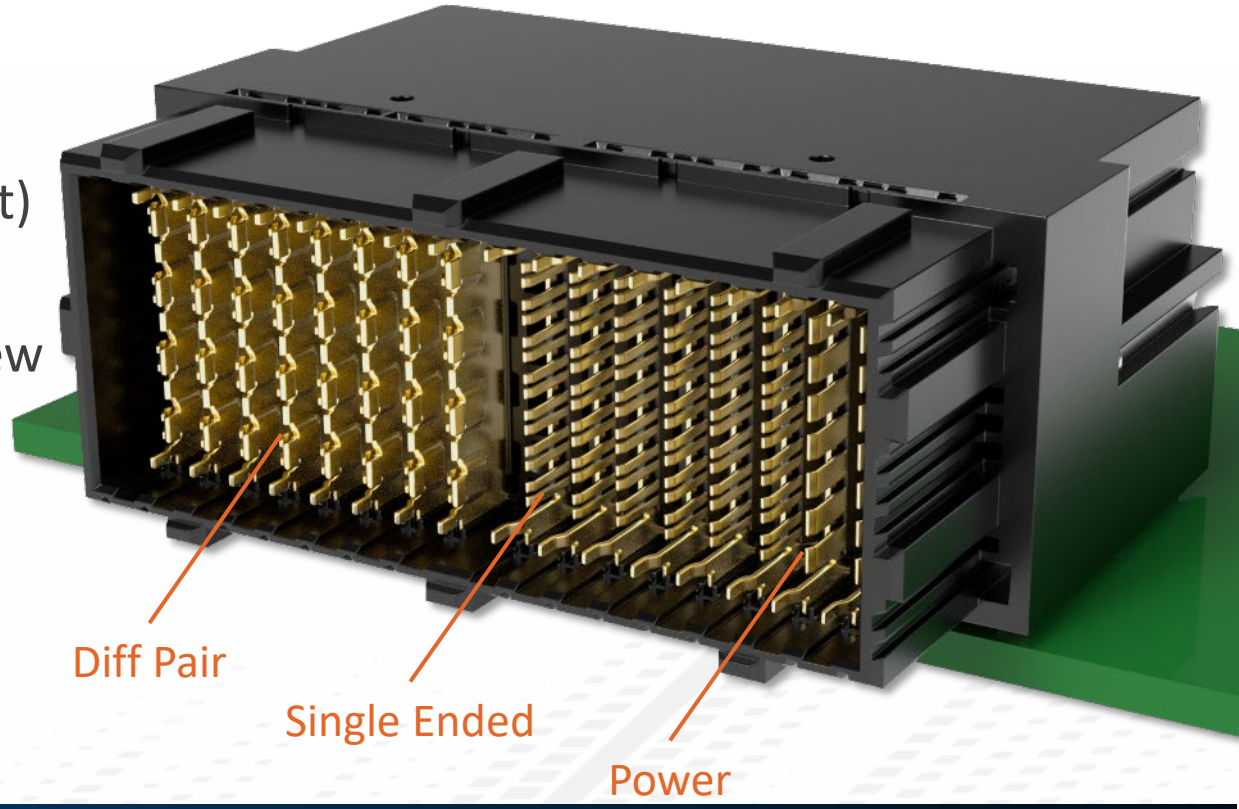
NovaRay™ Micro Rugged Backplane

PAM4 128 Gbps

- Rugged blind-mate housing design with optional guide posts and keying
- Up to 128 DPs (32 wafers) in one connector
- Supports 1” slot pitch (less than 17.5 mm height)
- Innovative wafer design eliminates intrapair skew
- Offset footprint for optimal SI performance
- Weld tabs for increased shear strength

SAMPLES NOW AVAILABLE

NVBM-RA / NVBF / NVCM / NVCF



Key Takeaways

- Samtec offers a comprehensive portfolio of high-performance interconnect solutions ideally suited for AI system architectures in the data center
- Samtec's global team of SI technical experts, online design tools and world-class customer service are available to support any AI system architectures in the data center
- Samtec's new AI Interconnect Solutions Guide
- For more information:
- www.samtec.com/ai