HIGH-SPEED

BOARD-TO-BOARD & BACKPLANE

INTERCONNECT SOLUTIONS GUIDE

HIGH-SPEED
BOARD-TO-BOARD & BACKPLANE

Samtec offers the largest variety of high-speed board-to-board and backplane interconnects in the industry with full engineering support, online tools and an unmatched service attitude.

HIGH-SPEED PERFORMANCE

Speeds to 112 Gbps PAM4

More than 4.0 Tbps of aggregate bandwidth

Extremely low crosstalk to 40 GHz

APPLICATION FLEXIBILITY

10 – 3,000 positions

0.33 mm – 40 mm stack heights

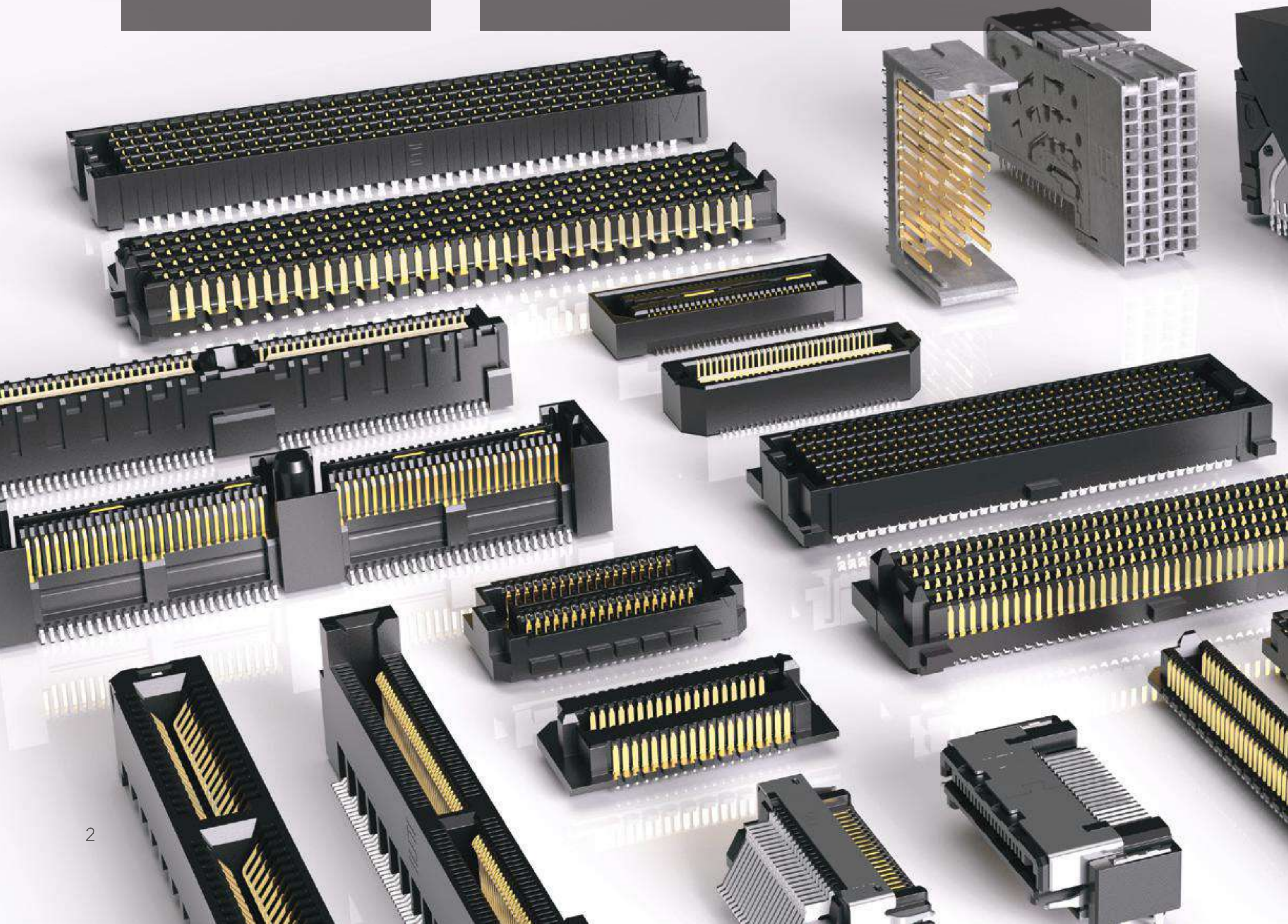
Vertical, right-angle, edge mount

SIGNAL INTEGRITY SUPPORT

Free test reports, models, app notes, Break Out Region

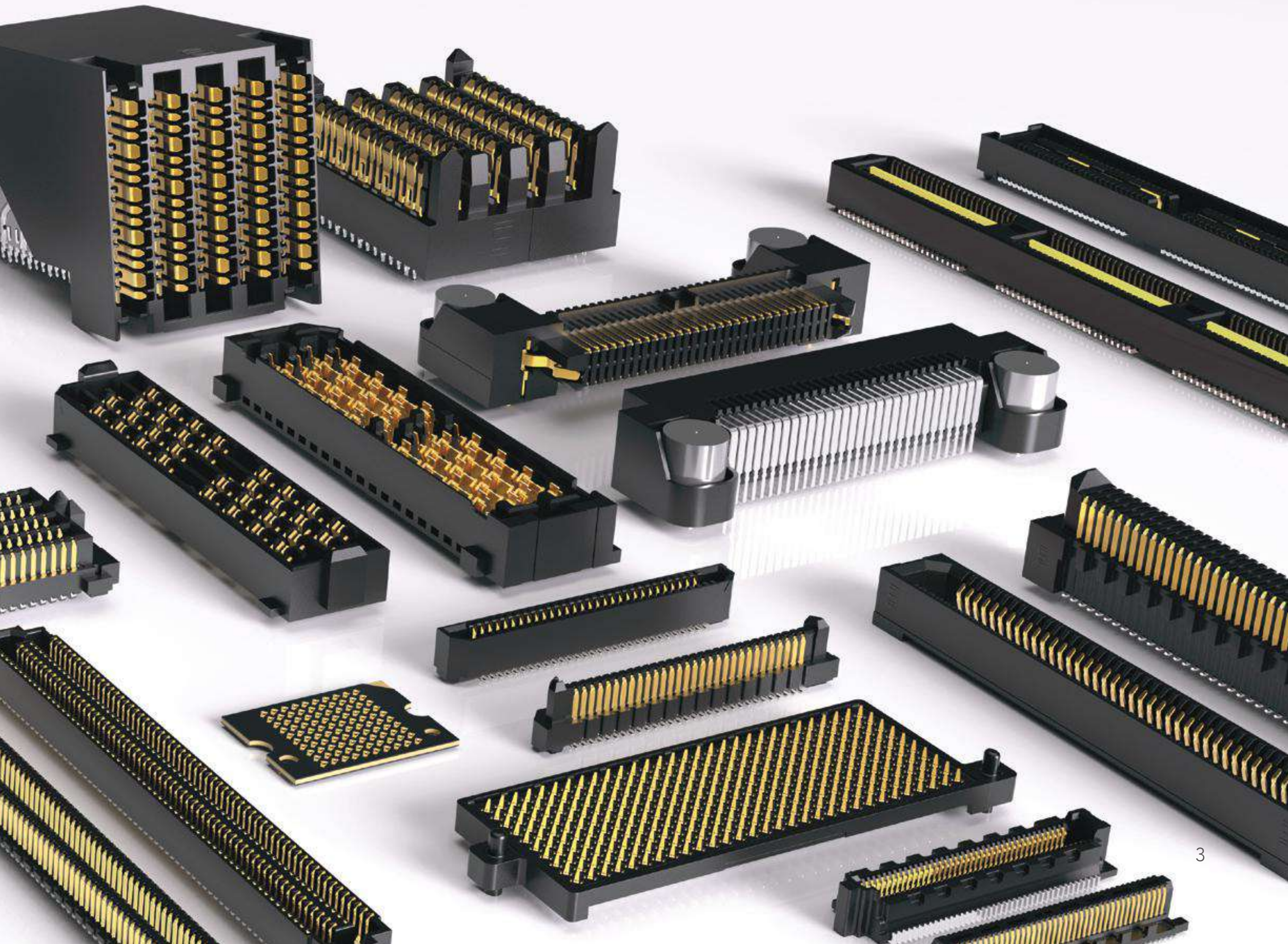
Easy access to live EE support

Online tools: Simulator™ and Channelyzer®



Learn more at
samtec.com

HIGH-DENSITY ARRAYS 4-7
EDGE RATE® CONNECTOR STRIPS 8-9
GROUND PLANE CONNECTORS 10-11
ULTRA MICRO INTERCONNECTS.. 12-13
EDGE CARD SYSTEMS 14-17
HIGH-SPEED BACKPLANE SYSTEMS................................. 18-23
HIGH-SPEED CABLE ASSEMBLIES 24
SUPPORT, TOOLS & CUSTOM SOLUTIONS 25-27



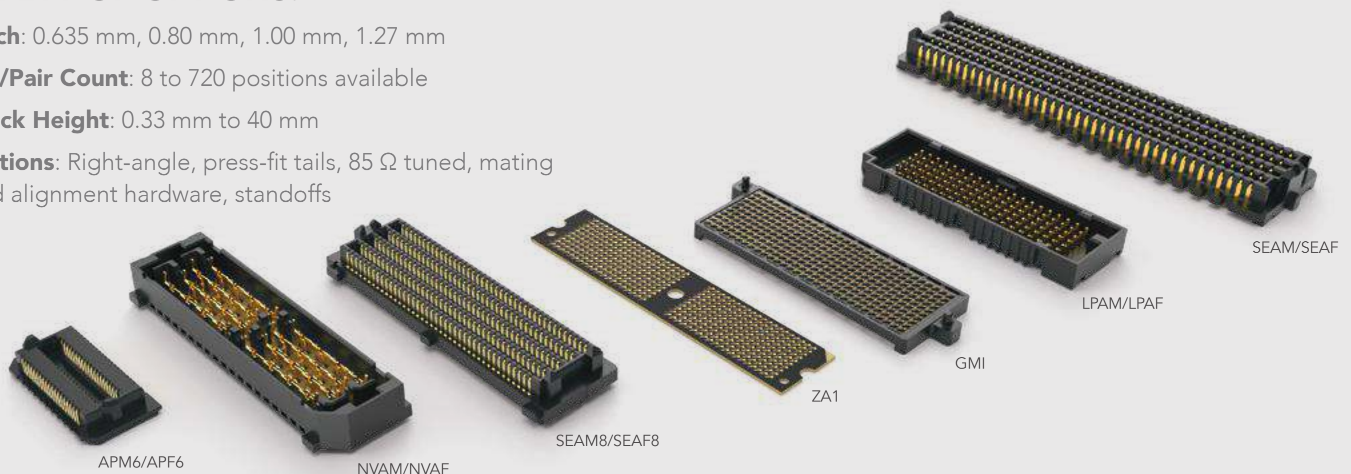
HIGH-DENSITY ARRAYS

EXTREME PERFORMANCE • OPEN-PIN-FIELD • LOW-PROFILE

SEAM/SEAF
Shown with 400 pins

VARIETY OF OPTIONS:

- **Pitch**: 0.635 mm, 0.80 mm, 1.00 mm, 1.27 mm
- **Pin/Pair Count**: 8 to 720 positions available
- **Stack Height**: 0.33 mm to 40 mm
- **Options**: Right-angle, press-fit tails, 85 Ω tuned, mating and alignment hardware, standoffs



PCI-SIG®, PCI Express® and the PCIe® design marks are registered trademarks and/or service marks of PCI-SIG.

EXTREME PERFORMANCE ARRAYS

- 4.0 Tbps aggregate data rate - 9 IEEE 400G channels
- Two points of contact ensure a more reliable connection
- Fully shielded differential pair design
- Extremely low crosstalk (to 40 GHz) and incredibly tight impedance control
- Minimal variance in data rate as stack height increases
- Utilizes 40% less space with the same data throughput as compared to traditional arrays

NVAM/NVAF

NOVARAY™

NRZ 56 Gbps | PAM4 112 Gbps

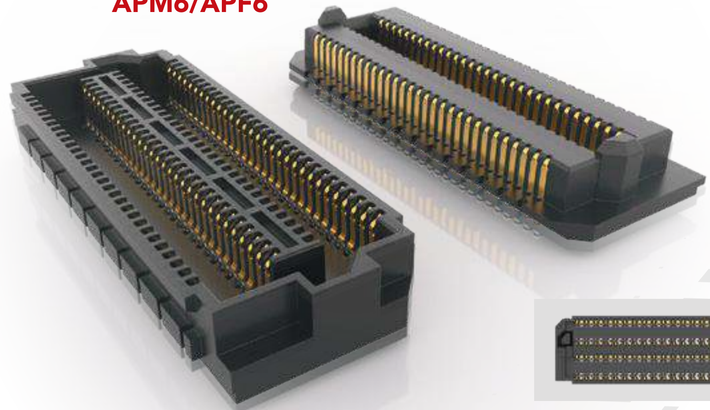
Right-angle in development (NVAM-RA)

NVAM Series; 32 pairs (actual size shown)

MICRO ARRAYS

- Flexible open-pin-field and cost optimized, extreme performance solution
- Low-profile 5 mm stack height and up to 10 mm
- 0.635 mm pitch
- Four row design with up to 400 total pins
- Data rate compatible with PCIe® Gen 5 and 100 GbE
- Cable assembly in development

APM6/APF6



ACCELERATE®

NRZ 56 Gbps | PAM4 112 Gbps

APF6 Series; 120 pins (actual size shown)

LOW-PROFILE ARRAYS

- Up to 400 total pins in 4, 6 or 8 rows
- 1.27 mm pitch
- Dual beam contact system
- Solder crimped termination for ease of processing
- Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility
- Press-in or threaded standoffs available to assist unmating (JSO)

LPAM/LPAF

LPARRAY™

NRZ 28 Gbps | PAM4 56 Gbps

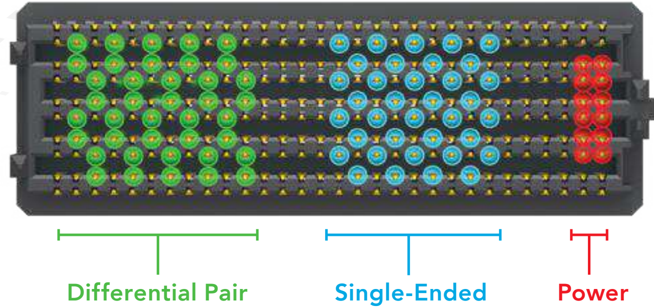
LPAM Series; 120 pins (actual size shown)

HIGH-DENSITY ARRAYS

1.27 mm PITCH ARRAYS

- Maximum grounding and routing flexibility
- Up to 560 Edge Rate® contacts optimized for signal integrity performance
- 7 mm to 40 mm stack heights; right-angle available
- Supports high-speed protocols such as Ethernet, PCI Express®, Fibre Channel and InfiniBand™
- Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility

OPEN-PIN-FIELD FLEXIBILITY

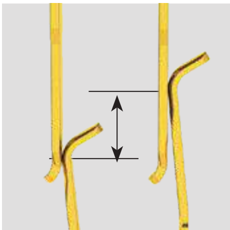


SEARAY™

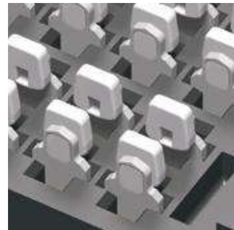
NRZ 28 Gbps | PAM4 56 Gbps

SEAM/SEAF

SEAM-RA

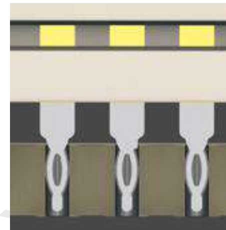


1.15 mm (.045") contact wipe



Solder charge terminations (IPC-A-610F & IPC J-STD-001F Class 3)

Elevated stack heights available (SEAR)

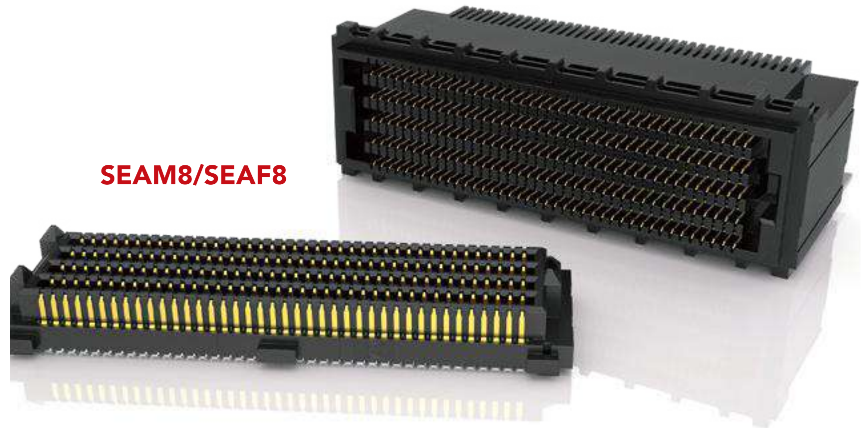


Press-fit tails available (SEAMP/SEAFP)

Jack screw standoffs (JSO)

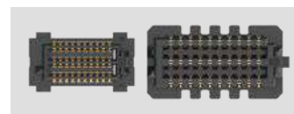
HIGH-DENSITY 0.80 mm PITCH ARRAYS

- 2x the density of 1.27 mm pitch arrays
- 0.80 mm pitch
- Up to 720 Edge Rate® contacts; higher pin counts in development
- 7 mm and 10 mm stack heights
- 2 mm extended wipe in development
- Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility



SEARRAY™ .8mm

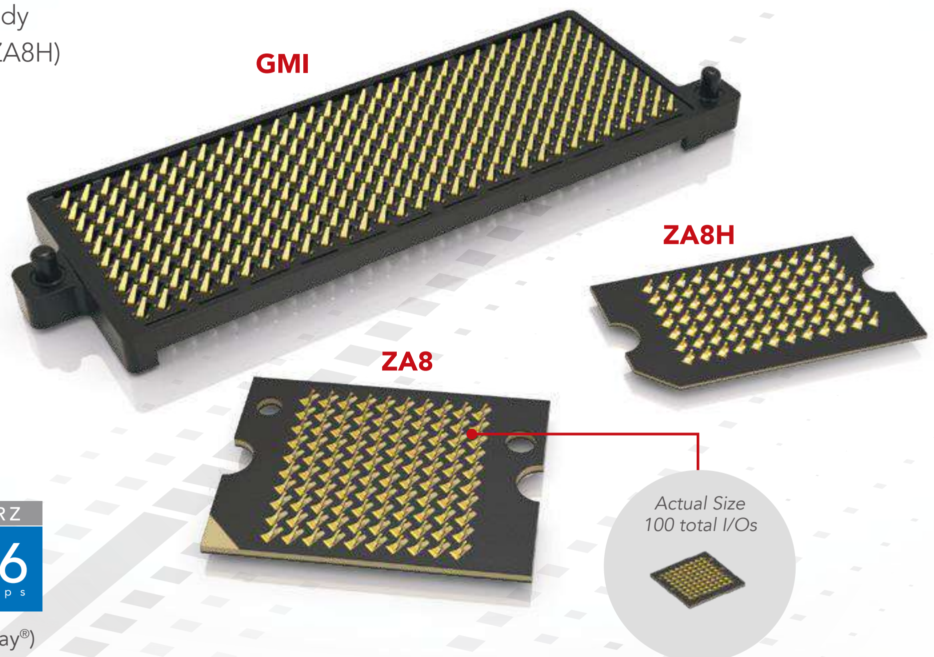
NRZ 28 Gbps | PAM4 56 Gbps

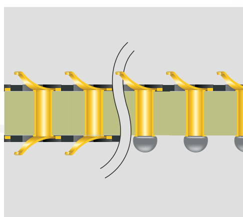


0.80 mm pitch vs. 1.27 mm pitch
(actual size shown; 60 pins)

ULTRA-LOW PROFILE ONE-PIECE ARRAYS

- 0.80 mm or 1.00 mm pitch
- 1 mm body height (ZA8/ZA1); 0.33 mm body height provides the shortest signal path (ZA8H)
- 1.27 mm and 2 mm body heights (GMI)
- Up to 400 pins standard; 3,000+ pins with custom capabilities on Z-Ray®
- Z-Ray® is customizable in X, Y, and Z axes, stack height, pin count, shape, plating thickness, etc.
- Alignment/compression hardware available for Z-Ray® (ZHSI, ZSO, ZD)





Dual compression, or single compression with solder balls

PAM4 56 Gbps (GMI) | NRZ 56 Gbps (Z-Ray®)

EDGE RATE® CONNECTOR STRIPS

OPTIMIZED FOR SPEED • HIGH CYCLES • INCREASED CONTACT WIPE

EDGE RATE® CONTACT

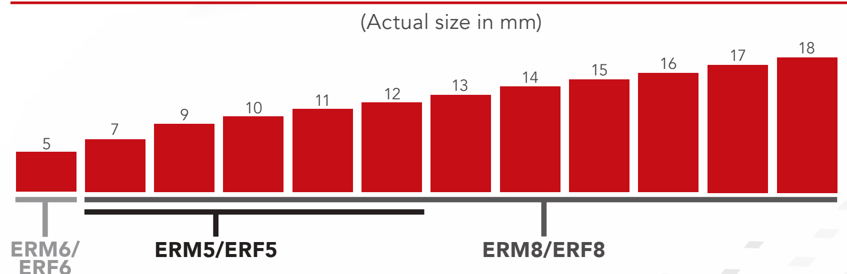
ERM8/ERF8
Right-angle
with latching shown

EDGE RATE® CONTACT SYSTEM:

- Smooth milled mating surface reduces wear and increases durability
- Lower insertion and withdrawal forces
- Robust when "zippered" during unmating
- Minimized parallel surface area reduces broadside coupling and crosstalk
- Designed, simulated and optimized for 50 Ω and 100 Ω systems

STACK HEIGHT FLEXIBILITY

(Actual size in mm)



0.80 mm PITCH SYSTEM

- 1.5 mm contact wipe for a reliable connection
- Differential pair and hot swap options
- Stack heights from 7 mm to 18 mm (8 mm in development)
- Supports high-speed protocols including Ethernet and PCI Express®

PAM4
56 Gbps

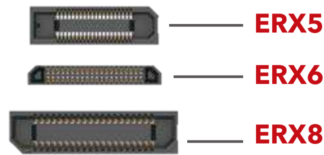
Rugged 360° shielding and metal latching options

Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility

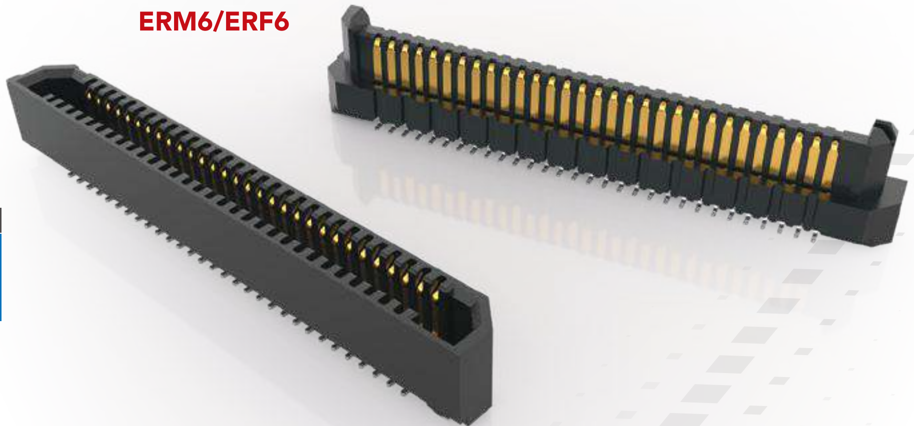
0.635 mm PITCH SYSTEM

- Extremely slim 2.5 mm body width
- Up to 120 positions in a 2-row design
- 5 mm stack height (others in development)
- Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility

Sockets shown actual size at 40 total positions



PAM4
56 Gbps



0.50 mm PITCH SYSTEM

- 1.00 mm contact wipe
- Up to 40% PCB space savings with 0.50 mm pitch vs. 0.80 mm pitch
- Stack heights from 7 mm to 12 mm
- 20 to 150 total positions

28 Gbps

ERM5/ERF5

Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility

GROUND PLANE CONNECTORS

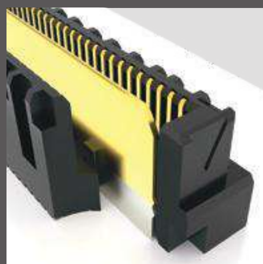
RELIABLE SI PERFORMANCE • LOW-PROFILE • SLIM FOOTPRINT

QTH/QSH
5 mm stack height shown

QSERIES®

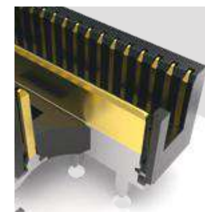
INTEGRAL GROUND/POWER PLANE

- Surface mount ground plane between two signal rows improves electrical performance
- Significantly reduces row-to-row crosstalk
- Integral metal plane for power to 25 Amps

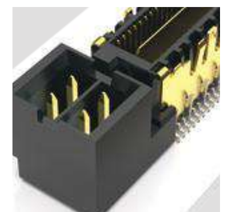


FEATURES

Differential pairs reduce noise



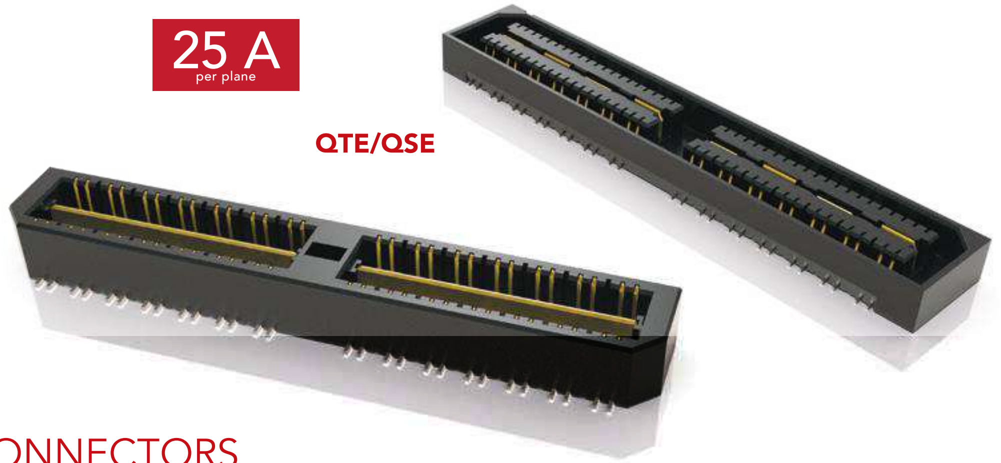
Mixed technology (MIT/MIS)



Options for power, retention & RF

LOW-PROFILE GROUND PLANE CONNECTORS

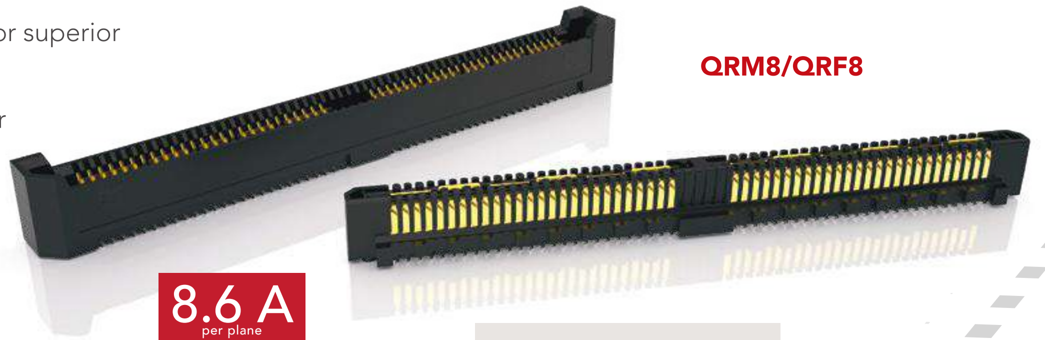
- 0.50 mm, 0.635 mm and 0.80 mm pitch
- 5 mm to 25 mm stack heights
- Integral ground/power plane
- Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility



Q STRIP® | 28 Gbps

SLIM GROUND PLANE CONNECTORS

- 0.80 mm pitch and 1.20 mm contact wipe
- Edge Rate® contacts optimized for superior signal integrity performance
- Right-angle available for coplanar and perpendicular mating
- Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility



Q RATE® | 28 Gbps

Slim 4.60 mm body width saves board space

RUGGED GROUND PLANE CONNECTORS

- 0.635 mm pitch
- Increased insertion depth for rugged applications
- Up to 156 signal pins/48 signal pairs standard
- Vertical, right-angle and edge mount
- Shielded systems available (QMSS/QFSS)
- Compatible with mPower™ (UMPT/UMPS) for power/signal flexibility

15.7 A
per plane

Q2™ | 25 Gbps

ULTRA MICRO INTERCONNECTS

SPACE SAVING DESIGNS • HERMAPHRODITIC • HIGH-DENSITY

LSHM

ADM6/ADF6
120 total positions shown

Self-mating connectors reduce inventory costs and can be interchanged for varying stack heights.

5 mm stack height

12 mm stack height

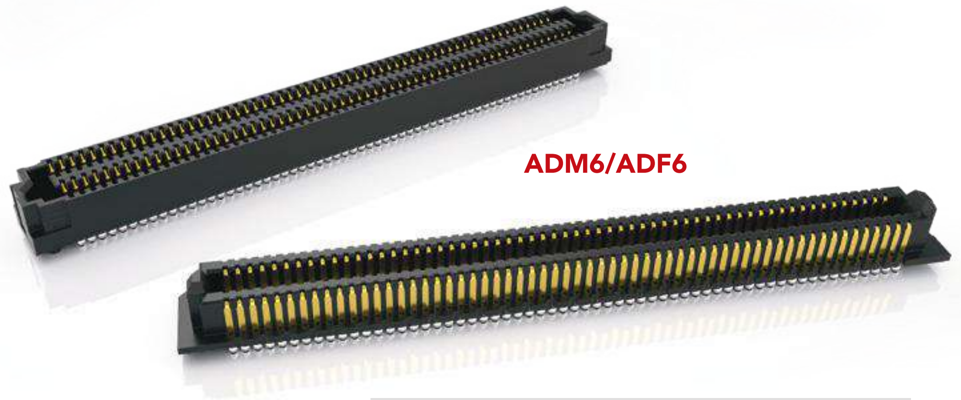
ACTUAL SIZE SHOWN - SLIM BODY DESIGNS

(40 total positions each)

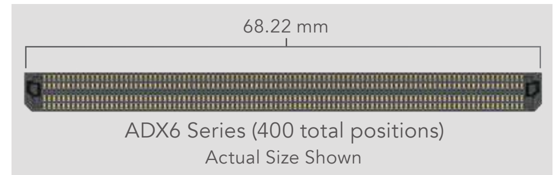
HIGH-DENSITY MULTI-ROW STRIPS

- Low-profile 5 mm stack height and slim 5 mm width
- 0.635 mm pitch Edge Rate® contacts
- Up to 400 I/Os in a 4-row design
- Open-pin-field design for grounding and routing flexibility

Right-angle and other stack heights in development (ADF6-RA)



ACCELERATE® HD

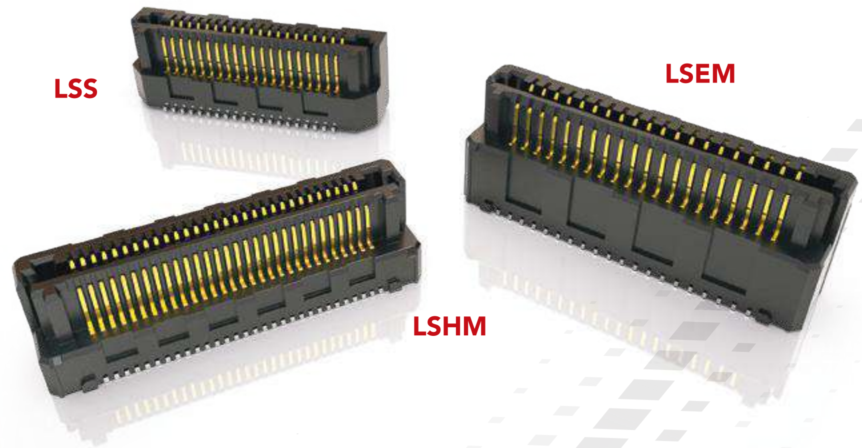


ADX6 Series (400 total positions)
Actual Size Shown

RUGGED HERMAPHRODITIC CONNECTORS

- Razor Beam™ contacts for high-speed and fine-pitch systems
- 0.50 mm, 0.635 mm and 0.80 mm pitch
- Stack heights from 5 mm to 12 mm
- 10 - 100 positions

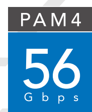
RAZOR™ BEAM SYSTEM



LOW-PROFILE STRIPS

- Micro 0.40 mm and 0.50 mm pitch
- Stack heights from 2 to 6 mm
- Slim body designs for increased PCB space savings
- 20 - 160 positions

RAZOR™ BEAMLP SYSTEM



EDGE CARD SYSTEMS

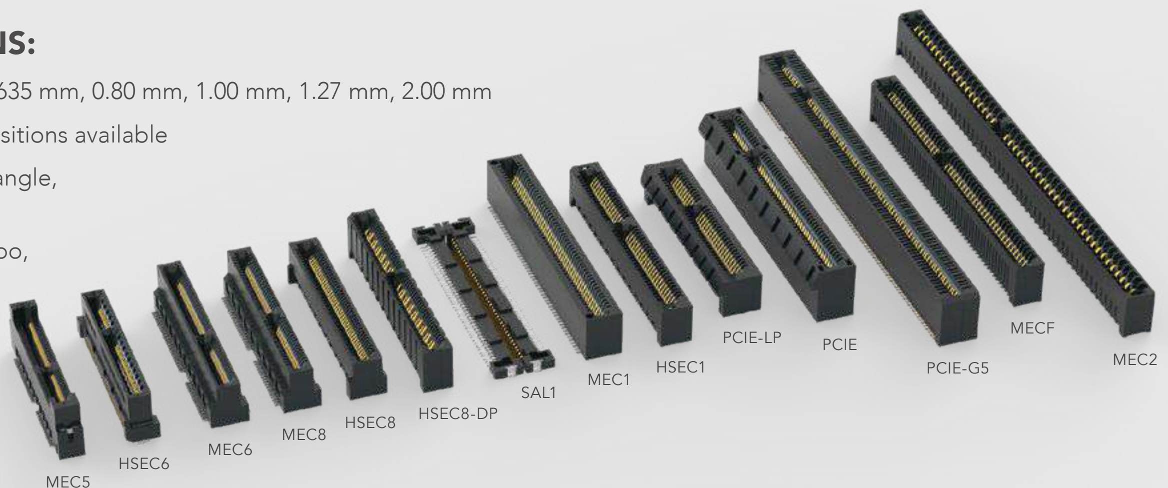
SPEEDS TO 56 Gbps • EDGE RATE® CONTACTS • VARIETY OF OPTIONS

HSEC8-DP
Twelve total
differential pairs shown

MEC5-RA
Right-angle shown

VARIETY OF OPTIONS:

- **Pitch**: 0.50 mm, 0.60 mm, 0.635 mm, 0.80 mm, 1.00 mm, 1.27 mm, 2.00 mm
- **Pin Count**: 10 – 200 total positions available
- **Orientation**: Vertical, right-angle, edge mount, pass-through
- **Options**: Power/signal combo, press-fit tails, PCI Express®, rugged weld tabs, locks and latches



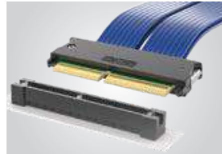
0.60 mm PITCH SOCKETS

- Differential pair Edge Rate® contacts
- Compliant to SFF-TA-1002: x4 (IC), x8 (2C), x16 (4C and 4C+)
- Mates with .062" (1.60 mm) thick cards
- PCI Express® Gen 5 compatible

HSEC6

EDGE® RATE CONTACT

PAM4 56 Gbps



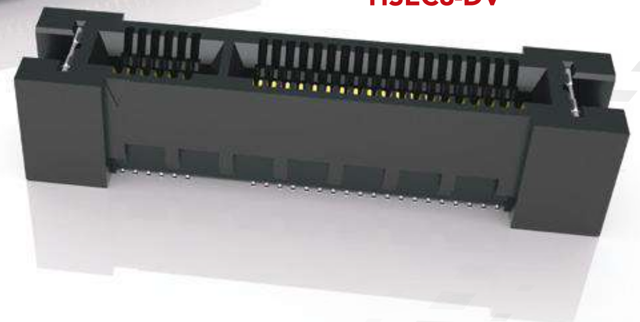
0.60 mm pitch mating high-speed cable assembly in development

0.80 mm PITCH SOCKETS

- Up to 200 high-speed Edge Rate® contacts
- Mates with .062" (1.60 mm) and .093" (2.36 mm) thick cards
- Power/signal combo (HSEC8-PV)
- PCI Express® Gen 3/4 compatible; rugged Gen 4 compatible socket in development (HTEC8)

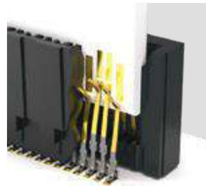
HSEC8-EM

HSEC8-DV



EDGE® RATE CONTACT

PAM4 56 Gbps



56 Gbps PAM4 with differential pair (HSEC8-DP)

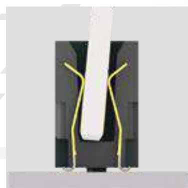
1.00 mm PITCH SOCKETS

- Edge Rate® contact system for decreased crosstalk
- 20 – 140 positions
- Mates with .062" (1.60 mm) thick cards
- PCI Express® Gen 3/4 compatible; Gen 5 compatible differential pair socket in development (HSEC1-DP)

HSEC1-DV

EDGE® RATE CONTACT

28 Gbps

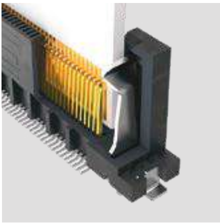


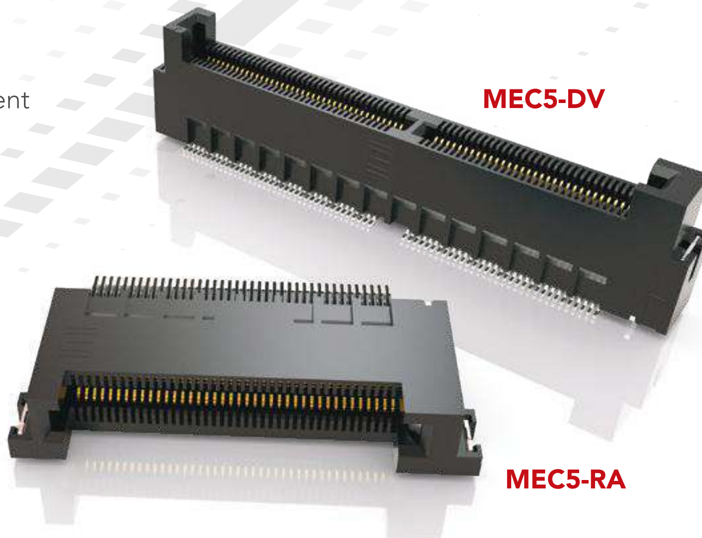
Custom designs can aid with misalignment in the X-Y axes

EDGE CARD SYSTEMS

0.50 mm PITCH HIGH-SPEED, LOW-COST SOCKETS

- Justification beam enables use of standard PCB tolerance
- Up to 200 total I/Os; 300 I/Os in development
- PCIe® Gen 4 compatible
- Mates with .062" (1.60 mm) thick cards

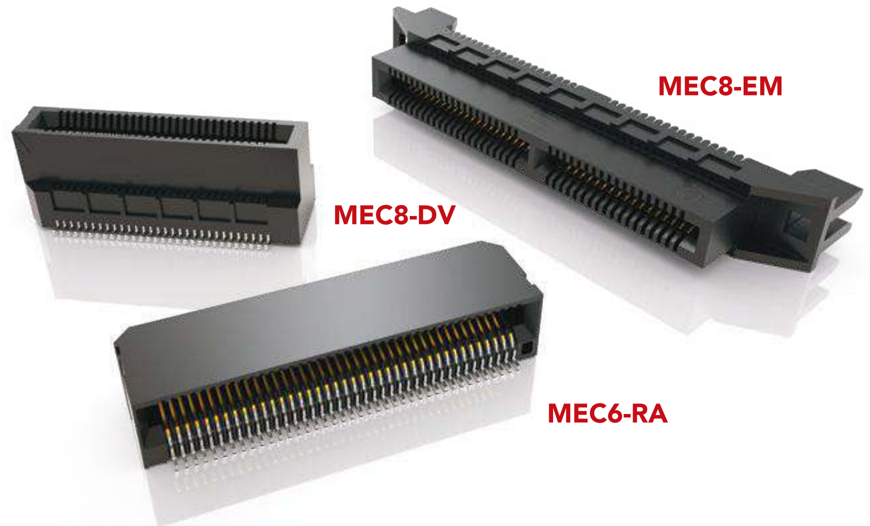

Beam ensures card and body are flush



0.635 mm & 0.80 mm PITCH MICRO SOCKETS

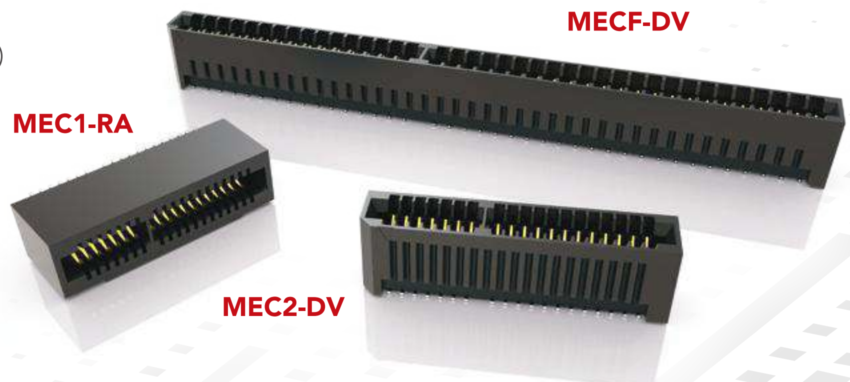
- Up to 140 total I/Os
- Vertical and right-angle; edge mount (MEC8)
- Press-fit tails available (MEC8)
- Mates with .062" (1.60 mm) thick cards

Staggered press-fit tails



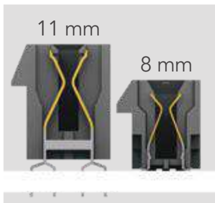
1.00 mm, 1.27 mm & 2.00 mm PITCH SOCKETS

- Up to 140 total I/Os
- Right-angle and edge mount available (MEC1)
- Optional weld tabs, alignment pins and polarization
- Mates with .062" (1.60 mm) and .093" (2.36 mm) thick cards



GEN 3 & 4 PCI EXPRESS® SOCKETS

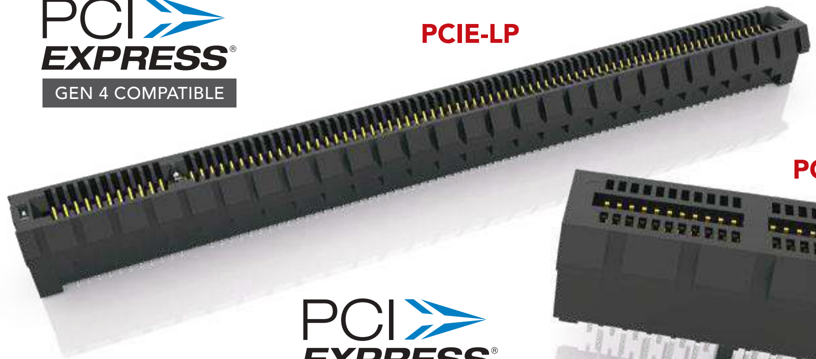
- 1.00 mm pitch in x1, x4, x8 or x16
- Gen 3 compliant (PCIE) and Gen 4 compatible (PCIE-LP)
- Low-profile version for space savings; through-hole tails in development
- Mates with .062" (1.60 mm) thick cards
- Gen 4 slim body socket with Edge Rate® contacts in development (PCIE-G4)



PCI-Express® Jumpers available for use as loop back extender, SerDes physical extender or as a physical extender for PCIe® card debug and analysis

PCI EXPRESS® GEN 4 COMPATIBLE

PCIE-LP



PCIE

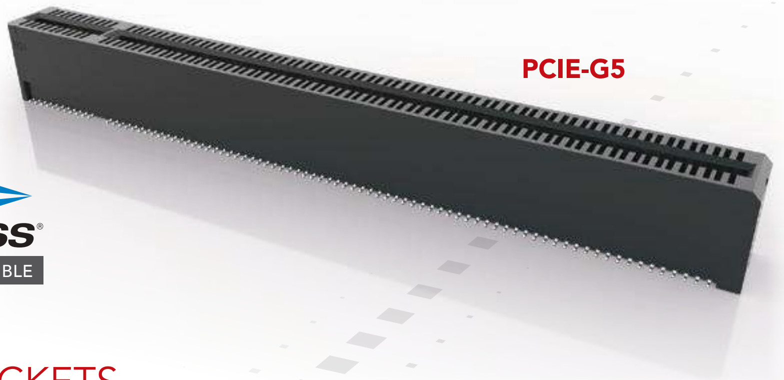
PCI EXPRESS® GEN 3 COMPLIANT

GEN 5 PCI EXPRESS® SOCKETS

- Differential pair system
- Design-in today for future-proof data rates
- Mates with standard PCIe® expansion cards
- 1, 4, 8 and 16 PCI Express® link options
- Currently in development

PCI EXPRESS® GEN 5 COMPATIBLE

PCIE-G5



1.00 mm PITCH MICRO PLANE SOCKETS

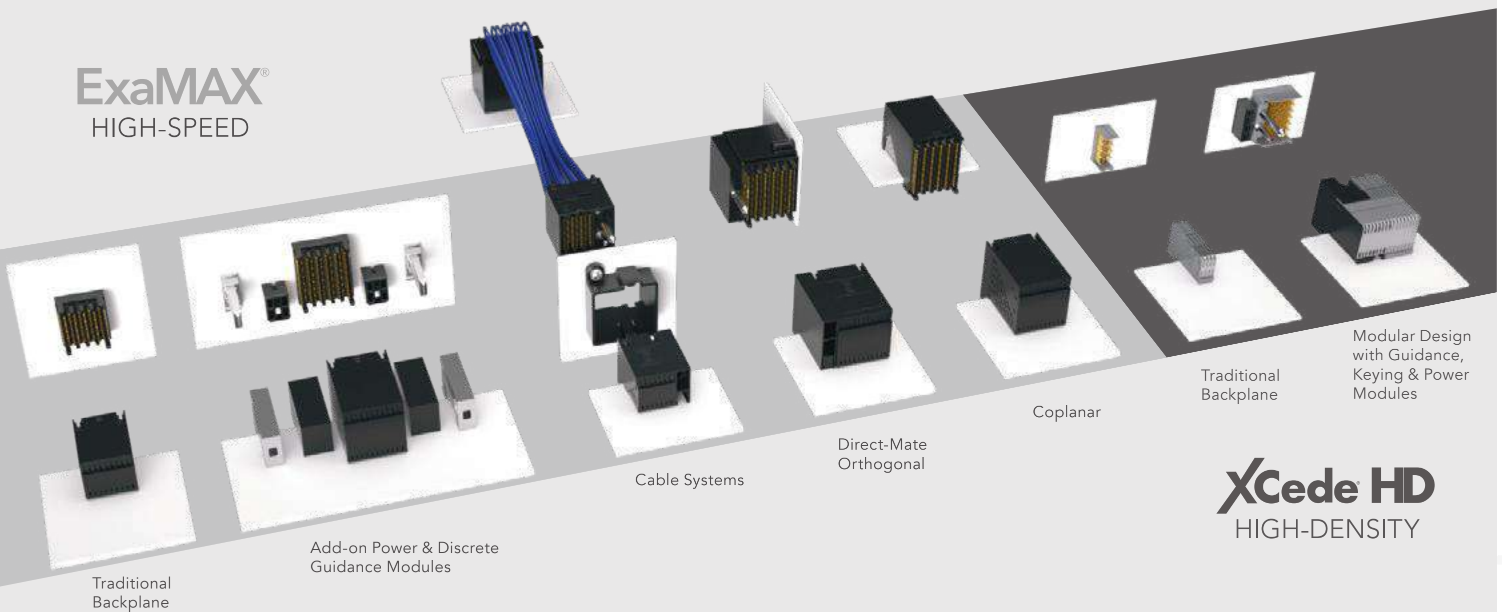
- 40 to 80 I/Os per pair
- Mounts in pairs on same or opposite sides for easy signal routing
- BeCu contacts with large deflection
- PCI Express® Gen 3 compatible
- Mounting flexibility for variable mating card thickness and pass-through applications

SAL1

HIGH-SPEED BACKPLANE SYSTEMS

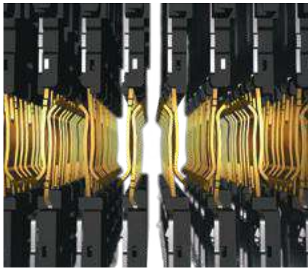
HIGH-DENSITY • DESIGN FLEXIBILITY • HIGH RELIABILITY

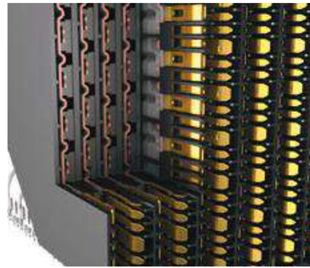
EBTM/EBTF-RA
Shown with power and guidance options



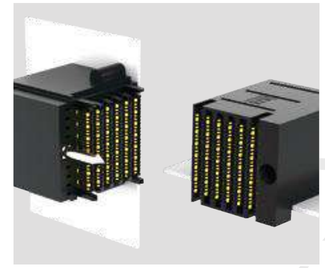
EXAMAX® HIGH-SPEED BACKPLANE

- Meets industry specifications such as PCI Express®, Intel OPI and VPI, SAS, SATA, Fibre Channel, InfiniBand™ and Ethernet
- Exceeds OIF CEI-28G-LR specification for 28 Gbps standards
- 24 - 72 pair designs (4 and 6 pairs; 6, 8, 10 and 12 columns)
- Wafer design increases isolation for reduced crosstalk
- Press-fit tails provide a reliable electrical connection
- Cable assemblies available (see pages 22 - 23)


Two reliable points of contact

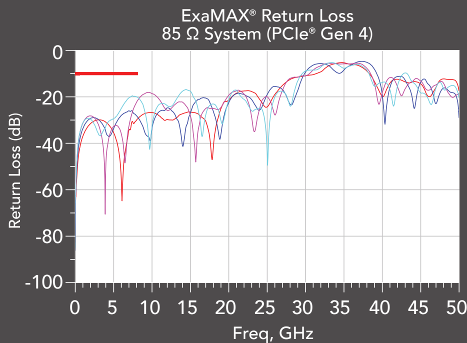

Staggered differential pair design with an embossed ground plane

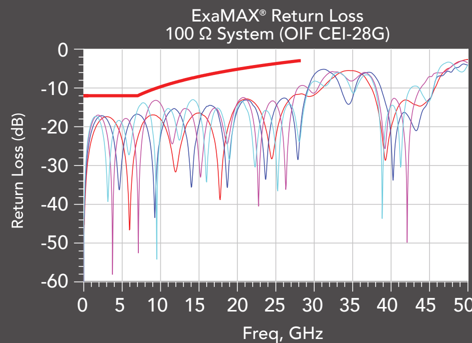
Coplanar available to bypass the midplane (EBTM-RA)

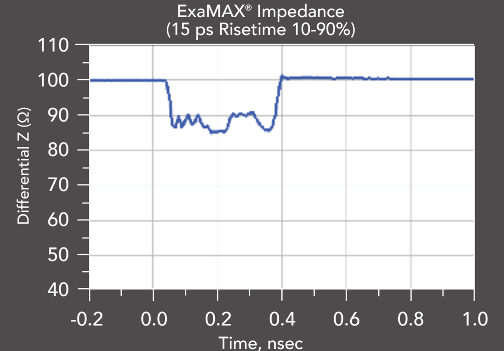

Direct-mate orthogonal (EBDM-RA) eliminates the midplane for a shorter signal path

PERFORMANCE CHARTS

ExaMAX® is engineered for 92 Ω impedance to address both 85 Ω and 100 Ω applications



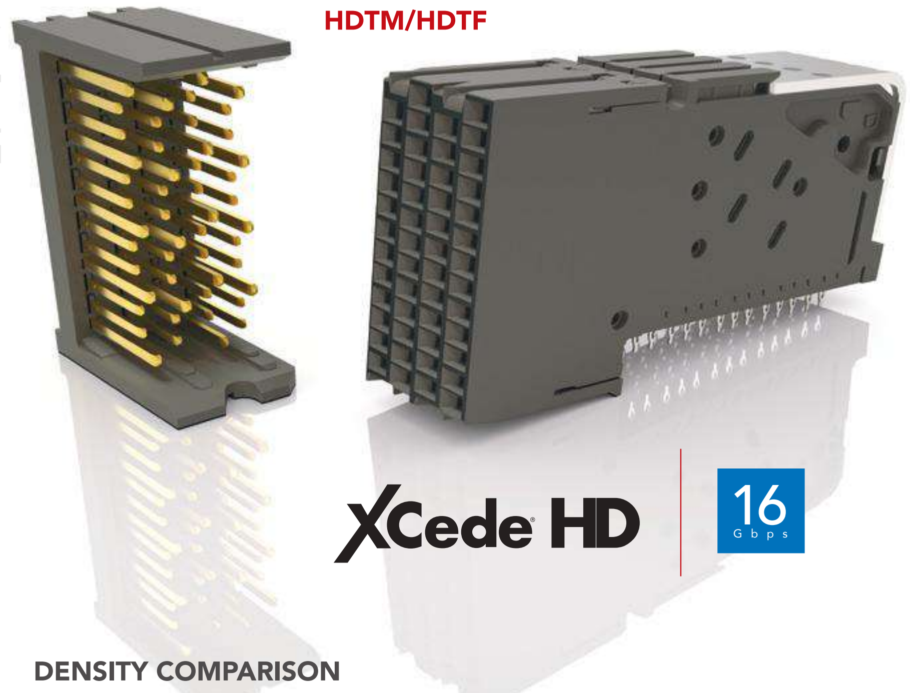




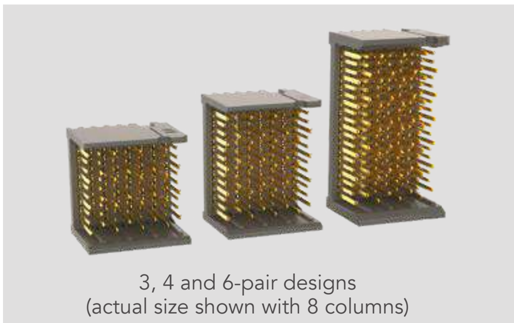
ExaMAX® is a trademark of AFCI

XCEDE® HD HIGH-DENSITY BACKPLANE

- Small form factor and modular design provides significant space-savings and flexibility
- High-performance system
- Up to 84 differential pairs per linear inch
- 3, 4 and 6-pair designs on 4, 6 and 8 columns
- Integrated power, guidance, keying and end walls available
- 85 Ω and 100 Ω options
- Combine any configuration of modules to create one integrated receptacle (BSP Series); corresponding terminal modules are individually mounted to the backplane

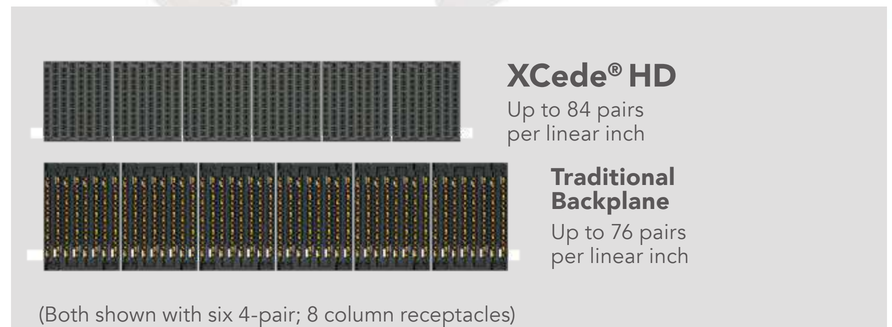


SMALL FORM FACTOR



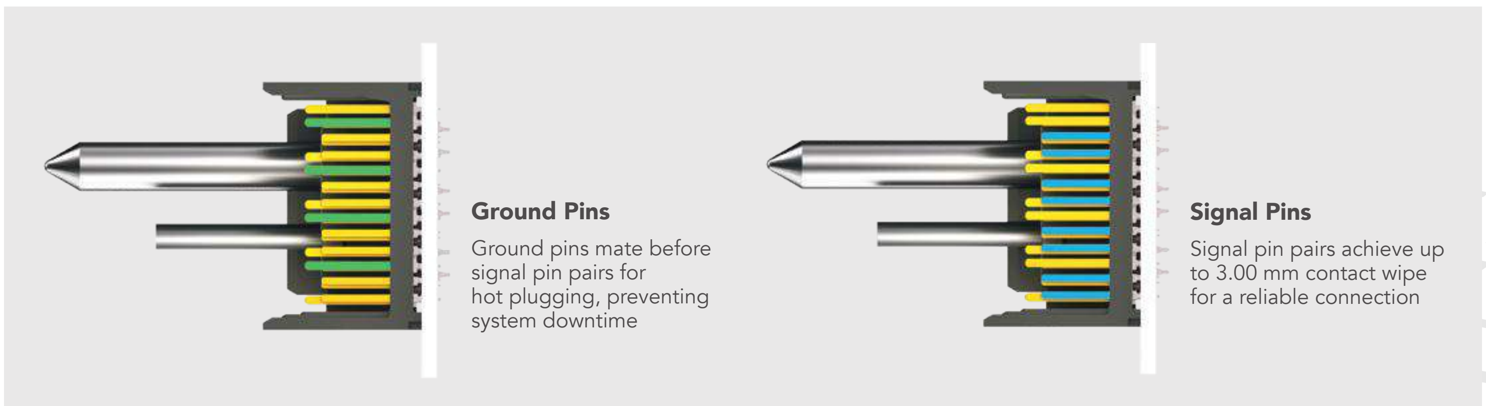
3, 4 and 6-pair designs
(actual size shown with 8 columns)

DENSITY COMPARISON



(Both shown with six 4-pair; 8 column receptacles)

SIGNAL/GROUND PIN STAGING

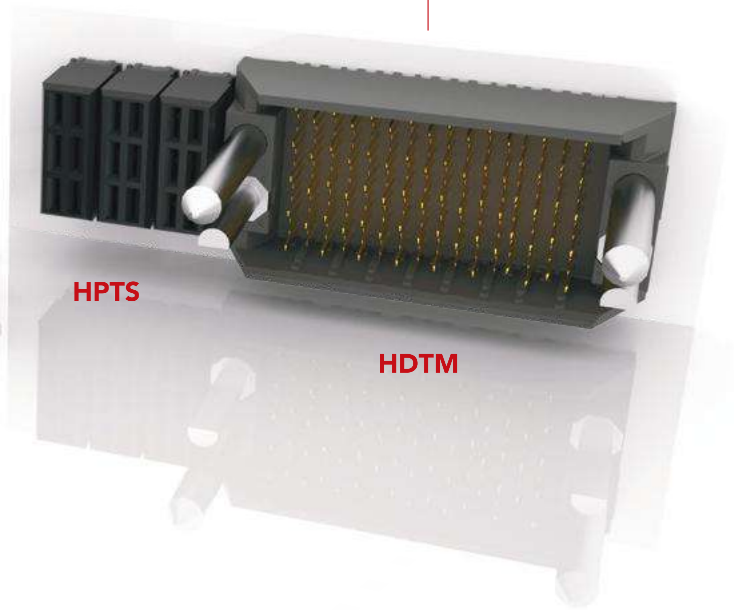


MODULAR DESIGN

XCede® HD consists of signal, power and keying/guidance modules for incredible design flexibility. The modules can be customized in any configuration to meet specific application requirements. Contact HSBP@samtec.com for more information about building a full XCede® HD solution.

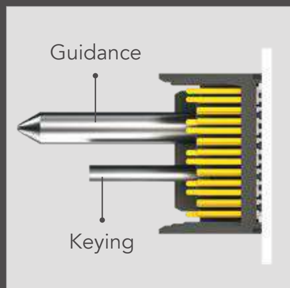
How to build a full solution:

1. Right-angle modules can be built into a single customizable BSP
2. Build a BSP part by combining any number, in any configuration, of HDTFs, power and keying/guidance modules to create one receptacle
3. Header modules mount to the backplane individually, in any configuration of HDTM and HPTS Series



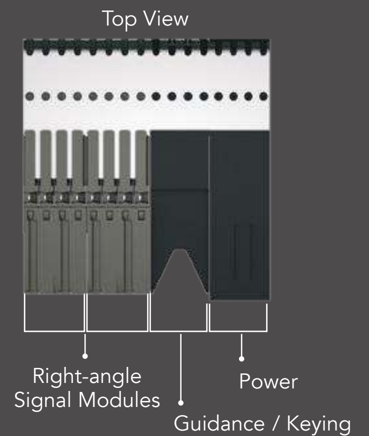
XCede® is a registered trademark of Amphenol Corporation.

PRODUCT BREAKDOWN (BSP Custom Configuration Shown)



Side View

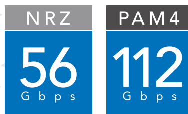
Top View



EXAMAX® BACKPLANE CABLE ASSEMBLIES

- Utilizes Samtec's Eye Speed® ultra low skew twinax cable technology for improved signal integrity, increased flexibility and routability
- Highly customizable with modular flexibility
- Reduce costs due to lower layer counts
- 30 and 34 AWG
- Multiple end options available

ExaMAX®



DESIGN FLEXIBILITY

4 and 6 pairs;
6, 8, 10 and 12 columns

Intermateable with all ExaMAX® connectors (EBTM/EBTF-RA)

Integrated guidance and keying options

Cable-to-DMO
(Direct Mate Orthogonal)

HIGH-DENSITY APPLICATION

Increases architectural flexibility by overcoming the limitations of traditional connector-to-connector backplane

EBTF-RA

Industry's lowest mating force with excellent contact normal force

EBCB

Two reliable points of contact with a 2.4 mm wipe

EBCM

Wafer design increases isolation for reduced crosstalk

Includes one sideband signal per column

Staggered differential pairs provide higher data rates

30 and 34 AWG ultra low skew twinax cable to support various cable lengths

EBCB

Designed for blind-mate systems

EBCF

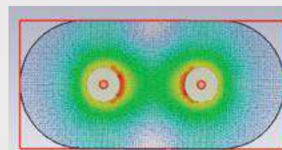
Vertical and right-angle

ULTRA LOW SKEW TWINAX CABLE

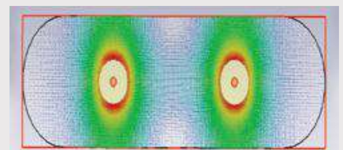
Samtec's Eye Speed® co-extruded twinax cable technology eliminates the performance limitations and inconsistencies of individually extruded dielectric twinax cabling, improving signal integrity, bandwidth and reach for high-performance system architectures.

- Tight coupling between signal conductors
- Improved bandwidth and reach
- Improved signal integrity and eye pattern opening

EYE® SPEED CABLE



✔ **Good** design coupling with co-extruded low skew twinax



✖ **Bad** design coupling with paralleled pair twinax

HIGH-SPEED CABLE ASSEMBLIES

EYE SPEED® COAX & TWINAX CABLE • MIX & MATCH

Samtec offers both sides of the system – high-speed connectors and mating cable assemblies.
This vertical integration allows for the ultimate combination of design flexibility and customer service.

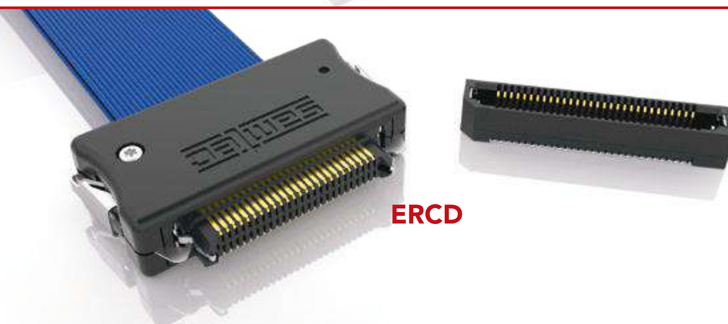
SEARAY™ HIGH-DENSITY ASSEMBLIES

- Up to 14 Gbps
- 34 AWG coax (ESCA); 36 AWG coax or 34 AWG twinax (SEAC)
- Mates with SEARAY™ and SEARAY™ 0.80 mm (pages 6 - 7)

NovaRay™ cable system to 112 Gbps PAM4 (NVAC)

EDGE RATE® ASSEMBLIES

- Up to 14 Gbps
- 34 AWG coax (ERCD); 30 AWG twinax (ERDP)
- Mates with 0.80 mm Edge Rate® connectors (pages 8 - 9)



Q SERIES® ASSEMBLIES

- Up to 14 Gbps
- 34 and 38 AWG coax; 30 AWG twinax
- 0.50 mm (HQCD/HQDP) and 0.80 mm pitch (EQCD/EQDP/EQRD)
- Mates with Q Series® connectors (pages 10 - 11)

ULTRA MICRO & EDGE CARD ASSEMBLIES

- Up to 14 Gbps
- 38 AWG coax mates with 0.50 mm pitch Razor Beam™ (HLCD; pages 12-13)
- 30 AWG twinax mates with 0.80 mm pitch edge card sockets (ECDP; pages 14 - 15)
- Mating assembly for PCI Express® edge cards (PCIEC; page 17)

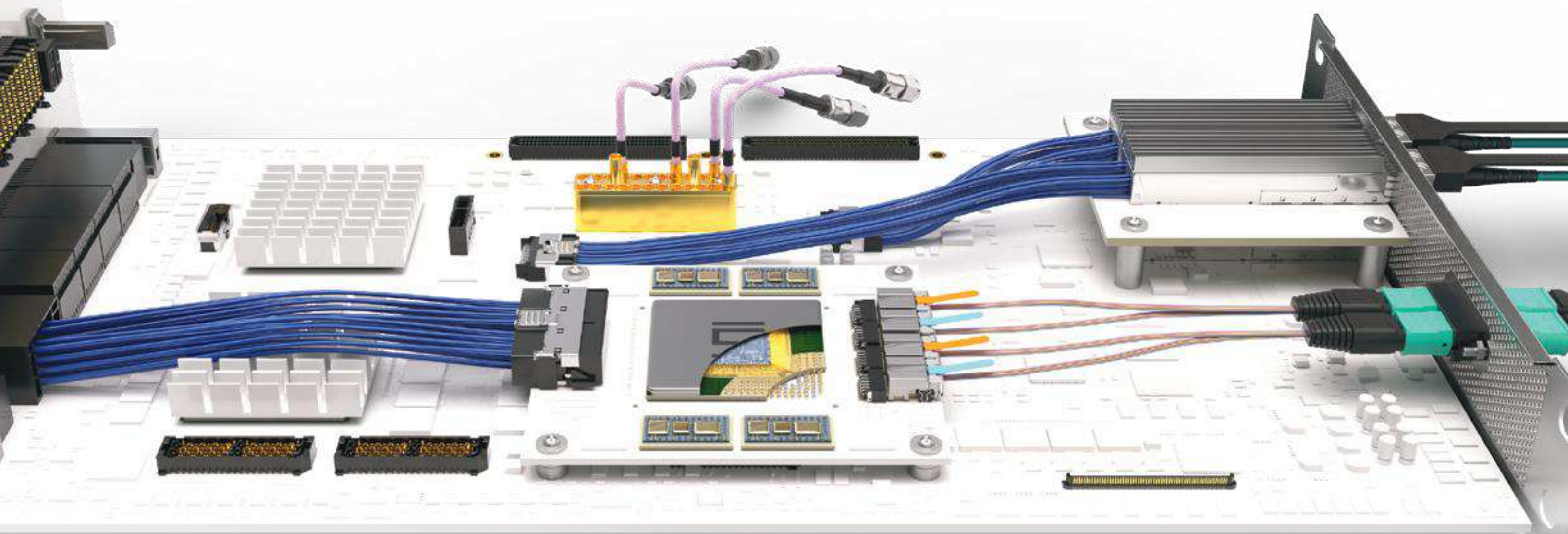
samtec.com/high-speed-cables

TECHNOLOGY CENTERS

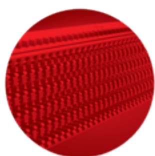
COMPLETE SYSTEM OPTIMIZATION FROM SILICON-TO-SILICON™

Samtec's Technology Centers offer high-level design and development of advanced interconnect systems and technologies, along with industry-leading signal integrity expertise which allows us to provide effective strategies and technical support for optimizing the entire serial channel of high-performance systems.

Because Samtec's Technology Centers are not limited by the boundaries of traditional business units, we are able to work in a fully integrated capacity that enables true collaboration and innovation to support the demands of today, and the challenges of tomorrow.



INTEGRATION LEADS TO INNOVATION



ADVANCED INTERCONNECTS

High precision stamping, plating, molding and automated assembly

HIGH-SPEED CABLE

In-house R&D and manufacturing of precision extruded cable and assemblies

OPTICS

R&D, design, development and support of micro optical engines and assemblies

SYSTEM SIGNAL INTEGRITY

Full channel signal and power integrity analysis, testing and validation services

PRECISION RF

RF interconnect design and development expertise, with testing to 65 GHz

MICROELECTRONICS

Advanced IC packaging design, support and manufacturing capabilities

samtec.com/tech-centers

ONLINE TOOLS

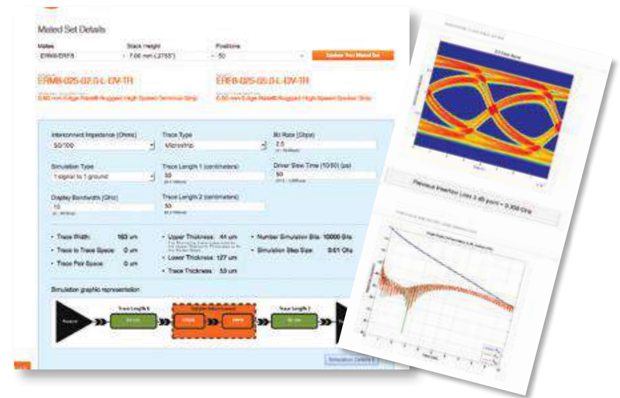
DESIGN • PERFORMANCE • SIMULATION

QUICKLY BUILD MATED CONNECTOR SETS ONLINE

- Wide variety of search parameters and filters: pitch, signaling, stack height, pin count, etc.
- Easily sort search results to find the right mated set
- Live chat with engineers for custom options
- Immediately download models and open Specs Kit
- **samtec.com/solutionator**

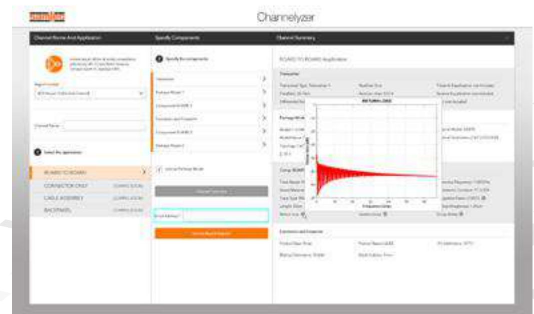
REAL-TIME HIGH-SPEED PERFORMANCE SIMULATIONS

- Integrates and blends data from models to project performance in the user-defined system
- Outputs include:
  - Insertion and return loss
  - Crosstalk (NEXT and FEXT)
  - Eye diagrams
- **samtec.com/simulator**



ONLINE FULL CHANNEL SIMULATION & ANALYSIS

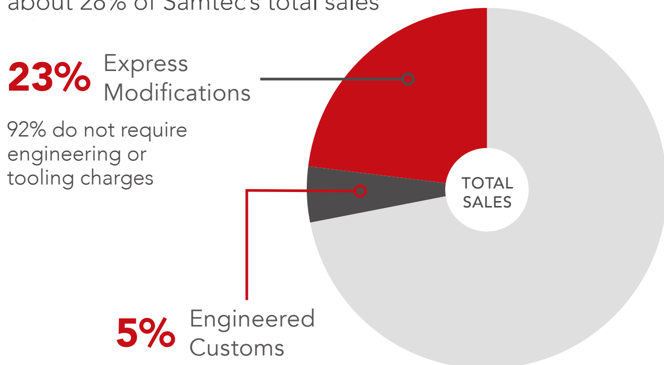
- Channel modeling based on inputs provided by the user
- Results for standards and transceivers at varying equalization levels and data rates
- Individual receiver performance data per Tx/Rx assignments
- Channel overview and strategies for improved performance
- **samtec.com/channelyzer**



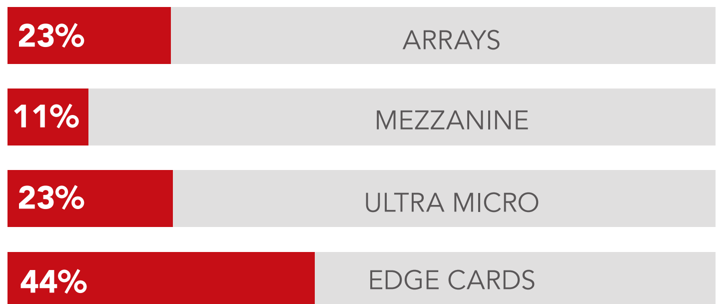
MODIFIED & CUSTOM SOLUTIONS

WILLINGNESS, SUPPORT & EXPERTISE

Customs and Modifications make up about 28% of Samtec's total sales



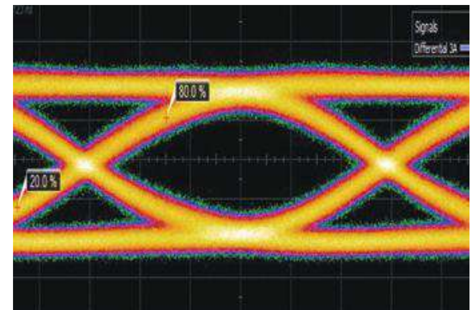
A substantial percentage of Samtec's high-speed board-to-board product segments are custom



INDUSTRY LEADING CUSTOMER SERVICE

FLEXIBLE IN-HOUSE MANUFACTURING

SIGNAL INTEGRITY EXPERTISE



FLEXIBLE CAPABILITIES

- Full engineering, design and prototype support
- Design, simulation and processing assistance
- Quotes and samples turned around in 24 hours
- Flexible, quick-turn manufacturing
- Dedicated Application Specific Product engineers and technicians
- Modified or custom options for board level connectors and cable assemblies including: contacts, bodies, stamping, plating, wiring, molding, ruggedizing features and much more

Express Modification
Standard low-profile compression array (GMI) with non-standard pin-out

Engineered Custom
Custom body and pin layout with rotated pairs to cancel magnetic coupling

Contact the Application Specific Products Group at **asp@samtec.com** for express modifications or engineered customs.

samtec
SUDDEN SERVICE®

UNITED STATES • NORTHERN CALIFORNIA • SOUTHERN CALIFORNIA • SOUTH AMERICA • UNITED KINGDOM
GERMANY • FRANCE • ITALY • NORDIC/BALTIC • BENELUX • ISRAEL • INDIA • AUSTRALIA / NEW ZEALAND
SINGAPORE • JAPAN • CHINA • TAIWAN • HONG KONG • KOREA

JANUARY 2019