



HIGH-SPEED BOARD-TO-BOARD

APPLICATION DESIGN GUIDE

HIGH-SPEED BOARD-TO-BOARD

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

HIGH-SPEED PRODUCTS

Signal integrity optimized Edge Rate® contacts

Speeds up to 40 Gbps

Variety of pitch, density, stack height & orientation

FULL SYSTEM SIGNAL INTEGRITY SUPPORT

Teraspeed Consulting & Signal Integrity Group

Optimized 28+ Gbps systems

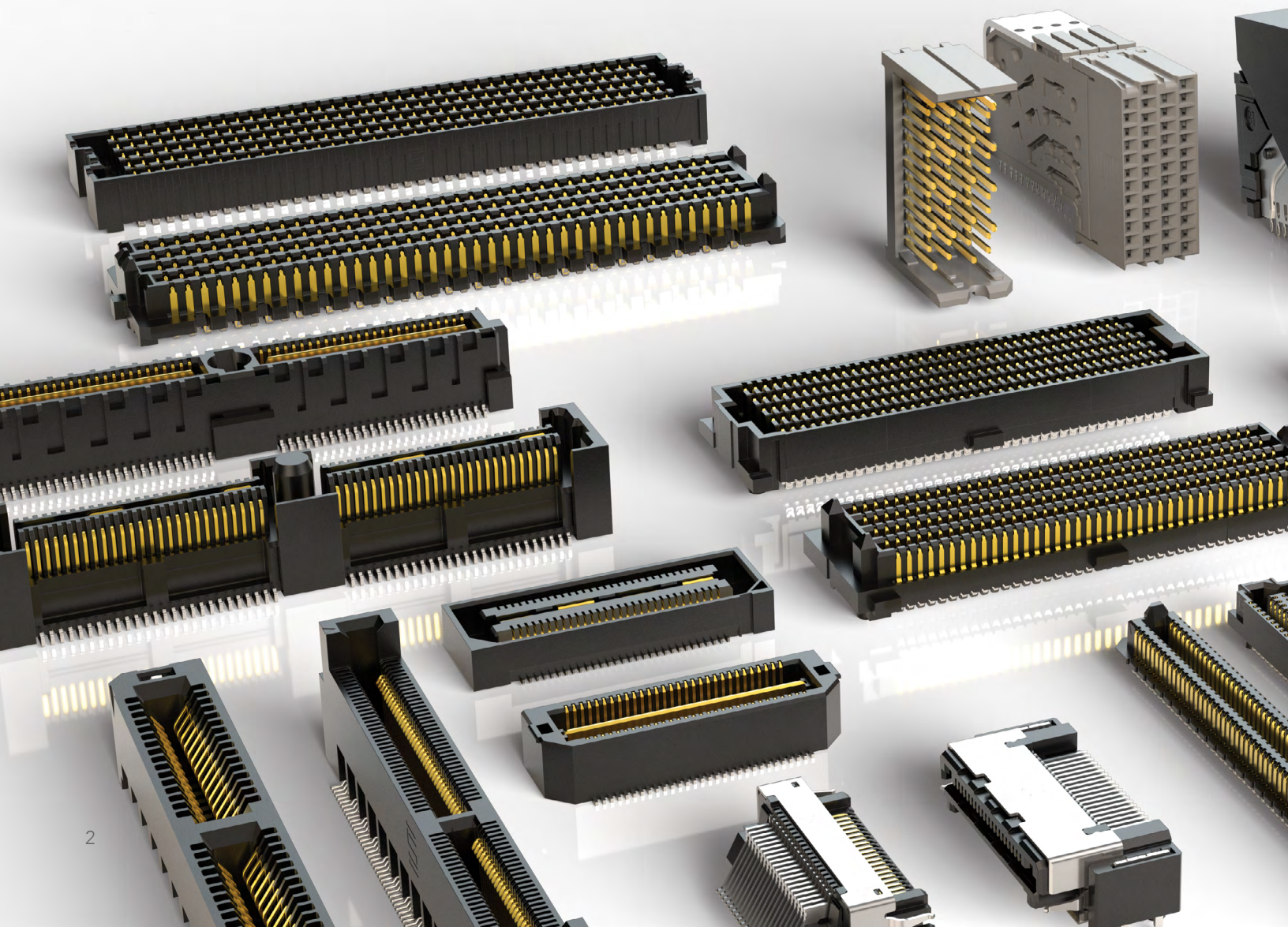
Electrical design and analysis expertise

ONLINE TOOLS

Solutionator®: Quickly build a mated set online

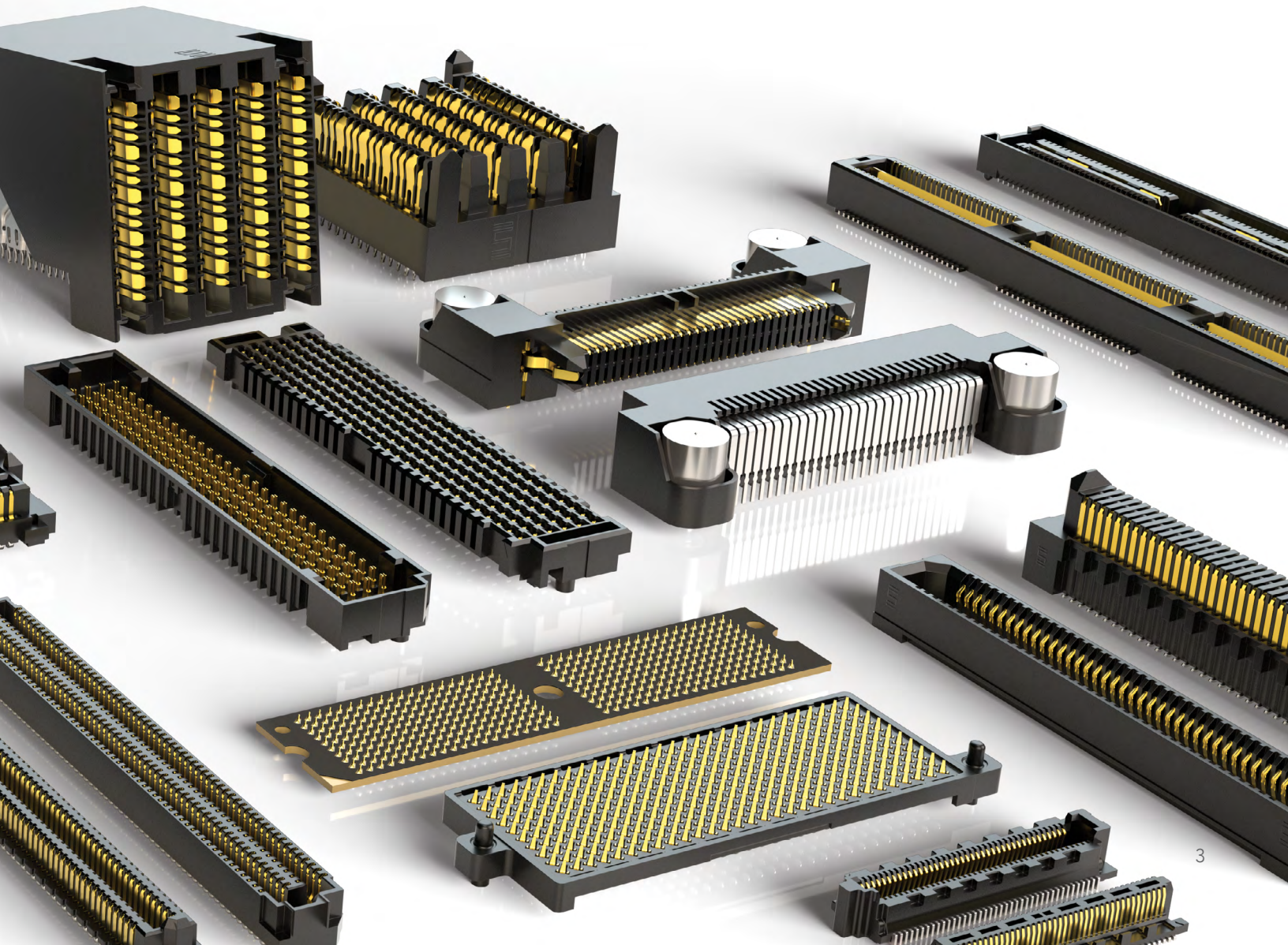
Simulator™: Real-time high-speed performance simulations

Channelyzer™: Full-channel simulation and analysis



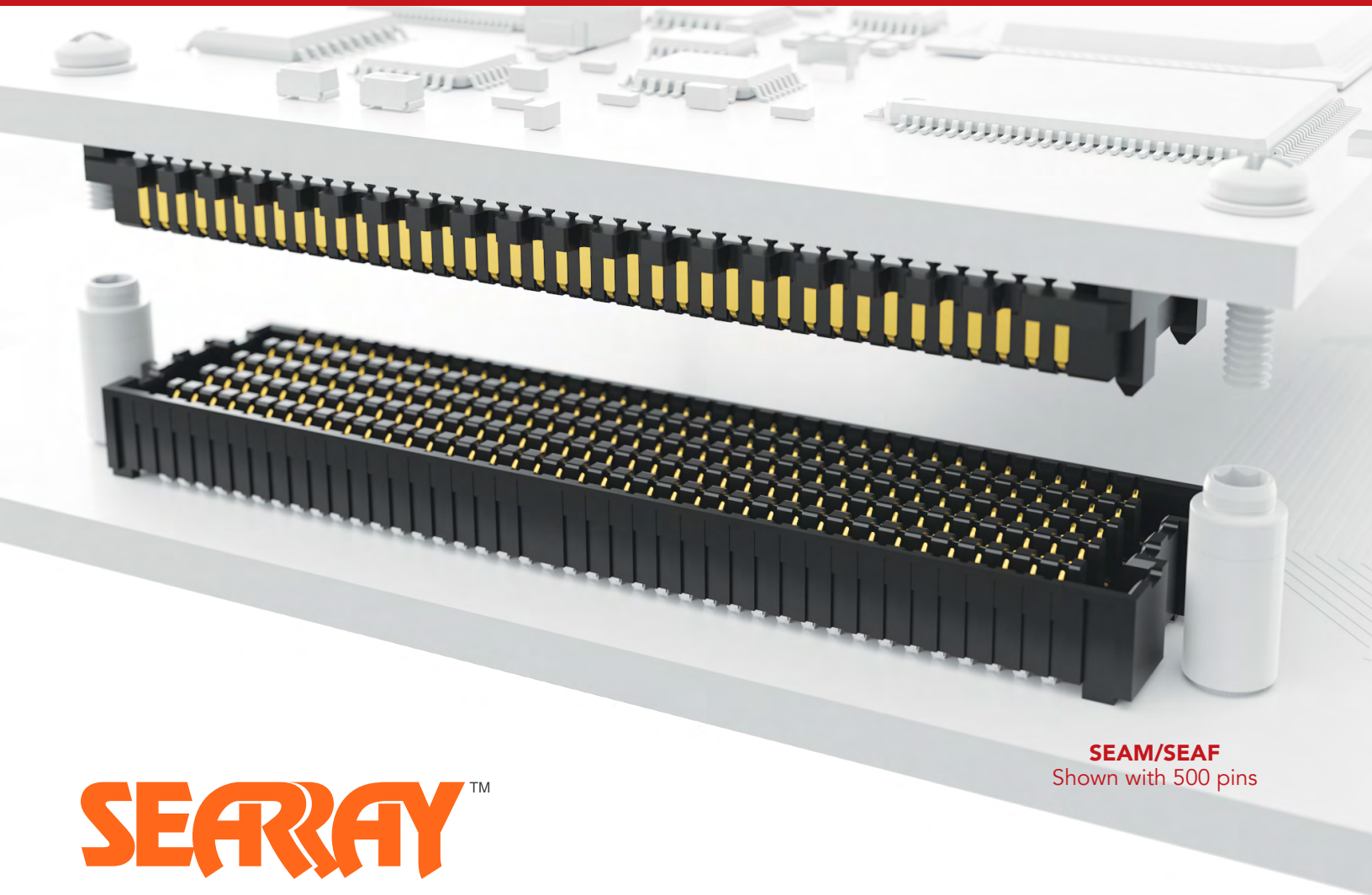
Learn more at
samtec.com

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HIGH-DENSITY ARRAYS

OPEN-PIN-FIELD • LOW-PROFILE • ONE-PIECE DESIGNS

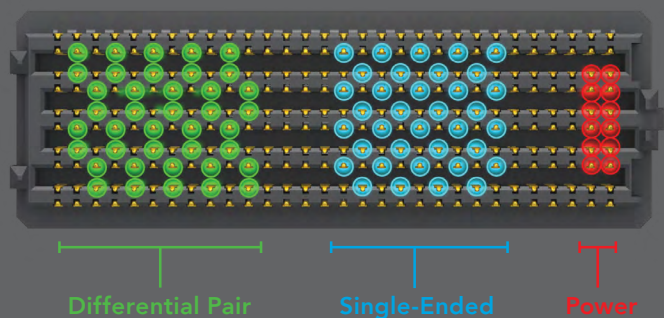


SEAM/SEAF
Shown with 500 pins

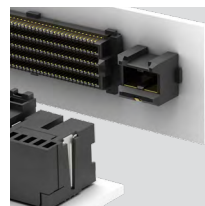
SEARRAYTM

ADDITIONAL SERIES

OPEN-PIN-FIELD FLEXIBILITY



Jack screw
standoffs (JSO)



Power modules
(UBPT/UBPS)



56G array system in
development



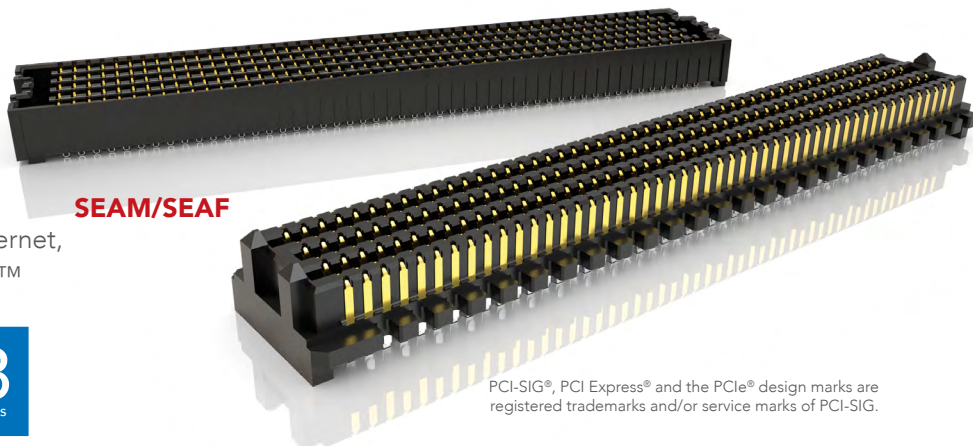
Application-specific SEARAY™ interconnects meet VITA standards for FMC and FMC+ FPGAs. Visit samtec.com/fmc

1.27 mm PITCH ARRAYS

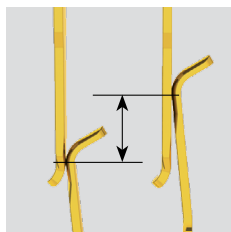
- 1.27 mm x 1.27 mm pitch
- Up to 560 Edge Rate® contacts optimized for signal integrity performance
- 7 mm to 40 mm stack heights; right-angle available
- Supports high-speed protocols such as Ethernet, PCI Express®, Fibre Channel and InfiniBand™

SEARAY™

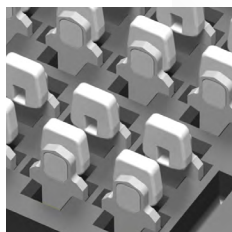
28
G b p s



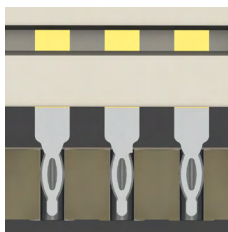
PCI-SIG®, PCI Express® and the PCIe® design marks are registered trademarks and/or service marks of PCI-SIG.



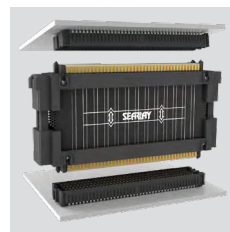
1.15 mm (.045")
contact wipe



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



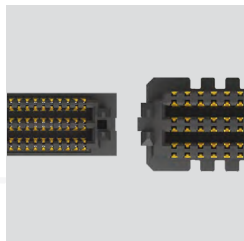
Press-fit tails available
(SEAMP/SEAFP)



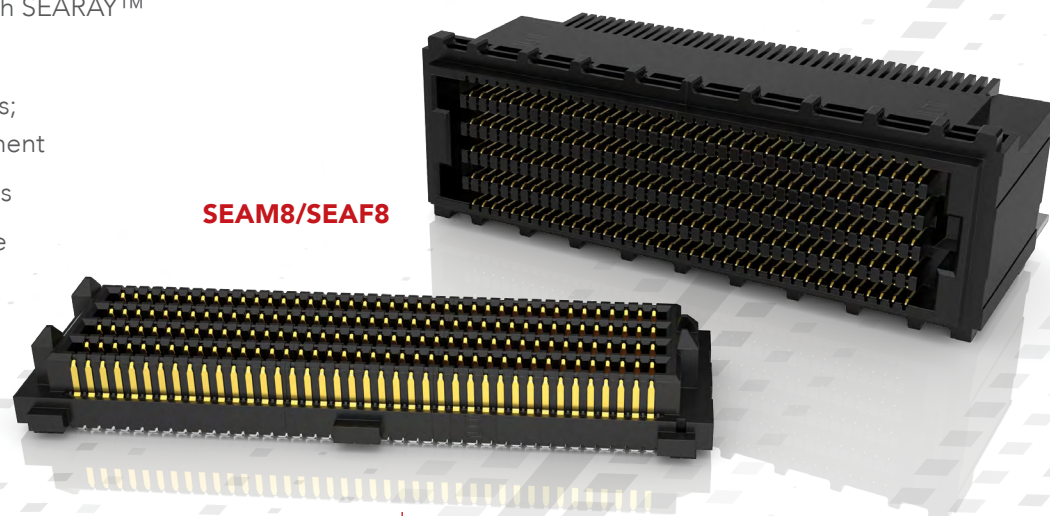
Elevated stack heights
available (SEAR)

0.80 mm PITCH ARRAYS

- 2x the density of 1.27 mm pitch SEARAY™
- 0.80 mm (.0315") pitch
- Up to 500 Edge Rate® contacts; higher pin counts in development
- 7 mm and 10 mm stack heights
- 2 mm extended wipe available



0.80 mm pitch vs.
1.27 mm pitch



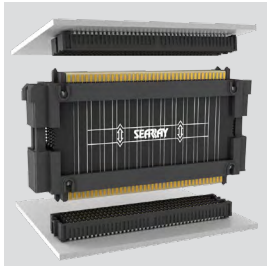
SEARAY™.8mm

28
G b p s

HIGH-DENSITY ARRAYS

ELEVATED ARRAYS

- Super elevated to 20, 30 and 40 mm stack heights
- 85 Ω system
- 240 - 500 total pins



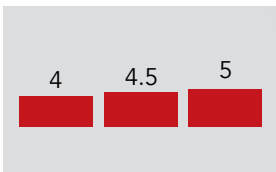
Mates with 1.27 mm pitch SEARAY™ socket (SEAF)

SEARAY™

SEAR

LOW-PROFILE ARRAYS

- Up to 320 total pins; 400 pin count in development
- 1.27 mm pitch
- Solder crimped termination for ease of processing
- Press-in or threaded standoffs available to assist unmating (JSO)



Available stack heights (mm)
(actual size)

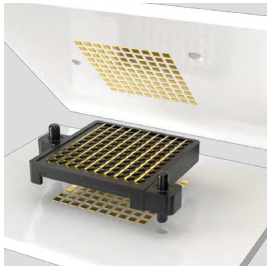
LPARRAY™

40
G b p s

LPAM/LPAF

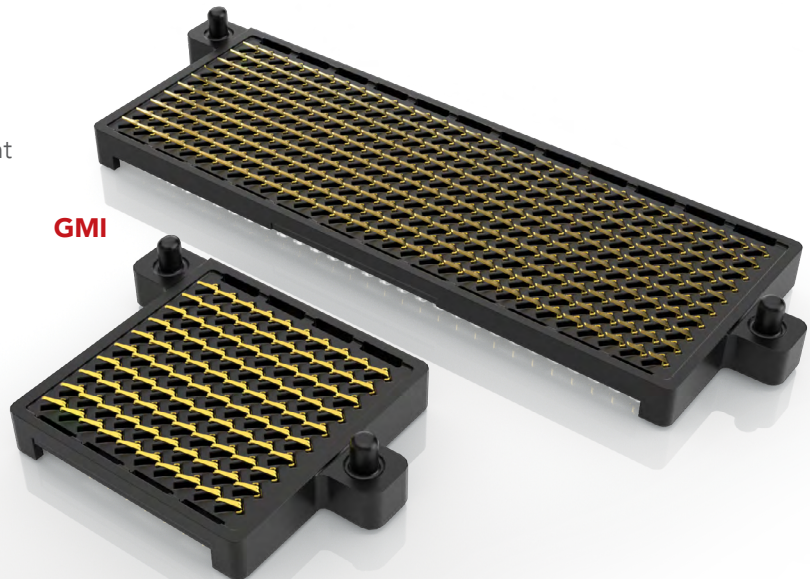
LOW-PROFILE COMPRESSION ARRAYS

- 1.27 mm and 2 mm body heights
- 100 - 400 total pins on a 1.00 mm pitch
- Dual compression contacts; single compression with solder balls in development
- Minimizes thermal expansion issues



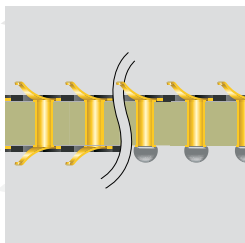
Ideal for low-cost board stacking, module-to-board and LGA interfaces

40
Gbps



ULTRA-LOW-PROFILE ONE-PIECE ARRAYS

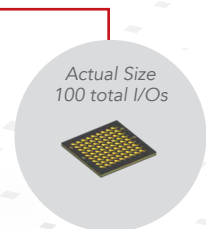
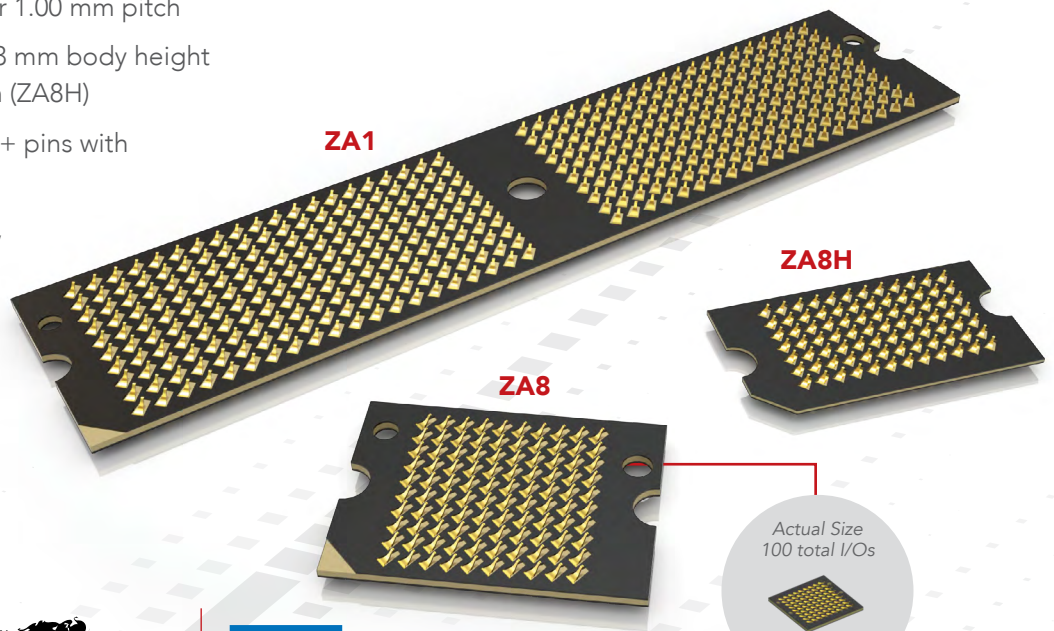
- One-piece design on 0.80 mm or 1.00 mm pitch
- 1 mm body height (ZA8/ZA1); 0.3 mm body height provides the shortest signal path (ZA8H)
- Up to 400 pins standard or 3,000+ pins with custom capabilities
- Customizable in X, Y, and Z axes, stack height, pin count, shape, plating thickness, etc.
- Alignment/compression hardware available (ZHSI, ZSO, ZD)



Dual compression, or single compression with solder balls

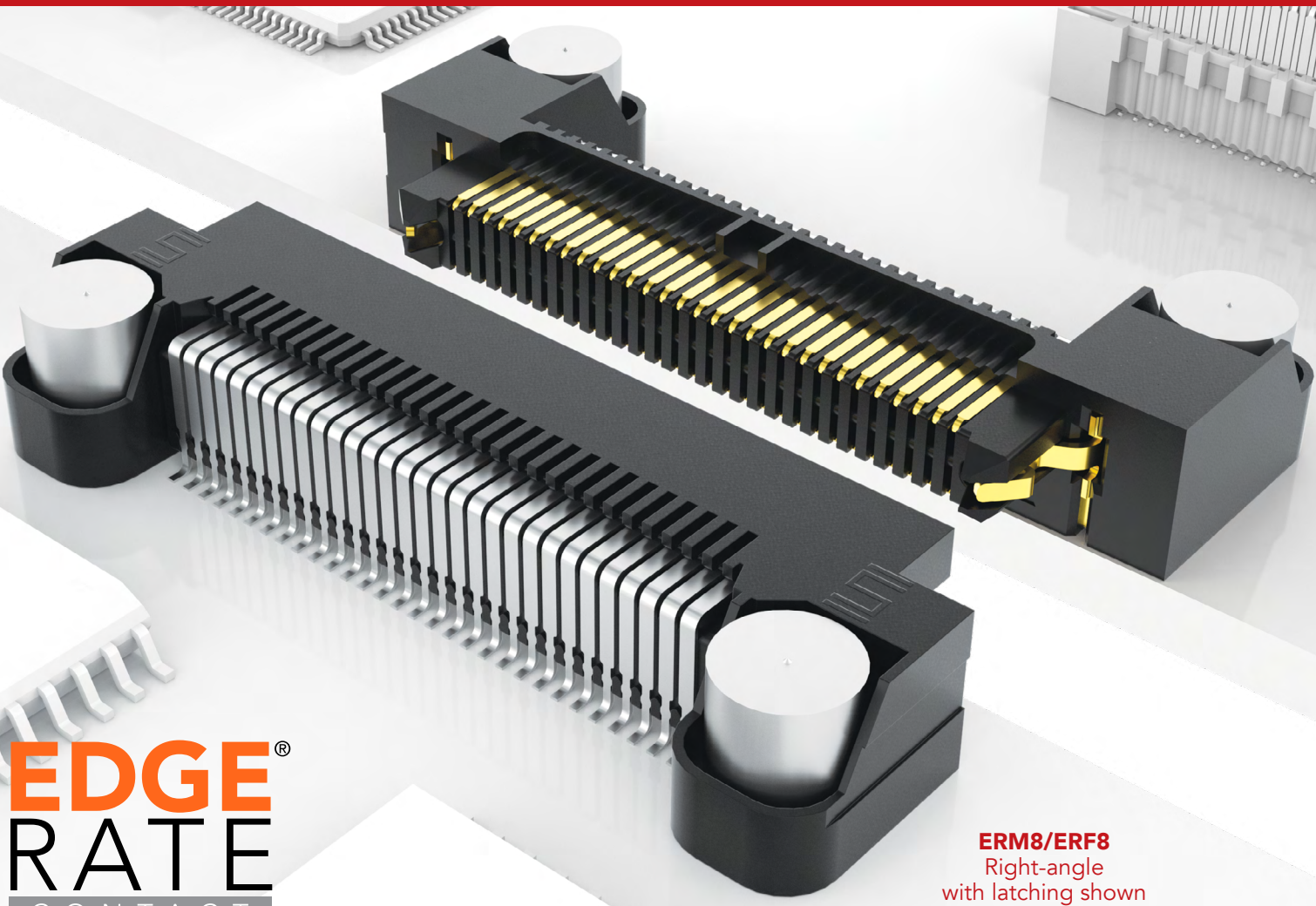
RAY

56
Gbps



EDGE RATE[®] CONNECTOR STRIPS

OPTIMIZED FOR SPEED • HIGH CYCLES • INCREASED CONTACT WIPE



**EDGE
RATE[®]**
CONTACT

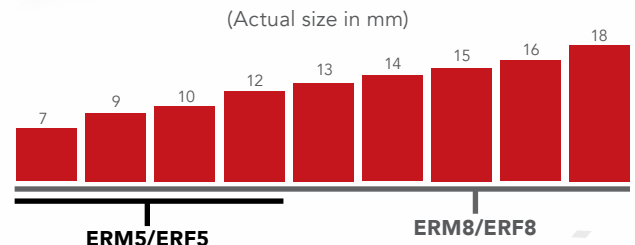
ERM8/ERF8
Right-angle
with latching shown

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

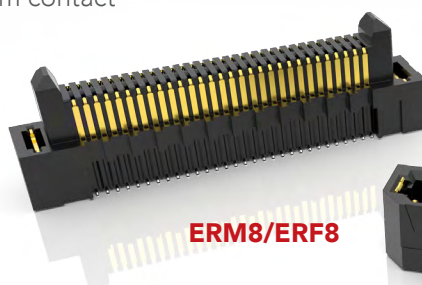




Samtec ships over 600
FREE samples per day.

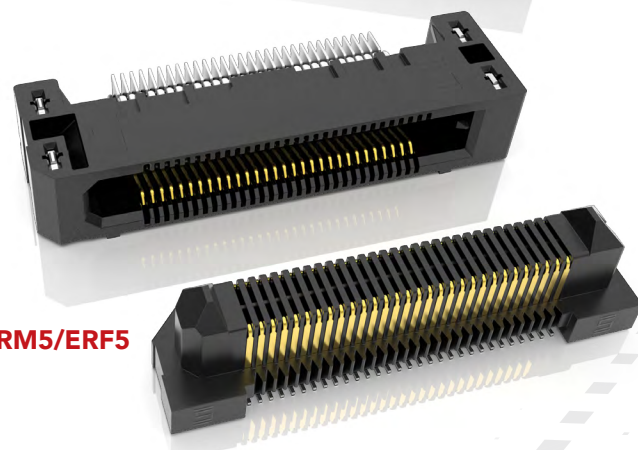
0.50 mm AND 0.80 mm PITCH SYSTEM

- 1.00 mm contact wipe (ERM5/ERF5) or 1.5 mm contact wipe (ERM8/ERF8) for a reliable connection
- Differential pair and hot swap options (ERM8/ERF8)
- Up to 40% PCB space savings with 0.50 mm pitch vs. 0.80 mm pitch
- Stack heights from 7 mm to 18 mm
- Supports high-speed protocols including Ethernet and PCI Express®
- 0.635 mm pitch Edge Rate® Slim strips with 5 mm stack height and 2.5 mm body width in development

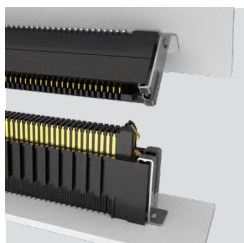


ERM8/ERF8

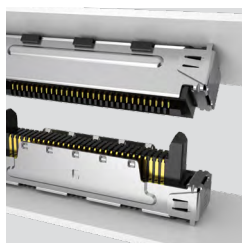
28
Gbps



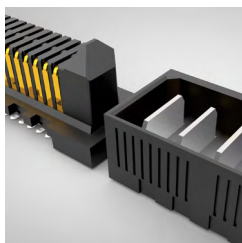
ERM5/ERF5



Metal solder lock in development for a rugged board connection



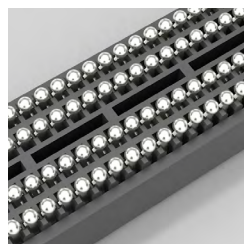
360° shielding option reduces EMI



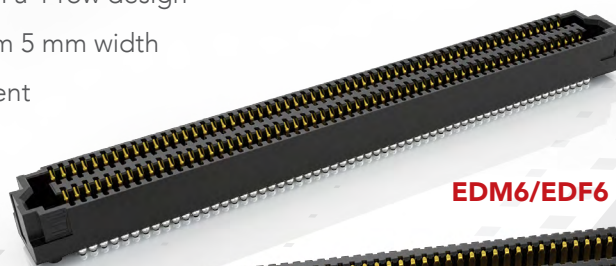
Micro power system (UMPT/UMPS) for power/signal flexibility

HIGH-DENSITY MULTI-ROW STRIPS

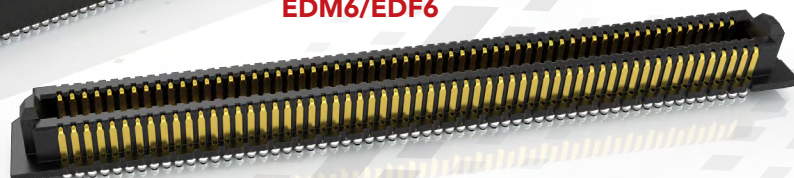
- Incredibly dense with up to 240 I/Os in a 4-row design
- Low-profile 5 mm stack height and slim 5 mm width
- Additional stack heights in development



Solder ball technology for ease of processing

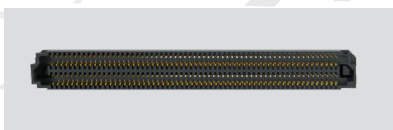


EDM6/EDF6



EDGERATE[®]HD

28
Gbps



Actual size (240 total positions)

samtec.com/edgerate

GROUND PLANE CONNECTORS

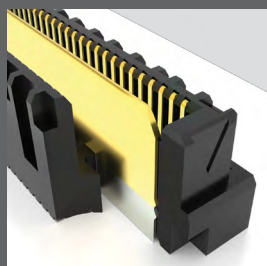
RELIABLE SI PERFORMANCE • LOW-PROFILE • SLIM FOOTPRINT

QTH/QSH
5 mm stack height shown

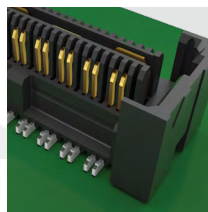
QSERIES®

INTEGRAL GROUND PLANE

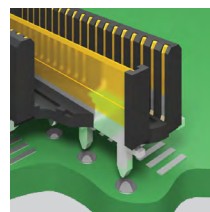
- Surface mount ground plane between two signal rows improves electrical performance
- Significantly reduces row-to-row crosstalk
- Reduces coupling between pins within a row



FEATURES



Differential pairs
reduce noise



Mixed technology
(MIT/MIS)



Options for power,
retention & RF



Samtec plates over
1 billion pins per month.

LOW-PROFILE GROUND PLANE CONNECTORS

- 0.50 mm, 0.635 mm and 0.80 mm pitch
- 5 mm to 25 mm stack heights
- Integral power/ground plane rated for up to 25 A

QSTRIP®

28
Gbps

QTE/QSE

SLIM GROUND PLANE CONNECTORS

- 0.80 mm pitch
- Edge Rate® contacts optimized for superior signal integrity performance
- Right-angle available for coplanar and perpendicular mating

QRATE®

28
Gbps

QRM8/QRF8

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)

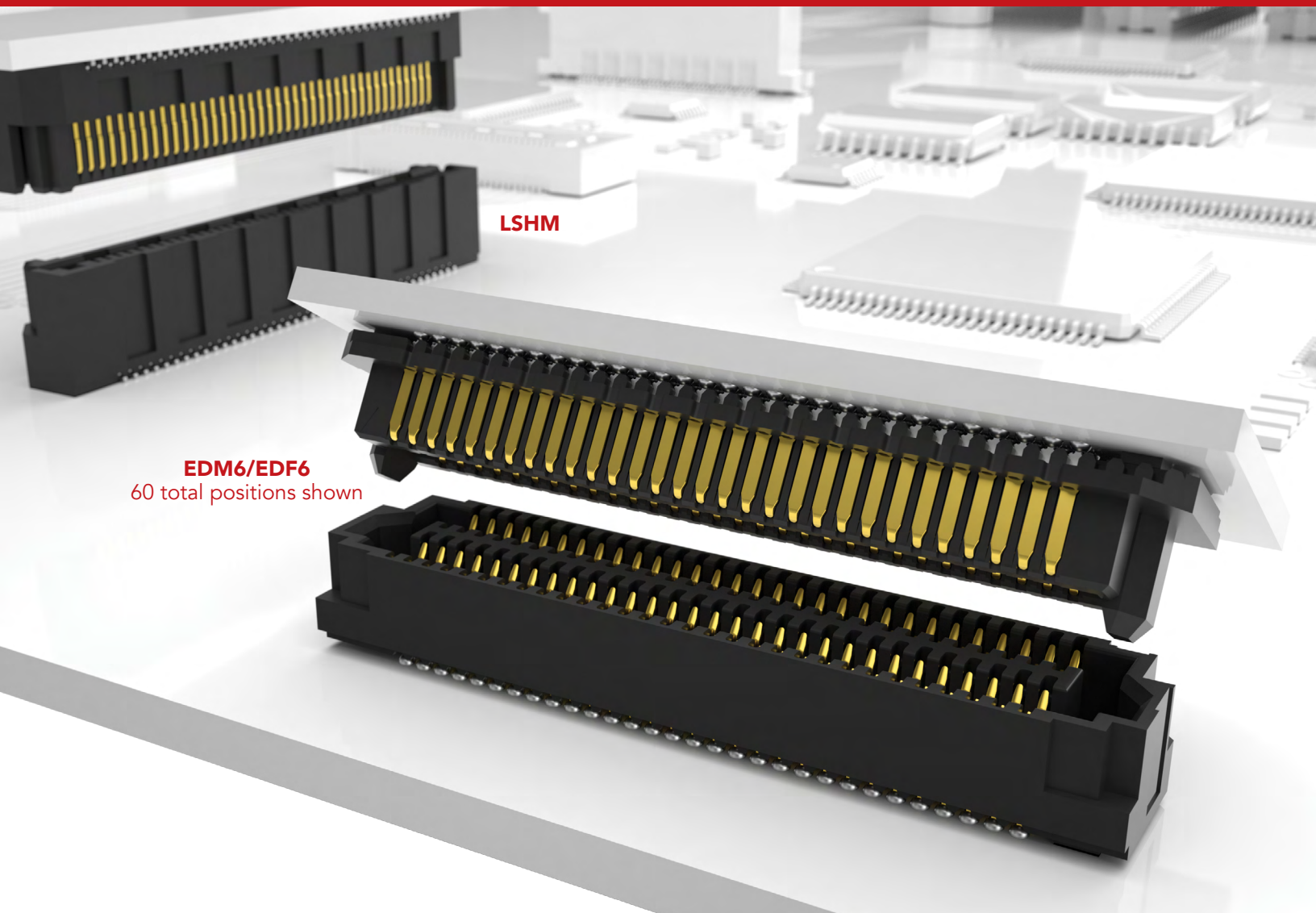
Q2™

25
Gbps

QMS/QFS

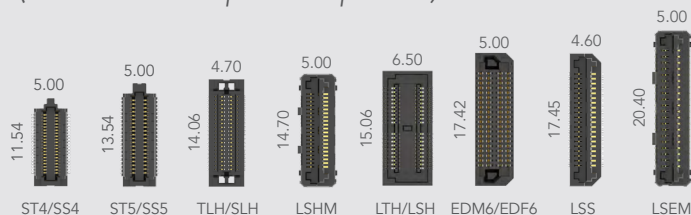
ULTRA MICRO INTERCONNECTS

SPACE SAVING DESIGNS • HERMAPHRODITIC • HIGH-DENSITY

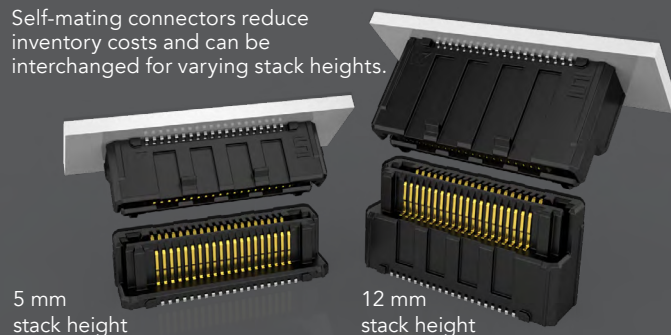


SLIM BODY DESIGNS

(Actual size @ 20 positions per row)



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

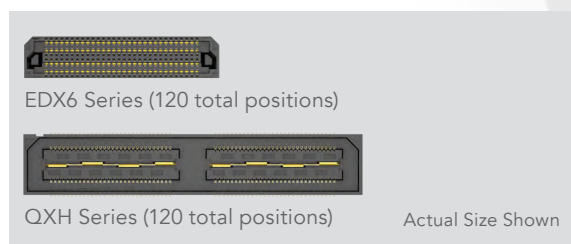
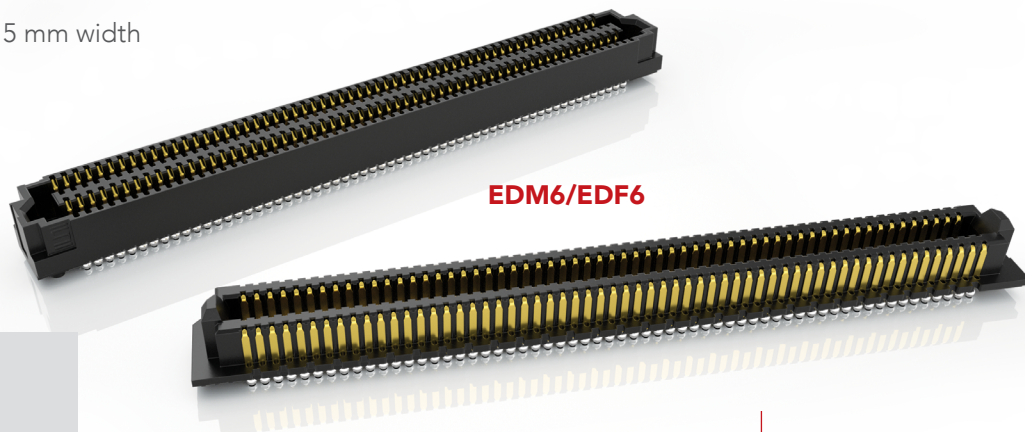




90% of Samtec's orders are built to order and shipped in 3-5 days.

HIGH-DENSITY MULTI-ROW STRIPS

- Low-profile 5 mm stack height and slim 5 mm width
- 0.635 mm pitch in a 4-row design
- Edge Rate® contact system optimized for signal integrity performance
- Other stack heights in development



EDGERATE[®]HD

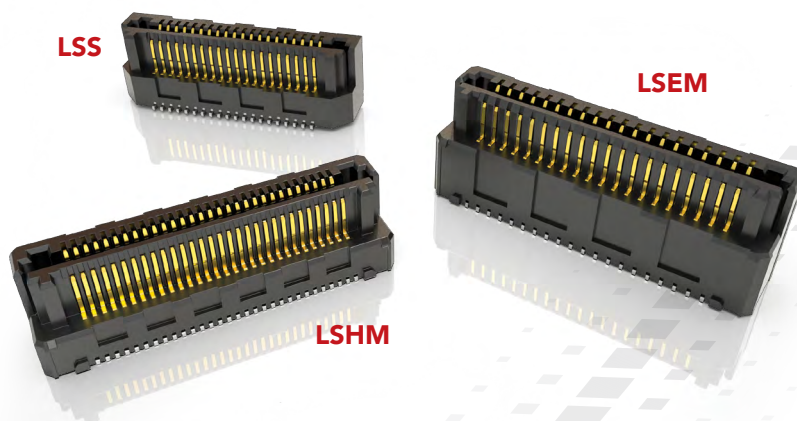
28
Gbps

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

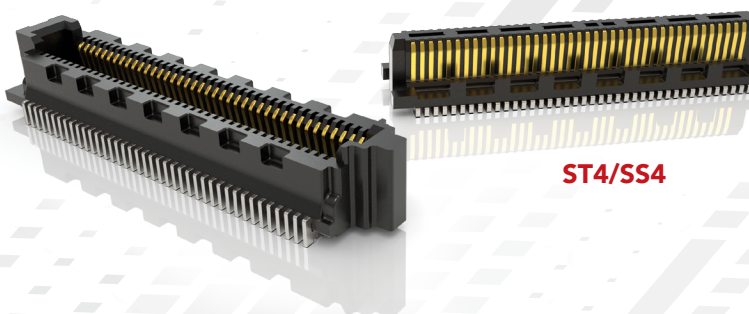
RAZOR[™]
BEAM
SYSTEM

25
Gbps



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[™]
BEAMPLP
SYSTEM

28
Gbps

samtec.com/ultra-micro

EDGE CARD SYSTEMS

SPEEDS TO 40 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, 0.635 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

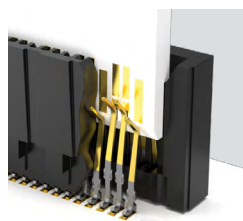




Samtec's edge cards meet transmission demands for broadcast video applications. Visit samtec.com/12gsdi

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
- Surface mount, right-angle, edge mount and pass-through
- Power/signal combo available (HSEC8-PV)



40 Gbps with differential pair (HSEC8-DP)

**EDGE
RATE®**
CONTACT

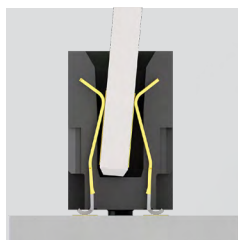
40
Gbps

HSEC8-EM

HSEC8-DV

1.00 mm PITCH SOCKETS

- Edge Rate® contact system for decreased crosstalk
- Custom designs allow for misalignment mitigation
- 20 – 140 positions
- Mates with .062" (1.60 mm) thick cards



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

**EDGE
RATE®**
CONTACT

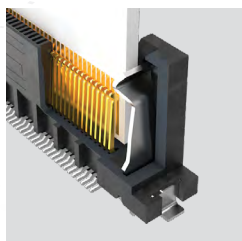
28
Gbps

HSEC1-DV

EDGE CARD SYSTEMS

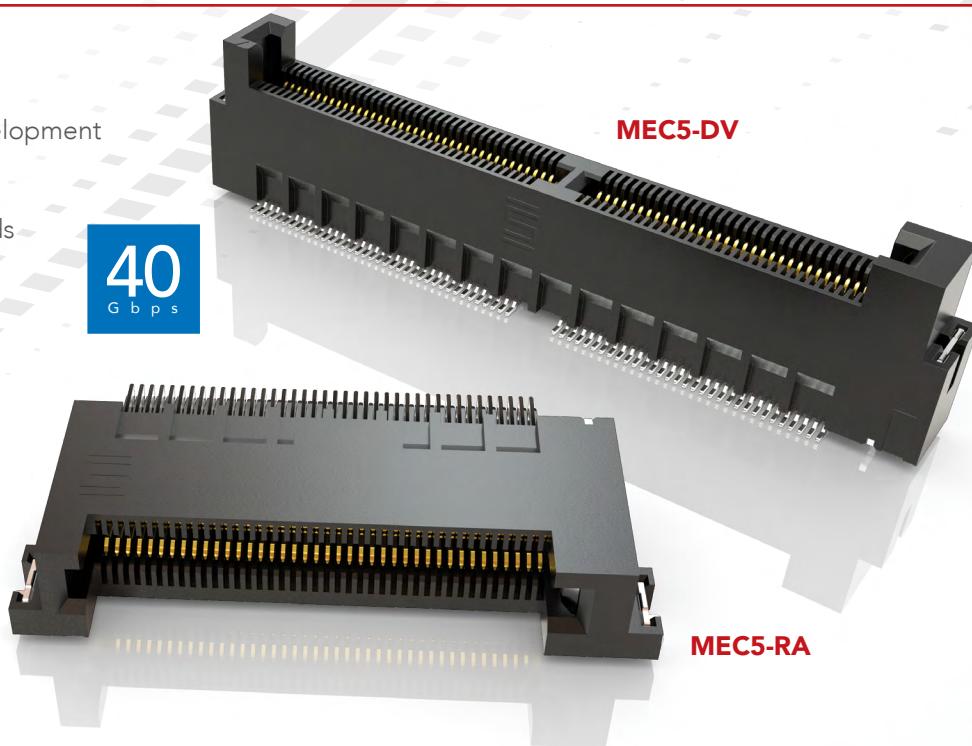
0.50 mm PITCH HIGH-SPEED, LOW-COST SOCKETS

- Justification beam enables use of standard PCB tolerance
- Up to 200 total I/Os; 300 I/Os in development
- Supports PCIe® Gen 4
- Mates with 0.62" (1.60 mm) thick cards



Beam ensures card and body are flush

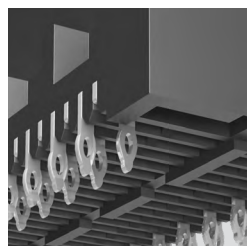
40
Gbps



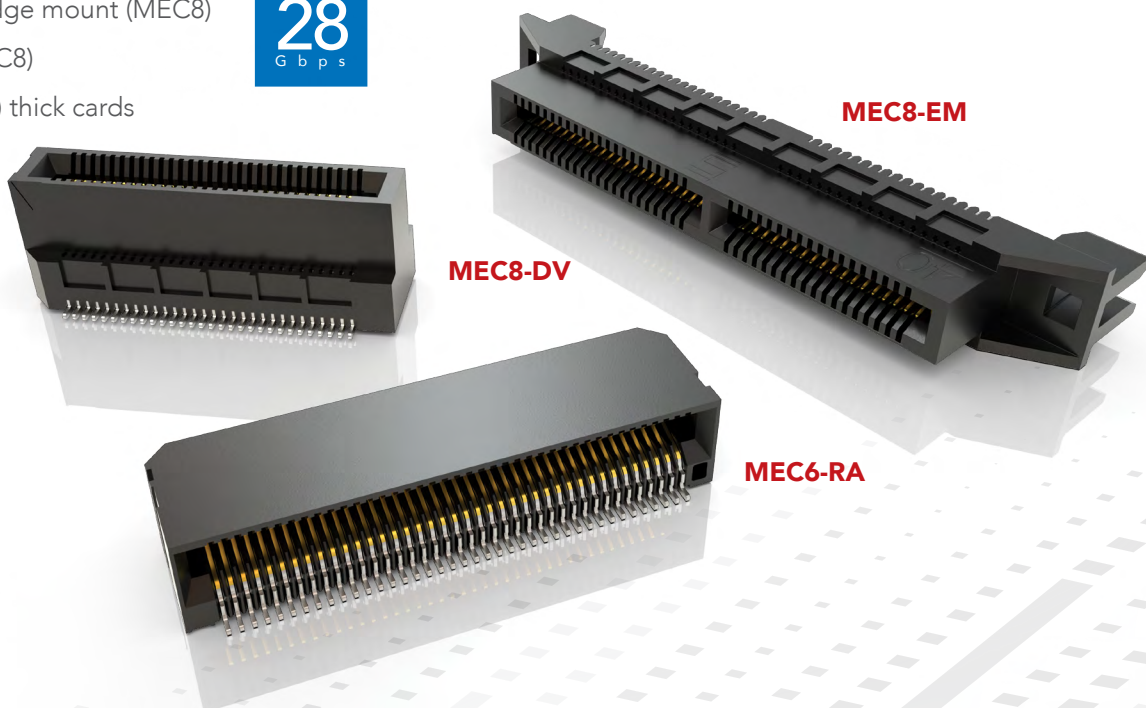
0.635 mm & 0.80 mm PITCH MICRO SOCKETS

- Up to 140 total I/Os
- Vertical and right-angle; edge mount (MEC8)
- Press-fit tails available (MEC8)
- Mates with 0.62" (1.60 mm) thick cards

28
Gbps



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 0.62" (1.60 mm) and 0.93" (2.36 mm) thick cards

28
Gbps

MEC1-RA

MECF-DV

MEC2-DV

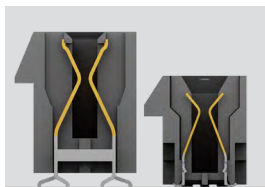
PCI EXPRESS® EDGE CARD SOCKETS

- 1.00 mm pitch in x1, x4, x8 or x16 positions
- Compatible to Gen 4 speeds (PCIE-LP)
- Low-profile version for space savings
- Mates with 0.62" (1.60 mm) thick cards

PCI
EXPRESS®

PCIE-LP

PCIE

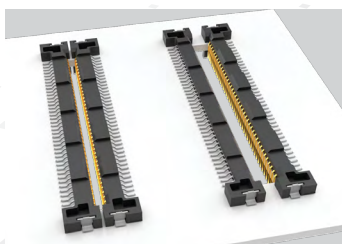


8 mm vs. standard
11 mm height

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
- Mates with 0.62" (1.60 mm) and 0.93" (2.36 mm) thick cards

SAL1



Mounting flexibility for
pass-through applications

HIGH-SPEED BACKPLANE SYSTEMS

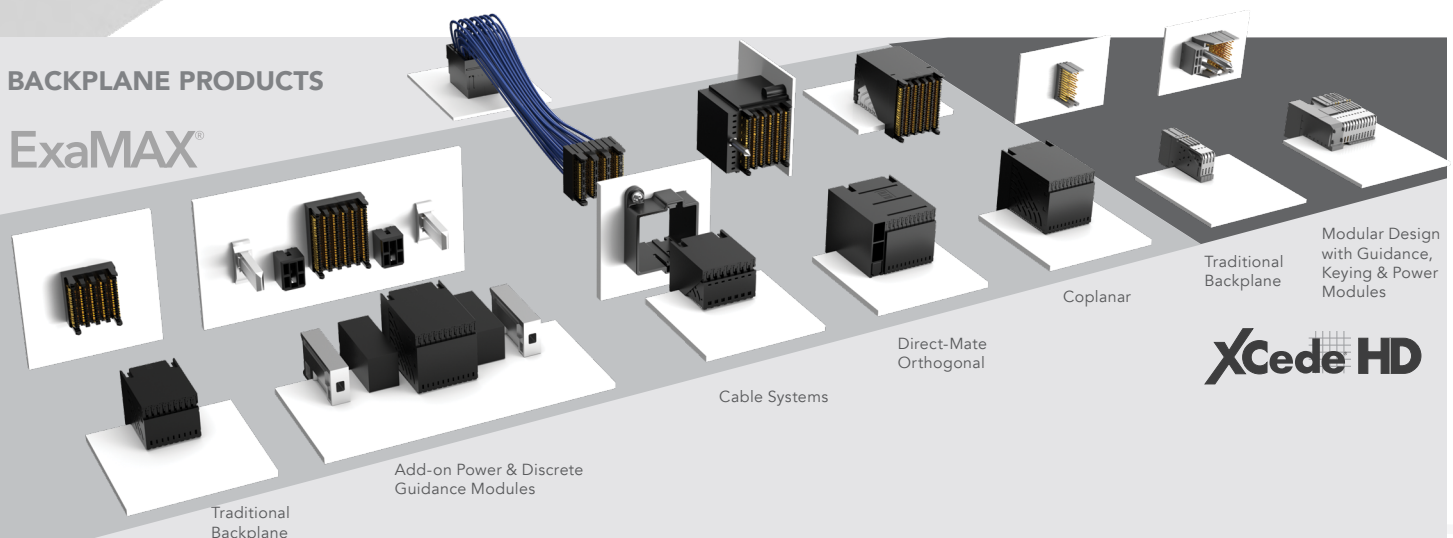
HIGH-DENSITY • DESIGN FLEXIBILITY • HIGH RELIABILITY



EBTM/EBTF-RA
Shown with power
and guidance options

BACKPLANE PRODUCTS

ExaMAX®



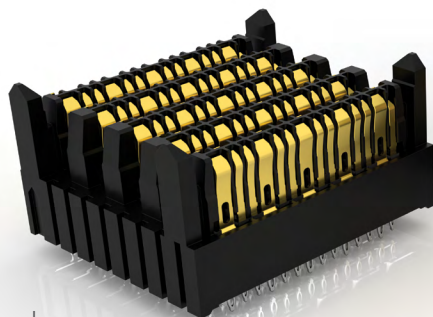


ExaMAX® cable assemblies incorporate Samtec's Flyover technology for 28+ Gbps applications. Visit samtec.com/twinax-flyovers

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
- Direct-mate orthogonal (EBDM-RA) and cable assemblies available (see page 23)

EBTM/EBTF-RA

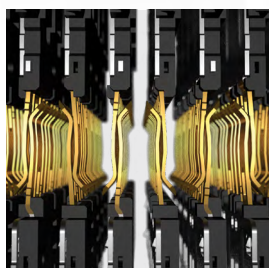


ExaMAX®

56
Gbps



Individual signal wafers with an embossed ground plane



Two reliable points of contact



Staggered differential pair design

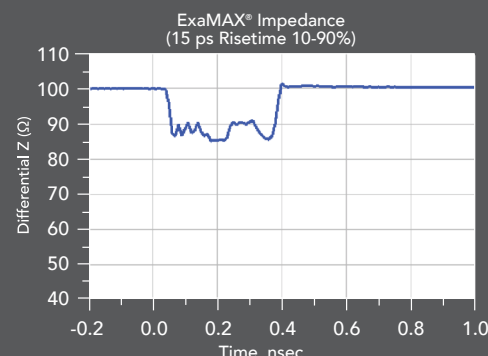
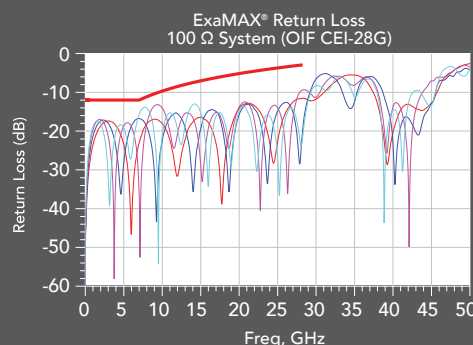
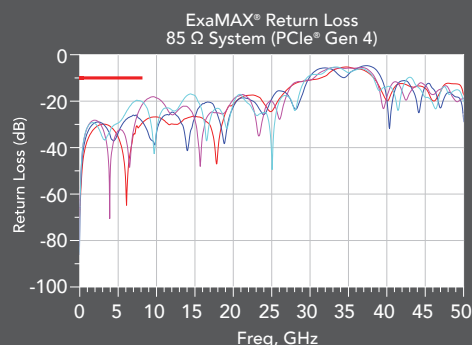


Power and guidance modules available

ExaMAX® is a trademark of AFCI

PERFORMANCE CHARTS

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



HIGH-SPEED BACKPLANE SYSTEMS

EXAMAX® DIRECT-MATE ORTHOGONAL

- Eliminates the need for a backplane or midplane
- Direct-mate provides a shorter signal path for improved signal integrity
- Requires two fewer connectors for decreased cost
- Optimizes system airflow and cooling for increased thermal efficiency
- 2.00 mm column pitch
- 6 pairs; 10 or 12 columns
- Integral guidance for blind mating
- Power modules with up to 10 contacts and 120 A per contact in development



APPLICATION



Improves system airflow and requires fewer connections by eliminating the midplane or backplane



Power modules with press-fit tails in development



Guidance modules available

MULTI-LINE CARD APPLICATION



Increases architectural density and performance by overcoming the limitations of space and airflow inherent with traditional backplane

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

HDTM/HDTF



Xcede HD

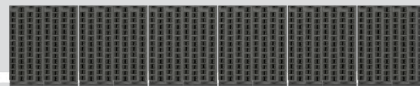
16
Gbps

MODULAR DESIGN



Modularity provides design flexibility to create any configuration for a specific application

DENSITY COMPARISON



Xcede® HD
Up to 84 pairs
per linear inch

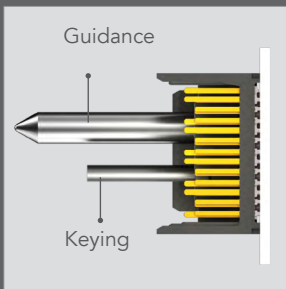


ExaMAX®
Up to 76 pairs
per linear inch

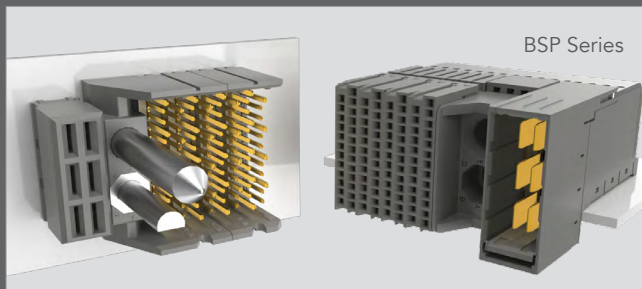
(Both shown with six 4-pair, 8 column receptacles)

Xcede® is a registered trademark of Amphenol Corporation.

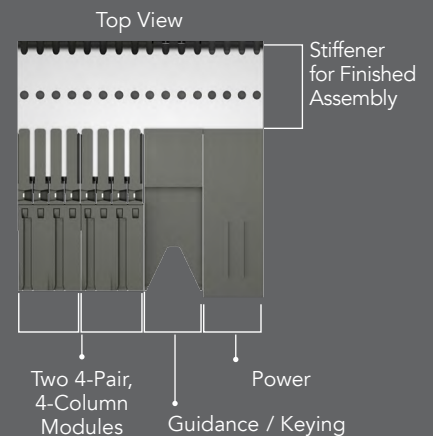
PRODUCT BREAKDOWN (4-Module System Shown)



Side View



BSP Series



HIGH-SPEED CABLE ASSEMBLIES

EYE SPEED® COAX & TWINAX CABLE • MIX AND MATCH

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

HIGH-DENSITY ASSEMBLIES

- Up to 16 Gbps
- 1.27 mm (SEAC) and 0.80 mm pitch (ESCA)
- 32 or 36 AWG coax; 34 AWG twinax
- Mates with SEARAY™ and SEARAY™ 0.80 mm arrays (see pages 4 - 5)
- Z-Ray® mating assembly available for up to 29 Gbps (see page 7)

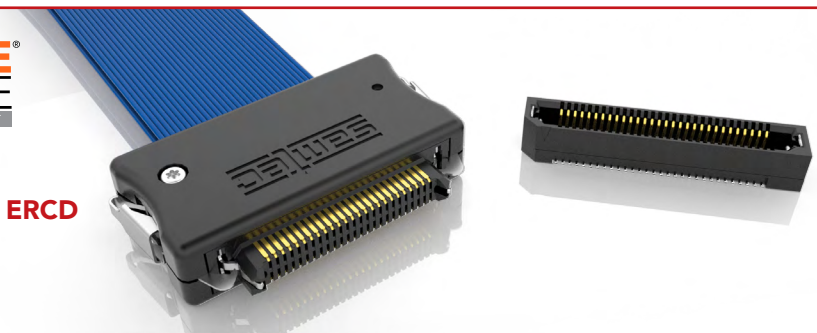


Mating cable for GMI compression array in development (see page 7)

EDGE RATE® ASSEMBLIES

- Up to 16 Gbps
- 34 AWG coax (ERCD); 30 AWG twinax (ERDP)
- Mates with 0.80 mm Edge Rate® connectors (see pages 8 - 9)

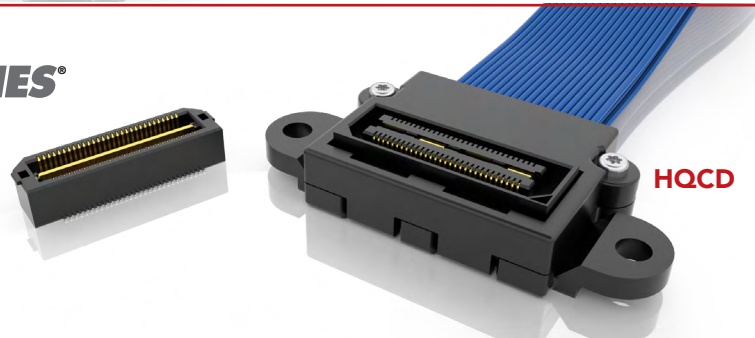
EDGE
RATE
CONTACT



Q SERIES® ASSEMBLIES

- Up to 13 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 (see pages 10 - 11)

QSERIES®



ULTRA MICRO ASSEMBLIES

- 16 Gbps
- 38 AWG coax
- Mates with 0.50 mm pitch Razor Beam™ connectors (see pages 12 - 13)

RAZOR
BEAM
SYSTEM

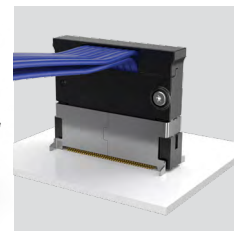
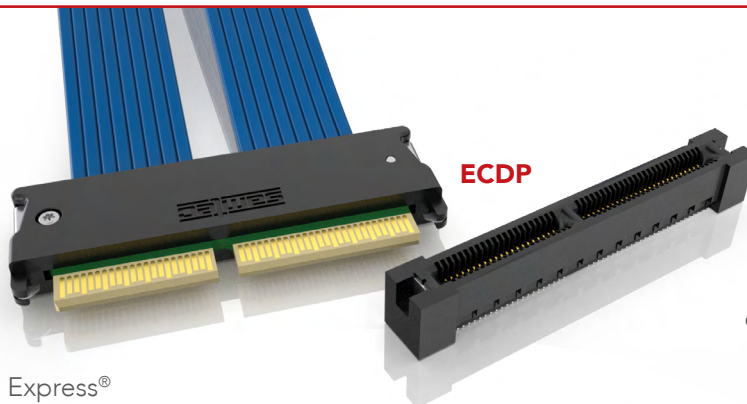




Samtec's High-Speed Cable Tech Center focuses on R&D and manufacturing of micro coax and twinax cable for 28+ Gbps systems. Visit samtec.com/tech-centers

EDGE CARD ASSEMBLIES

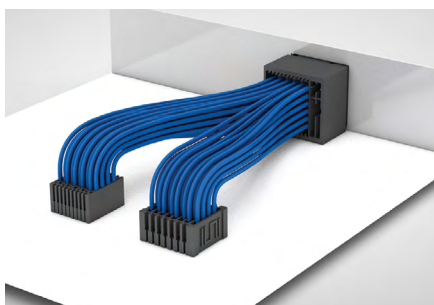
- Up to 20 Gbps
- 30 AWG twinax
- ECDP mates with 0.80 mm pitch Edge Rate® edge card sockets (see pages 14 - 15)
- Passive equalization available (ECDP-E) for higher speeds or longer reach
- Mating assembly available for PCI Express® edge cards (PCIEC; see page 17)



Vertical & right-angle mating cable assemblies for MEC5 in development (see page 16)

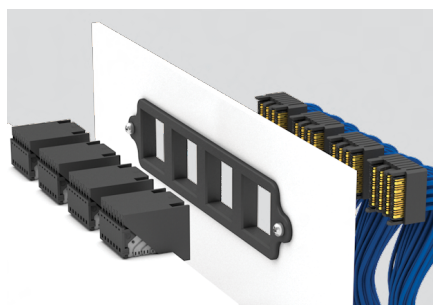
EXAMAX® BACKPLANE ASSEMBLIES IN DEVELOPMENT

ExaMAX®



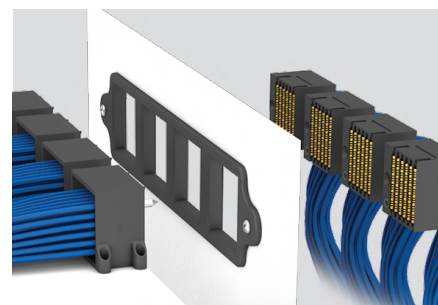
Cable-to-Board Press-Fit

28+ Gbps Direct Connect™ system



Cable-to-ExaMAX®

28 - 56 Gbps NRZ performance



Cable-to-Cable

56+ Gbps NRZ performance

EYE SPEED® MICRO COAX & TWINAX CABLE

Micro Coax

Samtec's foamed dielectric cable technology reduces dielectric constant and overall cable size for higher speeds, longer lengths and higher densities at lower costs.

Twinax

Samtec's proprietary co-extruded twinax cable technology eliminates the performance limitations and inconsistencies of individually extruded dielectric twinax cabling to achieve 28+ Gbps speeds and greater reach.

High-Speed Cable Manufacturing

Samtec can connect micro coax and twinax cable to almost any Samtec connector, procure and test new materials and develop truly differentiated products. For additional information contact Samtec's Cable Group at HDR@samtec.com



High-Speed Cable Technology Center, Wilsonville, Oregon

AT 28+ Gbps EVERYTHING MATTERS

From high-speed connectors and cables to PCB breakout regions, at next generation speeds,

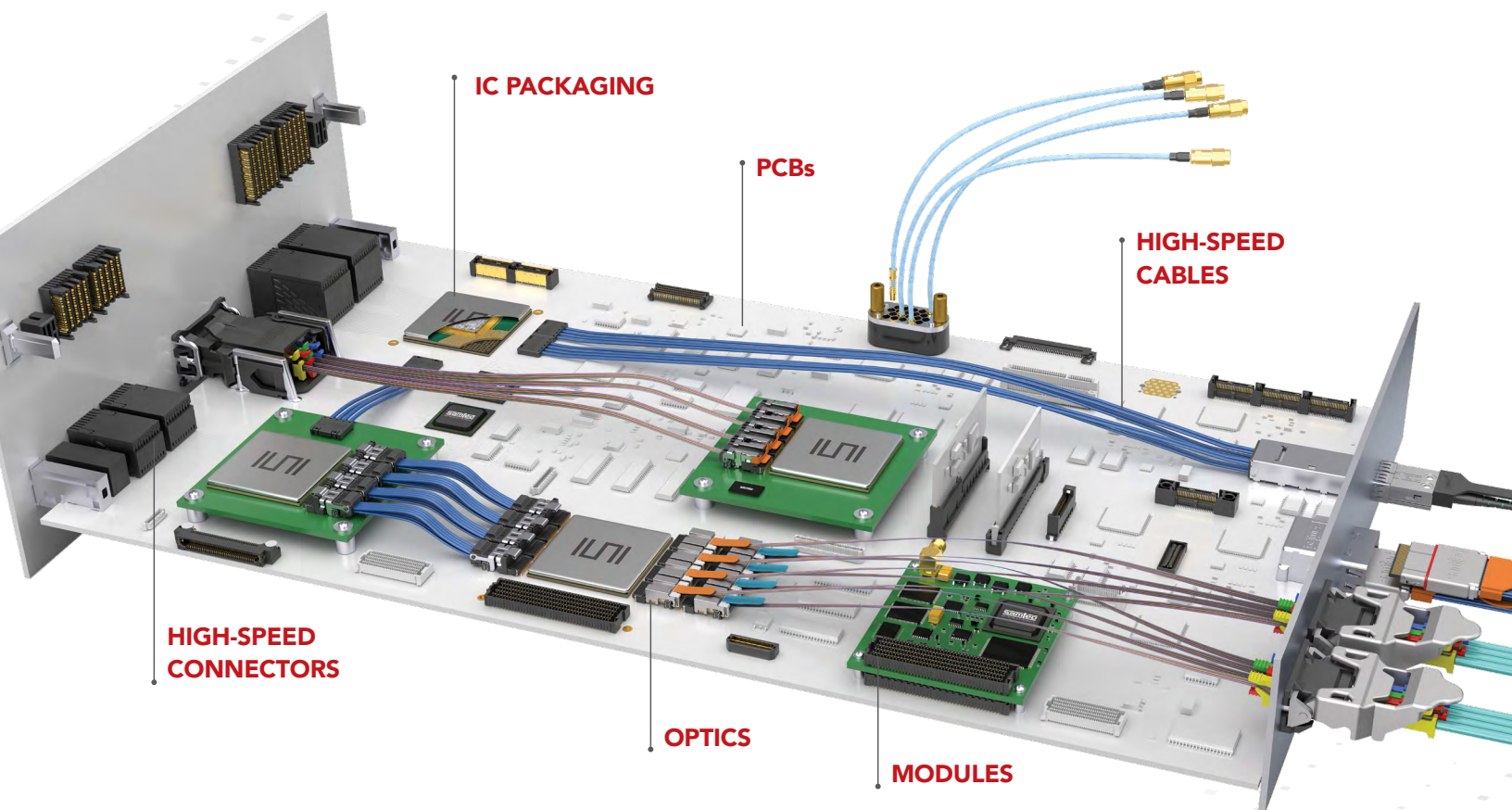
EVERY POINT OF INTERCONNECTION IS A POTENTIAL COMPLICATION.

Samtec offers extensive electrical design and analysis expertise to address the critical signal integrity issues inherent in 28+ Gbps systems.

PCB ROUTING, DENSITY
AND BREAKOUT REGIONS

PROTOCOL
COMPLIANCE

POWER & THERMAL
MANAGEMENT



COST CONTROL

DEMAND FOR SMALLER
FORM FACTORS WITH
INCREASED FUNCTIONALITY

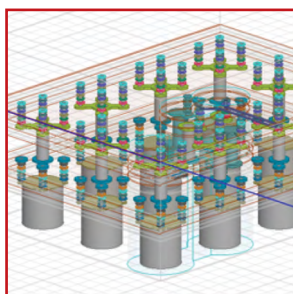
MATERIALS SELECTION



TERASPEED AND SIGNAL INTEGRITY GROUP ENGINEERS HELP OPTIMIZE AND VALIDATE YOUR HIGH-PERFORMANCE SYSTEM.

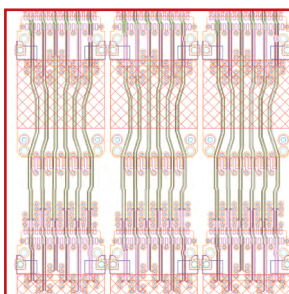
Services are available at any level you require: from early stages of the design process including package design, material selection and PCB routing, through in-depth analysis, modeling and simulation, with measurement validation services available to 67 GHz.

FULL SYSTEM SIGNAL INTEGRITY



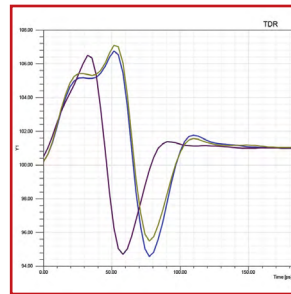
PACKAGE DESIGN & MATERIALS

- Bumpout / Ballout Optimization
- Layout & Routing
- Ballout Transition Structures
- Material Recommendations



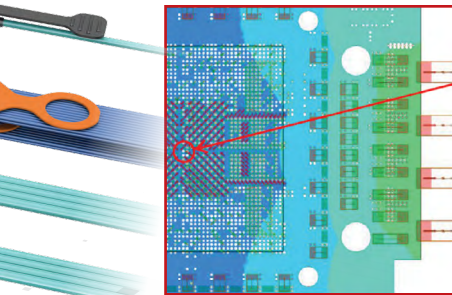
MODELING

- High Bandwidth Full-Wave
- Custom & Commercial Software



SIMULATION

- Design Rules for Package & PCB Designs
- Validate Implementation and Signaling Requirements for Critical Channels
- Simulations via High-Performance Computing



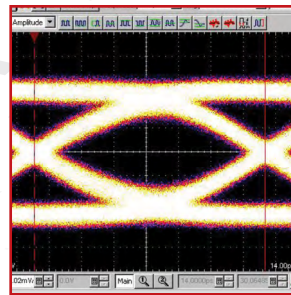
ANALYSIS

- Package, PCB and System-Level Power Integrity
- Package, PCB and System-Level Signal Integrity



TESTING

- Post Design Simulation & Measurements
- Measurement of Test Structures for Signal Integrity / Power Integrity Optimization
- Material Characterization



VALIDATION

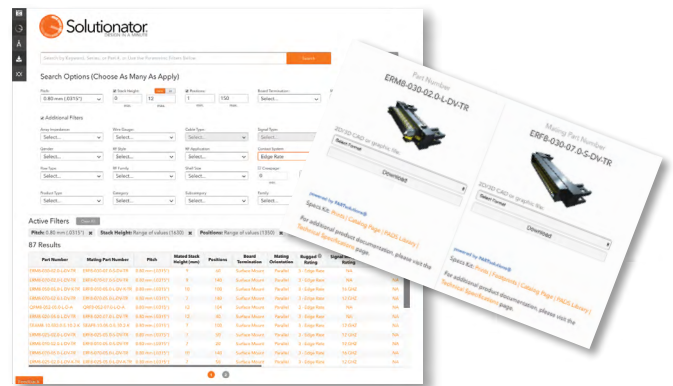
- Validation Platform Engineering
- Connectors, Packages & Devices
- Characterization at Frequencies to 67 GHz

ONLINE TOOLS

DESIGN • PERFORMANCE • SIMULATION

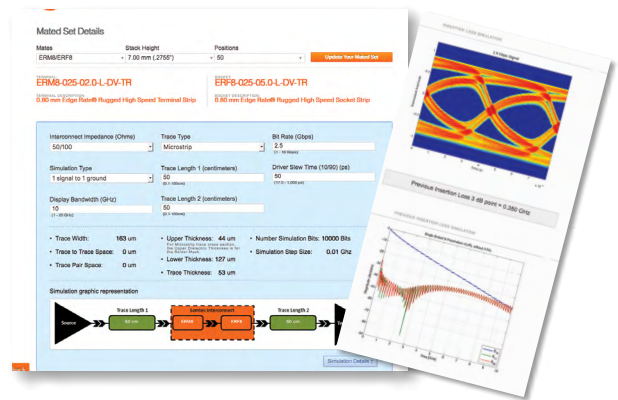
QUICKLY BUILD MATED CONNECTOR SETS ONLINE

- 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

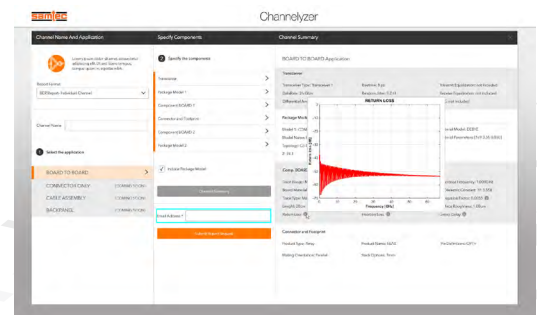
- Integrates and blends data from models to project performance in the user-defined system
- Outputs include:
 - Insertion and return loss
 - Crosstalk (NEXT and FEXT)
 - Eye diagrams



- 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

23%

Express Modifications

92% do not require engineering or tooling charges

5%

Engineered Customs

Total Sales

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

21%

ARRAYS

11%

MEZZANINE

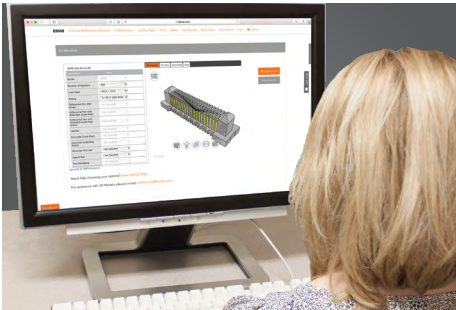
28%

ULTRA MICRO

35%

EDGE CARDS

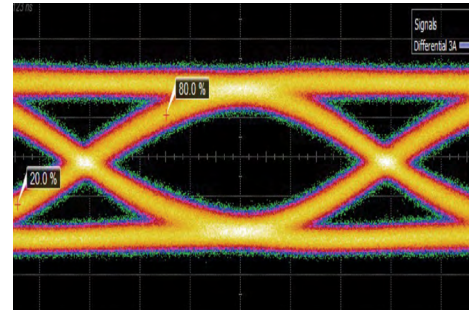
INDUSTRY LEADING CUSTOMER SERVICE



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



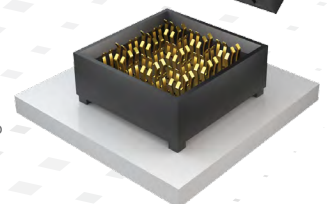
Express Modification

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 customasp@samtec.com for engineered customs.



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SINGAPORE • JAPAN • SHANGHAI • SHENZHEN • TAIWAN • HONG KONG • KOREA

MAY 2017