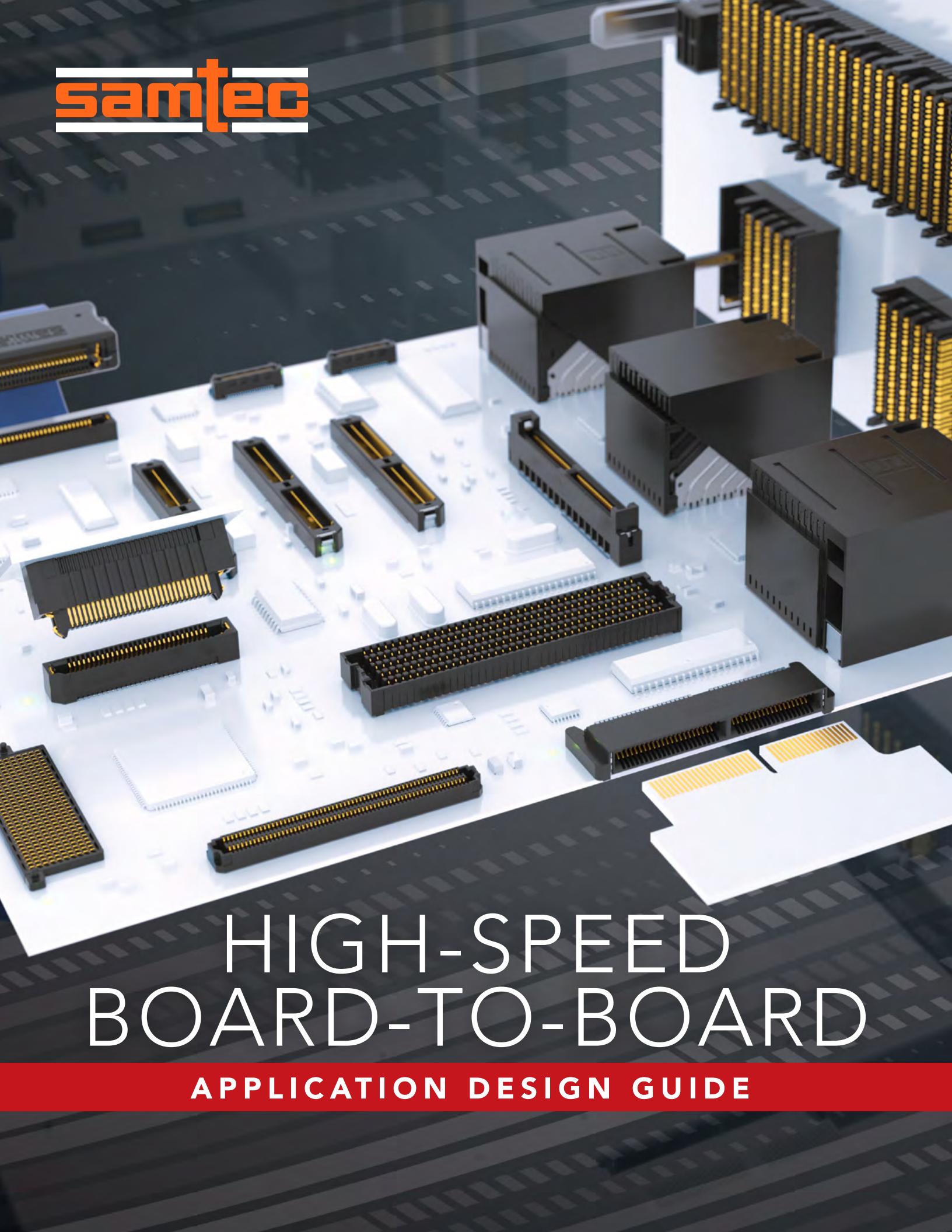


HIGH-SPEED BOARD-TO-BOARD

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

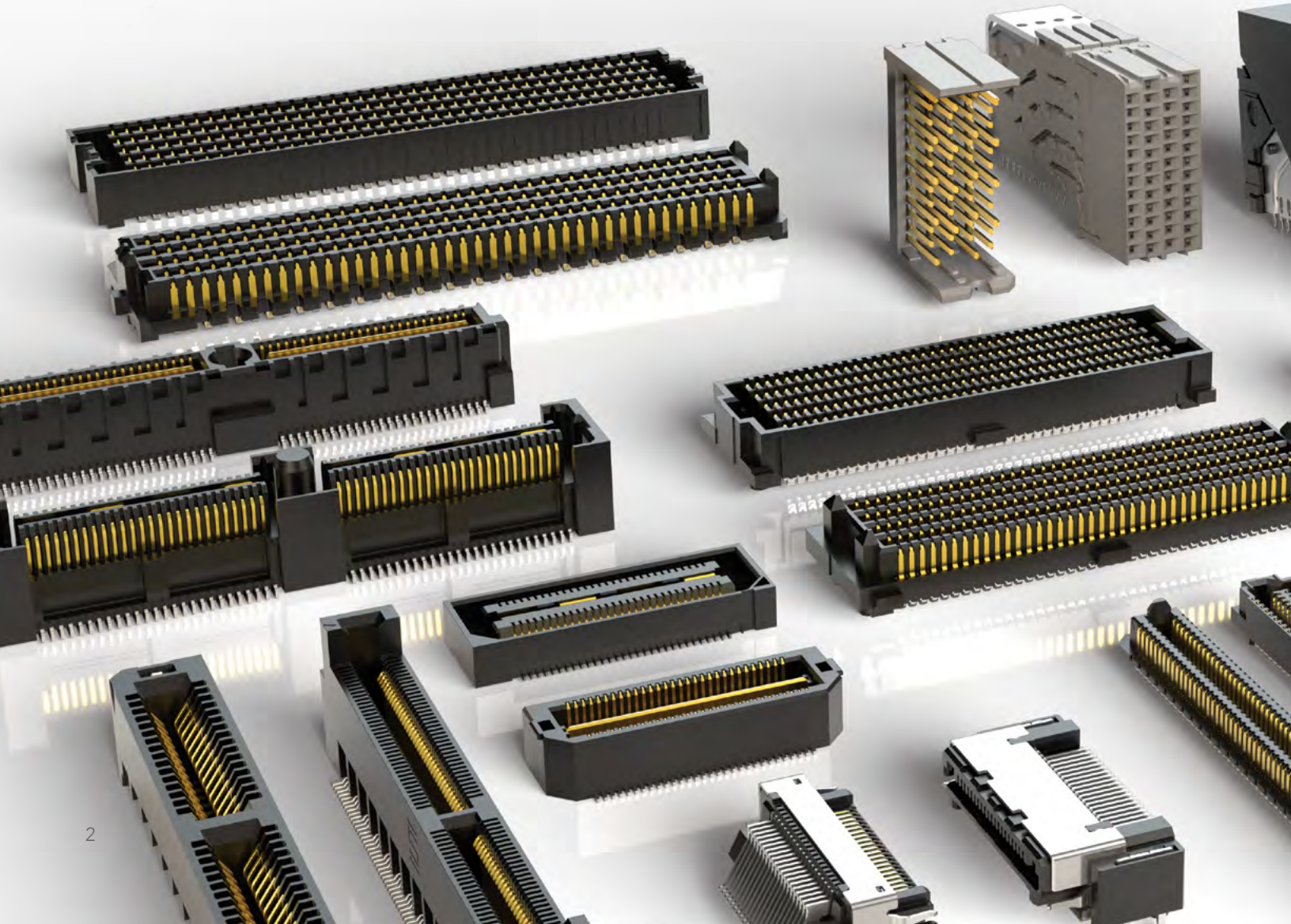
Electrical design and analysis expertise

ONLINE TOOLS

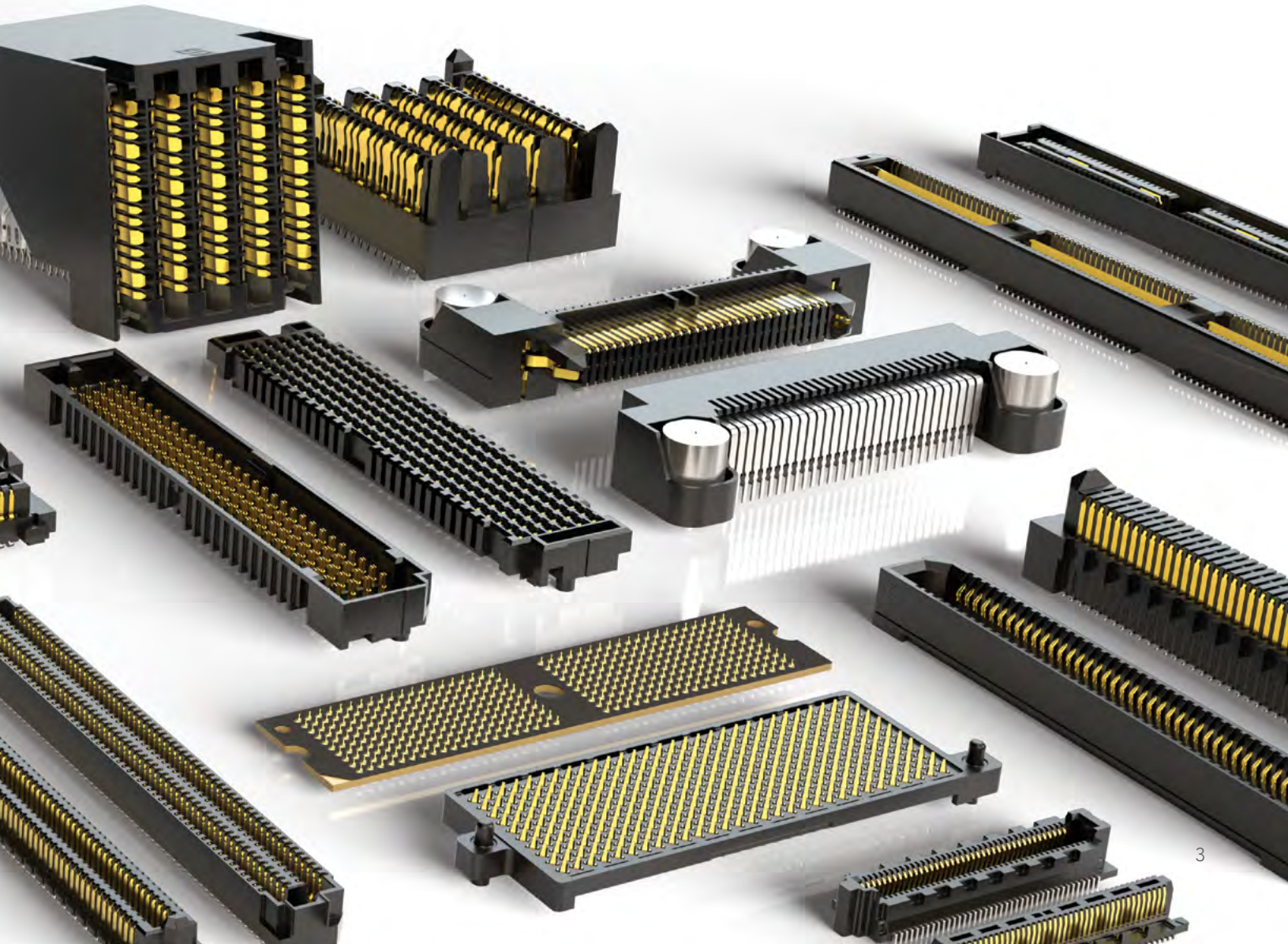
Solutionator®: Quickly build a mated set online

Simulator™: Real-time high-speed performance simulations

Channelyzer™: Full-channel simulation and analysis

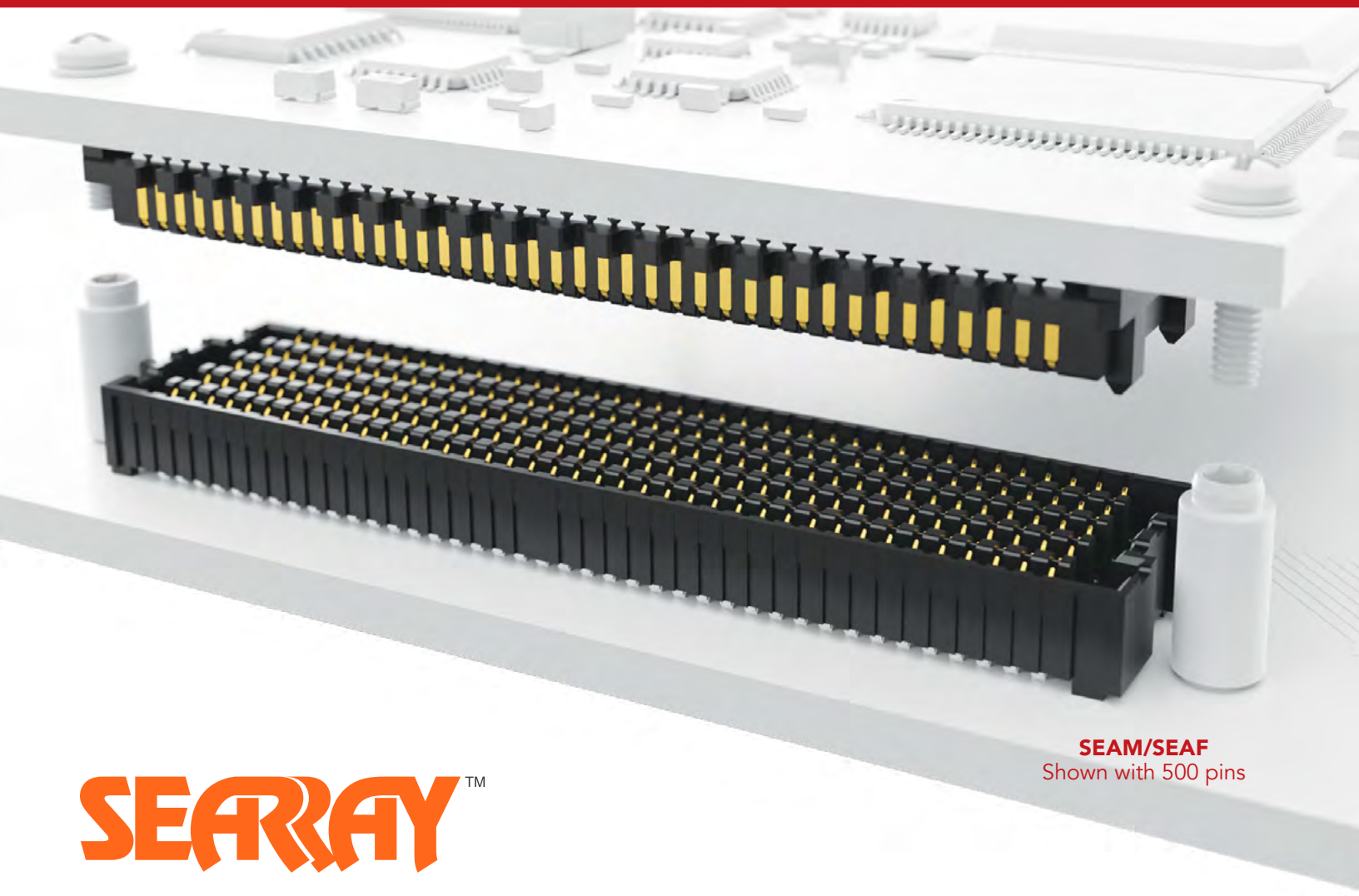


Learn more at
samtec.com



HIGH-DENSITY ARRAYS

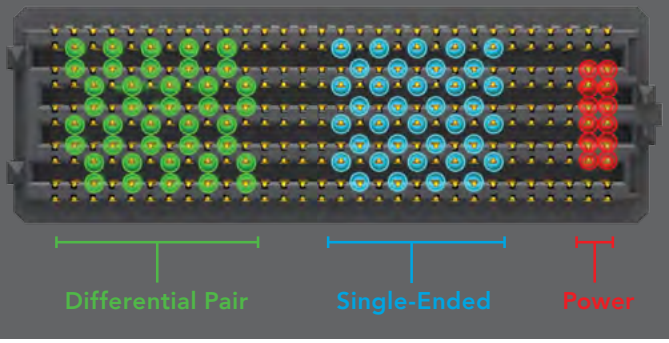
OPEN-PIN-FIELD • LOW-PROFILE • ONE-PIECE DESIGNS



SEAM/SEAF
Shown with 500 pins

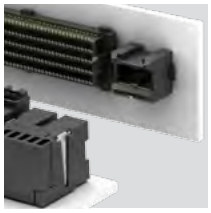
SEARAY™

OPEN-PIN-FIELD FLEXIBILITY



ADDITIONAL SERIES

Jack screw standoffs (JSO)



Power modules (UBPT/UBPS)

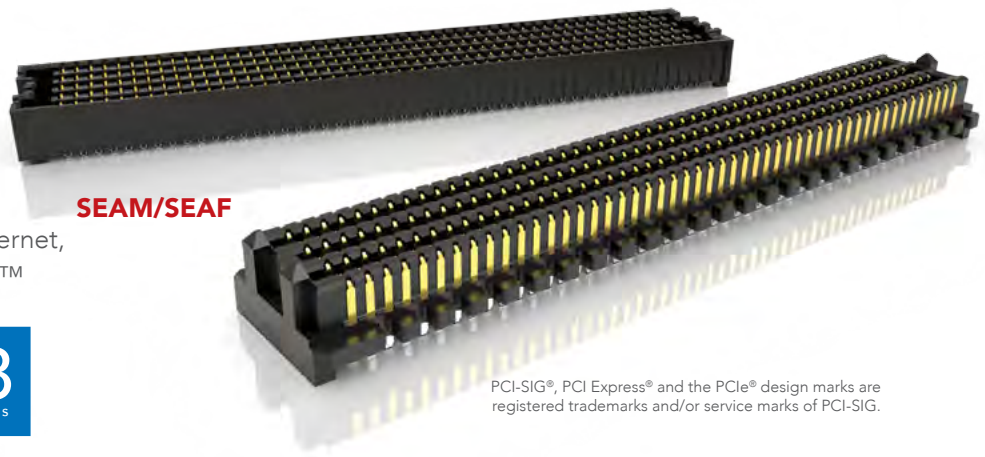
56G array system in development

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

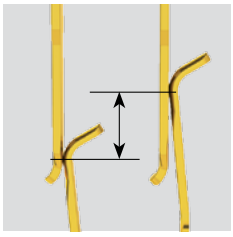
1.27 mm PITCH ARRAYS

- 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 Gbps

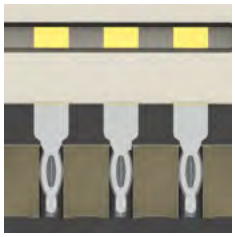


SEAM/SEAF



1.15 mm (.045") contact wipe

Solder charge terminations (IPC-A-610F & IPC J-STD-00IF Class 3)



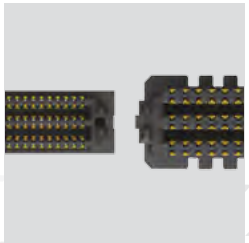
Press-fit tails available (SEAMP/SEAFP)

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

SEAM8/SEAF8



0.80 mm pitch vs. 1.27 mm pitch

SEARAY.8mm™ | 28 Gbps

samtec.com/arrays

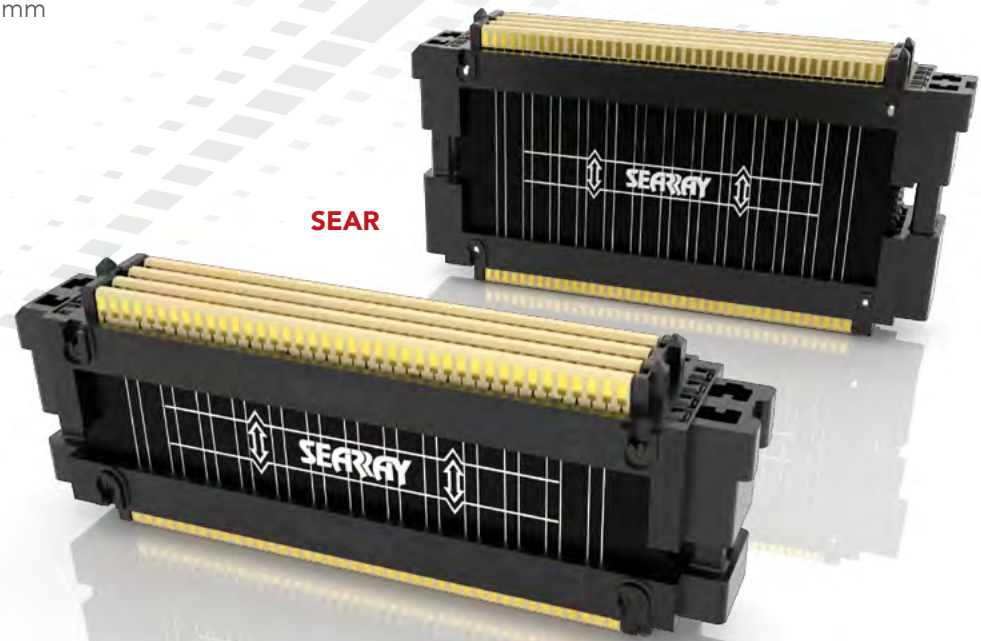
HIGH-DENSITY ARRAYS

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)

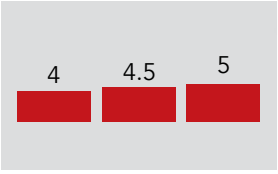
SEARAY™



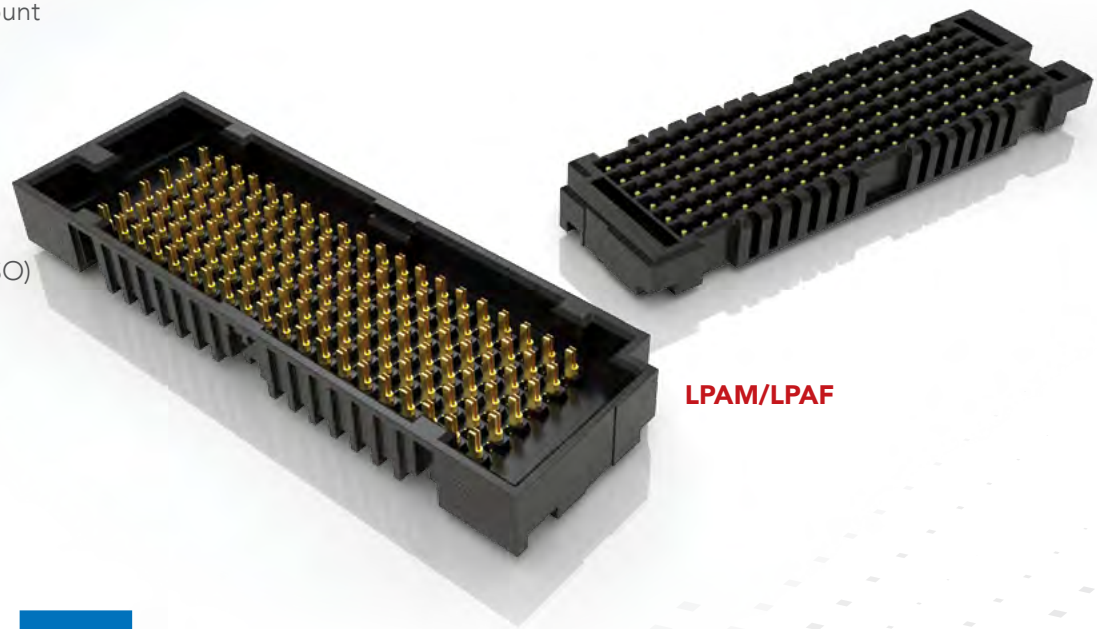
SEAR

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)

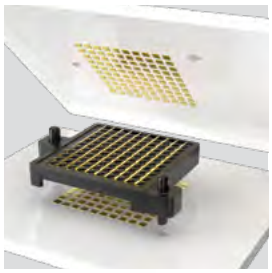


LPAM/LPAF

LP ARRAY™ | 40 Gbps

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

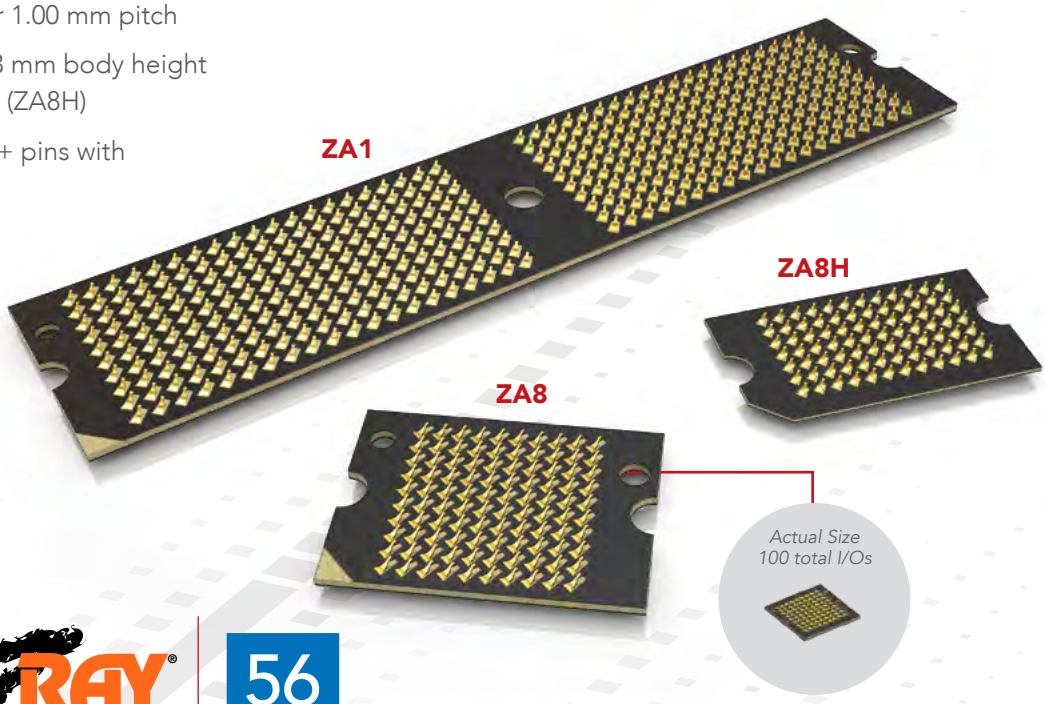


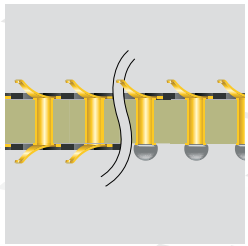
Ideal for low-cost board stacking, module-to-board and LGA interfaces

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)



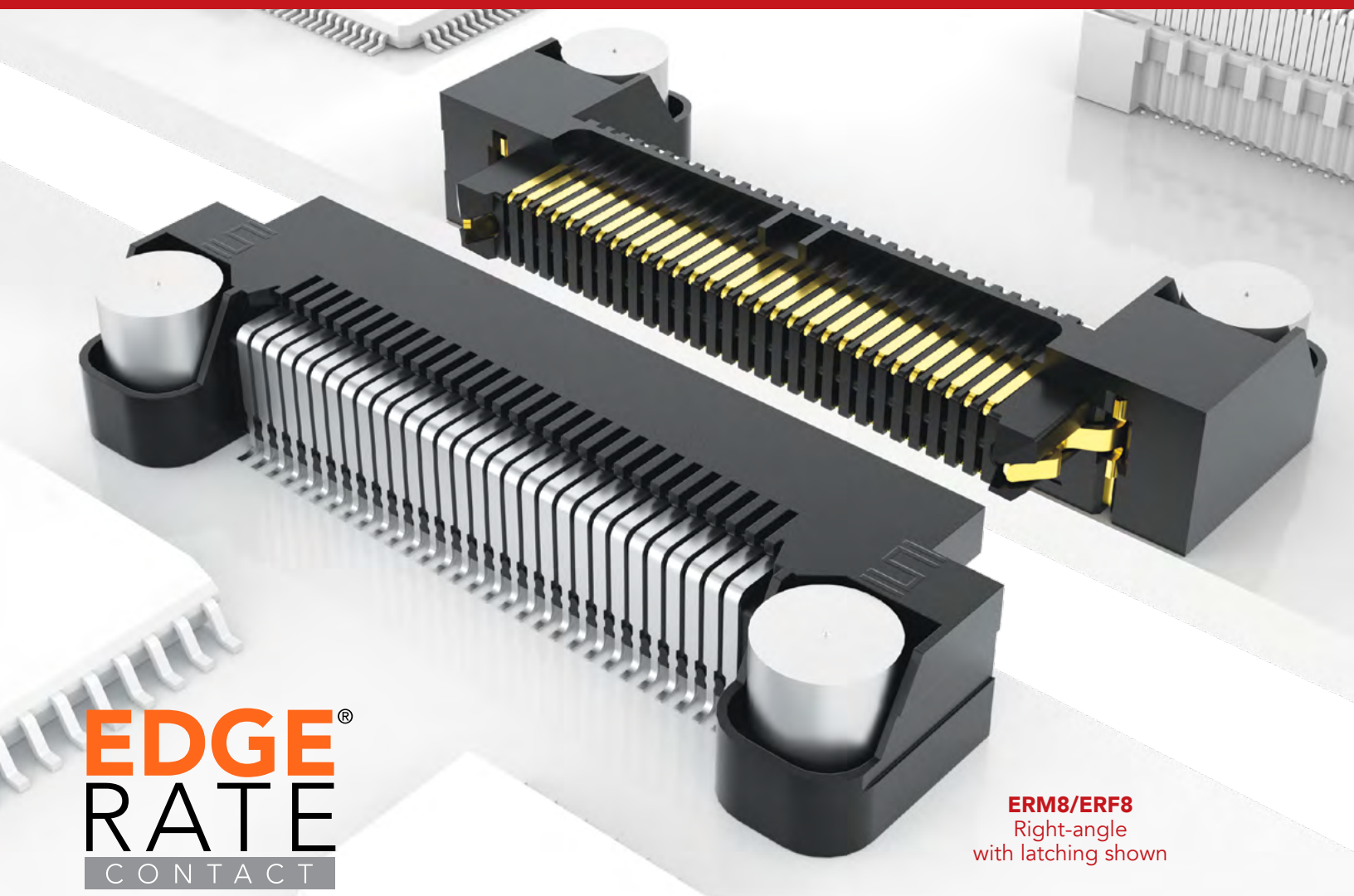


Dual compression, or single compression with solder balls

ZRAY® 56 Gbps

EDGE RATE® CONNECTOR STRIPS

OPTIMIZED FOR SPEED • HIGH CYCLES • INCREASED CONTACT WIPE



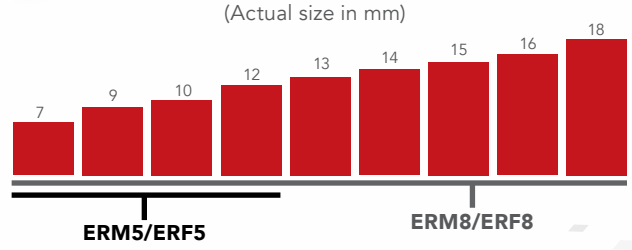
EDGE® RATE CONTACT

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 optmized for 50 Ω and 100 Ω systems

STACK HEIGHT FLEXIBILITY



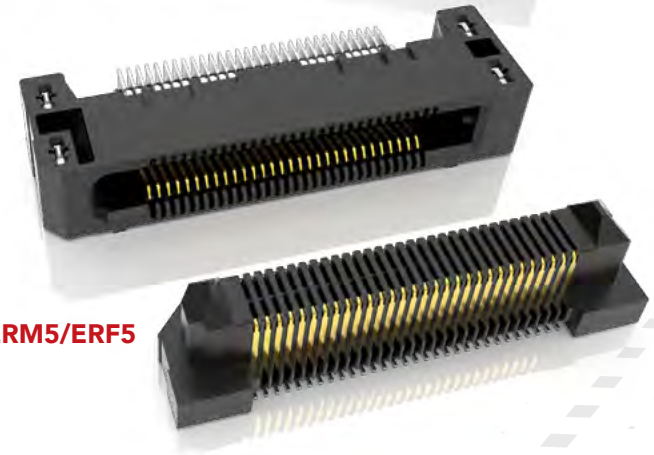
samtec.com/edgerate

0.50 mm AND 0.80 mm PITCH SYSTEM

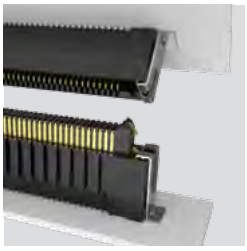
- 1.00 mm contact wipe (ERM5/ERF5) or 1.5 mm contact wipe (ERM8/ERF8) for a reliable connection
- Differential pair and hot swap options (ERM8/ERF8)
- Up to 40% PCB space savings with 0.50 mm pitch vs. 0.80 mm pitch
- Stack heights from 7 mm to 18 mm
- Supports high-speed protocols including Ethernet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

28 Gbps

ERM8/ERF8



ERM5/ERF5



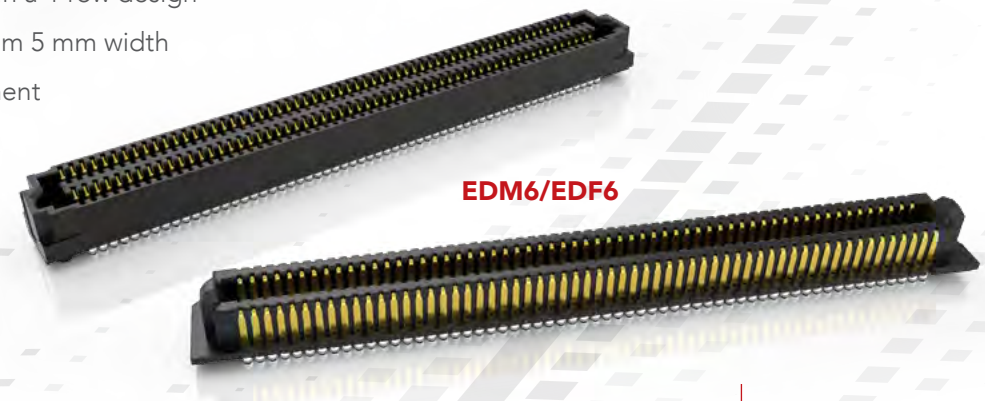
Metal solder lock in development for a rugged board connection

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



EDM6/EDF6

Solder ball technology for ease of processing

Actual size (240 total positions)

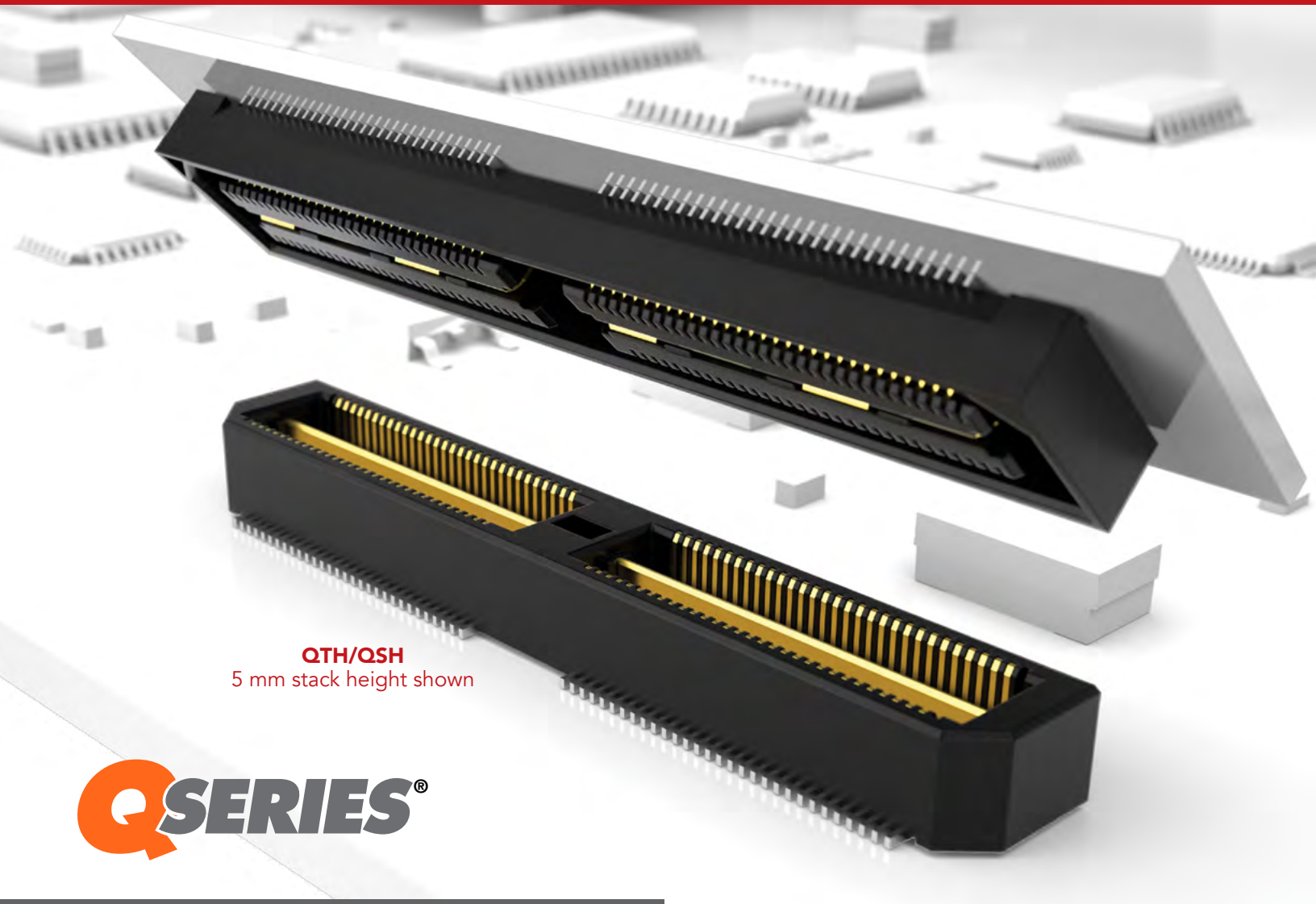
EDGERATE® *HD*

28 Gbps

samtec.com/edgerate

GROUND PLANE CONNECTORS

RELIABLE SI PERFORMANCE • LOW-PROFILE • SLIM FOOTPRINT

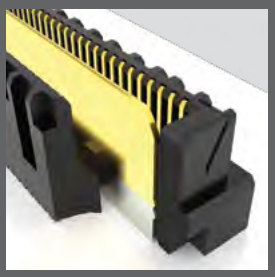


QTH/QSH
5 mm stack height shown

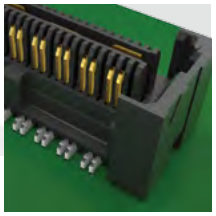
QSERIES®

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

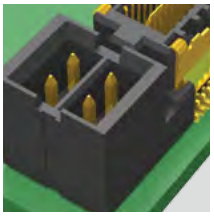


FEATURES



Differential pairs reduce noise

Mixed technology (MIT/MIS)



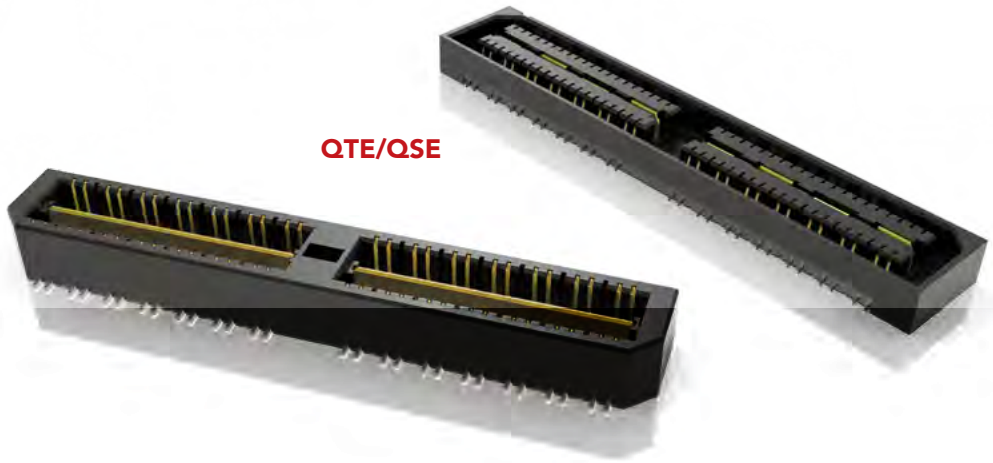
Options for power, retention & RF

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

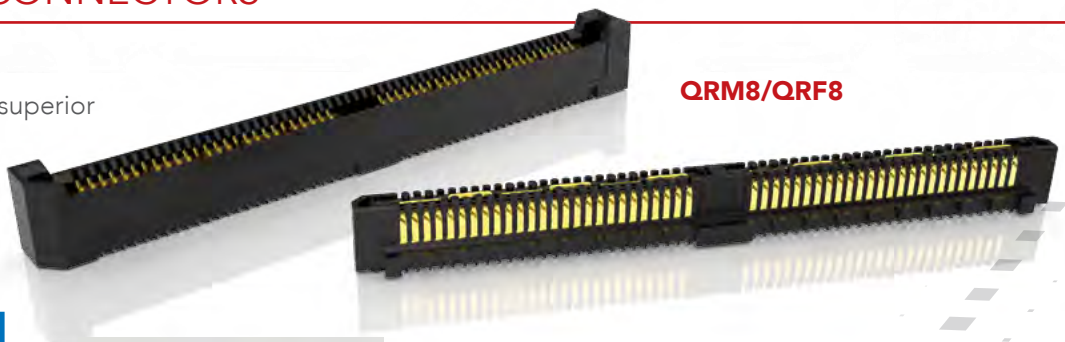


QTE/QSE

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



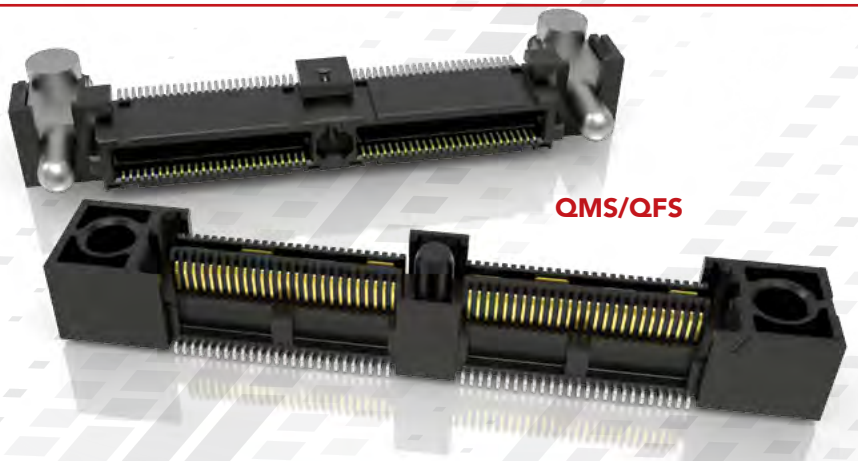
QRM8/QRF8

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

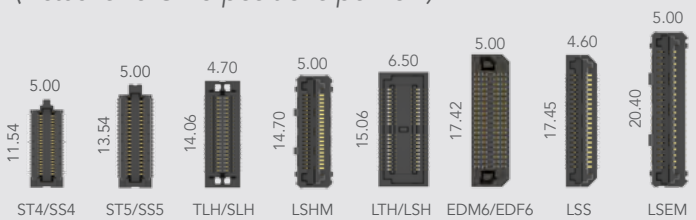
ULTRA MICRO INTERCONNECTS

SPACE SAVING DESIGNS • HERMAPHRODITIC • HIGH-DENSITY

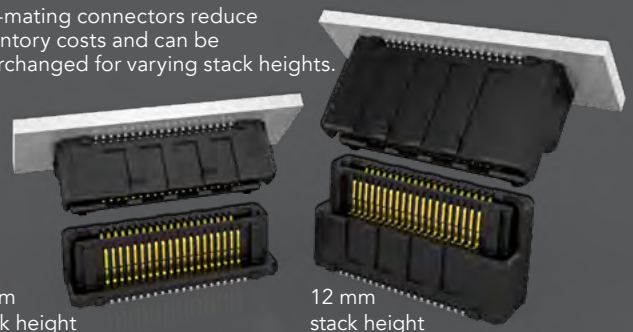
LSHM

EDM6/EDF6
60 total positions shown

SLIM BODY DESIGNS
(Actual size @ 20 positions per row)



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



5 mm stack height

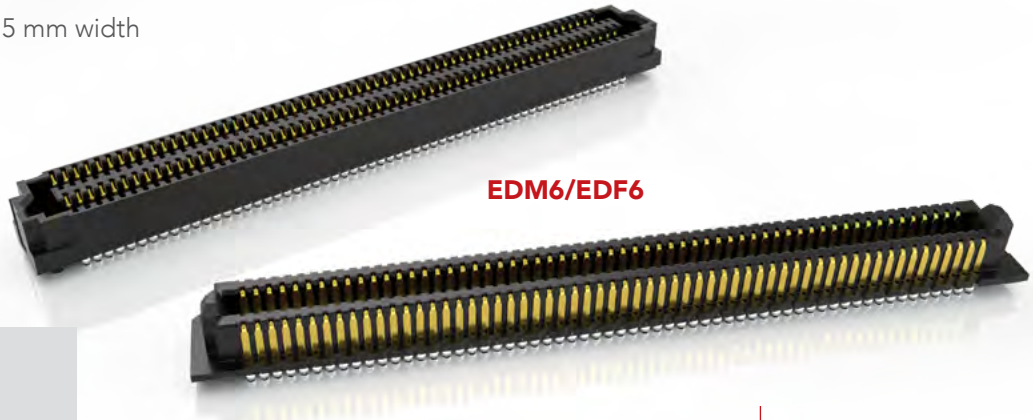
12 mm stack height

samtec.com/ultra-micro

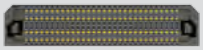
90% of Samtec's orders are built to order and shipped in 3-5 days.

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



EDM6/EDF6



EDX6 Series (120 total positions)

QXH Series (120 total positions)

Actual Size Shown

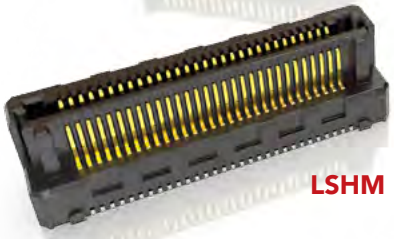
EDGERATE®HD | 28 Gbps

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

LSS

LSEM

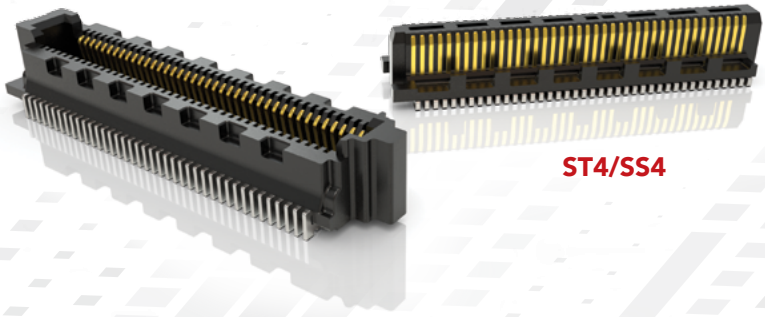


LSHM

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



ST4/SS4

RAZOR™ BEAM LP SYSTEM | 28 Gbps

EDGE CARD SYSTEMS

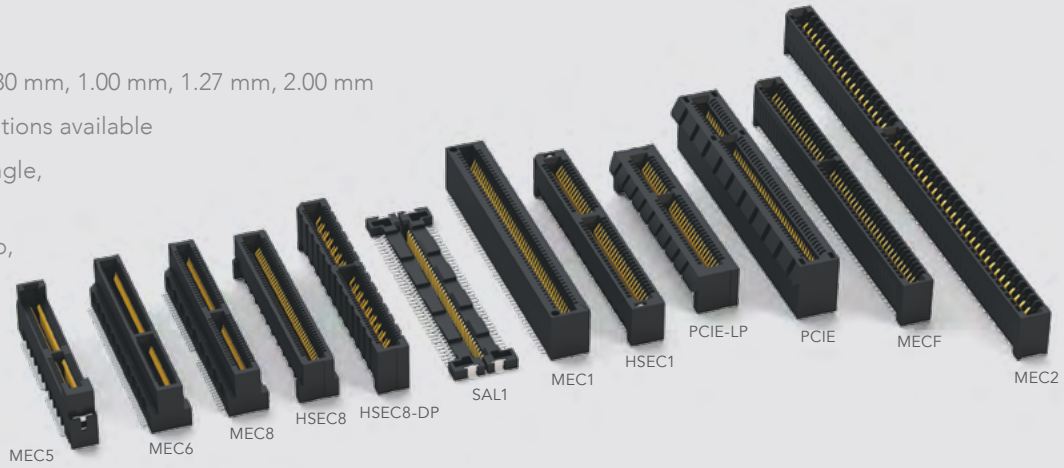
SPEEDS TO 40 Gbps • EDGE RATE® CONTACTS • VARIETY OF OPTIONS

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)

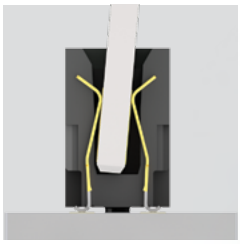
EDGE® RATE CONTACT | 40 Gbps

HSEC8-EM

HSEC8-DV

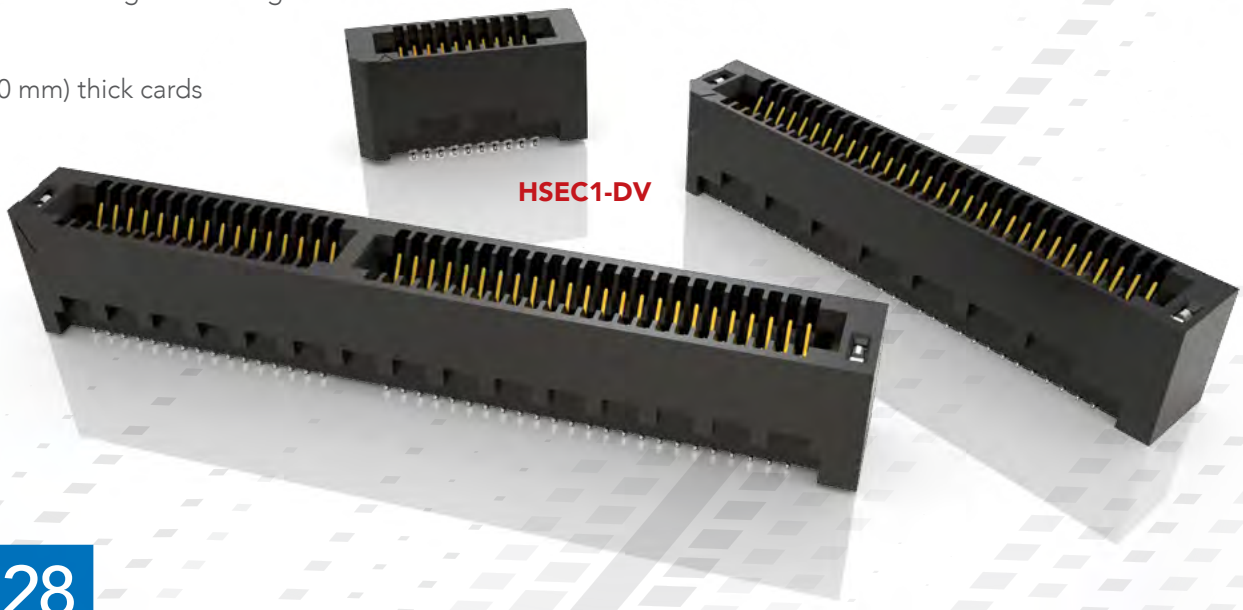
1.00 mm PITCH SOCKETS

- 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

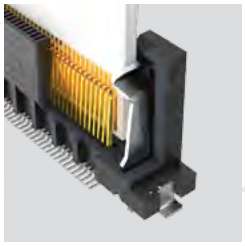
HSEC1-DV



EDGE® RATE CONTACT | 28 Gbps

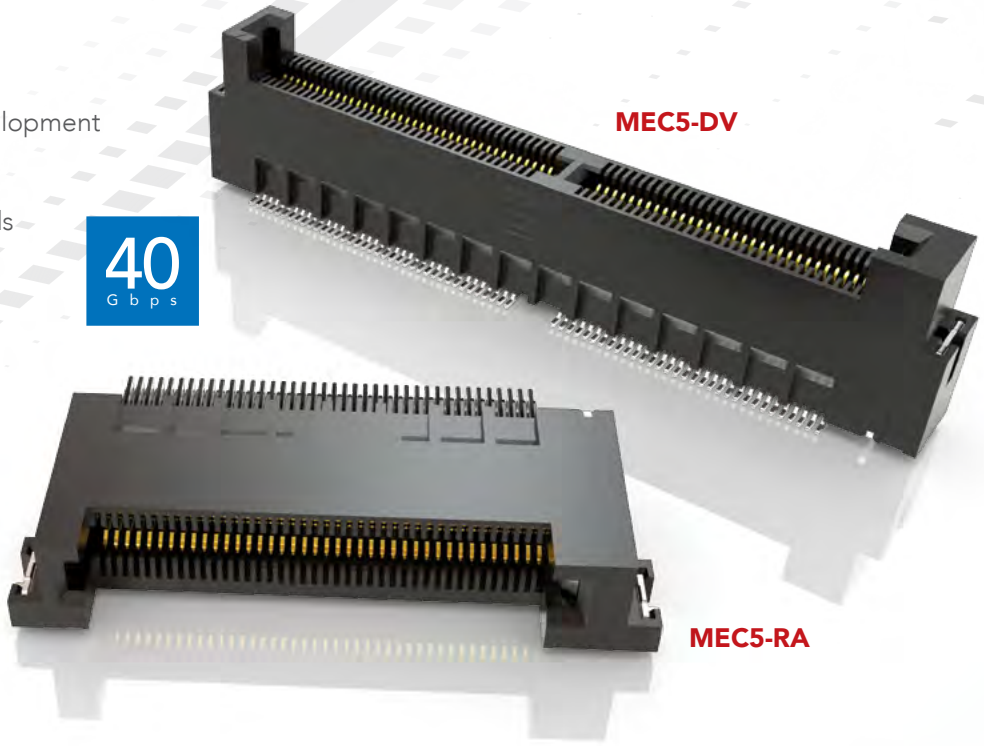
0.50 mm PITCH HIGH-SPEED, LOW-COST SOCKETS

- 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



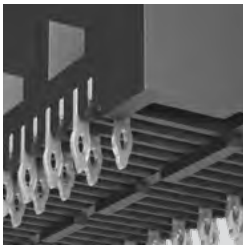
MEC5-DV

MEC5-RA

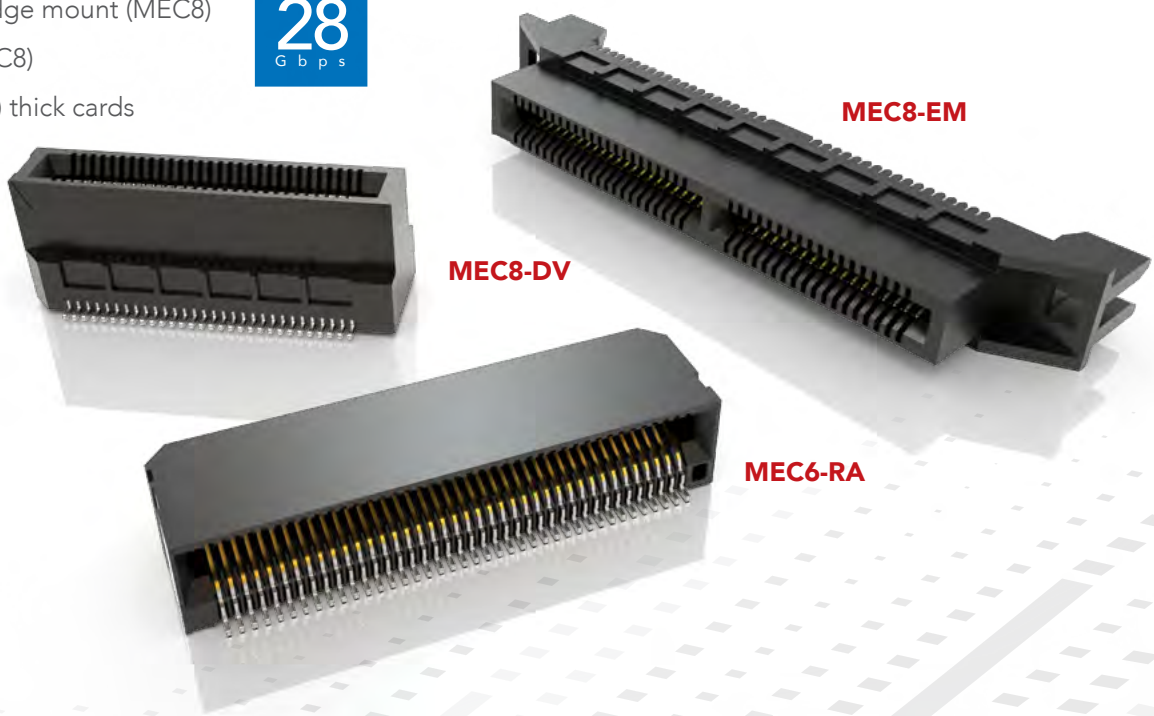
0.635 mm & 0.80 mm PITCH MICRO SOCKETS

- 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



MEC8-EM

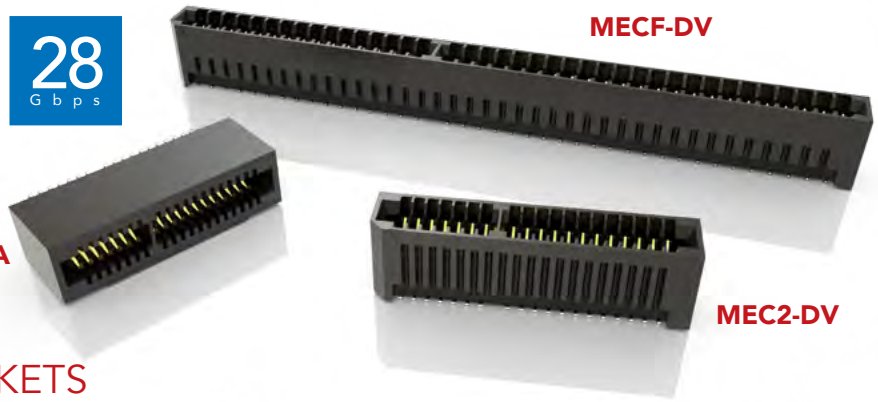
MEC8-DV

MEC6-RA

1.00 mm, 1.27 mm & 2.00 mm PITCH SOCKETS

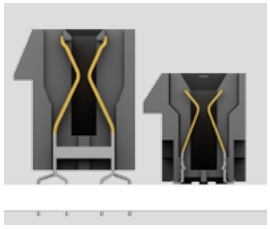
- Up to 140 total I/Os
- Right-angle and edge mount available (MEC1)
- Optional weld tabs, alignment pins and polarization
- Mates with 0.62" (1.60 mm) and 0.93" (2.36 mm) thick cards

28 Gbps

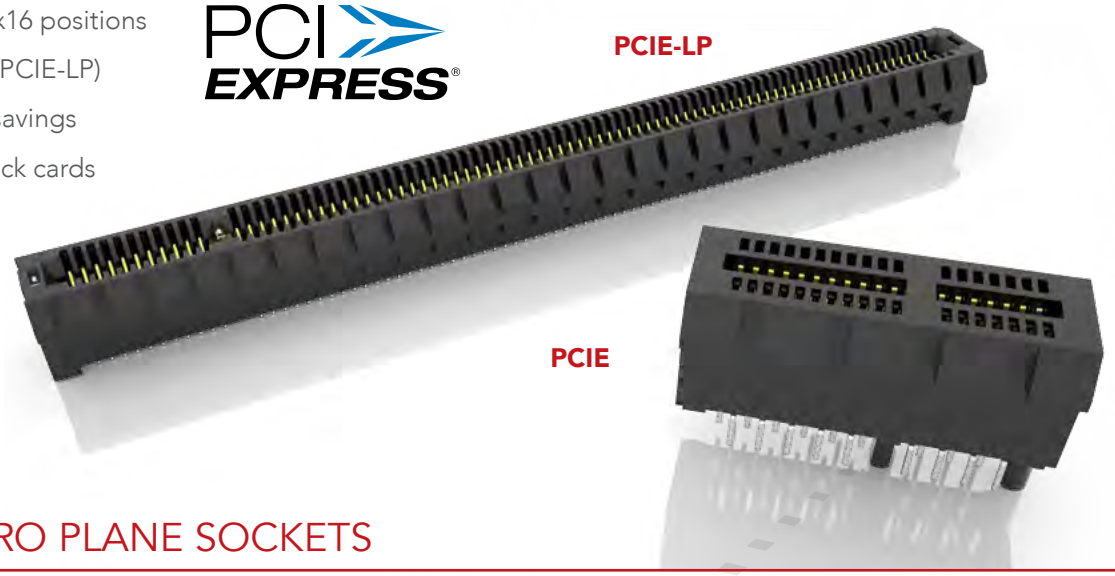


PCI EXPRESS® EDGE CARD SOCKETS

- 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

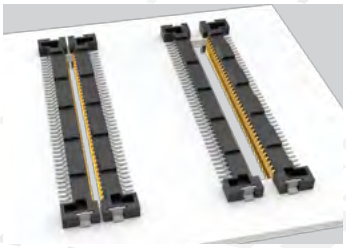


8 mm vs. standard
11 mm height



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

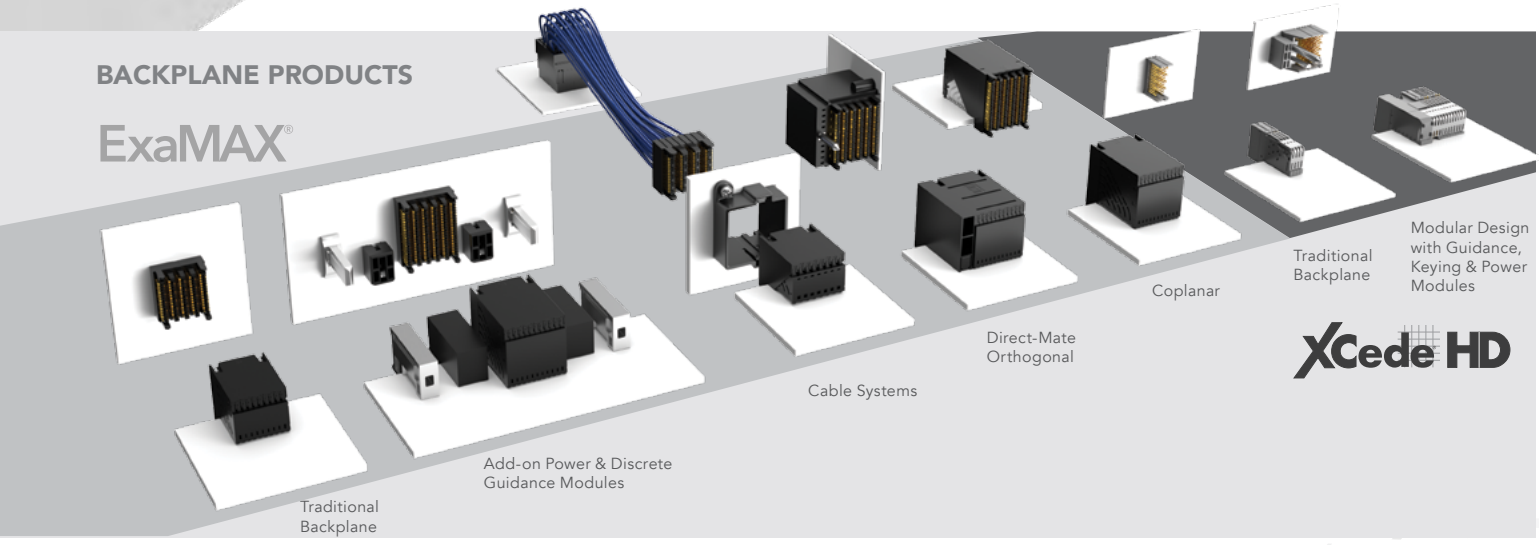


Mounting flexibility for
pass-through applications

HIGH-SPEED BACKPLANE SYSTEMS

HIGH-DENSITY • DESIGN FLEXIBILITY • HIGH RELIABILITY

EBTM/EBTF-RA
Shown with power
and guidance options



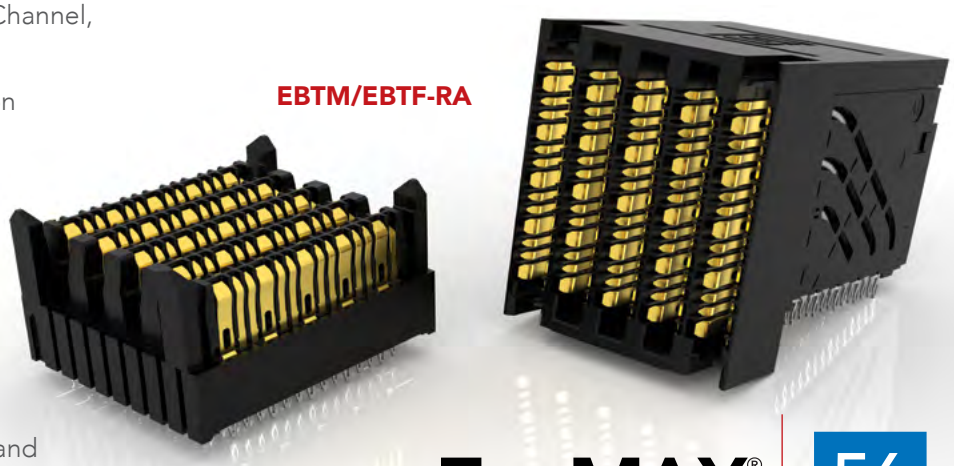
samtec.com/backplane

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

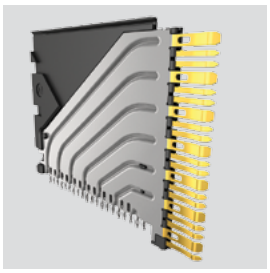
EXAMAX® HIGH-SPEED BACKPLANE

- 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)

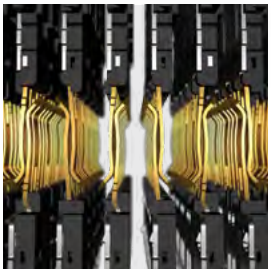
EBTM/EBTF-RA



ExaMAX® 56 Gbps



Individual signal wafers with an embossed ground plane



Two reliable points of contact

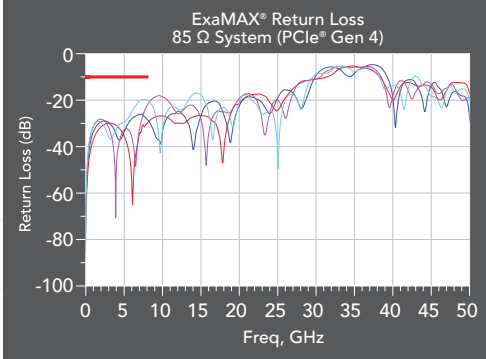
Staggered differential pair design

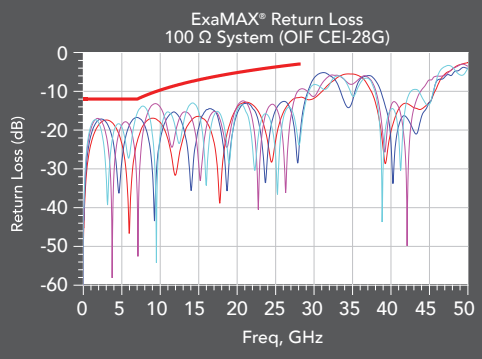
Power and guidance modules available

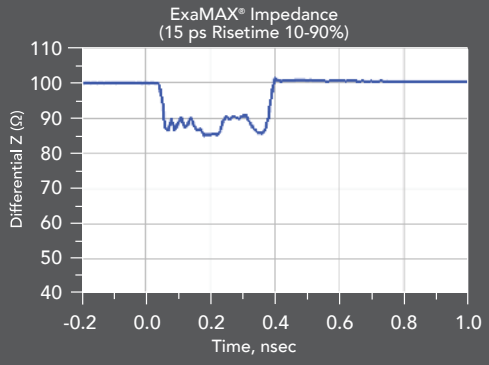
ExaMAX® is a trademark of AFCI

PERFORMANCE CHARTS

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







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

EBDM-RA

ExaMAX® | 56 Gbps

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

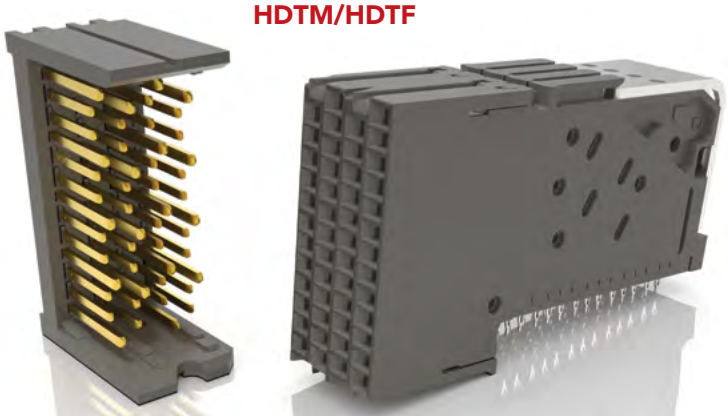
MULTI-LINE CARD APPLICATION

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

XCEDE® HD HIGH-DENSITY BACKPLANE

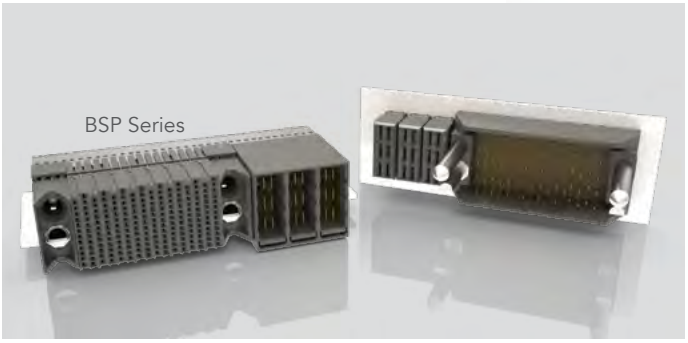
- Small form factor and modular design provides significant space-savings and flexibility
- High-performance system
- Up to 84 differential pairs per linear inch
- 3, 4 and 6-pair designs on 4, 6 and 8 columns
- Integrated power, guidance, keying and end walls available
- 85 Ω and 100 Ω options
- Combine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

HDTM/HDTF



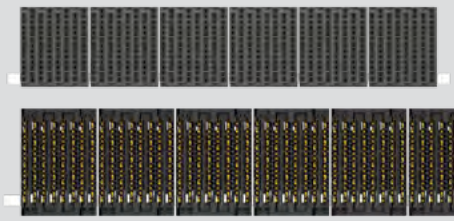
XCede HD | 25 Gbps

MODULAR DESIGN



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

DENSITY COMPARISON

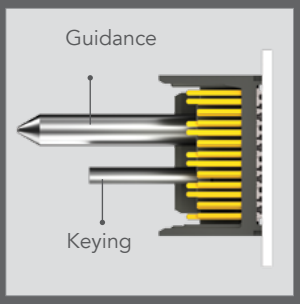


XCede® HD
Up to 84 pairs per linear inch

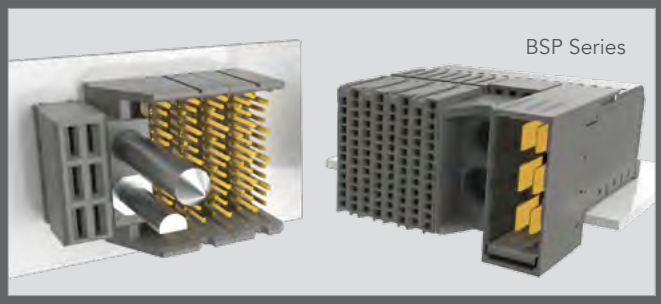
ExaMAX®
Up to 76 pairs per linear inch

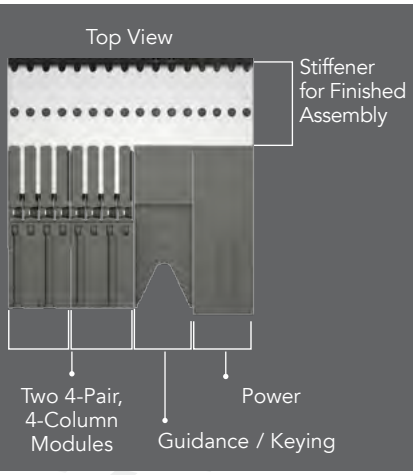
(Both shown with six 4-pair, 8 column receptacles)

PRODUCT BREAKDOWN (4-Module System Shown)



Side View





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)

SEARAY™

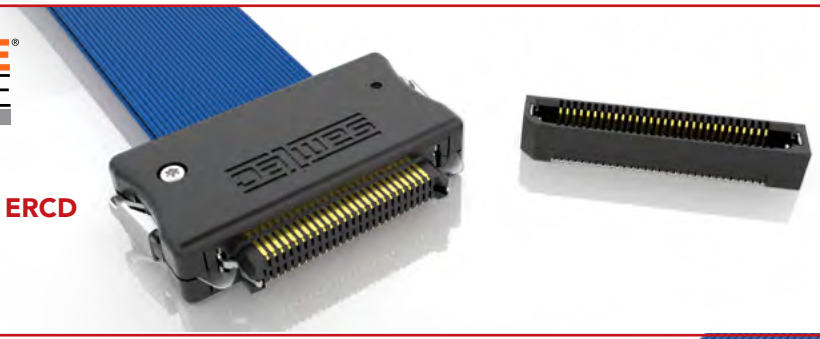
SEAC

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

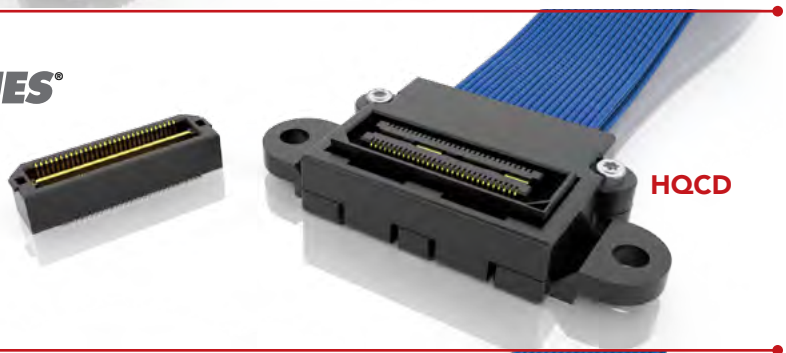


ERCD

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®

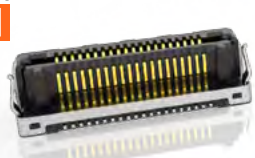


HQCD

ULTRA MICRO ASSEMBLIES

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

RAZOR™ BEAM SYSTEM



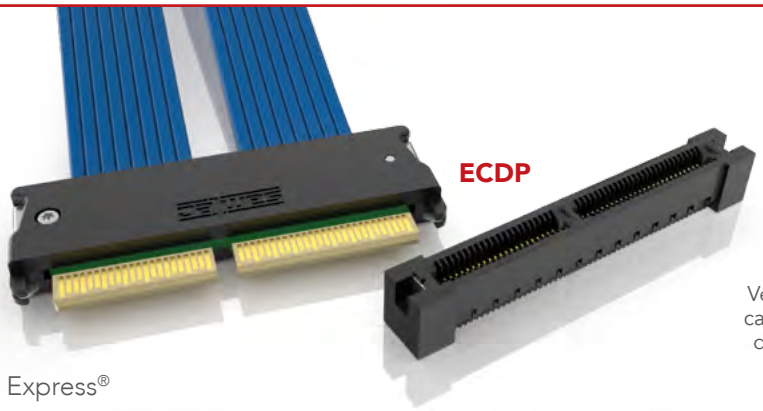
HLCD

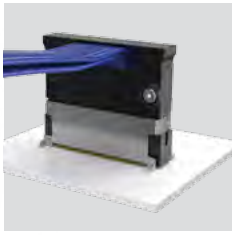
samtec.com/high-speed-cables

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

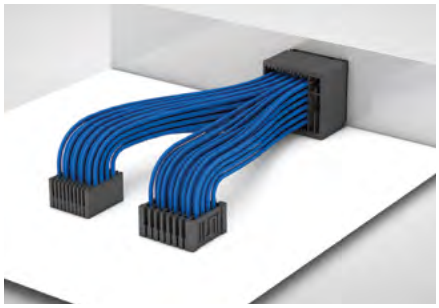
- Up to 20 Gbps
- 30 AWG twinax
- ECDP mates with 0.80 mm pitch Edge Rate® edge card sockets (see pages 14 - 15)
- Passive equalization available (ECDP-E) for higher speeds or longer reach
- Mating assembly available for PCI Express® edge cards (PCIEC; see page 17)





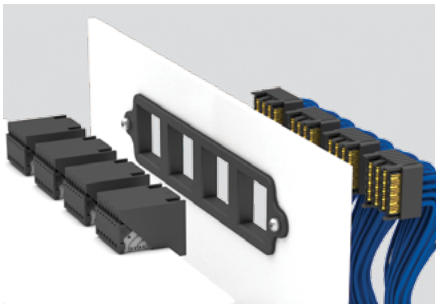
Vertical & right-angle mating cable assemblies for MEC5 in development (see page 16)

EXAMAX® BACKPLANE ASSEMBLIES IN DEVELOPMENT ExaMAX®



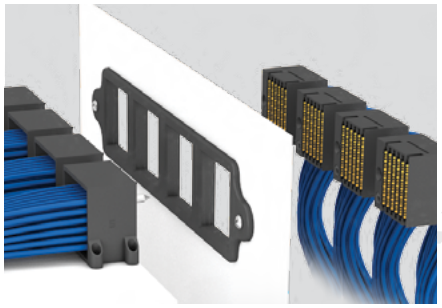
Cable-to-Board Press-Fit

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 Technology Center, Wilsonville, Oregon

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**

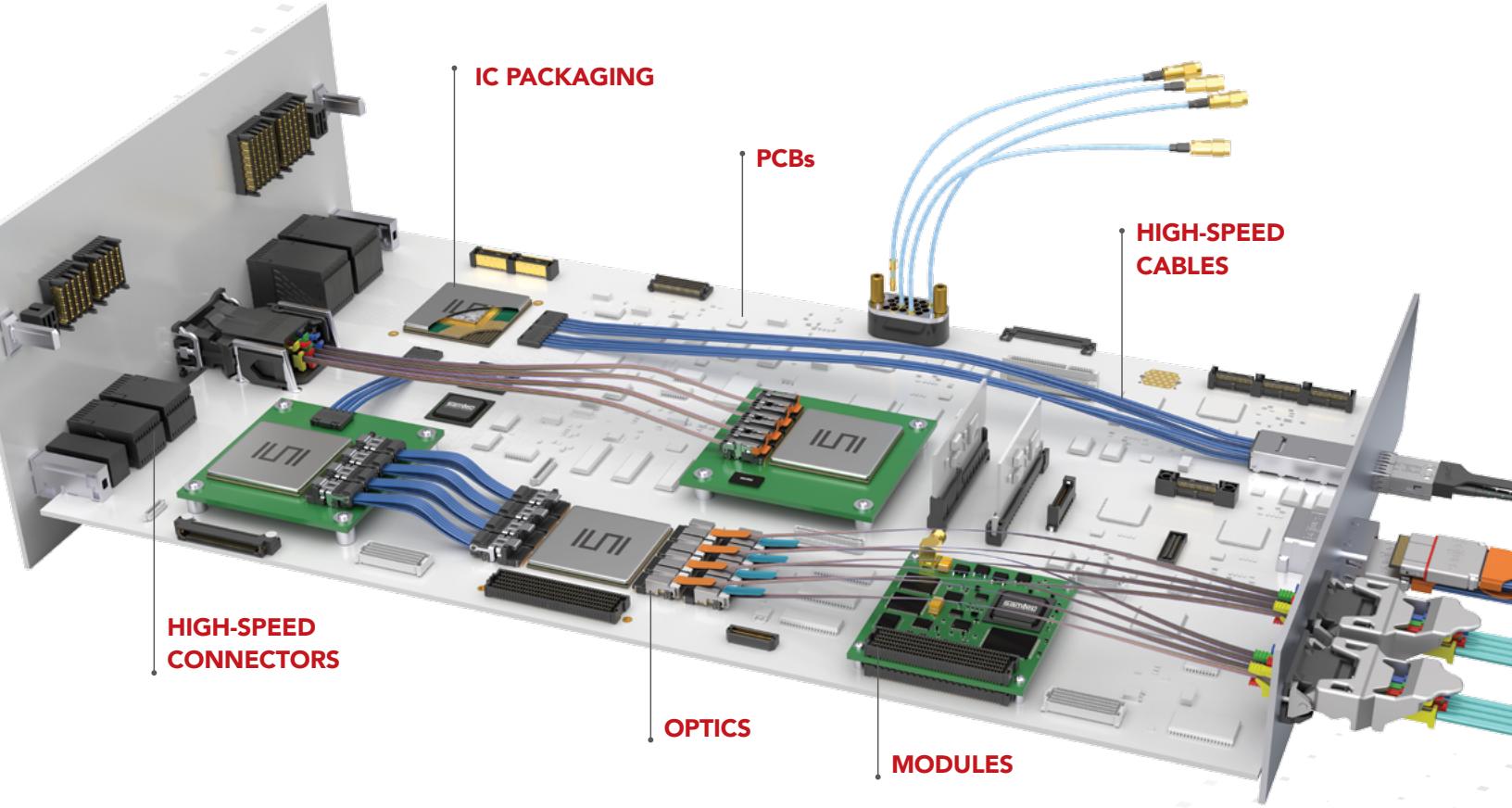
AT 28+ Gbps
EVERYTHING MATTERS

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

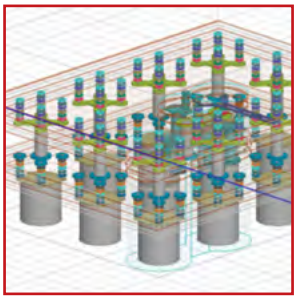
MATERIALS SELECTION

samtec.com/tech-centers

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

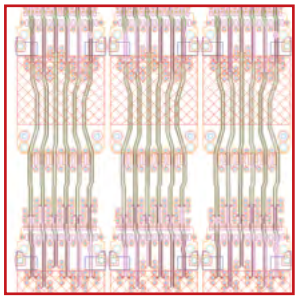
Services are available at any level you require: from early stages of the design process including package design, material selection and PCB routing, through in-depth analysis, modeling and simulation, with measurement validation services available to 67 GHz.

FULL SYSTEM SIGNAL INTEGRITY



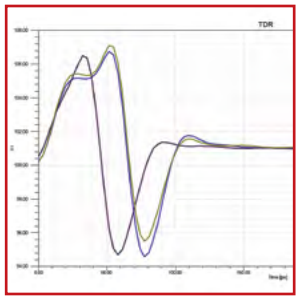
PACKAGE DESIGN & MATERIALS

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



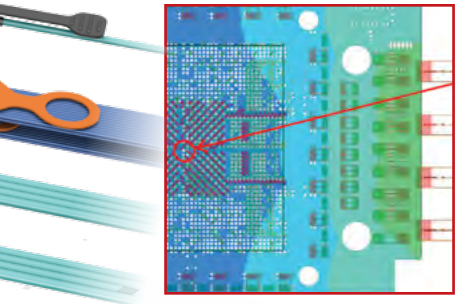
MODELING

- 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

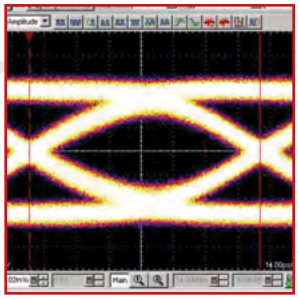


ANALYSIS

- 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

samtec.com/tech-centers

ONLINE TOOLS

DESIGN • PERFORMANCE • SIMULATION

QUICKLY BUILD MATED CONNECTOR SETS ONLINE

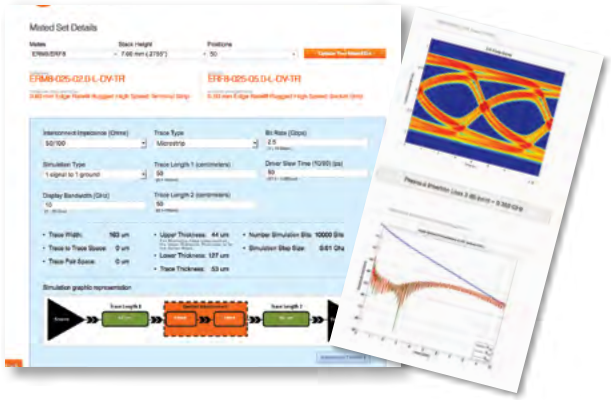
- Wide variety of search parameters and filters: pitch, signaling, stack height, pin count, etc.
- Easily sort search results to find the right mated set
- Live chat with engineers for custom options
- Immediately download models and open Specs Kit
- **samtec.com/solutionator**

Solutionator
DESIGN IN A MINUTE

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**

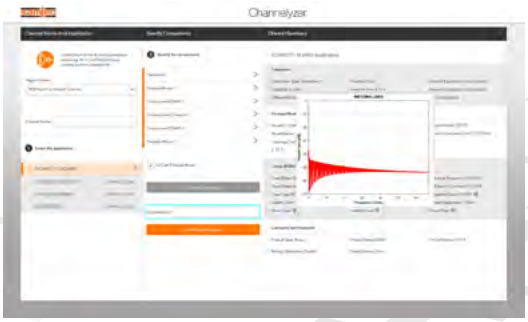
Simulator™
SIMULATE IN A MINUTE



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**

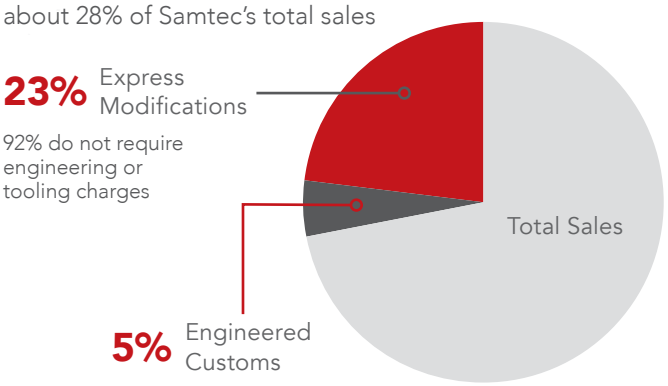
Channelyzer™



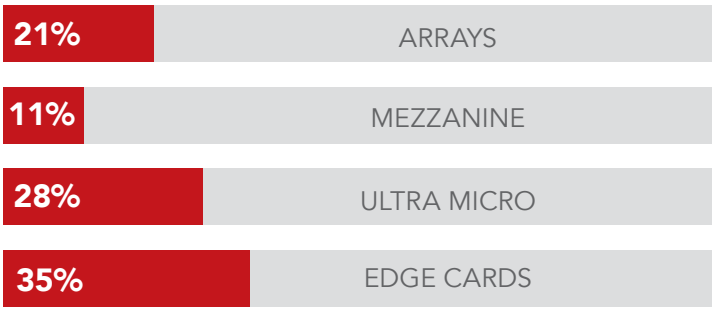
MODIFIED & CUSTOM SOLUTIONS

WILLINGNESS, SUPPORT & EXPERTISE

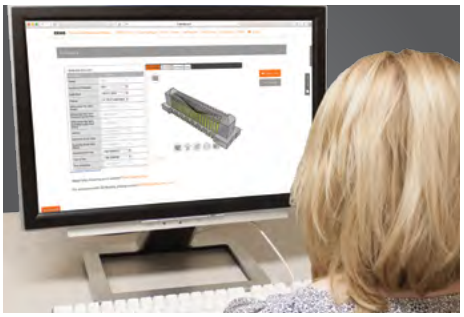
Customs and Modifications make up about 28% of Samtec's total sales



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

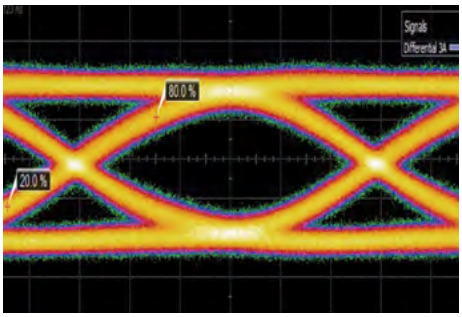


INDUSTRY LEADING CUSTOMER SERVICE



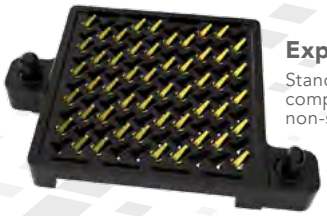
FLEXIBLE IN-HOUSE MANUFACTURING

SIGNAL INTEGRITY EXPERTISE



FLEXIBLE CAPABILITIES

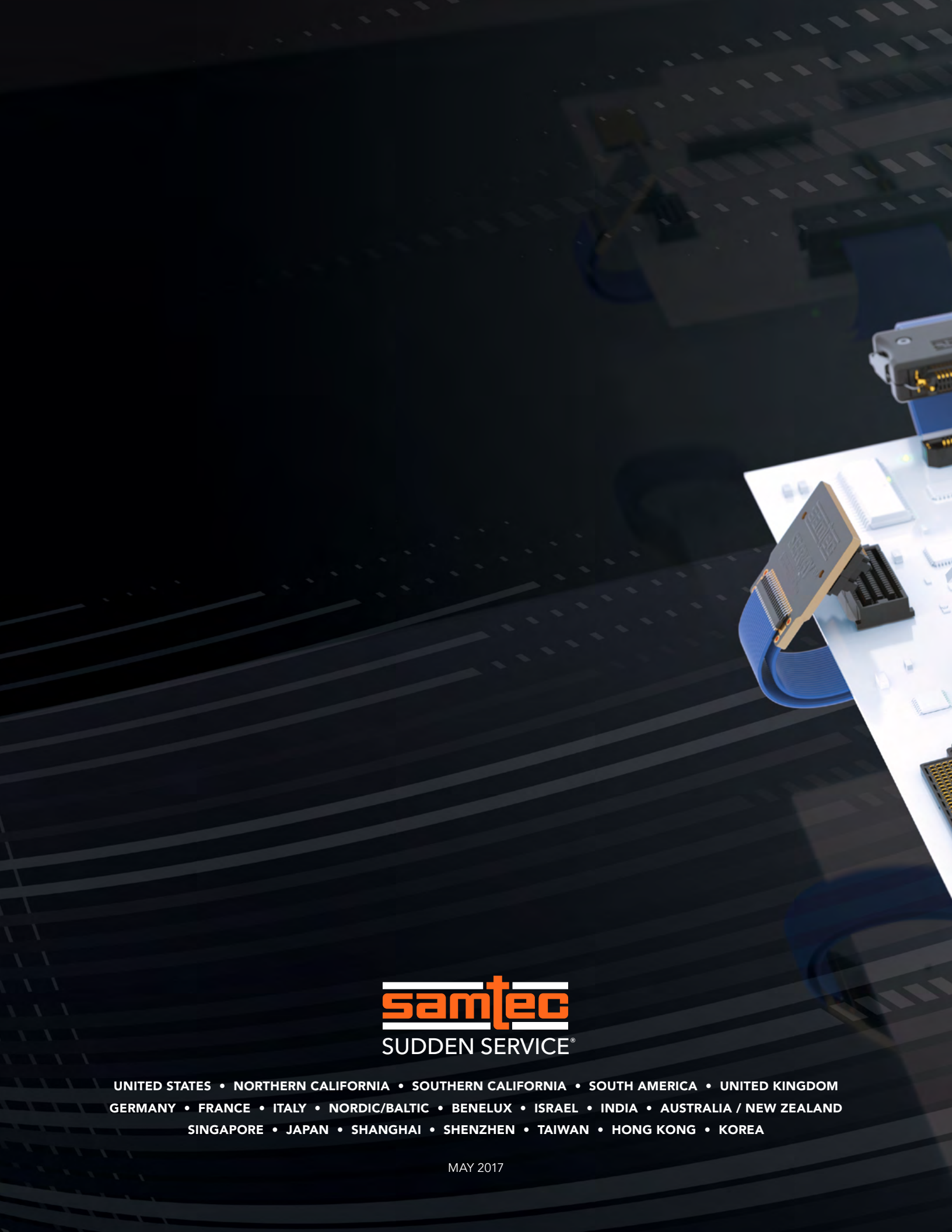
- Full engineering, design and prototype support
- Design, simulation and processing assistance
- Quotes and samples turned around in 24 hours
- Flexible, quick-turn manufacturing
- Dedicated Application Specific Product engineers and technicians
- Modified or custom options for board level connectors 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 **customasp@samtec.com** for engineered customs.



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