



FLYOVER[®] TECHNOLOGY



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THE PROBLEM

PCB REACH AT NEXT GEN SPEEDS

As bandwidth requirements rapidly increase, effectively managing heat and routing signals through lossy PCBs, vias and other components have become complex challenges.

BANDWIDTH VS. TRADITIONAL & HIGH-SPEED MATERIALS

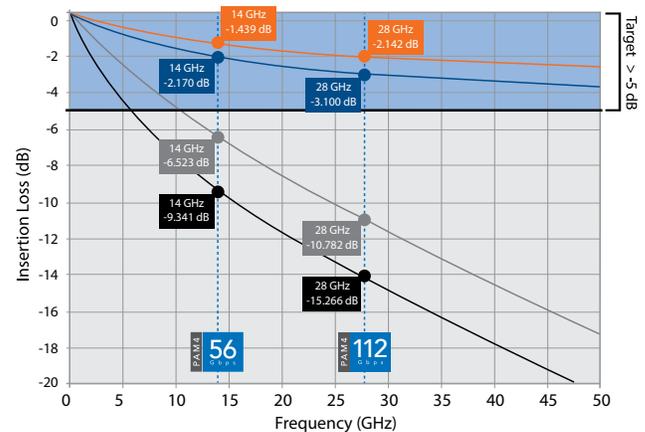
(Comparison at -5 dB Insertion Loss Point)

	FR408	MEGTRON 6	MICRO TWINAX
PAM4 56 Gbps	0.0"	up to 2"	36"+
PAM4 112 Gbps	0.0"	0.0"	18"+

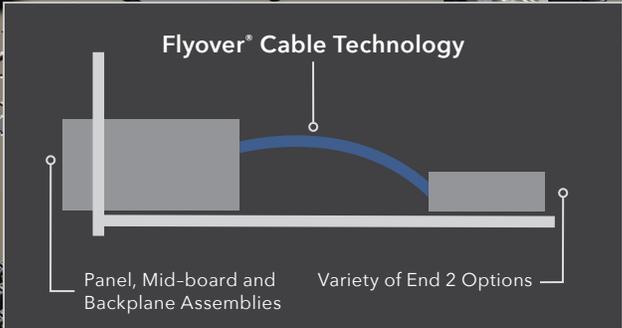
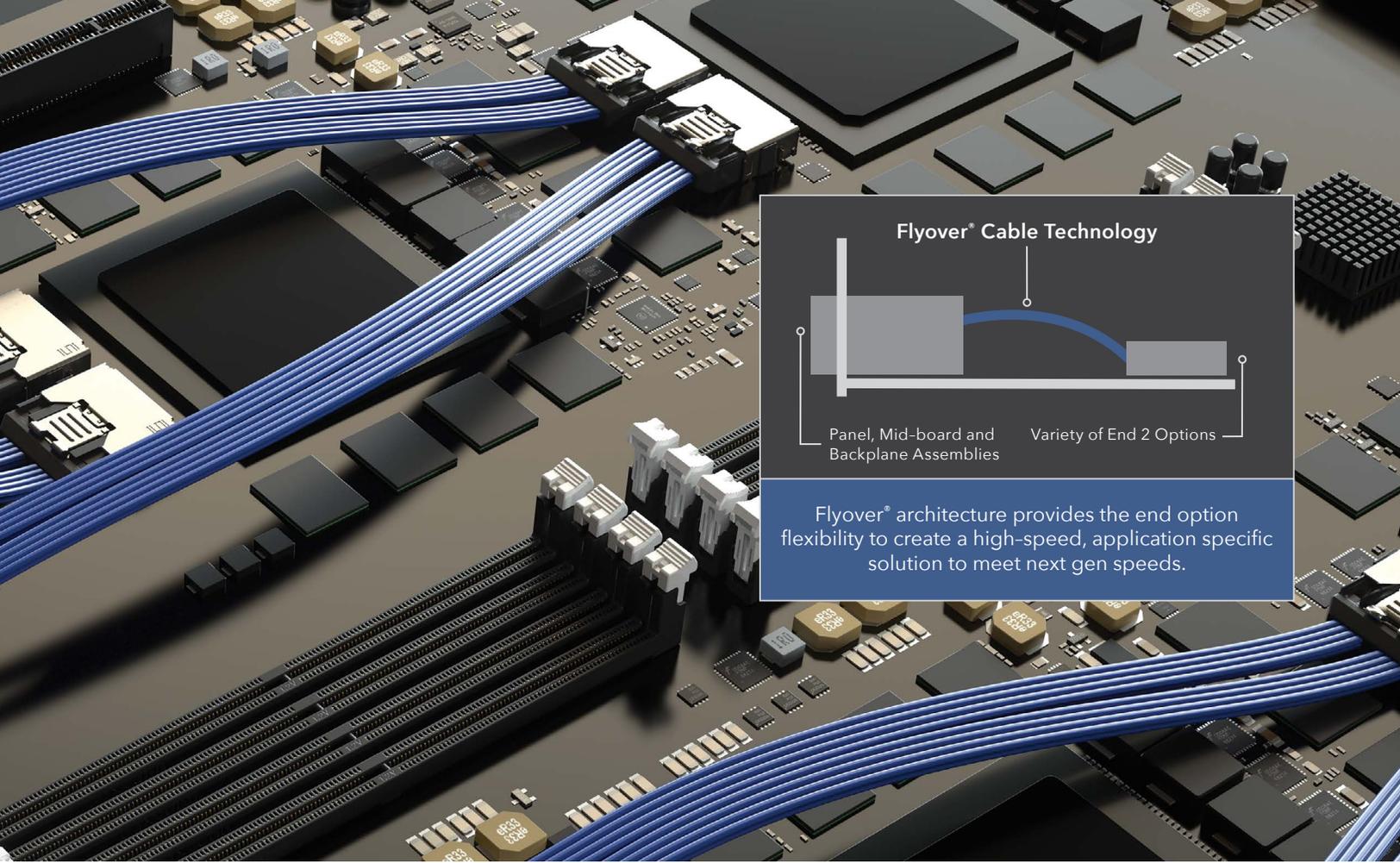
THE SOLUTION

SAMTEC FLYOVER[®] SYSTEMS

Samtec Flyover[®] design breaks the constraints of traditional signaling substrate and hardware offerings, resulting in a cost-effective, high-performance and heat efficient answer to the challenges of 56 Gbps bandwidths and beyond.



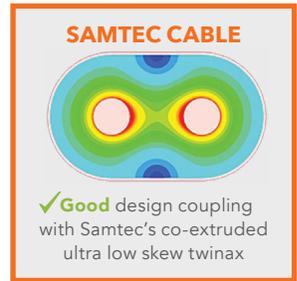
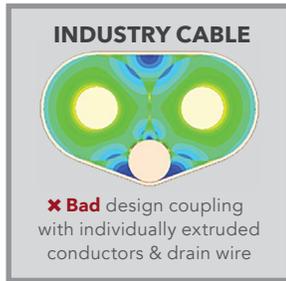
- 30 AWG 100 Ω Eye Speed[®] Low Skew Twinax Cable
 - 34 AWG 100 Ω Eye Speed[®] Low Skew Twinax Cable
 - Low Loss Backplane PCB trace, 5.7 mil wide, 8.3 mil space
 - Ultra Low Loss Backplane PCB trace, 5.7 mil wide, 8.3 mil space
- *Loss values based on 12" trace.



Flyover® architecture provides the end option flexibility to create a high-speed, application specific solution to meet next gen speeds.

EYE SPEED® TWINAX CABLE TECHNOLOGY

- Ideal for 28-112+ Gbps applications
- Tight coupling between signal conductors
- Ultra low skew twinax < 3.5 ps/meter
- 40% smaller cross-sectional area (Thinax™)
- In Development: Eye Speed® AIR™ foamed twinax for significantly improved signal integrity and even lower intra-pair skew



PERFORMANCE & COST ADVANTAGES

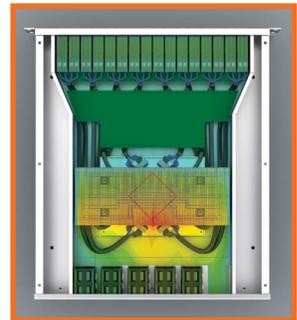
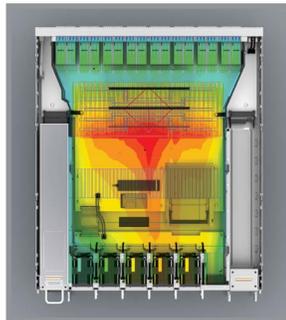
- 28-56 Gbps NRZ & Beyond
- Simplified Board Layout
- Fewer PCB Layers
- Less Expensive PCB Materials
- Eliminate Expensive Re-timers

NRZ	PAM4	NRZ	PAM4
28 Gbps	56 Gbps	56 Gbps	112 Gbps

SUPPORT

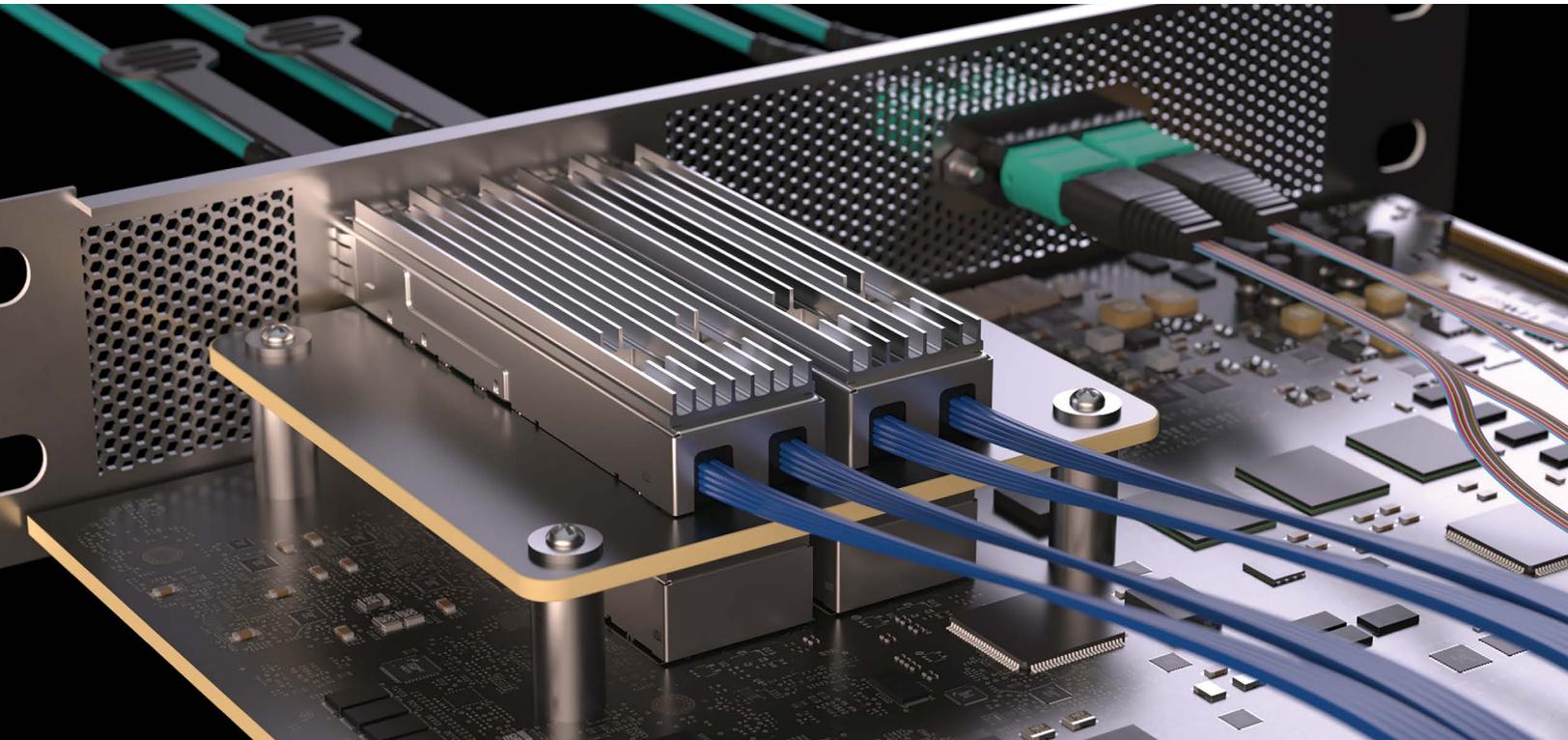
Fully integrated technology teams provide support to enable full system optimization from Silicon-to-Silicon™, including Samtec's High-Speed Cable Plants.

THERMAL IMPROVEMENT



Standard Network Switch vs. **Samtec Flyover® Technology**

FLYOVER® PANEL ASSEMBLIES



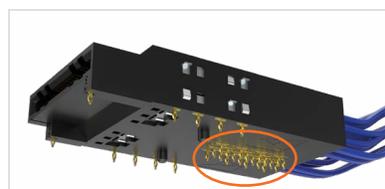
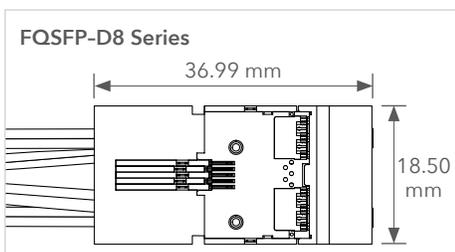
FLYOVER® QSFP SYSTEMS

- Up to 800 Gbps PAM4 aggregate data rate (112 Gbps PAM4 per channel)
- 4 channels (x4 bidirectional, 8 differential pairs) or 8 channels (x8 bidirectional, 16 differential pairs)
- Double density versions feature belly-to-belly mating for maximum density (FQSFP-DD, FQSFP-D8)
- Multiple heat sink options for optimal dissipation
- Variety of end 2 options including AcceleRate®, NovaRay®, Si-Fly™, FireFly™ and ExaMAX®
- Evaluation Kits available, visit samtec.com/kits
- Additional front panel ports in development: Flyover® SFP112, Flyover® OSFP 112 Gbps PAM4

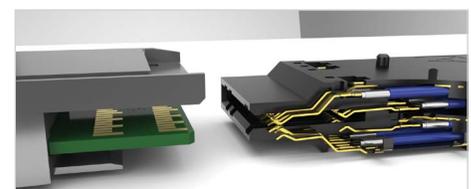


NRZ	PAM4
56 Gbps	112 Gbps

FQSFP-D8



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



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

NOVARAY® I/O EXTREME PERFORMANCE SYSTEM

- Up to 3,584 Gbps PAM4 aggregate data from the IC package to the panel and beyond
- No heat sinks required for panel space savings
- 16 and 32 differential pair configurations
- Accommodates PCIe® x4 or x8 plus sidebands
- 28 or 34 AWG (external) and 34 AWG (internal) ultra low skew twinax; single-ended coax option also available
- Cable-to-cable bulkhead panel connection using Flyover® cable technology
- Multiple end 2 high-speed connector options including AcceleRate®, NovaRay® and Si-Fly™

NOVARAY® I/O

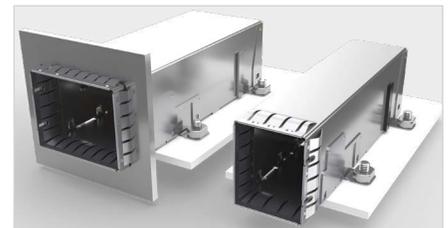


NVACP/NVACE/NVC

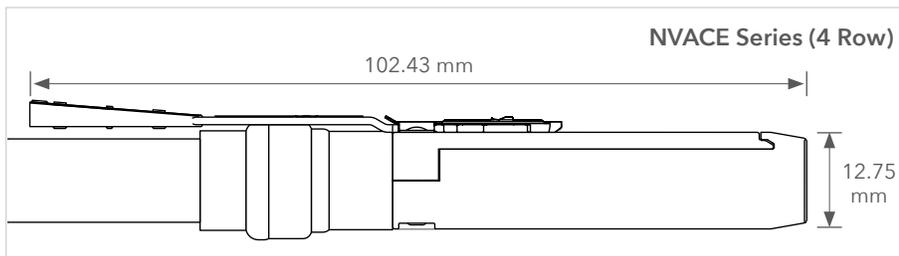
PAM4
112
Gbps

PCI EXPRESS®
6.0 Capable

TARGETED CONFIGURATIONS	AGGREGATE DATA RATE
8 Pair (in development)	896 Gbps
16 Pair	1792 Gbps
32 Pair	3584 Gbps
x4 (8 Pair + PCIe® Sidebands)	512 Gbps
x8 (16 Pair + PCIe® Sidebands)	1024 Gbps



Right-angle to front panel available for design flexibility



NovaRay® I/O in a rugged 38999 shell & lag fog resistant to 48 hours (NVA3E/NVA3P)

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

ExaMAX® I/O SHIELDED CABLE SYSTEM

- Fully shielded external cable and cage for EMI protection
- Rugged pull latch for mating/unmating
- Cage designed for use with ExaMAX® right-angle board connector (EBTM-RA)
- 30 and 34 AWG ultra low skew twinax
- 24 to 72 pairs (4 and 6 pairs; 6, 8, 10 and 12 columns)
- Roadmap: cable-to-cable bulkhead panel connection for increased performance to 112 Gbps PAM4

ExaMAX®

PAM4
56
Gbps

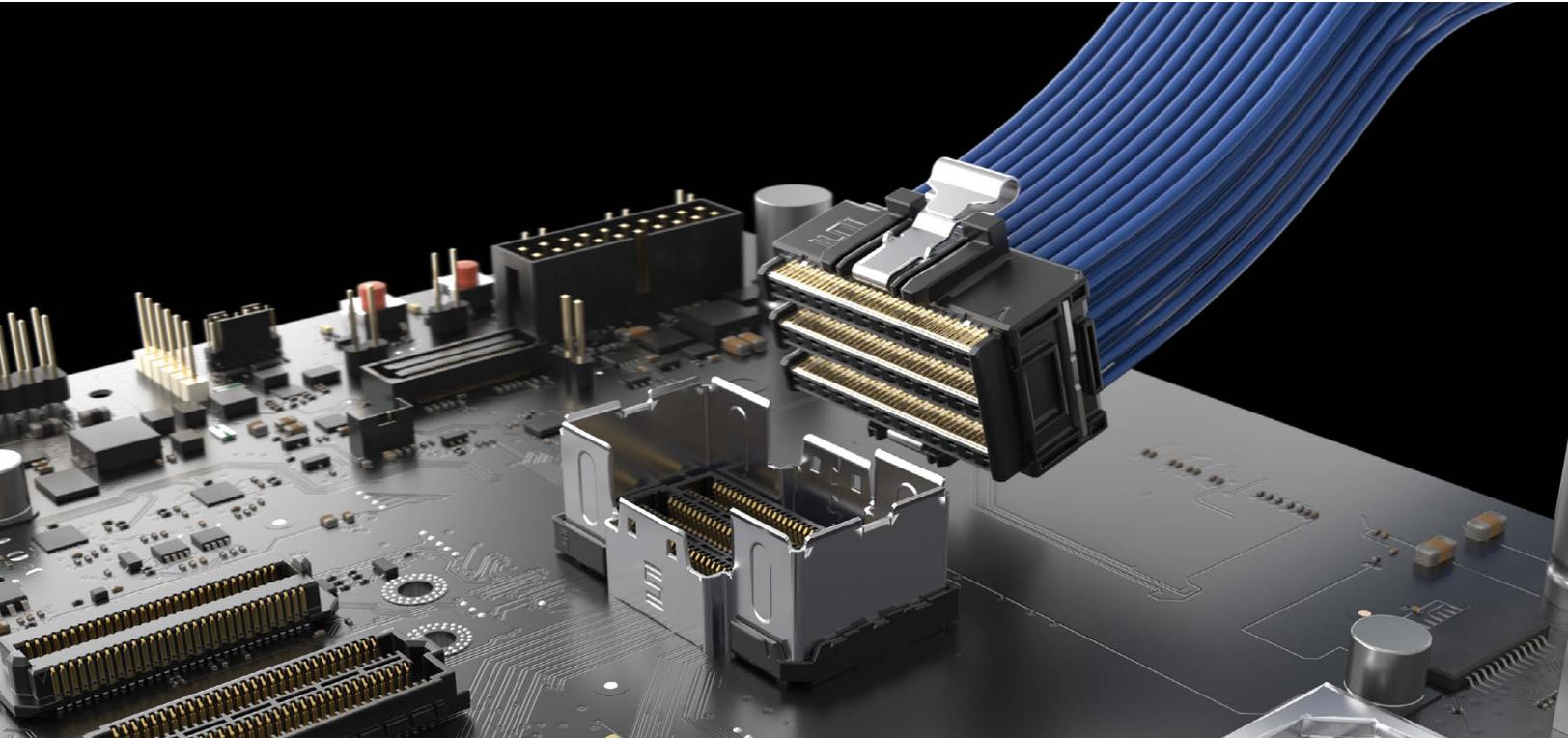
EBCE/EBTC



ExaMAX® is a registered trademark of AFCI.

FLYOVER[®]

MID-BOARD ASSEMBLIES

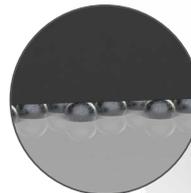


NOVARAY[®] EXTREME HIGH-SPEED, HIGH-DENSITY CABLE

- Industry leading aggregate data rate density – 2x the data rate in 60% of the space
- Proprietary pin to ground configuration enables extremely low crosstalk (beyond 40 GHz) and very tight impedance control
- Two reliable points of contact guaranteed
- BGA attach for density and optimized trace breakout region
- Evaluation Kit available, visit samtec.com/kits
- Eye Speed[®] Thinax[™] ultra-performance twinax cable version in development

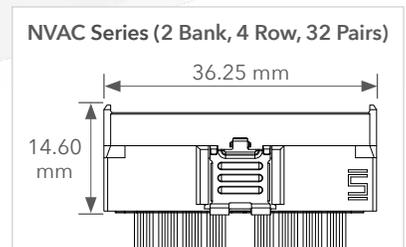
NRZ	PAM4
56 Gbps	112 Gbps

NOVARAY[®]



NVAC/NVAM-CT

AGGREGATE DATA RATE (NRZ)						
448 Gbps	672 Gbps	896 Gbps		1344 Gbps	1792 Gbps	4032 Gbps*
1 Bank			2 Bank			3 Bank*
2 Row	3 Row	4 Row	2 Row	3 Row	4 Row	6 Row*
8 Pairs	12 Pairs	16 Pairs		24 Pairs	32 Pairs	72 Pairs*



*In development

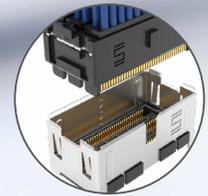
ACCELERATE® HP EXTREME DENSITY SYSTEM

- Industry's highest density 112 Gbps PAM4 cable-to-board system
- Supports today's 256-channel chip and tomorrow's 512-channel chip
- Staggered row-to-row spacing of 2.2 mm x 2.4 mm allows adequate routing lanes for optimized traces; 0.635 mm contact pitch
- 32 to 72 differential pairs; up to 96 pairs in development
- Eye Speed® 34 AWG ultra low skew twinax cable
- BGA solder ball attach for simplified board processing
- Right-angle shielded mating connector in development (APF6-RA)
- Eye Speed® ThinSE™ 34 AWG single-ended micro coax version in development with 12 or 18 coax per row

ACCELERATE®HP

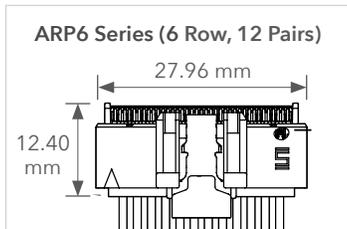


ARP6/APF6-L



Locking available for maximum density

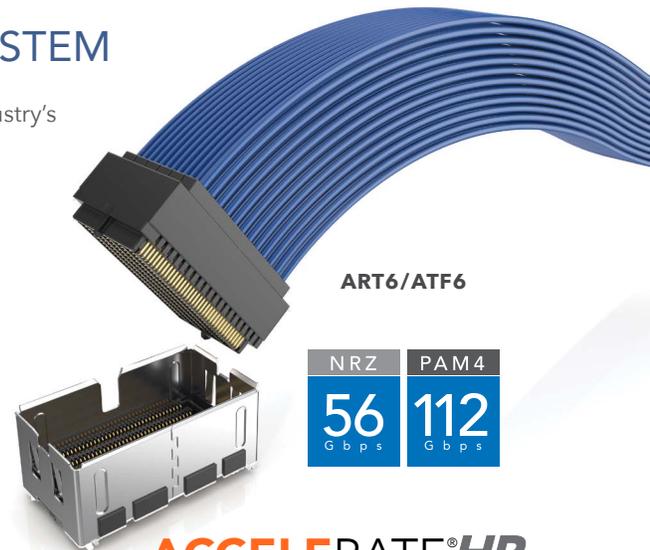
PAM4
112
Gbps



35 mm x 35 mm footprint holds two 72 differential pair connectors (144 total pins)

ACCELERATE® HP GEN 2 ON-PACKAGE SYSTEM

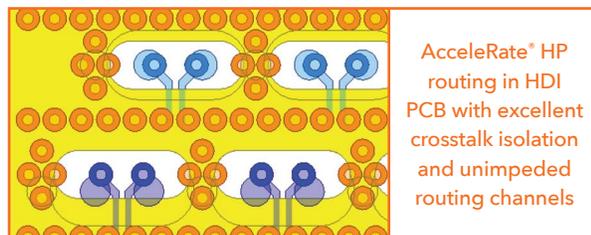
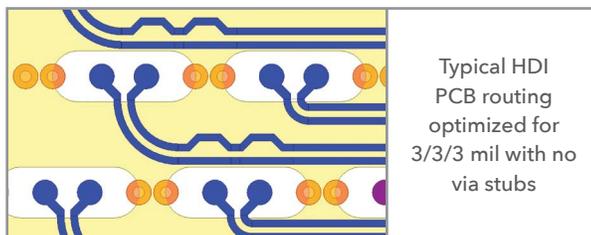
- Samtec is the first to achieve a direct-to-chip package solution with the industry's highest density 112 Gbps PAM4 interconnect
- Double the density in the same Gen 1 footprint; up to 144 differential pairs
- 182 differential pairs per square inch
- Staggered row-to-row spacing; 0.635 mm contact pitch
- Eye Speed® Thinax™ ultra performance twinax cable
- Vertical cable application provides the highest footprint density
- 2-piece system for high reliability and thermal performance required for co-packaged solutions
- Roadmap: Eye Speed® ThinSE™ single-ended micro coax cable assembly, and mixed wafer technology with ThinSE™ single-ended micro coax and Thinax™ ultra-performance twinax cable



ART6/ATF6

NRZ 56 Gbps | PAM4 112 Gbps

ACCELERATE®HP





ACCELERATE® SLIM, DIRECT ATTACH SYSTEM

- Slimmest cable assembly in the industry – 7.6 mm width
- 8, 16 and 24 differential pair configurations in a high-density 2-row design; 72 pairs in development
- Supports 64 Gbps PAM4 (32 Gbps NRZ) applications
- PCIe® 6.0 capable
- Contacts directly soldered to the twinax improves signal integrity by eliminating the transition board and its variability
- Eye Speed® 34 AWG ultra low skew twinax cable
- Rugged metal latching and shielding
- “Reversed Polarity” pinout option for reduced Far-End Crosstalk
- Evaluation Kits available, visit samtec.com/kits

PAM4
64
Gbps

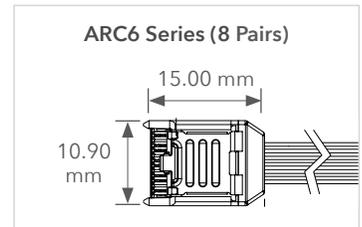
ACCELERATE®



ARC6/ARF6



Right-angle board mate available (ARF6-RA)

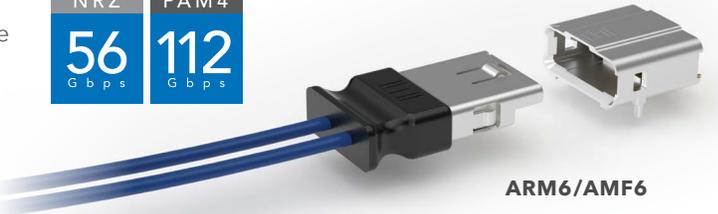


ACCELERATE® MINI EXTREME PERFORMANCE SYSTEM

- Eye Speed® 34 AWG Thinax™ ultra performance twinax cable
- One or two differential pairs
- Vertical and right-angle mating board connector
- Design flexibility as an End 2 option for Flyover® assemblies
- Friction retention latching and alignment pins

NRZ PAM4
56 Gbps 112 Gbps

ACCELERATE® mini

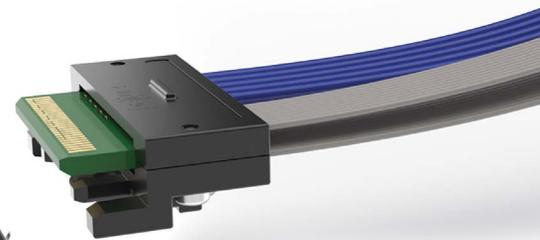
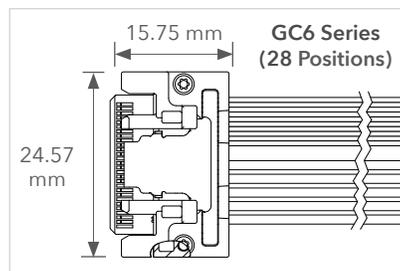


ARM6/AMF6

GENERATE™ HIGH-SPEED EDGE CARD SYSTEM

- Compatible with SFF-TA-1002 (1C, 2C, 4C & 4C+)
- Supports 64 Gbps PAM4 (32 Gbps NRZ) applications
- PCIe® 6.0 capable
- Edge Rate® contacts optimized for signal integrity performance
- Vertical or right-angle cable launch
- Mates with Generate™ 0.60 mm pitch high-speed edge card socket (HSEC6)
- Rugged metal latching system

PAM4
64
Gbps

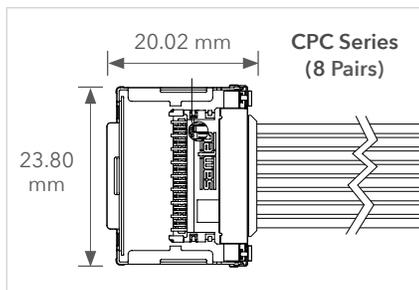
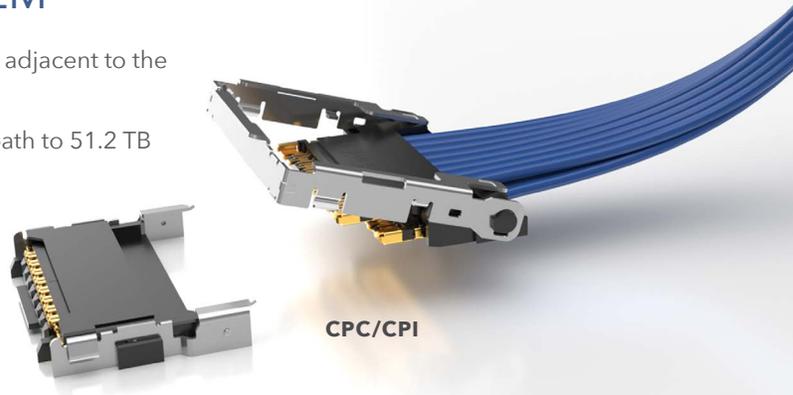


GC6/HSEC6

GENERATE™

SI-FLY™ LOW PROFILE CABLE SYSTEM

- Up to 16 pairs in an extremely low 4 mm profile for placement adjacent to the IC package, under heat sinks or other cooling hardware
- 112 Gbps PAM4 per lane enabling 25.6 TB aggregate with a path to 51.2 TB
- High-density 8 or 16 pairs for routing 4 or 8 channels
- Eye Speed® 34 AWG ultra low skew twinax cable
- 8.4 mm minimum height required for mating
- Evaluation Kit available, visit samtec.com/kits

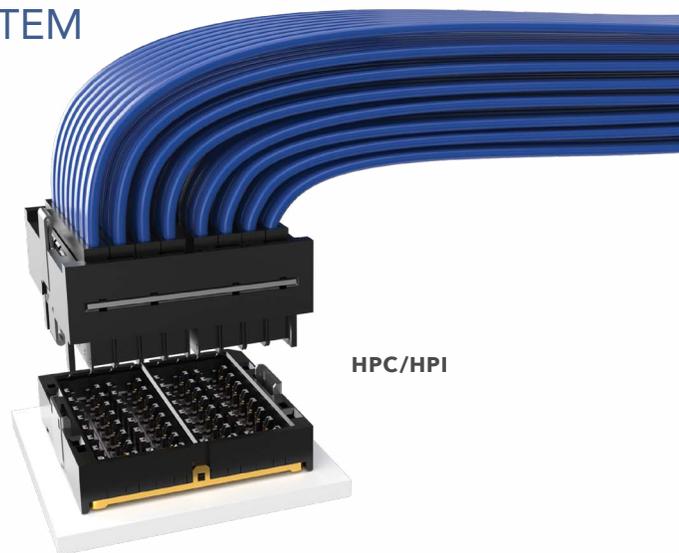


SI-FLY™ LP

NRZ	PAM4
56 Gbps	112 Gbps

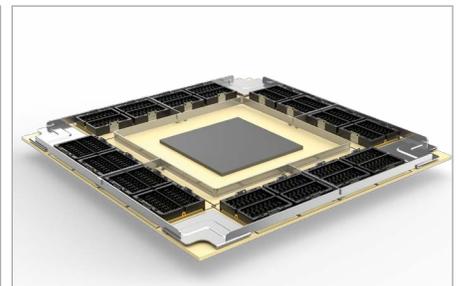
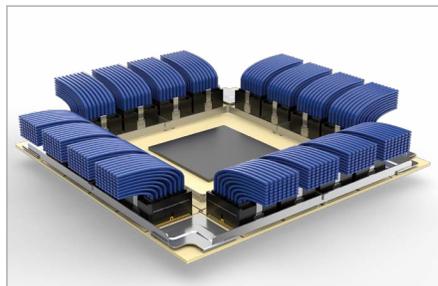
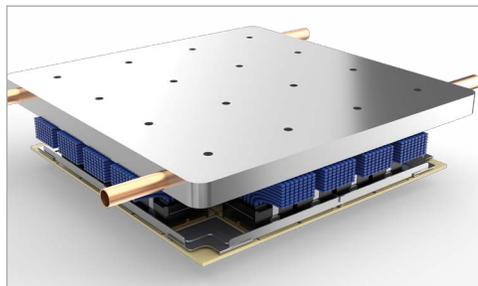
SI-FLY™ HIGH-DENSITY ON-PACKAGE SYSTEM

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



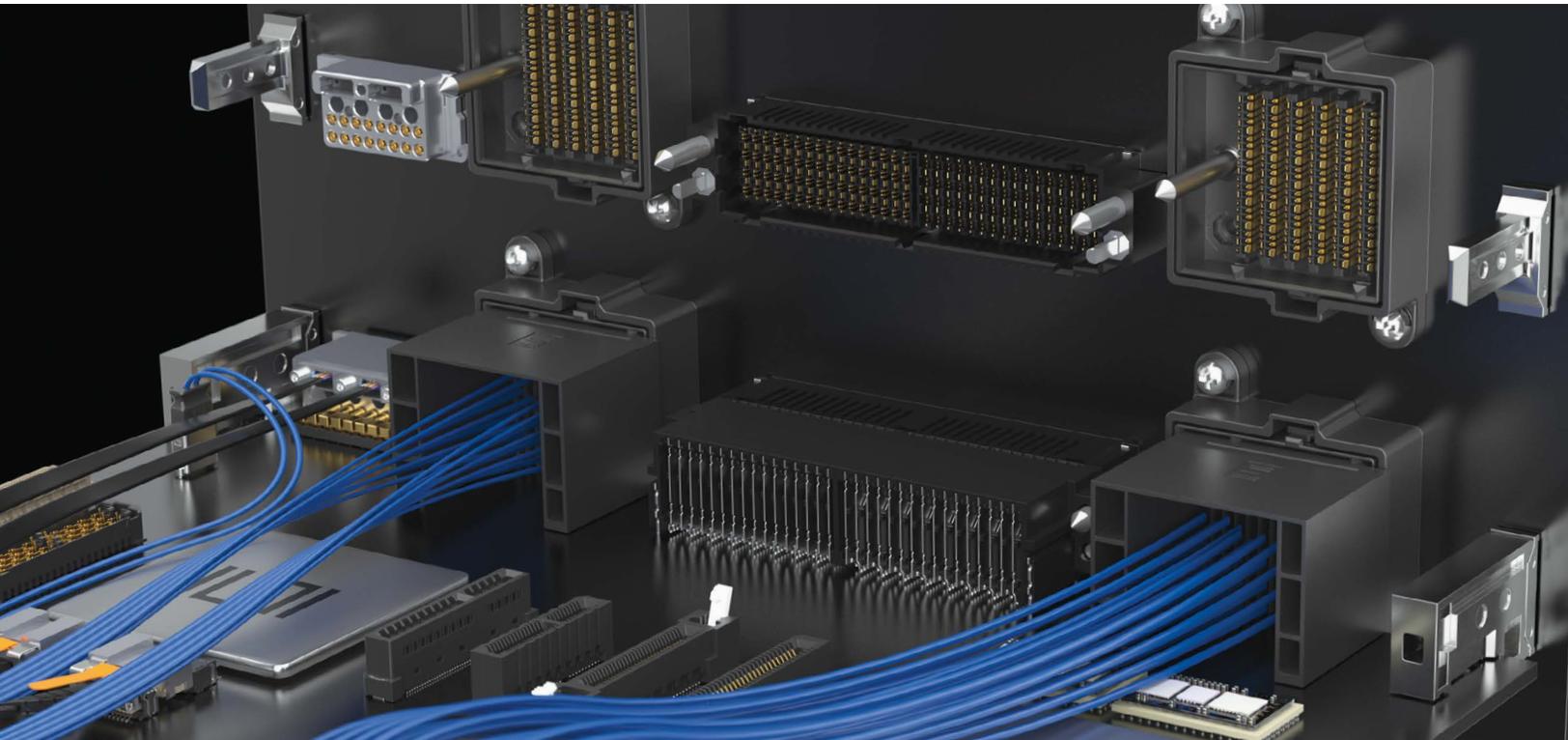
SI-FLY™ HD

PAM4
224 Gbps



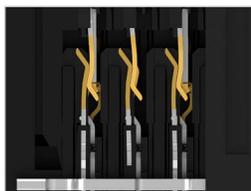
Ultra-high density solution for co-packaged applications.

FLYOVER[®] BACKPLANE CABLES

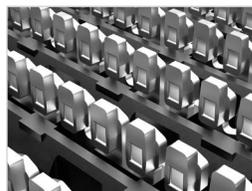


NOVARAY[®] MICRO RUGGED BACKPLANE SYSTEM

- True 112 Gbps PAM4 signal integrity with Flyover[®] support
- Cable-to-board, cable-to-cable, board-to-board
- Configurable signal banks for design flexibility
- Offset footprint for optimal signal integrity performance
- Reliable two points of contact for stub free mating
- Large continuous ground blades between and surrounding the differential pairs eliminate resonances
- Optional guidance and keying for blind mate



Precision Insert Molded
Contact System



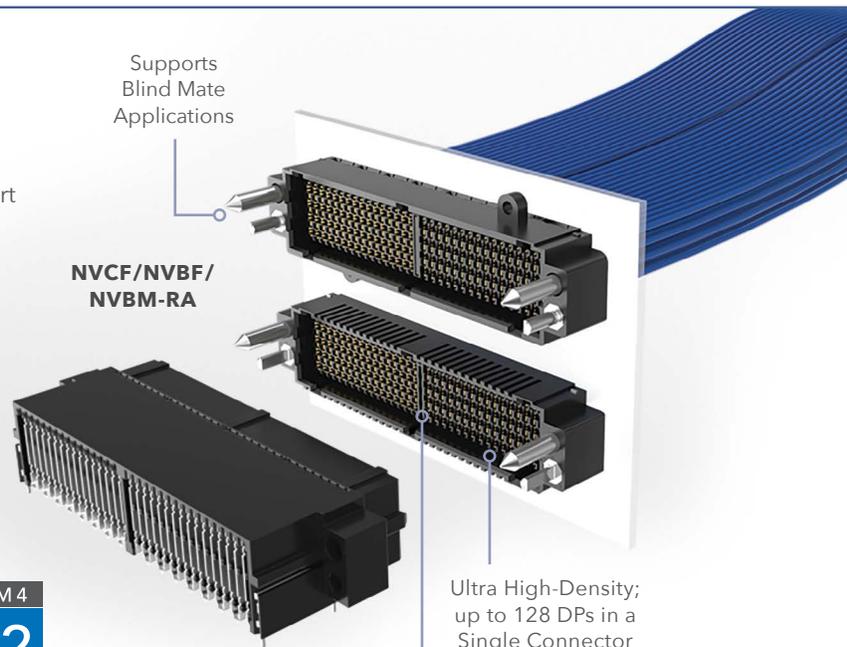
Solder Charge Termination
for Higher Densities

PAM4
112
Gbps

NOVARAY[®]

Supports
Blind Mate
Applications

NVCF/NVBF/
NVBM-RA



Ultra High-Density;
up to 128 DPs in a
Single Connector

Single-Ended or
Differential Pair
Wafers

ExaMAX® HIGH-SPEED BACKPLANE SYSTEM

- Cable-to-cable, cable-to-board, mid-board and panel applications
- Highly customizable with modular flexibility
- Reduced costs due to lower PCB layer counts
- 4 and 6 pairs; 4-16 columns
- Integrated guidance and keying options
- Multiple end 2 options available
- Evaluation Kit available, visit samtec.com/kits
- Eye Speed® Thinax™ ultra performance twinax cable version in development

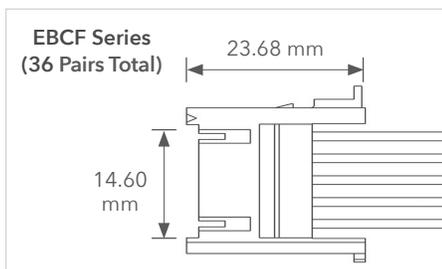
NRZ	PAM4
56	112
Gbps	Gbps

ExaMAX®



EBCF/EBDM-RA

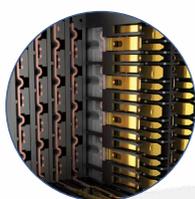
Cable-to-DMO
(Direct Mate Orthogonal)



ExaMAX® I/O Cable System also available



Roadmap: 8 Pairs for Greater Design Flexibility



Staggered Differential Pairs Provide Higher Data Rates

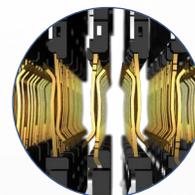
Designed for Blind-Mate Systems

Industry's Lowest Mating Force with Excellent Contact Normal Force

EBTF-RA

EBCB

Two Reliable Points of Contact with a 2.4 mm Wipe



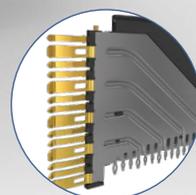
EBCM

30 and 34 AWG Ultra Low Skew Twinax Cable Supports Various Cable Lengths

EBCF

Vertical and Right-Angle

Wafer Design Increases Isolation for Reduced Crosstalk and Includes One Sideband Signal per Column



EYE SPEED® CABLE TECHNOLOGY



ULTRA LOW SKEW TWINAX CABLE

Samtec's proprietary 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 (28-112+ Gbps) and reach
- Improved signal integrity and eye pattern opening
- Ultra low skew (< 3.5 ps/meter) over extended lengths
- Supports Samtec Flyover® technology

Micro Cellular Dielectric Extrusion

- Critical dimensions measured at every dielectric spool
- Inline laser and CAPAC devices for capacitance monitoring and diameter control
- In-process stats summary sheet for Cpk acceptance

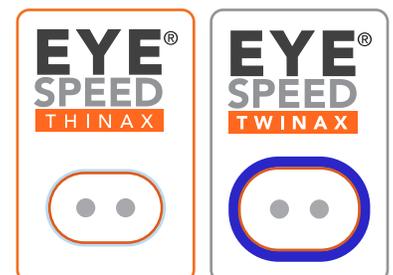


Eye Speed® Ultra Low Skew Twinax			28 AWG	30 AWG	32 AWG	34 AWG	36 AWG
Nominal Performance Specifications							
14 GHz (28G NRZ/ 56G PAM4)	0.25 m	IL (dB)	-1.0	-1.2	-1.5	-1.8	-2.2
	1.00 m		-4.1	-4.7	-5.9	-7.5	-8.9
28 GHz (56G NRZ/ 112G PAM4)	0.25 m		-1.5	-1.8	-2.2	-2.7	-3.2
	1.00 m		-6.1	-7.1	-8.7	-10.9	-13.0
Density/Flexibility			Good	Good	Better	Best	Best

* Eye Speed® Ultra Low Skew Twinax Cable is available in engineered impedance configurations of 85 Ω, 92 Ω and 100 Ω.

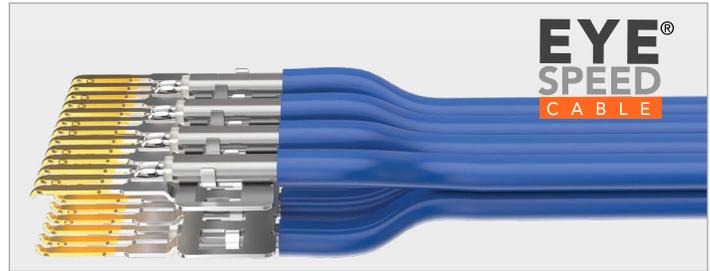
THINAX™ ULTRA PERFORMANCE TWINAX CABLE

- 40% smaller cross-sectional area
- 112 Gbps PAM4 performance
- Taped jacket miniaturizes the cable to match smaller, more dense connectors
- Allows for a smaller pitch within a row
- Achieving a smaller row-to-row pitch is dependent upon stack-up and BOR; customizable per application needs
- In Development: Eye Speed® AIR™ foamed twinax for significantly improved signal integrity and even lower intra-pair skew



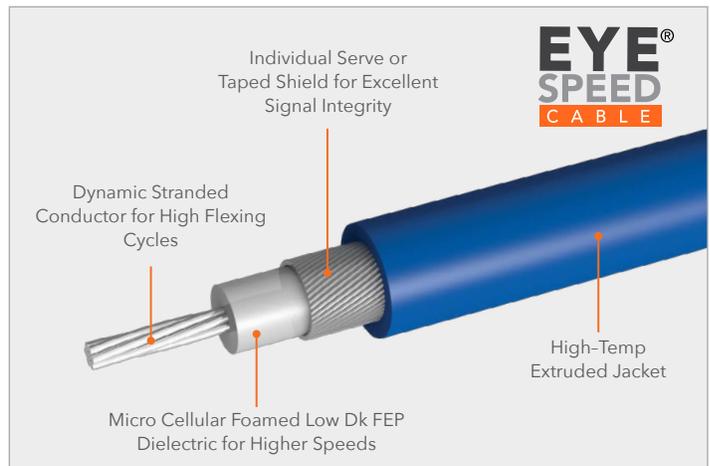
DIRECT ATTACH CABLE

- High-density contacts directly soldered to the Eye Speed® ultra low skew twinax cable
- Improved signal integrity by eliminating the transition board and its variability
- Achieves tighter tolerances



MICRO COAX CABLE

- Foaming introduces air voids for signal to travel faster
- Solid extrusion of foamed dielectric provides a constant and more durable construction
- Lighter weight and smaller size with higher bandwidth capabilities at longer lengths
- 26 - 38 AWG cable available
- Choice of signal conductor, shield and FEP dielectric to meet performance and cost specifications

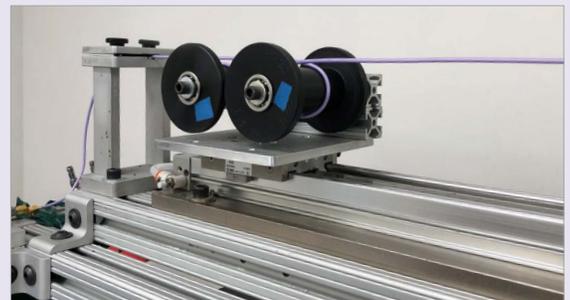


DYNAMIC TESTING

Samtec Eye Speed® Ultra Low Skew Twinax cable underwent Dynamic Insertion and Return Loss testing, proving the cable to be rugged with stable electrical performance after 250 flex/bend cycles.

This arduous flex and bend test determined that the performance of Samtec Eye Speed® ultra low skew twinax is essentially indistinguishable from the original raw, unbent cable.

Ultra low skew twinax provides the lowest insertion loss in the industry, controlled performance across temperature, and robust insertion loss in any assembly and operation environment. Contact HDR@samtec.com for higher cycle results.



Six feet of ultra low skew twinax cable on mandrels was coiled/uncoiled moving back and forth on a slide at a rate of 20-25 cycles per minute.

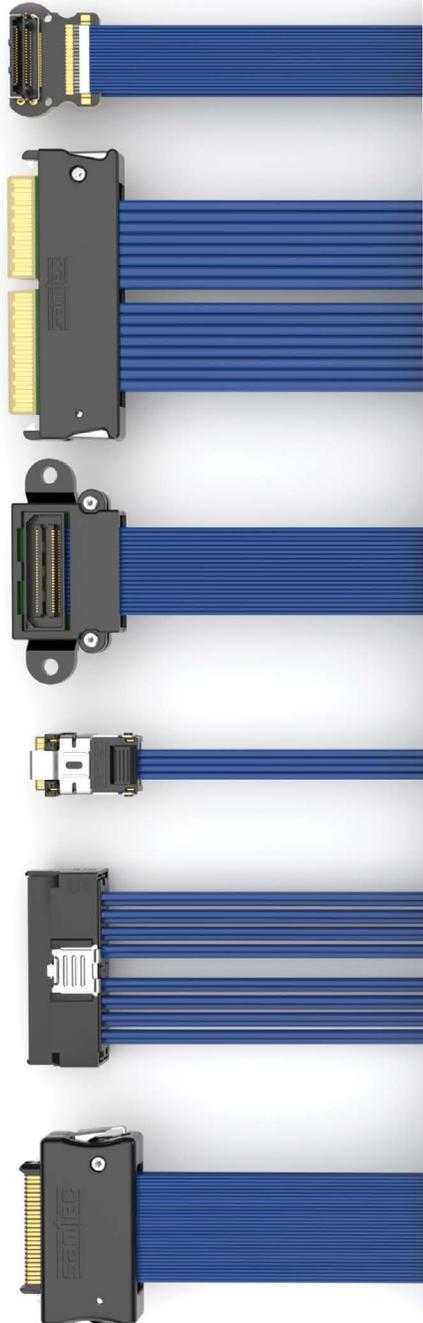
CABLE MANAGEMENT

- Samtec works with system architects in the early stages to optimize the architecture for cable management while keeping signal integrity and thermals in mind
- Complimentary service using mockups with accurate cable lengths
- Minimize number of SKUs within one system
- Minimize pressure drop



HIGH-SPEED CABLE

DESIGN FLEXIBILITY



ANY
high-speed
connector

ANY
break-out
configuration

ANY
high-speed
precision cable

... to create a solution for
any specific application.

HDR@samtec.com



Visit samtec.com/custom for additional information.

WILLINGNESS, SUPPORT & EXPERTISE

Industry-Leading Customer Service

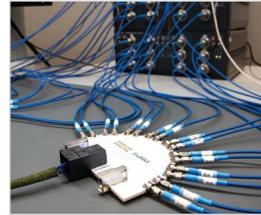
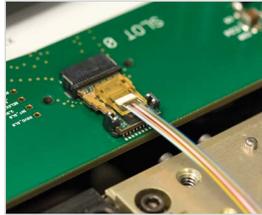
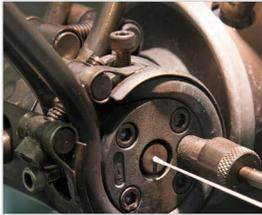
- Quotes and samples in 24 hours
- Prototype and processing assistance
- Dedicated Application Specific Product engineers and technicians

Flexible, In-House Manufacturing

- Global Operations, including multiple cable fabrication & assembly facilities
- Quick-turn samples and prototypes
- Custom & modified product support

Signal Integrity Expertise

- Industry-leading engineering support for high-performance system design
- Full system optimization assistance, including simulation, testing, analysis and evaluation



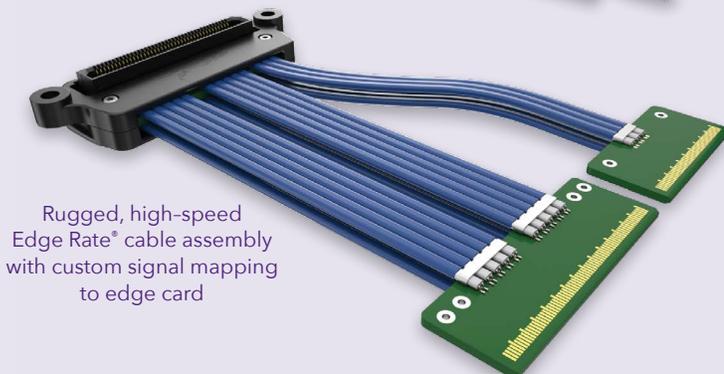
CUSTOMS & EXPRESS MODIFICATIONS

Samtec is able to support completely new and/or custom designs, as well as common simple modifications to cable assemblies and board-to-board products - often with low or no NRE charges, short lead times, quick-turn samples, and low or no MOQ's. Capabilities include:

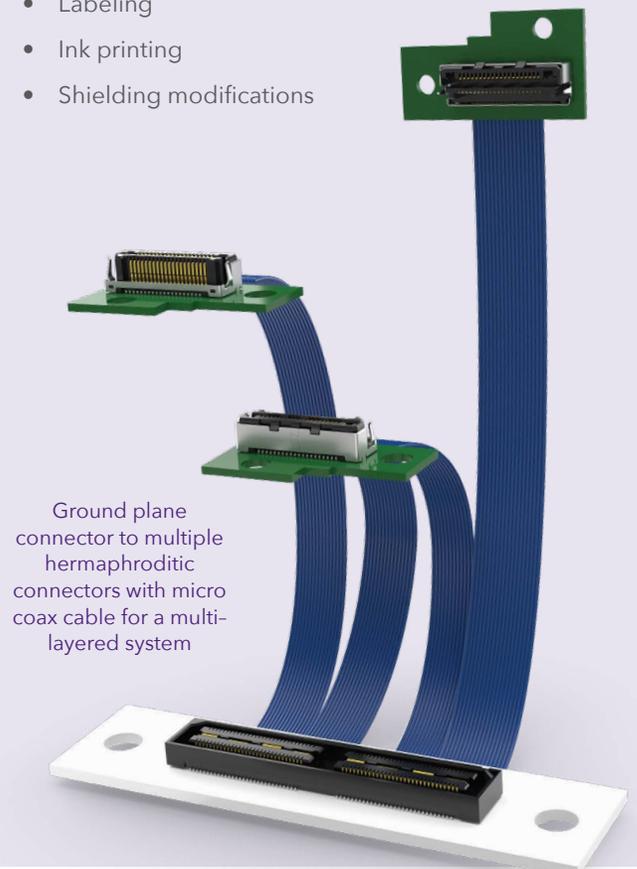
- Contacts
- Bodies
- Stamping
- Ruggedizing features
- Wiring
- Molding
- Plating
- Polarization
- Packaging
- Labeling
- Ink printing
- Shielding modifications



Double-ended micro coax cable assembly with two panel mount ground plane connectors



Rugged, high-speed Edge Rate cable assembly with custom signal mapping to edge card



Ground plane connector to multiple hermaphroditic connectors with micro coax cable for a multi-layered system



samtec
SUDDEN SERVICE®

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GERMANY • FRANCE • ITALY • NORDIC/BALTIC • BENELUX • ISRAEL • INDIA • AUSTRALIA / NEW ZEALAND
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