HIGH-SPEED CABLE

INTERCONNECT SOLUTIONS GUIDE

HIGH-SPEED CABLE SOLUTIONS

SAMTEC FLYOVER™ ARCHITECTURE

Flexibility to improve signal integrity reach at higher data rates

In-house high level design and engineering support

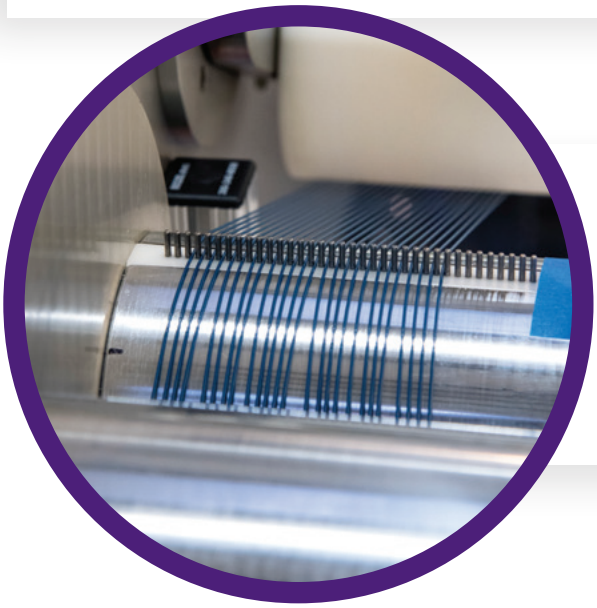
Expertise in full system signal integrity optimization

FLEXIBILITY & CUSTOMIZATION

Mix-and-match connector end options

Extensive customizing capabilities

Modular backplane flexibility



MANUFACTURING & CAPABILITIES

R&D/manufacturing of precision extruded cable

Co-extruded, ultra low skew twinax cable technology

Samtec Flyover™ designs route signals above lossy PCB

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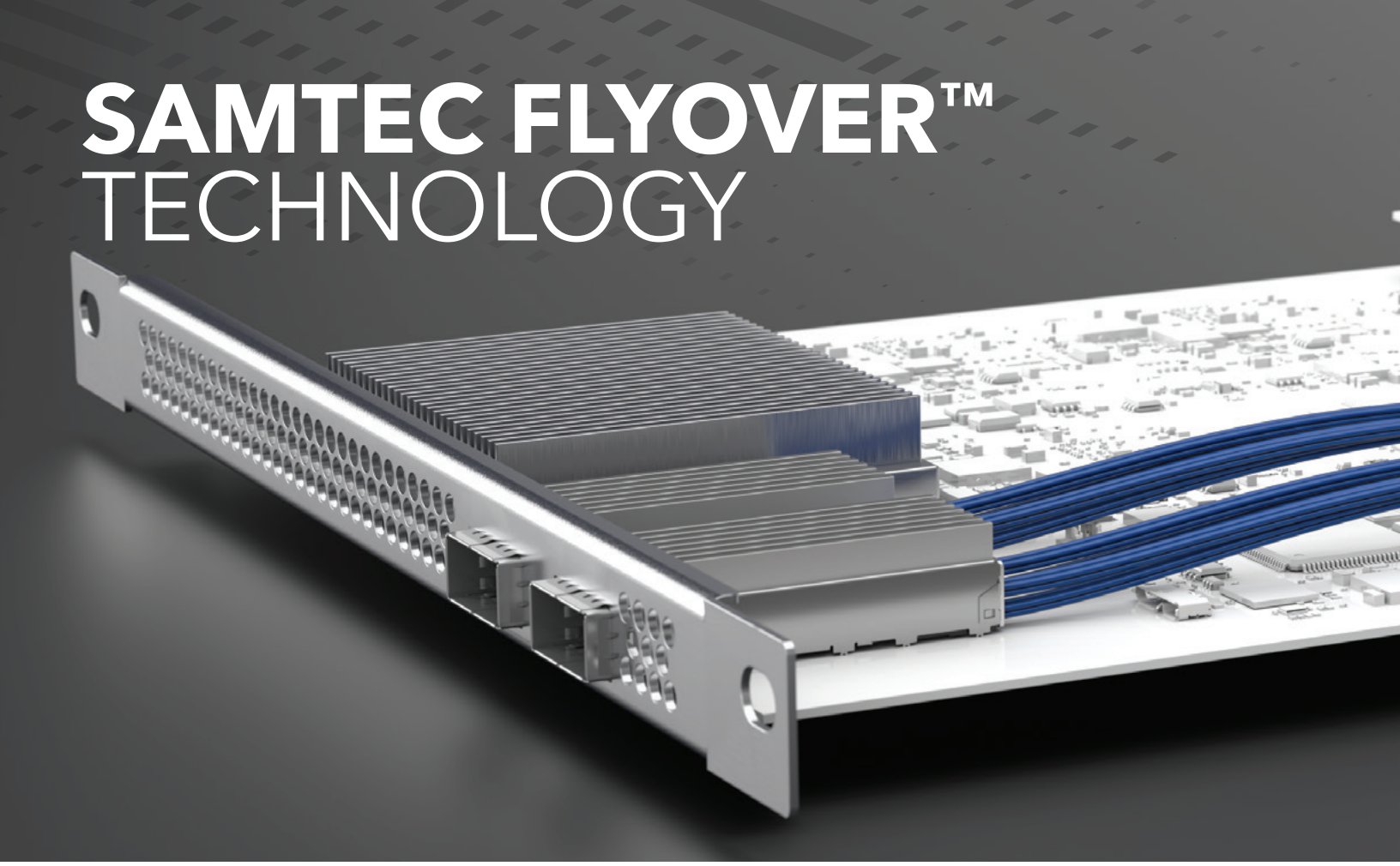
SAMTEC FLYOVER™ TECHNOLOGY



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.

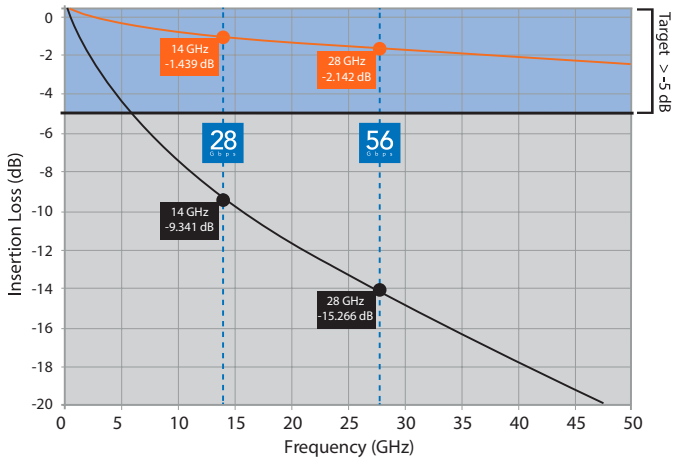
BANDWIDTH VS. TRADITIONAL & HIGH-SPEED MATERIALS

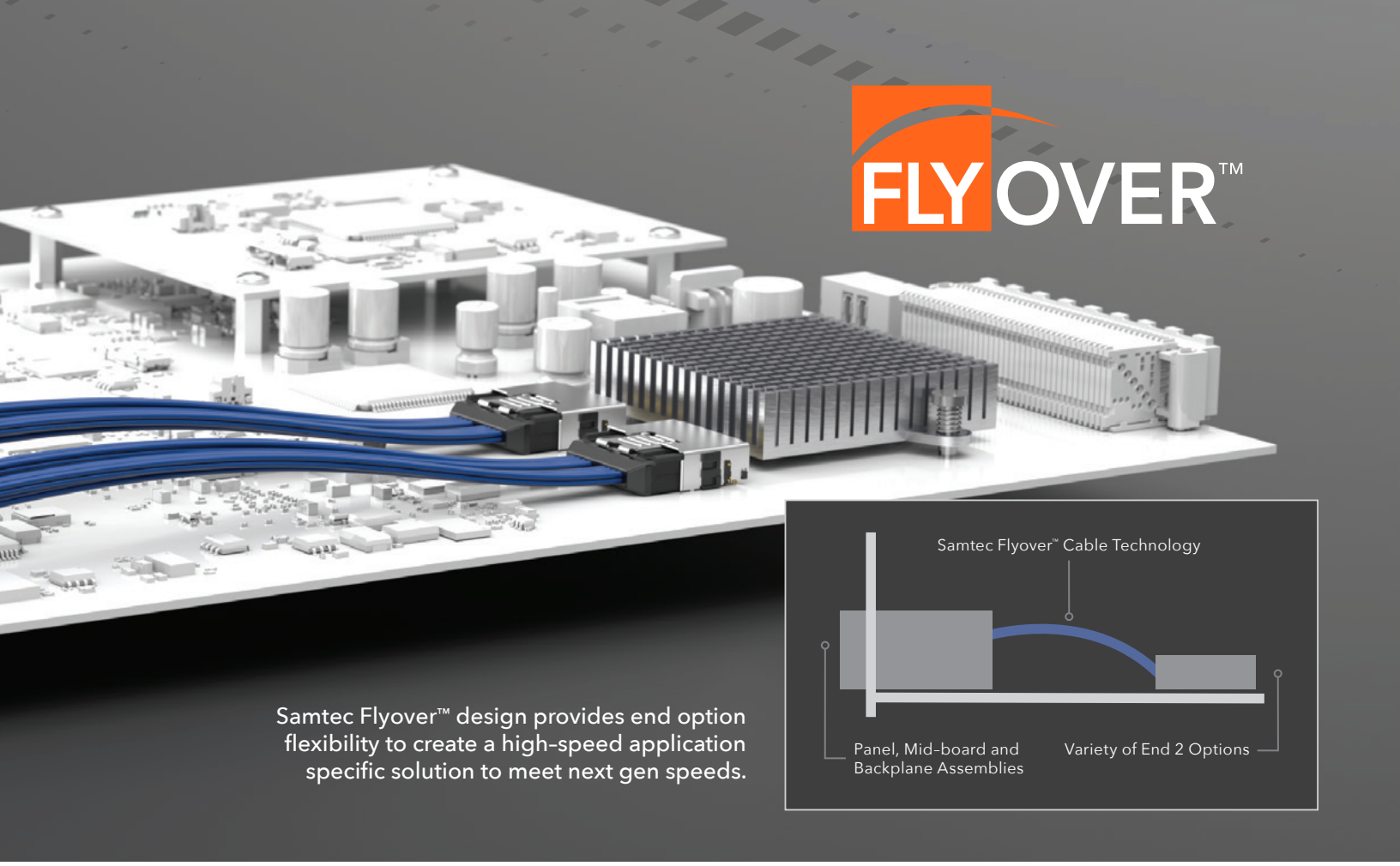
	FR408	MEGTRON 6	MICRO TWINAX	OPTICS
10 Gbps	up to 10"	10"+	up to 39"	100 m+
14 Gbps	up to 5"	up to 10"	up to 33"	100 m+
28 Gbps	up to 2"	up to 5"	up to 23"	up to 100 m
56 Gbps	0.0"	up to 2"	up to 12"	TBD
112 Gbps	0.0"	0.0"	up to 6"	TBD

(-5 dB Loss Target, Reach Estimate. For OIF VSR applications.)

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.





ULTRA LOW SKEW CABLE TECHNOLOGY

- Ideal for 28–112+ Gbps applications
- Tight coupling between signal conductors
- Ultra low skew twinax < 3.5 ps/meter
- See page 22–23 for cable specifications

INDUSTRY CABLE

✖ **Imperfect** Sequencing

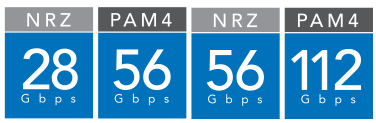
SAMTEC CABLE

✔ **Perfect** Intra-Pair Sequencing

EYE® SPEED CABLE

PERFORMANCE & COST ADVANTAGES

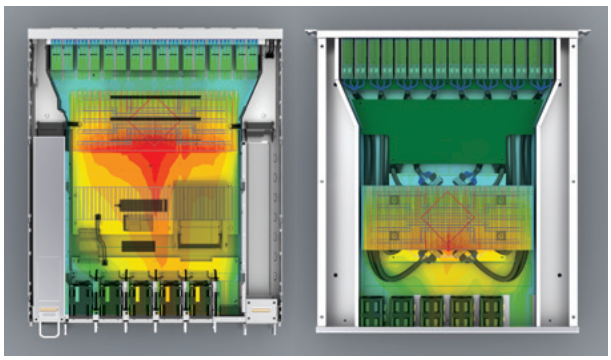
- 28–56 Gbps NRZ & Beyond
- Simplified Board Layout
- Fewer PCB Layers
- Less Expensive PCB Materials
- Eliminate Expensive Re-timers



SUPPORT

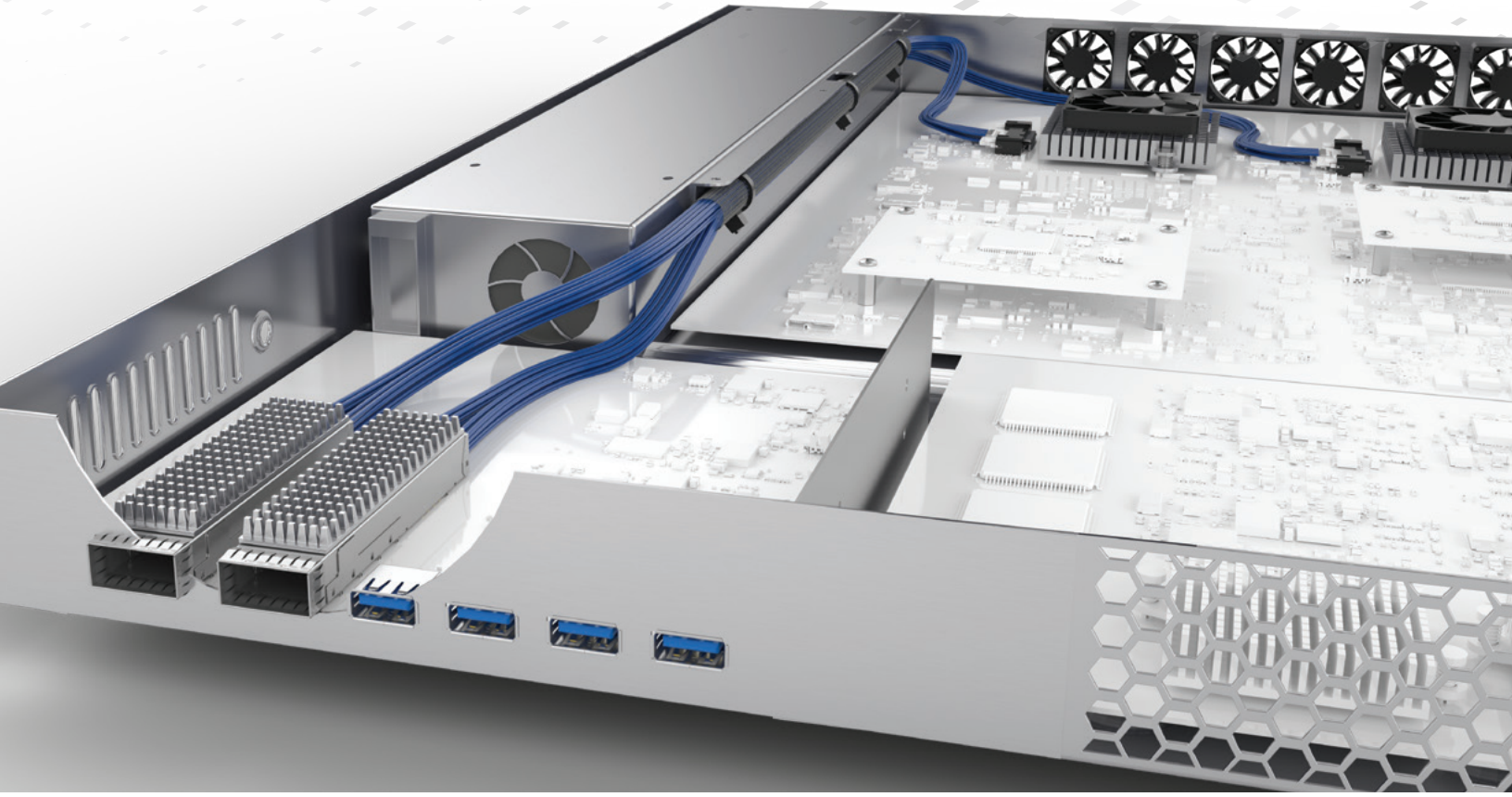
Fully integrated Technology Centers for full system optimization from Silicon-to-Silicon. See page 20–21 for information about Samtec's High-Speed Cable Group.

THERMAL IMPROVEMENT



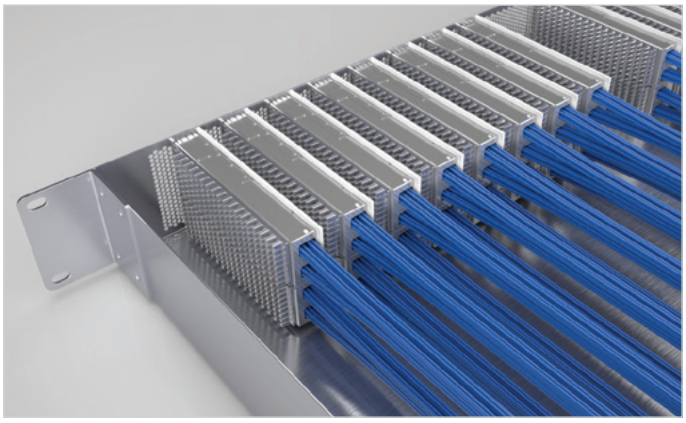
Standard Network Switch vs. **Samtec Flyover™ Technology**

SAMTEC FLYOVER™ PANEL ASSEMBLIES



DIRECT ATTACH QSFP28 SYSTEMS

QSFP28 systems utilize Samtec Flyover™ technology to route data above lossy PCB, simplifying board layout and extending signal reach. The modular design enables optimized systems that improve heat management, increase signal integrity performance, build in scalability for future upgrades and reduce costs by creating a multifunction board.



Standard 1U rack tray with side stackable configurations

Increases panel density and optimizes airflow

SAMTEC FLYOVER™ QSFP28 SYSTEM

4 Channels (x4 bidirectional, 8 differential pairs)

~100 Gbps NRZ aggregate (~200 Gbps PAM4)

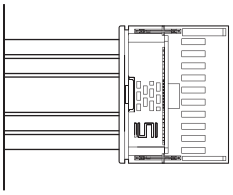
Compatible with all MSA QSFP pluggables

Heat dissipation: ~3.5 W/cable

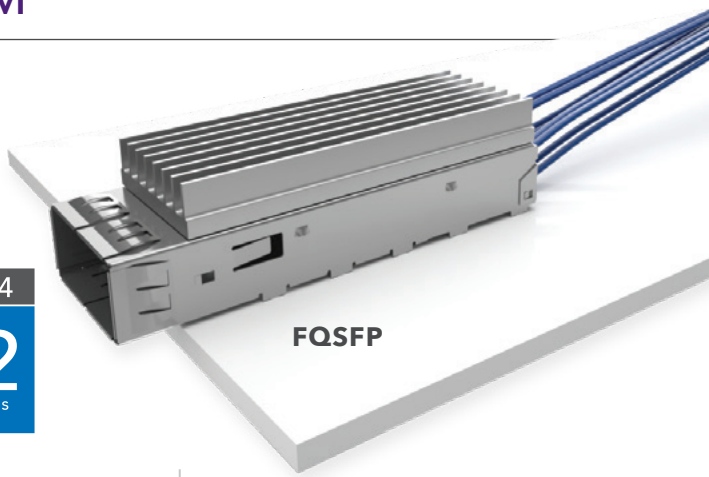
Eye Speed® 30 or 34 AWG twinax cable
(See page 22 for specifications)

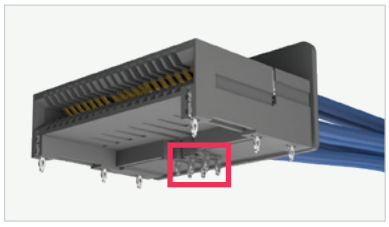
Multiple end 2 options for design flexibility

Characterization Kit available
(REF-200471-X.XX-XX), visit samtec.com/kits

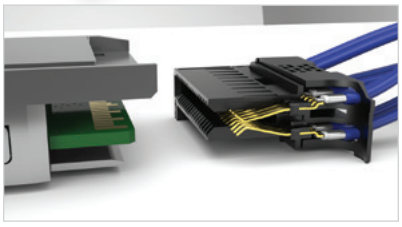


FQSFP
Actual Size





Localized press-fit control and power contacts eliminate the need for a secondary cable and connector



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

DOUBLE DENSITY QSFP28 SYSTEM

8 Channels (x8 bidirectional, 16 differential pairs)

~200 Gbps NRZ aggregate (~400 Gbps PAM4)

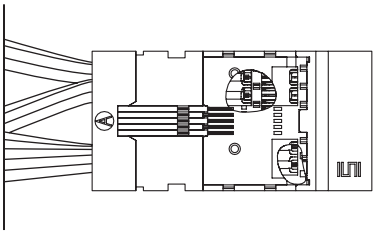
Belly-to-belly mating for maximum density

Backward compatible with QSFP modules

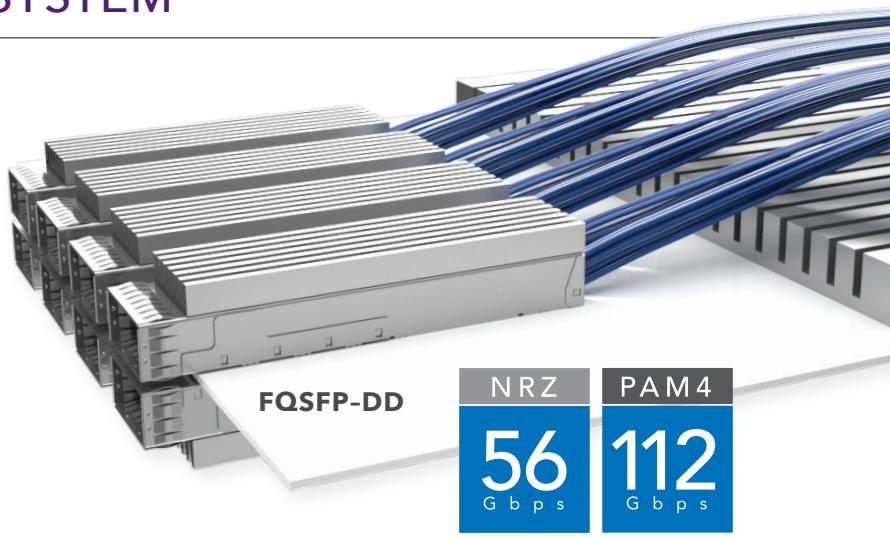
Heat dissipation: ~7+ W/cable

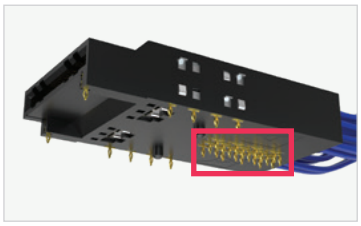
Variety of end 2 options

Characterization Kit available
(REF-203424-X.XX-XX), visit samtec.com/kits

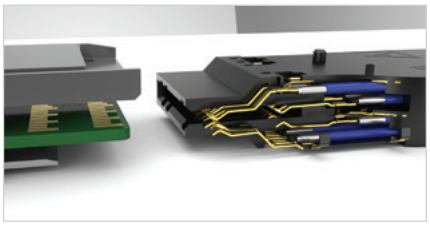


FQSFP-DD
Actual Size



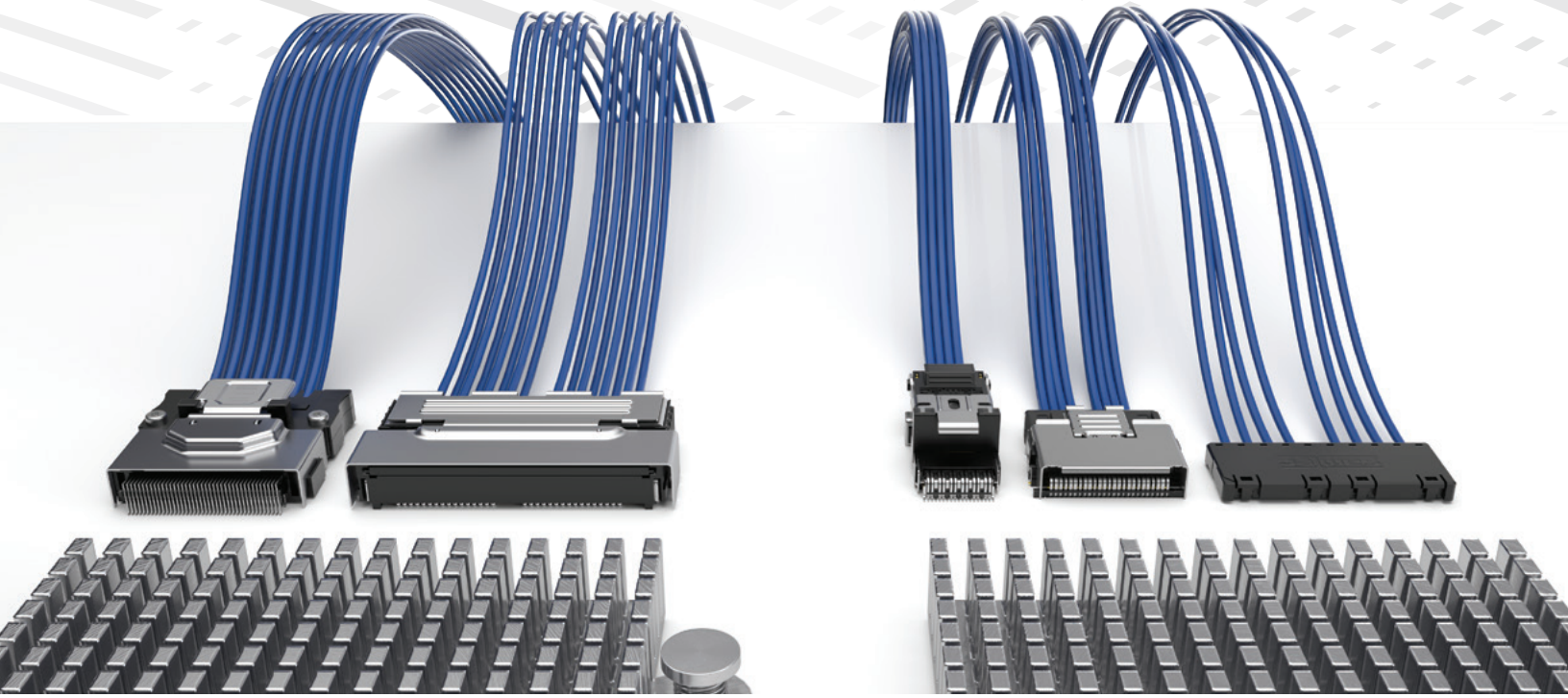


Sideband signals are routed through press-fit contacts for increased airflow



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

SAMTEC FLYOVER™
MID-BOARD ASSEMBLIES



EXTREME HIGH-SPEED, HIGH-DENSITY CABLE

NOVARAY®

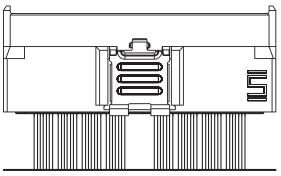
8 to 32 signal pairs with two reliable points of contact guaranteed; 72 pairs in development

BGA attach for density and optimized trace breakout region

NRZ	PAM4
56 Gbps	112 Gbps

Industry leading aggregate data rate density – 2x the data rate in 60% of the space

Proprietary pin to ground configuration enables very low crosstalk (to 40 GHz) and very tight impedance control



NVAC Actual Size
(2 Bank, 4 Row, 32 Pairs)

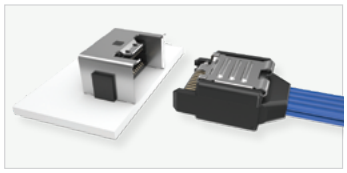
Aggregate Data Rate (NRZ)					
448 Gbps	672 Gbps	896 Gbps	1344 Gbps	1792 Gbps	4032 Gbps*
1 Bank		2 Bank			3 Bank*
2 Row	3 Row	4 Row	2 Row	3 Row	4 Row	6 Row*
8 Pairs	12 Pairs	16 Pairs	24 Pairs	32 Pairs	72 Pairs*
					***In development**

SLIM BODY CABLE ASSEMBLY

- Slimmest cable assembly in the industry – 7.6 mm body width
- High-density 2-row design
- 8 and 16 pair configurations (24 pair in development)
- Eye Speed® 34 AWG ultra low skew twinax (See page 22 for specifications)
- Characterization Kit available (REF-203425-X.XX-XX), visit samtec.com/kits

NRZ 28 Gbps | PAM4 56 Gbps

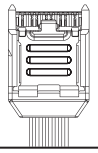
ARC6



Right-angle available

ARF6

ACCELERATE®



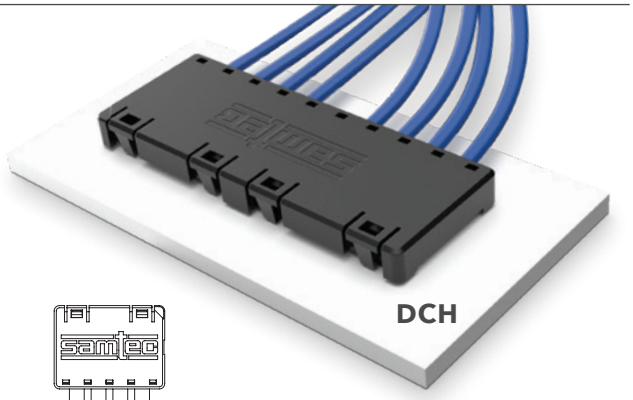
ARC6 Actual Size (8 Pairs)

DIRECT CONNECT™ HORIZONTAL CABLE

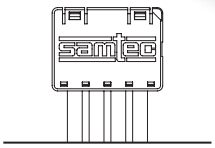
- Ultra-low 3 mm profile saves space for high-density applications
- 4 and 8 pair configurations
- Supports and surpasses PCIe® Gen 3 speeds at 2 meters
- Characterization Kit available (REF-202013-X.XX-XX), visit samtec.com/kits

NRZ 28 Gbps | PAM4 56 Gbps

Press-fit termination for high retention



DCH

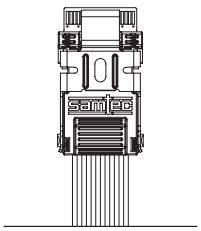


DCH Actual Size (4 Pairs)

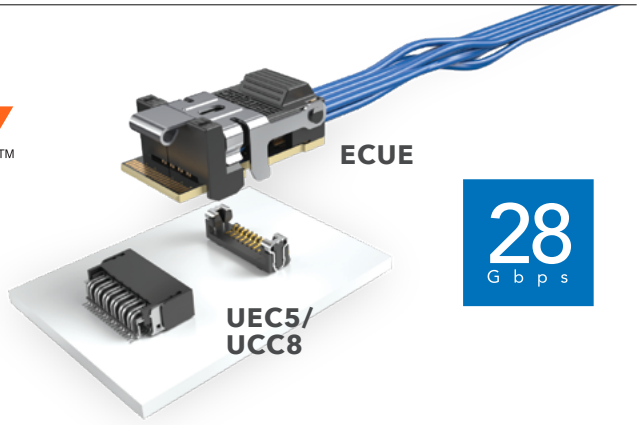
FIREFLY™ COPPER SYSTEMS

- High-performance, high-density copper Samtec Flyover™ solution
- Pin compatible with FireFly™ optical using the same connector system (ECUO; see pages 12-13)
- x4, x8 and x12 configurations
- PCIe® Gen 4 compatible system (PCUE)
- Characterization Kit available (REF-201830-XX), visit samtec.com/kits

FIREFLY™



ECUE Actual Size (x12)



ECUE

UEC5/ UCC8

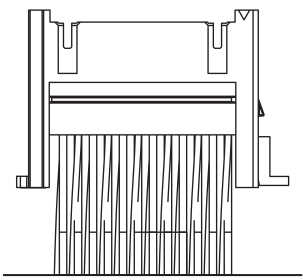
28 Gbps

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

BACKPLANE CABLE ASSEMBLIES

HIGH-SPEED BACKPLANE CABLE

ExaMAX®



EBCF Actual Size
(72 Pairs Total)

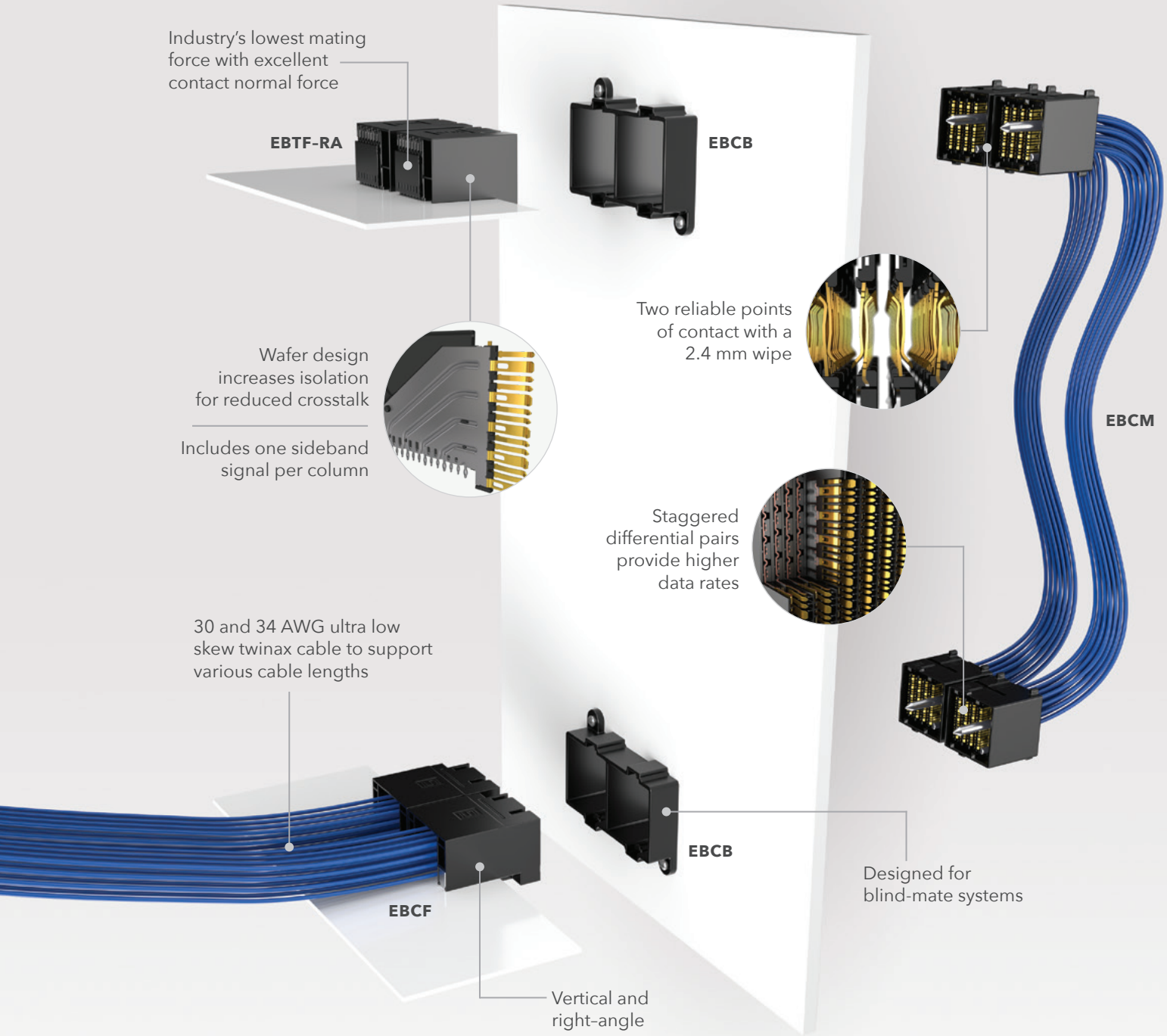
EBCF

EBTM/ EBCL

NRZ	PAM4
56 Gbps	112 Gbps

- Utilizes Samtec's Eye Speed® ultra low skew twinax cable technology for improved signal integrity, increased flexibility and routability
- Highly customizable with modular flexibility
- Reduce costs due to lower PCB layer counts
- See page 22 for **co-extruded** twinax cable specifications
- Characterization Kit available (REF-205463-01), visit samtec.com/kits

ExaMAX® is a registered trademark of AFCI.



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

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

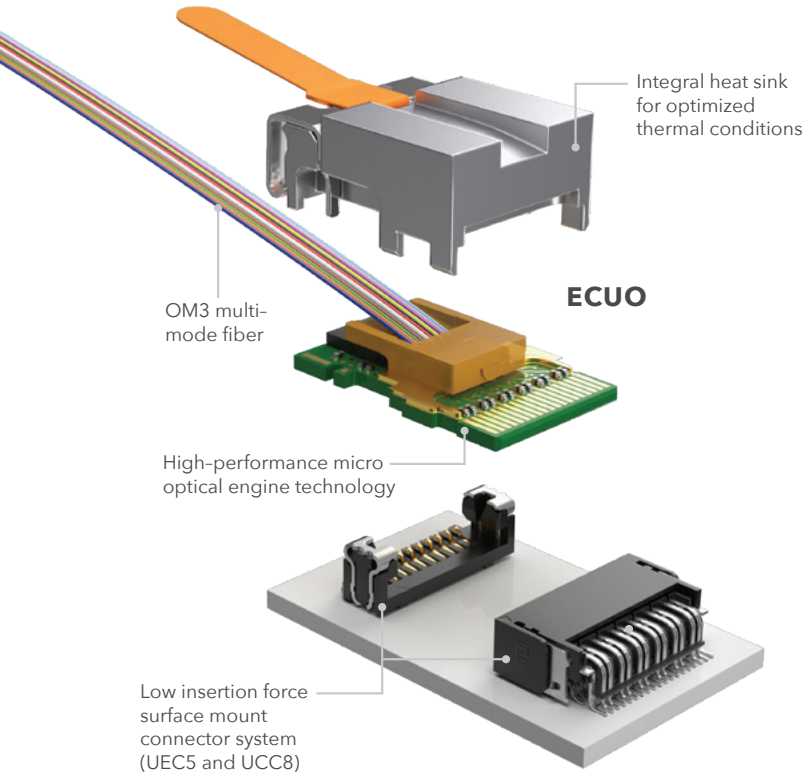
Integrated guidance and keying options

Cable-to-DMO (Direct Mate Orthogonal)

FIREFLY™ OPTICAL MICRO FLYOVER SYSTEM™

FIREFLY™ OPTICAL TECHNOLOGY

FIREFLY™ 28 Gbps



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

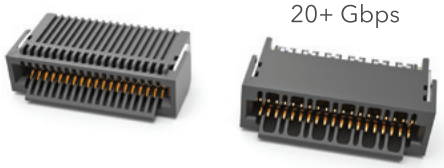
Industry leading miniature footprint allows for higher density close to the data source

Rugged, simple to use system with easy insertion/removal and trace routing

Supports data center, HPC and FPGA protocols, including Ethernet, InfiniBand™, Fibre Channel, Aurora and PCIe®

Gen 1:
Up to 20 Gbps

Gen 2:
20+ Gbps



0.50 mm pitch high-speed data connector available in two generations (UEC5)

FIREFLY™ OPTICAL SYSTEMS

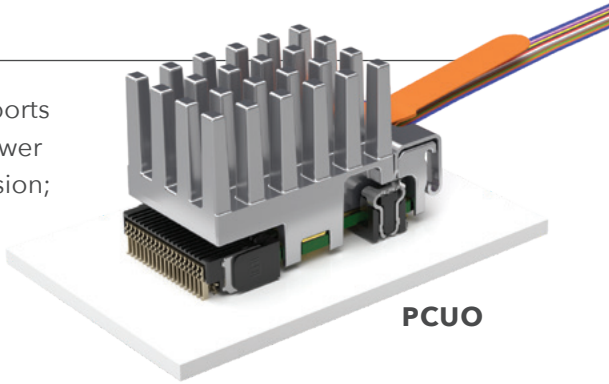
Designed for flexibility, optical (ECUO) for greater distances and copper (ECUE; page 9) for cost optimization

x4 and x12 configurations

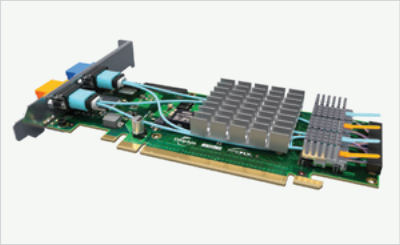
Multiple end 2 options including MTP®, MXC®, MT and ARINC 801

PCIe®–Over–FireFly™ (PCUO) supports PCIe® protocol for low latency, power savings and guaranteed transmission; Gen 4 in development

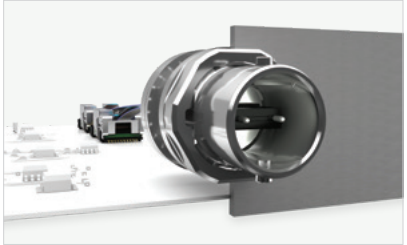
–40 °C to +85 °C extended temperature system (ETUO); PCIe® version available (PTUO)



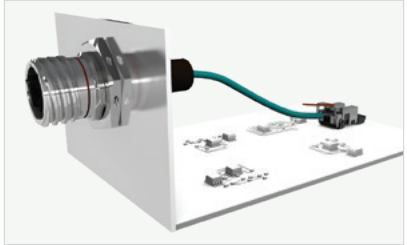
PCUO



PCIe®–over–Fiber adaptor card (PCOA), available in x4, x8 or x16 configurations, supports Gen 3 platform and transparent or non–transparent bridging



Optical FireFly™ to ARIB STD-B58 BNC–type interface with MT ferrule for ultra-high density applications



Extended temperature FireFly™ with Amphenol® Aerospace's bulkhead interconnects (MT38999) for rugged applications

Amphenol® is a registered trademark of Amphenol Corp.

PASSIVE & ACTIVE OPTICAL SOLUTIONS

FireFly™ is compatible with optical backplane systems in multiple configurations

PCIe® Active Optical assemblies for Gen 3 speeds up to 100 m (PCIEO)

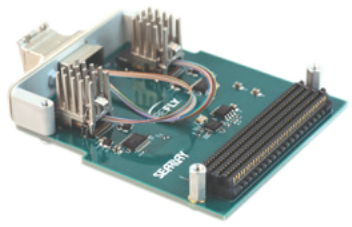
High–density solutions for front panel or backplane applications with MXC® connectors

Industry standard passive MPO–to–MPO panel adaptor (OPA) and optical patch cable (FOPC)

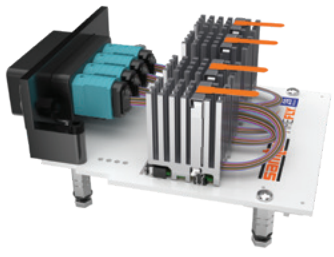
MTP® and MXC® are registered trademarks of US Conec Ltd.

FIREFLY™ TEST & DEVELOPMENT KITS

For more information visit samtec.com/kits or contact kitsandboards@samtec.com.



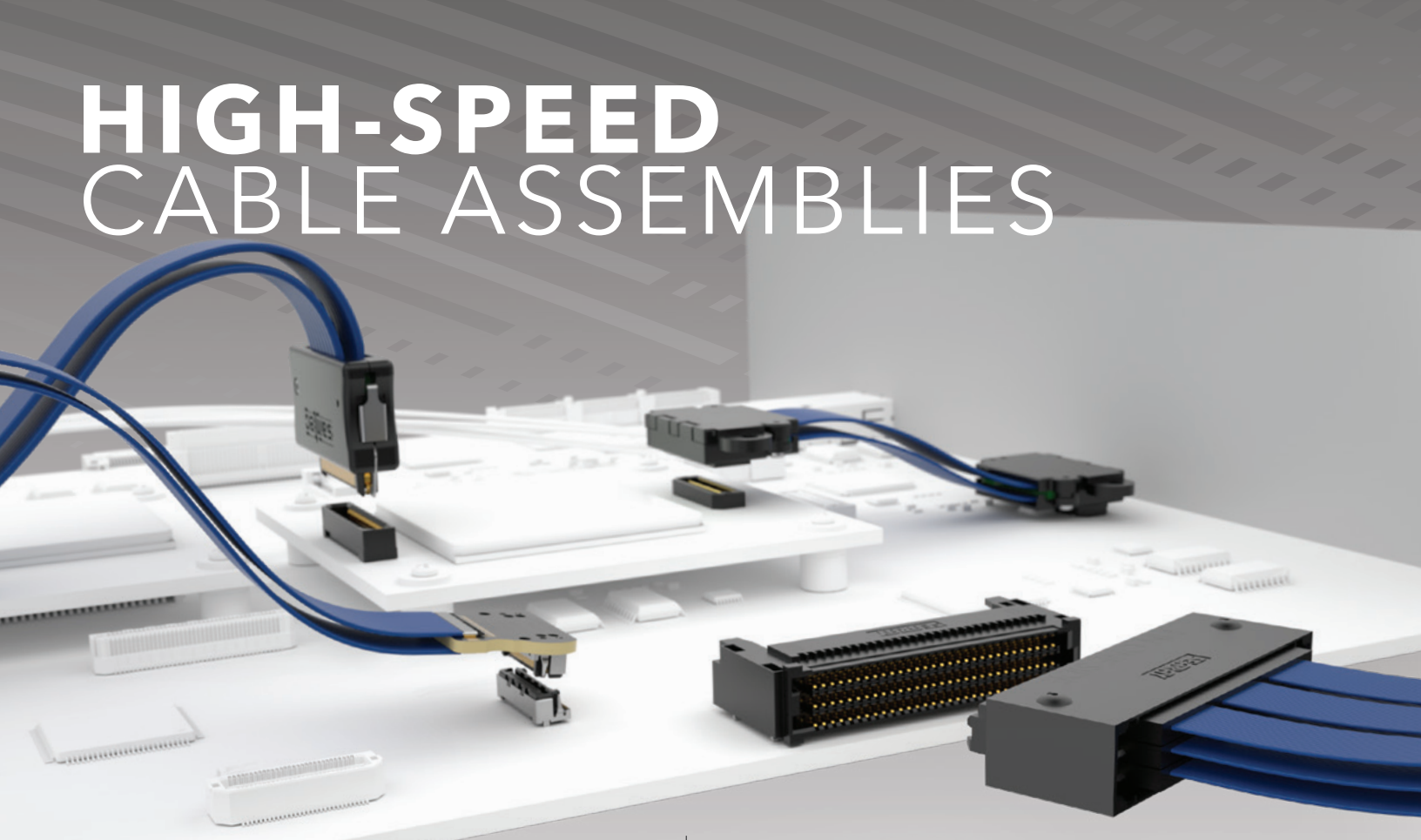
14 Gbps FireFly™ FMC Development Kit (REF-193429-01)



25/28 Gbps FireFly™ FMC+ Development Kit (REF-200772-XXX-XX-01)

FireFly™ Test Kit (FIK-FIREFLY-XX)

HIGH-SPEED CABLE ASSEMBLIES



14 Gbps MICRO COAX & TWINAX CABLE ASSEMBLIES

Ability to mix-and-match end options for application-specific requirements with extensive customizing capabilities

Single-ended 50 Ω and differential 100 Ω standards

Rugged features and options including strain relief, plastic housings, screw downs, latches, locks, etc.

Many non-cataloged standards available including 75 Ω micro coax and high-density twinax solutions

EYE® SPEED® CABLE TECHNOLOGY

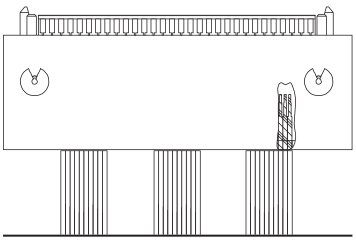
Excellent signal integrity performance with individual copper serve or braid shielding

Stranded conductor for small bend radii and dynamic high flexing cycle applications

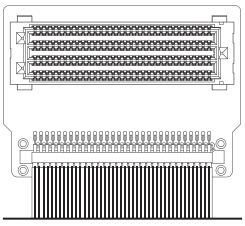
Cost-effective ribbonizing eliminates discrete wires

26-38 AWG coax and twinax construction
(See page 22-23 for specifications)

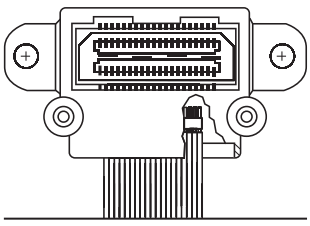
20 Ω, 50 Ω, 85 Ω and 100 Ω



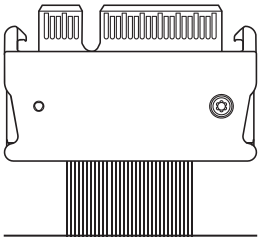
SEAC Actual Size
(30 Positions/Row)



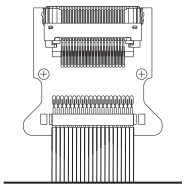
ESCA Actual Size
(30 Positions/Row)



EQCD Actual Size
(20 Positions/Row)



ECDP Actual Size
(16 Pairs Total)



HLCD Actual Size
(20 Positions/Row)

HIGH-DENSITY ASSEMBLIES

1.27 mm (SEAC) and
0.80 mm pitch (ESCA)

34 or 36 AWG coax; 32 AWG twinax

Mates with SEARAY™ and
SEARAY™ 0.80 mm arrays

Optional rugged latching

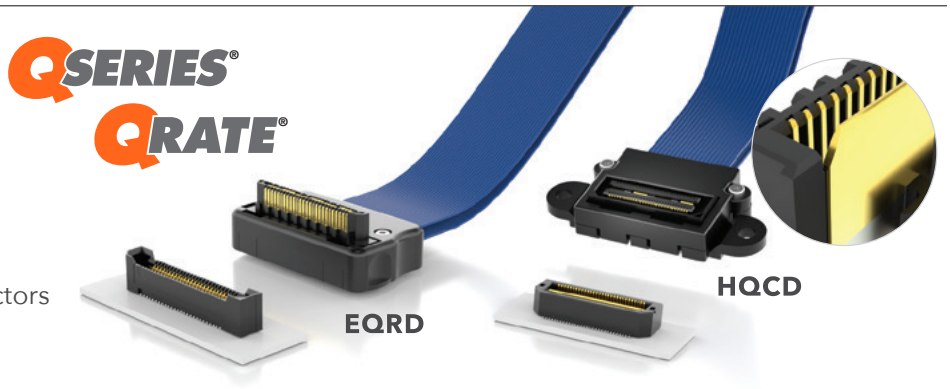
GROUND PLANE ASSEMBLIES

Integral power/ground plane

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® and Q Rate® connectors



EDGE CARD ASSEMBLIES

14 Gbps (ECDP) and 16 Gbps (FEDP) performance

30 AWG twinax (ECDP); mates with 0.80 mm pitch
edge cards (HSEC8)

34 AWG ultra low skew twinax (FEDP); mates with
0.50 mm pitch edge card (FCDP)

HIGH-SPEED ASSEMBLIES

Ultra-micro hermaphroditic Razor Beam™
coax assemblies with rugged shielding (HLCD)

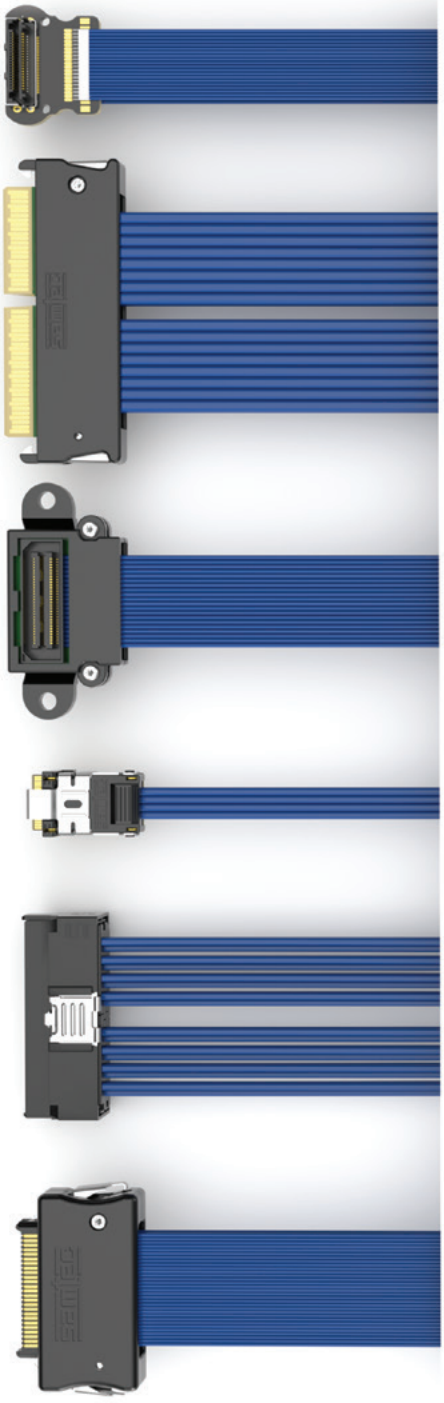
0.80 mm pitch Edge Rate® coax and
twinax assemblies (ERCD, ERDP)

PCI Express® twinax assemblies support
1, 4, 8 and 16 links (PCIEC)

34 or 38 AWG coax and 30 AWG
twinax assemblies

CUSTOMIZED
HIGH-SPEED ASSEMBLIES

EXTREME FLEXIBILITY



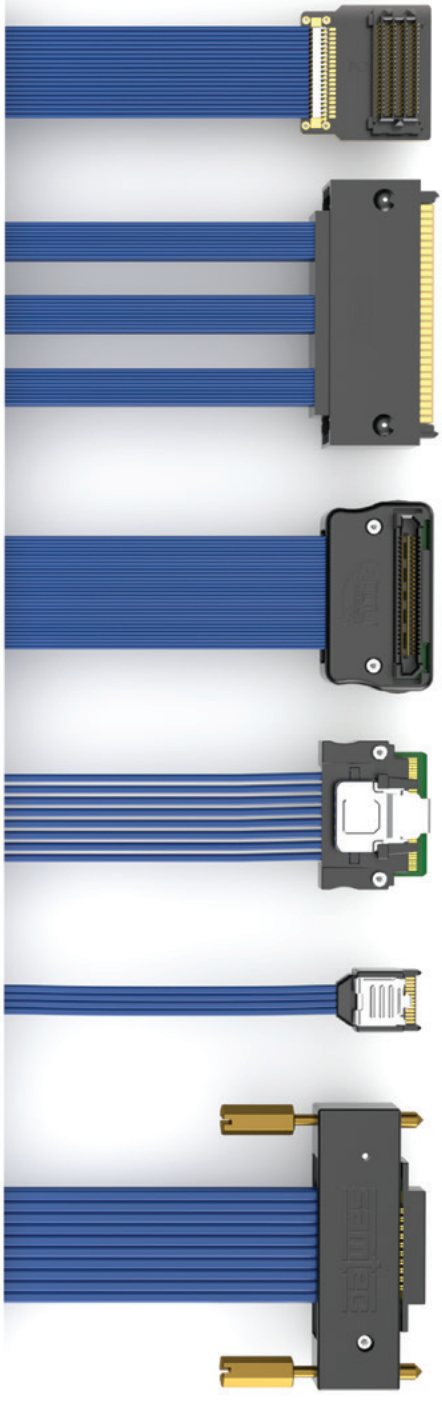
ANY
high-speed
connector

ANY
break-out
configuration

ANY
high-speed
precision cable

... to create a solution for
any specific application

HDR@samtec.com



WILLINGNESS, SUPPORT & EXPERTISE

Engineering, design and prototype support

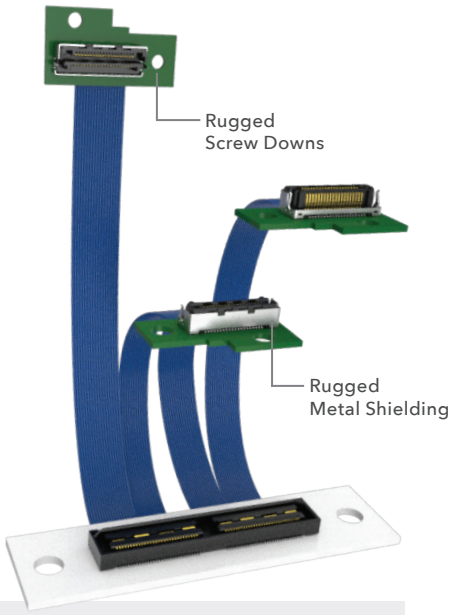
Design, simulation and processing assistance

Quotes and samples turned around in 24 hours

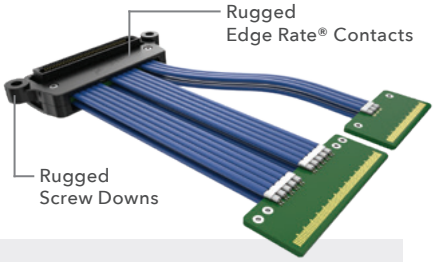
Flexible, quick-turn manufacturing

Dedicated Application Specific Product engineers and technicians

Modified or custom options for cable assemblies and board level connectors include: contacts, bodies, stamping, plating, wiring, molding, ruggedizing features and much more



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



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

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

HIGH-SPEED I/O SYSTEMS

HIGH-DENSITY I/O ASSEMBLIES

Industry's densest I/O cable system

HyperTransport™ HT 3.1 performance

32 AWG low skew pair twinax cable

Mates with HDI6 (connector) and HDC (cage)

RUGGED I/O ASSEMBLIES

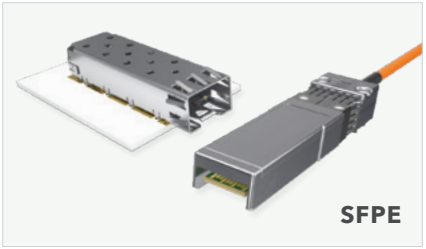
Space saving 0.80 mm pitch

High-cycle two-piece system

Shielded for EMI protection

32 AWG low skew pair twinax cable

Mates with ERI8 (connector) & ERC (cage)



SFP+ PASSIVE JUMPERS

Up to 10 Gbps data transmission

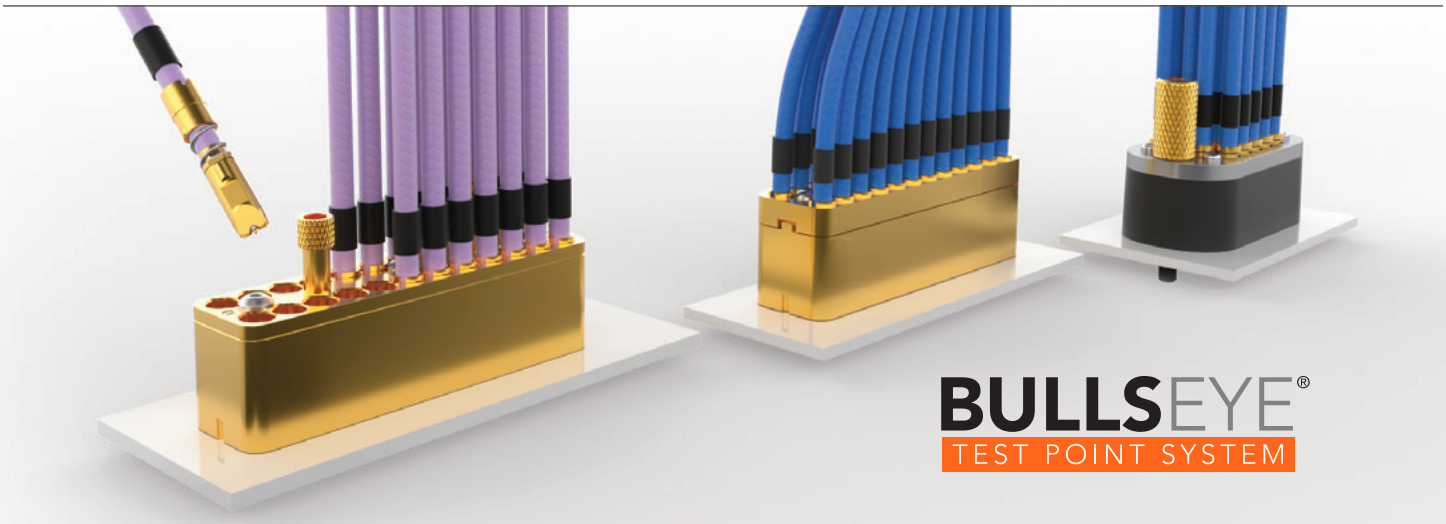
Compliant to SFP+, SFP, XFP and XENPAK

32 AWG low skew pair twinax cable

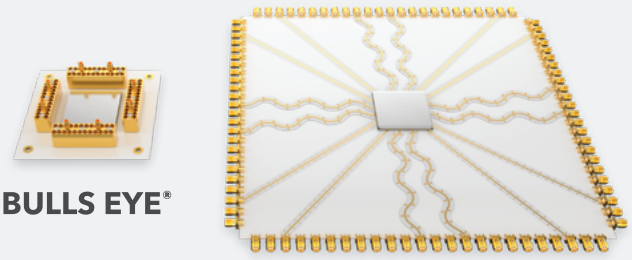
Mates with MECT (connector) and SFPC (cage)

HIGH-PERFORMANCE TEST TO 65 GHz

BULLS EYE® TEST POINT SYSTEM



- High-performance test to 65 GHz
- High-density array designs & high cycle count
- Advanced microwave cabling solutions
- Compression interface to the board provides easy on/off and eliminates soldering costs
- Small footprint design saves board space
- Microstrip or Stripline PCB transmission
- Cable management available with protective sleeve

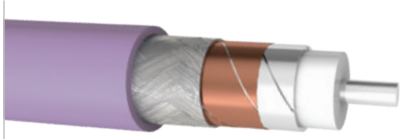


Traditional with SMAs

Bulls Eye® enables smaller evaluation boards and shorter trace lengths.

SAMTEC MICROWAVE CABLE

50 Ω, 23 AWG HIGH-DYNAMIC STABILITY



Insertion Loss	0.25 m	1 m
-3 dB	>40 GHz	13 GHz
-7 dB	>40 GHz	>40 GHz

Used with BE40A

Insertion Loss	0.25 m	1 m
-3 dB	>20 GHz	16.6 GHz
-7 dB	>20 GHz	>20 GHz

Used with BDRA and BQRA

65 GHz & 50 GHz BULLS EYE® ASSEMBLIES

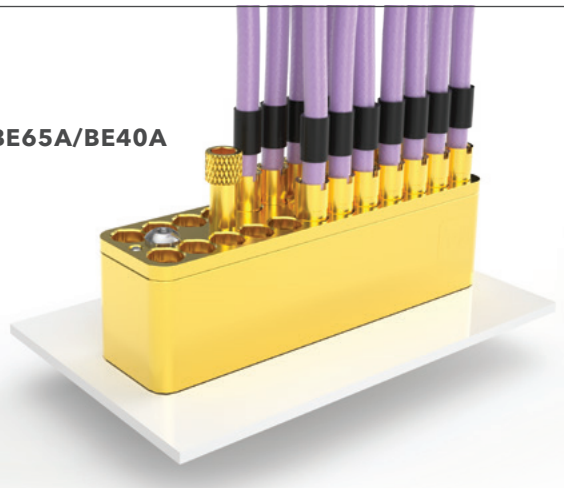
65 GHz with fixed-pin for signal/ground (BE65A, in development)

50 GHz with pogo-pin for signal/ground (BE40A)

High-density double row; 50 Ω impedance

086 ultra-low loss microwave cable (BE65A) or high-stability microwave cable (BE40A)

End 2: 1.85 mm (BE65A), 2.40 mm and 2.92 mm (BE40A)



BE65A/BE40A

20 GHz BULLS EYE® ASSEMBLIES

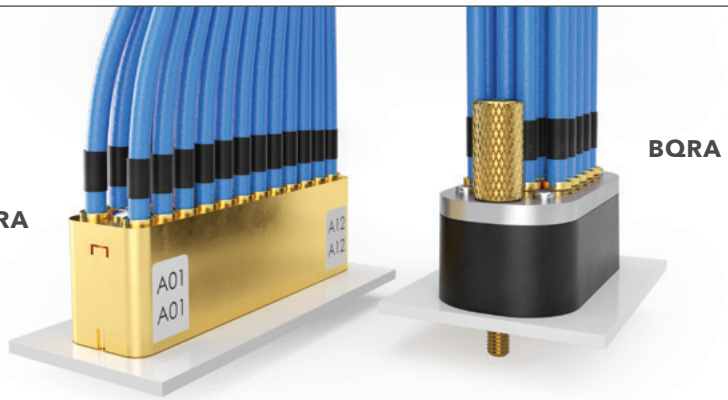
Fixed-pin for signal and elastomer for ground

Double-row (BDRA) or quad-row (BQRA) arrays

23 AWG low-loss microwave cable

End 2: 2.92 mm

BE40A is backward compatible with BDRA



BDRA

BQRA

PRECISION RF ASSEMBLIES & INTERCONNECTS

High-frequency bands from 18 GHz to 110 GHz

Includes: 1.0 mm, SMPM, 1.85 mm, 2.40 mm, SMP, SSMA, 2.92 mm, 3.50 mm, N Type, TNC, SMA

2.92 mm cross-mateable to other industry standards (SMA)

2.40 mm and 1.85 mm are intermateable

1.0 mm to 110 GHz

Microwave/millimeter wave assemblies

Contact RFTechnicalGroup@samtec.com

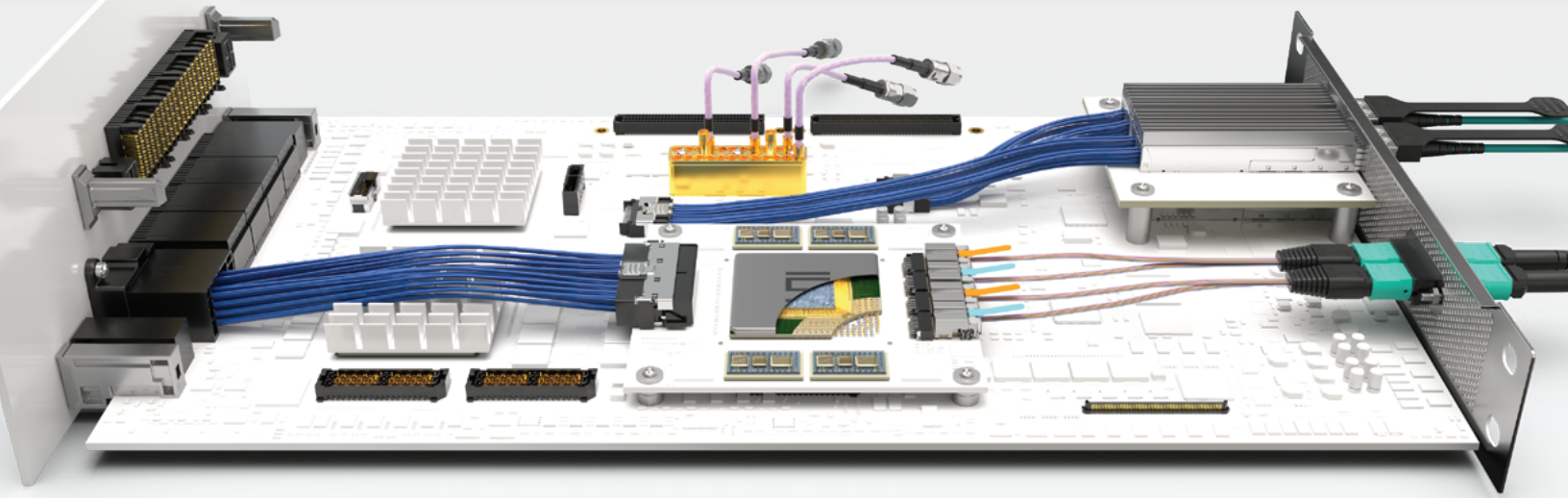
Highest level of customer service and support in the industry: launch designs, custom product solutions, simulations, and physical test and measurement verifications

TECHNOLOGY CENTERS

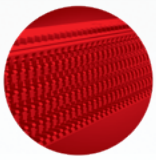
COMPLETE SYSTEM OPTIMIZATION FROM SILICON-TO-SILICON™

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

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



INTEGRATION LEADS TO **INNOVATION**



ADVANCED INTERCONNECTS

High precision stamping, plating, molding and automated assembly

HIGH-SPEED CABLE

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

OPTICS

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

SYSTEM SIGNAL INTEGRITY

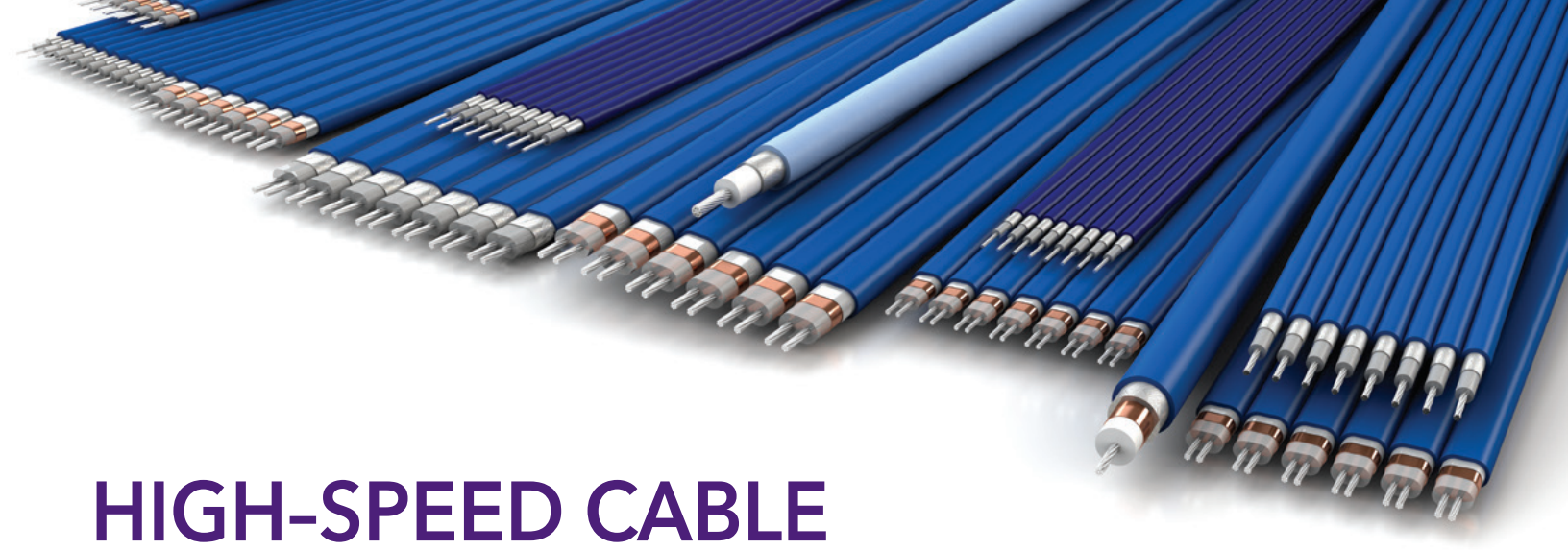
Full channel signal and power integrity analysis, testing and validation services

PRECISION RF

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

MICROELECTRONICS

Advanced IC packaging design, support and manufacturing capabilities



HIGH-SPEED CABLE

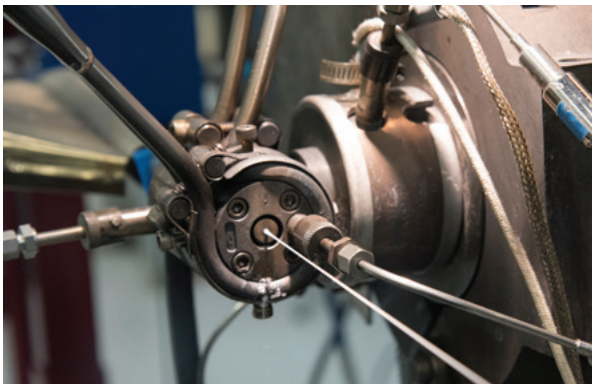
NEW CAPABILITIES ENABLE NEW TECHNOLOGY

Samtec's state-of-the-art **High-Speed Cable Plant** is focused on R&D and manufacturing of precision extruded micro coax and twinax cable. Being vertically integrated allows Samtec to offer full system solutions, which creates the ideal combination of design flexibility and customer service to develop truly differentiated products.

Manufacturing Technology & Support

- World-class in-house expertise
- Internally developed proprietary processes
- Extensive customization capabilities
- Procurement and test of new materials
- Quick-turn design and manufacturing
- Shorter, controlled lead times
- Unparalleled pricing and delivery

As one of Samtec's six Technology Centers, the **High-Speed Cable Group** is aggressively pursuing next generation micro coax and twinax products that solve existing and future signal integrity challenges for 112 Gbps and beyond.



Next Generation Innovation

- Real-time closed-loop control to adjust parameters
- Microcellular dielectric extrusion
- Co-extruded, low loss twinax cable
- Extreme density twinax cable
- High frequency microwave coax with phase stability
- Halogen-free materials
- Thermal capabilities

ULTRA LOW SKEW **TWINAX**

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.

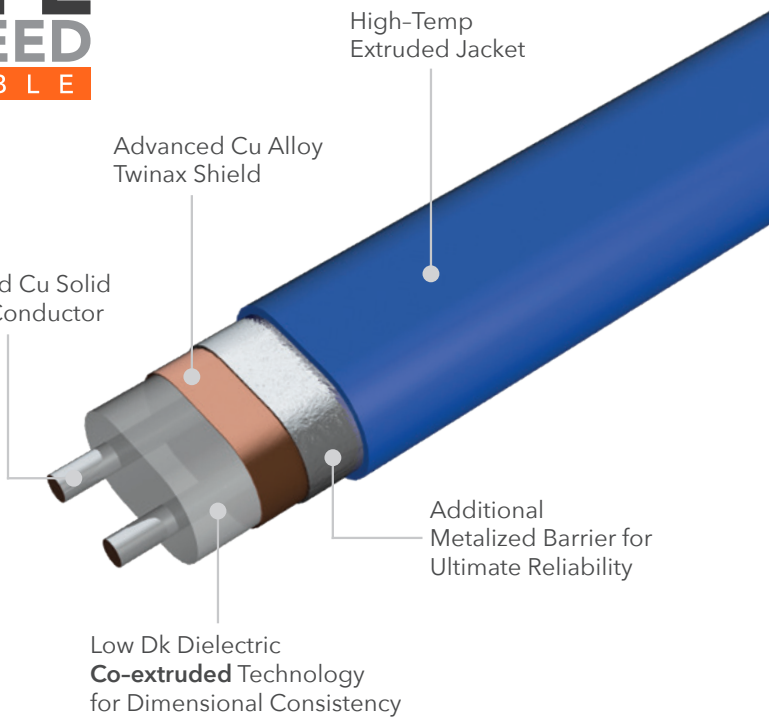
Ultra Low Skew Twinax

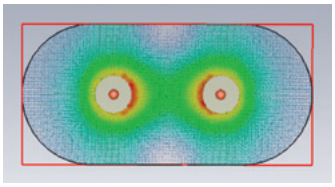
- Tight coupling between signal conductors
- Improved bandwidth (28–112+ Gbps) and reach
- Improved signal integrity and eye pattern opening
- Low skew (< 3.5 ps/meter) over extended lengths
- Supports Samtec Flyover™ technology

Micro Cellular Dielectric Extrusion

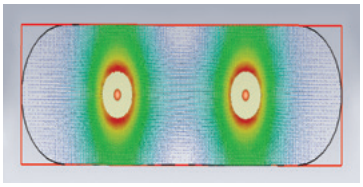
- Critical dimensions measured at every dielectric spool
- Inline laser and CAPAC devices for capacitance monitoring and diameter control
- In-process stats summary sheet for Cpk acceptance

EYE® SPEED CABLE



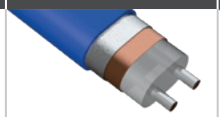
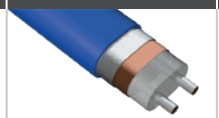
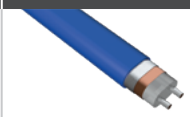


✔ **Good** design coupling with **co-extruded** low skew twinax



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

NOMINAL PERFORMANCE SPECIFICATIONS

			28 AWG	30 AWG	32 AWG	34 AWG	36 AWG
Eye Speed® Ultra Low Skew Twinax Cable							
14 GHz (28G NRZ/ 56G PAM4)	**0.25 m**	**IL (dB)**	-1.0	-1.2	-1.5	-1.8	-2.2
	1.00 m		-3.9	-4.7	-5.9	-7.2	-8.7
28 GHz (56G NRZ/ 112G PAM4)	**0.25 m**		-1.5	-1.8	-2.2	-2.6	-3.2
	1.00 m		-6.0	-7.0	-8.7	-10.6	-12.7
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.

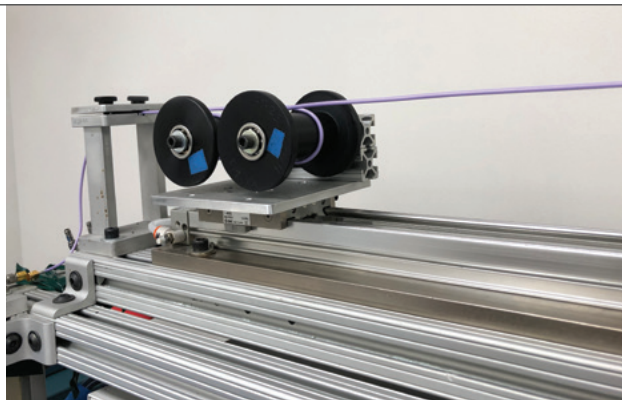
DYNAMIC **TESTING**

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

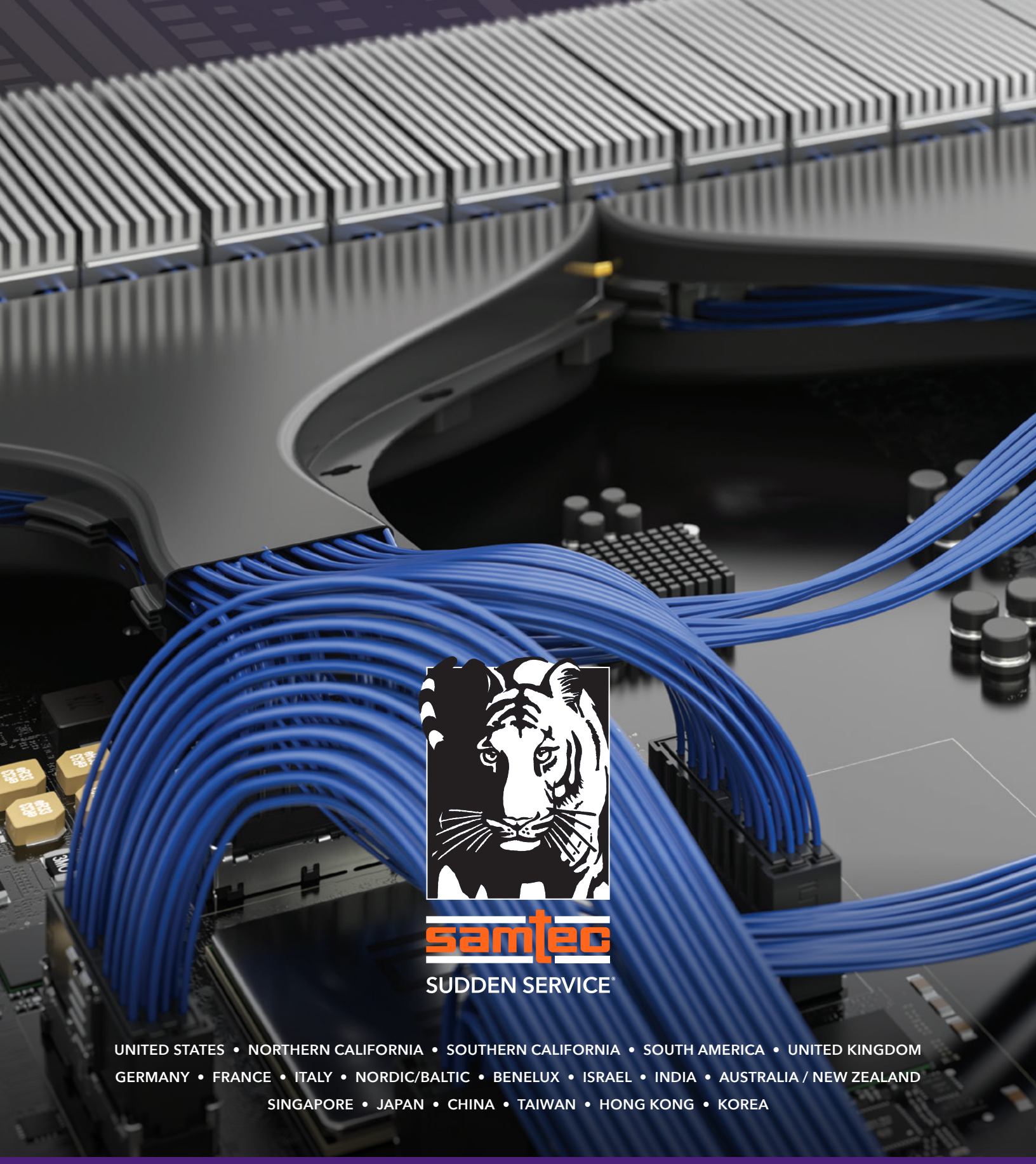
Complimentary service using mockups with accurate cable lengths

Minimize number of SKUs within one system

Minimize pressure drop

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



SUDDEN SERVICE®

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GERMANY • FRANCE • ITALY • NORDIC/BALTIC • BENELUX • ISRAEL • INDIA • AUSTRALIA / NEW ZEALAND
SINGAPORE • JAPAN • CHINA • TAIWAN • HONG KONG • KOREA

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