

# 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

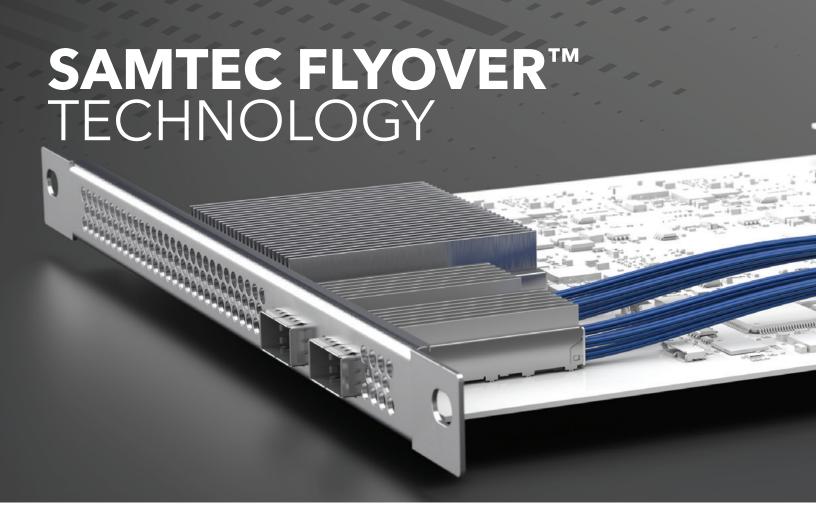
R&D/manufacturing of precision extruded cable

Co-extruded, ultra low skew twinax cable technology

Samtec Flyover™ designs route signals above lossy PCB

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### 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.

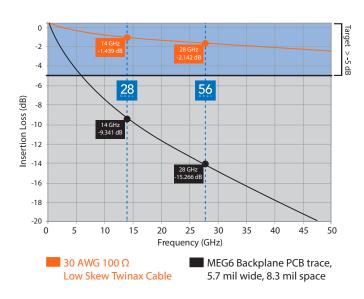
BAN	BANDWIDTH VS. TRADITIONAL & HIGH-SPEED MATERIALS					
	FR408	MEGTRON 6	MICRO TWINAX	OPTICS		
10 Gbps		10"+	up to 39"	100 m+		
14 Gbps			up to 33"	100 m+		
28 Gbps	up to 2"		up to 23"	up to 100 m		
56 Gbps	0.0"	up to 2"	up to 12"	TBD		
112 Gbps	0.0"	0.0"		TBD		

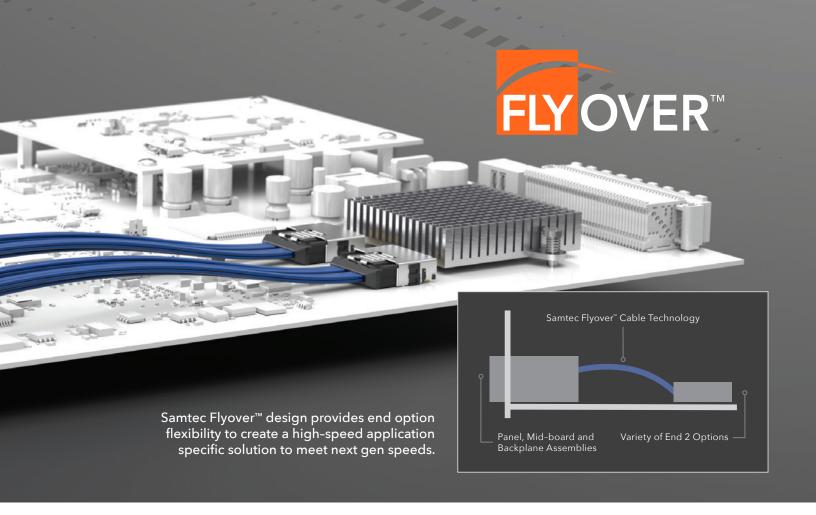
(-5 dB Loss Target, Reach Estimate. For OIF VSR applications.)

### THE SOLUTION

### SAMTEC FLYOVER™ SYSTEMS

Samtec Flyover™ design breaks the constraints of traditional signaling substrate and hardware offerings, resulting in a cost-effective, highperformance 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**





### **PERFORMANCE & COST ADVANTAGES**

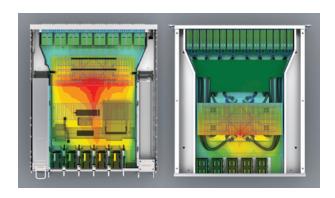
- 28-56 Gbps NRZ & Beyond
- Simplified Board Layout
- Fewer PCB Layers
- Less Expensive PCB Materials
- Eliminate Expensive Re-timers

## NRZ PAM4 NRZ PAM4 28 56 56 112 G b p s G b p s

### **SUPPORT**

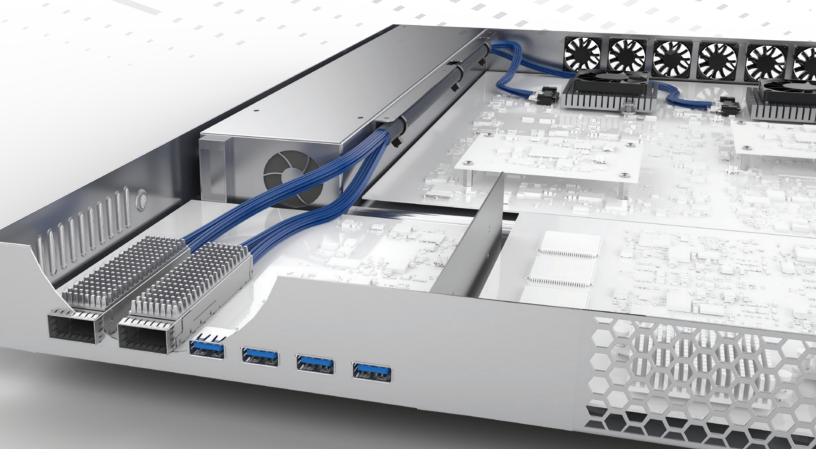
Fully integrated Technology Centers for full system optimization from Silicon-to-Silicon. See page 20-21 for information about Samtec's High-Speed Cable Group.

### THERMAL IMPROVEMENT



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

## SAMTEC FLYOVERTM 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)

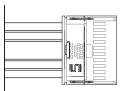
Compatible with all MSA QSFP pluggables

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









**FQSFP** 

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



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

### **DOUBLE DENSITY OSFP28 SYSTEM**

8 Channels (x8 bidirectional, 16 differential pairs)

~200 Gbps NRZ aggregate (~400 Gbps PAM4)

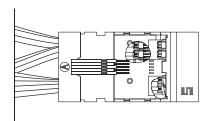
Belly-to-belly mating for maximum density

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™ D-BOARD ASSEMBLIES







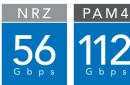
### EXTREME HIGH-SPEED, HIGH-DENSITY CABLE

NOVARA

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

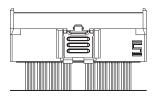
> BGA attach for density and optimized trace breakout region





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

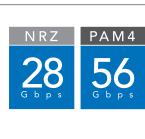
Slimmest cable assembly in the industry - 7.6 mm body width

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







Right-angle available





**ACCELE**RATE®

**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

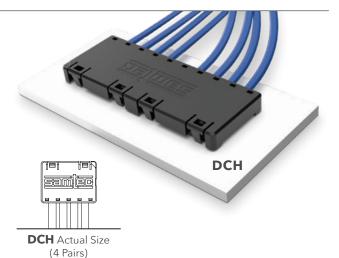
Characterization Kit available (REF-202013-X.XX-XX), visit samtec.com/kits







Press-fit termination for high retention



### FIREFLY™ COPPER SYSTEMS

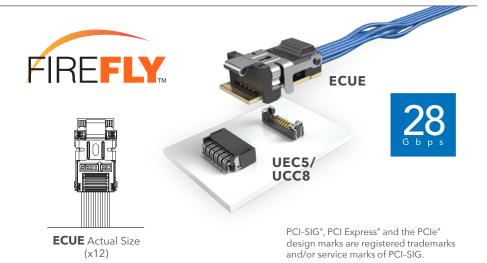
High-performance, high-density copper Samtec Flyover™ solution

Pin compatible with FireFly<sup>™</sup> 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

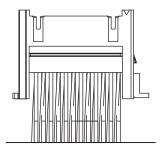


## BACKPLANE CABLE ASSEMBLIES



### HIGH-SPEED BACKPLANE CABLE

### **ExaMAX**®



**EBCF** Actual Size (72 Pairs Total)



N R Z 56

**EBCF** 

EBTM/ EBCL

ExaMAX® is a registered trademark of AFCI.

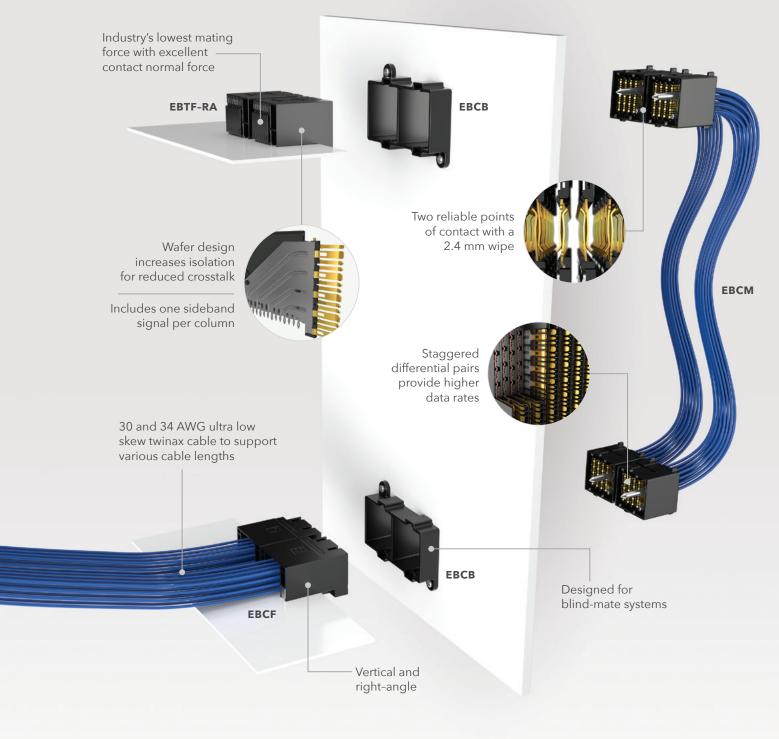
Utilizes Samtec's Eye Speed® ultra low skew twinax cable technology for improved signal integrity, increased flexibility and routability

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





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



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

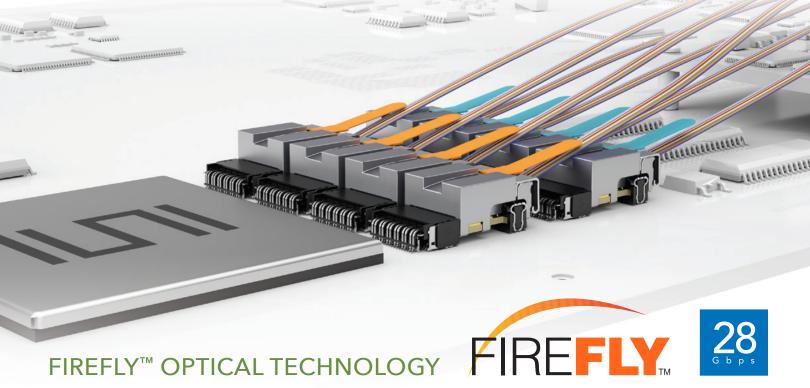


Integrated guidance and keying options



Cable-to-DMO (Direct Mate Orthogonal)

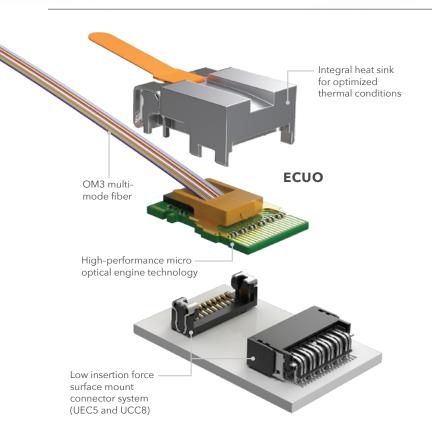
## FIREFLY™ OPTICAL MICRO FLYOVER SYSTEM™











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<sup>™</sup>, Fibre Channel, Aurora and PCIe®



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



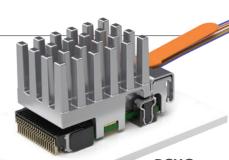
PCle\*-over-Fiber adaptor card (PCOA), available in x4, x8 or x16 configurations, supports Gen 3 platform and transparent or non-transparent bridging

PCle®-Over-FireFly™ (PCUO) supports PCle® 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)



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



**PCUO** 



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<sup>™</sup> 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)

 $\mathsf{MTP}^*$  and  $\mathsf{MXC}^*$  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)

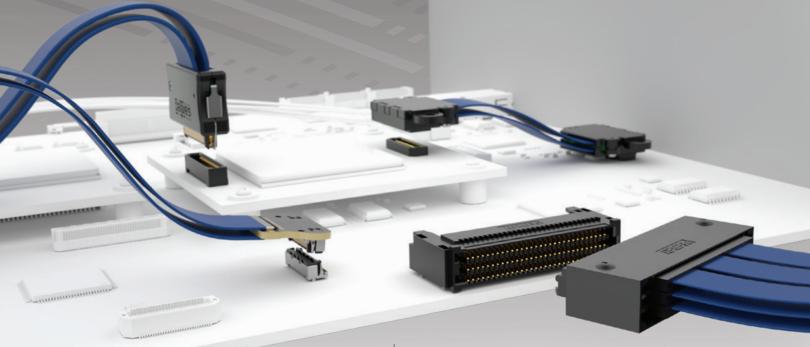


25/28 Gbps FireFly™ FMC+ Development Kit (REF-200772-XXX-XX-01)



FireFly<sup>™</sup> Test Kit (FIK-FIREFLY-XX)

## HIGH-SPEED CABLE ASSEMBLIES



14 G b p s

## MICRO COAX & TWINAX CABLE ASSEMBLIES

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

Single-ended 50  $\Omega$  and differential 100  $\Omega$  standards

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

Many non-cataloged standards available including 75  $\Omega$  micro coax and high-density twinax solutions



## EYE SPEED® CABLE TECHNOLOGY

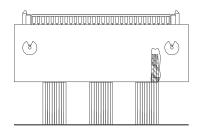
Excellent signal integrity performance with individual copper serve or braid shielding

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

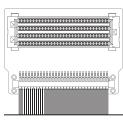
Cost-effective ribbonizing eliminates discrete wires

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

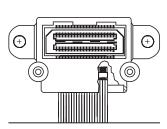
 $20 \Omega$ ,  $50 \Omega$ ,  $85 \Omega$  and  $100 \Omega$ 



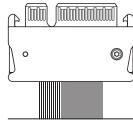
**SEAC** Actual Size (30 Positions/Row)



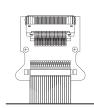
**ESCA** Actual Size (30 Positions/Row)



**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<sup>™</sup> and SEARAY<sup>™</sup> 0.80 mm arrays

Optional rugged latching



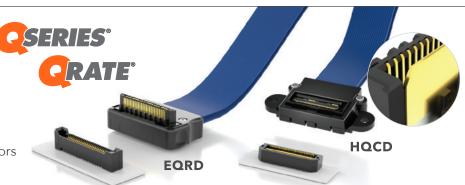
### **GROUND PLANE ASSEMBLIES**

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<sup>™</sup> coax assemblies with rugged shielding (HLCD)

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

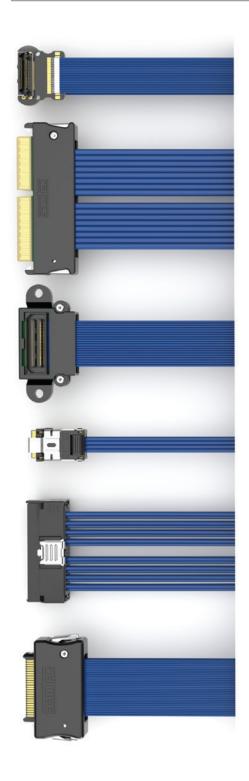
PCI Express® twinax assemblies support 1, 4, 8 and 16 links (PCIEC)

34 or 38 AWG coax and 30 AWG twinax assemblies



## CUSTOMIZED HIGH-SPEED ASSEMBLIES

### **EXTREME FLEXIBILITY**



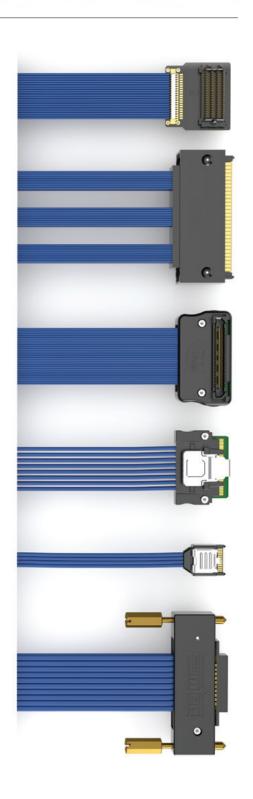
ANY
high-speed
connector

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

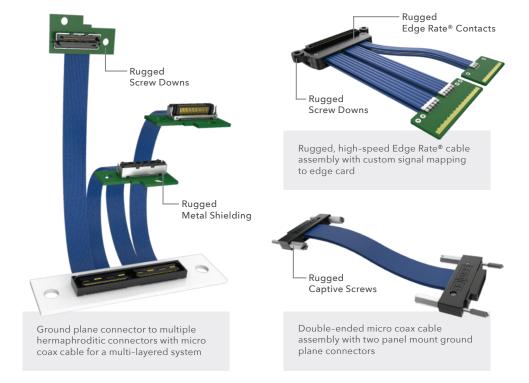
Design, simulation and processing assistance

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



## 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

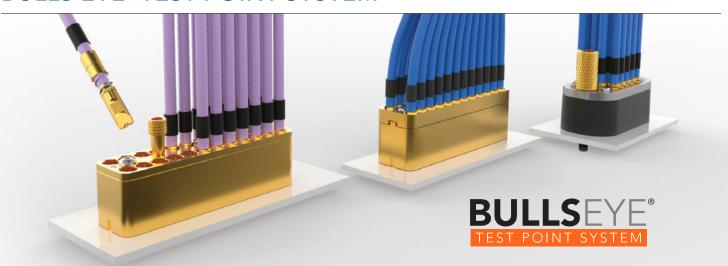
Compliant to SFP+, SFP, XFP and XENPAK

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

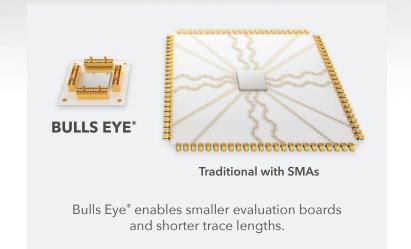
Advanced microwave cabling solutions

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



### **SAMTEC MICROWAVE CABLE**

### 50 $\Omega$ , 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  $\Omega$  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)



### 20 GHz BULLS EYE® ASSEMBLIES

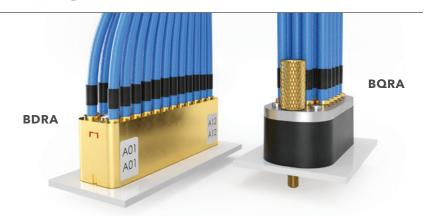
Fixed-pin for signal and elastomer for ground

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



### 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

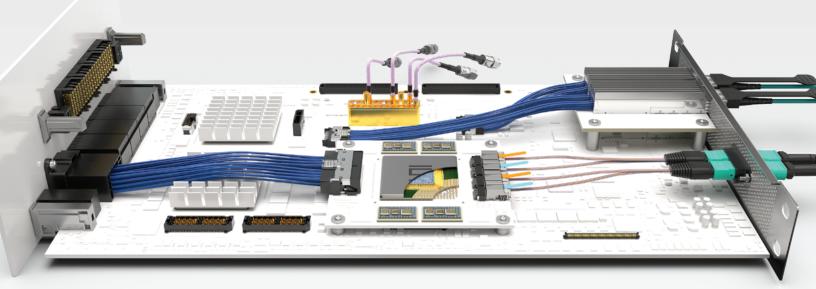


## **TECHNOLOGY** CENTERS

### 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



### **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

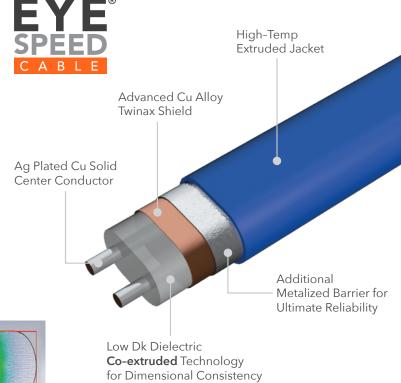
Samtec's proprietary Eye Speed® **co-extruded** twinax cable technology eliminates the performance limitations and inconsistencies of individually extruded dielectric twinax cabling, improving signal integrity, bandwidth and reach for high-performance system architectures.

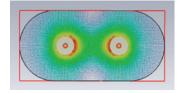
### Ultra Low Skew Twinax

- 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<sup>™</sup> technology

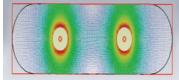
### Micro Cellular Dielectric Extrusion

- 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









**Bad** design coupling with paralleled pair twinax

### NOMINAL PERFORMANCE SPECIFICATIONS

			28 AWG	30 AWG	32 AWG	34 AWG	36 AWG
Eye Speed <sup>®</sup> Ultra Low Skew Twinax Cable					W.	A.	
14 GHz 0.25 m (28G NRZ/ 56G PAM4) 1.00 m	0.25 m		-1.0	-1.2	-1.5	-1.8	-2.2
	(dB)	-3.9	-4.7	-5.9	-7.2	-8.7	
28 GHz	0.25 m	m =	-1.5	-1.8	-2.2	-2.6	-3.2
(56G NRZ/ 112G PAM4)	1.00 m		-6.0	-7.0	-8.7	-10.6	-12.7
Density/Fle	exibility		Good	Good	Better	Best	Best

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

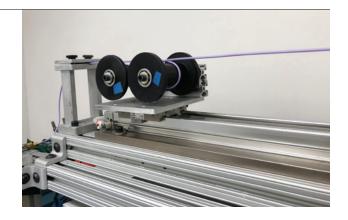
### DYNAMIC TESTING

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



