



HIGH-SPEED CABLE

INTERCONNECT SOLUTIONS GUIDE

HIGH-SPEED CABLE SOLUTIONS



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
Interchangeable FireFly™ copper and optical



MANUFACTURING & CAPABILITIES

R&D/manufacturing of precision extruded cable
Co-extruded, ultra low skew twinax cable technology
Flyover designs route signals over lossy PCB

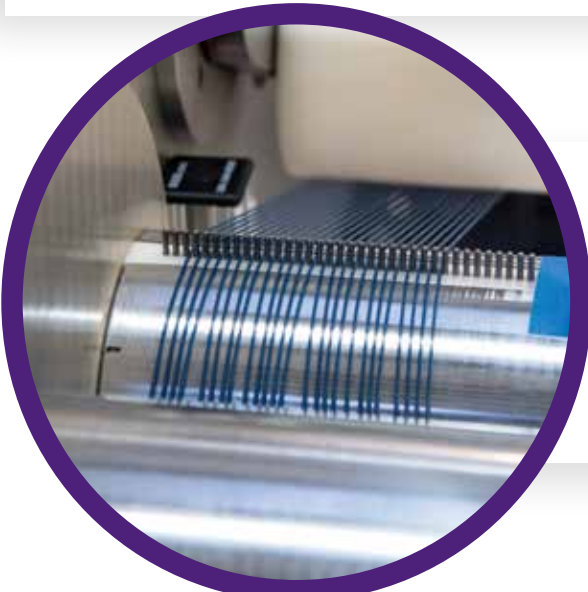


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HIGH-SPEED CABLE SYSTEMS

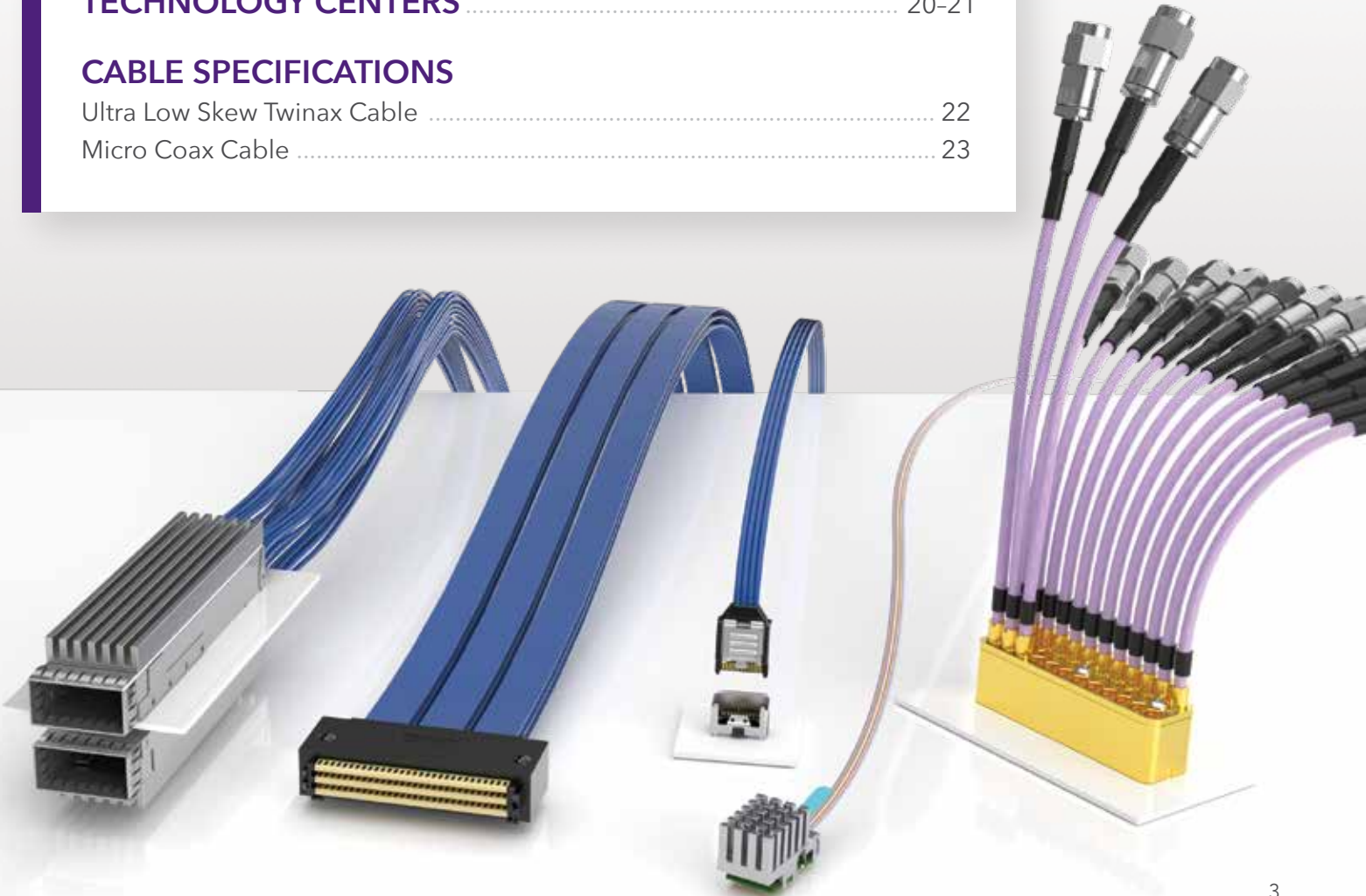
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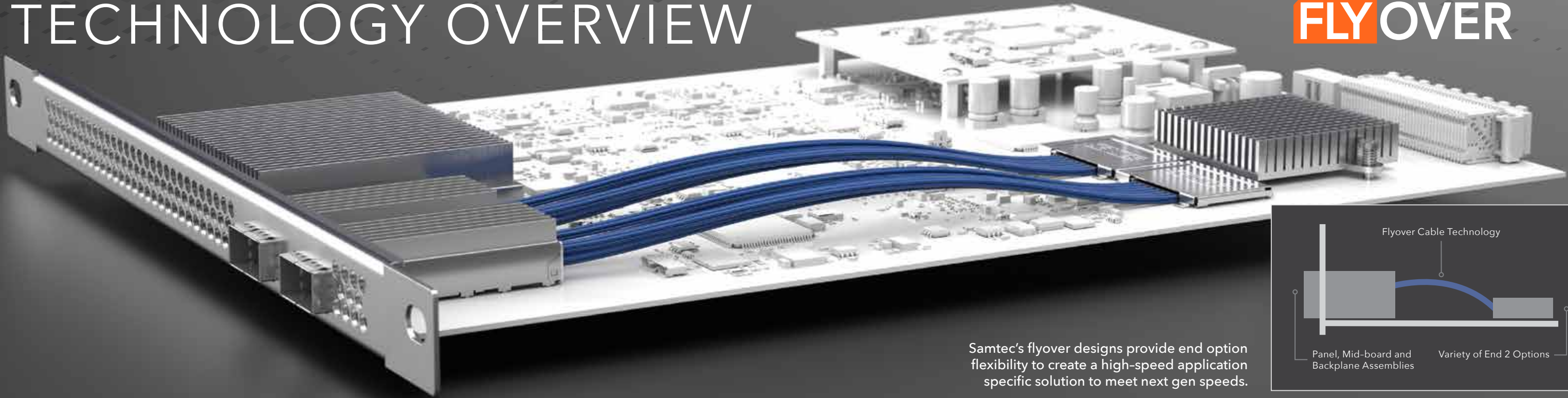
TECHNOLOGY CENTERS

CABLE SPECIFICATIONS

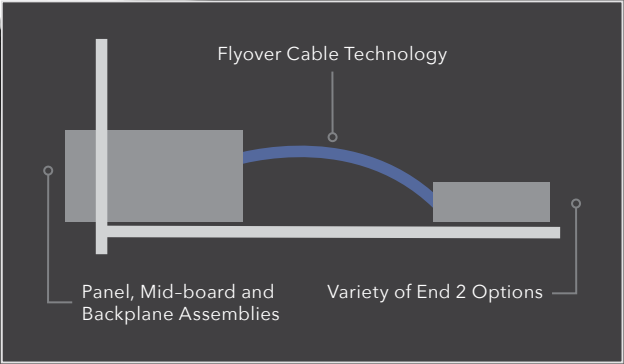
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FLYOVER TECHNOLOGY OVERVIEW



Samtec's flyover designs provide end option flexibility to create a high-speed application specific solution to meet next gen speeds.



THE PROBLEM PCB REACH AT NEXT GEN SPEEDS

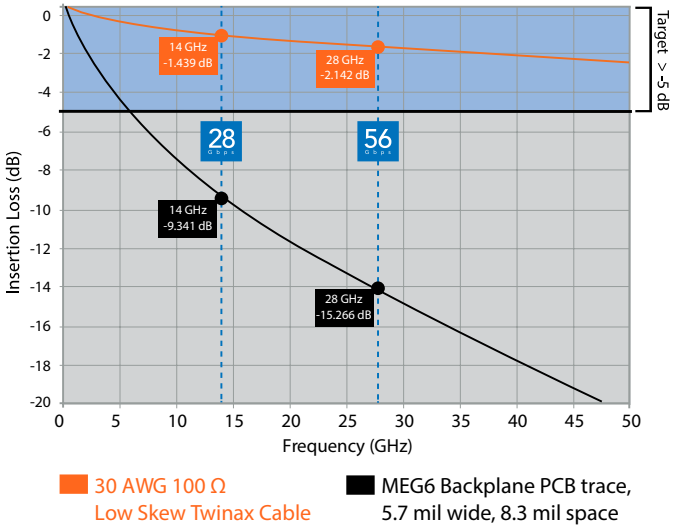
As bandwidth requirements rapidly increase, routing signals through lossy PCBs, vias and other components has become a complex challenge.

BANDWIDTH VS. TRADITIONAL & HIGH-SPEED MATERIALS				
	FR408	MEGTRON 6	MICRO TWINAX	OPTICS
10 Gbps	<10"	10"+	10"+	10"+
14 Gbps	<5"	<10"	10"+	10"+
28 Gbps	<2"	<5"	10"+	10"+
56 Gbps	0.0"	<2"	10"+	10"+
112 Gbps	0.0"	0.0"	<10"	10"+

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

THE SOLUTION SAMTEC FLYOVER SYSTEMS

Samtec's "flyover" design breaks the constraints of traditional signaling substrate and hardware offerings, resulting in a cost-effective, high-performance answer to the challenges of 56 Gbps bandwidths and beyond.



ULTRA LOW SKEW CABLE TECHNOLOGY

Samtec's proprietary **co-extruded**, low loss twinax cable technology eliminates the performance limitations and inconsistencies of individually extruded dielectric twinax cabling, improving signal integrity, bandwidth and reach.

- Ideal for 28-56+ Gbps applications
- Tight coupling between signal conductors
- Ultra low skew twinax < 3.5 ps/meter
- See page 22-23 for cable specifications



NEXT GEN PERFORMANCE AND COST ADVANTAGES

High-performance, low loss twinax cable systems support 56+ Gbps speeds for extended reach and system architecture design flexibility – without adding cost to the overall system.

Performance Advantages

- Reduced Thermal Challenges
- Simplified Board Layout
- 28-56 Gbps NRZ & Beyond

Cost Advantages

- Eliminate Expensive Re-timers
- Fewer PCB Layers
- Less Expensive PCB Materials

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

SUPPORT

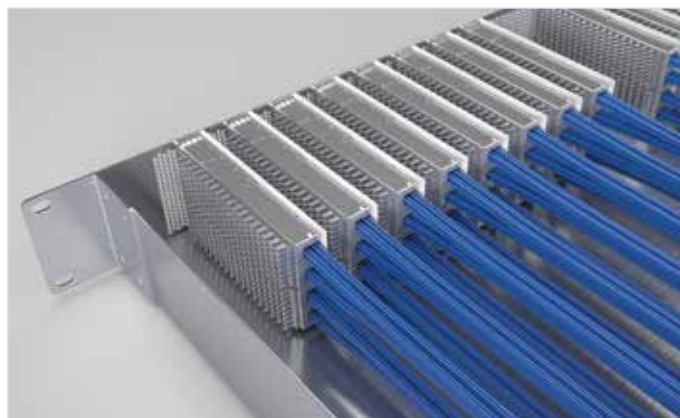
Fully integrated, complimentary and cross-functional Technology Centers for full system interconnect performance and cost optimization from Silicon-to-Silicon. See page 20-21 for more about Samtec's High-Speed Cable Group.

FLYOVER PANEL ASSEMBLIES



DIRECT ATTACH QSFP28 SYSTEMS

Flyover QSFP28 systems utilize Samtec's flyover technology to fly data over 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

FLYOVER QSFP28 SYSTEM

4 Channels (x4 bidirectional,
8 differential pairs)

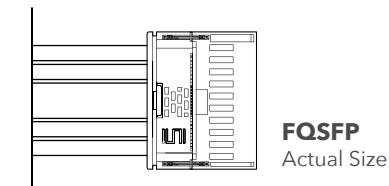
~100 Gbps NRZ aggregate
(~200 Gbps PAM4)

Compatible with all QSFP
cable assemblies

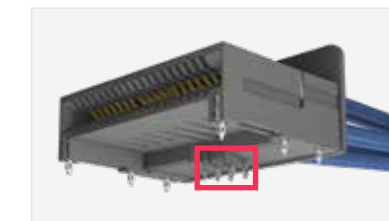
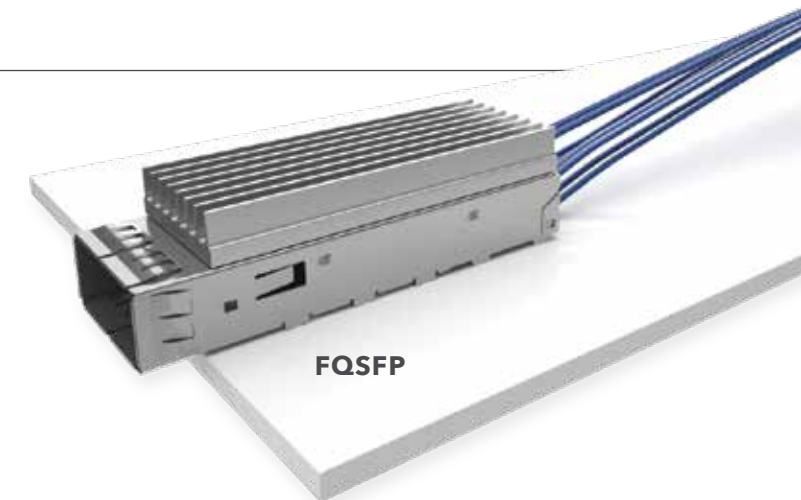
Heat dissipation: ~3.5 W/cable

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

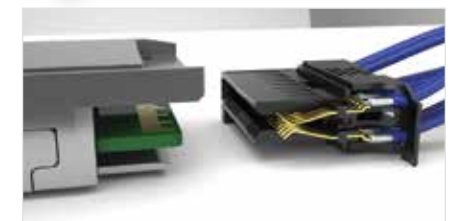
Multiple end options for design flexibility



NRZ	PAM4
28 Gbps	56 Gbps



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 FLYOVER QSFP28 SYSTEM

8 Channels (x8 bidirectional,
16 differential pairs)

~200 Gbps NRZ aggregate
(~400 Gbps PAM4)

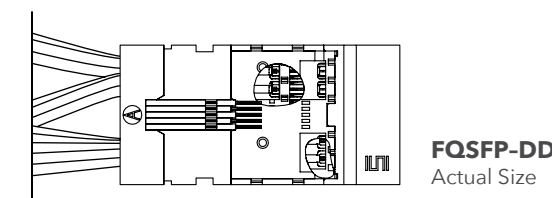
Belly-to-belly mating for
maximum density

Backward compatible with
QSFP modules

No retimers required for reduced
cost and power consumption

Heat dissipation: ~7 W/cable

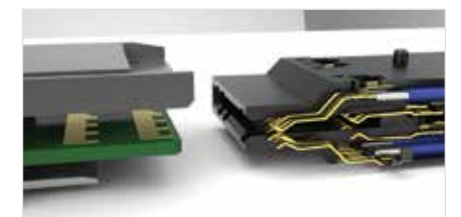
Variety of end 2 options



NRZ	PAM4
28 Gbps	56 Gbps



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



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

FLYOVER MID-BOARD ASSEMBLIES

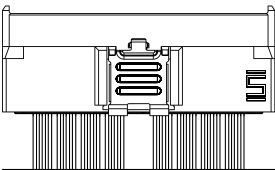


EXTREME HIGH-SPEED, HIGH-DENSITY CABLE

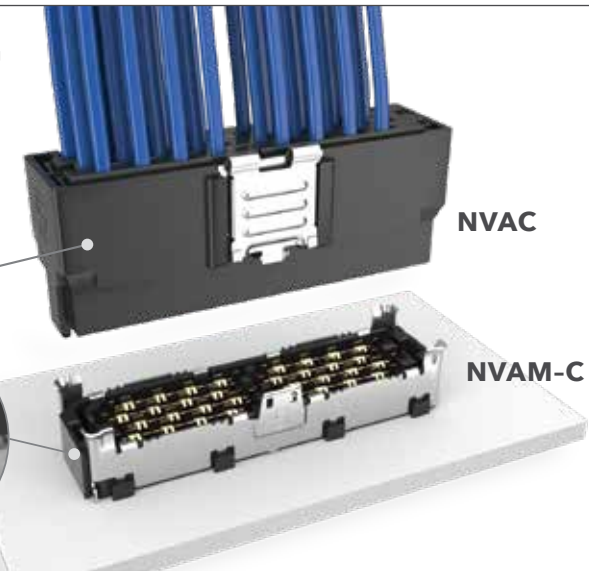
NOVARAY™

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



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



NRZ	PAM 4
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

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
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 (32 pair in development)

Rugged metal latching & shielding

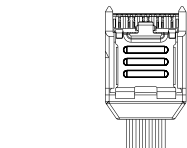
Eye Speed® 34 AWG ultra low skew twinax (See page 22 for specifications)

ACCELERATE®

NRZ	PAM 4
28 Gbps	56 Gbps



Right-angle in development



ARC6 Actual Size
(8 Pairs)

DIRECT CONNECT™ PLUGGABLE HORIZONTAL CABLE

Easily removable for plug/unplug mating

Ultra-low 3 mm profile saves space for high-density applications

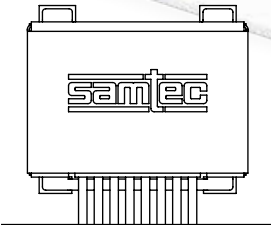
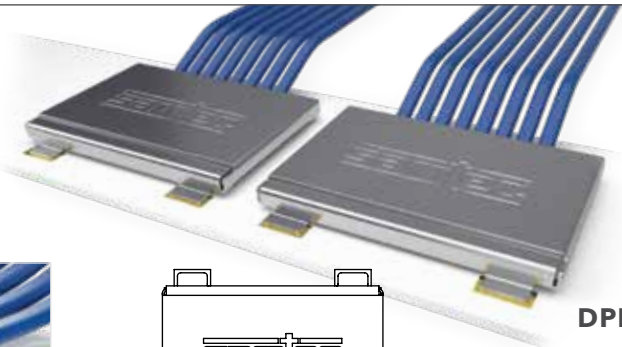
4 and 8 pair configurations

Rugged metal cage for a more secure connection

NRZ	PAM 4
28 Gbps	56 Gbps



Press-fit termination available for higher retention (DCH)



DPH Actual Size
(8 Pairs)

MICRO EDGE CARD CABLE ASSEMBLY

Micro 0.50 mm pitch

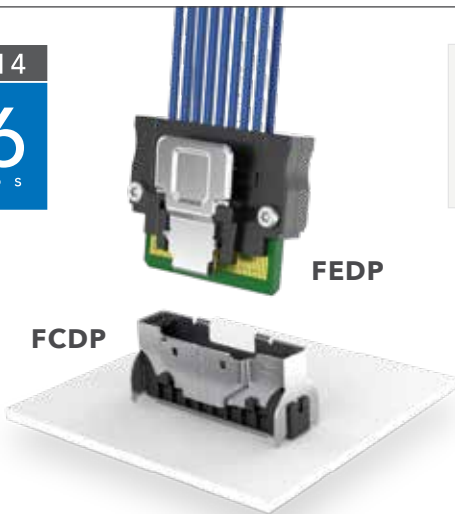
16 differential pairs

Eye Speed® 34 AWG ultra low skew twinax (See page 22 for specifications)

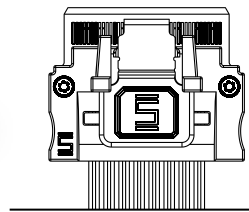
.062" (1.60 mm) thick card

Rugged metal latching and shielding

NRZ	PAM 4
28 Gbps	56 Gbps



Right-angle design available



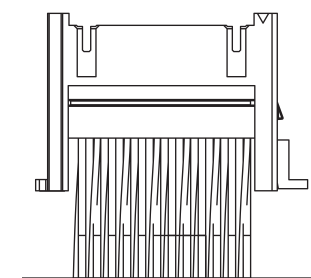
FEDP Actual Size
(16 Pairs)

BACKPLANE CABLE ASSEMBLIES



HIGH-SPEED BACKPLANE CABLE

ExaMAX®



EBCF Actual Size
(72 Pairs Total)



EBCF

EBTM/
EBCL

NRZ
28
Gbps

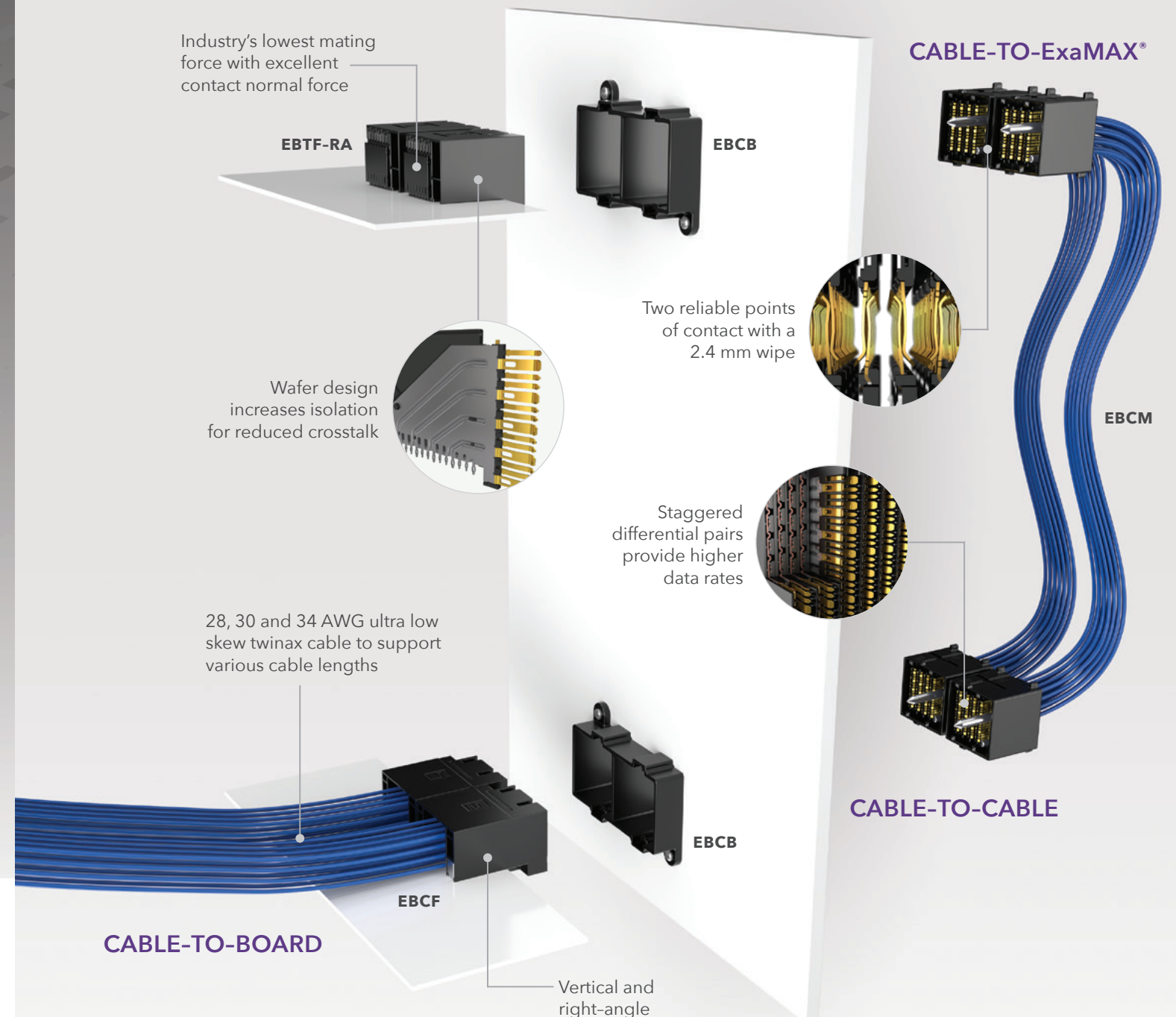
PAM4
56
Gbps

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

Highly customizable with modular flexibility

Reduced cost due to lower layer counts

See page 22 for **co-extruded** twinax cable specifications



4 and 6 pairs;
8, 10 and 12 columns



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

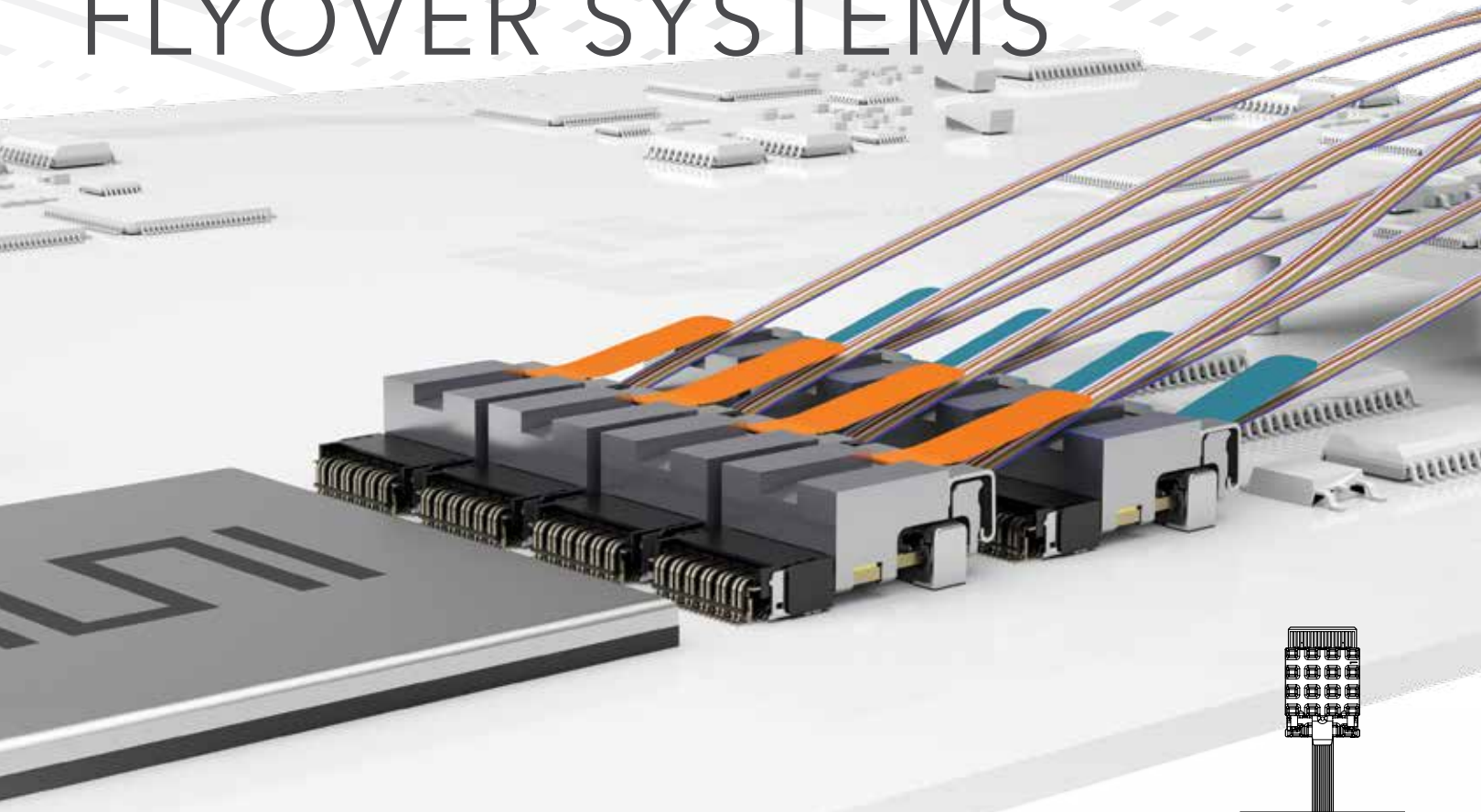


Integrated guidance
and keying options

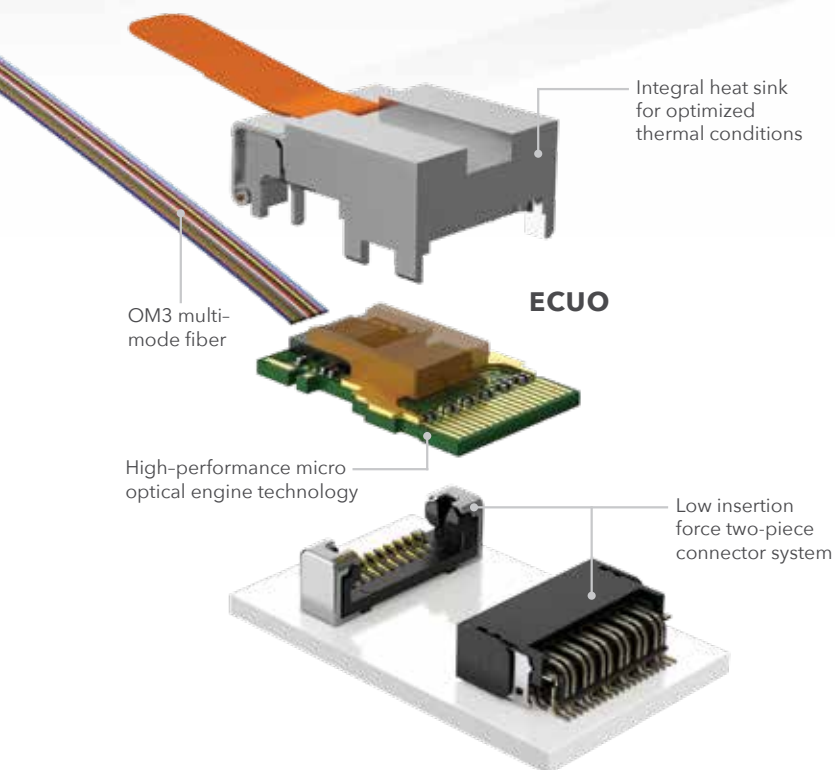


Cable-to-DMO
(Direct Mate Orthogonal)
in development

FIREFLY™ OPTICAL/COPPER FLYOVER SYSTEMS



FIREFLY™ OPTICAL TECHNOLOGY



FIREFLY™

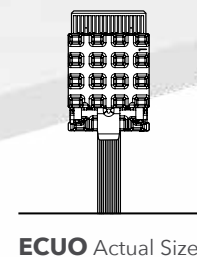
28
Gbps

Data "flies" over lossy PCB, simplifying board layout and enhancing signal integrity from IC to faceplate

Interchangeable with FireFly™ copper using the same micro connector system

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



FIREFLY™ OPTICAL SYSTEMS

x4 and x12 configurations

Up to 28 Gbps per channel

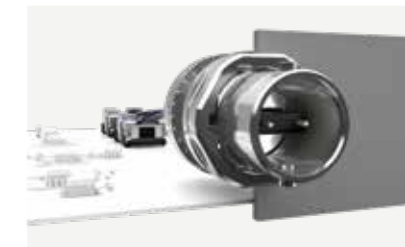
Surface mount connector system with no screws required and rugged tabs (UEC5/UCC8)



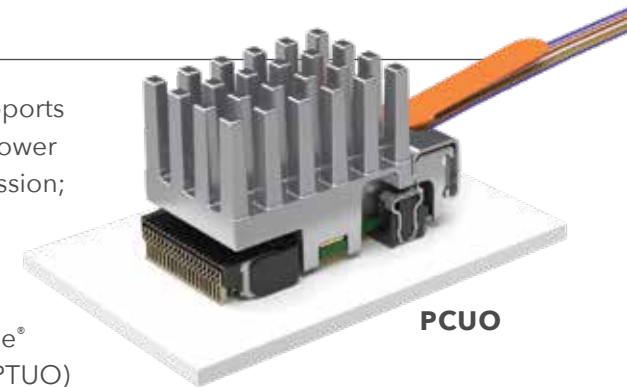
PCIe®-over-Fiber adaptor card available in x4, x8 or x16 configurations (PCOA) supports Gen 3 platform and transparent or non-transparent bridging

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

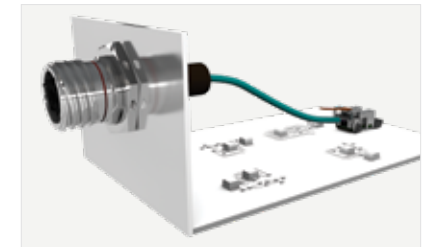
-40 °C to +85 °C extended temperature system (ETUO); PCIe® Gen 3 version in development (PTUO)



Optical FireFly™ to ARIB BNC-type interface with MT ferrule for broadcast video applications



PCUO



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

FIREFLY™ COPPER SYSTEMS

Finest 0.50 mm pitch copper flyover solution

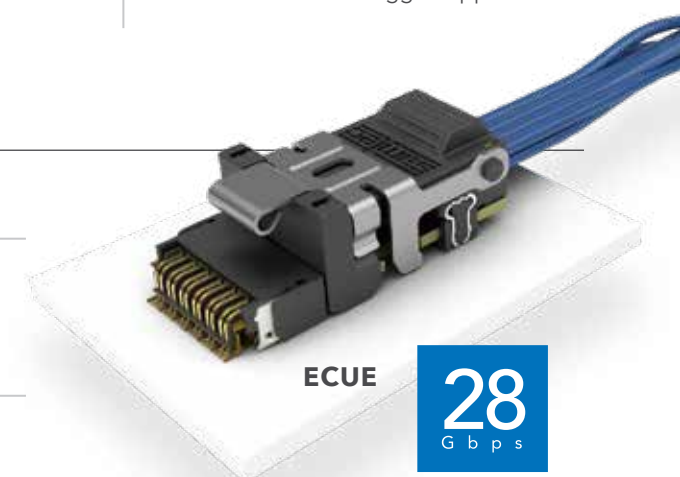
Pin compatible with FireFly™ optical using the same connector system

x4, x8 and x12 configurations

Variety of end 2 options

Low-cost solution for seamless integration of new or existing designs

PCIe® Gen 3 protocol compatible system (PCUE)



ECUE

28
Gbps

PASSIVE & ACTIVE OPTICAL SOLUTIONS

FireFly™ is compatible with optical backplane systems in multiple configurations

Evaluation Kit (FIK-FIREFLY-XX) and 14 Gbps FireFly™ FMC Development Kit (REF-193429-01) available for system testing

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)

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

**MXC® is a registered trademark of US Conec Ltd.



Pentek Flexor® 5973 with two x12 optical FireFly™ meets VITA 66.4 specifications and 14 Gbps/channel

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 EYE SPEED[®] CABLE TECHNOLOGY

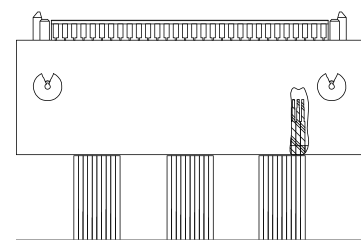
Excellent signal integrity performance with individual copper serve or braid shielding

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

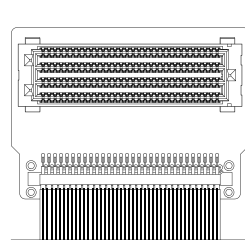
Cost-effective ribbonizing eliminates discrete wires

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

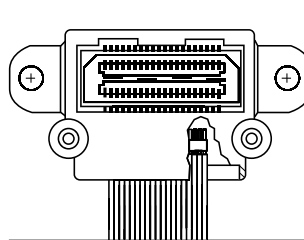
20 Ω , 50 Ω , 85 Ω and 100 Ω



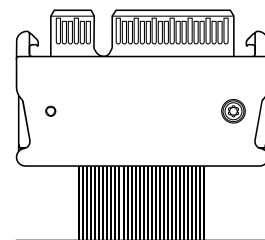
SEAC Actual Size
(30 Positions/Row)



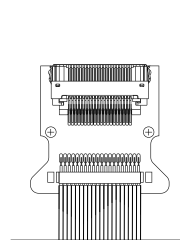
ESCA Actual Size
(30 Positions/Row)



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



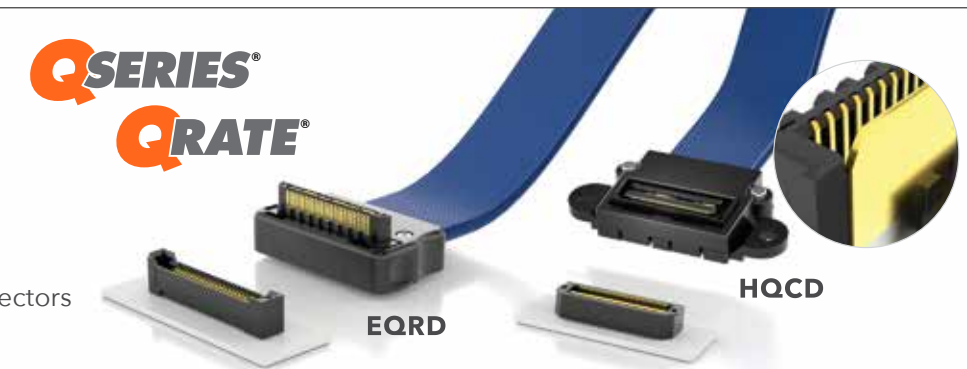
GROUND PLANE ASSEMBLIES

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



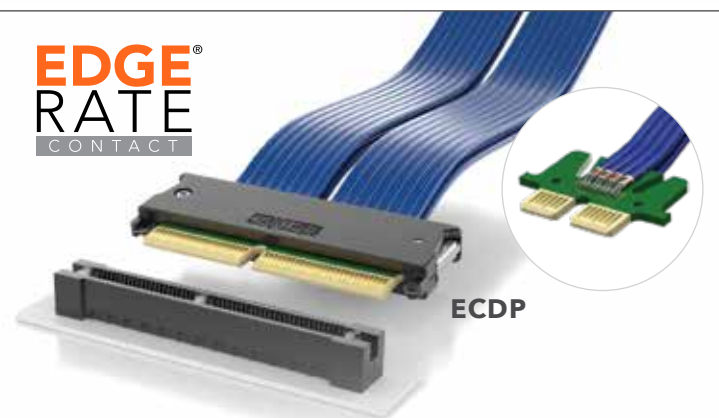
EDGE CARD ASSEMBLIES

Edge Rate[®] contacts for reduced broadside
coupling and increased signal integrity performance

30 AWG twinax

Available without housing for cost savings

Mates with 0.80 mm edge card connectors
(HSEC8)



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

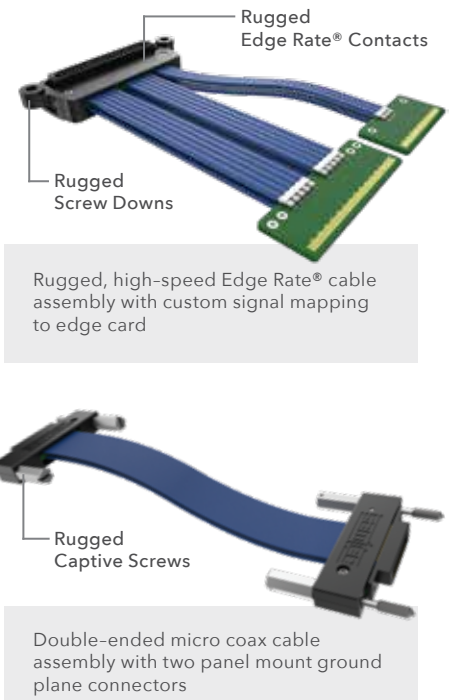
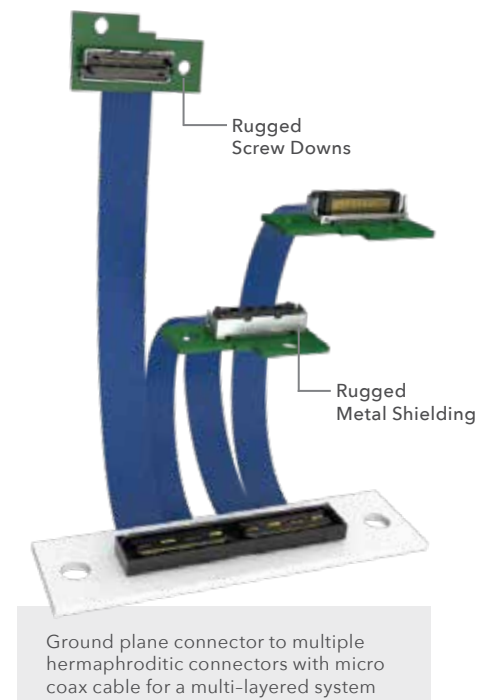
Design, simulation and
processing assistance

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



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

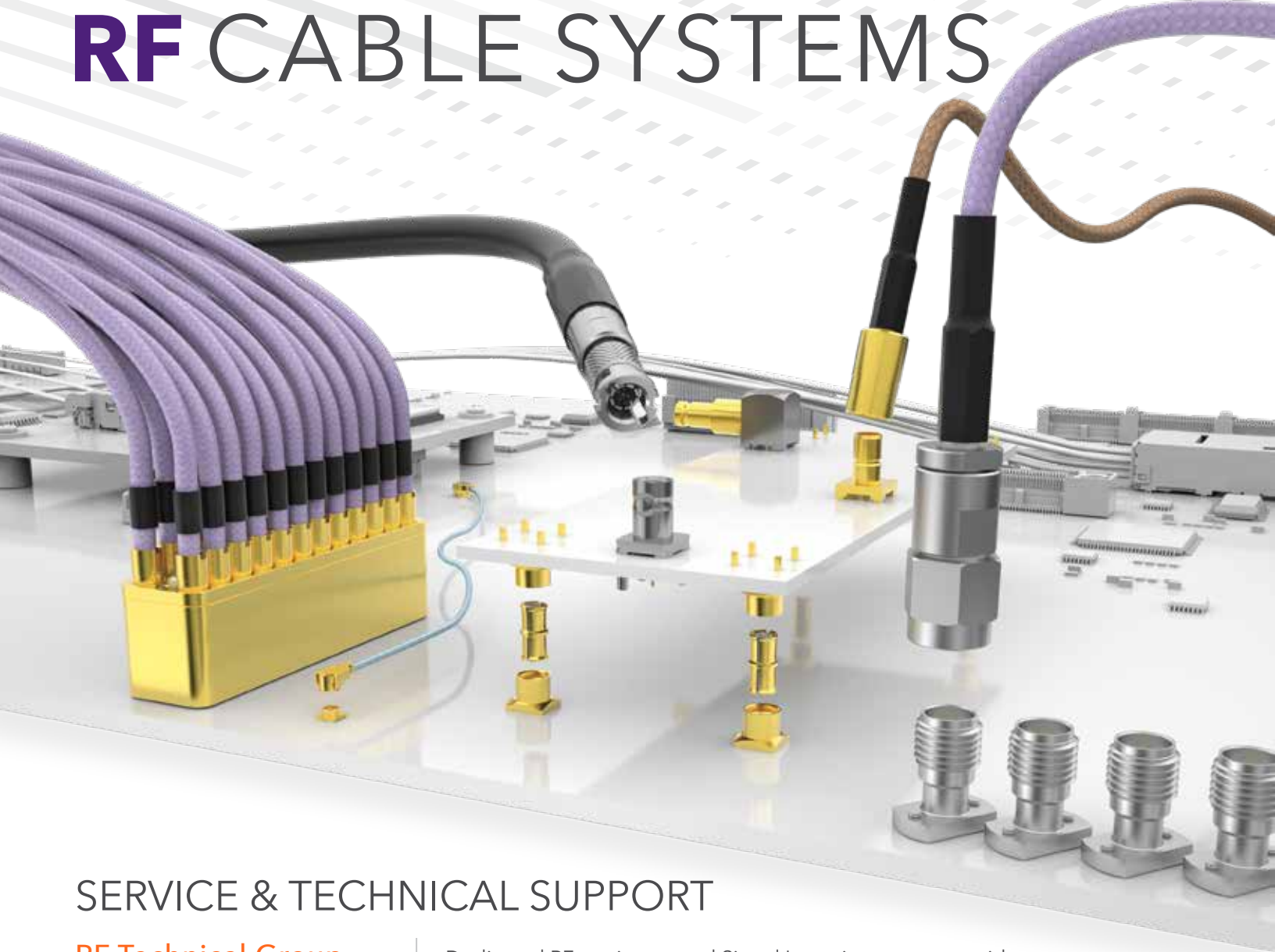
Up to 10 Gbps data transmission

Compliant to SFP+, SFP, XFP
and XENPAK

32 AWG low skew pair twinax cable

Mates with MECT (connector)
and SFPC (cage)

RF CABLE SYSTEMS



SERVICE & TECHNICAL SUPPORT

RF Technical Group
RFTechnicalGroup@samtec.com

Signal Integrity Group
SIG@samtec.com

Dedicated RF engineers and Signal Integrity experts provide personal support for meeting your specific challenges.

Launch Optimizations • Simulations • Test & Measurements • Customs

Go to samtec.com/catalog to order or view the RF Interconnect Catalog

HIGH FREQUENCY MICROWAVE			
CABLE	AWG	END OPTIONS	SERIES
MWC-2350CU-01	23	3.5 mm, 2.92 mm, 2.4 mm	RF23C
MWC-2550-01	25	SMA, SMP	RF25S
CCA-047	46	HMHF1, SMA	RF047
RG 405	24	SMA, SMP	RF405
RG 402	19	SMA	RF402

50 Ω RF CABLES			
CABLE	AWG	END OPTIONS	SERIES
0.81	36	MHF1, MHF3, SMA	MH081
1.13	32	MHF1, SMA	MH113
RG 178	30	MMCX, MCX, SMA, SMB, BNC, TNC, N Type	RF178
RG 174	26	MMCX, MMCXV, MCX, SMA, SMB, BNC, TNC, N Type	RF174
RG 316*	26	MMCX, MMCXV, MCX, SMA, SMB, BNC, TNC, N Type	RF316, IJ5C, IJ5H, GRF1-C, GRF1H-C
RG 58	20	SMA, TNC, N Type	RF058

75 Ω RF CABLES			
CABLE	AWG	END OPTIONS	SERIES
RG 179	30	MCX, MMCX7, SMB, BNC, DIN 1.0/2.3	RF179, GRF7-C, GRF7H-C
1855A	23	HD-BNC, DIN 1.0/2.3	RFB8T
1694A	18	BNC, HD-BNC, DIN 1.0/2.3	RFB6T
RG 6	18		RFA6T

*Double-shielded available (RS316 Series)

PRECISION RF

Bulls Eye® to 50 GHz;
65 GHz in development

Significantly saves space on the board compared to traditional test point systems

Precision interconnects for high-performance testing (see chart)

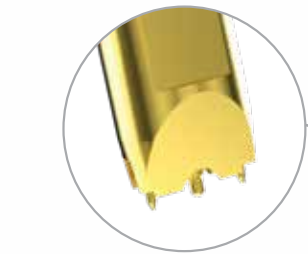
Single cable with Precision 2.92 mm and 2.4 mm interconnects available to 50 GHz

23 AWG solid dielectric microwave cable with copper foil shield

Phase matched pairs, 50 Ω impedance

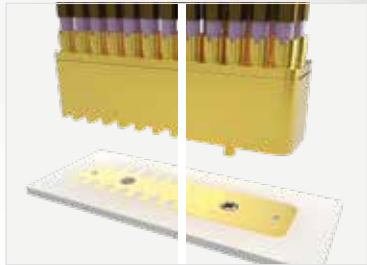
BE40A is backward compatible with BDRA

BULLSEYE®
TEST POINT SYSTEM



BE40A

BE40A cable features pogo style pins with both signal and ground



Microstrip or Stripline compression interface to the board

Precision Interconnects	3.5 mm	2.92 mm, SMP	2.4 mm	1.85 mm, SMPM	1.00 mm
Performance (GHz)	34	40	50	65	110

Wide variety of Precision interconnects for high-performance testing

50 & 75 Ω CABLE SOLUTIONS

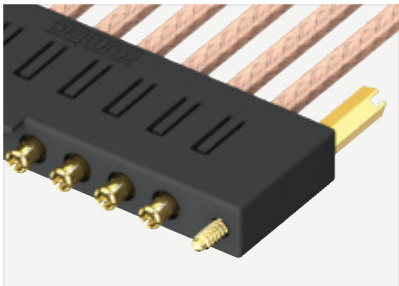
Wide variety of industry standard cables and components with mix-and-match flexibility

Mating cables available for 12G-SDI optimized connectors

High-speed U.FL to 500 cycles/10 GHz (RF047)

High-vibration and 75 Ω MMCX cable end options (MMCXV & MMCX7)

IsoRate® isolated signal systems for 90% performance at 50% of the cost (IJ5C and IJ5H)



Ganged micro scale isolated signal systems (GRF1 & GRF7)



Circular RF 100 Ω shielded twisted pair system

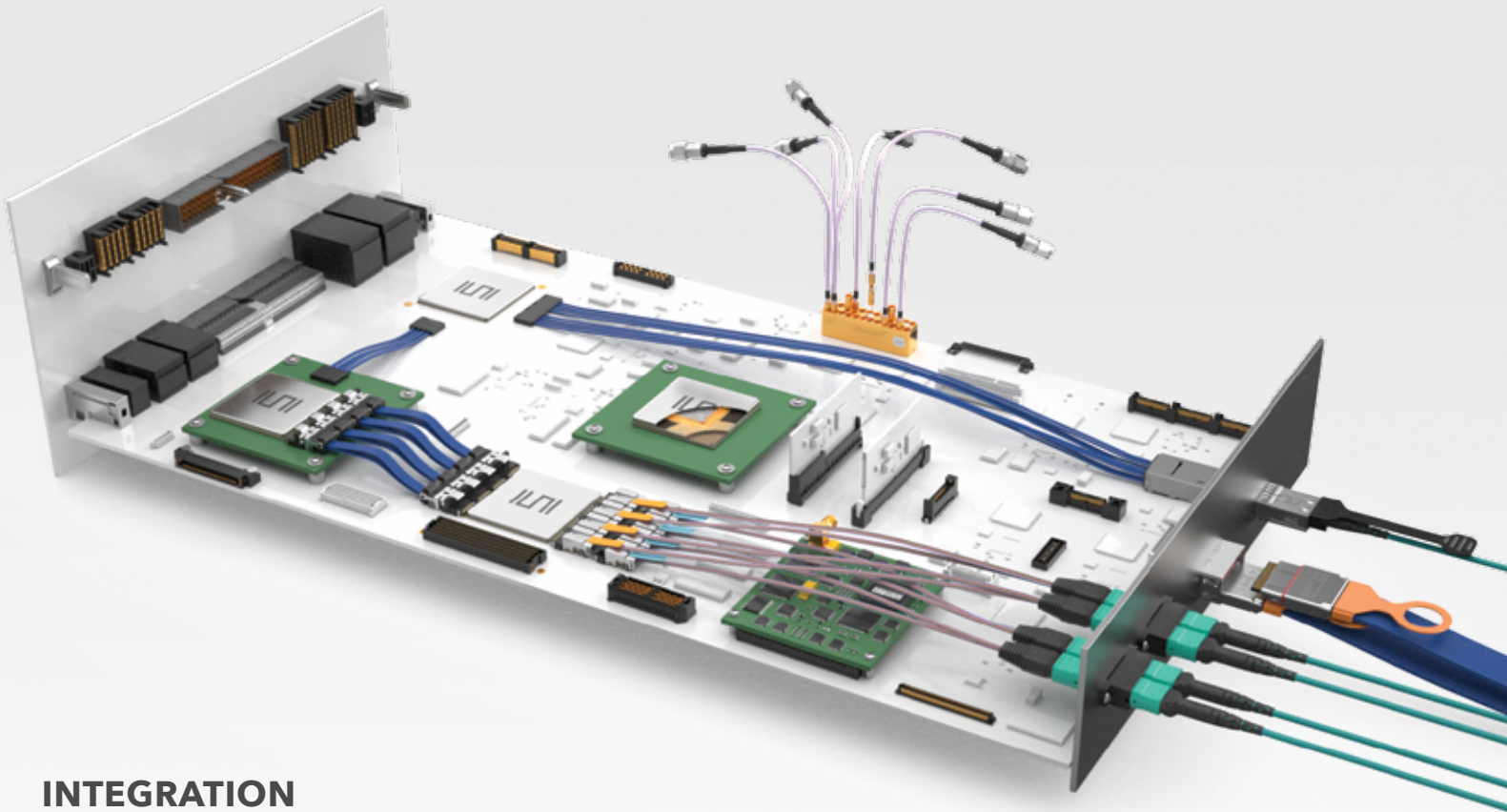


C28S/CJT

TECHNOLOGY CENTERS

ENABLING COMPLETE SYSTEM OPTIMIZATION FROM SILICON-TO-SILICON

By integrating specialized Technology Centers led by industry experts working side-by-side, Samtec fosters a unique environment conducive to true innovation and collaboration, along with the ability to provide the most complete level of service and support for interconnect system design, development and production in the industry.



INTEGRATION LEADS TO INNOVATION



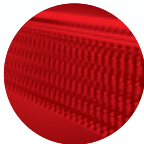
HIGH-SPEED CABLE GROUP

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



SIGNAL INTEGRITY GROUP & SAMTEC TERASPEED CONSULTING

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



ADVANCED INTERCONNECT DESIGN

High precision stamping, plating, molding and automated assembly



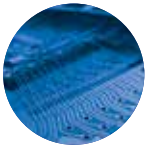
SAMTEC OPTICAL GROUP

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



PRECISION RF GROUP

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



SAMTEC MICROELECTRONICS GROUP

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 56 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

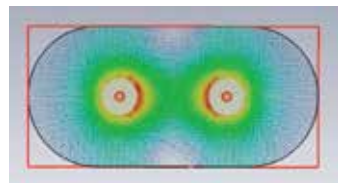
Samtec's Eye Speed® **co-extruded** twinax cable technology eliminates the performance limitations and inconsistencies of individually extruded dielectric twinax cabling, improving signal integrity, bandwidth and reach for high-performance system architectures.

Ultra Low Skew Twinax

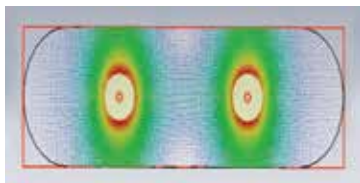
- Tight coupling between signal conductors
- Improved bandwidth and reach
- Improved signal integrity and eye pattern opening
- Low skew over extended lengths
- Supports Samtec's flyover technology

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

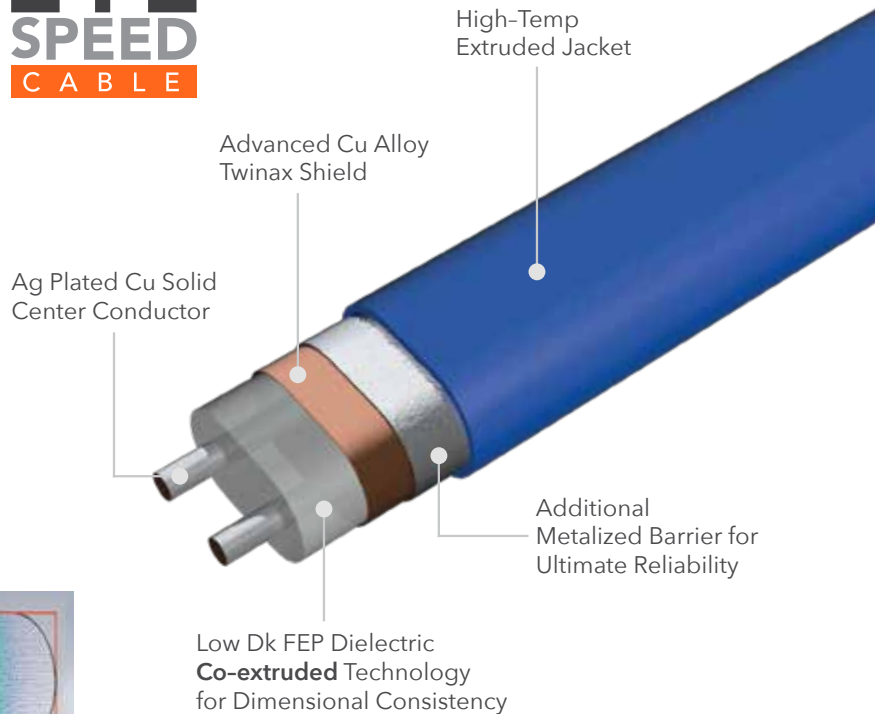


✓ **Good** design coupling with co-extruded low skew twinax








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

**EYE
SPEED
CABLE**



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

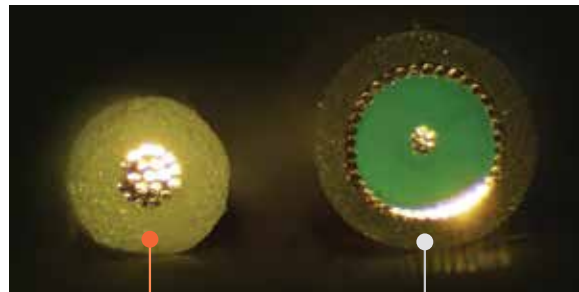
Eye Speed® Ultra Low Skew Twinax Cable is available in engineered impedance configurations of 85 Ω, 92 Ω and 100 Ω.

MICRO COAX

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

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
- Incredible flexibility with mix and match end options to create application specific solutions
- 26 - 38 AWG cable available
- Choice of signal conductor, shield and FEP dielectric to meet performance and cost specifications







Samtec's Foamed Dielectric vs. Traditional Solid Dielectric

**EYE
SPEED
CABLE**



NOMINAL PERFORMANCE SPECIFICATIONS

			30 AWG	32 AWG	34 AWG	36 AWG	38 AWG
Eye Speed® Micro Coax Cable							
5 GHz (10 Gbps)	0.25 m	IL (dB)	-0.9	-1.0	-1.3	-2.2	-2.6
	1.00 m		-3.4	-3.3	-6.0	-6.9	-8.5
10 GHz (20 Gbps)	0.25 m		-1.4	-1.6	-2.2	-3.5	-4.0
	1.00 m		-5.1	-5.5	-9.0	-10.7	-12.7
Density/Flexibility			Good	Better	Better	Best	Best

Eye Speed® Micro Coax Cable is available in engineered impedance configurations of 50 Ω and 75 Ω.



samtec

SUDDEN SERVICE®

UNITED STATES • NORTHERN CALIFORNIA • SOUTHERN CALIFORNIA • SOUTH AMERICA • UNITED KINGDOM
GERMANY • FRANCE • ITALY • NORDIC/BALTIC • BENELUX • ISRAEL • INDIA • AUSTRALIA / NEW ZEALAND
SINGAPORE • JAPAN • SHANGHAI • SHENZHEN • TAIWAN • HONG KONG • KOREA