

HIGH-SPEED CABLE

INTERCONNECT SOLUTIONS GUIDE

HIGH-SPEED CABLE



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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TECHNOLOGY CENTERS 20-21

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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	MEGTRON 6 MICRO TWINAX			
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

mmagana

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





PERFORMANCE & COST ADVANTAGES

PAM4

5

- 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



PAM4

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



FQSFP

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

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

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





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

samtec.com/flyover

SAMTEC FLYOVER™ MID-BOARD ASSEMBLIES







EXTREME HIGH-SPEED, HIGH-DENSITY CABLE



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





EFFFFFFFFFF

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	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 F	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



ACCELERATE®

PAM4

ARF6



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



Press-fit termination for high retention



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



samtec.com/flyover

BACKPLANE CABLE ASSEMBLIES



HIGH-SPEED BACKPLANE CABLE



EBCF Actual Size (72 Pairs Total)



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[™]

Lauren Carris

FIREFLY" OPTICAL TECHNOLOGY

and a commentation

- management



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

annannan

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[®]



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





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)

samtec.com/firefly

HIGH-SPEED 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 $\Omega,$ 50 $\Omega,$ 85 Ω and 100 Ω





SEAC Actual Size (30 Positions/Row)

ESCA Actual Size (30 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



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)



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 break-out configuration



... 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



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



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

Used with BE40A

50 Ω, 23 AWG HIGH-DYNAMIC STABILITY



Insertion Loss	ertion Loss 0.25 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)

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



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PRECISION RF ASSEMBLIES & INTERCONNECTS

BE65A/BE40A

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

samtec.com/tech-centers



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



 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® I Twina	Ultra Low Sk ax Cable	ew					42.
	0.25 m		-1.0	-1.2	-1.5	-1.8	-2.2
(28G NRZ/ 56G PAM4)	1.00 m	IL (dB)	-3.9	-4.7	-5.9	-7.2	-8.7
28 GHz	0.25 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 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.

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

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.



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





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