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.

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.

BANDWIDTH VS. TRADITIONAL & HIGH-SPEED MATERIALS

<table>
<thead>
<tr>
<th>FR408</th>
<th>MEGTRON 6</th>
<th>MICRO TWINAX</th>
<th>OPTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Gbps</td>
<td>up to 10&quot;</td>
<td>10&quot;+</td>
<td>up to 39&quot;</td>
</tr>
<tr>
<td>14 Gbps</td>
<td>up to 5&quot;</td>
<td>up to 10&quot;</td>
<td>up to 33&quot;</td>
</tr>
<tr>
<td>28 Gbps</td>
<td>up to 2&quot;</td>
<td>up to 5&quot;</td>
<td>up to 23”</td>
</tr>
<tr>
<td>56 Gbps</td>
<td>0.0&quot;</td>
<td>up to 2&quot;</td>
<td>up to 12”</td>
</tr>
<tr>
<td>112 Gbps</td>
<td>0.0&quot;</td>
<td>0.0°</td>
<td>up to 6”</td>
</tr>
</tbody>
</table>

(-5 dB Loss Target, Reach Estimate. For OIF VSR applications.)
Samtec Flyover™ design provides end option flexibility to create a high-speed application specific solution to meet next gen speeds.

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

- 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
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

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
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

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

<table>
<thead>
<tr>
<th>Aggregate Data Rate (NRZ)</th>
<th>448 Gbps</th>
<th>672 Gbps</th>
<th>896 Gbps</th>
<th>1344 Gbps</th>
<th>1792 Gbps</th>
<th>4032 Gbps*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bank</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Bank</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Row</td>
<td>8 Pairs</td>
<td>12 Pairs</td>
<td>16 Pairs</td>
<td>24 Pairs</td>
<td>32 Pairs</td>
<td>72 Pairs*</td>
</tr>
<tr>
<td>3 Row</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Row</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Row</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Row</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4 Row</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Row*</td>
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</tr>
</tbody>
</table>

*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

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

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
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)

Industry’s lowest mating force with excellent contact normal force

Wafer design increases isolation for reduced crosstalk

Includes one sideband signal per column

30 and 34 AWG ultra low skew twinax cable to support various cable lengths

Staggered differential pairs provide higher data rates

Vertical and right-angle

Two reliable points of contact with a 2.4 mm wipe

Designed for blind-mate systems
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®

**OM3 multi-mode fiber**

**ECUO**

**High-performance micro optical engine technology**

**Integral heat sink for optimized thermal conditions**

**Low insertion force surface mount connector system (UEC5 and UCC8)**

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)

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)

samtec.com/firefly
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 (HSECB)

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 (ERC, ERDP)

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

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

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**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 ER18 (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)

samtec.com/HDR
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 Ω, 23 AWG HIGH-DYNAMIC STABILITY

<table>
<thead>
<tr>
<th>Insertion Loss</th>
<th>0.25 m</th>
<th>1 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3 dB</td>
<td>&gt;40 GHz</td>
<td>13 GHz</td>
</tr>
<tr>
<td>-7 dB</td>
<td>&gt;40 GHz</td>
<td>&gt;40 GHz</td>
</tr>
</tbody>
</table>

Used with BE40A

<table>
<thead>
<tr>
<th>Insertion Loss</th>
<th>0.25 m</th>
<th>1 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3 dB</td>
<td>&gt;20 GHz</td>
<td>16.6 GHz</td>
</tr>
<tr>
<td>-7 dB</td>
<td>&gt;20 GHz</td>
<td>&gt;20 GHz</td>
</tr>
</tbody>
</table>

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

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

samtec.com/RF
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
- **SYSTEM SIGNAL INTEGRITY**: Full channel signal and power integrity analysis, testing and validation services
- **HIGH-SPEED CABLE**: In-house R&D and manufacturing of precision extruded cable and assemblies
- **PRECISION RF**: RF interconnect design and development expertise, with testing to 65 GHz
- **OPTICS**: R&D, design, development and support of micro optical engines and assemblies
- **MICROELECTRONICS**: Advanced IC packaging design, support and manufacturing capabilities

samtec.com/tech-centers
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.

**NEW CAPABILITIES ENABLE NEW TECHNOLOGY**

### 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

Contact [HDR@samtec.com](mailto:HDR@samtec.com)
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

NOMINAL PERFORMANCE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Eye Speed® Ultra Low Skew Twinax Cable</th>
<th>28 AWG</th>
<th>30 AWG</th>
<th>32 AWG</th>
<th>34 AWG</th>
<th>36 AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 GHz (28G NRZ/56G PAM4)</td>
<td>-1.0</td>
<td>-1.2</td>
<td>-1.5</td>
<td>-1.8</td>
<td>-2.2</td>
</tr>
<tr>
<td>0.25 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.00 m</td>
<td>-3.9</td>
<td>-4.7</td>
<td>-5.9</td>
<td>-7.2</td>
<td>-8.7</td>
</tr>
<tr>
<td>28 GHz (56G NRZ/112G PAM4)</td>
<td>-1.5</td>
<td>-1.8</td>
<td>-2.2</td>
<td>-2.6</td>
<td>-3.2</td>
</tr>
<tr>
<td>0.25 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.00 m</td>
<td>-6.0</td>
<td>-7.0</td>
<td>-8.7</td>
<td>-10.6</td>
<td>-12.7</td>
</tr>
<tr>
<td>Density/Flexibility</td>
<td>Good</td>
<td>Good</td>
<td>Better</td>
<td>Best</td>
<td>Best</td>
</tr>
</tbody>
</table>

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

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

Contact HDR@samtec.com for more information.