

# FIREFLY™

APPLICATION DESIGN GUIDE

# FIREFLY™

## MICRO FLYOVER SYSTEM™

### FUTURE-PROOF

Interchangeability of FireFly™ copper and optical using the same high-performance connector set.

### MINIATURE FOOTPRINT

Allows for greater density and closer proximity to the IC, simplifying board layout and enhancing signal integrity.

### HIGH PERFORMANCE VERSATILITY

Data “flies” over lossy PCB for up to 28 Gbps per lane with a path to 56 Gbps via optical cable at greater distances – or copper for shorter reach.

### EASE OF USE

Simple assembly process with easy insertion/removal and trace routing, no screws required, and a 2-piece surface mount connector system.

### SAMTEC OPTICAL GROUP

Engineering team dedicated to the design, development and application support of high-performance micro optical engines, active optical assemblies and passive optical panel solutions. For more information contact [FireFly@samtec.com](mailto:FireFly@samtec.com).



**FIREFLY™ OPTICAL SYSTEMS**

**PG. 4-5**

**EXTENDED TEMP FIREFLY™**

**PG. 6-7**

**PCIe®-OVER-FIBER**

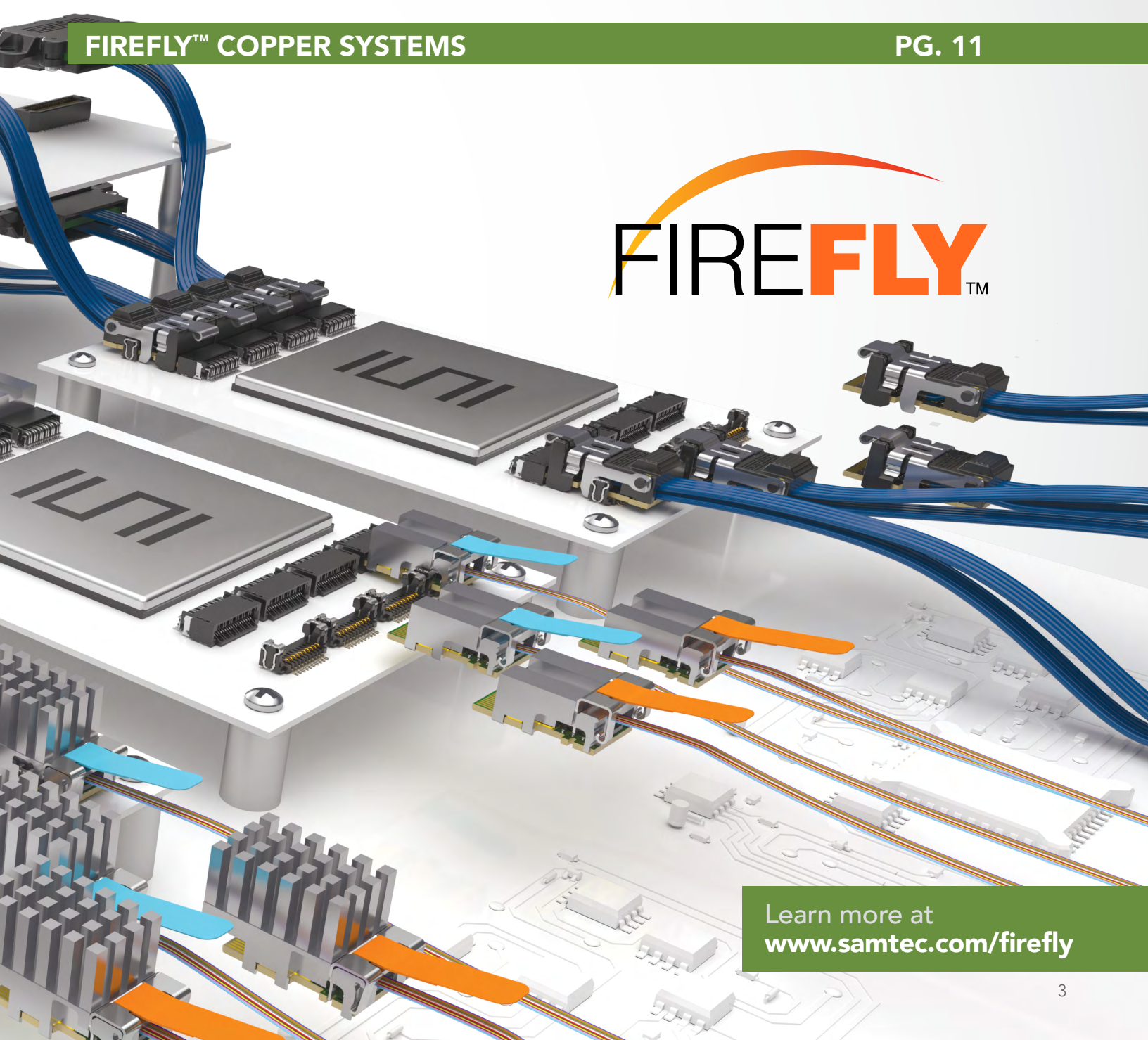
**PG. 8-9**

**KITS & SERVICES**

**PG. 10**

**FIREFLY™ COPPER SYSTEMS**

**PG. 11**



Learn more at  
[www.samtec.com/firefly](http://www.samtec.com/firefly)

# FIREFLY™ OPTICAL

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

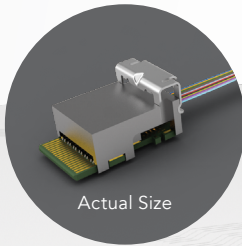
- Interchangeable with FireFly™ copper using the same micro connector system
- Industry leading miniature footprint allows for higher density close to the data source
- Simple to use system with easy insertion/removal and trace routing, no screws required, and a surface mount connector system
- Supports data center, HPC and FPGA protocols, including Ethernet, InfiniBand™, Fibre Channel and Aurora

Integral heat sink for optimized thermal management

OM3 multi-mode fiber

Low insertion force two-piece connector system (UEC5 & UCC8)

High-performance mid-board optical engine

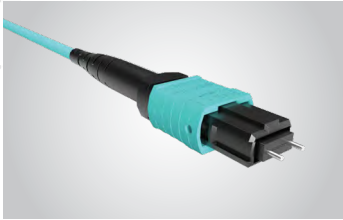


14 Gbps	x4 x12
16 Gbps	x12
25 Gbps	x4
28 Gbps	x4



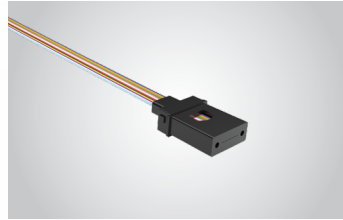
SERIES	WIDTH	DATA RATE	OVERALL LENGTH	0	HEAT SINK	1	FIBER TYPE	END OPTION*
ECUO	-T12 = x12 Tx Simplex -R12 = x12 Rx Simplex -Y12 = x12 Duplex (Y Configuration) -B04 = x4 Duplex	-14 = 14 Gbps per lane -16 = 16 Gbps per lane (x12 only) -25 = 25 Gbps per lane (x4 only) -28 = 28 Gbps per lane (x4 only)	-"XXX" = Overall Length in Centimeters (011 cm - 999 cm) (Minimum length will depend on fiber type and End 2 option specified)	-1 = Flat -2 = Pin-Fin (-14 & -16 only) -3 = Flat with 3-ribbon pass-through -4 = PCIe® Pin-Fin (-14 & -16 only) -5 = High-Performance Pin-Fin	-3 = Bare ribbon -4 = Coated ribbon with protective boot (in development) -5 = Loose tube with protective boot	-Y12 requires 24 fibers		
						<b>12 Fibers</b> -01 = MTP®, male -02 = MTP®, female -05 = MT male -06 = MT female -07 = MXC®	<b>24 Fibers</b> -21 = MTP®, male -22 = MTP®, female -25 = MT male -26 = MT female -27 = MXC®	

## END OPTION FLEXIBILITY



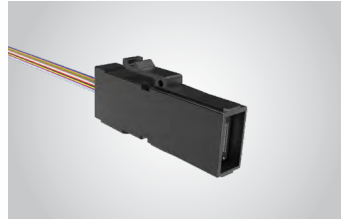
### MPO (MTP®)

High-density connectors for panel applications and minimal keep-out areas on the board



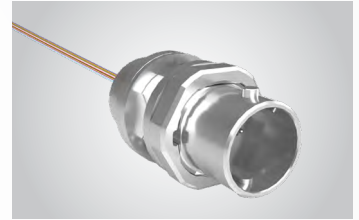
### MT

Low insertion force connectors for high-density cabling and backplane applications



### MXC®

High-density connectors for front panel or backplane applications

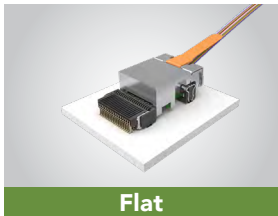


### ARIB

BNC-type connector with optical MT ferrule for broadcast video applications

## HEAT SINK FLEXIBILITY

### Conduction Cooling



Flat



Grooved

Groove allows ribbon cables to pass through so FireFly™ can be placed closer together



PCIe® Pin-Fin

PCIe® card height compliant

### Convection Cooling



Standard Pin-Fin

Accommodates applications with specific power and temperature requirements



High-Performance

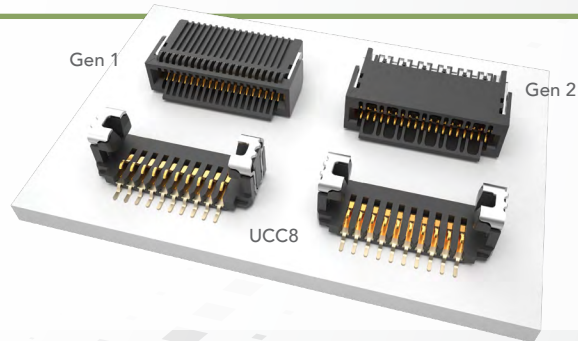
## FIREFLY™ CONNECTOR SYSTEM

### UEC5 - 0.50 mm Pitch High-Speed Data

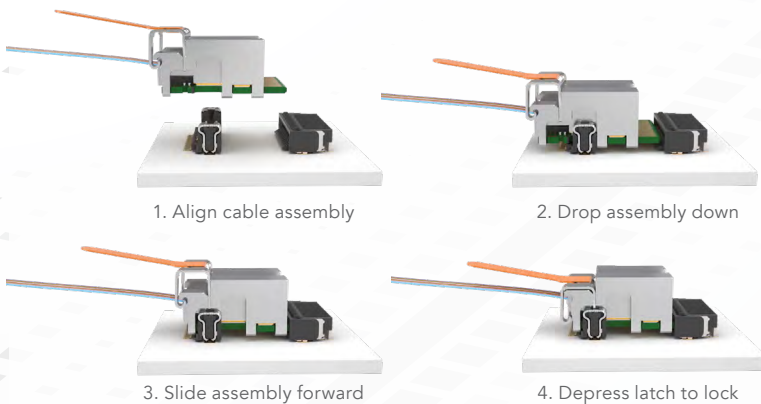
- Two generations available
  - Gen 1 (UEC5-XXX-1) for up to 20 Gbps
  - Gen 2 (UEC5-XXX-2) for 20+ Gbps

### UCC8 - 0.80 mm Pitch Power & Communication

- Power pins & low speed control signals



## EASY MATING INSERTION SEQUENCE



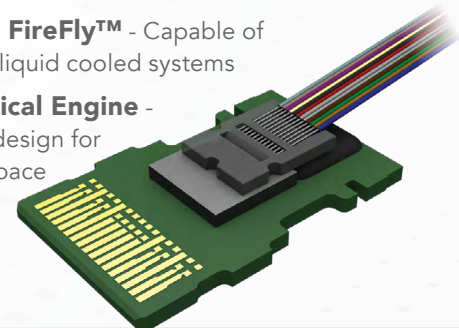
## ROADMAP

**Silicon Photonics** - Samtec is focused on bringing to market 56+ Gbps solutions that are scalable, manufacturable and cost-efficient

**Submersible FireFly™** - Capable of immersion for liquid cooled systems

### Rugged Optical Engine -

Lower profile design for military, aerospace and industrial applications



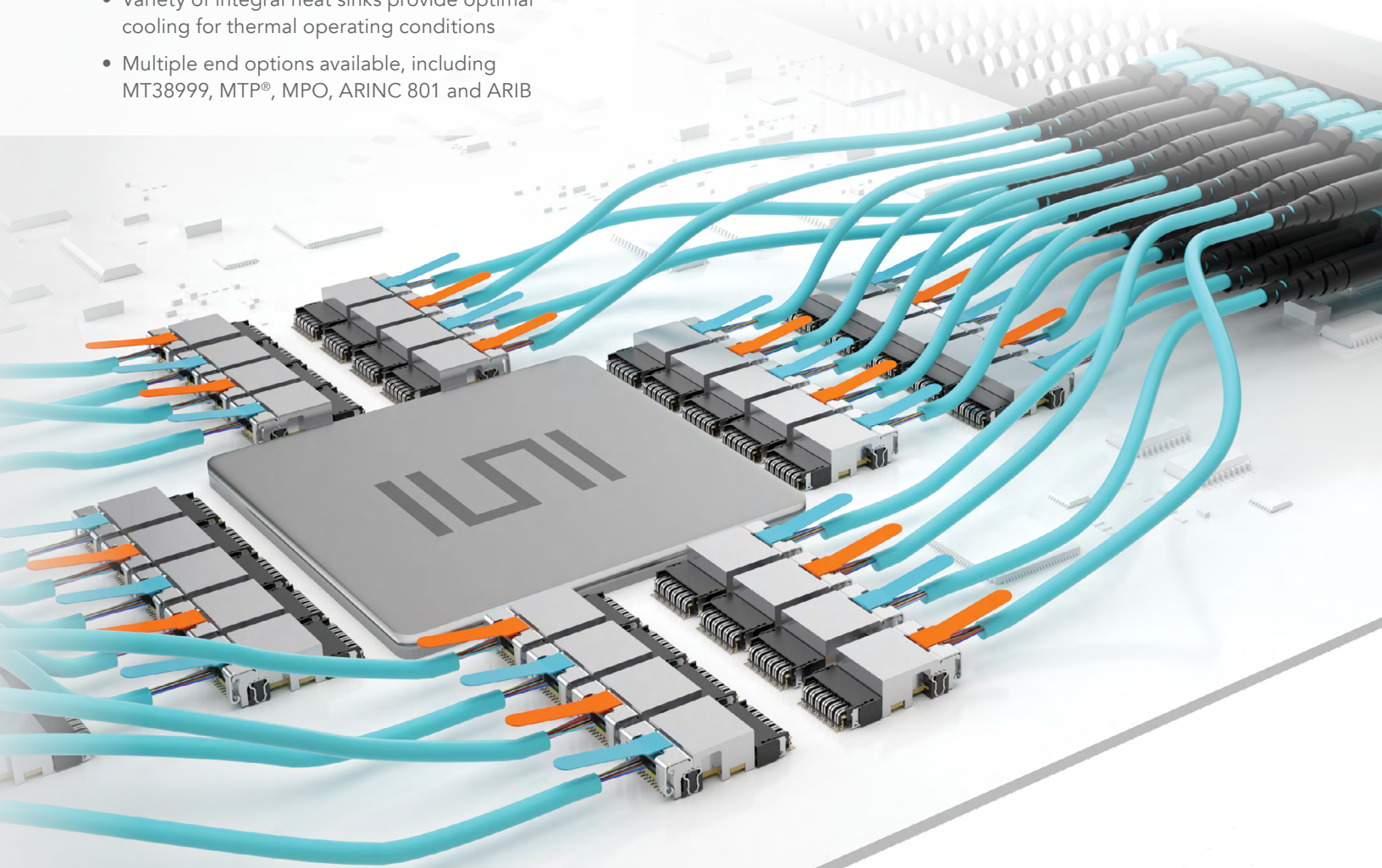
# EXTENDED TEMP FIREFLY™

Extended temperature range from -40 °C to +85 °C for military and industrial applications

- Demonstrated error-free transmission during applied external vibrations and shock test to methods specified in MIL-STD-810G
- Variety of integral heat sinks provide optimal cooling for thermal operating conditions
- Multiple end options available, including MT38999, MTP®, MPO, ARINC 801 and ARIB

**10**  
G b p s

x4  
x12



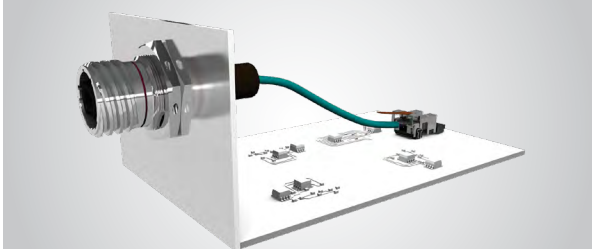
SERIES	WIDTH	DATA RATE	OVERALL LENGTH	0	HEAT SINK	1	FIBER TYPE	END OPTION*
<b>ETUO</b>	<b>-T12</b> = x12 Tx Simplex <b>-R12</b> = x12 Rx Simplex <b>-Y12</b> = x12 Duplex (Y Configuration) <b>-B04</b> = x4 Duplex	<b>-10</b> = 10.3125 Gbps	<b>"XXX"</b> = Overall Length in Centimeters (011 cm - 999 cm) (Minimum length will depend on fiber type and End 2 option specified) (Custom higher loss link budgets are supported; contact Samtec)		<b>-1</b> = Flat <b>-2</b> = Pin-Fin <b>-3</b> = Flat with 3-ribbon pass-through <b>-5</b> = High-Performance Pin-Fin		<b>-3</b> = Bare ribbon <b>-4</b> = Coated ribbon with protective boot (in development) <b>-5</b> = Loose tube with protective boot	-Y12 requires 24 fibers
								<b>12 Fibers</b> -01 = MTP®, male -02 = MTP®, female -05 = MT male -06 = MT female -07 = MXC®

\*These are standard options. See page 7 for other end options available.

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

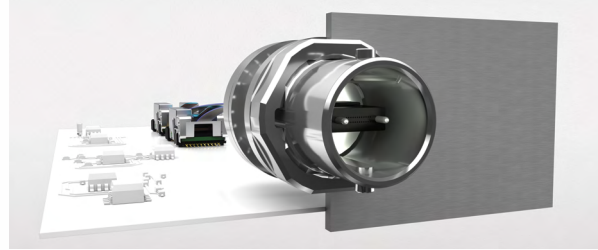
## END OPTION FLEXIBILITY

Samtec has partnered with companies such as Amphenol® and Positronic® to combine FireFly™ with a variety of rugged end 2 options, including:



### Amphenol® MT38999

- Samtec's Extended Temp FireFly™ optical with Amphenol® Aerospace bulkhead interconnects (MT38999) for rugged, passive optical solutions
- Developed for industrial and military applications



### ARIB

- BNC-type interface with MT ferrule combined with Extended Temp FireFly™
- Developed for broadcast video applications



### ARINC 801 Termini

- Genderless terminus for ease of use combined with Extended Temp FireFly™ ensures accurate alignment with low-insertion loss and return loss values (shown: ARINC 801 Connector in D38999 shell and ARINC 801 in Optik-D™)

ARINC 801 Termini and ARINC 801 Connector in D38999 Shell photos courtesy of Amphenol® Aerospace | Optik-D™ Series photo courtesy of Positronic®



## APPLICATION FLEXIBILITY

Extended Temperature FireFly™ is ideal for military, aerospace and industrial applications.



## ROADMAP

**Extended Temp PCIe®-Over-Fiber** - Gen 3 compliant with temperature ranges of -40 °C to +85 °C and -5 °C to +85 °C (PTUO)

**25 Gbps Extended Temp FireFly™**



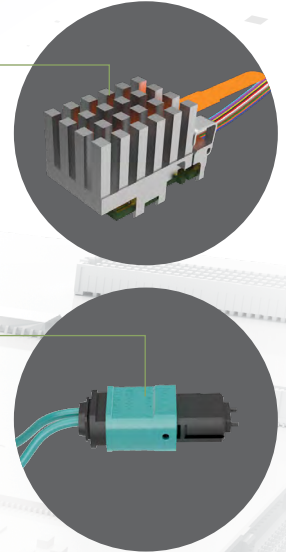
# PCIe®-OVER-FIBER

## FIREFLY™ OPTICAL CABLE SYSTEM

- Transmits PCIe® signals at Gen 3 data transfer rates through FireFly™ optical up to 100 m
- Supports PCIe® protocol for low latency, power savings and guaranteed transmission
- Duplex auxiliary signals allow both transparent and non-transparent bridging
- Micro optical engines allow for easy design into downstream systems, ultimately making these systems smaller
- Gen 4 in development

PCIe® card electromechanical height compliant heat sink

MTP® connectors for high-density panel applications and minimal keep-out areas on the board



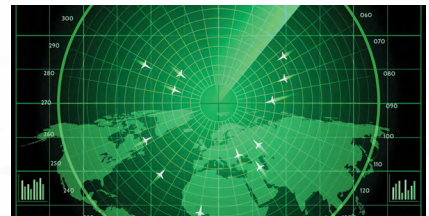
**8**  
G T p s

Gen 3 x4  
Gen 3 x8  
Gen 3 x16

SERIES	SPEED	WIDTH	CABLE LENGTH
<b>PCUO</b>	<b>-G3</b> = Gen 3 speed	<b>-04</b> = x4 PCIe® Gen 3 <b>-08</b> = x8 PCIe® Gen 3	<b>-"XXX"</b> = Overall Length in Centimeters (10 cm minimum)

## TARGET APPLICATIONS

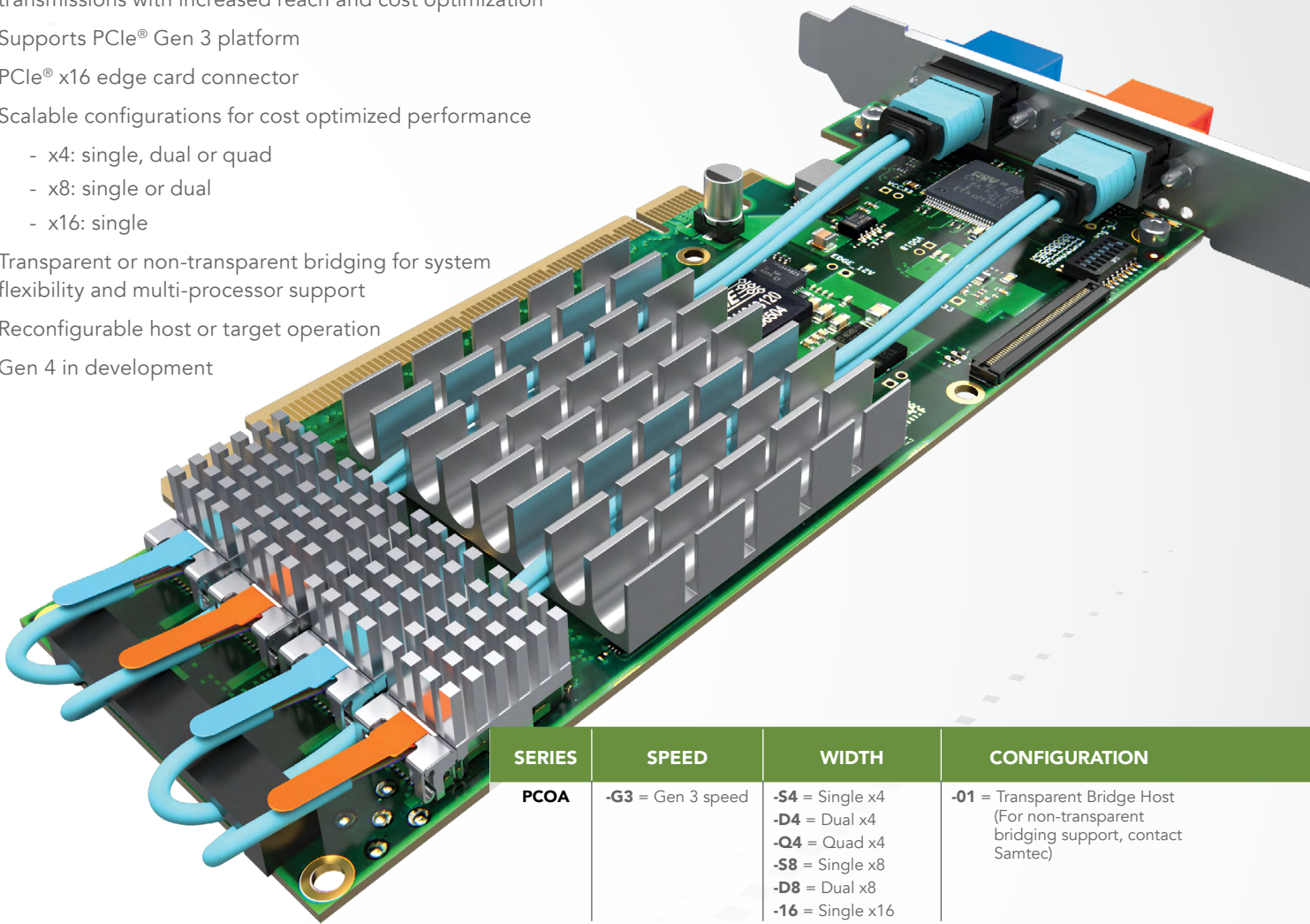
Ideal for high-density applications such as broadcast video, HPC, storage, military and disaggregated computing.





## ADAPTOR CARD WITH FIREFLY™

- Uses PCUO FireFly™ optical cable for clear signal transmissions with increased reach and cost optimization
- Supports PCIe® Gen 3 platform
- PCIe® x16 edge card connector
- Scalable configurations for cost optimized performance
  - x4: single, dual or quad
  - x8: single or dual
  - x16: single
- Transparent or non-transparent bridging for system flexibility and multi-processor support
- Reconfigurable host or target operation
- Gen 4 in development



SERIES	SPEED	WIDTH	CONFIGURATION
PCOA	-G3 = Gen 3 speed	-S4 = Single x4 -D4 = Dual x4 -Q4 = Quad x4 -S8 = Single x8 -D8 = Dual x8 -16 = Single x16	-01 = Transparent Bridge Host (For non-transparent bridging support, contact Samtec)

## APPLICATION FLEXIBILITY

The Adaptor Card enables computer-to-computer or computer-to-endpoint over long distances, and is ideal for high-performance and data quality applications including: AR/VR high-definition cameras, video editing systems, security systems, data acquisition and industrial applications.



# KITS & SERVICES

## CHARACTERIZATION & DEVELOPMENT KITS

From concept and prototype to development and production, Samtec-designed and Partner-designed kits and boards featuring FireFly™ Micro Flyover System™ simplify design and reduce time to market. For more information, please visit [Samtec.com/kits](http://Samtec.com/kits) or contact [KitsAndBoards@samtec.com](mailto:KitsAndBoards@samtec.com)

### FireFly™ Test Kit

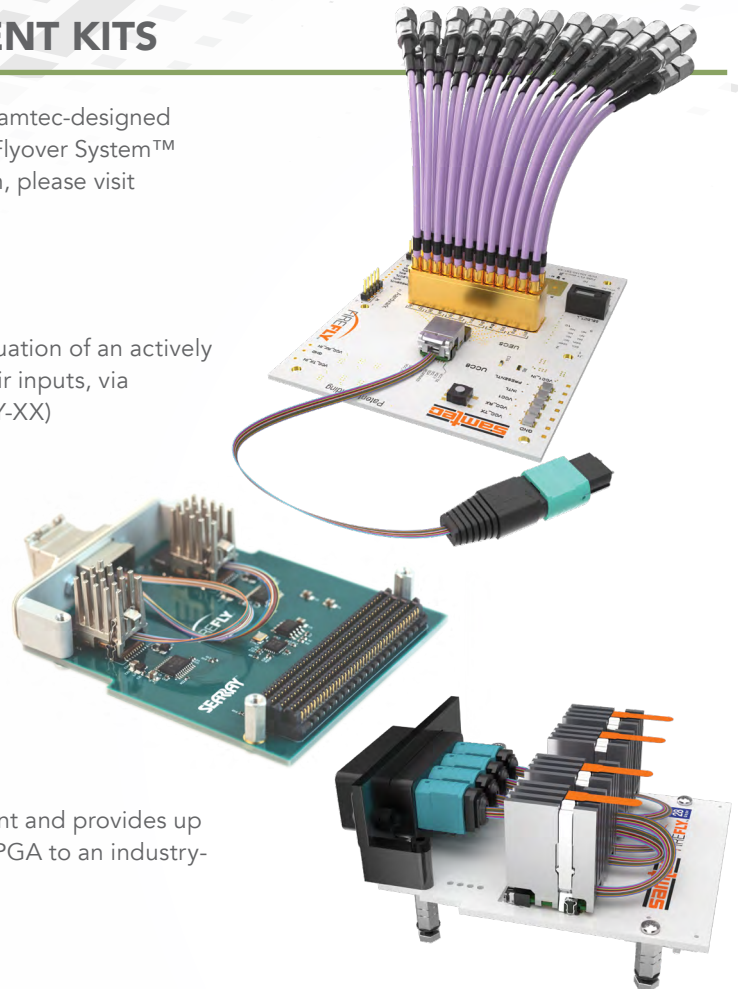
Rated up to 25 Gbps, this kit allows the designer real-time evaluation of an actively running copper or optical FireFly™ system in their lab, with their inputs, via Samtec's Bulls Eye® test point system. (Samtec P/N: FIK-FIREFLY-XX)

### 14 Gbps FireFly™ FMC Development Kit

Samtec's 14 Gbps FireFly™ FMC Development Kit is VITA 57.1 compliant and provides up to 140 Gbps full-duplex bandwidth over 10 channels from an FPGA to an industry-standard multi-mode fiber optic cable. (Samtec P/N: REF-193429-01)

### 28 Gbps FireFly™ FMC+ Development Kit

Samtec's 28 Gbps FireFly™ FMC+ Module is VITA 57.4 compliant and provides up to 448 Gbps full-duplex bandwidth over 16 channels from an FPGA to an industry-standard multi-mode fiber optic cable. (In development)

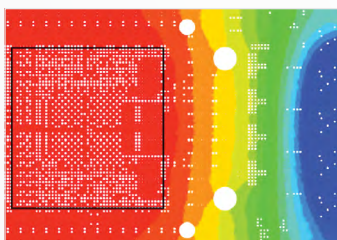


## ADVANCED DESIGN SERVICES

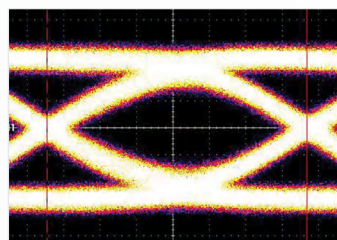
Samtec Signal Integrity engineers use their design expertise and extensive experience in high-performance systems to provide Tier 1 level support for advanced optical systems.

Our advanced techniques for system analysis are executed with custom simulation software and High-Performance Computing (HPC), enabling reliable results which are validated through measurements to 67 GHz.

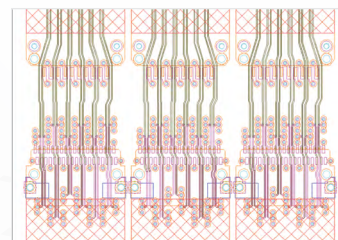
For more information, or to discuss your specific application, please contact [FireFly@samtec.com](mailto:FireFly@samtec.com).



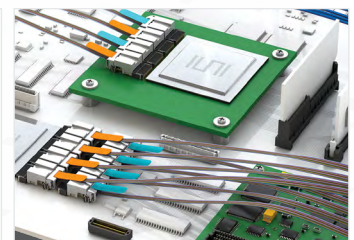
Power Integrity



Signal Integrity



Package Design & Analysis



PCBs, Modules & Connectors

# FIREFLY™ COPPER

## High-performance, high-density copper flyover solution

- Pin compatible with optical FireFly™ using the same connector system
- Low-cost solution for seamless integration of new and existing designs
- Variety of end 2 termination options

14  
G b p s

x4 Bidirectional ECUE  
x12 Unidirectional ECUE

28  
G b p s

x4 Bidirectional ECUE-2



### Standard Copper (ECUE)

- 14 Gbps
- 100 Ω, 34 AWG or 36 AWG Eye Speed® twinax cable



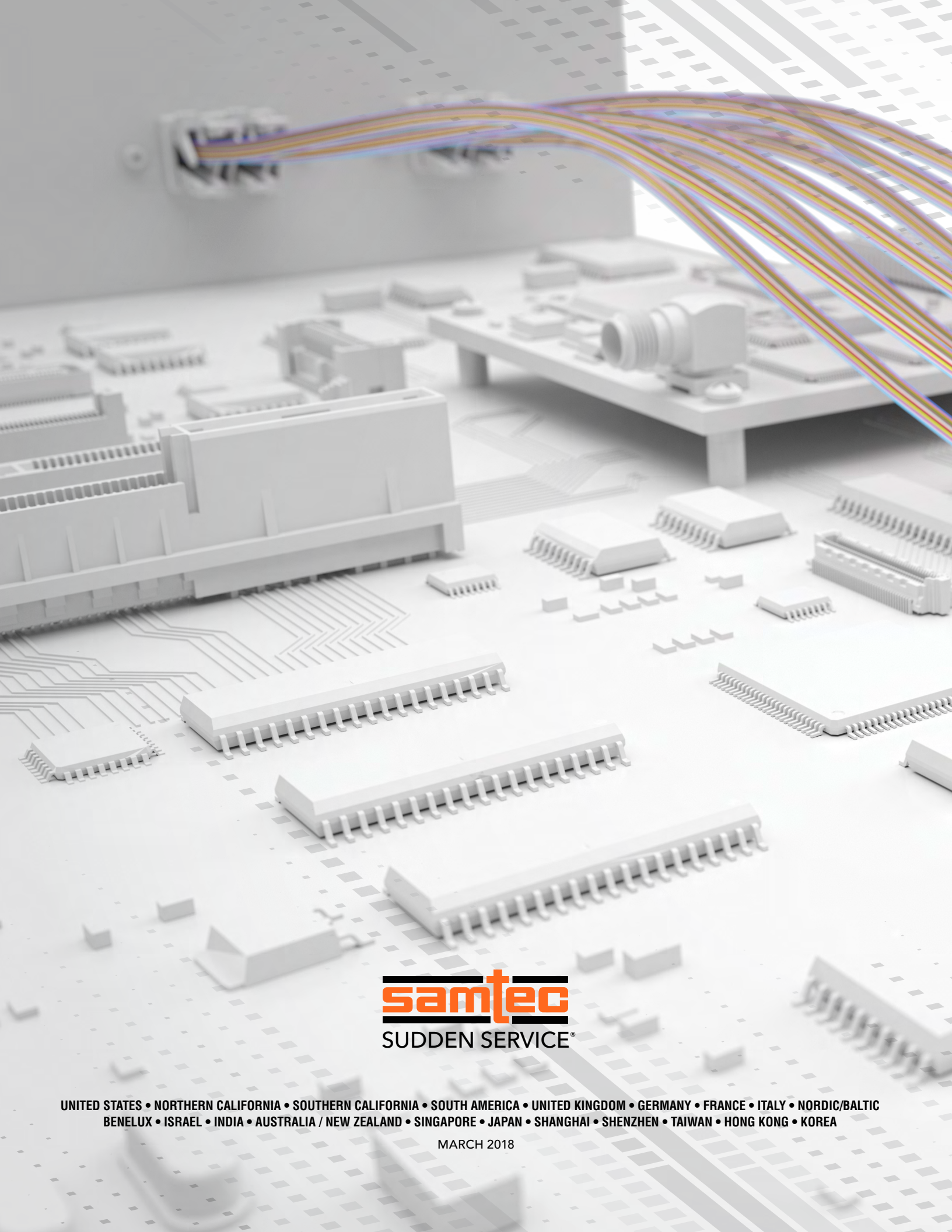
### Optimized Copper (ECUE-2)

- 28 Gbps card design
- 100 Ω, 34 AWG Eye Speed® ultra low skew twinax cable
- Optimized for use with connector UEC5-2



### PCIe®-Over-FireFly™ Copper (PCUE)

- Gen 4 compatible
- 100 Ω, 34 AWG Eye Speed® ultra low skew twinax cable
- Optimized for use with connector UEC5-2



**samtec**  
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MARCH 2018