FIREFLY™

APPLICATION DESIGN GUIDE

FIREFLY™

MICRO FLYOVER SYSTEM™

| FUTURE-PROOF MICRO FOOTPRINT	HIGH PERFORMANCE VERSATILITY	EASE OF USE	RUGGEDNESS
Flexibility of copper and optical using the same micro connector allows for increased density, simplified PCB and reduced power dissipation.	Data connection is taken "off board" for up to 28 Gbps per lane with a path to 112 Gbps PAM4 via optical cable at greater distances – or copper for cost optimization.	Simple assembly process with easy insertion/removal and trace routing, no through-holes, and a 2-piece surface mount connector system.	Variety of rugged options ideal for harsh environmental applications.
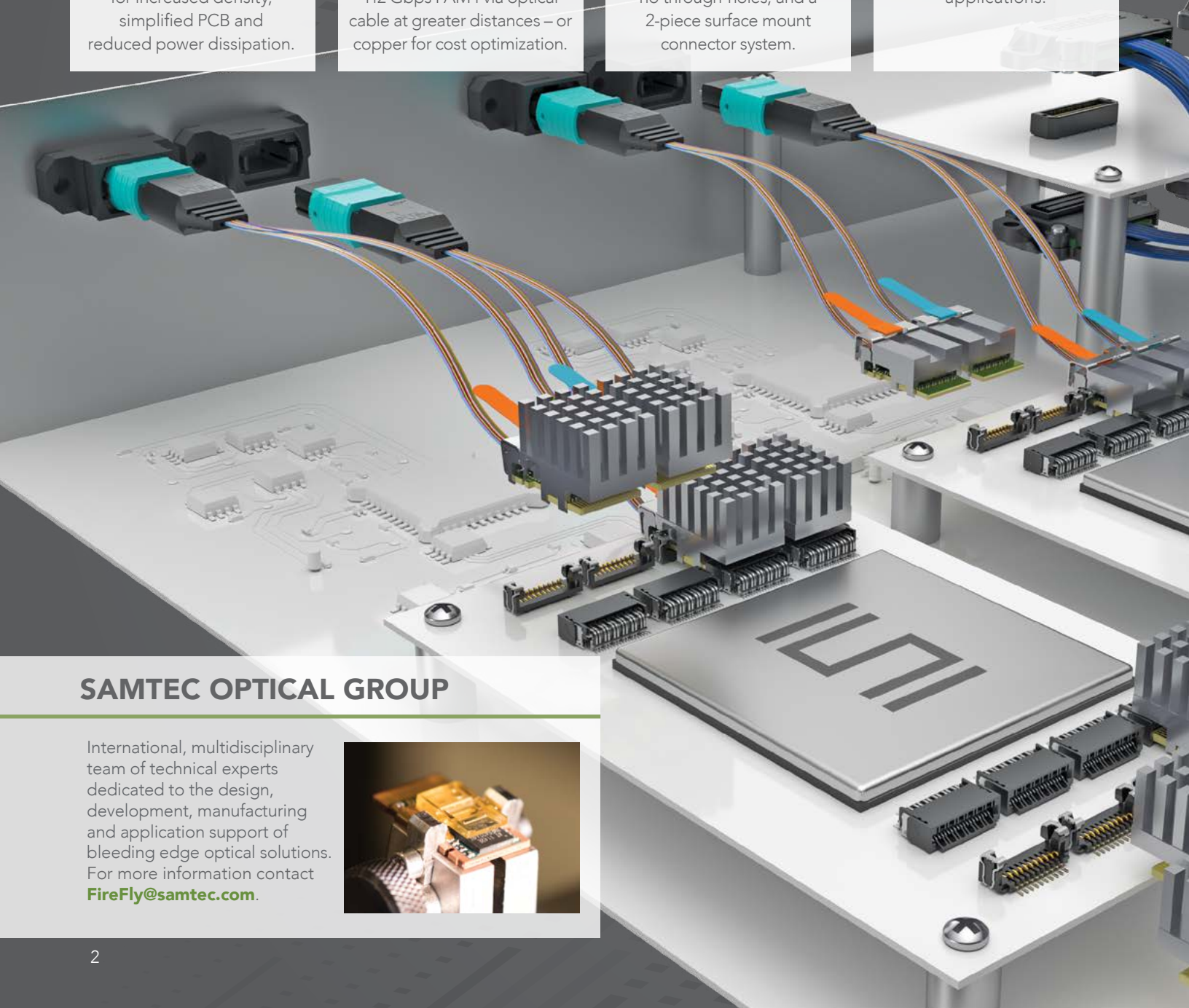
SAMTEC OPTICAL GROUP

International, multidisciplinary team of technical experts dedicated to the design, development, manufacturing and application support of bleeding edge optical solutions. For more information contact **FireFly@samtec.com**.
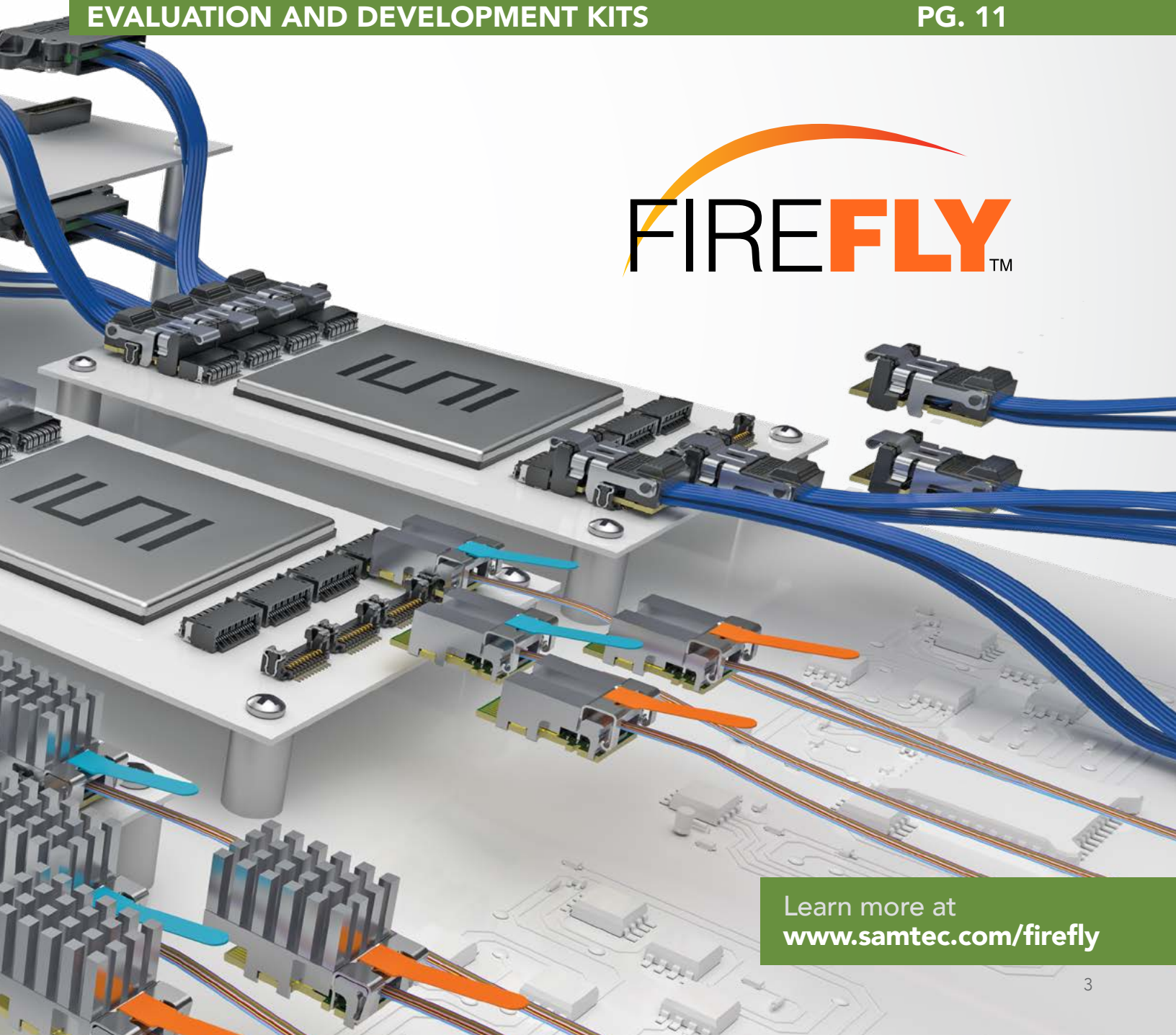
FIRE**FLY**™

Learn more at
www.samtec.com/firefly

COMMERCIAL FIREFLY™

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

- Up to 28 Gbps per channel via optical cable for greater reach

- 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 through-holes, and a surface mount connector system

- Supports data center, HPC and FPGA protocols, including 10/40/100 GbE Ethernet, InfiniBand™, Fibre Channel and Aurora

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

Actual Size
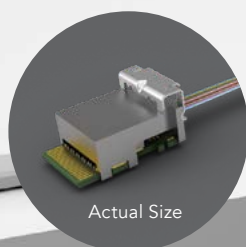
FIREFLY™

SERIES	WIDTH	DATA RATE	OVERALL LENGTH	0	HEAT SINK	1	FIBER TYPE	END OPTION*
ECUO	**-T12** = x12 Tx Transceiver **-R12** = x12 Rx Receiver **-U12** = x12 Tx to Rx **-Y12** = x12 Duplex (Y Configuration) **-B04** = x4 Duplex	**-14** = 14 Gbps per lane **-16** = 16 Gbps per lane (x12 only) **-25** = 25.7 Gbps per lane (x4 only) **-28** = 28.1 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 (For use with -25 & -28)		**-4** = Loose tube with protective boot **-5** = Jacketed ribbon with protective boot **-6** = Jacketed ribbon	-Y12 requires 24 fibers **12 Fibers** -01 = MTP®, male -02 = MTP®, female -07 = MXC® -0E = MPO Plus®, male, bayonet **24 Fibers** -21 = MTP®, male -22 = MTP®, female -27 = MXC® -2E = MPO Plus®, male, bayonet

* These are standard options. See page 5 for other end options available.

EASY MATING INSERTION SEQUENCE
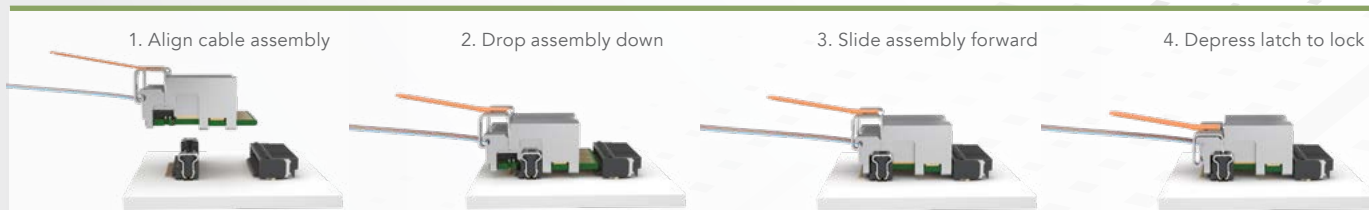
1. Align cable assembly

2. Drop assembly down

3. Slide assembly forward

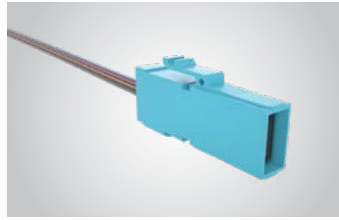4. Depress latch to lock

END OPTION FLEXIBILITY

MPO (MTP®)
High-density connectors for panel applications and minimal keep-out areas on the board
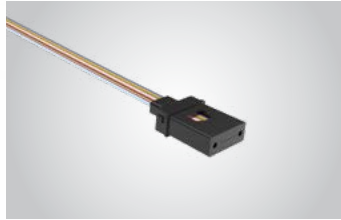
MT
Low insertion force connectors for high-density cabling and backplane applications

MXC®
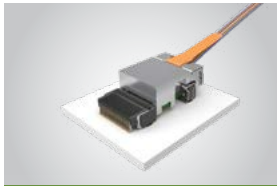High-density connectors for front panel or backplane applications

U-SDI Interface
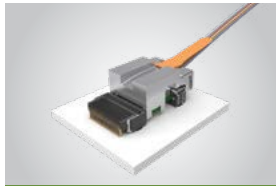BNC-type connector with optical MT ferrule for ultra-high density applications
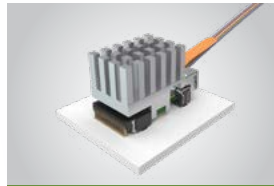
HEAT SINK FLEXIBILITY

Conduction Cooling

Flat

Grooved

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

Convection Cooling

PCIe® Pin Fin

PCIe® card height compliant

Standard Pin Fin

High-Performance

Accommodates applications with specific power and temperature requirements
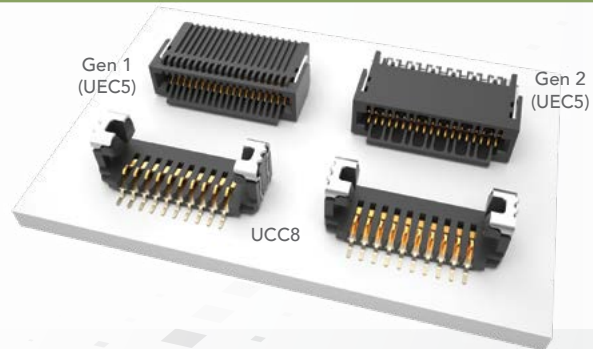
FIREFLY™ CONNECTOR SYSTEM

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
    (Backward compatible with all FireFly™ optical)

UCC8 - 0.80 mm Pitch Power & Communication

- Power pins & control signals

Gen 1 (UEC5)

Gen 2 (UEC5)

UCC8

APPLICATION FLEXIBILITY

Ideal for high-performance applications such as medical, test and measurement, FPGA and AI/HPC.

ROADMAP

Advanced Optics - Samtec is focused on bringing to market 112 Gbps PAM4 solutions that are scalable, manufacturable and cost-efficient.

Immersion Cooling - Capable of immersion for liquid cooled systems.

Direct Connect™ - On-package interconnect enables 56 Gbps PAM4 performance, eliminates distortion through the BGA region and improves density.

PCI EXPRESS®-OVER-FIBER

FIREFLY™ OPTICAL CABLE SYSTEM

- Transmits PCIe® Gen 3/4 data rates through FireFly™ optical up to 100 m

- Supports PCIe® protocol for low latency, power savings and guaranteed transmission

- Extended temperature version with a range of -40 °C to +85 °C

- 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

PCIe® card electromechanical height compliant heat sink

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

8 GTps	Gen 3 x4 Gen 3 x8 Gen 3 x16
16 GTps	Gen 4 x4 Gen 4 x8 Gen 4 x16

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

| SERIES	SPEED	WIDTH	CABLE LENGTH
PCUO	**-G3** = Gen 3 speed **-G4** = Gen 4 speed	**-04** = x4 **-08** = x8	**-"XXX"** = 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 3/4 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
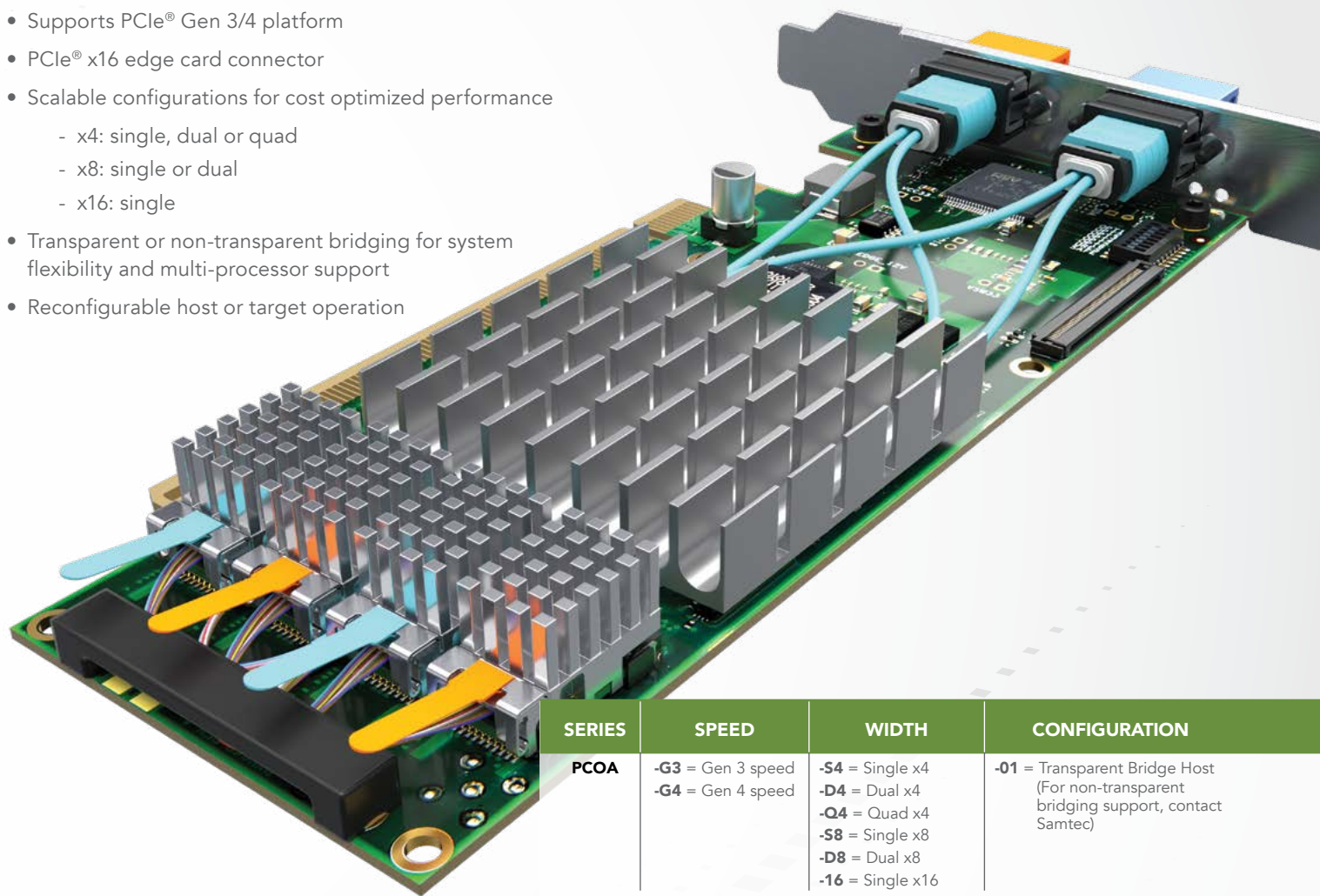
SERIES	SPEED	WIDTH	CONFIGURATION
PCOA	**-G3** = Gen 3 speed **-G4** = Gen 4 speed	**-S4** = Single x4 **-D4** = Dual x4 **-Q4** = Quad x4 **-S8** = Single x8 **-D8** = Dual x8 **-16** = Single x16	**-01** = Transparent Bridge Host (For non-transparent bridging support, contact Samtec)

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.
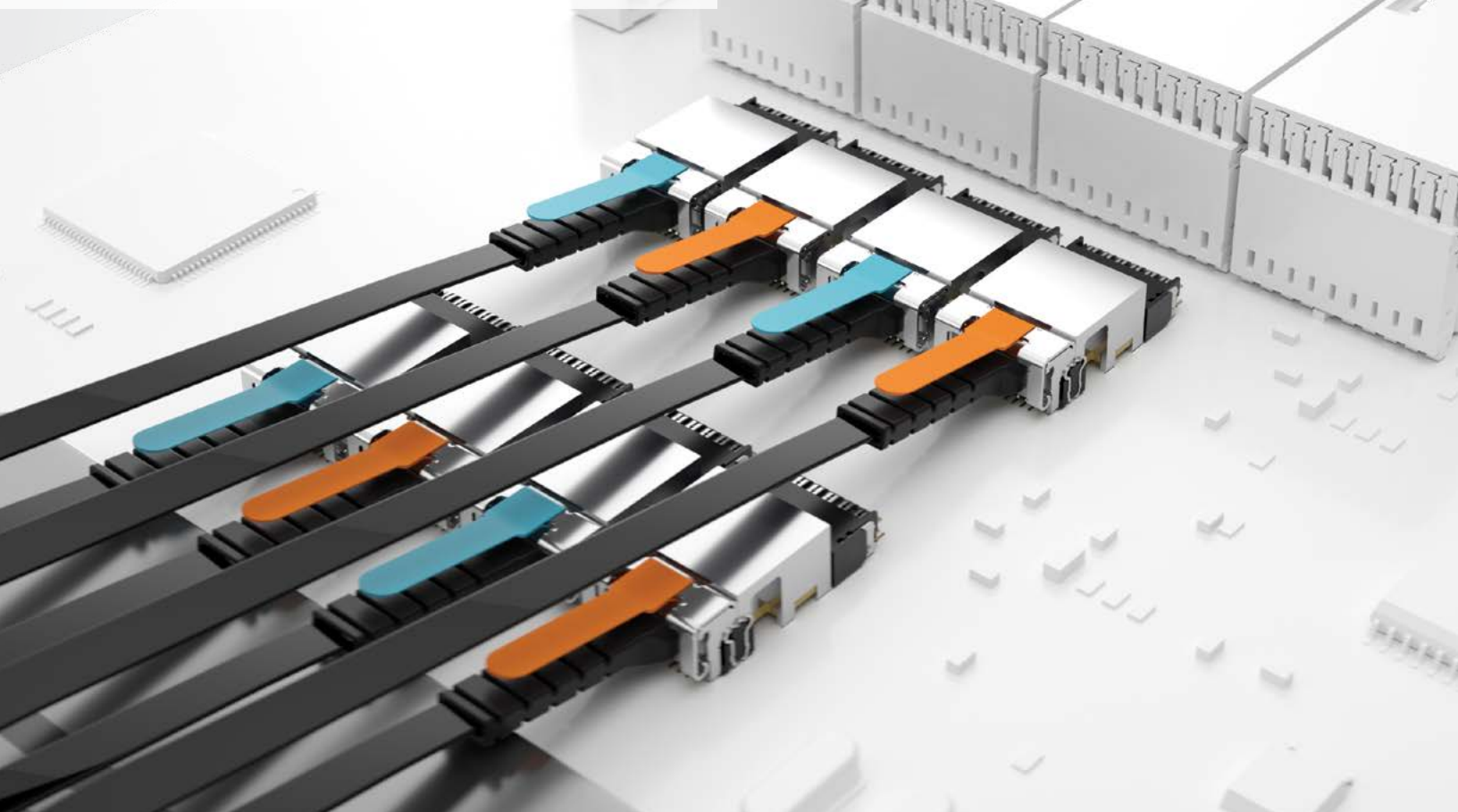
EXTENDED TEMP FIREFLY™

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

- Demonstrated error-free transmission during applied external vibrations and shock test to methods specified in MIL-STD-810

- Variety of integral heat sinks provide optimal cooling for thermal operating conditions

- Multiple end options available, including MT38999, MTP®, MXC®, ARINC 801, VITA 66.X and other common rugged interfaces

| **10** G b p s	x4 x12
25 G b p s	x4

SERIES	WIDTH	DATA RATE	OVERALL LENGTH	0	HEAT SINK	1	FIBER TYPE	END OPTION*		
ETUO	**-T12** = x12 Tx Transceiver **-R12** = x12 Rx Receiver **-U12** = x12 Tx to Rx **-Y12** = x12 Duplex (Y Configuration) **-B04** = x4 Duplex	**-10** = 10.3125 Gbps	**-"XXX"** = 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)		**-1** = Flat **-2** = Pin Fin **-3** = Flat with 3-ribbon pass-through **-4** = PCIe® Pin Fin **-5** = High-Performance Pin Fin (x4 only)		**-5** = Jacketed ribbon with protective boot **-6** = Jacketed ribbon	-Y12 requires 24 fibers		
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*These are standard options. See page 9 for other end options available.
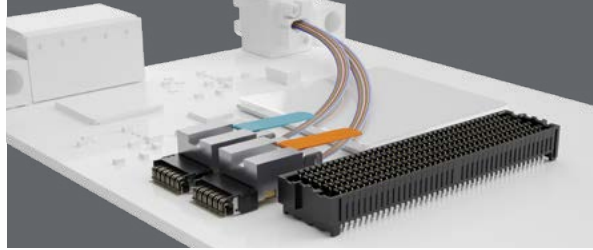
END OPTION FLEXIBILITY

Samtec and partners combine FireFly™ with a variety of rugged end 2 options, including:
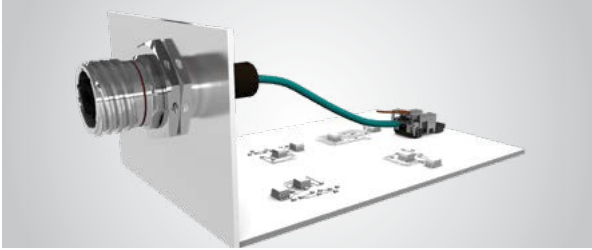
Amphenol® MT38999

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


VITA 66.X Interface

- Extended Temp FireFly™ with MT ferrule attach to blind mate fiber optic interconnects for use in VPX backplanes and plug-in modules
- Ideal for ruggedized, embedded computing 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 photo courtesy of Amphenol® Aerospace | Optik-D™ Series photo courtesy of Positronic®
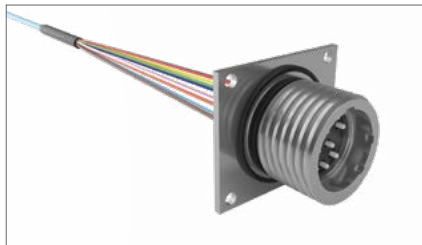
RUGGEDIZATION CAPABILITIES

- Tin whisker mitigation
- Conformal coating
- Salt fog testing
- Extreme vibration
- MIL-STD testing
- Fungal resistant

For more information, please contact **FireFly@samtec.com**

APPLICATION FLEXIBILITY

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

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 Gbps	x4 Bidirectional ECUE x12 Unidirectional ECUE
PAM4	
56 Gbps	x4 Bidirectional ECUE-2

Flyover® QSFP28 and QSFP Double Density end 2 options available

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

PCI Express®-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

KITS

EVALUATION & 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** or contact **KitsAndBoards@samtec.com**.

28 Gbps FireFly™ Evaluation Kit

Samtec's 28 Gbps FireFly™ Evaluation Kit offers an easy-to-use platform for testing and real-time evaluation of the FireFly™ Micro Flyover System™. The kit supports copper or optical FireFly™ in x4, x8 or x12 configurations. (Samtec P/N: REF-209623-01)
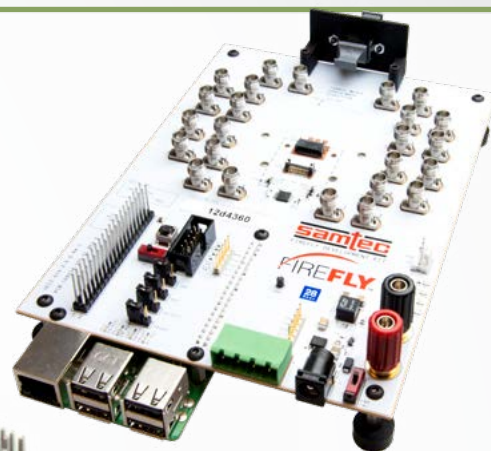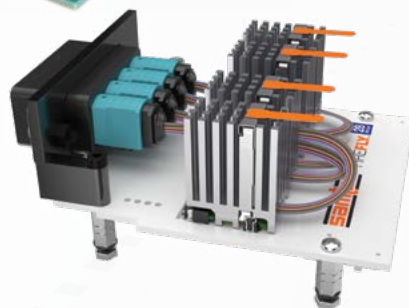
14 Gbps FireFly™ FMC Development Kit

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)
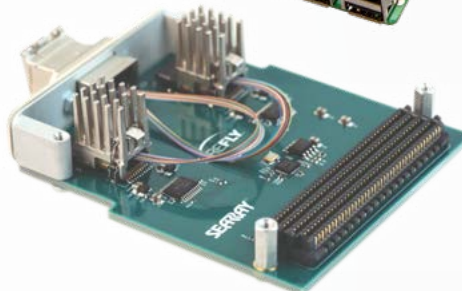
25/28 Gbps FireFly™ FMC+ Development Kit

Samtec's 25/28 Gbps FireFly™ FMC+ Module is VITA 57.4 compliant and provides up to 400/448 Gbps full-duplex bandwidth over 16 channels from an FPGA to an industry-standard multi-mode fiber optic cable. (Samtec P/N: REF-200772-XXX-XX-01)

25 Gbps FireFly™ FMC+ Development Kit (In development)

Samtec's 25 Gbps FireFly™ FMC+ Module is VITA 57.4 compliant and provides up to 300 Gbps full-duplex bandwidth over 12 channels from an FPGA to an industry-standard multi-mode fiber optic cable.

ECUE Flyover® SI Evaluation Kit

Samtec's ECUE Evaluation Kit routes eight high-precision differential pairs via UEC5-2/UCC8 series mating connectors, user-selected twinax cable lengths and 2.4 mm RF connectors. (Samtec P/N: REF-201830-XX)

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SUDDEN SERVICE®