FIREFLY™

APPLICATION DESIGN GUIDE

FIREFLY™
MICRO FLYOVER SYSTEM™

FUTURE-PROOF MICRO FOOTPRINT

Flexibility of copper and optical using the same micro connector allows for increased density, simplified PCB and reduced power dissipation.

HIGH PERFORMANCE VERSATILITY

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.

EASE OF USE

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

RUGGEDNESS

Variety of rugged options ideal for harsh environmental applications.
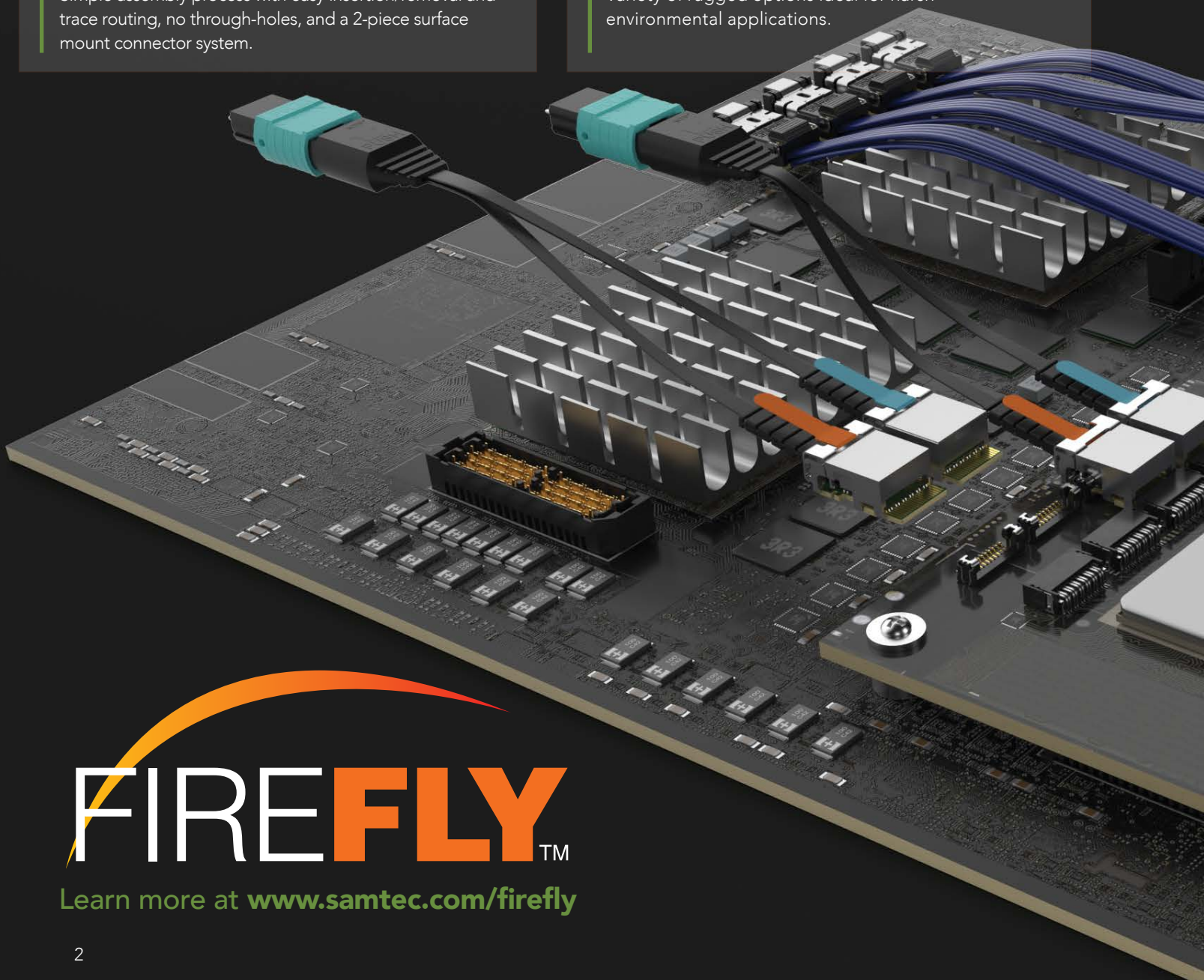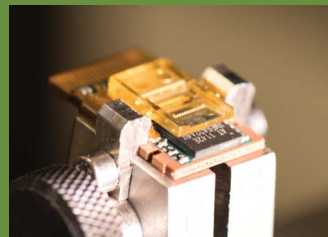
FIRE**FLY**™

Learn more at **www.samtec.com/firefly**

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**.

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COMMERCIAL FIREFLY™

FIRE**FLY**™

Actual Size

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

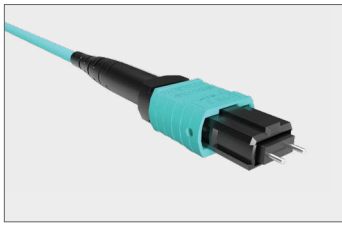| 14 Gbps | x4 x12 | 25 Gbps | x4 x12 |
| 16 Gbps | x12 | 28 Gbps | x4 |

ECUO	WIDTH	DATA RATE	CABLE LENGTH	0	HEAT SINK	1	FIBER TYPE	END 2 OPTIONS*
	–B04 = 4 Tx + 4 Rx **–T12** = 12 Tx **–R12** = 12 Rx **–Y12** = 12 Tx + 12 Rx **–U12** = 12 Channel AOC (Unidirectional)	**–14** = 14 Gbps per lane **–16** = 16.1 Gbps per lane (N/A –B04) **–25** = 25.7 Gbps per lane **–28** = 28.1 Gbps per lane (–B04 only)	**–"XXX"** = Overall Length in Centimeters		**–1**= Flat **–2** = Pin-fin (–14 & –16 only) **–3** = Flat with groove **–4** = PCIe® Pin-fin (–14 & –16 only) **–5** = 1.75 cm tall Pin-fin (–B04 only)		**–4** = Aqua loose tube with Boot **–5** = Jacketed ribbon with boot **–6** = Jacketed ribbon **–7** = Black loose tube with boot **–8** = Black loose tube	-Y12 requires -2X end option (Leave blank for -U12) **12 Fibers** **–01** = MTP® Male **–02** = MTP® Female **–07** = MXC® Internal Plug **–0E** = MPO Plus®, Male, bayonet **24 Fibers** **–21** = MTP® Male **–22** = MTP® Female **–27** = MXC® Internal Plug **–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
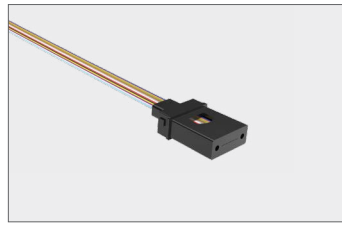
4 Depress latch to lock
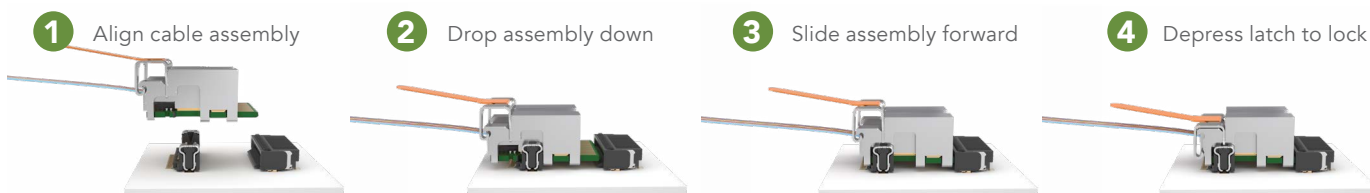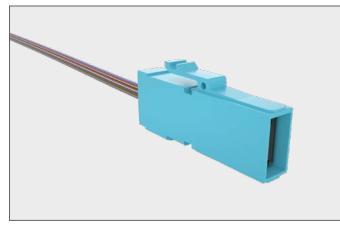
END OPTION FLEXIBILITY

MPO (MTP®)
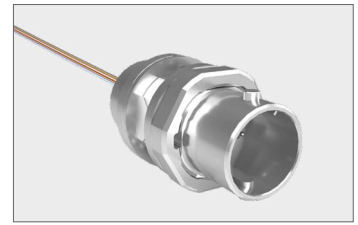High-density connectors for panel applications and minimal keep-out areas on the board

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

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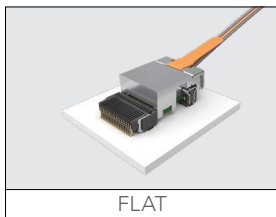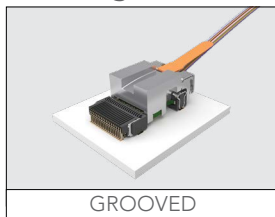High-density connectors for front panel or backplane applications

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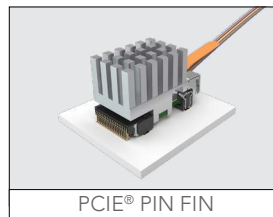
HEAT SINK FLEXIBILITY
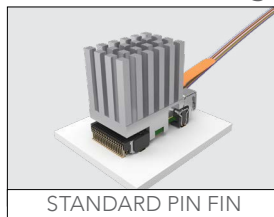
Conduction Cooling

FLAT	GROOVED

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

Convection Cooling

PCIE® PIN FIN	STANDARD PIN FIN	HIGH-PERFORMANCE

PCIe® card height compliant

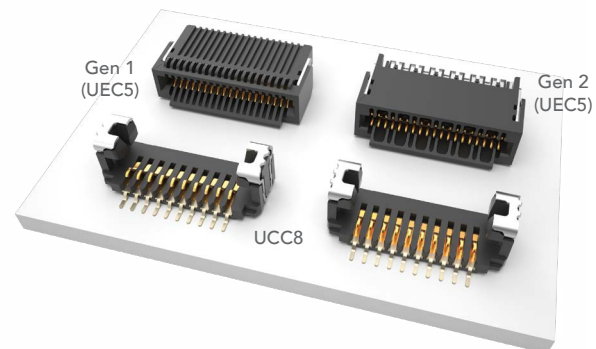Accommodates applications with specific power and temperature requirements
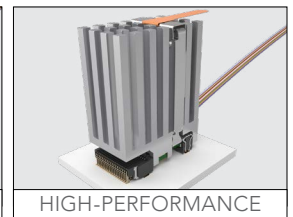
FIREFLY™ CONNECTOR SYSTEM

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

APPLICATION FLEXIBILITY

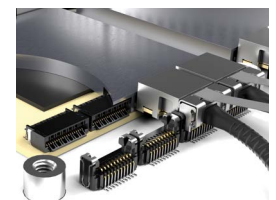Ideal for high-performance applications such as medical, test and measurement, FPGA and AI/HPC.

ROADMAP

Advanced Optics - Samtec is focused on bringing to market 112 Gbps PAM4 solutions that are scalable, manufacturable and cost-efficient.
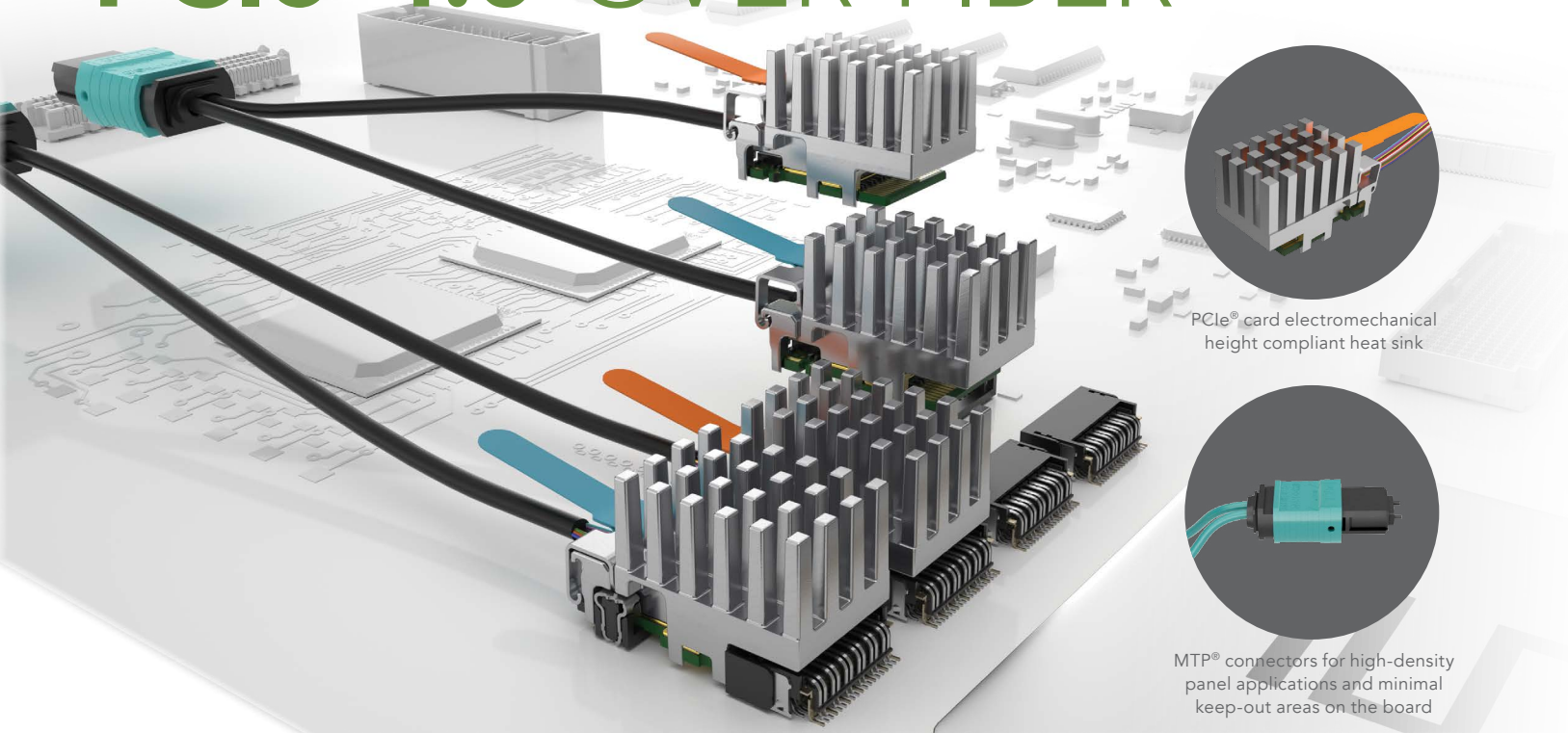
Immersion Cooling - Capable of immersion for liquid cooled systems.

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

PCIe® 4.0-OVER-FIBER

PCIe® card electromechanical height compliant heat sink

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

FIREFLY™ OPTICAL CABLE SYSTEM

- Transmits PCIe® 3.0/4.0 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

| 8 GTps | PCIe® 3.0 x4 PCIe® 3.0 x8 PCIe® 3.0 x16 | 16 GTps | PCIe® 4.0 x4 PCIe® 4.0 x8 PCIe® 4.0 x16 |

PCUO	WIDTH	SPEED	CABLE LENGTH	0	HEAT SINK	1	FIBER TYPE	END 2 OPTIONS
	–04 = x4 Lanes	–G4 = 4.0	–"XXX"		–1 = Flat		–7 = Black loose tube with boot	(–08 width requires –2X end option)
	–08 = x8 Lanes		= Overall Length in Centimeters		–4 = PCIe® Pin-fin		–8 = Black loose tube	–01/–21 = MTP® Male

For PCIe® 3.0 support, contact Samtec.
**PCI-SIG®, PCI Express® and the PCIe® design marks are registered trademarks and/or service marks of PCI-SIG.

TARGET APPLICATIONS

Ideal for high-density applications such as ATE, broadcast video, mil/aero and factory automation.
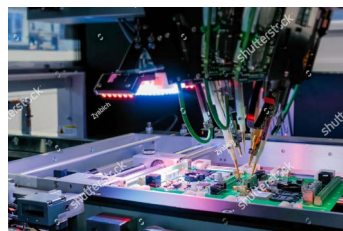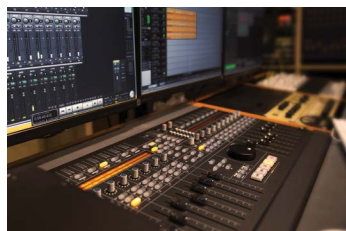
ADAPTOR CARD WITH FIREFLY™

- Uses PCUO FireFly™ optical cable for clear signal transmissions with increased reach and cost optimization

- Supports PCIe® 3.0/4.0 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
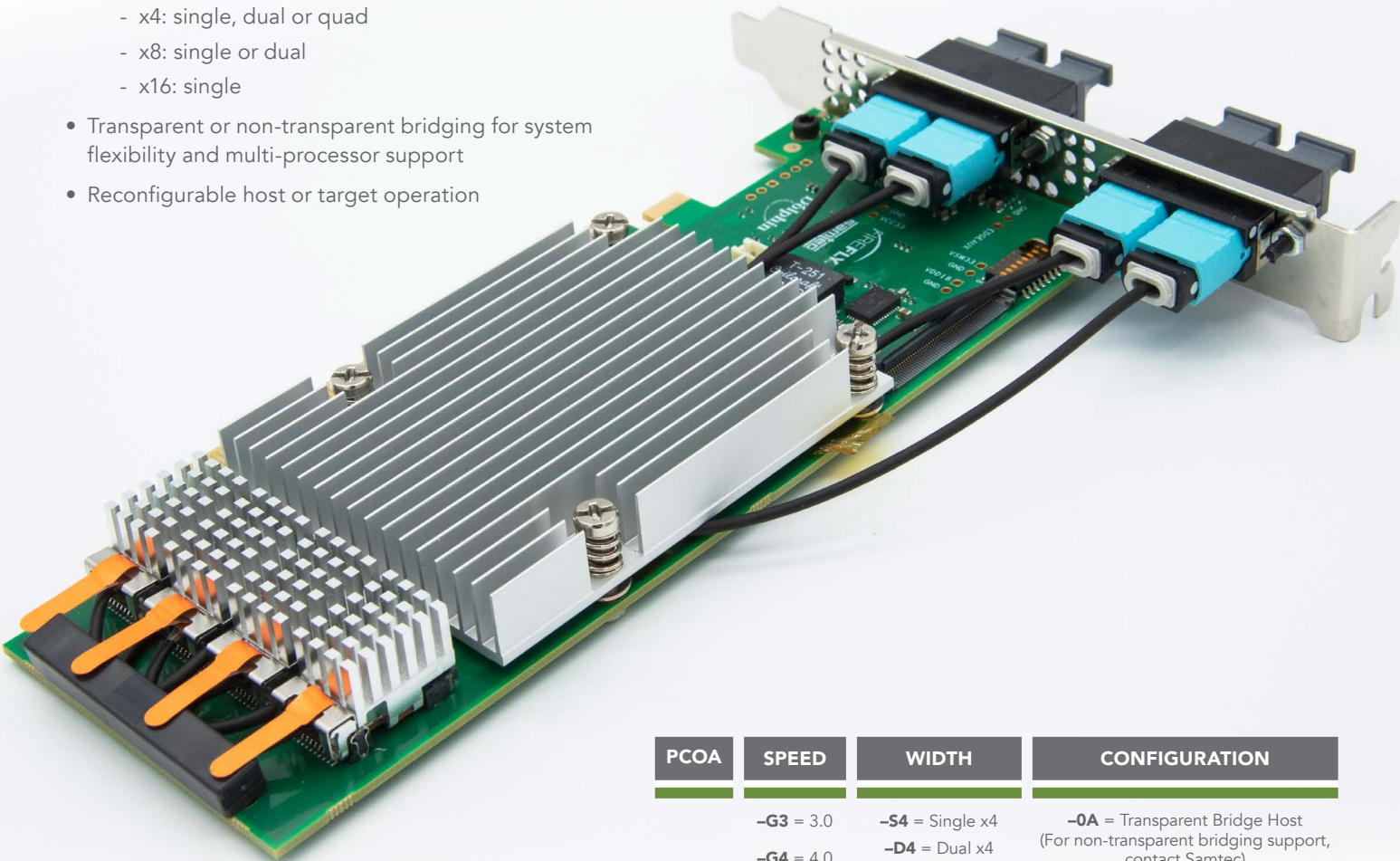
PCOA	SPEED	WIDTH	CONFIGURATION
	–G3 = 3.0	**–S4** = Single x4	**–0A** = Transparent Bridge Host (For non-transparent bridging support, contact Samtec)
	–G4 = 4.0	**–D4** = Dual x4	
		–Q4 = Quad x4	
		–S8 = Single x8	
		–D8 = Dual x8	
		–16 = Single x16	

APPLICATION FLEXIBILITY

The Adaptor Card enables computer-to-computer or computer-to-endpoint communications over long distances, and is ideal for high-performance and data quality applications including: AI and HPC, rugged embedded computing, video broadcast, machine vision, optical inspection, data acquisition and factory automation.

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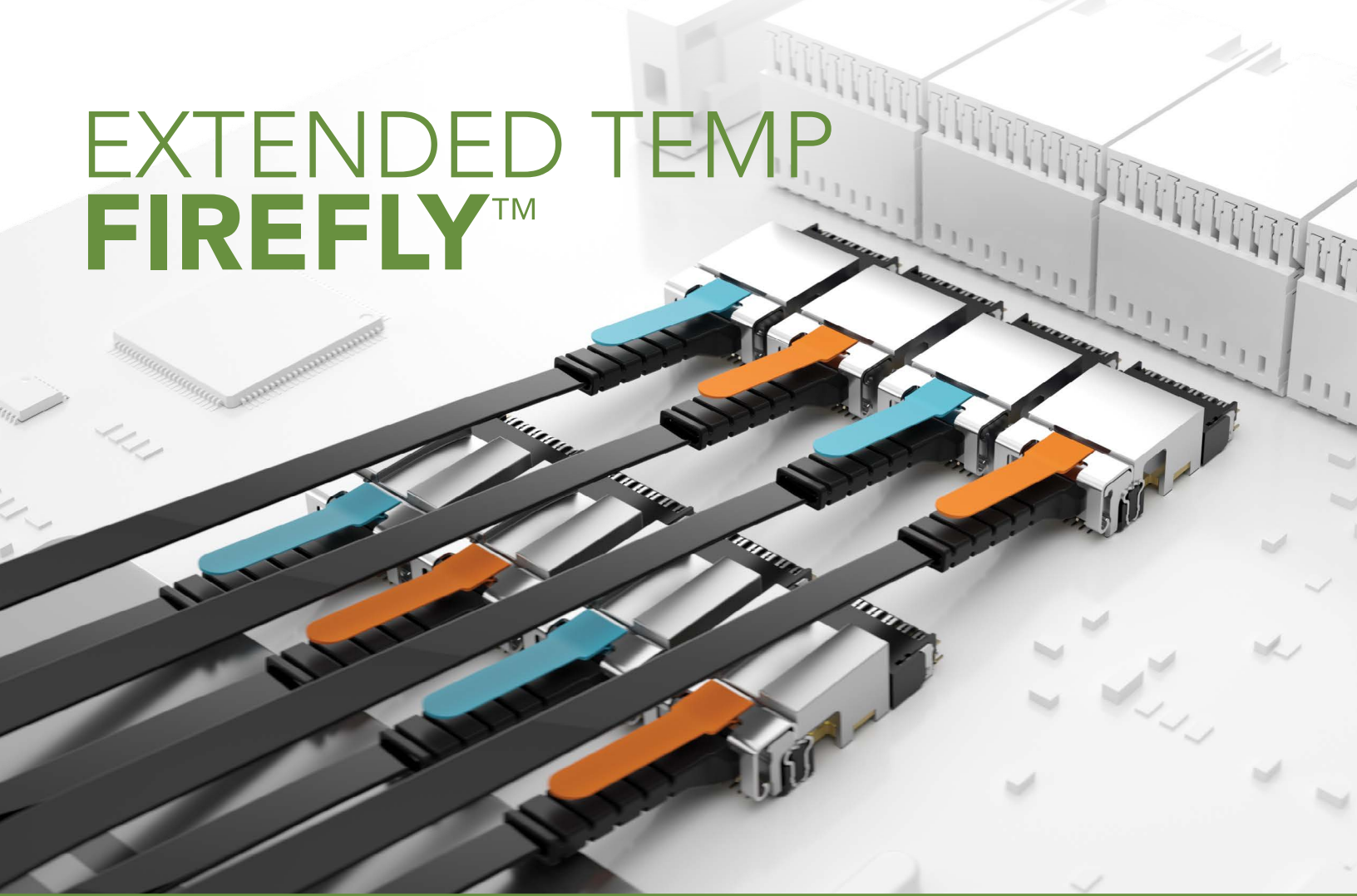
Extended temperature range from -40 °C to +85 °C for military, aerospace and industrial applications

- 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®, Glenair® Series 79, VITA 66.X and other common rugged interfaces

10 Gbps	x4 x12
25 Gbps	x4

ETUO	WIDTH	DATA RATE	CABLE LENGTH	0	HEAT SINK	1	FIBER TYPE	END 2 OPTIONS*
	–B04 = 4 Tx + 4 Rx **–T12** = 12 Tx **–R12** = 12 Rx **–Y12** = 12 Tx + 12 Rx **–U12** = 12 Channel AOC (Unidirectional)	**–10** = 10.3125 Gbps **–25** = 25.7 Gbps (–B04 only)	**–"XXX"** = Overall Length in Centimeters		**–1** = Flat **–2** = Pin-fin **–3** = Flat with groove **–4** = PCIe® Pin-fin (–10 only) **–5** = 1.75 cm tall Pin-fin (–B04 only)		**–5** = Jacketed ribbon with boot **–6** = Jacketed ribbon **–7** = Black loose tube with boot **–8** = Black loose tube	-Y12 requires -2X end option (Leave blank for -U12) **12 Fibers** **–01** = MTP® Male **–02** = MTP® Female **–07** = MXC® Internal Plug **–0A** = VITA 66.X Ready **–0C** = MT38999 Male **–0E** = MPO Plus®, Male, bayonet **24 Fibers** **–21** = MTP® Male **–22** = MTP® Female **–27** = MXC® Internal Plug **–2A** = VITA 66.X Ready **–2C** = MT38999 Male **–2E** = MPO Plus®, Male, bayonet

*These are standard options. See page 9 for other end options available.
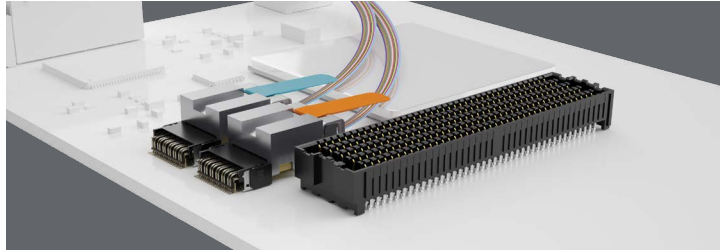
END OPTION FLEXIBILITY

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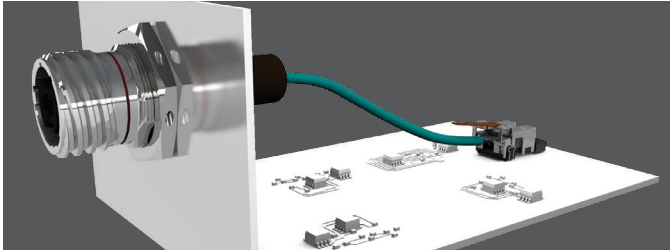
Amphenol® MT38999

- Samtec's Extended Temp FireFly™ optical with Amphenol® Aerospace bulkhead interconnects (MT38999) for rugged, 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

Glenair® Series 79 MT Connector

- Samtec's Extended Temp FireFly™ optical with Glenair® Series 79 MT fiber optic connector
- Features ultra miniature size, reduced weight, shielding and environmental protection
- Ideal for military, aerospace and industrial applications

RUGGED ENVIRONMENT CAPABILITIES

- Tin whisker mitigation
- Conformal coating
- Salt fog testing
- Extended shock and vibration

- MIL-STD testing
- Fungal resistant
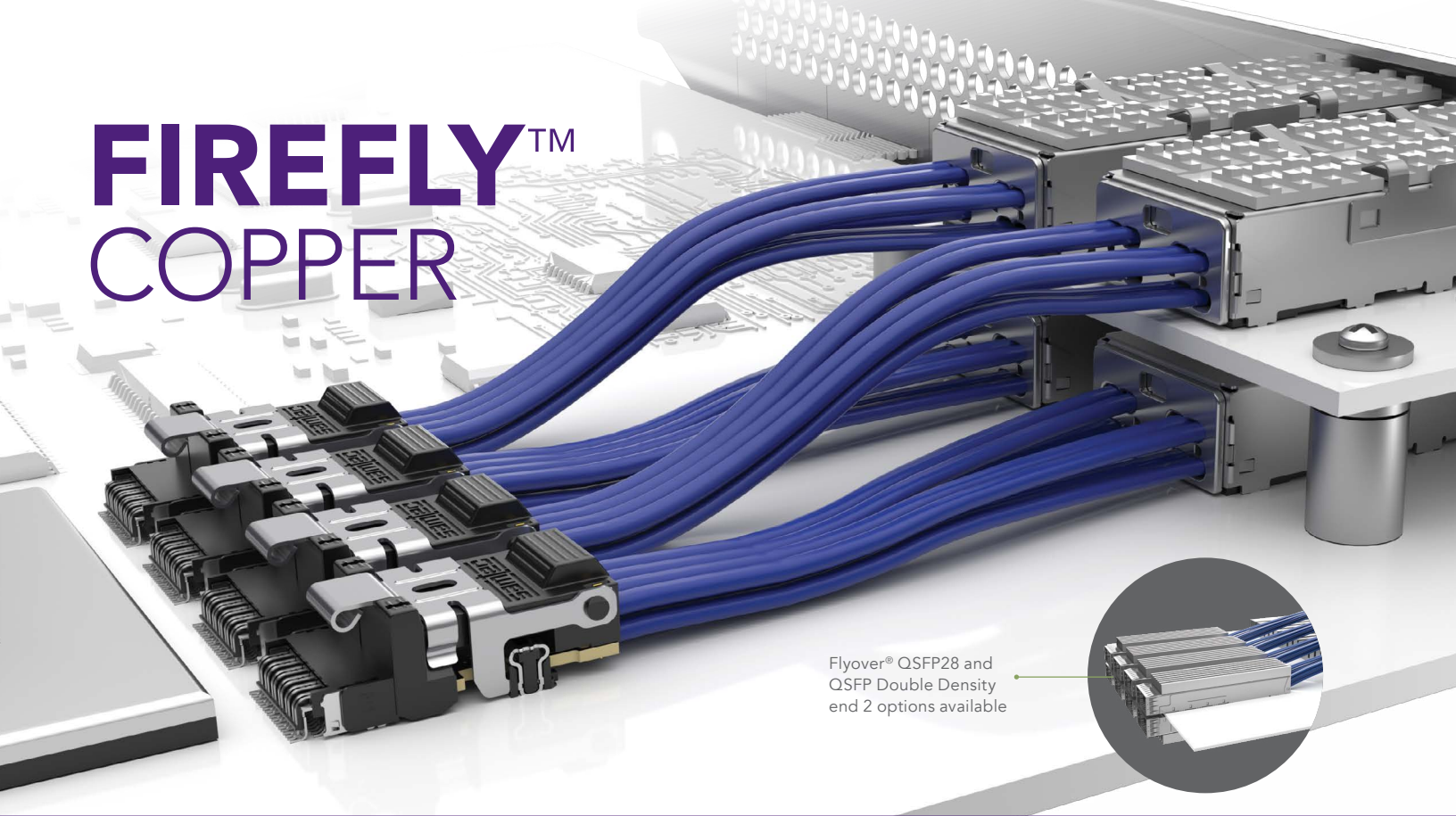- Extended temperature ranges
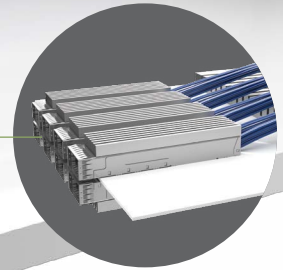- Additional ruggedization capabilities
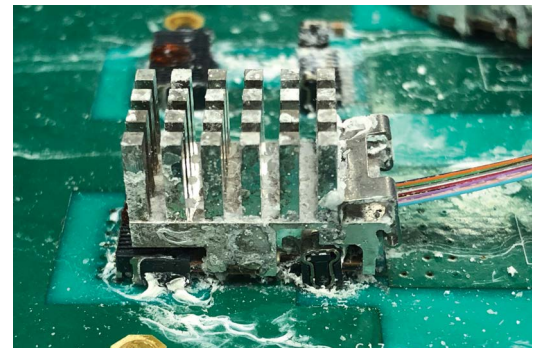
APPLICATION FLEXIBILITY

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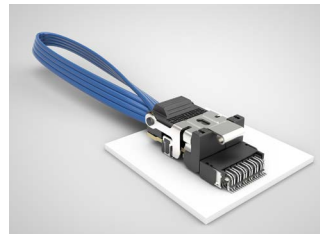
FIREFLY™
COPPER

Flyover® QSFP28 and
QSFP Double Density
end 2 options available

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
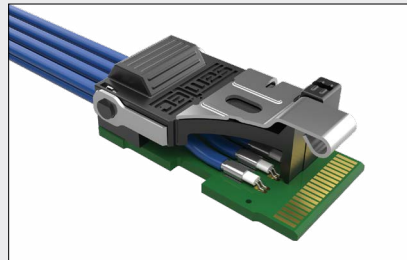- FireFly™ loopback cable assemblies available for testing and debugging

FireFly™ Loopback Cable Assembly
(HDR-190945-01-ECUE shown)

PAM4

| **56** Gbps | x4 Bidirectional ECUE-2 |

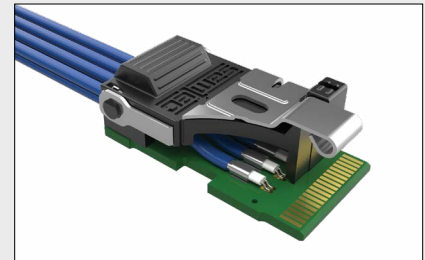| **14** Gbps | x4 Bidirectional ECUE
x12 Unidirectional ECUE |
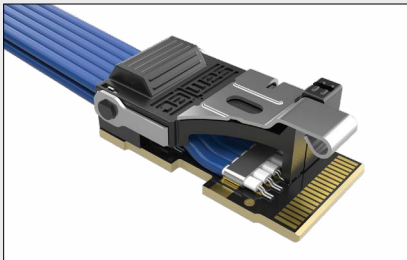
Standard Copper (ECUE)
- 14 Gbps
- 100 Ω, 34 AWG or 36 AWG Eye Speed® twinax cable

Optimized Copper (ECUE-2)
- 28 Gbps NRZ/56 Gbps PAM4 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)
- PCIe® 4.0 capable
- 100 Ω, 34 AWG Eye Speed® ultra low skew twinax cable
- Optimized for use with connector UEC5-2

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.
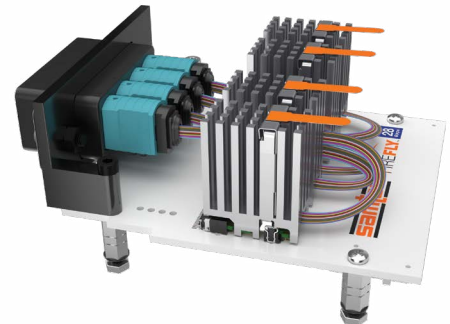(Samtec P/N: REF-209623-01)
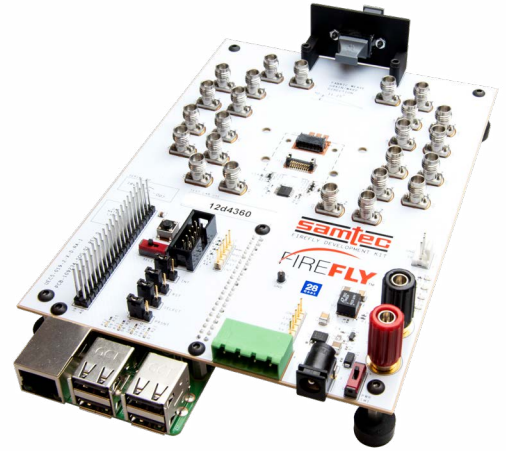
14 Gbps FIREFLY™ FMC DEVELOPMENT KIT

Samtec's 14 Gbps FireFly™ FMC Development Kit is VITA 57.1 electrically 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)
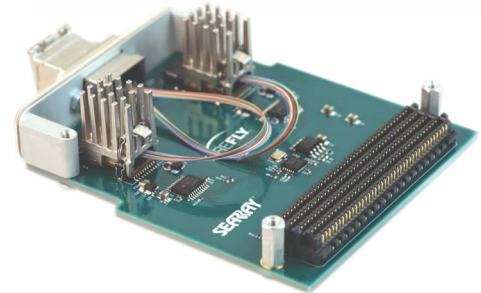
25/28 Gbps FIREFLY™ FMC+ DEVELOPMENT KIT

Samtec's 25/28 Gbps FireFly™ FMC+ Module is VITA 57.4 electrically 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

Samtec's 25 Gbps FireFly™ FMC+ Module is VITA 57.4 electrically 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.
(Samtec P/N: REF-223064-01)

ECUE FLYOVER® SI EVALUATION KIT

Samtec's ECUE Evaluation Kit routes eight high-speed differential pairs via UEC5-2/UCC8 series mating connectors, user-selected twinax cable lengths and 2.40 mm RF connectors.
(Samtec P/N: REF-201830-XX)

samtec
SUDDEN SERVICE®
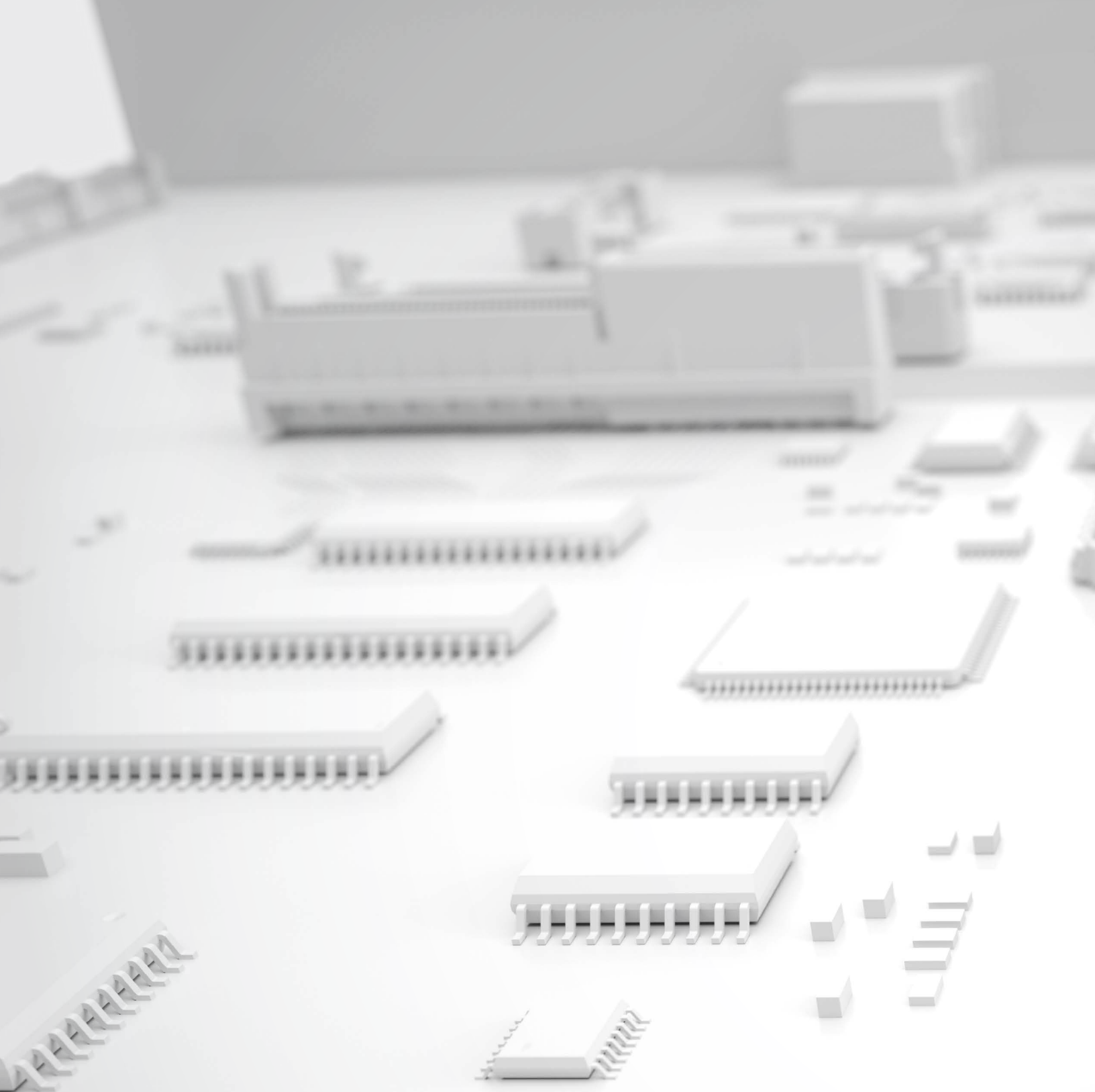
UNITED STATES · NORTHERN CALIFORNIA · SOUTHERN CALIFORNIA · SOUTH AMERICA · UNITED KINGDOM · GERMANY · FRANCE · ITALY
NORDIC/BALTIC · BENELUX · ISRAEL · INDIA · AUSTRALIA / NEW ZEALAND · SINGAPORE · JAPAN · CHINA · TAIWAN · HONG KONG · KOREA