



# 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

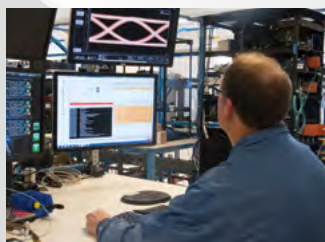
Data “flies” over lossy PCB for up to 28 Gbps per lane with a path to 56 Gbps via optical cable at greater distances – or copper for shorter reach.

### EASE OF USE

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

### 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 [Optics@samtec.com](mailto:Optics@samtec.com).





**FIREFLY™ OPTICAL SYSTEMS**

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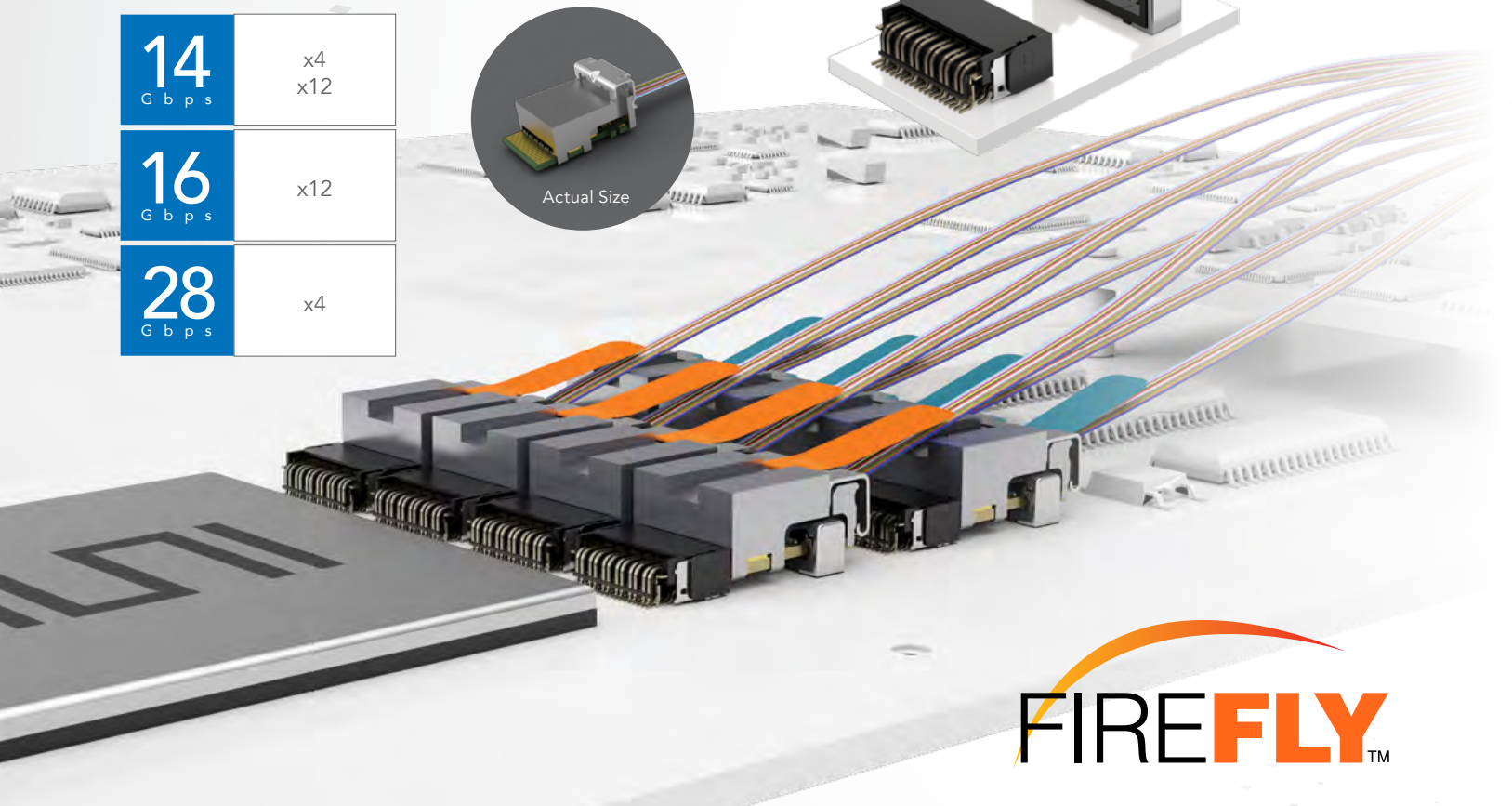
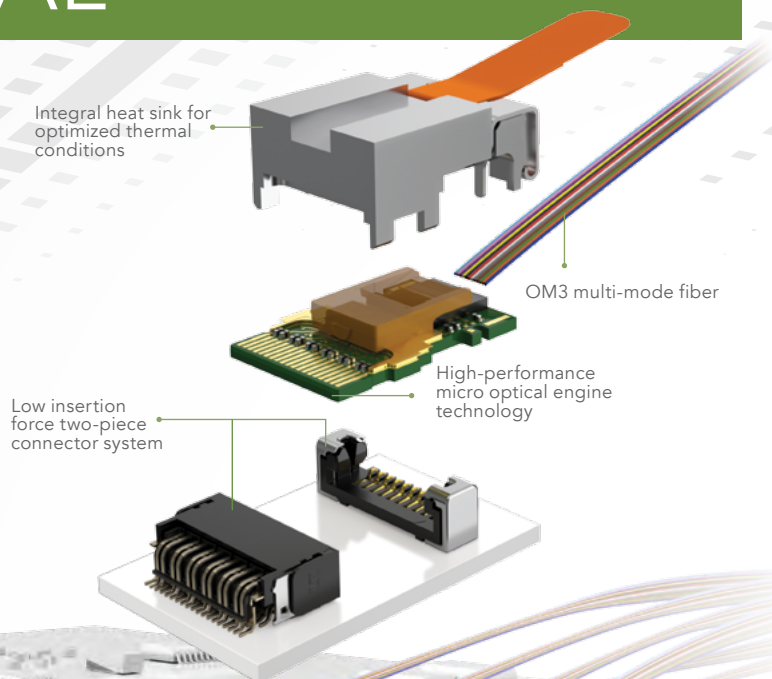
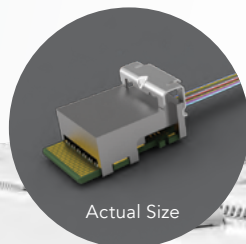
Learn more at  
[www.samtec.com/firefly](http://www.samtec.com/firefly)

# 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, and a surface mount connector system with no screws required
- Supports data center and HPC protocols, including Ethernet, InfiniBand™ and Fibre Channel

14 Gbps	x4 x12
16 Gbps	x12
28 Gbps	x4



**FIREFLY™**

SERIES	WIDTH	DATA RATE	OVERALL LENGTH	0	HEAT SINK	1	FIBER TYPE	END OPTION
ECUO	-U12 = x12 Tx to Rx Simplex Optical -T12 = x12 Tx Simplex Optical -R12 = x12 Rx Simplex Optical -Y12 = x12 Duplex Optical (Y Configuration) -B04 = x4 Duplex Optical	-14 = 14 Gbps (168 Gbps aggregate) -16 = 16 Gbps (x12 only; 192 Gbps aggregate) -28 = 28 Gbps (x4 only; 112 Gbps aggregate)	-“XXX” = Overall Length in Centimeters (008 cm - 999 cm) (Minimum length will depend on fiber type and End 2 option specified)	-1 = Flat -2 = Pin-Fin (-14 data rate only) -3 = Flat with 3-ribbon pass-through -4 = PCIe® Pin-Fin	-1 = OM3 Low Bend Radius Ribbon -2 = OM3 Low Bend Radius Loose Tube	Leave blank for -U12. -Y12 requires 24 fibers		
							<b>12 Fibers</b> -01 = MTP®, male -02 = MTP®, female -03 = MPO, male -04 = MPO, female -05 = MT male -06 = MT female	<b>24 Fibers</b> -21 = MTP®, male -22 = MTP®, female -23 = MPO, male -24 = MPO, female -25 = MT male -26 = MT female

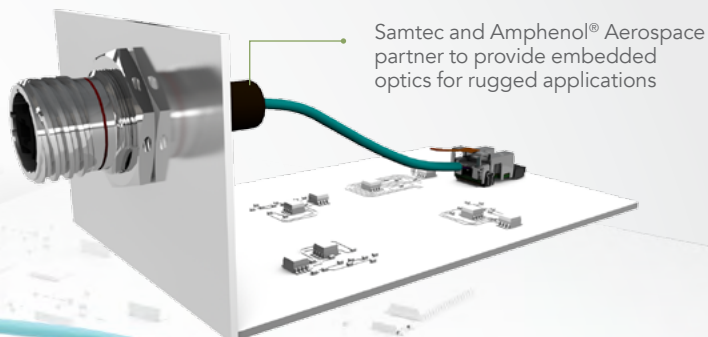
\*MTP® is a registered trademark of US Conec Ltd.



# EXTENDED TEMP FIREFLY™

**Extended temperature range  
from -40 °C to +85 °C**

- 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
- MT38999, MTP® and MPO end options



**10**  
G b p s

x4  
x12



Extended temperature FireFly™ is ideal for military and industrial applications

SERIES	WIDTH	DATA RATE	OVERALL LENGTH	0	HEAT SINK	1	FIBER TYPE	END OPTION	
ETUO	-T12 = x12 Tx Simplex Optical -R12 = x12 Rx Simplex Optical -U12 = x12 Tx to Rx Simplex Optical -Y12 = x12 Duplex Optical (Y Configuration)	-10 = 10 Gbps	-"XXX" = Overall Length in Centimeters (008 cm - 999 cm) (Minimum length will depend on fiber type and End 2 option specified)	-1 = Flat -2 = Pin-Fin -3 = Flat with 3-ribbon pass-through -4 = PCIe® Pin-Fin		-1 = OM3 Low Bend Radius Ribbon -2 = OM3 Low Bend Radius Loose Tube	Leave blank for -U12. -Y12 requires 24 fibers		
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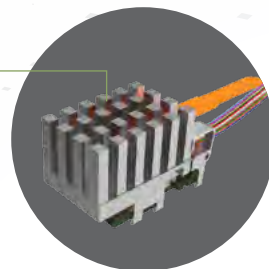
\*PCI-SIG®, PCI Express® and the PCIe® design marks are registered trademarks and/or service marks of PCI-SIG.

# PCIe®-OVER-FIREFLY™

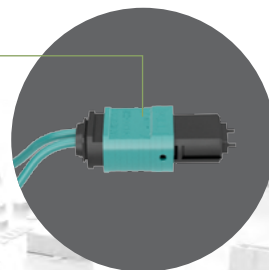
Transmits PCIe® signals at Gen 3 data transfer rates through FireFly™ optical up to 100 m

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

PCIe® card electromechanical compliant heat sink



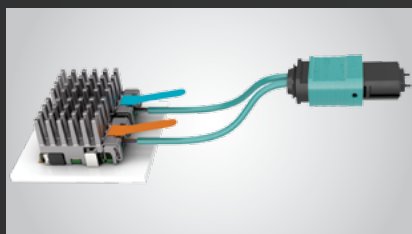
MPO connectors for high-density panel applications and minimal keep-out areas on the board



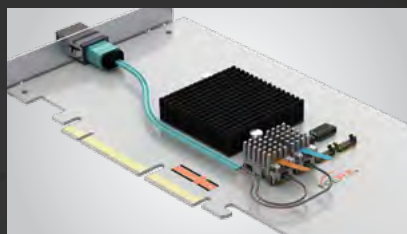
8  
G T p s

Gen 3 x4  
Gen 3 x8  
Gen 3 x16

SERIES	LANES	SPEED	CABLE LENGTH
PCUO	-04 -08	-G3 = Gen 3 speed	-"XXX" = Overall Length in Centimeters (007 cm - 999 cm)



Extended Temperature PCIe®-Over-FireFly™ (PTUO Series)



Host/Target adaptor card supporting transparent and non-transparent bridge links



# ACTIVE & PASSIVE OPTICS

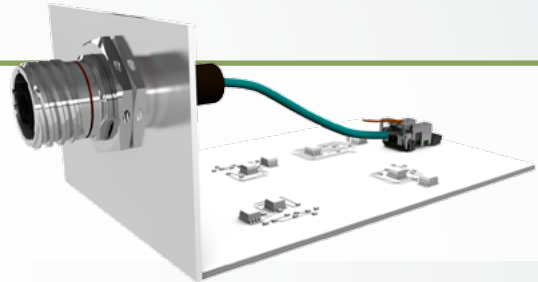
## BNC-TYPE OPTICAL SOLUTION

- ARIB BNC-type interface with MT ferrule
- Developed for broadcast video applications



## RUGGED OPTICAL SOLUTION

- Samtec and Amphenol® Aerospace partner to combine extended temperature FireFly™ optical with bulkhead interconnects (MT38999) for rugged, passive optical solutions
- Developed for industrial and military applications



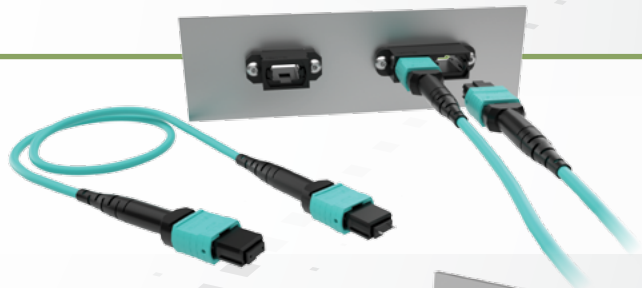
## VITA 66.4

- Pentek Flexor® 5973 VIRTEX® -7 processor and FMC carrier board (3U VPX) with two x12 optical FireFly™ for up to 14 Gbps per channel
- Enables gigabit backplane communications between boards independent of the PCIe® interface



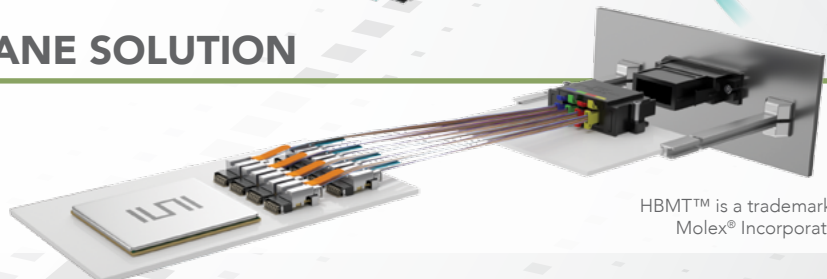
## INDUSTRY STANDARD SOLUTIONS

- Industry standard passive MPO to MPO panel adaptor (OPA Series) and optical patch cable (FOPC Series)
- Compliant with TIA-604-5-D (FOCIS 5) and IEC-61754-7 specifications



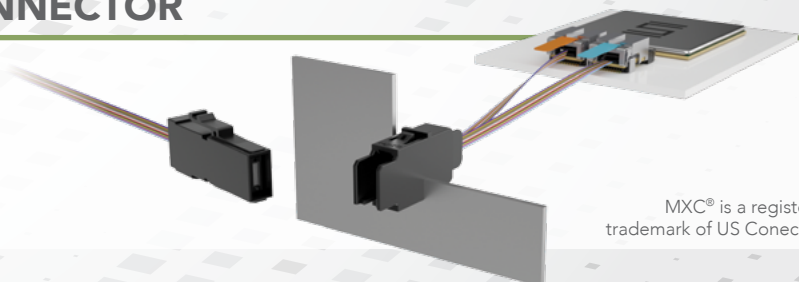
## GANGED OPTICAL BACKPLANE SOLUTION

- Compatible with optical backplane systems such as Molex® HBM™
- Multiple configurations available



## LOW INSERTION FORCE CONNECTOR

- FireFly™ is compatible with MXC® connectors as a cost-effective, high-density solution for front panel or backplane applications
- High-reliability for direct interfacing with embedded, mid-board optics



# APPLICATIONS

High-speed interconnect expertise, in-house microelectronics capabilities, and leading edge innovations such as the ultra-micro FireFly™ optical system make Samtec an ideal partner to help take a silicon application design to the next level.

## DEVELOPMENT SOLUTIONS

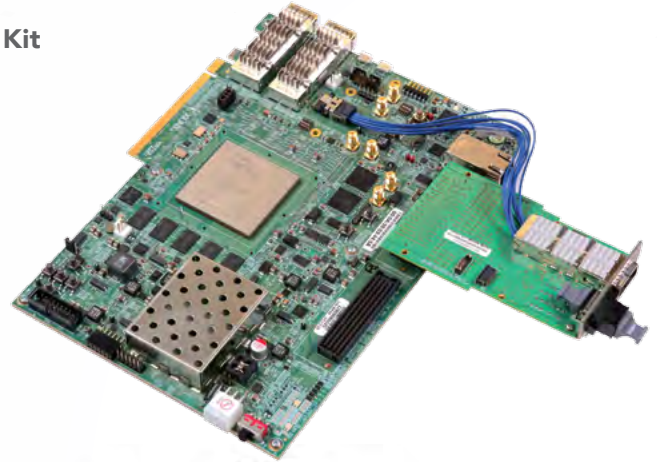
### Xilinx® Virtex® UltraScale+™ FPGA VCU118 Development Kit

VCU118 Board:

- 28G x4 FireFly™ optical assembly, optional
- FireFly™ loopback copper cable assembly
- FireFly™ 2-piece connector system
- VITA 57.4 FMC+ SEARAY™ socket connector
- VITA 57.1 FMC SEARAY™ socket connector

Active Loopback Card:

- Flyover QSFP28 to FireFly™ cable assembly
- VITA 57.4 FMC+ SEARAY™ terminal connector
- VITA 57.1 FMC SEARAY™ terminal connector



### Samtec FireFly™ Optical FMC Module

- 14G x10 FireFly™ optical assembly
- FireFly™ 2-piece connector system
- VITA 57.1 FMC SEARAY™ terminal connector



### Guzik Fiber Optics Bridge Card V2 Powered by Altera® Arria® 10 FPGA

- 14G x12 FireFly™ cable assembly
- FireFly™ 2-piece connector system



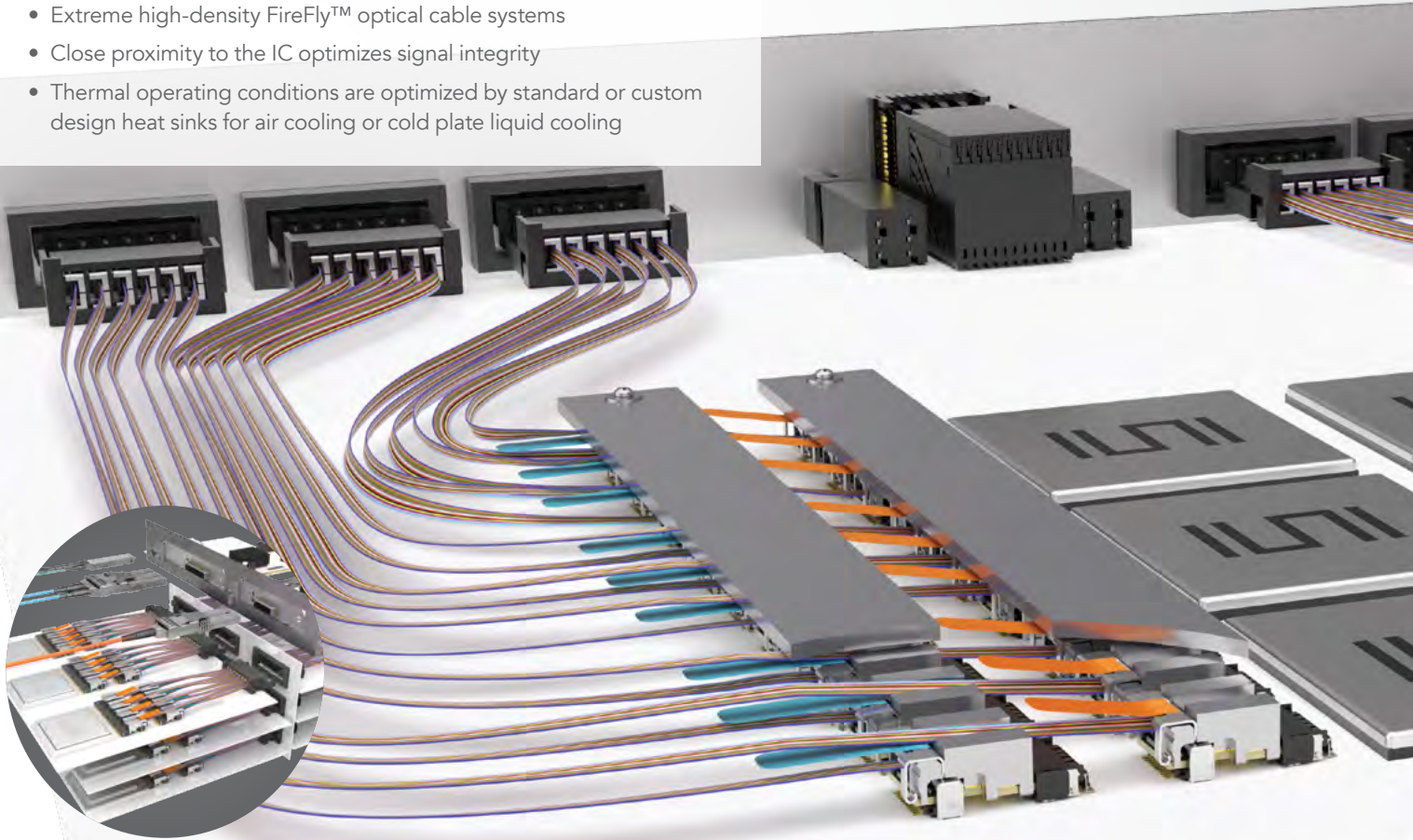
### Additional Solutions

- HiTech Global HTG-712 Virtex®-7 High-End Networking Card
- HiTech Global HTG-888 Virtex® UltraScale™ High-End Networking Card
- HiTech Global FireFly™ Module with Z-Ray® FPGA Interface
- PLDA Gen4SWITCH PCIe® 4.0 Platform Development Kit
- TechwaY TigerFMC+ Mezzanine Card
- TechwaY TigerFMC Mezzanine Card
- Alpha Data ADM-PCIE-8K5 Kintex® Ultrascale™ FPGA Development Board
- Alpha Data ADM-PCIE-9V3 Virtex® Ultrascale Plus™ FPGA Development Board
- Alpha Data ADM-PCIE-8V3 Virtex® Ultrascale™ FPGA Development Board
- 4DSP PC821 Virtex®/Kintex® UltraScale™ PCIe® Gen 3 Development Card
- Sundance SE100 Virtex® UltraScale™ FPGA Development Board
- Pentek Flexor® 5973 Virtex®-7 3U OpenVPX FMC Carrier Board
- Guzik Fiber Optics-to-PCIe® Bridge Card V1 Powered by Altera® Stratix® V GS FPGA
- ReFLEX CES Boards in development with FireFly™ and Altera® EDFA



## HIGH-DENSITY SOLUTIONS

- Extreme high-density FireFly™ optical cable systems
- Close proximity to the IC optimizes signal integrity
- Thermal operating conditions are optimized by standard or custom design heat sinks for air cooling or cold plate liquid cooling



## TESTING SOLUTIONS

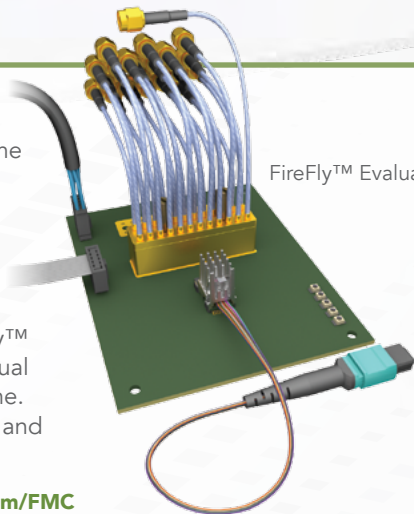
### FireFly™ Evaluation Kit (FIK-FIREFLY-XX)

Rated up to 28 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® system.

### FireFly™ Optical FMC Module

Samtec's FMC module features a 14G x10 optical FireFly™ system in an FMC VITA 57.1 form factor that can run actual system data or BERT testing all channels at the same time. This makes evaluation with a specific FPGA much easier and is an ideal substitute for 28G test equipment.

For more information go to [Samtec.com/FireFly](http://Samtec.com/FireFly) or [Samtec.com/FMC](http://Samtec.com/FMC)



FireFly™ Evaluation Kit



FireFly™ Optical FMC Module

# ADVANCED DESIGN SERVICES

Samtec has assembled a unique team of the industry's leading signal integrity engineers to support the extensive electrical design and analysis expertise required to optimize the bandwidth, performance and density of next generation high-performance systems.

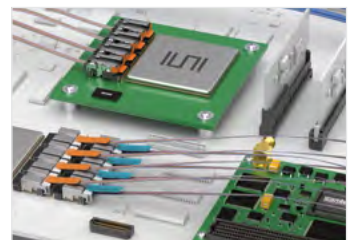
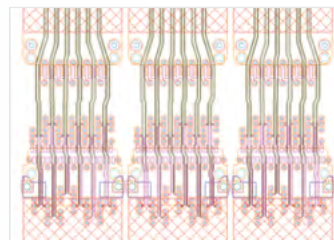
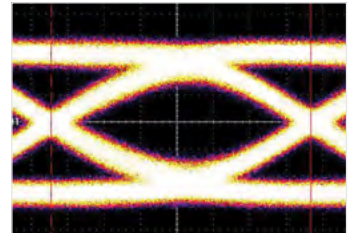
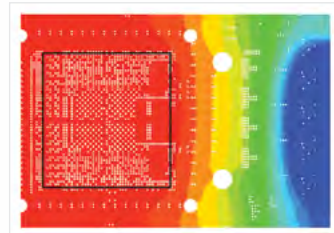


## EXPERTISE

Samtec's Teraspeed® 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 beyond 50 GHz.

- **Signal Integrity:** Full system analysis, including simulation of critical channels to validate implementation and signaling requirements
- **Power Integrity:** Analysis, modeling and performance testing for proper electrical and thermal management
- **Package Design & Analysis:** Package layout, material characterization and design guidelines for integrating ICs with high-performance optical assemblies
- **PCBs, Modules & Connectors:** Verification of optical/copper/cable interconnects for the highest possible data rates



In addition to high-performance optical services, the design expertise of Teraspeed® enables support for high-speed board level systems including high-density backplane, high-speed cables and microelectronics.

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

## ROADMAP

28  
Gbps

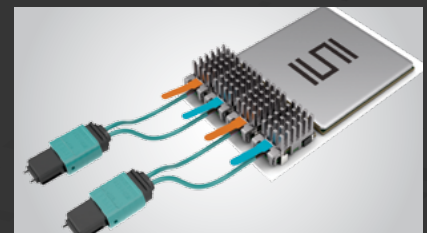


x8 simplex and x8 duplex (based on upcoming COBO specification) form factors to meet the demands of future data center growth.

56  
Gbps



Samtec is focused on bringing to market Silicon Photonic solutions that are scalable, manufacturable and cost-efficient.



PCIe®-Over-FireFly™ at Gen 4 data transfer rates in development.



# FIREFLY™ COPPER

## Highest performance and highest 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
- PCIe® protocol compatible (PCUE Series)

28  
G b p s

x4 active equalized  
x8 passive equalized  
x12 standard copper  
x12 passive equalized

Compliance cables enable test/verification of connectors during manufacturing, allowing early diagnosis of data connectivity issues.



### Standard Copper (ECUE Series)

- Lowest cost solution
- 100  $\Omega$ , 34 AWG or 36 AWG twinax ribbon cable



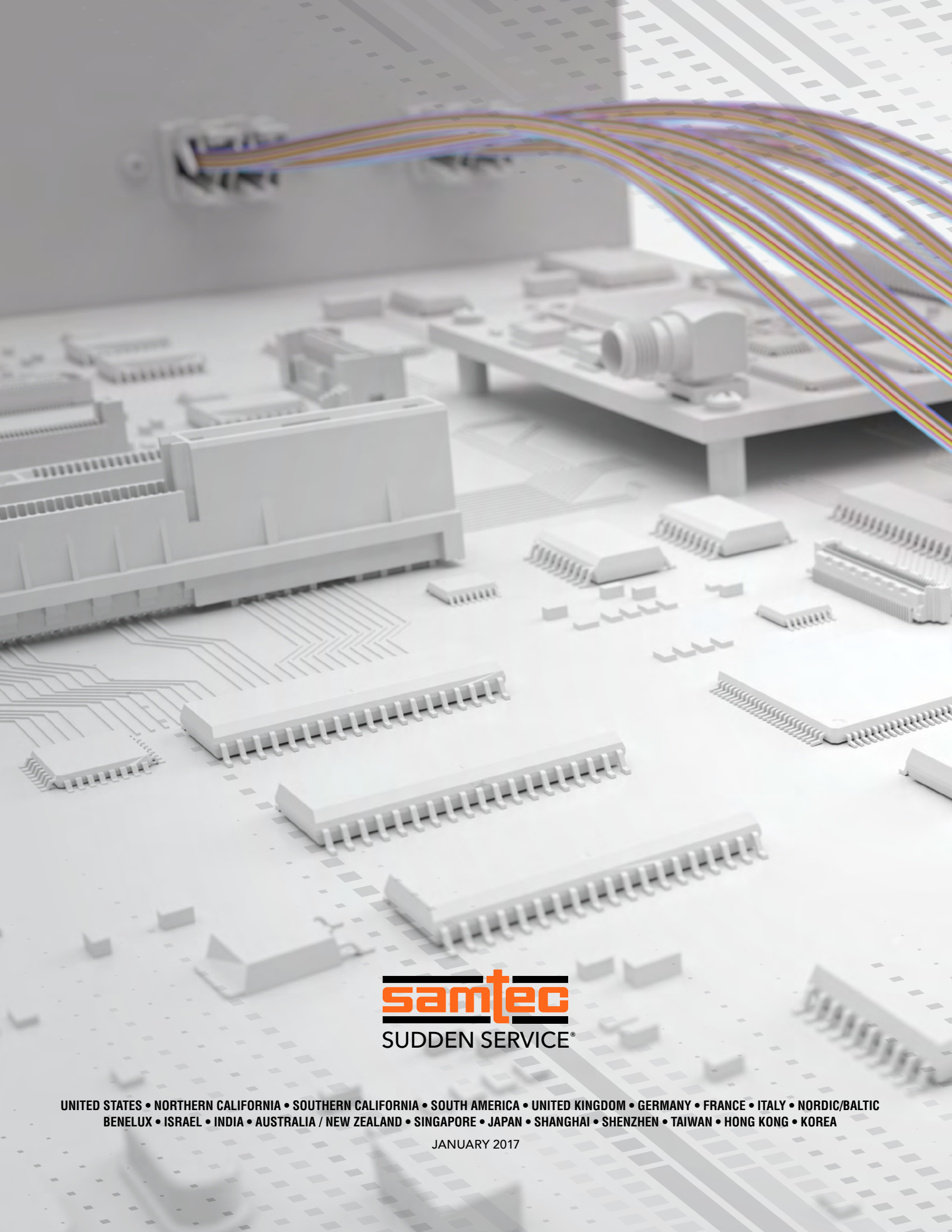
### Passive Equalized Copper (ECUE-E Series)

- Provides a performance boost, enables longer cable lengths or achieves higher data rates
- 100  $\Omega$ , 34 AWG or 36 AWG twinax ribbon cable



### Active Equalized Copper (ECUE-E Series)

- Provides greater performance boost, enables even longer cable lengths or achieves even higher data rates
- 100  $\Omega$ , 34 AWG twinax ribbon cable
- Low power consumption



**samtec**  
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