



5G APPLICATIONS SOLUTION GUIDE

HIGH-PERFORMANCE INTERCONNECTS FOR 5G DESIGN CHALLENGES



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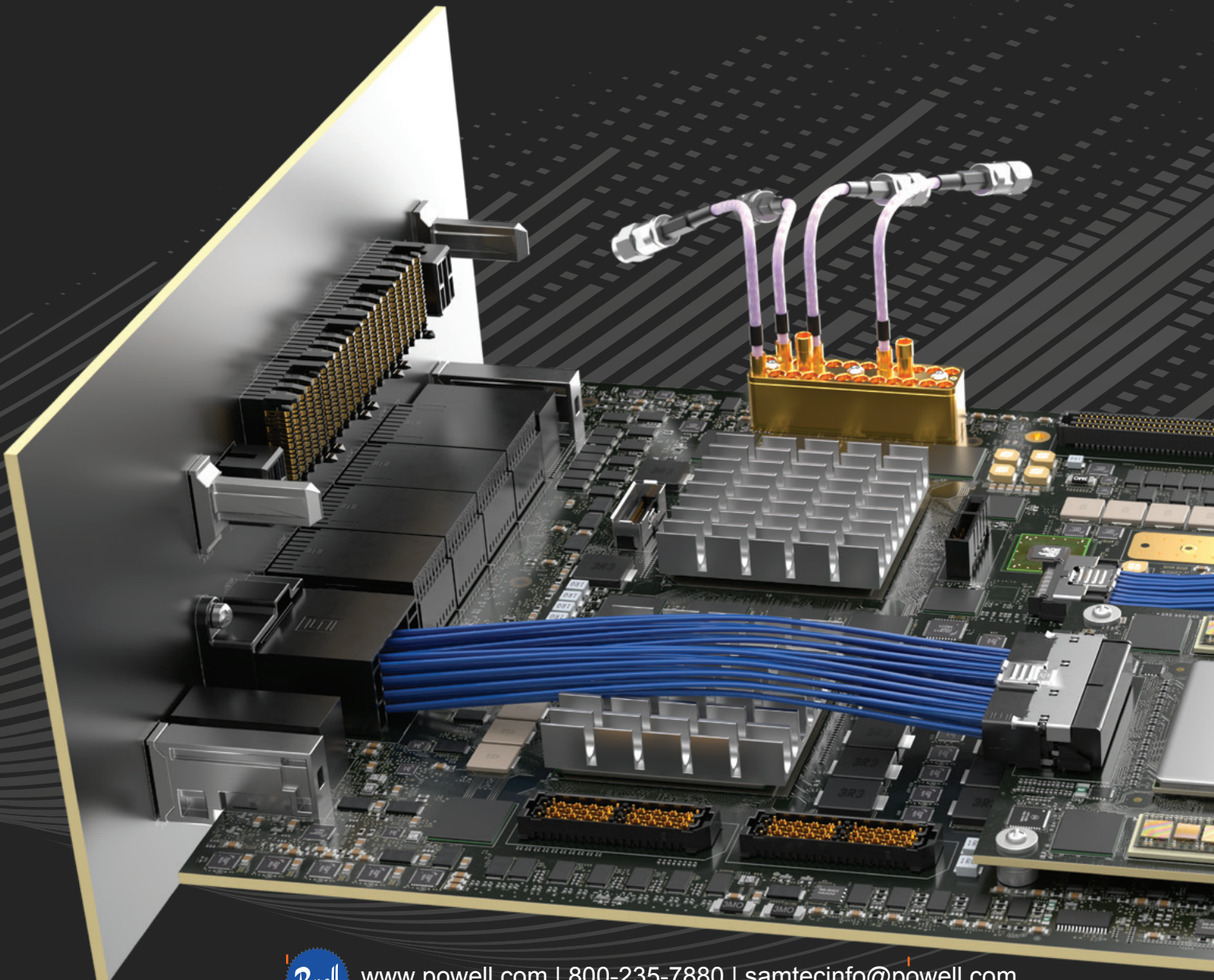
samtecinfo@powell.com





HIGH-PERFORMANCE INTERCONNECT SOLUTIONS & TECHNICAL EXPERTISE

As implementation of the 5G network quickly gains momentum, new **high-performance** devices, systems, and test & measurement equipment are needed to support the **ultra-high frequencies** and **high data rates** that technologies like mmWave, Massive MIMO, beamforming and full duplex demand.



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5G NETWORK APPLICATIONS



Test & Development Systems | 6

Design Flexibility • High-Frequencies • Increased Bandwidths



Remote Radio & Active Antennas | 8

High-Density • High-Speed • High-Performance Systems



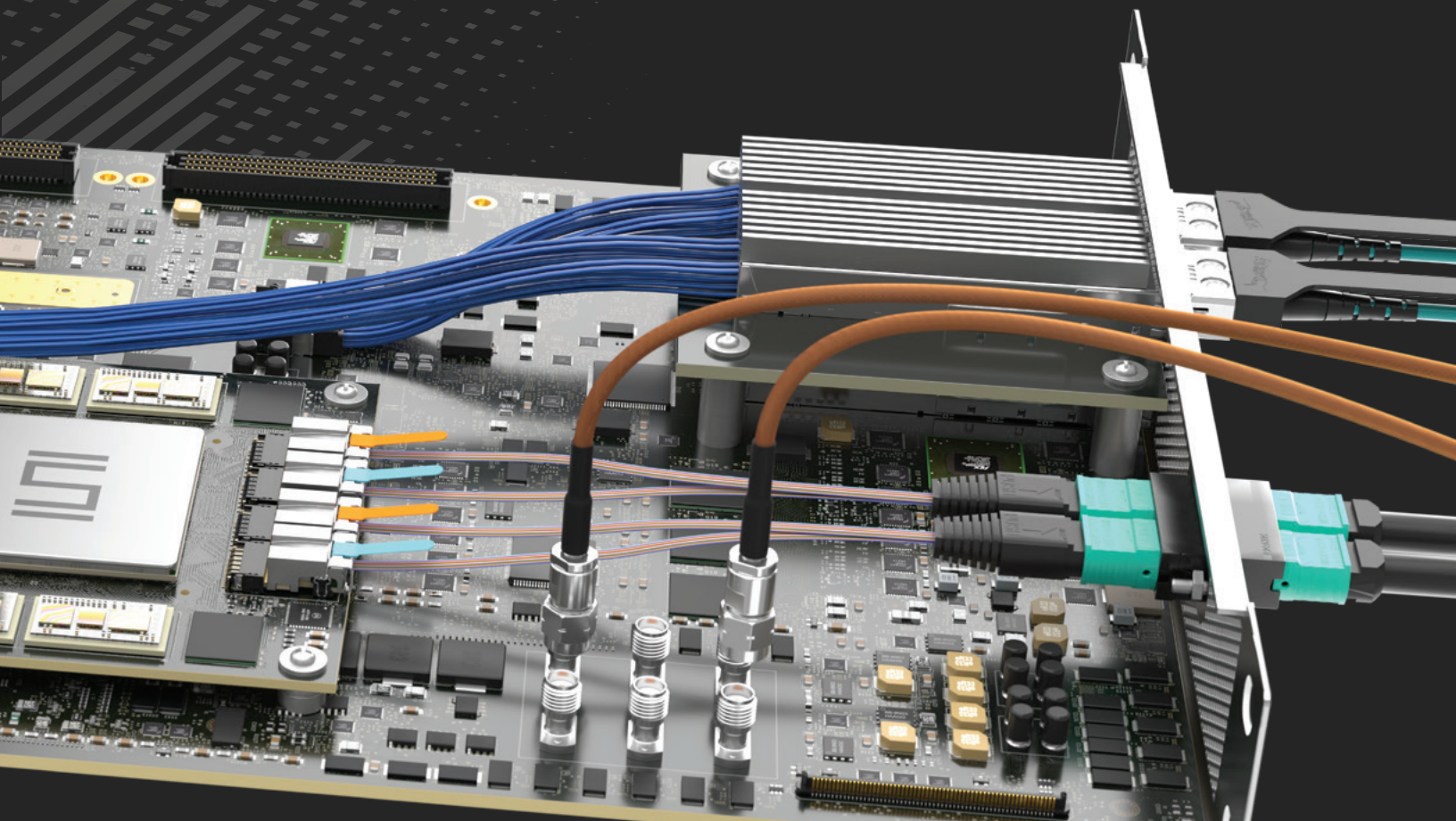
Network Equipment | 10

Small Form Factors • High Data Rates • SI Optimization



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High Frequencies • High-Speeds • Rugged Environments

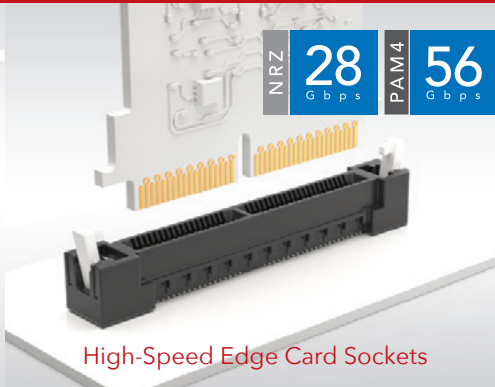
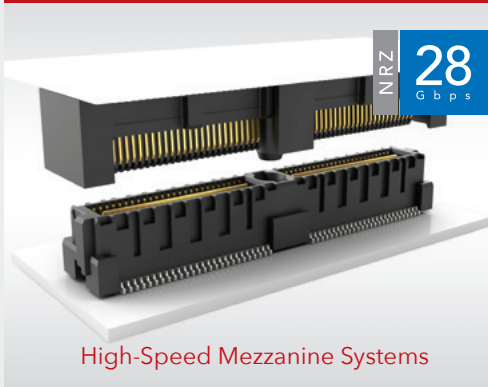




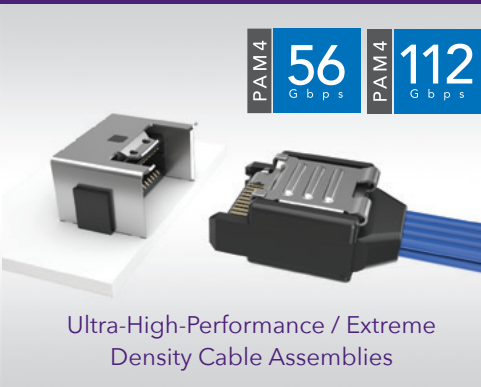
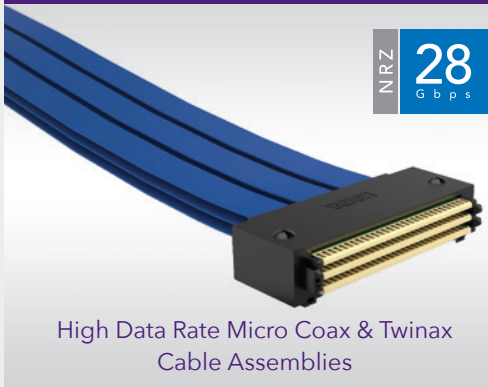
HIGH-PERFORMANCE INTERCONNECT

Next Gen Challenges: Increasing Bandwidths • Signal Integrity Optimization • Smaller Footprints

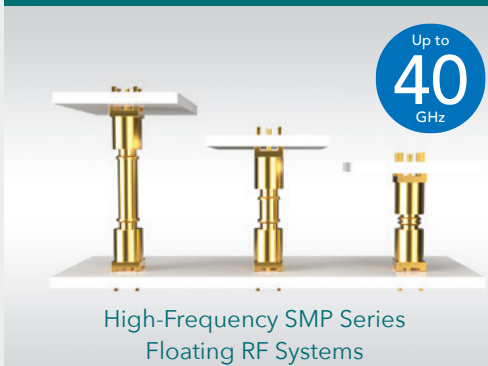
HIGH-SPEED BOARD-TO-BOARD



HIGH-SPEED / HIGH DATA RATE CABLE



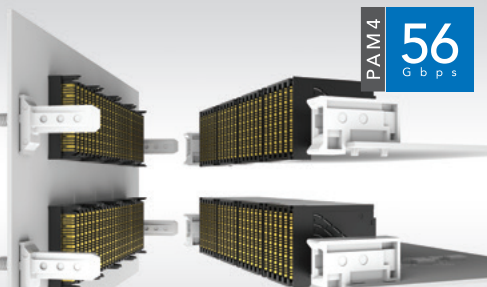
RF



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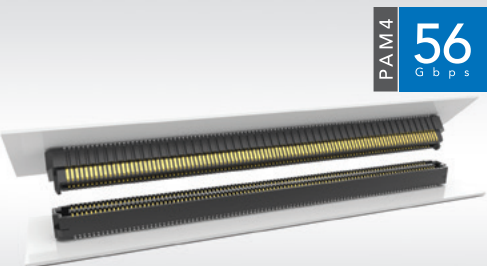
SOLUTIONS FOR NEXT GEN DEMANDS

Next Gen Solutions: Industry Leading SI Expertise • High-Performance Solutions • Innovative Strategies



PAM4 56 Gbps

High-Speed Backplane Systems



PAM4 56 Gbps

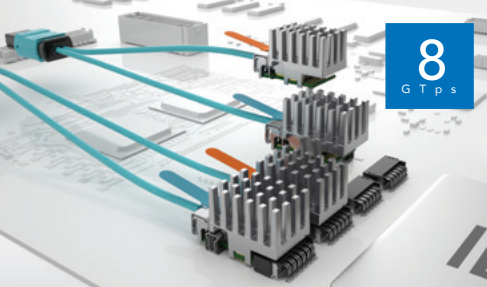
Ultra-Dense, High-Performance Mezzanine Strips



PAM4 112 Gbps

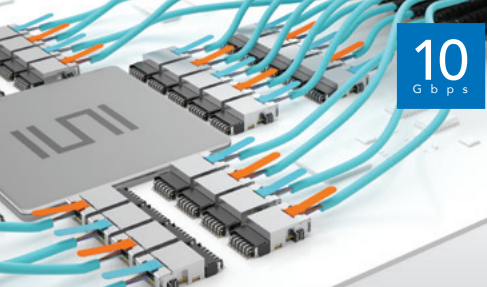
Ultra-High Performance, Extreme Density Arrays

OPTICS



8 Gbps

PCIe®-Over-Fiber Optical Cable Systems



10 Gbps

Extended Temp Optical Micro Flyover System™



NRZ 28 Gbps PAM4 56 Gbps

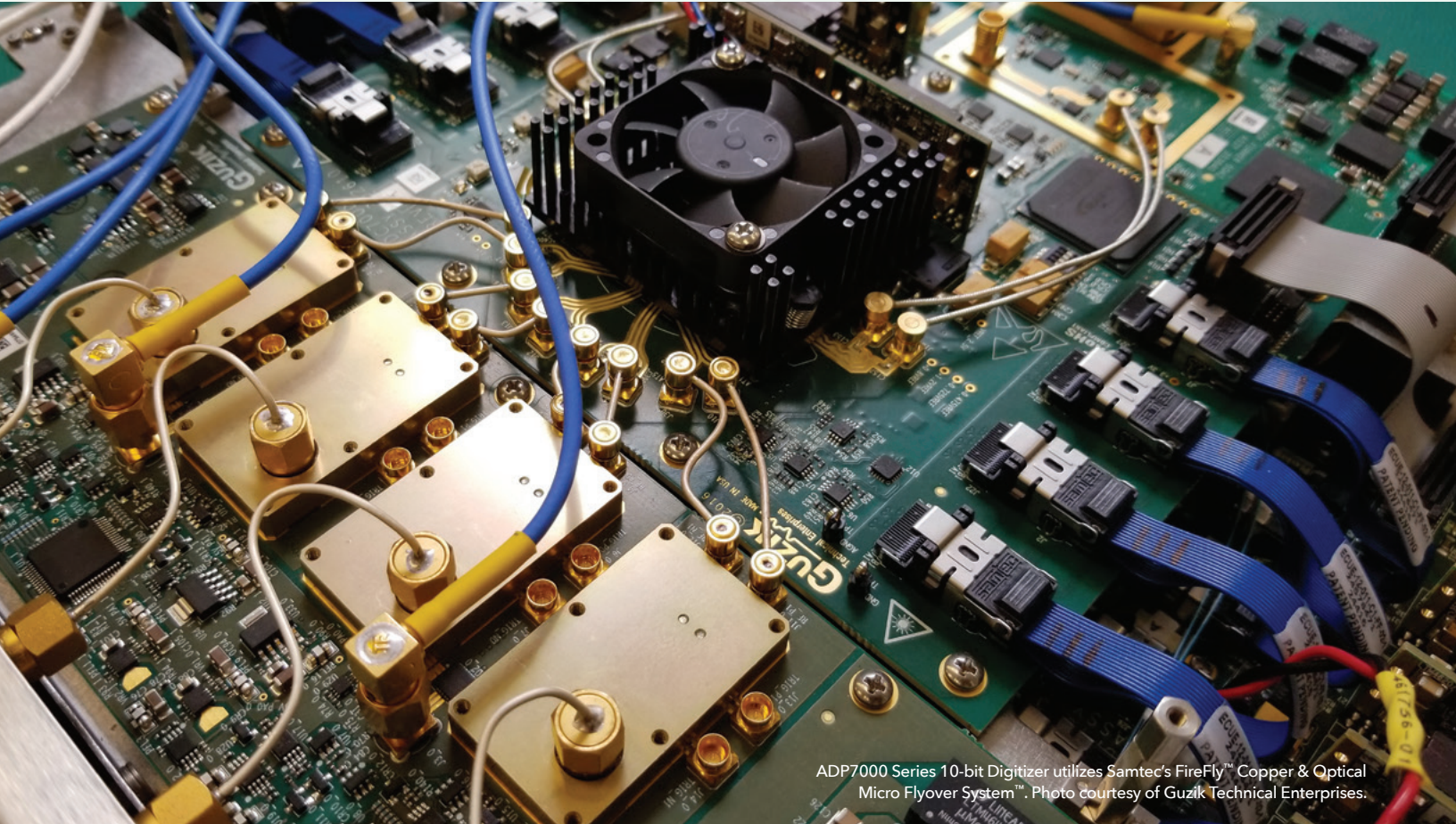
High-Performance Optical Micro Flyover System™



Samtec Offers the Industry's **Most Comprehensive Product Portfolio & Highest Level of Technical Expertise** Supporting the Demands of 5G Network Connectivity.



TEST & DEVELOPMENT SYSTEMS



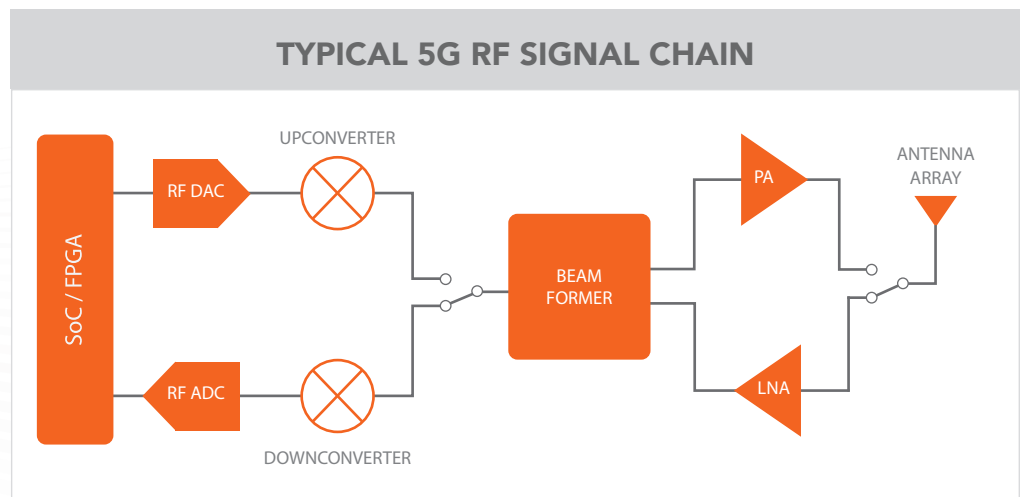
ADP7000 Series 10-bit Digitizer utilizes Samtec's FireFly™ Copper & Optical Micro Flyover System™. Photo courtesy of Guzik Technical Enterprises.

The heart of any 5G-enabled device remains the mmWave Silicon ICs transmitting and receiving data from bits to antenna. 5G system development typically links multiple RF signal chain and digital IC development boards mimicking end applications. System testing of next-generation 5G systems must validate sub-6 GHz and mmWave radio solutions supporting governmental, industry and carrier standards.

Samtec's **broad product portfolio** and **high-performance interconnect expertise** enable 5G system prototyping and connectivity between test and measurement equipment alike.

Solutions include:

- FireFly™ Micro Flyover System™
- Bulls Eye® Test Point System
- High Precision RF Cable Systems
- Precision RF / Test and high-speed interconnect design support



FireFly™ Copper & Optical Micro Flyover System™

Future-proof system offers interchangeability of copper and optical using the same high-performance micro connector system to support 5G data rates and beyond.

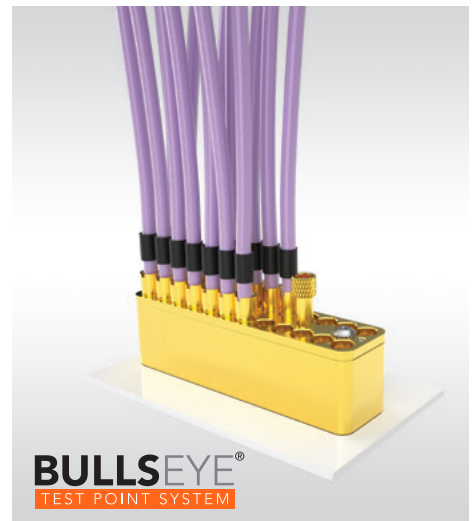
- Data connection is taken “off-board”
- Up to 28 Gbps per lane (112 Gbps PAM4 systems in development)
- Industry-leading miniature footprint allows for higher density close to the data source
- Simple assembly process with easy insertion/removal and trace routing
- Copper: x4 bidirectional or x12 unidirectional, 100 Ω, 34 or 36 AWG Eye Speed® twinax cable
- Optical: x4 and x12 designs, OM3 multi-mode fiber, high-performance optical engine; ODI versions available
- Please visit samtec.com/firefly for additional information



High-Performance RF Test & Precision RF Cable Systems

Samtec offers a variety of high-performance test solutions ideal for 5G networking, including technical support for launch optimization, simulation and test & measurement.

- Bulls Eye® Test Point System:
 - Optimized performance to 50 GHz (65 GHz system in development)
 - Compression interface to the board for easy on/off and no soldering costs
 - High-density and high cycle count
 - High-performance 23 AWG, solid dielectric low-loss microwave cable
 - Visit samtec.com/bullseye for details
- Precision RF Cable Solutions:
 - Full microwave/millimeter wave cable assemblies to 65 GHz (110 GHz system in development)
 - 2.40 mm, 2.92 mm, 3.50 mm & SMP
 - Cable components, assemblies and customized solutions
 - In-house support via RF Technical Group
 - Visit samtec.com/RF for details



5G Application | Anritsu MT8000A Radio Communication Test Station

Anritsu’s MT8000A offers all-in-one support for RF measurements and protocol tests in sub-6 GHz and mmWave bands. With a 5G base station emulation function, a single MT8000A test platform supports both the sub-6 GHz, including band n41, and the mmWave bands used by 5G.

Combining it with the OTA Chamber enables both mmWave band RF measurements and beamforming tests using call connections specified by 3GPP. Several of Samtec’s high-performance interconnect solutions are used in the system, including:

- FireFly™ Optical Micro Flyover System™, future-proof high-speed connector set, and optical patch adaptor
- Q Strip® High-Speed Ground Plane Socket Strip on 0.50 mm pitch
- Surface Mount .025" Square Post Terminal Strips (Extended Life Product™ passes 10 year Mixed Flowing Gas (MFG) and mating cycle tests)
- Please visit anritsu.com for additional information



The MT8000A Test Station uses several high-performance interconnect solutions from Samtec, including the FireFly™ optical system. Test Station photo courtesy of Anritsu Corporation.



REMOTE RADIO & ACTIVE ANTENNAS



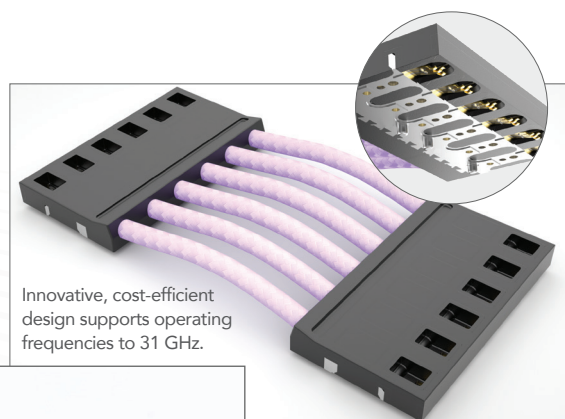
Beamcraft™ Series High Definition Active Antenna Systems™ use Samtec high-speed board-to-board connectors to route signals from the main digital board to the antenna modules. Photo courtesy of Blue Danube.

5G Remote Radio and Active Antenna Systems leverage Massive MIMO and beamforming technology to extend the reach of 5G networks. Integrating an increasing number of high frequency, multi-band RF signal paths into smaller form factors depends on high-performance interconnects for optimized operations. Samtec offers a full line of **high-speed, high-density and high-frequency products**, along with **high-level engineering support** for complete **system optimization**, and development of **innovative solutions** to support these demands.

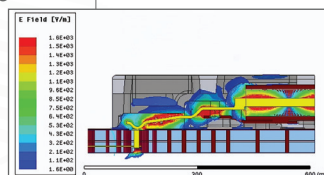
Innovating for 5G and Beyond

Samtec recently developed an innovative custom solution for a Technology Partner in need of a low-cost alternative to expensive RF cables that would also meet stringent electrical and mechanical requirements.

- Samtec Direct Attach cable designs and methodologies were modified to improve coupling, and an application-specific microwave cable was designed for processing in an automated manufacturing environment
- The result is a cost-competitive, ultra-low profile, separable interface that eliminates the need for a board-mounted connector
- The custom design offers reduced signal loss, high operating frequency, crosstalk isolation, and industry-leading data rates in a small-form factor



Innovative, cost-efficient design supports operating frequencies to 31 GHz.



Precision RF Connectors

RF Microwave/mmWave precision interconnects offer the precision, quality and performance needed to move into the mmWave spectrum through 110 GHz.

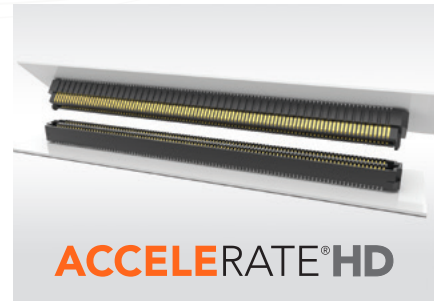
- High-frequency bands (DC to 110 GHz)
- 2.92 mm cross-mateable to other industry standards (SMA)
- 2.40 mm and 1.85 mm are intermateable
- Cable components and assemblies are also available
- In-house support via RF Technical Group
- Visit samtec.com/RF for details



AcceleRate® Ultra-Dense, High-Speed Mezzanine Strips

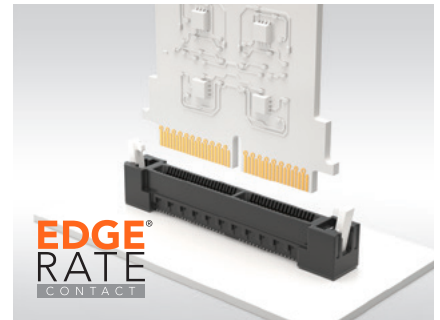
Innovative design provides hundreds of I/Os in a compact footprint, while providing excellent Signal Integrity at 56 Gbps PAM4 data rates.

- Incredibly dense; up to 400 total I/Os
- Ultra-slim 5 mm width
- Open-pin-field design for maximum routing and grounding flexibility
- Supports 56 Gbps PAM4 applications
- Rugged Edge Rate® contacts designed for high-speed and high-cycles
- Visit samtec.com/accelerateHD for details



High-Speed Edge Card Systems

- High-speed edge card sockets in vertical, right-angle and edge mount designs
- 0.50 mm, 0.60 mm, 0.635 mm, 0.80 mm, 1.00 mm, 1.27 mm and 2.00 mm pitches
- Rugged, Signal-Integrity-optimized Edge Rate® contact systems
- High-speed riser card system in 19 mm, 25 mm and 30 mm standard stack heights
- Visit samtec.com/edgecard for more information and additional high-speed edge card products

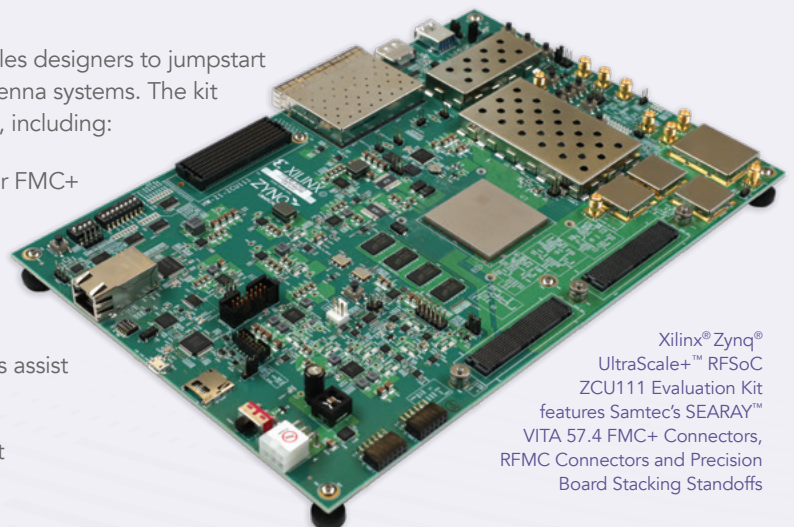


5G Application

Xilinx® Zynq® UltraScale+™ RFSoc ZCU111 Evaluation Kit

The Zynq® UltraScale+™ RFSoc ZCU111 Evaluation Kit enables designers to jumpstart RF-Class analog designs, remote radio heads and active antenna systems. The kit utilizes Samtec interconnects found in many 5G applications, including:

- SEARAY™ VITA 57.4 FMC+ Connectors: up to 560 I/Os for FMC+ carriers and daughter cards
- LP Array™ Low Profile, High-Speed Array: 320 I/Os for RFMC daughter cards
- JSO Series Jack Screws: Precision board stacking standoffs assist with mating and unmating RFMC daughter cards
- Please visit samtec.com/standards/rfsoczcu111 or contact KitsAndBoards@samtec.com for additional information



Xilinx® Zynq®
UltraScale+™ RFSoc
ZCU111 Evaluation Kit
features Samtec's SEARAY™
VITA 57.4 FMC+ Connectors,
RFMC Connectors and Precision
Board Stacking Standoffs



NETWORK EQUIPMENT VENDORS

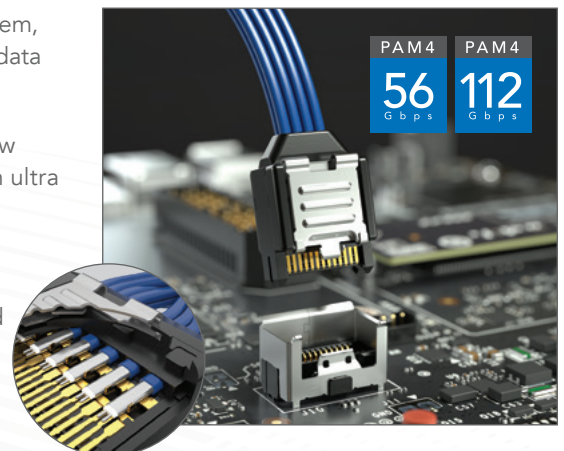


Next-generation 5G network equipment must be scalable, intelligent and flexible. New technologies will dramatically increase coverage and data throughput while supporting multiple standards, bands and sub-networks. From the front panel to the IC, to the backplane and between PCBs, Samtec's **high-performance interconnect expertise and product solutions** are designed to support **56 Gbps PAM4 to 112 Gbps PAM4 data rates**, along with **increased system density and optimized signal integrity**.

Innovating for 5G and Beyond

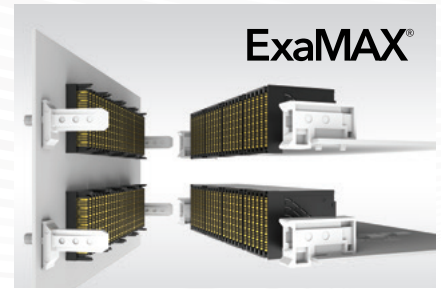
Samtec's new AcceleRate® Cable Assembly is the industry's slimmest cable system, and with the ability to support up to 112 Gbps PAM4 data rates, is ideal for the data throughput that 5G network equipment requires now – as well as in the future.

- Samtec Direct Attach cable technology provides improved signal integrity by eliminating the transition board and its variability
- Samtec's proprietary co-extruded, low loss, Eye Speed® twinax cable technology improves signal integrity, bandwidth and reach
- Incredibly small form factor: low profile, slim 7.6 mm width in an ultra high-density 2-row design
- Ideal as a high-performance, high-density "End 2" solution for Samtec Flyover™ mid-board cable systems
- Visit samtec.com/accelerate



ExaMAX® High-Speed Backplane Systems

- Provides designers the option to optimize density or minimize board layer count
- Individual signal wafers with a staggered differential pair design (72 or 40 pairs)
- Up to 56 Gbps electrical performance on a 2.00 mm column pitch
- One-piece embossed ground structure on each signal wafer reduces crosstalk
- Two reliable points of contact, even when subjected to angled mating
- Visit samtec.com/examax for details



Samtec Flyover™ QSFP28 & Double Density QSFP28 Cable Systems

- Provides improved signal integrity and architectural flexibility by taking signals "off-board" and directly to the panel via ultra low skew twinax cable
- Double Density Samtec Flyover™ QSFP: 8 channels (x8 bidirectional, 16 DPs), ~200 Gbps NRZ aggregate (~400 Gbps PAM4), and belly-to-belly mating for maximum density
- Samtec Flyover™ QSFP System: 4 channels (x4 bidirectional, 8 DPs), ~100 Gbps NRZ aggregate (~200 Gbps PAM4)
- Visit samtec.com/flyover for details



NovaRay™ Ultra High-Performance Extreme Density Array

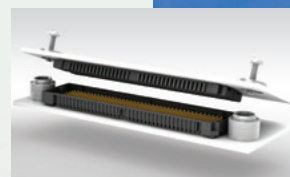
- 112 Gbps PAM4 per channel
- Innovative, fully shielded differential pair design enables:
 - Extremely low crosstalk (to 40 GHz)
 - Tight impedance control
 - Minimal variance in data rate as stack height increases
- 4.0 Tbps aggregate data rate - 9 IEEE 400G channels
- 112 differential pairs per square inch
- Utilizes 40% less space than traditional arrays with the same data throughput
- BGA attach to board for greater density and optimized trace breakout region
- Please visit samtec.com/novaray for additional information



5G Application | Distributed Unit & Centralized Unit Base Stations

Whether at the base of a cell tower or in a data center, next-gen 5G base stations must combine higher channel count with low power and optimized costs. Samtec offers a variety of high-performance interconnect solutions to meet these demands, including:

- High-Frequency SMP Series Floating RF Systems
 - Ideal for routing mmWave signals between PCBs
 - Three piece "bullet" style system offering misalignment compensation and flexible stack heights
- High-Density, Ultra Low Profile LP Array™
 - Increased system density at 56 Gbps PAM4 / 112 Gbps PAM4 data rates
 - Ultra low profile with maximum grounding and routing flexibility



For more information, please visit samtec.com/s2s.



AUTOMOTIVE & TRANSPORTATION

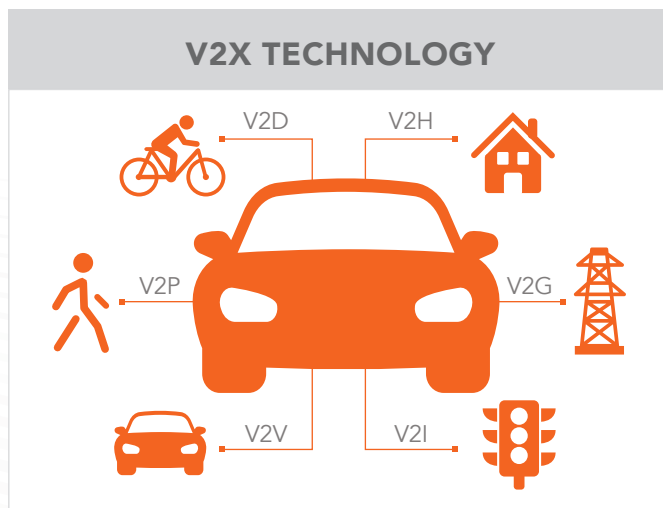


Connected vehicles are the future of mobility. Leveraging next-gen 5G networks and cloud services, V2X technologies enable vehicle intelligence, improve traffic flow and increase safety.

Samtec's expanding **automotive interconnect portfolio** helps route data from 5G radios to sensors throughout the vehicle.

Combined with its IATF 16949 certification, Samtec offers **technical expertise and systems designed specifically to support the unique challenges of automotive and transportation applications.**

With **global manufacturing facilities and full custom product development capabilities**, Samtec is uniquely positioned to support custom interconnect needs of many automotive and transportation applications as well.



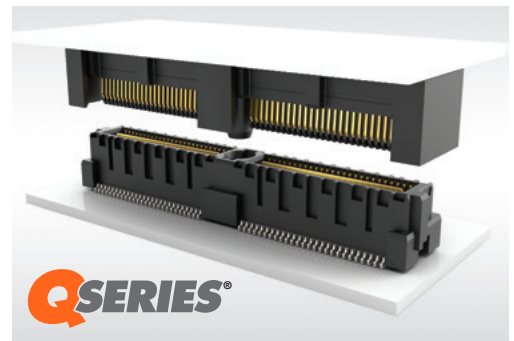
SEARAY™ Open-Pin-Field Arrays

- Samtec's SEARAY™ family is the industry's largest line of high speed, high-density open-pin-field arrays
- Supports 28+ Gbps applications
- Open-pin-field design for maximum routing and grounding flexibility
- Lower insertion/extraction forces vs. typical array products
- Performance up to 18 GHz/pair
- Up to 720 I/Os
- 1.27 mm (.050") pitch and space saving 0.80 mm pitch
- Rugged Edge Rate® contact system
- System can be "zippered" during mating/unmating
- SEARAY™ A-series versions meet PPAP Level 3 process
- Visit samtec.com/searay for details



Q Series® High-Speed Ground Plane Connector Strips

- Designed for high-speed board-to-board applications where signal integrity is essential
- Performance up to 14.0 GHz/28 Gbps (single-ended) and up to 10.5 GHz/21 Gbps (differential pair)
- Optimized for 100 Ω systems
- Up to 180 I/Os (single-ended) and up to 100 pairs (differential pair)
- Designs for vertical, perpendicular and coplanar applications
- Q Series® A-series versions meet PPAP Level 3 process
- Visit samtec.com/qseries for details



5G Automotive Products

High Data Rate & High-Frequency Cable Assemblies

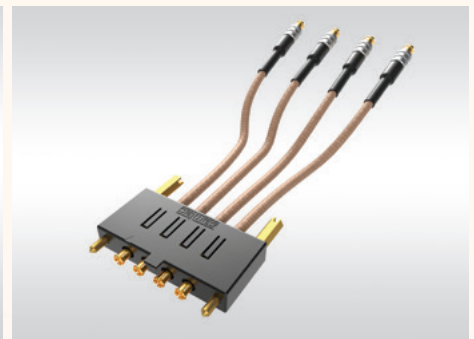
Many multi-function antenna systems, instrument clusters and telematic systems leverage Samtec High-Speed Cable Assemblies. Options include high-density array, integral ground plane, hermaphroditic, rugged Edge Rate® and rugged RF systems. Contact HDR@samtec.com to discuss your specific application.



SEARAY™ High-Speed High-Density Array Cable Assembly designed for high-speed, micro pitch applications



50 Ω High-Frequency RF Flexible Cable Assembly, U.FL compatible plug to 500 cycles with HMHF1 termination



Ganged Micro-Scale RF System with performance to 6 GHz; full ganged, or ganged with industry standard End 2 options

GLOBAL MANUFACTURING & SUPPORT



FREE SAMPLES
IN 24 HOURS



2-DAY SHIPPING
TO ALL MAJOR MARKETS



3-DAY SHIPPING
OF MOST PRODUCTS



**#1 CONNECTOR
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