TEC-DAY DRESDEN – OKTOBER 2018

Neue Technologien und High Speed Verbindungssysteme

für Datenraten von 28/56Gbps+

Michael Grubmüller
Field Application Engineer D/A/CH

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SAMTEC DASHBOARD

FOUNDED
1976

HEADQUARTERS
NEW ALBANY, IN USA

RATING
5A1 D&B
Debt Free

GLOBAL REACH

5,900+
EMPLOYEES

40+
LOCATIONS

125
COUNTRIES SERVED

SALES GROWTH

SAMTEC VS. INDUSTRY
(2008-2017)

$713M
2017 SALES

SUDDEN SERVICE

24 HOUR
FREE SAMPLES

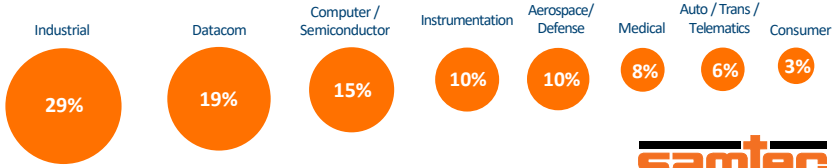
3-DAYS
PRODUCTS SHIPPED

RECOGNITIONS

#1 CONNECTOR MANUFACTURER
Bishop & Associates

Top 25 BEST WORK PLACES
Fortune Magazine

MARKETS SERVED



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WORLDWIDE LOCATIONS

40+ locations and over **5,900** employees

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Worldwide
DESIGN SUPPORT

BUSINESS MODEL

SILICON-TO-SILICON

- HIGH SPEED BOARD-TO-BOARD
- OPTICS
- HIGH SPEED CABLES
- PRECISION RF

CORE BOARD-TO-BOARD

- MICRO/RUGGED
- FLEXIBLE STACKING

SUDDEN SERVICE

- CORE SERVICE
- TECH SUPPORT
- WEB TOOLS
- SYSTEM SERVICE

GLOBAL INFRASTRUCTURE

- SALES
- ENGINEERING
- OPERATIONS
- QUALITY
- IT/MIS

OUR CULTURE

- FLEXIBILITY
- INNOVATION
- SPEED
- WIN/WIN

INDUSTRY DEMANDS

FASTER, SMALLER, VERSATILTY

S2S

Innovative new products that enable engineers to meet these challenges for the entire signal path, from Silicon-to-Silicon.

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The problem – pcb vs next gen speeds

Bandwidth\ Materials\Reach	FR408	MEGTRON 6	Micro-Twinax	Optics
10 Gbps	<10”	10”+	10”+	10”+
14 Gbps	<5”	<10”	10”+	10”+
28 Gbps	<2”	<5”	10”+	10”+
56 Gbps	0.0”	<2”	<10”	10”+
112 Gbps	0.0”	0.0”	<5”	10”+

- -5 dB LOSS TARGET
- REACH ESTIMATED

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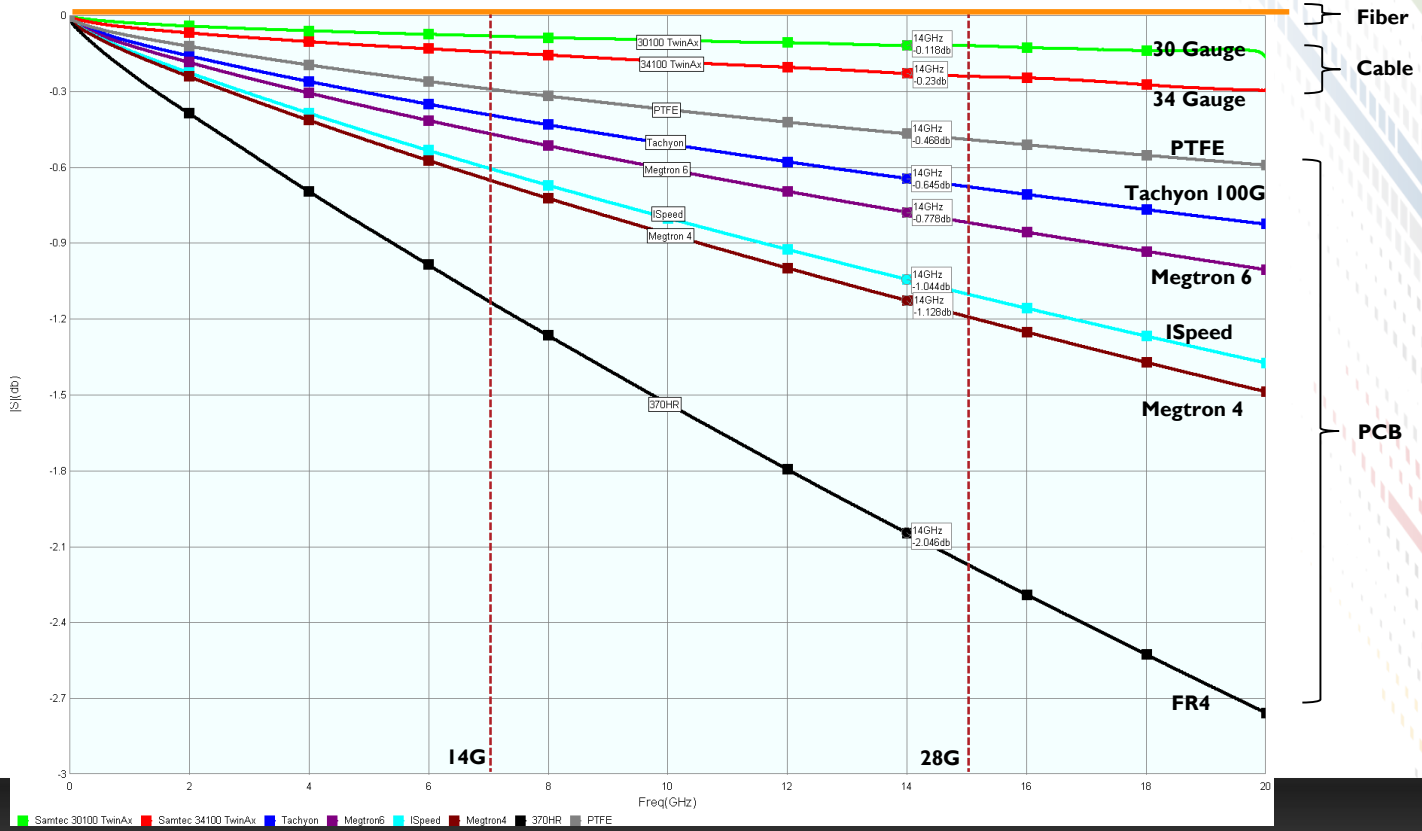
Loss in dB per Inch for 28 Gbps Designs

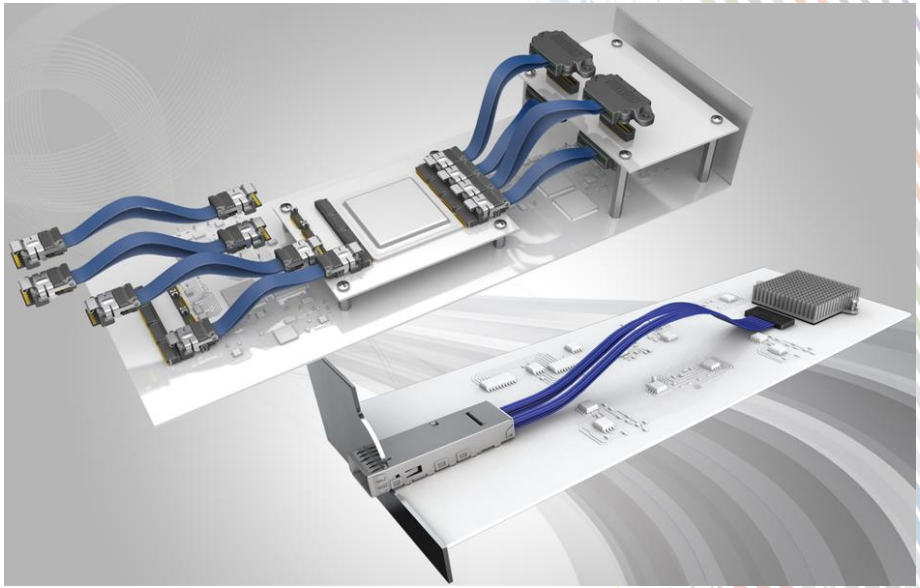


FLYOVER IS NO LONGER JUST A CONCEPT…

It’s becoming a mainstream silicon-to-silicon design-in requirement

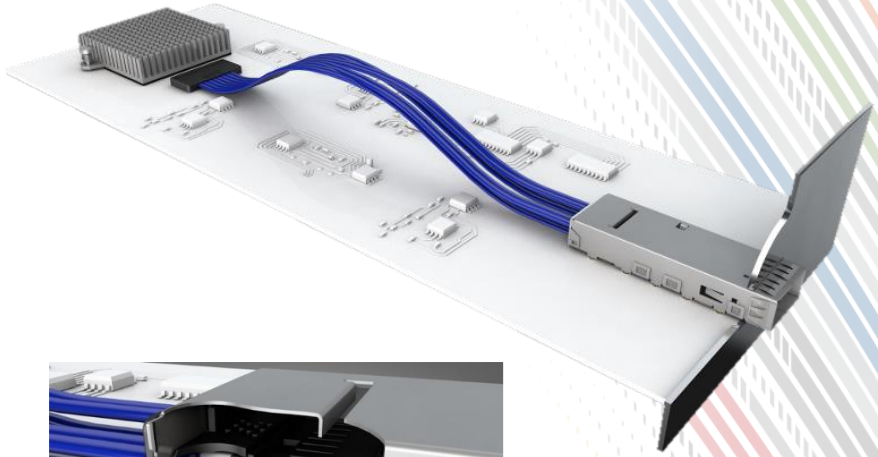
28 Gbps protocols are difficult to implement even with highest-end PCB materials

That sounds great, but how do we prove this?



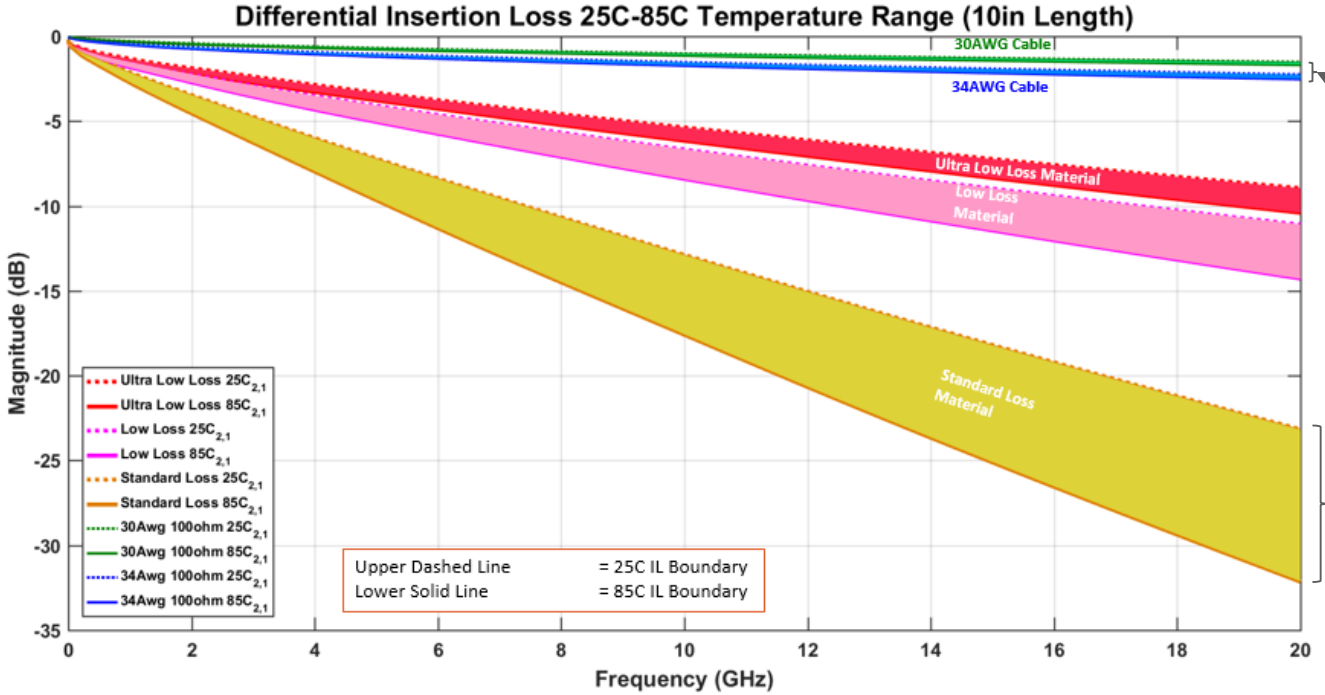
FLYOVER HIGH SPEED CABLE “SYSTEM OPTIMIZATION”

- High Speed Cable interconnects to “Fly Over” the PCB to eliminate trace loss.
- Better electrical performance at longer lengths.
- Lower system cost due to:
  - Reduced PCB layers.
  - Traditional PCB material used (exotic/expensive materials minimized).
  - Less need for repeaters.
  - Facilitate thermal management for better location of “hot” processors

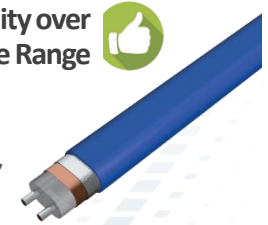


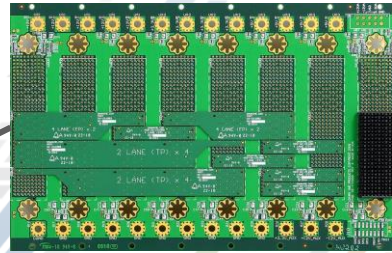
SAMTEC EYE SPEED® TWINAX

Temperature Stability vs pcb traces



Stability over Temperature Range





More Loss More Variation with Temperature

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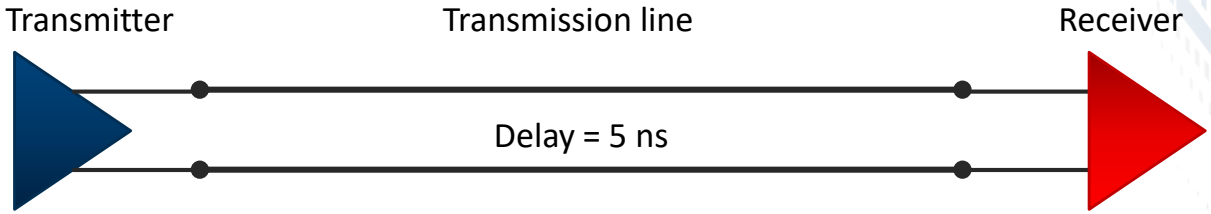
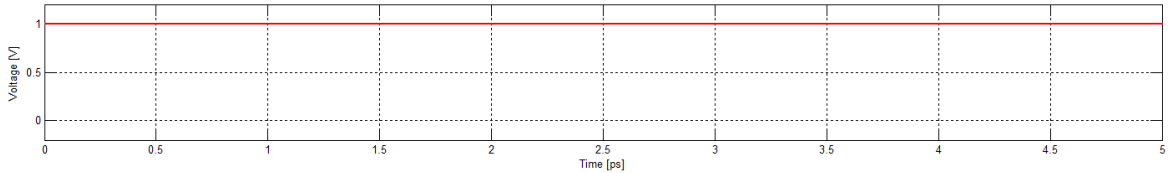
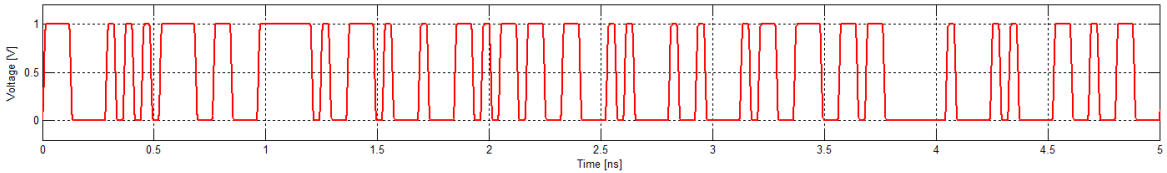
25 Mb/s vs 25 Gb/s



25 Mb/s



25 Gb/s

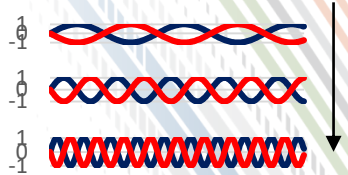


Skew 101, “It’s all About timing”

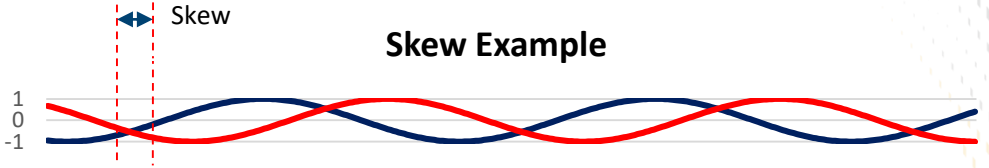
As frequency increases, allowable skew decreases

Freq/Data Rate	Twinax Skew Limit
7GHz/14Gbps	14ps/m
14GHz/28Gbps NRZ	7ps/m
28GHz/56Gbps NRZ	3.5ps/m

As frequency increases, mask margin decreases



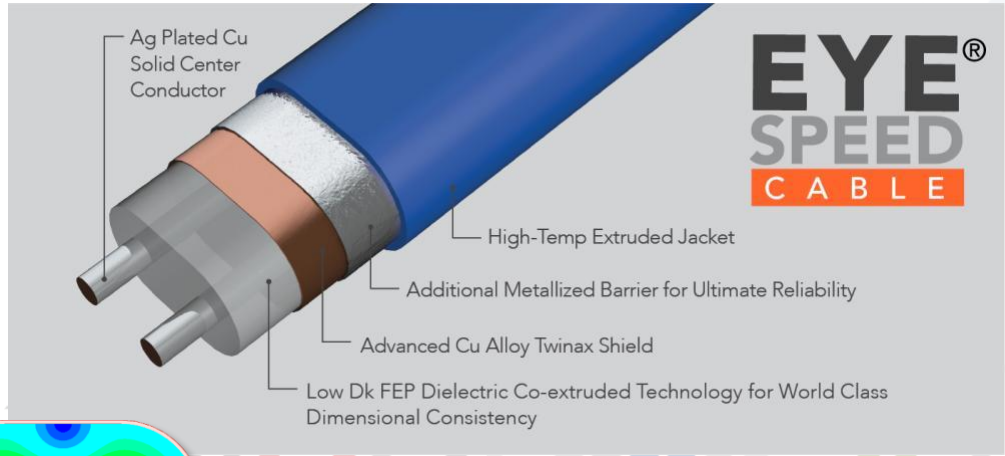
Samtec Eyespeed™ Twinax
- Industry Leading Lowest Skew
- Less Jitter, More Channel Margin
- Enables Higher Data Rates

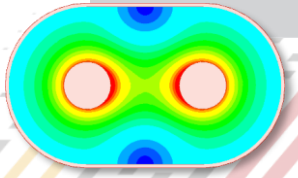


Cable | eye speed® ultra low skew twinax

Low Loss, High Performance Design Optimized for 28+ Gbps System Demands

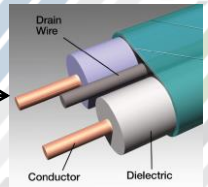
- Co-extruded, low loss construction
- Proprietary cable technology
- Ideal for 28 - 56+ Gbps applications
- Tight coupling between signal conductors
- Improved bandwidth and reach
- Improved signal integrity
- Ultra low skew twinax < 3.5 ps / meter





Tight coupling between signal conductors

Contrast with conventional approach using single extruded conductors and drain wires



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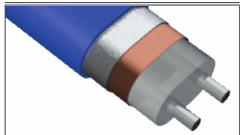
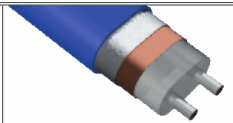
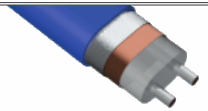
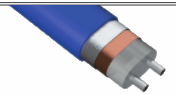
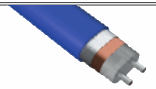
Cable | eye speed® ultra low skew twinax

Choice of High-Performance Cable Options for Design Flexibility

Nominal Performance Specifications			28 AWG	30 AWG	32 AWG	34 AWG	36 AWG
							
14 GHz (28 Gbps)	0.25 m	IL (dB)	-1.0	-1.2	-1.5	-1.8	-2.2
	1.00 m		-3.9	-4.7	-5.9	-7.2	-8.7
28 GHz (56 Gbps)	0.25 m		-1.5	-1.8	-2.2	-2.6	-3.2
	1.00 m		-6.0	-7.0	-8.7	-10.6	-12.7
Density / Flexibility			Good	Good	Better	Best	Best

Eye Speed® Ultra Low Skew Twinax Cable is available in engineered impedance configurations of 85 Ω, 92 Ω and 100 Ω.

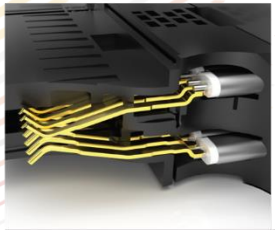
Example: new high performance direct attach QSFP Systems

Flyover QSFP28

Samtec FQSFP Series

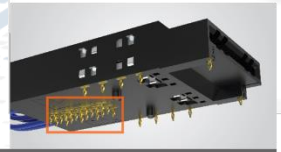
- 4 Channels (x4 Bidirectional, 8 Differential Pairs)
- 25 Gbps NRZ per channel
- Aggregate: 100 Gbps NRZ (200 Gbps PAM4)
- Heat Dissipation: ~3.5W / Cable
- 1 Row of Contact Pads
- Compatible with all QSFP cable assemblies

Localized Press-Fit Control & Power Contacts
Direct Connect Sidebands =
Increased Airflow & No Extra Cables Needed



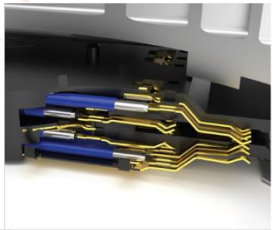
Direct Solder Attach to Connector Contacts

Flyover QSFP28 Double Density



Samtec FQSFP-DD Series

- 8 Channels (x8 Bidirectional, 16 Differential Pairs)
- 25 Gbps NRZ per channel
- Aggregate: 200 Gbps NRZ (400 Gbps PAM4)
- Heat Dissipation: ~7W / Cable
- 2 Rows of Contact Pads
- Backward compatible with all QSFP modules
- Belly-to-Belly mating for maximum density



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ExaMAX® +BACKPLANE CABLE

PAM4 56 Gbps → PAM4 112 Gbps

112G PAM4 Capable

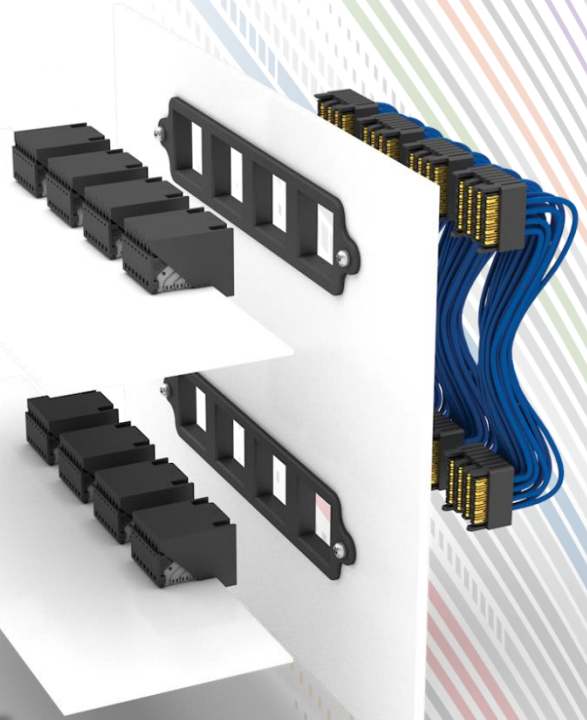
EBTF/EBTM
4-PAIR: 4X6, 4X8, 4X10

6-pair: 6x6, 6x8, 6x10, 6x12
Right Angle Receptacles and VT Headers
Internal guidance and Keying options

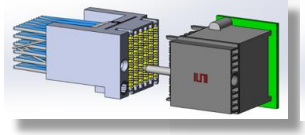
EBCM/EBCF SERIES

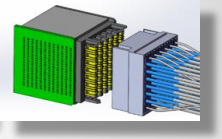
Eliminates PCB SI challenges by flying high-speed data card-to-card

- Fewer transitions improves signal integrity
  - 4 and 6 pair cable
  - Mates directly with EBTF right-angle receptacle
  - 28-34 AWG Eye Speed® cable
  - Highly-customizable solutions
  - Roadmap: Cable-to-DMO

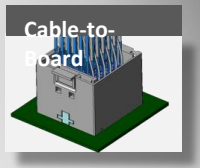


Cable-to-DMO





Cable-to-Board



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Firefly™ micro flyover system™

28 Gbps

Higher Speeds • Simplified Routing • Increased Density

A cabling solution that flies critical data over densely populated boards at speeds up to 28 Gbps, using only a very tiny footprint.

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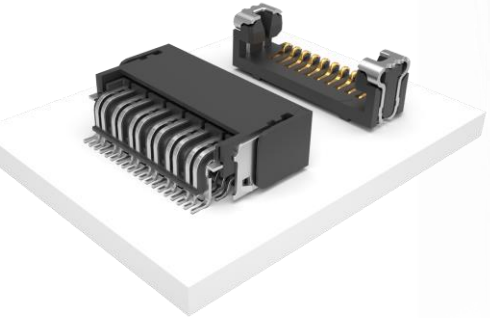
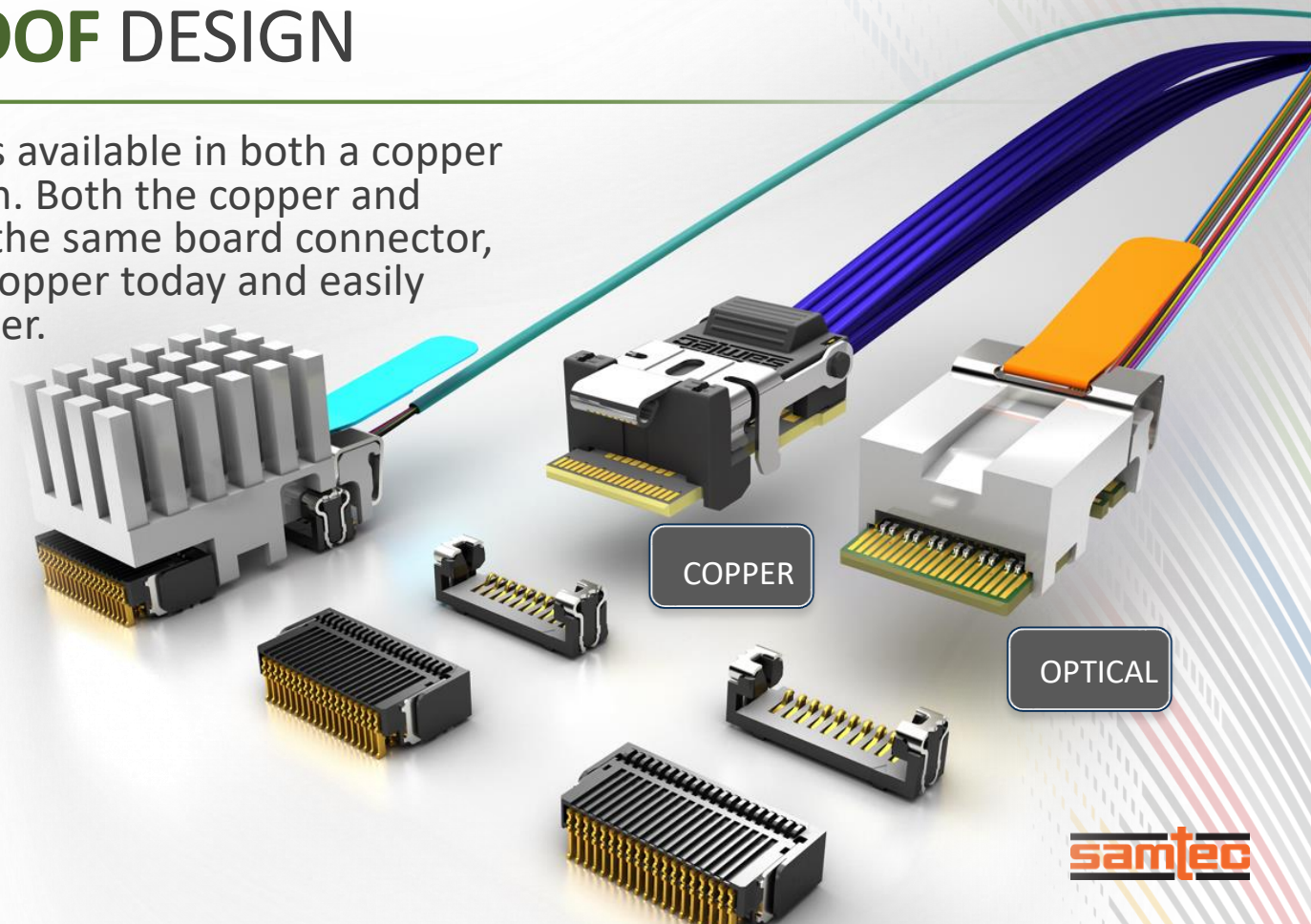
FUTURE-PROOF DESIGN

The FireFly™ system is available in both a copper and an optical version. Both the copper and optical cables utilize the same board connector, enabling you to use copper today and easily upgrade to optical later.





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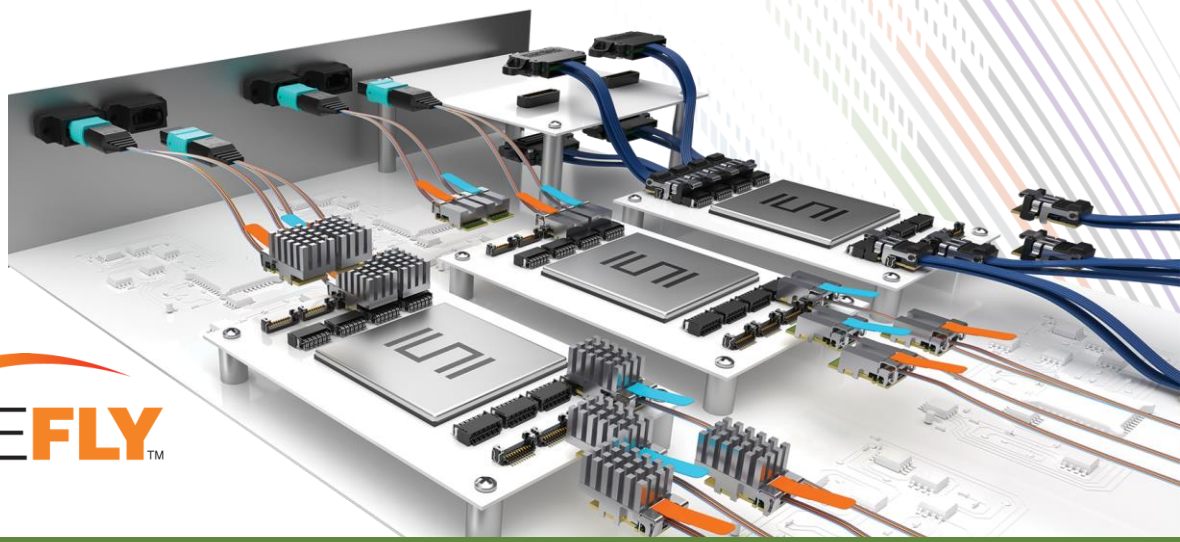
SAMTEC OPTICAL GROUP

Engineering team dedicated to design, development and application support of micro optical engines, active and passive optical solutions.



FIREFLY™

FIREFLY™ MICRO FLYOVER SYSTEM™

ECUO	ETUO	PCUO	ECUE
Optical FireFly™	Extended Temp FireFly™	PCIe®-Over-Fiber	Copper FireFly™
14 Gbps X4, x12	10 Gbps X4, x12	8 GTps Gen 3 X4, x8, x16	14 Gbps X4 Bidirectional ECUE x12 Unidirectional ECUE
16 Gbps x12		Gen 4 In development	28 Gbps X4 Bidirectional ECUE-2
25 Gbps x4			
28 Gbps x4			

TECHNOLOGY ROADMAP

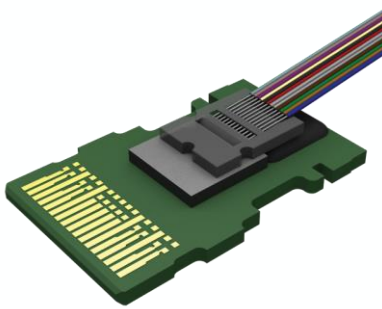
Submersible FireFly™ - Capable of immersion for liquid cooled systems

Rugged Optical Engine – Lower profile design for military, aerospace and industrial applications

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

25G Extended Temp FireFly™

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



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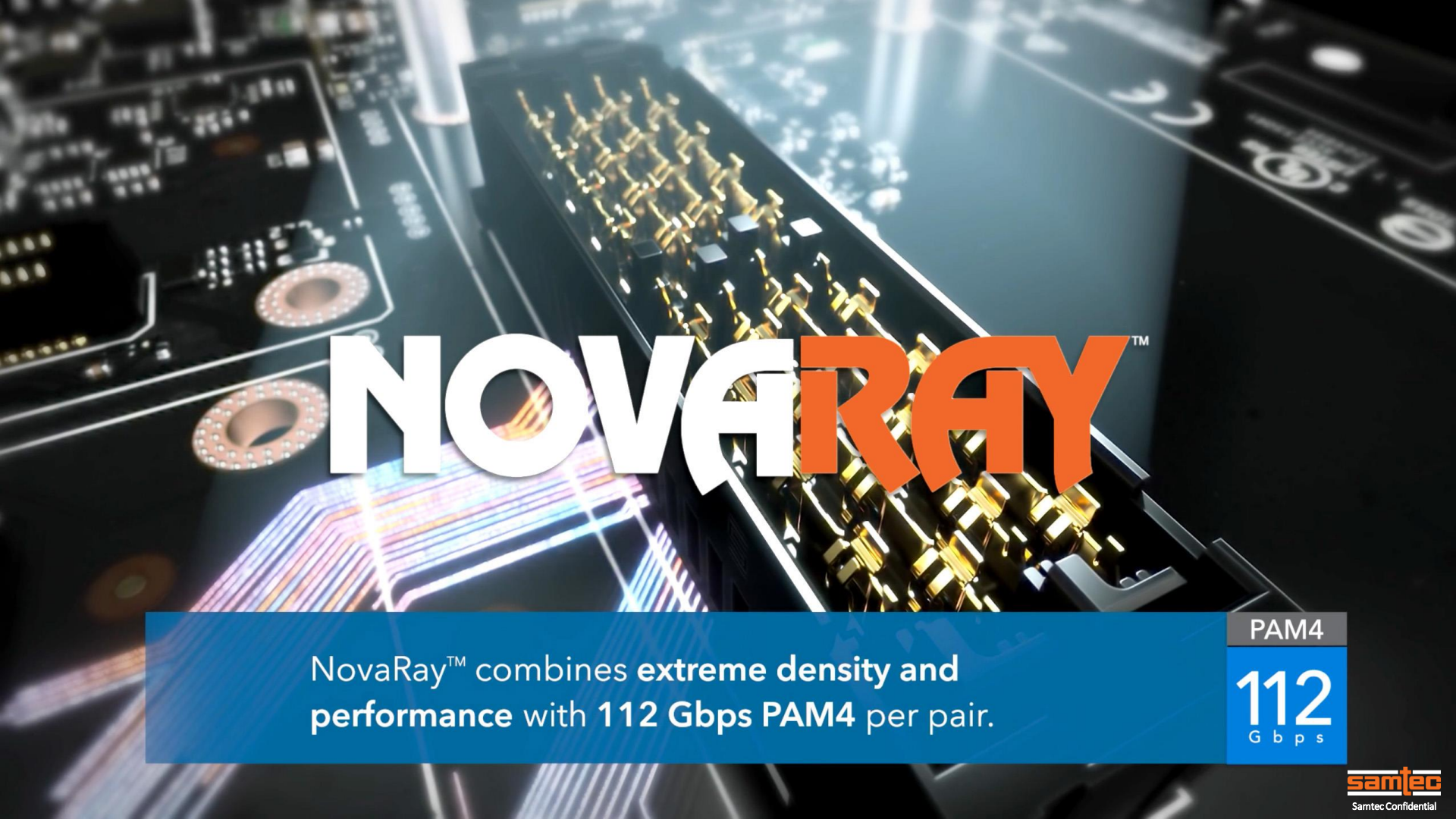

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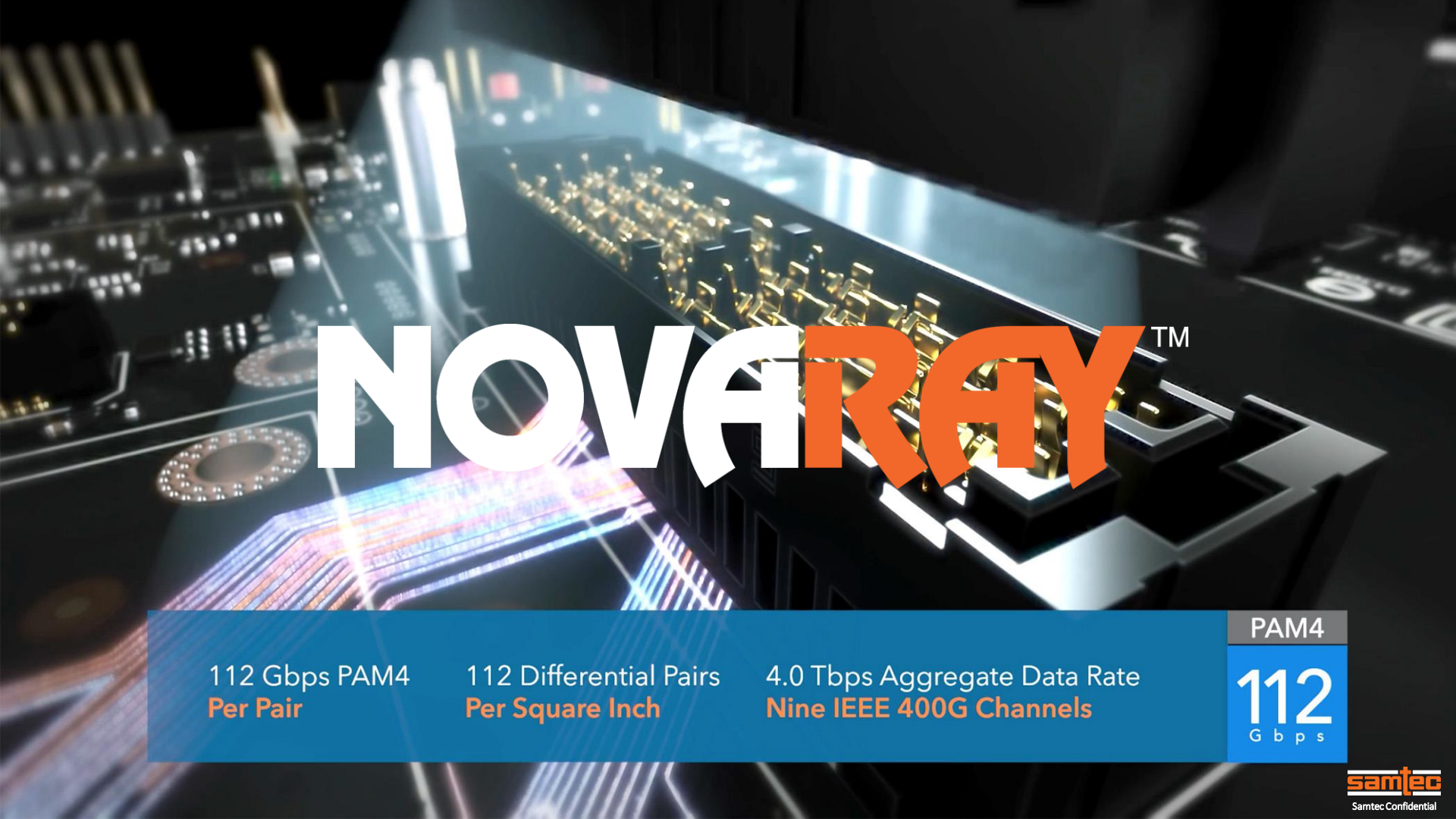

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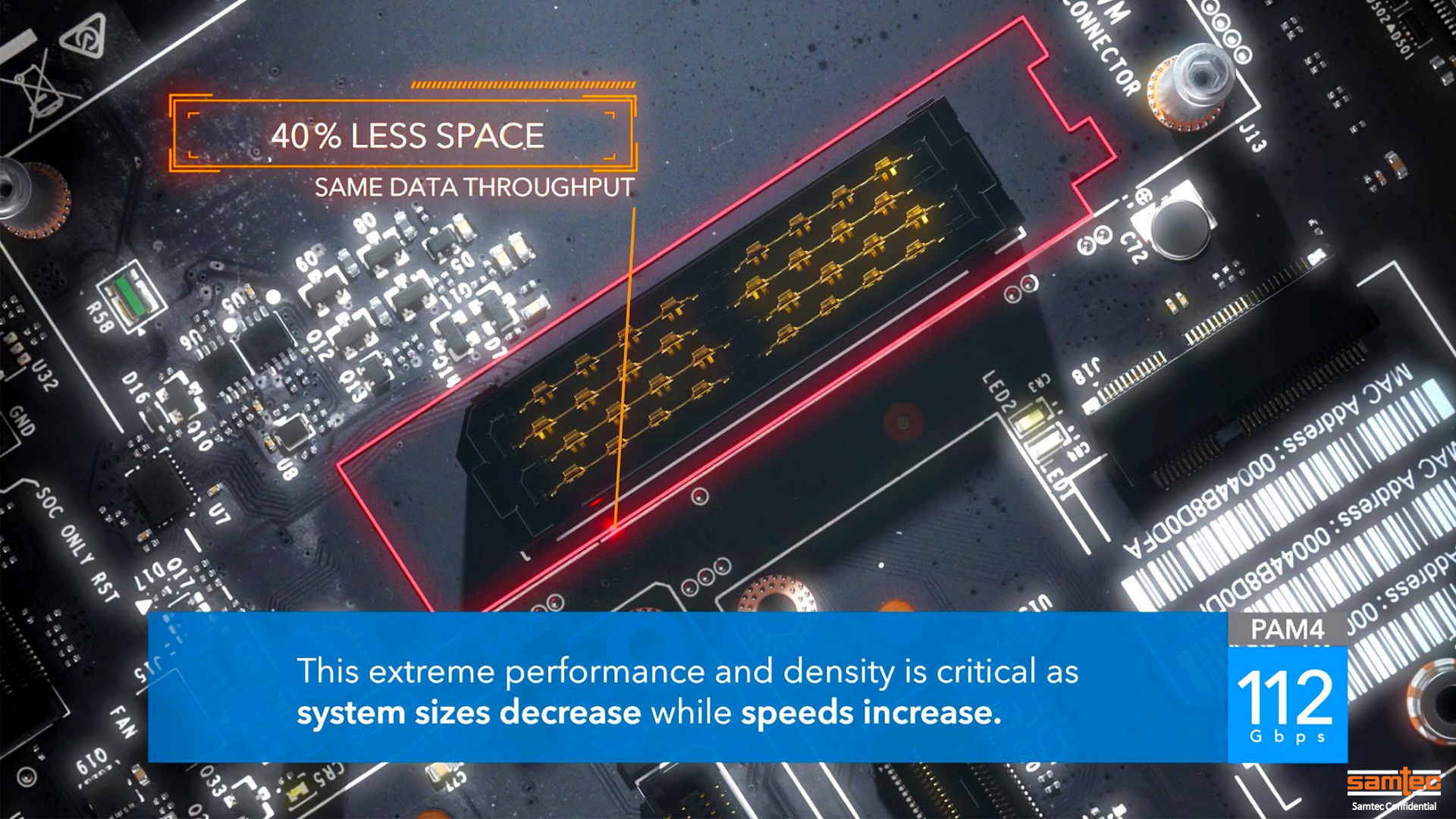

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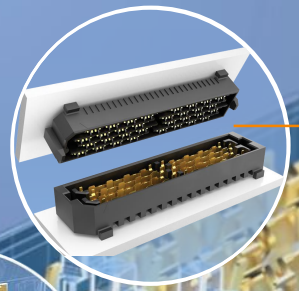
NovaRay's innovative, fully shielded differential pair design enables highest performance



MINIMAL VARIANCE IN DATA RATE AS STACK HEIGHT INCREASES

TIGHT IMPEDANCE CONTROL

EXTREMELY LOW CROSSTALK
(TO 40 GHz)

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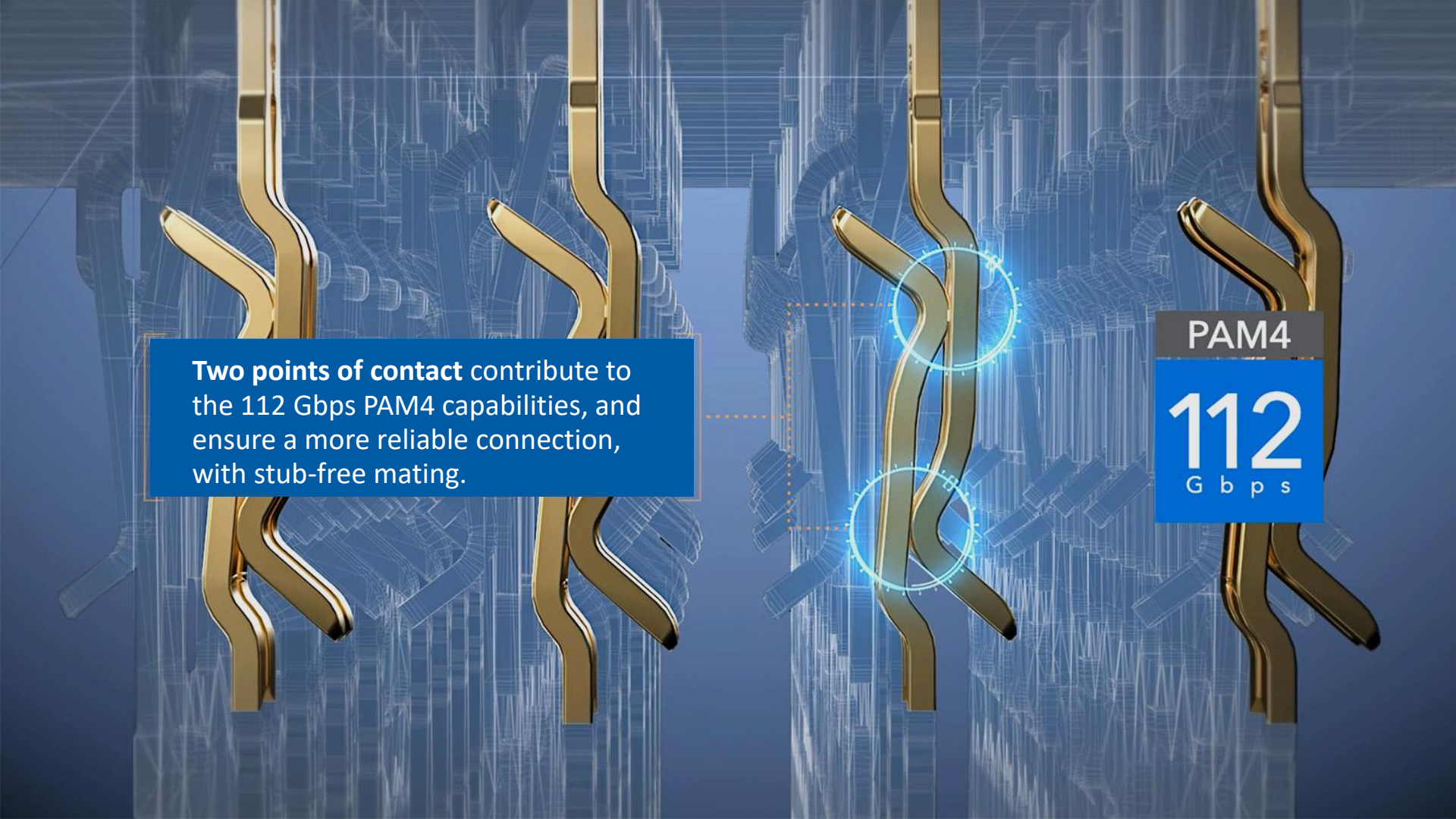
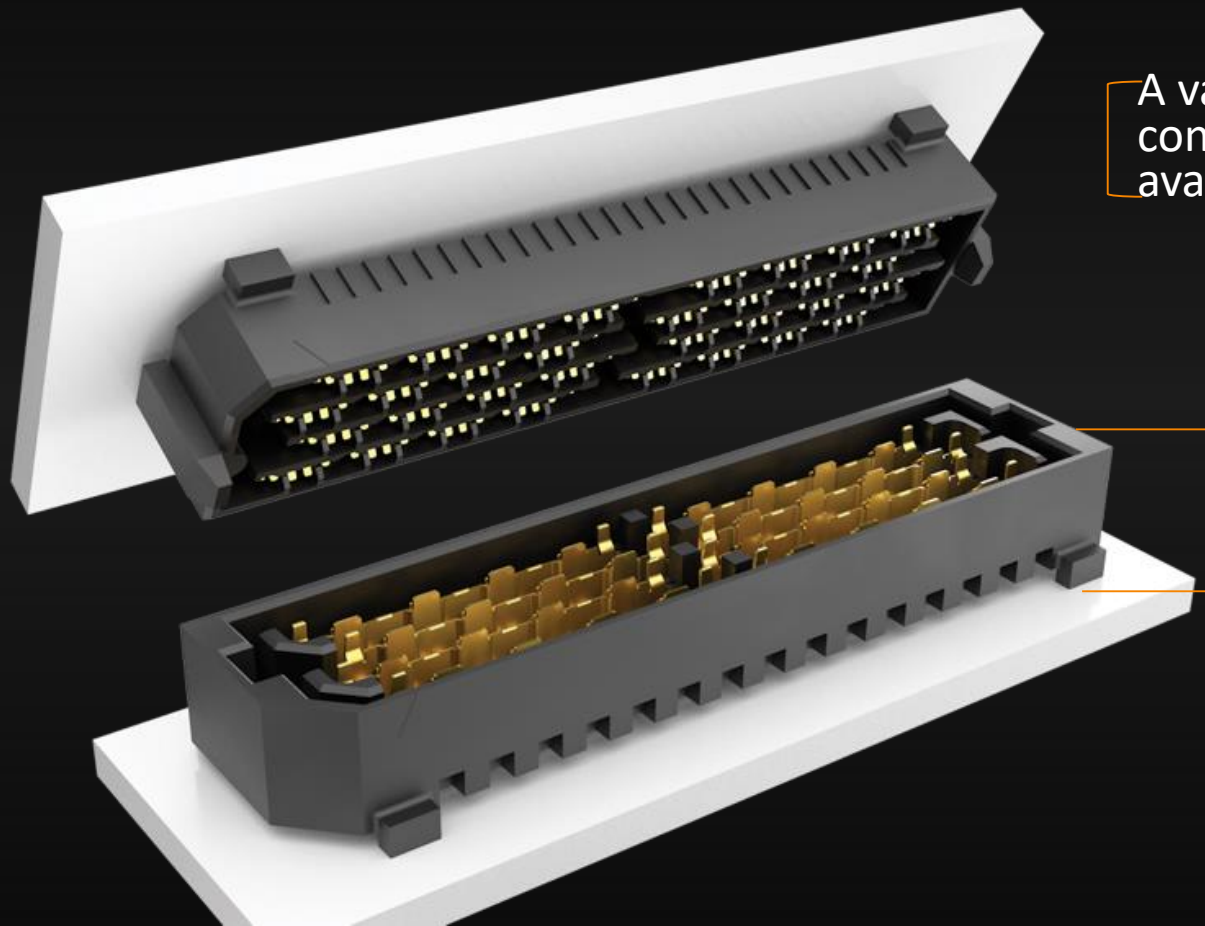

Two points of contact contribute to the 112 Gbps PAM4 capabilities, and ensure a more reliable connection, with stub-free mating.
PAM4
112
Gbps



A variety of board-to-board configurations are available.

32 PAIRS/1.8 Tbps AGGREGATE

16 PAIRS/896 Gbps AGGREGATE

8 PAIRS/448 Gbps AGGREGATE

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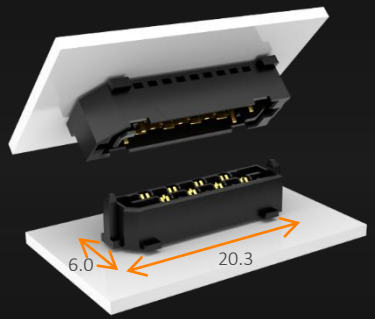
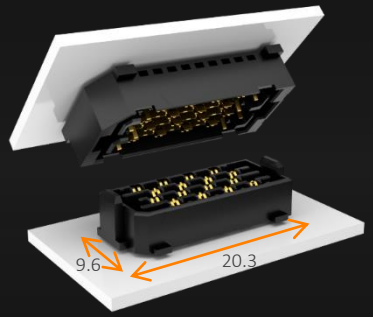
Aggregate data rate DETAILS

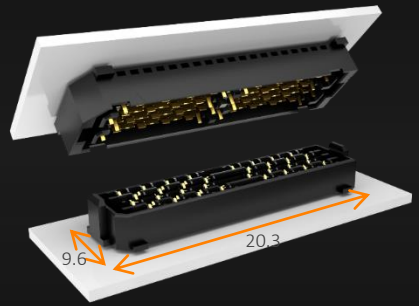
Tooling design capable from 7 mm to 20 mm stack height
Design capable of up to 4 0mm stack height



- 1 Bank
- 2 Row
- 8 Pairs
- Total Gbps: 448

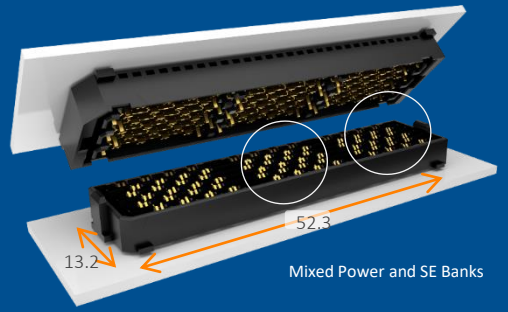


- 1 Bank
- 4 Row
- 16 Pairs
- Total Gbps: 896



- 2 Bank
- 4 Row
- 32 Pairs
- Total Gbps: 1.8 Tbps

ROADMAP



- 3 Bank
- 6 Row
- 72 Pairs
- Total Gbps: 4032

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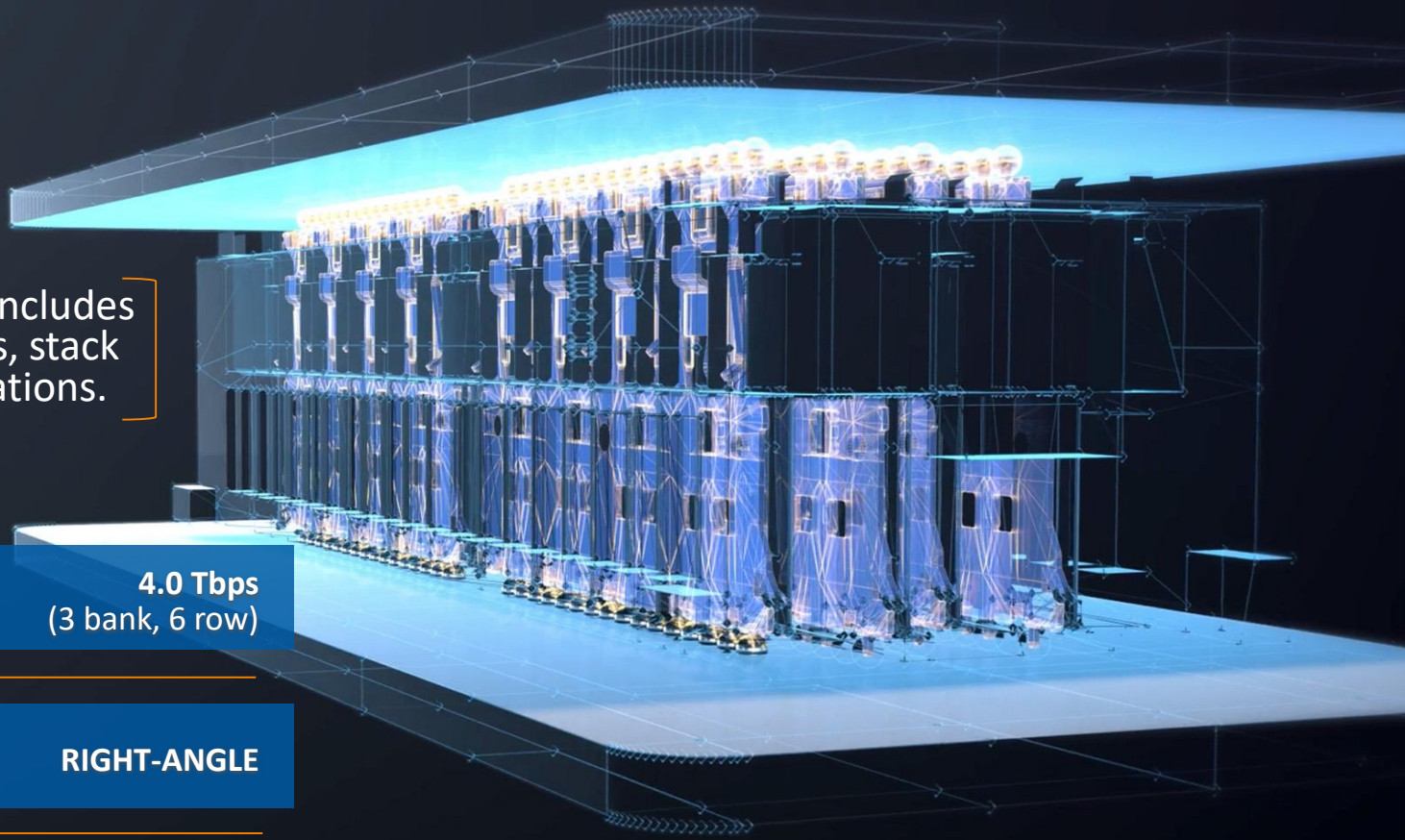
Product Roadmap includes choice of pin counts, stack heights, and orientations.



4.0 Tbps
(3 bank, 6 row)

RIGHT-ANGLE

MODULAR DESIGN
(DP/SE/Power)

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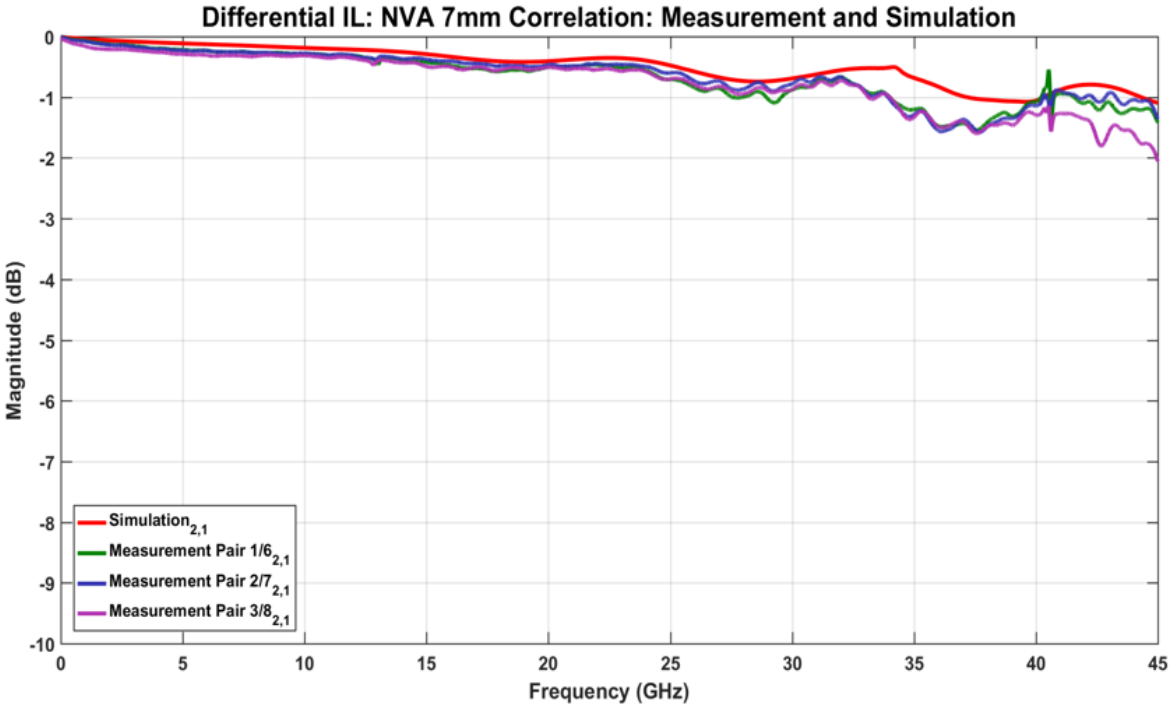
performance | Differential Insertion Loss



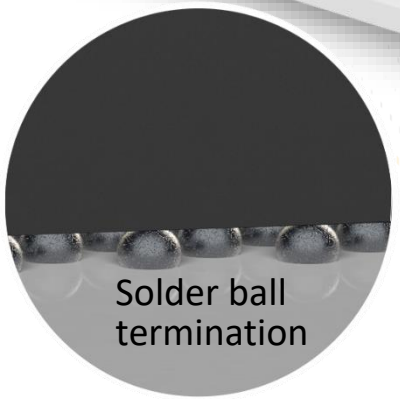
NOVARAY™

NRZ 56 Gbps

NVAM/NVAF SERIES

- 56G NRZ capable / 112 PAM4 per channel
  - Proprietary pin to ground configuration enables very
    low crosstalk to 40 GHz+ and very tight impedance control
  - Minimal variance in data rate with increased stack heights
  - Industry leading aggregate data rate average of 1.33 Tbps/sq inch

7…20mm stackheight, tools in progress



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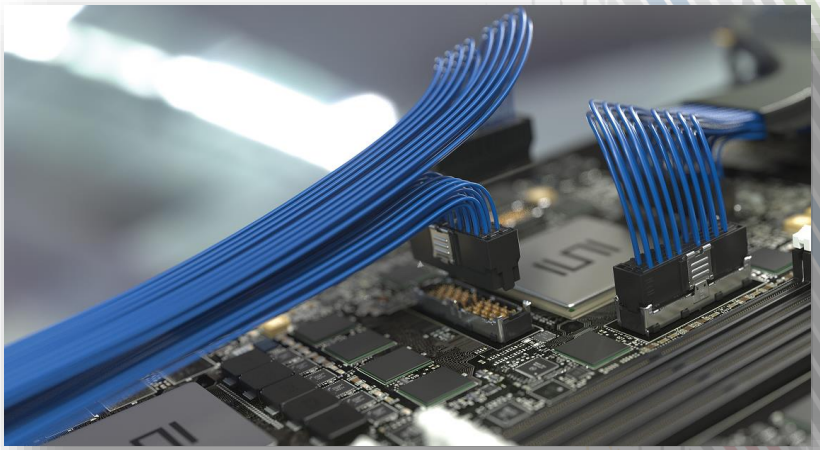
NOVARAY™

NRZ 56 Gbps

CABLE

- 56G NRZ / 112G PAM4
  - Very low cross-talk to 40 GHz+
  - Very tight impedance control
- NovaRay™ Product family includes:
  - High Speed Mezzanine Interconnects
  - High Speed Cable Assemblies
- High Density
  - 60 pairs/in^2
- Roadmap to 72 pairs



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DCC/ZRDP/ZCI/ZCC

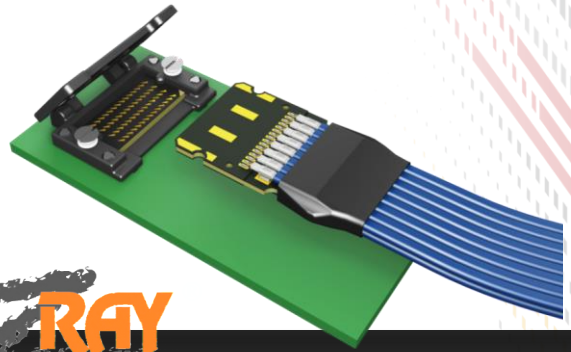
Press-Fit, Cost Effective, High Speed Cable

4 and 8 pairs released, 2 in development
3 mm mated height
32 AWG 100 Ω twinax
Easy termination to customer's board

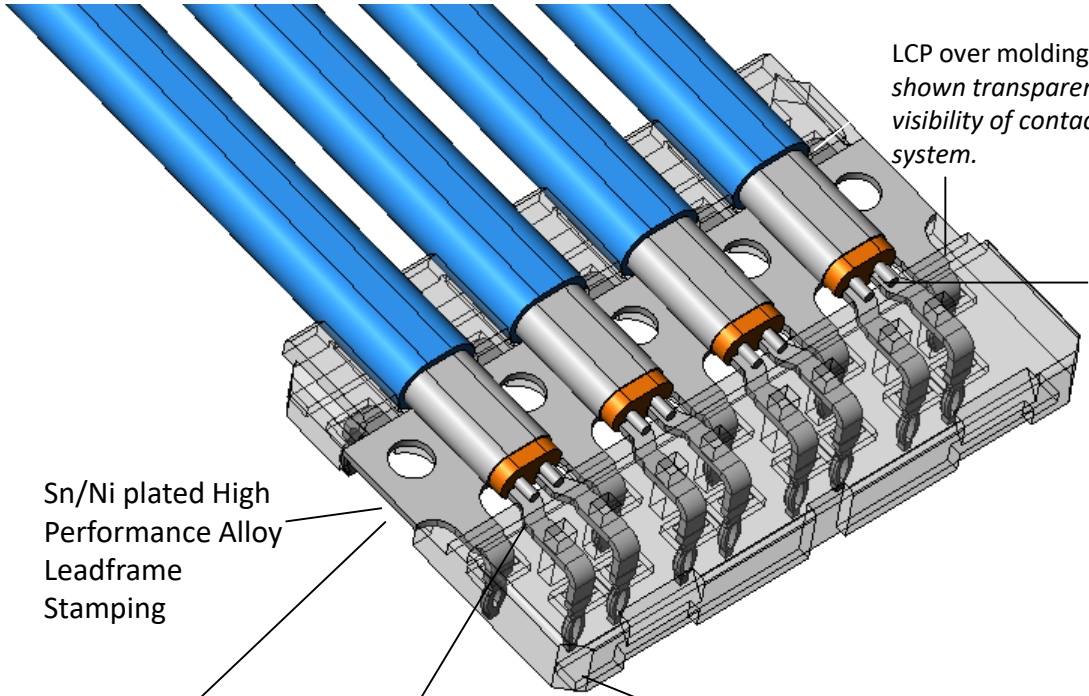
Design in flexibility: Various End 2 options
PCIe® Gen 3 speed and beyond
Ultra-high-speed 2.0 version also in development

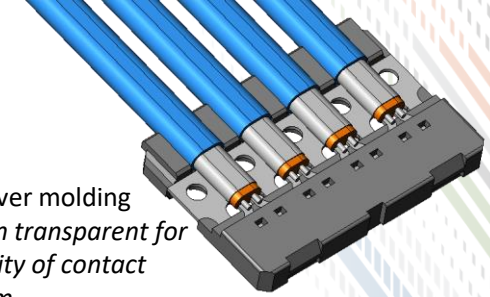
High Density, Low Profile, Z-Ray® Based Cable

- 0.80 mm pitch interposer
- 8 & 16 high speed differential pairs, 34 AWG twinax cable
- Overall height: *Less than 4,00 mm*
- 32 pair version in design
- Various End 2 options
- Flex variation also in development (ZFDP)



DIRECT CONNECT DESIGN

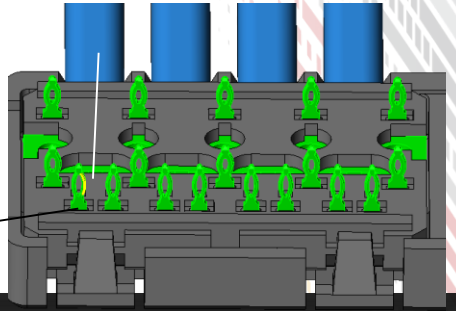




LCP over molding *shown transparent for visibility of contact system.*

Short dielectric transition distance

Proven Reliable Eye of the Needle Pressfit Contacts



Sn/Ni plated High Performance Alloy Leadframe Stamping

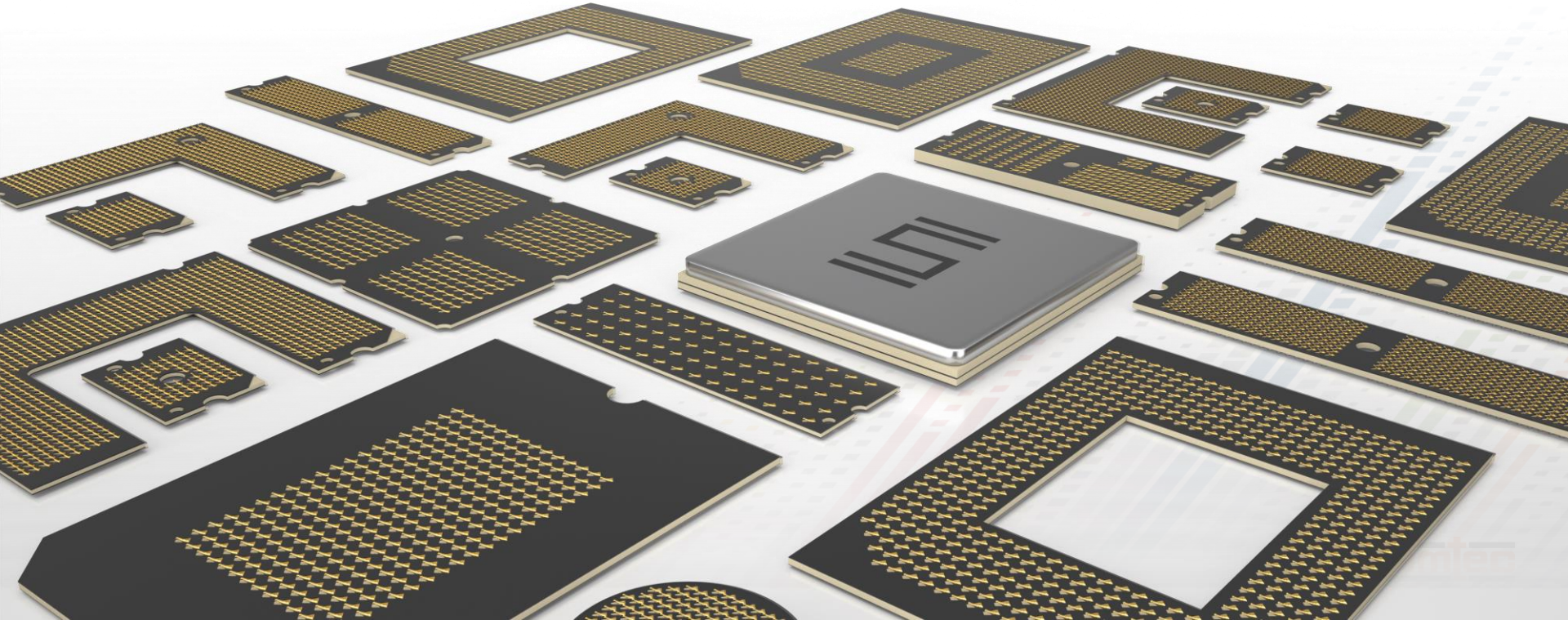
Common shielding/ground

Minimal center conductor length

Impedance matched DP contacts

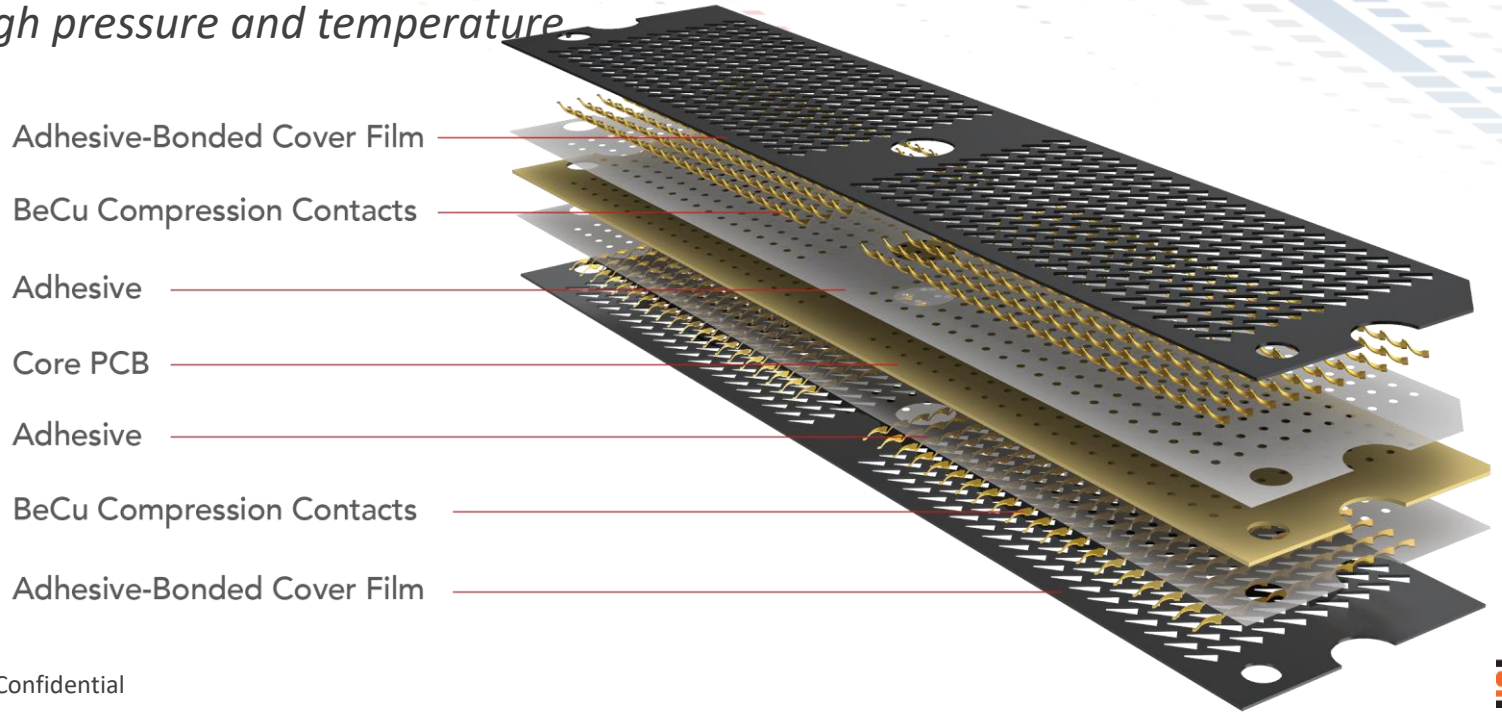
Z-RAY® **ULTRA-LOW PROFILE ARRAYS**

The lowest profile, most flexible high-density, high-speed micro-interposer in the industry, Z-Ray® is ideal for the demands of military / defense, aerospace and R&D applications including radar, radio, navigation and sensors.



Z-ray® one-piece construction

Z-Ray® interposers are assembled into rugged low profile FR4 substrate under high pressure and temperature.



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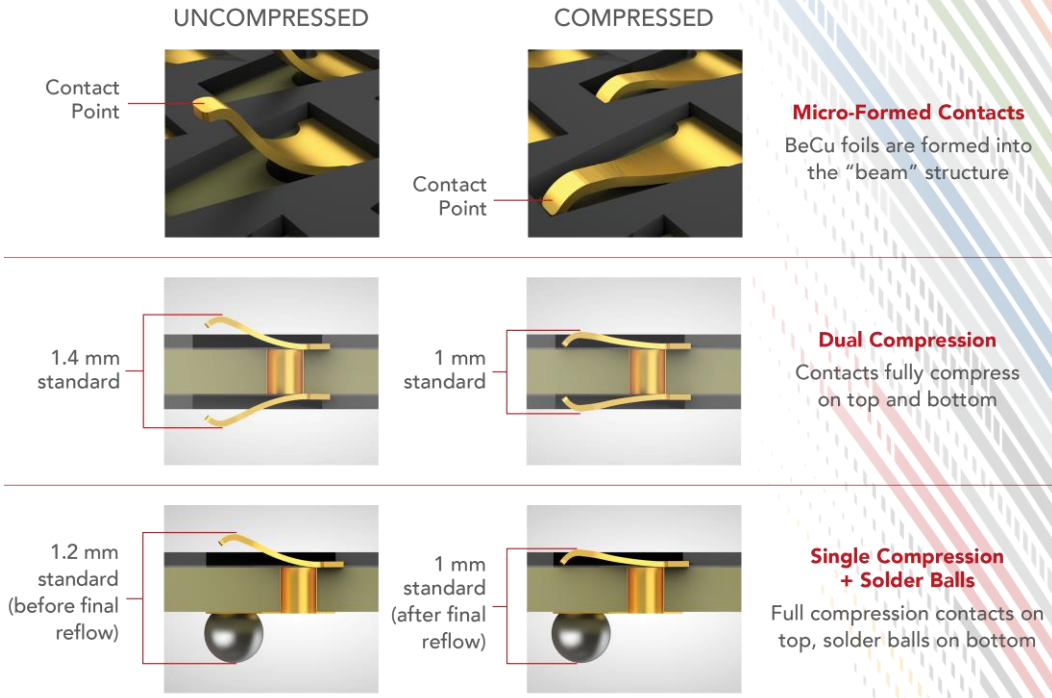
Z-RAY® | CONTACT DESIGN & TERMINATION OPTIONS

- Choice of dual compression contacts or single-compression with solder balls on 0.80 mm and 1.00 mm pitches
- Interposers are built standard with a 1 mm board-to-board thickness; mated height is established by the cover film
- Each beam is attached to the FR4 substrate through a lamination and plating operation
- Signals pass through the interposer through a plated via connecting opposing beams on each side of the interposer
- Minimum Normal Force to maintain acceptable connection/LLCR is 15 grams



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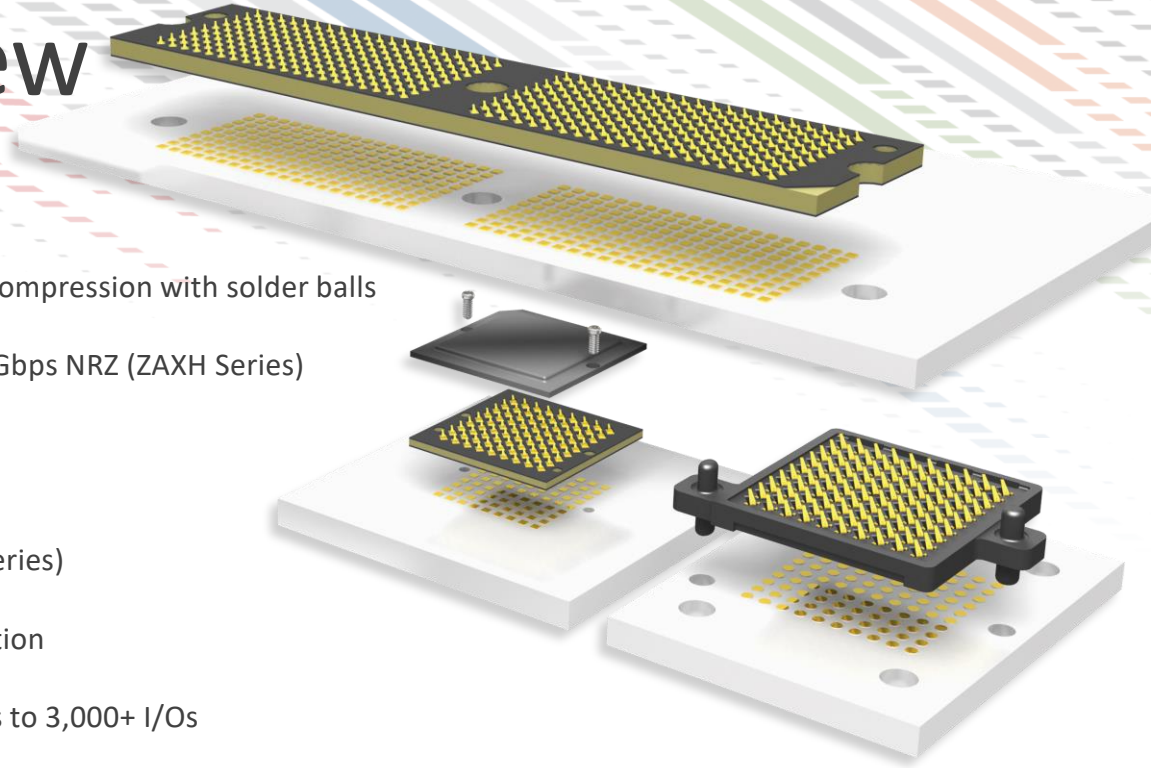
Z-ray® overview



0.80 mm or 1.00 mm pitch arrays

BeCu micro-formed dual compression or single compression with solder balls

Performance up to 14 Gbps (ZAX Series) and 56 Gbps NRZ (ZAXH Series) with a migration path to 100 Gbps

Low profile 1 mm body height (ZAX Series)

0.33 mm height for shortest signal path (ZA8H Series)

Low 30 g normal force with .008" contact deflection

Up to 400 I/Os standard with custom capabilities to 3,000+ I/Os

Up to 1,000 cycles; alternate contact design for up to 3,000 cycles (tested to 85˚C) also available

Also Available: 1.00 mm pitch system with up to 400 I/Os, 1.27 mm & 2 mm standard heights, and up to 56 Gbps performance (GMI Series)

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Z-ray® design flexibility

Z-Ray® interposers are highly customizable and available with a wide variety of custom geometries and pin counts.

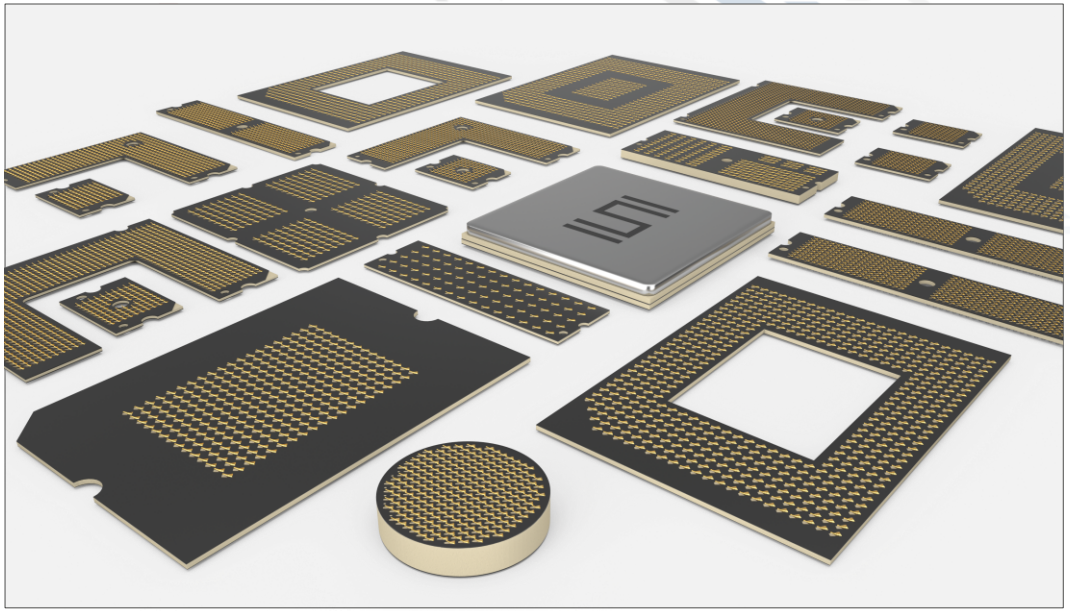
Configurations for any application, complete with detailed footprints

Customer-specific stack heights, pin counts, insulator shapes and plating thicknesses

Customizable in X-Y-Z axes

Quick-turn customization with minimal NRE and tooling charges

Various compression and alignment configurations



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Z-ray® CABLE ASSEMBLIES

Ultra-low profile Z-Ray® Cable Assembly (ZRDP Series)

- Designed for high-speed, micro pitch applications
- Up to 16 signal pairs on 0.80 mm pitch
- 100 ohm differential pair signal routing
- High performance Eye Speed®
  34 AWG twinax ribbon cable
- Cable interface and cage assemblies
  also available

0.80 mm pitch
ZRDP Series

Z-Ray®-on-Flex
custom assembly

Design flexibility enables endless possibilities for high-speed cabling solutions, including low-cost alternatives using flex, low profile RF capabilities

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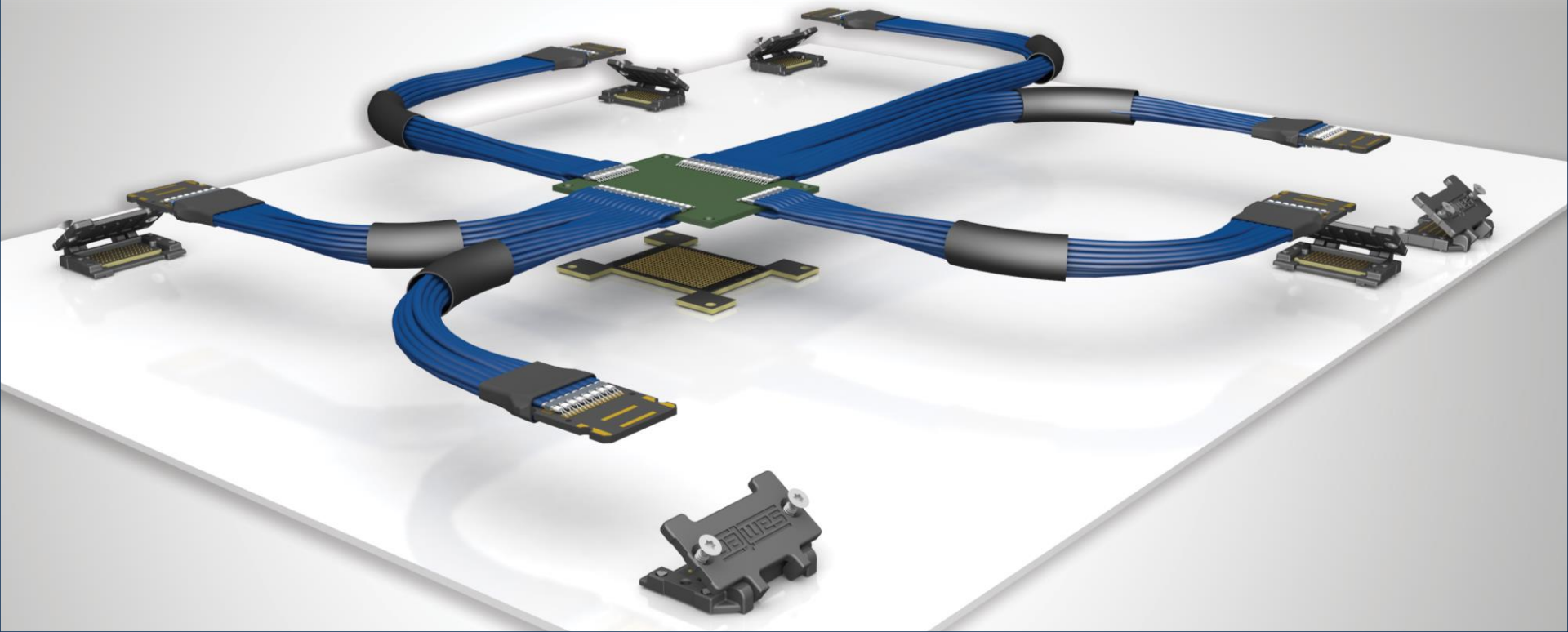
Z-RAY® **CABLE-TO-BOARD APPLICATIONS**

Ultra-low profile cable assemblies are designed for high-speed, micro pitch applications; low-cost cable alternatives and custom solutions are also available.



Z-ray® performance specifications

Z-Ray® interposers offer performance to 14 Gbps (ZAX Series) and 56 Gbps NRZ (ZAXH Series) with a migration path to 100 Gbps.

		Single Compression w/ Solder Balls		Dual Compression			
Series		ZA8	ZA1	ZA8	ZA1	Custom	ZA8H
Pitch		0.80 mm	1.00 mm	0.80 mm	1.00 mm	1.27 mm	0.80 mm
Max Row		25	20	50	58	58	14
Max Column		25	20	50	58	37	50
Thickness	Kapton Core	N/A	N/A	0.33 to 0.5 mm	0.33 to 0.5 mm	0.33 to 0.5 mm	0.33 mm
	FR4 Core	1.00 to 4 mm	1.00 to 4 mm	0.5 to 4 mm	0.5 to 4 mm	0.5 to 4 mm	N/A
Thickness Tolerance	Kapton Core	N/A	N/A	±5%	±5%	±5%	±5%
	FR4 Core	±10%	±10%	±10%	±10%	±10%	N/A
Deflection / Normal Force per Pin		0.20 mm / 30g				0.20 mm / 25-50g	0.20 mm / 30g
Operating Temperature		-55˚C to +105˚C (85˚C Single Cycle)					

THANK YOU
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