HIGH PERFORMANCE COMPUTERS AND ZONE CONTROLLERS CONNECTIVITY SOLUTIONS GUIDE

Current automotive E/E architectures have reached their scalability limit and the industry is now evolving towards a centralized service orientated approach. This paper will examine the role of physical connectivity to both enable the design as well as realizing the benefits of these new architectures. Specifically, it will focus on the significance of hybrid connector component design to support automated harness assembly to support ECU consolidation and will look at examples of TE Connectivity's (TE) solutions.

1. TRANSFORMATION TO "SMART" ARCHITECTURES

New car buyers will be familiar with the process of selecting all the features, functionality and add-ons for their new vehicle. At a basic level, this could be selecting the paint color or upholstery material but increasingly it includes choosing from a vast array of electronic safety, convenience, entertainment and communications options.

This selection is often made using simple on-line "drag and drop" configurator tools without the buyer ever setting foot in the car showroom. Consumers, however, will be less familiar with the sheer level of complexity, "under the hood," that is required to realize their choice - with each vehicle containing a unique electrical/electronic system (E/E) customized to their specific choice.

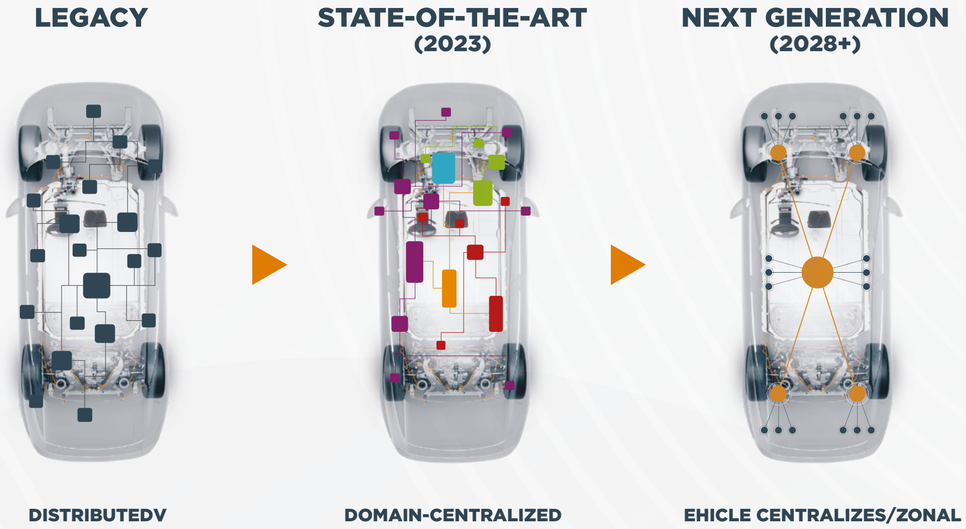
The new generation of automotive consumers increasingly expect a fully customizable driving or passenger experience. The automotive industry has responded by adding more and more new features and functions - with an ever-increasing number of sensors, actuators and electronic control units (ECUs) - with millions of lines of software code. Indeed, modern cars can contain over 150 ECUs and 5 km of wiring – with the main wire harness, at up to 80 kilograms, often being the third heaviest component in the vehicle.

However, the automotive industry has realized that the complexity of the current vehicle E/E architecture has reached its scalability limits. The industry is now exploring a new approach that will transform the vehicle from flat and highly fragmented E/E architectures to more centralized "domain-" or "zonal-" architectures.

This E/E architectural transformation will be based on the following core principles:

Consolidation/Centralization

Consolidation of multiple functions, that are today served by separate dedicated ECUs – with up to 200 software suppliers, into highly powerful centralized platforms. These will feature a reduced number of software instances with richer multifunctional functionality that can support an increasing number of interdependent automated driving functions.



Wiring Optimization

New networking topologies to reduce complexity, cable length, weight and cost. This E/E architectural transformation will be based on the following core principles:

Software-Driven Service-Oriented Architecture

Evolution towards a Service-Oriented Architecture whereby the historical role of the ECU is performed by service specific software on common operating systems that can be easily updated, over-the-air, in response to new safety or security requirements.

The above would require new a high-speed communication network moving away from legacy bus architectures to a modern Ethernet-based backbone. In addition to the reduction in physical complexity, there are a number of other significant technology and business drivers of this centralization.

The evolution towards autonomous driving, with an increasing number of automated driving functions, will require massive computing power, high-speed networking across multiple interdependent functions, high levels of functional redundancy as well as strong cyber security and on-going updates.

In addition, OEMs may be able to benefit from after-market extensions and upselling that would have previously have been highly impractical - with the requirement for integration of additional hardware and other wiring modifications. In theory, with these new architectures, it would be possible to just simply “turn-on” new features via over-the-air (OTA) updates. Other advantages include after-market purchase of new software-based functions, live vehicle diagnostics as well as new business models based on the sale of vehicle generated data.

The Importance of EMI Shielding

Next generation automotive E/E Architecture include a wide range of electronics, many of which have a high risk of propagating Electromagnetic Interference (EMI). It is critical to consider EMI/RFI shielding solutions that effectively reduce susceptibility to electronic malfunctions by either blocking external electromagnetic waves or preventing the emission of internal electromagnetic waves that could interfere with surrounding circuits or devices. Such malfunctions could range from the innocuous, such as an odd noise on a car radio to more serious incidents, such as accidents resulting from the failure of safety equipment. As vehicles integrate more advanced electronics, effective EMI shielding to addresses vulnerabilities at all levels of design from the PCB layout to the enclosure ensuring signal integrity, reduces cross-talk, and maintains reliable operation of safety-critical functions.

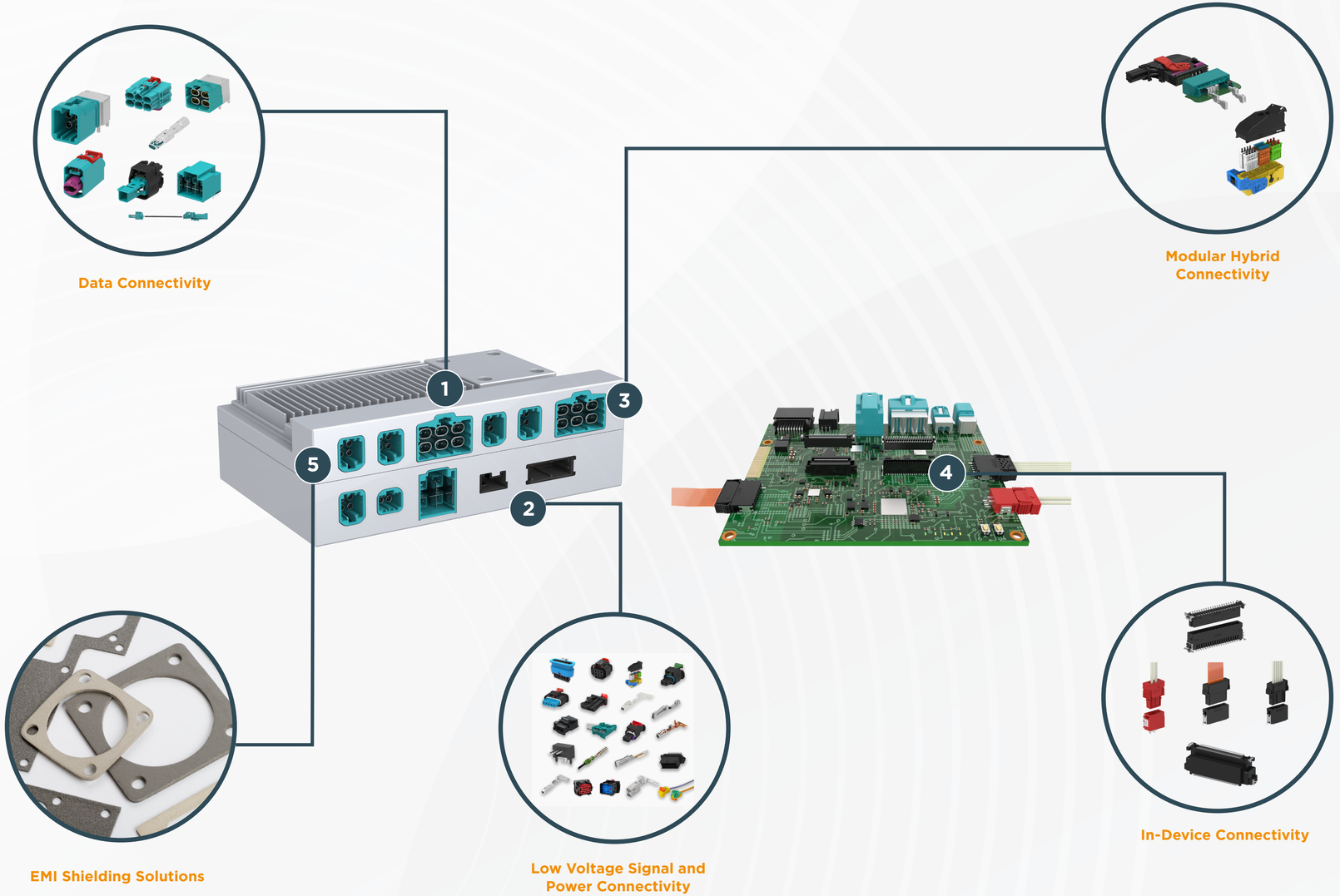
THE ROLE OF CONNECTIVITY IN CENTRALIZED E/E AUTOMOTIVE ARCHITECTURES

Connectivity has always been a key enabler of automotive E/E architectural design. Connector systems have needed to support highly complex and reliable connections between sensors, ECUs and actuators - often in extreme high-vibration/ high-temperature environments. More recently, connector technology has been required to keep pace with the geometric challenges of reduced wire sizes and the increasing space constraints of the modern vehicle, with their vast number of electronic devices and wiring. They have also needed to comply with regulations governing insertion forces during assembly in order to protect the health of assembly line workers.

Connectivity therefore plays a critical role in meeting some of the key design challenges and leveraging some of the benefits from the evolution of automotive E/E architectures as they evolve toward more centralized designs. In particular, with the increasing importance of functional safety measures, the reliability of manually manufactured harnesses may no longer be sufficient.

The transformation to simpler more consolidated E/E architectures provides an opportunity, for the first time, to reduce the scale and complexity of the physical network while simultaneously standardizing the interfaces between each module. In addition, the increased digitization of the E/E architecture will enable a complete system simulation. This will enable engineers, who must consider thousands of functional system requirements, to avoid critical design rules potentially being overlooked. This includes the interdependencies of signal, data and power that, in the foreseeable future, can be analyzed at an early stage using artificial intelligence to design the optimal layout of an E/E architecture and its physical layer.

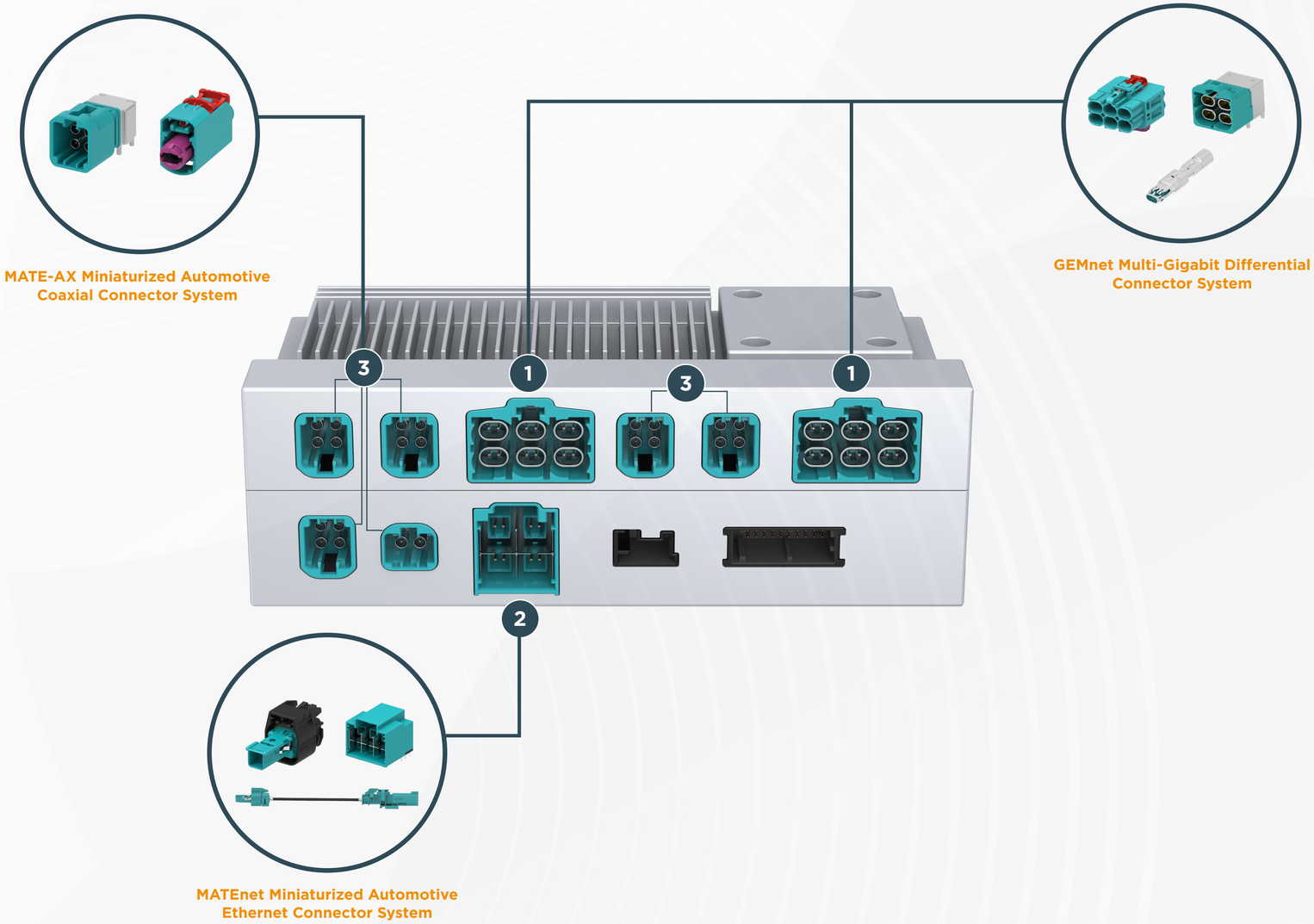
CONNECTIVITY SOLUTIONS FOR AUTOMOTIVE HIGH PERFORMANCE COMPUTERS AND ZONE CONTROLLERS



KEY CONNECTIVITY SOLUTIONS

CLICK AND JUMP TO

CONNECTIVITY SOLUTIONS FOR AUTOMOTIVE HIGH PERFORMANCE COMPUTERS AND ZONE CONTROLLERS



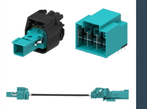
1 DATA CONNECTIVITY

Click on the image to learn more!

1, GEMnet

Multi-Gigabit Differential Connector System

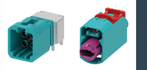
- Enabling 15 GHz and up to 56 Gbps
- Automotive-grade design: Leads-in, anti-stubbing, lower mating forces
- Protocols: 100BASE-T1, 1000BASE-T1, 2.5/5/10GBASE-T1; GMSL, APIX, GVIF, FPD-Link, ASA Motion Link, MiPi, HDBase-T; USB, PCIe



2, MATEnet

Miniaturized Automotive Ethernet Connector System

- Enabling up to 1 Gbps (100BASE-T1 and 1000BASE-T1) and 4 Gbps with alternative technologies
- Modular and Scalable solution: The standardized core module can be assembled into various housing frames
- Protocols: 100BASE-T1 (100Mbps – IEEE802.3bw) and 1000BASE-T1 (1 Gbps – IEEE802.3bp PoDL / Class 3-48 Volt); A2B; HDBaseT



3, MATE-AX

Miniaturized Automotive Coaxial Connector System

- Enabling up to 9 GHz RF performance
- Up to 75 % space reduction
- Up to 34 % weight reduction (4x 1pos. FAKRA connector vs. 4pos. MATE-AX connector)
- Protocols: MIPI, ASA (Automotive SerDes Alliance), GMSL2/3, FPD-Link

CLICK AND JUMP TO

1 Data Connectivity

2 Low Voltage Signal and Power Connectivity

3 Modular Hybrid Connectivity (Data, Signal and Power)

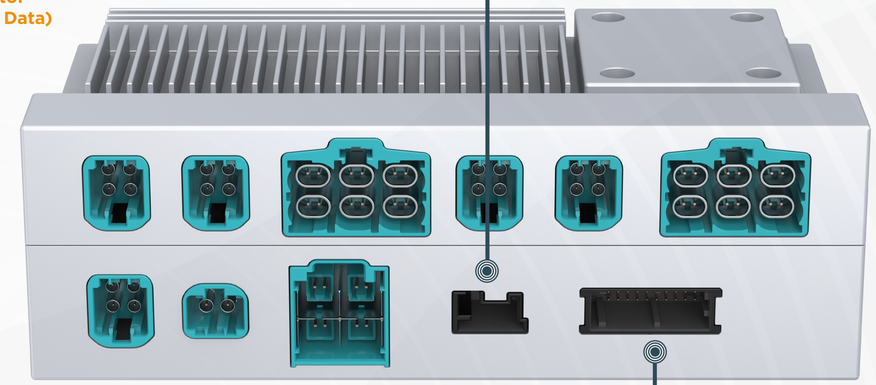
4 In-Device Connectivity

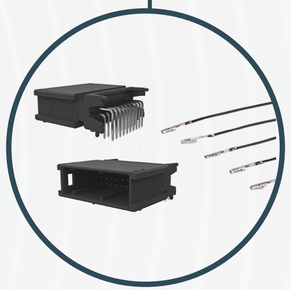
5 EMI Shielding Solutions

BACK TO START

CONNECTIVITY SOLUTIONS FOR AUTOMOTIVE HIGH PERFORMANCE COMPUTERS AND ZONE CONTROLLERS

Mixed and Hybrid Connector Solutions (Signal, Power and Data)





NanoMQS 0.50mm Miniaturized Automotive Connector System

- Temperature Range: -40°C to +140°C (+120°C for tin)
- Orientation: 90°/180°
- Sealed and unsealed are available

2 LOW VOLTAGE SIGNAL AND POWER CONNECTIVITY

Click on the image to learn more!

PicoMQS

Miniaturized Automotive Connector System

- Wire size: 0.13 mm² – 0.75 mm² (0.22FLU/FLR)
- 1.27mm pin pitch
- Current: 4 Amps
- Protocols: LV214

NanoMQS 0.50mm

Miniaturized Automotive Connector System

- Wire size: 0.13 mm² – 0.75 mm²
- 1.8mm pin pitch
- Current: 6 Amps
- Protocols: LV214/ USCAR*

MQS 0.63mm

Automotive Signal Connector System

- Wire size: 0.08 mm² – 0.75 mm²
- 2.54mm pin pitch
- Current: 7.5 Amps
- Protocols: LV214/ USCAR

Generation Y 0.64

Automotive Signal Connector System

- Wire size: 0.13 mm² – 0.75 mm²
- 2.2mm pin pitch
- Current: 10.5 Amps
- Protocols: USCAR

MCON 1.2mm

Automotive Low Power Connector System

- Wire Size: 0.5 mm² – 1.5 mm²
- Current: 17 Amps
- Protocols: LV214/ USCAR

AMP MCP 1.5, 2.8 and 6.3mm

Automotive Medium Power Connector System

- Wire Size: 0.2 mm² – 6.0 mm²
- Current: 18-78 Amps
- Protocols: LV214/USCAR

MCON 8, 9.5 and 12mm

Automotive Medium Power Connector System

- Wire Size: 2.5 mm² – 35 mm²
- Current: 78-179 Amps
- Protocols: LV214/USCAR

Mixed Connectivity Solutions

Mixed Signal and Power in a single connector interface

- 0.50mm to 12mm terminals
- Wire Size: 0.13 mm² – 35 mm²
- Current: 6A - 179A
- 2-152 positions

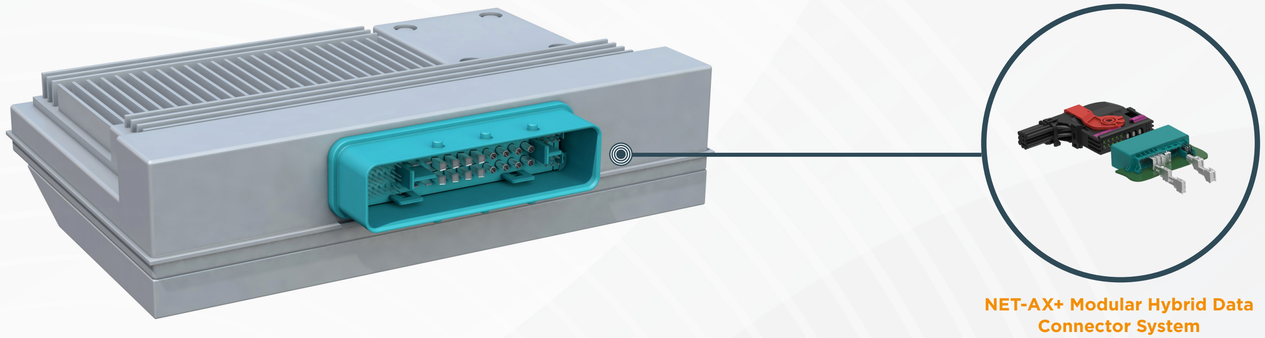
Hybrid Connectivity Solutions

Signal, Power and Data in a single connector interface

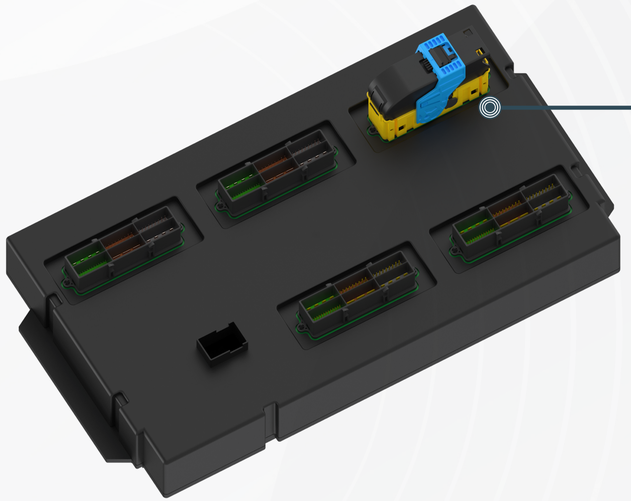
- 0.63mm to 6.3mm terminals / Ethernet and Coax
- Enabling up to 9GHz RF performance and 40A
- 2-280 positions

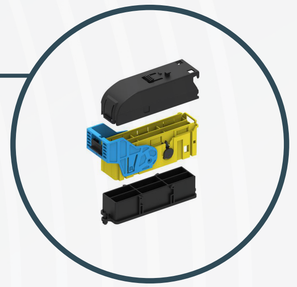
* USCAR validation in progress

CONNECTIVITY SOLUTIONS FOR AUTOMOTIVE HIGH PERFORMANCE COMPUTERS AND ZONE CONTROLLERS



NET-AX+ Modular Hybrid Data Connector System





Modular Hybrid System (MHS)

3 MODULAR HYBRID CONNECTIVITY

Click on the image to learn more!

NET-AX+ Modular Hybrid Data Connector System

- Interfaces / Platform available for
  - GEMnet, BEAMnet, MATE-AX, NanoMQS, AMP MCP 2.8, MCON 1.2

Benefits

- Supports signal, power and data connectivity
- Up to 40% space saving reduction
- Up to 80% fewer mating assemblies

Modular Hybrid System (MHS)

- Interfaces / Platform available for
  - NanoMQS 0.50, MQS 0.63, Generation Y 0.64, MCON 1.2, AMP MCP 2.8, AMP MCP 6.3/4.8K, GEMnet, MATE-AX, HSD

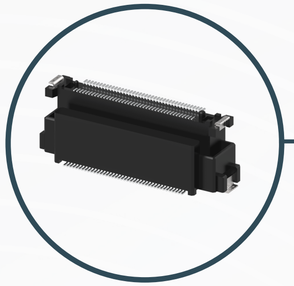
Benefits

- Modular hybrid system featuring flexible plug and header configurations for signal, power and data connectivity
- Scalable for many vehicle platforms
- Delivers up to a 40% reduction in both space and weight
- Automation-ready

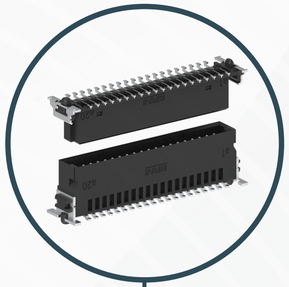
the Modular Hybrid Connectivity products are customized solutions

CONNECTIVITY SOLUTIONS FOR AUTOMOTIVE HIGH PERFORMANCE COMPUTERS AND ZONE CONTROLLERS

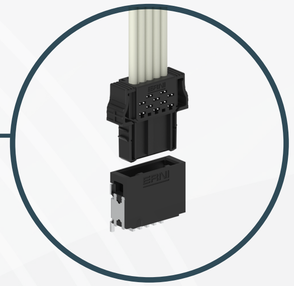
Board to Board Solution
Floating connector system



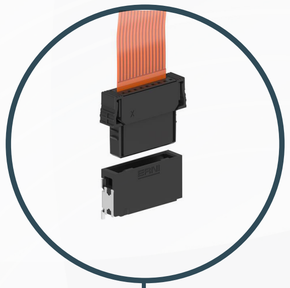
Board to Board Solutions
ERNI SMC connector system



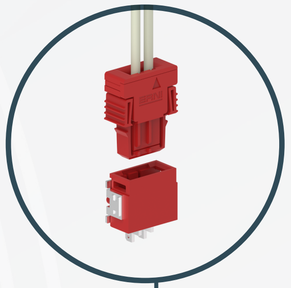
Wire to Board Solution
ERNI MicroBridge connector system

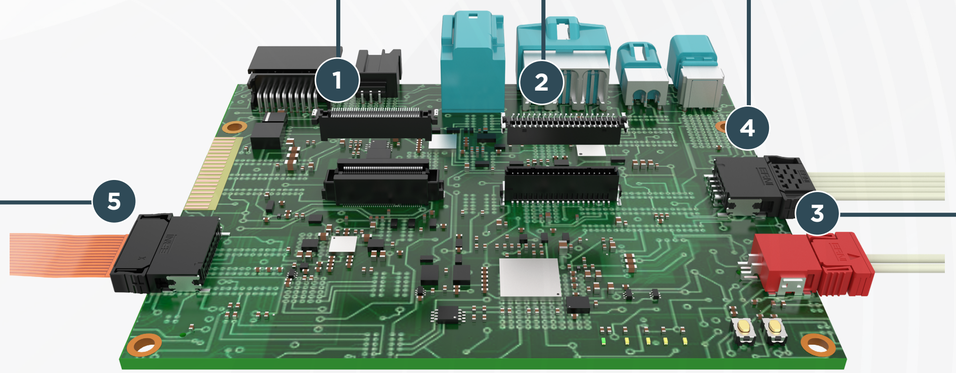


Flex to Board
ERNI MicroBridge Flexfoil connector system



Wire to Board Solution
ERNI MaxiBridge connector system





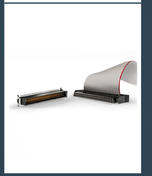
4 IN-DEVICE CONNECTIVITY

Click on the image to learn more!

Board to Board Solutions

1, Floating connector system*

- Current: signal only; signal and power
- Temperature: -55- 125 °C
- No. of Pins: 20-180 Max**
- Pitch: 0.5mm



2, ERNI SMC connector system

- Current: up to 1.7 A per contact
- Temperature: -55- 125 °C
- No. of Pins: 12, 16, 20, 26, 32, 40, 50, 68, 80
- Pitch: 1.27mm
- Standard: LV214 ***
- Terminal technology: SMT

Wire to Board Solutions

2, ERNI SMC connectors (see above)

3, ERNI MaxiBridge connector system

- Current: up to 12 A (depends on cable)
- Temperature: -55- 150 °C
- No. of Pins: 2, 3, 4, 5, 6, 8, 10, 2x5, 2x10
- Pitch: Single- and double-row system with a 2.54mm pitch
- Standard: LV 214 and USCAR-2 compliant
- Terminal technology: Male connector SMT, female connector crimp

4, ERNI MicroBridge connector system

- Current: up to 9A
- Temperature: -40- 150 °C
- No. of Pins: 2-20 pin (single-row) possible
- Pitch: 0.5 x 0.4mm pins with 1.27mm pitch
- Standard: LV 214
- Terminal technology: Male connectors SMT
  Female connectors IDC

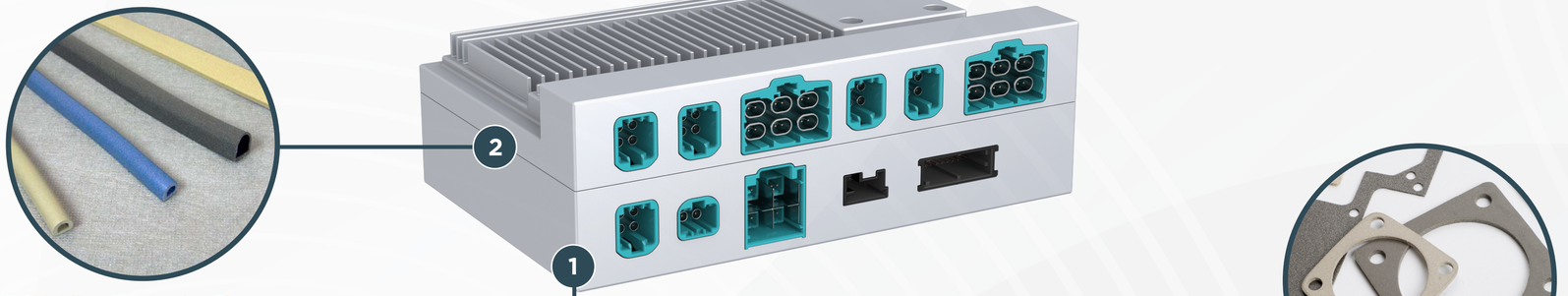
Flex to Board Solutions

5, ERNI MicroBridge Flexfoil connector system

- Current: up to 12 A (depends on cable)
- Temperature: -40- 150 °C
- No. of Pins: 8 / 20 (single-row)
- Pitch: 0.5 x 0.4mm pins with 1.27mm pitch
- Standard: LV 214
- Terminal technology: Male connectors SMT
  Female connectors piecing

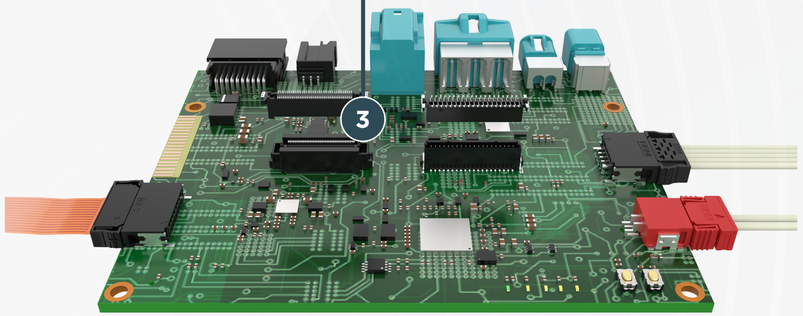
* The product is not SOP yet, if you get any question please contact us

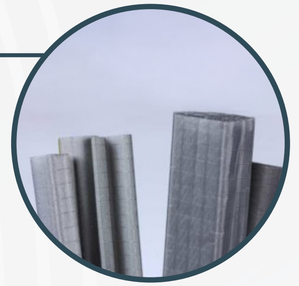
CONNECTIVITY SOLUTIONS FOR AUTOMOTIVE HIGH PERFORMANCE COMPUTERS AND ZONE CONTROLLERS



EMI Shielding Conductive Elastomer

EMI Shielding Connector Gasket





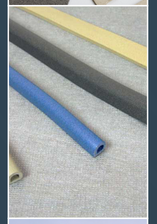
EMI Shielding Fabric over foam

5 EMI SHIELDING SOLUTIONS

Click on the image to learn more!

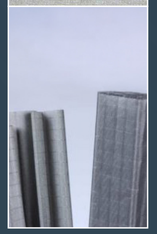
1, EMI Shielding Connector Gasket

- Meet standard size and common sub D connector gaskets
- The compression stop also provides for additional electrical bonding between the surfaces with a very low contact resistance
- Surface mounted gaskets are to be used where groove mounted gaskets such as O-Rings cannot be accommodated



2, EMI Shielding Conductive Elastomer

- Silicone or fluorosilicate loaded with highly conductive particles providing superior performance
- EMI shielding performance combined with excellent environmental sealing
- Material options to provide required EMI performance and galvanic compatibility
- Provides low contact resistance between mating surfaces



3, EMI Shielding Fabric over foam

- Have fire resistant properties to UL94VO
- Compression between approximately 10% and 70%
- Wide variety of profiles where full EMC screening is required between component parts
- Provide an excellent EMI gasket with low compression set
- Excellent abrasion resistance for high cycling and wiping applications

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