

# EDGE COMPUTING SOLUTIONS

---

## Quick Reference Guide

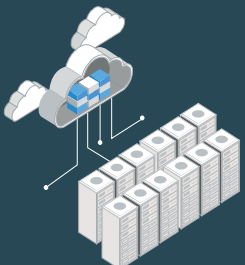













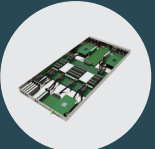
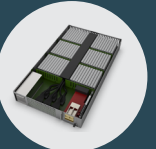


Bringing performance and reliability to edge computing with solutions that address ruggedization, cooling, EMI and physical security



### RELIABILITY AND PERFORMANCE AT THE EDGE

As the expectation for consuming massive amounts of data at faster speeds with low latency is ever increasing, the need for edge computing has become paramount. Across a growing range of applications, from autonomous vehicles and smart power grids to industrial manufacturing and healthcare, the ability to compute data close to the source is critical for faster transfer and response times. Metro and premise edge data centers, servers and end devices must perform seamlessly to meet these demands. That's why TE Connectivity (TE) offers products and expertise to help meet challenging and varied requirements.

### HOW TE SUPPORTS THE EDGE ECOSYSTEM

Core	Edge			
Cloud Data Center	Metro Edge/ Near Core	Access/ Network Edge	Premise Edge	Device Edge
				<ul style="list-style-type: none"> <li> Automotive/Transportation</li> <li> Agriculture</li> <li> Banking and Finance</li> <li> Energy and Utilities</li> <li> Healthcare</li> <li> Machine Learning</li> <li> Manufacturing</li> <li> Public Sector</li> <li> Retail</li> </ul>
Network Switch	Server/AI	Storage	Cellular Networks	IoT Devices
				
<ul style="list-style-type: none"> <li>• High Speed I/O</li> <li>• Hybrid Cable Assemblies</li> <li>• Internal Card Edge Cables &amp; Connectors</li> <li>• Memory</li> <li>• Power Connectors &amp; Cable Assemblies</li> <li>• Sockets &amp; Hardware</li> </ul>	<ul style="list-style-type: none"> <li>• High Speed I/O</li> <li>• High Speed Sockets</li> <li>• Internal Cabling</li> <li>• Power Interconnects</li> </ul>	<ul style="list-style-type: none"> <li>• Backplane Connectors</li> <li>• High Speed I/O</li> <li>• Internal cabling</li> <li>• Power Connectors</li> <li>• Storage Interconnects</li> </ul>	<ul style="list-style-type: none"> <li>• Antennas</li> <li>• Connector Sealing System &amp; Cable Assemblies</li> <li>• Power Connectors &amp; Cable Assemblies</li> <li>• RF Signal Interconnects</li> </ul>	<ul style="list-style-type: none"> <li>• Antennas</li> <li>• Board Level Shielding</li> <li>• Interface Connectors</li> <li>• Memory Connectors</li> <li>• Power Connectors</li> <li>• RF Signal Interconnects</li> <li>• Sensors</li> <li>• SIM Connectors</li> </ul>

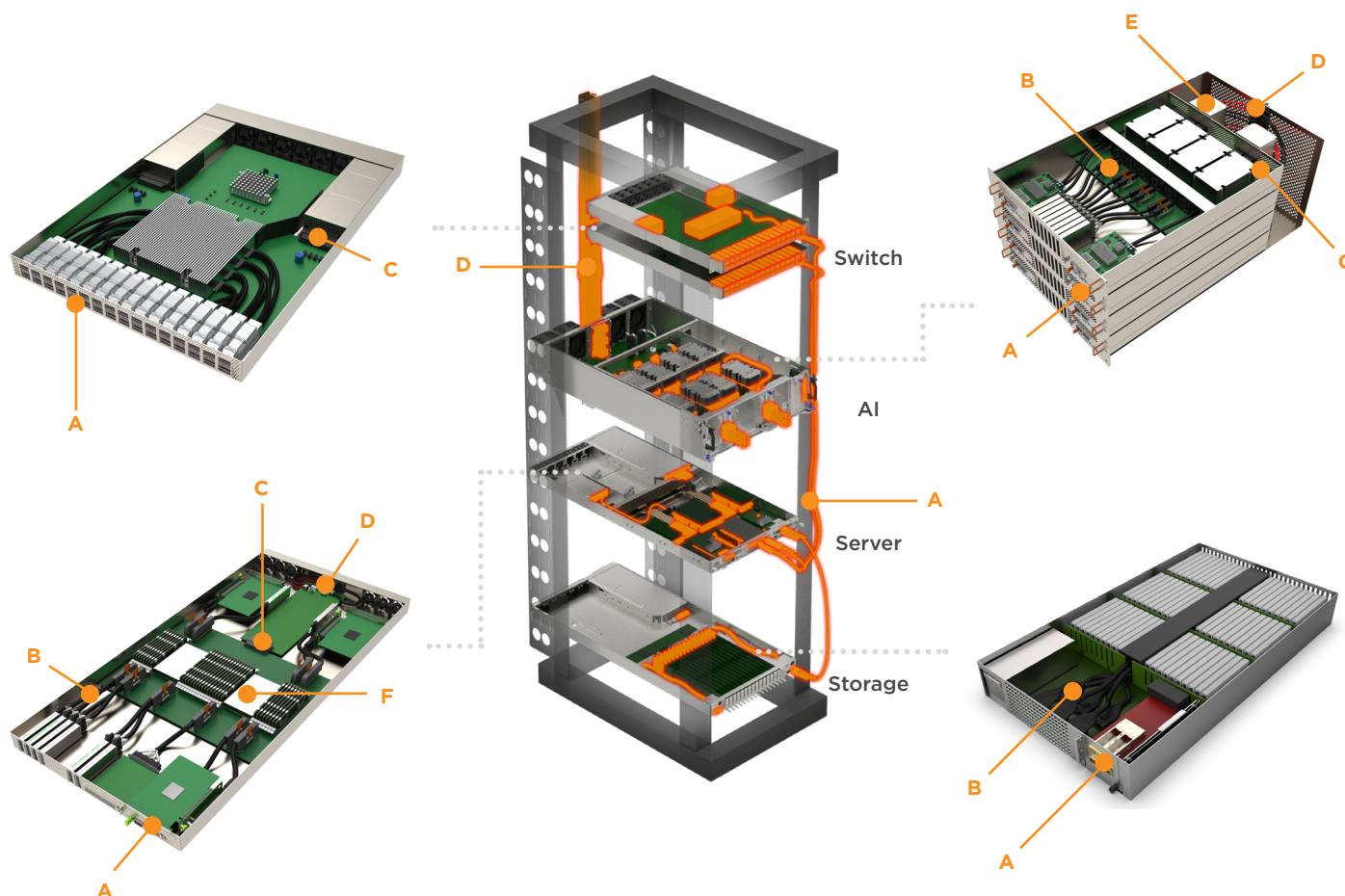


### KEY REQUIREMENTS FOR EDGE DATA CENTERS

High Speed/Low Latency	Low latency should ideally be 5 milliseconds (Ms) or less.
Extreme Temperature Tolerance	Components must be able to operate in environments ranging from 40°C (-40°F) up to +125°C (257°F).
Power Supply Utilization	Server configuration, component selection and choice of thermal cooling technology can impact power usage.
Small Footprint	Server configuration design optimization and smaller format component selection play a critical role in maximizing floor space.
Silent Operation	Noise levels can reach up to 92 dB(A). Liquid cooling technologies, such as immersion or cold plate, can significantly reduce noise.
Minimize Electromagnetic Interference (EMI)	Antennas, components, shielding selection and positioning must be considered early in the design phase.



## TE COMPONENTS SUPPORTING EDGE DATA CENTERS



### A - High Speed I/O

- QSFP Connectors and Cages
- QSFP-DD Connectors and Cable Assemblies
- SFP Connectors
- RJ point-to-point Connectors
- OSFP Connectors and Cages
- CDFP Connectors, Cages & Cable Assemblies
- CDFP PCIe Gen 5 and 6 Connectors
- Active and Passive Copper Cable Assemblies
- Active Optical Cable Assemblies

### B - Internal Connectors and Cable Assemblies

- ICC Internal Cable Connectors
- Sliver Cabled Interconnects
- Mini Cool Edge IO (MCIO) Interconnects
- PCIe Gen 5 CEM Connectors

### C - Power Connectors & Cable Assemblies

- MINIPAK HDL Connectors
- ORv3 (Open Rack Version 3) IT Gear Power Input Solution
- MULTI-BEAM Plus Connectors
- Thermal Bridge I/O Connectors
- ICCON Block and ICCON Insert High Power Pins and Sockets
- Card Edge Power Connectors
- ELCON Mini Connectors and Cable Assemblies
- RAPID LOCK Power Connector

### D - Busbar Solutions

- Power Busbar Connectors
- ELCON Drawer Connectors
- 48V Vertical Busbar
- Liquid Busbars

### E - Backplane Connectors

- STRADA Whisper Connectors
- STRADA Whisper Absolute Connectors
- AdrenaLINE Catapult, AdrenaLINE Slingshot, and AdrenaLINE Fastlane Connectors

### F - Sockets & Hardware

- LGA 4677 Socket
- LGA 3647 Socket
- PCIe GEN 5 CEM Connectors
- DDR5 DIMM Sockets

### Accessories

- Performance Materials for EMI Protection
- Antennas
- Sensors



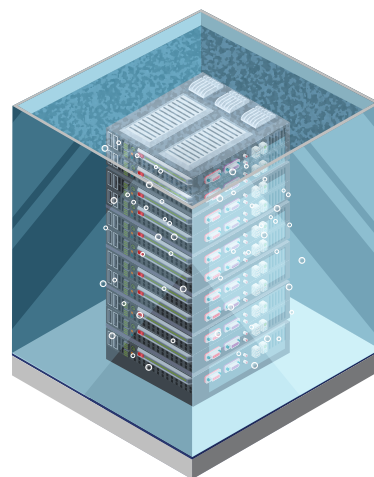
## TE SOLUTIONS FOR THERMAL PERFORMANCE

As the demand to process more data increases every year, so too does the need for higher-power data racks and more efficient edge data centers. A forced air data rack can consume as much as 30 to 50 kilowatts of energy. Higher temperatures that occur due to higher power levels can directly affect the longevity of components in the data rack if the thermal design is not optimized. TE offers products for air and cold plate cooling solutions, but is also focused on developing a robust portfolio of products to support state-of-the-art immersion cooling technology.

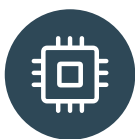
### IMMERSION COOLING

When comparing traditional air cooling, cold plate cooling and immersion cooling technologies, one can think of them as “good, better and best” choices.

- **Air Cooling (Good)** - Long-term operational costs add up from power consumption associated with running air conditioners and server fans.
- **Cold Plate Cooling (Better)** - Offers a more enhanced method with closed loop water cooling, but comes at a high cost with added system complexity and other required cooling equipment.
- **Immersion Cooling (Best)** - Removes the need for fans and air conditioning, introducing a host of benefits, including:



Energy Savings



Increased Compute Density



Superior Thermal Management



Noise Reduction



Reduced Footprint

### MEETING THE COMPONENT REQUIREMENTS OF IMMERSION COOLING

Immersion cooling offers distinct advantages for edge data centers; however, the performance of the system is only as good as its components. As TE evolves existing products and develops new ones to support immersion cooling, we consider:

#### Impact on performance

Through simulations and testing, we evaluate how submersion impacts impedance in our existing products and identify required modifications.

#### Material compatibility

Engineering products with materials that can be submerged for long periods of time without degradation.

#### Component protection

Sealing of components that will be submerged is critical for long-term performance.



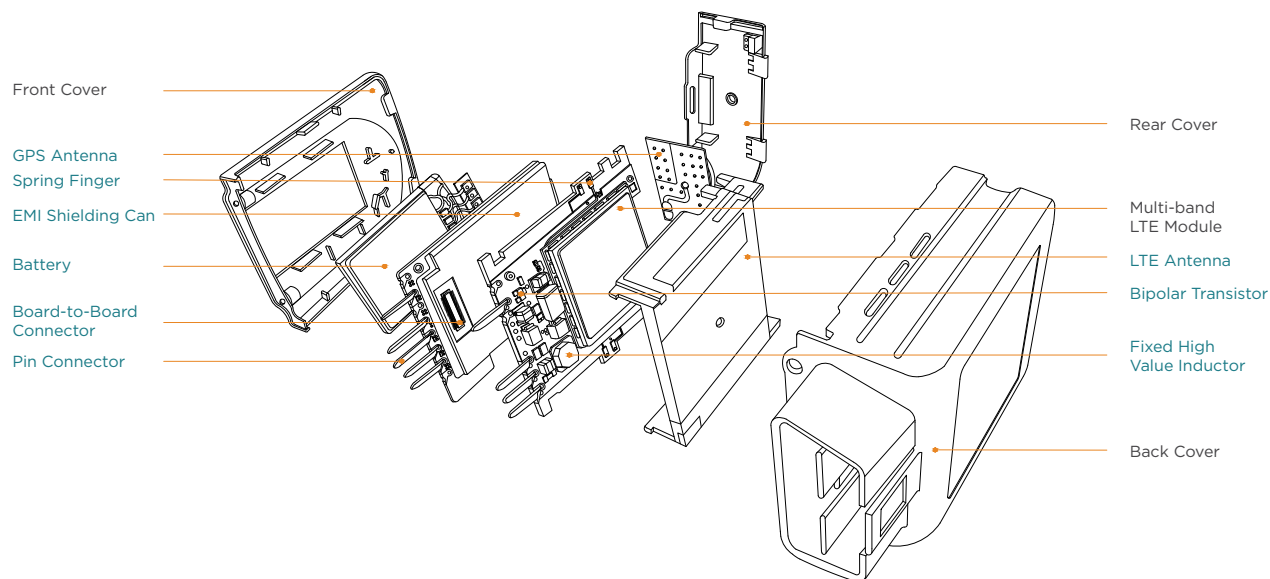
### KEY REQUIREMENTS FOR EDGE COMPUTING DEVICES

Robust I/O and Wireless Connectivity	Provide secure data transmission with low latency, failure detection and automatic fail-safe functionality.
Extreme Temperature Tolerance	-40°C (-40°F) up to +70°C (158°F).
Ingress Protection	Devices must be designed with components that can help minimize or prevent the ingress of dust and liquids per standards.
Shock and Vibration Resistance	Edge PCs and components should withstand up to 50 g of shock force.
Small Footprint	Given the space constraints of rugged edge PCs, smaller format components can be critical.
Low Power Consumption	Proper antenna and component selection and positioning within the device are key considerations in improving power efficiency.
Electromagnetic Interference (EMI)	Antennas, components, shielding selection and positioning must be considered early in the design phase to avoid degraded signal performance.
Physical Security	Helping to prevent unauthorized physical access, such as tampering, is an important consideration in remote, unattended applications.

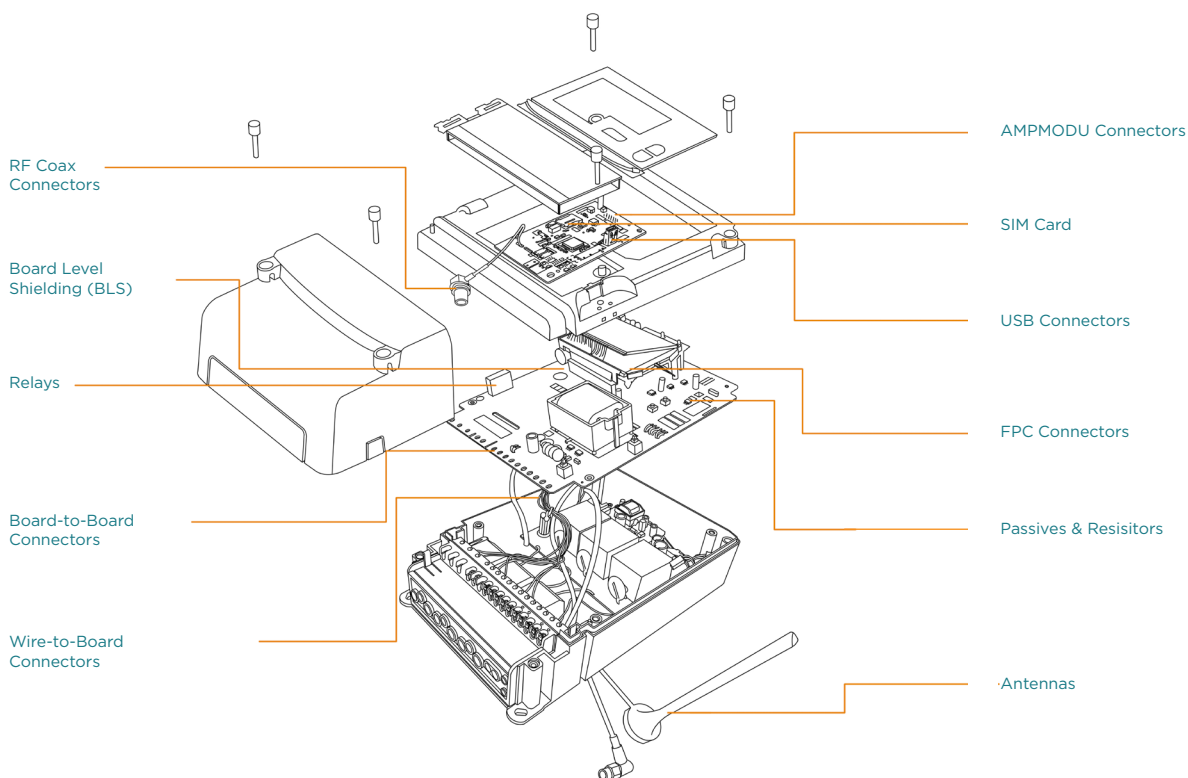
## TE COMPONENTS SUPPORTING EDGE DEVICES

Across a range of applications from fleet telematics and smart metering to smart buildings and medical devices, TE connectors, antennas and components help deliver performance, reliability and long operational lifetimes in harsh environments. Below are just a couple examples of how our products are incorporated into device designs.

### FLEET TELEMATICS



### SMART METERS





## WHY PARTNER WITH TE?



Our history in design engineering, global manufacturing prowess, materials science expertise and signal integrity analysis are benefits that contribute to the value of partnering with us. At TE, we view our role of consultant as a trusted advisor, who helps to bring value to our customers through innovative and customized solutions.



### Partnerships that Enhance Innovation

We collaborate closely with customers and peers in the development of new technologies.



### Solutions for High Performance

Our products can support high-speed, energy-efficiency, and miniaturization in cloud, IoT end point and edge markets.



### Faster, Flexible Service

TE's manufacturing and value-added services deliver top quality, highly efficient products to meet dynamic design cycles.



### End-to-End Connectivity

TE offers a broad range of product options across data communications and IoT applications, giving customers the opportunity to consolidate their supplier base.



### Sustainable Partnership

TE's engineering and manufacturing expertise, combined with our global footprint provides one of the largest connectivity and sensor portfolios.

### te.com

TE Connectivity, TE Connectivity (logo) AMPMODU, RJ point five, Sliver, MINIPAK, MULTI-BEAM Plus, ICCON, ELCON Mini, ELCON, RAPID LOCK, STRADA Whisper, AdrenaLINE Catapult, AdrenaLINE Slingshot, AdrenaLINE Fastlane are trademarks owned or licensed by the TE Connectivity Ltd. family of companies. All other logos, products and/or company names referred to herein might be trademarks of their respective owners.

The information given herein, including drawings, illustrations and schematics which are intended for illustration purposes only, is believed to be reliable. However, TE Connectivity makes no warranties as to its accuracy or completeness and disclaims any liability in connection with its use. TE Connectivity's obligations shall only be as set forth in TE Connectivity's Standard Terms and Conditions of Sale for this product and in no case will TE Connectivity be liable for any incidental, indirect or consequential damages arising out of the sale, resale, use or misuse of the product. Users of TE Connectivity products should make their own evaluation to determine the suitability of each such product for the specific application.

©2023 TE Connectivity. All Rights Reserved.

02/23 Original

### TE Technical Support Center

USA:	1.800.522.6752
Canada:	1.905.475.6222
Mexico:	52.0.55.1106.0800
Latin/S. America:	54.0.11.4733.2200
Germany:	49.0.6251.133.1999
UK:	44.0.800.267666
France:	33.0.1.3420.8686
Netherlands:	31.0.73.6246.999
China:	86.0.400.820.6015