

Precision Small Busbar System Design



Overview

Design Guide for bus bars | Mersen Important characteristics of laminated bus bars are resistance, series inductance, and capacitance. As performance parame.

Key Takeaways

A precision small busbar system should combine low inductance, optimized current distribution, compact multilayer design, proper insulation, and thermal management to achieve high efficiency and reliability. Core Design Principles

1. Electrical Performance

- **Low Inductance:** Use tightly coupled, parallel copper sheets or laminated busbars to minimize stray inductance, which is critical for high-speed switching applications. Avoid unnecessary bends or sharp corners, as these increase surface impedance and eddy currents .
- **Current Distribution:** Symmetrically position DC input connections relative to power modules to ensure uniform current flow. For AC connections, maintain symmetry between DC-link capacitors and semiconductor modules .
- **Resistance and Impedance:** Select conductor thickness and width to balance low DC resistance with minimal AC losses. Laminated busbars with insulation layers can reduce impedance and EMI .

- **Compact Multilayer Layout:** For small systems, multilayer busbars allow high current density in a reduced footprint. Ensure that active layers are prioritized for switching cells, while auxiliary conductors are placed to minimize magnetic interference .
- **Thermal Management:** Use copper with high thermal conductivity and consider spacing or heat sinks to dissipate heat. Avoid sharp edges to reduce localized heating .

• **Flexibility:** In constrained spaces, flexible or press-fit connectors can accommodate assembly tolerances and mechanical misalignment without compromising electrical performance .

3. Insulation and Safety

- **Insulation Materials:** Use high-quality materials such as Nomex®, Kapton®, Mylar®, or epoxy-glass laminates to separate layers and prevent short circuits. Insulation also increases capacitance, which can help reduce inductance .
 - **Layer Lamination:** Adhesive-coated insulation allows multiple layers to be laminated together, maintaining structural integrity while optimizing electrical characteristics .
- ### 4. Simulation and Validation

- **Modeling:** Employ 3D CAD and simulation tools like PEEC (Partial Element Equivalent Circuit) to predict stray inductance, capacitance, and current distribution before fabrication .
 - **Testing:** Validate designs with high-precision impedance analyzers to ensure that the busbar meets performance targets, particularly for high-frequency switching applications .
- ### 5. Integration and Application

- **High-Density Systems:** For applications like electric vehicles or compact inverters, small busbars must handle high currents in limited space. Use pluggable connectors or SMT/press-fit interfaces to maintain modularity and ease of assembly .
- **Smart Monitoring:** Incorporate temperature and current sensors if possible to enable real-time monitoring and prevent overheating or failure in critical systems .

Recommended Workflow

- Define DC-link capacitor and power module geometry to determine busbar complexity and current paths.
- Choose conductor material, thickness, and width for target current density.
- Design multilayer layout with insulation and minimal stray inductance.
- Simulate electrical and thermal performance using PEEC or equivalent methods.
- Optimize terminal connections and bends to reduce impedance and voltage drop.
- Fabricate and validate with impedance and thermal testing.

- Integrate smart monitoring if required for high-reliability applications. By following these principles, a precision small busbar system can achieve high efficiency, low EMI, reliable current distribution, and compact form factor, suitable for modern power electronics and high-density applications .

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8US Busbar Systems

Introduction to busbar systems 2 The use of busbar systems with their versatile rail-adaptable connection, switching and installation

Electrical busbar system

185 mm Busbar System (Current carrying capacity up to 2500 Amps) Fabrication and Manufacturing The efficiency of a busbar

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BUS BAR DESIGN

We can also provide critical input that leads to greater design for manufacturing flexibility because our engineers have built bus

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Good busbar design uses controlled centerline spacing, consistent support points, and insulation systems appropriate to the

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Bus Bar Theory of Operation

Figure 1 shows the alternate approach using two DRV425 devices. When a cutout (hole or slot) is placed in the center of the bus bar,

High Power Multi-layer Molded Busbars: Design Considerations

Best practices for today's power systems should always start with collaboratively answering these key questions, preferably in

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ENNOVI-BusMate Pluggable Busbar Connectors Figure 2 – ENNOVI-BusMate Connector One of the most significant advances in

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