System Solution Guide - Preview

Small Electric Vehicles

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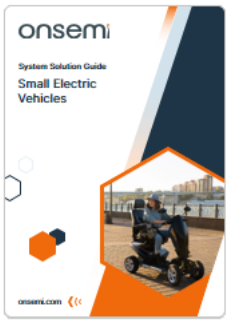

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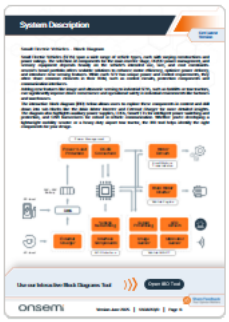

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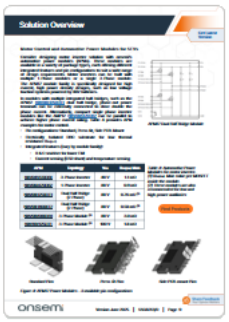

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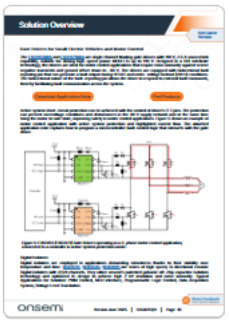

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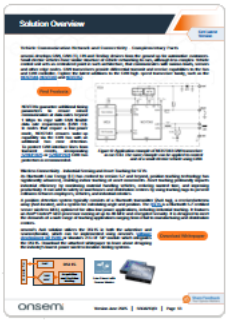

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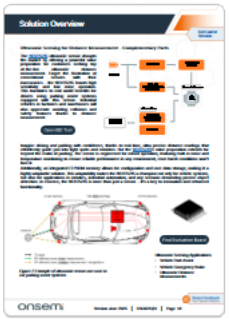

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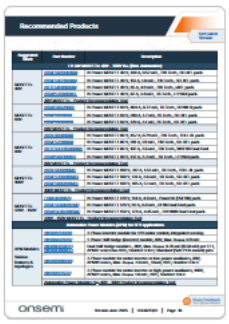

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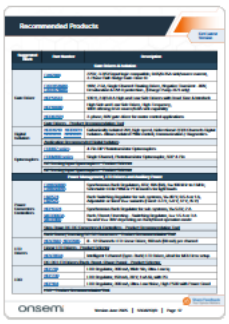

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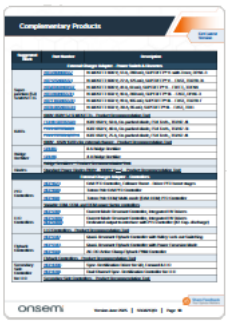

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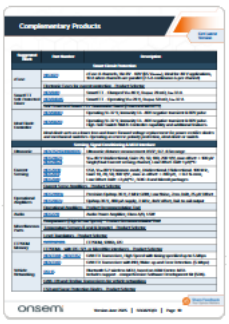

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Block Diagram

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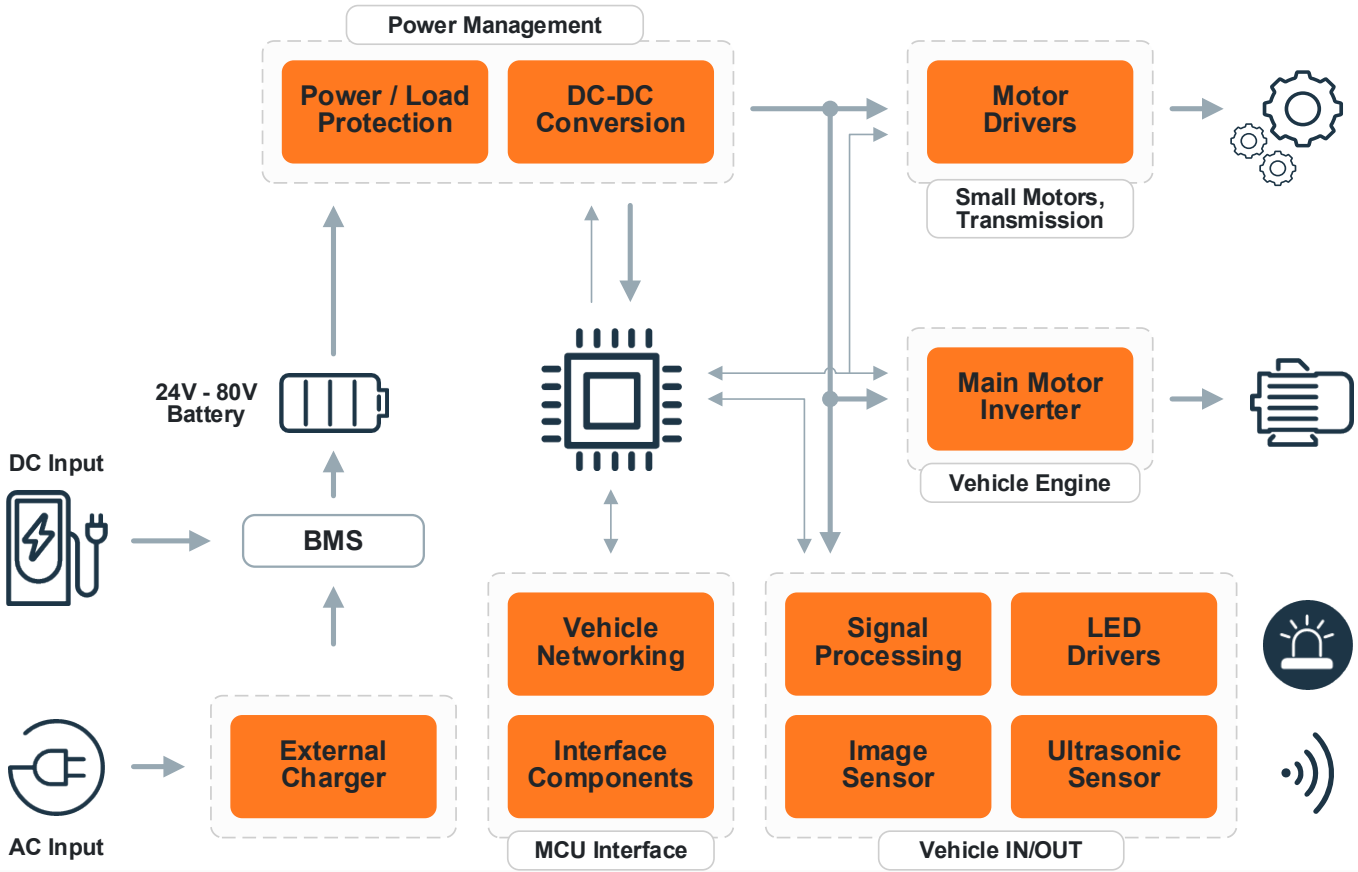
Small Electric Vehicles - Block Diagram

Small Electric Vehicles (SEVs) span a wide range of vehicle types, each with varying constructions and power ratings. The selection of components for the main inverter stage, DC/DC power management, and sensory equipment depends heavily on the vehicle's intended use, size, and cost constraints. **onsemi's** broad portfolio offers scalable solutions to enhance motor efficiency, optimize power delivery, and introduce new sensing features. While each SEV has unique power and control requirements, they often share common elements in their BOM, such as control circuits, protection components and communication interfaces.

Adding new features like image and ultrasonic sensing to industrial SEVs, such as forklifts or tow tractors, can significantly improve driver convenience and operational safety in industrial environments like factories and warehouses.

The interactive block diagram (IBD) below allows users to explore these components in context and drill down into sub-blocks like the *Main Motor Inverter* and *External Charger* for more detailed insights. The diagram also highlights auxiliary power supplies, LDOs, SmartFETs for intelligent power switching and protection, and CAN transceivers for robust in-vehicle communication. Whether you're developing a lightweight mobility scooter or a heavy-duty airport tow tractor, the IBD tool helps identify the right components for your design.



Use our Interactive Block Diagrams Tool

Open IBD Tool

MOSFETs for Small Electric Vehicles

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Discrete Si MOSFETs for SEV Applications

Discrete Si MOSFETs are among the most widely used electronic components in Small Electric Vehicles (SEVs), serving multiple roles in applications such as motor inverters, battery management system, protection circuits and LED lighting drivers. Customers can select from **onsemi's** extensive portfolio of LV-MV MOSFETs that match power requirements and battery voltage of their vehicle.

Explore these product options by selecting one of the voltage categories in table 3. Designers can choose from multiple component technologies and packages. It is important to keep sufficient V_{DS} headroom as the voltage may spike due to the inductive kick and cause damage to the power switch. Motor inverters are more sensitive than protection applications.

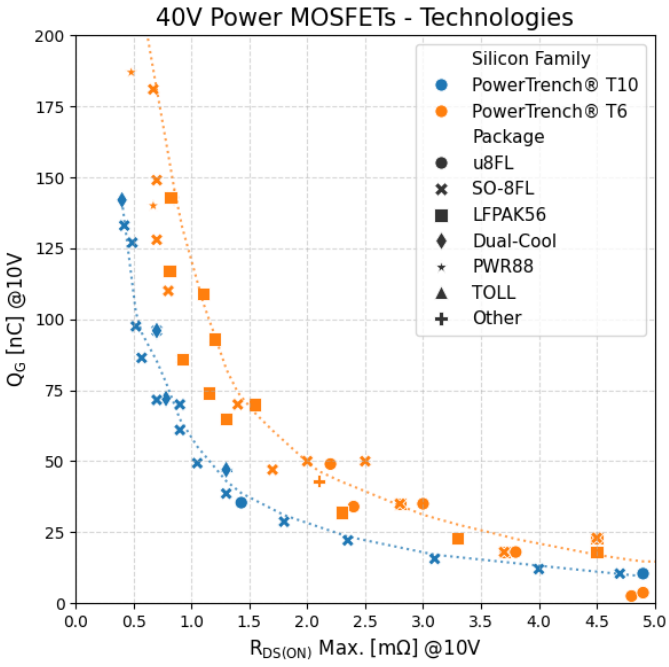
Alternative design options are compact TCPAK57, TCPAK10 top side cooling packages, which allow heat dissipation through exposed drain on the top of the package. Additionally, Dual Cool packages contain cooling pads on both top and the bottom of the package, one for source pin and one for drain pin.

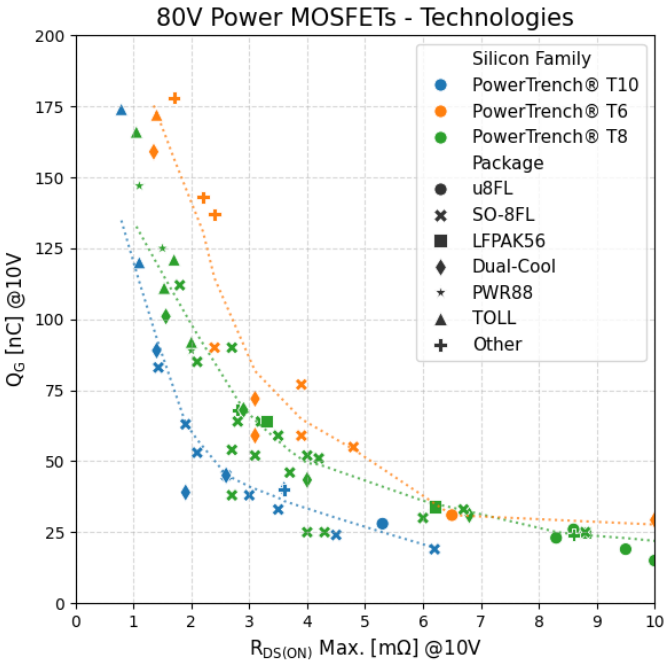
*Table 3 : Recommended **onsemi** MOSFETs for 12V, 48V and 80V systems.*

40V MOSFET	Explore
60V MOSFET	Explore
80V MOSFET	Explore
100V MOSFET	Explore
120V - 150V MOSFET	Explore

PowerTrench® T10 Shielded Gate Trench Technology

New **onsemi's** PowerTrench® T10 technology is targeting DC-DC conversion applications (T10S variant) and motor control, load switch (T10M variant). It aims to optimize efficiency, low output capacitance and figures of merit (FOM) with lower $R_{DS(ON)}$ and gate charge Q_G. Vertical channel and shield electrode enable higher epi doping, as well as lower C_{GD}. Compared to conventional trench MOSFETs, the higher epi doping and very high channel density of T10 enable to create lower $R_{DS(ON)}$. In comparison to legacy T8 and T6 technologies, the T10 has achieved lower specific resistance ($R_{DS(ON)}$ vs Area), improved FOM and reductions to ringing, overshoots and noise thanks to silicon layout improvements in soft recovery body diode (Qrr, Trr). Figures below show these advancements of T10 technology over the T8 and T6.





LED Drivers for Small Electric Vehicles

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LED Lighting and Linear Drivers for Vehicle Lights

Good lighting is essential for every vehicle, whether to illuminate the road ahead or to provide safety functions. In transportation vehicles, lighting ensures visibility in various weather and lighting conditions, both for the driver and for other road users. In industrial environments such as manufacturing plants, warehouses, or airports, vehicle lighting plays a key role in signaling presence, movement, or intent of the vehicle. Industrial vehicles often use specialized lights tailored to specific tasks.

For example, colored warning and strobe lights on forklifts improve visibility and help prevent accidents by alerting nearby personnel. In outdoor industrial or airport settings, LED beacon lights are commonly used to improve operational safety. In all these applications, lighting systems must be highly reliable and durable, especially in low-visibility conditions.

LEDs offer significant advantages over traditional lighting technologies - they are more energy-efficient, lighter, and have a longer lifespan. **onsemi** provides a wide range of LED drivers and controllers to meet diverse power and application needs. For signaling with RGB LEDs, multi-output linear LED drivers offer precise control. Linear LED driver is an alternative solution to the SMPS (switched mode power supply) LED driver. **onsemi's** flexible LED driver solutions can be used in front lights, fog lamps, rear lights, signal and warning indicators, externally modulated applications and even dashboard applications.

12 Channel – Linear LED Driver NCV7685

The driver consists of 12 linear programmable constant current sources. Duty cycle is adjustable using PWM via I2C interface. The advanced signals control can be performed by individual PWM channels.

- Independent PWM duty cycle control with up to 60mA per channel
- Open LED string and undervoltage diagnostic
- Independent diagnostic feedback per function
- On chip 150, 300, 600 or 1200Hz PWM
- Single resistor for current set
- SSOP-24 package

8 Channel – Linear LED Driver NCV7683

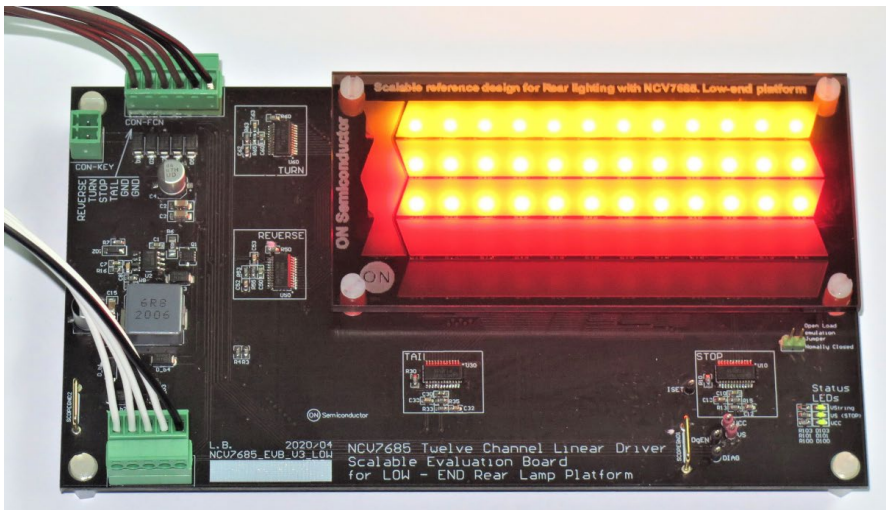
The driver consists of 8 programmable constant current sources for LED rear combination lamps. Allows for two programmed levels of duty cycle for stop and taillight, or PWM dimming. Can be used for applications without MCU communication, reducing system costs.

- 8 channels, up to 100mA per channel
- Open LED string diagnostic
- On-chip 800Hz Tail PWM dimming
- Single resistor for current set
- Single resistor for tail dimming set
- SSOP-24 package

NCV7685 Evaluation Kit

This kit uses multiple NCV7685 drivers to demonstrate vehicle rear-combination lamp application. The board is controlled via BCM (body control module). The BCM can activate the board functions and provides diagnostics. Evaluation kit also includes full animation control, individual LED control and RSL10 for control via Bluetooth interface.

Find Evaluation Board



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