LED Drivers for Automotive Exterior Lighting Applications

Texas Instruments

www.ti.com/autoled

2018

Build Innovative, Reliable and Cost-Effective Automotive Exterior Lighting Systems with TI

Introduction

Automotive exterior LED drivers from TI help you build innovative, reliable, cost-effective lighting systems that exceed today's stringent automotive requirements. Our highly efficient LED solutions extend the life of your lighting system, enable greater driver and pedestrian safety, and enhance the driver experience.

From headlights to taillights and everything in between, TI delivers reliable, scalable and power-efficient linear and switching solutions for simple and complex LED lighting systems.

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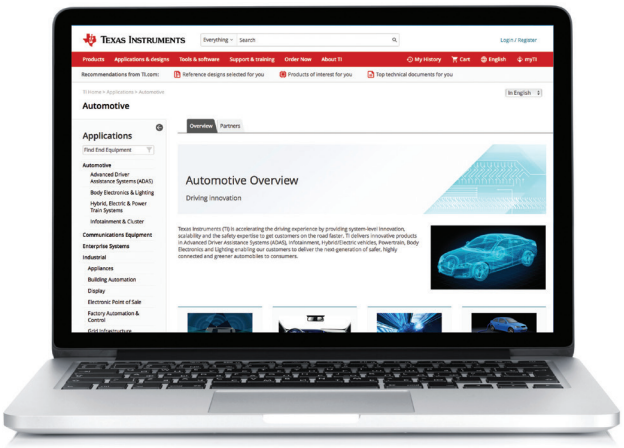
Design Resources and Support

TI provides many resources for your external lighting needs to help you design systems faster, including reference designs and easy-to-use tools. We also offer worldwide support to ensure your questions are answered fast.

Learn more about TI's automotive LED lighting portfolio on ti.com

- Automotive LED driver solutions: www.ti.com/autoled
- All TI automotive solutions: www.ti.com/automotive



Jump start your design process with comprehensive reference designs:

- Automotive LED driver reference designs: www.ti.com/autoled/reference
- All TI Automotive reference designs: www.ti.com/tidesigns

TIDesigns

Find answers to your technical questions in the TI E2E™ community.

Ask questions, share knowledge and help solve problems with fellow engineers. Visit e2e.ti.com.

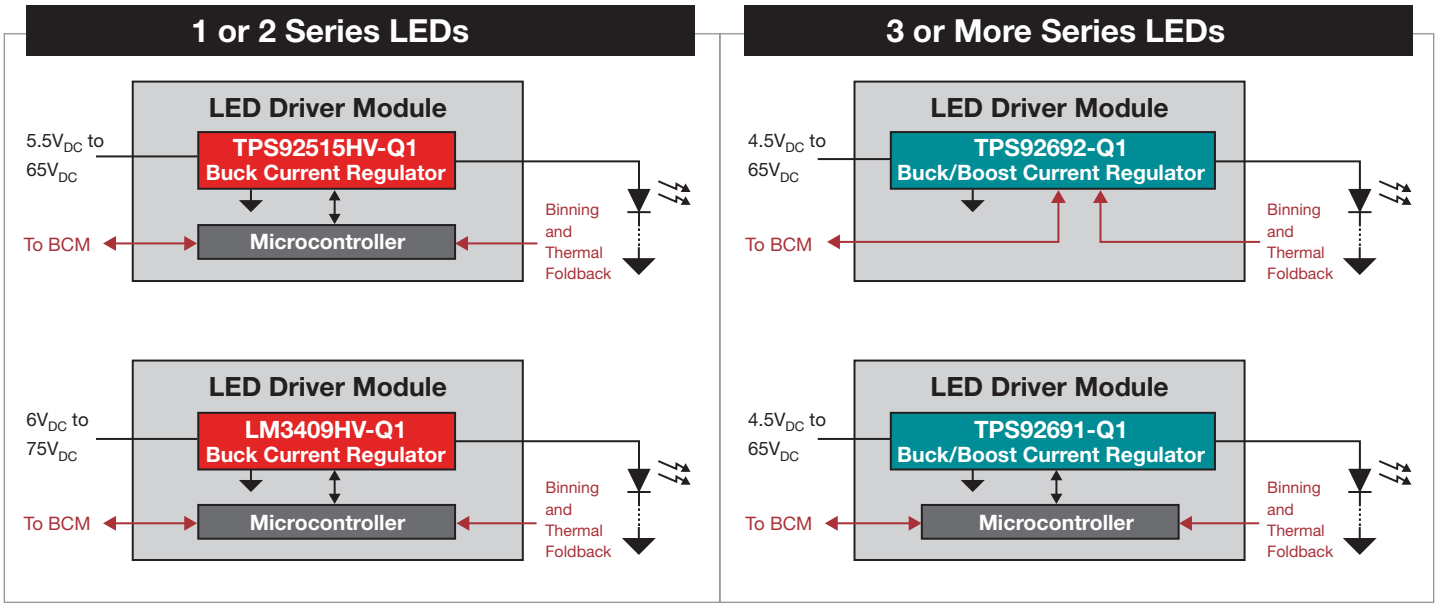
TI E2E™ Community

Front Lighting – Single Feature

Single-stage power conversion architecture enabling flexible designs

A single-stage LED driver is a simple and cost-effective solution for single headlight features like day-time running light, turn indicator, or high and low beam functions. Buck topology LED drivers are an effective solution if the LED string voltage is always lower than the battery voltage. However, since the battery voltage varies significantly in cold crank or load dump conditions, many applications require LED drivers that can be configured as a boost, buck-boost, SEPIC, Flyback or Cuk topologies. Ultimately, the LED driver must provide a constant output current to the LEDs in all possible operating conditions.

TI's flexible, single-stage LED driver products are highly configurable point-of-load solutions with advanced dimming capabilities. With diagnostic and protection features in addition to EMI mitigation techniques like spread spectrum, TI's portfolio provides the necessary functionality to create robust, high-performance platform electronic solutions for single feature front lighting functions.



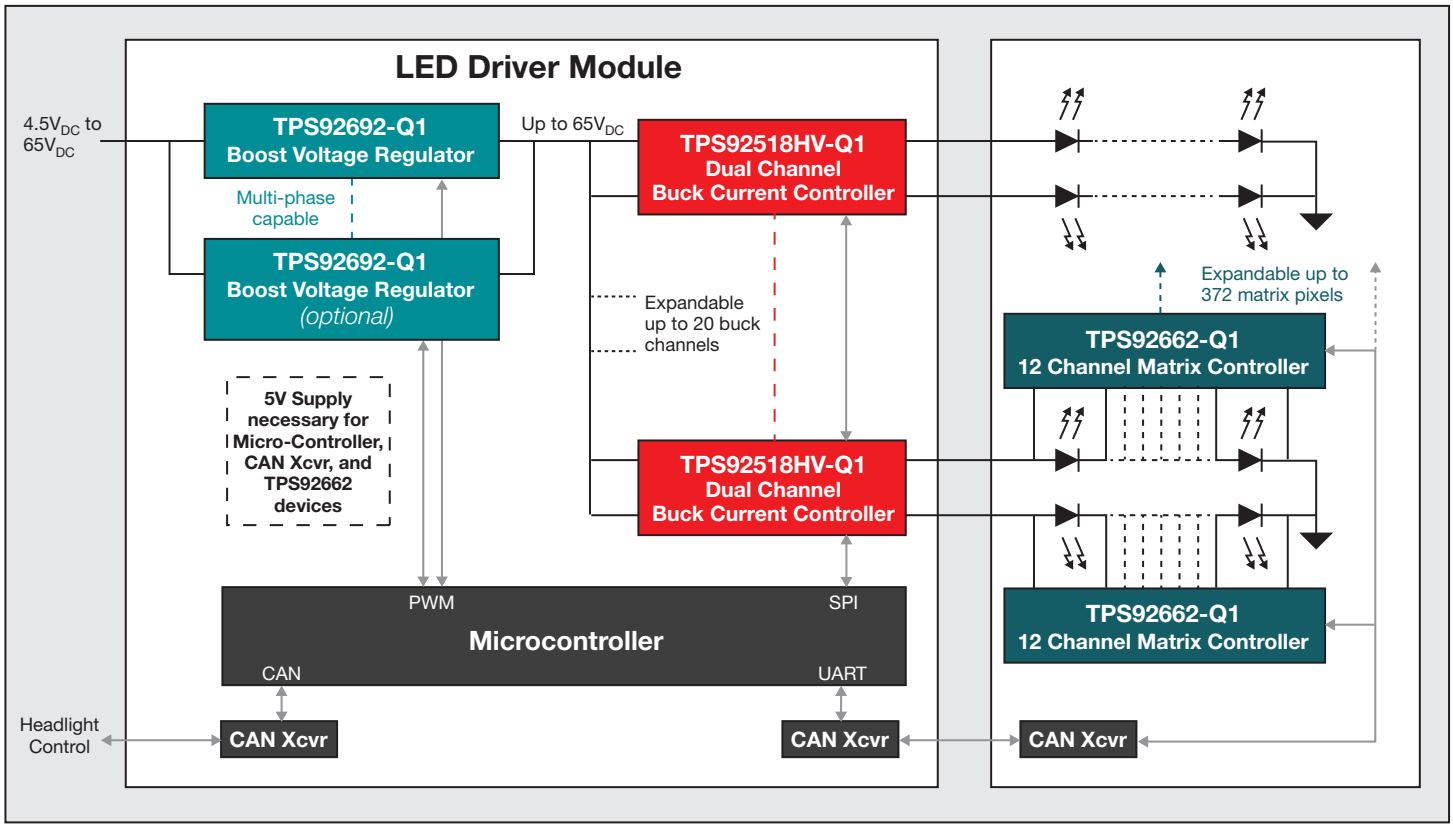
Device	# of Channels	Internal Switch(s)	Input Voltage		Output Voltage		Max LED Current	Special Features
			Min	Max	Min	Max		
Multi-Topology Current Regulator								
TPS92692-Q1	1	No	4.5V	65V	2.5V	65V	No Limit	Analog & PWM Dimming, Spread Spectrum, Fault Handling
Multi-Topology Current Regulator								
TPS92691-Q1	1	No	4.5V	65V	0	65V	No Limit	Analog & PWM Dimming, Fault Handling, Rail-Rail Current Sense
Buck Current Regulator								
TPS92515HV-Q1	1	Yes	5.5V	65V	0	65V	2A	Analog & PWM Dimming
Buck Current Regulator								
LM3409HV-Q1	1	No	6.0V	75V	0	75V	No Limit	Analog & PWM Dimming

Front Lighting – Complete LED Headlamp

Modular solution enabling scalable headlight architecture with adaptive functionality

Vehicles adopting LEDs for many exterior lighting functions can benefit from a full LED ECU platform approach based on a dual-stage power conversion architecture. This approach consists of a boost voltage pre-regulator stage that creates a stable DC voltage supply for a high-bandwidth buck LED current regulator output stage. TI's portfolio includes boost voltage pre-regulators with fault handling and spread spectrum EMI features as well as dual-buck current controllers that employ a quasi-hysteretic control topology to handle dynamic LED loads and to enable advanced dimming capabilities.

The TPS92662-Q1 LED matrix manager is a perfect solution to provide pixel-level control of the LEDS for dynamic headlight functions like sequential turn-signals and adaptive front lighting. Using front-facing cameras for vehicle and object detection, an LED matrix solution enables vehicles to automatically adjust the intensity of light emitted from the high/low beams without physical movement of the headlamps to create optimal roadway illumination.

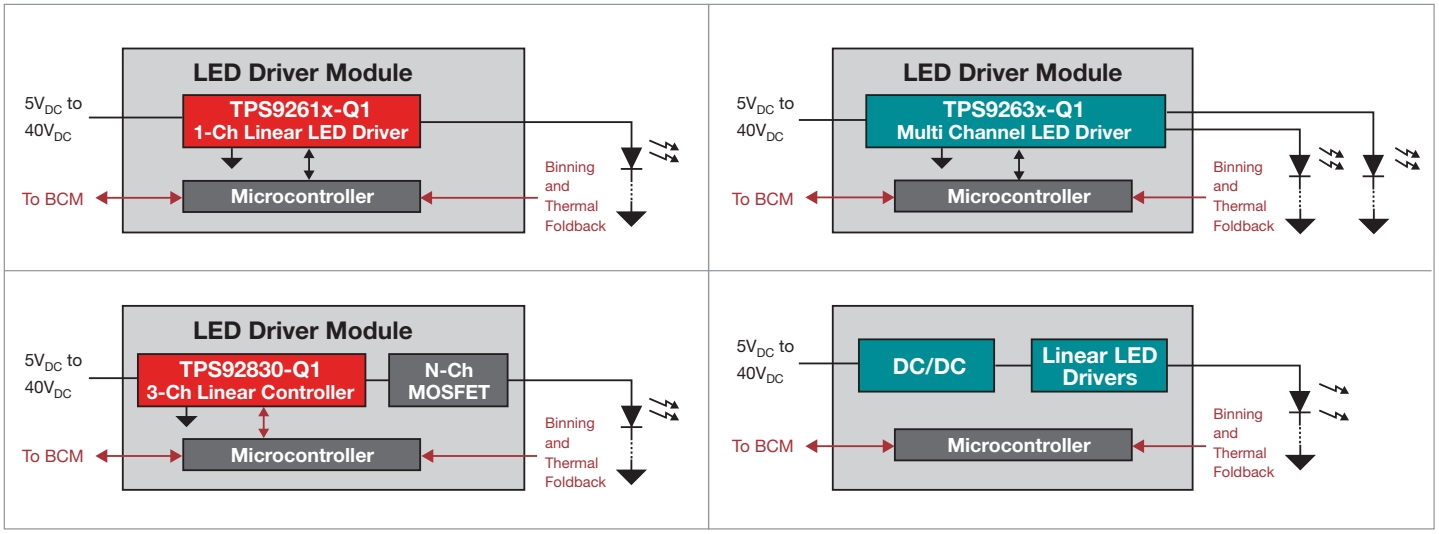


Device	# of Channels	Internal Switch(s)	Input Voltage		Output Voltage		Max LED Current	Special Features
			Min	Max	Min	Max		
Boost Voltage Regulator								
TPS92692-Q1	1	No	4.5V	65V	N/A	65V	N/A	Adjustable Reference, Spread Spectrum, Fault Handling
Buck Current Regulator								
TPS92518HV-Q1	2	No	6.5V	65V	0	65V	No Limit	Analog & PWM Dimming, SPI Interface, Fault Handling
Matrix Controller								
TPS92662-Q1	12	Yes	4.5V	60V	0	60V	2A	10 bit PWM Dimming, UART, Fault Handling

Rear Lighting: Reliable, Low EMI Solutions

Integrated solutions with full diagnostic and thermal management features

TI's linear LED driver portfolio consists of reliable, low-EMI solutions for rear stop, turn and backup lighting. The portfolio offers a full range of devices with full diagnostics (e.g., LED open, short and single-LED short) and thermal management features as well as different output channel counts and output current capabilities. The TPS92830-Q1 automotive LED controller is able to support higher power and greater system thermal performance simultaneously by removing the integrated MOSFET used in traditional LED drivers . TI's single-channel TPS9261x-Q1 LED drivers family provides much more flexibility for engineers designing an array of different simple exterior lighting applications.



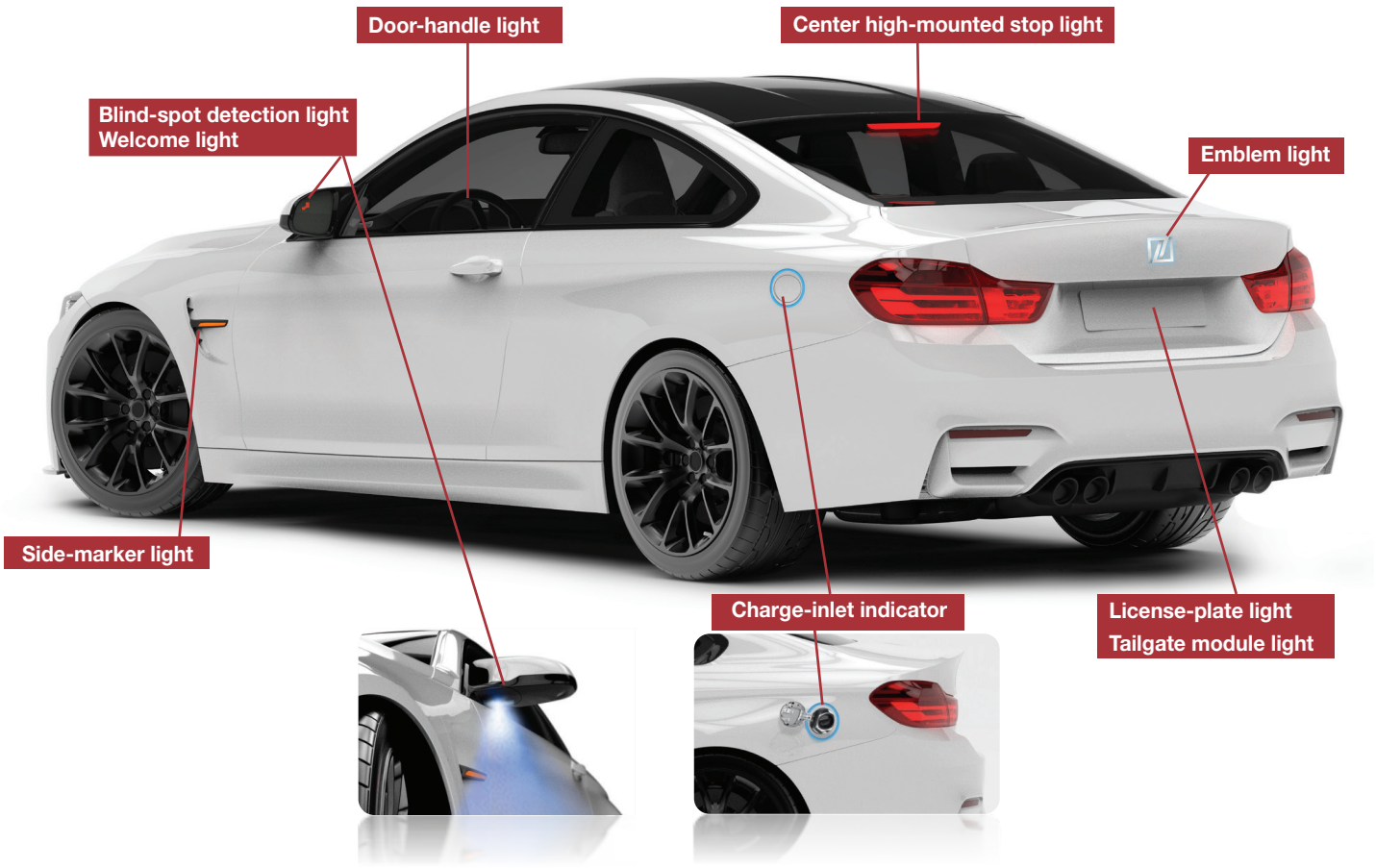
Device	# of Channels	FET Integrated	V_{IN} (V)	Output Current per Channel (mA)	Output Current Accuracy (%)	Diagnostics and Protections	Package
TPS92830-Q1	3	No	4.5 – 40	Decided by ext. FET	2.5	Open, Short, Output current derating	TSSOP-28
TPS92610-Q1	1	Yes	4.5 – 40	450	4.5	Open, Short, Single LED short, Thermal shutdown	HTSSOP-14
TPS92611-Q1	1	Yes	4.5 – 40	300	4.5	Open, Short, Thermal shutdown	MSOP-8
TPS92612-Q1	1	Yes	4.5 – 40	150	4.5	Open, Short, Thermal shutdown	SOT23-5
TPS92613-Q1	1	Yes	4.5 – 40	450	4.5	Open, Short, Thermal shutdown	TO263-7
TPS92630-Q1	3	Yes	4.5 – 40	150	1.5	Open, Short, Single LED short, Thermal foldback	HTSSOP-16
TPS92638-Q1	8	Yes	4.5 – 40	70	3.0	Open, Short, Thermal foldback	HTSSOP-20

Other Signal & Convenience Lighting

Flexible and easy-to-use LED solutions

LEDs are now widely used outside of traditional exterior lighting applications, enhancing the driver's experience with additional safety-enhancing and stylistic lighting options. TI's new TPS9261x-Q1 single-channel linear LED driver family enables more styling possibilities for signal and convenience lighting applications, such as the ones outlined in the diagram below.

Higher current accuracy, fewer system components, and more system protection have become the most critical design considerations for automotive design engineers. TI's TPS9261x-Q1 LED driver family offers differentiated output capabilities, packages, and diagnostic features, allowing design engineers to simplify their system by replacing many discrete components that would typically be used to achieve the same functionality. Learn more about TI's automotive LED driver portfolio at www.ti.com/autoled.



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