TLE9186 charge pump use case

About this document

Scope and purpose

Simple explanation of TLE9186 charge pump configuration options and supported use cases.

This document explains in a simple and user-friendly way how the TLE9186 gate driver can be configured with different external charge pump components. By selecting the appropriate charge pump configuration and diode type, the device can be optimized either for lowest system cost, lowest battery supply voltage, or highest MOSFET gate drive capability.

Intended audience

Hardware and software engineers.

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1 TLE9186 charge pump use cases

The TLE9186 is a flexible three-phase MOSFET gate driver. The same IC can be used in different applications by adapting only the external charge pump circuitry. This allows customers to cover different battery voltage ranges and different MOSFET gate charge requirements without changing the gate driver itself.

Table 1 Overview of supported use cases

Parameter	Cost optimized	High performance	Low supply
Charge pump configuration	Two-stage (CP_CFG = 0)	Three-stage (CP_CFG = 1)	Three-stage (CP_CFG = 1)
Recommended diode type	BAS16T, BAV99S (standard diodes)	BAT54S, BAT54TW, BAT54SDW (Schottky)	BAT54S, BAT54TW, BAT54SDW (Schottky)
Minimum battery supply	7 V	6 V	4.5 V
Supported MOSFET total gate charge (Qgtot)	Up to 60 nC	Up to 150 nC	Up to 40 nC

Cost optimized use case

This configuration is intended for cost-sensitive applications. Standard signal diodes such as BAS16T or BAV99S are used in the charge pump. The configuration supports battery voltages down to 7 V and MOSFETs up to 60 nC total gate charge.

1 TLE9186 charge pump use cases

Low supply use case

This configuration is optimized for operation at very low battery voltage. Schottky diodes are mandatory because their lower forward voltage drop improves charge pump efficiency. The system can operate down to 4.5 V battery voltage. Typical MOSFET capability is up to 40 nC total gate charge.

High performance use case

This configuration is optimized for driving larger MOSFETs. Schottky diodes are required to maximize charge pump output voltage and current capability. MOSFETs with total gate charge up to 150 nC can be driven while still supporting battery operation down to 6 V.

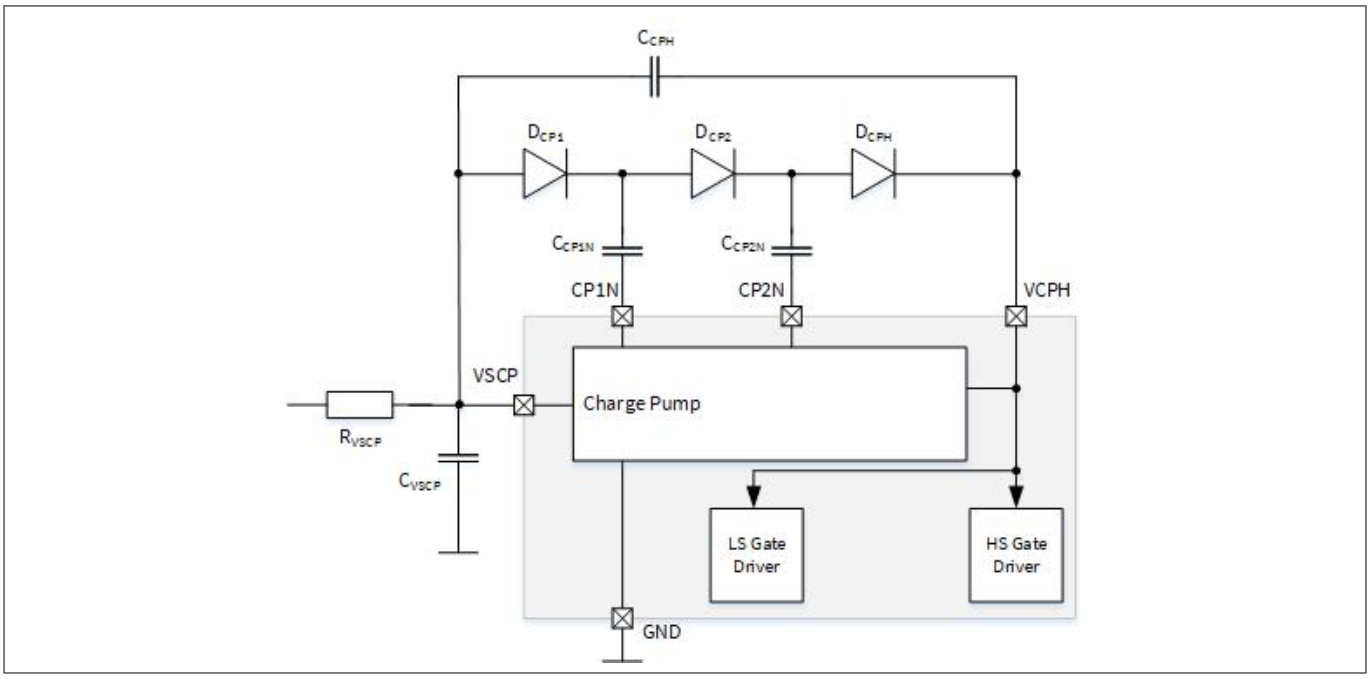


Figure 1 Cost optimized use case

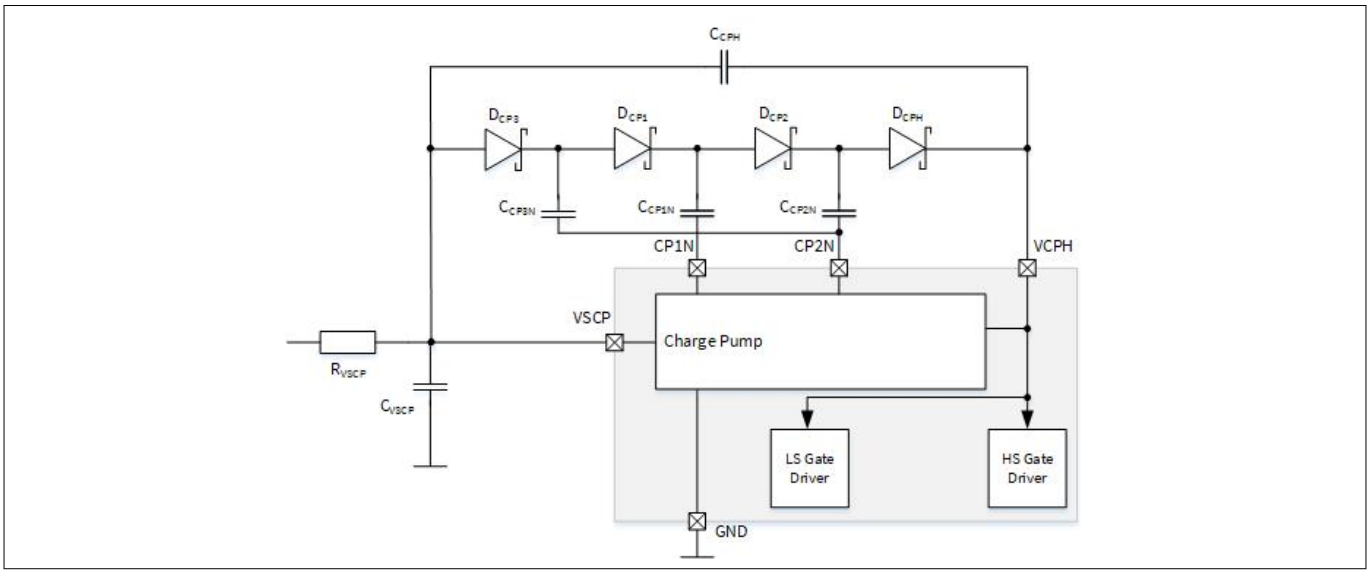


Figure 2 Low supply OR high-performance use case

2 External component selection

Why are Schottky diodes required?

The main difference between standard diodes and Schottky diodes is their forward voltage drop. Schottky diodes have a significantly lower forward voltage drop, therefore less energy is lost inside the charge pump. As a result, the charge pump can generate higher gate drive voltages and provide more current to the MOSFET gates. This is essential for low-supply operation and for driving MOSFETs with higher gate charge.

Table 2 Diode type selection

Characteristic	Standard diode	Schottky diode
Examples	BAS16T, BAV99S	BAT54S, BAT54TW, BAT54SDW
Best use	Lowest BOM cost	Low supply voltage and high performance

Choose the cost optimized configuration when BOM cost is the main target. Choose the low supply configuration when cranking or low battery voltage robustness is required. Choose the high performance configuration when large MOSFETs with high total gate charge are used (see Table 1).

Conclusion

The TLE9186 provides excellent flexibility. By changing only the external charge pump diode implementation and charge pump configuration, customers can optimize the same gate driver IC for cost, battery voltage range, or MOSFET drive capability. This allows platform reuse while minimizing redesign effort.

Revision history

Document version	Date of release	Description of changes
1.00	2026-08-18	Application note available

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