

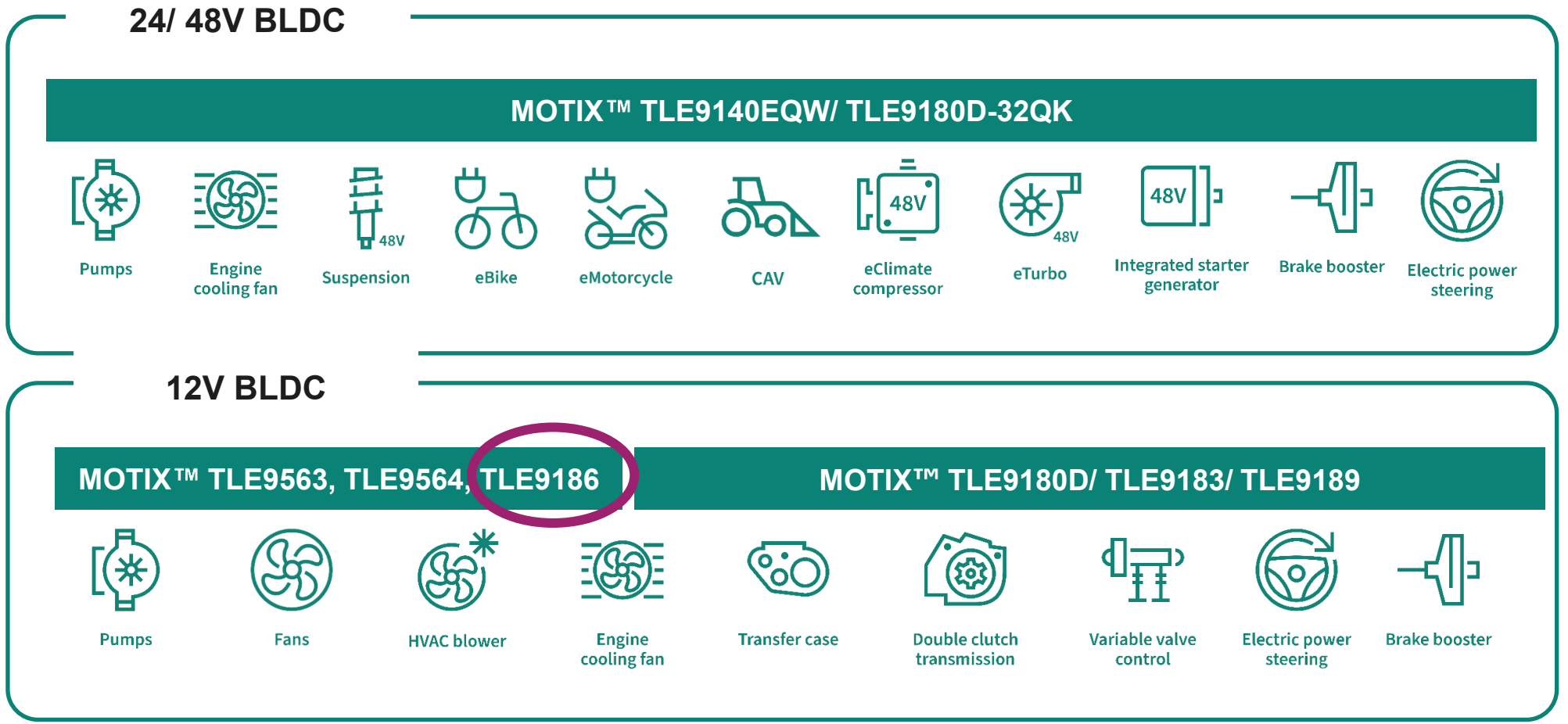
# MOTIX™ TLE9186QVW gate driver IC for BLDC motors

Infineon Technologies

Automotive Smart Power | Motor Control Solutions

Public

# MOTIX™ gate driver ICs for BLDC motors recommendation per application not incl. MOTIX™ MCU as alternative partitioning




www.infineon.com/bldc-motor-gate-driver-ics


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# ISO 26262-compliant BLDC motor control application example with MOTIX™ TLE9186QVW gate driver IC

## Driver stage

- MOTIX™ gate driver ICs for BLDC motors
- **TLE9186QVW (VQFN-32)**

## Motor system IC

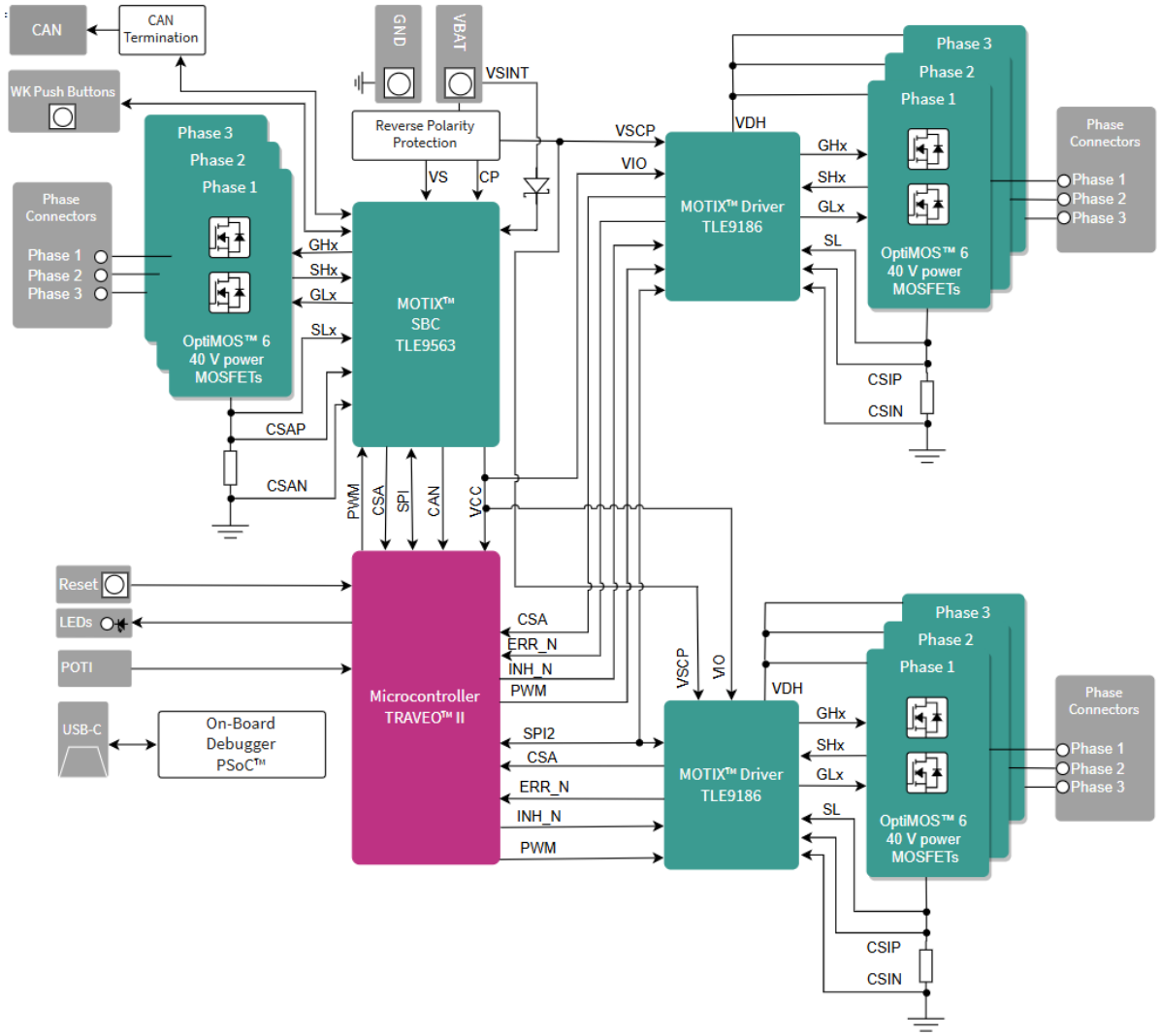
- MOTIX™ motor system ICs (SBC) for BLDC motors
- E.g TLE9563-3QX

## MOSFETs

- OptiMOS™ 6 40 V MOSFETs
- E.g. IAUC100N04S6N015
- E.g. IAUC120N04S6N013

## Microcontroller

- 32-bit TRAVEO™ T2G Arm® Cortex®
- E.g. TRAVEO™ T2G CYT2B7





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# Target applications

## MOTIX™ TLE9186QVW gate driver IC for BLDC motors

ISO 26262-compliant (ASIL B) 3-phase gate driver ICs for 12V BLDC motor applications



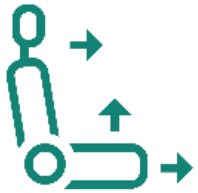
Pumps



Fans



Engine cooling fan



Power seat



BLDC motor

### Motivation

- Shift from brushed DC (BDC) to brushless DC (BLDC) across many applications
- Thermal management systems lead this trend due to rising energy-efficiency demands
- Need for innovative, cost-optimized, functional safety-ready solutions that simplify integration and handling of sophisticated device

### Product description

- Is a 3-phase gate driver with 150 nC gate charge per channel, with accurate current sense amplifier (CSA), ISO 26262-compliant (ASIL B), VQFN-32 (5 x 5 mm) package
- Target applications: ITMS* and SCM**; also suitable for a wide range of BLDC motor uses

* Integrated Thermal Managment System

** Seat Control Module


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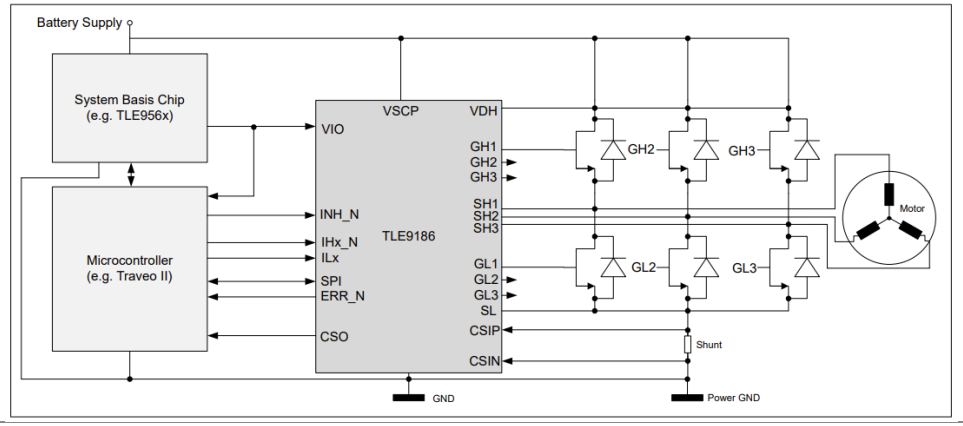
# MOTIX™ TLE9186QVW product overview

## Product highlights and benefits

- Improved EMC performance, reduced power losses and target switching time achieved
- Faster reaction by the gate driver IC and avoid mechanical damage to ECU
- Tiny VQFN-32 pin package to reduce space and number of external components and system costs
- All errors and warnings detected & configurability via SPI
- Automotive grade 0 qualified & ASIL B compliant




## Typical connection diagram/application diagram




## Key specifications

| Parameter | TLE9186QVW | TLE9189QVW | TLE9140EQW |
|---|---|---|---|
| Supply Voltage (V) | 4.5 - 32 | 4.2 - 36.0 | 8.0 - 72.0 |
| Driving Capability (nC at 20 kHz) | 150 | 200 | 230 |
| Current Sense Amplifier | 1 | 3 | - |
| Classification | ISO 26262-compliant (ASIL B) | ISO 26262-compliant (ASIL D) | ISO 26262-compliant (ASIL B) |
| Temperature (C) | -40°C – 175°C | -40°C – 175°C | --40°C – 175°C |

## Typical applications

- Integrated thermal management system
- Water pump
- Oil pump
- Engine cooling fan
- Seat control
- Sunroof adjustment
- HVAC blower

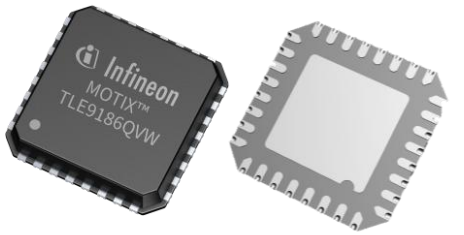
## Product information

- Product page
- Datasheet
- Product family BLDC motor gate driver


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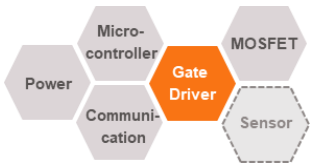
# TLE9186QVW gate driver IC: Product highlights

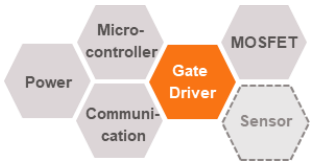
**Status: In production**

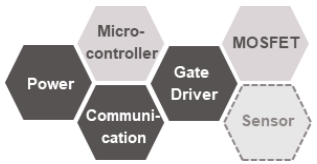



VQFN-32
(5x5mm)

# MOTIX™ gate driver and motor system ICs per application segment - seamless product offering with Generation 4



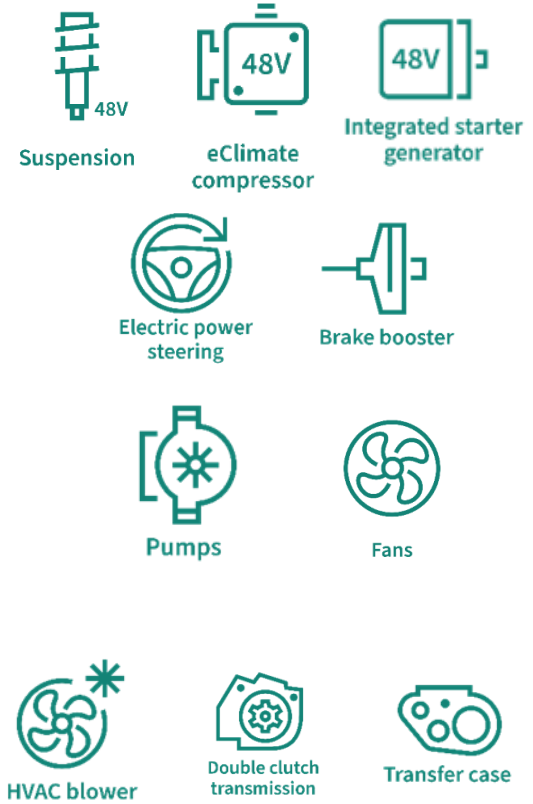




| | Generation 3 | Generation 4 |
|---|---|---|
| 48V driver | TLE9180 | TLE9140<br>ASIL B / no CSA |
| 12V driver | TLE9180<br>TLE9183 | TLE9189<br>ASIL D/ 3xCSA<br>TLE9186<br>ASIL B/ 1xCSA |
| 12V system ICs | TLE9563<br>TLE9564 | |

In production

## Example applications





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# MOTIX™ gate driver ICs for BLDC motors
# Portfolio overview

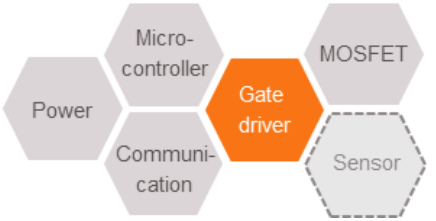
| | Product Family | Status | Supply voltage | Driving capability | Current sense | Package | ISO 26262-compliance | AEC-Q100 |
|---|---|---|---|---|---|---|---|---|
| 12V | TLE9183 | Available | 4V~50V | 300 nC | 3xCSA | LQFP-64 | ASIL D | Grade 1 |
| | TLE9189 | Available | 4.2V~36V | 200 nC | 3xCSA | VQFN-48 | ASIL D | Grade 0 |
| | TLE9186 | Available | 4.5V~32V | 150 nC | 1xCSA | VQFN-32 | ASIL B | Grade 0 |
| 24-48V | TLE9140 | Available | 8V~72V | 230 nC | - | TSD-DSO-32 | ASIL B | Grade 0 |
| 12-48V | TLE9180 | Available | 5.5V~60V | 300 nC | 2/ 3xCSA | LQFP-64 | Up to ASIL D | Grade 1 |

- **Diverse portfolio** of **high performance** & **cost optimized** gate drivers for BLDC motors with broad application use
- **Offering scalable product portfolio** for 12V, 24, & 48V applications reducing engineering & software efforts
- Products include adaptive MOSFET control, **flexible configurability** of **monitoring** and **failure behavior**

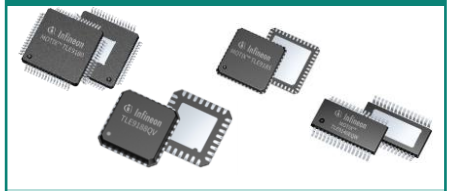
## Target applications




MOTIX™ Driver




## Packages



LQFP/ TQFP
VQFN/ TS-DSO

ISO 26262 compliant

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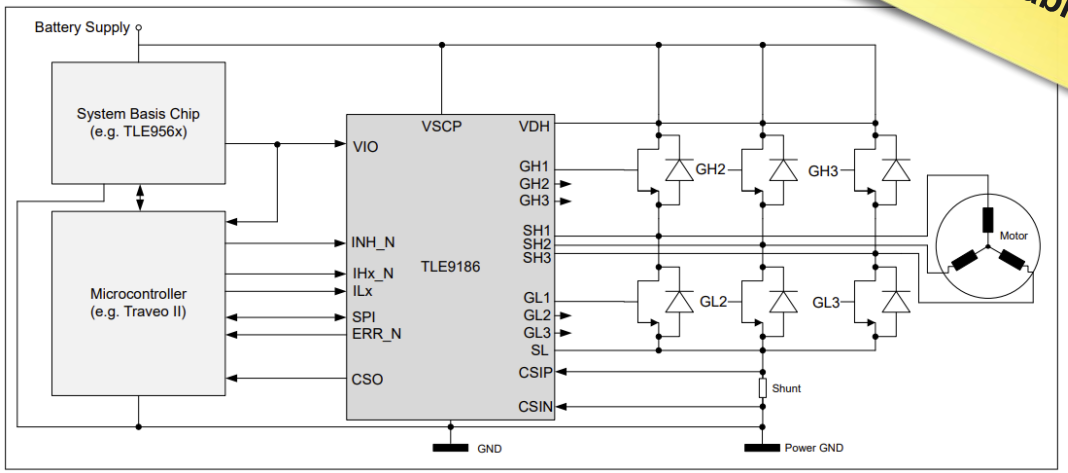
# MOTIX™ TLE9186 gate driver IC for BLDC motors
# Addressing 12V automotive body applications with ASIL B rating

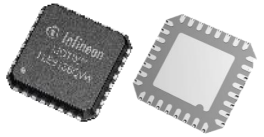
Available

## Main Features

- **Drives 6 MOSFETs** with each up to **QGtot = 150 nC at 20 kHz**
- **Current controlled output stages** for MOSFET switching control
- Redundant switch off path (INH_N) to deactivate Gxx output pins
- **Supply voltage range** of 4.5 V to 32 V
- **0...100% duty cycle adjustable** without restrictions
- Motor control concept with **PWM input**
- **SPI** for configuration and diagnostics
- **SPI communication** protected by CRC8
- **Motor connection pins** rated **-6 V** to **40 V**
- **Current sense CSA** with typ. 1µs settle time and ±0.8% accuracy
- Comprehensive monitoring and diagnostic functions
- Window watchdog function
- Error output pin: ERR_N
- Integrated PFB monitoring and multiplexed CSO / PFB function

## Application Diagram



VQFN-32
(5x5mm)

ISO 26262
compliant

AEC Qualified

## Key Benefits

- ISO 26262 **FuSa: ASIL B compliant**
- Extended temperature range **AEC Q100 (grade 0)**
- **Low ystem cost** due to reduced external components & pin-out
- **Current controlled output stages** to control slew rate of MOSFET to avoid EMC problems

## Target Applications

- Oil pumps
- Water pumps
- Cooling fans
- Seat control

## Status: In production


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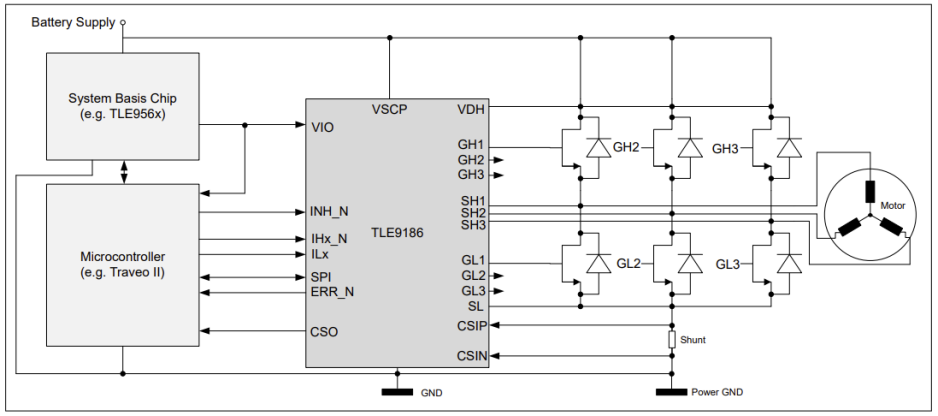
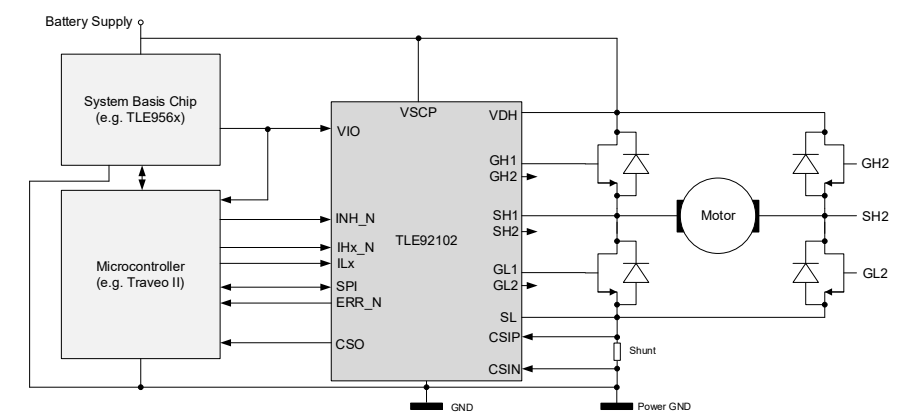
# Key features and benefits

| Key features | Key benefits | Value |
|---|---|---|
| Configurable gate current sequencer | – Improve EMC performance, reduce power losses and achieve target switching time | Highest efficiency and power density |
| Configurable failure reactions | – Accomplish faster reaction by the gate driver IC<br>– Avoid mechanical damage to ECU | |
| Comprehensive monitoring & diagnostic features integrated | – All detected errors and warnings can be read, multiple thresholds and filter timings are configurable via SPI | Optimized system costs and PCB space |
| Optimized feature set in small VQFN-32 pin package | – Reduce number of external components and system costs | |
| Automotive grade 0 qualified & ASIL B compliant | – Tailored for functional safety automotive applications | High system reliability, availability, security and robustness |


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# MOTIX™ TLE9186QVW and TLE92102QVW gate driver ICs for BLDC & BDC motors ASIL B rating adressing 12V body applications

## Main differences

| | MOTIX™ TLE9186QVW | MOTIX™ TLE92102QVW |
|---|---|---|
| Motor | Brushless DC Motor | Brushed DC Motor |
| Capability | Drives 6 MOSFETs up to QGtot = 150 nC at 20 kHz | Drives 4 MOSFETs up to QGtot = 150 nC at 20 kHz |
| Application diagram |  |  |
| Target applications | Fans, Pumps, Power seat, Sunroof, HVAC blower, Power Door | Power seat, Sunroof, Central door lock, Window lift, Fans, Body control module |

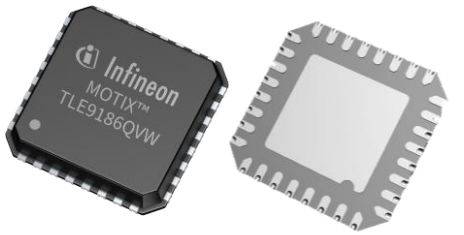





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# TLE9186QVW gate driver IC: Design support

**Status: In production**

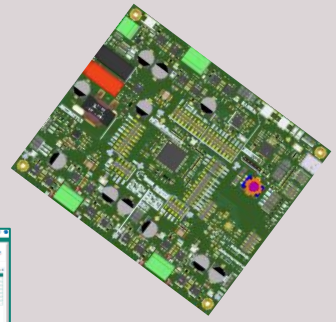



VQFN-32
(5x5mm)

# Comprehensive evaluation and software offering for the MOTIX™ TLE9186QVW

## Development support

**Evaluation board**



**GUI***



**User Guide**







## Key functions

- Easy TLE9186QVW hardware evaluation
- SPI register access
- Motor spin function
- Intuitive interface for fast evaluation

*available via Infineon Developer Center (IDC)

## Software support

### Device Driver (DD)*

**MOTIX™ TLE9186 Device Driver**

The MOTIX™ TLE9186 Device Driver provides a simple API to generate the control frames for the external bridge driver via SPI.

### Application software*

**MOTIX™ TLE9186 application software**

The MOTIX™ TLE9186 application software is an example application that demonstrate the use of the MOTIX™ TLE9186 device driver together with the MOTIX™ TLE9186 evaluation board to drive a brushless DC motor.

## Key functions

- Fast prototyping
- Getting started with product & DD & evaluation board
- Microcontroller independent


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# MOTIX™ TLE9186QVW Evaluation Board

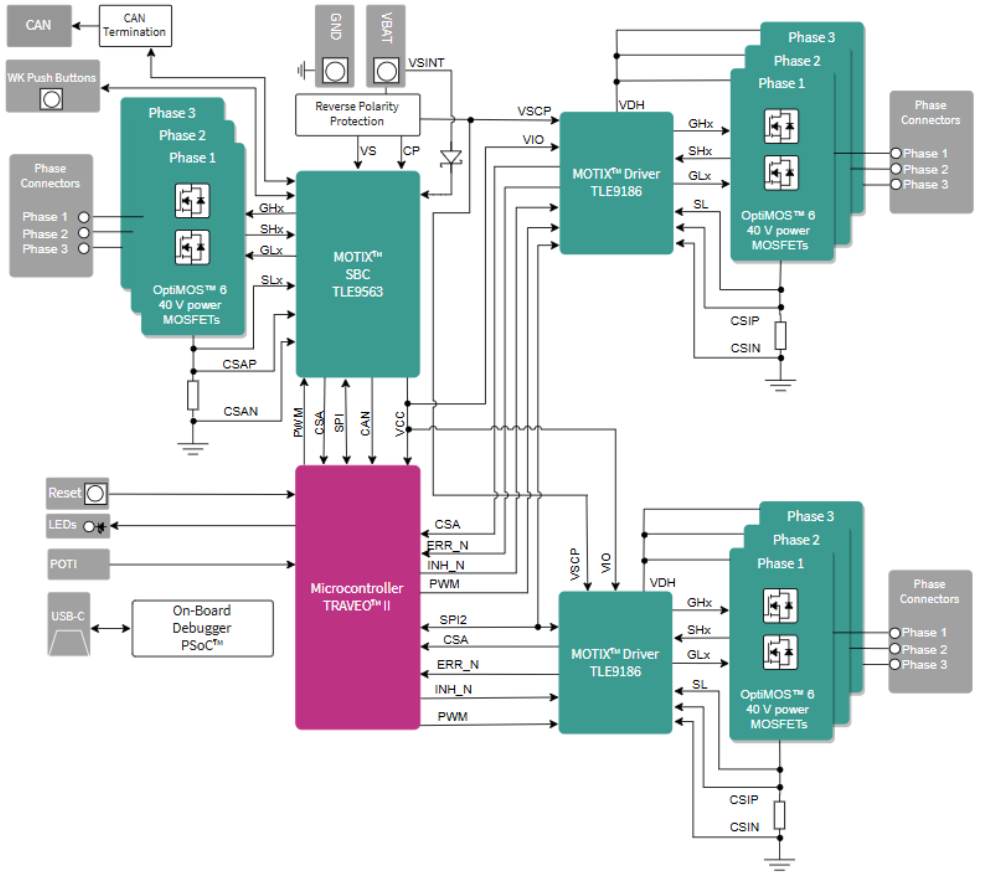
## EVAL_TLE9186QVW + EVALTLE9186QVWTOBO1

This evaluation board provides a flexible, easy-to-use prototyping and development tool for evaluating and testing Infineon's TLE9186QVW gate driver IC.

- Designed for 3-phase BLDC motors
- Plug & play for easy evaluation TLE9186QVW features
- B6 bridge onboard for direct motor connection
- Sensor interfaces for motor position: HALL
- Test points for easy measurement (eg. motor, analog signal etc)



## Block Diagram




Eval board TLE9186QVW & Graphical User Interface (GUI)


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# MOTIX™ Software - Device Driver for TLE9186QVW

## Main Features

- Ready-to-use API functions for
  - device initialization
  - setting and reading register
  - watchdog servicing
  - device mode switching
- Register values documentation directly at API function
- Cyclic-function for updating the device driver's shadow registers

## Key benefits

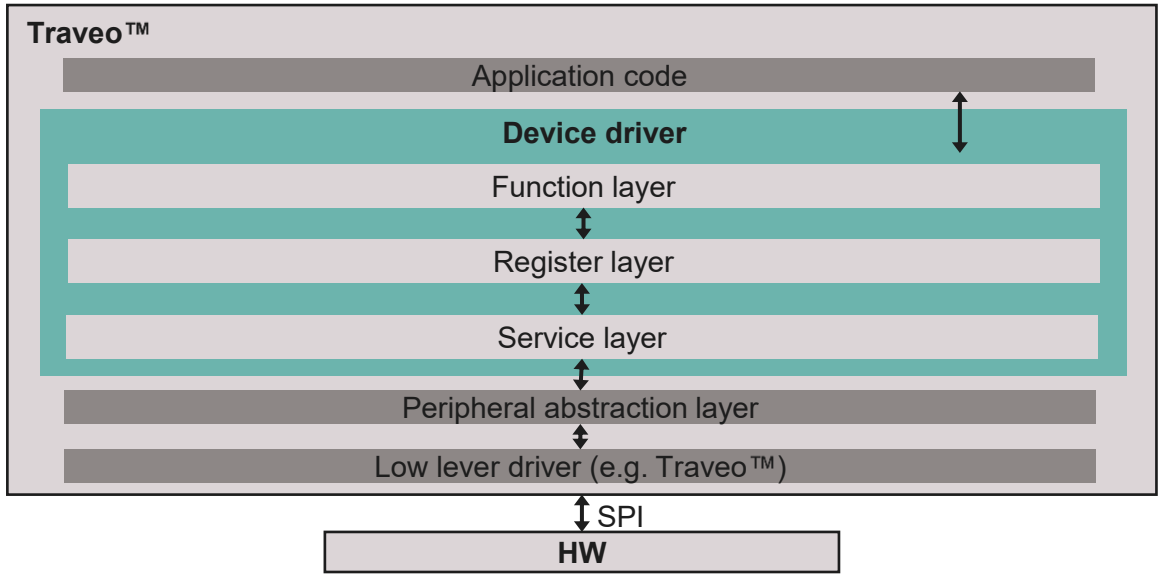
- Enables rapid prototyping
  - Simple integration
  - Reduces complexity in application SW
- Supports wide range of applications due to microcontroller independency

## Quality level: Example software

## Supported microcontroller

- Microcontroller independent, developed & tested on TRAVEO™ T2G

## SW top level architecture




## Supported tools

- Tool independent

## Available via Infineon Developer Center (IDC)


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# MOTIX™ TLE9186QVW gate driver IC for 12V BLDC motors ISO 26262 compliant (ASIL B) with current sense amplifier

| Technical documents | Status |
|---|---|
| Datasheet | online |
| User Manual | on request* |
| Safety Manual | on request* |
| Application note: Getting started | online |
| Application note: Hardware design guideline | online |

| Boards | Status |
|---|---|
| TLE9186 evaluation board | online |
| User manual evaluation board | online |

| Software | Status |
|---|---|
| Device driver | online |
| Application software | online |
| TLE9186 GUI | online |

| Others | Status |
|---|---|
| Power dissipation calculation sheet | on request* |
| CSA accuracy calculation sheet | on request* |
| Training video | online |
| Getting started video | online |

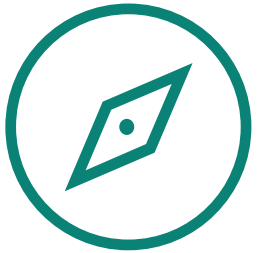
| Simulation tools | Status |
|---|---|
| PSpice | online |
| Simetrix | online |

www.infineon.com/TLE9186QVW or www.infineon.com/bldc-motor-gate-driver-ics

*Available via myInfineon Collaboration Platform (myICP); please contact you regional Infineon sales partner in order to get access to restricted information.


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# Further resources



**Product and application information**

- Product page
- Product family page
- Water Pump

**Reference designs & boards**

- Eval board TLE9186QVW

**Technical documents**

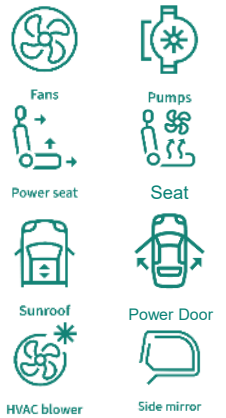
- View detailed datasheet
- Product page

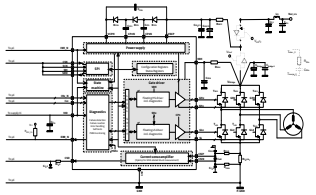
**Trainings and videos**

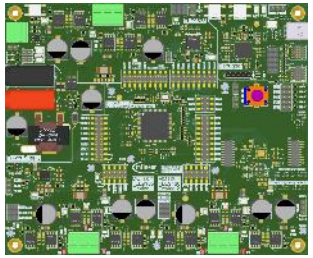
- Introducing MOTIX™ TLE9186QVW gate driver IC for BLDC motors
- Get started with the MOTIX™ TLE9186QVW Evaluation Board


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# Why select MOTIX™ TLE9186QVW gate driver IC for BLDC motors?





**Chipset designed specifically** to meet
the requirements of the constant transforming body applications

**Enable cost competitive systems**
- Reduced BOM for external components
- Can help reduce thermal losses

**Reduce engineering efforts**
- Diverse software offering available
- Comprehensive collateral bundles

ISO 26262 compliant

AEC Qualified

**ISO 26262 ASIL B compliant**
- Developed according to latest ISO 26262 Edition 2018 & ASIL B compliant

**Extended Temperature Range**
- Qualified according to AEC Q100 grade 0

**High Quality Standards**
- Trusted partner for customers since 4 product generations (+25 years experience)


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