MOTIX™ SBCs
Motor System IC Product Family

Motor System IC
Product Family Page

Webcast: A unique level of integration for
Automotive 12V DC and BLDC motor control

Presenters

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BLDC Motor Driver ICs

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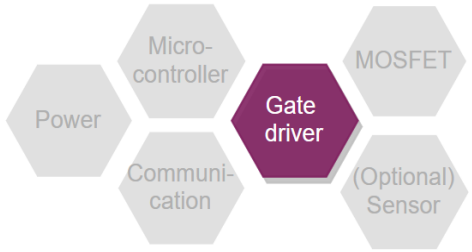
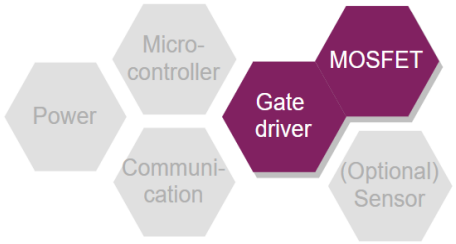
Product Application Engineer
BLDC Motor Driver ICs

Infineon MOTIX™: A scalable product portfolio from low to high integration level for motor control

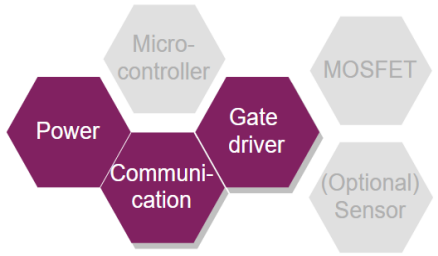
MOTIX™ Driver



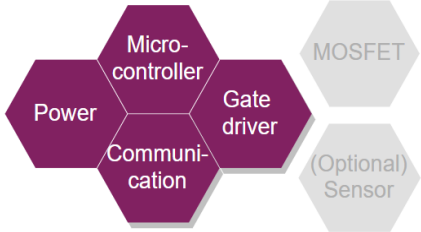
MOTIX™ Bridge



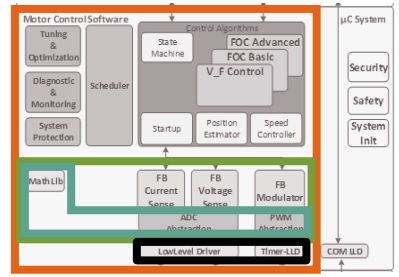
MOTIX™ SBC



MOTIX™ MCU



MOTIX™ software



MOTIX™ multi MOSFET driver ICs

TLE92104/8

MOTIX™ motor gate driver ICs

TLE9180x

TLE9185x

MOTIX™ single half-bridge ICs (NovalithIC™)

BTNxxxx / IFX007

MOTIX™ multi half-bridge ICs

TLE94xxx

MOTIX™ full bridge ICs

TLE9201 / IFX9201

MOTIX™ Motor system ICs

TLE956x

MOTIX™ Embedded Power ICs

TLE98xx

MOTIX™ Motor Control Software

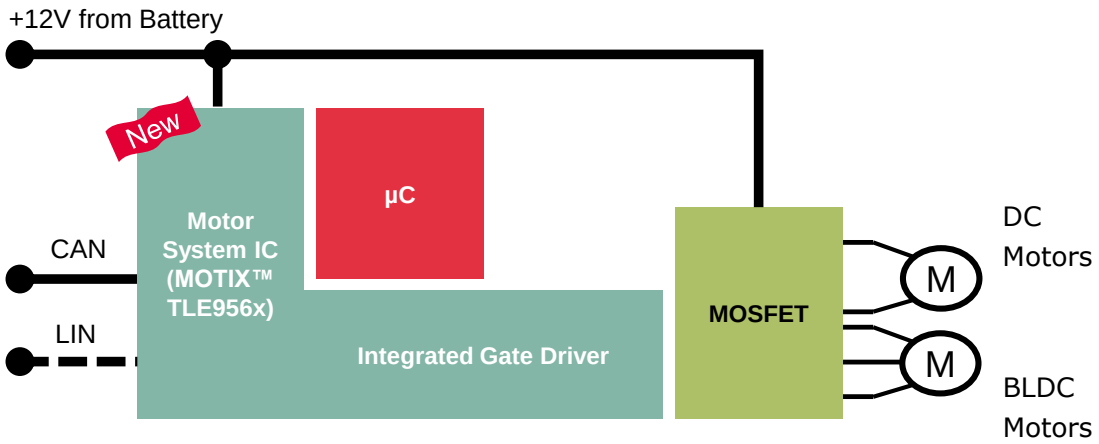
eSLx

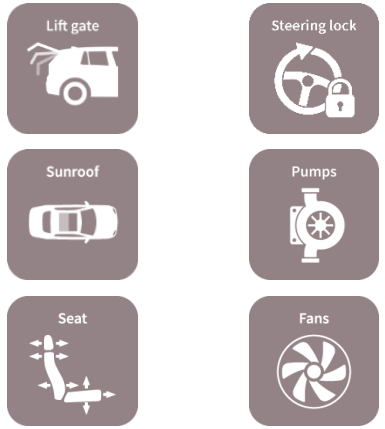
MOTIX™ Diagnostic Software

MOTIX™ Communication Software

MOTIX™ Tools

(BL)DC Motor System ICs provide a unique feature set for a wide range of applications





Space saving

First **IC with integrated gate driver IC, power supply and communication interface** in the market (reduced PCB board saving >80%)

Motor Control

DC motor versions with up to **4 integrated half bridge drivers** (100mA constant gate charge current) featuring CAN FD and LIN

BLDC Motor

BLDC motor version with **3(phase) half bridge drivers** (150mA constant gate charge current) featuring CAN FD or LIN

Adaptive MOSFET control

Patented principle: optimized MOSFET switching provides **lower switching losses and EMC optimization**

Configurable Brake Mode

Low power VS monitoring in sleep mode activate the low-side MOSFET to **prevents from VS voltage increase** which could damage the module

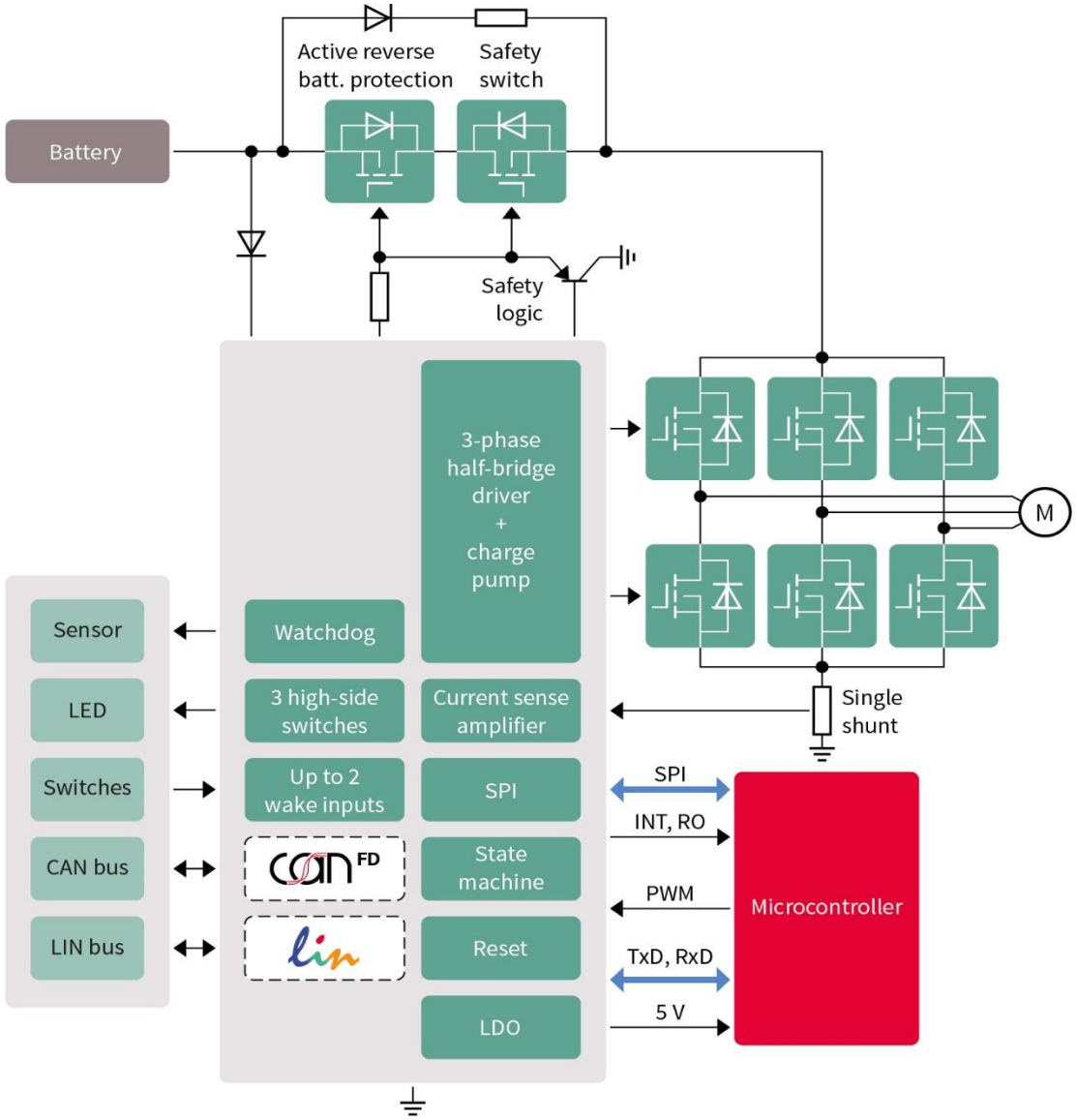
Multiple and flexible designs

Family approach as well as peerless scalability within the (BL)DC Motor System IC family and Multi MOSFET Driver IC to **reduce design-in efforts**

Motor System IC with BDC and BLDC driver

	Brushed DC Motor					Brushless DC Motor	
Product	MOTIX™ TLE9560-3QX	MOTIX™ TLE9561QX	MOTIX™ TLE9561-3QX	MOTIX™ TLE9562QX	MOTIX™ TLE9562-3QX	MOTIX™ TLE9563-3QX	MOTIX™ TLE9564QX
Bridges	2x Half-Bridges	4x Half-Bridges	4x Half-Bridges	4x Half-Bridges	4x Half-Bridges	3ph BLDC	3ph BLDC
PWM	1	4	4	2	2	6	6
Gate Control	100mA constant charge current					150mA constant charge current	
Adaptive MOSFET Control	√	√	√	√	√	√	√
CSA	x	x	x	x	x	√	√
VCC1	5V/250 mA	5V/250 mA	5V/250 mA	5V/250 mA	5V/250 mA	5V/250 mA	5V/250 mA
HS Switches	4	4	4	4	4	3	3
Wake Inputs	1	Up to 5	Up to 5	Up to 4	Up to 4	2	1
Communication	1x CAN FD, 1x LIN	1x CAN FD	1x CAN FD	1x CAN FD, 1x LIN	1x CAN FD, 1x LIN	1x CAN FD	1x LIN
Transmission Rate CAN	5 Mbit/s	5 Mbit/s	5 Mbit/s	5 Mbit/s	5 Mbit/s	5 Mbit/s	
CAN PN	√		√		√	√	
Application	Lift gate, Sunroof, Steering lock, Seat belt, Seat, Electric parking brake					Pumps, Fans, Sunroof	

BLDC Motor System IC Application Diagram with MOTIX™ TLE9563-3QX or TLE9564QX

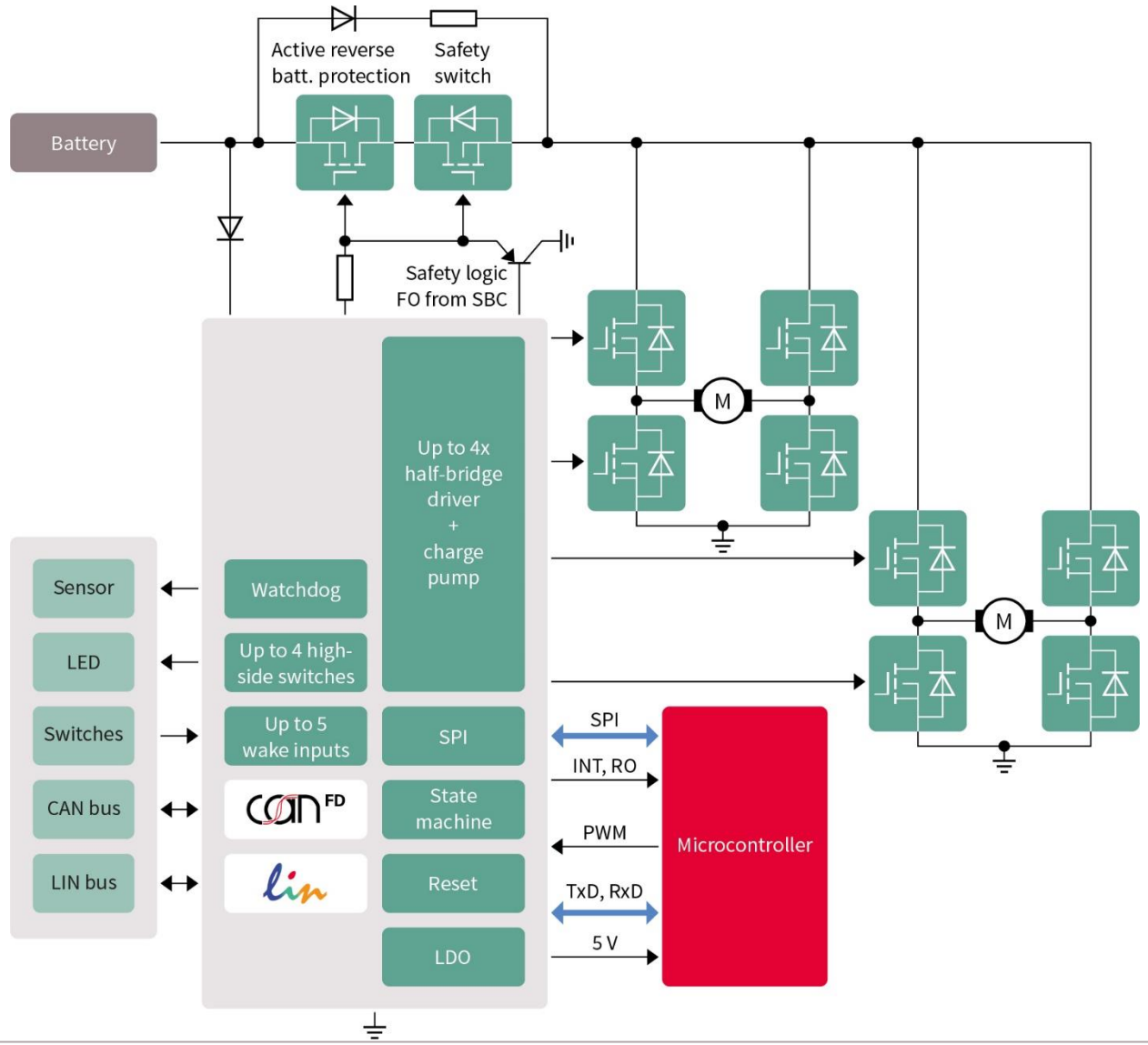


Key Benefits:

- **Cost optimized through system savings** – Bi-directional CSA can redundantise hall sensor usage if FOC is used saving ~0,12 €
- **Flexibility** – Compatibility for LIN and CAN FD reducing design-in effort
- **Peerless scalability** – Reduced software development effort by 50%
- **Best-in class** – First market solution with CAN FD interface and integrated half-bridge driver

Learn more about
12V Pump and Fan Applications

DC Motor System IC Application Diagram for two DC motors

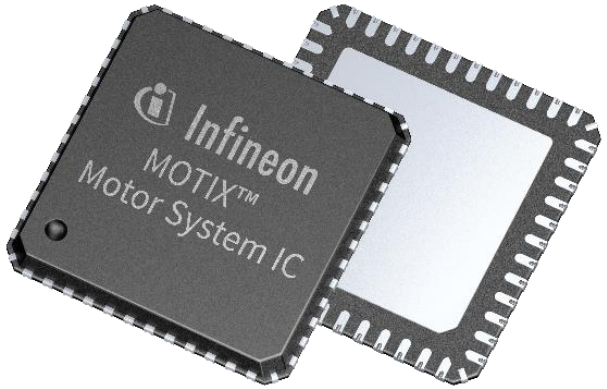


Key Benefits:

- **Flexibility** – Compatibility for 1 or two motor solution of DC as well as BLDC systems reducing design-in effort
- **Flexible component selection** – No end-of line MOSFET calibration → reduced EOL time of ~2 sec
- **Cost optimized through component savings** – Compared to discrete saves PCB-area by 50% as well as pick & place cost. In addition, saving of 0,05 EUR in comparison to discrete brake mode solution including lowering I_Q

Learn more about Infineon's Smart power closure systems

Today´s Technical Topics



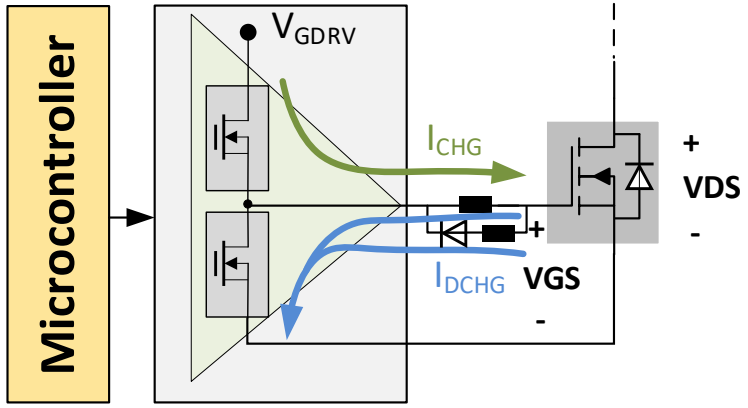
An overview over the unique **Adaptive MOSFET control concept**

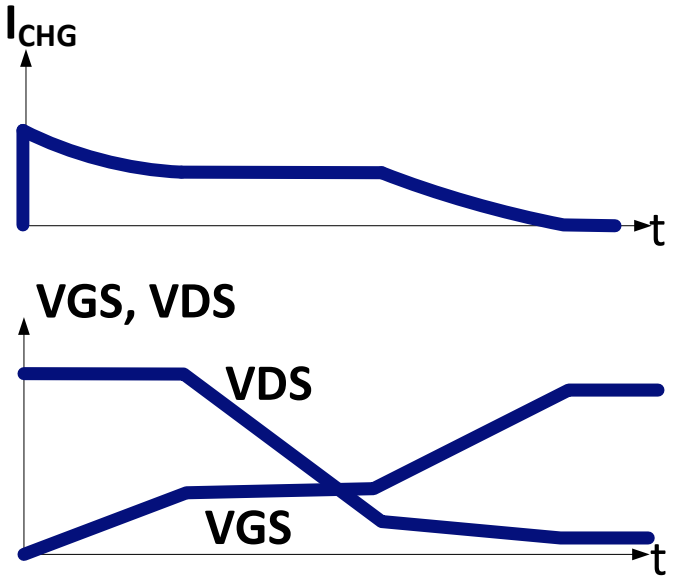
- Patented by Infineon and unique in the market

A deep dive into the **Brake mode**

- Preventing damages on ECU level when closing /opening manually

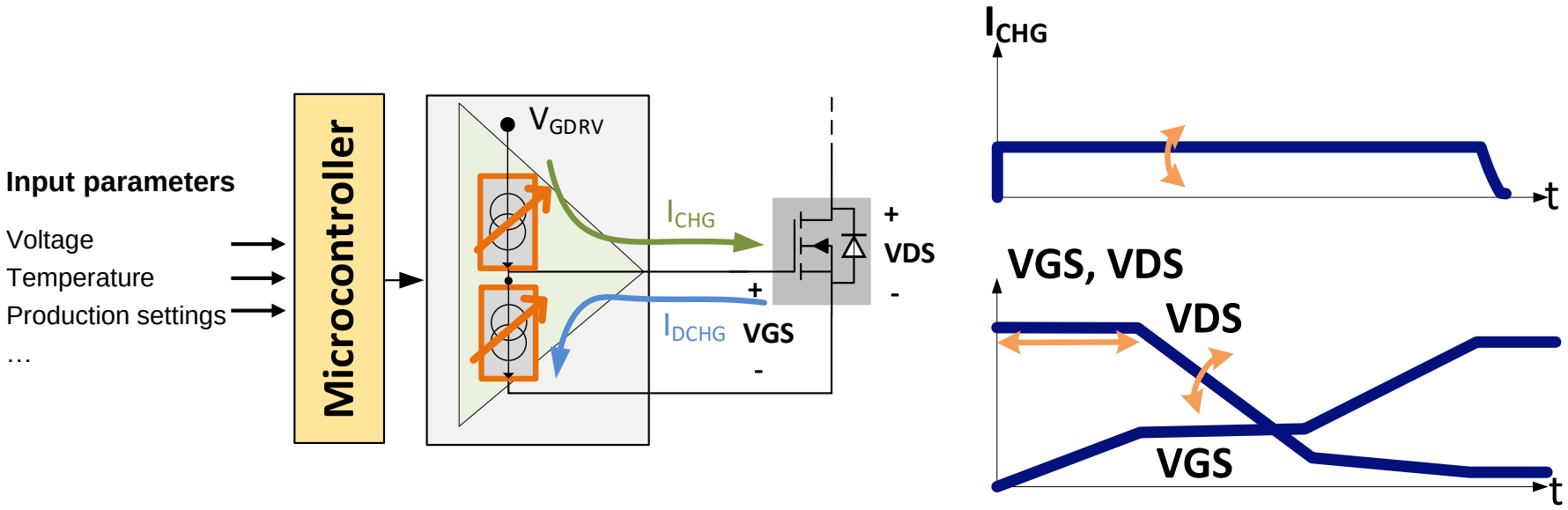
Optimization of the MOSFET drivers
Voltage-controlled MOSFET Driver





Hardware-determined charge current and switching behavior
No adaption of the switching times to external parameters is possible.

Optimization of the MOSFET drivers
Constant current-controlled MOSFET driver

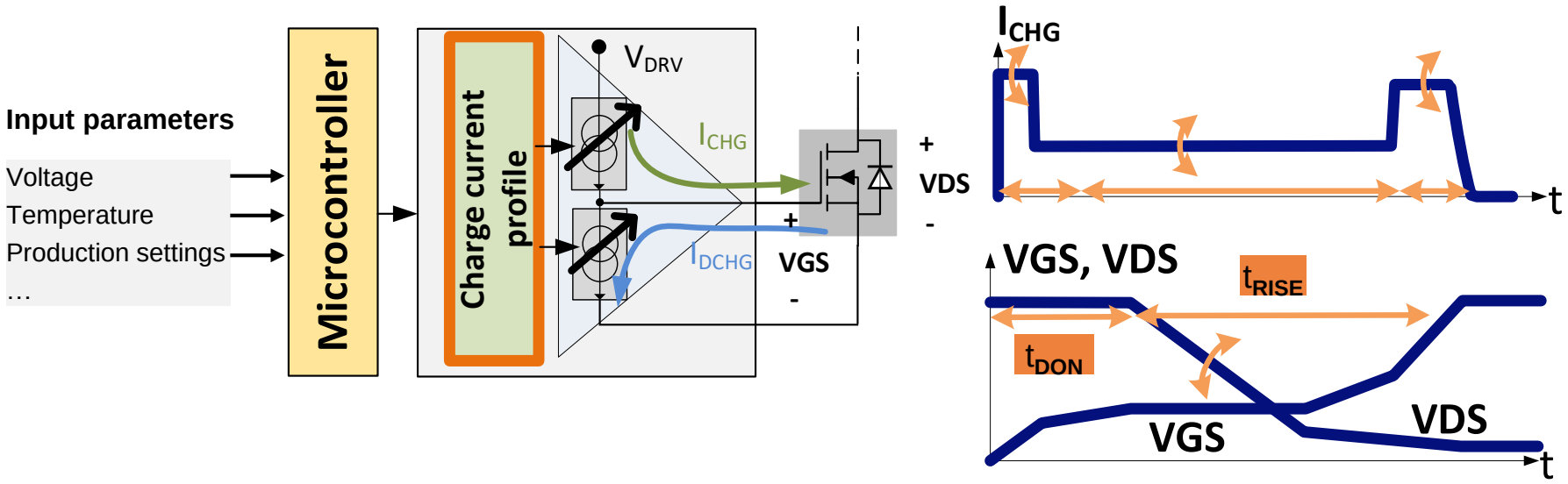


Configurable charge current by software

Constant current over the switching phase

Some control of switching phase **in open loop**

Optimization of the MOSFET drivers
Configurable current profile



Configurable **charge current profile**

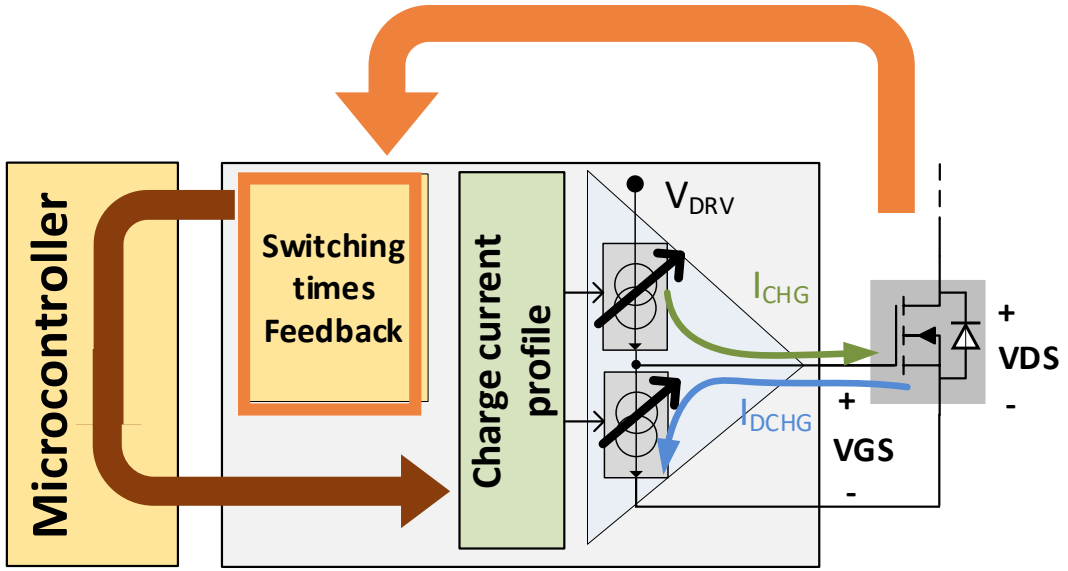
Open loop control of the different switching phases

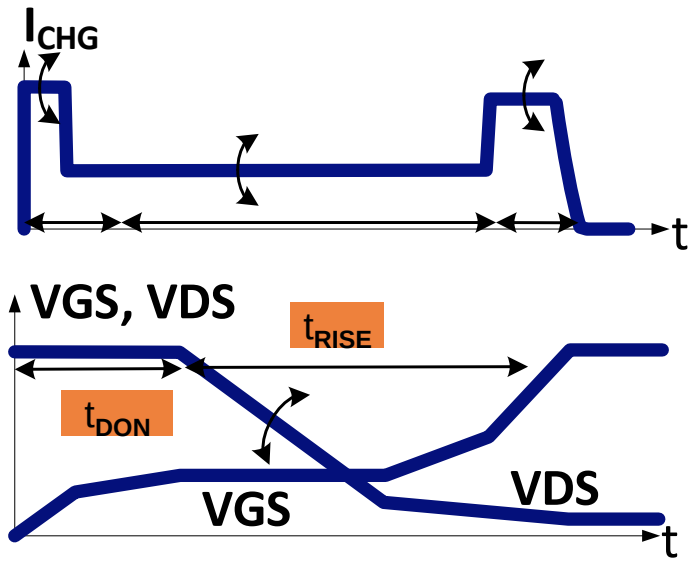
Optimization of the MOSFET drivers
Adaptive MOSFET control

Feedback of switching times

Input parameters

Voltage
Temperature
Production settings
…



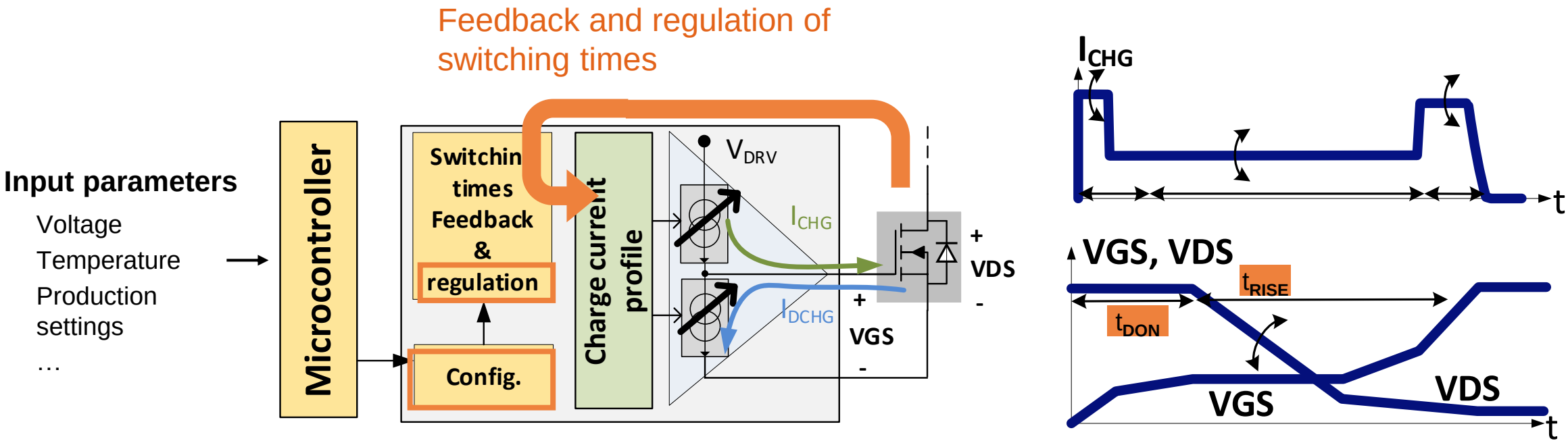


Closed loop adaption by software

Configurable charge current profile with feedback

The **feedback of the switching times** allow a **closed loop regulation** of the different switching phases **by the microcontroller**

Optimization of the MOSFET drivers
Adaptive MOSFET control



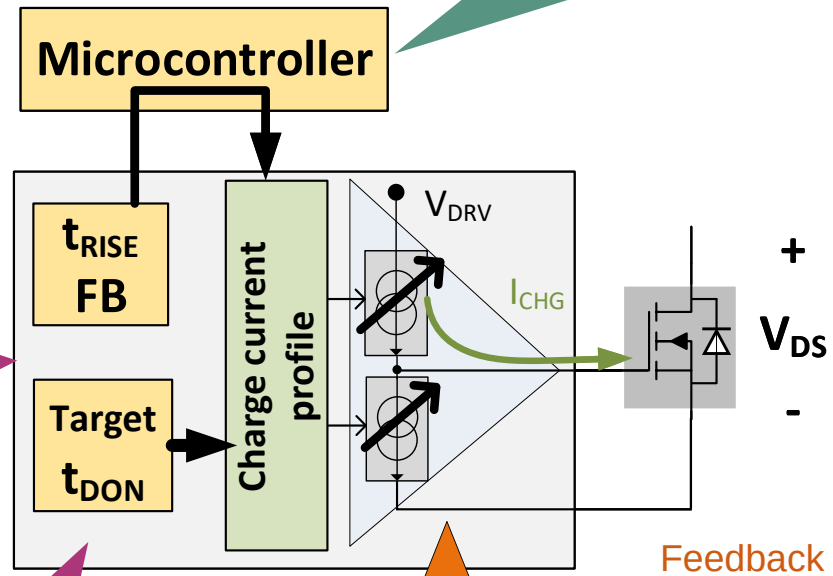
Microcontroller configures the switching times

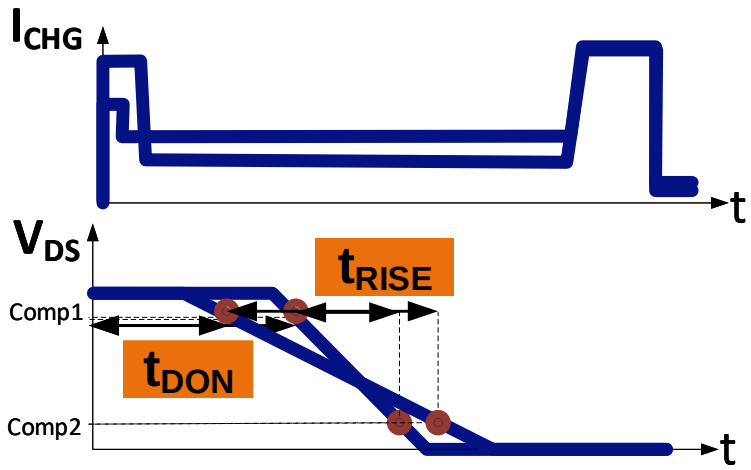
The **feedback of the switching times** allow a **closed loop regulation** of the different switching phases **by the MOSFET Driver**

Gate driver evolution
From current-controlled to adaptive MOSFET driver

t_{RISE} regulation by software

t_{DON} and t_{RISE} measured by MOSFET driver





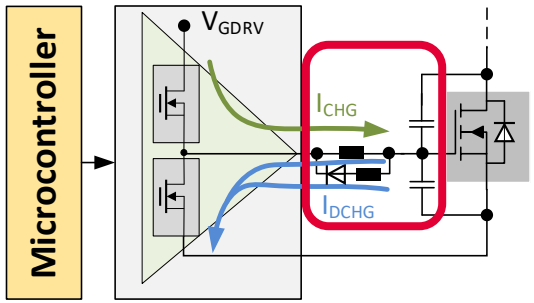
Feedback

Self-regulation of t_{DON}

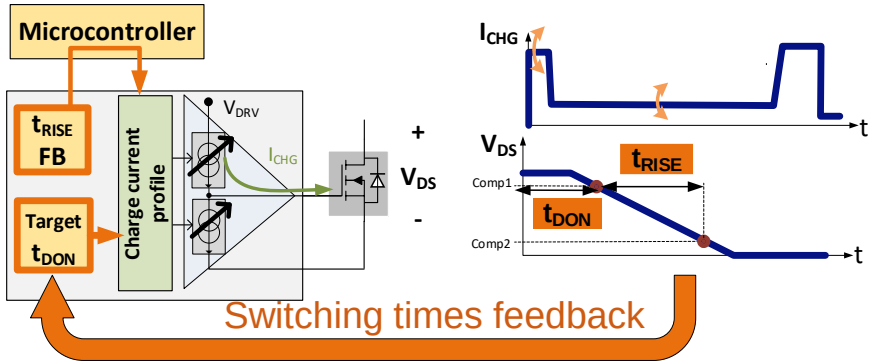
t_{DON} , t_{RISE} feedback

Adaptive MOSFET Control: Competitive Advantage (1)

Voltage source
Classic gate drivers



Current source
Adaptive MOSFET control



Many external components per MOSFET ☒

No components at the MOSFET gate required ☑

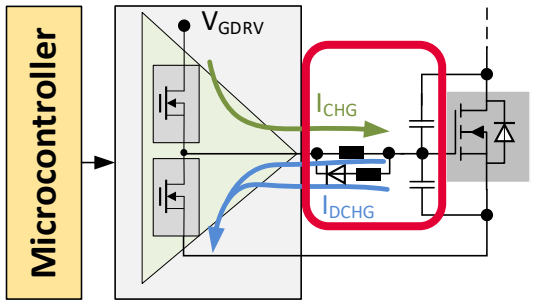
Regulated switching times without calibration, without MOSFET selection, without external capacitors and resistors

Removing two resistors and a diode per gate **save 0,03 EUR** per MOSFET

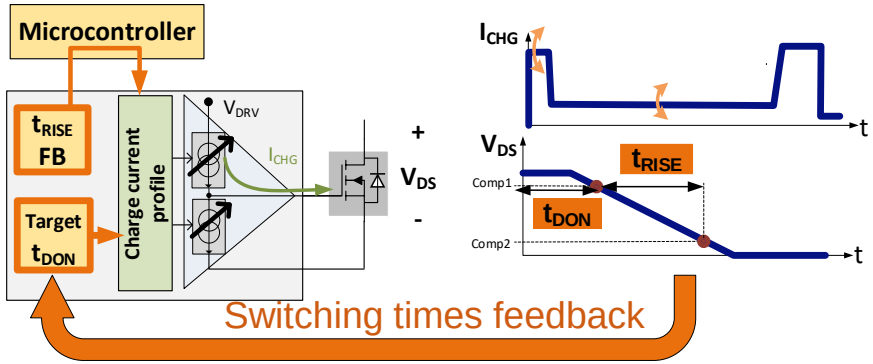
No end-of line MOSFET calibration, **reduced testing time** of ~2seconds

Adaptive MOSFET Control: Competitive Advantage (2)

Voltage source
Classic gate drivers



Current source
Adaptive MOSFET control



Switching times determined by hardware ☒

Switching times independent from the conditions, MOSFET type, production spread ☑

Variation of the switching times with temperature, current, voltage ☒

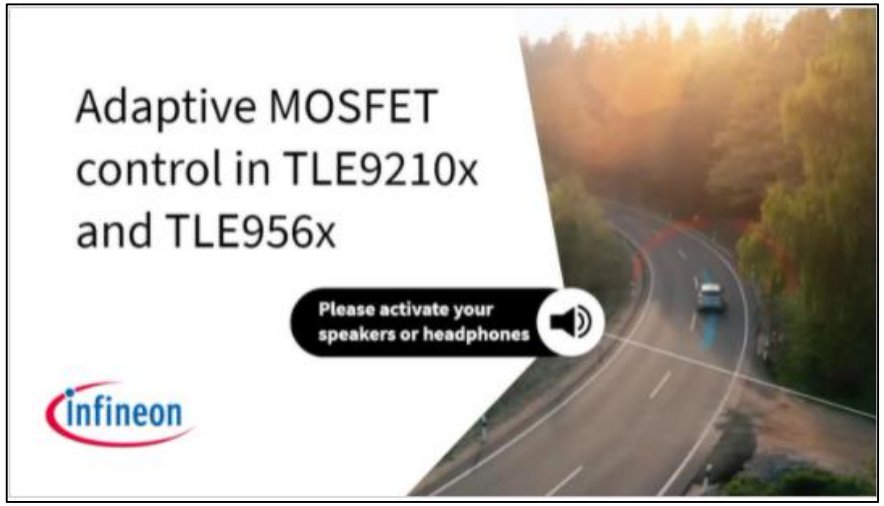
Reduction of the power losses ☑

Optimize the EMC by software (no external capacitors) through adaption to MOSFET spread
EMC constrains can be achieved without **expensive shielded cables/supply filters (1EUR savings/cable)**

Achieved emission/power losses trade-off without system over-dimensioning

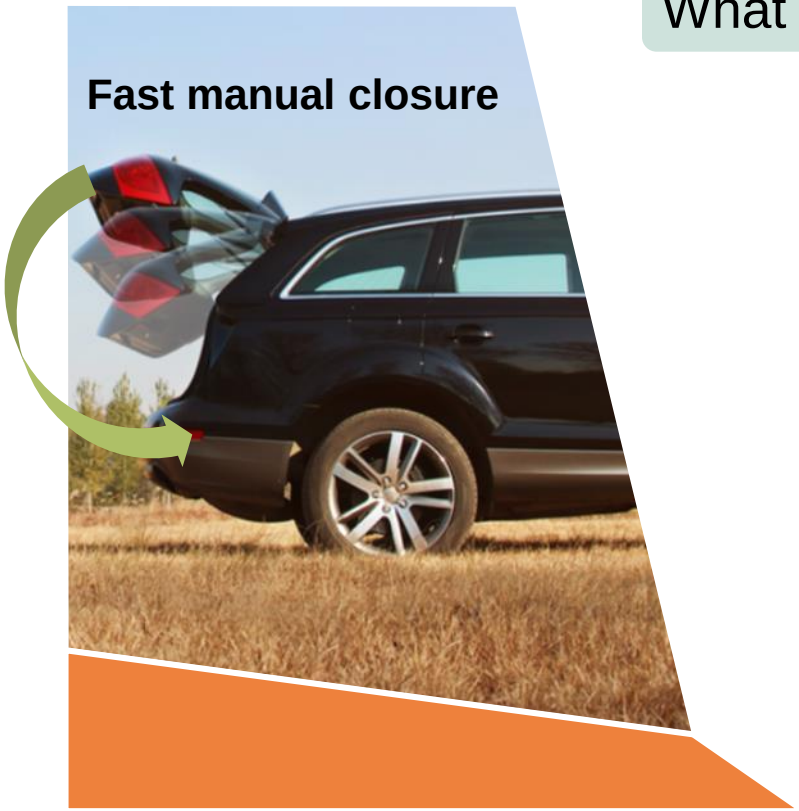
Adaptive MOSFET control: Support tools

Trainings

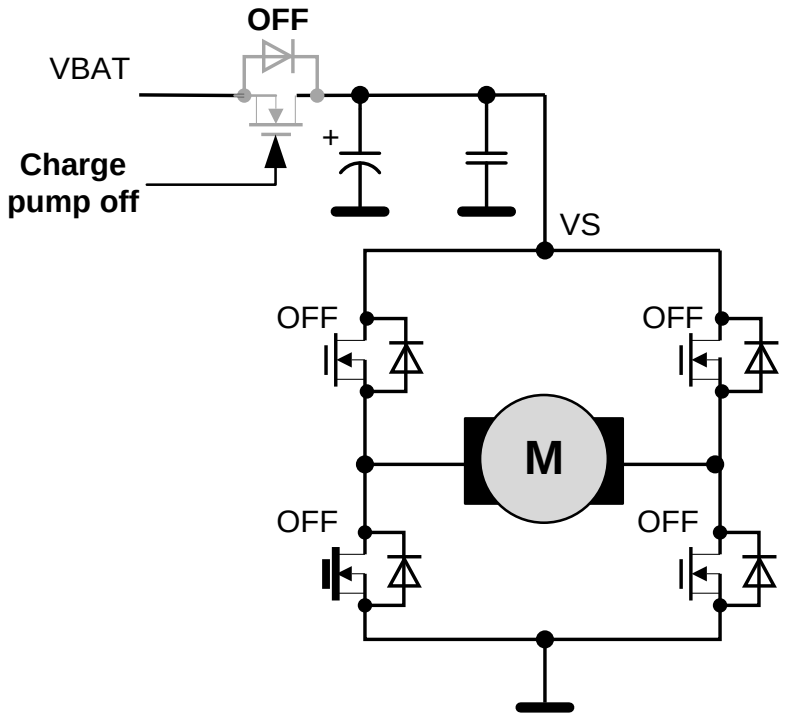


Learn more on Motor System IC
Videos and Trainings

Brake mode: Power lift gate



What happens during a manual closure in sleep mode?

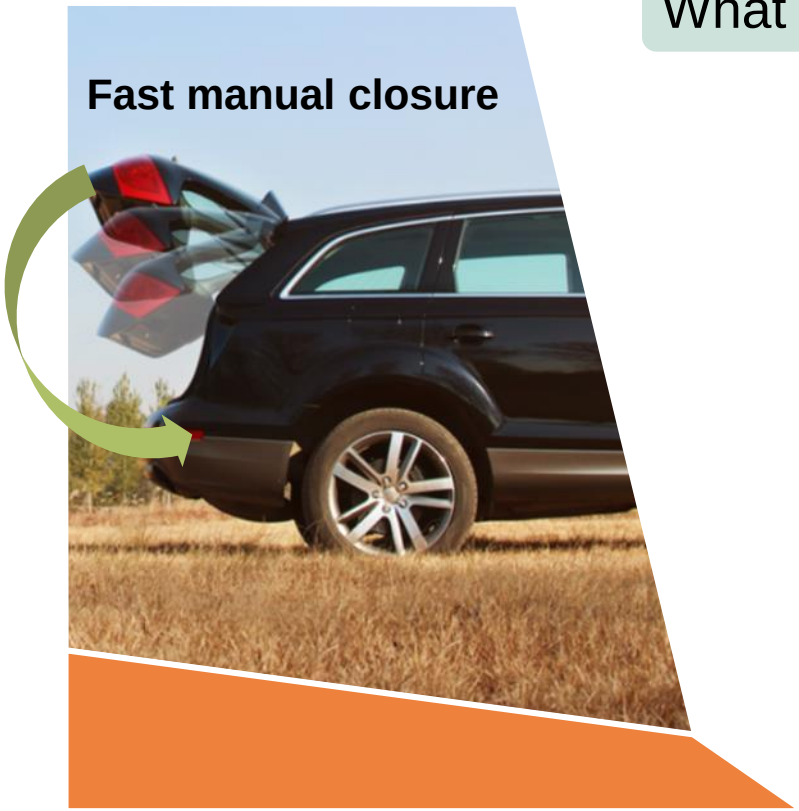


Conditions:

The charge pump is off → The reverse battery protection is off

The gate drivers and the MOSFETs are off

Brake mode: Power lift gate



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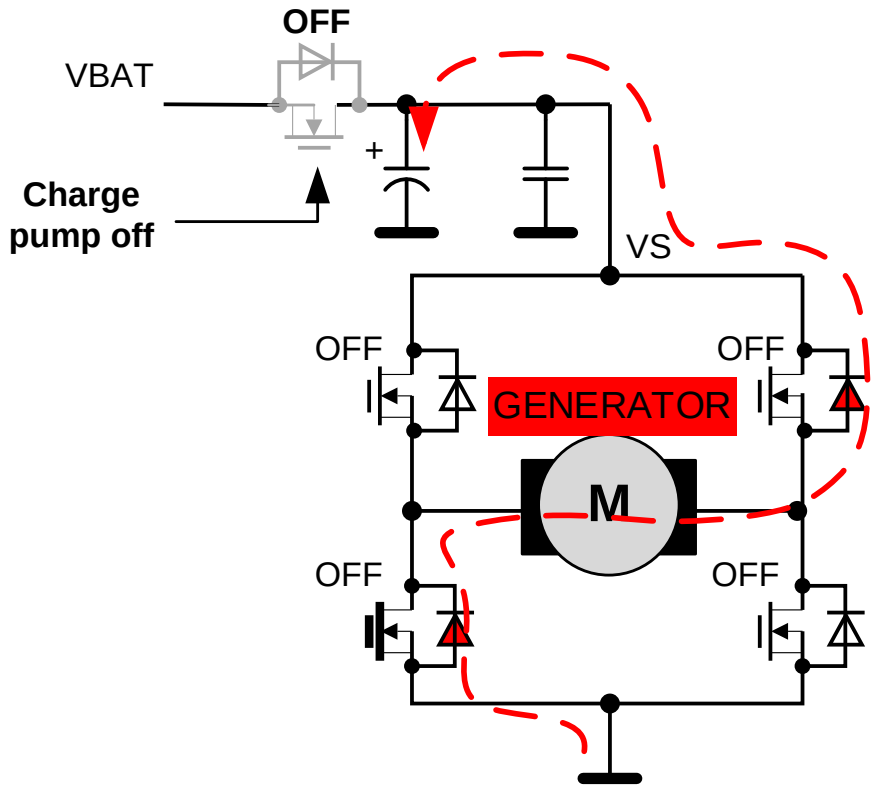
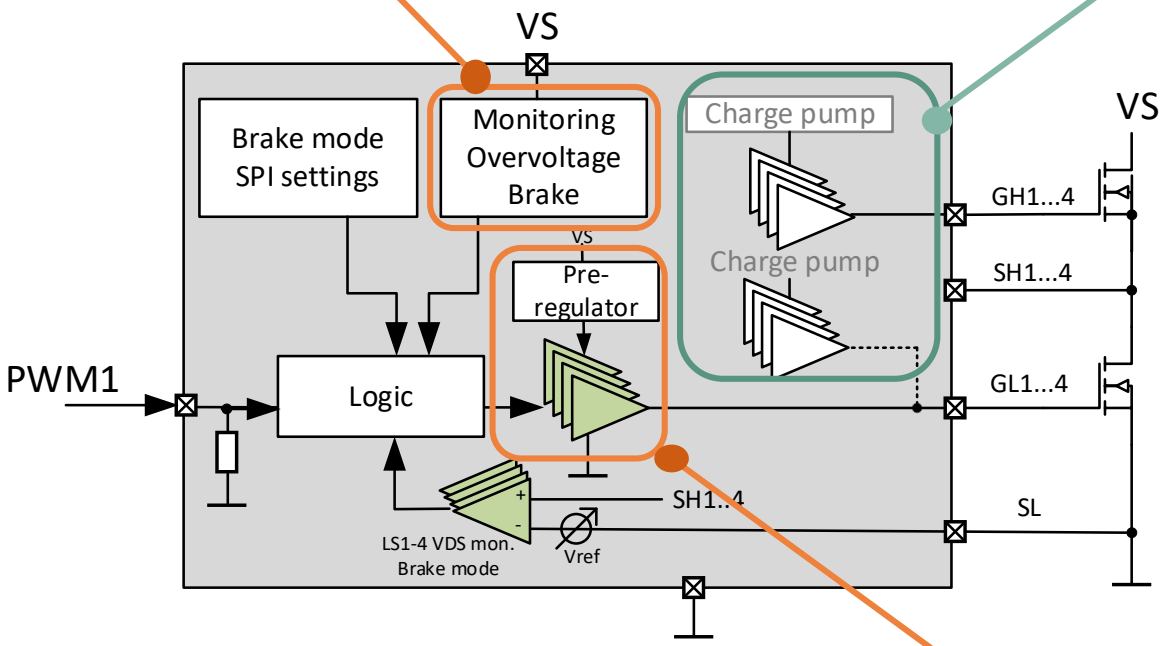


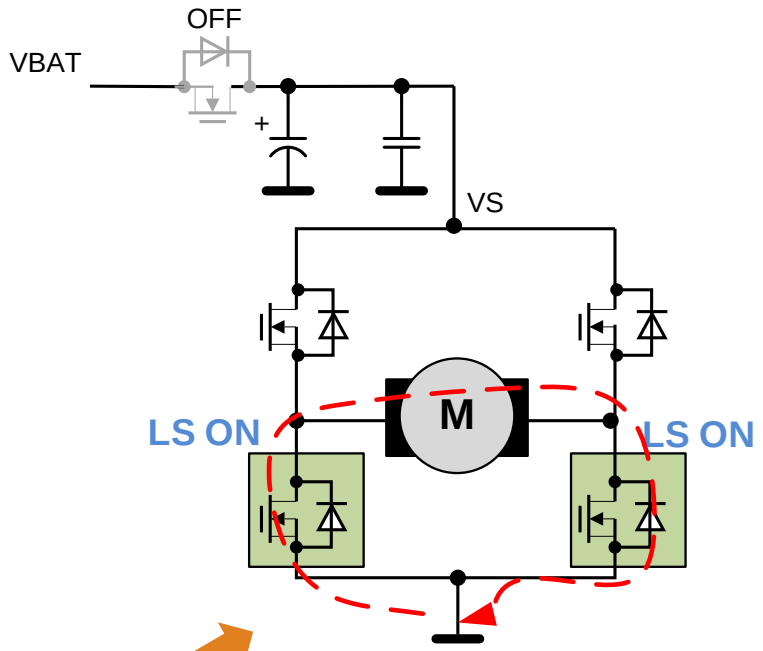
The motor operates as generator, injecting current back to supply causing a **VS voltage increase**

Brake mode: Power lift gate

VS overvoltage monitoring

The charge pump is off, the gate drivers for normal mode are off



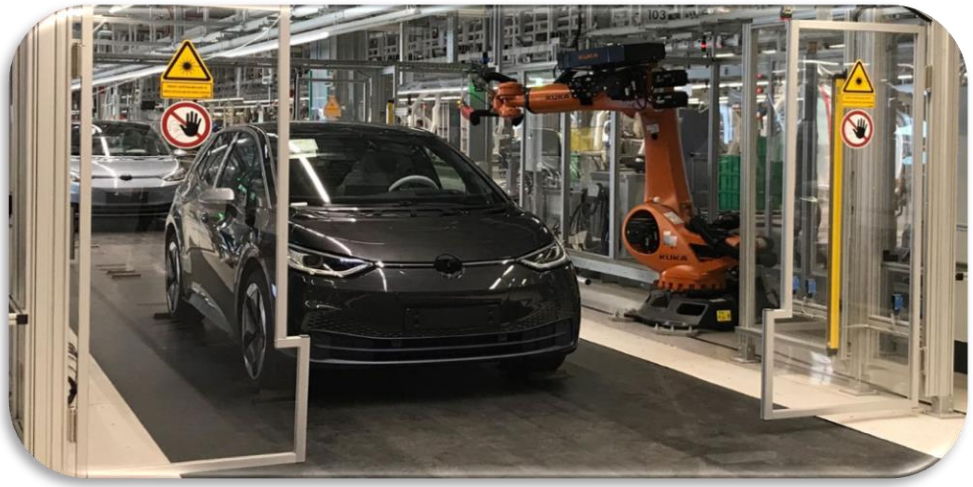


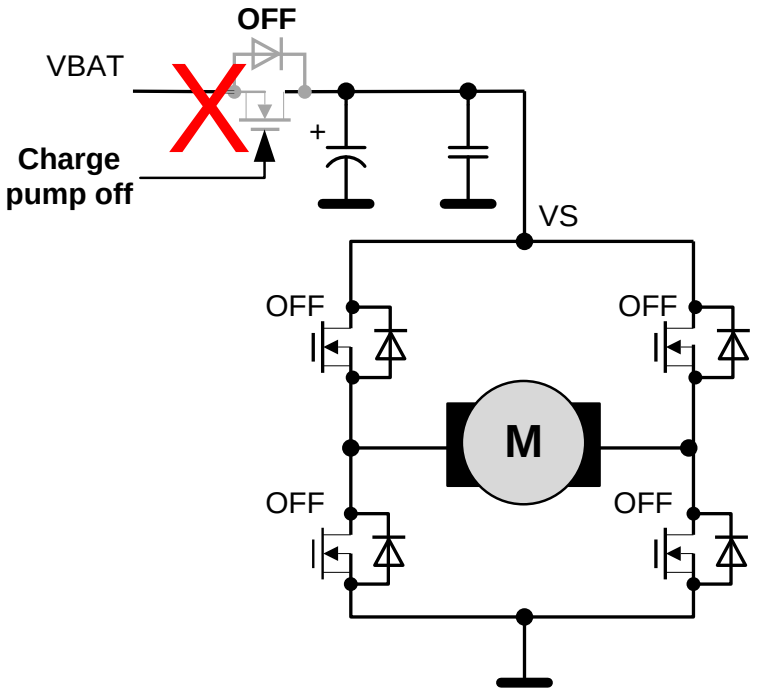
Gate drivers for brake mode

Low current consumption block also available in sleep mode

Brake mode: Unconnected supply

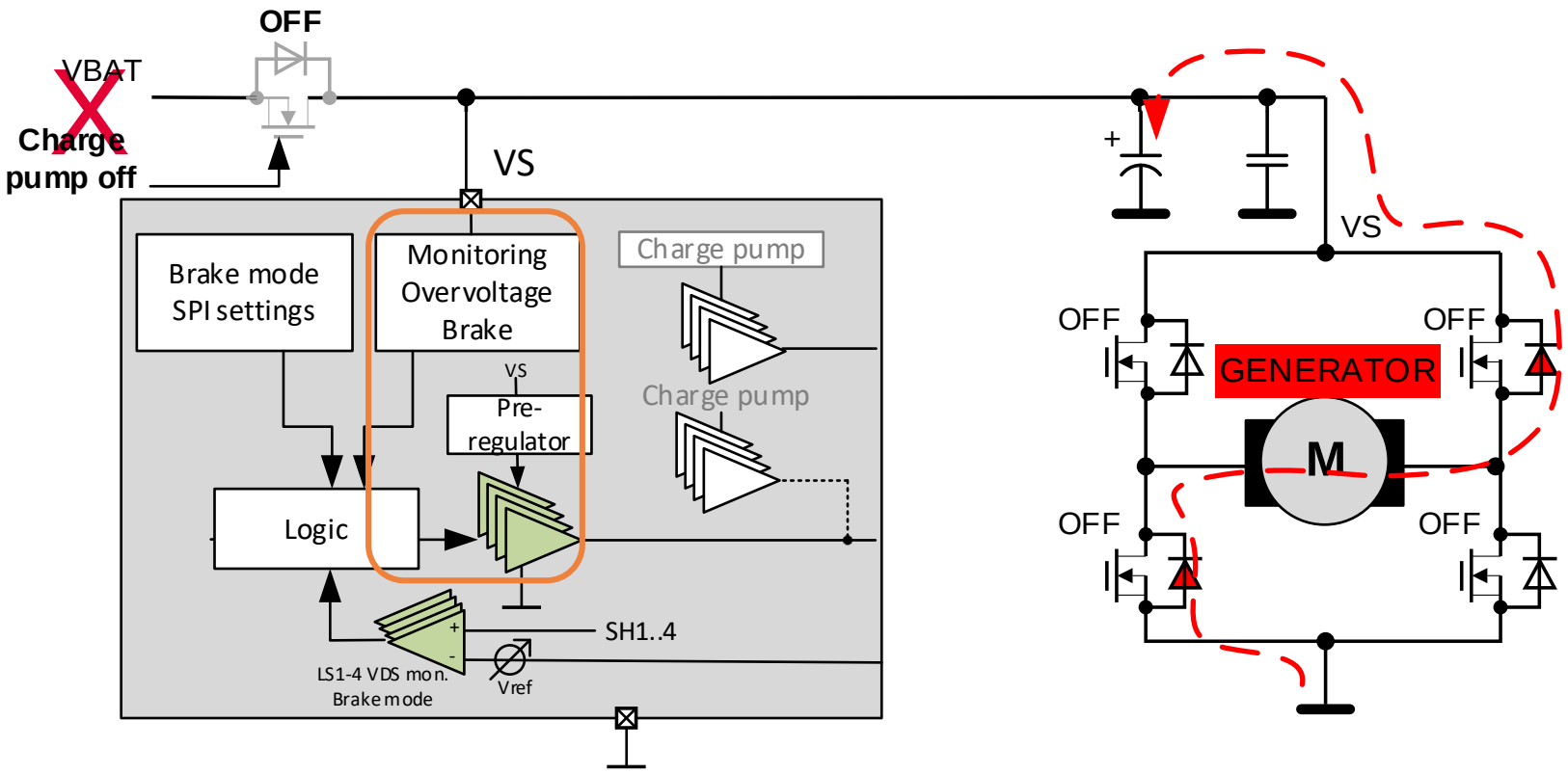
Situation:
- car factory
- the battery is not connected
- the module is unsupplied
- the trunk is manually closed





How can the unpowered bridge driver protect the application during the manual closure ?

Brake mode: Unconnected supply

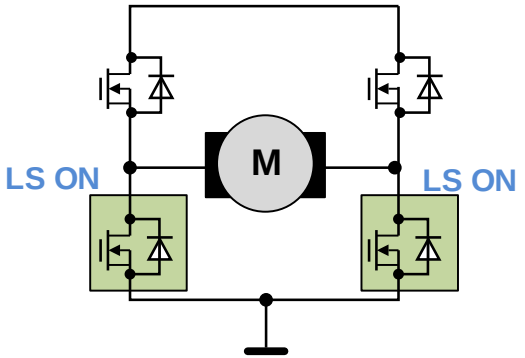


The overvoltage protection is available for even for unsupplied modules.
The voltage generated by the manual closure supplies the circuitry responsible for the low sides activation.

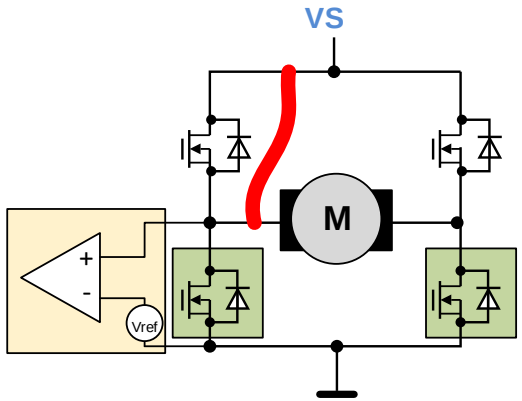
Permanent brake in sleep mode: Sunroof and window lift

A permanent motor brake can be required in sleep mode for window lift and sunroofs

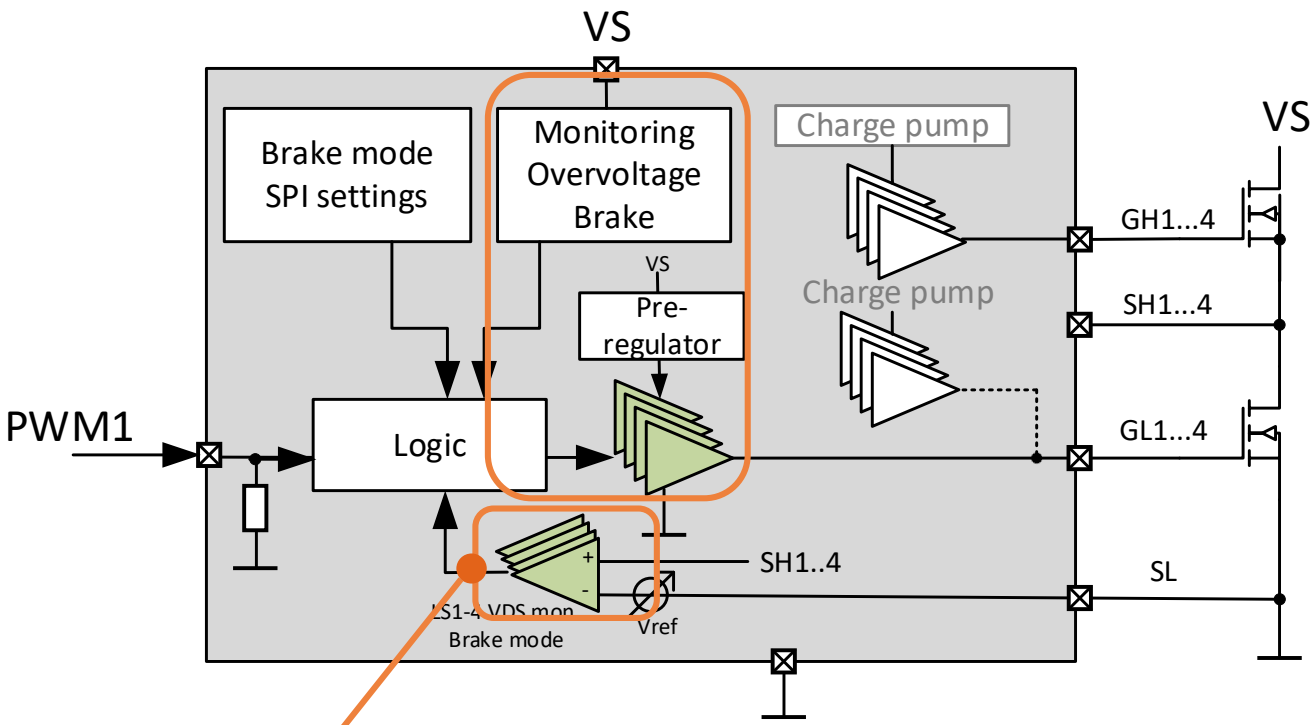
Permanent activation of the low sides is possible in sleep mode

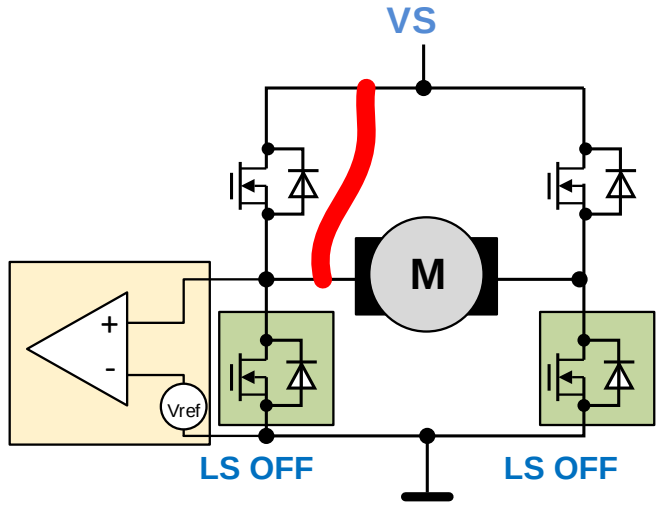


A short circuit detections can be activated even in sleep mode despite the low quiescent current



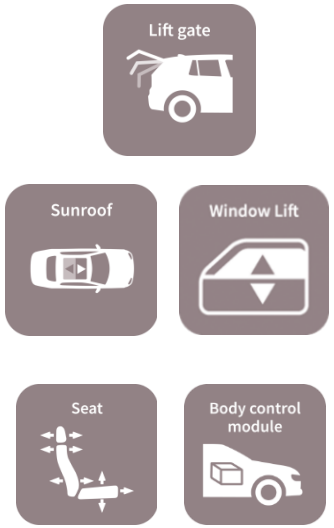
Brake mode: Power lift gate





Low current consumption Drain source monitoring

Configurable brake modes



Application	Motor brake in sleep mode	Remark
Power lift gate	Motor brake upon VS OV	7 µA additional consumption
Sunroof / window lift	Permanent motor brake	10 µA additional consumption Including the VDS monitoring
Seat adj., body controller	Not required	Lowest sleep current

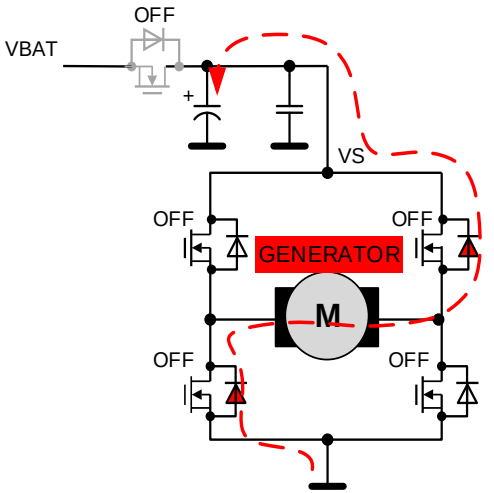
- Motor brake: activation of low-side MOSFETs
- VS OV: VS overvoltage
- VDS monitoring: Low side Drain-Source monitoring for short circuit protection

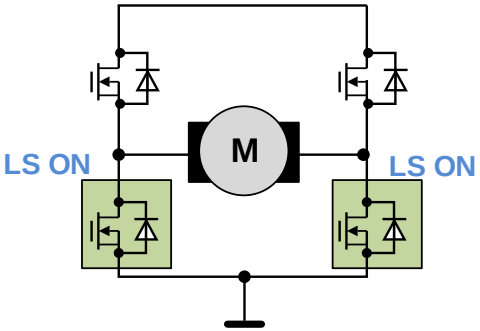
Brake mode: Competitive Advantage

Integrated supervision feature with
Low power VS monitoring in sleep mode
(saving of **0,05 EUR in comparison to discrete** brake mode solution)

A permanent motor brake in sleep mode
Required for application as Windows lift, sunroof

Improvement in quiescent current (I_Q) which cannot be accomplished with external devices





MOTIX™ SBC Forum

› If you have any question please visit our Forum:
https://community.infineon.com/t5/MOTIX-SBC/bd-p/MOTIXsbc

Support tools for development for MOTIX™ TLE956x

Boards

BLDC SHIELD with MOTIX™ TLE9563-3QX

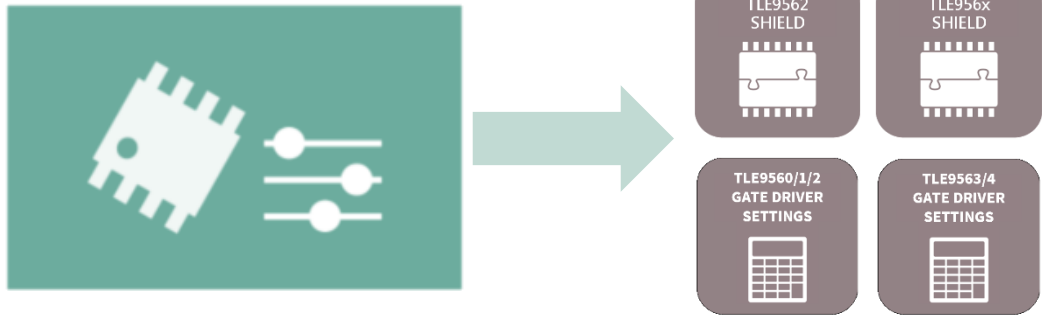
DC SHIELD with MOTIX™ TLE9562-3QX

Infineon Toolbox

Infineon Toolbox

Graphic User Interface

Config Wizard for Motor System IC

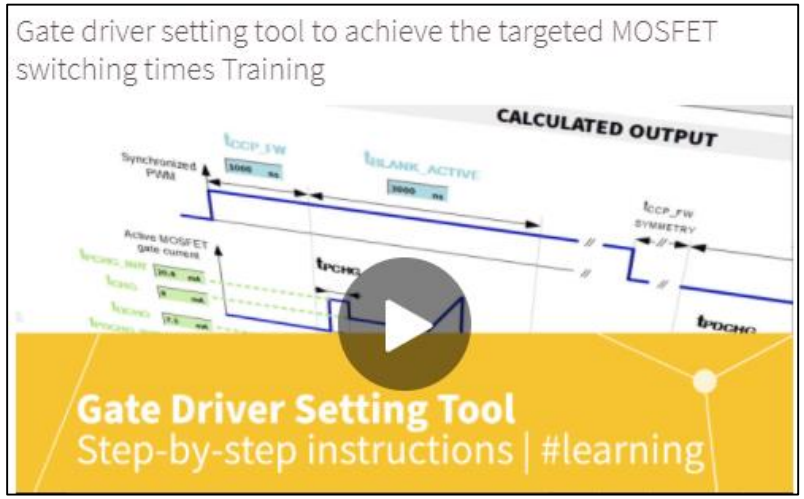


Software example @GitHub

C++ library for Infineon's Motor System IC MOTIX™ TLE956x family.

Support tools for development for MOTIX™ TLE956x

Videos and Trainings



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Videos and Trainings

Find out more about the Motor System IC Family MOTIX™ TLE956x

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Product Family Page

Application Notes

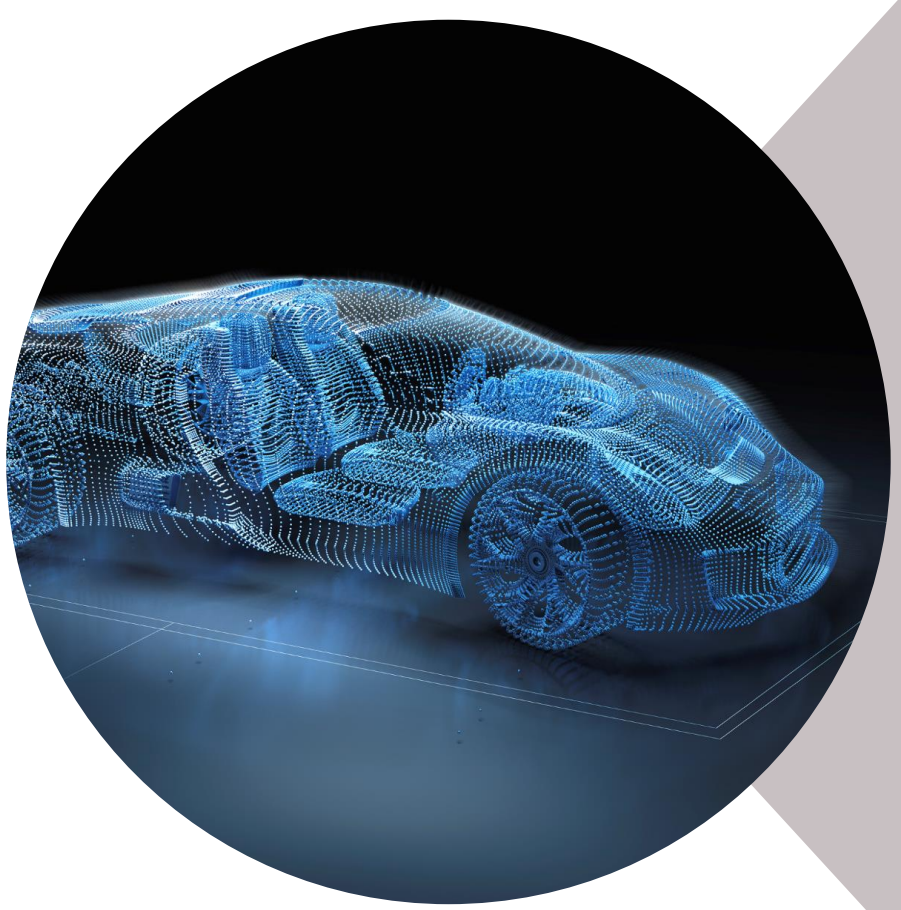
- MOTIX™ TLE9560/1/2 BDC Gate Driver Setting Guide
- MOTIX™ TLE9563/4 BLDC Gate Driver Setting Guide
- Off-state diagnostics with MOTIX™ TLE9563/64
- Off-state diagnostics with MOTIX™ TLE9560/61/62
- Rise fall time regulation with current source MOSFET gate drivers

Collaterals and Brochures

- Product presentation
- Customer connector
- User manual DC Shield MOTIX™ TLE9562-3QX
- User manual BLDC Shield MOTIX™ TLE9563-3QX

Visit us at www.infineon.com/motor-system-ics

Learn more about MOTIX™ and related motor control applications



Learn more about MOTIX™ product offering, reference designs and available videos

Discover related 12V automotive BDC and BLDC motor control applications

Smooth your design-in process with our tool and software offering in the Infineon developer center

Visit our Infineon developer community to get answers to your questions

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