

Motor control designed to drive your innovations



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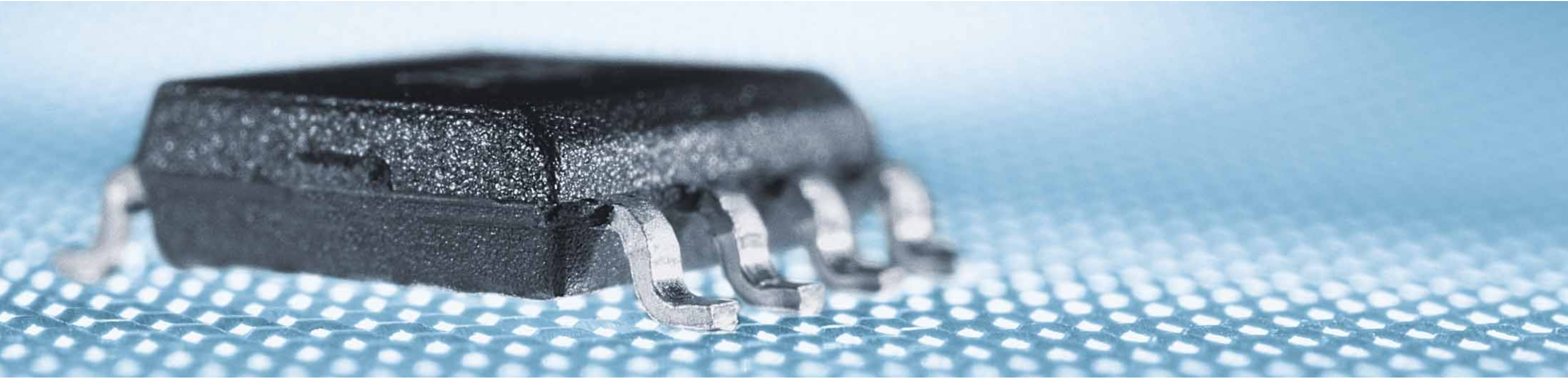


Never stop thinking



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## Designed to drive your innovations: Infineon motor control solutions

### Satisfying the demand for more efficient, feature-rich designs

SPURRED BY ENVIRONMENTAL LAWS mandating higher efficiency as well as consumer demand for more features and better functionality, designers have been turning to low-voltage 5V to 48V electric motor drives in recent years. The need for more efficient designs is prompting engineers to move from unipolar or H-Bridge motors to 3-Phase motors, ranging from simple 100mA DC drives for small motors to 100A 3-Phase motors.

THE VARIETY OF LOW-VOLTAGE MOTORS used is as diverse as the features they enable. Easiest to implement, DC brush motors are the most common electric motor used today. Stepper motors see wide use in positional control applications. Engineers turn to brushless DC motors for high-temperature, high-reliability control applications, and where size constraints limit the use of DC brush motors. High-current, high-reliability applications demand Permanent Magnet Synchronous Motors (PMSM).

### Reliable, viable, undeniable

INFINEON HAS SEIZED THE NO. 1 SPOT in automotive power semiconductors by creating innovative power control solutions. Engineers value the reliability and versatility designed into these low-voltage motor control products, and have used them successfully in many non-automotive applications.

### Innovative technologies, advanced techniques

INFINEON LEVERAGES MANY TECHNOLOGIES to create these innovations, for example trench N- and P-Channel MOSFETs, S-Smart power and logic, and Smart Power Technologies (SPT) featuring monolithic analog, digital and power. We also use advanced assembly techniques such as chip-by-chip, chip-on-chip and power bond for high-current wire bonding.

### Step up to the next generation

BY COMBINING THESE TECHNOLOGIES, Infineon produces forward-looking products designed to enable the next generation of innovative motor control solutions. Alongside a broad portfolio of motor control power products, we also offer all the building blocks for end-to-end motor control solutions, including voltage regulators, communication ICs, microcontrollers and hall sensors.

### Motor control designed to drive your innovations

INFINEON'S CREDO is Never stop thinking. If you wish to discover how this abstract idea translates into concrete reality, take a moment to review our wide range of motor control products. You're sure to find the perfect solution to drive your products among our offering of motor control products. We're looking forward to talking to you about how we can help you realize your next innovation.

# Motor drives application segments



Wipers



Snowmobiles and boats



Climate control



Automation and control



Toys



Cordless drills and battery-driven power tools



Power steering

## Automotive



HVAC fans



Printers and cutting printers

## Industry



Power-adjustable seats (as used in first-class cabins)



Door locks



Engine cooling fans



Home appliances



Medical: Dental chairs, ceiling arms for clean rooms, hospital beds, etc.



Sunroofs



Power windows

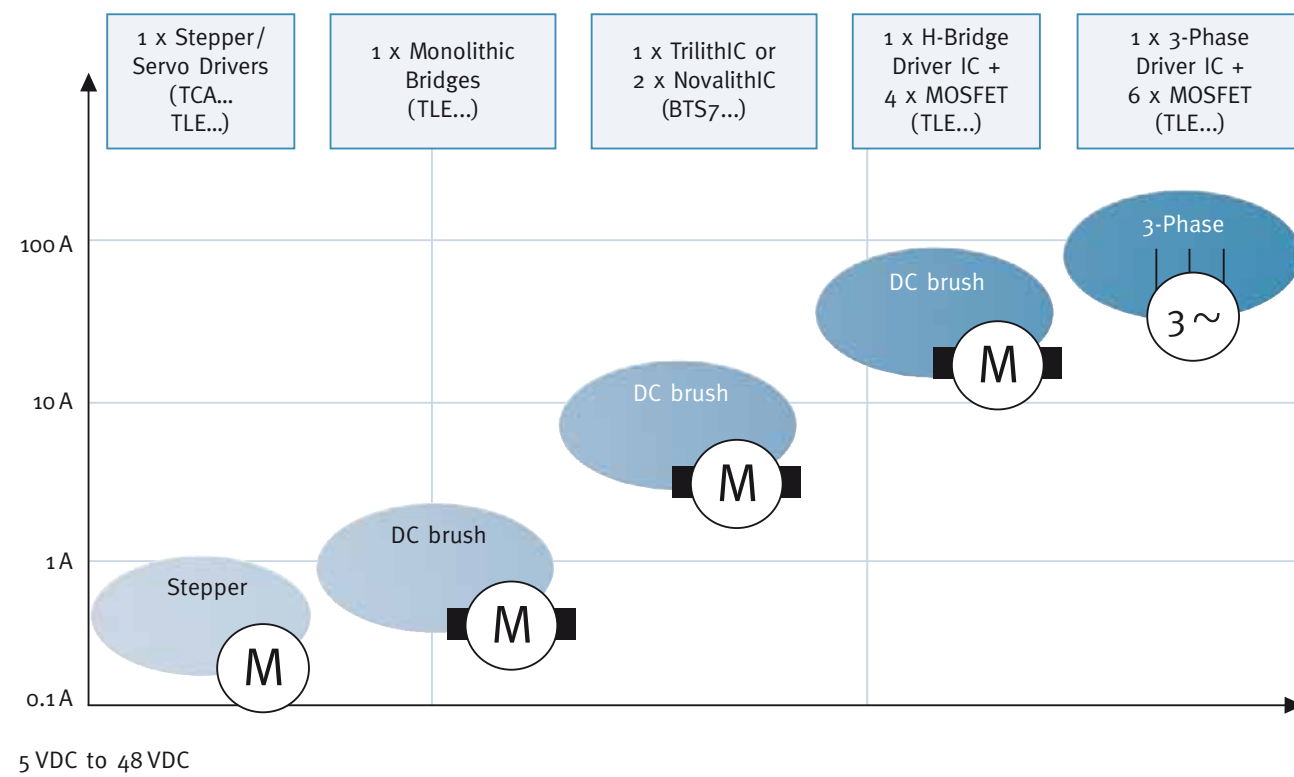


Robotics

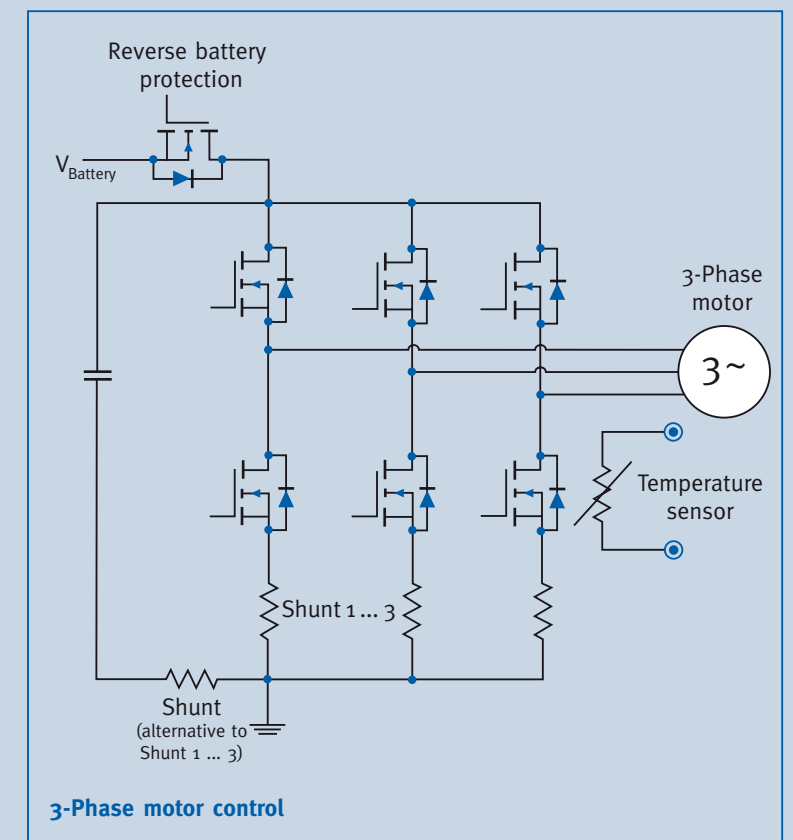
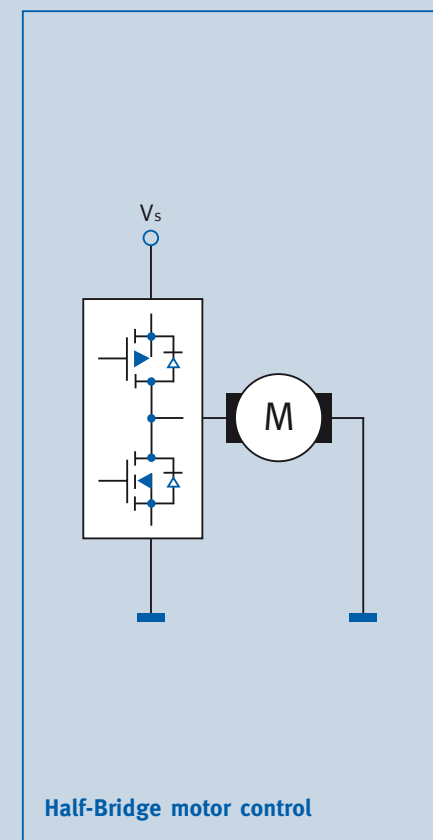
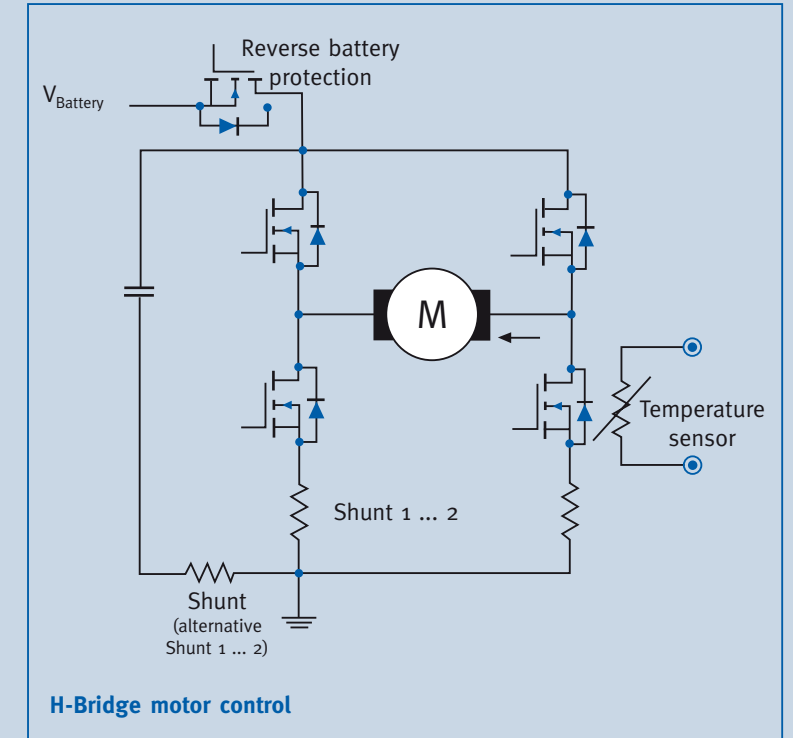
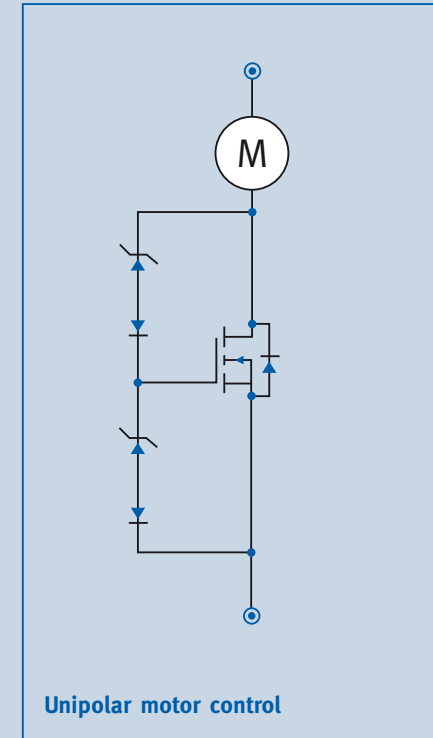


## The right driver for every motor

THE SEARCH FOR A SOLUTION to drive applications powered by low-voltage motors ends with Infineon. From 0.1 to 100A, and from steppers to 3-Phase drivers, we offer the right solution for every current range and application requirement.



## Example block diagrams



# Product overview

## Automotive MOSFETS

OptiMOS-T and OptiMOS-T2

Product name	R <sub>DS(on)</sub> [mΩ]	I <sub>d</sub> [A]	Voltage class
OptiMOS-T2 IPD90No3S4L-02 IPD30No3S4L-14	2.1 mΩ to 14.0 mΩ	90 A to 30 A	30 V N-Channel
OptiMOS-T IPB180No4S3-02 IPD50No4S3-08	1.6 mΩ to 8.0 mΩ	180 A to 50 A	40 V N-Channel
OptiMOS-T IPB100No6SL-03 IPD30No6S3-24	3.0 mΩ to 24.0 mΩ	100 A to 30 A	55 V N-Channel

## High Current motor drivers

TrilithIC and NovalithIC

Product name	Path R <sub>DS(on)</sub> [mΩ]	Protection
NovalithIC BTS/BTN 7965B, 7935B	16 ... 28 (typ) 30.5 ... 55 (max)	HSS + LSS protected
BTS/BTN 7930B, 7960B, 7970B	16 ... 28 30.5 ... 55	HSS + LSS protected, I-sense adj. Slew rate
TrilithIC BTS/BTM 7700G, 7710G, 7710GP, 7810K, 7811K	40 ... 110 ... 200 (typ) 100 ... 260 (max)	HSS protected
BTS/BTM 7740G, 7750G, 7750GP	115 ... 210 (typ) 285 ... 500 (max)	HSS + LSS protected
BTS/BTM 7741G, 7751G	115 ... 210 (typ) 285 ... 500 (max)	HSS + LSS protected open load off

## Bridge Driver ICs

H-Bridge Driver

Product name	Control inputs	Diagnosis	Over-temperature warning	Adjustable SCD and disable	Supply voltage range	Example applications
TLE6281G	2	2-bits	Yes	No	7.5 ... 60 V	Clutch, gearbox, transfer case, active suspension, belt pretensioner, EPS, power lift gate, sliding door, portable tools
TLE6284G	2	2-bits	Yes	Yes	7.5 ... 60 V	Clutch, gearbox, transfer case, active suspension, belt pretensioner, EPS, power lift gate, sliding door, portable tools
TLE6282G	4	1-bits	No	Yes	7.5 ... 60 V	Injection, valve, unipolar 4-Phase motor, boost converter, portable tools

3-Phase Driver

Product name	Supply voltage (operation)	Duty cycle	Low quiescent mode	OpAmps	Adjustable dead time	Adjustable short-circuit detection level	Example applications
TLE6280GP	8 ... 30 V	0 ... 95%	No	–	Yes	Yes	Power steering, water/fuel pump/braking, battery-operated drill/portable tools, wheel chairs, golf cart, electric scooter
TLE 7183F	5.5 ... 28 V	0 ... 100%	Yes	1	Yes	No (several fixed versions)	Power steering, water/fuel pump/braking, battery-operated drill/portable tools, wheel chairs, golf cart, electric scooter
TLE 7189F	5.5 ... 28 V	0 ... 100%	Yes	3	fix	Yes	Power steering, water/fuel pump/braking, battery-operated drill/portable tools, wheel chairs, golf cart, electric scooter
TLE 7185E	5.5 ... 33 V	0 ... 95%	Yes	–	Yes	Yes	Power steering, water/fuel pump/braking, battery-operated drill/portable tools, wheel chairs, golf cart, electric scooter

## Smart Power DC Motor Bridges

Door module ICs, H-Bridge, Multi-Half-Bridge, Servo driver and Stepper driver

Product name	Output current [A]	Operating range [V]	Protection	Example application
Door Module ICs TLE8201R	1.25; 1.8; 3; 6.25; 8	8 ... 20	Overcurrent, overtemperature, over-/undervoltage lookout, open load diagnosis, current sense	Door lock/unlock, mirror adjustment and mirror fold, mirror heating, puddle lamps, mirror turn signal
Multi-Half-Bridge TLE4208G TLE6208-3G	3 x 0.6 6 x 0.6 2 x 0.8 4 x 0.8	6 ... 18 6 ... 40	Overtemperature, over-/undervoltage lock-out, short circuit	HVAC flap control
Stepper Motor Drivers TLE4729G	2 x 0.75	5 ... 50 5 ... 16	Overtemperature Open load, overtemperature, short circuit	Ventilation flap control in industrial applications
Servo Drivers TLE4206G	0.8	6 ... 18 6 ... 32	Short circuit Overtemperature, over-/undervoltage lookout, short-circuit	Headlight beam leveling control

## H-Bridges

Bridges for idle speed and throttle control

Product name	Output current [A]	Operating range [V]	Short-circuit protection
TLE 5205-2	4	6 – 40	Protected
TLE 5206-2	4	6 – 40	Protected
TLE 6209	6	5 – 40	Protected
TLE 7209-2R	6	5 – 40	Protected

Motor Control N-Channel MOSFETS 30V, 40V, 55V



www.infineon.com/automotivemosfet

Optimos-T 40V, 55V and OptiMOS-T2 30V can serve as basic building blocks for unipolar, H-Bridge and 3-Phase motor solutions. Pair these products with driver IC products to create a complete motor drive solution.

Features:

- Extended current capability: up to 180A in D<sup>2</sup>PAK; 90A in DPAK
- Improved R<sub>DS(on)</sub>: as low as 1.6 mΩ in D<sup>2</sup>PAK and 2.1 mΩ in DPAK
- Best-in-class quality and reliability: full automotive qualifications with MSL1, 260°C reflow

H-Bridge Driver ICs

Bridge Driver ICs control and protect the MOSFET power stage in high-current motor applications. The Bridge Driver ICs can be combined with Power MOSFETs to realize a complete motor drive solution.

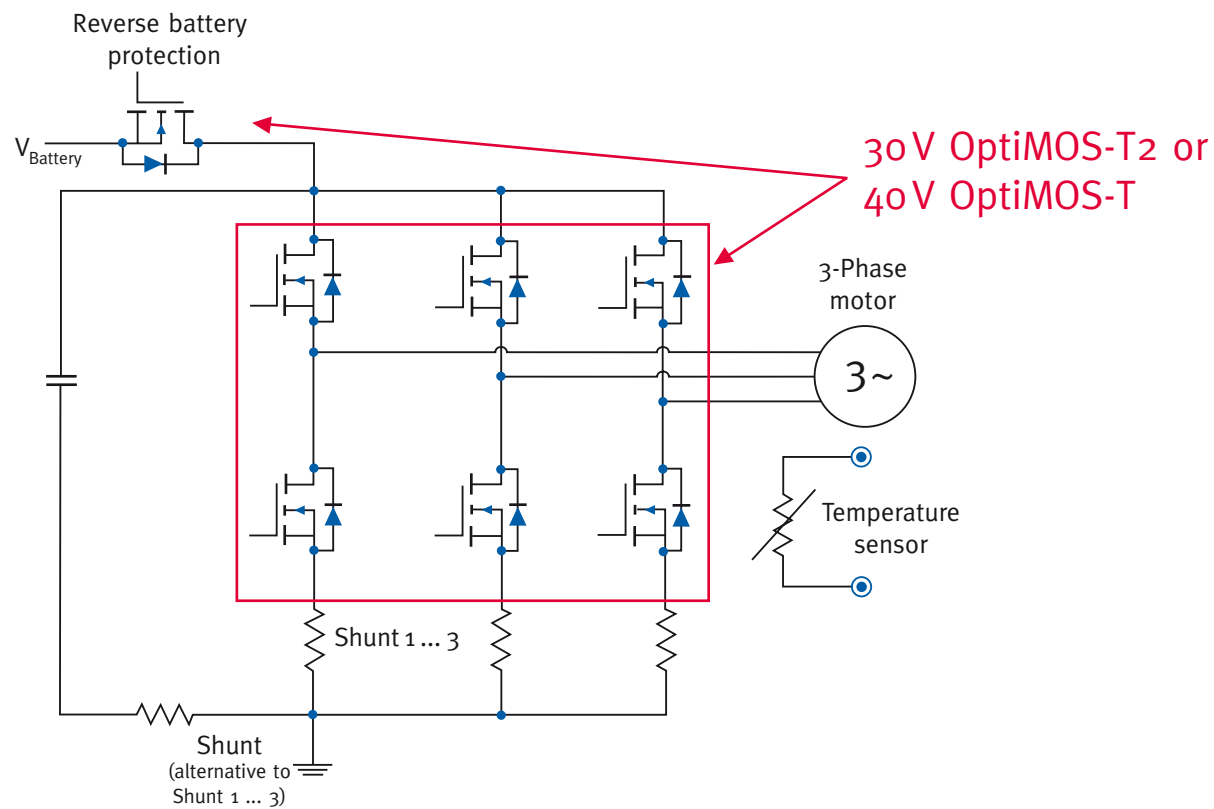
Features:

- TLE 6281 G
- H-Bridge driver IC
  - Driver IC for 7.5 ... 60V supply voltage
  - VDS monitor for short-circuit protection
  - PWM/DIR inputs for DC brush motors
- Low quiescent current (inhibit mode)
- Diagnostic ERR flag provides detailed feedback
- Adjustable dead time / deactivation possible

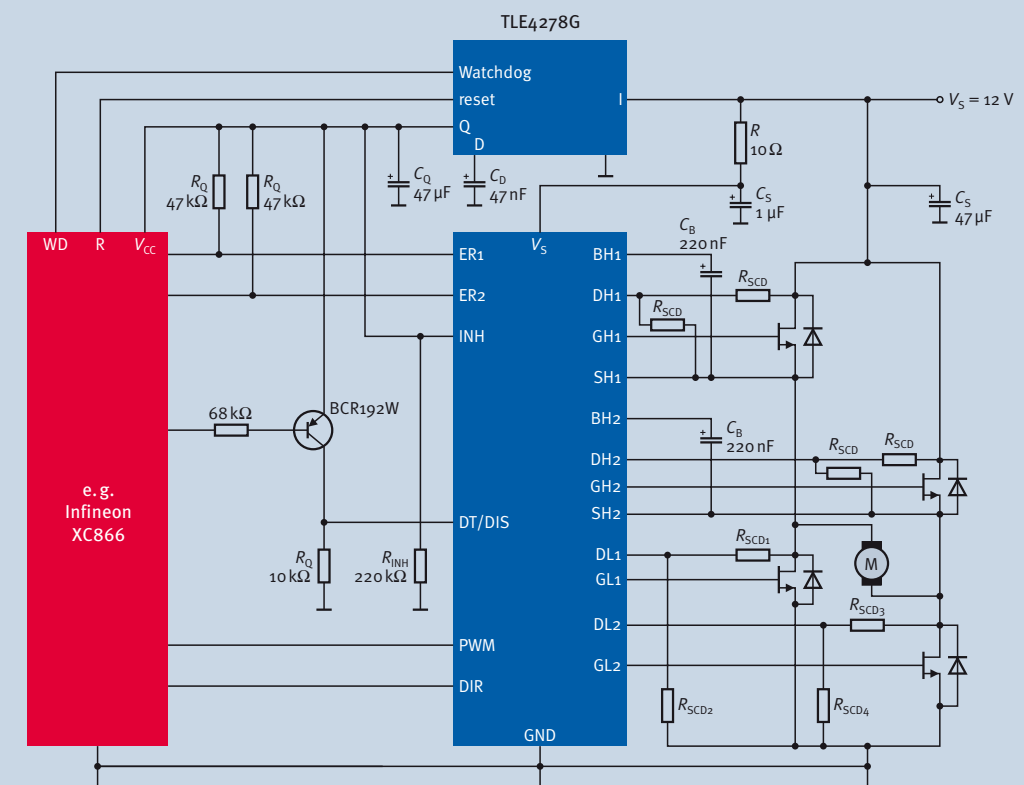


www.infineon.com/Driver-IC

An example of 3-Phase motor control



H-Bridge Driver



3-Phase driver ICs

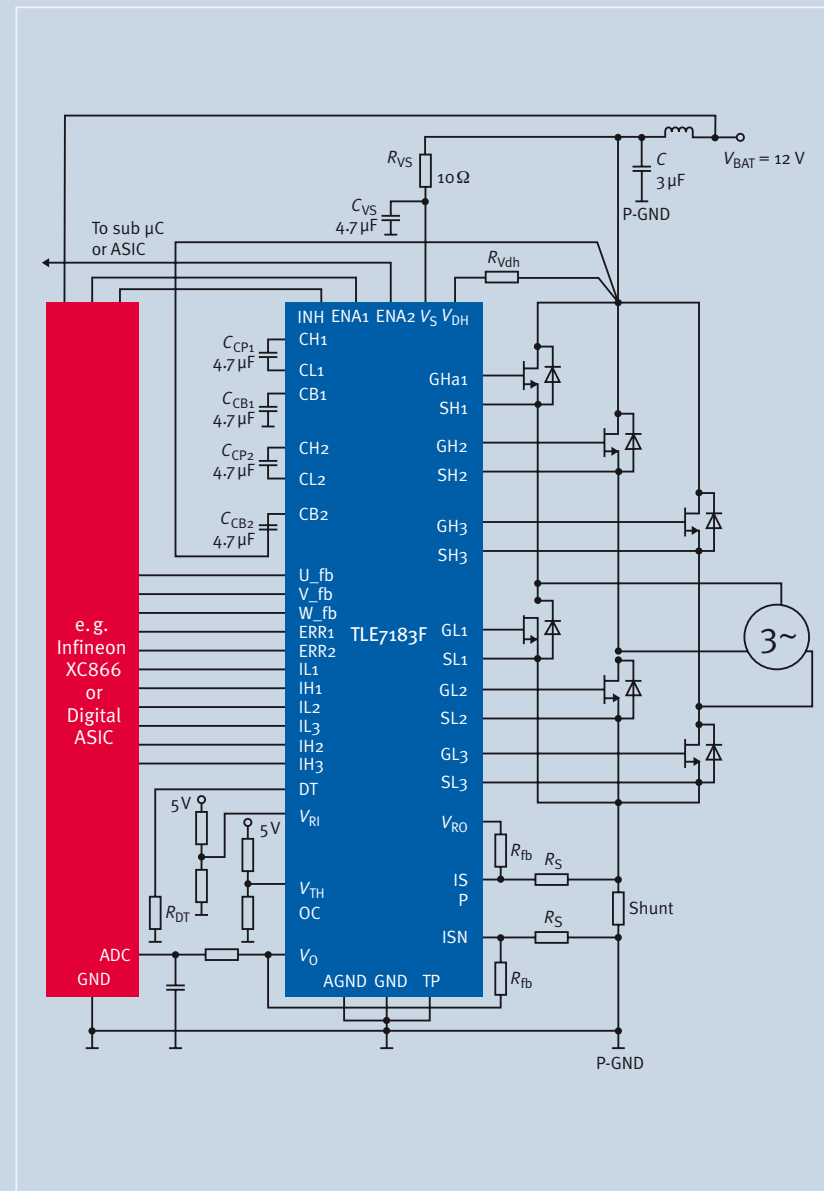


www.infineon.com/Driver-IC

3-Phase driver ICs control the motors for various applications such as power steering, fuel pumps and cooling fans. There are also many applications beyond automotive.

Features:

- TLE 7183 F
- 3-Phase driver
  - Compatible to very low ohm, normal level input
  - N-Channel MOSFETs
  - PWM frequency up to 30 kHz
  - Meets specifications down to 5.5 V supply voltage
  - Low EMC sensitivity and emission
  - Power package VQNF-48
  - TTL-compatible control inputs
  - Separate gate-source connection for each MOSFET
  - Integrated minimum dead time
  - Shoot-through protection
  - Short-circuit protection with fixed detection level
  - Disable function and sleep mode
  - Detailed diagnosis
  - Thermal overload warning for driver IC
  - Integrated overcurrent warning
  - Integrated current sense amplifier
  - 0 to 100 % duty cycle without refresh pulses



TrilithIC

Sophisticated solutions for smarter applications

The TrilithIC family provides an excellent drive solution for high-current DC motors. Infineon's broad TrilithIC portfolio covers a wide range of automotive and industrial applications. Integrating a Full-Bridge in a single package, it enables compact designs. This line features overtemperature and short-circuit protection, as well as undervoltage detection. Its sophisticated diagnostic and protection capabilities bring remarkable robustness and flexibility to diverse applications.

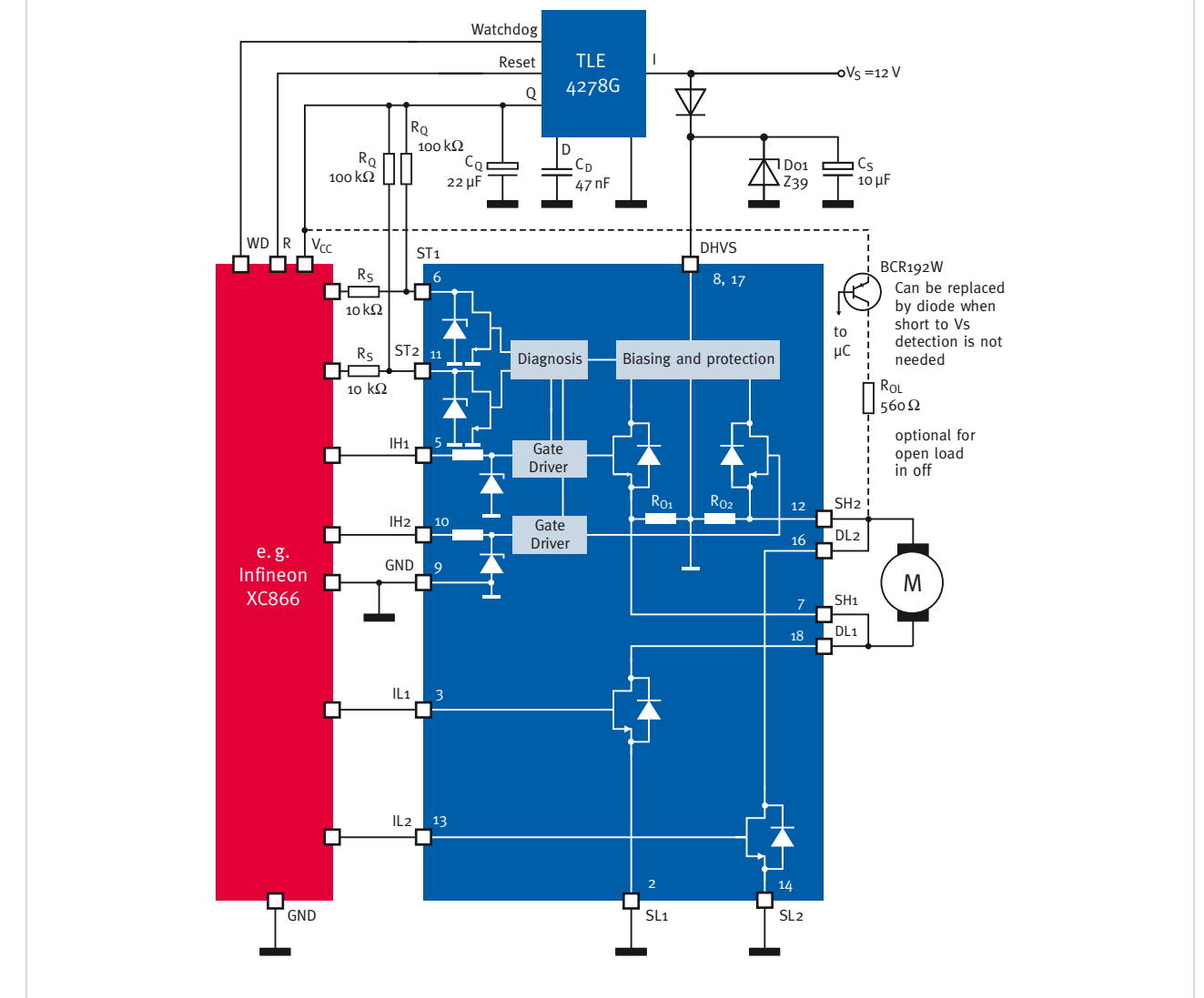


www.infineon.com/TrilithIC

Features:

- High-current H-Bridge in a single package
- Path  $R_{DS(on)}$  220 mΩ down to 50 mΩ
- Short-circuit protection
- Diagnostic feedback

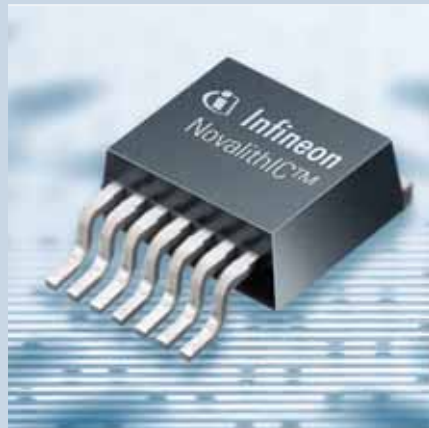
Example application in a headlight





**NovalithIC**

Advanced features for high-current motor drives



The NovalithIC is a fully integrated high-current Half-Bridge for motor drive applications. It contains one p-channel high-side MOSFET, one N-Channel low-side MOSFET and an integrated driver IC in one package. The integrated driver IC featuring logic level inputs makes interfacing to a microcontroller easy. The control chip also ships with integrated current-sensing diagnosis, slew rate adjustment and dead time generation, as well as overtemperature, overvoltage, undervoltage, overcurrent and short-circuit protection.

**No charge pump for less EMI**

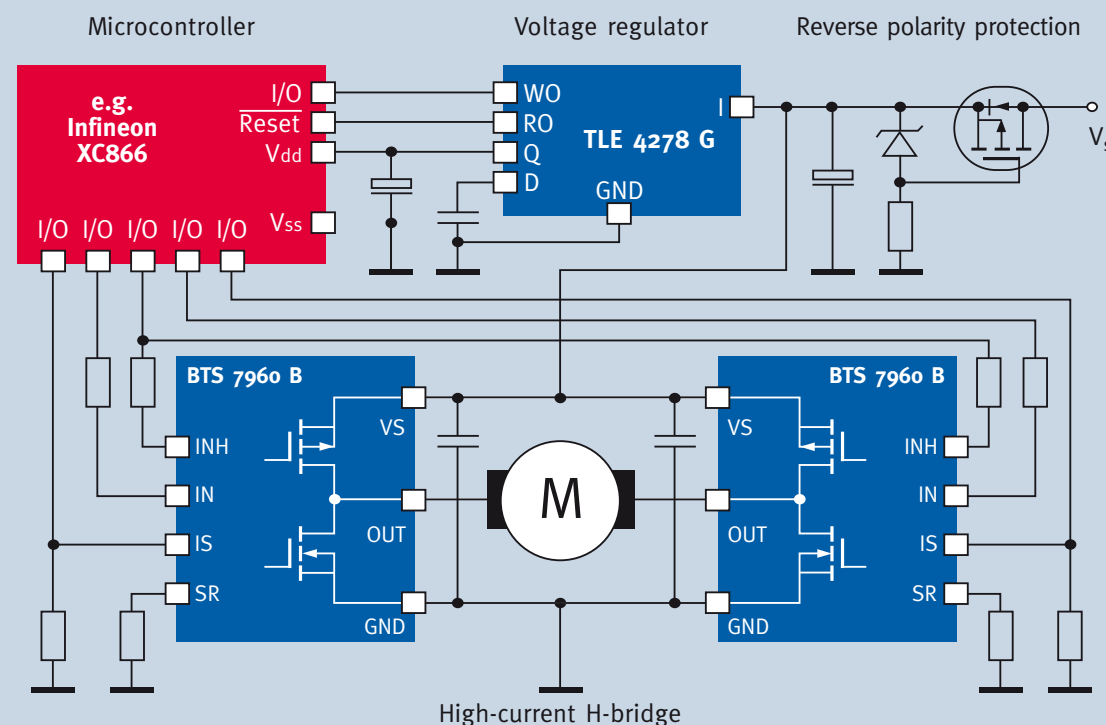
A P-Channel for the high-side switch reduces the need for a charge pump, thus reducing EMI. The P-Channel high-side switch also enables active freewheeling and switch mode current limiting. Both significantly reduce power dissipation within devices.

Remarkably robust, the NovalithIC family reduces EMI, delivers good thermal performance and offers PWM capability ranging up to 25 kHz. And that makes it your first-choice solution for high-current motor drives.

**Features:**

- High-current Half-Bridges
- Built-in driver and protection
- Switch mode current limiting
- Current sensing capability
- Active freewheeling
- Best-in-class thermal performance

Application examples include automotive wipers and power windows, battery-powered tools and wheelchairs for industrial applications.



**Door module ICs**

Enhanced reliability and performance for door modules

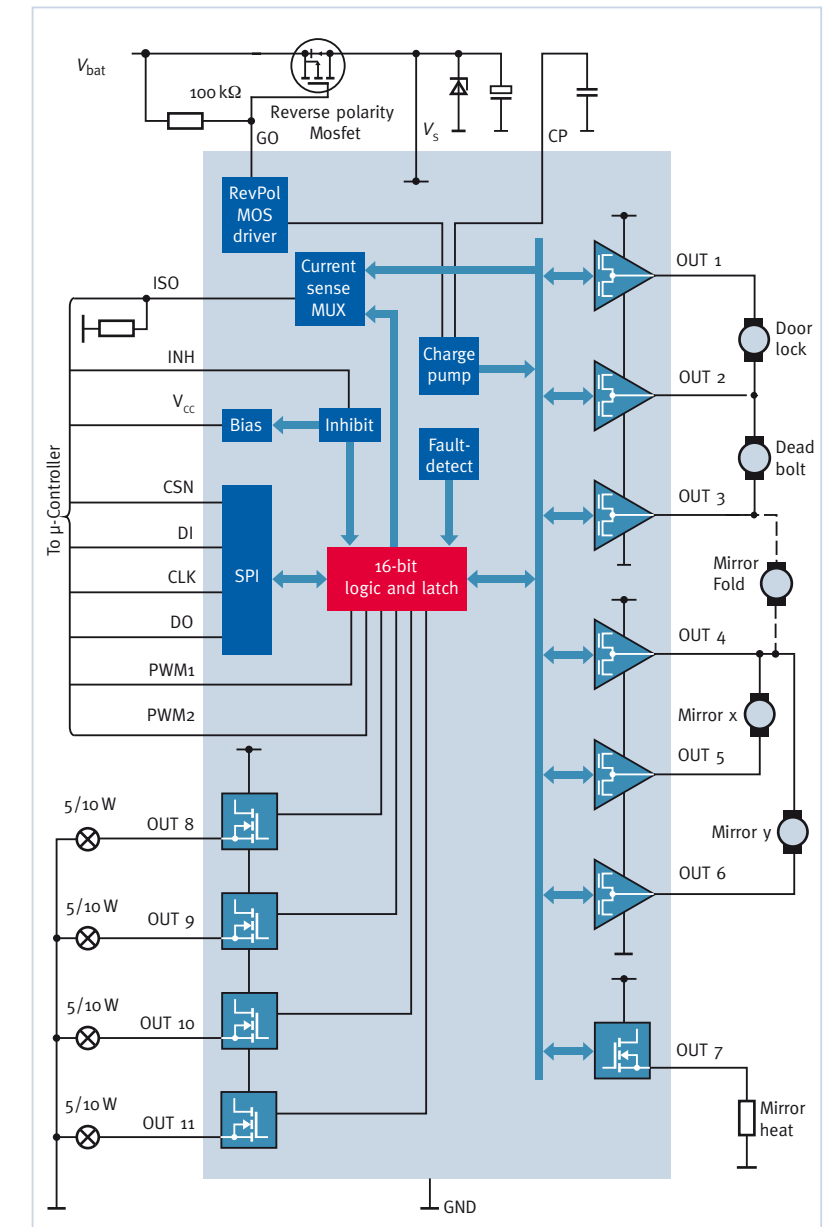
The TLE8201R is an application-specific standard product (ASSP) for automotive door modules. It comprises all power stages necessary to drive the loads in a typical front-door application. These include the central lock, safelock, mirror fold adjustment and defrost, as well as up to four 5/10W lamps used for turn signals, courtesy and warning lights, and control-panel illumination. Featuring a monolithic design, it uses Infineon's mixed technology SPT, which combines bipolar and CMOS control circuitry with DMOS power devices. Short-circuit and overtemperature protection, as well as detailed diagnostic feedback, satisfy the safety requirements for automotive applications. Its current-sense output improves overall system reliability and performance. The standard SPI interface reduces microcontroller I/O lines while providing flexible control for power stages and detailed diagnostic feedback.



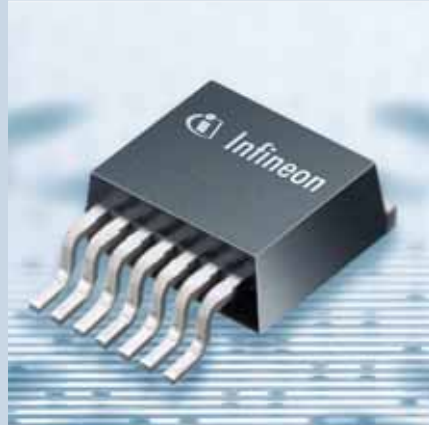
www.infineon.com/Door-Module-IC

**Features:**

- Full-Bridge (150mΩ) for the main door-lock motor
- Two Half-Bridges (400 mΩ) for deadbolt and mirror position or fold motor
- Two Half-Bridges (800mΩ) for mirror position
- High-side switch (100 mΩ) for mirror defrost
- Four high-side switches (500mΩ) for 5 W and 10 W lamps
- Analog current-sense output and built-in multiplexer for fewer μC ADC channels
- All outputs with short-circuit protection and diagnosis
- Overtemperature protection with warning
- Open load diagnosis for all outputs
- Pinning optimized for efficient PCB layout
- Charge pump output for N-Channel MOSFET enabling reverse-polarity protection
- Very low current consumption in sleep mode (max. 6 μA)
- Standard 16-bit SPI for control and diagnosis
- Over- and undervoltage lockout
- Power SO package with full-size heat slug for excellent thermal resistance
- Lead-free / halogen-free package



## 5 A H-Bridge

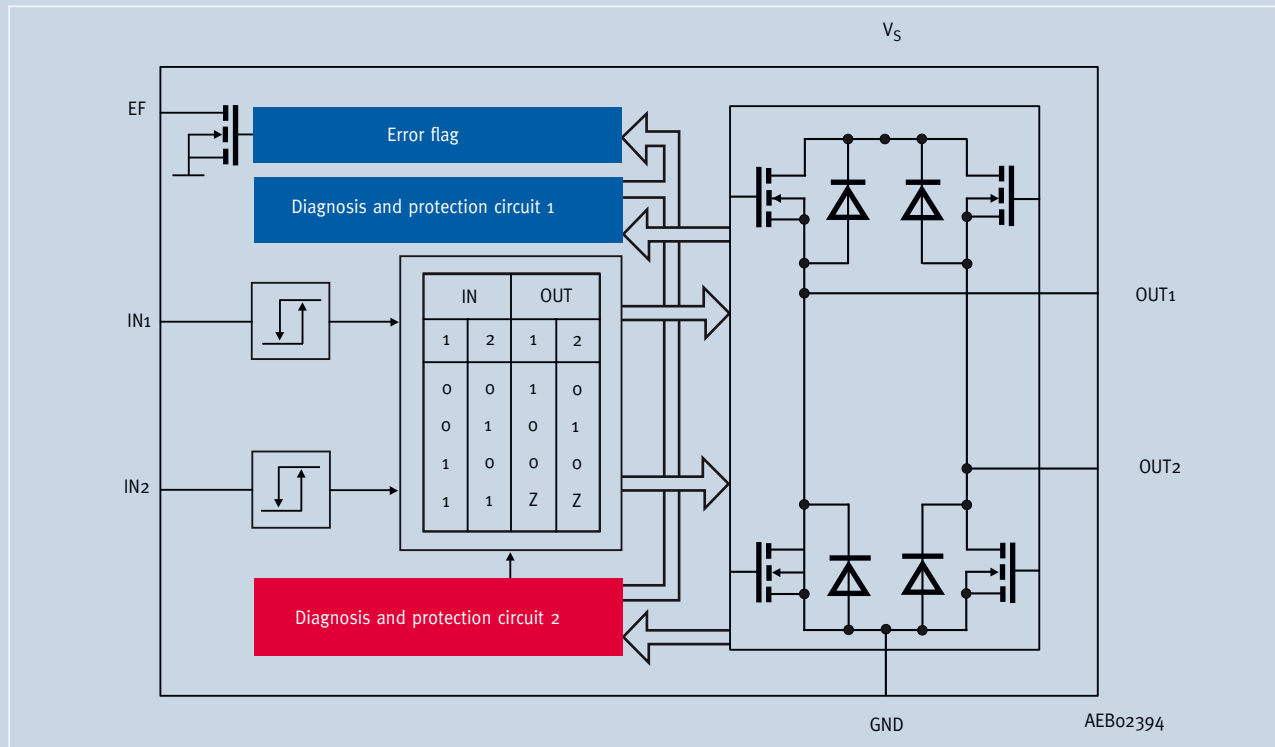


[www.infineon.com/Bridges](http://www.infineon.com/Bridges)

The TLE 5205-2 and TLE5206-2 are integrated power H-Bridges with DMOS output stages for driving DC motors. The parts are built using the SPT® Smart Power Technology which allows bipolar and CMOS control circuitry plus DMOS power devices to exist on the same monolithic structure. Operation modes forward (cw), reverse (ccw), brake and high impedance are invoked from just two control pins with TTL-/CMOS-compatible levels. The combination of an extremely low  $R_{DS(ON)}$  and the use of a power IC package with low thermal resistance and high thermal capacity helps to minimize system power dissipation. A blocking capacitor at the supply voltage is the only external circuitry due to the integrated freewheeling diodes.

### Features:

- Delivers up to 5 A continuous 6 A peak current
- Optimized for DC motor management applications
- Operates at supply voltages up to 40 V
- Very low  $R_{DS(ON)}$ ; typ. 200 m $\Omega$  @ 25 °C per switch
- Output short circuit protected
- Overtemperature protection with hysteresis and diagnosis
- Short-circuit diagnosis
- Open-load diagnosis (TLE 5205-2 only)
- Open-drain error flag
- Undervoltage lockout
- CMOS/TTL compatible inputs with hysteresis
- No crossover current
- Internal freewheeling diodes
- Wide temperature range; -40 °C < T<sub>j</sub> < 150 °C



5 A H-Bridge

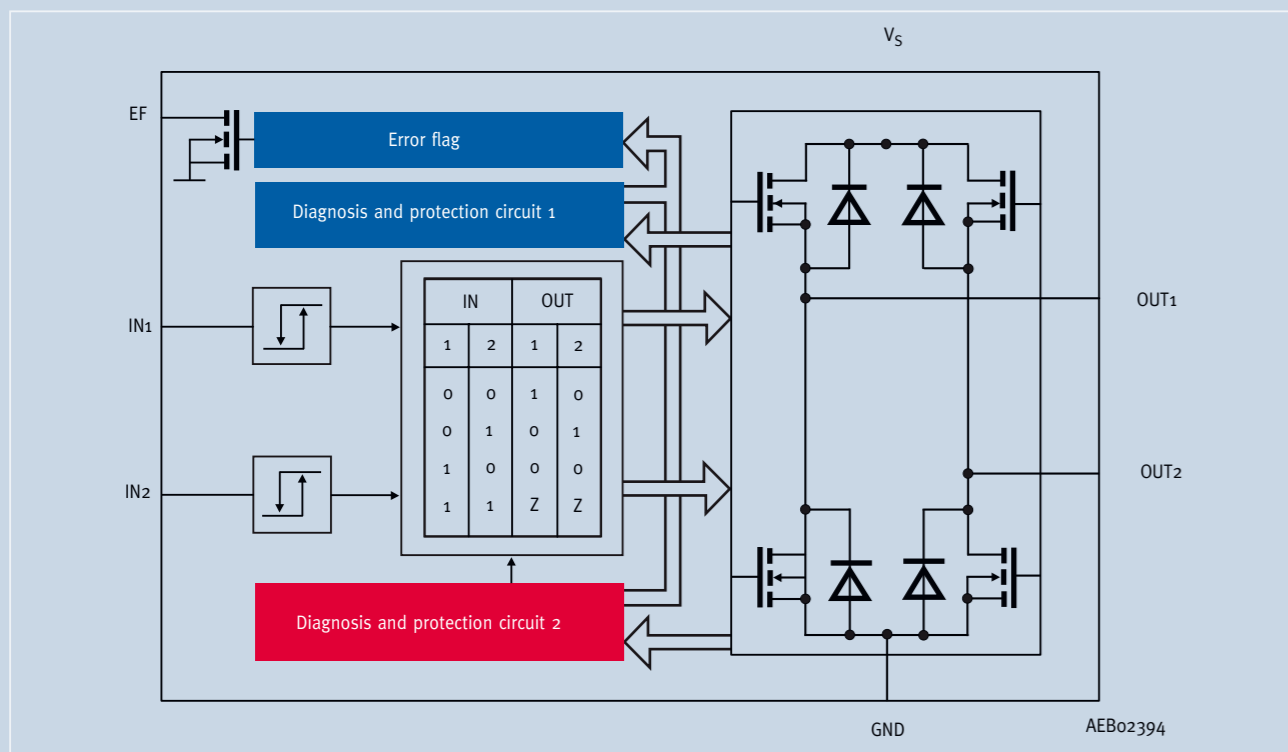


www.infineon.com/Bridges

The TLE 5205-2 and TLE5206-2 are integrated power H-Bridges with DMOS output stages for driving DC motors. The parts are built using the SPT® Smart Power Technology which allows bipolar and CMOS control circuitry plus DMOS power devices to exist on the same monolithic structure. Operation modes forward (cw), reverse (ccw), brake and high impedance are invoked from just two control pins with TTL-/CMOS-compatible levels. The combination of an extremely low  $R_{DS(ON)}$  and the use of a power IC package with low thermal resistance and high thermal capacity helps to minimize system power dissipation. A blocking capacitor at the supply voltage is the only external circuitry due to the integrated freewheeling diodes.

Features:

- Delivers up to 5 A continuous 6 A peak current
- Optimized for DC motor management applications
- Operates at supply voltages up to 40 V
- Very low  $R_{DS(ON)}$ ; typ. 200 mΩ @ 25 °C per switch
- Output short circuit protected
- Overtemperature protection with hysteresis and diagnosis
- Short-circuit diagnosis
- Open-load diagnosis (TLE 5205-2 only)
- Open-drain error flag
- Undervoltage lockout
- CMOS/TTL compatible inputs with hysteresis
- No crossover current
- Internal freewheeling diodes
- Wide temperature range; -40°C < Tj < 150 °C



7 A H-Bridges with SPI-Interface

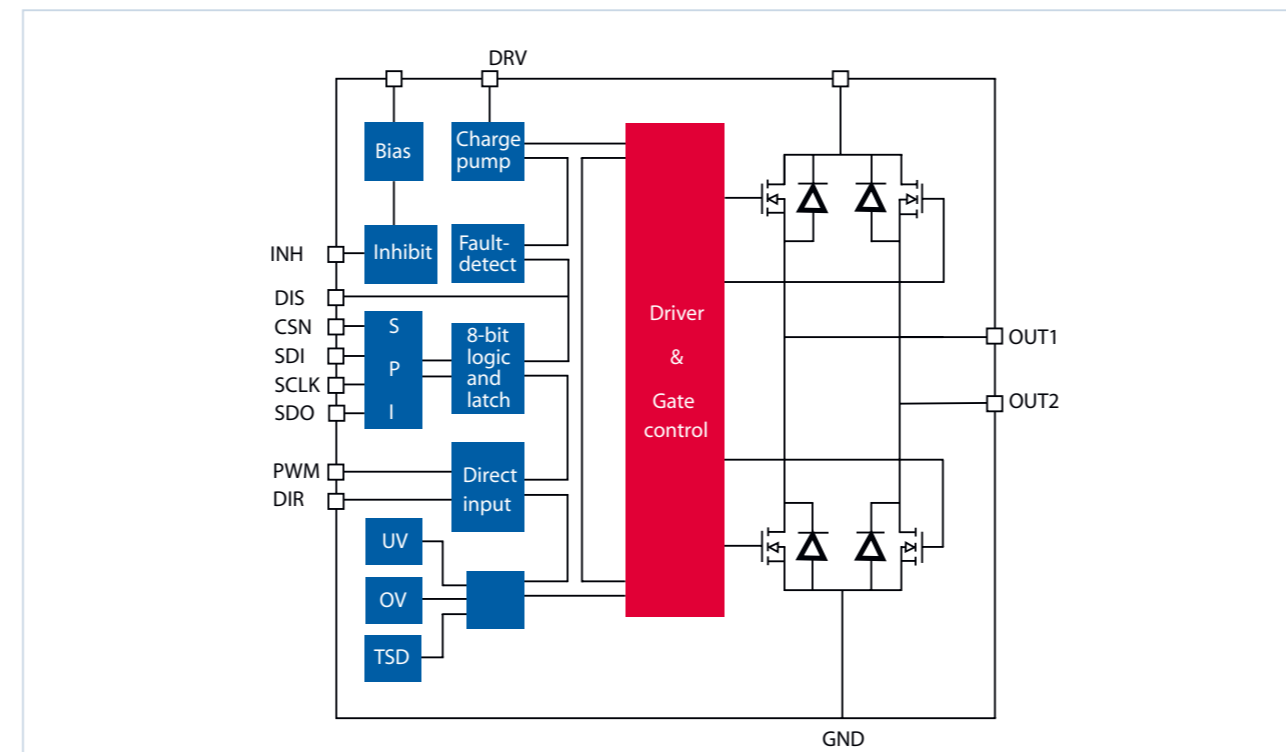
The TLE 6209R is an integrated power H-Bridge with DMOS output stages for driving loads such as DC motors. The design is based on Infineon's Smart Power Technology SPT which allows bipolar, CMOS and power DMOS devices on the same monolithic circuit. Operation modes forward (cw), reverse (ccw) and brake are invoked by two control pins PWM and DIR. Protection and a reliable diagnosis of overcurrent, openload, short-circuit to ground, to the supply voltage or across the load are integrated. Detailed diagnostic information is given via the 8-bit SPI status word. An integrated chopper current limitation limits the current e.g. to reduce power dissipation during mechanical block of a DC motor. Several device parameters can be set by the SPI control word. A three-level temperature monitoring with prewarning, warning and shutdown is included for controlled operation under critical power loss conditions. The full protection and diagnosis capability make the device especially suitable for safety relevant applications, e.g. in automotive ECUs.

Features:

- Delivers up to 6 A continuous and 7 A peak current
- Optimized for DC motor management applications
- Very low  $R_{DS(ON)}$  of typ. 150 mΩ @ 25 °C per switch
- Operates at supply voltages of up to 40 V
- Overvoltage protection against transients up to 45 V
- Outputs short-circuit protected
- Standard SPI-Interface, daisy-chain capability
- Adjustable chopper current regulation of up to 7 A
- Temperature monitor with prewarning, warning and shutdown
- Over- and undervoltage-lockout
- Open-load detection
- Detailed load-failure diagnosis by SPI
- Minimized power dissipation due to active free wheeling
- Low EMI due to voltage slope regulation
- Very low current consumption (typ. 20 μA @ 25 °C) in stand-by (Inhibit) mode
- Enhanced power P-DSO-Package



www.infineon.com/Bridges



7 A H-Bridges with SPI-Interface

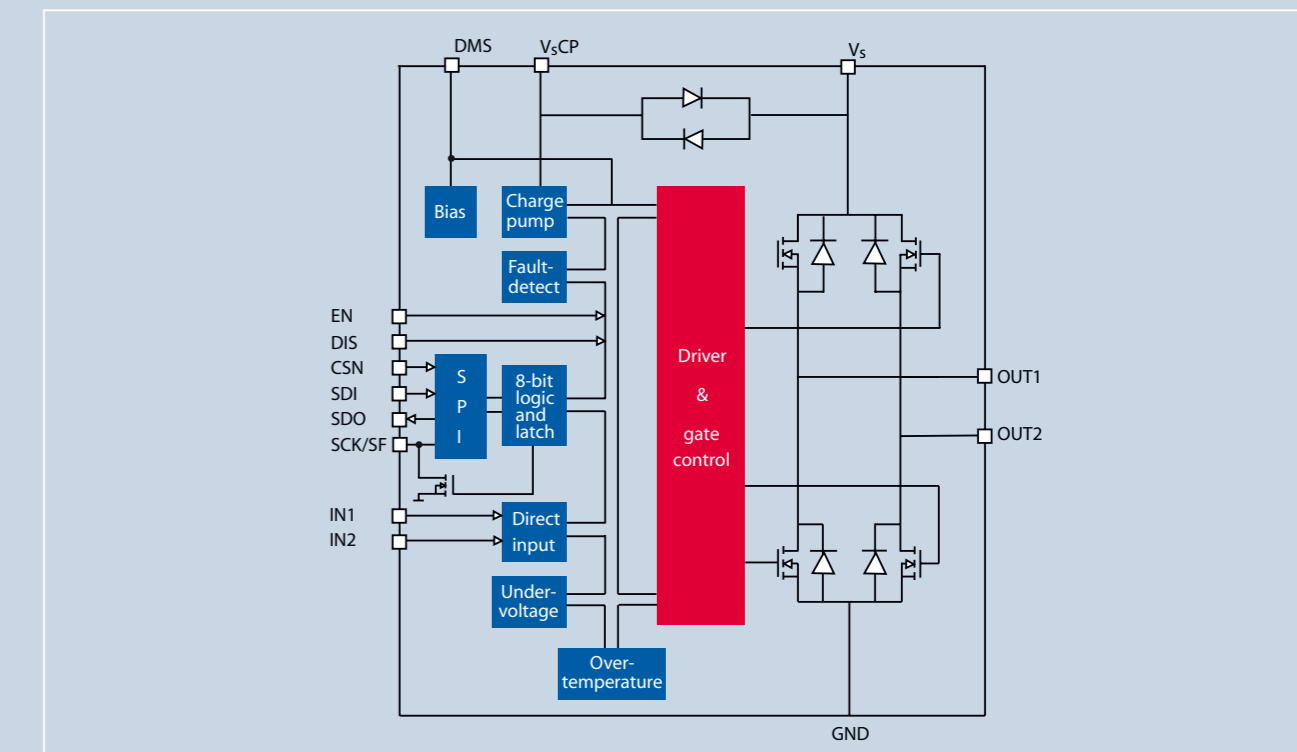
The TLE 7209-2R is an intelligent full H-Bridge, designed for the control of DC and stepper motors in safety-critical applications and under extreme environmental conditions. The H-Bridge is protected against overtemperature and short circuits and has an undervoltage lockout for all the supply voltages "VS" (main DC power supply). All malfunctions cause the output stages to go tristate. The device is configurable by the DMS pin. When grounded, the device gives diagnostic information via a simple error flag. When supplied with VCC = 5 V, the device works in SPI mode. In this mode, detailed failure diagnosis is available via the serial interface.

Features:

- Operating supply voltage 5 V to 28 V
- Typical  $R_{DS(on)}$  = 150 mΩ for each output transistor (at 25 °C)
- Continuous DC load current 5 A (TC < 100 °C)
- Output current limitation at typ. 6.6 A +/- 1.1 A
- Short-circuit shutdown for output currents over 8 A
- Logic inputs TTL-/CMOS-compatible
- Operating frequency up to 30 kHz
- Rise and fall times optimized for 0.5 – 2 kHz operating frequencies
- Overtemperature protection
- Short-circuit protection
- Undervoltage disable function
- Diagnostic by SPI or Status-Flag (configurable)
- Enable and disable input
- P-DSO-20 power package

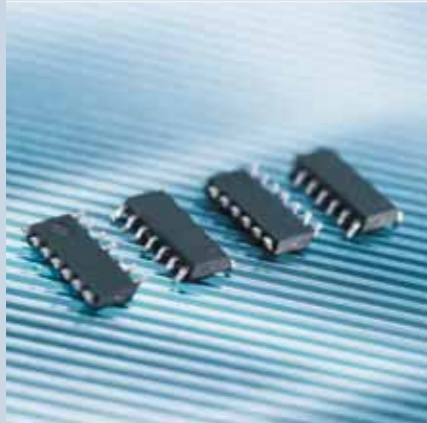


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Multi-Half-Bridge: TLE4207, TLE4208 bipolar technology

Compact, cost-effective control courtesy of our Multi-Half-Bridges



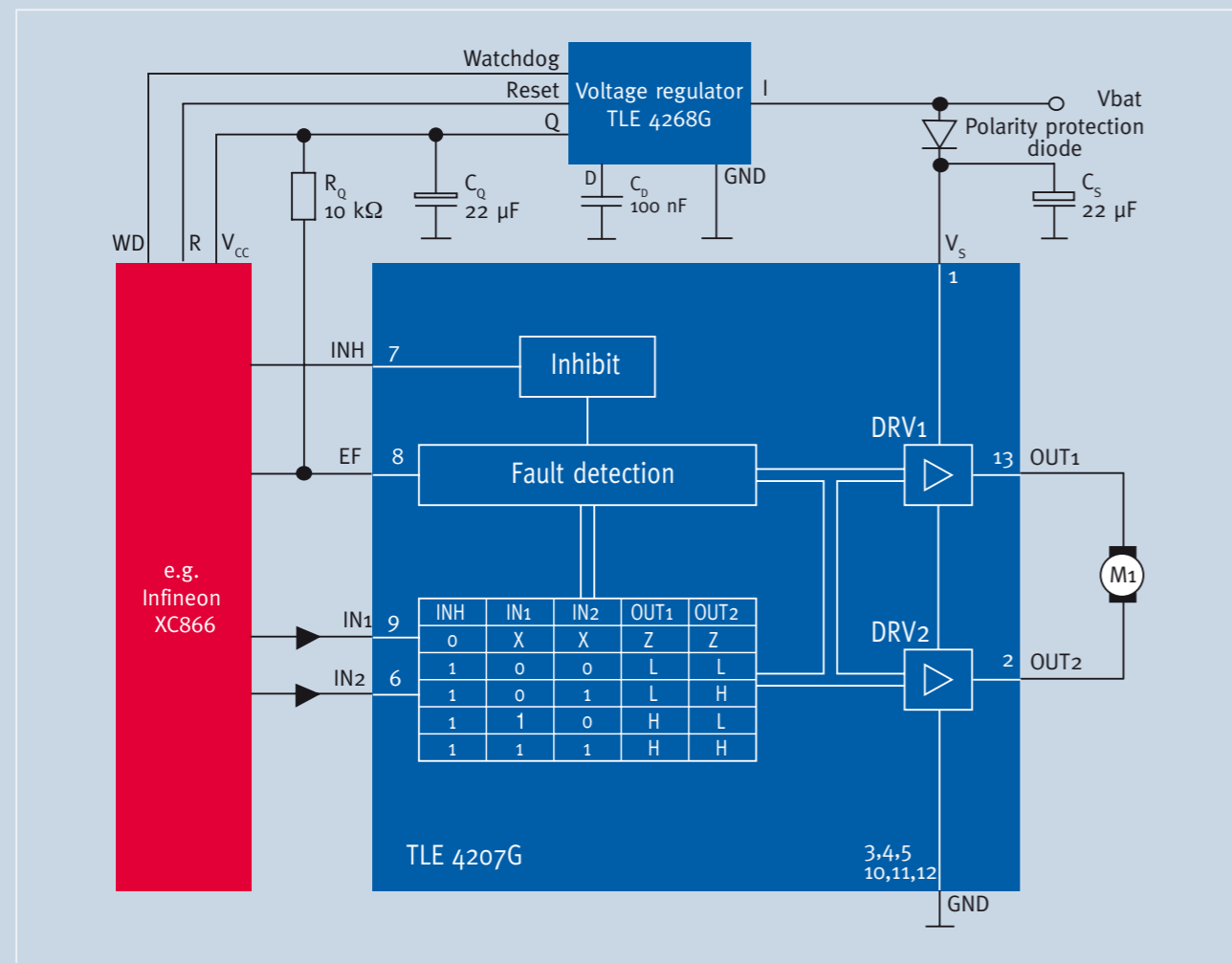
DC brush motor controls that drive low load currents (<1A) are best implemented using cost- and PCB space-effective IC solutions. With parallel control interfaces, smart power features, status feedback and thermally enhanced packaging, Infineon's single and dual H-Bridge solutions are the best choices for this type of application.

The DOPL Multi-Half-Bridge family features prominently in body electronics, for example, for mirror adjustment and HVAC flap applications. The benefits of its multifaceted feature set are many, making it very attractive for many applications.

www.infineon.com/Bridges

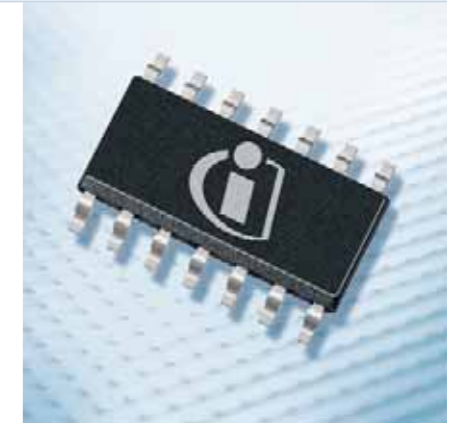
Features:

- Protected bipolar power stages
- Low saturation voltage
- Low current consumption
- Internal freewheeling diodes



Multi-Half-Bridge: TLE6208-3G/TLE6208-6G smart power technology

Automotive quality, flexibility and toughness



System electronics designers are increasingly opting for low-power DC motor control systems to drive functions such as exterior and interior mirror adjustment and air flaps in climate control systems. The TLE 6208-x Multi-Half-Bridge family provides a flexible, system-optimized solution for applications such as these.

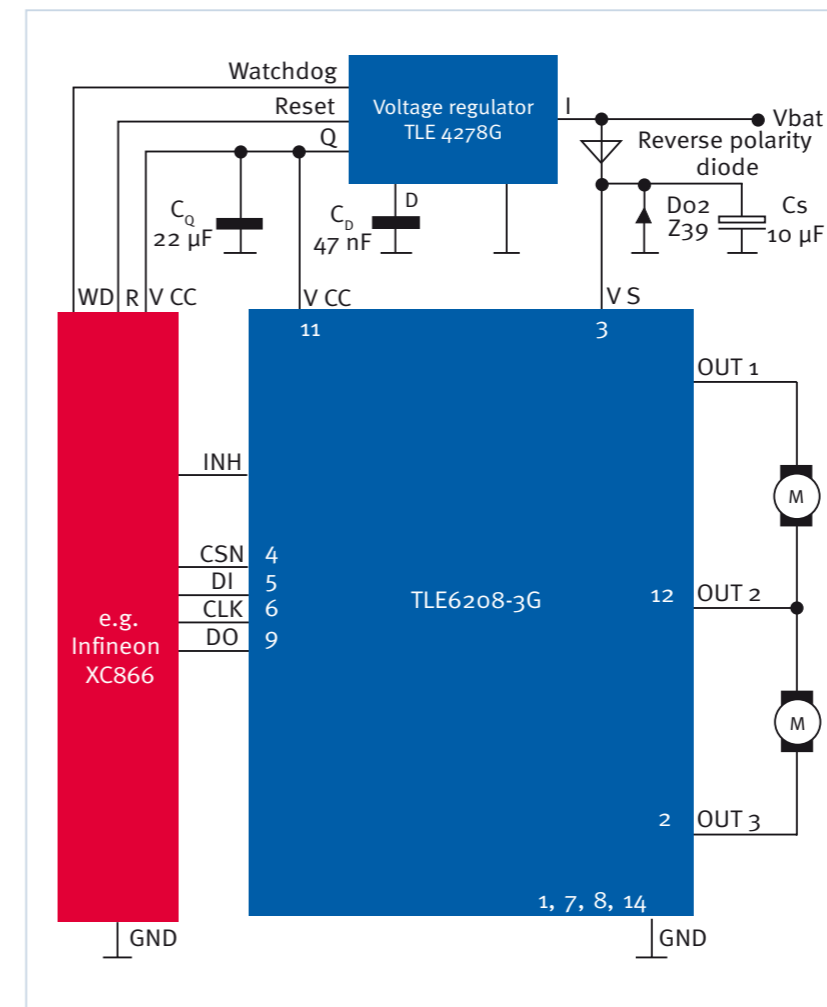
TLE 6208-x's protection and diagnostic features satisfy the requirements of modern automotive ECUs. A serial interface (SPI) sends all diagnostic feedback and power stage control commands.

These devices feature Infineon's Smart Power Technology (SPT), which combines DMOS power stages with bipolar analog and CMOS digital control circuits. Robust technology, protection circuits and the discerning quality standards of the Infineon Automotive & Industrial division endow this family with the rugged road-readiness automotive applications demand.

www.infineon.com/Bridges

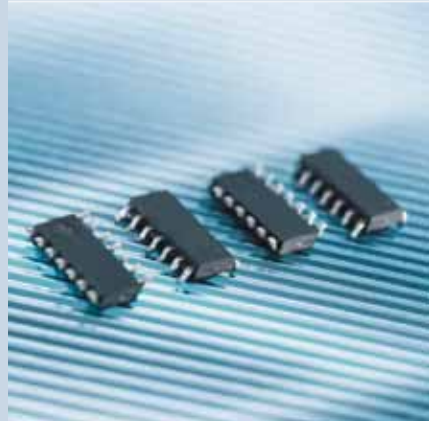
Features:

- Multiple DMOS Half-Bridges with protection and diagnosis
- Low ON resistance and current consumption
- Outputs fully short-circuit-protected with diagnosis
- Overtemperature protection with hysteresis and diagnosis
- Temperature prewarning
- Over- and undervoltage lockout
- Internal freewheeling diodes
- Very low current consumption (typically 10µA) in standby (inhibit) mode
- Standard 16-bit SPI for control and diagnosis
- TLE6208-6G freely configurable as a single switch or Half-Bridge
- Enhanced power DSO package



### Servo Driver

Robust, reliable, roadworthy



www.infineon.com/Bridges

The servo driver family comprises of three devices, TLE4206G, TLE4206-2G and TLE4209. They feature a fully integrated Full-Bridge with freewheeling diodes and smart power protection features for automotive headlight beam-leveling control applications. The standard thermally enhanced power P-DSO-14 package leverages low  $R_{TH}$  for environments with high ambient temperatures of 150 °C.

The servo driver family is offered in DOPL bipolar high-voltage power technology. With features such as overvoltage and undervoltage lockout as well as short-circuit and overtemperature built-in protection, these robust and reliable devices are perfect for automotive applications.

**Features:**

- Protected bipolar power stages
- Low saturation voltage
- Internal freewheeling diodes
- Optimized for Headlight Beam Control (HBC) applications
- TLE 4205 (for truck applications, 2 x 1A)
- TLE 4206G (manual HBC, 2 x 0.8A)
- TLE 4206-2G (automatic static HBC, 2 x 0.8A)
- TLE 4209 (manual HBC, 2 x 0.8A)

### Automatic headlight beam control

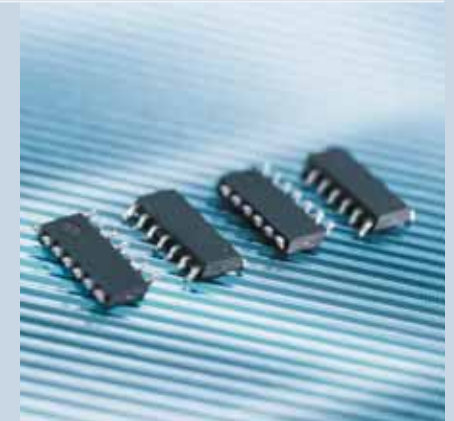
European, Indian, Korean and Japanese laws mandate automatic headlight beam control systems for cars with XENON bulbs. An automatic system adjusts the angle of the headlight beams without requiring driver intervention.

### Automatic static headlight beam control

This is the basic control system. Position sensors on the front and rear axles generate a differential feedback signal that apprises the Electrical Control Unit (ECU) of the car's load status. The ECU then periodically corrects the vertical headlight position, with the car's speed determining the frequency of adjustment. Higher speeds require more frequent correction to account for changes in gas tank volume. As periodic adjustment suffices, either DC brush motors or stepper motors (Driver IC TLE4729 recommended) can be used in automatic static control. The TLE4206-2G was designed to improve the performance of an automatic static system, equipped with DC brush motors.

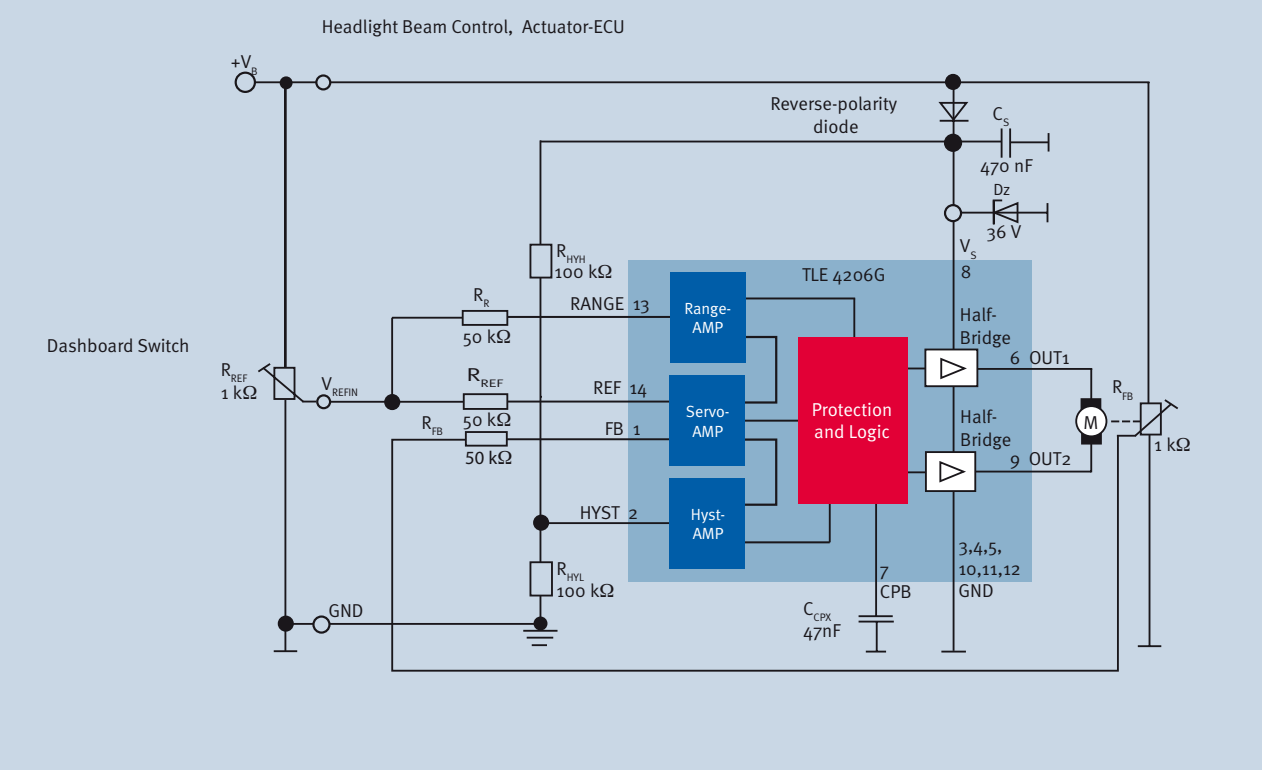
### Manual headlight beam control

A manual headlight beam control system enables the driver to adjust the angle of the headlight using a dedicated switch on the dashboard. The driver may adjust the headlight beam to suit the car's current load. This system is the standard solution for headlights equipped with halogen bulbs. The TLE4206G servo driver is suitable for driving the DC brush motor used for this application.

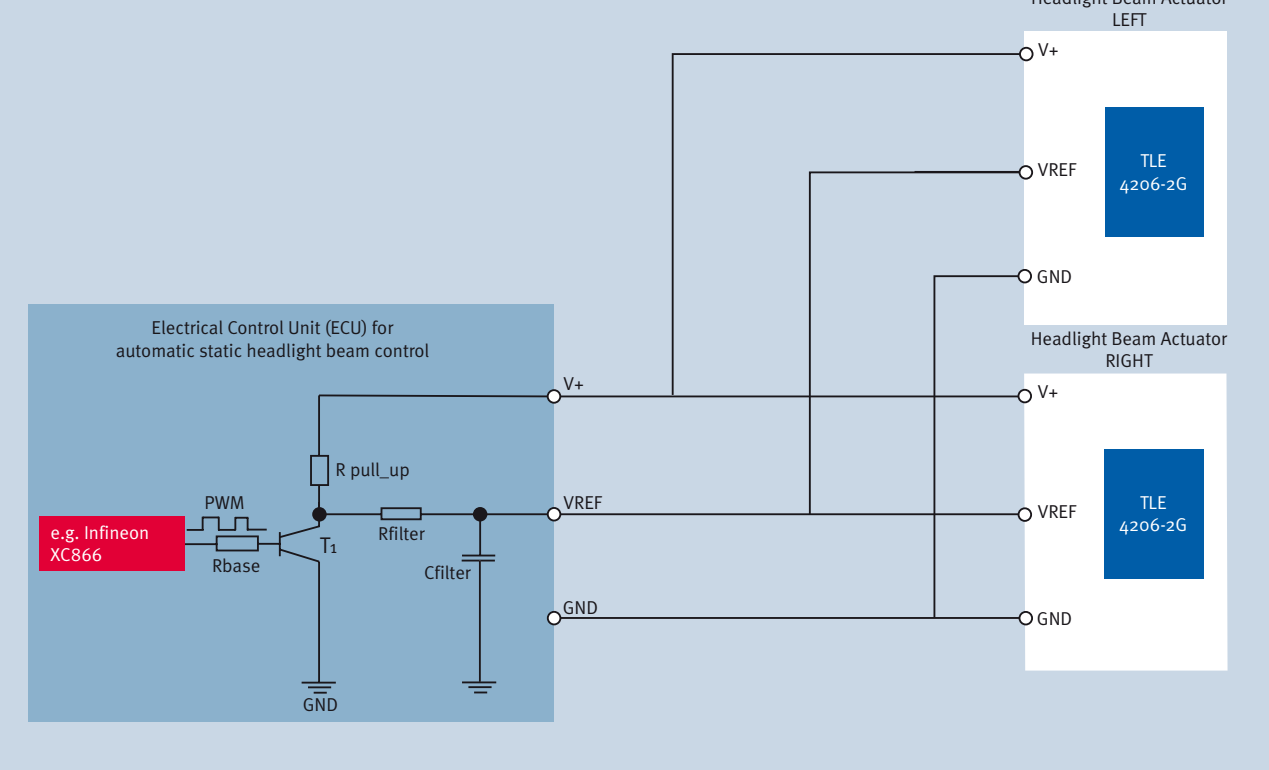


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### A detailed view of an applied TLE4206 circuit



### Block diagram of an automatic static HBC



### Stepper Driver

Cost-efficient, durable and reliable



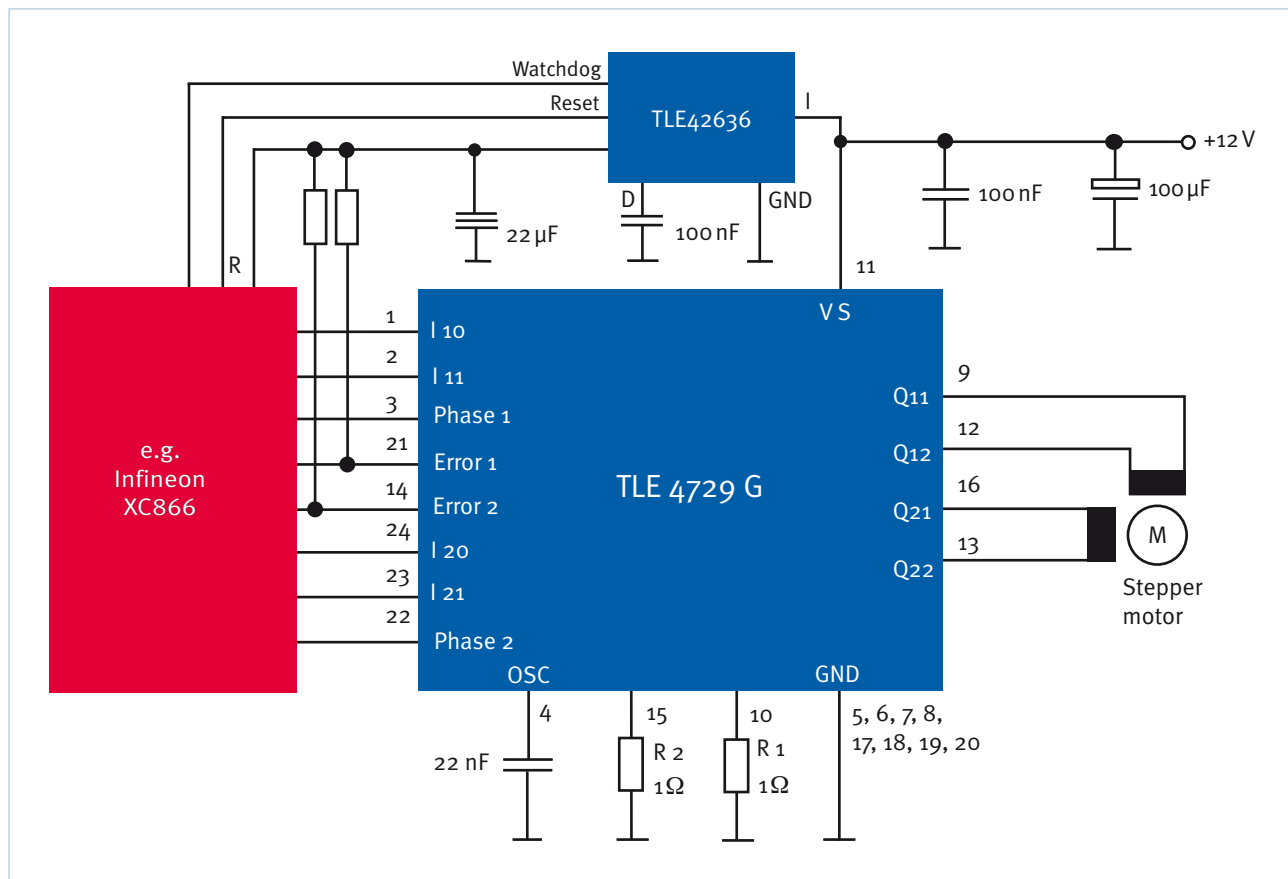
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In body electronics, stepper motors are featured in headlight beam leveling and HVAC flap systems. They are also widely used in engine management systems. A typical application is rpm management, where a motor-driven valve in the bypass air inlet controls idling speed. Infineon has engineered a product family for 2-Phase stepper motors and loads lower than 1A.

The TLE4727, TLE4728 and TLE4729 devices are flexible and offer a variety of feature sets for stepper motor applications in the automotive industry. Engineered to handle 24V operating voltage, the TLE4726F is an excellent choice for applications in trucks. Designed for electronic sewing machines, ink-jet printers and more, the TCA3727 is well-suited to industry applications.

**Features:**

- Full- to half-step operation
- Protected bipolar power stages
- Implemented current control
- Error flag for diagnosis
- TCA 3727 (suitable for industry application, 2 x 0.75 A)
- TLE 4726 (suitable for truck application, 2 x 0.75 A)
- TLE 4727 (2 x 0.75 A)
- TLE 4728 (2 x 0.75 A)
- TLE 4729 (2 x 0.75 3A)



## Automotive N-Channel MOSFET

### OptiMOS-T<sup>2</sup>® 30 V (Trench)

Type	max. $R_{DS(on)}$ [mΩ]	$I_D$ [A]	max. $R_{thjC}$ [K/W]	Package*
IPD90No3S4L-02	2.2	90	1.1	(10)
IPD90No3S4L-03	3.1	90	1.8	(10)
IPD70No3S4L-04	4.3	70	2.2	(10)
IPD50No3S4L-06	6.0	50	3.3	(10)
IPD30No3S4L-09	9.0	30	5.0	(10)
IPD30No3S4L-14	14.4	30	4.7	(10)
IPP/180No3S4L-03	2.6	80	1.1	(2), (9)
IPP/180No3S4L-04	3.7	80	1.8	(2), (9)
IPP/120No3S4L-15	15.4	20	4.7	(2), (9)
IPB80No3S4L-02	2.3	80	1.1	(12)
IPB80No3S4L-03	3.4	80	1.8	(12)
IPB20No3S4L-15	15.1	20	4.7	(12)

\*See packages on page 35

### OptiMOS-T® 40 V (Trench)

Type	max. $R_{DS(on)}$ [mΩ]	$I_D$ [A]	max. $R_{thjC}$ [K/W]	Package*
IPD90No4S3-04	3.8	90	1.1	(10)
IPD80No4S3-06	5.8	70	1.3	(10)
IPD70No4S3-07	6.8	78	1.9	(10)
IPD50No4S3-08	8.0	50	1.7	(10)
IPP/120No4S3-02	2.3	120	0.5	(2), (9)
IPP/100No4S3-03	3.3	100	0.7	(2), (9)
IPP/180No4S3-03	3.5	80	0.8	(2), (9)
IPP/180No4S3-04	4.3	80	1.1	(2), (9)
IPP/180No4S3-06	6.3	80	1.3	(2), (9)
IPP/170No4S3-07	7.1	78	1.9	(2), (9)
IPB180No4S3-02	1.6	180	0.5	(16)
IPB120No4S3-02	2.0	120	0.5	(12)
IPB160No4S3-H2	2.4	160	0.7	(16)
IPB100No4S3-03	3.0	100	0.7	(12)
IPB80No4S3-03	3.2	80	0.8	(12)
IPB80No4S3-04	4.0	80	1.1	(12)
IPB80No4S3-06	6.0	80	1.3	(12)
IPB70No4S3-07	6.8	78	1.9	(12)

\*See packages on page 35

## Automotive N-Channel MOSFET

## OptiMOS-T 55 V (Trench)

Type	max. $R_{DS(on)}$ [m $\Omega$ ]	$I_D$ [A]	max. $R_{thjC}$ [K/W]	Package*
IPD90No6S3L-05	5.0	90	1.1	(10)
IPD90No6S3-06	6.0	90	1.1	(10)
IPD50No6S3L-06	6.0	50	1.1	(10)
IPD50No6S3-07	6.9	50	1.1	(10)
IPD90No6S3L-07	7.1	90	1.4	(10)
IPD50No6S3L-08	7.8	50	1.4	(10)
IPD80No6S3-09	8.4	80	1.4	(10)
IPD50No6S3-09	9.0	50	1.4	(10)
IPD50No6S3L-13	12.6	50	2.3	(10)
IPD50No6S3-15	15.0	50	2.3	(10)
IPD30No6S3L-20	20.0	30	3.3	(10)
IPD30No6S3-24	24.0	30	3.3	(10)
IPP/100No6S3L-03	3.0	100	0.5	(2, 9)
IPP/100No6S3-03	3.3	100	0.5	(2, 9)
IPP/100No6S3L-04	3.8	100	0.7	(2, 9)
IPP/100No6S3-04	4.4	100	0.7	(2, 9)
IPP/180No6S3L-05	4.8	80	0.9	(2, 9)
IPP/180No6S3-05	5.4	80	0.9	(2, 9)
IPP/180No6S3L-06	5.9	80	1.1	(2, 9)
IPP/180No6S3-07	6.8	80	1.1	(2, 9)
IPP/180No6S3L-08	7.9	80	1.4	(2, 9)
IPP/177No6S3-09	9.1	77	1.4	(2, 9)
IPP/145No6S3L-13	13.1	45	2.3	(2, 9)
IPP/145No6S3-16	15.7	45	2.3	(2, 9)
IPP/125No6S3L-22	21.6	25	3.3	(2, 9)
IPP/125No6S3-25	25.1	25	3.3	(2, 9)
IPB100No6S3L-03	2.7	100	0.5	(12)
IPB100No6S3-03	3.0	100	0.5	(12)
IPB100No6S3L-04	3.5	100	0.7	(12)
IPB100No6S3-04	4.1	100	0.7	(12)
IPB80No6S3L-05	4.5	80	0.9	(12)
IPB80No6S3-05	5.1	80	0.9	(12)
IPB80No6S3L-06	5.6	80	1.1	(12)
IPB80No6S3-07	6.5	80	1.1	(12)
IPB80No6S3L-08	7.6	80	1.4	(12)
IPB77No6S3-09	8.8	77	1.4	(12)
IPB45No6S3L-13	13.0	45	2.3	(12)
IPB45No6S3-16	15.4	45	2.3	(12)
IPB25No6S3L-22	21.3	25	3.3	(12)
IPB25No6S3-25	24.8	25	3.3	(12)

\*See packages on page 35

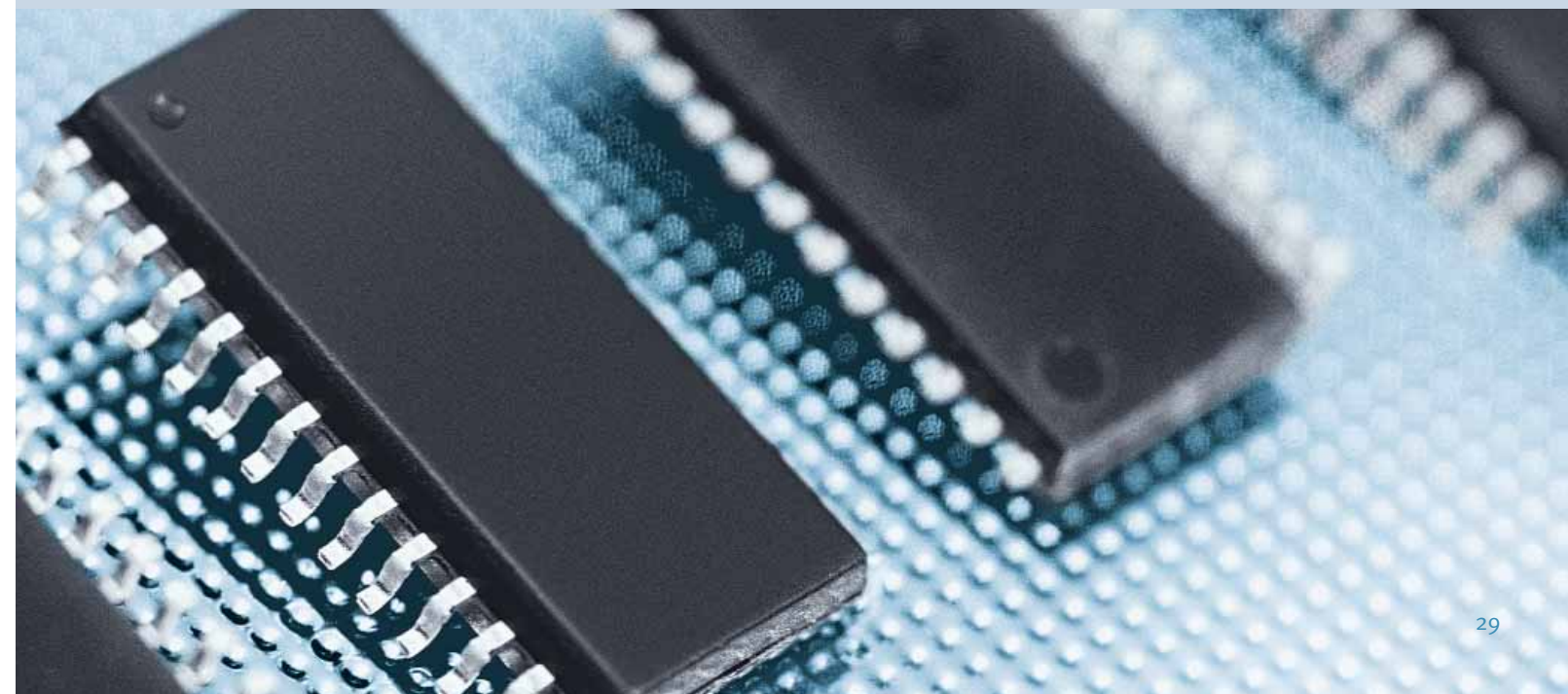
## Bridge Driver ICs

## H-Bridge/Dual-Half-Bridge drivers family overview

	TLE 6281 G / TLE 6284 G	TLE 6282 G
Control inputs	2	4
Target applications	Clutch, gear box, transfer case, active suspension, belt pretensioner EPS	Injection valve Unipolar 4-phase motor boost converter
Diagnosis	2-bit	1-bit
Overtemperature warning	Yes	No
Adjustable SCD and disable	Yes TLE 6284 G / No TLE 6281 G	Yes
Supply voltage range	7.5 ... 60 V	7.5 ... 60 V

## 3-Phases drivers family overview

	TLE6280GP	TLE 7183 F	TLE 7189F	TLE 7185E
Supply voltage (operation)	8 ... 30 V	5.5 ... 28 V	5.5 ... 28 V	5.5 ... 33 V
Duty cycle	0 ... 95 %	0 ... 100 %	0 ... 100 %	0 ... 95 %
Low quiescent mode	No	Yes	Yes	Yes
OpAmps	–	1	3	–
Adjustable dead time	Yes	Yes	Fix	Yes
Adjustable short-circuit detection level	Yes	No (several fixed versions)	Yes	Yes



# High Power Control DC Motor Bridges

## NovalithIC

Type	Peak current typ. [A]	Peak current min. [A]	Quiescent current [µA]	Operating range [V]	Path $R_{DS(on)}$ typ. [mΩ]	Path $R_{DS(on)}$ max. [mΩ]	Switching frequency max. [kHz]	Short-circuit protection	Load current sense	Self-protection	Error flag	Package*
BTS/BTN 7930 B	25	18	7	5.5 – 28	28	55	25	load + GND + battery	analog sense + overload det.	OT, OC, OV	OT, OC, OV	(17)
BTS/BTN 7935 B <sup>1)</sup>	25	18	7	5.5 – 28	28	55	2	load + GND + battery	overload det.	OT, OC, OV	OT, OC, OV	(17)
BTS/BTN 7960 B	43	33	7	5.5 – 28	16	30.5	25	load + GND + battery	analog sense + overload det.	OT, OC, OV	OT, OC, OV	(17)
BTS/BTN 7965 B <sup>1)</sup>	43	33	7	5.5 – 28	16	30.5	2	load + GND + battery	overload det.	OT, OC, OV	OT, OC, OV	(17)
BTS/BTN 7970 B	68	50	7	5.5 – 28	16	30.5	25	load + GND + battery	analog sense + overload det.	OT, OC, OV	OT, OC, OV	(17)

<sup>1)</sup>In concept    BTN = Green NovalithIC

\*See packages on page 35



## TrilithIC

Type	1 sec. pulse current [A]	Peak current [A]	Quiescent current [µA]	Operating range [V]	Path $R_{DS(on)}$ typ. [mΩ]	Path $R_{DS(on)}$ max. [mΩ]	Switching frequency max.	Short-circuit protection	Self-protection <sup>1) 2) 3)</sup>	Error flag	Package*
BTS/BTM 7700 G	4.3	9	8	5 – 42	200	500	HSS:1kHz LSS:1kHz	load + GND	OT + OC	OT	(30)
BTS/BTM 7710 G	5.8	15	8	5 – 42	110	260	HSS:1kHz LSS:1kHz	load + GND	OT + OC	OT	(30)
BTS 7710 GP	9	15	8	5 – 42	110	260	HSS:1kHz LSS:1kHz	load + GND	OT + OC	OT	(18)
BTM 7710 K	9	15	8	5 – 42	110	260	HSS:1kHz LSS:1kHz	load + GND	OT + OC	OT	(18)
BTS/BTM 7740 G	4.2	8	8	5 – 42	210	500	HSS:1kHz LSS:1kHz	load + GND + battery	OT + OC	OT	(30)
BTS/BTM 7741 G	4.2	8	8	5 – 42	210	500	HSS:1kHz LSS:1kHz	load + GND + battery	OT + OC	OT + OL	(30)
BTS/BTM 7750 G	5.6	12	8	5 – 42	115	285	HSS:1kHz LSS:1kHz	load + GND + battery	OT + OC	OT	(30)
BTS/BTM 7751 G	5.6	12	8	5 – 42	115	285	HSS:1kHz LSS:1kHz	load + GND + battery	OT + OC	OT + OL	(30)
BTM 7750 GP	7	12	8	5 – 42	115	285	HSS:1kHz LSS:1kHz	load + GND + battery	OT + OC	OT	(18)
BTM 7750 K	7	12	8	5 – 42	115	285	HSS:1kHz LSS:1kHz	load + GND + battery	OT + OC	OT	(18)
BTS/BTM 7810 K	25	42	9	5 – 42	40	100	HSS:1kHz LSS:1kHz	load + GND	OT + OC	OT + OL	(18)
BTS/BTM 7811 K	25	42	9	5 – 42	40	100	HSS:1kHz LSS:20kHz	load + GND	OT + OC	OT + OL	(18)

<sup>1)</sup> OL = Open load    <sup>2)</sup> OT = Overtemperature    <sup>3)</sup> OC = Overcurrent  
BTM = Green TrilithIC

\*See packages on page 35



# Smart Power DC Motor Bridges

## Door Module ICs (DoMoPo)

Type	Out-puts	Output current [A] <sub>(max.)</sub>	$R_{DS(on)}$	Driver stage	Quiescent current [uA]	Operating range [VS] **	Protection / diagnosis	Interface	Package*
TLE8201	Out 1, 2	8	150 mΩ (max @ Tj=25 °C) 260 mΩ (max @ Tj=150 °C)	Half-Bridge	6	8 – 20	overcurrent, over-temperature, over- and undervoltage lookout, open load diagnosis, current sense	SPI for programming and diagnostic, INH and PWM input	③②, ③③
	Out 3, 4	3	400 mΩ (max @ Tj=25 °C) 700 mΩ (max @ Tj=150 °C)	Half-Bridge					
	Out 5, 6	1.25	800 mΩ (max @ Tj=25 °C) 1.3 Ω (max @ Tj=150 °C)	Half-Bridge					
	Out 7	6.25	100 mΩ (max @ Tj=25 °C) 170 mΩ (max @ Tj=150 °C)	High side switch (mirror defrost)					
	Out 8 – 11	1.8	500 mΩ (max @ Tj=25 °C) 800 mΩ (max @ Tj=150 °C)	Lamp driver					
TLE8203 <sup>1)</sup>	Out 4	3	400 mΩ (max @ Tj=25 °C) 700 mΩ (max @ Tj=150 °C)	Half-Bridge	6	8 – 20	overcurrent, over-temperature, over- and undervoltage lookout, open load diagnosis, current sense	SPI for programming and diagnostic, INH and PWM input	③②
	Out 5, 6	1.25	800 mΩ (max @ Tj=25 °C) 1.3 Ω (max @ Tj=150 °C)	Half-Bridge					
	Out 7	6.25	100 mΩ (max @ Tj=25 °C) 170 mΩ (max @ Tj=150 °C)	High side switch (mirror defrost)					
	Out 8, 10	1.8	500 mΩ (max @ Tj=25 °C) 800 mΩ (max @ Tj=150 °C)	Lamp driver					

<sup>1)</sup>Product in development

\*See packages on page 35

## Motor control ICs

Type	Configuration	Output current [A]	Peak current [A]	Quiescent current [uA]	Operating range [V]	Protection	Diagnostic interface	HIGHLIGHT	$V_{sat} / R_{DS(on)}$	Package*
TLE 4207	2 x Half-Bridge	2 x 0.8	2 x 1	20	6 – 18	Over-temperature, over-/undervoltage lock-out, short circuit	Status flag	Very low saturation Voltage + error det.	1.6 V at 0.4 A <sup>1)</sup>	②⑤
TLE 4208	4 x Half-Bridge	4 x 0.8	4 x 1	20	6 – 18		Status flag	Dual Full-Bridge	1.6 V at 0.4 A <sup>1)</sup>	③⑩
TLE 6208-3	3 x Half-Bridge	3 x 0.6	3 x 1.5	10	6 – 40		16-Bit SPI	detailed diagnosis via SPI	800 mΩ/switch	②⑤
TLE 6208-6	6 x Half-Bridge	6 x 0.6	6 x 1.5	12	6 – 40		16-Bit SPI	single switch usage	800 mΩ/switch	③⑩

<sup>1)</sup>Total Drop Saturation Voltage typ. value @ 25 °C and 0.4 A

\*See packages on page 35

Type	Configuration	Output current [A]	Peak current [A]	Quiescent current [uA]	Operating range [V]	Protection	Diagnostic interface	HIGHLIGHT	$R_{DS(on)}$	Package*
TLE 5205-2	Full-Bridge	4	5	10	6 – 40	Protected	Status flag	Open load detection	220 mΩ/switch	⑥, ⑦, ⑱, ⑳
TLE 5206-2	Full-Bridge	4	5	10	6 – 40	Protected	Status flag	Break high and low	220 mΩ/switch	⑥, ⑦, ⑱, ⑳

\*See packages on page 35

# Smart Power DC Motor Bridges H-Bridges

## Stepper motor drivers

Type	Output current [A]	Peak current [A]	Step operations	Operating range [V]	Protection	Diagnostic interface	HIGHLIGHT	Package*
TCA 3727	2 x 0.75	2 x 1	Full to mini step	5 – 50	Over-temperature	–	High operating voltage	(29), (38)
TLE 4726	2 x 0.75	2 x 1	Full to mini step	5 – 50	Over-temperature	–	Low quiescent current	(29)
TLE 4727	2 x 0.75	2 x 1	Full to mini step	5 – 16	Openload, over-temperature, short circuit	Status flag	One error flag	(38)
TLE 4728	2 x 0.75	2 x 1	Full to mini step	5 – 16		Status flag	Two error flags	(29)
TLE 4729	2 x 0.75	2 x 1	Full to mini step	5 – 16		Status flag	Inhibit, very low quiescent current	(29)

\*See packages on page 35

## Servo drivers

Type	Output current [A]	Peak current [A]	Current consumption [mA]	Operating range [V]	Protection	Inhibit	HIGHLIGHT	$V_{sat} / R_{DS(on)}$	Package*
TLE 4205	0.8	1	0.01	6 – 32	Short circuit	✓	Dual power comparator for higher	2.1V at 0.6 A <sup>1)</sup> supply voltage	(27), (37)
TLE 4206	0.8	1	12	6 – 18	Over-temperature, over-/under-voltage lockout, short circuit	No	Servo driver with current peak blanking	1.2V at 0.4 A <sup>1)</sup>	(25)
TLE 4206-2	0.8	1	12	6 – 18		No	Switching hysteresis on range input	1.2V at 0.4 A	(25)
TLE 4209	0.8	1	12	6 – 18		No	Servo driver	1.2V at 0.4 A <sup>1)</sup>	(24), (36)

<sup>1)</sup> Total drop saturation voltage typ. value @ 25°C and 0.4 A

\*See packages on page 35

## Bridges for idle speed and throttle control

Type	Output current [A]	Peak current [A]	Quiescent current [mA]	Operating range [V]	Short-circuit protection	Diagnostic interface	HIGHLIGHT	$R_{DS(on)}$	Package*
TLE 5205-2	4	5	10	6 – 40	Protected	Status flag	Open load detection	220 mΩ/switch	(6), (7), (17), (28)
TLE 5206-2	4	5	10	6 – 40	Protected	Status flag	Break high and low	220 mΩ/switch	(6), (7), (17), (28)
TLE 6209	6	7	0.02	5 – 40	Protected	SPI	SPI, chopper current limitation, temp. prewarning	150 mΩ/switch	(28)
TLE 7209-2R	6	7	20	5 – 28	Protected	SPI	SPI, chopper current limitation, temp. prewarning	150 mΩ/switch	(28)

\*See packages on page 35

# Packages

2	P-TO220-3	6	P-TO220-7	7	P-TO220-7
9	P-TO262-3	10	P-TO252-3 (D-PAK)	12	P-TO263-3 (P-TO220-3 (SMD))
16	P-TO263-7 (P-TO220-7 (SMD))	17	P-TO263-7 (P-TO220-7 (SMD))	18	P-TO263-15
24	P-DSO-12	25	P-DSO-14	27	P-DSO-20
28	P-DSO-20 (Power-SO)	29	P-DSO-24	30	P-DSO-28
32	P-DSO-36-20	33	P-DSO-36 (Power-SO)	36	P-DIP-8
37	P-DIP-18	38	P-DIP-20	39	V-QFN-48

For the complete Automotive Power package overview, please refer to the Automotive Power Selection Guide.

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