Efficient Semiconductor Solutions for Motor Control and Drives

[www.infineon.com/motorcontrol]
Energy efficiency, mobility and security are the main challenges facing modern society. Our motor control solutions address all of these needs, providing outstanding reliability, excellent quality and leading-edge innovations. Rich functionality and extensive integration capabilities ensure easy design-in and fast time-to-market. Our broad portfolio maximizes flexibility across a wide range of voltage and power classes in industrial, consumer and automotive markets.

This guide showcases the full range of products, from microcontrollers and gate drivers through MOSFETs, IGBTs, voltage regulators and sensors to integrated bridge driver ICs, integrated power modules and high-power modules.

Our power products and microcontrollers enable efficient, robust and cost-effective designs for virtually all types of motors, including brushless DC and permanent magnet synchronous motors as well as induction and stepper motors and switched reluctance motors.

We complement this vast product offering with excellent customer support from our application experts, technical documentation and online training opportunities. We also deliver a variety of evaluation and application kits to support all motor designs. Each application kit comes with a reference code and instructions, along with all the software you need to start and successfully complete your design as quickly as possible.

We hope you enjoy exploring the benefits of our efficient semiconductor solutions for motor control and drive applications.
Typical Motor Control Block Diagram
Application Solutions for Motor Controls and Drives

Low-Voltage Applications

We are the partner of choice for low-voltage motor drive solutions, providing the perfect fit across the full current range from 0.1 to 100A. You can also rely on us to support the entire application spectrum from steppers to 3-phase drivers.

Infineon’s solutions cover a broad range of target low-voltage applications including:

- Pumps (fuel, heating, water)
- Fans / blowers
- Automotive applications
- E-bikes
- E-scooters
- Wheelchairs
- Trucks/transport
- Forklifts
- Scooters
- Wheelchairs
- Industrial drives
- Robotics
- Door openers
- Power tools, cordless power tools
- Gardening tools
- Small robots (cleaning robots)
- Electric toys
- Kitchen machines / food processors / coffee machines
Our products and solutions cover all of the main motor control design blocks. The block diagram shows an example of a 3-phase BLDC motor drive.
Application Solutions for Motor Control and Drives

High-Voltage Applications

Infineon offers gate driver ICs, discrete IGBTs, integrated modules and high-power modules across the entire power class range for high-voltage drives. Whatever power needs your application has we provide the optimized, cost-effective solution.

Infineon solutions cover a broad range of target high-voltage applications including:

- Pumps
- Fans / blowers
- Compressors
- Industrial drives
- Robotics
- Air conditioning systems
- Washing machines
- Dish washers
- Refrigerators
- Kitchen hoods
- Vacuum cleaners
- Door openers
Infineon products cover all of main high-voltage motor drive design blocks. The block diagram provides an overview of the product portfolio for high-voltage products.
XC800 Family – 8-bit Microcontrollers

The feature-rich XC800 microcontroller with its optimized peripheral set supports cost-optimized solutions in the industrial and automotive segments.

Application Segments
- Home appliance
- E-bikes
- Stepper gauges

- Fans
- Pumps
- Valve control

Product Benefits
- Up to 50% system cost savings – Field-Oriented Control (FOC) at lowest cost
- Portfolio from 2kB to 64kB Flash and from 16-pin to 64-pin package options, qualified AEC-Q100 and up to an ambient temperature of 150°C
- Optimized peripherals and code library in ROM for Field-Oriented Control
- Two PWM units with separate time bases to combine motor control and power factor correction algorithms on one chip
- For use in IEC 60730/Class B-certified applications
- Low cost stepper motor drive
- Free tool chain: www.infineon.com/davebench

Sensorless Field-Oriented Control for 3-Phase Motor e.g. PMSM Motor

Stepper Motor Drive e.g. Stepper Gauge

[ www.infineon.com/xc800 ]
**Microcontroller**

**ADC and CapCom6 – High-Performance PWM**

**ADC Features**
- 10-bit resolution, ± 2LSB
- Conversion time of <1.5μs
- Hardware synchronization with PWM enables noise-free sampling

**CapCom6 Features**
- Capture for time measurement
- Compare for PWM generation
- Block communication for brushless DC drives
- Programmable dead-time control

**High-Current I/O**

**High-Current Pad Features**
- High-current pads
- Direct drive of stepper gauges 25mA
- Sink current up to 50mA
- Over current detection

**Vector Computer Features**
- The vector computer is a powerful 16-bit coprocessor
  - Multiply and divide (MDU) unit
  - CORDIC
- Parallel processing of CPU, MDU and CORDIC is supported

**CORDIC and Vector Computer MDU**

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XC2000/XE166 Family – 16-bit Microcontrollers

The highly scalable XC2000/XE166 family is ideal for a wide range of motor control designs, including applications based on DC brushed control, DC servo control, AC induction scalar-slip control, BLDC commutated control, permanent magnet AC field-oriented control and AC induction field-oriented control.

Application Segments

Industrial
- Inverters
- Elevators
- Spindle drives
- PLC, Servo, CNC

Automotive
- Steering (e.g. EPS)
- Heating, ventilation, air condition (e.g. HVAC) control systems
- Pumps

Product Benefits

- Reduced BOM cost – XE166/XC2000 family offers up to 4 PWM units with separate time bases for combined control of two motors and the PFC algorithm on one chip
- High performance speeds up your motor control algorithm

- Two independent ADC units are triggered by the PWM timers
- The MAC unit provides DSP functionality by a seamless integration into the CPU instruction set
- Supports safety critical systems to achieve IEC61508/ISO26262 compliance
- Free tool chain: www.infineon.com/davebench
**MAC Unit – Multiply-Accumulate Operation Unit**

- **CPU Unit**
  - Fetch Unit (PU)
  - Instruction Pipeline (IPPI)
- **MAC Unit**
  - Arithmetic and Logic Unit (ALU)
  - Address and Data Unit (ADU)
  - 16x16 Multiplier
  - 40-bit ALU
  - Shifter
  - 40-bit Accumulator

**MAC Unit Provides**
- Single instruction cycle
- 75% of all MAC instructions executed in one CPU clock cycle
- Multiplication with cumulative subtractions/additions (32-bit)
- 40-bit accumulator to handle overflow

**CapCom6 – High-Performance PWM**

- **Input/Output Control**
- **T12**
- **Channel 0**
- **Dead-Time Control**
- **T13**
- **Channel 3**
- **Multi-Channel Control**
- **Trap Control**

**CapCom6 Features**
- Capture for time measurement
- Compare for PWM generation
- Block commutation for brushless DC drives
- Programmable dead-time control

**ADC – Enhance Analog-Digital Converter**

**ADC Features**
- Two synchronizable A/D converters with up to 12-bit resolution, ± 2LSB
- Conversion time down to 1.2μs
- External or internal trigger events automatic conversion sequencing
TriCore™ Family – 32-bit Microcontrollers

The Infineon TriCore™ family is optimized for 3-phase motor control applications in the industrial and automotive segments, including Permanent Magnet Synchronous Motors (PMSM) and AC Induction Motors (ACIM).

Application Segments

Industrial
- AC Servo drives
- PLC
- Mobile controllers
- Process control

Automotive
- Steering (e.g. EPS)
- Electric propulsion for hybrid and electric vehicles

Product Benefits
- High performance speeds up your motor control algorithm
- TriCore™ DSP instruction set for multiple motor control algorithms (e.g. park, clarke, space vector modulation)
- Software library for Field-Oriented Control ("e-motor module") facilitates fast implementation
- Supports safety critical systems to achieve IEC61508/ISO26262 compliance
- Free tool chain: www.infineon.com/davebench

AUDO MAX 32-bit Microcontroller

TriCore™ CPU
Motor Control Algorithm

GPTA
PWM Generation Unit

PCP
Encoder/
Resolver Interface

ADC0
ADC1

SV PWM 1
SV PWM 2
SV PWM 3

3-Phase Inverter

V_{dc}

Generator/ Break Operation

Encoder/ Resolver Circuit

PMSM

ω
θ
ω_{ref}
ib
ic
ia

[ www.infineon.com/tricore ]
TriCore™ comes with advanced peripherals for sophisticated algorithms such as FOC, sensorless FOC and state observers.

Enhanced Analog-Digital Converter (ADC)

Features and Benefits
- 1-4 synchronizable A/D converters with up to 64 channels
- 8/10/12-bit resolution, +/- 2LSB @ 10-bit
- Conversion time down to 1.0μs
- Data reduction pre-processing
- Results accumulation and limit check

General Purpose Timer Array (GPTA)

Features and Benefits
- Very flexible digital input filtering
- Tracking of all kinds of rotating shafts
- Scalable high resolution
- Independent access to time and angle domain
- All types of PWM generation supported thanks to Local Timer Cell (LTC) array
- Digital PLL for fine grain angle resolution
- PCP2 is the ideal coprocessor to handle critical real time GPTA interrupt tasks from the GPTA
- Ideal for field test and repair work
Infineon XMC4000 family of microcontrollers is tailored to power industrial applications with a need for advanced motor controls. Its unique combination of Infineon’s leading-edge timers, PWM and analog front-end peripherals with the real-time and signal processing capabilities of the ARM® Cortex™-M4 make XMC4000 the ideal solution for industrial drive applications.

Overview of XMC4000 Family

<table>
<thead>
<tr>
<th>Core</th>
<th>System Performance</th>
<th>Communication</th>
<th>Timer &amp; Actuator Control</th>
<th>Analog &amp; Mixed Signal</th>
<th>Proven Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>XMC4100</td>
<td>XMC4200</td>
<td>XMC4400</td>
<td>XMC4500</td>
<td>XMC4700*</td>
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<td>Core AMR® Cortex™-M4</td>
<td>CPU frequency (at 125˚C)</td>
<td>80MHz</td>
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<td>120MHz</td>
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<td>Floating Point Unit</td>
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<tr>
<td>Co-proc</td>
<td>4kB</td>
<td>4kB</td>
<td>6kB</td>
<td>6kB</td>
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<tr>
<td>Flash size</td>
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<td>1x</td>
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<td>2x</td>
<td>4x</td>
<td>4x</td>
<td>6x</td>
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<td>FS DEV</td>
<td>FS OTG</td>
<td>FS OTG</td>
<td>FS OTG</td>
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<td>6x</td>
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<tr>
<td>Serial Memory I/F</td>
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<td>4x</td>
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</tr>
<tr>
<td>CAN</td>
<td>2x</td>
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<tr>
<td>Touch button</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

* I²C: Under development

[www.infineon.com/xmc]
In advanced motor control, microcontrollers must offer high real-time performance to handle fast digital control loops. XMC4000 peripherals are autonomous and therefore free up the CPU kernel to a large degree, enabling it to service other requests. They are specifically designed to implement efficient motor control algorithms:

- 4 ADC kernels for simultaneous 3-phase current measurement + Power Factor Correction (PFC)
- 2 POSIF modules provide a programmable interface to process inputs from rotary encoders or Hall sensors; the position and velocity of the motor can be easily determined when used in series with CCU4
- 24 independent PWM timers for generating complex pulses and sequential patterns for any kind of power inverter topology for motor control and power supplies
- 4 high-resolution PWM channels for advanced power conversion methods (e.g. peak current control)
- 4 delta-sigma demodulators for direct interface to external delta-sigma modulators supporting galvanic isolated in-phase current measurement, power measurement or resolver feedback
- Pattern generator for resolver primary coil excitation
- 2 DAC channels for analog wave generation for sensor stimulation or calibration

**Example of Motor Control Application**

![Motor Control Application Diagram]
Infineon Safety Computing Platform – Safe Computing for 3-Phase Motor Control

ISO26262 and IEC61508-compliant safety applications require an independent watchdog with a robust monitoring channel for the main microcontroller. With its small footprint, CIC61508 is the ideal watchdog solution for safety applications where space and cost are the main drivers. It monitors the main microcontroller through a range of features that detect common clock and power supply failure modes as well as temperature-related computational errors on the microcontroller. It therefore acts as an independent diagnostic monitoring device supporting approval up to ASIL-D for 3-phase motor control applications.

Reliability is key
- Proven management of power-off sequence even when MCU is in fail safe; CIC61508 offers a power off sequence with up to 3 steps

Key Benefits
- Allows energy circulation before final power down
- Reduced voltage / current spike on power stage due to abrupt power-off when MCU enters fail safe
- Increased component life time

Availability has to be ensured
- Single transient error should not stop the application
- 3-phase motor applications must keep running in case of a single transient error, e.g. xEV, steering

Key Benefits
- Safe support for error recovery and limp mode
- Reduced error recovery time (no steering assistance provided)
- Reduced false alarm

[ www.infineon.com/SIL ]
Industry MOSFETs – Power Density for the Next Level of Energy Efficiency

Our OptiMOS™ family sets new standards for power MOSFETs, offering the industry’s lowest $R_{D\text{\text{on}}}$ and Figure of Merit (FOM) in all voltage classes from 30V to 250V. Available in high-performance packages featuring state-of-the-art process technologies, the OptiMOS™ portfolio is the right fit for all motor control applications.

**Key Benefits**

- Highest power density thanks to minimum conduction losses and reduced need for device paralleling
- Cost savings due to smaller heat sinks
- Board space savings of up to 50%
- DC currents of up to 180A per device in CanPAK™, 100A in SuperSO8 and 40A in S308 package
- High-current capability for motor control applications
- Extremely low on-state resistance and high-current capability up to 180A in D²PAK-7Pin version

**Available Packages**

[www.infineon.com/optimos]
Automotive MOSFETs – Benchmark for Motor Control Applications

Best-in-Class OptiMOS™ Products

Infineon OptiMOS™ range combines leading MOSFET technology with a robust package to deliver best-in-class performance and outstanding current capacity. Automotive-qualified MOSFET packages now have even higher current capacity thanks to our PowerBond technology.

- Best-in-class $R_{\text{on}}$ performance for increased system efficiency
- Highest current DPAK + D2PAK on the market for reduced ECU module size
- Lowest switching and conduction power losses for increased thermal system reliability
- Robust green package for easy process handling

Evolution of Package Current Capability

OptiMOS™ for Motor Control Solutions

OptiMOS™ T2 30V, 40V, 60V products are the future building blocks for all half-bridge, H-bridge and 3-phase motor control solutions. They can be paired with driver IC products to create all-inclusive motor drive solutions.

Product Overview

<table>
<thead>
<tr>
<th></th>
<th>Voltage Class [V]</th>
<th>OptiMOS™-T2 (Trench)</th>
<th>OptiMOS™-T (Trench)</th>
<th>OptiMOS™ (Planar)</th>
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<tbody>
<tr>
<td>Single MOSFET</td>
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<td></td>
<td></td>
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<tr>
<td>N-Channel</td>
<td>30</td>
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<tr>
<td>N-Channel</td>
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<tr>
<td>N-Channel</td>
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<tr>
<td>N-Channel</td>
<td>60</td>
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<tr>
<td>N-Channel</td>
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<td>N-Channel</td>
<td>100</td>
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<td>N-Channel</td>
<td>250</td>
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<td>P-Channel</td>
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<tr>
<td>P-Channel</td>
<td>40</td>
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<td>•</td>
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<tr>
<td>Dual MOSFET</td>
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<tr>
<td>Dual N-Channel</td>
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<td>Dual N-Channel</td>
<td>2 x 55</td>
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</tbody>
</table>

[ www.infineon.com/automotivemosfet ]
Bridge Drivers – H-Bridge and 3-Phase Gate Driver ICs

The trend toward greater efficiency in automotive applications extends to electric motors as well. In the future, applications such as power steering, HVAC compressors and engine cooling fans will all be controlled by electronic motors. Our family of configurable, H-bridge and 3-phase gate driver ICs can be combined with MOSFETs to provide the required power and efficiency these systems need.

**Basic Features**
- Strong output stage up to 1.5A
- Precise OpAmp for current shut monitoring
- Operation down to 5.5V
- Duty cycle adjustable up to 100%

**Diagnostic Features**
- Undervoltage
- Short circuit
- Overtemperature
- Overvoltage

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**H-Bridge/ Dual Half-Bridge Driver Family**

- **Product Type**: TLE718x
- **Operating Range**: 7.0 ... 36.0 V
- **OpAmp**: 0 ... 95%
- **PWM/DIR Input**: 0
- **Reverse Polarity Protection**: 0
- **Diagnosis**: UV, OT, SCD
- **Package**: PG-SSOP-24

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**3-Phase Bridge Driver IC**

- **Product Type**: TLE6280x
- **Operating Range**: 7.0 ... 36.0 V
- **Drives Stage**: 1.5/1.5 A
- **PWM/DIR Input**: 0 ... 95%
- **Reverse Polarity Protection**: 0
- **Diagnosis**: UV, OT, SCD, DT
- **Package**: PG-VQN-48

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**Application Example for BLDC Motors**

![Application Example for BLDC Motors](image)

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[www.infineon.com/driver-ic]
**Speed PROFET™ – Protected High-Side Switch for PWM-Driven Applications**

The Speed PROFET™ BTF50060-1TEA is a high-side switch for high PWM frequencies such as 25 kHz. It can be used for controlling, driving and protecting a 12V DC motor (e.g. 100W) or valve. In combination with a freewheeling diode or a low-side switch, the Speed PROFET™ can be set up in a half-bridge or boost converter topology. It can also be driven with a 25kHz PWM signal directly from a microcontroller. This device is capable of a 100% duty cycle. Its feature set simplifies hardware and software design and includes protection functions such as short-circuit and overtemperature shutdown. It also offers an accurate load current measurement and open load or short-to-battery detection.

**Key Features**
- PWM capability of more than 25kHz
- 6mΩ $R_{\text{DS(on)}}$ (max. 12mΩ @ 150°C) with high inrush current
- No external bootstrap capacitor necessary
- 3.3V and 5V compatible logic inputs
- Advanced analog load current sense signal
- Overload and overtemperature protection, with defined diagnostic signal

**Key Benefits**
- Reduced power dissipation
- Small package for high-current motor drive, less PCB space
- Reduced component count and easier PCB layout
- Direct connection to the MCU
- Easy current sense calibration

**Application Example for Fuel Pump**

![Application Diagram](chart)

**Product Overview**

<table>
<thead>
<tr>
<th>Product Type</th>
<th>$R_{\text{DS(on)}}$ @ Tj = 25°C [mΩ]</th>
<th>Typical Load Current [A]</th>
<th>$E_{\text{on}}$ [mJ]</th>
<th>Recommended Operating Voltage Range [V]</th>
<th>$I_{\text{LSC}}$ (typ) [A]</th>
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<tbody>
<tr>
<td>BTF50060-1TEA</td>
<td>6</td>
<td>16.5</td>
<td>280 @ 20A</td>
<td>4.7 ... 28.0</td>
<td>75</td>
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</table>

<table>
<thead>
<tr>
<th>Number of Channels</th>
<th>Load Current</th>
<th>Overvoltage Shutdown</th>
<th>Sense Enable</th>
<th>Latch</th>
<th>Reverseable</th>
<th>Package</th>
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<tr>
<td>1</td>
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<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td>DPAK-5pin</td>
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</tbody>
</table>

[ www.infineon.com/profet ]
NovalithIC™ – Integrated Half-Bridge Driver

NovalithIC™ provides a complete, low-ohmic protected half bridge in a single package (typ. path resistance @ 25°C: 16mΩ down from 28mΩ). It can also be combined with an additional NovalithIC™ to create an H-bridge or 3-phase bridge. The NovalithIC™ family has the capability to switch to up to 25kHz while providing overcurrent, overvoltage and overtemperature protection. The NovalithIC™ family offers cost-optimized, scalable solutions for protected high-current PWM motor drives with very restrictive board space. NovalithIC™ includes a P-N MOSFET enabling a significant reduction of EME (Electro Magnetic Emissions) and power dissipation thanks to an optimized switching shape and the absence of a charge pump.

Basic Features
- Low quiescent current
- Capable for high PWM frequency (e.g. 25kHz)
- Logic level input
- Adjustable slew rate
- Cross current protection

Diagnostic Features
- Overtemperature
- Overvoltage
- Overcurrent
- Current sense and status

Protection Features
- Overtemperature shutdown
- Overvoltage (lockout or smart clamp)
- Undervoltage
- Overcurrent

Application Example for High-Current PWM Motor Drives

NovalithIC™ Product Overview

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Operating Range (V)</th>
<th>VRSS (Typ) (mΩ)</th>
<th>IDLIM (Typ) (A)</th>
<th>Switch Time (Typ) (µs)</th>
<th>Diagnosis</th>
<th>Protect</th>
<th>Package</th>
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</tr>
<tr>
<td>BTN 8980TA</td>
<td>4.5 ... 40.0</td>
<td>9.0</td>
<td>70</td>
<td>7.0</td>
<td>ON, OT, CS, UV, OT, OC</td>
<td>PG-TO-263-7</td>
<td></td>
</tr>
</tbody>
</table>

1) Product in development, electrical values specified must be considered as target values
2) Target values calculated
3) Target values for the HS switch only
ON = Overvoltage
OC = Overcurrent
CS = Current Sense
UV = Undervoltage
OT = Overtemperature
SCL = Short Circuiting

[www.infineon.com/novalithic]
Trilith IC – Integrated Full-Bridge Driver

Trilith IC family members combine two high-side and two low-side switches in a single package. They are designed to drive high-current DC motors in an H-bridge configuration (peak currents of up to 42A), but can also be used as single independent switches. All Trilith ICs include overcurrent and overtemperature protection for high-side switches. For low-side switches, designers can choose between fast unprotected switches and protected switches for lower frequencies (typ. path resistance @ 25°C from 210mΩ down to 40mΩ). The third generation of Trilith IC (BTM7742G/BTM7745G/BTM7752G/BTM7755G) is based on the Novalith™ concept and includes P-N MOSFET. This enables a significant reduction of EME (Electromagnetic Emissions) and power dissipation thanks to an optimized switching shape and the absence of a charge pump.

Basic Features
- Low quiescent current
- Capable for high PWM frequency

Protection Features
- Overvoltage
- Undervoltage
- Overtemperature
- Short-circuit / overcurrent detection

Diagnostic Features
- Overvoltage
- Overtemperature
- Short-circuit / overcurrent detection
- Current sense / status
- Open Load

Application Example for DC Brush Motors

Trilith IC Product Overview

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Operating Range (V)</th>
<th>RDS(on) Path (Typ. @ 25°C) (mΩ)</th>
<th>IDR(lim) (Type) (A)</th>
<th>IQ (Type) (µA)</th>
<th>Switch Freq. (Type) (kHz)</th>
<th>Diagnose</th>
<th>Protect</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTM 7730G</td>
<td>4.8 ... 12.0</td>
<td>210</td>
<td>8.0</td>
<td>1</td>
<td>OT, OL, OT, SC</td>
<td>PG-DSO-28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BTM 7731G</td>
<td>4.8 ... 12.0</td>
<td>190</td>
<td>9.5</td>
<td>1</td>
<td>OT, OL, OT, SC</td>
<td>PG-DSO-28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BTM 7700G</td>
<td>4.8 ... 12.0</td>
<td>115</td>
<td>12.0</td>
<td>1</td>
<td>OT, OL, OT, SC</td>
<td>PG-DSO-28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BTM 7700G 1</td>
<td>4.8 ... 12.0</td>
<td>115</td>
<td>12.0</td>
<td>1</td>
<td>OT, OL, OT, SC</td>
<td>PG-70-263-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BTM 7701G</td>
<td>4.8 ... 12.0</td>
<td>110</td>
<td>15.0</td>
<td>1</td>
<td>OT, OL, OT, SC</td>
<td>PG-DSO-28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BTM 7702G</td>
<td>5.5 ... 28.0</td>
<td>150</td>
<td>12.0</td>
<td>1</td>
<td>OT, OL, OT, SC</td>
<td>PG-DSO-36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BTM 7710G</td>
<td>5.5 ... 28.0</td>
<td>250</td>
<td>12.0</td>
<td>2</td>
<td>OT, OL, OT, SC</td>
<td>PG-DSO-36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) AEC grade, 1.75mm = 55°C, 150°C = 105°C, CS = Current Sense, OL = Open Load, UV = Undervoltage, OT = Overtemperature, SC = Short Circuit, OC = Overcurrent

[www.infineon.com/trilithic]
Multi Half Bridges – Single-Chip Solutions for Low-Current Applications

Cost-effective, space-saving IC solutions are ideal for implementing DC brush motor controls that drive low load currents (<1A). We offer a broad range of half-bridge drivers – from 2-fold half-bridge drivers with parallel interface in a DSO-14 pin package to a 10-fold, half-bridge driver with SPI interfaces in a SSOP-24 pin package. All products are equipped with protection features and support diagnostics via a status flag or SPI. Typical applications include flap motors for climate control and motors for mirror adjustment or idle speed control.

Basic Features
- Overvoltage
- Undervoltage
- Overtemperature
- Short circuit

Application Example for HVAC Control Module

1) In development, samples available

Product Overview

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Config</th>
<th>(i_{\text{max}})</th>
<th>(i_{\text{max}})</th>
<th>(i_{L})</th>
<th>(V_{\text{CE(sat)}})</th>
<th>Protection</th>
<th>Diagnostic</th>
<th>Highlights</th>
<th>(V_{\text{CE(sat)}}/\text{R}_{\text{DS(on)}}) Path</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLE4207G</td>
<td>2x Half bridge</td>
<td>2 x 0.8</td>
<td>2 x 1.5</td>
<td>20</td>
<td>8 ... 18</td>
<td>L0</td>
<td>Status flag</td>
<td>Error detection</td>
<td>1.2V</td>
<td>PG-DSO-14</td>
</tr>
<tr>
<td>TLE4208G</td>
<td>4x Half bridge</td>
<td>4 x 0.8</td>
<td>4 x 1.5</td>
<td>10</td>
<td>8 ... 18</td>
<td>L0</td>
<td>Status flag</td>
<td>Error detection</td>
<td>1.2V</td>
<td>PG-DSO-28</td>
</tr>
<tr>
<td>TLE46456G</td>
<td>6x Half bridge</td>
<td>6 x 0.5</td>
<td>6 x 0.9</td>
<td>1</td>
<td>8 ... 16</td>
<td>O</td>
<td>Status flag</td>
<td>Open-load detection in OK state</td>
<td>600\Omega/switch</td>
<td>PG-SSOP-24</td>
</tr>
<tr>
<td>TLE62645G</td>
<td>10x Half bridge</td>
<td>10 x 0.5</td>
<td>10 x 1.0</td>
<td>8 ... 40</td>
<td>O</td>
<td>O</td>
<td>Status flag</td>
<td>Detailed diagnosis via SPI</td>
<td>800\Omega/switch</td>
<td>PG-DSO-16</td>
</tr>
<tr>
<td>TLE62646G</td>
<td>10x Half bridge</td>
<td>10 x 0.5</td>
<td>10 x 1.0</td>
<td>12</td>
<td>8 ... 40</td>
<td>O</td>
<td>Status flag</td>
<td>Single switch usage possible</td>
<td>800\Omega/switch</td>
<td>PG-DSO-28</td>
</tr>
<tr>
<td>TLE63504G</td>
<td>10x Half bridge</td>
<td>10 x 0.5</td>
<td>10 x 1.0</td>
<td>2</td>
<td>7 ... 18</td>
<td>O</td>
<td>Status flag</td>
<td>Pin compatible with TLE 84106SL</td>
<td>800\Omega/switch</td>
<td>PG-SSOP-24</td>
</tr>
<tr>
<td>TLE63515G</td>
<td>10x Half bridge</td>
<td>10 x 0.5</td>
<td>10 x 1.0</td>
<td>3</td>
<td>7 ... 18</td>
<td>O</td>
<td>Status flag</td>
<td>Pin compatible with TLE 84106SL</td>
<td>800\Omega/switch</td>
<td>PG-SSOP-24</td>
</tr>
</tbody>
</table>

[www.infineon.com/bridges]
Door Power IC – Single-Chip Devices for Door Zone Modules

Single-chip solutions for door zone modules help maximize PCB space by integrating common door loads into a single package. TLE8201R and TLE8203E drive loads such as DC motors for door locks (TLE8201R only) and x-y mirror adjustment as well as resistive loads such as mirror heaters and lamps/LEDs. TLE8201R is available in a DSO-48 pin package, while TLE8203E comes in the smaller SSOP-36 package. Both devices feature integrated protection against short circuits and overtemperature as well as an SPI interface for programming and diagnosis.

Key Features
- SPI interface
- $I_q = 3 \mu A$
- Operating range: 8–20V

Block Diagram of TLE8201

![Block Diagram of TLE8201](image)

Product Overview

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Outputs</th>
<th>$I_{Q \text{min}}$</th>
<th>Package</th>
<th>Driver Stage</th>
<th>Operating Range (V)</th>
<th>Protect</th>
<th>Diagnosis</th>
<th>Target Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLE8201R</td>
<td>1, 2</td>
<td>8.0</td>
<td>130</td>
<td>Half bridge</td>
<td>8–20</td>
<td>OC, OT, UV, OV, UV</td>
<td>CS</td>
<td>Central lock</td>
</tr>
<tr>
<td></td>
<td>3, 4</td>
<td>3.0</td>
<td>350</td>
<td>Half bridge</td>
<td></td>
<td></td>
<td>CS</td>
<td>Mirror folding</td>
</tr>
<tr>
<td></td>
<td>5, 6</td>
<td>1.25</td>
<td>650</td>
<td>Half bridge</td>
<td></td>
<td></td>
<td>OC, OT</td>
<td>Mirror X-Y</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>6.25</td>
<td>85</td>
<td>High-side switch (mirror defrost)</td>
<td></td>
<td></td>
<td>CS</td>
<td>Mirror defrost</td>
</tr>
<tr>
<td></td>
<td>8–11</td>
<td>1.8</td>
<td>400</td>
<td>Lamp driver</td>
<td></td>
<td></td>
<td>OC, OT</td>
<td>Repeater</td>
</tr>
<tr>
<td>TLE8203R</td>
<td>4</td>
<td>3.0</td>
<td>350</td>
<td>Half bridge</td>
<td>8–20</td>
<td>OC, OT, UV, UV</td>
<td>CS</td>
<td>Mirror folding</td>
</tr>
<tr>
<td></td>
<td>5, 6</td>
<td>1.25</td>
<td>650</td>
<td>Half bridge</td>
<td></td>
<td></td>
<td>OC, OT</td>
<td>Mirror X-Y</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>6.25</td>
<td>85</td>
<td>High-side switch (mirror defrost)</td>
<td></td>
<td></td>
<td>CS</td>
<td>Mirror defrost</td>
</tr>
<tr>
<td></td>
<td>8, 10</td>
<td>1.8</td>
<td>400</td>
<td>Lamp driver</td>
<td></td>
<td></td>
<td>OC, OT</td>
<td>Repeater</td>
</tr>
</tbody>
</table>

LO = Lockout, OL = Open Load, OC = Overcurrent, OT = Overtemperature, OV = Overvoltage, UV = Undervoltage, SC = Short Circuit
Servo Driver – Robust and Reliable

The servo driver family comprises three devices: TLE4206G, TLE4206-2G and TLE4209. Each one features 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 PG-DSO-14 package leverages low RTH for environments with high ambient temperatures of 150°C. Additional features such as over- and undervoltage lockout, short-circuit protection and overtemperature protection open the way for a wide range of additional automotive and industrial applications.

Key Features
- Protected bipolar power stages
- Low saturation voltage
- Internal freewheeling diodes
- Optimized for Headlight Beam Control (HBC) applications

Block Diagram of TLE4209G

Product Overview

<table>
<thead>
<tr>
<th>Product Type</th>
<th>$I_{\text{cover}}$</th>
<th>$I_{\text{cover}}$</th>
<th>$I_{\text{q}}$</th>
<th>$V_{\text{sat}}$</th>
<th>Protection</th>
<th>Inhibit</th>
<th>Highlights</th>
<th>$V_{\text{sat max}}$</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLE4205G</td>
<td>0.6</td>
<td>1.0</td>
<td>0.01</td>
<td>6 ... 32</td>
<td>SC</td>
<td>•</td>
<td>Dual power comparator for higher voltage</td>
<td>2.1V at 0.6A 1)</td>
<td>PG-DSO-20/PG-DIP-18</td>
</tr>
<tr>
<td>TLE4206G</td>
<td>0.8</td>
<td>1.5</td>
<td>12</td>
<td>8 ... 18</td>
<td>OT, OV, UV, LO, SC</td>
<td>Servo driver with current peak blanking</td>
<td>1.2V at 0.4A 1)</td>
<td>PG-DSO-14</td>
<td></td>
</tr>
<tr>
<td>TLE4206-2G</td>
<td>0.8</td>
<td>1.5</td>
<td>12</td>
<td>8 ... 18</td>
<td>Switching hysteresis on range input</td>
<td>1.2V at 0.4A 1)</td>
<td>PG-DSO-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLE4206-4G</td>
<td>0.9</td>
<td>1.6</td>
<td>13</td>
<td>8 ... 19</td>
<td>Adapted range input</td>
<td>1.2V at 0.4A 1)</td>
<td>PG-DSO-16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLE4209A</td>
<td>0.8</td>
<td>1.5</td>
<td>12</td>
<td>8 ... 18</td>
<td>Servo driver</td>
<td>1.2V at 0.4A 1)</td>
<td>PG-DIP-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLE4209G</td>
<td>0.8</td>
<td>1.5</td>
<td>12</td>
<td>8 ... 18</td>
<td>Servo driver</td>
<td>1.2V at 0.3A 1)</td>
<td>PG-DSO-14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Total drop saturation voltage typ. value @ 25°C

10 = Lockout
11 = Open Load
12 = Overvoltage
13 = Undervoltage
14 = Overtemperature
15 = Overload
16 = Short Circuit

[www.infineon.com/bridges]
Monolithic H-Bridges

Infineon offers a broad range of automotive-qualified H-bridges for industrial applications, from gardening equipment through printers and scanners to coffee machines. Originally designed for the extreme environments of powertrain engine applications, the H-bridges can be used for all types of DC motor applications and feature state-of-the-art SmartPower™ technology.

Product Features
- Supply range \(^{1)}: 5V – 40V
- Output current \(^{1)}: 1A – 8,6A
- \(R_{\text{on}}(\text{typ})\) \(^{1)}: 120m\Omega – 230m\Omega\)
  (typ.25°C per transistor)

Protection Features
- Diagnosis capability \(^{1)}
- Broad green package portfolio

\(^{1)}\) depending on selected H-Bridge

Product Overview

<table>
<thead>
<tr>
<th>Feature</th>
<th>Max. at 10°C</th>
<th>Current Limit Type</th>
<th>Output Current Min.</th>
<th>Short Circuit Det. Min.</th>
<th>Output Control</th>
<th>(V_{\text{DD}}) Monitoring</th>
<th>Max. Switching Freq.</th>
<th>Status Flag</th>
<th>SPI</th>
<th>All I/O 3.3V Tolerance</th>
<th>Open Load Detection</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLE5205</td>
<td>500mW</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>IN1/IN2</td>
<td>-</td>
<td>not specified</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>White OFF</td>
<td>PG-TD-220-F</td>
</tr>
<tr>
<td>TLE5206</td>
<td>300mW</td>
<td>6.0/6.4/6.8</td>
<td>6.0/7.0/7.5</td>
<td>-</td>
<td>PWM/DIR</td>
<td>-</td>
<td>not specified</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>White ON</td>
<td>PG-DSD-20</td>
</tr>
<tr>
<td>TLE6209</td>
<td>280mW</td>
<td>4.0/5.0/5.5/6.0</td>
<td>4.0/5.0/5.5/6.0</td>
<td>5.5/6.0/6.5/7.0</td>
<td>PWM/DIR</td>
<td>-</td>
<td>not specified</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>White OFF</td>
<td>PG-DSD-20</td>
</tr>
<tr>
<td>TLE7209</td>
<td>250mW</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>√</td>
<td>11kHz</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>White OFF</td>
<td>PG-DSD-20</td>
</tr>
<tr>
<td>TLE8209</td>
<td>250mW</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>√</td>
<td>11kHz</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>White OFF</td>
<td>PG-DSD-20</td>
</tr>
</tbody>
</table>

[www.infineon.com/powertrain-ic]
Stepper Drivers – Cost-Efficient, Durable and Reliable

In body electronics, stepper motors are used in headlight beam leveling and HVAC flap systems. They are also widely used in engine management systems, for example, in rpm management, where a motor-driven valve in the bypass air inlet controls idling speed.

Key Features
- Full- to half-step operation
- Protected bipolar power stages
- Implemented current control
- Error flag for diagnosis

Application Example for Stepper Motor Drive

Product Overview

<table>
<thead>
<tr>
<th>Product Type</th>
<th>I_{L(max)/min}</th>
<th>T_{on}</th>
<th>V_{CC} (V)</th>
<th>Step Operations</th>
<th>Protection</th>
<th>Diagnostic Interface</th>
<th>Highlights</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current controlled</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCA 3727G</td>
<td>2 x 0.75</td>
<td>2 x 1.5</td>
<td>200</td>
<td>5–50</td>
<td>Full step</td>
<td>G0</td>
<td>High operating voltage, low quiescent current with inhibit</td>
<td>PG-DSO-24/ PG-DIP-20</td>
</tr>
<tr>
<td>TLE4726G</td>
<td>2 x 0.75</td>
<td>2 x 1.5</td>
<td>200</td>
<td>5–50</td>
<td>Full step</td>
<td>G0</td>
<td></td>
<td>PG-DSO-24</td>
</tr>
<tr>
<td>TLE4729G</td>
<td>2 x 0.7</td>
<td>2 x 1.5</td>
<td>50</td>
<td>6–16</td>
<td>Full step</td>
<td>OL, OT, SC</td>
<td>Very low quiescent current with inhibit</td>
<td>PG-DSO-24</td>
</tr>
<tr>
<td>Voltage controlled</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLE4208G</td>
<td>4 x 0.8</td>
<td>4 x 1.5</td>
<td>20</td>
<td>8–18</td>
<td>Full step</td>
<td>SC, OT, OV, UV</td>
<td>Dual full bridge</td>
<td>PG-DSO-28</td>
</tr>
<tr>
<td>TLE4444SL</td>
<td>4 x 0.5</td>
<td>4 x 0.9</td>
<td>1</td>
<td>8–18</td>
<td>Full step</td>
<td>SC, OT, UV, OL, OV, OL</td>
<td>Open-load detection in ON state</td>
<td>PG-SSOP-24</td>
</tr>
</tbody>
</table>

LO = Lockout
OL = Open Load
OV = Overvoltage
SC = Short Circuit
UV = Undervoltage
OT = Overtemperature
PG-DSO-24, PG-DIP-20, PG-DSO-28, PG-SSOP-24

[www.infineon.com/bridges]
Infineon 600V and 1200V TRENCHSTOP™ IGBTs are the most efficient devices available on the market today. This makes them ideal for applications where efficiency is a key priority. The 600V and 1200V TRENCHSTOP™ IGBTs are typically used in UPS and solar inverters as well as in welding and industrial drives up to 10kW. The new 600V RC-D (Reverse Conducting for Drives) family is a cost-optimized, space-saving solution in DPAK or IPAK up to 15A. These devices are the perfect fit for the white goods segment up to 2kW, where cost and performance are key issues.

**RC Drives for 600V Hard-Switching Applications**

**Key Features**
- Optimized for consumer markets
- Best in class $V_{(sat)}$ and $V_f$ for outstanding efficiency at frequencies up to 20kHz
- Soft current turn-off waveforms

**Key Benefits**
- Outstanding space saving capabilities
- Cost optimized
- Lowest power dissipation
- Low cooling and reduced EMI filtering requirements

**RC Drives Fast IGBTs for Comfort and Quietness**

We have developed new versions of our RC drives IGBT devices to meet rising demand for IGBTs in the low-power motor drive consumer market.

**Key Features**
- Optimized $E_{on}$, $E_{off}$, and $Q_{rr}$ for up to 20% lower switching losses
- Smooth switching performance leading to low EMI levels
- Very tight parameter distribution
- Operating range of 4kHz to 30kHz

**Key Benefits**
- Best cost/performance for hard switching applications
- Up to 60% space saving on the PCB
- Excellent EMI behavior
At switching frequencies greater than 40kHz, the new 600V and 1200V third-generation, high-speed family (HS3) offers low switching losses and excellent EMI performance.

Key Features and Benefits
- High efficiency thanks to lowest switching losses for switching frequencies up to 60kHz
- Soft switching waveforms for excellent EMI behavior
- Low conduction losses thanks to low $V_{(sat)}$
- Optimized diode for target applications with low diode losses and fast recovery times
- RoHS compliance
- Positive $V_{(sat)}$ temperature coefficient for easy paralleling and no thermal runaway
- 10μs short-circuit rating

Product Overview
Infineon has launched a new family of EiceDRIVER™ IGBT / MOSFET gate driver ICs for applications with blocking voltages from 600V up to 1200V. The new 6ED series is also available in a 200V version. Based on innovations such as thin-film, silicon-on-insulator technology (600V) and coreless transformer technology (1200V), these products increase reliability levels, reduce losses and improve performance.

Family member 1ED020I12-F2 (1200V) is a single-channel, isolated IGBT / MOSFET driver IC that provides bidirectional galvanic isolation as well as feedback and integrated protection features. 1ED020I12-B2 (1200V) also offers basic isolation at a maximum working voltage of 1420V. A special two-level turn-off feature is integrated in the 1ED020I12-FT and 1ED020I12-BT models.

2ED020I12-F2 (1200V) is a dual-channel, isolated IGBT / MOSFET driver IC. It bundles the same functionality as two 1ED020I12-F2 ICs in a single, compact package. The 2ED020I06-B2 (600V) and 2ED020I12-B2 (1200V) half-bridge driver ICs include galvanic isolation on the high-side channel as well as customizable overcurrent protection.

The new 200V and 600V 6ED series comprises 3-phase gate driver ICs, which offer excellent robustness against negative transients down to -50V. Variants are available with or without fully integrated bootstrap functionality, positive or negative logic, different undervoltage lockouts and overcurrent protection.

Application Example 1200V 3-Phase Drives
High-Power Modules

Variable-speed drive systems play a key role to enhance energy efficiency. We can help to boost energy performance with our latest chip technologies and innovative module designs covering the power range from 0.5kW up to more than 1MW. We recently introduced three new module platforms in the low and medium power range: MIPAQ™, SmartPIM & SmartPACK and the EconoPACK™4. PrimePACK™ and IHM-B are new packages in the high-power segment.

SmartPIM and SmartPACK – Flexible Assembly Through Self-Acting PressFIT Technology

Infineon has expanded our PressFIT technology range to include the new SmartPIM and Smart-PACK housing concepts.

The new housing enables the module to be connected with the heat sink and the PCB in a single mounting process. The PressFIT pin is pressed into the PCB, the PCB is stabilized and the module is mounted on the surface of the heat sink in a single step. The whole mounting concept can be performed using an adapted screwdriver. No additional tools are required. This new technology is suited to all conventional electrical circuits. The housing accommodates current up to 75A.

This module family combines all the reliability of established PressFIT technology with a range of advanced features:

- Press-in process by simply tightening a single screw
- Flexible mounting
- The new module and mounting concept reduces process time
- Robust housing concept with decoupled DCB force
- Gas-tight contact so immune to ambient atmosphere
- Decreased FIT rates for interconnections
- Reliable, cold-welded connection of module pins and PCB
- Can be mounted on both sides of standard PCBs

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<th>Ic [A]</th>
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[www.infineon.com/SMART]
MIPAQ™ – New Level of Extended Functionality and Integration

MIPAQ™ is the latest addition to our IGBT module portfolio, enabling electronics to be integrated into power modules.

MIPAQ™ combines an IGBT module with sensing and drive electronics, making it the ideal solution for designing powerful and compact inverters for cost-effective, low and medium-power applications. The resulting energy savings benefit profitability and the environment.

The MIPAQ™ family is based on IGBT modules and offers advanced functions for power ranges between 22kW and 75kW:
- **MIPAQ™ base** module offers integrated shunts
- **MIPAQ™ sense** module offers additional current measurement feature and is fully digital with galvanically isolated output signals
- **MIPAQ™ serve** module includes driver electronics

**MIPAQ™ Serve Functional Diagram**

The MIPAQ™ serve module is a 3-phase, full-bridge IGBT module with integrated drivers and digital temperature measurement.

These features make it a full plug-and-play solution for high-current drive applications. The module contains galvanically isolated drivers based on our coreless transformer technology. Eliminating optical couplers further enhances the module’s long-term stability.

MIPAQ™ serve modules are based on the new EconoPACK™4 and utilize IGBT4 technology. They cover the 1200V range and manage currents of 100A, 150A and 200A. Screws are used for high-current connections. The modules feature standardized connectors for supply voltage and logic signals for plug-and-play functionality.

[www.infineon.com/MIPAQ]
EconoPACK™4 – The New Standard for Compact Inverter Designs

EconoPACK™4 is a new member in our highly-rated Econo product family. The new EconoPACK™4 IGBT modules feature screw power terminals with excellent electric connections, separate DC and AC links and PressFIT control pins for solder-less inverter assembly. All of which makes them the ideal choice for industrial applications.

- Superb reliability, conductivity and efficiency
- Low stray inductance design
- IGBT4 650V and IGBT4 1200V and 1700V chip technologies
- Screw power terminals and PressFIT control pins
- Robust design

3-Phase, Full-Bridge (SixPACK) Configuration:
- 650V/1200V: 100A, 150A, 200A
- 1700V: 100A, 150A

3-Level, 1-Phase Configuration:
- 650V: 200A, 300A

3-Level, 1-Phase NPC2 Configuration:
- 1200V/650V: 300A, 400A
- 1700V/1200V: 300A

3-Level, 1-Phase Configuration:
- 650V: 300A

[www.infineon.com/EconoPACK4]
PrimePACK™ and IHM-B – Revolutionizing Current and Future Designs

Infineon PrimePACK™ standardizes a novel approach to high-power inverter designs. The innovative housing utilizes a special heat sink that is more efficient than ever before. It is the first high-power module in the market to feature an embedded NTC sensor. The module’s new layout enables very compact and high-power three-level inverter topology configurations.

The new IHM-B family meets the reliability requirements of today’s widespread IHM high-power modules. The module family also features several new technologies tailored to applications subject to harsh environments. To meet designers’ needs, the IHM-B housing has the same outline as the IHM-A.

Key Technologies Implemented in Both Housings

- Ultrasonically welded power and auxiliary terminals
- IGBT4 for 1200V and 1700V
- IGBT3 for 3300V
- Green products able to operate up to Tj=150°C

Both PrimePACK™ and IHM-B products provide optimum design flexibility and are available in half-bridge or chopper configurations (IHM-B as single switch). These two families feature the very latest silicon technology and are available in the following voltage and current ranges:

**PrimePACK™:**
- 450A - 1400A for 1200V
- 450A - 1400A for 1700V

**IHM-B:**
- 1200A - 3600A for 1200V and 1700V
- 1000A - 1500A for 3300V

[www.infineon.com/PrimePACK]
Hall IC Switches

Infineon TLE4968-1K and TLE4961-1K bipolar Hall-effect switches enable exact rotor position detection in BLDC motor commutation. These automotive-qualified sensors feature precise magnetic switching thresholds of +/- 1mT (TLE4968-1K) and +/- 2mT (TLE4961-1K) which enables motors with smooth torque. With an operating voltage of 3V to 32V and a typ. current consumption of just 1.6mA, the sensors are ideally suited for energy efficient system requirements. Offered in a small package, very compact BLDC systems can be realized.

Common Sensor Features

- Operation from unregulated power supply
- 3.0V to 32V extended high operating supply voltage
- Overvoltage capability up to 42V (no additional, external resistor necessary)
- Reverse battery protection (~ 18V)
- High sensitivity and high stability of the magnetic switching points
- High resistance to mechanical stress due to active error compensation
- Superior temperature stability
- Extended ESD performance (± 7kV HBM)
- Low jitter (typ. 0.3 μs for a square input signal)
- Automotive qualified
- Output overcurrent & overtemperature protection
- Available in SMD packages SC59 and SOT23 and leaded package PG-SSO-3

Application Example TLE496x

Product Overview

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<th>Package</th>
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<td>PG-SSO-3</td>
<td>Bipolar Switch</td>
<td>1mT</td>
<td>-1mT</td>
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</tbody>
</table>

[ www.infineon/hall-switches ]
GMR-Based Magnetic Angle Sensor

Infineon magnetic angle sensing principle is based on tried-and-tested, automotive-qualified integrated Giant Magneto Resistive (iGMR) technology. iGMR technology combines magneto resistive sensing elements and integrated circuits into one chip. The iGMR technology can determine the absolute orientation of a magnetic field between 0° and 360°. The product portfolio covers a wide range of integrated signal processing and interfaces. Infineon iGMR sensors combine high angular accuracy and resolution with fast signal processing and short delay times, making them ideal for rotor position sensing in electrical drives.

Key Features
- Integrated GMR (iGMR) technology
- 0 - 360° angle measurement with sine and cosine bridge
- Supply voltage 3.3 or 5.0V
- -40°C to +150°C
- On-chip signal processing with angle calculation
- Digital and analog interfaces
- Automotive qualified

Application Example

Product Overview

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Packages</th>
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<th>Package</th>
<th>Interface</th>
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### Support Tools

#### XMC4500 Low Voltage Motor Drive Kit  
[www.infineon.com/xmc](www.infineon.com/xmc)  

**Key Features**
- XMC4500
- ARM® Cortex™-M4 with 120MHz, 1MB Flash, 160kB RAM
- PWM with emergency shutdown and ADC trigger
- Quad-ADC with 4x12-bit and 70ns sample time
- Delta Sigma Demodulator for resolver feedback
- Pattern Generator for resolver excitation
- 3-phase halfbridge inverter for Motors with 24V/7.5A
- Multi-phase current measurement
- Quadrature Encoder Interface (Maxon Motor compatible)
- Resolver Interface
- Communication: Ethernet, USB, CAN and RS485
- HMI: OLED Display and touch buttons
- Mobile mass storage: SDMMC Card slot
- IDE: Free Tool Chain DAVE™ 3 including compiler and debugger
- Software: DAVE™ 3 Motor Control App
- Code Instrumentation with DAVE™ 3 XSPY-Plugin

**Applications**
- General purpose industrial motor applications:
  - Conveyor Belts
  - Transportation and Lifting Systems
  - Linear Drives
  - Positioning and Synchronized Drives
  - HVAC

#### Automotive BLDC Motor Drive Kit  
[www.infineon.com/bldc](www.infineon.com/bldc)  

**Key Features**
- Scalable, 3-phase inverter
- Sample code: FOC & V/f for XC886 and XC2238N
- Integrated protection features for high system reliability
- Complete IDE software packages included
- Easy installation, plug & play

**Applications**
- Pumps
- Fans
**BLDC (Brushless DC) Application Kit**

**Key Features**
- XC866
- PWM unit
- Fast ADC with <200ns sample time
- Power board 9V-18V, 20A
- 50W PMSM motor and plug-in power supply 12V
- Uses Infineon NovalithIC™ BTN 7960B and TLE4264 LDO

- DAVETM Drive auto-code generator (fully functional application code) for Block switching with Hall sensors and sensorless
- Free tool chain including compiler and debugger
- Digital isolated, real-time monitoring tool (USB to JTAG and CAN bridge)
- Tutorial videos demonstrating how to use the kit
- Suitable for Windows 98/2000/XP

**Applications**
- Water pumps
- Fuel pumps
- Fans
- Valves
- Power tools

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**DAVETM Drive Application Kit**

**Key Features**
- XC886 with vector computer
- PWM unit
- Fast ADC with <200ns sample time
- Power board 23V-56V, 7.5A
- 15W PMSM motor and plug-in power supply 24V
- Uses Infineon 6ED003L06 gate driver, BSC196N10, MOSFETs, CoolSET™ ICE3B0565 power supply and TLE4264 LDO
- DAVETM Drive auto-code generator (fully functional application code) for Block switching with Hall sensors and sensorless
- Sensorless FOC of PMSM

- Free tool chain integrated in DAVETM Drive
- Flexibly generates optimized code and is not based on static libraries
- Configures Infineon’s powerful and flexible motor control peripherals
- Compresses a detailed user manual into a few mouse clicks
- Helps designers to quickly and easily implement advanced motor control techniques on low-cost components
- Digital isolated real-time monitoring tool (USB to JTAG and CAN bridge)
- Suitable for Windows 98/2000/XP

**Applications**
- Industrial motor controls
- Transportation systems
- Consumer motor controls
- Appliance motor controls
## FOC Drive Application Kit

**Key Features**
- XC878 with vector computer
  - Two independent PWM units
  - Fast ADC with <200ns sample time
- XE164 real-time signal controller with MAC unit
  - Three independent PWM units
  - Two independent fast ADCs with <200ns sample time
- Power board 23V - 56V, 7.5A
- 15W PMSM motor and plug-in power supply 24V

- Uses Infineon 6ED003L06 gate driver, BSC196N10, MOSFETs, CoolSET™
  - ICE3B0565 power supply and TLE4264 LDO
- Software package including source code
  - Sensorless FOC of PMSM with XE164
  - Sensorless FOC of PMSM with XC878
- Free tool chain for XC878 and XE164 including compiler and debugger
- Digital isolated, real-time monitoring tool (USB to JTAG and CAN bridge)
- DAVETM-compatible software packages
- Suitable for Windows 98/2000/XP

**Applications**
- Industrial drives
- Fans, blowers

## Air-Conditioning Reference Board

**Key Features**
- XC878 with vector computer
- XE164 real-time signal controller with MAC unit
- Power board
- 1kW compressor inverter stage using 15A RC drives IGBT in DPAK (TO-252)
- 200W outdoor fan inverter stage using 4A RC drives IGBT in DPAK (TO-252)
- 1.5kW CCM-PFC using 20A high-speed 3 IGBT and 10A SIC diode

- Software package including source code
  - Simultaneous control of two PMSMs with sensorless FOC & digital PFC with XE164
  - Sensorless FOC & digital PFC with XC878
- V/f control of ACIM for quick evaluation
- Free tool chain for XC878 and XE164 including compiler and debugger
- Digital isolated, real-time monitoring tool (USB to JTAG and CAN bridge)
- DAVETM-compatible software packages
- Suitable for Windows 98/2000/XP/7

**Applications**
- Air conditioning
- Industrial drives
- Fans, blowers
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Where you need it. When you need it.

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- China, mainland ........... 4001 200 951 (Mandarin/English)
- India ........................... 000 800 4402 951 (English)
- USA ........................... 1-866 951 9519 (English/German)
- Other countries ............ 00* 800 951 951 951 (English/German)
- Direct access .............. +49 89 234-0 (interconnection fee, German/English)

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