



Commercial, Construction and Agricultural Vehicles

Application Guide



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Introduction to Commercial, Construction and Agricultural Vehicles (CAV)

As the demand for fuel and operation efficiency rises, electrification is an increasingly attractive option for commercial, construction and agricultural vehicles (CAV). Going electric offers two key benefits: compliance with stricter legislation regarding emission levels and energy efficiency, along with increased process efficiency and yield rates. By opting for hybrid or fully electric drivetrains, CAV operators can reduce or even eliminate their fuel consumption and CO₂ emissions. More important, electric drivetrains require less maintenance, and are therefore more reliable and productive. And, as automation becomes increasingly widespread, the global demand for electronics is also on the rise in order to boost production and meet the demands associated with a growing world population and less agricultural land.

Traditionally, commercial, construction and agricultural vehicles (CAV) have relied on two main technologies – a central combustion engine provides mechanical power while hydraulic systems control huge forces, normally at very low speeds. Nowadays, electric drives controlled by modern power electronics can be used as a complement or substitute for both. Electric machines can support or fully replace the combustion drivetrain in the engine. In a hybrid design, the combustion engine delivers part of the propulsive power, while the electric drive provides torque for peak loads. Such a system reduces fuel consumption and allows energy to be recovered during braking. This energy can later be used to accelerate the vehicle and boost fuel efficiency.

Furthermore, an electric motor can also operate as a starter-generator, reducing the complexity of the drivetrain by combining these two parts – a design concept similar to the hybrid drive for the automotive industry. A diesel-electric drivetrain concept, in which the combustion engine ensures efficiency while driving a generator, is another alternative. Here, the generator provides the electric power needed to operate the vehicle, which is always driven electrically. A battery stores energy recovered during deceleration to ensure an independent supply of energy – regardless of whether or not power is being generated. The gearbox and clutch are eliminated and, unlike combustion engines, electric machines can provide maximum torque at zero speed, making them ideal for heavy-duty applications.

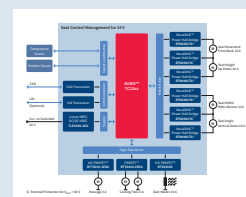
Finally, in the case of electric drives, an on-board energy storage solution, such as a battery or fuel cell, can provide enough energy to operate the vehicle for a reasonable length of time. In an electric forklift truck, for example, this could be a shift of several hours while a few minutes may be sufficient for an urban bus that can recharge at each bus stop. Eliminating the combustion engine also represents a major step in improving availability and reliability.

With proven expertise in CAV and a comprehensive portfolio of robust, high-quality control and power semiconductor solutions, Infineon helps designers and developers to engineer CAVs that deliver improved fuel economy, productivity and reliability.

Visit our application solutions site for comprehensive system block diagrams, products and resources to complete your design.



www.infineon.com/cav-seat





Body Applications

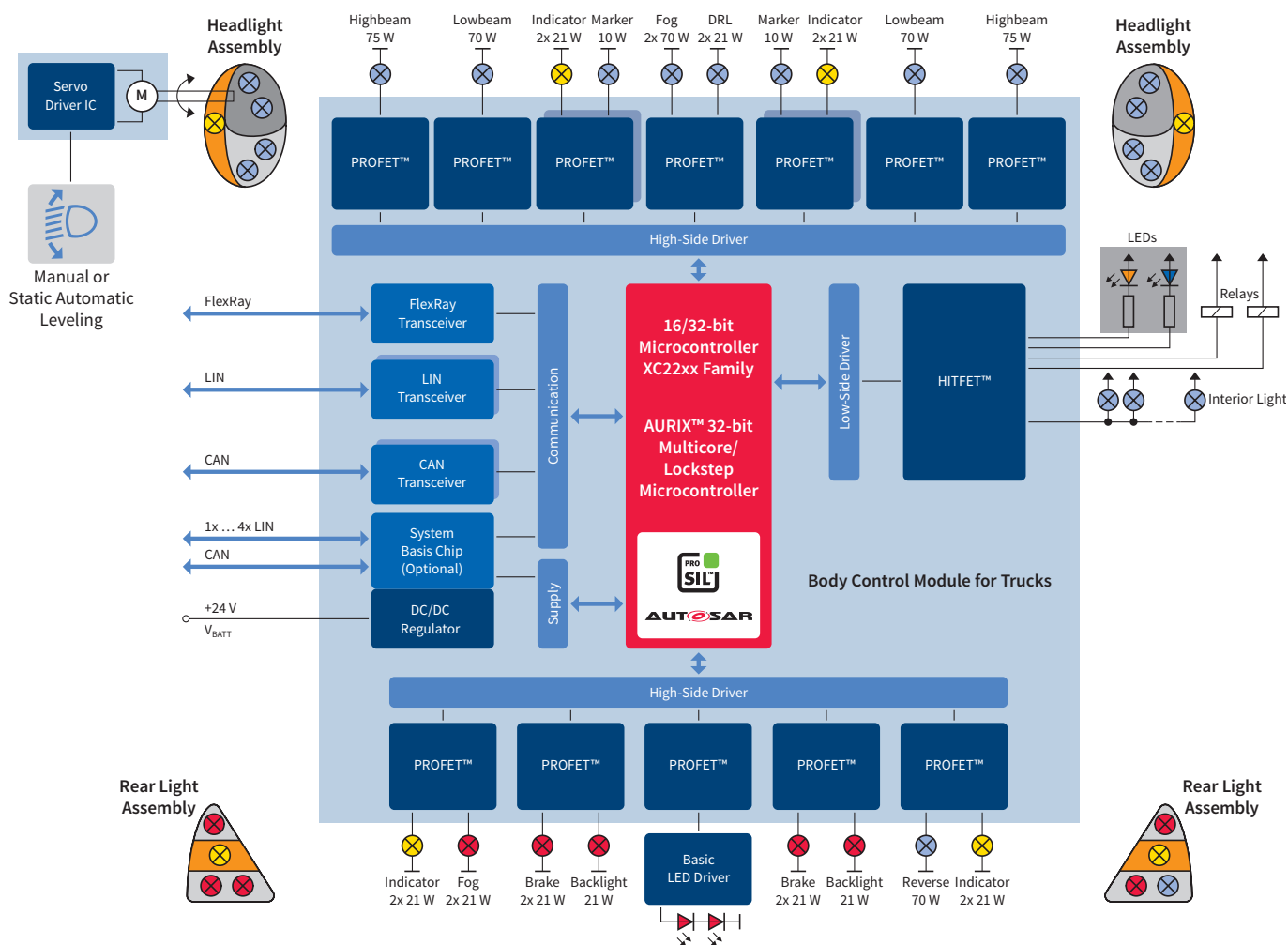
24 V body applications for trucks and agricultural vehicles can be divided into three sections: truck body Electric Control Unit (ECU), seat control and LED lighting. The success of each hinges on the use of top-quality 24 V solutions specifically engineered for the high demands of CAVs. Design challenges common to body applications must also be overcome, whether involving the limited space available for a body ECU and seat control, or the high efficiency demands of LED lighting.

Nowadays, a truck ECU has to master an ever-growing list of functions despite ever-decreasing board space.

Achieving this requires products for 24 V systems with a high level of integration. Seat control modules based on 24 V require, first and foremost, a compact design with integrated motor drivers. Since lighting has become a major differentiator in vehicle design, there is a soaring demand for highly flexible solutions that accommodate a broad range of LED configurations in trucks, such as those with a highly efficient and flexible DC/DC controller. What's more, it's important to know when a LED has burned out, which is why a diagnostic feature has been integrated into the LED rear light module. But there is also pressure to design a module that is both highly functional and low in cost.



Body ECU



System Benefits

- Reduced board space due to integrated functionality
- PROFET™+ 24V provides excellent diagnostic and protection features and a high current sense accuracy, even for the smallest loads, such as LEDs
- Supports the “Limp Home” functional safety concept
- Maximum design flexibility and a lower design outlay due to identical footprint & pin-compatibility
- Automotive LED driver products supporting the transition of lighting solutions to LED exclusively

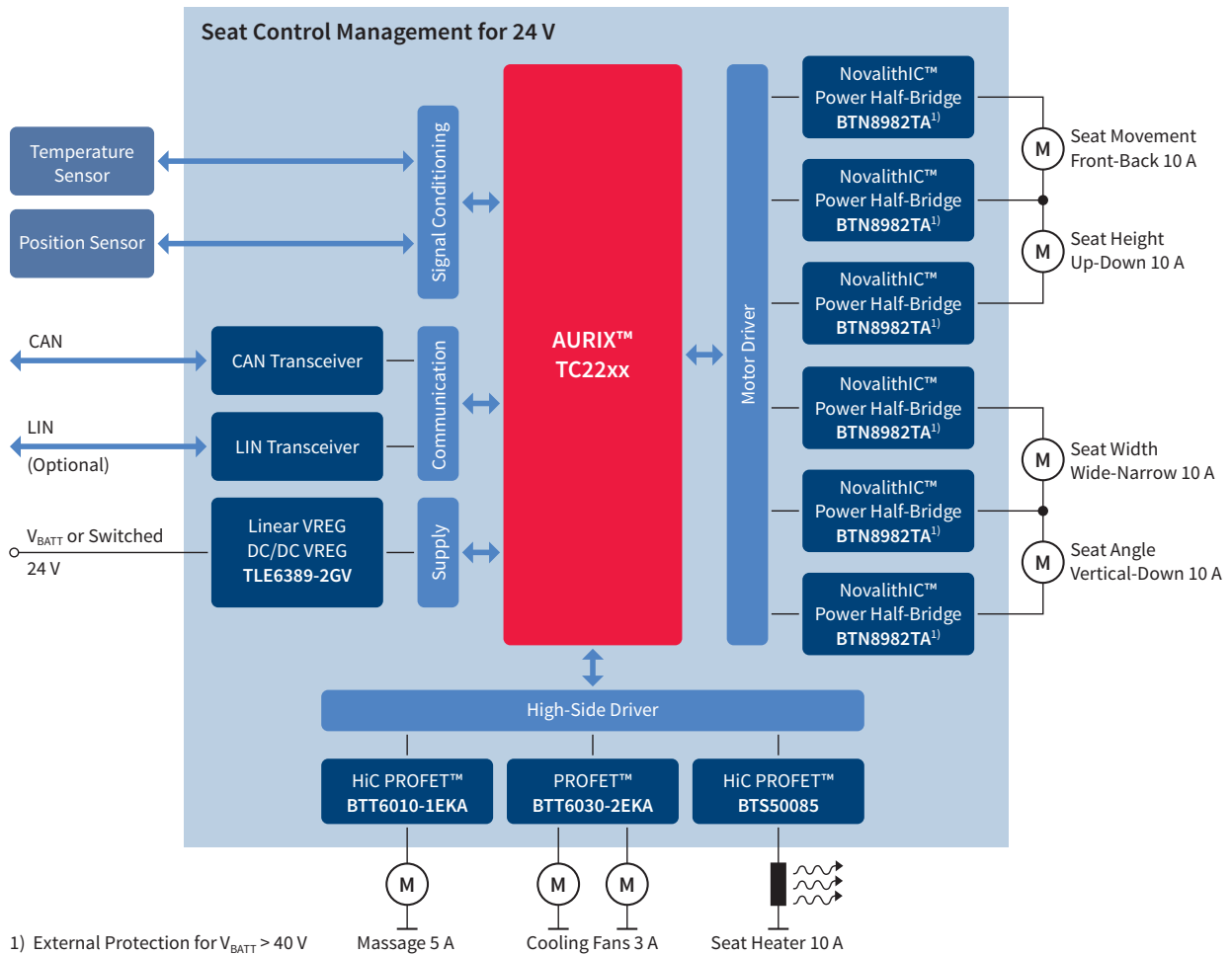


Suggested Products

Product	Description
AURIX™	Scalable 32-bit TriCore™ microcontroller family from single- to multicore (PRO-SIL™)
Supply ICs	Voltage regulators, DC/DC converters
SPIDER, HITFET™	Single- and multi-channel protected high- and low-side switches
LITIX™ Basic	Scalable linear current sources family for automotive LED applications
SBCs, Network Transceiver	System basis chips, CAN, LIN and FlexRay transceiver
PROFET™	Single- and multi-channel protected high-side switches



Seat Control Module



System Benefits

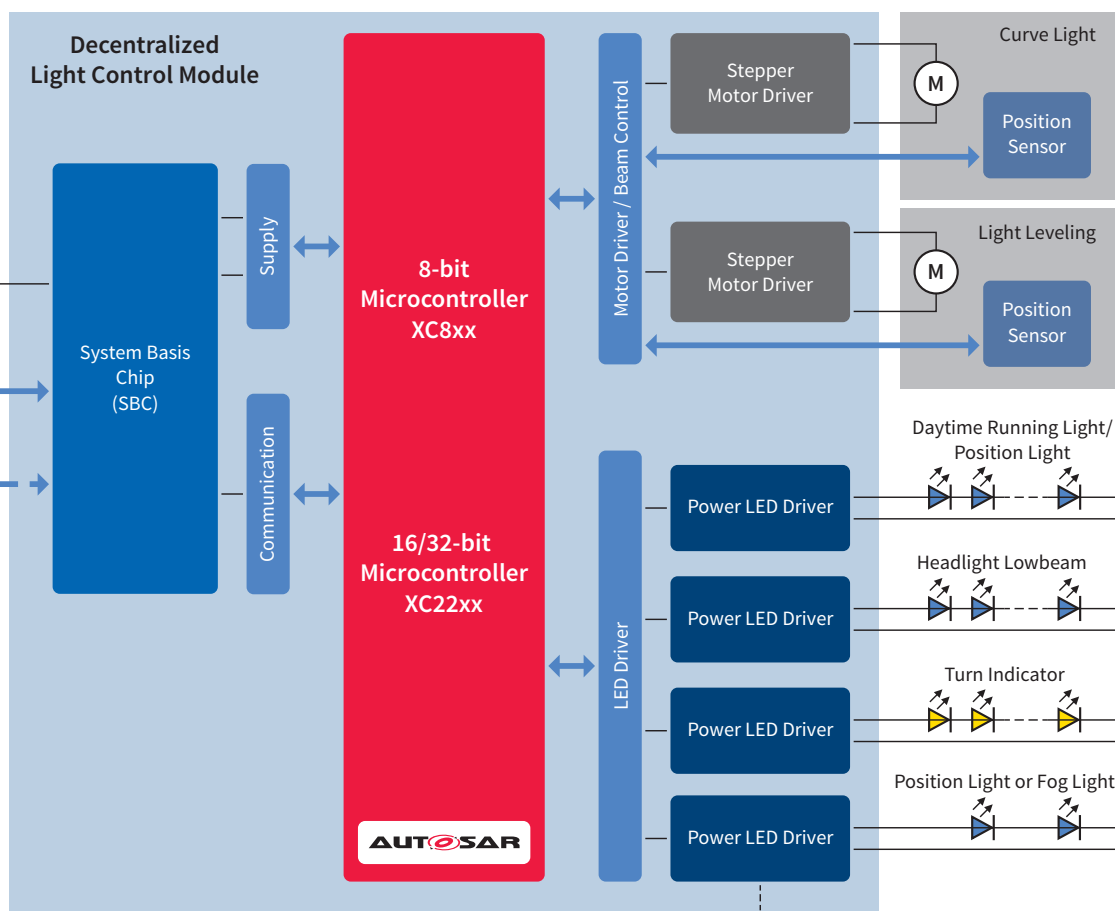
- System-in-a-package solutions for high-power integrated and protected motor control
- Protected load control with sophisticated diagnostic features
- Reduced board space due to integrated functionality

Suggested Products

Product	Description
AURIX™ TC22xL	Scalable 32-bit TriCore™ microcontroller family from single to multicore (PRO-SIL™)
NovalithIC™ BTN8982TA	Integrated half-bridge driver
High-Current PROFET™	Smart low-ohmic high-side switches for heating applications
PROFET™+ 24V	Smart high-side switches for 24 V applications
TLE6389	DC/DC converter (automotive)
Network Transceivers	LIN and CAN transceivers



LED Lighting



System Benefits

- Automotive LED drivers for high-brightness LEDs
- LED driver ICs support various DC/DC topologies (buck, boost, SEPIC)
- Microcontroller peripherals for light control with a low CPU load
- System basis chips combine the supply, network transceiver and monitoring functions in a monolithic device

Suggested Products

Product	Description
AURIX™	32-bit high-performance microcontroller family
LITIX™ Basic	Scalable linear current sources family for automotive LED applications
Network Transceivers	LIN and CAN transceivers
Position Sensors	Magnetic position sensor and angle sensors





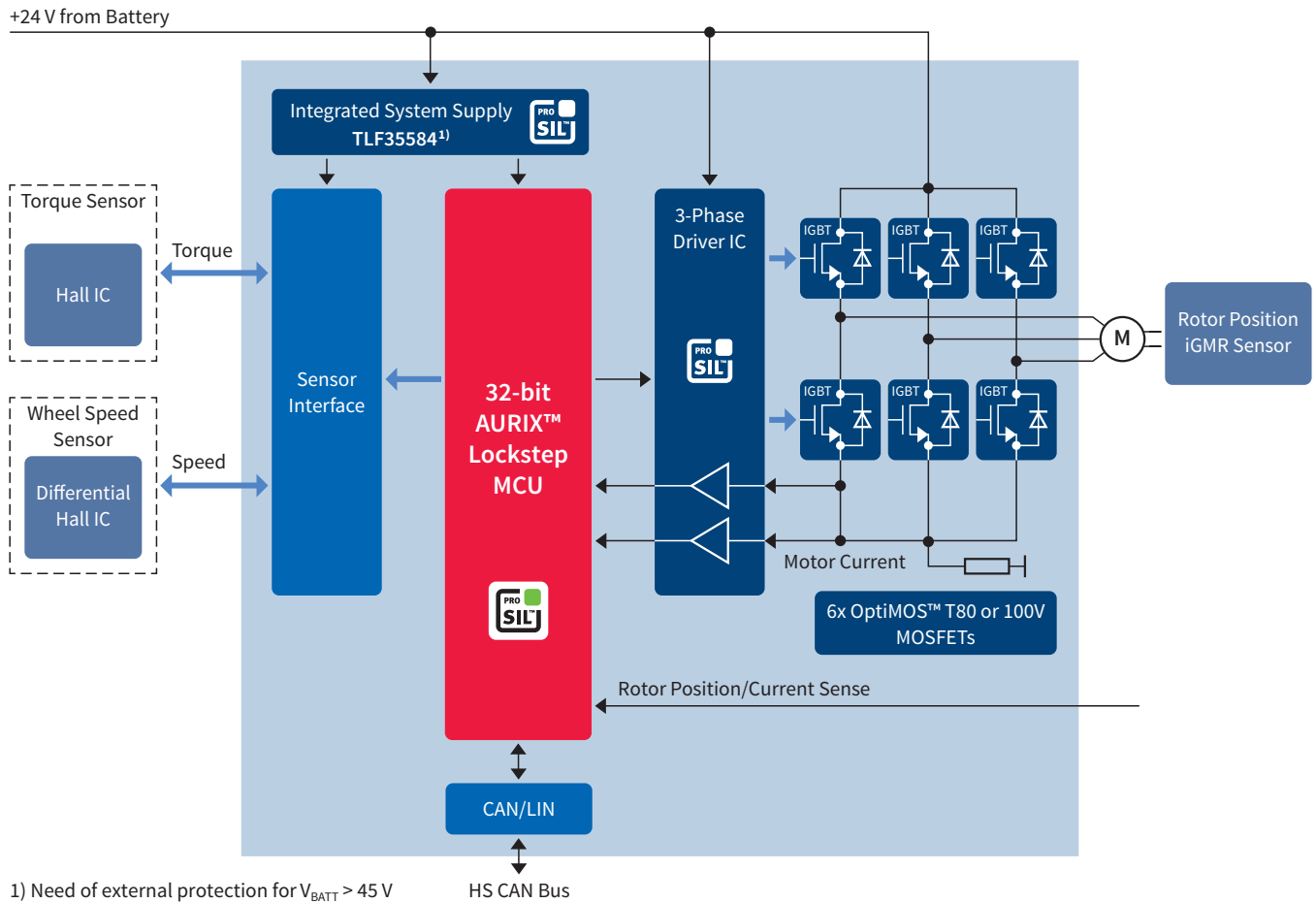
Low Voltage Motor Control

No matter which kind of motor – brushless DC, brushed DC or unidirectional – motor control for trucks and agricultural vehicles has to be extremely robust and come with the diagnostic and protective functions required in CAVs.

But that's not all – the motor control industry faces growing pressure to find new ways of, among other things, increasing energy efficiency. With software assuming a central role, the systems themselves are becoming ever more complex.



Brushless DC Motor Control



System Benefits

- Integrated solution reduces the design outlay
- PWM control
- Discrete solution optimized for all motors thanks to a broad selection of MOSFETs
- Protection functions, including SC, overload, OT and ESD
- Diagnostic functions, including open load, OT detection, integrated OPAMP and current sense

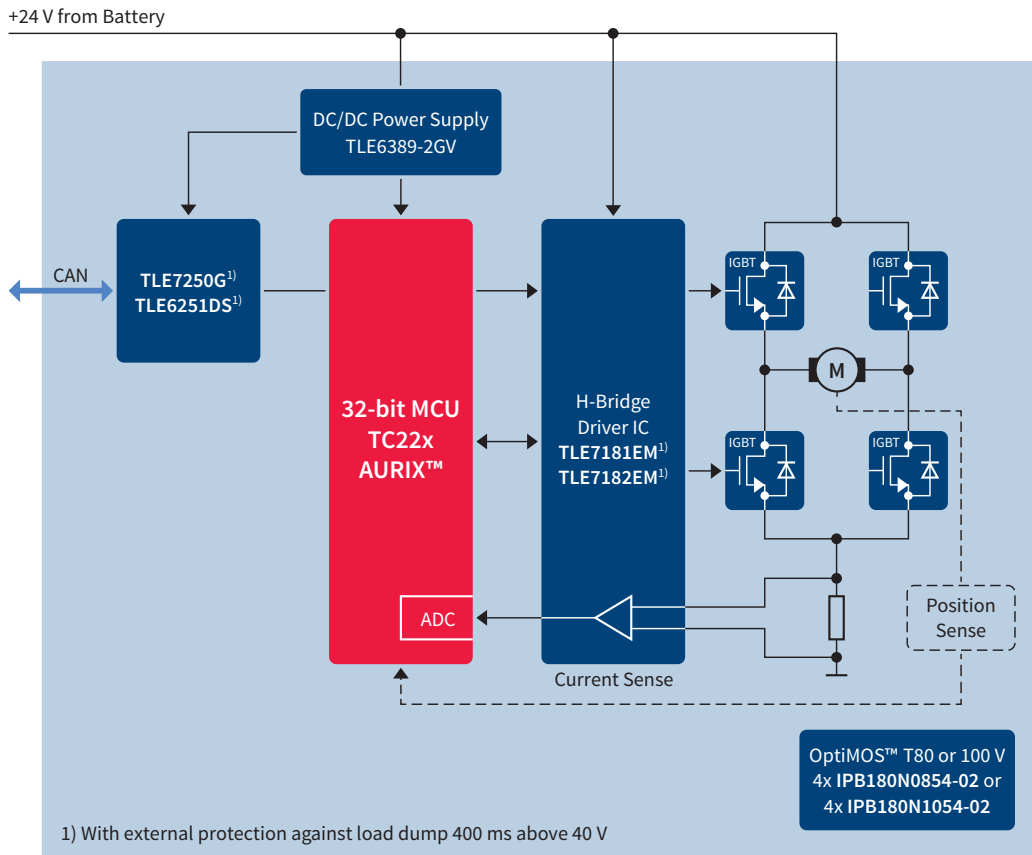


Suggested Products

Product	Description
AURIX™	Scalable 32-bit TriCore™ microcontroller family from single to multicore (PRO-SIL™)
TLE9180	3-phase bridge driver IC for automotive safety applications (PRO-SIL™)
Position Sensor	Magnetic position sensor and angle sensors
ATV MOSFETs 80/100V	Single: n-channel 80 V/100 V MOSFET
TLF35584	System power supply with Integrated watchdog (PRO-SIL™)
IKW/IKQxxN60/N120/T/H3	Discrete IGBT PG-TO247/Plus 1200 V/600 V/8–120 A



Brushed DC Motor Control



System Benefits

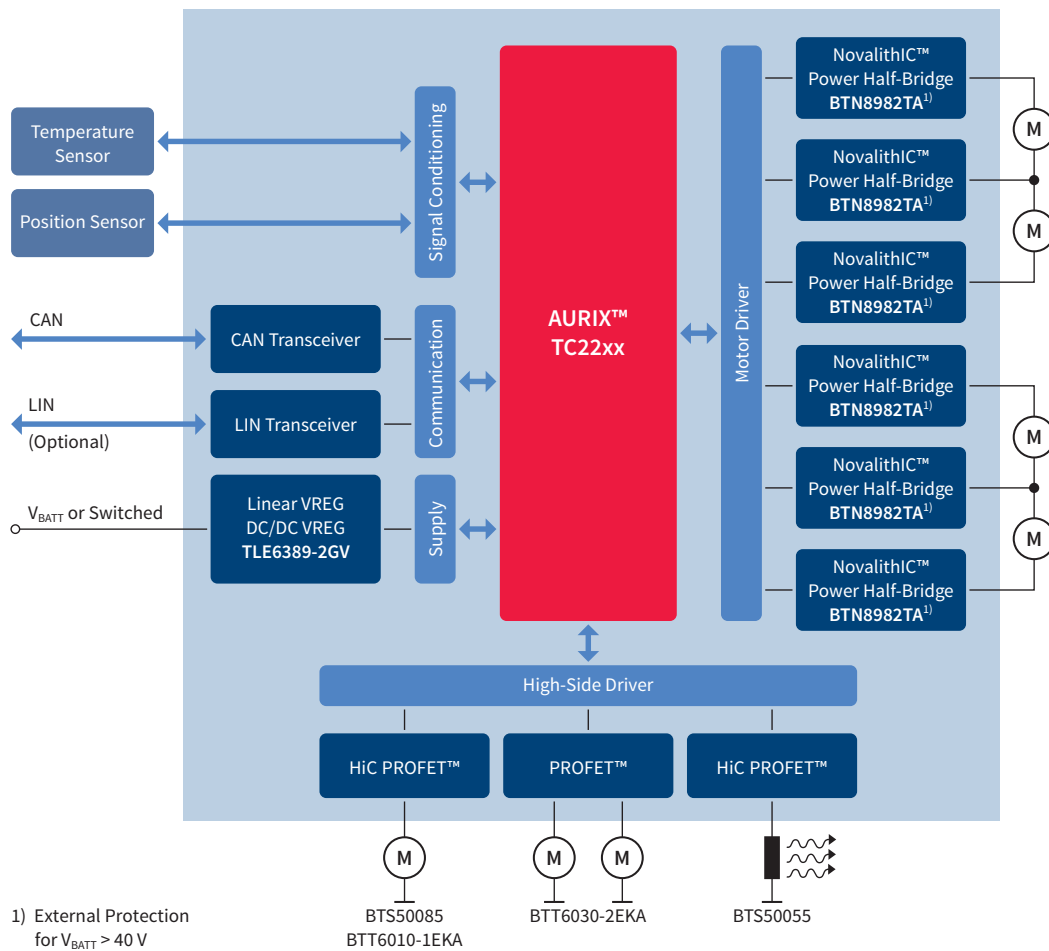
- Integrated solution reduces the overall outlay
- Discrete solution optimized for all motors thanks to a broad selection of MOSFETs
- PWM control
- Protection functions, including SC, overload, OT and ESD
- Diagnostic functions, including open load, OT detection, integrated OPAMP and current sense

Suggested Products

Product	Description
AURIX™	Scalable 32-bit TriCore™ microcontroller family from single to multicore (PRO-SIL™)
Network Transceivers	CAN transceivers
Driver ICs TLE7181/7182	MOSFET driver for H bridge configuration
ATV MOSFETs 80/100V	Single: n-channel 80 V/100 V MOSFET
TLE6389	DC/DC converter (automotive) for 24 V applications
IKW/IKQxxN60/N120/T/H3	Discrete IGBT PG-TO247/Plus 1200 V/600 V/8–120 A



Unidirectional Control of DC Motor



System Benefits

- Integrated solution reduces design the design outlay
- Discrete solution optimized for all motors thanks to a broad selection of PROFET™ switches
- PWM control
- Protection functions, including SC, overload, OT and ESD
- Diagnostic functions, including open load, OT detection, integrated OPAMP and current sense

Suggested Products

Product	Description
AURIX™ TC22xL	Scalable 32-bit TriCore™ microcontroller family from single to multicore (PRO-SIL™)
NovalithIC™ BTN8982TA	Integrated half-bridge driver
High-Current PROFET™	Smart low-ohmic high-side switches for heating applications
PROFET™+ 24V	Smart high-side switches for 24 V applications
TLE6389	DC/DC converter (automotive)
Network Transceivers	LIN and CAN transceivers





Hybrid Electric Solutions

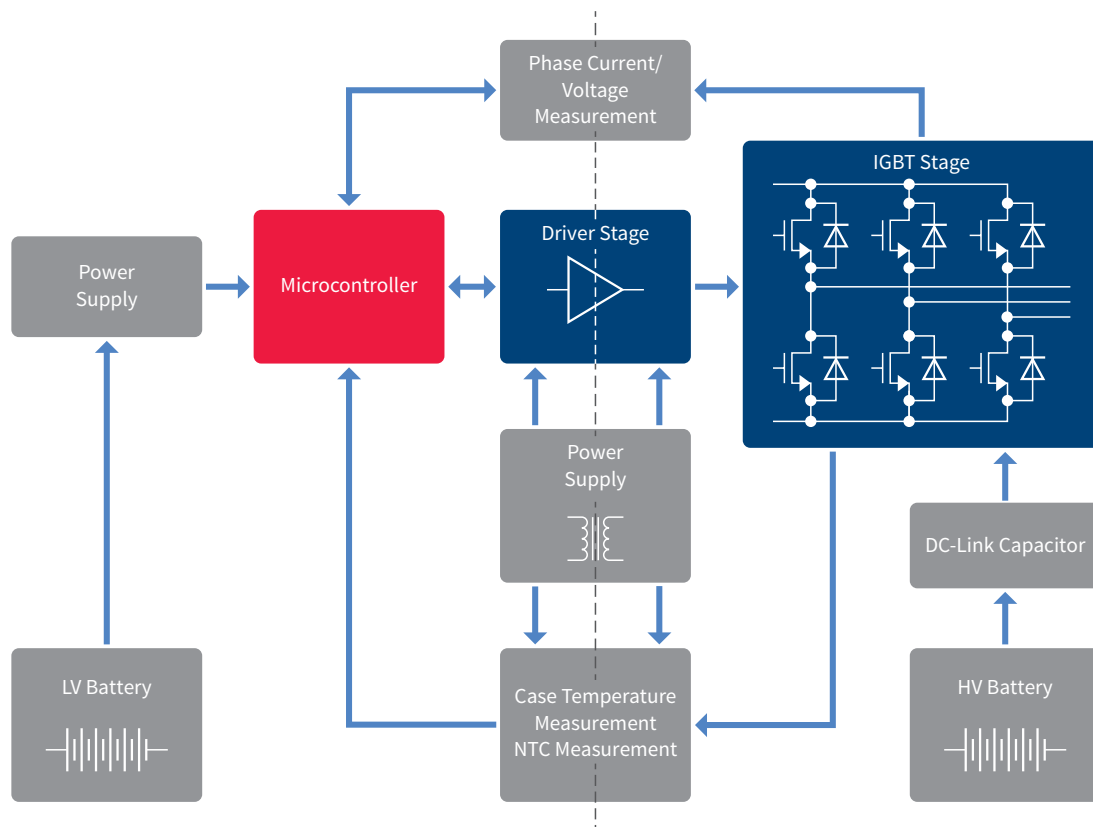
Market trends, such as the drive for increased efficiency and fuel economy, have become an indispensable feature of contemporary CAV design. Electrification, in particular (for example of the drivetrain), is an attractive option because it allows manufacturers to comply with ever-stricter legislation regarding emission levels and energy efficiency. While at the same time, electrification also allows operators to enjoy higher process efficiency and yield rates. Electric drivetrains also less maintenance, making them more reliable and productive.

Fuel economy is yet another benefit of hybrid or 100% electric drivetrains. Fully electric engines, in particular, potentially eliminate the consumption of fossil fuels and help reduce the carbon footprint. Improved passenger comfort and lower noise levels are additional pluses. The net effect of going electric in CAV applications is evident to all – a better quality of life in our cities and throughout the world.

The potential benefits associated with the electrification of CAV drivetrains and auxiliary machines keep increasing. An electric drivetrain has far fewer parts, especially moving ones, resulting in fewer failures and maintenance issues. Using electric rather than hydraulic power in CAV auxiliary machines – including saws, balers and mowers – leads to increased productivity by enabling higher speed and accuracy.



Auxiliary Applications



System Benefits

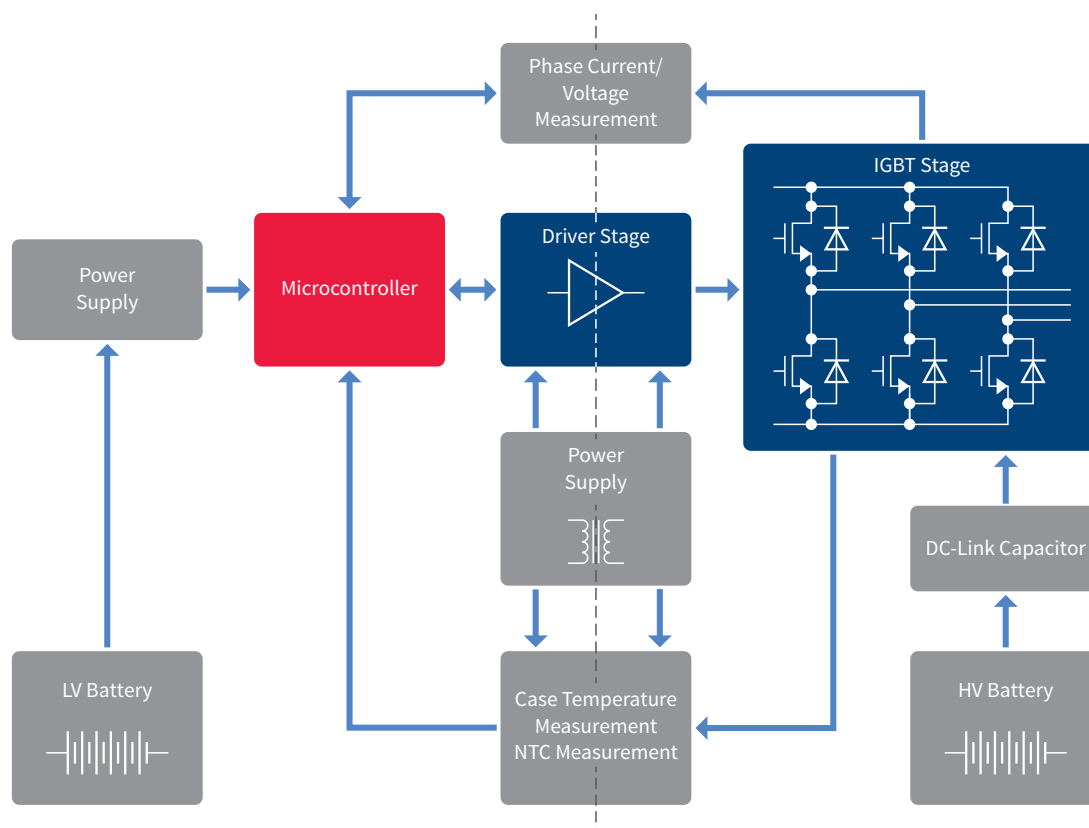
- Power-product portfolio including both power module and discrete solutions
- Gate drivers featuring galvanic isolation
- Highly efficient 3-phase motor operation thanks to very low conduction losses, even at high switching frequencies
- Broad 32-bit microcontroller solutions dedicated to (H)EV applications

Suggested Products

Product	Description
FF450R12ME4A	EconoDUAL™ 3 half-bridge power module, 1200 V/450 A
FF600R12ME4A	EconoDUAL™ 3 half-bridge power module, 1200 V/600 A
FF900R12IP4V	PrimePACK™ 2 half-bridge power module 1200 V/900 A
FD/DF600R12IP4V	PrimePACK™ 2 high- and low-side chopper modules 1200 V/600 A
IKW/IKQxxN60/N120/T/H3	Discrete IGBT PG-TO247/Plus 1200 V/600 V/8–120 A
2ED300C17-S/ST	Half-bridge high-power IGBT-driver
1ED020I12-FA	Single-channel IGBT-driver IC
2ED010I12-XXX	Dual-channel IGBT-driver IC



Powertrain Inverter



System Benefits

- Product portfolio supporting a wide range of motors, generators and power classes
- Highly efficient 3-phase driver thanks to very low conduction losses, even at high switching frequencies
- Isolation-integrated in gate driver
- Wide range of 32-bit microcontroller solutions dedicated to (H)EV applications with an extremely cost-effective resolver interface

Suggested Products

Product	Description
FF450R12ME4A	EconoDUAL™ 3 half-bridge power module, 1200 V/450 A
FF600R12ME4A	EconoDUAL™ 3 half-bridge power module, 1200 V/600 A
FF900R12IP4V	PrimePACK™ 2 half-bridge power module 1200 V/900 A
FD/DF600R12IP4V	PrimePACK™ 2 high- and low-side chopper modules 1200 V/600 A
IKW/IKQxxN60/N120/T/H3	Discrete IGBT PG-TO247/Plus 1200 V/600 V/8–120 A
2ED300C17-S/ST	Half-bridge high-power IGBT-driver
1ED020I12-FA	Single-channel IGBT-driver IC
2ED010I12-XXX	Dual-channel IGBT-driver IC





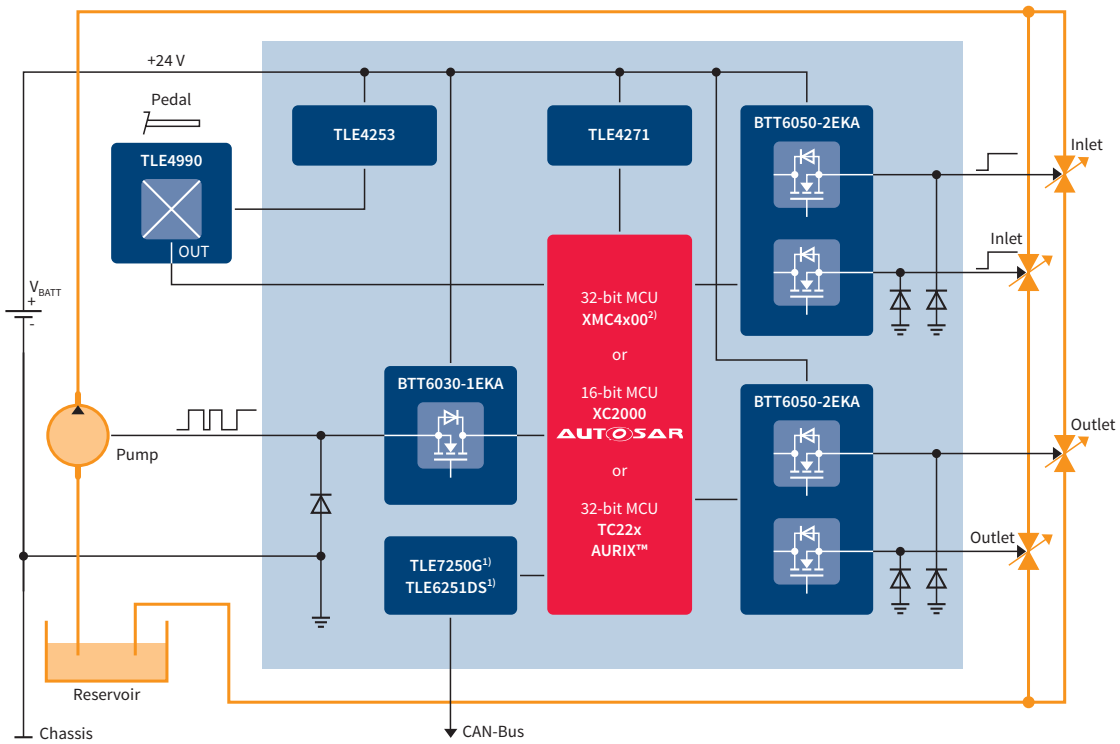
Valve Control

Whether hydraulic or pneumatic, control valve management systems must have the right characteristics and functions to meet CAV demands. To efficiently control an inductive valve, a hydraulic management system has to be precise and robust enough to withstand harsh environments and engineered to provide the right selection

of protective and diagnostic functions. A pneumatic management system, on the other hand, is typically chosen because it's cost friendly and easier to integrate (no need for a reservoir) than its hydraulic counterpart, but can still withstand a harsh environment.



Hydraulic Management System



1) If the ECU is permanently supplied, you may need to add external protection against load dump 400 ms above 40 V.
 2) Not AEC-Q100 qualified

System Benefits

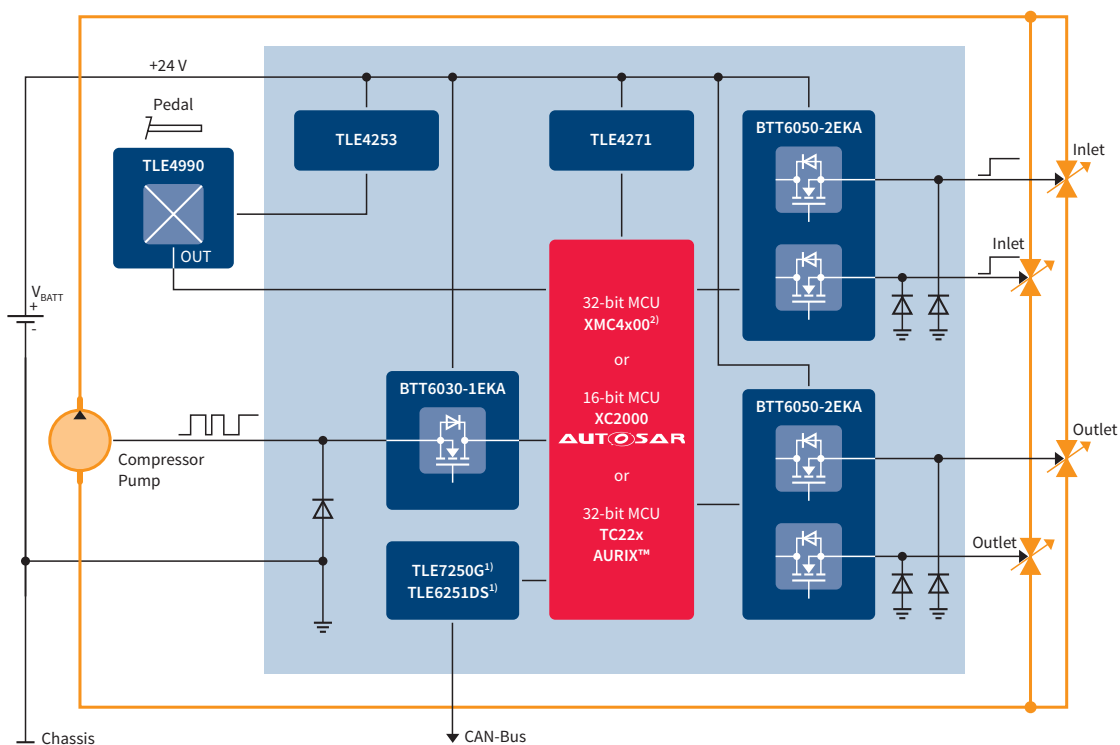
- Integrated solution reduces the design outlay
- Pin-to-pin compatibility between the 12 and 24 V PROFET™+ families
- Family concept with $R_{DS(on)}$ scalability reduces the engineering outlay
- Protection functions, including SC, overload, OT and ESD
- Diagnostic functions, including open load, OT detection, integrated OPAMP and current sense
- One-stop shop: supply, microcontrollers, actuators and sensors

Suggested Products

Product	Description
AURIX™/XMC	32-bit high-performance microcontroller families (automotive/industrial)
PROFET™+ 24V	Smart high-side switches for 24 V applications
Network Transceivers	LIN and CAN transceivers
Hall Sensors	Magnetic speed sensors
Supply ICs	Linear voltage regulator
TLE6389	DC/DC converter (automotive)



Pneumatic Management System



1) If the ECU is permanently supplied, you may need to add external protection against load dump 400 ms above 40 V.

2) Not AEC-Q100 qualified

System Benefits

- Integrated solution reduces the design outlay
- Pin-to-pin compatibility between the 12 and 24 V PROFET™+ families
- Family concept with $R_{DS(on)}$ scalability reduces the engineering outlay
- Protection functions, including SC, overload, OT and ESD
- Diagnostic functions, including open load, OT detection, integrated OPAMP and current sense
- One-stop shop: supply, microcontrollers, actuators and sensors

Suggested Products

Product	Description
AURIX™/XMC	32-bit high-performance microcontroller families (automotive/industrial)
PROFET™+ 24V	Smart high-side switches for 24 V applications
Network Transceivers	LIN and CAN transceivers
Hall Sensors	Magnetic speed sensors
Supply ICs	Linear voltage regulator
TLE6389	DC/DC converter (automotive)



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