Solutions for Smarter Driving
Automotive Applications Overview

Content

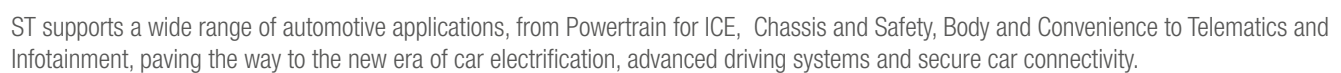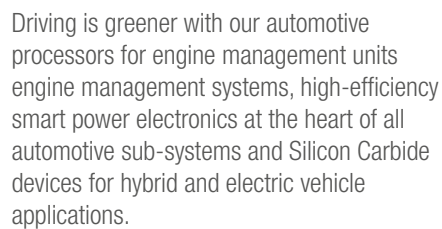# Smart Driving

It is estimated that 80% of all innovations in the automotive industry today are directly or indirectly enabled by electronics. With vehicle functionality improving with every new model this means a continuous increase in the semiconductor content per car. With over 30 years' experience in automotive electronics, ST is a solid, innovative, and reliable partner with whom to build the future of transportation.
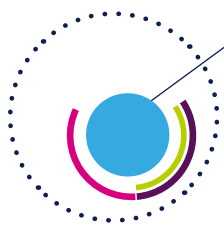
ST's Smart Driving products and solutions are making driving safer, greener and more connected through the combination of several of our technologies.

SAFER

Driving is safer thanks to our Advanced Driver Assistance Systems (ADAS) products – vision processing, radar, imaging and sensors, as well as our adaptive lighting systems, user display and monitoring technologies.

GREENER

Driving is greener with our automotive processors for engine management units engine management systems, high-efficiency smart power electronics at the heart of all automotive sub-systems and Silicon Carbide devices for hybrid and electric vehicle applications.

MORE CONNECTED

And vehicles are more connected using our infotainment-system and telematics processors and sensors, as well as our radio tuners and amplifiers, positioning technologies, and secure car-to-car and car-to-infrastructure (V2X) connectivity solutions.

ST supports a wide range of automotive applications, from Powertrain for ICE, Chassis and Safety, Body and Convenience to Telematics and Infotainment, paving the way to the new era of car electrification, advanced driving systems and secure car connectivity.

ADAS

Advanced Driver Assistance Systems (ADAS) aim to drastically reduce road accidents and the associated casualties by helping drivers avoid accidents altogether. These systems react faster than any human, are constantly vigilant, and are already being adopted and deployed across car segments, from premium to economy models.
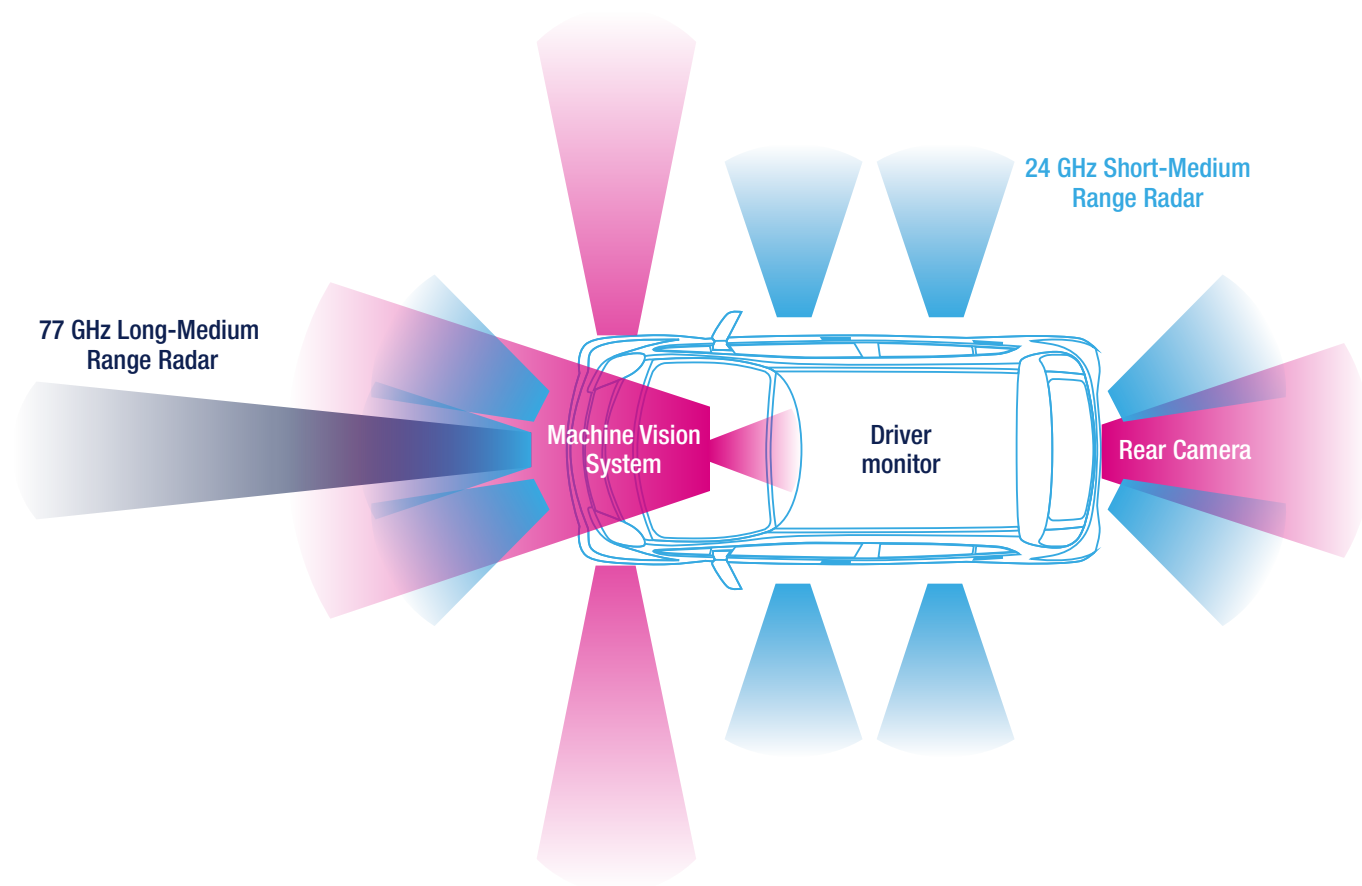
ADAS systems constantly monitor the vehicle surroundings, alert the driver of hazardous road conditions, and take corrective actions, such as slowing or stopping the vehicle. These systems use inputs from multiple sensors, such cameras and radars. The fusion of these inputs is processed and the information is delivered to the driver and other parts of the system. The sensors are the key to autonomous driving.

Camera-based technologies provide high-reliability and adaptability for a wide-range of driver assistance applications, for example, front vision, rear vision and 360° surround coverage. Radar-based ADAS uses two different carrier frequencies, 24 GHz for short-range (SRR) and 77 GHz for long-range (LRR) applications, to support features such as blind-spot detection and collision avoidance.

ST has a leading-edge product portfolio including Monolithic Microwave Integrated Circuits (MMIC), CMOS High Dynamic Range (HDR) image sensors and advanced Image Signal Processors (ISP) with dedicated HW engines for video analytics and lens correction. ST also has a wide range of Automotive Microcontrollers, Security ICs and Power Management ICs to ensure the reliability of the mission critical ADAS systems.

KEY APPLICATIONS

77 GHz Long-Medium Range Radar

24 GHz Short-Medium Range Radar

Machine Vision System

Driver monitor

Rear Camera

SOLUTIONS

ST's key products and solutions for ADAS applications include:

Image Signal Processor	Power Management	EOS and ESD Protection	32-bit Automotive Microcontrollers
Image Sensor	Automotive Radar Transceiver	Ultrafast and Schottky diodes	

HW & SW Development Tools – Sample Kits, Evaluation Kits, Product Selectors

Smart Driving

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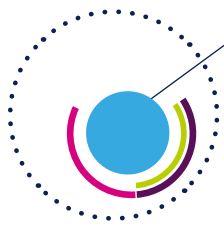
Short-medium range Radar (24 Ghz)
Long-medium range Radar (77 Ghz)
Vision Systems
Camera System

Body and Convenience

Car body and convenience applications are evolving to increase the comfort of both drivers and passengers. Vehicle manufacturers need solutions that have the flexibility to cover a wide range of car models and a broad range of options. These solutions need to communicate increasing amounts of data to enable decentralized control, enhanced functional safety levels, as well as efficient diagnostic and maintenance capabilities.
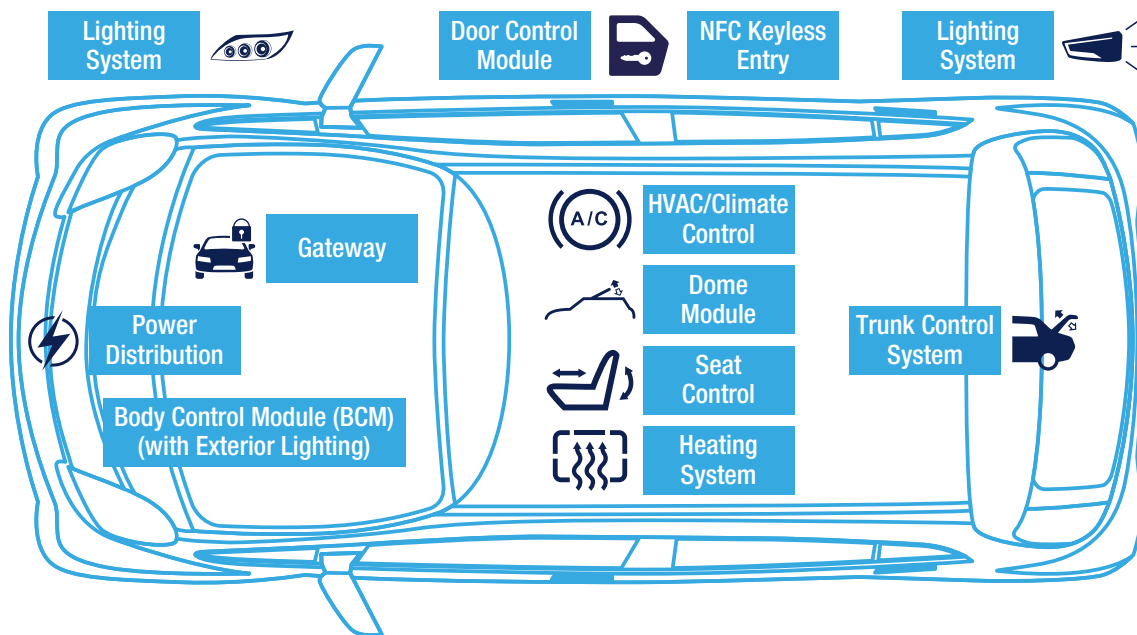
Body control modules (BCM) are increasingly being used to control multiple vehicle functions, with integration becoming a key discriminator. Cost-effective flexible semiconductor solutions for BCMs depend upon having the right technology for the application needs.

ST has the broadest product portfolio dedicated to body and convenience solutions, covering interior and exterior lighting systems for bulbs, xenon HID and LEDs and drive controllers for stepper, brushed and brushless DC motors. We provide complete solutions for seat positioning and trunk, mirror, window, wiper and lock control as well as everything required for automatic climate control systems. In addition, we supply connectivity solutions to link all the sub-systems together, whether with LIN, CAN or Ethernet.

Our proven automotive grade Smart Power technologies, Bipolar-CMOS-DMOS (BCD) and VIPower can combine multiple functions on a single chip to provide unprecedented levels of integration. Our CMOS and discrete power technologies complement the Smart Power technologies and our wide range of automotive packages completes the offer.

KEY APPLICATIONS

Lighting System	**Door Control Module**	**NFC Keyless Entry**	**Lighting System**

Gateway

Power Distribution

Body Control Module (BCM) (with Exterior Lighting)

HVAC/Climate Control

Dome Module

Seat Control

Heating System

Trunk Control System

SOLUTIONS

ST's key products and solutions for body and convenience applications include:

VIPower and BCD Actuators, Motor Control and LED drivers	Sensors	EEPROM	Power Management	EOS and ESD Protection	32-bit Automotive Microcontrollers
	NFC	Connectivity	Power Diode, MOSFET & IGBT	Dedicated Door Module ICs	

HW & SW Development Tools – Sample Kits, Evaluation Kits, Product Selectors
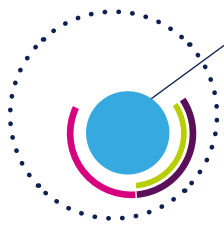
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https://www.st.com/content/st_com/en/applications/body-and-convenience.html?icmp=tt7375_gl_qron_jun2018

Body Control Module	Head-up Display
Consumer Device Charging	Heating System
Dome Module	HVAC / Climate Control
Door Lock	LED Lighting System
Door Module	NFC Keyless entry
Exterior Lighting	Power Distribution
Gateway	Seat Control

Chassis and Safety

Active and passive safety systems that reduce the risk of accidents, as well as their consequences, are becoming more sophisticated with an increasing electronic component count.
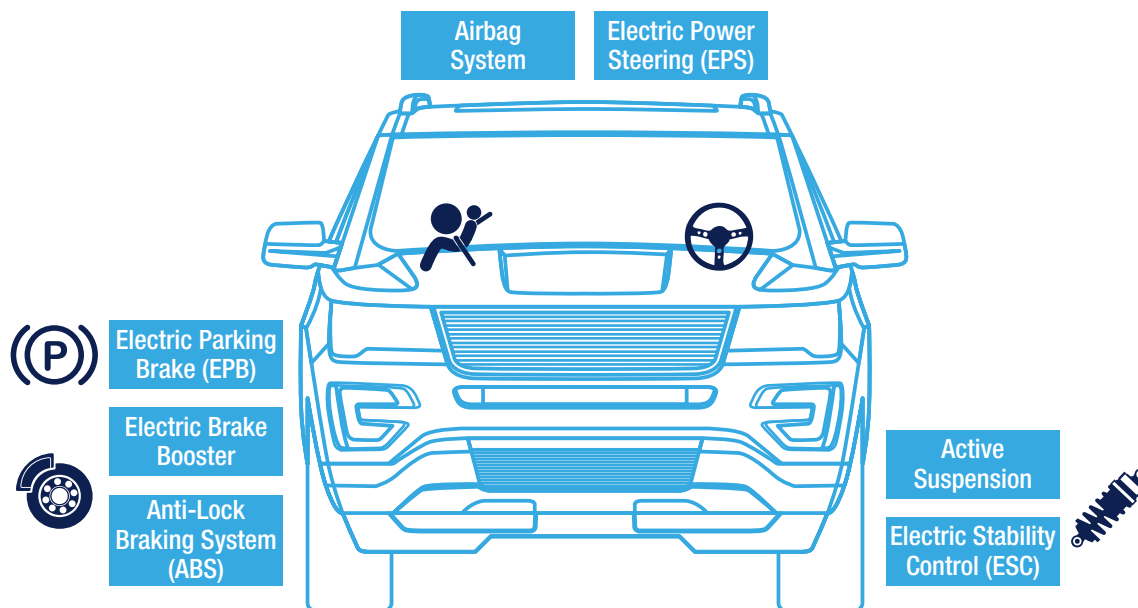
Active safety applications such as electric power steering, electric parking brakes, active suspension, anti-lock braking systems (ABS) increasing rely on sensors, brushed and brushless motors and microcontrollers to improve performance and reliability. Passive applications like seat-belt tensioners and airbags also benefit from the latest technology.

ST offers a range of both standard and dedicated devices to enable all these chassis and safety applications. These include standard low-side, high-side, bridge and pre-drivers, Smart Power devices for driving solenoids, brushed, brushless and stepper motors; dedicated ICs for actuator driving and one of the industry's broadest ranges of Power MOSFETs. We also supply System Basis Chips (SBC) for fully integrated smart-power solutions, MEMS accelerometers and gyroscopes, and powerful 32-bit automotive microcontrollers to provide reliable control.
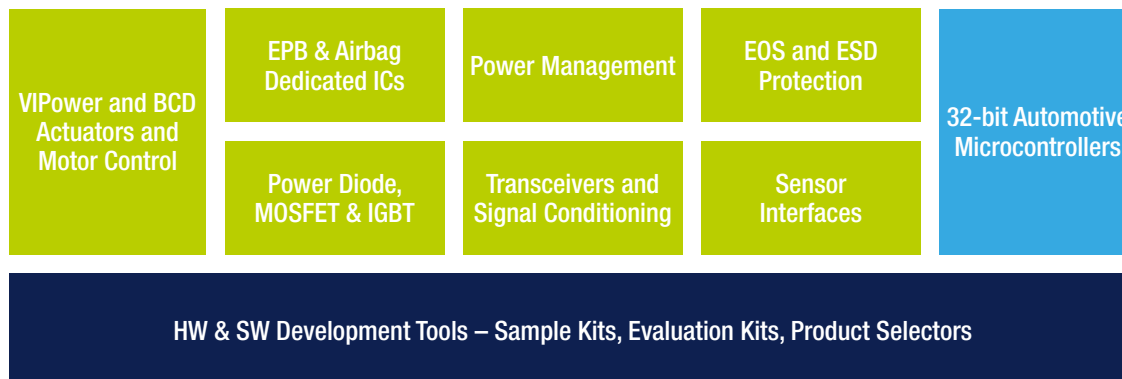
KEY APPLICATIONS

Airbag System	Electric Power Steering (EPS)

Electric Parking Brake (EPB)

Electric Brake Booster

Anti-Lock Braking System (ABS)

Active Suspension

Electric Stability Control (ESC)

SOLUTIONS

ST's key products and solutions for Chassis and Safety applications include:

VIPower and BCD Actuators and Motor Control	EPB & Airbag Dedicated ICs	Power Management	EOS and ESD Protection	32-bit Automotive Microcontrollers
	Power Diode, MOSFET & IGBT	Transceivers and Signal Conditioning	Sensor Interfaces	

HW & SW Development Tools – Sample Kits, Evaluation Kits, Product Selectors

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Electrical Power Steering
Electrical Parking Brake
Electric Brake Booster
Belt Tensioner

Airbag System
Active Suspension
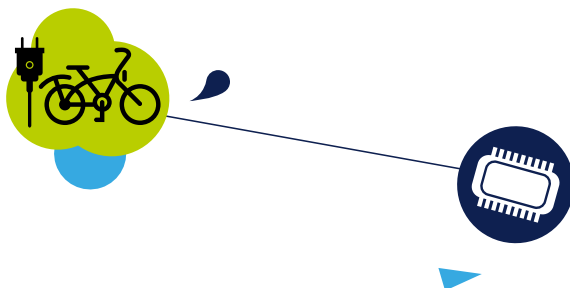ABS and ESC
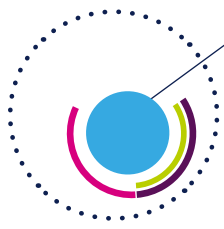
Electro-Mobility

The electrification of vehicles is increasing rapidly, driven by the availability of higher-performance and more cost-effective battery technologies, and improved mileage vehicles as well as ecological awareness, and government incentives and regulation.
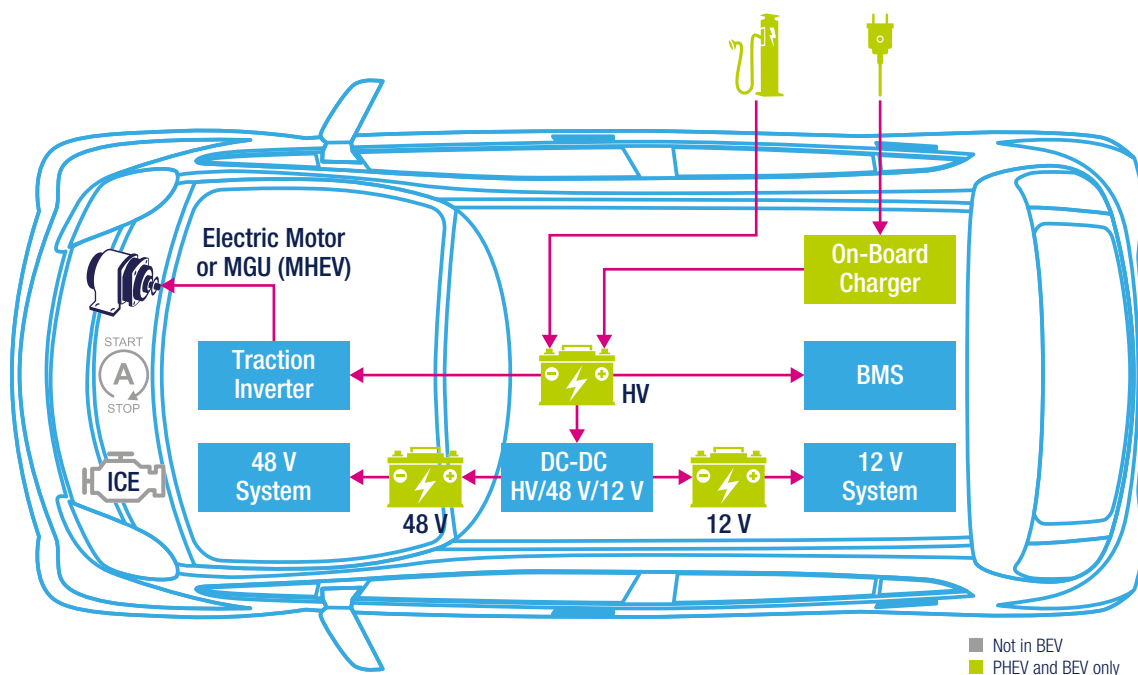
ST provides leading-edge solutions for hybrid (HEV), and battery electric vehicles (BEV) based upon proven and innovative technologies and backed up with our extensive power management experience.

Best-in-class IGBT, silicon and SiC (Silicon Carbide) MOSFETs and diodes, protection components, isolated gate drivers and microcontrollers make up an unrivalled offer for electric vehicle power management. They are available as discrete components, or as part of dedicated system solutions, all in accordance with the AEC-Q100 and AEC-Q101 standards.

If you are looking the cost-effective, yet emission reducing first step on the electrification ladder with silicon solutions for 48 V systems for mild hybrids, we have the solutions. If you need traction inverter, battery management system and on-board charger solutions for a fully electric vehicle, ST has the products you need too.

KEY APPLICATIONS

Electric Motor or MGU (MHEV)

START
A
STOP

ICE

Traction Inverter

48 V System — 48 V

DC-DC HV/48 V/12 V — HV

On-Board Charger

BMS

12 V System — 12 V

■ Not in BEV
■ PHEV and BEV only

SOLUTIONS

ST's key products and solutions for Electro-Mobility applications include:

SiC MOSFETs and Diodes	Transceivers	Signal Conditioning	Power Management	32-bit Automotive Microcontrollers
Power MOSFETs and IGBTs	Power Diodes and thyristors	EOS and ESD Protection	BCD Integrated and Isolated Drivers	

HW & SF Development Tools – Sample Kits, Evaluation Kits, Product Selectors
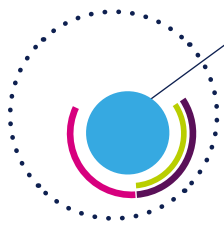
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Battery Management System (BMS)
Charging Station
DC-DC Converter
Electric 2-wheelers

Electric Traction (Main Inverter)
Mild Hybrid 48 V Systems
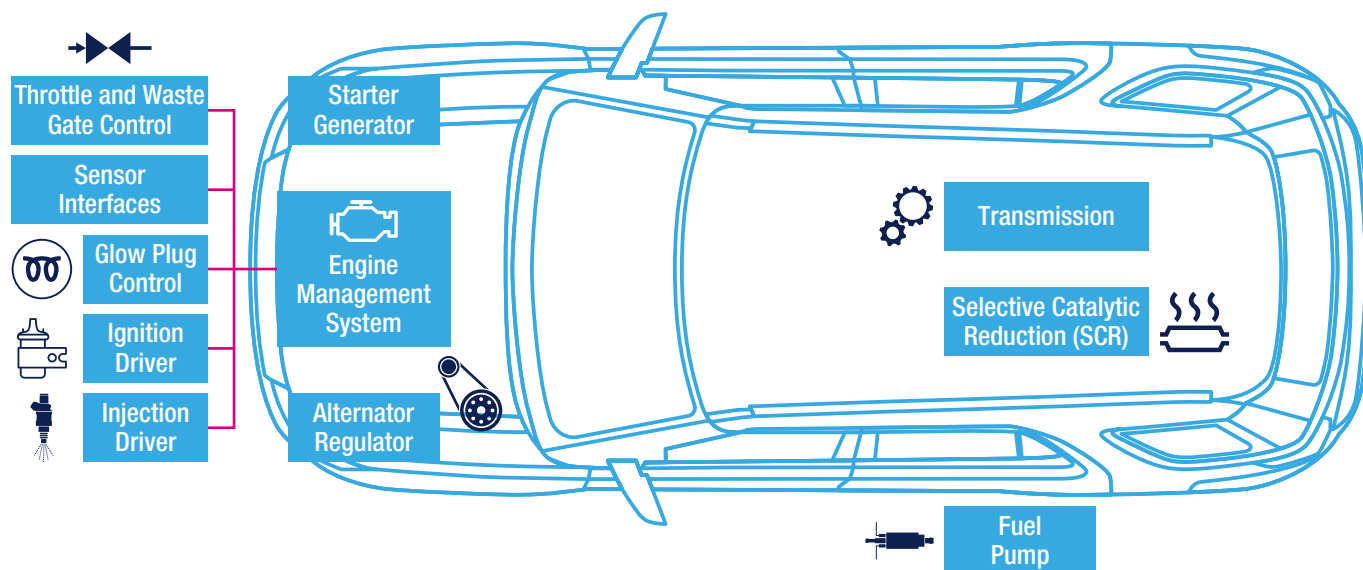On Board Charger (OBC)

Powertrain for ICE

Reducing CO_2 and particle emissions, while increasing engine performance and improving the overall driving experience requires ever more sophisticated semiconductor-based solutions. A combination of increased processing power, built-in security and safety features, and innovative power technologies are revolutionizing Internal Combustion Engine (ICE) powertrain applications.

ST provides silicon solutions for a broad range of Engine Management Systems (EMS), from motorbikes to multi-cylinder gasoline direct injection and common-rail diesel engines, as well as for transmission control and actuation. Our broad in-house technology portfolio enables a complete range of solutions, from cost-effective highly integrated systems to solutions meeting the most advanced high-performance application requirements.

Our product portfolio addresses your entire system solution, providing 32-bit automotive microcontrollers, standard low-side, high-side and bridge smart power devices for driving solenoids, DC motors and stepper motors. Dedicated ICs for actuator driving, charging and power management, together with one of the industry's broadest ranges of Power MOSFETs and IGBTs complete the ICE powertrain offer.

KEY APPLICATIONS

Throttle and Waste Gate Control

Sensor Interfaces

Glow Plug Control

Ignition Driver

Injection Driver

Starter Generator

Engine Management System

Alternator Regulator

Transmission

Selective Catalytic Reduction (SCR)

Fuel Pump

SOLUTIONS

ST's key products and solutions for Powertrain for Internal Combustion Engines applications include:

- VIPower and BCD Actuators and Motor Control
- Transceivers
- Power Management
- EOS and ESD Protection
- Power Diode, MOSFET & IGBT
- Signal Conditioning
- Sensor Interfaces
- 32-bit Automotive Microcontrollers

HW & SW Development Tools – Sample Kits, Evaluation Kits, Product Selectors

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Engine Management Systems	Alternator Regulator
24 V Engine Management	Electric Turbo Compressor
Gasoline Direct Injection	Fuel Pump
Gasoline multi-port Injection	Motorcycle Engine Control
Diesel Direct Injection	Selective Catalytic Reduction
LPG Engine Control	Transmission
CNG Engine Control	
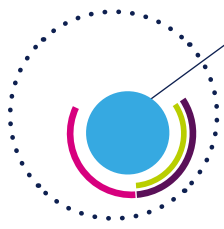
In-vehicle Infotainment

Consumer experiences with personal electronics are shaping expectations for in-vehicle infotainment systems making it a fast-evolving segment of the automotive industry. Vehicle occupants expect to be entertained, connected and able to seamlessly access information and content from a variety of sources.

At ST, we have been developing innovative integrated circuits for in-vehicle Infotainment since our first car radio ICs. Our latest designs provide IC solutions for complex infotainment clusters, integrating advanced audio and video features, mirroring smartphones and multimedia devices and running apps, while transmitting data quickly and securely inside and outside the car. Greater processing power, high in-car bandwidth, secure external communication links and world-class audio amplifiers all combine to ensure that you can build infotainment systems for all your markets.

Our extensive infotainment portfolio covers everything from the high-end integrated platforms, digital radio and outstanding class AB and class D audio power amplifiers.

KEY APPLICATIONS

- ((⊳ ⊲)) Sound system
- Infotainment head Unit
- Terrestrial Tuner
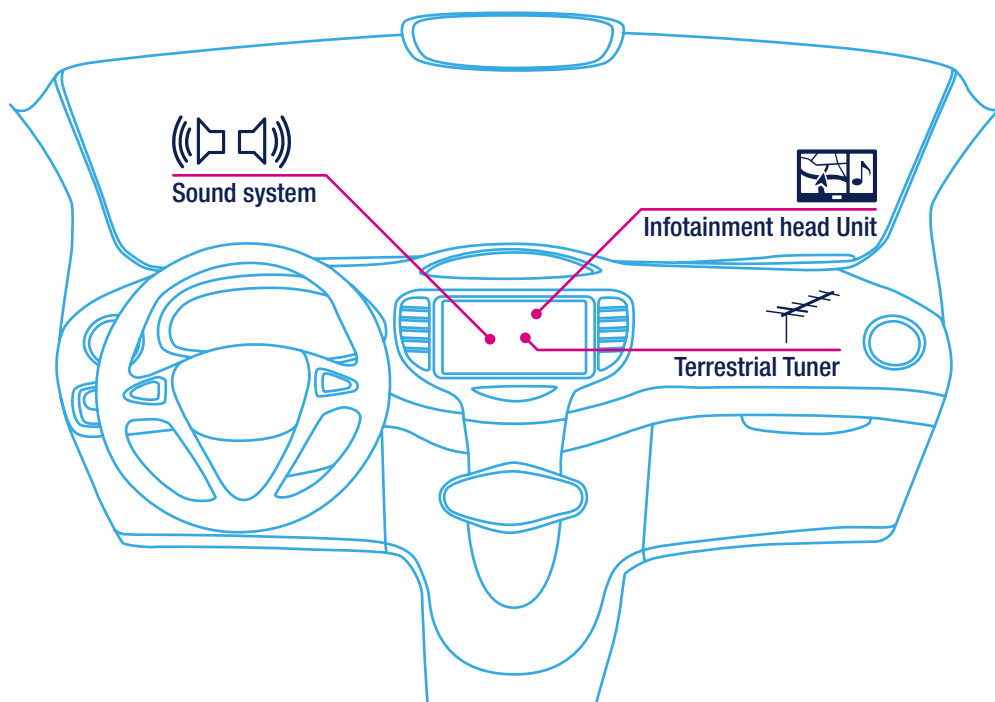
SOLUTIONS

ST's key products and solutions for In-Vehicle Infotainment applications include:

Audio Power Amplifiers	GNSS	Power Management	EOS and ESD Protection	Infotainment & Digital Audio Processors and Secure Processors
Tuners	Bluetooth, USB and Connectivity	Sensors	MEMS Microphones	

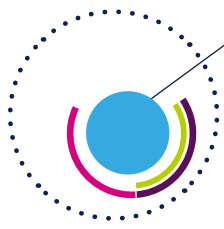**HW & SW Development Tools – Sample Kits, Evaluation Kits, Product Selectors**

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Infotainment Module	Positioning system
Terrestrial Tuner	Infotainment Head Unit
Sound System	Digital Clusters

Telematics and Networking

Connectivity is revolutionizing the vehicles on our roads. Connectivity to the cloud and cloud based services benefit occupants but also manufacturers by enabling over-the-air software upgrades and predictive maintenance. The increasing count of electronic control units (ECUs) for safety, engine management, motor control, infotainment all need to be networked, upgradeable and secure. In-car connectivity for occupants, Wi-Fi or Bluetooth needs to fit seamlessly with the other networks. Vehicle-to-Vehicle (V2V) and Vehicle-to-Everything (V2X) communications are coming soon and all these communication channels need to be secured and linked with a telematics gateway.

ST's product range covers a wide selection of telematics and networking devices from the most accurate GNSS positioning products to powerful multicore telematics processors with embedded security modules, from sensors for vehicle acceleration/deceleration monitoring and crash detection to smart gateways enabling Firmware-over-the-Air (FOTA) updates.

To provide you with the car connectivity solutions you need, we leverage our extensive hardware and software expertise and our partnerships with market leaders.
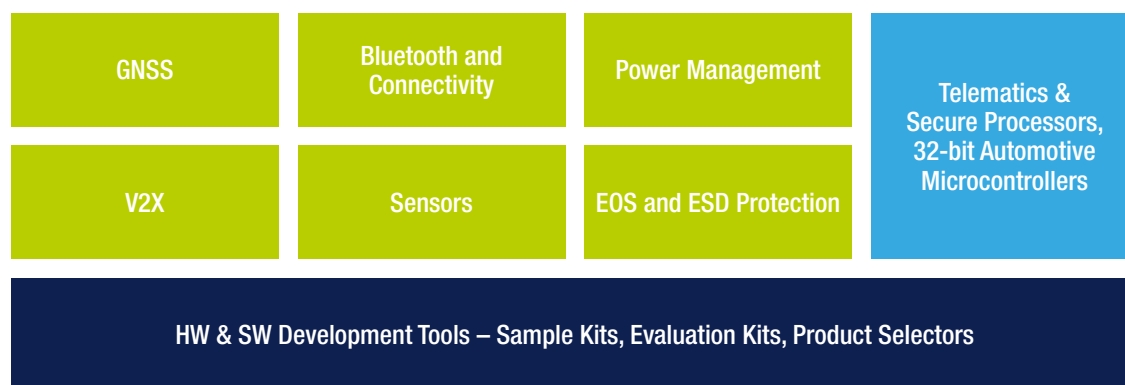
KEY APPLICATIONS

Vehicle to Everything (V2X)

Firmware-over-the-Air (FOTA)

Smart Antenna

Telematics & Connectivity Control Unit

Secure Connectivity Module

Gateway
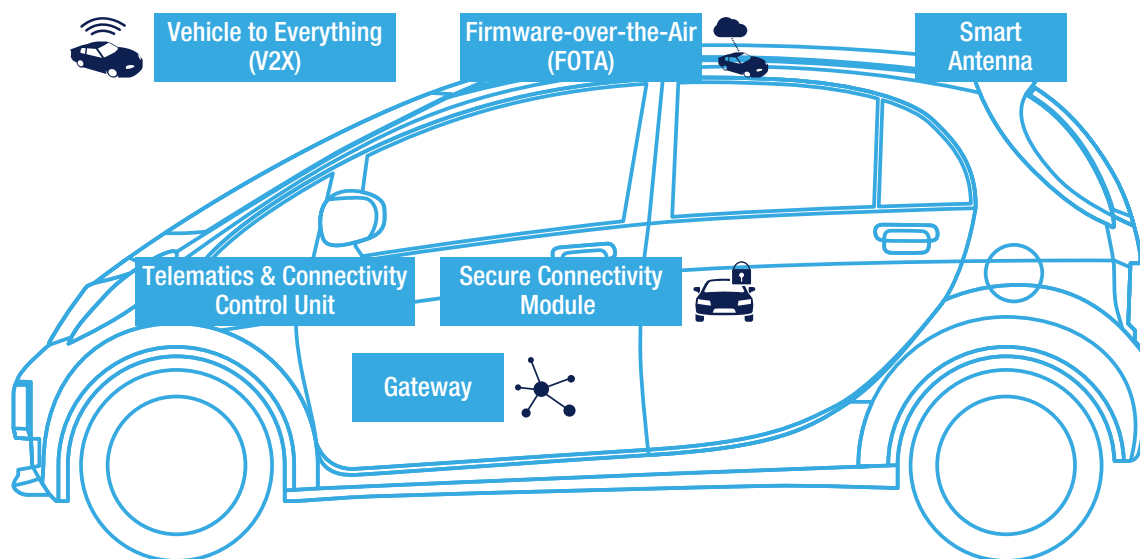
SOLUTIONS

ST's key products and solutions for Telematics and Networking applications include:

GNSS	**Bluetooth and Connectivity**	**Power Management**	**Telematics & Secure Processors, 32-bit Automotive Microcontrollers**
V2X	**Sensors**	**EOS and ESD Protection**	

HW & SW Development Tools – Sample Kits, Evaluation Kits, Product Selectors
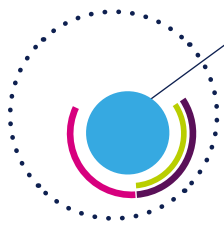
Smart Driving

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Vehicle-to-Everything (V2X)
Insurance Telematics Box
Smart Antenna
Secure Connectivity

Positioning & Navigation
Firmware Over the air (FOTA)
Gateway

Mobility Services

Mobility services are growing rapidly as vehicles become more connected. Powerful processing, vehicle connectivity and innovative sensors enable new possibilities for software service developers and a wealth of applications for car owners.

Car Safety enhancing services like "emergency call" in the event of an accident rely on sensors to detect an accident, on telematics processing and GNSS positioning to transmit the accident location, and on-board cameras to record the event and provide advance information to the arriving emergency services. Insurance boxes can record events prior to accidents but are also changing the market by enabling driver monitoring which provides data to customize tariffs based upon the driver's behavior.

Other mobility services range from fleet management, to car sharing, from free parking place detection to road tolling. All these services rely on automotive sensors, processing and communications semiconductors available from ST.

As the car evolves from a personal vehicle to a shared service provided by a fleet of driverless vehicles in a smart city environment the level of offered services will grow dramatically. ST's products are used in many advanced driving systems, and our proven record in secure connectivity and sensor technologies can serve as the platform on which Mobility services can be built.

KEY APPLICATIONS

Connected Vehicle Cloud — Car Sharing, Automatic Tolling, e-Call, Fleet Management, Insurance Box
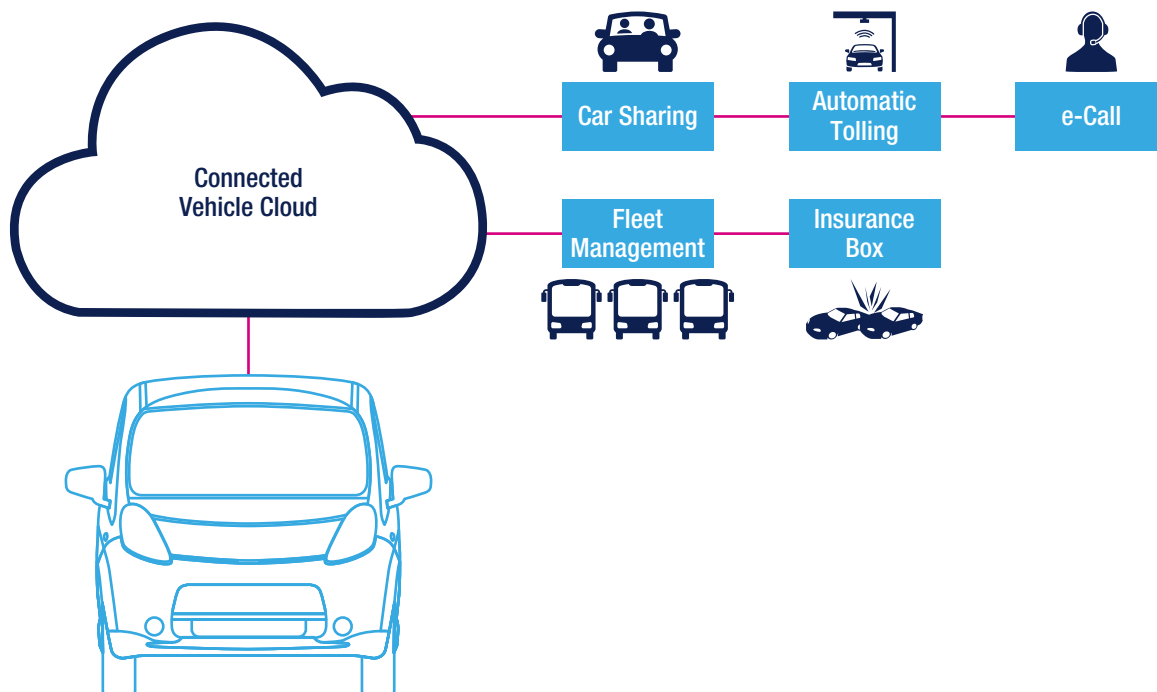
SOLUTIONS

ST's key products and solutions for Mobility Services applications include:

GNSS	Bluetooth, NFC and Connectivity	Ultrafast and Schottky Diodes	Transceivers and Interfaces
Audio Power Amplifier	Power Management	EOS and ESD Protection	Sensors

Telematics Processors and 32-bit Automotive Microcontrollers

HW & SW Development Tools – Sample Kits, Evaluation Kits, Product Selectors

Smart Driving

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e-Call
Insurance Telematics Box
Fleet Management

Car Sharing
Automatic Tolling

Key Technologies

RESEARCH & DEVELOPMENT AND MANUFACTURING

To keep its technology edge, ST maintains a strong commitment to innovation, with approximately 7,400 people working in R&D and product design and spending about 16% of its revenue in R&D. Among the industry's global technology leaders, ST owns and continuously refreshes a substantial patent library (~17,000 patents; ~9,500 patent families and ~500 new patent filings per year).

The Company draws on a rich pool of chip-manufacturing technologies, including advanced FD-SOI (Fully Depleted Silicon-on-Insulator) CMOS (Complementary Metal Oxide Semiconductor), differentiated Imaging technologies, RF-SOI (RF Silicon-On-Insulator), BiCMOS, BCD (Bipolar, CMOS, DMOS), Silicon Carbide, VIPower, and MEMS technologies.

ST believes in the benefits of owning manufacturing facilities and operating them in close proximity and coordination with its R&D operations. ST has a worldwide network of front-end (wafer fabrication) and back-end (assembly and test and packaging) plants. ST's principal wafer fabs are located in Agrate Brianza and Catania (Italy), Crolles, Rousset, and Tours (France), and in Singapore. These are complemented by assembly-and-test facilities located in China, Malaysia, Malta, Morocco, the Philippines, and Singapore.
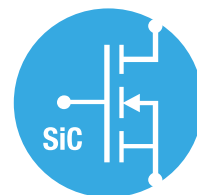
KEY TECHNOLOGIES FOR AUTOMOTIVE PRODUCTS

Silicon Carbide

Silicon Carbide (SiC) is a wide bandgap material, with many advantages compared to silicon in the field of power electronics. Operating temperatures are higher, heat dissipation is improved and switching and conduction losses are lower making it an ideal technology for vehicle electrification. Silicon Carbide based traction inverters can increase electric vehicle range and SiC based chargers reduce the charge time.

ST has been working with Silicon Carbide since 1996. In 2009 ST started to produce its first SiC MOSFETs and since then we have added 1200 V versions of both SiC MOSFETs and power Schottky diodes to complement the original 650 V versions.

ST produces the automotive-grade SiC power devices, in a dedicated 6" front-end wafer fab, that are becoming the key enabler in the automotive industry for vehicle electrification.

VIPower™

VIPower™ is a technology developed by ST and in production since 1991. Vertical Intelligent Power technologies provide control, protection and diagnostics for medium/high power automotive loads. The technology combines Vertical Double Diffused MOS Power devices with their own temperature and current sensors and CMOS and HV components for Power-Analog-Mixed design.

VIPower technology is the perfect choice for the control of automotive exterior and interior lighting, DC motors for seat adjustment, door locks and window lifts, resistive heaters and any kind of power load that needs control and sensing as well as power. VIPower products are replacing a host of electro-mechanical solutions, and providing lower power, lower chip count and lower pin-count solutions.

VIPower technology will play a key role in the move towards electric vehicles. The smart 48 V networks used in Mild and Full Hybrid cars require intelligent power switches to drive high- and low-sided loads and electric motors, with very low losses and high current sense accuracy, all monitored via the connections to the ECUs microcontroller.

BCD (BIPOLAR-CMOS-DMOS)

BCD (BIPOLAR-CMOS-DMOS) is a key technology for power ICs. BCD combines the strengths of three different process technologies onto a single chip: Bipolar for precise analog functions, CMOS (Complementary Metal Oxide Semiconductor) for digital design and DMOS (Double Diffused Metal Oxide Semiconductor) for power and high-voltage elements.

This combination of technologies brings many advantages: Improved reliability, reduced electromagnetic interference and smaller chip area. BCD has been widely adopted and continuously improved to address a broad range of products and applications in the fields of power management, analog data acquisition and power actuators.

BCD technology is used widely in the automotive industry and products are found in active suspension, braking, transmission, airbag, car audio and notably engine management and charging applications. A key engine management application is for fully integrated System-on-Chip solutions for CO_2 reducing Gasoline Direct Injection (GDI) systems. For EV charging BCD is ideal for battery management systems (BMS).

Development Tools

PRODUCT SELECTORS, SAMPLES, EVALUATION BOARDS

ST provides a set of Smart Selectors tuned to the needs of the Automotive Industry. Once the appropriate products have been selected, a wide range of samples and evaluation boards are available to help you get started and reduce your development times. In addition to boards, ST provides schematics, BOM and Gerber files to facilitate your hardware design and demonstration software packages are available too.

Product Selectors

Rapidly find the most relevant automotive products for your designs.

Evaluation Boards

ST evaluation boards help you evaluate the features and performance of selected products and system solutions that demonstrate optimized and tested solutions for your application design.

SPC5 AUTOMOTIVE MCU EVALUATION TOOLS: EASIER EVALUATION AND FASTER DEVELOPMENT

A complete range of hardware evaluation and emulation tools supports the SPC5 family of automotive microcontrollers. Discovery and Premium development boards are available to support your development from preliminary evaluation through to advanced solution development.

ST Discovery boards, available for each product line enable a quick and easy way to evaluate the microcontroller's main features. The expansion connector makes it easy to plug in application and extension modules for rapid prototyping.

ST Premium boards, available for all lines and packages provide user access to the device's complete feature set and functionalities for advanced development. The SPC5 motherboards, used in combination with adapters, enable full access to all of the MCU's signals and peripherals (such as CAN, SPI, LIN, FlexRAY and Ethernet).

The offer is complemented by a series of emulation solutions for high-speed tracing, monitoring and bypassing.

A full range of state-of-the-art tools and software from major third parties is also available for the SPC5 family of automotive microcontrollers.

SPC5 MCUs toolchain

Discovery kits
Quick starter kit for early evaluation
ST Discovery boards enable the user for a quick evaluation of main device features

Premium boards
Complete HW solutions for advanced development
ST Premium boards ensure full access to device's features and functionalities

SPC5Studio
Freeware Eclipse based Development Studio
SPC5Studio integrates our Resources Configurator, Code Generator supporting major third party tools

Embedded Software & AUTOSAR Solutions
Drivers and Software Libraries
Crypto and flash SW Libraries
Core & Instruction Self test Libraries
AUTOSAR MCAL

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mcu-eval-tools/spc5-automotive-mcu-eval-tools.html?icmp=tt7555_gl_qron_jun2018

SIMULATORS FOR MOTOR CONTROL

TwisterSIM is a unique Electro-Thermal simulator that helps shorten the design solution cycle by enabling, in a few clicks, complex engineering evaluations with accurate simulations like load-compatibility, wiring harness optimization, fault condition impact analysis, diagnostic behavior analysis and dynamic thermal performance.
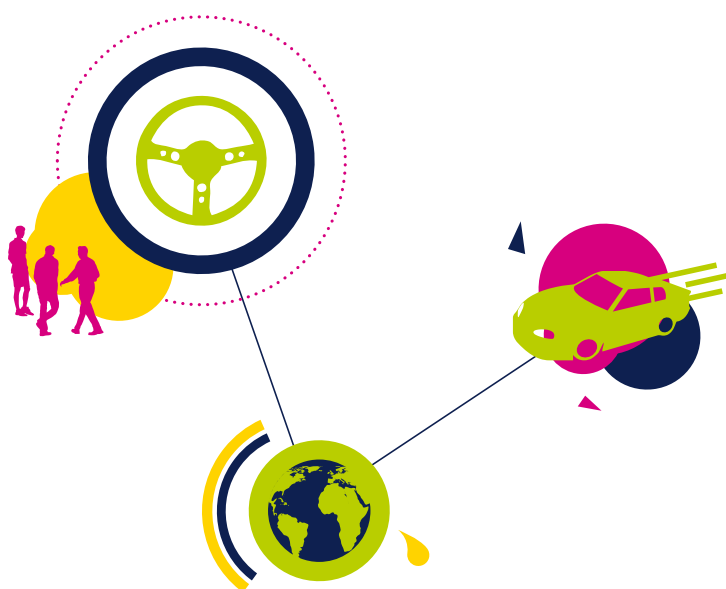
A built-in Interactive selector provides a short list of suitable devices based on first level system requirements. It assists you in detailing your actual system configuration with layout, load and driving profile customization to build an accurate model of the final application.

TwisterSIM supports a large selection of Low/High-side driver/switches and H-bridges for Motor Control.

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