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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.
Reducing CO₂ 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 motorcycles 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.
ST’s key products and solutions for Powertrain for Internal Combustion Engines applications include:

- Engine Management Systems
- 24 V Engine Management
- Gasoline Direct Injection
- Gasoline multi-point Injection
- Diesel Direct Injection
- LPG Engine Control
- CNG Engine Control
- Alternator Regulator
- Electric Turbo Compressor
- Fuel Pump
- Motorcycle Engine Control
- Selective Catalytic Reduction
- Transmission
- Transmission
- Selective Catalytic Reduction (SCR)
- Fuel Pump
- Engine Management System
- Alternator Regulator
- Starter Generator
- Throttle and Waste Gate Control
- Sensor Interfaces
- Glow Plug Control
- Ignition Driver
- Injection Driver
- Power Diode, MOSFET & IGBT
- Signal Conditioning
- Sensor Interfaces
- Power Management
- EOS and ESD Protection
- 32-bit Automotive Microcontrollers
- HW & SW Development Tools – Sample Kits, Evaluation Kits, Product Selectors

FIND OUT MORE

www.st.com/powertrain-for-ice
Governmental regulations, energy concerns and market requirements for very high performing vehicles brought the automakers to develop enhanced engine solutions. A key application combining fuel saving and high performances is Gasoline Direct Injection (GDI).

ST, with a strong portfolio of advanced technologies, can provide dedicated solutions for all the gasoline direct injection application needs. Our highly integrated System Basis Chips (SBC) combine all the required functions, including voltage regulation, bus interface, high/low side drivers, etc.
GASOLINE MULTI-POINT INJECTION

Gasoline multi-point fuel injection (MPI) is the most widely used powertrain system for spark ignition engines. This system, where fuel is injected at low pressure in the inlet air manifold, is a proven, robust and simple technology.

To control and optimize performance, a wide range of semiconductor solutions are required that are specifically designed for automotive applications.

We have a wide and comprehensive offer including SPC5 32-bit microcontrollers and specifically designed System Basis Chips (SBC) that combine voltage regulators for the various DC rails, bus interface ICs for the most common standards including CAN, ISO 9141 K-line, Variable Reluctance Sensors (VRS) and high- and low-side drivers.

Gasoline Multi-point Injection

FIND OUT MORE

www.st.com/gasoline-multi-point-injection
DIESEL DIRECT INJECTION

The diesel engine is one of the most efficient types of internal combustion engine. Advanced fuel injection technologies based on high-pressure common rail systems and optimized exhaust gas after-treatment systems help reduce noise and particle emissions while maintaining high performance and efficiency.

The use of electronic control plays an increasingly central role in optimizing performance at the appropriate cost point while helping ensure compliance with emission regulations and provide greater fuel efficiency.

We have a complete offer with specifically designed System Basis Chips (SBC) that combine voltage regulators for the various DC rails, bus interface ICs for the most common standards including CAN, ISO 9141 K-line, Variable Reluctance Sensors (VRS) and high- and low-side drivers. The SPC5 32-bit microcontroller family can provide the processing power and connectivity.

Diesel Direct Injection
LPG ENGINE CONTROL

The growing demand for engines with reduced fuel costs or tax and mobility incentive schemes implemented in many countries has pushed car manufacturers to develop systems running on alternative fuels. Gasoline internal combustion engines running on Liquid Petroleum Gas (LPG) are based on proven technologies and typically have lower emissions and lower fuel costs than gasoline and diesel vehicles.

LPG is often used in bi-fuel vehicles, where it can be used alternatively with gasoline or diesel.

We have a wide and comprehensive offer including SPC5 32-bit microcontrollers and specifically designed System Basis Chips (SBC) that combine voltage regulators for the various DC rails, bus interface ICs for the most common standards including CAN, ISO 9141 K-line, Variable Reluctance Sensors (VRS) and high- and low-side drivers.
The growing demand for engines with reduced fuel costs or tax and mobility incentive schemes implemented in many countries has pushed car manufacturers to develop systems running on alternative fuels. Gasoline internal combustion engines running on Compressed Natural Gas (CNG) are based on proven technologies and typically have lower emissions and lower fuel costs than gasoline and diesel vehicles.

CNG is often used in bi-fuel gasoline vehicles, where it can be used alternatively with gasoline.

ST offers dedicated solutions for controlling powertrains in CNG and dual fuel vehicles.

**CNG Engine Control**

**Power Supply**
- Protection SMxTY

**Crankshaft Sensor**
- K-Line BUS

**K-Line BUS**
- Voltage regulator
- HS CAN transceiver
- VRS interface
- K-Line ISO9141 transceiver
- Sensors power supply

**SBC L9779WD**
- Low side drivers
- HS/LS (stepper) driver
- IGBT pre-drivers

**Sensors Interface**
- L9966

**Sensors**
- CAN bus
- Data Line ESD Protection ESDCAN0x
- Crankshaft sensor
- K-Line BUS
- Data Line ESD Protection ESDLINx

**CAN Transceiver L9616**
- SPC57 K Line
- SPC58 E Line

**Serial EEPROM M95512-A125**

**Configurable pre-driver L9945**
- Integrated H-Bridge L9960T
- Lambda interface L9780

**Lambda interface L9780**
- 40V MOSFET STB / STD

**Ignition coils**
- Turbo waste gate
- Throttle valve

**CNG Injectors**
- 40V MOSFET STB / STD

**MIL Shut-off valve, Gasoline pump relay**
- Gasoline injectors
- CNG valve relay
- CNG injectors relay
- CNG lamp
- Switches fan
- $O_2$ sensor heater

**Starter relay**
- AC relay
- 2x
- 4x

**Canister variable valve timing**
- up to 8x
- IGBT STGB / STGD

**SBC L9779WD**
- L9945
- 40V MOSFET STB / STD
Increasingly strict motorcycle emission regulations require engine manufacturers of both traditional and emerging markets to replace carburetors with electronically controlled injection systems. Improved fuel efficiency and reduced emissions as well as driving performance — all at an appropriate cost point — are the key challenge for motorcycle manufacturers, especially those building smaller motorcycles and scooters.

We offer dedicated solutions for motorcycle engine management. These include SPC5 32-bit microcontrollers and specifically designed System Basis Chips (SBC) that combine voltage regulators for the various DC rails, bus interface ICs for the most common standards including CAN, ISO 9141 K-line, Variable Reluctance Sensors (VRS) and high- and low-side drivers.

**Single-Cylinder Motorcycle Engine**

![Diagram of Single-Cylinder Motorcycle Engine Control System]
MOTORCYCLE BI-CYLINDER

Solutions for bi-cylinder motorcycle engine management. SPC5 32-bit microcontrollers for the control unit and specifically designed System Basis Chips (SBC) that combine voltage regulators, bus interfaces, Variable Reluctance Sensors (VRS), low-side drivers and O₂ sensor heaters.

Two-Cylinder Motorcycle Engine

Power Supply Protection SMxTY

12 V

Voltage Rectifier TN1610H-6T

Magnetos

CAN bus

Crankshaft sensor

K-Line BUS

Dataline ESD protection ESDLINx

Dataline ESD Protection ESDCAN0x

Sensors

Sensors interface L9966

Voltage regulator

VRS interface

K-Line ISO9141 transceiver

Sensors power supply

Voltage Rectifier TN1610H-6T

CAN Transceiver L9616

Control Unit

SPC57 M Line

Low side drivers

Stepper motor driver

O₂ sensor heater

MOSFET/IGBT pre-drivers A6387

IGBT STGB / STG

Ignition coils

MIL Fuel pump

Fan coolant Starter

Injectors

Idle actuator

O₂ sensor heater

MEMS 6-axis ASM330LH

Serial EEPROM M95512-A125

FIND OUT MORE

www.st.com/two-cylinder-motorcycle-engine
MOTORCYCLE MULTI-CYLINDER

Solutions for multi-cylinder motorcycle engine management. SPC5 32-bit microcontrollers for the control unit and specifically designed System Basis Chips (SBC) that combine voltage regulators, bus interfaces, Variable Reluctance Sensors (VRS), low-side drivers, O₂ sensor heaters and IGBT pre-drivers.

Multi-Cylinder Motorcycle Engine
ALTERNATOR REGULATOR

Found in every Internal Combustion Engine (ICE) vehicle, the alternator – and its associated control electronics – is becoming increasingly important as a key component due to the growing number of electrically actuated functions and their impact on overall power requirements.

ST has an extensive range of efficient and reliable control solutions that can be integrated using any of the various protocols used by different OEMs. Our offer covers from basic multi-function IC solutions up to advanced ECU IC controlled solutions.

Alternator Regulator
TRANSMISSION CONTROL / ELECTRIC TRANSMISSION

An Automated Manual Transmission (AMT) is an advanced control system for gear shifting that eliminates the need for a clutch pedal while still letting the driver decide when to change gears. This electronically actuated and synchronized clutch and gear-box can help improve driving experience – especially in city traffic – as it completes the clutch and gear-shift operations more quickly and accurately than a human.

A complete electric transmission solution including SPC5 32-bit microcontrollers for control units, an SBC with High-side pre-drivers, Motor Driver ICs and STripFET™ Full-Bridge power devices.

Electric Transmission
HIGH-END HYDRAULIC TRANSMISSION

A complete High-end Hydraulic Transmission solution including SPC5 32-bit microcontrollers for control units, an SBC with High-side pre-drivers, Motor Driver ICs and STripFET™ Full-bridge power devices.

High-end Hydraulic Transmission
CVT AND LOW-END HYDRAULIC TRANSMISSION

A complete Continuously Variable Transmission (CVT) and low-end Hydraulic Transmission solution including SPC5 32-bit microcontrollers for control units, an SBC with high and low-side pre-drivers, Motor Driver ICs and STripFET™ Full-bridge power devices.

CVT and Low-end Hydraulic Transmission

![Diagram of CVT and Low-end Hydraulic Transmission system]

- **Power Supply Protection SMxTY**
- **U-chip L9300**
  - Voltage regulator
  - Watchdog
  - Wake-up
  - Wake-up and reset
  - Sensors power supply
- **Control Unit**
  - SPC57 S Line
  - SPC58 E Line
  - 6x integrated valve drivers
- **High side pre drivers**
- **Hydraulic solenoid**

- **Protection switch VN5R003H**
- **High Side Driver VN7003AH**
- **Motor Driver L9907**
- **Full Bridge STripFET F7 Series**
- **Oil Pump**

- **CAN bus**
- **ESD Protection ESDCAN0x**
- **CAN Transceiver L9616**
- **Sensors Interface L9966**
- **Serial EEPROM M95512-A125**

**FIND OUT MORE**

www.st.com/cvt-and-low-end-hydraulic-transmission
SELECTIVE CATALYTIC REDUCTION (SCR)

Selective Catalytic Reduction (SCR) is a chemical process converting nitrogen oxides (NOx) into diatomic nitrogen and water as well as a small amount of carbon dioxide. This process is facilitated by the addition of automotive-grade urea – known as Diesel Exhaust Fluid (DEF) or commercial brands like AdBlue and Bluetechn – to convert hazardous NOx emissions from diesel engines into harmless nitrogen and water.

The SCR block controls a pump that draws DEF from its tank and injects it, with an appropriate dosing valve, into the diesel exhaust gases. To optimize fuel efficiency, a gas sensor is located after the catalytic reduction process and its information is fed to the diesel engine ECU that combines this information with the engine status and gives to the SCR unit accurate information regarding the right amount of DEF liquid to release.

We have a range of three-phase gate drivers and Power MOSFETs for the commonly used brushless DC (BLDC) motors, as well as SPC5 32-bit microcontrollers and dedicated power management ICs with voltage regulators and CAN and LIN Interface ICs to simplify the design of high-efficiency solutions.

SCR

![Diagram of SCR components]

- **12 V Power Supply**
- **Protection SMxTY**
- **Monolithic PM L99PM62/72**
- **Power Supply**
- **Contact monitoring**
- **CAN bus**
- **ESD Protection ESDCAN0x**
- **LIN Bus**
- **ESD Protection ESDLINx**
- **Transceivers**
- **Serial EEPROM M95512-A125**
- **Control Unit**
- **Power Supply Protection SMxTY**
- **High Side Driver VN7010AJ**
- **Low Side Driver VNL5030J**
- **High Side Driver VND7040AJ**
- **High Side Driver VN7140AJ**
- **Tank pipes heaters**
- **Pipe heaters Plate heaters**
- **Valve**
- **Tank pressure pump**
- **BLDC/DC motor pre-driver L99H01 L99ASC03G L9907**
- **Full Bridge STripFET F7 Series**
- **Rail to Rail precise op amps TSZ182IYDT TSZ1211YLT**
- **Current shunts**
- **Full Bridge STripFET F7 Series**

FIND OUT MORE

www.st.com/selective-catalytic-reduction-scr
**FUEL PUMP**

Tackling the challenge of achieving improved fuel efficiency, reducing CO₂ emissions and increasing the reliability of vehicles means looking at every possible source of energy loss and rethinking the way the associated sub-system is built. This is why electric fluid pumps are replacing mechanical systems as they can help reduce losses from hydraulic friction.

Electric fuel pumps are most often implemented with brushless DC (BLDC) motors and ST has a complete range of three-phase gate drivers and Power MOSFETs to power them. SPC5 32-bit automotive-grade microcontrollers plus dedicated voltage regulators and power management ICs simplify the design of high-efficiency solutions.

**Fuel Pump**

![Fuel Pump Diagram]

12 V  
 wake  
 Power Supply Protection SMxTY  
 Voltage regulators L9001  
 Protection switch VN5R003H  
 High Side Driver VN7003AH  
 STripFET F7 Series  
 Control Unit SPC56 P Line  
 Gate driver L9907  
 CAN bus  
 ESD Protection ESDCAN0x  
 CAN Transceiver L9616  
 Brushless motor  
 Shunt Sensing  
 24
GLOW PLUG CONTROL

A glow plug is a pencil-shaped piece of metal with a heating element at the tip. Despite its simple design and electronic content, it plays a fundamental role in diesel injection systems by igniting the fuel even when the engine is insufficiently hot for normal operation, thus reducing the cranking time to start the engine.

ST has a range of solutions based on our proprietary VIPower™ silicon technology that enable compact and robust glow plug control unit design.

Glow Plug Control
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 (SiC), 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, 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.
**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: improvement 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 CO2 reducing Gasoline Direct Injection (GDI) systems. For EV charging BCD is ideal for Battery Management Systems (BMS).
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.

ViPower™ Smart Selector

ViPower’s Smart Selector is designed to help and assist users to choose the best ViPower™ high/low-side switch or H-bridge device for their Automotive application. All you need to do is select a few parameters related to your specific application, and the selector provides the relevant device. Parameters include nominal voltage (12 V for automotive cars or 24 V for trucks), a topology (high-side, low-side or h-bridge), the number of channels and type of load to drive (bulbs, motors, etc.). The selection can be further refined by setting source type (DC or PWM), temperature and PCB type.

FIND OUT MORE

www.st.com/vipower-smartselector

Easyboards

The Easyboard concept was created to give customers the chance to evaluate products without committing to the expense, time and resources typically needed to design a custom circuit board. Easyboards are simple and low-cost evaluation tools that connect a ViPower™ product to a load. This allows a straightforward evaluation of the device and of all the application functionalities, including the auto-protection capability for hazardous conditions. Each evaluation board includes a ViPower™ device soldered onto a small 2-layer PCB with heavy copper and thermal vias, to support maximum device current and customer-configured thermal relief strategies. Easyboards come with the following part numbers:

- EV-VNx7xxx: ViPower M0-7 High Side Switches single, dual and quad channels for 12 V battery lines
- EV-VNx5Txxx: High Side Switches for 24V systems
- EV-VNH7xxx: Motor Control solutions

FIND OUT MORE

www.st.com/automotive-evalboards
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.

**FIND OUT MORE**

www.st.com/auto-sp5-mcu-evaltools
Dynamic Electro-Thermal simulator for devices in VIPower technology

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.

FIND OUT MORE
www.st.com/twistersim

VIPower-FINDER

VIPOWER-FINDER is the application available for Android™ and iOS™ that allows you to explore the ST VIPOWER product portfolio using portable devices. You can easily define the device that best fits your application using the Smart or the parametric search engine. You can also find your product thanks to the efficient part number search engine.

Key Features
• Smart, parametric or part number search capability for product
• Technical datasheet downloading and off-line consulting
• Ability to share technical documentation via social media or via email
• Available on Android™ and iOS™ app stores

FIND OUT MORE
www.st.com/vipower-finder