

# VEHICLE ELECTRIFICATION SOLUTIONS

SEMICONDUCTOR SYSTEM SOLUTIONS FOR THE NEXT GENERATION OF ELECTRIFIED VEHICLES



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## INTRODUCTION

### BACK TO THE CHARGE

The megatrends that have shaped our automotive industry development over the past few years are taking on a new importance with the massive societal changes we're experiencing. With the dramatic drop in emissions during the stay-at-home orders around the world and a broad consumer acceptance of changing the way we interact, the opportunity for future mobility use cases is tremendous.

### CONSUMER PRESSURE

Renewed government incentives to tackle pollution and consumer interest in a greener, cleaner and safer future are redefining energy industry objectives and providing a notable boost to the electrified vehicle market. For example, the subsidy program in China will now run through 2022 with an extension to the New Energy Vehicle Mandate. In Europe, governments have reworked the CO<sub>2</sub> emissions standards.<sup>1</sup> Meanwhile, climate change activists have increased public awareness and made greener living seem more attainable and attractive. NXP is responding to this global support with our vehicle electrification portfolio and our "Vision Zero" goals: zero emissions, zero accidents and zero time wasted.

## WHICH ENERGY TO USE?

A frequent detracting argument for electric vehicles is over the increased use of electricity for slow charging. The counter point to this argument is the reduction in gasoline and diesel displacement and the resulting decrease in CO<sub>2</sub> emissions.

With more than 2 million in sales, electric vehicles made up 2.6% of the global car sales in 2019—Another big step from the previous year.<sup>1</sup>

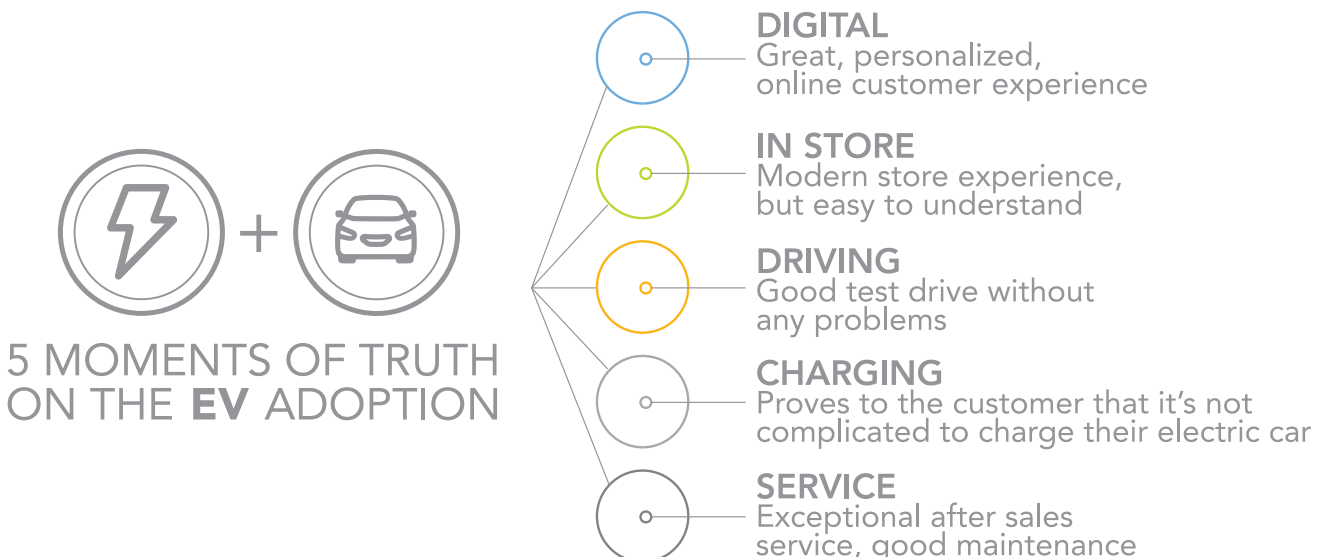
## CHARGING INFRASTRUCTURE

The scale of the electric charging infrastructure is a sensitive area that hasn't been favorable for EV adoption. Desperately inadequate for mass adoption, the majority of the 7.3 million chargers<sup>1</sup> worldwide are privately owned. While the necessity of home-based charging is clear, the convenience and reassurance of widespread charge points are undeniable.

## BATTERY PACK EVOLUTION

Through all this, the challenge for the automotive industry is to find the path to make electric vehicles more profitable than ICE models. The sticking point here is the balance between the size and cost of the battery pack and the consumer acceptance for the vehicle range on a single charge. The unit cost of the battery pack and manufacturing capacities are key to the expansion of the electric vehicle market.

<https://www.nxp.com/company/blog/back-to-the-charge:BL-BACK-TO-THE-CHARGE>



### 5 moments of truth for EV adoption

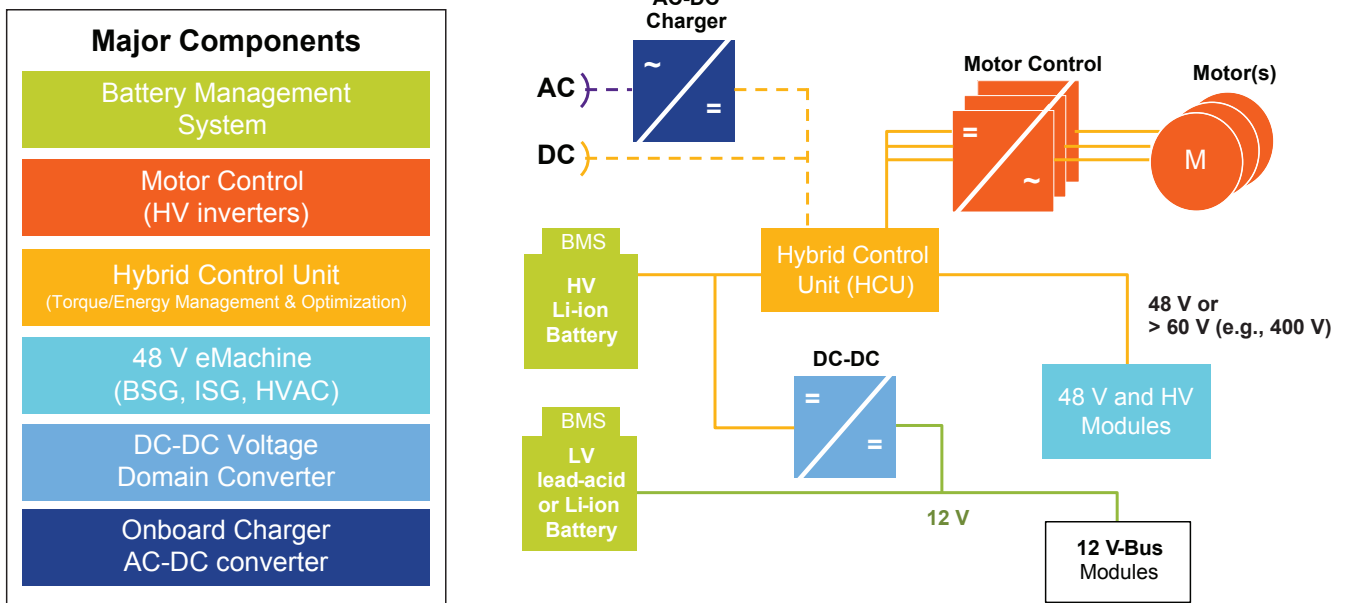
<sup>1</sup> Iea. "Global EV Outlook 2020 – Analysis." Accessed September 15, 2020. <https://www.iea.org/reports/global-ev-outlook-2020>.

## WHY NXP FOR ELECTRIFICATION?

Accelerate to zero emissions with NXP's electrification solutions. From battery management to propulsion Domain control, our aim is to simplify the electrification transition. NXP delivers an electrified system solution, incorporating optimal performance, robust functional safety, and power management features that automakers and developers require for their next generation of vehicles.

Our automotive electrification products feature

- High-performance microprocessors.
- Scalable functional safety
- MCUs with associated power management ICs and system basis chips (SBCs)
- In-vehicle networking components for CAN, LIN, FlexRay™ and Ethernet
- Battery cell controller and battery management solutions
- Electric motor driver solutions, based on advanced functional safety IGBT gate drivers
- Enablement platforms, reference designs and evaluation boards
- Worldwide presence and support
- Automotive robustness





## PROPULSION DOMAIN CONTROL

The hybrid/electrical control unit is the brain of the powertrain control for hybrid or electric vehicles. It will control the power distribution, energy storage, engine and motor. As such, it is key for enhancing the efficiency of the xEV powertrain.

### BENEFITS

- NXP S32S/E: market leader for propulsion domain architecture with automotive ASIL D compute performance
- Virtual automotive ECU development platform available

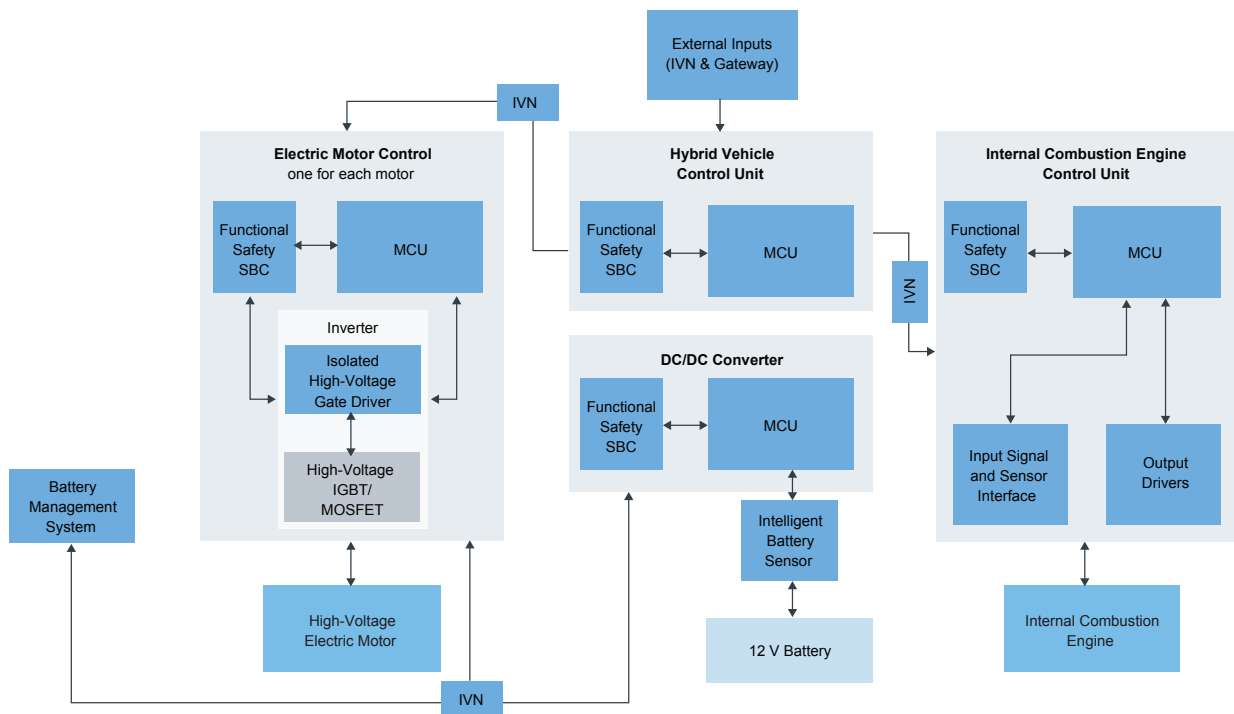
### FEATURES

- Executes multiple applications, including hybrid electric control with advanced algorithms, all under hypervisor
- Energy and thermal management
- Regenerative braking
- Battery states (charge, health, function) management
  - Advanced algorithms (torque vectoring, A-ECMS, etc.)
  - Inter-domain communication, acts on ADAS domain messages (GLOSA)

## SUPPORTED DEVICES

- FS6600: functionally safe multi-output power supply integrated circuit
- S32S24: Based on the Arm Cortex-R52 core, the S32S24 microcontroller is designed for automotive vehicle dynamics, domain control and safety coprocessor applications. It offers support for the highest levels of automotive safety and with more than 7x the performance of the previous generation of NXP devices, provides the performance headroom to manage the transition to advanced electrification and autonomous vehicle applications.

Reference platform part number: S32EDEVPL



NXP Technology

HEV Powertrain Control Block Diagram

# BATTERY MANAGEMENT REFERENCE PLATFORM

## BATTERY MANAGEMENT REFERENCE DESIGN FOR HIGH VOLTAGE BMS

The RD33771CNTREVM provides a solution for a centralized and distributed architecture for lithium-ion battery management in automotive applications. This board allocates four MC33771C devices controlled by one MCU. The MCU could be bypassed and stacked to a long daisy chain for a flexible BMS architecture. BCC can measure lithium batteries having 7 to 14 cells each. The BCCs communicate by TPL daisy chain or capacitor Isolation. The MCU is supplied by an SBC that is powered by a 12 VDC power source.

### KEY FEATURES

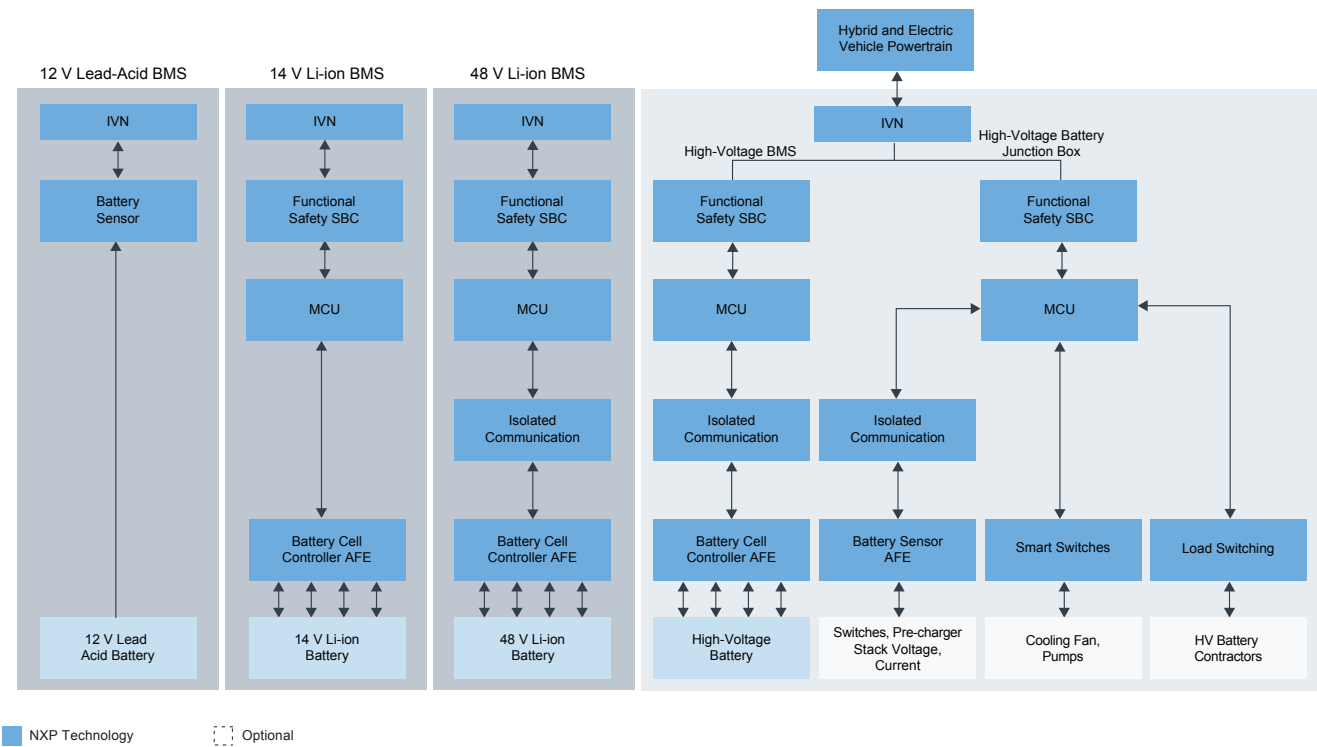
- 56-cell sense inputs with low pass filter
- 24 external temperature sensors
- Integrated cell balancing resistors
- Daisy chainable boards

## REFERENCE DESIGN KIT CONTENTS

- Evaluation board
- Schematic, layout and Gerber files
- Quick start guide
- User manual
- Software drivers

## SUPPORTED DEVICES

- MC33771C: 14-Channel Li-ion Battery Cell Controller IC
- MC33664: isolated network high-speed transceiver
- S32K1: microcontrollers for general purpose
- UJA1169TK: Mini High-Speed CAN System Basis Chip
- Reference platform: RD33771CNTREVM



Battery Management System Reference Platform Solution Block Diagrams

# HEV/EV POWER INVERTER SYSTEM REFERENCE PLATFORM

## HEV/EV POWER INVERTER SYSTEM REFERENCE PLATFORM

The xEV power inverter system solution is a small footprint 400 V ASIL D 100 kW power inverter platform which includes:

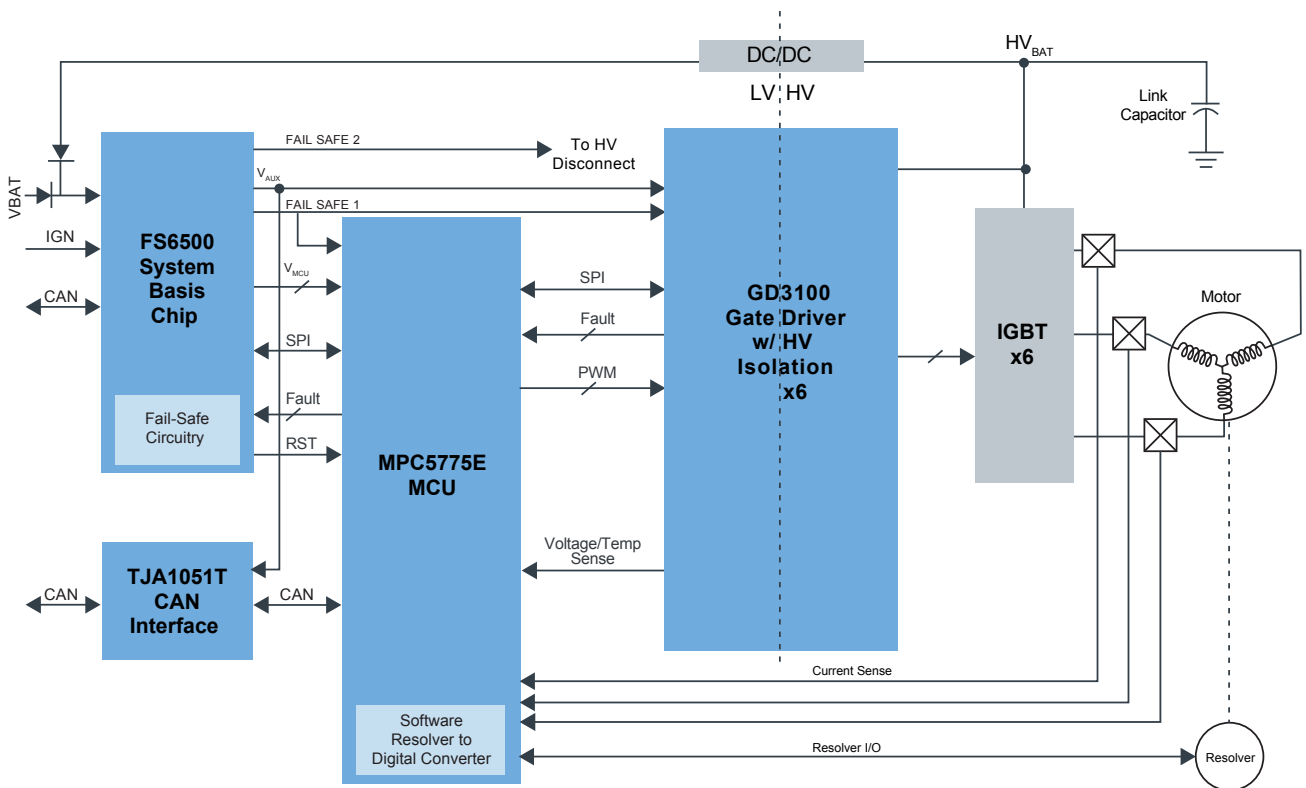
- MPC5775E: secure multi-core 32-bit lockstep MCU with software resolver
- FS6500: Grade1/Grade0 Safety SBC, fit for ASIL D, with two fail-safe outputs for motor control safety management
- GD3100: advanced isolated IGBT/SiC gate driver with < 2 μs overcurrent protection
- TJA1051: redundant CAN bus interface with low-power standby
- Enablement software with API and functional safety case

## BENEFITS

- ASIL C/D compliancy with small, compact 9 IC system footprint
- Robust fail-silent SBC with operation from 36 V down to 2.7 V
- Secure multicore 32-bit lockstep MCU with eTPU and SW RDC
- Functional safety case and enablement software with API
- < 2 μs iSense-compatible 2-level IGBT OC protection with soft shutdown

## FEATURES

- Efficiently drives 100 kW 3-phase motor from 400 V supply
- Integrated galvanic signal isolation in IGBT/SiC gate drivers
- Redundant CAN bus interface with low-power standby
- Primary and backup battery inputs with no negative gate driver supply
- Supported by S32DS SDK with MCAL drivers

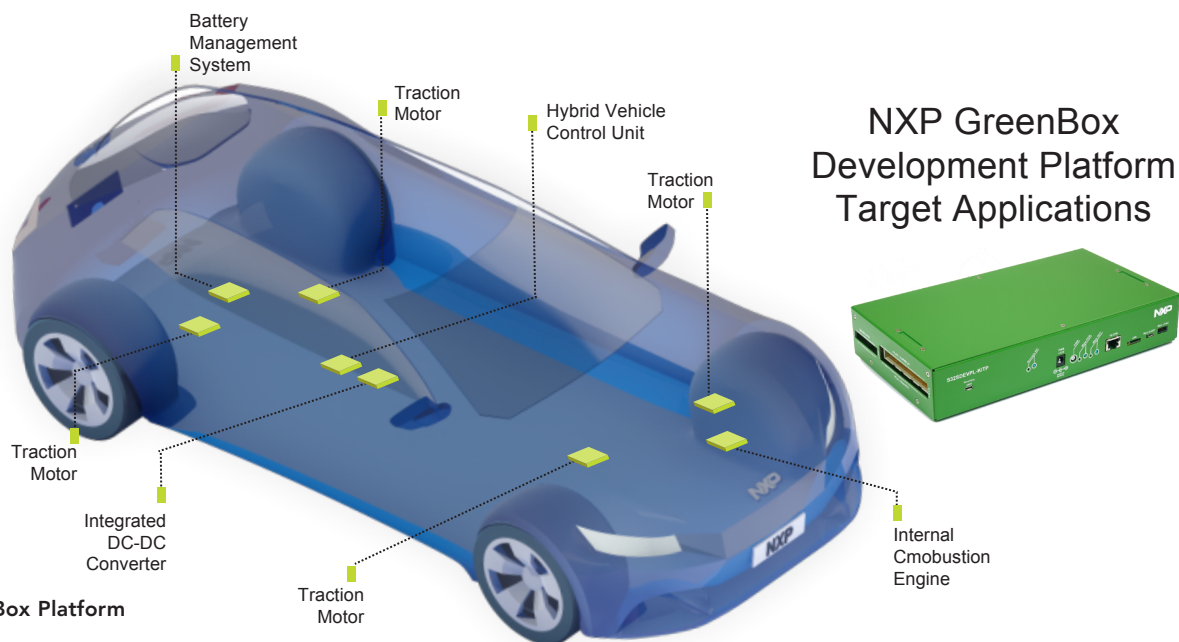


Hybrid and EV Powertrain Block Diagram

## DEVELOPMENT PLATFORMS

In addition to our development platforms, evaluation boards and tools are available to help accelerate your electrification designs.

	EVb NAME	DESCRIPTION
HV BMS - Cell Supervision Circuit (CSC)	S32EDEVPL	GreenBox, advanced performance, peripherals and multicore Arm® environment for HEV and EV development with peripheral board for HEV and ICE applications
	MTRCKTDP55643L	Dual 3-phase PMSM development kit with MPC5643L microcontroller; suitable for applications requiring 2 PMSM motors, such as active suspension or electric powertrain
	MPC5775BE-416DS adapter	MPC5775B MCU targets industrial and automotive battery management systems (BMS); the MPC5775E targets HEV/ EV inverter control systems that require advanced performance; eTPU-based timer system and ISO 26262/ IEC 61508 functional safety support up to ASIL D
	MPC5775BE-516DS adapter	For automotive engine control applications that require advanced performance, timing systems and functional safety capabilities
	DEVKIT-MPC5744P	Offers dual e200z4 lockstep cores, motor control, safety and communication interfaces to facilitate a complete safety/ chassis solution for motor control applications
	RD33771CNTREVM	Battery Management Reference Design for High Voltage BMS
	RD33771CDSTEVB	14-channel Li-Ion BCC with isolated daisy chain interface with MC33771C BCC
	FRDM33771CSPEVB	14-channel high performance Li-Ion BMS with SPI interface using MC33771C BCC
	FRDM33771BTPLEVB	Dual TPL interface between MCU and isolated network with loopback using MC33664 device
	FRDM33771BTPLEVB	14-channel Li-ion battery cell controller with isolated daisy chain interface using MC33771B BCC
	FRDM33664BEVB	TPL interface between MCU and isolated network using MC33664 device
HV BMS - Battery Junction Box (CSC)	RD33772BJBEVM	High Voltage Battery Junction Box RD with functional safety, voltage, current, temperature and insulation measurement function
	FRDM33772BTPLEVB	6-channel Li-Ion BCC with isolated daisy chain interface using MC33772B BCC
	FRDM33664BEVB	Transceiver physical layer (TPL) interface between MCU and isolated network using MC33664 device
HV-BMS Battery Management Unit	MPC5775B-EVB	Low-cost development boards engineered for battery applications
	RDVCU5775EVM	Reference design for high-voltage BMS and vehicle control unit integration for ASIL D applications
48 V BMS Solutions	RD33771-48VEVM	48 V mild hybrid auxiliary battery management system reference design
	FRDM33771CSPEVB	14-channel high performance Li-Ion BMS with SPI interface using MC33771C BCC
	FRDM33771BSPIEVb	14-channel Li-ion battery cell controller with SPI interface using MC33771B BCC
	FRDM33771BTPLEVB	14-channel Li-ion battery cell controller with isolated daisy chain interface using MC33771B BCC
	FRDM33664BEVB	Transceiver physical layer (TPL) interface between MCU and isolated network using MC33664 device
12 V BMS Solutions	NEWTEC-NTBMS	12 V battery management system for Li-Ion batteries supporting ASIL C safety levels
	RD9Z1-638-4LI	4-Cell Li-Ion BMS with high EMC performance and CAN interface using MM9Z1_638 sensor
	RD9Z1-638-12V-C	12 V lead-acid BMS with high EMC performance with CAN interface using MM9Z1_638 sensor
	RD9Z1-638-12V	12 V lead-acid BMS with high EMC performance with LIN interface using MM9Z1_638 sensor
	FRDM33772BSPIEVb	6-channel BCC for Li-Ion battery applications with SPI interface using MC33772B BCC
General Tools	KIT9Z1J638EVM	Battery sensor for current, voltage and temperature with CAN/LIN interface using MM9Z1_638 sensor
	BATT-6EMULATOR	6-cell battery pack to supply MC33772 EVBs—emulates a multi-cell battery pack
	BATT-14CEMULATOR	14-cell battery pack to supply MC33771C EVBs—emulates a multi-cell battery pack
	BATT-14EMULATOR	14-cell battery pack emulator made to supply MC33771B BCC EVBs
	BATT-14EXTENDER NE	Allows for the connection up to four evaluation boards using only one single battery emulator
	BATT-14AAPACK	A configurable battery pack that can be used to supply the MC33771 or MC33772 evaluation boards.
	FRDMGD3100HBIEVM	Half-bridge evaluation kit populated with two MC33GD3100 single-channel IGBT gate drive devices on a half-bridge evaluation board
FRDM-GD3100EVB	Half-bridge evaluation board for GD3100	



GreenBox Platform

[nxp.com/electrification](http://nxp.com/electrification)



## MICROCONTROLLER HYBRID CONTROL UNIT

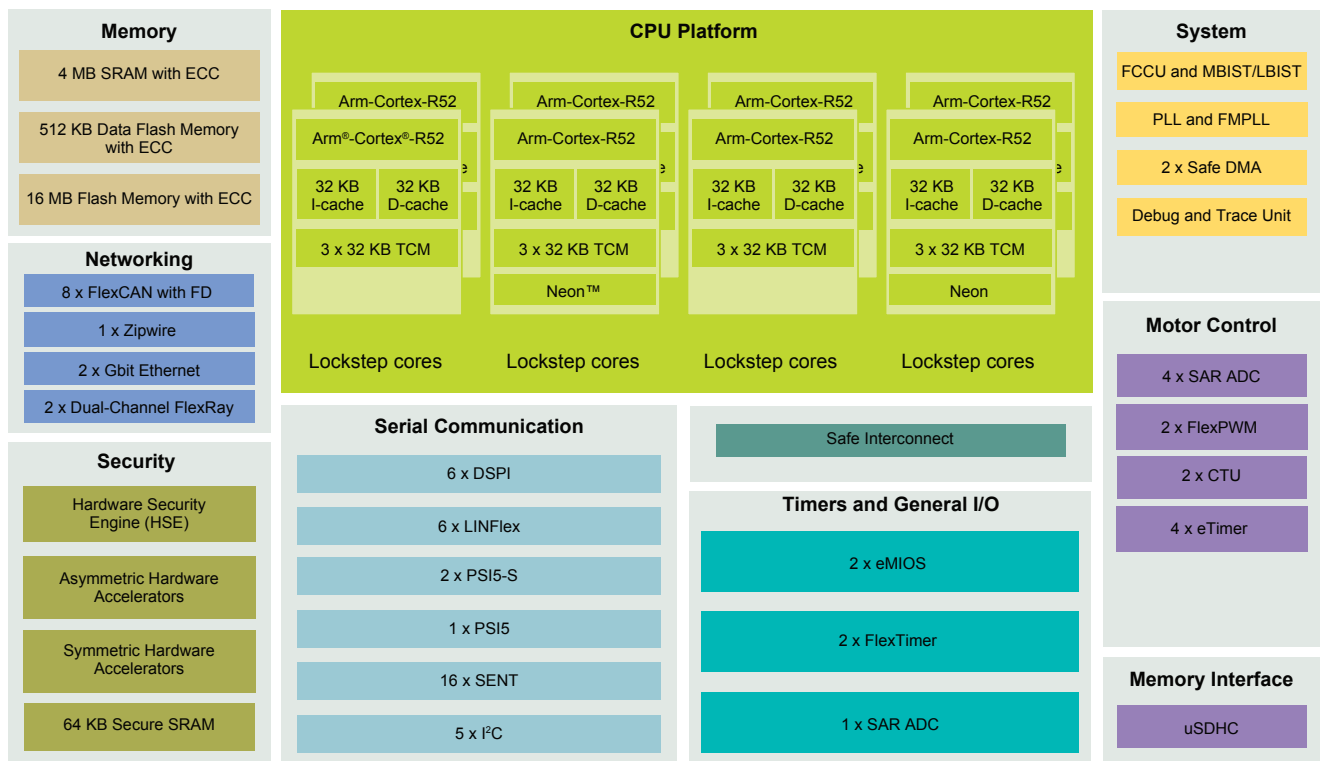
The hybrid control unit (HCU) is a core control component for hybrid and electric vehicles. It uses input signals to calculate and manage output parameters such as engine power or motor torque.

### S32S24 SAFETY MICROCONTROLLER

The S32S24 is an Arm-R52-based microcontroller for automotive vehicle dynamics, domain control and safety coprocessor applications. It offers support for the highest levels of automotive safety and with more than 7x the performance of the previous generation of NXP devices, provides the performance headroom to manage the transition to advanced electrification and autonomous vehicle applications.

### FEATURES AND BENEFITS

- 4 x Arm-R52 cores in lockstep (8 cores total), operating at 800 MHz
- Large integrated flash memory (up to 64 MB)
- On-the-fly, over-the-air update capability with zero processor downtime
- Advanced safety functionality and fault recovery to support ASIL D applications
- Hardware security engine supporting public and private key encryption
- AEC-Q100 Grade 1 device with support from -40 °C to 150 °C (junction)



S32S Block Diagram

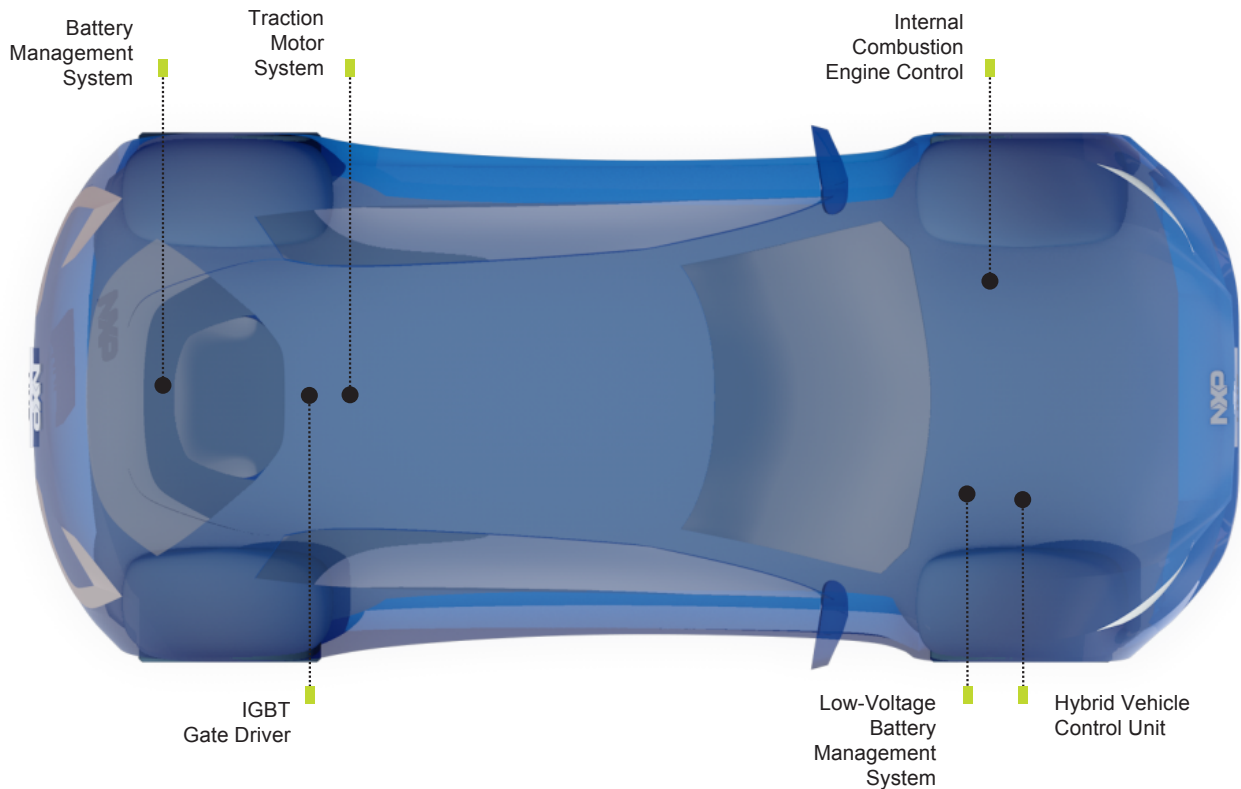
## VEHICLE DYNAMICS AND SAFETY MCUs

### MPC5744P, MPC5777C, MPC5775B AND MPC5775E FOR BATTERY MANAGEMENT SYSTEMS AND INVERTER APPLICATIONS

These microcontrollers target automotive and industrial battery management and inverter applications that require advanced performance, security and ASIL D support.

#### FEATURES AND BENEFITS

- High-performance cores with advanced programmable motor control timers and analog modules
- Functional Safety ISO 26262 targeting ASIL D with lockstep cores, ECC, temperature and voltage sensors, clock monitoring, and fault collection unit
- Hardware security module (CSE) with encryption and decryption, secure boot and key storage; pre-programmed firmware simplifies production
- Communication peripherals via CAN FD, Ethernet, SPI, LIN
- Software enablement with AUTOSAR® MCAL, S32 Design Studio



### MPC5744P, MPC5777C, MPC5775B and MPC5775E Automotive Applications

## ELECTRIFIED GENERAL-PURPOSE NODES

### THE SCALABLE S32K1 FAMILY: ACCELERATED DESIGN TIME, LOW-POWER PERFORMANCE

- Performance and integration with future-proof designs
- Automotive-grade software with minimized complexity
- Broad portfolio allows maximized reuse

### S32K FUNCTIONAL SAFETY SOFTWARE

- Cortex-M Core Self-Test Library: Structural Core Self-Test Library (SCST) is a safety measure against permanent faults in the cores
- Developed for detecting hardware permanent faults in a core by means of executing machine op-codes with fixed set of operands and comparing their execution results
- This library is considered as Safety Element out of Context and was developed according to ASIL B
- SCST library provides tests to achieve the claimed diagnostic coverage (analytically estimated)

### HARDWARE PLATFORM

- Low-cost development board compatible to Arduino® shields
- Onboard debugger and system basis chip

### RUNTIME SOFTWARE

- Automotive-grade NXP software development kit (SDK)
- NXP middleware e.g., core self test, LIN stack
- AUTOSAR 4.0 and 4.2 MCAL
- FreeRTOS
- Bootloader

### SOFTWARE DEVELOPMENT TOOLS

- IAR, GHS and GNU toolchains
- Full-featured, no-cost development platform (S32 DS)
- FreeMASTER

### APPLICATION SPECIFIC

- Motor control
- Touch sensing
- Secure communication
- Wireless charging
- Near-field communication

S32K11x MCUs		Common Features	S32K14x MCUs			
S32K116 MCU	S32K118 MCU		S32K142 MCU	S32K144 MCU	S32K146 MCU	S32K148 MCU
Arm® Cortex®-M0+ Core @ 48 MHz		AEC-Q100	Arm Cortex-M4F Core @ 112 MHz			
128 KB Flash	256 KB Flash	CSEc Security Module	256 KB Flash	512 KB Flash	1 MB Flash	2 MB Flash
16 KB SRAM	24 KB SRAM	ASIL B Compliant	32 KB SRAM	64 KB SRAM	128 KB SRAM	256 KB SRAM
up to 42 I/Os	up to 58 I/Os	Low-Power Operating Modes & Peripherals	up to 89 I/Os		up to 128 I/Os	up to 156 I/Os
4-ch. eDMA		Flex I/O	16-ch. eDMA			
1 x FlexCAN with 1x FD		MPU	2 x FlexCAN with 1 x FD	3 x FlexCAN with 1 x FD	3 x FlexCAN with 2 x FD	3 x FlexCAN with 3 x FD
1 x 13-ch. 12-bit ADC	1 x 13-ch. 16-bit ADC	JTAG	2 x 16-ch. 12-bit ADC		2 x 24-ch. 12-bit ADC	2 x 32-ch. 12-bit ADC
QFN-32	LQFP-64	FlexTimer	LQFP-64			LQFP-176
LQFP-48		SDK	LQFP-100			
		NFC Stack	MAPBGA-100			
		ISELED Driver				LQFP-144
		AUTOSAR® MCAL/OS				ENET
		S32 Design Studio IDE				QuadSPI
						ETM Trace
						SAI

### S32K General-Purpose Microcontroller Common Features

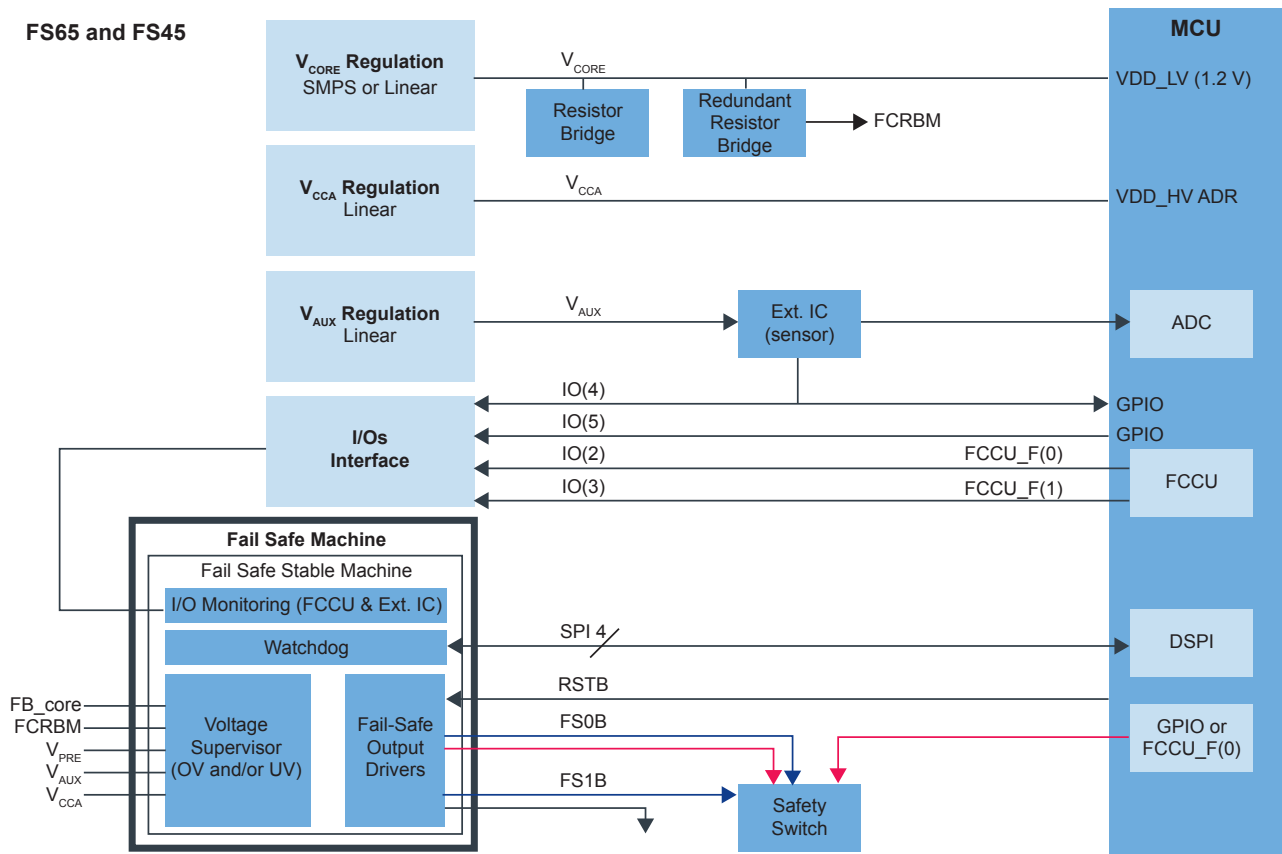
## POWER MANAGEMENT: FUNCTIONALLY SAFE SYSTEM BASIS CHIPS

### FS45 AND FS65 GRADE 1 AND GRADE 0 SAFETY POWER SYSTEM BASIS CHIPS

The family of FS4500 and FS6500 safety SBC chips provides power management to MCUs by the optimization of energy consumption through DC-DC switching regulators, linear regulators and ultra-low-power saving modes.

#### FEATURES AND BENEFITS

- Physical and electrical independence to target ASIL B or D applications
- Power management monitoring unit (UV/OV/OC)
- Analog and digital built-in self-test to minimize latent faults
- Redundant reference and supply to reduce common cause failure
- $V_{CORE}$  external monitoring
- FCCU: fault collection control unit
- Monitor lock-step MCUs
- Configurable RSTb activation provides more system availability
- Redundant system fail-safe enabler
- Second fail-safe pin to assert safety path with configurable delay after failure
- Long-duration timer (from seconds to months) to simplify RTC function and reduce costs
- Tracker rail, short circuit to battery proof, to supply external ECU loads (sensors, etc.)
- FCRBM: Feedback Core Resistor Bridge Monitoring



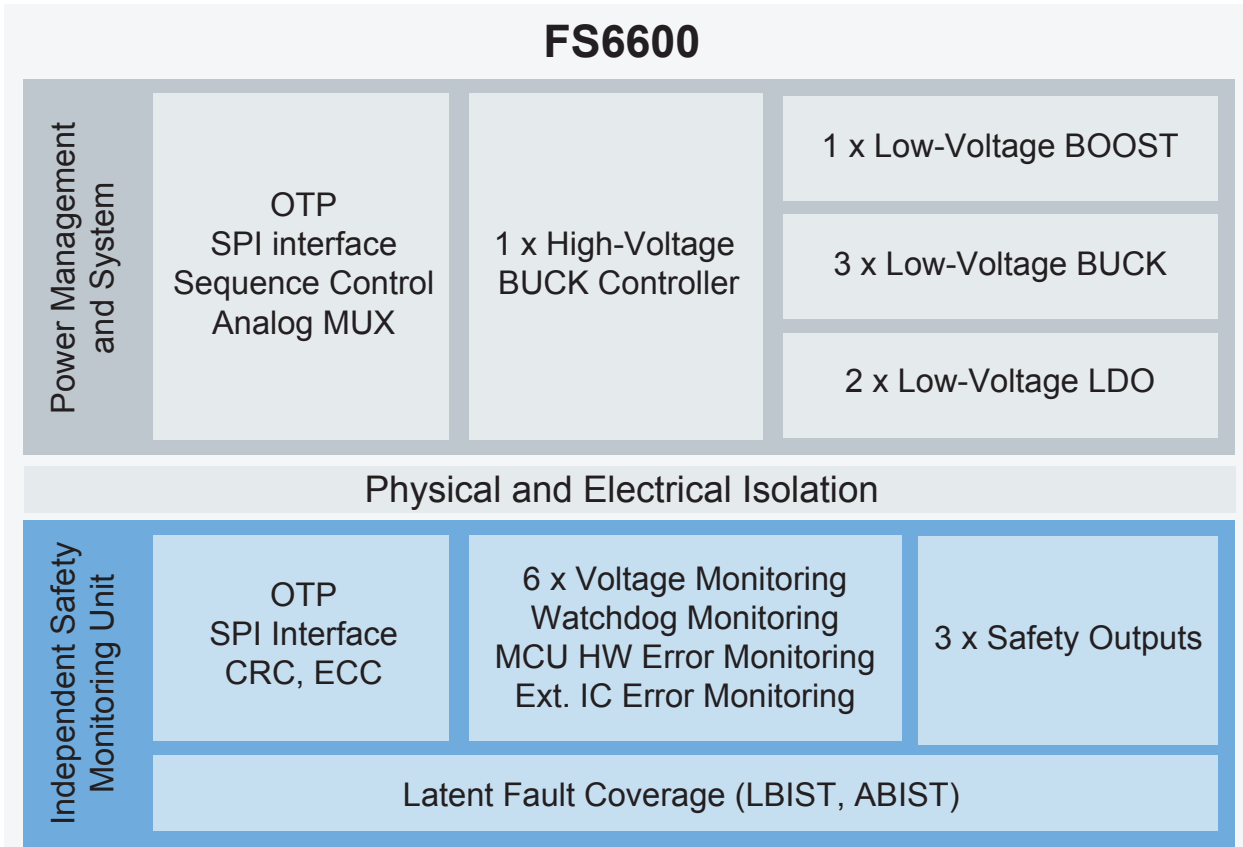
FS6500 Functionally Safe System Basis Chip Block Diagram

**POWER MANAGEMENT: FUNCTIONALLY SAFE SYSTEM BASIS CHIPS**

The FS6600 is an automotive, functionally safe multi-output power supply integrated circuit. It's focused on powertrain, safety and chassis applications and is the primary companion chip of the S32S2 microcontroller.

**FEATURES**

- 60 V DC maximum input voltage fits for 12 V and 24 V systems
- Multiple SMPS and LDO to supply S32S2 microcontroller and more
- Standby OFF mode with very low sleep current (<10 µA)
- 32-bit SPI interface with CRC
- Fit for ASIL D with independent safety monitoring unit



FS6600 Block Diagram



## BATTERY MANAGEMENT SYSTEMS

### MC33771 AND MC33772 REV C BATTERY CELL CONTROLLER SOLUTION

#### Battery topology flexibility

- Scalable software- and hardware-compatible BMS solution supporting 3 to >800 cells per daisy chain
- MC33771 (7 to 14 cells) and MC33772 REV C (3 to 6 cells) fully compatible
- Supporting centralized, distributed daisy chain, distributed CAN

#### High integration level

- Synchronized on-chip current sensor
- Synchronized on-chip coulomb counter
- Integrated passive balancing up to 300 mA per channel
- 4.0 Mbit/s SPI or isolated 2.0 Mbit/s differential communication with transformer
- Averaging of cell voltage measurement

#### Lifetime guaranteed high accuracy

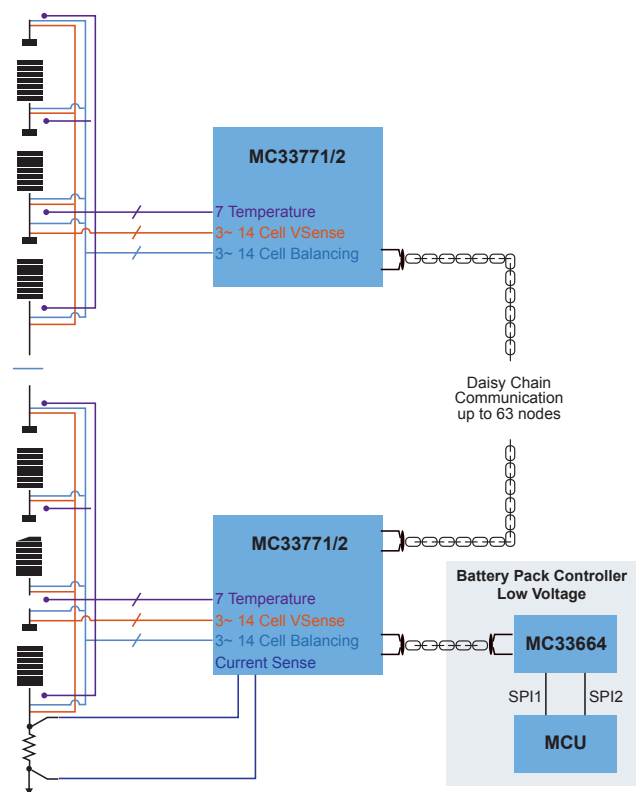
- $\pm 0.8$  mV cell voltage measurement error
- $\pm 0.5\%$  total stack voltage measurement
- $\pm 0.5\%$  integrated current sensor gain error

#### Diagnosis and functional safety supporting ISO 26262 with single chip

- Designed to support ISO 26262 up to ASIL D safety system
- Sleep mode OV/UV and temperature monitor
- Detection of internal and external faults, i.e., open lines, shorts, and leakages
- Integrated balancing diagnostics

#### Automotive robustness

- ESD, EMC; Hot Plug, AEC-Q 100
- Temp range:  $-40$  °C to  $105$  °C
- Operational low-power mode



MC33771 Battery Cell Controller Solution Block Diagram

## BATTERY PRESSURE MONITORING SENSORS

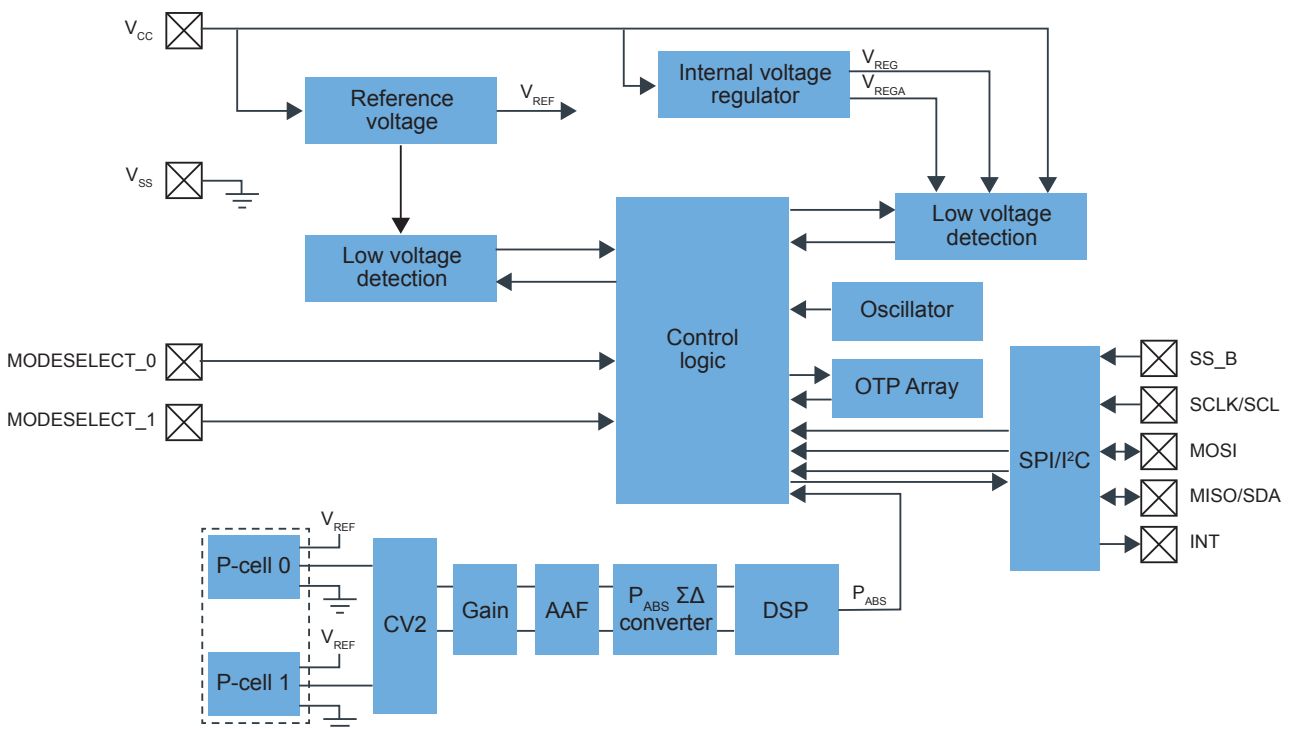
### FXPS7250D4: Absolute Pressure Sensor

- Absolute pressure range: 20 to 250 kPa
- Automotive robustness
  - Redundant pressure transducers enable embedded self test
  - Common-mode and digital self test for transducer and signal chain verification
  - Digital self test
  - Operating temperature range:  $-40\text{ }^{\circ}\text{C}$  to  $130\text{ }^{\circ}\text{C}$
  - AEC-Q100 Grade 1 compliant
- I<sup>2</sup>C compatible serial interface
  - Slave mode operation
  - Standard mode, fast mode, and fast-mode plus support
- 32-bit SPI compatible serial interface
- Secure and fast data communication
  - 12-bit data for absolute pressure
  - 8-bit data for temperature
  - 2-bit basic status and 2-bit detailed status fields
  - 3, 4, or 8-bit configurable CRC

- Capacitance to voltage converter with anti-aliasing filter
- Sigma delta ADC plus sinc filter
- 800 Hz or 1000 Hz low-pass filter for absolute pressure
- Small package suitable for PCB integration
  - Lead-free, 16-pin QFN 4x4x1.98mm with wettable flank
  - Pressure sensor protected by chemical-resistant gel
- Analog version output available

### Current solution FXPS7250x or FXPS165D

- Absolute pressure range:
  - 20 kPa to 250 kPa or 60 kPa to 165 kPa
  - Calibrated Pressure and Temperature measurements
- I<sup>2</sup>C, SPI or Analog output interface
- Automotive robustness
  - Redundant pressure transducers enable embedded self test
  - Common-mode and digital self test for transducer and signal chain verification
  - Qualified to AEC-Q100 Grade 1
  - Operating temperature range:  $-40\text{ }^{\circ}\text{C}$  to  $130\text{ }^{\circ}\text{C}$
  - QFN 4 x 4 x 1.98 mm, 16 pins, 0.8 mm pitch

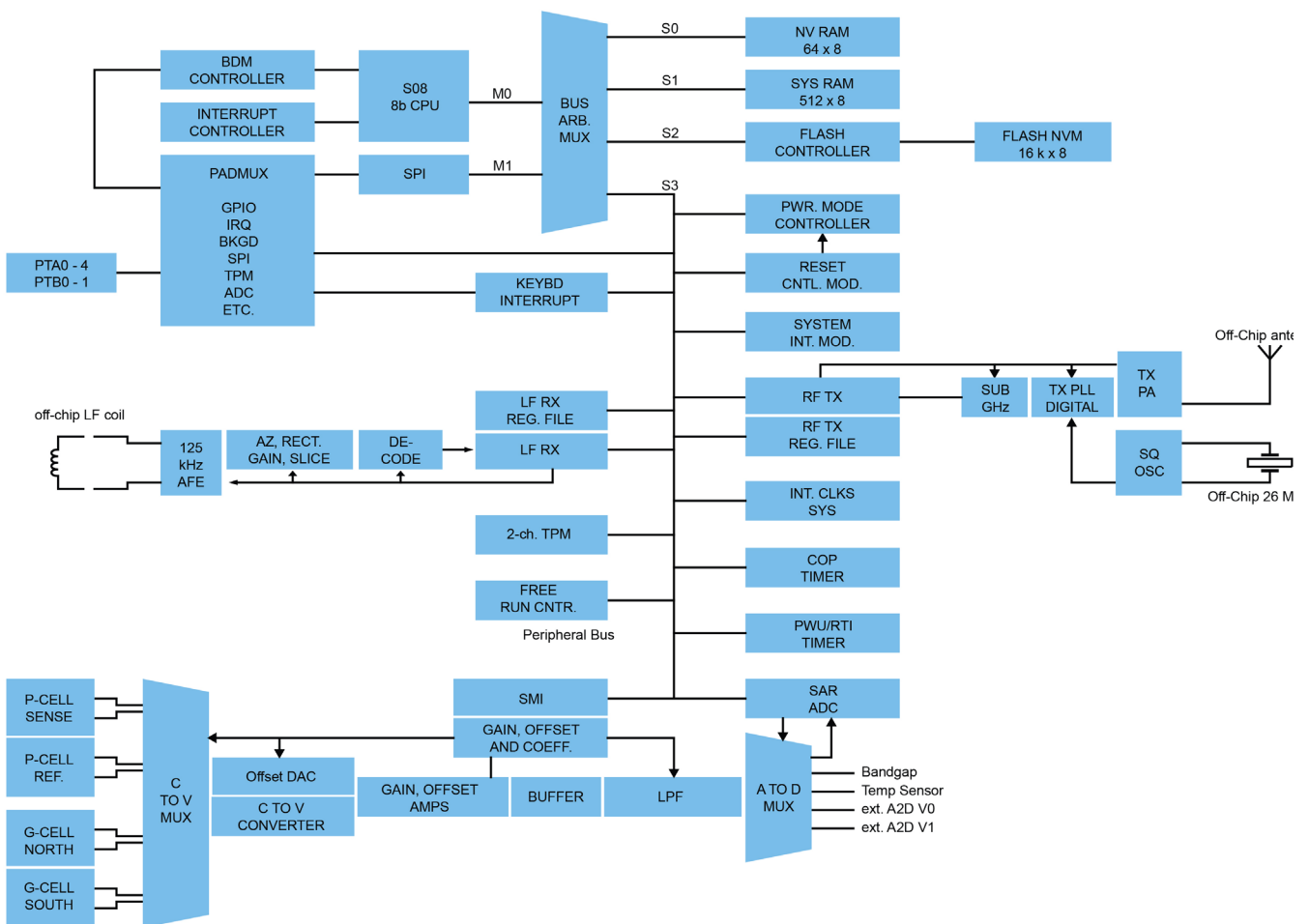


FXPS7250D4 Block Diagram

## BATTERY PRESSURE MONITORING SENSORS — FEATURES

### NBP8/9FDxT1

- Absolute pressure range:
  - 40 kPa to 250 kPa operating range
  - Calibrated pressure and temperature measurements capability
- Internal sleep mode between measurements
- Host can enter sleep mode until needed
  - Last 12 pressure measurements saved in FIFO memory
- Auto detects pressure change and sends alarm to host MCU by any of the following events:
  - Fixed pressure threshold breach
  - Relative pressure threshold breach
  - Pressure rate-of-change breach ( $\Delta P/\Delta t$ )
- Diagnostics
  - Pressure transducer (sense and reference cell), internal connections
- SPI interface, ready/interrupt, power supply enable
- Automotive robustness
  - Qualified to AEC-Q100 Grade 1
  - Operating temperature range:  $-40\text{ }^{\circ}\text{C}$  to  $130\text{ }^{\circ}\text{C}$
  - QFN 4 x 4 x 1.98 mm, 24 pins, 0.5 mm pitch



NBP8-9x Block Diagram

## MOTOR CONTROL: HIGH-VOLTAGE INVERTERS

### GD3100 AND GD3160 GATE DRIVER IC WITH HV ISOLATION

The GD3160 and GD3160 are programmable high-voltage gate drivers with advanced functional safety, control and protection features developed for automotive and EV powertrain applications. The GD3100 supports implementation of high voltage HEV/EV traction inverters, DC/DC converters, and on-board chargers using Si IGBTs or SiC MOSFETs. They offer integrated high-voltage galvanic isolation and fast short circuit protection. They are compliant with ISO 26262 ASIL C/D functional safety standards. The GD3160 gate driver offers wider parametric range tailored to SiC MOSFETs as well as IGBTs and is footprint compatible with the GD3100 gate driver.

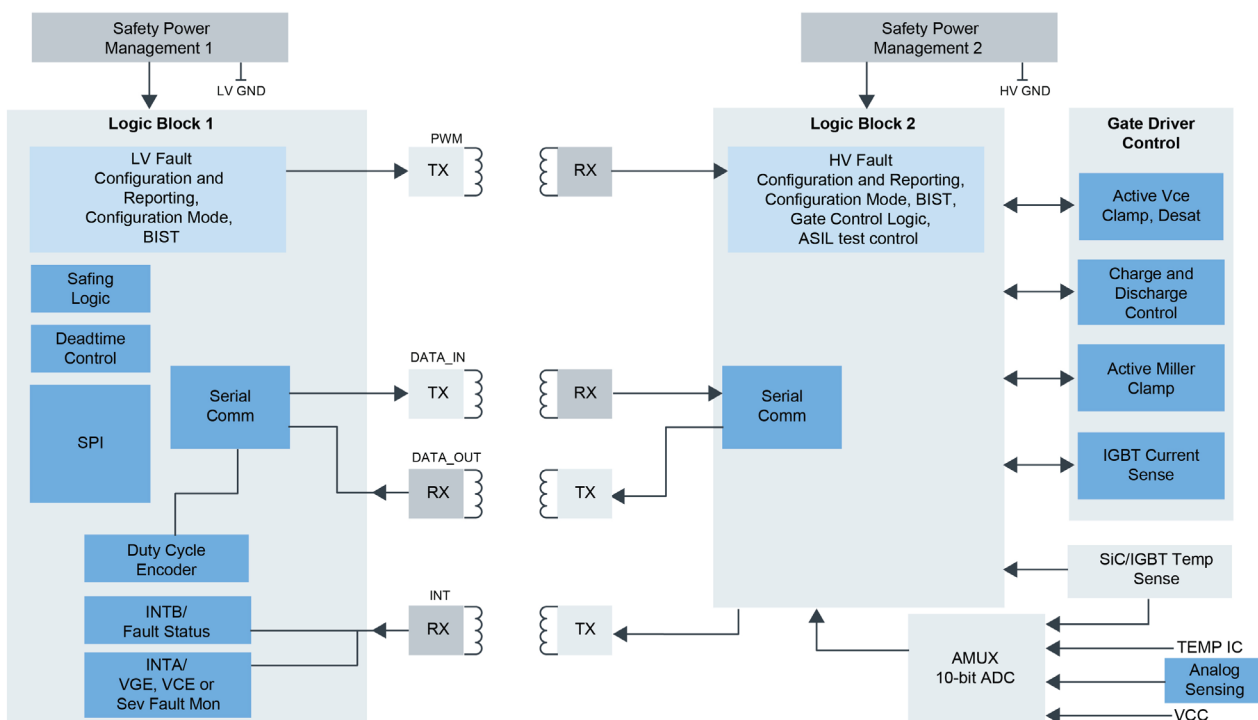
### FEATURES AND BENEFITS

- High level of integration and flexibility for any IGBT module:
  - 15 A turn on/off integrated power stage
  - Fully programmable active Miller clamp
  - SPI for programmability and diagnostics
  - 5 kV galvanic signal isolation
  - 3.3 or 5.0 V I/O
  - Compatible with 200 to 1700 V IGBT and SiC power devices
  - Reduces BOM costs and PCB size
- Fast < 2  $\mu$ s overcurrent or short-circuit protection
  - Compatible for both i-Sense or DESAT sense
  - Two-level turn-off
  - Soft shutdown

- Compliant with ISO 26262 ASIL C/D functional safety requirements
  - VGE monitoring verifies communication between PWM input and gate output
  - Fail-safe pins allow redundant gate control
  - Secure SPI settings with cycle redundancy check (CRC)
  - Enforced deadtime protection
  - Integrated temperature sense
  - Built-in self-test (BIST) for analog and digital circuits

### GD3160 NEW FEATURES

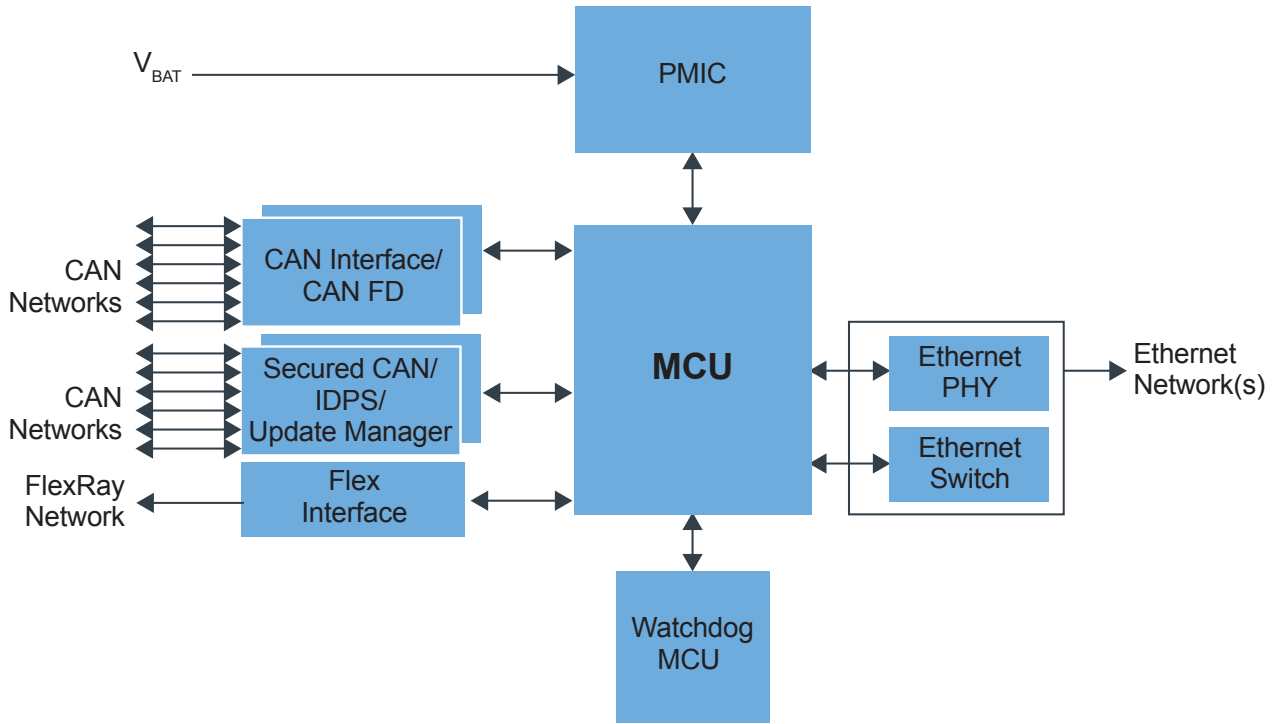
- Enhanced DESAT SC protection
- Segmented Drive to reduce over-shoot
- Increased gate voltage range
- Programmable gate regulator
- Additional report channel (INTA) for fault or real-time power device status



GD3160 Advanced IGBT Gate Driver Block Diagram

### VEHICLE NETWORK PROTOCOLS

As vehicles become more connected, the need for reliable and secure communication within the car is clear. New isolated CAN for electric vehicles, hybrids and 48 V networks use unique wake-up functions to maximize efficiency and bridge voltage domains. In a distributed car network, central ECUs need to exchange data or configuration with each other within a critical time frame. Automotive Ethernet can be used to build a time-sensitive network (TSN) that connects microcontrollers directly in an Ethernet backbone.



 NXP Technology

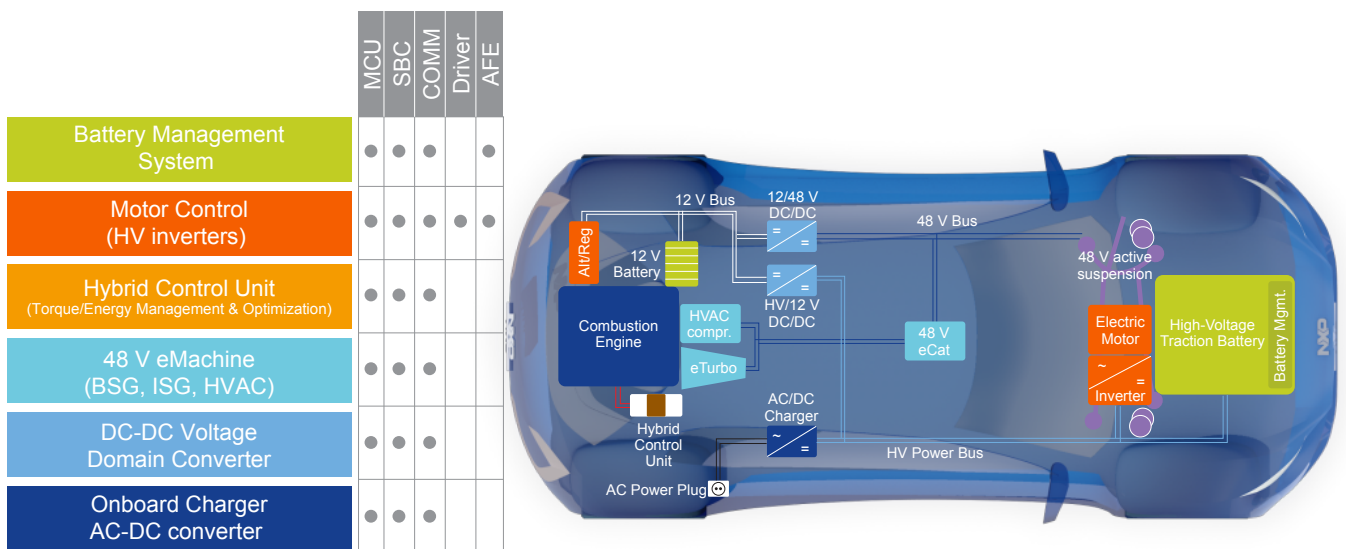
#### In-Vehicle Networking for HEV and EV Architectures

For further information on the complete in-vehicle networking portfolio, please visit [www.nxp.com/ivn](http://www.nxp.com/ivn).



## NXP: YOUR ELECTRIFICATION PARTNER

At NXP, we're leveraging our commitment to quality and security, our broad product portfolio and our application leadership in automotive power control to provide system solutions that deliver the optimal performance, functional safety and power management required for the next generation of electric and hybrid vehicles. When you explore NXP, you'll find that we're more than the products we create—we're a dedicated partner committed to automakers and developers in their quest to accelerate EV system development and meet the ever-growing demand for vehicle electrification.



## NXP PRODUCT SUMMARY

DEVICE	DESCRIPTION
S32S24	The S32S24 is an Arm®-R52-based microcontroller for automotive vehicle dynamics, domain control and safety coprocessor applications. It offers support for the highest levels of automotive safety and with more than seven times the performance of previous generation devices, provides the performance headroom to manage the transition to advanced HEV/EV and autonomous vehicles applications.
MPC5744P MPC5777C MPC5775B/E	These microcontrollers target automotive and industrial battery management and inverter applications that require advanced performance, security and ASIL D support.
S32K1	S32K is a scalable family of AEC-Q100 qualified 32-bit Arm Cortex®-M4F and Cortex-M0+ based MCUs targeted for general-purpose automotive and high-reliability industrial applications.
FS45/FS65	The FS4500 and FS6500 are system basis chips (SBCs) that provide power to MCUs and optimize energy consumption through DC-DC switching regulators, linear regulators and ultra-low-power saving modes.
FS6600	The FS6600 is an automotive, functionally safe multi-output power supply integrated circuit. It includes a multiple switch mode, linear voltage regulators and enhanced safety features with fail-safe outputs
MC33771/2	The MC33771/2 are battery cell controllers designed to address safety risks related to Li-ion batteries by accurately controlling critical Li-ion cell characteristics (voltages, temperatures, current) and by providing embedded balancing functions along with extensive system diagnostics.
FXPS7250D4	The FXPS7250D4 is high-performance, high-precision absolute pressure sensor for Battery Pressure Monitoring.
GD3100	The GD3100 is an advanced single-channel gate driver for IGBTs. Integrated Galvanic isolation and low on-resistance drive transistors provide high charging and discharging current, low dynamic saturation voltage and rail-to-rail gate voltage control.
GD3160	The GD3160 is an advanced single-channel high-voltage isolated gate driver with enhanced features for driving and protecting silicon carbide (SiC) MOSFETs or IGBTs and functional safety.
IVN	IVN is a broad NXP portfolio of in-vehicle networking solutions for LIN, CAN, FlexRay™ and Ethernet.

## SAFEASSURE® FUNCTIONAL SAFETY PROGRAM

The NXP SafeAssure program does more than align our development process to ISO 26262 across our business lines. It affirms our corporate commitment to supporting functional safety through safety-conscious culture, discipline and collaboration.

### THE SAFEASSURE PROGRAM:

- Simplifies the process of system compliance, with solutions designed to address the requirements of automotive and industrial functional safety standards
- Reduces the time and complexity required to develop safety systems that comply with ISO 26262 and IEC 61508 standards
- Supports the most stringent safety integrity levels (SILs), enabling designers to build with confidence
- Adheres to a zero-defect methodology from design to manufacturing and helps ensure that our products meet the stringent demands of safety applications



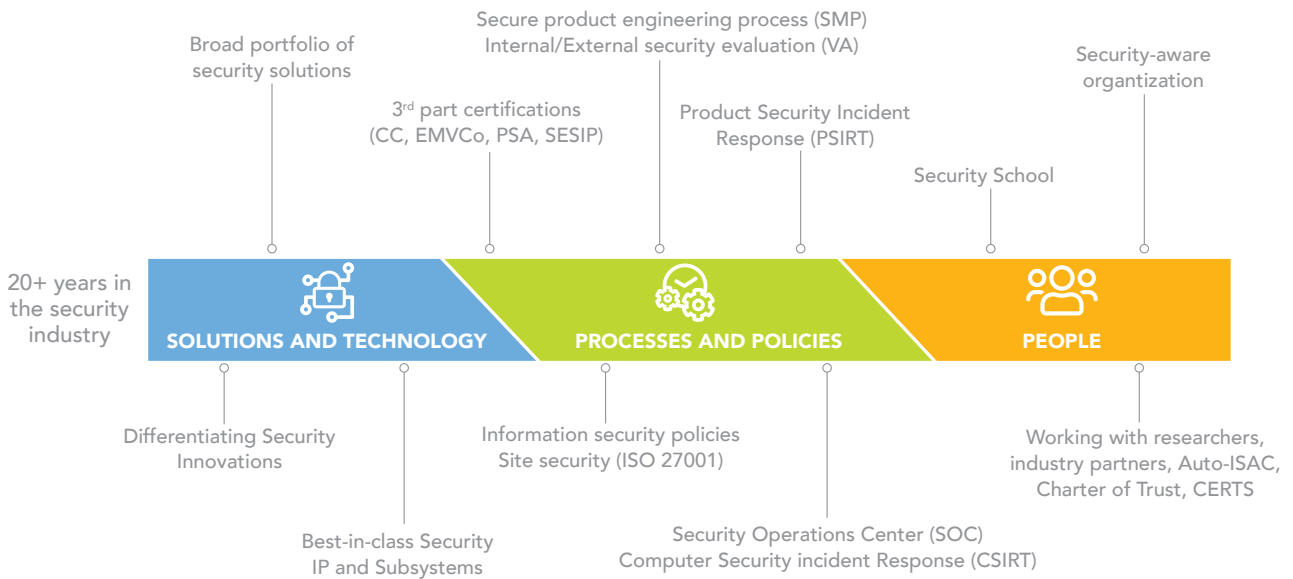
PRODUCTS	TARGET APPLICATION	ASIL
MC337711/2	HEV, EV, ESS, UPS systems	C
FS4500	Automotive: vision systems, electrical power steering, engine and battery management; Industrial: drone and robot automation, building control, transportation, mobile computing, power and energy; healthcare	D
FS6500	Automotive: active suspension, gearbox, transmission, EV, HEV, inverter, ADAS, EPS, engine and battery management; mobile computing; building control; drones and robots; automation; medical	D
FS6600	BMS, electrical traction, high-voltage DC-DC converter, HEV, internal combustion engine	D
MPC5744P	Safety Domain Control	D
MPC577C MPC5775E/	BMS, Traction Motor Control, Direct Injection Engines, Common Rail Diesel Injection Systems, Electronically Controlled Transmissions, Diesel Engine Management, Gasoline Engine Management	D
S32K	Body and Chassis Control, Climate Control, Windows/Door/Sunroof, Powertrain Companion, PMSM/BLDC Motor Control, BMS	B
GD3100	Traction Motor Inverter	D



NXP's Safety Strategy Evolution Visual

**SECURITY PROGRAM :**

A holistic approach to cyber security – aligned with industry standards and best practices



With the complexity of vehicles on the roads today – it is essential that drivers and passengers are able to trust their cars.

NXP leads the industry with the most complete portfolio of automotive semiconductor security solutions, complemented by a comprehensive, holistic, automotive cybersecurity program.

Cybersecurity needs a holistic approach: not only with solutions, but also with processes, policies and the appropriate security-oriented organization.

NXP's security program has matured over time and contains a broad portfolio of automotive security solutions that are par to market requirements.

[www.nxp.com/automotivesecurity](http://www.nxp.com/automotivesecurity)

## AVAILABLE RESOURCES

For more information, please visit  
[nxp.com/electrification](https://www.nxp.com/electrification)

[www.nxp.com](https://www.nxp.com)

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