Safety SBCs for Automotive

Scalable functional safety solutions across automotive applications

SAFE ASSURE by NXP

NXP

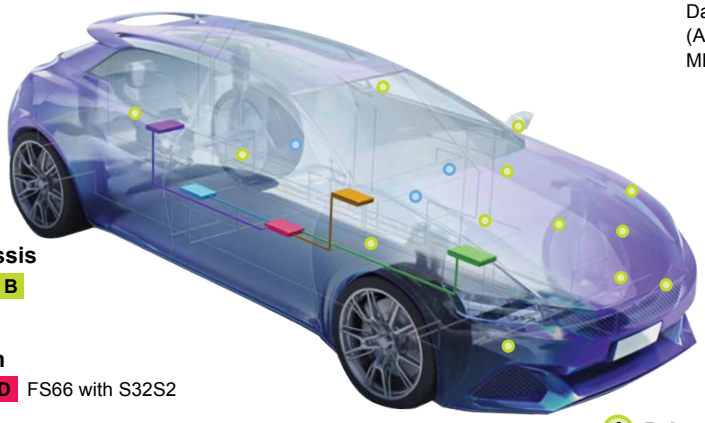
SBC Overview

System basis chips (SBCs) with functional safety architectures and behaviors are crucial for the automotive designs that support key vehicle electrification and autonomy trends. For decades, NXP has developed innovative SBCs that combine advanced power management with functional safety monitoring. Our growing SBC family with scalable microcontrollers and safety power management systems components is ideal for automotive-grade, system-oriented solutions that require high safety and high integrity performance.

NXP SBCs combine a linear voltage regulator or DC-DC power supply with CAN or LIN physical layer transceivers. An MCU controls the SBCs through a serial peripheral interface (SPI). In turn, the SBCs support different MCUs in terms of voltage, current, accuracy and load/line regulation. Q&A Watchdog and FCCU monitoring oversee microcontroller operation externally, while multiple diagnostics — including overcurrent, undervoltage and overtemperature — allow configurable safety behavior.

These SBCs support NXP MCU designs and other MCUs for powertrain, chassis, ADAS and gateway applications with associated safety levels.

NXP® POWER SBC APPLICATION EXAMPLES



8 Drive Train—Safety & Chassis
Transmission, Transfer Case – **ASIL D**
FS650x with other MCU

7 Drive Train—Safety & Chassis
Suspension/Dumping – **ASIL C**
FS65 with other MCU

6 Drive Train—Safety & Chassis
Electric Power Steering with Fail Safe & Fail Operational strategies - FS65 or FS45 with MPC5744P **– ASIL D**

5 Drive Train—Safety & Chassis
Engine Management Unit – **ASIL B**
FS651x with MPC5777C

4 Drive Train—Electrification
Hybrid Vehicle Controller – **ASIL D** FS66 with S32S2

3 Drive Train—Electrification
Inverter, DC-DC converter - **ASIL D** FS650x or FS45
Vepco high-voltage inverter RD - **ASIL D**
MPC5775 with FS651x & GD3100

1 Networking—Gateway & Domain Controller
Service-oriented gateway & domain controller – **ASIL D**
VR5510 with S32G VNP

2 Drive Train—Electrification
Electric Motor (Alterno Starter, eAxel drive…) – **ASIL C** FS45

1 ADAS
Bluebox development platform- **ASIL D**
S32V234, S32R27, LS2084A + FS65

2 ADAS—Vision
Data Fusion – **ASIL D**
(Autonomous Drive) FS652x attach with MPC5777C or other MCU

3 ADAS—Radar
SRR, MRR, LRR – **ASIL D**
FS652x with S32R2

4 ADAS—Camera Sensor
S32V + FS85 + PF82 – **ASIL B**

5 ADAS—ACC
Adaptive Cruise Control – **ASIL C**
FS652x with MPC5744P

1 Drive Train—Electrification
Battery Management (12 V, 48 V, HV) FS650x with MPC5744P & MC33771 – **ASIL C**
NewTec RD: S32K with FS45 – **ASIL C**
MPC577x with FS650x – **ASIL D**

ASIL QM A B C D

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Powertrain – Electrification, Chassis and Safety

SAFETY SBC PRODUCT FEATURES FOR POWERTRAIN

Features	MC33907	MC33908	FS4500	FS6500	FS6600
Orderable part numbers	MC33907LAE, MC33907NAE	MC33908LAE, MC33098NAE	MC33FS45xx (Grade 1) MC35FS45xx (Grade 0)	MC33FS65xx (Grade 1) MC35FS65xx (Grade 0)	MC33FS6600
V pre-regulator	2.0 A /6.5 V VPRE capable 2.7 V to 28 V buck/ boost	2.0 A /6.5 V VPRE capable 2.7 V to 28 V buck/ boost	2.0 A / 6.5 V VPRE capable 2.7 V to 28 V buck/ boost	2.0 A /6.5 V VPRE capable 2.7 V to 28 V buck/ boost	Configurable 3.3/ 5.0 V to 10.0 A buck
Targeted system	12 V system	12 V system	12 V system	12 V system	12 or 24 V system
MCU core supply VCORE/ 2%	2.4 MHz VCORE, 0.8 A DC-DC	2.4 MHz VCORE, 1.5 A DC-DC	VCORE LDO 0.5 A	2.4 MHz VCORE 0.8/1.5/ 2.2 A DC-DC	2x bucks 0.8 V/ 2.5 A/ SVS/ multiphase
Auxiliary ECU supply VAUX/3%	Up to 300 mA tracker/ auxiliary	Up to 300 mA tracker/ auxiliary	Up to 400 mA tracker/ auxiliary	Up to 400 mA tracker/ auxiliary	1 x buck 1.2-3.3 V/ 2.5 A
CAN interface	1	1	1 (optional)	1 (optional)	0
LIN interface	1 (optional)	1 (optional)	1 (optional)	1 (optional)	0
I/Os	6 (incl. F/S inputs)	6 (incl. F/S inputs)	5 (incl. F/S inputs)	5 (incl. F/S inputs)	2 (inputs only)
AMUX (battery, I/O, temp, VREF)	Yes	Yes	Yes	Yes	Yes
Fail safe	Fail-safe state machine RSTb, RS0b	Fail-safe state machine RSTb, RS0b	Fail-safe state machine RSTb, FS0b, FS1b	Fail-safe state machine RSTb, FS0b, FS1b	Fail-safe state machine PGOOD, RSTb, FS0b
ASIL	ASIL D ready	ASIL D ready	ASIL D ready	ASIL D ready	Fit for ASIL D
Package	LQFP48eP 7 x 7 mm	LQFP48eP 7 x 7 mm	LQFP48eP 7 x 7 mm	LQFP48eP 7 x 7 mm	56 QFN 8 x 8 mm
Typical application	Electric power steering, motor control, chassis control	Electric power steering, motor control, chassis control	Gearbox, battery management and DCDC	EPS, battery management, active suspension, inverters,gearbox and transmission	Hybrid vehicle control unit
MCU alignment	MPC564xM, MPC564xA, MPC5643L, MPC5744P	MPC564xM, MPC564xA, MPC5643L, MPC5744P	S32K1x	MPC574x MPC577x	S32S2x

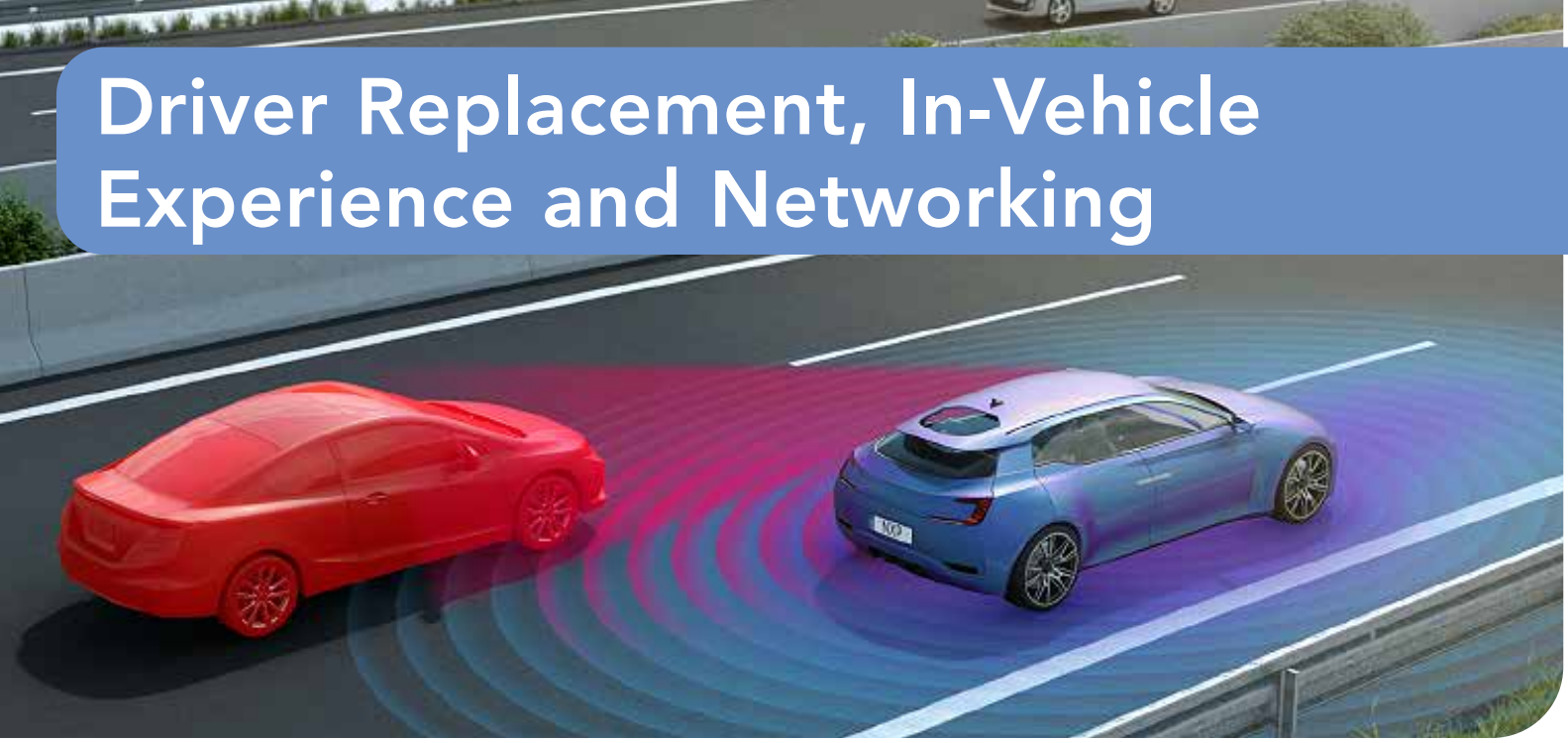
In powertrain applications, the safety SBC architecture supports independent monitoring of safety critical parameters. This is an essential function for the energy and power management of electric and hybrid electric vehicle applications battery management systems as well as steering and transmission control.

Key safety SBCs features

- High quality, robustness and reliability
- Optimal scalability
- System integration
- Ultra-Low power modes
- Independent fail-safe state machine, fit for ASIL D

FS6500/FS4500 system basis chips meet Grade 0 performance with high-temperature capability up to Tj=175°C

Driver Replacement, In-Vehicle Experience and Networking



The flexible and scalable NXP System Basis Chips (SBCs) complement MCU platforms that require functional safety such as ADAS applications, as radar and vision and other applications as networking, radio, infotainment and V2X. Offering superior performance for tomorrow's vehicles. With buck and buck-boost DC-DC architectures that support input voltage ranges from 2.7 V to 60 V for 12 and 24 V markets and scalable power options, these SBCs provide an energy-efficient solution for high-performance MCUs.

Key features

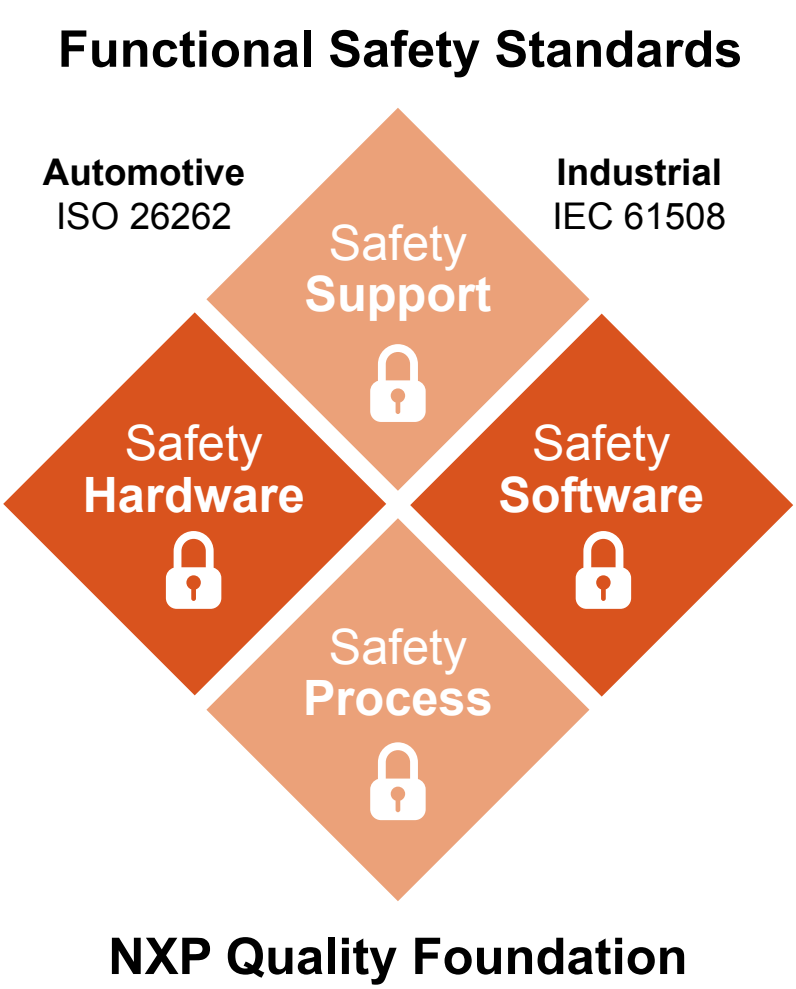
- Input supply to 60 V for 12 V and 24 V systems
- Low-power mode with 10 µA in LPOFF
- Independent monitoring unit
- Process compliancy to ISO 26262 standard
- Proven and robust
- Scalable

	Features	FS8500 SAFE ASSURE	FS8400 SAFE ASSURE	VR5500	FS5502	VR5510 SAFE ASSURE
Power	V pre-regulator (12 and 24 V, 10 A HV Buck)	1	1	1	1	1
Power	Boost (5 to 5.74 V, 1.5 A, int. MOS)	1	1	1		1
Power	Buck (0.4 to 1.8V, 2.5A)	Up to 3	Up to 3	3	2	3
Power	LDO (configurable 1.1 to 5 V, up to 400 mA)	2	2	2	1	3 + 1 HV LDO (12 and 3.3 V input, 10 mA)
System	Communications	SPI I²C	SPI I²C	I²C	I²C	I²C
Safety	**Qualification/ Safety Level**	**ASIL D**	**ASIL B**	**QM**	**QM**	**ASIL D**
Safety	Safety Output Pins	PGOOD RSTB FS0B	PGOOD RSTB FS0B	PGOOD RSTB	PGOOD RSTB	PGOOD RSTB FS0B
Safety	Monitoring	VCOREMON VDDIO, 4 x VMONx Challenger WD FCCU External IC (ERRMON)	VCOREMON VDDIO 2 x VMONx Simple WD	VCOREMON VDDIO 1 x VMONx	VCOREMON VDDIO 1 x VMONx	VCOREMON VDDIOMON HVLDOMON 4 x VMONx Challenger WD FCCU
Safety	Other	MCU Fault Recovery Strategy Analog BIST and Logical BIST AMUX	Analog BIST AMUX	AMUX		MCU Fault Recovery Analog BIST Logical BIST AMUX/FOUT
Safety	Documentation	FMEDA Safety Manual	FMEDA Safety Manual			FMEDA Safety Manual
	Typical Automotive Applications	ADAS Vision and Radar		Radio, V2X and Infotainment	Radar	Service-oriented gateway and domain controller

SafeAssure Functional Safety Program

Launched in 2011, the NXP SafeAssure program aligns our development process to ISO 26262 across our businesses. The program is our corporate commitment to supporting functional safety through a safety-conscious culture, discipline and collaboration. It also:

- 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 to help ensure our products meet the stringent demands of safety applications



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Document Number: SBCAUTOBR REV 4