SAFETY SBCs FOR AUTOMOTIVE

SCALABLE FUNCTIONAL SAFETY SOLUTIONS ACROSS AUTOMOTIVE APPLICATIONS

SAFE ASSURE by NXP

NXP

System basis chips (SBCs) with functional safety architectures and behaviors are crucial for the automotive designs that support key vehicle electrification, autonomy and connectivity trends. At NXP, we combine advanced power management with functional safety monitoring ideal for automotive-grade, system-oriented solutions that require high safety, efficiency and high-integrity performance.

SYSTEM SOLUTION

EFFICIENCY

SAFETY

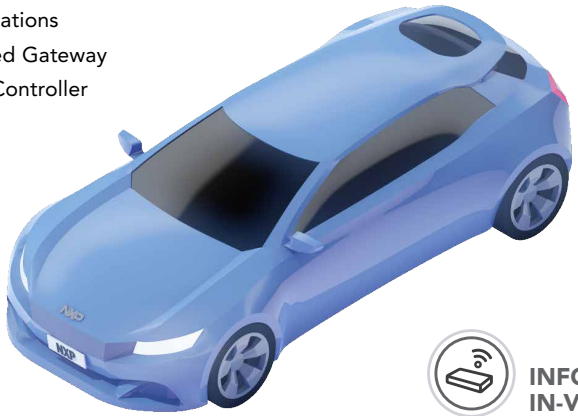
YOUR FUNCTIONAL SAFETY AND POWER MANAGEMENT PARTNER

ENABLING SMART SYSTEM POWER PLATFORM STRATEGIES FOR FLEXIBLE AND SCALABLE SOLUTIONS

SYSTEM SOLUTION

ADAS AND HIGHLY AUTOMATED DRIVING
Radar Systems
Vision Systems
High Performance Compute

CONNECTIVITY AND VEHICLE NETWORKING
V2X Communications
Service-Oriented Gateway
Zone/Domain Controller



POWERTRAIN AND VEHICLE DYNAMICS
Safety & Chassis
Transmission and Gearbox
Electric Power Steering
Battery Management System
EV Power Inverter

BODY AND COMFORT
Electric Pumps
HVAC
Body Control Module

INFOTAINMENT IN-VEHICLE EXPERIENCE
Instrument Cluster
eCockpit

EFFICIENCY

Efficient energy storage and management are key in new car architecture. NXP safety SBCs offer different low power mode strategies and benefits for the system and low current consumption for longer duration of the stored energy.

LPOFF MODE

- All regulators OFF
- Low quiescent current to reduce battery discharge (mainly SBC low power budget)
- SBC can wake up the system by Wake pin or CAN (If available)
- This low power capability is required in powertrain, chassis, safety and electrification applications started with car wake up

LPON / STAND BY MODE

- Regulators ON with limited current capability
- Low quiescent current to reduce battery discharge
- MCU already powered (memory and some critical function) to accelerate system wake up
- This low power capability is required in Body, Gateway, and some Infotainment applications requiring faster wake up

RUN MODE

- Regulators ON with full current capability
- Application in normal mode until request to move to low power

BYLINK SYSTEM POWER PLATFORM

The missing link to safely power all ECUs.

NXP's safe, scalable, expandable BYLink System Power Platform is the answer to an easy and vital link towards a safe and configurable power management design, connecting various NXP SBCs / PMICs devices together as a single power system.

ADDRESSES KEY CHALLENGES

- Power dissipation management
- Functional safety integration
- Complex power up/down sequence management

KEY BENEFITS

- Accelerate time-to-market
- Simplify safety analysis
- Enable platform approach

TARGET APPLICATIONS

- ADAS domain controllers
- Zone controllers
- Electrification domain controllers
- eCockpit

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SBCs WITH LOW POWER ON/OFF MODES

	Features	MC33903/4/5	FS23 (Pre-Production)	FS24 (Pre-Production)	FS26	VR5510	FS56
Power Management Features	Orderable part numbers	MC33903/4/5	PFS230xAMBEP PFS232xAMBEP	PFS240xAVMA0ES PFS240xAVBA0ES	PFS2630AMDA0AD	MVR5510AMDAx	MFS5600AMEA0ES
	VPRE HV Buck	–	1.9 V to 5 V Configurable/ 0.4 A*	1.9 V to 5 V Configurable/ 0.4 A*	3.7 V to 6.35 V configurable / 1.5 A synch. rectification (internal FET)	3.3 V to 5.2 V configurable / 10 A (external FET)	1X 1.8 V to 8 V / 3 A (internal FET) 1X 1.8 V to 7.2 V / 10 A (external FET)
	MCU core supply	3.3 V to 5 V –150 mA LDO +300 mA option ext PNP	1.9 V to 5 V Configurable/ 0.4 A*	-	0.8 V to 3.35 V DC–DC 0.8 A to 1.65 A	0.4 V to 1.8 V / 2.5 A DC–DC up to 5 A in multiphase configuration	–
	Buck	–	-	-	–	1 x 0.4 V to 1.8 V / 2.5 A DC–DC 1 x 1 V to 4.1 V / 2.5 A DC–DC	–
	Boost	–	-	-	HV Boost Driver Config Front/Back	Boost Converter 4,5 V to 6 V / 1.1 A (internal MOSFET)	–
	LDO	Vaux 3.3 V–5 V / 150 mA Ext PNP Vcan 5 V / 160 mA	3.3 V or 5V 150 mA	3.3 V or 5V 150 mA	2 x (3.3 V or 5 V / 400 mA)	2 x 1.5 V to 5 V / 400 mA 1 x 1.1 V to 5 V / 400 mA	–
	Trackers	–	3.3 V/5 V/100 mA	-	2 x (1.2 V/1.8 V / VREF/LDO / 150 mA) (internal MOSFET)	–	–
	Others	–	150 mA with cyclic sensing and PWM capability	-	0.75% Vref 3.3 V or 5 V / 30 mA	1x HV LDO 0.8 V or 3.3 V / 10 mA	–
Safety Features (listed for higher level of ASIL)	Fit for ASIL	QM	QM/B	QM/B	B / D	QM / B / D	QM / B
	Watchdog	Simple (with advanced Q&A)	Simple	Simple	Simple / Challenger	Simple / Challenger	Simple / Challenger
	MCU Error Mon	–	Yes	Yes	Yes (incl. PWM)	Yes	Yes
	ext Vmon	–	Yes	Yes	1	4	Up to 4
	BIST	–	ABIST	ABIST	ABIST and LBIST	ABIST and LBIST	ABIST and LBIST
	ABIST On Demand	–	Yes	Yes	Yes	–	Yes (Option)
	Safety Output	–	RSTB, FS0B, LIMP0/1/2	LIMP0	FS0b, FS1b, RSTB	FS0b, PGOOD, RSTB	FS0b, PGOOD1, PGOOD2
	IC ext Monitoring	–	Yes	No	Yes	–	Yes
	Fault recovery Strategy	–	Yes	No	Yes	Yes	–
	Documentation/ Analysis	–	FMEDA, Safety Manual, FIT report, FTA, DFA audit on site	FMEDA, Safety Manual, FIT report, FTA, DFA audit on site	FMEDA, Safety Manual, FIT report, FTA, DFA audit on site	FMEDA, Safety Manual, FIT report, FTA, DFA audit on site	FMEDA, Safety Manual, FIT report, FTA, DFA audit on site
System Features	Targeted battery system	12 V	12 V	12 V	12 V	12 or 24 V	12 V
	Low–power Off Mode (25°C) All Reg Off	15 µA	30 µA	30 µA	30 µA	15 µA	7 µA
	Low–power On Mode Vpre ON / Reg could be switched On	Yes	20 µA	Standby mode with Vpre in PFM: 20µA	Standby mode with Vpre in PFM: 29µA	Standby mode with Vpre + HVLDO ON: 35 µA. Deep sleep mode: 15 µA	Standby mode with Vpre in PFM: 65 µA
	GPIO	Up to 4	2xHVIO, 4xLVIO, 2 Wakeup	HVIO1, LIMP0/GPO	2 bidirectional GPIO (HV IO)	–	4 GPIOs 2 x Enable
	AMUX (battery, I/O, temp, VREF)	Yes	Yes	Yes	Yes	Yes	–
	Long Duration Timer	–	Yes	Yes	Yes	–	–
	Communication	SPI	SPI/I²C	SPI	SPI	I²C	I²C
	CAN interface	1	1	1	–	–	–
	LIN interface	Up to 2	1	-	–	–	–
	Package (mm)	32 SOIC EP	48 QFN (7x7)	32 QFN (5x5)	48 LQFP EP (7x7)	56 QFN (8x8)	32 QFN (5x5)
	Typical application	Body, safety applications	Body and Comfort	Smart Access, Small Body	BMS, DC–DC, OBC, inverter, VCU, BCM, BJB	Service–oriented gateway, V2X, domain controller	Infotainement, telematics, clusters
	MCU alignment	S32K1 MPC56x	S32K1 S32K31x	NCJ29Dx, KW4x	S32K3x	S32G	General
BYLink System Power Platform		–	–	–	Yes	Yes	Yes

SBCs WITH LOW POWER OFF MODES

	Features	MC33907/08	FS45	FS5502	FS65	FS66	FS84/85	FS86	VR5500
Power Management Features	Orderable part numbers	MC33907(N/L)AE MC33908(N/L)AE	MC33FS45xx (Grade 1) MC35FS45xx (Grade 0)	MC33FS5502Y0ES	MC33FS65xx (Grade 1) MC35FS65xx (Grade 0)	MC33FS6600M0ES	MC33FS8530A0ES (56 QFN) MFS8416AMBP0ES (48 QFN)	MFS8613BMDA0ES	MC33VR5500V0ES
	VPRE HV Buck	6.5 V fixed/ 2.0 A Asynchronous	6.5 V fixed/ 2.0 A Asynchronous	4.1 V and 5 V configurable/10 A (external MOSFET)	6.5 V fixed/ 2.0 A Asynchronous	3.3 V to 5 V configurable/10 A (external MOSFET)	3.3 V to 5 V configurable/10 A (external MOSFET)	3.3 V to 5 V configurable/15 A with HS short-circuit protection (external MOSFET)	3.3 V to 5 V configurable/10 A (external MOSFET)
	MCU core supply	0.8 A DC-DC (33907) / 1.5 A DC-DC (33908)	1 V to 5 V 0.5 A LDO	0.8 V to 1.8 V/2.5 A DC-DC	1 V to 5 V 0.8/1.5/ 2.2 A DC-DC	0.8 V to 1.8 V/2.5 A DC-DC up to 5 A in multiphase configuration	0.8 V to 1.8 V/2.5 A DC-DC up to 5 A in multiphase configuration	–	0.8 V to 1.8 V/2.5 A DC-DC up to 5 A in multiphase configuration
	Buck	–	–	1 V to 3.3 V/ 2.5 A DC-DC	–	1 x (0.8 V to 1.8V/2.5 A) 1 x (1 V to 3.3 V/2.5 A)	Extra rails depending version 1 x (0.8 V to 1.8 V/2.5 A) 1 x (1 V to 3.3 V/2.5 A)	1 x (1 V to 3.3 V/2.5 A)	1 x (0.8 V to 1.8 V/2.5 A) 1 x (1 V to 3.3 V/2.5 A)
	Boost	Buck/Boost Topology on Vpre (external Mosfet)	Buck/Boost Topology on Vpre (external Mosfet)		Buck/Boost Topology on Vpre (external Mosfet)	Boost Converter 5 to 5.74 V/1.1 A (internal Mosfet)	Boost Converter 5 to 5.74 V/1.1 A (internal Mosfet)	Boost Converter 5 to 5.74 V/1.1 A (internal Mosfet)	Boost Converter 5 to 5.74 V/1.1 A (internal Mosfet)
	LDO	Vcan 5 V/100 mA Vcca 3.3 V/5 V/100 mA	Vcan 5 V/100 mA Vcca 3.3 V/5 V/100 mA	2 x (1.1 V to 5 V/400 mA)	Vcan 5 V/100 mA Vcca 3.3 V/5 V/100 mA	2 x (1.1 V to 5 V/400 mA)	2 x (1.1 V to 5 V/400 mA)	1 x (1.5 V to 5 V/400 mA) 1 x (1.1 V to 5 V/400 mA)	2 x (1.1 V to 5 V/400 mA)
	Trackers	1 x (3.3 V/5 V/400 mA) ext.PNP	1 x (3.3 V/5 V/400 mA) ext.PNP	–	1 x (3.3 V/5 V/400 mA) ext.PNP	–	–	–	–
	Others	Use Vcca as Vref	Use Vcca as Vref	–	Use Vcca as Vref	–	–	–	–
Safety Features (listed for higher level)	Fit for ASIL	D	B/D	QM	B/D	D	QM/B/D	QM/B/D	QM
	Watchdog	Challenger	Simple/Challenger	–	Simple/Challenger	Challenger	Simple/Challenge	Simple/Challenger	–
	MCU Error Mon	Yes	Yes	–	Yes		Yes	Yes	–
	ext Vmon	–	–	1	–	4	Up to 4	Up to 9	1
	BIST	ABIST and LBIST	ABIST and LBIST	–	ABIST and LBIST	ABIST and LBIST	ABIST and LBIST	ABIST and LBIST	–
	ABIST On Demand	–	–	–	–	–	–	–	–
	Safety Output	FS0b	FS0b and FS1b (option)	PGOOD, RSTB	FS0b and FS1b (option)	FS0b, PGOOD, RSTB	FS0b, PGOOD, RSTB	FS0b, PGOOD, RSTB	PGOOD, RSTB
	IC ext Monitoring	Yes	Yes	–	Yes	Yes	Yes	Yes	–
	Fault recovery Strategy	–	–	–	–	Yes	Yes	Yes	–
	Documentation/ Analysis	FMEDA, Safety Manual	FMEDA, Safety Manual		FMEDA, Safety Manual	FMEDA, Safety Manual, FIT report FTA and DFA audit on site	FMEDA, Safety Manual, FIT report FTA and DFA audit on site	FMEDA, Safety Manual, FIT report FTA and DFA audit on site	
System Features	Targeted battery system	Yes	12 V	12 or 24 V	12 V	12 or 24 V	12 or 24 V	12 or 24 V	12 V
	Low-power Off Mode (25°C) All Reg Off	30 µA	30 µA	10 µA	30 µA	10 µA	10 µA	10 µA	10 µA
	Low-power On Mode Vpre ON/Reg could be switched On	–	–	–	–	–	–	–	–
	GPIO	4	–	2 x Wake inputs	–	–	–	2 x Wake inputs 2 x double function GPO Yes	2 x Wake inputs
	AMUX (battery, I/O, temp, VREF)	Yes	Yes	–	Yes	Yes	Yes		Yes
	Long Duration Timer	–	Yes	–	Yes	–	–	-	–
	Communication	SPI	SPI	I²C	SPI	SPI	SPI/I²C	I²C	I²C
	CAN interface	1	1 (optional)	–	1 (optional)	–	–	–	–
	LIN interface	1 (optional)	1 (optional)	–	1 (optional)	–	–	–	–
	Package (mm)	48 LQFP EP (7x7)	48 LQFP EP (7x7)	56 QFN EP (8x8)	48 LQFP EP (7x7)	56 QFN EP (8x8)	56 QFN EP (8x8) 48 QFN EP (7x7)	48 QFN EP (7x7)	56 QFN EP (8x8)
	Typical application	Electric power steering, motor control, chassis control	Gearbox, battery management and DC-DC	QM radar	EPS, battery management, active suspension, inverters, gearbox and transmission	Hybrid vehicle control unit	ADAS vision and radar, safety island, domain controller	ADAS vision and radar, safety island, propulsion domain controller	Radio, V2X and infotainement
	MCU alignment	MPC564xM, MPC564xA, MPC5643L, MPC5744P	S32K1x	S32R274	MPC574x MPC577x	S32S2x	S32R, S32V	General	General
BYLink System Power Platform		–	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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), helping 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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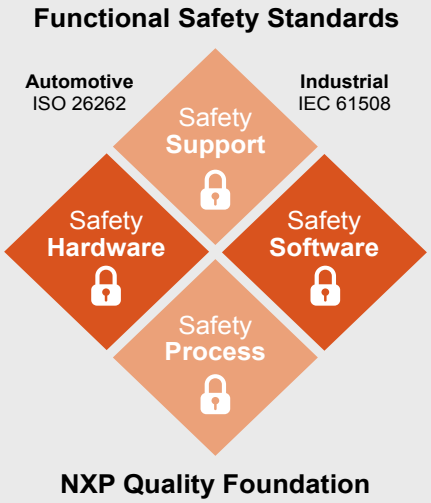
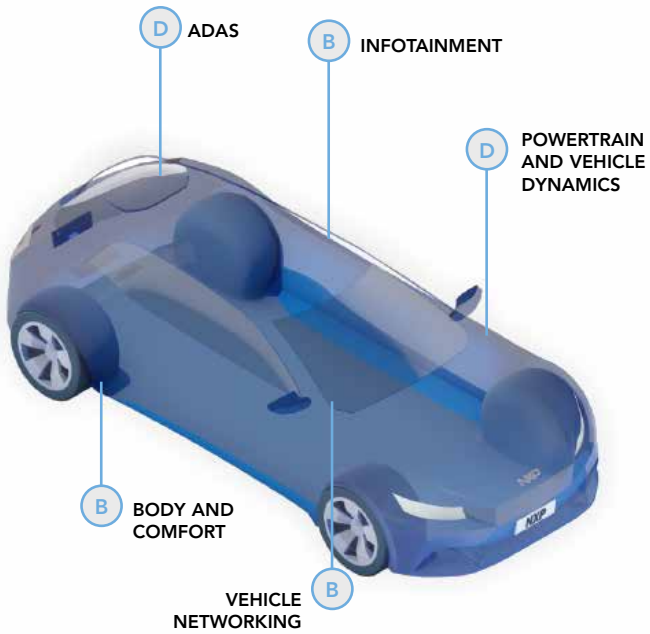


ASIL LEVEL EXAMPLES FOR DIFFERENT SOLUTIONS

Domain	Application	Hazardous Event (example)	ASIL
ADAS HAD	Radar and safe central compute	Inadvertent hard braking during driving	D
POWERTRAIN AND VEHICLE DYNAMICS	Airbag	Inadvertent deployment during driving	D
	EPS	Self steer during driving	D
	Stability control	One wheel lock during driving	D
	ABS	One wheel lock during hard braking	C
	HEV/EV motor control	Sudden Torque Up/Down	C
	Transmission	Speed down on express way	C
	Engine control	Decreasing of engine torque	B
BODY AND COMFORT	Brake lamp	No brake lighting during braking	B



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