Safety SBCs for Automotive

Scalable functional safety solutions across automotive applications
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

1. **ADAS-Gateway**
   - 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 + FS65 + PF82 - **ASIL B**

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

6. **Drive Train—Electrification**
   - Hybrid Vehicle Controller - **ASIL B**
   - FS66 with S32S2

7. **Drive Train—Safety & Chassis**
   - Transmission, Transfer Case - **ASIL D**
   - FS650x with other MCU

8. **Drive Train—Safety & Chassis**
   - Suspension/Damping - **ASIL C**
   - FS65 with other MCU

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

10. **Drive Train—Safety & Chassis**
    - Engine Management Unit - **ASIL B**
    - FS651x with MPC5777C

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

12. **Drive Train—Electrification**
    - Electric Motor (Alterno Starter, eAxel drive...) - **ASIL D**
    - FS45

13. **Drive Train—Electrification**
    - Battery Management (12 V, 48 V, HV) FS650x
    - with MPC5744P & MC35771 - **ASIL C**
    - NewTec RD: S32K with FS45 - **ASIL C**
    - MPC577x with FS650x - **ASIL D**

### Drive Train—Safety & Chassis

- **ASIL A B C D**
Powertrain – Electrification, Chassis and Safety

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

### SAFETY SBC PRODUCT FEATURES FOR POWERTRAIN

<table>
<thead>
<tr>
<th>Features</th>
<th>MC33907</th>
<th>MC33908</th>
<th>FS4500</th>
<th>FS6500</th>
<th>FS6600</th>
</tr>
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<tbody>
<tr>
<td>Orderable part numbers</td>
<td>MC33907LAE, MC33907NAE</td>
<td>MC33908LAE, MC33908NAE</td>
<td>MC33FS45xx (Grade 1)</td>
<td>MC33FS65xx (Grade 1)</td>
<td>MC33FS6600</td>
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<tr>
<td>V pre-regulator</td>
<td>2.0 A / 6.5 V VPRE capable 2.7 V to 28 V buck/ boost</td>
<td>2.0 A / 6.5 V VPRE capable 2.7 V to 28 V buck/ boost</td>
<td>2.0 A / 6.5 V VPRE capable 2.7 V to 28 V buck/ boost</td>
<td>2.0 A / 6.5 V VPRE capable 2.7 V to 28 V buck/ boost</td>
<td>Configurable 3.3/ 5.0 V to 10.0 A buck</td>
</tr>
<tr>
<td>Targeted system</td>
<td>12 V system</td>
<td>12 V system</td>
<td>12 V system</td>
<td>12 V system</td>
<td>12 or 24 V system</td>
</tr>
<tr>
<td>MCU core supply V CORE/2%</td>
<td>2.4 MHz VCORE, 0.8 A DC-DC</td>
<td>2.4 MHz VCORE, 1.5 A DC-DC</td>
<td>VCORE LDO 0.5 A</td>
<td>2.4 MHz VCORE 0.8/1.5/ 2.2 A DC-DC</td>
<td>2x bucks 0.8 V/ 2.5 A/ SVS/ multiphase</td>
</tr>
<tr>
<td>Auxiliary ECU supply V AUX/3%</td>
<td>Up to 300 mA tracker/ auxiliary</td>
<td>Up to 300 mA tracker/ auxiliary</td>
<td>Up to 400 mA tracker/ auxiliary</td>
<td>Up to 400 mA tracker/ auxiliary</td>
<td>1 x buck 1.2-3.3 V/ 2.5 A</td>
</tr>
<tr>
<td>CAN interface</td>
<td>1</td>
<td>1</td>
<td>1 (optional)</td>
<td>1 (optional)</td>
<td>0</td>
</tr>
<tr>
<td>LIN interface</td>
<td>1 (optional)</td>
<td>1 (optional)</td>
<td>1 (optional)</td>
<td>1 (optional)</td>
<td>0</td>
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<tr>
<td>I/Os</td>
<td>6 (incl. F/S inputs)</td>
<td>6 (incl. F/S inputs)</td>
<td>5 (incl. F/S inputs)</td>
<td>5 (incl. F/S inputs)</td>
<td>2 (inputs only)</td>
</tr>
<tr>
<td>AMUX (battery, I/O, temp, VREF)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Fail safe</td>
<td>Fail-safe state machine RSTb, R50b</td>
<td>Fail-safe state machine RSTb, R50b</td>
<td>Fail-safe state machine RSTb, F50b, F51b</td>
<td>Fail-safe state machine RSTb, F50b, F51b</td>
<td>Fail-safe state machine PGOOD, RSTb, F50b</td>
</tr>
<tr>
<td>ASIL</td>
<td>ASIL D ready</td>
<td>ASIL D ready</td>
<td>ASIL D ready</td>
<td>ASIL D ready</td>
<td>Fit for ASIL D</td>
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<tr>
<td>Package</td>
<td>LQFP48eP 7 x 7 mm</td>
<td>LQFP48eP 7 x 7 mm</td>
<td>LQFP48eP 7 x 7 mm</td>
<td>LQFP48eP 7 x 7 mm</td>
<td>56 QFN 8 x 8 mm</td>
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<tr>
<td>Typical application</td>
<td>Electric power steering, motor control, chassis control</td>
<td>Electric power steering, motor control, chassis control</td>
<td>Gearbox, battery management and DCDC</td>
<td>EPS, battery management, active suspension, inverters, gearbox and transmission</td>
<td>Hybrid vehicle control unit</td>
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<tr>
<td>MCU alignment</td>
<td>MPC564xM, MPC564xA, MPC5643L, MPC5744P</td>
<td>MPC564xM, MPC564xA, MPC5643L, MPC5744P</td>
<td>S32K1x</td>
<td>MPC574x, MPC577x</td>
<td>S32S2x</td>
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</tbody>
</table>
The flexible and scalable NXP System Basis Chips (SBC) complement MCU platforms in ADAS applications that require functional safety such as radar and vision and other applications like radio, infotainment and V2X that require 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

<table>
<thead>
<tr>
<th>Features</th>
<th>FS8500</th>
<th>FS8400</th>
<th>VR5500</th>
<th>FSS502</th>
</tr>
</thead>
<tbody>
<tr>
<td>V pre-regulator (12 and 24 V, 10 A HV Buck)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Boost (3 to 5.74 V, 1.5 A, int. MOS)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Buck</td>
<td>Up to 3</td>
<td>Up to 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>LDO (configurable 1.1 to 5 V, up to 400 mA)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Communications</td>
<td>SPI</td>
<td>SPI</td>
<td>PC</td>
<td>PC</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Qualification / Safety Level</th>
<th>ASIL D</th>
<th>ASIL B</th>
<th>QM</th>
<th>QM</th>
</tr>
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<tbody>
<tr>
<td>Safety Output Pins</td>
<td>PGOOD RSTB FS0B</td>
<td>PGOOD RSTB FS0B</td>
<td>PGOOD RSTB</td>
<td>PGOOD RSTB</td>
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<tr>
<td>Monitoring</td>
<td>VCOREMON VDDIO, 4 x VMONx, Challenger WD, FCCU, External IC (ERRMON)</td>
<td>VCOREMON VDDIO, 2 x VMONx, Simple WD</td>
<td>VCOREMON VDDIO, 1 x VMONx</td>
<td>VCOREMON VDDIO, 1 x VMONx</td>
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<tr>
<td>Other</td>
<td>MCU Fault Recovery Strategy, Analog BIST and Logical BIST AMUX</td>
<td>Analog BIST AMUX</td>
<td>AMUX</td>
<td></td>
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<tr>
<td>Typical Automotive Applications</td>
<td>ADAS Vision and Radar</td>
<td>Radio, V2X and Infotainment</td>
<td>Radar</td>
<td></td>
</tr>
</tbody>
</table>
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

Functional Safety Standards

Automotive
ISO 26262

Safety Support

Safety Hardware

Safety Process

Industrial
IEC 61508

Safety Software

NXP Quality Foundation