Solutions for Safety Critical Automotive Applications

VEHICLE DYNAMICS EXPO 2010

22, 23, 24 JUNE 2010 MESSE STUTTGART | STUTTGART | GERMANY

Matthieu Reze

EMEA - Automotive Sensors Marketing

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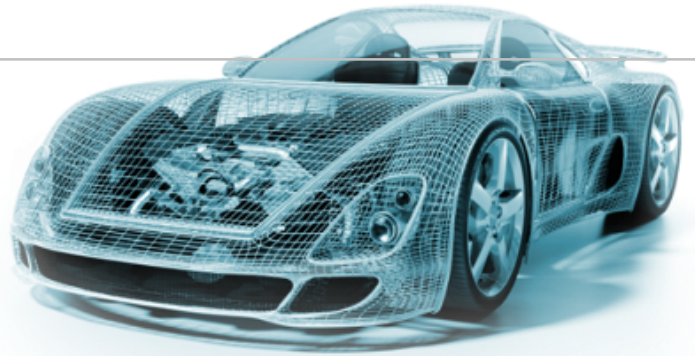
Agenda

1. The market landscape
2. Introduction to Functional Safety
3. Microcontroller & Software for Chassis & Safety Applications
4. Sensor solutions for Chassis & Safety Applications
5. Conclusion



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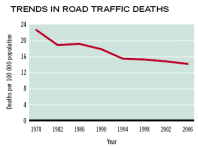
1.3 million people are killed on world roads every year

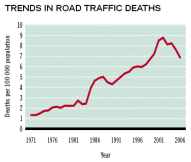
or more than 3,500 people per day….

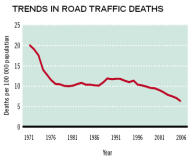



Country	USA	Germany	China	Japan
Population (million)	306	83	1,336	128
Car Park (million)	251	56	145	91
Death (people)	42,642	4,979	89,455	6,639
Death / 100k people		6.0	6.7	5.2
Death / 100k cars		9.0	61.6	7.3



Trends in Road TrafficDeaths





Source: http://www.who.int/violence_injury_prevention/road_safety_status/2009/en/

And in India, 105,725 killed; Russia, 33,308 killed; Brazil, 35,155 killed…

Electronic Market Growth Dynamics:

1. New systems are introduced in high end vehicles based on consumer demand for safety.
2. Government safety regulations are changed to mandate the new system.
3. Increasing legislation for safety systems (ABS, ESP) is driving the Adoption of electronic braking, and safety systems in many regions.
4. ADAS, Radar and Camera systems expected to be next for mandate.

Network Effects in Chassis & Safety

Steering
Electric power steering
Active front steering
Steering Torque Sensors
High torque EPS

Driver Assistance
Front & rear radar
Multifunction Camera
Blindspot detection
Ultra-sonic park assist
Camera parking aid
MPE sensors
Adaptative Cruise Control
Lane Keeping assistant

Suspension
Semi active suspension
Fully active suspension

Powertrain
Traction control
Regenerative Braking

Brake / Active Safety
Anti-lock braking
Vehicle stability control
Electric parking brake
Regenerative Braking

Airbag/ Passive Safety
Front airbag, Side airbag
Seatbelt Pretensioner
Pedestrian Protection

New: Safety controller

- **-High Computing power required**
- **-Complex Software implemented**
- **-Functional Safety**
- **-High Bandwidth Network**
- **-Sensor Fusion**
- **- Low power consumption**

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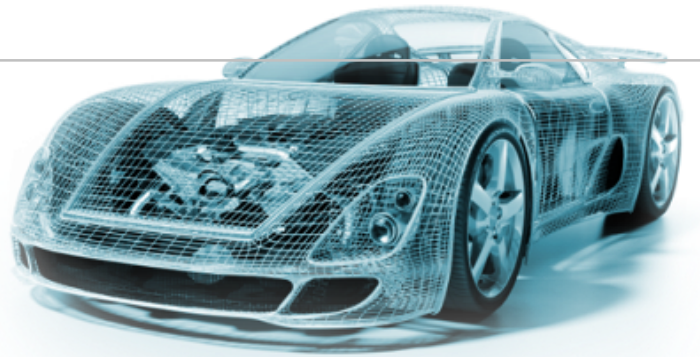

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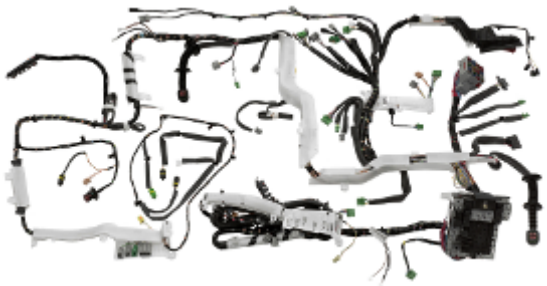
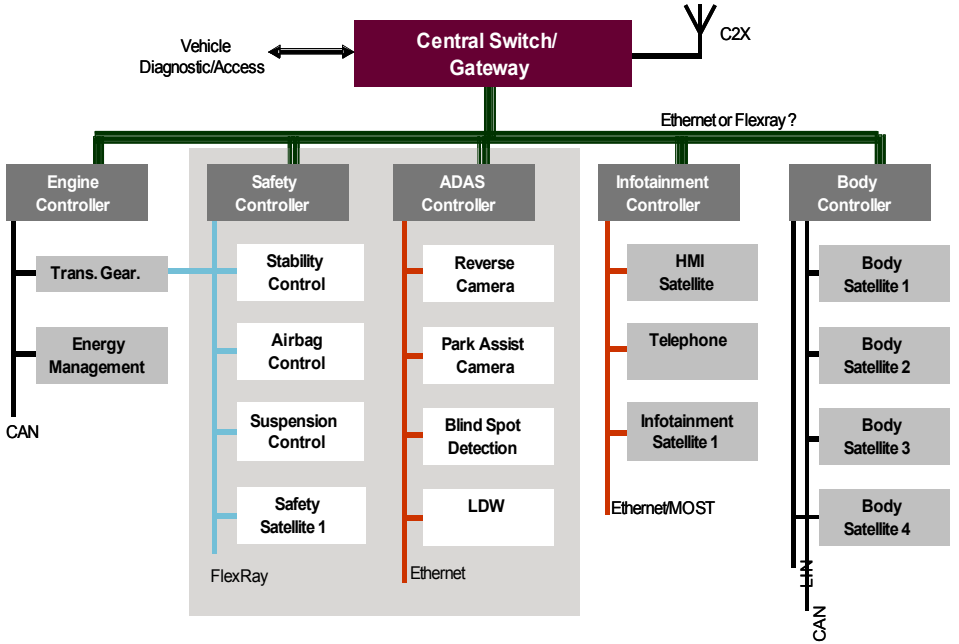
New trends in Vehicle Architecture

- Vehicle E/E Architecture are
  - Too **complex**
  - Too much **power**
  - Too many **ECUs**
  - Too many **cables**
  - Too many **connectors**
  - Too much **weight**
  - Too many too many…



Future Evolution
Domain Based Network



Higher ECU integration and emergence of domain controller will create new challenges in terms of functional safety (ISO26262)

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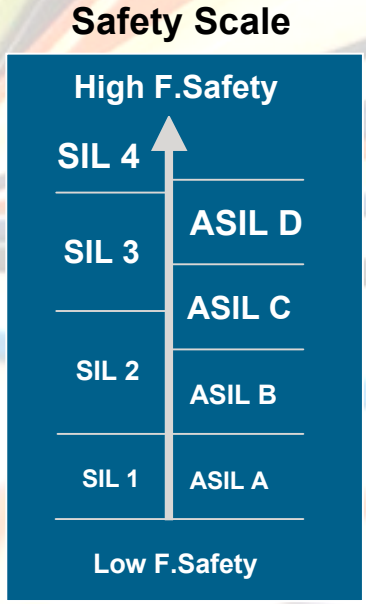
Functional Safety, what is that ?

▶ Functional Safety Definition

- **Ability of a system to fullfil given functional requirements**
  - **Within a set of operation conditions**
  - **Within a given time period**
  - **Within known failure mode**

▶ Two relevant safety standards

- **IEC 61508**
  - Generic standard for functional safety of electronic systems
  - **SIL levels** (Safety Integrity Level) 1 to 4
- **ISO 26262 (in preparation)**
  - 'Derivate' of IEC 61508 for automotive applications
  - **ASIL levels** (Automotive SIL) A to B



Safety standards are becoming the key enabler for the design of all new electronic application in the vehicle and associated semiconductor development

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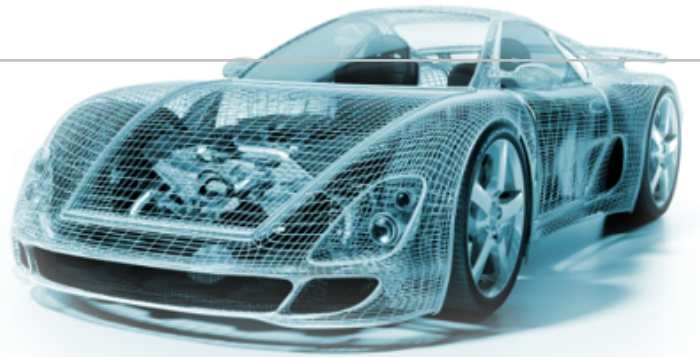

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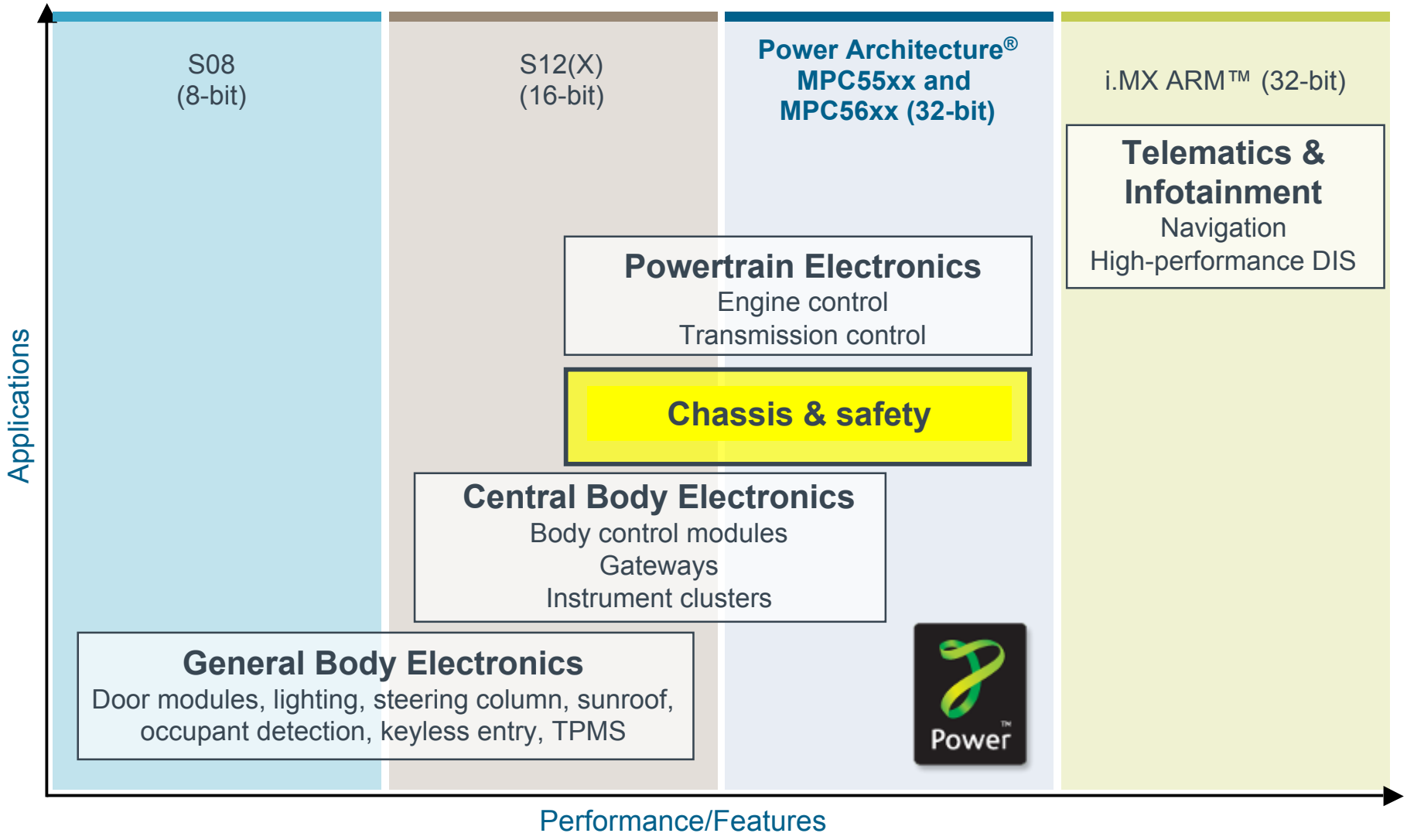
Freescale Automotive Cores



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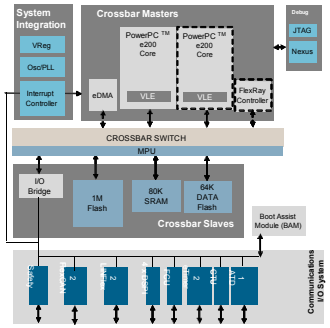
A Scalable familly of 32-bit 90nm Microcontroller for Chassis & Safety Application

MPC560xP/T

- e200z0 Single & Dual core
- Up to 64 MHz
- 192kB to 1MB Flash
- FlexCAN, LINFlex, FlexRay

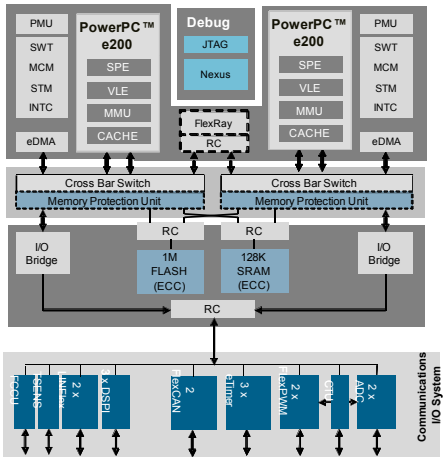


Airbag
Antilock Brake System
Electric Power Steering
Ultrasonic Park Assist

Suround camera
(*MPC5604X version with MJPEG and FEC*)

MPC564xL

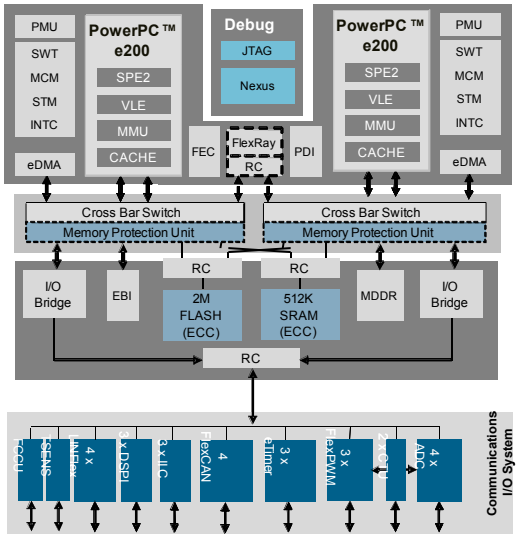
- e200z4 Dual core, Dual Issue
- Lockstep or decoupled mode
- Up to 120 MHz
- 384kB to 1MB Flash
- FlexCAN, LINFlex, FlexRay



Electric Power Steering
Electronic Stability Control
24 & 77GHz radar controller
Domain Controller

MPC567xK

- e200z7 Dual core, Dual Issue
- Lockstep or decoupled mode
- Up to 200 MHz
- 1MB to 2MB Flash
- FlexCAN, LINFlex, FlexRay, Ethernet



Chassis Controller
Domain Controller
High Performance Radar / Camera

Performance scale

MCU Architectures for Safety Critical Applications

	 Single Core	 Asymmetric Cores	 Lockstep Dual Core	 Decoupled Dual Core	Detection of SW Errors	SW Effort
Single SW Instance	-	-	ASIL D	-	No	Low
Replicated SW Instances	ASIL A (Time redundancy)	Not common	Makes little sense	ASIL D	No	Medium
Diverse SW Instances	ASIL A-B (Time redundancy)	ASIL C-D	ASIL D (Time redundancy)	ASIL D	Yes	High
Core Perfomances	1x	1.2x	1.0x	1.5x		

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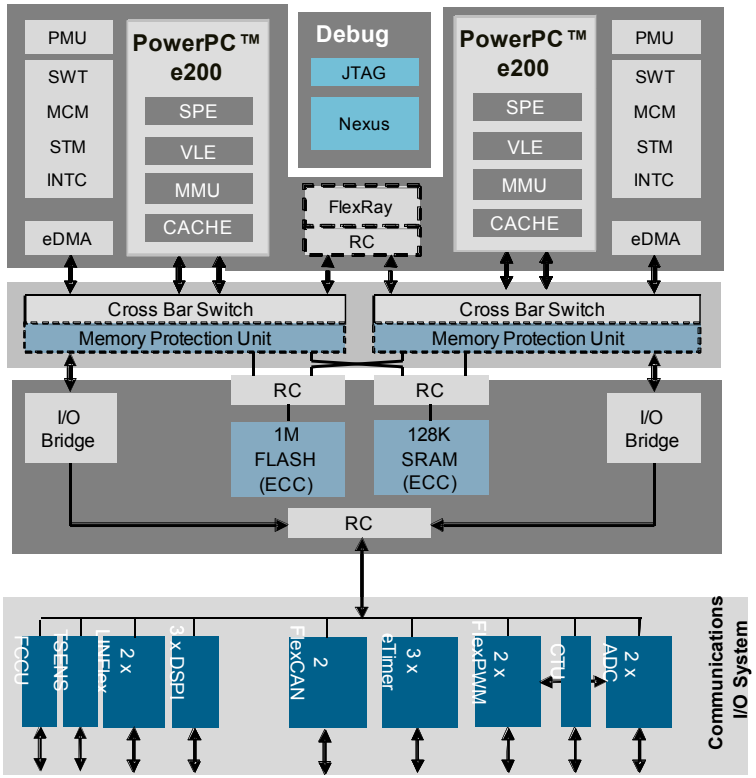
New Dual Core MCU for safety critical Applications

MPC5643L

- First dual-core, dual-issue controller available that can switch between **lock-step mode** and **dual parallel mode** to address **functional safety** and **performance**
- Duplication of all computational elements to address **IEC61508/ISO26261** level applications
- More than **600 DMIPS performance** from dual core, dual issue e200 running at 120 MHz



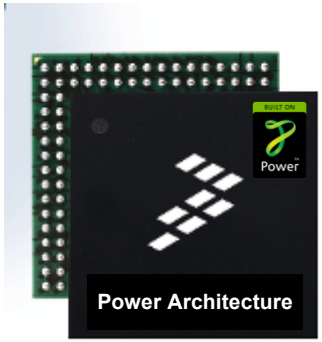
Winner of the 20th annual EDN Innovation Awards April 26th, 2010

Proof Point: Effective cooperation on Functional Safety

Freescale Press Release, October 2007

Freescale and Continental collaborate on multi-core 32-bit microcontroller for electronic braking systems [..]

The SPACE device integrates three e200 cores based on Power Architecture™ technology, making it the industry's first triple-core automotive MCU.



http://media.freescale.com/phoenix.zhtml?c=196520&p=irol-newsArticle&ID=1063162&highlight=

Continental Press Release, November 2009

Continental has received a **safety certification according to the IEC 61508 SIL-3** standard for a chipset used as brake controller [..]

The chipset in question consists of a **SPACE microcontroller** and a PCU mixed-signal chip.

http://www.conti-online.com/generator/www/com/de/continental/presseportal/themen/pressemitteilungen/3_automotive_group/chassis_safety/press_releases/pr_2009_11_03_sil3_zertifikat_de.html

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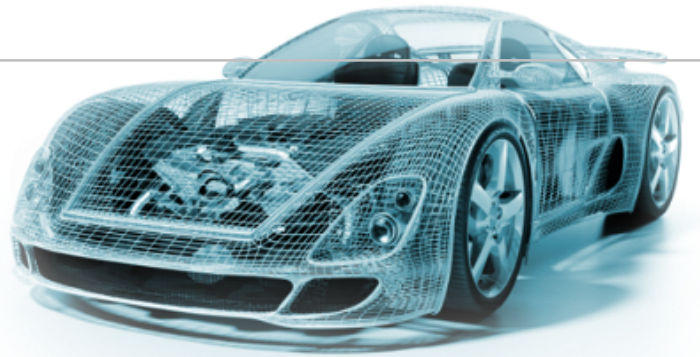

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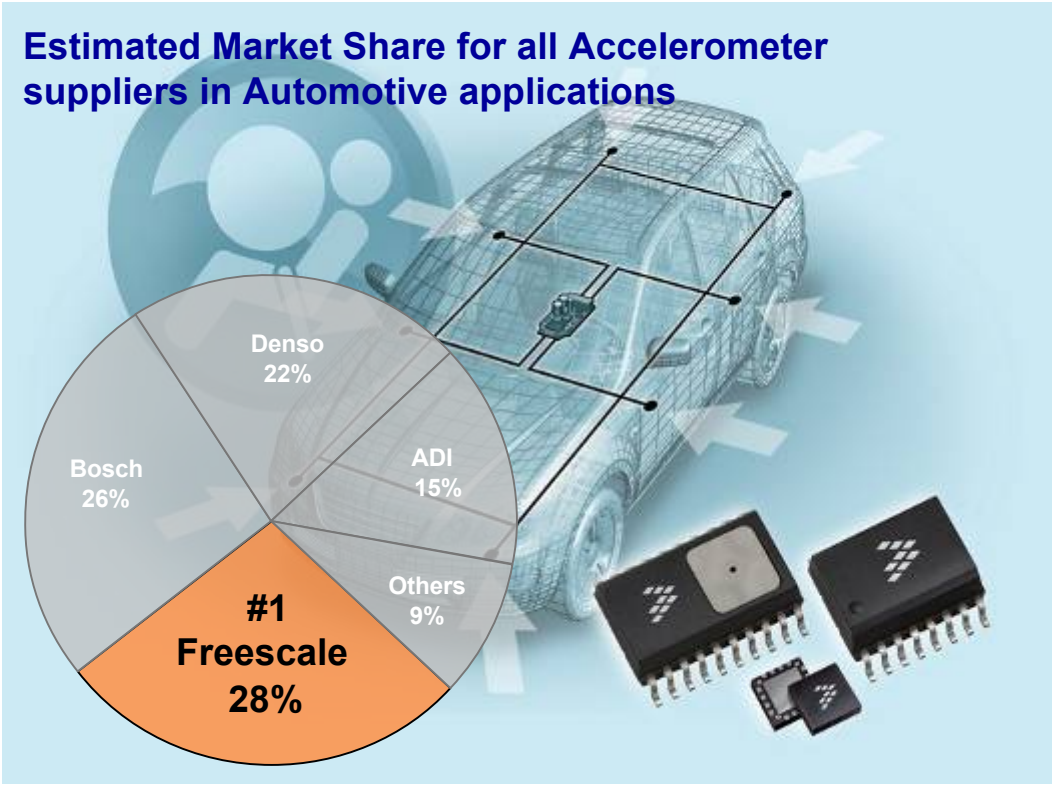
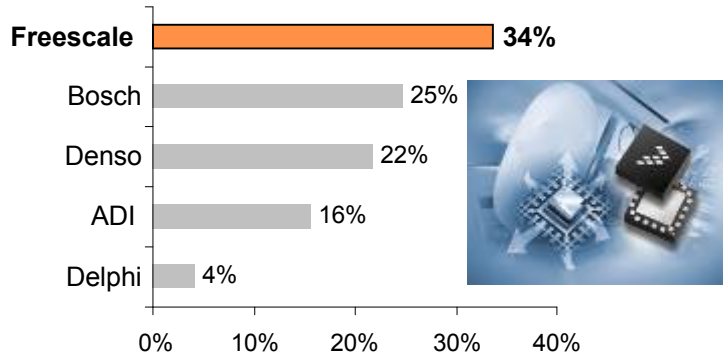
Freescale, The undisputed leader in Automotive Accelerometer

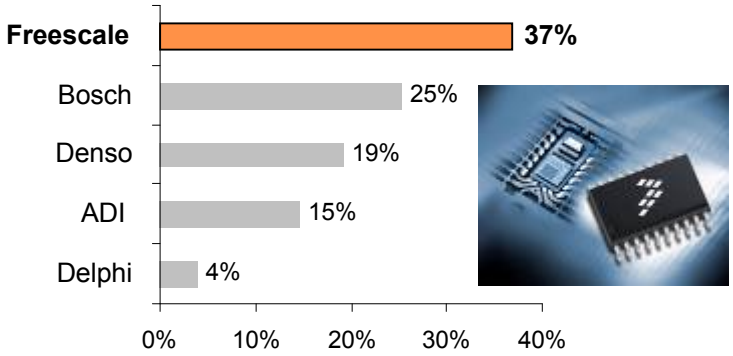
Estimated Market Share for all Accelerometer suppliers in Automotive applications



Medium and high G in Automotive



Medium and high G in Satellite Airbags

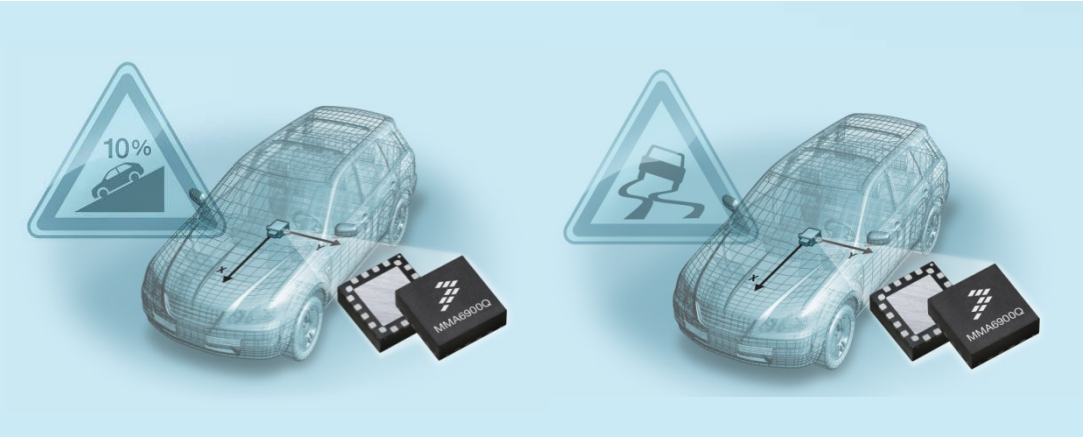


Source: iSupply, Automotive MEMS H2 2009 Market Tracker

MMA6900Q Dual axis low g accelerometer

Thanks to:

- **Its robust design**
- **Temperature stability**
- **Low noise**
- **Compact package**
- **Automotive qualification**



MMA6900Q is suitable for safety critical automotive applications such as Electronic Stability Control (ESC) and Electronic Parking Brake (EPB).

It also detects accurately vehicle tilt like for car alarms. For industrial applications it can be used as inclinometers and low level motion detector (Low detection threshold of 8.6mg or >= 0.5°).

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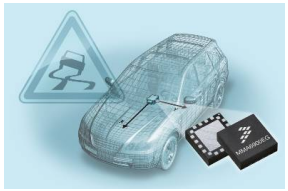
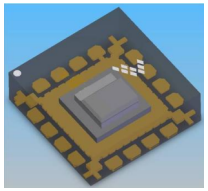
MMA6900Q Accuracy of Data: 5 Key Features

Dual XY axis Sensors with fully digital signal processing:

- Digital output (10 or 11 Bits)
- 3.3V or 5V Power Supply
- Bi-directional Self-test
- Programmability (Various LP/HP filters, ...)



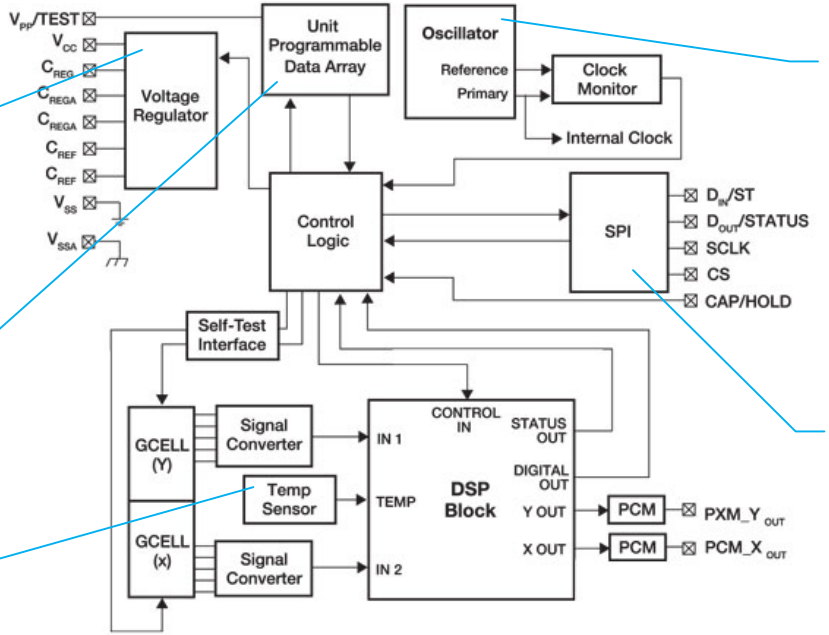
VSC Module



QFN Package

The following features and functions are incorporated into the MMA6900Q design to ensure accuracy of reported results:

1. Internal Voltage Monitoring
2. Programmed Data Integrity
3. Temperature Limit Detection
4. Oscillator Frequency Monitoring
5. SPI Communications Integrity



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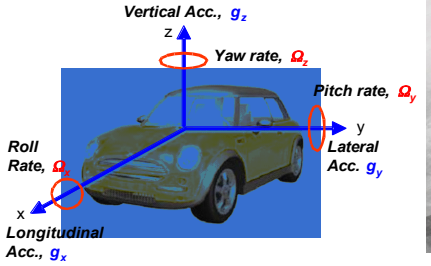
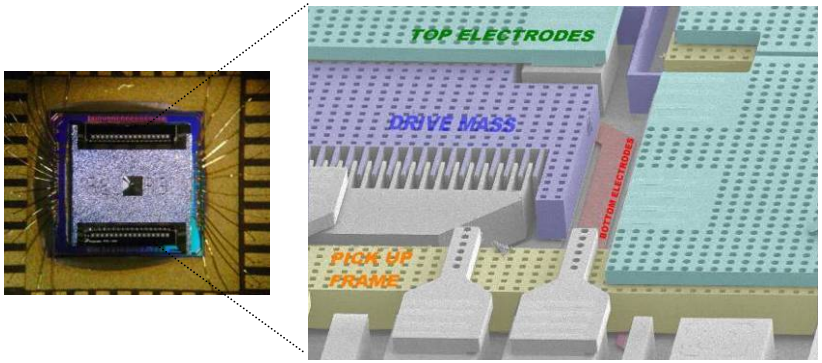
Vehicle Stability Control: Angular Rate Sensors

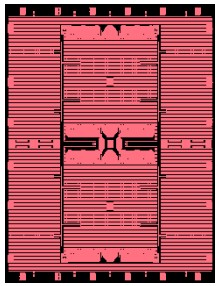
- **Angular Rate with fully digital signal processing:**
  - **X-axis rate sensor: ± 100°/s to 300 °/s**
  - **Z-axis rate sensor: ± 100°/s to 300 °/s**
  - **Closed loop architecture**
  - **Digital Output (SPI) – 16 bit format**
  - **3.3V or 5V Power Supply**
  - **Continuous Function Monitoring**



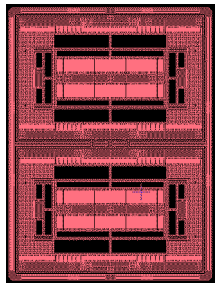
Car with and without VSC



Coriolis based double mass balanced design



X-Axis Gyro design



Z-Axis Gyro design

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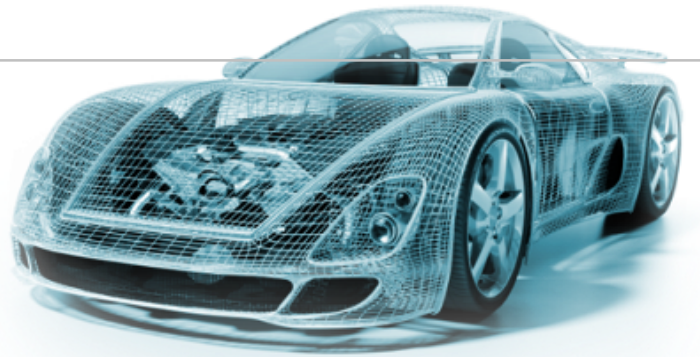

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Freescale Automotive Investment for the Future

▶ Green Technologies

- Multi-core Power Architecture processors for next-generation powertrain (GDI, Diesel, HEV, EV)
- Intelligent power switching (IDC, E-Switch) and communication solutions to replace hydraulic systems
- Cost reduced system solutions for emerging markets

▶ Advanced Safety

- **High-performance Power Architecture**™ solutions for active and passive safety fusion – Domain controllers
- 77 GHz RF solutions for radar
- **Gyro and low-g** sensors for vehicle dynamics

▶ Infotainment

- i.MX application processors for advanced multimedia
- Symphony audio DSPs for radio head units, external amplifiers and aftermarket audio solutions
- Cost reduced components for in car networking applications

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Our common goals

ZERO

Emissions
Fatalities
Defects

Electronic is imperative to balance increasing individual transportation and reducing fuel cost, emissions and casualties.

Consumer awareness, legislation and competitive differentiation join forces driving automotive electronics

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