Freescale Automotive Body MCU

Introduction

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Agenda

• Automotive Body Electronics Overview
• Freescale Body MCU Roadmap
• KEA Family for general purpose MCU
• MagniV for Distributed Nodes
• MPC574xG for BCM/Gateway
Automotive Body Electronics Overview
Body MCU Market Overview

**SAM Overview**

- Body control and HVAC systems dominate the SAM.
- OEM function optionalism driving growth in LIN connected solutions.
- Growth in LED lighting
- 8/16-bit still very significant portion of the SAM in 2010
- 32-bit SAM growing

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**2010 SAM by bits**

- 8 bit: 27%
- 16 bit: 29%
- 32 bit: 44%

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**Body Control**

- HVAC
- Lighting
- Window Lift, Mirror And Wiper
Kinetis 32-Bit ARM MCU comes to automotive - KEA Series

Kinetis E Auto: 32-bit ARM Auto MCU

- 32bit M0+ 48MHz high performance & low power
- 8K to 128K embedded flash, pin to pin compatible
- AECQ100 qualified, -40C to 125C, enhanced ESD (6kV)
- Automotive connectivity: CAN, LIN(SCI), SPI and IIC
- Automotive IPs: ADC, ACMP, Timers (FTM, PWM, PIT, PWT, RTC)
- Vdd = 2.7 - 5.5V, 3.3V or 5V convenience

Start your design easily today!

- Most complete MCU + development environment
- 24 Hours to prototype level, 2 months to production grade
- Samples and Evaluation Boards (8K to 128KB)
- PPAP July 2014
Our **S12 MagniV** portfolio simplifies system design with the integration on High-Voltage (HV) analog features onto MCUs for automotive applications.

<table>
<thead>
<tr>
<th><strong>MM912/S12VR</strong></th>
<th><strong>S12ZVM</strong></th>
<th><strong>S12ZVC</strong></th>
<th><strong>S12ZVL</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Window Lift</td>
<td>BLDC Motor Control</td>
<td>Small CAN nodes</td>
<td>LIN Nodes</td>
</tr>
</tbody>
</table>

- **Reduced PCB Space**
- **Reduced Bill of Material**
- **Improved manufacturing efficiency**
- **Simplified development**
Introducing the *New* Qorivva MPC5748G Body Control Module/Gateway MCUs

**Unprecedented Integration**
Single-chip solution offering multicore architecture and advanced networking protocols for next generation communication requirements while reducing the quantity of body control/gateway ECUs

**Low Power Management**
New low-power modes, analog comparators, and pretended networking support help meet stringent next generation power budgets and ensure greener vehicles

**Functional Safety and Security**
Security modules protect ECUs against various attack scenarios and Safety modules ensure robust operation per ISO 26262
Applications:
- Automotive general purpose

Operating Characteristics:
- Voltage range: 2.7 to 5.5 V
- Temperature range: -40 to 125°C

Key Features:
- ARM Cortex M0+ core 48MHz
- Up to 128K embedded flash
- Up to 16K RAM
- External OSC and internal ICS for clock
- System functions: LVD, WDG, CRC, LP modes
- Communication: SPI, SCI, IIC, CAN
- Timers: FTM, PWM, PIT, PWT, RTC
- 12bit ADC and ACMP

Packages:
- 16TSSOP, 24QFN, 32/64 and 80LQFP
- Pin compatible within KEA family

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## KEA products comparison table

<table>
<thead>
<tr>
<th>Device</th>
<th>Flash</th>
<th>RAM</th>
<th>EE PROM</th>
<th>Freq</th>
<th>MS CAN</th>
<th>SCI</th>
<th>SPI</th>
<th>ATD</th>
<th>PWT</th>
<th>Flex-Tim</th>
<th>ACMP</th>
<th>IIC</th>
<th>GPIO</th>
<th>Packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEAZN8</td>
<td>8K</td>
<td>1K</td>
<td>emulate</td>
<td>48MHz</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>12c12b</td>
<td>1</td>
<td>6c+2c 16b</td>
<td>2</td>
<td>1</td>
<td></td>
<td>Up to 22</td>
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<tr>
<td>KEAZN16</td>
<td>16K</td>
<td>2K</td>
<td>256B</td>
<td>40MHz</td>
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<td>3</td>
<td>2</td>
<td>16c12b</td>
<td>NA</td>
<td>6c+2c+ 2c 16b</td>
<td>2</td>
<td>2</td>
<td></td>
<td>Up to 57</td>
</tr>
<tr>
<td>KEAZN32</td>
<td>32K</td>
<td>4K</td>
<td>256B</td>
<td>40MHz</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>16c12b</td>
<td>NA</td>
<td>6c+2c+ 2c 16b</td>
<td>2</td>
<td>2</td>
<td></td>
<td>Up to 57</td>
</tr>
<tr>
<td>KEAZN64</td>
<td>64K</td>
<td>4K</td>
<td>256B</td>
<td>40MHz</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>16c12b</td>
<td>NA</td>
<td>6c+2c+ 2c 16b</td>
<td>2</td>
<td>2</td>
<td></td>
<td>Up to 57</td>
</tr>
<tr>
<td>KEAZ64</td>
<td>64K</td>
<td>8K</td>
<td>emulate</td>
<td>48MHz</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>16c12b</td>
<td>1</td>
<td>6c+2c+ 2c 16b</td>
<td>2</td>
<td>2</td>
<td></td>
<td>Up to 71</td>
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<tr>
<td>KEAZ128</td>
<td>128K</td>
<td>16K</td>
<td>emulate</td>
<td>48MHz</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>16c12b</td>
<td>1</td>
<td>6c+2c+ 2c 16b</td>
<td>2</td>
<td>2</td>
<td></td>
<td>Up to 71</td>
</tr>
</tbody>
</table>
Applications:
• Seats/Sun Roof
• Windows/Doors
• Mirror/Wiper
• Fuel/Water Pump controller
• Body Control
• Park Assist
• DC/BLDC Motor control
• Ambient lighting
• Infotainment connection module
• GPS/Radio companion MCU

Reference Solutions:
• BLDC motor control
• Vehicle Interior / Exterior LED Lighting
• Low Power LIN/CAN Node Networking
• Motorcycle Engine Control
Kinetis EA Series MCUs for Automotive
Built on the ARM® Cortex®-M0+ Processor

Energy Efficiency
• 2-stage pipeline – reduced cycles per instruction (CPI) enabling faster branch instruction and ISR entry
• Program memory access on alternate cycles

Processing
• Only 56 Instructions, mostly coded on 16-bit. Option for fast MUL 32x32 bit in 1 cycle
• Cortex-M0/3/4 compatible
• 1.77CM/MHz
• Best-in-class code density – reduced cost, power consumption and pin-count

Single-Cycle I/O Port
• 50% higher GPIO toggling frequency than standard I/O
• Improves reaction time to external events allowing bit-banding and software protocol emulation
• Save precious cycles, e.g. set faster peripherals for low-power access
• Access GPIO/peripherals while processor fetches the next instruction

Micro Trace Buffer
• Powerful, lightweight trace solution enabling fast debug
• Non-intrusive – trace information stored in small area of MCU SRAM (size defined by programmer)
• Trace read over Serial Wire/JTAG (CPU stopped)
24 Hours to Prototype: Typical Development Flow

1. Choose Your Hardware
   - Demo boards
   - Reference solutions

2. Install Development Suite
   - Initialization / autocoding
   - Compiler
   - Debug

3. Prototype with Demo Code
   - Low-level drivers: CAN, LIN, Flash
   - Demo code: CAN wakeup, LIN comms
   - Peripheral enhancement routines
Kinetis EA Series MCUs for Automotive IDE Support

**Freescale (CodeWarrior 10.1)**
- Includes MQX Task Aware Debug plug-in option
- MCU v10.1 Compiler Update for MQX3.7
- Includes Processor Expert

**IAR (Embedded Workbench)**
- Reliable, Powerful and Easy to Use
- The most widely used C/C++ tool chain for ARM MCUs
- Support for Kinetis 10/20/30/40/60, ColdFire+ and ColdFire
- Freescale MQX™ RTOS integration
- Ready-made project templates
- Professional technical support organization

**Keil (MDK)**
- Tailored to ARM Cortex-M devices
- Optimized Compiler, IDE, Debugger, Debug/Trace Adapters
- Support advanced Cortex-M and CoreSight technologies
Kinetis EA Series MCUs for Automotive
Motor Control Libraries

Wide group of algorithms

- Basic mathematics, logic, controllers, modulations, transformations up to observers
- Tool for beginners as well as for professionals
- Libraries are optimized, tested and easy to use
- Implemented with C-callable function interface

Implemented Algorithms

- Sine, Cosine, Tangent, Arcus Sine, Arcus Cosine, Arcus Tangent, Arcus Tangent, Shifted Arcus Tangent, Square Root, Ramp, Limiter, Hysteresis, Signum, Look-up Table, PI Controller
- Clarke Transformation, Inverse Clarke Transformation, Park Transformation, Inverse Park Transformation, Space Vector Modulation, Vector Limiter, PMSM Decoupling, DC Bus Ripple Elimination
- IIR filter, Moving avg. filter
Kinetis EA Series MCUs for Automotive
MQX™ Lite RTOS - Overview

Very light MQX kernel for resource-limited MCUs
• Targeted at the Kinetis L family initially
• Packaged as a Processor Expert component

I/O capability provided by Processor Expert
• USB via FSL bare-metal stack, also a Processor Expert component
• No POSIX-like drivers or file access

Programming model allows upward code migration
• A true subset of the full MQX RTOS
• Code built with MQX Lite will move to full MQX RTOS easily
• Same task templates, same API - some very minor differences

Available as a component within the Freescale s/ware offerings
• Processor Expert software, MCU driver suite - Supports IAR, Keil, and GCC compilers / build chains
• CodeWarrior Development Studio V10.3
A Technology Sweetspot for Sensor and Actuators

Digital Logic
S12, PWMs, Timers, SRAM, SPI, SCI, GPIO, Watchdogs, etc.

High-Voltage Analog
Low Side & High Side Drivers, Voltage Regulator LIN/CAN Phy. etc.

Non-Volatile Memory
Flash, EEPROM

Existing
Low Leakage 180nm CMOS+NVM

40V UHV Devices
15+ Years of System in Package (SiP) Experience

- **1997**: Start of SiP R&D
  - HC05PV8: 8-bit HC05 Hyper-integrated Relay Driver
  - Troll - MUX3: 8-bit HC05 Hyper-integrated Climate Stepper Driver
  - Monolithic Architecture
  - HC05 Microcontroller with EEPROM (IDR60% -1.2um)
  - Mechatronics Package

- **1998**: 1st Gen
  - HC05 Microcontroller with EEPROM
  - HC08 Microcontroller with flash
  - SMOS5 (0.8um)
  - 54ld SOIC Package

- **1999**: 2nd Gen
  - SiP Architecture
  - HC08 Microcontroller with flash (0.5um)
  - SMOS5 (0.8um)
  - 54ld SOIC Package

- **2000** to **2006**: 1st Gen + 2nd Gen
- **2007**: 3rd Gen
  - SMOS8 (0.25um)
  - QFN Package
  - LL18UHV technology

- **2008**: 3rd Gen
  - S12 Core (0.25um)
  - Architecture Repartitioning

- **2009**: 3rd Gen + 4th Gen
  - S12 Core (0.25um)

- **2010**: 4th Gen
  - S12 Core (0.25um)

- **2014**: 4th Gen
  - Monolithic SiP
  - S12Z Core

- **2015**: 4th Gen
  - LL18UHV technology

- **S12VR64** (first part of MagniV family)
  - S12ZVM
  - S12ZVL
  - S12ZVC
S12 MagniV Benefits

S12 MagniV solutions deliver optimal **system cost** and **physical footprint** for sensor and actuator applications.

- **Reduced PCB Space**
  - Up to 30%

- **Improved manufacturing efficiency**
  - Replacing typically 3 IC by 1 MagniV reduces assembly and test cost while quality improves

- **Reduced Bill Of Material (BOM)**
  - Fewer components to purchase, handle, store and qualify

- **Simplified motor control that speeds up time-to-market**
  - Save up to 6 months on development, validation and ISO26262 implementation
    - Abstract the complexity of 3-phase motor control software development
    - Production ready Automotive quality SW and Tools
    - SafeAssure program
# Motor Control Solutions

## Motor Control Options

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>LIN Applications</th>
<th>CAN Applications</th>
<th>PWM Controlled Apps</th>
<th>High Temp Option</th>
<th>Switch Panel Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brushless DC Motors</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>H-Bridge driven DC-motors</strong></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Relay-driven DC-motors</strong></td>
<td></td>
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</tbody>
</table>

## Motor Control Chipsets

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>LIN with PHY</th>
<th>2nd 5V VREG for ext CAN</th>
<th>100nC</th>
</tr>
</thead>
<tbody>
<tr>
<td>S12ZVM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S12ZVML</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S12ZVMC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S12ZVMLC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S12VR</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Chipset Specifications

- **S12ZVM**: 16/32KB; 64pin; 50nC
- **S12ZVML**: 32-128KB; 64pin; 100nC
- **S12ZVMC**: 64-128KB; 64pin; 100nC
- **S12VR**: 48K-64KB; 32/48pin; LIN with PHY; LS drivers

## Motor Control Chipsets for Different Motor Types

- **< 200W Motors**
  - **S12ZVM**
  - **S12ZVML**
- **> 200W Motors**
  - **S12ZVMC**
  - **S12VR**
Window Lift with S12VR

Pinout representing functionality,
Physical pins location is not correct
HARDWARE:
- **S12VR64EVB**: S12VR Evaluation Board ($149,-)
- **USBMULTILINKBDM**: In-Circuit Debugger/Programmer

COMPILER, DEBUGGER:
- **CW_V5.1HCS12_VR64SP**: CodeWarrior for HCS12(X) v5.1 VR64 Service Pack
- **ZAP 6812 ICD**: Cosmic ZAP HCS12 BDM Debugger.

APPLICATION NOTE, REFERENCE DESIGN, MIDDLEWARE:
- **AN4540**: Comparison Between the MC9S12VR and MM912_634
- **AN4650**: Functional Differences between Tomar 2.1 (2N05E) & Tomar 3 (0N59H)
  - Anti-Pinch Window Lift Reference Design
- **FSL_LIN_2.1_DRIVER**: LIN 2.1 / J2602 Driver

TRAINING:
- **AN4448**: MC9S12VR Family Demonstration Lab Training
- **S12 MagniV Mixed-Signal Microcontroller Introduction**: Overview on S12-MagniV family, including S12VR64 introduction
- [http://www.youtube.com/watch?v=dCnc7X9mptc&feature=player_embedded](http://www.youtube.com/watch?v=dCnc7X9mptc&feature=player_embedded)
S12ZVL – Key Features

**LIN Physical Layer**
LIN2.2 and SAE J2602 compliant +/- 8kV ESD capability

**SPI, IIC**
Serial link to other ICs, e.g. sensors,…

**NGPIO**
1-3# 5V / 25mA sink
Eg. for RGB-LED

**External Supply**
5V / 20mA switchable for local (same PCB), over current protected

**Voltage Regulator**
5V/70mA total supply or 170mA with external ballast for more current and lower power dissipation

**Vsup sense**
Monitoring supply voltage (sense after protection diode)

**Packaging Options**
32-LQFP and 48-LQFP
32-QFN 5x5mm

**High Voltage Input**
12V Input for Switch Monitoring Routable to ADC
# S12ZVL Family Feature Set Summary

<table>
<thead>
<tr>
<th>Product Name</th>
<th>S12ZVL</th>
<th>S12ZVLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>48-LQFP</td>
<td>32-LQFP</td>
</tr>
<tr>
<td>Flash memory (ECC)</td>
<td>32 / 16 / 8 kB</td>
<td></td>
</tr>
<tr>
<td>EEPROM (ECC)</td>
<td></td>
<td>128B</td>
</tr>
<tr>
<td>RAM (ECC)</td>
<td></td>
<td>1kB</td>
</tr>
<tr>
<td>SCI / SPI / IIC</td>
<td></td>
<td>2 / 1 / 1</td>
</tr>
<tr>
<td>LIN-PHY</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>HVI</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>V reg</td>
<td>12V/70mA; extendable to 170mA with ext. Ballast</td>
<td></td>
</tr>
<tr>
<td>Timer</td>
<td>6ch + 2ch (16 Bit)</td>
<td></td>
</tr>
<tr>
<td>PWM</td>
<td>8ch 8 Bit (or 4ch 16Bit)</td>
<td></td>
</tr>
<tr>
<td>ADC</td>
<td>10ch 10Bit</td>
<td>6ch 10Bit</td>
</tr>
<tr>
<td>eVdd (5V/20mA)</td>
<td></td>
<td>1ch (source)</td>
</tr>
<tr>
<td>N-GPIOs (5V / 25mA)</td>
<td>3ch (sink)</td>
<td>1ch (sink)</td>
</tr>
<tr>
<td>Temperature options</td>
<td></td>
<td>C / V / M</td>
</tr>
</tbody>
</table>
## Target Applications

<table>
<thead>
<tr>
<th>LIN-Sensors</th>
<th>LIN-switchpanels</th>
<th>LIN-Actuator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Function</strong></td>
<td><strong>Product Function</strong></td>
<td><strong>Product Function</strong></td>
</tr>
<tr>
<td>• Hooking up sensors into automotive LIN-Network (with signal pre-conditioning)</td>
<td>• Reading multiple switch-positions and feeding into LIN-network</td>
<td>• Converting LIN-command into an activity (eg driving LEDs)</td>
</tr>
<tr>
<td><strong>Market Requirements</strong></td>
<td><strong>Market Requirements</strong></td>
<td><strong>Market Requirements</strong></td>
</tr>
<tr>
<td>• LIN-PHY, 12V-Vreg, MCU</td>
<td>• LIN-PHY, 12V-Vreg, MCU</td>
<td>• LIN-PHY, 12V-Vreg, MCU</td>
</tr>
<tr>
<td>• Small formfactor (QFN)</td>
<td>• Multiple GPIOs</td>
<td>• Drivers (3x25mA drive strength in case of RGB-LED)</td>
</tr>
<tr>
<td>• ADC, SPI</td>
<td>• ADC</td>
<td>• ADC</td>
</tr>
</tbody>
</table>
Switch Panel with S12ZVL

LIN Bus

Dials

On-board Switches
Off-board Switches
LED Backlight
Wakeup

LIN-PHY

Pierce Osc.
 Temp Sense
 10-Bit ADC

SCI 1  SCI 0
SCI 1  SCI 0

SPI  IIC
SPI  IIC

BDM  BDC  KWU  Win  Wdog
BDM  BDC  KWU  Win  Wdog

TIM 16b  6+2ch
TIM 16b  6+2ch

PWM 8ch 8b or 4ch 16b
PWM 8ch 8b or 4ch 16b

1# E-Vdd  1-3# NGPIO
1# E-Vdd  1-3# NGPIO

HV Input

LIN-PHY

S12Z 32MHz Bus
S12Z 32MHz Bus

8-32KB Flash (ECC)
8-32KB Flash (ECC)

128B EEPROM (ECC)
128B EEPROM (ECC)

1kB RAM (ECC)
1kB RAM (ECC)

PLL
PLL

RCosc. +/-1.3%
RCosc. +/-1.3%

70, or up to 170mA with ext. Ballast
70, or up to 170mA with ext. Ballast

Vreg
Vreg

Vs supreme
Vs supreme

5V Analogue Components
5V Analogue Components

MCU Core and Memories
MCU Core and Memories

High-Voltage Components
High-Voltage Components

Digital Components
Digital Components

freescale
Intelligent Sensor Application

LIN Bus

LIN-PHY
- LIN-PHY
- Pierce Osc.
- PLL
- Temp Sense
- 10-Bit ADC

GPIO
- SCI 1
- SCI 0
- SPI
- IIC
- BDM
- BDC
- KWU
- Win
- Wdog
- TIM 16b
- 6+2ch
- PWM 8ch 8b
- or 4ch 16b
- 1#
- E-Vdd
- 1-3#
- NGPIO

Automotive Voltage

Rain / Light Sensor ASIC

5V Supply

S12ZVL Development Tools and Enablement

HARDWARE:
- **X-TWR-S12ZVL32** & **X-TRK-S12ZVL** (both available now, TRK will replace TWR, $99 each)
- **TRK-S12ZVL**: OOBE EVB (available for launch, $99)
- **USBMULTILINKBDM**: In-Circuit Debugger/Programmer (available now)

COMPILER, DEBUGGER:
- **CW V10.x**: CodeWarrior for S12ZVL
- **ZAP 6812 ICD**: Cosmic ZAP HCS12 BDM Debugger.

APPLICATION NOTE, REFERENCE DESIGN, MIDDLEWARE:
- **Reference Designs / Demos**:
  - Ultrasonic distance measurement (available for launch)
  - LIN-RGB (LED) (available for launch)
- **FSL_LIN_2.1_DRIVER**: LIN 2.1 / J2602 Driver (available now)
MPC574xG for High-end Gateway
Multiplex Architecture for modern cars

- **Ethernet**
- **Central or Integrated Gateway**
- **MOST**
- **Potentially other interfaces**
- **Flexray**
  - Potentially active star

- **Diagnostic CAN**
- **Comfort CAN**
- **Body CAN**
- **Powertrain CAN**
- Up to 6 x CAN

Switch or PHY
32-bit Body Electronics MCU Roadmap

90nm Body Products

- **MPC5668G/E**
  - z6+z0, 116MHz,
  - Up to 2M Flash, 592k RAM
  - Flex, Ether, MLB, CAN, LIN

- **MPC5646/5/4C**
  - z4+z0, 120MHz,
  - Up to 3M Flash, 256k RAM
  - Flex, Ether, Security, CAN, LIN

55nm Body Products

- **MPC5748/7/6G**
  - z4+z4+z2, 160MHz,
  - 3M-6M Flash,
  - Flex, Ether, Security, MLB, USB, CAN, LIN

- **MPC5748/7C**
  - z4+z2, 160MHz,
  - 4M-6M Flash,
  - Flex, Ether, Security, CAN, LIN

- **MPC5746/5C**
  - z4+z2, 160MHz,
  - 2M to 3M Flash,
  - Flex, Ether, Security, CAN, LIN

- **MPC5746/5B**
  - z4, 160MHz,
  - 2M to 3M Flash,
  - Flex, Security, CAN, LIN

**Integrated Gateways**

**Mid-High BCM**

**Entry BCM**

- **MPC5646/5/4B**
  - z4, 120MHz,
  - Up to 3M Flash, 192k RAM
  - Flex, Security, CAN, LIN

- **MPC5607/6/5/B**
  - z0, 64MHz,
  - Up to 1.5M Flash, 96k RAM
  - CAN, LIN

- **MPC5604/3/2/B/C**
  - z0, 64MHz,
  - Up to 512k Flash, 48k RAM
  - CAN, LIN

- **MPC5602/1D**
  - z0, 48MHz,
  - Up to 256k Flash, 16k RAM
  - CAN, LIN

First Sample Date (left edge)

Product Qualification (right edge)

Proposal

Planning

Execution

Production

- Red: Triple Core
- Orange: Dual Core
- Blue: Single Core

Security
C5748C/G - Development Device and High End Gateway/BCM Solution

Applications:
- High end Gateway and Body Modules

Key Characteristics:
- 2x e200z4 + 1x z2 cores, FPU on z4 cores
- 160 MHz max for z4s and 80 MHz on z2
- HSM Security Module option supports both SHE and EVITA low/medium standard
- Media Local Bus supports MOST communication
- 2x USB 2.0 (1 OTG and 1 Host module) support interfacing to 3G modem and infotainment domain
- 2x Ethernet 10/100 Mbps RMII, MII, +1588, AVB
- Ethernet switch
- CAN module optionally supports CAN FD
- SDHC provides standard SDIO interface
- Low Power Unit provides reduced CAN, LIN, SPI, ADC functionality in low power mode
- Designed to ISO26262 process for use in ASIL B
- -40 to +125C (ambient)
- 3.0V to 5.5V

Packages:
- 176 LQFP, 256 BGA, 324 BGA

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*Mixture of internal and external channels
Features available depend on package and device version