Freescale 8-bit Products Overview and Wireless Networking

Presenter: Moshe Levy
Wireless Networking using the HCS08

- Freescale Semiconductor
- 8-bit Microcontrollers
  - 8/32 bit Controller Continuum
- Development Tools Overview
  - Discovery Kit
- ZigBee Solutions
  - Next generation PiP
• For the first time: True 8 bit to 32 bit **Processor Continuum**
• Wide range of competitive **low power/low cost** 8 bit MCUs which fit to your application.
• Comprehensive, **free/low cost, easy to use** development tools - Fast Track
• Full **ZigBee solution** hw/sw including ZeeStack, BeeKit, SiP and PiP
Operating Around the World

- **Americas**
  - 9,200 employees
  - 4 factories
  - 10 design centers

- **EMEA**
  - 4,500 employees
  - 3 factories
  - 8 design centers

- **Asia Pacific/Japan**
  - 9,000 employees
  - 3 factories
  - 8 design centers

Legend:
- World Headquarters
- Wafer Manufacturing
- Assembly & Test
- R or D Facilities

- $5.7B 2004 revenue
- 30 countries
- 10,000+ customers
- 22,000+ employees
Internal Worldwide Manufacturing

Designates 8-bit Manufacturing Sites

Note: Freescale also uses external manufacturing sites such as TSMC

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Freescale’s Business Groups

- **Wireless & Mobile Systems Group**
  - Platforms for cellular handsets & other products
  - Baseband components
  - Application processors
  - RF components
  - Software solutions

- **Networking & Computing Systems Group**
  - PowerQUICC™ communications processors
  - PowerPC® (1) processors
  - DSPs
  - RF devices
  - Network multimedia & connectivity
  - SemiCustom ASICs

- **Transportation & Standard Products Group**
  - Microcontrollers
  - Embedded microprocessors
  - Analog & mixed-signal integrated circuits
  - Sensors
  - Digital Signal Controllers

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Freescale’s Embedded Processor Continuum

- Power PC
- ColdFire
- ARM
- DSP
- Digital Signal Controllers
- Design Alliance and Tools Alliance Partners
- Sensor & Analog Products
- Wireless and RF
- CodeWarrior
- Freescale’s Embedded Processor Continuum

- S12X
- S12
- S08
- 08
- RS08

- 8, 16-bit
- 16, 32-bit

Performance

Features
8-bit to 32-bit Controller Continuum
Microcontroller Landscape Is Changing

- **Development Support** Essential
- **Application Performance** Pushing Migration
- **Price/performance Driver for New Entrants**
- **Reduced Cost** Increasing 32-Bit Access

- **8-Bit**
- **16-Bit**
- **32-Bit**

Price/Performance Pushing Migration

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Freescale MCU Portfolio Positioned for Growth

Reinforcing Low-End 8-bit
- 9S08QG delivers more for less
- RS08KA2 targets the sub 50¢ level
- CodeWarrior® 5.0 sets new bar for ease-of-use

16-bit Targeting Special Applications
- S12 and S12X showing strong growth in automotive
- Digital signal controllers delivering motor control solutions

Adding Muscle to ColdFire®
Control – Connectivity – Security
- First 32-bit MCUs for single-chip Ethernet and USB-OTG
- 32-bit performance at 16-bit price widens entry point
32-bit Performance Becoming More Accessible

Playing to Freescale's 8-bit Strength
- Expanding on-chip peripherals
- Extending flash memory sizes

Lowering the 32-bit Entry Point
- New ColdFire® devices continue to strip out cost while maintaining performance and functionality
ColdFire® V1: Controller Continuum Missing Link

**Industry’s First 8/32-bit Compatible Architectures**

- 32-bit performance with 8-bit ease of use
- Peripheral set and pin compatibility
- New version of CodeWarrior® development tool to support both S08 and ColdFire® V1 architectures
# Freescale 8-Bit MCUs in Consumer and Industrial

## Global Leadership
- Freescale a leading supplier of 8-Bit MCUs to the consumer and industrial market.

## Long-term Presence
- We know Consumer and Industrial requirements.
  - We’ve been delivering since 1950s

## Performance
- Freescale’s Consumer and Industrial MCUs are high performance
  - Our technology is improving battery life in portable devices and making home entertainment, appliances, and PC peripherals more intelligent, reliable, and connected.

## Portfolio
- Broadest portfolio & still expanding with innovative, cost-effective, and easy to use products for a wide range of 8-bit applications.
  - include HCS08, HC08, and RS08

## Services and Support
- Freescale is partnered and supported by leading global providers of software tools, emulators, compilers, drivers and services.

## Cost Effective
- Freescale’s MCUs are cost competitive.
Freescale’s 8-bit Cores

► The HC08 Core
- *Industry workhorse* with an impressive array of peripherals – analog, timers, communications protocols (CAN, LIN, RF, USB), & communication modules in SPI, SCI (UART), IIC
- Designed for programming in C – efficient, modular coding
- Strong memory protection features in COP, LVI, POR
- .50µ technology

 ► The HCS08 Core
- Optimized for *extreme operating economy* – multiple stop modes, along with wait & standby
- Designed for programming in C – efficient, modular coding
- High performance up to 50 MHz CPU, 25 MHz Bus
- Utilizes .25µ 3rd generation embedded Flash technology
- Outstanding memory security and protection features including POR, LVI,
- On-chip In-circuit emulation and background debug mode

► The RS08 Core
- Designed specifically for small pin-count, low memory devices
- Efficient and cost-effective for *ultra low-end applications* – 30% smaller than HCS08

Note: HC08, HCS08, & RS08 are all code compatible to Freescale legacy HC05 core.
<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC9S08AW60</td>
<td>60K, 32K, 16K flash options, 5V General Purpose</td>
</tr>
<tr>
<td>MC908LV8</td>
<td>Low-end LCD</td>
</tr>
<tr>
<td>MC908JL16</td>
<td>Upward expansion to existing JL Family</td>
</tr>
<tr>
<td>MC9RS08KA</td>
<td>Introduction of RS08 core, ultra-low end</td>
</tr>
<tr>
<td>MC08LT8</td>
<td>Low-end remote control</td>
</tr>
<tr>
<td>MC908EY16A</td>
<td>Next generation to existing EY Family</td>
</tr>
<tr>
<td>MC9S08GBxxA</td>
<td>Next generation to existing GB family</td>
</tr>
<tr>
<td>MC9S08GTxxA</td>
<td>Next generation to existing GT Family – adds 8K option and more RAM at low end</td>
</tr>
<tr>
<td>MC9S08QD4</td>
<td>5V general purpose</td>
</tr>
<tr>
<td>MC908JR12</td>
<td>Integrated 27 MHz RF</td>
</tr>
</tbody>
</table>
## Products—General Purpose

<table>
<thead>
<tr>
<th>High Integration/General Purpose</th>
<th>Communications and low voltage functionality for use in a wide range of general purpose applications. Often used in combination with Zigbee™ technologies.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MC9S08GB</strong> – 1.8V to 3.3V operation</td>
<td></td>
</tr>
<tr>
<td><strong>MC9S08GT</strong> – Smaller packages and fewer timers than GB.</td>
<td></td>
</tr>
<tr>
<td><strong>MC9S08AW</strong> – 2.7V to 5.5V operation</td>
<td>High end functionality ideally suited for large appliances, motor control, automotive applications.</td>
</tr>
</tbody>
</table>

### High Resolution Analog

| **908AP** | Mid-range appliance devices |
| **908GR** | High Resolution analog with 24 channel ADC |

### Mid-range pin count

| **MC908JL/JK** | Mid-range I/O and memory in small footprint with analog resolution, timers, and communications for motor control, small appliances, industrial control |
| **MC908QC** |                                                                                                                                   |
| **MC908QB** |                                                                                                                                   |
### Small Package Devices

**Most new designs use the RS08/S08 devices.**

<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC9RS08KA</td>
<td>Lowest end MCU, based on RS08 (1.8V to 5.5V)</td>
</tr>
<tr>
<td>MC9S08QG</td>
<td>Highly integrated, 1.8V to 3.3V compatible with MC9RS08KA</td>
</tr>
<tr>
<td>MC9S08QD</td>
<td>2.7V to 5.5V upwardly compatible from MC9RS08KA</td>
</tr>
</tbody>
</table>

**MC908Q family devices provide solid functionality in a variety of low pin count packages**

<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC908QT</td>
<td>Base Q device with 8-pin packages – 10-bit ADC</td>
</tr>
<tr>
<td>MC908QY</td>
<td>Based Q devices 16-pin packages – 10-bit ADC</td>
</tr>
<tr>
<td>MC908QB</td>
<td>Larger memory sizes, more ADC channels (10), more timer channels, SCI, and SPI</td>
</tr>
<tr>
<td>MC908QC</td>
<td>Larger memory (up to 16K Flash), 2\textsuperscript{nd} independent timer, larger pin count options (up to 28 pins)</td>
</tr>
</tbody>
</table>
**MC9RS08KA**

- **Supply Voltage / Performance**
  - 1.8-5.5V

- **Core**
  - RS08 Core

- **Memory**
  - 1K / 2K Flash
  - 63 B RAM

- **Analog Comparator**
  - Full rail-to-rail supply operation
  - Can operate in STOP mode

- **Features/ Benefits**
  - Integrated Clock Source (ICS) up to 10MHz internal bus operation with 2% deviation over full temperature and voltage range
  - Computer operating properly feature (COP)
  - 8-bit Modulo Timer, Auto wakeup
  - 3 / 5 channel keyboard interrupt (KBI)
  - LVD (low voltage detect) with reset or stop wakeup
  - External Vpp required for Flash programming

- **Fast Track Development Tools**
  - DEMO9RS08KA2 and Fast Track CodeWarrior v5.1

- **Packaging**
  - 6 pin DFN, 8 pin NB-SOIC, 8 pin PDIP

- **Target Applications:**
  - Small appliance, toys, simple analog comparator / simple logic replacement, HB-LED
9S08QD4

(Low Cost, 8pin, S08)

Key Features/Benefits

• Supply Voltage/ Performance
  • 4MHz bus @3.0 V ±10%, 8MHz bus @5.0 V ±10%, -40 to 105C

• Core
  • S08 Core

• Memory
  • 2-4K FLASH, 256 RAM

• Features/ Benefits
  • Precision trimming Internal Clock Source provide 0.2% resolution with 2%
    deviation for full operating temperature and voltage
  • 1 one-channel and 1 two-channel 16-bit Timer with selectable IC, OC, or PWM
  • Computer Operating Properly and LVI with selectable trip point
  • 4 ch, 10-bit Analog to Digital Converter
  • 4 x Keyboard Interrupts
  • Port : 4GPIO, 1 output, 1 input. Slew rate selection is available for all output
    pins.
  • COP

• Available Packages
  • 8 pin SOIC narrow body, 8 pin PDIP
  • Pin compatible to 9S08QG8/4 & 9RS08KA2 (8-pin)

• Development Tools/ Documentation
  • H/W: Standard MMEVS, MMDS
  • S/W: The existing CodeWarrior tool suite

• Target Applications:
  • DC Fan, CDI, general purpose

HCS08 CPU
Up to 8MHz

2-4K Flash

Up to 256B RAM

ICG
(0.2% resolution,
2% deviation)

4-ch 10-Bit ADC

2ch + 1ch
16 bit Timers

4 KBI

Periodic
Interrupt
Timer

LVI plus
LVW

4 GPIO
1 input
1 output

4 x Keyboard Interrupts

8 pin SOIC narrow body, 8 pin PDIP
MC9S08QD4CSC .... $0.69/1kpcs
**Key Features/Benefits**

**Supply Voltage**
*1.8V – 3.6V, -40C to +125 C*

**Core**
*16MHz HCS08 Core/ 8MHz Bus Frequency*

**Memory**
*4kB - 8kB Flash/ 256B - 512B RAM*

**Communications**
*ESCI, SPI, IIC*

**Features/ Benefits**
*8MHz Internal @ 1.8V – 3.6V*
*Flash Read/Write @ 1.8V*
*Internal Osc (2% Precision over temperature & frequency)*
*On-chip ICE (DBG)*
*Background Debug Controller (BDC)*
*2-ch, 16-bit, IC/ OC, or PWM*
*COP, 10-bit ADC, ICS with FLL, LVI, RTI*
*Up to 13 GPIO*
*Power Saving Modes*
*On-chip temperature Sensor*
*Pincompatibility to 9S08QD4 & 9RS08KA2 (8-pin)*

**Available Packages**
*16-pin SOIC/TSSOP/PDIP*
*8-pin DFN/ SOIC/PDIP*

**Target Applications:**
*Electronic power meters, Sensors, Wireless comm.*
*Home appliances, Security systems, etc…*
The KA2 Anti-Crash Robot is a toy robot that moves by itself and is able to avoid obstacles changing its direction when it approaches an object.

<table>
<thead>
<tr>
<th></th>
<th>MC9R508KA2</th>
<th>KA2 Robot</th>
</tr>
</thead>
<tbody>
<tr>
<td>IO</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Flash</td>
<td>2K</td>
<td>439 Bytes</td>
</tr>
<tr>
<td>RAM</td>
<td>84 bytes</td>
<td>9 bytes</td>
</tr>
<tr>
<td>Analog Corriogator</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>KEI</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Bus Clock</td>
<td>Up to 10 MHz</td>
<td>8 MHz</td>
</tr>
<tr>
<td>MTIM</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>RTI</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Package</td>
<td>8 SOIC, 8 DFN, 8 DIP</td>
<td>8 SOIC</td>
</tr>
</tbody>
</table>

Other applications:
- Distance measurement can be used in an ultrasonic automotive backup warning system.
- Small handheld devices
MC9S08AW60/32/16 – Feature Set

Features

► Memory
  • 16 - 64 k Flash, capable of EEPROM emulation
  • 1k – 2k bytes of RAM

► Internal Clock Generator (ICG)
  • Up to 20 MHz bus
  • FLL with 8 software selectable multipliers
  • On-chip oscillator – Requires no external components
  • Bus clock divider with 8 software selectable settings
  • Separate self-clocked source for real time interrupt
  • 0.5% typical. 2% accuracy over full operating range

► Serial Communication
  • IIC (synchronous), SPI (synchronous), and 2 SCI (asynchronous)

► Timers
  • 6 - channel Timer/PWM Module (TPM)
  • 2 - channel Timer/PWM Module (TPM)

► Analog Modules
  • 16 - ch, 10 - bit Analog-to-digital converter
  • Enhanced LVD

► Development Tools
  • On chip ICE and BDM

► Available Packages- 64 QFP, 64 LQFP, 48 QFN, 44 LQFP

1K Unit MSRP:
MC9S08AW60 $5.83
MC9S08AW32 $4.62
MC9S08AW16 $4.07
MC9S08AWxx Target Applications

► Home Appliance
► Kitchen Appliance
► Automotive
► LIN Applications

► Industrial control
► Security system
► Lighting control

Many other general market applications

OUR CUSTOMERS’ IMAGINATION IS THE ONLY LIMIT!
Sensorless BLDC Motor Control using MC9S08AW60

► Application Diagram

3 Phase BLDC Power Stage
- DC Bus Voltage & Current Sensing
- 3 Phase Back EMF Sensing

3 Phase Inverter

ADC Module
- Back EMF Voltages
- DC Bus Voltage
- Commutation Control

SCI Module
- Superior system

GPIO Module
- Start / Stop
- Speed/Torque Up / Down
- Other purposes

Ramp Generation

1/T

Torque PI Controller
- Actual speed
- Required speed
- Limitations

Speed PI Controller
- Required torque

Zero Crossing Period & Position Recognition

Commutation Control
- DC Bus Current

On Board Programming
- FreeMaster

3 Phase BLDC Motor

Sensorless Back-EMF zero cross algorithm
- Sensing voltage on disconnected phase
- When sensed voltage crosses half of DC bus voltage, the rotor is in middle between two commutation
- The detection of this zero crossing allows to detect rotor position
**Features / Benefits**
- Supports LCD
  - 3 and 5 V glass
- LCD Segment Offerings
  - 4/3 x 32/33
  - 4/3 x 40/41
  - 4/3 x 42/43
- Enhanced EEPROM emulation
- Internal clock generation (ICG)
  - FLL generates 8 MHz to 40 MHz
  - Up to 20 MHz bus rates
  - IRG: Two controlled clock sources
  - Option of external RC, external clock, crystal or resonator or trimmable internally generated clock
  - Configurable two timer/pulse-width modulators for PWM

**Supply Voltage / Performance**
- 1.8 – 3.6 V operation
- -40 to 85°C operation

**Core**
- 40 MHz HCS08 core
- 20 MHz bus frequency

**Memory**
- 60K Flash, 4K RAM

**Communications**
- SCI, two SPI modules, IIC bus module up to 100 kbps
- 12-bit ADC w/ internal reference voltage

**Packages**
- 18 to 24 LQFP, 80 LQFP

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Market Focused Devices

► Remote Control
  • MC9S08RG
  • MC9S08RE
  • MC9S08RD
  • MC9RS08KA
  • MC08LT

► USB
  • MCHC908JW – USB 2.0 Full-speed
  • MC908JB - USB 1.1

► LCD
  • MC908LJ – 4 x 32 LCD
  • MC908LV – 4 x 24 LCD
  • MC9S08LC - 4 x 40 segment-based LCD

New

• MC9S08R Family devices include a Carrier Module Timer specifically for remote control devices (see AN3053)
• Reference design available for low-end remote control on the MC9RS08KA (see DRM081)
Industrial Communications

- CAN protocol use is expanding rapidly into factory automation, industrial machine control, measurement systems, and building controls.

- **CAN**
  - MC908AS
  - MC908AZ
  - MC908GZ
  - MC9S08DZ/DV New

- **LIN** *(Local Interconnect Network)*
  - MC908EY
  - MC908QL-incorporate the SLIC module
  - MC908GR

- **Integrated RF**
  - MC908RF
  - MC9S08JR
Fast Track CodeWarrior v5.1 Tools

► **Fast, Easy, Simple** - Fast Track
► CodeWarrior v5.1 tools *remove the complication* of using powerful software

► CodeWarrior is an intricate advantage to using Freescale’s 8-bit products
  
  • Create projects based on your needs—simple projects (e.g. absolute assembly) to complex multi-developer projects
  
  • Keep the *focus on the value-added* portion of the application (initialization code and drivers are configured and automatically generated for your application)
  
  • **Speed!** Keep projects on time and on budget to meet the end-application market window (e.g. port your application to a larger and/or newer derivative with a few clicks)
Demonstration Board – MSRP $25 to $75
- Basic user I/O functions to test application code
- Most MCU pins are available via I/O headers for easy expandability
- CodeWarrior™ Special Edition included
- Most recent boards include USB-to-BDM connection on the board (No need for USBMULTILINKBDM)

Evaluation Board – MSRP $75 to $250
- Prototyping area for custom interfacing
- Selectable MCU modes of operation

Cyclone Pro – MSRP $495
- Real-time, in-circuit flash programmer and debugger
- USB, Serial, and Ethernet programmer and debugger

USB Multilink – MSRP $99
- Multilink cable handles the proper powering sequences and programming / debugging routines.

In-Circuit Emulator (FSICE) – MSRP starts at $1495
- Cost effective programming
- Device-specific emulation module
- Device-specific target cable
- For HC08 only – HCS08 has on-chip ICE& RS08 has on-chip background debugging
Spyder - Smallest BDM tools in the market

1) **USB Connection:**
USB Device Connector for connection to host PC; Full Speed USB Standard A Device Connector

2) **Target Device:**
Initial tool will be populated with socketed S08QG8 (8pin PDIP). Can be swapped out for any 8pin PDIP (R)S08 device.

3) **Header Pins:**
A provision for a header connector with all of the microcontroller signals bonded out (8 signals).

4) **6pin BDM Connector & Cable:**
Allows connection to target application boards for (R)S08KA2, QD, QG devices not in 8pin PDIP Package.

Dimensions ~ 25 mm x 15 mm x 75 mm
Benefits of using the On-Chip Real-Time ICE with HCS08

► Reduces interconnect by putting ICE inside
  - Capture buffers, comparators, and logic are becoming much smaller than bonding pads
  - Full access and debug even in very tight spaces

► Eliminates timing, loading, and drive issues
  - Target IS the actual MCU not just an emulated equivalent
  - Capture buffer and logic are the same as the target MCU so no marginal timing

► Emulate at full target speed and with all target circuitry including crystal components

► No issues with temperature or voltage

► Eliminates expensive external emulator box and interconnect
Broad Third Party Tool Partners

► Compilers
  • Avocet Systems, BP Micro, Bytecraft, Cosmic, IAR, Imagecraft, TASKING

► Emulators/BDM
  • iSYSTEMS, Lauterbach, Noral, P&E Micro, SofTec

► Eval Boards
  • Axiom, Avnet, Future, Beta Control, Dipl. Ing., Elektronikladen, Hitex, New Micros, Oztechnics P/L, Prometero S.r.l., Softec, Technological Arts

► RTOS & Misc Debug/Simulation
  • Metrowerks, Avocet, CMX, Cosmic, PE Micro, NOICE

► Gang Programmers
  • BP Micro, Data I/O, Lloyd Research, Promik, System General Corporation, Xeltek
ZigBee
## Wireless Standards Compared

<table>
<thead>
<tr>
<th>Feature(s)</th>
<th>IEEE 802.11b Wi-Fi</th>
<th>IEEE 802.15.3 Bluetooth</th>
<th>IEEE 802.15.4 ZigBee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Profile</td>
<td>Hours</td>
<td>Days</td>
<td>Years</td>
</tr>
<tr>
<td>Complexity</td>
<td>Very Complex</td>
<td>Complex</td>
<td>Simple</td>
</tr>
<tr>
<td>Nodes/Master</td>
<td>32</td>
<td>7</td>
<td>64000</td>
</tr>
<tr>
<td>Latency</td>
<td>Enumeration upto 3 seconds</td>
<td>Enumeration upto 10 seconds</td>
<td>Enumeration 30ms</td>
</tr>
<tr>
<td>Range</td>
<td>100 m</td>
<td>10m</td>
<td>70m-300m</td>
</tr>
<tr>
<td>Extendability</td>
<td>Roaming possible</td>
<td>No</td>
<td>YES</td>
</tr>
<tr>
<td>Data Rate</td>
<td>11Mbps</td>
<td>1Mbps</td>
<td>250Kbps</td>
</tr>
<tr>
<td>Security</td>
<td>Authentication Service Set ID (SSID)</td>
<td>64 bit, 128 bit</td>
<td>128 bit AES and Application Layer user defined</td>
</tr>
</tbody>
</table>
ZigBee Value Propositions

- Addresses the unique needs of most remote monitoring and control network applications
  - Infrequent, low rate data
- Enables the broad-based deployment of wireless networks with low cost & low power solutions
  - Supports peer-to-peer, star and mesh networks
- Supports applications with low-power requirements
  - Months to Years of Battery Life
- Provides a business environment that supports deployment of these applications
  - Profiles for Interoperability
  - Reduced Cost of Entry compared with other Wireless standards

What is ZigBee?
ZigBee network Topologies

► Addressing
  - All devices have 64-bit addresses
  - Short 16-bit addresses can be allocated
  - Addressing modes:
    - Network + device identifier (star)
    - Source/destination identifier (peer-peer)

► Two channel access mechanisms
  - Beacon-enabled network
  - Non-beacon network

► Three levels of security specified by ZigBee profile
  - None
  - Access control lists
  - Symmetric key employing AES-128

Mesh

Cluster Tree

Star

NWK Topology Models

MESH NETWORK
Application Example – Hotel system
  - Central hub at front desk (PAN co-ordinator)
  - Can remotely configure power, temperature, etc (FFD)
  - Door entry via rf card - RFD

CLUSTERTREE
Similar applications to mesh network,
Application Example – Smart Building System
  - Heating, lighting, security systems on same cluster tree network
  - All networks pass thru central node

STAR NETWORK
Application Example – Home Burglar Alarm
  - Main Control Box – PAN Co-ordinator
  - Sensors, PIR Detectors, siren – RFD
  - Remote dial-in - FFD

Full Function Device (FFD)
  - Any topology
  - Network coordinator capable
  - Talks to any other device

Reduced Function Device (RFD)
  - Limited to star topology
  - Cannot become a network coordinator
  - Talks only to a network coordinator
ZigBee Solutions – Hardware
MC1320X Overview

Overview
- 2.4 GHz Transceiver with integrated Tx/Rx switch

RF Component Count (No Controller)
- 9 external components: 6 caps, 1 inductor, 1 balun, 1 crystal

Network Support
- Point-to-Point, Star, Cluster Tree and Mesh

Connection to controller
- 4-wire SPI

Low Power Modes
- Off, Hibernate (1mA), Doze (3mA), and Idle (40mA)

Sensitivity
- Up to -92 dBm

Power Output
- -27 dBm to +4 dBm

GPIO
- 7

Operating Voltage
- 2.0 to 3.4 V

Operating Temp
- -40° to +85°C

Package
- 5x5x1 mm 32-pin QFN (Meets RoHS requirements)

► Software compatible to the MC1319X
  • Proprietary Applications using SMAC
  • IEEE® 802.15.4 Compliant Modem
  • ZigBee Compliant Platform
  • Millennial Net Meshscape

► Availability
  • In production
## MC1320X Transceiver Family

<table>
<thead>
<tr>
<th></th>
<th>MC13201</th>
<th>MC13202</th>
<th>MC13203</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview</strong></td>
<td>Low cost 2.4 GHz transceiver for proprietary applications</td>
<td>IEEE 802.15.4 Compliant 2.4 GHz transceiver</td>
<td>ZigBee-Ready 2.4 GHz transceiver</td>
</tr>
<tr>
<td></td>
<td>Buffered transmit and receive data packets for use with low cost MCUs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low component count reduces complexity and cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Programmable clock output available to MCU</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Network Topology</strong></td>
<td>Point-to-Point and Star</td>
<td>Peer-to-Peer, Star and Mesh</td>
<td></td>
</tr>
<tr>
<td><strong>Software</strong></td>
<td>Simple MAC (SMAC)</td>
<td>IEEE 802.15.4 MAC or non-F8W ZigBee Stack</td>
<td>F8W ZigBee Stack</td>
</tr>
<tr>
<td><strong>Transfer Mode</strong></td>
<td>Packet</td>
<td>Packet and Streaming</td>
<td></td>
</tr>
<tr>
<td><strong>Throughput</strong></td>
<td>250 Kbps, O-QPSK Modulation, DSSS Energy Spreading Scheme</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tx/Rx Switch</strong></td>
<td>Integrated on-chip</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low Power Modes</strong></td>
<td>Off, Hibernate (1μA), Doze (3μA), and Idle (40μA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>-91 dBm</td>
<td></td>
<td>-92 dBm</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>2.0 to 3.4 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MCU Support</strong></td>
<td>8-bit MCU, ColdFire, S12, DSC</td>
<td>HCS08, ColdFire (Feb.)</td>
<td>HCS08, ColdFire (Sept.)</td>
</tr>
<tr>
<td><strong>MCU Interface</strong></td>
<td>SPI Interface to MCU</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Power Output</strong></td>
<td>-27 dBm to +4 dBm (software selectable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operating Temp</strong></td>
<td>-40° to +85°C Operating Temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Package</strong></td>
<td>5x5x1 mm 32-pin QFN (Meets RoHS requirements)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>10K SRP USD</strong></td>
<td>$2.35</td>
<td>$2.75</td>
<td>$3.28</td>
</tr>
</tbody>
</table>
MC1321X Overview

- **Overview**
  - 2nd Generation ZigBee platform with 2.4 GHz Transceiver and MC9S08GT Family 8-bit MCU

- **Component Count**
  - 10 external components: 7 caps, 1 inductor, 1 balun, 1 crystal

- **Network Support**
  - Point-to-Point, Star, Cluster Tree and Mesh

- **Sensitivity**
  - -92 dBm

- **Power Output**
  - -27 dBm to +4 dBm

- **Memory**
  - Up to 60 KB FLASH, 4 KB RAM

- **Low Power Modes**
  - 4-RF (Off, Hibernate, Doze, Idle) and 4-MCU (Run, Wait, STOP2, STOP3)

- **I/O**
  - Up to 39 GPIO, 8-channel 10-bit ADC, 9 Timers, 2 SCI, IIC, LVI, ICG, COP

- **Operating Volt.**
  - 2.0 to 3.4 V

- **Operating Temp**
  - -40° to +85°C

- **Package**
  - 9x9x1 mm 64-pin LGA
  - Meets RoHS requirements

► Software compatible to the MC1319X
- Proprietary Applications using SMAC
- IEEE® 802.15.4 Compliant Modem
- ZigBee Compliant Platform
- Millennial Net Meshscape

► Availability
- In production

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## MC1321X SiP Family

<table>
<thead>
<tr>
<th>Overview</th>
<th>MC13211</th>
<th>MC13212</th>
<th>MC13213/214</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview</td>
<td>2.4 GHz Transceiver with Integrated GT16 MCU</td>
<td>IEEE 802.15.4 Compliant 2.4 GHz Transceiver with Integrated GT32 MCU</td>
<td>ZigBee-ready 2.4 GHz Transceiver with Integrated GT60 MCU</td>
</tr>
<tr>
<td></td>
<td>Integrated 2.4 GHz Transceiver with Tx/Rx switch and HCS08 GT Family MCU</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low power modes for months to years of battery powered applications</td>
<td>Ulta low component count reduces complexity and cost</td>
<td></td>
</tr>
<tr>
<td>Network Topology</td>
<td>Point-to-Point and Star</td>
<td>Peer-to-Peer, Star and Mesh</td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Simple MAC (SMAC)</td>
<td>IEEE 802.15.4 MAC or non-F8W ZigBee Stack</td>
<td>F8W ZigBee Stack</td>
</tr>
<tr>
<td>Transfer Mode</td>
<td></td>
<td>Packet and Streaming</td>
<td></td>
</tr>
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<td>Throughput</td>
<td></td>
<td>250 Kbps, O-QPSK Modulation, DSSS Energy Spreading Scheme</td>
<td></td>
</tr>
<tr>
<td>Low Power Modes</td>
<td></td>
<td>4-RF (Off, Hibernate, Doze, Idle) and 4-MCU (Wait, STOP1, STOP2, STOP3)</td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td></td>
<td>-92 dBm</td>
<td></td>
</tr>
<tr>
<td>Operating Voltage</td>
<td></td>
<td>2.0 to 3.4 V</td>
<td></td>
</tr>
<tr>
<td>FLASH Memory</td>
<td>16 KB FLASH, 1 KB RAM</td>
<td>32 KB FLASH, 2 KB RAM</td>
<td>60 KB FLASH, 4 KB RAM</td>
</tr>
<tr>
<td>I/O</td>
<td>Up to 39 GPIO, 8-channel 10-bit ADC, 4 Timers, 2 SCI, IIC, LVI, ICG, COP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Output</td>
<td></td>
<td>-27 dBm to +4 dBm (software selectable)</td>
<td></td>
</tr>
<tr>
<td>Operating Temp</td>
<td></td>
<td>-40º to +85ºC Operating Temperature</td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td></td>
<td>9x9x1 mm 64-pin LGA (Meets RoHS requirements)</td>
<td></td>
</tr>
<tr>
<td>10K SRP USD</td>
<td>$3.61</td>
<td>$3.94</td>
<td>$4.32 / $4.85</td>
</tr>
<tr>
<td></td>
<td>MC13192</td>
<td>MC13202</td>
<td>MC13213</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>Package Size</strong></td>
<td>25 mm² 5x5x1 mm</td>
<td>25 mm² 5x5x1 mm</td>
<td>81 mm² 9x9x1 mm</td>
</tr>
<tr>
<td><strong>8-bit MC9S08GT60 Package Size</strong></td>
<td>49 mm² 7x7x1 mm</td>
<td>49 mm² 7x7x1 mm</td>
<td>Internal</td>
</tr>
<tr>
<td><strong>Platform External Part Count for 50ohm Single-Ended Output (antenna not included)</strong></td>
<td>17 (includes MCU &amp; bypass cap)</td>
<td>11 (Includes MCU &amp; bypass cap)</td>
<td>10 (includes bypass cap)</td>
</tr>
<tr>
<td><strong>Integrated Tx/Rx Switch</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>-92 dBm</td>
<td>-92 dBm</td>
<td>-92 dBm</td>
</tr>
<tr>
<td><strong>Total Solution Size (antenna not included)</strong></td>
<td>300 mm²</td>
<td>250 mm²</td>
<td>200 mm²</td>
</tr>
<tr>
<td><strong>Silicon Cost (2006 10K SRP USD)</strong></td>
<td>$6.10</td>
<td>$6.28</td>
<td>$4.32</td>
</tr>
<tr>
<td><strong>External Component Cost USD (antenna not included)</strong></td>
<td>$1.06</td>
<td>$0.77</td>
<td>$0.77</td>
</tr>
</tbody>
</table>
MC1322x -single-chip ZigBee® Platform in Package™

- Ultra-low-power consumption
  - Onboard buck converter for ultra-low-power applications
- TurboLink technology delivering up to 10X data
  - Switch automatically between the IEEE 802.15.4 protocol and TurboLink
- MC1322x PiP solution features
  - IEEE 802.15.4 transceiver
  - 32-bit processor capable of running up to 26 MHz
  - All RF tuning components and balun are contained within the MC1322x package,
  - Hardware accelerator and security
  - Dual 12-bit analog-to-digital converters
  - Multiple serial ports and peripherals
  - Onboard ROM, containing device drivers and a fully compliant IEEE 802.15.4 MAC
  - RAM and flash memory for cost-sensitive wireless applications
- Availability: 4Q 2007
ZigBee Solutions – Software
Multi-Offering Approach with 802.15.4 / ZigBee

Simple Wireless Connectivity

802.15.4 Solution

ZigBee

- P31
- P1
- ZDO

- APS
- ZigBee NWK

802.15.4 MAC

802.15.4 PHY

MCU

RFIC

MCU

RFIC

MCU

RFIC
Proprietary Solutions (SMAC)

Features Highlights
- Portfolio’s Lowest Cost Solution
- Ease of Use
  - Uses Simple Media Access Controller Software (SMAC)
  - Only 16 Primitives
  - Requires Less than 2.5K bytes of Memory
  - ANSI C Source Code Provided
- Flexibility
  - Generic SPI Targets any MCU
  - Provides Migration Path to ZigBee

Target Applications
- Point to Point and Star Networks
- Ultra Low Power Requirements
- Ultra Low Memory Requirements

Processors supported
- HCS08, HC12, DSC, ColdFire
IEEE 802.15.4 Standard-Based Proprietary

Hardware Features
► 802.15.4 PHY Compliant
  • MC13192/3 Transceiver
  • Supports Packet and Streaming Mode
  • Compliant to all RF Specs
► Targets the HCS08GT60

Software Features
► 802.15.4 MAC Compliant
  • Standardized Communication Protocol
  • Supports Beaoned and Non-Beaconed NWKs
  • GTS, 128 AES Encryption
  • Co-existence Mitigation Algorithm CSMA-CA
  • Mesh & Clustertree NWKs
► Option to Remove Unnecessary Features to reduce code size
► Provided in Object Code

Target Applications
• Mesh/Clustertree NWKs
• Robust Communication and Timing Critical Protocol
• NWK Standard not needed
• Interoperability not needed

Processors Supported
► HCS08, ColdFire (Feb/Mar)
Fully Compliant ZigBee

Features Highlights
► ZigBee Compliant Platform
► Complete Wireless Networking Standard – from Antenna to API
► Wireless Embedded or Dongle Options

Target Applications
► Mesh & Clustertree NWKs
► Established Routing Algorithm
► Network Recovery and Healing
► Device Interoperability

Processors Supported
► HCS08, ColdFire (Sep/Oct)
BeeKit / BeeStack

(Run a ZigBee network in less than 30 minutes)

**Product Summary & Differentiators**

- Computer-based development environment for proprietary, 802.15.4 and ZigBee applications.
- Supports all available development boards (DSKs, NSKs, EVKs)
- User-defined hardware target function.
- Applications are decoupled from the stack implementation. Allows for easy code updates and promotes code reuse.
- Downloadable free of charge on website
- ZigBee-2006 certified BeeStack

**Target Applications**

- Remote Keyless Entry
- Home Automation (HVAC, Lighting)
- Garage door opener
- Remote Metering
- RF Data Transfer
- Building Automation (Access Control)
- Industrial Control (Asset Monitoring)
- Automotive Keyless Remote

**Milestone | Availability & Ordering**

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Availability &amp; Ordering</th>
</tr>
</thead>
</table>
| BeeKit    | Available for download on website  
            | Burnt on a CDROM with devkits in March 2007 |
| BeeStack  | March 2007              |
| Launch    | March 2007              |
| SRP       | BeeKit (SMAC, 15.4 codebases) : FREE  
            | BeeStack (90-day license) : FREE  
            | BeeStack Standard License : $995 (BEESTK-S08-STD)  
            | BeeStack Floating License : $1495 (BEESTK-S08-FLT) |
BeeKit defined:
► Comprehensive code base of wireless networking libraries, application templates, and sample applications
► Graphical user interface (GUI) for the creation, modification and updating of wireless networking implementations
► Automated validation of configuration parameters
► Generation of workspace files to be imported into an integrated development environment (IDE) for continued development and debugging through xml
► Easily scalable to support new code bases and functionality
MCU’s ideal for Zigbee
MC9S08QG8/4 – Feature Set

**Features**

**Memory**
- 4k - 8k Flash, capable of EEPROM emulation
- 1k - 2k bytes of RAM

**Internal Clock Generator (ICG)**
- Up to 10 MHz bus
- FLL
- On-chip oscillator – Requires no external components
- External crystal support (16-pin only)
- Separate self-clocked source for real time interrupt
- 0.5% typical. 2% accuracy over full operating range

**Serial Communication**
- IIC (synchronous)
- SPI (synchronous)
- SCI (asynchronous)

**Timers**
- 2-channel Timer/PWM Module (TPM)
- 8-bit Modulo Timer Module (MTIM)

**Analog Modules**
- 8-channel, 10-bit Analog-to-Digital Converter
- Analog Comparator

**Development Tools**
- On chip ICE and BDM

Available Packages
- 8 DIP, 8 SOIC, 8 DFN, 16 DIP, 16 TSSOP, 16 QFN

Supply Voltage Range: 1.8V to 3.6V,
Operating Temperature: -40 to +85°C
## MC9S08AW60/48/32/16 – Feature Set

### Features

**Memory**
- 16k - 60k Flash, capable of EEPROM emulation
- 1k - 2k bytes of RAM

**Internal Clock Generator (ICG)**
- Up to 20 MHz bus
- FLL with 8 software selectable multipliers
- On-chip oscillator – Requires no external components
- Bus clock divider with 8 software selectable settings
- Separate self-clocked source for real time interrupt
- 0.5% typical. 2% accuracy over full operating range

**Serial Communication**
- IIC (synchronous)
- SPI (synchronous)
- 2 x SCI (asynchronous)

**Timers**
- 6-channel Timer/PWM Module (TPM)
- 2-channel Timer/PWM Module (TPM)

**Analog Modules**
- 16-channel, 10-bit Analog-to-Digital Converter
- Enhanced LVD

**Development Tools**
- On chip ICE and BDM

---

### Available Packages
- 64 QFP, 64 LQFP, 48 QFN, 44 LQFP

### Supply Voltage Range:
- 2.7V to 5.5V

### Operating Temperature:
- -40 to +125°C
MC9S08GB60A/32A – Feature Set

Features

►Memory
  • 32k - 60k Flash, capable of EEPROM emulation
  • 2k - 4k bytes of RAM

►Internal Clock Generator (ICG)
  • Up to 20 MHz bus
  • FLL with 8 software selectable multipliers
  • On-chip oscillator – Requires no external components
  • Bus clock divider with 8 software selectable settings
  • Separate self-clocked source for real time interrupt
  • 0.5% typical. 2% accuracy over full operating range

►Serial Communication
  • IIC (synchronous)
  • SPI (synchronous)
  • 2 × SCI (asynchronous)

►Timers
  • 5-channel Timer/PWM Module (TPM)
  • 3-channel Timer/PWM Module (TPM)

►Analog Modules
  • 8-channel, 10-bit Analog-to-Digital Converter
  • Enhanced LVD

►Development Tools
  • On chip ICE and BDM

Supply Voltage Range: 1.8V to 3.6V,
Operating Temperature: -40 to +85°C

Available Packages
64 LQFP

Up to 56 GPIO
<table>
<thead>
<tr>
<th>Features</th>
<th>32k Flash</th>
<th>60k Flash</th>
<th>SCI</th>
<th>SCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>S08 Core</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-ch 16-bit Timer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICE &amp; BDM</td>
<td></td>
<td></td>
<td>COP</td>
<td></td>
</tr>
<tr>
<td>2-ch 16-bit Timer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICS 20 MHz</td>
<td></td>
<td></td>
<td>POR</td>
<td></td>
</tr>
<tr>
<td>8-ch 10-bit ADC</td>
<td></td>
<td></td>
<td>LVI</td>
<td></td>
</tr>
</tbody>
</table>

**Up to 39 GPIO**

Available Packages
48 QFN, 44 QFP

Supply Voltage Range: 1.8V to 3.6V,
Operating Temperature: -40 to +85°C

**Features**

- **Memory**
  - 32k - 60k Flash, capable of EEPROM emulation
  - 2k - 4k bytes of RAM

- **Internal Clock Generator (ICG)**
  - Up to 20 MHz bus
  - PLL with 8 software selectable multipliers
  - On-chip oscillator – Requires no external components
  - Bus clock divider with 8 software selectable settings
  - Separate self-clocked source for real time interrupt
  - 0.5% typical. 2% accuracy over full operating range

- **Serial Communication**
  - IIC (synchronous)
  - SPI (synchronous)
  - 2 x SCI (asynchronous)

- **Timers**
  - 2-channel Timer/PWM Module (TPM)
  - 2-channel Timer/PWM Module (TPM)

- **Analog Modules**
  - 8-channel, 10-bit Analog-to-Digital Converter
  - Enhanced LVD

- **Development Tools**
  - On chip ICE and BDM
ZigBee Solutions – Platforms
MC13192 Developers Starter Kit

- Affordable demonstration system
- SMAC and IEEE 802.15.4 network development
- 2 Sensor Applications Reference Boards (SARD)
  - Based on Freescale’s MC13192 and MC9S08GT60 MCU
  - Integrated X-Y and Z-axis acceleration sensors (MMA6261Q, MMA1260D)
  - LEDs and switches for demonstration monitoring and control
  - Onboard Background Debug Module port for MCU flash reprogramming and in-circuit hardware debugging
  - RS-232 port for monitoring and Flash programming
  - Range approximately 125m line-of-sight
- Dual printed antenna reference design
- Power Adapters, Batteries and Cables
- USB Multilink BDM Programmer/Debugger
  - 13192DSK-BDM-A00

- Includes Metrowerks CodeWarrior™ Development Studio for HCS08 16 KB Special Edition
- SMAC Source Code and Sample Apps
- IEEE 802.15.4 Object Code and Test Tools
- Orderable part number:
  - 13192DSK-A00: Suggested resale: $199 USD
  - 13192DSK-BDM-A00: Suggested resale $299 USD
MC13192 Sensor Applications Reference Board

MC13192 Transceiver

MC9S08GT60 MCU
MC1321X Development Kits

►2nd generation development kit
►Hardware
  • End Node
    ▪ 13213-SRB
  • Coordinator/Router Board
    ▪ 13213-NCB
►Features/Benefits
  • MC13213 ZigBee-compliant 2.4GHz SiP
  • MMA7260Q 3-axis Acceleration Sensor (13213-SRD only)
  • Temperature Sensor (13213-SRD only)
  • Printed F antenna
  • Onboard expansion capabilities for external application-specific development activities
  • LEDs and switches for demonstration monitoring and control
  • LCD for demonstration messaging (13213-NCB only)
  • Connections for battery or external power supply
  • RS232 and USB
  • USB Multilink BDM Debugger/Programmer (-BDM kits only)
  • Scalable Software support for easy development of customer specific network topologies
MC1321X Network Coordinator Board

MC13213
MCU + Transceiver
**RD3152MMA7260Q: ZigBee Sensing Triple Axis Reference Design (ZSTAR)**

**RD3152MMA7260Q Features:**

Provides robust wireless communication using the powerful, easy-to-use 2.4GHz frequency MC13191 transceiver.

**System Features:**
- Consumer and industrial wireless sensing applications
- Demo Modules for 6 sensing functions - Fall, Tilt, Motion, Positioning, Shock and Vibration - for multifunctional applications.

**Hardware Features:**
- Pin to pin compatible with MC13192 and MC13193 allowing implementation of ZigBee applications.
- MC68HC908JW32 (USB 2.0 Full Speed) and MC9S08QG8
ZSTAR DEMO RD3152MMA7260Q

B1 Mode Button to select 2 basic modes:

1) Mouse-pointer (no separate GUI needed)
2) Datatransfer – (additional GUI needed)

3V battery
On backside
CR2032 or DL2032
(Not included !)
• **Supply Voltage/ Performance**
  - 3V – 5.5V Operating Voltage, 8MHz bus operation

• **Core**
  - 8bit HC08 core upward compatible with HC05

• **Memory**
  - 32K Flash, 1K bytes of RAM

• **Communications**
  - USB 1.1/2.0 PHY with Full speed transfer capability, SPI

• **Features/ Benefits**
  - 1 x 2 channels 16bit Timer, PS2 Clock Generator, Time base wakeup module, 2 dedicated external interrupt, 12 individual LED driver, Up to 34 GPIO

• **Available Packages**
  - 48 QFN, 52 QFP
MC9S08QG8 – MCU used in ZSTAR DEMO

Key Features/Benefits
Supply Voltage
1.8V – 3.6V, -40C to +125 C
Core: 16MHz HCS08 Core/ 8MHz Bus Frequency
Memory : 4kB - 8kB Flash/ 256B - 512B RAM
Communications: ESCI, SPI, IIC
Features/ Benefits:
8MHz Internal @ 1.8 V – 3.6V
Flash Read/Write @ 1.8V
Internal Osc (2% Precision over temp. & frequency)
On-chip ICE (DBG)
Background Debug Controller (BDC)
2-ch, 16-bit, IC/OC, or PWM
COP, 10-bit ADC, ICS with FLL, LVI, RTI
Up to 13 GPIO
Power Saving Modes
On-chip temperature Sensor
Pincompatibility to 9S08QD4 & 9S08KA2 (8-pin)

Available Packages
16-pin SOIC/TSSOP/PDIP
8-pin DFN/SOIC/PDIP

Target Applications:
Electronic power meters, Sensors, Wireless comm.
Home appliances, Security systems, etc…

<table>
<thead>
<tr>
<th></th>
<th>Flash</th>
<th>RAM</th>
<th>Timer</th>
<th>I/O</th>
<th>Serial</th>
<th>ADC</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>9S08QG8</td>
<td>8K</td>
<td>512</td>
<td>2 ch 16bit</td>
<td>13</td>
<td>I2C, SCI, SPI</td>
<td>8ch 10bit</td>
<td>16 pin PDIP/QFN/TSSOP/PDIP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IC/OC/PWM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9S08QG8</td>
<td>8K</td>
<td>512</td>
<td>1 ch 16bit</td>
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<td>I2C</td>
<td>4ch 10bit</td>
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• For the first time: True 8 bit to 32 bit Processor Continuum
• Wide range of competitive low power/low cost 8 bit MCUs which fit to your application.
• Comprehensive, free/low cost, easy to use development tools - Fast Track
• Full ZigBee solution hw/sw including ZeeStack, BeeKit, SiP and PiP
ZSTAR – characteristics to demonstrate

The ZSTAR Demo

Tools
- Exit
- Help!
- Calibrate
- Acquire Data
- G-Select

- Shock
  - Shock Detection

- General
  - Raw Data
  - Shipping and Handling

- Motion
  - Battery Save
  - FreeFall

- Position
  - XYZ

- Orientation
  - Scope

- Tilt
  - Tilt

- Anti-Theft Alarm

- PDA Scrolling

- Digitally Filtered Tilt