Freescale Semiconductor
Product Brief

Document Number: MC9S08LG32PB
Rev. 4, 2/2009

MC9S08LG32 Series MCUs Product Brief

8-bit Low-Cost, Low-Power, and High-Performance HCS08 MCU

Covers: MC9S08LG32 and MC9S08LG16

The MC9S08LG32 and MC9S08LG16 are the members of low-cost, low-power, and high-performance HCS08 family of 8-bit microcontroller units (MCUs). All MCUs in the family use the enhanced HCS08 core and are available with a variety of memory sizes and package types.

The MC9S08LG32 series MCUs are targeted to serve automotive, consumer and industrial markets. Please check the ordering part numbers for different qualification tier products in *Ordering Information section of MC9S08LG32 Data Sheet*.

Contents

1 Application Examples

MC9S08LG32 series MCUs are general-purpose devices suitable for a wide range of applications, including:

- Auto Cluster
- Home Appliance System

1.1 Auto Cluster Application

Figure 1 outlines a typical auto cluster application built around the MC9S08LG32 series microcontroller.

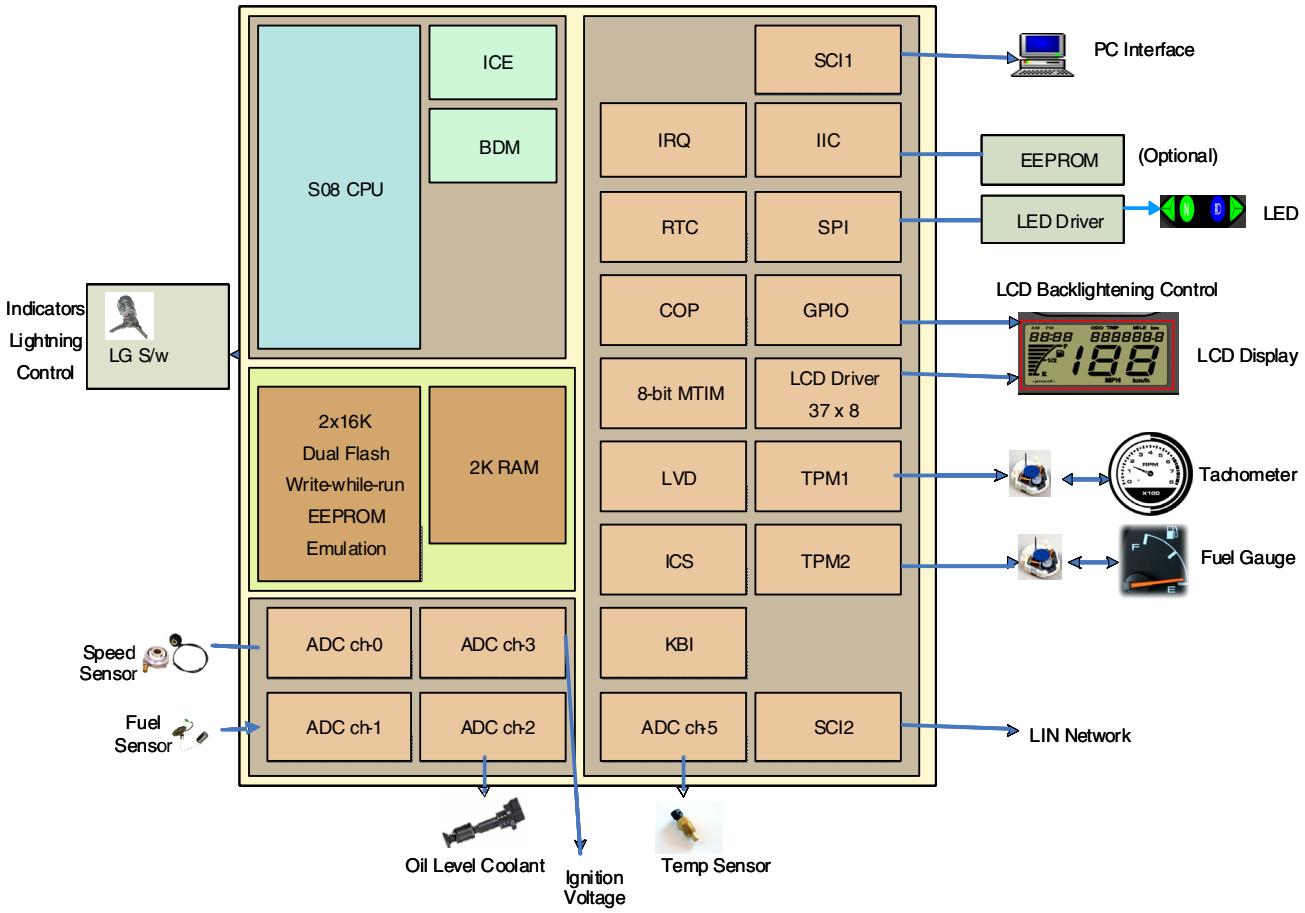

Figure 1. MC9S08LG32 Series Auto Cluster Application

1.2 Home Appliance System

Figure 2 shows a typical home appliance system using MC9S08LG32 series microcontroller.

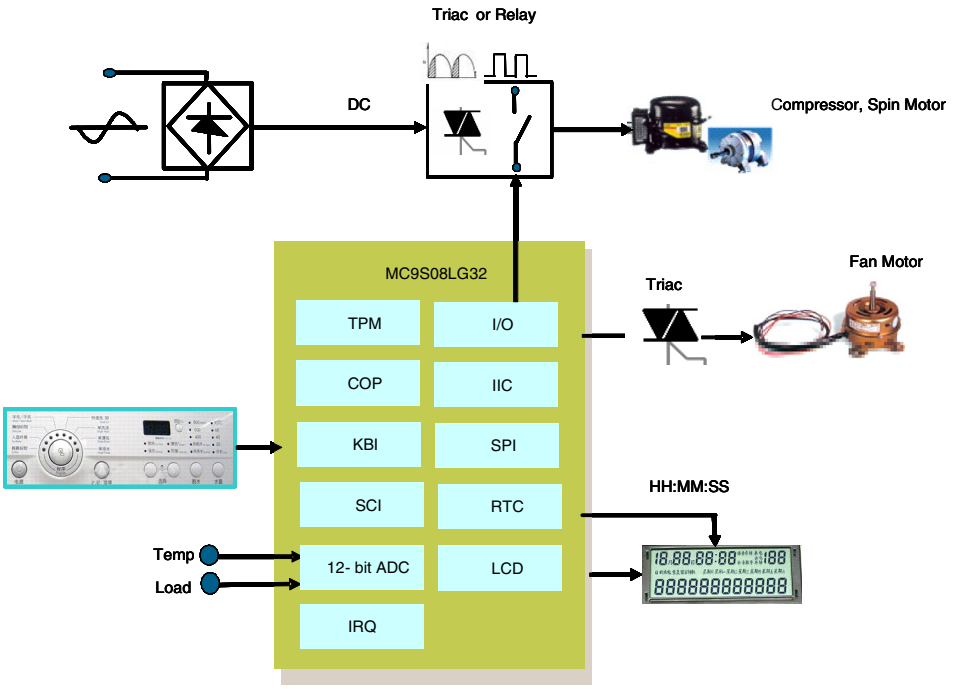

Figure 2. Home Appliance System

2 Features

This section describes the key features of the MC9S08LG32 series MCUs.

2.1 MC9S08LG32 Series Comparison

Table 1 provides a summary of different members of the MC9S08LG32 series and their proposed features. This information is intended to provide an understanding of the range of functionality offered by this microcontroller family.

Table 1. MC9S08LG32 Series Features by MCU and Package

Feature	MC9S08LG32			MC9S08LG16	
Flash size (bytes)	32,768			18,432	
RAM size (bytes)	1984				
Pin quantity	80	64	48	64	48
ADC	16 ch	12 ch	9 ch	12 ch	9 ch
LCD	8 x 37 4 x 41	8 x 29 4 x 33	8 x 21 4 x 25	8 x 29 4 x 33	8 x 21 4 x 25
ICE + DBG	yes				
ICS	yes				
IIC	yes				
IRQ	yes				
KBI	8 pin				

Table 1. MC9S08LG32 Series Features by MCU and Package (continued)

Feature	MC9S08LG32			MC9S08LG16	
GPIOs	69	53	39	53	39
RTC	yes				
MTIM	yes				
SCI1	yes				
SCI2	yes				
SPI	yes				
TPM1 channels	2				
TPM2 channels	6				
XOSC	yes				

2.2 Block Diagram

Figure 3 shows a top-level block diagram for the MC9S08LG32 series.

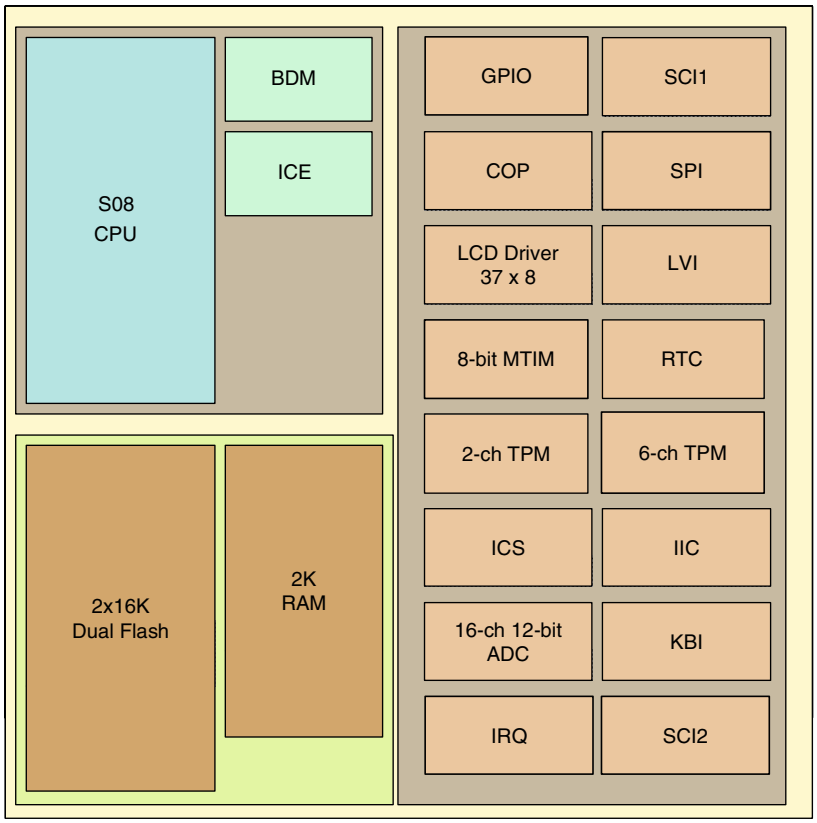

Figure 3. MC9S08LG32 Series Block Diagram

2.3 Critical Performance Parameters

Table 2 shows the operating conditions of the MC9S08LG32 series.

Table 2. MC9S08LG32 Series Operating Conditions

Parameter	Symbol	Min.	Max
Operating Voltage	V_{DD}	2.7 V	5.5 V
Operating Temperature	T_A	–40 °C	105 °C
Bus Frequency	f_{Bus}	DC	20 MHz

Table 3 shows the design targets for supply currents.

Table 3. Supply Current Characteristics

Num	C	Parameter	Symbol	Bus Freq	V_{DD} (V)	Typ[1]	Max	Unit	Temp (°C)
1	C	Run supply current FEI mode, all modules on	RI_{DD}	20 MHz	3	16.38	27.85	mA	–40 °C to 85 °C
	C						28.05		–40 °C to105 °C
	C			1 MHz		1.67	2.84		–40 °C to 85 °C
	C						2.87		–40 °C to105 °C
	P			20 MHz	5	16.55	28.14	mA	–40 °C to 85 °C
	P						28.35		–40 °C to105 °C
	C			1 MHz		1.77	3.01		–40 °C to 85 °C
	C						3.05		–40 °C to105 °C
2	T	Run supply current FEI mode, all modules off	RI_{DD}	20 MHz	3	11.9	20.25	mA	–40 °C to 85 °C
	T						21.72		–40 °C to105 °C
	T			1 MHz		1.16	1.95		–40 °C to 85 °C
	T						1.98		–40 °C to105 °C
	T			20 MHz	5	12.68	21.56	mA	–40 °C to 85 °C
	T						23.12		–40 °C to105 °C
	T			1 MHz		1.4	2.39		–40 °C to 85 °C
	T						2.41		–40 °C to105 °C
3	T	Wait mode supply current FEI mode, all modules off	WI_{DD}	20 MHz	3	7.9	13.42	mA	–40 °C to 85 °C
	T						13.59		–40 °C to105 °C
	T			1 MHz		0.88	1.49		–40 °C to 85 °C
	T						1.51		–40 °C to105 °C
	P			20 MHz	5	8.13	13.81	mA	–40 °C to 85 °C
	P						13.98		–40 °C to105 °C
	T			1 MHz		1.12	1.91		–40 °C to 85 °C
	T						1.94		–40 °C to105 °C

Table 3. Supply Current Characteristics (continued)

Num	C	Parameter		Symbol	Bus Freq	V_{DD} (V)	Typ[1]	Max	Unit	Temp (°C)
4	C	Stop2 mode supply current		$S2I_{DD}$	n/a	3	1.1	16.0	µA	–40 °C to 85 °C
	C							39.0		–40 °C to105 °C
	P					5	1.2	18.7	µA	–40 °C to 85 °C
	P							46.1		–40 °C to105 °C
5	C	Stop3 mode supply current No clocks active		$S3I_{DD}$	n/a	3	1.2	22.4	µA	–40 °C to 85 °C
	C							56.2		–40 °C to105 °C
	P					5	1.32	25.5	µA	–40 °C to 85 °C
	P							63.9		–40 °C to105 °C
6	T	Stop2 adders:	RTC using LPO	—	n/a	3	210	—	nA	–40 °C to 105 °C
			RTC using low power crystal oscillator				4.25	—	µA	
			LCD[2] with rbias (Low Gain)				1.2[3]	—		
			LCD[2] with rbias (High Gain)				18[4]	—		
			LCD[2] with Cpump				4.05[3]	—		–40 °C to 85 °C
			RTC using LPO			5	210	—	nA	–40 °C to 105 °C
			RTC using low power crystal oscillator				4.22	—	µA	
			LCD[2] with rbias (Low Gain)				1.5[3]	—		
			LCD[2] with rbias (High Gain)				32[4]	—		
			LCD[2] with Cpump				7.12[3]	—		–40 °C to 85 °C

Table 3. Supply Current Characteristics (continued)

Num	C	Parameter		Symbol	Bus Freq	V_{DD} (V)	Typ[1]	Max	Unit	Temp (°C)
7	T	Stop3 adders:	RTC using LPO	—	n/a	3	210	—	nA	–40 °C to 105 °C
			RTC using low power crystal oscillator				4.75	—	µA	
			LCD[2] with rbias (Low Gain)				1.2[3]	—		
			LCD[2] with rbias (High Gain)				18[4]	—		
			LCD[2] with Cpump				4.35[3]	—		–40 °C to 85 °C
			RTC using LPO			5	230	—	nA	–40 °C to 105 °C
			RTC using low power crystal oscillator				4.74	—	µA	
			LCD[2] with rbias (Low Gain)				1.5[3]	—		
			LCD[2] with rbias (High Gain)				32[4]	—		
			LCD[2] with Cpump				7.49[3]	—		–40 °C to 85 °C
8	T	Stop3 adders:	EREFSTEN = 1	—	n/a	3	4.58	—	µA	–40 °C to 105 °C
			IREFSTEN = 1				71.7	—		
			LVD				94.35	—		
			EREFSTEN = 1			5	4.61	—	µA	
			IREFSTEN = 1				71.69	—		
			LVD				107.34	—		

NOTES:
1 Typical values are measured at 25 °C. Characterized, not tested.
2 LCD configured for Charge Pump Enabled V_{LL3} connected to V_{DD}..
3 This does not include current required for 32 kHz oscillator.
4 This is the maximum current when all LCD inputs/outputs are used.

2.4 Packages

MC9S08LG32 series devices are offered in the following packages:

- 80-pin LQFP
- 64-pin LQFP
- 48-pin LQFP

2.5 Chip-Level Features

On-chip modules available within the family include the following features:

- Up to 40 MHz HCS08 CPU core
- Up to 32 KB on-chip dual flash
- Up to 2 KB on-chip RAM
- 8-bit modulo timer (MTIM) with configurable clock inputs
- Two serial communication interface (SCI) modules
- Up to 16-channel 12-bit resolution successive approximation analog-to-digital converter (ADC)
- One internal clock source (ICS)
- One serial peripheral interface (SPI) module
- One inter-integrated circuit (IIC) module
- LCD driver, configurable up to 37 x 8
- One 2-channel and one 6-channel timer/pulse-width modulator (TPM)
- Real-time background debug mode (BDM) with ICE
- Up to 69 standard GPIOs
- 8 keyboard (KBI) and one IRQ interrupt with selectable polarity
- 8-bit real time counter (RTC) with low power operation and wakeup

2.6 Module Features

The following sections provide more details of the modules implemented on the MC9S08LG32 series MCUs.

2.6.1 8-Bit HCS08 Central Processor Unit (CPU)

- Up to 40 MHz HCS08 CPU at 5.5 V to 2.7 V across temperature range of –40 °C to 85 °C and –40 °C to 105 °C
- HCS08 instruction set with added BGND instruction
- Support for up to 32 interrupt/reset sources.

2.6.2 On-Chip Memory

- 32 KB or 18 KB dual array flash. Read/program/erase over full operating voltage and temperature
- 1984 byte random access memory (RAM)
- Security circuitry to prevent unauthorized access to RAM and flash contents

2.6.3 Power-Saving Modes

- Two low power stop modes (stop2 and stop3)
- Reduced power wait mode
- Peripheral clock gating register can disable clocks to unused modules, thereby reducing currents
- Low power on-chip crystal oscillator (XOSC) that can be used in low-power modes to provide accurate clock source to real time counter and LCD controller

- 100 µs typical wakeup time from stop3 mode

2.6.4 System Clocks and Clock Generation

- Oscillator (XOSC) — Loop-control Pierce oscillator; Crystal or ceramic resonator range of 31.25 kHz to 38.4 kHz or 1 MHz to 16 MHz
- Internal Clock Source (ICS) — Internal clock source module containing a frequency-locked-loop (FLL) controlled by internal or external reference; precision trimming of internal reference allows 0.2% resolution and 2% deviation over temperature and voltage; supports bus frequencies from 1 MHz to 20 MHz.

2.6.5 System Protection

- COP reset with option to run from dedicated 1 kHz internal clock or bus clock
- Low-voltage warning with interrupt
- Low-voltage detection with reset
- Illegal opcode detection with reset
- Illegal address detection with reset
- Flash and RAM protection

2.6.6 Liquid Crystal Display (LCD)

- Up to 4 × 41 or 8 × 37 LCD driver with internal charge pump

2.6.7 Analog-to-Digital Converter (ADC)

- Up to 16-channel, 12-bit resolution
- 2.5 µs conversion time
- Automatic compare function
- 1.7 mV/°C temperature sensor
- Internal bandgap reference channel
- Operational in stop3 and can wake up the system
- Fully functional from 5.5 V to 2.7 V

2.6.8 Serial Communications Interface (SCI)

- Two serial communications interface modules with optional 13-bit break
- Full duplex non-return to zero (NRZ)
- LIN master extended break generation
- LIN slave extended break detection
- Wakeup on active edge.

2.6.9 Serial Peripheral Interface (SPI)

- One serial peripheral interface
- Full-duplex or single-wire bidirectional
- Double-buffered transmit and receive
- Master or slave mode
- MSB-first or LSB-first shifting

2.6.10 Inter-Integrated Circuit (IIC)

- Up to 100 kbps with maximum bus loading
- Multi-master operation
- Programmable slave address
- Interrupt driven byte-by-byte data transfer
- Supports broadcast mode and 10-bit addressing

2.6.11 Timer/Pulse-Width Modulator (TPM)

- One 6-channel (TPM2) and one 2-channel (TPM1)
- Selectable input capture, output compare, or buffered edge- or center-aligned PWM on each channel

2.6.12 Modulo Timer (MTIM)

- 8-bit counter with match register
- Three clock sources with prescaler dividers for periodic wakeups

2.6.13 Real-Time Counter (RTC)

- 8-bit modulus counter with binary or decimal based prescaler
- Three clock source including one external source. Can be used for time base, calendar, or task scheduling functions
- Free running on-chip low power oscillator (1 kHz) for cyclic wakeup without external components
- Runs in all MCU modes

2.6.14 Input/Output

- 39, 53, or 69 GPIOs
- 8 KBI and 1 IRQ interrupt with selectable polarity
- Hysteresis and configurable pullup device on all input pins
- Configurable slew rate and drive strength on all output pins.

3 Pinouts

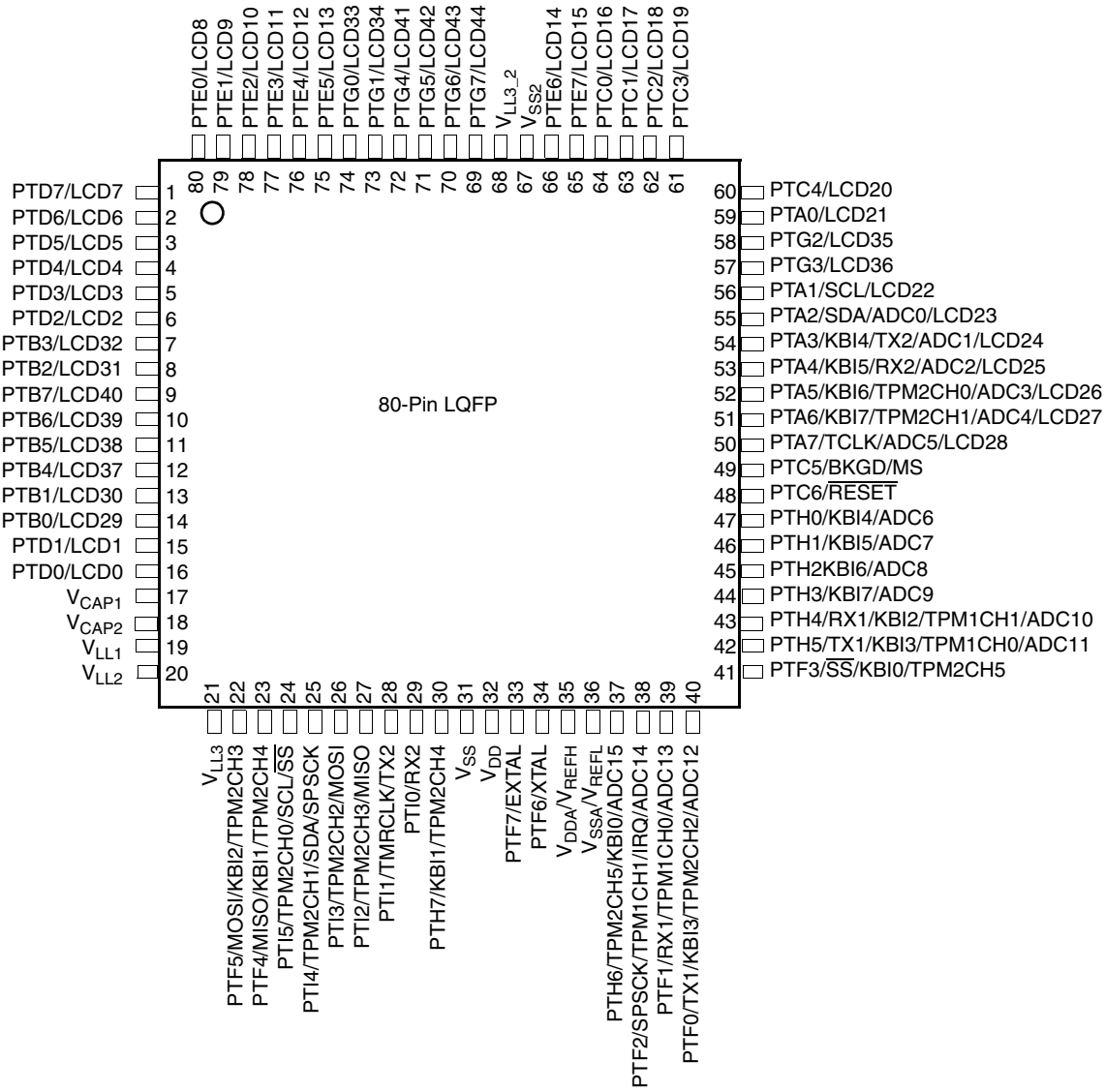

Figure 4. 80-Pin LQFP

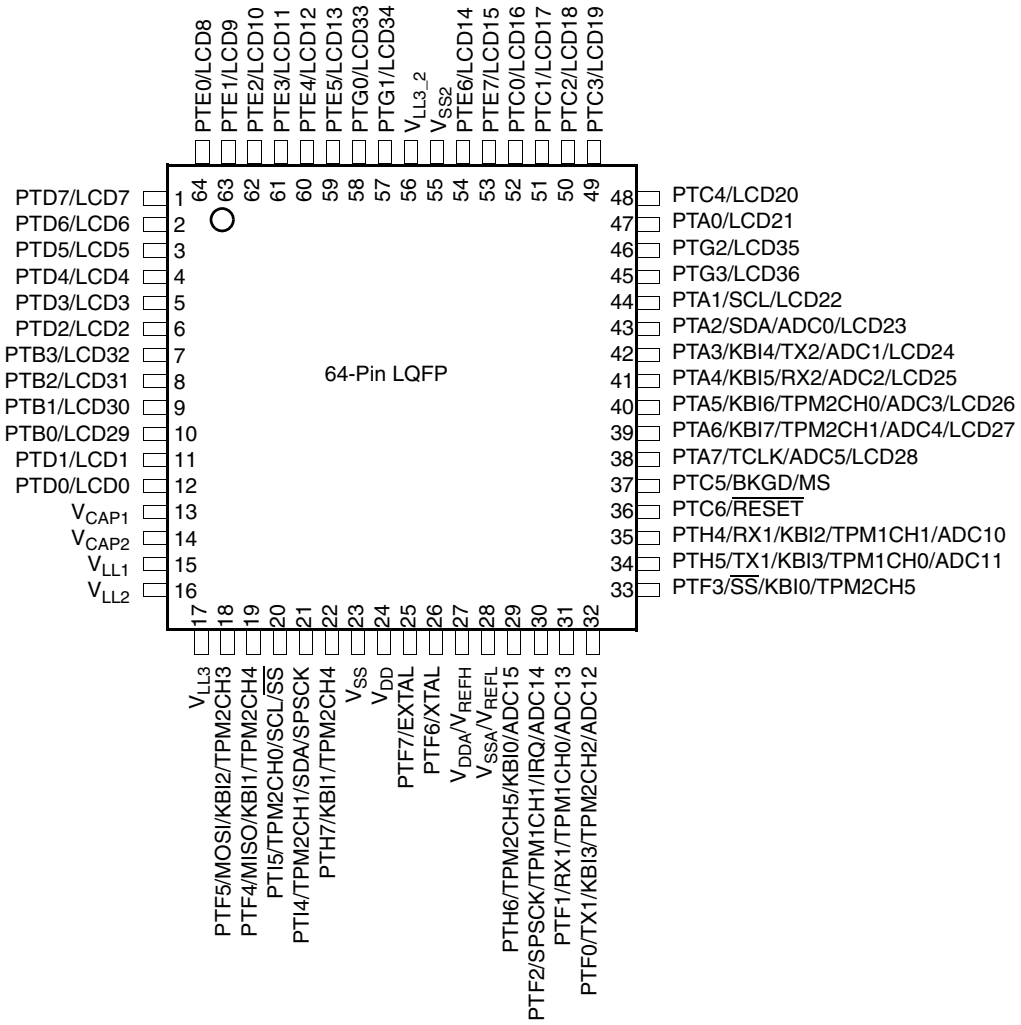

Figure 5. 64-Pin LQFP

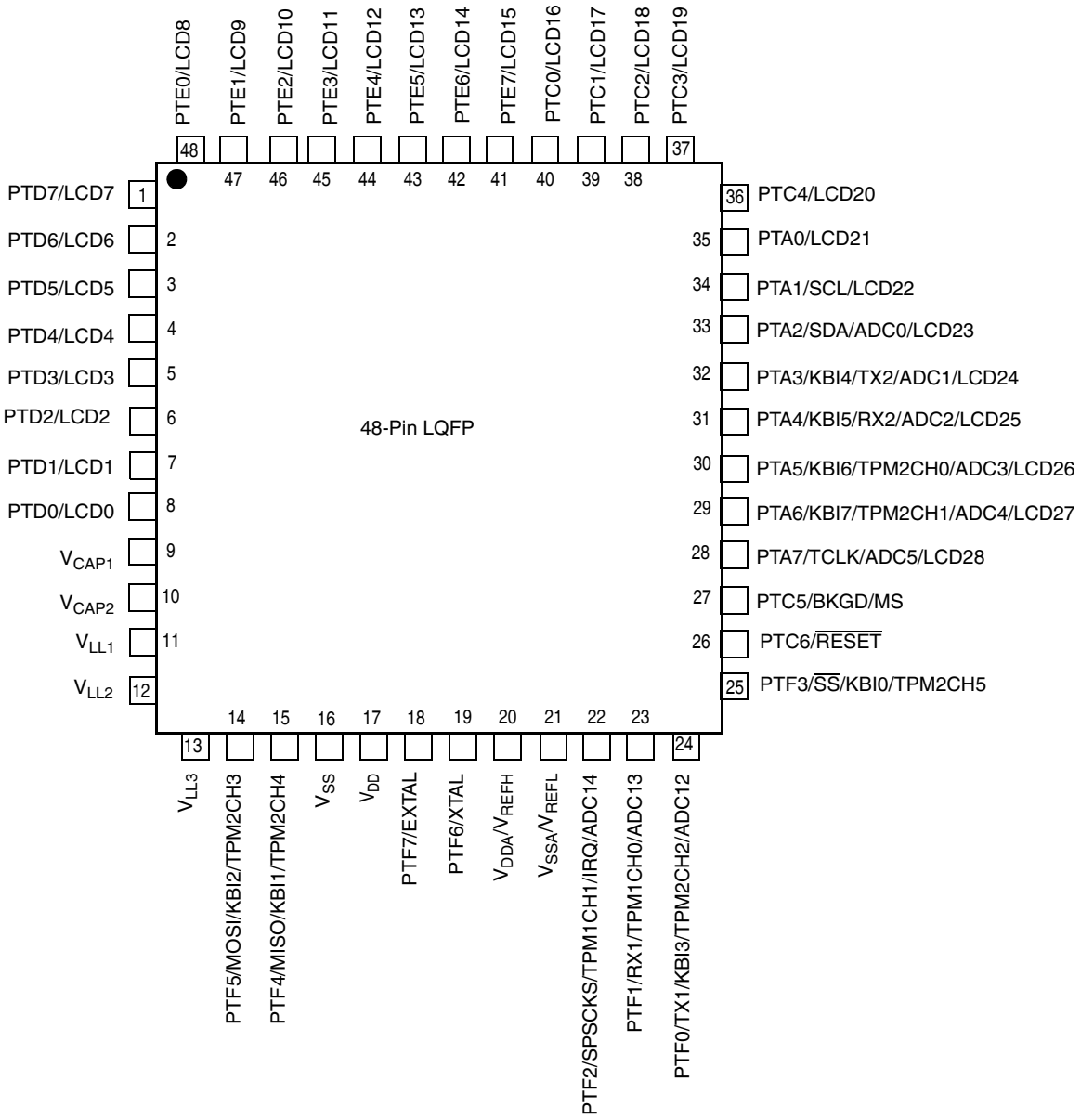

Figure 6. 48-Pin LQFP

4 Developer Environment

- Single-wire background debug interface
- Breakpoint capability to allow single breakpoint setting during in-circuit debugging (plus two more breakpoints in on-chip debug module)
- On-chip in-circuit emulator (ICE) debug module containing three comparators and nine trigger modes. Eight deep FIFO for storing change-of-flow addresses and event-only data. Debug module supports tag and force breakpoints

5 Document Revision History

Identifies content changes compared to the previously released version.

Table 4. Revision History

Revision	Dat	Substantive Change(s)
1	09/2008	Internal Release
2	10/2008	First Initial Release.
3	11/2008	Alpha Customer Release.
4	2/2009	Launch Release.

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Japan:
Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:
Freescale Semiconductor China Ltd.
Exchange Building 23F
No. 118 Jianguo Road
Chaoyang District
Beijing 100022
China
+86 10 5879 8000
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