

Microcomputer General Presentation

October 2005

Renesas Technology Corp.

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Programmer

M16C Family Development Support Tool

Microcomputer General Presentation

Introduction of Renesas MCU

October 28, 2005

Rev.2.00

Standard Product Business Group
Renesas Technology Corp

Roadmap of Renesas Microcomputers

32-bit RISC

32-bit CISC

16 bits

8 bits

4 bits

SuperH Family Core development

SH-2A

Processor type

SH-4A

Controller type

SH2-DSP

SH3-DSP

SH-4

SH-1

SH-2

SH-3

Superscalar

MMU

H8SX Family

1 instruction in
1 clock cycle

H8SX/1600

H8SX/1500

SH/Tiny

Tiny

Under development

M16C Family

1 instruction
in 1 clock cycle

M32C/100

M32C/90

M32C/80

M16C/80

M16C/60

M16C/30

H8S Family

1 instruction
in 1 clock cycle

H8S/2600

H8S/2500

H8S/2400

H8S/2300

H8S/2200

H8S/2100

H8/500

H8/300H

H8 Family

H8/300

H8/300L

H8/300L
Super Low Power

Tiny

H8/Tiny

32 to 80 pins

M16C/Tiny

48 to 80 pins

R8C/Tiny

20 pins and more

740 Family

7600

38000

740

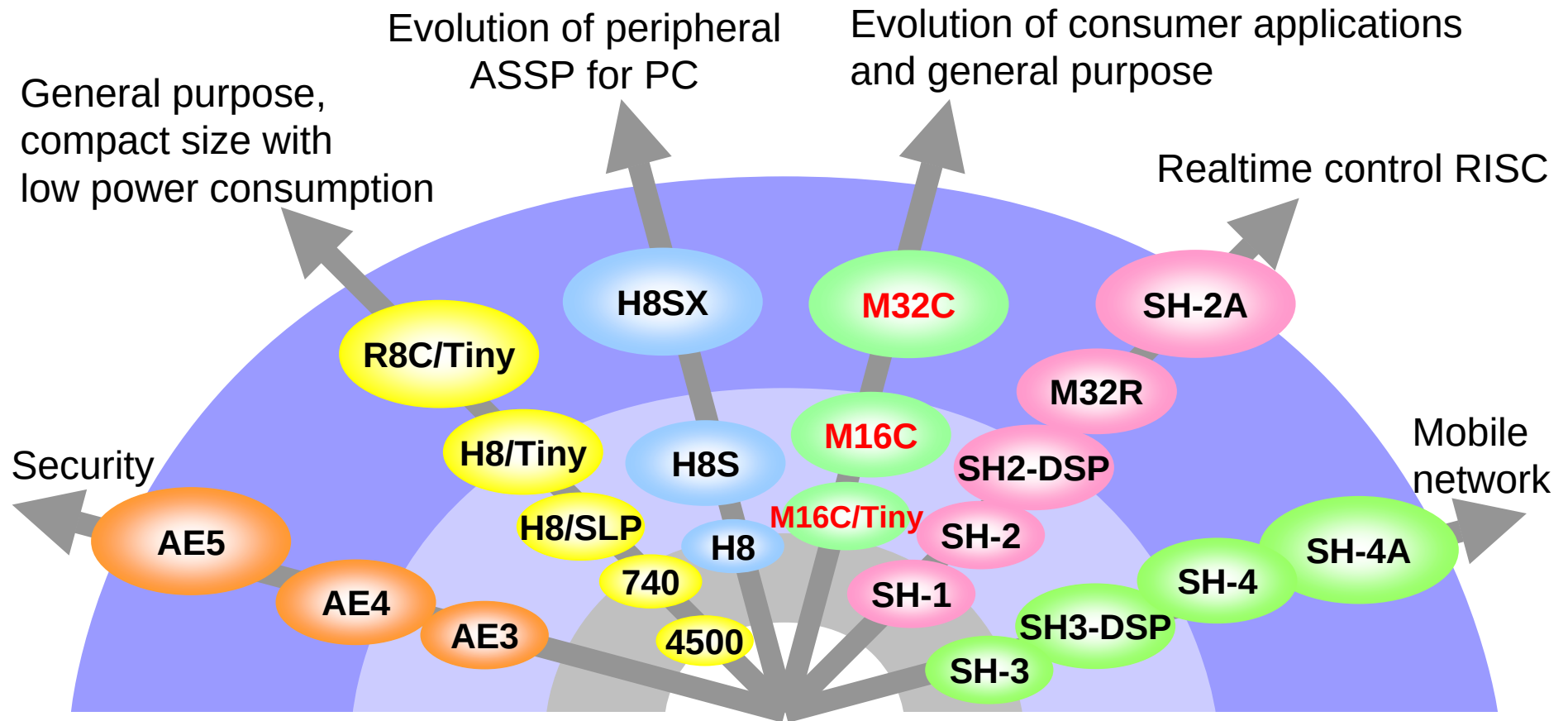
HMCS400

4500

720

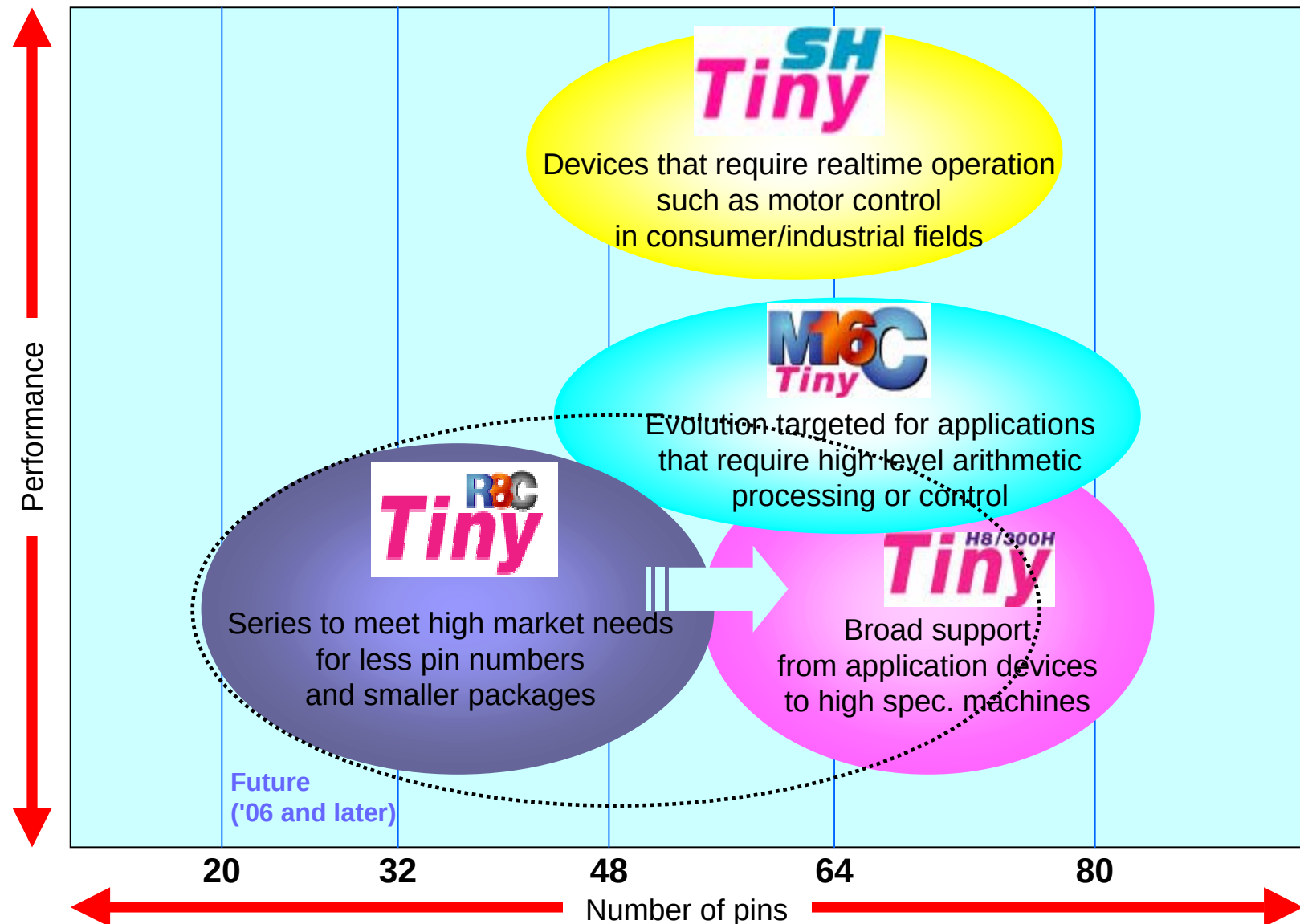
Core Evolution for Suitable Applications

Controller Type



Position of Tiny Microcomputers

Tiny



Support with Collective Strength by Renesas

- We support customers in various situations
from development to post-mass production as a total solution provider -

- **Broad product evolution**

4- to 32-bit microcomputers, ASSPs, SOCs

- **High elemental technology**

Flash memory, A/D converter (12 bits, $\Delta\Sigma$ A/D converter),
low power consumption, EMC, etc.

- **Abundant development environment**

Original systems, as well as abundant software
and hardware provided by partner vendors

- **Development support capability for application systems**

Development capability of application systems by Renesas Solutions

- **Worldwide support**

System to support customers worldwide

Strong Technical Support for Microcomputer Applications

We provide customers with good-quality support in each process stage such as planning for product development to mass production.

- Proposal of solution using demo set or reference kit
- Reduction of introduction and evaluation periods using starter kit, while achieving cost reduction
- Secure support for system development, system to develop entrusted custom software

Initial evaluation kit with CPU board, compiler, and debugger included



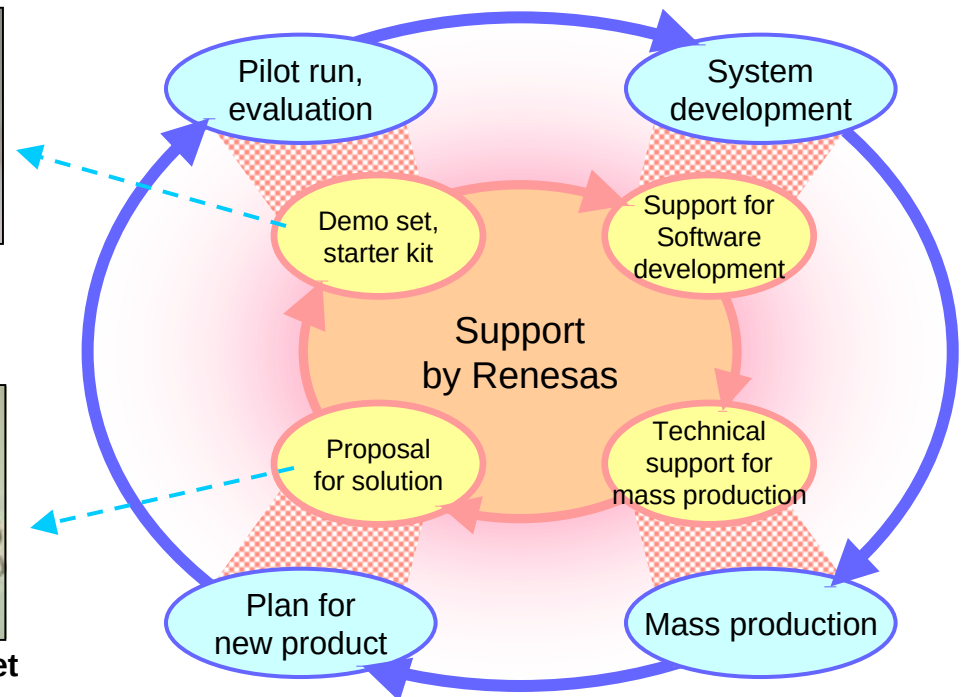
R8C/15 starter kit

Control for 120° rectangular wave, 180° sine wave, position sensor, and 1-shunt vector control



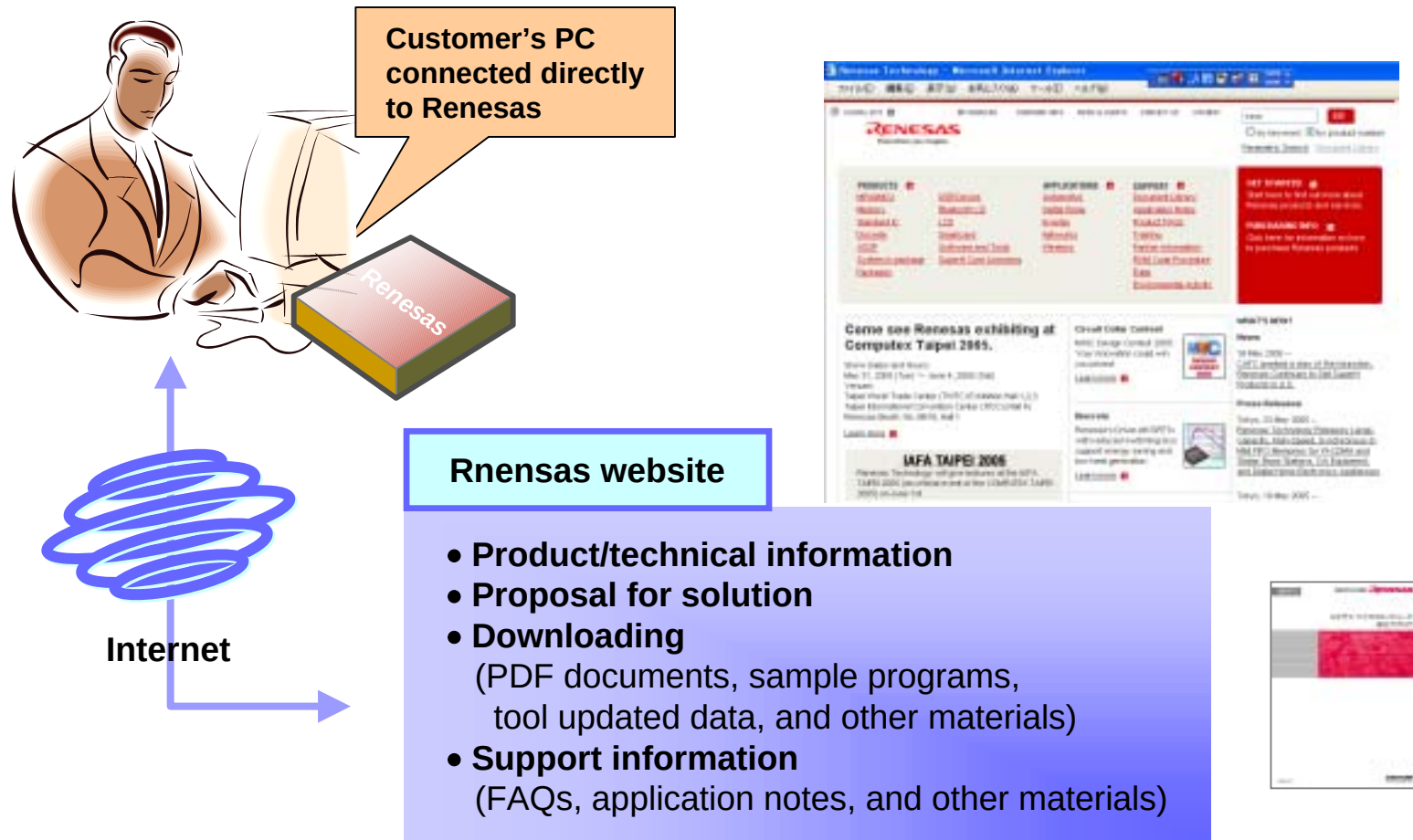
Brushless DC motor demo set

Development cycle for customers



Enhanced Support Using the Internet

We provide Internet support to customers who work globally 24 hours.



<http://www.renesas.com/>

Development Environment for Renesas Microcomputers

- We respond to requests for development environment for microcomputers -

Latest tools to support advanced system development

We lead the trends of development tools and provide customers with the latest tools. The user can:

- **Code generation:** improve quality and reduce development period using CASE and modeling tools
- **Collaborate verification:** start software debugging before hardware and LSI are completed
- **Middleware:** have the latest standards quickly embedded in the product
- **Linux:** use the latest network protocol

High-performance tools at low cost

We provide on-chip emulator at low-price to full-specs. Emulator with high performance so that the customers can select any product(s) which meet(s) their purpose and cost.

Full-specs. emulator	E200F, E6000(H) PC7501	SuperH, H8, R8C, M16C/M32C
Compact emulator	CPE	H8, R8C, M16C/M32C, 4/8 bits
On-chip debugger	E10A-USB E7, E8	SuperH, H8, R8C, M16C/M32C

High function,
high performance



Realtime emulation



Low cost

Renesas MCU Provides Customers with "Safety", "Service", and "Satisfaction"

Offer safety by highly reliable design and high quality manufacturing.

Safety

RENESAS

Offer satisfactory solutions to share prosperity with customers.

Satisfaction

Service

Offer complete solutions of design to production stage.

Microcomputer General Presentation

MCU with Emb.-Flash Memory

- Flash Memory vs. Mask ROM -

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Rev.2.00

Standard Product Business Group
Renesas Technology Corp

Advantages of Using Microcomputers with Emb.-Flash Memory

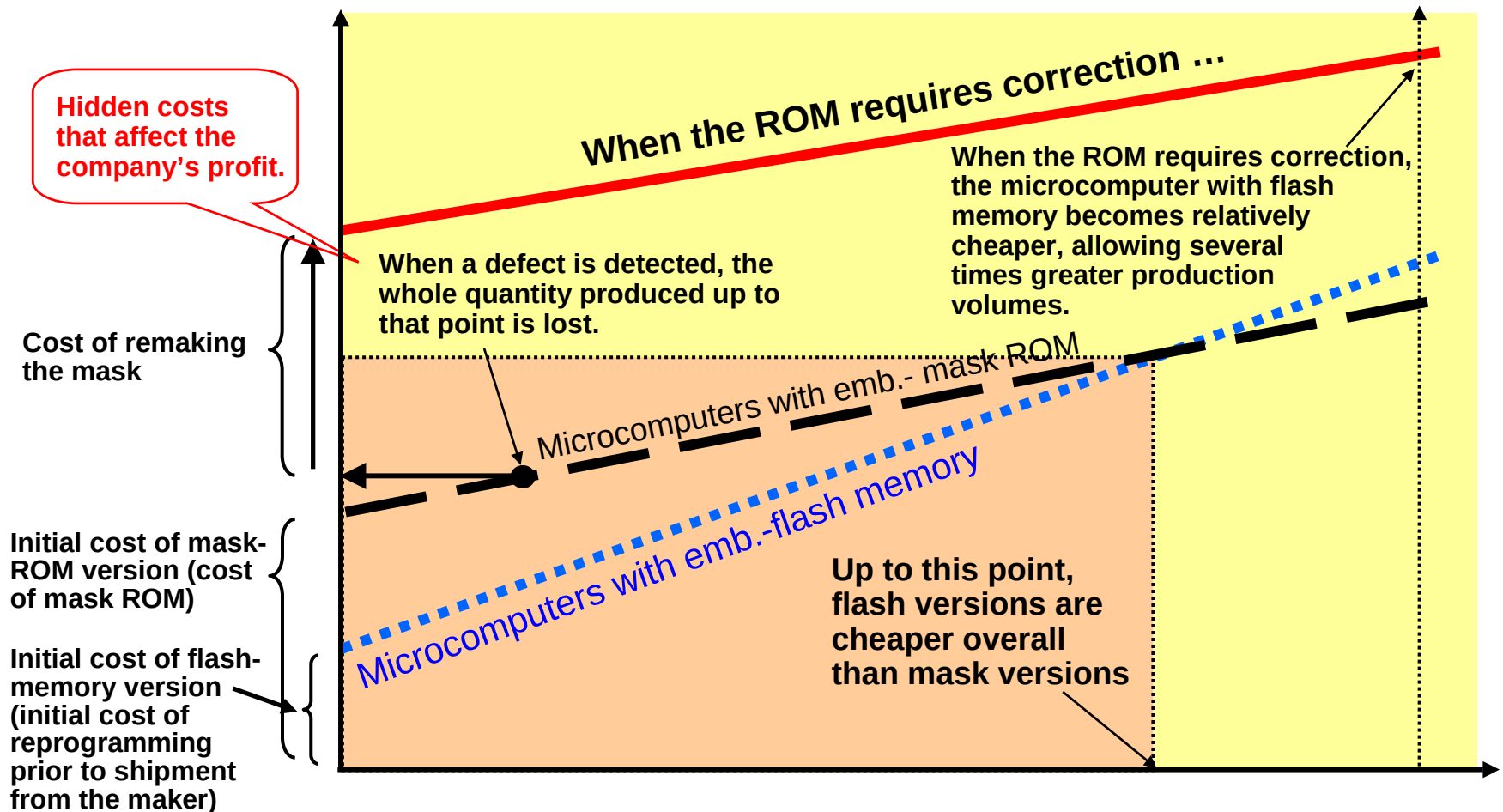
- **Reduced turn-around time (TAT) in development**
 - **Eliminating the masking process reduces TAT**
- **Reduced development and management costs**
 - **Elimination of mask ROM management costs**
 - **Reduced program-management costs**
- **Good for small quantities of multiple product variants**
- **Flash memory is reprogrammable in the field**
Use the Internet or other means for convenient reprogramming of system code and parameters.

Merits of Microcomputers with Emb.-Flash Memory

Item	MCU with Emb.- Mask ROM	MCU with Emb.-Flash Memory	Merit
Initial cost	Expense of a ROM order (expense of programming the mask ROM)	None (replaced by a small initial cost for programming by the chip maker prior to shipment)	Eliminates the need for troublesome ROM changes and potential risks when bugs occur
Development period	Samples are not available until one month after the program is complete	Mass production can start as soon as the program is complete	A faster development process prevents lost opportunities
Evaluation	Both evaluation of flash-equipped prototypes during development and reevaluation of the mask ROM for mass-production are required.	Evaluation of flash ROM is completed at the same time as development	Avoids multiple rounds of evaluation
Production/ process management	Required for each ROM version	Only one type	Simplified management, products in stock do not become unusable
Problems with the program after the product is on the market	Recalling/replacing all units	Reprogramming flash memory	No cost of product recall, no lost production, fast support
Adding functionality to products on the market	Not possible	Possible	Greater added value
Inventory	Discontinuation of mass production or changes to ROM → unusable products in stock	Discontinuation of mass production or changes to ROM → reusable products in stock	Products in stock are reprogrammable for use as new products
Programming	Chip maker creates a mask to order	User or programming company (Renesas programs units prior to shipment from the factory)	Factory-programmed products can be treated in the same way as mask-programmed products

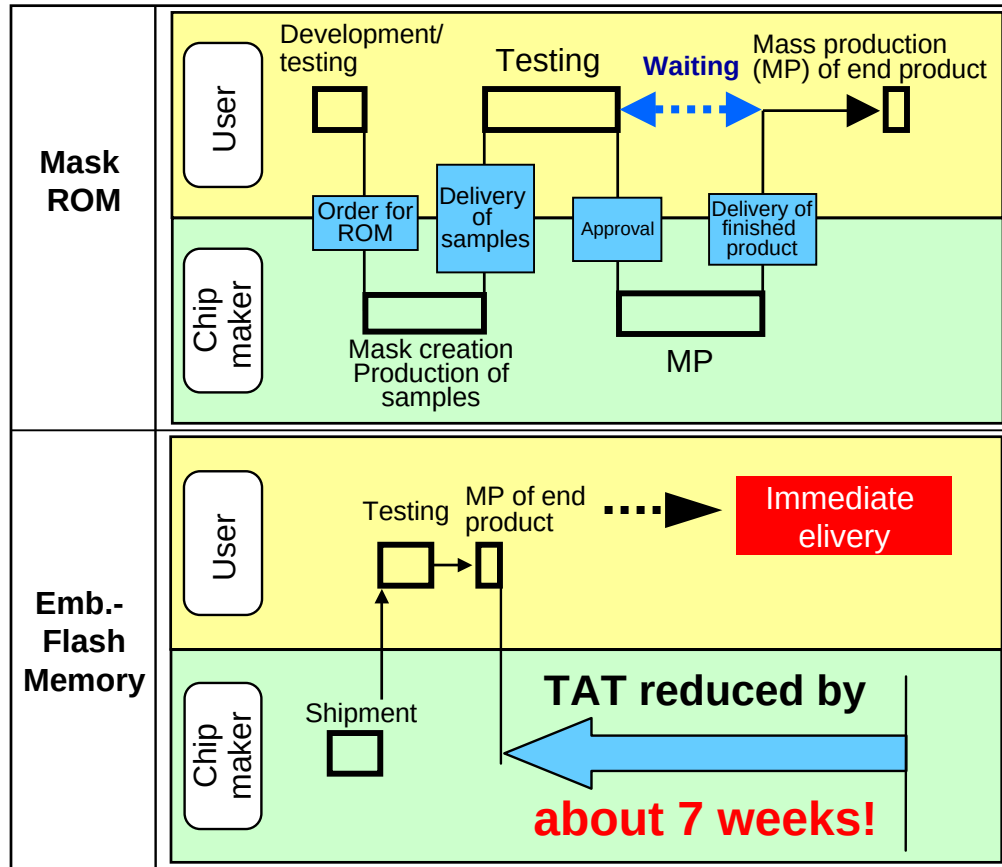
Reduction of Total Costs

- Flash memory suits mid-scale mass production -

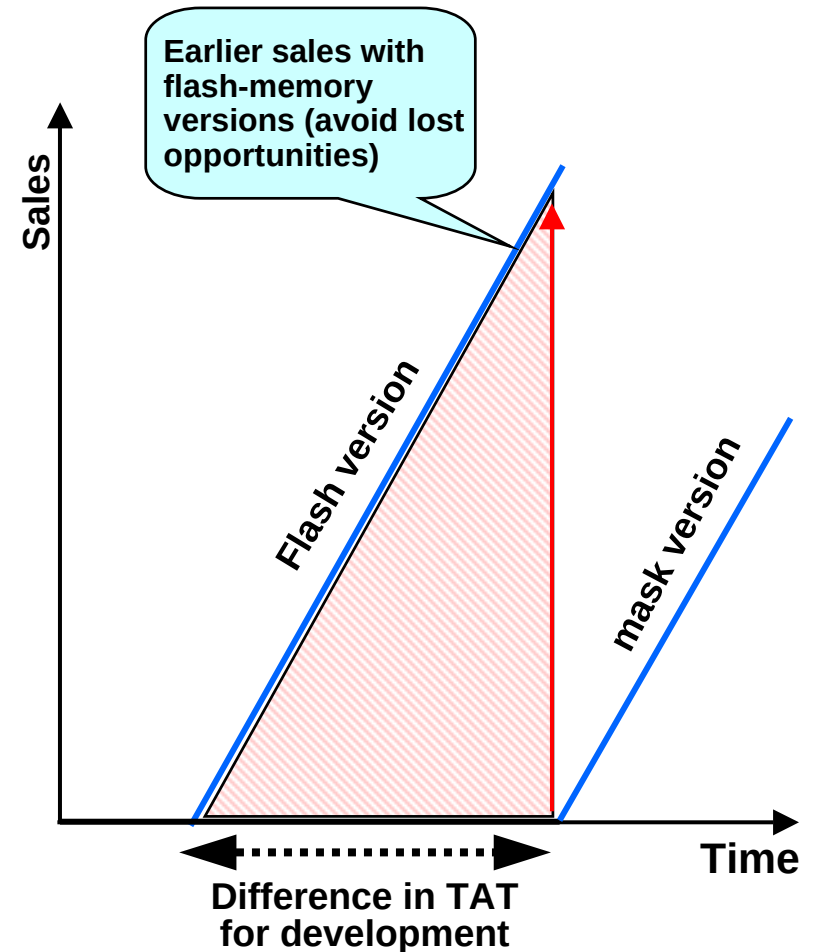


Reduced TAT* for Development

Development of application programs



* Turn-around time

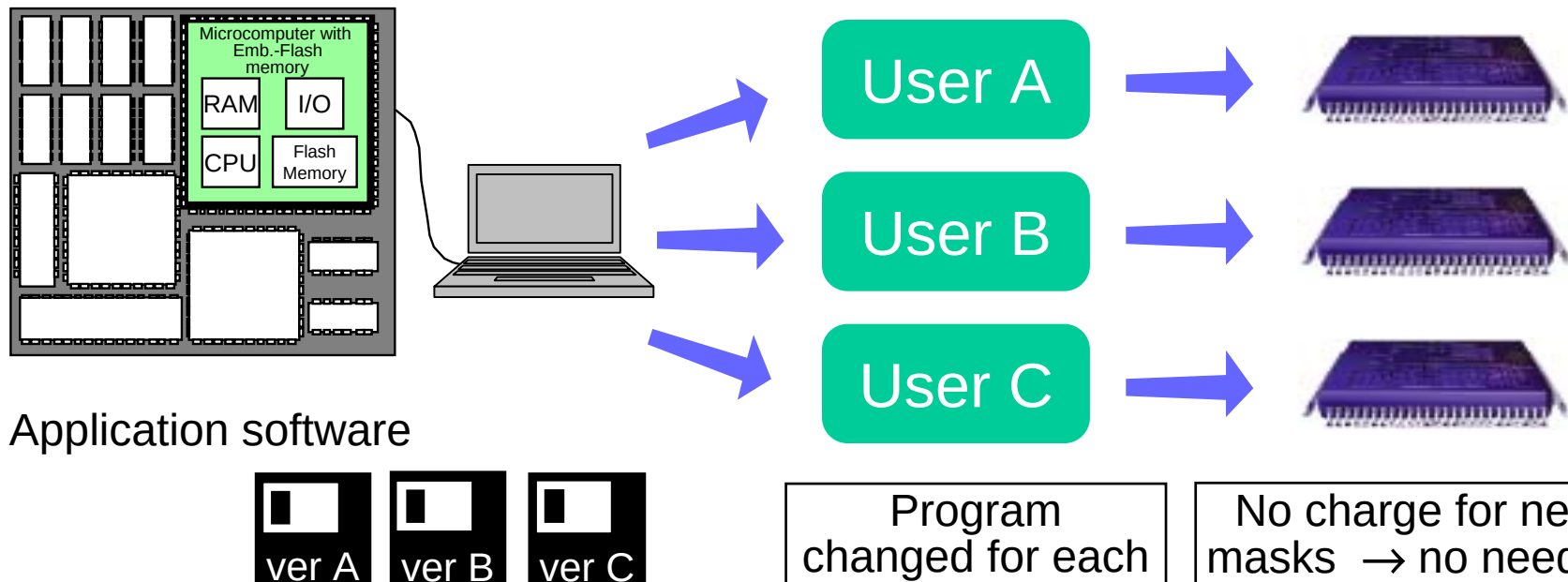


Support for Small Quantity Production (Process Management)

- implement a different software specification for each OEM -

A microcomputer with emb.-flash memory lets you tailor a single device to suit various end-user specifications.

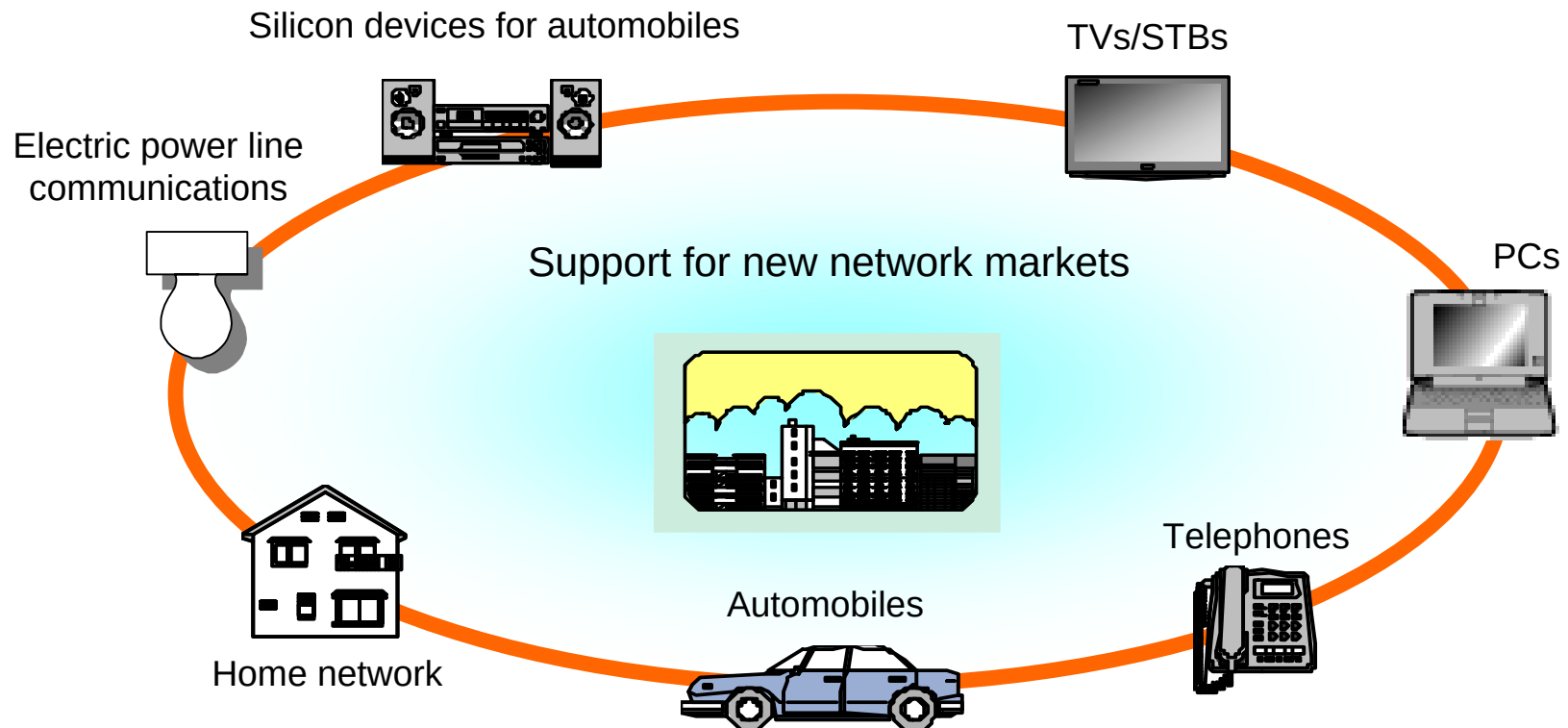
Common system board



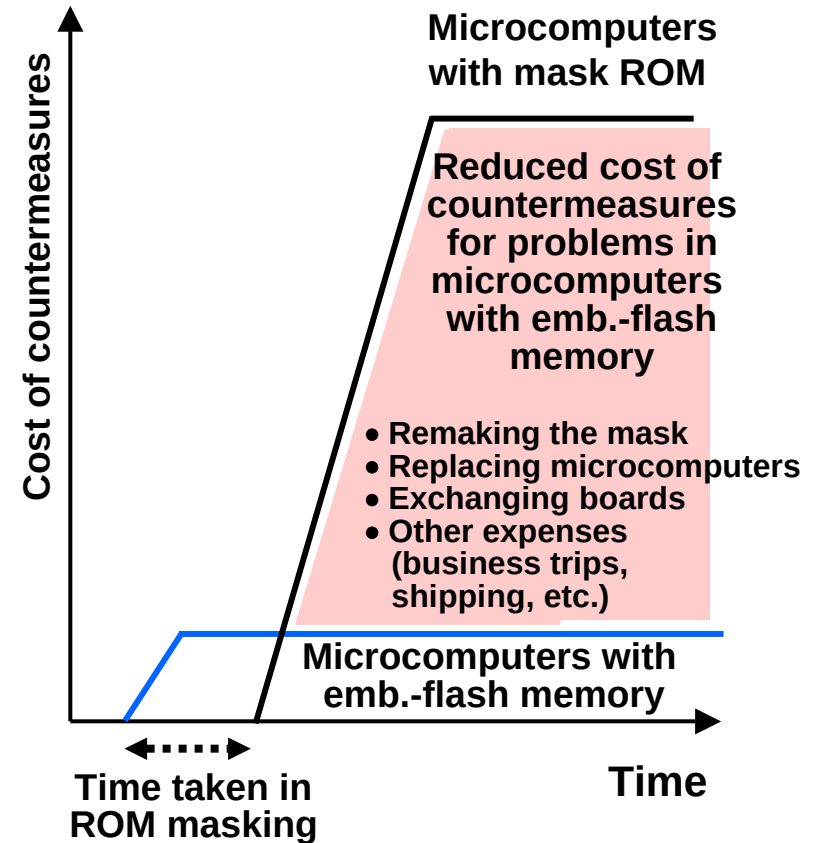
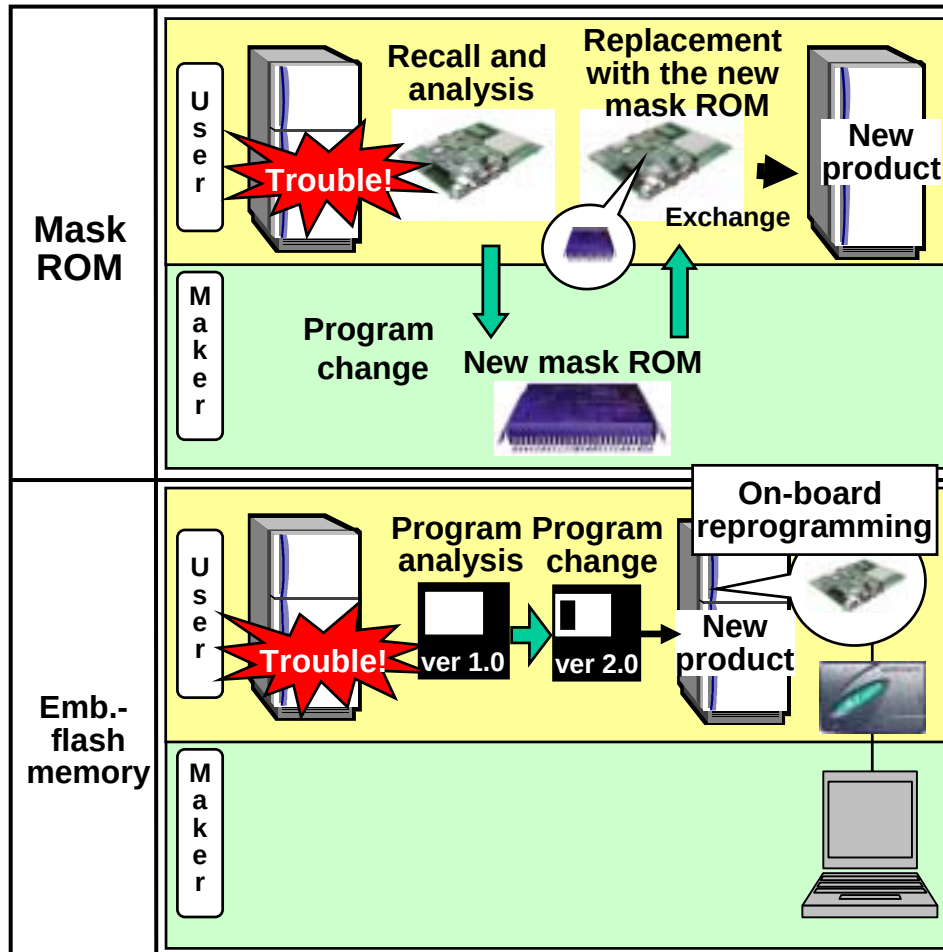
Network Support

Programs can be updated on board via network

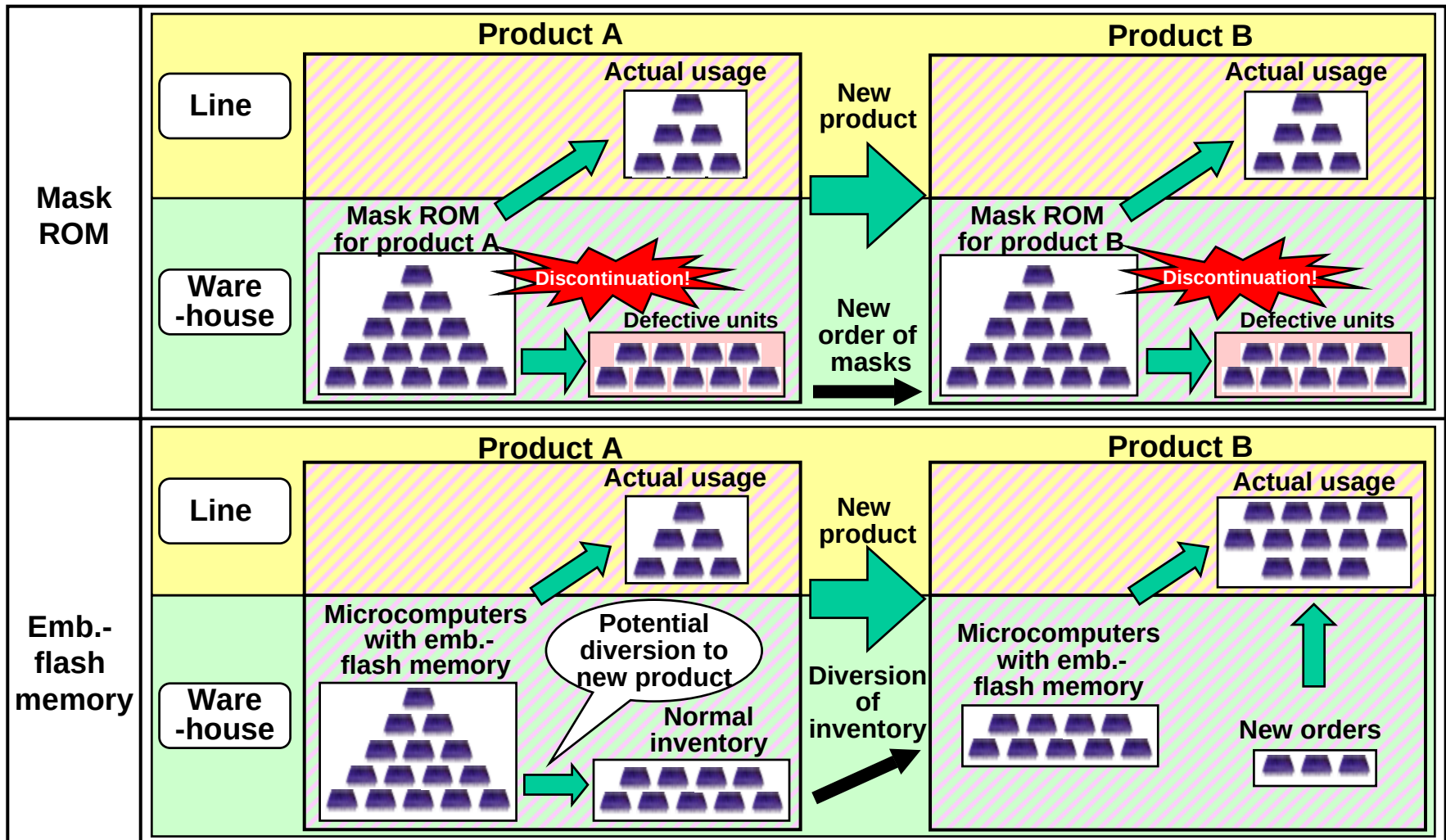
(for greater added value, upgrading of installed software, and add-on software business).



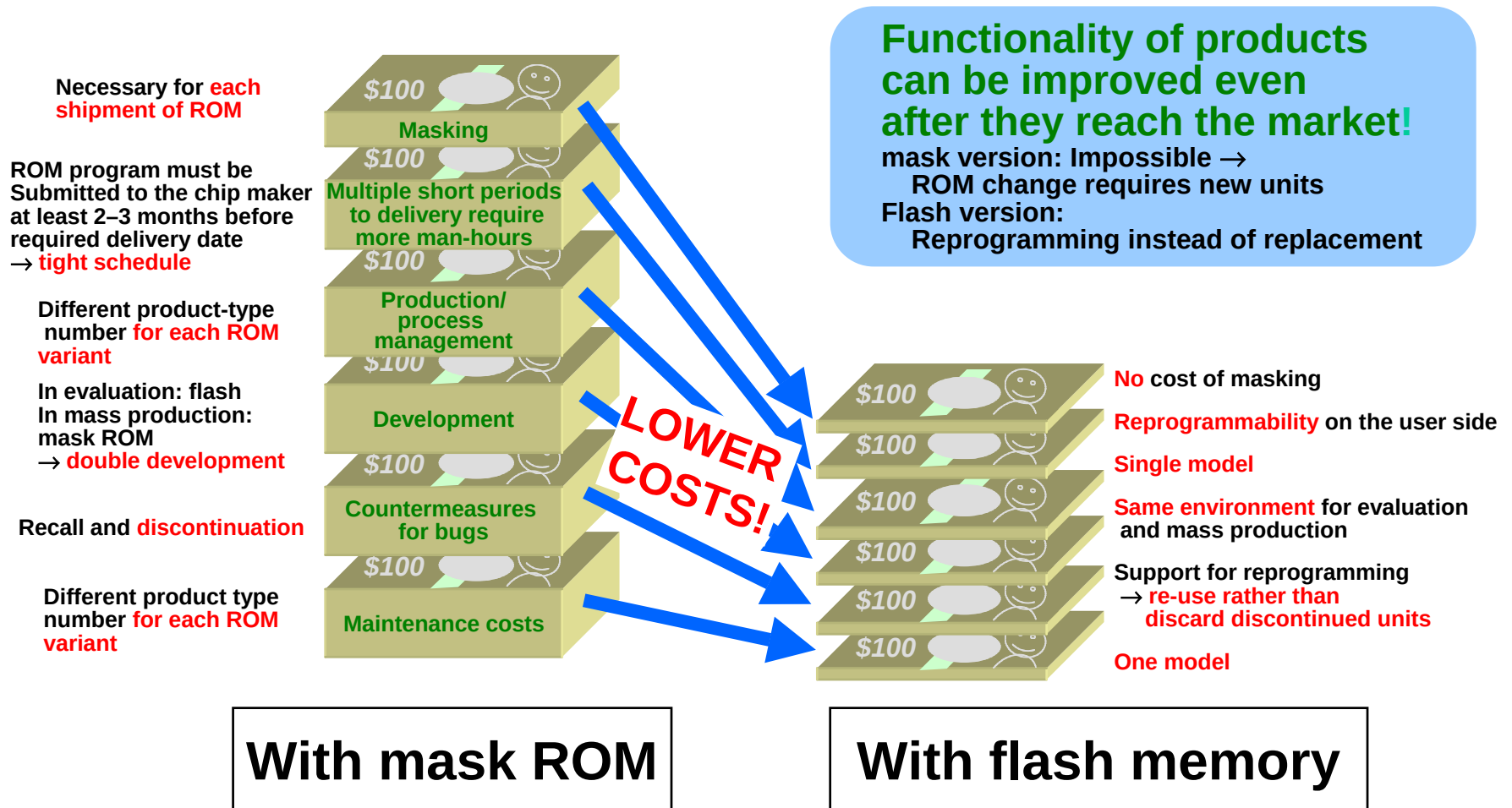
Countermeasures for Problems in Products on the Market



Flow of Inventory



Cost Benefits of Using Microcomputers with Emb.-Flash Memory



Microcomputer General Presentation

SuperH RISC engine Family

October 28, 2005

Rev.2.00

Standard Product Business Group
Renesas Technology Corp

What is the SuperH?



- New Generation RISC for Better Cost Performance -

Microcomputer Needs

Solution by SuperH RISC engine

Higher performance

- Most instructions can be executed in one clock cycle, a result of the RISC architecture
- Multiplication capability similar to DSP

Compact system

- High programming efficiency with 16-bit fixed-length instruction set
- Memory and peripheral functions integrated in one chip
- Bus interface supports direct connection to peripheral devices

Lower power requirements

- Low-voltage operation (MIPS/W)
- Low-power mode

More efficient development

- Optimized C compiler
- Integrated development environment centered on C

CPU Performance (Dhrystone)^{Note}

SuperH
RISC engine

H8S/2000
(20 MHz)

SH-1
(20 MHz)

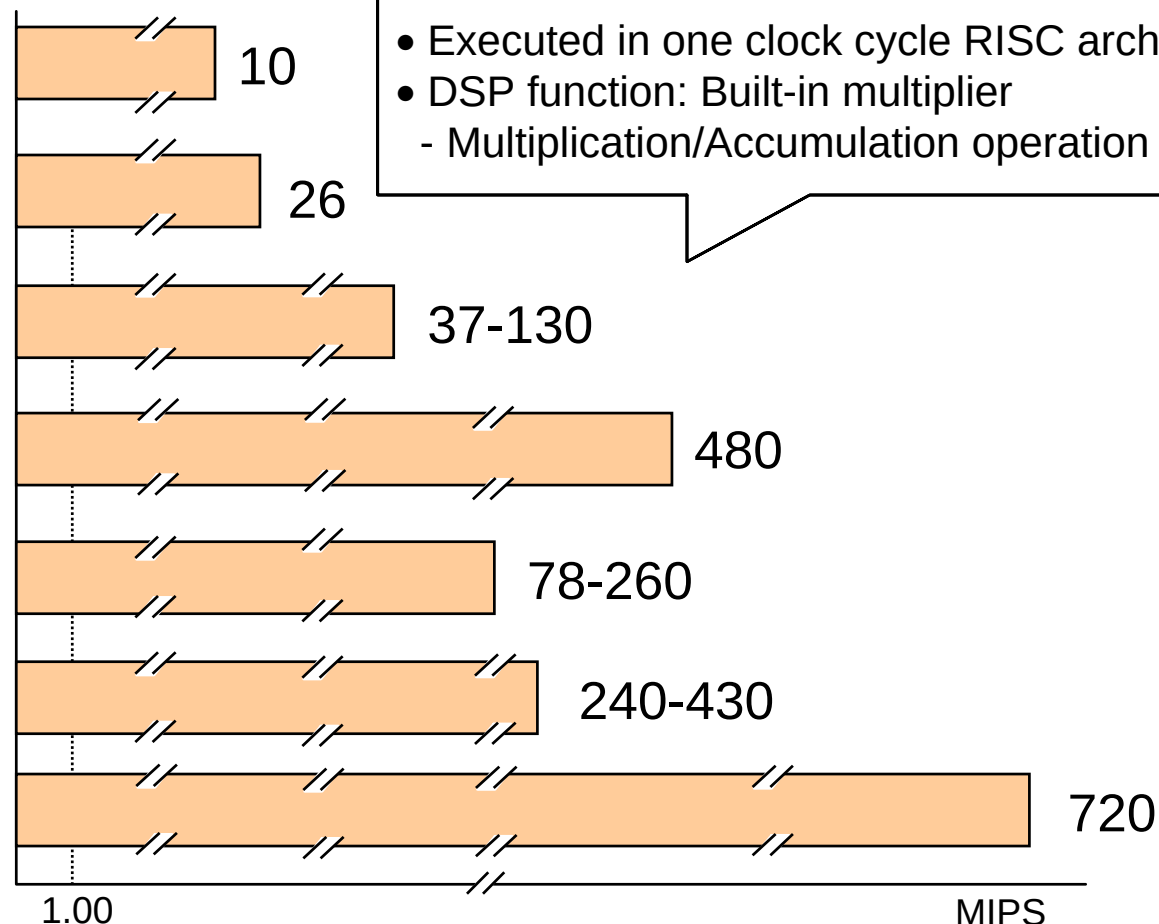
SH-2/SH2-DSP
(28.7-100 MHz)

SH-2A
(200 MHz)

SH-3/SH3-DSP
(60-200 MHz)

SH-4
(133-240 MHz)

SH-4A
(400 MHz)



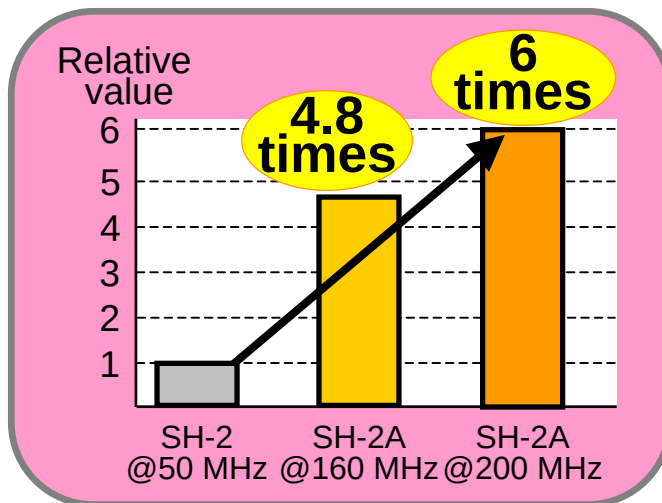
- Executed in one clock cycle RISC architecture
- DSP function: Built-in multiplier
- Multiplication/Accumulation operation

Note: This is a benchmarks for measuring the integer calculating performance of a processor.
It is shown in MIPS, relative to the 1 MIPS performance of a VAX-11/780.
The source is written in C.

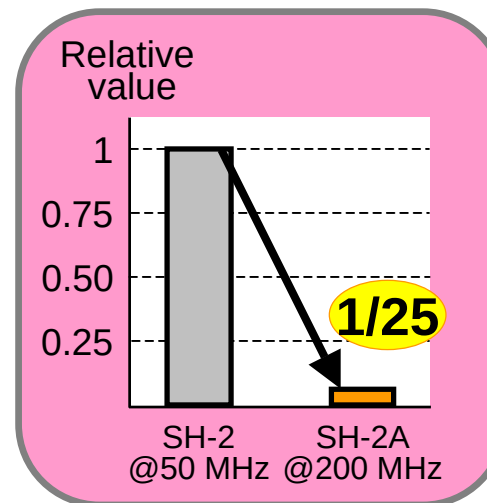
SH-2A Performance

SuperH
RISC engine

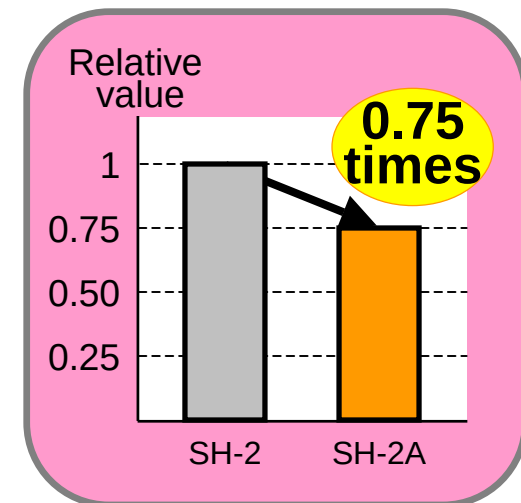
- Execution performance
 - Execution performance per 1 MHz is more than 1.5 times better than that of the SH-2.
 - Interrupt response time
 - Faster response to interrupts: 6 cycles for the SH-2A vs. 37 cycles for the SH-2.
 - Object-file size
 - Object files generated from C source code are only 75% as large as those for the SH-2.
- *Applies when version 5 of the C compiler is in use.



• Execution performance



• Interrupt response time



• Object-file size

Pipeline Operation

_PROC7

MOV #2, R0

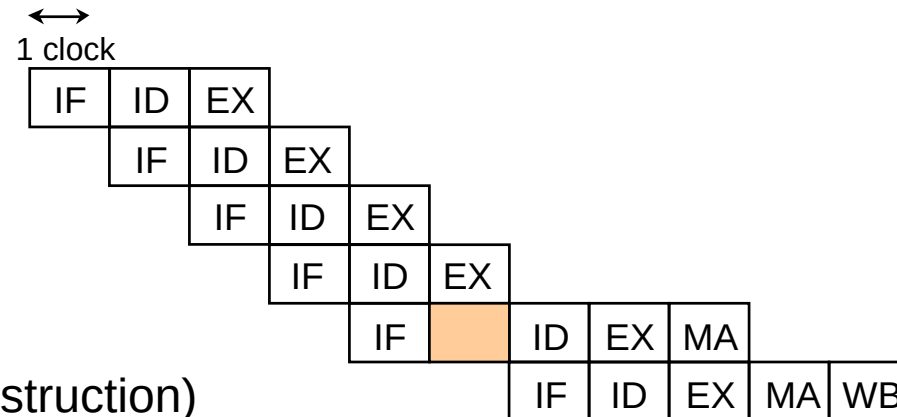
ADD R4, R0

ADD R5, R0

RTS

MOV.L R0, @R6

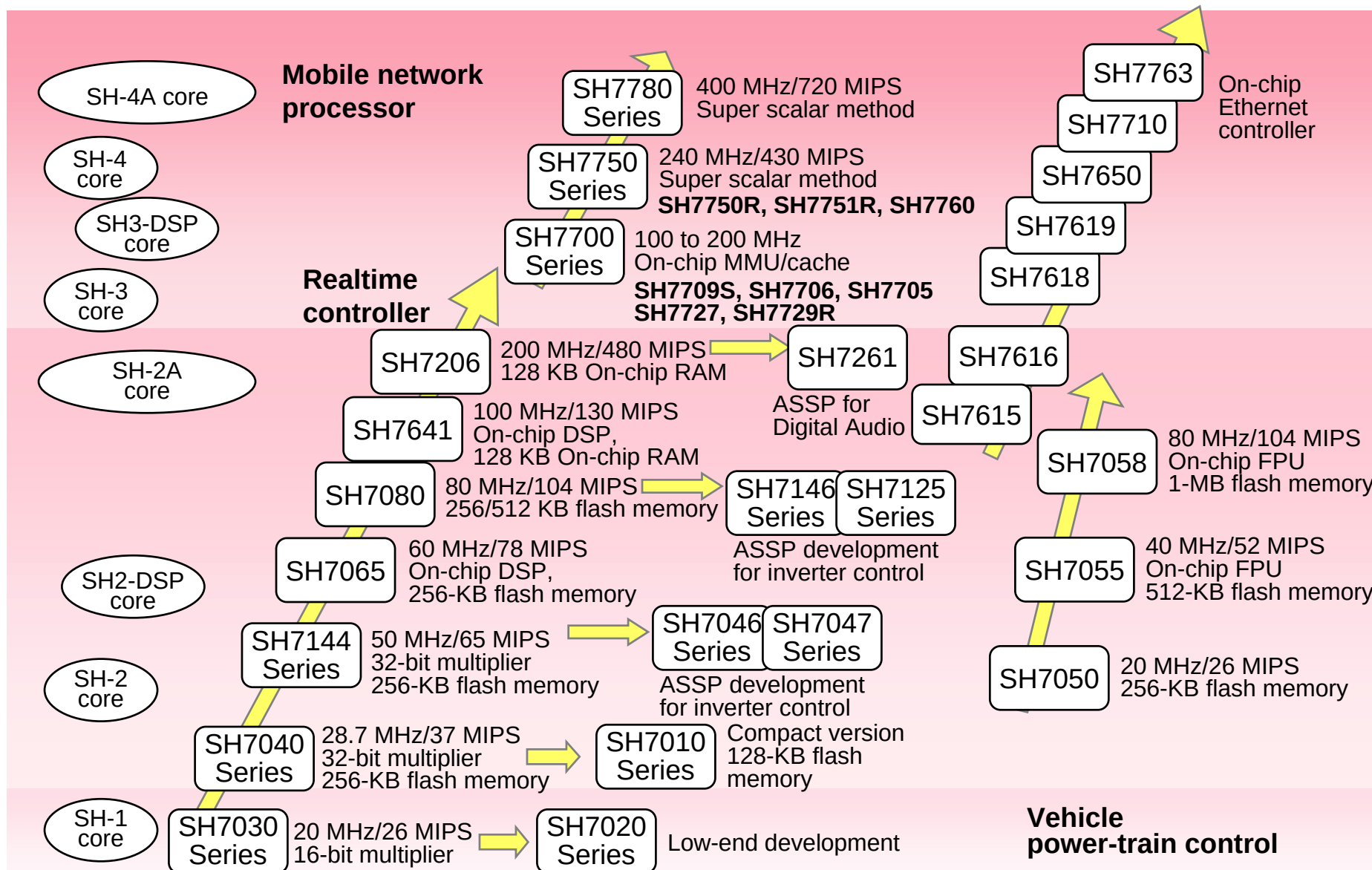
(Return destination instruction)



IF	: Instruction fetch (fetches an instruction from the memory)
ID	: Decode (decodes the instruction)
EX	: Execution/address calculation (data operation/address calculation)
MA	: Memory access (accesses data to the memory)
WB	: Write back (stores the result of memory access to a register)

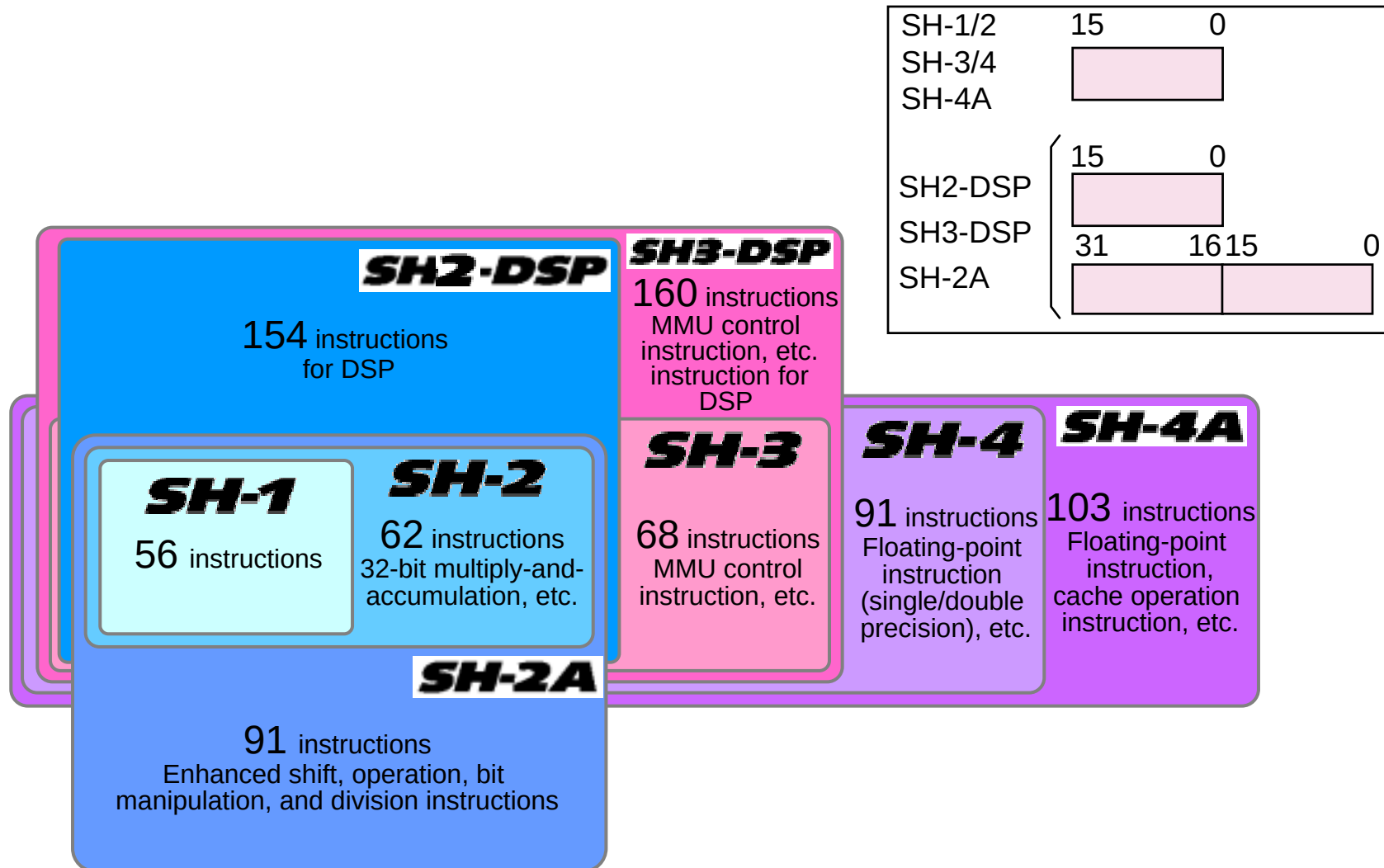
SuperH RISC engine Road Map

SuperH
RISC engine



SuperH Instruction System

SuperH
RISC engine



Achievement of Low-Power Consumption

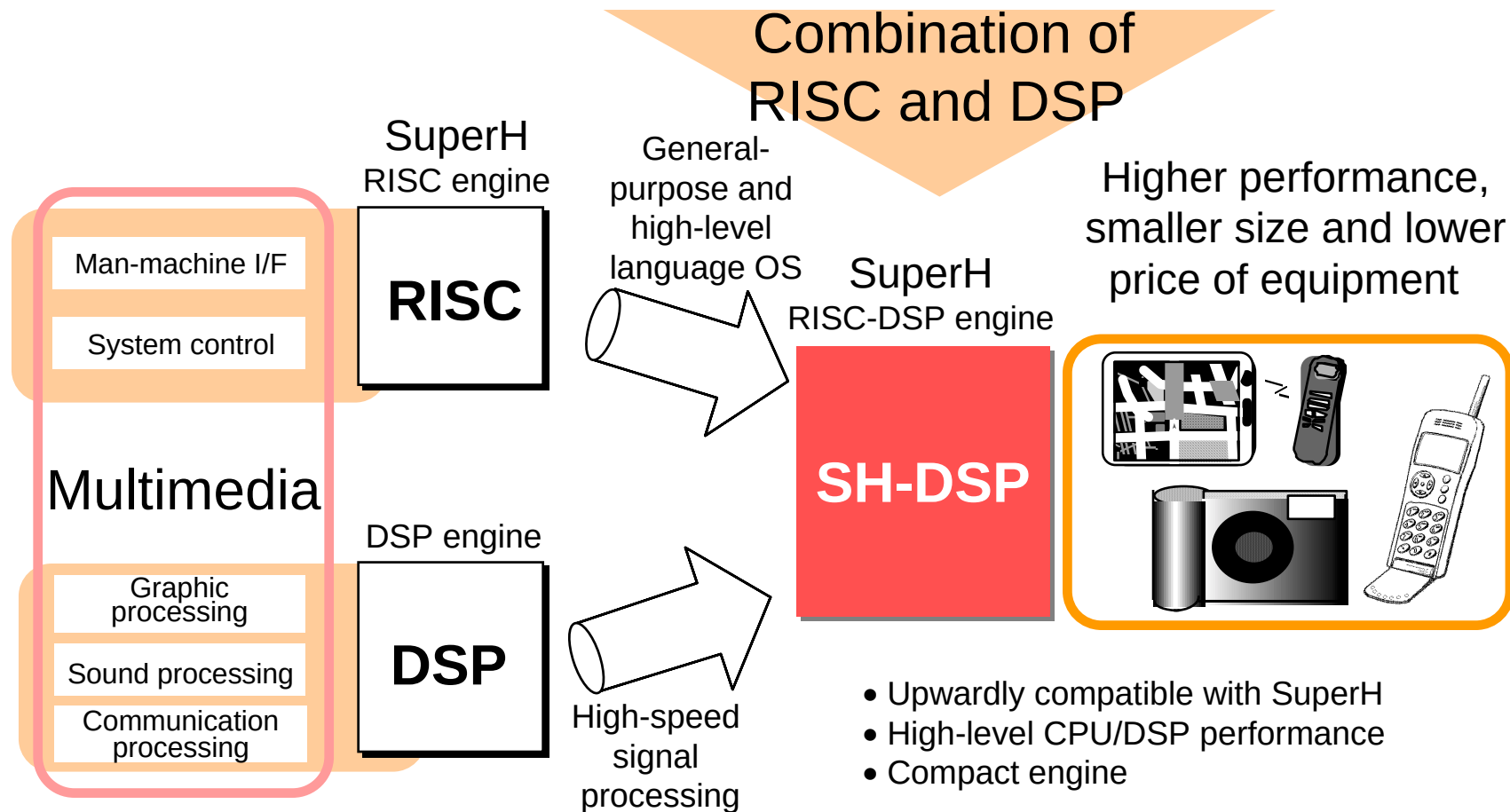


	SH7034B	SH7618	SH7709S	SH7705	SH7750R	SH7206
Operating frequency (MHz)	20	100	133	133	200	200
Current* consumption (mA)	35	100 (Internal)	250 (Internal)	133 (Internal)	190 (Internal)	150
Power* consumption (mW)	115	150	450	200	285	188

*: Calculated from typical values.

SH-DSP Development Concepts

SuperH
RISC engine



Features of SH-DSP



DSP features

- Harvard architecture
 - Multiplication/accumulation in one cycle
- Repeat function
 - Repeat processing without overheads
- 16-bit/32-bit instruction code length
 - DSP instructions that enable parallel operation
- Modulo addressing
 - Effective filter processing

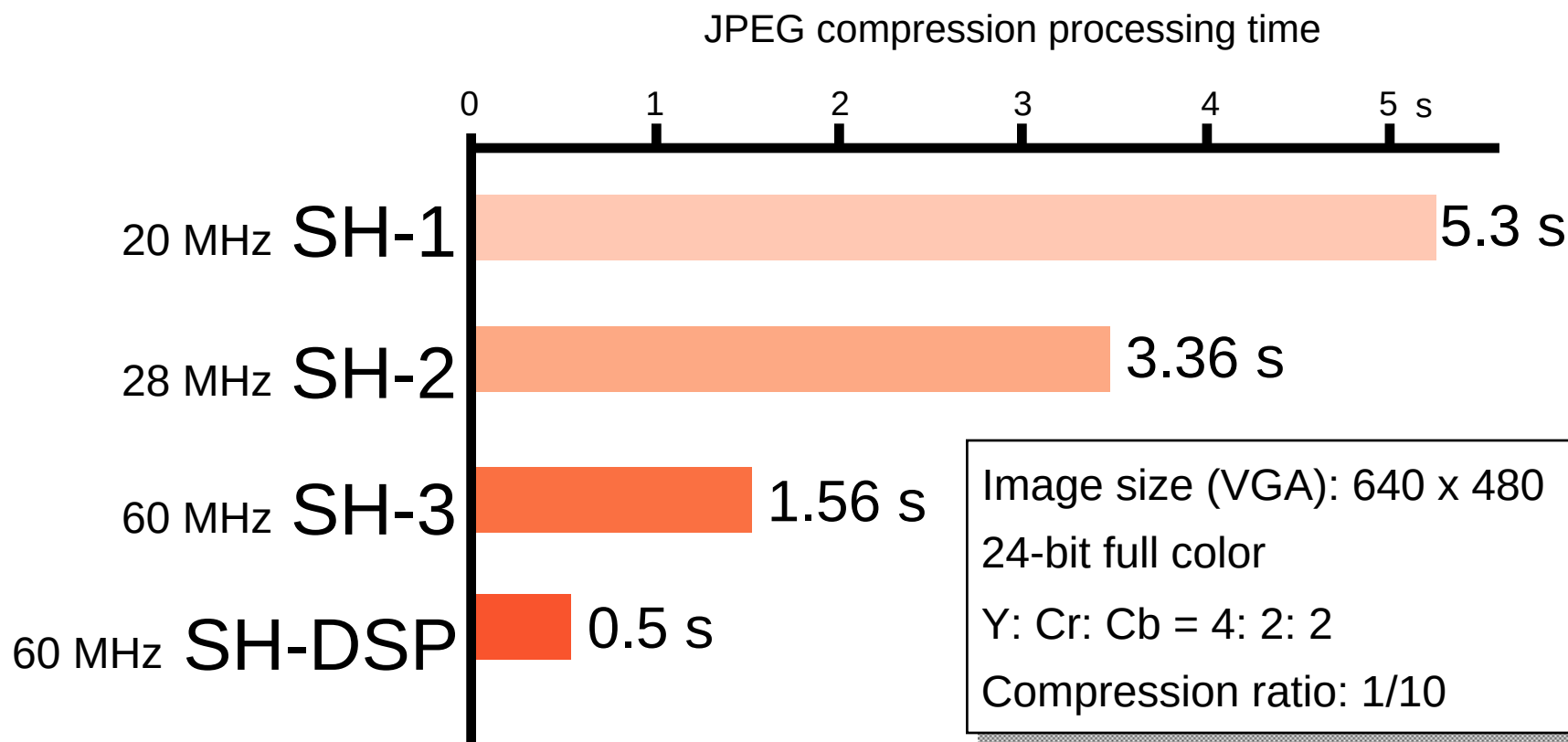
CPU features

- Software of SH-1, SH-2, or SH-3 is upwardly compatible at the object level
 - 60 to 133 MHz operation

Signal Processing Performance of SH-DSP

SuperH
RISC engine

JPEG image compression/expansion processing performance:
10 times higher than SH-1, 3 times higher than SH-3

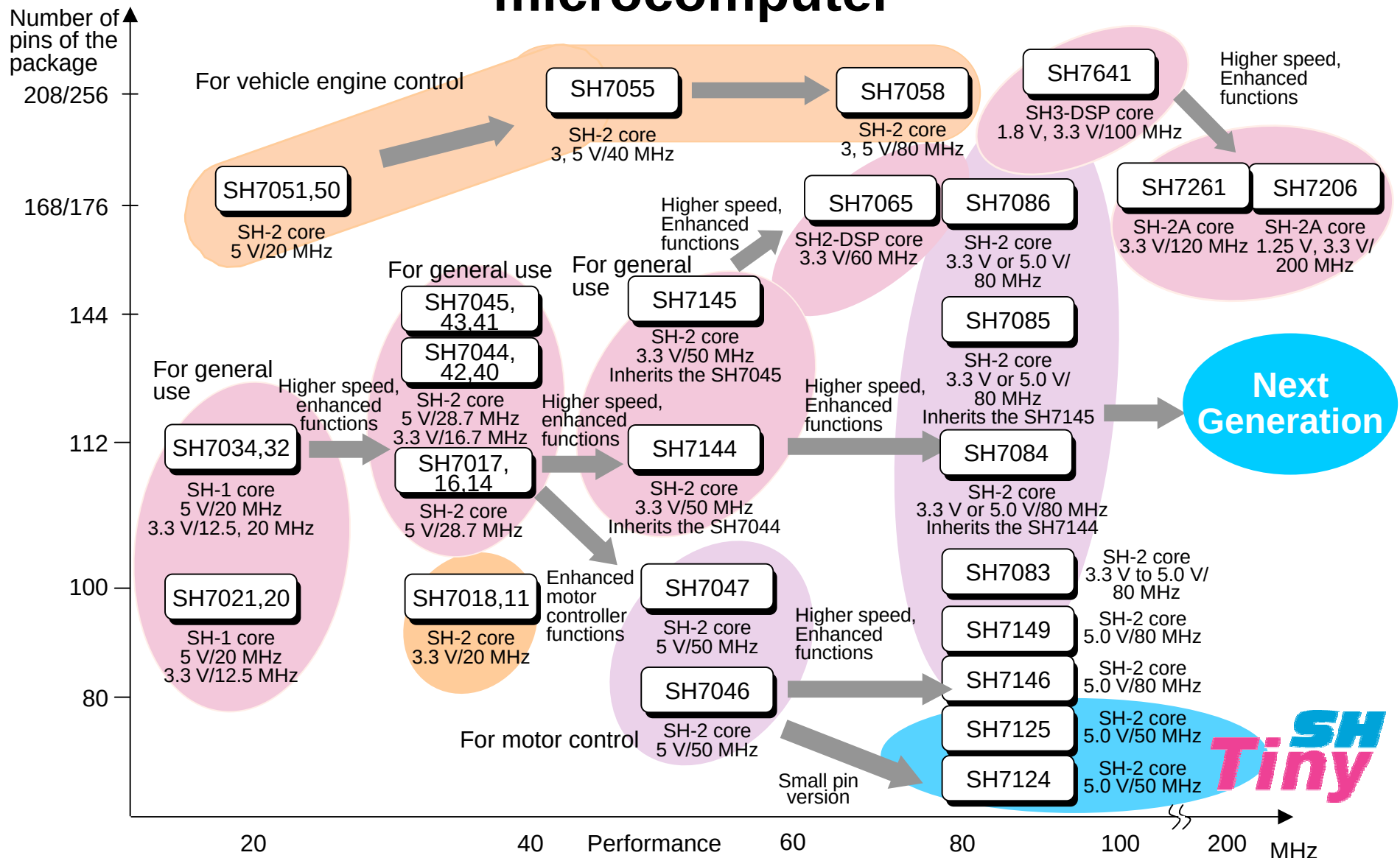


Controller Type

SH7125 Series	SH7010 Series	SH7200 Series
SH7144 Series	SH7020 Series	SH7641 Series
SH7146 Series	SH7030 Series	SH7080 Series
SH7046 Series	SH7050 Series	
SH7040 Series	SH7060 Series	

Roadmap of controller type microcomputer

SuperH
RISC engine



Functions and Features of SH7206

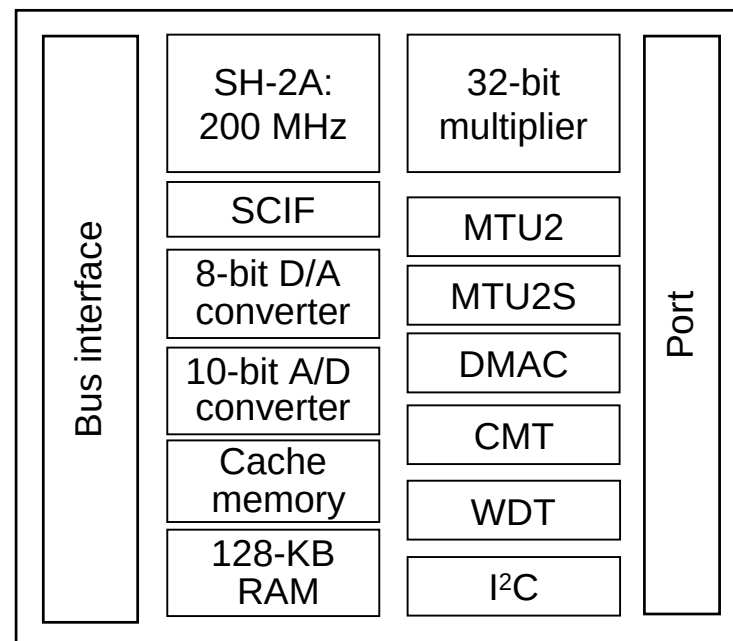


- High-performance SH-2A CPU core
 - Equivalent to SH-4 → 480 MIPS @ 200 MHz
 - Faster response to interrupts → internal register banks
- Low-power consumption and high performance: 2560 MIP software
- Large-capacity RAM: 128-KB/200-MHz access
- On-chip data/instruction separation cache: Total 16 KB
- Abundant bus interface
 - SDRAM I/F, PCMCIA
 - Burst ROM I/F, etc.
- On-chip peripheral functions for real time control
 - Multi-functional timer: 16 bits x 11 ch, motor control
 - Various analog input/output: 10-bit A/D converter, 8-bit D/A converter

Overview of the SH7206

- CPU core
 - SH-2A (SuperH RISC engine)
 - 32-bit on-chip multiplier (32 bits $\times$ 32 bits $\rightarrow$ 64 bits)
 - Harvard architecture
- Operating frequency
 - CPU clock: 200 MHz (max.)
 - Bus clock: 66 MHz (max.)
 - Peripheral clock: 33 MHz (max.)
 - Clock dedicated for the MTU2S: 100 MHz (max.)
- Power supply voltage
 - 3.0 to 3.6 V and 1.15 to 1.35 V (analog power supply: 3.0 to 3.6 V)
- Internal memory
 - 32 K-bit RAM $\times$ 4 mat: a total of 128 Kbytes
 - Instruction cache: 8 Kbytes
 - Operand cache: 8 Kbytes
- External memory interface
 - SRAM, byte selectable SRAM, multiplexed I/O, PCMCIA, burst ROM
 - External bus width: selectable from 8 bits, 16 bits, or 32 bits
 - External memory spaces can be divided into 9 spaces (576 Mbytes at maximum)
- On-chip functions
 - Multifunctional 16-bit PWM timer: 6 ch (MTU2) and 3 ch (MTU2S)
 - Port output enable (POE): 9 ch
 - 16-bit cycle timer: 2 ch
 - Watchdog timer (WDT): 1 ch
 - I²C bus interface: 1 ch

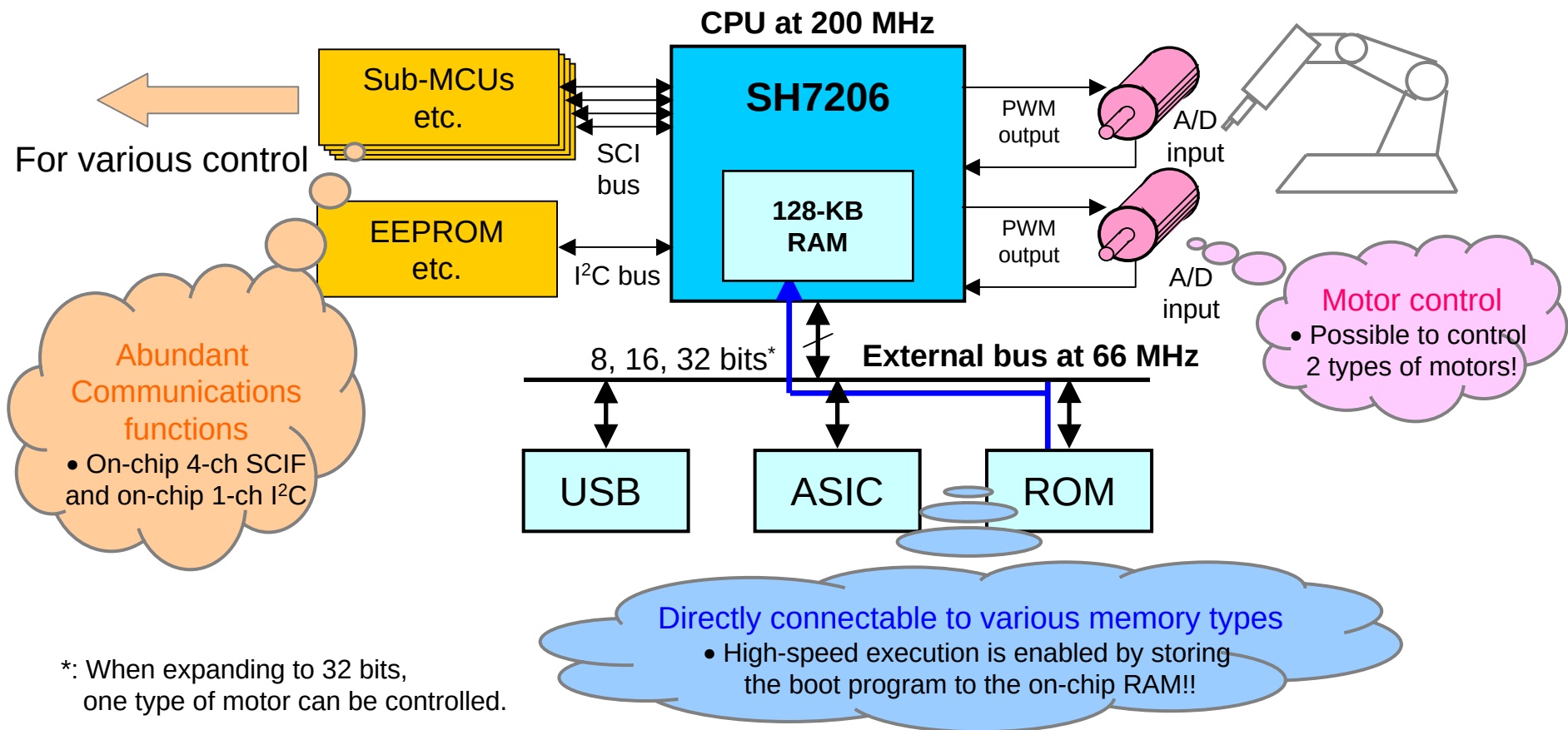
- On-chip functions
 - DMA controller: 8 ch
 - 10-bit A/D converter: 4 ch $\times$ 2
 - 8-bit D/A converter: 2 ch
 - SCIF: 4 ch (16-stage built-in FIFO for transmit and receive operations)
 - I/O port: 81 ch
 - External interrupt pins: 17
 - JTAG interface



Package: LQFP-176 (24 mm square, 0.5-mm pitch)

Example: AC Servo System Configuration Using SH7206

- Achieves maximum CPU performance by having programs resident in internal RAM.
- On-chip cache improves the performance of externally installed programs.
- Abundant functions such as three-phase PWM output timer, 10-bit A/D converter, and more.



- Incorporates high-performance SH-2A core
 - CPU performance equivalent to the SH-4 → 288 MIPS@120 MHz
 - High-speed response to interrupt processing → On-chip register bank
- On-chip double-precision FPU
 - Realizes signal processing performance higher than the DSP
 - Enhances software development by the FPU
(eliminates digit alignment processing)
- Abundant interfaces such as CAN, SSI, and I²C-bus
- Rich set of bus interface
 - SDRAM interface
 - Burst ROM interface, etc.
- Internal peripheral functions for realtime control
 - Many on-chip timers: 16 bits x 11 ch, motor control is possible
 - Ample analog input/output 10-bit AD converter, 8-bit D/A converter

Overview of the SH7261

SuperH
 RISC engine

 Under
 Development

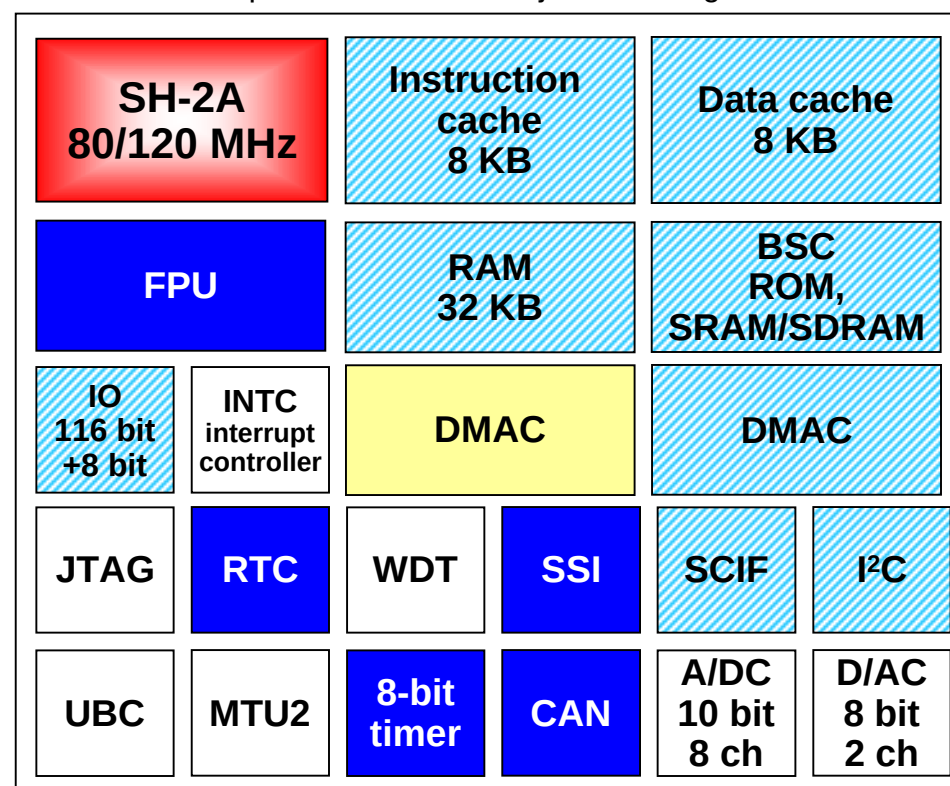
- CPU core
 - SH-2A (SuperH RISC engine)
 - 32-bit multiplier (32 bits x 32 bits → 64 bits)
 - Harvard architecture
- Operating frequency

	General Spec.	Automotive Spec.
- CPU clock:	120 MHz (max)	80 MHz (max)
- Bus clock:	60 MHz (max)	60 MHz (max)
- Peripheral clock:	40 MHz (max)	40 MHz (max)
- Power-supply voltage
 - 3.0 to 3.6 V
- Internal memory
 - RAM: 32 KB
 - Instruction cache: 8 KB
 - Operand cache: 8 KB
- External memory interface
 - SRAM, SDRAM interface
 - External bus width is selectable from 8, 16 bits or 32 bits
 - External memory spaces can be divided into 7 areas (64 MB max.)
- Internal functions
 - Multi-functional 16-bit PWM timer: 6 ch (MTU2)
 - 8-bit timer (waveform output): 2 ch
 - Watchdog timer: 1 ch
 - CAN interface: 2 ch (2.0A, 2.0B)
 - I²C bus interface: 3 ch
 - DMA controller: 8 ch (includes 4 ch for external requests)
 - 10-bit A/D converter: 4 ch x 2
 - 8-bit D/A converter: 2 ch
 - SCIF: 8 ch
(16-stage transmit/receive FIFO included)
 - SSI: 2 ch
 - CD-ROM decoder (Mode0, 1/2, 2 Form1/2, Form2)

- I/O port: I/O: 116ch, Input: 8 ch
- External interrupt pin: 17 ch
- JTAG interface

- Package
 - 176-pin LQFP (24-mm square, 0.5-mm pitch)

*Specifications are subject to change.



- Functions newly added to the SH7206
- Functions changed from the SH7206

Development Concepts of SH7080 Series



Various features to achieve high-end embedded systems

Usage : Printers, DVD recorders, fax machines, AC servo motors, and inverters for industrial use.

Feature 1 With on-chip high-speed flash memory and 80-MHz/104-MIPS high-performance CPU arithmetic operation

Achieves high-performance control

Feature 2 Upper model of SH7040/7144 Series and 3.3-V or 5-V single-power supply

No need of external regulators

Feature 3 Bus extension function and improved PWM timer, high-speed A/D converter (2.5 μ s/ch)

Peripheral functions suitable for machine and system controls

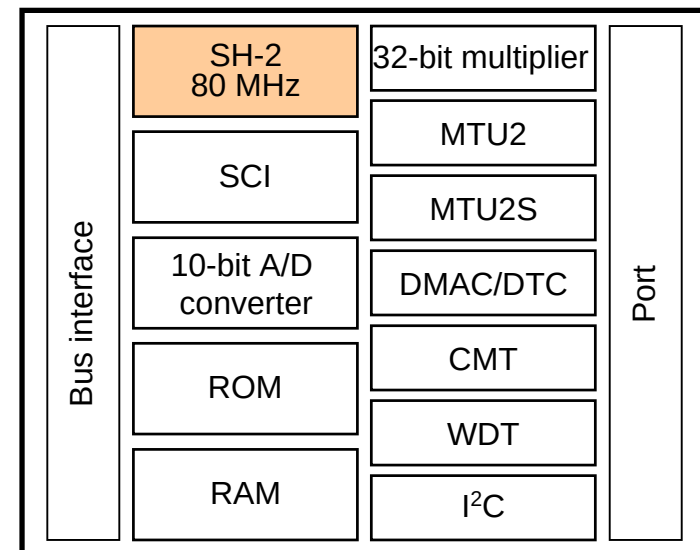
Feature 4 On-chip debugging function, full spec. ICE, and JTAG-ICE are available.

Reasonable development tools

Overview of the SH7080



- CPU Core
 - SH-2 (SuperH RISC engine)
 - 32-bit multiplier (32 bits x 32 bits → 64 bits)
- Operating Frequency
 - CPU clock: 80 MHz (max.)
 - External bus clock: 40 MHz (max.)
 - Peripheral clock: 40 MHz (max.)
 - Clock dedicated for MTU2S: 80 MHz (max.)
- Power Supply
 - 3.3 ± 0.3 V or 5.0 ± 0.5 V (5.0 ± 0.5 V for analog supply)
- Internal Memory (Flash memory/RAM)
 - SH7083/7084/7085: 256 KB/16 KB
 - SH7085/7086: 512 KB/32 KB
- External Memory Interface
 - SRAM, SRAM with byte selection, multiplex I/O
 - SDRAM, PCMCIA, burst ROM (3.3-V version only)
- Internal Functions
 - Multi-function 16-bit PWM timer: 6 ch (MTU2), 3 ch (MTU2S)
 - Port output enable (POE)
 - 16-bit cyclic timer: 2 ch
 - Watchdog timer: 1 ch
 - I²C bus interface: 1 ch
 - Synchronous serial interface unit: 1 ch
 - DMA controller: 4 ch
 - DTC (simple DMA controller): 34 ch or more
- Internal Functions
 - High-speed 10-bit A/D converter:
 - 4 ch x 2 (SH7083/84/85)
 - 4 ch x 2 + 8 ch (SH7086)
 - SCI: 4 ch (1 ch for 16-stage transmit and receive FIFO)
 - I/O port: 73 ch (SH7083), 84 ch (SH7084)
108 ch (SH7085), 134 ch (SH7086)
 - External interrupt pins: 9 ch
 - JTAG interface
- Packages
 - TQFP1414-100 (SH7083)
 - LQFP2020-112 (SH7084)
 - LQFP2020-144 (SH7085)
 - LQFP2424-176 (SH7086)



Development Concepts of SH7146 Series



Various features suitable for high-performance motor control.

Usage : Invertors for consumer electronics such as air-conditioning outside equipment and washing machine, invertors for general use, and devices for industrial use.

Feature 1 80-MHz and 104-MIPS high-performance CPU arithmetic operation

Achieves vector and PAM controls in a single chip

Feature 2 Enhanced usability by 5-V single power supply

Realizes one-shunt vector control. Controls fan motor and compressor in a single chip

Feature 3 Improved two-way PWM timers
Three high-speed A/D converters (2.5 μ s/ch)

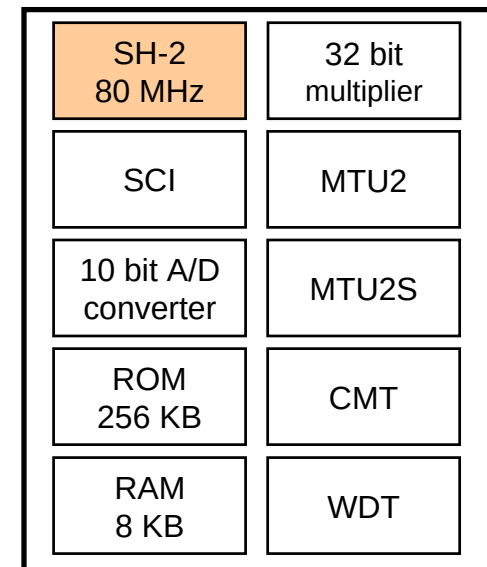
Feature 4 New on-chip debugging functions:
Full spec. ICE and JTAG-ICE

Reasonable development tools

SH7146 Series Overview



- CPU Core
 - SH-2 (SuperH RISC engine)
 - 32-bit multiplier
(32 bits x 32 bits → 64 bits)
- Operating Frequency
 - CPU clock: 80 MHz (max.)
 - Bus clock: 40 MHz (max.)
 - Peripheral clock: 40 MHz (max.)
 - Clock dedicated for MTU2S: 80 MHz (max.)
- Power Supply
 - 5.0 V $\pm$ 0.5 V
- Internal Memory
 - Flash memory: 256 KB
 - Internal RAM: 8 KB
- External Memory Interface (SH7149 only)
 - 8-/16-bit external bus, SRAM I/F
- Internal Functions
 - Multi-functional 16-bit PWM timer: 6 ch (MTU2), 3 ch (MTU2S)
 - Port output enable (POE): 9 ch
 - Watchdog timer: 1 ch
- Internal Functions
 - High-speed 10-bit A/D converter: 2 ch x 2 + 8 ch (total 12 ch)
 - SCI: 3 ch
 - I/O ports: 57 ch (SH7146)
 - 75 ch (SH7149)
 - External interrupt pins: 5 ch
 - JTAG interface
- Packages
 - 80-pin LQFP (14 mm square, 0.65-mm pitch) (SH7146)
 - 100-pin LQFP (14 mm square, 0.5-mm pitch) (SH7149)



Development Concept of SH7125 Series



Various features to realize small high-performance motor control system.

Usage : Invertors for consumer electronics such as refrigerators and vacuum cleaners, and motor control devices such as pumps, fans, and compressors.

Feature 1 32-bit RISC-engine microcomputer in a small package: 64 pins/48 pins

Feature 2 50-MHz and 65-MIPS high-performance CPU arithmetic operation

Feature 3 Improved PWM timers:
Two high-speed A/D converters (2 μ s/ch)

Feature 4 On-chip debugging functions:
Full spec. ICE and JTAG-ICE

Much higher-performance of CPU compared to that of 8-bit/16-bit CPU

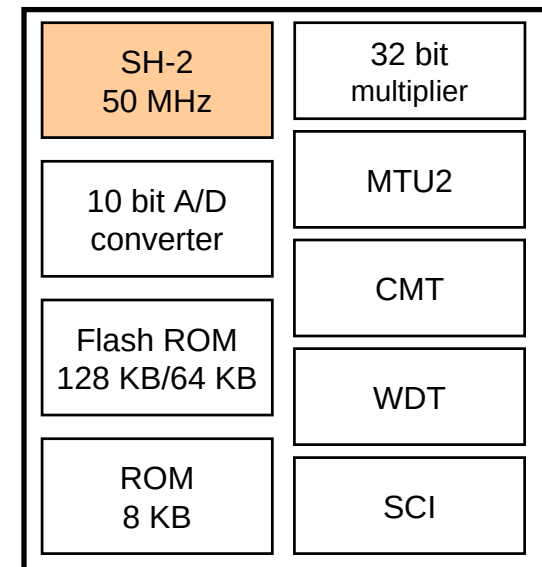
Achieves one-shunt vector control

Reasonable development tools

SH7125 Series Overview



- CPU Core
 - SH-2 (SuperH RISC engine)
 - 32-bit multiplier
(32 bits x 32 bits → 64 bits)
- Operating Frequency
 - CPU clock and peripheral I/O clock:
50 MHz, 25 MHz or 40 MHz, 40 MHz
- Power Supply Voltage
 - 5.0 V $\pm$ 0.5 V
- Internal Memory (flash memory, RAM)
 - Flash memory: 128 KB/64 KB
 - RAM: 8 KB
- Internal Functions
 - Multi-functional 16-bit PWM timer: 6 ch (MTU2)
 - Port output enable (POE)
 - Watchdog timer: 1 ch
 - High-speed 10-bit A/D converter: 4 ch x 2 (total 8 ch)
 - SCI: 3 ch
 - I/O ports: 33 ch (SH7125) 26 ch (SH7124)
 - External interrupt pins: 4 ch
 - JTAG interface
- Packages
 - 64-pin LQFP-64
(0.5-mm pitch/10 mm square) (SH7125)
 - 64-pin QFP-64A
(0.8-mm pitch/14 mm square) (SH7125)
 - 48-pin LQFP-48
(0.65-mm pitch/10 mm square) (SH7124)



Features of the SH7144 Series



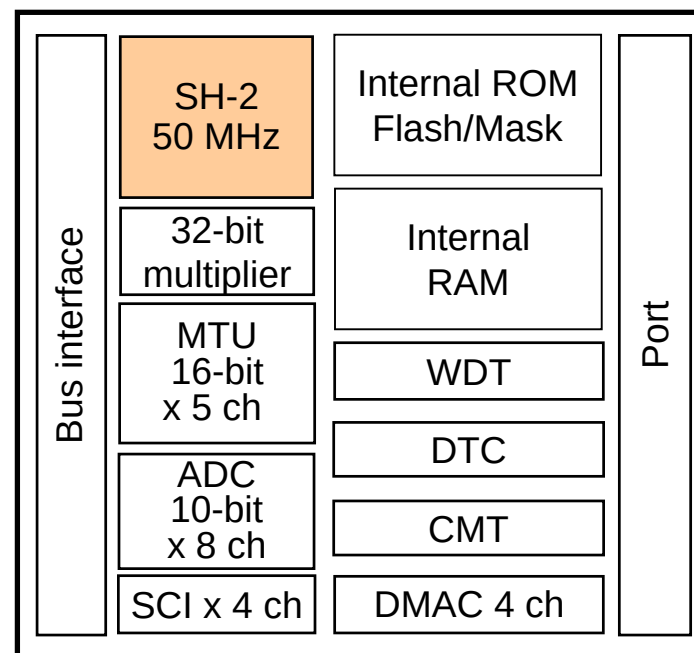
A general-purpose microcomputer with a 256-Kbyte on-chip flash memory -useful for various applications, such as digital home appliances, System controllers for the OA equipment, and industrial use.

- Single-cycle access to ROM at 50 MHz makes a maximum CPU performance of 65-MIPS, possible. This places the product in the industry's highest class.
- Can easily be replaced from the SH7040 Series
- The 4-ch serial I²C bus interface strengthens functionality for communication function with a host and a variety sensors.
- The device is equipped with an on-chip debugging function, providing an inexpensive development environment.

Features

- CPU core
 - SH-2 with an operating frequency of 50 MHz, 3.0 to 3.6 V operation
 - 32-bit multiplier (32 bits x 32 bits → 64 bits)
- Internal memory
 - ROM: 256 Kbytes (Flash/Mask/ROMless)
 - RAM: 8 Kbytes
- Internal functions
 - Multi-functional 16-bit timer (MTU): 5 ch
 - Internal DMAC and DTC
 - External bus: 8/16/32 bits
 - A/D converter: 10 bits, 8 ch (4 ch x 2 units)
 - SCI: 4 ch
 - I²C: 1 ch
- Package
 - QFP-112 (SH7144)/LQFP-144 (SH7145)
- Main areas of application
 - Digital consumer appliances, OA equipment industrial use

SH7144 Series Block Diagram



Features of SH7046 and SH7047



- 32-bit Single-Chip Microcomputer Suitable for Motor Control -

- High-speed CPU with built-in 32-bit multiplier
 - 180° current-carrying sensor-less sine-wave drive by using the vector control
- Ample built-in peripherals suitable for inverter control
 - Two motors can be simultaneously controlled by a single chip using 2-ch built-in timers for inverter control
- 5-V single power supply operation with internal step-down circuit
 - Achieves high tolerance against noise and an easy interface with the driver IC
- Development environment that realizes realtime debugging environment during high-speed operation

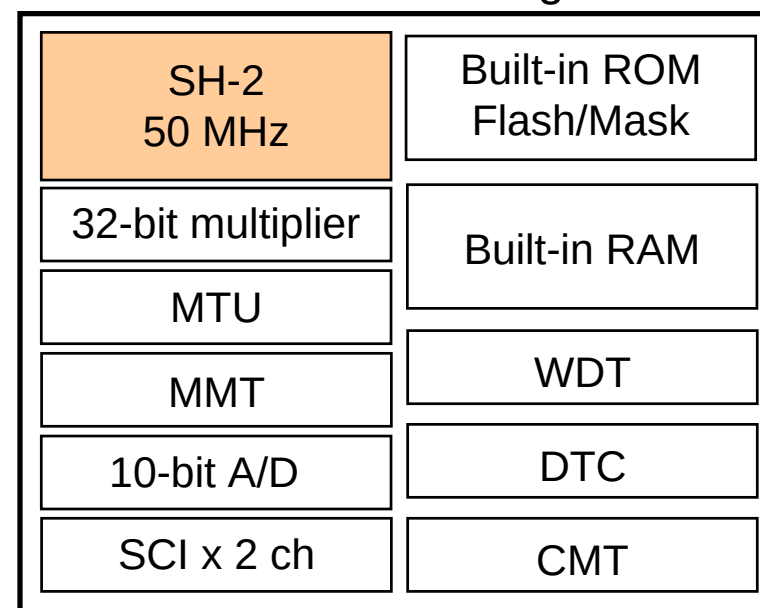
SH7046 Overview

- Single-Chip Microcomputer in a Small Package -

Features

- CPU core
 - SH-2 (Renesas's original SuperH 32-bit RISC)
 - Max. operating frequency: 50 MHz at 4.0- to 5.5-V operation
 - 32-bit multiplier (32 bits x 32 bits → 64 bits)
(The SH7101: 40 MHz)
- Internal functions
 - Powerful 16-bit timer (MTU, MMT)
Enables output of a max. 15-phase PWM waveform
 - Built-in DTC
 - A/D converter: 10 bits, 12 ch (4 ch x 3 units)
 - SCI: 2 ch
SH7101: Without MMT and DTC
8 channel A/D (4 ch x 2 units)
- Main applications
White ware goods with inverters such as air conditioners, washing machines, and refrigerators, and industrial applications such as inverters, AC servos, FA, UPS, and FA sequencers

SH7046 Block Diagram



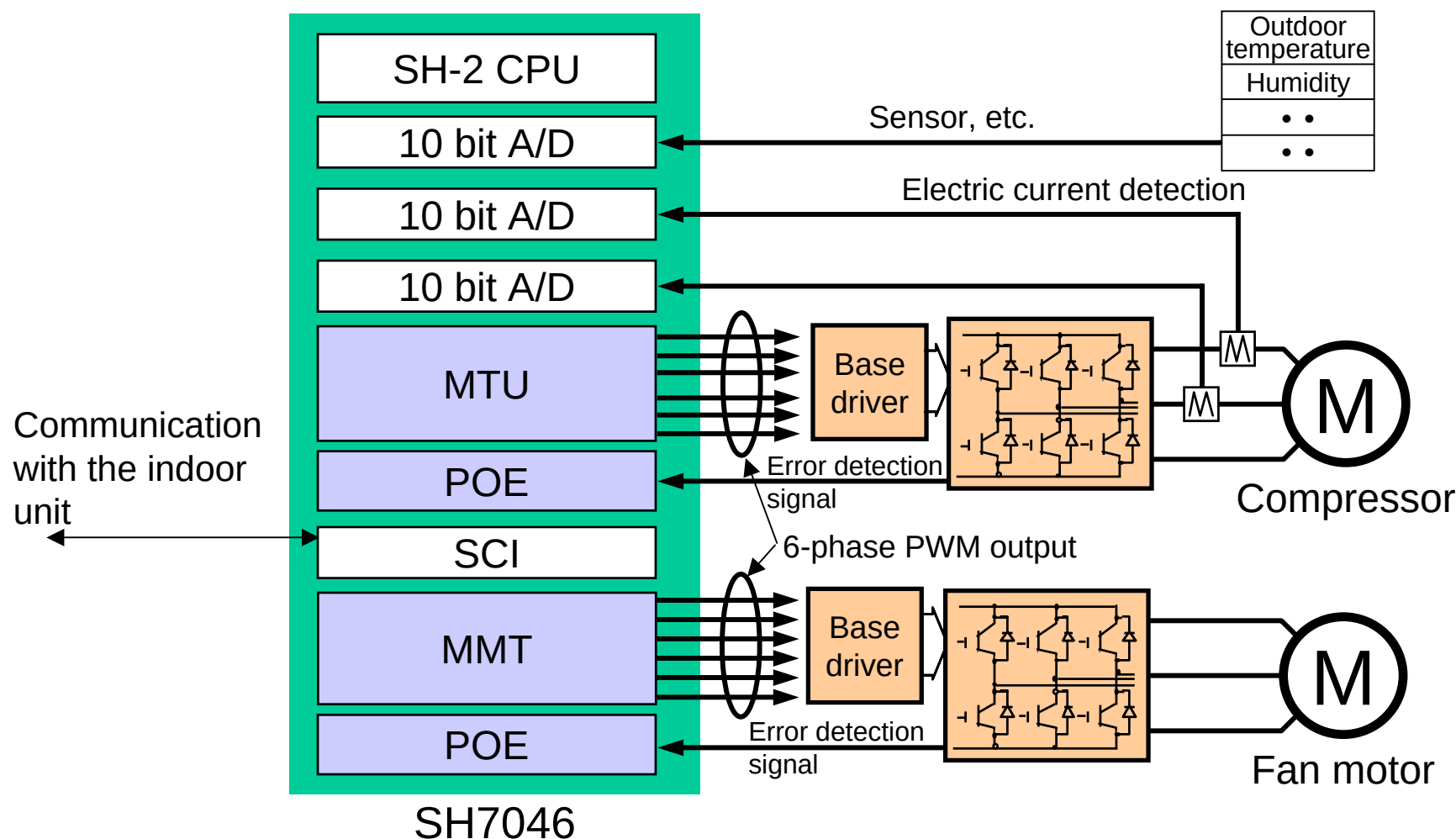
80-pin QFP

	ROM	RAM
SH7046F (Flash Version)	256 KB	12 KB
SH7104 (Mask Version)*	256 KB	8 KB
SH7048 (Mask Version)	128 KB	4 KB
SH7108 (Mask Version)*	128 KB	4 KB
SH7148 (Mask Version)	64 KB	4 KB
SH7106 (Mask Version)*	64 KB	4 KB
SH7101 (Mask Version)**	32 KB	2 KB

*: Without DTC **: Without DTC and MMT

SH7046 Application Example

- Controls the Outdoor Air Conditioner Device with a Single Chip -



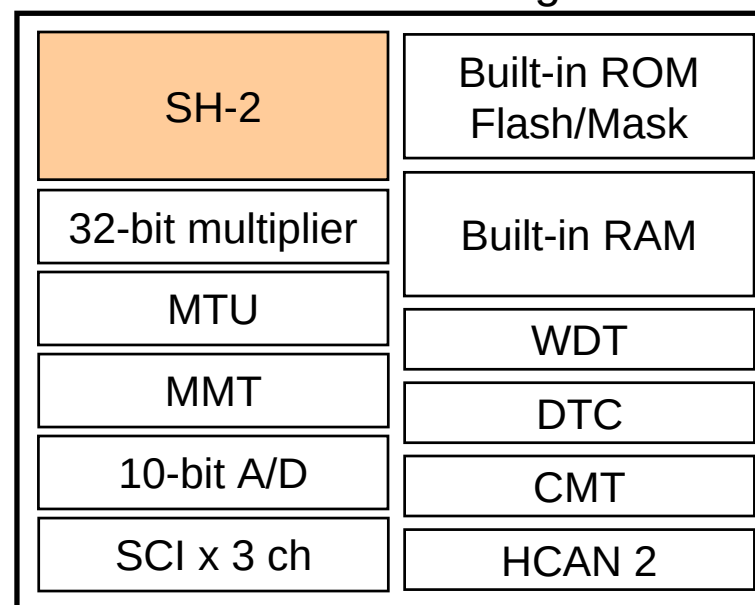
SH7047 Overview

- Microcomputer with a Built-in CAN Bus Interface -

Features

- CPU core
 - SH-2 (Renesas original SuperH 32-bit RISC)
 - Max. operating frequency: 50 to 40 MHz at 4.5 to 5.5-V operation
 - 32-bit multiplier (32 bits x 32 bits → 64 bits)
- Internal functions
 - Powerful 16-bit timer (MTU, MMT)
Enables output of a max. 15-phase PWM waveform
 - Built-in DTC
 - A/D converter: 10 bits, 16 ch (8 ch x 2 units)
 - SCI: 3 ch
 - HCAN2: 1 ch
- Main applications
Automobile applications such as EPS and airbags, and industrial applications such as inverters, AC servo, FA, UPS, and FA sequencers

SH7047 Block Diagram



100-pin QFP

* SCI: 2 ch
Without DTC

	ROM	RAM
SH7047F (Flash Version)	256 KB	12 KB
SH7049 (Mask Version)	128 KB	8 KB
SH7105 (Mask Version)*	256 KB	8 KB
SH7109 (Mask Version)*	128 KB	4 KB
SH7107 (Mask Version)*	64 KB	4 KB

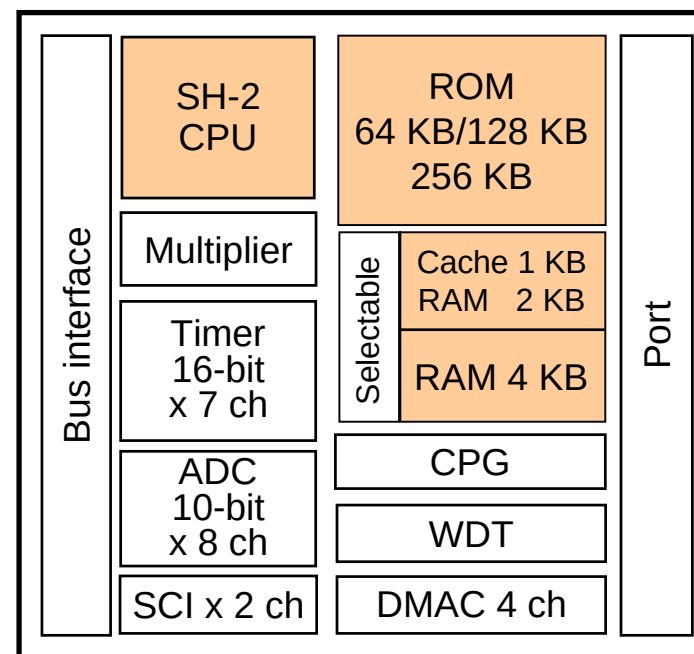
Features

- SH-2 core high-performance single-chip RISC
 - 37 MIPS/28.7 MHz
 - Built-in 32-bit multiplier
- Built-in large-capacity memory
 - ROM: 64 KB (mask)/128 KB (mask, ZTAT)/256 KB (mask, F-ZTAT) /ROMless
 - RAM: 4 KB (can be used as 1-KB cache + 2-KB RAM)
- Built-in cache memory
 - 1-KB instruction cache, 256 entries, and direct mapping
- Various peripheral functions
 - Powerful timer: MTU, 2-ch compare-match timer
 - A/D converter: 10 bit x 8 ch
 - Serial interface: 2 ch
 - DMAC: 4 ch
- Lineup of 6 types (ROMless type is also available)

	ROM size	Package
SH7040/42/44	64 KB/128 KB/256 KB	QFP-112
SH7041/43/45	64 KB/128 KB/256 KB	QFP-144

Note: SH7042 (3.3-V Version): TQFP-120

SH7040 Series Block Diagram



- Main applications
 - Motor controls, navigation systems, digital cameras, PPCs, printers, FAXs, and JPEG application system

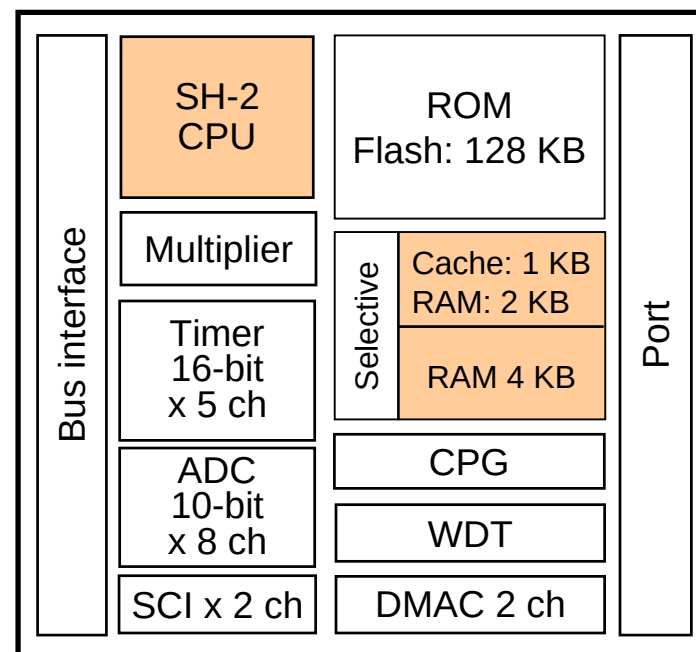
SH7014, SH7016, and SH7017 Overview

Features

- High-performance single-chip RISC with SH-2 core
 - 37 MIPS/28.7 MHz/5 V
 - Built-in 32-bit multiplier
 - Built-in memory
 - ROM: 64 KB (Mask)/128 KB (F-ZTAT™)/ROMless
 - RAM: 3 KB/4 KB
(can be used as 1-KB cache + 1-KB/2-KB RAM)
 - Built-in cache memory
 - 1-KB instruction cache, 256 entries, and direct mapping
 - Peripheral functions
 - Powerful timer: 16 bit x 5 ch (MTU: 0-2 ch, CMT: 2 ch)
 - A/D* converter: 10 bit x 8 ch
 - Serial interface: 2 ch
 - DMAC: 2 ch
- *: A/D module is different between SH7014 and SH7016/17
- Product lineup

	ROM size	RAM	Package	f/V
SH7014	-	3 KB	QFP-112	
SH7016	64 KB (Mask)	3 KB	QFP-112	28.7 MHz/5 V
SH7017	128 KB (Flash)	4 KB	QFP-112	

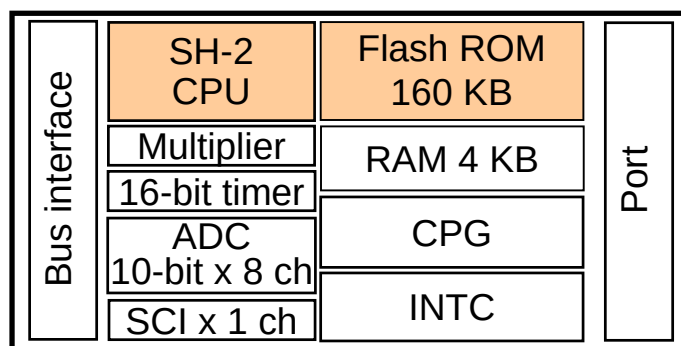
SH7017F Block Diagram



- Main applications
Video printers, liquid crystal projectors, Scanners, and electronic musical instruments, etc.

Features

- CPU core
 - SH-2 core (26 MIPS/20 MHz/3.3 V)
 - Built-in 32-bit multiplier
- Peripheral functions
 - Powerful timer: 16 bits x 5 ch + 8 bit timer
 - A/D converter: 10 bit: 8 ch (SH7018), 7 ch (SH7011)
 - Serial interface: 1 ch
 - Address area: 4 MB x 4 areas (ROM/RAM)
 - I/O ports: 70 (SH7018), 11 (SH7011)
 - CPG: Built-in duty adjustment circuit (1:1 oscillation)
 - Power-down state: Sleep mode



SH7018 Block Diagram

Differences between SH7018 and SH7011

	SH7018	SH7011
Frequency (MHz)	20	20
Supply voltage	3.3 V* ¹	3.3 V
Built-in flash ROM	160 KB	-
Built-in RAM	4 KB	4 KB
Memory I/F	ROM/RAM	ROM/RAM
Timer	16 b x 5 ch 8 b x 1 ch	16 b x 5 ch 8 b x 2 ch
SCI	1 ch	1 ch
A/D (10 bits)	8 ch	7 ch
I/O (input/output)	70	11
Package* ²	TQFP-100	TQFP-100

*¹: 5-V power is required for some I/O

*²: Pin assignment is different

• Main applications

Printer, scanner, and OA equipment

SH7020 and SH7030 Series Overview

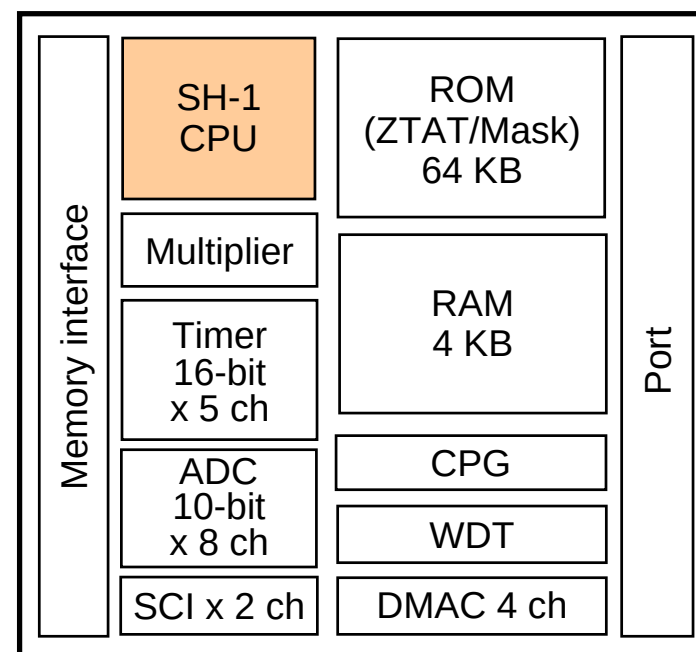
- Another Low Price ROMless Version is Added to the Lineup -

Features

- 32-bit single-chip RISC with high-performance 26 MIPS/20 MHz
- Built-in 16-bit multiplier
- Various built-in large-capacity memories
ROM: 64 KB/32 KB/16 KB/ROMless
RAM: 8 KB/4 KB/1 KB
- Various built-in peripheral functions (16-bit timer, A/D converter, DMAC, SCI, INTC, BSC, etc)
- Package
TQFP-120, QFP-112, and TQFP-100
- Product lineup
5 types (ROMless Versions for the SH7034 and SH7020 also available)

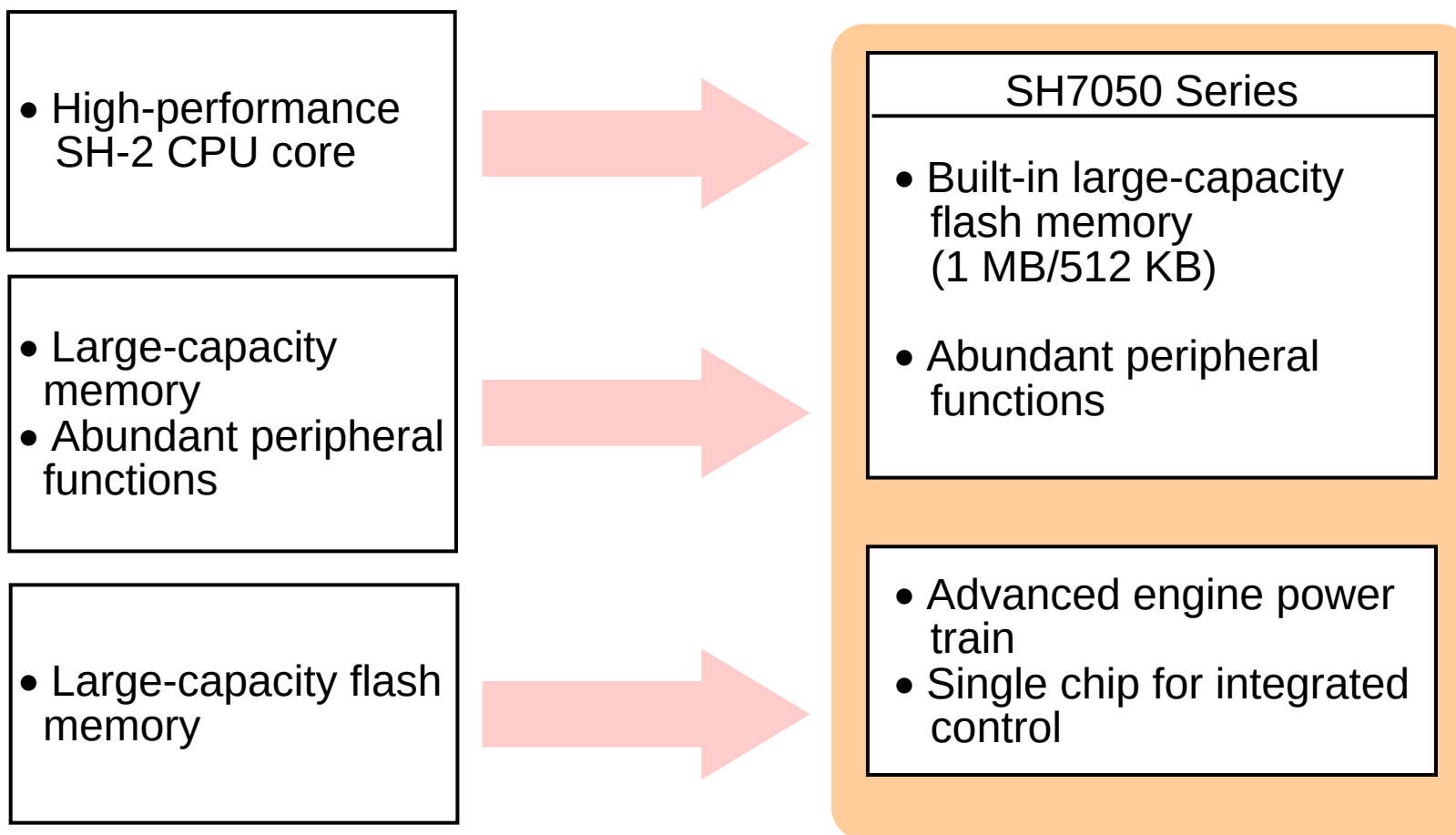
	ROM/RAM	ADC	Package
SH7032	-/8 KB	Yes	QFP-112 TQFP-120
SH7034	64 KB/4 KB	Yes	
SH7034B	-/4 KB	Yes	
SH7021	32 KB/1 KB	-	TQFP-100
SH7020	16 KB/1 KB	-	

SH7034 Block Diagram



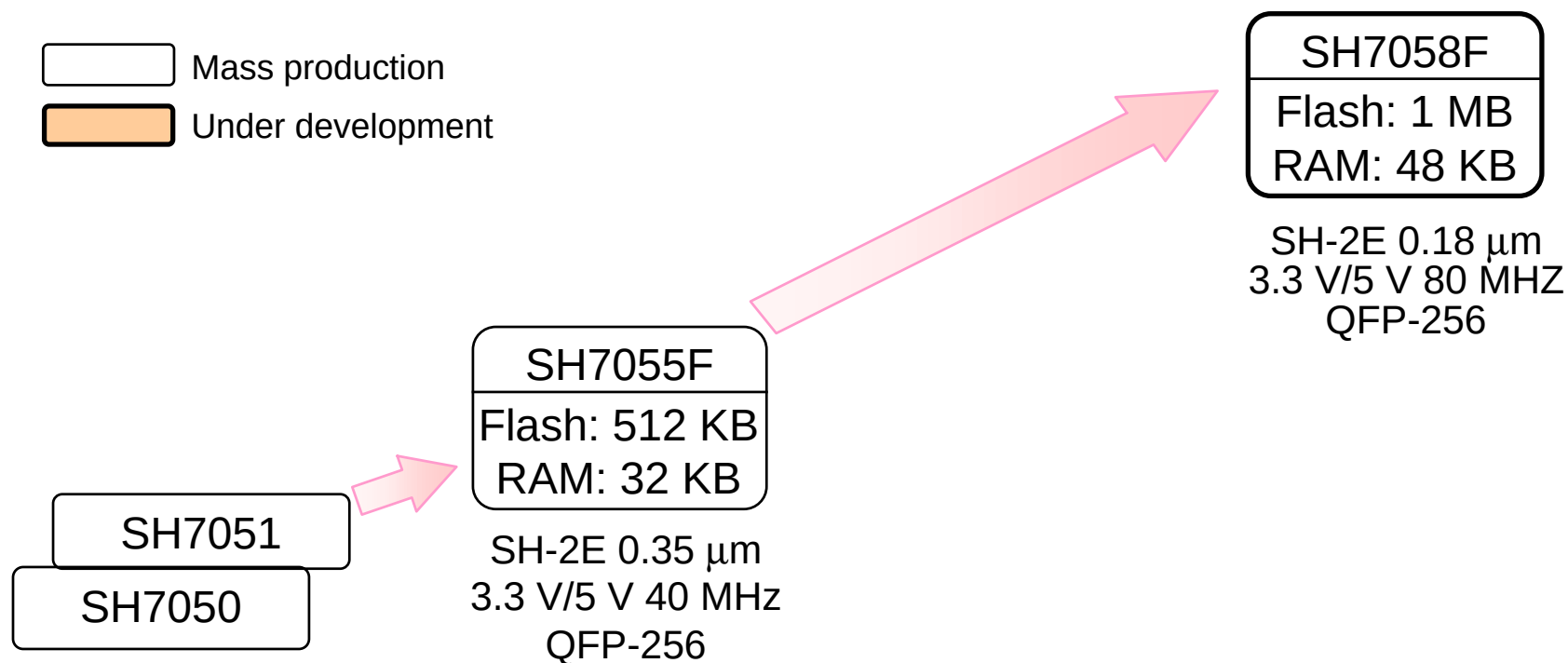
- Main applications:
 - Motor controls, FAs, navigation systems, HDDs, printers, FAXs, digital cameras, etc

SH7050 Series Development Concepts



SH7050 Series Evolution Plan

 Mass production
 Under development



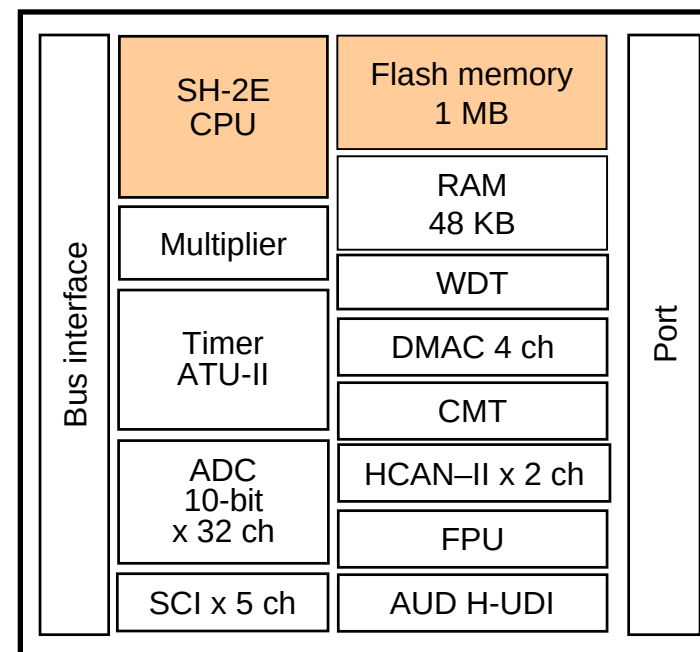
SH7058F Overview

- Realizes max. operating frequency of 80 MHz
- Built-in large-capacity flash memory of 1 MB -

Features

- High-performance single-chip RISC: SH-2E (SH-2 + FPU) core
 - 104 MIPS/80 MHz, 3.3 V and 5 V (2 power supply method)
- High-speed multiply-and-accumulation operation
 - Built-in 32-bit multiplier
 - FPU is incorporated (single-precision floating-point operation unit)
- Single-power large-capacity flash memory and large-capacity RAM
 - 1 MB Flash ROM / 48-Kbyte RAM
- Enhanced peripheral functions
 - Timers: ATU-II (Max. 65 input/output processings)
 - Compare-match timer: 2 ch
 - A/D: 10-bit x 32 ch (multiple-trigger function)
 - Serial Interface: 5 ch
 - DMAC: 4 ch
 - HCAN-II: 2 ch (1 ch is shared with serial interface)
(32 message buffers/ch)
- Development environment
 - Full-specification emulator E6000H
- Package
 - QFP-256 (40 mm x 28 mm, 0.5 pitch)
 - P-BGA2121-272 (21 mm x 21 mm, 1 pitch)

SH7058F Block Diagram

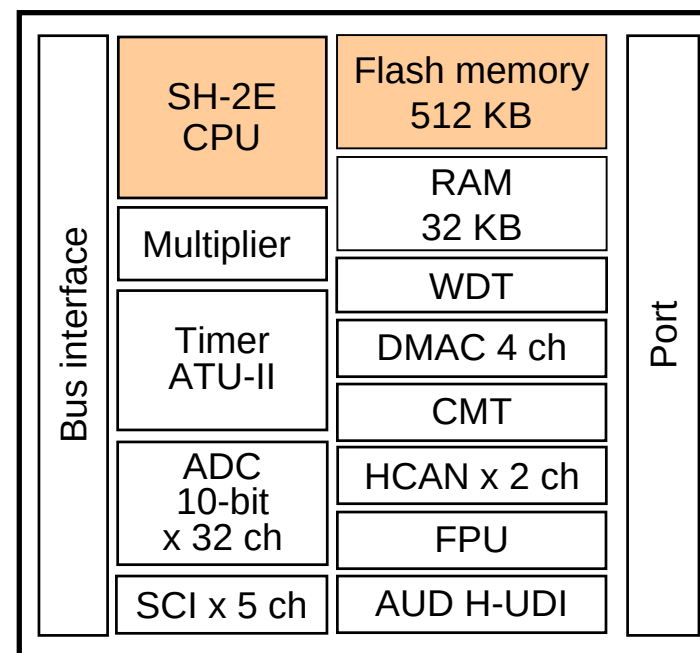


- Main applications
 - Automobile engine control, AT control, Suspension control, FA, sequencers, NC, industrial equipment application systems, Communications terminals, color PPCs

Features

- High-performance single-chip RISC with SH-2E core
 - 52 MIPS/40 MHz/3.3 V and 5 V (2 power supply method)
- High-speed multiplication/accumulation operations
 - Built-in 32-bit multiplier
 - Built-in single-precision floating-point operation unit
- Built-in large capacity flash memory with a single power supply and large-capacity RAM
 - Write and erase operations available with the single power supply
 - 512 KB flash ROM and 32 KB RAM
- Powerful peripheral functions
 - Timer: ATU-II (a maximum of 65 input and output process) Compare-match timer x 2 ch
 - A/D: 10 bits x 32 ch
 - Serial: 5 ch
 - DMAC: 4 ch
 - HCAN: 2 ch (1 ch is shared with a serial interface)
- Development environment
 - Full-function emulator E8000
- Package
 - QFP-256

SH7055F Block Diagram



- Main applications
 Automobile engine control, FAs, industrial equipment, communication terminals, and color PPCs

Features of the High-Performance Single-Chip SH7065

- High-performance CPU with a 60-MHz operating frequency
 - SH-2 core and 16-bit fixed-point DSP core included
- Built-in large-capacity flash memory with a 3.3-V single power supply
 - 256 KB, 60-MHz operation
- Various high-performance peripheral modules
 - Serial communication interface with a built-in high-speed FIFO, multifunctional timers, analog input and output control A/D, D/A etc
- Development environment that enables a 60-MHz realtime emulation
 - Full-specification emulator E8000

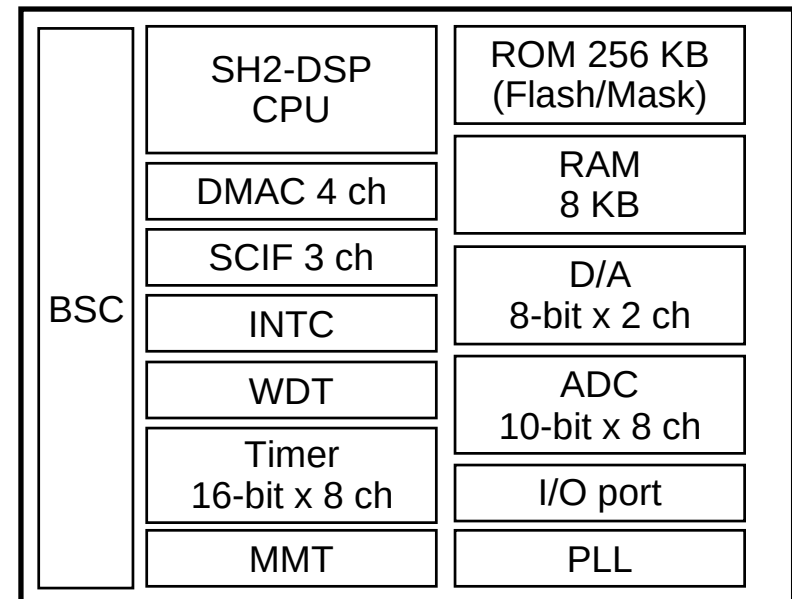
SH7065 Overview

- High-Performance Single-Chip RISC Microcomputer
 with a Built-in Large-Capacity Flash Memory -

Features

- SH-core (with an enhanced DSP function)
 high-performance single-chip RISC
 - 60 MHz/3.3 V
 - All SH-2 instructions + DSP-function enhanced instructions (SH2-DSP core)
- Built-in large-capacity memory
 - ROM: 256 KB (Flash/Mask)
 - RAM: 8 KB (X-RAM: 4 KB, Y-RAM: 4 KB)
- Powerful peripheral functions
 - Timer: 6-ch TPU + 2-ch CMT + 1-ch MMT
 - A/D: 10 bits x 4 ch x 2 units
 - D/A: 8 bits x 2 ch
 - SCIF: (FIFO) 3 ch
 - DMAC: 4 ch
 - INTC (interrupt controller), WDT etc
- Direct memory interface (BSC)
 - Directly connected with ROM/SRAM/DRAM/EDO
- Power management unit
 - Can be switched between the CPU, internal peripheral, and external bus clock
 - Module standby function
- Endian switching of external data available
- Package
 - LQFP-176 (24 mm x 24 mm , 0.5-mm pitch)

SH7065 Block Diagram



- Main applications
 MFPs, high-performance digital cameras, digital video cameras, DVD systems, communication terminals, and industrial controllers

Features of the SH7641

High-End Controller with a Built-in USB

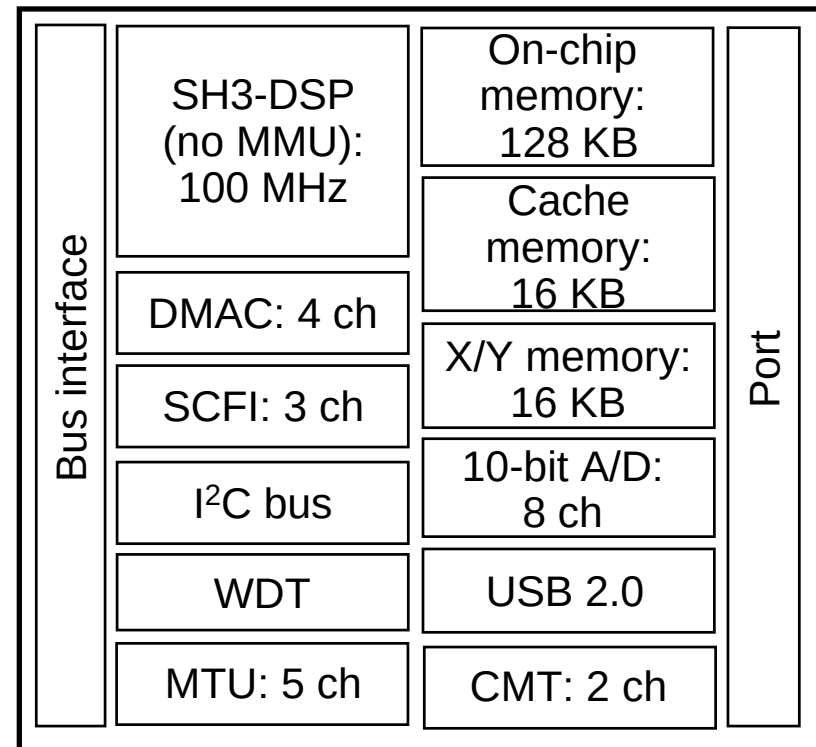
- Performance of the SH-3 CPU and the peripheral functions of the SH-2 is incorporated in a single chip -

- CPU: Incorporating a DSP-equipped CPU core for 100-MHz operation
 - High-end controller with the fast operation
Optimal for high-speed, high-performance systems
- Timers: Ample timers for motor-control applications
 - 3-phase PWM output, encoder counter
Optimal for machine-control applications, e.g. inverters and AC servos
- SRAM: 144-KB large-capacity SRAM accessible in one clock cycle
 - Also incorporates 16-KB cache
For real-time, high-speed control
- Interfaces: Support for various interfaces, including I²C, USB, SCIF
 - In addition, 164-channel I/O and 32-bit external bus
Direct connection of peripheral devices and chips reduces the number of components
- Applications
 - Inverters, AC servos, vending machines, ATMs, MFP/Fax machines, PPCs, card readers, etc.

Features

- CPU core
 - SH3-DSP (no MMU)
 - Max. operating frequency: 100 MHz 1.8/3.3-V operation
 - 32-bit multiplier (32 bits x 32 bits → 64 bits)
 - On-chip 16-bit fixed-decimal-point DSP
- On-chip peripheral functions
 - Strong 16-bit-timer facilities (MTU, CMT, WDT)
Output of waveforms for up to 12-phase control
 - DMA controller: 4 ch
 - A/D converter: 10 bits, 8 ch
 - SCIF: 3 ch
 - I²C-Bus: 1 ch
 - USB 2.0 full speed (Function): 1 ch

SH7641 Block Diagram



- Package: BGA-256 (17 mm square)

SuperH with built-in Ether

SH-Ether Overview



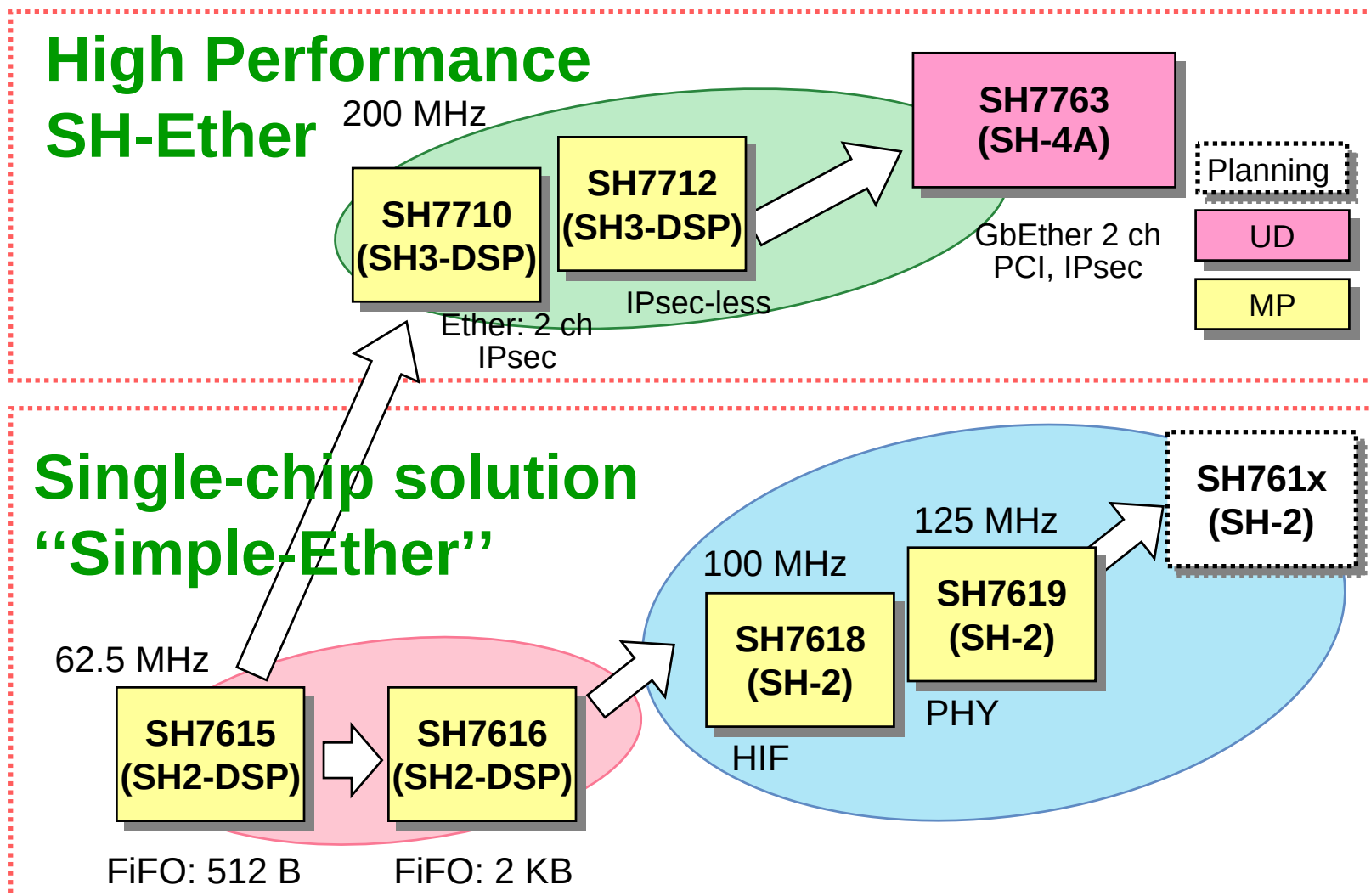
The SH-Ether Series products are the SuperH microcomputers equipped with the 10/100-Mbps supporting Ethernet controllers in compliance with the IEEE802.3u standard.

- Target applications
 - LBPs (Laser Beam Printer), MFPs (Multi Function Printer)
 - LAN cards (PC peripherals, FA devices)
 - Digital home electronics, IP Phones
 - Amusement devices
 - POS systems
 - Monitoring systems
 - Others(The Ethernet required systems)

**Adopted for various
embedded Ethernet
systems**

SH-Ether Roadmap

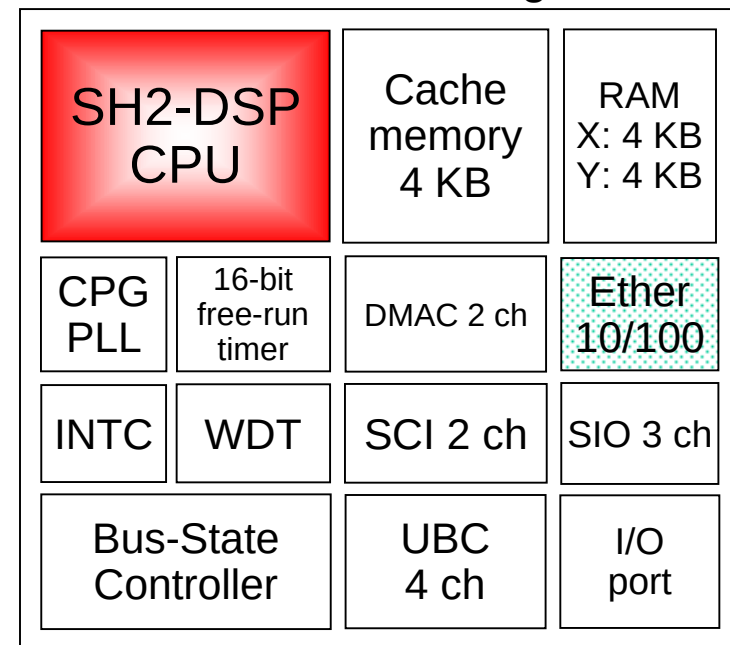
SuperH
RISC engine



Features

- High performance RISC engine SuperH core (SH2-DSP)
 - 81 MIPS, 125 MOPS (max)@62.5 MHz
- Instruction/data combination type cache (4 KB)
 - 4-way set associative, 64 entries, 16-byte line length
- Internal RAM (8 KB)
- SDRAM Interface
 - Supports high-speed access: external bus to 62.5 MHz (max)
 - Possible 16 Byte DMA dual burst access
- Ethernet controller
 (MAC^{*1}: accordance with IEEE802.3u)
 - transmission rate: 10/100 Mbps, Full duplex transmit and receive
 - Assembles/Disassembles data frame, CRC
 - Supports MII^{*2}, Magic packet ^{TM*3}
 - FIFO 512 Byte each for transmission and reception
- Boundary Scan
 - Boundary Scan Function (accordance with IEEE1149.1)
- Peripheral function
 - TPU (3 ch), SCIF (2 ch), DMAC (2 ch), INTC, WDT (1 ch), FRT (1 ch)
 - SIO (3 ch), I/O port etc
- Vcc = 3.3 V (supports 5 V I/F regarding I/O and Ethernet pin)

SH7615 Block Diagram



Ether FiFO = 512 B
PKG: QFP-208 / CSP-240

*1 MAC:Media Access Control,

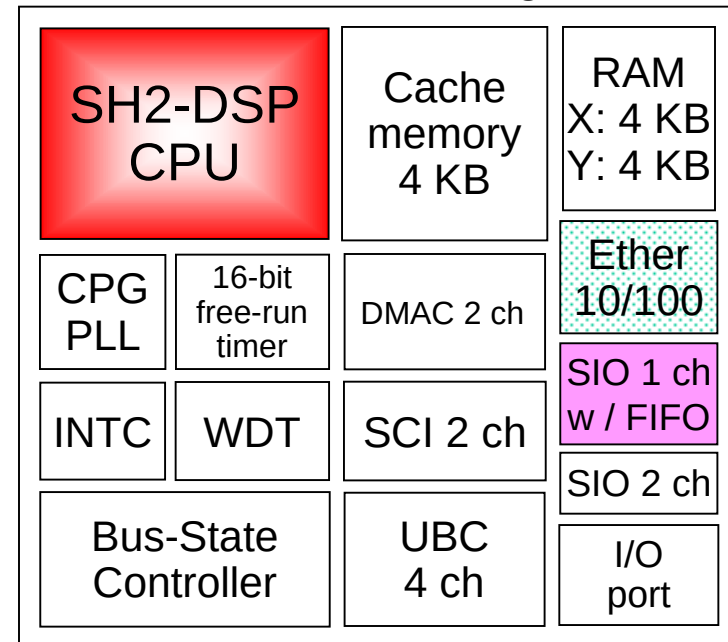
*2 MII:Media Independent Interface,

*3 Magic Packet is a trademark of
 Advanced Micro Devices, Inc.

Features

- High performance RISC engine SuperH core (SH2-DSP)
 - 81 MIPS, 125 MOPS (max) @62.5 MHz
- Instruction/data combination type cache (4 KB)
 - 4-way set associative, 64 entries, 16-byte line length
- Internal RAM (8 KB)
- SDRAM Interface
 - Supports high-speed access: external bus to 62.5 MHz(max)
 - Possible 16 Byte DMA dual burst access
- Ethernet controller (MAC*¹: accordance with IEEE802.3u)
 - transmission rate: 10/100 Mbps, Full duplex transmit and receive
 - Assembles/Disassembles data frame, CRC
 - Supports MII*², Magic packet TM*³
 - FIFO 2 KB each for transmission and reception
- Boundary Scan
 - Boundary Scan Function (accordance with IEEE1149.1)
- Peripheral function
 - TPU (3 ch), SCIF (2 ch), DMAC (2 ch), INTC, WDT (1 ch), FRT (1 ch), SIO (2 ch), I/O port etc
 - SIO with FIFO (16 bit x 16) for CODEC
- Vcc = 3.3 V (supports 5 V I/F regarding I/O and Ethernet pin)

SH7616 Block Diagram



Ether FiFO = 2 KB
SIO with FIFO 1 ch
PKG: QFP-208

*1 MAC: Media Access Control,
 *2 MII: Media Independent Interface,
 *3 Magic Packet is a trademark of
 Advanced Micro Devices, Inc.

Difference between SH7615 and SH7616



FIFO (up to 2 KB)

- possible one transaction per frame
- improve the efficiency of transmission and reception of frames

CAM match signal

- Multi Address support
- Useful for FA network

SIOF (SIO with FIFO)

- Improve the efficiency of G.729a handling
- Support for CODEC having Communication Data
e.g. Si 3000 (Silicon Laboratories), STLC7550 (SGS Thompson)

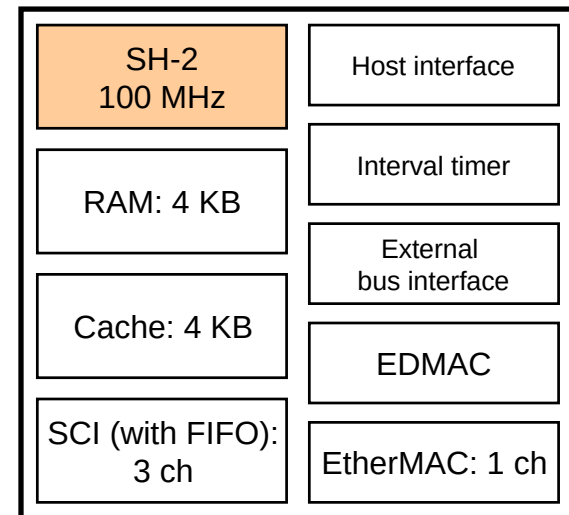
Overview of SH7618/7618A Specifications



Inexpensive network controller incorporating EtherMAC and host interface

- CPU Core
 - SH-2 (SuperH 32-bit RISC engine, 32-bit multiply-and-accumulation operation)
 - PVcc = 3.0 to 3.6 V, Vcc = 1.4 to 1.6 V
- Operating Frequency
 - CPU clock: 100 MHz
 - Bus clock: 50 MHz
- Internal Memory
 - RAM: 4 KB
 - Cache memory:
 - 4 KB (Four-way set associative): 7618
 - 16 KB (Four-way set associative): 7618A
- Host I/F
 - 1 KB x 2 sections
 - HIF boot function
- Ethernet functions
 - EtherMAC (10/100 Mbps): 1 ch
 - MII interface is also available.
 - Transmit and receive FIFO: 256 bytes each (7618), 512 bytes each (7618A)
 - Dedicated DMA controller: 2 ch
- External Memory Interfaces
 - SRAM, SDRAM, and PCMCIA I/F
 - Switchable to big/little endian
 - External bus can be extended up to 16 bits

- Peripheral Functions
 - Serial communication interface: 3 ch
Switchable to UART/clock synchronous
16-stage transmit and receive FIFO
 - 16-bit interval timer: 2 ch
 - Watchdog timer: 1 ch
 - General-purpose I/O port: 78 ch
 - JTAG interface support
 - External interrupt pins: 9 ch
- Package
 - CSP-176 (13 mm square, 0.8-mm pitch)

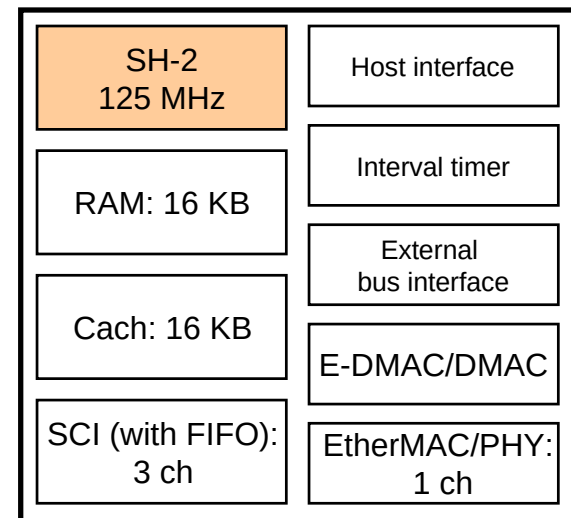


Overview of SH7619 Specifications



PHY in a single chip improves performance

- CPU Core
 - SH-2 (32-bit SuperH RISC engine, 32-bit multiply-and-accumulation operation)
 - PVcc = 3.0 to 3.6 V, Vcc = 1.7 to 1.9 V
- Operating Frequency
 - CPU clock: **125 MHz**
 - Bus clock: **62.5 MHz**
- Internal Memory
 - RAM: **16 KB**
 - Cache memory: **16 KB** (4-way set associative)
- Host I/F
 - 1 KB x 2 sections
 - HIF boot function
- Ethernet Functions
 - EtherMAC (10/100 Mbps): 1 ch
 - **EtherPHY (10/100 Mbps): 1 ch (MII interface is also available)**
 - Transmit and receive FIFO: **512 bytes** each
 - Dedicated DMA controller: 2 ch
- External Memory Interface
 - SRAM, SDRAM, and PCMCIA
 - Switchable to big/little endian
 - External bus can be extended up to **32 bits**
- **General-Purpose DMA Controller**
 - 4 ch
- Peripheral Functions
 - Serial communication interface: 3 ch
Switchable to UART/clock synchronous
16-stage transmit and receive FIFO
 - 16-bit internal timer: 2 ch
 - Watchdog timer: 1 ch
 - General-purpose I/O ports: 78 ch
 - JTAG interface support
 - External interrupt pins: 9 ch
- Package
 - CSP-176 (13 mm square, 0.8-mm pitch)



SH7650 Functions and Features



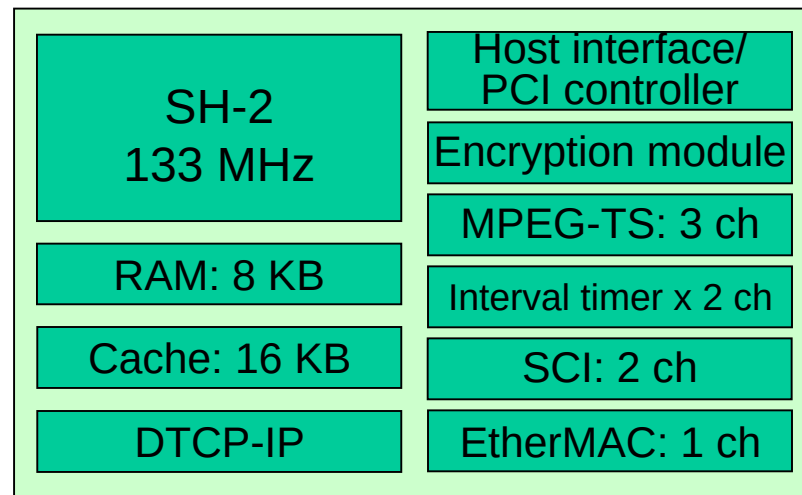
- Incorporates high-performance SH-2 core
 - Realizes network processing and DTCP processing at 173 MIPS@133 MHz with no load on the main CPU
- On-chip functions supporting DTCP-IP*
 - Authentication between systems and encryption/decryption of contents are achieved by hardware and supplied firmware
- Internal PCI bus controller and host interface
 - Facilitates connection with the main CPU
- Includes wireless LAN interface and MPEG-TS port for moving image streaming
- Abundant bus interfaces
 - SDRAM interface
 - Burst ROM interface, etc.

*: DTCP-IP standard is a standard for protecting contents on the IP network standardized by DTLA (Digital Transmission Licensing Administrator)

SH7650 Overview

SuperH
RISC engine
Under
Development

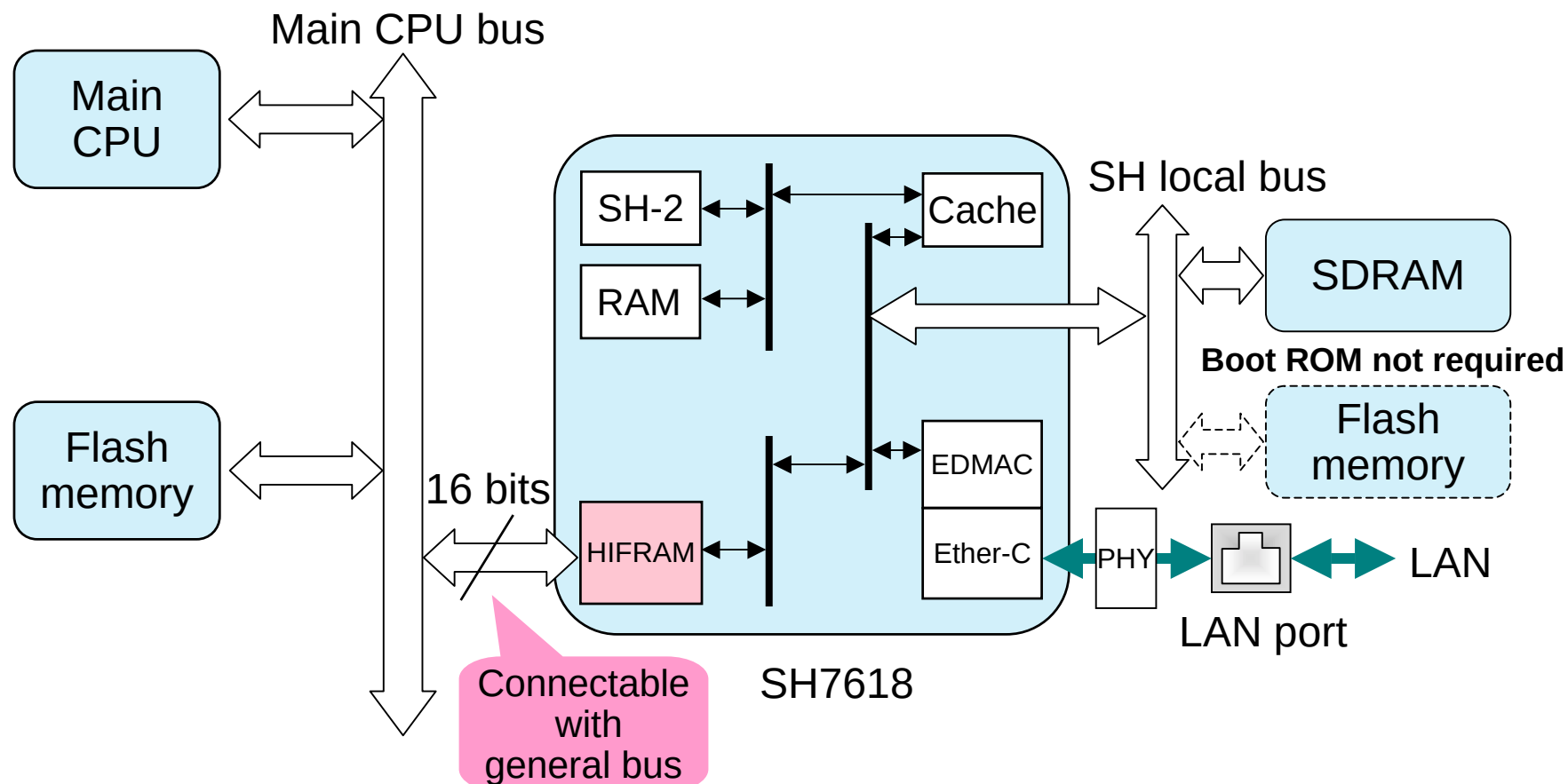
- CPU core
 - SH-2(SuperH 32-bit RISC, with on-chip 32-bit multiplier)
 - PVcc = 3.0 to 3.6 V, Vcc = 1.4 to 1.6 V
- Operating frequency
 - CPU clock: **133 MHz**
 - Bus clock: 66 MHz
- Internal memory
 - Internal RAM: 8 Kbytes
 - Cache memory: 16 Kbytes
- On-chip DTCP-IP
- Host interface
 - 1 KB x 2 banks
 - Includes HIF boot function
- **PCI controller**
 - 33 MHz/32 bits
- Ethernet controller
 - EtherMAC (10/100 Mbps): 1 ch
 - Includes MII interface
 - Transmit/receive FIFO: each 512 bytes
 - Dedicated DMA controller: 2 ch
 - **Incorporates TCP/IP checksum accelerator**
- Memory interface
 - SRAM, SDRAM interface
 - External bus can be extended up to 32 bits
- **Encryption module**
 - AES encryption/decryption
 - Dedicated DMA controller
- **On-chip MPEG-TS interface**
 - Includes 3 channels
- Peripheral functions
 - Serial communication interface: 2 ch
 - 16-bit interval timer: 2 ch
 - Support for JTAG interface, external interrupt pin, and I/O ports
- Package
 - CSP-336 (17-mm square, 0.8-mm pitch)



Host interface (HIF)

Features:

1. Connectable to the main CPU with parallel bus
2. HIF boot function eliminates the need for boot ROM



SH7712 is IPsec-less version of SH7710

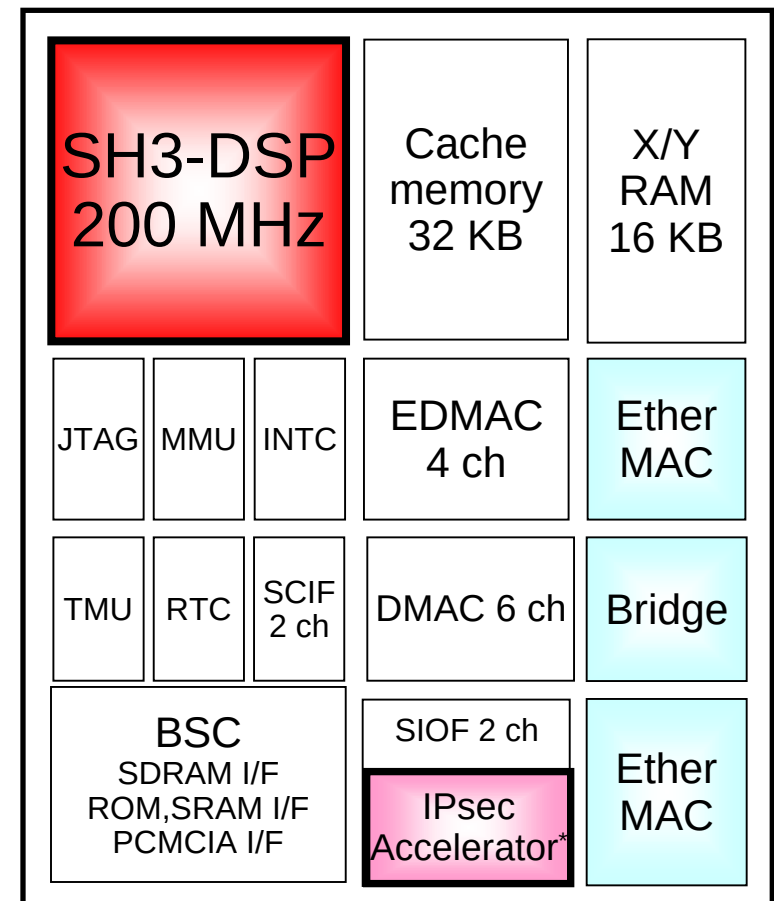
Features

- High performance RISC engine
SH3-DSP core
 - 260 MIPS@200 MHz
- Ethernet Controller
(MAC: IEEE802.3u compliant)
 - 10/100 Mbps, Full duplicate mode supported
 - Transfer/Receive FIFO: 2 KB each
 - Bridge: transfer FIFO: 3 KB each
- IPsec accelerator*
 - Authentication algorithm: SHA-1, MD5
 - Cryptography algorithm: DES, 3 DES
 - Dedicated DMAC 4 ch
- Unified Cache: 32 KB
- Internal RAM: 16-KB XY-RAM
- SDRAM interface
- Power Supply: Core 1.5 V, I/O 3.3 V
- Package: QFP-256, CSP-256

Main applications

- Home gateway, VoIP-TA, IP phone, IP camera, Security equipment, etc

SH7710 Block Diagram



*: Only SH7710

SH7763 Overview

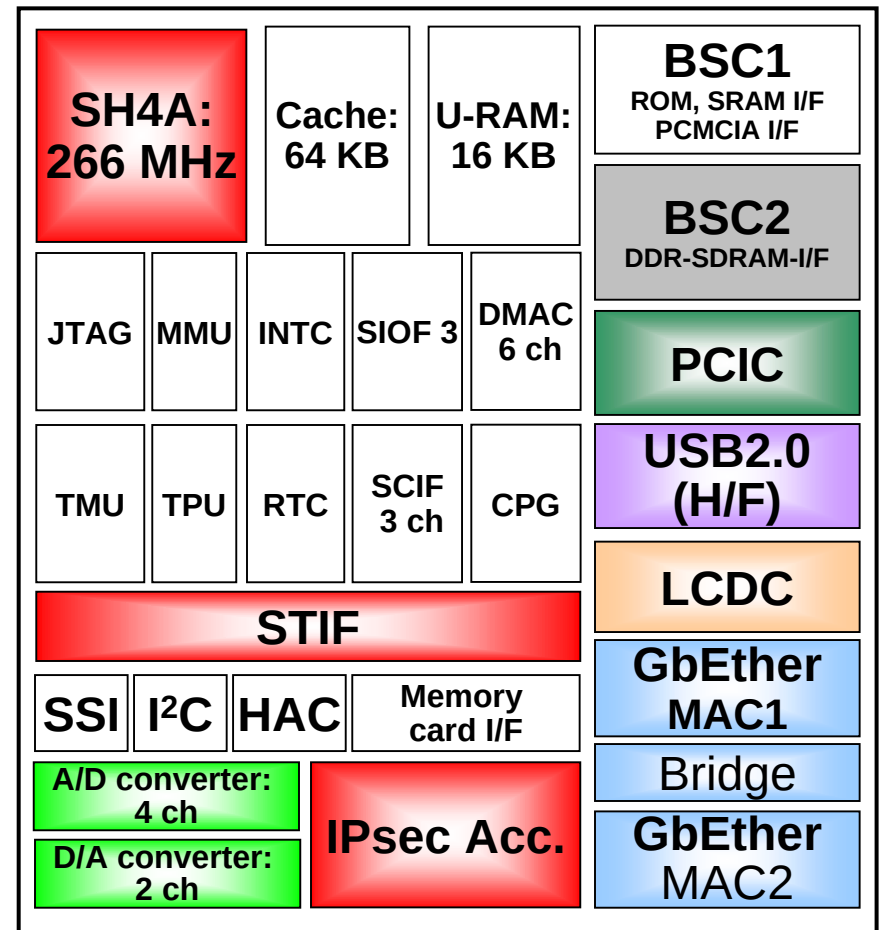


Features

- SH4A core (266 MHz)
- Cache (instruction: 32 KB, data: 32 KB)
- On-chip MMU
- On-chip RAM (16 KB)
- SDRAM interface
 - Double data rate: 32-bit data bus, 133 MHz (DDR266), Class 1
- On-chip STIF (stream interface)
- Ethernet controller (IEEE802.3) 2 ch
 - 10/100/1000 Mbps full duplex transfer supported
 - Flow control (IEEE802.3x) supported
 - On-chip E-DMAC: 2 ch (Tx, Rx)
 - 2-KB send/8-KB receive FIFO
- IPsec accelerator
 - Authentication algorithm: SHA-1, MD5
 - Encryption algorithm: DES, 3DES, AES
 - On-chip IPsec DMAC: 2 ch
- PCI controller: PCI ver2.2
- LCD controller: SVGA full color display is supported
- USB Host/Function: Ver. 2.0 Full Speed is supported
- Peripheral functions: SCIF (3), DMAC (6 ch), INTC, RTC, TMU, SIOF (3), SSI, I²C, HAC, various memory card I/Fs, I/O ports, A/D converter, D/A converter, etc.
- Vcc
 - Core = 1.2 V, I/O = 3.3 V, DDR I/O = 2.5 V
- Package
 - PBGA2121-449, ball pitch: 0.8 mm

Block diagram of the SH7763

(Product Type No.: R5S77630Y-266BGV)



List of Specifications for the SH-Ethernet Products (1)



Item	SH7615	SH7616	SH7618/18A	SH7619
	DSP function enhanced version	FIFO expanded version	EtherMAC	EtherMAC, PHY
CPU	SH2-DSP core		SH2 core	
Operating frequency	62.5 MHz		100 MHz	125 MHz
Power supply voltage	3.3 V		1.5 V/3.3 V	1.8 V/3.3 V
Cache memory	4 KB		4 KB/16KB	16 KB
On-chip RAM	8 KB		4 KB	16 KB
General DMAC	2 ch		0	4 ch
Ethernet controller	1 ch		1 ch	1 ch, PHY
Rx/Tx FIFO	512 B/512 B	2 KB/2 KB	SH7618: 256 B/256 B SH7618A: 512 B/512 B	512 B/512 B
Ethernet-specific DMAC	2 ch		2 ch	
User break controller	4 ch		2 ch	
Timer unit	3 ch		2 ch	
Free-run timer	1 ch		0 ch	
Serial communication I/F with FIFO	2 ch		3 ch	
Serial I/O	3 ch		0	1 ch
Package	208LQFP (SH7615ARF) 240CSP (SH7615ARBP)	208LQFP	176CSP	

List of Specifications for the SH-Ethernet Products (2)

SuperH
RISC engine

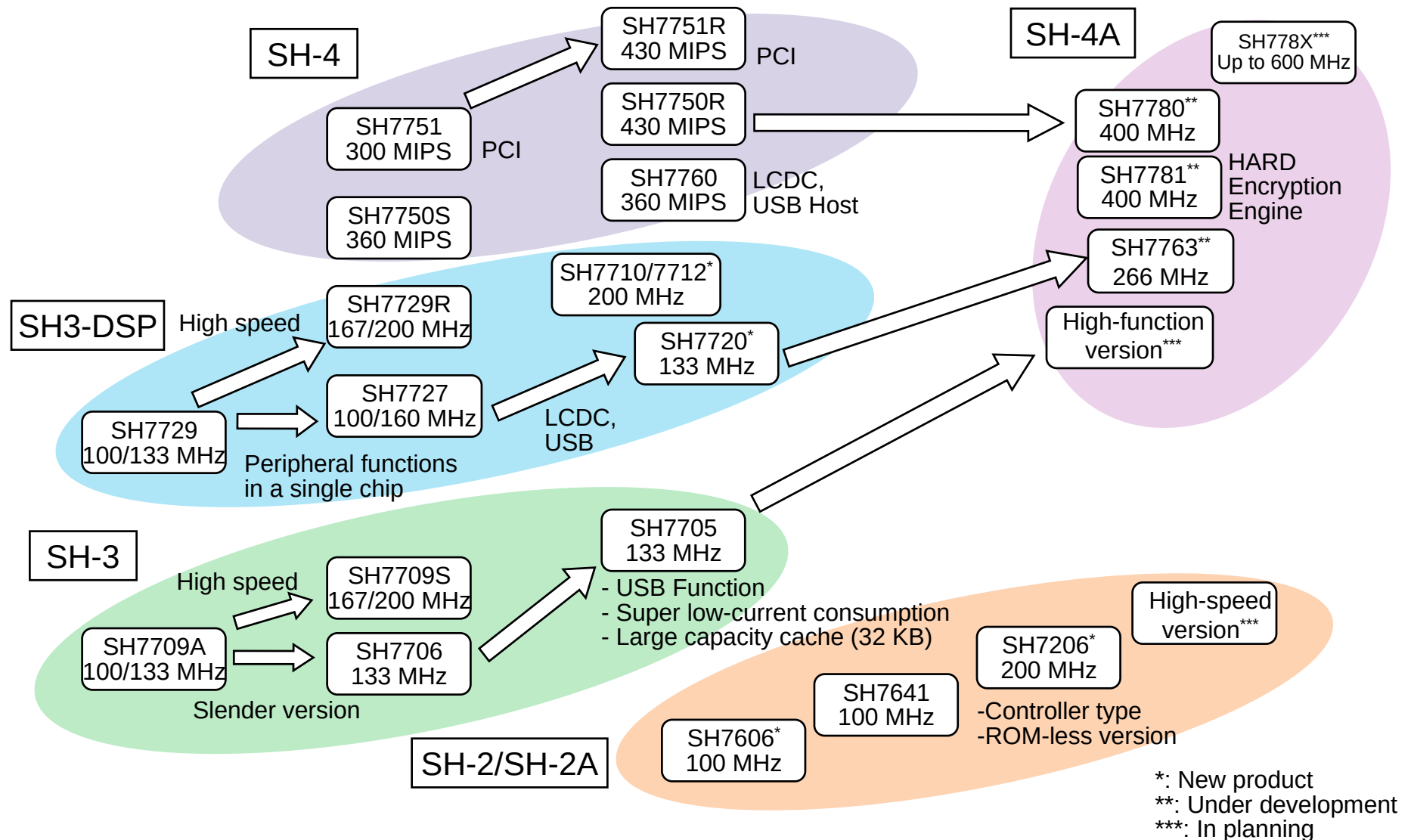
Item	SH7710	SH7712	SH7650	SH7763
	EtherMACx2, IPsec	EtherMAC x 2	EtherMAC x 1, DTCP-IP	Gb EtherMAC x 2, PCI
CPU	SH3-DSP core		SH-2 core	SH-4A core
Operating frequency	200 MHz		133 MHz	266 MHz
Power supply voltage	1.5 V/3.3 V		1.5 V/3.3 V	1.5 V/3.3 V/2.5 V
Cache memory	32 KB		16 KB	64 KB
On-chip RAM	16 KB		8 KB	16 KB
General DMAC	6 ch		-	6
Ethernet controller	2 ch		1 ch	2 ch (6 bit)
Rx/Tx FIFO	2 KB/2 KB x 2 pairs		512 B/512 B	8 KB/2 KB x 2
Ethernet-specific DMAC	4 ch		2 ch	4 ch
User break controller	2 ch		2 ch	2 ch
Timer unit	3 ch		2 ch	6 ch
Free-run timer	-		0 ch	-
Serial communication I/F with FIFO	2 ch		2 ch	3 ch
Serial I/O	2 ch (incl.FIFO)		0 ch	3 ch
Package	HQFP2828-256 256CSP		BP1717-336	PBGA2121-449

Processor Type

SH7700 Series
SH7750 Series

Roadmap of Processor type microcomputer

SuperH
RISC engine



High-Performance 32-Bit RISC Processor



Features

- Low power and high performance:
133 mA @133 MHz (SH7705)
- MMU (Memory Management Unit), cache on chip
- Power management
 - Low-power mode
 - Frequency control
 - Module ON/OFF control
- Compatible with SH-1 and SH-2 instruction sets

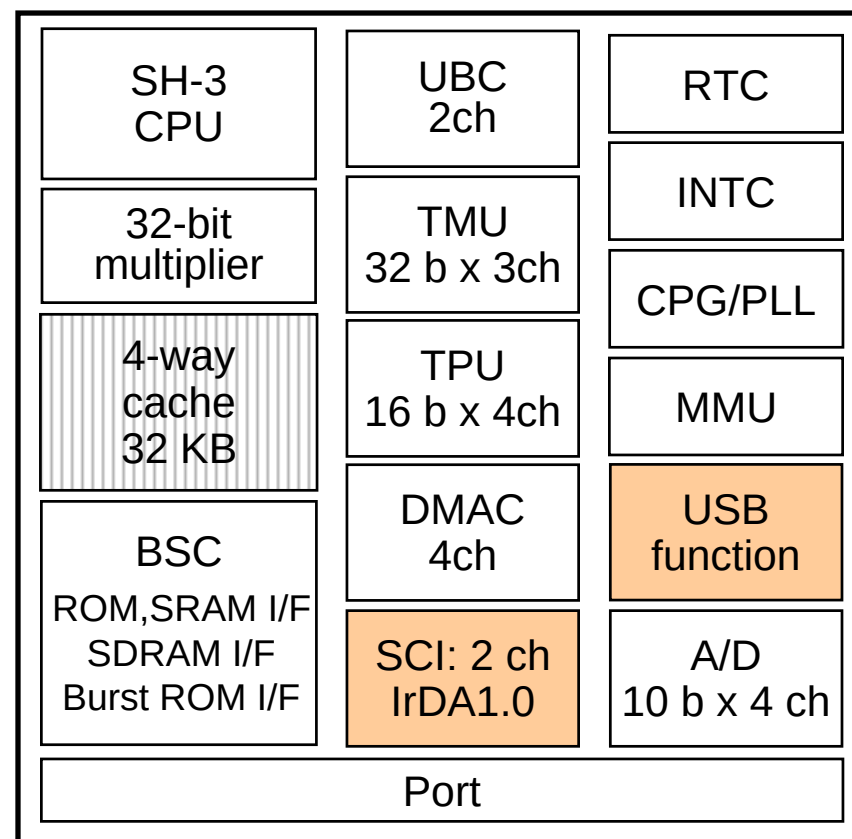
SH7705 Overview

- SH-3 Low Power Version -

Features

- High-performance ultra-low power RISC CPU SH-3
 - Low power-consumption: 1 mA/MHz (typ)
@1.5 V (Internal)
 - CPU clock: 133 MHz/bus clock: 66 MHz
- Cache: Large Capacity 32 KB
- On-chip USB Function Ver2.0 (Full Speed)
 - On-chip USB transceiver
 - Control/bulk/interrupt transfer support
- BSC (bus state controller)
 - Page mode FLASH, ROM, SRAM, SDRAM
- Enriched on-chip peripheral functions
 - DMAC, WDT, ADC, CMT, RTC, etc.
- On-chip high-speed serial interface
 - UART/clock synchronous switchover type
(on-chip 64-byte FIFO): 2 ch
1 ch for IrDA1.0
- Powerful power management function
 - Sleep, standby, module standby,
hardware standby
- Package: LQFP-208 (28 mm square),
CSP-208 (12 mm square)

SH7705 Block Diagram



Main applications

- DSC, DVC, Video printer, Fax, Ink-jet printer, Barcode Reader, PDA, and POS terminal

SH7706 Overview

- SH-3 Compact Version -

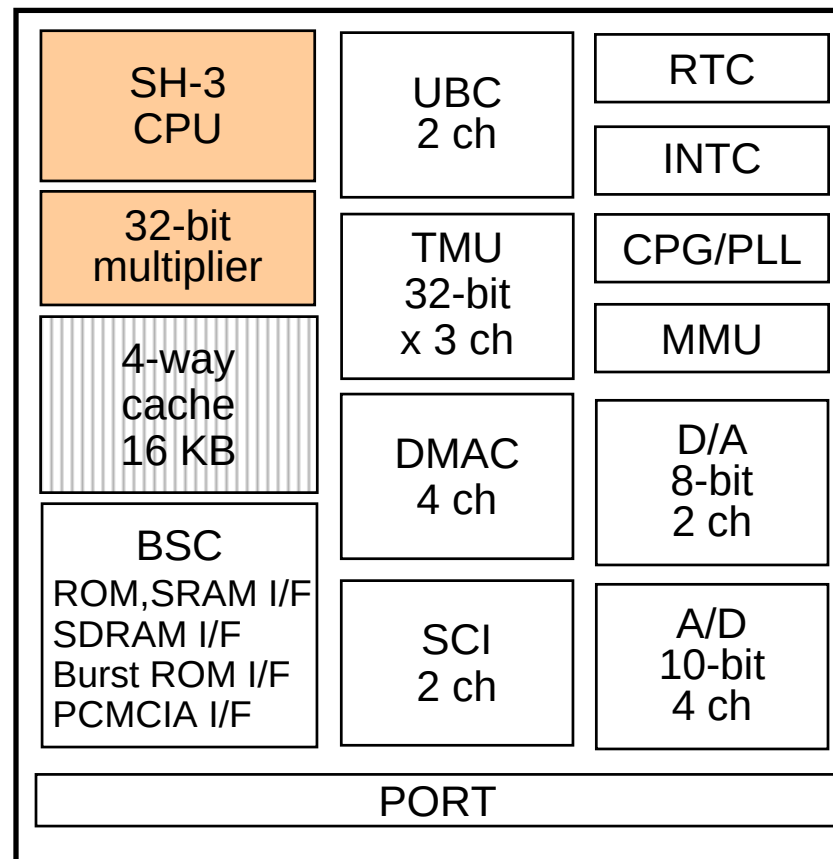
Features

- CPU SH-3: 133 MHz
- Cache: 16 KB
- Peripheral functions
 - 4-ch DMAC
 - 10-bit 4-ch A/D converter
 - 8-bit 2-ch D/A converter
 - 2-ch SCI (with FIFO: 1 ch)
 - 3-ch timer (32 bits)
 - RTC
- Power management function
- High-performance, low consumption power
- Package: 176-pin LQFP, 208-pin CSP

Main applications

- MFP/Ink-jet printers, fax, scanners, DVD Recorder, and DVC

SH7706 Block Diagram



SH7709S Overview

- SH-3 High-speed Version -

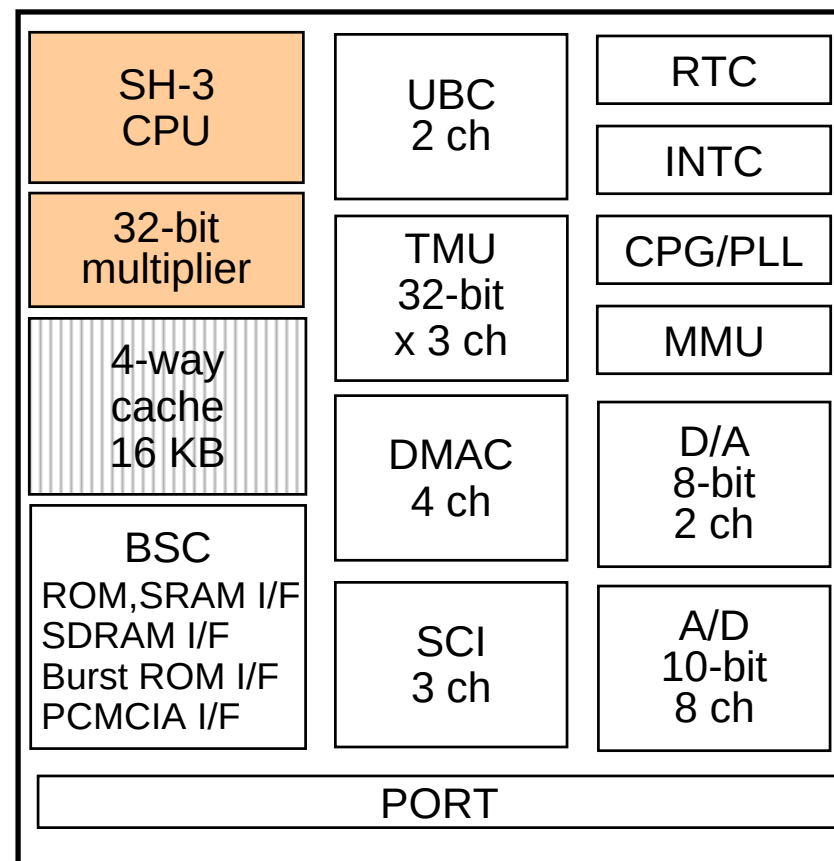
Features

- Improved CPU operation performance
200 MHz (260 MIPS) MAX
 Line-up is 100/133/167/200 MHz
 Version
- Cache: 16 KB
- Peripheral functions
 - 4-ch DMAC
 - 10-bit 8-ch A/D converter
 - 8-bit 2-ch D/A converter
 - 3-ch SCI (with FIFO: 2 ch)
 1 ch for IrDA 1.0
- Power management function
- High-performance and low-power voltage
- Package
 - LQFP-208, CSP-240 (100/133/167 MHz)
 - HQFP-208 (200 MHz)

Main applications

- Portable information equipment, internet equipment, LBP, printer, scanner, and network equipment

SH7709S Block Diagram



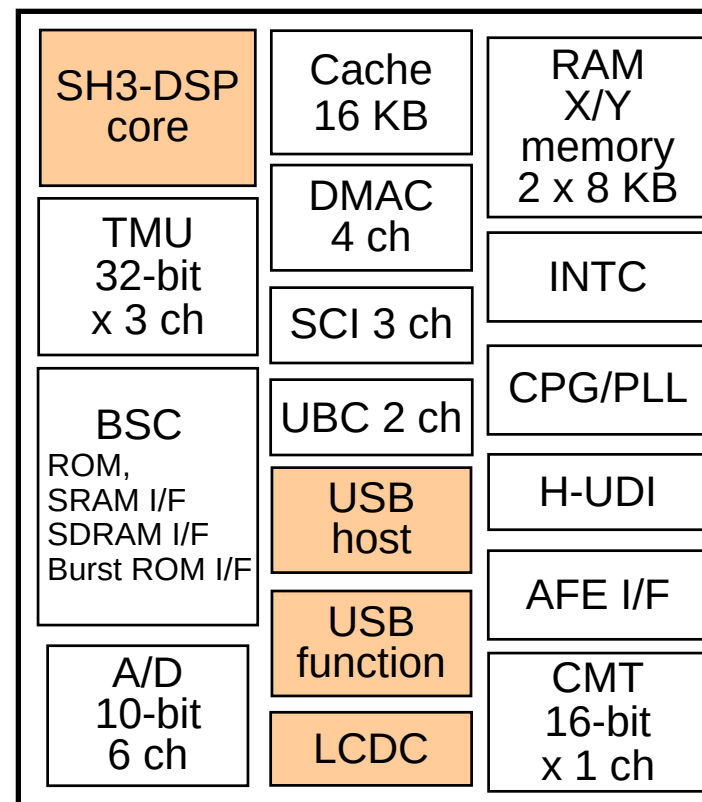
Features

- Supports DSP instructions (16-bit fixed decimal points)
 - to 100/160 MHz
 - to 200/320 MOPS
- MMU
- Cache: 16 KB
- X/Y memory (DSP core)
 - RAM: 2 x 8 KB (total 16 KB)
- LCDC (color)
- USB function Ver2.0 (Full Speed)
- USB host (Full / Low Speed),
OHCI: Ver.1.0
- AFE interface
- Other functions: A/D and PCMCIA I/F etc
- On-chip debugger
 - JTAG interface H-UDI (subset)
 - User break controller (UBC)
- Package
 - HQFP-240
 - CSP-240

Main applications

- FAX, printer, AV equipment terminal, webphone, POS terminal, internet terminal, and DSC printer.

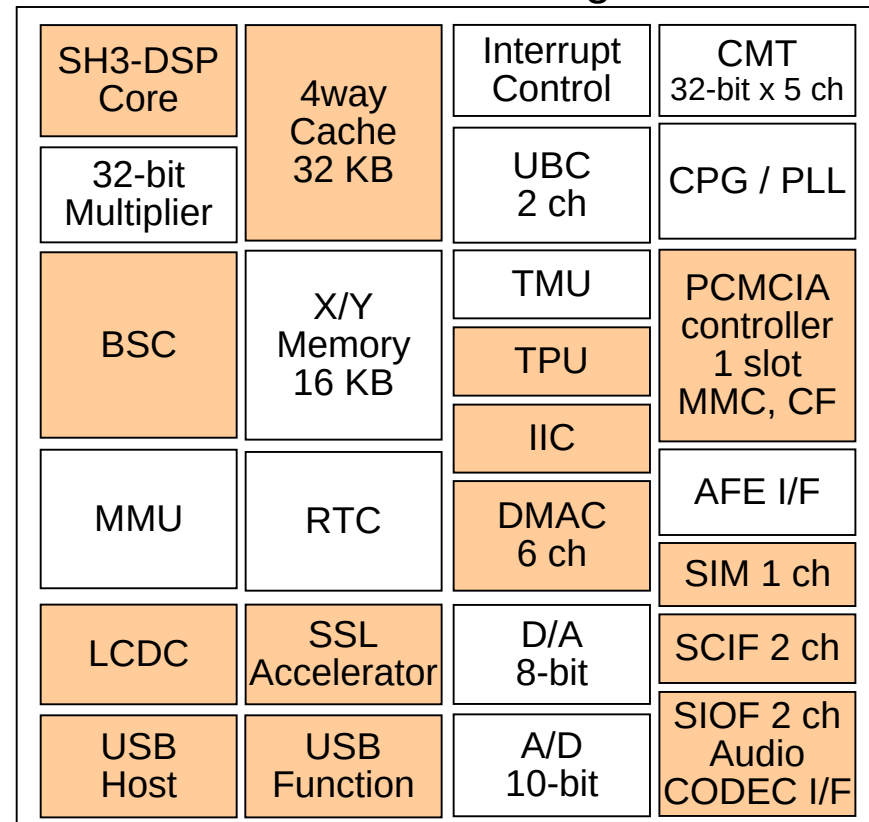
SH7727 Block Diagram



Features

- Supports DSP instructions (16-bit fixed decimal points)
 - to 133 MHz
 - to 266 MOPS
- MMU
- Cache 32 KB
- SSL accelerator
- XY memory (DSP core)
 - RAM: 2 x 8 KB (total 16 KB)
- LCDC (color)
- USB function (Ver. 2.0 Full Speed)
- USB Host (Full / Low Speed)
 - OHCI: Ver.1.0
- I²C bus interface:
- DMAC x 6 channels
- TMU: 32-bit timer x 3 channels
- TPU: 16-bit timer x 4 channels
- SCIF: Serial interface with FIFO x 2 channels
- IrDA interface (Ver. 1.0)
- SIOF: Audio serial interface with FIFO x 2 channels
- Smart Card Interface
- AFE I/F
- A/D 10-bit x 4 ch , D/A 8-bit x 2 ch
- PCMCIA I/F, MMC I/F
- PKG FBGA256
 - (17 mm x 17 mm, ball pitch: 0.8 mm)
 - (11 mm x 11 mm, ball pitch: 0.5 mm)

SH7720 Block Diagram



Main applications

- IP Phone, FAX, Printer, AV equipment terminal, Webphone POS terminal, Internet terminal, and DSC printer

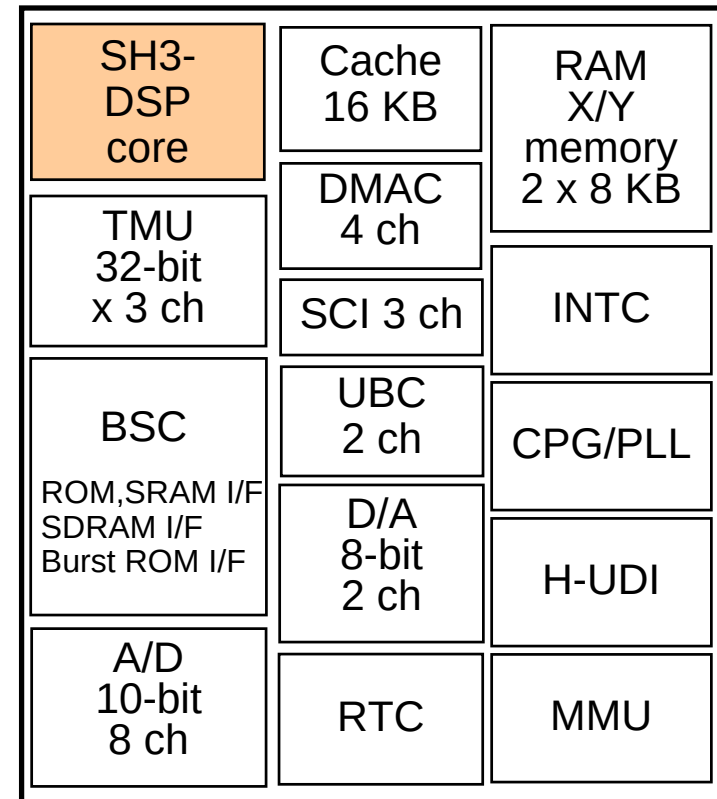
Features

- DSP instruction (SH3-DSP)
 - 100 MHz/133 MHz/167 MHz/200 MHz
 - 200 MOPS/266 MOPS/334 MOPS/400 MOPS
- MMU
- Cache
 - MMU fully compatible with the SH-3 (TLB)
 - Cache fully compatible with the SH-3 (16 KB)
- Built-in memory for DSP processing (X/Y memory)
 - RAM: 2 x 8 KB (total 16 KB)
- Built-in debugging function
 - Emulation interface that conforms to JTAG (H-UDI)
 - User break controller (UBC)
- Package
 - LQFP-208, CSP-240 (100/133/167 MHz)
 - HQFP-208 (200 MHz)

Main applications

- Network application (VoIP), internet FAX, webphone, DSC, and TV conference system

SH7729R Block Diagram



Multimedia SH-4 RISC Processor



Features

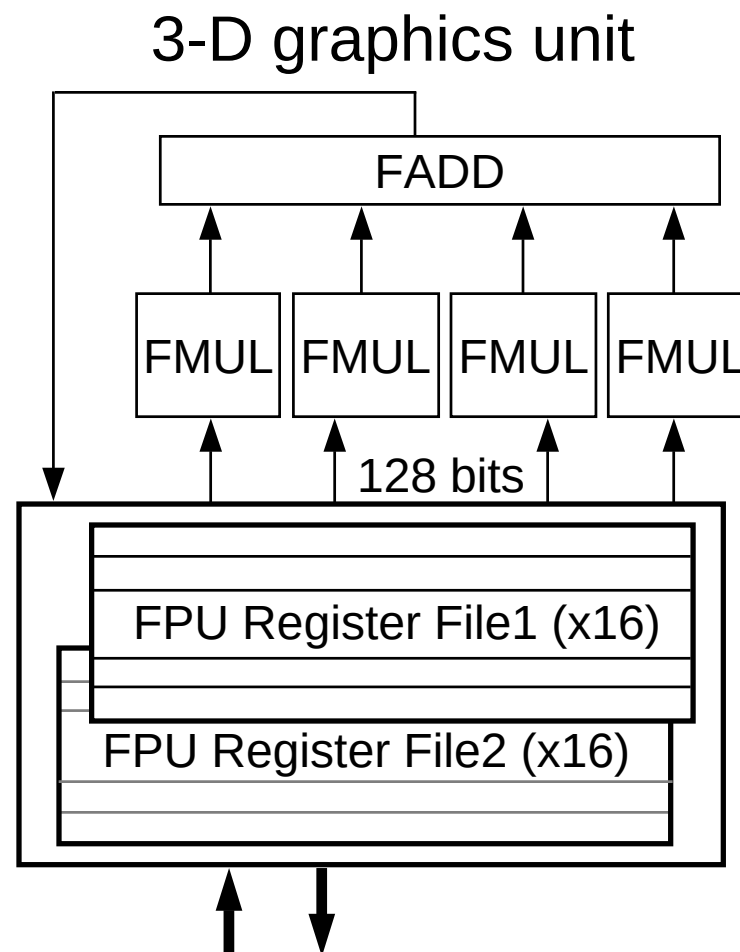
- High performance CPU that enables parallel execution of two instructions
- Ultra-high-speed 3D vector multiplier
- Upwardly compatible with SH-1/SH-2/SH-3 instruction sets
 - 16-bit fixed-length instructions
 - IEEE754 floating-point instructions are supported (high-speed single precision and double precision)

Ultra-High-Speed Floating-Point Operation

FTRV instruction XMTRX, FVn

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix} \times \begin{pmatrix} x \\ y \\ z \\ i \end{pmatrix} = \begin{pmatrix} x' \\ y' \\ z' \\ i' \end{pmatrix}$$

- 16 multiplications and 12 additions are executed in four clock cycles
- Loading/storing to other registers during an operation is possible



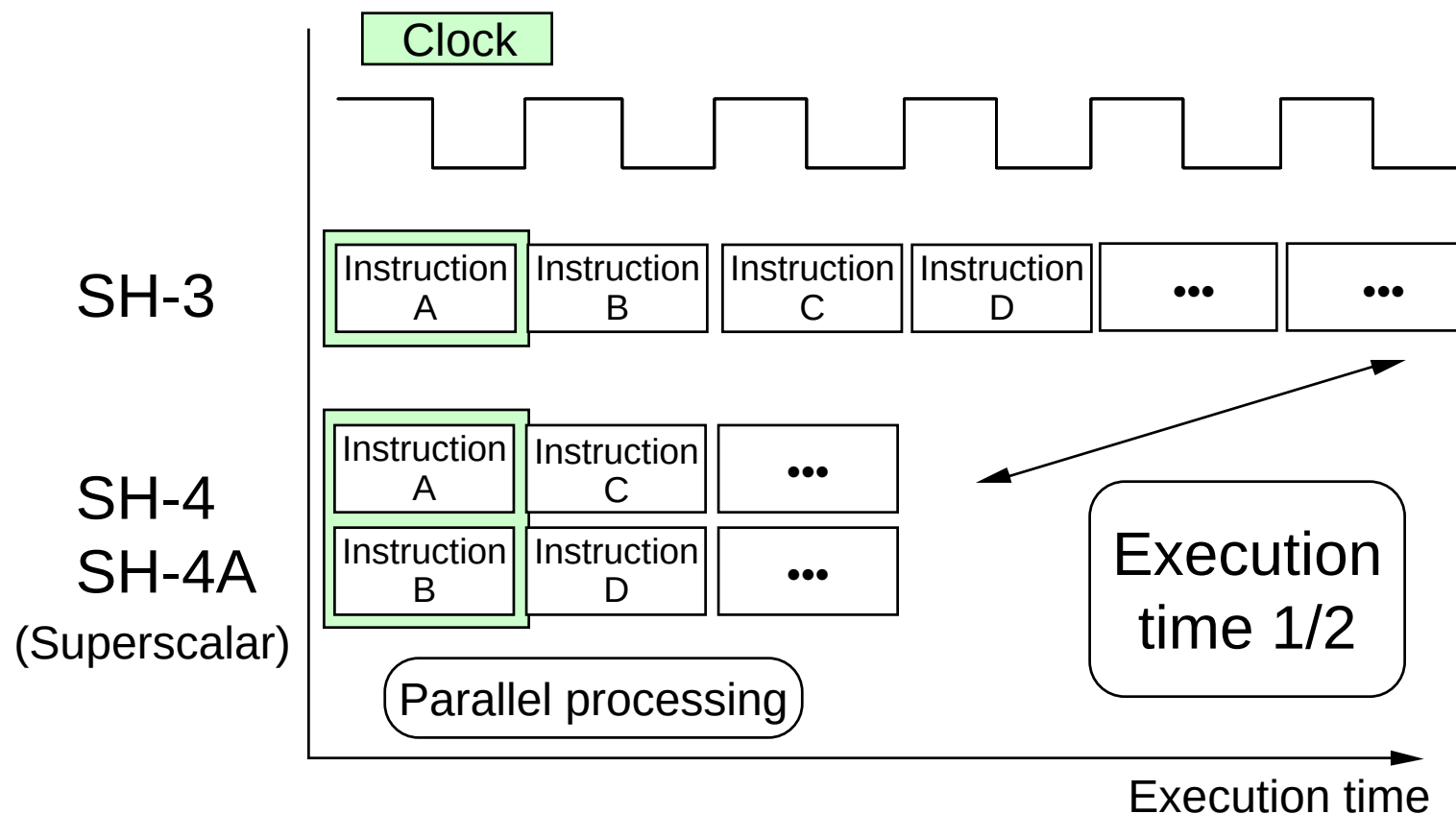
SH-4

SH-4A

Features of SH-4

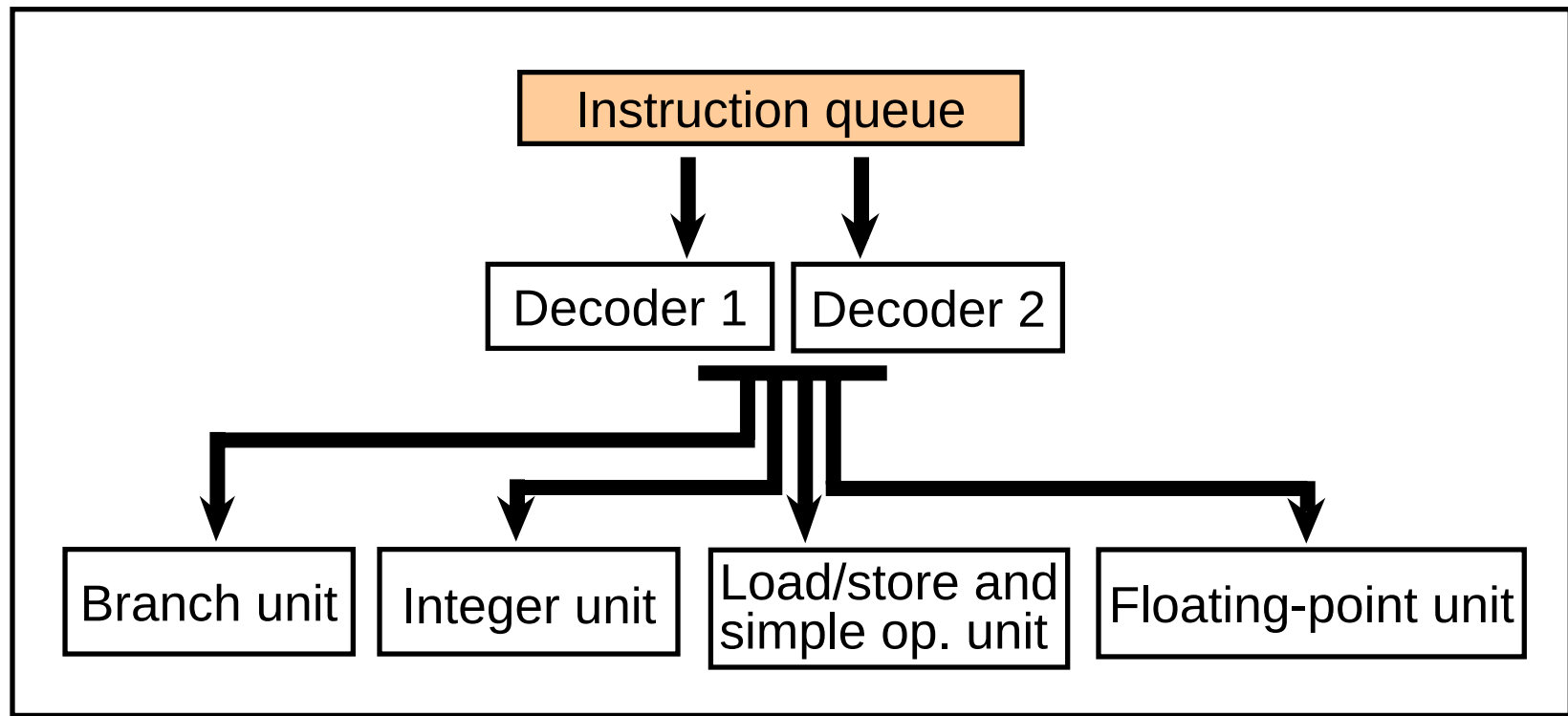
- Superscalar -

SuperH
RISC engine



2-Way Superscalar Method

- 2-instruction parallel execution
- Improved execution efficiency with simple hardware



SH7750S Overview

- 2-way superscalar structure -

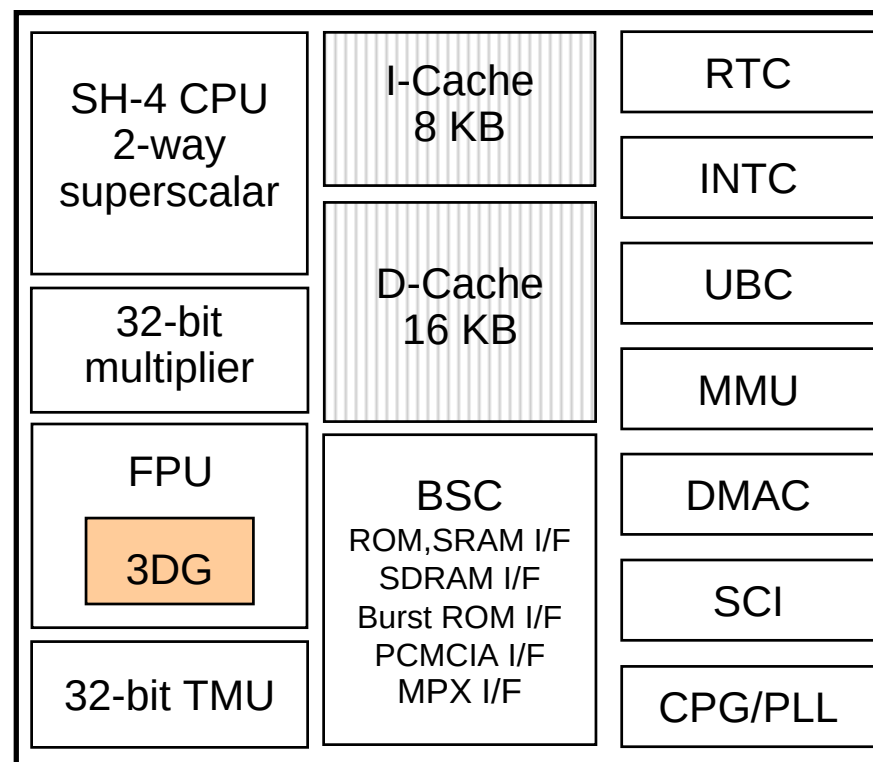
Features

- Operating frequency
Internal: 133/167/200 MHz
External: x1/2, x1/3, x1/4, x1/6, x1/8
- Performance
Integer: 360 MIPS (Dhrystone)/200 MHz
Floating point: 1.4 GFLOPS/200 MHz
- Internal method: Two-instruction parallel execution
- Cache: 8-KB instruction + 16-KB data
- Package
BGA-256: 200 MHz
QFP-208: 167/200 MHz
QFP-208: 133 MHz (SH7750SV)

Main applications

- Car navigation, image processing, STB, digital TV, printer, and MFP

SH7750S Block Diagram



SH7750R Overview

- 2-way superscalar architecture -

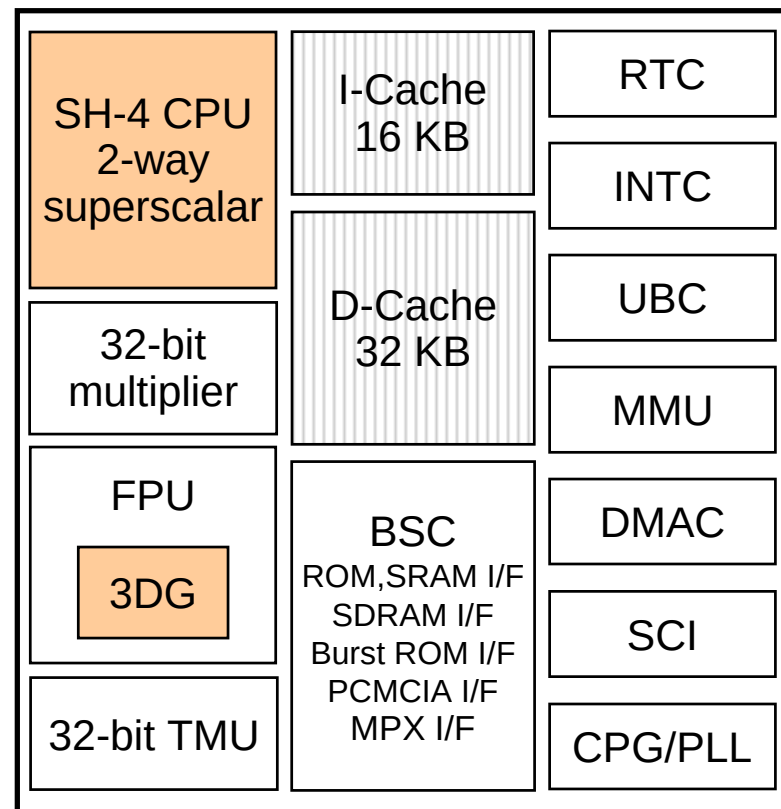
Features

- High-performance 2-way superscalar
- Operating frequency: 200/240 MHz
 - Internal power supply voltage: 1.5 V (typ)
- Performance
 - Integer: 430 MIPS (Dhrystone)/240 MHz
 - Floating point: 1.7 GFLOPS/240 MHz
- Built-in MMU
- Cache: (Harvard architecture)
 - large-capacity cache:
 - 16-KB instruction + 32-KB data
(2-way set associative)
- Pin compatible with SH7750 and SH7750S
- DMAC: 8 channels
- When bus width is 64 bits, 256-Mbit SDRAM (x16) is supported
- Package: BGA-256
QFP-208

Main applications

- Car navigation, image processing, STB, digital TV, and printer

SH7750R Block Diagram



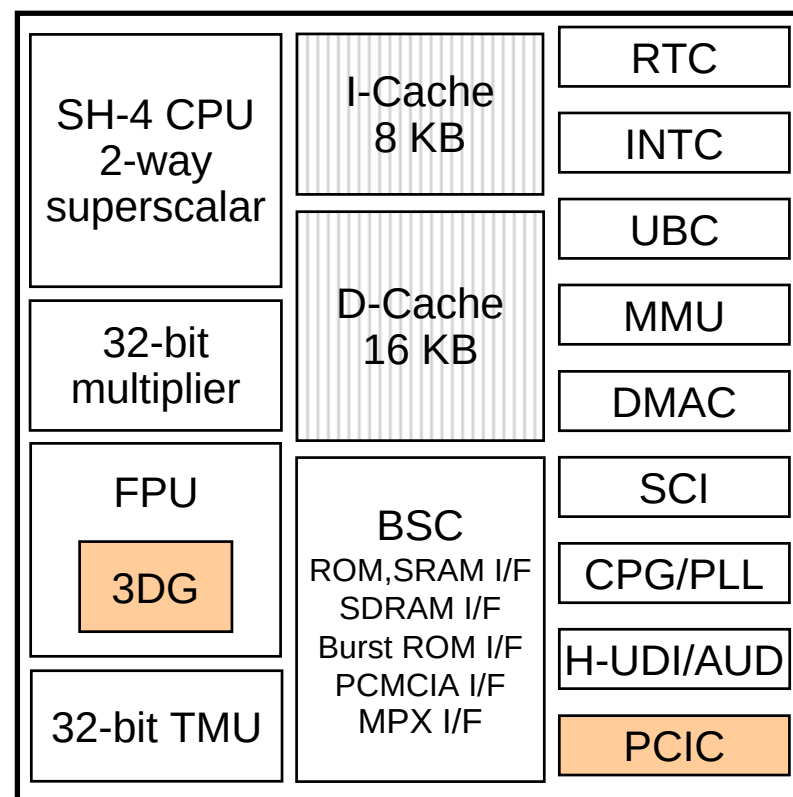
Features

- Operating frequency: 167 MHz
- Use of a superscalar (2-instruction parallel execution)
 - Integer performance: 300 MIPS (Dhrystone)/167 MHz
 - Floating point performance: 1.2 GFLOPS/167 MHz
- Upwardly compatible with SH-3 instruction sets
 - 16-bit fixed-length instructions (best code efficiency)
 - IEEE754 floating-point instructions supported: single precision and double precision
- Built-in PCI bus controller
 - 32-bit bus: 33/66 MHz
 - Built-in PCI of DMAC (4 channels)
- Cache: 8-KB instruction + 16-KB data (32-B/line)
- Debugging function: Built-in H-UDI
- Package: QFP-256,BGA-256

Main applications

- Telecommunication: Router, PBX, and LAN/WAN
- OA/PC peripheral: Printer, scanner, and PPC

SH7751 Block Diagram



SH7751R Overview

- SH-4 on-chip PCI version -

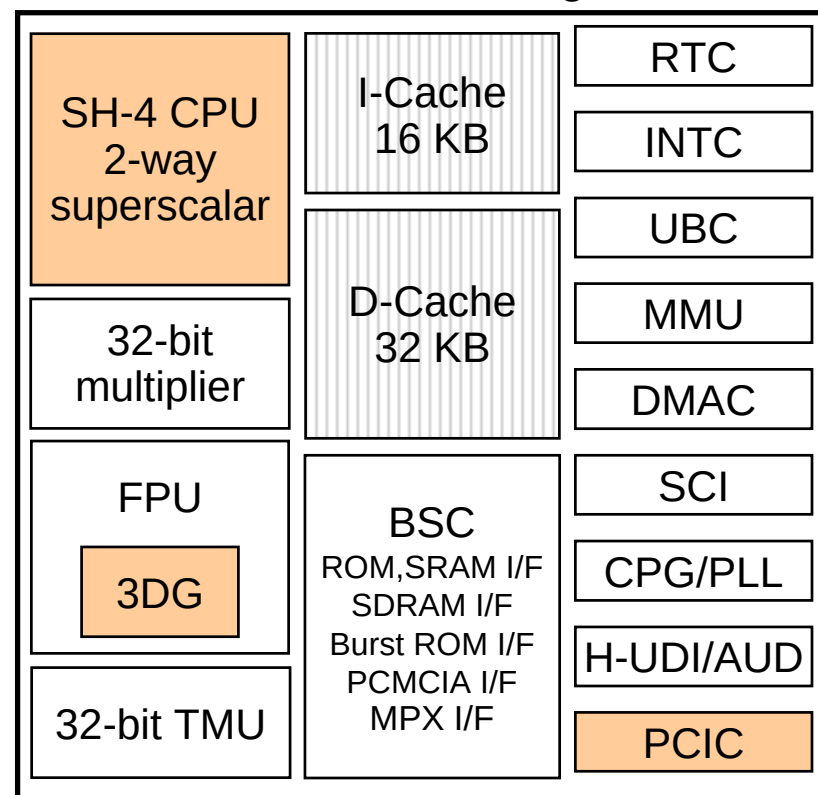
Features

- High-performance 2-way superscalar
- Operating frequency: 200/240 MHz
 - Internal power supply voltage: 1.5 V (typ)
- Performance
 - Integer: 430 MIPS (Dhrystone)/240 MHz
 - Floating point: 1.7 GFLOPS/240 MHz
- Built-in MMU
- Cache: (Harvard architecture)
 - large-capacity Cache:
16-KB instruction + 32-KB data
(2-way set associative)
- Pin compatible with SH7751
- DMAC: 8 channels
- Package: BGA-256, QFP-256

Main applications

- Communications: Routers, PBX, LAN/WAN, and NAS
- OA/PC peripherals: Printer, scanner, and PPC

SH7751Block Diagram



SH7760 Overview

- High-performance processor with on-chip LCD controller and USB host -

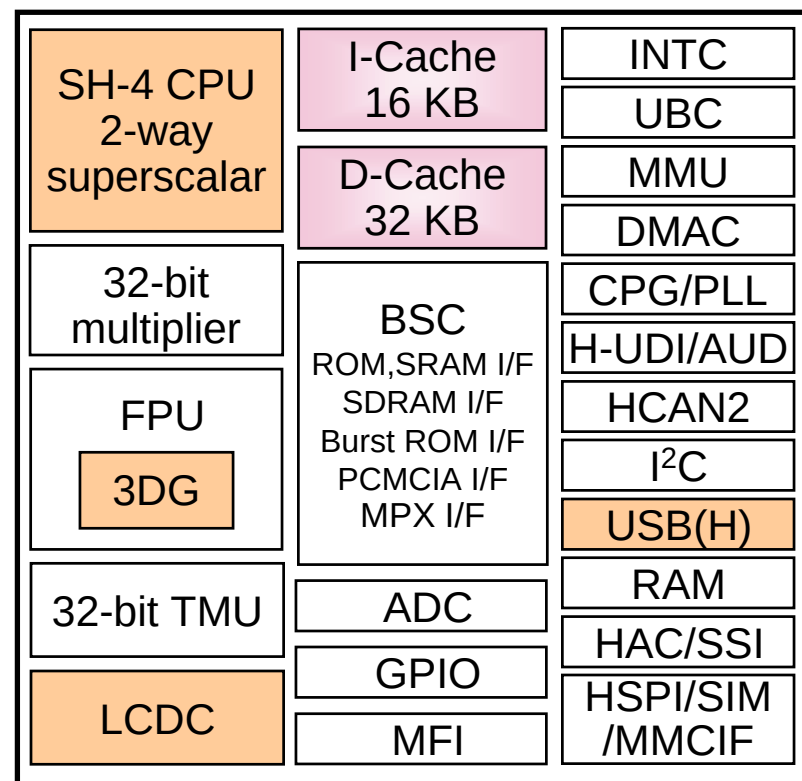
Features

- High-performance 2-way superscalar
- Operating frequency:
200 MHz (Internal)/66 MHz (Bus)
 - Internal power supply voltage: 1.5 V (typ)
- Performance
 - Integer: 360 MIPS (Dhrystone)@200 MHz
 - Floating point: 1.4 GFLOPS@200 MHz
- large-capacity Cache:
16-KB instruction + 32-KB data
(2-way set associative)
- Peripheral functions
 - LCDC: LCD controller (640 x 480: 256 colors, etc.)
 - USB: USB host (Full / Low Speed)
 - OHCI: Ver.1.0
 - SCIF, HAC, SSI, I²C, HSPI, SIM, MMCIF, CMT, ADC, MFI, and GPIO
- Package: BGA-256 (21 x 21, 1-mm pitch)
BGA-256 (17 x 17, 0.8-mm pitch)

Main applications

- Car navigation, Telematics

SH7760 Block Diagram



Features

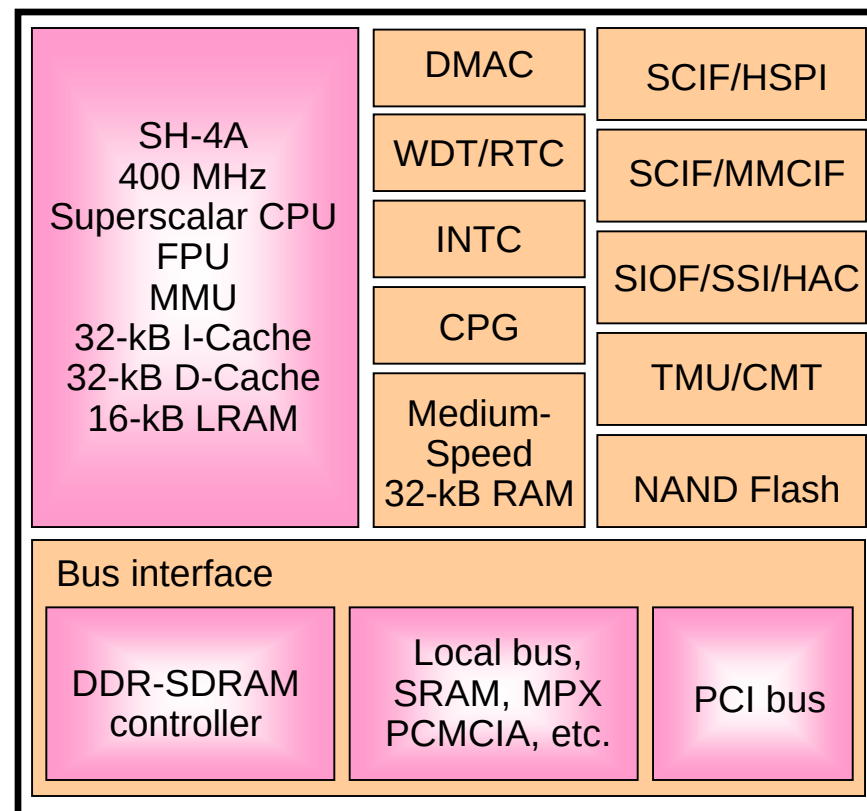
- CPU core
 - CPU core: SH-4A
 - Operating frequency: 400 MHz@1.25V
- External bus interface (3-bus configuration)

	Voltage	Bus width	Operating frequency
- DDR I/F	2.5 V	32 bits	160 MHz
- Local bus	3.3 V	32 bits	100 MHz
- PCI	3.3V	32 bits	33/36 MHz
- Cache memory/on-chip memory
 - Instruction cache: 32 kbytes (4-way set associative)
 - Data cache: 32 KB (4-way set associative)
 - LRAM(high-speed): 16 KB
 - Medium-speed RAM: 32 KB
- On-chip peripheral modules
 - DMAC: 12 ch
 - SCIF: 2 ch
 - SIOF/SSI/HAC
 - NAND flash controller
 - MMCIF
- Package: BGA-449 (21 x 21, 0.8-mm pitch)

Main applications

- Car navigation, amusement equipment, network terminals, laser-beam printers

SH7780 Block Diagram



Features

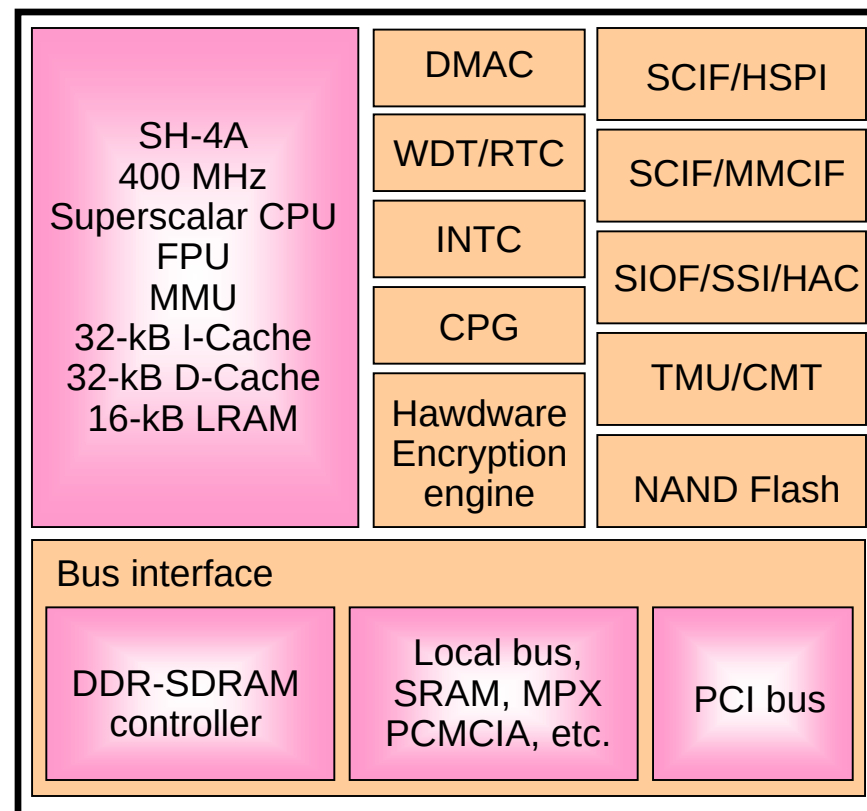
- CPU core
 - CPU core: SH-4A
 - Operating frequency: 400 MHz@1.25V
- External bus interface (3-bus configuration)

	Voltage	Bus width	Operating frequency
- DDR I/F	2.5 V	32 bits	160 MHz
- Local bus	3.3 V	32 bits	100 MHz
- PCI	3.3V	32 bits	33/36 MHz
- Cache memory/on-chip memory
 - Instruction cache: 32 kbytes (4-way set associative)
 - Data cache: 32 KB (4-way set associative)
 - LRAM(high-speed): 16 KB
- On-chip peripheral modules
 - DMAC: 12 ch
 - SCIF: 2 ch
 - SIOF/SSI/HAC
 - NAND flash controller
 - MMCIF
 - Hardware encryption engine (SHA-1, MDS, 3DES, AES, MISTY, camellia)
- Package: BGA-449 (21 x 21, 0.8-mm pitch)

Main applications

- Network control systems in general such as NAS (Network Attached Server) and broadband VPN router

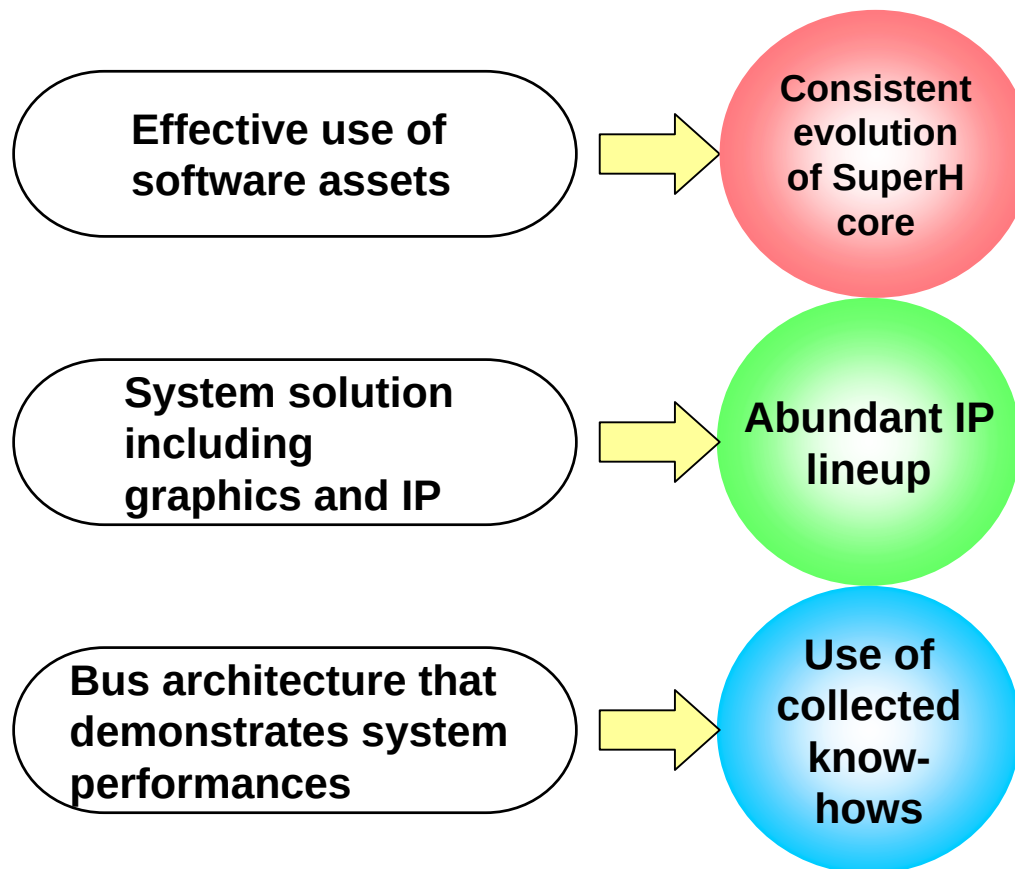
SH7781 Block Diagram



SH7770 for Full Graphics Display Type **SuperH** In-Vehicle Terminal RISC engine



- All-in-one chip with graphics accelerator
- Introduction of newly developed 400-MHz SH-4A core



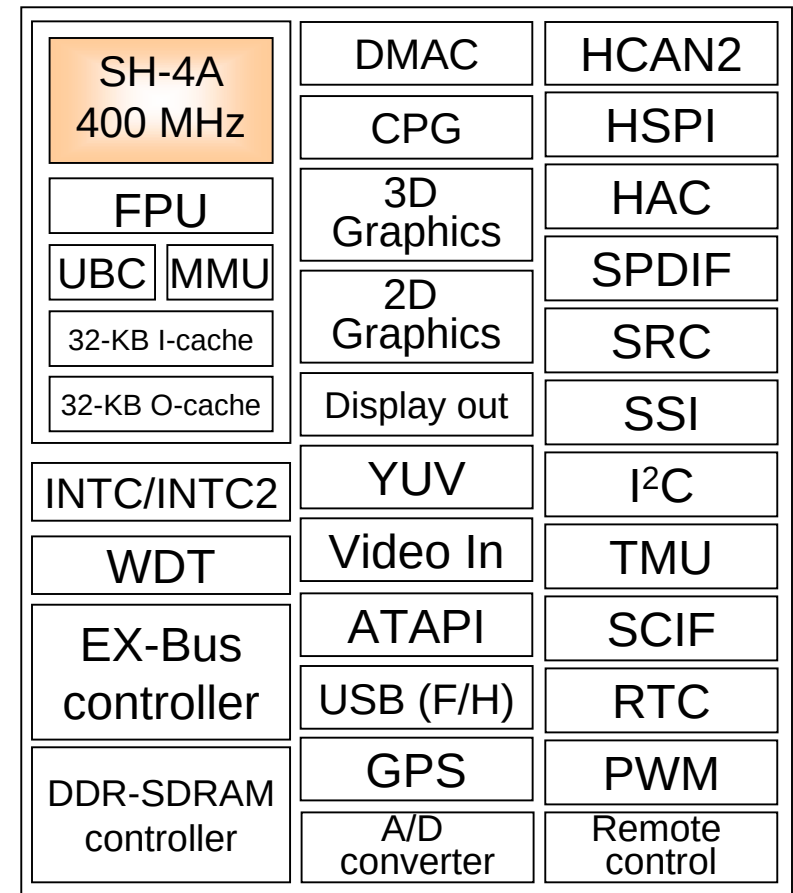
SH7770 Overview

SuperH
RISC engine

SH7770

Features

- Max. internal operating frequency of SH-4A core: 400 MHz
- Power supply: 3.3 V (I/O), 2.5 V (DDR), 1.25 V (core)
- Performance: 720 MIPS (Dhrystone) @ 400 MHz
- 2-way superscalar, 7-stage pipeline
- Cache: 32-KB 4-way set associative (I-, O-cache)
- Memory: DDR SDRAM I/F
- 3D/2D Graphics
 - 2D Engine
 - 3D Engine
- Display: WVGA 854 dots x 480 dots (16-bit pixel)
- Peripheral functions:
Please refer to the diagram at right.
- Package: BGA-520 pins
(33 mm x 33 mm, 1.0-mm pitch)

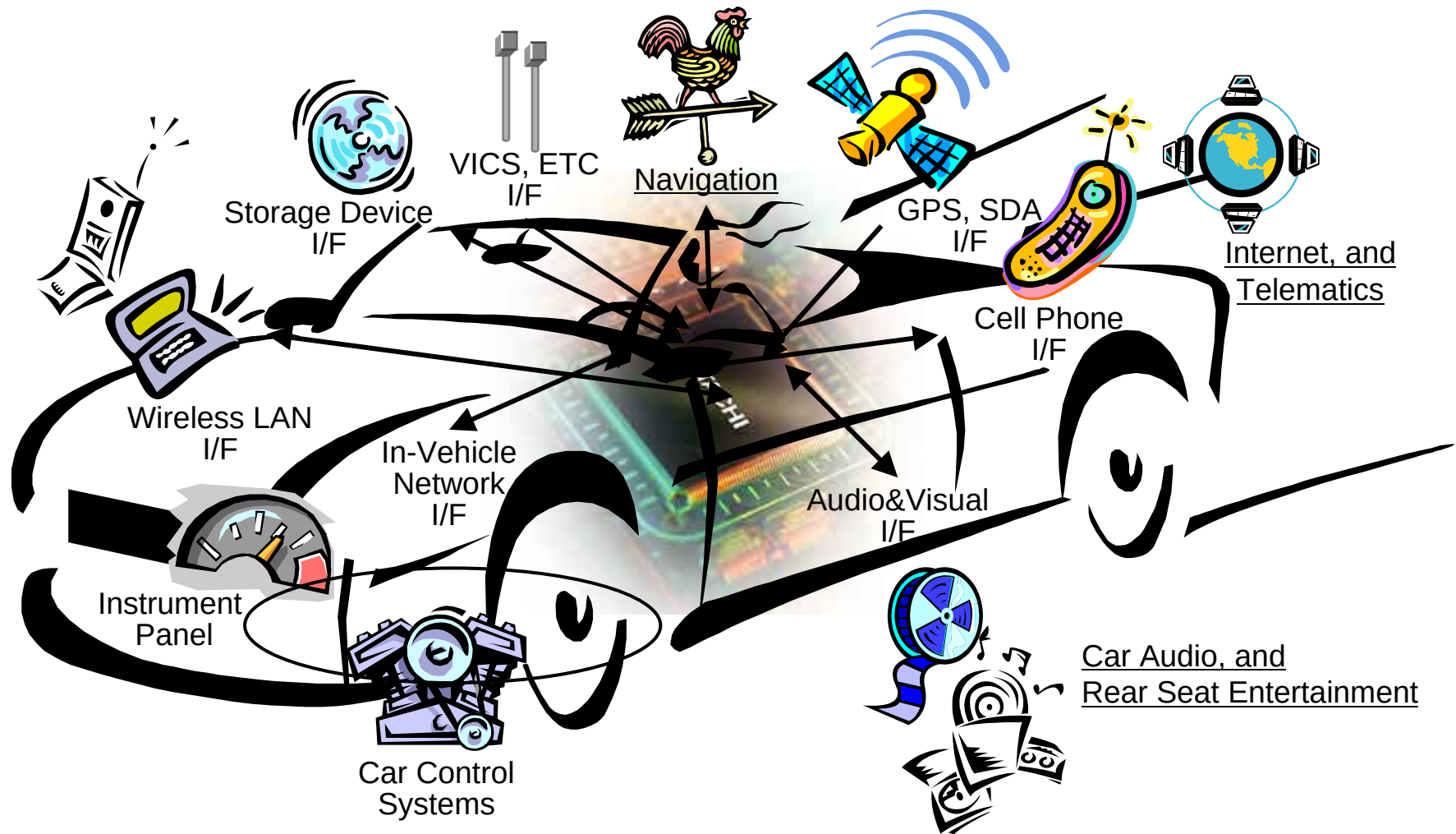


Graphics LSI

Realizes Car Information Systems

SuperH
RISC engine

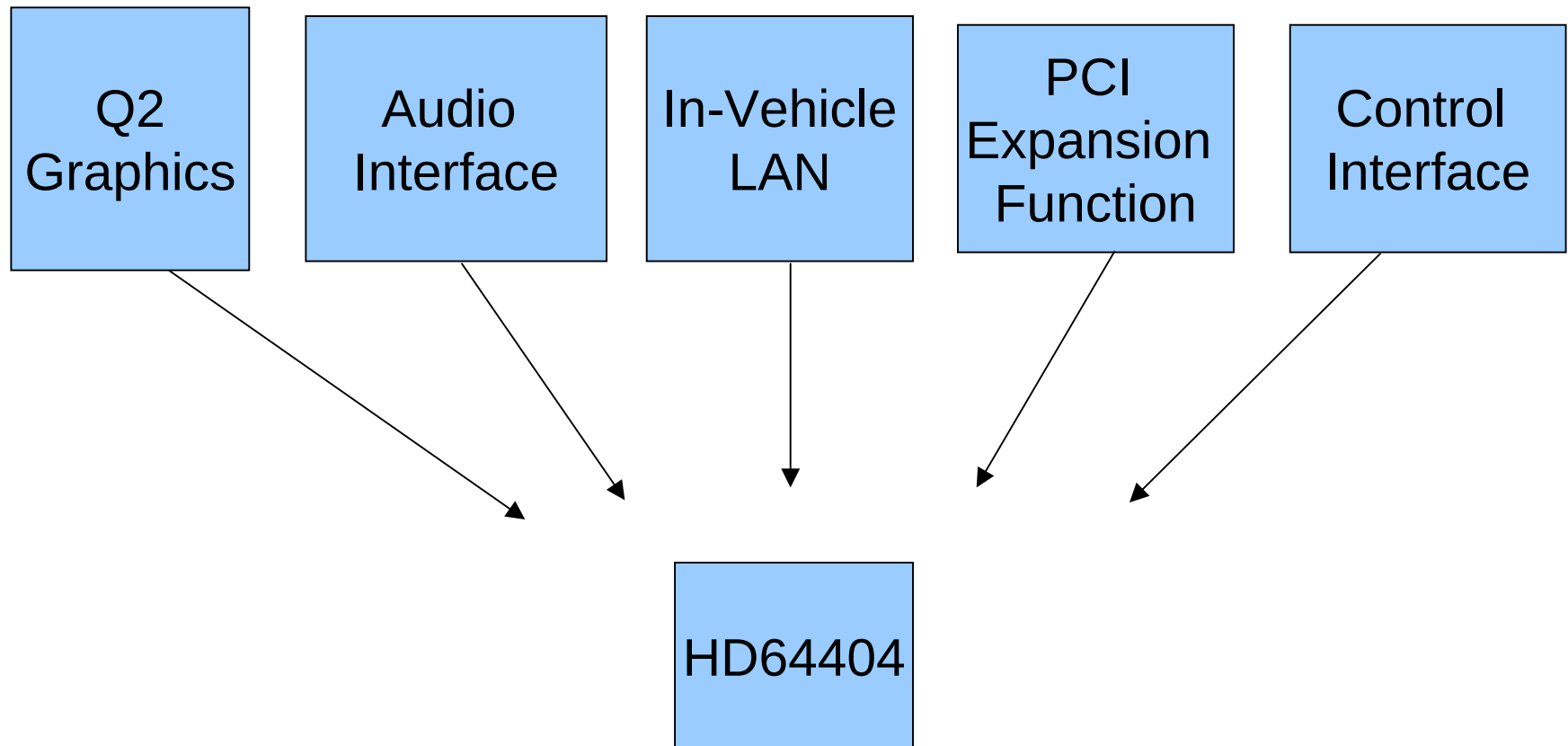
- Together with Peripheral LSIs that Support Various Functions... -



Introduction to the HD64404



Enhanced I/O is added to the graphic engine Q2, which has a good reputation in the current navigation system. The HD64404 is a peripheral LSI that includes the following peripheral functions.



Main Functions of the HD64404



- Provides the system solution together with the 32-bit RISC SH-4 CPU
- Integrates IPs that are required for the CIS and the graphic core in one chip
- Supports in-vehicle networks MOST and CAN
- Includes 33-MHz PCI bus
- Max. 128-MB SDRAM (100 MHz) can be used
- System memory and frame memory for an image can be shared by the UMA architecture

Major Included Functions of the HD64404

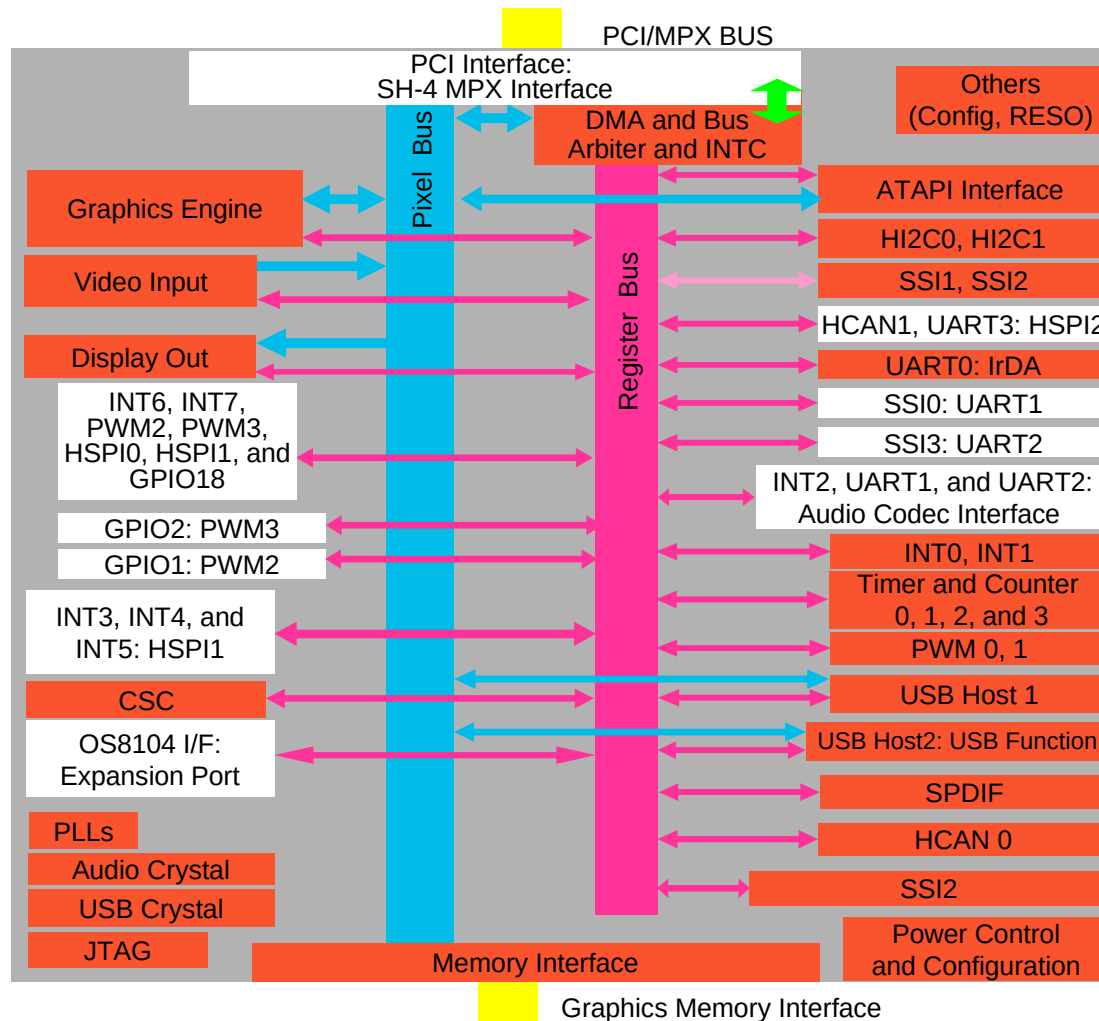
SuperH
RISC engine

PCI interface	SPDIF
INTC (interrupt controller)	SSI Interface x 2 ch
DMAC	Audio Codec Interface
Graphics engine	I ² C Interface x 2 ch
Video Input	HSPI x 3 ch
Display Out	Timer/counter 4-input capture
ATAPI	PWM x 4 ch
USB Host	UART x 4 ch
USB Function	IrDA
HCAN x 2 ch	CSC
MOST (OS8104 interface)	

SSI: Serial Sound Interface
CSC: Color Space Converter
I²C bus is a trademark of Phillips Corp.

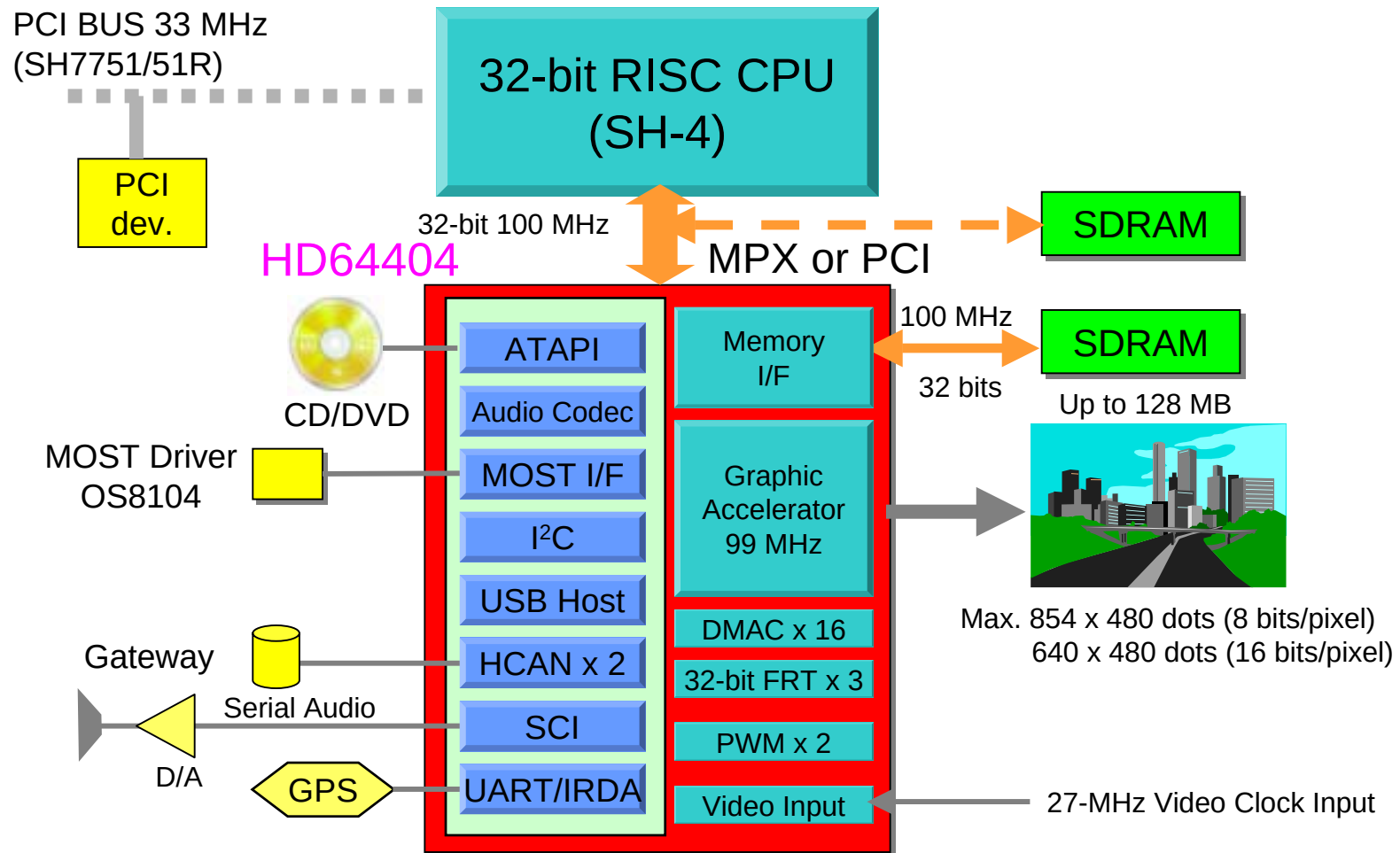
HD64404 Block Diagram

SuperH
RISC engine



Example of the HD64404 System

SuperH
RISC engine



HD64404 and Car Information System (CIS)



Interfaces between various multi-media related products are enabled by incorporating ample peripheral functions that support CIS and correspond to in-vehicle functions that are becoming more efficient. Thus, CIS with enhanced functions can be realized with a simple system configuration that includes the LSI. By connecting to the SH-4 Series PCI interface, further expansion of functions is possible.

The SH-4, which supports middleware and OS systems, contributes to the realization of CIS products that are expected to be developed in the future.

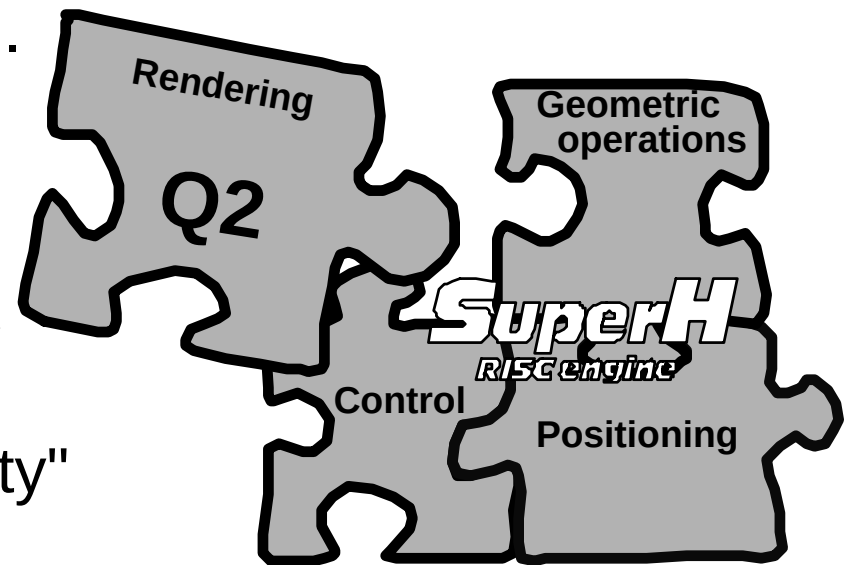
What Does the Q2 Do?



Quick 2D Graphics Renderer

By using the chip set forms when employed together with the SuperH RISC engine Family, the Q2 provides you with the geometric, rendering, and display processing needed for a graphic display system of a compact size and high speed.

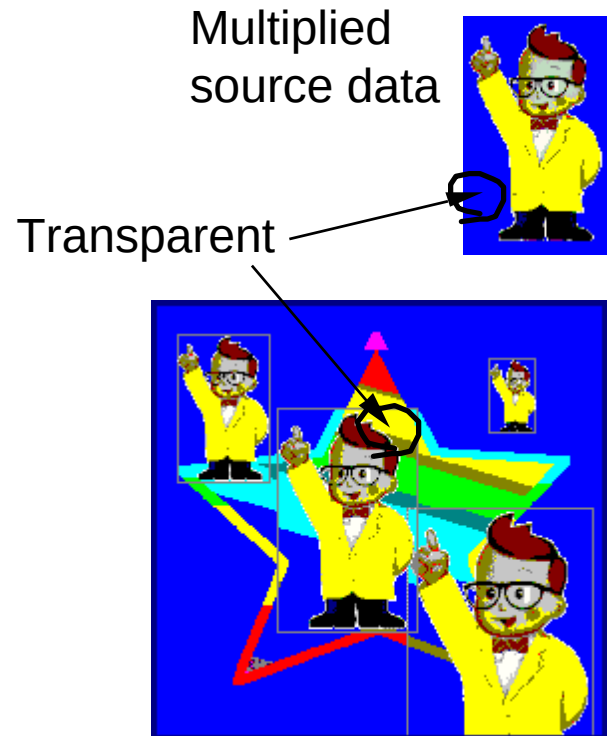
The Q2 handles rendering and display processing matched to the SuperH RISC engine Family, with "simple", "realtime", and "upgrade ability" as its key concepts.



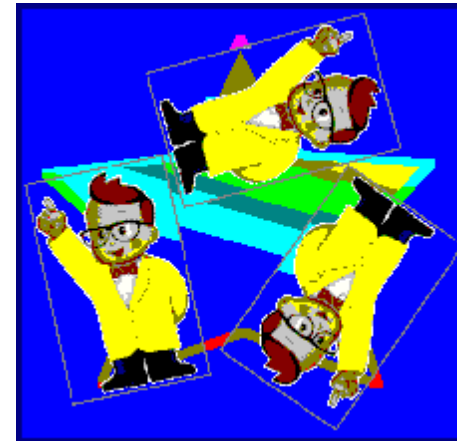
Features of Q2

SuperH
RISC engine

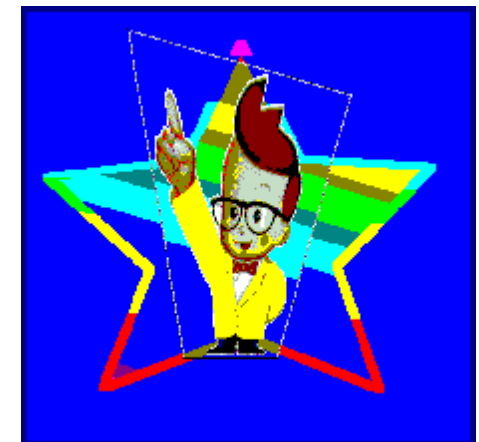
■ Application examples of plane drawing



Arbitrary enlargement
and reduction



Arbitrary rotation

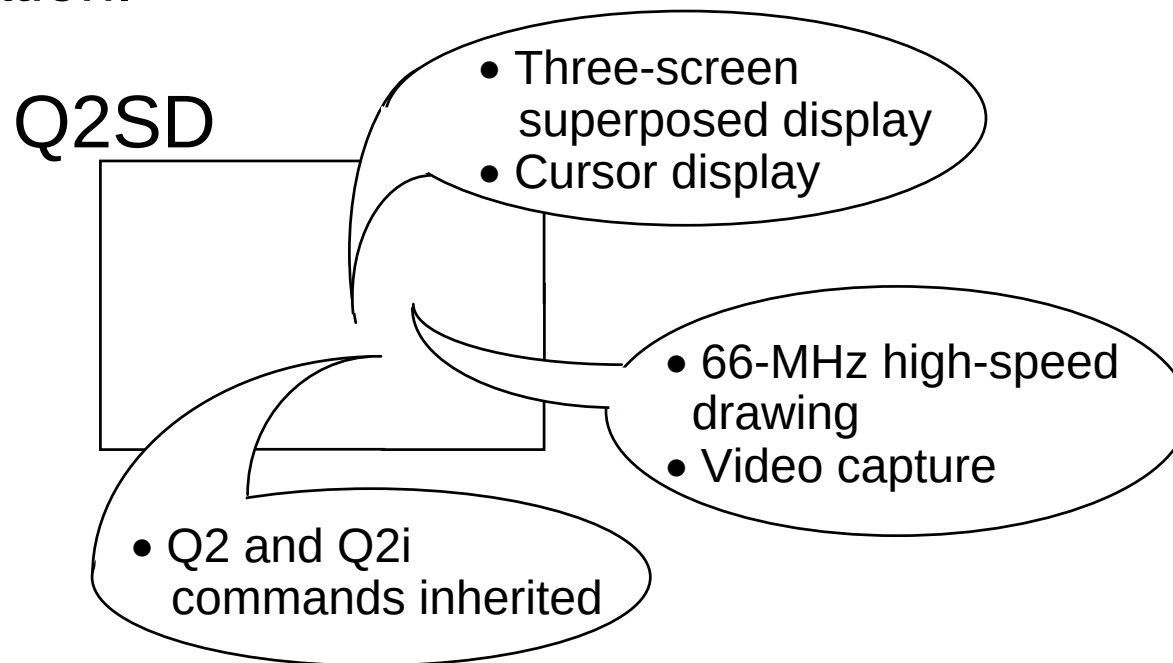


Arbitrary
deformation

Q2SD (HD64413A)

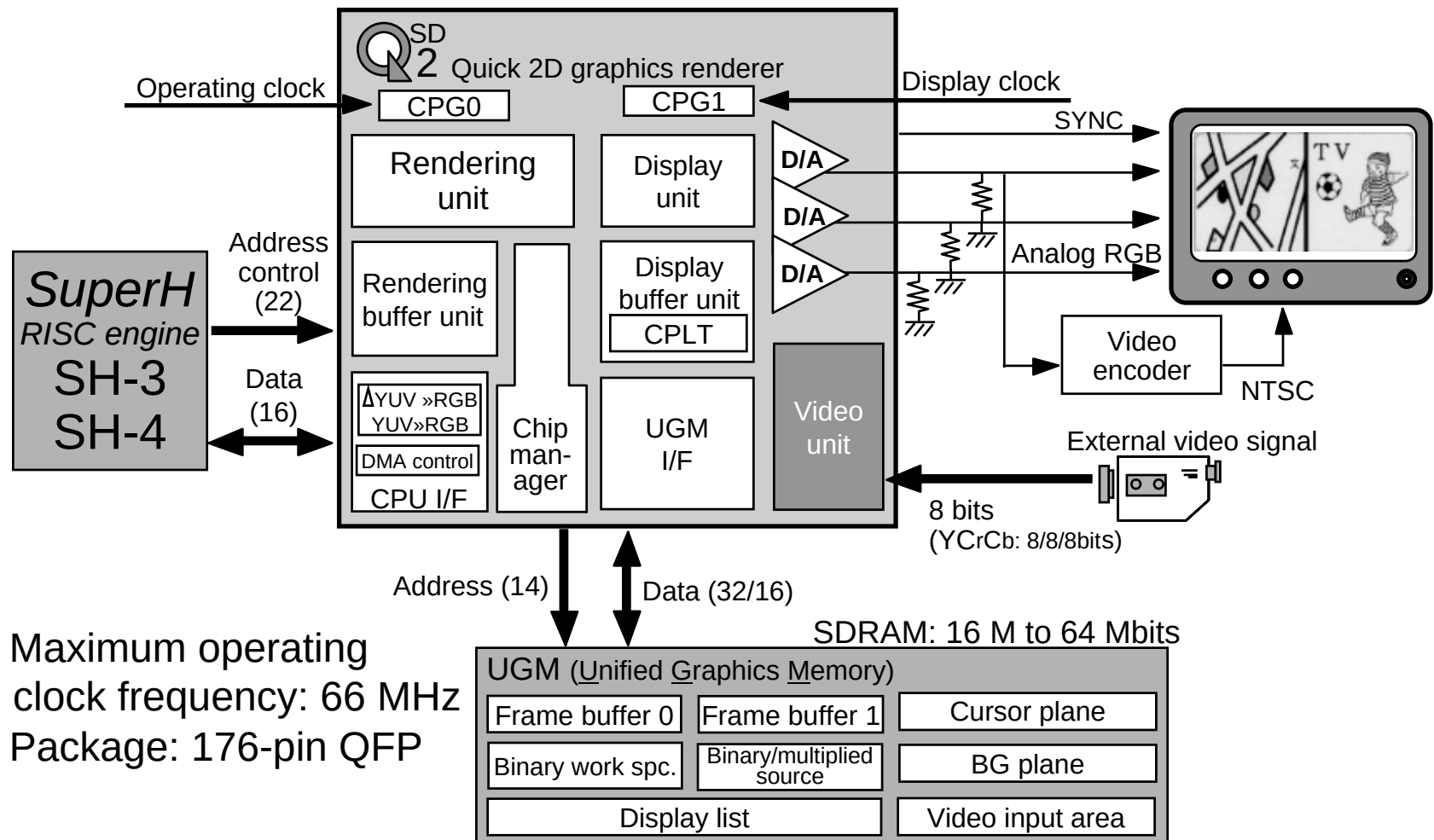
SuperH
RISC engine

Q2SD (Quick 2D Graphics Renderer with Synchronous DRAM Interface) is a graphics renderer LSI which enables three-screen superposed display in realtime. High-speed drawing processing in a compact configuration.



System Configuration of Q2SD (HD64413A)

SuperH
RISC engine



- Maximum operating clock frequency: 66 MHz
- Package: 176-pin QFP

Functions of Q2/Q2i/Q2SD

SuperH
RISC engine

Item		HD64411 (Q2)	HD64412 (Q2i)	HD64413A (Q2SD)
Maximum operating frequency	Internal drawing operation	33 MHz		66 MHz
	Display operation	16.5 MHz		33 MHz
Drawing performance*1	Polygons/s	23,000		91,000
	Lines/s*3	480,000		1,200,000
Drawing function	Drawing command	Plane, broken line, and work pattern		
	Drawing control command	Coordinate offset setting, current pointer setting, and clipping setting		
	Sequence control command	Jump and subroutine		
	Coordinate	Rendering coordinate, work coordinate, and binary/multi-level coordinate		
	Drawing halt and restart	No support	Hardware support	
Display function	Display size example	Non-interlaced 320 x 240, 400 x 240 pixels Interlaced sync. & video 640 x 480 pixels		The same as on the left + Non-interlaced 640 x 480 pixels
	CRT scanning	Non-interlaced, interlaced, and interlaced sync. & video		
	External signal synchronization	TV synchronization		
	Screen synthesis	No	Background	Background, video, and cursor planes
	Display color	256 colors (selected among 262,144 colors) or 65,536 colors		256 colors or 65,536 colors selectable for each plane
	CSYNC output	No equalizing pulse		Equalizing pulse included
Interface function	Video capture	No		4: 2: 2 YCrCb digital
	DMA transfer	Single address Cycle stall mode		Single address, dual address Cycle stall mode
	Compressed data expansion	YUV/ Δ YUV to RGB conversion		
	SuperH applied	SH-1, SH-2, and SH-3		SH-3, and SH-4
	UGM	EDO-DRAM/32 Mbits max.		SDRAM/64 Mbits max.
	Output data	YCrCb digital Digital RGB	Digital RGB	Analog RGB
Process		0.6- μ m CMOS		0.35- μ m CMOS
Package		144-pin QFP2020 (0.5-mm pitch)		176-pin LQFP2424 (0.5-mm pitch)
Power-supply voltage		5.0 V $\pm$ 5%		3.3 V $\pm$ 0.3 V
Temperature range*2		0°C to 70°C		

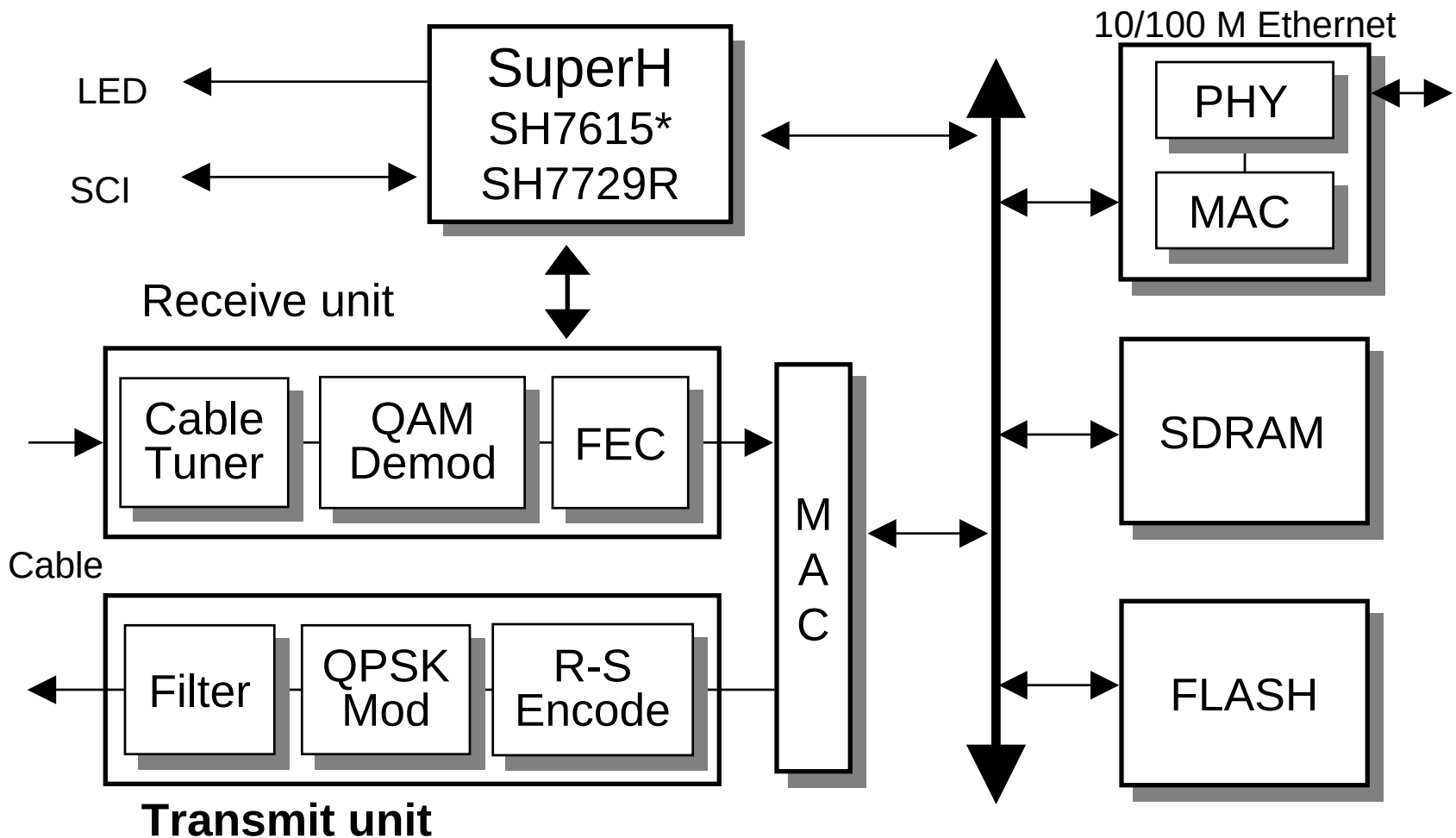
Notes: 1. Polygon = 25 x 20 pixels, line = 10 pixels 2. For -40°C to +85°C specification products, contact sales persons in charge.

3. The same result is achieved when drawing a line in any direction.

SuperH RISC engine System Application

Configuration Example of the Cable Modem

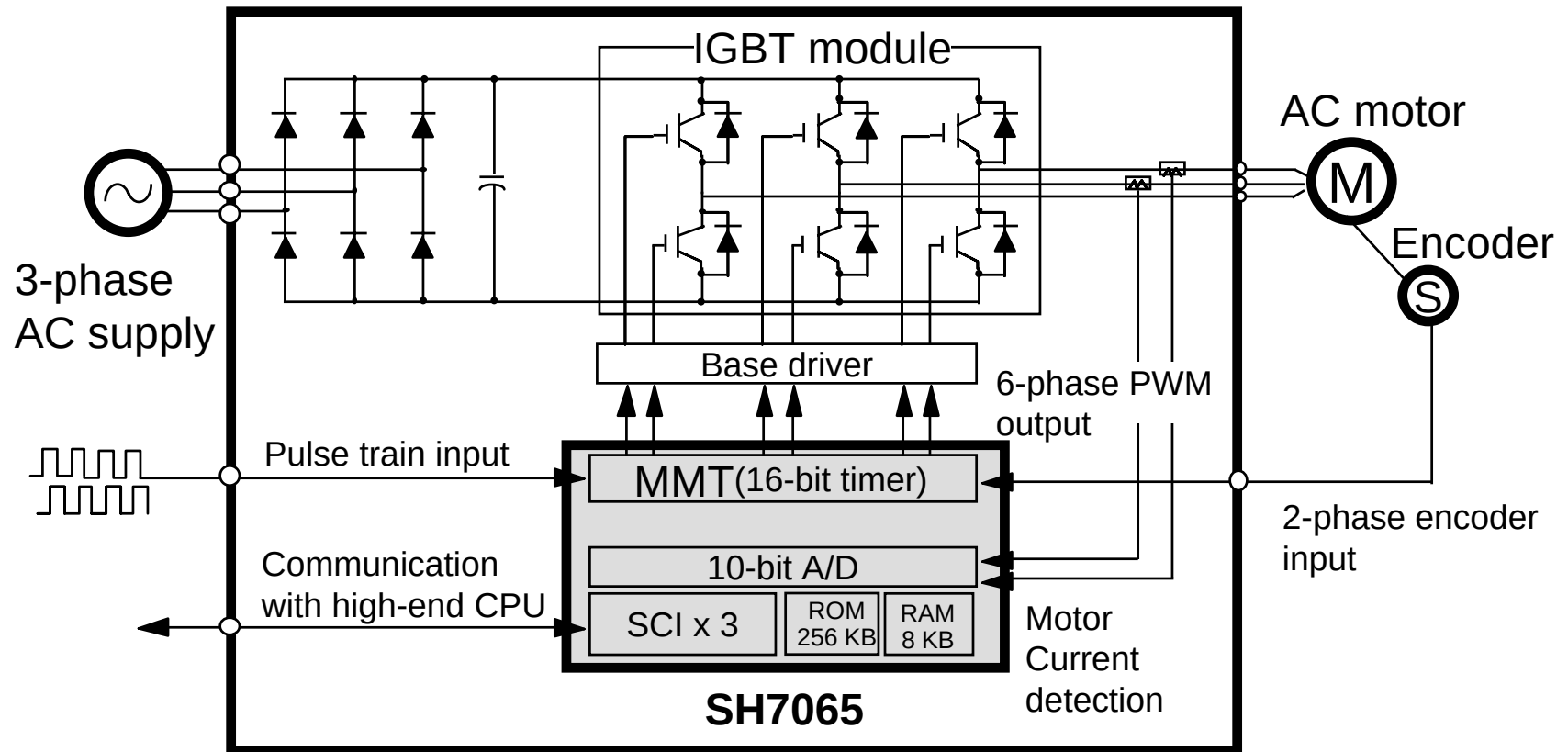
SuperH
RISC engine



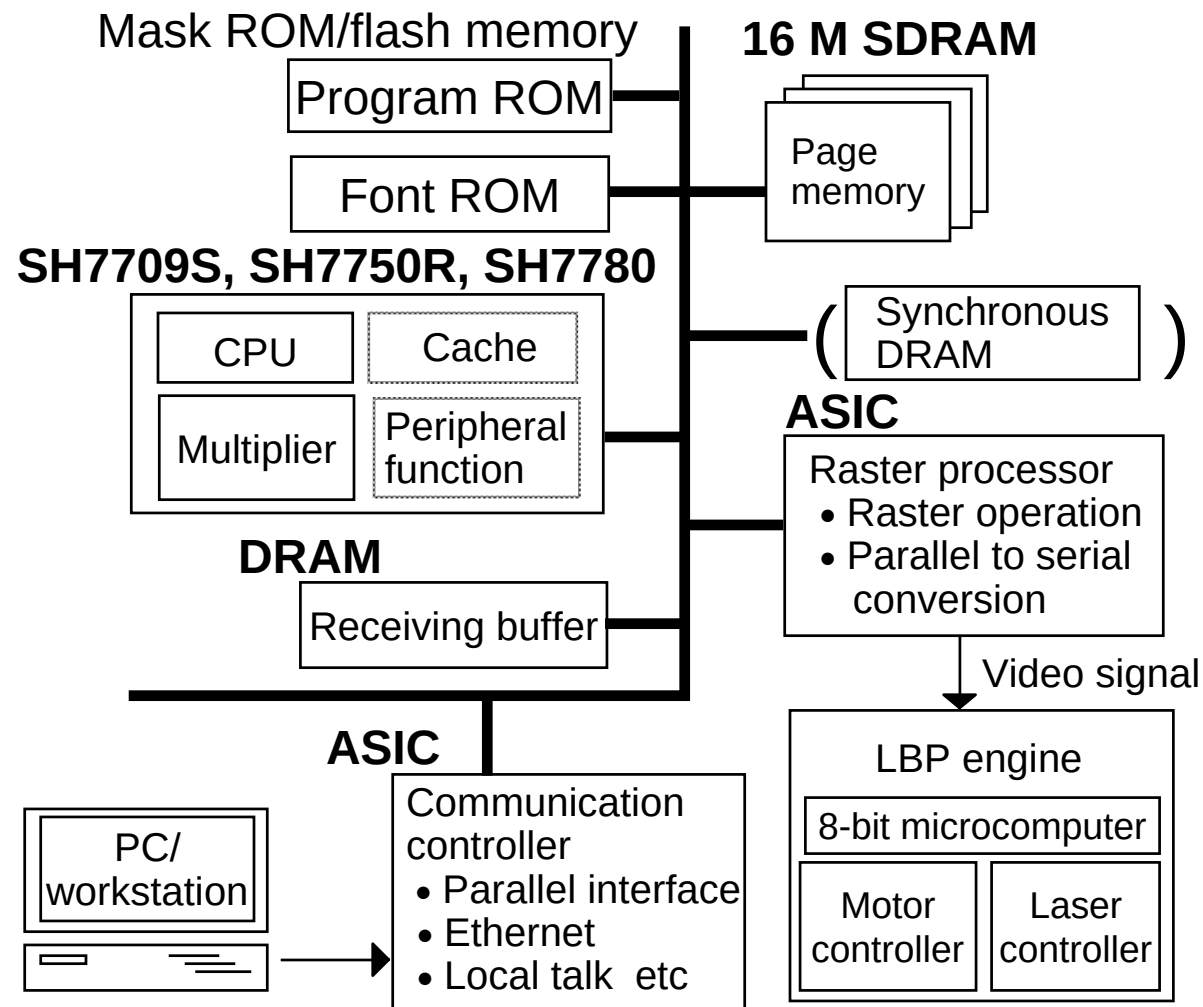
* Built-in Ether MAC

Configuration Example of the AC Servo Control System

SuperH
RISC engine

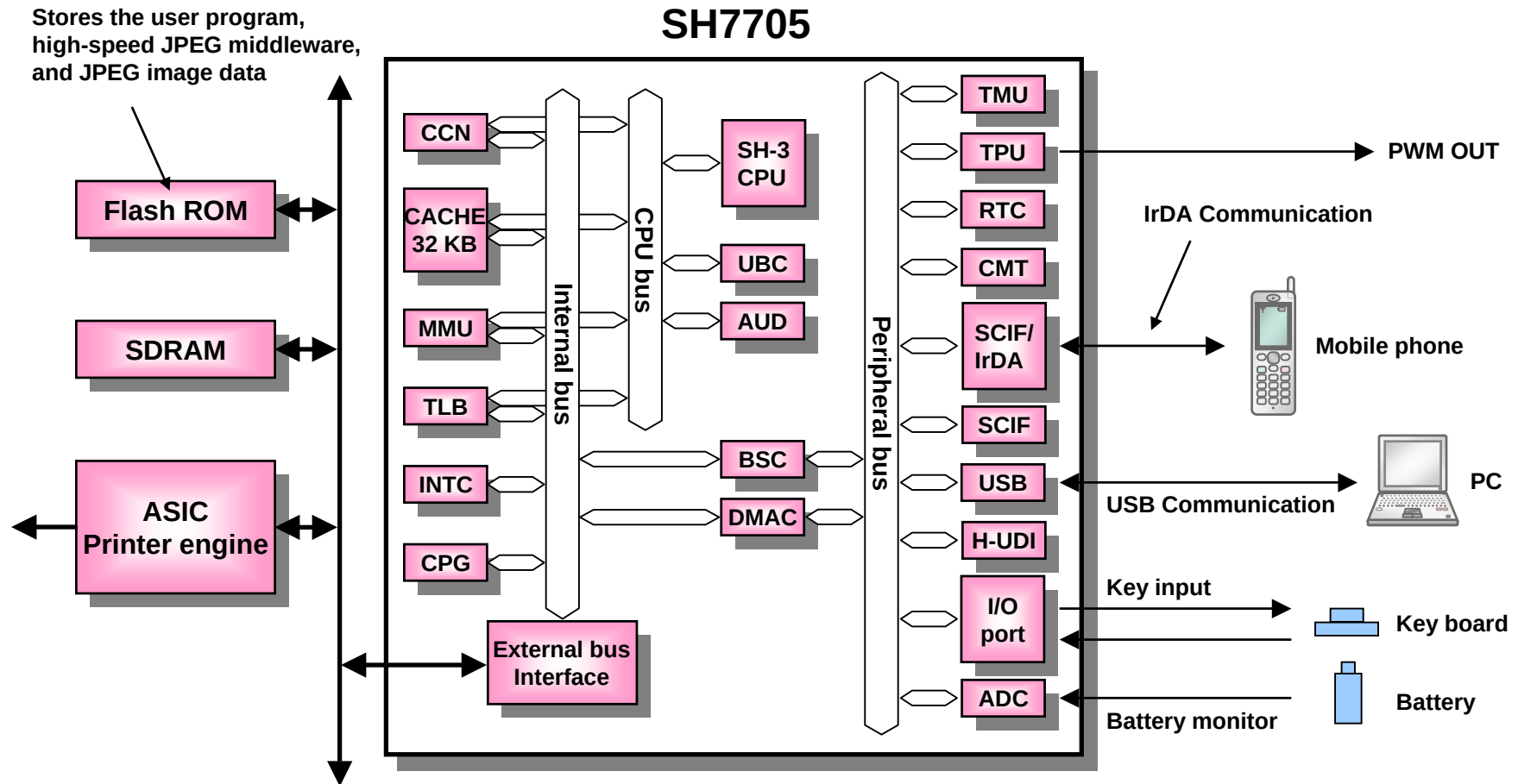


Configuration Example of the Page Printer System



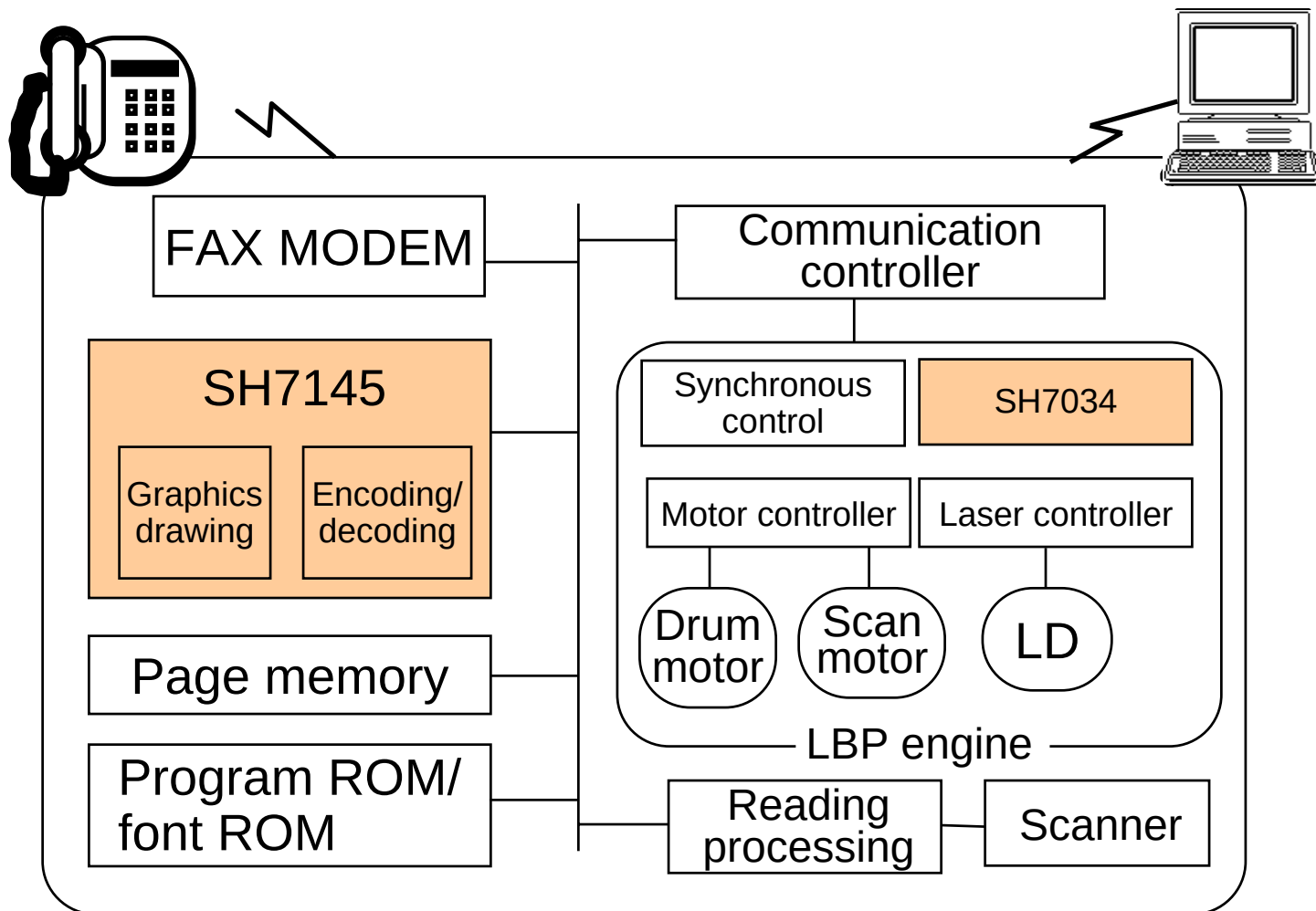
Configuration Example of the Compact Printer System

SuperH
RISC engine



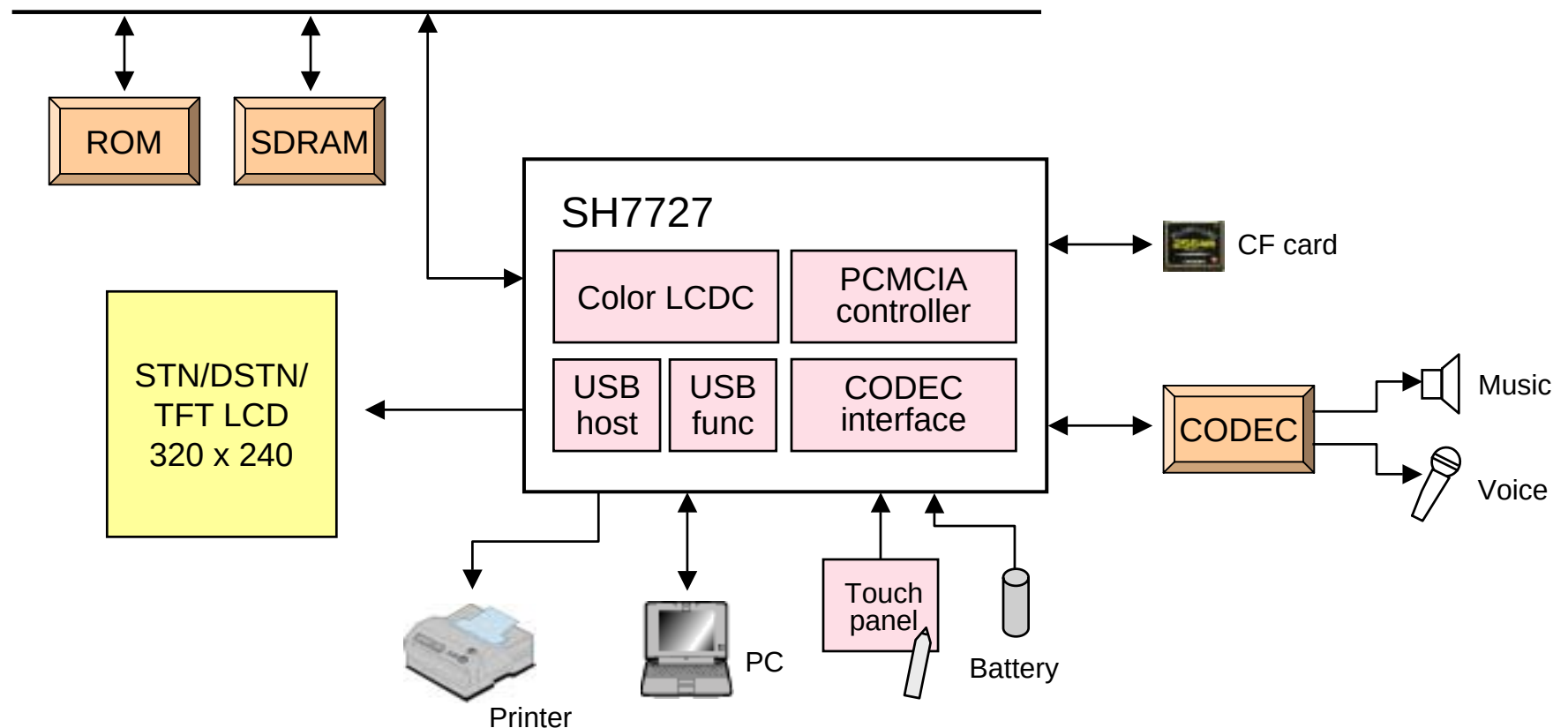
Configuration Example of the Multi-Function Printer

SuperH
RISC engine



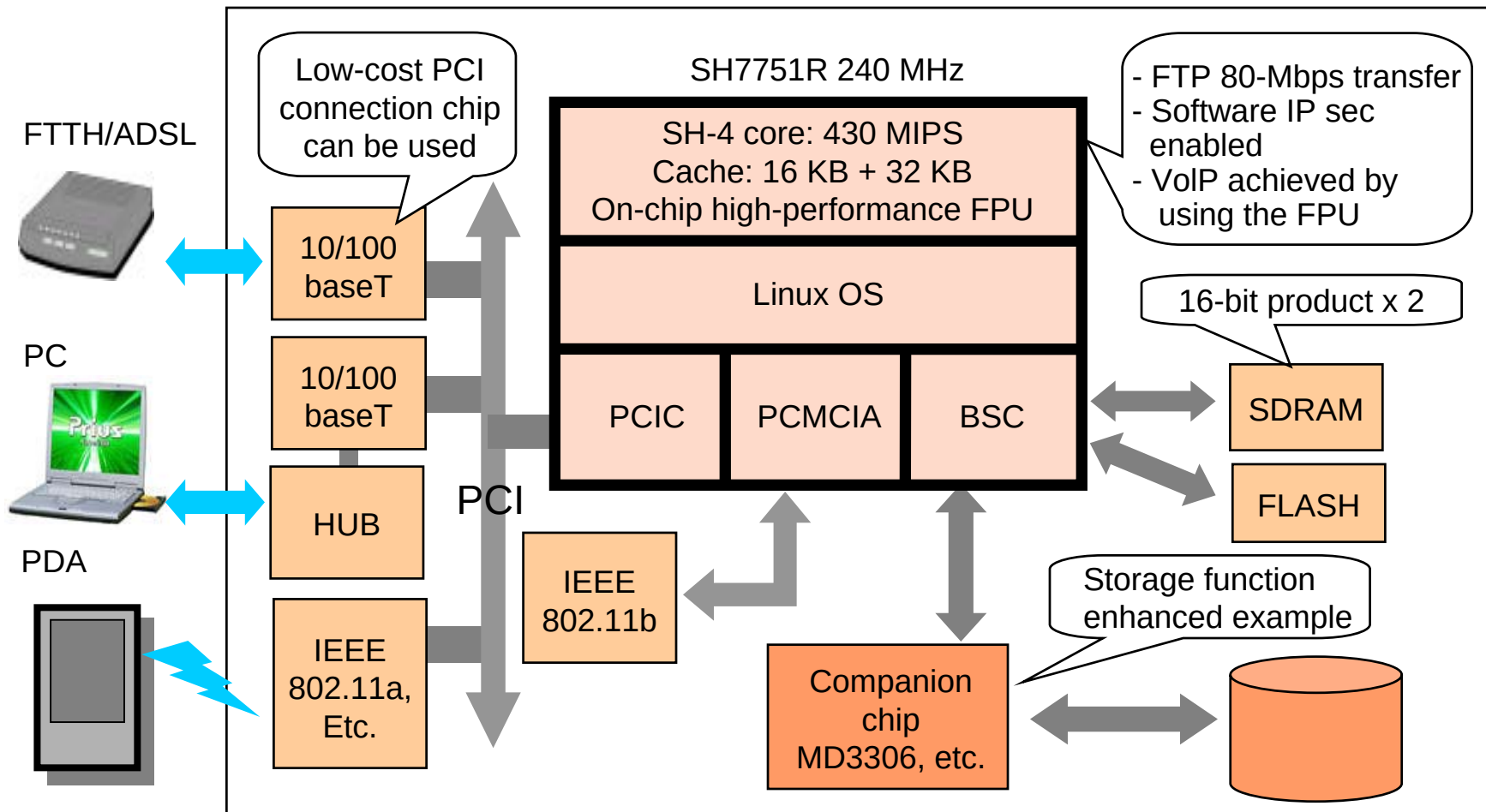
Configuration Example of the Portable Information Terminal System

SuperH
RISC engine



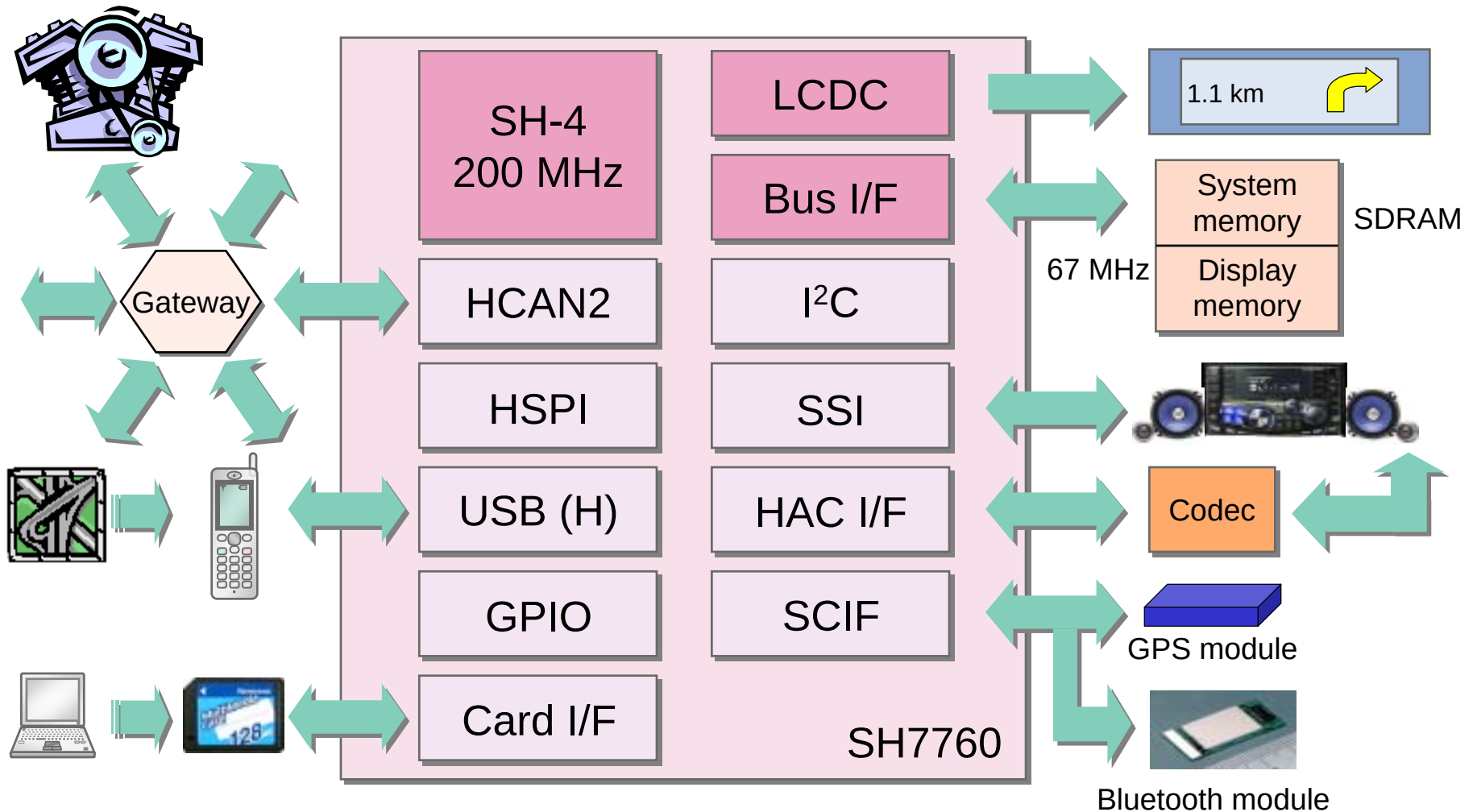
Gateway Configuration Example Using the SH-4

SuperH
RISC engine



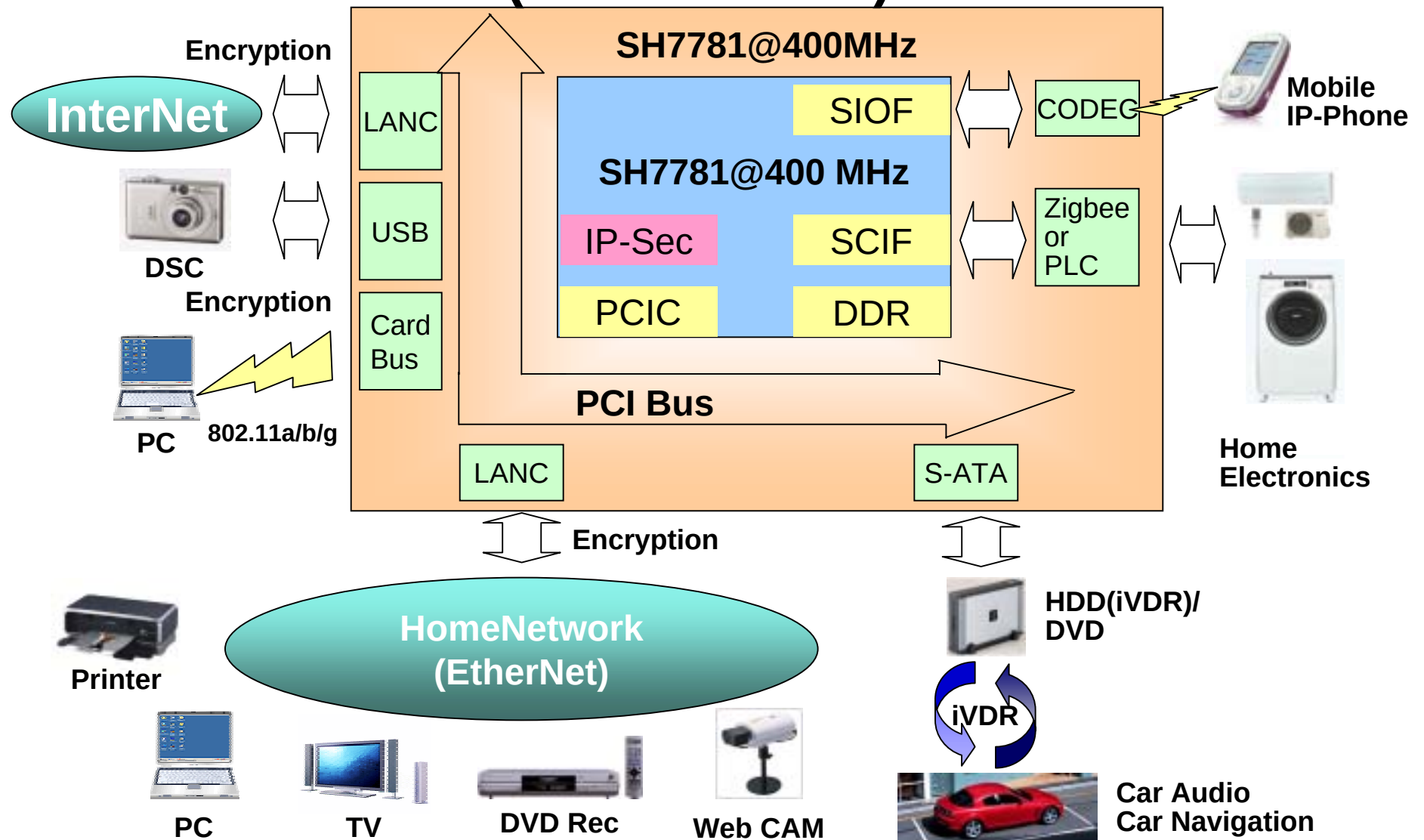
Telematics System Configuration Example

SuperH
RISC engine



Example of SH7781 Application (Home Server)

SuperH
RISC engine



Microcomputer General Presentation

M32R Family

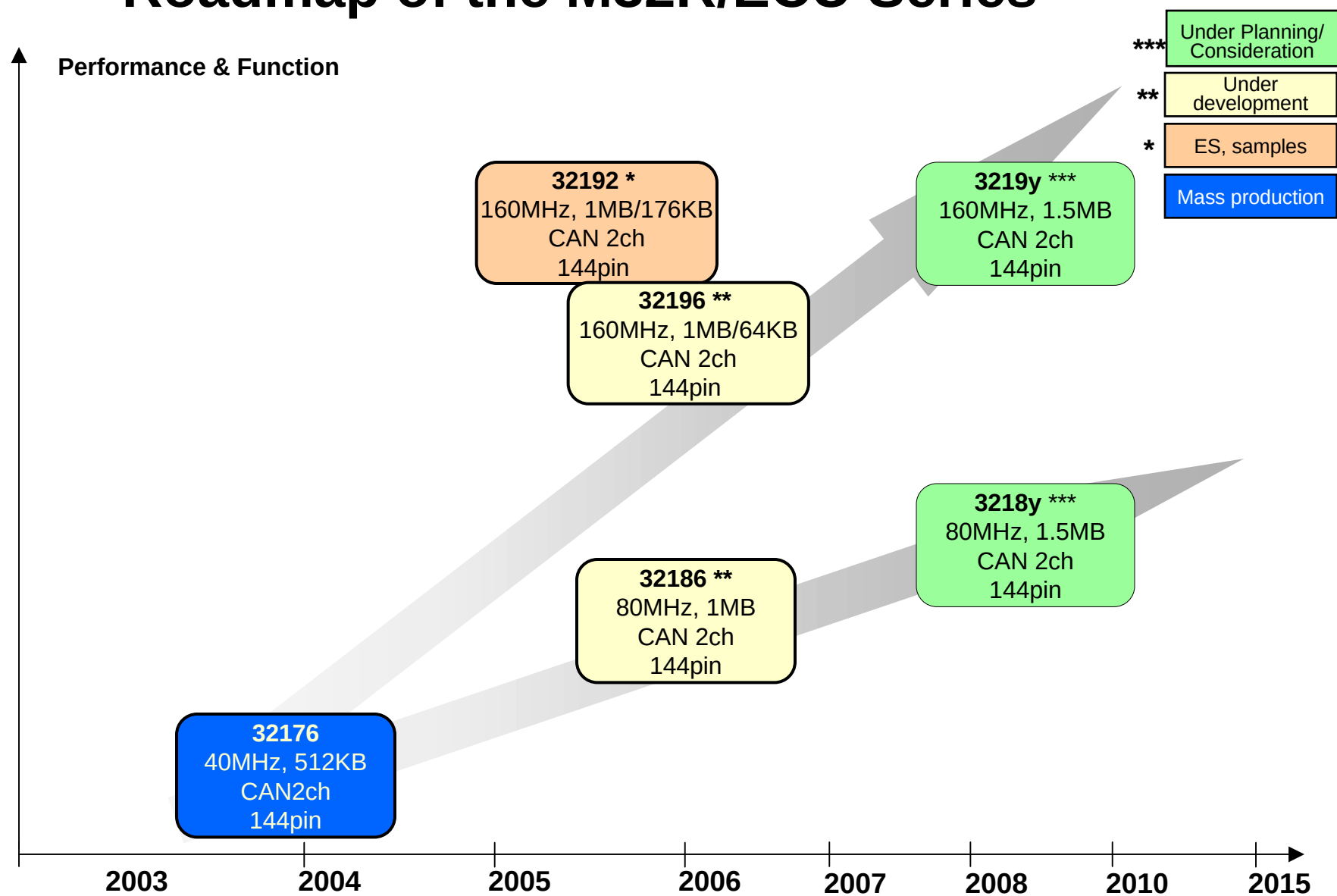
M32R/ECU series

October 28, 2005

Rev.2.00

System Solution Business Group
Renesas Technology Corp

Roadmap of the M32R/ECU Series



Features of the M32R/ECU Series

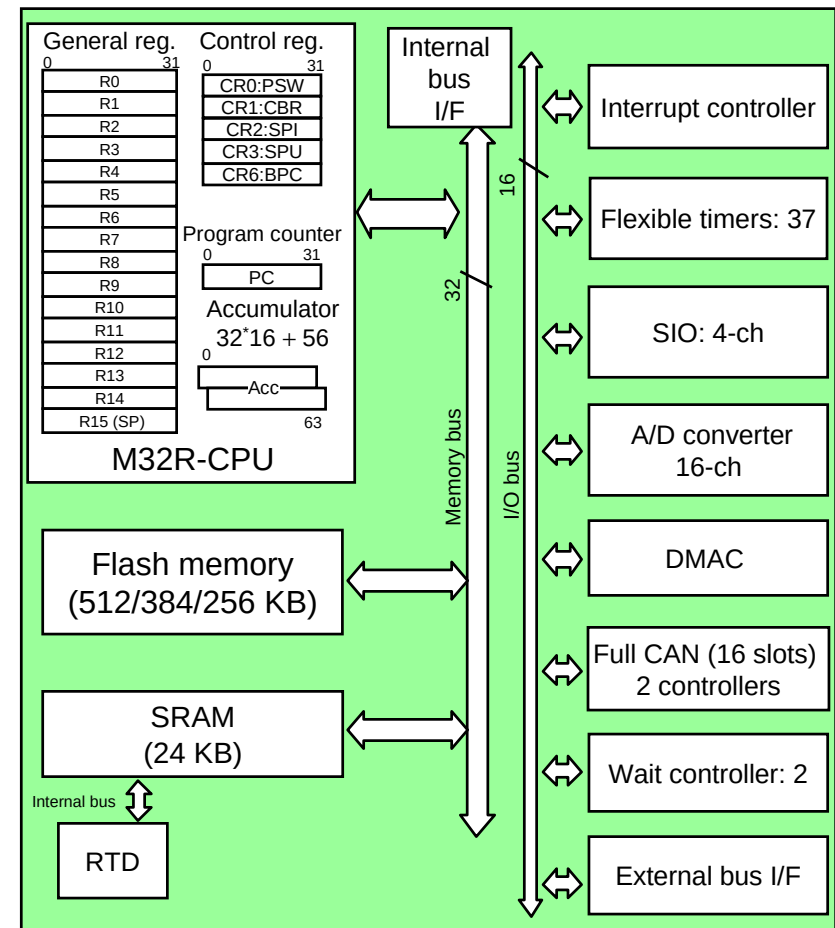
- **Large-capacity, fast-reprogrammable on-chip flash memory**
 - Contains flash memory of the industry's largest size in its kind
 - Wide variety of size : 1024 / 768 / 512 / 384 / 256-Kbyte
 - Can reprogram 64 Kbytes of flash memory within 2 seconds
- **High-performance, compact 32-bit RISC core**
 - Most of the instructions can be executed in one clock cycle due to the internal pipeline mechanism
 - Comes standard with DSP function CPU
 - 32186/32192/32196 group product incorporates a FPU fully compliant with IEEE754
- **Abundant peripheral functions**
 - Can operate with internal peripheral functions that are combined efficiently
 - Built-in CAN for the entire series
(All microcontrollers in this series contain a Full-CAN controller compliant with CAN specification 2.0B active standard)
 - Comes standard with RTD (Real-Time Debugger), virtual flash emulation function, etc
- **Wide operating temperature range, fast operation, and low power consumption**
 - Based on Renesas' technology in automotive electronics applications, this microcontroller series provides high reliability, high accuracy, and low noise
- **Development environment**
 - Contains a debug interface (SDI) common to the series
 - MATLAB-based environment provides a development environment available from predevelopment to mass production stages

32176 Group Outline

Mass
Production

- 32-bit embedded RISC core (M32R)
- Max 40 MHz operation
- Abundant on-chip peripheral functions
 - Flash memory: 512 / 384 / 256 KB
 - RAM: 24 KB
 - Full CAN x 2
 - 37-ch flexible timers
 - 16-ch A/D converter
 - 4-ch serial interface
 - 10-ch DMA controller
 - RTD (real-time RAM monitor) x 1
- On-board debug function
- Fast reprogramming flash ROM (serial reprogramming is possible)
- External extended bus (16-bit data bus)
- 3.3 V or 5V single power supply
- Low noise, low power consumption
- 40 MHz@85°C / 32 MHz@125°C operation guaranteed
- LQFP-144 (0.5 mm)

32176 Group Block Diagram



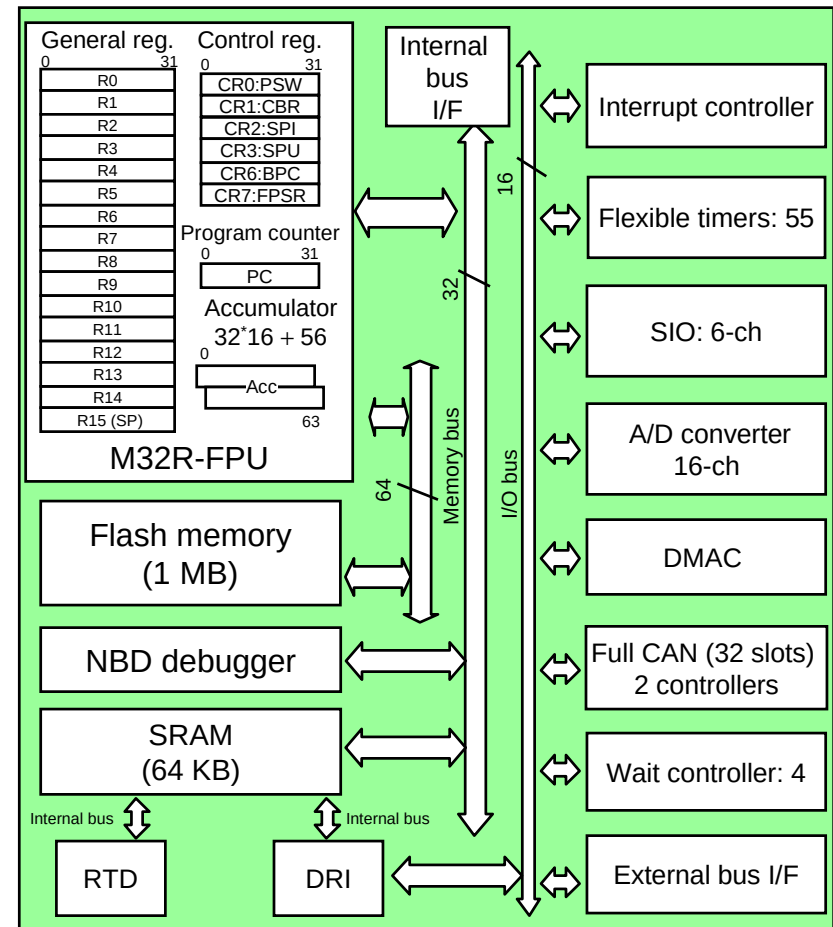
Note : This does not guarantee that the microcomputer can operate continuously at 125°C.
Consult Renesas if the microcomputer is going to be used for 125°C applications.

32186 Group Outline

Under
Development

- 32-bit embedded RISC core (M32R)
- Built-in single-precision FPU (fully compliant with IEEE754)
- Max 80 MHz operation (peripherals: max 20 MHz)
- Abundant on-chip peripheral functions
 - Flash memory: 1 MB (1 wait/64-bit access)
 - RAM: 64 KB (no wait)
 - Built-in Direct RAM I/F (DRI) module, supporting the entire RAM area
 - Full CAN: 32 slots x 2
 - NBD debug function (pin shared with JTAG and RTD)
 - 55-ch flexible timers
 - 16-ch A/D converter
 - 6-ch serial interface
 - 10-ch DMA controller
 - RTD (real-time RAM monitor) x 1
- On-board debug function
- Fast reprogramming flash ROM (serial reprogramming is possible)
- External extended bus (16-bit data bus)
- 3.3 V single power supply or 5 V single power supply
- 80 MHz@125°C operation guaranteed
- LQFP-144 (0.5 mm)

32186 Group Block Diagram



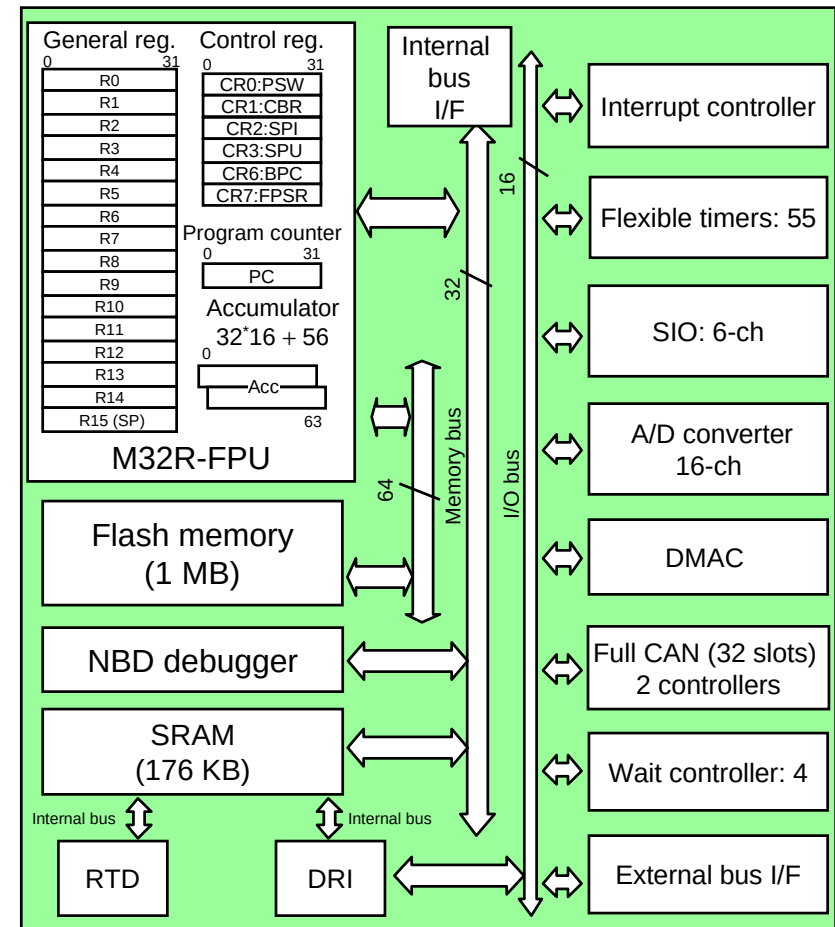
Note : There is a limitation on the duration of use for the operation temperature in the power supply voltage and operating frequency.

32192 Group Outline

Under
Development

- 32-bit embedded RISC core (M32R)
- Built-in single-precision FPU (fully compliant with IEEE754)
- Max 160 MHz operation (peripherals: max 40 MHz)
- Abundant on-chip peripheral functions
 - Flash memory: 1 MB (1 wait/64-bit access)
 - RAM: 176 KB (no wait)
 - Built-in Direct RAM I/F (DRI) module, supporting the entire RAM area
 - Full CAN: 32 slots x 2
 - NBD debug function (pin shared with JTAG and RTD)
 - 55-ch flexible timers
 - 16-ch A/D converter
 - 6-ch serial interface
 - 10-ch DMA controller
 - RTD (real-time RAM monitor) x 1
- On-board debug function
- Fast reprogramming flash ROM (serial reprogramming is possible)
- External extended bus (16-bit data bus)
- 3.3 V single power supply or 3.3 V (internal)/ 5 V (I/O) dual power supply (3.3 V or 5 V single power supply for the M32192F8TFP)
- 160 MHz@105°C / 128 MHz@125°C operation guaranteed
- LQFP-144 (0.5 mm)

32192 Group Block Diagram



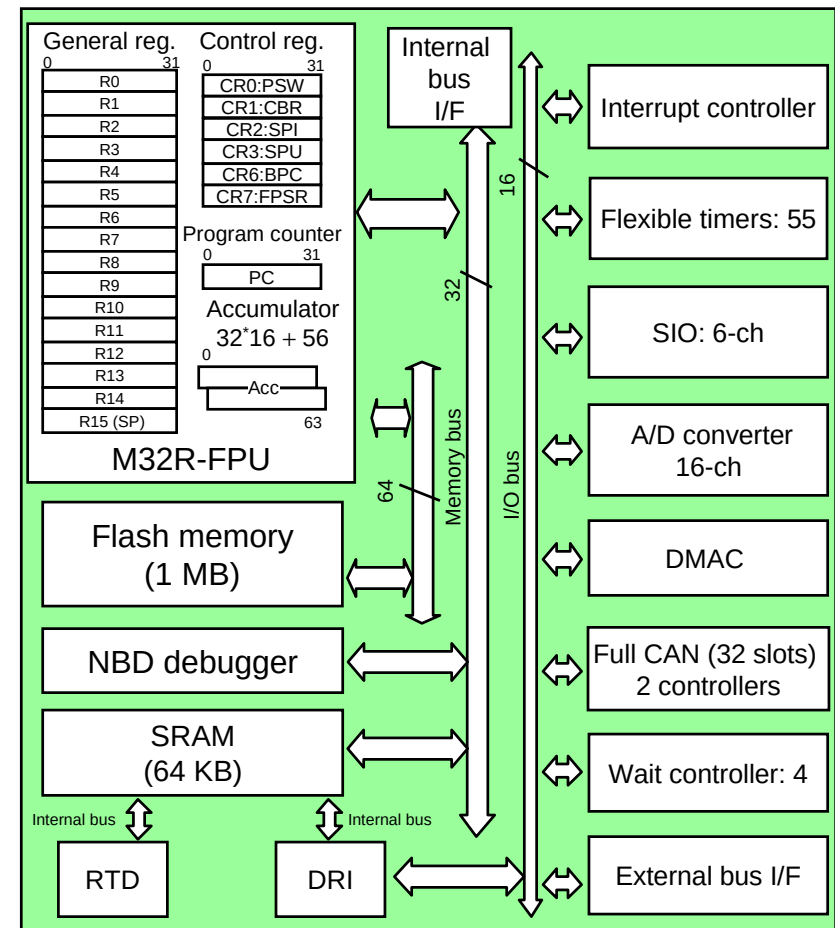
Note : There is a limitation on the duration of use for the operation temperature in the power supply voltage and operating frequency.

32196 Group Outline

Under
Development

- 32-bit embedded RISC core (M32R)
- Built-in single-precision FPU (fully compliant with IEEE754)
- Max 160 MHz operation (peripherals: max 40 MHz)
- Abundant on-chip peripheral functions
 - Flash memory: 1 MB (1 wait/64-bit access)
 - RAM: 64 KB (no wait)
 - Built-in Direct RAM I/F (DRI) module, supporting the entire RAM area
 - Full CAN: 32 slots x 2
 - NBD debug function (pin shared with JTAG and RTD)
 - 55-ch flexible timers
 - 16-ch A/D converter
 - 6-ch serial interface
 - 10-ch DMA controller
 - RTD (real-time RAM monitor) x 1
- On-board debug function
- Fast reprogramming flash ROM (serial reprogramming is possible)
- External extended bus (16-bit data bus)
- 3.3 V single power supply or 3.3 V (internal)/ 5 V (I/O) dual power supply (3.3 V or 5 V single power supply for the M32196F8TFP)
- 160 MHz@105°C / 128 MHz@125°C operation guaranteed
- LQFP-144 (0.5 mm)

32196 Group Block Diagram



Note : There is a limitation on the duration of use for the operation temperature in the power supply voltage and operating frequency.

Advantages of the 32176 Group

- Automatically generates a chip-level power supply from the external 3.3- or 5-V power supply
 - On-chip down converter simplifies board design
 - Eliminating the need for multiple power supplies lowers system costs
- Strengthened range of fail-safes and self-diagnostic functions contributes to safety design
 - XIN oscillation stop detection
 - A-D converter disconnection-detection assistance, input-current bypass
 - CAN self-diagnostic mode
 - Output levels on port output pins are readable
- Improved usability
 - Switching of port-input threshold values, abundant peripheral functions including 10-bit A/D converters (2.65 μ s) with 400-ns high-speed sample-hold

New Features for Improved Usability (1)

XIN oscillation-stop detection

Support:

- 32176
- 32186
- 32192
- 32196

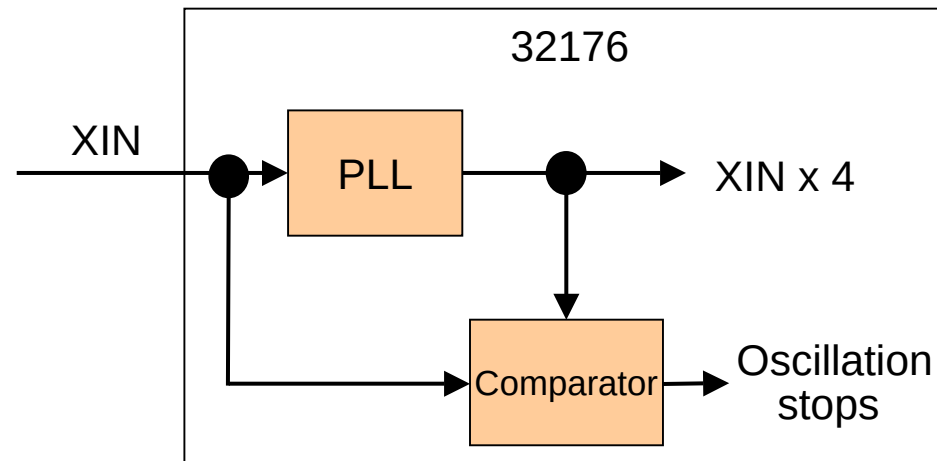
Oscillation stops →

detection →

supply substitute CPU clock

→ processing for system termination

- Knowing when oscillation terminates gives you a chance to supply a substitute clock to the CPU and run processing for smooth system termination.
- Response to clock termination: Setting of the XIN oscillation state flag
- Substitute clock source: Dedicated oscillator; in models that have built-in PLLs, oscillation continues at the minimum oscillation frequency.



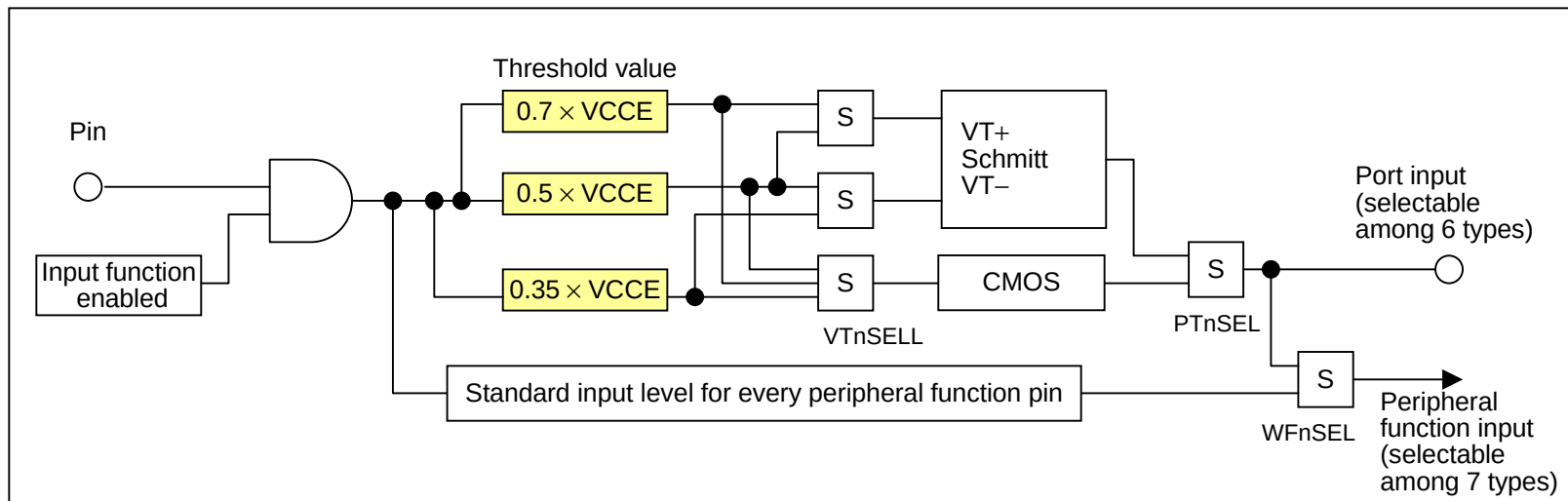
New Features for Improved Usability (2)

Port-input threshold value switchover function

Support:

- 32176
- 32186
- 32192
- 32196

The threshold voltage for judging the input level can be selected to suit the voltage applied to the input pin.



- CMOS level: $0.5 \times VCCE$
- TTL level: $0.35 \times VCCE$
- Others: $0.7 \times VCCE$

*Current applied to the input pin: 1 mA (max)

- Schmitt input
 - (1) $0.35-0.7 \times VCCE$
 - (2) $0.5-0.7 \times VCCE$
 - (3) $0.35-0.5 \times VCCE$

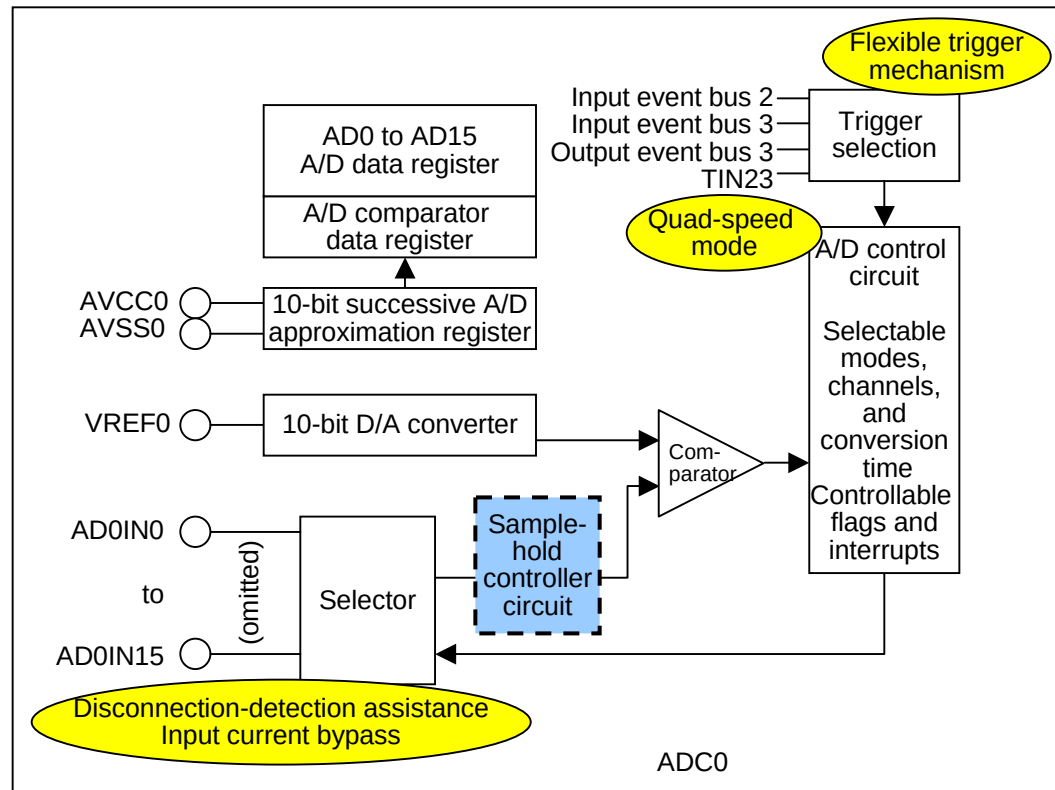
New Features for Improved Usability (3)

10-bit A/D converter with sample-and-hold circuit

Support:

- 32176
- 32186
- 32192
- 32196

In addition to implementing the sample-and-hold circuit, a high-speed mode is implemented for reducing conversion time.



- Scanning channel
1 to 16 settable
- Built-in sample-and-hold circuit
High-speed sampling (within 400 ns)
S&H circuit is dead-band free
- Conversion speed
2.65 μ s (when $f(XIN) = 10$ MHz)
normal/double-speed/high-speed modes available
*Quad-speed mode = normal,
*double-speed, *high-speed mode
- More flexible triggering of A/D conversion

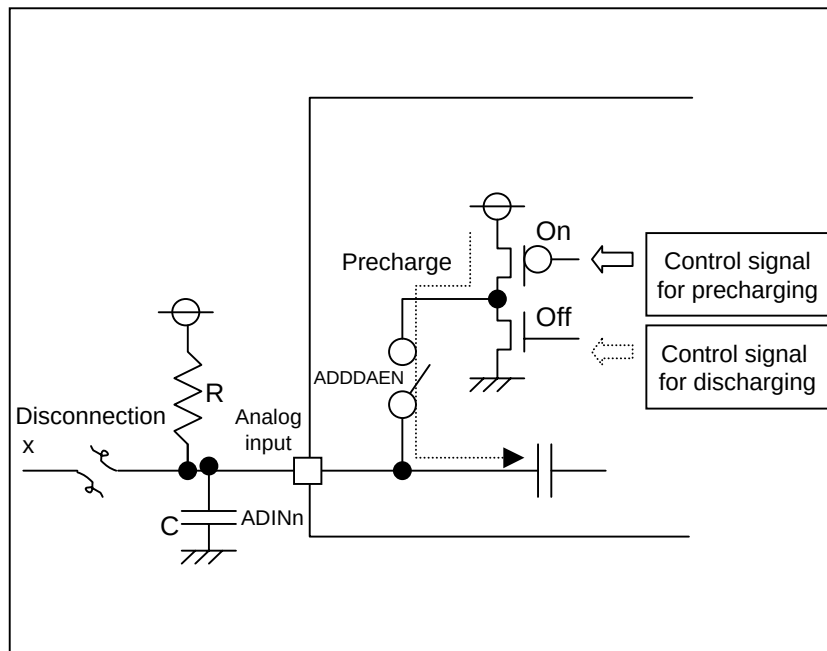
New Features for Improved Usability (4)

A/D converter disconnection-detection assistance,
bypass mechanism for input current

Support:

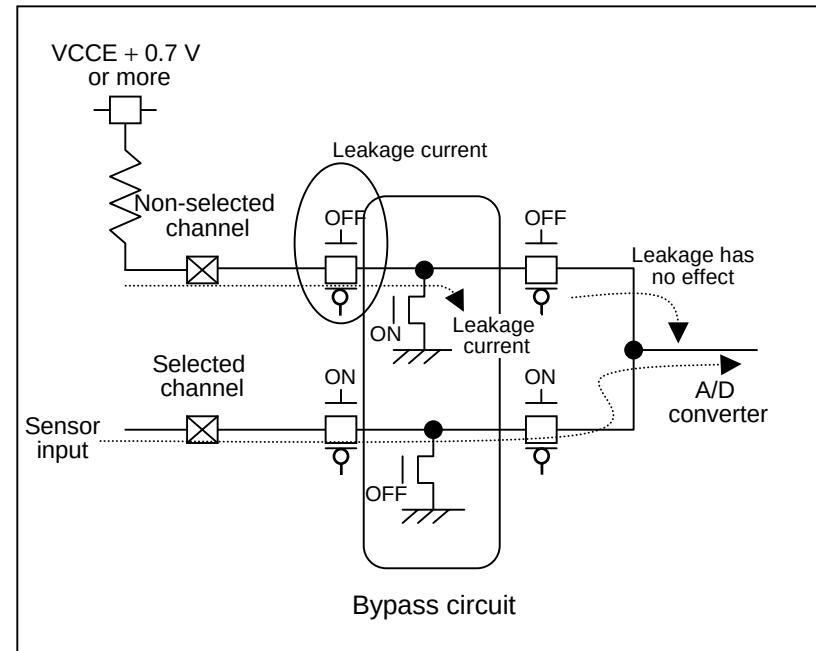
- 32176
- 32186
- 32192
- 32196

- Disconnection-detection assistance



Example: detecting disconnection of the A/D converter on the AVCC side
(when precharging is selected before conversion)

- Bypass for input current



$VCCE + 0.7 V$ or more is applied to the input-current bypass circuit

New Features for Improved Usability (5)

Support:

- 32176
- 32186
- 32192
- 32196

- 32170 Group CAN module functions
 - Upward compatibility with the #4 CAN modules
 - Enhanced upper-layer support functions
 - Listen-only mode
 - Self-diagnostic mode
 - Single-shot mode
 - DMA transfer

32176/32186/32192/32196 Group CAN

32170 Group CAN

Full CAN, 1 Mbps
Transmit / Receive slot x 16
Acceptance filter x 3

Abort transmission
Timestamp
Return from bus off

Register bits have the same functions and arrangement on all M16C/M32C models

Dual CAN controllers
Listen-only mode

Self-diagnostic mode

Single-shot mode

DMA transfer

CAN slot increase (32 slot)*1

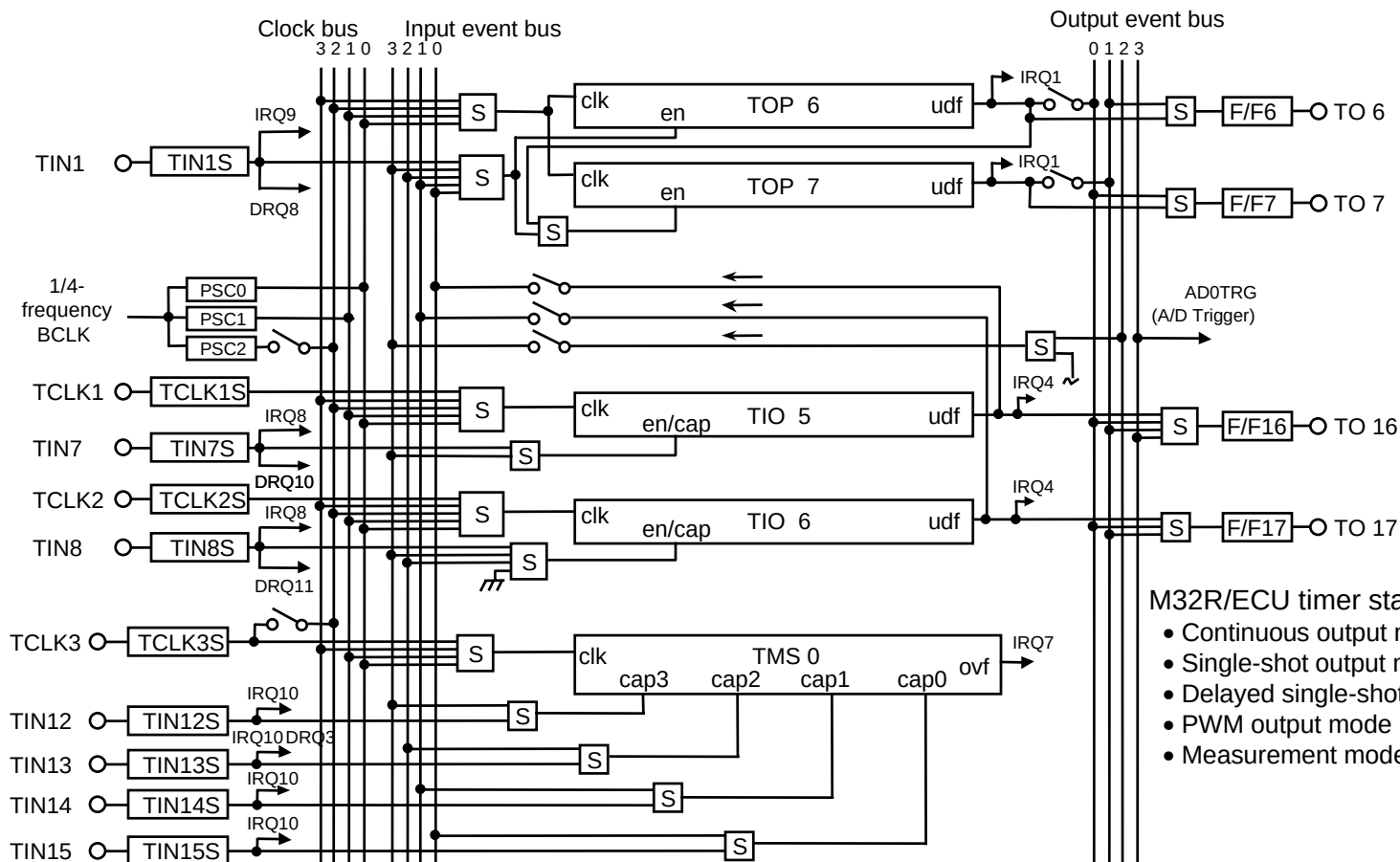
*1: 32186/32192/32196 Group

Standard Functions of M32R/ECU

(Overview of the MJT: Multijunction Timers)

Support:
 • all groups
 (except for 32172,32173)

MJT timers have an internal event bus (clock, input, output). Use combinations of timers to accomplish peripheral operations that require complex timing.



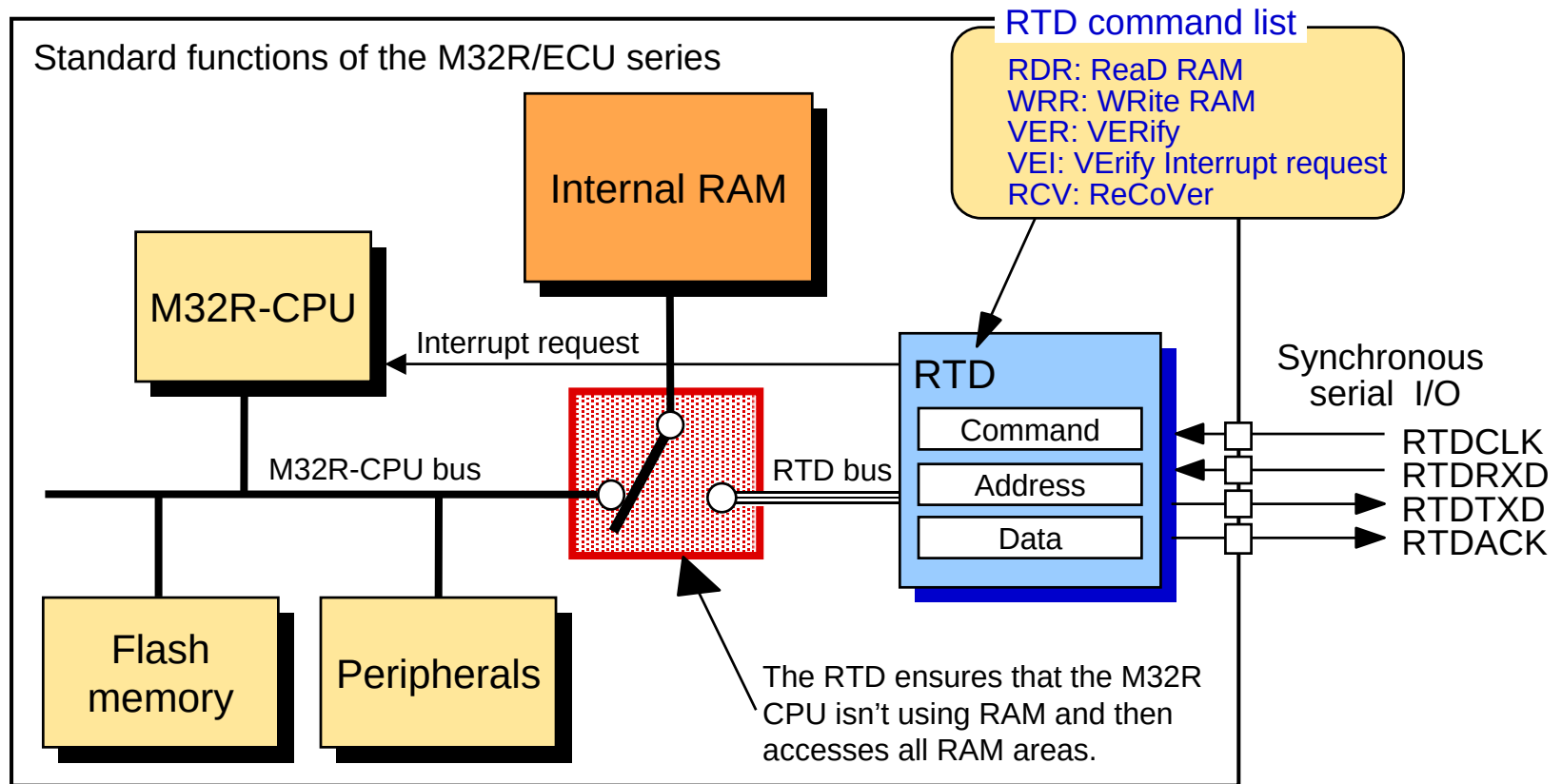
M32R/ECU timer standard functions

- Continuous output mode
- Single-shot output mode
- Delayed single-shot output mode
- PWM output mode
- Measurement mode

Standard Functions of the M32R/ECU Series: The RTD Module

Support:
• all products

The realtime debugger (RTD): CPU-independent access to the internal RAM

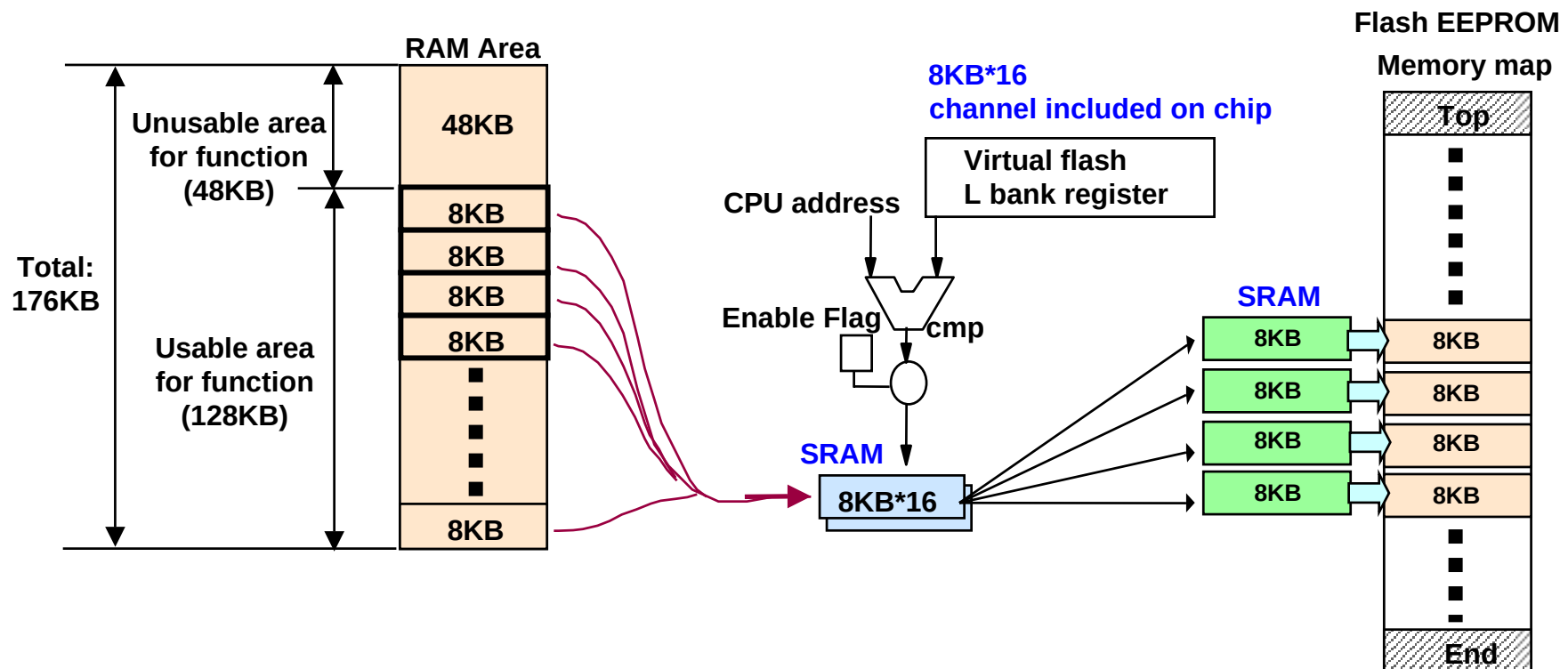


M32R/ECU Standard Functions (RAM to Flash Address Exchange)

Support:
• all products

Virtual-flash emulation function (Example of 32192)

- Can replace part of flash memory with internal RAM.
- Any addresses in the entire flash memory area can be corresponded to RAM in units of 8 KB (banks).



M32R/ECU Products: Comparison of Functions

The M32R/ECU

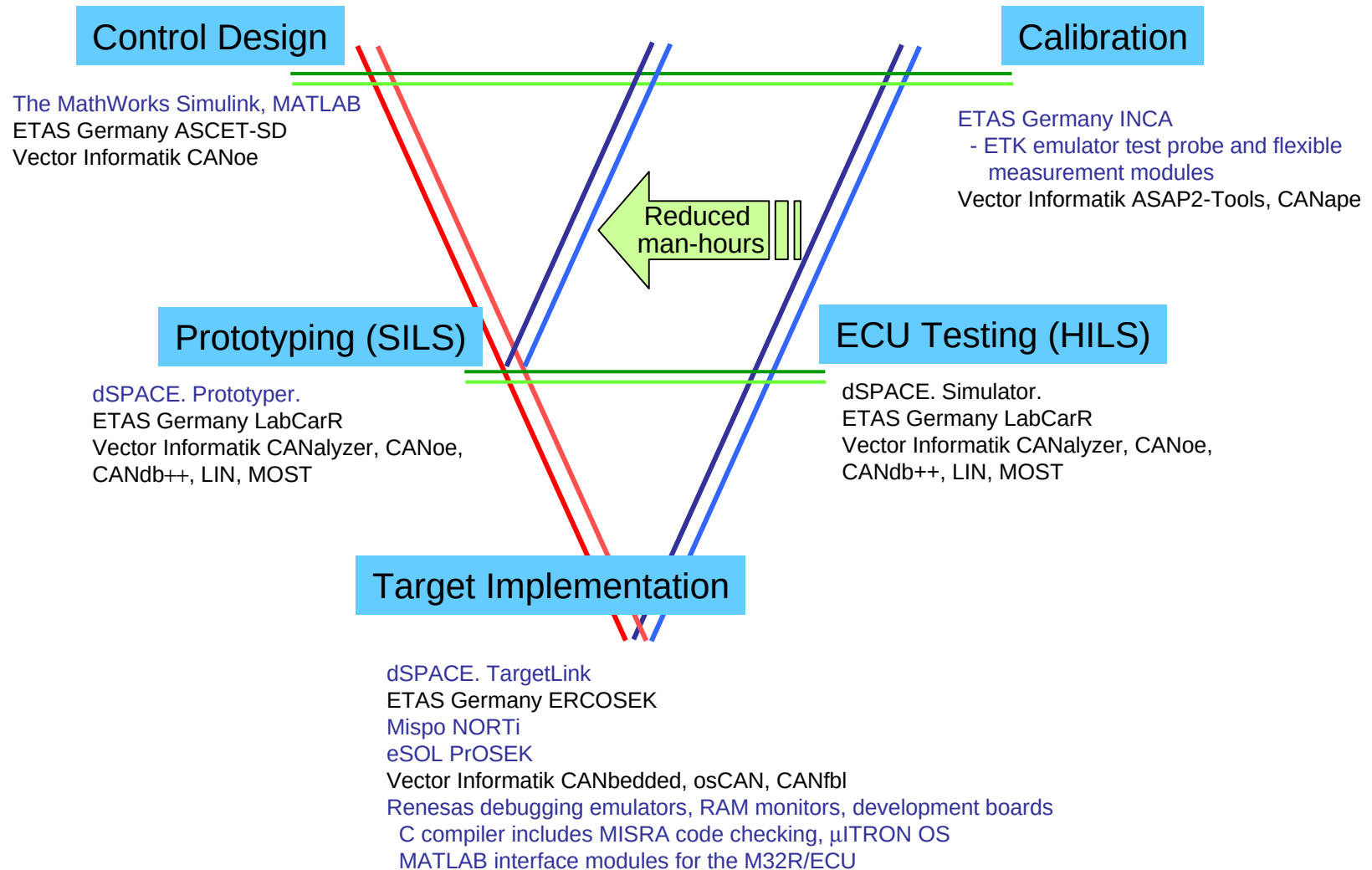
Jun. 2005

Type No.		M32176Fx	M32186F8* ¹	M32192F8* ¹	M32196F8* ¹
Function					
CPU core		M32R	M32R-FPU		
Maximum Operating frequency		40 MHz, 32 MHz (with x 4 PLL)	80 MHz, 64 MHz (with x 8 PLL)	160 MHz, 128 MHz (with x 8 PLL)	
Internal memory	ROM (flash): KB	512/384/256	1024	1024	1024
	RAM: KB	24	64	176	64
Peripheral functions	16-bit output timer	11	11		
	24-bit output timer	0	16		
	16-bit I/O timer	10	10		
	16-bit input timer	8	10		
	32-bit input timer	8	8		
	10-bit A/D converter	16 ch (with S&H)		16 ch (with S&H x 2)	
	DMA	10 ch			
	Serial interface	4 ch	6 ch		
	DRI	None	1 ch		
	RTD	Available			
	Wait controller	2	4		
	CAN	16 slots x 2 ch	32 slots x 2 ch		
	JTAG	Available			
	NBD	None	Available		
Power-supply voltage		3.3 V or 5.0 V single power supply	3.3 V or 5.0 V single power supply, or 3.3 V / 5.0 V dual-power supply	TFP: 3.3 V or 5.0 V single power supply, or 3.3 V / 5.0 V dual-power supply	
				UFP,VFP: 3.3 V single power supply, or 3.3 V / 5.0 V dual-power supply	
External memory space		Max 2 MB	Max 31 MB		
Package		LQFP-144			
Operation temperature. (°C)	VFP	-40 to 125 (@32 MHz)	-40 to 125 (@128 MHz)	-40 to 125 (@128 MHz)	
	UFP	-	-	-40 to 105 (@160 MHz)	
	TFP	-40 to 85 (@40 MHz)	-	-40 to 85 (@160 MHz)	

*1: under planning

Development Environment

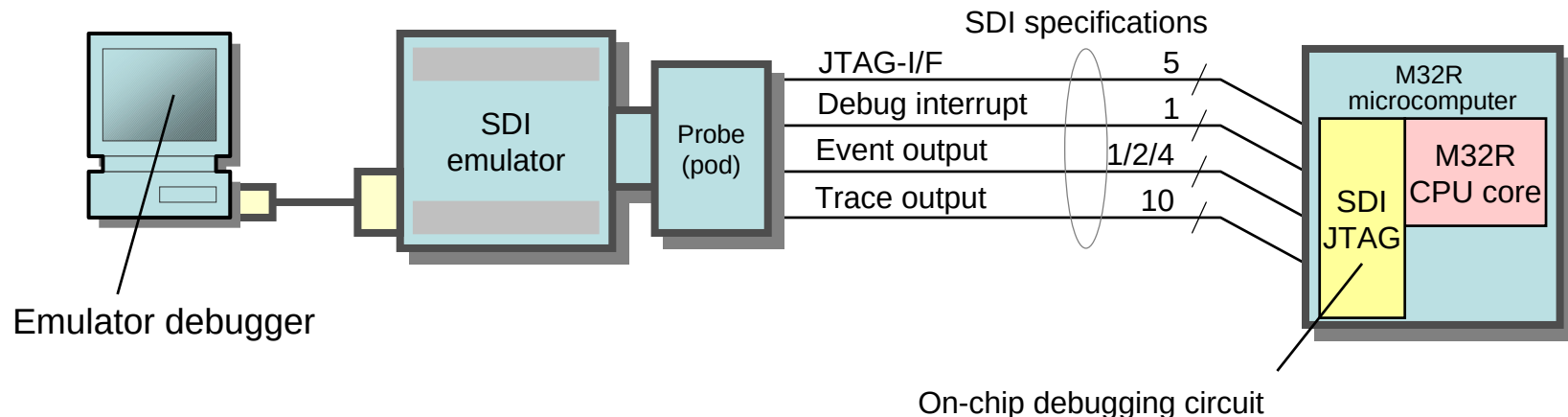
Software Development Environment



The SDI (Scalable Debug Interface) Module

- Common to all M32R products, provides an on-chip debugging module for system LSIs -

- Standard on-chip debugging module for all M32R-family products
- Features
 - JTAG unit + debugging-dedicated signal lines connecting the emulator and M32R microcomputer
 - Enables debugging while running the microcomputer at high speeds.
 - Tracing during program execution (branches/data)



USB-compliant Simple Debugging Tool: M32100T-EZ-E

Specifications

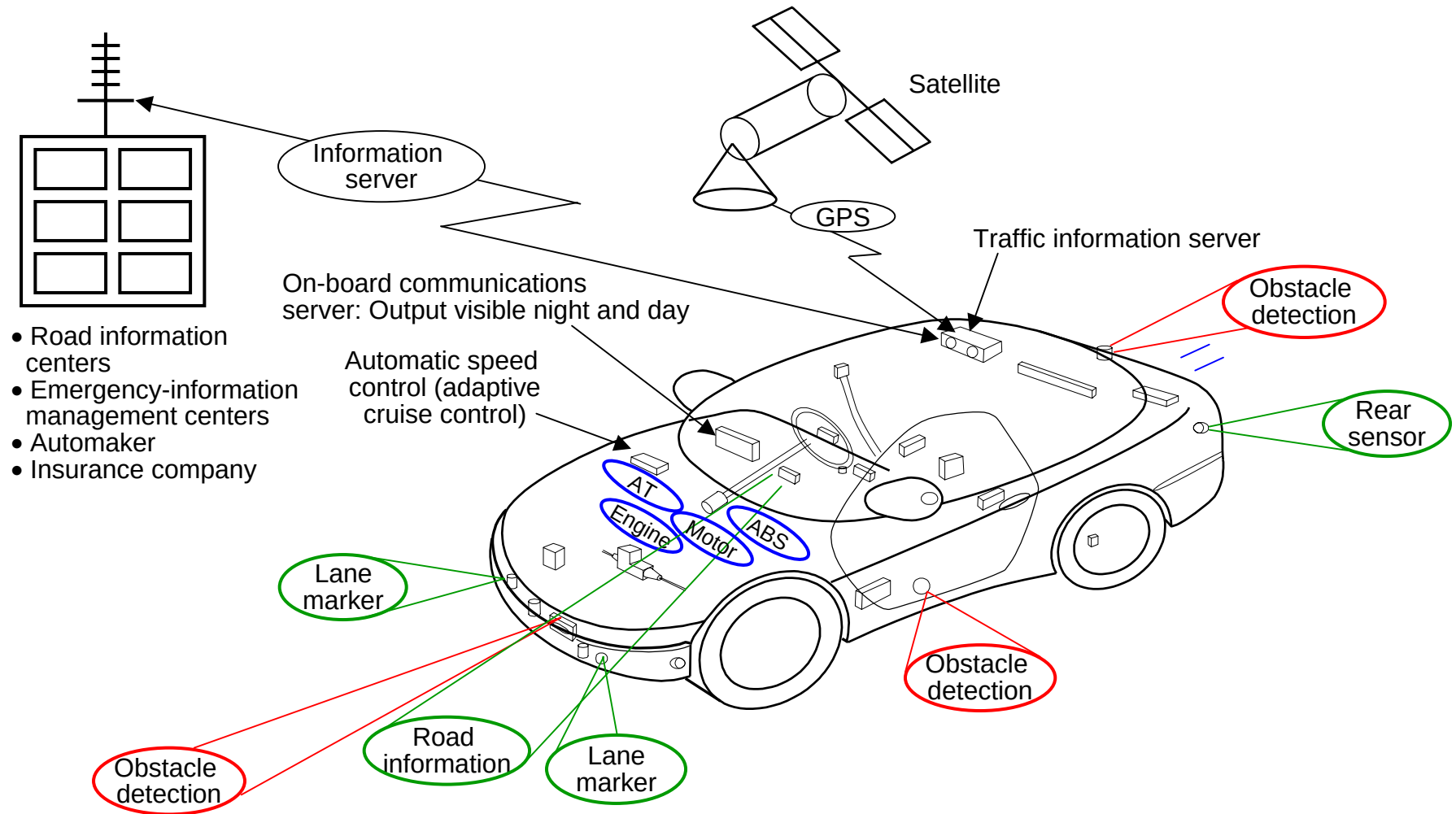
Item	Specifications
Target connection	JTAG
Download Target	RAM, internal flash memory
Trace function	None
Break function	MCU internal break (PC before execution: 1, PC after execution: 1, data access: 2) software break, no break function realized based on the trace information
Time measurement	None
Memory operations	Possible when program is in execution or not in execution
Register operations	Possible when program is not in execution
Others	Continuous debugging is possible during resupplying power to the target MCU MCU internal breakpoint settings can be changed during execution
Host interface	Full-speed USB 1.1
Power supply	USB-bus powered (external power supply is not required)

M32100T-EZ-E



Sample Applications

M32R/ECU Application (ITS/ACC)



Microcomputer General Presentation

M16C Family

M16C Series Product Introduction

M16C/Tiny Series, M16C/30 Series, M16C/60 Series

October 28, 2005

Rev.2.00

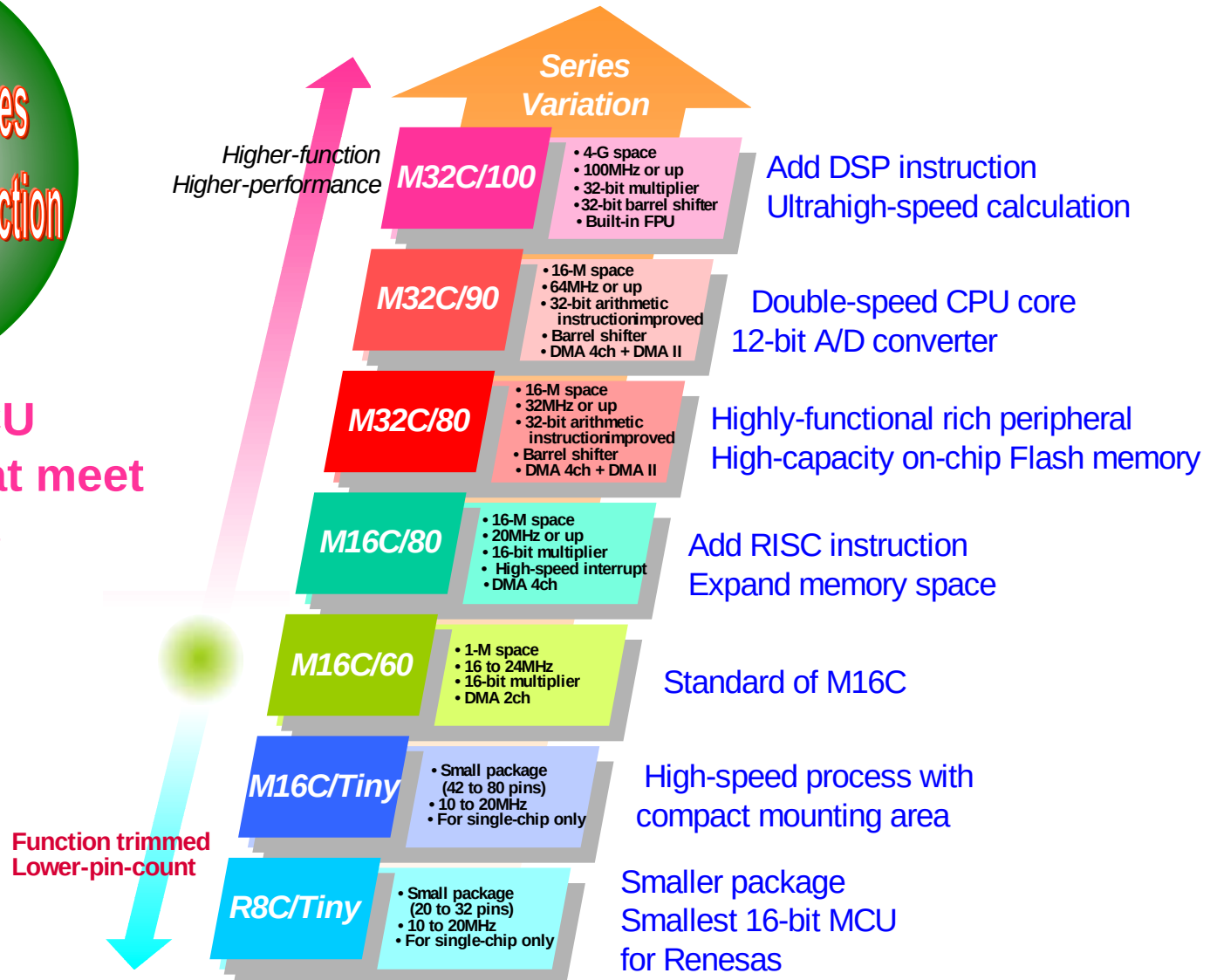
Standard Product Business Group
Renesas Technology Corp

M16C Family Road Map



Multi-purpose MCU with functions that meet a variety of needs

- ◆ Car audio
- ◆ Audio
- ◆ Automotive
- ◆ TV / LCD / PDP
- ◆ Terminal/Mobile device
- ◆ Amusement
- ◆ Industry (motor, inverter)
- ◆ White goods
- ◆ Camera / Digital Camera
- ◆ PC / OA, etc.



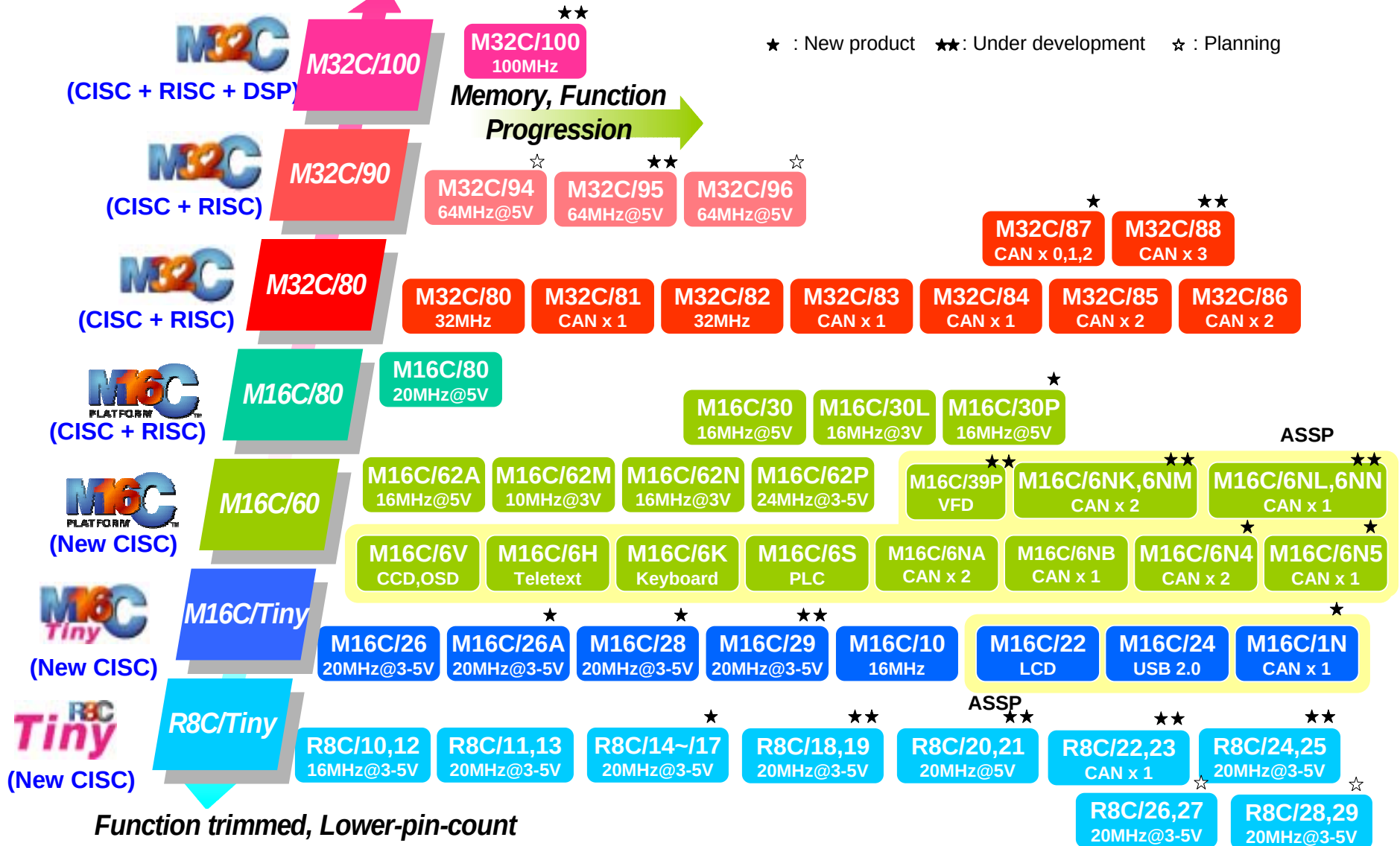
M16C Family Lineup

M16C Powerful Processors
-Easy to Use

Higher-function, Higher-performance

★ : New product ★★ : Under development ☆ : Planning

*Memory, Function
Progression*

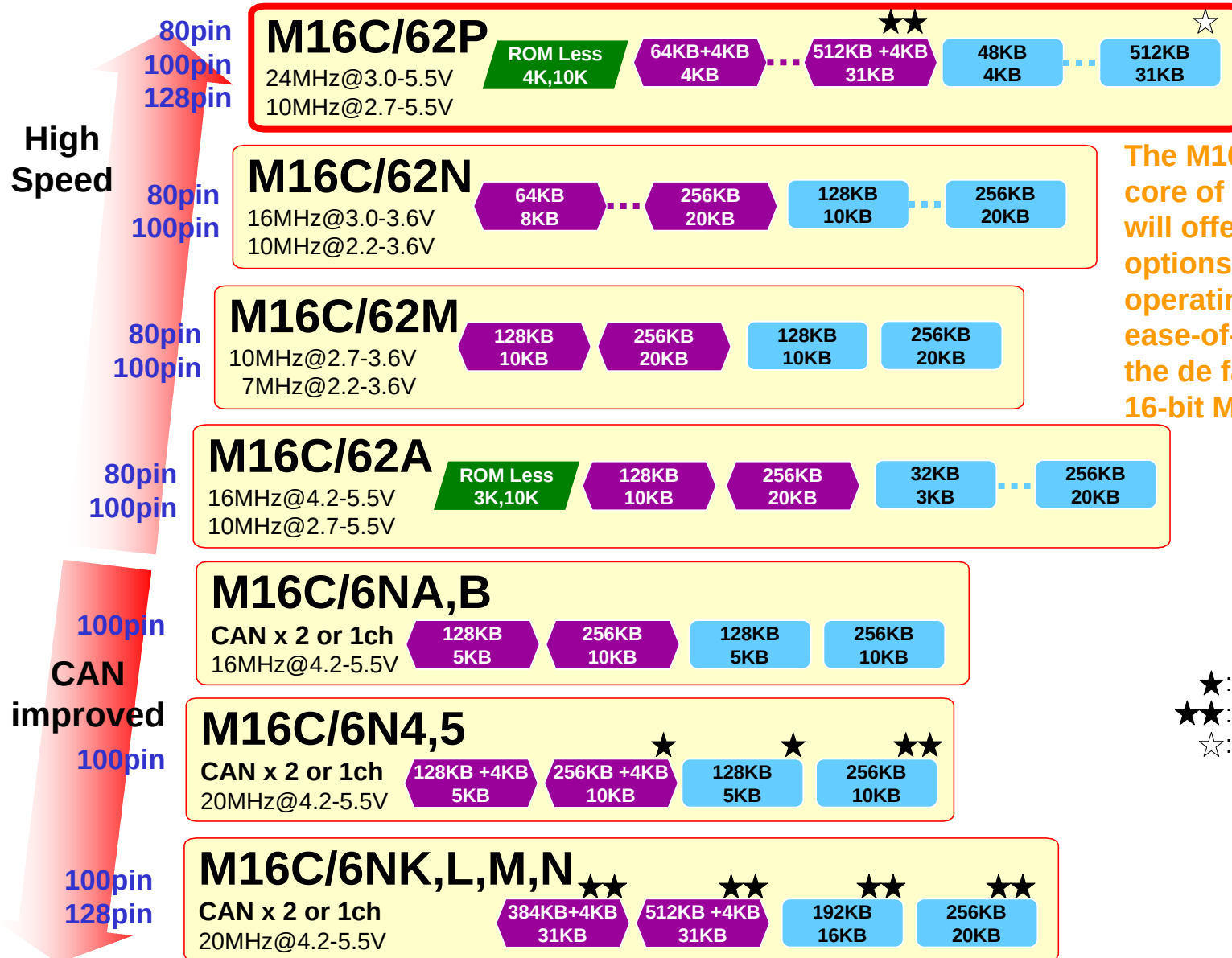


Memo

M16C/62P Group

M16C/62 Series of Standard M16C Family

M16C/60 Series Lineup



The M16C/62 group, a core of the M16C Family, will offer more memory options with enhanced operating frequency and ease-of-use to become the de facto standard of 16-bit MCUs.

★: New product
★★: Under development
☆: Planning

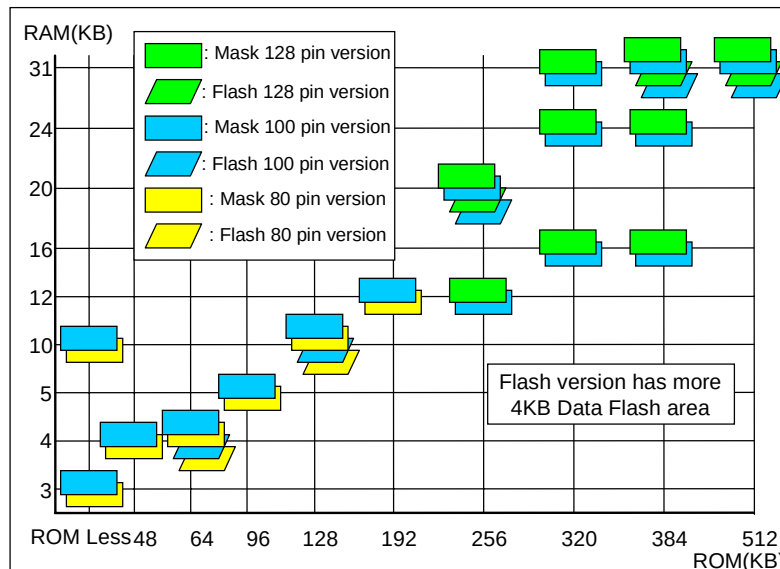
ROM Less
Flash
Mask



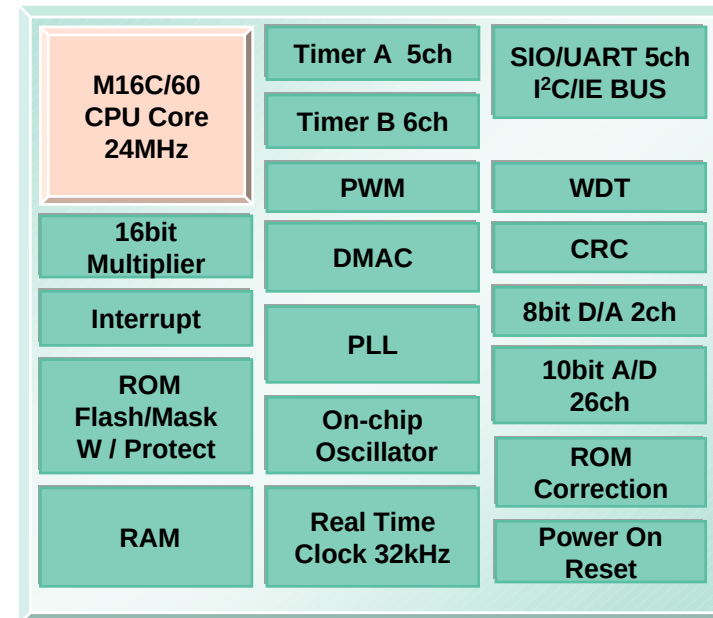
Feature of M16C/62P Group



- Inherit features of M16C/62A, /62M, /62N
- **Expand memory variation**
(ROM/RAM : ROM less/3KB to 512KB/31KB)
- **High-speed operation** (24MHz, 1.5 times higher speed of M16C/62A, /62N)
- 3V and 5V peripheral power can be used and 3V memory can be connected with 5V device directly
- M16C/62P can connect with other devices by applicable SIO(3ch) for IE Bus, I²C-bus sub set
- Wait insert of 0 to 3 can be selected and M16C/62P can connect with the device whose access speed is slower.
- Provide higher-reliability by improving the watchdog timer and including the oscillation stop detection circuit and new reset circuit.



Memory/Package Line up



M16C/62P Block Diagram

I²C-bus is a registered trademark of Philips. IE Bus is a trademark of NEC Electronics.

Dual I/O-Supplies Functions (5V and 3V)

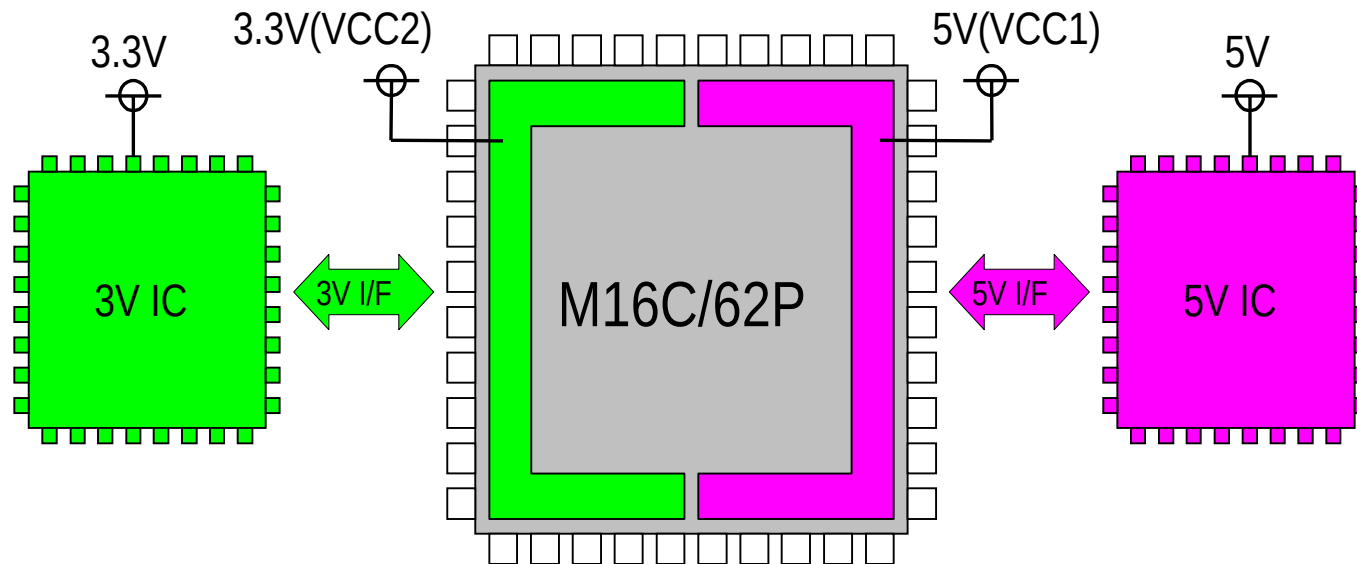
While lowering voltage such as high-speed memories, many ICs such as a driver have only 5V interface.



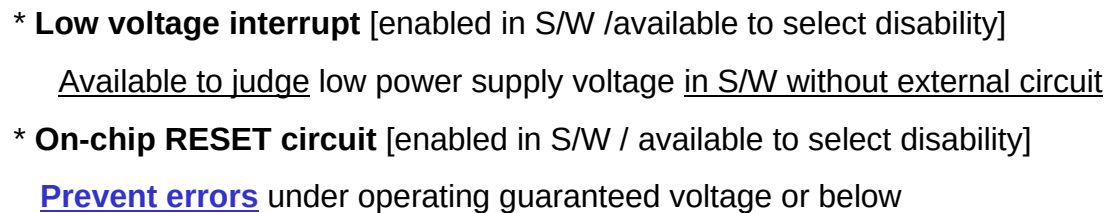
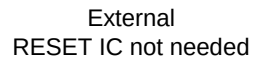
5V type peripheral IC and 5V type peripheral IC can be connected simultaneously without external circuit

P6 to P10, P11, P14: $2.7V \leq VCC1 \leq 5.5V$

P0 to P5, P12, P13: $2.7V \leq VCC2 \leq VCC1$



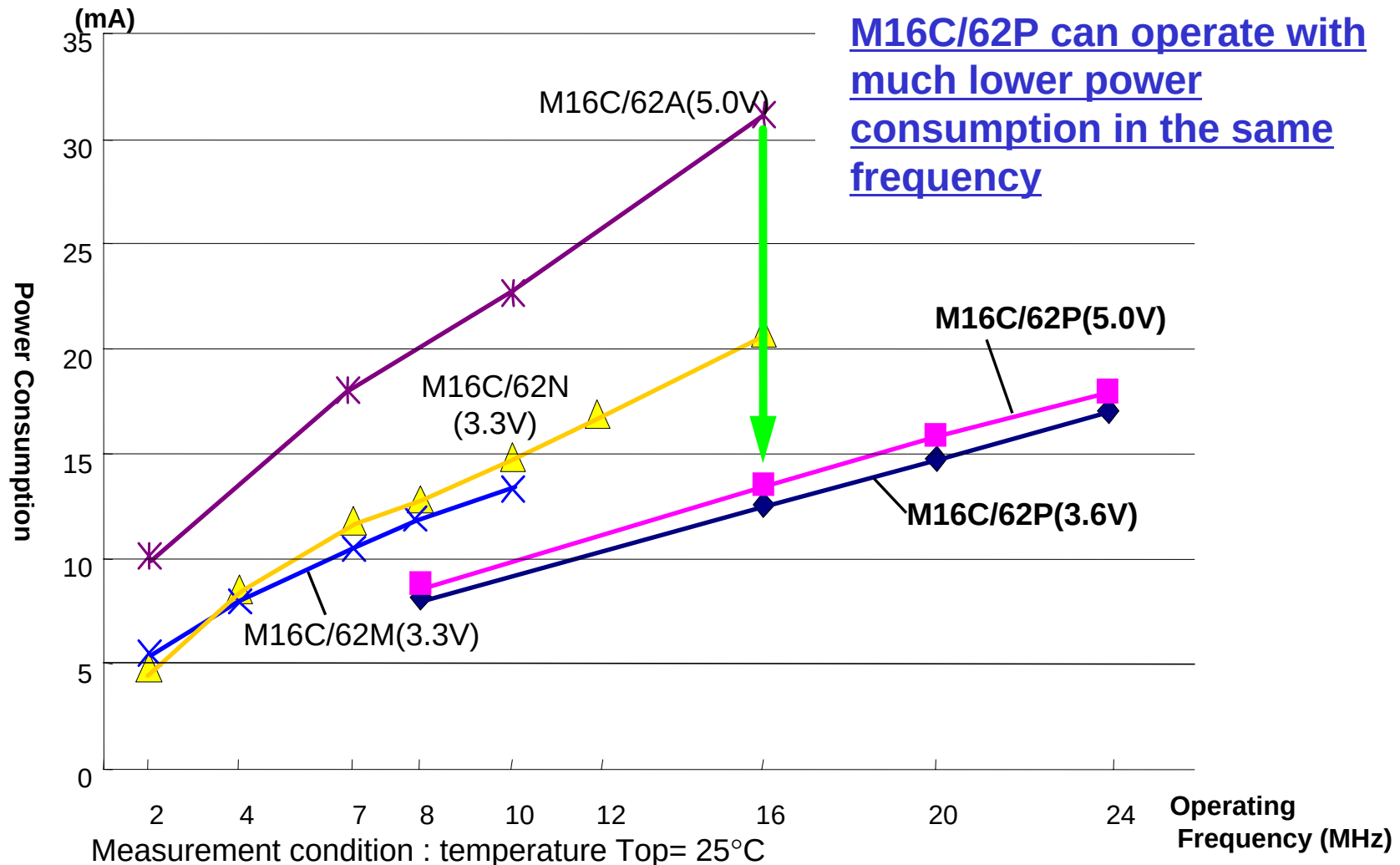
Powerful Processors
-Easy to Use



Compare power consumption (Flash version)



between M16C/62P and Existing M16C/60 Groups



M16C/30P Group

***Low cost is feasible
by focusing on frequently-use functions***

M16C/30 Series Lineup



Achieve low price by optimizing
memory size and peripheral functions

M16C/62x

Optimized
memory
and
peripherals

M16C/30P

16MHz@4.2-5.5V
10MHz@2.7-5.5V

★★

ROM Less
6K

★★

96KB
5KB

★

128KB
5KB

★

192KB
6KB

☆

256KB
6KB

100pin

M16C/39P

16MHz@3.0-5.5V
10MHz@2.7-5.5V

(Note)

★★

192KB
6KB

★★

128KB
5KB

★★

192KB
6KB

SIP(M16C/30P
+VFD Controller)

VFD.Vacuum Fluorescent Display
(Note).Only for development

M16C/30

16MHz@4.2-5.5V
10MHz@2.7-5.5V

32KB
2KB

64KB
2KB

96KB
3KB

128KB
3KB

100pin

M16C/30L

16MHz@3.0-3.6V
7MHz@2.4-3.6V
7MHz@2.2-3.6V(1wait)

64KB
2KB

96KB
3KB

128KB
3KB

100pin

★: New product
★★: Under development
☆: Planning

ROM Less

Flash

Mask

Introduction of M16C/30P



- Feature

- As for M16C/30P, cost can be lowered by reducing functions/memory from M16C/62P.

(For mask ROM version only. M16C/62P supports flash version.
Limited to 100 pins for package)

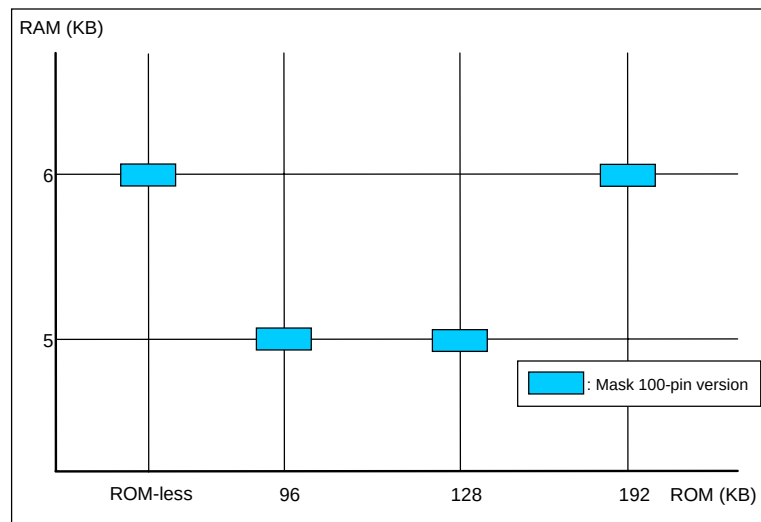
- Since the characteristics of M16C/62P are the same, the development tools of M16C/62P are used.

- Application

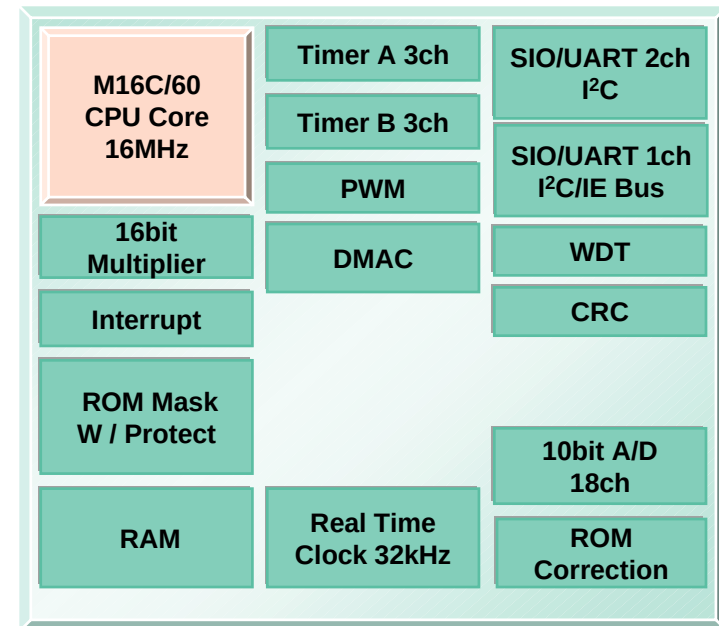
Car audio, Audio, Consumer

Feature of M16C/30P

- Inherit feature of M16C/62P and cost can be lowered by reducing function or ROM/RAM.
- The operating frequency is limited to 16MHz
- Reduce peripheral functions (Timer : 6ch, SIO : 3ch, A/D : 18ch),
Limit to only functions frequently used
- Package : Limit to 100 pins
- For single-chip only
- Flash version : Use M16C/62P
- Development support tool : Use tools of M16C/62P



Memory Line up



M16C/30P Block Diagram

I²C-bus is a registered trademark of Philips. IE Bus is a trademark of NEC Electronics.

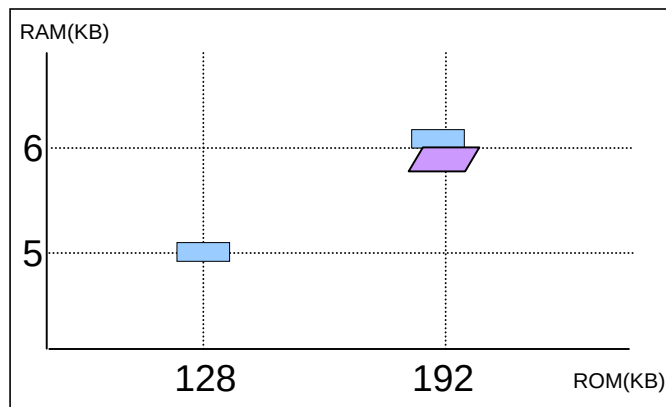
Compare Specification of M16C/62P and M16C/30P

Item		M16C/62P	M16C/30P	Difference
Number of Basic Instruction		91	91	
Minimum Instruction Execution Time		41.6ns (24MHz, 0wait, Vcc=5.0V) 100ns (10MHz, 0wait, Vcc=3.0V)	62.5ns (16MHz, 0wait, Vcc=5.0V) 100ns (10MHz, 0wait, Vcc=3.0V)	✓
Memory Capacity	ROM	ROM-less, 64 K, 96 K, 128 K, 192 K, 256 K, 384 K, 512 Kbyte	ROM-less, 96 K, 128 K, 192 Kbyte	
	RAM	3K, 4 K, 5 K, 10 K, 12 K, 16 K, 20 K, 24 K, 31 Kbyte	6K, 5 K, 5 K, 6 Kbyte	✓
I/O Port	P0 to P10	8bit x 10, 7bit x 1	8bit x 10, 7bit x 1	
Input Port	P85	1bit x 1	1bit x 1	
Timer		11 (Timer A x 5, Timer B x 6)	6 (Timer A x 3, Timer B x 3)	✓
Serial Interface		Synchronous/Asynchronous x 3ch (I ² C, IE Bus x 3ch), Synchronous x 2ch	Synchronous/Asynchronous/ I ² C x 3ch (IE Bus x 1ch)	✓
A/D Converter		10bit x Max. 26ch, ± 3LSB (One-shot, repeat, single-sweep, repeat sweep 0,1)	10bit x Max. 18ch, ±5LSB (One-shot, repeat)	✓
D/A Converter		Yes	No	✓
DMAC		2ch	2ch	
CRC		Yes	Yes	
Watchdog Timer		15bit x 1ch (with prescaler)	15bit x 1ch (with prescaler)	
External Interrupt		NMI, INT0, INT1, INT2, INT3, INT4, INT5, key input(8 factors)	NMI, INT0, INT1, INT2, INT3, INT4, key input(7 factors)	✓
Address Match Circuit		4	2	✓
Clock Generating Circuit		4 : PLL, on-chip oscillator, Xin Xcin (Built-in feedback resistor, ceramic resonator or external crystal oscillator)	2 : Xin Xcin (without main clock oscillation stop detection function) (Built-in feedback resistor, ceramic resonator or external crystal oscillator)	✓
Supply Voltage		3.0 to 5.5V (24MHz), 2.7 to 5.5V (10MHz)	3.0 to 5.5V (16MHz), 2.7 to 5.5V (10MHz)	✓
Pin	Electrical Strength	5V	5V	
	Current	1mA	1mA	
Package		80pin (80P6S-A), 100pin (100P6S-A, 100P6Q-A)	100pin (100P6S-A, 100P6Q-A)	✓
Operating Mode		Single-chip, memory expansion, microprocessor	Single-chip	✓
Tool		For M16C/62P	Use for M16C/62P of upper compatibility	

Feature of M16C/39P (Built-in VFD controller,SIP)

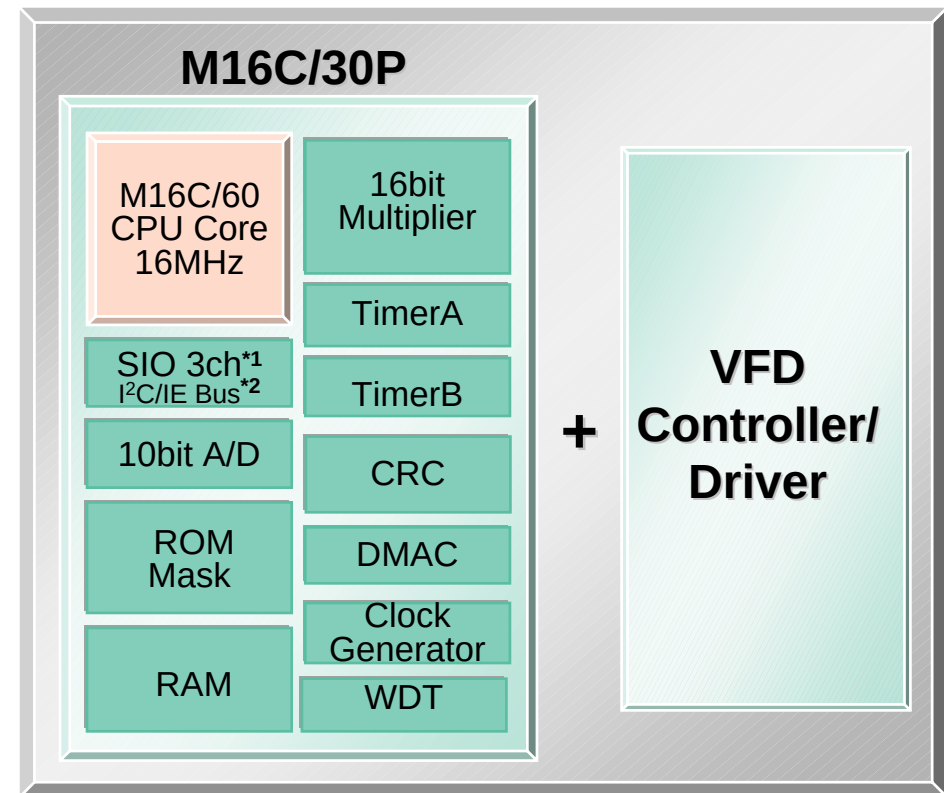
- General-purpose microcontroller and **VFD controller/driver in a single package** (100pin QFP, 0.65mm pin pitch)
- Peripheral functions have been condensed into an optimal configuration for consumer applications.
- 34 high-voltage ports, and allows settings to be made for up to **32 segments and 2 to 16 digits (columns)**.

SIP : Solution Integrated Product
VFD : Vacuum Fluorescent Display



■ : Mask version 100pin package
▤ : Flash version 100pin package

Memory/Package Line up



M16C/39P Block Diagram (SIP)

*1: The 1ch of SIO 3ch is used for VFD control, user available channel of SIO are 2 channels.

*2: I2C bus is a registered trademark of Koninklijke Philips Electronics N. V. IEBus is a registered trademark of NEC Electronics Corporation.

M16C/Tiny Series

***Engineers had been thinking
if M16C could have Tiny Series***

M16C/Tiny Series Lineup



M16C/62, M16C/30, M16C/Tiny Next

Trimmed peripheral function
Smaller ROM/RAM
Lower-pin-count package

Under development

M16C/29 80pin 64pin

20MHz@3.0-5.5V
10MHz@2.7-5.5V

64KB+4KB 4KB	96KB+4KB 8KB	128KB+4KB 12KB
64KB 4KB	96KB 8KB	128KB 12KB

Flash in production

M16C/28 80pin 64pin

20MHz@3.0-5.5V
10MHz@2.7-5.5V

48KB+4KB 4KB	64KB+4KB 4KB	96KB+4KB 8KB
48KB 4KB	64KB 4KB	96KB 8KB

Flash/Mask production started

M16C/26A 48pin 42pin

20MHz@3.0-5.5V
10MHz@2.7-5.5V

24KB+4KB 1KB	48KB+4KB 2KB	64KB+4KB 2KB
24KB 1KB	48KB 2KB	64KB 2KB

Mass production

M16C/26 48pin

20MHz@3.0-5.5V
10MHz@2.7-5.5V

24KB+4KB 1KB	48KB+4KB 2KB	64KB+4KB 2KB

Mask Flash

★ : New product ★★ : Under development ☆ : Planning

M16C/Tiny Function Succession

- **CAN (2.0B, 1ch)** M16C/29 additional function
- **Input capture, output compare** M16C/28 Additional function
- **Hardware Multi-Master I²C** M16C/28 Additional function
- **On-chip oscillator frequency modification function** M16C/26A Additional function
- **On-chip oscillator is selected after reset**
- **Digital debounce function ($\overline{\text{NMI}}$, $\overline{\text{INT5}}$)**
- **Position-data-retain function**
- **Flash erase suspend function** M16C/26 Additional function
- **New reset function** Success M16C/62P function
- **Oscillation stop detection circuit**
- **New WDT function (system clock which does not stop) (WDT operation with on-chip oscillator)**
- **Safe design (H/W reset of watchdog timer selected) (Clock stop→ divide-by-8 selected at return)**
- **Small-capacity flash memory block for storing data "Data Flash" (option)**

Introduction of M16C/Tiny



- **Feature**

- M16C/Tiny has low-pin-count (42 pins to 80 pins) package with M16C/60 CPU core (20MHz@3-5V operation).
- Package : 0.5mm pitch, 48 pins (10mm x 10mm corner)
0.5mm pitch 64 pins (10mm x 10mm corner)
0.5mm pitch 80 pins (12mm x 12mm corner)
SSOP package with 42 pins
- All include the 3-phase PWM output timer and are enabled for motor control. Especially, M16C/26A,28,29 include the hardware for 3-phase motor control and the hardware is more enabled for motor control .

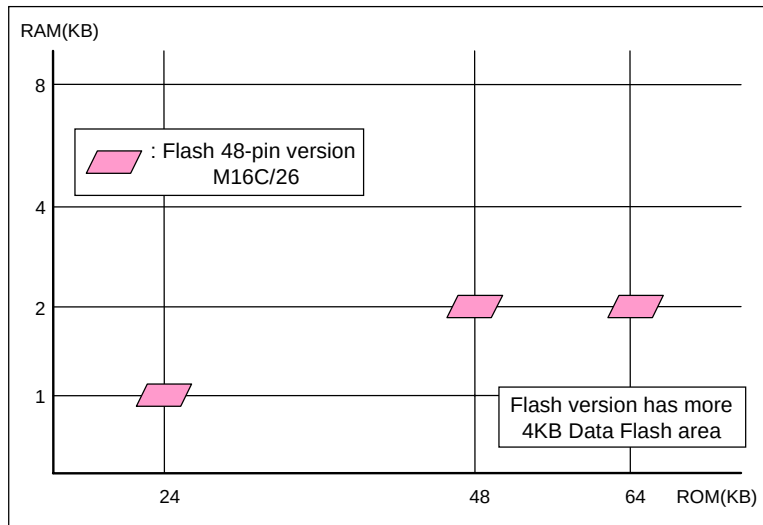
- **Application**

Motor application, white goods, industry, automobile

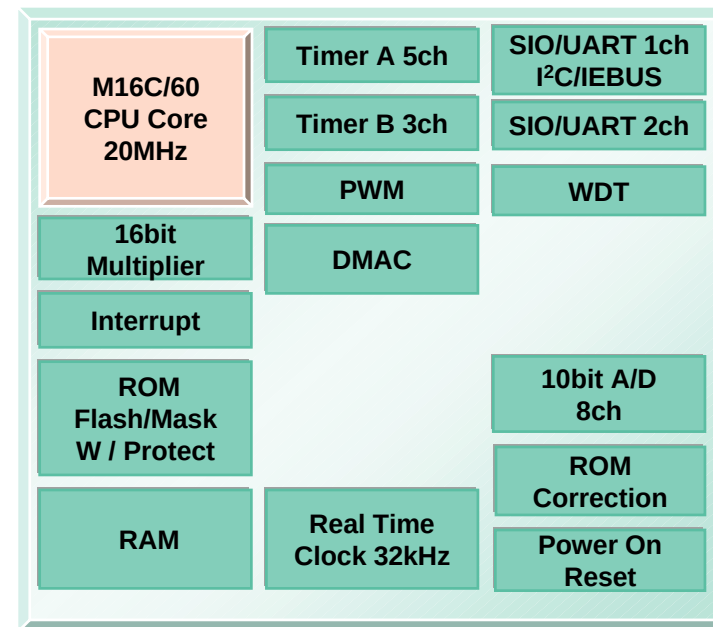
Feature of M16C/26 Group



- High-speed operation (20MHz@5V) is available with **small footprint (7mm corner 48pin).**
- Maintain the compatibility of the instruction, peripheral functions and easy for program porting from M16C/62A, /62N.
- Inherit 3-phase motor control timer from M16C/62A, /62N and motor control is available with small-size device.
- External reset circuit is not needed by the on-chip reset circuit and available for small footprint.
- **M16C/26 has data flash area** which is substitute for external EEPROM.



Memory Line up



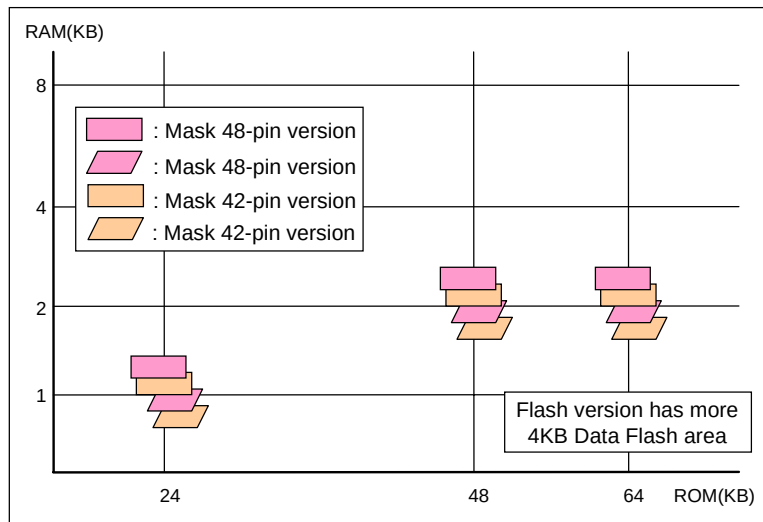
M16C/26 Block Diagram

I²C-bus is a registered trademark of Philips. IE Bus is a trademark of NEC Electronics.

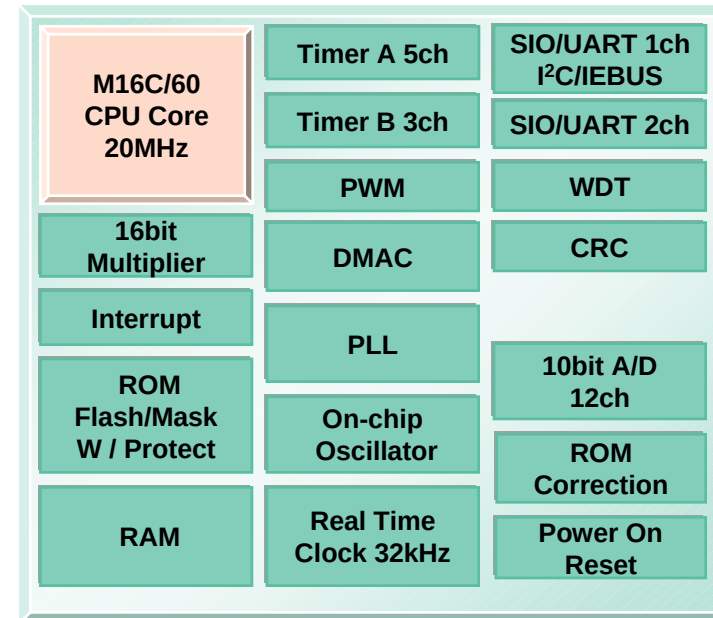
Feature of M16C/26A Group



- High-speed operation (20MHz@5V) is available with small footprint (7mm corner 48pin).
42 pin SSOP package can be used.
- **Maintain the compatibility of the instruction, peripheral functions and easy for program porting from M16C/62A, /62N.**
- Inherit 3-phase motor control timer from M16C/62A, /62N and motor control is available with small-size device.
M16C/26A includes motor control dedicated circuit and various controls are enabled.
- External reset circuit is not needed by the on-chip reset circuit and available for small footprint.
- **M16C/26A has data flash area** which is substitute for external EEPROM.



Memory Line up



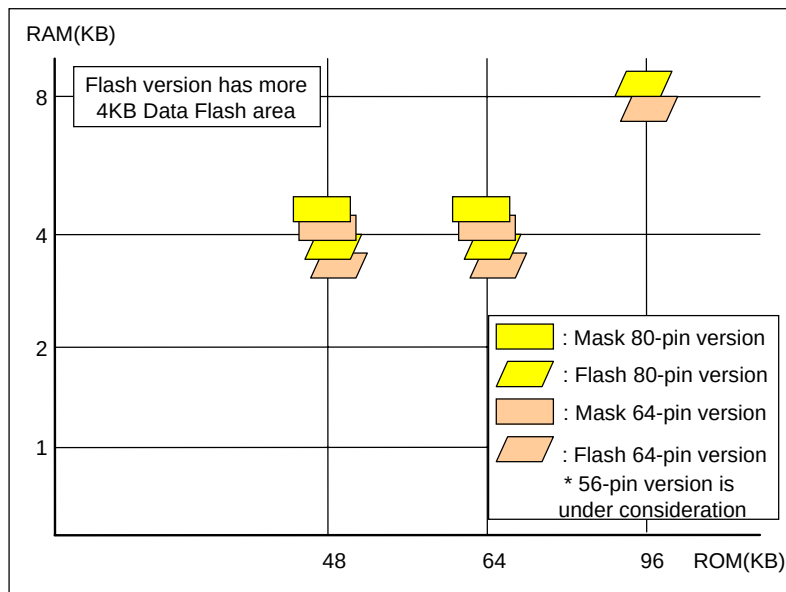
M16C/26A Block Diagram

I²C-bus is a registered trademark of Philips. IE Bus is a trademark of NEC Electronics.

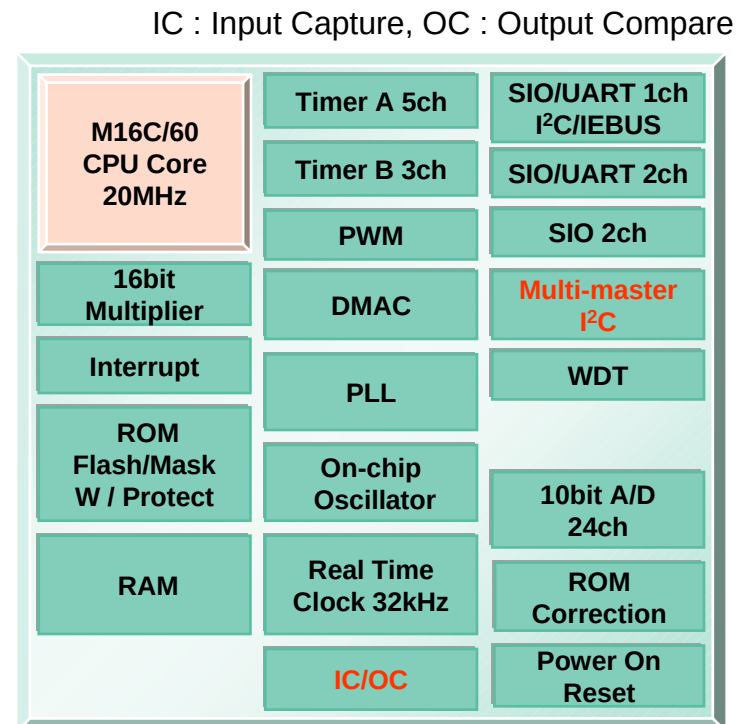
Feature of M16C/28 Group



- High-speed operation (20MHz@5V) is available with small footprint.
- Maintain the compatibility of the instruction, peripheral functions and easy for program porting from M16C/62A, /62N.
- Inherit 3-phase motor control timer from M16C/62A, /62N and motor control is available with small-size device.
- M16C/28 include **input capture and output compare** more flexible signal can be controlled
- **M16C/28 includes multi-master I²C bus, up to 2ch for I²C-bus**
- External reset circuit is not needed by the on-chip reset circuit and available for small footprint.
- **M16C/28 has data flash area** which is substitute for external EEPROM.



Memory Line up



M16C/28 Block Diagram

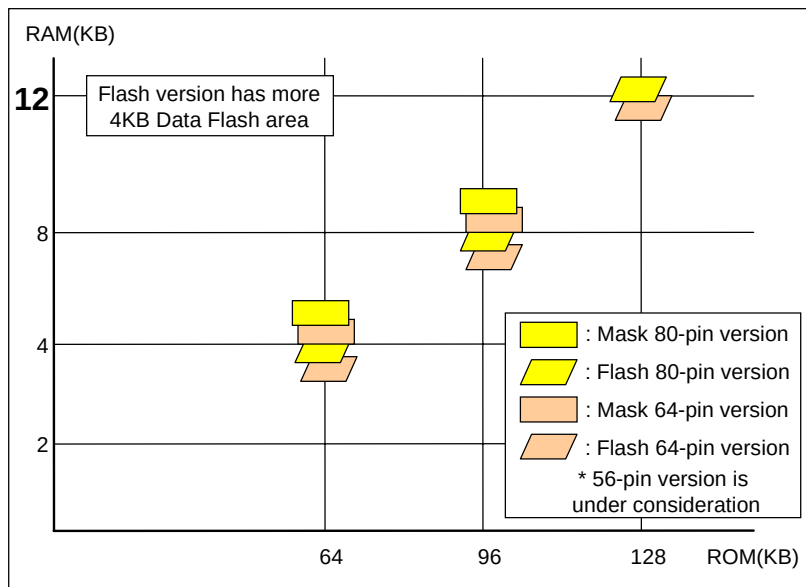
I²C-bus is a registered trademark of Philips. IE Bus is a trademark of NEC Electronics.

Feature of M16C/29 Group

Under
Development

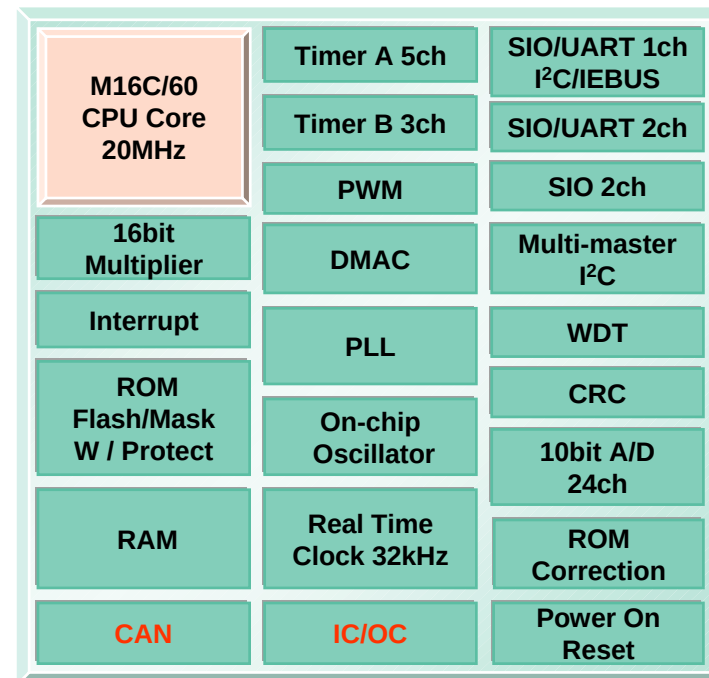
- **Single CAN 2.0B** is added to **M16C/28**. M16C/29 has upper compatibility of M16C/28.
- High-speed operation (**20MHz@5V**) is available with small footprint.
- Maintain the compatibility of the instruction, peripheral functions and easy for program porting from M16C/62A, /62N.
- Inherit 3-phase motor control timer from M16C/62A, /62N and motor control is available with small-size device.
- M16C/28 include **input capture and output compare** more flexible signal can be controlled

- **M16C/28 includes multi-master I²C bus, up to 2ch for I²C-bus**
- External reset circuit is not needed by the on-chip reset circuit and available for small footprint.
- **M16C/29 has data flash area** which is substitute for external EEPROM.



Memory Line up

IC : Input Capture, OC : Output Compare



M16C/29 Block Diagram

I²C-bus is a registered trademark of Philips. IE Bus is a trademark of NEC Electronics.

Outline Specification of M16C/26, 26A, 28, 29**



★★

Under
Development

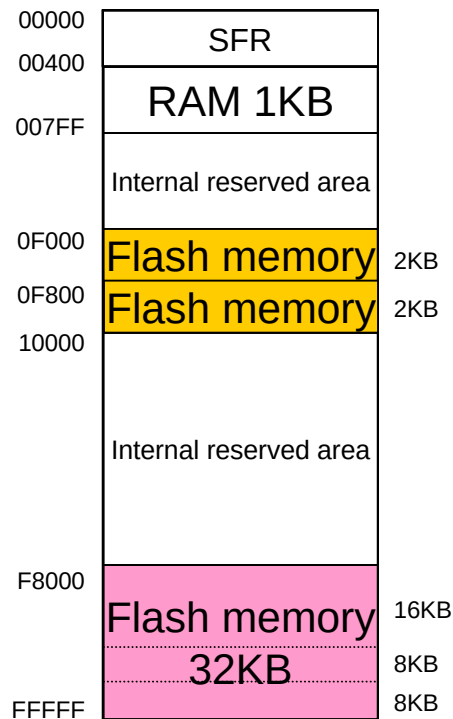
	M16C/26,26A Group	M16C/28, /29 Group
Minimum Instruction Execution Time	50ns (f(Xin)=20MHz, Vcc=3.0V to 5.5V), 100ns (f(Xin)=10 MHz, Vcc=2.7V to 3.0V)	
Supply Voltage	2.7 to 5.5V	
Power Consumption	In operation : <u>16mA</u> (Typ.) @ 20MHz, 0 wait, In Wait : <u>1.8uA</u> (Typ.), In Stop : <u>0.7uA</u> (Typ.)	
Memory (FLASH ROM / RAM)	(24+4)KB/1KB, (48+4)KB/2KB, (64+4)KB/2KB	M16C/28 : (48+4)KB/4KB, (64+4)KB/4KB, (96+4)KB/8KB M16C/29 : (64+4)KB/4KB, (96+4)KB/4KB, (128+4)KB/8KB
(MASK ROM / RAM)	24KB/1KB, 48KB/2KB, 64KB/2KB	48KB/4KB (M16C/28 only), 64KB/4KB, 96KB/8KB, 128KB/12KB (M16C/29 only)
Serial I/O	U(S)ART/SIO 2ch, U(S)ART/SIO/I ² C ¹ /IEbus ² 1ch	U(S)ART/SIO 2ch, U(S)ART/SIO/I ² C ¹ /IEbus ² 1ch, SIO 2ch, Multi-Master I ² C ¹ 1ch
CAN 2.0B	—	1ch (M16C/29 only)
A/D Converter	10 bit x 12ch (M16C/26 : 8ch)	10bit x 27ch (M16C/28 : 24ch)
Timer	16-bit timer : 8ch (Timer A : 5ch, Timer B : 3ch), Watchdog timer	
CRC	1ch (M16C/26A only)	1ch (M16C/29 only)
High-performance Timer	—	Input capture : 8, output compare : 8
Key Input Interrupt	4	
General-Purpose I/O Port	39 (M16C/26 : 38)	71
Clock Generating Circuit	3 : (Xin, Xcin, on-chip oscillator) PLL(M16C/26A only)	4 : (Xin, Xcin, on-chip oscillator, PLL)
Reset Circuit	Low Voltage Detection Function (Option)	
Package	48 LQFP, (40 LQFP), 42SSOP(M16C/26A only)	80 LQFP, 64 LQFP, (56 LQFP)

I²C-bus is a registered trademark of Philips. IE Bus is a trademark of NEC Electronics. Both 1) and 2) are option function

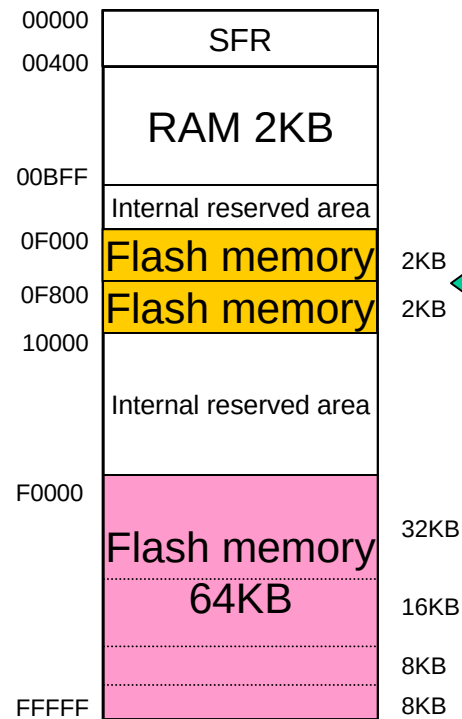
Data Flash

<Memory Map of M16C/26, 26A>

32+4KB Version



64+4KB Version



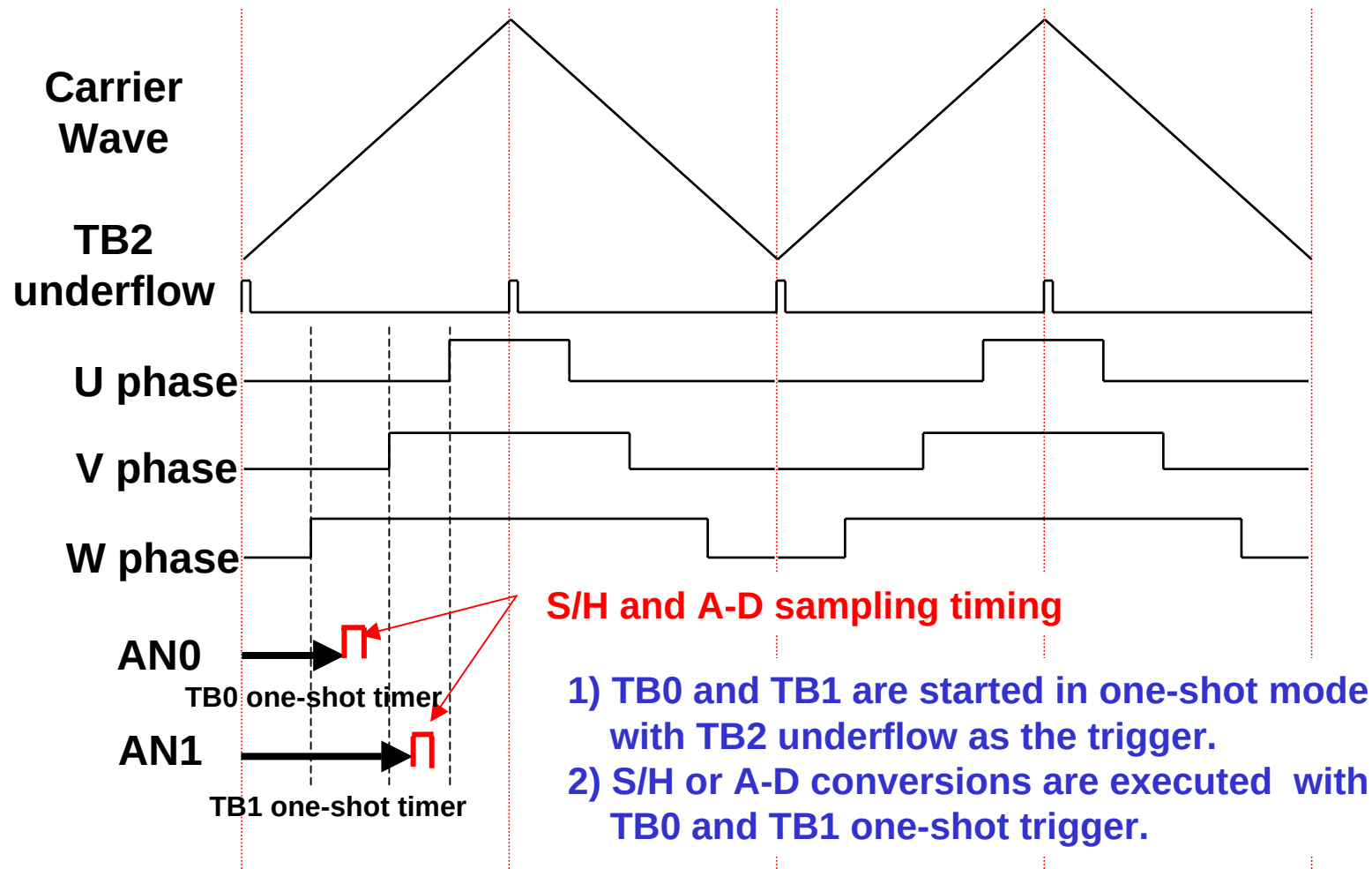
For data storing
Small capacity flash memory block

2KB x 2 blocks "data flash"

Rewrite endurance : standard 10,000 times (option)

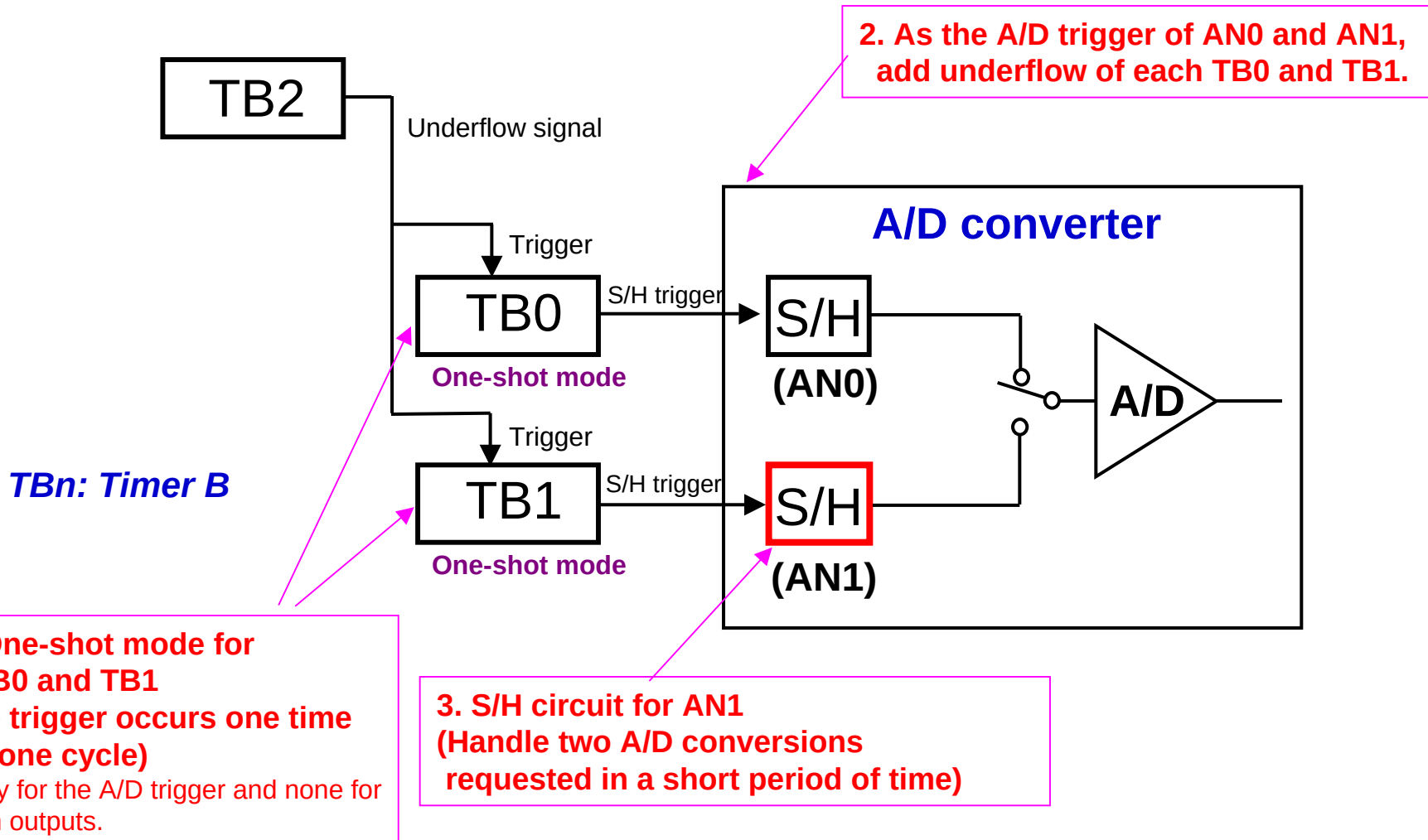
*: R8C, M16C/Tiny
M16C/62P, M32C/84,85,86,87,90 :
4KB x 1 block

A/D converter with Delay Trigger(1)



A/D converter with Delay Trigger(2)

A/D converter and timer B (TB2) additional functions



Memo

[illegible]

M16C/6NK Group

M16C/6NK. 6NL, 6NM, 6NN with CAN

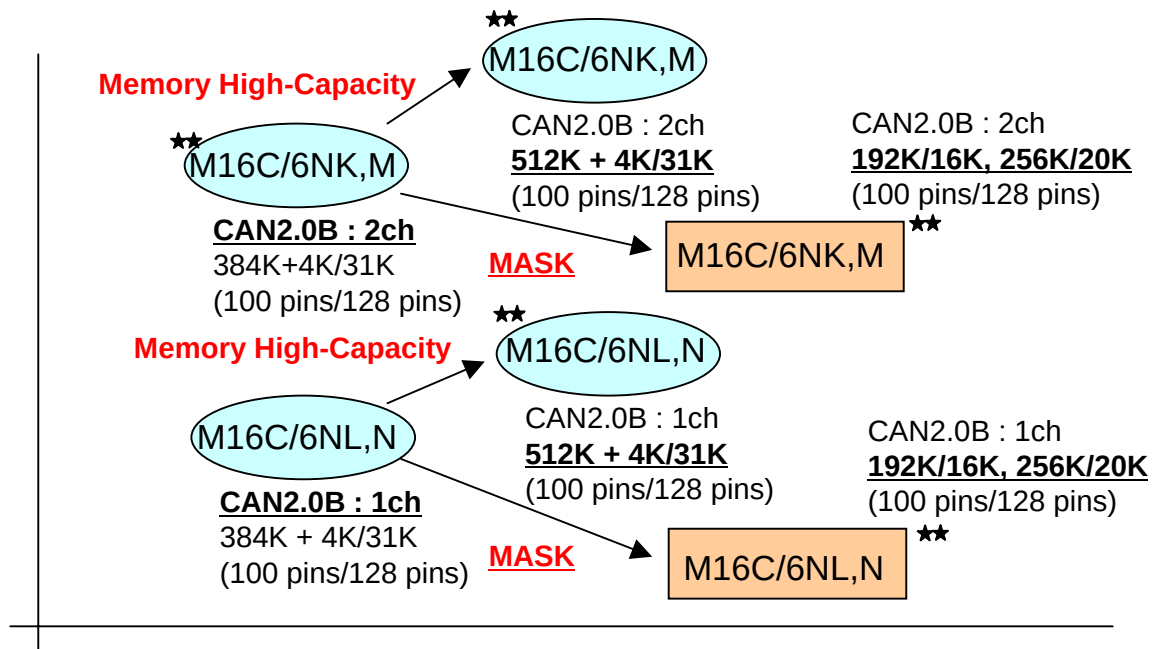
Progression of M16C/6NK, 6NM, 6NL, 6NN

- Feature

- Inherit features of M16C/62P (CPU core, low power consumption, EMI characteristics, peripheral functions), including CAN (support for 2.0B)
M16C/6NK, M : CAN2.0B 2ch, M16C/6NL, N : CAN2.0B 1ch
- Add communicating functions
CAN, serial interface : 5ch (M16C/6NK, L/7ch (M16C/6NM, N)
- Add external interrupts with improving the watchdog timer, fail-safe function, such as including the oscillation stop detection circuit
9ch : M16C/6NM, N

- Application

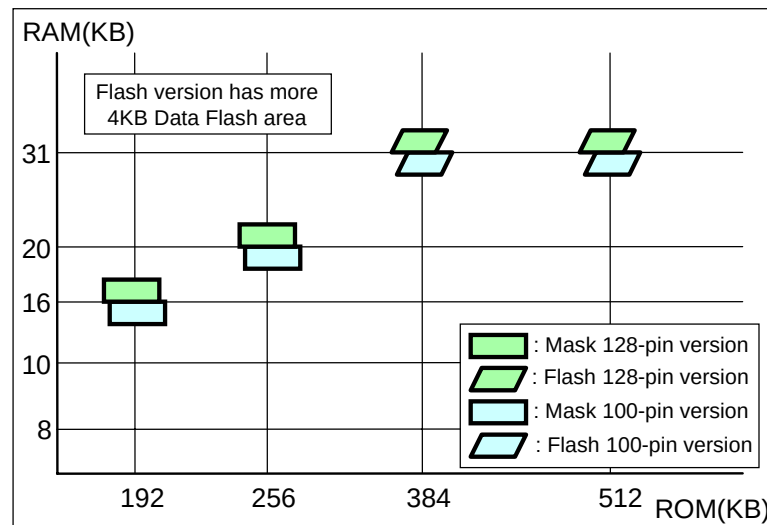
Car audio, Industrial equipments



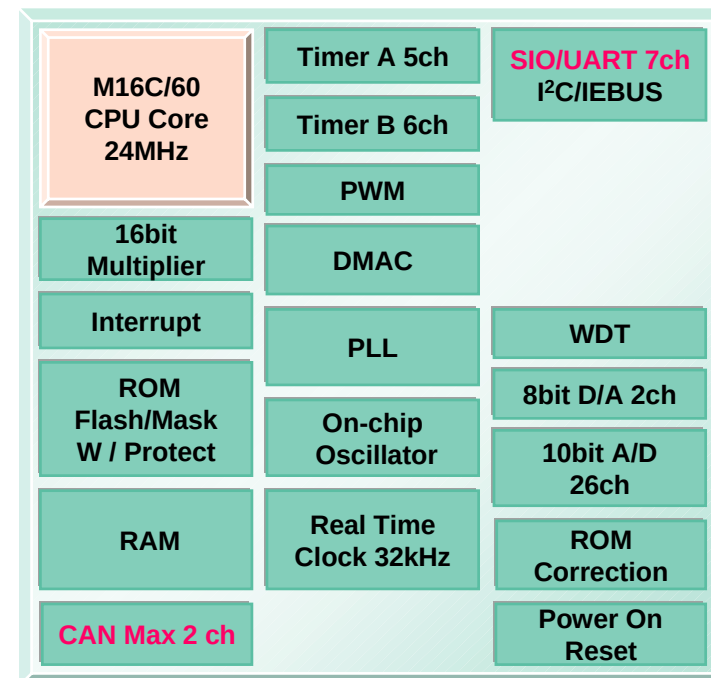
★★ : Under development

Feature of M16C/6NK, 6NM, 6NL, 6NN

- M16C/60 core : Maximum operating frequency
24MHz@5V(PLL)
- Supply voltage : **3.0 to 5.5V (f(BCLK) = 24MHz, 0wait)**
- **On-chip memory : Maximum 512KB Flash, 31KB RAM**
- General-purpose timer : Timer A : 16 bits x 5
Timer B : 16 bits x 6
3-phase motor control,
event counter
- AD converter : 10 bits x 1 circuit, maximum : 26 input
- Data Flash : 4KB [Flash version only]
- CAN2.0B 2ch (/6NK, /6NM)
1ch (/6NL, /6NN)
- Communication : 128-pin version **SIO/UART x 7ch**
100-pin version **SIO/UARTx 5ch**
IE Bus x 3ch, I²C bus x 3ch, SPI x 3ch
Inherit M16C/62P functions
CRC calculation circuit, ROM collection
- Others
- Package
100-pin version (0.5mm pitch) : /6NK, /6NL
128-pin version (0.5mm pitch) : /6NM, /6NN



Memory / Package Lineup



Block Diagram

Memo

[illegible]

Microcomputer General Presentation

M16C Family

M32C Series Product Introduction

M32C/80 Series, M32C/90 Series

October 28, 2005

Rev.2.00

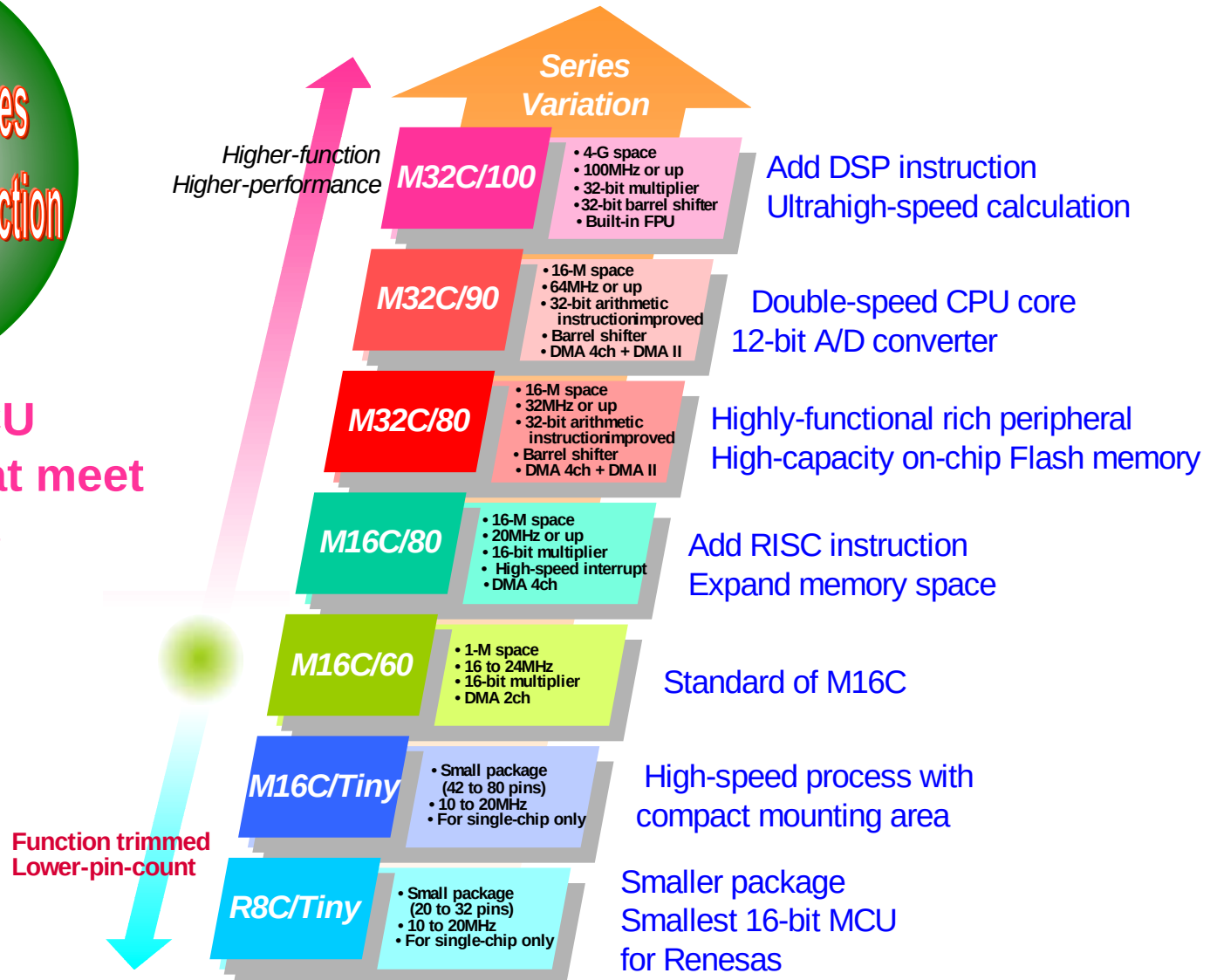
Standard Product Business Group
Renesas Technology Corp

M16C Family Road Map



**Multi-purpose MCU
with functions that meet
a variety of needs**

- ◆ Car audio
- ◆ Audio
- ◆ Automotive
- ◆ TV / LCD / PDP
- ◆ Terminal/Mobile device
- ◆ Amusement
- ◆ Industry (motor, inverter)
- ◆ White goods
- ◆ Camera / Digital Camera
- ◆ PC / OA, etc.



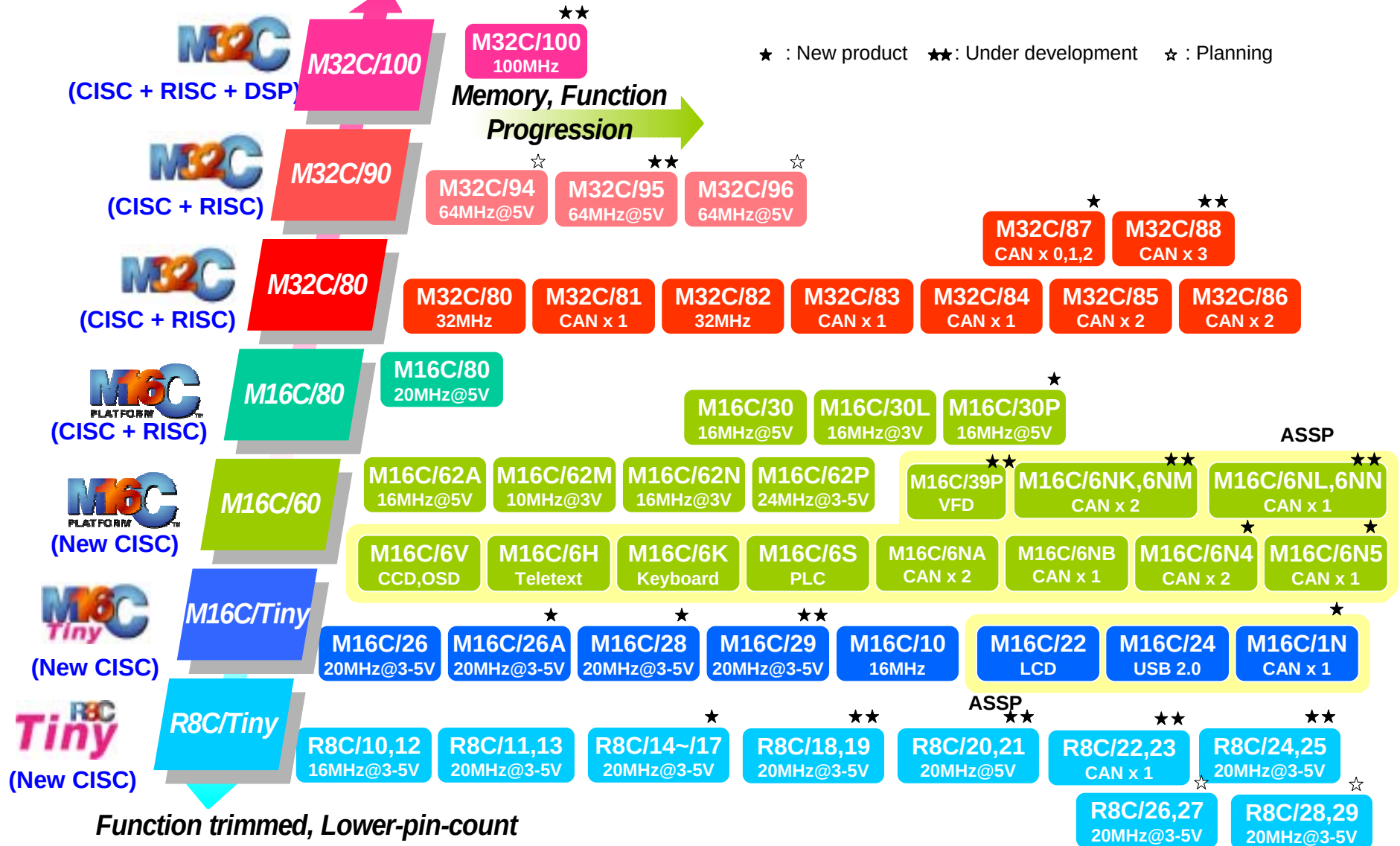
M16C Family Lineup

M32C Powerful Processors
-Easy to Use

Higher-function, Higher-performance

★ : New product ★★: Under development ☆ : Planning

*Memory, Function
Progression*



Memo

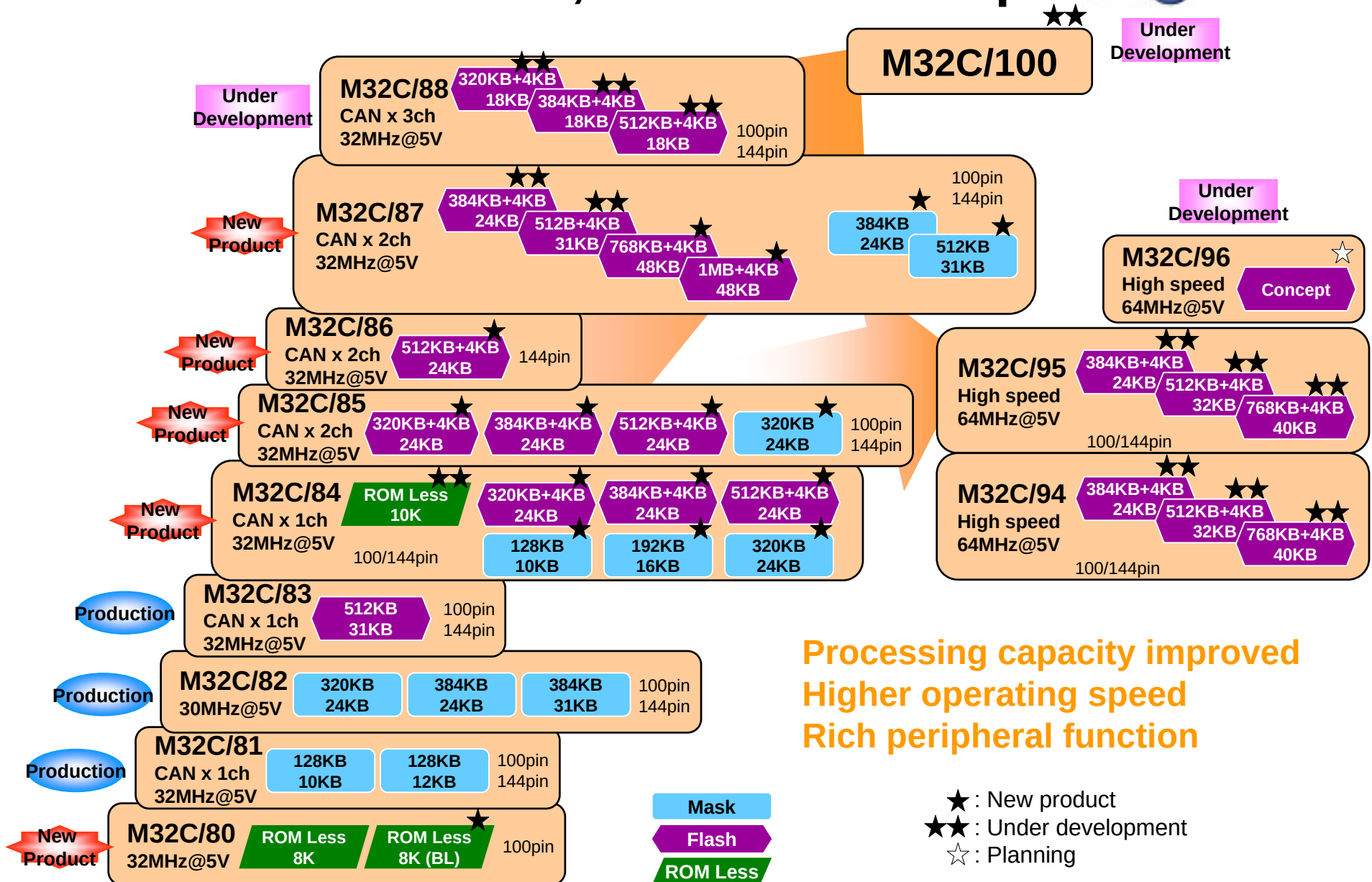
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M32C/80 Series

**High-Speed, High-Performance Series
in M16C Family**

M32C/8x, 9x Series Lineup

M32C Powerful Processors
-Easy to Use

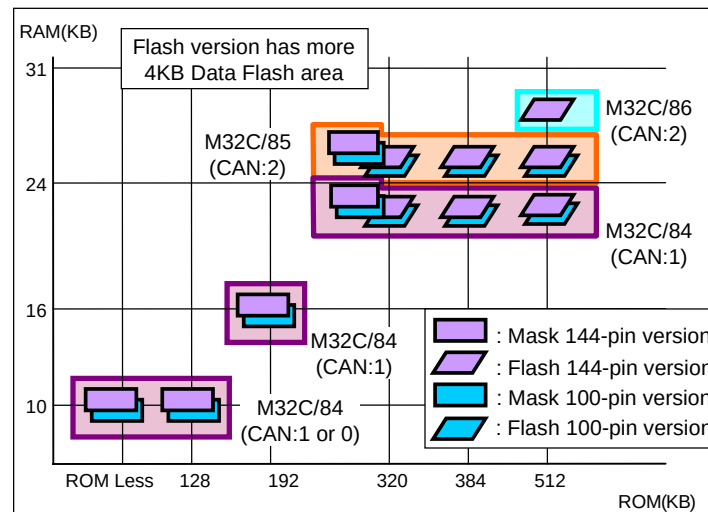


Processing capacity improved
Higher operating speed
Rich peripheral function

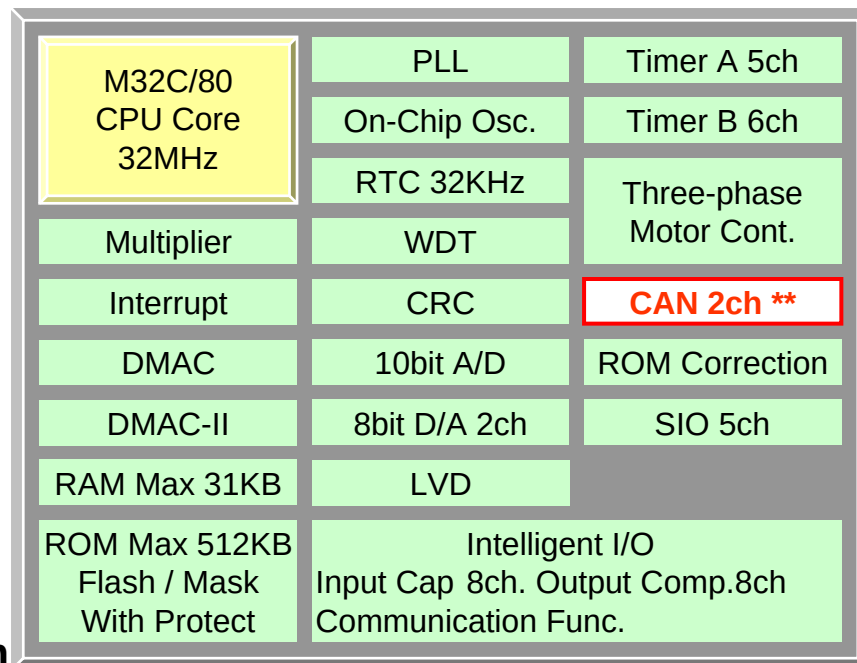
Feature of M32C/84, 85, 86 Groups Powerful Processors -Easy to Use

- M32C/80 core M16C/80 upper compatibility
Maximum operating frequency : **32MHz@5V**
- Clock 4, main, PLL, RTC, on-chip oscillator
- DMA DMAC 4ch
- Multi-functional DMA DMA II : Start is feasible from the interrupt request of all peripheral I/O
- High-functional timer **Intelligent I/O**
Input capture x 8ch [144-pin version]
Output compare x 8ch [144-pin version]
8-bit SIO (clock synchronous/asynchronous),
HDLC data process
2-phase stepping motor control : 4ch x 4
[only M32C/86]
- General-purpose timer Timer A : 16 bits x 5,
Timer B : 16 bits x 6
3-phase motor control, even counter
- AD converter 10 bits (conversion time 2.06μs) x 1 circuit,
34 input
- Data Flash 4KB [Flash version]
- Communication
Clock synchronous/asynchronous shared x 5ch
IE Bus x 5ch, I²C bus x 5ch, SIM I/F x 5ch
SPI x 5ch, **CAN 2.0B x 2ch** [x1ch : M32C/84] **
(each function maximum ch numbers)
- Bus I/F Wait 0 to 6, setup/hold time variable
- Others Protect on-chip memory is read
ROM collect : 4 points, XY conversion, CRC
All ports include pull-up resistor
LVD (low voltage detection circuit),
Oscillation stop detection function

Memory Package



Block Diagram

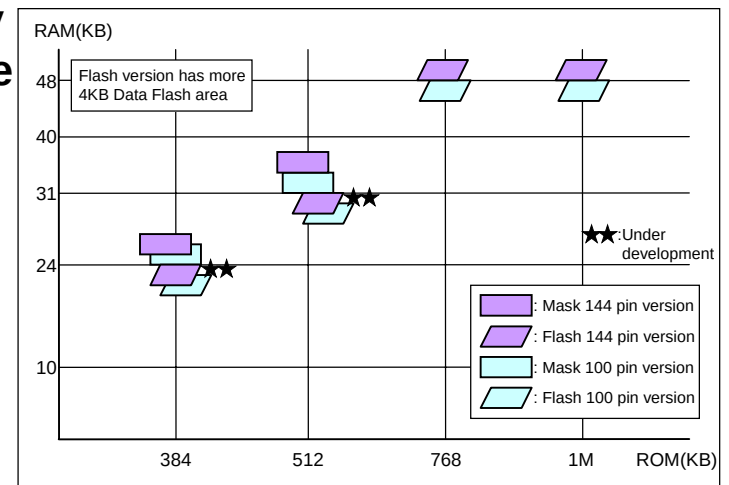


Feature of M32C/87 Group

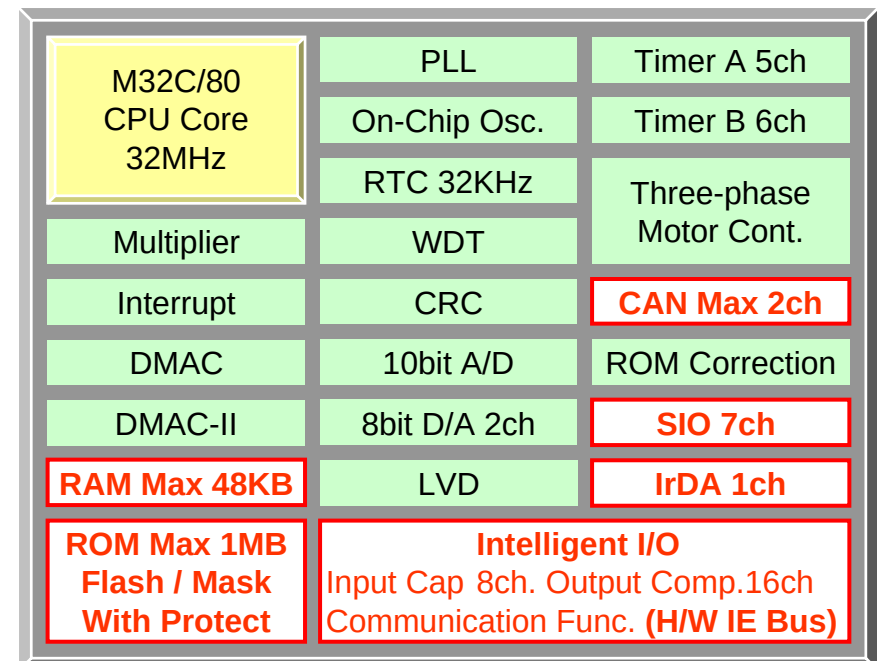


- M32C/80 core M16C/80 upper compatibility
Maximum operating frequency **32MHz@5V**
- On-chip memory **High capacity 1MB Flash, 48KB RAM**
- High-functional timer **Intelligent I/O**
Input capture x 8ch [144pin]
Output compare x 16ch [144pin]
8-bit SIO, HDLC data process,
H/W IE Bus
- General-purpose timer Timer A : 16 bits x 5
Timer B : 16 bits x 6
3-phase motor control,
event counter
- AD converter 10 bits (2.06μ) x 1 circuit, 34 input
- Data flash 4KB [Flash version only]
- Communication **Clock synchronous/asynchronous shared x 7ch,**
IE Bus x 5ch, I²C bus x 5ch
SPI x 5ch, **CAN 2.0B x 2ch**
IrDA 1.0 x 1ch
(maximum ch numbers each function)
- Others Inherit M32C/84, 85, 86 functions
CAN x 1ch, products without CAN are under development

Memory Package



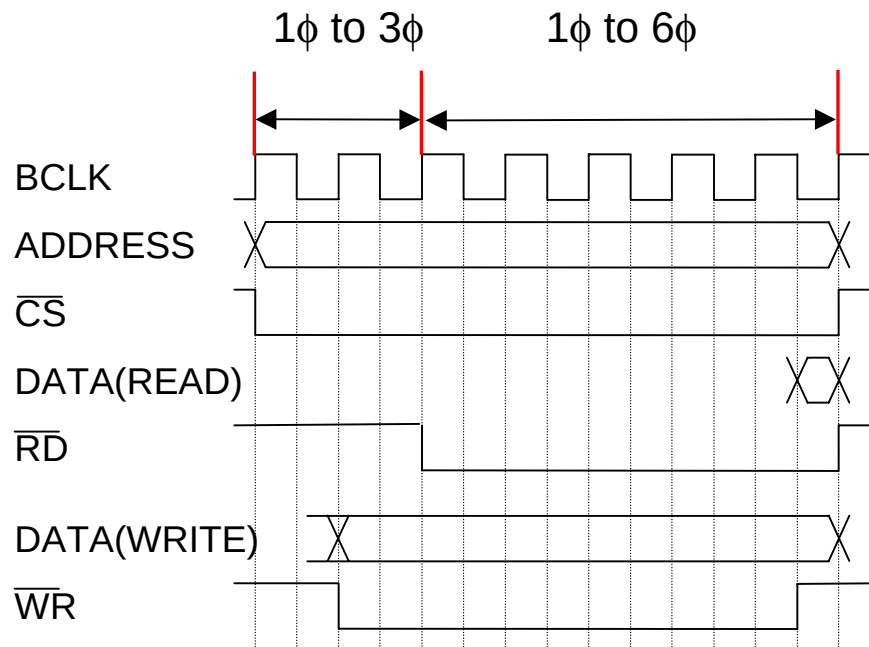
Block Diagram



Improve function of external bus access(1)

● Expand Wait numbers

1 to 7 Wait bus cycles



Access cycle to external area
(In 32MHz)

- 0 Wait 62.4ns
- 1 Wait 93.6ns
- 2 Waits 124.8ns
- 3 Waits 156.0ns

- 4 Waits 187.2ns
- 5 Waits 218.4ns
- 6 Waits 249.6ns
- 7 Waits 280.8ns

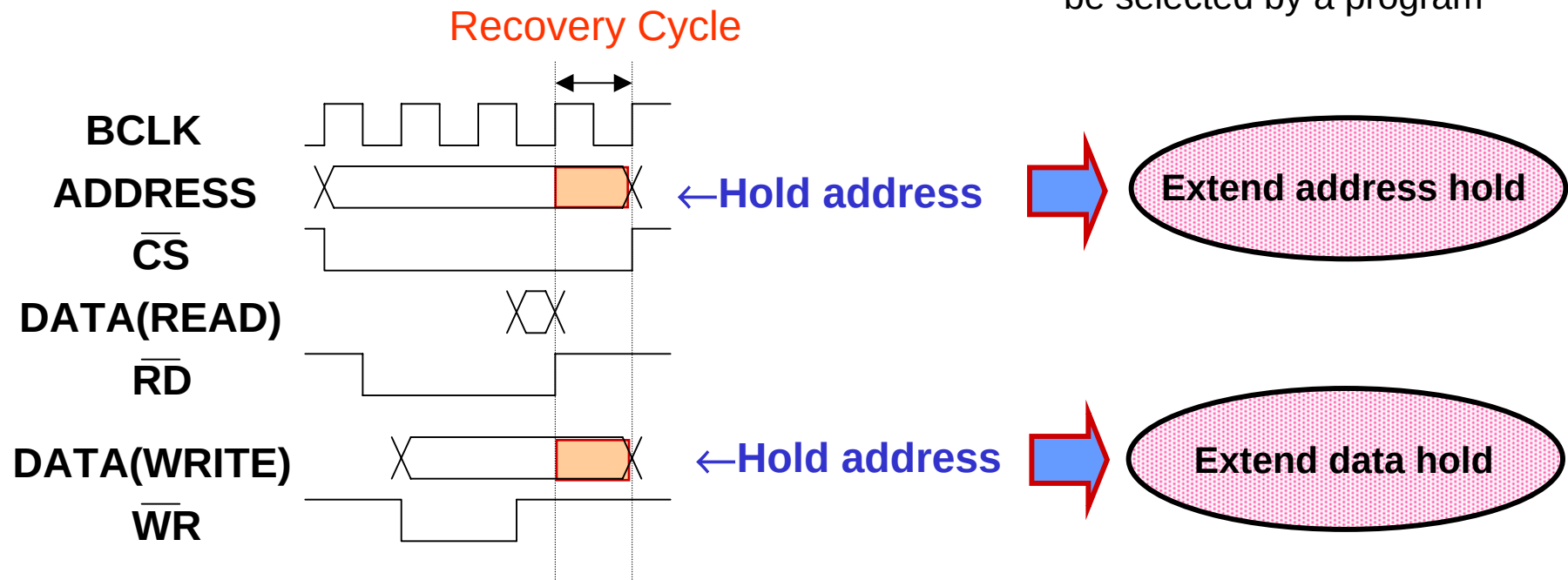
Function
improved

These MCUs can connect with
the external ASIC or memory whose access
speed is slower at high-speed operation

Improve function of external bus access(2)

- Expanded cycle function of address, data hold
(Support recovery cycle function)

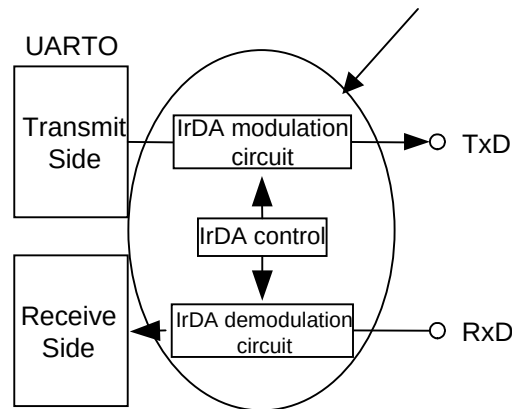
Insert of recovery cycle can be selected by a program



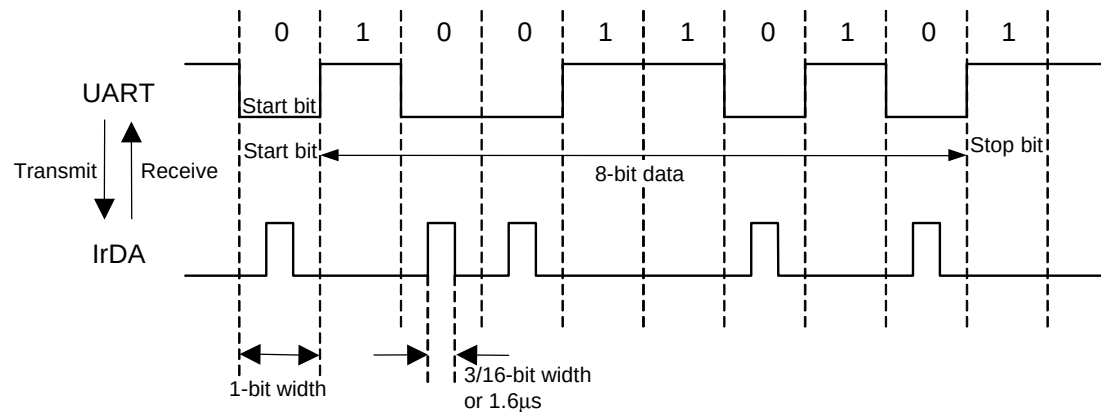
IrDA Ver. 1.0 Function

- Waveform modulation and demodulation based on **IrDA Ver1.0**

IrDA waveform generation circuit is added to UART0 function



IrDA Block Diagram

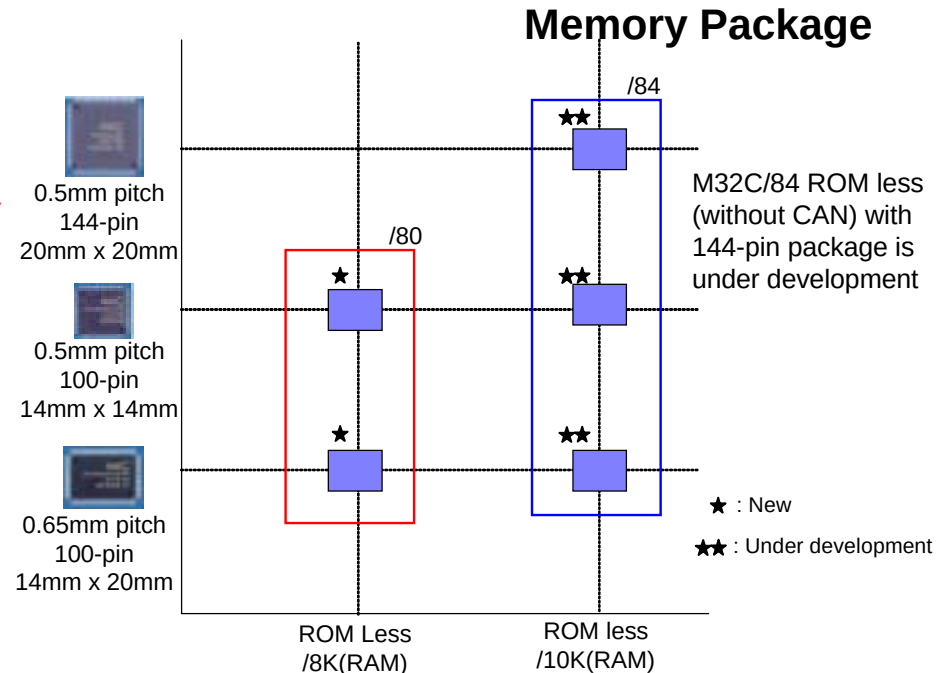


IrDA Frame Waveform

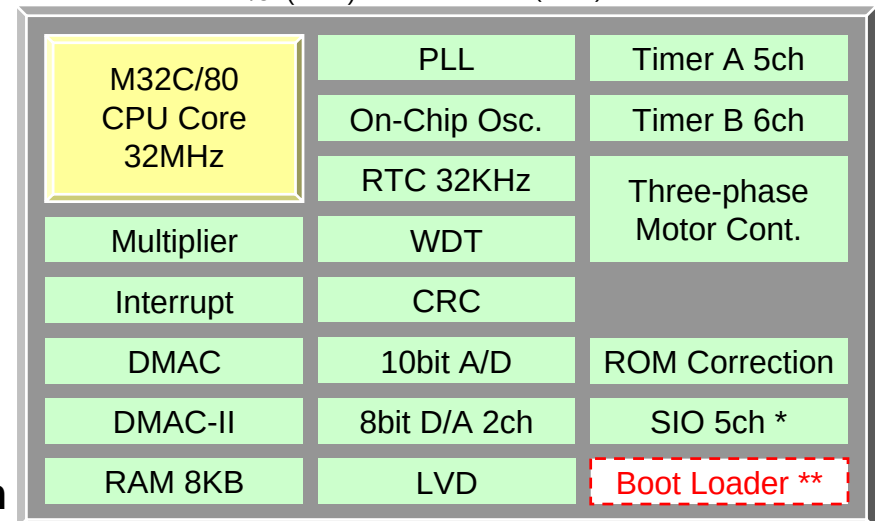
- IrDA frame : 1-bit start bit “0”, 8-bit data, 1-bit stop bit “1”
 - Transmit : Convert the UART data to the **IrDA** frame waveform with the modulation circuit before output
Output “H” of 1-bit width 3/16 when the data is set to “0”
Output “L” when the data is set to “1”
 - Receive : Convert the **IrDA** frame waveform to the UART data with the demodulation circuit before output
 - Transfer speed : 2400bps,9600bps,19200bps,38400bps,57600bps,115200bps can be set

Feature of M32C/80 ROM Less Powerful Processors -Easy to Use

- **M32C/80 core** M16C/80 upper compatibility, 16MB memory space
Maximum operating frequency **32MHz@5V, 24MHz@3V**
 - **Clock** 4 : main, PLL, RTC, on-chip oscillator
 - **DMA** DMAC 4ch
 - **Multi-functional DMA** DMA II : Start is feasible from the interrupt request of all peripheral I/O
 - **General-purpose timer** Timer A : 16 bits x 5, Timer B : 16 bits x 6
3-phase motor control, event counter
 - **AD converter** 10 bits (conversion time 2.06μ x 1 circuit, 10 input)
 - **DA converter** 8 bits x 2ch
 - **Communication*** Clock synchronous/asynchronous shared x 5ch,
IE Bus x 3ch, I²C bus x 3ch, SIM I/F x 3ch
SPI x 3ch (each function maximum ch numbers)
 - **Bus I/F** Wait 0 to 6, setup/hold time variable
4 chip select output, **5V/3V IC integrated can be connected**
 - **On-chip memory** ROM less/RAM 8KB
 - **Others** Address match : 4 points, XY conversion, CRC,
All port include pull-up resistor (4-pin unit)
LVD (low voltage detection circuit),
Oscillation stop detection function
 - **Package** 100-pin plastic mold QFP
(0.65mm, 0.5mm pitch)
- Offer products with boot loader which can reprogram external Flash memory**



Block Diagram



M32C/90 Progression

High-Speed or High-Performance in M32C Series

M32C/90 Series with Double-Speed Core



Maximum operating frequency in the M32C/90 series is 2 times (64 MHz) the one in the M32C/80 series. M32C/95 includes CAN x 3ch (1ch : for 32-message slot) and applicable for several networks. Also, the M32C/96 with the high-speed 12 bit A/D converter is under development.

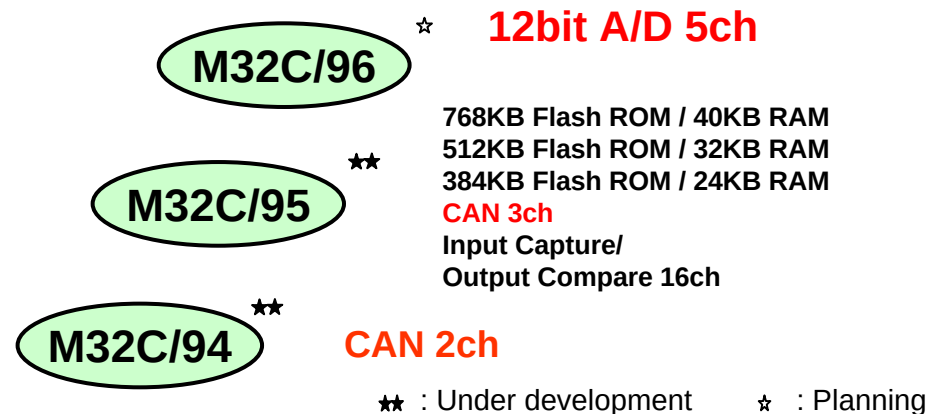
●Feature

- (1) **Maximum operating frequency is double (64MHz@5V)** for the M32C/80 series
- (2) **New Single wire debug I/F which can connect by only 1 pin is included**
- (3) Improve communicating function (CAN : 3ch, SI/O : 7ch) and M32C/90 series is the most appropriate for a gateway connected to several networks

●Application

Air bag, HEV/EV, EPS, Gateway
Body control module, Car audio,
Motor control,
Applications which need
high-speed process such as FA

●M32C/9x lineup (In review)



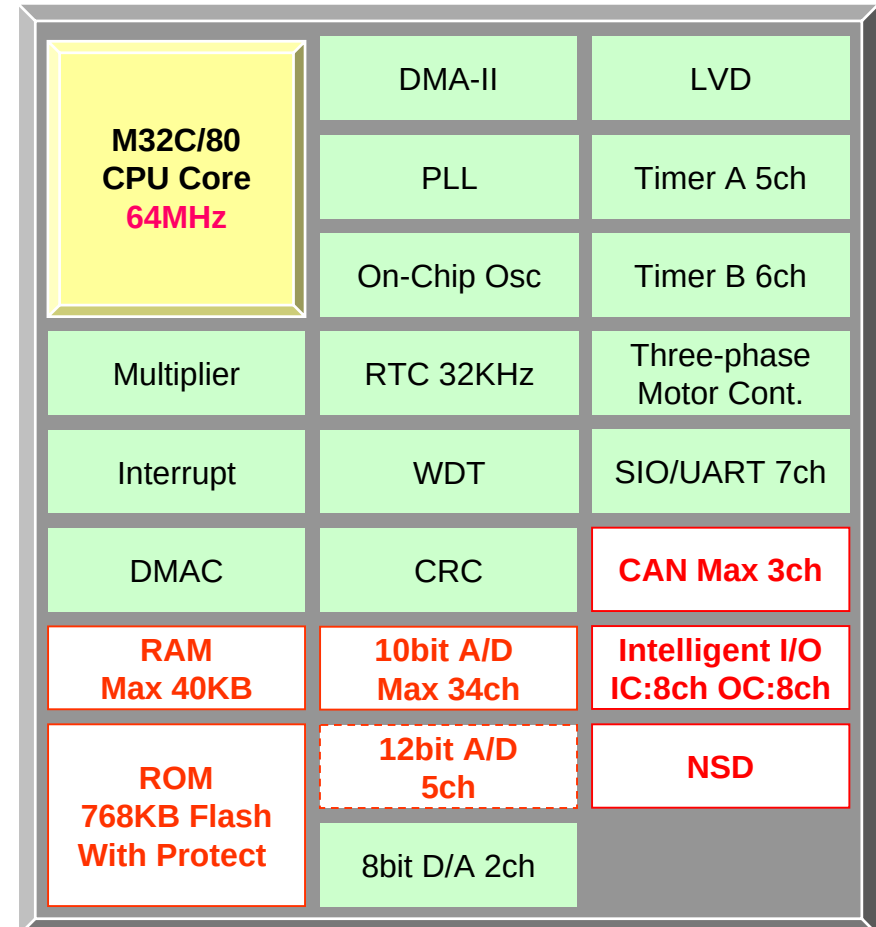
Feature of M32C/9x



Under development

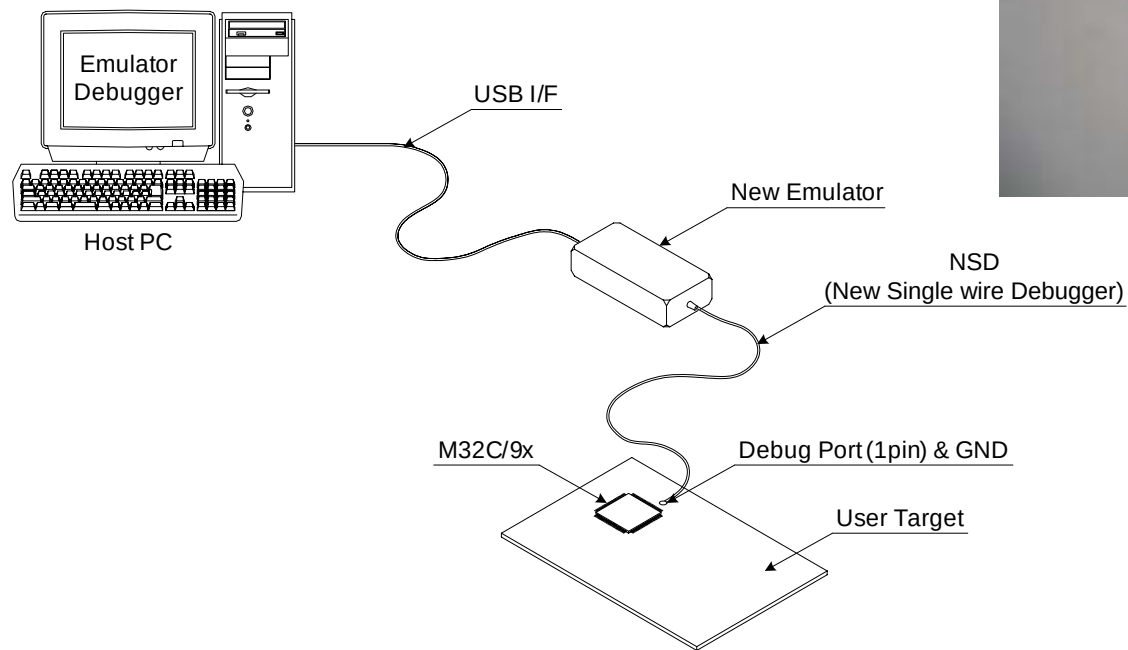
- M32C/80 core M16C/80 upper compatibility
Maximum operating frequency
64MHz@5V
- On-chip memory 768K Flash, 40KB RAM (scheduled)
- High-performance timer Intelligent I/O
Input capture x 8ch
Output compare x 8ch
8-bit SIO, HDLC data process
H/W IE Bus
- General-purpose timer Timer A : 16 bits x 5
Timer B : 16 bits x 6
3-phase motor control
Event counter
- AD converter 10 bits (2.06μ) x 1 circuit,
34 input
12 bits x 1 circuit,
5 input (M32C/96)
- Data flash 4KB
- Communication Clock synchronous/asynchronous
shared x 7ch,
IE Bus x 5ch, I²C bus x 5ch,
SPI x 5ch, CAN 2.0B max 3ch,
- Others Inherit M32C/84,85,86 functions
New Single wire Debugger (NSD)
(debug function, RAM monitor function)

Block Diagram



IP: Input Capture, OC: Output Compare

NSD (New Single wire Debugger) *Powerful Processors -Easy to Use*



Experimental model photo

Microcomputer General Presentation

M16C Family

R8C/Tiny Series Introduction

October 28, 2005

Rev.2.00

Standard Product Business Group
Renesas Technology Corp

R8C/Tiny Series Development Concept *Tiny*

Family Name

M16C Family
(M16C PLATFORM)

CPU Name

R8C ----- **R8C/Tiny**
R8C/10, 11, 12, 13, 14...

Series Name

R: Renesas

8: Internal Bus Width (CPU: 16-bit)

C: Compact (Same as M16C Family)

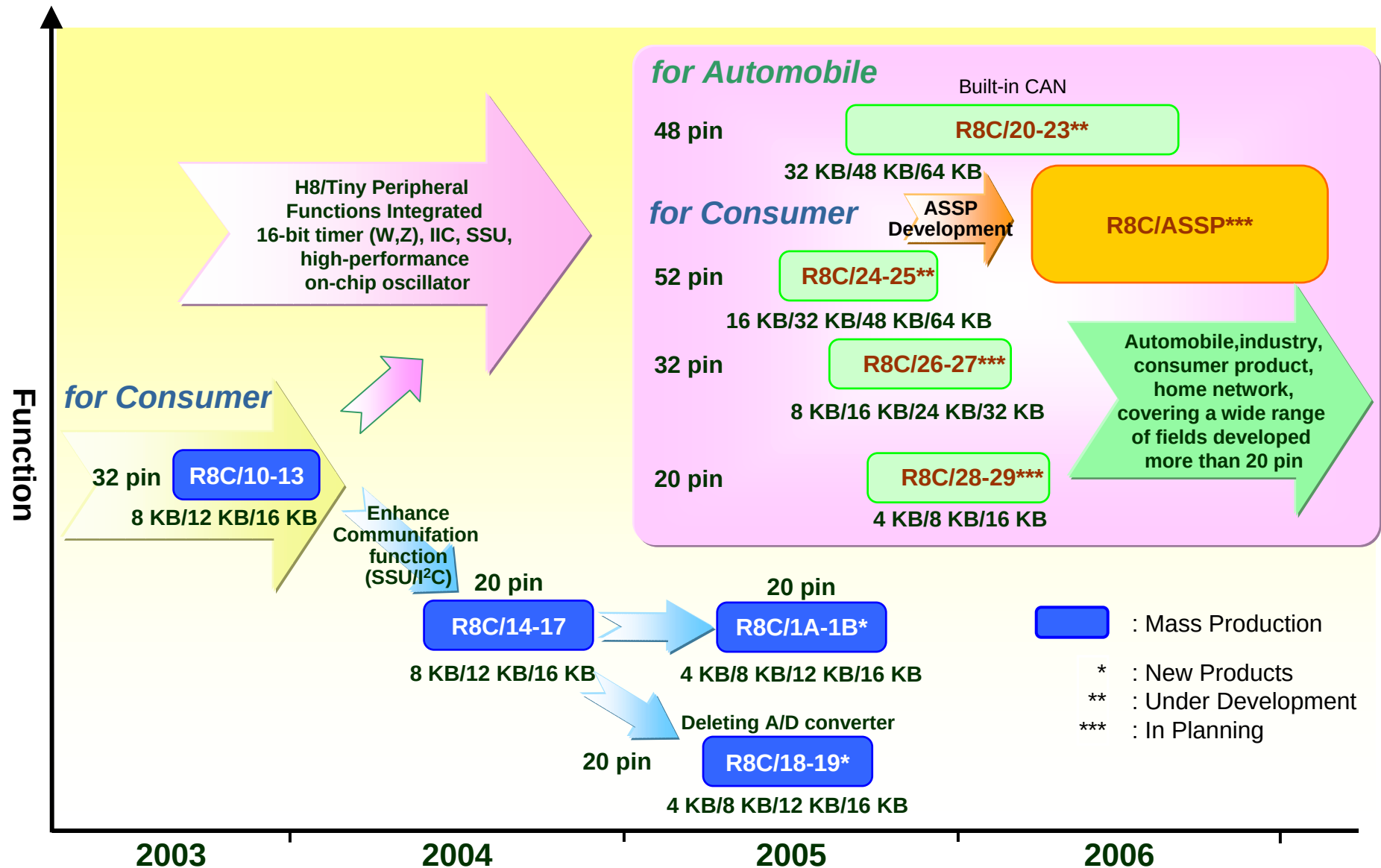
Tiny: Small pin count, Small FLASH Memory MCU

[Development Concept]

- Low power dissipation operation, high-speed operation
(Maximum operating frequency 20 MHz), high ROM efficiency
- Low cost FLASH MCU (write-in shipment at factory is in operation)
- High performance peripherals
(High speed internal on-chip oscillator, voltage detection circuit, data flash and I²C)
- Low pin count and small package MCU: 20 pin
- Good support environment
(Web base support : Application Note, Manuals, Tool information etc.)
- Low cost program development environment:
Low cost on-chip debugger, CPU board are released.

R8C/Tiny Series Road Map

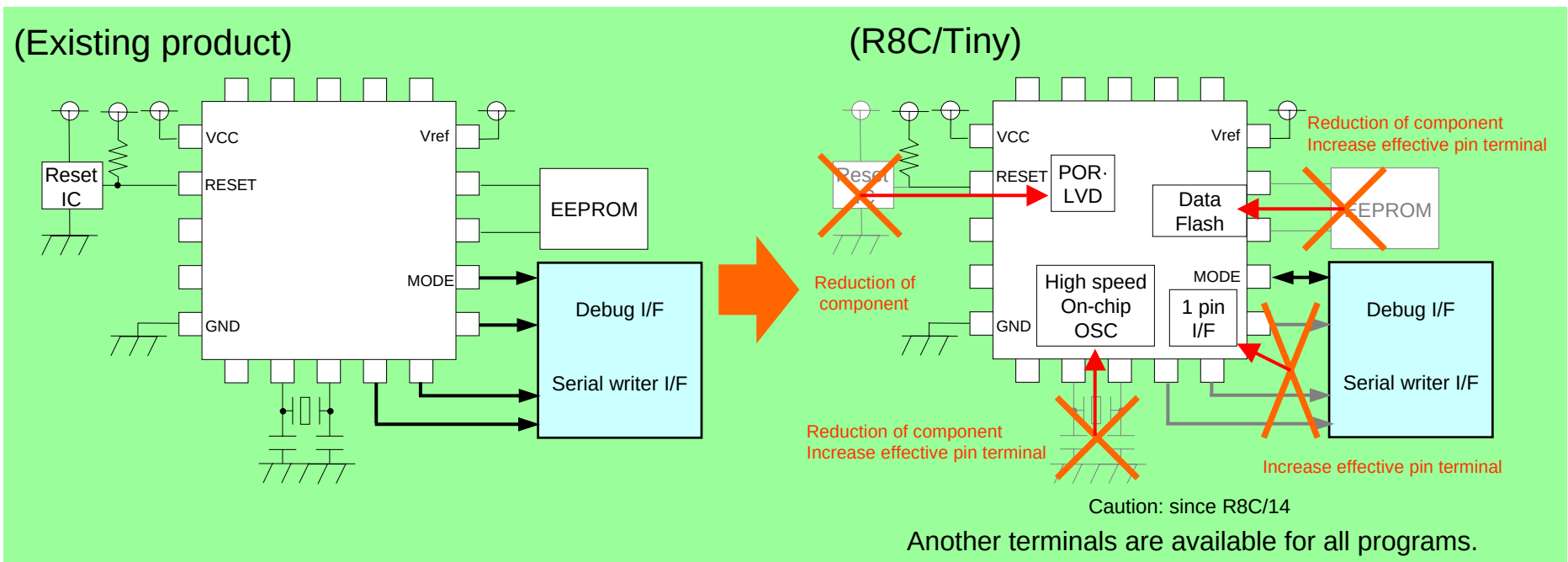
Tiny



Introduction of R8C/Tiny characteristic function

Tiny

- R8C/Tiny series includes high-performance CPU, low-current consumption, and **highly functional peripheral modules**.
 - 1) Reduction of external parts
...High-speed on-chip oscillator, POR, LVD, Data Flash
 - 2) Enlarge effective pin terminal
... 20-pin I/O: 13+I: 2 ports, **Debugging environment without use of user pin (since R8C/14)**
 - 3) Safety design
...Oscillation stop detection, **high-reliability WDT**, ROM protect function



Integrated Timer RA, RB, RC, RD and RE *Tiny*

Timer integrated with the H8/Tiny Series is incorporated!

Timer RA = R8C/1x Timer X function (improved register allocation)

Timer RB = R8C/1x Timer Z function (improved register allocation)

**Timer RC = H8/Tiny Timer W function + IH 100-V waveform output
+ noise canceller**

**Timer RD = H8/Tiny Timer Z function + IH 200-V waveform output
+ noise canceller**

Timer RE = H8/Tiny RTC function + pulse output

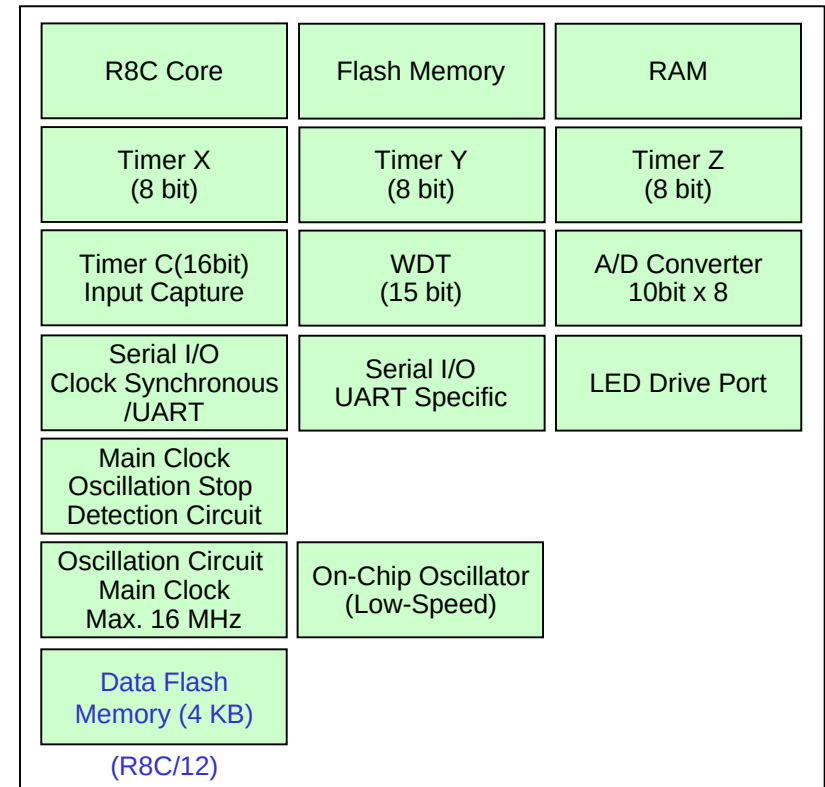
Features of R8C/10, 12 Group

Tiny

- CPU: R8C 16-bit CPU Core
- Minimum Instruction Execution Time:
62.5 nsec ($f(XIN)=16$ MHz)
- Power-supply Voltage:
3.0 to 5.5 V ($f(XIN)=16$ MHz, no wait)
2.7 to 5.5 V ($f(XIN)=10$ MHz, no wait)
- Internal Memory:
Flash ROM: 8 KB/RAM: 512 B
ROM:12 KB/RAM: 768 B
ROM:16 KB/RAM: 1 KB
- Data Flash 2 KB x 2 Blocks (R8C/12)
- Clock Generation Circuit: 2 circuits are incorporated
(XIN-XOUT, Low-speed on-chip oscillator)
(Built-in main clock oscillation stop detection circuit)
- Peripheral Functions
 - Multi-functional Timer: 8-bit timer: 3 ch
16-bit timer: 1 ch
(built-in input-capture circuit)
 - Serial I/O: Clock Synchronous/Asynchronous: 1 ch
Clock Asynchronous-specific: 1 ch
 - A/D Converter: 10 bit x 8 ch
 - Port: Programmable I/O Ports: 22
Input Ports: 2
 - LED Drive Port: 8
 - Pull-up Resistor: All ports, other than input port,
are settable
 - Watchdog Timer: 1 ch (applicable for H/W reset)
 - Package: 32-pin plastic mold QFP



R8C/10, 12 Block Diagram



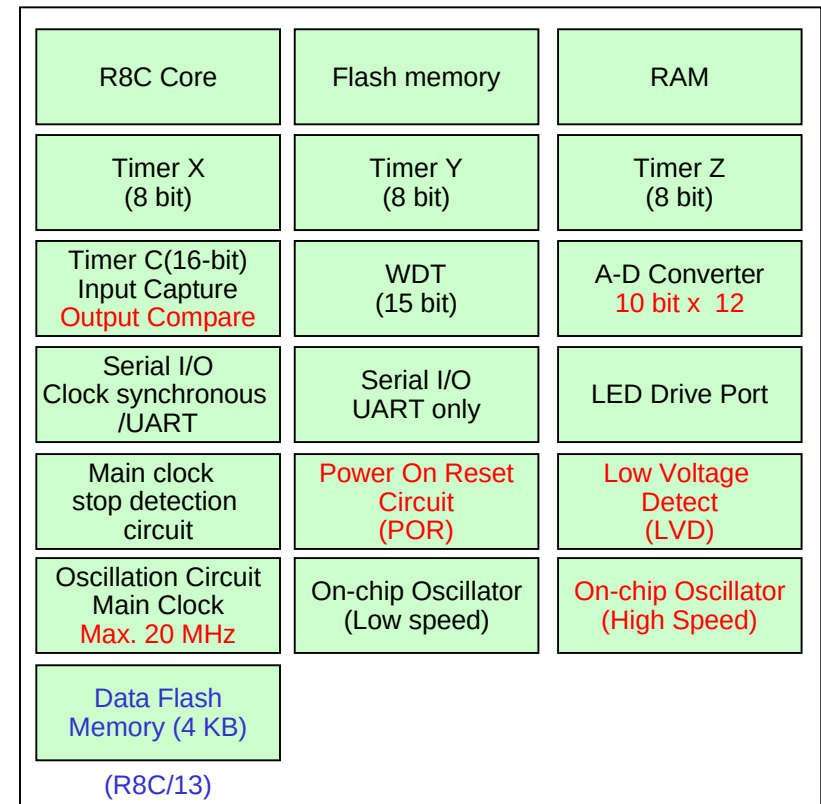
Features of R8C/11, 13 Group

Tiny

- CPU: R8C 16-bit CPU Core
- Minimum Instruction Execution Time:
50 nsec (f(XIN)=20 MHz)
- Power-supply Voltage:
3.0 to 5.5 V (f(XIN)=20 MHz, no wait)
2.7 to 5.5 V (f(XIN)=10 MHz, no wait)
- Internal Memory:
Flash ROM: 8 KB/RAM: 512 B
ROM:12 KB/RAM: 768 B
ROM:16 KB/RAM: 1 KB
- **Data Flash 2 KB x 2 Blocks (R8C/13)**
- Clock Generation Circuit: 2 circuits are incorporated (XIN-XOUT, **High-speed**, Low-speed on-chip oscillator) (Built-in main clock oscillation stop detection circuit)
- **Built-in Voltage Detection Circuit (@Vcc=5 V±10%)**
- **Built-in Power-on Reset Circuit (@Vcc=5 V±10%)**
- Peripheral Functions
 - Multi-functional Timer: 8-bit timer: 3 ch
16-bit timer: 1 ch
(built-in input-capture circuit)
(includes output-compare circuit)
 - Serial I/O: Clock Synchronous/Asynchronous: 1 ch
Clock Asynchronous-specific: 1 ch
 - A/D Converter: 10 bit x **12 ch**
 - Port: Programmable I/O Ports: 22
Input Ports: 2
 - LED Drive Port: 8
 - Pull-up Resistor: All ports, other than input port, are settable
 - Watchdog Timer: 1 ch (applicable for H/W reset)
 - Package: 32-pin plastic mold QFP



R8C/11, 13 Block Diagram



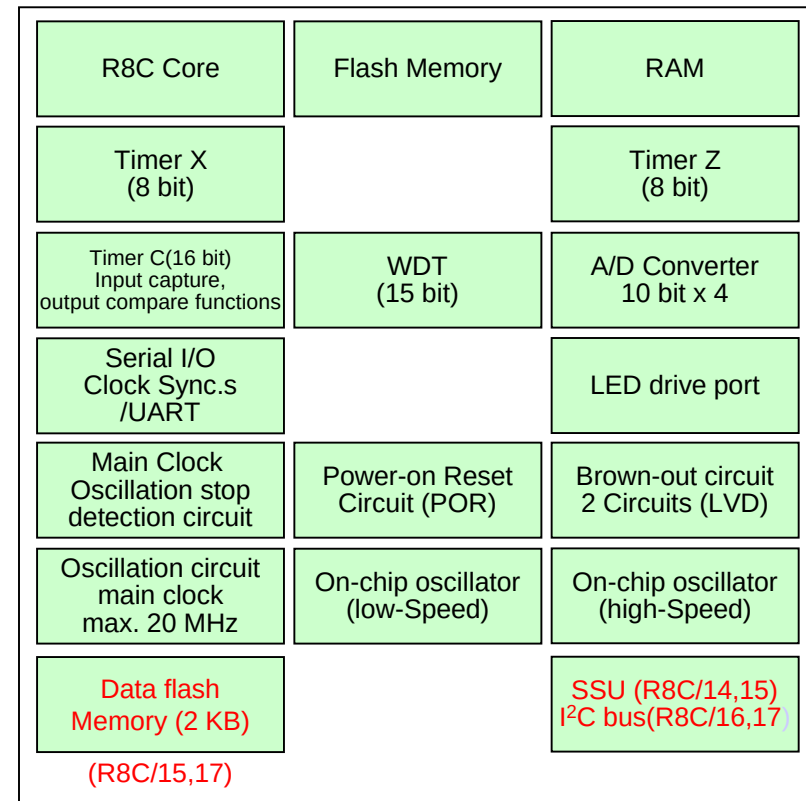
Features of R8C/14 to 17 Group

Tiny

- CPU: R8C 16-bit CPU Core
- Minimum instruction execution time:
50 nsec (f(XIN)=20 MHz)
- Power-supply voltage:
3.0 to 5.5 V (f(XIN)=20 MHz, no wait states)
2.7 to 5.5 V (f(XIN)=10 MHz, no wait states)
- On-chip memory:
Flash ROM: 8 KB/RAM: 512 B
ROM:12 KB/RAM: 768 B
ROM:16 KB/RAM: 1 KB
- **Data Flash 1 KB x 2 blocks (R8C/15, R8C/17 groups)**
- Clock generation circuit: 2 circuits included
(XIN-XOUT, High-speed, Low-speed on-chip oscillator)
(Built-in main clock oscillation stop detection circuit)
- Voltage detection circuits: 2 ch (@Vcc=3.0 V to 5.5 V)
- Power-on Reset Circuit (@Vcc=3.0 V to 5.5 V)
- Peripheral Functions
 - Multi-functional timers: 8-bit timer: 2 ch
16-bit timer: 1 ch
(includes input-capture and output-compare circuits)
 - Serial I/O: Clock Sync./Asynchronous: 1 ch
Clock Asynchronous-specific: 1 ch
 - **SSU: 1 ch (R8C/14, 15)**
I²C Bus: 1 ch (R8C/16, 17)
 - A/D Converter: 10 bit x 4 ch
 - Port: Programmable I/O Ports: 13
Input-only port: 2
 - LED drive port: 4
 - Pull-up Resistor:
Can be set for all ports (not for input-only ports)
 - Watchdog timer: 1 ch (H/W reset is supported)
 - Package: 20-pin SSOP



R8C/14 to 17 Block Diagram



NOTES:

1. SSU: (Synchronous Serial Communication Unit)
2. I²C bus is a trademark of Koninklijke Philips electronics N.V

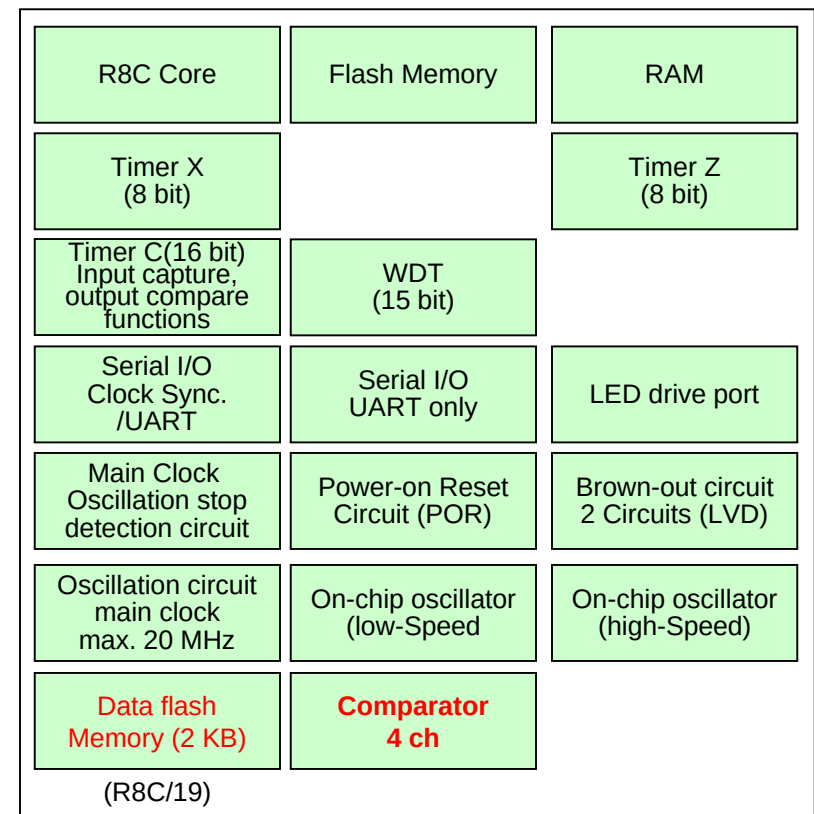
Features of R8C/18, 19 Group

Tiny

- CPU: R8C 16-bit CPU Core
- Minimum instruction execution time:
50 nsec ($f(XIN)=20$ MHz)
- Power-supply voltage:
3.0 to 5.5 V ($f(XIN)=20$ MHz, no wait states)
2.7 to 5.5 V ($f(XIN)=10$ MHz, no wait states)
- Internal Memory:
Flash ROM: 4 KB/RAM: 384 B
ROM: 8 KB/RAM: 512 B
ROM: 12 KB/RAM: 768 B
ROM: 16 KB/RAM: 1 KB
- Data Flash 1 KB x 2 blocks (R8C/19 group)
- Clock generation circuit: 2 circuits included
(XIN-XOUT, High-speed and low-speed on-chip oscillators)
(includes main clock oscillation stop detection circuit)
- Voltage detection circuits: 2 ch
- Power-on reset circuit
- Peripheral functions
 - Multi-functional timers 8-bit timer: 2 ch
16-bit timer: 1 ch
(includes input capture and output-compare circuits)
 - Serial I/O: Clock Sync. /UART 1 ch
UART only: 1 ch
 - Comparator 4 ch
 - Port Programmable I/O port: 13
Input-only port: 3
 - LED Drive Port: 4
 - Pull-up resistor: Can be set for all ports
(not for input-only ports)
 - Watchdog Timer: 1 ch (H/W reset is supported)
 - Package: 20-pin SSOP, 20-pin SDIP



R8C/18,19 Block Diagram



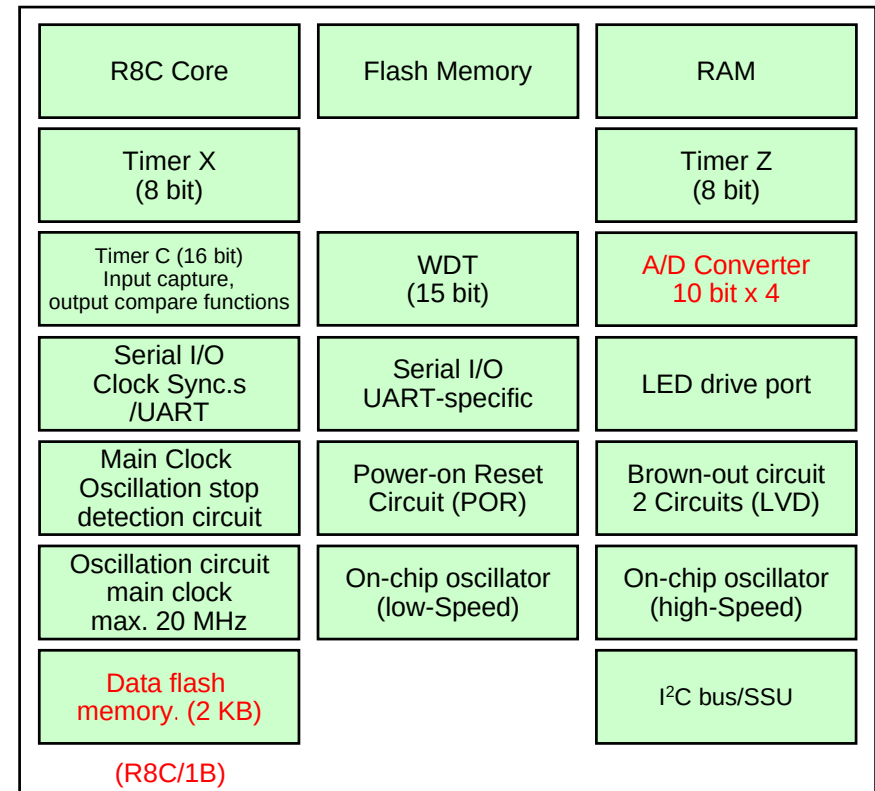
Features of R8C/1A, 1B Group

Tiny

- CPU: R8C 16-bit CPU Core
- Minimum instruction execution time:
50 nsec (f(XIN)=20 MHz)
- Power-supply voltage:
3.0 to 5.5 V (f(XIN)=20 MHz, no wait states)
2.7 to 5.5 V (f(XIN)=10 MHz, no wait states)
- On-chip memory: Flash ROM: 4KB/RAM: 384B
ROM: 8KB/RAM: 512B
ROM: 12KB/RAM: 768B
ROM: 16KB/RAM: 1KB
- Data Flash 1 KB x 2 blocks (R8C/1B)
- Clock generation circuit: 2 circuits included
(XIN-XOUT, High-speed, Low-speed on-chip oscillator)
(Built-in main clock oscillation stop detection circuit)
- Voltage detection circuits: 2 ch
- Power-on Reset Circuit
- Peripheral Functions
 - Multi-functional timers: 8-bit timer: 2 ch
16-bit timer: 1 ch
(includes input-capture and output-compare circuits)
 - Serial I/O: Clock Sync./Asynchronous: 1 ch
UART-specific: 1 ch
SSU (1 ch) and IIC (1 ch) switchable
 - A/D converter 10 bits x 4 ch
 - Port Programmable I/O port: 13
Input-only port: 3
 - LED driver port 4
 - Pull-up resistor: Can be set for all ports
(not for input-only ports)
 - Watchdog timer 1 ch (H/W reset is supported)
 - Package 20-pin SSOP, 20-pin SDIP



R8C/1A, 1B Block Diagram



NOTES:

- 1.SSU: (Synchronous Serial Communication Unit)
2. I²C bus is a trademark of Koninklijke Philips electronics N.V

Features of R8C/20-23 Group

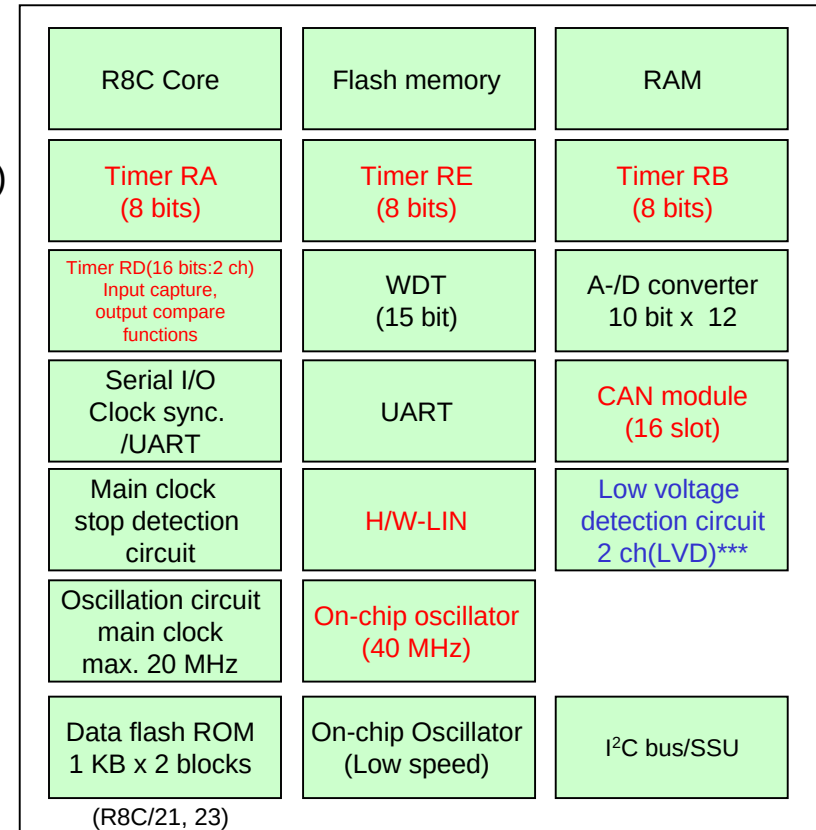
Tiny

Under
Development

- CPU: R8C 16-bit CPU Core
- Minimum instruction execution time: 50 nsec ($f(XIN)=20$ MHz)
- Power-supply Voltage:
3.0 V to 5.5 V ($f(XIN)=20$ MHz, no wait states)
(2.7 V to 5.5 V ($f(XIN)=10$ MHz, no wait states) ***
- On-chip memory FLASH ROM 32 KB/RAM 2 KB
ROM 48 KB/RAM 2.5 KB
ROM 64 KB/RAM 3 KB
- Data flash memory 1 KB X 2 blocks (R8C/21, R8C/23 Group)
- Clock generation circuit 2 circuits included
 - XIN-XOUT main clock
 - **High Speed(40 MHz)** and low Speed on-chip oscillators
(includes main clock oscillation stop detection circuit)
- **Low voltage detector function 2 circuits included 2ch *****
- Peripheral functions
 - Multi-functional timers
8-bit timer 2 ch(timer RA, timer RB)
8-bit timer: includes RTC function: 1 ch (timer RE)
16-bit timer: 2 ch (timer RD)
(includes input capture and output-compare circuits)
 - Serial I/O clock sync. /UART :1 ch
UART only: 1 ch
I²C bus / SSU: 1 ch
H/W-LIN (UART and timer RA are used)
 - **CAN** 16 slot x 1 ch (R8C/22, R8C/23 groups)
 - A-D converter 10 bits x 12 ch
 - Port Programmable I/O port: 41
Input-only port: 3
 - Pull-up resistor : Can be set for all ports (not for input-only ports)
 - Watchdog timer 1 ch(H/W reset is supported)
 - Package 48 pin plastic molded LQFP



R8C/20-23 Block Diagram



*** This product is currently under development and is subject to change without prior notice.

Features of R8C/24, 25 Group

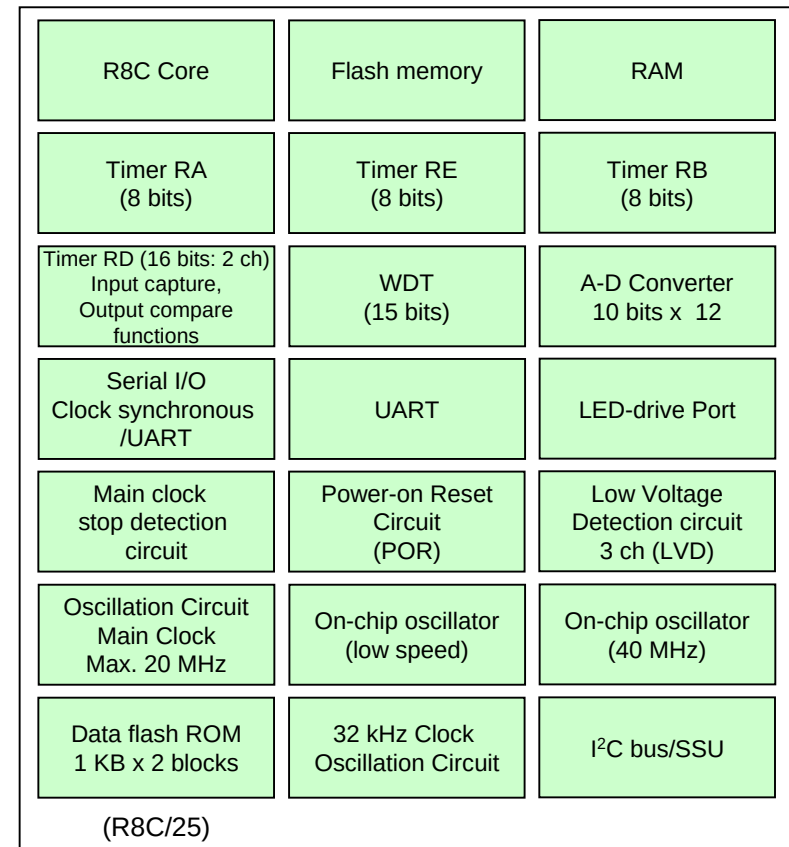
Tiny

Under
Development

- CPU: R8C 16-bit CPU Core
- Minimum instruction execution time: 50 nsec ($f(XIN)=20$ MHz)
- Power-supply voltage:
 - 3.0 to 5.5 V ($f(XIN)=20$ MHz, no wait states)
 - 2.7 to 5.5 V ($f(XIN)=10$ MHz, no wait states)
 - 2.2 to 5.5 V (under discussion)
- On-chip memory:
 - Flash ROM 16 KB/RAM 1KB (under development)
 - ROM 32 KB/RAM 2 KB (under development)
 - ROM 48 KB/RAM 2.5 KB (in planning)
 - ROM 64 KB/RAM 3 KB (in planning)
- Data flash ROM 1 KB X 2 blocks (R8C/25 groups)
- Clock generation circuit: 3 built-in circuits
 - XIN-XOUT main clock , **XCIN-XCOUT sub-clock**
 - **High Speed(40 MHz) and low speed on-chip oscillators**
(includes main clock oscillation stop detection circuit)
- **Low-voltage detection circuit 3 built-in circuits**
- Power on reset circuit
- Peripheral functions
 - Multi-functional timers
 - 8-bit timer: 2 ch(timer RA, timer RB)**
 - 8-bit timer: includes RTC function: 1 ch (timer RE)**
 - 16-bit timer: 2 ch (timer RD)**
(includes input capture and output-compare circuits)
 - Serial I/O
 - Clock sync. /UART : 2 ch
 - I²C bus/ SSU: 1 ch
 - H/W-LIN (UART and timer RA are used)**
 - A-D converter 10 bits x 12 ch
 - Port programmable I/O port: 41(48-pin version)
(LED drive port: 8), Input-only port: 3
 - Pull-up resistor: Can be set for all ports (not for input-only ports)
 - Watchdog timer 1 ch(H/W reset is supported)
 - Package 52-pin 0.65-mm pitch plastic molded LQFP



R8C/24,25 Block Diagram



Note: I²C bus is a registered trademark of Koninklijke Philips Electronics N. V.

Microcomputer General Presentation

H8SX Family

32 bit CISC

October 28, 2005

Rev.2.00

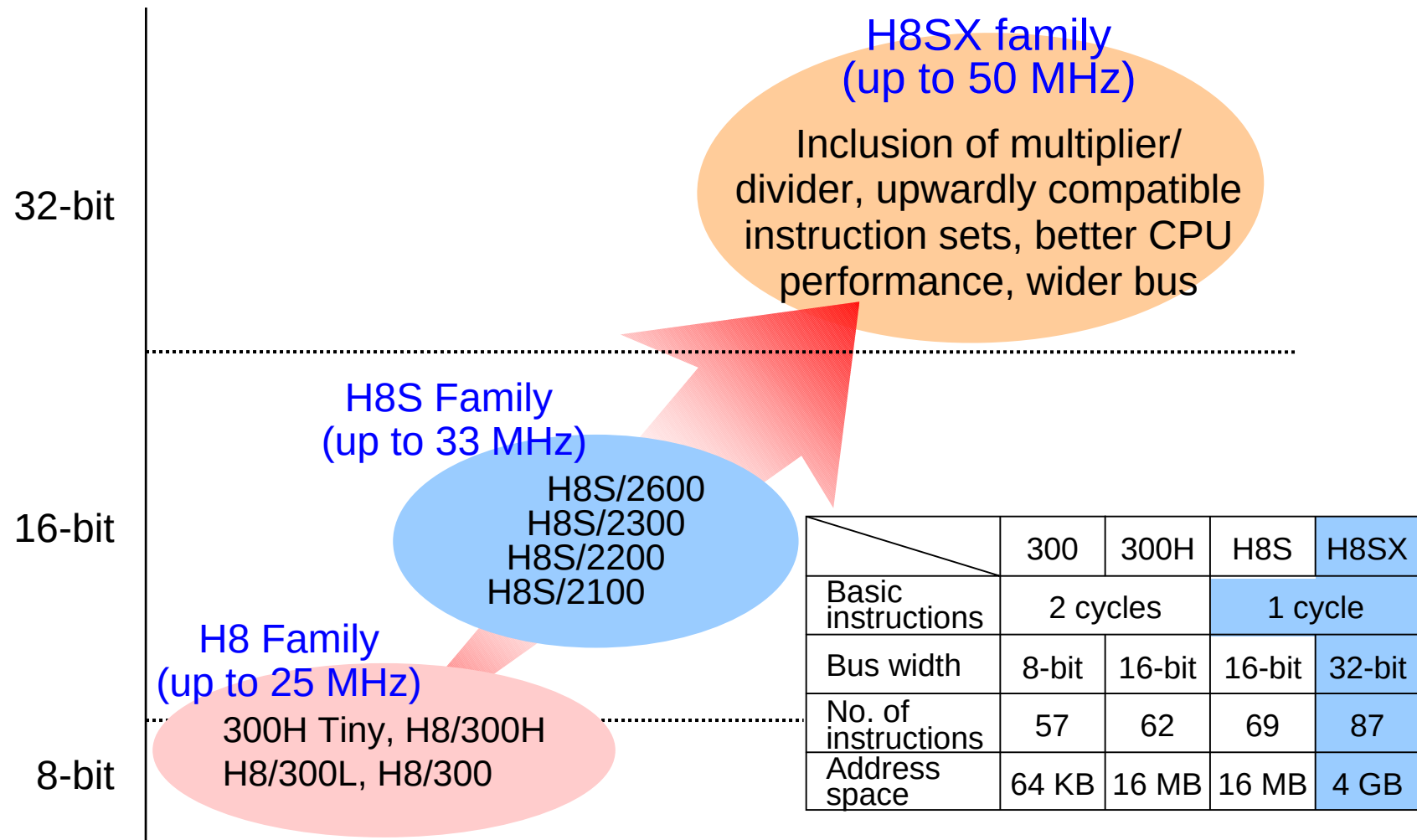
MCU Product Marketing Dept

MCU Business Unit

Standard Product Business Group

Renesas Technology Corp

Development of the H8, H8S, and H8SX CISC Microcomputers



H8SX Family Products Concepts and Features

Product Concepts

Features

High CPU
performance



High-speed instruction and data fetching:
access in one clock cycle using 32-bit internal bus

Maximum operating frequency: 50 MHz
(minimum instruction execution time: 20 ns)

New high performance on-chip 32-bit multiplier and
divider achieves high-speed operation

Improved
system throughput



Improved interrupt response and fast access to
external I/O by adding new registers:
VBR (Vector Base Register) and
SBR (Short address Base Register)

Improved connectivity with external devices
by adding new functions to the bus controller:
support for address/data multiplexed bus and
addition of converting functions for big/little endian

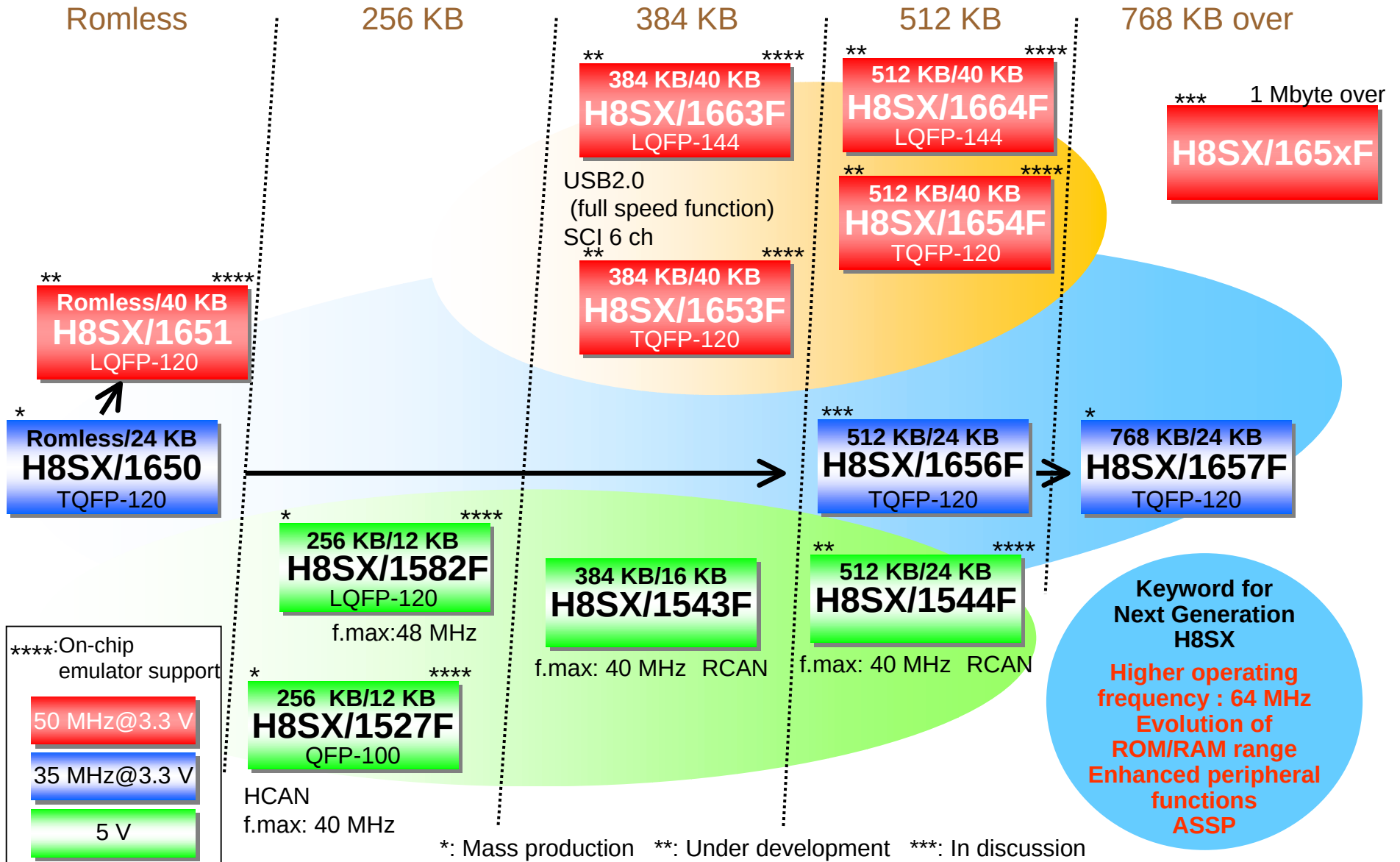
Compatibility



Inherited instruction set of the H8/H8S family and
improved code-efficiency by adding new instructions and
addressing modes

While succeeding the peripheral functions of the H8/H8S family,
functions are enhanced

Evolution Plan of the H8SX Family Products



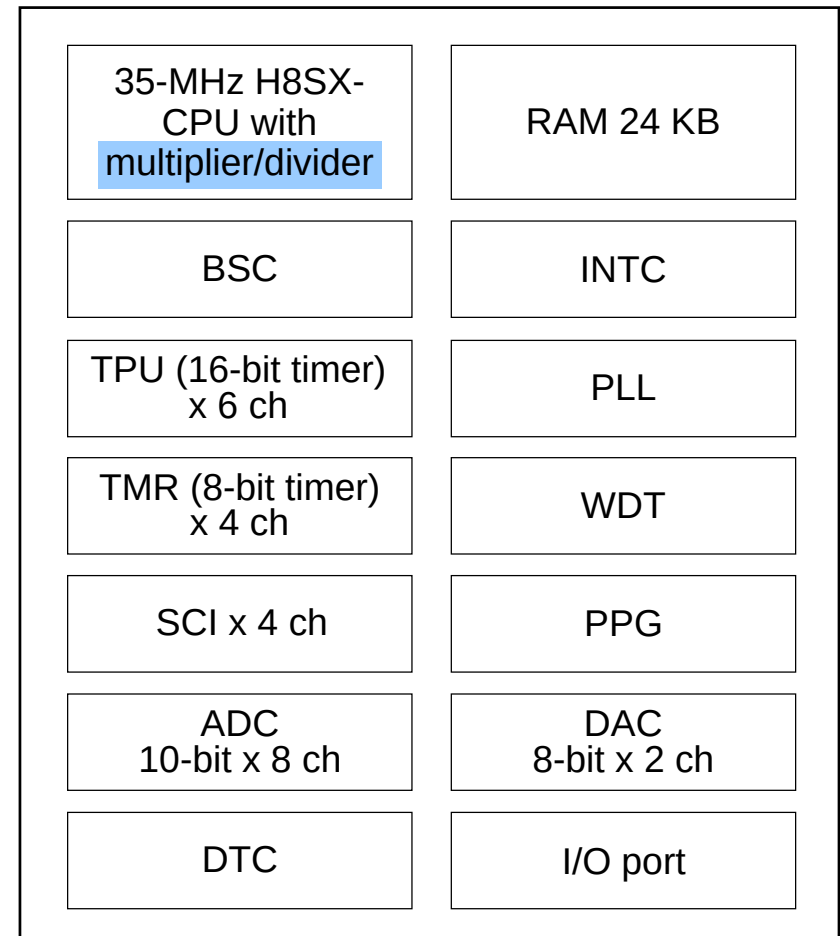
H8SX/1650 Product Overview

Features

- High-performance H8SX-CPU (0.18- μ m process)
 - High-speed operation: Basic instruction executed in one cycle*
 - Minimum instruction-execution time: 28.6 ns (35 MHz@3.3 V)*
 - Multiplier/divider
- Widened data bus: 16 bits $\rightarrow$ 32 bits
 - H8SXCPU
 - On-chip memory (RAM: 24 KB)
- Improved code efficiency through enhanced instruction set
 - Addition of addressing mode for direct operation in memory
 - Addition of convenient array-addressing mode
 - Addition of abbreviation for immediate instructions
 - Enhanced bit-manipulation instructions
- Abundant peripheral functions
 - Inherits peripheral function set of the H8S microcomputers, including timers, PPG, AD, DA, TPU, TMR, etc.
 - Enhanced bus controller
 - Byte-control SRAM, support for multiplexed bus I/O interface and selection of big/little endian
 - Full spec. ICE (E6000H) MY-ICE from Hitachi ULSI Systems, Co., Ltd.
- Package: TQFP-120

* When internal memory is used

H8SX/1650 Block Diagram



H8SX/1651 Product Overview

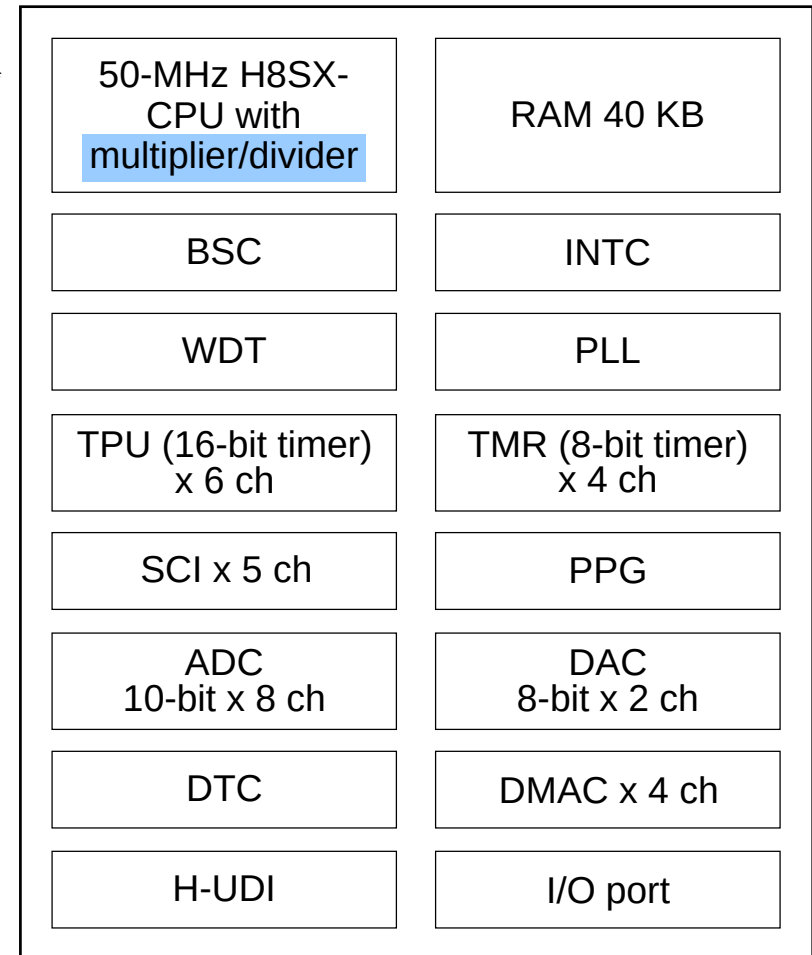
Under
Development

Features

- High-performance H8SX CPU (0.18- μ m process)
 - High-speed operation: Basic instructions are executed in one state*
 - Min. instruction execution time: 20 ns (50 MHz@3.3 V)*
 - On-chip multiplier and divider
- Data bus width extension: 16 bits→32 bits
- On-chip memory
 - ROM-less/RAM: 40 KB
- Rich peripheral functions
 - Enhanced SCI: 5 ch included (H8SX/1650, H8SX/1657F: 4 ch)
- Other functions
 - DMAC 4 ch(not installed for the H8SX/1650)
 - Pin compatibles with the H8SX/1650 and H8SX/1657F
- Development support tools
 - E10A-USB(on-chip emulator)
 - Full spec. ICE (E6000H) MY-ICE from Hitachi ULSI Systems, Co., Ltd.
- Package:LQFP-120

* When internal memory is used

H8SX/1651 Block Diagram



H8SX/1653F Product Overview

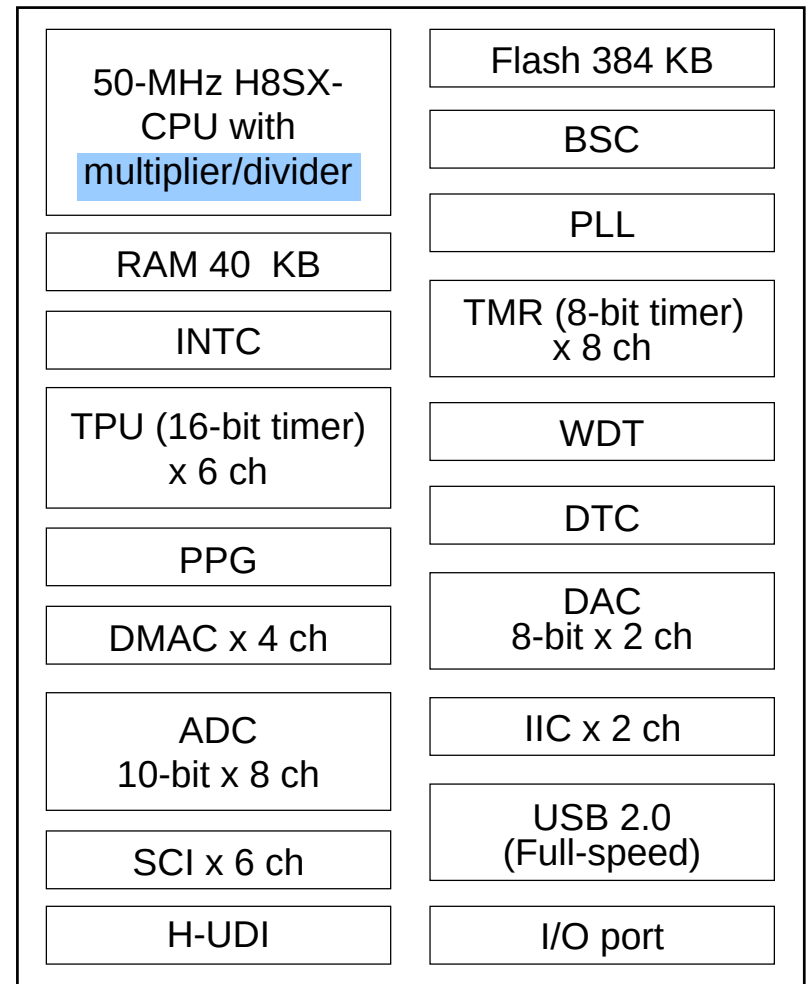
Under
Development

Features

- High-performance H8SX CPU (0.18- μ m process)
 - High-speed operation:
Basic instructions are executed in one state*
 - Min. instruction execution time:
20 ns (50 MHz@3.3 V)*
 - On-chip multiplier and divider
- Rich peripheral functions
 - USB2.0Function (Full speed) is added
→ Support Control/Bulk/Interrupt transfer
 - SCI 6 ch included
→ Smart Card I/F: 6 ch
→ Hi-speed SCI : 2 ch
- Other functions
 - Data transfer
→ DMAC 4 ch and DTC
- Development support tools
 - E10A-USB (on-chip emulator)
 - E6000H (full spec. ICE)
- Package: TQFP-120

* When internal memory is used

H8SX/1653F Block Diagram



H8SX/1654F Product Overview

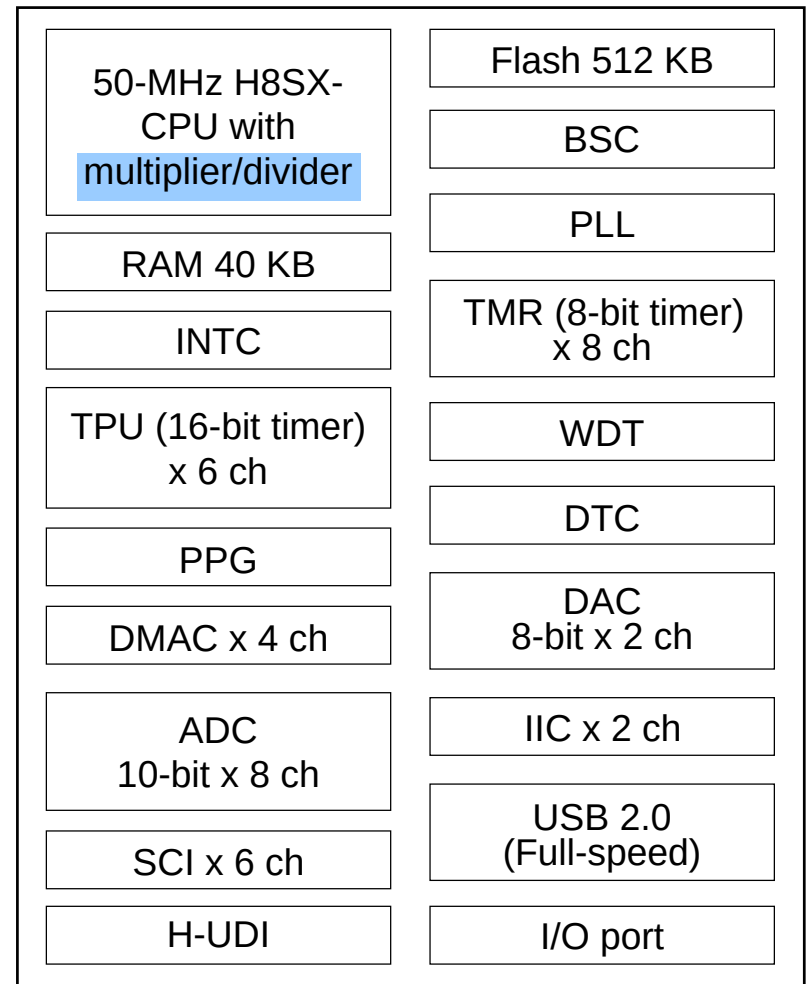
Under
Development

Features

- High-performance H8SX CPU (0.18- μ m process)
 - High-speed operation:
Basic instructions are executed in one state*
 - Min. instruction execution time:
20 ns (50 MHz@3.3 V)*
 - On-chip multiplier and divider
- Rich peripheral functions
 - USB2.0Function (Full speed) is added
→ Support Control/Bulk/Interrupt transfer
 - SCI 6 ch included
→ Smart Card I/F: 6 ch
→ Hi-speed SCI : 2 ch
- Other functions
 - Data transfer
→ DMAC 4 ch and DTC
- Development support tools
 - E10A-USB (on-chip emulator)
 - E6000H (full spec. ICE)
- Package: TQFP-120

* When internal memory is used

H8SX/1654F Block Diagram

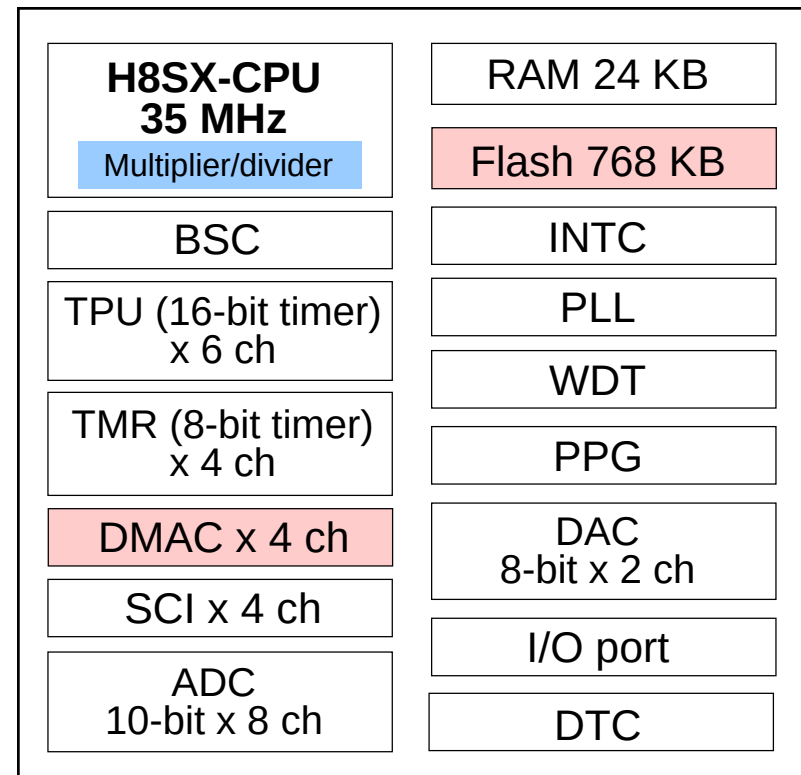


H8SX/1657F Product Overview

Features

- High-performance H8SX CPU (0.18-μm process)
 - High-speed operation: Basic instructions are executed in one state
 - Min. instruction execution time: 28.6 ns (35 MHz@3.3 V)
 - On-chip multiplier and divider
- On-chip large-capacity flash memory
 - Large capacity of 768 KB
 - High-speed fetching of program code (32 bits per one clock access)
- Expanded internal data bus width 16 bits → 32 bits
 - H8SX CPU
 - On-chip memory (RAM: 24 KB)
- Improved code efficiency by enhanced instructions
 - Addition of addressing mode for direct operation in memory
 - Addition of array-addressing mode
 - Addition of abbreviation for immediate instructions
 - Enhanced bit-operation instructions
- Abundant peripheral functions
 - Inherited peripheral functions of the H8S microcomputers: Timer, PPG, AD, DA, TPU, TMR, etc.
 - In-built DMAC: Address update execution with an off-set, addition of extended repeat-area function.
 - Enhanced bus controller: Byte-control SRAM, support for multiplexed bus I/O interface, support for big and little endians
 - Full spec. ICE (E6000H) MY-ICE from Hitachi ULSI Systems, Co., Ltd.

H8SX/1657F Block Diagram



- Package
TQFP-120 (pin compatible with the H8S/1650)

Functions of the H8SX Microcomputers (1)

		H8SX family				
Type No.		H8SX/1650	H8SX/1651	H8SX/1653F	H8SX/1654F	H8SX/1657F
ROM		-	-	384 KB	512 KB	768 KB
RAM		24 KB	40 KB	40 KB	40 KB	24 KB
ROM for development		-	-	-	-	-
Address space (bytes)		16 MB	16 MB	16 MB	16 MB	16 MB
External data bus (bits)		8/16 (internal: 32 bits)	8/16 (internal: 32 bits)	8/16 (internal: 32 bits)	8/16 (internal: 32 bits)	8/16 (internal: 32 bits)
Multiplier		Yes	Yes	Yes	Yes	Yes
Divider		Yes	Yes	Yes	Yes	Yes
Timer	TPU (16 bits)	6	6	6	6	6
	8 bits	4	4	8	8	4
	WDT	1	1	1	1	1
DMAC		-	4	4	4	4
DTC		Yes	Yes	Yes	Yes	Yes
SCI		4	5	6	6	4
Address/ data-multiplexed I/O interface		Yes	Yes	Yes	Yes	Yes
Endian conversion		Yes	Yes	Yes	Yes	Yes
10-bit A/D converter		8	8	8	8	8
D/A converter		2	2	2	2	2
PPG		16 bits	16 bits	8 bits	8 bits	16 bits
Oscillation method		Multiplication oscillation*	Multiplication oscillation*	Multiplication oscillation*	Multiplication oscillation*	Multiplication oscillation*
External interrupts		13	13	13	13	13
On-chip debugging function		-	Yes	Yes	Yes	-
Operating frequency/ operating voltage		35 MHz/ 3.0 to 3.6 V	50 MHz/ 3.0 to 3.6 V	50 MHz/ 3.0 to 3.6 V	50 MHz/ 3.0 to 3.6 V	35 MHz/ 3.0 to 3.6 V
Package		TQFP-120	LQFP-120	TQFP-120	TQFP-120	TQFP-120

* Multiplied oscillation: x1/2, x1, x2, x4

Functions of the H8SX Microcomputers (2)

		H8SX family		
Type No.		H8SX/1527F	H8SX/1582F	H8SX/1544F
ROM		256 KB	256 KB	512 KB
RAM		12 KB	12 KB	24 KB
ROM for development		-	-	-
Address space (bytes)		16 MB	16 MB	16 MB
External data bus (bits)		internal: 32 bits	internal: 32 bits	8/16 (internal: 32 bits)
Multiplier		Yes	Yes	Yes
Divider		Yes	Yes	Yes
Timer	TPU (16 bits)	12	12	6
	8 bits	-	-	-
	WDT	1	1	1
DMAC		4	4	4
DTC		-	Yes	-
SCI		2	2	3
Address/ data-multiplexed I/O interface		-	-	Yes
Endian conversion		-	-	Yes
10-bit A/D converter		16	16	16
D/A converter		-	-	2
PPG		16 bits	16 bits	16 bits
Oscillation method		Multiplication oscillation*	Multiplication oscillation*	Multiplication oscillation*
External interrupts		16	17	17
On-chip debugging function		Yes	Yes	Yes
Operating frequency/ operating voltage		40 MHz/ 4.5 to 5.5 V	48 MHz/ 4.5 to 5.5 V	40 MHz/ 4.5 to 5.5 V
Package		QFP-100	LQFP-120	LQFP-144

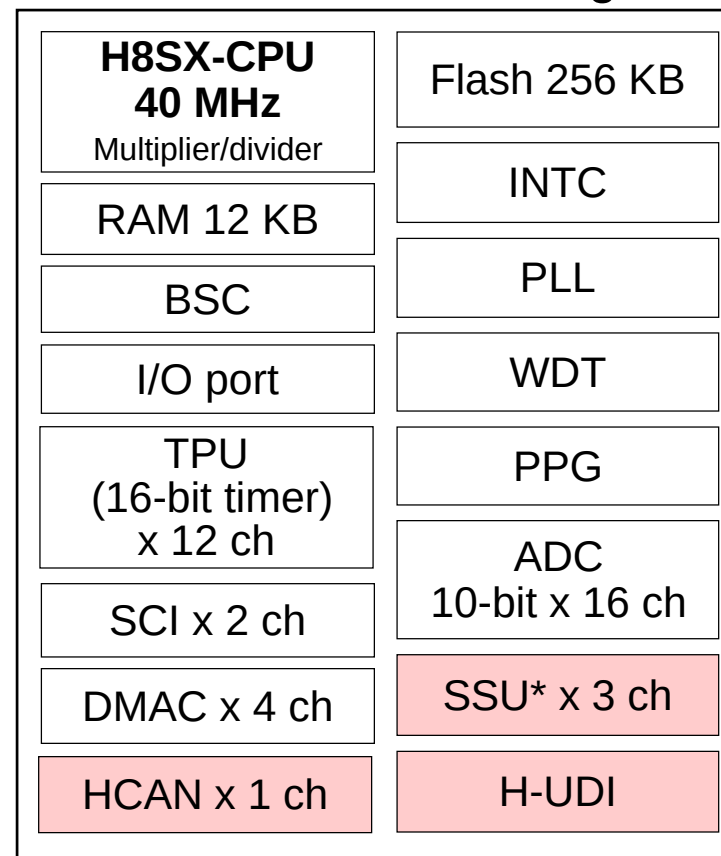
* Multiplied oscillation: x1/2, x1, x2, x4

Features

- High-performance H8SX-CPU (0.18-μm process)
 - High-speed operation: Basic instruction execution in one state
 - Min. instruction-operation time: 25 ns (40 MHz@5 V)
 - On-chip 32-bit multiplier and divider
- Expanded data bus width: 16 bits → 32 bits
 - H8SX CPU
 - On-chip flash memory: 256 KB
 - On-chip memory (RAM: 12 KB)
- Enhanced instructions and improved code efficiency
- Abundant peripheral functions
 - High TPU (16-bit timer): Max. 12 channels
 - On-chip PPG, pulse output function, interfactable with TPU
 - Various serial interfaces
 - SCI to support asynchronous/clock synchronous modes: 2 channels
 - SSU: 3 channels,
 - CAN interface: 1 channel
 - High analog function
 - A/D converter: 16 channels
 - Easy debugging function: In-built H-UDI
- Environment for development
 - E6000H (full spec. ICE)
 - E10A-USB (on-chip emulator)
- Package: QFP-100

V_{CC} = 5.0 V

H8SX/1527F Block Diagram



*SSU: Synchronous Serial communication Unit

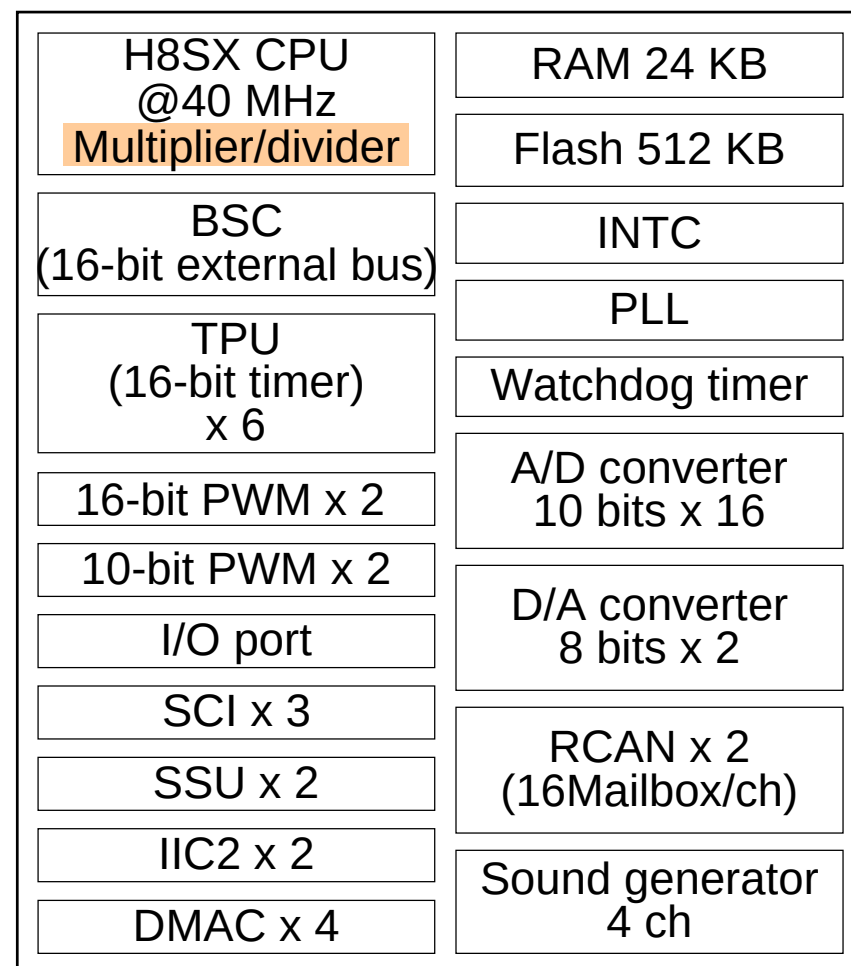
H8SX/1544F Overview

Under
Development

Features

- High-performance H8SX-CPU (0.15- μ m process)
 - High-speed operation: Basic instruction execution in 1 state
 - Minimum instruction execution time: 25 ns (40 MHz@5 V)
 - On-chip multiplier and divider
 - Internal 32-bit data bus
- Large capacity memory
 - On-chip flash memory (1 state access): 512 KB (1544), 384 KB (1543)
 - On-chip memory (RAM): 24 KB (1544), 16 KB (1543)
- Improved instruction code efficiency
- Rich on-chip peripheral functions
 - Enhanced timers
 - 16-bit general timer (TPU): 6 channels (16 I/O max.)
 - 16-bit PWM timer (TPU): 3 channels (12 outputs max.)
 - 10-bit PWM (large-current port included): 2 ch (16 outputs max.)
 - Ample communication interface
 - CAN interface(RCAN): 2 channels (16 mailboxes, 16 filters)
 - Async./sync serial communication (SCI): 3 channels
 - Clock synchronous serial communication (SSU): 2 channels
 - IIC2 communication (IIC2): 2 channels
 - On-chip analog modules
 - 10-bit A/D converter: 16 channels
 - 8-bit D/A converter: 2 channels
 - Direct memory transfer function (DMAC): 4 channels.
- External expansion functions
 - On-chip 16-bit external bus expansion function
- Development support tools
 - Full-spec. emulator (E6000H)
- Package: LQFP-144
- Support for high-temperature: -40°C to +105°C

H8SX/1544F Block Diagram



*SSU: Synchronous Serial communication Unit

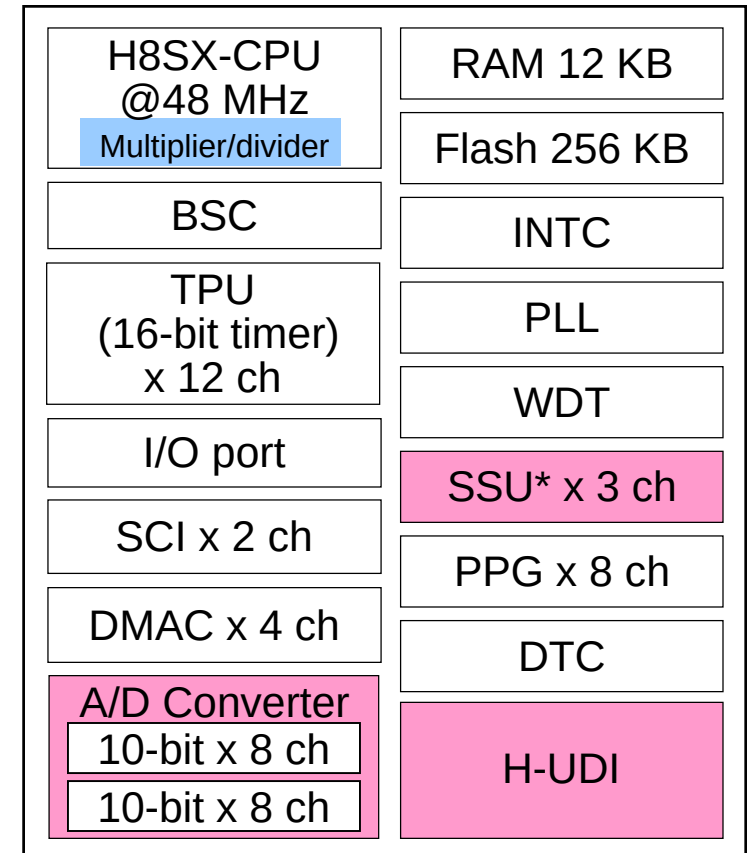
H8SX/1582F Products Overview

Features

- High-performance H8SX-CPU (0.18-μm process)
 - High-speed operation: basic instruction execution in one state
 - Min. instruction execution time: 21 ns (48 MHz@5 V)
 - On-chip 32-bit multiplier and divider
 - Vcc = 5.0 V±10%
- Data bus width extension: 16 bits→32 bits
 - H8SX CPU
 - On-chip flash memory: 256 KB
 - On-chip memory (RAM: 12 KB)
- Improved code efficiency with enhanced functions
- Enhanced peripheral functions
 - Enhanced TPU (16-bit timer): Max. 12 ch usable
 - On-chip PPG (pulse output function) operate with the TPU
 - Enriched serial interface
 - Asynchronous/clock synchronous mode SCI: 2 ch SSU: 3 ch
 - Strong analog functions
 - A/D converter: 16 ch
 - Support for on-chip emulator: H-UDI
- Development environment
 - Full spec. ICE (E6000H)
 - Support by on-chip emulator: E10A-USB
- Package
 - LQFP-120

Vcc = 5.0 V

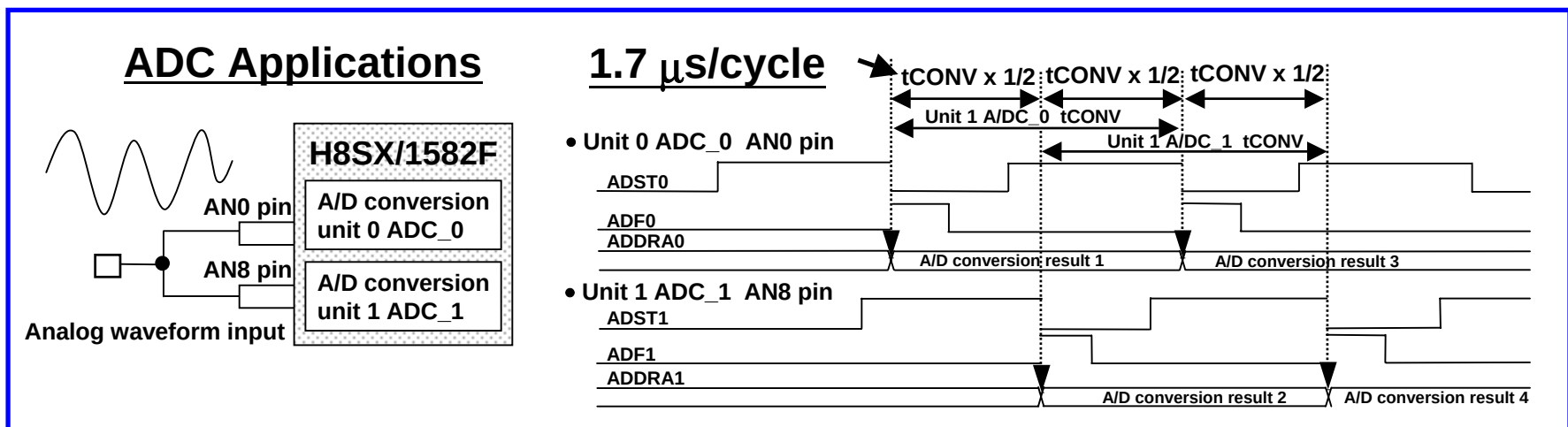
H8SX/1582F Block Diagram



*SSU : Synchronous Serial communication Unit

H8SX/1582F Features

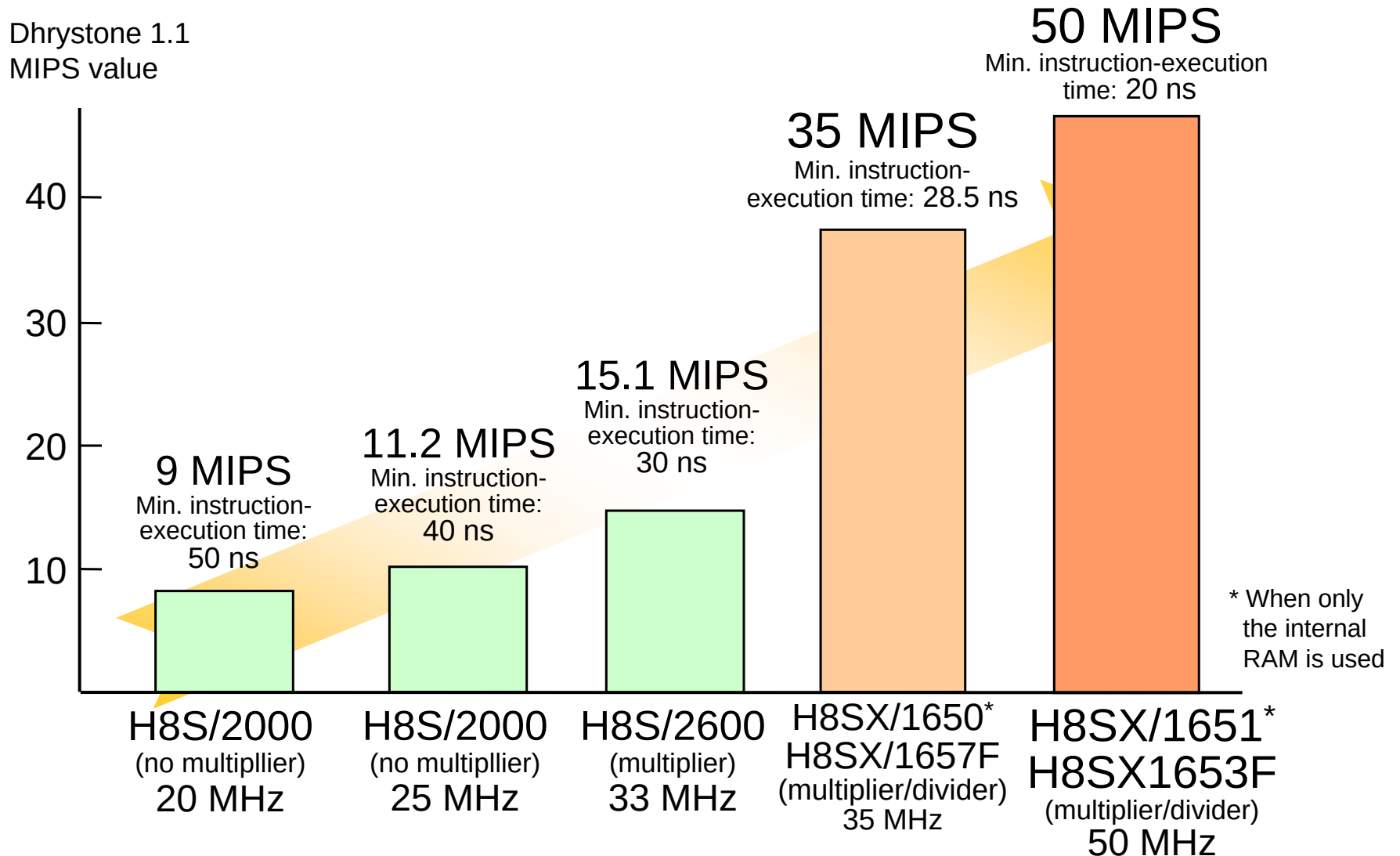
- Enhanced A/D Converter
 - Single mode A/D conversion time: Min. = **3.4 μ s**, A/D conversion absolute precision = **+4.0 LSB**
 (Measurement condition: $V_{cc} = 4.5$ to 5.5 V, $AV_{cc0} = 4.5$ to 5.5 V, $AV_{cc1} = 4.5$ to 5.5 V, $V_{ss} = AV_{ss} = 0$ V, $P\phi = 8$ to 35 MHz, $T_a = -20$ to $+75^\circ\text{C}$, output impedance = $1\text{ k}\Omega$)
- Two ADC modules of max. 16 ch usable



- On-chip RAM: Built-in error correction function
 - On-chip RAM includes error correction ECC (Error Checking and Correcting)
 - 1-bit detection/1-bit error correction possible
 - Read cycle = 1 cycle, write cycle = 2 cycles
- Synchronous serial communication unit
 - On-chip synchronous serial communication unit (SSU)
- On-chip emulator E10A-USB
 - Compact debugging environment
 - User system debugging in the product form
 - On-chip debugging and on-chip flash programming possible only with the E10A-USB

H8SX CPU Core

H8SX Positioning (Built-In ROM/RAM)



Features of the 32-Bit H8SX CPU

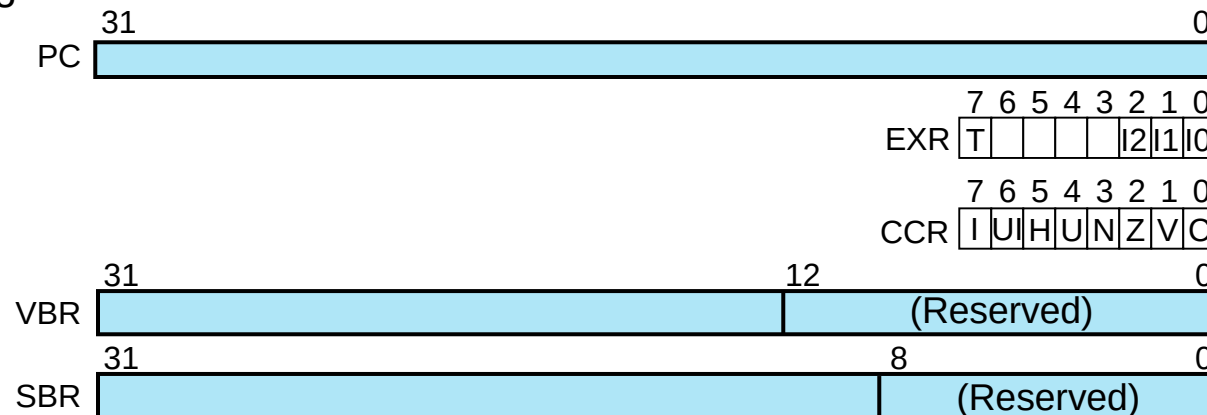
- Improved operating frequency
Realizes top-level CISC-microcomputer performance in operation at the max. rate of 50 MHz.
- Upward compatibility of the H8/300, H8/300H, and H8S/2000 CPUs
Design resources for the H8 and H8S microcomputers are reusable.
- Improved speed of arithmetic operations
Incorporation of a multiplier and divider speeds up arithmetic operations.
- Improved code efficiency and higher speeds
New instructions and addressing modes have been added for improved code efficiency.
32-bit-wide bus shortens the instruction-execution cycle.
Twice as fast as the H8S for a given level of CPU performance.
- Architecture for greater ease of use
Position of the vector table can be modified by the VBR (vector base register), and position of 8-bit absolute address space can be modified by the SBR (short address base register)

Register Configuration

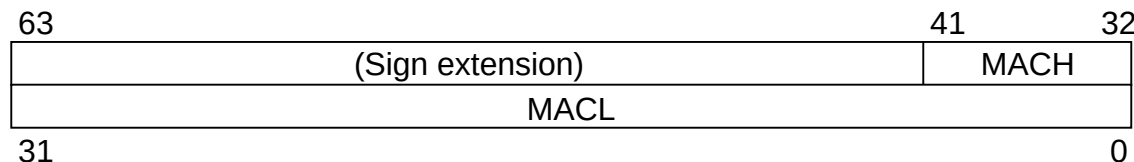
General registers and extended registers

	15	0 7	0 7	0
ER0	E0	R0H	R0L	
ER1	E1	R1H	R1L	
ER2	E2	R2H	R2L	
ER3	E3	R3H	R3L	
ER4	E4	R4H	R4L	
ER5	E5	R5H	R5L	
ER6	E6	R6H	R6L	
ER7 (SP)	E7	R7H	R7L	

Control registers



MAC registers



 : Retained or modified from the H8S

VBR (Vector Base Register)

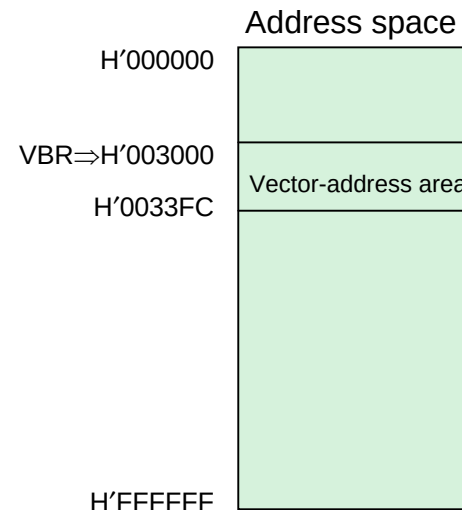
The value in VBR acts as the base address of the vector area for exceptions other than reset and CPU-address errors. The user can place the vector table at a desired address by setting this register, which consists of 32 bits (the upper 20 bits are valid). In reading, 0 is read from the lower 12 bits.



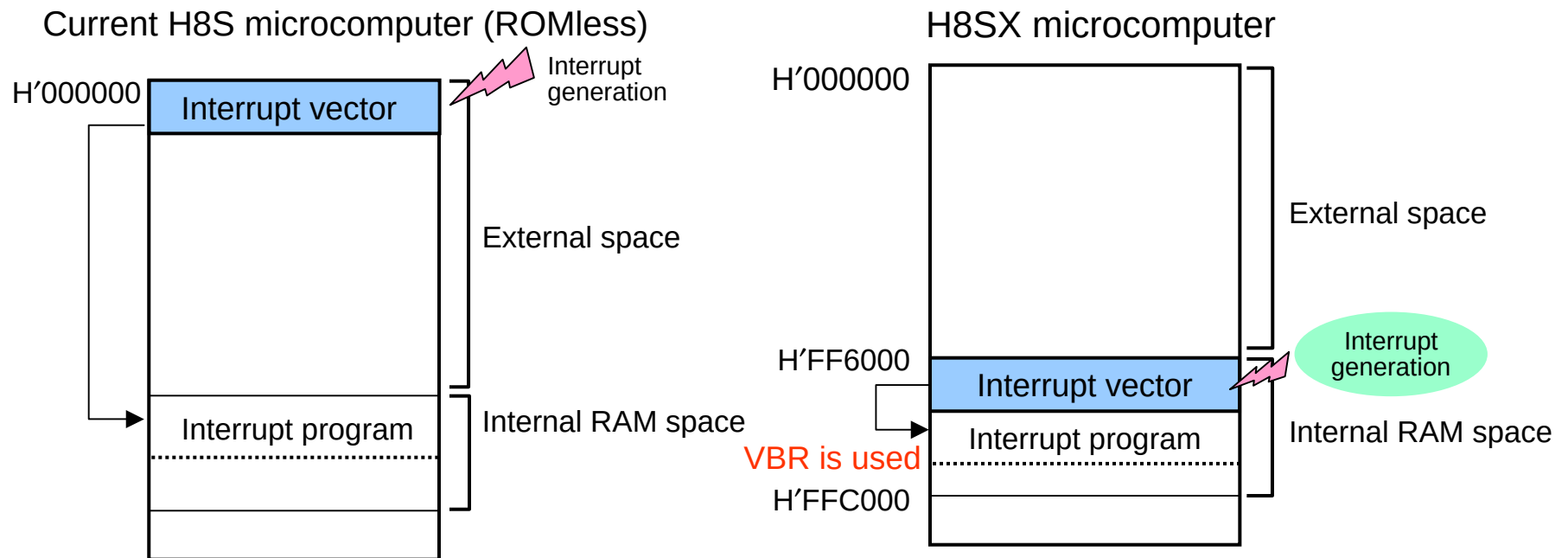
<Setting Example>

At initialization, the VBR is set to the address H'3000. The address of each interrupt vector is then H'3000 + (vector address of the interrupt source).

Interrupt source	Vector-table address
NMI	H'301C
IRQ0	H'3100
IRQ1	H'3104
IRQ2	H'3108
IRQ3	H'310C
•	•
•	•
•	•



The VBR: Example of Usage



VBR provides the base address of the vector area for CPU-address errors. By setting this register, **the user can place the vector table at any desired address.**



Setting the VBR to place the vector table in the internal RAM area reduces the interrupt response time. Although the microcomputer is ROMless, this still allows data-fetching in one clock cycle, achieving high-speed operation.

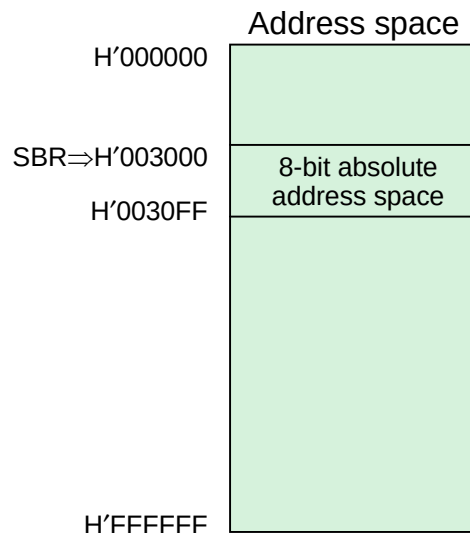
SBR (Short Address Base Register)

The SBR lets the user specify a desired location for the 8-bit absolute address space. The upper part of the value is stored at initialization for use as a base address with the 8-bit absolute addressing mode with short-base register (@aa:8). The register has 32 bits; the upper 24 bits are valid. In reading, 0 is read from the lower eight bits.



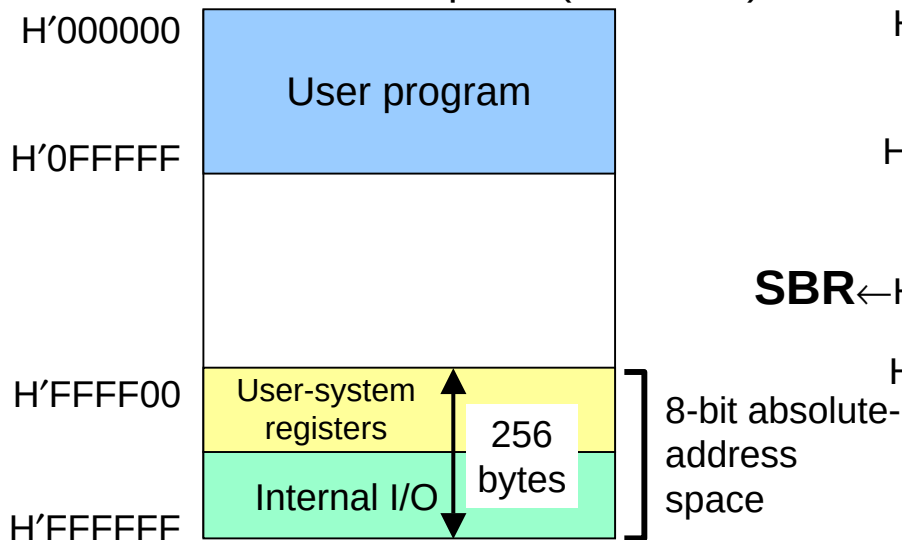
<Setting Example>

When SBR contains H'3000 at initialization, the 8-bit absolute-address space starts from the address H'3000.



The SBR: Example of Usage

Current H8S microcomputer (ROMless)



The internal I/O area is within the 8-bit absolute-address space, so the 256-byte space cannot be used effectively.

Example of the SBR's utility

Condition: 8-bit bus width/3-cycle access

<Conventional H8S>

MOV.B #imm:8,R0L

MOV.B R0L,@200000:32

Total of 8 bytes/7 cycles

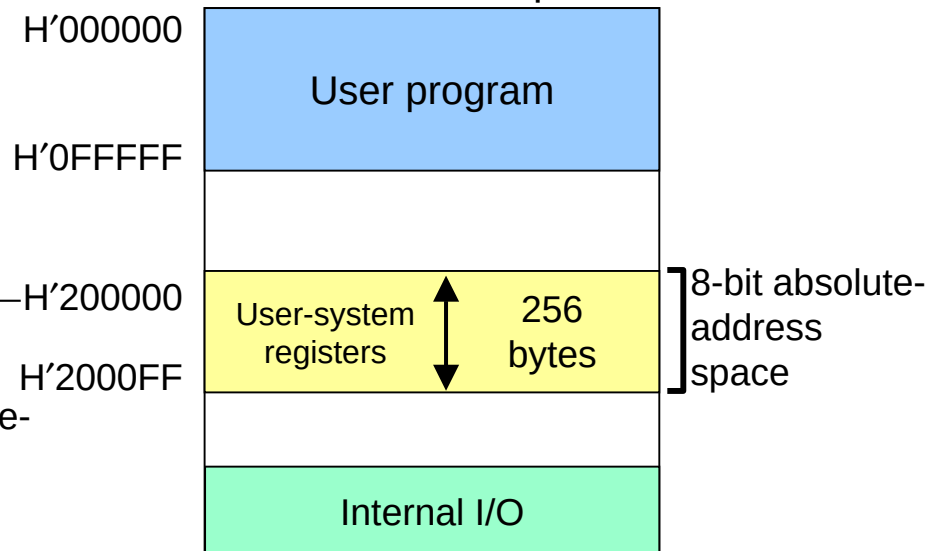
<H8SX>

MOV.B #imm:8,R0L

MOV.B R0L,@00:8

Total of 4 bytes/5 cycles

H8SX microcomputer

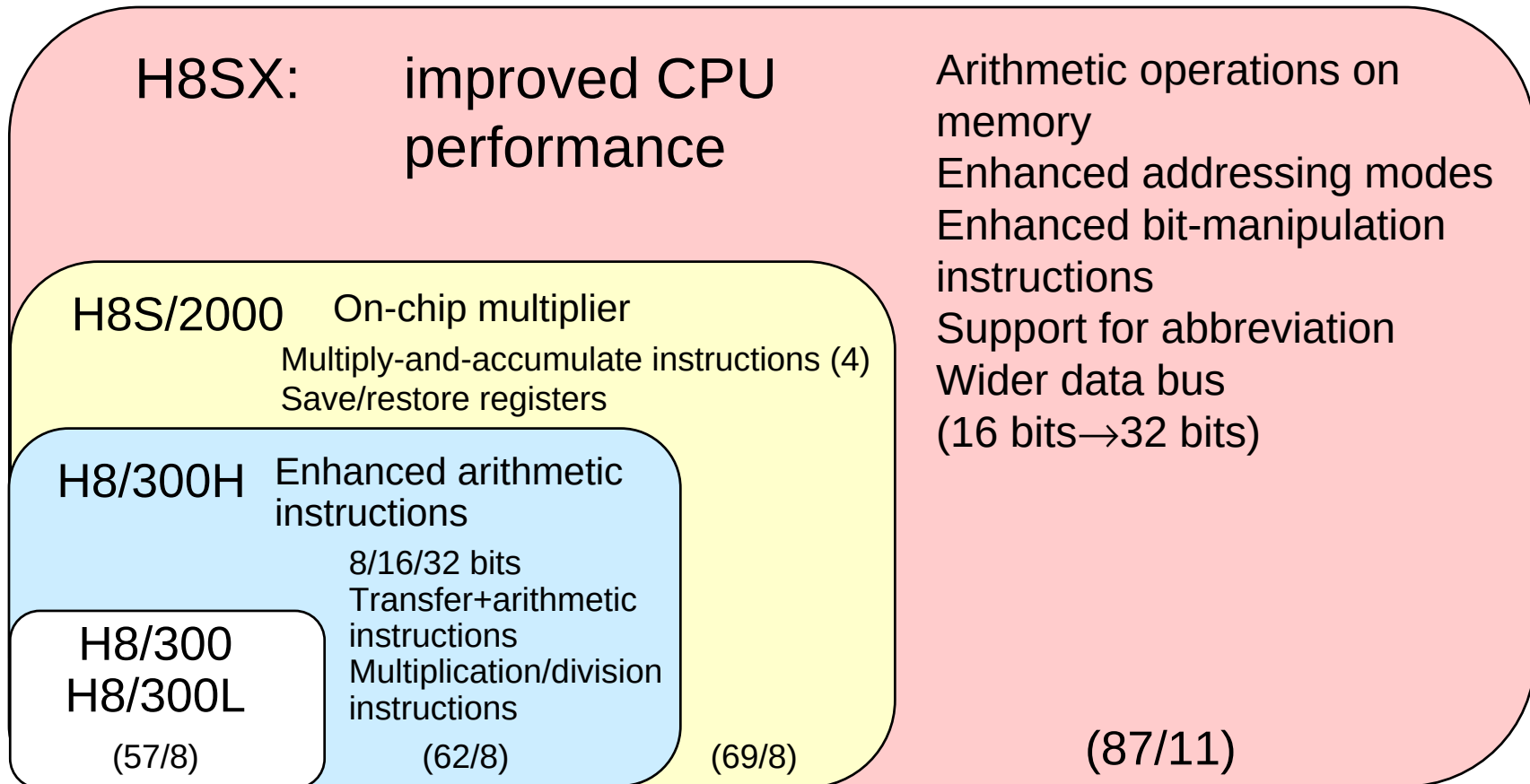


SBR lets the user specify a desired Location for the 8-bit absolute-address space and **use the whole 256-byte space.**

High-speed system operation is realized by allocating the space to all or some of the user-system registers for which high-speed access is required.

H8SX Instruction Set

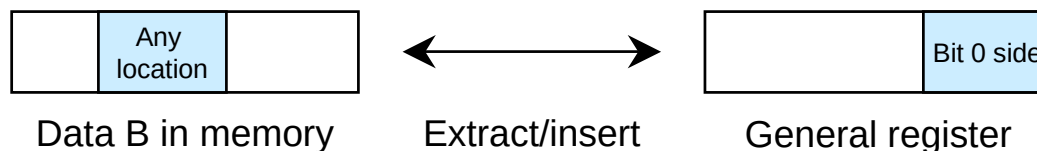
Succession of Instruction Sets



$(x/y) = (\text{no. of instructions})/(\text{no. of addressing modes})$

Enhanced Instructions

- Support for arithmetic operations on memory
 - Basic arithmetic operations (addition and subtraction/logic) x basic addressing
- Enhanced addressing modes
 - For arrays (@(d,ERn.B/W/L))
- Support for abbreviation
 - Extended memory indirect (128 entries)
 - Multiple-bit shifting (SHLL/R #1/2/4/8/16)
 - Word/longword-size immediate abbreviations (#x:3, 4, 8, 16, 32)
- Enhanced bit-manipulation instructions
 - Set/clear multiple bits
 - Bit-field transfer

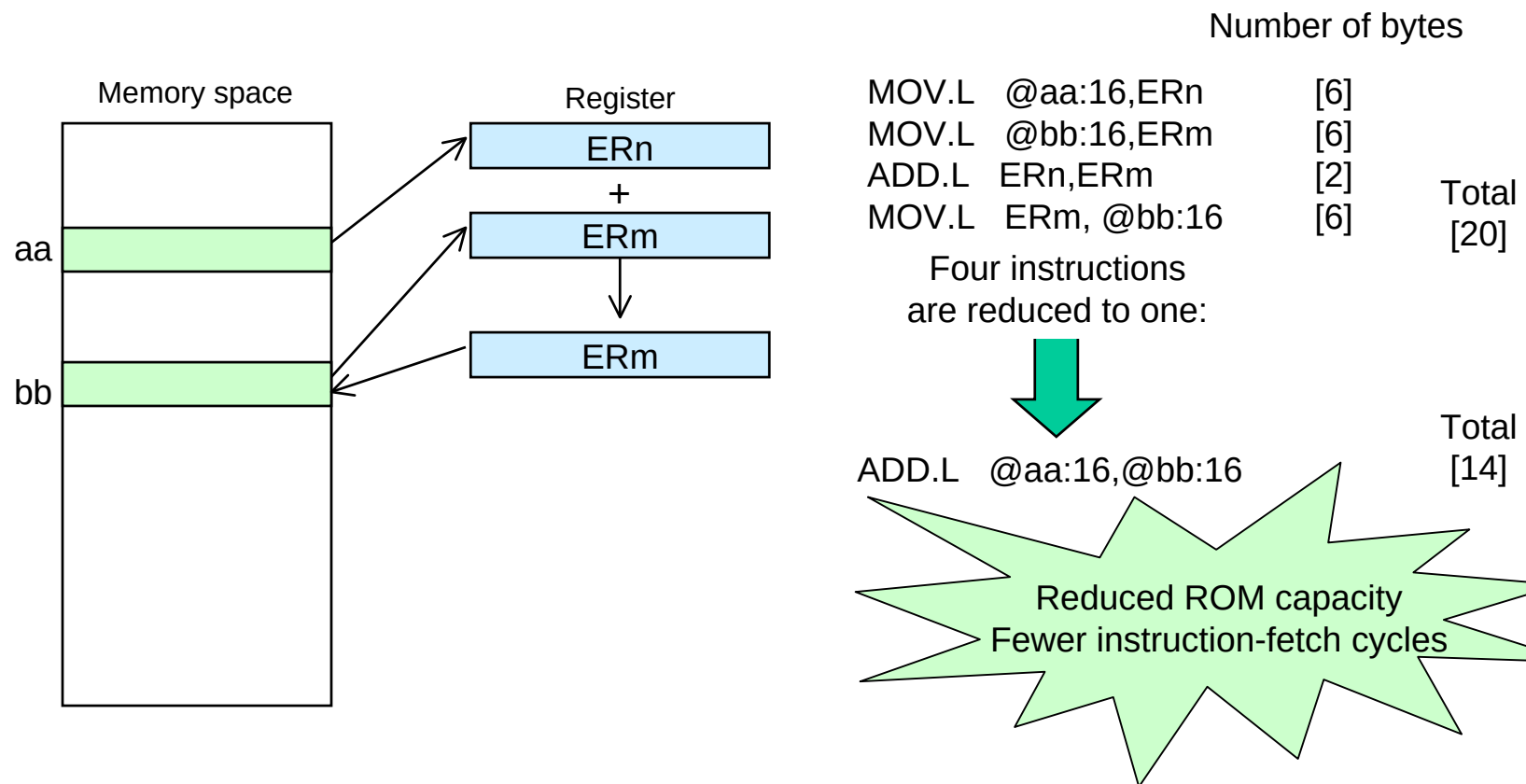


- Enhanced multiplication and division instructions
 - 32-bit multiplier/divider

Support for Arithmetic Operations on Memory

Number of additional instructions = basic arithmetic operations
(addition and subtraction/logic) x basic addressing modes

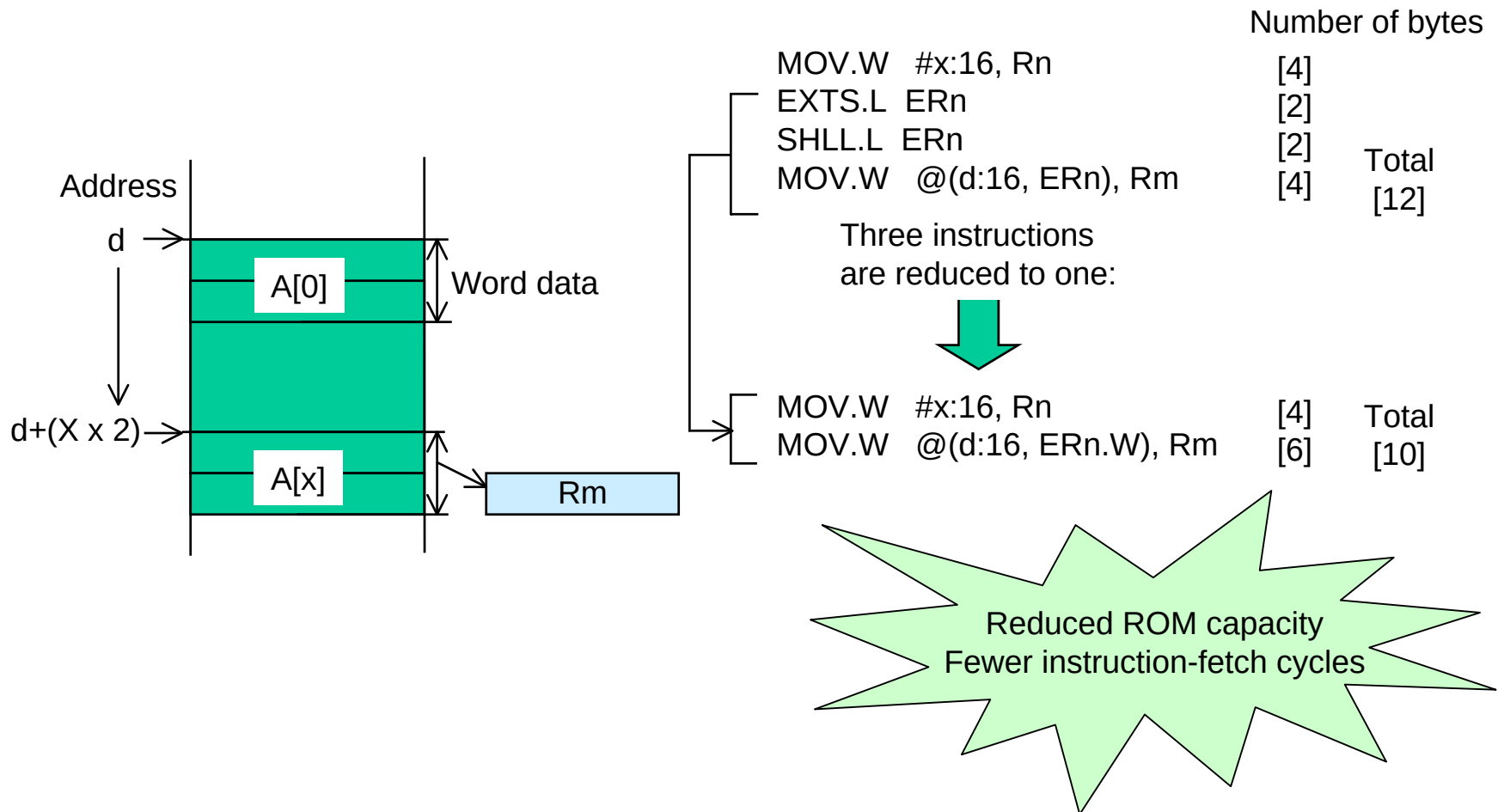
Example: Addition of longword data in memory



Enhanced Addressing Modes

- Useful for Arrays (@(d,Ern.B/W/L)) -

Example: Write the xth word after address d to a register



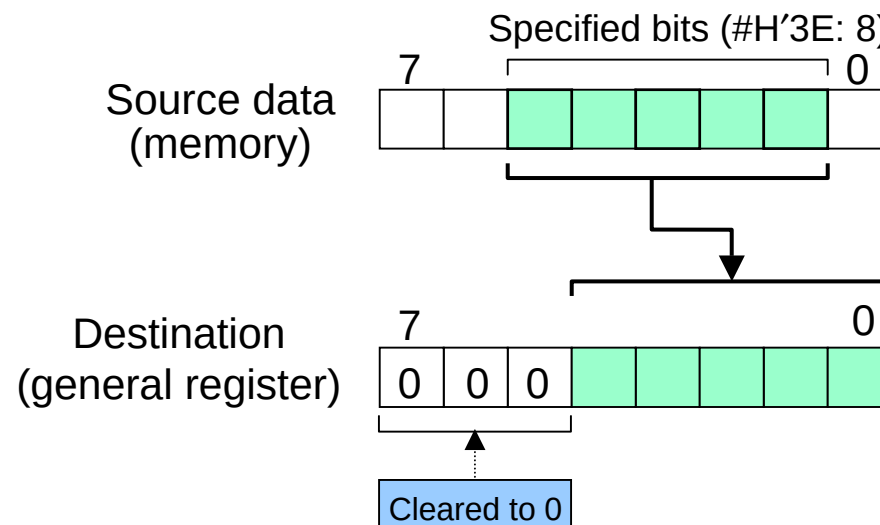
Bit-Field Transfer (1)

BFLD (Bit Field Load)

Transfers the specified fields of the source operand to the lower-order bits of 8-bit register Rd.

The bit fields are specified by the bits set to 1 in the 8-bit immediate operand.

<Example>

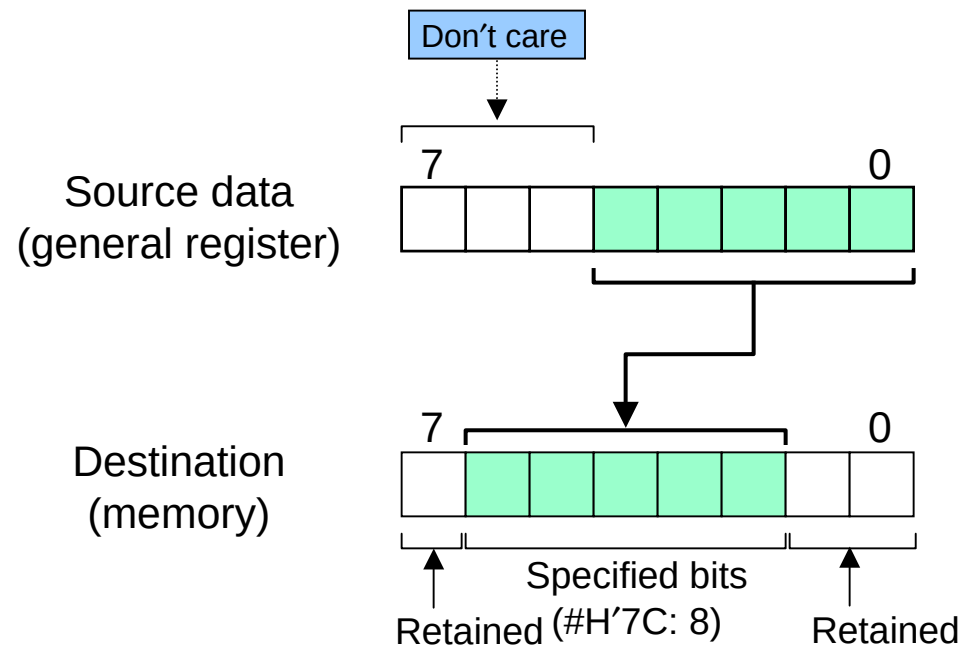


Bit-Field Transfer (2)

BFST(Bit Field STore)

Transfers bits from the 8-bit register Rs to the specified fields of the destination operand. The bit fields are specified by the bits set to 1 in the 8-bit immediate operand.

< Example >



Numbers of Cycles for Execution of H8SX Multiplication/Division Instructions

Number of Cycles for H8S/H8SX Multiplication-Instruction Execution (Multiplier Used)

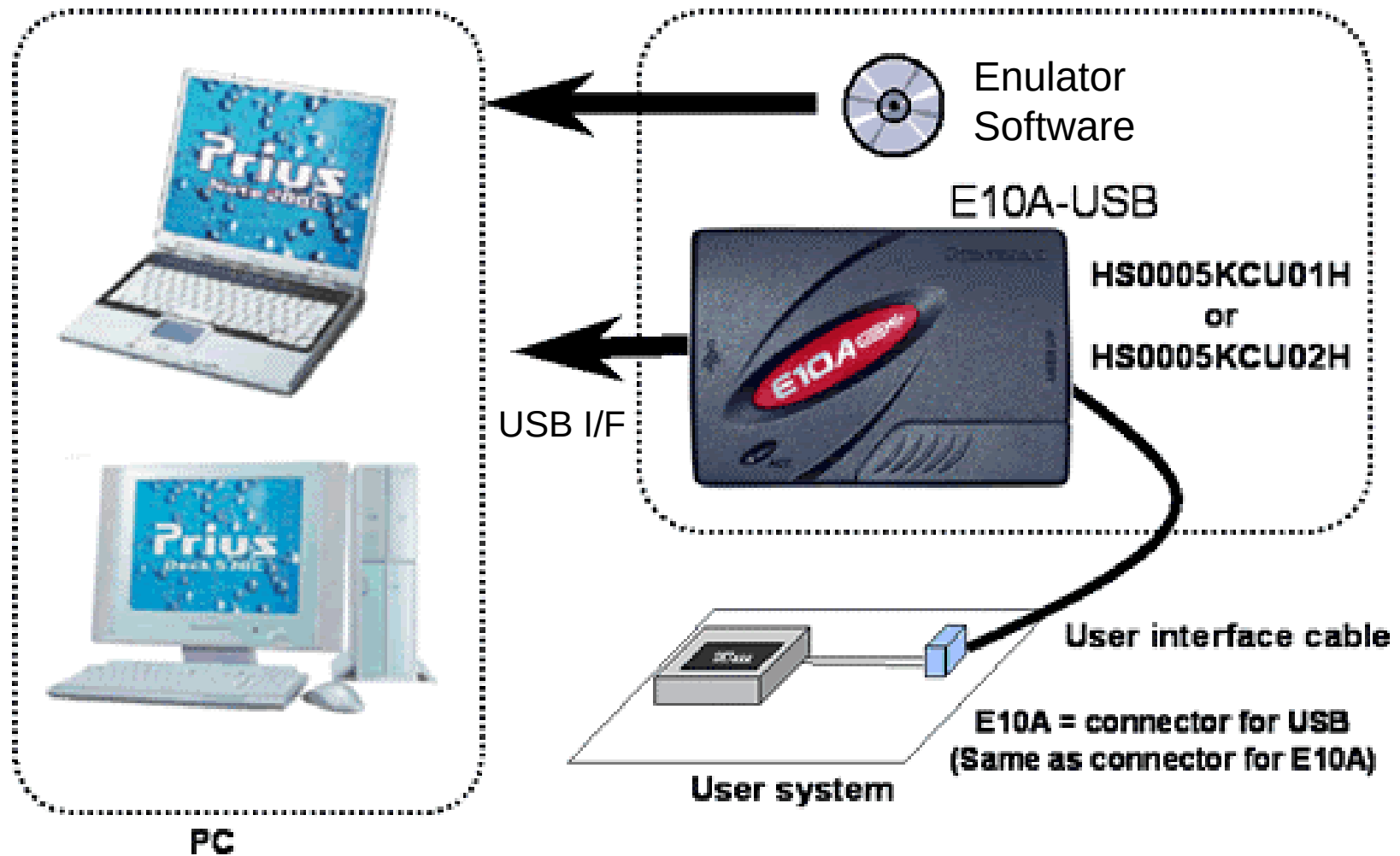
Instruction	H8S	H8SX	Instruction	H8S	H8SX
MULXU.B	3	1	MULS.L	-	5
MULXU.W	4	1	MULU/U.L	-	6
MULXS.B	4	2	MULS/U.L	-	6
MULXS.W	5	2	CLRMAC	1	1
MULU.W	-	2	LDMAC	1	1
MULU.L	-	5	STMAC	2	1
MULS.W	-	2	MAC	4	4

Number of Cycles for H8S/H8SX Division-Instruction Execution (Multiplier Used)

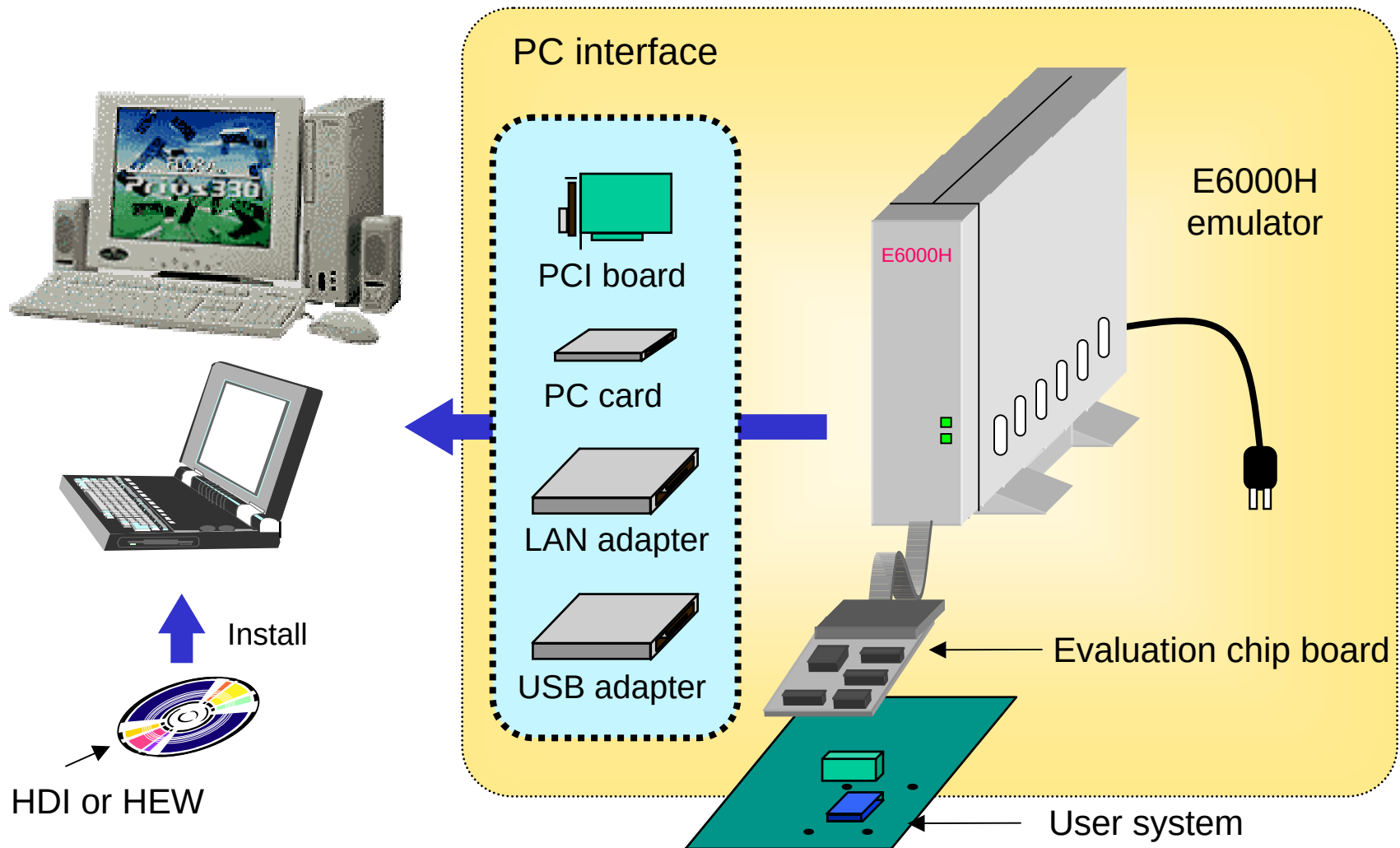
Instruction	H8S (no divider)	H8SX (with divider)	Instruction	H8S (no divider)	H8SX (divider used)
DIVXU.B	12	10	DIVU.W	-	10
DIVXU.W	20	18	DIVU.L	-	18
DIVXS.B	13	12	DIVS.W	-	11
DIVXS.W	21	20	DIVS.L	-	19

Development Environment

E10A-USB

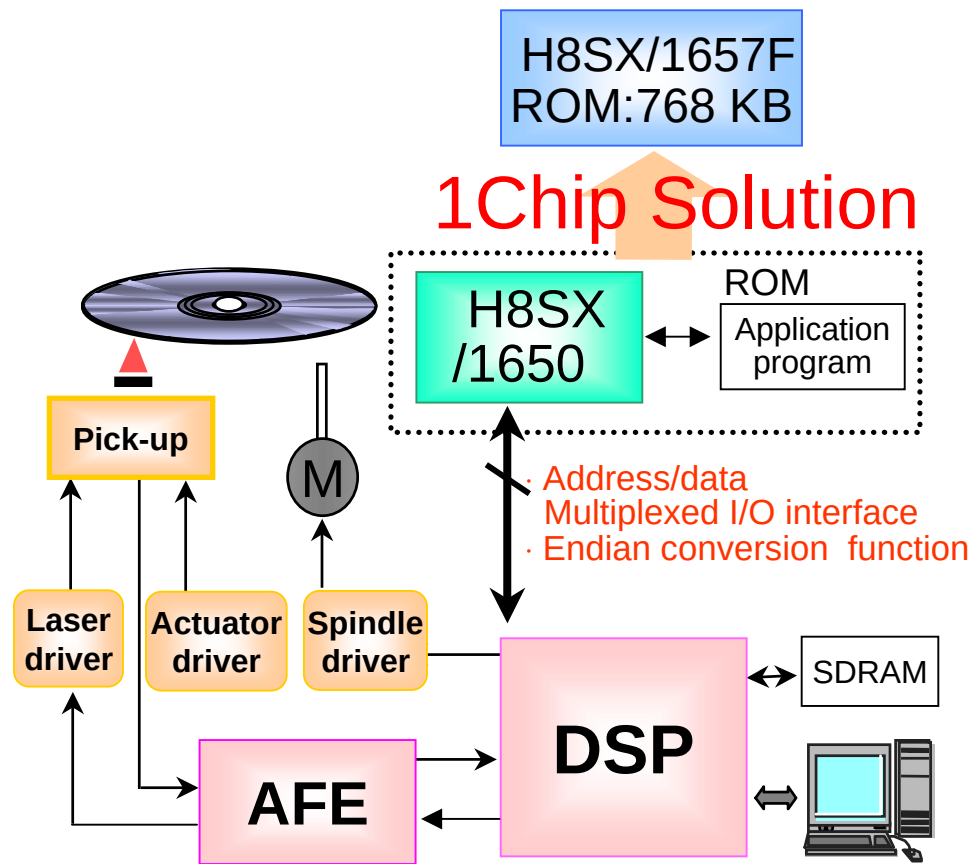


E6000H



H8SX Solutions

Example of H8SX System Configuration for the ODD (optical disk drive) Applications



< Block Diagram of the H8SX System >

Merits of Using H8SX for ODD Applications

- Improved CPU performance
 - High operating frequency 25 MHz → 35 MHz improved code efficiency by additional set of instructions (improved by 83% compared to conventional product)
 - Faster arithmetic operation speed by built-in multiplier/divider (more than 10 times compared to the H8/300H)
 - Settable 8-bit absolute address space → SBR
 - Location of the vector table is settable by the user → VBR
 - 1-clock access is achieved by incorporating on-chip RAM of 24 KB
- Improved performance of bus controller
 - Data/address multiplexed I/O I/F enables direct connection with the DSP
 - Little/big endian conversion function
 - 32-bit registers and internal buses
- On-chip large-capacity flash memory
 - Large-capacity flash memory of 768 KB is On chip
 - Large Application program can be incorporated
 - Eliminates external memory

Example of H8SX System Configuration for LBP/PPC Engines

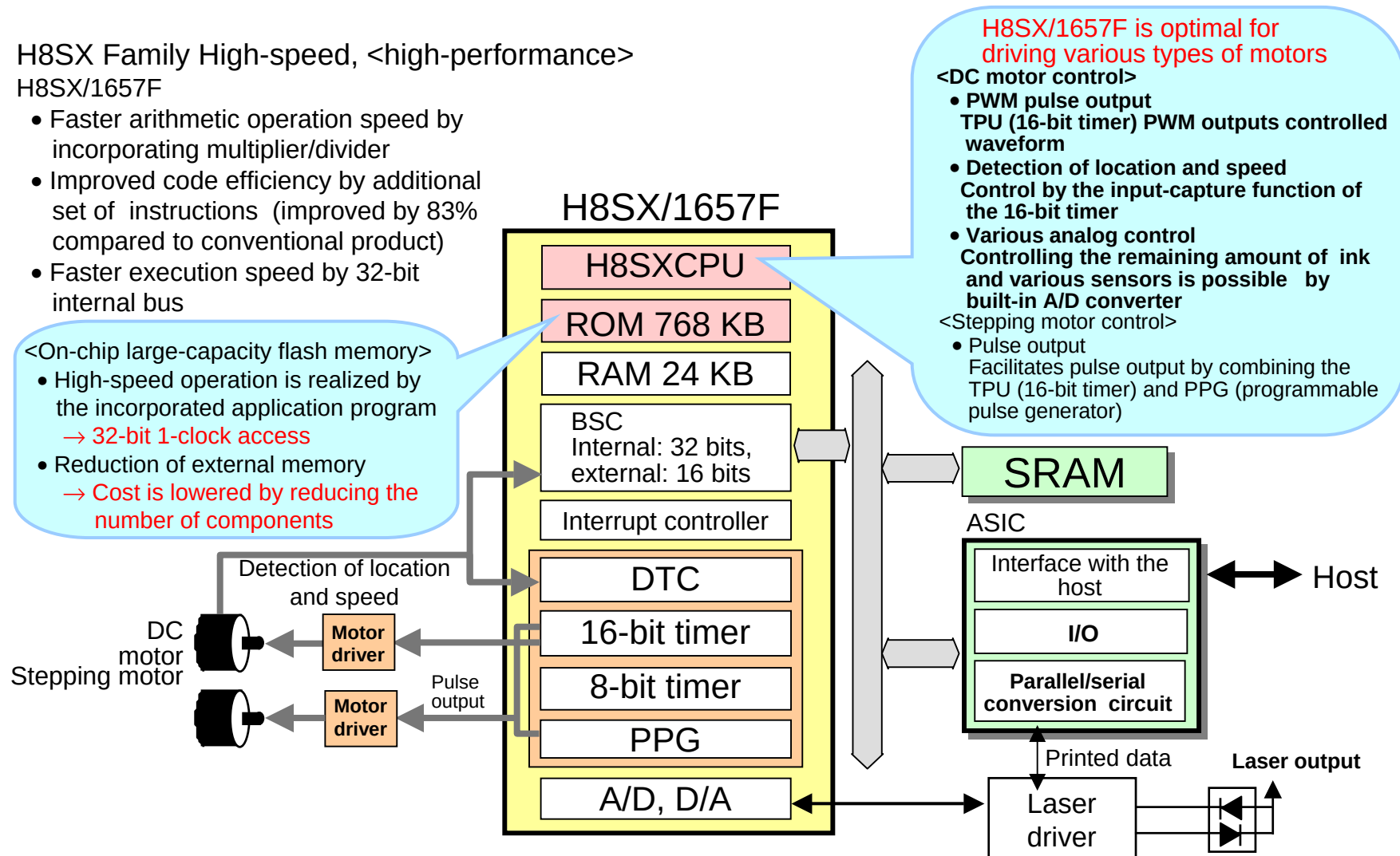
H8SX Family High-speed, <high-performance>

H8SX/1657F

- Faster arithmetic operation speed by incorporating multiplier/divider
- Improved code efficiency by additional set of instructions (improved by 83% compared to conventional product)
- Faster execution speed by 32-bit internal bus

<On-chip large-capacity flash memory>

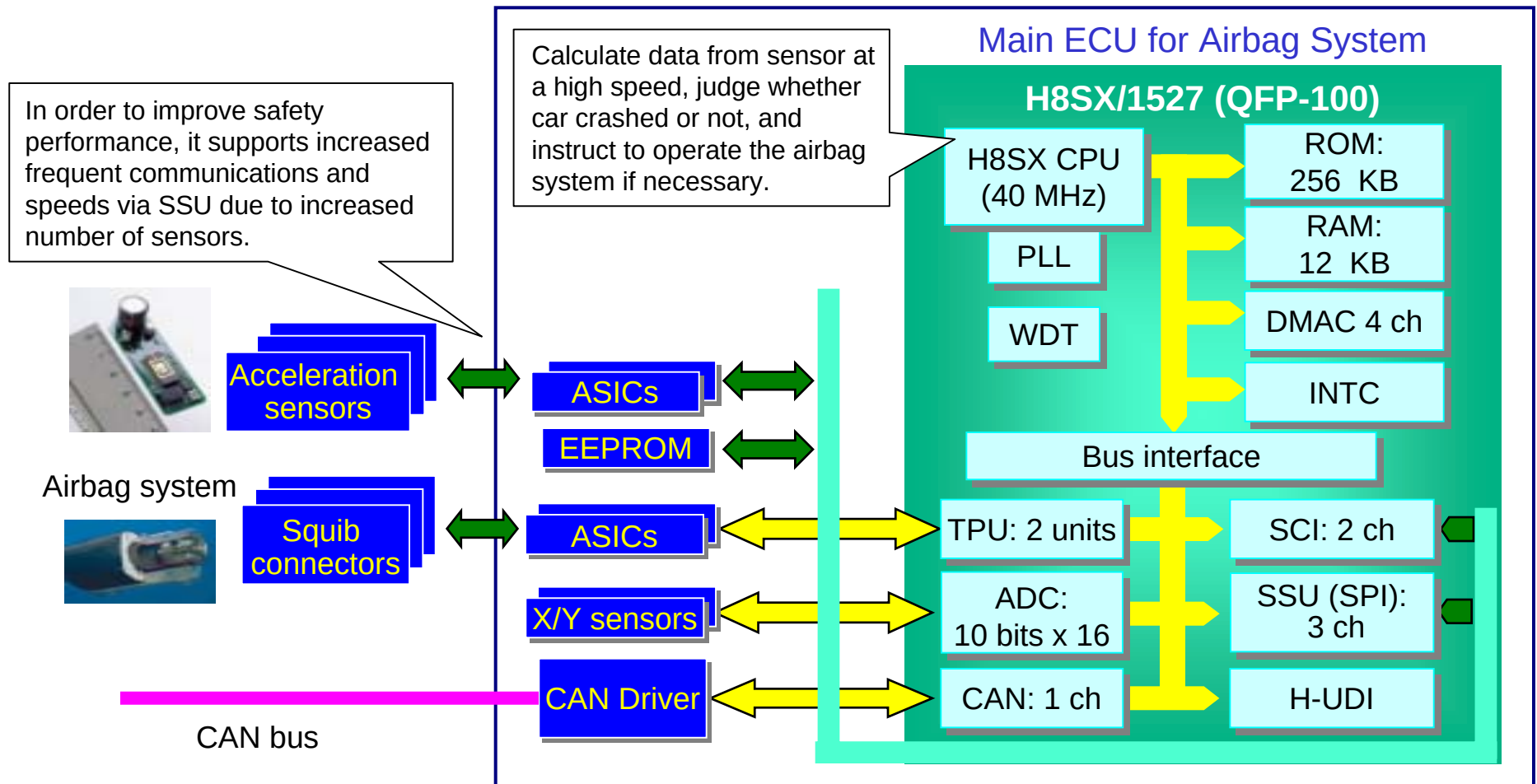
- High-speed operation is realized by the incorporated application program
→ 32-bit 1-clock access
- Reduction of external memory
→ Cost is lowered by reducing the number of components



Application Example: The Airbag System Using the H8SX/1527

Features of the H8SX/1527

- 32-bit high performance CPU core (up to 40 MHz)
- Various peripheral functions (such as SSU,SCI, DMAC, TPU, and CAN)



Microcomputer General Presentation

H8S Family

October 28, 2005

Rev.2.00

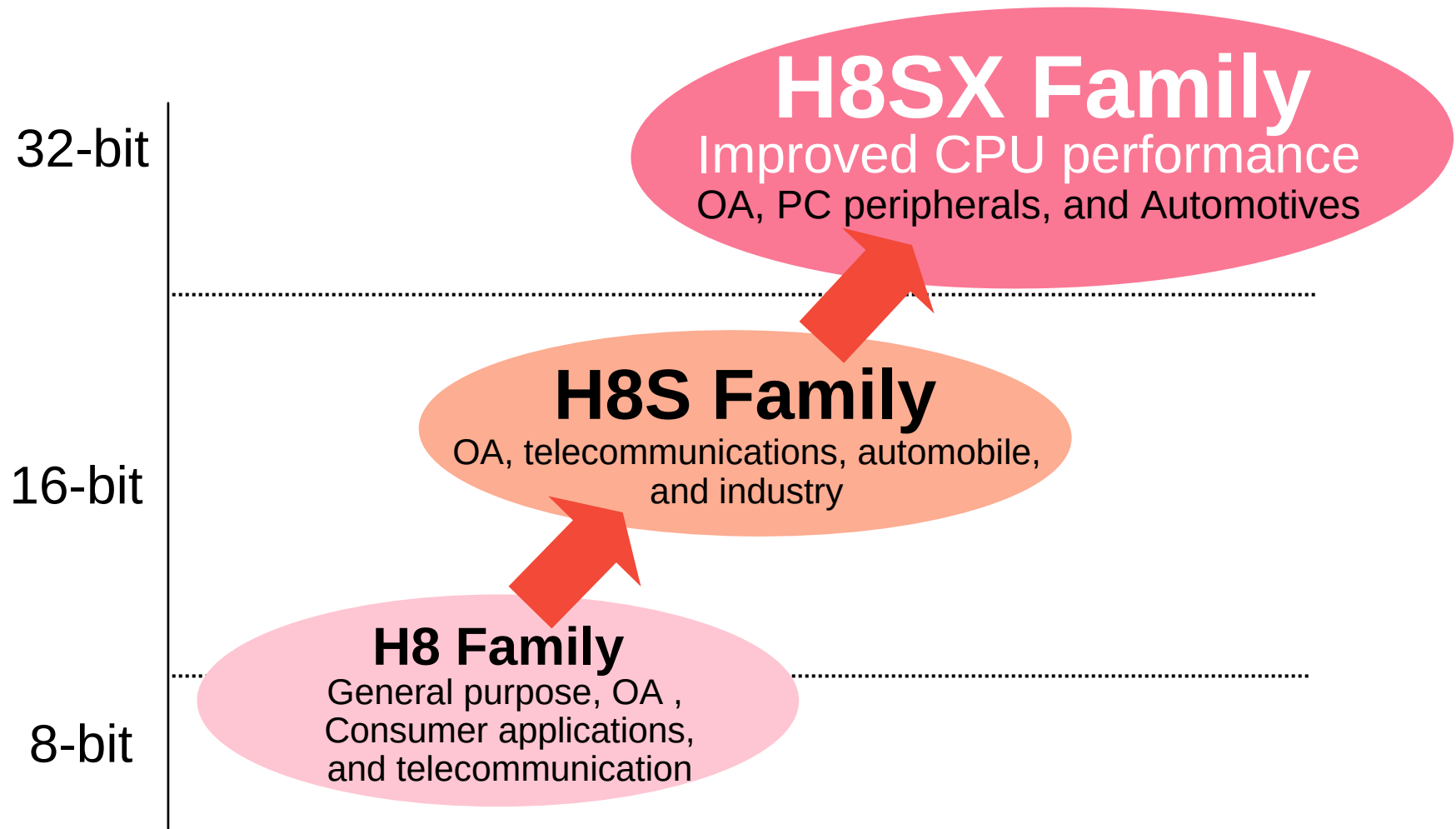
MCU Product Marketing Dept

MCU Business Unit

Standard Product Business Group

Renesas Technology Corp

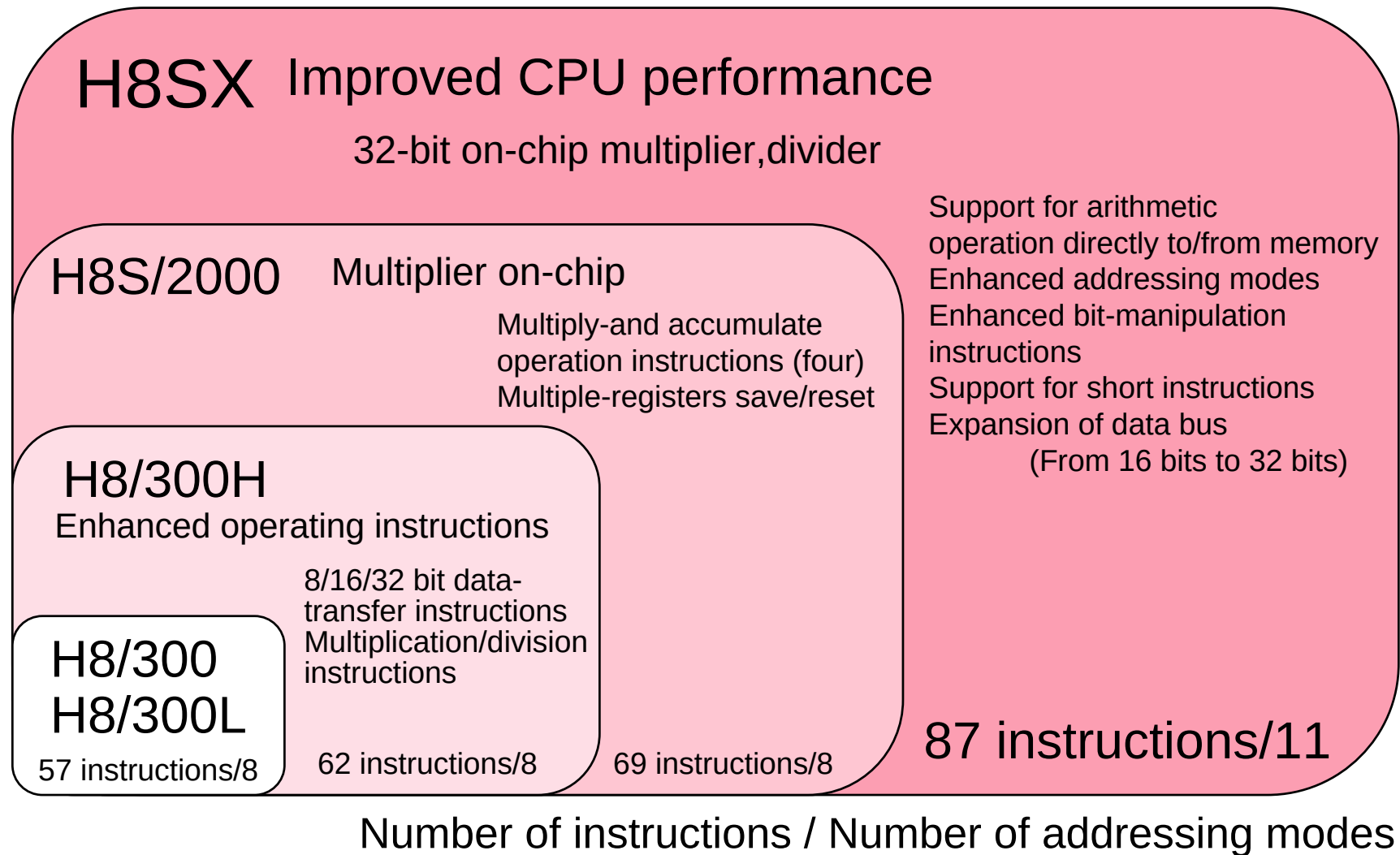
Product Evolution of H8, H8S, and H8SX Family



Features of the H8S Family

- One of the world's fastest 16-bit CPUs
 - 28.6 ns @35 MHz(H8S/2378 Group)
- Higher performance with lower power requirements
 - Basic instructions are executed in 1 state
 - 16 x 16 bit multiplier on-chip
 - Multiply and multiplication-and-accumulation:
113 ns (at 35-MHz operation)
 - Adoption of low-power consumption technique
(Static circuit, gear function, and module stop function)
- Upward compatible with H8/300H instructions

H8, H8S, and H8SX Family Succession

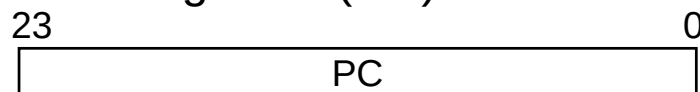


H8S/2600 and H8S/2000 CPU Register Configuration

General registers

	31	15	7	0
	E0	R0H	R0L	
	E1	R1H	R1L	
	E2	R2H	R2L	
	E3	R3H	R3L	
	E4	R4H	R4L	
	E5	R5H	R5L	
	E6	R6H	R6L	
SP	E7	R7H	R7L	

Control registers (CR)

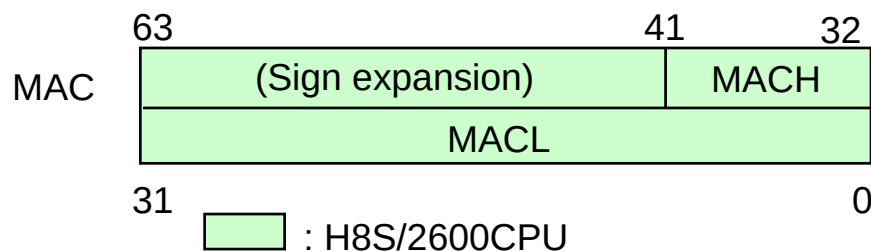


CCR

7	6	5	4	3	2	1	0
I	UI	H	U	N	Z	V	C

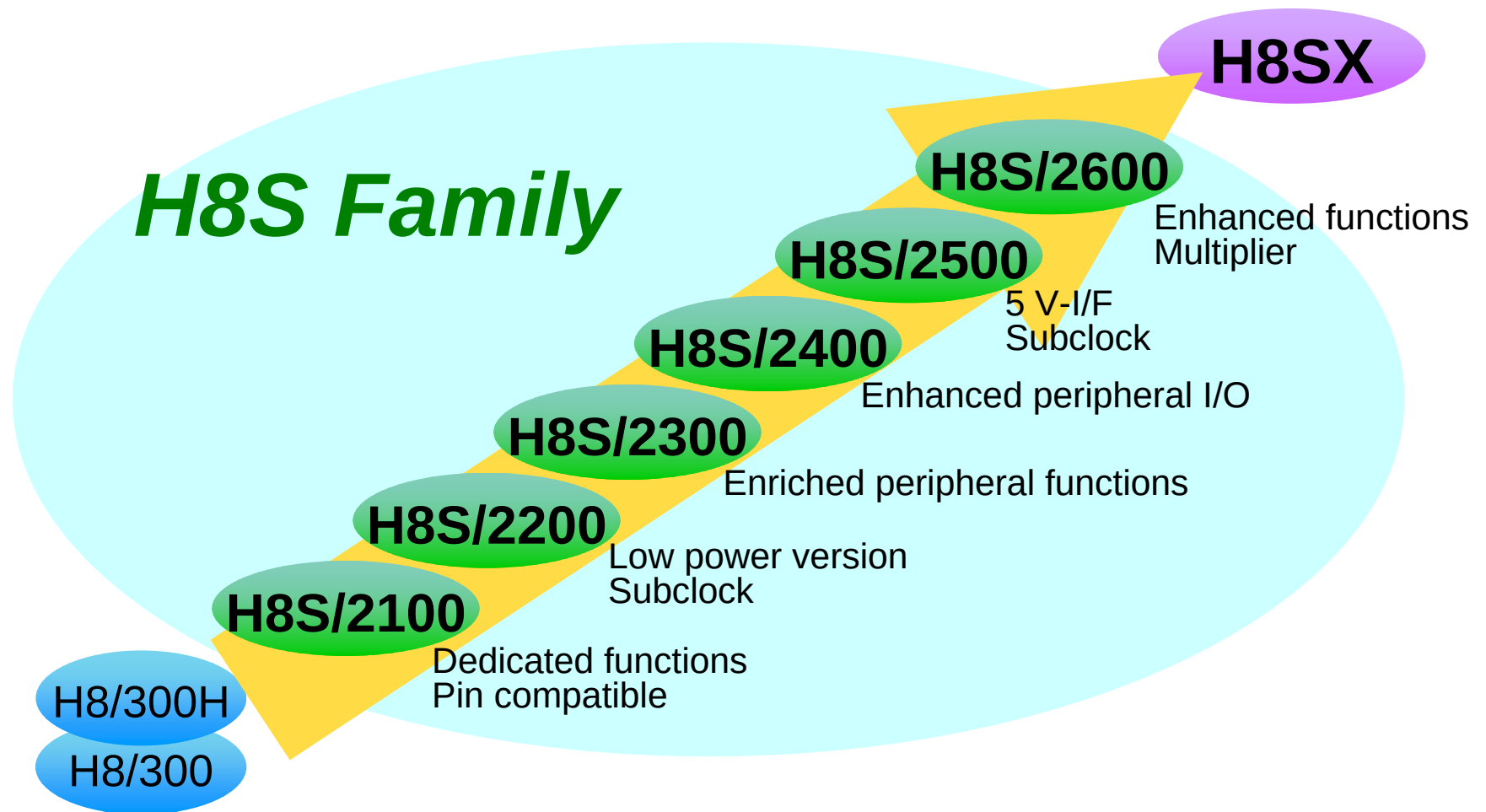
EXR

7	6	5	4	3	2	1	0
T	-	-	-	-	I2	I1	I0



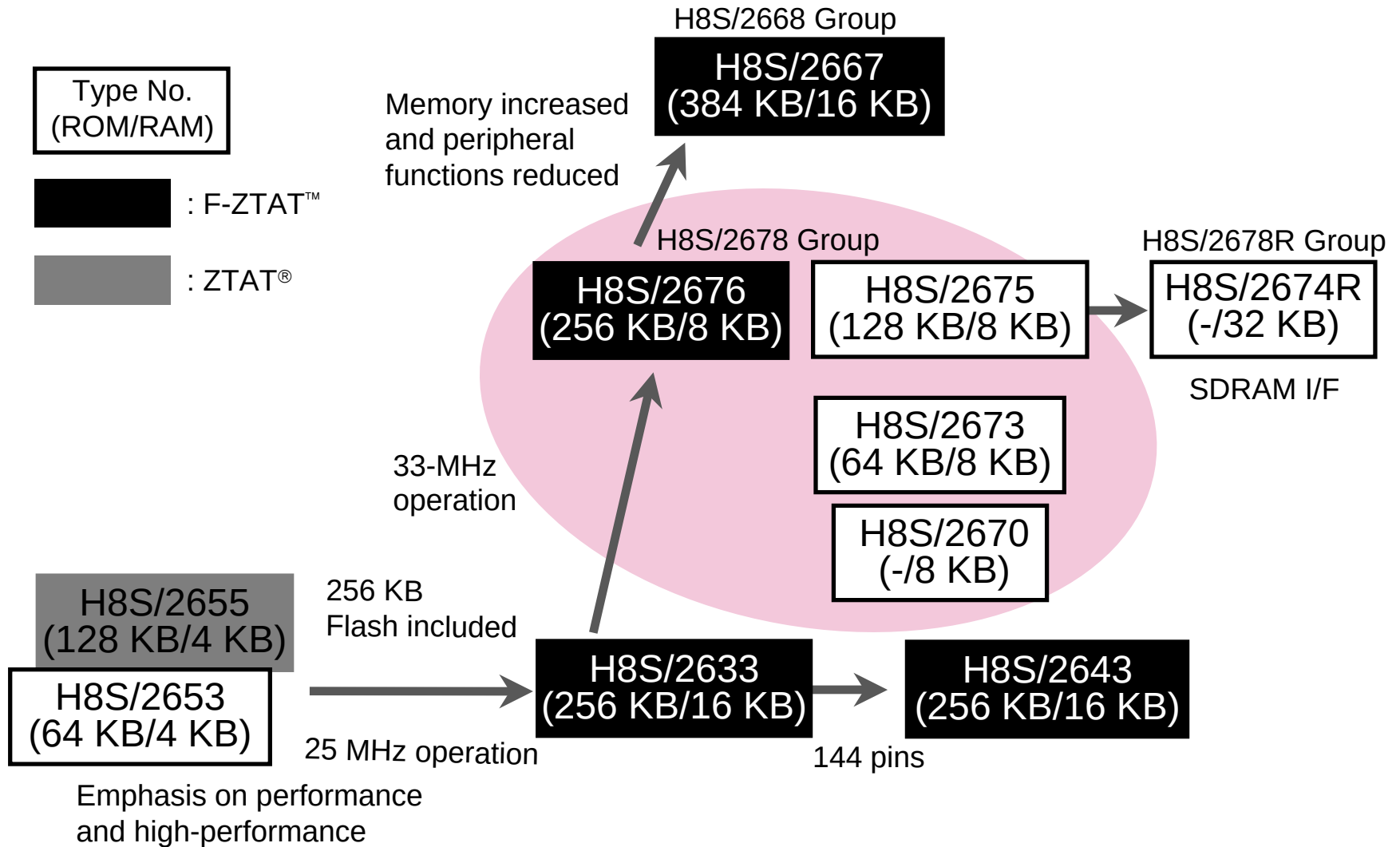
H8S/2678 Group	H8S/2643 Group	H8S/2615 Group
H8S/2678R Group	H8S/2639 Group	H8S/2612 Group
H8S/2668 Group	H8S/2638 Group	H8S/2437 Group
H8S/2655 Group	H8S/2636 Group	
H8S/2649 Group	H8S/2635 Group	
H8S/2648 Group	H8S/2633 Group	
H8S/2646 Group	H8S/2630Group	
	H8S/2628Group	

H8S Family Evolution



H8S/2600 Series

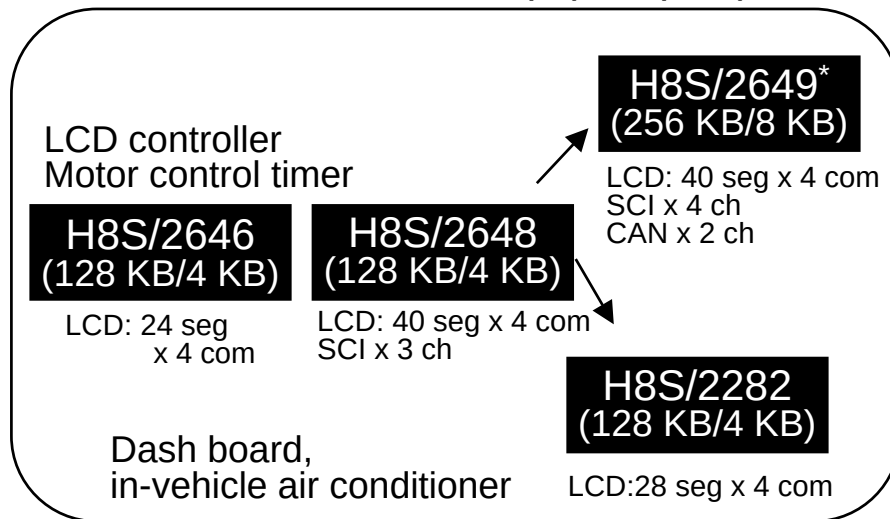
Evolution of the H8S/2600 Series (1)



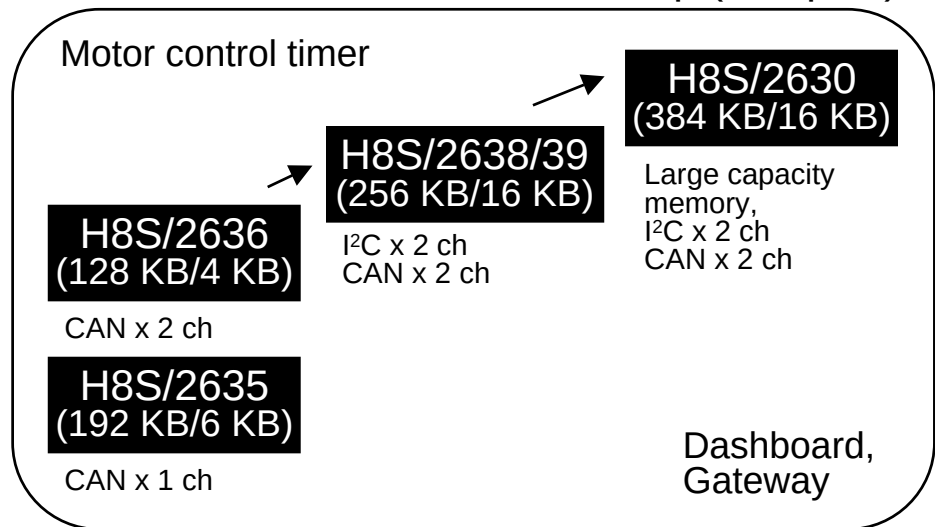
Evolution of the H8S/2600 Series (2)

- Built in CAN Version -

H8S/2646,48 and 49 Group (144 pins),
H8S/2282 Group (100 pins)



H8S/2635, 36, 38, 39 and 30 Group (128 pins)



H8S/2615 Group (80 pins)



H8S/2612 Group (80 pins)

Small package with built-in MMT

H8S/2612 (128 KB/4 KB) EPS, ABS, Body control, inverter control

H8S/2628 Group (100 pins)

Built-in SSU

H8S/2628 (128 KB/8 KB)

Type. (ROM/RAM) : F-ZTAT™

*: Under development

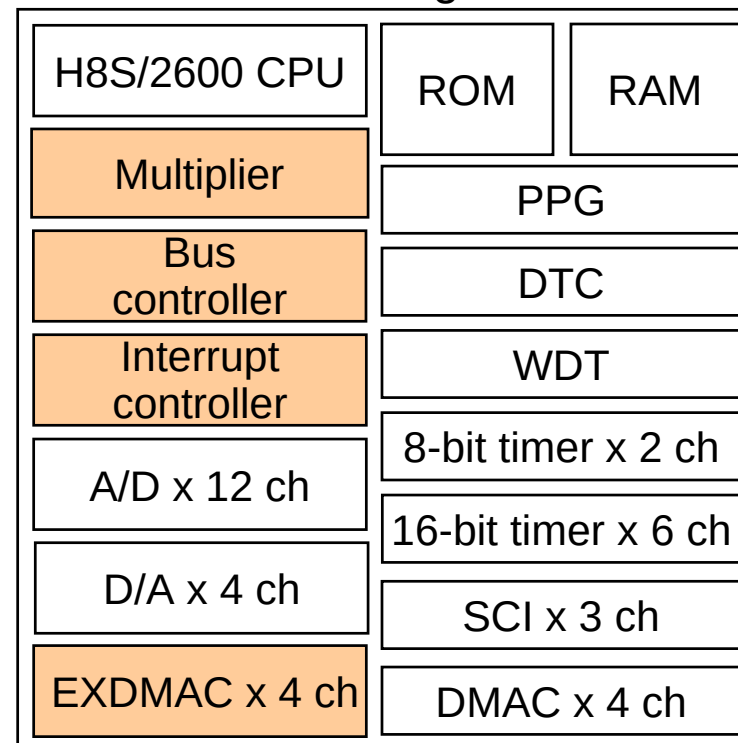
H8S/2678 Group Overview

- 33 MHz operation and 18.9 MIPS available -

Features

- 33 MHz (3.0 V to 3.6 V)
- Minimum instruction-execution time
 - 30 ns (33 MHz/3.3 V)
- Large-capacity memory
 - 256 KB/8 KB (single power supply F-ZTAT™): H8S/2676F
 - 256 KB/8 KB: H8S/2676
 - 128 KB/8 KB: H8S/2675
 - 64 KB/8 KB: H8S/2673
 - - /8 KB: H8S/2670
- Ease of use
 - EEPMOV instruction: Dummy read deleted
 - IPR independence (EXDMAC and IRQ)
- Bus controller improved
 - OE signal added (for fast page/EDO)
 - 64-Mb DRAM direct Interface supported
 - Two burst ROM areas (area 0/1)
- Various peripheral functions
 - 16 IRQs
 - EXDMAC x 4 ch added
- Package
 - QFP-144

Block Diagram



 : Function improvements from the H8S/2328 and 2338

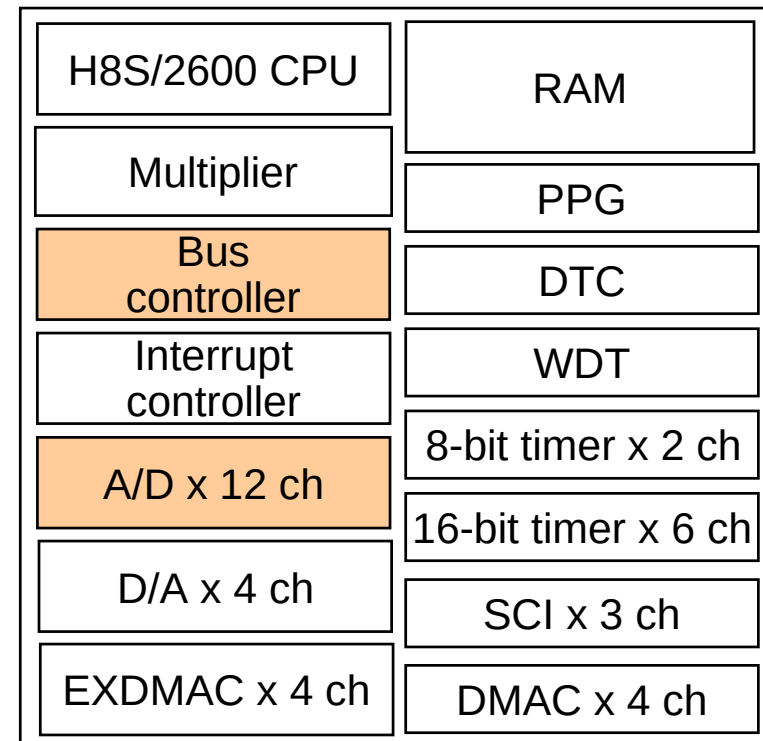
H8S/2678R Group Overview

- Includes an on-chip SDRAM interface compatible with that of H8S/2678 Group products -

Features

- 33 MHz (3.0 V to 3.6 V)
- Minimum instruction-execution time
 - 30 ns (33 MHz/3.3 V)
- ROMless Version
 - H8S/2674R (-/32 k)
- Internal SDRAM interface
 - 64-Mbit direct connection interface
 - Hold times are assured by the dedicated SDRAM ϕ
 - Includes a clock suspension function
- Functional improvement module
 - A/D registers: 4 $\rightarrow$ 8 (more useful)
- Package
 - LQFP-144

Block Diagram



 : Function improvements from the H8S/2678 Group

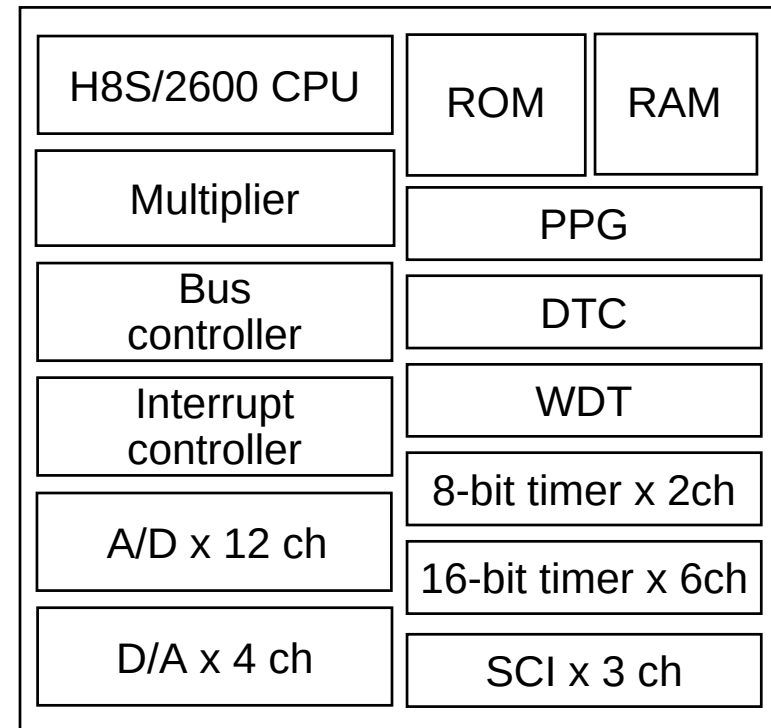
H8S/2668 Group Overview

- Memory capacity increased from H8S/2678 Group with reduced peripheral functions -

Features

- 33 MHz (3.0 V to 3.6 V)
- Minimum instruction-execution time
 - 30 ns (33 MHz/3.3 V)
- Large-capacity memory
 - 384 KB/16 KB
 - (single power supply F-ZTAT™): H8S/2667F
- Reduced peripheral functions
- Pins compatible with H8S/2678 Group
 - LQFP-144

Block Diagram

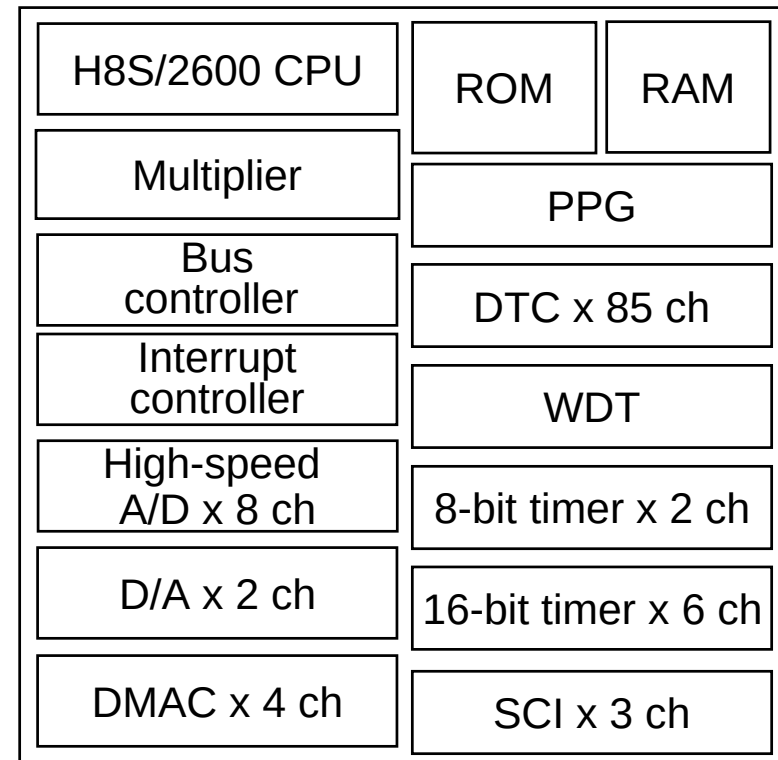


H8S/2655 Group Overview

Features

- Built-in multiplier
 - 16 x 16 bits (4 states)
- Minimum instruction execution time
 - 50 ns (20 MHz/5 V)
 - 100 ns (10 MHz/3 V)
- Bus controller
 - Divides address spaces into 8 areas
 - Sets bus specifications by area (Bus width, wait state, and output CS)
 - Supports DRAM fast page mode
 - Supports ROM page mode
 - External write buffer function
- High-performance peripheral functions
 - High-speed A/D converter x 8 ch (High-speed conversion: 1 μ s)
 - DMAC controller etc

Block Diagram



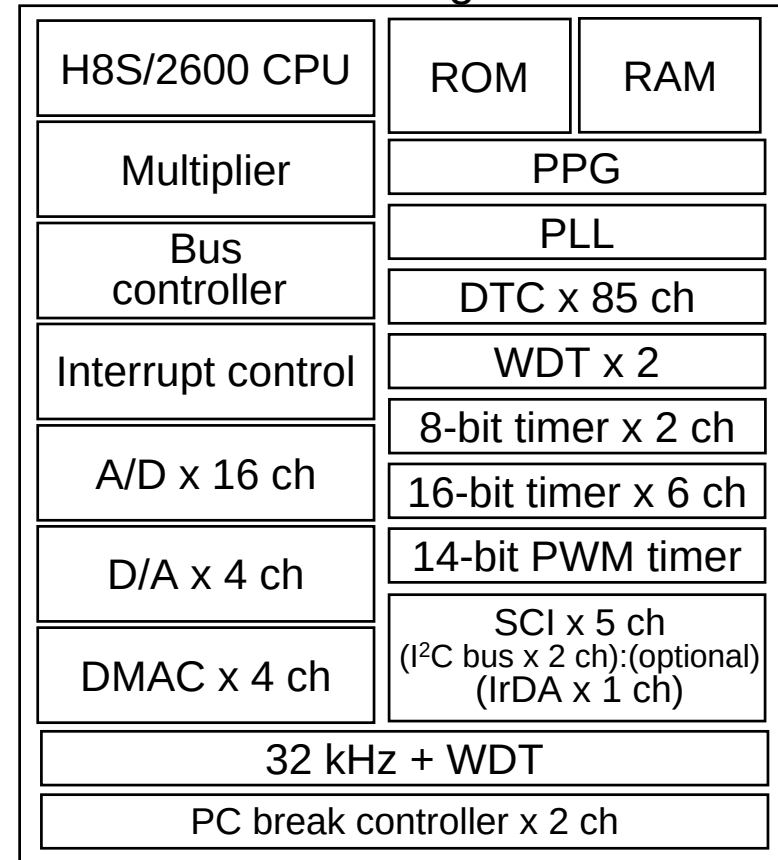
PPG: Programmable pulse generator
DTC: Data transfer controller

H8S/2633 and H8S/2643 Group Overview

- Internal-function enhanced Group:
SCI x 5 ch, A/D x 16 ch, and subclock operation -

- High-performance H8S/2600 CPU
 - High-speed operation: Basic instructions executed in one state
 - Minimum instruction execution time
 - <H8S/2633R>
 - : 35.7 ns (28 MHz/PVcc = AVcc = 5.0 V)
 - <H8S/2643, 33>
 - : 40 ns (25 MHz/Vcc = 3.3 V, PVcc = 5.0 V)
- Built-in multiplier: 16 bits x 16 bits (four states)
- Built-in large-capacity memory
 - 256 KB flash ROM
 - 16 KB RAM
- Powerful timer
 - TPU (16-bit timer pulse unit) x 6 ch
 - 8 bit timer x 2 ch
- SCI x 5 ch included
- A/D converter x 16 ch included
- Built-in clock multiplication PLL
- Subclock operation (32 kHz)
- Packages
 - QFP-128, TQFP-120 (H8S/2633 Group)
 - QFP-144 (H8S/2643 Group)

Block Diagram



PPG: Programmable pulse generator
DTC: Data transfer controller

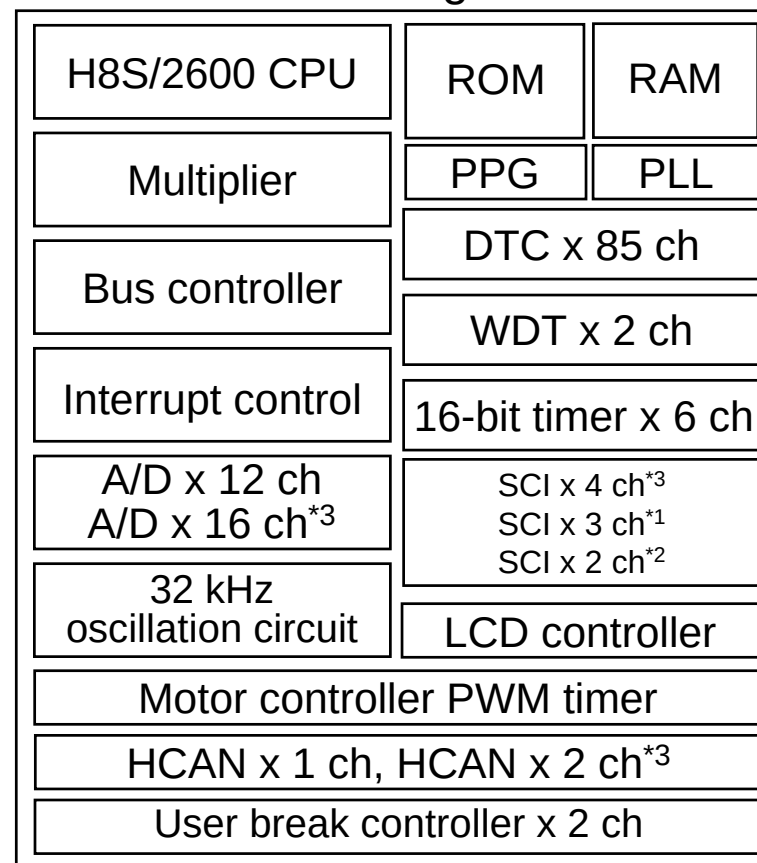
With CAN

H8S/2646, H8S/2648 and H8S/2649 Group Overview

Features

- High-performance H8S/2600 CPU
 - High-speed operation: Basic instructions executed in one state
 - Minimum instruction execution time: 50 ns (20 MHz)
- Built-in multiplier: 16 bits x 16 bits (four states)
- HCAN : x 1 ch included (2646,48 group)
: x 2 ch included (2649 group)
- Powerful timer
 - TPU (16-bit timer pulse unit) x 6 ch
- Motor control PWM timer: 16 ch output available
- Built in LCD controller:
 - 40 seg x 4 com (H8S/2648,49 Group)
 - 24 seg x 4 com (H8S/2646 Group)
- SCI x 4 ch included (H8S/2649 Group)
SCI x 3 ch included (H8S/2648 Group)
SCI x 2 ch included (H8S/2646 Group)
- 10-bit A/D converter x 12 ch included
- Subclock (32 kHz) operation
- User break controller x 2 ch included
- Built-in clock multiplication PLL
- Package
 - QFP-144 (20 mm x 20 mm, 0.5-mm pitch)

Block Diagram



PPG: Programmable pulse generator

DTC: Data transfer controller

*1: H8S/2648

*2: H8S/2646

*3: H8S/2649

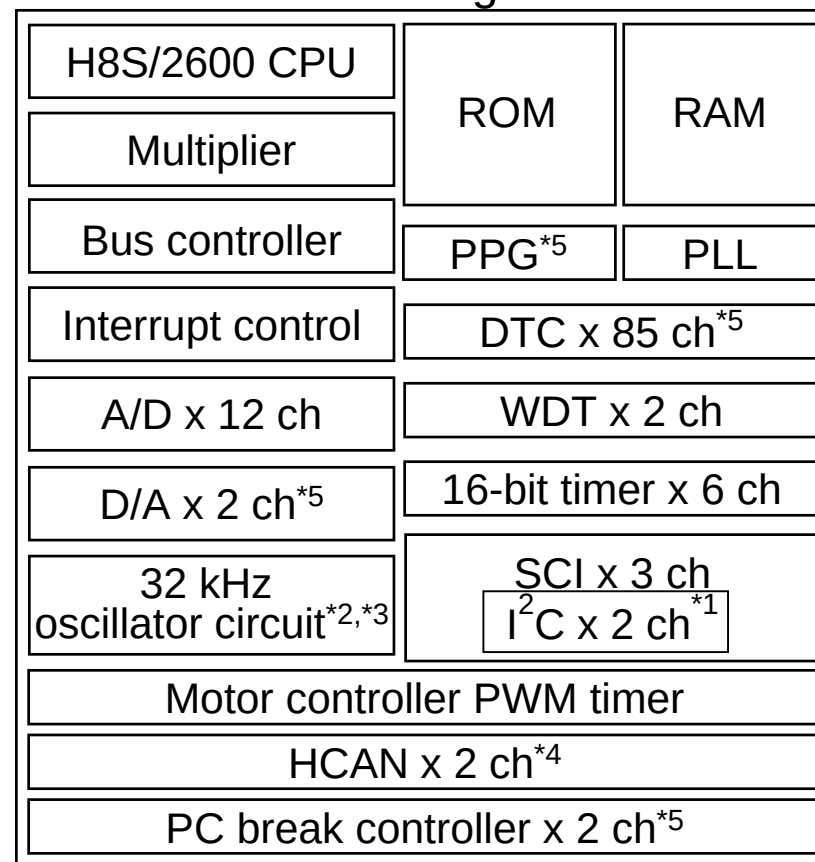
With CAN

H8S/2630, H8S/2639, H8S/2638, H8S/2636, and H8S/2635 Group Overview

Features

- High-performance H8S/2600 CPU
 - High-speed operation: Basic instructions executed in one state
 - Minimum instruction execution time: 50 ns (20 MHz)
- Built-in multiplier: 16 bits x 16 bits (four states)
- HCAN x 2 ch included^{*4}
- Powerful timer
 - TPU (16-bit timer pulse unit) x 6 ch
- Motor control PWM timer
16 ch output available
- SCI x 3 ch included
I²C x 2 ch included^{*1}
- 10-bit A/D converter x 12 ch included
- Subclock (32 kHz) operation^{*2,*3}
- PC break controller x 2 ch included^{*5}
- Built-in clock multiplication PLL^{*5}
- Package
 - QFP-128 (14 mm x 20 mm, 0.5-mm pitch)

Block Diagram



*1: H8S/2638W and H8S/2639 *2:H8S/2636U, H8S/2638U, H8S/2638W and H8S/2639

*3: Subclock is generated from an internal clock on the H8S/2639 and H8S/2635

*4: H8S/2635 is 1 ch *5: H8S/2635 not use

PPG: Programmable pulse generator

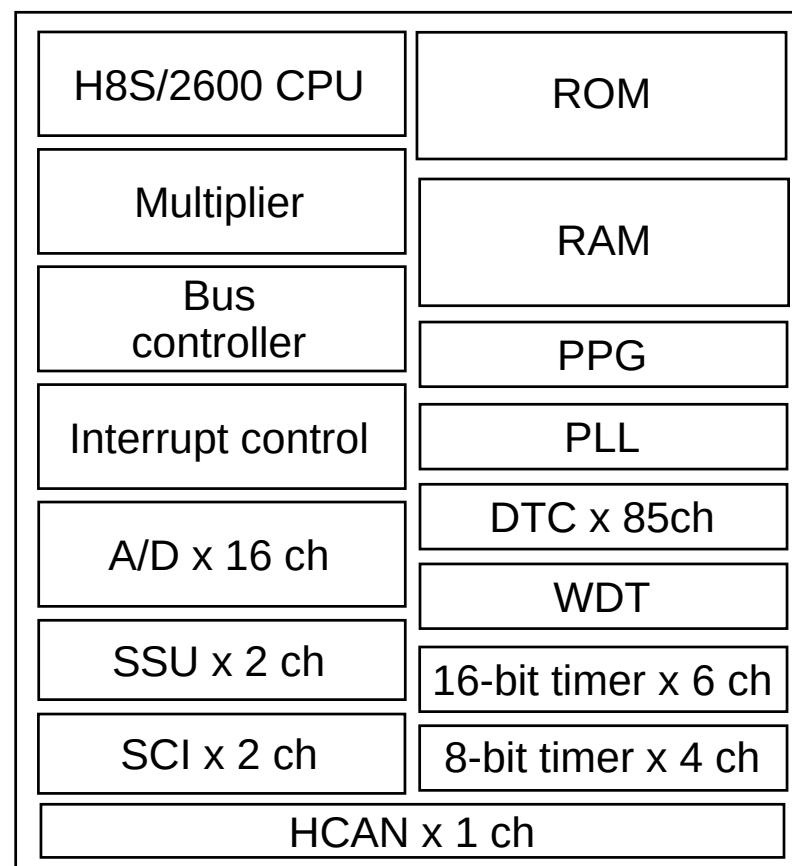
DTC: Data transfer controller

H8S/2628 Group Overview

Features

- High-performance H8S/2600 CPU
 - Maximum operating frequency:
24 MHz (1.2 times faster than conventional device)
- Built-in multiplier:
 - 16 bit x 16 bits (4 states)
- Enhanced serial communication function
 - High-speed synchronous serial communication:
SSU x 2 ch
 - SCI x 2 ch
- HCAN x 1 ch included
 - Built-in CAN wake-up function using CAN operation
- General-purpose timer functions
 - TPU (16-bit Timer Pulse Unit) x 6 ch
 - 8-bit timer x 4 ch
 - PPG: 8 bits
- Built-in 10-bit A/D converter x 16 ch
- PLL for clock multiplication
- Package: QFP-100
(14 mm x 14 mm, 0.5 mm pitch)

Block Diagram



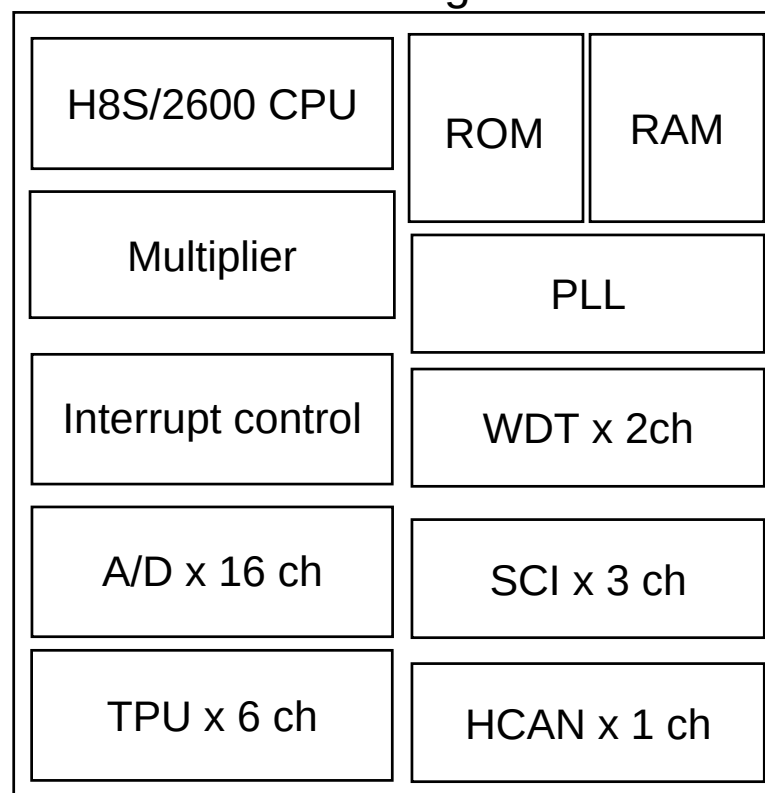
PPG: Programmable pulse generator
 DTC: Data transfer controller
 SSU: Synchronous serial communication unit

H8S/2615 Group Overview

Features

- High-performance H8S/2600 CPU
 - High-speed operation: Basic instructions executed in one state
 - Minimum instruction execution time: 41.6 ns (24 MHz)
- Built-in multiplier:
16 bits x 16 bits (four states)
- HCAN x 1 ch included
- Multi-functional timer
 - TPU (16-bit Timer Pulse Unit) x 6 ch
- SCI x 3ch included
- A/D converter x 16 ch included
- Built-in clock multiplication PLL
- Package: QFP-80
(14 mm x 14 mm, 0.65 mm pitch)
- Pin compatible with the H8S/2612

Block Diagram

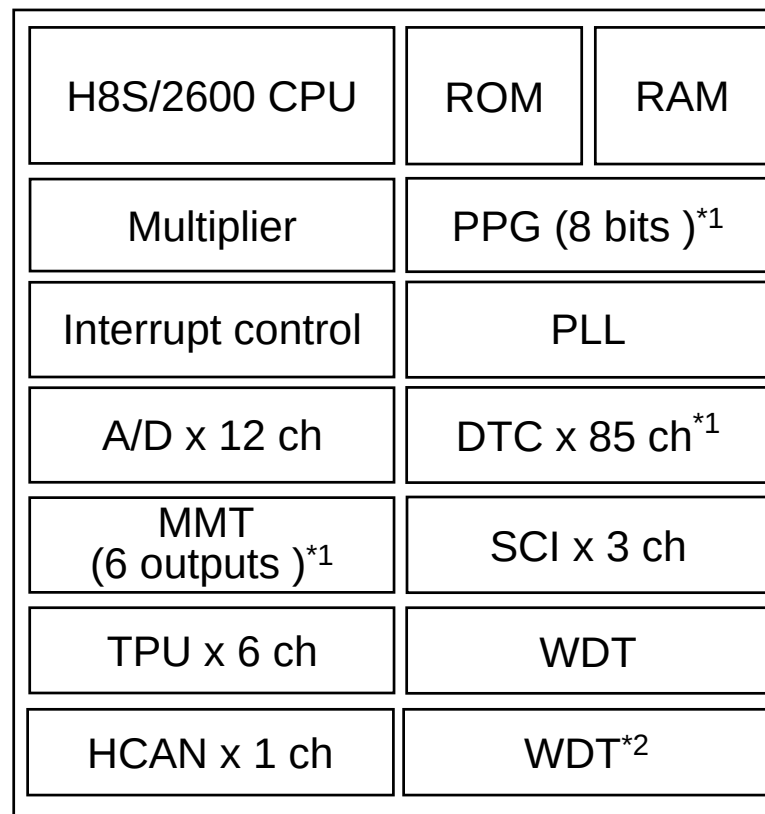


H8S/2612 Group Overview

Features

- High-performance H8S/2600 CPU
 - High-speed operation: Basic instructions executed in one state
 - Minimum instruction execution time: 50 ns (20 MHz)^{*1}, 41.6 ns (24 MHz)^{*2}
- Built-in memory:
 - ROM: 128 KB/64 KB
 - RAM: 4 KB
- Built-in multiplier:
 - 16 bits x 16 bits (four states)
- HCAN x 1 ch included
- Multi-functional timer
 - TPU (16-bit Timer Pulse Unit) x 6 ch
 - MMT (Motor Management Timer)^{*1} x 6 phase output
- SCI x 3 ch included
- A/D converter x 12 ch included
- Built-in clock multiplication PLL
- Package: QFP-80
(14 mm x 14 mm, 0.65 mm pitch)

Block Diagram



^{*1}: H8S/2612 only

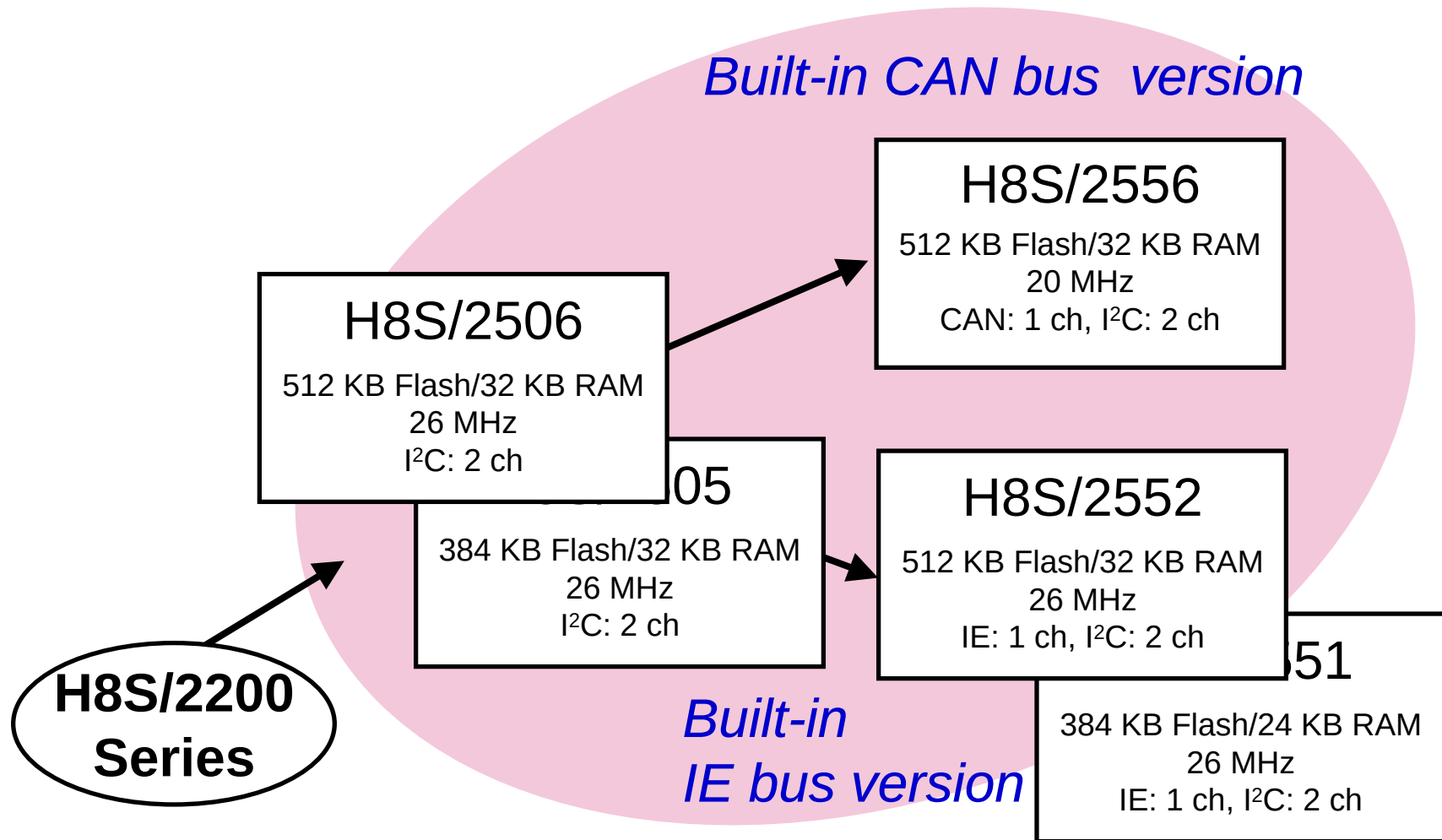
^{*2}: H8S/2614, 2616 only

H8S/2500 Series

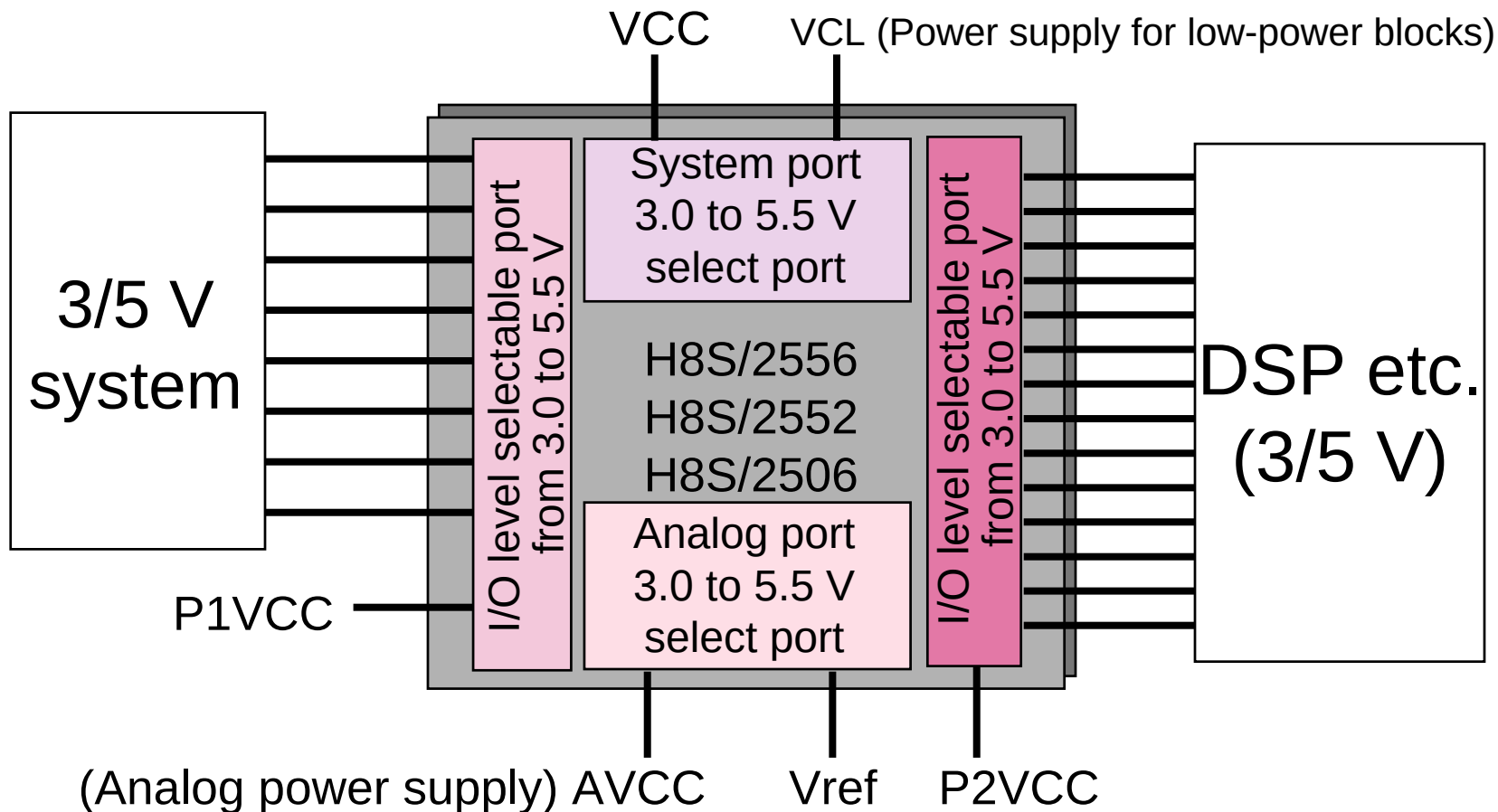
Features of the H8S/2500 Series

- Low power consumption
 - Lineup of products with built-in subclock
 - Ample power-down modes
- Enhanced communications functions
 - Lineup of products with SCI x 5 ch
 - Lineup of products with I²C bus x 2 ch
 - Lineup of products with IE bus x 1 ch
 - Lineup of products with CAN bus x 1 ch
 - Lineup of BGA package products
- Large-capacity memory
 - Flash ROM: 512 KB to 384 KB
 - RAM: 32 KB to 24 KB

H8S/2500 Series Roadmap



H8S/2556, 2552, 2506 Selecting the Port's I/O Level



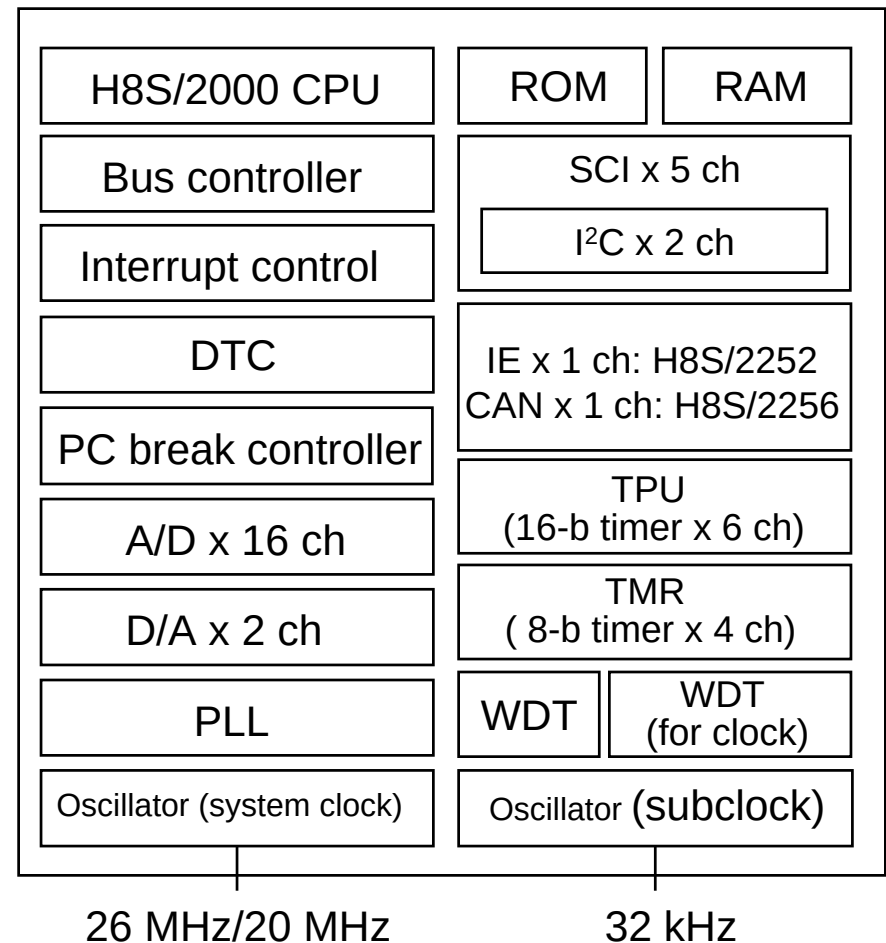
Note: ICE (E6000) is HS2556EPI62H supported.

H8S/2556, 2552 and 2506 Group Overview

Features

- H8S/2000 CPU
 - 20 MHz / 3.0 to 5.5 V (H8S/2556)
 - 26 MHz / 3.0 to 5.5 V (H8S/2552, H8S/2506)
- I/O port
 - Two types of power supply is selectable (3.0 to 5.5 V)
- Built-in large-capacity memory (512 KB)
 - 512 KB/32 KB (H8S/2556, 2552, 2506: Flash ROM/RAM)
 - 384 KB/32 KB (H8S/2505: Flash ROM/RAM)
 - 384 KB/24 KB (H8S/2551: Flash ROM/RAM)
- PLL circuit
 - Multiplication of system clock is possible (x1 or x2)
- Bus interface function
 - SCI x 5 ch
 - I²C x 2 ch
 - IE x 1 ch (H8S/2552, 2551)
 - CAN x 1 ch (H8S/2556)
- Package
 - PRGP0144KB-A (FP-144J)
 - PLBG0176GA-A (BP-176V)
 - : No H8S/2556

Block Diagram



H8S/2400 Series

H8S/2400 Series Features

- The high peripheral functions of the H8S/2300 Series and the specific functions of the H8S/2100 Series is integrated in a single chip
- H8S/2600 CPU, the uppermost H8S CPU core is used for enhanced arithmetic operation processing capabilities
 - On-chip 16 x 16-bit multiplier enables high-speed processing of multiplication and multiply-and-accumulate operations
- Enhanced interface with peripheral LSIs
- On-chip debugging function available (E10A)
- Low-voltage, high-speed operation, low power consumption
 - 3-V/20-MHz operation
 - Low power consumption: 1/3 than prior H8S Series products
 - Plenty of low power consumption modes

H8S/2400 Series Product Evolution

H8S/2437 Group

In mass production

20 MHz/128 pins

H8S/2437F

ROM:256 KB/RAM:16 KB

SCI x 5 ch, I²C x 4 ch
(5-V tolerant)
Sync-processor

Enhanced ROM

In planning

20 MHz/128 pins/144 pins

H8S/2439F

ROM:512 KB/RAM:24 KB

H8S/2438F

ROM:384 KB/RAM:24 KB

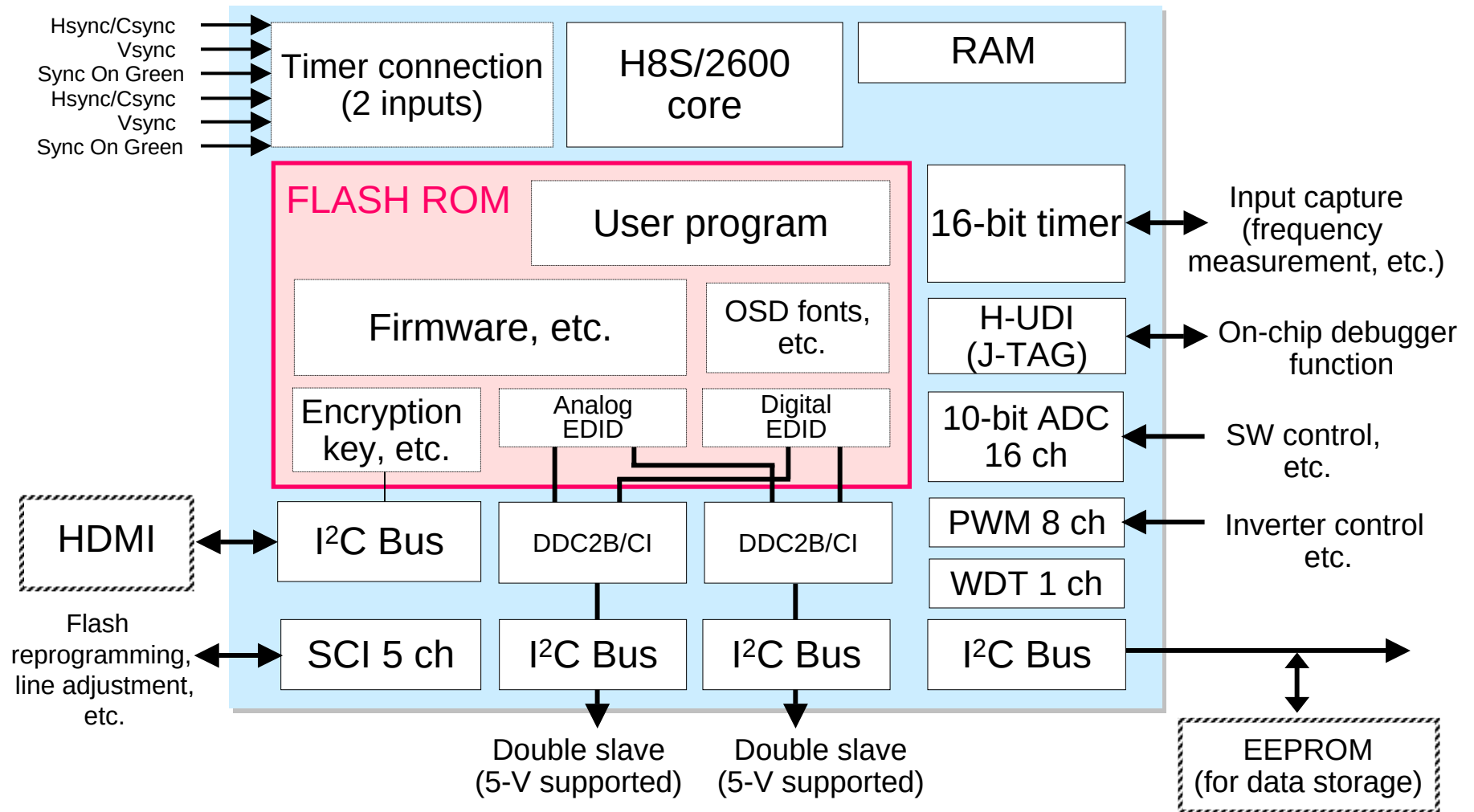
SCI x 5 ch, I²C x 4 ch
(5-V tolerant)
Sync-processor
Sub clock operation

H8S/2437F Group Features

- Flash-ROM version evolution supports mass
 - F-ZTAT™ mass production
- DDC control
 - DDC1/2B IC can be eliminated
 - Support for next-generation monitor interface DDC2B/CI
- Enhanced interface functions
 - I²C Bus: 4 ch (triple slave/multi-slave address)
 - SCI bus: 5 ch
- On-chip multiply-and-accumulate operation function
- Multiplexed bus
 - Simplified interface with peripheral LSIs
- Timer connection functions
 - Using a 16-bit timer and an 8-bit timer, synchronous measurement and synchronous separation of synchronous signals for monitors is achieved

H8S/2437F Group Block Diagram

 : Microcomputer block

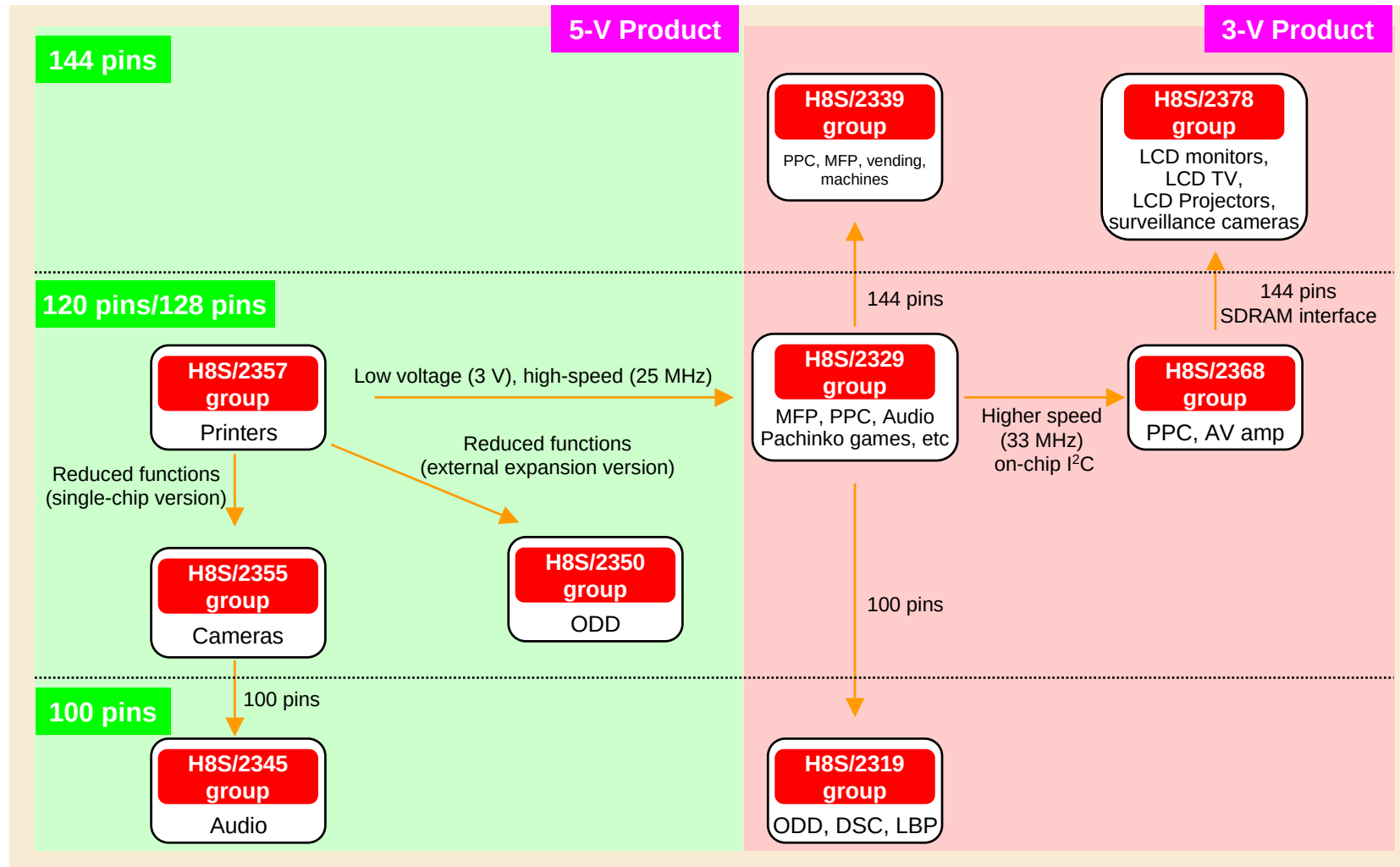


H8S/2437F Group Specifications Outline

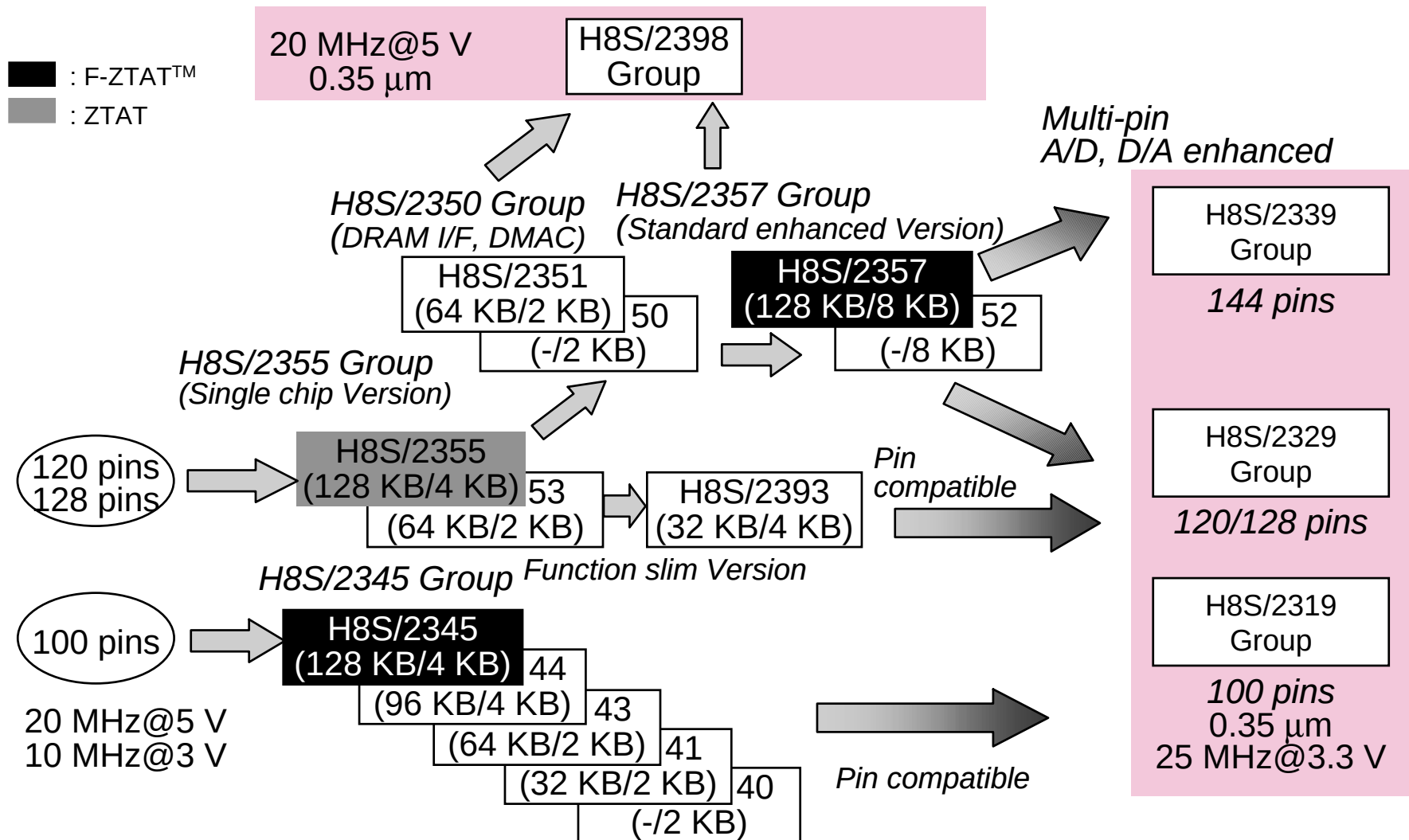
- CPU:H8S/2600 core (16-bit CPU)
- Operating frequency: $f_{osc} = 5$ to 20 MHz ($V_{cc} = 3.0$ to 3.6 V)
- ROM: Flash memory (block reprogramming) 256 KB/384 KB/512 KB
- RAM: 16 KB/24 KB
- Multiply-and-accumulate-operation: On-chip MAC register
- I²C Bus: 4 ch (multi-task support)
 - At slave operation (support for triple slave address/multi-slave address)
 - DDC2B/CI compliant for monitor, 5-V tolerant
- SCI: 5 ch(clock synchronous/asynchronous)
- Timers: 16-bit timer (TPU) x 3 ch, 8-bit timer x 2 ch
Timer connection (Configuration: 16-bit timer (FRT) x 1 + 8-bit timer x 3) x 2ch
 - Sync-processor (synchronous measurement, synchronous separation is possible)
 - When the timer connection is not used, 16- and 8-bit timers can be used as the normal timers
8-bit counter x 1 ch (period and polarity can be detected)
- PWM output: 14-bit x 2 ch (pulse division), 8-bit x 8 ch(pulse division)
- WDT: 1 ch
- External interrupts: IRQ x 8, NMI x 1
- ADC input: 10-bit x 16 ch
- Operating mode: Single-chip mode, expansion mode (address/data multiplexed)
- Low-power modes:
Clock division (gear function), sleep, software/hardware standby, module-stop modes
- H-UDI(J-TAG): On-chip debugger function
- Package: QFP-128/144

H8S/2300 Series

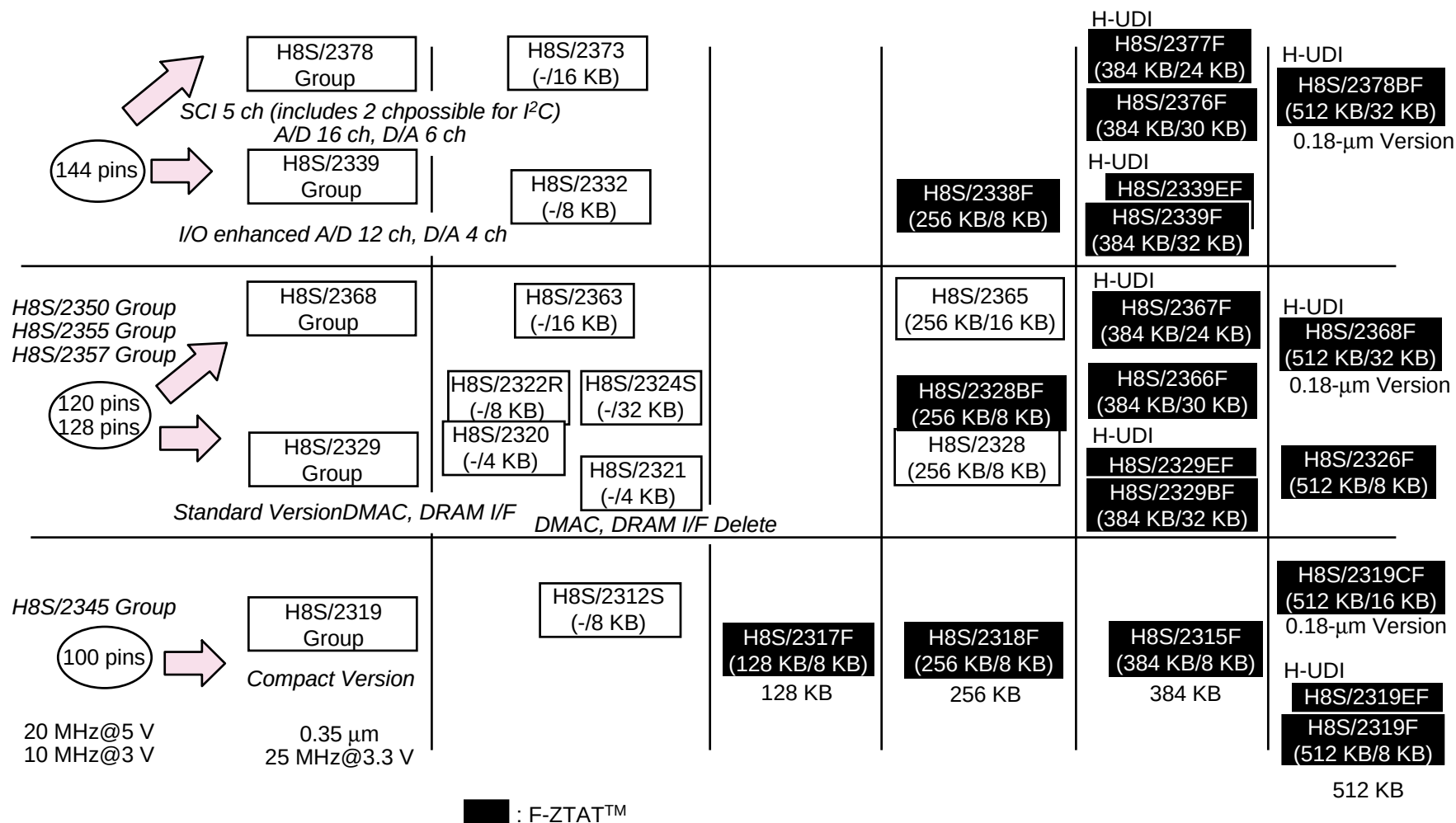
Evolution of the H8S/2300 Series



Evolution of the H8S/2300 Series (5-V Products)



Evolution of the H8S/2300 Series (3-V Products)



H8S/2339 Group Overview

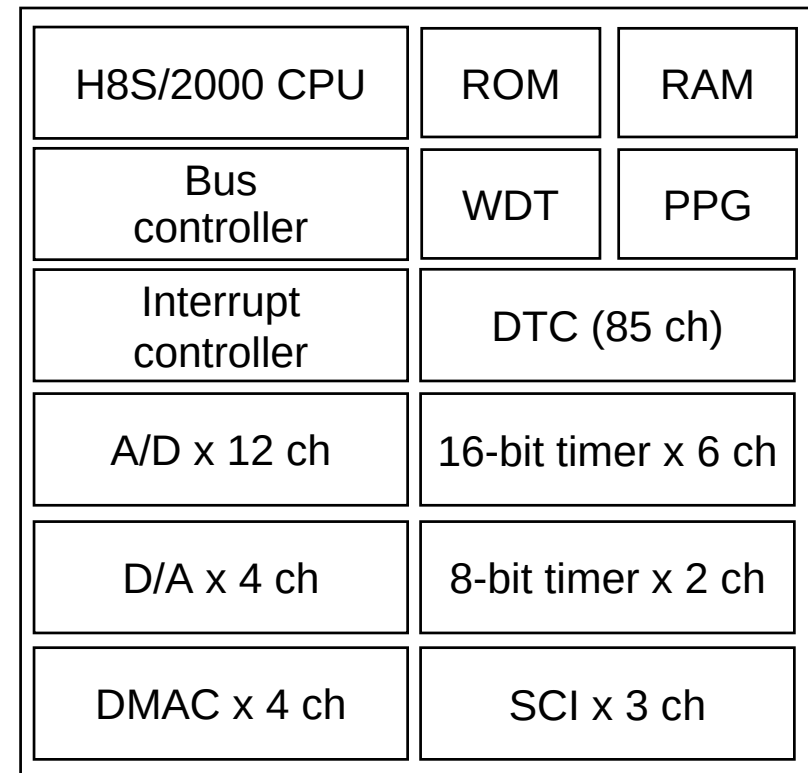
- Microcomputer with built-in flash memory -

Features

- Low-voltage and high-speed operation
 - 3 V/20 MHz, 3.3 V/25 MHz operation
 - Minimum instruction execution time:
50 ns/40 ns
- Various lineup
 - 384 KB/32 KB H8S/2339F*, 2339EF*
 - 256 KB/8 KB H8S/2338F*, 2338
 - 128 KB/8 KB H8S/2337
 - -/8 KB H8S/2332
- Analog enhanced
 - A/D x 12 ch, D/A x 4 ch
- Package
 - QFP-144
- Supports on-chip debugging function (E10A)
 - H8S/2339EF

* : F-ZTAT™ Version with 25 MHz/3.3 V Version.

Group Block Diagram



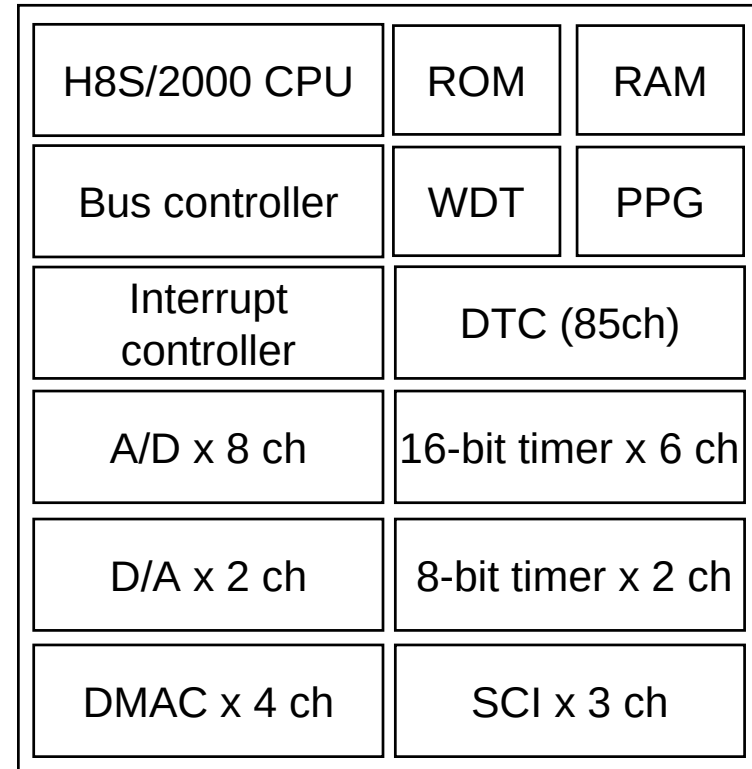
H8S/2329 Group Overview

- Built-in flash memory -

Features

- Low-voltage and high-speed operation
 - 3 V/20 MHz, 3.3 V/25 MHz operation
 - Minimum instruction execution time: 50 ns/40 ns
- Various lineup
 - 512 KB /8 KB H8S/2326F*
 - 384 KB/32 KB H8S/2329BF*, H8S/2329EF*
 - -/32 KB H8S/2324S
 - 256 KB/8 KB H8S/2328BF*, 2328
 - 128 KB/8 KB H8S/2327
 - 32 KB/8 KB H8S/2323
 - -/8 KB H8S/2322R
 - -/4 KB H8S/2321
 - (DRAM I/F, DMAC deleted)
 - -/4 KB H8S/2320
- Upwardly pin compatible with H8S/2655, 2350, 2355 and 2357 Group
 - QFP-128, TQFP-120
- Supports on-chip debugging function (E10A)
 - H8S/2329EF

Group Block Diagram



* : F-ZTAT™ Version with 25 MHz/3.3 V Version.

H8S/2319 Group Overview

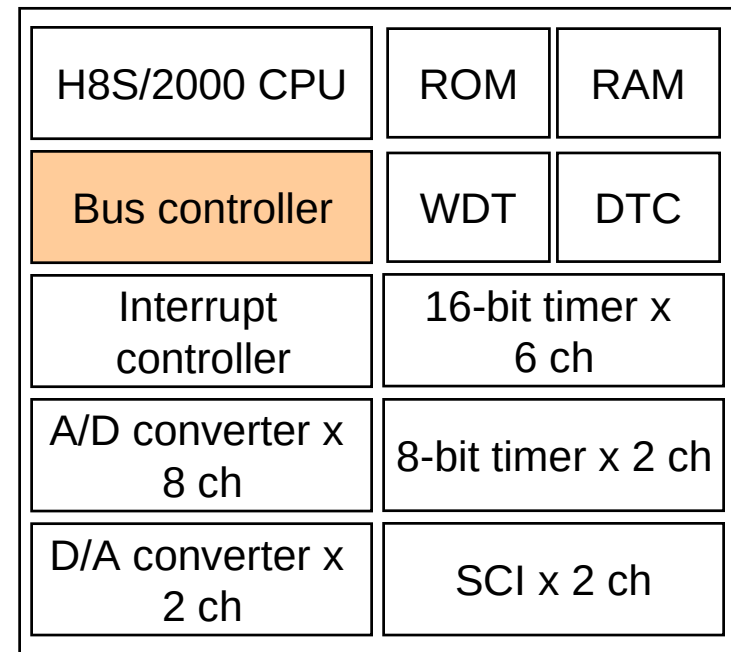
- Built-in flash memory -

Features

- Low-voltage high-speed operation
 - 3 V/20 MHz, 3.3 V/25 MHz
 - Min. instruction execution time: 50 ns/40 ns
- Abundant lineup
 - 512 KB/16 KB H8S/2319CF
 - 512 KB/8 KB H8S/2319F^{*1}, 2319EF^{*1}, 2319
 - 384 KB/8 KB H8S/2315F^{*1}, 2315
 - 384 KB/4 KB H8S/2314F^{*1}, 2314
 - 256 KB/8 KB H8S/2318F^{*1, *2}, 2318^{*3}
 - 128 KB/8 KB H8S/2317F^{*1, *2}, 2317S^{*2, *3}
 - 64 KB/8 KB H8S/2316^{*3}
 - -/8 KB H8S/2312S
- Support for on-chip debugging function (E10A)
 - H8S/2319EF
- Packages
 - TQFP-100B, QFP-100A
 - TQFP-100G^{*3}, TLP-113V^{*4}

New package

Block diagram



 DRAM I/F deleted

*1. F-ZTAT™ version is 25 MHz/3.3 V.

*2. TQFP-100G is for H8S/2318F, H8S/2317S, and H8S/2317F only.

*3. TLP-113V is for H8S/2319CF, H8S/2316, and H8S/2317S only.

H8S/2398 Group Overview

- Supports 0.35- μ m 5-V V_{CC} -

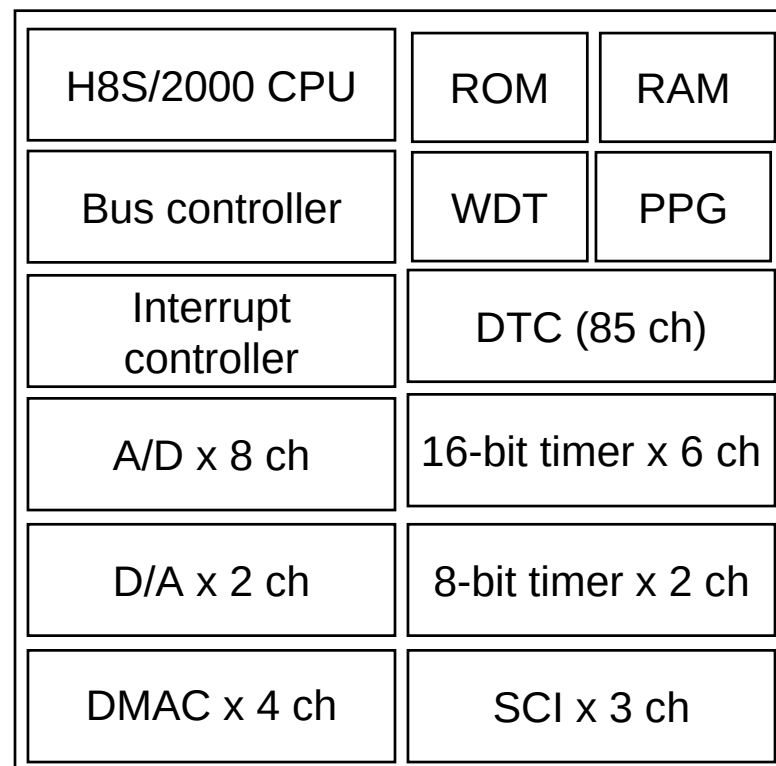
Features

- Pins*, functions, and performance are compatible with H8S/235x Group
 - 5 V/20 MHz operation
 - Minimum instruction execution time: 50 ns
- Various lineup
 - 256 KB/8 KB H8S/2398F, 2398
 - -/32 KB H8S/2394
 - -/8 KB H8S/2392
 - -/4 KB H8S/2390
- Packages
 - QFP-128 and TQFP-120

Most emulators for H8S/235x can be used

*: With internal step-down voltage pin V_{CL}

Block Diagram



H8S/2378 Group Overview

- F-ZTAT™ Version with enhanced serial communications function and analog functions -

Features

- Low-voltage high-speed operation
 - 3.0 V to 3.6 V/33 MHz*1
 - Minimum instruction execution time: 30 ns
- Enhanced serial communications function and analog functions
 - SCI x 5 ch (I²C x 2 ch optional)
 - A/D x 16 ch, D/A x 6 ch
- Built-in SDRAM interface
 - H8S/2378RF, 2377RF, 2375R, 2373R
- Supports on-chip debugging function (E10A)
 - H8S/2378BF, 2378RF, 2377F, 2377RF,
- Lineup
 - 512 KB/32 KB: H8S/2378BF, 2378RF
 - 384 KB/24 KB: H8S/2377F, 2377RF
 - 384 KB/30 KB: H8S/2376F*2
 - 256 KB/16 KB: H8S/2375, 2375R
 - 16 KB: H8S/2373, 2373R
- Multiple-pin package
 - LQFP-144
 - LGA-145*3(H8S/2378BF)

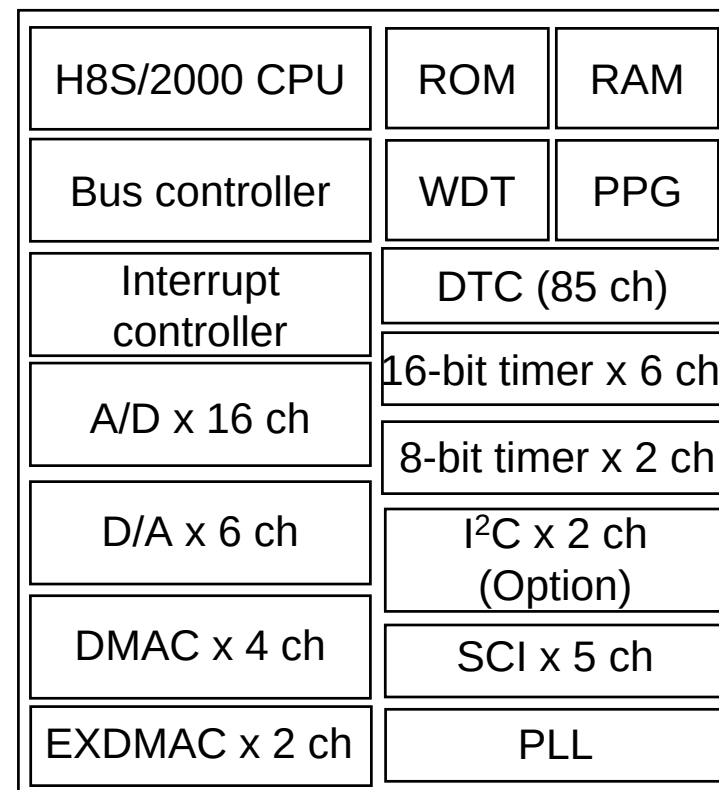
*1: H8S/2378BF is 35 MHz operation

*2: Reduced peripheral functions *3: Under Development

Note: Not pin-compatible with the H8S/2338 and 2678 Group

H8S/2378BF and 2378RF have V_{CL} pin.

Block Diagram



H8S/2376F: No EXDMAC, no DMAC, no PPG, no DRAM I/F, D/A x 4 ch

H8S/2375, 2373 and 2373R : No EXDMAC, D/A x 2 ch

H8S/2368 Group Overview

- F-ZTAT™ Version with enhanced serial communications function -

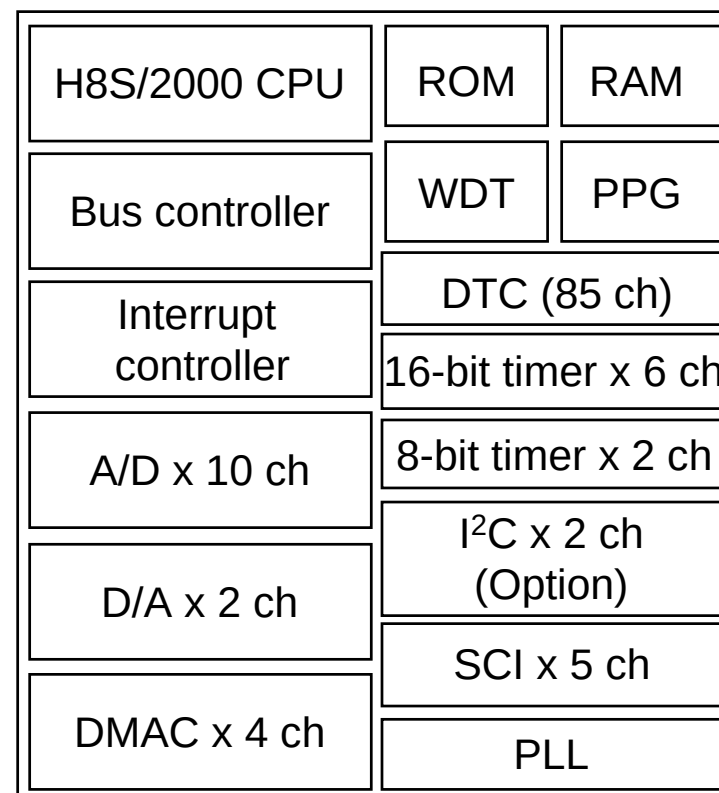
Features

- Low-voltage high-speed operation
 - 3.0 V to 3.6 V/33 MHz
 - Minimum instruction execution time: 30 ns
- Enhanced serial communications function
 - SCI x 5 ch (I²C x 2 ch optional)
- Supports on-chip debugging function (E10A)
 - H8S/2368F, H8S/2367F
- Lineup
 - 512 KB/32 KB: H8S/2368F
 - 384 KB/24 KB: H8S/2367F
 - 384 KB/30 KB: H8S/2366F*1
 - 256 KB/16 KB: H8S/2365
 - - /16 KB: H8S/2363
- Package
 - QFP-128, TFP-120

*1: Reduced peripheral functions

Note: Not pin compatible with the H8S/2329 and 2328 Group.
H8S/2368F has V_{CL} pin.

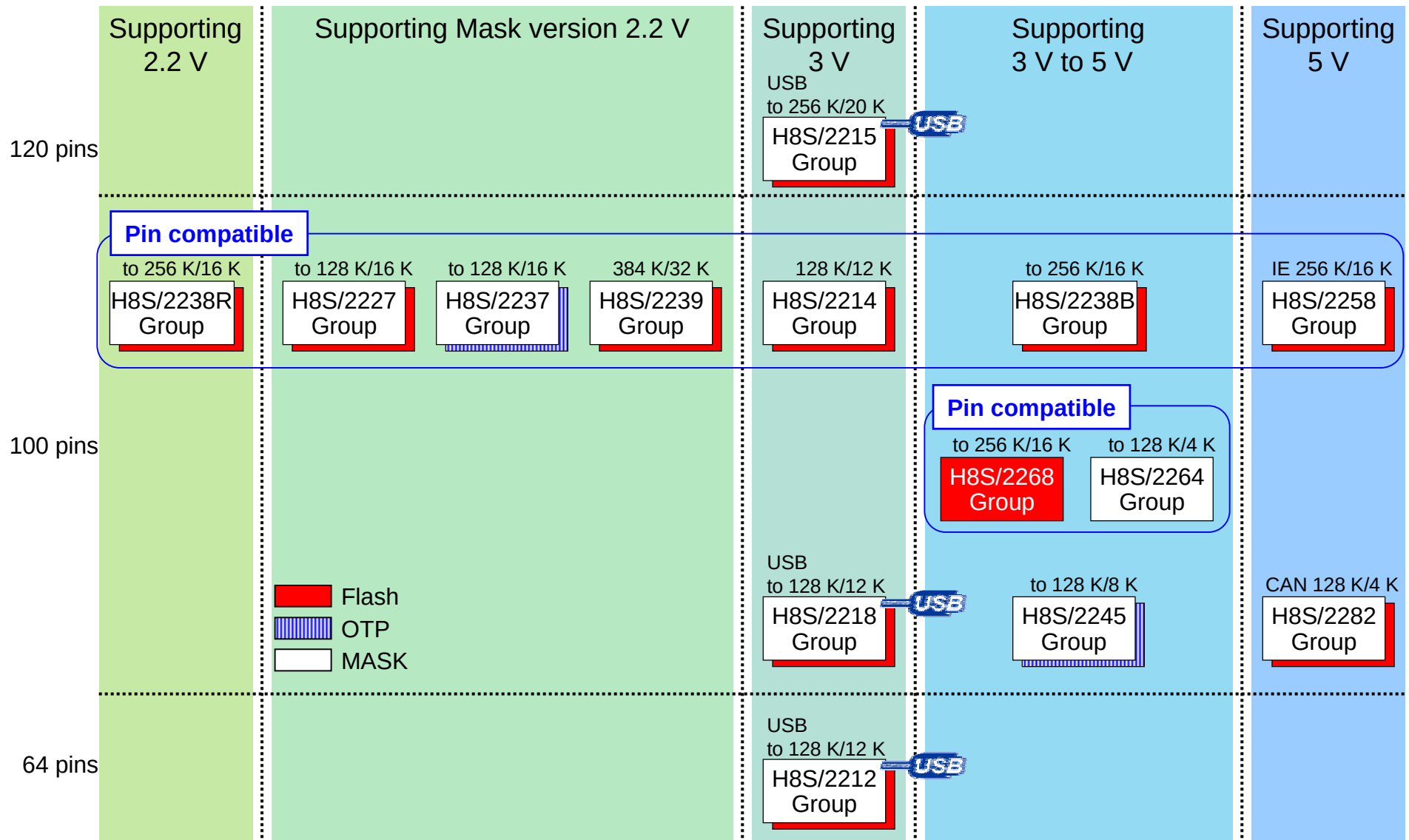
Block Diagram



H8S/2366F: No DMAC, no PPG, no DRAM I/F

H8S/2200 Series

H8S/2200 Series Roadmap

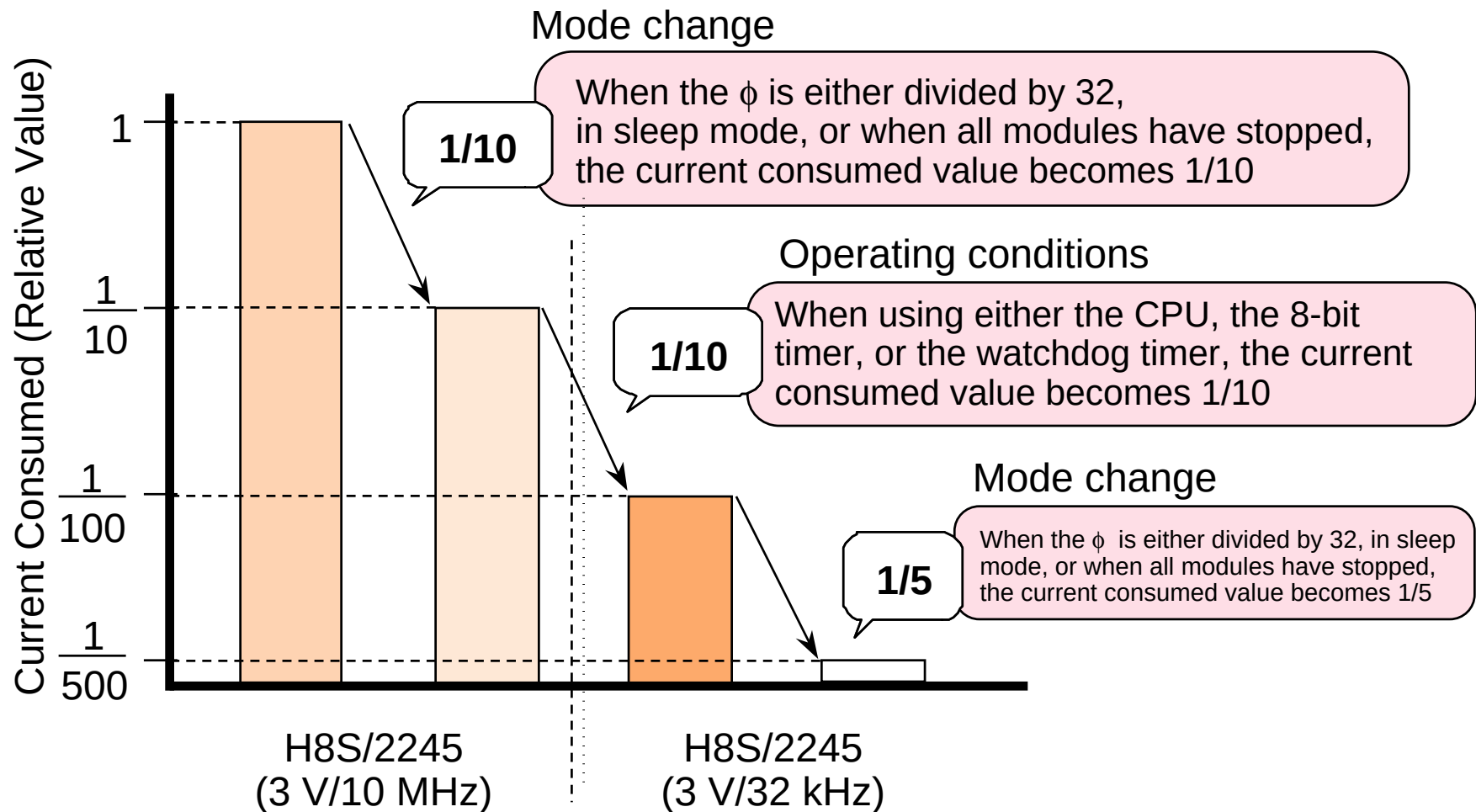


Features of the H8S/2200 Series

- Lower power consumption
 - Lineup of subclock incorporated products
 - Various low-power modes
 - Lineup of low-voltage (2.2-V) operation products
- Enhanced telecommunications functions
 - Lineup of 4-ch SCI products
 - Lineup of 2-ch I²C-bus products
 - Lineup of high-speed SCI incorporated products
 - Lineup of 1-ch USB (Ver2.0 Full speed) products
 - Lineup of BGA package products
- Wide memory variations
 - ROM: 384 KB to ROMless
 - RAM: 4 KB to 32 KB

H8S/2200 Low-Power Dissipation Mode

Current Dissipation Comparison (typ.)

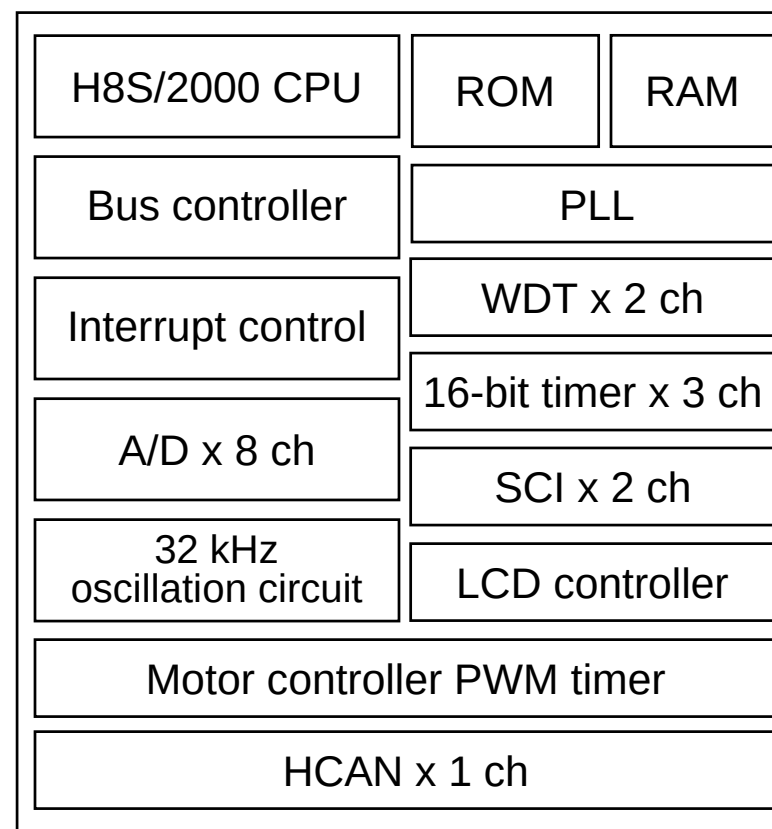


H8S/2282 Group Overview

Features

- High-performance H8S/2000 CPU
 - High-speed operation: Basic instructions executed in one state
 - Minimum instruction execution time: 50 ns (20 MHz)
- HCAN x 1 ch included
- Powerful timer
 - TPU (16-bit timer pulse unit) x 3 ch
- Motor control PWM timer:
 - 16 ch output available
- Built in LCD controller: 28 seg x 4 com
- SCI x 2 ch included
- 10-bit A/D converter x 8 ch included
- Subclock operation (internal division)
- Built-in clock multiplication PLL
- Package
 - QFP-100 (14 mm x 20 mm, 0.65-mm pitch)

Block Diagram

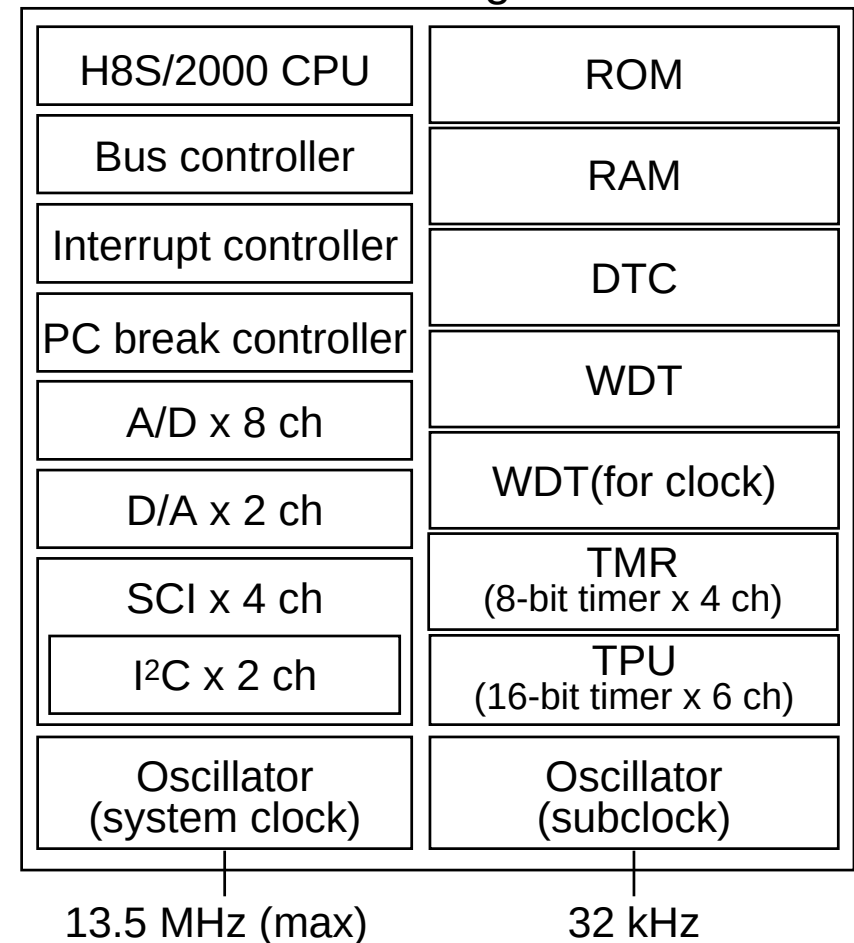


H8S/2238R Group Overview

Features

- H8S/2000 CPU
 - 13.5 MHz/2.7 to 3.6V
 - 6.25 MHz/2.2 to 3.6 V
- Built-in memory
 - 256KB/16 KB
(H8S/2238R: Flash, MASK)
 - 128KB/8KB
(H8S/2236R: MASK)
- Interface functions
 - SCI x 4 ch
 - I²C x 2 ch (MASK Optional)
- Package
 - PRQP0100KA-A (FP-100B)
 - PTQP0100KA-A (TFP-100B)
 - PTQP0100LC-A (TFP-100G)
 - PLBG0112GA-A (BP-112) Flash Only
 - TTBG0112GA-A (TBP-112A) Flash Only

Block Diagram



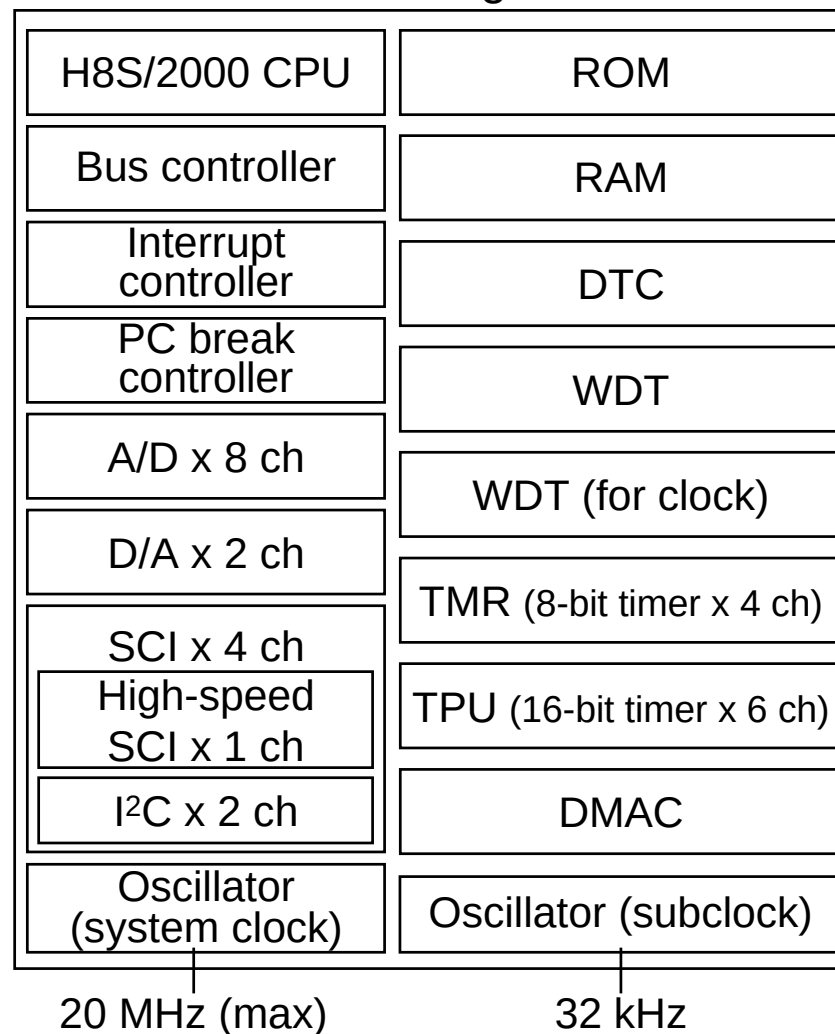
H8S/2239 Group Overview

Features

- H8S/2000 CPU
 - Flash: 20 MHz/3.0 to 3.6 V
16 MHz/2.7 to 3.6 V
 - MASK: 20 MHz/3.0 to 3.6 V
16 MHz/2.7 to 3.6 V
6.25 MHz/2.2 to 3.6 V
- Built-in memory
 - 384 KB/32 KB (Flash, MASK)
- Interface function
 - SCI x 4 ch
 - I²C x 2 ch (MASK Option)
 - High-speed UART x 1 ch
720 kbps/460 kbps/115 kbps at 16 MHz
- Package
(pin compatible with the H8S/2238R Group)
PRGP0100KA-A (FP-100B)
PTGP0100KA-A (TFP-100B)
PTQP0100LC-A (TFP-100G)
TTBG0112GA-A (TBP-112A) Flash only*

*: Under development

Block Diagram

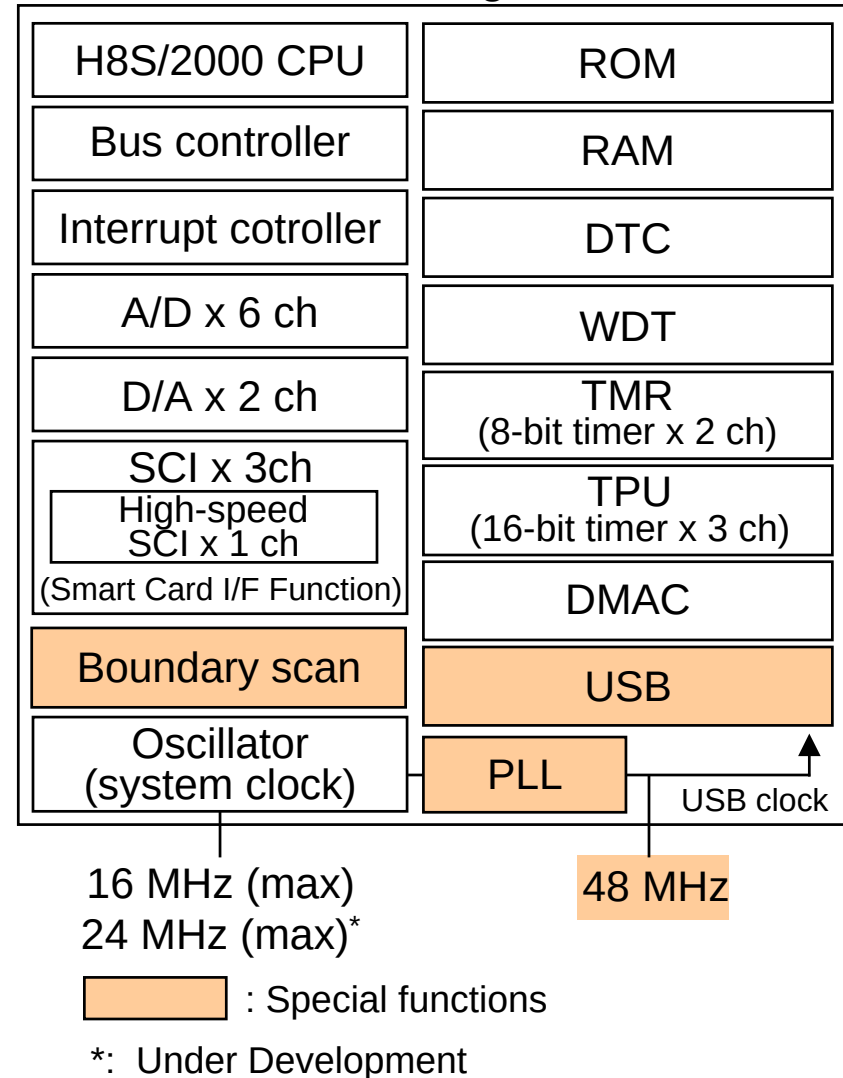


H8S/2215 Group Overview

Features

- H8S/2000 CPU:
 - Low-voltage high-speed operation
 - 24 MHz/3.0 V to 3.6 V (H8S/2215R*, 15T* Only)
 - 16 MHz/3.0 V to 3.6 V (H8S/2215T*, is not useal)
- Built-in memory
 - 256 KB/20 KB (H8S/2215R*, 15T*: Flash)
 - 256 KB/16 KB (H8S/2215: Flash)
 - 128 KB/16 KB (H8S/2215B: MASK)
 - 64 KB/8 KB (H8S/2215C: MASK)
- High-speed SCI
 - High-speed UART mode: 720 kbps/460 kbps/115 kbps at 16 MHz
- USB Ver2.0 Full speed function: 12 Mbps
 - Transfer mode: 4 modes (Control, interrupt, bulk, and isochronous)
 - Endpoints: 9 max
 - FIFO Total 1288 bytes
 - Max 256 bytes (Isochronous)
- On Chip Debugger (E10A) support (H8S/2215R*, 15T* only)
- Boundary scan function
 - Conforms to IEEE 1149.1
- For USB selahlock (H8S/2215T* only)
- Package
 - PTQP0120LA-A (TFP-120)
 - PLBP0112GA-A (BP-112)

Block Diagram

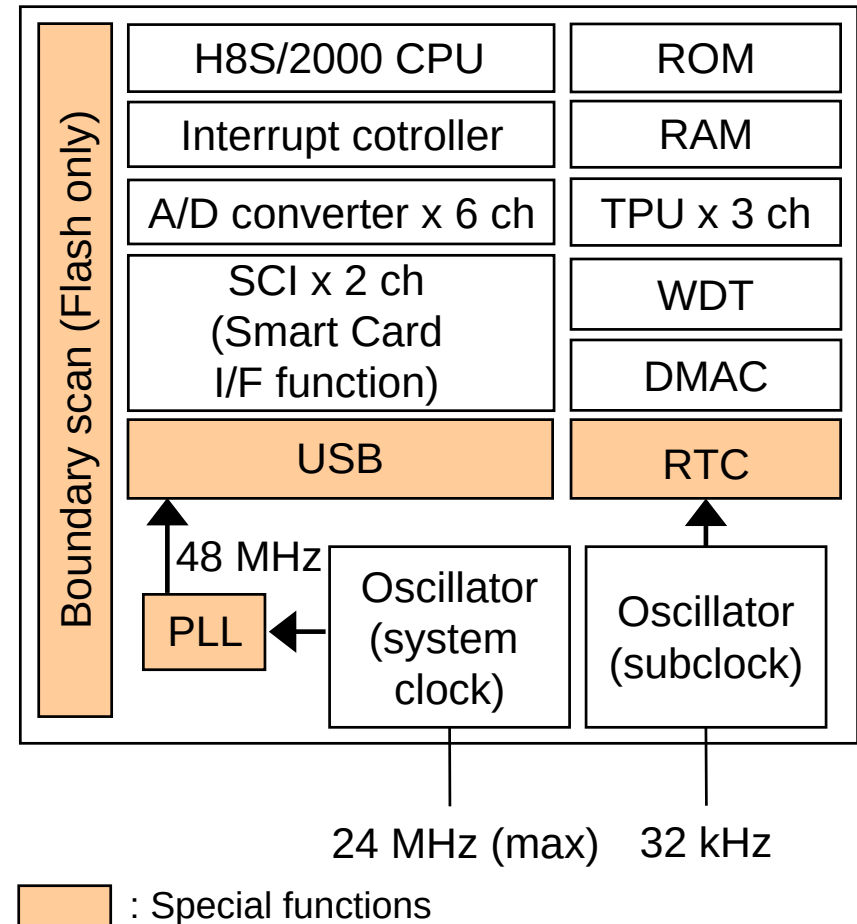


H8S/2218 Group Overview

Features

- H8S/2000 CPU
 - 24 MHz/3.0 V to 3.6 V
- Built-in memory
 - 128 KB/12 KB (H8S/2218: Flash)
 - 64 KB/8 KB (H8S/2217: MASK)
- USB Ver2.0 Full speed Function: 12 Mbps
 - Transfer mode: 3 modes
 - Endpoints: 4 points
(Control x 1, Bulk x 2, Interrupt x 1)
 - FIFO Total 456 bytes (MAX: 128 bytes)
- RTC (Real Time Clock)
- Boundary scan function (Flash only)
 - Conforms to IEEE 1149.1
- On Chip Debugger (E10A) support (Flash only)
- Package
 - PTQP0100LC-A (TFP-100G)
 - PLBG0112GA-A (BP-112)

Block Diagram

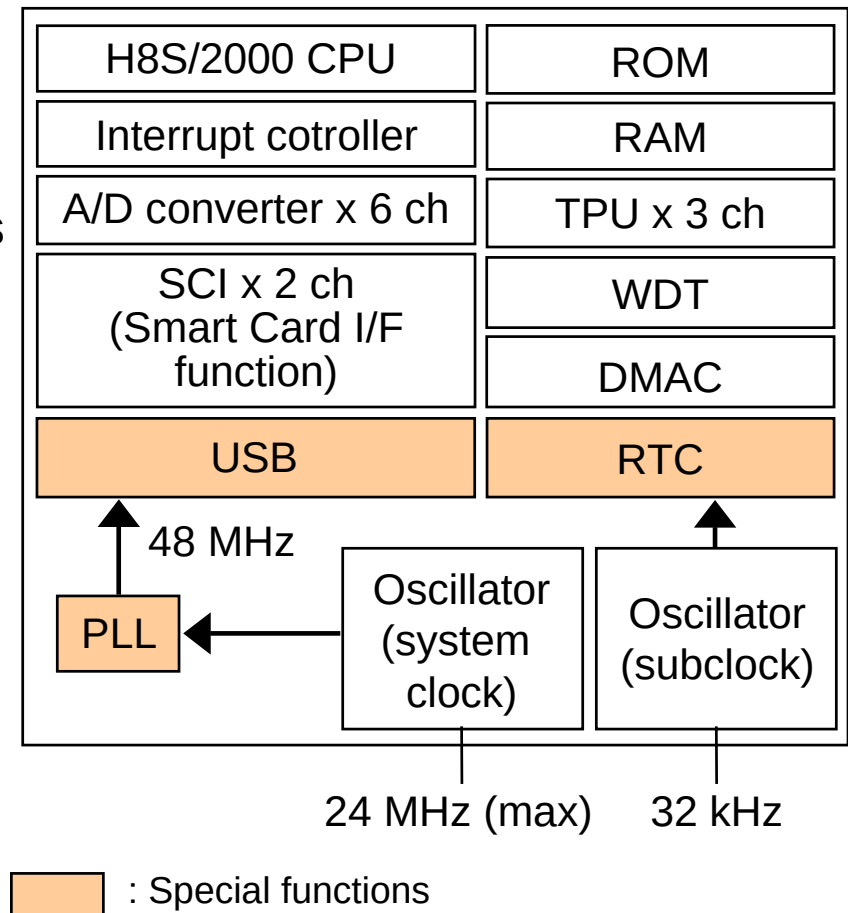


H8S/2212 Group Overview

Features

- H8S/2000CPU: Single Chip mode
 - 24 MHz/3.0 V to 3.6 V
- Built-in memory
 - 128 KB/12 KB (H8S/2212: Flash)
 - 64 KB/8 KB (H8S/2211: Flash, MASK)
 - 32 KB/4 KB (H8S/2210: MASK)
- USB Ver2.0 Full speed Function: 12 Mbps
 - Transfer mode: 3 modes
 - Endpoints: 4 points
(Control x 1, Bulk x 2, Interrupt x 1)
 - FIFO Total 456 bytes (MAX: 128 bytes)
- RTC (Real Time Clock)
- On Chip Debugger (E10A) support
(Flash only)
- Package
PLQP0064KC-A (FP-64E)

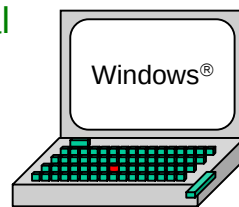
Block Diagram



Flash writing of the H8S/2215, 2218, and 2212

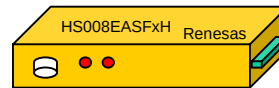
- Supports USB boot.
- On-board programming to internal flash memory is possible via USB interface.
 - H8S/2215UF, H8S/2215RUF*, H8S/2215TUF*
 - H8S/2218UF
 - H8S/2212UF

Conventional

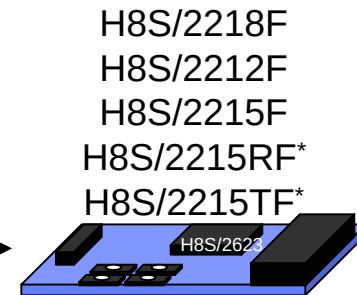


PC

RS-232C

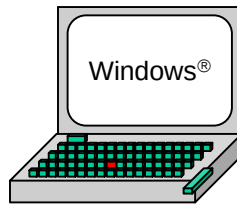


Adapter board or external circuit



User system

New



PC

USB

Max: 12 Mbps



User system

Write enabled by
directly connecting to PC

*: Under development

H8S/2100 Series

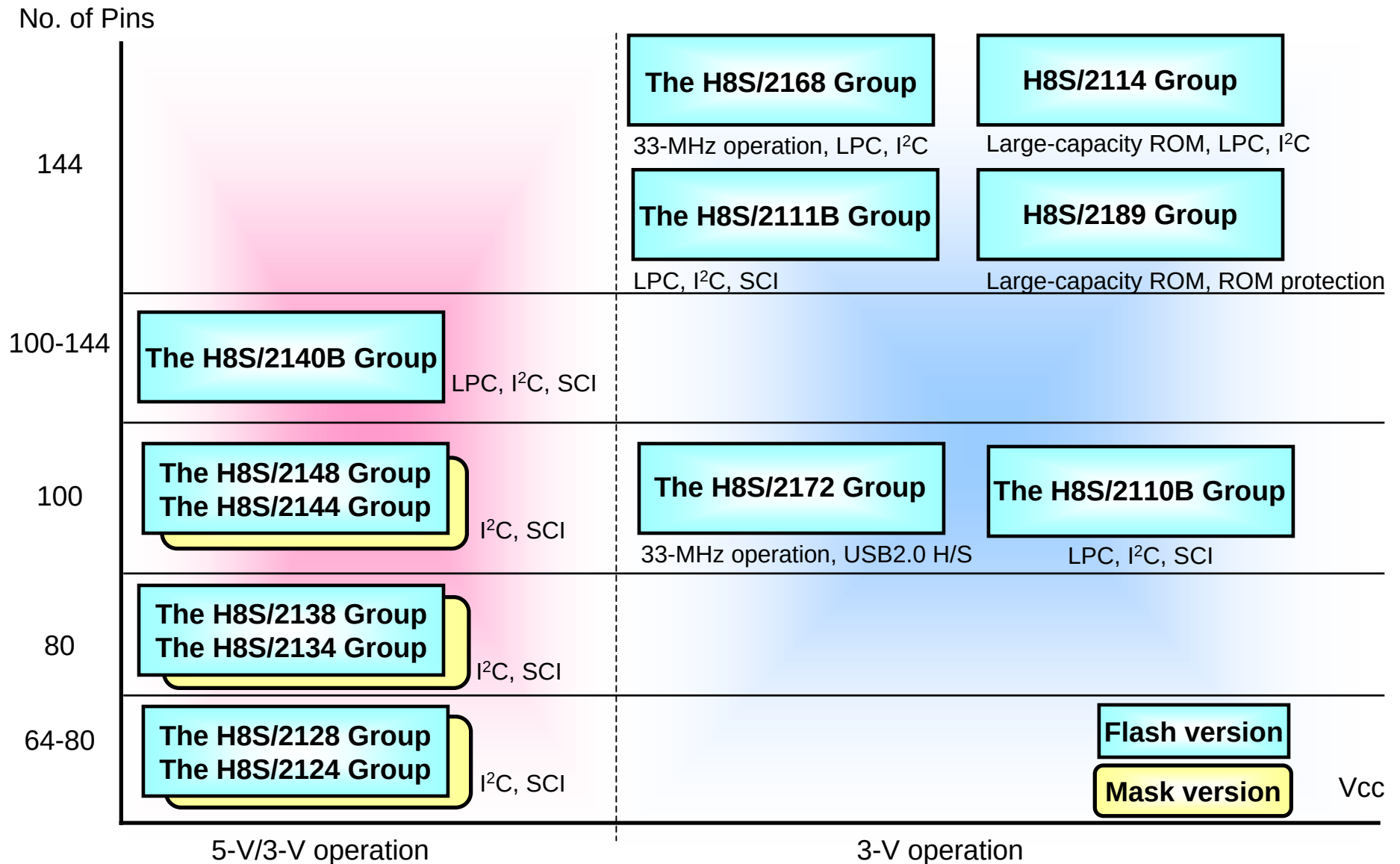
Features of the H8S/2100 Series

- Ample memory types:
 - ROM: 1 MB, 512 KB, 384 KB, 256 KB, 128 KB, 64 KB, 32 KB
 - RAM: 40 KB, 32 KB, 10 KB, 8 KB, 6 KB, 4 KB, 2 KB
- Lineup of low-voltage high-speed operation products
 - Minimum instruction execution time: 30 ns (3 V/33 MHz operation)
- Built-in interface with standardized PC peripherals
 - I²C bus, keyboard buffer controller, ISA bus interface, and LPC interface
- Power-down mode
 - Sleep mode
 - Standby mode (hardware and software)
 - Active (medium speed) mode ($\phi/2$, $\phi/4$, $\phi/8$, $\phi/16$, and $\phi/32$)
 - Subclock mode (external 32 kHz clock)
 - Module stop mode
- Built-in H8S/300 Series peripheral functions
 - Facilities to support conversion to the 16-bit chip

Features of the H8S/2168 Group

- Specifications that are suitable for the system monitoring controller of PC/UNIX servers
- Optimal for network-related applications such as servers and routers
- Optimal for systems that require LPC interface
- Optimal for systems that require a large number of general I/O ports
- For designing larger systems than with the current H8S Family
 - Built-in 40KB RAM reduces the program load
 - 33-MHz operation enables the design of faster systems
- Facilitates communication with the external devices using multi-channel I²C bus interface
 - Communication speed is selectable for each channel

Product Lineup of the H8S/2100 Series

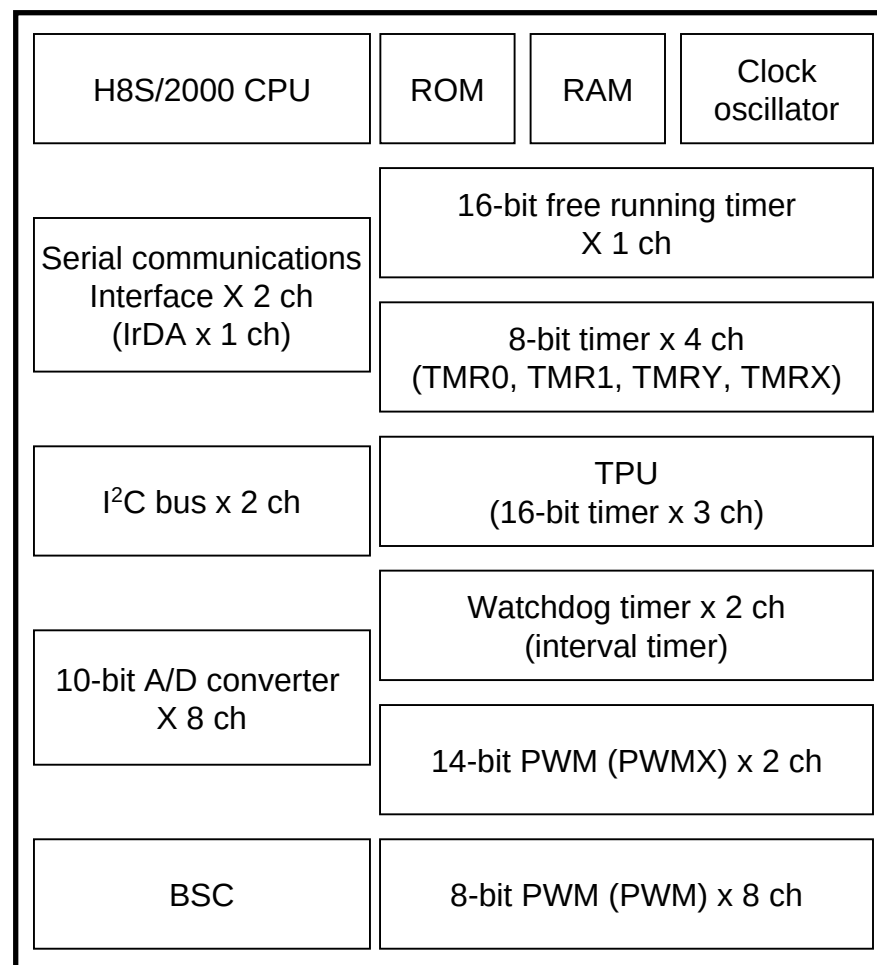


Overview of the H8S/2189 Group

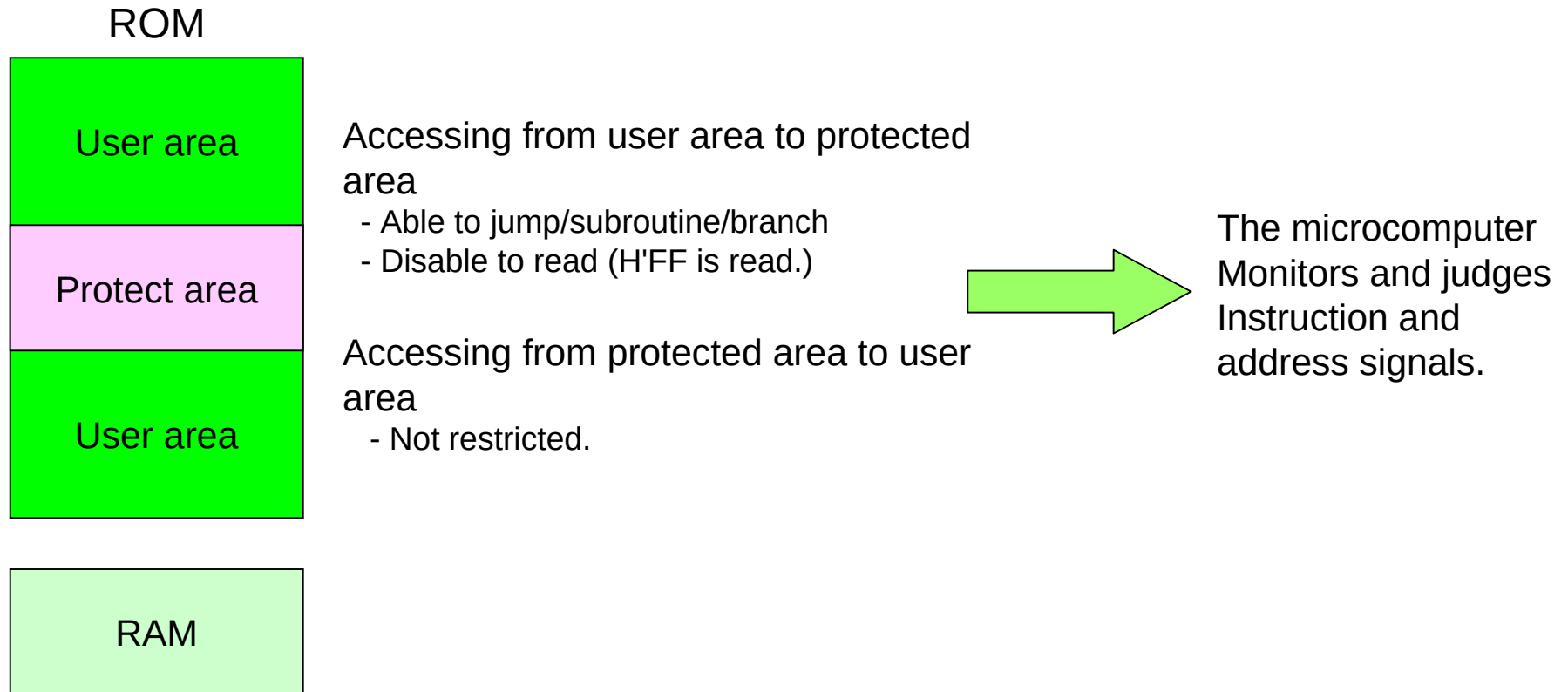
Specifications Overview

- H8S/2000 CPU
 - Low-voltage high-speed operation: 3 V/20 MHz
 - Basic instructions executed in one state
- ROM protection function (64 KB)
- Large capacity on-chip ROM/RAM
 - 1 MB/6 KB
- Improved timer
 - TPU (16-bit timer x 3 ch)
- Support for on-chip debugging function (E10A)
- I/O port (input/output)
 - 106 pins
- Support for low-power consumption modes
- Multi-pin package
 - PTQP0144LC-A (TFP-144)

Block Diagram



ROM protection

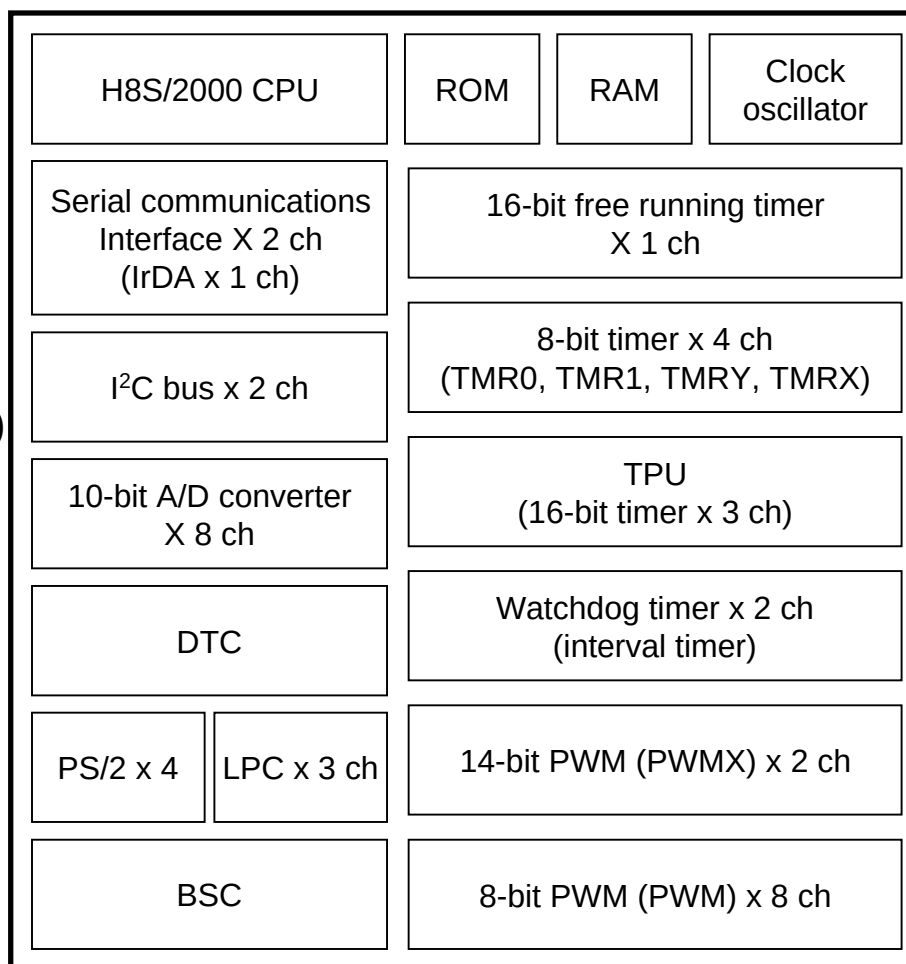


Overview of the H8S/2114 Group

Specifications Overview

- H8S/2000 CPU
 - Low-voltage high-speed operation: 3 V/20 MHz
 - Basic instructions executed in one state
- Large capacity on-chip ROM/RAM
 - 1 MB/8 KB
- Improved timer
 - TPU (16-bit timer x 3 ch)
- Support for on-chip debugging function (E10A)
- I/O port (input/output)
 - 106 pins
- Support for low-power consumption modes
- Multi-pin package
 - PTQP0144LC-A (TFP-144)

Block Diagram

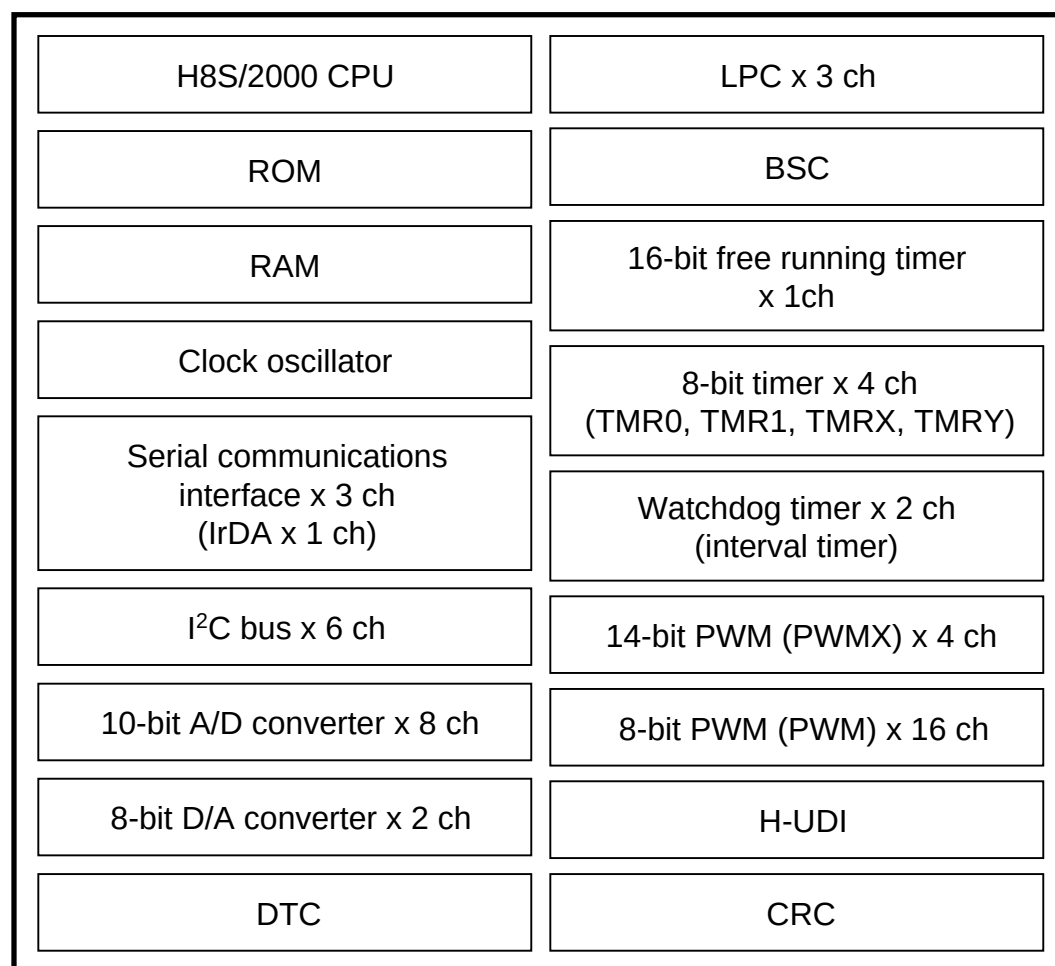


Overview of the H8S/2168 Group

Specifications Overview

- H8S/2000 CPU
 - High-speed operation:
3.0 to 3.3 V/33 MHz
 - Basic instructions executed in one state
- ROM/RAM
 - 512 KB/40 KB (H8S/2166)
 - 384 KB/40 KB (H8S/2167)
 - 256 KB/40 KB (H8S/2168)
- I/O port (input/output)
 - 115 pins
- Support for low-power consumption modes
- Package
 - PTQP0144LC-A (TFP-144)

Block Diagram of H8S/2168, 67 and 66

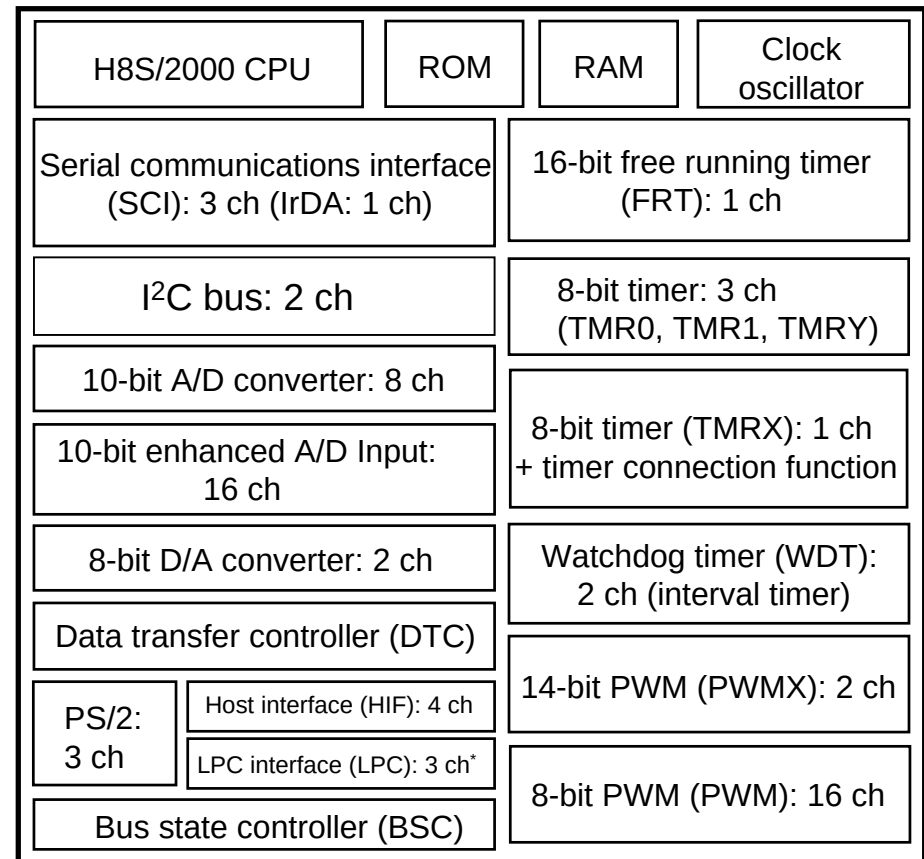


Overview of the H8S/2140B Group

Outline of specification

- H8S/2000 CPU
 - High speed operation:
5 V/20 MHz and 3 V/10 MHz
 - Basic instruction in one state
- ROM/RAM
 - 256 KB/8 KB (H8S/2145B)
 - 128 KB/4 KB (H8S/2141B, 48B, and 61B)
 - 64 KB/4 KB (H8S/2140B and 60B)
- I/O port (input/output)
 - 74 channels (H8/2140, 41, 45, and 48)
 - 114 channels (H8/2160 and 61)
- Support for the low-power consumption modes
- Package
 - PRQP0100KA-A (FP-100B),
PTQP0100KA-A (TFP-100B)
: H8/2140, 41, 45, and 48
 - PTQP0144LC-A (TFP-144)
: H8/2160 and 61

Block Diagram of the H8/2140, 41, 45, 48, 60, and 61



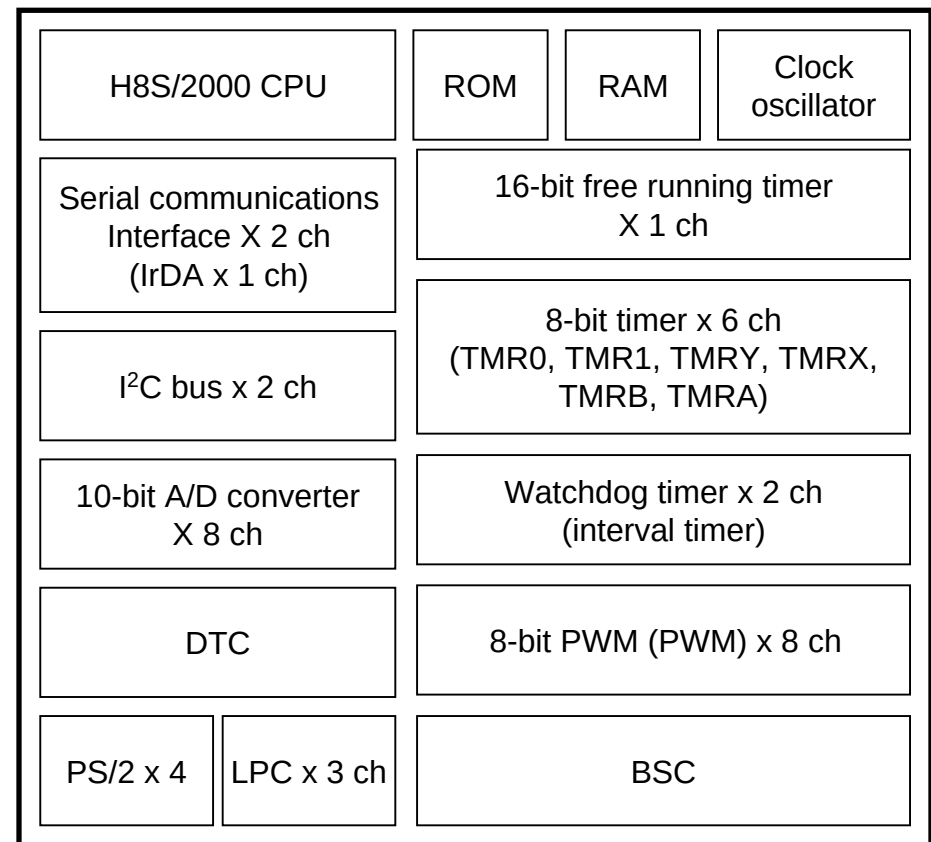
*: LPC is not incorporated in the H8S/2145B (5-V version) and H8S/2148B (5-V and 3-V versions).

Overview of the H8S/2111B Group

Specifications Overview

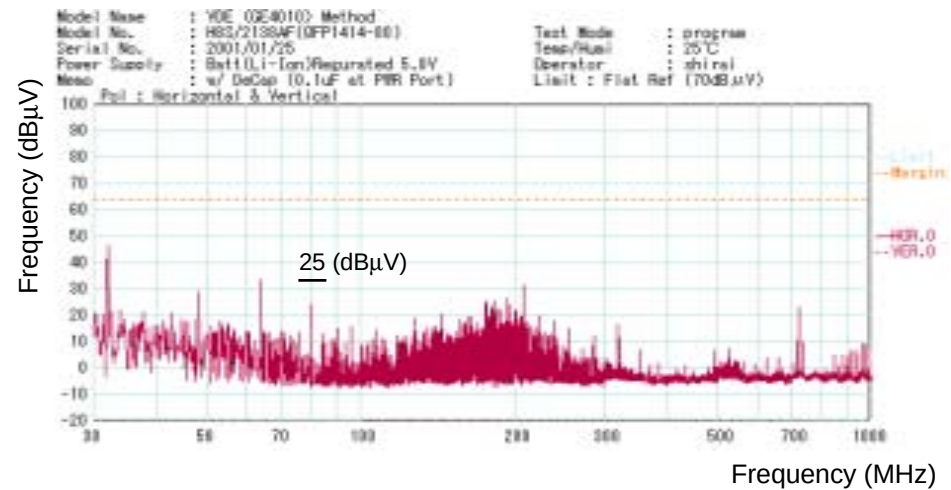
- H8S/2000 CPU
 - 3-V/10-MHz operation
 - Basic instructions executed in one state
- ROM/RAM
 - 64 KB/2 KB (H8S/2111BVB)
 - 64 KB/3 KB (H8S/2111BVC)
- Improved timer
 - 8-bit timer x 6 ch
- I/O port (input/output)
 - 122 pins
- Support for low-power consumption modes
- Multi-pin package
PTQP0144LC-A (TFP-144)

Block Diagram

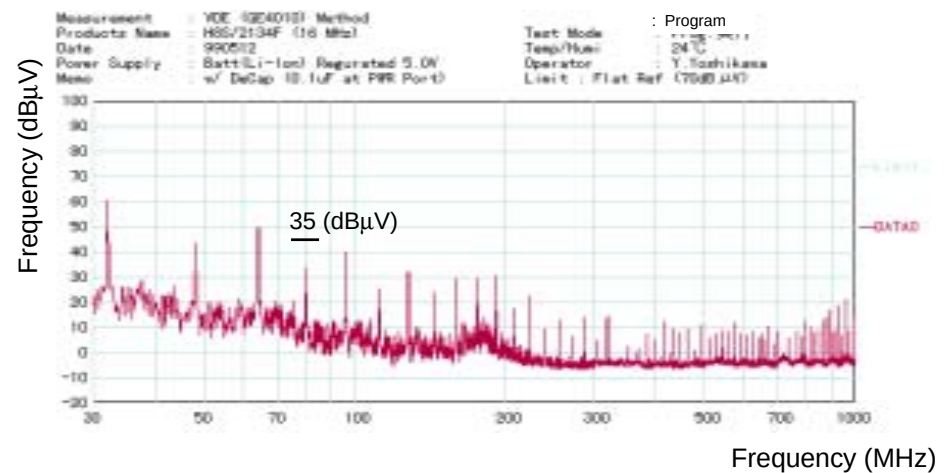


EMI Noise Comparison between 0.35- μm and 0.5- μm Products

- H8S/2138AF (0.35 μm)
16-MHz operation with bypass capacitor
Program operation with internal step-down circuit



- H8S/2134AF (0.5 μm)
16-MHz operation with bypass capacitor
Program operation without internal step-down circuit



H8S Family System Application

Configuration Example of Dashboard System

Features

- High-performance CPU: 20-MHz operation
- Lineup of flash memory: 128 KB to 384 KB
- On-chip driver which can directly drive 5-V stepper motors
- On-chip sub-clock to support low power consumption

The H8S/264x and H8S/228x groups

- Internal LCD: 24 segments × 4 COMs to
40 segments × 4 COMs
- Various I/O: 144-pin package
- CAN: 1 to 2 ch

The H8S/263x group

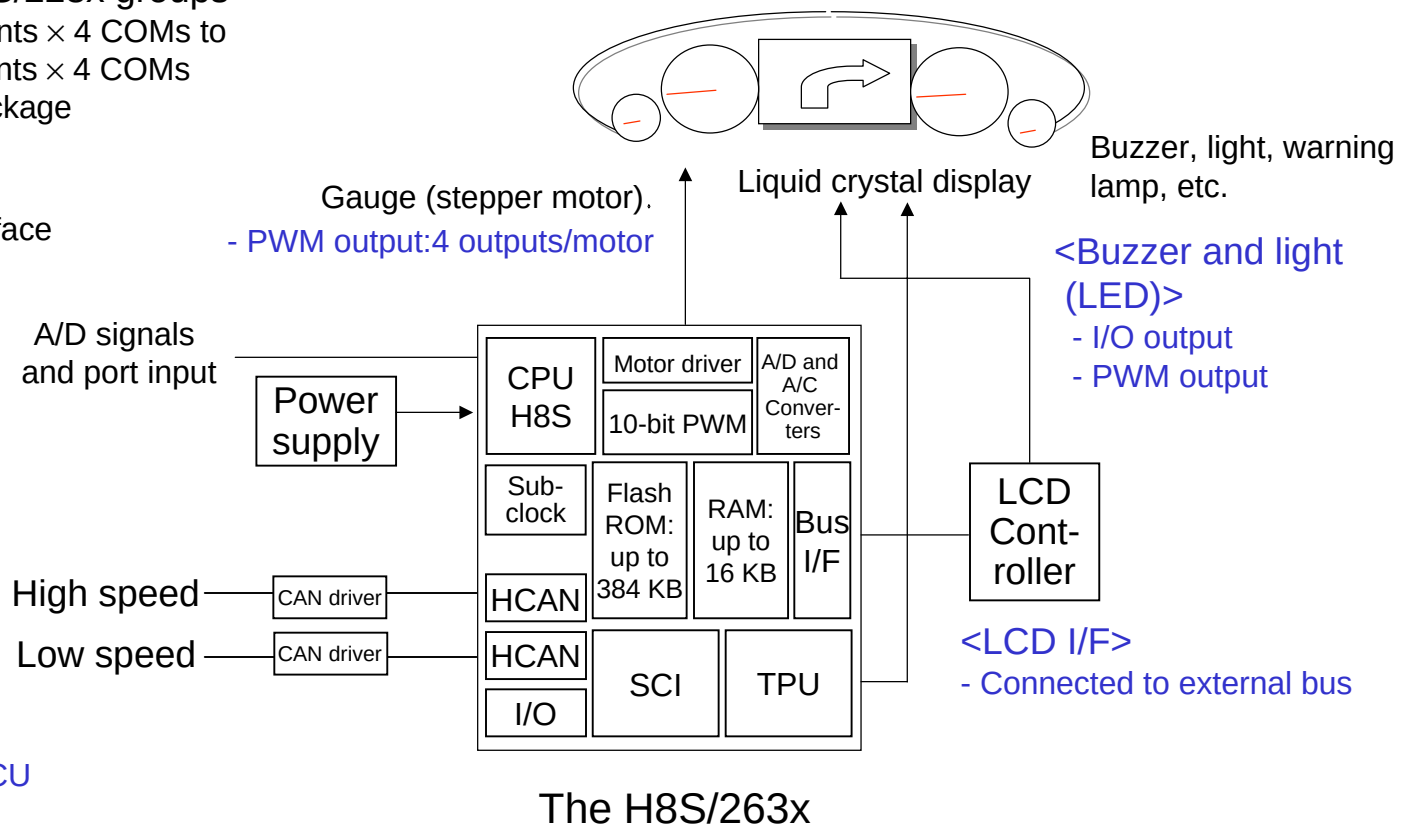
- 16-bit external bus interface
- CAN: 2 ch

<A/D signals and port input data>

- Remaining fuel
- Various SW signals

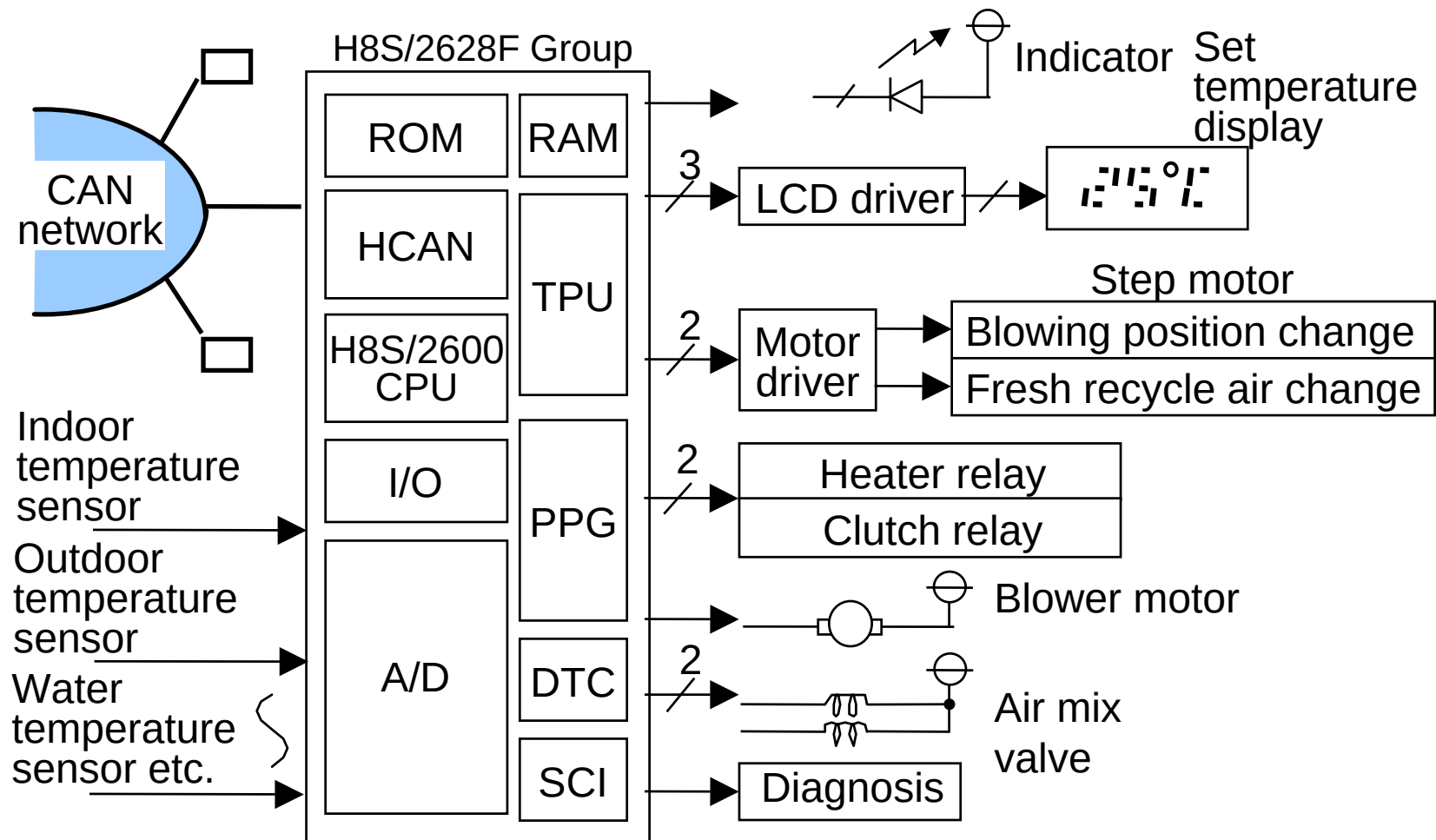
<Data through CAN>

- Number of engine rotation
- Water temperature
- Speed of automobile
- Status signal of each ECU (emission control unit)
- Audio/navigation data



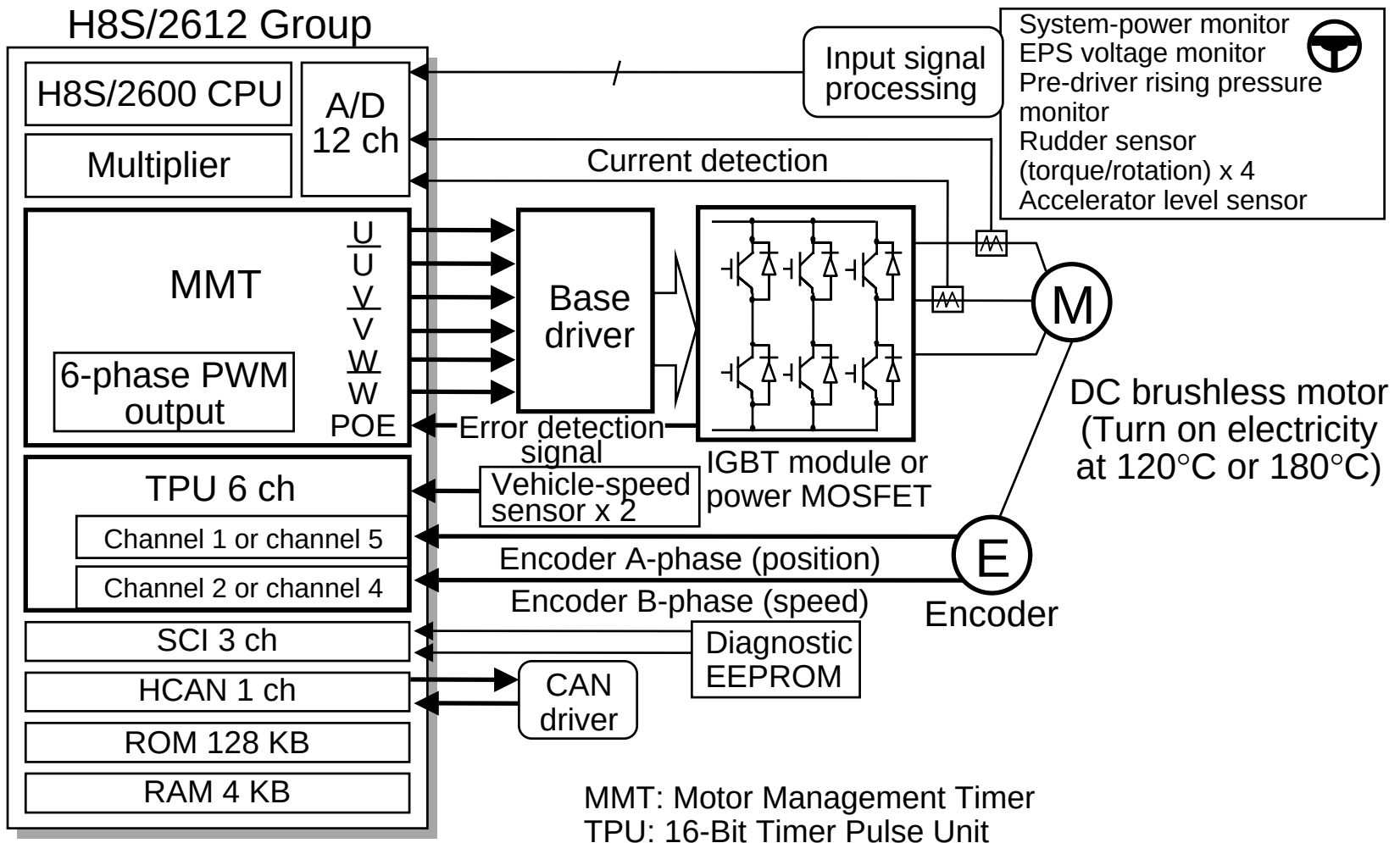
Configuration Example of Automotive Air Conditioner

- H8S/2628F -



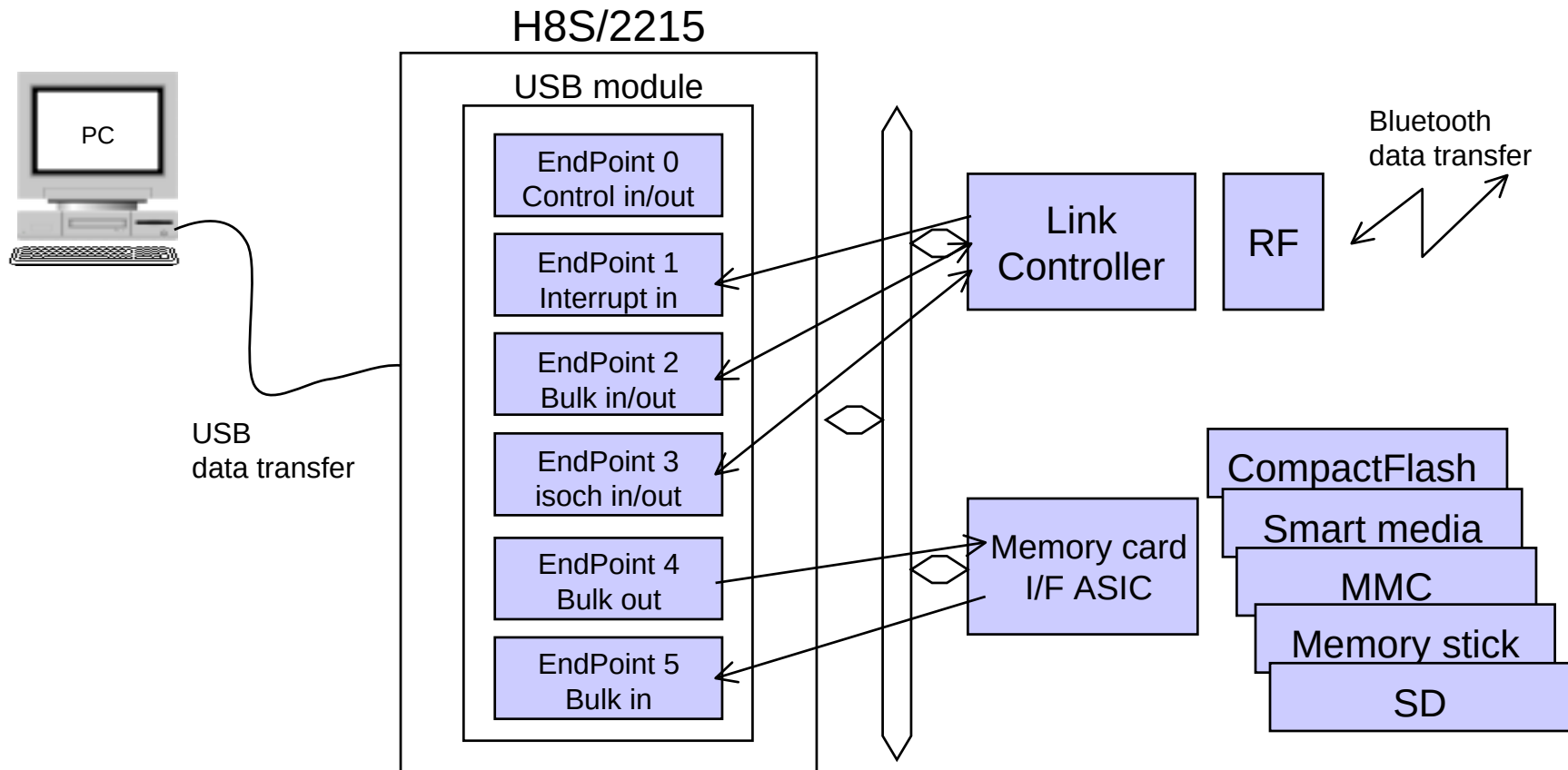
Configuration Example of EPS System

- H8S/2612 -



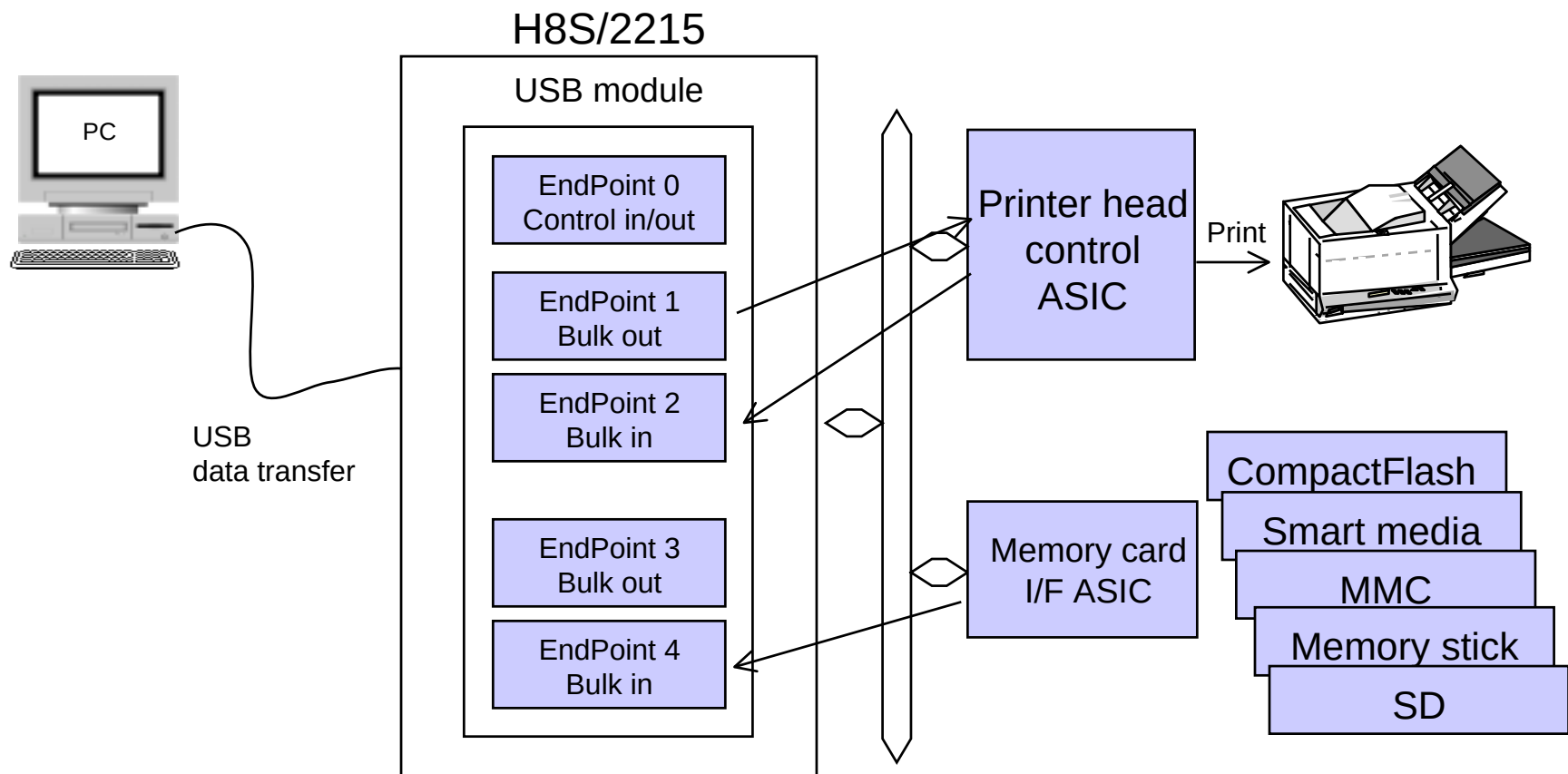
Configuration Example of Bluetooth Device with Storage Function

- H8S/2215 -



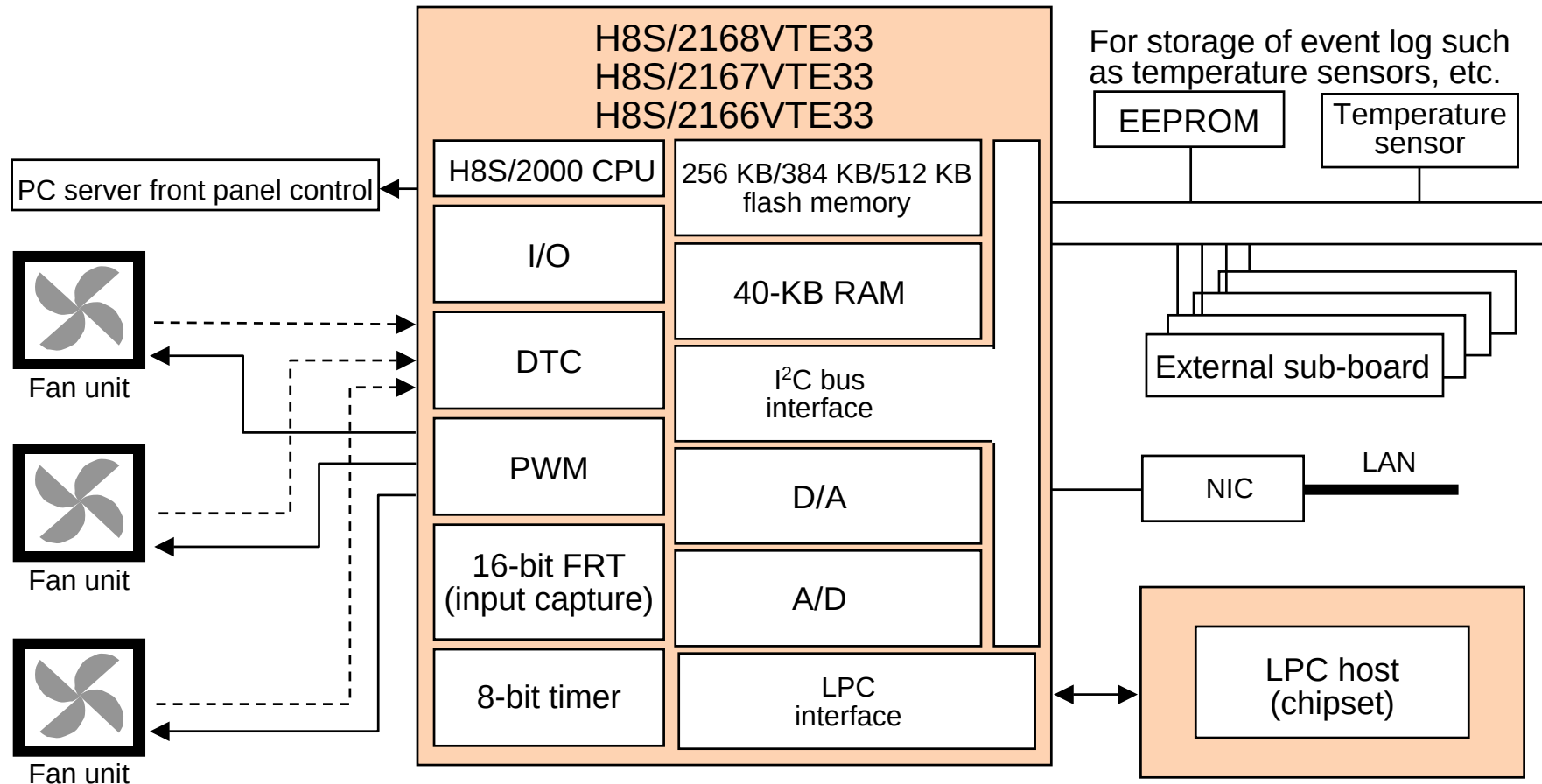
Configuration Example of Printer with Storage Function

- H8S/2215 -



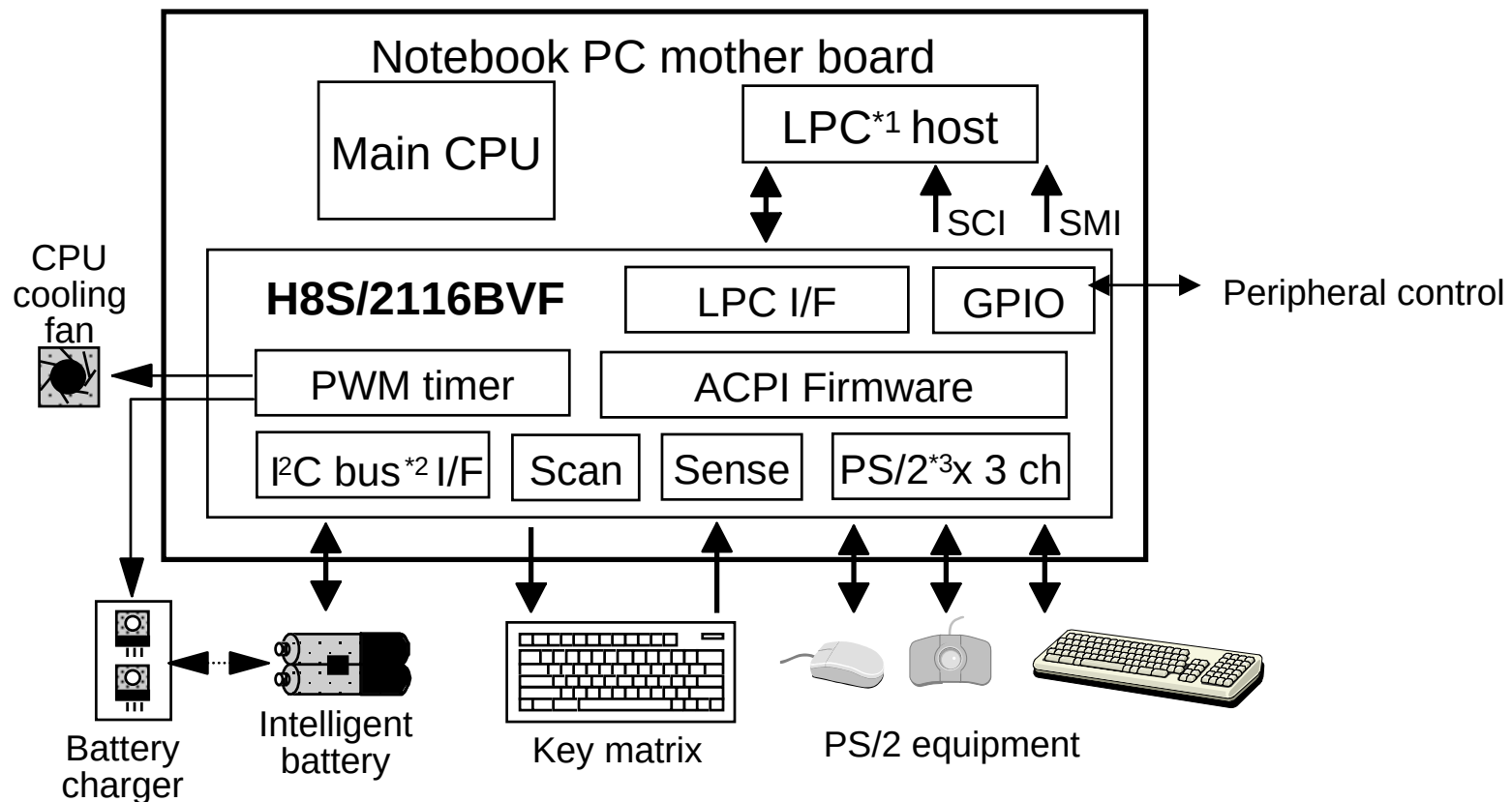
Configuration Example of PC Server System Management Controller

- H8S/2168F, H8S/2167F and H8S/2166F -



Configuration Example of Notebook PC Battery Control System

- H8S/2116BVF -



*1: Low Pin Count: A new internal bus for PC proposed by Intel Corporation.

*2: I2C bus is a trademark of Philips Electronics.

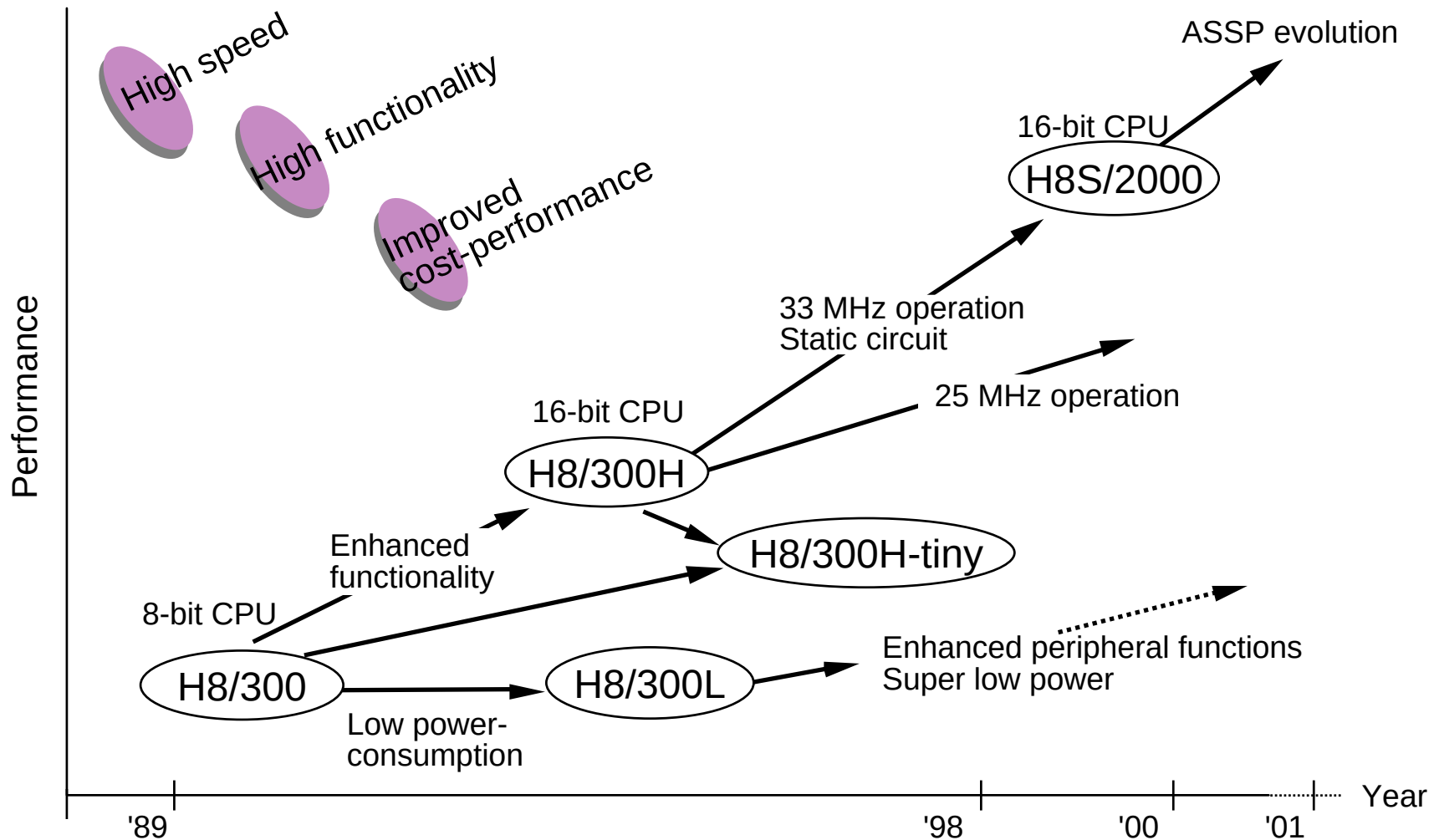
*3: PS/2 is a trademark of IBM Corporation.

Microcomputer General Presentation

H8 Family

October 28, 2005
Rev.2.00
Standard Product Business Group
Renesas Technology Corp

H8 Family CPU Evolution



H8/300H Series

Features of the H8/300H Series

- The 16-bit CPU for the efficient processing of a large amount of data
 - Maximum operating frequency: 25 MHz
 - Minimum instruction execution time: 80 ns
 - 16-Mbyte linear address space
 - Sixteen 16-bit general registers
- Optimized instruction systems which are upward-compatible with the H8/300
 - 8-/16-/32-bit transfer and arithmetic instructions: 32 ±32 (80 ns)
 - Signed multiply and divide instructions:
16 bits x 16 bits (0.96 μs) and 32 bits/16 bits (0.96 μs)
- Lineup of the 5-V/3-V single power-supply on-chip flash memory products
- Supported by the on-chip emulator (E10T):
H8/3048F-ONE and H8/3029F

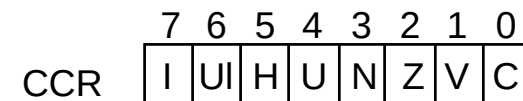
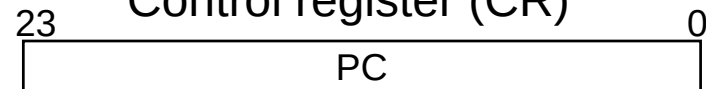
H8/300H Series CPU

Register Configuration

General register (Rn)/Extended register (En)

	15	07	07	0
	E0	R0H	R0L	
	E1	R1H	R1L	
	E2	R2H	R2L	
	E3	R3H	R3L	
	E4	R4H	R4L	
	E5	R5H	R5L	
	E6	R6H	R6L	
SP	E7	R7H	R7L	
	31	15		0

Control register (CR)



SP : Stack pointer

PC : Program counter

CCR : Condition code register

I : Interrupt mask bit

UI : User bit/Interrupt mask bit

H : Half carry bit

N : Negative flag

Z : Zero flag

V : Overflow flag

C : Carry flag

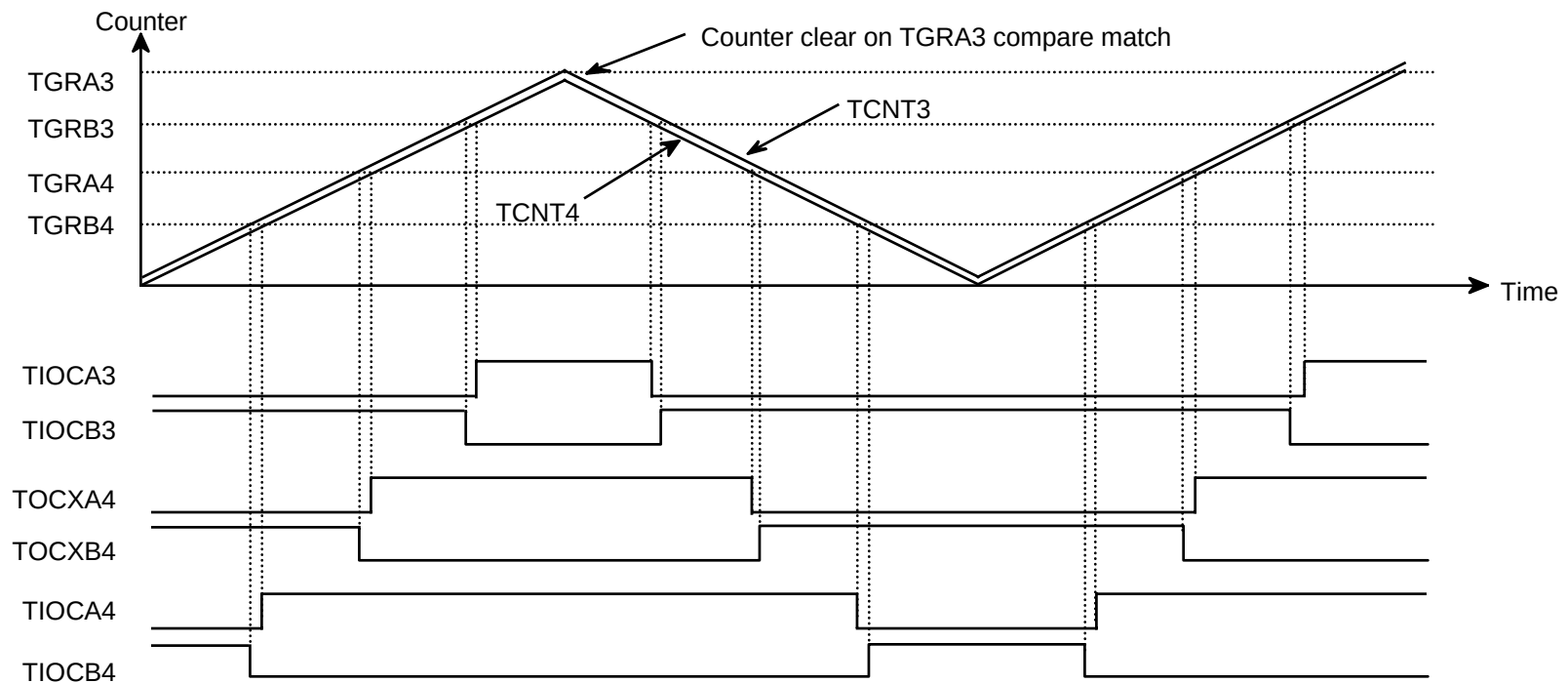
Features of the 1st and 2nd Generations

	First generation	Second generation
Operating frequency	16, 25 MHz/5 V 10, 13, 25 MHz/3 V	25 MHz/5 V 25 MHz/3 V
ROM variation	MASK/ZTAT/Flash memory products	MASK/Flash memory products
On-chip flash memory product specifications	Dual (H8/3048F)/ single power supply (H8/3039F) (H8/3048F-ONE)	Single power supply
Timer specifications	ITU x 5 ch Specific function for motor control	16 bits x 3 ch, 8 bits x 4 ch, general-purpose timer
Bus controller	DRAM interface possible, bus width and number of states can be set by each area	Functions added

ITU

- 16-bit Integrated Timer Pulse Unit -

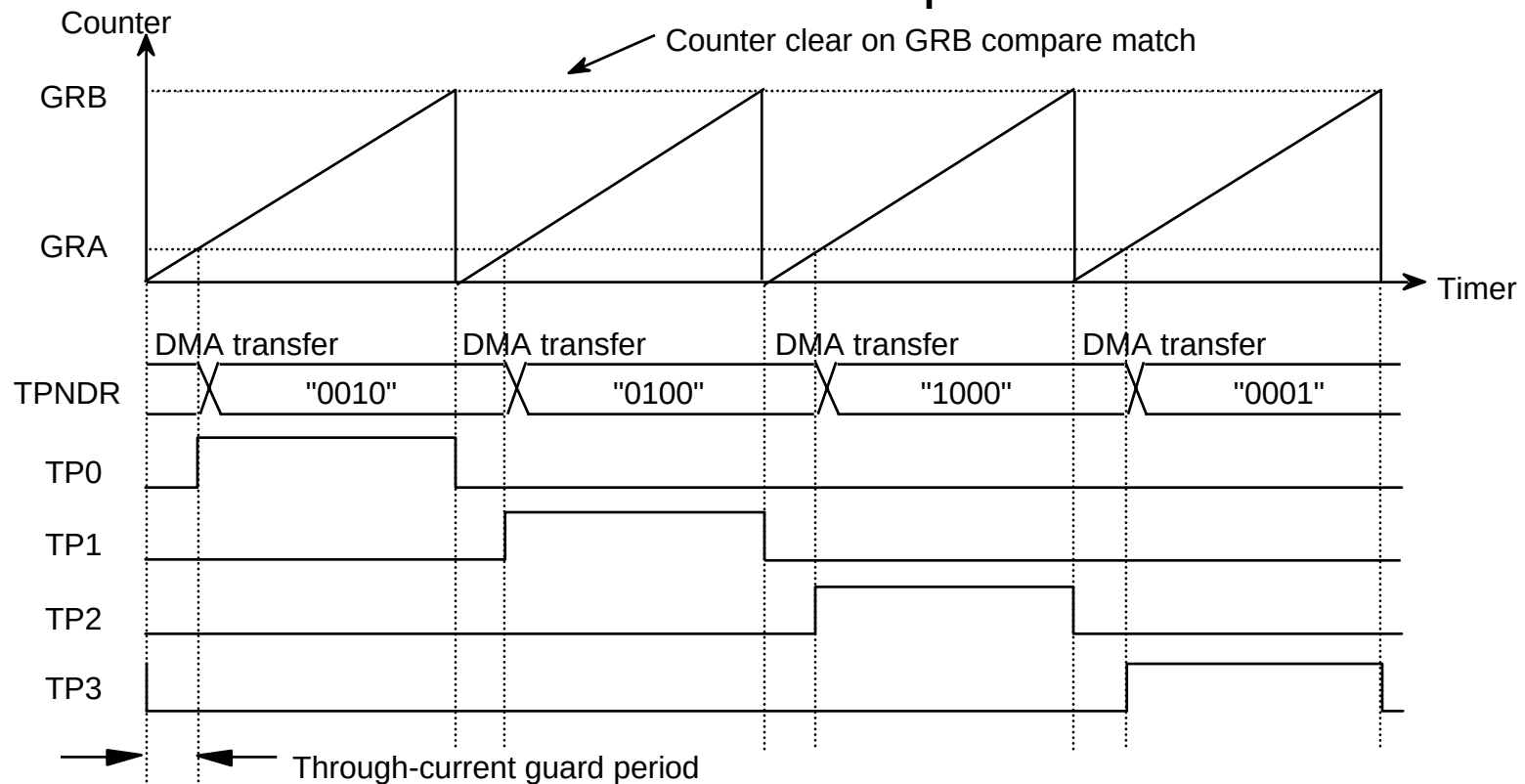
- Complementary PWM output example
(During increment/decrement operation)
 - Complementary PWM output on timer channels 3 and 4



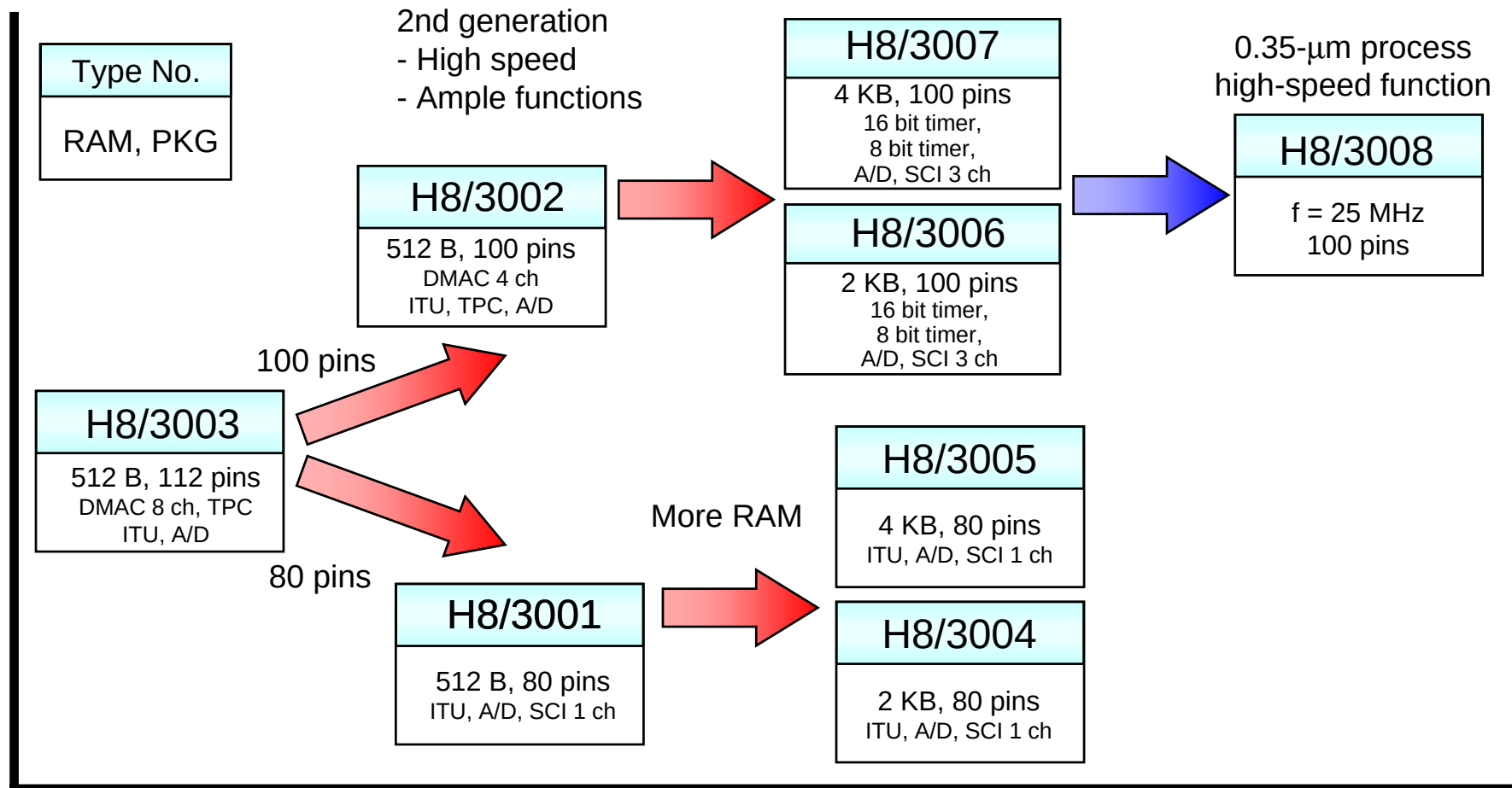
TPC

- Programmable Timing Pattern Controller -

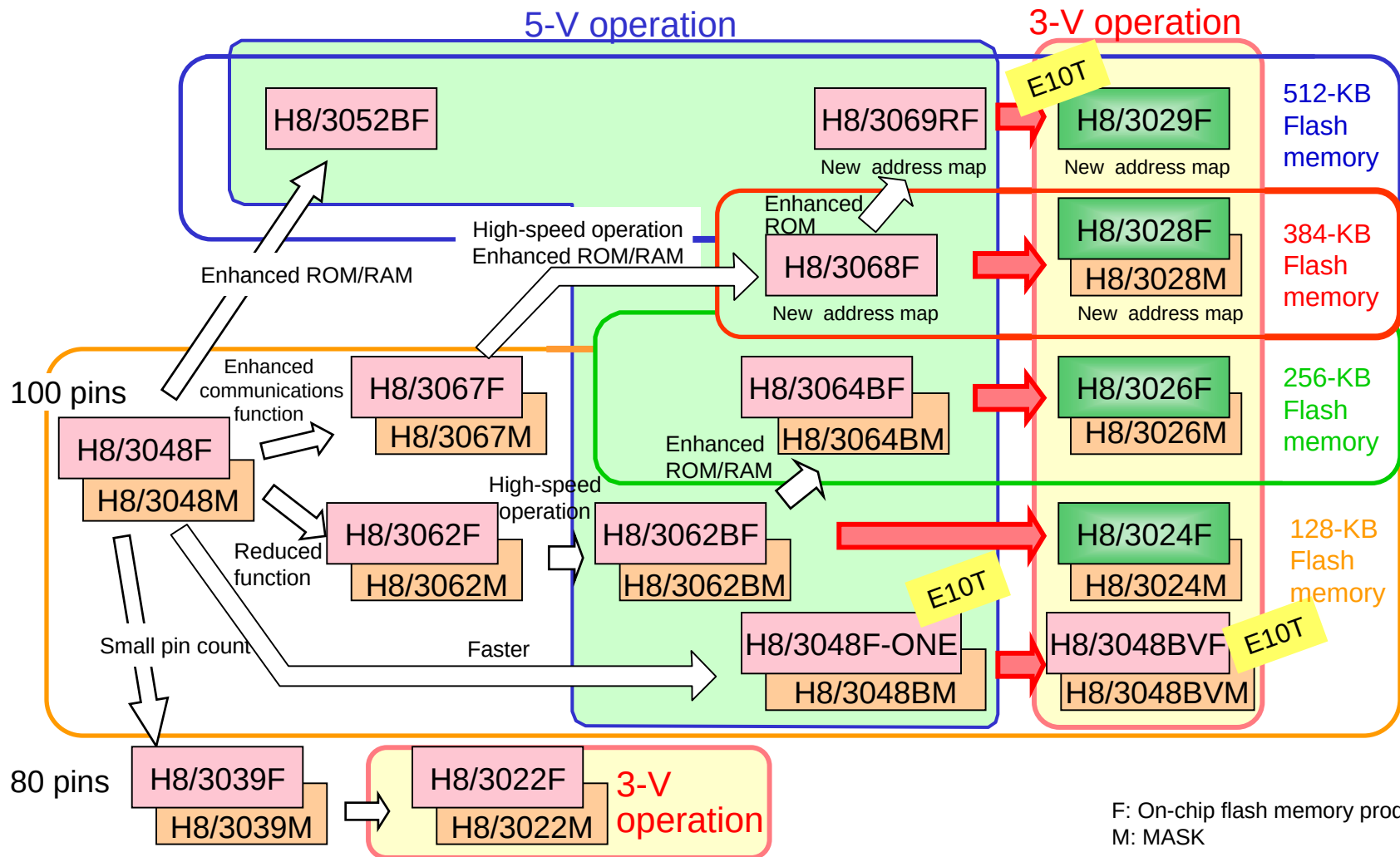
- 4 phase 1 excitation output: 4 phase 1 excitation output on timer channel 0



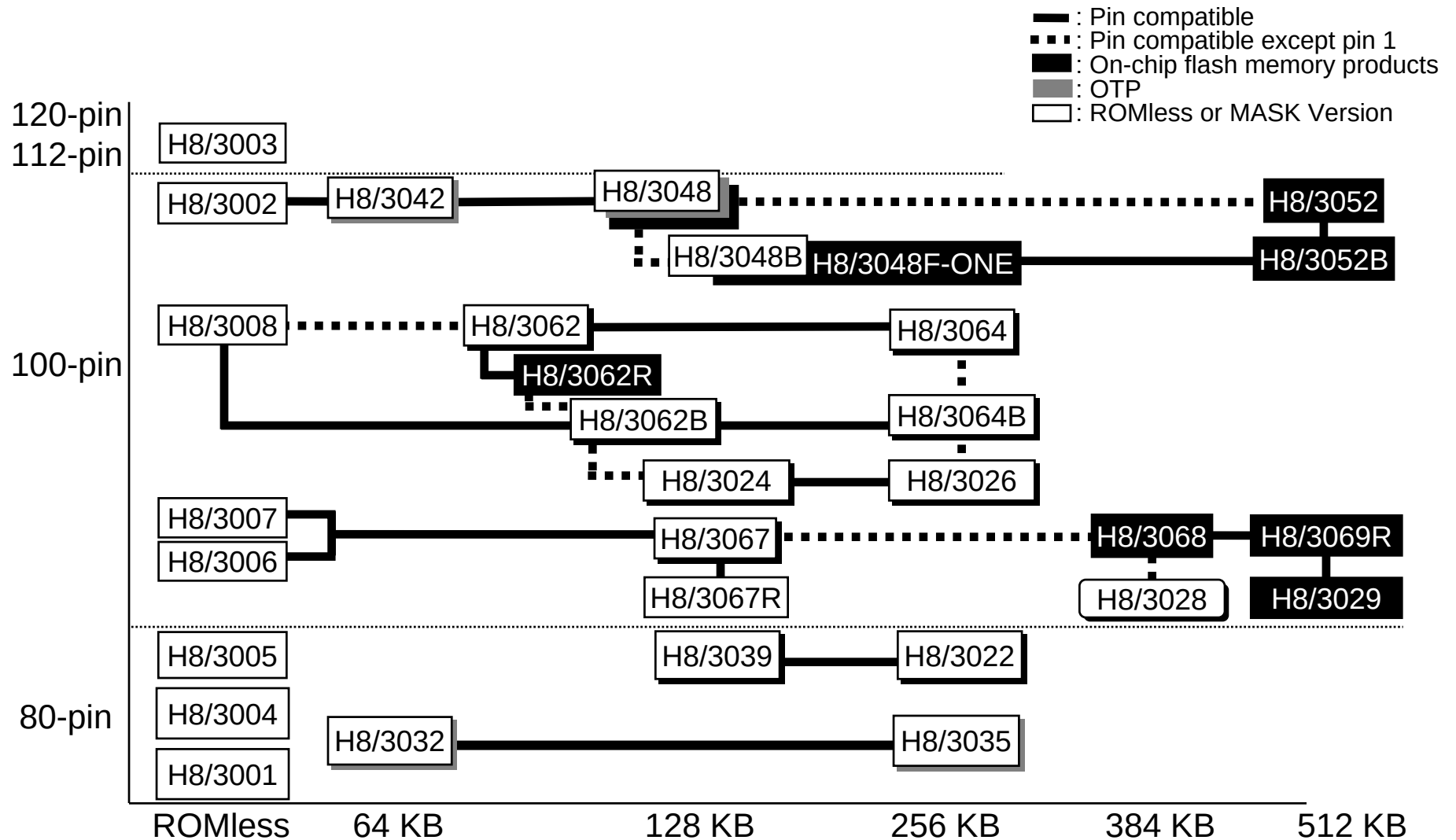
H8/300H Series Product Evolution (ROMless Version)



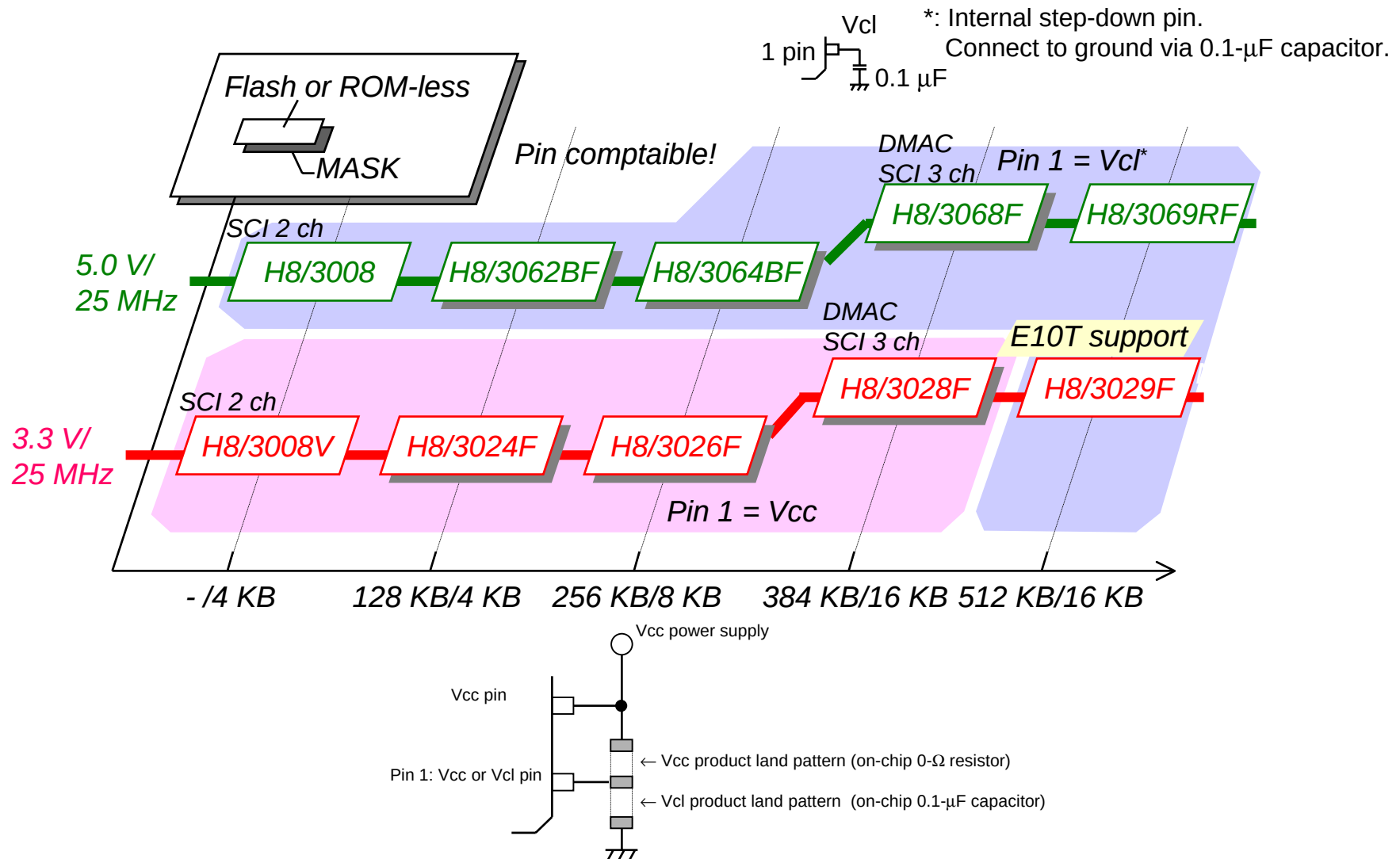
H8/300H Series Product Evolution (On-chip flash memory products, MASK)



H8/300H Product Matrix



H8/300H Pin Compatibility Evolution Roadmap



Features of the H8/3029F

(New Model: On-chip Flash Memory Products)

H8/3029F Features

- Large-capacity memory of 512 KB/16 KB
 - Lineup of products for 3-V operation: From 128 KB to 512 KB of on-chip flash memory products
- Pin compatibility
 - Complete pin compatibility with the H8/3069RF 5-V product
- On-chip emulator (E10T) is available

New Features: On-chip Flash Memory Products (0.18- μ m)

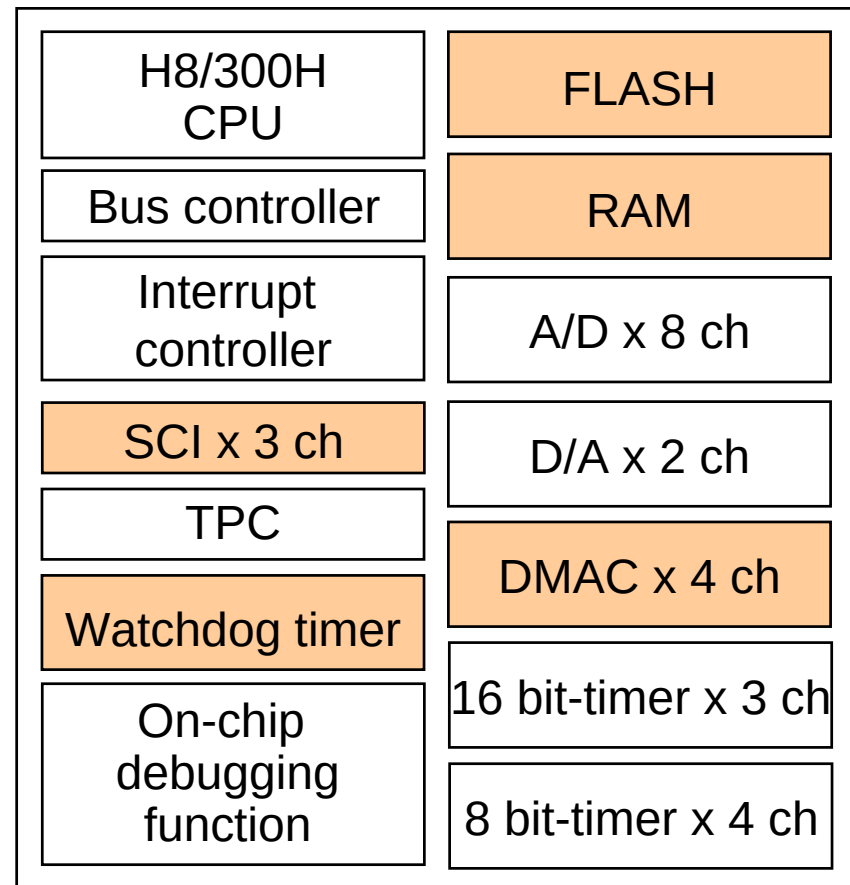
- Support for user boot
 - Lets you create your own boot programs. Supports various interfaces (ATAPI, CAN, USB, etc.) to suit the target application.
- Reduced programming time
 - The programming and erase times are greatly reduced from those for conventional products
E.g. 0.35- μ m H8/3052F: About 50 s $\rightarrow$ 0.18- μ m H8/3069F: 20 to 30 s
(512 KB) (512 KB)
- Command method simplifies the programming-control program
 - The programming/erase program is incorporated in the boot ROM. Merely issue commands to call the program; this greatly simplifies the creation of user programming-control programs.

H8/3029F Overview

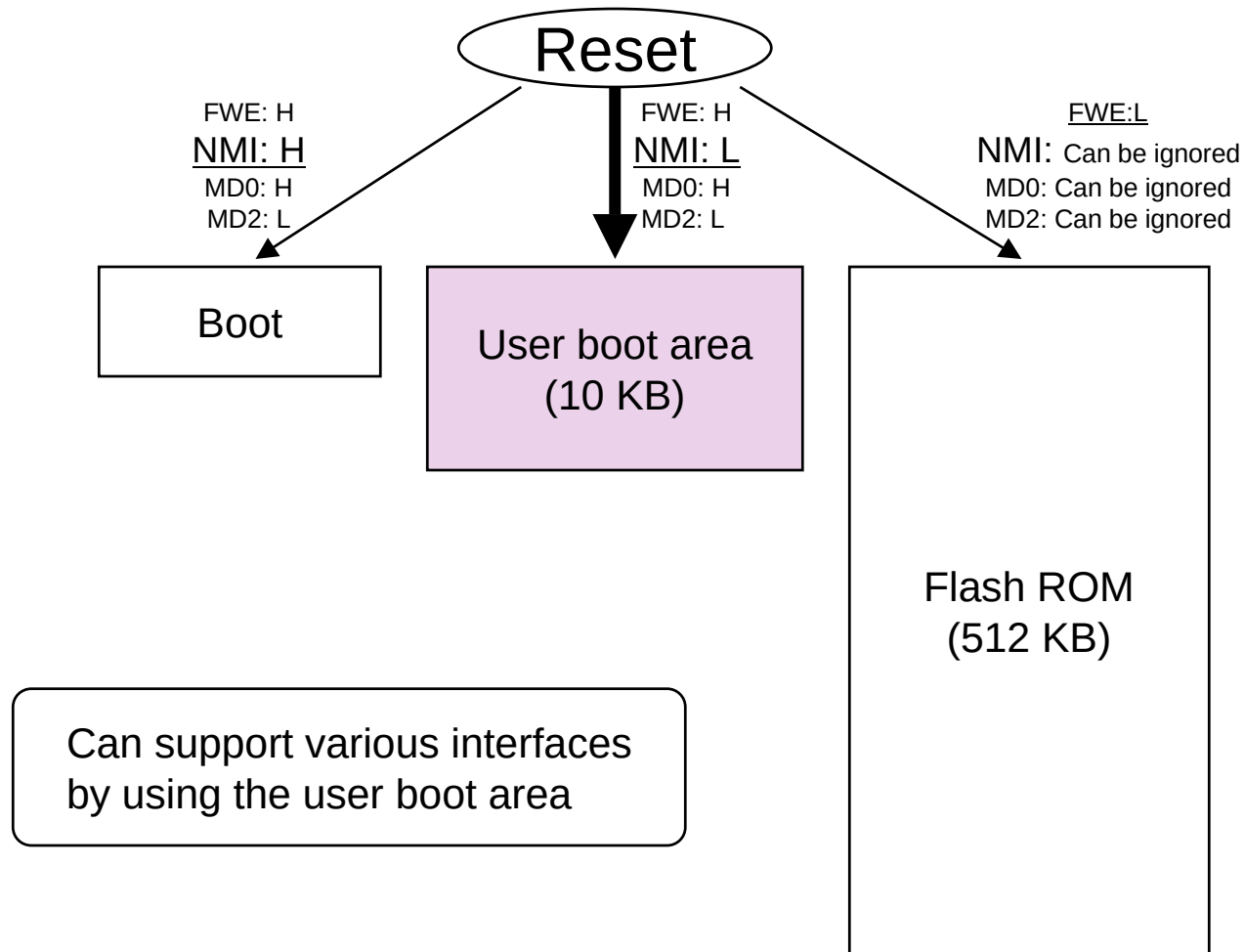
Features

- Max. operating frequency: 25 MHz
- 5-V operation
- Flash/RAM
 - H8/3029F: 512 KB/16 KB
- DMA controller: 4 ch
- 16-bit timer: 3 ch
- 8-bit timer: 4 ch
- Interval timer: 1 ch (WDT)
- SCI: 3 ch
- 10-bit A/D: 8 ch
- 8-bit D/A: 2 ch
- On-chip emulator (E10T) available
- Package: QFP-100

Block Diagram



New User Boot: On-chip Flash Memory Products (H8/3029F)



Merits of New Command Method: On-chip Flash Memory Products

On-Board Writing	Problem	Improvement (Merits)
When normal boot mode (SCI) is used	When a new product is released, software must be revised accordingly.	Device inquiry method is introduced  A common tool (write software) can be used
When a mode other than the boot mode (not SCI) is used	- The user must create a complicated write-control program by referring to the manual flow. - The write-control flow is different for every process.	Incorporates a write/erase program  Incorporated program calling method can be used

What is the H8/3048F-ONE?

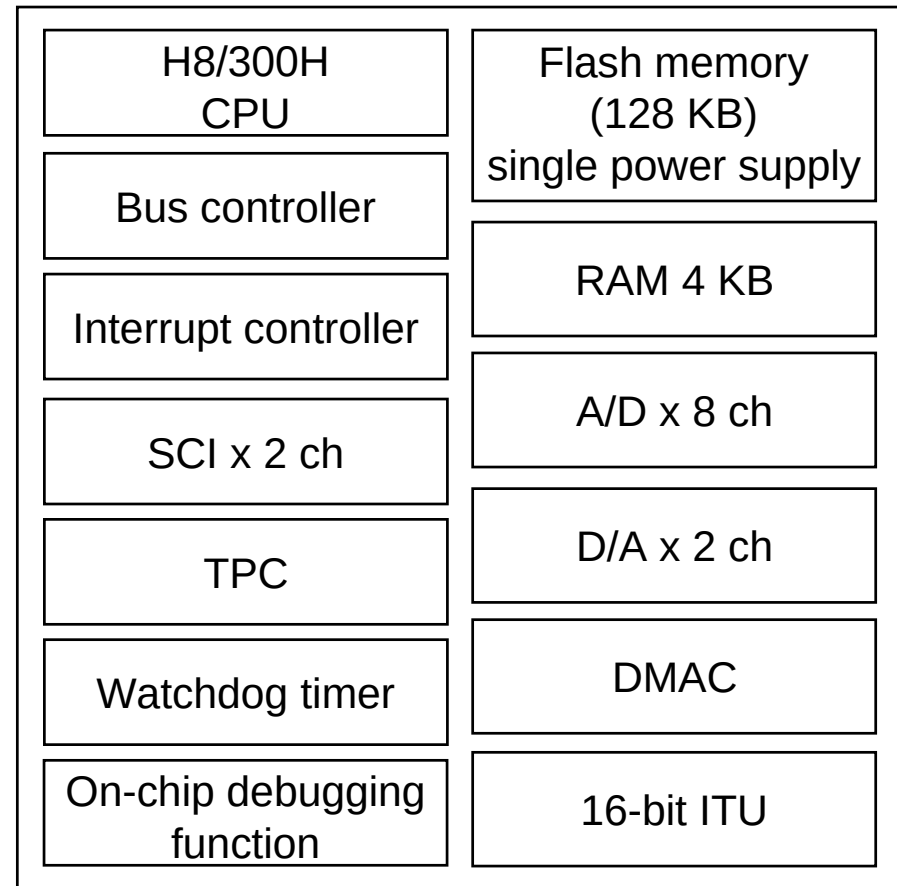
- F-ONE: Single power-supply flash memory
 - Dual power supply to a single power supply
- F-ONE: On-chip debugging
 - Supports effective debugging with low-priced tool E10T
- High-speed operation: 25 MHz at 5 V or 3 V
 - Easier realization of better performance systems

H8/3048F-ONE Specification Overview

Features

- Flash memory
(writing from single power supply)
 - Rewriting by normal operating voltage
- 128 KB flash/4 KB RAM
- Various peripheral functions
 - Timer function
16-bit timer x 5 ch (ITU)
Watchdog timer
 - Serial communication interface x 2 ch
 - 10-bit A/D converter x 8 ch
 - 8-bit D/A converter x 2 ch
 - DMA controller
 - Timing pattern controller (TPC)
- Supports on-chip emulator E10T
- Packages
 - QFP-100 and TQFP-100

Block Diagram

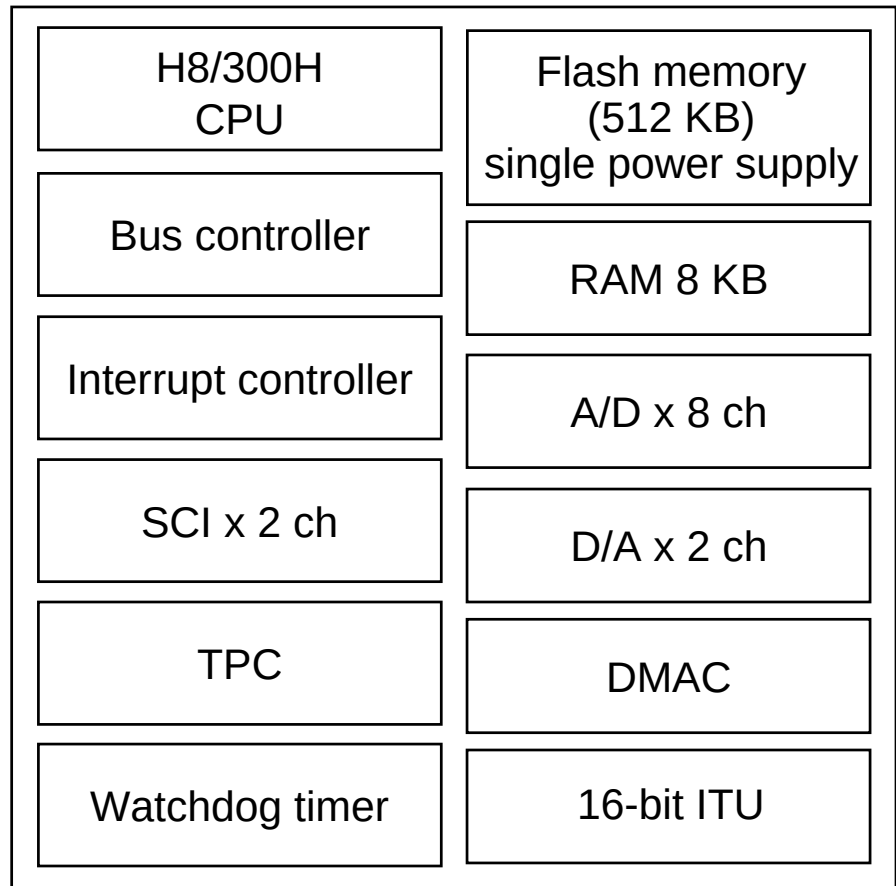


H8/3052BF Specification Overview

Features

- Flash memory
(writing from single power supply)
 - Rewriting by normal operating voltage
- 512-KB flash/8-KB RAM
- Various peripheral functions
 - Timer function
16-bit timer x 5 ch (ITU)
Watchdog timer
 - Serial communication interface x 2 ch
 - 10-bit A/D converter x 8 ch
 - 8-bit D/A converter x 2 ch
 - DMA controller
 - Timing pattern controller (TPC)
- Packages
 - QFP-100 and TQFP-100

Block Diagram

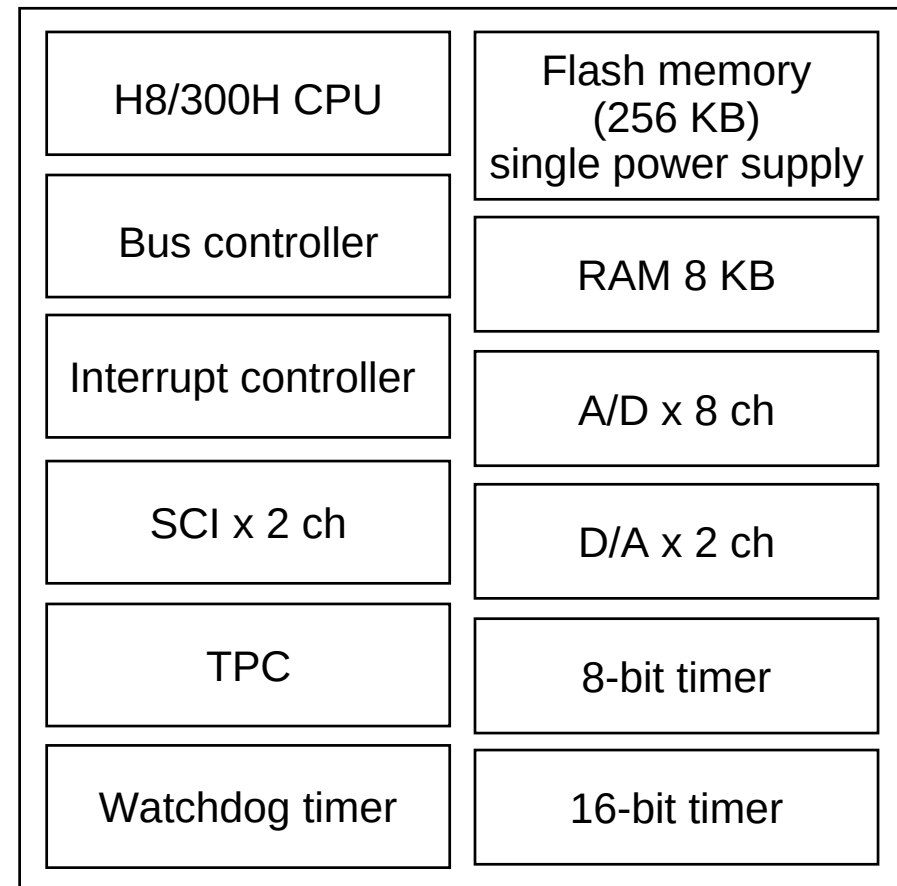


H8/3064BF Specification Overview

Features

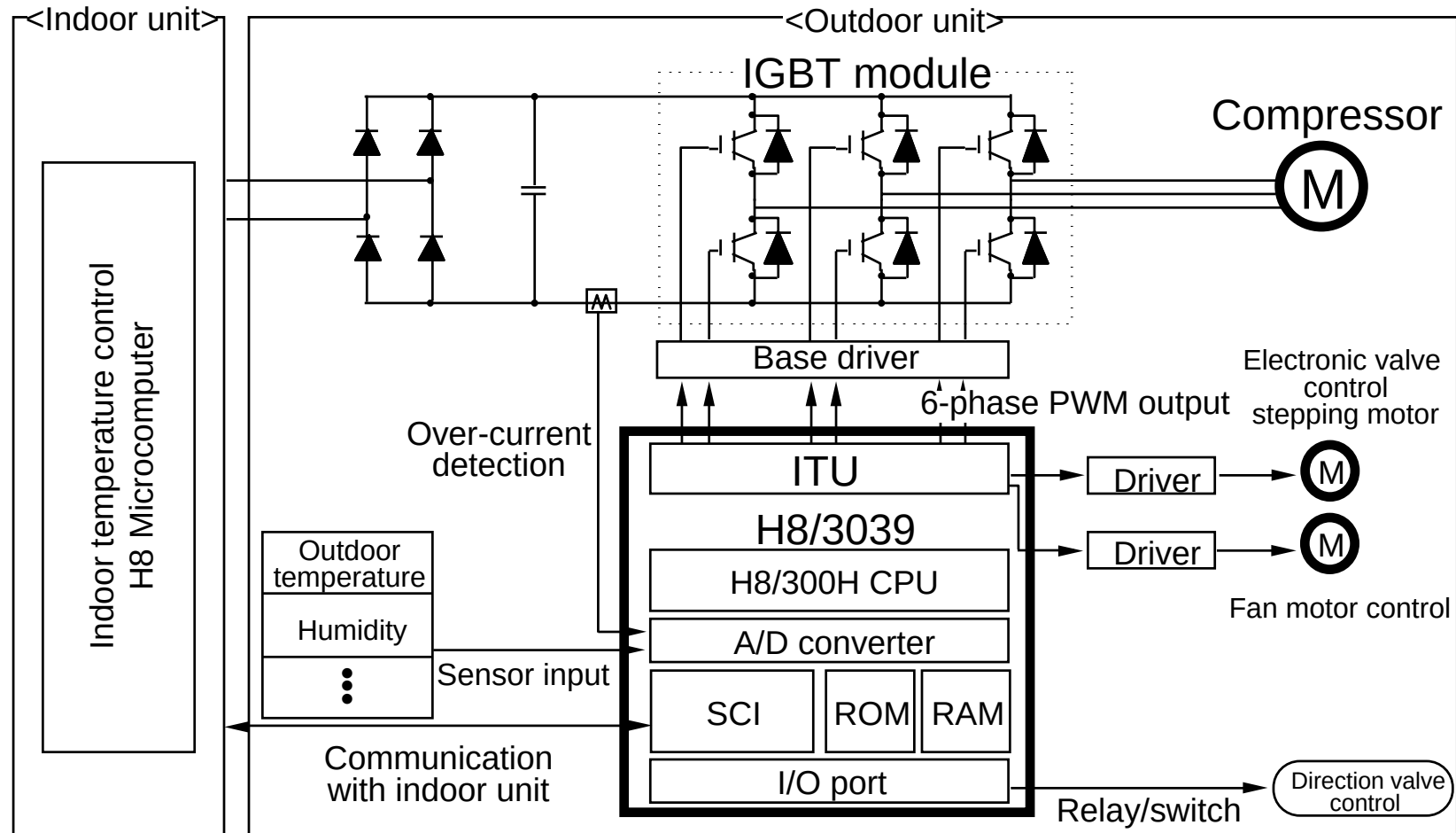
- Flash memory
(writing from single power supply)
 - Rewriting by normal operating voltage
- 256-KB flash/8-KB RAM
- Various peripheral functions
 - Timer function
 - 8-bit timer x 4 ch
 - 16-bit timer x 3 ch
 - Watchdog timer
 - Serial communication interface x 2 ch
 - 10-bit A/D converter x 8 ch
 - 8-bit D/A converter x 2 ch
 - Timing pattern controller (TPC)
- Packages
 - QFP-100 and TQFP-100

Block Diagram



H8/3039 Application

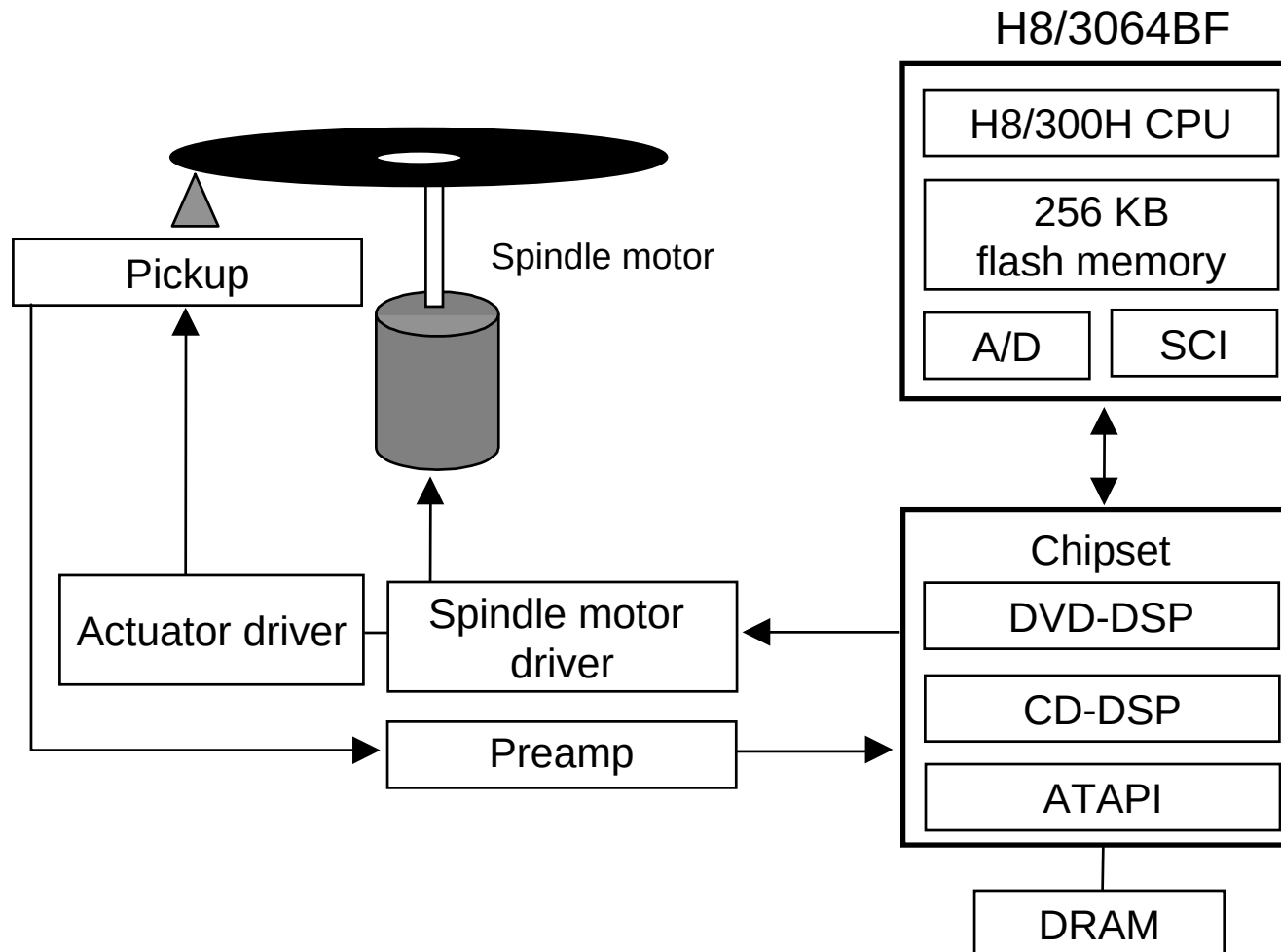
- Inverter Air Conditioner Configuration -



ITU: Integrated timer unit

H8/3064BF Application

- DVD System Configuration -



H8/300H Tiny Series

Development Concepts for H8/300H Tiny Series Products

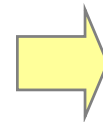
Tiny^{H8/300H}

Various pin specifications
(32, 42, 48, 64, 80, and 100 pins)
Small packages (10 x 10 mm, 7 x 7 mm)
High-speed operation ($\phi = 20$ MHz)



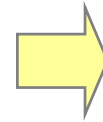
High performance in small packages!

Product lineup of on-chip single power flash
memory
(8, 16, 32, 56, 96, and 128 KB)



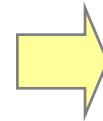
Abundant flash-memory variants!

Revolution of 4-Kbit EEPROM products for
data storage



Taking more types of usage into account!

Application of proven peripheral modules for
H8/300L and 300 Series products



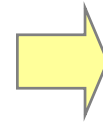
An easy step up from current H8-Family
products!

C compiler for development support



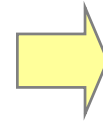
A development environment in the
mainstream of programming today!

On-chip emulation function enables on-board
debugging (E8 emulators)



High development efficiency through use
of the actual chip!

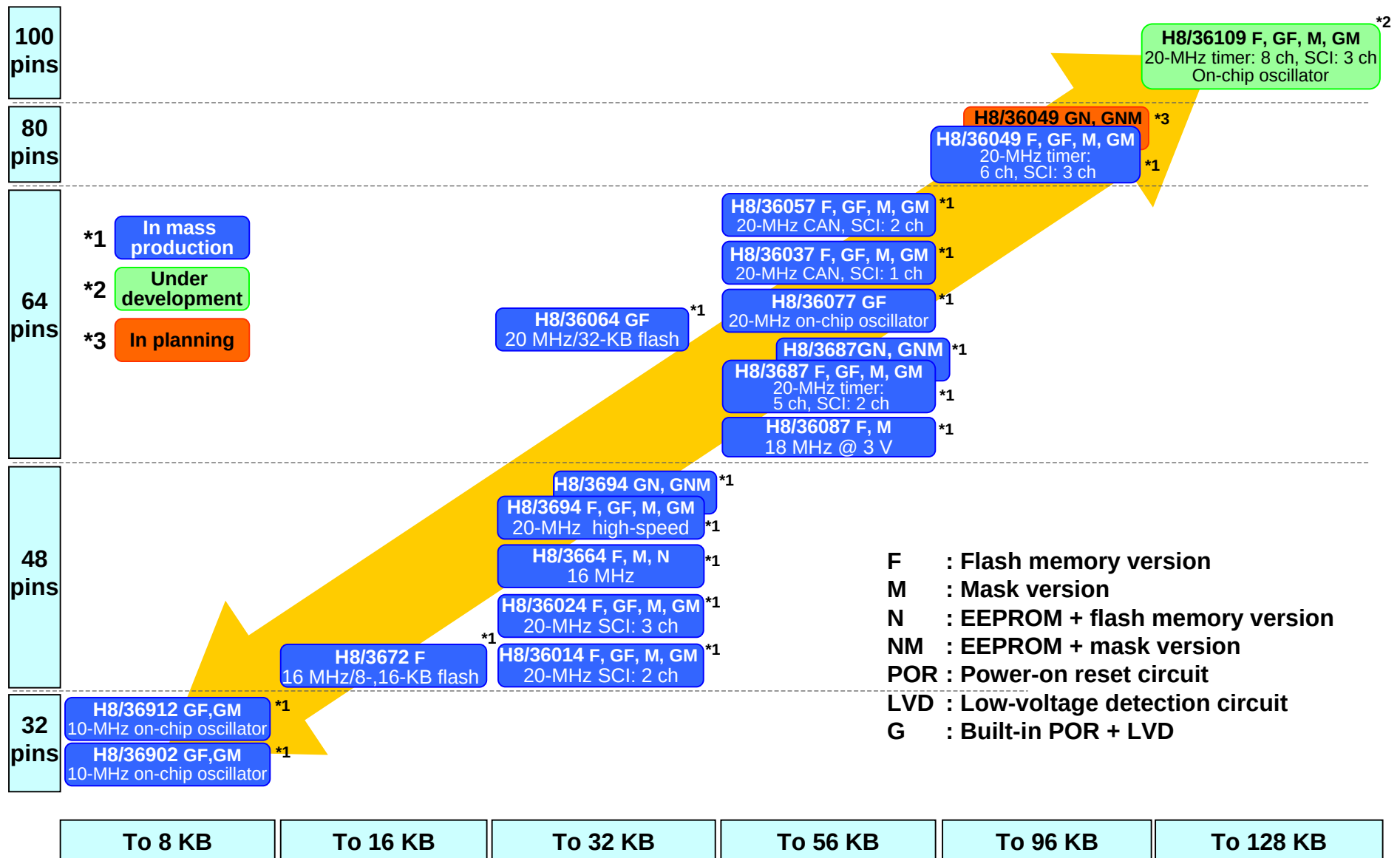
Pin compatibility for products in a package



Facilitates portability within the group!

H8/300H Tiny Series Roadmap

Tiny H8/300H



Features of H8/300H Tiny Series Products H8/300H **Tiny**

- On-chip peripheral functions -

(1) Highly accurate on-chip oscillator

- H8/36109G, 36077G, 36902G, and 36912G

(2) POR (power-on reset) circuit

- H8/36109G, 3687G, 3694G, 36037G, 36057G, 36014G, 36024G, 36049G, 36064G, 36077G, 36902G, and 36912G

(3) LVD (low-voltage detection) circuit

- H8/36109G, 3687G, 3694G, 36037G, 36057G, 36014G, 36024G, 36049G, 36064G, 36077G, 36902G, and 36912G

(4) Independent WDT (watchdog timer)

- On-chip oscillator

(5) RTC (real-time clock) circuit

- H8/36109, 3687, 36049, 36077G, and 36087

(6) High performance timer for motor control (timer Z or RD: 16-bit timer x 2 ch)

- H8/36109, 3687, 36037, 36057, 36064G, 36049, 36077G, and 36087

(7) I²C bus interface 2 circuit

- H8/36109, 3687, 3694, 36049, 36064G, 36077G, 36087, and 36912G

(8) SCI with noise elimination function

- H8/36109, 36049, 36902G, and 36912G

(9) CAN incorporated

- H8/36037 and 36057

(10) SSU incorporated

- H8/36037 and 36057



H8/36902 Group Outline

- 32-pin version -

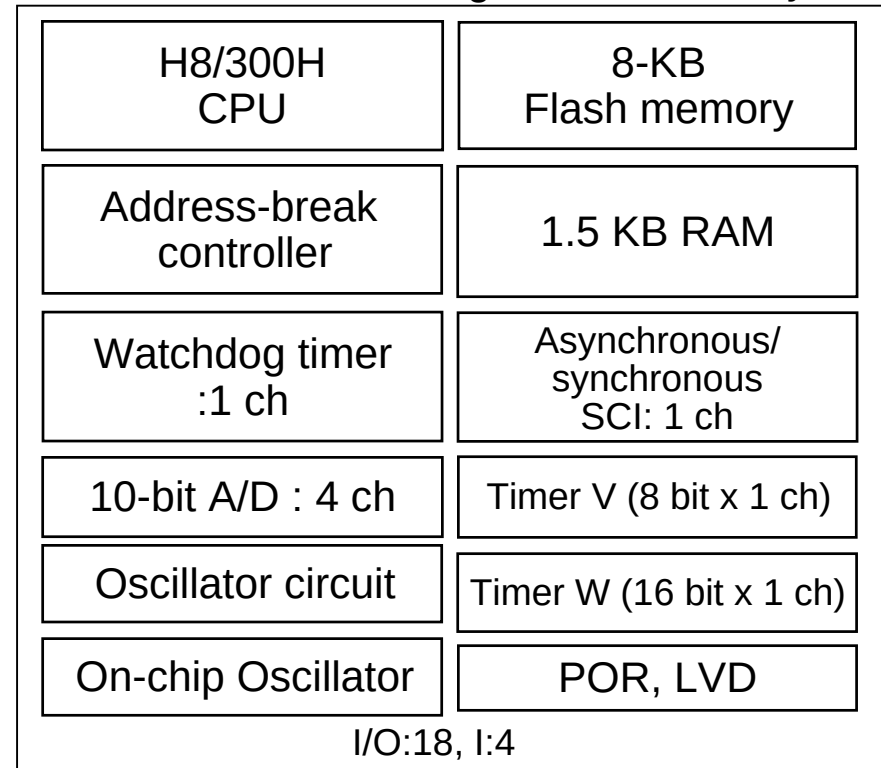


Features

- 0.35- μ m process
- H8/300H CPU
 - Crystal/ceramic oscillator: 2 to 12 MHz/
2.7 to 5.5 V (Flash memory products: 3.0 to 5.5V)
 - On-chip oscillator:
typ. 8 MHz (Flash: +/-3%) or 10 MHz
- On-chip H8/300, 300L peripheral functions
 - 8-bit timer (timer V)
 - 16-bit timer (timer W)
 - Serial communications interface: 1 channel
- Watchdog timer
 - On-chip internal oscillator
- Memory capacity
 - Flash: 8 KB/1.5-KB RAM (H8/36902GF)
 - Mask: 8 KB/512-B RAM (H8/36902GM)*
 - 4 KB/256-B RAM (H8/36901GM)*
 - 2 KB/256-B RAM (H8/36900GM)*
- On-chip POR (power-on reset) and LVD (low-voltage detection) circuits
- Package
 - FP-32D (11.30 x 20.45, 1.27-mm pitch)
<Renesas Code: PRSP0032DC-A>
 - FP-32A (7 x 7, 0.8-mm pitch)
 - DP-32S (400-mil, 1.778-mm pitch)

H8/36902F Block Diagram

<Tiny32>



*Minimum order: 10 kpcs



H8/36912 Group Outline

- 32-pin version -

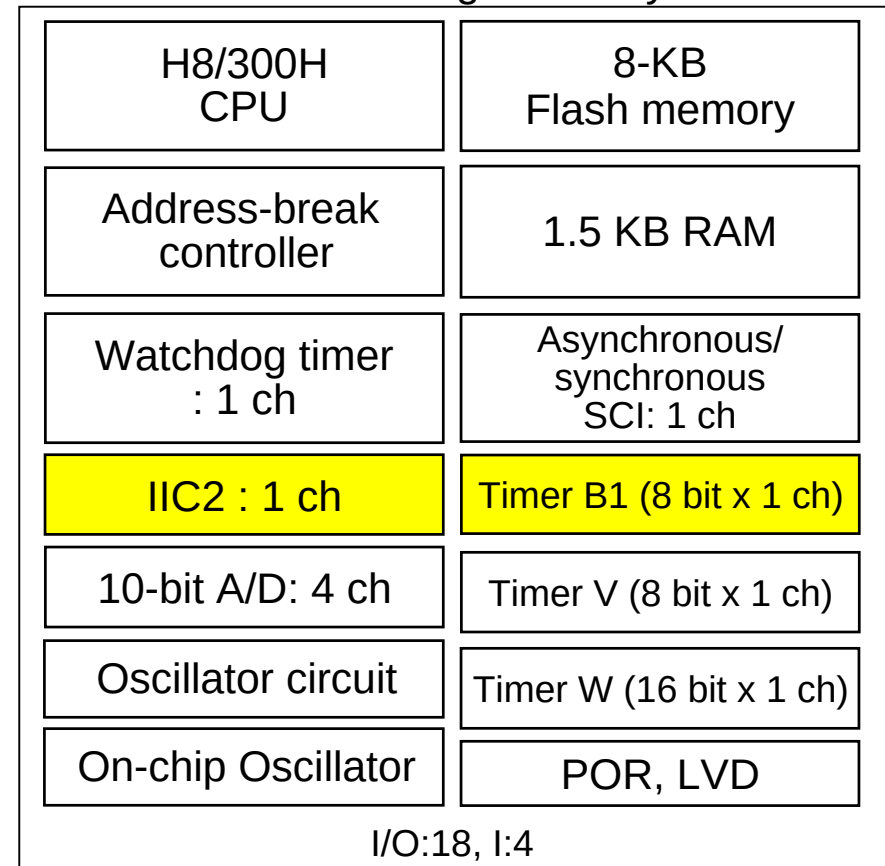
Tiny H8/300H

Mass
Production

Features

- 0.35- μ m process
- H8/300H CPU
 - Crystal/ceramic oscillator: 2 to 12 MHz/2.7 to 5.5 V
(Flash memory products: 3.0 to 5.5 V)
 - On-chip oscillator:
typ. 8 MHz (Flash: +/-3%) or 10 MHz
- On-chip I²C bus interface²
- On-chip H8/300, 300L peripheral functions
 - 8-bit timer (timer B1, timer V)
 - 16-bit timer (timer W)
 - Serial communications interface: 1 channel
- Watchdog timer
 - On-chip internal oscillator
- Memory capacity
 - Flash: 8 KB/1.5-KB RAM (H8/36912GF)
 - Mask: 8 KB/512-B RAM (H8/36912GM)*
4 KB/256-B RAM (H8/36911GM)*
- On-chip POR (power-on reset) and LVD (low-voltage detection) circuits
- Package
 - FP-32D (11.30 x 20.45, 1.27-mm pitch)
<Renesas Code: PRSP0032DC-A>
 - FP-32A (7 x 7, 0.8-mm pitch)
 - DP-32S (400-mil, 1.778-mm pitch)

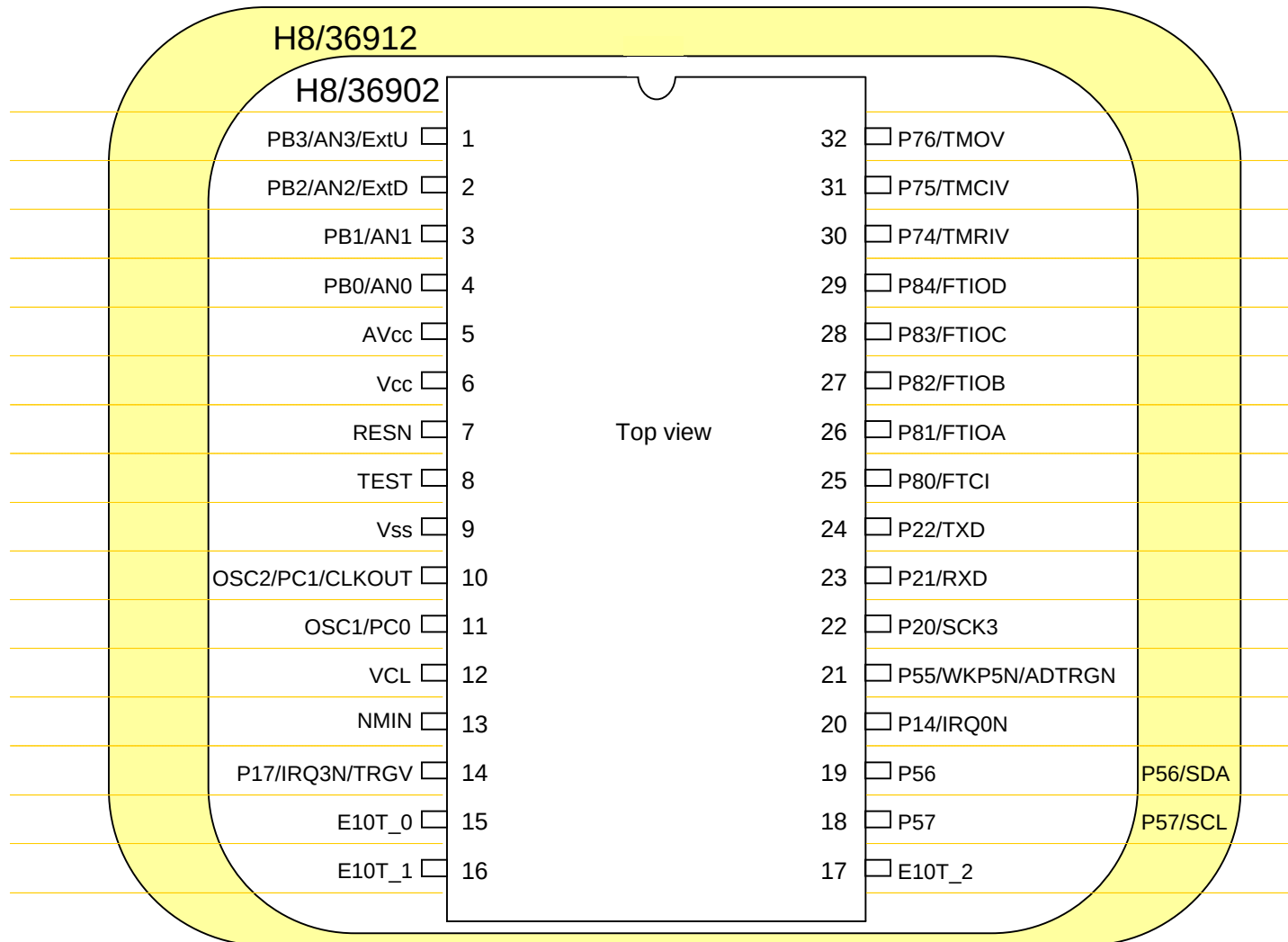
H8/36912F Block Diagram <Tiny32>



 Difference from the H8/36902

*Minimum order: 10 kpcs

Pin Assignment (32-Pin FP-32D, DP-32S) *Tiny* ^{H8/300H}





H8/3672 Group Overview

Tiny H8/300H

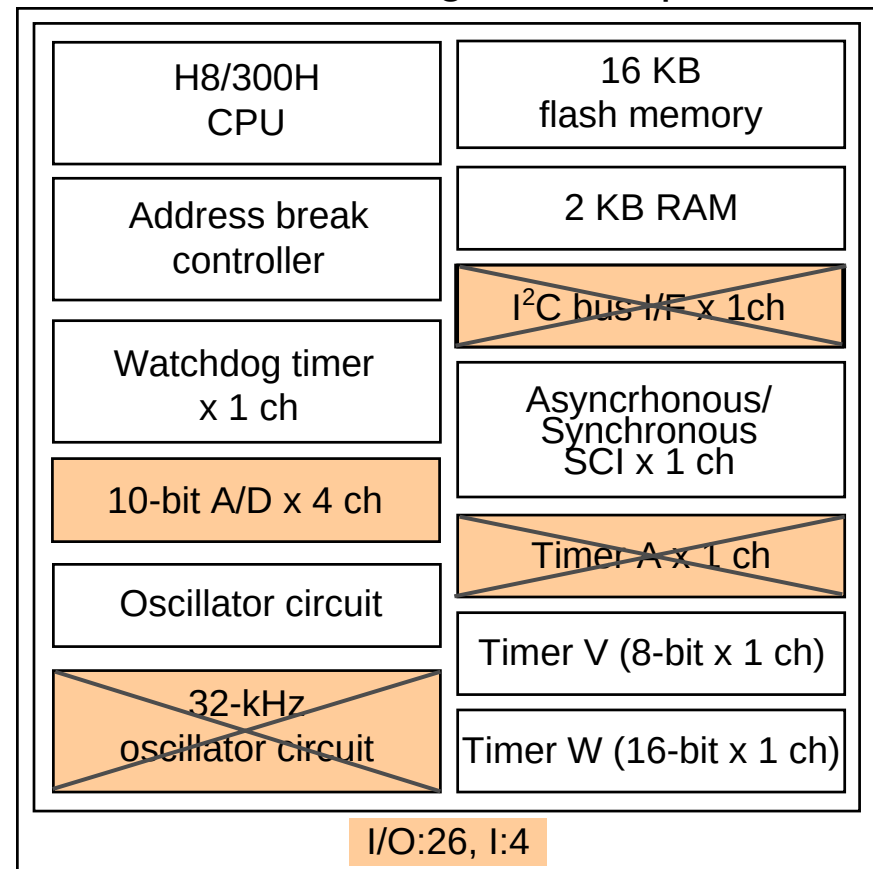
Mass
Production

- On-Chip Small Capacity Flash Memory, Reduced Pins -

Features

- Small capacity Flash memory products (16 KB, 8 KB)
- 0.35- μ m process is used
- On-chip H8/300 and H8/300L peripheral functions
 - 8-bit timer (timer V)
 - 16-bit timer (timer W)
 - Serial communication I/F
- Watchdog timer
 - With internal oscillator circuit
- H8/300H CPU
 - 1 to 10 MHz/3.0 to 5.5 V
 - 1 to 16 MHz/4.0 to 5.5 V
- Interrupts
 - External interrupts: 9
 - Internal interrupts: 17
- Memory capacity
 - 16 KB/2 KB (H8/3672F)
 - 8 KB/2 KB (H8/3670F)
- Packages
 - FP-64E ($\square$ 10mm x 10mm)
<Renesas Code: PLQP0064KC-A >
 - FP-48F ($\square$ 10mm x 10mm)
<Renesas Code: PLQP0048JA-A>
 - FP-48B ($\square$ 7mm x 7mm)
<Renesas Code: PLQP0048KC-A>

H8/3672F Block Diagram <Super slim I>



: Different from H8/3664



H8/36014 Group Overview

- H8/3672F Group Communication Enhanced -

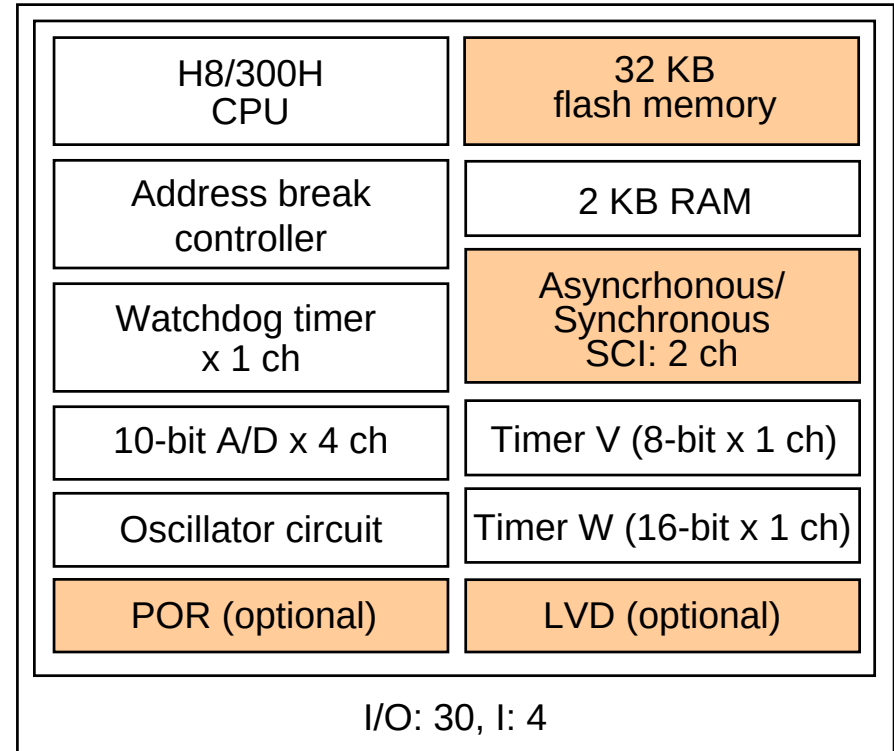
Tiny H8/300H

Mass
Production

Features

- 0.35- μ m process is used
- H8/300H CPU
 - 1 to 10 MHz/2.7 to 5.5 V
(Flash memory products: 3.0 to 5.5 V)
 - 1 to 20 MHz/4.0 to 5.5 V
- Small size Flash memory products (32 KB, 16 KB)
- On-chip H8/300 and H8/300L peripheral functions
 - 8-bit timer (Timer V)
 - 16-bit timer (Timer W)
 - Serial communication I/F: 2 ch
- Watchdog timer
 - With internal oscillator circuit
- Memory capacity
 - 32 KB/2 KB (H8/36014F)
 - 32 KB/1 KB (H8/36014M)
 - 24 KB/1 KB (H8/36013M)
 - 16 KB/2 KB (H8/36012F)
 - 16 KB/512 B (H8/36012M)
 - 12 KB/512 B (H8/36011M)
 - 8 KB/512 B (H8/36010M)
- On-chip POR and LVD (Optional)
 - when LVD is used: 1 to 16 MHz/4.5 to 5.5 V
- Packages
 - FP-64E (□ 10 mm x 10 mm)
<Renesas Code: PLQP0064KC-A>
 - FP-48F (□ 10 mm x 10 mm)
<Renesas Code: PLQP0048JA-A>
 - FP-48B (□ 7 mm x 7 mm)
<Renesas Code: PLQP0048KC-A>
 - TNP-48 (□ 7 mm x 7 mm)
<Renesas Code: PVQN0048KA-A>

H8/36014F Block Diagram <Super slim Π >



 : Different from H8/3672



H8/36024 Group Overview

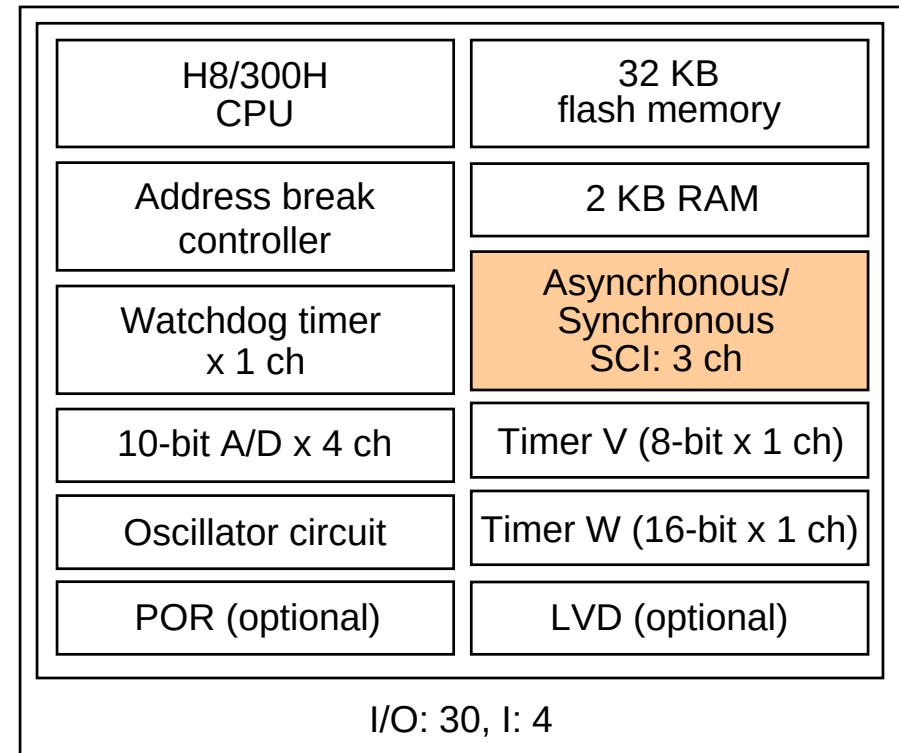
Tiny H8/300H

Mass
Production

Features - H8/36014F Group Communication Enhanced -

- 0.35-μm process is used
- H8/300H CPU
 - 1 to 10 MHz/2.7 to 5.5 V*
 - (Flash memory products: 3.0 to 5.5 V)
 - 1 to 20 MHz/4.0 to 5.5 V
- Small size Flash memory products (32 KB)
- On-chip H8/300 and H8/300L peripheral functions
 - 8-bit timer (Timer V)
 - 16-bit timer (Timer W)
 - Serial communication I/F: 3 ch
- Watchdog timer
 - With internal oscillator circuit
- Memory capacity
 - 32 KB/2 KB (H8/36024F)
 - 32 KB/1 KB (H8/36024M)
 - 24 KB/1 KB (H8/36023M)
 - 16 KB/2 KB (H8/36022F)
 - 16 KB/512 B (H8/36022M)
- On-chip POR and LVD (Optional)
 - when LVD is used: 1 to 16 MHz/4.5 to 5.5 V
- Packages
 - FP-64E (□ 10 mm x 10 mm)
<Renesas Code: PLQP0064KC-A>
 - FP-48F (□ 10 mm x 10 mm)
<Renesas Code: PLQP0048JA-A>
 - FP-48B (□ 7 mm x 7 mm)
<Renesas Code: PLQP0048KC-A >
 - TNP-48 (□ 7 mm x 7 mm)
<Renesas Code: PVQN0048KA-A >

H8/36024F Block Diagram <Super slim III>



: Different from H8/36014



H8/3694 Group Overview

Tiny H8/300H

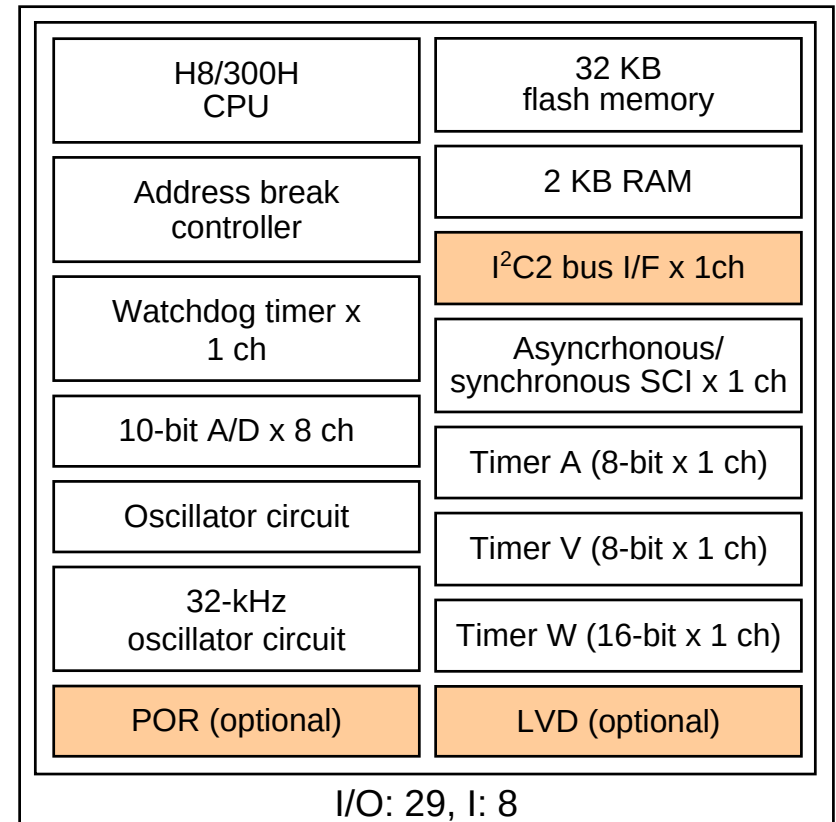
Mass
Production

Features

- H8/3664 Functions Enhanced -

- Small capacity Flash memory products
- On-chip I²C bus interface²
- On-chip H8/300 and H8/300L peripheral functions
 - 8-bit timers (timer A and timer V)
 - 16-bit timer (timer W)
 - Serial communication I/F
- Watchdog timer
 - With internal oscillator circuit
- H8/300H CPU
 - 1 to 10 MHz/2.7 to 5.5 V (Flash memory products: 3.0 to 5.5 V)
 - 1 to 20 MHz/4.0 to 5.5 V
- Memory capacity
 - 32 KB/2 KB (H8/3694F)
 - 32 KB/1 KB (H8/3694M)
 - 24 KB/1 KB (H8/3693M)
 - 16 KB/512 B (H8/3692M)
 - 12 KB/512 B (H8/3691M)
 - 8 KB/512 B (H8/3690M)
- On-chip POR and LVD (optional)
 - when LVD is used: 1 to 16 MHz/4.5 to 5.5 V
- Packages
 - FP-64A (□ 14 mm x 14 mm) <Renesas Code: PRQP0064GB-A>
 - FP-64E (□ 10 mm x 10 mm), <Renesas Code: PLQP0064KC-A>
 - FP-64K (□ 10 mm x 10 mm)* <Renesas Code: PLQP0064KB-A>
 - FP-48F (□ 10 mm x 10 mm) <Renesas Code: PLQP0048JA-A>
 - FP-48B (□ 7 mm x 7 mm) <Renesas Code: PLQP0048KC-A>
 - TNP-48 (□ 7 mm x 7 mm) <Renesas Code: PVQN0048KA-A>

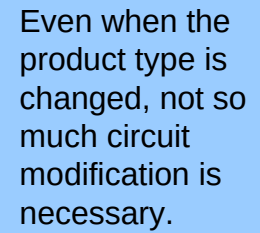
H8/3694F Block Diagram
<General-purpose high-speed Version>



 : Different from H8/3664

*: Under development. For in-vehicle use only.

Tiny H8/300H





H8/3687 Group Overview

Tiny H8/300H

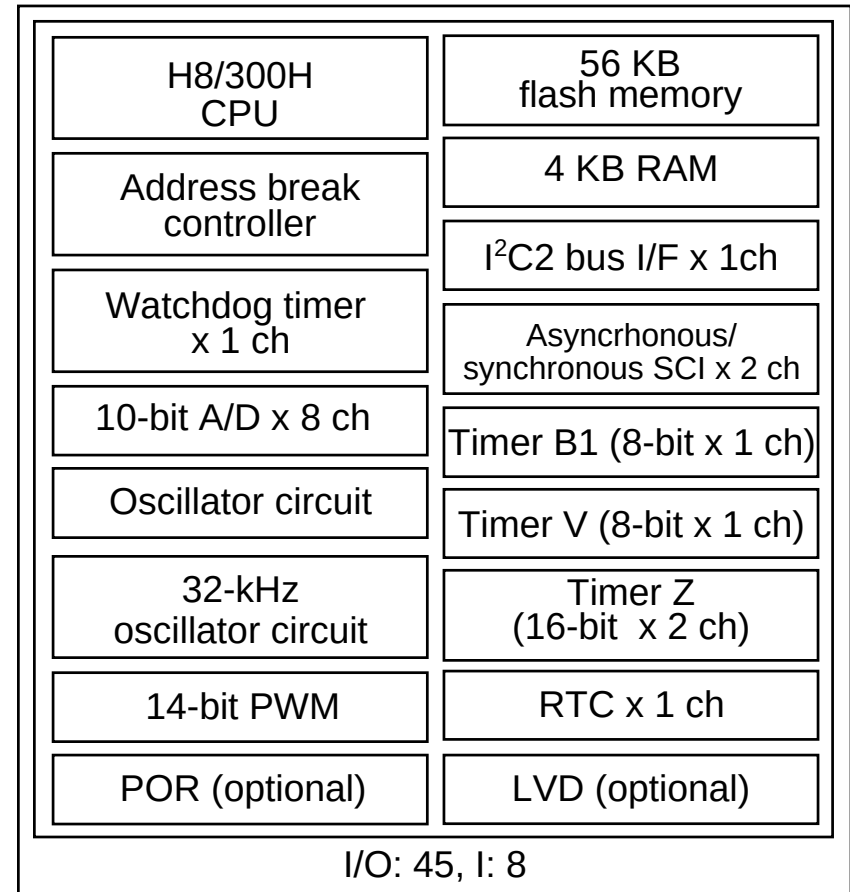
Mass
Production

- H8/3664 Peripheral Functions Enhanced -

Features

- 0.35- μ m process is used
- On-chip I²C bus interface²
- On-chip H8/300 and H8/300L peripheral functions
 - RTC (realtime clock)
 - 8-bit timer (timer B1 and timer V)
 - 16-bit timer x 2 ch (timer Z)
 - Serial communication I/F x 2 ch
 - 14-bit PWM x 1 ch
- Watchdog timer
 - With internal oscillator circuit
- H8/300H CPU
 - 1 to 10 MHz/2.7 to 5.5 V (Flash memory products: 3.0 to 5.5 V)
 - 1 to 20 MHz/4.0 to 5.5 V
- Interrupts
 - External interrupts: 11
 - Internal interrupts: 37
- Memory capacity
 - 56 KB Flash memory products/4 KB RAM (H8/3687F)
 - 32 KB Flash memory products/4 KB RAM (H8/3684F)
 - 56 KB/3 KB (H8/3687M)
 - 48 KB/3 KB (H8/3686M)
 - 40 KB/3 KB (H8/3685M)
 - 32 KB/3 KB (H8/3684M)
 - 24 KB/3 KB (H8/3683M)
 - 16 KB/3 KB (H8/3682M)
- On-chip POR and LVD (optional)
 - when LVD is used: 1 to 16 MHz/4.5 to 5.5 V
- Packages
 - FP-64A (□ 14 mm x 14 mm) < Renesas Code: PRQP0064GB-A >
 - FP-64E (□ 10 mm x 10 mm) < Renesas Code: PLQP0064KC-A >
 - FP-64K (□ 10 mm x 10 mm)* < Renesas Code: PLQP0064KB-A >

H8/3687F Block Diagram
<Enhanced timer Version>



*: Under development. For in-vehicle use only.



H8/36087 Group Overview

Tiny H8/300H

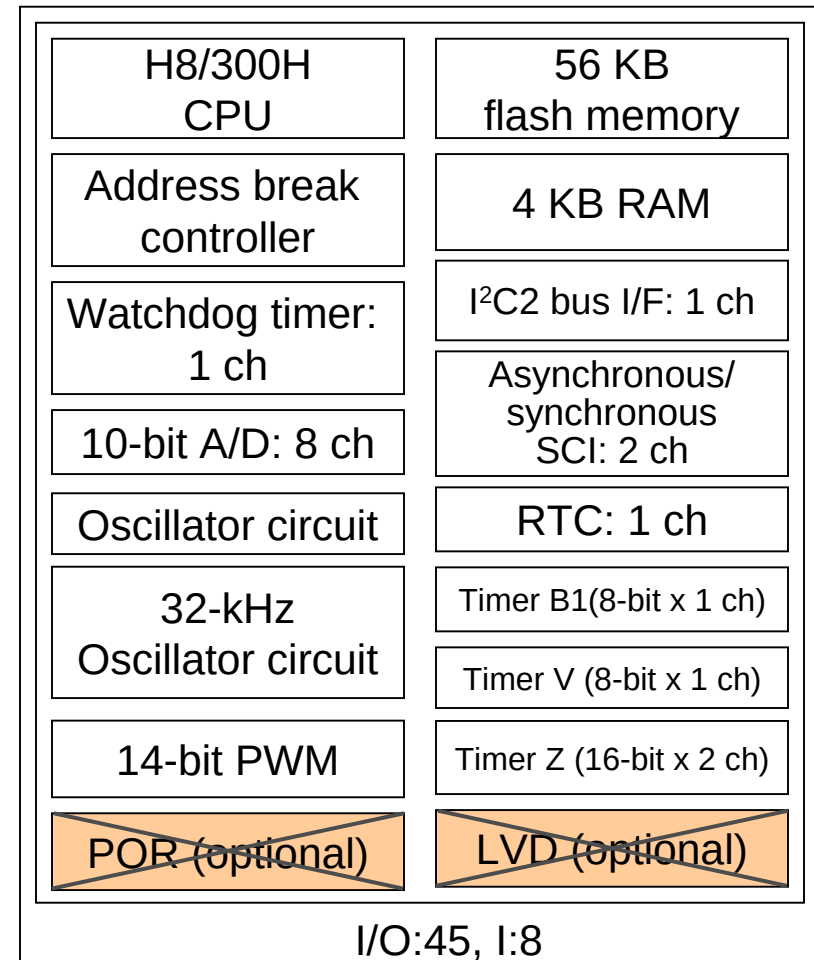
Mass
Production

Features

- H8/3687 18 MHz@3-V version -

- 0.35-μm process is adopted
- H8/300H CPU
 - 4 to 18 MHz/3.0 to 3.6 V
- Memory capacity
 - 56 KB Flash memory products/4 KB RAM (H8/36087F)
 - 56 KB/3 KB (H8/36087M)
 - 48 KB/3 KB (H8/36086M)
 - 40 KB/3 KB (H8/36085M)
 - 32 KB/3 KB (H8/36084M)
 - 16 KB/3 KB (H8/36082M)
- On-chip H8/300, and 300L peripheral functions
 - RTC (realtime clock)
 - 8-bit timer (timers B1, V)
 - 16-bit timer x 2 ch (timer Z)
 - Serial communication I/F: 2 channel
 - 14-bit PWM: 1 channel
- On-chip I²C bus interface2
- Watchdog timer
 - On-chip oscillator circuit
- Interrupt
 - External: 11 types, internal: 37 types
- Package
 - FP-64A (14 mm x 14 mm)
 - < Renesas Code: PRQP0064GB-A >
 - FP-64E (10 mm x 10 mm)
 - < Renesas Code: PLQP0064KC-A >

H8/36087F Block Diagram



 : Different from the H8/3687



H8/36064F Group Overview

Tiny H8/300H

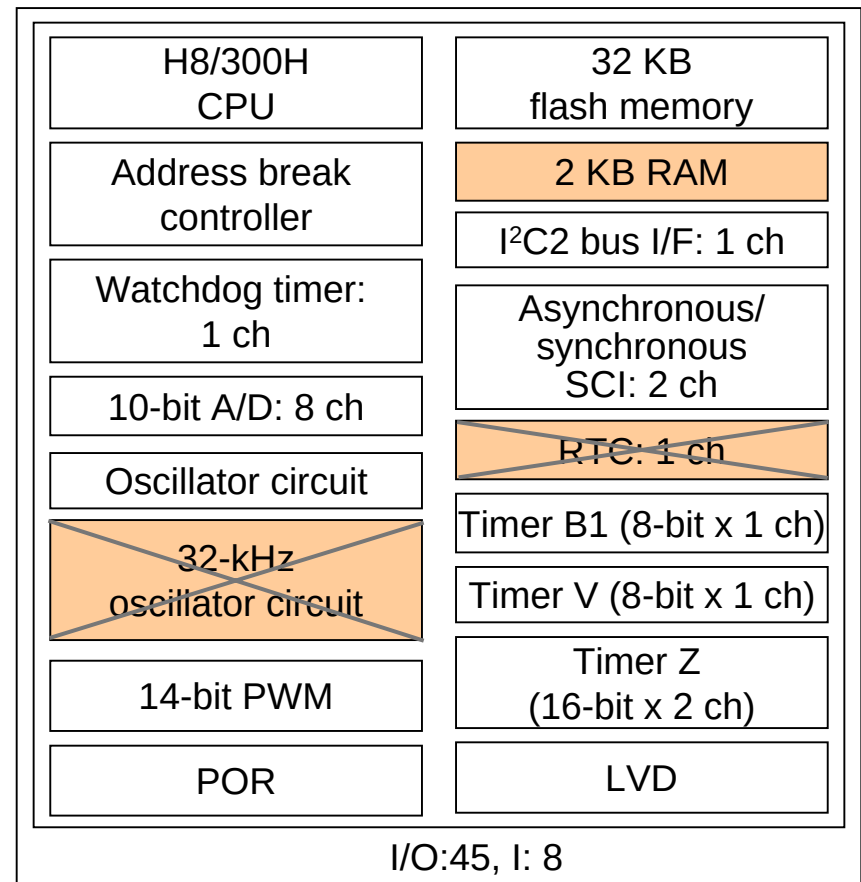
Mass
Production

Features

- 64-Pin Slim Version -

- 0.35- μ m process is used
- On-chip I²C bus interface2
- Incorporates H8/300, H8/300L peripheral functions
 - 8-bit timer (timer B1, V)
 - 16-bit timer (timer Z: 2 ch)
 - Serial communication I/F: 2 ch
 - 14-bit PWM: 1 ch
- Watchdog timer
 - Built-in internal oscillator circuit
- H8/300H CPU
 - When no LVD is used:
 - 1 to 10 MHz/3.0 to 5.5 V
 - 1 to 20 MHz/4.0 to 5.5 V
 - When LVD is used:
 - 1 to 16 MHz/4.5 to 5.5 V
- Interrupts
 - External interrupts: 11 sources
- Memory capacity
 - 32KB Flash memory products/2KB RAM (H8/36064F)
- Built-in POR and LVD
- Packages:
 - FP-64A (□ 14 mm x 14 mm)
< Renesas Code: PRQP0064GB-A >
 - FP-64E (□ 10 mm x 10 mm)
< Renesas Code: PLQP0064KC-A >
 - FP-64K (□ 10 mm x 10 mm)*
< Renesas Code: PLQP0064KB-A >

H8/36064F Block Diagram <64-pin Slim>



 Different from the H8/3684F

*: Under Development



H8/36077 Group Overview

Tiny H8/300H

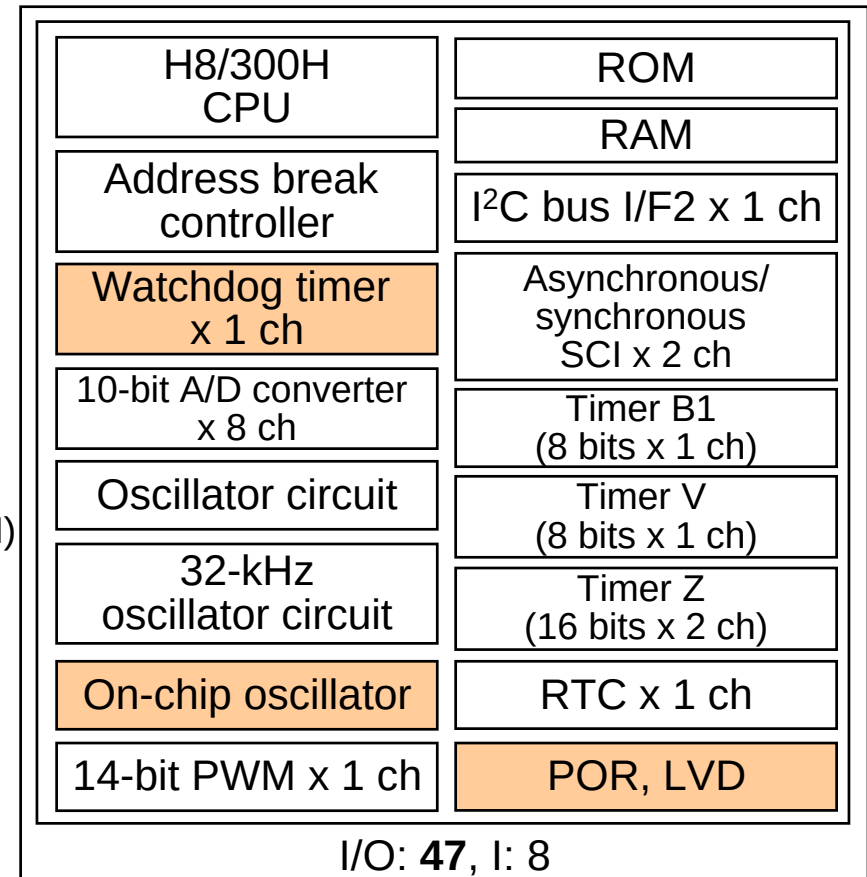
Mass
Production

Features

- H8/3687 Group products with on-chip oscillator -

- H8/300H CPU
 - When not using LVD circuit: 4 to 20 MHz/4.5 to 5.5 V
 - When using LVD circuit: 4 to 16 MHz/4.5 to 5.5 V
- Capacity of ROM/RAM
 - Flash memory version: 56 KB/4 KB (H8/36077F)
 - 32 KB/4 KB (H8/36074F)
- Interrupt control
 - Number of external interrupt sources: 11
 - Number of internal interrupt sources: 39
- Inherited peripheral functions of H8/300 and H8/300L Series products
- Communications functions
 - Serial communications I/F: 2 channels
 - I²C bus interface2: 1 channel
- Timer
 - 8-bit timer: 3 channels (timer B1, timer V, RTC)
 - 16-bit timer: 2 channels (timer Z)
- A/D converter: 10 bit x 8 channels
- 14-bit PWM: 1 channel
- Watchdog timer (on-chip oscillator circuit, initial value ON)
- POR
- LVD (comparator with internal/external selection function, always ON)
- **On-chip oscillator**
Typ. 16 (+/- 3%) or 20 MHz (internal dividing function)
- **External clock oscillation stop detection function**
- On-chip sub-clock
- **Reset source judgment function (POR/LVD, WDT, RESN pin)**
- Package
 - FP-64A (□ 14 mm x 14 mm, 0.8-mm pitch)
 - FP-64K (□ 10 mm x 10 mm, 0.5-mm pitch)

Block Diagram of H8/36077



 : Difference from H8/3687GF



H8/36057, H8/36037 Group Overview

Tiny H8/300H

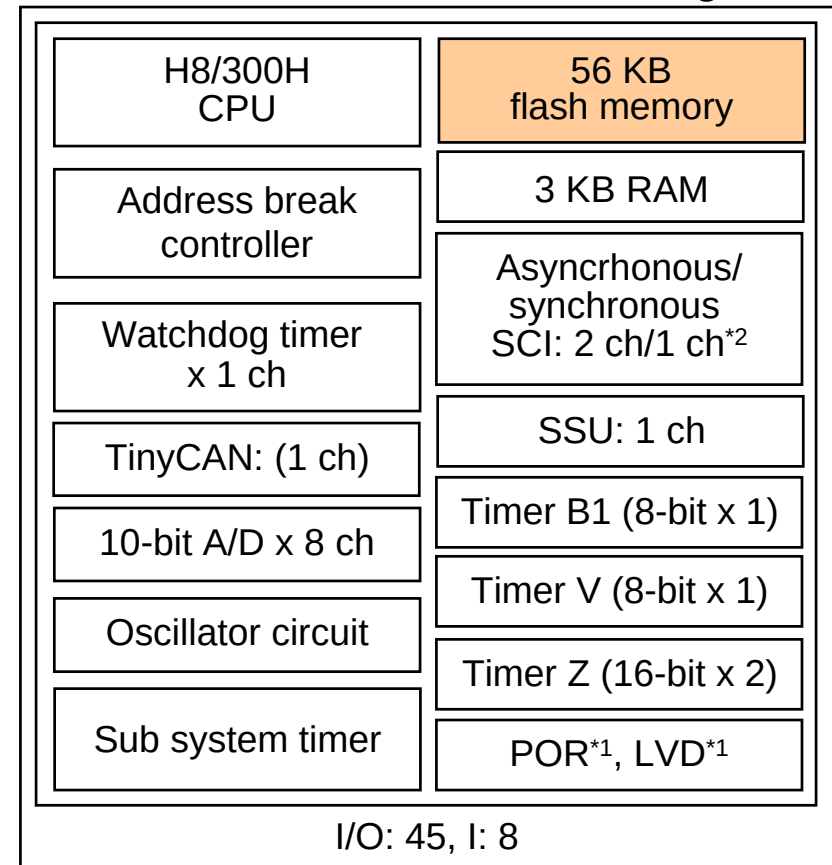
Mass
Production

Features

- On-chip CAN Microcomputer -

- H8/300H CPU
 - 1 to 10 MHz/2.7 to 5.5 V
(Flash memory products: 3.0 to 5.5 V)
 - 1 to 20 MHz/4.0 to 5.5 V
- Memory capacity
 - H8/36057, 37 Group
 - Flash Version: 56 KB/3 KB, 32 KB/2 KB
 - Mask Version^{*3}: 56 KB/2 KB, 48 KB/2 KB,
40 KB/2 KB 32 KB/2 KB,
24 KB/1 KB, 16 KB/1 KB
- TinyCAN x 1 ch
- 8-bit timer x 2 ch (Timer V, Timer B1)
- 16-bit timer x 2 ch (Timer Z)
- Serial communication I/F (SCI3)^{*2}
- Synchronous serial communication unit (SSU) x 1 ch
- Watchdog timer (WDT) x 1 ch
- A/D converter 10-bit x 8 ch
- Sub system timer (Sub timer)
- On-chip POR and LVD (Optional)
- Packages
 - FP-64A (□ 14 mm x 14 mm)
< Renesas Code: PRQP0064GB-A >
 - FP-64E (□ 10 mm x 10 mm)
< Renesas Code: PLQP0064KC-A >
 - FP-64K (□ 10 mm x 10 mm)
< Renesas Code: PLQP0064KB-A >

H8/36057F, 36037F Block Diagram



*1: Option *2: H8/36057 Group: SCI3 x 2 ch, H8/36037 Group: SCI3 x 1 ch

*3: Only H8/36037 Group. Mask Version only 56 KB, 32 KB.



H8/36049 Group Overview

Tiny H8/300H

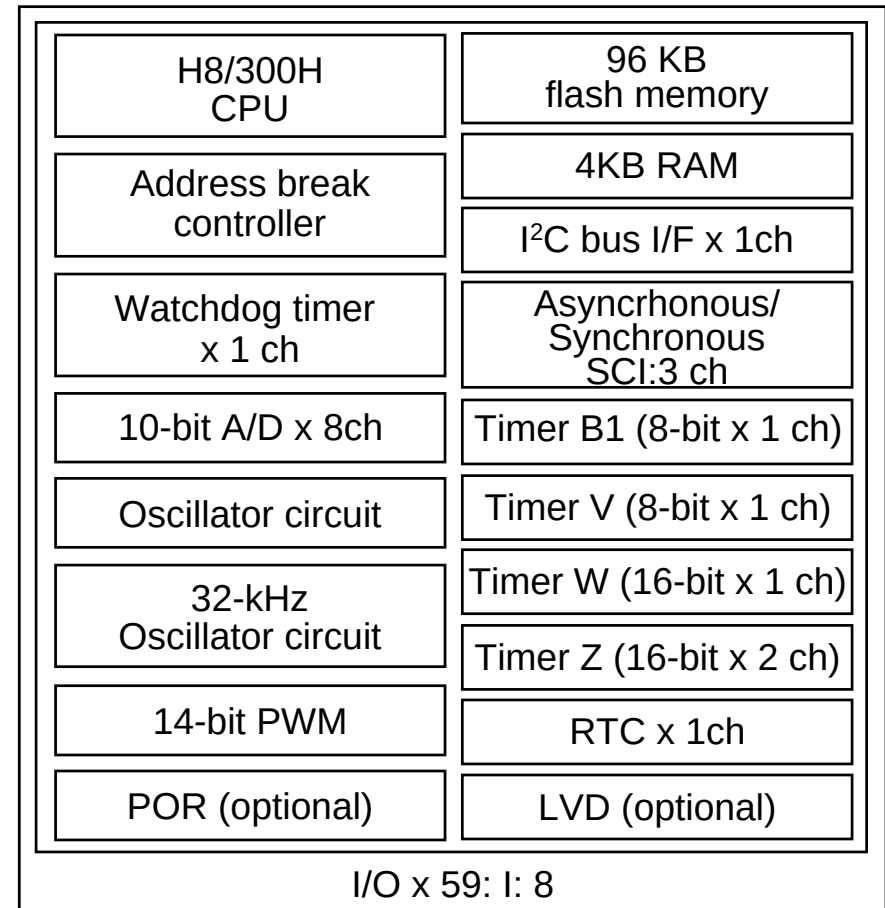
Mass
Production

Features

- 80-pin function enhanced -

- 0.35- μ m process is used
- On-chip I²C bus interface
- On-chip H8/300 and H8/300L peripheral functions
 - RTC (realtime clock)
 - 8-bit timer (timer B1 and timer V)
 - 16-bit timer (timer W: 1 ch, timer Z: 2 ch)
 - Serial communication I/F x 3 ch
 - 14-bit PWM x 1 ch
- Watchdog timer
 - With internal oscillator circuit
- H8/300H CPU
 - 1 to 10 MHz/2.7 to 5.5 V *
 - (Flash memory products: 3.0 to 5.5 V)
 - 1 to 20 MHz/4.0 to 5.5 V
- Interrupts
 - External interrupts: 11
 - Internal interrupts: 48
- Memory capacity
 - 96 KB/4 KB (H8/36049F)
 - 96 KB/3 KB (H8/36049M)
 - 80 KB/3 KB (H8/36048M)
 - 64 KB/3 KB (H8/36047M)
- On-chip POR and LVD (optional)
 - when LVD is used: 1 to 16 MHz/4.5 to 5.5 V
- Packages
 - FP-80A ($\square$ 14 mm x 14 mm)
 - <Renesas Code: PRQP0080JB-A>

H8/36049F Block Diagram <Tiny 80>



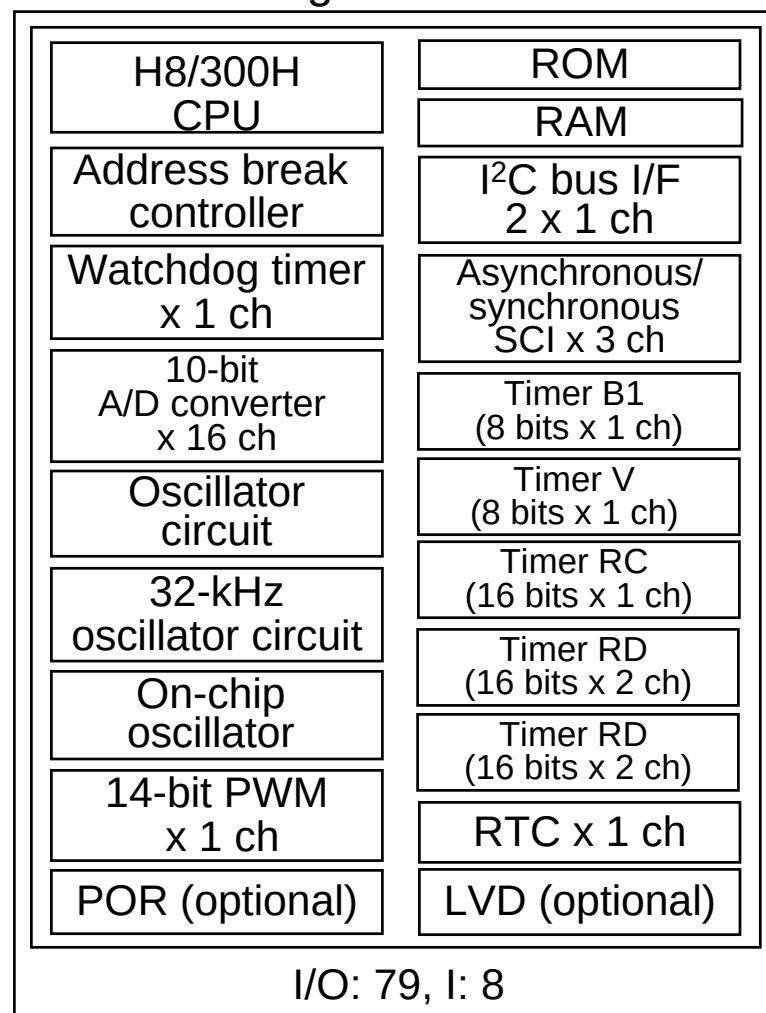
H8/36109 Group Overview

Features

- 100-pin timer enhanced products -

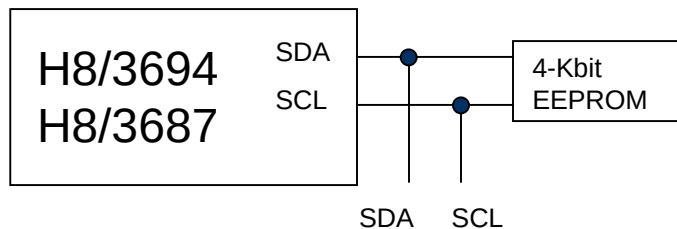
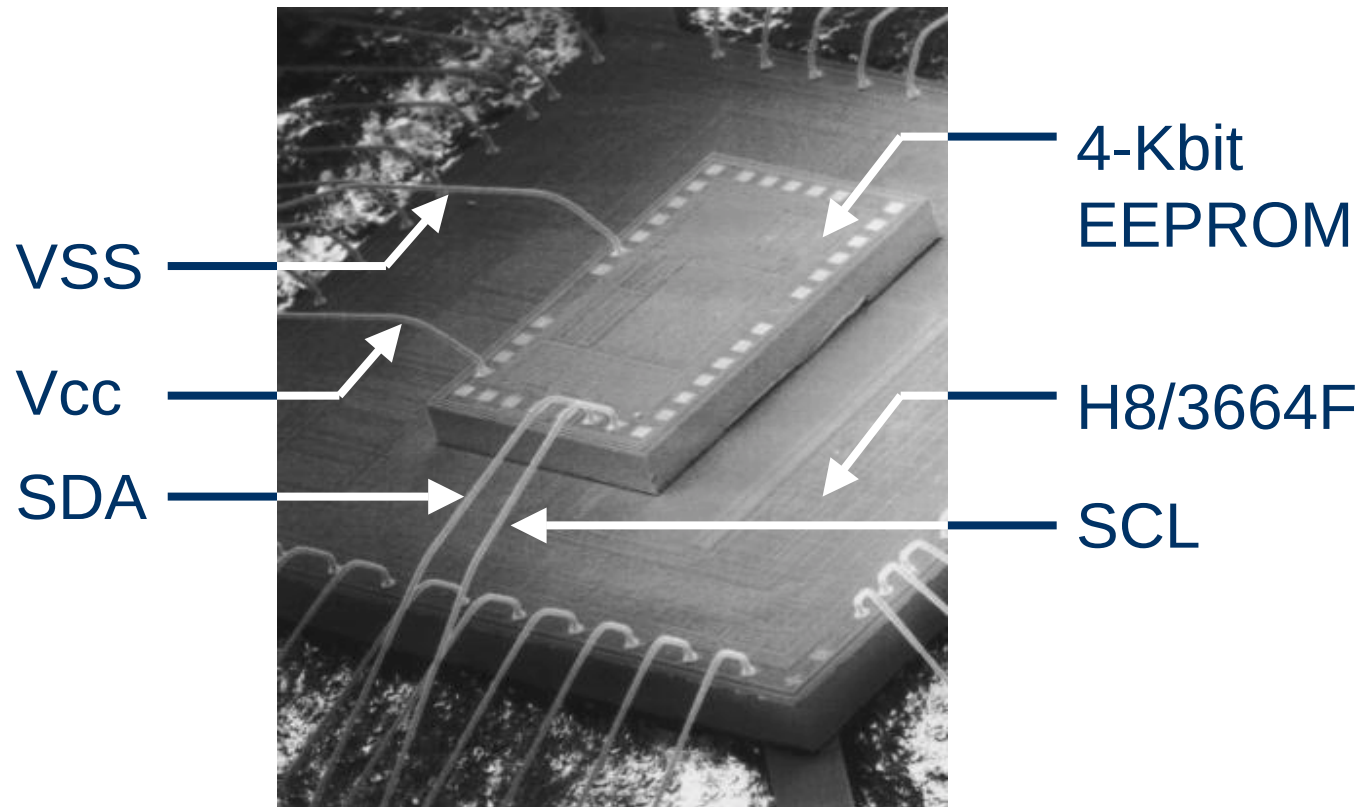
- H8/300H CPU
 - When not using LVD circuit: 4 to 10 MHz/2.7 to 5.5 V (F-ZTAT: 3.0 to 5.5 V)
 - 4 to 20 MHz/4.0 to 5.5 V
 - When using LVD circuit: 4 to 16 MHz/4.5 to 5.5 V
- Capacity of ROM/RAM
 - Flash memory version: 128 KB/5 KB (H8/36109F)
 - Mask version: 128 KB/4 KB (H8/36109M)
 - 96 KB/4 KB (H8/36108M)
 - 64 KB/4 KB (H8/36107M)
- Interrupt control
 - External interrupt source: 11
 - Internal interrupt source: 60
- Inherited peripheral functions of H8/300 and H8/300L Series products
- Communications functions
 - Serial communications I/F: 3 channels (Noise elimination circuit is available only for 1 channel)
 - I²C bus interface2: 1 channel
- Timer
 - 8-bit timer: 3 channels (timer B1, timer V, RTC)
 - 16-bit timer: 5 channels (timer RC, timer RD: 2 channels)
- **40-MHz operation**
- A/D converter: 10 bits x 16 channels
- 14-bit PWM: 1 channel
- Watchdog timer (On-chip oscillator circuit, initial value ON)
- POR, LVD (optional)
- **On-chip oscillator**
Typ. 16 or 20 MHz (internal dividing function)
- On-chip sub-clock
- Package
 - FP-100 (□ 14 mm x 20 mm, 0.65-mm pitch)

Block Diagram of H8/36109



EEPROM Stacked Layer Product Structure

Tiny H8/300H



Connection is by wire bonding via the lead frame. Bringing the SDA and SCL pins outside the package enables connection to any device equipped with an I²C bus interface.



H8/3694GN Group Overview

- H8/3694G stacked EEPROM layer version -

Tiny H8/300H

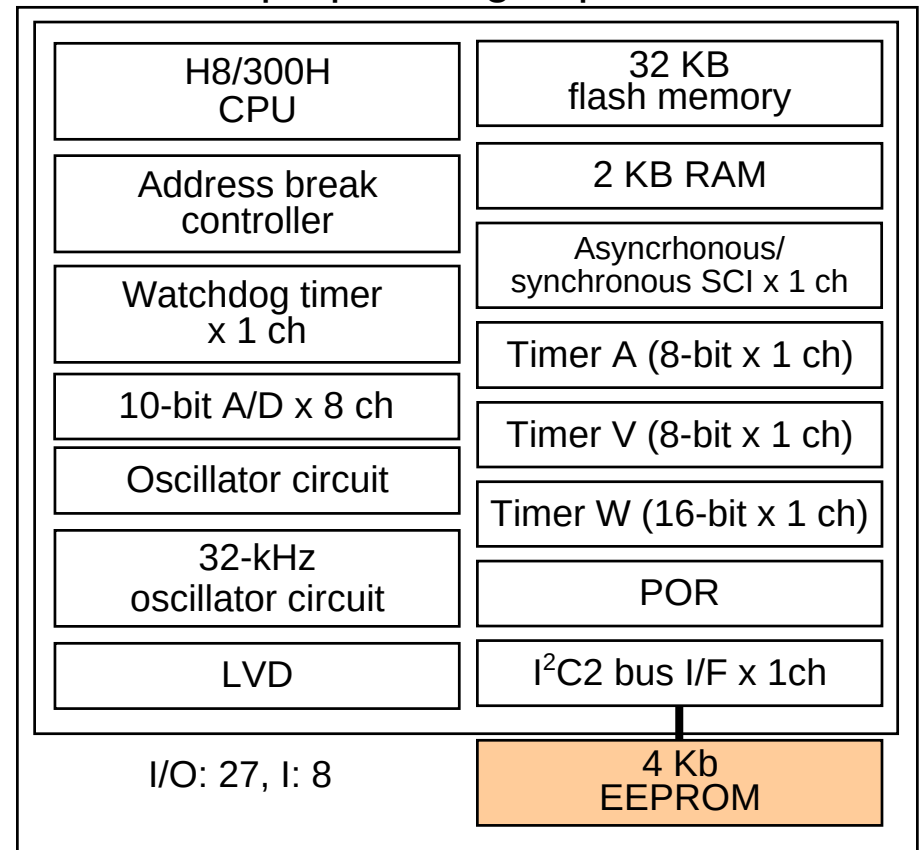
Mass
Production

Features

- 4-Kbit EEPROM is stacked in the H8/3694G
- Small capacity Flash memory products
- On-chip I²C bus interface²
- On-chip H8/300 and H8/300L peripheral functions
 - 8-bit timer (timer A and timer V)
 - 16-bit timer (timer W)
 - Serial communication I/F
- Watchdog timer
 - With internal oscillator circuit
- H8/300H CPU
 - 1 to 10 MHz/2.7 to 5.5 V
 - (Flash memory products: 3.0 to 5.5 V)
 - 1 to 20 MHz/4.0 to 5.5 V
- Memory capacity
 - 32 KB Flash memory products/2 KB RAM/
 - 4 Kb EEPROM (H8/3694GN)
 - 32 KB MaskROM/1 KB RAM/
 - 4 Kb EEPROM (H8/3694GNM)
- On-chip POR and LVD
 - when LVD is used: 1 to 16 MHz/4.5 to 5.5 V
- Packages
 - FP-64E (□10 mm x 10 mm)
 - <Renesas Code: PLQP0064KC-A>

Block Diagram

<General-purpose high-speed Version>





H8/3687GN Group Overview

- H8/3687G stacked EEPROM layer version -

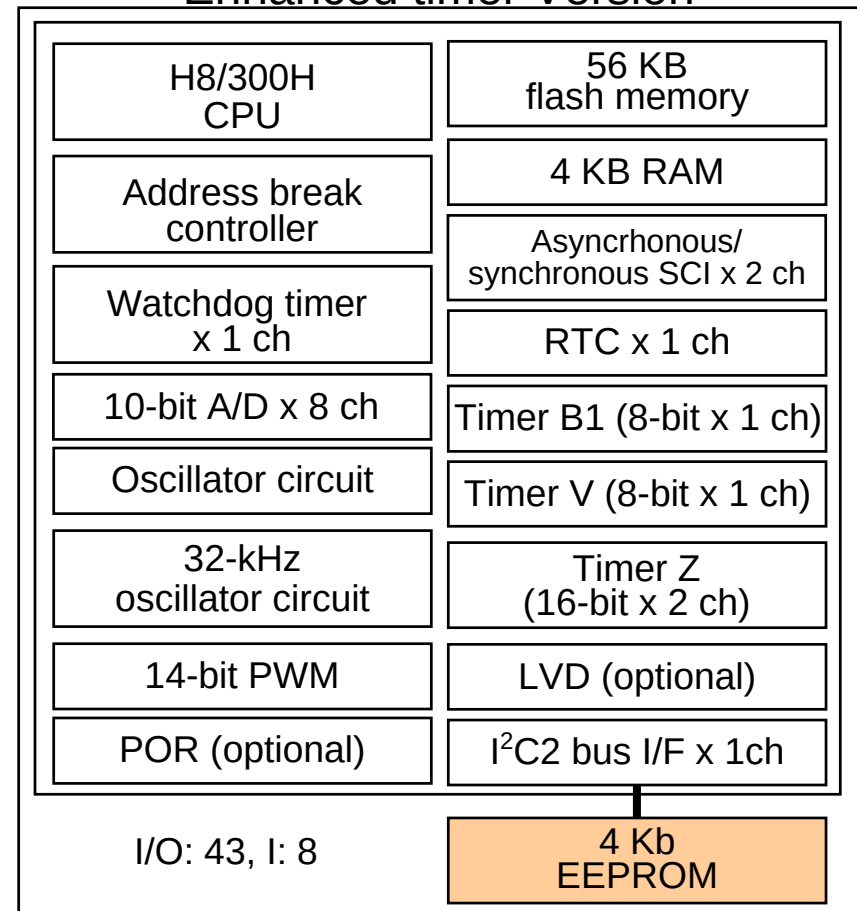
Tiny H8/300H

Mass
Production

Features

- 4-Kbit EEPROM is stacked in the H8/3687G
- 0.35- μ m process is used
- On-chip I²C bus interface2
- On-chip H8/300 and H8/300L peripheral functions
 - RTC (realtime clock)
 - 8-bit timer (timer B1 and timer V)
 - 16-bit timer x 2 ch (timer Z)
 - Serial communication I/F x 2 ch
 - 14-bit PWM x 1 ch
- Watchdog timer
 - With internal oscillator circuit
- H8/300H CPU
 - 1 to 10 MHz/2.7 to 5.5 V
 - (Flash memory products: 3.0 to 5.5 V)
 - 1 to 20 MHz/4.0 to 5.5 V
- Interrupts
 - External interrupts: 11
 - Internal interrupts: 37
- Memory capacity
 - 56 KB Flash memory products/
4 KB RAM/4 Kb EEPROM (H8/3687GN)
 - 56 KB MaskROM/3 KB RAM/4 Kb EEPROM (H8/3687GNM)
- On-chip POR and LVD
 - when LVD is used: 1 to 16 MHz/4.5 to 5.5 V
- Packages
 - FP-64E (□ 10 mm x 10 mm)
 - <Renesas Code: PLQP0064KC-A>

Block Diagram
<Enhanced timer Version>



H8/300H Tiny Series: High-Quality Products



For applications in the automotive field, etc., the H8/300H Tiny series includes products for high-temperature operation that have particularly high quality. These high-quality products are included in the list below.

Optional functions, operating voltage, max. operating frequency, operating-temperature range, packages

Group*1	Optional functions*2			Operating-Temperature range*3	Maximum operating frequency/operating voltage	Packages
	Included	POR	LVD			
H8/3664	No	-		J	16 MHz/5 V	FP-64A <Renesas Code: PRQP0064GB-A>, FP-64E <Renesas Code: PLQP0064KC-A>
H8/3694	No	-		J	20 MHz/5 V	FP-64A <Renesas Code: PRQP0064GB-A> FP-64E <Renesas Code: PLQP0064KC-A> FP-48B <Renesas Code: PLQP0048KC-A> FP-64K*4 <Renesas Code: PLQP0064KB-A>
				JE/K	16 MHz/5 V	
	Yes	Yes		J	16 MHz/5 V	
			No	JE/K	16 MHz/5 V	
H8/3687	No	-		J	20 MHz/5 V	FP-64A <Renesas Code: PRQP0064GB-A> FP-64E <Renesas Code: PLQP0064KC-A> FP-64K*4 <Renesas Code: PLQP0064KB-A>
				JE/K	16 MHz/5 V	
	Yes	Yes		J	16 MHz/5 V	
			No	JE/K	16 MHz/5 V	
H8/36014 H8/36024	No	-		J	20 MHz/5 V	FP-64E <Renesas Code: PLQP0064KC-A> FP-48B <Renesas Code: PLQP0048KC-A>
				JE*4	16 MHz/5 V	
	Yes	Yes		J	16 MHz/5 V	
			No	JE*4	16 MHz/5 V	
H8/36037 H8/36057	No	-		J	20 MHz/5 V	FP-64A <Renesas Code: PRQP0064GB-A>, FP-64E <Renesas Code: PLQP0064KC-A> FP-64K*4 <Renesas Code: PLQP0064KB-A>
				JE*4/K*4	16 MHz/5 V	FP-64A <Renesas Code: PRQP0064GB-A>, FP-64K*4 <Renesas Code: PLQP0064KB-A>
	Yes	Yes		J	16 MHz/5 V	FP-64A <Renesas Code: PRQP0064GB-A>, FP-64E <Renesas Code: PLQP0064KC-A> FP-64K*4 <Renesas Code: PLQP0064KB-A>
			No	JE*4/K*4	16 MHz/5 V	FP-64A <Renesas Code: PRQP0064GB-A>, FP-64K*4 <Renesas Code: PLQP0064KB-A>

*1. EEPROM-stacked versions of H8/300H Tiny series products do not include high-quality products.

*2. The power-on reset (POR) and low-voltage detection (LVD) circuits are optional.

These optional functions are for 5-V power-supply systems only, i.e. they are not supported for products with 3-V power supplies.

JE-spec. and K-spec. products include only POR. Although the hardware manuals for these products describe both POR and LVD circuits, the LVD is not supported in these cases.

*3. J spec: (operating-temperature range from -40. to +85°C), JE spec.: (operating temperature range from -40. to +105°C), K spec: (operating-temperature range from -40°C to +125°C). For details, refer to [Microcomputer product quality and temperature range for usage](#).

*4. Under development

Note: For lead-free versions of H8/300H Tiny series products, contact your nearest Renesas sales office.

Announcement to Customers!



The H8/300H Tiny Series Homepage is Now Open at:

<http://www.renesas.com/en/h8tiny>

Visit the page for a full range of useful information, including the latest manuals, technical updates, data on current consumption, and development tools.

Super Low Power

Microcomputer General Presentation

Super Low-Power Microcomputers

H8/300L
Super Low Power

H8/300H
Super Low Power

H8S
Super Low Power

October 28, 2005

Rev.2.00

Application Engineering Div.1

Microcomputer Application Engineering Dept.

Renesas Solutions Corp.

What is a Super Low-Power Microcomputer?

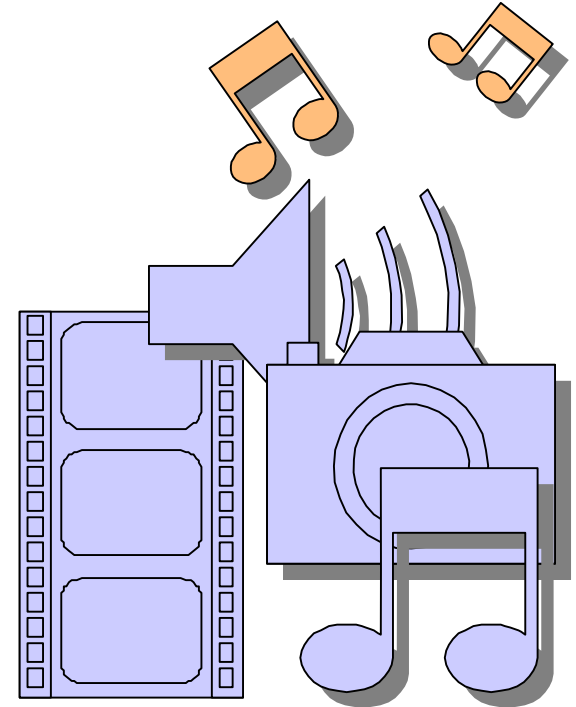
**Super
Low Power**

It is the general-purpose microcomputer which has features of low voltage and low current consumption.

1. Long lifetime of battery with 1.8-V operation
2. Reliable and proven flash memory
3. World's least amount of current consumed during wait ($0.5 \mu\text{A}/1.8 \text{ V}$)
4. Abundant development support tools
 - Low-cost development tools for Tiny Series products
 - Technical support via the Web
 - Variety of demo sets

*: Typ. value in the watch mode (during clock count operation)
(At this point)

The super low-power microcomputers include 8-bit (H8/300L) and 16-bit (H8/300H and H8S) versions.



Current Consumption Concept of the Super Low-Power Microcomputers

**Super
Low Power**

Low-voltage operation

1.8-V operation products that operates up to the end of battery's lifetime



Low-voltage operation of F-ZTAT version

Lineup of 1.8-V operation flash memory

Current reduction during wait

The amount of current during standby, which takes the large portion of the current consumption, is reduced, achieving long operation time with battery



Low current consumption in the watch mode

Reduced current consumption in system wait state by world's least current consumption in the watch mode (1.8 V/0.5 μ A*)

Short oscillation stabilization time

The amount of current consumed during repeated operation of oscillation and halt of the main clock is reduced



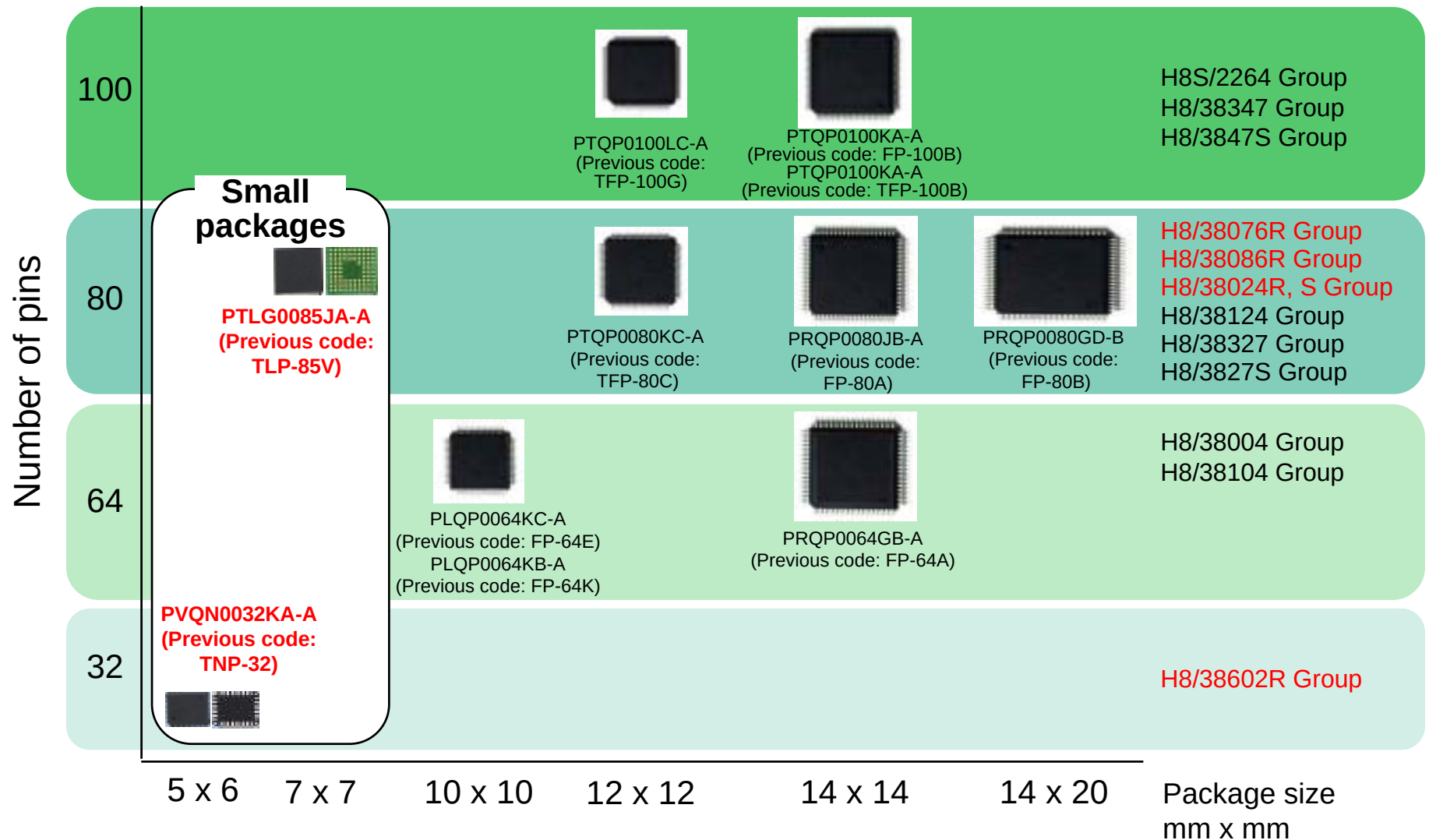
Short oscillation stabilization time/on-chip oscillator

Reduced current dissipation, on-chip circuit for short oscillation stabilization time

*: Typ. value in the watch mode (during clock count operation)
(At this point)

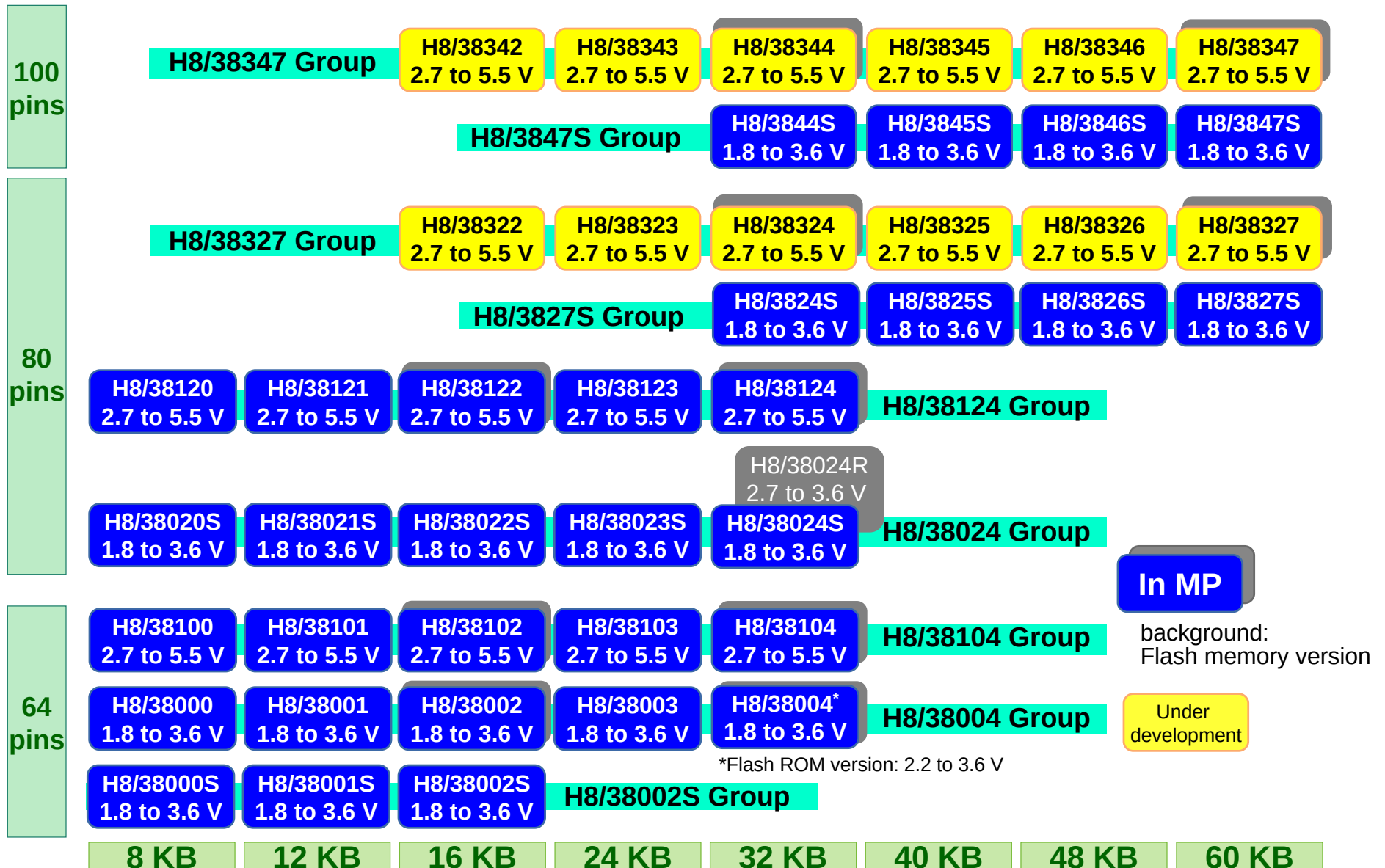
Packages for Super Low-Power products

**Super
Low Power**



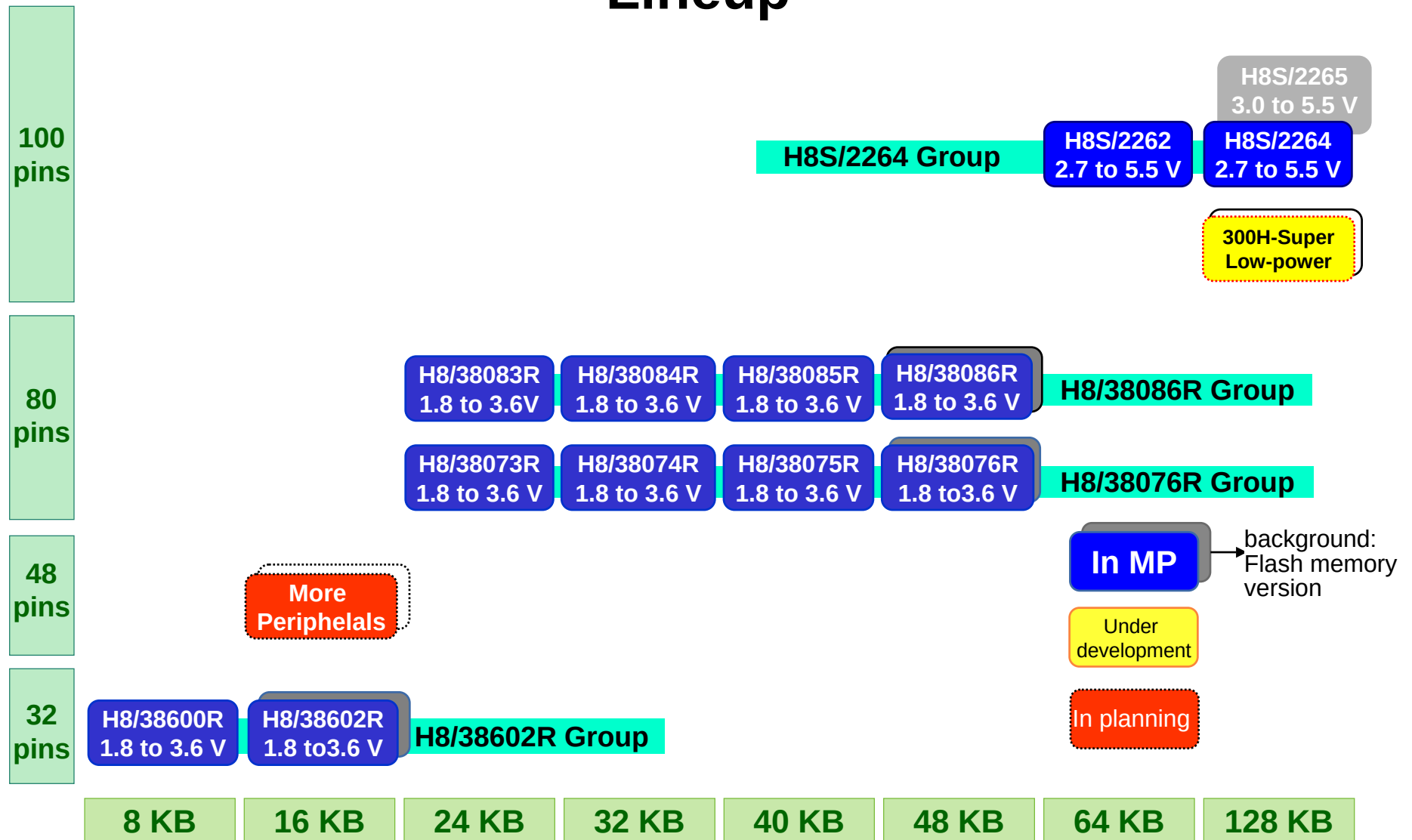
H8/300L-Super Low-Power Lineup

*Super
Low Power*



H8/300H, H8S-Super Low-Power Lineup

**Super
Low Power**



Overview of H8/38104 Group

- 5-V Flash Memory Version of H8/3802 and 38004*1 -

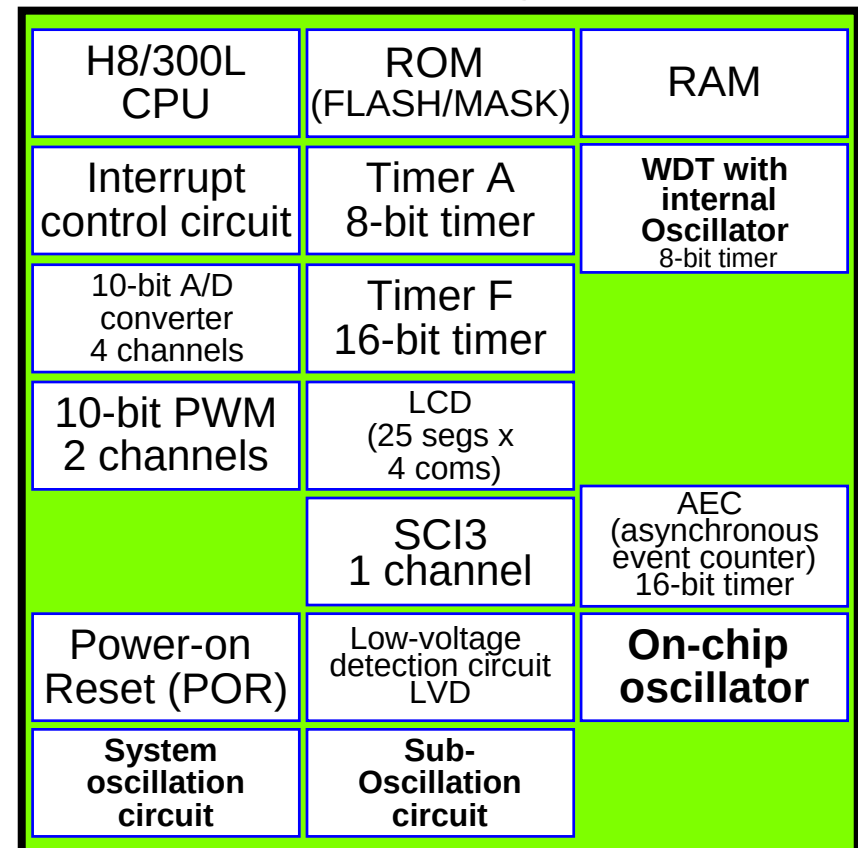


Mass
Production

Features

- H8/300L CPU
 - 2 to 20 MHz/2.7 V to 5.5 V (1/2 division of internal clock)
- ROM/RAM
 - 32 KB/1 KB (H8/38104F^{*2}, M)
 - 24 KB/1 KB (H8/38103M)
 - 16 KB/1 KB (H8/38102F^{*2}, M)
 - 12 KB/512 B (H8/38101M)
 - 8 KB/512 B (H8/38100M)
- Interrupts
 - External interrupt: 3 (IRQ), 8 (wake-up)
- Timer: 8 bits x 1 ch, 16 bits x 2 ch, WDT, 10-bit PWM x 2 ch,
 - Timer A (8 bits, for clocks and interval timers)
 - Timer F (16 bits, interval timer, event counter, output compare)
 - AEC (16 bits, interval timer, event counter)
 - WDT (with internal oscillation circuit)
 - 10-bit PWM x 2 ch
- SCI: SCI3 x 1 channel (UART/synchronous)
- A/D: 10 bits x 4 channels
(successive approximation type)
- LCD: 25 segments x 4 coms
- Power-on reset circuit (POR)
- Low-voltage detection circuit (LVD)
- On-chip oscillator
- Packages:
 - PRQP0064GB-A (Former code: FP-64A)
(14 x 14, 0.8-mm pitch)
 - PLQP0064KC-A (Former code: FP-64E)
(10 x 10, 0.5-mm pitch)

Block Diagram



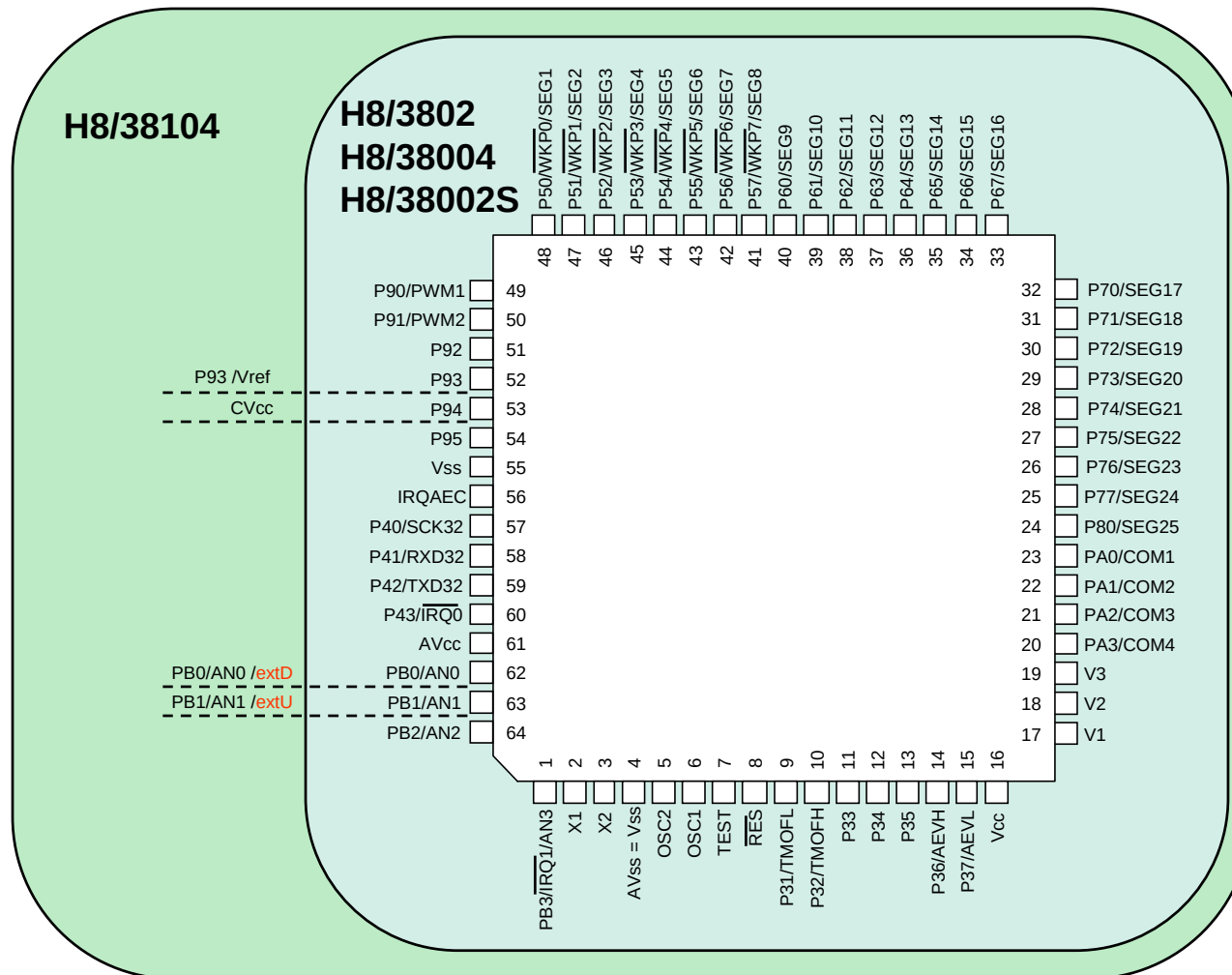
Incorporates the emulation function enabling on-chip debugging with the E7/E8.

*1: Part of pin assignment may be different.

*2: Flash memory version incorporates 1-Kbyte RAM separately for flash memory reprogramming.

Comparison: Pin Assignment of H8/3802, 38004, and H8/38104

**Super
Low Power**



Overview of H8/38124 Group

- 5 V flash memory version of H8/38024*1 -

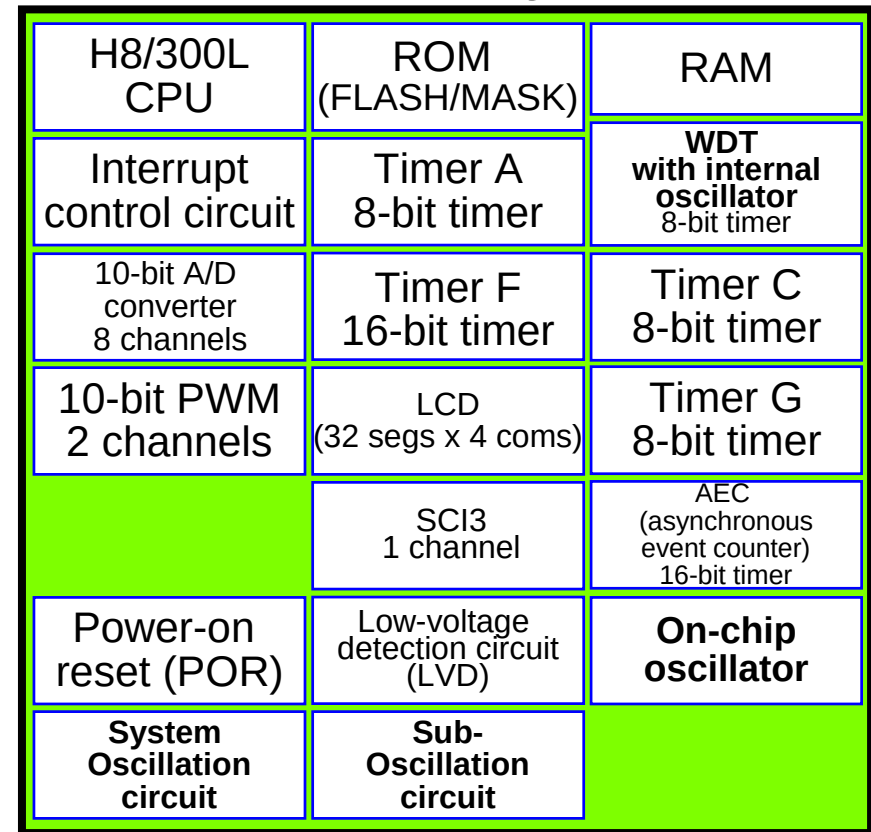


Mass
Production

Features

- H8/300L CPU
 - 2 to 20 MHz/2.7 V to 5.5 V (1/2 division of internal clock)
- ROM / RAM
 - 32 KB/1 KB (H8/38124F*2, M)
 - 24 KB/1 KB (H8/38123M)
 - 16 KB/1 KB (H8/38122F*2, M)
 - 12 KB/512 B (H8/38121M)
 - 8 KB/512 B (H8/38120M)
- Interrupts
 - External interrupt: 5 (IRQ) and 8 (wake-up)
- Timer: 8 bits x 3 ch, 16 bits x 2 ch, WDT, 10-bit PWM x 2 ch
 - Timer A (8 bits, for clock, interval timer)
 - Timer C (8 bits, interval timer, event counter)
 - Timer G (8 bits, interval timer, input capture)
 - Timer F (16 bits, interval timer, event counter, output compare)
 - AEC (16 bits, interval timer, event counter)
 - WDT (with internal oscillator)
 - 10-bit PWM x 2 ch
- SCI: SCI3 x 1 ch (UART/synchronous)
- A/D converter: 10 bits x 8 channels (successive approximation type)
- LCD: 32 segments x 4 coms
- Power-on reset circuit (POR)
- Low-voltage detection circuit (LVD)
- On-chip oscillator
- Packages:
 - PRQP0080JB-A (Former code: FP-80A) (14 x 14, 0.65-mm pitch)
 - PTQP0080KC-A (Former code: TFP-80C) (12 x 12, 0.5-mm pitch)

Block Diagram



Incorporates the emulation function enabling on-chip debugging with the E7/E8.

*1: Part of pin assignment may be different.

*2: Flash memory version incorporates 1-Kbyte RAM separately for flash memory reprogramming.

***Super
Low Power***



Overview of H8/38327 Group

- 5-V Flash Memory Version of H8/3827 (80 pins)*1 -

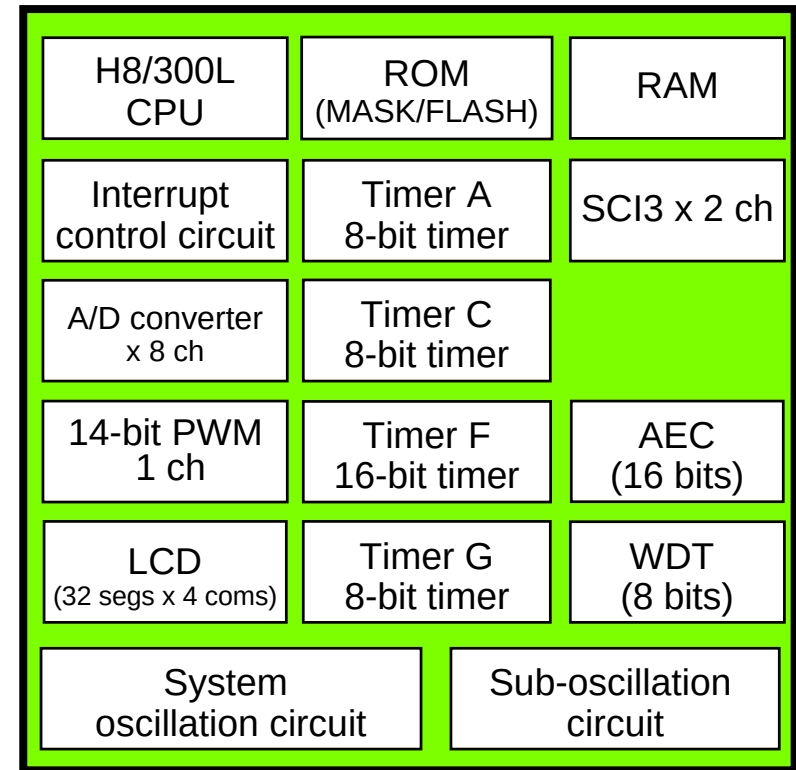


Mass
Production*3

Features

- H8/300L CPU
2 to 16 MHz/2.7 V to 5.5 V (1/2 division of internal clock)
- ROM/RAM:
 - 60 KB/2 KB (Flash memory*2, Mask)
 - 48 KB/2 KB (Mask)
 - 40 KB/2 KB (Mask)
 - 32 KB/2 KB (Flash memory*2, Mask)
 - 24 KB/1 KB (Mask)
 - 16 KB/1 KB (Mask)
- Timer: 8 bits x 3 ch, 16 bits x 2 ch, WDT, 14-bit PWM
 - Timer A (8 bits, watch, interval)
 - Timer C (8 bits, interval, event counter)
 - Timer G (8 bits, interval, input capture)
 - Timer F (16 bits, interval, event counter, output compare)
 - Asynchronous event counter (16 bits, interval, event counter)
 - Watchdog timer
 - 14-bit PWM
- SCI: SCI3 x 2 ch (synchronous/clock synchronous)
- A/D converter: 10 bits x 8 ch
- LCD: 32 segments x 4 coms
- External interrupts: 5 (IRQ), 8 (Wake-up)
- Packages: PRQP0080JB-A (Previous code: FP-80A)
(14 x 14, 0.65-mm pitch)
PTQP0080KC-A (Previous code: TFP-80C)
(12 x 12, 0.5-mm pitch)

Block Diagram



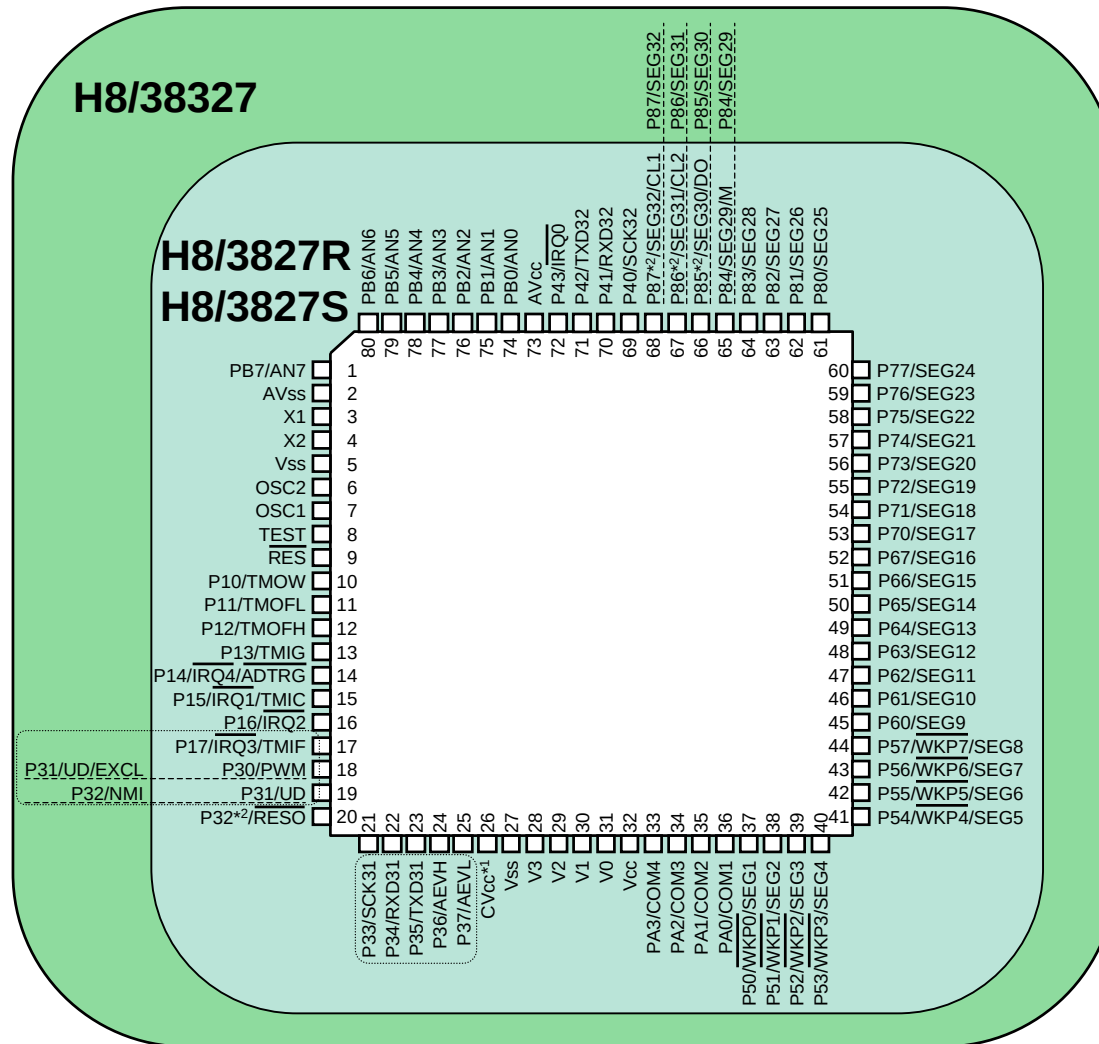
Incorporating the emulation function enables on-chip debugging with the E7/E8.

*1: Part of pin assignment may be different.

*2: Flash memory version incorporates 1-Kbyte RAM separately for flash memory rewrite.

*3: Flash version only. Mask version is under development.

Comparison: Pin Assignment of H8/3827 and H8/38327



*1 Vcc is used for S version
*2 E7 pin : P32,P85,P86,P87

Overview of H8/38347 Group

- 5-V Flash Memory Version of H8/3847 (100 pins)^{*1} -

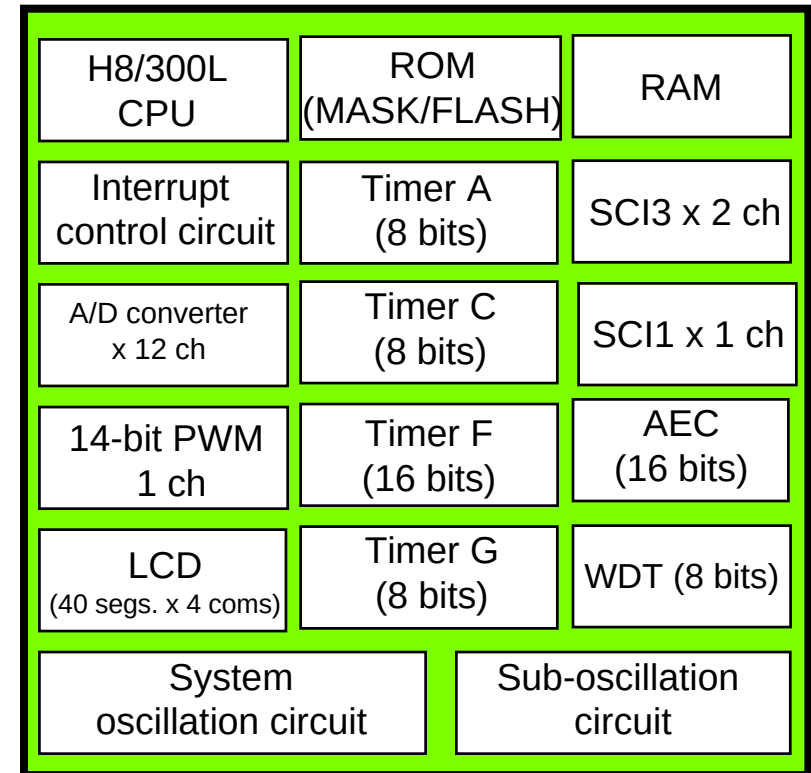
H8/300L
Super Low Power

Mass
Production^{*3}

Features

- H8/300L CPU
2 to 16 MHz/2.7 V to 5.5 V (1/2 division of internal clock)
- ROM/RAM
 - 60 KB/2 KB (Flash memory^{*2}, Mask)
 - 48 KB/2 KB (Mask)
 - 40 KB/2 KB (Mask)
 - 32 KB/2 KB (Flash memory^{*2}, Mask)
 - 24 KB/1 KB (Mask)
 - 16 KB/1 KB (Mask)
- Timer: 8 bits x 3 ch, 16 bits x 2 ch, WDT, 14-bit PWM
 - Timer A (8 bits, watch, interval)
 - Timer C (8 bits, interval, event counter)
 - Timer G (8 bits, interval, input capture)
 - Timer F (16 bits, interval, event counter, output compare)
 - Asynchronous event counter (16 bits, interval, event counter)
 - Watchdog timer
 - 14-bit PWM
- SCI: SCI3 x 2 ch (synchronous/clock synchronous)
SCI1 x 1 ch (clock synchronous)
- A/D converter: 10 bits x 12 ch
- LCD: 40 segments x 4 coms
- External interrupts: 5 (IRQ), 8 (Wake-up)
- Packages: PRQP0100KA-A (Previous code : FP-100B)
(14 x 14, 0.5-mm pitch)
PTQP0100KA-A (Previous code : TFP-100B)
(14 x 14, 0.5-mm pitch)
PTQP0100LC-A (Previous code : TFP-100G)
(12 x 12, 0.4-mm pitch)

Block Diagram



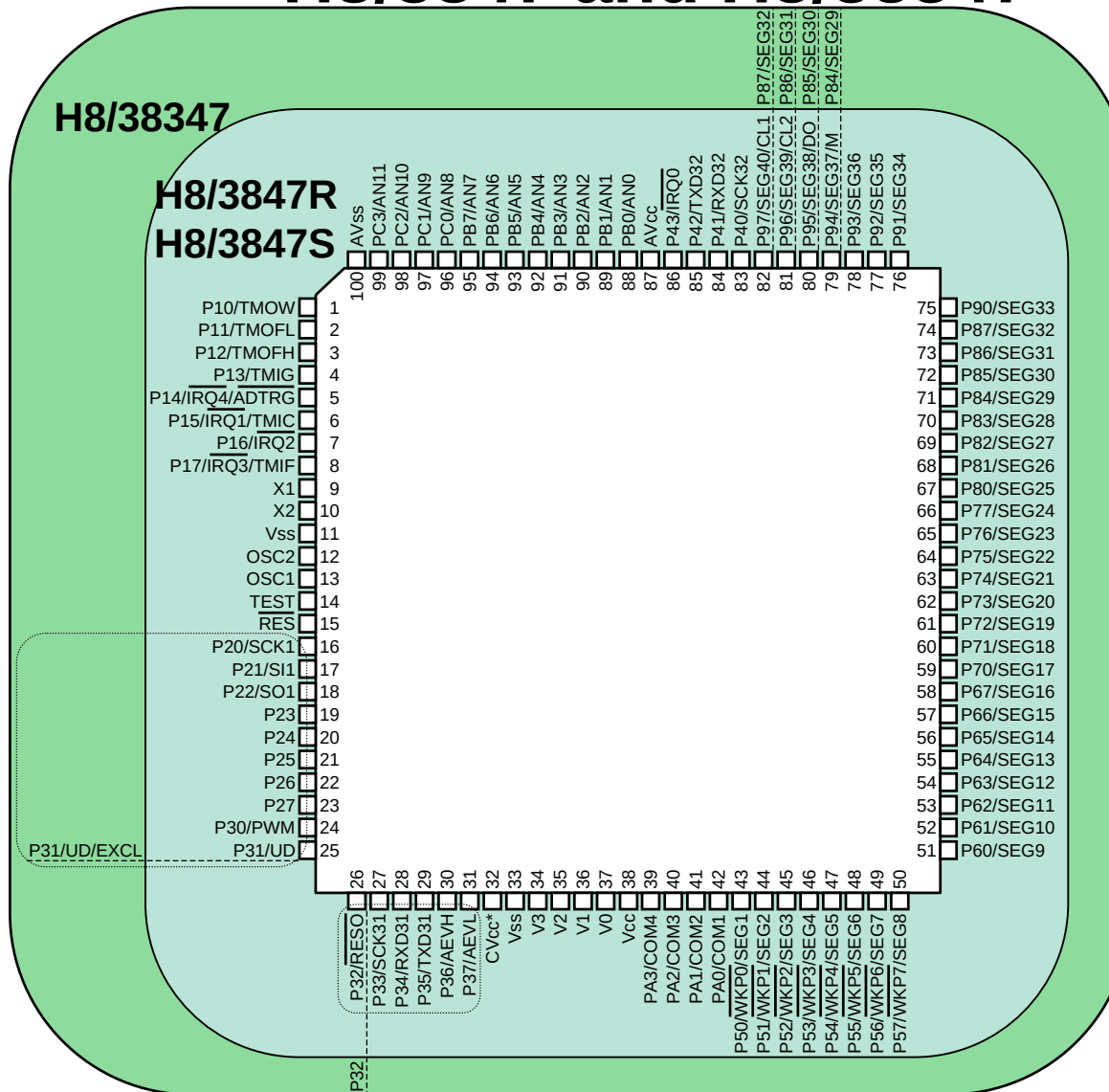
Incorporating the emulation
function enables on-chip
debugging with the E7/E8.

^{*1}: Part of pin assignment may be different.

^{*2}: Flash memory version incorporates 1-Kbyte RAM separately
for flash memory rewrite.

^{*3}: Flash version only. Mask version is under development.

Comparison: Pin Assignment of H8/3847 and H8/38347



*1 Vcc is used for S version

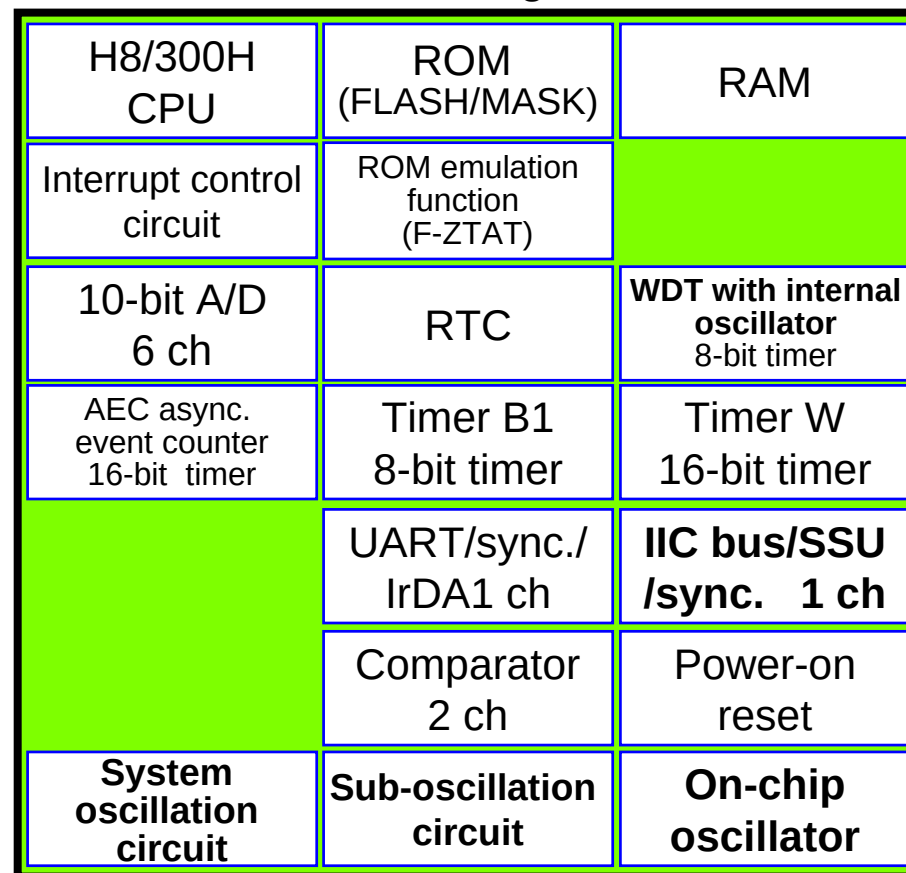
H8/38602R Group Overview

- Low voltage, high-function, compact package -

Features

- H8/300H CPU
4 to 10 MHz/2.7 V to 3.6 V
2 to 4.2 MHz/1.8 V to 3.6V
- ROM/RAM
16 KB/1 KB (Mask, Flash*)
8 KB/512 B (Mask)
- Interrupts
 - External interrupts: 3 (IRQ)
 - Internal interrupts: For each module
- Timer: 8 bits x 1 ch, 16 bits x 2 ch, RTC, WDT
 - Timer B1 (8 bits, interval timer, reload timer),
 - Timer W (16 bits, output compare, input capture 3-phase PWM)
 - AEC (16 bits, event counter, interval timer, PWM)
 - RTC (can also be used for week-clock counter, 8-bit interval timer)
 - WDT (with internal oscillation circuit, can also be used for 8-bit interval timer)
- SCI: SCI3 x 1 ch (UART/sync/IrDA),
IIC2/SSU x 1 ch (IIC bus, four-wire serial, sync)
- A/D converter: Successive approximation type,
10 bits x 6 ch
- Comparator x 2 ch (external/internal reference
potential selectable)
- Power-on reset circuit (POR)
- On-chip oscillator
- Package: PVQN0032KA-A (Former code: TNP-32)
(5 x 6, 0.5-mm pitch)

Block Diagram



Incorporates the emulation function enabling on-chip debugging with the E7/E8.

*: Flash memory version incorporates 1-Kbyte RAM and 4-Kbyte ROM separately for on chip debugging.

Overview of H8/38076R Group

- Low voltage, high function, LCD -

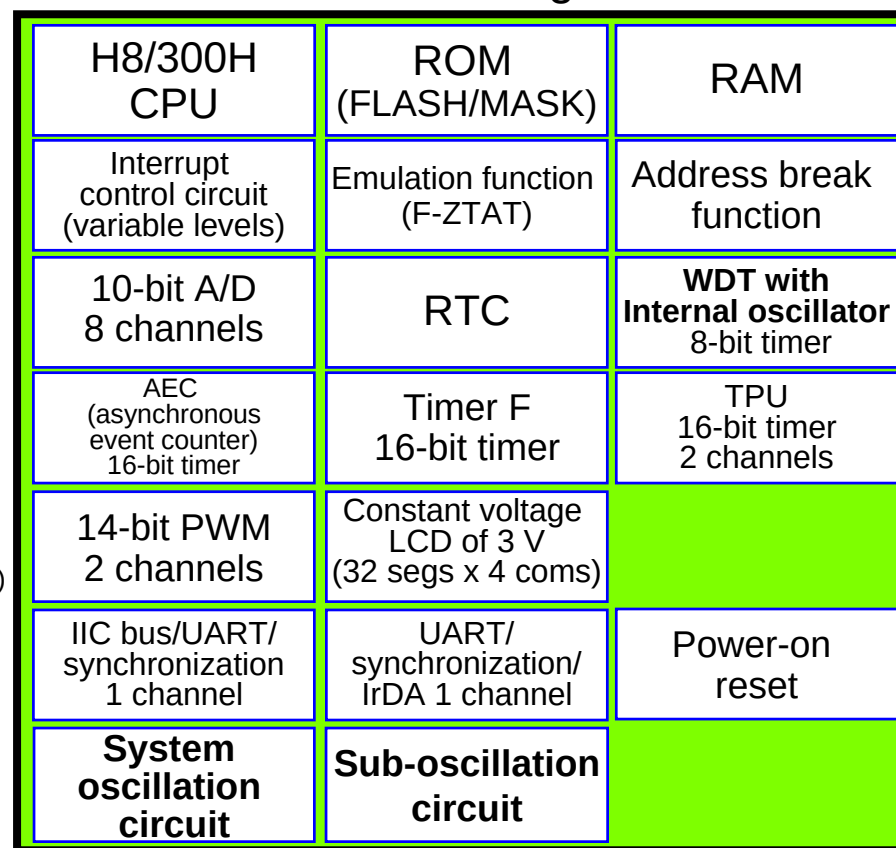


Mass
Production

Features

- H8/300H CPU
 - 4 to 10 MHz/2.7 V to 3.6 V
 - 2 to 4.2 MHz/1.8 V to 3.6 V
- ROM/RAM
 - 48 KB/2 KB (Mask, Flash^{*1})
 - 40 KB/2 KB (Mask)
 - 32 KB/1 KB (Mask)
 - 24 KB/1 KB (Mask)
- Interrupts
 - External interrupt: 5 (IRQ) and 8 (wake-up)
 - Internal interrupt: For each peripheral function
 - Priority control function (3 levels)
- Address break function
- Timer: 16 bits x 4 ch, RTC, WDT, 14-bit PWM x 2 ch
 - TPU x 2 ch (16 bits, general)
 - Timer F (16 bits, interval timer, event counter, output compare)
 - AEC (16 bits, event counter, interval timer, PWM)
 - RTC (can also be used for week-clock counter, 8-bit interval timer)
 - WDT (with internal oscillation circuit, can also be used for 8-bit interval timer)
 - 14-bit PWM x 2 ch
- SCI:
 - SCI3 + IrDA x 1 ch (UART/synchronous/IrDA)
 - SCI3 x 1 ch (UART/synchronous) / IIC2 x 1 ch (IIC bus/synchronous)
- A/D converter: Successive approximation type (10 bits x 8 channels)
- LCD: 32 segments x 4 coms (3-V constant voltage step-up and down circuit)
- Power-on reset circuit (POR)
- Packages:
 - PRQP0080JB-A (Former code : FP-80A) (14 x 14, 0.65-mm pitch)
 - PTQP0080KC-A (Former code : TFP-80C) (12 x 12, 0.5-mm pitch)
 - PTLG0085JA-A (Former code : TLP-85V) (LGA 7 x 7, 0.65-mm pitch)
 - Chip shipment

Block Diagram



E7/E8
support

Incorporates the emulation function enabling on-chip debugging with the E7/E8.

^{*1}: Flash memory version incorporates 1-Kbyte RAM and 4-Kbyte ROM separately for on chip debugging.

Overview of H8/38086R Group

- High accuracy $\Delta\Sigma$ type A/D converter, LCD -



Mass
Production

Features

- H8/300H CPU:
 - 4 to 10 MHz/2.7 V to 3.6 V
 - 2 to 4.2 MHz/1.8 V to 3.6 V
- ROM / RAM
 - 48 KB/2 KB (Mask, flash*1)
 - 40 KB/2 KB (Mask)
 - 32 KB/1 KB (Mask)
 - 24 KB/1 KB (Mask)
- Interrupts
 - External interrupt: 5 (IRQ) and 8 (wake-up)
 - Internal interrupt: Each peripheral function
 - Priority control function (3 levels)
- Address break function
- Timer: 16 bits x 4 ch, RTC, WDT, 14-bit PWM x 2 ch
 - TPU x 2 ch (16 bits, general)
 - Timer F (16 bits, interval timer, event counter, output compare)
 - AEC (16 bits, event counter, interval timer PWM)
 - RTC (can also be used for week-clock counter, 8-bit interval timer)
 - WDT (with internal oscillation circuit, can also be used for 8-bit interval timer)
 - 14-bit PWM x 2 ch
- SCI
 - SCI3 + IrDA x 1 ch (UART/sync/IrDA)
 - SCI3 x 1 ch (UART/sync) / IIC2 x 1 ch (IIC bus/sync)
- A/D converter:
 - Successive approximation type, 10 bits x 3 channels
 - $\Delta\Sigma$ A/D type, 14 bits x 2 channels
- LCD: 32 segments x 4 coms
 - (3-V constant voltage step-up and down circuit)
- Power-on reset circuit
- Packages:
 - PRQP0080JB-A (Former code : FP-80A) (14 x 14, 0.65-mm pitch)
 - PTQP0080KC-A (Former code : TFP-80C) (12 x 12, 0.5-mm pitch)
 - PTLG0085JA-A (Former code : TLP-85V) (7 x 7, 0.65-mm pitch)
 - Chip shipment

Block Diagram

H8/300H CPU	ROM (FLASH/MASK)	RAM
Interrupt control circuit (variable levels)	Emulation function (F-ZTAT)	Address break function
10-bit A/D converter 3 channels	RTC	WDT with internal oscillator 8-bit timer
AEC (asynchronous event counter) 16-bit timer	Timer F 16-bit timer	TPU 16-bit timer 2 channels
IIC bus/UART /Synchronous 1 channel	UART/Synchronous/ IrDA 1 channel	
14-bit PWM 2 channels	3-V constant voltage LCD (32 segs x 4 coms)	Power-on reset (POR)
System oscillation circuit	Sub-oscillation circuit	14-bit $\Delta\Sigma$ A/D 2 channels



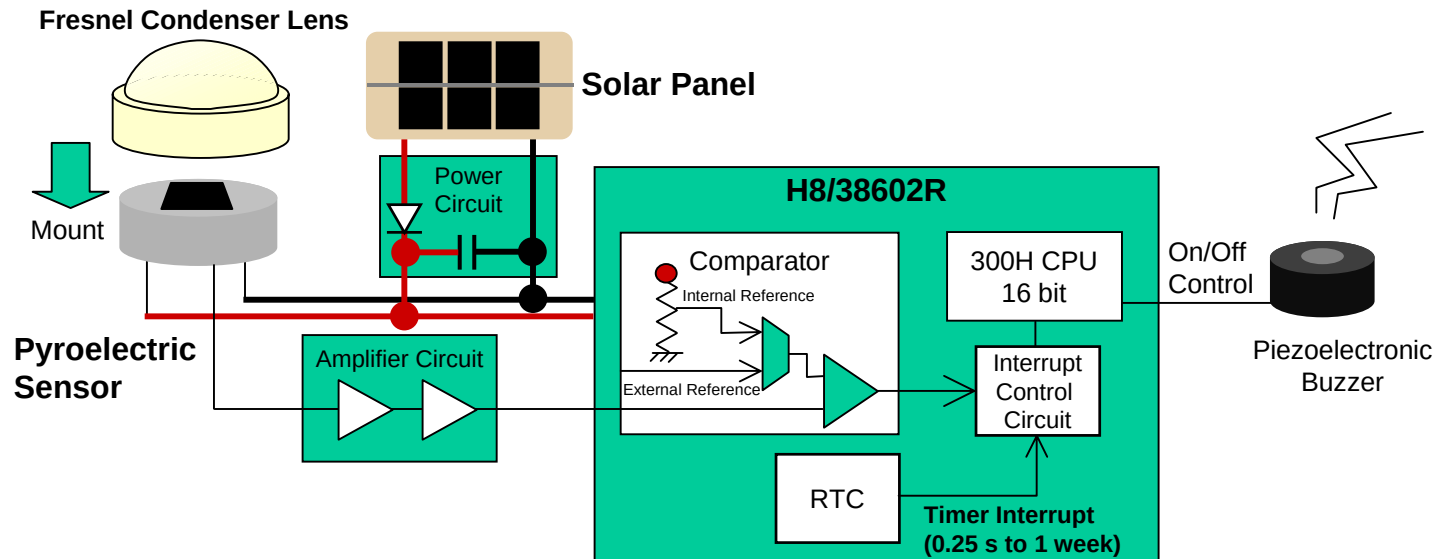
Incorporates the emulation function
enabling on-chip debugging with the E7/E8.

*1: Flash memory version incorporates 1-Kbyte RAM and 4-Kbyte ROM
separately for on chip debugging.

Super Low Power microcontroller Human Body Detection Demo System

**Super
Low Power**

System Configuration



Specification

Demo System	Detection Region	With fresnel lens: about 5 m / Without fresnel lens: about 1 m
	Current Consumption	Standby: 600 uA / Alarm: 1 mA
Pyroelectric Sensor	Product	Murata made pyroelectric sensor IRA-E700
	Specification	Sensitivity 4.3 mVp-p / Region 45°C
MCU	Product	HD64F38602R *F means Flash ROM.
	Comparator	Selectable of 13 levels internal reference and external reference
	Current Consumption	Comparator operation: 10 uA / CPU operation: 100 uA
Solar Panel	Maximum Rating	Open: 3 V / Short: 300 mA
	Actual Value	While 40 W incandescent lights from 20 cm, open: 3 V / Short: 12 mA

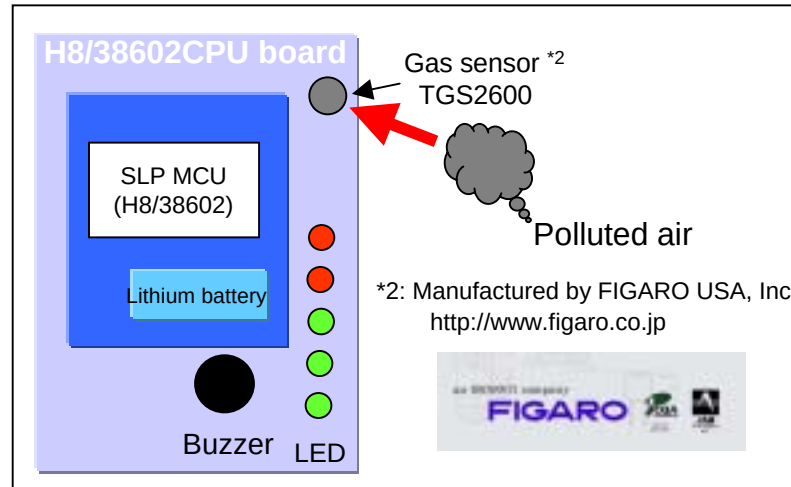
Application

Industrial Sensor,
Building Automation Equipment,
Security Equipment,
Toy,
Home Appliance, etc.

Super Low Power microcontroller Gas Sensor Demonstration System

In this demonstration system, we use H8/38602 group MCU and gas sensor TGS2600 which is made by FIGARO USA, Inc.

System Configuration



The demonstration system with Super Low Power MCU and gas sensor

After detecting the air is mixed with gas, the LED will light up and the buzzer will alarm.

It can be connected to E7 emulator

Because E7 emulator pins are on the CPU board,
programming or debugging can be simply done with real board and real tip.

Specification

Item	Specification
CPU	H8/38602 Flash
Sensor	TGS2600 (FIGARO)
Power supply	Vcc = 3.0 V (sensor 5 V)
Frequency	Fosc = 4 MHz

Application

Air cleaner control,
Ventilator control,
Indoor air monitor, etc.

Super Low-Power Website

**Super
Low Power**



- Application examples (programs)
- Parameter calculation
- Current consumption calculation
- FAQs



(English) <http://www.renesas.com/en/slp>

We provide information the users need such as the latest manuals, technical updates, application notes, and Q&A.

Microcomputer General Presentation

740 Family

Outline Specification

October 28, 2005

Rev.2.00

Standard Product Business Group

Renesas Technology Corp

Features of the 8-bit 740 Family (M38000 Series)



- Instruction set suitable for control applications
- Wide product lineup with diverse features to meet diverse needs (ASSP expansion)
- A variety of ROM/RAM expansion with pin-compatibility maintained
- Supports flash memory version and One Time PROM version
- Lineup of small-package/SDIP package
- Lowest power consumption and lowest voltage operating class in the industry
- Increase speed, enhanced peripheral functions
- Low noise emission; high tolerance against noise
- Common emulator for 8- and 16-bit microcomputers (supports USB)
- Low-cost compact emulator (to support USB)
 - Including software, the system is to provide almost the same functionality as the full spec. emulator
 - Simply replace the emulator MCU to emulate the MCUs of other groups
 - The emulator MCU is connected to the target via a socket; this reduces the effects of noise and allows debugging in an environment with characteristics similar to those of the actual MCU
 - The compact emulator leaves all ports available during debugging
- Support for C compiler (Partner vendor)

Application Map of 8-bit 740 Family



*: New Products

	General-purpose MCUs featuring low pin-count package.	General-purpose MCUs	LCD driver embedded type	Specific function embedded type
VCRs	7542			
Audio	7544A 7546**			
Home appliances	7547**	3803H	3822A	
Phones	3850A 3858*	3804 3886	38C1 38C2A 38C5	3826A
Amusement products	3851		38D5 **	
Remote controllers	7516		38C8	
Cameras			7560A	38C2A
Communications equipment				3826A
OA equipment	3850A, 7542 7546**, 7547**	3803H		
Automotive apps.	7542			7630, 7632
Notebook PCs [KBC]				7516, 7517, 3885, 3886
PC peripherals [USB]				7534, 7641, 7643 38K0, 38K2
TVs [OSD]				7150, 7220, 7160, 7280

Overview: M37542 Group



Features

- Min. instruction execution time: 0.25 μ s
(oscillation frequency of 8 MHz in double-speed mode)
- 7540-group products are pin-compatible
(upwardly compatible)
- Support for flash memory version
- Enhanced timers functions
(twice as many channels for I/O waveform control as 7540-group products. 16-bit timer: waveform generation: 4ch, time measurement: 2ch controllable)
- A frequency-selection function has been added to the on-chip oscillator mode of 7540-group products
- Fail-safe: Oscillation stop detection circuit
- Operating voltage (ceramic or crystal oscillation)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 8 MHz, double-speed mode)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8 MHz, high-speed mode)
 - Vcc = 2.4 to 5.5 V (f(Xin) = 4 MHz, high-speed mode) ^{Note1}
 - Vcc = 2.2 to 5.5 V (f(Xin) = 2 MHz, high-speed mode) ^{Note1}
 - Vcc = 2.7 to 5.5 V (f(Xin) = 4 MHz, high-speed mode) ^{Note2}
- Operating voltage (RC oscillation)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 4 MHz, high-speed mode)
 - Vcc = 2.4 to 5.5 V (f(Xin) = 2 MHz, high-speed mode) ^{Note1}
 - Vcc = 2.2 to 5.5 V (f(Xin) = 1 MHz, high-speed mode) ^{Note1}
 - Vcc = 2.7 to 5.5 V (f(Xin) = 2 MHz, high-speed mode) ^{Note2}
- Low power consumption
 - 8 MHz, double-speed mode, Vcc= 5 V: 5.5 mA (typ.) ^{Note1}
4.8 mA (typ.) ^{Note2}
- Operating ambient temperature: -20 to 85°C
(Wide operating temperature range versions:
-40 to 85°C or -40 to 125°C)

Applications

- Home appliances • Consumer appliances
- Industrial equipment • Automotives
- PC peripheral OA equipment

Product Expansion (): ROM/RAM size

*:New Product **:Under development

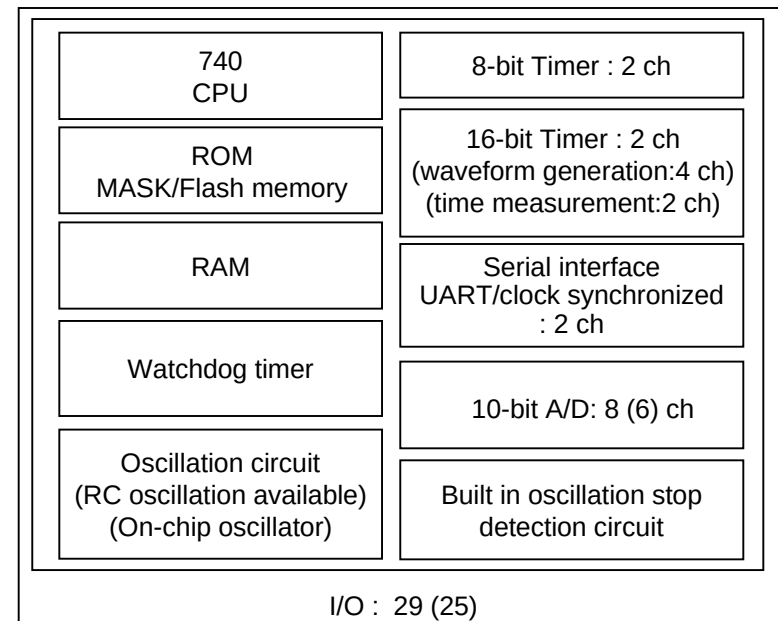
- M37542M2-XXXSP/GP/FP/HP (8 K/384)(HP**)
- M37542M2T-XXXGP/FP* (8 K/384)
- M37542M2V-XXXGP/FP* (8 K/384)
- M37542M4-XXXSP/GP/FP/HP (16 K/512)(HP**)
- M37542M4T-XXXGP/FP* (16 K/512)
- M37542M4V-XXXGP/FP* (16 K/512)
- M37542F8SP/GP/FP/HP* (32 K+4 K/1 K)(HP is only ES)
- M37542F8TGP/FP* (32 K+4 K/1 K)
- M37542F8VGP/FP* (32 K+4 K/1 K)

SP : 32P4B : 32-pin SDIP (1.778-mm pitch)

GP : 32P6U-A : 32-pin LQFP (0.8-mm pitch)

FP : 36P2R-A : 36-pin SSOP (0.8-mm pitch)

HP : 36PJW-A : 36-pin WQFN (0.8-mm pitch)



Note1: Mask ROM version Note2: Flash memory version



Overview: M37546/47 Group



New
Product

Features

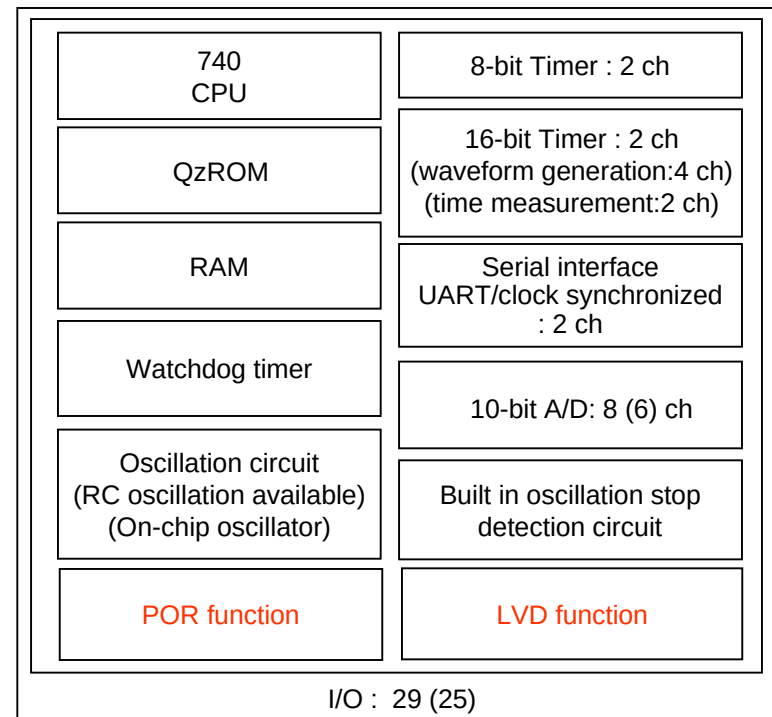
- Min. instruction execution time: 0.25 μ s
(oscillation frequency of 8 MHz in double-speed mode)
- 7542-group products are pin-compatible
(upwardly compatible)
- Enhanced timers functions
(twice as many channels for I/O waveform control as 7540-group products. 16-bit timer: waveform generation: 4ch, time measurement: 2ch controllable)
- A frequency-selection function has been added to the on-chip oscillator mode of 7540-group products
- Fail-safe: Oscillation stop detection circuit
- Operating voltage (ceramic or crystal oscillation)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 8 MHz, double-speed mode)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8 MHz, high-speed mode)
 - Vcc = 2.4 to 5.5 V (f(Xin) = 4 MHz, high-speed mode)
 - Vcc = 2.2 to 5.5 V (f(Xin) = 2 MHz, high-speed mode)
- Operating voltage (RC oscillation)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 4 MHz, high-speed mode)
 - Vcc = 2.4 to 5.5 V (f(Xin) = 2 MHz, high-speed mode)
 - Vcc = 2.2 to 5.5 V (f(Xin) = 1 MHz, high-speed mode)
- Operating voltage (On-chip oscillator)
 - Vcc = 1.8V to 5.5V
- Low power consumption
 - 8 MHz, double-speed mode, Vcc = 5 V: **TBD**
- Operating ambient temperature: -20 to 85°C

Applications

- Home appliances • Consumer appliances
- Industrial equipment • PC peripheral OA equipment

Product Expansion (): ROM/RAM size

- M37546G4-XXXSP/GP/HP(16K/512)
- M37547G4-XXXFP(16K/512)
- M37546G4SP/GP/HP(16K/512)
- M37547G4FP(16K/512)
 - SP : 32P4B : 32-pin SDIP (1.778-mm pitch)
 - GP : 32P6U-A : 32-pin LQFP (0.8-mm pitch)
 - FP : 36P2R-A : 36-pin SSOP (0.8-mm pitch)
 - HP : 36PJW-A : 36-pin WQFN (0.8-mm pitch)



Overview: M37544 Group



Features

- Min. instruction execution time: 0.25 μ s
(oscillation frequency of 8 MHz in double-speed mode)
- Pin-compatible with 7540-group products
(downwardly compatible)
- Support for OTP version
(on-board serial writing possible)
- High-speed operation
- Fail-safe: Oscillation stop detection circuit
- Abundant peripheral functions in small packages
- Operating voltage (ceramic or crystal oscillation)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 8 MHz, double-speed mode)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8 MHz, high-speed mode)
- Operating voltage (RC oscillation)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 4 MHz)
- Low power consumption:
Using the clock signal from the on-chip oscillator enables lower power consumption
 - 8 MHz, double-speed mode, Vcc = 5 V : 4.8 mA (typ.)
 - On-chip oscillator mode, Vcc = 5 V : 250 μ A (typ.)
- Operating ambient temperature: -20 to 85°C

Applications

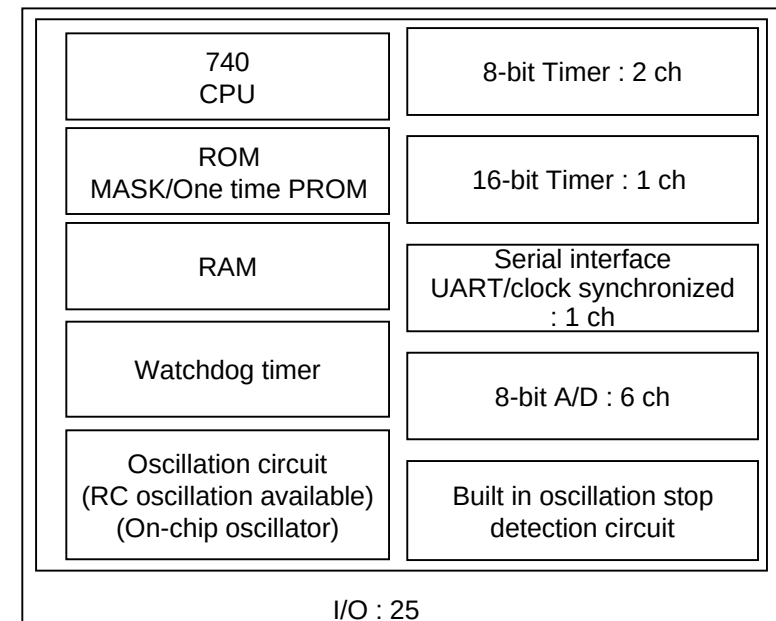
- Home appliances
- Consumer appliances
- PC peripheral OA equipment

Product Expansion (): ROM/RAM size

** : Under development

- M37544M2-XXXSP/GP/HP (8 K/256)(HP**)
- M37544G2-XXXSP/GP (8 K/256)
 - SP: 32P4B : 32-pin SDIP (1.778-mm pitch)
 - GP: 32P6U-A : 32-pin LQFP (0.8-mm pitch)
 - HP^{note}: 36PJW-A : 36-pin WQFN (0.8-mm pitch)

Note : HP package dose not have the OTP version.



Features

- Min. instruction execution time: 0.25 μ s
(oscillation frequency of 8 MHz in double-speed mode)
- Pin-compatible with 7540-group products
(downwardly compatible)
- Support for OTP version
(on-board serial writing possible)
- High-speed operation
- Fail-safe: Oscillation stop detection circuit
- Abundant peripheral functions in small packages
- Operating voltage (ceramic or crystal oscillation)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 8 MHz, double-speed mode)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8 MHz, high-speed mode)
 - Vcc = 2.4 to 5.5 V (f(Xin) = 4 MHz, high-speed mode)
- Operating voltage (RC oscillation)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 4 MHz)
 - Vcc = 2.4 to 5.5 V (f(Xin) = 2 MHz)
- Operating voltage (on-chip oscillator)
 - Vcc = 1.8 to 5.5 V
- Low power consumption:
Using the clock signal from the on-chip oscillator enables lower power consumption
- Operating ambient temperature: -20 to 85°C

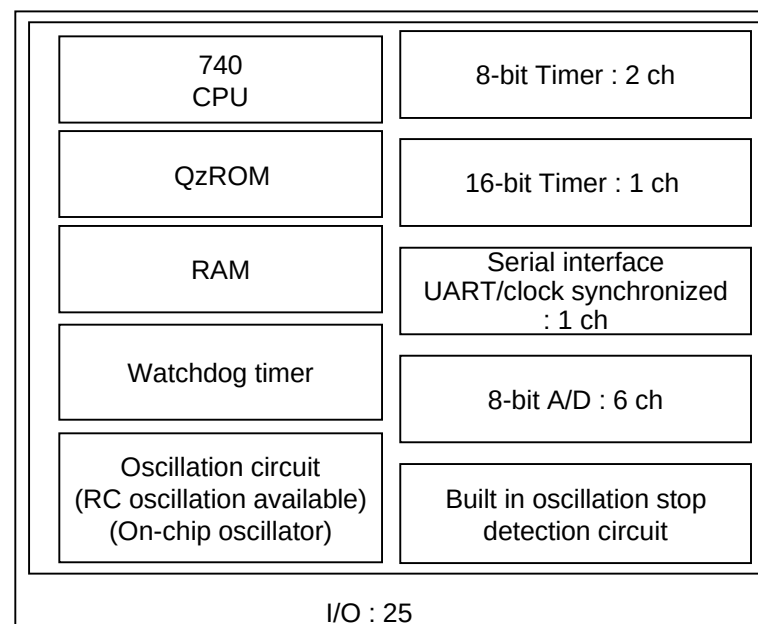
Applications

- Home appliances
- Consumer appliances
- PC peripheral OA equipment

Product Expansion (): ROM/RAM size

** : Under development

- M37544G2A-XXXSP/GP**(8 K/256)
- M37544G2ASP/GP**(8 K/256)
 - SP : 32P4B : 32-pin SDIP (1.778-mm pitch)
 - GP : 32P6U-A : 32-pin LQFP (0.8-mm pitch)



Comparison of M37540/7542/7544 Groups

	7542 Group	7540 Group	7544 Group
Instruction-exec. time	0.25 μ s (8-MHz double-speed)	0.34 μ s (6-MHz double-speed)	0.25 μ s (8-MHz double-speed)
Memory	Flash memory version Flash memory : 32 K/RAM: 1 K	One Time PROM version ROM: 32 K/RAM: 768	One Time PROM version ROM: 8 K/RAM: 256
	mask ROM version ROM: 16 K/RAM: 512 ROM: 8 K/RAM: 384	mask ROM version ROM: 16 K/RAM: 512	mask ROM version ROM: 8 K/RAM: 256
I/O ports	29 (32-pin version and QFN package: 25)		25 (32-pin version only)
Interrupts	18 sources, 16 vectors	15 sources, 15 vectors (32-pin version: 14 sources, 14 vectors)	12 sources, 12 vectors
Timers	8-bit x 2 , 16-bit x 2	8-bit x 4 , 16-bit x 1	8-bit x 2 , 16-bit x 1
Serial I/O1	8-bit x 1 (UART or clock-synchronized Operating)		
Serial I/O2	8-bit x 1 (UART or clock sync.)	8-bit x 1 (clock sync.)	None
A/D converter	10-bit x 8 channels (32-pin version and QFN package : 6 channels)		8-bit resolution x 6 channels
Clock generating	ceramic resonator, quartz crystal oscillator, RC oscillation, low-power consumption through the on-chip oscillator is possible		
Watchdog timer	16-bit x 1		
Packages	36-pin SSOP (36P2R), WQFN**, 32-pin LQFP (32P6U), 32-pin SDIP (32P4B)	36-pin SSOP (36P2R), 32-pin LQFP (32P6U), 32-pin SDIP (32P4B)	32-pin LQFP, 32-pin SDIP, 36-pin WQFN**

** : mask ROM version only, under development

Features

- Min. instruction execution time: 2.00μs (oscillation frequency of 4MHz)
- Support for only QzROM version (On-board Writing is possible in serial mode.)
- Operating voltage(ceramic)
- Vcc = 1.8 to 3.6V (f(Xin)= 4 MHz)
- Built-in carrier-wave generator circuit
- Watch dog timer function
- Operating ambient temperature: -20 to 85°C
- LED output port: 10
- Key-on wakeup: 8

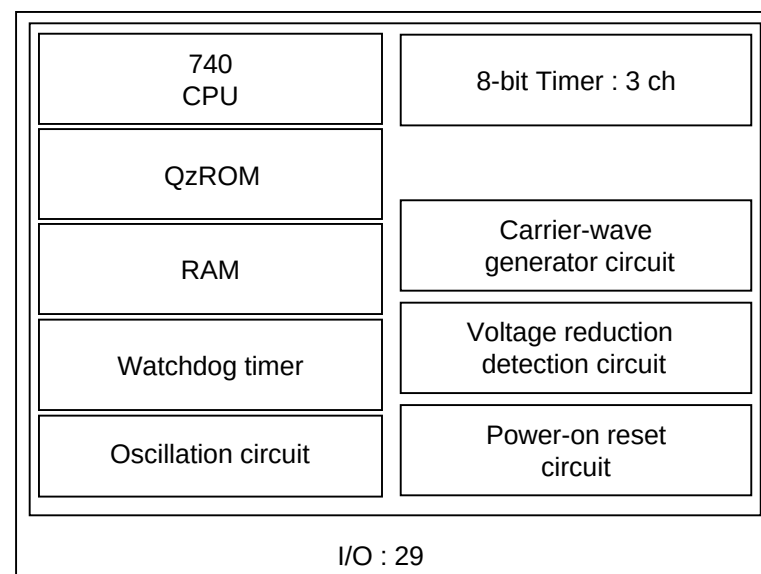
Applications

- Preset remote control transmitter

Product Expansion (): ROM/RAM size

**: Under development

- M37545G4-XXXGP**(16K/512)
 - M37545G6-XXXGP**(24K/512)
 - M37545G8-XXXGP**(32K/512)
 - M37545G8GP**(32K/512)
 - M37545G6GP**(24K/512)
 - M37545G4GP**(16K/512)
- GP: 32P6U-A: 32-pin LQFP(0.8-mm pitch)



Features

- Min. instruction execution time: 0.32 μ s
(oscillation frequency of 12.5 MHz in high-speed mode)^{Note1}
- LED direct drive (port P1): 8 ch
- Low-voltage, high-speed operation (12.5 MHz)
- High-resolution multi-channel A/D converter
(four more channels than the H specs.)^{Note1}
Serviceable in low-speed mode
- Support for flash memory version
- Abundant peripheral functions
- Fewer external elements required for processing of unused pins: All pins are internally pulled up under software control.
- Operating voltage
 - Vcc = 4.0 to 5.5 V (f(Xin) = 12.5 MHz, high-speed mode)^{Note1}
 - Vcc = 2.7 to 5.5 V (f(Xin) = 6 MHz, high-speed mode)^{Note1}
 - Vcc = 2.7 to 5.5 V (f(Xin) = 12.5 MHz, middle-speed mode)^{Note1}
 - Vcc = 1.8 to 5.5 V (f(Xin) = 6.3 MHz, middle-speed mode)^{Note2}
 - Vcc = 2.7 to 5.5 V (f(Xcin) = 32 kHz, low-speed mode)
 - Vcc = 1.8 to 5.5 V (f(Xcin) = 32 kHz, low-speed mode)^{Note2}
- Low power consumption (Mask ROM version) :
 - 12.5 MHz, high-speed mode, Vcc = 5 V : 6.5 mA (typ.)
 - 32 kHz, low-speed mode, Vcc = 3 V : 20 μ A (typ.)

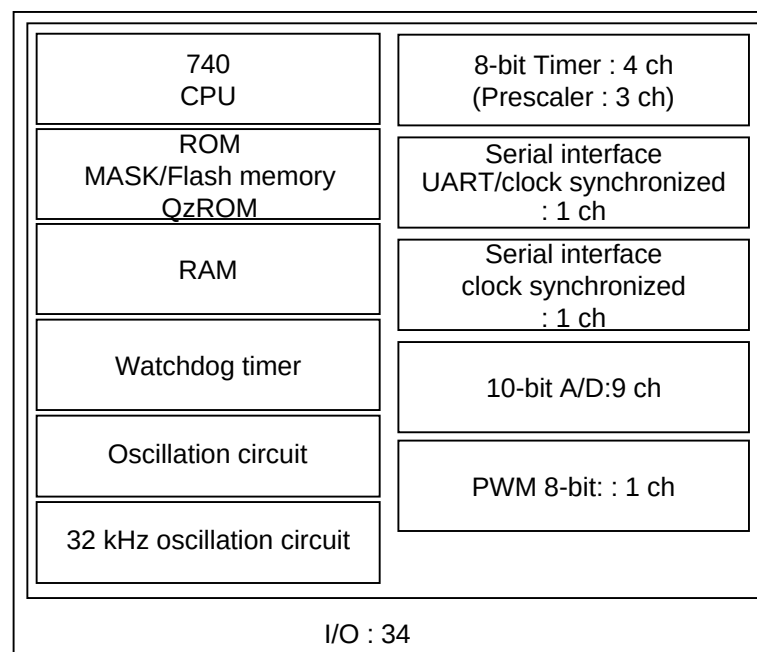
Applications

- Home appliances
 - Refrigerators, washing machines, air conditioners, microwave ovens, dishwashers, etc.
- Consumer appliances
 - Cameras, home audio systems, telephones, chargers, etc.

Product Expansion (): ROM/RAM size

*: New Product **: Under development

- M38503M2A-XXXSP/FP (8 K/512)
 - M38503M4A-XXXSP/FP (16 K/512)
 - M38504M6A-XXXSP/FP* (24 K/640)
 - M38507M8A-XXXSP/FP* (32 K/1 K)
 - M38507F8ASP/FP* (32 K/1 K)
 - M38503G8ASP/FP* * (16 K/512)
- SP : 42P4B : 42-pin SDIP (1.778-mm pitch)
FP : 42P2R-A/E : 42-pin SSOP (0.8-mm pitch)



Note1: New specifications for the 3850 (spec. A)

Note2: New specifications for the 3850 (spec. A)QzROM

Features

- Minimum instruction execution time: 0.24 μ s (oscillation frequency of 16.8 MHz in high-speed mode)
- LED direct-drive ports: 8 ch (ave: 10 mA, peak: 20 mA, total current: 80 mA)
- Low-voltage, high-speed operation
- High-resolution multi-channel A/D converter
- Support for flash memory version
- Abundant peripheral functions, enhanced timer functions and communications functions
- Fewer external elements required for processing of unused pins: All pins are internally pulled up under software control.
- Operating voltage
 - Vcc = 4.5 to 5.5 V (f(Xin) = 16.8 MHz, high-speed mode)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 12.5 MHz, high-speed mode)
 - Vcc = 2.7 to 5.5 V (f(Xin) = 8.4 MHz, high-speed mode)
 - Vcc = 2.2 to 5.5 V (f(Xin) = 4.2 MHz, high-speed mode)*Note
 - Vcc = 2.0 to 5.5 V (f(Xin) = 2.1 MHz, high-speed mode)*Note
 - Vcc = 1.8 to 5.5 V (f(Xin) = 6.3 MHz, middle-speed mode)*Note
- Low power consumption (Mask ROM version)
 - 16.8 MHz, high-speed mode, Vcc = 5 V : 8.0 mA (typ.)
 - 32 kHz, low-speed mode, Vcc = 3 V : 15 μ A (typ.)
- Operating ambient temperature: -20 to 85°C

*Mask ROM, QzROM version only

Applications

- Home appliances • Audio systems • Housing equipment
- OA equipment • Amusement • Communication systems

Product Expansion (): ROM/RAM size

*: New Product **: Under development

- M38034M4H-XXXSP/FP/HP/KP (16K/640)
 - M38037M6H-XXXSP/FP/HP/KP (24K/1K)
 - M38037M8H-XXXSP/FP/HP/KP/WG (32K/1K)
 - M38039MCH-XXXSP/FP/HP/KP (48K/2K)
 - M38039MFH-XXXSP/FP/HP/KP/WG (60K/2K)
 - M38039GCHSP/HP/KP/WG(48K/2K)**
 - M38039GCH-XXXHP/KP/WG(48K/2K)**
 - M38039FFHSP/FP/HP/KP/WG (60K/2K)(WG)
- SP: 64P4B : 64-pin SDIP (1.778-mm pitch)
 FP: 64P6N-A : 64-pin QFP (0.8-mm pitch)
 HP: 64P6Q-A : 64-pin LQFP (0.5-mm pitch)
 KP: 64P6U-A : 64-pin LQFP (0.8-mm pitch)
 WG: 64F0G : 64-pin FLGA (0.65-mm pitch)

740 CPU	8-bit Timer: 4 ch (Prescaler: 3 ch)
ROM MASK/Flash memory QzROM	16-bit Timer: 1 ch
RAM	Serial interface UART/clock synchronized : 2 ch
Watchdog timer	Serial interface clock synchronized : 1 ch
Oscillation circuit	10-bit A/D: 16 ch
32 kHz oscillation circuit	8-bit D/A: 2 ch
	PWM 8-bit : 1 ch
I/O : 56	

Overview: M3886 Group



Features

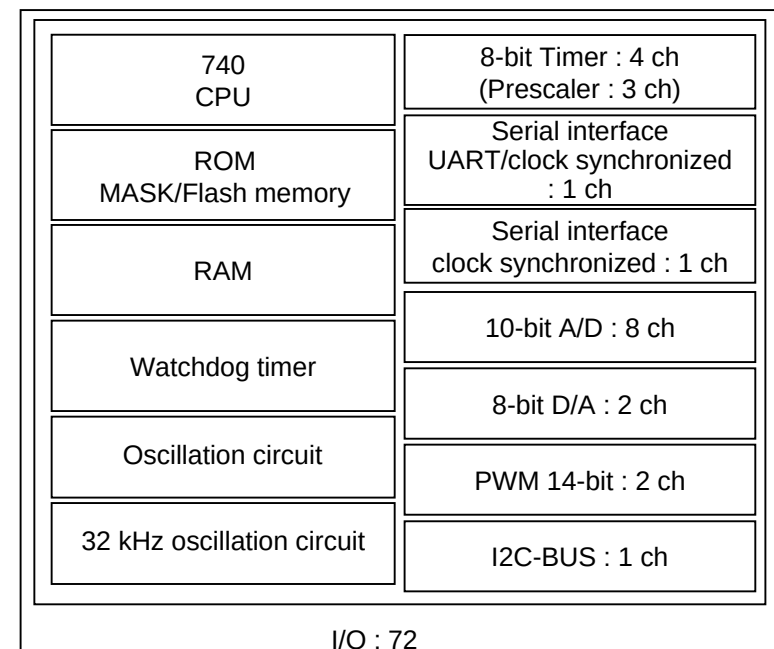
- Minimum instruction execution time: 0.4 μ s (oscillation frequency of 10 MHz in high-speed mode)
- Support for flash memory versions
- ROM : 32 to 60 Kbytes
- Large-capacity RAM (2 Kbytes)
- High-resolution multi-channel A/D converter
- 2-channel D/A converter
- LED direct-drive ports: 4 ch (ave: 15 mA, peak: 20 mA, total current: 40 mA)
- Key-on wakeup function
- Operating voltage
 - Vcc = 4.0 to 5.5 V (f(Xin) = 10 MHz, high-speed mode)
 - Vcc = 2.7 to 5.5 V (f(Xin) = 10 MHz, middle-speed mode)
 - Vcc = 2.7 to 5.5 V (f(Xcin) = 32 kHz, low-speed mode)
- Low power consumption
 - 10 MHz, high-speed mode, Vcc = 5 V : 8.0 mA (typ.)
 - 8 MHz, high-speed mode, Vcc = 5 V : 6.8 mA (typ.)
 - 32 kHz, low-speed mode, Vcc = 3 V : 20 μ A (typ.)
- Operating ambient temperature: -20 to 85°C

Applications

- Home appliances • Consumer appliances
- Communications equipment • Notebook PCs

Product Expansion (): ROM/RAM size

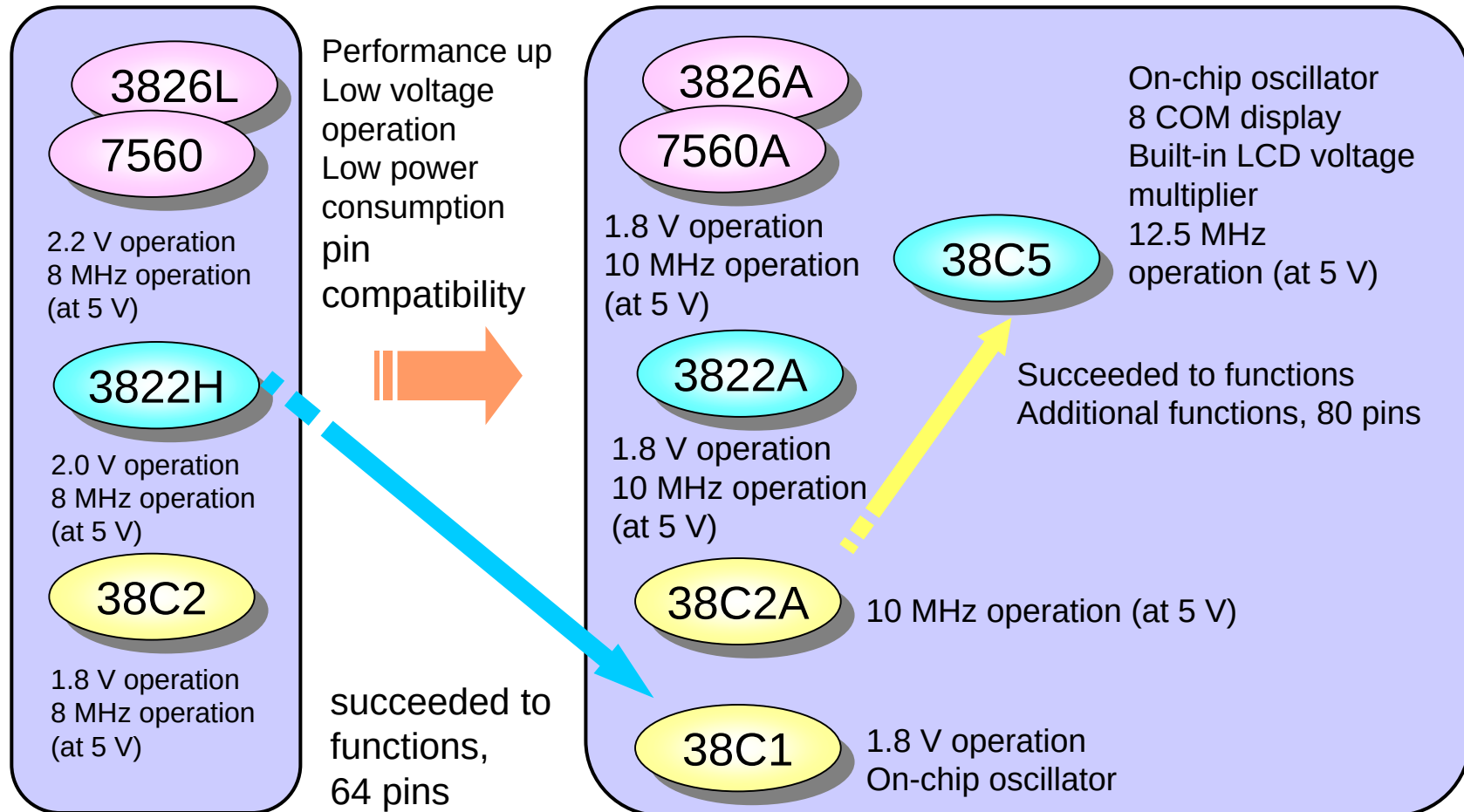
- M38869M8A-XXXGP/HP (32 K/2 K)
- M38869MCA-XXXGP/HP (48 K/2 K)
- M38869MFA-XXXGP/HP (60 K/2 K)
- M38869FFAGP/HP (60 K/2 K)
 - GP : 80P6S-A : 80-pin QFP (0.65-mm pitch)
 - HP : 80P6Q-A : 80-pin LQFP (0.5-mm pitch)



Expansion of LCD-MCUs (Segment-type)



*: New Product



Overview: M3822 Group



Features

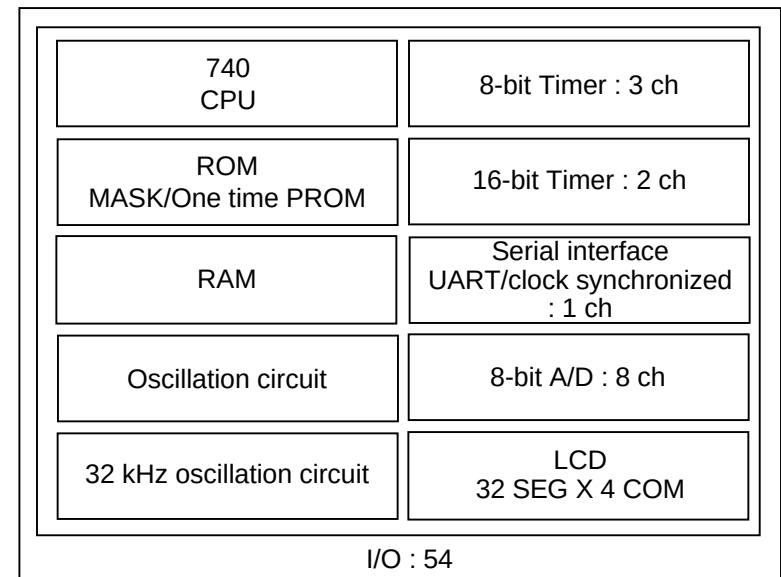
- long-selling 4 COM x 32 SEG 80-pin product
- A version
 - Extended operating voltage range
1.8 to 5.5 V, ($f(XIN) \leq 6$ MHz, medium-speed mode)
 - High-speed operation at $V_{CC} = 4.5$ to 5.5 V,
 $f(XIN) = 10$ -MHz operation is guaranteed.
 - Low power consumption: About half of H ver.
- Highly accurate low-voltage-operable 8-bit A/D converter
 - At 2.0 to 2.2 V, ± 3.0 LSB, at 2.2 to 5.5 V, ± 2.0 LSB
- LED direct drive port : 33 (10 mA)
- Operating voltage (Mask ROM A version)
 - $V_{CC} = 4.5$ to 5.5 V ($f(XIN) = 10$ MHz, high-speed mode)
 - $V_{CC} = 4.0$ to 5.5 V ($f(XIN) = 8$ MHz, high-speed mode)
 - $V_{CC} = 1.8$ to 5.5 V ($f(XIN) = 6$ MHz, middle-speed mode)
 - $V_{CC} = 1.8$ to 5.5 V (low-speed mode)
 - One-time PROM version : $V_{CC} = 2.5$ to 5.5 V
- Low power consumption (Mask ROM A version)
 - $V_{CC} = 5$ V, $f(XIN) = 8$ MHz, in high-speed mode : typ. 3 mA
 - $V_{CC} = 3$ V, $f(XIN) = \text{stop}$, in low-speed mode : typ. 8 μ A
- Available in bare-chip form (ROM 48 K ver.)
- All 3822 products are completely pin-compatible
- Compact emulator (M38000T2-CPE) supported

Applications

- Home appliances, Audio equipment, Microwave ovens,
Compact cameras, Remote controllers,
Body-fat measurers, Oil-fan heaters

Product Expansion (): ROM/RAM size

- M38223M4A-XXXFP/HP (16 K/512) A version
- M38224M6A-XXXFP/HP (24 K/640) A version
- M38227M8A-XXXFP/HP (32 K/1024) A version
- M38227MCA-XXXFP/HP (48 K/1024) A version
- M38227MCDXXXFP (48 K/1024)
- M38227ECFP/HP (48 K/1024)
- M38227ECFS (EPROM Version for development)
FP : 80P6N-A : 80-pin QFP (0.8-mm pitch)
HP : 80P6Q-A : 80-pin LQFP (0.5-mm pitch)



Features

- long-selling 4 COM x 32 SEG 80-pin product
- Highly accurate low-voltage-operable 8-bit A/D converter
 - At 2.0 to 2.2 V, ± 3.0 LSB, at 2.2 to 5.5 V, ± 2.0 LSB
- Supported QzROM
(On-board Writing is possible in serial mode.)
- LED direct drive port : 33 (10 mA)
- Operating voltage (Mask ROM A version)
 - Vcc = 4.5 to 5.5 V (f(XIN) = 12.5 MHz, high-speed mode)
 - Vcc = 4.0 to 5.5 V (f(XIN) = 8 MHz, high-speed mode)
 - Vcc = 1.8 to 5.5 V (f(XIN) = 6 MHz, middle-speed mode)
 - Vcc = 1.8 to 5.5 V (low-speed mode)
- Low power consumption
- All 3822 products are completely pin-compatible and Software compatible
- Compact emulator (M38000T2-CPE) supported

Applications

- Home appliances, Audio equipment, Microwave ovens, Compact cameras, Remote controllers, Body-fat measurers, Oil-fan heaters

Product Expansion (): ROM/RAM size

** : Under development *** : Under planning

- M38234G4-XXXXFP/HP*** (16K/640)
- M38234G4FP/HP*** (16K/640)
- M38235G6-XXXXFP/HP*** (24K/768)
- M38235G6FP/HP*** (24K/768)
- M38238G8-XXXXFP/HP** (32K/1.5K)
- M38238G8FP/HP** (32K/1.5K)
- M38239GC-XXXXFP/HP** (48K/2.0K)
- M38239GCFF/HP** (48K/2.0K)
- M3823AGF-XXXXFP** (60K/2.5K)
- M3823AGFFFP/HP** (60K/2.5K)

FP : 80P6N-A : 80-pin QFP (0.8-mm pitch)

HP : 80P6Q-A : 80-pin LQFP (0.5-mm pitch)

740 CPU	8-bit Timer : 3 ch
QzROM	16-bit Timer : 2 ch
RAM	Serial interface UART/clock synchronized : 1 ch
Watchdog timer	8(10)-bit A/D : 8 ch
Oscillation circuit (on-chip oscillator)	LCD 32 SEG X 4 COM
32 kHz oscillation circuit	ROM Correction

I/O : 54

Overview: M3826 Group



Features

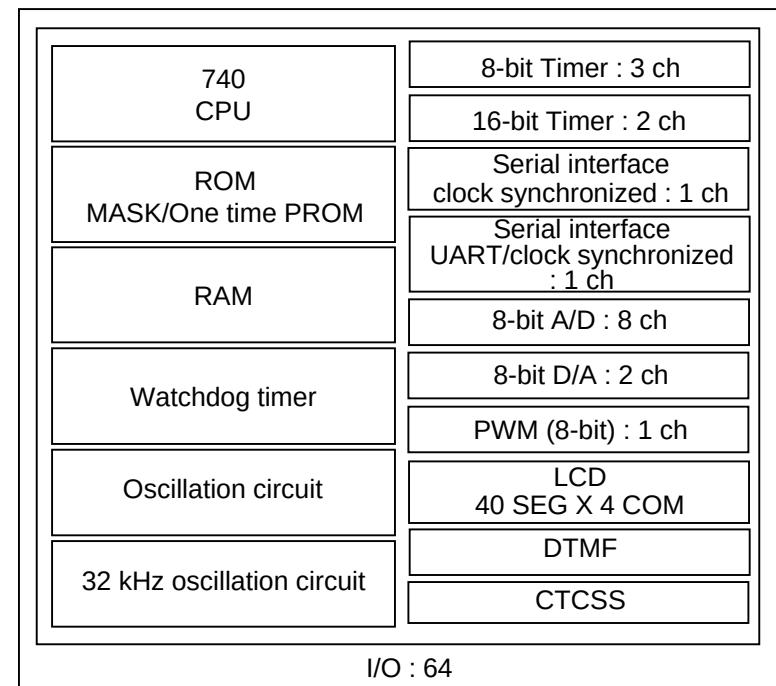
- 2.5 Kbytes RAM
- Built-in 8-bit A/D converter and D/A converter
- Built-in LCD drive control circuit
 - Voltage multiplier: 3 Times
 - Bias: 1/2, 1/3 bias
 - Duty ratio: 2, 3, 4
 - Common output: 4
 - Segment output: 40
- Built-in DTMF, CTCSS (shared with the D/A pin)
 - DTMF : Dual Tone Multi Frequency
 - CTCSS : Continuous Tone-Controlled Squelch System
- Operating voltage (Mask ROM A version)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 10 MHz, high-speed mode)
 - Vcc = 4.0 to 5.5 V (f(XIN) = 8 MHz, high-speed mode)
 - Vcc = 1.8 to 5.5 V (f(Xin) = 6 MHz, middle-speed mode)
 - Vcc = 1.8 to 5.5 V (low-speed mode)
 - One-time PROM version : Vcc = 2.5 to 5.5 V

Applications

- Walkie-talkies, Cordless phones, etc.

Product Expansion (): ROM/RAM size

- M38268MCA-XXXFP/GP (48 K/1536) A version
- M3826AMFA-XXXFP/GP (60 K/2560) A version
- M3826AEFFP/GP (60 K/2560)
- M3826AEFFS (EPROM Version for development)
 - FP : 100P6S-A : 100-pin QFP (0.65-mm pitch)
 - GP : 100P6Q-A : 100-pin LQFP (0.5-mm pitch)



Overview: M38C1 Group



Features

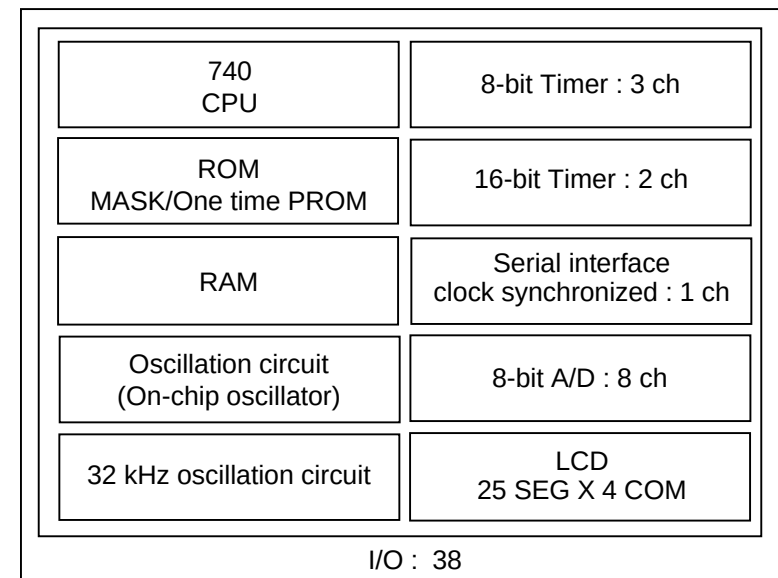
- Low-voltage operation A/D converter
(Vcc = 2.0 V, OTP version: 2.2 V)
 - Operating in low-speed mode
 - ± 2 LSB accuracy is maintained at Vcc = 2.2 to 5.5 V
- ADKEY x 4
 - Wake-up from stop and wait mode on analog voltage input (under $(0.7 \times V_{cc} - 0.5)$ V).
A/D converter starts automatically.
Since the on-chip oscillator is used to start it up, there's no wait for oscillation
- LED direct drive port : 5 (15 mA)
- On-chip oscillator operation
 - External oscillator can be deleted
- Operating voltage (Mask ROM version)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8 MHz, high-speed mode)
 - Vcc = 1.8 to 5.5 V (f(Xin) = 6 MHz, middle-speed mode)
 - Vcc = 1.8 to 5.5 V (low-speed mode)
 - One-time PROM version : Vcc = 2.2 to 5.5 V
- Low-power consumption equivalent to the 38C2 Group (Mask ROM version)
 - Vcc = 2.5 V, 32-kHz operation: Icc = 7.0 μ A (typ.)
 - Vcc = 2.5 V, 32-kHz WAIT: Icc = 3.5 μ A (typ.)
- Available in bare-chip form (ROM 24 K ver.)
- Compact emulator (M38000T2-CPE) supported

Applications

- Home appliances,
General consumer appliances

Product Expansion (): ROM/RAM size

- M38C12M4-XXXXFP/HP (16 K/384)
- M38C13M6-XXXXFP/HP (24 K/512)
- M38C13E6FP/HP (24 K/512)
 - FP : 64P6U-A : 64-pin LQFP (0.8-mm pitch)
 - HP : 64P6Q-A : 64-pin LQFP (0.5-mm pitch)



Overview: M38C2 Group (A version)



Features

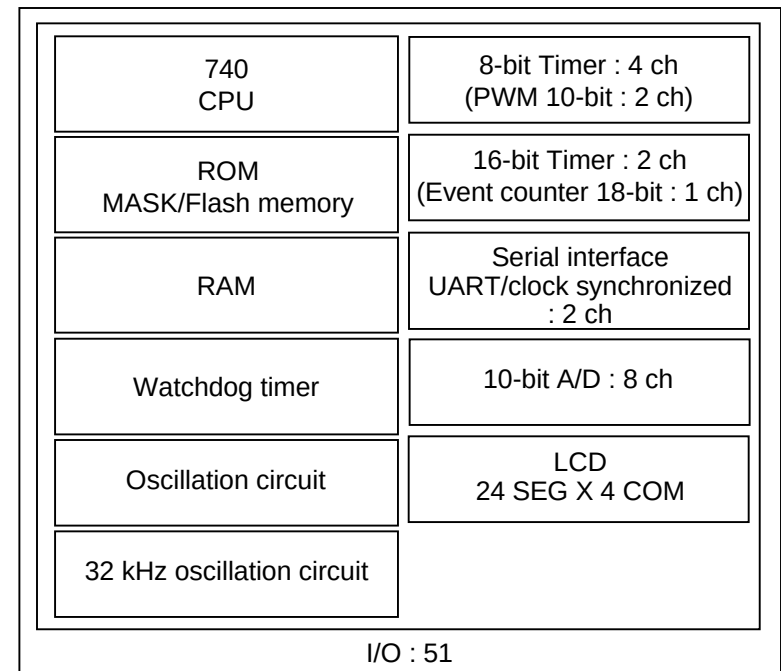
- Various peripheral functions
- Higher speed: Xin (max.) 8 MHz → 10 MHz
- 38C2 (A version.) provides stable oscillation, high-speed operation, and noise suppression.
- LED direct drive port : 10 (15 mA), 41 (10 mA)
- Built-in dividing resister for LCD power
- Operating voltage(Mask ROM version)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 10 MHz, frequency/2 mode)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8 MHz, frequency/2 mode)
 - Vcc = 1.8 to 5.5 V (f(Xin) = 4 MHz, frequency/4 mode, A-D operation excluded)
 - Vcc = 1.8 to 5.5 V (low-speed mode)
 - Flash memory version : Vcc = 2.5 to 5.5 V
- Low power consumption (mask version)
 - 8 MHz operation: Vcc = 5 V: 2.7 mA (typ)
 - 32 kHz WAIT: Vcc = 3 V: 4 μA (typ)
- On-board programming of flash memory version
- Available in bare-chip form (ROM 24 K ver.)
- Compact emulator (M38000T2-CPE) supported

Applications

- Measuring devices, IH controllers, Cameras, Home appliances

Product Expansion (): ROM/RAM size

- M38C24M4A-XXXFP/HP (16 K/640) A version
- M38C24M6A-XXXFP/HP (24 K/640) A version
- M38C29MCA-XXXFP/HP (48 K/2048) A version
- M38C29FFAFP/HP (60 K/2048) A version
 - FP : 64P6U-A : 64-pin LQFP (0.8-mm pitch)
 - HP : 64P6Q-A : 64-pin LQFP (0.5-mm pitch)



Overview: M38C5 Group



Features

- 8-COM drive achieves display and I/O while staying in the 100-pin class
- Inherits functions of the 38C1 and 38C2 and higher speed operation.
- LED direct drive port : 6 (15 mA), 21 (10 mA)
- Operating voltage (Mask ROM version)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 12.5 MHz, high-speed mode)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8 MHz, high-speed mode)
 - Vcc = 1.8 to 5.5 V (f(Xin) = 6 MHz, middle-speed mode)
 - Vcc = 1.8 to 5.5 V (low-speed mode)
 - OTP version: Vcc= 1.8 to 3.6 V, max. rating of Vcc is 4.0 V
- Low power consumption (Mask ROM version)
 - At 12.5 MHz, high-speed mode : Vcc = 5 V: 6.4 mA (typ)
 - At 32 kHz in WAIT mode : Vcc = 2.5 V: 3.5 μ A (typ)
- On-chip oscillator mode for even lower power consumption
(2.5 V operation: typ.35 μ A, at WAIT: typ. 25 μ A)
- OTP version supports serial programming
- Compact emulator (M38000T2-CPE) supported

Applications

- Measuring devices, IH controllers, Cameras, Audio equipment, Home appliances

Product Expansion (): ROM/RAM size

* : New product

- M38C58M8-XXXXFP/HP (32 K/1536)
- M38C59MC-XXXXFP/HP (48 K/2048)
- M38C59MF-XXXXFP/HP (60 K/2048)
- M38C59GFFP/HP (60 K/2048)

FP : 80P6U-A : 80-pin LQFP (0.8-mm pitch)

HP : 80P6Q-A : 80-pin LQFP (0.5-mm pitch)

740 CPU	8-bit Timer : 4 ch (PWM 10-bit : 2 ch)
ROM MASK/One time PROM	16-bit Timer : 2 ch (Event counter 18-bit : 1 ch)
RAM	Serial interface Clock synchronized : 1 ch
Watchdog timer	Serial interface UART/clock synchronized : 1 ch
Oscillation circuit (On-chip oscillator)	10-bit A/D : 8 ch
32 kHz oscillation circuit	LCD 36 SEG X 4 COM (32 SEG X 8 COM)

I/O : 61

Overview: M38D5 Group



Under Development

Features

- 8-COM drive achieves display and I/O while staying in the 100-pin class
- Pin-compatible with 38C5-group products and software compatible.
- Support for QzROM version.
(On-board Writing is possible in serial mode.)
- ROM correction function: 2vector x 32bytes
- LED direct drive port : 6(15 mA), 21(10 mA)
- Operating voltage (QzROM version)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 12.5MHz, high-speed mode)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8MHz, high-speed mode)
 - Vcc = 1.8 to 5.5 V (f(Xin) = 5MHz, middle-speed mode)
 - Vcc = 1.8 to 5.5 V (low-speed mode)
 - OTP version: Vcc= 1.8 to 3.6V, max. rating of Vcc is 4.0V
- Low power consumption
- On-chip oscillator mode for even lower power consumption
(2.5 V operation: typ.35μA, at WAIT: typ. 25μA)
(Stop function and fixed clock are added.)
- Enhanced WDT function
- Compact emulator (M38000T2-CPE) supported

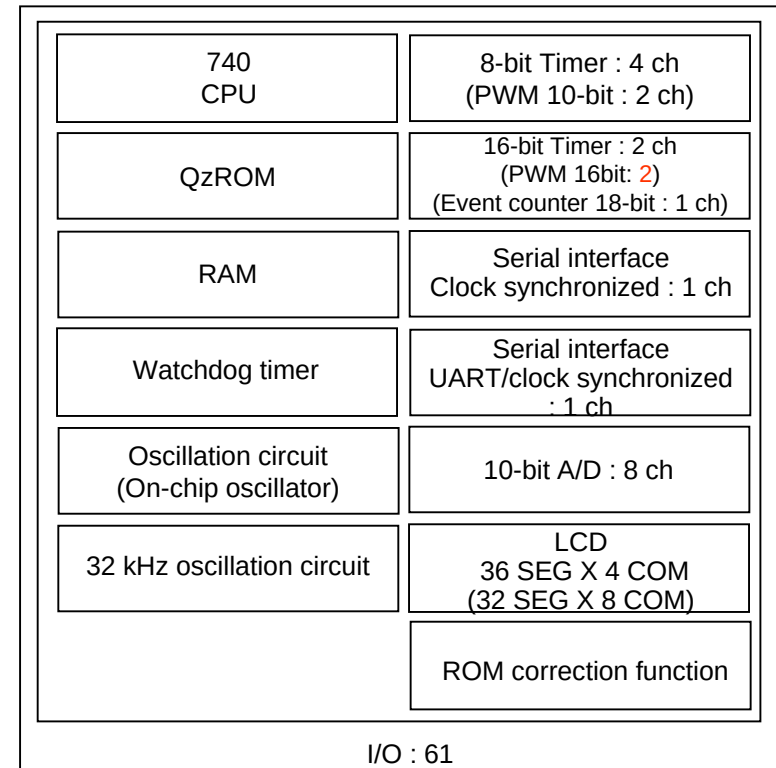
Applications

- Measuring devices, IH controllers, Cameras, Audio equipment, Home appliances

Product Expansion (): ROM/RAM size

** : Under development

- M38D58G8-FP/HP** (32K/1536)
- **M38D5XFXFP** (Flash version for development)**
 FP: 80P6N-A: 80-pin LQFP (0.8-mm pitch)
 HP: 80P6Q-A: 80-pin LQFP (0.5-mm pitch)



Overview: M38Dx Group (planning)



Under
Planning

Features

- Additional peripheral function version of 38C2 Group
- Pin-compatible with 38C2-group products and (upwardly compatible)
- Support for QzROM version.
(On-board Writing is possible in serial mode.)
- ROM correction function: 2vector x 32bytes
- Built-in on chip oscillator: $f(\emptyset)=f(\text{ROSC})/32$
- POR function ***in planning
- LVD function (voltage detection circuit) ***in planning
- LED drive port: 10(15mA), 41(10mA)
- Built-in division resistance for LCD power supply
- Low current consumption
- Enhanced WDT function (Selectable counter source)
- Compact emulator (M38000T2-CPE) supported

Applications

- Measuring devices, IH controllers, Cameras, Home appliances

Product Expansion (): ROM/RAM size ***: in planning

- M38Dx4G6-FP/HP***

FP: 64P6U-A: 64-pin LQFP (0.8-mm pitch)

HP: 64P6Q-A: 64-pin LQFP (0.5-mm pitch)

740 CPU	8-bit Timer : 4 ch (PWM 10-bit : 2 ch)
QzROM	16-bit Timer : 2 ch (PWM 16bit: 2) (Event counter 18-bit : 1 ch)
RAM	Serial interface UART/clock synchronized : 2 ch
Watchdog timer	10-bit A/D : 8 ch
Oscillation circuit (On-chip oscillator)	LCD 24SEG X 4COM
32 kHz oscillation circuit	LVD function***
POR function***	ROM correction function

I/O : 51

***: Under Planning

Overview: M37560 Group



Features

- 2.5 Kbytes RAM
- Built-in 10-bit/8-bit switchable A/D converter
- Built-in LCD drive control circuit
 - Voltage multiplier: 3 times
 - Bias: 1/2, 1/3 bias
 - Duty ratio: 2, 3, 4
 - Common output: 4
 - Segment output: 40
- Operating voltage (Mask ROM A version)
 - Vcc = 4.5 to 5.5 V (f(Xin) = 10 MHz, high-speed mode)
 - Vcc = 4.0 to 5.5 V (f(XIN) = 8 MHz, high-speed mode)
 - Vcc = 1.8 to 5.5 V (f(Xin) = 6 MHz, middle-speed mode)
 - Vcc = 1.8 to 5.5 V (low-speed mode)
 - One-time PROM version : Vcc = 2.5 to 5.5 V
- Available in bare-chip form (ROM 60 K ver.)
- Wide operating temperature range version
 - M37560MFD-XXXFP, M37560EFDFF

Applications

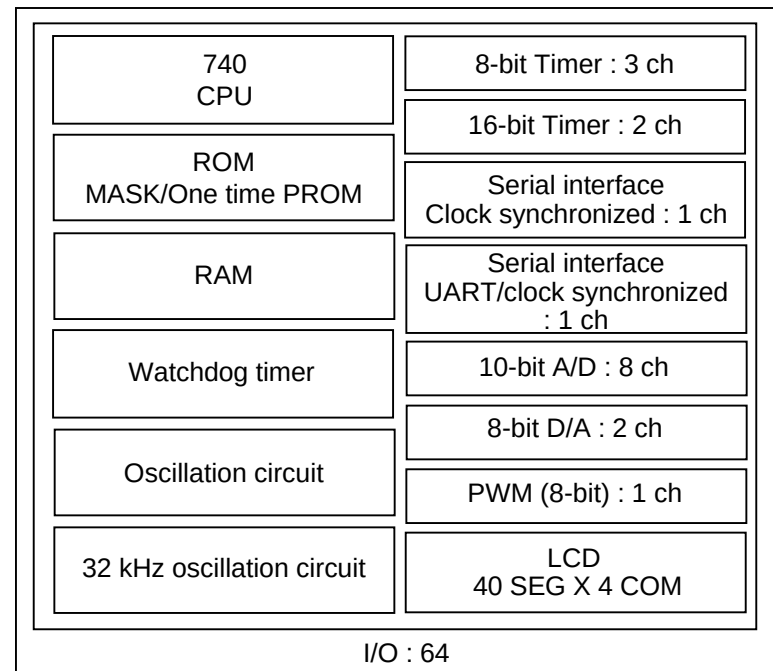
- Audio equipment
 - Mini-component stereo sets, MD and CD players, VCD, etc.

Product Expansion (): ROM/RAM size * : New product

- M37560M8A-XXXFP/GP* (32 K/1024) A version
- M37560MFA-XXXFP/GP (60 K/2560) A version
- M37560MFD-XXXFP (60 K/2560)
- M37560EFFF/GP (60 K/2560)
- M37560EFDFF (60 K/2560)
- M37560EFFS (EPROM Version for development)

FP : 100P6S-A : 100-pin QFP (0.65-mm pitch)

GP : 100P6Q-A : 100pin LQFP (0.5-mm pitch)



Overview: M38C8 Group



Features

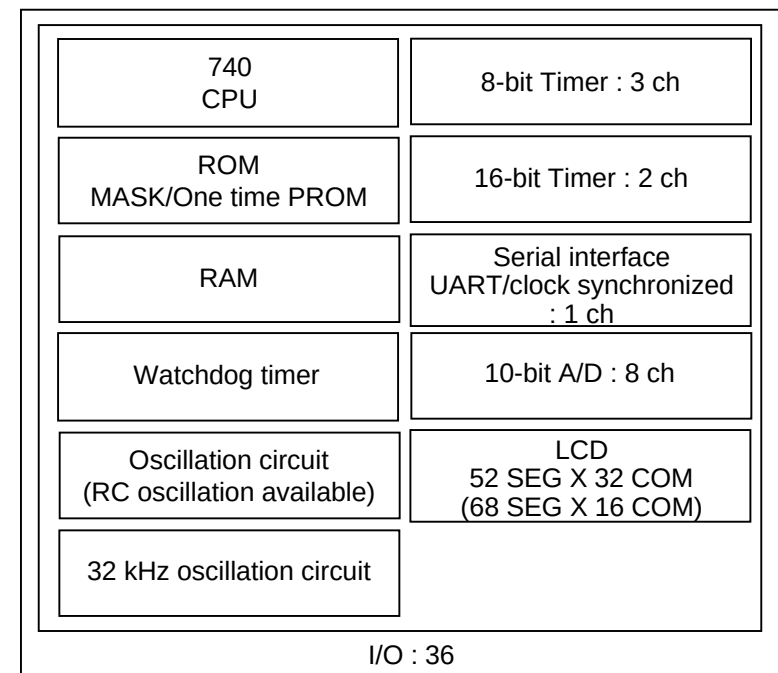
- Drives LCD displays with up to 1664 dots
- Split layout of COM-lines against SEG-lines enables easy print-pattern drawing
- Voltage Multiplier: 3 Times
- A/D conversion possible in 32-kHz operation
- RC oscillation (8.2 kΩ between Xin and Xout, about 2.5 MHz) reduces the cost of peripheral components
- Other functions
 - A/D-start trigger pin, key-on wake-up, large-volume buzzer output pin
- Available in bare-chip form
- Operating voltage (Mask ROM version)
 - Vcc = 4.0 to 5.5 V (f(Xin) = 8 MHz, high-speed mode)
 - Vcc = 2.2 to 5.5 V (f(Xin) = 4 MHz, middle-speed mode)
 - Vcc = 2.2 to 5.5 V (low-speed mode)
 - One-time PROM version : Vcc = 2.5 to 5.5 V

Applications

- Equipment with dot-matrix LCD displays (Portable game machines, Body-fat measurers, Home appliances, Portable audio equipment, etc.)

Product Expansion (): ROM/RAM size

- M38C89MF-XXXXFP (60 K/2048)
 - M38C89EFFP (60 K/2048)
- FP : 144P6Q-A : 144-pin LQFP (0.5-mm pitch)



M3T-ICC740

C compiler package for 740 family



Features

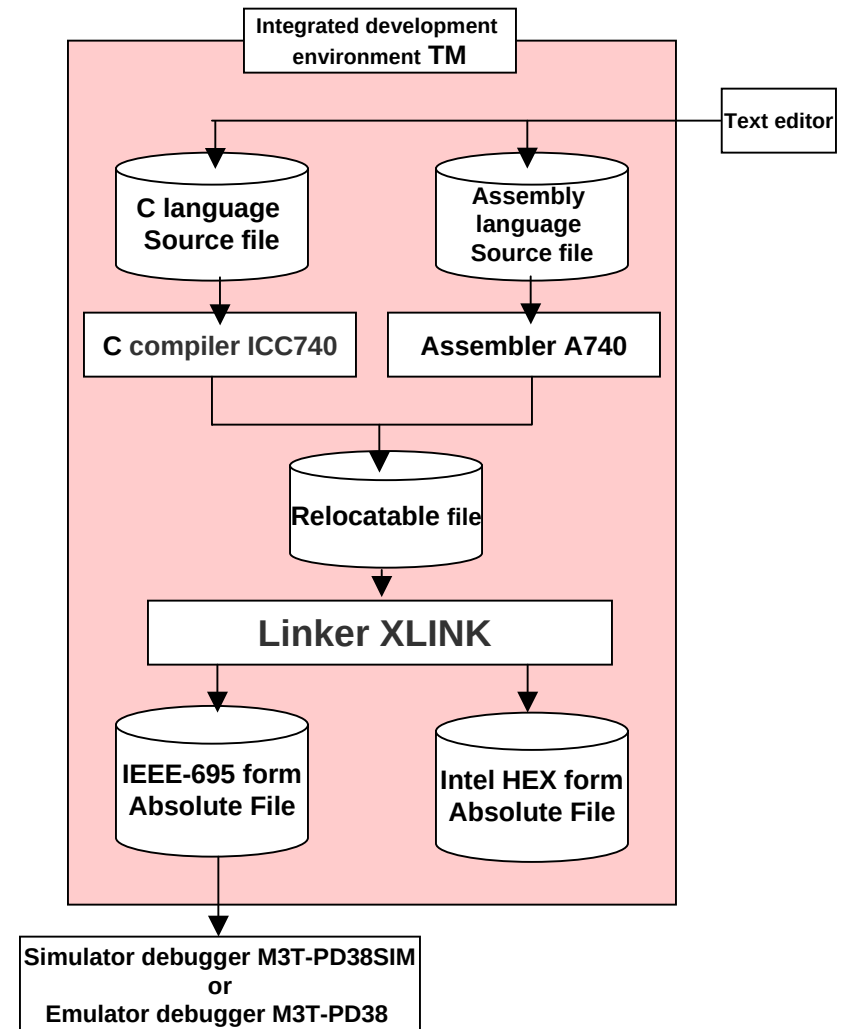
- It corresponds to integrated development environment TM from Renesas
- ISO/ANSI standard C compiler
- The highly efficient optimizer which specialized in 740 family, C extension function
- It's full of assembler pseudo-operation and operator set
- It corresponds to various object formats starting with ieee695. (It realizes compatibility with PC4701U etc.)
- It supports a library function.
- Software protection form
- Bundled simulator debugger M3T-PD38S
- Bundled source file converter SC74 (It made source of M3T-SRA74 operational.)

Contact

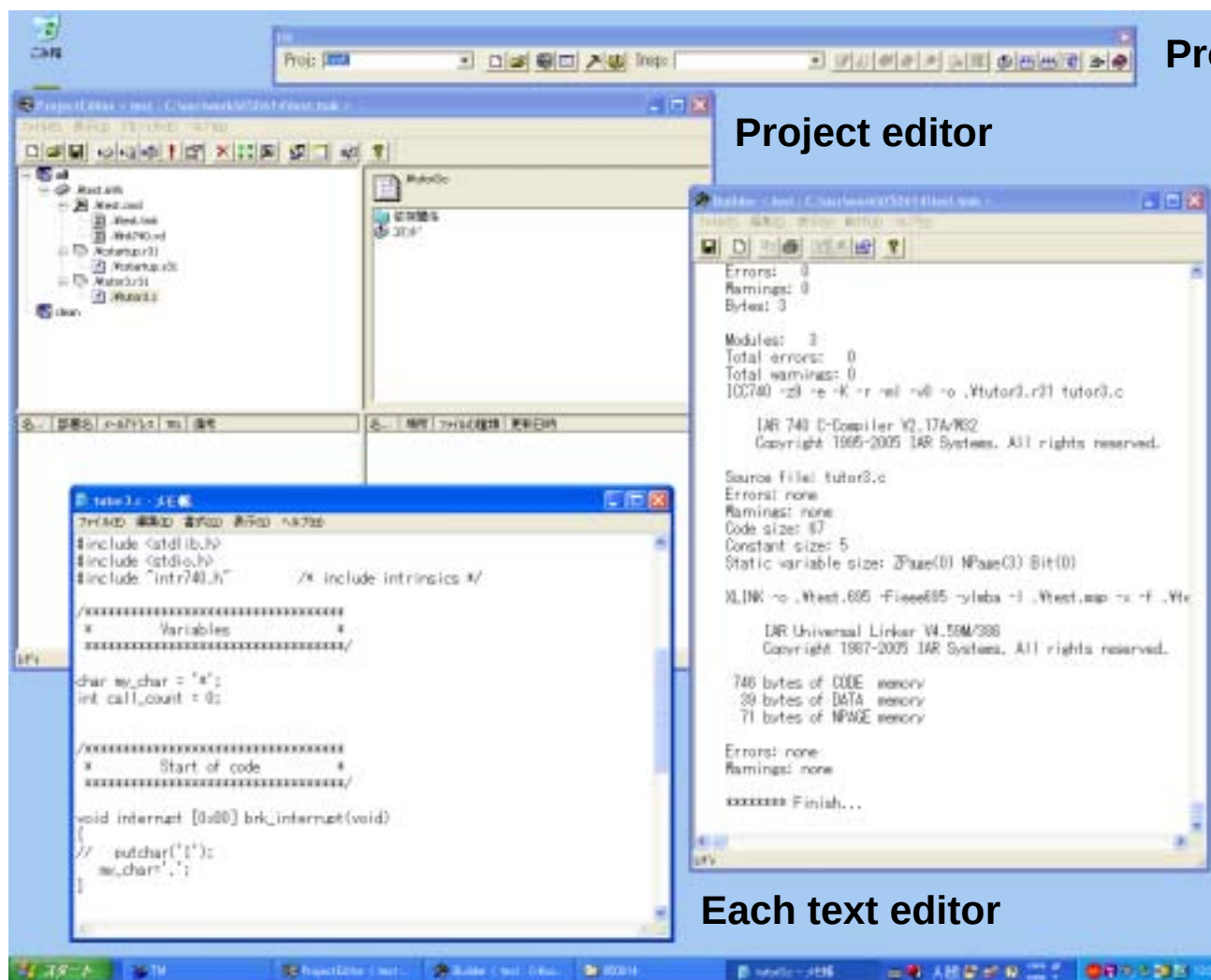
Tool technical support window : support_tool@renesas.com

M3T-ICC740 Homepage

http://www.renesas.com/fmwk.jsp?cnt=m3t_icc740_tools_product_landing.jsp&fp=/products/tools/coding_tools/c_compilers_assemblers/m3t_icc740/&site=i



M3T-ICC740 development environment :TM



M3T-ICC740 development environment :PD30M



The screenshot displays the M3T-ICC740 development environment with the following windows:

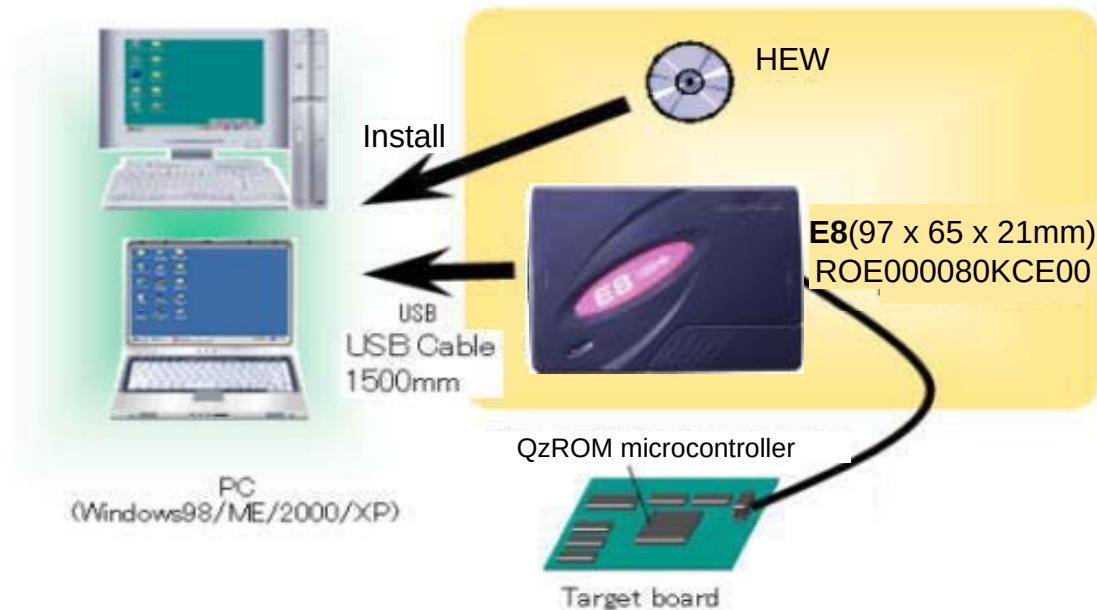
- Program Window:** Shows the assembly code for the program. The main function is defined as:


```
void main(void) /* mainルーチン */
{
    disable_interrupt(); /* 割り込み禁止 */
    P40 = 0x00; /* P4方向レジスタ設定 */
    INTEDGE_b0 = 0; /* INT0割り込みエッジ立ち上がりエッジ */
    ICON1_b0 = 1; /* INT0割り込み許可ビット */
    IREQ1_b0 = 0; /* INT0割り込み要求ビット */
    enable_interrupt(); /* 割り込み許可 */
    while(1)
    {
        count++;
    }
}
end of program
```
- Register Window:** Displays the current state of the registers. The PC register is at address 0x0000, and the SP register is at address 0x0001. The status registers (N, V, T, B, D, I, Z, C) are also shown.
- Source Window:** Shows the source code for the program, including the main function and the interrupt service routine.
- RAM Monitor Window:** Displays the memory contents of the RAM. The address range is from 0x0000 to 0x00FF. The data is shown in hexadecimal and decimal format.

QzROM Starter Kit



TOOL constitution



E8 Emulator



Schedule

7544 Starter Kit	'05/4Q(FoUSB Version)
7546/7 Starter Kit	'05/4Q(ES)
3803 Starter Kit	'06/1Q(Planning)
38D5 Starter Kit	'06/1Q(Planning)

Compact Emulator for the 740 Family

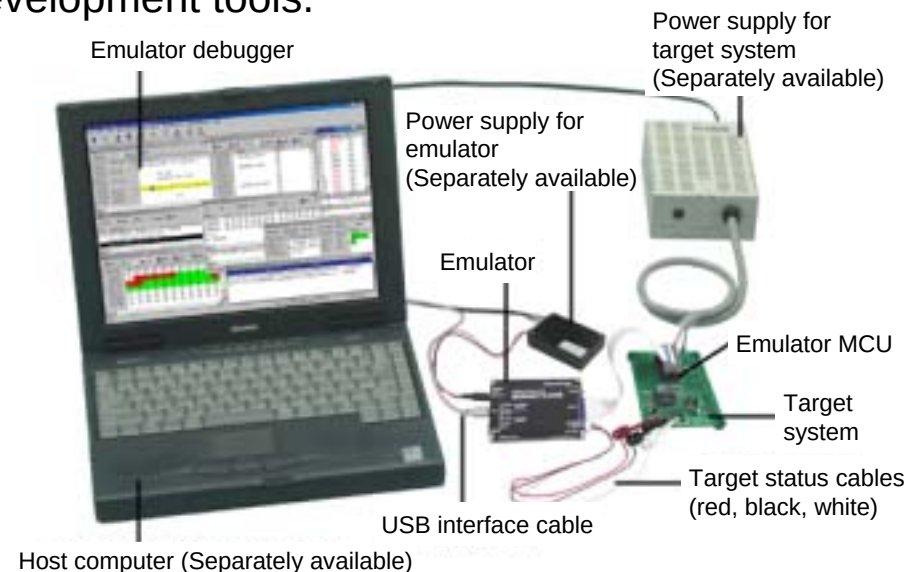


- Outline

- The succession emulator of simple tool system (M38517T-PAC etc.). And equips with useful function of real-time trace etc.
- Because emulator MCU method is adopted as well as M38000TL2-FPD, it can be used by the general purpose.
- **MCU supported :**
M37540RSS, M37542RSS, M37544RSS, M38049RLSS, M38227RFS, M38507ARLSS, M38517RSS, M38C13RLFS, M38C29RLFS, M38C59T-RLFS, M38K09RFS.
Others are also due to be supported one by one.
- Includes an emulator and other required development tools.

- Functions

- Equips with the real-time trace function, the hardware break function, and real-time RAM monitor function.
- Communication I/F is USB.
- Corresponds to the low voltage operation and RLFS/RLSS.

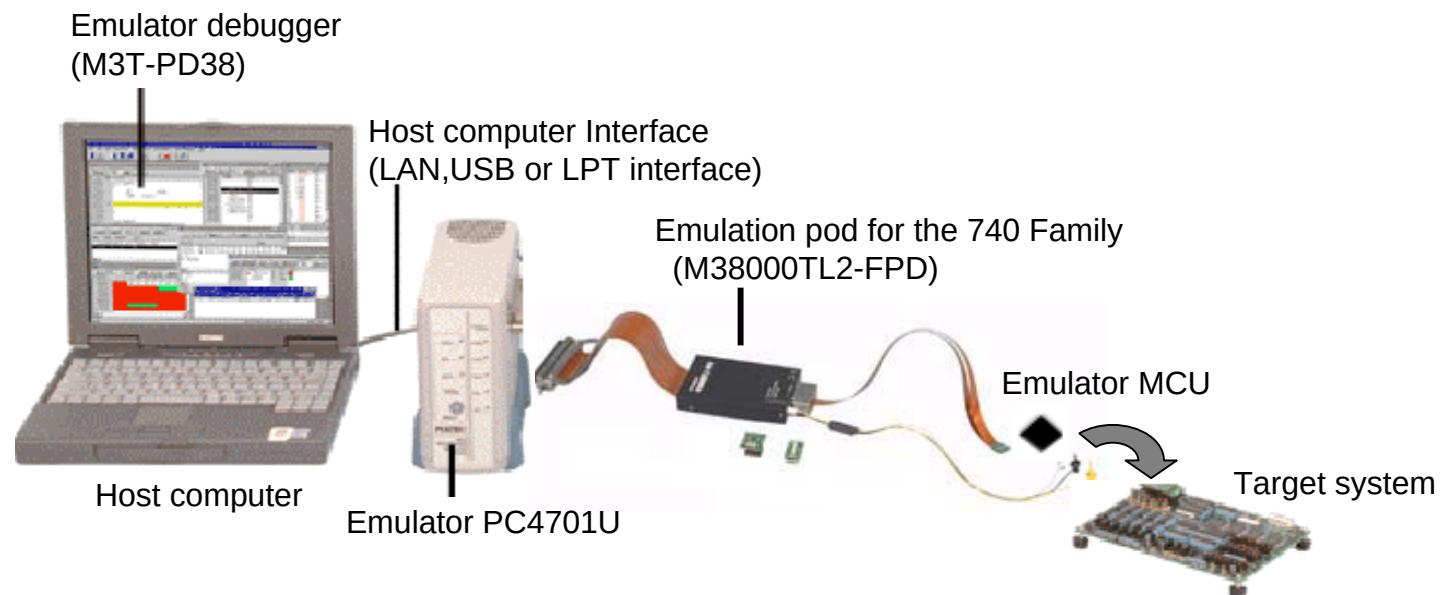


M38000T2-CPE system configuration

High performance Emulator For the 740 Family



- The PC4701U is a high performance emulator designed for Renesas M16C, 740 Families (8- and 16-bit MCUs).
- It allows you to build an emulation system for each MCU Family by being connected to an emulation pod.
- For 8-bit 740 family MCUs, the common emulation pod (M38000TL2-FPD) and the emulator MCU for each MCU groups are used.
- It is available to debug for each MCUs by only exchanging the emulator MCUs.



Microcomputer General Presentation

4500 Series

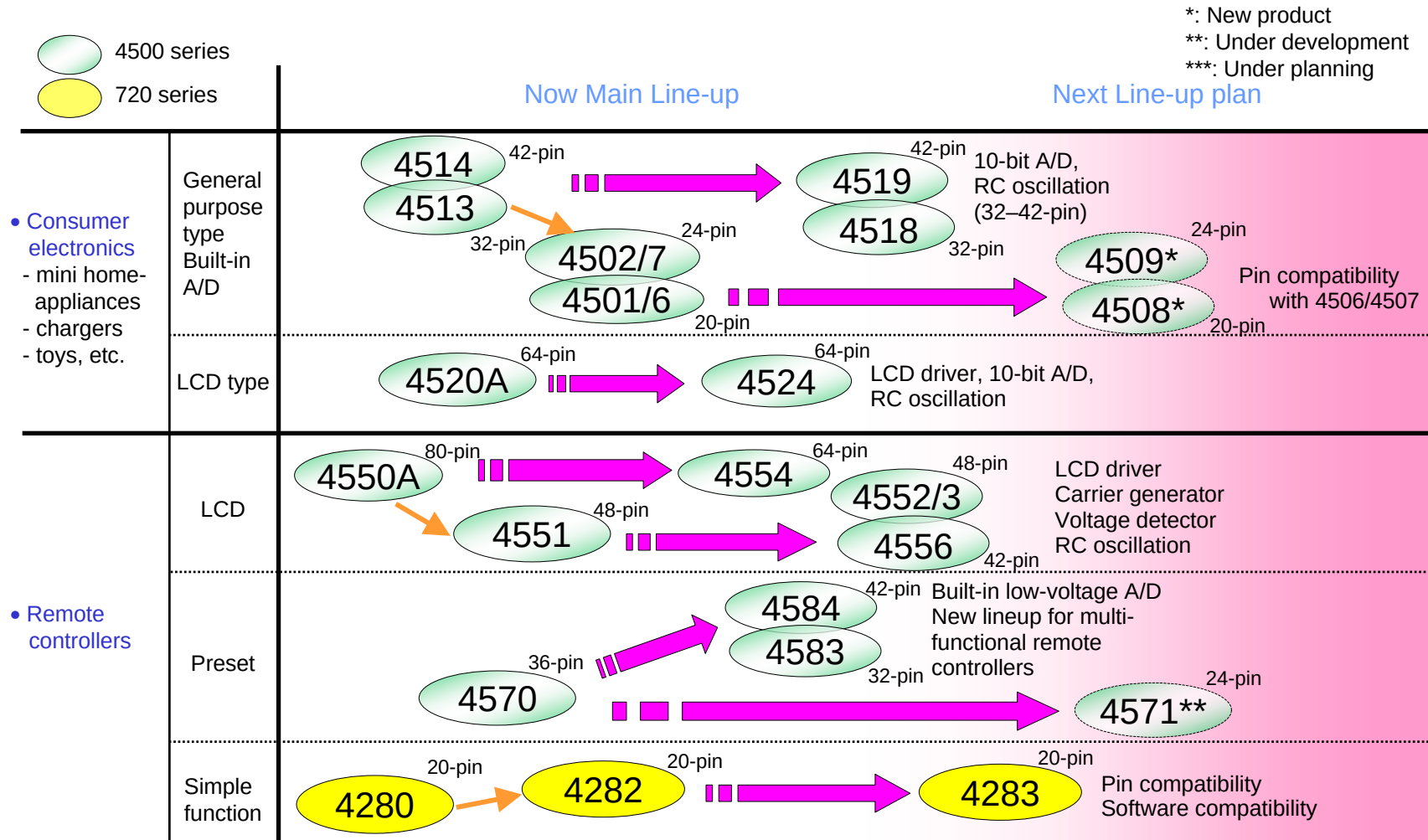
Outline Specification

October 28, 2005

Rev.2.00

Standard Product Business Group
Renesas Technology Corp

Roadmap for 4-bit 4500 Series MCUs



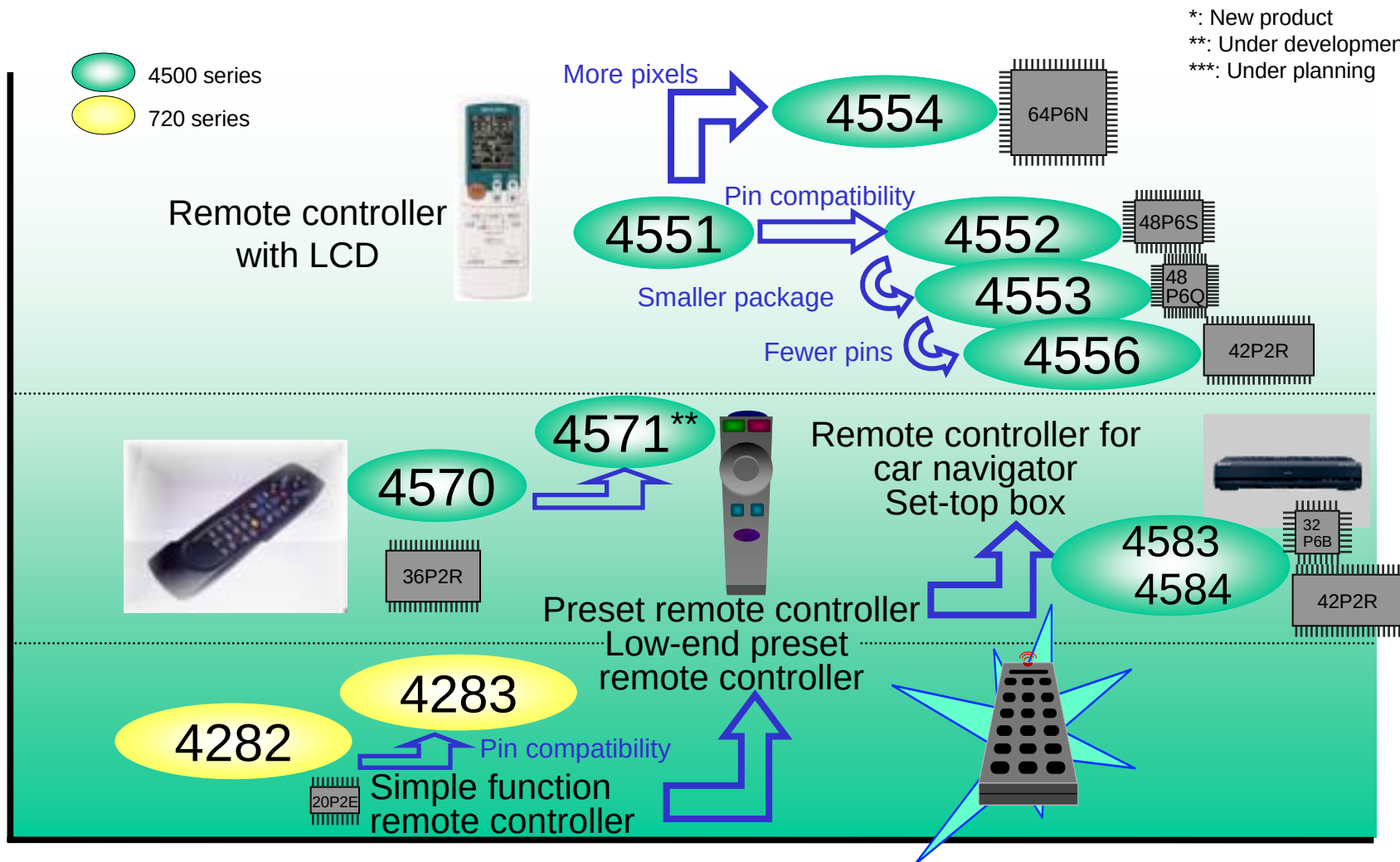
Applications of 4-bit Microcomputers for Home Appliances

4500 Series

General purpose: General home appliances, toys



Applications of 4-bit Microcomputers for Remote Controllers



*: New product
 **: Under development
 ***: Under planning

4-bit 4500 Series MCU Lineup



*: New product

Type	Group	Package	Memory capacity	Functions and Features
General-purpose type (built-in A/D)	4519	42P2R	6 K to 8 Kword 384 word	10-bit A/D (8 ch), voltage-drop detection, serial I/O, 8-bit timer x 4, watchdog, RC oscillation
	4518	FP:32P6U-A SP:32P4B	2 K to 8 Kword 256 to 384 word	10-bit A/D (4 ch), voltage-drop detection, serial I/O, 8-bit timer x 4, watchdog, RC oscillation
	4502 4501	24P2Q-A 20P2N-A	2 K to 4 Kword 128 to 256 word	10-bit A/D (4 ch/2 ch), voltage-drop detection (3.5 V), RC oscillation, power-on reset, 8-bit timer x 2, watchdog
	4507 4506	24P2Q-A 20P2N-A	2 K to 4 Kword 128 to 256 word	10-bit A/D (4 ch /2 ch), RC oscillation, 8-bit timer x 2, Watchdog, low-voltage operation (2.0 to 5.5V)
LCD type	4524	64P6N-A	8 K to 12 Kword 512 word	LCD (20 x 4), 8-bit timer x 4, 16-bit timer x 1, voltage-drop detection, 10-bit A/D (8 ch), serial I/O, RC oscillation, subclock (crystal)

Type	Group	Package	Memory capacity	Functions and Features
Simple function remote controller	4283	20P2E/F-A	1 to 2 Kword 48 to 64 word	8-bit timer x 2, voltage-drop detection, power-on reset, multi-carrier wave output, Support for 56 keys possible
Preset remote controller	4570	36P2R-A	4 K to 16 Kword 128 word	8-bit timer x 2, 10-bit timer x 1, voltage-drop detection, power-on reset, multi-carrier wave output
	4584	42P2R-A	16 Kword 384 word	8-bit timer x 4, 2-ch of low-voltage 10-bit A/D (from 2.0 V), voltage-drop detection, power-on reset, multi-carrier wave output,
	4583	32P6U-A	16 Kword 384 word	8-bit timer x 4, 2-ch of low-voltage 10-bit A/D (from 2.0 V), voltage-drop detection, power-on reset, multi-carrier wave output
LCD remote controller	4552/3/6	48P6S-A 48P6Q-A 42P2R-A	4 K to 8 Kword 288 word	LCD (28/29/23 x 4), 8-bit timer x 2, 16-bit timer x 1, voltage-drop detection, power-on reset, subclock (crystal), multi-carrier wave output
	4554	64P6N-A	8 K to 12 Kword 512 word	LCD (32 x 4), 8-bit timer x 2, 16-bit timer x 1, voltage-drop detection, power-on reset, subclock (crystal), multi-carrier wave output

M34518/4519 Group



Features

- High-resolution multi-channel A/D converter
- Pull-up resistors in RESET pin
- Comparison with the 4513/4514 group
 - C-MOS output is selectable by software
 - period measurement function is added
- Key-on wakeup function
- Ultra-low power-consumption operation
 - 55 μ A (typ.) at quartz: 32 kHz, VDD = 5 V
- Min. instruction execution time
 - 0.5 μ s : f(XIN) = 6 MHz, XIN through mode)
- Clock generating circuit
 - ceramic resonator / RC oscillation / quartz-crystal oscillator / on-chip oscillator
- Power-supply voltage (Mask ROM version)
 - VDD = 4.0 to 5.5 V (f(STCK) $\leq$ 6 MHz)
 - VDD = 2.7 to 5.5 V (f(STCK) $\leq$ 4.4 MHz)
 - VDD = 2.0 to 5.5 V (f(STCK) $\leq$ 2.2 MHz)
 - VDD = 1.8 to 5.5 V (f(STCK) $\leq$ 1.1 MHz)
 - One time PROM version : 2.5 to 5.5 V

It depends on operation source clock, oscillation frequency and operation mode.

Applications

- Home appliances
- Consumer appliances
- OA equipment

Product Expansion (): ROM/RAM size

- M34518M2-XXXXFP/SP (2 K/256)
- M34518M4-XXXXFP/SP (4 K/256)
- M34518M6-XXXXFP (6 K/384)
- M34518M8-XXXXFP (8 K/384)
- M34518E8FP/SP (8 K/384)
 - FP : 32P6U-A : 32-pin LQFP (0.8-mm pitch)
 - SP : 32P4B : 32-pin SDIP (1.778-mm pitch)
- M34519M6-XXXXFP (6 K/384)
- M34519M8-XXXXFP (8 K/384)
- M34519E8FP (8 K/384)
 - FP : 42P2R-E : 42-pin SSOP (0.8-mm pitch)

4500 CPU	8-bit Timer : 4 ch
ROM (x 10 bits) MASK/One time PROM	Serial Interface clock synchronized : 1 ch
RAM (x 4 bits)	10-bit A/D 4 ch (4518), 8 ch (4519)
Watchdog timer	Voltage-drop detection circuit 3.5 V (typ.) (reset occurrence) 3.7 V (typ.) (reset release)
Oscillation circuit (RC oscillation) (On-chip oscillator)	
I/O:25 (4518), 35 (4519)	

Features

- On-chip high-accuracy A/D converter
 - 10-bit resolution, linearity error ± 2 LSB
- Comparison with the 4506/4507 group
 - C-MOS output is selectable by software
 - Highly functional timer with two reload registers
 - Serial I/O
 - Voltage-drop detection circuit (only H version)
 - A/D converter 2 ch is added
 - Low-voltage operation A/D converter (2.0 to 5.5 V)
- Key-on wakeup function
- LED direct drive with large-current drive ports
 - 4508 Group : 4
 - 4509 Group : 6
 - Includes 2 (D0, D1) for large-current drive
- Clock generating circuit:
 - ceramic resonator / RC oscillation / on-chip oscillator
- Min. instruction execution time
 - $0.68 \mu\text{s}$: $f(\text{XIN}) = 4.4 \text{ MHz}$, High-speed through mode)
- Power-supply voltage: 2.0 to 5.5 V

It depends on operation source clock, oscillation frequency and operation mode.

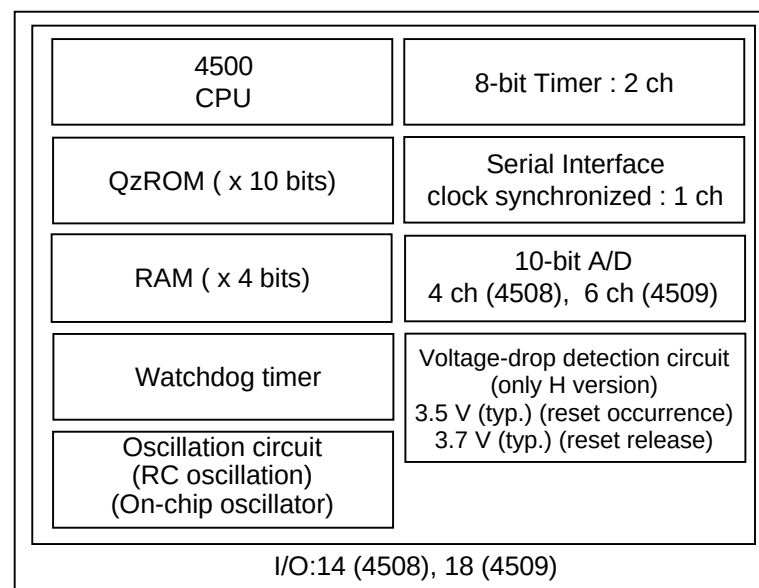
Applications

- Home appliances
 - Electric pots, Irons, Cleaners, etc.
- Consumer appliances
 - Portable audio system,
 - Game machine pad, Charger, etc.

Product Expansion (): ROM/RAM size

** : Under development

- M34508G4FP** (4 K/256) H ver : M34508G4H**
- M34508G4-XXXFP** (4 K/256) H ver : M34508G4H**
FP : 20P2N-A : 20-pin SOP (1.27-mm pitch)
- M34509G4FP** (4 K/256) H ver : M34509G4H**
- M34509G4-XXXFP** (4 K/256) H ver : M34509G4H**
FP : 24P2Q-A : 24-pin SSOP (0.8-mm pitch)



M34524 Group



Features

- On-chip 80-pixel LCD driver
- High-resolution multi-channel A/D converter
- Key-on wakeup function
- Clock generating circuit:
 - Main : ceramic resonator / RC oscillation / on-chip oscillator
 - Sub : quartz-crystal oscillator
- Min. instruction execution time
 - 0.5 μ s : f(XIN) = 6 MHz, through mode)
- Power-supply voltage (Mask ROM version)
 - VDD = 4.0 to 5.5 V (f(STCK) $\leq$ 6 MHz)
 - VDD = 2.7 to 5.5 V (f(STCK) $\leq$ 4.4 MHz)
 - VDD = 2.0 to 5.5 V (f(STCK) $\leq$ 2.2 MHz)
 - One time PROM version : 2.5 to 5.5 V

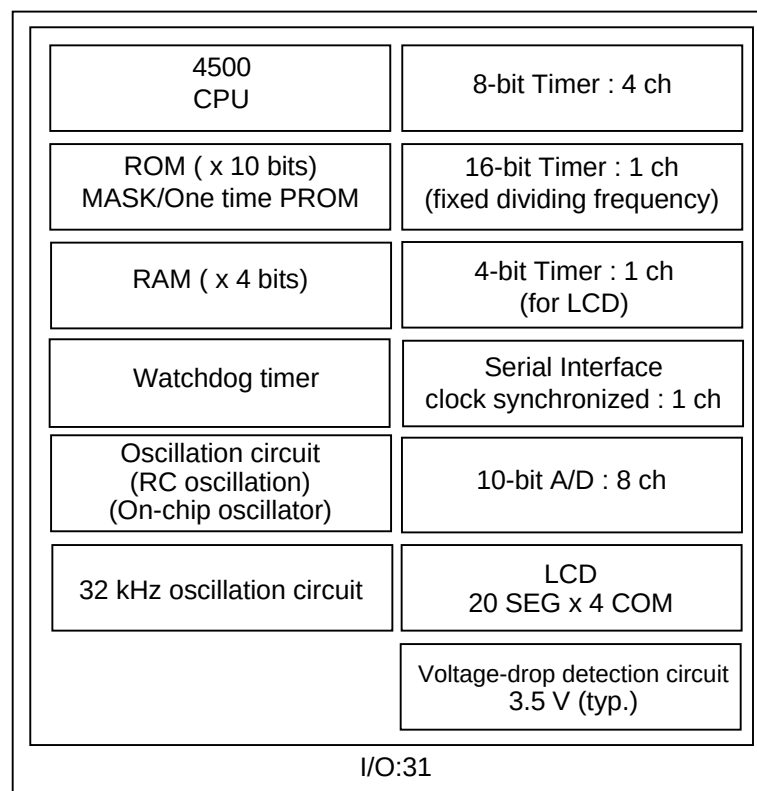
It depends on operation source clock, oscillation frequency and operation mode.

Applications

- Consumer appliances
 - Rice cooker, Electric pot, Bread maker, etc.

Product Expansion (): ROM/RAM size

- M34524M8-XXXFP (8 K/512)
 - M34524MC-XXXFP (12 K/512)
 - M34524EDFP (16 K/512)
- FP : 64P6N-A : 64 -pin QFP (0.8-mm pitch)



Features

- Timer with automatic controller for carrier wave output, and timer with carrier-wave generator enables efficient output of various waveforms for remote control
- Key-on wakeup function
- LED direct drive: 1 (E0)
- Min. instruction execution time
- $8.0 \mu\text{s}$: $f(\text{XIN}) = 4 \text{ MHz}$, system clock = $f(\text{XIN}) / 8$
- Power-supply voltage 1.8 to 3.6 V

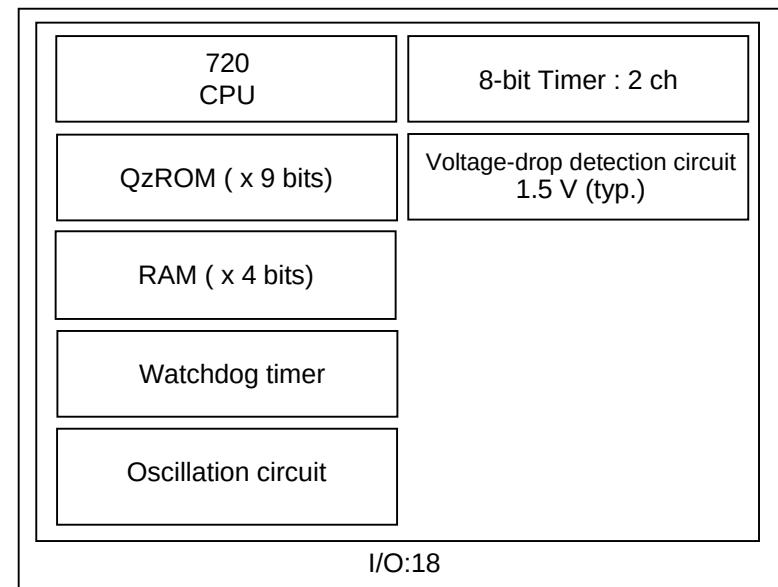
Applications

- Single-function remote controller

Product Expansion (): ROM/RAM size

** : Under development

- M34283G2GP** (2 K/64)
- M34283G2-XXXGP** (2 K/64)
GP : 20P2E/F-A : 20-pin SSOP (0.65-mm pitch)



M34570 Group



Features

- Timer with automatic controller for carrier wave output, and timer with carrier-wave generator enables efficient output of various waveforms for remote control
- Key-on wakeup function
- LED direct drive: 4
- Min. instruction execution time
 - At system clock = $f(XIN)$
 $1.5 \mu s$ $f(XIN) = 2$ MHz, $VDD = 4.5$ to 5.5 V
 - At system clock = $f(XIN) / 4$
 $2.86 \mu s$ $f(XIN) = 4.2$ MHz, $VDD = 2.0$ to 5.5 V
- Power-supply voltage 2.0 to 5.5 V
 - $VDD = 2.0$ to 5.5 V (Mask ROM version)
 - $VDD = 2.5$ to 5.5 V (One time PROM version)

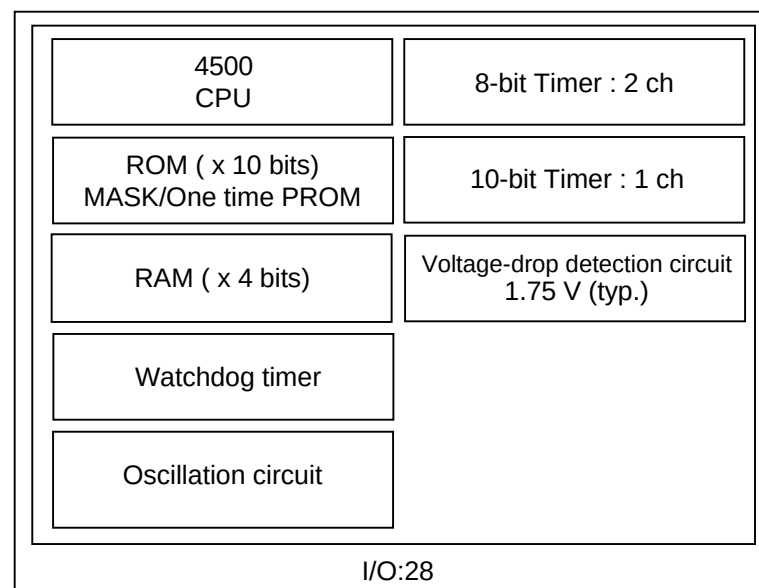
It depends on oscillation frequency and operation mode.

Applications

- Preset remote controller

Product Expansion (): ROM/RAM size

- M34570M4-XXXXFP (4 K/128)
 - M34570M8-XXXXFP (8 K/128)
 - M34570MD-XXXXFP (16 K/128)
 - M34570E8FP (8 K/128)
 - M34570EDFP (16 K/128) only ES product
- FP : 36P2R-A : 36-pin SSOP (0.8-mm pitch)



M34552/4553/4556 Group



Features

- 4552 is pin-compatible with 4551 Group
- 4553 inherits functions of 4552 in a smaller package
- 4556 is the low-pin count version of 4552/4553
- Enhanced I/O port
 - on/off control of pull-up transistors
 - key-on wakeup control
- LCD power-supply pin is shared with segment pin
 - Circuit suitable for LCD panel size can be configured
- Min. instruction execution time
 - MASK : 0.5 μ s (f(XIN) = 6 MHz, High-speed through mode)
 - OTP : 0.68 μ s (f(XIN) = 4.4 MHz, High-speed through mode)
- Clock generating circuit (on-chip oscillator)
- Power-supply voltage
 - VDD = 1.8 to 5.5 V (Mask ROM version)
 - VDD = 1.8 to 3.6 V (One time PROM version)

It depends on operation source clock, oscillation frequency and operation mode.

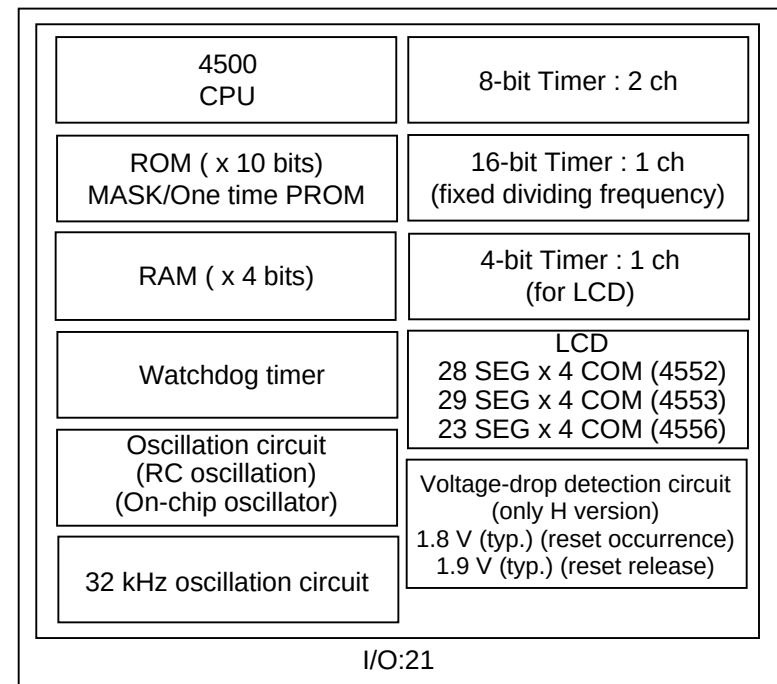
Applications

- Remote controllers with LCD display

Product Expansion (): ROM/RAM size * : New product

- M34552M4-XXXXFP* (4 K/288) H ver : M34552M4H*
 - M34552M8-XXXXFP* (8 K/288) H ver : M34552M8H*
 - M34552G8-XXXXFP* (8 K/288) H ver : M34552G8H*
- FP : 48P6S-A : 48-pin QFP (0.65-mm pitch)

- M34553M4-XXXXFP* (4 K/288) H ver : M34553M4H*
 - M34553M8-XXXXFP* (8 K/288) H ver : M34553M8H*
 - M34553G8-XXXXFP* (8 K/288) H ver : M34553G8H*
- FP : 48P6Q-A : 48-pin LQFP (0.5-mm pitch)
- M34556M4-XXXXFP* (4 K/288) H ver : M34556M4H*
 - M34556M8-XXXXFP* (8 K/288) H ver : M34556M8H*
 - M34556G8-XXXXFP* (8 K/288) H ver : M34556G8H*
- FP : 42P2R-A : 42-pin SSOP (0.8-mm pitch)



Comparison of M34552, M34553, and M34556 Groups



Item	4552	4553	4556
Number of pins	48	48	42
Package	Outline: 48P6S-A 0.65-mm pitch, Body: 7 x 10 mm, mounting height: 2.15 mm	Outline: 48P6Q-A 0.5-mm pitch, Body: 7 x 7 mm, mounting height: 1.4 mm	Outline: 42P2R-A 0.8-mm pitch, Body: 8.4 x 17.5 mm, mounting height: 2.0 mm
LCD control circuit SEG x COM	28 SEG x 4 COM 112 pixels	29 SEG x 4 COM 116 pixels	23 SEG x 4 COM 92 pixels
SEG pin	SEG13 pin not existing assigned as Vss	SEG13 pin available	SEG11 to SEG16 pins not existing

Comparison of standard and H-version products

Item	Standard	H version
Voltage-drop detection circuit	-	available

M34554 Group



Features

- Microcomputer for remote controllers with LCD display
- Key-on wakeup function
- Clock generating circuit:
 - Main : ceramic resonator / RC oscillation / on-chip oscillator
 - Sub : quartz-crystal oscillator
- Min. instruction execution time
 - 0.5 μ s : f(XIN) = 6 MHz, through mode)
- Power-supply voltage (when ceramic resonator is used)
 - VDD = 4.0 to 5.5 V (f(STCK) $\leq$ 6 MHz)
 - VDD = 2.7 to 5.5 V (f(STCK) $\leq$ 4.4 MHz)
 - VDD = 2.0 to 5.5 V (f(STCK) $\leq$ 2.2 MHz)
 - One time PROM version : 2.5 to 5.5 V

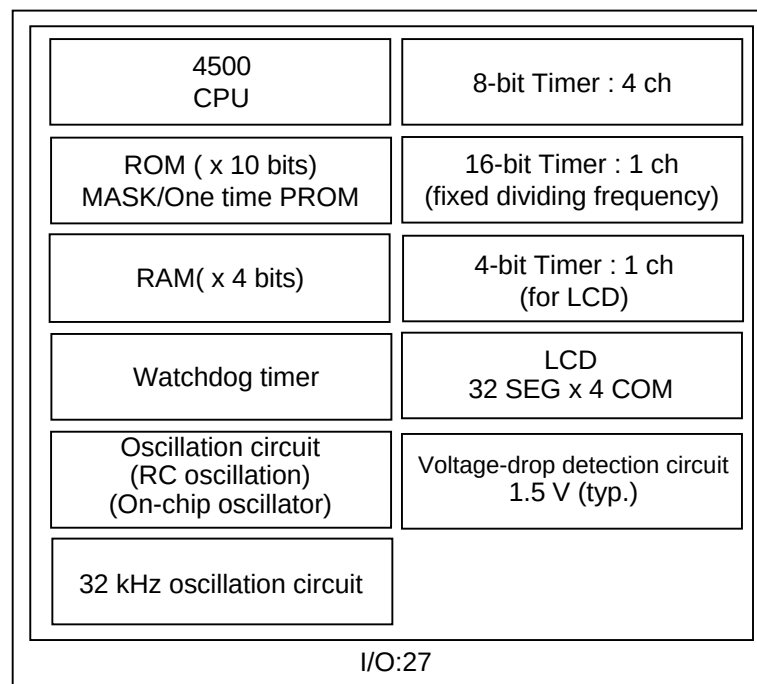
It depends on operation source clock, oscillation frequency and operation mode.

Applications

- Remote controllers with LCD display

Product Expansion (): ROM/RAM size * : New product

- M34554M8-XXXXFP (8 K/512)
 - M34554MC-XXXXFP (12 K/512)
 - M34554EDFP* (16 K/512)
- FP : 64P6N-A : 64-pin QFP (0.8-mm pitch)



Features

- Timer with automatic controller for carrier wave output, and timer with carrier-wave generator enables efficient output of various waveforms for remote control
- Key-on wakeup function
- Min. instruction execution time
 - At system clock = $f(XIN)$
 $0.5\mu s f(XIN) = 6MHz$, $V_{DD} = 4.0$ to $5.5 V$
 - At system clock = $f(XIN) / 4$
 $2.7\mu s f(XIN) = 4.4MHz$, $V_{DD} = 1.8$ to $5.5 V$
- Power-supply voltage
 - $V_{DD} = 1.8$ to $5.5 V$
 (It depends on oscillation frequency and operation mode.)

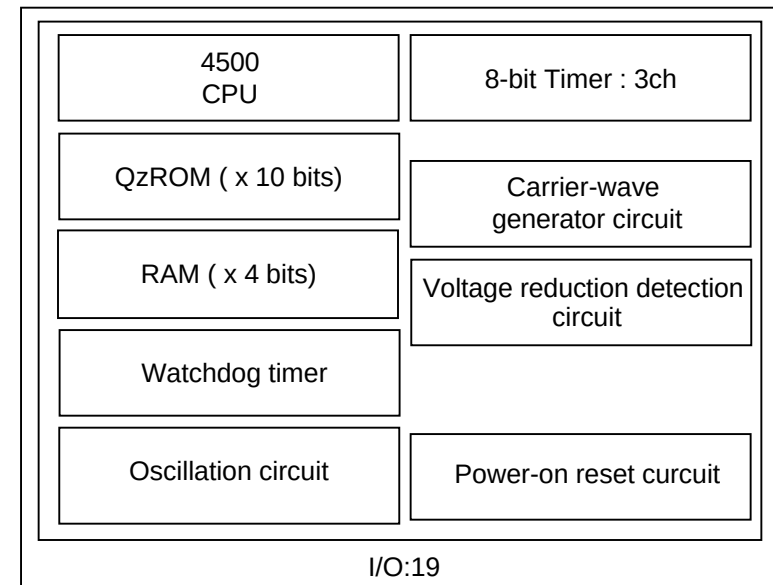
Applications

- Preset remote controller

Product Expansion (): ROM/RAM size

** : Under development

- M34571G4-FP** (4K/128)
 - M34571G6-FP** (6K/128)
 - M34571G4-XXXFP** (4K/128)
 - M34571G6-XXXFP** (6 K/128)
- FP: 24P2Q-A: 24-pin SSOP (0.8-mm pitch)



Development Tools for the M4500 Series

Development Tools for the 4500 Series

	Supported Group
PC4504 system	4501, 4502, 4506, 4507 4524, 4554, 4570
Compact emulator	4518, 4519, 4583, 4584 4552, 4553, 4556

- Only compact emulators are available for the 4552, 4553, and 4556 Group.
- New MCUs for the 4500 Series will be supported by the compact emulators.

Compact Emulators for the 4500 Series

Group	Compact Emulator
4518, 4519, 4583, 4584	M34519T2-CPE
4552, 4553, 4556	M34552T2-CPE
4282, 4283	M34282T2-CPE

PC4504 Systems

Group	Emulator Debugger	Emulator	MCU Board
4501, 4502, 4506, 4507	M3T-PD45 The assembler ASM45 is bundled.	PC4504	M34502T-MCU
4518, 4519, 4583, 4584			M34519T-MCU
4524, 4554			M34524T-MCU
4570			M34570T-MCU

Development Tools for the 4282/4283 Group

Group	Emulator Debugger		Emulator	Dedicated Board
4282	M3T-PD72 (Windows ver)	The assembler ASM72 is bundled.	PC4400	M34282T5-OPT
4283	M3T-RTT72 (DOS ver)			

Compact Emulator for the 4500 Series (1)

1. Specifications

Overview

Compact emulator product package includes software tools such as assembler and emulator debugger. The user can develop and debug the application program immediately after purchasing the compact emulator.

Features

- Enhanced debugging functions
(the same debugging functions as the PC4505 system)
- Compact (emulator body size: W:120 mm x D: 85 mm x H: 31 mm)
- Includes tools for programming and debugging
- Low cost
- Support for USB (USB1.1 full speed)

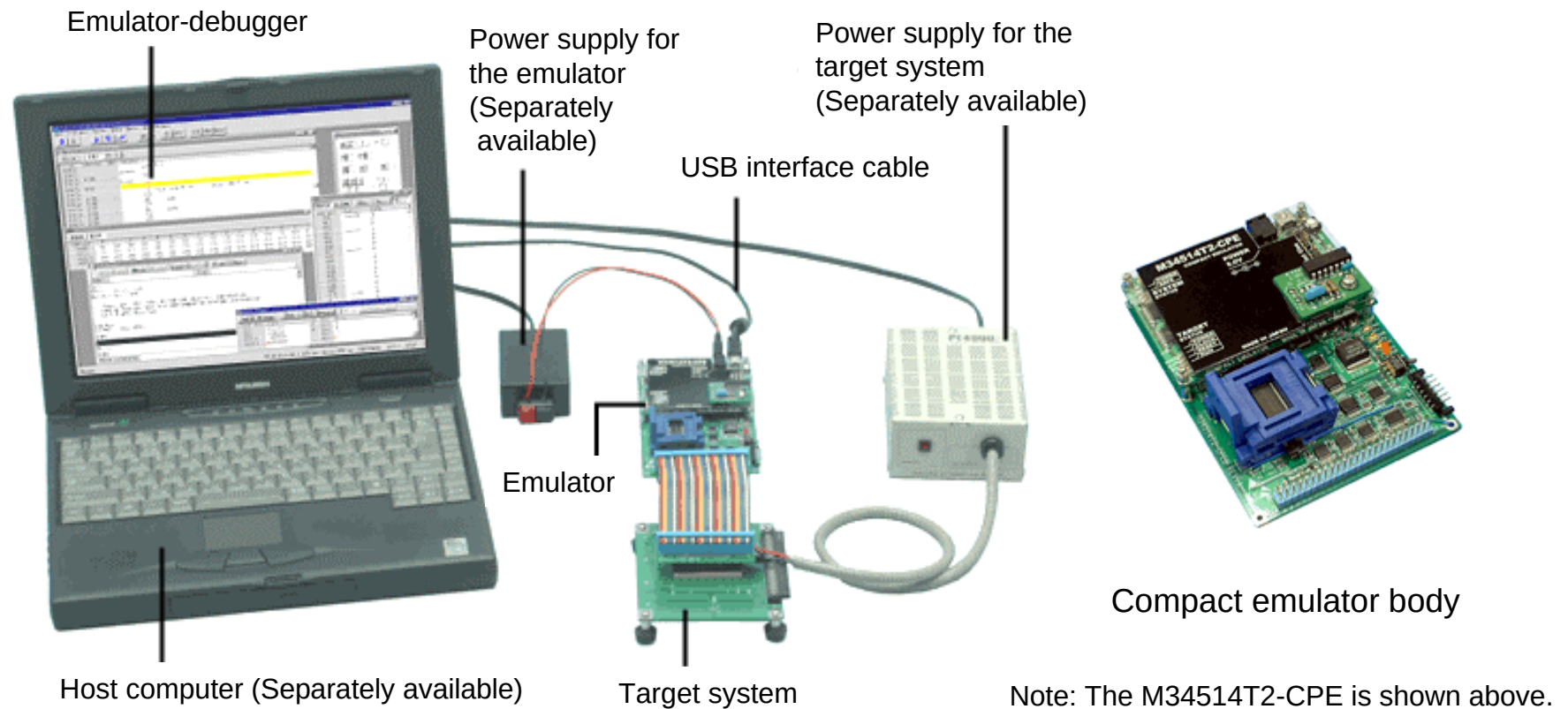
Product Package Contents

- Emulator • Evaluation MCU • USB interface cable
- Power cable (power supply must be separately prepared) • User's manual (PDF)
- External trace cable • 50-core standard pitch cable
- Oscillation circuit board
- Emulator debugger: M3T-PD45M (specifically for the compact emulator)

*Includes assembler ASM45

Compact Emulator for the 4500 Series (2)

2. Example of Connecting the 4500-Series Compact Emulator



M3T-PD72 debugger with the PC4400 for 720 series



Outline

The M3T-PD72 consists of the PD72 emulator debugger and the ASM72 absolute assembler, which are used in combination with the PC4400 emulator for the 720 series of 4-bit microcomputers.

This product is the Windows version of the M3T-RTT72 emulator debugger for DOS and has the equivalent functions to it. The customers who have already made their user registration of the M3T-RTT72 can upgrade it to the M3T-PD72 free of charge.

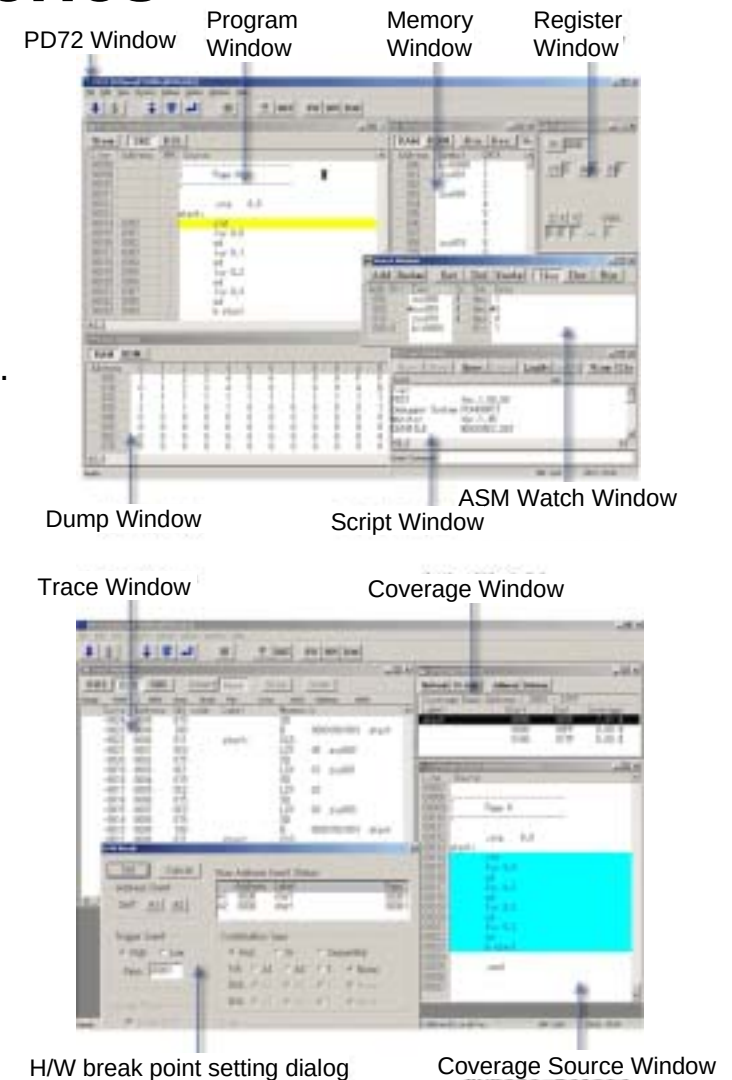
MCUs Supported

- 720 Series 4282 Group M34282M1, M34282M2
- 720 Series 4283 Group M34283G2 **

Features

- Comes with Assembler ASM72
- Emulator Debugger M3T-PD72
- Includes multi-window compatible with Windows.
- Compatible operability with M3T-PD45 (4500 Series debugger)
- Supports Assembler language source level debug
- Supports real-time trace, C0 coverage supports.

** : Under Development



Compact Emulator for the 720 Series M34282T2-CPE

4500 Series

Compact Design

- Downsized version of 4-bit emulator offering enhanced PC4400 functions.
W: 85 mm x D: 120 mm x H: 30 mm

Functions

- Debug function compatible with PC4504 (with advanced PC4400 functions)
- Supports 3 V operation
- USB communication I/F

Low Cost

- Comes with essential crosstools for development with emulator uni
 - Emulator Debugger M3T-PD72M (for compact emulators only)
 - M3T-PD72M is a dedicated debugger for compact emulators.
Cannot be used in control of the PC4400 Emulator
 - Absolute Assembler ASM72



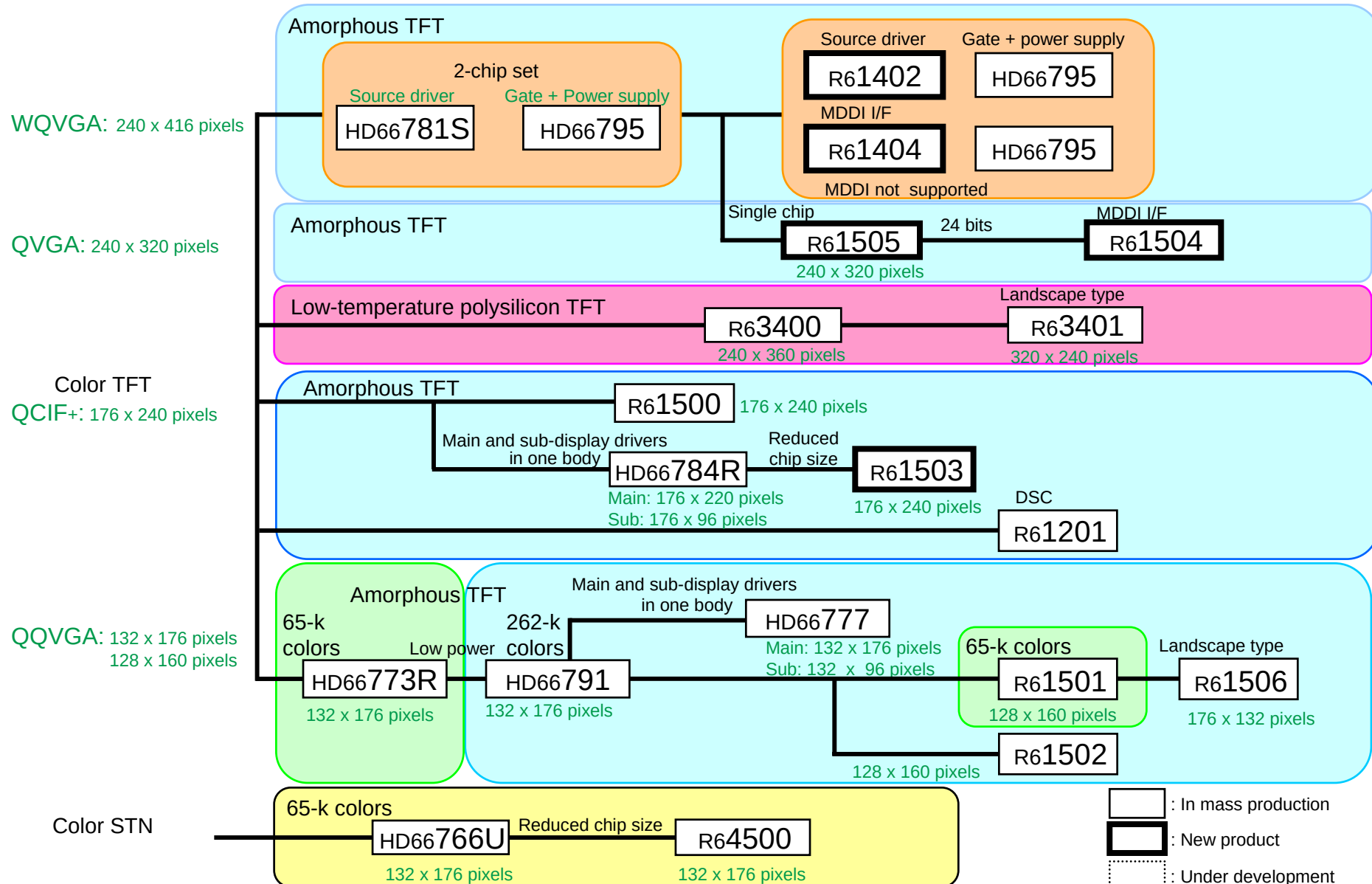
External view of similar emulator

Microcomputer General Presentation

LCD Display Control

October 28, 2005
Rev.2.00
LCD Business Unit
Standard Product Business Group
Renesas Technology Corp

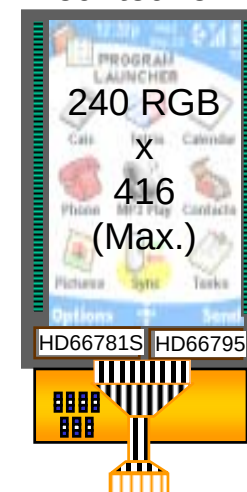
Roadmap of Products for Mobile Applications



Lineup of Products for Wide VGA

- Wide QVGA: suitable for 240 x 416-dot display system
- Wide display with double chip structure
- Lineup of products for mobile display digital interface (MDDI-I/F) in addition to conventional CPU-I/F and RGB-I/F
- Low-current-consumption type LCD driver chip set

Mounted form



Comparison of Functions

Product Type No.		HD66781S (source)	R61402 (source)	R61404 (source)
		HD66795 (gate + power supply)	HD66795 (gate + power supply)	HD66795 (gate + power supply)
Applied panel	Amorphous	Available	Available	Available
	LTPS/CGS	Available	—	—
Display size	Main	240 RGB X 416 (source driver)	240 RGB x 416 (source driver)	240 RGB x 416 (source driver)
	Sub	Max. 240 x 96 dots (For main QVGA)	Max. 240 x 96 dots (For main QVGA)	Max. 240 x 96 dots (For main QVGA)
No. of display colors		26-k colors	26-k colors	26-k colors
Interfaces	CPU bus	80-type 18/16/9/8 bits	Not available	80-type 18/16/9/8 bits
	RGB	18/16/6 bits	Not available	Not available
	Clock synchronous serial	Available	Not available	Not available
	Vsync	Available	Not available	Not available
	DMA	Available	Not available	Not available
	MDDI	Not available	Available	Not available
Display RAM (bytes)		224,640	224,640	224,640
Interface voltage (V)		16.5 to 3.3 V	16.5 to 3.3 V	16.5 to 3.3 V
DMA high speed data transfer		Available	Available	Available
Bus cycle (high-speed write)		10 MHz (20 MHz)	10 MHz (20 MHz)	10 MHz (20 MHz)
Synchronous programming		BST signal (fixed)	FMARK signal (optional)	FMARK signal (optional)
Display function	OSD	Available	Available	Available
	α blending	Available	Available	Available
	Resizing	Available	Available	Available

Comparison of Functions

- Support for QVGA (240 x 320 dots) -

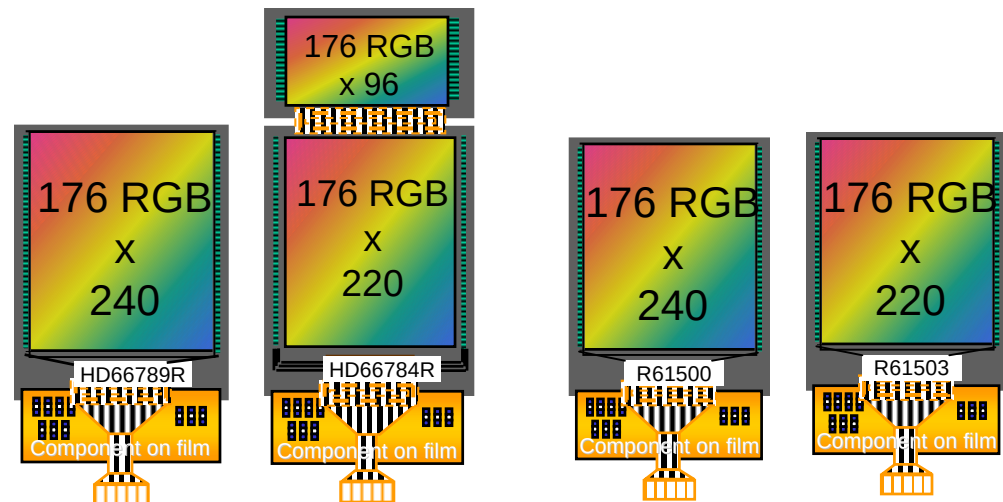
		R63400	R63401	R61505	R61504
Applied panel	Amorphous	—	—	Available	Available
	LTPS/CGS	Available	Available	—	—
No. of display colors		262-k colors	262-k colors	262-k colors	1677-k colors
Interfaces	CPU bus	8/9/16/18 bits	8/16/18 bits	8/9/16/18 bits	8/16 bits
	RGB	6/16/18 bits	6/16/18 bits	6/16/18 bits	8/16 bits
	VSYNC	Available	Available	Available	MDDI - VSYNC
	FMARK	Available	Available	Available	MDDI - FMARK
	Clock synchronous serial	Available	Available	Available	Available
Resolution		240 RGB (x360)	320 RGB (x240)	240 RGB (x320)	240 RGB (x320)
Display RAM (bytes)		194,400	172,800	172,800	230,400
Interface voltage (V)		1.65 to 3.3 V	1.65 to 3.3 V	1.65 to 3.3 V	1.65 to 3.1 V
Bus cycle (high-speed write)		6.6 MHz (13.3 MHz)	6.6 MHz (13.3 MHz)	TBD	TBD
Setting of involatile Vcom		—	—	—	—
Display function	OSD	Available	—	—	—
	α blending	Available	—	—	—
	Chroma-key	Available	—	—	—
	Resizing	Available	Available	Available	Available
Others		RGB independent γ			MDDI Interface

Lineup of Products for QCIF⁺

- QCIF⁺ (176 x 220 to 240 dots) -

		HD66789R	HD66784R	R61500	R61503
Applied panel	Amorphous	Available	Available	Available	Available
No. of display colors		262-k colors	262-k colors	262-k colors	262-k colors
Interfaces	CPU bus	8/9/16/18 bits	8/9/16/18 bits	8/9/16/18 bits	8/9/16/18 bits
	RGB	8/9/16/18 bits	6x3/16/18 bits	6x3/16/18 bits	8/9/16/18 bits
	SPI	Available	Available	Available	Available
Resolution		176 x 240 dots	176 x 316 dots	176 x 240 dots	176 x 220 dots
Display RAM (bytes)		95,040	125,316	95,040	87,120
Bus cycle (high-speed write)		5 MHz (10 MHz)	5 MHz (10 MHz)	5 MHz (10 MHz)	5 MHz (10 MHz)
Display function	OSD	—	Available	—	—
	α blending	—	Available	—	—
	Resizing	—	Available	—	—

- Mounted form

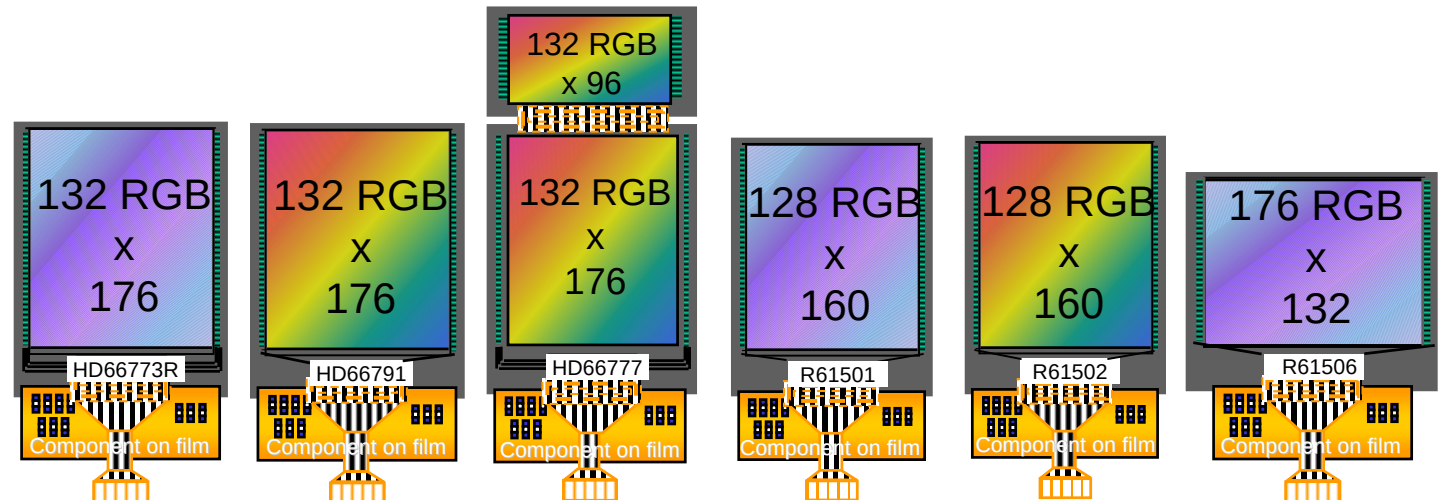


Lineup of Products for Sub QCIF/QQVGA

- Sub QCIF (132 x 176 dots), QQVGA (128 x 160 dots) -

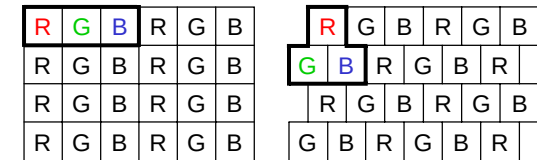
		HD66773R	HD66791	HD66777	R61501	R61502	R61506
Applied panel	Amorphous	Available	Available	Available	Available	Available	Available
	LTPS/CGS	—	—	—	—	—	—
No. of display colors		65-k colors	262-k colors	262-k colors	65-k colors	262-k colors	65-k colors
Interfaces	CPU bus	8/9/16/18 bits	8/9/16/18 bits	8/9/16/18 bits	8/16 bits	8/16/18 bits	8/16 bits
	RGB	—	6x3/16/18 bits	6x3/16/18 bits	—	—	—
	SPI	Available	Available	Available	Available	Available	Available
Resolution		132 x 176 dots	132 x 176 dots	132 x 272 dots	128 x 160 dots	128 x 160 dots	176 x 132 dots
Display RAM (bytes)		46,464	52,272	80,784	40,960	46,080	46,464
Interface Voltage (V)		2.2 and more	1.65 and more	1.65 and more	1.65 and more	1.65 and more	1.65 and more
Bus cycle (high-speed write)		5 MHz (10 MHz)	5 MHz (10 MHz)	6.7 MHz (10 MHz)	TBD	TBD	TBD
Setting of involatile Vcom		—	—	—	Available	Available	Available
Display function	OSD	—	—	Available	—	—	—
	α blending	—	—	Available	—	—	—
	Resizing	—	—	Available	—	—	—

- Mounted form



R61201 Product for Digital Still Cameras

- Driver for 187 RGB x 240-dot DSC display
- Support for both DSC-specific delta arrays and conventional stripe arrays
- On-chip source, gate driver and power supply, panel operation in a single chip
- RGB digital interface which prevents graphic data from deteriorating



Stripe array (left) and delta array (right)

Item	Specifications for R61201
Display size	187 RGB x 240 pixels
No. of display colors	256-k colors
No. of outputs	Source: 561 outputs (187 x 3 [RGB]), gate: 240 outputs
Display function	Delta and stripe arrays are switchable
Interface	• Clock synchronous serial • Interface for moving image: 8-/24-bit RGB bus, VSYNC, HSYNC and DOTCLK
Low current consumption function	Stoppage of faced electrodes, source output and gate output are separate
Other function	RGB γ adjustment function
Logic power supply voltage	2.5 to 3.6 V
Interface, I/O voltage	1.65 to 3.6 V
Liquid crystal operating voltage	4.0 to 5.5 V
Gate scan voltage	-17.5 to 17.5 V
Max. operating frequency (DOTCLK)	30 MHz

Features of Products for Color STN Display

- Lineup of single-chip products for controlling displays of up to 65-k colors
- Flicker-free display with reference voltage supply^{*1}
- Power-management control incorporated in functions such as partial display and standby mode for low current consumption
- Countermeasure for bright line at power off with voltage drop detector^{*1 *2}
- Suitable for mobile phones running WWW browsers and small information terminals with large displays, up to 132 RGB x 176 dots

LCD-panel display (example)



Comparison of Functions

	HD66766U	R64500
Display color	65-k colors	65-k colors
Display resolution	132 RGB x 176	132 RGB x 176
MPU interface	8-/16-bit parallel Serial (SPI)	8-/16-bit parallel Serial (SPI)
Drive method	Hi-FAS	Hi-FAS
Gray-scale control	PWM	PWM
High-speed write mode	Available	Unavailable
EEPROM I/F	Unavailable	Available
Reference voltage supply	Unavailable	Available
Voltage drop detector	Unavailable	Available
Comparator with temperature sensor	Unavailable	Available
GRAM	46 Kbytes	41 Kbytes
Operating voltage	2.4 to 3.6 V	2.4 to 3.6 V

*1: On-chip R64500 function

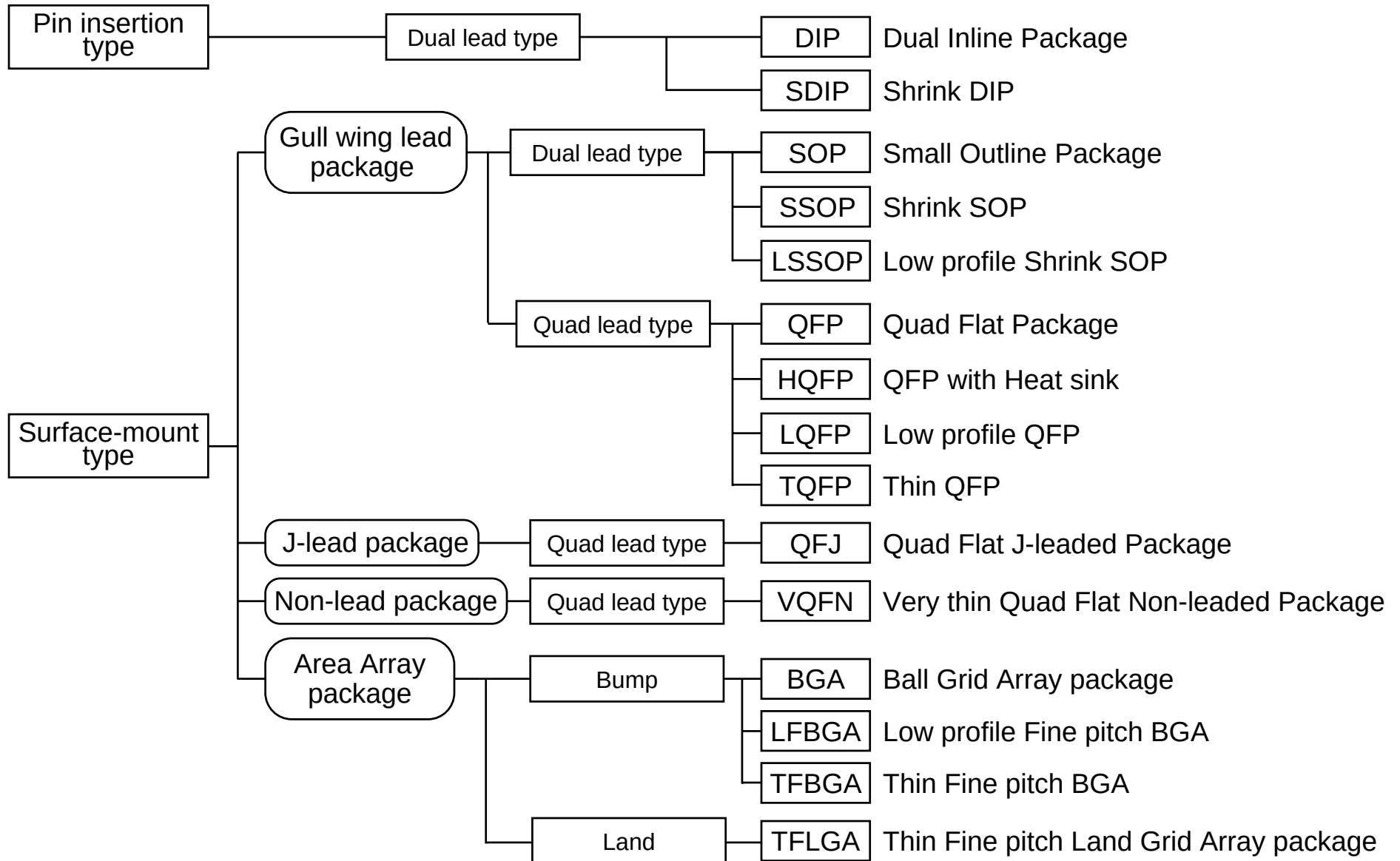
*2: Depends on voltage drop speed.
Please examine and conduct evaluation using the module and set thoroughly before usage.

Microcomputer General Presentation

Package

October 28, 2005
Rev.2.00
Standard Product Business Group
Renesas Technology Corp

Packages for Renesas Microcomputers



Package Code and Size Table

Package Name	Renesas Code	Previous Code	Terminal Count	Package Dimensions mm (mil)	Terminal Pitch mm	Mounting Height (Max.) mm
DIP	PRDP0024AE-A	DP-24	24	13.4 x 31.6 (600)	2.54	5.70
	PRDP0028AB-A	DP-28	28	13.4 x 35.6 (600)	2.54	5.70
	PRDP0040AB-A	DP-40	40	13.4 x 52.8 (600)	2.54	5.06
	PRDP0042AB-A	DP-42	42	13.4 x 52.8 (600)	2.54	5.06
	PRDP0048AA-A	DP-48	48	13.4 x 61.7 (600)	2.54	5.10
	PRDP0064AA-A	DP-64	64	21 x 82 (900)	2.54	5.10
SDIP	-	42S1B-A	42	41.1 x 15.8	1.778	5.00
	PRDP0028BB-A	DP-28S	28	8.8 x 27.1 (400)	1.78	5.10
	PRDP0032BB-A	DP-32S	32	8.9 x 28 (400)	1.778	5.08
	PRDP0042BB-A	DP-42S	42	14 x 37.3 (600)	1.78	5.10
	PRDP0064BB-A	DP-64S	64	17 x 57.6 (750)	1.78	5.08
	PRDP0090BA-A	DP-90S	90	21 x 82 (900)	1.78	5.08
	PRDP0020BA-A	20P4B	20	6.3 x 19 (300)	1.778	4.50
	PRDP0032BA-A	32P4B	32	8.9 x 28 (400)	1.778	5.08
	-	42S1B-A	42	41.1 x 15.8	1.778	5.0
	PRDP0042BA-A	42P4B	42	13 x 36.72 (600)	1.778	5.50
	PRDP0052BA-A	52P4B	52	13 x 45.85 (600)	1.778	5.50
	-	64S1B-E	64	58.5 x 19.55	1.778	5.35
	PRDP0064BA-A	64P4B	64	17 x 56.4 (750)	1.778	5.08
C-DIP	-	DC-64	64	22.86	2.54	-
C-SDIP	-	DC-64S	64	19.05	1.778	5.60
PGA	-	PC-68	68	10*	2.54	-
	-	PC-135	135	14*	2.54	4.95
SOP	PRSP0024DE-A	FP-24D	24	8.4 x 15.8 (450)	1.27	2.50
	-	FP-28DA	28	11.43 (450)	1.27	-
	PRSP0032DC-A	FP-32D	32	11.3 x 20.45 (525)	1.27	3.00
SSOP	PRSP0020DA-A	20P2N-A	20	5.3 x 12.6 (300)	1.27	2.10
	PRSP0030JA-A	FP-30D	30	8 x 11	0.65	2.00
	PRSP0024GA-A	24P2Q-A	24	5.3 x 10.1	0.80	2.10
	PRSP0036GA-A	36P2R-A	36	8.4 x 15	0.80	2.40
	-	42P2R-A	42	17.5 x 8.4	0.8	2.4
	PRSP0042GA-B	42P2R-E	42	8.4 x 17.5	0.80	2.40
LSSOP	PLSP0020JA-A	20P2E-A	20	4.4 x 6.5	0.65	1.45
	PLSP0020JB-A	20P2F-A	20	4.4 x 6.5	0.65	1.45
QFP	PRQP0044GC-A	FP-44A	44	14 x 14	0.80	3.05
	PRQP0064GB-A	FP-64A	64	14 x 14	0.80	3.05
	PRQP0064FB-A	FP-64	64	14 x 20	1.00	3.10
	PRQP0064FB-B	FP-64B	64	14 x 20	1.00	3.10
	PRQP0056FA-A	FP-54	56/54	14 x 20	1.00	3.10
	PRQP0080GD-A	FP-80	80	14 x 20	0.80	3.10
	PRQP0080JB-A	FP-80A	80	14 x 14	0.65	3.05
	PRQP0080GD-B	FP-80B	80	14 x 20	0.80	3.10
	PRQP0080JD-A	FP-80Q	80	14 x 14	0.65	3.05
	PRQP0100JE-A	FP-100	100	14 x 20	0.65	3.10
	PRQP0100JE-B	FP-100A	100	14 x 20	0.65	3.10
	PRQP0100KA-A	FP-100B	100	14 x 14	0.50	3.05
	PRQP0100KB-A	FP-100M	100	14 x 14	0.50	3.05
	PRQP0112JA-A	FP-112	112	20 x 20	0.65	3.05
	-	FP-128	128	14 x 20	0.5	3.15
	PRQP0128KB-A	FP-128B	128	14 x 20	0.50	3.15
	-	FP-144	144	20 x 20	0.5	-
	PRQP0144KA-A	FP-144G	144	20 x 20	0.50	3.05
	PRQP0144KB-A	FP-144J	144	20 x 20	0.50	3.05
	-	44P6N-A	44	10.0	0.8	3.05
	-	48P6S-A	48	7 x 10	0.65	2.15
	PRQP0064GA-A	64P6N-A	64	14 x 14	0.80	3.05
	PRQP0080JA-A	80P6S-A	80	14 x 14	0.65	3.05
	PRQP0080GB-A	80P6N-A	80	14 x 20	0.80	3.05
	PRQP0100JB-D	100P6P-E	100	14 x 20	0.65	3.05
	PRQP0100JB-A	100P6S-A	100	14 x 20	0.65	3.05
	PRQP0240KA-A	240P6Y-A	240	32 x 32	0.50	4.10
	PRQP0208KE-B	FP-208E	208	28 x 28	0.50	3.56
	PRQP0240KC-B	FP-240B	240	32 x 32	0.50	3.95
	PRQP0256LA-B	FP-256G	256	28 x 28	0.40	3.95

Package Name	Renesas Code	Previous Code	Terminal Count	Package Dimensions mm (mil)	Terminal Pitch mm	Mounting Height (Max.) mm
LQFP	PLQP0032GC-A	FP-32A	32	7 x 7	0.80	1.70
	PLQP0048KC-A	FP-48B	48	7 x 7	0.50	1.70
	PLQP0048JA-A	FP-48F	48	10 x 10	0.65	1.70
	PLQP0064KC-A	FP-64E	64	10 x 10	0.50	1.70
	PLQP0064KB-A	FP-64K	64	10 x 10	0.50	1.70
	PLQP0176KC-A	FP-176	176	24 x 24	0.50	1.70
	-	FP-144A	144	20 x 20	0.5	-
	PLQP0144KB-A	FP-144F	144	20 x 20	0.50	1.70
	PLQP0144KC-A	FP-144H	144	20 x 20	0.50	1.70
	PLQP0208KA-A	FP-208C	208	28 x 28	0.50	1.70
	PLQP0032GB-A	32P6U-A	32	7 x 7	0.80	1.70
	PLQP0048KB-A	48P6Q-A	48	7 x 7	0.50	1.70
	PLQP0052JA-A	52P6A-A	52	10 x 10	0.65	1.70
	PLQP0064KB-A	64P6Q-A	64	10 x 10	0.50	1.70
	PLQP0064GA-A	64P6U-A	64	14 x 14	0.80	1.70
	PLQP0080GA-A	80P6U-A	80	14 x 20	0.80	1.70
	PLQP0080KB-A	80P6Q-A	80	12 x 12	0.50	1.70
	PLQP0100KB-A	100P6Q-A	100	14 x 14	0.50	1.70
	PLQP0120LA-A	120P6R-A	120	14 x 14	0.40	1.70
	PLQP0128KB-A	128P6Q-A	128	14 x 20	0.50	1.70
TQFP	PLQP0116JA-A	116P6A-A	116	20 x 20	0.65	1.70
	PLQP0144KA-A	144P6Q-A	144	20 x 20	0.50	1.70
	PLQP0176KB-A	176P6Q-A	176	24 x 24	0.50	1.70
	-	TFP-80	80	14 x 14	0.65	1.20
	-	TFP-80A	80	12 x 12	0.5	-
	PTQP0080KC-A	TFP-80C	80	12 x 12	0.50	1.20
	PTQP0080JA-B	TFP-80F	80	14 x 14	0.65	1.20
	PTQP0100KA-A	TFP-100B	100	14 x 14	0.50	1.20
C-QFP	PTQP0100LC-A	TFP-100G	100	12 x 12	0.40	1.20
	PTQP0144LC-A	TFP-144	144	16 x 16	0.40	1.20
	PTQP0100LB-A	100PFB-A	100	12 x 12	0.40	1.20
	PTQP0144LA-A	144PFB-A	144	16 x 16	0.40	1.20
QFJ	-	FC-256T	256	36 x 36	0.5	10.50
	PRQJ0044DB-A	CP-44	44	16.58 x 16.58	1.27	4.60
	PRQJ0052DB-A	CP-52	52	19.12 x 19.12	1.27	4.60
	PRQJ0068DB-A	CP-68	68	24.2 x 24.2	1.27	4.60
VQFN	PRQJ0084DB-A	CP-84	84	29.28 x 29.28	1.27	4.60
	PVQN0032KA-A	TNP-32	32	5 x 6	0.50	0.95
	PVQN0048KA-A	TNP-48	48	7 x 7	0.50	1.00
QFN (LCC)	-	CG-84	84	29.21 (1150)	1.27	4.03
	-	CG-84A	84	29.21 (1150)	1.27	4.03
	-	44PJX-A	44	7.0	0.5	1.0
	-	64D0	64	15.6	0.8	3.13
	-	80D0	80	15.6 x 21.0	0.8	3.32
	-	100D0	100	15.6 x 21.0	0.65	5.0
BGA	PRBG0256DE-A	BP-256	256	27 x 27	1.27	2.50
	PRBG0256DE-B	BP-256A	256	27 x 27	1.27	2.50
	PLBG0112GA-A	BP-112	112	10 x 10	0.80	1.40
LFBGA	-	BP-176V	176	13 x 13	0.8	1.4
	PLBG0240JA-A	BP-240A	240	13 x 13	0.65	1.40
	PLBG0240JA-A	BP-240AV	240	13 x 13	0.65	1.40
	PLBG0261JA-A	261FHE	261	13 x 13	0.65	1.40
	-	261F7J	261	13.0	0.65	1.4
	TTBG0112GA-A	TBP-112A	112	10 x 10	0.80	1.2
TFLGA	PTLG0064JA-A	64F0G	64	6 x 6	0.65	1.05
	PTLG0085JB-A	85F0G	85	7 x 7	0.65	1.05
	PTLG0085JA-A	TLP-85V	85	7 x 7	0.65	1.2
	PTLG0113JA-A	TLP-113V	113	8 x 8	0.65	1.20

Notes*The number of pins in one pin row or column of the pin matrix of the package (including latent pins)

* For the latest information on packages, refer to the URL below.
<http://www.renesas.com/en/package>

Microcomputer General Presentation

Quality and Operating Temperature Range of Microcomputer Products

October 28, 2005

Rev.2.00

Standard Product Business Group
Renesas Technology Corp

About Microcomputer Product Quality

Renesas prepares products with various specifications to ensure the reliability of semiconductor devices for wide temperature operation, from general products with a wide temperature range (WTR) to high quality products (J/T, JE/U, and K/V Versions). Renesas also recommends the product with the most suitable specifications for particular uses.

High-quality specifications products:

- Evaluation with higher quality systems to improve precision in the fabrication process.
- Carefully selects the test items and conditions, and evaluates devices to obtain higher reliability and to ensure reliability to meet the market demands.
- Improves the manufacturing process and tightens up process quality control conditions
- Enhances screening to maintain quality in the earlier production stage.

Please select the high-quality specifications products for your purposes when high quality and the detailed analysis, etc. are required.

Comparison of Standard and High-Quality Products

Applies to products starting with R

	Applications			
	Standard Products		High-Quality Products	Special Spec. Product
	Consumer devices	Industrial devices	Devices which require high-quality	Special uses
Target initial failure rate (PPM)	100	50	10	Supported individually

Operating Temperature Range of Conventional Microcomputer Products

	Applications			
	Standard Products		High-Quality Products	Special Spec. Product
	Consumer devices	Industrial devices	Devices which require high-quality	Special uses
Type No. Indication and Temperature Range During Usage	None: - 20 to + 75°C or 85°C D or W* (I) : - 40 to + 85°C		J or T: - 40 to + 85°C JE or L, U: - 40 to + 105°C** K or V: - 40 to + 125°C	Supported individually

Note : Products other than above state the operating temperature range in the column "Notes"

*: "I" is shown for some products.

** : The temperature of some products is 110 °C

Quality and Operating Temperature Range of Microcomputer Products (1)

Category	Type No.	Package				Notes
		DIP	PLCC	QFP	TQFP	
SuperH Family	SH7010 Group			I		
	SH7020 Group				I	
	SH7030 Group			I, J	I	
	SH7040 Group			I, J		
	SH7046 Group			W		
	SH7047 Group			W, J		JE and K specifications are supported by the HLQFP
	SH7144 Group			W		
	SH7050/7051			J, JE		
	SH7055/7054/7053/7052			J, JE		
	SH7058			JE, K		
H8SX/1650 Series	H8SX/1650 Group				I	
H8SX/1500 Series	H8SX/1520 Group			J		
	H8SX/1544 Group			J*, JE*		No Standard Version
	H8SX/1580 Group					Standard Version only
H8S/2600 Series	H8S/2612 Group			J, JE, K		No Standard Version 2614, 2616: J only
	H8S/2615 Group			J, JE, K		No Standard Version JE, K spec: 20 MHz
	H8S/2628 Group			J		No Standard Version
	H8S/2630 Group			J, JE		No Standard Version JE spec: 16 MHz
	H8S/2633 Group			I, J*	I	* Flash only
	H8S/2635 Group			J, JE		No Standard Version
	H8S/2639, 38, 36 Group			J, JE		No Standard Version JE spec: 16 MHz
	H8S/2643 Group			I		
	H8S/2649, 48, 46 Group			J, JE		No Standard Version JE spec: 16 MHz
	H8S/2655 Group			I	I	
	H8S/2668 Group			W		
	H8S/2678 Group			I		
H8S/2500 Series	H8S/2556 Group			D		No Standard Version
	H8S/2552 Group			D		No Standard Version
	H8S/2506 Group			D		
H8S/2400 Series	H8S/2437 Group					Standard Version only
H8S/2300 Series	H8S/2319 Group			I	I	
	H8S/2329 Group			I, W*	I, W*	* W spec. For some products
	H8S/2339 Group			I		
	H8S/2345 Group			I, J	I	
	H8S/2350 Group			I	I	
	H8S/2355 Group			I	I	
	H8S/2357 Group			I	I	
	H8S/2368 Group			W	W	
	H8S/2378 Group			W	W	
	H8S/239x Group			I, W*	I, W*	* W spec. For some products
H8S/2200 Series	H8S/2212 Group			W		
	H8S/2214 Group				I	
	H8S/2215 Group				W	
	H8S/2218 Group				W	
	H8S/2227 Group			I	I	
	H8S/2237 Group			I	I	
	H8S/2238 Group			I	I	

Quality and Operating Temperature Range of Microcomputer Products (2)

Category	Type No.	Package				Notes
		DIP	PLCC	QFP	TQFP	
H8S/2200 Series	H8S/2238R Group			I	I	
	H8S/2239 Group			I	I	
	H8S/2245 Group			I	I	
	H8S/2258 Group			I	I	
	H8S/2264 Group			W	W	
	H8S/2268 Group			W	W	
	H8S/2282 Group			J		No Standard Version

Category	Type No.		Package				Notes
			DIP	PLCC	QFP	TQFP	
H8S/2100 Series	H8S/2124 Group	H8S/2120, 22			J, JE	I	
	H8S/2128 Group	H8S/2126R, 27R			J	I	
		H8S/2128F			J, JE	I	
		H8S/2128S					Standard Version only
	H8S/2134 Group	H8S/2130, 32			J, JE	I	
		H8S/2133S, 34S			J, JE	I	
		H8S/2132F, 34F			J	I	
		H8S/2134AF			J, JE	I	
	H8S/2138 Group	H8S/2137S, 38S			J	I	
		H8S/2138F			J, JE		
		H8S/2138AF			J	I	
	H8S/2140B Group	H8S/2140BVF, 41BVF					Standard Version only
		H8S/2145BVF, 45BF					Standard Version only
		H8S/2148BF				I	
		H8S/2148BVF					Standard Version only
		H8S/2160BVF, 61BVF					Standard Version only
	H8S/2144 Group	H8S/2142			J	I	
		H8S/2143S, 44S			J	I	
		H8S/2142F, 44F			J	I	
		H8S/2144AF			J	I	
	H8S/2148 Group	H8S/2147S, 48S				I	
		H8S/2148F			J	I	
		H8S/2148AF			J	I	
		H8S/2147AF					Standard Version only
	H8S/2114 Group	H8S/2114					Standard Version only * Under development
	H8S/2111B Group	H8S/2111BVB, BVC					Standard Version only * Under development
	H8S/2110B Group	H8S/2110BVF					Standard Version only
	H8S/2172 Group	H8S/2170VF					Standard Version only
	H8S/2168 Group	H8S/2168VF					Standard Version only
		H8S/2167VF, 66VF					Standard Version only
	H8S/2189 Group	H8S/2189					Standard Version only

Quality and Operating Temperature Range of Microcomputer Products (3)

Category	Type No.	Package						Notes
		DIP	PLCC	QFP	LQFP	TQFP	QFN	
H8/300H Series	H8/3001,02,03			I*, J		I		* H8/3002 QFP-100B only
	H8/3004, 05			I, J		I		
	H8/3032 group			I, J		I		
	H8/3035 group			I, J		I		
	H8/3039 group			I, J		I		
	H8/3042 group			I*, J		I		* QFP-100B only
	H8/3048 group			I, J		I		
	H8/3048F-ONE			W		W		
	H8/3006, 07			I*, J		I		* QFP-100B only
	H8/3008			I		I		
	H8/3062 group			I*, J		I		* QFP-100B only
	H8/3062B, 64B group			I		I		
	H8/3024, 26 group			W		W		
	H8/3067 group			I*, J		I		* QFP-100B only
	H8/3028 group			W		W		
	H8/3068F, 69RF, 3029F			W		W		
H8/300H Super Low-Power Series	H8/38076R group			W		W		
	H8/38086R group			W		W		
	H8/38602R group						W	
H8/300H Tiny Series (For details, refer to H8 Family on page 45.)	H8/36087 group			W	W			
	H8/36064 group			W	W			
	H8/36902, 36912 group				W			SOP, SDIP: W spec.
	H8/36037, 36057 group			W, J, JE, K	W			
	H8/36049 group			W				
	H8/36014 group			W, J, JE	W		W	
	H8/36024 group			W, J, JE	W		W	
	H8/3672 group			I	I			
	H8/3664 group	I		I, J	I			
	H8/3664N group			I	I			
H8/300L Series	H8/3694 group			I, J, JE, K	I			
	H8/3687 group			I, J, JE, K	I			
	H8/3614 group	I		I				
	H8/3637 group			I		I		
	H8/3644 group	I, J		I, J		I		
	H8/3657 group			I		I		
	H8/3714 group	I		I				
	H8/3724 group			I				
	H8/3814 group			I				
	H8/3834 group			I				
	H8/3854 group			I		I		
	H8/3857 group			I		I		
	H8/3877 group			I		I		
	H8/3927 group			I		I		

Quality and Operating Temperature Range of Microcomputer Products (4)

Category	Type No.	Package						Notes
		DIP	PLCC	QFP	LQFP	TQFP	QFN	
H8/300L Super Low-Power Series	H8/3802 group	I		I	I			
	H8/38004 group			I	I			
	H8/38024 group			I		I		
	H8/3827R group			I		I		
	H8/3847R group			I		I		
	H8/3867 group			I		I		
	H8/3887 group			I		I		
	H8/38104 group			W	W			
	H8/38124 group			W		W		
	H8/38327 group			W		W		
	H8/38347 group			W		W		

Category	Type No.	Package						Notes
		DIP	QFP	SOP	SSOP	TQFP		
H8/300 Series	H8/3297 group	I*, J, JE*				I		* MASK only
	H8/3337 group		I*, J, JE*			I		* MASK only
	H8/3397 group		I*, J, JE*			I		* MASK only
	H8/3437 group		I*, J, JE*			I		* MASK only
HMSC400 Series	H4394 group	I		I	I			SSOP package ADC x 4, medium withstanding voltage
	H4318 group	I, J*	I					* MASK only
	H4358 group	I, J	I, J					ADC x 8, medium withstanding voltage
	H4339 group	I	I					ADC x 12, high withstanding voltage
	H4369 group	I, J	I, J					ADC x 12, medium withstanding voltage
	H4328 group		I					ADC x 4, LCD MASK only
	H4618 group		I					DTMF, LCD
	H4818 group		I					LCD, comparator
	H4849 group		I					ADC x 8, LCD

Quality and Operating Temperature Range of Microcomputer Products (5)

Category	Type No.	Package						Notes
		SDIP	SSOP	QFP	LQFP	TQFP	FBGA	
M32R/ECU Series	32172 group				V			
	32173 group				V			
	32176 group				T, V			
	32186 group				V			
	32192 group				T, U, V			
	32196 group				T, U, V			
M32C/90 Series	M32C/95 group				T			
M32C/80 Series	M32C/80 group							Standard: -20 to 85°C or -40 to 85°C
	M32C/81 group			T, V	T, V			Standard: -20 to 85°C or -40 to 85°C
	M32C/82 group							Standard: -20 to 85°C or -40 to 85°C
	M32C/83 group				T, V			Standard: -20 to 85°C or -40 to 85°C
	M32C/84 group				T, U			Standard: -20 to 85°C or -40 to 85°C
	M32C/85 group				T			Standard: -20 to 85°C or -40 to 85°C
	M32C/86 group				T			Standard: -20 to 85°C or -40 to 85°C
	M32C/87 group							Standard: -20 to 85°C or -40 to 85°C
M32C/88 group				T			Standard: -20 to 85°C or -40 to 85°C	
M16C/80 Series	M16C/80 group							Standard: -20 to 85°C or -40 to 85°C
M16C/60 Series	M16C/62A group			T, U, V	T, U			Standard: -20 to 85°C or -40 to 85°C
	M16C/62M group							Standard: -20 to 85°C or -40 to 85°C
	M16C/62N group							Standard: -20 to 85°C or -40 to 85°C
	M16C/62P group			T, V	T, V			Standard: -20 to 85°C or -40 to 85°C
	M16C/6H group							Standard: -20 to 70°C
	M16C/6K group							Standard: -20 to 85°C
	M16C/6N group			T, V	T, V			Standard: -40 to 85°C
	M16C/6S group							Standard: -20 to 85°C
M16C/30 Series	M16C/6V group							Standard: -10 to 70°C, -20 to 70°C
	M16C/30 group							Standard: -20 to 85°C or -40 to 85°C
	M16C/30L group							Standard: -20 to 85°C or -40 to 85°C
M16C/30P group	M16C/30P group							Standard: -20 to 85°C or -40 to 85°C
	M16C/20 Series	M16C/24 group						Standard: -20 to 85°C
M16C/Tiny Series	M16C/26 group							Standard: -20 to 85°C
	M16C/26A group				T, V			Standard: -20 to 85°C or -40 to 85°C
	M16C/28 group				T, V			Standard: -20 to 85°C or -40 to 85°C
	M16C/29 group				T, V			Standard: -20 to 85°C or -40 to 85°C
M16C/10 Series	M16C/10 group							Standard: -20 to 85°C
	M16C/1N group				T			
R8C/Tiny Series	R8C/10 group				D			Standard: -20 to 85°C, D: -40 to 85°C
	R8C/11 group				D			Standard: -20 to 85°C, D: -40 to 85°C
	R8C/12 group				D			Standard: -20 to 85°C, D: -40 to 85°C
	R8C/13 group				D			Standard: -20 to 85°C, D: -40 to 85°C
	R8C/14 group			D				Standard: -20 to 85°C, D: -40 to 85°C
	R8C/15 group			D				Standard: -20 to 85°C, D: -40 to 85°C
	R8C/16 group			D				Standard: -20 to 85°C, D: -40 to 85°C
	R8C/17 group			D				Standard: -20 to 85°C, D: -40 to 85°C
	R8C/18 group	D	D	D				Standard: -20 to 85°C, D: -40 to 85°C
	R8C/19 group	D	D	D				Standard: -20 to 85°C, D: -40 to 85°C
	R8C/1A group	D	D	D				Standard: -20 to 85°C, D: -40 to 85°C
	R8C/1B group	D	D	D				Standard: -20 to 85°C, D: -40 to 85°C
	R8C/20 group				J,K			
	R8C/21 group				J,K			
	R8C/22 group				J,K			
	R8C/23 group				J,K			
	R8C/24 group				D			Standard: -20 to 85°C, D: -40 to 85°C
	R8C/25 group				D			Standard: -20 to 85°C, D: -40 to 85°C

Quality and Operating Temperature Range of Microcomputer Products (6)

[illegible]

Microcomputer General Presentation

Development Environment

Cross Tools

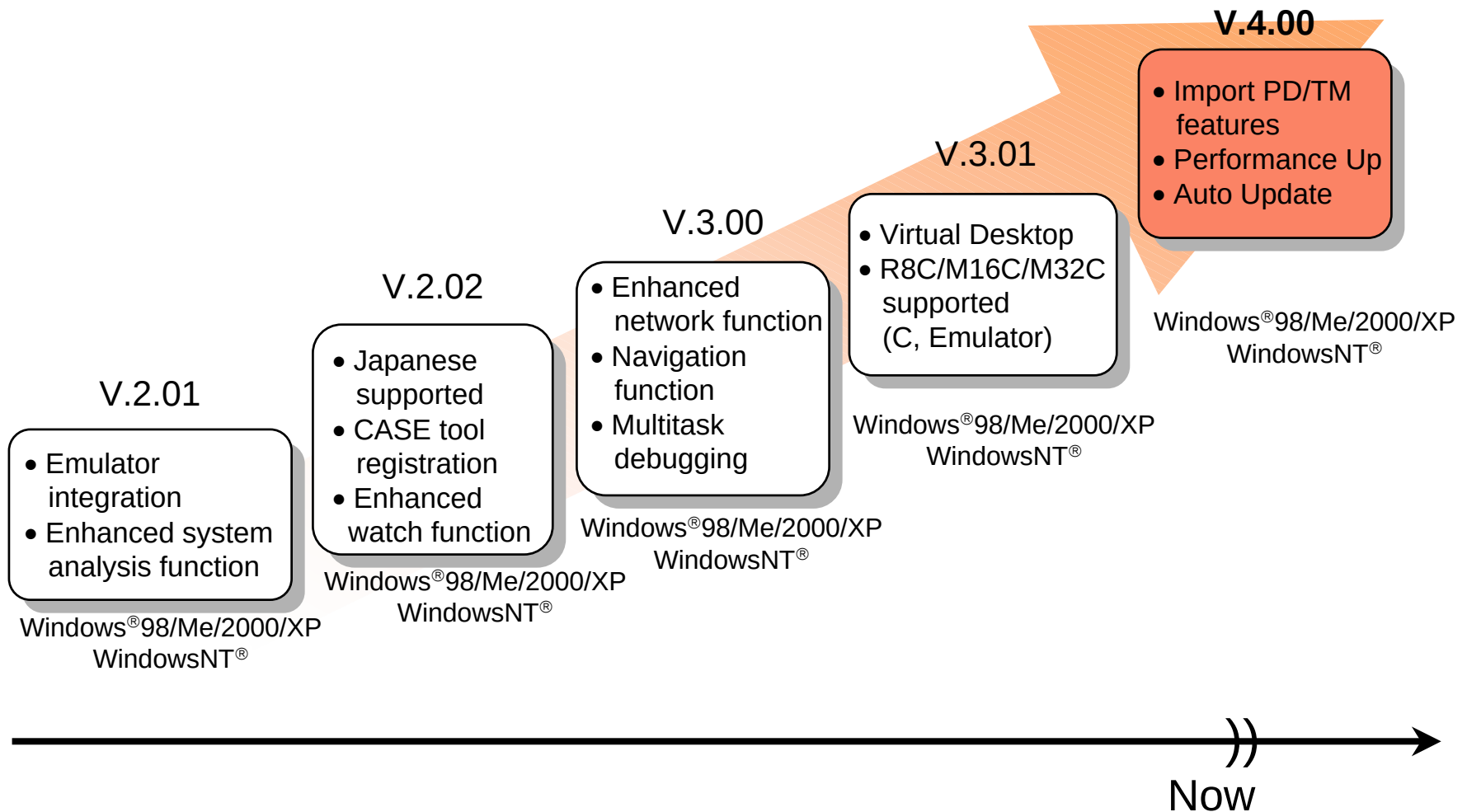
October 28, 2005

Rev.2.00

Microcomputer Tool Marketing Dept.
Renesas Solutions Corp

Integrated Development Environment

Road Map of High-performance Embedded Workshop



Summary and Functions

Summary

- Support for SuperH, H8SX, H8S, H8/300, M32R, and M16C cross tools
- Automatic Generation of Startup Code
- Customization according to the user environment is possible:
 - Bind user editors/user tools
 - Bind 3rd Party's version control tools (Exp. Visual SourceSafe)
 - Tcl/tk 8.4.1 support
- Providing of latest information that synchronizes with the Internet
- Cooperation with partner vender's tool
- Windows[®]98/Me/2000/XP, WindowsNT[®]4.0

Functions

- Built Function
 - Build for each projects
 - Multiple configuration, custom-built phase
- Debugging Function
 - Coverage (C/C++ language level, Assembly-language level)
 - Profiler, Realtime watch, image data display, waveform display
- Simulator Function
 - Pseudo-interrupt operation
 - Support peripheral modules(Cache, MMU, Time, etc)

Main Window

The screenshot shows the main window of the Renesas Cross tool, titled "ceatec_demo - High-performance Embedded Workshop - Reset". The window is divided into several panes:

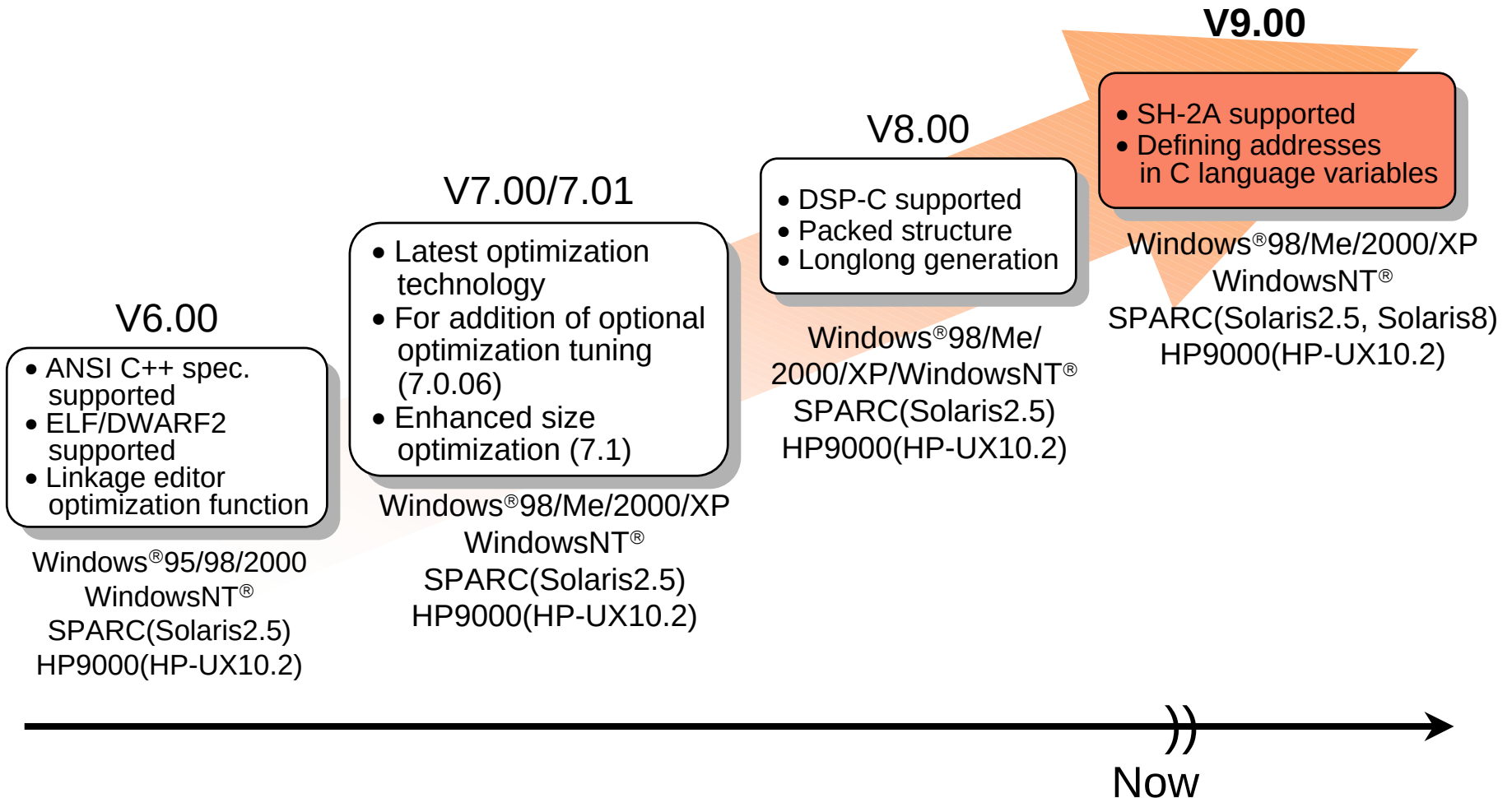
- Workspace Window:** Located on the left, it shows a project tree with folders like "C source file", "data.c", "demo0.c", "demo1.c", "demo2.c", "reset.c", "Download modules", "ceatec_demo", "Dependencies", "inch", and "print".
- Editor Window:** The central pane displays the source code for "reset.c". It includes a function definition for "func" and a "Reset()" function that sets up memory and registers. A red dot indicates the current execution point.
- Register Window:** Located on the right, it shows the current values of registers R0 through R15 and the PC (Program Counter).
- Memory Window:** Located at the bottom right, it shows a memory dump with addresses, labels, and hex values. A small image viewer is embedded within this window, displaying a landscape photo.
- Image Viewer:** A small window at the bottom right, showing a landscape image.

Annotations with blue boxes and arrows point to these specific windows:

- Workspace Window
- Editor Window
- Register Window
- Memory Window
- Image Viewer

Integration of coding and debugging functions

SuperH RISC engine C/C++ Compiler Road Map



Summary

- Support for SuperH RISC Engine Family
- Selectable Optimization Setting
 - many tuning options (Exp. Actual effectable optimization by changing the order of pipelines)
- Support for Extended Intrinsic Functions and Extended
 - SR, VBR, and GBR control
 - MAC (multiply-and accumulation) instruction generation
 - 64-bit multiplication
 - NOP, SLEEP etc.
- #pragma Functions
 - Short addressing: abs
 - Inline assembly: inline_asm
 - Stack size specification: stacksize etc.
- Support for ELF/DWARF2 Object Format
- Support for ANSI C/C++

H8SX, H8S and H8 Families C/C++ Compiler Road Map

V6.01

- Enhanced optimization (H8S)
- Specification of Absolute Address for Variables

V6.00

- H8SX support
- Near pointer
- Bit field allocation and order change
- Enhanced optimization

Windows®98/Me/2000/XP
WindowsNT®
SPARC(Solaris2.5)
HP9000(HP-UX10.2)

V4.00

- ANSI C++ spec. supported
- ELF/DWARF2 supported
- Enhanced optimization inter linkage editor
- Optimization in function units

Windows®98/Me/2000/XP
WindowsNT®
SPARC(Solaris2.5)
HP9000(HP-UX10.2)

V3.00

- Integrated C/C++
- Packed structure
- Enhanced register allocation
- Enhanced speed option

Windows®95/98
WindowsNT®
SPARC(Solaris2.4)
HP9000(HP-UX10.0)

Windows®98/Me/2000/XP
WindowsNT®
SPARC
(Solaris2.5, Solaris8)
HP9000(HP-UX10.2)

*There is no V5.0 in the H8 C/C++ compiler

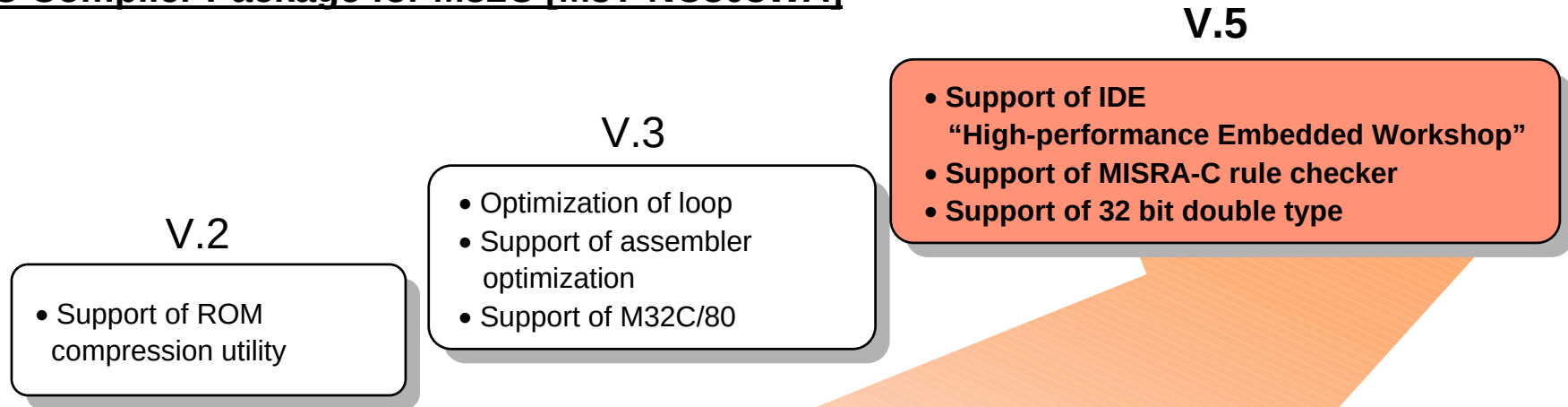
Now

Summary

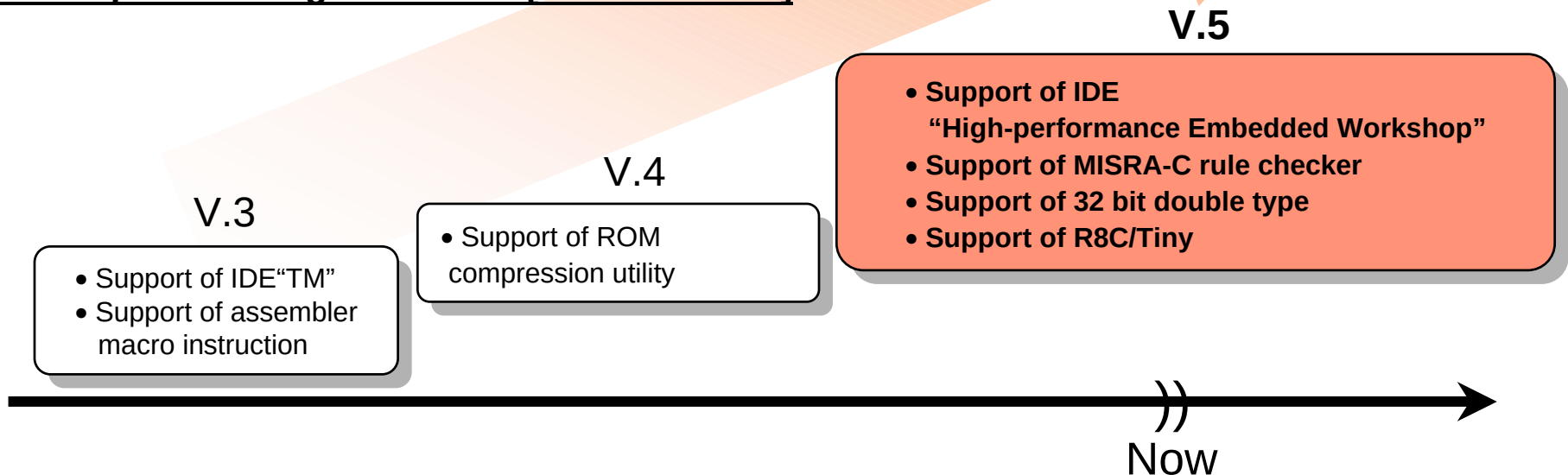
- Support for H8SX, H8S and H8 Families
- Selectable Optimization Setting
 - Selectable by Various Options
- Support for Extended Intrinsic Functions
 - Use of multiplier (H8SX, H8S/2600): `mac`, `mac1`
 - Condition code register control: `set_imask_ccr`, `get_imask_ccr`
 - System control: `trapa`, `sleep`, `tas`, `nop` etc.
- `#pragma` Functions
 - Short addressing: `abs`
 - Inline assembly: `inline_asm`
 - Entry function registration: `entry` etc.
- Support for ELF/DWARF2 Object Format
- Support for ANSI C++

M16C C Compiler Road Map

C Compiler Package for M32C [M3T-NC308WA]



C Compiler Package for M16C [M3T-NC30WA]



Relation table for M16C family C compiler

C Compiler Package for M32C [M3T-NC308WA]

- M16C Family M32C/90 Series (32/16-bit) * Preparing to support
- M16C Family M32C/80 Series (32/16-bit)
- M16C Family M16C/80 Series (16-bit)
- M16C Family M16C/70 Series (16-bit)

C Compiler Package for M16C [M3T-NC30WA]

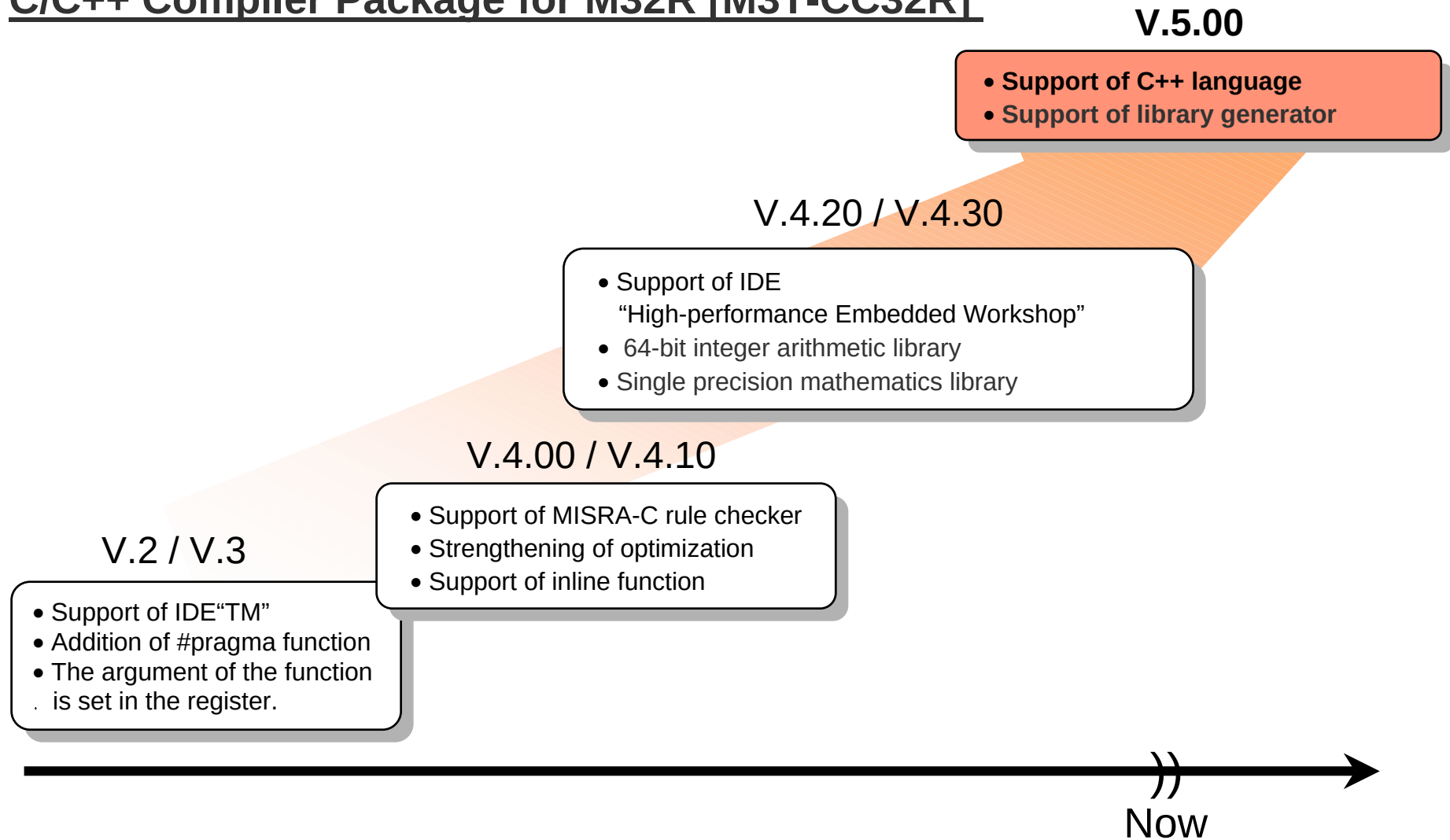
- M16C/60 Series (16-bit)
- M16C/30 Series (16-bit)
- M16C/20 Series (16-bit)
- M16C/10 Series (16-bit)
- M16C/Tiny Series (16-bit)
- R8C/Tiny Series (16-bit)

Summary

- ANSI Compatibility
 - Supports floating-point arithmetic.
 - Can initialize a structure and array consisting of "auto" variables
- Optimizations
 - Can choose between code generation for program manipulation speed and ROM code size, while also optimizing both.
- Creating ROMable Programs
 - Specifying interrupt functions
 - Moving constant data into ROM
 - In-line assembling
 - Calling assembly language subroutine
 - Defining I/O addresses etc.
- Specifying Memory Models of Variables
 - Qualifier "near"
 - Qualifier "far"

M32R C/C++ Compiler Road Map

C/C++ Compiler Package for M32R [M3T-CC32R]



Summary

- Conformance with ANSI C and ISO C++
- Support of Floating-point operation
- 64-bit integer arithmetic library
 - It consists of functions which allow integer arithmetic in 64-bit dynamic range by using the structure defined by type LONG64.
- Supports two-byte Japanese character codes of EUC, Shift-JIS and Unicode character sets.
- Outputs utilization size of the stack into a file.
- The base register function, which reduces the size of ROM
- Embedding a C/C++ function with the "inline" declaration.
- Optimization features
 - Optimization at assembly language level (e.g., eliminating unnecessary codes)
 - Local optimization
 - Global optimization (e.g., analyzing language structure)
- Calling an assembler subroutine
 - In C/C++ source file, assembler subroutine can be called and arguments can be passed via registers

Microcomputer General Presentation

Development Environment

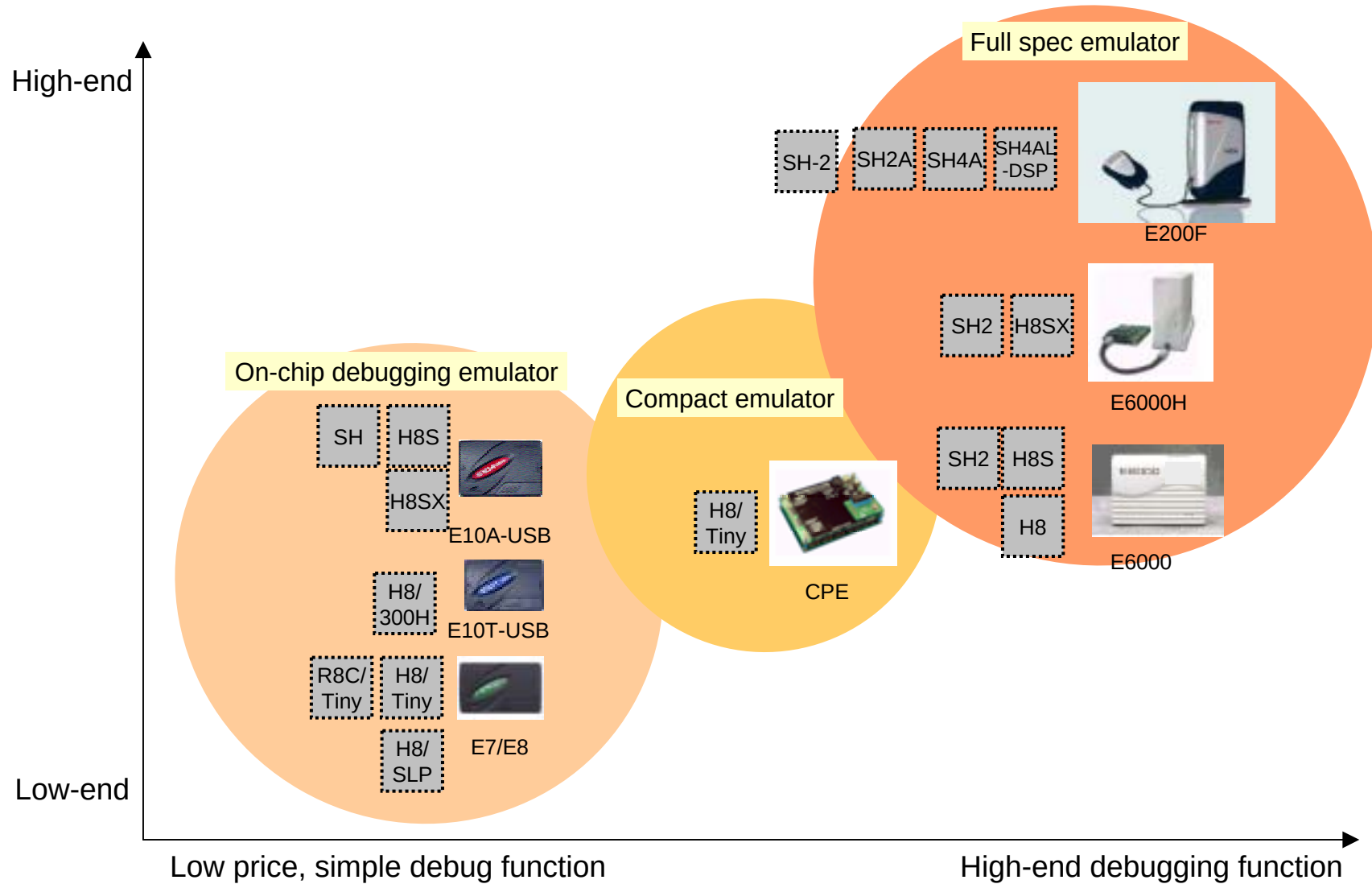
Emulators

October 28, 2005

Rev.2.00

Microcomputer Tool Marketing Dept.
Renesas Solutions Corp

Emulator Development



*: Device supported with E10A/E10T are being supported with E10A-USB/E10T-USB.

E10A-USB Emulator

Features of the E10A-USB (1)

- **The OCD emulator excellent in cost performance.**

E10A-USB can be used with all microcomputers which has H-UDI function.

The body size is very small as 97mm x 65mm x 22mm.

- **Real time Emulation**

The real time emulation in the highest operation frequency of CPU is available.

- **Excellence Operationally**

This emulator is possible to debug for user program with pointing device (mouse etc.) by using High-performance Embedded Workshop that running on Microsoft® Windows XP®, Microsoft® Windows®98SE, Microsoft® Windows®ME, or Microsoft® Windows®2000®.

Also, the emulator performs high-speed file download.

And the build environment and the debug environment can be integrated by installing it with the compiler package.

Features of the E10A-USB (2)

- **Substantial Debug Function**

Debug efficiency improvement by substantial break and trace function.
Set break point and break condition in exclusive window, display trace information to window.

Also, provide abundant command line function.

- **Debug for User System in product configuration**

The debug target configuration is almost same as the user's filial product system.

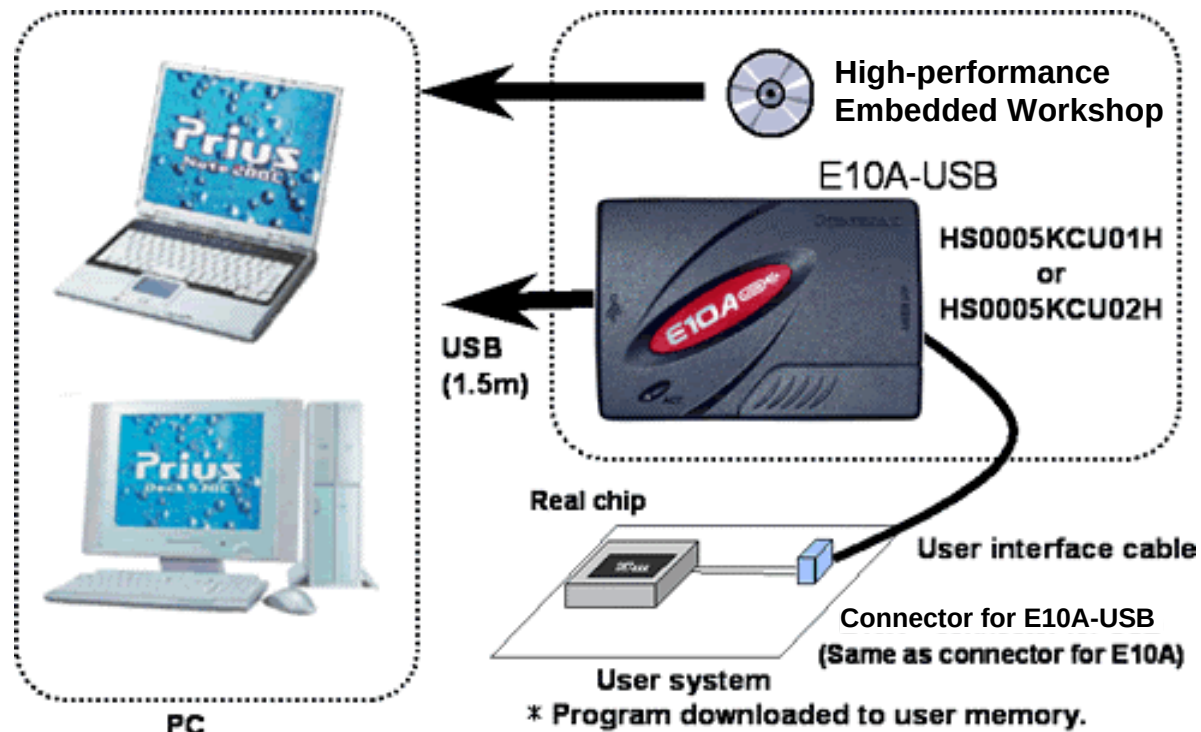
- **Debug environment using USB interface**

The E10A-USB can be used in both of laptop PC and desktop PC since PC interface is USB. And the emulator is USB bus powered.

Note1: E10A-USB Emulator software for SH requires SuperH RISC engine C/C++ compiler package Ver.6 or later.
SH7780 and SH-Mobile3 requires SuperH RISC engine C/C++ compiler package Ver.8 or later.
SH7206 require SuperH RISC engine C/C++ compiler package Ver.9 or later.

Note2 : E10A-USB Emulator software for H8S requires H8S,H8/300 C/C++ compiler package Ver.4 or later.
H8SX family requires H8SX,H8S,H8/300 C/C++ compiler package Ver.6 or later.

System configuration of the E10A-USB Emulator (1)



Note1 : Note that the pin assignments of the H-UDI port connector is different from those of the connector manufacturer

System configuration of the E10A-USB Emulator (2)

Initial Purchase



Notes on Installation for Prospective Purchasers

You do not need to purchase a Device Group Addition (License Tool for Device Group Additions) to support the first device group, the E10A-USB is shipped with an installer that allows the user to support any one of these.

Our range of Device Group Additions are for adding subsequent device groups to an existing system. Refer to the Product Configuration on the E10A-USB home page for further details.

Further information is available from your Renesas distributor or sales representative.

System configuration of the E10A-USB Emulator (3)

Subsequent Purchase



How to install additional device groups

If the user subsequently wishes to upgrade their E10A-USB to support an additional device group, Device Group Additions (License Tool for Device Group Additions) are available as additional purchases (subject to release schedule). The Device Addition is supplied as a CD-ROM with the desired Group software. This is used in conjunction with the original E10A-USB unit.

Note: It is possible for one E10A-USB unit to support ALL of these devices groups if all of the Device Group Additions are purchased and installed.

Table1 E10A-USB Product lineup

Product type No.	E10A-USB	User I/F cable	Remarks
HS0005KCU01H	TypeA (without AUD function)	14 pin	High-performance Embedded Workshop included (with license for one device group)
HS0005KCU02H	TypeB (with AUD function)	14 pin + 36 pin	High-performance Embedded Workshop included (with license for one device group)

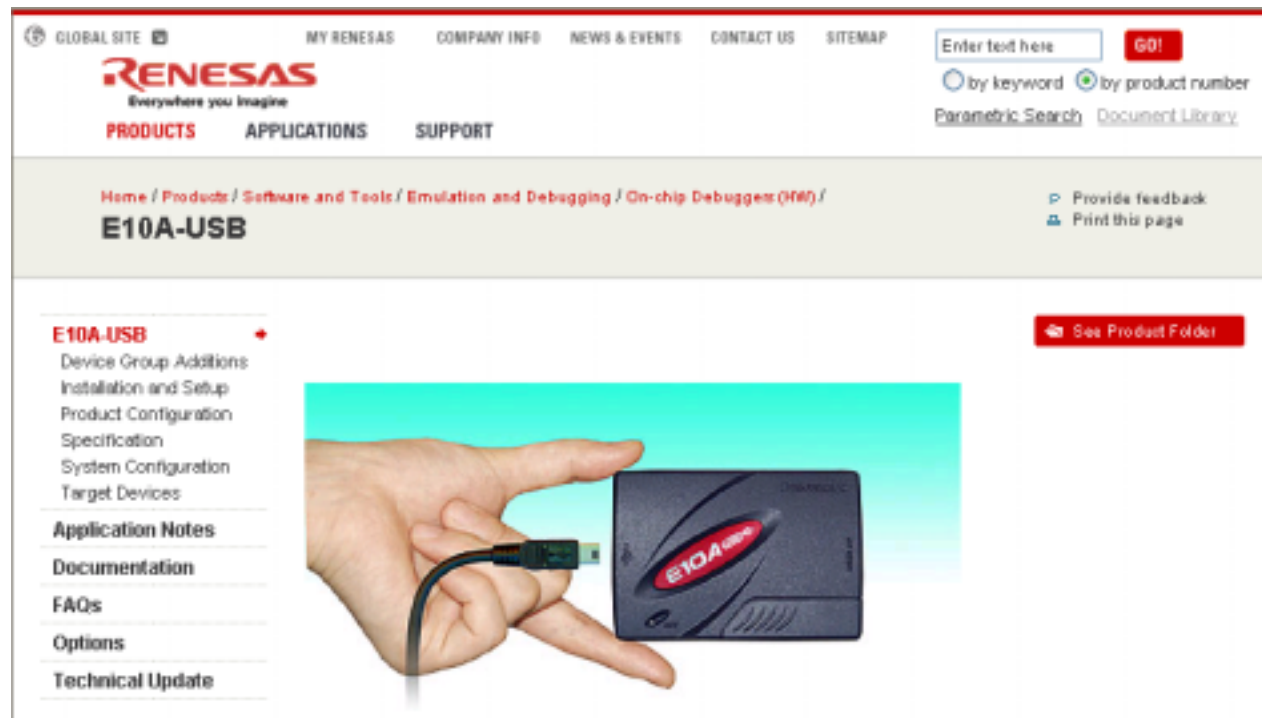
Table2 E10A-USB “License tool for device group addition” product lineup

Product type No.	Device group
HS2339KCU01SR	H8S
HS1527KCU01SR	H8SX
HS7047KCU01SR	SH-2
HS7206KCU01SR	SH-2A
HS7729KCU01SR	SH-3
HS7290KCU01SR	SH-Mobile
HS7318KCU01SR	New SH-Mobile
HS7751KCU01SR	SH-4
HS7780KCU01SR	SH-4A

Table3 E10A-USB support device list for SH family ,H8S family and H8SX family

Device group	Supported device	Shipment schedule
H8S device group	H8S/2212F , H8S/2212UF , H8S/2218F , H8S/2218UF , H8S/2377F , H8S/2377RF , H8S/2378F , H8S/2378RF , H8S/2367F , H8S/2368F , H8S/2168F , H8S/2167F , H8S/2166F , H8S/2437F , H8S/2114F , H8S/2339EF , H8S/2329EF , H8S/2319EF , H8S/2170F , H8S/2171F , H8S/2172F , H8S/2158F , H8S/2189F , H8S_custom_SoC	In mass production
	H8S/2116F , H8S/2115F , H8S/2115RF , H8S/2115TF	2005/12/E
	H8S/2153F	2006/1Q
H8SX device group	H8SX/1527F , H8SX/1525F , H8SX/1582F , H8SX/1653F	In mass production
	H8SX/1651 , H8SX/1654F	2005/12/E
	H8SX/1663F , H8SX/1664F , H8SX/1527RF	2005/12/E
SH-2 device group	SH7615 , SH7616 , SH7047F , SH7144F , SH7145F	In mass production
	SH7618 , SH7619 , SH7606	
	SH7083 , SH7084 , SH7085 , SH7086 , SH7146 , SH7149	2006/1Q
	SH7124 , SH7125	2006/1Q
SH-2A device group	SH7206	In mass production
	SH72611 , SH72612	2005/12/E
SH-3 device group	SH7705 , SH7630 , SH7710 , SH7641 , SH7660 , SH7720 Series SH7729 , SH7709A , SH7729R , SH7709S , SH7727 , SH7706 SH7712 , SH-3(core)_custom_SoC	In mass production
SH-Mobile device group	SH-Mobile 1/J/V/J2/V2/L	In mass production
New SH-Mobile device group	SH-Mobile3	In mass production
SH-4 device group	SH7750S , SH7750R , SH7751 , SH7751R , SH7760 SH7750Rbase_SOC	In mass production
SH-4A device group	SH7770 , SH7780 , SH7781 , SH7763	In mass production

E10A-USB Emulator information on the WEB



http://www.renesas.com/fmwk.jsp?cnt=e10a_usb_tools_product_landing.jsp&fp=/products/tools/emulation_debugging/onchip_debuggers/e10ausb/

Here and software version-up program and emulator related documents.

http://download.renesas.com/eng/mpumcu/upgrades/on_chip_debuggers/e10a_usb/index.html

MEMO

E200F Emulator

Feature of E200F (1)

(1) Real time emulation

- The Real time emulation is available in the highest operation frequency of CPU and peripheral I/O.

(2) Break function

Hardware brakes

- Brake built in device : max 10 ch (differ by microcomputer)
- AUD brake : max 8 ch (differ by microcomputer)
- Bus brake (In case connecting external bus trace unit) : 6 ch

Software brake

- 1000 points

(3) Trace function

- CPU internal trace by AUD: 256k cycles in maximum
 - a) Branch address
 - b) Data in the specified memory area
 - c) Valuables that assigned to general registers
- External bus trace with optional "external bus trace unit": 256k cycles in maximum

Feature of E200F (2)

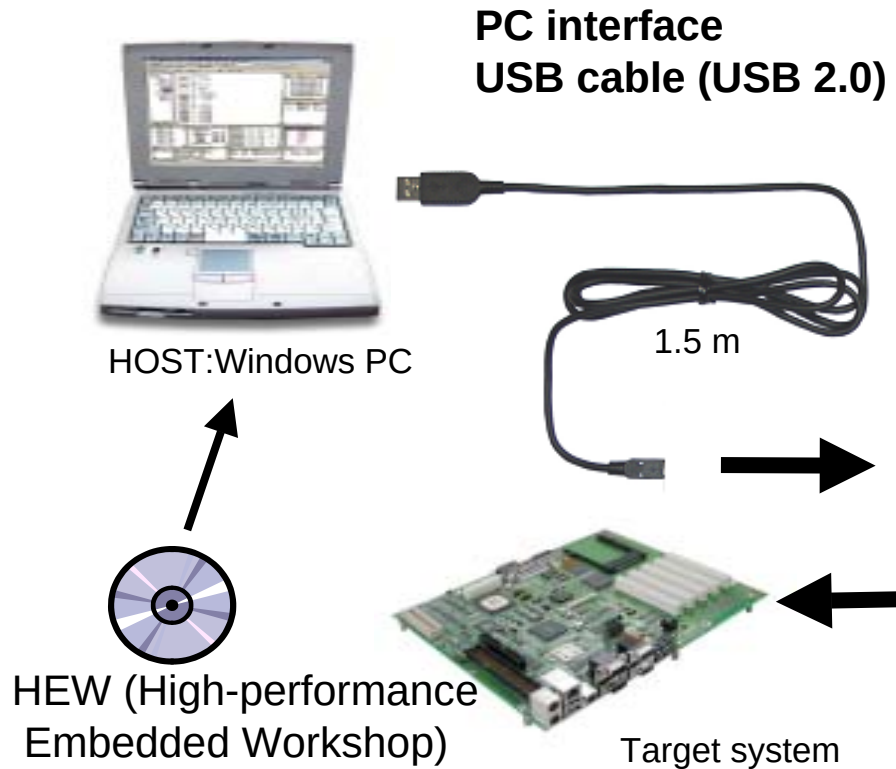
- (4) Performance analysis function (operate without stop program)
 - Point-to-point measurement. Execution count measurement.
 - Number of cache miss. Analyze system bus. Measure the number of CPU various event.
- (5) Function of real time profile (operate without break the program)
 - Time and pass count for each function

(6) Support device plan

SH7200 Series	SH7206			
SH7080 Series	SH7083*	SH7084*	SH7085*	SH7086*
SH7146 Series	SH7146*	SH7149*		
SH-Mobile	SH-Mobile3			
SH7780 Series	SH7780			
SH7125 Series	SH7124*	SH7125*		

* : under development

System Configuration of E200F (PC interface)



Notice : E10A-USB Emulator software for SH requires SuperH RISC engine C/C++ compiler package Ver.6 or later.
SH7780 series and SH-Mobile3 requires SuperH RISC engine C/C++ compiler package Ver.8 or later.
SH7206 series requires SuperH RISC engine C/C++ compiler package Ver.9 or later.

E200F Product lineup (1)

MCU		E200F		
Series	Group	Emulator	Option A	Option B
SH7780	SH7780	R0E200F0EMU00	R0E200F0ETU00 (Exteernal bus trace unit)	-
SH-Mobile	SH-Mobile3		R0E0200F0EPU00 (Extended profile unit)	R0E02MF00EPA00 (Peripheral IO analyzer unit)
SH7200	SH7206	R0E0200F1EMU00	R0E572060VKK00 ^{*1} (Evaluation chip unit) R0E0200F1ETU00 ^{*1} (Exteernal bus trace unit) R0E0200F0ACC00 (Trace cable) R0E0200F0EPU00 (Extended profile unit) R0E0200F0MSR00 (8 M byte emulation memory unit) R0E0200F0MSR01 (16 M byte emulation memory unit)	R0E572060CFK00 (User interface board) (FP-176C)

*1: Trace cable is required.

E200F Product lineup (2)

MCU		E200F		
Series	Group	Emulator	Option A	Option B
SH/Tiny	SH7124	R0E0200F1EMU00 *2	R0E570800VKK00 ***1 (Evaluation chip unit)	R0E571240CFJ00 ** (User interface board) (FP-48F)
	SH7125		R0E0200F0ACC00 (Trace cable)	R0E571250CFK00 ** (User interface board) (FP-64K)
			R0E0200F0EPU00 (Extended profile unit)	R0E571250CFG00 ** (User interface board) (FP-64A)
SH7146	SH7146	R0E0200F1EMU00 *2	R0E570800VKK00 ***1 (Evaluation chip unit)	R0E571460CFJ00 ** (User interface board) (FP-80W)
	SH7149		R0E0200F1ETU00 *1 (External bus trace unit)	R0E571490CFK00 ** (User interface board) (FP-100U)
SH7080	SH7083	R0E0200F1EMU00 *2	R0E0200F0ACC00 (Trace cable)	R0E570830CFK00 ** (User interface board) (TFP-100B)
	SH7084		R0E0200F0EPU00 (Extended profile unit)	R0E570840CFJ00 ** (User interface board) (FP-112E)
	SH7085		R0E0200F0MSR00 (8 M byte emulation memory unit)	R0E570850CFK00 ** (User interface board) (FP-144L)
	SH7086		R0E0200F0MSR01 (16 M byte emulation memory unit)	R0E570860CFK00 ** (User interface board) (FP-176C)

**: Under development

*1: Trace cable is required.

*2: Emulator software is under development.

Function outline by product (1)

1. E200F main unit



1. E200F basic function is as same as E10A-USB.
The followings are the added function on the E10A-USB.
2. USB2.0 (High-speed communication with host PC)
USB1.1 (Full-speed communication with host PC)
3. 256 k cycle trace acquisition.
4. Conditional trace is available by AUD trace information analyzing.
Trace start/stop/, sequential condition match trace
5. Performance analyzing is available without break the program.
Performance channel : 4 ch in max (point to point, execution time measurement of the address range.)
6. Real-time profiling is available without break the program.
Performance profiling for each function.

2. External bus trace unit



1. Allows external bus trace
2. Burst ROM and DDR-SDRAM trace are not supported

Function outline by product (2)

3. Evaluation chip unit



1. Allows debuggng without user system.
2. Allows debuggng using AUD for AUD nonsupport device.
3. Allows debuggng using AUD for non-mounted H-UDI/AUD connector.
4. Evaluation chip unit is used with User interface board.

4. User interface board



1. User interface board is necessary to connect Evaluation chip unit to the user circuit board.
2. User interface board is different in the each package.
3. User interface board is connected to the IC socket of the user circuit board.

5. Trace cable



1. Trace cable connects E200F main unit and a Trace unit and Evaluation chip unit.

Function outline by product (3)

6. Expansion profile unit



1. Comparison with standard configuration

Real time profile function

- Function measurement should be within the range of 12 Mbytes (4 Mbytes for standard component) from an AUD terminal output of the CPU.

Execution time of function

Number of the function calls

- Number of function counted: 60 k (20 k for standard configuration)

7. Peripheral I/O analyzer unit



1. MFI bus trace and MFI terminal information analyzing are available when the debug target is an SH-Mobileseries CPU.

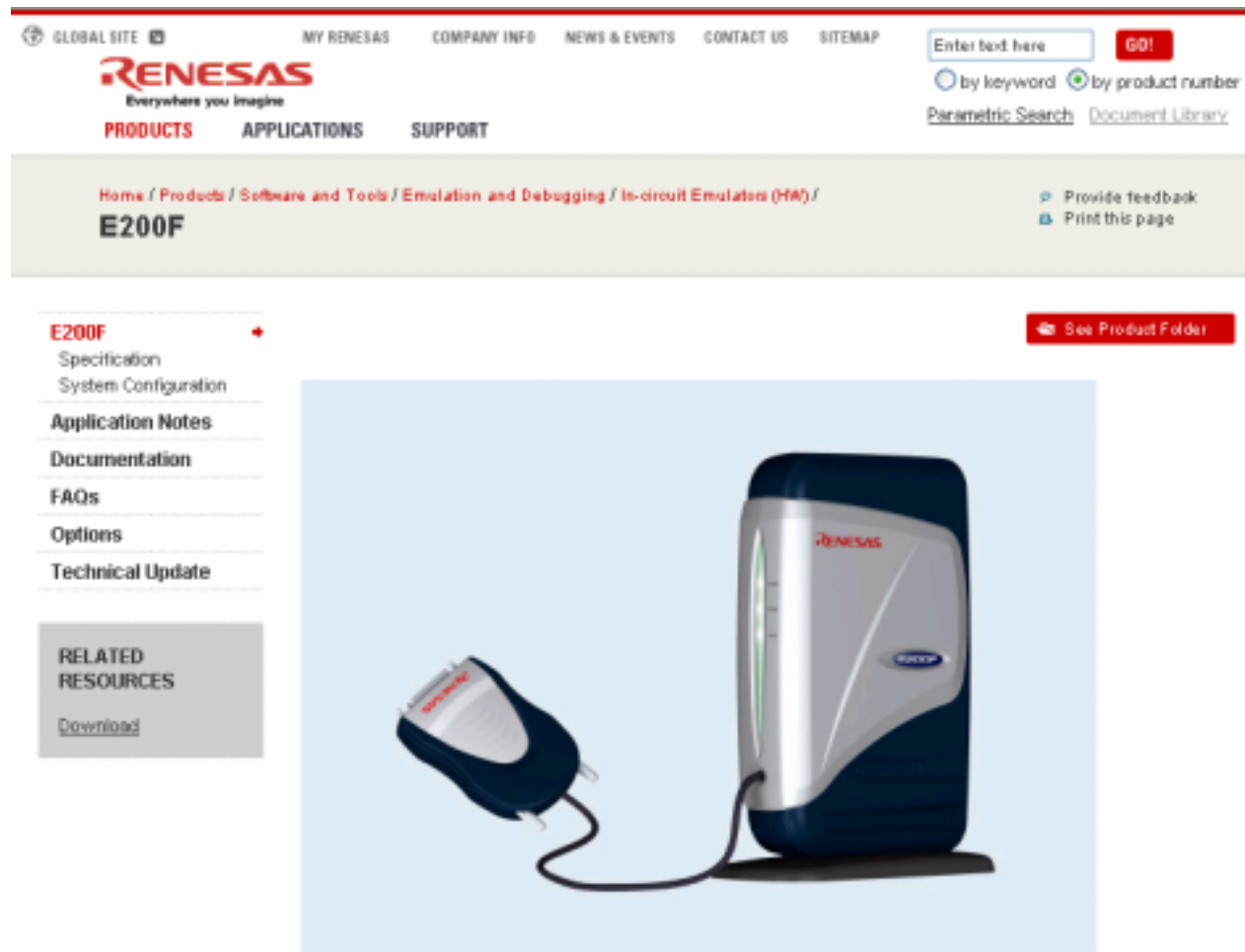
The hardware configuration of peripheral I/O analyzer unit for SH-Mobile3 is just ONE CABLE, without any boards.

8. Emulation memory unit (8 M byte/16 M byte)



1. Emulation memory (8 M byte/16 M byte)

E200F Emulator information on the WEB



http://www.renesas.com/fmwk.jsp?cnt=e200f_tools_product_landing.jsp&fp=/products/tools/emulation_debugging/incircuit_emulators/e200f/

E10T-USB Emulator

Features and target device by E10T-USB

Features

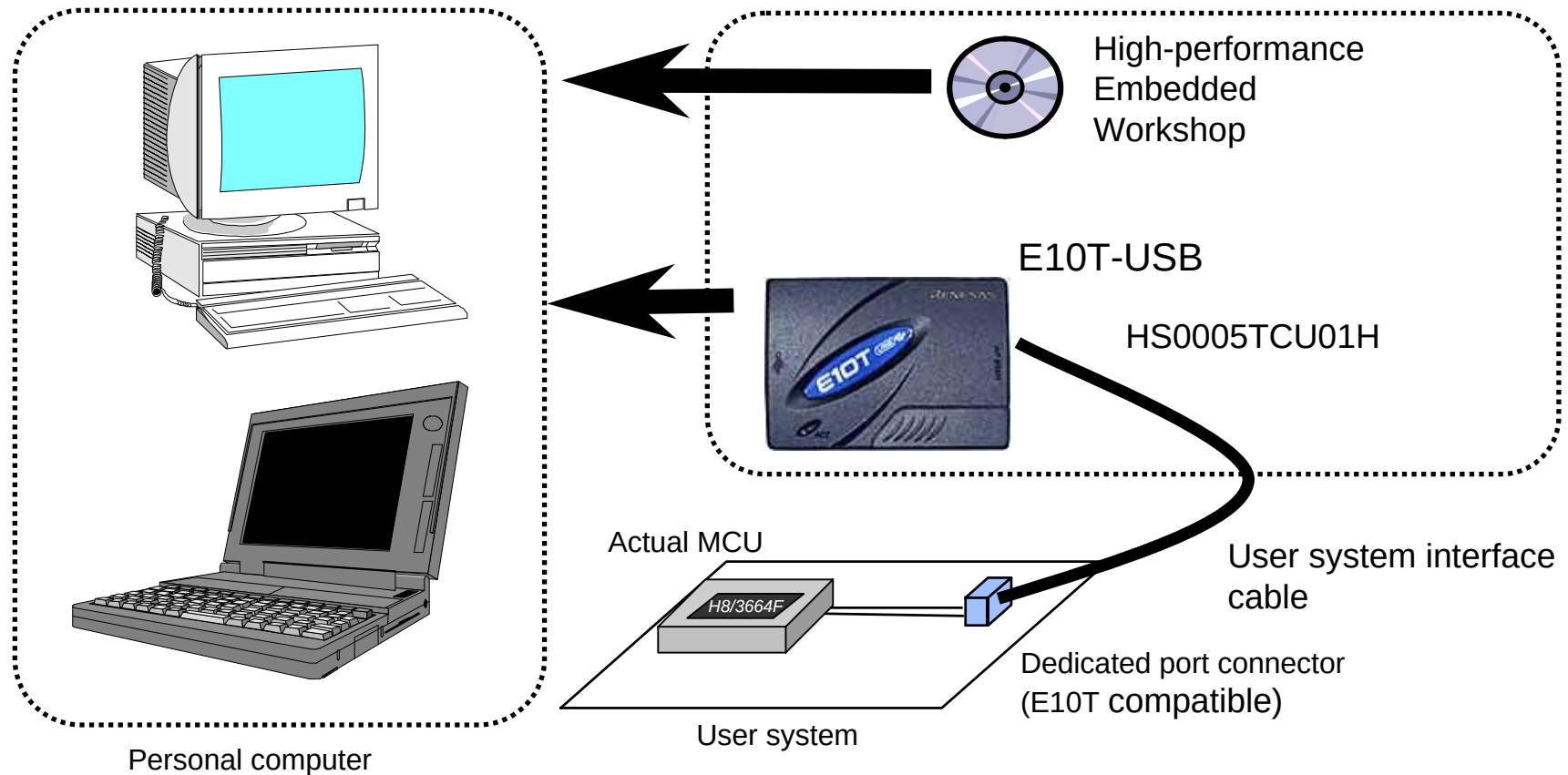
- Debugging is enabled using the actual MCU on the user system
- The included USB interface makes the E10T-USB usable with either a laptop PC or desktop PC.
- Cheaper than full specification emulators
- Can also be used as the flash memory programming tool
- High-performance Embedded Workshop which runs on Windows® 98SE, ME, 2000, and XP is provided

Target device: H8/3048BF (F-ONE), H8/3029F
Type number: HS0005TCU01H

Caution

- Need the H8S, H8/300 C/C++ compiler package ver.4 or upper version.

E10T-USB Emulator System Configuration



* The program must be downloaded to the internal flash memory.

E10T-USB Emulator information on the WEB

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Target Devices

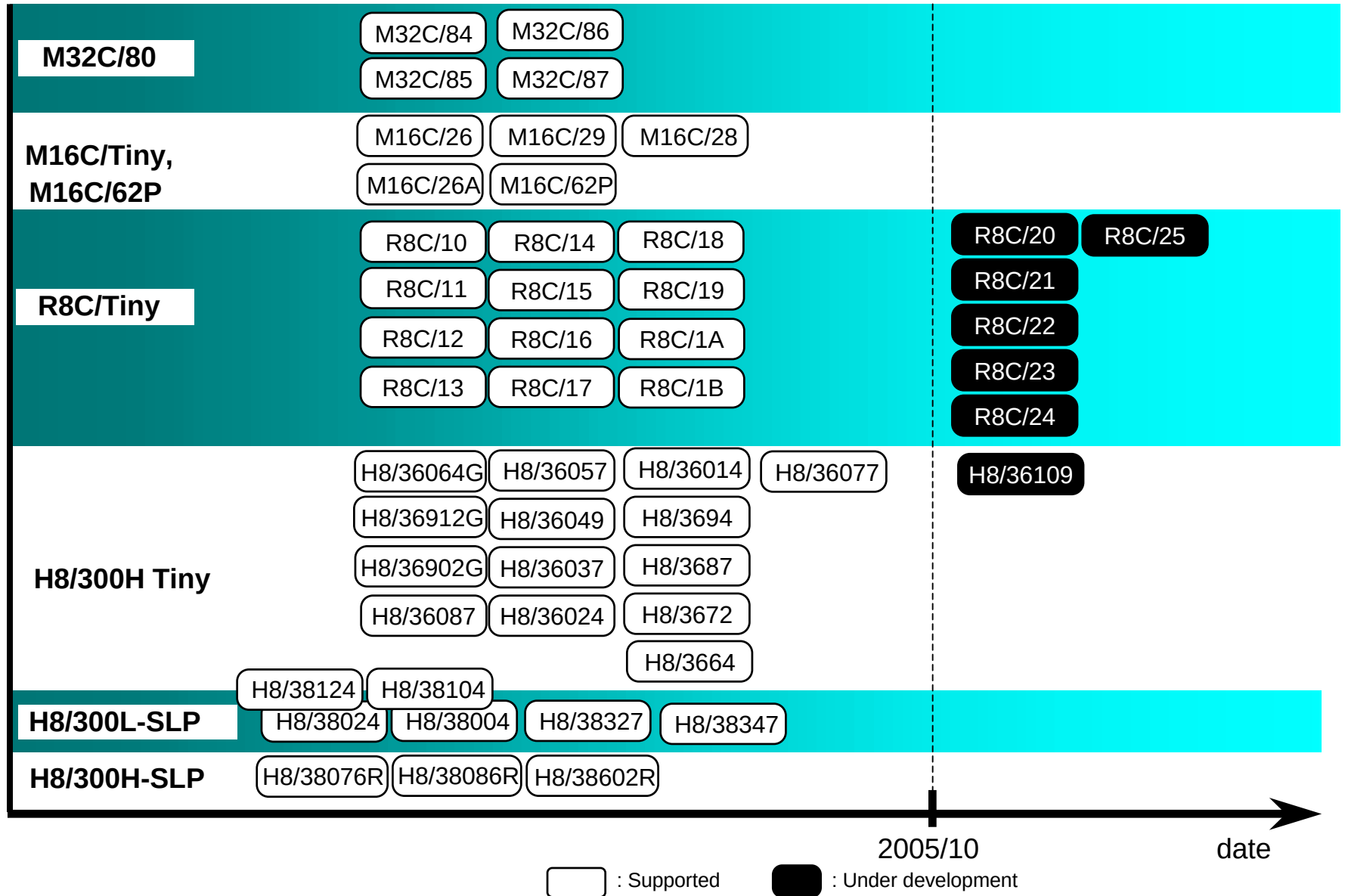
- H8/3048F-ONE(H8/3048BF) , H8/3029F

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http://www.renesas.com/fmwk.jsp?cnt=e10t_usb_tools_product_landing.jsp&fp=/products/tools/emulation_debugging/onchip_debuggers/e10t_usb/

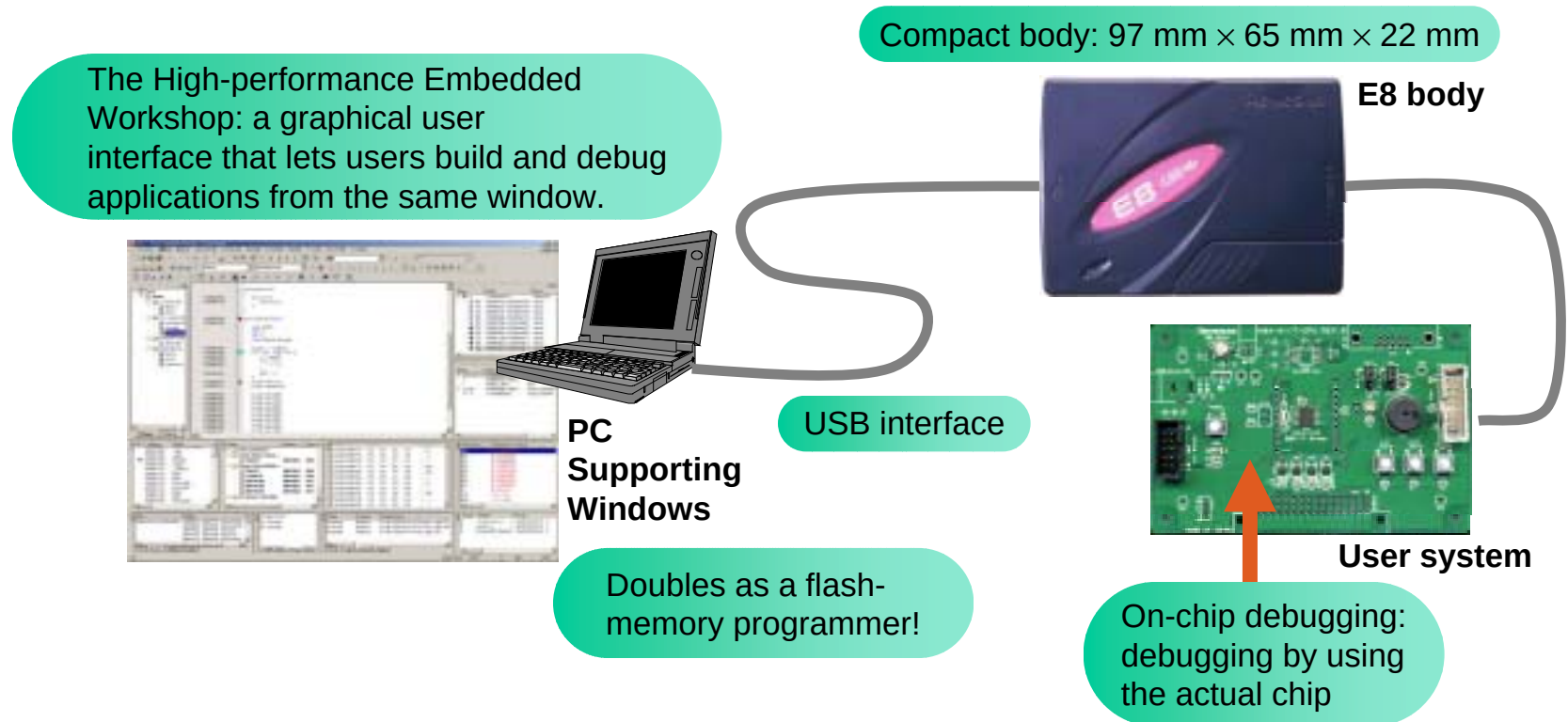
E8 Emulator

E8 Supported Device Roadmap



What is the E8 emulator?

- The E8 emulator takes advantage of the MCU's on-chip debugging function to allow debugging of the MCU mounted on the user system.
- Supported MCU: M16C family R8C/Tiny series R8C/14 to 2x series (one-wire system)



Features of the E8 emulator (1)

- **Compact** (body size: 97 mm × 65 mm × 22 mm)
- **Enriched debugging functionality**
Real-time emulation at the CPU's maximum operating frequency.
Ample break and trace functionality* for developing Tiny-MCU-based systems.
Note: *Details of break and trace functionality depend on the debugging functions incorporated in the MCU.
- **Evaluation can continue in near-final phases of development**
Debugging of the user system in a form much like the finished product is possible.
- **Super-easy operation**
The attached emulator–debugger enables the setting of breakpoints and break conditions in a dedicated window, in which trace information is also displayed, and has abundant command-line functions, realizing efficiency in debugging. Fast downloading of load modules is also supported.
- **Seamless support for overall system development through the High-performance Embedded Workshop**
The High-performance Embedded Workshop: an integrated development environment accommodates not only the emulator debugger, but also the C compiler package, to form a single integrated environment for building and debugging.
Various functions can be executed by easy and consistent mouse operations.
When H8 device is used, need the H8S, H8/300 C/C++ compiler package ver.4 or upper version.

Features of the E8 emulator (2)

- **USB-bus power eliminates the need for an external power supply**

Support for USB-bus power means that power can be supplied from the PC rather than from an external power supply. **In turn, the E8 emulator is capable of supplying power to the user system** (3.3 V or 5 V, 300 mA (max.)).

- **User interface: 14-pin connector**

Communication between R8C/14- to R8C/2x-Goup MCUs and the E8 emulator only requires a **single MODE pin**. All user port pins remain available, and clock oscillation can be checked.

Note: Communication with R8C/10- to R8C/13-Group MCUs requires two dedicated port pins (P00 and P37), the MODE pin, and the CNVss pin.

- **On-board programming**

Since the E8 supports a writer mode, programming of the on-chip flash memory can proceed immediately after the user has finished debugging the program.

- **Compatibility with the E7 emulator for a smooth inter-environment transition**

The E8 inherits the emulation functions and usability of the current E7 emulator. Third-party products and user systems that support standard interfaces with the E7 emulator can be used without change.

- **Low cost:**

The new version supports those models not supported in the original release.

Function Comparison: On-chip Debuggers and Full-Spec Emulators for H8/300H Tiny Series

	E8 (H8/300H Tiny)	E6000 (H8/300H Tiny)
Host interface	USB interface (USB1.1 full speed)	USB interface (USB1.1 full speed) PCMCIA, PCI, LAN (option)
Software break	255 Points	256 Points
Hardware break condition	1 Point Address,Data,R/W cycle,PC value	12 point (8: event detection break 4: range break) Address (point, range, pattern), Data (pattern, bit-masked), access type, R/W cycle Condition satisfaction count (65,535 counts max.) (8 point), Delay count (65,535 cycle max.) (8 point), interrupt signal, E6000 external probe (four)
Special break	Forced break by BREAK key	Forced break by BREAK key, break when accessing write-protected area, break when accessing card area
Trace capacity	Latest 4 branches	32768 cycle
Trace contents	Addresses in the branch source	Address, data, R/Cycle, memory-area type, status, external interrupt signal, 4 external probe, specified address data,time stamp
Display form	Text form (C-source level, assembler level)	Text form (C-source level, assembler level)
Display mode	-	Free trace, range trace, stop trace
Bus monitor function (Real time watch)	none	Monitor of 8 blocks max. of a contiguous 256-byte area (one time per 100 millisecond)
Flash-memory writing function	enable	disenable

E8 Emulator information on the WEB

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Target Devices

- M16C Family R8C/Tiny Series (16 bits):
 - R8C/10, R8C/11, R8C/12, R8C/13 Groups * *Updater required.*
 - R8C/14, R8C/15, R8C/16, R8C/17 Groups
 - R8C/18, R8C/19 Groups * *Under development*

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<http://www.renesas.com/en/e8>

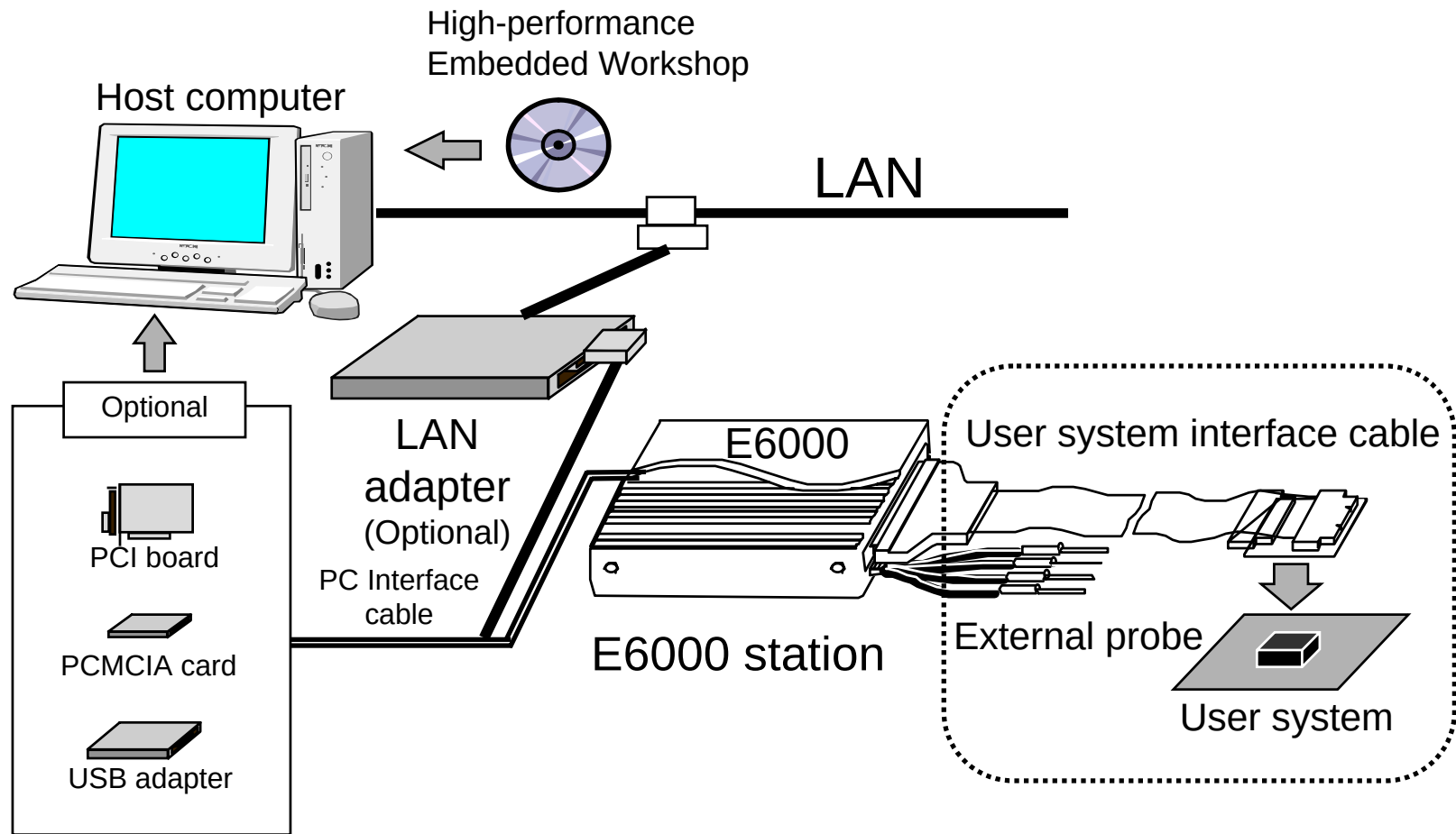
Here is a site for software version-up program and emulator related documents.

http://download.renesas.com/eng/mpumcu/upgrades/on_chip_debuggers/e8/index.html

MEMO

E6000 Emulator

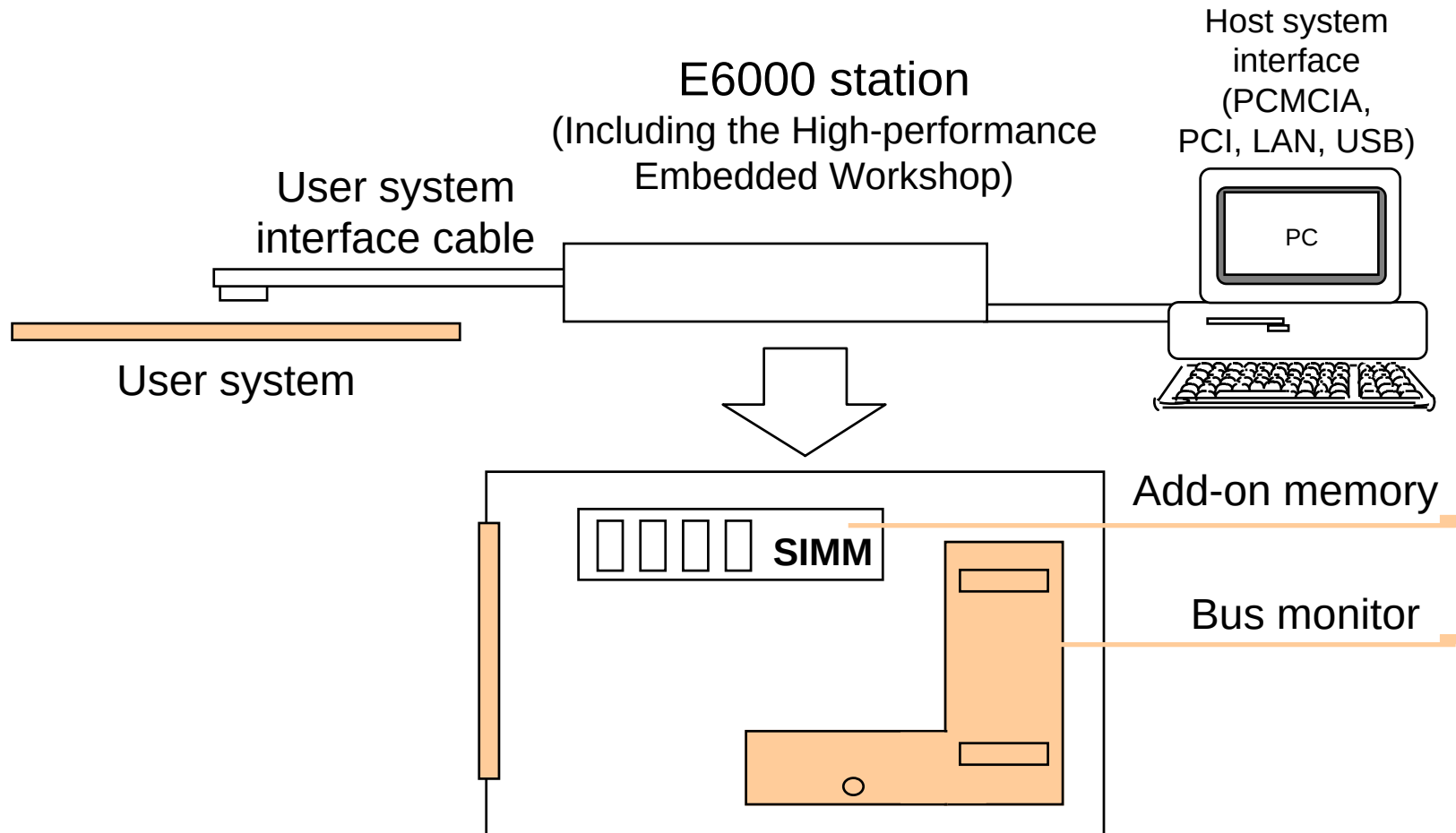
E6000 System Configuration



Features of the E6000

- Compact size
 - 220 x 160 x 57 mm
- Oscillation circuit at the end of the user system interface cable
- Easy-to-use debugging functions due to environment supporting Windows® (Windows® 98, ME, NT® 4.0, 2000, or XP)
Since the High-performance Embedded Workshop is supported, the debugging and the build can be performed in the same window.
Need the H8S, H8/300 C/C++ compiler package Ver.4 or upper version.
- Software development efficiency improved by C-source level debugging functions (applicable to optimized programs as well)
- Break and trace trigger using the event detection circuit
 - Input condition: Address bus, data bus, R/W, and external probe etc
 - Count of events: Delay-count specification function
 - Sequential specification function
 - Event interval time measurement function
- Break functions
 - Software break: 256 points
 - Hardware break: 12 points max.
- Trace modes
 - Free trace, range trace, filter, suppress, trace stop, time stamp and delayed stop

Options of the E6000

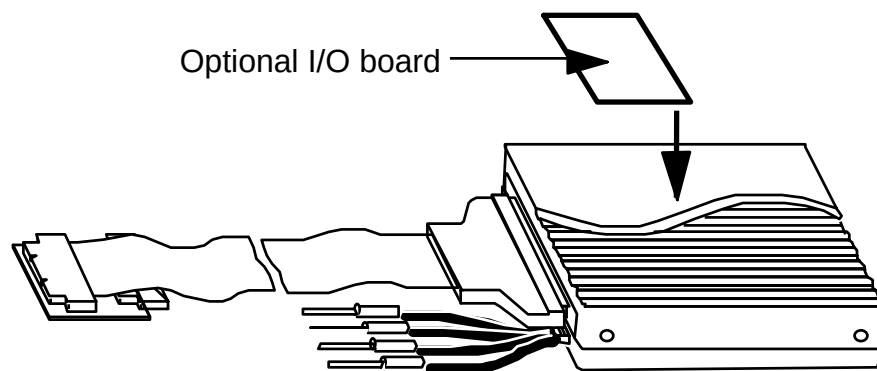


Note: The bus monitor is provided as standard or optional depending on the supported MCU.

E6000 Optional I/O Board

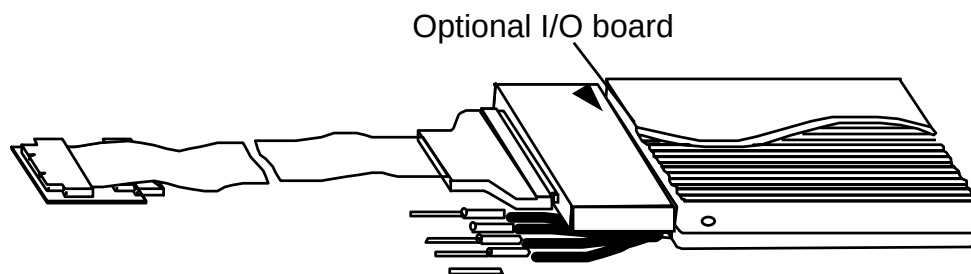
Type 1

Inserted into the E6000 emulator station



Type 2

Connected between the E6000 emulator station and the user cable



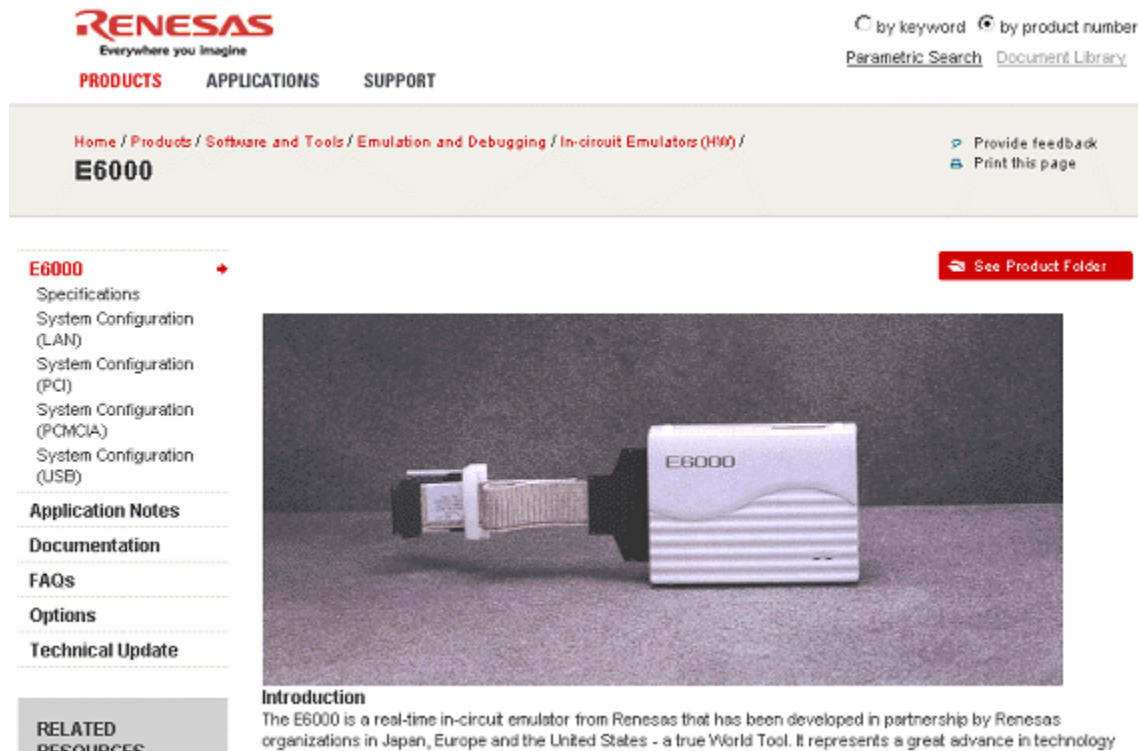
Type 1 Optional board list

Supported device	Optional I/O board	E6000 emulator
H8S/2623, 26 Group	HS2623EIO61H (HCAN board)	HS2633EPI61H
H8S/2258 Group	HS2258EIO61H (IEBus™)	HS2633EPI61H

Type 2 Optional board list

Supported device	Optional I/O board	E6000 emulator
H8S/2140B	HS2140EIO61H (LPC board)	HS2140EPI61H
H8S/2160B	HS2160EIO61H (LPC board)	
H8/3857 Group	HS3857EIO60H (Expansion board)	HS3L08EPI60H +HS3834EVI60H
H8/3854 Group	HS3854EIO60H (Expansion board)	
H8/3937	HS3937EIO60H (FLEX™ decoder board)	HS388REPI60H
H8/3937R	HS3937REIO60H (FLEX™ decoder board)	
H8S/2276	HS2276EIO61H (FLEX™ decoder board)	HS2214EPI62H
H8S/2276R	HS2276REIO61H (FLEX™ decoder board)	
H8/36057, 36037 Group	HS36037EIO61H (H-CAN board)	HS3664EPI62H
H8/36024 Group	HS36024EIO61H (Serial board)	
H8/36049 Group		
H8/36912 Group		
H8/36902 Group		

E6000 Emulator information on the WEB



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E6000

Introduction
The E6000 is a real-time in-circuit emulator from Renesas that has been developed in partnership by Renesas organizations in Japan, Europe and the United States - a true World Tool. It represents a great advance in technology

http://www.renesas.com/fmwk.jsp?cnt=e6000_tools_product_landing.jsp&fp=/products/tools/emulation_debugging/incircuit_emulators/e6000/

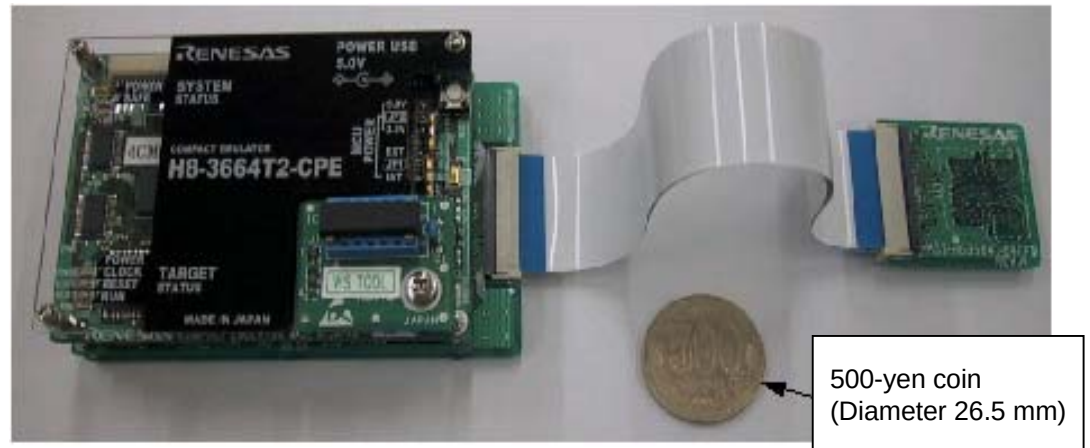
Here is a site for software version-up program and emulator related documents.

http://download.renesas.com:/eng/mpumcu/upgrades/in_circuit_emulators/e6000/index.html

Compact emulator for H8/300H Tiny series

Features

- Despite being small, the compact emulator incorporates rich debugging functionality, including real-time tracing, making it competitive with full-spec. emulators. Also, it is a low-price emulator.



Compact emulator for the H8/300H Tiny series

- **Compact design and low price**
Much smaller main unit than conventional emulator system.
Low price due to mounting frequently-used functions only.
- **Includes a set of development tools** (integrated development environment, compiler, and debugger)
Function-limited cross software tool is also included with emulator main unit, enabling the development and debugging of application programs immediately after purchase.
When H8 device is used, need the H8S,H8/300 C/C++ compiler package Ver.4 or upper version.
- **Rich debugging functionality**
Though low-priced, this emulator incorporates functions necessary for actual development.:
Real-time trace, hardware break, and real-time RAM monitor, etc.

Function Comparison: Compact and Full-Spec Emulators for H8/300H Tiny Series (Reference)

Function	Compact Emulator R0E436640CPE00	Full-spec Emulator E6000
MCU mode	Single-chip mode	Single-chip mode
Emulation memory	External SRAM	External SRAM
Software breakpoints	64 points	256 points
Hardware break	2 points (switchover with trace point) Prefetch/access	12 points (shared with trace point) Prefetch/access PC break
Combination of hardware breaks	AND/OR/Synchronous AND Bus count: 255 times	AND/OR/sequential (Maximum 8 levels) Bus count: 65,535 times
Exception detection	—	Write protected break Guarded area break
Real-time trace	64 k cycles Address, data, read/write cycle, memory area types, status Whether to write or not when an event occurs	32 k cycles Address, data, read/write cycle, memory area types, status, external interrupt signals, 4 external probes, specified address data, time stamp
Trace mode	Free/full/point	Free/point
Real-time RAM monitor	1 KB (256 B × 4 blocks) data/last access	2 KB (256 B × 8 blocks) data/final access
Time measurement	Max. 30 hrs (100 ns) between program execution and program stop.	Max. 4800 hrs between program execution and program stop (setting up resolution variable).
Performance	—	Max. 8-ch execution time measurement Max. 65,535 subroutine execution measurement
Coverage	—	—
Trigger output	—	2
External trigger input	—	4
I/F between hosts	USB interface (USB1.1, Full speed)*	PCI/PCMCIA/LAN (optional) USB interface (USB1.1, Full speed)*
Dimensions	96.0 × 60.0 × 37.8 mm	219.0 × 170.0 × 54.0 mm

*Can be connected to USB2.0 supporting host device

Compact Emulator Support Groups for the H8/300H Tiny Series

- Bundled with accessory (by MCU package) and compact emulator body

MCU group	package type	package number	type number	product component
H8/3664	64 pin 0.8 mm pitch QFP	FP-64A	R0E436640CPE10	Compact emulator body R0E436640CPE00 and conversion board for 64 pin 0.8 mm pitch QFP (FP-64A) R0E436640CFG20
H8/3664N				
H8/3694				
H8/3687				
H8/36064				
H8/36087				
H8/3664	64 pin 0.5 mm pitch LQFP	FP-64E	R0E436640CPE20	Compact emulator body R0E436640CPE00 and conversion board for 64 pin 0.5 mm pitch LQFP (FP-64E) R0E436640CFK20
H8/3664N				
H8/3694				
H8/3672				
H8/36014				
H8/3687				
H8/36064				
H8/36087				

- H8/36049 group will be supported in Dec 2005.
- Separate sales for compact emulator body and conversion board

type number	product component
R0E436640CPE00	Compact emulator body for H8/300H Tiny series
R0E436640CFG20	Conversion board for 64pin 0.8mm pitch QFP (FP-64A)
R0E436640CFK20	Conversion board for 64pin 0.5mm pitch LQFP (FP-64E)

E6000H Emulator

E6000H new product information

- Support of H8SX/1651

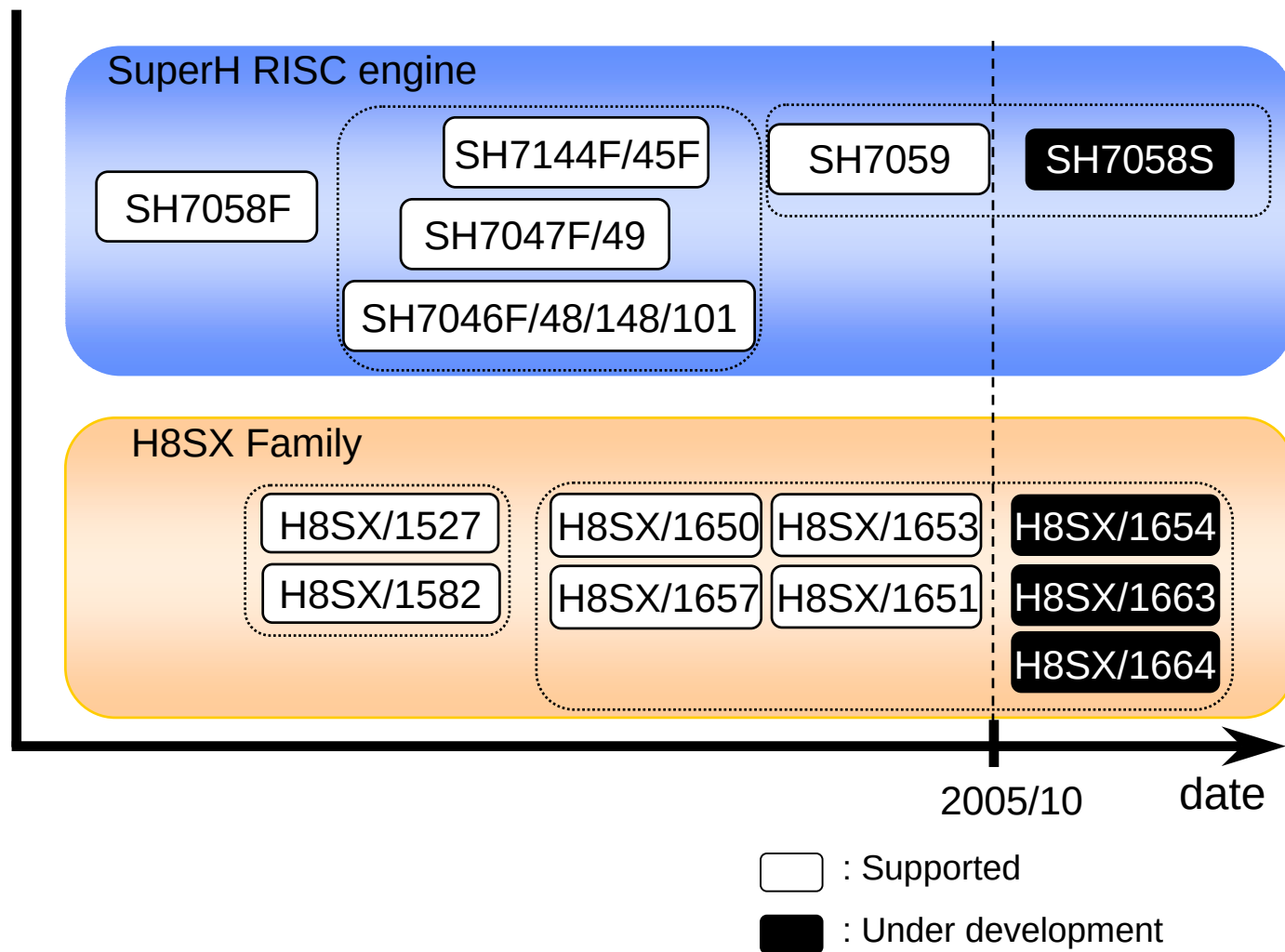
Emulator station type#: HS1650EPH60H

User's cable type#: HS1651ECN61H (FP-120B)

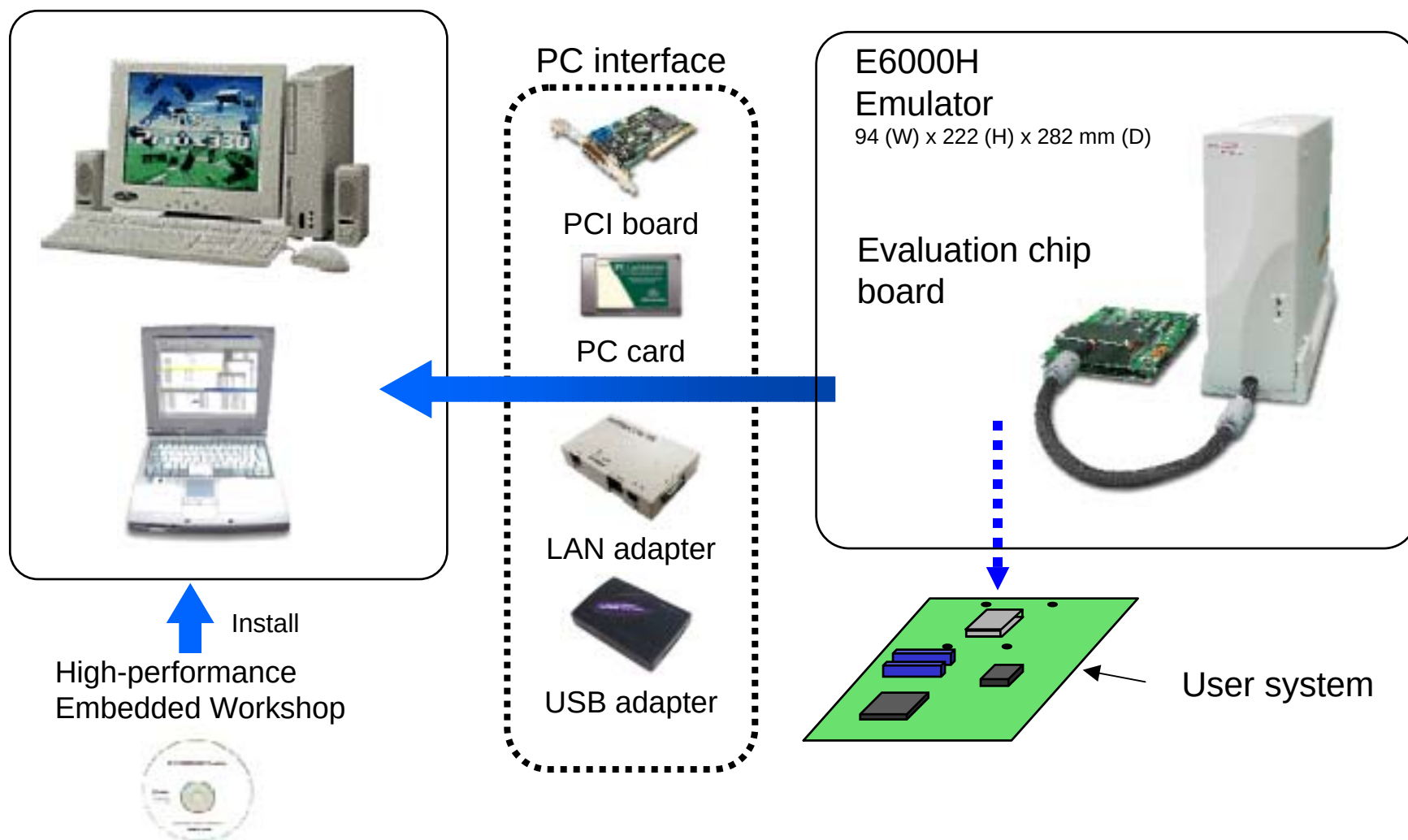
When customer already has HS1650EPH60H, please download the emulator software for H8SX/1651 from the following.

http://download.renesas.com/eng/mpumcu/upgrades/in_circuit_emulators/e6000h/index.html

Road Map of Devices Supported by E6000H



System Configuration of the E6000H Emulator



Features of the E6000H Emulator

- **Real time emulation**

- Real time emulation enabled at the chips internal and external maximum frequency (max. 100 MHz)

- **Break functions**

- Hardware breaks: Can be set to max. 4 ch independently + UBC break
Software breaks: max. 255 points

- **Trace function**

- Trace capacity: 128 bits x 128-K bus cycles
Trigger points: max. 8 ch

- **Performance function**

- Subroutine execution count measurement module: max. 8 ch
Real time watch function

- **Supports multiple platforms**

- Windows®98SE, Windows®ME, Windows NT® 4.0, Windows® 2000, and Windows® XP

- E6000H Emulator software for H8SX requires H8S, H8/300 C/C++ compiler package Ver.6 or later.

- E6000H Emulator software for SH requires SuperH RISC engine C/C++ compiler package Ver.6 or later.

E6000H Product Lineup and Supported Devices

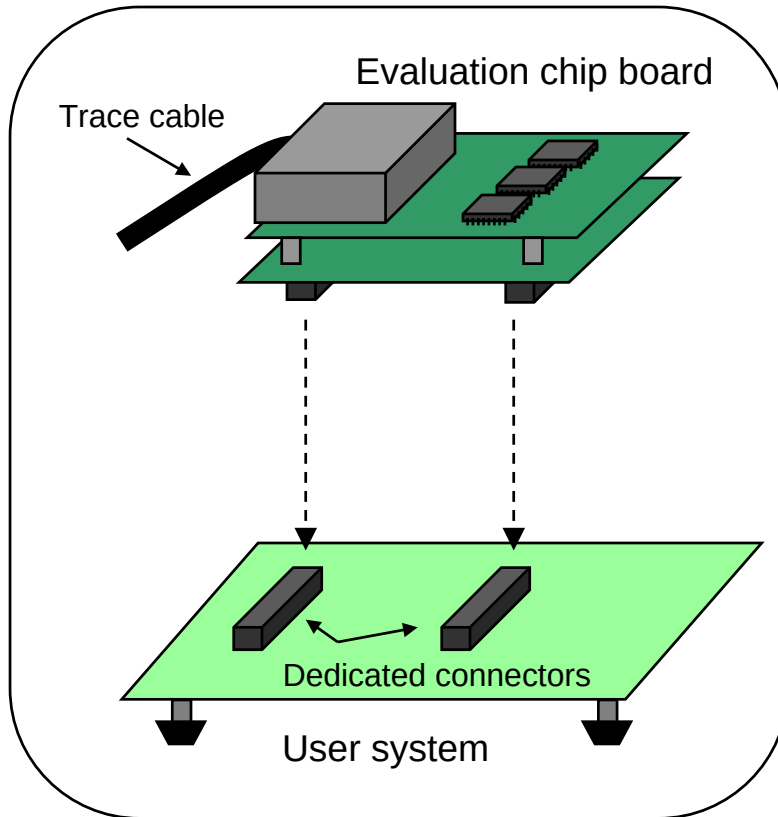
Target device	E6000H main unit	User system interface
SH7059	HS7059EPH60H	HS7058ECF61H (FP-256H)
SH7058S ^{*1}		
SH7058	HS7058EPH60H	HS7058ECF61H (FP-256H)
		HS7058ECB61H (BP-272)
SH7046 SH7048 SH7148 SH7101	HS7046EPH60H	HS7046ECH61H (FP-80Q)
SH7047 SH7049		HS7047ECH61H (FP-100M)
SH7144		HS7144ECH61H (FP-112B)
SH7145		HS7145ECH61H (FP-144F)
H8SX/1650 H8SX/1657	HS1650EPH60H	HS1650ECN61H (TFP-120)
H8SX/1653		HS1653ECN61H (TFP-120)
H8SX/1654 ^{*1}		
H8SX/1663 ^{*1}		T.B.D ^{*2}
H8SX/1664 ^{*1}		
H8SX/1651		HS1651ECN61H (FP-120B)
H8SX/1525 H8SX/1527	HS1527KEPH60H	HS1527ECH61H (FP-100M)
H8SX/1582		HS1582ECH61H (FP-120B)

*1: Emulator software is under development.

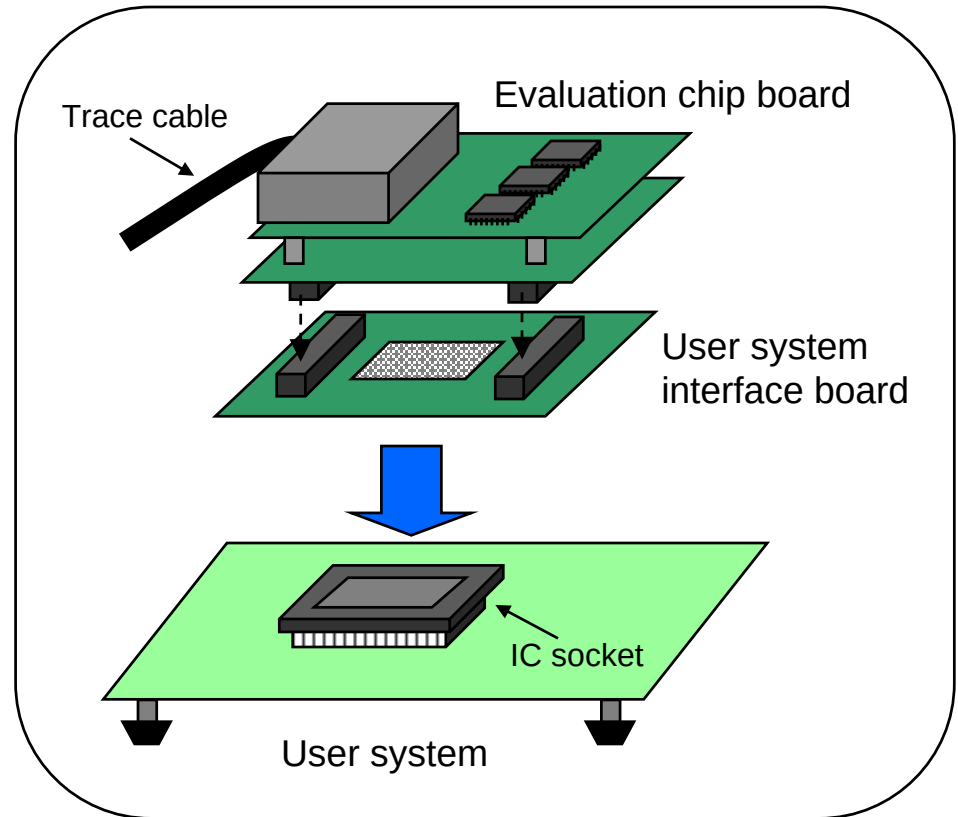
*2: Under development

User System Interface (Except HS1527ECH61H, HS1582ECH61H)

Connection with the Dedicated Connectors

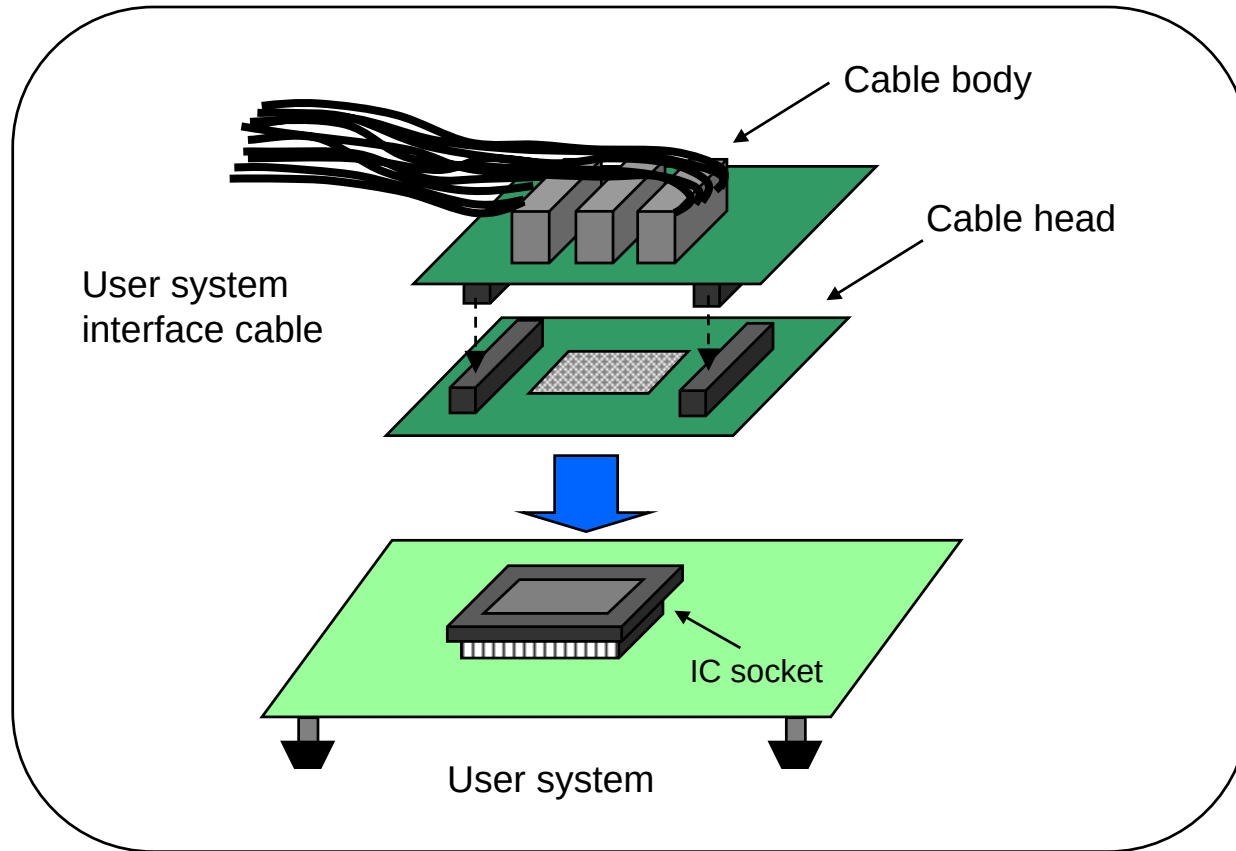


Connection with the IC Socket

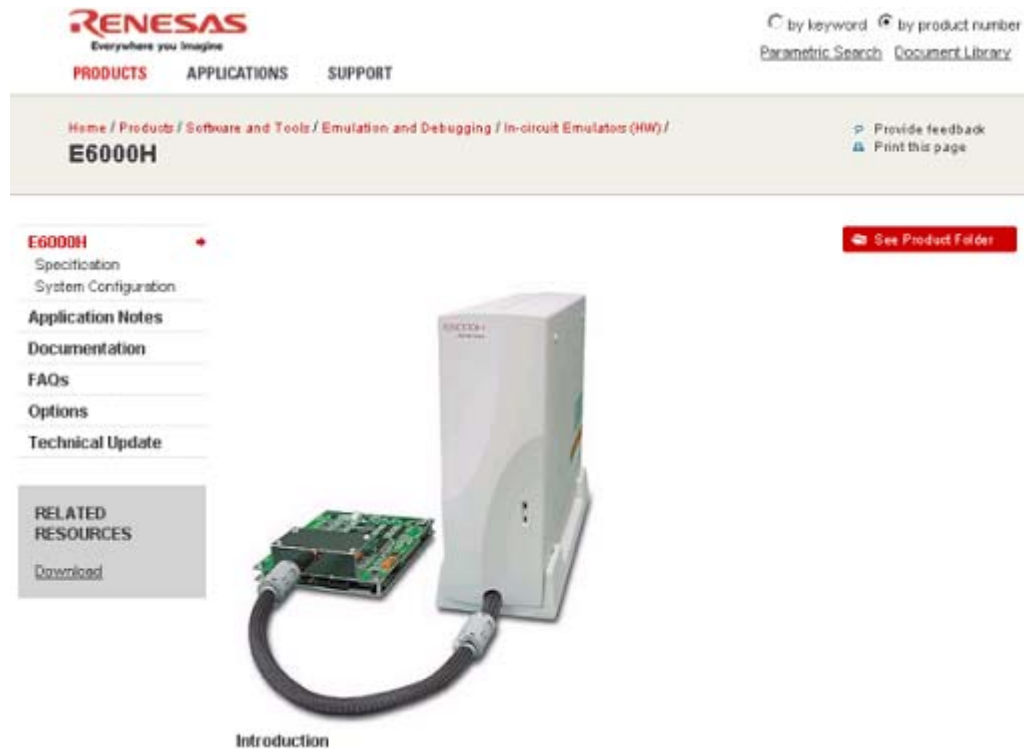


User System Interface (HS1527ECH61H, HS1582ECH61H)

Connection with the IC Socket



E6000H Emulator information on the WEB



http://www.renesas.com/fmwk.jsp?cnt=e6000h_tools_product_landing.jsp&fp=/products/tools/emulation_debugging/incircuit_emulators/e6000h/

Here is a site for software version-up program and emulator related documents.

http://download.renesas.com/eng/mpumcu/upgrades/in_circuit_emulators/e6000h/index.html

Microcomputer General Presentation

Development Environment

Programmer

October 28, 2005

Rev.2.00

Microcomputer Tool Marketing Dept.
Renesas Solutions Corp

MEMO

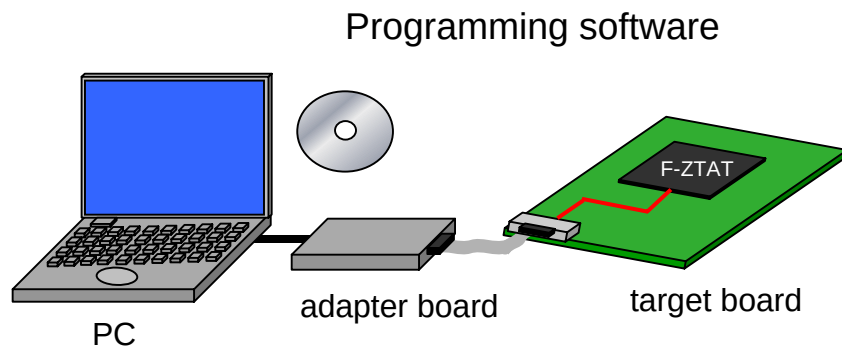
Programmer

Programmer

The programmer is used for on-chip flash memory of MCU programming. There are two types of programmer. One is an "on-board programmer" and the other is an off-board programmer called as "P-ROM programmer". Renesas delivers the various of programmers with the powerful co-operating partner vendors.

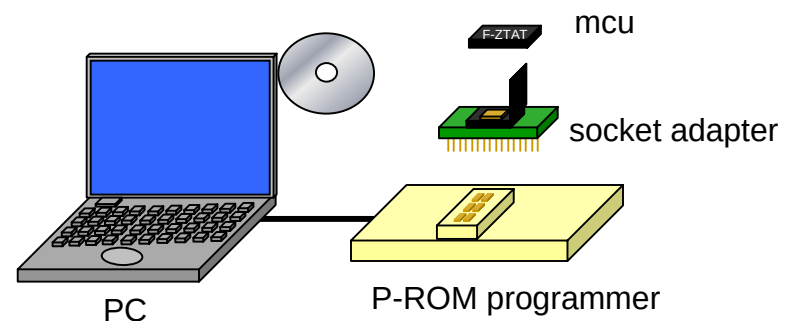
On-board programmer

On-board programmers are used for on-chip flash memory of MCU programming. This tool is used at the debugging or at the field re-programming.



P-ROM programmer

P-ROM programmers are used before assemble the MCU onto the target board. This tool is used at the mass production.

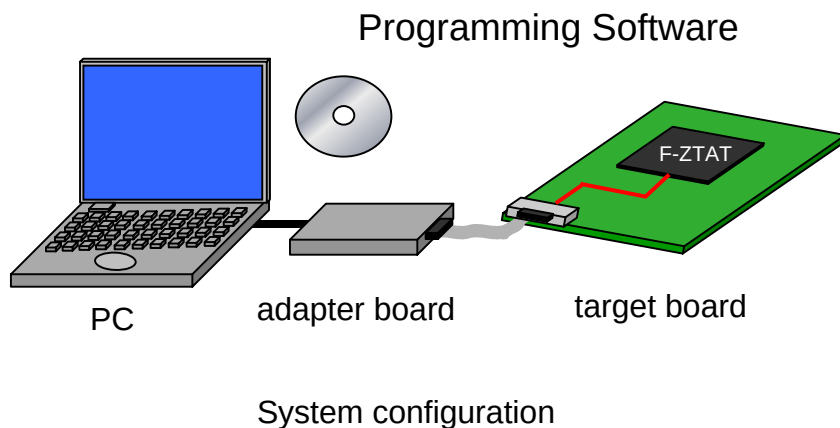


On-board programmers

There are two types of on-board programmers as follows.

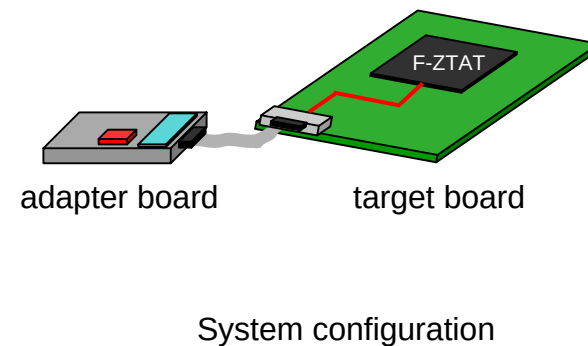
1. On-line operation

The programmer is always communicating with the host PC, and the operation is guided by PC display. This type of tool is easy to add the new MCU or to modify the system configuration.

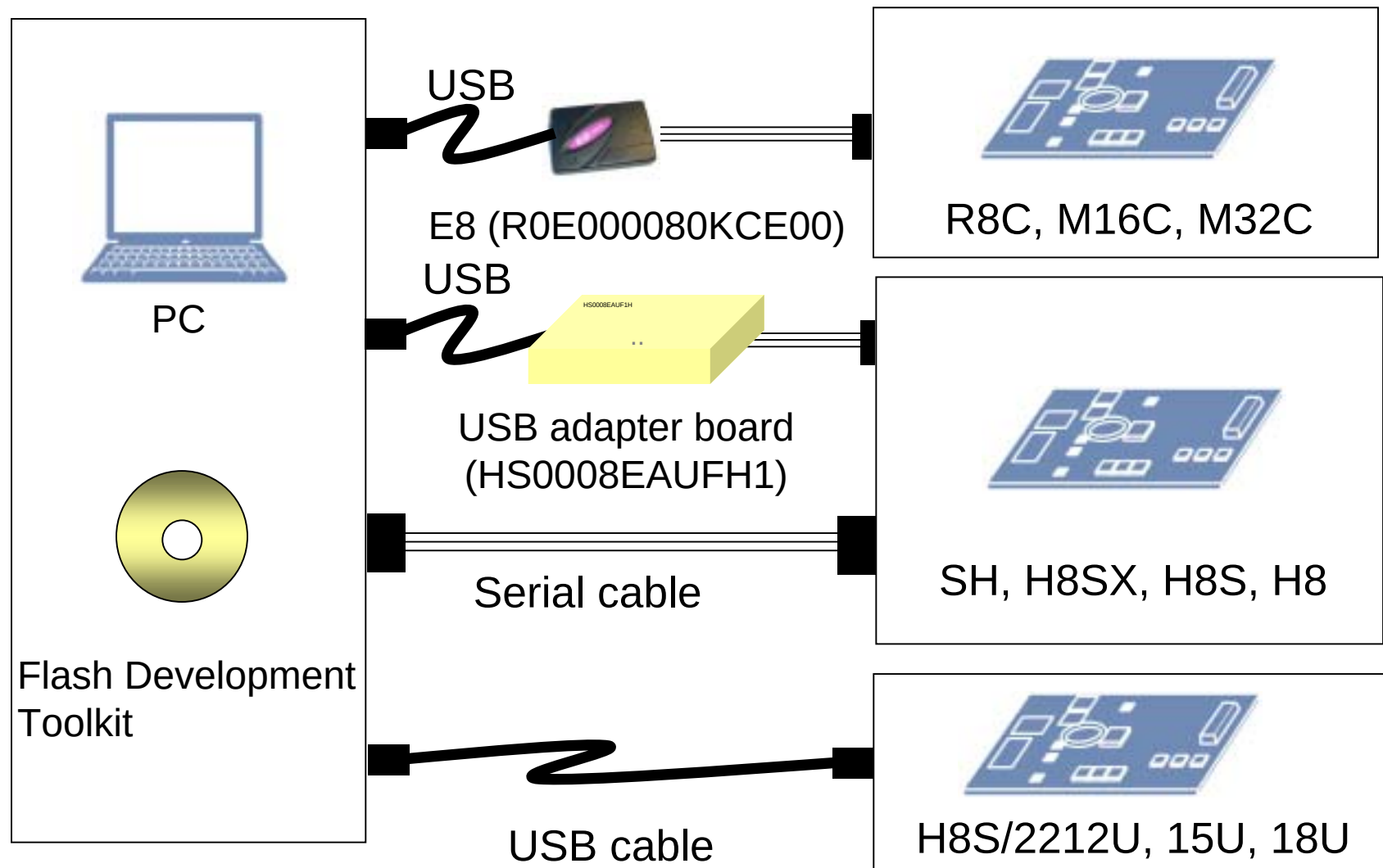


2. Off-line operation

After download the target program into the programmer, the programmer does not communicate with the host PC. It makes the download time short, because PC communication is skipped. This type of tool has a simple man-machine interface and is easy to use at the mass production line.



Renesas programming tool configuration

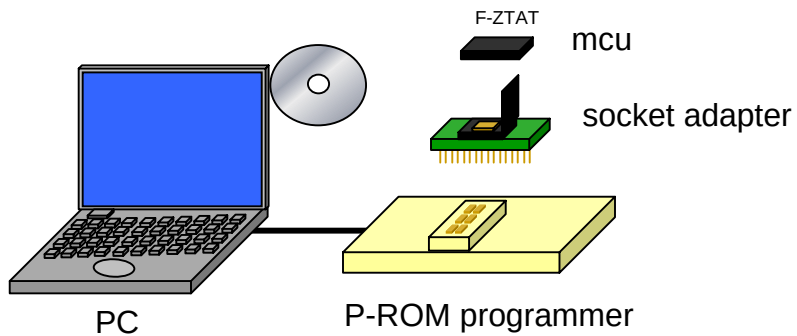


P-ROM programmers

There are three types of P-ROM programmers as follows.

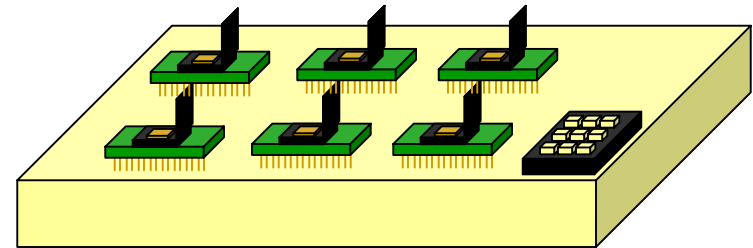
1. Single device programmer

For R&D or small volume of prototype manufacturing.



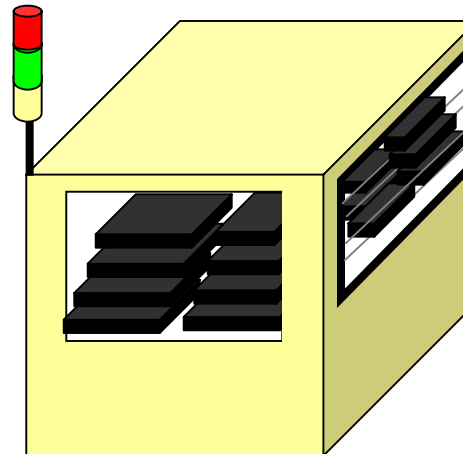
2. Gang programmer

For mass production



3. Programmer with handler

For large volume of mass production



Programmer maker introduction (On-Board Programmer)

- Renesas Technology

- http://www.renesas.com/fmwk.jsp?cnt=flash_development_toolkit_mid_level_landing.jsp&fp=/products/tools/flash_prom_programming/flash_development_toolkit/
- http://www.renesas.com/fmwk.jsp?cnt=m3a_0665.jsp&fp=/products/tools/flash_prom_programming/flash_programmers/m3a_0665/&site=i

- Alpha Project

- <http://www.apnet.co.jp/eng/products/flash2.html>

- Sunny Giken

- <http://www.sunnygiken.co.jp/english/flash-e.html>

- Suisei Electronics System

- http://www.suisei.co.jp/product/prod_e.htm

- Yokogawa Digital Computer

- <http://www.yokogawa-digital.com/emb/en/product/NETIMPRESS/index.html>

Programmer maker introduction (P-ROM Programmer)

- ADVANTEST
 - http://green.advantest.co.jp/techinfo_e/www_e/product_e/R4945A_e.html
- Wave Technology
 - http://www.y1000.com/index_e.html
- Sunny Giken
 - <http://www.sunnygiken.co.jp/english/flash-e.html>
- Suisei Electronics System
 - http://www.suisei.co.jp/product/prod_e.htm
- Data I/O
 - <http://www.dataio.com/>
- HI-LO SYSTEMS
 - <http://www.hilosystems.com.tw/>
- Flash Support Group
 - <http://www.j-fsg.co.jp/e/top.html>
- MINATO ELECTRONICS
 - http://www.minato.co.jp/products/programmer/programmer_e.html

Microcomputer General Presentation

Development Environment

M16C Family Development Support Tool **Development Environment, StarterKit**

October 28, 2005

Rev.2.00

Standard Product Business Group
Renesas Technology Corp

Powerful Processors

- Easy to Use

[illegible]

M16C Family Development Environment

M16C Family Development Environment



★Programming Environment

- **Renesas C compiler**
(with integrated development environment)
- C/C ++ compiler made by partners
IAR, Tasking, GAIO etc.
- Made by partners
Partnership with CASE tool
such as CATS Co., LTD.

★Debug Environment

- Emulator system
manufactured by Renesas
High function : PC7501, PC4701U
Low cost : Compact emulator
- Emulator manufactured by Partners
YDC, Sophia, Sunny Giken
Ashling, Nohau, etc.

★Real-Time OS

- **Renesas real-time OS**
(base on μ ITRON specification)
- Real-time OS made by partners
OSEK, Nucleus, OPENplus, etc.

★Plat Form

- Reference board manufactured
by Renesas
- Demo board manufactured by
Renesas

★Middleware

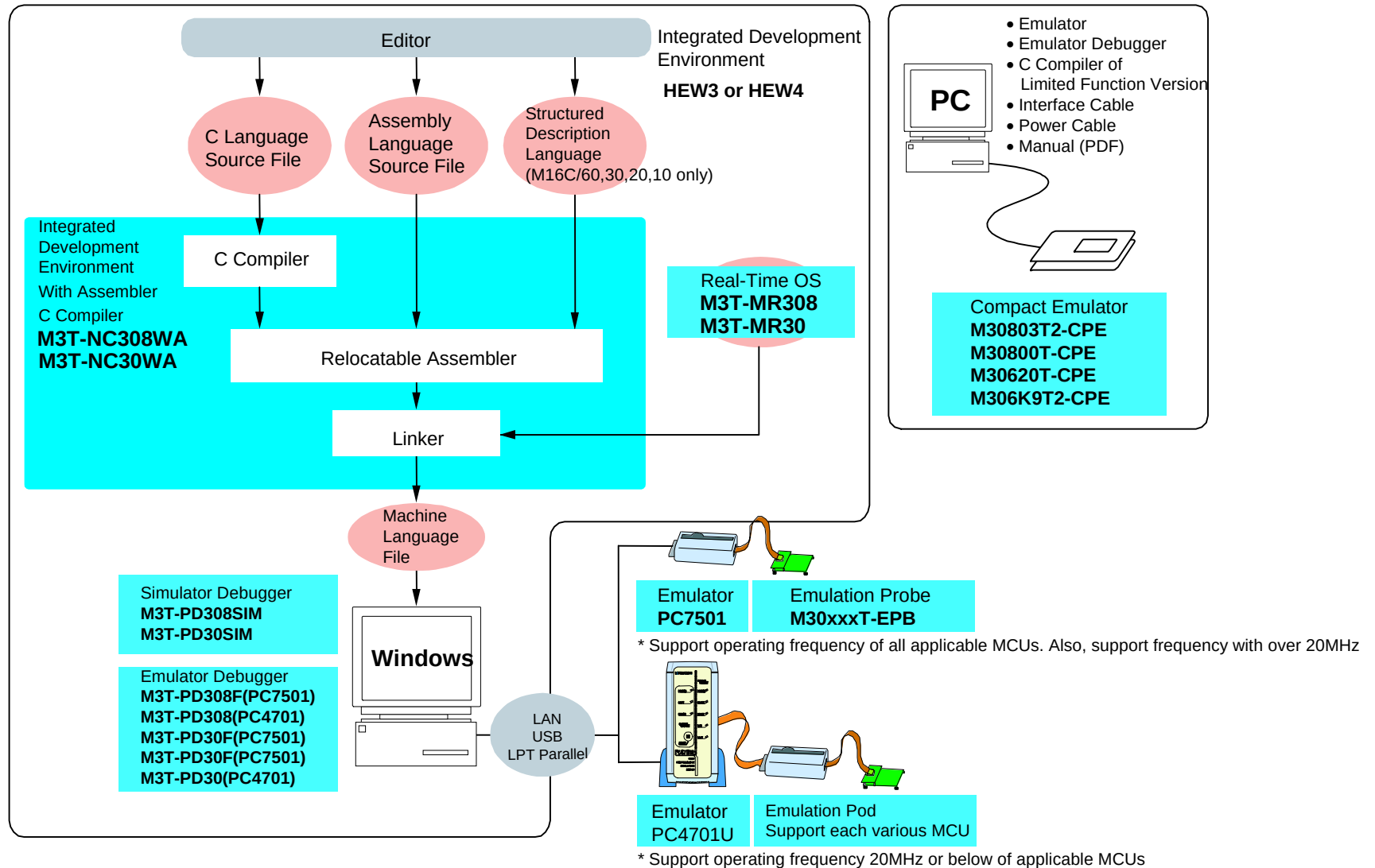
- Middleware manufactured by
Renesas
TCP/IP, JPEG, FAT,
Handwriting recognition
Security related
- Middleware manufactured by
partners
(Elmic systems, ILC, etc.)



M16C Family Tool Lineup

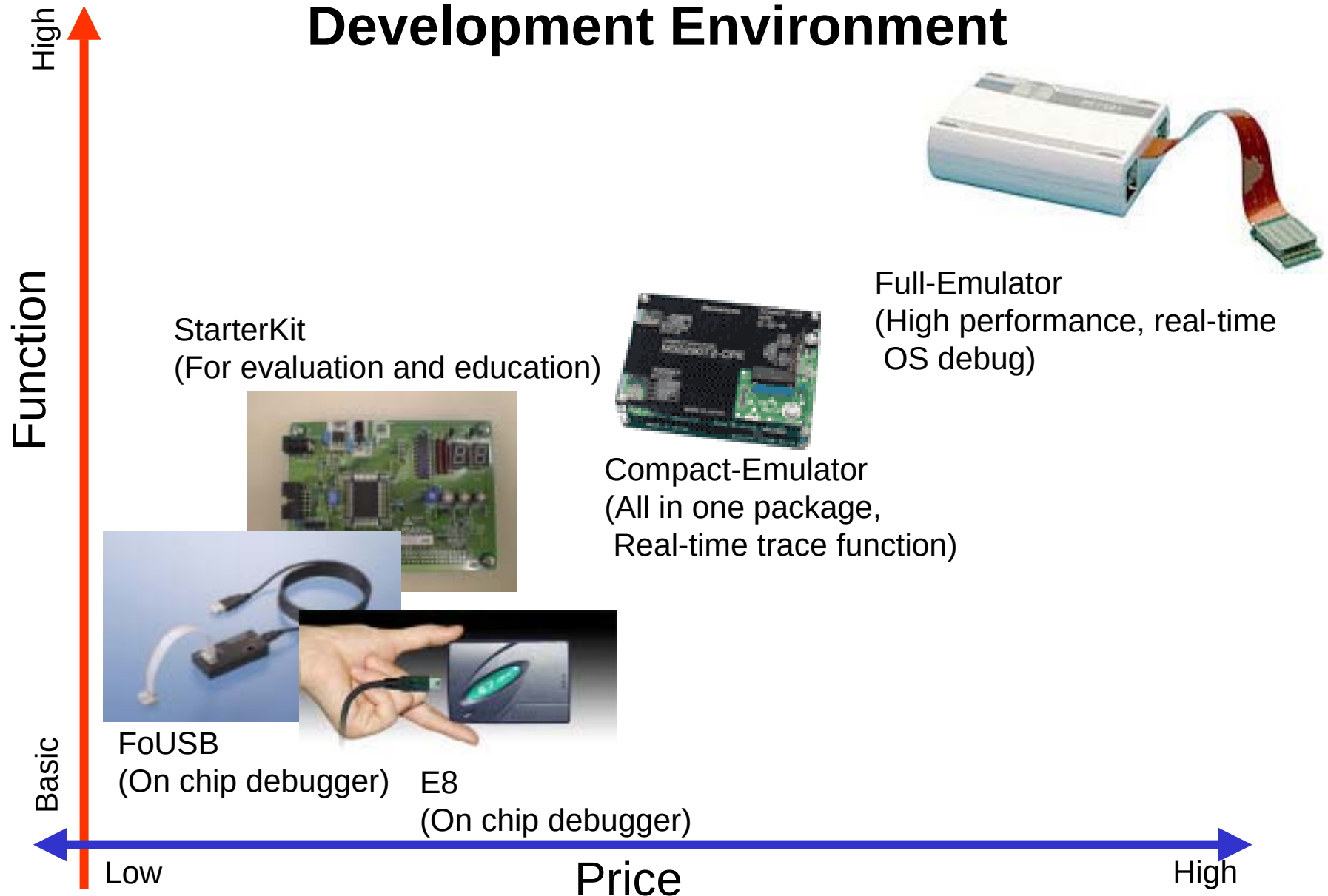


● Tool for Real Development



Variety of M16C Family Development Environment

M16C PLATFORM
Powerful Processors
-Easy to Use



M16C Family StarterKit

StarterKit Selection (1)

☆☆ : Under development

Series	Group	Starter Kit Part Number		Included Chip
 M16C/60	M16C/62P	M3A-0664		M16C/62P
	M16C/30P			
	M16C/62N	M3A-0654G01		M16C/62M
	M16C/62M			
	M16C/62A	M3A-0654G02		M16C/62A
	M16C/30			
 M16C/Tiny	M16C/26,/26A	☆☆ M16C/26A RSK		M16C/26A
	M16C/28,/29	M3A-0284 (for All M16C/Tiny)		☆☆ M16C/29
 R8C/Tiny	R8C/10,/11,/12,/13		M3A-0113	R8C/13
	R8C/14,/15,/16,/17	M3A-0115	M3A-0117	R8C/15 R8C/17

StarterKit Selection (2)

☆☆ : Under development

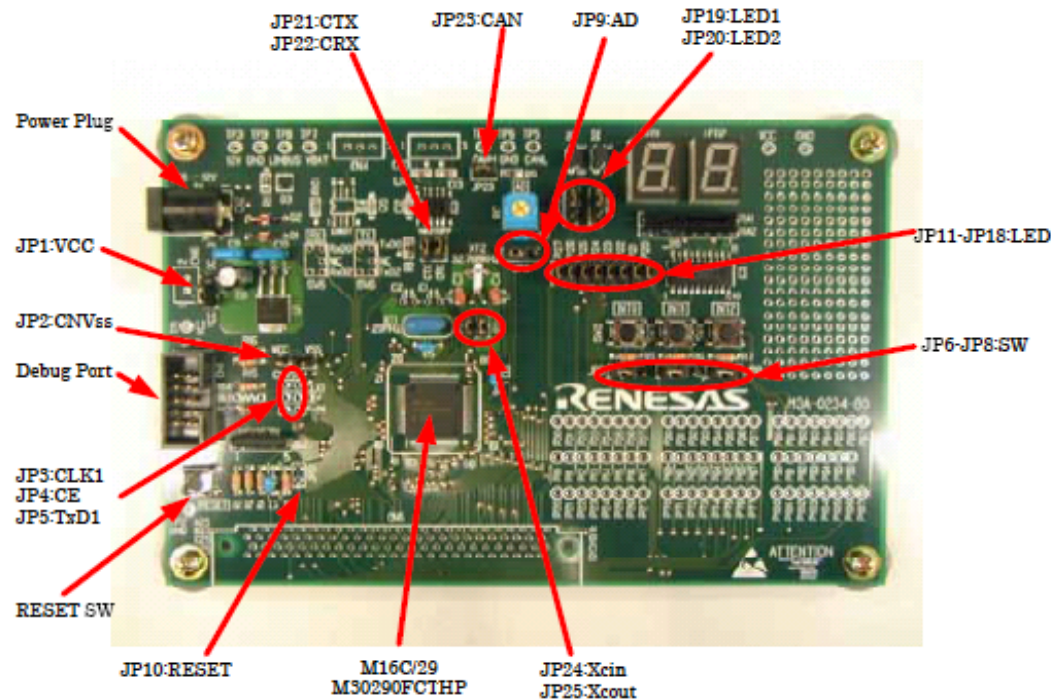
Series	Group	Starter Kit Part Number	Included Chip
 M32C/80	M32C/86		
	M32C/85	☆☆ M3A-0885	M32C/85
	M32C/84		
	M32C/83		
	M32C/82	M3A-0835 100pin M3A-0836 144pin	M32C/83
	M32C/81		
	M32C/80		
M16C/80	M16C/80	M3A-0801G02 100pin M3A-0802G02 144pin	M16C/80

StarterKit with M16C/29 (M3A-0284)



- StarterKit with M16C/29 (M30290FCTHP : 128K/12K, 80 pins) in production
- The most appropriate compiler and debugger included for evaluation and education of M16C/29, M16C/28 (“All In Package”)
- Usable for evaluation of M16C/26, 26A (48 pins) with different package

M3A-0284 : CPU Board Dimension



M3A-0284 Package List



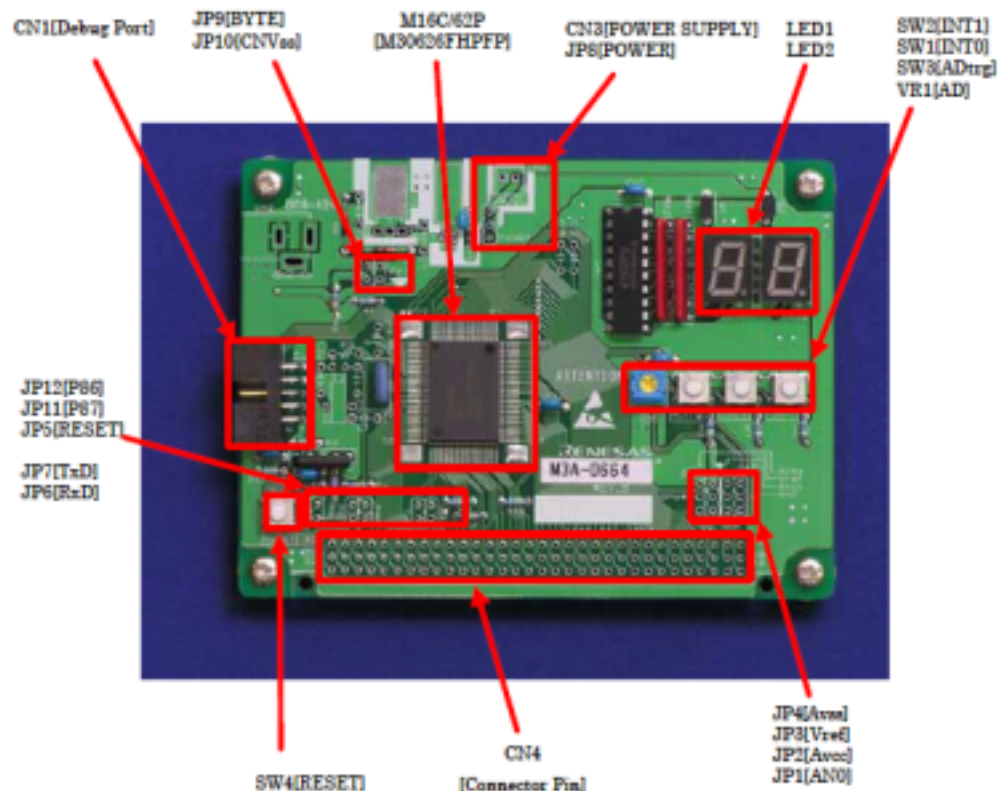
- CPU Board
- Debugger (FoUSB)
- CD-ROM
(compiler, debugger (KD30), sample program or various manual)

StarterKit with M16C/62P (M3A-0664)



- StarterKit with M16C/62P (M30626FHPFP : 384K/31K, 100 pins) in production
- The most appropriate compiler and debugger included for evaluation and education of M16C/62P (“All In Package”)
- Usable for evaluation of all M16C/62P

M3A-0664 : CPU Board Dimension



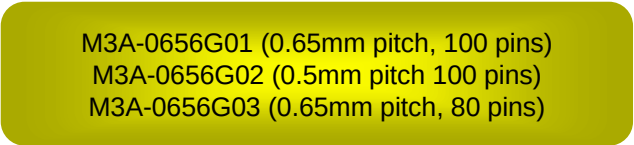
M3A-0664 Package List



- CPU board
- Debugger (FoUSB)
- CD-ROM
(compiler, debugger (KD30), sample program or various manual)

Flash Writer Selection (1)

☆☆ : Under development ☆☆☆ : Concept

Series	Group	M3A-0665 USB Writer	M3A-0655G02 PC Card Type	M3A-0806 UART Writer	IC Socket Board
	M16C/62P				
	M16C/62N				
	M16C/62M				
	M16C/62A				
	M16C/30				
M16C/Tiny	M16C/26 26A 28 29				
	R8C/10 11 12 13				
	R8C/14 15 16 17				

* : E8 can be used as a flash writer for R8C/14 to 17

Flash Writer Selection (2)

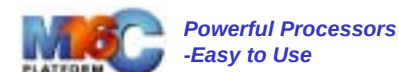
☆☆ : Under development ☆☆☆ : Concept

Series	Group	M3A-0665 USB Writer	M3A-0655G02 PC Card Type	M3A-0806 UART Writer	IC Socket Board
M32C/80	M32C/87			☆☆ 	
	M32C/86				*1 : When using USB Writer, IC socket boards need to be modified
	M32C/85				M3A-0656G01 (0.65mm pitch 100 pins) M3A-0656G02 (0.5mm pitch 100 pins) M3A-0656G04 (0.5mm pitch 144 pins) *1
	M32C/84				*1 : When using USB Writer, IC socket boards need to be modified
	M32C/83				M3A-0656G01 (0.65mm pitch 100 pins) M3A-0656G02 (0.5mm pitch 100 pins) M3A-0656G04 (0.5mm pitch 144 pins) *1
	M32C/82				
	M32C/81				
	M32C/80				
MASK or ROM LESS					
M16C/80	M16C/80				M3A-0656G01 (0.65mm pitch 100 pins) M3A-0656G02 (0.5mm pitch 100 pins) M3A-0656G04 (0.5mm pitch 144 pins)

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

M16C Family Demo Set

M16C Family Demo Set



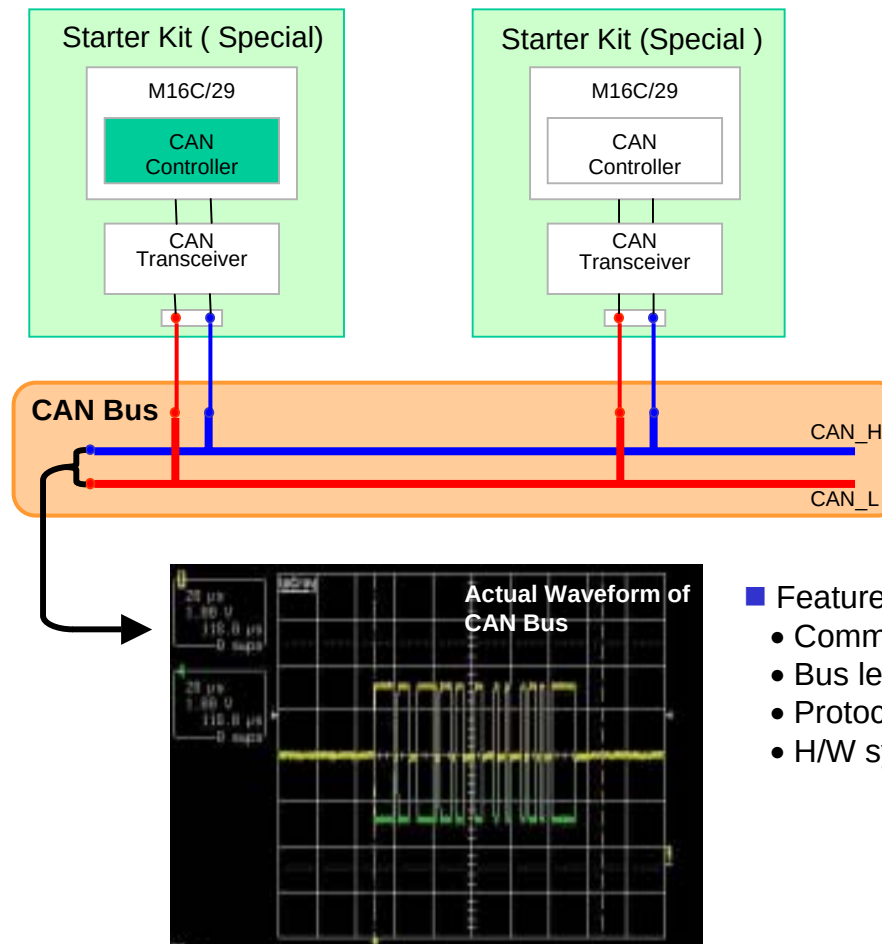
★ : New

M32C/80	M32C/86	Gauge (in-vehicle meter) Demo Set		
	M32C/83	HDD Music Server	3-Phase Motor Drive Demo Set	Stepping Motor Drive Demo
M16C/80	M16C/80			
M16C/60	M16C/62P	★ Oscillation Stop Detection Function Demo Set	★ Low Voltage Detection Function Demo Set	
	M16C/62N			
	M16C/62M	JPEG Demo Set	Scheduler Demo Set	AR Camera Connection Demo Set (WWW Connection)
	M16C/62A			
M16C/30	M16C/30			
M16C/Tiny	M16C/26 26A	★ CAN Communication Demo Set for Industrials	★ Motor Control Demo Set	
	M16C/28 29			
R8C/Tiny	R8C/10 11 12 13	Misty Demo	PPP/HTTP Protocol Demo (ChoroQ)	Motor Drive Demo Set

CAN Communication

Demo Set for Industries (M16C/29)

Advantage : Evaluate how to control CAN communication easily using CAN controller with M16C/29
Feature of demo set : Measure CAN communication waveform on CAN bus directly using StarterKit for M16C/29



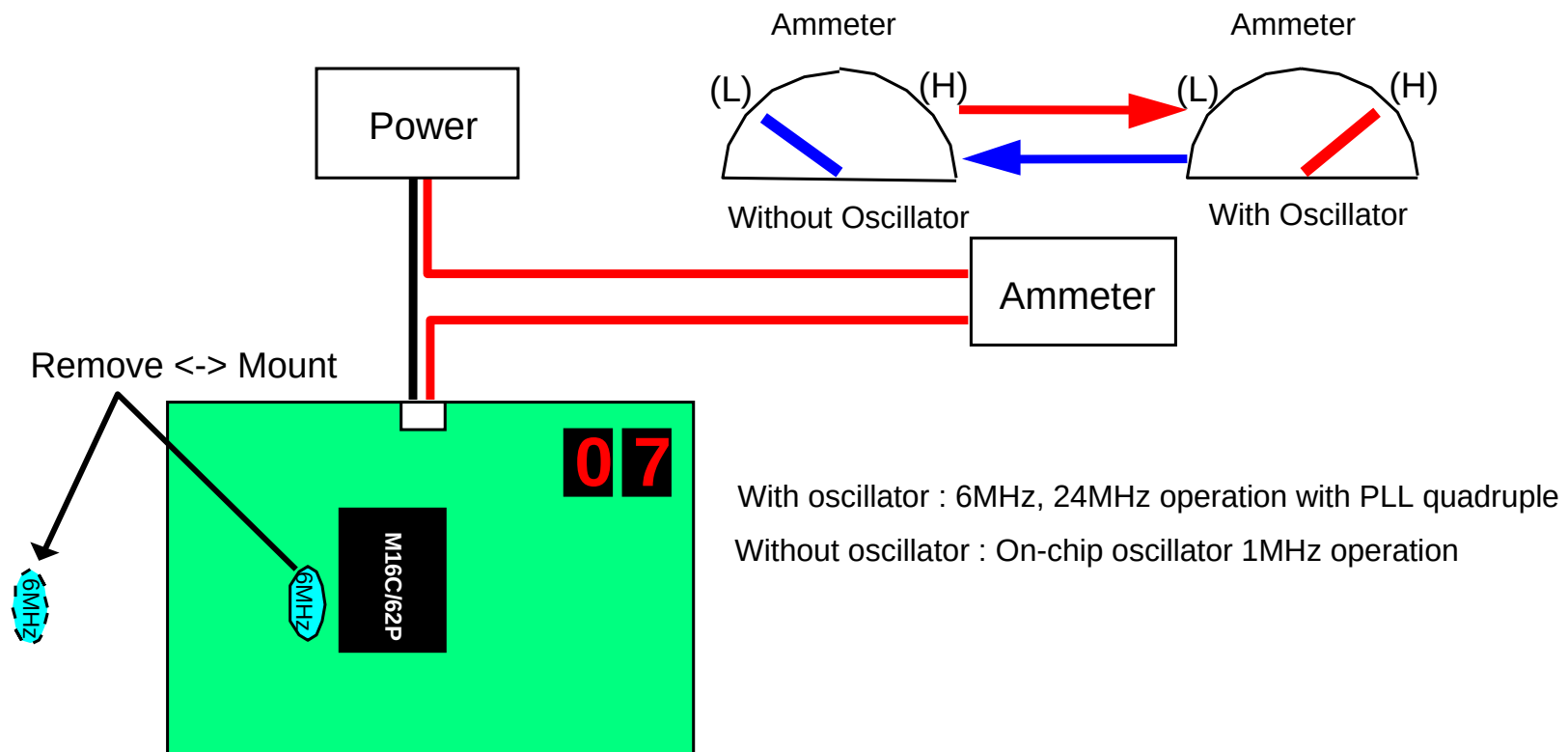
- Feature of CAN controller
 - Communication Speed : Max.1 Mbps
 - Bus length : 40m/1Mbps
 - Protocol standard : Ver.2.0B
 - H/W synchronous / re-synchronous

Oscillation Stop Detection Function Demo Set (M16C/62P)



Advantage : When an external oscillator stops due to system failure, the internal on-chip oscillator is automatically switched as soon as an interrupt is generated and the urgent processing can be executed easily with super-low power consumption

Feature of demo set : Operation can be confirmed by the on-chip oscillator with removing the oscillator and power consumption decrease can be confirmed when the on-chip oscillator operates

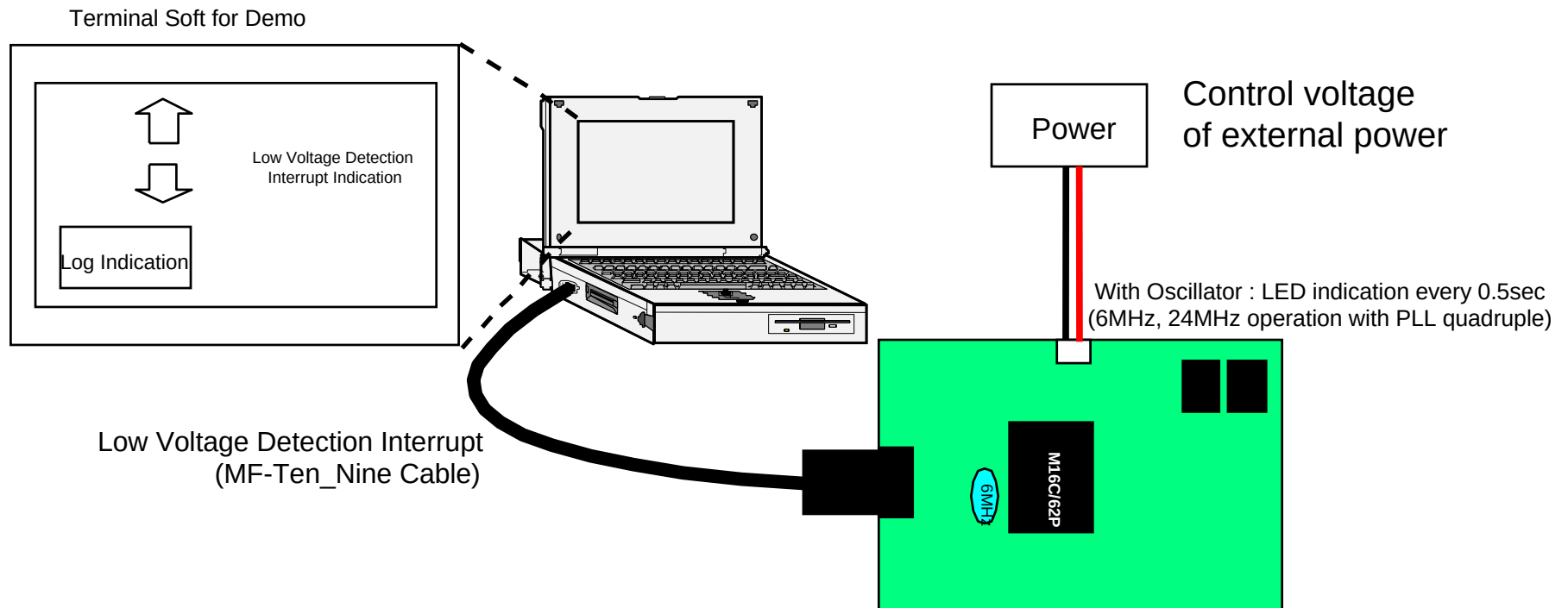


Low Voltage Detection Function Demo Set (M16C/62P)



Advantage : Reset circuit, voltage detection circuit are included and low voltage of external power can be detected and auto-reset can be operated. Low external power can be detected and back-up operation can be performed. The judgment after driving the $\overline{\text{RESET}}$ pin "H" is easier with the cold/warm start detection bit.

Feature of demo set : The low voltage detection interrupt is generated by reducing external power and inform its interrupt generation to the external PC with the serial communication. Also, Judge the cold/warm start after driving the $\overline{\text{RESET}}$ pin "H" and its result is informed to the external PC.



- Only the outline of functions is described. For details, refer to the Renesas Microcomputer General Catalog.
- Former package codes are used. For new package codes, refer to the Package section, and the URL below.

<http://www.renesas.com/en/package>

*: New Product
 **: Under Development
 ***: In Planning

[illegible]

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<http://www.renesas.com/en/package>

*: New Product
**: Under Development
***: In Planning

Series	Group	Type No.	Memory				CPU				DMA	External expansion bus			Clock	A/D converter	D/A converter	Timer				Serial interface		Smart card/SIM	Synchronous serial communication unit/ special serial I/O	CAN	Ethernet	USB HOST	USB Function	IrDA	LCD	I/O port		Interrupt (source)	Other function	Package	Operating frequency/ Power Supply voltage	Oprating ambient temperature (°C)
			ROM (bytes)	RAM (bytes)	ROM type	Cache memory (bytes)	CPU	Drystone	Multiplier	FPU	MMU	DMAC (ch)	DTCD/MACII	Bus	SDRAM controller	PCI controller	Endian conversion	realtime clock	Resolution x channels	Resolution x channels	8 bit	16 bit										32 bit	3-phase inverter control	Watchdog timer	Clock synchronous/ Asynchronous shared			
SH7200	SH7206*	R5ST7206W200FPV*	128 K	L	16 K	SH-2A core	480 MIPS (200 MHz)	32 x 32 → 64	-	8	-	Separate bus (8/16/32-bit)	Yes	-	-	10-bit x 8	8-bit x 2	-	11 (MTU2, MTU2S, CMT)	MTU2, MTU2S	4	1	-	-	-	-	-	-	-	-	-	8	71	9	-	FP-176C	200 MHz/ 1.25 V + 3.3 V	-20 to 85
	SH-2A core (on-chip FPU)	288 MIPS (120 MHz)				Yes	-		-									6 (MTU2)	MTU2	8	3	SSI x 2		2	14							104	17	FP-176EV		120 MHz/3.3 V 80 MHz/3.3 V	-20 to 70 -40 to 85	
	R5ST72611FPV**	R5ST72612FPV**				-	-		-									-	-	-	-	-		-	-							-	-	-		-	-	-
SH7606	SH7606*	HD6417606*	4 K			SH-2 core	130 MIPS (100 MHz)	-	-	-	-	Separate bus (8/16-bit)	Yes	-	-	-	-	-	2	-	3	-	-	-	78	9	BP-176	100 MHz/ 3.3 V + 1.5 V	-20 to 75									
SH7641	SH7641	HD6417641BP	144 K			SH3-DSP core (MMU less)			4	SRAM/ SDRAM	-	-				-	10-bit x 8	9 (MTU, CMT)	MTU	3	1	1		156	CSP-256		100 MHz/ 1.8 V/3.3 V	-40 to 85										

- Only the outline of functions is described. For details, refer to the Renesas Microcomputer General Catalog.
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<http://www.renesas.com/en/package>

◆: Two ports with analogtransceiver (one is common with USB function controller)

[illegible]

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***: In Planning

Series	Group	Type No.	Memory				CPU				DMA	External expansion bus			Clock	A/D converter	D/A converter	Timer				Serial interface	Smart card/SIM	Synchronous serial communication unit/ special serial I/O	CAN					I/O port	Interrupt (source)	Other function				Package	Operating frequency/ Power Supply voltage	Oprrating ambient temperature (°C)					
			ROM (bytes)	RAM (bytes)	ROM type	Cache memory	CPU	Dynastone	Multiplier	FPU	MMU	DMAC (ch)	DTCD/MACII	SDRAM controller	PCI controller	Endian conversion	realtime clock	Resolution x channels	Resolution x channels	8 bit	16 bit	32 bit			3-phase inverter control						Watchdog timer	Clock synchronous/ Asynchronous shared	I ² C bus	Channels	Ethernet				USB HOST	USB F-unction	IrDA	LCD	Input only
SH-Ether	SH7615	HD6417615F	8 K	L	4 K	SH2-DSP core	81 MIPS (62.5 MHz)	-	-	2	-	Yes	-	Yes	CS2, CS4 area only	-	-	-	16-bit free-running timer x 1, timer pulse unit x 3	-	-	2	-	-	Serial IO x 2	1	-	-	-	-	-	-	29	NMI+4 (15 level)	DSP function	E-DMAC x 2	-	FP-208C	62.5 MHz/ 3.3 V	-20 to 75			
		HD6417615ARF																																									
		HD6417615ARB																																									
		HD6417615RBP																																									
	SH7616	HD6417616F	4 K	16 K	SH-2 core	81 MIPS (62.5 MHz)	-	-	-	-	-	-	-	-	-	-	-	compare match timer x 2	-	-	3	-	-	-	1 (PHY mounted)	-	-	-	-	-	-	71	9 (NMI+8)	-	-	-	-	TBP-176	100 MHz/ 3.3 + 1.5 V	-40 to 85 -20 to 75			
		HD6417616SF																																									
	SH7618	HD6417618RBP	4 K	L	16 K	SH-2 core	130 MIPS (100 MHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100 MHz/ 3.3 + 1.5 V	-40 to 85 -20 to 75	
		SH7618A**																																									HD6417618ABP
	SH7619	R4S76190N125BGV	16 K	L	32 K	SH3-DSP core	163 MIPS (125 MHz)	32 x 32 → 64	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Serial IO x 1	1 (PHY mounted)	-	-	-	-	-	-	-	-	-	-	-	-	125 MHz/ 3.3 + 1.8 V	-20 to 75 -20 to 85			
		SH7619A*																																									
SH7710	HD6417710BP	16 K	L	32 K	SH3-DSP core	260 MIPS (200 MHz)	-	Yes	6 (2 of them are possible externally)	-	-	-	-	Yes	Yes (not separtaed power supply voltage)	-	-	-	-	-	-	-	-	-	Serial IO x 2	2 (with Bridge)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	BP-256H	200 MHz/ 1.5 V (core), 3.3 V (IO)	-20 to 75
	HD6417710F																																										
	HD6417712BP																																										
	HD6417712F																																										
SH7650	R4S76500B	8 K	16 K	SH-2 core	173 MIPS (133 MHz)	-	-	-	-	-	Yes	-	-	-	-	-	-	compare match timer x 2	-	-	-	-	-	1	-	-	-	-	-	-	148	9 (NMI+8)	DTCP function	Encryption circuit	TS-I/F x 3	BP-336	133 MHz/ 3.3 + 1.5 V	-20 to 70					

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Note 1: Only transferable to internal RAM and internal peripheral I/O area.
Not transferable to internal ROM and external expansion area.

Note 2: Continuous operation in the temperature of 85 °C or higher will not be guaranteed.
To customers who consider applying such operation in the temperature above,
please contact Renesas Technology Corp.

Note 3: Includes 1 channel with automatic wave form generation function

Note 4: 12-channel analog input-only pins, 20-channel I/O port/peripheral I/O shared pins

Series	Group	Type No.	Memory					CPU			DMA	External Bus Expansion		Clock		A/D Converter		D/A Converter	Timer							Serial Interface		CAN		I/O Port		Interrupts (Sources)	Debugging Function					Operating Frequency/ Power Supply Voltage	Operating Ambient Temperature (°C) (Note2)																									
			ROM (Bytes)	RAM (Bytes)	ROM Type	Data Flash	Program Security	CPU	Basic Instructions	Minimum Instruction Execution Time (ns)		Multiplier	Multiply-and-accumulation Instruction	Barrel Shifter	PFU	DMAC (Channels) (Note1)	Address Space (Bytes)		External Bus Interface	Bus Structure	Clock Generation Circuit	PLL	Oscillation Stop Detection	Resolution X Channels	Sample and Hold	Multi-Channel Sample and Hold	Resolution X Channels	16 bit	24 bit	32 bit	Prescaler		Input Capture	PWM Output	Event Counter					2-phase Encoder Input	3-phase Inverter Control	Clock Asynchronous/Clock Synchronous	Clock Asynchronous Only	Channels	Buffers	Input Only (Numbers)	CMOS I/O Only (Numbers)	External	Boundary Scan/TAG	On-Chip Debugging	On-Board Flash memory reprogramming	Others	Package											
M32R/ECU	32172	M32172F2VFP	16 K	256 K	32 K	-	M32R core	83	25 (@40 MHz), 31.25 (@32 MHz)	TFP: 25 (@40 MHz), VFP: 31.25 (@32 MHz)	2 M	Wait controller (1 to 4 wait cycles inserted prolonged by external WAIT signal input)	Yes (4 x multiplier)	10-bit x 32 (Note4)	-	8-bitx2 (Note 3)	TOM x 16, TMS x 4, TIO x 2, TPD x 4, TEP x 4	TML x 4	TMS, TML, TPD	TOM	TID, TEP	TID	TOM	4 (SIO0, SIO1, SIO4, SIO5)	4 (SIO2, SIO3, SIO6, SIO7)	16 (transmit/ receive buffers)	17	81	17	Yes (Scalable debugging interface, Real-Time Debugger)	-	3.3 V single or 3.3 and 5.0 V dual-power supply	-40 to 85 (@40 MHz), -40 to 125 (@32 MHz)																															
	M32176F2VFP	24 K	Yes (Option)																															Flash memory protecting ID, Protecting by FP pin, Protecting by FENTRY bit, Protecting by lock bit	M32R-FPU core (on-chip single-precision FPU)	12.5 (@60 MHz)	7.8125 (@128 MHz)	16 x 32 → 48	16 x 32 + 56 → 56	Yes	10	Separate bus (16-bit)	2 circuits (Oscillation Circuit, PLL)	Yes	10-bit x 16	Yes	Yes (synchronous sampling function)	TML x 8	Yes	TMS, TML	TIO, TOU	TID	TOU	4 (SIO0, SIO1, SIO4, SIO5)	2 (SIO2, SIO3)	2 (Ver., 2.0B active)	32 (transmit/ receive buffers)	1 (Input level switch function, Output drive performance switch function, Noise canceller control function)	96 (Input level switch function, Output drive performance switch function, Noise canceller control function)	Yes (Scalable debugging interface, Real-Time Debugger, Non-Break -Debug)	Direct RAM Interface	144-pin LQFP	TFP: 3.3 V single, 5.0 V single or 3.3 and 5.0 V dual-power supply, UFP: 3.3 V single or 3.3 and 5.0 V dual-power supply, VFP: -40 to 125 (@128 MHz)	TFP: -40 to 85 (@40 MHz), -40 to 125 (@32 MHz)
	M32176F21FP																																																															
	M32176F3VFP																																																															
	M32176F4VFP																																																															
	32176	M32176F3TFP	384 K	512 K	24 K	Yes (Option)	Flash memory protecting ID, Protecting by FP pin, Protecting by FENTRY bit, Protecting by lock bit	M32R-FPU core (on-chip single-precision FPU)	100	6.25 (@160 MHz)	7.8125 (@128 MHz)	16 x 32 → 48	16 x 32 + 56 → 56	Yes	10	Separate bus (16-bit)	2 circuits (Oscillation Circuit, PLL)	Yes	10-bit x 16	Yes	Yes (synchronous sampling function)	TML x 8	Yes	TMS, TML	TIO, TOU	TID	TOU	4 (SIO0, SIO1, SIO4, SIO5)	2 (SIO2, SIO3)	2 (Ver., 2.0B active)	32 (transmit/ receive buffers)	1 (Input level switch function, Output drive performance switch function, Noise canceller control function)	96 (Input level switch function, Output drive performance switch function, Noise canceller control function)	Yes (Scalable debugging interface, Real-Time Debugger, Non-Break -Debug)	Direct RAM Interface	144-pin LQFP	TFP: 3.3 V single, 5.0 V single or 3.3 and 5.0 V dual-power supply, UFP: 3.3 V single or 3.3 and 5.0 V dual-power supply, VFP: -40 to 125 (@128 MHz)	TFP: -40 to 85 (@40 MHz), -40 to 125 (@32 MHz)																										
	M32176F4TFP																																																															
	M32186F8VFP	64 K																																																														
	M32192F8VFP	176 K																																																														
	32192	M32192F8UFP	1 M	-	176 K	-	Flash memory protecting ID, Protecting by FP pin, Protecting by FENTRY bit, Protecting by lock bit	M32R-FPU core (on-chip single-precision FPU)	100	6.25 (@160 MHz)	7.8125 (@128 MHz)	16 x 32 → 48	16 x 32 + 56 → 56	Yes	10	Separate bus (16-bit)	2 circuits (Oscillation Circuit, PLL)	Yes	10-bit x 16	Yes	Yes (synchronous sampling function)	TML x 8	Yes	TMS, TML	TIO, TOU	TID	TOU	4 (SIO0, SIO1, SIO4, SIO5)	2 (SIO2, SIO3)	2 (Ver., 2.0B active)	32 (transmit/ receive buffers)	1 (Input level switch function, Output drive performance switch function, Noise canceller control function)	96 (Input level switch function, Output drive performance switch function, Noise canceller control function)	Yes (Scalable debugging interface, Real-Time Debugger, Non-Break -Debug)	Direct RAM Interface	144-pin LQFP	TFP: 3.3 V single, 5.0 V single or 3.3 and 5.0 V dual-power supply, UFP: 3.3 V single or 3.3 and 5.0 V dual-power supply, VFP: -40 to 125 (@128 MHz)	TFP: -40 to 85 (@40 MHz), -40 to 125 (@32 MHz)																										
	M32192F8TFP																																																															
	M32196F8VFP	64 K																																																														
32196	M32196F8UFP	64 K	-	64 K	-	Flash memory protecting ID, Protecting by FP pin, Protecting by FENTRY bit, Protecting by lock bit	M32R-FPU core (on-chip single-precision FPU)	100	6.25 (@160 MHz)	7.8125 (@128 MHz)	16 x 32 → 48	16 x 32 + 56 → 56	Yes	10	Separate bus (16-bit)	2 circuits (Oscillation Circuit, PLL)	Yes	10-bit x 16	Yes	Yes (synchronous sampling function)	TML x 8	Yes	TMS, TML	TIO, TOU	TID	TOU	4 (SIO0, SIO1, SIO4, SIO5)	2 (SIO2, SIO3)	2 (Ver., 2.0B active)	32 (transmit/ receive buffers)	1 (Input level switch function, Output drive performance switch function, Noise canceller control function)	96 (Input level switch function, Output drive performance switch function, Noise canceller control function)	Yes (Scalable debugging interface, Real-Time Debugger, Non-Break -Debug)	Direct RAM Interface	144-pin LQFP	TFP: 3.3 V single, 5.0 V single or 3.3 and 5.0 V dual-power supply, UFP: 3.3 V single or 3.3 and 5.0 V dual-power supply, VFP: -40 to 125 (@128 MHz)	TFP: -40 to 85 (@40 MHz), -40 to 125 (@32 MHz)																											
M32196F8TFP																																																																

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** : Under development

Note 3 Clock asynchronous (UART) of Intelligent IO is 1 channel

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*: New Product
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[illegible]

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** : Under development

Series	Group	Part No.	Memory			CPU			DMA	External Bus Expansion		Clock			Voltage Detection	AD Converter	D/A Converter	Timer					Serial Interface			CAN																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					

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** : Under development

Series	Group	Type No.	Memory				CPU				DMA	External Bus Expansion		Clock				Voltage Detection		A/D Converter	D/A Converter	Timer										Serial Interface		PC Bus Interface	I2C Bus	Smart Card Interface	SPI/Special Serial I/O	CAN		USB Function	LPC-BK	SDA	QSD	CRC Calculation Circuit	I/O Port				Interrupts (Sources)		Debug Function		Other Functions		Operating Frequency/Supply Voltage	Operating Ambient Temperature (°C)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
			ROM (Bytes)	RAM (Bytes)	EEPROM	Flash	Program Security	Base Instructions	Advanced Instructions (Execution Time (ns))	Multiplier	Memory Accelerator Instruction	Memory Buffer	DMA2 Channels	DTC/DMA2	Address Span (Mbits)	External Bus Interface	Bus Structure	DMA2 Controller	Clock Generator/Circuit	PLL	Master Clock	On-Chip Oscillator	Clockload Step Detection	Frequency Divider	Power Down	Power On Reset/POR	Low Voltage Detection	Resolution Channels	Input and Output	Resolution Channels	8-bit	16-bit	Prescaler					Free-Running	Capacitive Compare						PWM Output	Real-Time BRT	Event Counter	2-phase Encoder Input	3-phase Inverse Control	Watch-Dog Timer	UART0 to UART2	Clock Asynchronous Clock Synchronization	Clock Synchronization Only	Clock Asynchronous Only			XT Converter	Host Only (Numbers)	CAN0/1 (Numbers)	CAN0/2 (Numbers)	High Current Driver (Not)	Fast I/O Resistor	External	On-Chip Debug	On-Chip Flash Program	ROM/EEPROM Function	Others	Package																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
M16C25A	M16C25A	M30200MA.XXXXXP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

M16C family Products Lineup

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*: New Product

** : Under development

Series	Group	Type No.	Memory		CPU		DMA	External Bus Expansion		Clock		Voltage Detection		A/D Converter		D/A Converter	Timer		Serial Interface		PC User Interface	I/O Bus	Serial Communication Interface	CAN		USB Function	LIN Bus	I/O Port	Interrupts (Sources)		Debug Function		Other Functions		Package	Operating Frequency/Supply Voltage	Operating Ambient Temperature (°C)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
			ROM (Kbit)	RAM (Kbit)	ROM Type	Program Security		Max Instructions	Max Instructions Execution Time (ns)	Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions		Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions				Max JTAG	Max JTAG Instructions				Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions				Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions	Max JTAG	Max JTAG Instructions																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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*: New product
**: Under development
***: In planning

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group	Product No.	Memory		CPU				DMA		External bus expansion				Clock		A/D converter	D/A converter	Timer							Serial interface						I/O port							Interrupt (source)	Debugging function		Operating frequency/ Power Supply voltage	Orprating ambient temperature (°C)																					
		ROM (bytes)	RAM (bytes)	ROM type	Number of basic instruction	Minimum instruction execution time (ns)	Multipiler	Multiply-and-accumulation instruction	DMAC (ch)	EXDMAC	DTC/DMAcII	Address space (byte)	Bus state controller	Bus	SDRAM controller	DRAM controller	Host interface	PLL	Sub clock	realtime clock	Resolution x channels	Resolution x channels	8 bit	16 bit							32 bit	Prescaler	Input capture	Output compae	PWM output	Realtime port	Programmable pulse generator		Event counter	2-phase encoder input			Watchdog timer	Click synchronous/ Asynchronous shared	°C bus	IEBus	Smart card/SIM	Synchronous serial communication unit/ special serial I/O	Channels	USB Function	LPC/ISA	IDA	LCD	CRC arithmetic circuit	Input only	CMOS output only	CMOS input/output	High withstanding voltage port	N-channel open drain port	DTMF	High current drive port	Pull-up resistor	NMOS push-pull
H8S/2319	H8S/2312S	-	8 K	L	65	50 ns (20 MHz), 40 ns (25 MHz)	-	-	-	-	DTC	16 M	Direct connection to ROM, SRAM	Separate bus (8/16-bit)	-	-	-	-	-	10-bit x 8	8-bit x 2	TMR x 2	TPU x 6, TMR x 1	TPU x 2	-	6 (TPU)	6 (TPU)	TPU	-	-	TPU, TMR	TPU	Yes	2	-	-	Yes	Multi-processor communication function	-	-	-	-	-	8	-	54	-	10	-	-	36	-	9	-	-	PRQP0100JE-B (FP-100A), PTQP0100KA-A (TFP-100B), PTQP0100LC-A (TFP-100G), 113pinLGA (TLP-113V)*	20 MHz/ 2.7 to 3.6 V	25 MHz/ 3.0 to 3.6 V	-20 to 75, -40 to 85				
	H8S/2314F	384 K	F	Yes																																																								PRQP0100JE-B (FP-100A), PTQP0100KA-A (TFP-100B)			
	H8S/2315F		F																																																												
	H8S/2316S	64 K	M																																																												
	H8S/2317F		F																																																												
	H8S/2317S	128 K	M																																																												
	H8S/2318	8 K	M																																																												
	H8S/2318F	256 K	F																																																												
	H8S/2319		M																																																												
	H8S/2319CF	512 K	F																																																												
	H8S/2319EF																																																														
	H8S/2319F	8 K																																																													
H8S/2329	H8S/2320		4 K	L	65	40 (25 MHz)	-	-	4	-	DTC	16 M	Direct connection to ROM/ SRAM/ DRAM	Separate bus (8/16-bit)	-	Yes	-	-	-	-	10-bit x 8	8-bit x 2	TMR x 2	TPU x 6	TPU x 2	-	6 (TPU)	6 (TPU)	TPU	-	PPG + TPU	TPU, TMR	TPU	Yes	3	-	-	-	1	Multi-processor communication function	-	-	-	-	-	8	-	87	-	14	-	-	40	-	9	-	-	PRQP0100JE-B (FP-100A), PTQP0100KA-A (TFP-100B), PTQP0100LC-A (TFP-100G)	25 MHz/ 3.0 to 3.6 V	20 MHz/ 2.7 to 3.6 V	-20 to 75, -40 to 85		
	H8S/2321																																																														
	H8S/2322R	8 K	M																																																												
	H8S/2323	32 K	L																																																												
	H8S/2324S	-	32 K	L																																																											
	H8S/2326F	512 K	F																																																												
	H8S/2327	128 K	M																																																												
	H8S/2328	256 K																																																													
	H8S/2328BF																																																														
	H8S/2329BF	384 K	F																																																												
	H8S/2329F	32 K	F																																																												
	H8S/2339	H8S/2332	-																																																											L	65
H8S/2337		128 K	M																																																												
H8S/2338F		256 K																																																													
H8S/2339EF		384 K	F																																																												
H8S/2339F		32 K	F																																																												
H8S/2345	H8S/2340	-		L	65	50 (20 MHz)	-	-	-	DTC	16 M	Direct connection to SRAM, ROM	Separate bus (8/16-bit)	-	-	-	-	-	-	10-bit x 8	8-bit x 2	TMR 0.1 x 2	TPU x 6	TPU x 2	-	6 (TPU)	6 (TPU)	6 (TPU)	-	-	-	6 (TPU)	Yes	2	-	-	1	Multi-processor communication function	-	-	-	-	-	8	-	71	71	10	-	Port for LED drive x 28	36	-	9	-	-	TFP-100B, TFP-100G, FP-100A, FP-100B	20 MHz/ 4.4 to 5.5 V	-20 to 75, -40 to 85					
	H8S/2341	32 K	2 K																																																												
	H8S/2343	64 K	M																																																												
	H8S/2344	96 K																																																													
	H8S/2345	128 K	4 K	Z																																																											
	H8S/2345F		F																																																												

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*: New product
 **: Under development
 ***: In planning

[illegible]

Product lineup of 2400 series products in the H8S Family

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*: New product
**: Under development
***: In planning

group	Product No.	Memory		CPU		DMA	External bus expansion				Clock	A/D converter	D/A converter	Timer						Serial interface	I ² C bus	IEBus	Smart card/SIM	Synchronous serial communication unit/ special serial I/O	CAN	USB Function	LPC/ISA	IrDA	LCD	CRC arithmetic circuit	I/O port						Interrupt (source)	Debugging function	Other function	Package	Operating frequency/Power Supply voltage	Operating ambient temperature (°C)																	
		ROM (bytes)	RAM (bytes)	ROM type	Number of basic instruction	Minimum instruction execution time (ns)	Multiplier	Multiply-and-accumulation instruction	DMAC (ch)	EXDMAC	DTCDMACII	Address space (byte)	Bus state controller	Bus	SDRAM controller	DRAM controller	Host interface	PLL	Sub clock												realtime clock	Resolution x channels	Resolution x channels	8 bit	16 bit	32 bit	Prescaler	Input capture	Output compare				PWM output	Realtime port	Programmable pulse generator	Event counter	2-phase encoder input	Watchdog timer	Clock synchronous/ Asynchronous shared	Input only	CMOS output only	CMOS input/output	High withstanding voltage port	N-channel open drain port	DTMF	High current drive port	Pull-up resistor	NMOS push-pull	External
H8S/2437	H8S/2437F	256 K	16 K	F	69	50 (20 MHz)	16 x 16 → 32	16 x 16 + 42 → 42	-	-	16 M	Direct connection to SRAM, ROM	Separate, Multiple x bus (8/16-bit)	-	-	-	-	-	-	10-bit x 16	-	TMR x 8	FRT x 2, TPU x 3	Yes	-	TPU x 3, FRT x 2, 8-bit timer (TMRV)	PWM x 3, FRT x 2, PWM X x 2, TPU x 3	-	-	-	-	Yes (x1)	5	Yes (x 4)	-	-	-	-	-	-	-	-	-	17	-	85	-	8	-	32	8	9	-	Yes (E10A)	Yes	Built-in duty measurement circuit	PRQP0128KB-A (FP-128B)	20 MHz/ 3.0 to 3.6 V	-20 to 75

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group	Product No.	Memory		CPU		DMA		External bus expansion				Clock		A/D converter	D/A converter	Timer								Serial interface	I ² C bus	IEBUS	Smart card/SIM	Synchronous serial communication unit/ special serial I/O	CAN	USB Function	LPC/ISA	IDA	LCD	CRC arithmetic circuit	I/O port				Interrupt (source)	Debugging function	Other function	Package	Operating frequency/Power Supply voltage	Operating ambient temperature (°C)																																																																			
		ROM (bytes)	RAM (bytes)	ROM type	Number of basic instruction	Minimum instruction execution time (ns)	Multiplier	Multiply-and-accumulation instruction	DMAC (ch)	EXDMAC	DTCDMACII	Address space (byte)	Bus state controller	Bus	SDRAM controller	DRAM controller	Host interface	PLL	Sub clock	realtime clock	Resolution x channels	Resolution x channels	8 bit												16 bit	32 bit	Precalater	Input capture							Output compare	PWM output	Realtime port	Programmable pulse generator	Event counter	2-phase encoder input	Watchdog timer	Clock synchronous/ Asynchronous shared	Input only	CMOS output only	CMOS input/output	High withstand voltage port	N-channel open drain port	DTMF	High current drive port	Pull-up resistor	CMOS push-pull	External	Boundary scan/JTAG	On-chip debugging	On-board flash memory reprogramming	ROM correction																																													
H8S/2506	H8S/2505F	384 K	32 K	F	65	38 (26 MHz)	-	-	-	Yes (DTC)	16 M	Direct connection to EXRAM, ROM	Separate bus (8/16-bit)	-	-	-	Yes (x 1 x 2)	Yes (WDT for watch)	10-bit x 16	8-bit x 2	4 (TMP)	6 (TPU)	Possible with TPU x 2	-	6 (TPU)	6 (TPU)	6 (TPU)	-	-	-	6 (TPU)	2	5	2	-	1	Yes	-	-	-	-	16	-	104	-	10	-	-	40	2	9	-	-	Yes	FP-144J, BP-176V	26 MHz/ 3.0 to 5.5 V	-20 to 75, -40 to 85																																																						
	H8S/2506F	512 K																																																																																																													
H8S/2552	H8S/2551F	384 K	24 K																																																							F	65	38 (26 MHz)	-	-	-	Yes (DTC)	16 M	Direct connection to EXRAM, ROM	Separate bus (8/16-bit)	-	-	-	Yes (x 1 x 2)	Yes (WDT for watch)	10-bit x 16	8-bit x 2	4 (TMP)	6 (TPU)	Possible with TPU x 2	-	6 (TPU)	6 (TPU)	6 (TPU)	-	-	-	6 (TPU)	2	5	2	-	1	Yes	-	-	-	-	16	-	104	-	10	-	-	40	2	9	-	-	Yes	FP-144J, BP-176V	26 MHz/ 3.0 to 5.5 V	-20 to 75, -40 to 85
	H8S/2552F																																																																																																														
H8S/2556	H8S/2556F	512 K	32 K	F	65	50 (20 MHz)	-	-	-	Yes (DTC)	16 M	Direct connection to EXRAM, ROM	Separate bus (8/16-bit)	-	-	-	Yes (x 1 x 2)	Yes (WDT for watch)	10-bit x 16	8-bit x 2	4 (TMP)	6 (TPU)	Possible with TPU x 2	-	6 (TPU)	6 (TPU)	6 (TPU)	-	-	-	6 (TPU)	2	5	2	-	-	Yes	-	-	-	-	-	17	1	102	-	-	-	40	2	9	-	-	Yes	FP-144J	20 MHz/ 3.0 to 5.5 V	-40 to 85																																																						

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*: New product
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Group	Product No.	Memory		CPU			DMA		External bus expansion			Clock		A/D converter	D/A converter	Timer							Serial interface	CAN																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										

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group	Product No.	Memory				CPU	DMA	External bus expansion				A/D converter	D/A converter	Timer								Serial interface		I/O port				Interrupt (source)	Debugging function			Operating frequency/ Power Supply voltage	Oprating ambient temperature (°C)																												
		ROM (bytes)	RAM (bytes)	ROM type	Program security			Number of basic instruction	Minimum instruction execution time (ns)	DMAc (ch)	Address space (byte)			Bus state controller	Bus	DRAM controller	Resolution x channels	Resolution x channels	8 bit	16 bit				Input capture	Output compare	PWM output	Programmable pulse generator		Event counter	2-phase encoder input				3-phase inverter control	Watchdog timer	Clock synchronous/ Asynchronous Shared	Smart card/SIM	Input only	CMOS input/output	High withstanding voltage port	Pull-up resistor	External	On-chip debugging	On-board flash memory reprogramming	Package																
3001	3001		512	L	-	62	111 (@18 MHz)	-	16 M	ROM/ SRAM	-	10-bit x 4	-	5 (ITU)	5 (ITU)	5 (ITU)	ITU	TPC + ITU	ITU	ITU	ITU	-	1		4	28	32	8	4		-	TFP-80C, FP-80A	18 MHz/4.5 to 5.5 V 13 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V	-20 to 75, -40 to 85																											
3002	3002						118 (@17 MHz)	4		ROM/ SRAM/ DRAM	Yes	10-bit x 4										5 (ITU)	5 (ITU)			5 (ITU)	ITU		TPC + ITU				ITU		ITU	ITU	2	8	38	28	7	TFP-100B, FP-100A, FP-100B	17 MHz/4.5 to 5.5 V 10 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V																		
3003	3003						125 (@16 MHz)	8																													FP-112, TFP-120	16 MHz/4.5 to 5.5 V 10 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V																							
3004	3004						2 K	4 K		111 (@18 MHz)	-	ROM/ SRAM										-	ROM/ Burst ROM/ SRAM/ DRAM			Yes	8-bit x 2	4	3 (16-bit timer), 2 (8-bit timer available)				3 (16-bit timer), 4 (8-bit timer)		3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer, 8-bit timer	-	Yes (x1)	1	11	21	28	-	6	TFP-80C, FP-80A	18 MHz/4.5 to 5.5 V 10 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V												
	3005						3006			2 K	100 (@20 MHz)	4										TFP-100B, FP-100A, FP-100B																				20 MHz/4.5 to 5.5 V 13 MHz/3.0 to 5.5 V 10 MHz/2.7 to 5.5 V																			
3006	3007						4 K	M		F	Yes	80 (@25 MHz)										4	ROM/ Burst ROM/ SRAM/ DRAM			Yes	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 2 (8-bit timer available)				3 (16-bit timer), 4 (8-bit timer)		3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	Yes	3	12	35	20	8	7	TFP-100B, FP-100A, FP-100B	25 MHz/4.5 to 5.5 V 25 MHz/3.0 to 3.6 V	-20 to 75, -40 to 85											
3022	3020	128 K	4 K	8 K	M	111 (@18 MHz)			-				ROM/ SRAM	-	10-bit x 8	5 (ITU)	5 (ITU)	5 (ITU)	ITU	TPC + ITU	ITU			ITU	ITU					2	8	55		28								12							5		TFP-80C, FP-80A	18 MHz/3.0 to 3.6 V	-20 to 75								
	3021	192 K	F																																																			9	70	20	20	7	TFP-100B, FP-100A, FP-100B	25 MHz/3.0 to 3.6 V	
	3022	256 K																																																											M
	3022F	8 K																																																											
3024	128 K		4 K	M	F																																																								
3026	256 K		8 K			M	F																																																						
3028	3028	384 K	16 K					M	3	70	20	20	7	TFP-100B, FP-100B	25 MHz/3.0 to 3.6 V																																														
3028F	512 K	16 K	F	Yes	Yes			TFP-100B, FP-100A, FP-100B								18 MHz/4.5 to 5.5 V 10 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V																																													
3029						3029F	512 K		16 K	F	Yes	Yes	TFP-100B, FP-100A, FP-100B	18 MHz/4.5 to 5.5 V 10 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V																																															
3032	3030	16 K	512	M	Yes	111 (@18 MHz)	-	ROM/ SRAM	-	10-bit x 8	5 (ITU)	5 (ITU)	5 (ITU)	ITU	TPC + ITU	ITU	ITU	ITU	1	-	9	55	28	12	6	TFP-80C, FP-80A	18 MHz/4.5 to 5.5 V 10 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V	-20 to 75, -40 to 85																																	
	3031	32 K	1 K																										Z																																
	3032	64 K	2 K																											Z																															
	3032																																																												
3035	3033	128 K	4 K	M	Yes	111 (@18 MHz)	-	ROM/ SRAM	-	10-bit x 8	5 (ITU)	5 (ITU)	5 (ITU)	ITU	TPC + ITU	ITU	ITU	ITU	1	-	9	55	28	12	5	TFP-80C, FP-80A	18 MHz/4.5 to 5.5 V 10 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V	-20 to 75, -40 to 85																																	
	3035	256 K	4 K																										Z																																
	3036	16 K	512																											M	F																														
	3037	32 K	1 K																																																										
3039	3038	64 K	2 K	M																																																									
	3039	128 K	4 K		F																																																								
	3039F																																																												
3042	3040	32 K	2 K	M	Yes	118 (@17 MHz)	4	ROM/ SRAM	Yes	8-bit x 2	-	5 (ITU)	5 (ITU)	5 (ITU)	ITU	TPC + ITU	ITU	ITU	2	-	9	70	20	7	TFP-100B, FP-100A, FP-100B	16 MHz/4.5 to 5.5 V 10 MHz/3.0 to 5.5 V 8 MHz/2.7 to 5.5 V	-20 to 75, -40 to 85																																		
	3041	48 K																										Z																																	
	3042	64 K																																																											
	3042																																																												

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group	Product No.	Memory				CPU		DMA	External bus expansion			A/D converter	D/A converter	Timer							Serial interface		I/O port			Interrupt (source)	Debugging function			Operating frequency/ Power Supply voltage	Oprating ambient temperature (°C)													
		ROM (bytes)	RAM (bytes)	ROM type	Program security	Number of basic instruction	Minimum instruction execution time (ns)		DMAC (ch)	Address space (byte)	Bus siate controller			Bus	DRAM controller	Resolution x channels	Resolution x channels	8 bit	16 bit	Input capture			Output compare	PWM output	Programmable pulse generator		Event counter	2-phase encoder input				3-phase inverter control	Watchdog timer	Clock synchronous/ Asynchronous shared	Smart card/SIM	Input only	CMOS input/output	High withstanding voltage port	Pull-up resistor	External	On-chip debugging	On-board flash memory reprogramming	Package	
3048	3044	32 K	2 K	M	Yes	62	111 (@18 MHz)	4	ROM/ SRAM/ DRAM	Yes	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 2 (8-bit timer available)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	2	1	8	28	20	7	-	-	TFP-100B, FP-100B	18 MHz/4.5 to 5.5 V 13 MHz/3.15 to 5.5 V 8 MHz/2.7 to 5.5 V													
	3045	64 K																													4 K	Z	80 (@25 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	Yes	Yes	-	TFP-100B, FP-100B	16 MHz/4.5 to 5.5 V 8 MHz/2.7 to 5.5 V	
	3047	96 K	F	M			25 MHz/4.5 to 5.5 V 25 MHz/3.0 to 3.6 V																																					
	3048	128 K																																									F	25 MHz/4.5 to 5.5 V
	3048F																																											
3048B	3048 F-ONE	128 K	4 K	F	80 (@25 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	2	1	8	28	20	7	Yes	-	TFP-100B, FP-100B	25 MHz/4.5 to 5.5 V 25 MHz/3.0 to 3.6 V														
3052B	3052BF	512 K	8 K	F	-	62	100 (@20 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	2	1	8	28	20	7	Yes	-	TFP-100B, FP-100A, FP-100B	25 MHz/4.5 to 5.5 V												
3062	3060	64 K	2 K	M	Yes	62	80 (@25 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 2 (8-bit timer available)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	9	20	7	-	-	TFP-100B, FP-100A, FP-100B	20 MHz/4.5 to 5.5 V 13 MHz/3.0 to 5.5 V 10 MHz/2.7 to 5.5 V														
	3061	96 K	4 K	F																										Yes	25 MHz/4.5 to 5.5 V													
	3062	128 K	4 K	F																										Yes	25 MHz/4.5 to 5.5 V													
	3062RF	128 K	4 K	F																										Yes	25 MHz/4.5 to 5.5 V													
	3060B	64 K	2 K	M																										Yes	25 MHz/4.5 to 5.5 V													
	3061B	96 K	4 K	M																										Yes	25 MHz/4.5 to 5.5 V													
	3062B	128 K	4 K	M																										Yes	25 MHz/4.5 to 5.5 V													
	3064B	256 K	8 K	F																										Yes	25 MHz/4.5 to 5.5 V													
3067	3062BF	128 K	4 K	F	-	62	100 (@20 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	9	20	7	Yes	-	TFP-100B, FP-100A, FP-100B	20 MHz/4.5 to 5.5 V 13 MHz/3.0 to 5.5 V 10 MHz/2.7 to 5.5 V															
	3064BF	256 K	8 K	F	-	62	100 (@20 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	9	20	7	Yes	-	TFP-100B, FP-100A, FP-100B	20 MHz/4.5 to 5.5 V 13 MHz/3.0 to 5.5 V 10 MHz/2.7 to 5.5 V															
	3065	64 K	2 K	M	-	62	100 (@20 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	9	20	7	Yes	-	TFP-100B, FP-100A, FP-100B	20 MHz/4.5 to 5.5 V 13 MHz/3.0 to 5.5 V 10 MHz/2.7 to 5.5 V															
3068	3068F	384 K	16 K	F	Yes	62	80 (@25 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	9	20	7	Yes	-	TFP-100B, FP-100B	25 MHz/4.5 to 5.5 V															
3069R	3069RF	512 K	16 K	F	Yes	62	80 (@25 MHz)	-	16 M	ROM/ SRAM	Separate bus (8/16-bit)	-	10-bit x 8	8-bit x 2	4 (TMR0, 1, 2, 3)	3 (16-bit timer), 4 (8-bit timer)	16-bit timer, 8-bit timer	TPC + 16-bit timer	16-bit timer, 8-bit timer	16-bit timer	-	1	9	20	7	Yes	-	TFP-100B, FP-100B	25 MHz/4.5 to 5.5 V															

H8 Family H8/300H Tiny Series Products Lineup

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<http://www.renesas.com/en/package>

*: New Product

** : In Planning

group	Product No.	Memory				Clock			power supply voltage detection		A/D converter	Timer						Watchdog timer	Serial interface		Synchronous serial communication unit/ special serial I/O	CAN	I/O port			Interrupt (source)		Operating frequency/ Power Supply voltage						
		ROM (bytes)	RAM (bytes)	EEPROM (bytes)	ROM type	Sub clock	On-chip oscillator	oscillation stop detection	power-on reset/ POR	low voltage detection/ LVD	Resolution x channels	8 bit	16 bit	Input capture	Output compare	PWM output	Event counter						3-phase inverter control	Clock synchronous/ Asynchronous shared	Channels				Input only	CMOS input/output	High withstanding voltage port	External	Package	
36109	36107	64 K	4 K	-	M	Yes	High speed	-	Yes (Option)	Yes (Option)	10-bit x 16	RTC x 1, Timer B1 x 1, Timer V x 1	Timer RC x 1, Timer RD x 2	Timer RC, Timer RD	Timer V, Timer RC, Timer RD	14-bit PWM, Timer V, Timer RC, Timer RD	Timer B1	Timer RD	Yes (selectable internal oscillator)	3	1	-	-	8	79	20	11	FP-100A	4 to 20 MHz/4.0 V to 5.5 V, 4 to 10 MHz/3.0 V to 5.5 V					
	36108	80 K																												F				
	36109	128 K																																
36049	36047	64 K	3 K		M						RTC x 1, Timer B1 x 1, Timer V x 1	Timer W x 1, Timer Z x 1	Timer W, Timer Z	Timer V, Timer W, Timer Z	14-bit PWM, Timer V, Timer W, Timer Z				3	1	-	-		59	13	FP-80A	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V							
	36048	80 K																										F						
	36049	96 K																																
	36049F																																	
36057	36054	32 K	2 K		M																								FP-64K, FP-64A	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V				
	36054F																														F			
	36057																															M		
	36057F																																F	
36037	36032	16 K	1 K		M						Timer B1 x 1, Timer V x 1, sub timer x 1																				FP-64K, FP-64A	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V		
	36033	24 K																															F	
	36034	32 K																																
	36034F	40 K																																
	36035	48 K																																
	36036	56 K																																
	36037	3 K																																F
	36037F	3 K																																F
36077	36077F	56 K	4 K		F	Yes	High speed	Yes			10-bit x 8		Timer Z x 1	Timer Z	Timer V, Timer Z							8	47		8		11		4 to 20 MHz/4.5 to 5.5 V					
	36074F	32 K																																
3687	3682	16 K	3 K		M						RTC x 1, Timer B1 x 1, Timer V x 1																			FP-64E, FP-64A	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V			
	3683	24 K																														F		
	3684	32 K																																
	3684F	40 K																																
	3685	48 K																																
	3686	56 K																																
	3687	4 K																															F	
	3687F	3 K																															M	
3687N	56 K	3 K	512	M																									FP-64E	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V				
		4 K	F																															
36087	36082	16 K	3 K		M																									FP-64E, FP-64A	4 to 18 MHz/3.0 to 3.6 V			
	36083	24 K																																
	36084	32 K																																
	36085	40 K																																
	36086	48 K																																
	36087	56 K																																
36087F	4 K	F																																
36064G	36064GF	32 K	2 K		F	-			Yes	Yes		Timer B1 x 1, Timer V x 1															FP-64K, FP-64A, FP-64E	1 to 10 MHz/3.0 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V						

H8 Family H8/300H Tiny Series Products Lineup

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*: New Product

** : In Planning

group	Product No.	Memory				Clock			power supply voltage detection		A/D converter	Timer					Watchdog timer	Serial interface	I ² C bus	Synchronous serial communication unit/ special serial I/O	CAN	I/O port			Interrupt (source)	Package	Operating frequency/ Power Supply voltage																			
		ROM (bytes)	RAM (bytes)	EEPROM (bytes)	ROM type	Sub clock	On-chip oscillator	oscillation stop detection	power-on reset/ POR	low voltage detection/ LVD	Resolution x channels	8 bit	16 bit	Input capture	Output compare	PWM output		Event counter			3-phase inverter control	Clock synchronous/ Asynchronous shared	Channels	Input only	CMOS input/output			High withstanding voltage port	External																	
3694	3690	8 K	512	-	M	Yes			Yes (option)	Yes (option)	10-bit x 8	Timer A x 1, Timer B1 x 1, Timer V x 1		Timer W				1	1		8	29	8	11	FP-48B, FP-64E, FP-64A, FP-48F, TNP-48	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																				
	3691	12 K																																												
	3692	16 K																																												
	3693	24 K	1 K	F	M																512	F				27	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																			
	3694	32 K																																												
	3694F																																													
3694N	1 K	M	2 K	F	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																																									
3664	3660	8 K	512	-	M			-	-	10-bit x 8 (DP-42S: 4)	Timer A x 1, Timer V x 1									29	27	1 to 10 MHz/2.7 to 5.5 V 1 to 16 MHz/4.0 to 5.5 V																								
	3661	12 K																																												
	3662	16 K																																												
	3663	24 K	1 K	F	512																		DP-42S, FP-48B, FP-64E, FP-64A, FP-48F	1 to 10 MHz/2.7 to 5.5 V 1 to 16 MHz/4.0 to 5.5 V																						
	3664	32 K																																												
	3664F																																													
3664N	2 K	F	1 to 10 MHz/3.0 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																																											
36024	36022	16 K	512		M								Timer W				3			30		5	9	FP-48B, FP-64E, FP-48F, TNP-48	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																					
	36022F	2 K																							F	1 to 10 MHz/3.0 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																				
	36023	24 K	1 K																						M	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																				
	36024	32 K	2 K																						F	4	1 to 10 MHz/3.0 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																			
	36024F																																													
36014	36010	8 K	512		M																								10-bit x 4	Timer V x 1		Timer V, Timer W				2			4	5	4	FP-48B, FP-64E, FP-48F, TNP-48	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V			
	36011	12 K																																												
	36012	16 K				2 K	F	1 to 10 MHz/3.0 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																																						
	36013	24 K	1 K			M	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																																							
	36014	32 K	2 K			F	18	4	FP-32A, FP-32D, DP-32S	1 to 10 MHz/2.7 to 5.5 V 1 to 20 MHz/4.0 to 5.5 V																																				
	36014F																																													
3672	3670F	8 K	2 K	F						-	-									1	1		26		4	FP-48B, FP-64E, FP-48F	1 to 10 MHz/3.0 to 5.5 V 1 to 16 MHz/4.0 to 5.5 V																			
	3672F	16 K																																												
36912G	36911	4 K	256																				M				Yes		Yes	Yes		Timer B1 x 1, Timer V x 1									18			4	FP-32A, FP-32D, DP-32S	1 to 12 MHz/2.7 to 5.5 V
	36912	512	F																																											1 to 12 MHz/3.0 to 5.5 V
	36912F	8 K	1.5 K				M	2 to 12 MHz/2.7 to 5.5 V																																						
36902G	36900	2 K	256				M																																							
	36901	4 K	M																																											
	36902	8 K	512	M																																										
	36902F	8 K	1.5 K	F																																										

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** : In Planning

group	Product No.	Memory			Voltage detector	A/D converter	Timer						Watchdog timer	Serial interface	I ² C bus	Synchronous serial communication unit/ special serial I/O	LCD	I/O port			Interrupt (source)	Debugging function		Other function		Package	Operating frequency/ Power Supply voltage
		ROM (bytes)	RAM (bytes)	ROM type			Power on-reset	Resolution x channels	8 bit	16 bit	Input capture	Output compare						PWM output	Event counter	Input only		CMOS input/output	High withstanding voltage port	External	On-chip debugging		
38602R	38600R*	8 K	512	M	Power on-reset	10-bit x 6	B1 x 1	Timer W x 1, AEC x 1	Timer W	Timer W	Timer W AEC	Timer W	Yes (On-chip internal oscillator, available as interval timer)	SCI3 x 1	SSU x 1	-	6	13	3	3	Yes (E7 emulator available)		Yes	RTC x 1	TNP-32 (5 x 6 mm)	4.2 MHz/ 1.8 to 3.6 V 10 MHz/ 2.7 to 3.6 V	
	38602R*	16 K	1 K																								F
	38602RF*																										
38086R*	38083R*	24 K	1 K	M	Yes	10-bit x 3, 14-bit ΔΣ x 2		Timer F x 1, TPU x 2, AEC x 1	TPU	TPU, timer F	TPU, 14-bit PWM	TPU, AEC		SCI3_1 x 1, SCI3_2 x 1	1	32 seg x 4 comon-chip avarage voltage circuit for LCD	5	56	4	14	Adress Break, Yes (E7 emulator available)	Yes	-	TLP-85V, TFP-80C, FP-80A			
	38084R*	32 K																									
	38085R*	40 K	2 K																							F	
	38086R*	48 K																									
	38086RF*																										
38076R*	38073R*	24 K	1 K	M		10-bit x 8											8	55									
	38074R*	32 K																									
	38075R*	40 K	2 K																							F	
	38076R*	48 K																									
	38076RF*																										

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** : In Planning

group	Product No.	Memory			A/D converter	D/A converter	Timer					Watchdog timer	Serial interface		I ² C bus	Synchronous serial communication unit/ special serial I/O	LCD	VFD	OSD	I/O port			Interrupt (source)	Debugging function	Other function	Package	Operating frequency/ Power Supply voltage							
		ROM (bytes)	RAM (bytes)	ROM type	Resolution x channels	Resolution x channels	8 bit	16 bit	Input capture	Output compare	PWM output		Event counter	Clock synchronous/ Asynchronous shared						Clock synchronous only	Input only	CMOS Input/output	High current drive port	DTMF	External			On-board flash memory reprogramming	ROM correction					
3614	3612	16 K	512	M	8-bit x 8	-	5 (TimerA, B, C, D, E)	-	-	-	-	-	2	-	-	-	-	-	-	10	38	-	-	6	-	-	-	DP-64S, FP-64A	2.1 MHz/2.7 to 5.5 V 4.2 MHz/4.0 to 5.5 V					
	3613	24 K	1 K																											Z				
	3614	32 K																																
	3614	32 K																																
3627	3622S	16 K	1 K	M	8-bit x 2		2 (Timer A, G)	1 (Timer F)	1 (Timer G)	1 (Timer F)	-	-	-						-	3	50	-	1	13				-	-	13	-	-	FP-64E, FP-64A	2.5 MHz/2.2 to 5.5 V 5.0 MHz/2.7 to 5.5 V
	3623S	24 K																																
	3624S	32 K																																
	3625	40 K																																
	3626	48 K																																
	3627	60 K																																
	3627	60 K																																
	3627	60 K																																
3637	3635S	40 K	2 K	M	8-bit x 4	-	-	-	-	-	-	-	5	61	-	-	13	-	-	13	-	-	TFP-80C, TFP-80F, FP-80B	5.0 MHz/2.7 to 5.5 V										
	3636S	48 K																																
	3637S	60 K																																
	3637S	60 K																																
3644	3640R	8 K	512	M	8-bit x 8	-	3 (Timer A, B1, V)	1 (Timer X)	1 (Timer X)	1 (Timer X)	1	1	1	-	2	-	-	-	-	8	45	-	12	-	-	-	TFP-80C, DP-64S, FP-64A	5.0 MHz/2.5 to 5.5 V 8.0 MHz/4.0 to 5.5 V						
	3640	12 K																																
	3641R	12 K																																
	3641	16 K																																
	3642R	16 K																																
	3642	24 K																																
	3643R	24 K																																
	3643	32 K																																
	3644R	32 K																																
	3644	32 K																																
	3644R	32 K																																
	3644	32 K																																
	3642AF	16 K	1 K	Z																														
	3643F	24 K																																
	3644F	32 K																																
	3644F	32 K																																
3657	3652	16 K	1 K	M	8-bit x 8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	TFP-80F, FP-80A, FP-80B	2.5 MHz/2.2 to 5.5 V 5.0 MHz/2.7 to 5.5 V								
	3653	24 K																																
	3654	32 K																																
	3655	40 K																																
	3656	48 K																																
	3657	60 K																																
	3657	60 K																																
	3657	60 K																																
3714	3712	16 K	384	M	-	5 (TimerA, B, C, D, E)	-	-	-	-	-	-	-	16 dig x 24 seg	-	-	-	-	9	12	-	4	-	-	DP-64S, FP-64A	2.1 MHz/2.7 to 5.5 V 4.2 MHz/4.0 to 5.5 V								
	3713	24 K																																
	3714	32 K																																
	3714	32 K																																
3724	3723	24 K	384	M	-	5 (TimerA, B, C, D, E)	-	-	-	-	1	-	-	-	-	-	-	-	-	16 dig x 28 seg	24	-	6	-	-	FP-80A, FP-80B	2.1 MHz/2.7 to 5.5 V 4.2 MHz/4.0 to 5.5 V							
	3724	32 K																																
	3724	32 K																																
	3725	40 K	640	M																														
	3726	48 K																																
	3726	48 K																																
	3726	48 K																																

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** : In Planning

group	Product No.	Memory			A/D converter	D/A converter	Timer							Serial interface						I/O port				Interrupt (source)	Debugging function	Other function																											
		ROM (bytes)	RAM (bytes)	ROM type			Resolution x channels	Resolution x channels	8 bit	16 bit	Input capture	Output compare		PWM output	Event counter					Watchdog timer	Clock synchronous/ Asynchronous shared	Clock synchronous only	I ² C bus						Synchronous serial communication unit/ special serial I/O	LCD	VFD	OSD	Input only	CMOS input/output	High current drive port	DTMF	External	On-board flash memory reprogramming	ROM correction	Package	Operating frequency/ Power Supply voltage												
3814	3812	16 K	512	M	8-bit x 12	-	2 (Timer A, G)	1 (Timer F)	1 (Timer G)	1 (Timer F)	-	-	-	2	-	2	40 seg x 4 com	-	-	-	13	71	-	-	13	-	-	-	-	FP-100A, FP-100B	2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V																						
	3812S																																																				
	3812U																																																				
	3813																																																				
	3813S	24 K					2 (Timer A, G)						1 (Timer F)																	-		-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	TFP-100B FP-100A, FP-100B
	3813U																																																				
	3814																																																				
	3814S																																																				
3814U	32 K																																																				
3834	3832S	16 K	1 K	M	8-bit x 12	-	4 (Timer A, B, C, G)	1 (Timer F)	1 (Timer G)	1 (Timer F)	-	-	1	2	-	-	40 seg x 4 com	-	-	-	13	71	-	-	13	-	-	-	-	TFP-100B, FP-100A, FP-100B																							
	3833	24 K																														Z																					
	3833S																																																				
	3833U																																																				
	3834	32 K	M																																																		
	3834																																																				
	3834S																																																				
	3834U																																																				
	3834U	40 K	M																																																		
	3835																																																				
	3835S																																																				
	3835U																																																				
	3836	48 K	M																																																		
	3836S																																																				
	3836U																																																				
	3837																																																				
3837	60 K	Z																																																			
3837S																																																					
3837U																																																					
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group	Product No.	Memory			A/D converter	D/A converter	Timer							Serial interface					I/O port				Interrupt (source)	Debugging function	Other function						
		ROM (bytes)	RAM (bytes)	ROM type			Resolution x channels	Resolution x channels	8 bit	16 bit	Input capture	Output compare		PWM output	Event counter				Watchdog timer	Clock synchronous/ Asynchronous shared	Clock synchronous only	I ² C bus						Synchronous serial communication unit/ special serial I/O	LCD	VFD	OSD
3854	3852	16 K	1 K	M	8-bit x 4		8 bit	16 bit	Input capture	Output compare	PWM output	Event counter	Watchdog timer	Clock synchronous/ Asynchronous shared	Clock synchronous only	I ² C bus	Synchronous serial communication unit/ special serial I/O	40 seg x 16 com, 40 seg x 8 com	VFD	OSD	5	24	10 mA x 8 (Max 80 mA)		12	On-board flash memory reprogramming		FP-144H, TFP-144	2.5 MHz/3.0 to 5.5 V 5.0 MHz/4.0 to 5.5 V		
	3853	24 K		F																											
	3854	32 K																													
	3854F	60 K																													
3857	3855	40 K		M		Yes	Yes	Yes	Yes	1 (14-bit PWM)	Yes (Timer B,C,F)		1				40 seg x 32 com, 56 seg x 16 com, 64 seg x 8 com			9	35	10 mA x 16 (Max 80 mA)	-	13	Yes		FP-144H, TFP-144	2.5 MHz/3.0 to 5.5 V 5.0 MHz/4.0 to 5.5 V			
	3856	48 K																											F		
	3857	60 K																													
	3857F																														
3877	3875	40 K	2 K	M	8-bit x 8	-	2 (Timer A,G)	1 (Timer F)	1 (Timer G)	1 (Timer F)	-		-	1	1	-	-	52 seg x 4 com	-		8	72	Yes	14		-	TFP-100B, FP-100A, FP-100B	2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V			
	3875U	60 K																										Z M Z	2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V		
	3876																												48 K	M	2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V
	3876U																														2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V
	3877																														2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V
	3877U																														2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V
	3877U																														2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V
3877N	3875N	40 K	M	Z																					-	TFP-100B, FP-100A, FP-100B	2.5 MHz/2.5 to 5.5 V 5.0 MHz/4.0 to 5.5 V				
	3876N	48 K																									2.5 MHz/2.5 to 5.5 V 5.0 MHz/4.0 to 5.5 V				
	3877N	60 K																									Z	2.5 MHz/2.5 to 5.5 V 5.0 MHz/4.0 to 5.5 V			
	3877N																											2.5 MHz/2.5 to 5.5 V 5.0 MHz/4.0 to 5.5 V			
3927	3924	32 K	1 K	M		8-bit x 4	7 (Timer A, B1, B2, B3, C, E, V)	2 (Timer X, Y)	1 (Timer X)	1 (Timer X)	1		1		2						12	56			13		TFP-80F, FP-80B	2.5 MHz/2.5 to 5.5 V 5.0 MHz/4.0 to 5.5 V			
	3925	40 K																										60 K	Z	2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V	
	3926	48 K																												2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V	
	3927	60 K																													
	3927																														
3947	3945	40 K	2 K	M			8-bit x 7	16-bit x 1	1 (Timer G)	1 (Timer F)	8			1	2						17	69		14		FP-100A	2.5 MHz/2.7 to 5.5 V 5.0 MHz/4.0 to 5.5 V				
	3946	48 K																										Z			
	3947	60 K																											768	M	
	3947																														
3977R	3974R	32 K	1 K	M	8-bit x 12	-	8-bit x 4	1 (Timer X)	-	-	3			2	-	2			Yes	12	46		8			FP-100A	5.0 MHz/4.0 to 5.5 V				
	3975R	40 K																										Z			
	3976R	48 K																											60 K		
	3977R	60 K																													
	3977R																														

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group	Product No.	Memory			Voltage detector		A/D converter	Timer						Watchdog timer	Serial interface		LCD	I/O port			Interrupt (source)	Debugging function		Package	Operating frequency/ Supply voltage																			
		ROM (bytes)	RAM (bytes)	ROM type	Power on-reset	Low voltage detector	Resolution x channels	8 bit	16 bit	Input capture	Output compare	PWM output	Event counter		Clock synchronous/ Asynchronous stated	Clock synchronous only		Input only	CMOS input/output	High current drive port	External	On-chip debugging	On-board flash memory reprogramming																					
3802	3800	8 K	512	M							10-bit PWM x 2		-				25 seg x 4 com	5	39	13	11	-	-	DP-64S, FP-64E, FP-64A, Chip	2 MHz /1.8 to 5.5 V 5 MHz /2.7 to 5.5 V 8 MHz /4.5 to 5.5 V																			
	3801	12 K																																										
	3802	16 K																								1 K	Z																	
	3802	1 K																																										
38002S*	38000S*	8 K	512	M							10-bit PWM x 2, AEC											using H8/38004F	-	FP-64K, FP-64A	2 MHz /1.8 to 3.6 V 5 MHz /2.7 to 3.6 V																			
	38001S*	12 K																																										
	38002S*	16 K																																										
	38002S*	16 K																																										
38004	38000	8 K	512	M							10-bit PWM x 2	Timer F, AEC								11	Yes (Flash version only)	Yes (Flash version only)	FP-64E, FP-64A, Chip	Flash Version 2 MHz/ 2.2 to 3.6 V 5 MHz/2.7 to 3.6 V Mask ROM Version 2 MHz/1.8 to 3.6 V 5 MHz/2.7 to 3.6 V																				
	38001	12 K																																										
	38002	16 K																																										
	38002F	16 K																																										
	38003	24 K																																										
	38004	32 K																																										
	38004F	32 K																																										
38004F	32 K																																											
38104*	38100*	8 K	512	M	Yes	Yes					10-bit PWM x 2, AEC										11	Yes (Flash version only)	Yes (Flash version only)	FP-64E, FP-64A	10 MHz /2.7 to 5.5 V																			
	38101*	12 K																																										
	38102*	16 K																																										
	38102F*	16 K																																										
	38103*	24 K																																										
	38104*	32 K																																										
	38104F*	32 K																																										
38104F*	32 K																																											
38024	38020	8 K	512	M							10-bit PWM x 2												TFP-80C, FP-80A, FP-80B, Chip	2 MHz/1.8 to 5.5 V 5 MHz/2.7 to 5.5 V 8 MHz/4.5 to 5.5 V																				
	38021	12 K																																										
	38022	16 K																																										
	38023	24 K																																										
	38024	32 K																																										
	38024	32 K																																										
38024	32 K																																											
38024R	38024RF	32 K	1 K	F	-	-	10-bit x 8	Timer A, Timer C, Timer G		Timer F	10-bit PWM x 2											Yes (Flash version only)	Yes (Flash version only)	TLP-85V, TFP-80C, FP-80A, chip	5 MHz /2.7 to 3.6 V																			
38024R	38024RF	32 K	1 K	F	-	-																																						
38024S	38020S	8 K	512	M																																							2.7 to 5.5 V/8 MHz	
38024S	38021S	12 K																																										
38024S	38022S	16 K																																										
38024S	38023S	24 K																																										
38024S	38024S	32 K																																										
38124*	38120*	8 K	512	M	Yes	Yes																									10-bit PWM x 2, AEC	Timer C, Timer F, AEC								13	Yes (Flash version only)	Yes (Flash version only)	TFP-80C, FP-80A	10 MHz /2.7 to 5.5 V
	38121*	12 K																																										
	38122*	16 K																																										
	38122F*	16 K																																										
	38123*	24 K																																										
	38124*	32 K																																										
	38124F*	32 K																																										
38327**	38322**	16 K	1 K	M								14-bit PWM x 1											Yes (Flash version only)	Yes (Flash version only)	TFP-80C, FP-80A, chip	2.7 to 5.5 V/8 MHz																		
	38323**	24 K																																										
	38324**	32 K																																										
	38324F**	32 K																																										
	38325**	40 K																																										
	38326**	48 K																																										
	38327**	60 K																																										
38327F**	60 K																																											
3827S	3824S	32 K	2 K	M																				TFP-80C, FP-80A, FP-80B, chip	2 MHz /1.8 to 3.6 V 5 MHz /2.7 to 3.6 V																			
	3825S	40 K																																										
	3826S	48 K																																										
	3827S	60 K																																										
	3827S	60 K																																										
3827R	3822R	16 K	1 K	M																					2 MHz /1.8 to 5.5 V 5 MHz /2.7 to 5.5 V 8 MHz /4.5 to 5.5 V																			
	3823R	24 K																																										
	3824R	32 K																																										
	3825R	40 K																																										
	3826R	48 K																																										
	3827R	60 K																																										
	3827R	60 K																																										

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*: New product
 **: Under development
 ***: In planning

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** : Under development

s	Other		

Series	Group	Type No.	Memory				CPU	Clock				Voltage Detection		A/D Converter	Timer						Serial Interface		I/O Port				Interrupts (Sources)	Other Functions								
			ROM (Bytes)	RAM (Bytes)	ROM Type	Program Security	Basic Instructions	Minimum Instruction Execution Time (ns)	Clock Generation Circuit	Subdock	On-Chip Oscillator	Frequency Divider	Power Save	Power-On Reset(POR)	LVD (Low Voltage Detection)	Resolution X Channels	8 bit	10 bit	16 bit	Prescaler			PWM Output	Event Counter	Clock Synchronous Only	LCD	Input Only (Numbers)	CMOS Output Only (Numbers)			CMOS I/O (Numbers)	N-channel Open Drain Port (Numbers)	High Current Drive Port	Pull-up Resistor	External	Others
720	4282	M34282M1-XXXGP	1024	48	68	800 (@4 MHz)	1 circuit (Ceramic resonator)	-	-	1/n (n = 1, 8)	RAM backup	Yes	detection circuit x 1	-	Timer 1 × 1, Timer 2 × 1	-	-	-	-	-	Yes	-	-	1	1	-	Pch open drain port ×14	-	Pull-down resistance × 11	-	Carrier wave generation	20-pin SSOP	1.8 to 3.6 V	-20 to 85		
		M34282M2-XXXGP	2048	64																															M	-
		M34282E2GP		O																															-	
	4283	M34283G2-XXXGP	2048	64																															Q2	Yes
		M34283G2GP																																		

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