

# Here is where you will find MCUs that perfectly match specific needs: the H8S/H8SX lineup.



## The 32-bit H8SX Family features high performance provided by the CISC architecture.

These MCUs take the maximum possible advantage of the merits of the CISC architecture: good code efficiency, low power, ability to make the most effective use of flash memory performance.

These MCUs achieve outstanding benchmark performance in automotive, digital home electronics, PC peripherals, and other application areas.

- Internal bus width: 32 bits
- Basic instruction execution states: 1 state
- Number of instructions: 87
- Maximum operating frequency: 50 MHz

★ : Under development

### H8SX/1700\*

Internal 32-bit multiplier/divider unit

|              |
|--------------|
| 5.0V @ 80MHz |
| CAN          |

Featuring 80 MHz operation at 5V, these MCUs provide high reliability for automotive and industrial applications. Built-in special communication functions (CAN bus)

### H8SX/1600

Internal 32-bit multiplier/divider unit

|              |                |        |
|--------------|----------------|--------|
| 3.3V @ 50MHz | Low Power      | ΔΣ/A/D |
| USB          | High-speed SCI |        |

Featuring 50 MHz operation at 3.3V, these MCUs cover a wide range of applications from ASSP to general-purpose areas. They provide a rich set of basic peripheral functions. Built-in special communication functions (including USB and high-speed UART)

### H8SX/1500

Internal 32-bit multiplier/divider unit

|              |                          |
|--------------|--------------------------|
| 5.0V @ 40MHz | High-speed A/D converter |
| CAN          | Sound Generator          |

Featuring 40 MHz operation at 5V, these MCUs provide high reliability for automotive and industrial applications. Built-in special communication functions (CAN bus and synchronous serial communications units) Improved peripheral functions (including timer, A/D converter, and sound generator units)

CPU upwards compatibility.

### H8S/2600

Internal 16-bit multiplier

|              |                      |
|--------------|----------------------|
| 5.0V @ 20MHz | I <sup>2</sup> C-Bus |
| 3.3V @ 33MHz | CAN                  |

Lineup of high-reliability products for automotive applications. Built-in special communication functions (CAN bus and I<sup>2</sup>C bus units) Extensive set of built-in peripheral functions (including 14-bit PWM timer and LCDC units)

High performance  
High functionality

### H8S/2500

Built-in 32 kHz oscillator, low power

|              |                            |       |
|--------------|----------------------------|-------|
| 5.0V @ 26MHz | Multi-voltage power supply | IEBus |
| 3.3V @ 26MHz | CAN                        |       |

Extensive set of low-power modes. Support for both 3V and 5V interfaces. Built-in special communication functions (including IEBus and CAN Bus) IEBus is a trademark of NEC Corporation.

### H8S/2400

Internal 16-bit multiplier

|               |             |                      |
|---------------|-------------|----------------------|
| 5.0V @ 33MHz  | 5V tolerant | I <sup>2</sup> C-Bus |
| 3.3V @ 34MHz* | USB*        |                      |

Enhanced I/F, USB, Ether PC/General

### H8S/2300

Standard group in the H8S series

|              |           |                      |
|--------------|-----------|----------------------|
| 5.0V @ 20MHz | SDRAM-I/F | I <sup>2</sup> C-Bus |
| 3.3V @ 35MHz | EXDMAC    |                      |

Provides a rich set of built-in basic peripheral functions. Extensive set of variations (from 100 to 144 pins). High-speed operation (Maximum operating frequency: 35 MHz)

### H8S/2200

Built-in 32 kHz oscillator, low-voltage operation

|              |       |                      |
|--------------|-------|----------------------|
| 5.0V @ 20MHz | IEBus | I <sup>2</sup> C-Bus |
| 3.3V @ 35MHz | USB   |                      |

Low-voltage operation. Rich set of low-power modes. Special communication functions (USB, IEBus, I<sup>2</sup>C bus, and high-speed UART) IEBus is a trademark of NEC Corporation.

### H8S/2100

Inherits the peripheral IP of the H8/300 Series.

|              |         |         |
|--------------|---------|---------|
| 5.0V @ 20MHz | ISA-Bus | LPC-Bus |
| 3.0V @ 33MHz | USB     |         |

Provides the standard PC interfaces (including I<sup>2</sup>C bus, LPC bus, ISA bus, and USB) Inherits the peripheral functionality of the H8/300 Series.

### H8S/Tiny\*

Single chip and low pin count versions of the H8S.

|              |
|--------------|
| 5.0V @ 20MHz |
| 3.0V @ 20MHz |

Lineup of 64 and 80-pin products. Rich set of peripheral functions (multifunction timers, I<sup>2</sup>C bus, and SCI)

Slimmed-down functionality  
Lower pin counts

- Internal bus width: 16 bits
- Basic instruction execution states: 2 states
- Number of instructions: 62
- Maximum operating frequency: 25 MHz

### H8/300H

Standard model in the H8 Series

### H8/Tiny

Single chip and low pin count H8

### H8/300

The standard for 8-bit CPUs

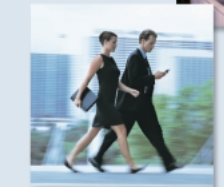
### H8/300L

Built-in 32 kHz oscillator and LCD controller/driver units



## The H8 Family is the standard for CISC architecture MCUs

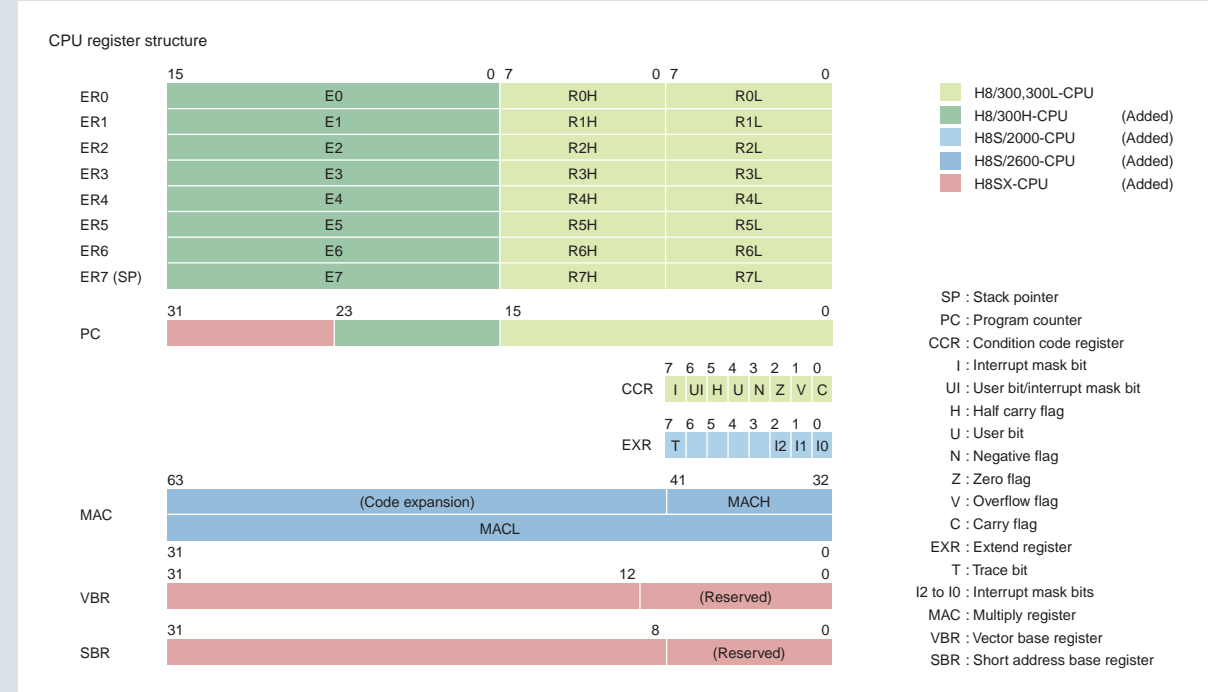
- Internal bus width: 8 bits
- Basic instruction execution states: 2 states
- Number of instructions: 57
- Maximum operating frequency: 20 MHz



# Inheriting the respected H8 architecture and improving processing ability and speed.

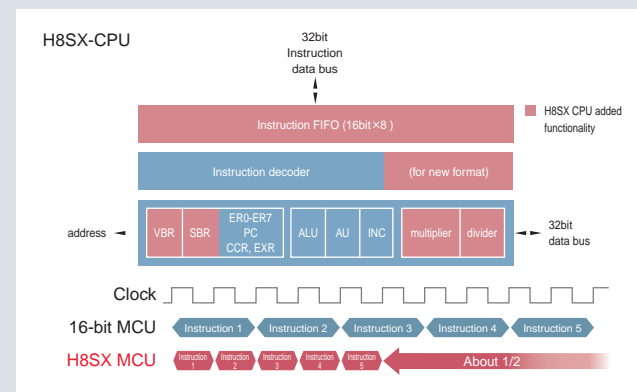
## High-performance CISC architecture

Based on core development focused on compatibility, the H8S Family and H8SX Family also feature upward compatibility in register layout and functionality. This makes reuse of software resources easy. Furthermore, functions that improve ease of use are added to each family.



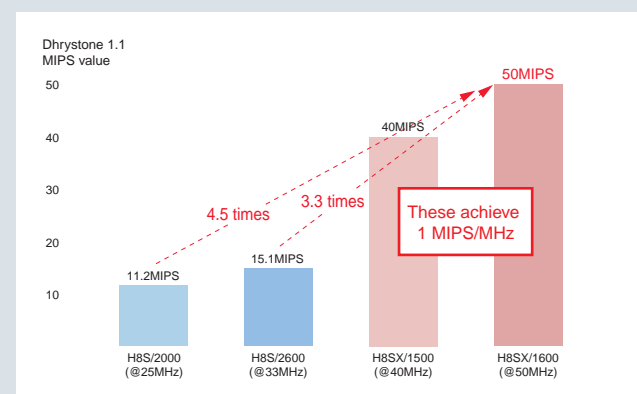
## High-speed 32-bit processing for high performance

These CPUs use a 2-stage pipelined processing plus instruction FIFO structure to achieve high-speed processing at one instruction per clock cycle. Furthermore, by making the internal CPU bus 32 bits wide, the instruction fetch time is reduced significantly from earlier 16-bit MCUs.



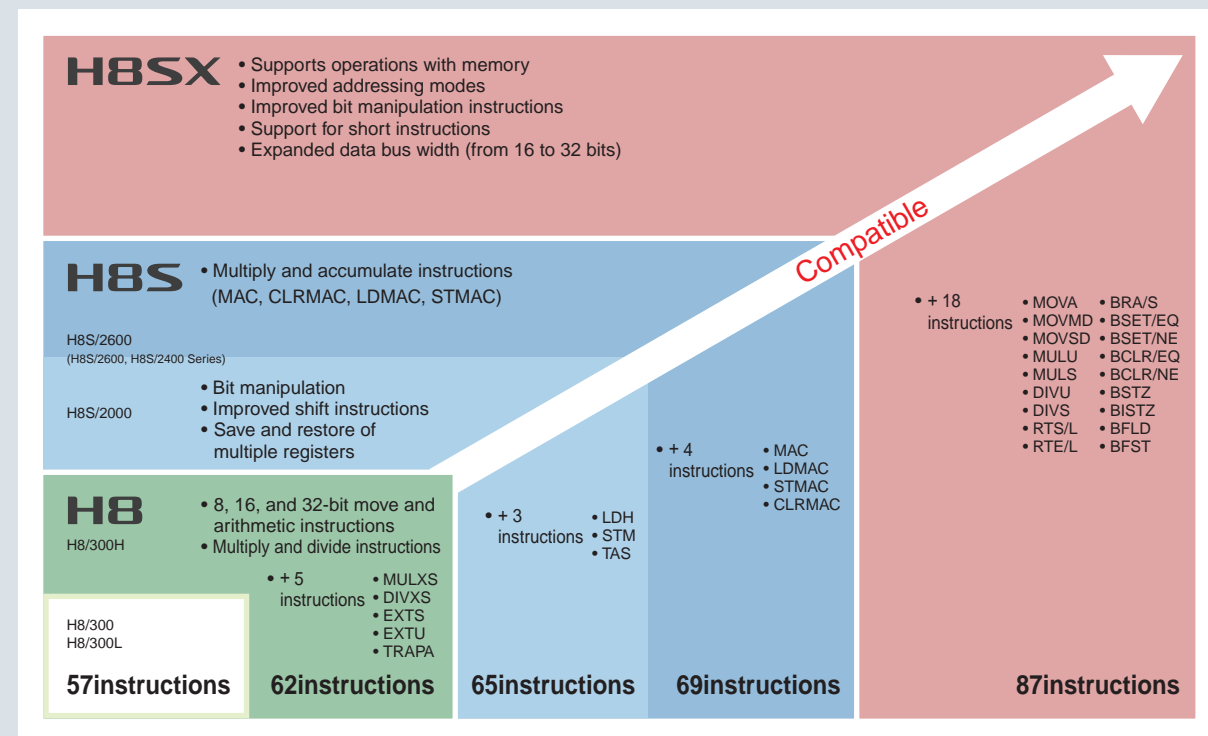
## The H8SX inherits the whole H8S instruction set.

In addition to inheriting the whole H8S instruction set, which is ideal for embedded applications, the H8SX adds new instructions and new addressing modes to improve ease of use even further. Arithmetic performance is improved greatly by the provision of 32-bit multiply and divide instructions.



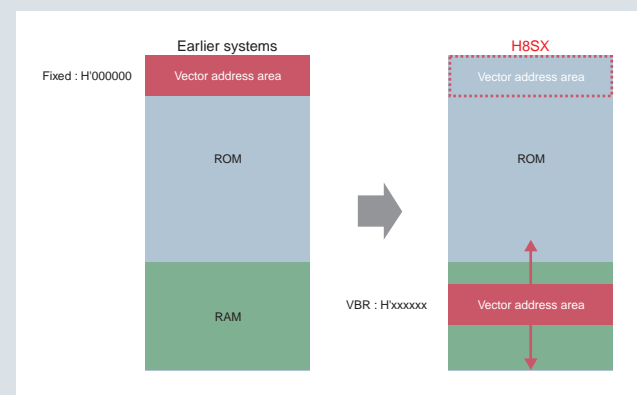
## Assuring compatibility at the object level

Firmware developed for the H8 CPU can be used on the 16-bit H8S CPU and the 32-bit H8SX CPU as well.



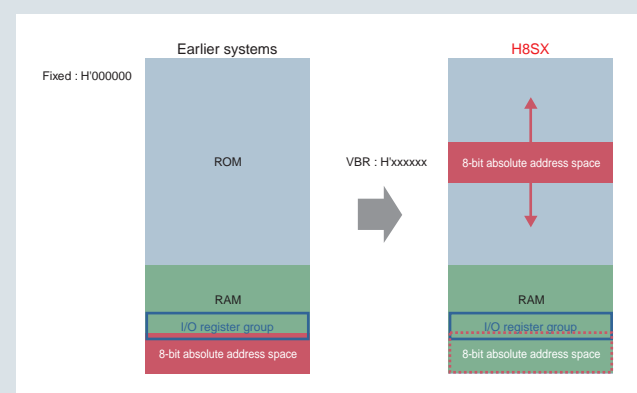
## VBR reduces the interrupt response time significantly.

These MCUs feature a VBR (vector base register) function that can set up an arbitrary address in a vector table. By allocating the vector in RAM, even ROM-less versions can perform interrupt handling quickly.



## SBR creates faster programs.

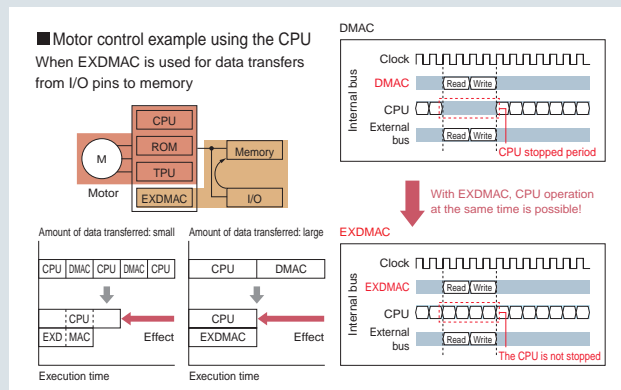
The SBR (short address base register) function makes it possible to set up a start address for an 8-bit absolute address space at an arbitrary location. Fast and efficient programs can be created by changing the start address of the 8-bit absolute address space.



# A rich set of advanced functions that can completely support a wide range of applications.

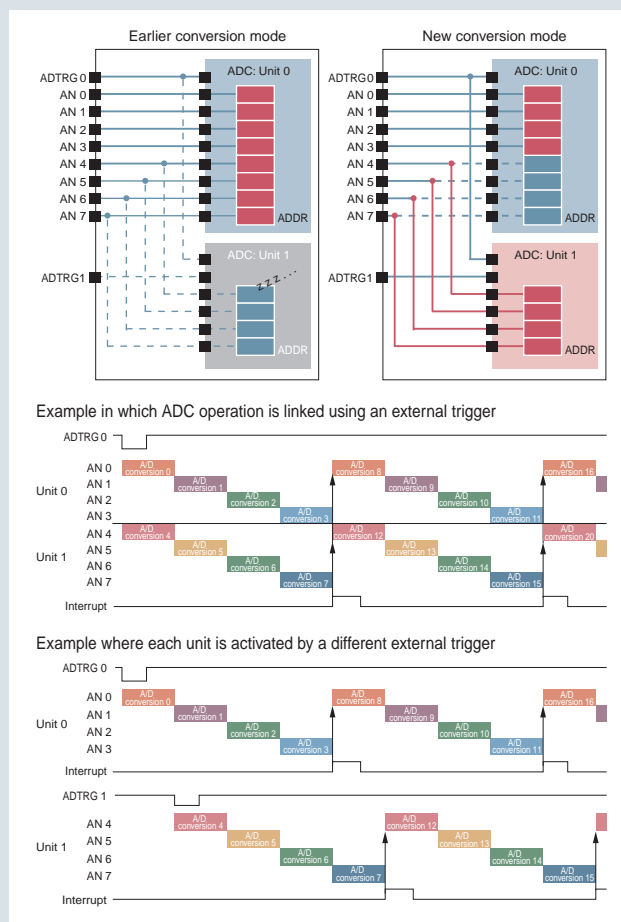
## EXDMAC makes high-speed data transfers possible.

These MCUs include the EXDMAC direct memory access controller that proves its worth in high-speed transfers of data between two external data busses. System performance increases significantly since data is transferred without stopping CPU operation.



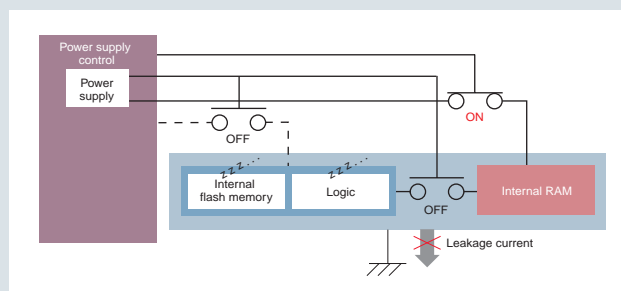
## New A/D conversion mode that doubles conversion speed.

Conversion speed is effectively doubled since the units can convert at the same time, making high-speed conversion possible. (Units 0 and 1 can operate independently from the same external trigger (ADTRG0).) It is also possible to activate the units independently from different external triggers.



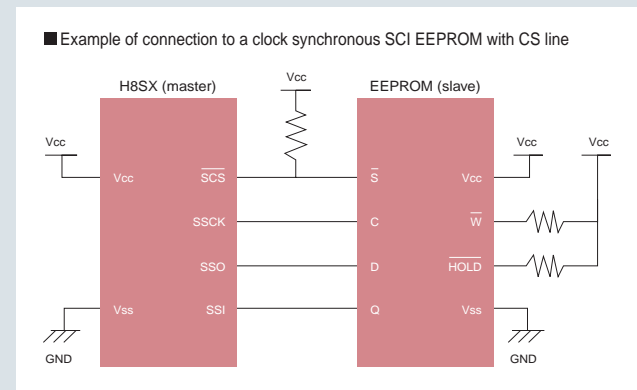
## Deep software standby mode

These MCUs provide deep software standby mode, which can suppress standby mode power consumption even further. Power to unneeded modules can be cut with register settings and leakage current can be reduced greatly.



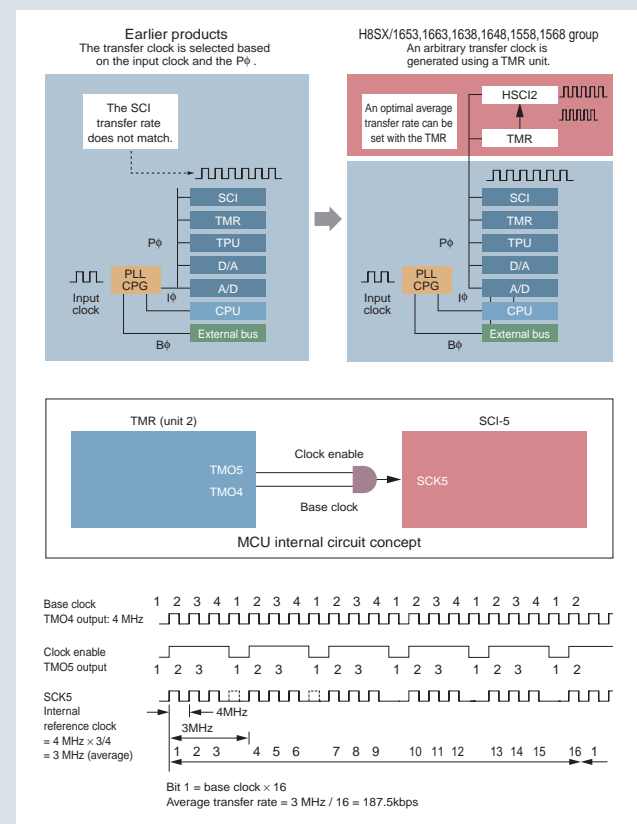
## Synchronous serial communications unit that provides high-speed synchronous serial communications

These MCU provide a synchronous serial communications unit that supports both a clock synchronous communications mode and a 4-wire bus communications mode. This unit supports communications with a wide range of devices that have a clock synchronous CSI unit with CS signal by providing clock polarity reversal, LSB/MSB first selection, conflict error detection and other functions.



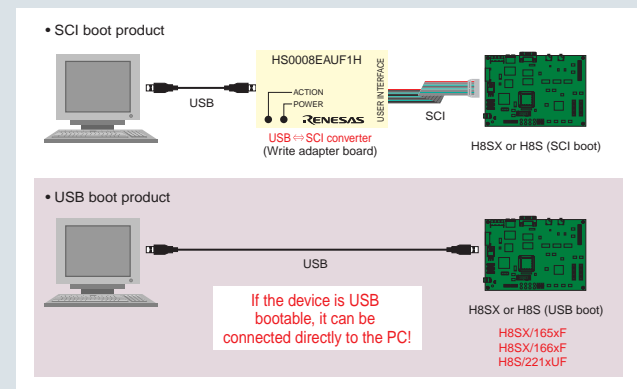
## HSCI2 allows selection of an optimal transfer clock.

HSCI2 (high-speed serial communications interface 2) allows the selection of an optimal SCI transfer clock without depending on the frequency of an oscillator element. It generates the optimal average transfer rate clock source required for the SCI from the MCU's internal 8-bit timer (TMR unit). This obviates the need to select an oscillator element constrained by the SCI transfer clock, and allows an oscillator element optimal for the system to be selected.



## USB boot function that can write to a connected flash memory.

The MCU's internal flash memory can be written directly from a PC using the USB boot function. Since this is a direct USB connection, high-speed writing is possible. Furthermore, on-site maintenance and other operations are quite and easy since no USB/SCI converter or other external circuits are required.





# H8SX /1600

## 3V series that features a built-in 32-bit multiplier/divider.

Extensive lineup with operating frequencies up to 50 MHz and internal flash memory capacities from 256 KB to 1024 KB.

ROMless products support onboard writing to external flash ROM.\*

Built-in functions include a high-precision 16-bit  $\Delta\Sigma$ A/D converter and a high-speed 10-bit successive approximation A/D converter.

\*. The user must provide write and erase programs for the specifications of the flash ROM actually used.

### Application Areas

PC peripherals and OA equipment (PC, storage devices, printers, and scanners), consumer equipment (digital home electronics), and industrial equipment (FA equipment, POS peripherals, meters, test equipment, and games).

### Features of the H8SX/1600 Series

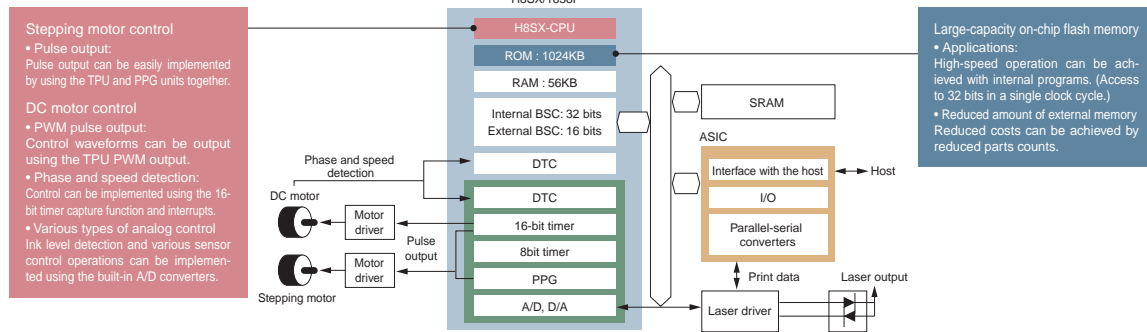
- Flash/ROM capacities from 256/24 KB to 1024/56 KB
- Improved peripheral functions, including dual TPU/PPG units, and high-speed SCI/I<sup>2</sup>C bus units
- Up to three high-speed 10-bit A/D converter units support simultaneous, independent, and continuous conversion.
- Built-in high-precision 16-bit  $\Delta\Sigma$  A/D converter
- Support for a wide variety of communication formats including USB 2.0 (full speed) and I<sup>2</sup>C bus.
- Built-in EXDMAC can operate the internal and external busses independently.
- New standby mode added. Supports even finer-grained control of the power supply and provides standby mode operation with low power consumption.
- Available in a variety of miniature packages including BP-176V (13 x 13 mm) and TLP-145V (9 x 9 mm).

■ H8SX/1648F Block Diagram

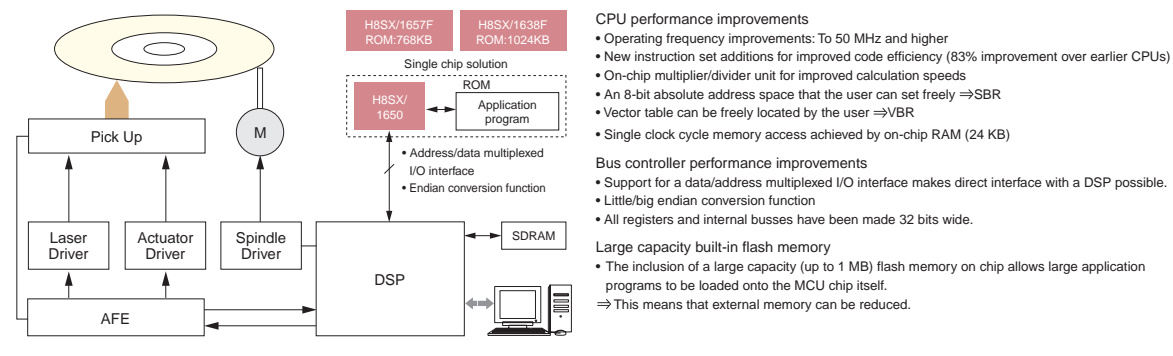
| H8SX-CPU | Clock oscillator | ROM  | RAM                             |
|----------|------------------|--|---------------------------------|
|          |                  | BSC  | INTC                            |
|          |                  | Multiplier and divider                           | TPU (16-bit timer): 12 channels |
|          |                  | UBC  | TPU (16-bit timer): 8 channels  |
|          |                  | DMAC   | WDT                             |
|          |                  | DTC  | I <sup>2</sup> C-Bus: 4ch       |
|          |                  | SCI: 7ch   | PPG: 2Unit                      |
|          |                  | High-speed A/D converters: three 4-channel units | PLL                             |
|          |                  | D/A 8bit: 2ch                                    | I/O port                        |
|          |                  | H-UDI  |                                 |

Special functions

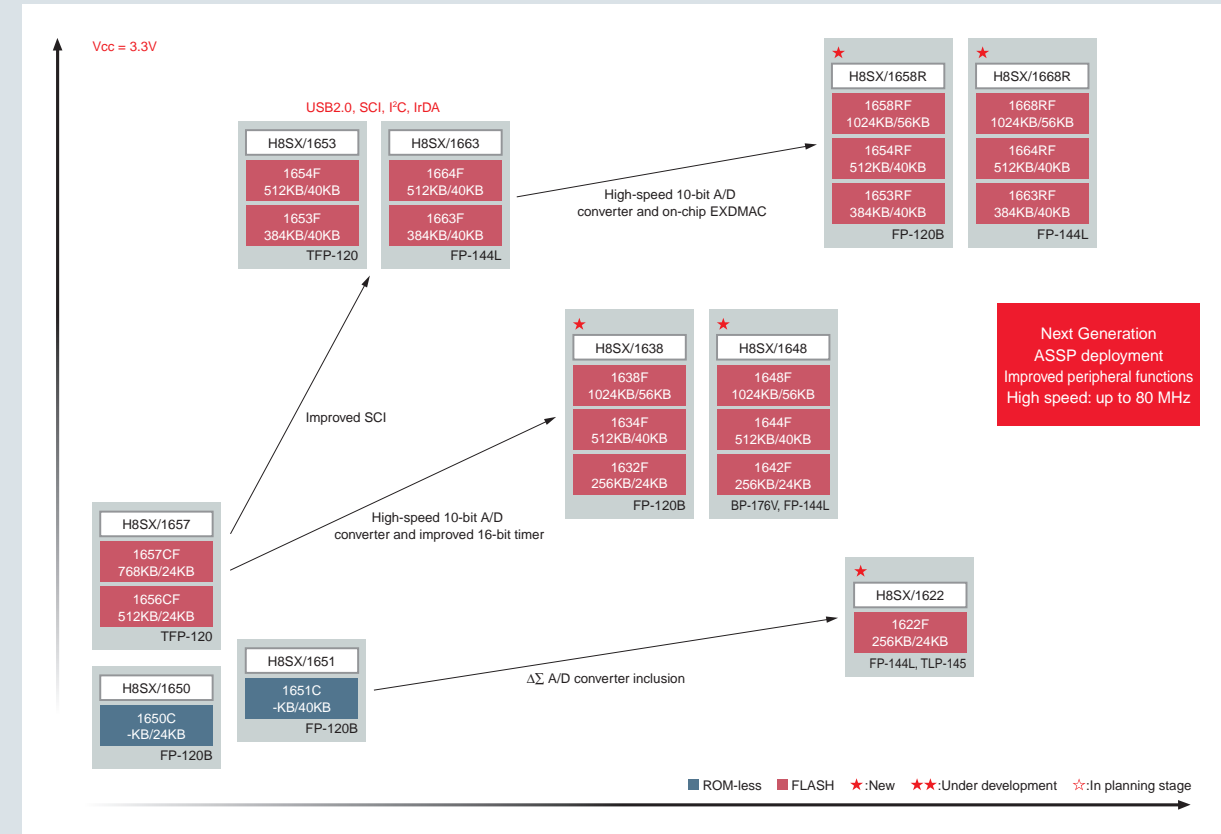
### ■ Laser Printer/Plain Paper Copier Engine System Structure Example



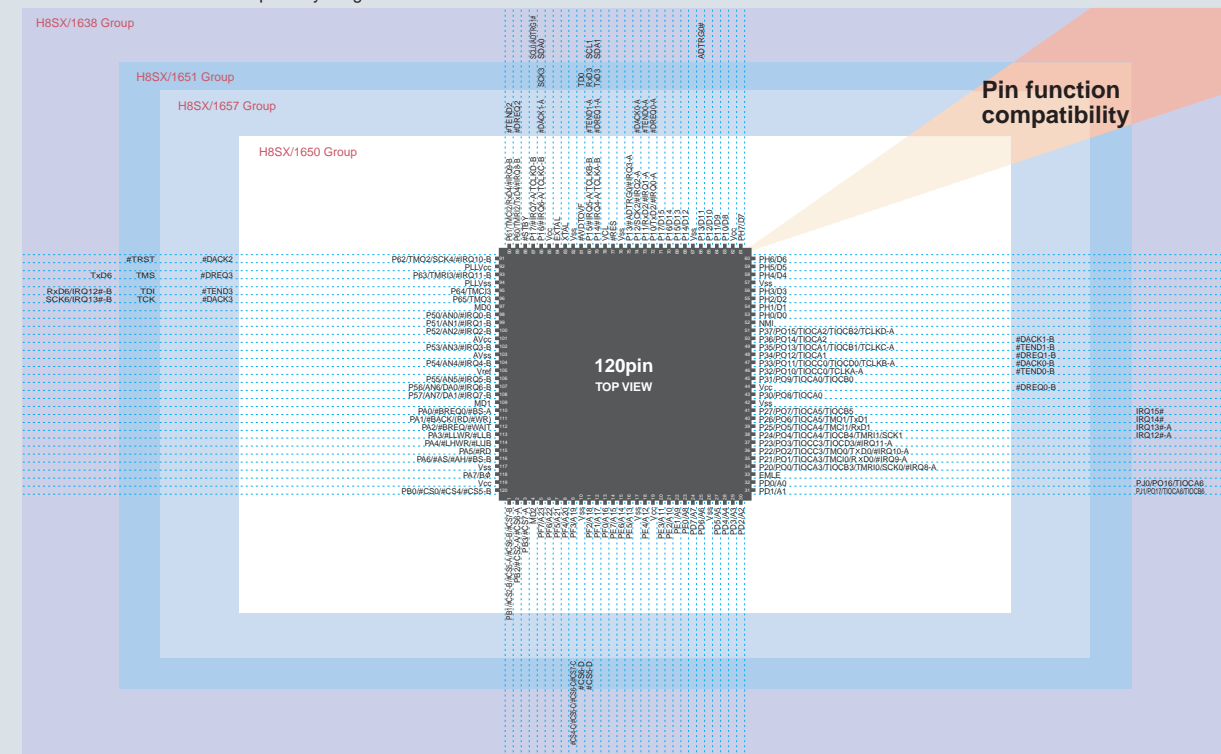
### ■ Optical Disc Drive System Structure Example



■ H8SX/1600 Series Product Development Chart



■ H8SX/1600 Series Pin Compatibility Diagram



# H8SX /1500

## 5V series that features a built-in 32-bit multiplier/divider.

Lineup features operating frequencies up to 48 MHz and ASSP products for automotive applications.

This is an extensive line with, in addition to a lineup of models with 256 KB to 1024 KB of on-chip flash memory, high quality grade versions for dashboard and airbag systems.

### Application Areas

Industrial equipment (FA control, HVAC, and vending machines) and automotive applications (dashboard and airbag systems).

### Features of the H8SX/1500 Series

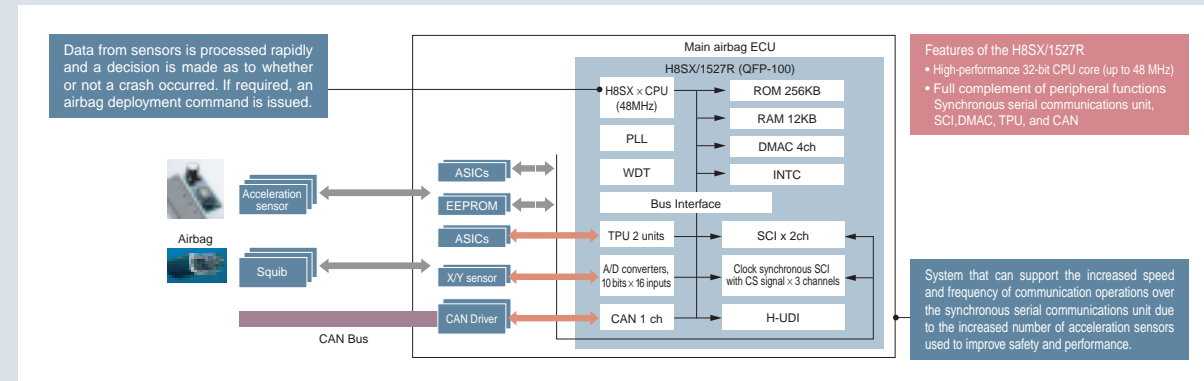
- Built-in PWM modules that provide 16 10-bit channels and 12 16-bit channels
- Extensive set of built-in communications functions, including synchronous serial communications unit, I<sup>2</sup>C bus, and CAN Bus.
- Sound generator function can produce sine waves in the range 31 Hz to 20 kHz with an accuracy of within 1%.
- Multi-signal pulse control can be implemented using up to two 16-bit PPG units and up to two 16-bit TPU units.
- Up to three high-speed 10-bit A/D converter units support simultaneous, independent, and continuous conversion.
- New standby mode added. Supports even finer-grained control of the power supply and provides standby mode operation with low power consumption.

### H8SX/1544F Block Diagram

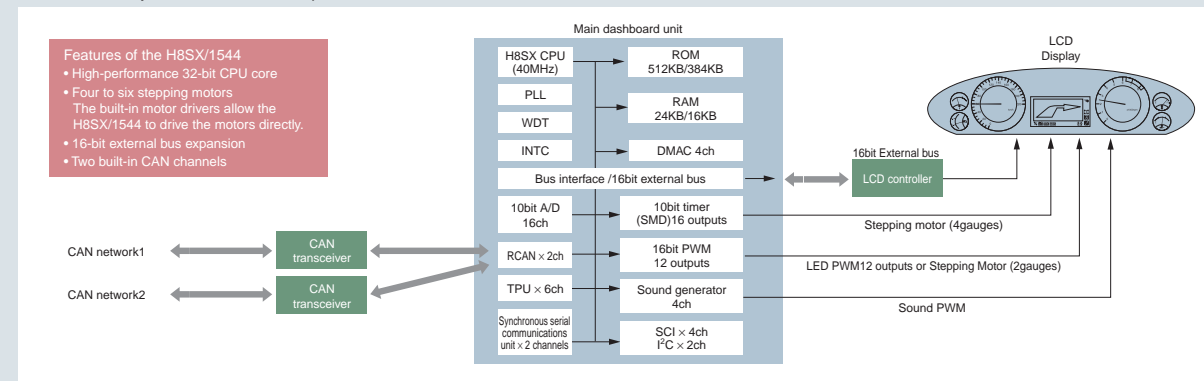
|                        |                  |  |     |
|------------------------|------------------|--|-----|
| H8SX-CPU               | Clock oscillator | ROM  | RAM |
| BSC                    |                  | INTC   |     |
| Multiplier and divider |                  | TPU (16-bit timer): 12 channels                    |     |
| Sound Generator: 4ch   |                  | 16-bit PWM timer: 3 channels                       |     |
| DMAC                   |                  | 10-bit PWM timer: 2 channels                       |     |
| RCAN: 2ch              |                  | WDT  |     |
| SCI: 4ch               |                  | I <sup>2</sup> C-Bus: 2ch                          |     |
| A/D 10bit: 16ch        |                  | Synchronous serial communications unit: 2 channels |     |
| D/A 8bit: 2ch          |                  | PLL  |     |
|                        |                  | I/O port   |     |

Special functions

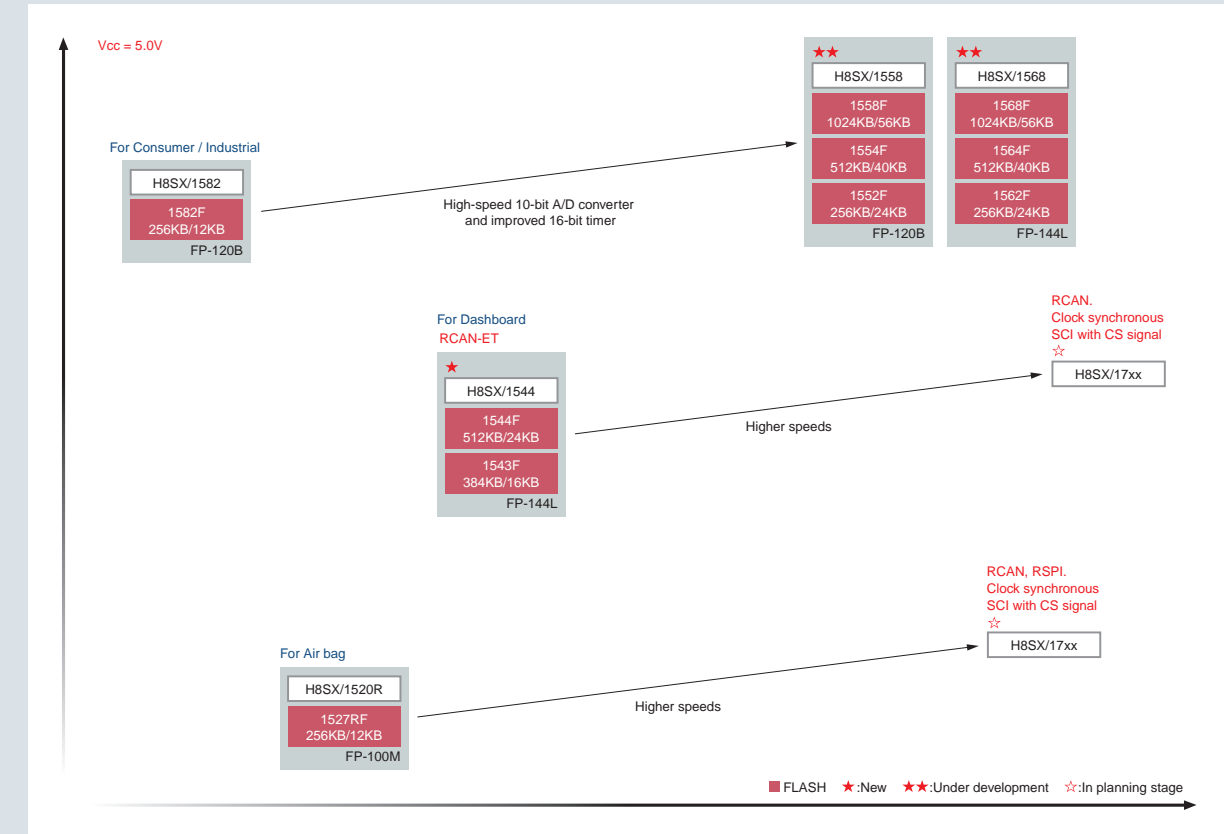
### Airbag System Structure Example



### Dashboard System Structure Example

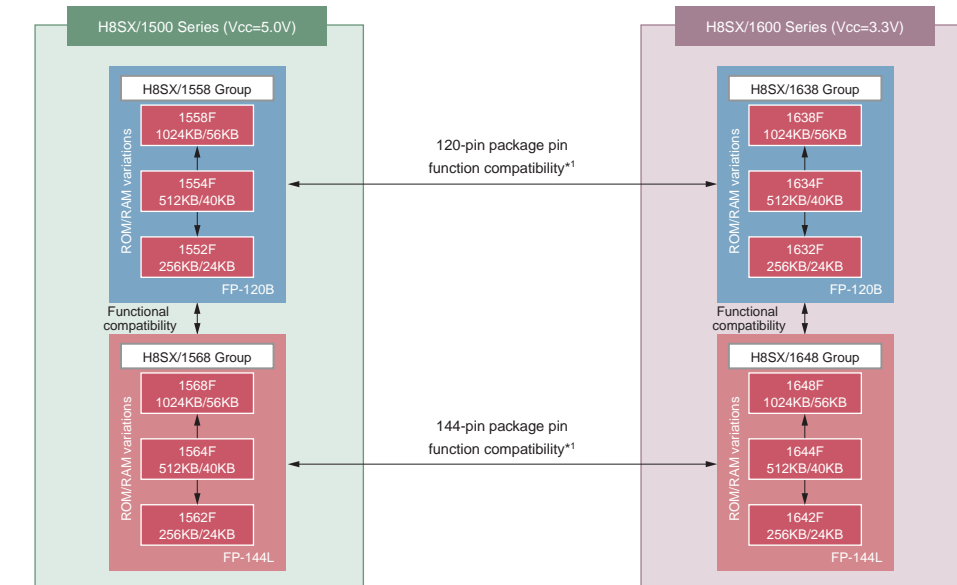


### H8SX/1500 Series Product Development Chart



### Compatibility with the Vcc = 3.3V H8SX/1600 Series

Even though the operating voltages differ between the H8SX/1500 Series and the H8SX/1600 Series, Renesas has emphasized pin compatibility when developing the product lines. Both the H8SX/1558 group and the H8SX/1638 group, and the H8SX/1568 group and the group, are pin function compatible\*1 products. If, in the future, a Renesas customer changes from a Vcc = 5.0 V to a Vcc = 3.3V power supply system, Renesas provides a product lineup that allows the switch to the H8SX/1638 group or H8SX/1668 group to be made with confidence.



\*1: The H8SX/1558 group and the H8SX/1568 group do not support external expansion. Also, their operating frequency range is 8 to 40 MHz.

# H8S/2600

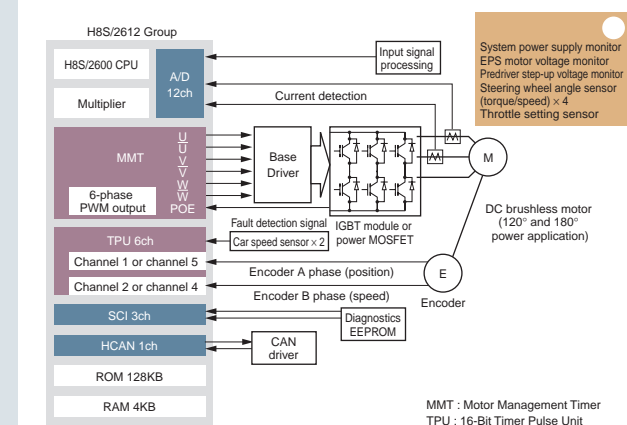
## High-end H8S Family series that features a built-in 16-bit multiplier.

Product lineup includes wide temperature range high-reliability products (-40 to +105°C, -40 to +125°C) for automotive applications. This series features not only special communications functions (I<sup>2</sup>C bus, CAN Bus, and synchronous serial communications units) but also special peripheral functions (including motor control PWM output and LCD controller units).

### Application Areas

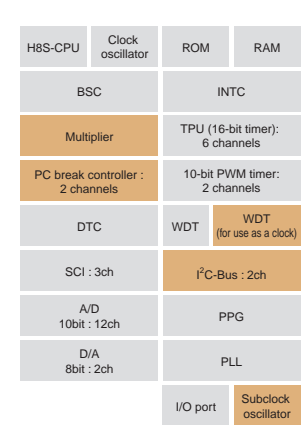
PC peripherals and OA equipment (printers), industrial equipment (FA control and inverter control), and automotive applications (dashboard, car air conditioning, gateways, EPS, ABS, and body control).

### ■ EPS System Structure Example



- 20 MHz, 5V operation
- Built-in multiplier
- Versions with 80, 100, 120, and 144 pins available.

### ■ H8S/2607 Group Block Diagram (under development)



Special functions

# H8S/2500

## Low-power 5V series that features a 32 kHz oscillator inherited from the H8S/2200 series.

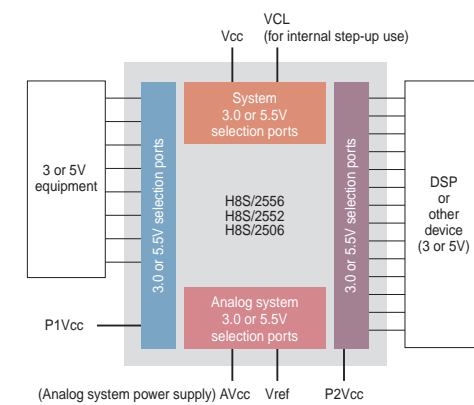
These MCUs include special communications functions (I<sup>2</sup>C bus, IEBus, and CAN bus) and support both 5V interface and 3V interface systems with a port pin power supply.

This series can also support 5V/3V mixed systems by supplying different port pin power supply voltages.

### Application Areas

Industrial equipment (FA control and inverter control) and automotive applications (car audio).

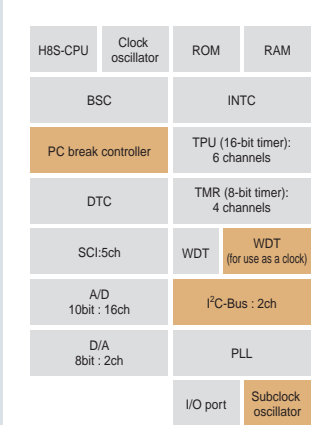
### ■ Pin Voltage Selection



\*: ICE (E6000) is supported with the HS2556EP162H.

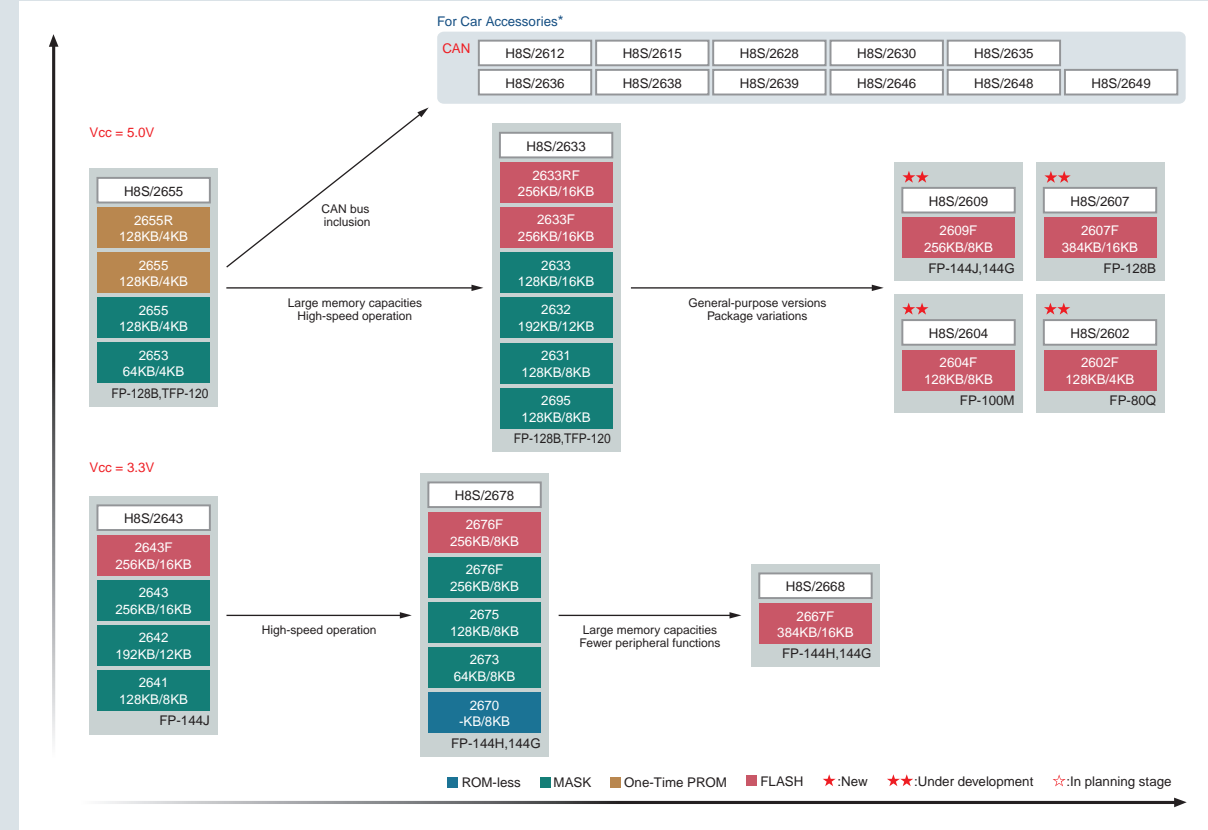
- Built-in 512 KB flash memory
- Built-in I<sup>2</sup>C bus interface
- A pin voltage of 3.0 or 5.5V can be selected.

### ■ H8S/2506F Block Diagram



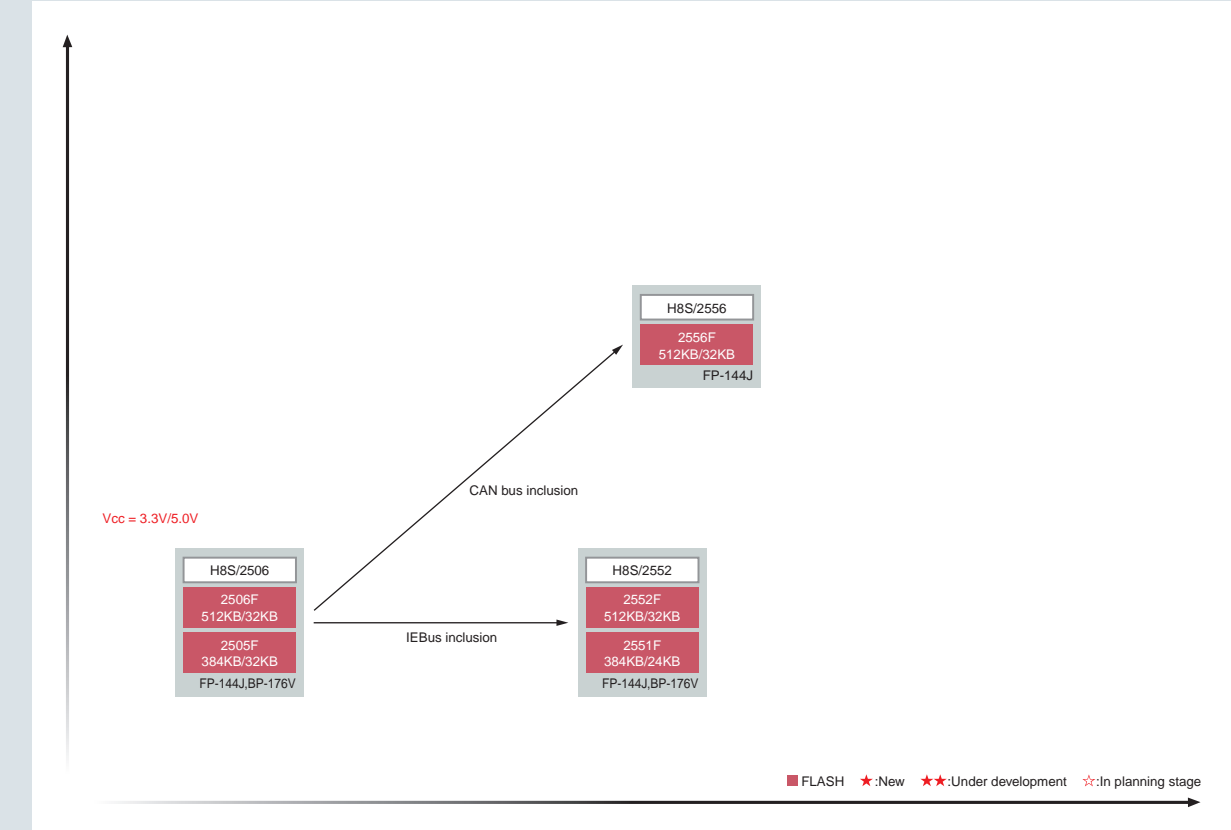
Special functions

### ■ H8S/2600 Series Product Development Chart



\*: See the Renesas Microcomputer Automotive LAN Microcomputer Catalog for details.

### ■ H8S/2500 Series Product Development Chart



# H8S /2400

# H8S /2300

## New H8S series that provides an extensive set of peripheral functions and a 16-bit multiplier.

Adopts the CPU from the H8S/2600 H8S Family high-end model for powerful arithmetic processing.

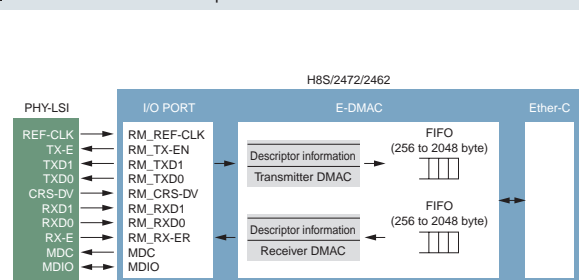
New models with built-in USB and Ethernet functions are under development.

This new series features low-voltage operation (3.3V@34 MHz) and a rich set of low-power modes.

### Application Areas

PC peripherals and OA equipment (POS terminals, printers, and USB equipment) and industrial equipment (card readers and wireless equipment)

### PHY LSI Connection Example



- Conforms to the Ethernet/IEEE 802.3 MAC layer (Media Access Control) standards.
- Supports both 10 Mbps and 100 Mbps transfers.
- Supports both full and half-duplex modes.
- Supports the IEEE 802.3u standard RMII (Reduced Media Independent Interface).
- Magic packet detection and Wake-On-LAN (WOL) signal output
- Connection to a physical layer LSI (PHY LSI) makes Ethernet/IEEE 802.3 transmission/reception possible.

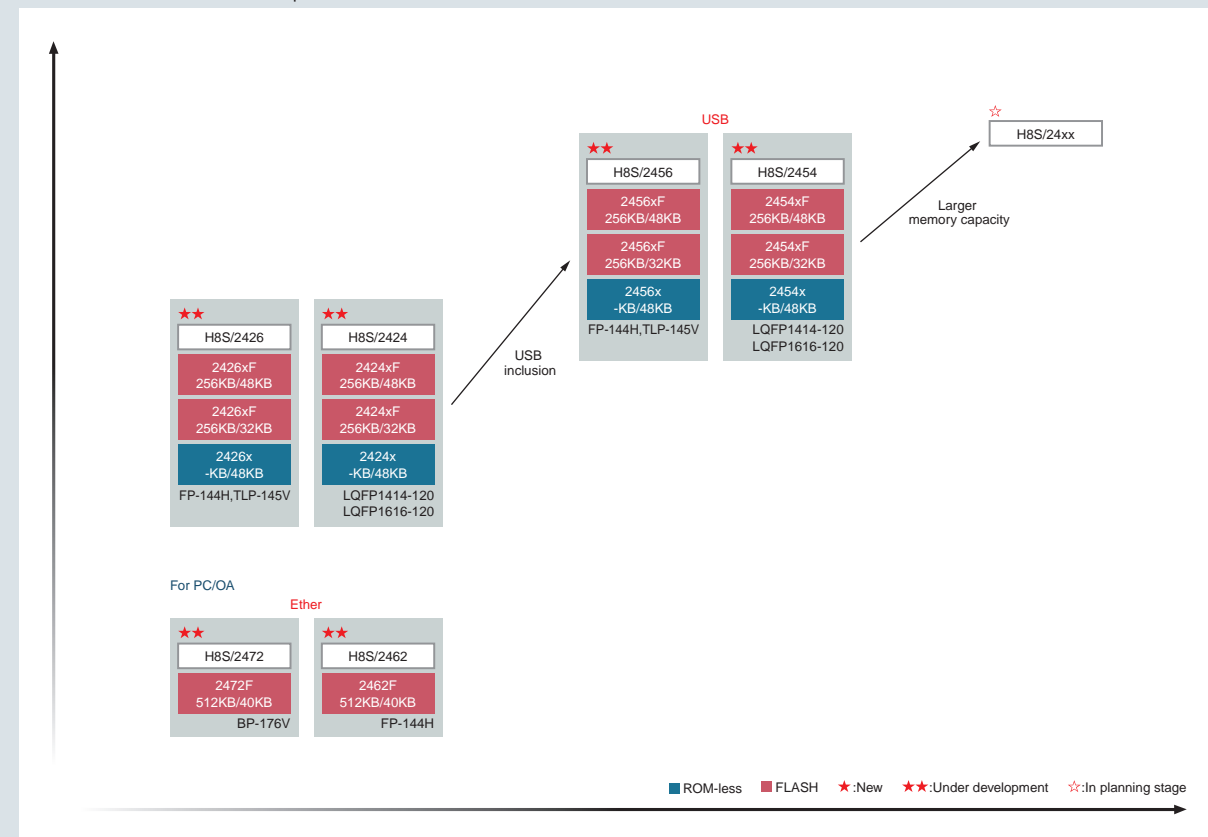
- Built-in multiplier
- Built-in CRC circuit
- Improved communications functions
- USB
- EtherC
- I<sup>2</sup>C bus: 6 channels
- Synchronous serial communications unit: 1 channel
- SCI with FIFO: 1 channel
- Miniature package
- BP-176V (13mm□)

### H8S/2472 Group Block Diagram (under development)

|   |                  |                                 |          |
|---|------------------|---------------------------------|----------|
| H8S-CPU   | Clock oscillator | ROM                             | RAM      |
| BSC   |                  |                                 | INTC     |
| Multiplier  |                  | TPU (16-bit timer): 12 channels |          |
| CRC calculation circuit                           |                  | TMR (8-bit timer): 2 channels   |          |
| DTC   |                  | 14-bit PWM timer: 4 channels    |          |
| SCI : 2ch   |                  | WDT : 2ch                       |          |
| SCI with FIFO: 1 channel                          |                  | I <sup>2</sup> C-Bus : 6ch      |          |
| Synchronous serial communications unit: 1 channel |                  | EtherC                          |          |
| A/D 10bit : 8ch                                   |                  | LPC                             |          |
| Boundary scan                                     |                  | USB                             | PLL      |
| PLL   |                  |                                 | I/O port |

Special functions

### H8S/2400 Series Product Development Chart



## H8S Family standard series that provides optimal support for a wide range of application areas.

This general-purpose series features the world's highest level of 16-bit CPU performance (H8S/2378 group: 28.6 ns at 35 MHz),

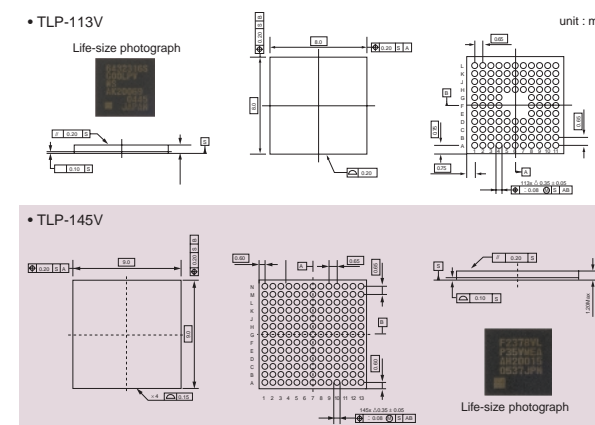
the smallest package in the H8S Family (TLP-112: 8 × 8 mm□), and an extensive memory lineup, from 32 KB/2 KB to 512 KB/32 KB,

and is optimal for a wide range of application areas.

### Application Areas

PC peripherals and OA equipment (printers and POS terminals), industrial equipment (card readers and FA control), and consumer products (LCD TVs and electronic musical instruments).

### Miniature Packages (8mm□:TLP-113V / 9mm□:TLP-145V)



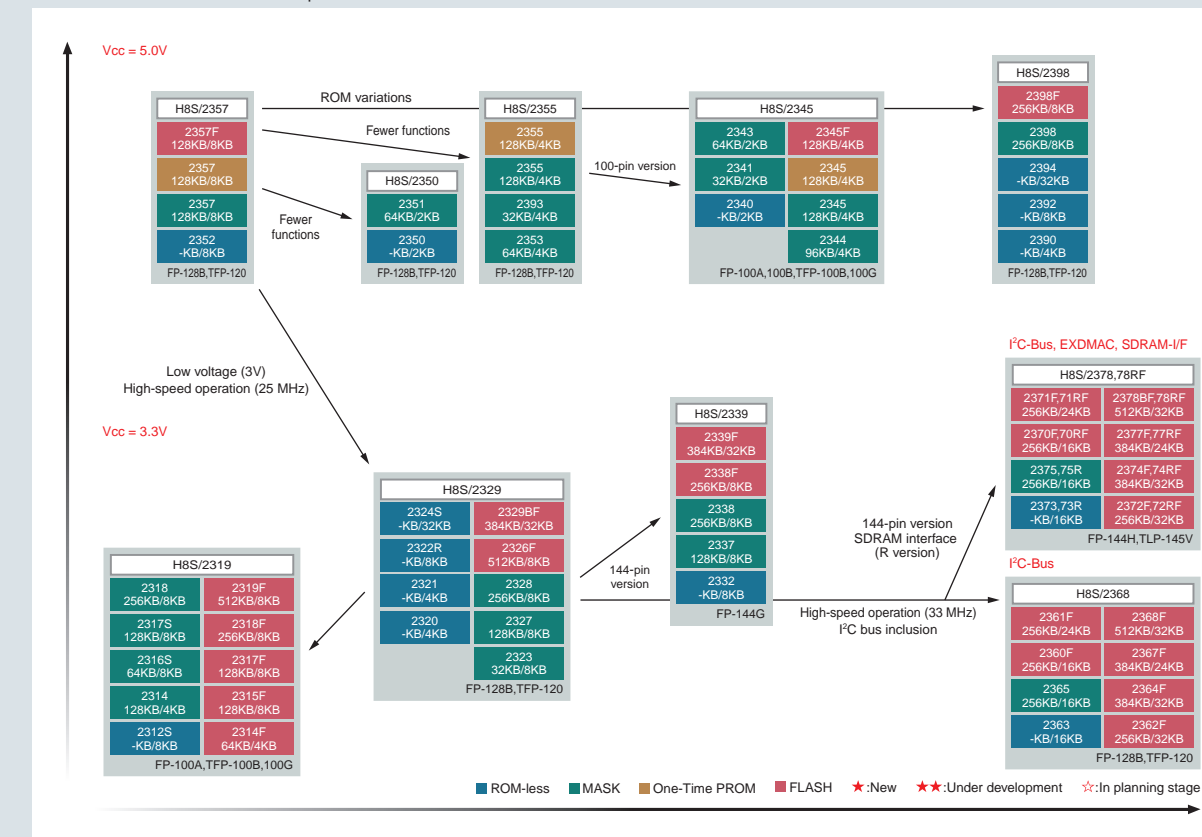
- 3.3V single power supply
- Built-in 384 KB flash memory
- Low-voltage/high-speed operation (35 MHz/3.3V)
- Improved peripheral functions
- Serial interfaces: 5 channels (I<sup>2</sup>C bus: 2 channels)
- A/D converters: 16 channels, and other units
- Built-in SDRAM interface\*1 (H8S/2378R group)
- On-chip debugging functions (with E10A-USB support)
- Miniature package: TLP-145V(9mm□)

Special functions

### H8S/2378,78R Group Block Diagram

|                    |                  |                                |          |
|--------------------|------------------|--------------------------------|----------|
| H8S-CPU            | Clock oscillator | ROM                            | RAM      |
| BSC (SDRAM-I/F *1) |                  |                                | INTC     |
| EXDMAC             |                  | TPU (16-bit timer): 6 channels |          |
| DMAC               |                  | 10-bit PWM timer: 2 channels   |          |
| DTC                |                  | WDT                            |          |
| SCI : 5ch          |                  | I <sup>2</sup> C-Bus : 2ch     |          |
| A/D 10bit : 16ch   |                  | PPG                            |          |
| D/A 8bit : 6ch     |                  | PLL                            |          |
| H-UDI *2           |                  |                                | I/O port |

### H8S/2300 Series Product Development Chart





# H8S /2200

## H8S series that aims for low power consumption by including a 32 kHz oscillator.

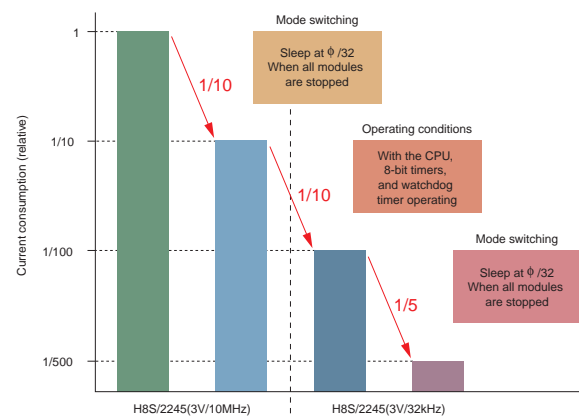
In addition to versions with a lowest guaranteed operating voltage of 2.2V, this series also features powerful communications functions (SCI: 4 channels, I<sup>2</sup>C bus: 2 channels, IEBus, high-speed SCI, and USB 2.0).

This is a microcomputer series that aims for low power consumption by providing a 32 kHz oscillator.

### Application Areas

PC peripherals and OA equipment (POS terminals, printers, and USB equipment), industrial equipment (card readers and wireless equipment), and consumer products (electronic health-related product)

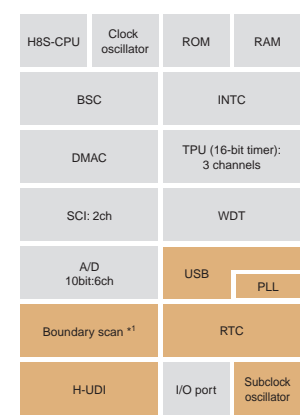
### H8S/2200 Series Low Power Modes



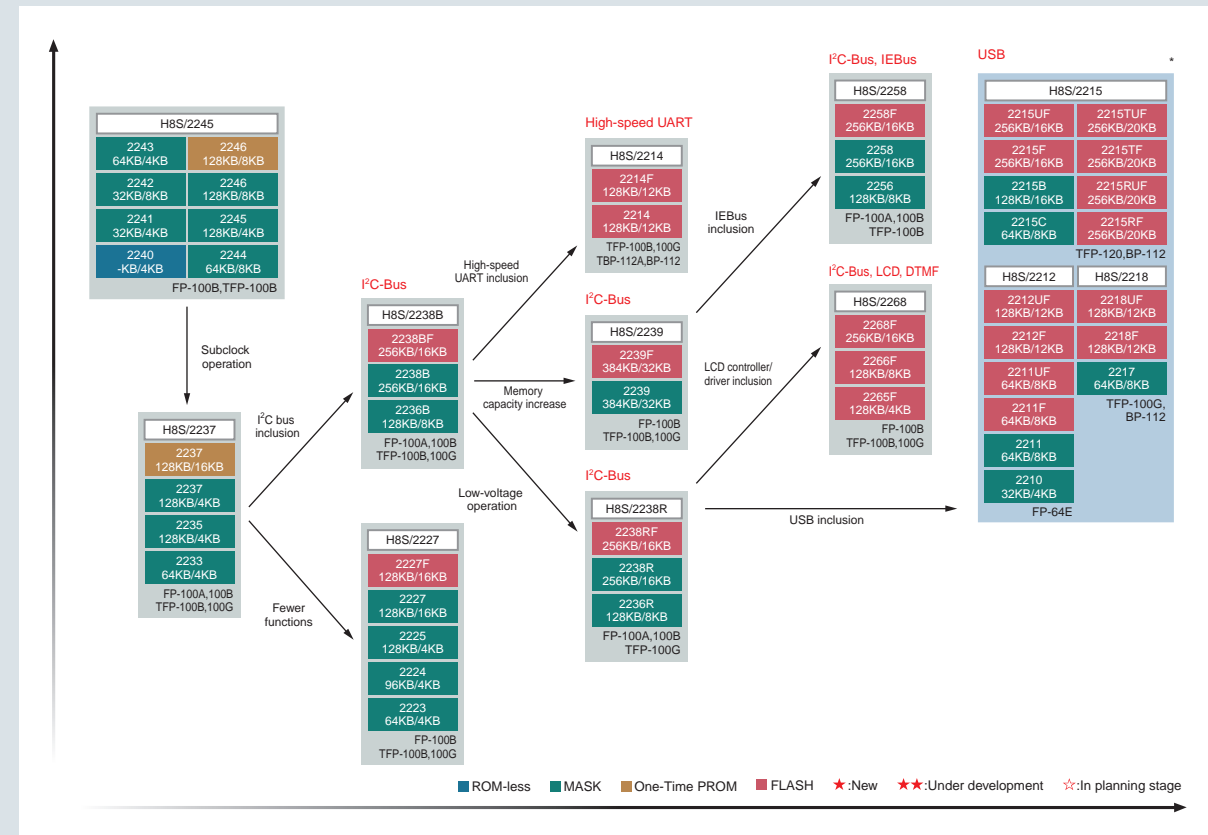
- Built-in high-speed SCI, DMAC, and DTC
- Built-in USB interface
- Flash memory can be programmed over a USB connection.
- On-chip debugging functions (with E10A USB support)
- Miniature packages  
BP-112 (10mm □)  
TBP-112A (10mm □)

\*1: Flash memory versions only  
Special functions

### H8S/2218 Group Block Diagram



### H8S/2200 Series Product Development Chart



\*: See the Renesas USB Device Catalog for details.

# H8S /2100

## 16-bit MCU series that inherits the peripheral functions of the H8/300 8-bit microcomputers.

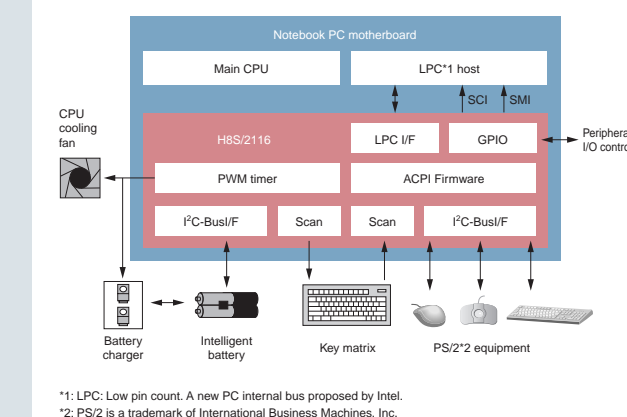
These devices maintain the same pin arrangements as the H8/300 Series to allow smooth replacement and include a wide range of PC-related peripheral functions, such as I<sup>2</sup>C bus, keyboard buffer controller, ISA bus, and LPC units.

This series also features an extensive set of memory options (ROM: 32 KB to 1 MB, RAM: 2 KB to 40 KB).

### Application Areas

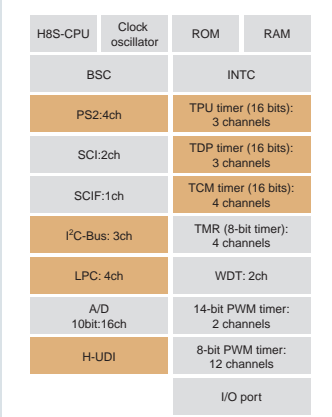
PC peripherals and OA equipment (PC servers, keyboard controllers, and battery control) and industrial equipment (card readers and meters).

### Notebook PC Keyboard/Battery Control System Structure Example



\*1: LPC: Low pin count. A new PC internal bus proposed by Intel.  
\*2: PS/2 is a trademark of International Business Machines, Inc.

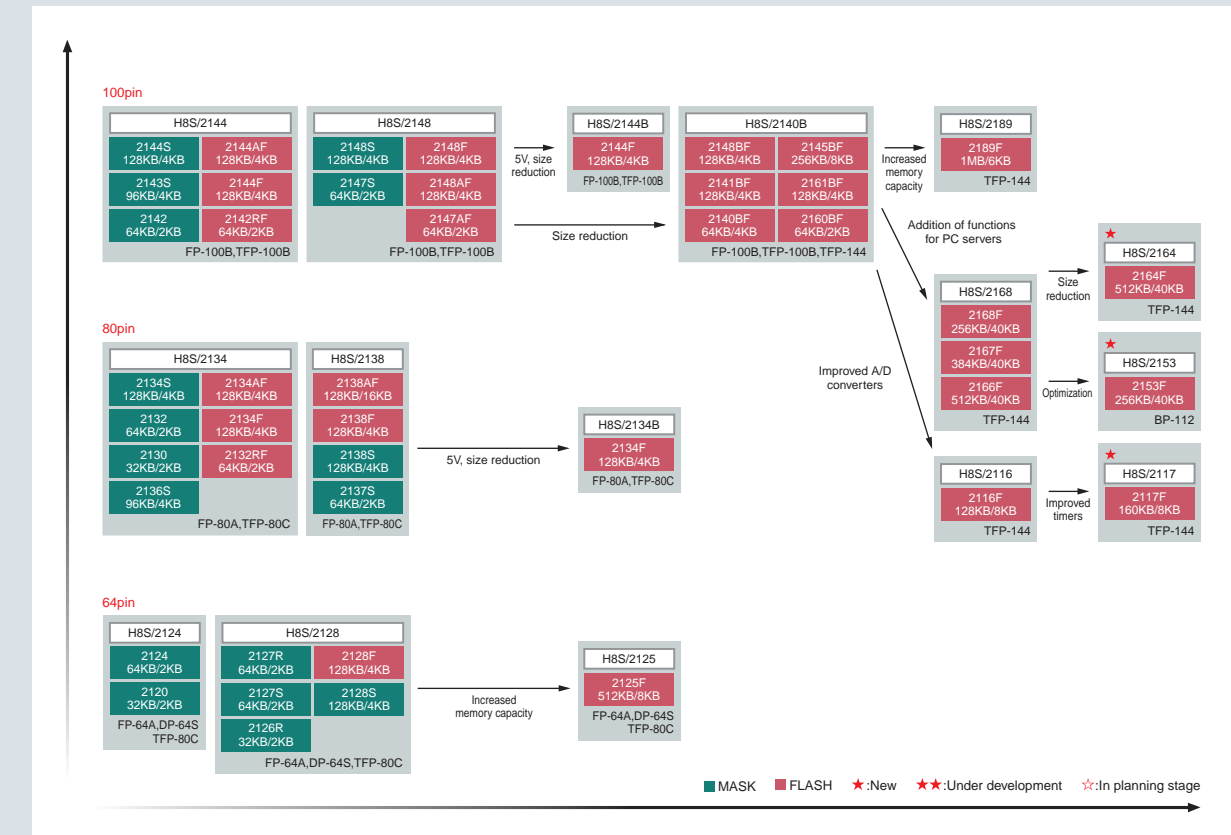
### H8S/2117 Group Block Diagram



- 3.3V single power supply
- On-chip flash memory: 160 KB
- Built-in LPC interface
- Built-in I<sup>2</sup>C bus interface
- Built-in PS/2 interface
- Improved timer functions
- On-chip debugging functions (with E10A USB support)

Special functions

### H8S/2100 Series Product Development Chart



MASK FLASH New Under development In planning stage





# H8S Family and H8SX Family Selection by ROM/RAM Capacity

ROM-less MASK One-Time PROM FLASH

| ROM  | RAM | ROMless | 2K | 3K | 4K | 6K | 8K | 12K | 16K | 20K | 24K | 32K | 40K | 56K | RAM | ROM  |
|------|-----|---------|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 1M   |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 1M   |
| 768K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 768K |
| 512K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 512K |
| 384K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 384K |
| 256K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 256K |
| 192K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 192K |
| 160K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 160K |
| 128K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 128K |
| 112K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 112K |
| 96K  |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 96K  |
| 80K  |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 80K  |
| 64K  |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 64K  |
| 32K  |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | 32K  |
| -40K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | -40K |
| -32K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | -32K |
| -24K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | -24K |
| -16K |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | -16K |
| -8K  |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | -8K  |
| -4K  |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | -4K  |
| -2K  |     |         |    |    |    |    |    |     |     |     |     |     |     |     |     | -2K  |
| ROM  | RAM | ROMless | 2K | 3K | 4K | 6K | 8K | 12K | 16K | 20K | 24K | 32K | 40K | 56K | RAM | ROM  |

