

# H8<sup>®</sup> Family of Microcontrollers

H8 • H8S • H8SX

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■ One of the world’s leading ITDM (Integrated Device and Technology Manufacturer) companies serving the global market

■ In-house manufacturing capability for advanced process nodes — 90, 65 and 45 nm

■ Complete System-Level Solutions in all core segments (automotive, mobile, consumer, industrial and PCs), with the right mix of technology such as networking (wired/wireless), security, low power and analog/RF interface capabilities, plus full-scale development support

■ Proven credibility based on more than 30 years of experience

- “Zero Defects” as the objective
- Compliance with international standards such as ISO/TS 16949
- High quality tested and proven by customers (automotive electronics)
- Commitment to safety and protection of environment



## Renesas — Your Best Decision for Microcontrollers and Microprocessors

*Choose for your next design; use for all your future ones.*

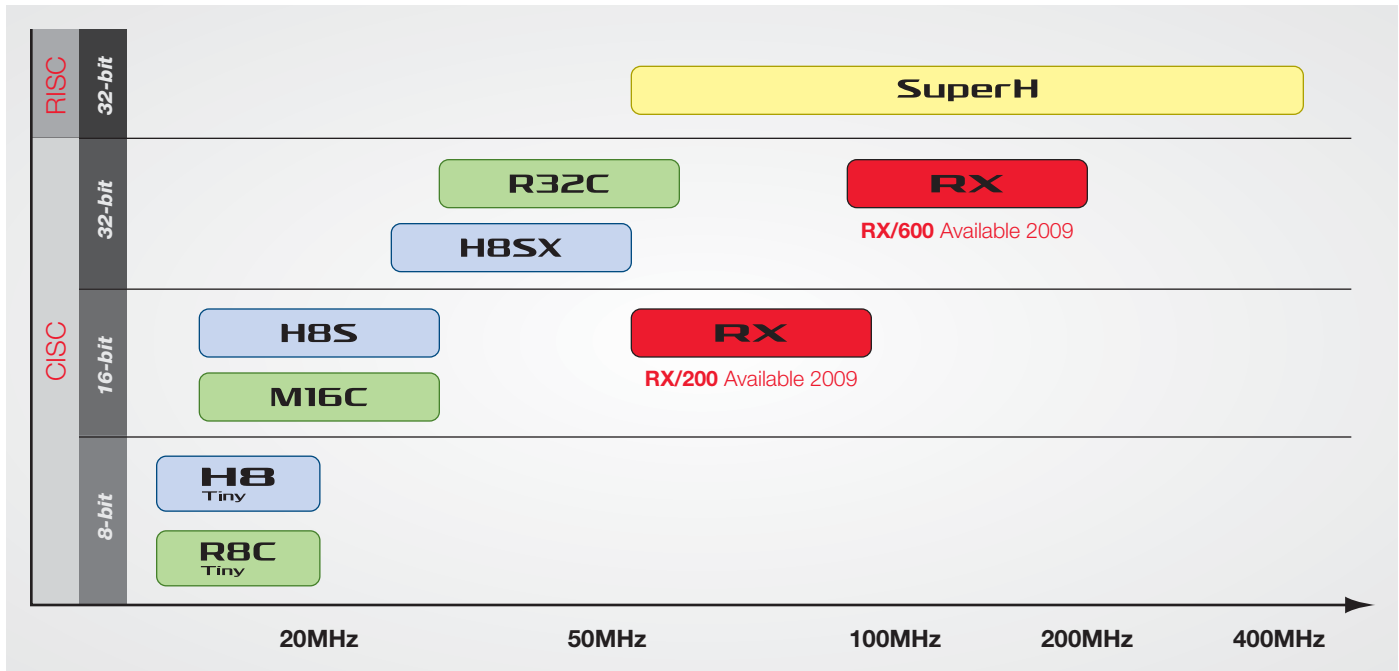
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\* According to Gartner Dataquest, March 2008

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- ▶ A community site and gathering place for technical information and those who use Renesas microcontrollers and microprocessors.



### Why choose Renesas?



- ▶ Renesas is one of the largest semiconductor companies in the world, and the #1 supplier of microcontrollers worldwide.
- ▶ Renesas microcontrollers feature modern architectures implemented in ranges of popular device families designed to suit virtually every type of embedded application.
- ▶ Renesas is totally committed to the embedded systems market globally and has developed and continues to enhance and expand its own microcomputer IP.
- ▶ Renesas provides world-class support to its customers, including the Renesas Alliance Partner Program, which is tiered to suit the voluntary participation of program members.
- ▶ Renesas establishes, nurtures, and values long-term business relationships based on performance, trust, and mutual success and satisfaction.

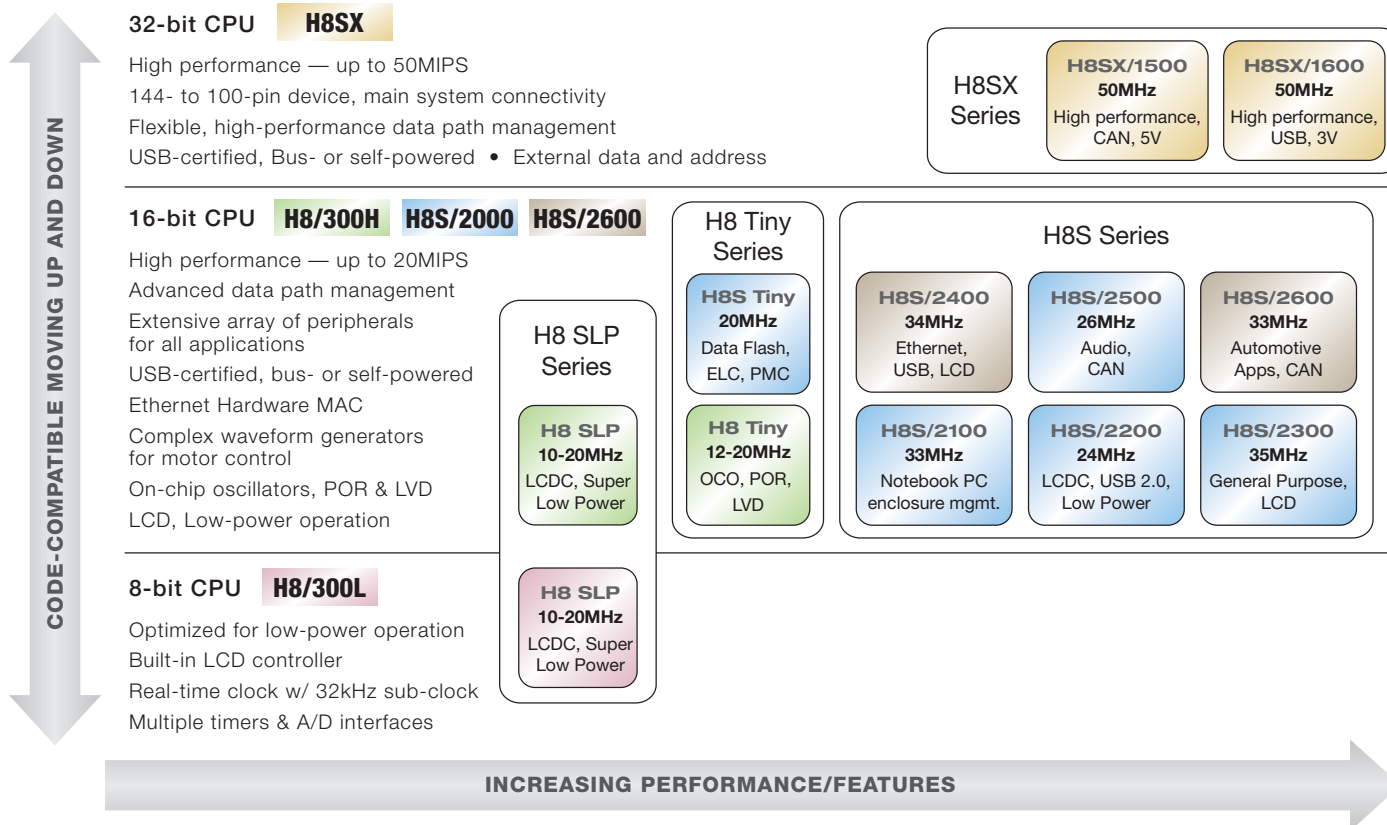
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## MCU Series in the H8 Family

The cost-competitive Renesas MCUs comprising the H8 family are ideal for low-power, high-performance embedded systems in consumer, industrial, medical, communication and automotive applications. The H8 platform encompasses a wide range of devices, from 8-bit low-cost, super low power, low pin-count MCUs to 32-bit high-performance devices. Upward code compatibility is maintained in the various H8 series.



Market Needs	Renesas H8 Solutions
High performance	Speeds up to 50MHz, providing 50MIPS with single-cycle flash access
Wide range of programmable memory	Single-voltage-programmable on-chip flash — 8KB to 1MB
Wide range of low-cost memory	Mask-ROM versions for many flash MCUs — 2KB to 512KB
Integrated peripherals, including support for industry-standard interfaces	Devices in the H8 series offer more than 100 different on-chip peripherals <ul style="list-style-type: none"> <li>• Match peripheral set to application</li> <li>• Choose from timers, A/Ds, D/As, on-chip oscillators, low-voltage detect, and DMA functions, among many others</li> <li>• UART, SPI, I<sup>2</sup>C, IrDA, CAN, LIN, USB, Ethernet, Smart Card, LCD, POR, etc.</li> </ul>
Low power consumption	<ul style="list-style-type: none"> <li>• Super-low-power CMOS technology — 200µA @ 1MHz, 0.4µA @ 32kHz</li> <li>• Up to eight power-down modes</li> <li>• 32kHz sub-clock oscillator</li> </ul>
Low radiation noise	Improved technology and design techniques for a 20dB reduction in noise compared to conventional products
Development environment	<ul style="list-style-type: none"> <li>• Fully integrated tool suite of H/W and S/W tools</li> <li>• Highly optimized Renesas C/C++ compiler</li> <li>• 100% upward code compatibility</li> </ul>
Cost/performance	Best in the industry
Support and training	<ul style="list-style-type: none"> <li>• Experienced application engineers</li> <li>• Training courses and development tools available online at <a href="http://www.renesasinteractive.com">www.renesasinteractive.com</a></li> </ul>

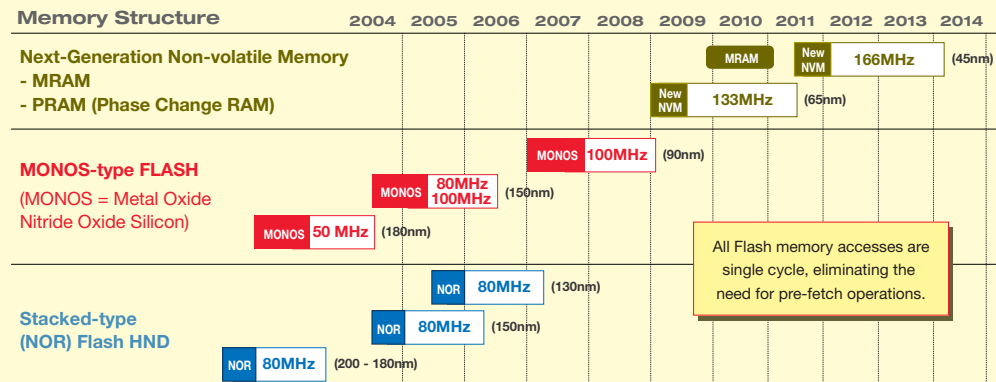
## Application Spectrum for H8 Microcontrollers by Series

	Medical/ Fitness	Metering	Consumer	Industrial	Security/ Office Automation	Computing/ Networking	Automotive
<b>H8 SLP</b>	Glucose meters, heart rate monitors, thermometers, weight scales	Utility meters, thermostats, handheld products	Remote controller, dehumidifiers, lawn sprinkler timers, home electronics	HVAC controls	Intrusion detection systems, smoke detectors, fire alarms	Remote actuators, remotely updatable displays	
<b>H8 Tiny H8S Tiny</b>			White goods, home electronics, game pads, vacuum cleaners	HVAC, thermostats, small DC brushless or stepper motor controllers	Security systems, mechanical controls for fax, printer, measurement devices		
<b>H8S/2100</b>	Health and fitness equipment	Utility meters	Handheld products, appliances, GPS	HVAC		Enclosure management for servers and routers, notebook PC power management, IPMI applications	Safety systems, LCD backlight controllers
<b>H8S/2200</b>	Glucose monitors, drug pump monitors, heart rate monitors	Utility meters, thermostats	White goods, home electronics, GPS	HVAC, emissions test equipment, data loggers, barcode scanners		Keyboard controllers, USB slaves, serial-mode converters, power monitors	Diagnostic instruments
<b>H8S/2300</b>	Blood oxygen monitors, drug pump monitors, heart rate monitors		General applications, GPS	Data analyzers, emission test equipment, barcode scanners		Printers, label printers, touch screen controllers, CD R/W drives, LAN Hubs	Car audio, diagnostic instruments
<b>H8S/2400</b>	Monitoring systems, health and fitness equipment	Thermostats	White goods, home electronics	Data analyzers	Home security	Printers, LCD connectivity, Ethernet connectivity, IPMI applications, PC server	Car audio, display interface
<b>H8S/2500</b>			Audio		Intercoms		Car audio
<b>H8S/2600</b>	Wireless base stations, fiber controllers for cable TV, network system controllers			Pump controls, test fixture controllers, thermal point controllers, siren controllers			Airbag controllers, radar collision avoidance systems, suspension systems, tire pressure monitors, electronic power steering
<b>H8SX/1500</b>			Handheld devices	Safety systems		Storage systems, imaging	Pedestrian safety, body/chassis systems, navigation, airbag controllers, power steering
<b>H8SX/1600</b>	Fitness machines	Thermostats	Handheld devices (Bluetooth), USB Dongles	Control modules (LCD, USB), barcode scanners, electronic point-of-sale	Control Panels	Printers	

## Renesas is the #1 Flash MCU Supplier

- Renesas, the world's #1 supplier of flash, has shipped over 1 billion flash MCUs
- Wide range of sizes of highly reliable F-ZTAT (flash) up to 1MB, in 0.18µm process
- Fastest flash write time: 2.5 sec./ 128KB for 0.18µm process
- Access as fast as 10ns @ 100MHz
- Up to -40°C to +125°C range
- Multiple user-friendly modes for programming/reprogramming flash memory

### Flash Memory Roadmap



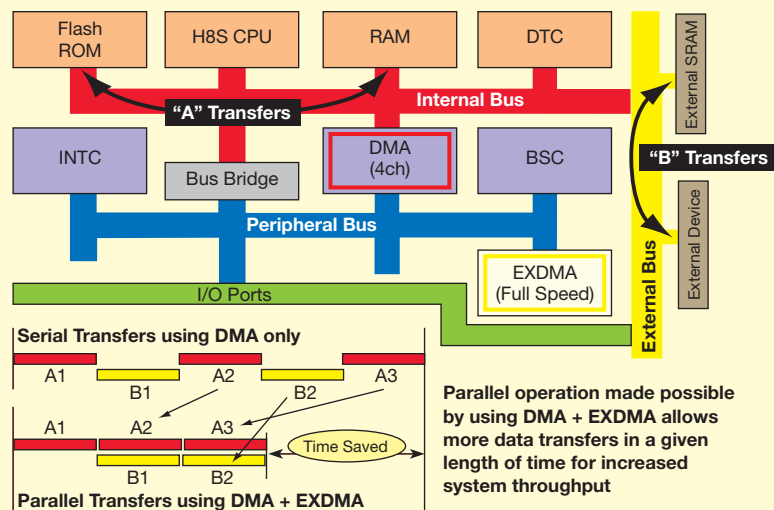
- User mode allows flash to be programmed or erased by user application software
- Boot mode allows in-system programming using RS-232 serial port
- USB devices can be optionally programmed via the USB port
- User Boot mode allows storing a custom flash update routine in a special protected area
- Write mode enables MCU programming with desktop or production programmers
- Flash can be programmed via the on-chip debug emulator

## Powerful Data Path Management

H8 products are fully optimized system solutions, so besides powerful CPU core processing, H8 MCUs have advanced data path management.

There are three types of data movement engines: System DMA, External DMA and Data Transfer Controller. The Advanced Bus System Controller manages complex data and control across the multiple-bus architecture.

The H8S and H8SX MCU architectures use 3 separate buses. Data movement on the External Bus and System Bus can operate in parallel, greatly increasing system performance by optimizing operation per clock cycle.



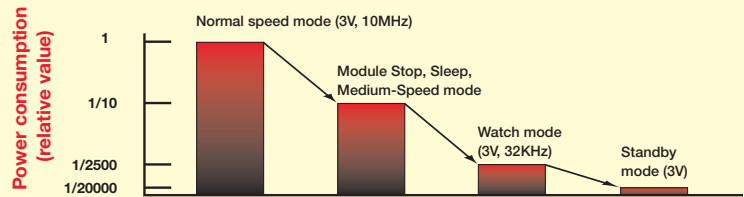
This example shows system operation (red) using the System DMA, while in parallel the External DMA is transferring data between an external device and the MCU (yellow). This parallel operation reduces time for operation.

### Low Power Consumption

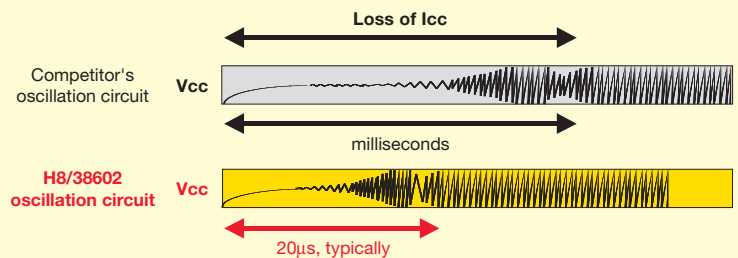
Multiple innovative techniques minimize MCU power consumption

- 0.4 $\mu$ A @ 32kHz
- Operating voltages as low as 1.8V
- Up to 8 power-down modes
- Module Standby mode allows software to selectively halt on-chip functions
- Dual clock oscillators with 32kHz sub-clock
- On-chip oscillators with short stabilization times (20 $\mu$ s, typically)
- Standby current as low as 0.1 $\mu$ A

### H8 Power Consumption: H8/38602



### Shorter Crystal Stabilization Time

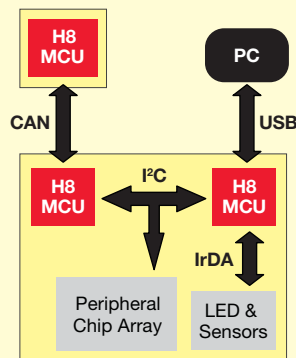


### On-chip Memory (SRAM)

- Many sizes of on-chip high-speed SRAM: 256 Bytes to 56KB
- 8KB of JTAG debug memory can be used for system operation (allowing 64KB on-chip SRAM)
- Single-cycle access at maximum speed

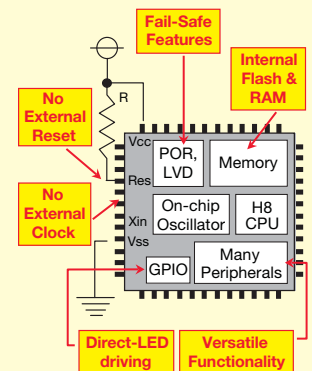
### Industry-standard Serial Communication Interfaces

- Certified USB full-speed and high-speed; bus- or self-powered
- Multiple channels of serial asynchronous/synchronous interface
- Synchronous serial unit (SSU) is compatible with Freescale (Motorola) SPI™
- I<sup>2</sup>C™ two-wire serial interface conforms to Phillips standard
- IrDA interface for easy wireless line-of-sight connectivity
- Smart Card interface conforms to ISO/IEC 7816-3
- Controller Area Network (CAN 2.0B) function for highly reliable networked embedded systems



### High component integration reduces system cost and design complexity

- On-chip oscillators as fast as 40 MHz available to CPU and all peripherals
- Low-voltage detect circuits to monitor power supplies efficiently without additional components
- Power-on Reset circuit eliminates external chip and guarantees a clean and reliable start-up
- High-current I/Os can drive LEDs directly
- LCD controllers with booster circuits drive higher voltage displays without the need of DC-DC converters
- Internal voltage regulators eliminate need for expensive power circuits
- Large range of internal reliable flash memory & high-speed RAM that suffice for most system requirements



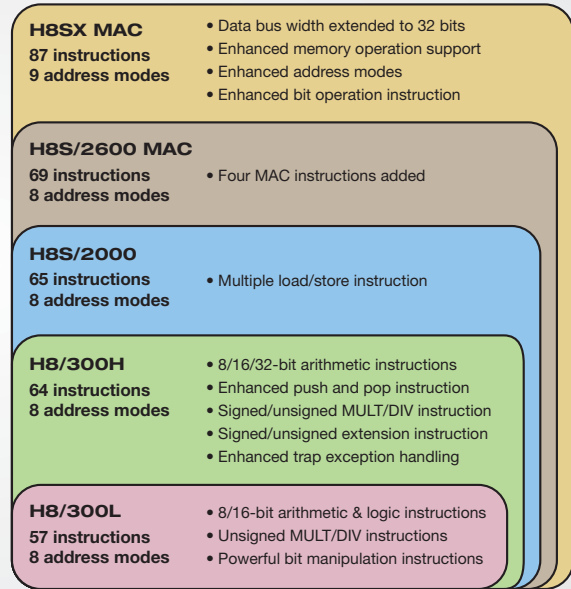
## H8 MCUs: Fully Upward Compatible

H8 CPUs are all CISC-based (Complex Instruction Set Computation), developed to allow compatibility up and down the various H8 series. This makes it easy to move between the product lines in the H8 family.

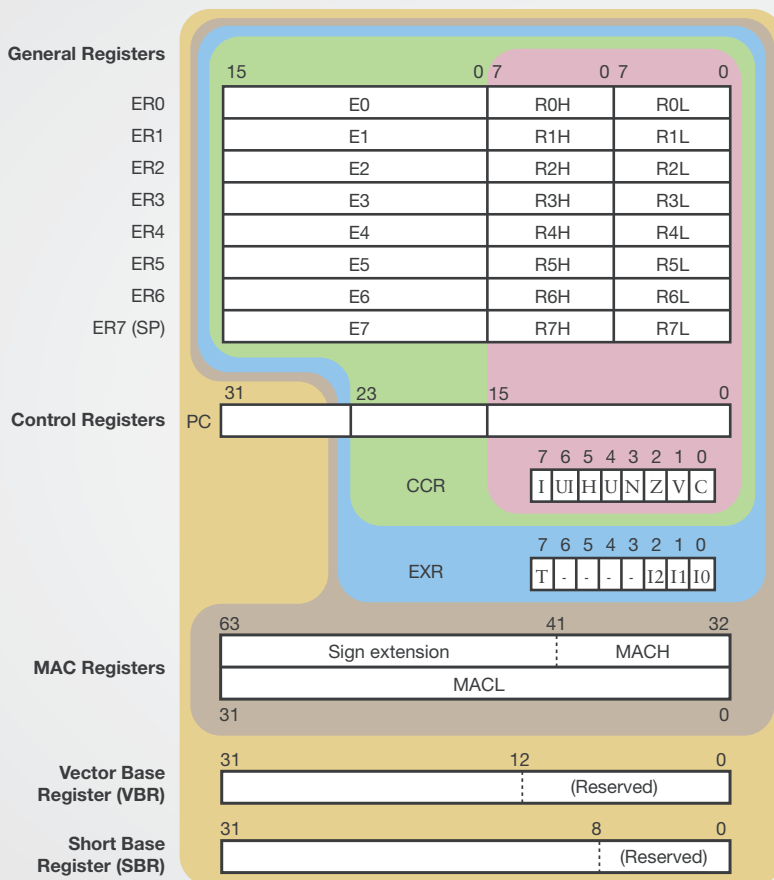
The CPUs within the H8 family range from 8-bit, low-power optimized cores to full 32-bit high-performance cores that achieve 1MIPS/MHz.

### Benefits of H8 CPU cores include:

- Most instructions execute in one clock cycle
- Built-in hardware MAC (H8S/2600 and H8SX only)
- Fast multipliers and dividers
- Enhanced memory addressing schemes (memory-to-memory access, one instruction)
- Advanced conditional branching instructions
- Powerful CISC instructions with small code size



## H8 CPU Register Set



The CPUs within the H8 family are designed from the same register set, allowing complete compatibility.

### H8/300L Series

use 8 general-purpose registers as 8 and 16 bits. PC is 16 bits wide.

### H8/300H Series

use 8 general-purpose registers as 8, 16 and 32 bits. PC is 24 bits wide.

### H8S/2000 Series

use 8 general-purpose registers as 8, 16 and 32 bits. PC is 24 bits wide.

### H8S/2600 Series

use 8 general-purpose registers as 8, 16 and 32 bits. PC is 24 bits wide. Hardware MAC.

### H8SX Series

use 8 general-purpose registers as 8, 16 and 32 bits. PC is 32 bits wide. Hardware MAC. VBR and SBR available.



### H8 MCUs: Faster Execution Times

Besides maintaining compatibility within the family, H8 CPUs have been optimized for high performance.

The majority of the instructions in the powerful CISC instruction set will execute in one clock cycle, giving RISC-like operation.

### Enhanced Hardware for Performance

Enhanced multipliers and dividers are included in the CPU core to boost throughput for mathematical operations and further enhance the performance of the CPU cores.

The H8S/2600 and H8SX CPU cores each have a hardware MAC (Multiply and Accumulate) block for extra performance in applications that involve data computations.

### H8 Family CPU Core Overview

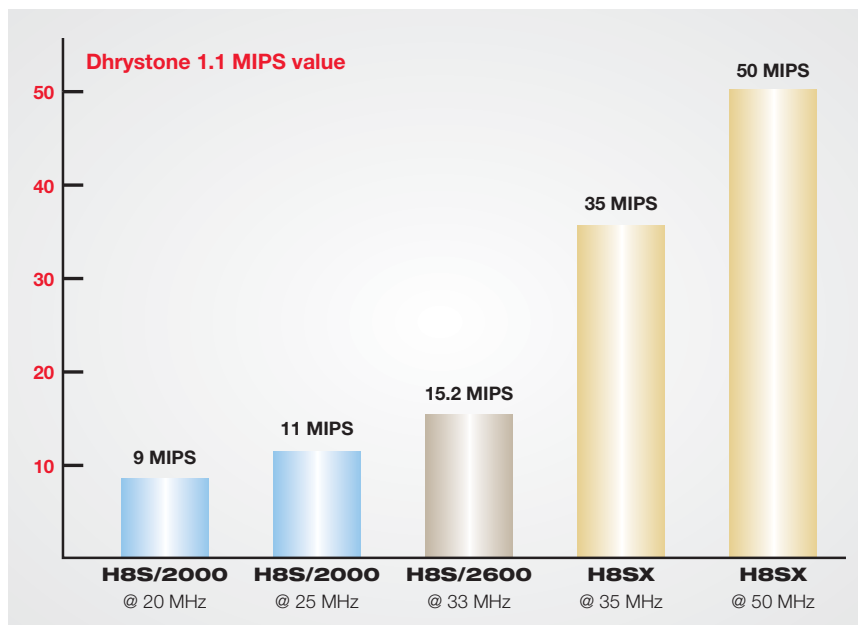
	H8/300	H8/300H	H8S/2000	H8S/2600	H8SX
<b>Basic Instructions Execution</b>	2 cycles	2 cycles	1 cycle	1 cycle	1 cycle
<b>Bus Width</b>	8-bit	16-bit	16-bit	16-bit	32-bit
<b>No. of Instructions</b>	57	64	65	69	87
<b>Address Space</b>	64KB	16MB	16MB	16MB	4GB

### Advanced Multiplier execution cycles

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

### Advanced Divider execution cycles

Instruction	H8S	H8SX
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



### H8 MCU System Performance

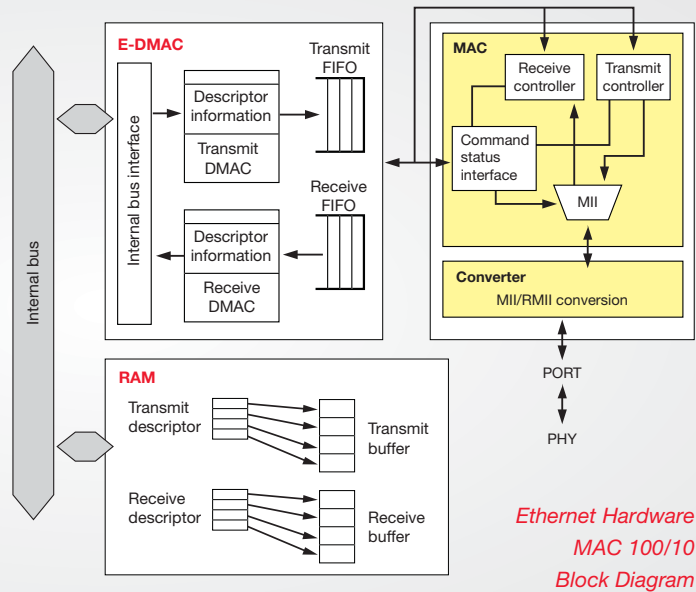
H8 microcontrollers are designed to deliver high throughput for excellent application performance.

For example, their CISC CPU cores execute most instructions in just one clock cycle, and their Advanced Data Management peripherals utilize a 3-bus architecture to speed data transfers.

Also, the on-chip Flash can be accessed in a single cycle, achieving the best possible performance per MHz.

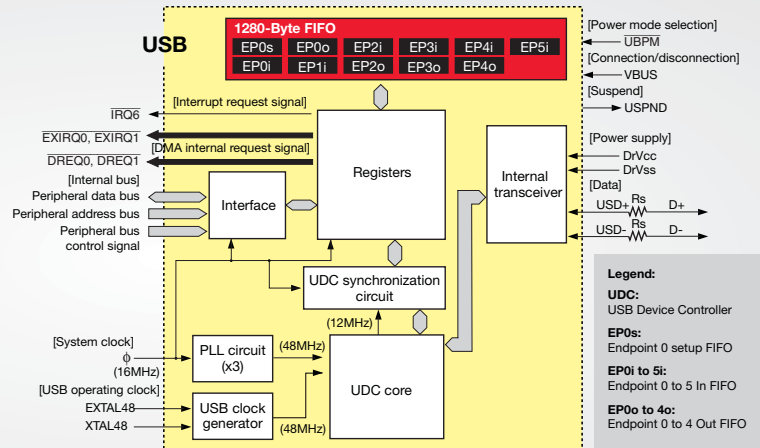
## ■ Ethernet Hardware MAC 100/10

- Transmission and reception of Ethernet/IEEE802.3 frames
- Supports 10/100 Mbps receive/transfer
- Supports full-duplex and half-duplex modes
- Conforms to IEEE802.3u standard MII (Media Independent Interface)
- Magic Packet detection and Wake-On-LAN (WOL) signal output
- Conforms to IEEE802.3x flow control
- Dedicated E-DMAC (DMA Controller)
- Transmit/receive frame status information is indicated in descriptors
- Achieves efficient system bus utilization through use of block transfer (16-byte units)
- Supports single-frame/multi-buffer operation



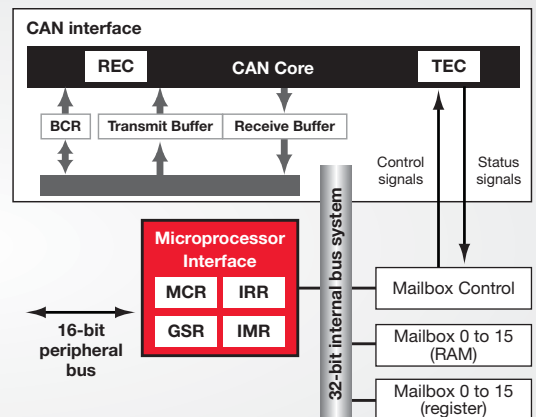
## ■ Universal Serial Bus

- Provides v2.0 support
- Offers full-speed, 12Mbps communication
- Bus-powered mode or self-powered
- Up to 9 endpoints can be specified
- Four transfer modes supported: Control, Interrupt, Bulk, and Isochronous
- On-chip bus transceiver with option for using external transceiver
- Total 1280-Byte FIFO buffer



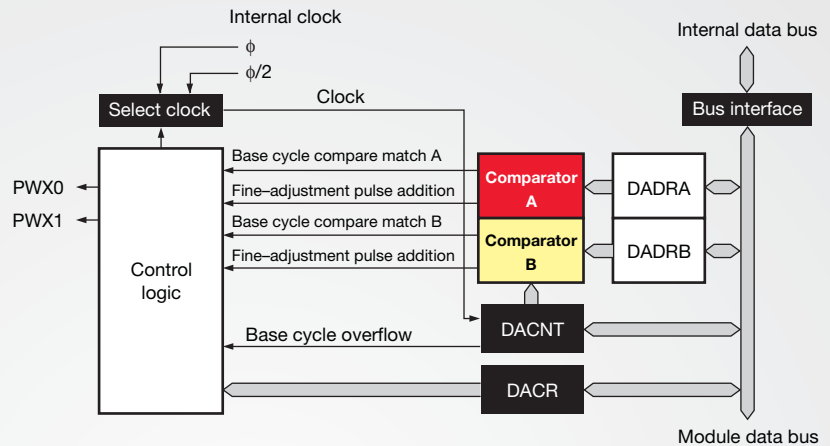
## ■ Controller Area Network (RCAN-ET)

- Supports CAN specification 2.0B
- Bit timing compliant with ISO-11898-1
- 16 Mailbox version
- 15 programmable Mailboxes for transmit/receive + 1 receive-only Mailbox
- Sleep mode for low power consumption and automatic recovery from sleep mode by detecting CAN bus activity
- Programmable receive filter mask (standard and extended identifier) supported by all Mailboxes
- Programmable CAN data rate up to 1MBit/s
- Transmit message queuing with internal priority sorting mechanism



### ■ Timers

- Rich suite of 8-bit and 16-bit multifunction, multipurpose timers
  - Input capture, output compare, auto reload, event counter, up/down counter, interval timer, and sleep mode timer
- 3-phase Motor Control Timer
  - 2-phase encoder with up/down count capability
  - Suitable for motor control apps
- Asynchronous Event Counter (AEC)
  - Counts events even when system clock is disabled for power saving
- Watchdog timer (WDT) with independent RC circuit for greater safety
- 10-bit or 14-bit Pulse Width Modulation (PWM) timer with ripple-reduction feature
  - Can be used as a D/A converter by adding an external low-pass filter
- Real-Time Clock (RTC): seconds, minutes, hours, days and weeks

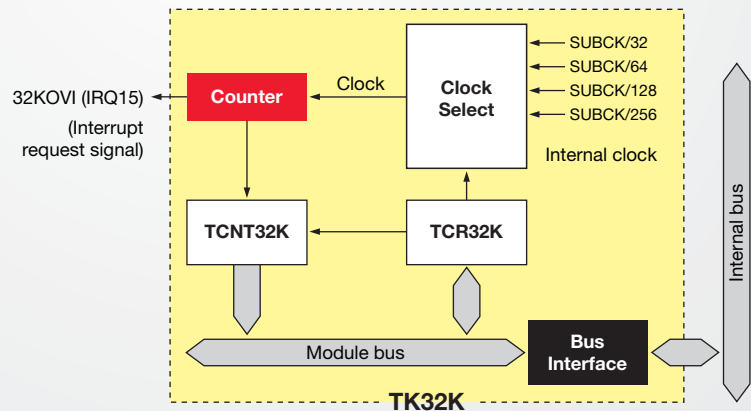


#### Legend:

**DACR:** PWM D/A control register  
**DADRA:** PWM D/A data register A

**DADRB:** PWM D/A data register B  
**DACNT:** PWM D/A counter

*H8/Tiny 14-bit PWM Timer Block Diagram*



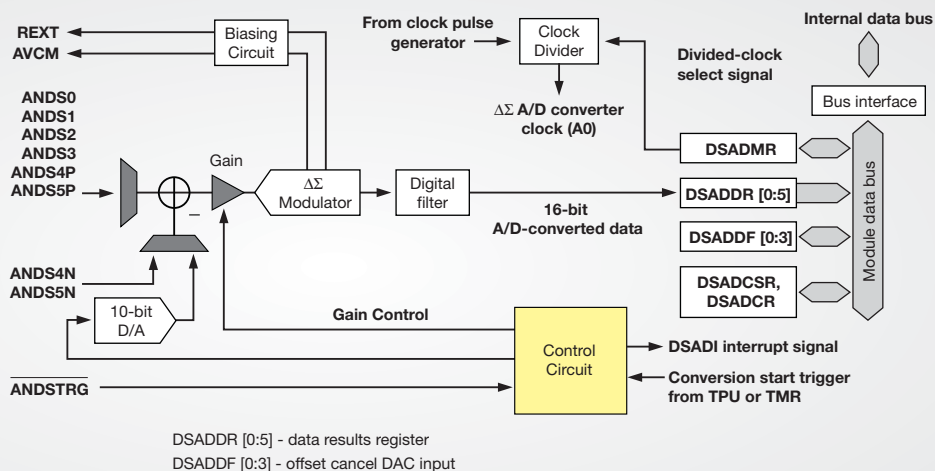
*H8S 32K Sleep Mode Timer Block Diagram*

### ■ Programmable Pulse Generator (PPG) / Timing Pattern Controller (TPC)

- Arbitrary waveform patterns are stored in memory and generated on output pins with the PPG or TPC in conjunction with a timer and DMA
- Provides 8/16-bit programmable pulse outputs using TPU as base
- Output trigger signals can be selected in 4-bit groups
- Each group can operate both simultaneously and independently
- Output trigger signals can operate in parallel with DTC and DMAC

## ■ Data Converters

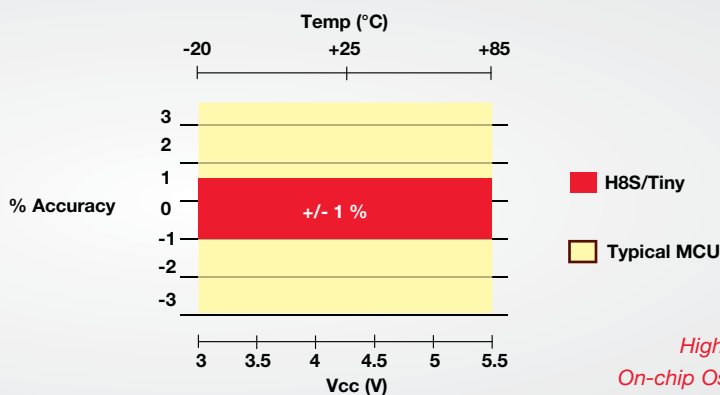
- 4- to 16-channel 10-bit successive-approximation A/D converter (ADC)
- 6-channel, 16-bit Delta-Sigma ADC, 91.5µs conversion time (H8SX)
- 2-channel 14-bit Delta-Sigma ADC (H8/SLP)
- 2- to 4-channel 8-bit D/A converter



H8SX 16-bit Delta-Sigma ADC

## ■ High-speed on-chip oscillator

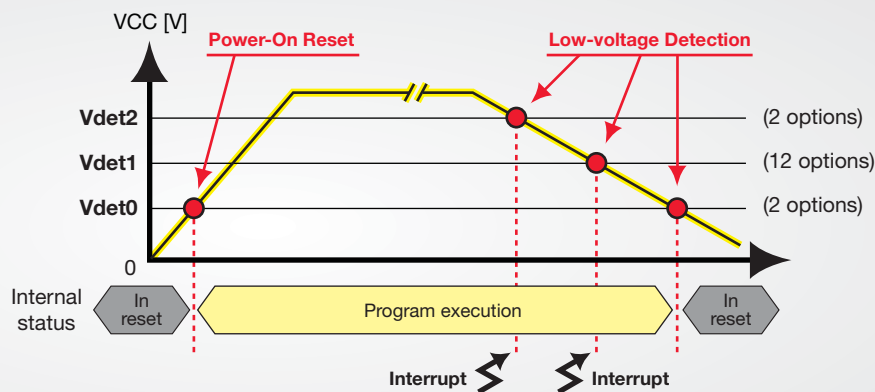
- 40MHz +/- 1% over temperature and voltage
- 32MHz setting also available to derive accurate UART baud rates
- Option to trim to custom frequency via software
- 40MHz clock available to timer modules



High-speed On-chip Oscillator

## ■ Built-in POR & LVD

- Power-On Reset circuit can be configured to detect two different voltage levels
- Low-Voltage Detect circuit can generate interrupts at 14 different levels set via software
- Power supply can also be monitored through pins to trigger LVD interrupts



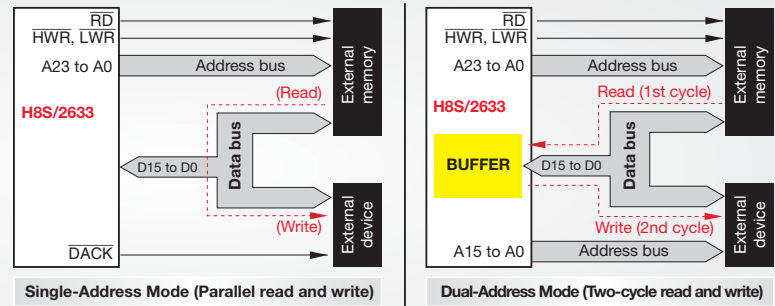
Built-in POR & LVD

## ■ Dual-Tone Multi-Frequency (DTMF) Generator

- Generates DTMF frequency sine waveform, with minimum distortion
- Synthesis or single waveform

### ■ DMA Controller (DMAC)

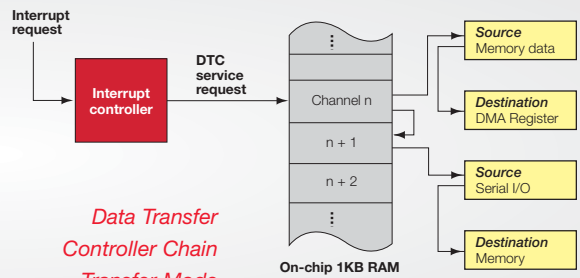
- Max. of 4 channels can be used
- Dual-address or single-address mode can be selected
- Supports Single, Burst, Sequential, Idle and Repeat Transfer modes
- Data can be transferred in word or byte units
- Activation: internal interrupt, external request, auto-request



DMA Controller Block Diagram

### ■ Data Transfer Controller (DTC)

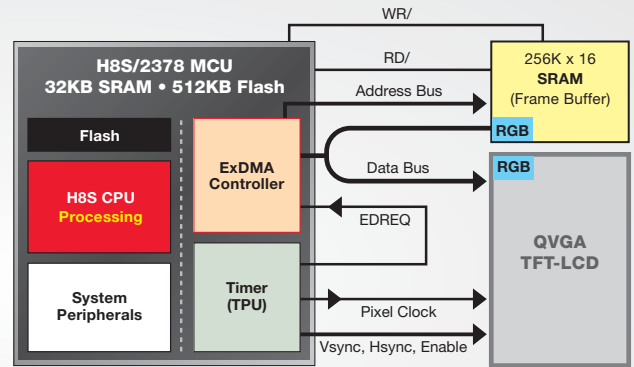
- Max. of 85 channels can be used
- Multiple transfers or multiple types of transfers possible for one activation source
- Supports Single, Burst, Chain and Repeat Transfer modes
- Data can be transferred in byte or word units
- Activation sources: interrupt and software



Data Transfer Controller Chain Transfer Mode

### ■ TFT-LCD Direct Drive (ExDMA)

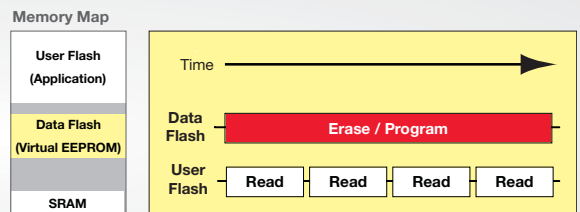
- 16bpp Direct Drive of TFT-LCD panels
- Pixel Clock, V-sync, H-sync, Data Enable and VCOM driven
- Fully flexible for different panel sizes and interface specifications
- H8S/2378 drives QVGA, WQVGA panels
  - WQVGA (480 x 272) driven at 116Hz
- H8SX/1668 drives VGA and WVGA
  - WVGA (800 x 480) driven at 65Hz
- CPU core is lightly loaded during LCD Direct Drive, leaving CPU core available for other system algorithms
  - H8S 6% loaded, H8SX 2% loaded
- Interleaved accesses allow frame buffer update for animation



TFT-LCD Direct Drive (ExDMA)

### ■ Data Flash with BGO

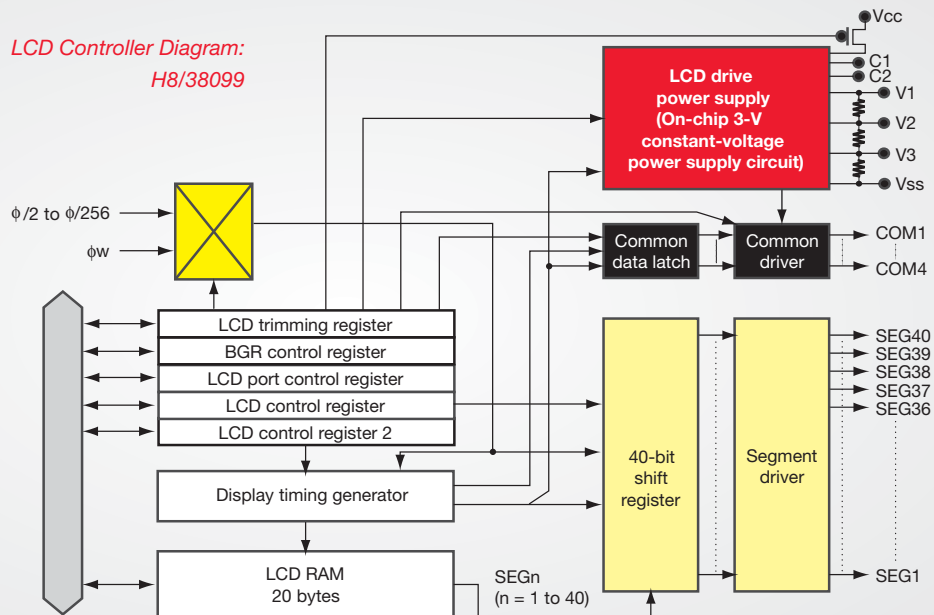
- Two blocks of 4KB each of Data Flash available for storage of non-volatile data
- BGO (Back Ground Operation) allows Erasing or Programming of Data Flash while executing application code.
- Erase operation can be suspended automatically to allow Reading/Programming of User or Data Flash



Data Flash with BGO Diagram

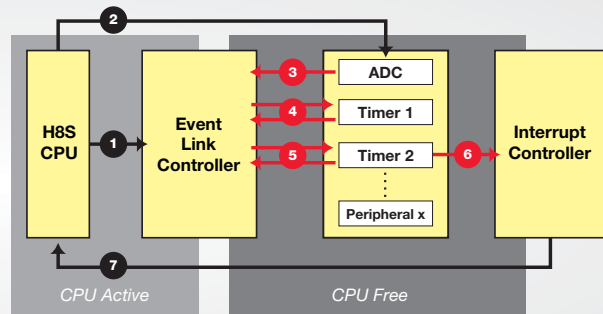
## ■ LCD Controller

- Option for using on-chip or external power supply
- Built-in LCD RAM (up to 128 bits) with byte or word access
- Supports multiple duty cycles: static, 1/2, 1/3, or 1/4



## ■ Event Link Controller (ELC)

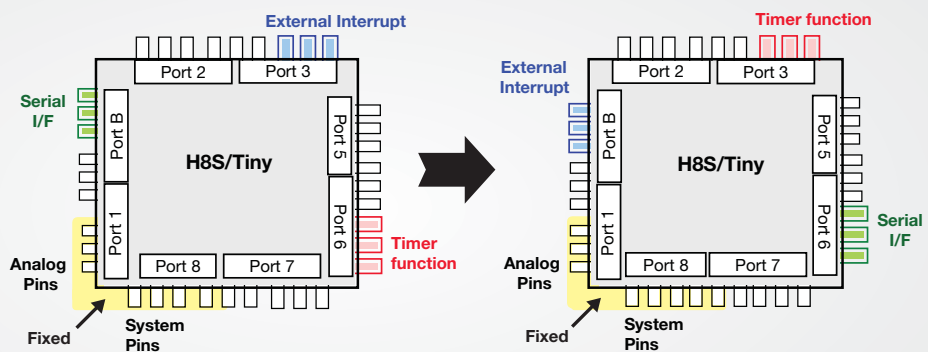
- ELC unit manages real-time interrupts to trigger multiple peripherals in sequence
- All peripherals including DTC (Data Transfer Controller) can be activated through ELC
- Frees up CPU to handle additional operations
- Eliminates code required for interrupt servicing



*Event Link Controller Diagram*

## ■ Peripheral I/O Mapping Controller (PMC)

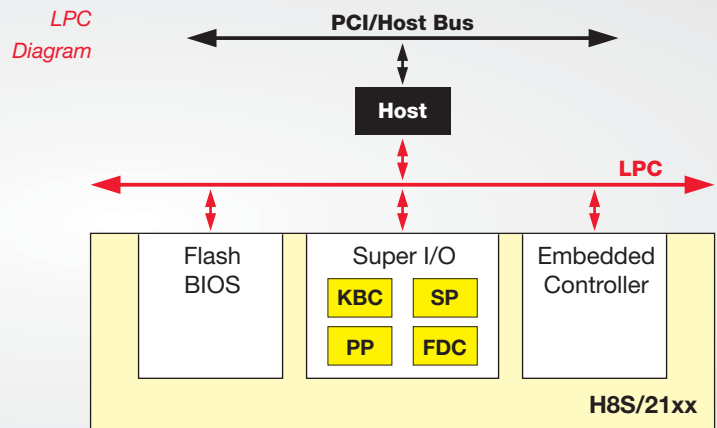
- Digital pins can be configured to a maximum of 7 different functions (ex: Serial, Timer, Interrupt, I/O, etc.)
- One board design can accommodate multiple product variations
- Optimizes pin compatibility between different MCU devices
- Reduces board revisions if layout errors occur



*PMC Diagram*

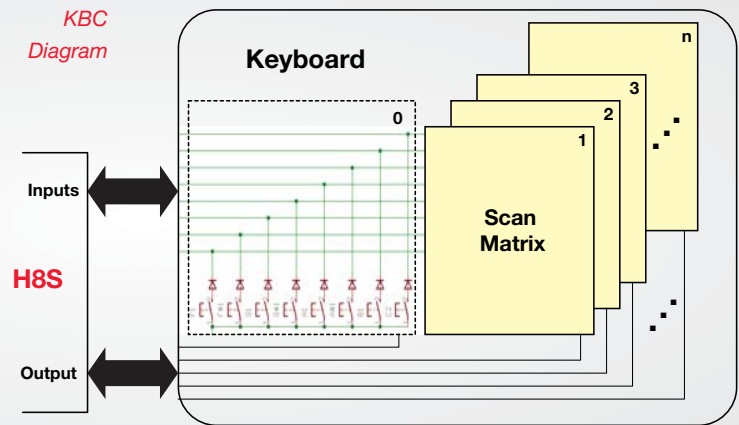
### ■ Low-Pin-Count (LPC) Interface

- A popular interface to communicate to PC chip set used in notebooks and PC servers
- Performs serial data and address transfer using 33MHz clock
- Supports I/O read and write cycles
- Supports serial interrupt on single line
- Supports power-down mode
- Reduced pin count



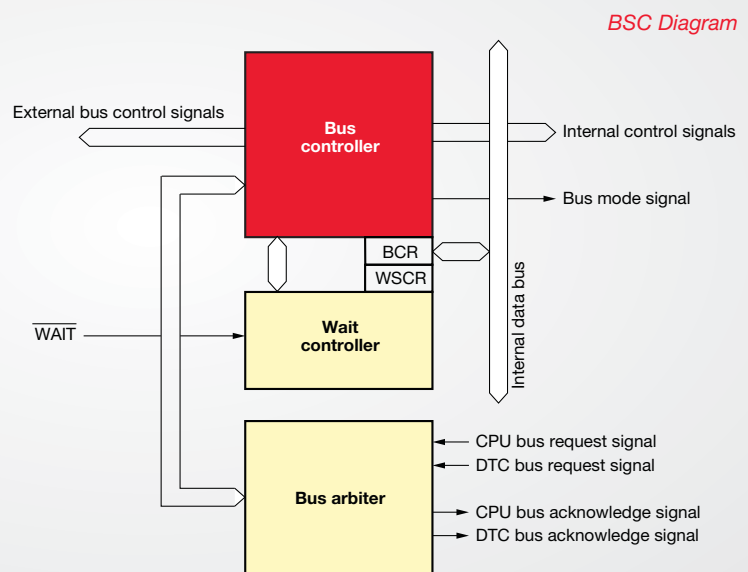
### ■ Keyboard Buffer Controller (KBC)

- Conforms to PS/2 specification
- Error detection, parity error and stop bit monitoring
- Five host interrupt requests



### ■ On-chip Bus Controller (BSC)

- Provides glueless interface with external devices
- Supports basic SRAM, burst-ROM interface
- Manages external, addressable 16MB region (8 different areas)
- Bus specification can be set independently for each region
- Selectable 8- or 16-bit bus width
- Choice of 0 to 7 programmable wait-state access
- Supports direct connection to SDRAM on selected devices
- Includes a bus arbiter for bus mastership arbitration
- Burst ROM interface can be set for area 0
- External write cycle and internal access can be executed in parallel
- Idle-cycle insertion capability



## EVALUATION

Experiment with and verify the performance of devices, the HEW IDE, and HW/SW tools

## DEBUGGING

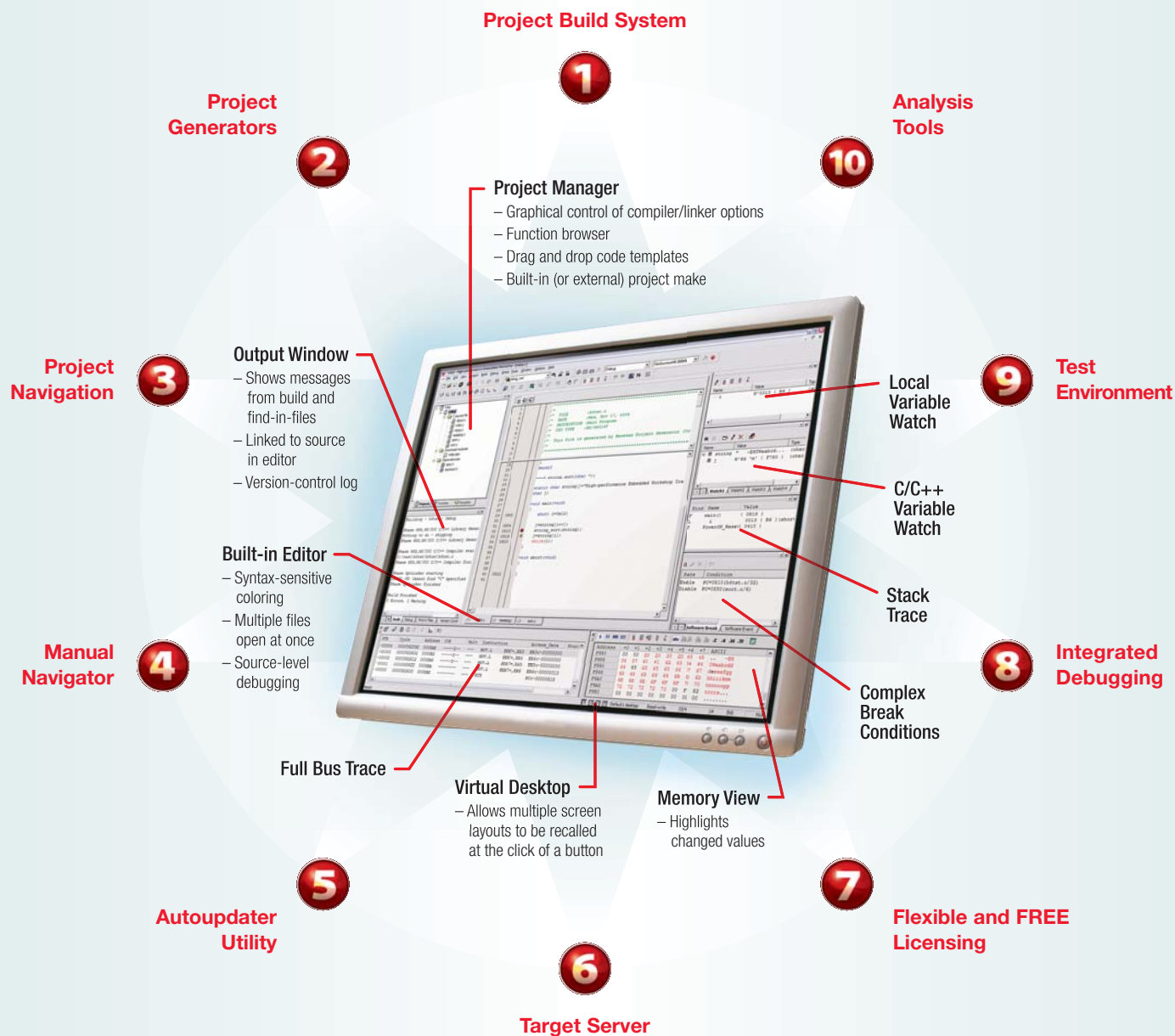
Develop code with optimized compilers; find elusive bugs with emulators' powerful capture/record capabilities

## PROGRAMMING

Download software to reliable on-chip flash memory easily with the Flash Development Toolkit.

## High-performance Embedded Workshop (HEW) INTEGRATED DEVELOPMENT & DEBUGGING SYSTEM

*The Renesas High-performance Embedded Workshop integrates everything you need to build and debug your embedded applications in a single flexible easy-to-use environment.*



Features 1-10 are detailed on pages 15 and 16, followed by info on debugging and programming.

More information about HEW is available at <http://www.america.renesas.com/HEW>

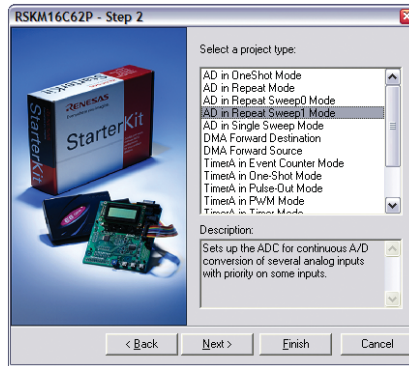


## 1 Project Build System

HEW provides an easy-to-understand graphical interface for setting toolchain options and lets you store multiple configurations of options-to-file mappings. HEW's highly flexible build engine manages the toolchain executables and make system. Custom phases for pre- and post-processing may be inserted at any stage in the build.

## 2 Project Generators

Wizards guide you through setting up your embedded application code. Starter Kits ship with sample code generators for all the peripherals.

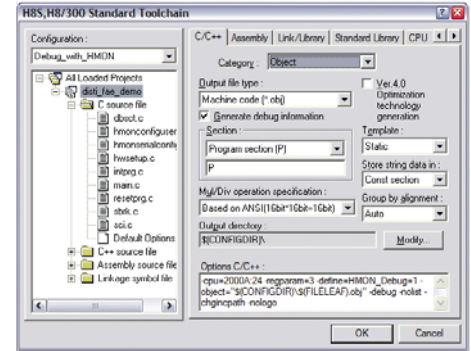
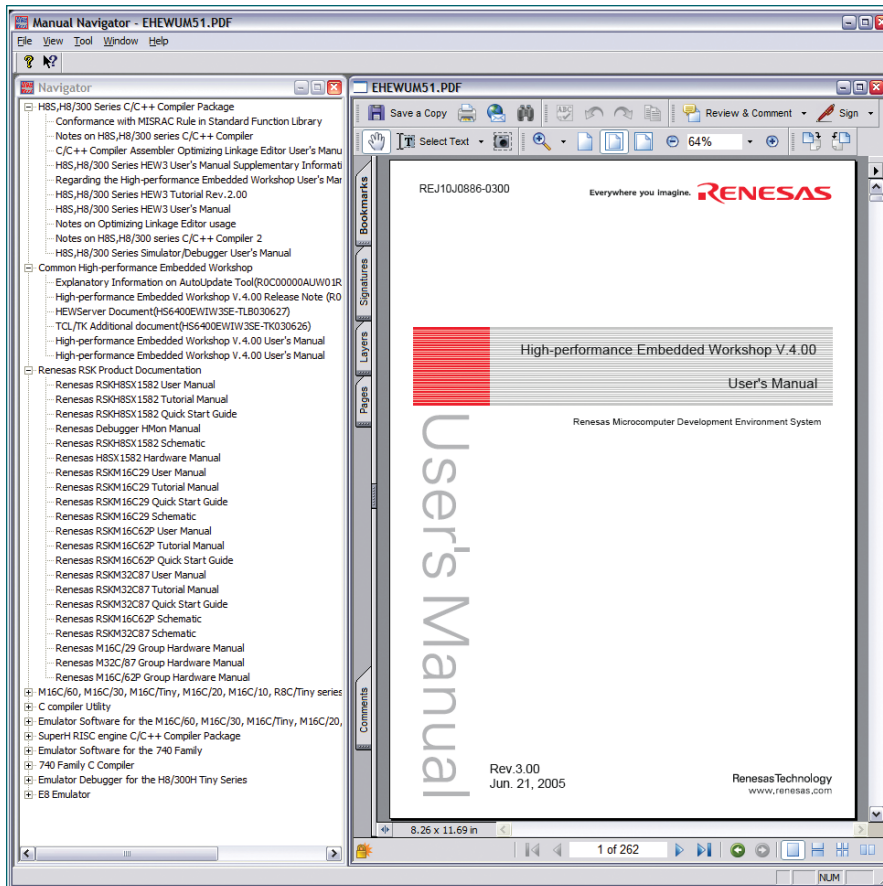


## 3 Project Navigation

HEW provides multiple views for efficiently navigating your project. The Workspace view shows the files that make up the project. You can even add project documentation or schematics to the project. The Navigator shows functions and variables. Double-clicking on any of the icons takes you to the object's definition.

## 4 Manual Navigator

The Manual Navigator is a central repository for all documentation relating to the Renesas tools installed on your system. A single location allows quick access for finding information.



## 5 Autoupdater Utility

HEW ships with a utility that can automatically search Renesas web downloads for updates to components in your system and install them for you.



## 6 Target Server

HEW Target Server publishes a set of API functions which let you write your own Basic, C++ or C# Windows applications to control the HEW environment or your target system.

## 7 Flexible and FREE Licensing

Multiple licensing options including free evaluation, workstation, floating network and USB keys give you ultimate flexibility. You can download a free evaluation copy of HEW with the compiler and generate unlimited code for 60 days. This is very useful for benchmarking optimization efficiency and architecture performance. After 60 days, code size is limited to 64 KB, which still allows you to evaluate the architecture or experiment with peripherals. For smaller devices, you can even complete a full application since the evaluation version is identical to the full version.



# H8 Development Tools: Debugging Software

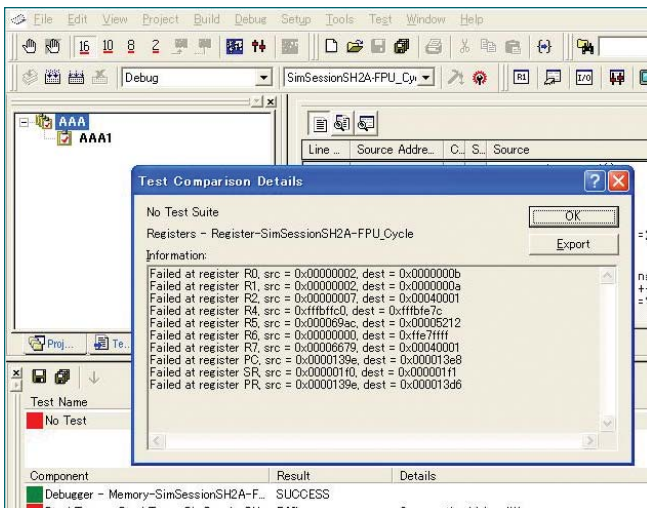
## 8 Integrated Debugging

HEW provides a common debug environment that lets you connect to multiple targets (**simulator, on-chip debugger or full in-circuit emulator**) from the same workspace and presents a consistent set of debugging views irrespective of the debug target you are using.

A simple **Session Wizard** lets you easily add a new debug target to an existing workspace. As well as standard source/assembly, watchpoints, locals, memory and stack trace views, HEW supports advanced debugging features such as **branch/bus trace** and complex events.

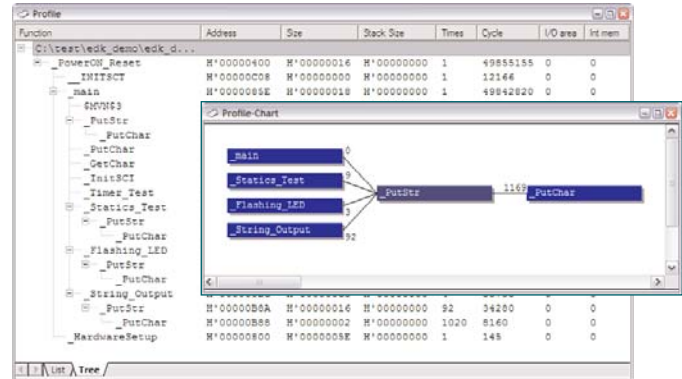
## 9 Test Environment

Automated testing options in HEW feature **TCL scripting** and recordable **macros**, which may be run to duplicate a set of actions. This is further enhanced by the **Test Suite** feature that allows you to record the output of the macro operation and later perform a differences analysis between the current and stored results.

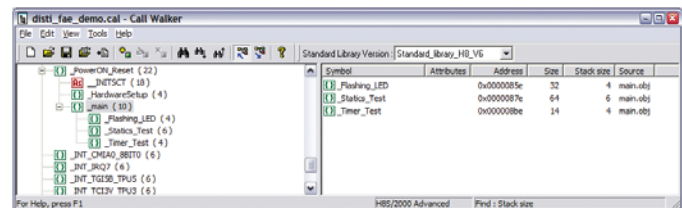


## 10 Analysis Tools

HEW's advanced analysis tools let you optimize your application code with features such as **Code Profiling, Performance Analysis, Stack Analysis** and graphical **Map View**.



Code Profiling



Stack Analyzer

Name	Start Address	End Address	Size	Attribute
HardwareSetup	000800	000855	00000056	Function
_main	000856	00085D	00000008	Function
_Flashing_LED	00085E	00087D	00000020	Function
_Static_Test	00087E	0008BD	00000040	Function
_Timer_Test	0008BE	0008CB	0000000E	Function
_INT_TG13B_TPU0	0008CC	0008F5	0000002A	Function
_Stack	0008F6	00091B	00000026	Function
_INITSTCT	00091C	00091B	00000000	None

Map View

## H8 StarterKit Plus [SKP...] & Renesas Starter Kits [RSK...]

Renesas' low-cost Starter Kits (RSKs) and StarterKit Plus (SKPs) are inexpensive ways to experience the performance of H8 microcontrollers. These kits bundle a low-cost target board with the on-chip debug emulator and the evaluation version of the HEW IDE to offer an integrated evaluation and development platform that lets you get up and running quickly with the H8 family.

Each kit comes complete with board and a CD-ROM that contains:

- Evaluation version of HEW (High-performance Embedded Workshop) and C/C++ compilers
- Flash Development Toolkit (FDT)

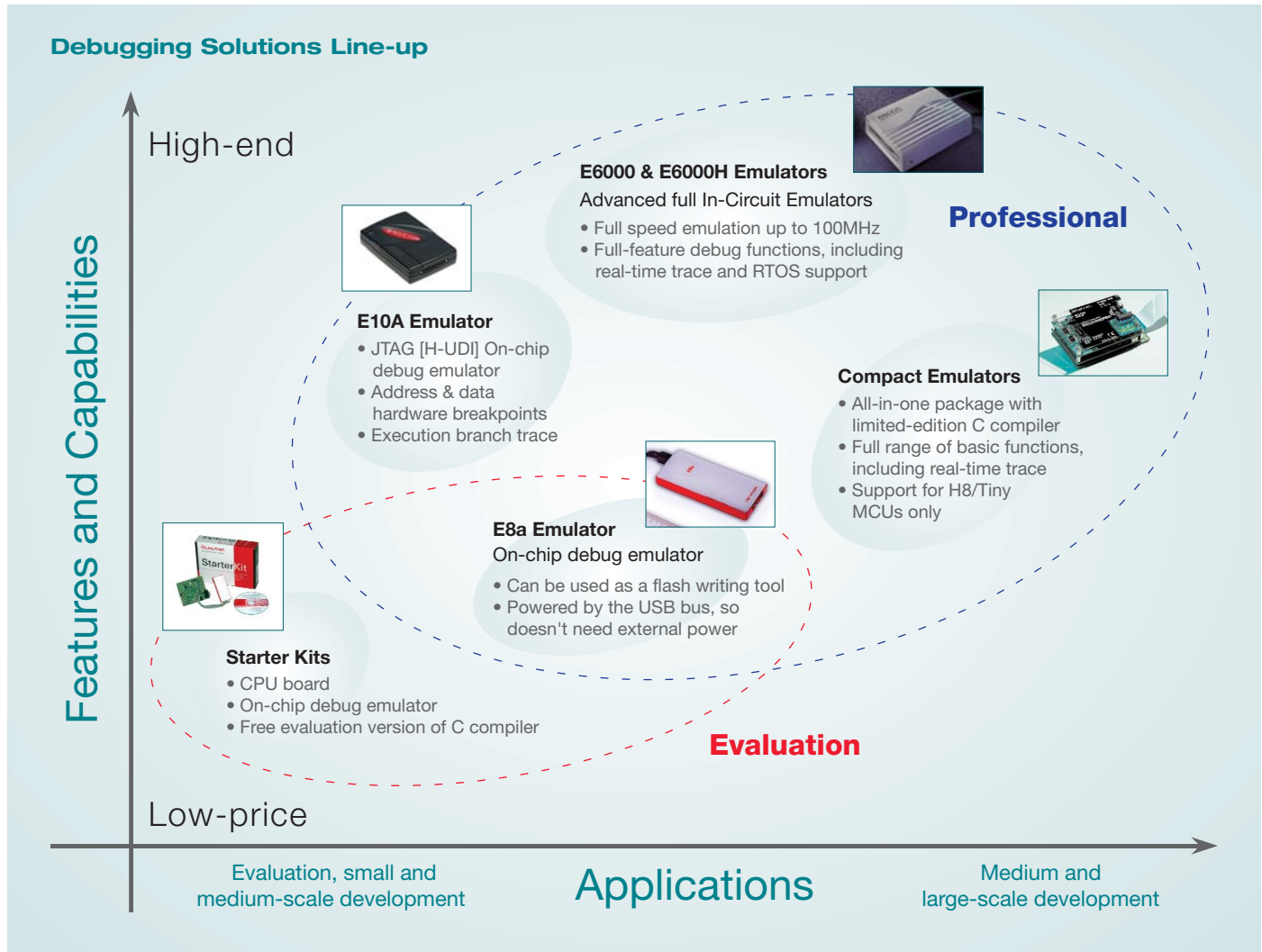
The CD included also has a quick-start guide that shows how to install the software and contains full documentation, plus a Project Generator HEW plug-in for tutorials and peripheral sample code.

The E8a emulator provides a foolproof connection to the host IDE and can also power the target board without the need for an external power supply.

RSK2 Starter Kits for H8S & H8SX devices include a special version of the E10A-USB on-chip debug emulator for debugging via the JTAG [H-UDI] debug port.

For more information on starter kits, please visit [america.renesas.com/rsk](http://america.renesas.com/rsk)





### ■ E8a and E10A-USB on-chip emulators

The E8a and E10A-USB emulators are designed to connect with Renesas' H8 Tiny and JTAG on-chip debugging interfaces, respectively. These low-cost tools provide real-time debugging on the target device, using the dedicated debugging resources built into the target microcontroller in your user hardware. The on-chip emulators connect to the target system via an interface that can be used both to debug the system and to program the MCU's on-chip flash memory.

The E8a and E10A-USB emulators use plug-and-play USB 2.0 compatible interfaces for easy connection to both notebook computers and desktop machines. These emulators offer:

- 255 PC breakpoints
- Hardware breakpoints on data and address
- Saved record of last 4-8 branches
- On-chip flash programming
- Integrated debugging support in HEW

### ■ Compact Emulators for H8 Tiny Series MCUs

For users who require full in-circuit emulation, but not the expanded resources of a traditional ICE, the compact emulator provides a superior cost-performance ratio in an extremely compact design. The emulator main unit comes in a significantly reduced size, compared with conventional emulator systems, allowing easier connection to target systems.

Although the compact emulator is very affordable, it has all the basic functions needed for real development such as access to all of the devices' pins and memory map. It also provides real-time trace and hardware breaks.

- Includes HEW integrated development and debugging environment and an evaluation copy of C/C++ compiler tools
- Supplied as a package, including the target cable and PCB adaptor

### ■ E6000/E6000H in-circuit emulators

Renesas' E6000 series comprises a range of advanced real-time in-circuit emulators, each of which supports a family of processors. You can use the emulators as totally self-contained solutions for software development and debugging, or connect them via a custom cable to a target system for debugging your hardware.

## In-Circuit Emulator — Feature Comparison Example

	COMPACT EMULATOR	FULL-SPEC EMULATOR	
Supported MCU	H8/300H Tiny Series		H8SX
Product Name	R0E436640CPE00 <sup>1</sup>	HS3664EPI62H(E6000)	(E6000H)
Supported MCU mode	Single-chip mode	Single-chip mode Expanded Bus (other E6000 targets)	Expanded bus Max. 100 MHz
Software break	64 points	256 points	255 points
Hardware break	2 points <sup>2</sup> (Address break/ Bus detection/ 255 pass count)	12 points (Fetch/Access/ 65,535 pass count)	Up to 8 ch. on chip (device specific)  4 ch. emulator (Fetch/Access/ 65,535 pass count)
Hardware break condition	AND/OR/simultaneous <sup>2</sup>	AND/OR/sequential	AND/OR/sequential
Exception event detection	N/A	Write-protected area break, guarded (access-prohibited) area break	Write-protected area break, guarded (access-prohibited) area break
Real-time trace	<p><b>Trace Range:</b> All cycles: 64K clock cycles Valid cycles: 64K bus cycles</p> <p><b>Trace Data:</b> address, data, R/W cycle, Memory area section, MCU status</p> <p><b>Trace Mode:</b> 5 modes (Before/Break/About/After/Full)  Record mode can be switched ON/OFF by events</p>	<p><b>Trace Range:</b> 32K bus cycles</p> <p><b>Trace Data:</b> address, data, R/W cycle, Memory area section, MCU status, External trace signal, 4 external probe pins, Range Trace Setting (Point to Point), time stamp</p> <p><b>Trace Mode:</b> 4 modes (Before/Break/About/After) Trace acquisition stop Trace filtering function</p>	<p><b>Trace Range:</b> 128bit x 128k bus cycle</p> <p>Free trace</p> <p>Subroutine trace (12 ch)</p> <p>Conditional subroutine trace (6 ch)</p> <p>Range specification trace (12 ch)</p> <p>Conditions: 12 ch individually, 8 level sequentially, or trace buffer full</p>
Real-time RAM monitor	1024 bytes (256 bytes x 4 blocks) Data / Last access result (Read/Write/Non-accessed)	2048 bytes (256 bytes x 8 blocks) Data / Last access result (Read/Write/Non-accessed)	32 byte x 8 area
Time measurement	Execution time between program start to stop  <b>Maximum time:</b> 30 hours  <b>Count clock:</b> 10MHz	Execution time between program start to stop  <b>Maximum time:</b> 4,800 hours	Max. 8 ch (Max./Mix. Display 4 ch.)  Measurement accuracy: 20ns, 1.6µs, 52µs  <b>Maximum time:</b> 1,560 hours
C0 coverage	N/A	N/A	N/A
PC interface	USB (USB 1.1, Full-speed) <sup>3</sup>	USB (USB 1.1, Full-speed) <sup>3</sup>  Other interface options are: - PCMCIA: HS6000EIP02H - PCI: HS6000EIC02H - LAN: HS6000ELN01H	USB (USB 1.1, Full-speed) <sup>3</sup>  Other interface options are: - PCMCIA: HS6000EIP02H - PCI: HS6000EIC02H - LAN: HS6000ELN01H
External trigger	N/A	4 points	4 in / 1 out
External dimensions	96.0mm x 60.0mm x 37.8mm	219.0mm x 170.0mm x 54.0mm	94.0mm x 222.0mm x 282.0mm

### NOTES

1. The compact emulator main unit [R0E436640CPE00] is bundled with set packages R0E436049CPE10, R0E436640CPE10 and R0E436640CPE20.
2. The hardware break function and trace point setting of the real-time trace function cannot be used simultaneously.
3. Connects to PC with a USB 2.0 port

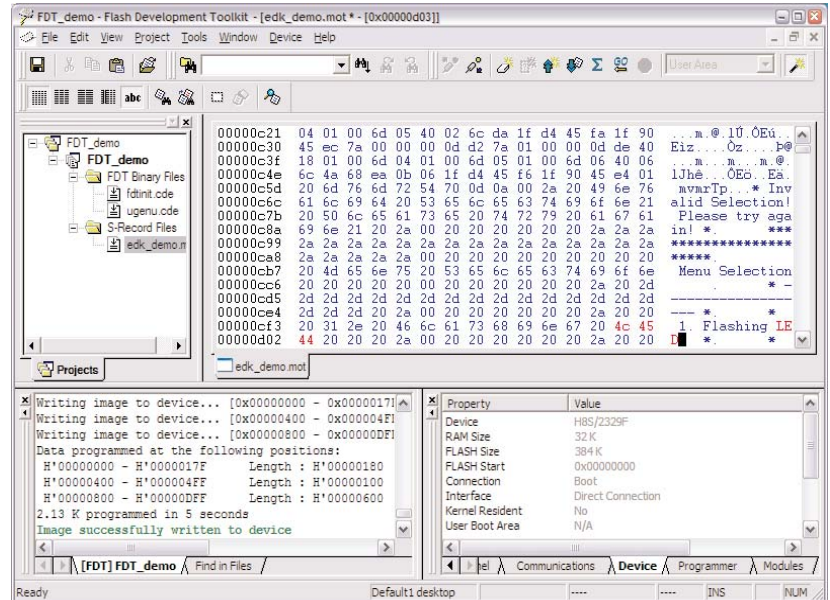
# H8 Development Tools: Programming / Third-party Tools

## Programming with the Flash Development Toolkit (FDT)

Renesas' Flash Development Toolkit (FDT) is an easy-to-use utility for programming your code into the on-chip flash memory of H8 MCUs. You can create workspaces to combine several s-record files into one download image and save connection settings to easily manage device programming.

FDT offers:

- Direct USB connection for USB boot mode devices
- Serial communication at up to 115,200 baud
- Simple mode for 1-button programming
- Hex image editor
- Extensive messaging that helps hardware development
- Support for programming via E8/E8a USB debugger



## Guide to Selected Third-party Development Tools

Many third-party experts offer hardware and software development tools supported by design services, RTOS, compilers, board-level solutions, custom firmware, and board-support packages (BSPs) to meet the needs of customers developing H8-based products.

**IAR Systems** offers a consistent IDE that supports nearly all MCU targets in the industry. The environment includes MISRA C support with integrated CSpy debugging, E8 and E10A-USB support and Elf/Dwarf debug output (compatible with HEW for debugging with full ICE). In addition, IAR offers RTOS-aware debugging with plug-ins for Micrium  $\mu$ C/OS-II, OSEK (ORTI) and Segger embOS. [www.iar.com](http://www.iar.com)



**Micrium** provides high-quality embedded software components by way of engineer-friendly source code, unsurpassed documentation and customer support. The company's world-renowned real-time operating system, the Micrium  $\mu$ C/OS-II, features the highest-quality source code available for today's embedded market. Micrium's products consistently shorten time-to-market throughout all product development cycles. [www.micrium.com](http://www.micrium.com)



**Segger Microcontroller Systems** provides a small and efficient real-time kernel embOS with graphical GUI and file system libraries. [www.segger.com](http://www.segger.com)



**KPIT Cummins Infosystems** provides free-of-charge maintenance and support for GNU compiler tools, including installers that integrate the GCC toolchain into the HEW IDE and allow use with Renesas debuggers and emulators. [www.kpitgnutools.com](http://www.kpitgnutools.com)



**K P I T Cummins  
Infosystems Limited**

**CMX Systems** focuses on providing its customers with all of the tools needed to program their embedded applications. The company's core business is to develop and support real-time, multi-tasking operating systems (RTOS), TCP/IP stacks, Flash File Systems and USB stacks for a wide variety of 8-bit, 16-bit, and 32-bit microcomputers, microprocessors, and digital signal processors. [www.cmx.com](http://www.cmx.com)



**Mentor Graphics/ATI** The Nucleus PLUS RTOS is renowned for its broad range of facilities for building efficient embedded systems. It provides an extensive set of real-time services including task control, task communication, task synchronization, memory management, and programmable timers. [www.mentor.com/embedded](http://www.mentor.com/embedded)



For more details about third-party support, please visit: <http://america.renesas.com/toolspartners>

## Development Tool Selector for focus products

Series	Group	Ordering Part Number	Renesas Package Code	Starter Kit Bold part numbered kits include E10A-for-Starter-Kit JTAG debugger	On-chip Debug Emulator	Compact Emulator (including PCB Adapter)	E6000 / E6000H Emulator		
							Base Unit including PC Interface	Personality Kit (Pod/Probe)	PCB Adapter (Target Cable)
SLP	H8/38602R	DF38602RFT4V	PVQN0032KA-A	SKP38602	R0E00008AKCE00	-	-	-	-
	H8/38004	DF38004H4V	PRQP0064GB-A	SKP38024	R0E00008AKCE00	-	HS38000EPI61H	HS3800EBK61H	HS3802ECH61H
	H8/38347	DF38347HV	PRQP0100KA-A	R0K438347S000BE	R0E00008AKCE00	-	HS38000EPI61H	HS388REBK61H	HS3887ECH61H
	H8/38076R	DF38076RH4V	PRQP0080JB-A	3DK38076	R0E00008AKCE00	-	-	-	-
	H8/38086R	DF38086RH4V	PRQP0080JB-A	3DK38086R	R0E00008AKCE00	-	-	-	-
	H8/38099	DF38099FP10V	PLQP0100KB-A	R0K438099S000BE	R0E00008AKCE00	-	-	-	-
H8/Tiny	H8/36094	DF36094GFZV	PLQP0064KB-A	SKP36077	R0E00008AKCE00	-	HS3664EPI62H	-	HS36014ECN61H
	H8/36077	DF36077GHV	PRQP0064GB-A	SKP36077	R0E00008AKCE00	R0E436640CPE10	HS3664EPI62H	-	HS3687ECH62H
	H8/36079	DF36079GHV	PRQP0064GB-A	R0K436079S000BE	R0E00008AKCE00	R0E436640CPE10	HS3664EPI62H	-	HS3687ECH62H
	H8/36049	DF36049GHV	PRQP0080JB-A	SKP36077	R0E00008AKCE00	R0E436049CPE10	HS3664EPI62H	HS36024EIO61H	HS36049ECH61H
	H8/36109	DF36109GHV	PLQP0100KB-A	R0K436079S000BE	R0E00008AKCE00	-	HS3664EPI62H	HS36109EIO61H	HS36109ECF61H
H8S	H8S/2168	DF2168VTE33V	PTQP0144LC-A	3DK2166	HS0005KCU11H	-	HS2168EPI61H-U	HS6000EMS12H	HS2168ECN61H
	H8S/2168	DF2166VTE33V	PTQP0144LC-A	3DK2166	HS0005KCU11H	-	HS2168EPI61H-U	HS6000EMS12H	HS2168ECN61H
	H8S/2212	DF2211UFP24V	PLQP0064KC-A	3DK2218	HS0005KCU11H	-	HS2214EPI62H-U	HS6000EMS12H	HS2212ECH61H
	H8S/2212	DF2212UFP24V	PLQP0064KC-A	3DK2218	HS0005KCU11H	-	HS2214EPI62H-U	HS6000EMS12H	HS2212ECH61H
	H8S/2218	DF2218UTF24V	PTQP0100LC-A	3DK2218	HS0005KCU11H	-	HS2214EPI62H-U	HS6000EMS12H	HS2218ECN61H
	H8S/2215	DF2215RUTE24V	PTQP0120LA-A	<b>R0K42215RS001BE</b>	HS0005KCU11H	-	HS2214EPI62H-U	HS6000EMS12H	HS2215RECN61H
	H8S/2239	DF2239FA20V	PRQP0100KA-A	EDK2239	-	-	HS2214EPI62H-U	HS6000EMS12H	HS2238ECH61H
	H8S/2327BL	DF2327BVFBL25V	PRQP0128KB-A	EDK2329	HS0005KCU11H	-	HS2339EPI61H-U	HS6000EMS12H	HS2328ECH61H
	H8S/2368	DF2368VTE34V	PTQP0120LA-A	EDK2378	HS0005KCU11H	-	HS2678REPI61H-U	HS6000EMS12H	HS2368ECN61H
	H8S/2378R	DF2372VVFQ34V	PLQP0144KC-A	EDK2378	HS0005KCU11H	-	HS2678REPI61H-U	HS6000EMS12H	HS2378ECH61H
	H8S/2378R	DF2378BVFQ35V	PLQP0144KC-A	EDK2378	HS0005KCU11H	-	HS2678REPI61H-U	HS6000EMS12H	HS2378ECH61H
	H8S/2472	R4F2472VBR34V	PLBG0176GA-A	<b>R05K52472VS000BE</b>	HS0005KCU11H	-	-	-	-
H8SX	H8SX/1622	DF61622N50FPV	PLQP0144KA-A	<b>R0K561622S000BE</b>	HS0005KCU11H	-	HS1650EPH60H	HS6000EIU02H	HS1622ECH61H
	H8SX/1638	DF61638N50FPV	PLQP0120LA-A	<b>R0K561648S000BE</b>	HS0005KCU11H	-	HS1650EPH60H	HS6000EIU02H	HS1638ECN61H
	H8SX/1651	DS61651CN50FPV	PLQP0120LA-A	<b>R0K561664S001BE</b>	HS0005KCU11H	-	HS1650EPH60H	HS6000EIU02H	HS1653ECN61H
	H8SX/1653	RSF61653RN50FTV	PTQP0120LA-A	<b>R0K561664S001BE</b>	HS0005KCU11H	-	HS1650EPH60H	HS6000EIU02H	HS1653ECN61H
	H8SX/1664	DF61664RN50FPV	PLQP0144KA-A	<b>R0K561664S001BE</b>	HS0005KCU11H	-	HS1650EPH60H	HS6000EIU02H	HS1664ECH61H
	H8SX/1668	DF61668N50FPV	PLQP0144KA-A	<b>R0K561668S000BE</b>	HS0005KCU11H	-	HS1650EPH60H	HS6000EIU02H	HS1664ECH61H

## HEW Ordering Numbers

Family	Node Locked		Floating Network		USB Key
	1 user	5 user	1 user	5 user	1 user
H8	RTA-HEWH8-1U	RTA-HEWH8-5U	RTA-HEWH8-1UL	RTA-HEWH8-5UL	RTA-HEWH8-1K

## E10A Emulator Selector

Part #	Description	AUD Trace	Targets	Add Family License
HS0005KCU11H	E10A-Lite with H-UDI (JTAG) connection to target	✗	MCU only H8S, H8SX, SH-2, SH-2A	✗
HS0005KCU01H	Full E10A with H-UDI (JTAG) connection to target.	✗	All H-UDI MCU & MPU	✓
HS0005KCU02H	Full E10A with H-UDI (JTAG) + AUD Trace connection to target.	✓	All H-UDI MCU & MPU	✓

## In-Circuit Emulator Selection

Choosing the components required to complete a full emulation system for a device can be a complicated task due to specific device support and package variations. The Renesas website provides a useful tool to aid in selecting the required components.

### Easy Instructions:

1

Go to the Renesas web site and browse to an emulator product page.

2

Click on the **Options** link in the navigation menu to open the selection search.

3

Select the emulator type in the “Tool Name” menu and then the required Family, Series and Group. Click “Display Results” for a list of the required components.

The screenshot shows the Renesas website's 'Options' tool for the E6000 emulator. The browser window title is 'Renesas Technology - Microsoft Internet Explorer'. The address bar shows 'http://america.renesas.com/request'. The tool interface includes a 'Tool Name' dropdown set to 'E6000', and three dropdown menus for 'Family' (H8S Family), 'Series' (H8S/2300 Series), and 'Group' (H8S/2329 Group). A red 'Display results' button is present. A note below the tool reads: 'note: Search for options to E6000. Please select a device and click "Display results". For details, see at the following the Accessory Guide. <http://tool-support.renesas.com/eng/accessories/index.html>'.

The results are organized into sections: 'H8S Family', 'H8S/2329 Group', and 'H8S/2300 Series H8S/2329 Group FP-128 Recommended products'. The first table lists components for the FP-128 group:

	Product name	Mass produced	Under development	Discontinued	Option Included	Note
Emulator Type Number	HS2339EP61H	x				
Memory Board	HS6000EMS12H	x			x	4MB Expanded Memory
User interface cable or User interface board	HS2328ECH61H	x				
IC socket (connect to target system)	NOPACK128RD	x			x	Tokyo Eletech Co., Ltd. (One socket is attached to the user interface board or user interface cable product.)
Host System Interface (at least one interface board)	HS6000EIP02H	x				PCMCIA Interface HS6000EIP01H has shifted to HS6000EIP02H.
	HS6000EIC02H	x				PCI Interface
	HS6000ELN01H	x				LAN Interface
	HS6000EIU02H	x				USB Interface

The second table lists components for the PTQP0120LA-A group:

	Product name	Mass produced	Under development	Discontinued	Option Included	Note
Emulator Type Number	HS2339EP61H	x				
Memory Board	HS6000EMS12H	x			x	4MB Expanded Memory
User interface cable or User interface board	HS2328ECN61H	x				
IC socket (connect to target system)	IC149-120-043-B51	x			x	Yamaichi Electronics Co., Ltd. (One socket is attached to the user interface board or user interface cable)

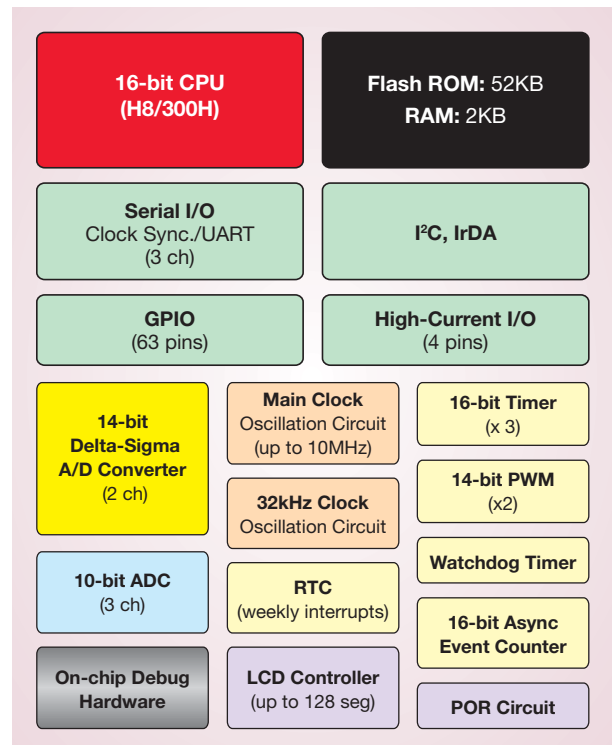
## H8 Super Low Power Series Line-up

<b>100 PINS</b>	<b>38347</b> 16-60KB ROM 1-2KB RAM	<b>38547</b> 16-60KB ROM 1-2KB RAM	<b>38099</b> 96-128KB ROM 2-4KB RAM	<b>38799</b> 96-128KB ROM 2-4KB RAM		
<b>80 PINS</b>	<b>38124</b> <b>38024R</b> 8-32KB ROM; 0.5-1KB RAM	<b>38327</b> 16-60KB ROM 1-2KB RAM	<b>38524</b> 8-32KB ROM 0.5-1KB RAM	<b>38537</b> 16-60KB ROM 1-2KB RAM	<b>38076R</b> <b>38086R</b> 24-52KB ROM 1-2KB RAM	<b>38776R</b> 24-52KB ROM 1-2KB RAM
<b>64 PINS</b>	<b>38104</b> 8-32KB ROM; 0.5-1KB RAM	<b>38004</b> 8-32KB ROM; 0.5-1KB RAM	<b>38504</b> 8-32KB ROM 0.5-1KB RAM		<b>38704</b> 8-32KB ROM 0.5-1KB RAM	
<b>32 PINS</b>	<div style="display: flex; align-items: center;"> <div style="width: 15px; height: 10px; background-color: black; margin-right: 5px;"></div> 3V Operation             <div style="width: 15px; height: 10px; background-color: red; margin-left: 20px; margin-right: 5px;"></div> 5V Operation           </div>				<b>38602R</b> 8-16KB ROM; 0.5-1KB RAM	
	<b>8-bit H8/300L Core with LCD controller</b>		<b>16-bit H8/300H Core with LCD controller</b>		<b>no LCD controller</b>	

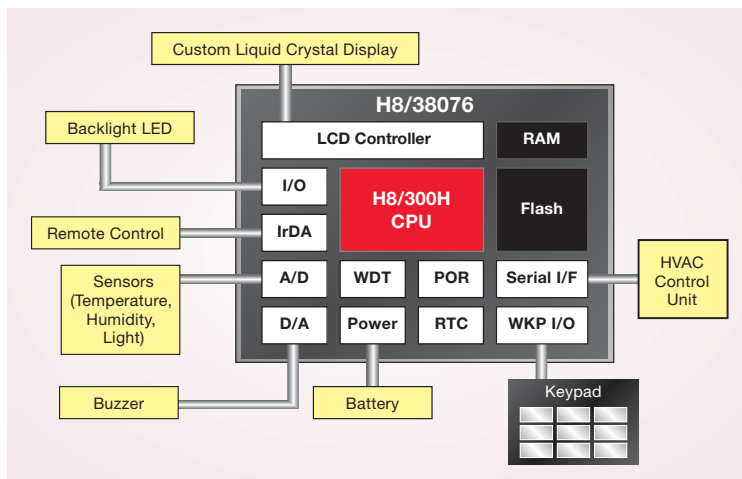
### ■ Features

- Low-power 1.8V CMOS technology and architecture considerations to extend battery life:
  - 0.1uA standby current (1.8V, 25°C)
  - Up to 9 low-power operating modes
  - 32 kHz sub-clock oscillator with day-of-week RTC (0.4uA@1.8V)
  - Peripheral-independent standby mode
  - Shorter oscillation wake-up from standby mode
- Advanced analog interfaces such as 14-bit ADC, comparator
- LCD controller with built-in voltage booster circuit eliminates need for external DC/DC converter
- High current port for driving LEDs directly
- 16-bit asynchronous event counter (AEC) and day-of-week RTC operates even when device is in standby mode

### H8/38086R Block Diagram



### H8/38076R Application Example: *Thermostat Solution*



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**H8/38099 Development Kit**  
(includes free compiler)

**Part Number:**  
**R0K438099S000BE**



H8 Super Low Power Series Selector Guide

Table with columns for Group, Catalog Part Number, Memory, Timers, Special Features, and Package Code: Part No. Suffix. Rows are categorized by 8-bit H8/300L Core and 16-bit H8/300H Core.

Notes:

- 1. Please refer to the Hardware Manual for the operating voltage of Mask ROM devices.
2. This is the sum of the I/O pins + input-only + output-only.
3. High-current is defined as greater than or equal to 10mA for a signal being driven low. This pin count is included in the GPIO total.
4. Please visit Renesas website for full part number, specification, and availability of extended temperature parts.
5. Full catalog part number includes Package Suffix for desired package. Example: "HD64F38347W" is 100-pin TQFP 12mm x 12mm (0.4mm pitch). Refer to Appendix for more details on packages and part numbering.
6. Y = Yes, includes 32kHz crystal oscillator circuitry.
7. The specification for this device is subject to change.

## H8/Tiny & H8S/Tiny Series Line-up

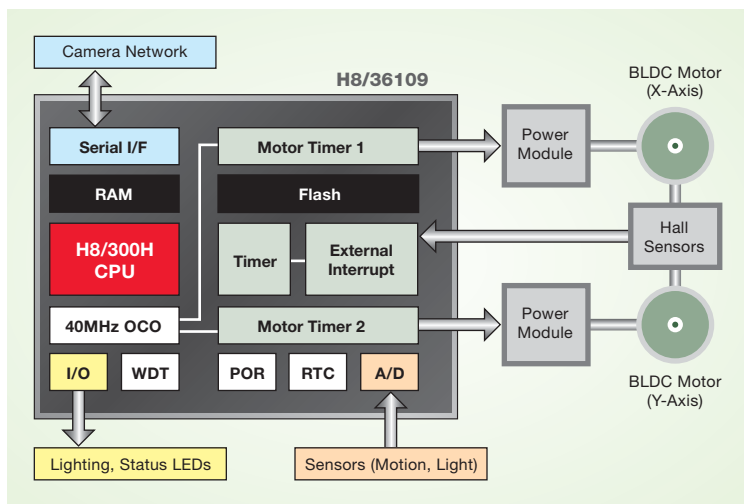
80-100 PINS	<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px;"> <p><span style="display: inline-block; width: 15px; height: 10px; background-color: black; margin-right: 5px;"></span> H8/Tiny (H8/300H CPU)</p> <p><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow; margin-right: 5px;"></span> H8S/Tiny (H8S/2000 CPU)</p> <p><b>G:</b> Power On Reset &amp; Low Voltage Detect</p> <p><b>O:</b> On-Chip Oscillator</p> </div> <div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36109</b> 20MHz; G,O</p> </div> <div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>20223</b> 20MHz; G,O</p> </div> </div>
	<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36049</b> 20MHz; G</p> </div> <div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>20203</b> 20MHz; G,O</p> </div> </div>
	<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36079</b> 20MHz; G,O</p> </div> <div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>20103</b> 20MHz; G,O</p> </div> </div>
48-64 PINS	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36077</b> 20MHz; G,O</p> </div>
	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36079L</b> 20MHz; O</p> </div>
32 PINS	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36094</b> 20MHz; G,O</p> </div>
	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36077L</b> 20MHz; O</p> </div>
	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36912</b> 12MHz; G,O</p> </div>
	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>36902</b> 12MHz; G,O</p> </div>
	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>2-8KB ROM</b></p> </div>
	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>16-56KB ROM</b></p> </div>
	<div style="border: 1px solid black; padding: 5px; width: 100px;"> <p><b>96-128KB ROM</b></p> </div>

### ■ Features

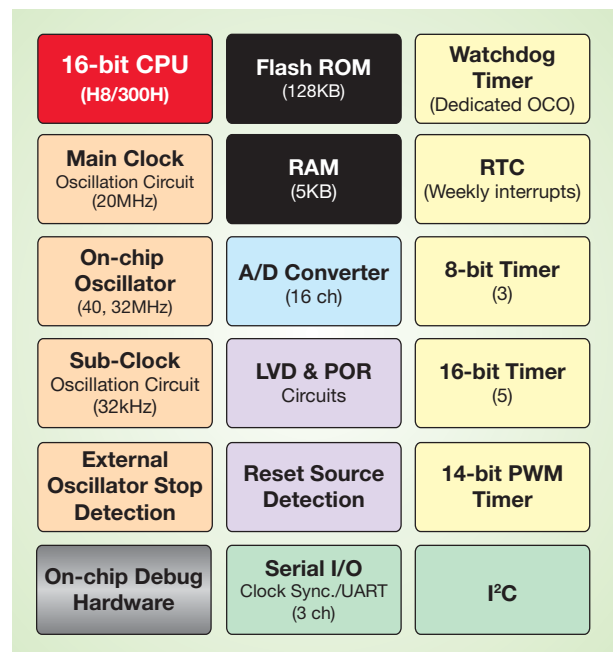
- High-performance 16-bit CPU and eight 32-bit general-purpose registers
- 32, 40 MHz On-chip oscillator reduces system cost
- Fail-safe features such as watchdog timer with independent internal oscillator, crystal resonator fail detection, low-voltage detection and reset source detection
- Multi-functional 8-, 14- and 16-bit timers for advanced waveform generation and signal capture operations
- High peripheral integration including real-time clock, up to 16 A/D channels and a range of communication interfaces

### H8/36109 Application Example:

*Security Camera Control*



### H8/36109 Block Diagram



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**H8/36079 Development Kit**  
(includes free compiler)

**Part Number:**  
**R0K436079S000BE**



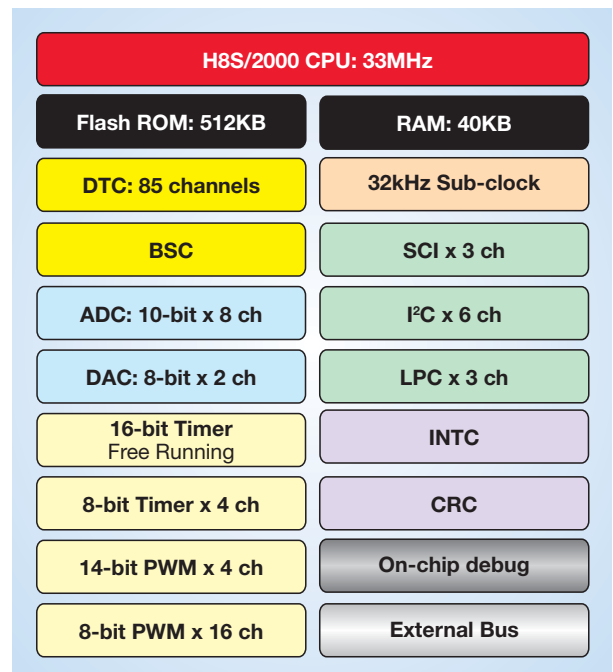
## H8S/2100 Series Line-up

144 to 176 PINS		<b>2112 Group</b> <b>2116 Group</b> <b>2117 Group</b> 128KB ROM; 8KB RAM
144 PINS		<b>2168 Group</b> <b>2114R Group</b> 256-512KB ROM; 40KB RAM   1024KB ROM; 8KB RAM <b>2111B Group</b> <b>2189R Group</b> 64KB ROM; 2-3KB RAM   1024KB ROM; 6KB RAM
100 to 144 PINS	<b>2140B Group</b> 64-256KB ROM; 4-8KB RAM	<b>2153 Group</b> 256KB ROM; 40KB RAM
100 PINS	<b>2148 Group</b> <b>2144B Group</b> 64-128KB ROM; 2-4KB RAM	<b>2110B Group</b> 64KB ROM; 2KB RAM
80 PINS	<b>2138A Group</b> <b>2132, 34 Group</b> 64-128KB ROM   32-128KB ROM 2-4KB RAM   2-4KB RAM	<input checked="" type="checkbox"/> E10A supported (JTAG debug)
64 to 80 PINS	<b>2128 Group</b> 32-128KB ROM; 2-4KB RAM	
<b>3V to 5V</b>		<b>3V</b>

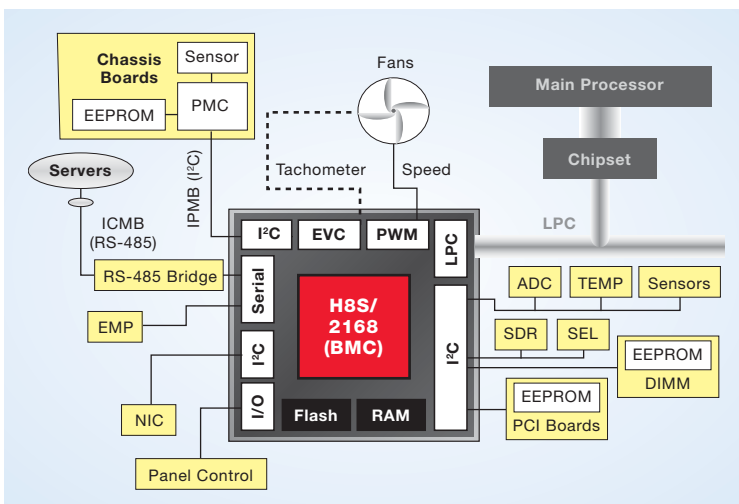
### ■ Features

- Low-Pin-Count (LPC) bus interface synched to 33MHz PCI clock
- X-Bus (ISA) bus interface for legacy devices
- Multiple independent Inter IC (I<sup>2</sup>C™) two-wire serial bus interfaces
- IrDA interface for easy wireless connectivity
- 3-channel on-chip keyboard buffer controller conforming to PS/2 interface specification
- Built-in Data Transfer Controller (DTC) with max. of 85 channels
- Fully integrated IPMI software available from Renesas partners
- Up to 16 PWM channels for multiple fan control

### H8S/2166 Block Diagram



### H8S/2168 Application Example: IPMI



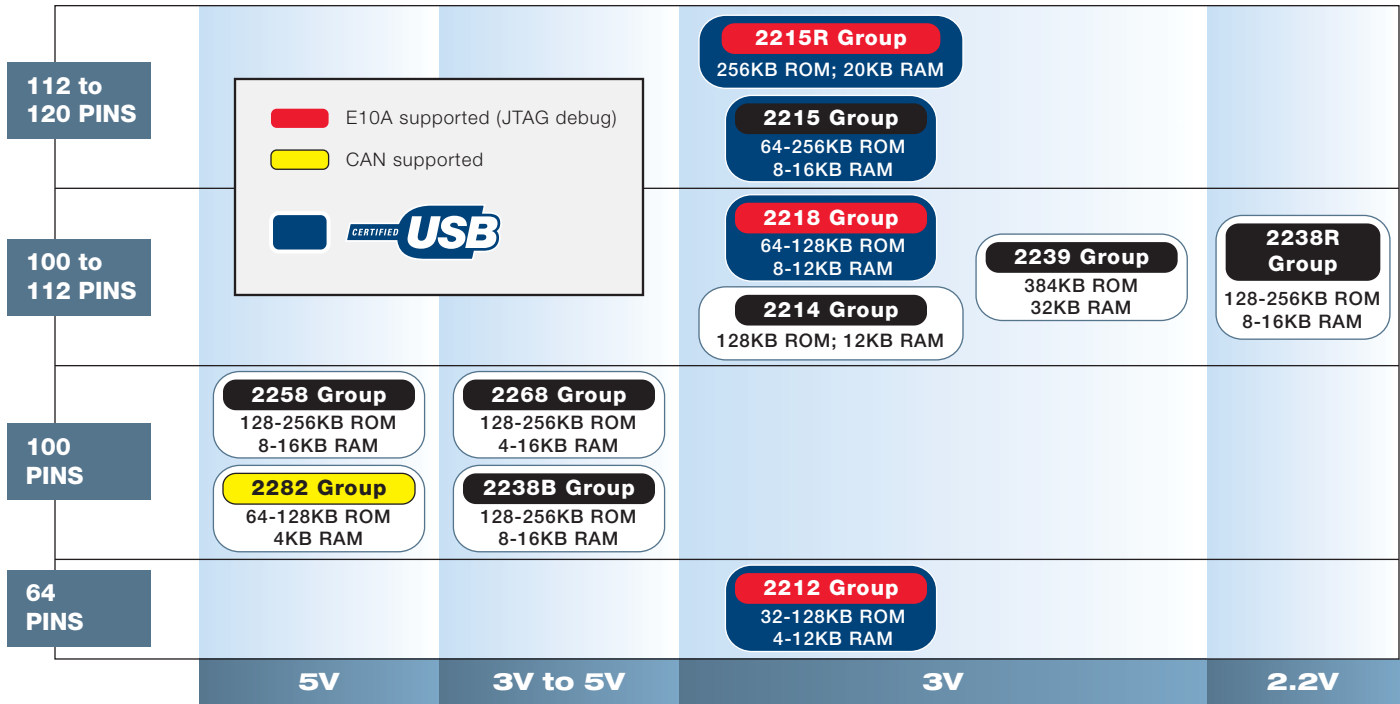
**GET STARTED NOW!**

**H8S/2166 Development Kit**  
(includes free compiler)

**Part Number:**  
**3DK2166**



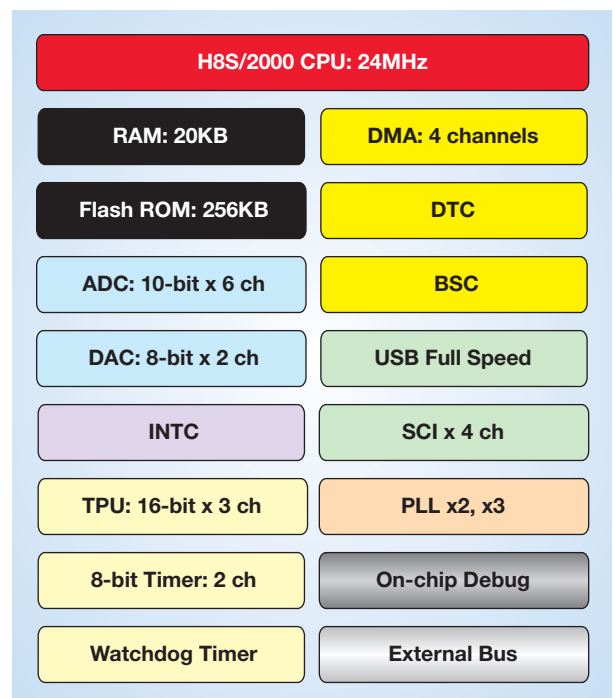
## H8S/2200 Series Line-up



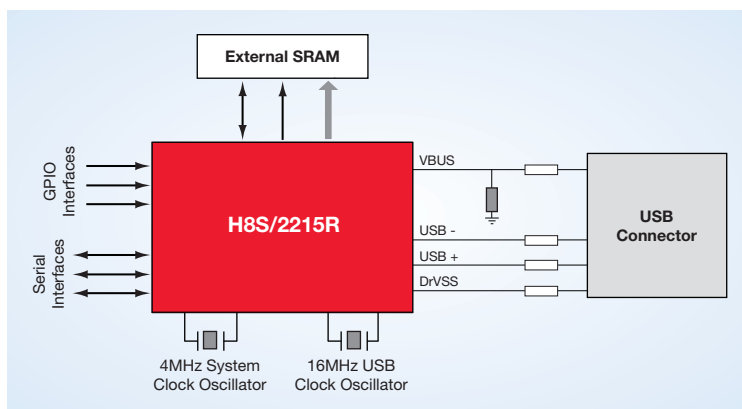
### ■ Features

- Bus-powered/self-powered on-chip USB (v2.0 full speed) core for easy serial connectivity
- 32kHz sub-clock oscillator circuit allows CPU to be switched to sub-active mode to save power
- Real Time Counter (seconds, minutes, hours, days, weeks), running from 32kHz sub-clock
- Flexible clock selection schemes for on-chip and external oscillators, allows lowest power and system cost
- System DMA for main data paths, DTC with 85 channels available for remaining data connectivity
- Full software support:  
Low level HID, CDC, MSC and Bulk example as well as fully supported 3rd party USB protocol stacks for H8S/2200 series devices

### H8S/2215R Block Diagram



### H8S/2215R Application Example: USB Slave Device



**GET STARTED NOW!**

**H8S/2215R Development Kit**  
(includes free compiler)

**Part Number:**  
**R0K42215RS000BE**



## H8S/2300 Series Line-up

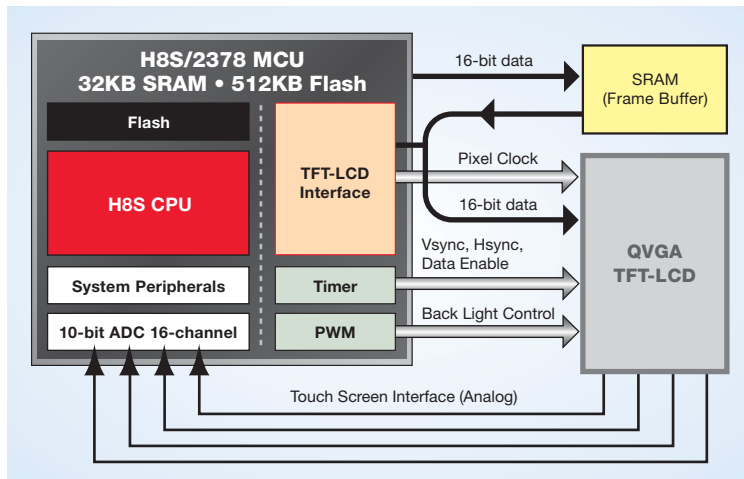
144 to 145 PINS		<b>2378R Group</b> ROMless-512KB ROM 16-32KB RAM	<b>2378 Group</b> ROMless-512KB ROM 16-32KB RAM
144 PINS		<b>2339 Group</b> ROMless-384KB ROM 8-32KB RAM	
120 to 128 PINS		<b>2357 Group</b> ROMless-128KB ROM; 8KB RAM	
		<b>2398 Group</b> ROMless-256KB ROM; 4-32KB RAM	
100 to 113 PINS		<b>2329 Group</b> ROMless-512KB ROM 4-32KB RAM	<b>2368 Group</b> ROMless-512KB ROM 16-32KB RAM
		<b>2319 Group</b> ROMless-512KB ROM 4-16KB RAM	
100 PINS		<b>2345 Group</b> ROMless-128KB ROM; 2-4KB RAM	
		<span style="margin-right: 100px;"><b>5V</b></span> <b>3V</b>	

### ■ Features

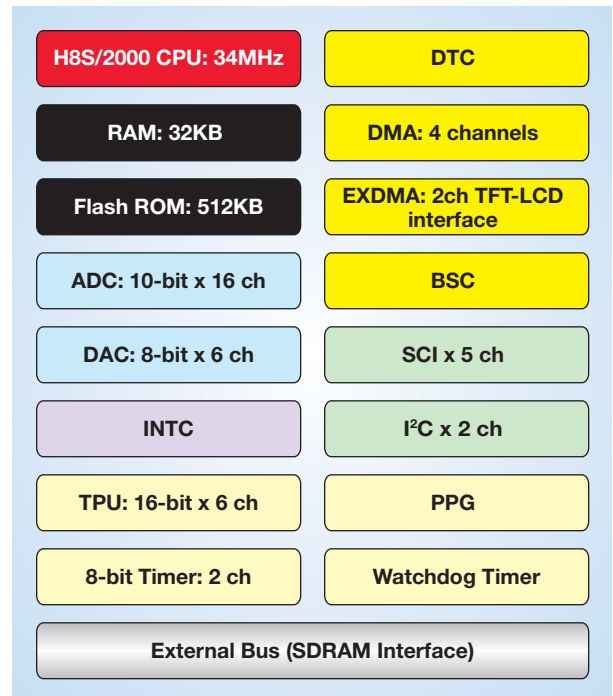
- Pin-for-pin compatibility with roadmap from ROMless to 512KB on-chip Flash
- Advanced bus architecture, with External Data bus operation independently of the main system bus, complemented with dedicated ExDMA engine
- TFT-LCD Interface (ExDMA) for direct drive of QVGA TFT-LCD panels, 16 bits per pixel
- IrDA Interface for easy wireless connectivity
- Supports Smart Card interface conforming to ISO/IEC 7816-3
- Multiple timers, PPG and serial interfaces for connectivity and real-time operation tasks
- External SDR SDRAM supported

### H8S/2378 Application Example:

*QVGA Touchscreen Display Controller*



### H8S/2378R Block Diagram



**GET STARTED NOW!**

**H8S/2378 Development Kit**  
(includes free compiler)

**Part Number:**  
**EDK2378**



## H8S/2300 Series Selector Guide — Part 1 of 2

Group	Catalog Part Number	Memory		Timers			Analog			Serial			DTC	DMA Channels	External Interrupts	GPIO <sup>1</sup> (High current) <sup>2</sup>	External Data Bus	Extended Temperature <sup>3</sup>	Special Features	Package Code			
		Flash (Kbytes)	Mask ROM Options (Kbytes)	RAM (Kbytes)	Vcc min	Vcc max	max. MHz @ Vcc max	8-bit	16-bit	Watchdog	Waveform Generator (PPG)	A/D 10-bit Resolution									D/A 8-bit Resolution	Serial (sync/async)	IrDA
H8S/2319	HD6412312SVF20V	-	-	8	3.0	3.6	20	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PRQP0100JE-B	
	HD6412312SVF25V	-	-	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PRQP0100JE-B	
	HD6412312SVTE20V	-	-	8	3.0	3.6	20	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A	
	HD6412312SVTE25V	-	-	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A	
	HD64F2314VTE25V	384	Y	4	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A	
	HD64F2315VF25V	384	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PRQP0100JE-B	
	HD64F2315VTE25V	384	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A	
	HD64F2317VTE25V	128	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A	
	HD64F2317VTF25V	128	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100LC-A	
	HD64F2318VF25V	256	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PRQP0100JE-B	
	HD64F2318VTE25V	256	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A	
	HD64F2318VTF25V	256	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100LC-A	
	HD64F2319CVF25V	512	-	16	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PRQP0100JE-B	
	HD64F2319CVLP25V	512	-	16	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTL0113JA-A	
	HD64F2319CVTE25V	512	-	16	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A	
	HD64F2319EVF25V	512	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PRQP0100JE-B	
	HD64F2319EVTE25V	512	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A	
HD64F2319VF25V	512	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PRQP0100JE-B		
HD64F2319VTE25V	512	Y	8	3.0	3.6	25	2	6	1	-	8	2	2	-	Y	-	9	79 (0)	Y	-	PTQP0100KA-A		
H8S/2329	HD6412320VF20V	-	-	4	2.7	3.6	20	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A
	HD6412320VF25V	-	-	4	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A
	HD6412320VTE20V	-	-	4	2.7	3.6	20	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A
	HD6412320VTE25V	-	-	4	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A
	HD6412321VF20V	-	-	4	2.7	3.6	20	2	6	1	16	8	2	3	-	Y	-	9	95 (0)	Y	-	PRQP0128KB-A	
	HD6412321VF25V	-	-	4	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	9	95 (0)	Y	-	PRQP0128KB-A	
	HD6412321VTE20V	-	-	4	2.7	3.6	20	2	6	1	16	8	2	3	-	Y	-	9	95 (0)	Y	-	PTQP0120LA-A	
	HD6412321VTE25V	-	-	4	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	9	95 (0)	Y	-	PTQP0120LA-A	
	HD6412322RVF20V	-	-	8	2.7	3.6	20	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A
	HD6412322RVF25V	-	-	8	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A
	HD6412322RVTE20V	-	-	8	2.7	3.6	20	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A
	HD6412322RVTE25V	-	-	8	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A
	HD6412324SVF25V	-	-	32	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A
	HD6412324SVTE20V	-	-	32	2.7	3.6	20	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A
	HD6412324SVTE25V	-	-	32	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A
	HD64F2326CVF25V	512	-	16	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A
	HD64F2326CVTE25V	512	-	16	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A
HD64F2326VF25V	512	-	8	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A	
HD64F2326VTE25V	512	-	8	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A	
HD64F2328BVF25V	256	Y	8	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A	
HD64F2328BVT25V	256	Y	8	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A	
HD64F2329BVF25V	384	-	32	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A	
HD64F2329BVT25V	384	-	32	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A	
HD64F2329EVF25V	384	-	32	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PRQP0128KB-A	
HD64F2329EVTE25V	384	-	32	3.0	3.6	25	2	6	1	16	8	2	3	-	Y	-	4	9	95 (0)	Y	-	PTQP0120LA-A	
H8S/2339	HD6412332VFC20V	-	-	8	2.7	3.6	20	2	6	1	16	12	4	3	-	Y	-	4	9	118 (0)	Y	-	PRQP0144KA-A
	HD6412332VFC25V	-	-	8	3.0	3.6	25	2	6	1	16	12	4	3	-	Y	-	4	9	118 (0)	Y	-	PRQP0144KA-A
	HD64F2338VFC25V	256	Y	8	3.0	3.6	25	2	6	1	16	12	4	3	-	Y	-	4	9	118 (0)	Y	-	PRQP0144KA-A
	HD64F2339EVFC25V	384	-	32	3.0	3.6	25	2	6	1	16	12	4	3	-	Y	-	4	9	118 (0)	Y	-	PRQP0144KA-A
	HD64F2339VFC25V	384	-	32	3.0	3.6	25	2	6	1	16	12	4	3	-	Y	-	4	9	118 (0)	Y	-	PRQP0144KA-A

(The H8S/2300 Series Selector Guide is continued on page 33)

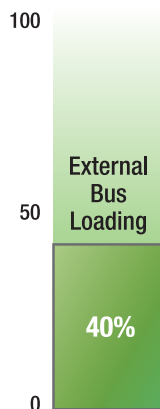
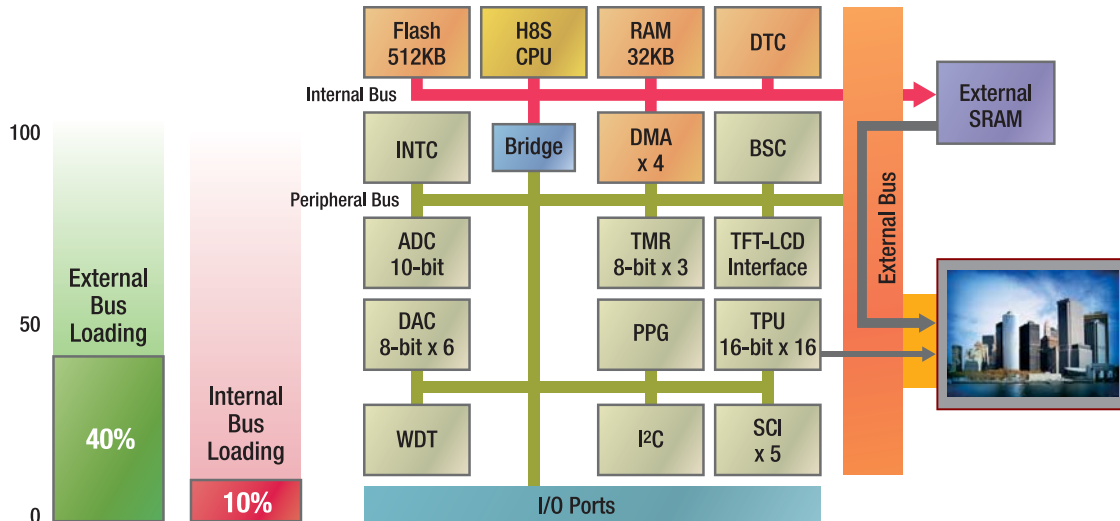
## Notes:

1. This is the sum of the I/O pins + input-only + output-only.
2. High-current is defined as greater than or equal to 10mA for a signal being driven low. This pin count is included in the GPIO total.
3. Please visit Renesas website for full part number, specification, and availability of extended temperature parts.

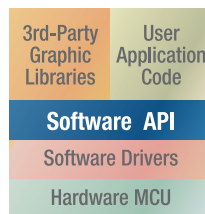


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Easy Steps.

# High Performance, Low Cost, Easy Path to TFT-LCD



- ▶ LCD direct-drive, minimal loading on CPU core
- ▶ Touch-screen direct connection, decode algorithm on CPU core
- ▶ Low-cost solution drives up to WVGA TFT-LCD panel size
- ▶ Full-screen animation at 25 frames per second
- ▶ Advanced graphic features available
  - Transparency, Alpha Blending
- ▶ Easy-to-use path with Software API for bitmap definition, animation
- ▶ Third-party graphics tools supported



Start your development today with the H8S2378 LCD Direct-Drive Demonstration Kit.

Ordering Part Number: **YLCDRSK2378**



Guide to LCD Direct Drive Solutions						
	System Clock	Flash	SRAM	Features	LCD panel	Maximum Frame rate
<b>H8S/2378</b>	35MHz	256-512KB	16-32KB	High-Speed Serial Interfaces, Timers	QVGA (320x240) WQVGA (480x272) VGA (640x480)	138 Hz 116 Hz 42 Hz
<b>H8S/2456</b>	34MHz	256KB	48KB	High-Speed Serial Interfaces, Timers, USB Device (12Mbps)	QVGA (320x240) WQVGA (480x272) VGA (640x480)	130 Hz 110 Hz 40 Hz
<b>H8SX/1668</b>	50MHz	384-1024KB	40-56KB	High-Speed Serial Interfaces, Timers, USB Device (12Mbps)	WQVGA (480x272) VGA (640x480) WVGA (800x480)	166 Hz 60 Hz 55 Hz


## H8S/2300 Series Selector Guide — Part 2 of 2

Group	Catalog Part Number	Memory			Vcc min Vcc max max MHz @ Vcc max			Timers			Analog			Serial			GPIO <sup>1</sup> (High current) <sup>2</sup>					Special Features	Package Code	
		Flash (Kbytes)	Mask ROM Options (Kbytes)	RAM (Kbytes)				8-bit	16-bit	Watchdog	Waveform Generator (PPG)	A/D 10-bit Resolution	D/A 8-bit Resolution	Serial (sync/async)	IrDA	Smart Card I/F	I <sup>2</sup> C	DTC	DMA Channels	External Interrupts	External Data Bus			Extended Temperature <sup>3</sup>
H8S/2345	HD6412340FA10V	-	-	2	2.7	5.5	10	2	6	1	-	8	2	2	-	Y	-	Y	-	9	79 (28)	Y	Y	PRQP0100KA-A PRQP0100KA-A PTQP0100KA-A
	HD6412340FA20V	-	-	2	4.5	5.5	20	2	6	1	-	8	2	2	-	Y	-	Y	-	9	79 (28)	Y	Y	PRQP0100JE-B PRQP0100KA-A PTQP0100KA-A
	HD6412340TE20V	-	-	2	4.5	5.5	20	2	6	1	-	8	2	2	-	Y	-	Y	-	9	79 (28)	Y	Y	PRQP0100KA-A PRQP0100JE-B PRQP0100KA-A PTQP0100KA-A
	HD64F2345F20V	128	Y	4	4.5	5.5	20	2	6	1	-	8	2	2	-	Y	-	Y	-	9	79 (28)	Y	Y	PRQP0100KA-A PTQP0100KA-A
	HD64F2345FA20V	128	Y	4	4.5	5.5	20	2	6	1	-	8	2	2	-	Y	-	Y	-	9	79 (28)	Y	Y	PRQP0100KA-A PTQP0100KA-A
	HD64F2345TE20V	128	Y	4	4.5	5.5	20	2	6	1	-	8	2	2	-	Y	-	Y	-	9	79 (28)	Y	Y	PRQP0100KA-A PTQP0100KA-A
H8S/2357	HD6412352F13V	-	-	8	3.0	5.5	13	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PRQP0128KB-A PTQP0120LA-A
	HD6412352F20V	-	-	8	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412352TE13V	-	-	8	3.0	5.5	13	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412352TE20V	-	-	8	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2357F20V	128	Y	8	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2357TE20V	128	Y	8	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2357VF13V	128	Y	8	3.0	5.5	13	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2357VTE13V	128	Y	8	3.0	5.5	13	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
H8S/2368	HD64F2360VTE	256	Y	16	3.0	3.6	33	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	TPTQ0120LA-A TPTQ0120LA-A TPTQ0120LA-A
	HD64F2361VTE	256	-	24	3.0	3.6	33	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2362VTE	256	-	32	3.0	3.6	33	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412363VF33V	-	-	16	3.0	3.6	33	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412363VTE33V	-	-	16	3.0	3.6	33	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	TPTQ0120LA-A TPTQ0120LA-A
	HD64F2364VTE	384	-	32	3.0	3.6	33	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2366VF33V	384	-	30	3.0	3.6	33	2	6	1	-	10	2	5	Y	Y	2	Y	-	9	94 (0)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2366VTE33V	384	-	30	3.0	3.6	33	2	6	1	-	10	2	5	Y	Y	2	Y	-	9	94 (0)	Y	-	HSS
	HD64F2367VF33V	384	-	24	3.0	3.6	33	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	DRAMC, HSS, BusTrace PTQP0120LA-A
	HD64F2367VTE33V	384	-	24	3.0	3.6	33	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	DRAMC, HSS, BusTrace PTQP0120LA-A
	HD64F2368VTE34V	512	-	32	3.0	3.6	34	2	6	1	16	10	2	5	Y	Y	2	Y	4	9	94 (0)	Y	-	DRAMC, HSS PTQP0120LA-A
	H8S/2378	HD6412370VFQ34V	256	Y	16	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-
HD6412371VFQ34V		256	-	24	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PLQP0144KC-A
HD6412372VFQ34V		256	-	32	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PLQP0144KC-A
HD6412373VFQ33V		-	-	16	3.0	3.6	33	2	6	1	16	16	2	5	Y	Y	2	Y	4	17	113 (0)	Y	-	DRAMC, HSS PLQP0144KC-A
HD6412374VFQ34V		384	-	32	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PLQP0144KC-A
HD64F2376VFQ33V		384	-	30	3.0	3.6	33	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PLQP0144KC-A
HD64F2378AVFQ34V		512	-	32	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	DRAMC, 2 ch EXDMAC PLQP0144KC-A
HD64F2378BVFQ35V		512	-	32	3.0	3.6	35	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PLQP0144KC-A
HD64F2378BVL35V	512	-	32	3.0	3.6	35	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PTLG0145JB-A	
H8S/2378R	HD6412370RVFQ34V	256	Y	16	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	SDRAM, 2 ch EXDMAC, HSS PLQP0144KC-A
	HD6412371RVFQ34V	256	-	24	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PLQP0144KC-A
	HD6412372RVFQ34V	256	-	32	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PLQP0144KC-A
	HD6412374RVFQ34V	384	-	32	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	PLQP0144KC-A
	HD64F2377RVFQ33V	384	-	24	3.0	3.6	33	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	SDRAM, 2 ch EXDMAC, HSS, BusTrace PLQP0144KC-A
	HD64F2377RVFQ33VV	384	-	24	3.0	3.6	33	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	SDRAM, 2 ch EXDMAC, HSS PLQP0144KC-A
	HD64F2378RVFQ34V	512	-	32	3.0	3.6	34	2	6	1	16	16	6	5	Y	Y	2	Y	4	17	113 (0)	Y	-	SDRAM, 2 ch EXDMAC, HSS PLQP0144KC-A
H8S/2398	HD6412390F20V	-	-	4	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412390TE20V	-	-	4	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412392F20V	-	-	8	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412392TE20V	-	-	8	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412394F20V	-	-	32	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD6412394TE20V	-	-	32	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2398F20V	256	Y	8	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A
	HD64F2398TE20V	256	Y	8	4.5	5.5	20	2	6	1	16	8	2	3	-	Y	-	Y	4	9	95 (32)	Y	-	PRQP0128KB-A PTQP0120LA-A

**Notes:**

1. This is the sum of the I/O pins + input-only + output-only.
2. High-current is defined as greater than or equal to 10mA for a signal being driven low. This pin count is included in the GPIO total.
3. Please visit Renesas website for full part number, specification, and availability of extended temperature parts.

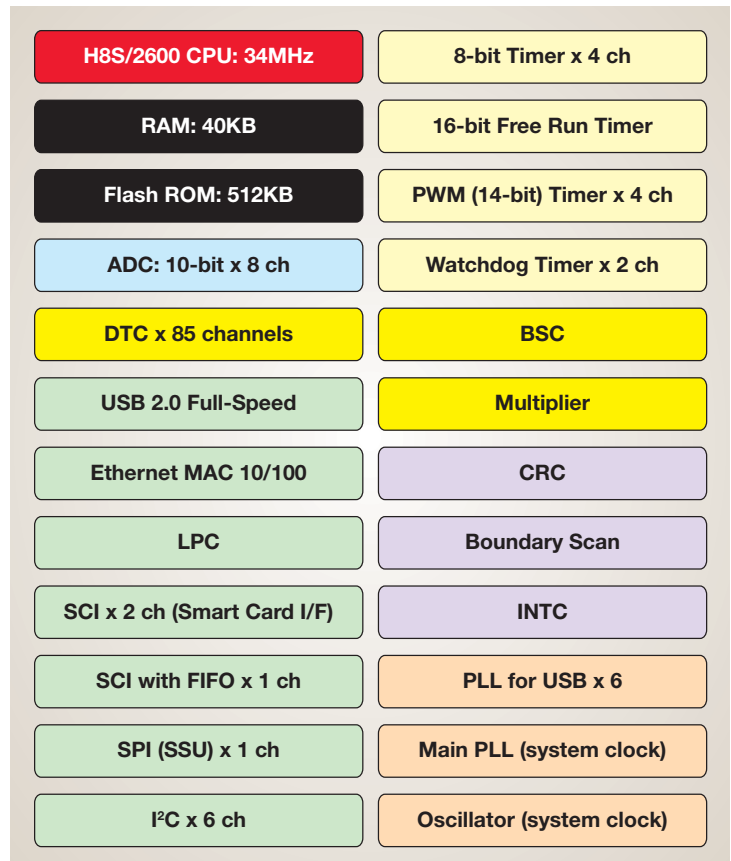
## H8S/2400 Series Line-up

		USB	Ethernet
176 PINS			<b>2472 Group</b> 512KB ROM; 40KB RAM E10A Support
145/144 PINS	<b>2426 Group</b> 256KB ROM; 48KB RAM E10A Support	<b>2456 Group</b> 256KB ROM; 48KB RAM E10A Support	
144 PINS			<b>2462 Group</b> 512KB ROM; 40KB RAM E10A Support
128 PINS	<b>2437 Group</b> 256KB ROM; 16KB RAM		
120 PINS	<b>2424 Group</b> 256KB ROM; 48KB RAM E10A Support	<b>2454 Group</b> 256KB ROM; 48KB RAM E10A Support	
<b>3V</b>			

### ■ Features

- Up to 34MHz, 16-bit CISC CPU with Hardware Multiply Accumulate block (H8S 2600 CPU)
- Ethernet Hardware MAC with external MII and RMII (IEEE802.3u compliant) interfaces
- TFT-LCD Interface (ExDMA) for direct drive of QVGA TFT-LCD panels, 16 bits per pixel
- USB v2.0 compliant device; full software driver support
- Low-Pin-Count (LPC) bus interface synchronized with 33MHz PCI clock

### H8S/2472 Block Diagram



**GET STARTED NOW!**

**H8S/2472 Development Kit**  
(includes free compiler)

**Part Number:**  
**R05K52472VC000BE**

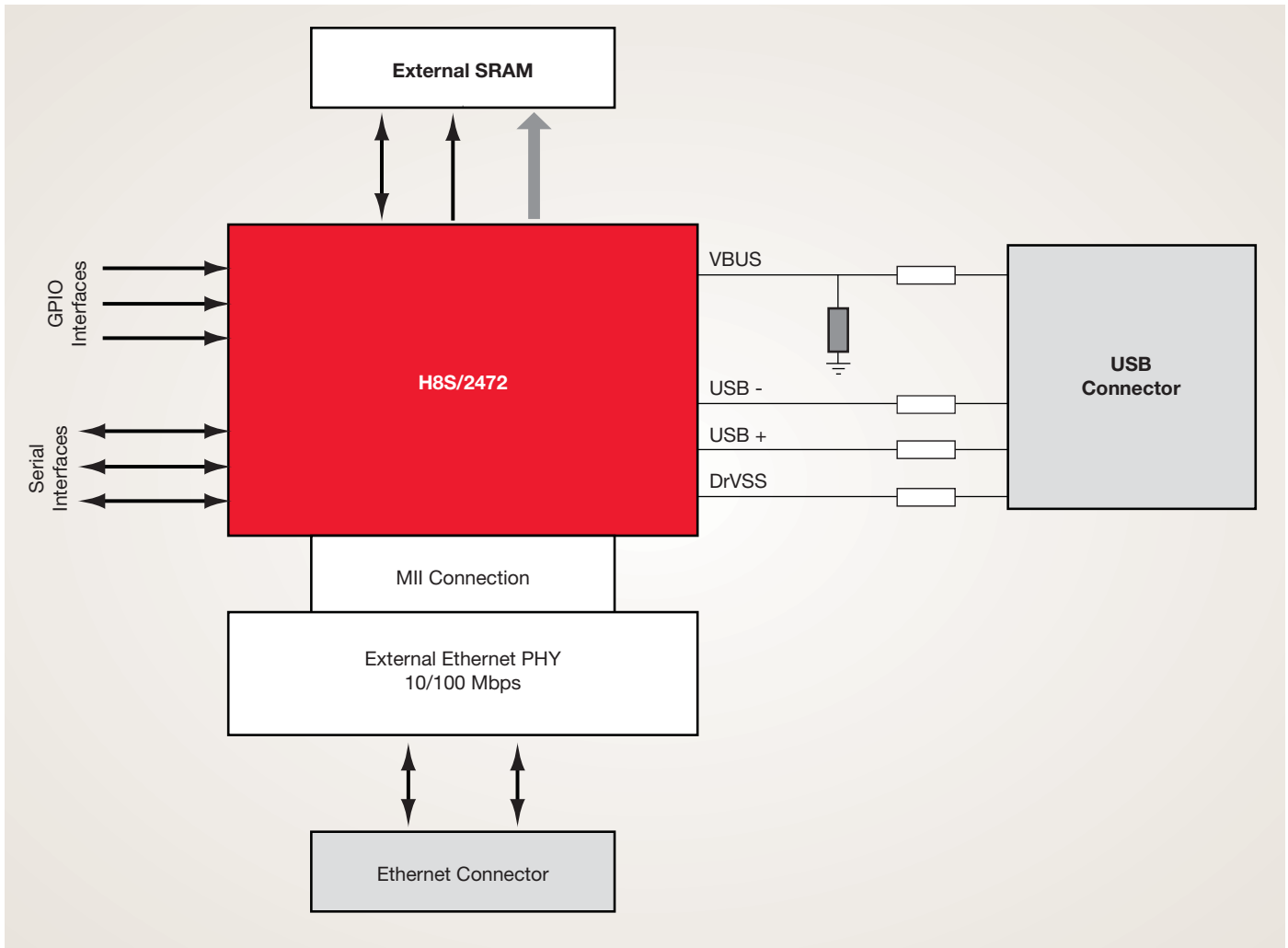
## H8S/2400 Series Selector Guide

Group	Catalog Part Number	Memory		Vcc min	Vcc max	max MHz @ Vcc max	Timers					Analog		Serial			DTC	DMA Channels	External Interrupts	GPIO <sup>1</sup>	External Data Bus	Extended Temperature <sup>2</sup>	Special Features	Package Code	
		Flash (Kbytes)	RAM (Kbytes)				8-bit Timers	16-bit Timers	Watchdog Timers	8-bit PWM	14-bit PWM D/A	A/D 10-bit Resolution	D/A 8-bit Resolution	Serial (sync/async)	IrDA	Smart Card I/F									°C
H8S/2424	HD64F2424VFQ33V	256	48	3.0	3.6	33	2	12	1	-	10	2	5	Y	Y	4	Y	4	17	113 (0)	Y	-	SSU, SDRAM, PPG	PLQP0120LA-A	
H8S/2426	HD64F2426VLP33V	256	48	3.0	3.6	33	2	12	1	-	16	2	5	Y	Y	4	Y	4	17	113 (0)	Y	-	TFT-LCD (EXDMAC), PPG, SSU, SDRAM, BSCAN	PTLG0145JB-A PLQP0144KC-A	
	HD64F2426VFQ33V	256	48	3.0	3.6	33	2	12	1	-	16	2	5	Y	Y	4	Y	4	17	113 (0)	Y	-			
H8S/2437	HD64F2437FV	256	16	3.0	3.6	20	4	5	1	8	2	16	-	5	-	-	4	-	-	9	110	Y	-	DMC, TMC, 5v IO, BusTrace	PRQP0128KB-A
H8S/2454	HD64F2426VFQ33V	256	48	3.0	3.6	33	2	12	1	-	10	2	5	Y	Y	4	Y	4	17	113 (0)	Y	-	USB, SSU, SDRAM, PPG	PLQP0120LA-A	
	HD64F2456VLP33V	256	48	3.0	3.6	33	2	12	1	-	16	2	5	Y	Y	4	Y	4	17	113 (0)	Y	-	TFT-LCD (EXDMAC), PPG, USB, SSU, SDRAM, BSCAN	PTLG0145JB-A PLQP0144KC-A	
H8S/2456	HD64F2456VLP33V	256	48	3.0	3.6	33	2	12	1	-	16	2	5	Y	Y	4	Y	4	17	113 (0)	Y	-	TFT-LCD (EXDMAC), PPG, USB, SSU, SDRAM, BSCAN	PTLG0145JB-A PLQP0144KC-A	
	HD64F2456VFQ33V	256	48	3.0	3.6	33	2	12	1	-	16	2	5	Y	Y	4	Y	4	17	113 (0)	Y	-			
H8S/2462	HD64F2472VFQ34V	512	40	3.0	3.6	34	4	1	2	-	4	8	-	3	-	Y	6	Y	-	17	113 (0)	Y	-	CRC, BSCAN, Ethernet, LPC, SSU	PLQP0144KC-A
H8S/2472	HD64F2472VLP35V	512	40	3.0	3.6	34	4	1	2	-	4	8	-	3	-	Y	6	Y	-	17	113 (0)	Y	-	CRC, BSCAN, USB, Ethernet, LPC, SSU	PLBG0176GA-A

**Notes:**

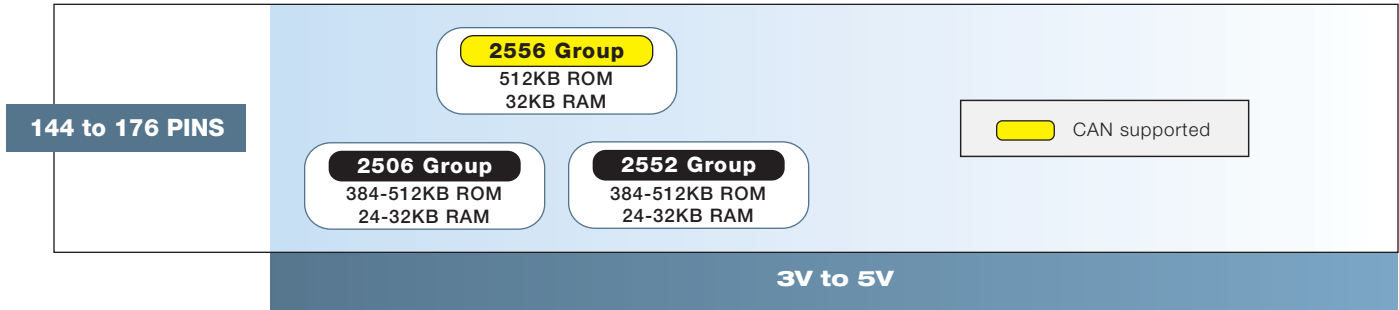
1. This is the sum of the I/O pins + input-only + output-only.
2. Please visit Renesas website for full part number, specification, and availability of extended temperature parts.

### H8S/2472 Application Example: Networked Home Appliances and Electronics



# H8S/2500 Series: Audio Applications

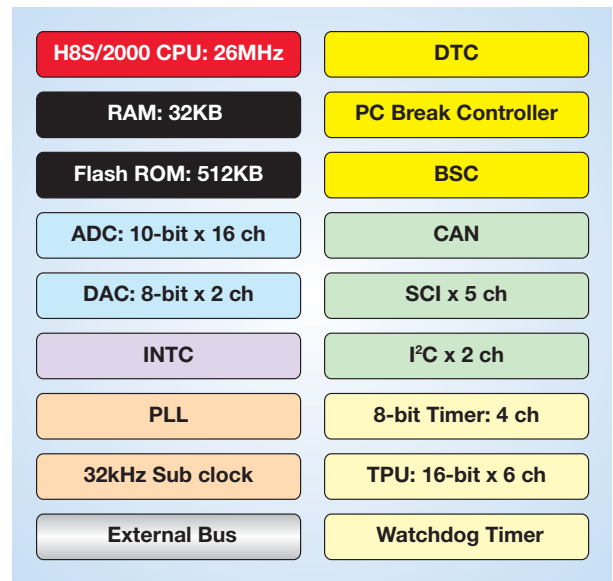
## H8S/2500 Series Line-up



### Features

- Up to 2-channel Controller Area Network (CAN v2.0) controller
- Up to 26MHz, 16-bit CISC CPU
- 6 power-down modes for reducing power consumption
- 32kHz sub-clock oscillator
- Built-in Data Transfer Controller (DTC) with maximum of 85 channels
- Support Smart Card interface conforming to ISO/IEC 7816-3
- Dual 3V and 5V I/O functions supported

### H8S/2556 Block Diagram



### H8S/2500 Series Selector Guide

Group	Catalog Part Number	Memory		V <sub>cc</sub> min V <sub>cc</sub> max max MHz @ V <sub>cc</sub> max	V <sub>cc</sub> IO Min <sup>1</sup> V <sub>cc</sub> IO Max <sup>4</sup> 32 kHz Sub Clock <sup>1</sup>	Timers					Analog		Serial			DTC External Interrupts GPIO <sup>2</sup> External Data Bus Extended Temperature <sup>3</sup>	Special Features	Package Code
		Flash (Kbytes)	RAM (Kbytes)			8-bit Timers	16-bit Timers	Watchdog Timers	8-bit PWM	14-bit PWM D/A	A/D 10-bit Resolution	D/A 8-bit Resolution	Serial (sync/async)	IrDA	Smart Card I/F			
I8S/2506	HD64F2505BR26DV	384	32	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y	PC Break, Dual V <sub>cc</sub> IO	PLBG0176GA-A PRQP0144KB-A PLBG0176GA-A PRQP0144KB-A							
	HD64F2505FC26V	384	32	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y									
	HD64F2506BR26DV	512	32	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y									
	HD64F2506FC26V	512	32	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y									
I8S/2552	HD64F2551BR26DV	384	24	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y	PC Break, Dual V <sub>cc</sub> IO, IEB	PLBG0176GA-A PRQP0144KB-A PLBG0176GA-A PRQP0144KB-A							
	HD64F2551FC26DV	384	24	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y									
	HD64F2552BR26DV	512	32	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y									
	HD64F2552FC26DV	512	32	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y									
I8S/2556	HD64F2556FC20DV	512	32	3.0 5.5 26	3.0 5.5 Y	4 6 2 - -	16 2	5 - Y 2	Y 9 120 Y Y	PC Break, Dual V <sub>cc</sub> IO, CAN	PRQP0144KB-A							

#### Notes:

1. Y = Yes, includes 32kHz crystal oscillator circuitry.
2. This is the sum of the I/O pins + input-only + output-only.
3. Please visit Renesas website for full part number, specification, and availability of extended temperature parts.
4. The voltage supply is specific to some of the GPIO pins and independent of V<sub>cc</sub>.

When it comes to USB,  
H8 stands in front.



simplicity + greater design versatility

## H8 Microcontrollers Can Be Self-Powered or USB Bus-Powered

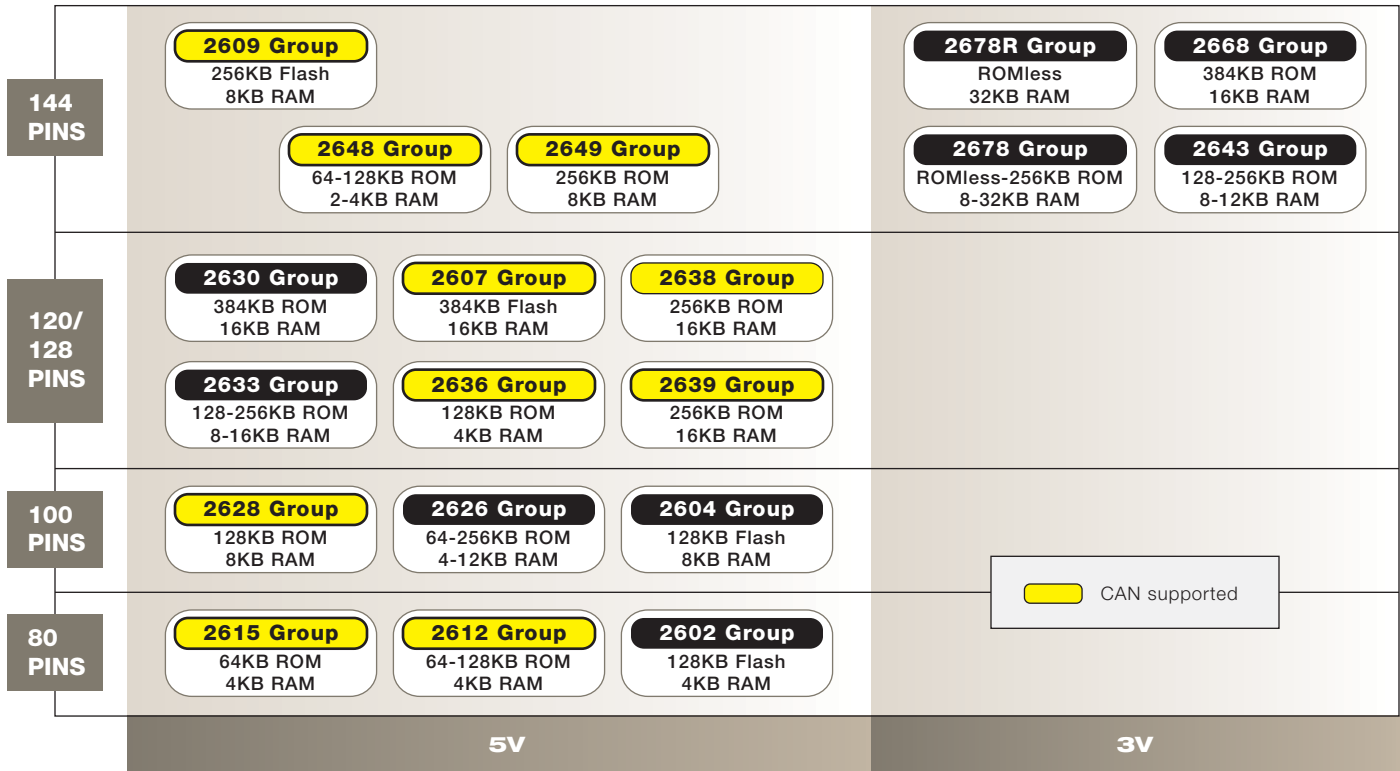
With Renesas H8 devices, there's no need to create two designs to satisfy different power requirements for applications that use USB links. Selection of self-powered or USB-bus powered operation is made via an input pin. Either way, when the USB cable is disconnected from your system, the microcontroller is automatically put into a defined state, a powered-down mode. A simple, effective solution. Apply it and see for yourself!



### Guide to USB-compatible H8S Devices

Group	ROM/RAM/Speed	Features
<b>USB 2.0 Full-Speed [Bulk, Interrupt, Control transfers supported]</b>		
H8S/2212	128KB/12KB/24MHz	Single Chip, Sub Clock, On-Chip Debugger
H8S/2211	64KB/8KB/24MHz	<b>USB FIFO: 456 Bytes</b> <b>Package: 64-pin QFP</b>
H8S/2218	128KB/12KB/24MHz	Sub Clock, On-Chip Debugger <b>USB FIFO: 456 Bytes</b> <b>Package: 100-pin QFP</b>
H8SX/1668	1024KB/56KB/48MHz	On-Chip Debugger
H8SX/1664	512KB/40KB/48MHz	<b>USB FIFO: 288 Bytes</b> <b>Package: 144-pin LQFP</b>
H8SX/1663	384KB/40KB/48MHz	
H8SX/1658	1024KB/56KB/48MHz	On-Chip Debugger
H8SX/1654	512KB/40KB/48MHz	<b>USB FIFO: 288 Bytes</b> <b>Package: 120-pin QFP</b>
H8SX/1653	384KB/40KB/48MHz	
<b>USB 2.0 Full-Speed [Isochronous, Bulk, Interrupt, Control transfers supported]</b>		
H8S/2215	256KB/16KB/16MHz	<b>USB FIFO: 1288 Bytes</b> <b>Packages: 120-pin QFP, 112-pin BGA</b>
H8S/2215R	256KB/20KB/24MHz	On-Chip Debugger, USB Cera Lock Support <b>USB FIFO: 1288 Bytes</b> <b>Packages: 120-pin QFP, 112-pin BGA</b>
<b>USB 2.0 High-Speed/Full-Speed [Bulk, Interrupt, Control transfers supported]</b>		
H8S/2170	256KB/32KB/33MHz	On-Chip Debugger <b>USB FIFO: 1224 Bytes</b> <b>Package: 100-pin QFP</b>

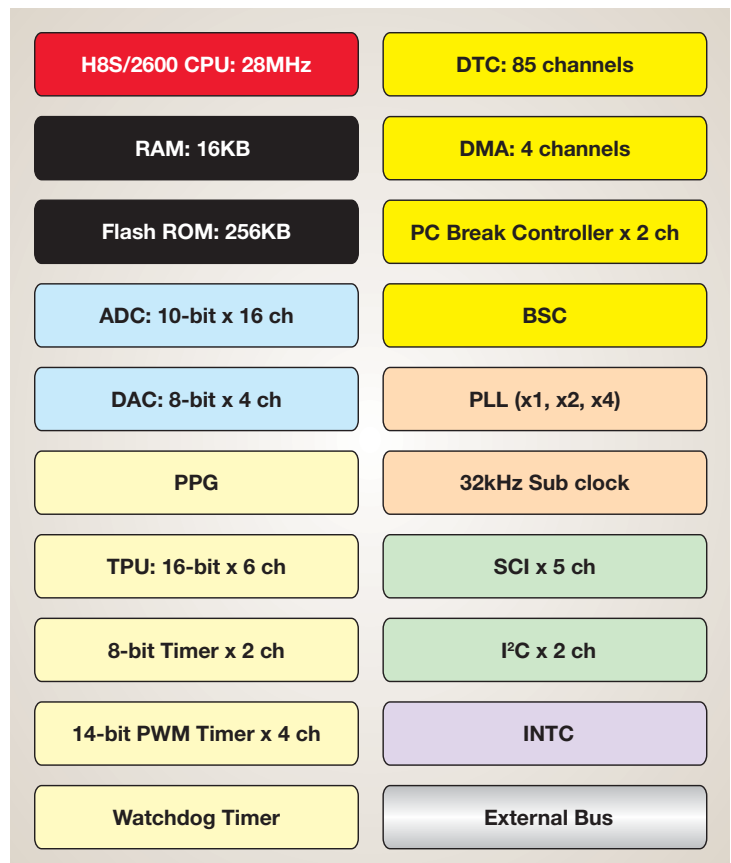
## H8S/2600 Series Line-up



### ■ Features

- Up to 2-channel Controller Area Network (CAN v2.0) controller
- 16-bit motor-control PWM
- 32kHz sub-clock oscillator circuit (some devices)
- Built-in Data Transfer Controller (DTC) with maximum of 85 channels, Built-in DMA controller (DMAC) with maximum of 4 channels
- Supports Smart Card interface conforming to ISO/IEC 7816-3
- 2-channel on-chip PC Break controller for self-monitoring debugger
- Built-in SDRAM interface (H8S/2674R only)

### H8S/2633 Series Block Diagram



**GET STARTED NOW!**

**H8S/2676 Development Kit**  
(includes free compiler)

**Part Number:**  
**EDK2676**



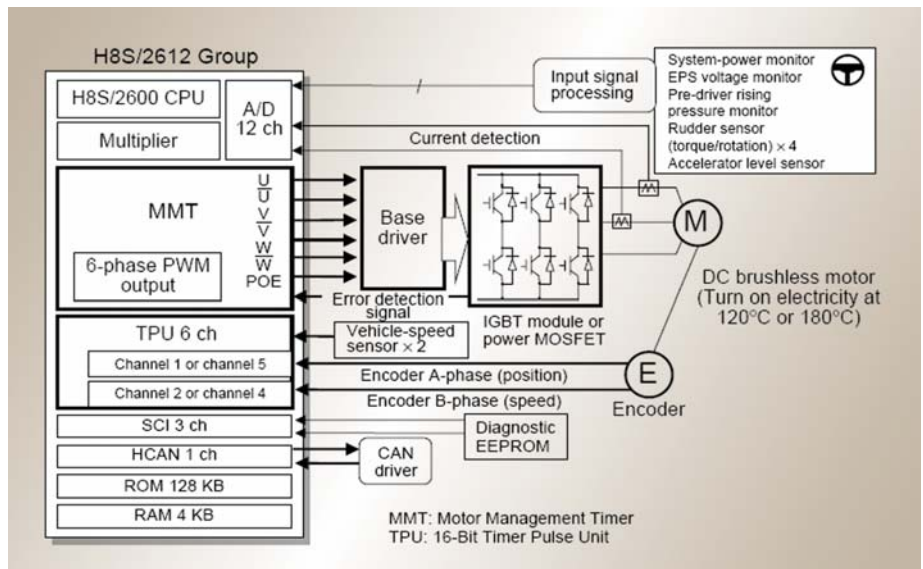
## H8S/2600 Series Selector Guide

Group	Catalog Part Number	Memory			Vcc			Timers					Analog		Serial				Special Features			Package Code											
		Flash (Kbytes)	Mask ROM Options (Kbytes)	RAM (Kbytes)	Vcc min	Vcc max	max MHz @ Vcc max	VccIO Min <sup>5</sup>	VccIO Max <sup>5</sup>	32 kHz Sub-Clock <sup>1</sup>	8-bit	16-bit Watchdog	Waveform Generator (PPG)	Motor Control/PWM Timer	14-bit PWM D/A	A/D 10-bit Resolution	D/A 8-bit Resolution	Serial (sync/async)	IrDA	Smart Card I/F	I <sup>2</sup> C		CAN	DTC	DMA Channels	External Interrupts	GPIO <sup>2</sup> (High current) <sup>3</sup>	External Data Bus	Extended Temperature <sup>4</sup>				
H8S/2602	HD64F2602F20V	128	Y	4	4.5	5.5	20	-	-	-	-	6	1	8	-	-	12	2	3	-	Y	-	-	Y	-	7	56 (0)	-	Y	PC Break	PRQP0080JD-A		
H8S/2604	HD64F2604F20V	256	Y	8	4.5	5.5	20	-	-	Y	-	4	1	8	-	-	16	-	2	2	Y	-	-	Y	-	7	68 (0)	Y	Y	PC Break	PRQP0100KB-A		
H8S/2607	HD64F2607F20V	384	Y	16	4.5	5.5	20	-	-	-	-	6	2	8	1	-	12	2	3	-	Y	2	-	Y	-	7	84 (16)	Y	Y	-	PRQP0128KB-A		
H8S/2609	HD64F2608FC20JV	128	Y	8	4.5	5.5	20	-	-	Y	-	6	2	8	1	-	16	-	4	-	Y	-	-	Y	-	7	113 (0)	Y	Y	PC Break	PRQP0144KA-A		
H8S/2612	HD64F2612FA20V	128	Y	4	4.5	5.5	20	-	-	-	-	-	6	1	8	MMT	-	12	-	3	-	Y	-	1	Y	-	7	56 (0)	-	Y	PC Break, MMT	PRQP0080JD-A	
H8S/2615	HD64F2615FA24V	64	Y	4	4.5	5.5	24	-	-	DIV	-	-	6	2	-	-	16	-	3	-	Y	-	1	-	-	7	56 (0)	-	Y	-	PRQP0080JD-A		
H8S/2626	HD64F2623FA20JV	256	Y	12	4.5	5.5	20	-	-	-	-	-	6	1	8	-	16	-	3	-	Y	-	1	Y	-	7	70 (0)	Y	Y	2-ch PC Break	PRQP0100KA-A		
	HD64F2623FA20V	256	Y	12	4.5	5.5	20	-	-	-	-	-	6	1	8	-	16	-	3	-	Y	-	1	Y	-	7	70 (0)	Y	Y		PRQP0100KA-A		
	HD64F2626FA20JV	256	Y	12	4.5	5.5	20	-	-	Y	-	-	6	2	8	-	16	2	3	-	Y	-	1	Y	-	7	68 (0)	Y	Y		PRQP0100KA-A		
	HD64F2626FA20V	256	Y	12	4.5	5.5	20	-	-	Y	-	-	6	2	8	-	16	2	3	-	Y	-	1	Y	-	7	68 (0)	Y	Y		PRQP0100KA-A		
H8S/2628	HD64F2628FA24V	128	Y	8	4.5	5.5	24	-	-	-	-	-	4	6	1	8	-	16	-	2	-	Y	-	2	Y	-	7	76 (0)	-	Y	PC Break, 2ch SSU	PRQP0100KB-A	
H8S/2630	HD64F2630F20V	384	Y	16	4.5	5.5	20	-	-	-	-	-	6	2	8	1	-	12	2	3	-	Y	-	2	Y	-	7	84 (16)	Y	Y	15mA IO, PC Break	PRQP0128KB-A	
	HD64F2630UF20V	384	Y	16	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	2	3	-	Y	-	2	Y	-	7	84 (16)	Y	Y		PRQP0128KB-A	
	HD64F2630WF20V	384	Y	16	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	2	3	-	Y	2	2	Y	-	7	84 (16)	Y	Y		PRQP0128KB-A	
H8S/2633	HD64F2633F16V	256	Y	16	3.0	3.6	16	3.0	5.5	Y	-	-	4	6	2	8	-	4	16	4	5	Y	Y	2	-	Y	4	9	89 (0)	Y	Y	PC Break, DRAMC	PRQP0128KB-A
	HD64F2633RF28V	256	-	16	4.5	5.5	28	4.5	5.5	Y	-	-	4	6	2	8	-	4	16	4	5	Y	Y	2	-	Y	4	9	89 (0)	Y	Y		PRQP0128KB-A
	HD64F2633RTE28V	256	-	16	4.5	5.5	28	4.5	5.5	Y	-	-	4	6	2	8	-	4	16	4	5	Y	Y	2	-	Y	4	9	89 (0)	Y	-		PTQP0120LA-A
	HD64F2633TE16V	256	Y	16	3.0	3.6	16	3.0	5.5	Y	-	-	4	6	2	8	-	4	16	4	5	Y	Y	2	-	Y	4	9	89 (0)	Y	Y		PTQP0120LA-A
H8S/2636	HD64F2636F20V	128	Y	4	4.5	5.5	20	-	-	-	-	-	6	2	8	1	-	12	2	3	-	Y	-	2	Y	-	7	84 (16)	Y	Y	15mA IO, PC Break	PRQP0128KB-A	
	HD64F2636UF20V	128	Y	4	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	2	3	-	Y	-	2	Y	-	7	84 (16)	Y	Y		PRQP0128KB-A	
H8S/2638	HD64F2638F20V	256	Y	16	4.5	5.5	20	-	-	-	-	-	6	2	8	1	-	12	2	3	-	Y	-	2	Y	-	7	84 (16)	Y	Y	15mA IO, PC Break	PRQP0128KB-A	
	HD64F2638UF20V	256	Y	16	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	2	3	-	Y	-	2	Y	-	7	84 (16)	Y	Y		PRQP0128KB-A	
	HD64F2638WF20V	256	Y	16	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	2	3	-	Y	2	2	Y	-	7	84 (16)	Y	Y		PRQP0128KB-A	
H8S/2639	HD64F2639UF20V	256	Y	16	4.5	5.5	20	-	-	DIV	-	-	6	2	8	1	-	12	2	3	-	Y	-	2	Y	-	7	84 (16)	Y	Y	15mA IO, PC Break	PRQP0128KB-A	
	HD64F2639WF20V	256	Y	16	4.5	5.5	20	-	-	DIV	-	-	6	2	8	1	-	12	2	3	-	Y	2	2	Y	-	7	84 (16)	Y	Y		PRQP0128KB-A	
H8S/2643	HD64F2643FC16V	256	Y	16	3.0	3.6	16	3.0	5.5	Y	-	-	4	6	2	16	-	-	16	4	5	Y	Y	2	-	Y	4	9	111 (0)	Y	Y	PC Break, DRAMC	PRQP0144KB-A
	HD64F2643FC25V	256	Y	16	3.0	3.6	25	4.5	5.5	Y	-	-	4	6	2	16	-	-	16	4	5	Y	Y	2	-	Y	4	9	111 (0)	Y	Y		PRQP0144KB-A
H8S/2648	HD64F2646RFC20JV	128	Y	4	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	-	2	-	Y	-	1	Y	-	7	108 (16)	Y	Y	15mA IO, PC Break, 24x4 LCDC	PRQP0144KB-A	
	HD64F2646RFC20V	128	Y	4	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	-	2	-	Y	-	1	Y	-	7	108 (16)	Y	Y		PRQP0144KB-A	
	HD64F2648RFC20JV	128	Y	4	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	-	3	-	Y	-	1	Y	-	7	108 (16)	Y	Y	15mA IO, PC Break, 40x4 LCDC	PRQP0144KB-A	
	HD64F2648RFC20V	128	Y	4	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	12	-	3	-	Y	-	1	Y	-	7	108 (16)	Y	Y		PRQP0144KB-A	
H8S/2649	HD64F2649FC20JV	256	Y	6	4.5	5.5	20	-	-	Y	-	-	6	2	8	1	-	16	-	4	-	Y	-	2	Y	-	7	113 (0)	Y	Y	PC Break, 40x4 LCDC	PRQP0144KA-A	
H8S/2668	HD64F2667VFC33V	384	-	8	3.0	3.6	33	-	-	-	-	-	2	6	1	16	-	-	12	4	3	Y	Y	-	-	Y	8	115 (0)	Y	Y	HSS	PLQP0144KC-A	
H8S/2678	HD6412670VFC33V	-	-	8	3.0	3.6	33	-	-	-	-	-	2	6	1	16	-	-	12	4	3	Y	Y	-	-	Y	8	115 (0)	Y	Y	4 ch EXDMAC, DRAMC	PRQP0144KA-A	
	HD64F2676VFC33V	256	Y	8	3.0	3.6	33	-	-	-	-	-	2	6	1	16	-	-	12	4	3	Y	Y	-	-	Y	8	115 (0)	Y	Y	4 ch EXDMAC, DRAMC	PRQP0144KA-A	
H8S/2678R	HD6412674RVFC33V	-	-	32	3.0	3.6	33	-	-	-	-	-	2	6	1	16	-	-	12	4	3	Y	Y	-	-	Y	8	117	115 (0)	Y	Y	SDRAM, 4 ch EXDMAC, HSS	PLQP0144KC-A

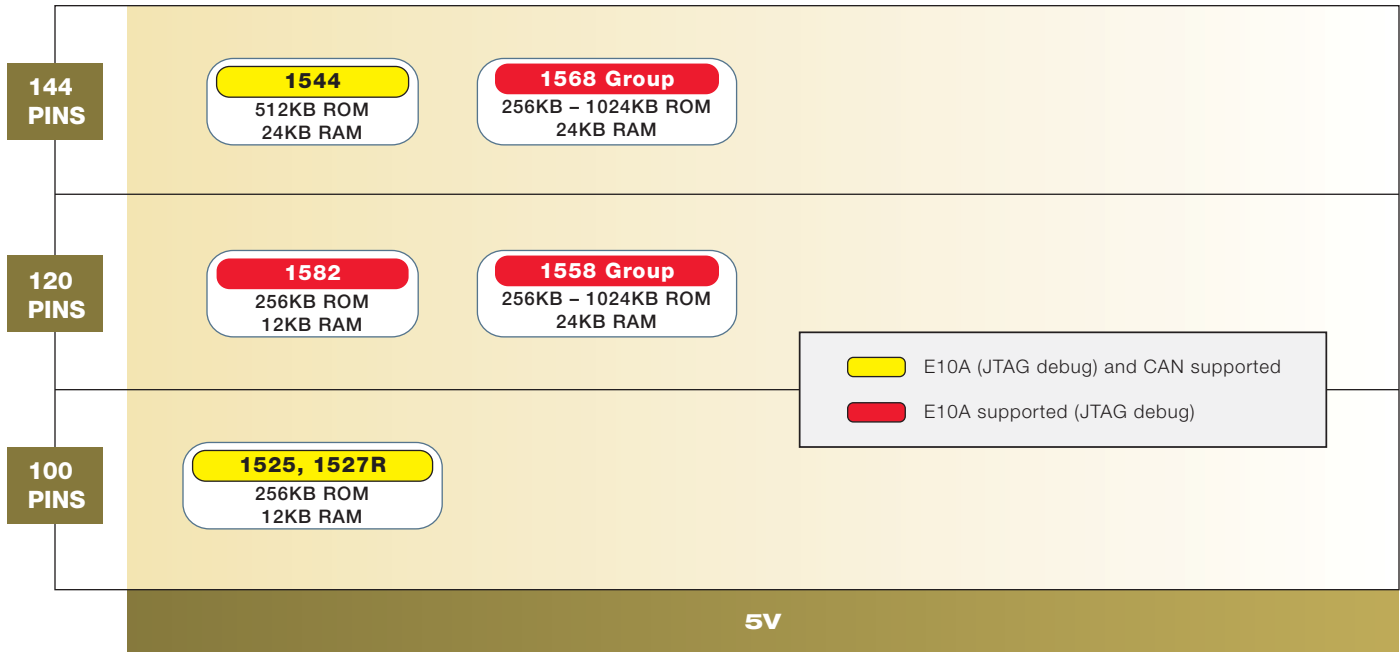
**Notes:**

- Y = Yes, includes 32kHz crystal oscillator circuitry; "DIV" = Main clock is divided down for sub-clock mode.
- This is the sum of the I/O pins + input-only + output-only.
- High-current is defined as greater than or equal to 10mA for a signal being driven low. This pin count is included in the GPIO total.
- Please visit Renesas website for full part number, specification, and availability of extended temperature parts.
- This voltage supply is specific to some of the GPIO pins and independent of Vcc.

### H8S/2612 Application Example: Electronic Power Steering



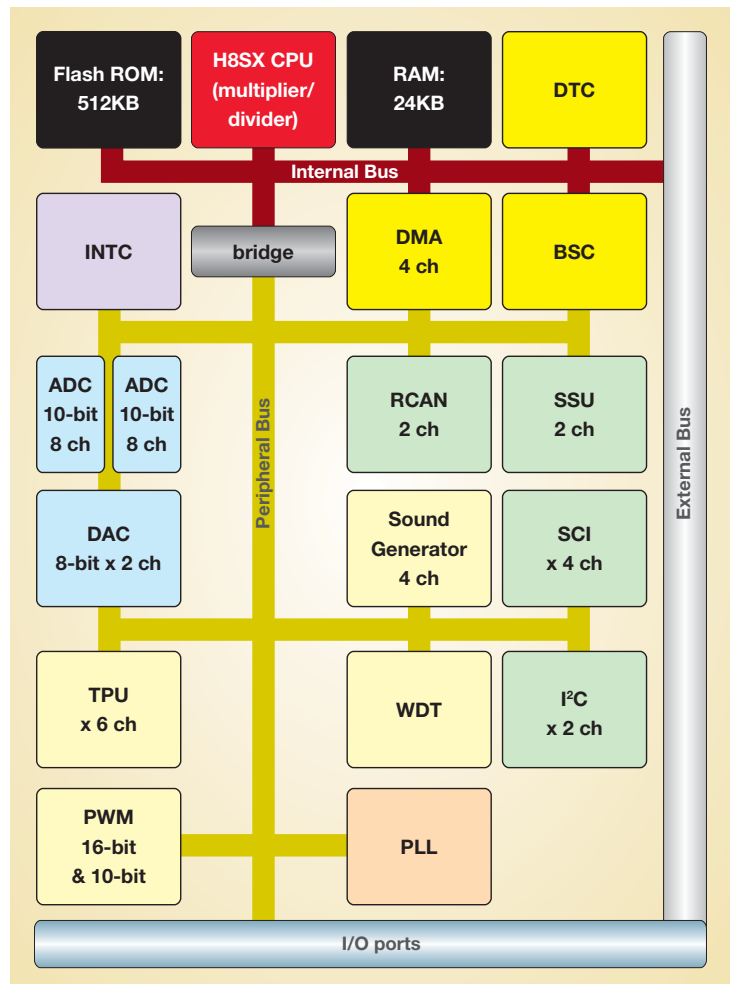
## H8SX/1500 Series Line-up



### Features

- Up to 48MHz, low-power, 32-bit static CISC CPU
- 6 power-down modes for reducing power consumption
- Highly reliable built-in single-supply flash: 64KB to 384KB
- On-chip high-speed SRAM: 12KB to 56KB
- Sound Tone Generator
- Enhanced data movement engines (System DMA and DTC) for efficient data path management
- Up to 2-channel Controller Area Network (CAN v2.0) controller (ISO 11898-1 compliant)
- Up to 3 ADC units allowing possible 1.5Msps ADC performance
- High-speed serial interfaces

### H8SX/1544 Block Diagram



**GET STARTED NOW!**

**H8SX/1582 Development Kit**  
(includes free compiler)

**Part Number:**  
**R0K561582S000BE**

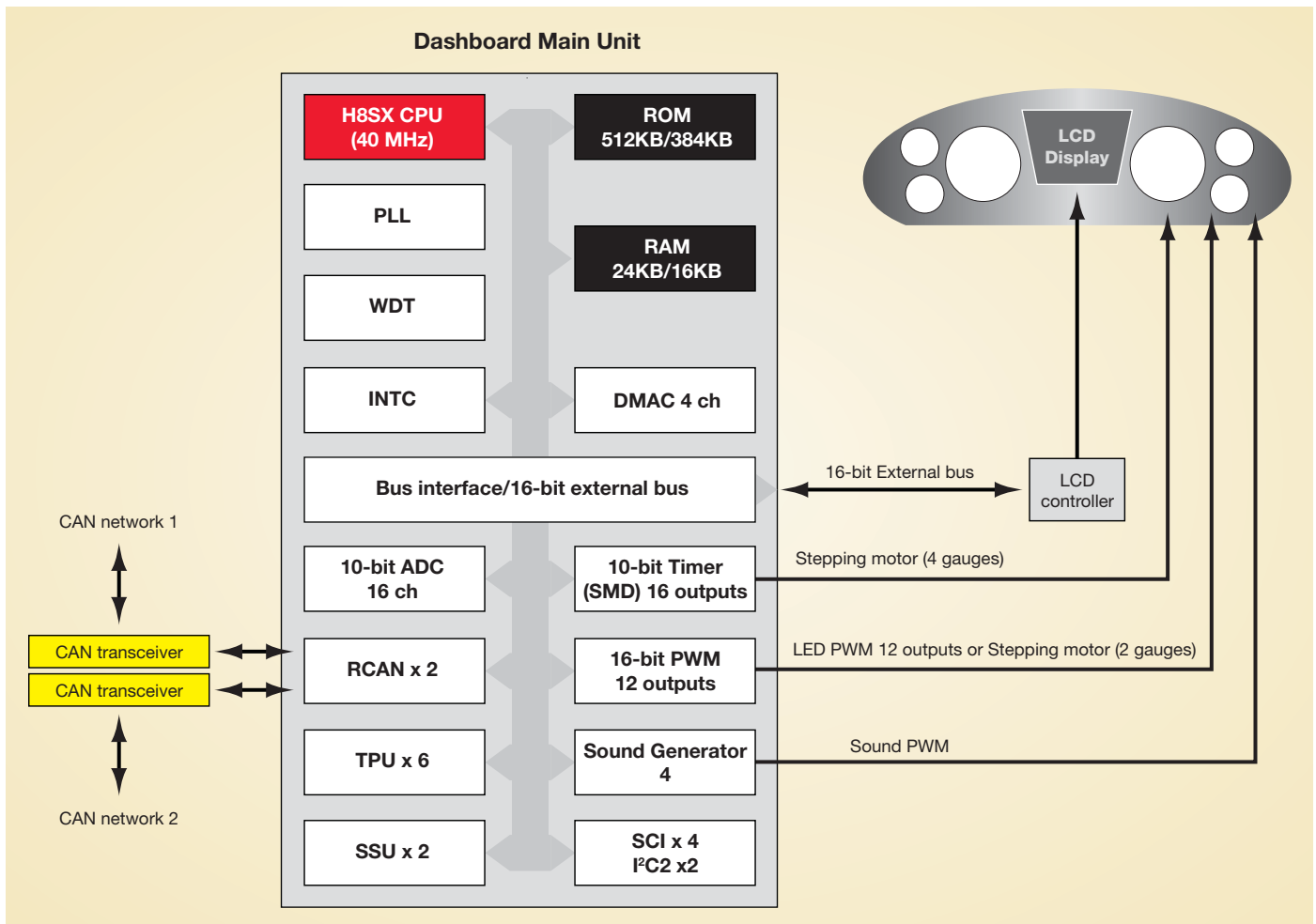
## H8SX/1500 Series Selector Guide

Group	Catalog Part Number	Memory		Vcc				Timers				Analog		Serial				Special Features				Package Code					
		Flash (Kbytes)	RAM (Kbytes)	Vcc min	Vcc max	max MHz @ Vcc max	32 kHz Sub-Clock <sup>1</sup>	8-bit timers	16-bit timers	Watchdog Timers	Waveform Generator (PPG)	A/D 10-bit Resolution	D/A 8-bit Resolution	Serial (sync/async)	SSU (SPI Compatible)	I2C	Smart Card I/F	PC	CAN	DTC	DMA Channels		External Interrupts	GPIO <sup>2</sup> (High current) <sup>3</sup>	External Data Bus	Extended Temperature <sup>4</sup>	
H8SX/1525	R5F61525N40FPV	256	12	4.5	5.5	48	-	-	6	1	-	16	-	2	3	Y	Y	-	1	-	4	16	82 (0)	-	Y	-	PRQP0100KB-A
H8SX/1527	R5F61527RN40FPV	256	12	4.5	5.5	48	-	-	12	1	8	16	-	2	3	Y	Y	-	1	-	4	16	82 (0)	-	Y	-	PRQP0100KB-A
H8SX/1544	R5F61543N48FPV	384	16	4.5	5.5	40	-	-	6	2	16	16	2	4	2	-	Y	2	2	-	4	16	115 (0)	Y	Y	Motor Control PWM	PRQP0144KB-A PRQP0144KB-A
	R5F61544N48FPV	512	24	4.5	5.5	40	-	-	6	2	16	16	2	4	2	-	Y	2	2	-	4	16	115 (0)	Y	Y	-	-
H8SX/1558	R5F61552N50FPV	256	24	4.5	5.5	40	-	4	12	1	-	16	2	6	-	-	Y	2	-	Y	4	16	90 (8)	Y	Y	Enhanced ADC	PLQP0120LA-A PLQP0120LA-A PLQP0120LA-A
	R5F61554N50FPV	512	40	4.5	5.5	40	-	4	12	1	-	16	2	6	-	-	Y	2	-	Y	4	16	90 (8)	Y	Y	-	-
	R5F61556N50FPV	1024	56	4.5	5.5	40	-	4	12	1	-	16	2	6	-	-	Y	2	-	Y	4	16	90 (8)	Y	Y	-	-
H8SX/1568	R5F61562N50FPV	256	24	4.5	5.5	40	-	4	12	1	-	16	2	6	-	-	Y	2	-	Y	4	16	109 (8)	Y	Y	Enhanced ADC	PRQP0144KB-A PRQP0144KB-A PRQP0144KB-A
	R5F61564N50FPV	512	24	4.5	5.5	40	-	4	12	1	-	16	2	6	-	-	Y	2	-	Y	4	16	109 (8)	Y	Y	-	-
	R5F61568N50FPV	1024	56	4.5	5.5	40	-	4	12	1	-	16	2	6	-	-	Y	2	-	Y	4	16	109 (8)	Y	Y	-	-
H8SX/1582	R5F61582N48FPV	256	12	4.5	5.5	48	-	-	12	1	8	16	-	2	3	Y	Y	-	-	Y	4	17	99 (0)	-	Y	-	PLQP0120LA-A

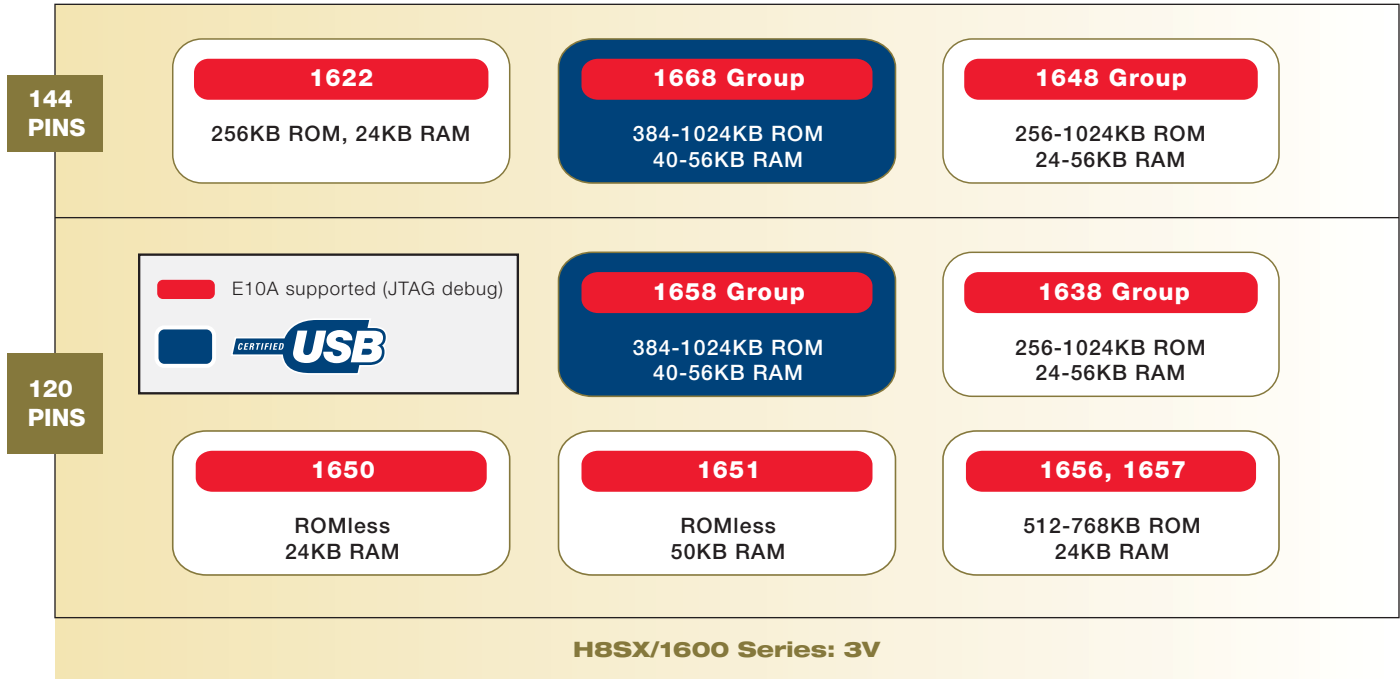
**Notes:**

1. Y = Yes, includes 32kHz crystal oscillator circuitry.
2. This is the sum of the I/O pins + input-only + output-only.
3. High-current is defined as greater than or equal to 10mA for a signal being driven low. This pin count is included in the GPIO total.
4. Please visit Renesas website for full part number, specification, and availability of extended temperature parts.

### H8SX/1544 Application Example: Dashboard



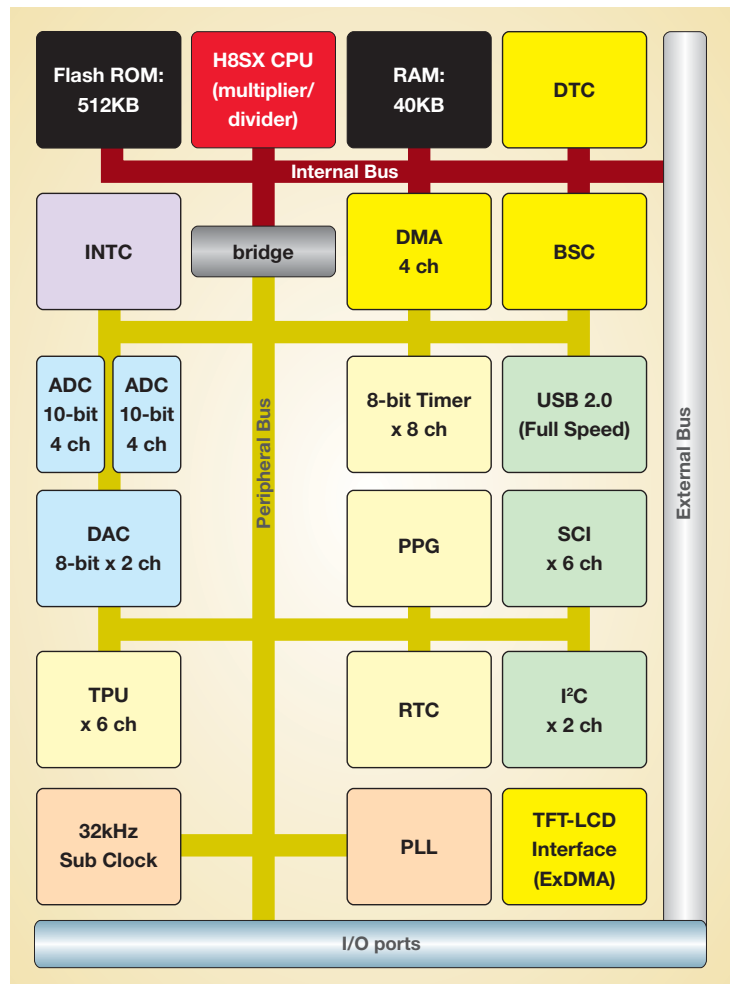
## H8SX/1600 Series Line-up



### ■ Features

- High-performance CISC CPU core running at 50MIPs
- Roadmap up to 1MB, single-cycle Flash and 56KB on-chip SRAM
- USB-certified connectivity device (12Mbps)
- External SDR SDRAM connectivity supported
- TFT-LCD Direct Drive for VGA and WVGA panels
- LCD Direct Drive performed in parallel to complex operations (example, JPEG decoding, MP3 decoding)
- Fast 16-bit Delta Sigma ADC
- 32kHz sub-clock support with dedicated timer for low-power applications
- 4µA (typ) Deep Software Standby current consumption, with wake-up from external interrupt

### H8SX/1664R Block Diagram



**GET STARTED NOW!**

**H8SX/1664 Development Kit**  
(includes free compiler)

**Part Number:**  
**R0K561664S000BE**

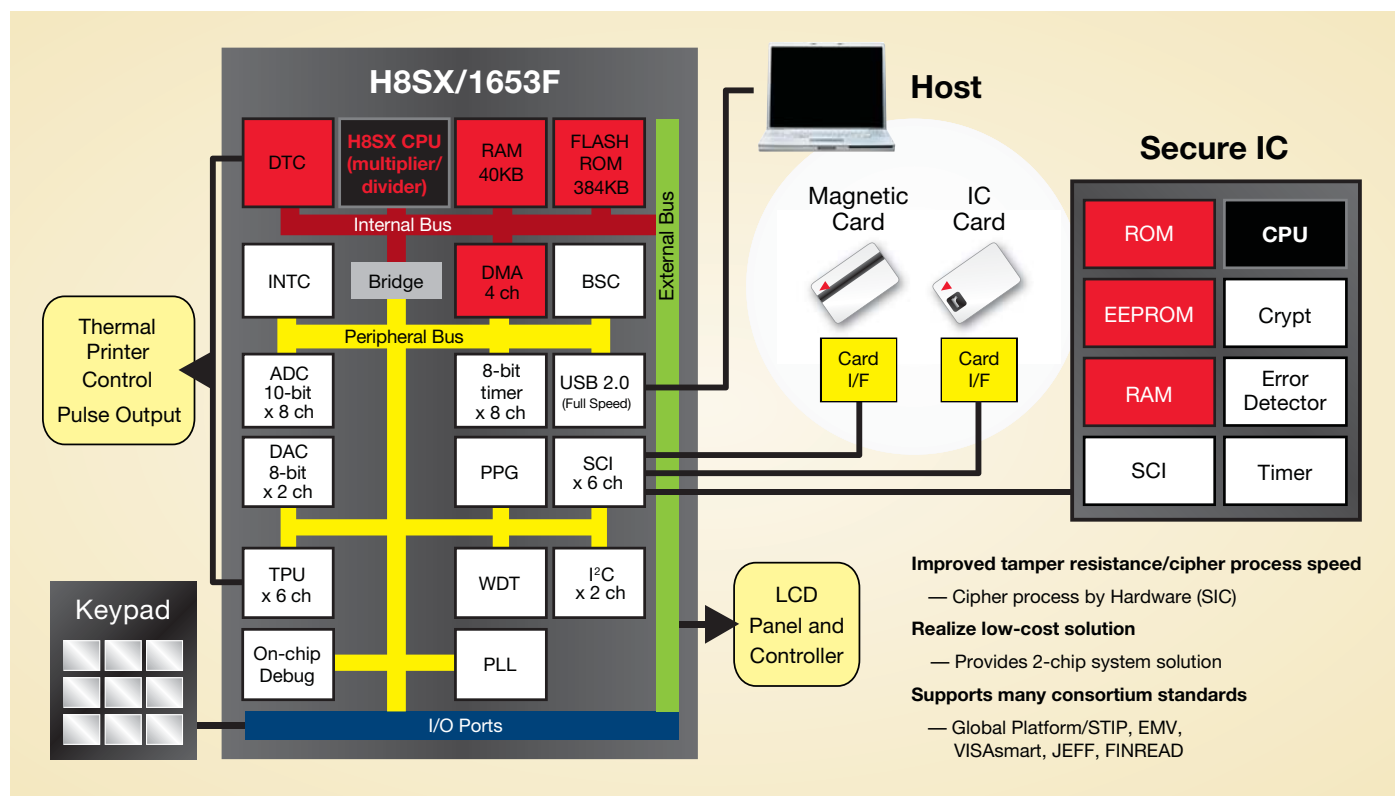
## H8SX/1600 Series Selector Guide

Group	Catalog Part Number	Memory		Vcc min	Vcc max	max MHz @ Vcc max	32 kHz Sub-Clock <sup>1</sup>	Timers				Analog		Serial				DTC	DMA Channels	External Interrupts	GPIO <sup>2</sup> (High current) <sup>3</sup>	External Data Bus	Extended Temperature <sup>4</sup>	Special Features	Package Code		
		Flash (Kbytes)	RAM (Kbytes)					8-bit Timers	16-bit Timers	Watchdog Timers	Waveform Generator (PPG)	A/D 10-bit Resolution	D/A 8-bit Resolution	Serial (sync/async)	SSU (SPI Compatible)	IrDA	Smart Card I/F									PC	CAN
H8SX/1622	R5F61622N50FPV	256	24	3.0	3.6	50	-	8	6	1	16	8	2	5	-	-	Y	2	16	91(8)	Y	-	16-bit Delta Sigma ADC 6 channels	PRQP0144KB-A PTLG0145JB-A			
H8SX/1638	R5F61632N50FPV	256	24	3.0	3.6	50	-	4	12	1	-	16	2	6	-	-	Y	4	16	90(8)	Y	Y	Deep Standby Mode, Enhanced ADC	PLQP0120LA-A PLQP0120LA-A PLQP0120LA-A			
	R5F61634N50FPV	512	40	3.0	3.6	50	-	4	12	1	-	16	2	6	-	-	Y	4	16	90(8)	Y	Y					
	R5F61638N50FPV	1024	56	3.0	3.6	50	-	4	12	1	-	16	2	6	-	-	Y	4	16	90(8)	Y	Y					
H8SX/1648	R5F61642N50FPV	256	24	3.0	3.6	50	-	4	12	1	-	16	2	6	-	-	Y	4	16	109(8)	Y	Y	Deep Standby Mode, Enhanced ADC	PRQP0144KB-A PRQP0144KB-A PRQP0144KB-A			
	R5F61644N50FPV	512	40	3.0	3.6	50	-	4	12	1	-	16	2	6	-	-	Y	4	16	109(8)	Y	Y					
	R5F61648N50FPV	1024	56	3.0	3.6	50	-	4	12	1	-	16	2	6	-	-	Y	4	16	109(8)	Y	Y					
H8SX/1650	R5S61650CN35FTV	-	24	3.0	3.6	35	-	4	6	1	16	8	2	4	-	Y	Y	-	-	Y	-	13	90(8)	Y	-	HSS	PTQP0120LA-A
H8SX/1651	R5S61651CN50FPV	-	50	3.0	3.6	50	-	4	6	1	16	8	2	4	-	Y	Y	-	-	Y	-	13	90(8)	Y	-	HSS	PLQP0120LA-A
H8SX/1656	R5F61656CN35FTV	512	24	3.0	3.6	35	-	4	6	1	16	8	2	4	-	Y	Y	-	-	Y	4	13	90(8)	Y	-	HSS	PTQP0120LA-A
H8SX/1657	R5F61657CN35FTV	768	24	3.0	3.6	35	-	4	6	1	16	8	2	4	-	Y	Y	-	-	Y	4	13	90(8)	Y	-	HSS	PTQP0120LA-A
H8SX/1658	R5F61653R50FTV	384	40	3.0	3.6	50	-	4	6	1	8	8	2	6	-	Y	Y	2	-	Y	4	13	84(0)	Y	-	HSS, USB	PTQP0120LA-A PTQP0120LA-A PTQP0120LA-A
	R5F61654RN50FTV	512	40	3.0	3.6	50	-	4	6	1	8	8	2	6	-	Y	Y	2	-	Y	4	13	84(0)	Y	-		
	R5F61658N50FTV	1024	56	3.0	3.6	50	-	4	6	1	8	8	2	6	-	Y	Y	2	-	Y	4	13	84(0)	Y	-		
H8SX/1668	R5F61663RN50FTV	384	40	3.0	3.6	50	Y	4	6	1	8	8	2	6	-	Y	Y	2	-	Y	4	13	101(8)	Y	-	HSS, USB, TFT-LCD (ExDMA)	PRQP0144KB-A PRQP0144KB-A PRQP0144KB-A
	R5F61664RN50FTV	512	40	3.0	3.6	50	Y	4	6	1	8	8	2	6	-	Y	Y	2	-	Y	4	13	101(8)	Y	-		
	R5F61668N50FTV	1024	56	3.0	3.6	50	Y	4	6	1	8	8	2	6	-	Y	Y	2	-	Y	4	13	101(8)	Y	-		

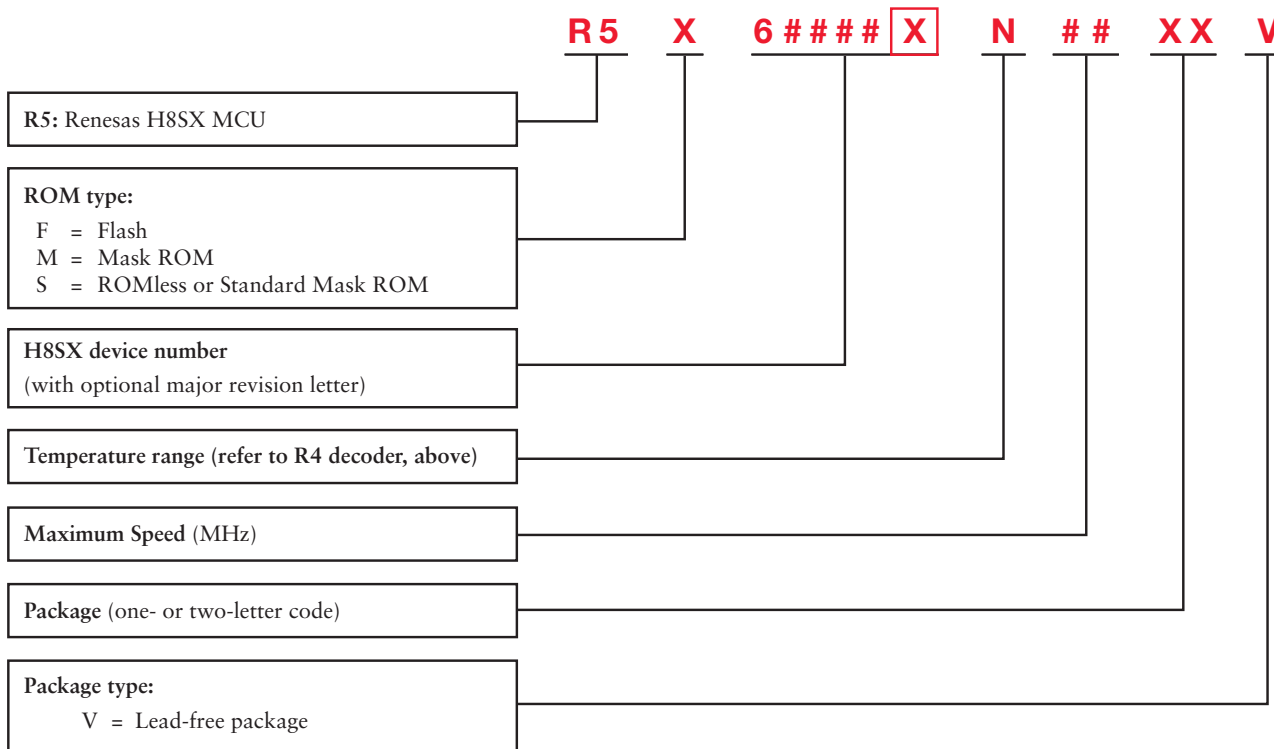
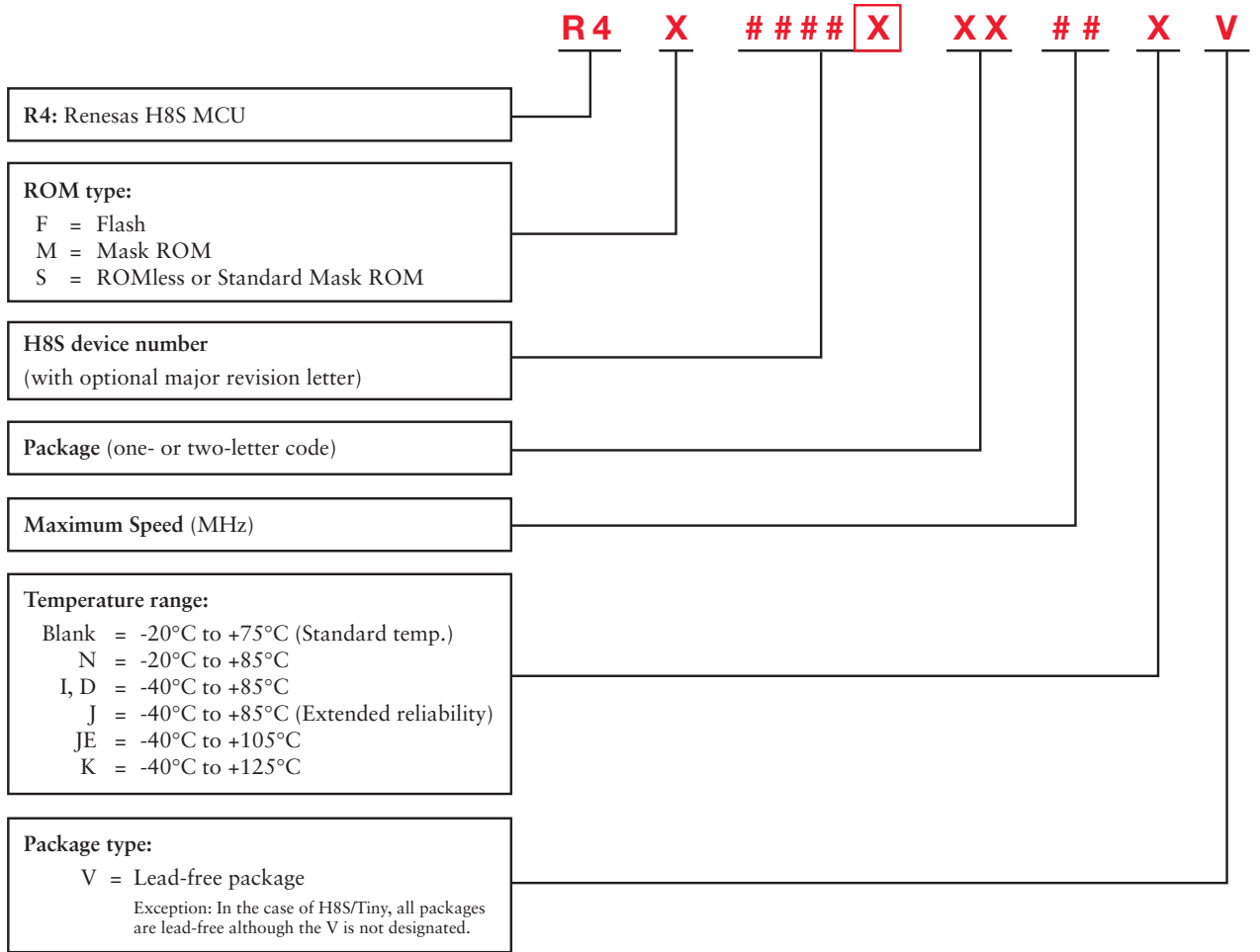
**Notes:**

1. Y = Yes, includes 32kHz crystal oscillator circuitry.
2. This is the sum of the I/O pins + input-only + output-only.
3. High-current is defined as greater than or equal to 10mA for a signal being driven low. This pin count is included in the GPIO total.
4. Please visit Renesas website for full part number, specification, and availability of extended temperature parts.

## H8SX/1653 Application Example: ePOS Solution

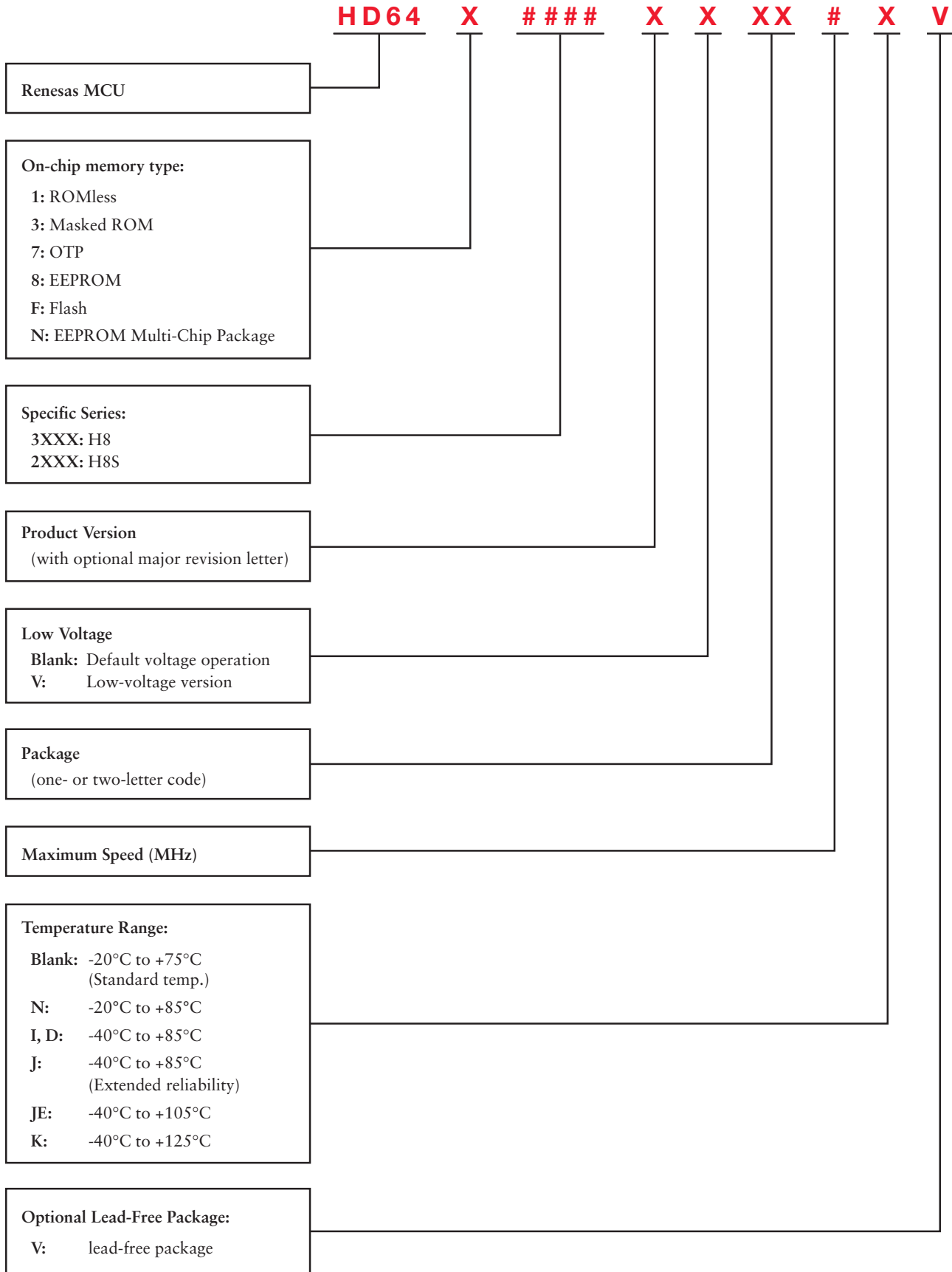


## ■ Appendix A-1: Catalog Part Number Decoders (1 of 2)



# Appendices

## ■ Appendix A-2: Catalog Part Number Decoders (2 of 2)



## ■ Appendix B: Abbreviations

15mA IO	Contains I/O pins that source/sink 15mA
5V IO	Contains I/O pins which are 5V tolerant
ADC	Analog-to-Digital Converter
AEC	Asynchronous Event Counter
BGO	Back Ground Operation
Boot from USB	Flash programmable via USB port
BSC	External Bus Controller
BSCAN	Boundary Scan
BusTrace	On-chip Memory Bus Trace
CAN	Controller Area Network
CRC	Cyclic Redundancy Check Generator
DAC	Digital to Analog Converter
DMAC	Direct Memory Access Controller
DMC	Duty Measurement Circuit
DRAMC	DRAM Controller
DTC	Data Transfer Controller
DTMF	Telephone Tone Generator
Dual Vcc IO	Two Vcc domains for I/O Ports
EC	Embedded Controller
ELC	Event Link Controller
EXDMAC	Enhanced DMA Controller
FRT	Free Running Timer
HSS	High-Speed Serial Communications
I <sup>2</sup> C™	Inter IC Bus
IEB	Inter Equipment Bus
IP protect	Software IP Security
IrDA	Infrared Serial Port
KBD	Keyboard Scan Function
LCDC	LCD Controller/Driver

LPC	Low-Pin-Count Interface Bus
LVD	Low-Voltage Detect
MMT	Motor Management Timer
OCO	On-Chip Oscillator
PC Break	PC Break Controller
PECI	Platform Environment Control Interface
PMC	Peripheral I/O Mapping Controller
POR	Power-On Reset
PPG	Programmable Pattern Generator
PS2	PS2 Interface
PWM	Pulse Width Modulation
RTC	Real-Time Clock
SCI	Serial Communications Interface
SCIF	16550 Legacy SIO Serial Port
SDRAM	SDRAM Bus Controller
SPI™	Serial Peripheral Interface
SST	Sub-system Timer
SSU	Synchronous Serial Unit (SPI compatible)
TCM	Timer for Cycle Measurement
TDP	Timer for Duty Period
TMC	Timer Connection Circuit
TPU	Timer Pulse Unit
USB	Universal Serial Bus Interface
USBH	Universal Serial Bus Interface – High Speed
X-Bus	ISA Bus Interface
WDT	WatchDog Timer
WDTO	Dedicated WatchDog Timer Oscillator

I<sup>2</sup>C is a trademark of Philips. SPI is a trademark of Freescale.

## ■ Appendix C: Package Specifications

Type	Renesas Code	Previous Code	Pin Count	Nominal Body Dimensions (mm)	Lead Pitch (mm)	Thickness (mm)	
QFP	Quad Flat Package	PRQP0064GB-A	FP-64A	64	14 x 14	0.8	3.05
		PRQP0080GD-B	FP-80B	80	20 x 20	0.8	3.10
		PRQP0080JB-A	FP-80A	80	14 x 14	0.65	3.05
		PRQP0080JD-A	FP-80Q	80	14 x 14	0.65	3.05
		PRQP0100JE-B	FP-100A	100	14 x 20	0.65	3.10
		PRQP0100KA-A	FP-100B	100	14 x 14	0.5	3.05
		PRQP0100KB-A	FP-100M	100	14 x 14	0.5	3.05
		PRQP0128KB-A	FP-128B	128	14 x 20	0.5	3.15
		PRQP0144KA-A	FP-144G	144	20 x 20	0.5	3.05
		PRQP0144KB-A	FP-144J	144	20 x 20	0.5	3.05
		LQFP	Low-profile QFP	PLQP0032GC-A	FP-32A	32	7 x 7
PLQP0048JA-A	FP-48F			48	10 x 10	0.65	1.70
PLQP0048KC-A	FP-48B			48	7 x 7	0.5	1.70
PLQP0064GA-A	64P6U-A			64	14 x 14	0.8	1.70
PLQP0064KB-A	FP-64K			64	10 x 10	0.5	1.70
PLQP0064KC-A	FP-64E			64	10 x 10	0.5	1.70
PLQP0080JA-A	FP-80W			80	14 x 14	0.65	1.70
PLQP0080KB-A	80P6Q-A			80	12 x 12	0.5	1.70
PLQP0100KB-A	FP-100U			100	14 x 14	0.5	1.70
PLQP0120LA-A	FP-120B			120	14 x 14	0.4	1.70
PLQP0144KC-A	FP-144H			144	20 x 20	0.5	1.70
TQFP	Thin QFP	PTQP0080KC-A	TFP-80C	80	12 x 12	0.5	1.20
		PTQP0100KA-A	TFP-100B	100	14 x 14	0.5	1.20
		PTQP0100LC-A	TFP-100G	100	12 x 12	0.4	1.20
		PTQP0120LA-A	TFP-120	120	14 x 14	0.4	1.20
		PTQP0144LC-A	TFP-144	144	16 x 16	0.4	1.20
LFBGA	LF Ball Grid Array	PLBG0112GA-A	BP-112	112	10 x 10	0.8	1.40
		PLBG0176GA-A	BP-176	176	13 x 13	0.8	1.40
TFBGA	Thin Fine-Pitch BGA	TTBG0112GA-A	TBP-112A	112	10 x 10	0.8	1.20
SDIP	Shrink Dual-Inline Package	PRDP0032BB-A	DP-32S	32	28 x 8.9	1.78	5.08
		PRDP0064BB-A	DP-64S	64	57.6 x 17	1.78	5.08
TFLGA	Thin Fine-Pitch Land Grid Array	PTLG0085JA-A	TLP-85V	85	7 x 7	0.65	1.20
		PTLG0113JA-A	TLP-113V	113	8 x 8	0.65	1.20
		PTLG0145JB-A	TLP-145V	145	9 x 9	0.65	1.20
QFN	Quad Flat Non-lead Pkg.	PVQN0048KA-A	TNP-48	48	7 x 7	0.5	1.00
VQFN	Very Small QFN	PVQN0032KA-A	TNP-32	32	5 x 6	0.5	0.95
		PVQN0064LB-A	TNP-64B	64	8 x 8	0.4	0.95
SOP	Small-Outline Package	PRSP0032DC-A	FP-32D	32	11.3 x 20.45	1.27	3.00



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Thermistor (Temperature): 25

Power Control: Power

Reset: Reset

User Control: Slide Switch S1, Pushbutton Switch S2, Pushbutton Switch S3, Oscillator (JP3)

User LED's: LED 1, LED 2, LED 3

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