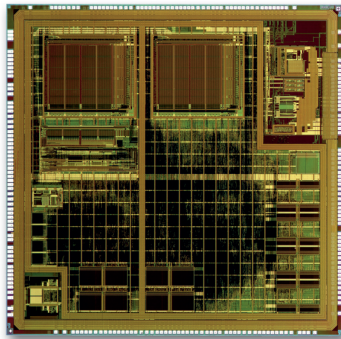


General purpose 16-/32-bit microcontrollers  
H8S/H8SX and H8/300H Family

# Introduction

**Renesas Technology is one of the largest semiconductor companies in the world**

- Established on April 1st, 2003 as a joint venture between Hitachi Ltd and Mitsubishi Electric Corp.
- Headquartered in Tokyo, Japan with over 26000 employees worldwide
- Designs and manufactures highly integrated semiconductor solutions for industrial, consumer, automotive and telecoms markets
- Ranked the No. 1 microcontroller supplier globally and the No. 1 global supplier of embedded flash MCU's



Renesas Technology owes its success, to its outstanding technology, its excellent quality and to its drive and commitment to listen and meet our customers' needs. As a result, today Renesas Technology is the world's leading microcontroller company offering a huge range of 8-, 16- and 32-bit microcontrollers. These feature:

- A complete product line-up
- Outstanding memory integration
- World leading embedded Flash technology
- Leading peripheral integration
- High performance CPU's
- Low power consumption
- Low EMS / EMI
- Advanced packaging options

## Renesas microcontroller families

Today, Renesas offer the H8 and M16C CISC microcontroller families and the high-performance SH RISC microcontroller family.

### H8 Microcontroller families

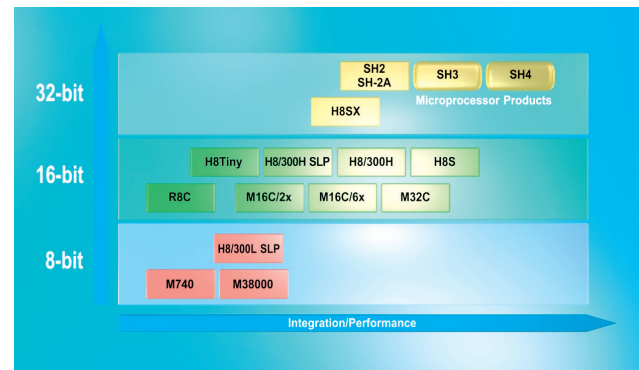
The H8 family comprises of a wide range of CISC microcontrollers from low-cost 8-bit to the most sophisticated, high performance 32-bit.

- The H8/300L Super Low Power series of 8-bit microcontrollers has been developed to meet the demands of the next generation of power critical applications.
- The H8/300H Tiny provides design engineers with a low cost 16-bit alternative to many 8-bit microcontrollers available today.
- The H8/300H provides a highly competitive 16-bit Flash microcontroller family for consumer and industrial applications.
- The H8S leading edge 16-bit family combines high memory and peripheral integration with high performance.
- The H8SX family now provides an H8 code-compatible roadmap to 32-bit performance.

### M16C Microcontroller families

The M16C platform consists of a wide range of 16-bit microcontrollers featuring high efficiency 'C' programming, high-speed processing and low power consumption.

- The R8C Tiny comes as an ultra low-cost, Flash family in small pin-count packages addressing the classic 8-bit market.
- The M16C/2x and M16C/6x high performance families provide high peripheral integration, low power consumption and low EMS/EMI.
- The M32C family with its rich set of peripherals builds the performance bridge between the 16-bit CISC and 32-bit RISC world.



### The SH Microcontroller Families

The SH microcontroller families offer the highest performance levels found on microcontrollers today. In particular SH-2A offers up to 480 DMIPS today and also interrupt response times of just 30ns. Renesas developed world's fastest Flash technology - called MONOS Flash - to support such high speed with no wait states. The family ranges from:

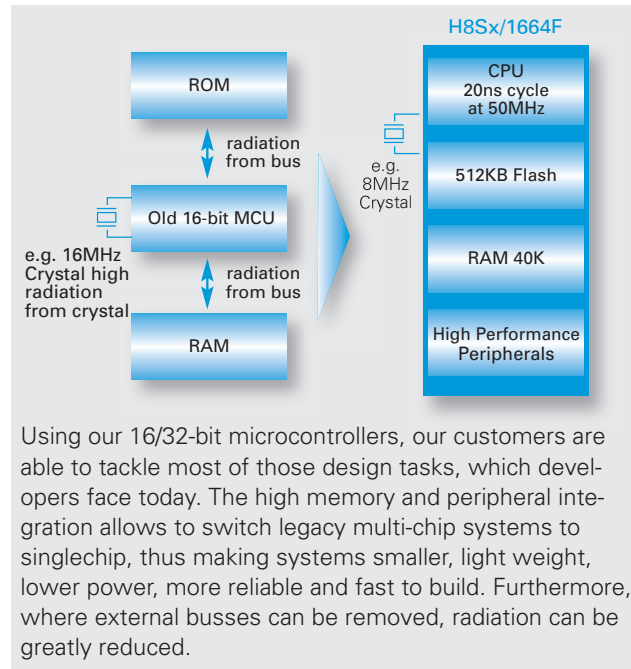
- The low cost SH-Tiny series with 64KB and 128KB Flash options and in 48-/64-pin packages. Aimed for example at white goods motor control.
- The mid-class SH2-based SH708xF and SH714xF series with up to 80MHz (zero wait) 512KB MONOS Flash and 176 pins, triple fast ADC as well as strong timer resources to drive up to two motors. Available in 3V and 5V.
- The highend SH-2A products with 512KB MONOS Flash in the SH7211F as well as a line-up of highly integrated rom-less versions with 4 x SCI, 3 x IIC, 2 x CAN, USB host and function and TFT drive on the SH7203, for example. At 200MHz and with additional FPU this device competes with industrial PC, yet is a fraction of the cost and power consumption, available long term and in Renesas' best-in-class quality.

# Roadmap and Benefits

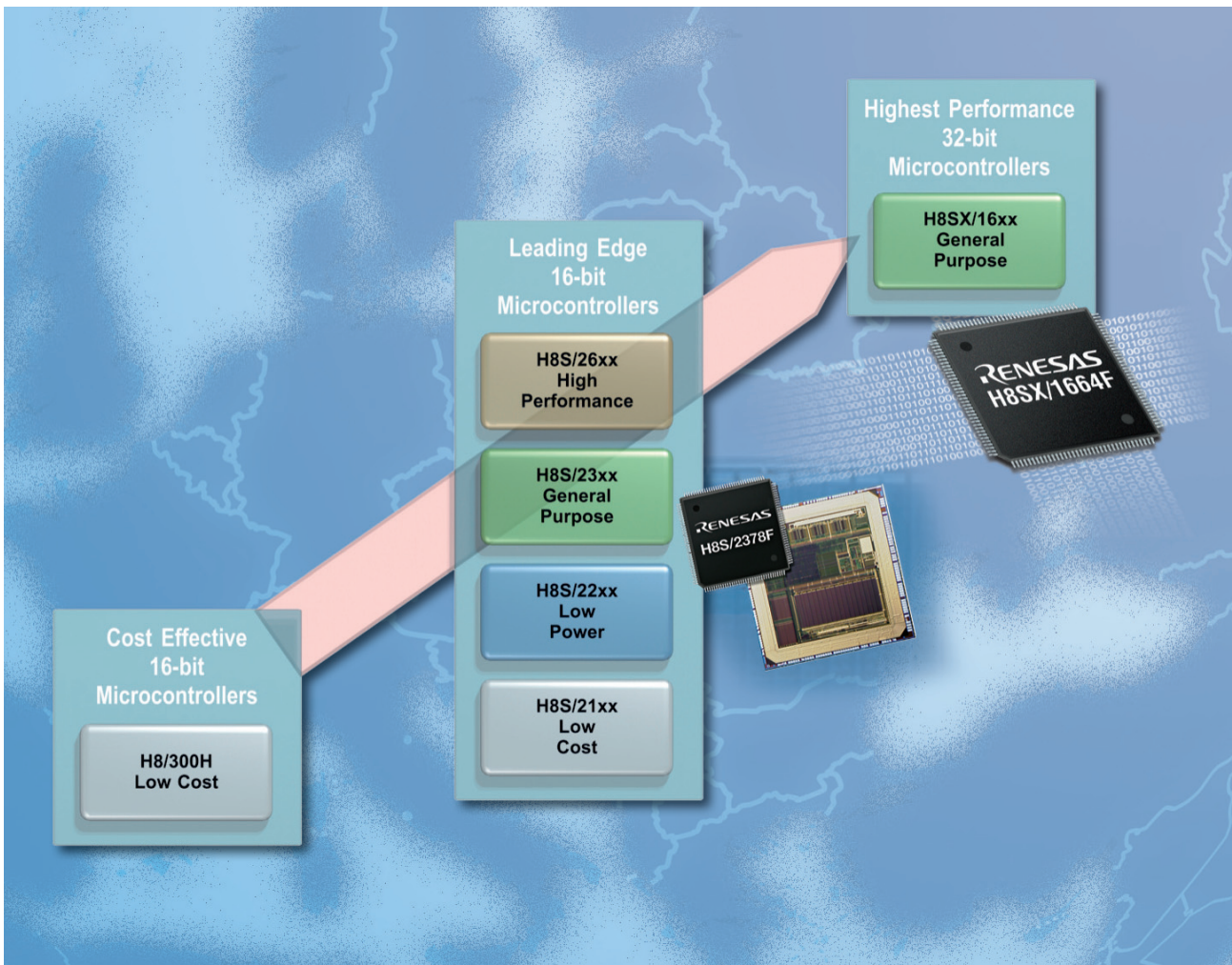
H8S/H8SX and H8/300H are part of Renesas Technology's H8 microcontroller family.

The H8 family comprises of a wide range of CISC microcontrollers from low-cost 8-bit to the most sophisticated, high-performance 32-bit. Yet all of these products are upwardly software compatible, for protection of our customer's software investment. This fact also allows our customers to quickly develop variants of a product, moving downwards to lower-cost-less features or upwards to higher functionality.

Where the performance of even the fastest H8 is still not enough, Renesas Technology customers can migrate to the SH range of RISC microcontrollers, boasting an impressive CPU performance of up to 480 DMIPS. SH-2 is not software compatible with H8, but shares many of the peripherals. And most of the tool chain has the same look and feel, so there is virtually no learning curve.



Using our 16/32-bit microcontrollers, our customers are able to tackle most of those design tasks, which developers face today. The high memory and peripheral integration allows to switch legacy multi-chip systems to singlechip, thus making systems smaller, light weight, lower power, more reliable and fast to build. Furthermore, where external busses can be removed, radiation can be greatly reduced.



## Application examples

### White Goods

Renesas Technology microcontrollers are being widely used in home appliances around Europe. The reason for this is Renesas Technology's complete command of embedded Flash technology, including high-yield mass production, resulting in low cost Flash microcontrollers such as the H8/306x series, H8S/21xx or H8S/231x, 2x. Embedded Flash speeds up time-to-market and reduces cost of development and inventory control. Renesas Technology and its partners also offer software solutions and system know-how relevant in white goods, such as embedded Internet solutions and consumer level motor control solutions.



### Gas-Water-Electricity Metering

Renesas Technology is the number one supplier of microcontrollers into metering applications, both worldwide and in Europe. Renesas Technology H8 is being used by virtually all the major European manufacturers in this area, because of our advanced low-power technology in both, 8- and 16-bit microcontrollers. Another reason is high CPU performance and peripheral integration, which allows the implementation of entire meters without a specialised external ASIC. For example, the H8S/223x series has Flash memory and a complete peripheral set, including 32KHz subclock, excellent timers, 4 x SCI, IIC and Renesas' popular Data Transfer Controller (DTC) - a versatile pseudo DMA function which can serve almost all peripherals.



### Electronic Point of Sales (EPOS)

Due to a combination of legal changes affecting liability and the wish to increase efficiency, retailers and banks around the globe are driving the EPOS market to grow fast. Renesas Technology has always enjoyed success in this market, mainly due to its best-in-class ISO7816-3 implementation on almost all H8S(X) devices. EPOS applications require high CPU performance to calculate encryption algorithms, many serial ports (e.g. for SAM's), USB and embedded Flash (for security) so Renesas Technology developed devices such as the H8S/221x, H8S/237x and the H8SX/1664x to deliver exactly this.



### Factory and Building Automation

Building Automation (BA) applications such as HVAC, security or smoke detectors requires a high level of connectivity in order to be able to connect a large number of sensors and actuators around the house and with the central unit controlling the system. Hence H8 products – e.g. the H8S/236x - offer numerous serial ports supporting many modes, USB (H8S/221x, H8SX/166x) and external busses for connecting ASIC, for example for additional Profibus connectivity. A Zigbee solution is under development. Many applications in the area of building automation also need low power, which is offered by all H8S/22xx products.



### Health Monitoring

Growing concerns about one's health and fitness are driving growth of electronic aids in this area. Devices such as blood glucose or pressure meters, heart rate sensors, muscle stimulators and anti apnoe alarms as well as fitness electronics, require low power consumption with 32KHz subclock as offered by H8S/223x. H8S/221x also feature USB connectivity to enable connecting these medical aids to computers, for example for long term data logging and analysis.



### Distribution

Renesas Technology Europe has for many years enjoyed tremendous success in the medium-sized industrial customer arena, greatly helped by our well-trained and highly motivated distribution network. Our European distributors have over 50 certified application engineers to help with technical questions and of course they offer excellent logistics services, as this is one of their core competencies. Several distributors across Europe also offer value-added services, such as Flash-microcontroller programming, development outsourcing, seminars and some even possess their own evaluation tools.



# MONOS Flash technology

## MONOS Flash technology: fast and low cost!

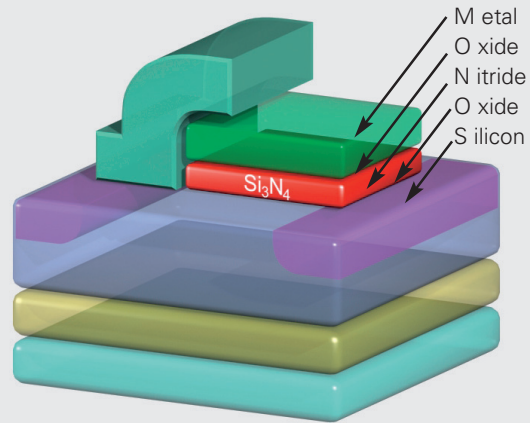
Renesas now has over 12 years experience producing embedded Flash MCU's. We have shipped 800 million pieces so far, at a current run rate of almost 10 million pieces per month, and no single piece has shown a data retention failure yet. Renesas has a 25% market share of the embedded Flash MCU market.

Metal-Oxide-Nitride-Oxide-Silicon (MONOS) Flash is our latest generation embedded Flash technology. At just 10ns, it offers the fastest access time of any Flash technology today. And the flash cells are small, so MONOS Flash is ideal to create fast microcontrollers at best prices. Just like all embedded MONOS Flash H8 devices, the H8S/2378BF features a build-in API software that allows user code to make function calls to control the Flash. This method is reliable and user friendly. The device also has a user boot mode (in addition to the build-in normal boot mode), associated with additional 8KB Flash, that allows customers to define their own boot mode.

### MONOS Flash

#### World's fastest embedded Flash Technology

- 12.5ns read access time now, 10ns soon.
- Nitride stops electrons from leaking off the floating gate in case of defects.
- Hence the cell can be made small whilst it is still highly reliable.
- Small means FAST and cost effective. It also enables BIG (currently up to 2 MByte) Flash modules.

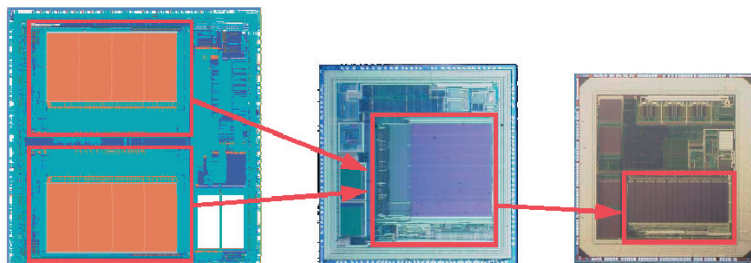


### Comparison of 512KB-Flash MCU

H8/3052F  
(0.35µm)  
2000

H8/3069RF  
(0.18µm)  
2002

H8/2378F  
(0.18µm MONOS)  
2004



Flash module area

100% → 52% → 22%

# Selector guide

Family	Group	Device	ROM (Byte)	RAM (Byte)	ROM types	Vcc	Clock	Data bus width	Timer functionality					Others	Async	Sync
									16-bit timers	8-bit timers	watchdog					
<b>H8/300H</b> lowest cost	H8/302x	H8/3024F	128K	4K	F	3	25	16	3	4	1			2	2	
		H8/3026F	256K	4K	F	3	25	16	3	4	1			2	2	
	H8/306x	H8/3029F	512K	16K	F	3	25	16	3	4	1			3	3	
		H8/3062BF	128K	4K	F	5	25	16	3	4	1			2	2	
	H8/300x	H8/3064BF	256K	4K	F	5	25	16	3	4	1			2	2	
		H8/3069RF	512K	16K	F	5	25	16	3	4	1			3	3	
		H8/3008	-	4K	R	3,5	25	16	3	4	1			2	2	
		H8/304x	H8/3048BF	128K	4K	FM	5	25	16	5	-	1	ITU (AC motor)	2	2	
H8/3048BVF		128K	4K	FM	3	25	16	5	-	1	ITU (AC motor)	2	2			
H8/305x	H8/3052BF	512K	8K	F	5	25	16	5	-	1	ITU (AC motor)	2	2			
<b>H8S/21xx</b> low cost	H8S/211x	H8S/2114F	1024K	8K	F	3	20	-	4	4	2	8+14bit PWM	2	2		
	H8S/213x	H8S/2134BF	128K	4K	FM	3,5	10,20	8	1	3	2	PWM	3	3		
		H8S/2138AF	128K	4K	FM	3,5	10,20	8	1	4	2	PWM	3	3		
	H8S/214x	H8S/2144BF	128K	4K	FM	3,5	10,20	16	1	3	2	PWM	3	3		
		H8S/2148BF	128K	4K	FM	3,5	10,20	16	1	4	2	PWM	3	3		
	H8S/217x	H8S/2145BF	256K	8K	F	3,5	10,20	16	1	4	2	PWM	3	3		
		H8S/2170BF	256K	32K	F	3	33	16	1	2	1	-	1	1		
<b>H8S/22xx</b> low power	H8S/221x	H8S/2211F	64K	8K	FM	3	24	-	3	-	1	32KHz subclock	2	2		
		H8S/2212F	128K	12K	FM	3	24	-	3	-	1	32KHz subclock	2	2		
		H8S/2215RF	256K	20K	FM	3	24	16	3	2	1	-	3	3		
	H8S/222x	H8S/2218F	128K	12K	FM	3	24	16	3	-	1	32KHz subclock	2	2		
		H8S/2227F	128K	16K	FM	3	13	16	3	2	2	32KHz subclock	3	3		
	H8S/223x	H8S/2238RF	256K	16K	FM	3	13	16	6	4	2	32KHz subclock	4	4		
		H8S/2238BF	256K	16K	FM	5	13	16	6	4	2	32KHz subclock	4	4		
H8S/2239F	384K	32K	FM	3	20	16	6	4	2	32KHz subclock	4	4				
<b>H8S/23xx</b> general purpose	H8S/231x	H8S/2312S	-	8K	R	3	25	16	6	2	1	-	2	2		
		H8S/2317F	128K	8K	FM	3	25	16	6	2	1	-	2	2		
		H8S/2318F	256K	8K	FM	3	25	16	6	2	1	-	2	2		
		H8S/2319CF	512K	16K	FM	3	25	16	6	2	1	-	2	2		
	H8S/232x	H8S/2321	-	4K	R	3	25	16	6	2	1	PPG	3	3		
		H8S/2322R	-	8K	R	3	25	16	6	2	1	PPG	3	3		
		H8S/2324	-	32K	R	3	25	16	6	2	1	PPG	3	3		
		H8S/2328BF	256K	8K	FM	3	25	16	6	2	1	PPG	3	3		
		H8S/2329BF	384K	32K	F	3	25	16	6	2	1	PPG	3	3		
	H8S/236x	H8S/2326F	512K	8K	F	3	25	16	6	2	1	PPG	3	3		
		H8S/2360F	256K	16K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2361F	256K	24K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2362F	256K	32K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2363	-	16K	R	3	33	16	6	2	1	PPG	5	5		
	H8S/237x	H8S/2364F	384K	32K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2368F	512K	32K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2370F	256K	16K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2371F	256K	24K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2372F	256K	32K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2373R	-	16K	R	3	33	16	6	2	1	PPG	5	5		
		H8S/2374F	384K	32K	F	3	34	16	6	2	1	PPG	5	5		
		H8S/2378BF	512K	32K	F	3	35	16	6	2	1	PPG	5	5		
	H8S/239x	H8S/2378RF	512K	32K	F	3	33	16	6	2	1	PPG	5	5		
		H8S/2390	-	4K	R	5	20	16	6	2	1	PPG	3	3		
		H8S/2392	-	8K	R	5	20	16	6	2	1	PPG	3	3		
		H8S/2394	-	32K	R	5	20	16	6	2	1	PPG	3	3		
		H8S/2398F	256K	8K	FM	5	20	16	6	2	1	PPG	3	3		
		<b>H8S/26xx</b> high performance	H8S/263x	H8S/2633RF	256K	16K	F	5	28	16	6	4	2	PPG	5	5
	H8S/266x		H8S/2667F	384K	16K	F	3	33	16	6	2	1	PPG	3	3	
	H8S/267x		H8S/2670	-	8K	R	3	33	16	6	2	1	PPG	3	3	
			H8S/2674R	-	32K	R	3	33	16	6	2	1	PPG	3	3	
	H8S/2676F	256K	8K	FM	3	33	16	6	2	1	PPG	3	3			
	<b>H8SX</b> highest performance	H8SX/165x	H8SX/1650A	-	24K	R	3	50	16	6	4	1	PPG	4	4	
H8SX/1651			-	40K	R	3	50	16	6	4	1	PPG	5	5		
H8SX/1653F			384K	40K	F	3	50	16	6	8	1	PPG	6	6		
H8SX/1654F			512K	40K	F	3	50	16	6	8	1	PPG	6	6		
H8SX/166x		H8SX/1656F	512K	24K	F	3	35	16	6	4	1	PPG	4	4		
		H8SX/1657F	768K	24K	F	3	35	16	6	4	1	PPG	4	4		
		H8SX/1663F	384K	40K	F	3	50	16	6	8	1	PPG, 32KHz	6	6		
		H8SX/1664F	512K	40K	F	3	50	16	6	8	1	PPG, 32KHz	6	6		

Serial functionality				Analog		DMA functionality			IO	Others	OCD	Package
IIC	USB	IrDA	Others	ADC (ch)	DAC (ch)	DMA (ch)	DTC (ch)	Other				
-	-	-	-	8	2	-	-		79		-	(T)FP-100BV
-	-	-	-	8	2	-	-		79		-	(T)FP-100BV
-	-	-	-	8	2	4	-		79		E10T	(T)FP-100BV
-	-	-	-	8	2	-	-		79		-	(T)FP-100BV
-	-	-	-	8	2	-	-		79		-	(T)FP-100BV
-	-	-	-	8	2	4	-		79		-	(T)FP-100BV
-	-	-	-	8	2	-	-		47		-	(T)FP-100BV
-	-	-	-	8	2	4	-		78		E10T	(T)FP-100BV
-	-	-	-	8	2	4	-		78		E10T	(T)FP-100BV
-	-	-	-	8	2	4	-		78		-	(T)FP-100BV
2	-	1	-	8	-	-	85	-	119		E10A	TFP-144V
-	-	-	-	8+8	2	-	-		66			FP-80AV, TFP-80CV
2	-	-	-	8+8	2	-	85		66			FP-80AV, TFP-80CV
-	-	-	-	8+16	2	-	-		82			(T)FP-100BV
2	-	-	-	8+16	2	-	85		82			(T)FP-100BV
2	-	-	-	8+16	2	-	85		82			(T)FP-100BV
-	1	-	-	-	-	4	-		76			TFP-100BV
-	1	-	ISO7816	6	-	6	-		58		E10A	FP-64EV
-	1	-	ISO7816	6	-	6	-		58		E10A	FP-64EV
-	1	-	ISO7816	6	2	6	85		89		E10A	TFP-120V, BP112V
-	1	-	ISO7816	6	-	6	-		93		E10A	TFP-100GV, BP112V
-	-	-	ISO7816	8	-	-	85		82		-	(T)FP-100BV, TFP-100GV
2	-	-	ISO7816	8	2	-	85		82		-	(T)FP-100BV, TFP-100GV, BP-112V
2	-	-	ISO7816	8	2	-	85		82		-	(T)FP-100BV, TFP-100GV
2	-	-	ISO7816	8	2	4	85		82		-	(T)FP-100BV, TFP-100GV, BP-112V
-	-	-	ISO7816	8	2	-	85		79		E10A	TFP-100BV
-	-	-	ISO7816	8	2	-	85		79		E10A	TFP-100BV
-	-	-	ISO7816	8	2	-	85		79		E10A	TFP-100BV
-	-	-	ISO7816	8	2	-	85		79		E10A	TFP-100BV, TLP-113V
-	-	-	ISO7816	8	2	4	85		95		E10A	FP-128BV, TFP-120V
-	-	-	ISO7816	8	2	4	85		95		E10A	FP-128BV, TFP-120V
-	-	-	ISO7816	8	2	4	95		95		E10A	FP-128BV, TFP-120V
-	-	-	ISO7816	8	2	4	85		95		E10A	FP-128BV, TFP-120V
-	-	-	ISO7816	8	2	4	85		95		E10A	FP-128BV, TFP-120V
-	-	-	ISO7816	8	2	4	85		95		E10A	FP-128BV, TFP-120V
2	-	-	ISO7816	10	2	-	85		94		E10A	FP-128B, TFP-120
2	-	-	ISO7816	10	2	-	85		94		E10A	FP-128B, TFP-120
2	-	-	ISO7816	10	2	-	85		94		E10A	FP-128B, TFP-120
2	-	-	ISO7816	10	2	4	85		94		E10A	FP-128B, TFP-120
2	-	-	ISO7816	10	2	-	85		94		E10A	FP-128B, TFP-120
2	-	-	ISO7816	10	2	-	85		94		E10A	FP-128B, TFP-120
2	-	1	ISO7816	16	2	4	85		113	R: SDRAM I/F	E10A	FP-144H, TLP-145V
2	-	1	ISO7816	16	2	4	85		113	R: SDRAM I/F	E10A	FP-144H, TLP-145V
2	-	1	ISO7816	16	2	4	85		113	R: SDRAM I/F	E10A	FP-144H, TLP-145V
2	-	1	ISO7816	16	2	4	85		113	R: SDRAM I/F	E10A	FP-144H, TLP-145V
2	-	1	ISO7816	16	2	-	85		113		E10A	FP-144H, TLP-145V
2	-	1	ISO7816	16	2	4	85		113	R: SDRAM I/F	E10A	FP-144H, TLP-145V
-	-	-	ISO7816	8	2	4	85		95		-	FP-128BV, TFP-120V
-	-	-	ISO7816	8	2	4	85		95		-	FP-128BV, TFP-120V
-	-	-	ISO7816	8	2	4	85		95		-	FP-128BV, TFP-120V
-	-	-	ISO7816	8	2	4	85		95		-	FP-128BV, TFP-120V
2	-	1	ISO7816	16	4	4	85		89		-	FP-128BV, TFP-120V
-	-	1	ISO7816	12	4	-	85		103		-	FP-144HV
-	-	1	ISO7816	12	4	4	85	EXDMAC	103		-	FP-144GV
-	-	1	ISO7816	12	4	4	85	EXDMAC	103	SDRAM interface	-	FP-144HV
-	-	1	ISO7816	12	4	4	85	EXDMAC	103		-	FP-144GV
-	-	-	ISO7816	8	2	-	85		90		E10A	FP-120BV
-	-	-	ISO7816	8	2	4	85		90		E10A	FP-120BV
2	1	1	ISO7816	8	2	4	85		84		E10A	TFP-120V
2	1	1	ISO7816	8	2	4	85		84		E10A	TFP-120V
-	-	-	ISO7816	8	2	4	85		90		-	TFP-120V
-	-	-	ISO7816	8	2	4	85		90		-	TFP-120V
2	1	1	ISO7816	8	2	4	85		101	SDRAM interface	E10A	FP-144LV
2	1	1	ISO7816	8	2	4	85		101	SDRAM interface	E10A	FP-144LV

Legend: ROM variants:  
F = Flash  
M = Mask ROM  
R = ROMless

**TPU:** Timing Pulse Unit (6ch 16-bit timer with up to 16 IC/OC)  
**ITU:** Integrated Timer Unit (5ch 16-bit timer with up to 10 IC/OC) and with electrical motor control modes  
**PPG/TPC:** 16ch Real Time Outputs  
**DTC:** Data Transfer Controller  
**USB:** Universal Serial Bus  
**IrDA:** Infrared  
**ADC/DAC:** Analog-Digital or Digital-Analog Converter

## Development Tools

The European electronics industry demands full service and support. Renesas Technology responded by setting up a European Engineering Division 20 years ago, based in Bourne End, UK. The Engineering Division provides our customers with locally designed and supported tools, ranging from low cost evaluation boards to fully featured real time emulators, plus all the software that goes with it.

Please visit [www.eu.renesas.com](http://www.eu.renesas.com) for more information, or visit [www.renesasinteractive.com](http://www.renesasinteractive.com) for comprehensive on-line training on devices and tools.



### Renesas Starter Kits (RSK)

Contains everything required to evaluate a series of Renesas microcontrollers. Full list on page 12.



### Renesas Technology Software Tools

Debugger, C-Compilers from Renesas and free-of-charge from KPIT, flashing via the free Flash-development-toolkit (FDT) and all of this under one easy-to-use GUI (HEW). For many products the application builder "MakeApp".



### On-Chip-Debug

Available for H8SX/1651, H8SX/1664F, H8S/221x, H8S/231x, H8S/232x, H8S/236x, H8S/237x from Lauterbach (Trace32-ICD) and Renesas Technology (E10A-USB). And for H8/3048BF, H8/3029F from Renesas Technology (E10T-USB).



### Third Party Software

- **Compiler:**
  - [www.iar.com](http://www.iar.com)
  - [www.gnu8.com](http://www.gnu8.com)
- **OS/Middleware:**
  - [www.acceleratedtechnology.com](http://www.acceleratedtechnology.com)
  - [www.livedevices.com](http://www.livedevices.com)
  - [www.ucos-ii.com](http://www.ucos-ii.com)
  - [http://www.3soft.de/index\\_e.htm](http://www.3soft.de/index_e.htm)
  - [www.ininet.ch](http://www.ininet.ch)
  - [www.h8-uclinux.com](http://www.h8-uclinux.com)
  - [www.thesycon.com](http://www.thesycon.com)

### E6000(H) emulators

The E6000(H) range of high-performance in-circuit emulators offers advanced features for demanding debugging tasks.



### Third Party Hardware

- **Emulator/OCD:**
  - [www.lauterbach.com](http://www.lauterbach.com)
  - [www.yokogawa-digital.com/emb/en/index.html](http://www.yokogawa-digital.com/emb/en/index.html)
- **Boards:**
  - [www.embesso.com](http://www.embesso.com)
- **Flash Programming:**
  - [www.lloyd-research.com/lr\\_h8.htm](http://www.lloyd-research.com/lr_h8.htm)
  - [www.data-io.com](http://www.data-io.com)



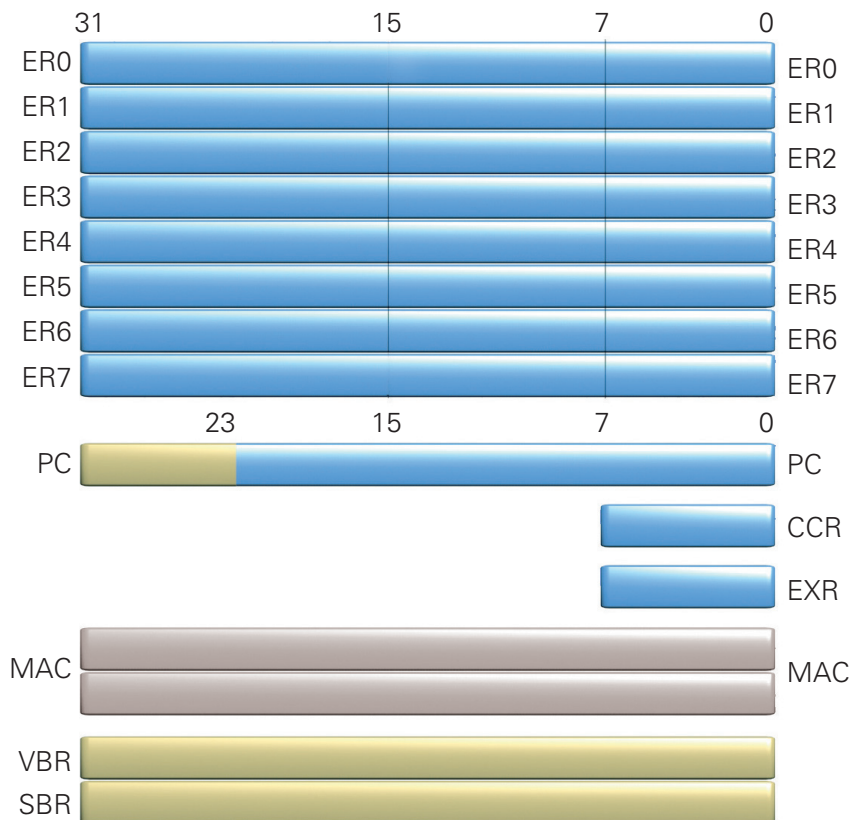
# CPU Core

## CPU 's

H8S/H8SX and H8/300H share the same basic CPU architecture, a general purpose register architecture, which offers advantages for:

<b>Programming in C</b>
<b>Linear Address Space</b>
<b>Code Density</b>
<b>Speed</b>

H8SX introduces numerous improvements to this basic architecture that leaves nothing left to be desired. Examples are: full 32-bit architecture, fast multiplier/divider hardware, vector base register, short address base register, muxed bus and endian-switch capability and last but not least, the H8SX CPU can run as fast as 80MHz.



The H8/300H and H8S CPU core features 32-bit wide registers, which can also be used in 32-bit, 16-bit and 8-bit fractions. Beyond this, the instruction set provides many powerful bit-manipulation-instructions.

H8/300H basic CPU architecture
Found on H8S/26xx and H8SX
Found on H8SX

# Peripherals

The peripherals on Renesas Technology's 16-/32-bit microcontrollers are designed to boost system performance and functionality.

## DMAC, EXDMAC and DTC

In systems with a high performance CPU and up to 16Mbyte of memory, it is paramount that the CPU's performance is not wasted transferring data. Instead the CPU should be concentrating on calculations, it's very purpose. Most peripherals are designed with this in mind, but there are two peripherals which serve no other purpose than moving data, the Direct Memory Access Controller (DMAC) and the Data Transfer Controller (DTC). Most H8/300H or H8S/H8Sx derivatives have either one of these or both. The DMAC focuses on peak transfer performance, while the DTC is slower but more flexible. In fact the DTC is a unique module with features that allow to build entire autonomous subsystems in conjunction with other peripherals, which then can handle significant tasks with almost no CPU intervention.

The EXDMAC specialises in transfers at the external bus, performing a transfer in a single cycle!

## Timers

Some H8/300H derivatives have the ITU timer unit, a 5 channel 16-bit timer with up to 10 input capture or output compare (IC/OC) and special AC motor control PWM modes, which make H8/300H a major success in Europe's motor drive market. Most H8S/H8Sx have the TPU timer unit with 6 channels of 16-bit timers and up to 16 IC/OC. Both, ITU and TPU, can be clocked straight from the system clock, also a feature rarely found on other microcontrollers. Most variants also have one or two watchdog timers (WDT), which can also be used as interval timers. Those products with two WDT have a 32KHz subclock to drive the second WDT. This feature allows numerous additional low-power features and can also be used to implement real-time clocks.

## Serial Ports

Renesas Technology's 16-/32-bit products feature up to 6 serial ports (SCI), which amongst them support an incredible 6 modes: asynchronous (UART style), synchronous, multi-master mode, a subset of ISO7816-3 (smart card interface), IIC and IrDA (infrared). On variants with a DTC, all SCI can be served by the DTC, therefore dramatically reducing the CPU load to handle the data traffic from and to up to 6 SCI. In fact without DTC support this amount of traffic could potentially, depending on baud rates, fully load the CPU.

## Realtime Outputs

Many derivatives feature a Timing Pattern Controller (TPC) or a Programmable Pulse Generator (PPG). These are up to 16 digital outputs which drive new data patterns onto the pins under timer control, hence without the jitter which would be caused by interrupt latency if the CPU was used. Also, obviously this mechanism of generating a stream of data patterns again reduces CPU load dramatically. These modules can be used, for example, to drive stepper motors or to replace a LCD timing controller.

## USB

USB function modules are found on H8S/221x, H8S/2170F and on H8SX/1653F, 1654F, 1663F and 1664F. The H8S/221x products also are low-power and are available in 10x10mm compact BGA packages, as well as in very low cost mask ROM versions, making the H8S/221x line-up ideal for many compact and cost-critical applications such as industrial sensors and health monitoring applications (e.g. blood sugar, blood pressure meters, fitness gadgets, etc). With USB all these MCU are of course also ideal for PC peripherals of any kind such as printers, DSC, etc. The USB modules are compliant to USB 2.0 supporting full speed (up to 12Mbit/s), H8S/2170F supports high-speed. H8S/2215RF has all four USB modes (control, interrupt, bulk, isochronous), all other products have control, interrupt and bulk modes. All of these MCU have sufficiently low power consumption to be powered off the USB port.

## Other Peripherals

Beyond all those peripherals mentioned, most products also have Analog-Digital-Converters (ADC), with 10-bit resolution and usually with 8 channels, some products also have Digital-Analog-Converters (DAC) with 8-bit resolution (usually 2 channel). Most products have bus state controller (BSC) for glueless connection of external memory or peripherals. All products have an interrupt controller with at least 2 priority levels (most H8S have 8) and a number of external interrupt pins. Last but not least, Renesas Technology's 16-/32-bit microcontrollers offer variants with over 100 input/output port pins, with features like 10mA drive, programmable open drain and pull-up, Schmitt Trigger characteristics and interrupt capability (depending on device).

## Selector guide by major peripheral feature (Examples)

	Device	Flash	RAM	Other key features	Comment
<b>USB</b>	low cost	H8S/2211F, H8S/2212F, H8S/2218F	8K-12K	2x SCI, low power, OCD, BGA package option	low cost mask ROM also available
	mid range	H8S/2215RF	20K	3x SCI, low power, OCD, BGA package option	low cost mask ROM also available
	mid range USB HS	H8S/2170BF	32K	DMA, TMR, SCI	-
	high performance	H8SX/1653F, 1654F, 1663F, 1664F	384K-512K	6x SCI, 2x IIC, OCD	50 MIPS
<b>IIC</b>	low cost	H8S/2138AF, H8S/2148BF	4K	8+8 ADC channels, 3x SCI, DTC	low cost mask ROM also available
	mid range	H8S/2238RF, H8S/2239F	16K-32K	low power, 4x SCI, DTC, BGA package option	low cost mask ROM also available
	highend	H8S/236x, H8S/237x	0-32K	5x SCI, DMA+DTC, TPU, OCD	ROM-less and mask also available
	high performance	H8SX/1653F, 1654F, 1663F, 1664F	384K-512K	USB, 6x SCI, TPU, DMA, DTC, OCD	-
<b>Many SCI</b>	low cost	H8S/2148BF	4K	3x SCI, 8+8 ADC, DTC	low cost mask ROM also available
	mid range/low power	H8S/2238RF, H8S/2239F	16K-32K	4x SCI, DTC, low power, BGA package option	low cost mask ROM also available
	mid range	H8S/236x, 237x	0-32K	5x SCI, DMA, DTC, TPU, OCD	ROM-less and mask also available
	high performance	H8SX/1653F, 1654F, 1663F, 1664F	384K-512K	6x SCI, 2x IIC, USB, TPU, DMA, DTC, OCD	-
<b>Large I/O count</b>	low cost	H8S/2370F	16K	113 I/O, 5x SCI, TPU, DMA, DTC, OCD	-
	mid range	H8S/2378BF	32K	113 I/O, 5x SCI, TPU, DMA, DTC, OCD	-
	high performance	H8SX/1663F, 1664F	40K	101 I/O, 6x SCI, 2x IIC, USB, OCD	-
	low cost	H8/3048BF	4K	ITU timer, 2x SCI, DMA, OCD	low cost mask ROM also available
<b>AC motor drive</b>	highend	H8/3052BF	8K	ITU timer, 2x SCI, DMA	-
	low cost (Mask)	H8S/2319CF	16K	8x8mm LGA	Also H8S/2317SM mask available
	low cost	H8S/2211F, H8S/2212F, H8S/2218F	8K-12K	10x10mm BGA	low cost mask ROM also available
	mid range	H8S/2215RF, H8S/2238RF, H8S/2239F	20K-32K	10x10mm BGA	low cost mask ROM also available
<b>32KHz subclock or RTC</b>	highend	H8S/2378BF	32K	9x9mm LGA	-
	low cost	H8S/2211F, H8S/2212F, H8S/2218F	8K-12K	USB, OCD, BGA package option	low cost mask ROM also available
	mid range	H8S/2238RF	16K	4x SCI, also 2.2V option available, BGA package option	low cost mask ROM also available
	high performance	H8S/2239F	32K	4x SCI, DMA+DTC, BGA package option	-
<b>SDRAM interface</b>	high performance	H8SX/1663F, 1664F	40K	6x SCI, 2x IIC, USB, OCD	-
	low cost	H8S/2373R	16K	5x SCI, DMA, DTC, large I/O count, 33MHz	-
	mid range	H8S/2674R	32K	3x SCI, DMA, DTC, large I/O count, 33MHz	-
	high performance	H8S/237xR	16K-32K	5x SCI, DMA, DTC, large I/O count, 35MHz	-
	H8SX/1663F, H8SX/1664F	384K-512K	40K	6x SCI, 2x IIC, USB, DMA, DTC, large I/O count, 50MHz	-

## Evaluation-Boards



Family	Board	Part Name	Device used	Devices Supported	Comments
H8/300H	H8/3029 E10T target board	MB3029	H8/3029F	H8/302x	Simple E10T target board (E10T not included).
H8S	RSK2215	R0K42215RS000BE	H8S/2215RF	H8S/221x with USB	Renesas Starter Kit with E8 and LCDC.
	3DK Board for H8S/2218F	3DK2218	H8S/2218F	H8S/2218	
	EDK Board for H8S/223x	EDK2239	H8S/2239F	H8S/222x, 223x	
	EDK Board for H8S/232x	EDK2329	H8S/2329EF	H8S/231x, 232x	Whilst stocks last.
	EDK Board for H8S/237x	EDK2378	H8S/2378F	H8S/236x, 237x	
	EDK Board for H8S/239x	EDK2398	H8S/2398F	H8S/239x	
H8SX	EDK Board for H8S/267x	EDK2676	H8S/2676F	H8S/267x	Whilst stocks last.
	RSK1664	R0K561664S000BE	H8SX/1664F	H8SX/1663F, 64F H8SX/1653F, 54F	
Specials	RSK1651				planned: please inquire.
	uClinix Board for H8S/2674R	EDOSK2674	H8S/2674R	-	Download uClinix under <a href="http://www.h8-uclinux.com">www.h8-uclinux.com</a> , whilst stocks last.
	EPOS demo board for H8S/237x	EDK2377DEMO1	-	H8S/237x	Add-on to EDK2378, whilst stocks last. Please inquire.

**Note:** EDK and 3DK contain HMON debugger, HEW and evaluation copy of the Renesas C Compiler and tutorials. RSK contain E8, LCDC and additional sample code.