

SH7216-The World's Fastest Embedded Flash MCU



Renesas Technology Europe

CID BU - Product Marketing

Robert Kalman



SPOTLIGHT PRODUCT - SH7216/4

The world's fastest embedded flash MCU

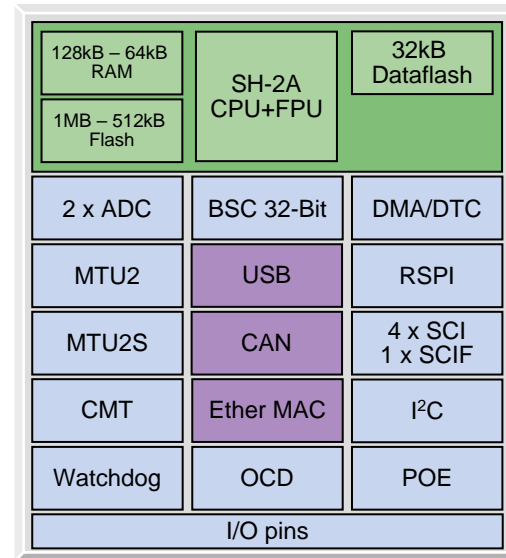
Renesas key strengths

- Number 1 MCU producer: total MCU commitment
- Broadest MCU portfolio: from <1Eur to 1000 MIPS
- Long product life time (average 15 years)
- Technology leadership. Own R&D/ Fabs
- Best reliability and quality (1,2bn MCUs delivered with zero flash field failures)

Target applications

- High end inverters
- Connectivity Solutions
- Motor Control / Drives
- Solar Inverters
- Real-time control

SH7216/4 Block diagram



Key features

Key benefits

200MHz / 400MIPS SH-2A CPU with single-cycle embedded flash.	Achieves high performance and also eliminates the need to execute code from RAM.
200MHz / 400MFLOPS FPU	Improved processing speeds for motor control algorithms using floating point maths.
Ethernet, USB, CAN	Enabling connectivity functions.
12bit fast ADC with 1us Conversion time and synchronised 100MHz PWM timer.	Motor control made very easy with limited load on the CPU.
1MB Flash and 128kB RAM	Headroom for the application to grow
32kB dataflash with background operation	No need for external EEPROMs

Ordering Reference

Part Name	Ordering Code	RSK Ordering Code
SH7216: 100MHz, 512k, 176pin -40->85C, FPU, Ether	R5F72165GDFP#V0	R0K572167S000BE

SH7216/4 Product family

72 Variation, including options with and without, FPU, Ethernet. 200MHz and 100MHz versions. And 3 different package variations. **105C Variants will be available in mid 2010**

Highest integration

Group	Memory		Operation		Timer	Connectivity					ADC	Pins	Temperature	Part Number	Other package available
	Flash	RAM	Frequency	FPU		IO lines	EtherMAC	USB2.0	SPI	CAN					
SH7216A	1M	128k	200MHz	yes	12	100	1	1	1	1	8ch 12-bit	176	-40->85C	R5F72167ADFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7216A	768k	96k	200MHz	yes	12	100	1	1	1	1	8ch 12-bit	176	-40->85C	R5F72166ADFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7216A	512k	64k	200MHz	yes	12	100	1	1	1	1	8ch 12-bit	176	-40->85C	R5F72165ADFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7216B	512k	64k	200MHz	yes	12	100	-	1	1	1	8ch 12-bit	176	-40->85C	R5F72165BDFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7214B	512k	64k	200MHz	-	12	100	-	1	1	1	8ch 12-bit	176	-40->85C	R5F72145BDFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7214A	512k	64k	200MHz	-	12	100	1	1	1	1	8ch 12-bit	176	-40->85C	R5F72145ADFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7216G	512k	64k	100MHz	yes	12	100	1	1	1	1	8ch 12-bit	176	-40->85C	R5F72165GDFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7216H	512k	64k	100MHz	yes	12	100	-	1	1	1	8ch 12-bit	176	-40->85C	R5F72165HDFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7214H	512k	64k	100MHz	-	12	100	-	1	1	1	8ch 12-bit	176	-40->85C	R5F72145HDFP#V0	176QFP 0.4mm, 176BGA 0.8mm
SH7214G	512k	64k	100MHz	-	12	100	1	1	1	1	8ch 12-bit	176	-40->85C	R5F72145GDFP#V0	176QFP 0.4mm, 176BGA 0.8mm

Connectivity solution

Lowest cost

SuperH Microcontrollers – Product family

High Performance SH-2 +SH2A High end Flash ROM-less	SH7201 SH2A-FPU @ 120MHz 280MIPS 2x CAN Many serial ports	SH7203 SH2A-FPU @ 200MHz 480MIPS 2x CAN, USB H/F Many serial ports SD-card, LCDC	SH767x SH2A-FPU @ 200MHz 480MIPS Ether, USB H/F SD-card	SH7205 Dual Core 2x SH2A-FPU @ 200MHz 960MIPS 2x CAN, USB H/F Many serial ports NAND, RGB-out
	SH708x SH2 @ 80MHz 256K-512K MTU2, MTU2S Many packages down to 10x10mm 3V or 5V Vcc	SH7211 SH2A @ 160MHz 512K Fast 12-bit ADC MTU2, MTU2S	SH7286/5 SH2A @ 100MHz 1M - 512k Tripple fast 12-bit ADC MTU2, MTU2S CAN, USB	SH7216/4 SH2A-FPU @ 200MHz 1M - 512k MTU2, MTU2S CAN, Ether, USB F
Mid End SH-2 +SH2A	SH713x SH2 @ 80MHz 128K-256K MTU2, MTU2S Double fast 12-bit ADC CAN 5V Vcc	SH714x SH2 @ 80MHz 128K-512K MTU2, MTU2S 0,1,2x CAN 5V Vcc	SH7243 SH2A @ 100MHz 256K Fast 12-bit ADC MTU2, MTU2S	
	SH7125/4 SH2 @ 50MHz 16K-128K MTU2 Many packages down to 7x7mm 5V Vcc			

Tools and support



Everything you need for development in one single package!

- The RSK includes:
- Development Board
 - E10A "JTAG style" debugger
 - Sample code (TCP/IP / USB / CAN)
 - Compiler (up to 256k)
 - HEW IDE

OS Packages available from: FreeRTOS Segger, Express Logic, Euros, Micrium, and others



Product related documentation:
www.eu.renesas.com/superh



Free of charge software libraries:
www.eu.renesas.com/swlibrary



Alliance partners:
www.eu.renesas.com/alliance



Online training:
www.renesasinteractive.com



Technical community:
www.renesasrulz.com

Winning with the SH7216/4

SH7216/4 - Key selling points

- Highest performance in industry
- All the connectivity you need
- Great quality
- High performance MONOS flash
- Very scalable!

Key Features	SH7216	TI TMS320 TMS320VC	STM Cortex - Connectivity line: STM32F107	TI Cortex M3 Stellaris 9000 series
CPU	SuperH SH2A (200MHz)	150-300MHz TMS320 DSP core	Cortex 32bit (CPU: 72 MHz CPU)	Cortex 32bit (CPU: 100 MHz CPU)
Flash	512k - 1M	32kB - 512kB	16-512 KB	128-256 KB
SRAM	64kB - 128kB	12kB - 68kB	up to 64 KB	up to 96 KB
Supply	3.0V or 5.0V	1.9V or 3.3V	2.0V to 3.6V	2.0V to 3.6V
Voltage detection			POR, LVD, LDO	POR, LVD, LDO
DMAC	Data Transfer Controller + DMA 8ch	Yes Std DMA controller	up to 12 channel DMA	up to 32 channel DMA
Timer	50MHz MTU2 (6ch 16bit) - Motor Control Timer 100MHz MTU2S (4ch 16bit) - Motor Control Timer 50MHz CMT (2ch 16bit) - Compare Match Timer	24-8 PWM channels, with 16-3 hi-res PWM. Including quad encoder channels 9-24 total timer channels	up to six 16 bit general purpose timer	up to eight 16 bit general purpose timer
	PWM	PWM	not on connectivity family	PWM
Serial interface	5xSCI, 1xSPI, 1xI2C	up to 4 USART, up to 3 SPI, up to 2 I2C	up to 5 USART, 3 SPI, 2 I2C	up to 3 UART, 2 SPI, 2 I2C, I2S
CRC	-		CRC-32	CRC-32
WDT	Watchdog Timer	Watchdog Timer	2 WDT (independent and window)	2 WDT (independent and window)
ADC	2x4ch 12bit ADC (1µs per channel)	16ch x12-bit ADC (80ns - 267ns)	1x12-bit ADC (1.17us@72MHz) (16 external ch. + 2 internal)	2x 8ch 10-bit ADC
DAC	none	none	12 bit (programmable to 8 bit)	n/a
Comparators	no	up to 3	no	3
USB	Yes	Yes	yes	yes
CAN	Yes	up to 2	yes	3ch
Ether	Yes	Yes	Yes	Yes
Others	-	-	Temperature sensor	
Temp range	-40°C to 85°C or 105°C	-40°C to 85°C or 105°C	-40°C to 85°C or 105°C	-40°C to 85°C
Package variants	176LQFP 176BGA	256BGA- 38TSSOP	36 QFN, 48 LQFP, 64 LQFP, 100 LQFP, 100 BGA, 144 LQFP 144 BGA	64 LQFP, 100 LQFP, 108 BGA,
Datasheet link	http://documentation.renesas.com/eng/products/mpumcu/rej09h0402_sh7137hm.pdf	http://focus.ti.com/lit/ml/sprb176e/sprb176e.pdf	http://www.st.com/mcu/download2.php?file=13902.pdf&info=STM32F101CB%20Reference%20Manual%20RM0008&url=http://www.st.com/stonline/products/literature/m/13902.pdf	http://www.luminarymicro.com/products/9000_series.html

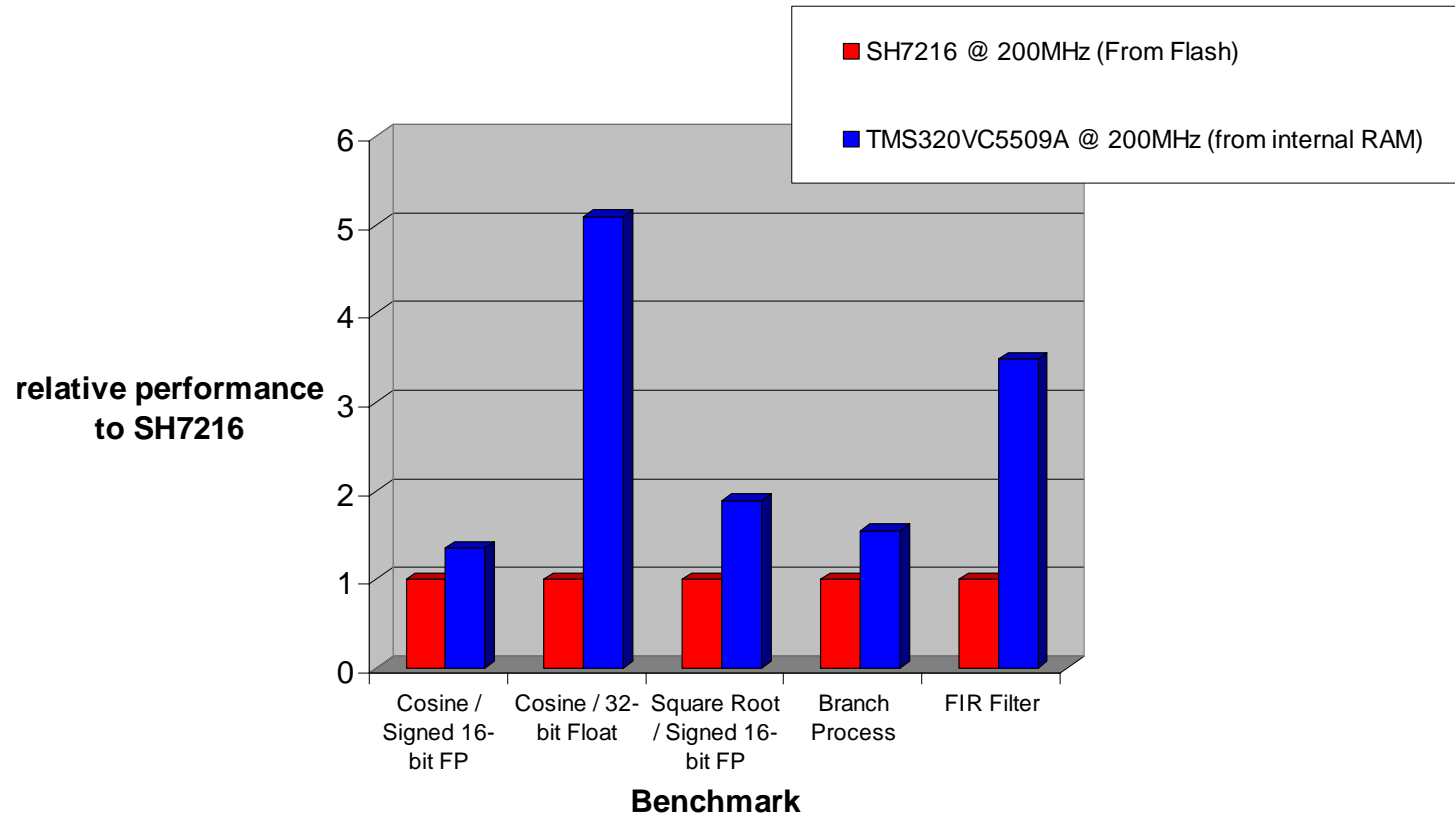
Winning with the SH7216/4

	advantage
	disadvantage

Key customer careabouts	SH7216/4	STM32 107 family	TI DSP	TI Cortex M3 Stellaris
Development time reduction	Leading edge IDE, Low cost RSK available. With sample code for USB, TCP/IP and CAN	31 errata on the first silicon. Device was unusable. Low cost tools are not suitable for full system development		
High Performance + Flash Performance	200MHz operation without wait states! Integrated FPU 30ns interrupt response time	24MHz is max flash performance. Only one instruction per clock cycle	30MHz is max flash performance Must run from RAM See benchmarking!!	50MHz is max flash performance Only one instruction per clock cycle
System reliability	1.5 billion flash MCUs shipped. Zero data retention failures	Customers comment often about quality of the Flash		
Simple to use	Programmable in C with optimised compiler and linker. True MCU architecture. Easy to understand.		DSP architecture. Not as intuitive and simple as an MCU. Can require writing code in assembler for optimisation.	
Scalability and roadmap	Scalable up and down within the SuperH architecture from 16k Flash 50MHz to 4.2GFLOPS of performance.	Spot solution from 16k to 512k. No Motor Control on connectivity line		Concerns over future of the family
Voltage range	5V or 3V system possible. (ADC is 5V which is less susceptible to noise)	Only 3.3V possible.	Only 3.3V or 1.8V possible.	Only 3.3V or 1.8V possible.

SH7216 vs TMS320 benchmarking

Benchmark comparison



Discovery Questions

- Q1: Will you run your routines directly from RAM?

A1: The SH7216 contains the industry's fastest Flash technology meaning that the code from flash runs as fast as it does from RAM. There is no need to copy performance critical routines to RAM. Other suppliers often run from Flash as slow as 24MHz or 30MHz.

- Q2: Do you program in assembler?

A2: In comparison to DSPs the SH7216 is a true Microcontroller, it facilitates easy programming in ,C' and is supported by a free tool chain for up to 256k of code. This enables re-use of code! It also incorporates an hardware FPU for mathematic intensive algorithms.

- Q3: Is flash reliability a key requirement in your system?

A4: Renesas has the best proven flash with an intelligent Flash control circuit for higher reliability. We have shipped more than 1,5 bn Flash MCU's and have zero returns due to retention failure.

- Q4: Do you want free drivers?

The RSK for the SH7216 comes with a free TCP/IP stack, USB driver, CAN driver and a great many more pieces of example code. For customer who want to use commercial solutions, there are also many commercial solutions too.

Success story: Industrial Drive

Application: High Performance Industrial Inverter

Product : SH7214
Volume: 400kpcs / yr

Renesas benefits over competition:

The Fastest Embedded Flash Solution on the Market

Best in class performance

Call to Action: Check your Industrial Inverter Customers



Success story: Solar Inverter Control

Application: Intelligent Industrial Sensor Controller

Product : SH7216

Volume: 40kpcs / yr



Renesas benefits over competition:

FPU on a Flash-based MCU for mathematic algorithms

100MHz option for cost effectiveness.

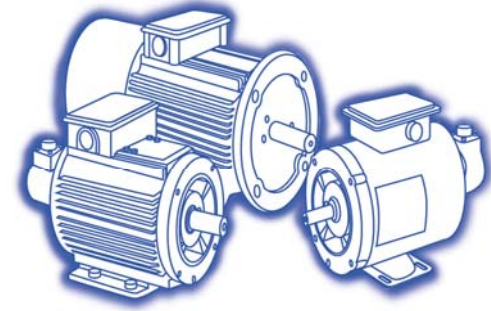
Call to Action: Check your Solar Inverter customers



Success story: Motor Control

Application: Industrial Inverter

Product : SH7216
Volume: 100kpcs / yr



Renesas benefits over competition:

Evaluation platform for SuperH use based on fastest solution worldwide.

1M of Flash and 128k RAM gives huge headroom

Call to Action: Check your Motor Control Customer Base





RENESAS