RENESAS RA
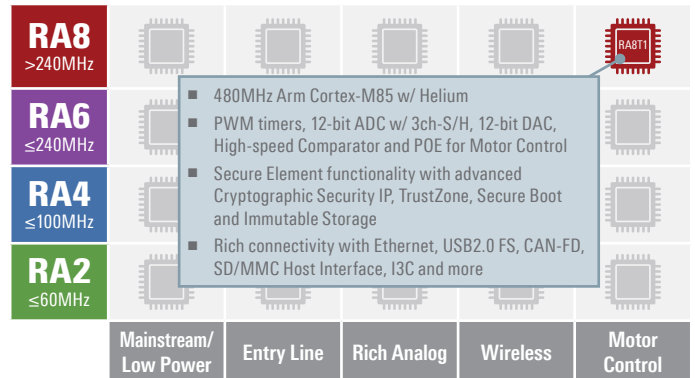
32-bit MCU Family
RENESAS RA8T1 GROUP

480 MHz Arm® Cortex®-M85 Based Microcontroller with Helium™ and TrustZone® for Motor Control

The RA8T1 Group 32-bit MCUs are based on the 480 MHz Arm Cortex-M85 core with Helium Technology and TrustZone with peripheral features optimized for motor or inverter controls. RA8T1 integrates up to 2MB large Flash memory, 1MB SRAM including TCM, PWM timers, analog features, multiple connectivity features, and also supports advanced security features and safety functions. These MCUs enable advanced motor control or additional functions on end systems with high performance and abundant integrated features. The RA8T1 Group supports the Flexible Software Package (FSP) and ecosystem partner solutions, as well as motor control evaluation kits, software, and tools.
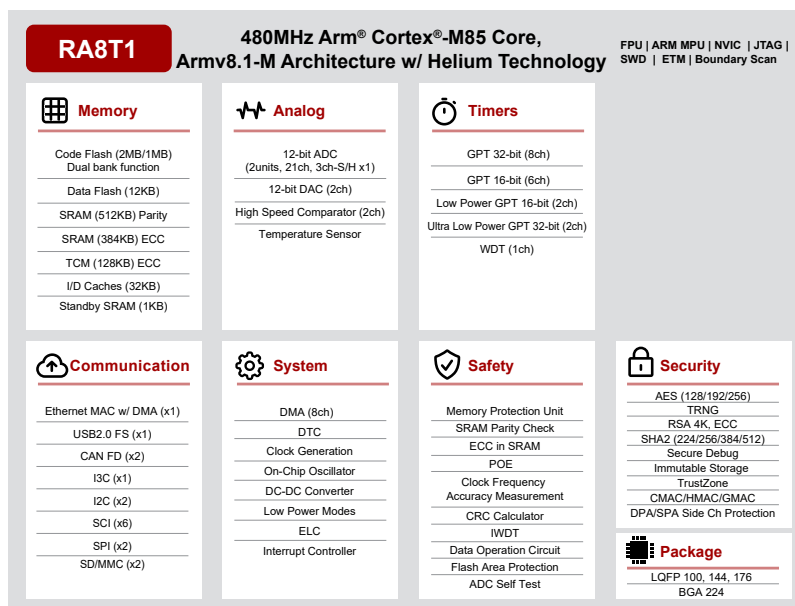
RA8 >240MHz					RA8T1
RA6 ≤240MHz					
RA4 ≤100MHz					
RA2 ≤60MHz					
	Mainstream/ Low Power	**Entry Line**	**Rich Analog**	**Wireless**	**Motor Control**

- 480MHz Arm Cortex-M85 w/ Helium
- PWM timers, 12-bit ADC w/ 3ch-S/H, 12-bit DAC, High-speed Comparator and POE for Motor Control
- Secure Element functionality with advanced Cryptographic Security IP, TrustZone, Secure Boot and Immutable Storage
- Rich connectivity with Ethernet, USB2.0 FS, CAN-FD, SD/MMC Host Interface, I3C and more

Key Features

- 480 MHz Arm Cortex-M85 with Helium Technology
- 1MB - 2MB Dual-bank Flash memory
- 1MB SRAM including TCM
- 14ch PWM Timers and 4ch Low-Power Timers
- 12-bit A/D Converter with 3-ch Sample and Hold
- 12-bit D/A Converter and High-speed Analog Comparator
- Ethernet MAC with DMA Controller
- USB2.0 Full-Speed Device/Host
- CAN FD, SD/MMC Host Interface
- Renesas Secure IP (RSIP-E51A)
- Immutable ROM for First Stage Boot Loader (FSBL)
- Scalable from 100-pin to 224-pin packages

Target Applications

- Industrial Automation (AC Drive, AC Servo, AGV/AMR)
- Building Automation (HVAC, Compressor, Solar Inverter)
- Smart Home (Air Conditioner, Washer/Dryer, Refrigerator, Vacuum Cleaner)
- Fields (Power Tools, Mower Machine)

Block Diagram

RA8T1 — 480MHz Arm® Cortex®-M85 Core, Armv8.1-M Architecture w/ Helium Technology
FPU | ARM MPU | NVIC | JTAG | SWD | ETM | Boundary Scan

Memory
- Code Flash (2MB/1MB) Dual bank function
- Data Flash (12KB)
- SRAM (512KB) Parity
- SRAM (384KB) ECC
- TCM (128KB) ECC
- I/D Caches (32KB)
- Standby SRAM (1KB)

Analog
- 12-bit ADC (2units, 21ch, 3ch-S/H x1)
- 12-bit DAC (2ch)
- High Speed Comparator (2ch)
- Temperature Sensor

Timers
- GPT 32-bit (8ch)
- GPT 16-bit (6ch)
- Low Power GPT 16-bit (2ch)
- Ultra Low Power GPT 32-bit (2ch)
- WDT (1ch)

Communication
- Ethernet MAC w/ DMA (x1)
- USB2.0 FS (x1)
- CAN FD (x2)
- I3C (x1)
- I2C (x2)
- SCI (x6)
- SPI (x2)
- SD/MMC (x2)

System
- DMA (8ch)
- DTC
- Clock Generation
- On-Chip Oscillator
- DC-DC Converter
- Low Power Modes
- ELC
- Interrupt Controller

Safety
- Memory Protection Unit
- SRAM Parity Check
- ECC in SRAM
- POE
- Clock Frequency Accuracy Measurement
- CRC Calculator
- IWDT
- Data Operation Circuit
- Flash Area Protection
- ADC Self Test

Security
- AES (128/192/256)
- TRNG
- RSA 4K, ECC
- SHA2 (224/256/384/512)
- Secure Debug
- Immutable Storage
- TrustZone
- CMAC/HMAC/GMAC
- DPA/SPA Side Ch Protection

Package
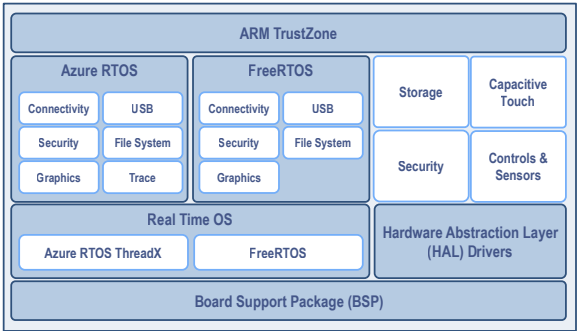- LQFP 100, 144, 176
- BGA 224

RENESAS RA8T1 GROUP

Software Package

The Renesas Flexible Software Package (FSP) is designed to provide easy-to-use, scalable, high-quality software for embedded system designs using RA MCUs.

The FSP is based on an open software ecosystem of production-ready drivers, supporting Azure® RTOS, FreeRTOS™ or bare-metal programming. It also includes a selection of other middleware stacks, providing great flexibility for migrating code from older systems or developing new applications from scratch.

ARM TrustZone					
Azure RTOS		**FreeRTOS**		Storage	Capacitive Touch
Connectivity	USB	Connectivity	USB		
Security	File System	Security	File System	Security	Controls & Sensors
Graphics	Trace	Graphics			
Real Time OS				**Hardware Abstraction Layer (HAL) Drivers**	
Azure RTOS ThreadX		FreeRTOS			
Board Support Package (BSP)					

Tools and Support

The e² studio IDE provides support with intuitive configurators and intelligent code generation to make programming and debugging easier and faster.

IDE	Renesas e²studio	Keil MDK	IAR EWARM
Compiler	• GCC • LLVM • Arm Compiler* • IAR Arm Compiler*	• Arm Compiler*	• IAR Arm Compiler*
Debug Probe	• Renesas E2/E2 Lite • SEGGER J-Link	• SEGGER J-Link • Keil ULINK / CMSIS-DAP (limited support)	• IAR I-jet • SEGGER J-Link • Renesas E2/E2 Lite • CMSIS-DAP (limited support)
Production Programmer	• Renesas PG-FP6 • SEGGER J-Flash • Partner solutions		

* Compiler must be purchased and licensed directly from third party

Evaluation Kit

- MCK-RA8T1 Renesas Flexible Motor Control Kit for RA8T1 Group including CPU board, inverter board, communication board, PMSM motor and accessories
- MCB-RA8T1 individual CPU board for RA8T1 enables connection to existing MCK platform boards and evaluation with the single board
- On-board debugging using SEGGER J-Link®
- Order the kit and download documentation, design package, development tools, and software at: renesas.com/mck-ra8t1 or renesas.com/mcb-ra8t1
- Orderable part number:
  - RTK0EMA5K0S00020BJ (MCK-RA8T1)
  - RTK0EMA5K0C00000BJ (MCB-RA8T1)

Ordering References

Flash/RAM	Tj				
2MB/1MB	-40 to 125 °C	R7FA8T1AHECFP	R7FA8T1AHECFB	R7FA8T1AHECFC	R7FA8T1AHECBD
1MB/1MB	-40 to 125 °C	R7FA8T1AFECFP	R7FA8T1AFECFB	R7FA8T1AFECFC	R7FA8T1AFECBD
Pin Count		100-pin	144-pin	176-pin	224-pin
Package		LQFP	LQFP	LQFP	BGA
Package size (body)		14 x 14 mm	20 x 20 mm	24 x 24 mm	13 x13 mm
Pitch		0.5 mm	0.5 mm	0.5 mm	0.8 mm

For more details, please visit: **renesas.com/ra8t1**