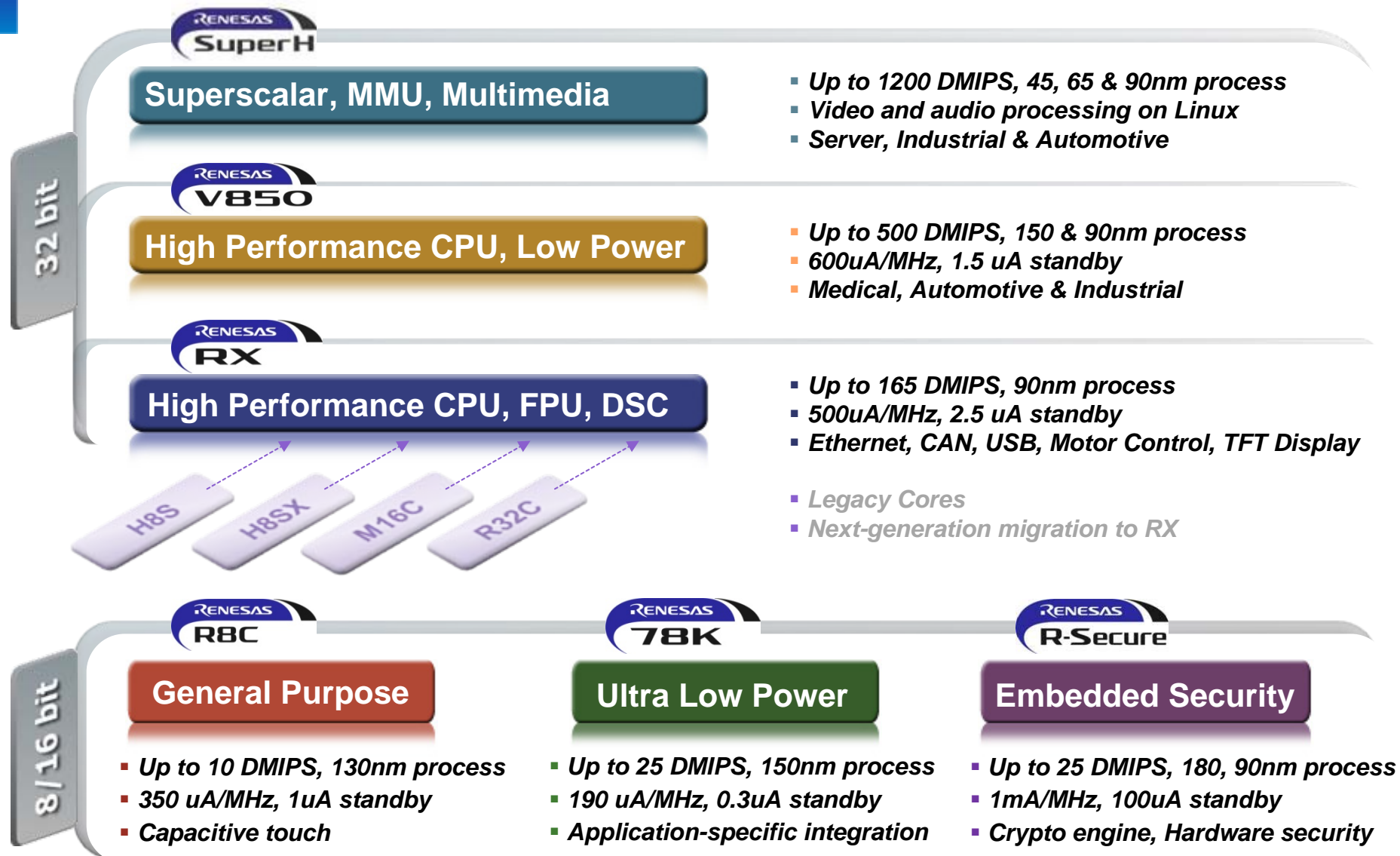# SuperH MCUs
SH7216 Highest Performance Flash-based MCU with Connectivity

Renesas Electronics America Inc.

Microcontroller and Microprocessor Line-up

32 bit

RENESAS SuperH

Superscalar, MMU, Multimedia

- *Up to 1200 DMIPS, 45, 65 & 90nm process*
- *Video and audio processing on Linux*
- *Server, Industrial & Automotive*

RENESAS V850

High Performance CPU, Low Power

- *Up to 500 DMIPS, 150 & 90nm process*
- *600uA/MHz, 1.5 uA standby*
- *Medical, Automotive & Industrial*

RENESAS RX

High Performance CPU, FPU, DSC

- *Up to 165 DMIPS, 90nm process*
- *500uA/MHz, 2.5 uA standby*
- *Ethernet, CAN, USB, Motor Control, TFT Display*

- *Legacy Cores*
- *Next-generation migration to RX*

H8S   H8SX   M16C   R32C

8 / 16 bit

RENESAS R8C

General Purpose

- *Up to 10 DMIPS, 130nm process*
- *350 uA/MHz, 1uA standby*
- *Capacitive touch*

RENESAS 78K

Ultra Low Power

- *Up to 25 DMIPS, 150nm process*
- *190 uA/MHz, 0.3uA standby*
- *Application-specific integration*

RENESAS R-Secure

Embedded Security

- *Up to 25 DMIPS, 180, 90nm process*
- *1mA/MHz, 100uA standby*
- *Crypto engine, Hardware security*

RENESAS

Our SH-2A MCU Solution

- High Performance SH-2A Process Core efficiencies Equivalent to Application Processors (2 DMIPS/MHz)
- Combined with High Performance Memory and Peripherals on MCUs

Application Processor Core With FPU

MCU Memory And Peripherals
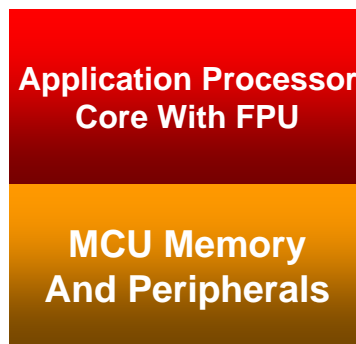
- The SH-2A with Floating Point Unit (FPU)
  - Integrates enough functionality to replace a DSP + MCU into a single chip
  - Benefits include smaller form factors, lower cost, less EMI
  - Software development is simple because everything is coded on a single platform

RENESAS

What's Unique about the SH7216?

The SH7216 shines when customer needs performance & high-throughput

Superscalar RISC Core

2.0 DMIPs/MHz   Double Precision 64 bit FPU   Short 9 cycle Interrupt Latency

Peripherals

Multifunction Timers 2 Inverters supported   12 bit ADC Fast 1.0uS Sampling Rate

High Speed Memory

Industry's Fastest 10ns Flash Memory (1MB)   Large SRAM Up to 128KB
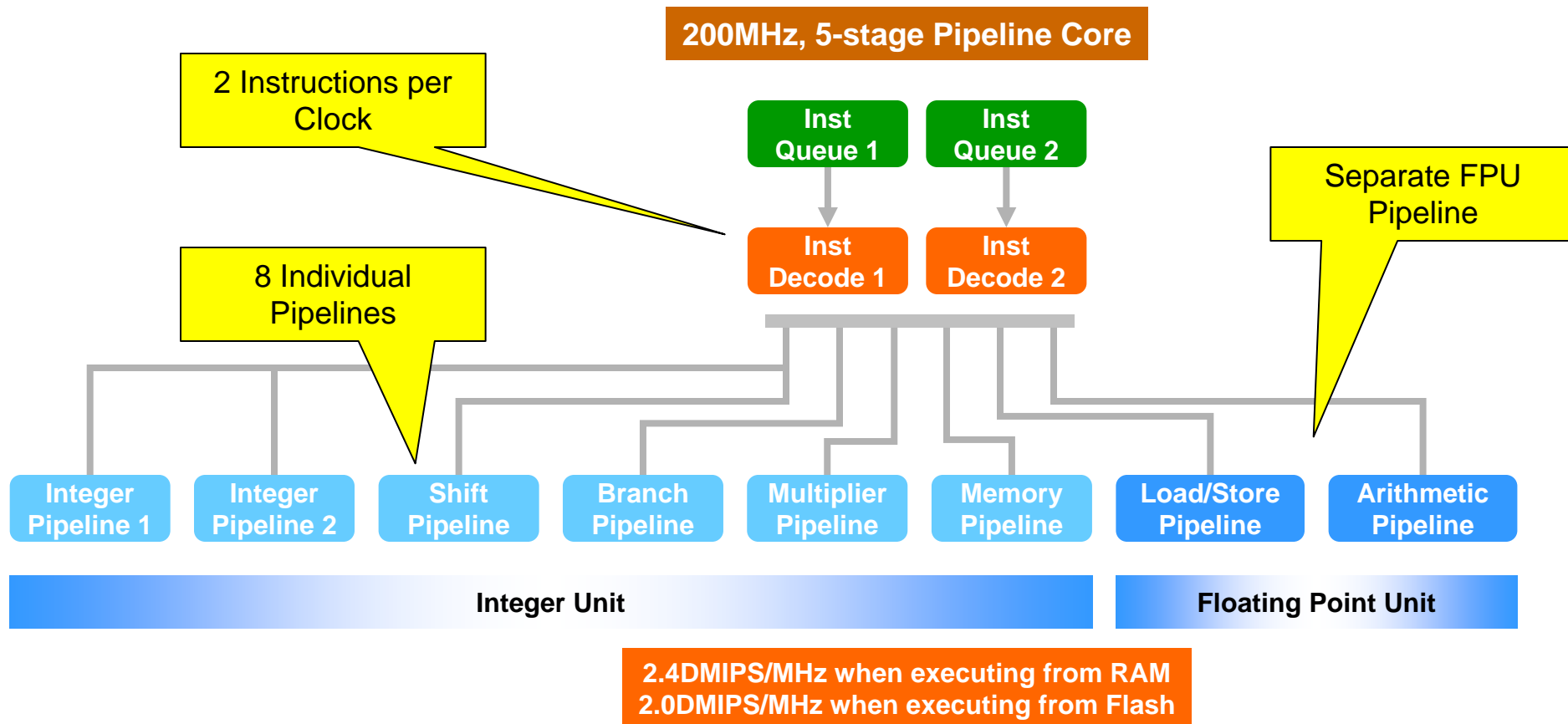
Rich Connectivity

10/100 Ethernet   CAN 2.0   USB 2.0

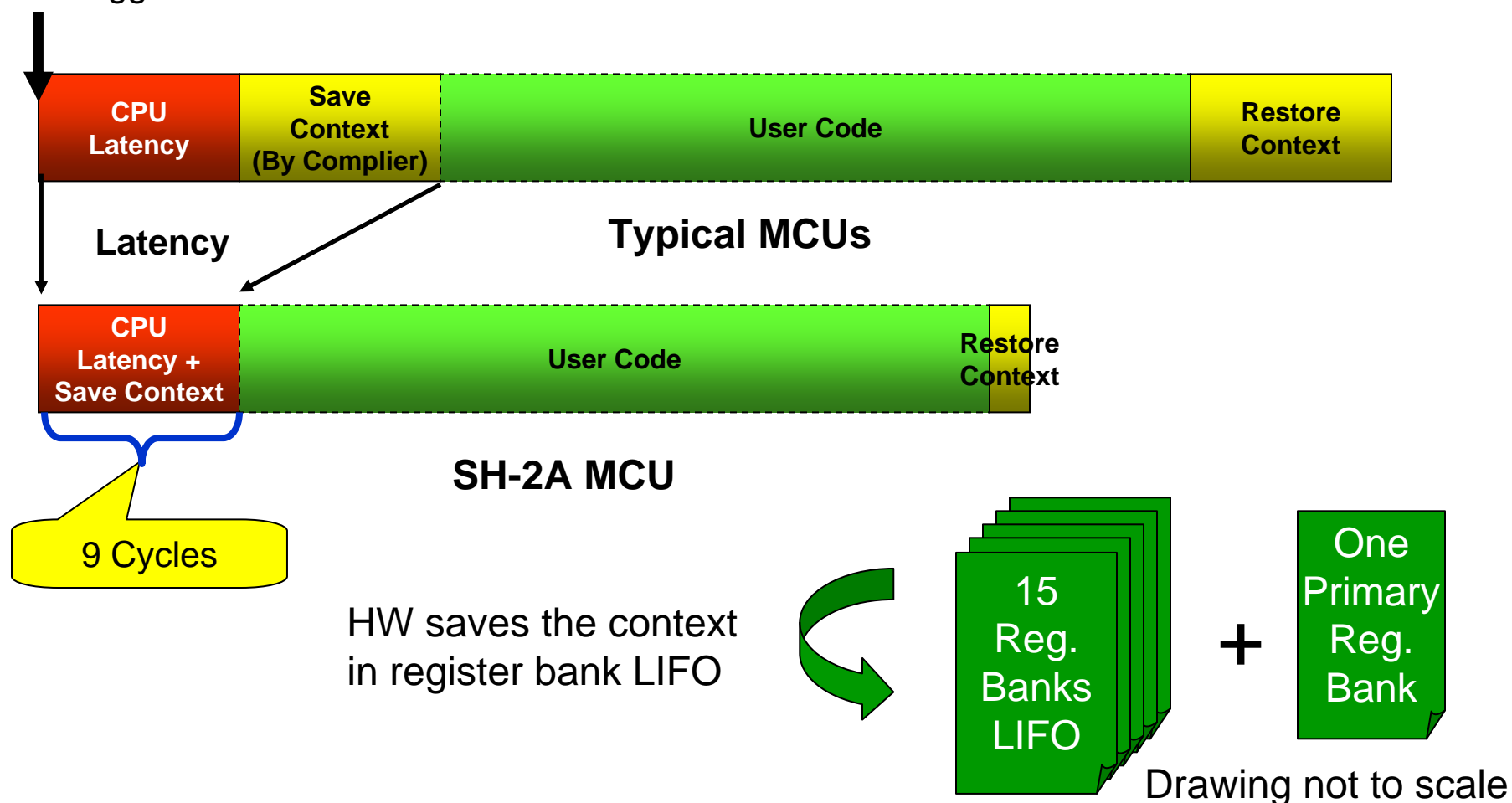Supported by leading Third Party SW & Tools:
CMX, Eclipse, Express Logic, GNU Tool suite, IAR, Micrium, Segger
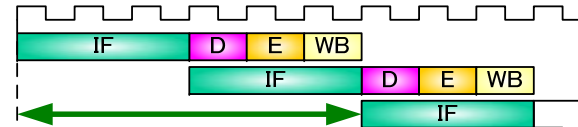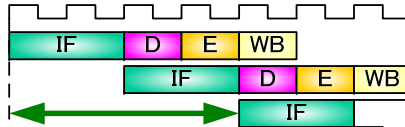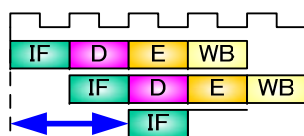
RENESAS

2 Instructions/Clock Core

200MHz, 5-stage Pipeline Core

2 Instructions per Clock

8 Individual Pipelines

Separate FPU Pipeline

Inst Queue 1

Inst Queue 2

Inst Decode 1

Inst Decode 2

Integer Pipeline 1

Integer Pipeline 2

Shift Pipeline

Branch Pipeline

Multiplier Pipeline

Memory Pipeline

Load/Store Pipeline

Arithmetic Pipeline

Integer Unit

Floating Point Unit

2.4DMIPS/MHz when executing from RAM
2.0DMIPS/MHz when executing from Flash

RENESAS

SH-2A Fast Interrupt Response

INT Trigger

CPU Latency | **Save Context (By Complier)** | **User Code** | **Restore Context**

Latency

Typical MCUs

CPU Latency + Save Context | **User Code** | **Restore Context**

SH-2A MCU

9 Cycles

HW saves the context in register bank LIFO

15 Reg. Banks LIFO **+** One Primary Reg. Bank

Drawing not to scale

	SH7216	Cortex-M3	ARM7TDMI	PIC32
MCU Interrupt Latency	9	18+	24 – 42	18 – 40+

RENESAS

SH7216 Uses Fastest Flash (10ns read time)

Other vendors employ wide-bus & prefetch buffers but they still cannot match 100MHz flash performance

SH7216 with 100 MHz flash

Processing performance gap

Competing MCU with 30 MHz flash

Processing performance

3 or more

2 wait cycles

1 wait cycle

30 MHz   100 MHz   MCU operating frequency

IF D E WB
IF D E WB
IF

IF D E WB
IF D E WB
IF

IF D E WB
IF D E WB
IF
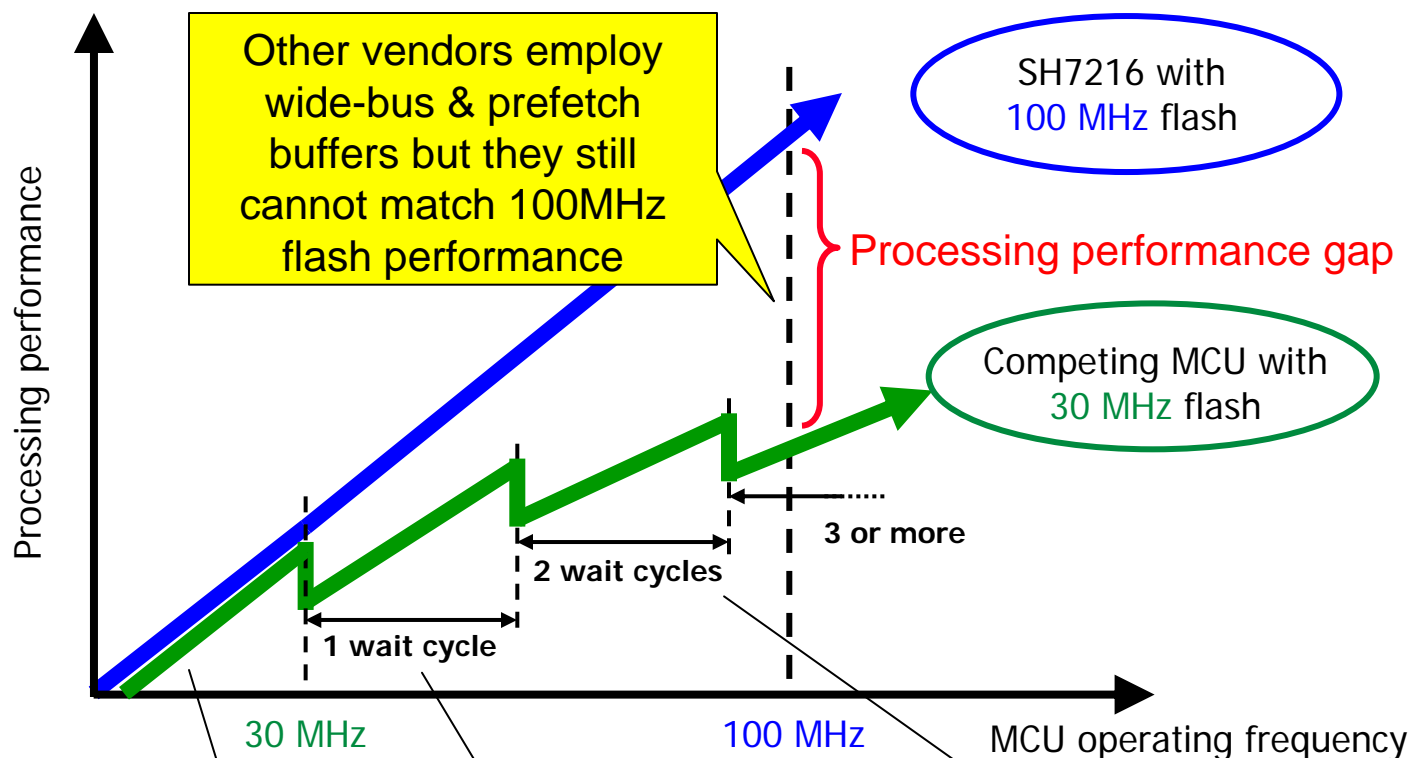
	SH7216	A	B	C	D	E
Max Freq (MHz)	200	72	72	66	80	150
Flash Speed (MHz)	100	24	20	33	30	27

RENESAS

Target Applications

Factory Automation
Precision Motion Control
Industrial Connectivity
Fast I/O Control

Operator Panels

Scientific & Medical
Signal Analysis
Quiet Motor Control
Connectivity

Operator Panels

Consumer
Media Players
User Interfaces

Office Automation
Image Processing
Precise Stepper Control
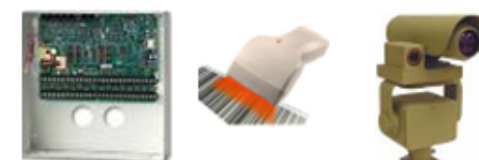Connectivity
Operator Panels

White Goods
Energy Efficient Motor Control

Information Displays

Building Automation
High-end Security Systems
Image Processing
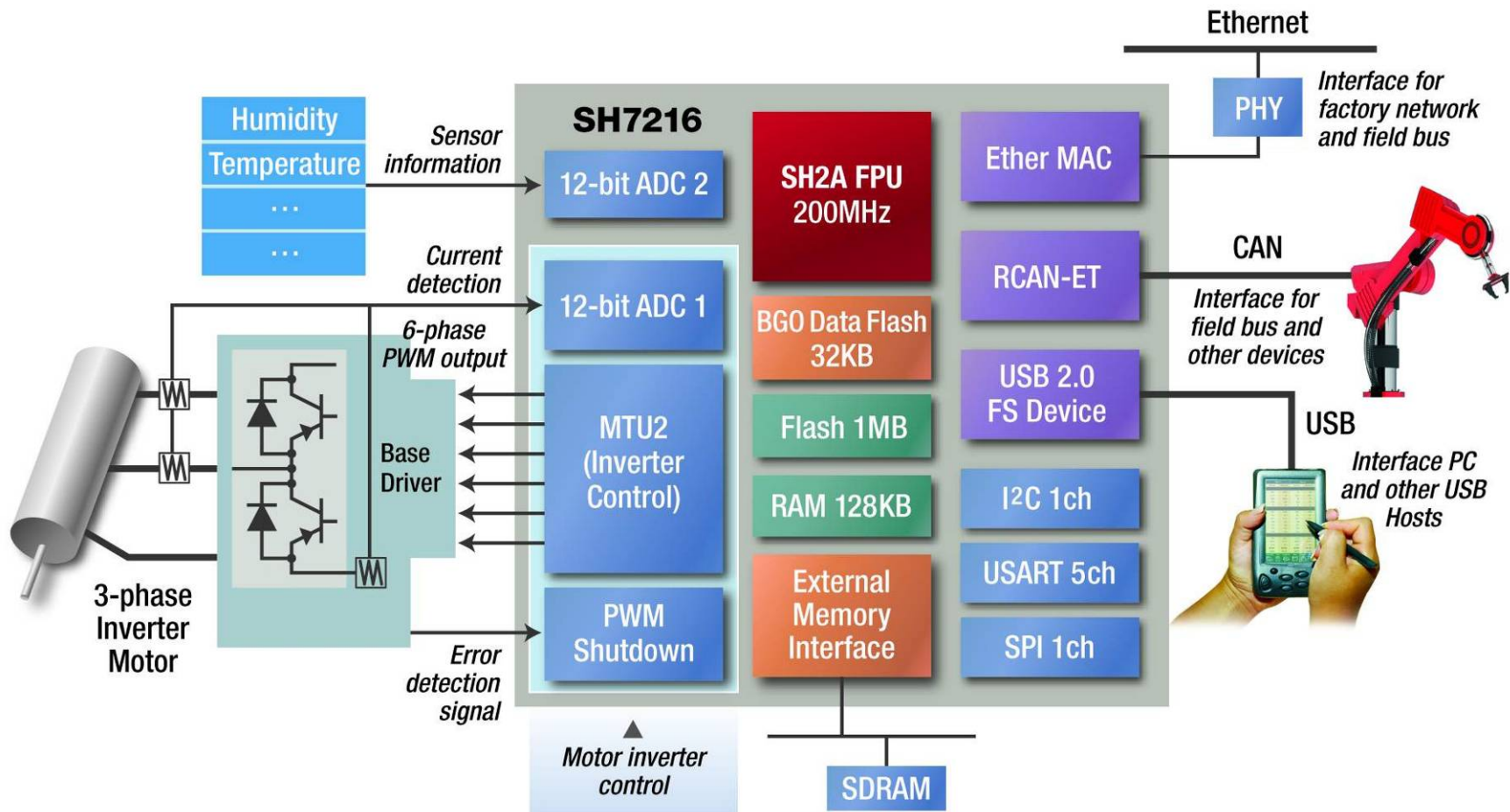Speech, Connectivity
Thermostat, Control Panel

Control Panels

RENESAS

SH7216 Application Example

Factory Automation

RENESAS

SH7216 RDK + Micrium uC/OS-II Boook

- A comprehensive tool to learn, evaluate, & prototype using SH7216

uC/OS-III Book with Example Applications

+

**SH7216 Board
+
USB Cable
+
Power Supply**

+

μC/**OS-III**
μC/**Probe**

All Software is downloaded from Micrium Site

- **Learn**
  - RTOS Theory of operation & Usage
  - SH7216 Architecture
- **Evaluate**
  - Pre-programmed Demo Application
  - Example Applications with Full Source
- **Prototype**
  - Full-featured, flexible board
  - Debugger included on the board
  - Power supply included

MSRP: $199   **Book Only MSRP: $89**

Available free with Future Promotion

RENESAS

Development Tools

C/C++ Compilers

High-performance Embedded Workshop 4

Green Hills SOFTWARE, INC.

MULTI®

GNU

FREE

KPIT GNU Tools

Evaluation Systems

StarterKit

RENESAS

Motor Control

Development Environments

High-performance Embedded Workshop 4

eclipse

FREE

Green Hills SOFTWARE, INC.

MULTI®

Emulators

E10A-USB   E200F

LAUTERBACH

GDB   **FREE**

FREE

RTOS & Middleware

SEGGER

Xexpresslogic

Micrium

CMX SYSTEMS

FREE

Sample Code & Libraries from Renesas

Software Library
1,000+ FREE sample codes. Software Library

CAN   USB

RENESAS

Free SW from Renesas

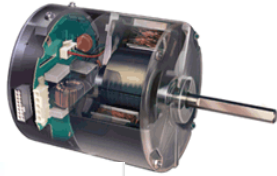**Software Library**
1,000+ FREE sample codes. Software Library

- Sample code for major peripherals

- Vector Control Motor Algorithms

- Ethernet Send/Receive, Open Source TCP/IP supporting uIP

- CAN API – compatible with R8C & R32C API

- USB Device – CDC, MSC, HID

- Fixed Point Math & DSP Libraries for SH-2A FPU

Available on am.renesas.com

RENESAS

SH7216 Third Party Support by SW Components

Third Party	IDE	Compiler	Debug	RTOS	TCP/IP Stack	USB Device	File
CMX	-	-	-	Y	Y	Y	Y
Express Logic	-	-	-	Y	Y	Y	Y
FreeRTOS.org	-	-	-	Y	Y	-	-
IAR	Y	Y	Y	-	-	-	-
KPIT GNU Tools	Y	Y	Y	-	-	-	-
Micrium	-	-	-	Y	Y	Y	Y
RoweBots	-	-	-	Y			Y
Segger	-	-	-	Y	Y	Y	Y

RENESAS

SH7216 Series Part Numbers

Ordering P/N	ROM/RAM	Package	Temperature	Features
R5F72165ADFA#V1	512K/64K	20x20 LQFP176	-40 to 85	200MHz, Ethernet, FPU, CAN, USB
R5F72167ADFA#V1	1M/128K	20x20 LQFP176	-40 to 85	200MHz, Ethernet, FPU, CAN, USB
R5F72165GDFA#V1	512K/64K	20x20 LQFP176	-40 to 85	100MHz, Ethernet, FPU, CAN, USB
R5F72167GDFA#V1	1M/128K	20x20 LQFP176	-40 to 85	100MHz, Ethernet, FPU, CAN, USB

Remaining part numbers are available for qualified opportunities – contact Marketing

RENESAS