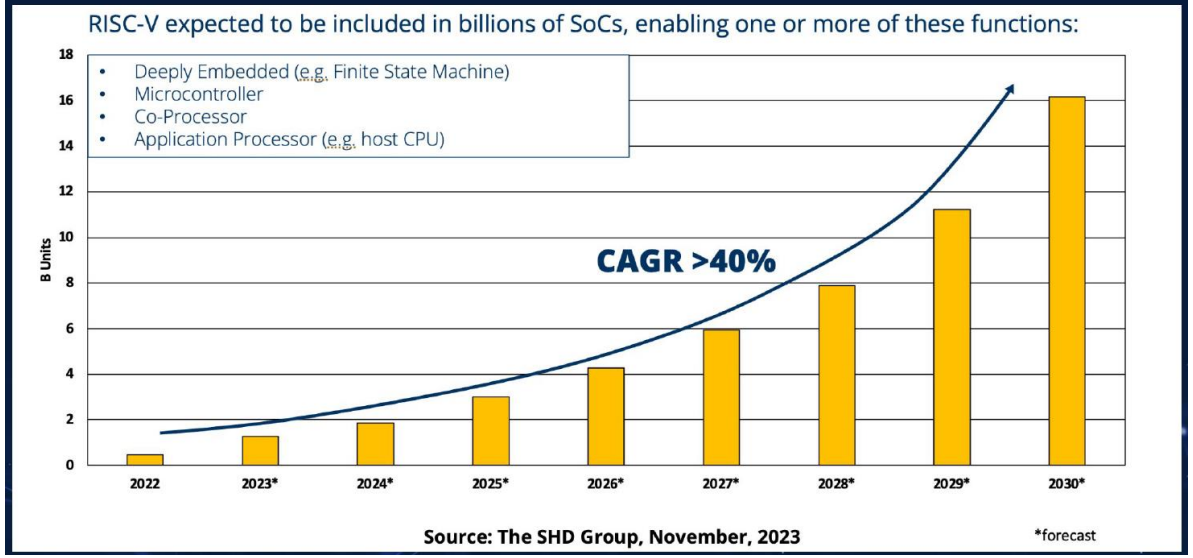
BREAKING THE RISC-V MCUs ECOSYSTEM BARRIERS

RISC-V SUMMIT EUROPE 2024
RENESAS ELECTRONICS CORPORATION

AGENDA

- RISC-V snapshot
- Embedded developers‘ challenges
- Breaking the barriers
- Renesas RISC-V MCU hardware and ecosystem details
- Summary

RISC-V will be in more than 16 billion SoCs by 2030



More than 4,300 RISC-V Members across 70 Countries

108 Chip
SoC, IP, FPGA

4 Systems
ODM, OEM

3 I/O
Memory, network, storage

17 Industry
Cloud, mobile, HPC, ML, automotive

21 Services
Fab, design services

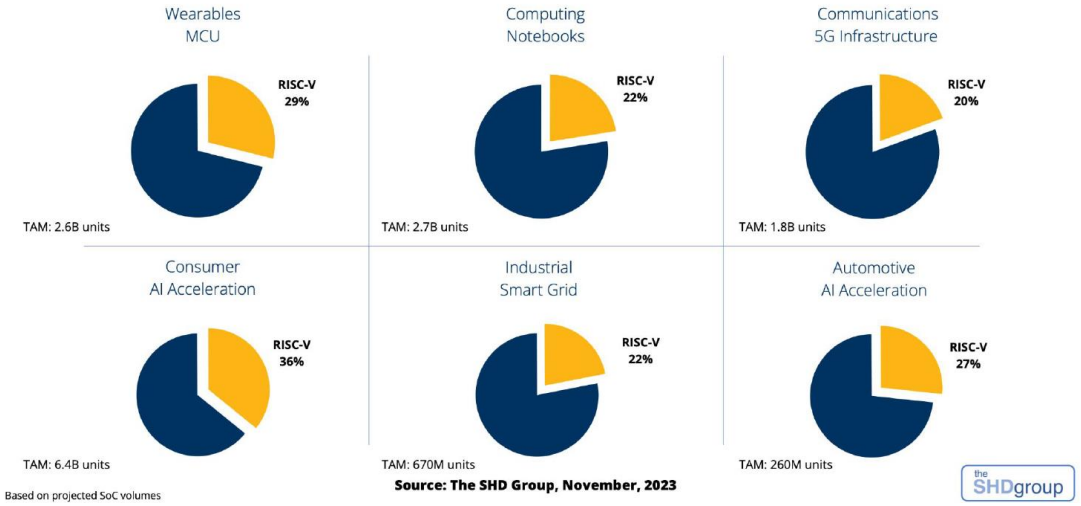
170 Research
Universities, Labs, other alliances

51 Software
Dev tools, firmware, OS

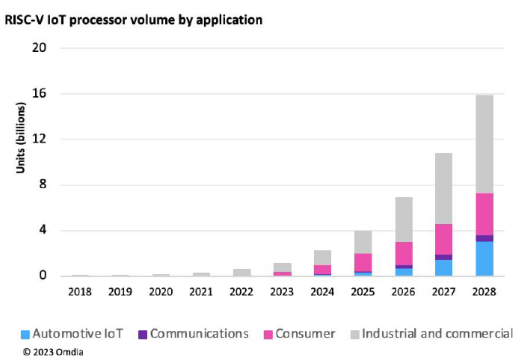
>3900 Individuals
RISC-V engineers and advocates

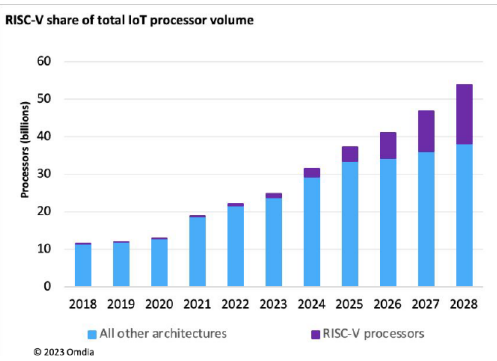
RISC-V membership up 28% in 2023

Selected Market Share Projections for RISC-V in 2030



RISC-V is showing amazing growth in IoT





- RISC-V IoT processors grew at roughly 150% compound annual growth rate (CAGR) between 2018 and 2023.
- From 2023 through 2028, the growth rate is expected to top 75% per year.
- In 2018, RISC-V processors accounted for just 0.1% of processors in the IoT. By 2028, that figure should approach 30%.

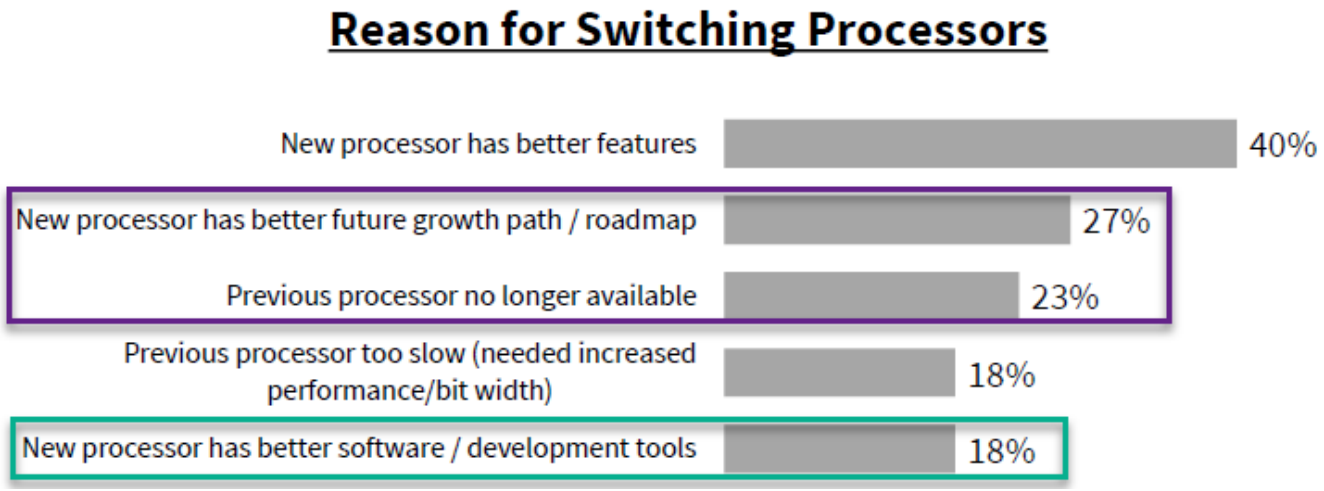
Source: Omdia, *RISC-V in the IoT - 2023 Analysis*

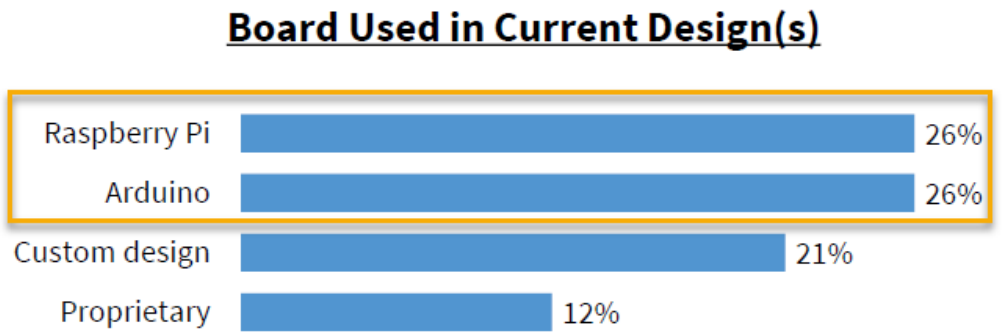
RISC-V is inevitable – „welcome to the open era of computing“

DEVELOPER'S CHALLENGES

EMBEDDED DEVELOPMENT CHALLENGES
WITH A PERSPECTIVE ON RISC-V OPPORTUNITIES

- ~55% of projects are incremental upgrades: add software features and/or better MPUs/MCUs (particularly in larger OEMs).
  - Main areas: industrial automation & instrumentation, IoT, communications, automotive. ~1/3 is related to IoT (sensor driven, industrial or mobile comms applications).
- C language still dominates. “Improved debugging process” top design challenge in near future. Usage of Raspberry Pi and Arduino for proof-of-concept development is popular (~52% use).
- Among those changing processors, ~54% chose a processor from a different family, **architecture or instruction set**.





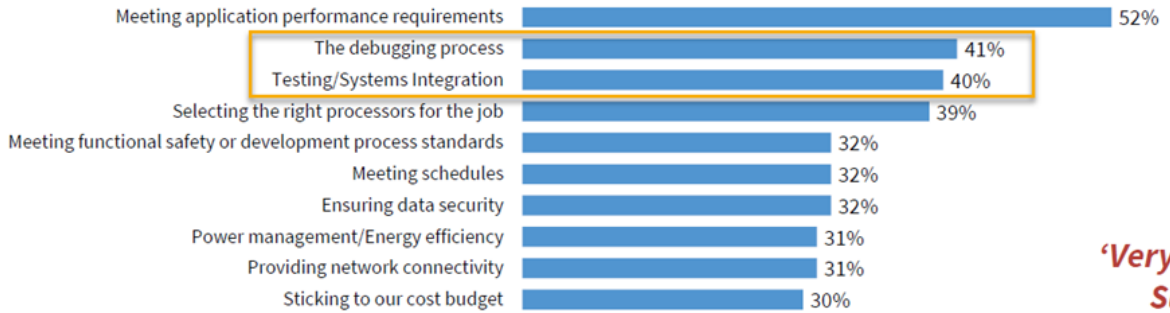
Courtesy of Aspencore, „Embedded Survey: The current state of embedded development, 2023“, www.embedded.com

EMBEDDED DEVELOPMENT CHALLENGES
WITH A PERSPECTIVE ON RISC-V OPPORTUNITIES

- Among obvious application requirements, most perceived challenges are **debug, integration and test**.

Meeting performance specs, processor choice and test/debugging are critical issues

Safety, security and power management are also high on the agenda (especially for EMEA and APAC designers)



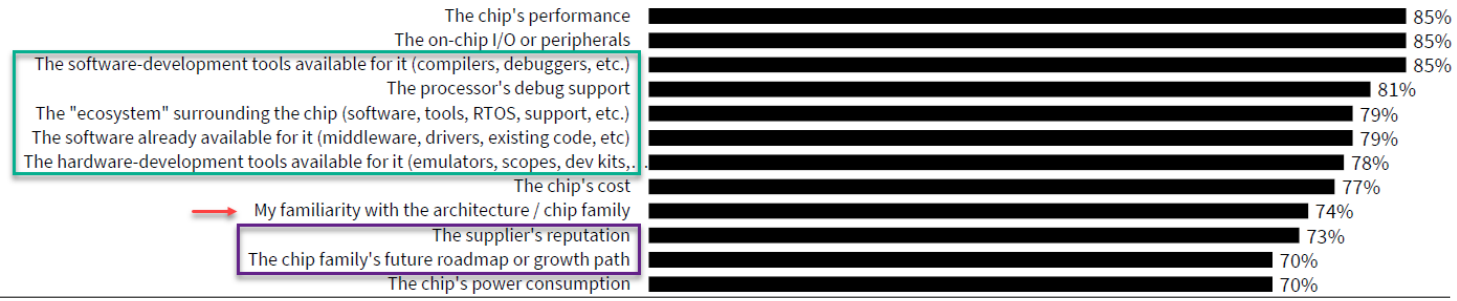
Courtesy of Aspencore, „Embedded Survey: The current state of embedded development, 2023“. www.embedded.com

'Very Important' Summary

- The “ecosystem” (IDEs, software, toolchain, development tools) **plays a dominant role**
- Choices in terms of architecture/chip family tend to be ‘sticky’
- **Broad commercial support** and **reliable sourcing** are important

Processor selection involves weighing many interrelated factors

Performance, available peripherals, HW/SW tool environment, support ecosystem, and other issues are high on developer agendas



CONCERNS AND ADOPTION BARRIERS
FROM A MICROCONTROLLER USER PERSPECTIVE

Tools availability

Tools support

Debug experience

Learn a new ISA and platform

Software ecosystem

Investment costs

Reliable supply

Software migration

BREAKING THE BARRIERS

SUPPORTING THE RISC-V GROWTH

The ecosystem is key

Renesas is engaged in developing the RISC-V ecosystem

- Provide free of charge IDE, compiler, configuration/debug/programming tools.
- Partner with market-leading suppliers of commercial debuggers, production programmers, software, IDEs.
- Continue expanding partner and solution network (hardware platforms, software stacks etc.)

Ease the migration

Crush adoption barriers!

- World-wide availability of low-cost development kit, MCU samples, application notes, training and support.
- Configuration and driver generation tool abstracts architectural details. Users can focus on the application.
- Establish RISC-V as open platform for next-generation non-proprietary solutions.

Reliable sourcing

Need for renowned suppliers

- Renesas leading the market with innovation, ready for the RISC-V momentum.
- Prove RISC-V commercial microcontroller products with excellent quality AND long term support.
- Support 8/16-bit mature designs migration to 32-bit at higher performance and lower cost.

RENESAS RISC-V MCU

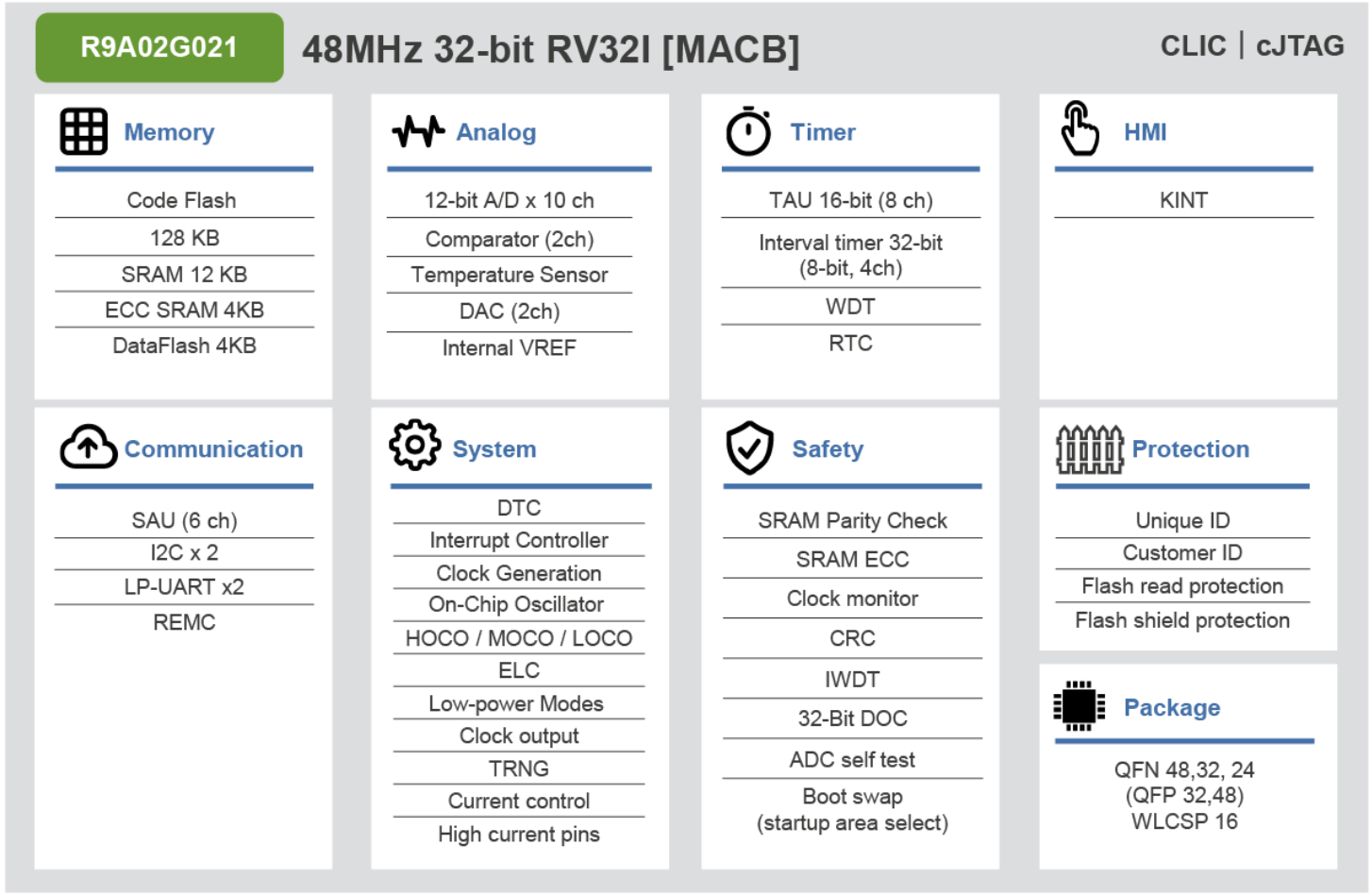
HARDWARE AND ECOSYSTEM DETAILS

RISC-V GENERAL PURPOSE MCU
128KB FLASH WITH 16KB RAM

- 110-nm low power, low leakage process
- Wide operating temperature range:
  Ta = -40°C to 125°C
- Wide Operating Voltage: 1.6V - 5V

Highlights:

- Renesas own CPU design
- High performance core (**3.88** CM/MHz*)
- Rich set of analog and digital interfaces
- Small packages: QFN 48/32/24, WLCSP16
- Lots of safety and protection features
- Fast startup



*IAR Compiler

https://www.renesas.com/r9a02g021

RENESAS RISC-V CPU
FEW IMPLEMENTATION DETAILS

CPU performance and safety features

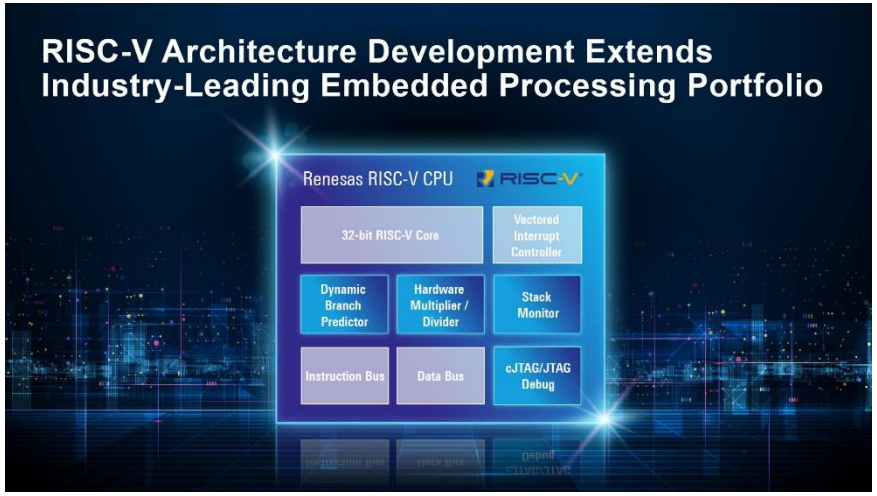
- **RV32I** + **M**(ultiply),**A**(tomic),**C**(ompressed),**B**(it-manipulation), Zce(*) extensions
- Single issue in-order 2-stage, with dynamic branch predictor.
- Most instructions execute in 1 cycle
- Little endian, Machine mode, Misaligned access not supported
- Stack overflow detection to detect pointer overflow during stack save/restore
- Performance monitors: cycle and instruction count registers, machine timer
- Achieve fast CPU context switch via register banks for save/restore (*)

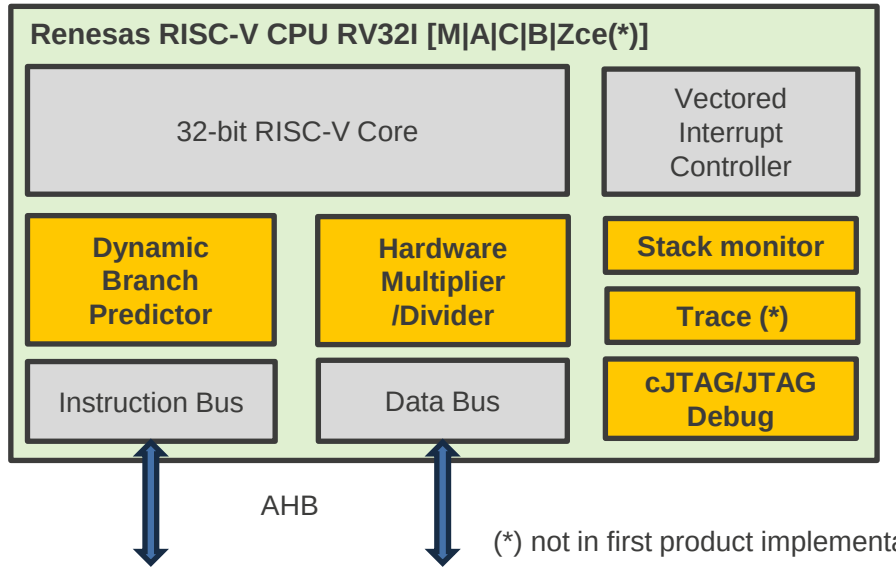
Interrupt controller

- Core Local Interrupt Controller (CLIC) with 32 interrupts, 16 interrupt levels
  - Selective hardware vectoring with priority preemption, NMI support

Debug

- Debug/Transport Module (DM, DTM), 4 hardware breakpoint registers
- Trace module for program flow tracing (*)





32-BIT RISC-V MCU
MARKETS AND APPLICATIONS

- Consumer electronics, home appliances w/ or w/o LCD
- Industrial sensors, sensor modules, bus powered sensors
- Medical sensors, health tracking
- Remote controls, battery powered applications
- Low power home accessories, detectors
- Vehicle tracking
- Intelligent power supplies, inverters
- AND MANY MORE…

- Early customer evaluations ongoing.

RISC-V MCU DEVELOPMENT ENVIRONMENT
BROADLY SUPPORTED AND EASY TO USE

On-Chip Debug

- Renesas E2 & E2 Lite

- SEGGER J-Link

- IAR I-Jet

- Opella-XD

IDE

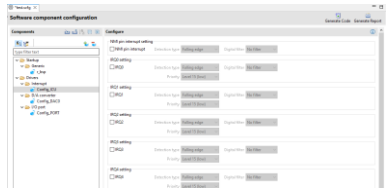
- Renesas e^2 studio
- SEGGER Embedded Studio
- IAR Embedded Workbench
- RiscFree SDK

Compiler

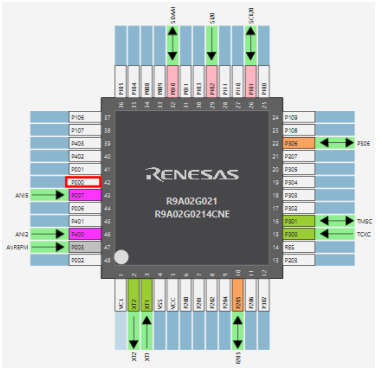
- LLVM llvm-gcc-renesas.com
- SEGGER RISC-V compiler
- IAR RISC-V Compiler
- Integrated toolchain

Support Tools

- Smart Configurator



- Pin configurator



- Standalone versions for IAR and SEGGER IDE

Kits and Boards

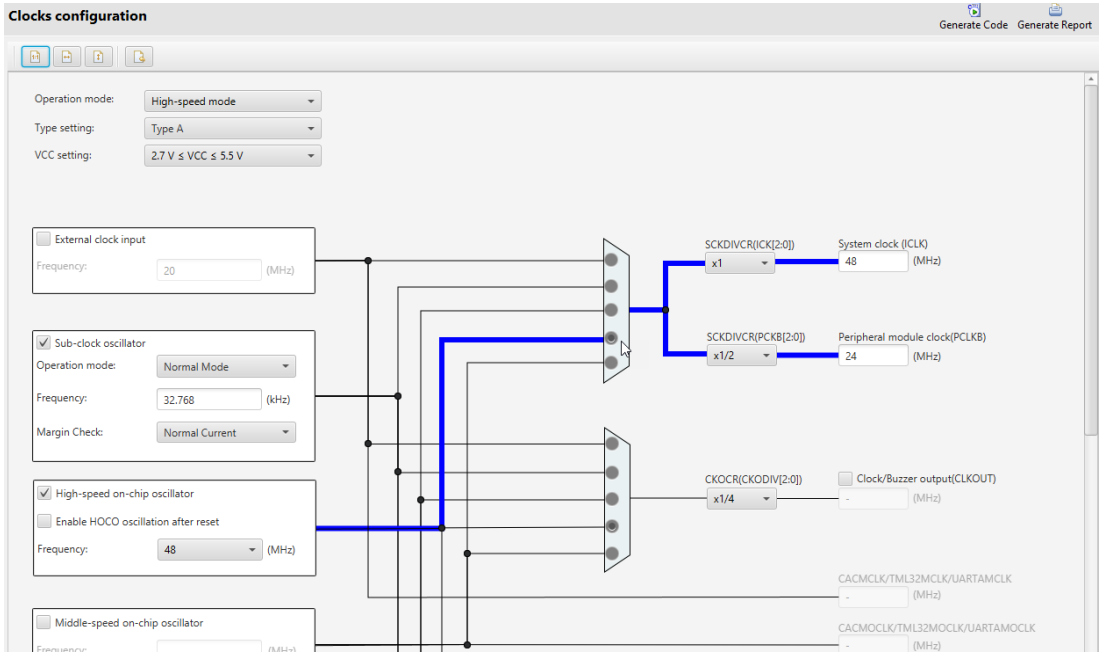
- Evaluation Kits

FPB-R9A02G021 with Jlink-OB

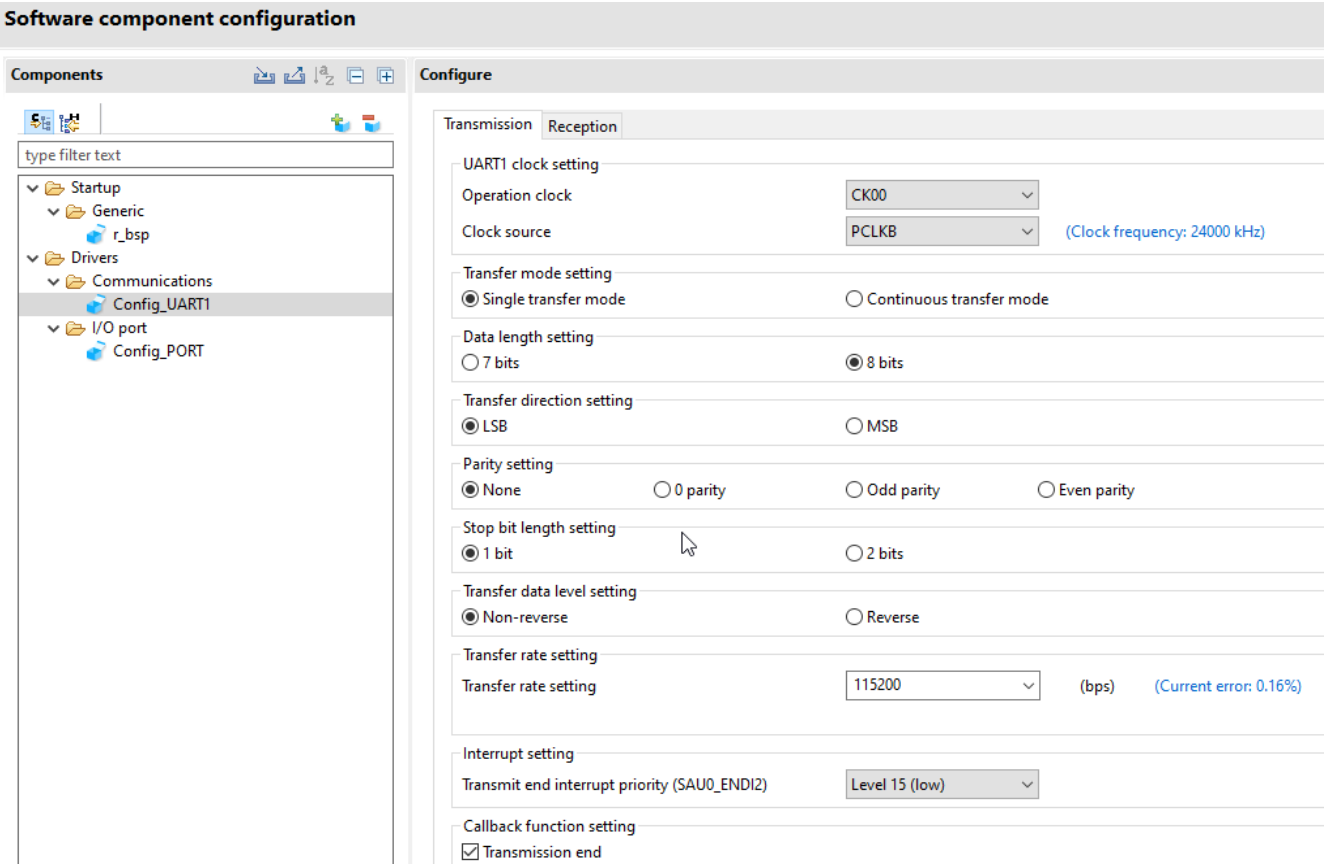
SMART CONFIGURATOR
QUICK AND NON-EXHAUSTIVE TOUR

https://www.renesas.com/us/en/software-tool/risc-v-smart-configurator

GUI environment for generating driver code that handles the details of chip startup and peripheral modules settings.

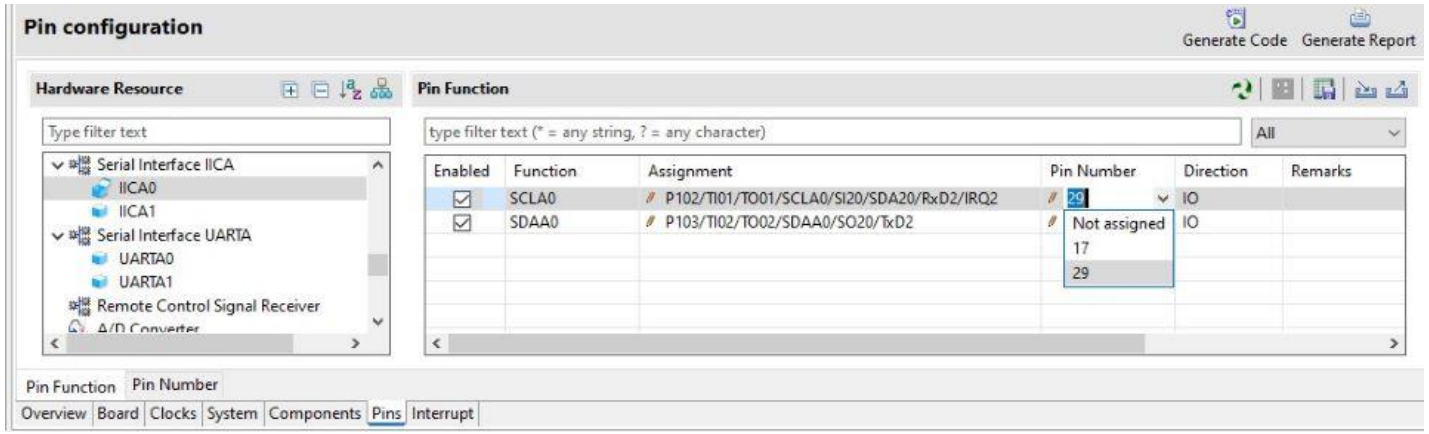


Select clock sources, configure and make connections in the block diagram

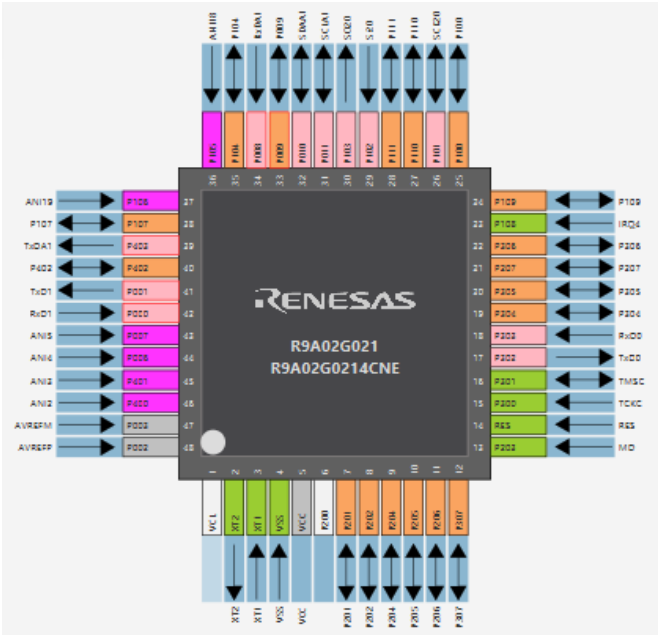


Add sw modules, setup peripherals, check for errors, switch the channels for use by drivers of multi-channel modules

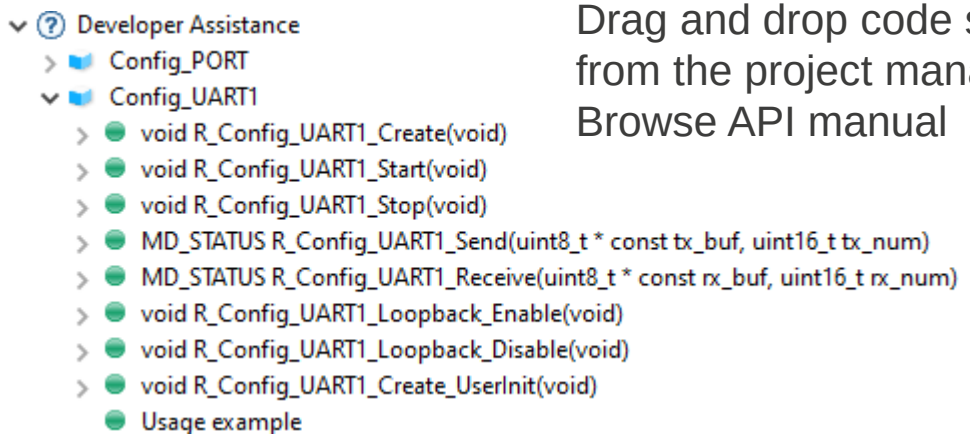
SMART CONFIGURATOR
QUICK AND NON-EXHAUSTIVE TOUR



Display pin function options, assign pins per each peripheral module, check consistency and resolve pin multiplexing conflicts automatically

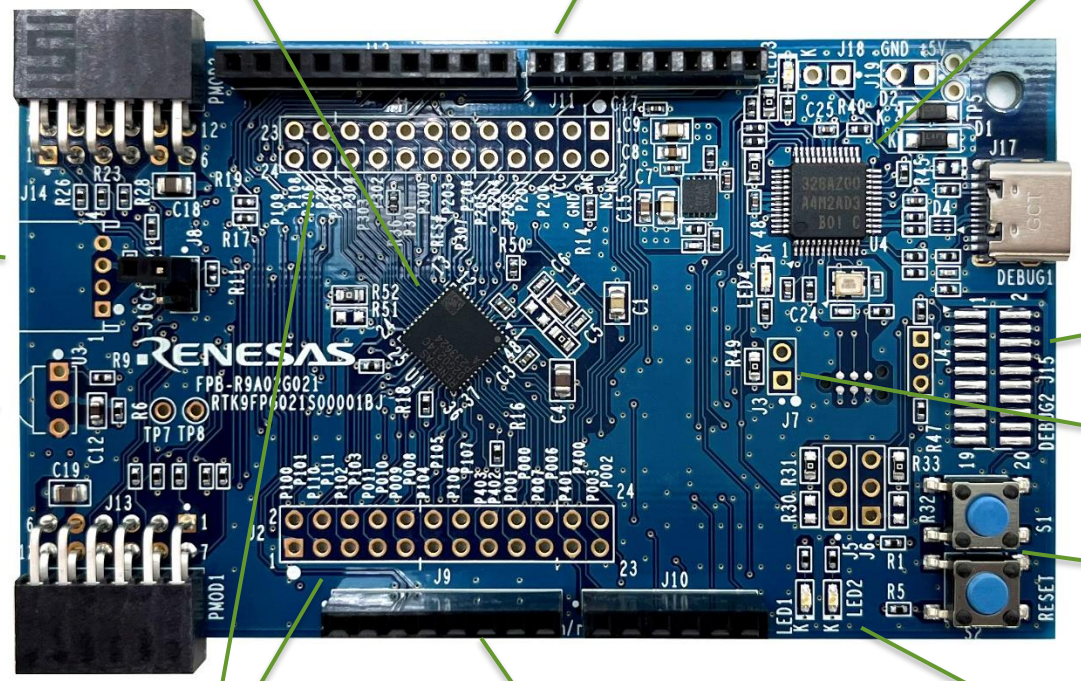


Display and assign symbolic names, check allocation status easily by color codes



Drag and drop code snippets from the project manager
Browse API manual

FPB-R9A02G021
RISC-V MCU FAST PROTOTYPING BOARD



renesas.com/fpb-r9a02g021 (User manual, quick start guide, development tools, schematics, design files & example projects)
RTK9FPG021S00001BJ (Orderable part number. **Available at broad market catalog distributors**)

SUMMARY

SUMMARY

Renesas leads the market and is RISC-V ready

- **Renesas high quality and support** ensures your RISC-V based MCU commercial success.
- **This MCU is an ideal choice for market leaders** which value non-proprietary ISAs like RISC-V.
- The innovative **Renesas RISC-V CPU** enables **efficient applications**, with **cost advantages** thanks to **rich feature set**

Easy development, low cost, with broad tools support

- Users can avoid upfront investments and **develop free of charge** using the Renesas tools.
- **Commercial support from industry tools leaders** like IAR, SEGGER, and a steadily expanding ecosystem.
- **Smart Configurator** tool mitigates the concern of learning the new ISA
- The **low-cost board** delivers an affordable and pleasuring out-of-the-box user experience.
- Application level support with extensive **documentation** and **software programming examples**

Renesas.com