

# 1.8GHZ RZ/G3E MPU FOR HIGH-PERFORMANCE HMI SYSTEMS WITH EDGE COMPUTING

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## RZ/G3E 64-bit MPU for HMI



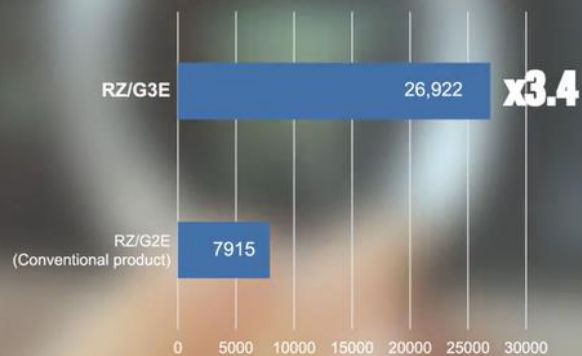
- 1.8GHz Quad Cortex®-A55
- AI Accelerator Ethos™-U55

# RZ/G3E

## at a glance

### HIGH-PERFORMANCE EDGE COMPUTING

CoreMark Benchmark results



Glmark2 Benchmark results



# BROAD AND SCALABLE PRODUCT PORTFOLIO

Embedded Processing PG

## Microcontrollers & Microprocessors, System-on-Chips (SoCs)



**High-end 32/64-bit MPUs**  
High-resolution HMI, IoT Gateway, Vision AI  
Industrial network & real-time control



**Advanced 32-bit MCUs**  
Arm ecosystem, Advanced security, Intelligent IoT



**High Power Efficiently 32-bit MCUs**  
Motor control, Capacitive touch, Functional safety, GUI

**RISC-V products**

**General-purpose 64-bit MPUs (RZ/Five Group)**  
**Application-specific 32-bit MCUs**



**Ultra-low Energy 8/16-bit MCUs**  
Bluetooth® Low Energy, SubGHz, LoRa®-based Solutions  
Automotive actuators & sensors, Low-end ECUs



**Automotive 32-bit MCUs**  
Rich functional safety and embedded security features



**Automotive SoCs**  
Next generation of automotive computing

HPC PG

## Analog and Power Devices

- Analog products
- Clocks & Timing
- Interface & Connectivity
- Memory & Logic
- Power & Power management
- Programmable Mixed-signal, ASIC, & IP products
- RF products
- Sensor products
- Space & Harsh environment
- Timing
- Wireless Power
- Battery Management
- Power Devices
- Power Management
- Sensors
- Video & Display

# RENESAS RZ FAMILY OVERVIEW

# RENESAS RZ FAMILY

## HIGH-PERFORMANCE APPLICATION FOCUSED AND GENERAL-PURPOSE PROCESSORS



### Vision AI

### Industrial Network

### Industrial real-time control



**RZ/V Series**

**RZ/N Series**

**RZ/T Series**

*AI accelerator + Linux*

*Multi-protocol Industrial Ethernet with Redundancy + Linux/ RTOS*

*Multi-protocol Industrial Ethernet Real-time control + Linux/RTOS*



### Human Machine Interface & IoT Edge



**RZ/G Series**

**RZ/A Series**

*3D Graphics + Linux/Android™*

*2D Graphics + RTOS*

**Vision AI**

**Renesas own cutting-edge AI technology "DRP-AI" for embedded AI application**

**Network**

**TSN and Multi-protocol Industrial network support**

**Real-time**

**High-performance Processing and High Precision Realtime Control**

**HMI**

**High-performance CPU operation and Graphics/Video Processing**

**Edge IoT**

**High-performance CPU and High-speed interfaces for IoT Edge products**

# RZ FAMILY PRODUCT PORTFOLIO

## Linux / Android™ / Multi-OS with RTOS

## RTOS

### Vision AI

#### RZ/V Series

|  |  |  |
|--|--|--|
| <b>RZ/V2M</b><br>1.0GHz Dual-core Cortex-A53,<br>DRP-AI(576-MAC), 4K-ISP               | <b>RZ/V2N</b><br>1.8GHz Quad-core Cortex-A55,<br>DRP-AI3(2K-MAC), 4K-ISP, 3D-GPU | <b>RZ/V2H</b><br>1.8GHz Quad-core Cortex-A55,<br>DRP-AI3(4K-MAC), 4K-ISP, 3D-GPU |
| <b>RZ/V2MA</b><br>1.0GHz Dual-core Cortex-A55, DRP-<br>AI(576-MAC), OpenCV Accelerator | <b>RZ/V2L</b><br>1.2GHz Dual-core Cortex-A55,<br>DRP-AI(576-MAC), 3D-GPU         |  |

### Industrial Network

#### RZ/N Series

|   |  |  |   |   |
|---|--|--|---|---|
| <b>RZ/N1D</b><br>500MHz Dual-core Cortex-A7, 125MHz<br>Cortex-M3, Industrial Ethernet | <b>RZ/N2H</b><br>1.2GHz Quad-core Cortex-A55, 1GHz<br>Dual-core Cortex-R52, 6-axis control | <b>RZ/N1L</b><br>125MHz Cortex-M3, Industrial Ethernet | <b>RZ/N1S</b><br>500MHz Cortex-A7, 125MHz Cortex-M3,<br>Industrial Ethernet | <b>RZ/N2L</b><br>400MHz Cortex-R52, Industrial Ethernet |
|---|--|--|---|---|

### Real-time Control

#### RZ/T Series

|  |  |   |
|--|--|---|
| <b>RZ/T2H</b><br>1.2GHz Quad-core Cortex-A55, 1GHz<br>Dual-core Cortex-R52, 9-axis control | <b>RZ/T2L</b><br>800MHz Cortex-R52, 2-axis motor<br>control, EtherCAT                            | <b>RZ/T2ME</b><br>800MHz Dual-core Cortex-R52, 2-axis<br>motor control, Industrial Ethernet, OTFD |
|  | <b>RZ/T1</b><br>600MHz Cortex-R4, 150MHz Cortex-M3,<br>1-axis motor control, Industrial Ethernet | <b>RZ/T2M</b><br>800MHz Dual-core Cortex-R52, 2-axis<br>motor control, Industrial Ethernet        |

### IoT Edge

#### RZ/G Series

|   |   |  |
|---|---|--|
| <b>RZ/G3S</b><br>1.1GHz Cortex-A55, 250MHz Dual-core<br>Cortex-M33, LPDDR4/DDR4 | <b>RZ/Five</b><br>RISC-V, 1.0GHz AX45MP, DDR4/3L,<br>GbEthernet, CAN-FD |  |
|---|---|--|

### HMI

#### RZ/G Series

|   |   |   |
|---|---|---|
| <b>RZ/G1H</b><br>1.4GHz Quad-core Cortex-A15 +<br>Cortex-A7, DDR3, 3DG, H.264 | <b>RZ/G2H</b><br>1.5GHz Quad-core Cortex-A57 +<br>Cortex-A53, LPDDR4, 3DG, H.264/5  | <b>RZ/G3E</b><br>1.8GHz Quad-core Cortex-A55,<br>LPDDR4/4X, 3DG, H.264/5, Ethos-U55 |
| <b>RZ/G1M</b><br>1.5GHz Dual-core Cortex-A15, DDR3L,<br>3DG, H.264            | <b>RZ/G2M</b><br>1.5GHz Dual-core Cortex-A57 + Cortex-<br>A53, LPDDR4, 3DG, H.264/5 | <b>RZ/G2L</b><br>1.2GHz Dual-core Cortex-A55,<br>DDR4/3L, 3DG, H.264, CAN-FD        |
| <b>RZ/G1N</b><br>1.5GHz Dual-core Cortex-A15, DDR3L,<br>3DG, H.264            | <b>RZ/G2N</b><br>1.5GHz Dual-core Cortex-A57,<br>LPDDR4, 3DG, H.264/5               | <b>RZ/G2LC</b><br>1.2GHz Dual-core Cortex-A55,<br>DDR4/3L, 3DG, CAN-FD              |
| <b>RZ/G1E</b><br>1.0GHz Dual-core Cortex-A7,<br>DDR3, 3DG, H.264              | <b>RZ/G2E</b><br>1.2GHz Dual-core Cortex-A53, DDR3L,<br>3DG, H.264/5                | <b>RZ/G2UL</b><br>1.0GHz Cortex-A55,<br>DDR4/3L, CAN-FD, ADC                        |

#### RZ/A Series

|   |  |  |
|---|--|--|
| <b>RZ/A1LU</b><br>400MHz Cortex-A9, 3MB RAM, LCDC,<br>JPEG, Ethernet, USB | <b>RZ/A1H</b><br>400MHz Cortex-A9, 10MB RAM, LCDC,<br>JPEG, Ethernet, USB          | <b>RZ/A3M</b><br>1.0GHz Cortex-A55, Built-in DDR3L<br>128MB, LCDC, MIPI-DSI, USB |
| <b>RZ/A1L</b><br>400MHz Cortex-A9, 3MB RAM, LCDC,<br>Ethernet, USB        | <b>RZ/A1M</b><br>400MHz Cortex-A9, 5MB RAM, LCDC,<br>JPEG, Ethernet, USB           | <b>RZ/A3UL</b><br>1.0GHz Cortex-A55, DDR4/3L,<br>LCDC, GbEthernet, USB           |
| <b>RZ/A1LC</b><br>400MHz Cortex-A9, 2MB RAM, LCDC,<br>Ethernet, USB       | <b>RZ/A2M</b><br>528MHz Cortex-A9, 4MB RAM, LCDC,<br>JPEG, MIPI-CSI, Ethernet, USB |  |

# RZ/G3E INTRODUCTION

# RZ/G MPU LINE-UP

## RZ/G Series



64-bit Cortex-A CPU, up to 1.8GHz  
3D graphics, video-codec,  
for HMI & Gateway Applications

Doorbell System



Home Security



Industrial Display



Handy Terminal



Business Purpose  
Equipment

| 64-bit RZ/G       | Main CPU   |          | Sub CPU       | Graphics     | Video Codec     | microNPU     |           |
|-------------------|------------|----------|---------------|--------------|-----------------|--------------|-----------|
| RZ/G2H            | Cortex-A57 | 4x +     | Cortex-A53 4x | Cortex-R7    | PowerVR 3D GPU  | H.265, H.264 |           |
| RZ/G2M            | Cortex-A57 | 2x +     | Cortex-A53 4x | Cortex-R7    | PowerVR 3D GPU  | H.265, H.264 |           |
| <b>NEW</b> RZ/G3E | Cortex-A55 | 4x or 2x |               | Cortex-M33   | Mali-G52 3D GPU | H.265, H.264 | Ethos-U55 |
| RZ/G2N            | Cortex-A57 | 2x       |               | Cortex-R7    | PowerVR 3D GPU  | H.265, H.264 |           |
| RZ/G2E            | Cortex-A53 | 2x       |               | Cortex-R7    | PowerVR 3D GPU  | H.265, H.264 |           |
| RZ/G3S            | Cortex-A55 |          |               | 2xCortex-M33 |                 |              |           |
| RZ/G2L            | Cortex-A55 | 2x or 1x |               | Cortex-M33   | Mali-G31 3D GPU | H.264        |           |
| RZ/G2LC           | Cortex-A55 | 2x or 1x |               | Cortex-M33   | Mali-G31 3D GPU |              |           |
| RZ/G2UL           | Cortex-A55 |          |               | Cortex-M33   |                 |              |           |

# RZ FAMILY FEATURES FOR HMI



| 4K   | FHD  |  |   | WXGA  | WXGA/XGA   |  |
|--|--|--|---|---|--|--|
| <p><b>Pin Compatible</b></p> <div style="display: flex; justify-content: space-around;"> <div style="background-color: #4CAF50; color: white; padding: 5px; text-align: center;">RZ/G2H</div> <div style="background-color: #4CAF50; color: white; padding: 5px; text-align: center;">RZ/G2M<br/>RZ/G2N</div> </div> | <div style="border: 2px solid red; padding: 5px; text-align: center;">RZ/G3E</div>   | <div style="background-color: #4CAF50; color: white; padding: 5px; text-align: center;">RZ/G2E</div> | <p><b>Pin Compatible</b></p> <div style="display: flex; justify-content: space-around;"> <div style="background-color: #F44336; color: white; padding: 5px; text-align: center;">RZ/V2L</div> <div style="background-color: #4CAF50; color: white; padding: 5px; text-align: center;">RZ/G2L</div> </div> | <div style="background-color: #4CAF50; color: white; padding: 5px; text-align: center;">RZ/G2LC</div> | <p><b>Pin Compatible</b></p> <div style="display: flex; justify-content: space-around;"> <div style="background-color: #4CAF50; color: white; padding: 5px; text-align: center;">RZ/G2UL</div> <div style="background-color: #2196F3; color: white; padding: 5px; text-align: center;">RZ/A3x</div> </div> | <div style="background-color: #2196F3; color: white; padding: 5px; text-align: center;">RZ/A1<br/>RZ/A2M</div> |
| <p>Cortex-A57&amp;53*<br/>LPDDR4</p> <p>H.265dec<br/>H.264enc/dec</p> <p>3DGfx</p> <p>HDMI/LVDS<br/>MIPI CSI-2</p>   | <p>Cortex-A55<br/>LPDDR4/4X</p> <p>H.265enc/dec<br/>H.264enc/dec</p> <p>3DGfx</p> <p>MIPI/LVDS/Parallel<br/>MIPI CSI-2</p> | <p>Cortex-A53<br/>DDR3L</p> <p>H.265dec<br/>H.264enc/dec</p> <p>3DGfx</p> <p>LVDS<br/>MIPI CSI-2</p> | <p>Cortex-A55<br/>DDR3L/4</p> <p>-<br/>H264enc/dec</p> <p>3DGfx</p> <p>MIPI DSI<br/>MIPI CSI-2</p>  | <p>Cortex-A55<br/>DDR3L/4</p> <p>-<br/>-</p> <p>3DGfx</p> <p>MIPI DSI<br/>MIPI CSI-2</p>              | <p>Cortex-A55<br/>DDR3L/4      Octa</p> <p>-<br/>-</p> <p>-</p> <p>Parallel<br/>MIPI CSI-2</p>   | <p>Cortex-A9<br/>Int. RAM</p> <p>-<br/>-</p> <p>2DGfx</p> <p>LVDS<br/>MIPI CSI-2*</p>                          |

\* RZ/G2N has Cortex-A57 only  
(No Cortex-A53)

\*: RZ/A2M only

**Linux**

**RTOS**

HDMI is a registered trademark of HDMI Licensing LLC.

# RZ/G3E TARGET APPLICATION & CONCEPT

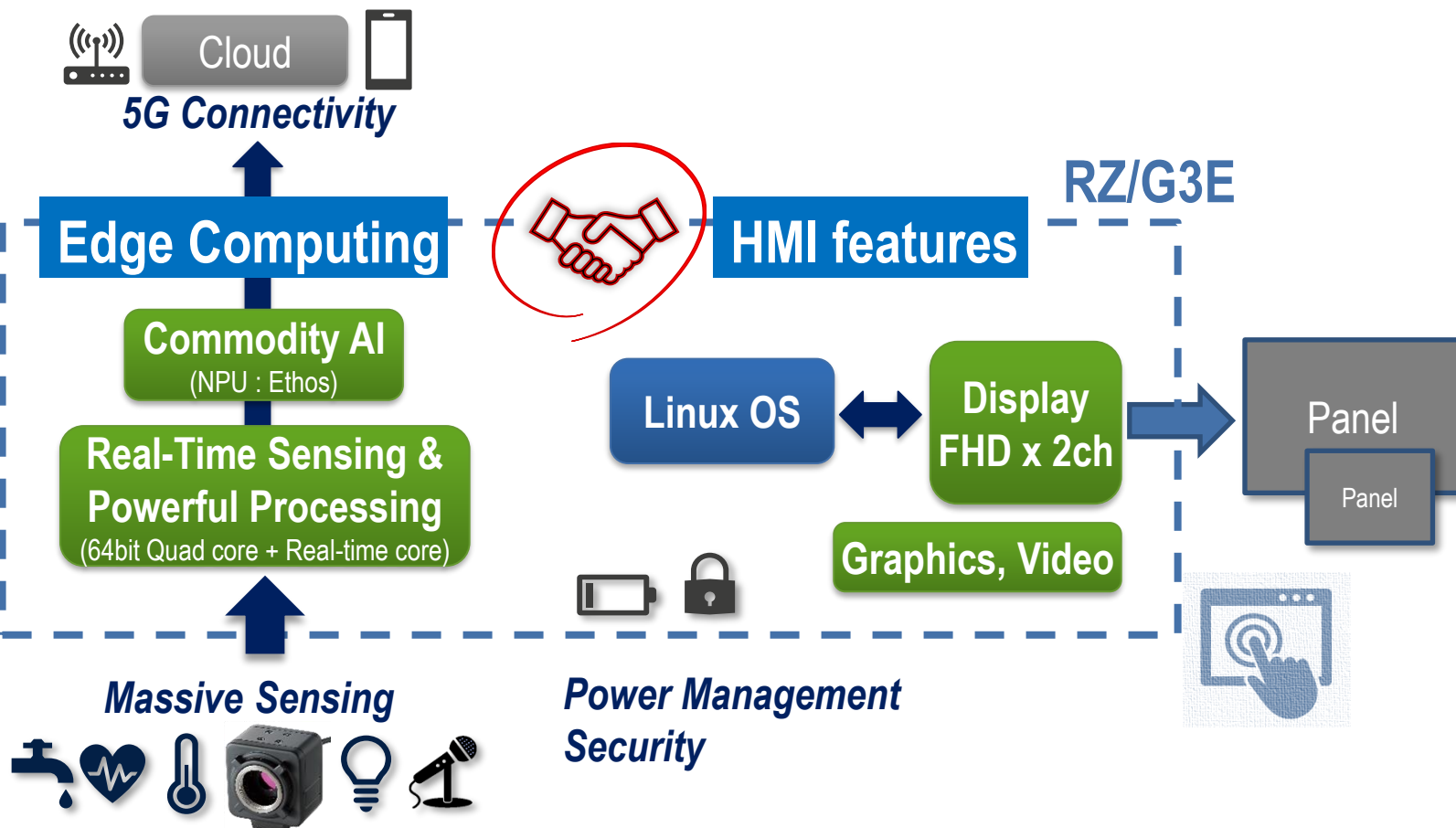
■ RZ/G3E is **GP-MPU for Mid-Class “HMI” application** integrated with **“Edge Computing”** & **“Hi-speed connectivity”**.

- Edge Computing : 64bit Quad core CPU + NPU (Arm Ethos-U55)
- High-speed Connectivity : PCIe Gen3 2lane, USB3.2, GbEther

## Target Application:

### Mid-Class HMI including Edge Computing

(Industrial/Medical HMI, Office & Energy, Smart Home)



# RZ/G3E: KEY FEATURES

**General Purpose MPU for HMI application integrated with Edge computing**  
**Over 26000 CoreMarks of CPU raw performance, 512 GOPS AI performance**

- Combining **1.8GHz Quad Cortex-A55** for main Linux operation and **1.0GHz NPU (Ethos-U55)** for AI edge inference allows for advanced HMI application
- Equip with **GPU, Video Codec** engine support displaying **high-definition GUI**. Support **two Full-HD display** outputs.
- Communicate with the cloud using **5G generation** by built-in high-speed interfaces - **PCIe Gen3, USB3.2**, and Gbit Ethernet
- Integrated 3 power domains and support both “**minimal standby power**” and “**fast Linux resume**” for HMI application
- Provide **multiple Linux software packages** to meet customers' diverse S/W requirements - Verified Linux Package (VLP), Linux BSP Plus, SDK

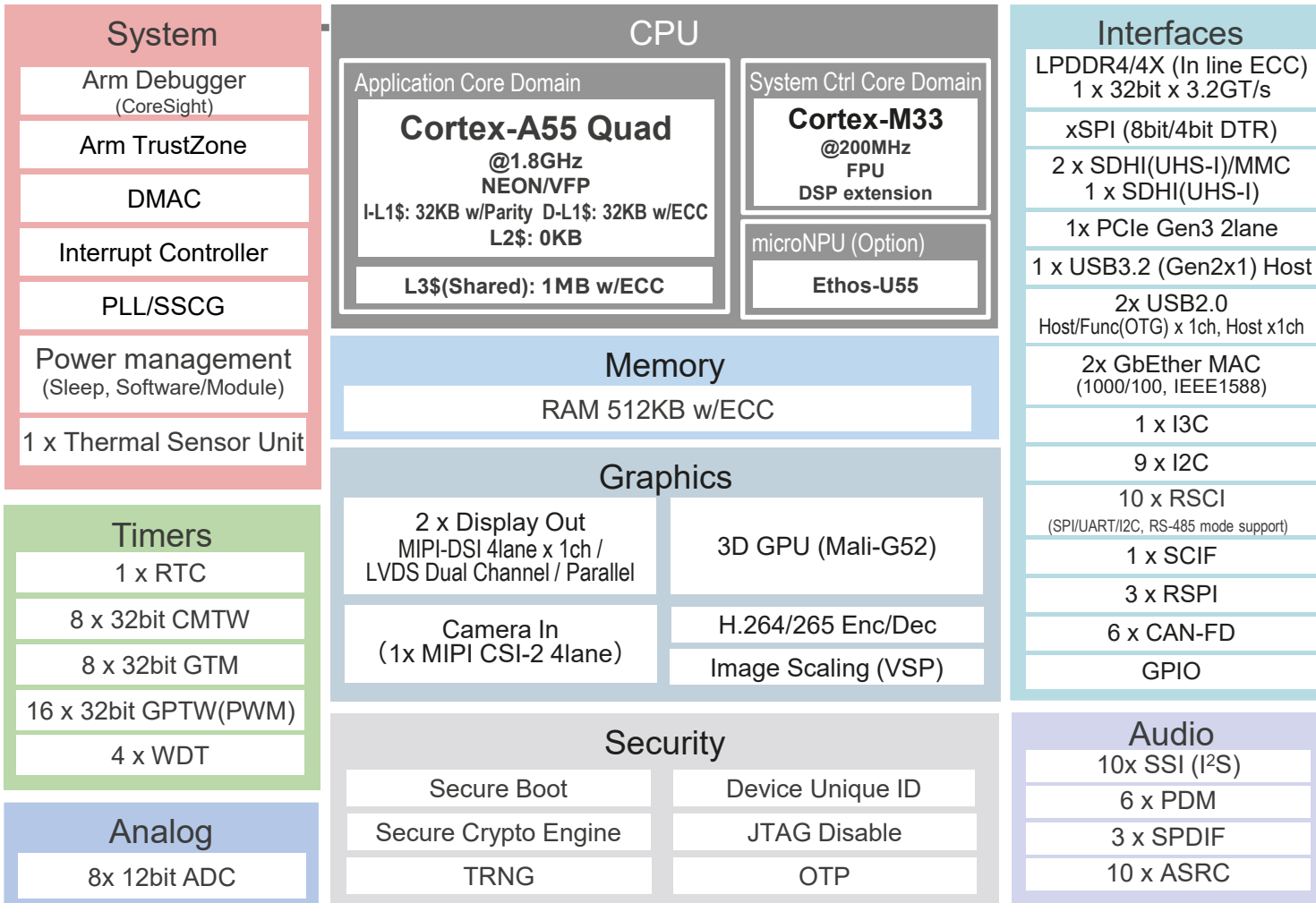


# RZ/G SERIES HMI LINEUP



| Items                          |             | <u>RZ/G2H</u>  | <u>RZ/G2M</u><br><u>RZ/G2N</u>                       | <u>RZ/G3E</u> <span style="border: 1px solid orange; border-radius: 50%; padding: 2px 5px; color: white; font-weight: bold;">NEW</span> | <u>RZ/G2E</u>  | <u>RZ/G2L</u>  |
|--------------------------------|-------------|--|--|---|--|--|
| <b>Main CP</b>                 |             | 4× Cortex-A57<br>4× Cortex-A53                       | 2× Cortex-A57<br>4× Cortex-A53                       | <b>4× Cortex-A55</b>  | 2× Cortex-A53  | 2× Cortex-A55  |
| <b>Sub CPU</b>                 |             | 1× Cortex-R7   | 1× Cortex-R7   | <b>1× Cortex-M33</b>  | 1× Cortex-R7   | 1× Cortex-M33  |
| <b>NPU</b>                     |             | –  | –  | <b>Ethos-U55</b>  | –  | –  |
| <b>DRAM I/F</b>                |             | 32-bit ×2ch<br>LPDDR4                                | 32-bit ×2ch<br>LPDDR4                                | <b>32-bit ×1ch<br/>LPDDR4/4X</b>  | 32-bit ×1ch<br>DDR3L                                       | 16-bit x 1ch<br>DDR4/3L                                |
| <b>HMI</b>                     | Display     | <b>4K</b> , 3 displays<br>HDMI, LVDS,<br>Digital RGB | <b>4K</b> , 3 displays<br>HDMI, LVDS,<br>Digital RGB | <b>Full-HD</b> , 2 displays<br><b>MIPI-DSI, LVDS (Dual),<br/>Digital RGB</b>  | <b>Full-HD</b> , 2 displays<br>LVDS (Dual), Digital<br>RGB | <b>Full-HD</b> , 1 display<br>MIPI-DSI, Digital<br>RGB |
|                                | Video Codec | H.264, H.265   | H.264, H.265   | <b>H.264, H.265</b>   | H.264, H.265   | H.264  |
|                                | Graphics    | 3D Graphics  | 3D Graphics  | <b>3D Graphics</b>  | 3D Graphics  | 3D Graphics  |
| <b>High Speed Connectivity</b> | PCIe        | 2x PCIe Gen2   | 2x PCIe Gen2   | <b>1 x PCIe Gen3</b>  | 1x PCIe Gen2   | –  |
|                                | USB         | 1x USB3.0/2.0<br>2x USB2.0                           | 1x USB3.0/2.0<br>2x USB2.0                           | <b>1x USB3.2 Gen2<br/>2x USB2.0</b>   | 1x USB3.0/2.0<br>1x USB2.0                                 | 2x USB2.0  |

# RZ/G3E BLOCK DIAGRAM (15mm, 21mm PKG)

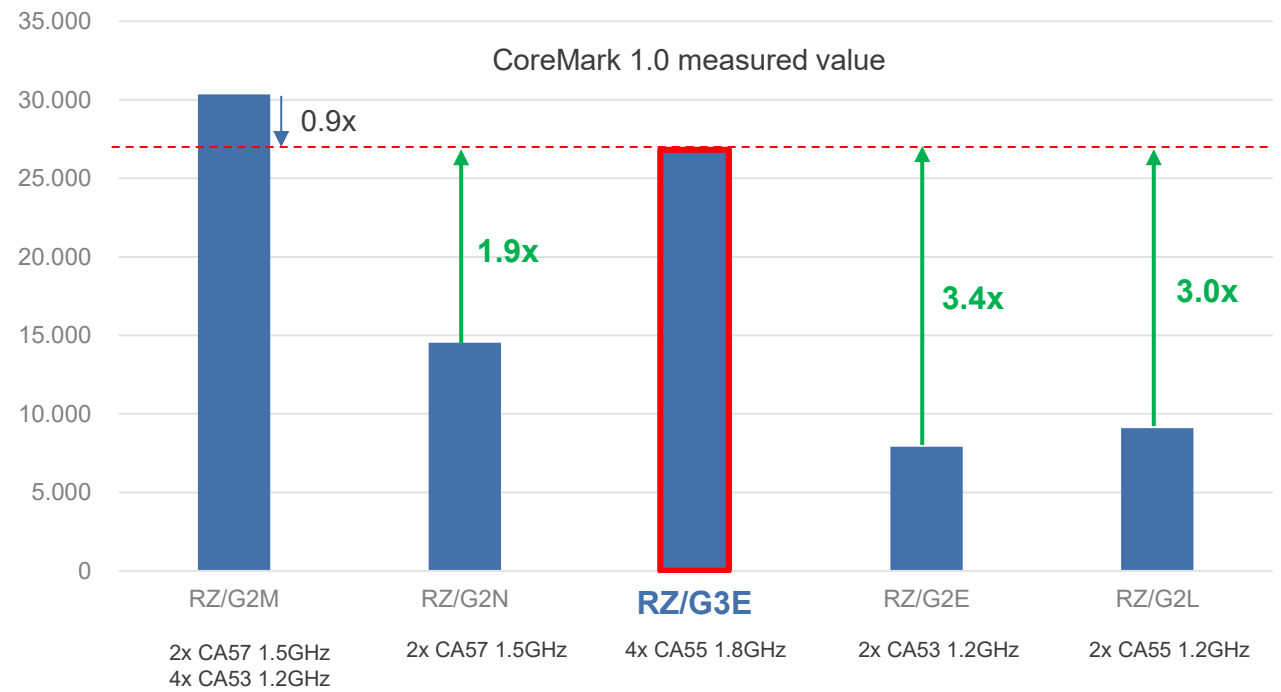


15x15mm 529pin 0.5mm pin-pitch  
21x21mm 625pin 0.8mm pin-pitch

- Advanced Processing for “Edge Computing”**
  - Main CPU: Arm Cortex-A55 1.8GHz Quad (Linux)
  - Sub CPU: Arm Cortex-M33 200MHz (RTOS)
  - NPU: Arm Ethos-U55 256MAC (512GOPS)
- Over Gbps I/F for “High-speed Connectivity”**
  - PCIe Gen3 2lane x 1
  - USB3.2 (Gen2x1) Host x 1
  - GbEther MAC (IEEE1588) x 2
- Powerful “HMI Features” handling rich contents**
  - 2 Display Support (MIPI-DSI / LVDS Dual Channel / Parallel)
  - Graphics: 3D GPU (Arm Mali-G52 – 30 GFLOPS)
  - Video Codec: H.264/265 Encode & Decode
- Power Management for “Low Power” operation**
  - Low Power Standby Mode
  - Independent power supply for CM33 Block (for Quick-boot & Low Power processing)
- Latest hardware “Security”**
  - Renesas’ latest security engine “SHIP”
  - Arm TrustZone support

# POWERED BY CPU (QUAD CORTEX-A55) AND NPU (ETHOS-U55)

- The 1.8GHz quad-core Cortex-A55 processor is responsible for Linux operations. Its performance is sufficient for HMI applications, and it has the capacity to handle edge computing processing.
- Compared to existing mid-range products such as RZ/G2N and RZ/G2E, RZ/G3E has extremely high CPU performance that is 1.9 to 3.4 times higher.
- Compared to the existing high-end product RZ/G2M, RZ/G3E has similar CPU performance and is a product with excellent cost performance.

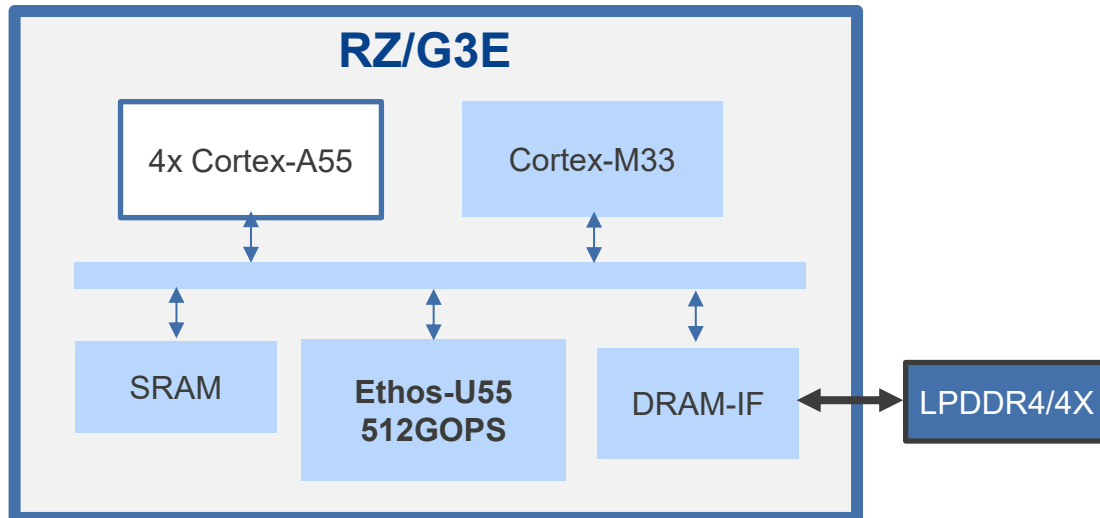


Note: RZ/G3E was measured using a preliminary library.

## KEY FEATURE #1

# POWERED BY CPU (QUAD CORTEX-A55) AND NPU (ETHOS-U55)

- Ethos-U55 is a dedicated AI inference processor that operates at 1.0GHz and boasts 512GOPS performance. RZ/G3E is suitable for entry-level **vision AI** applications but can also support **voice AI** and **sensor data base AI** applications.
- AI inference with Ethos-U55 is controlled by Cortex-M33, so Ethos-U55 can offload AI operation from Cortex-A55.
- In addition to the built-in SRAM, external DRAM can be used for AI inference, enabling the use of larger AI models. RZ/G3E can be an alternative solution of MCU AI solutions when the size of AI models exceed than MCU can handle.



(Illustrative system block)

## Comparison of Ethos & CPU in RZ/G3E with general AI models

| AI Use Case          | Inference time* (ms) |              | Model Size |
|----------------------|----------------------|--------------|------------|
|                      | Ethos-U55            | Cortex-A55x4 |            |
| Object-Detection     | 2.98                 | 8.78         | Large      |
| Image-Classification | 7.20                 | 19.13        | Large      |
| Keyword-Spotting     | 0.55                 | 0.89         | Medium     |
| Anomaly-Detection    | 1.22                 | 2.21         | Medium     |
| Keyword-Spotting     | 0.26                 | 0.28         | Small      |
| Noise-Reduction      | 0.25                 | 0.14         | Small      |

(\*These results are not based on whole system including input/output.)

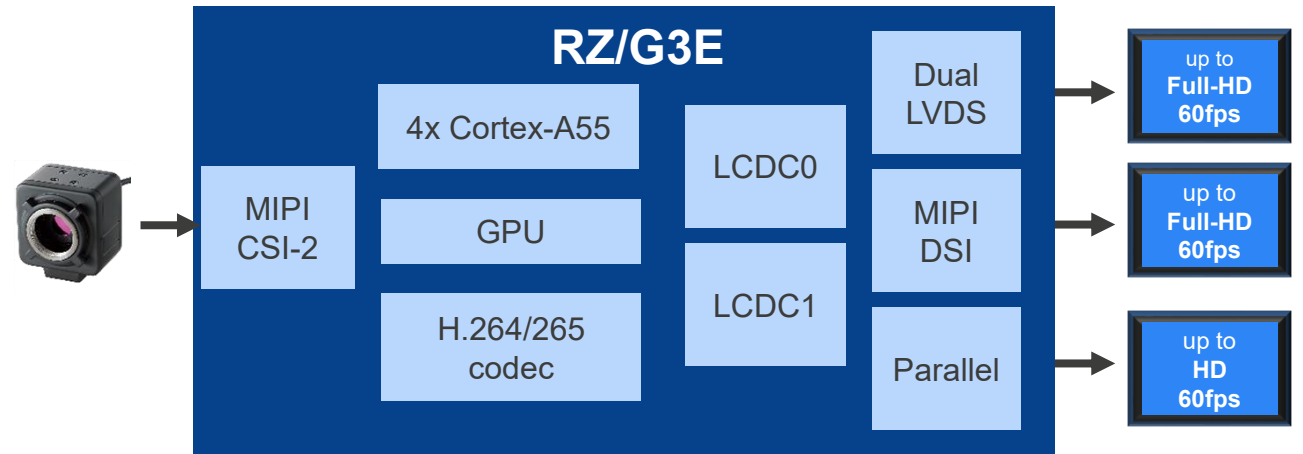
➔ Ethos-U55 is x1.5~3.0 faster in mid/large AI model size test.

KEY FEATURE #2

# GPU, VIDEO CODEC AND THREE TYPES OF IMAGE INTERFACES

- Equipped with MIPI-CSI as camera connection interface for applications using video input
- Built-in graphics engine (GPU) to display high-definition GUI and Built-in hardware video codec support for H.264/265
- Support 3 types of display interface: LVDS, MIPI-DSI, and parallel

| HMI Functions   | Details  |
|-----------------|--|
| Camera          | MIPI-CSI2 1/2/4 lane<br>up to FullHD 60 fps                            |
| Video Codec     | H.265 (enc/dec), H.264 (enc/dec)                                       |
| Graphics Engine | Mali-G52 630MHz<br>30GFLOPS  |
| Display         | 2x LCD Controller<br>3x Display I/Fs*<br>Dual LVDS, MIPI-DSI, Parallel |



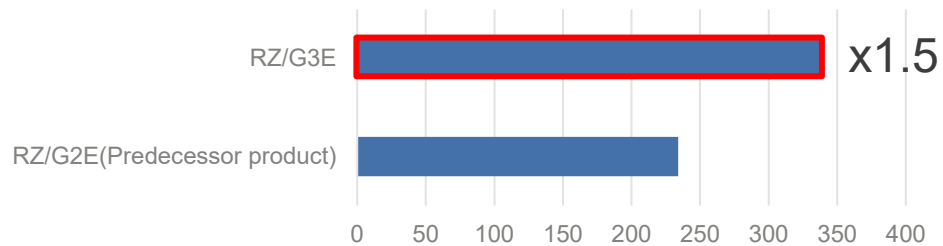
\* 2 independent images made by LCD0 & 1 can be output from 3 types of display interface

## KEY FEATURE #2

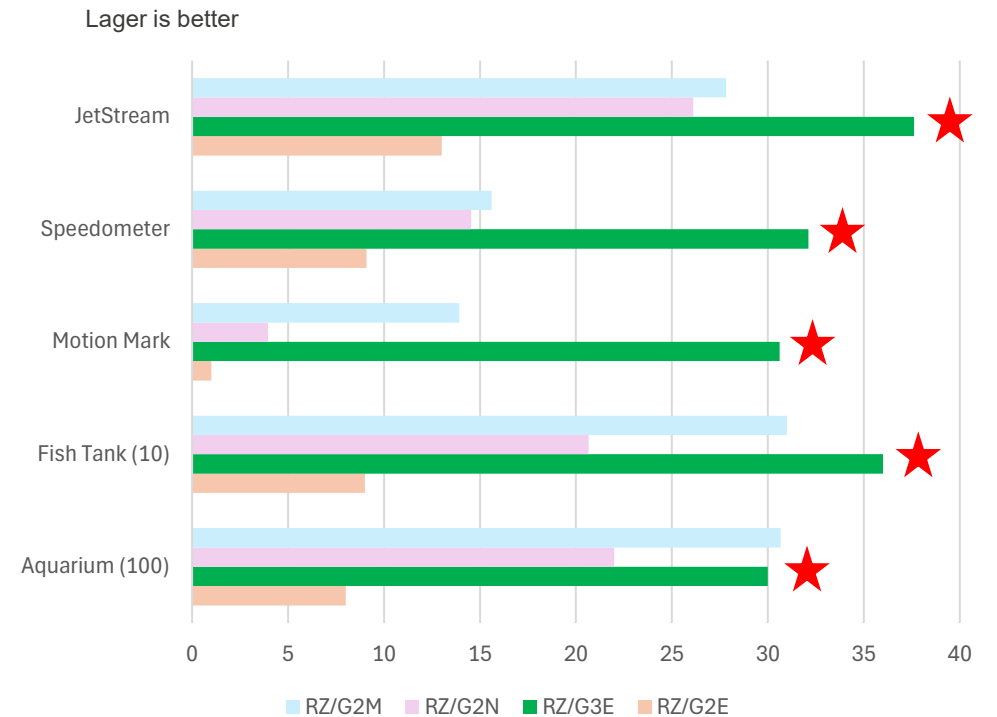
# GPU, VIDEO CODEC AND THREE TYPES OF IMAGE INTERFACES

- In the glmark2 benchmark, which measures GPU performance, RZ/G3E is approximately 1.5 times faster than its predecessor, RZ/G2E.
- In the Chromium benchmark, which tests overall system performance, including CPU, RZ/G3E outperforms the higher-end products RZ/G2M and RZ/G2N in many tests.

glmark2 Benchmark results



Chromium benchmark results

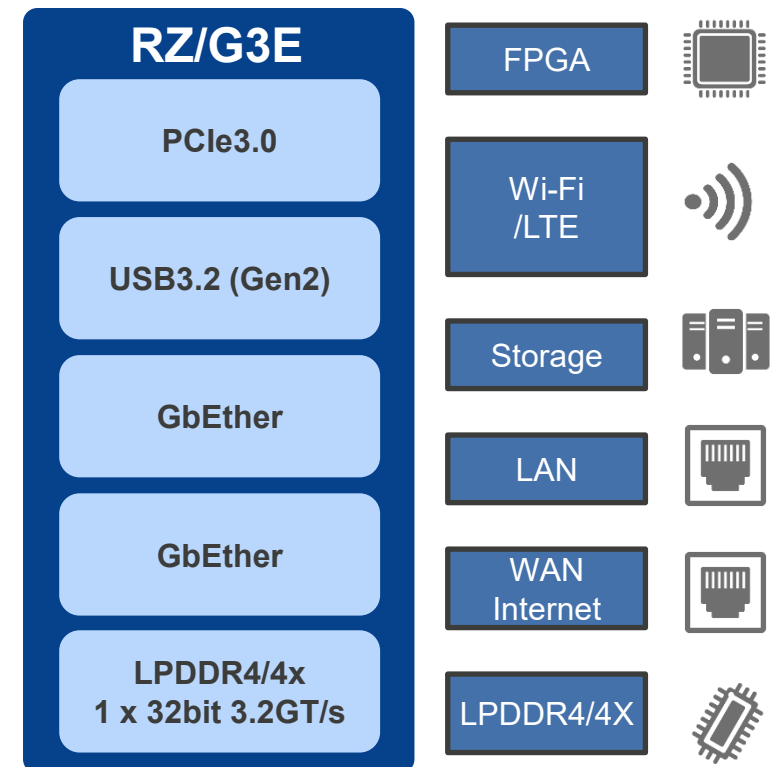


Note: RZ/G3E was measured using a preliminary library.

# BUILT-IN HIGH-SPEED INTERFACES

- 1x PCIe Gen3 2lane : Can access to the cloud through wireless communication using **8GT/s bandwidth**
- 1x USB3.2 (Gen2x1) Host : Can use **10Gbps bandwidth** for high-speed storage and high-speed communication
- 32bit LPDDR4/4X (3.2GT/s) : Sufficient bandwidth for the above high-speed communications

| High-speed Interfaces | Details  |
|-----------------------|--|
| PCI                   | 1x PCI Express 3.0 (2-lane)<br>Root complex or Endpoint selectable     |
| USB                   | 1x USB3.2 (Gen2) Host<br>1x USB2.0 (Host/Function)<br>1x USB2.0 (Host) |
| Ethernet              | 2x Gigabit Ethernet<br>Supports RGMII/MII Interfaces                   |
| DRAM                  | 1x 32bit LPDDR4/4X 3200MT/s  |



KEY FEATURE #4

# SUPPORT SUSPEND TO RAM FOR QUICK RESUME OF LINUX

- Low power modes for various applications by controlling three power supply domains  
 Standby for 50 mW class : AWO, AWO\_DDR\_RETENTION mode  
 Deep standby for 1mW class : DDR\_RETENTION mode
- Support DDR self-refresh for fast return to Linux applications

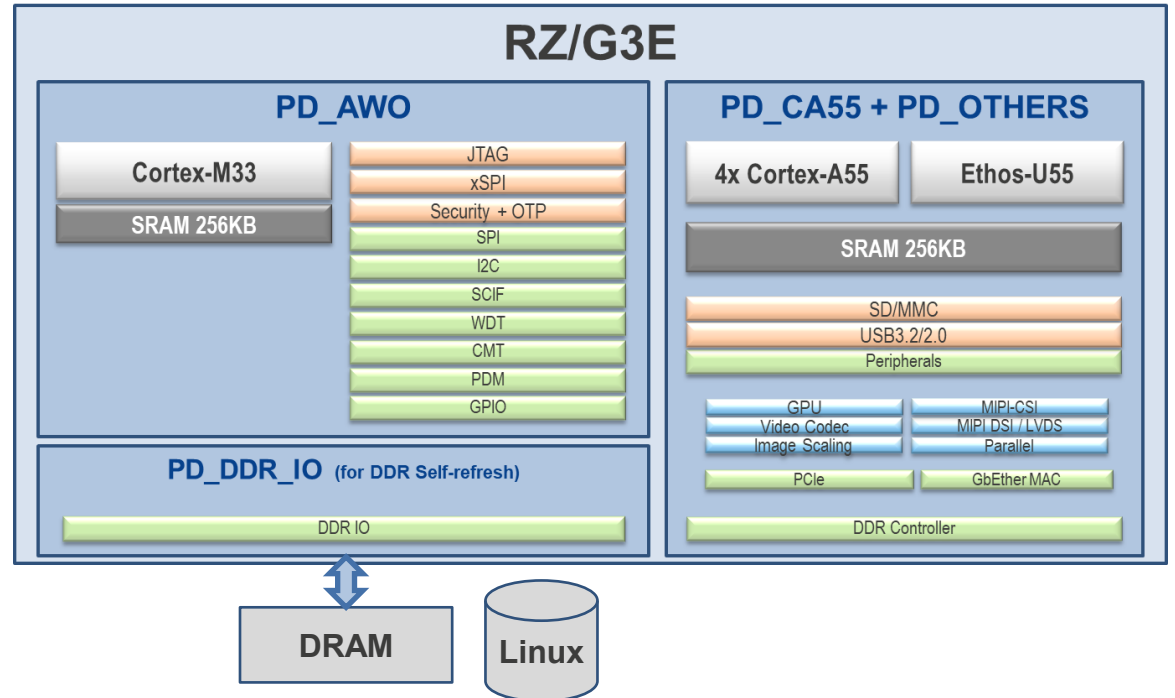
| Power mode   | Power domain        |        |           |
|--|---------------------|--------|-----------|
|  | PD_CA55 + PD_OTHERS | PD_AWO | PD_DDR_IO |
| <b>ALL ON</b><br>- 4x Cortex-A55 + 1x Cortex-M33 + others                | ✓                   | ✓      | ✓         |
| <b>AWO</b><br>- Cortex-M33(CPU idle)                                     |                     | ✓      |           |
| <b>AWO_DDR_RETENTION</b><br>- Cortex-M33(CPU idle)<br>- DDR self-refresh |                     | ✓      | ✓         |
| <b>DDR_RETENTION</b><br>- DDR self-refresh                               |                     |        | ✓         |
| <b>ALL OFF</b>   |                     |        |           |

**50mW class**  
(Typ. Target)

**50mW class**  
(Typ. Target)

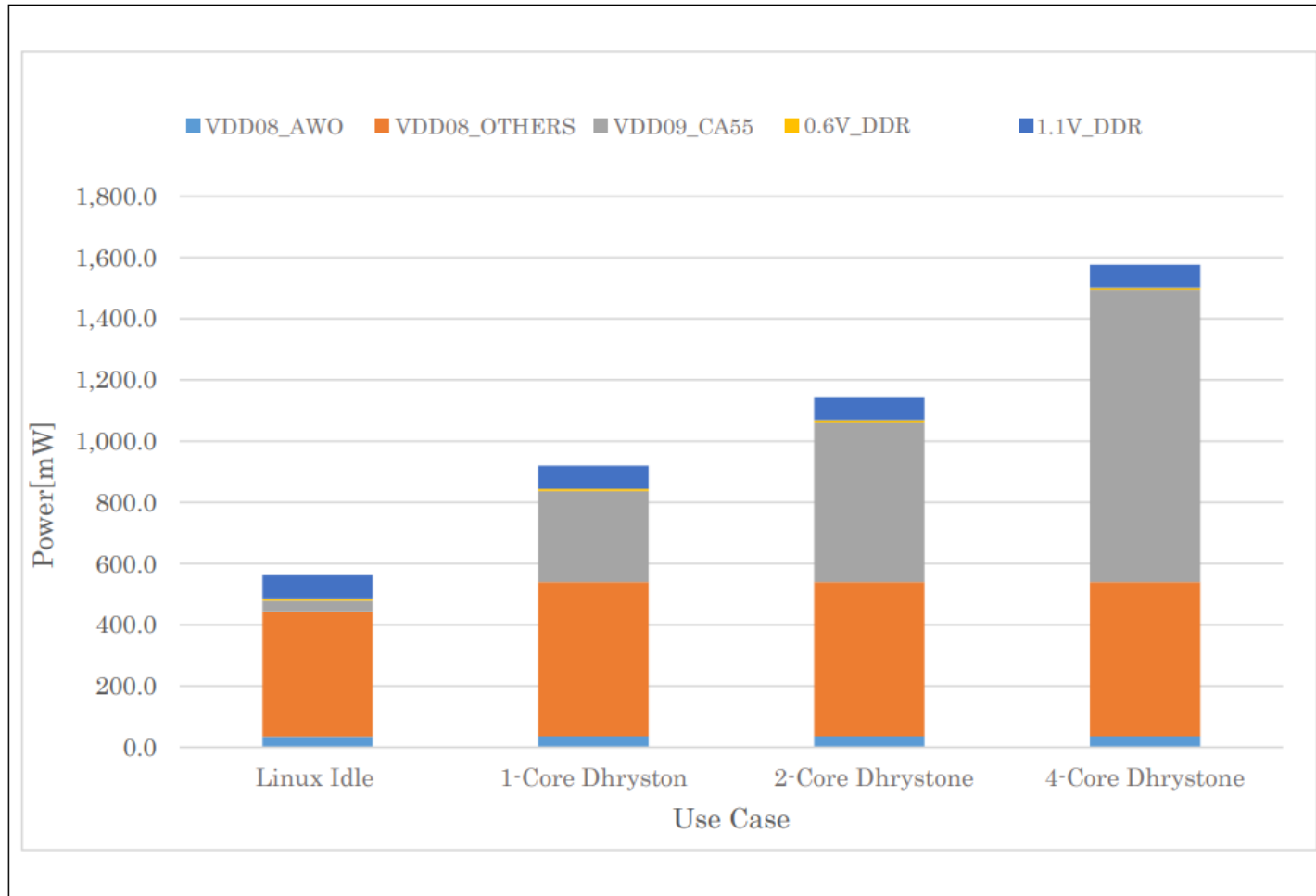
**1mW class**  
(Typ. Target)

**0W**



# MORE SPEC DETAILS

# POWER MEASUREMENTS (TYP)



- Device condition

- Process TYP
- VDD TYP
- Temperature Room ( $T_a \approx 25^\circ\text{C}$ )

**More details on our website:**

[RZ/G3E Power Consumption Measurement](#)

[RZ/G3E Power Estimation Examples](#)

Figure 3.1 Power consumption graph for each use case

## 2. Power consumption in each use case

The estimation result of power consumption in each use case is shown in **Table 2.1**.

Table 2.1 Power Consumption in Each Use Case

| Use Case | 0.8 V | 0.9 V | 1.2 V | 1.1 V | 0.6 V | 1.8 V | 3.3 V | Total |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|
| UseCase1 | 0.25  | 1.04  | 0.00  | 0.03  | 0.01  | 0.02  | 0.01  | 1.36  |
| UseCase2 | 0.97  | 1.04  | 0.01  | 0.13  | 0.06  | 0.08  | 0.07  | 2.36  |
| UseCase3 | 1.13  | 1.14  | 0.01  | 0.13  | 0.06  | 0.20  | 0.05  | 2.72  |

Unit: [W]

Table 1.1 Operation Summary of Each Use Case

| Use Case | Operation Summary  |
|----------|--|
| UseCase1 | Use case assuming the below condition <ul style="list-style-type: none"> <li>• Cortex-A55 (4Core): use rate 50%</li> <li>• System/Bus/Clock: use rate 25%</li> <li>• DDR(LPDDR4X): use rate 10%</li> <li>• AWO Domain: use rate 25%</li> </ul> |

UseCase2

Use case assuming the below condition

- Cortex-A55 (4Core): use rate 40%
- Cortex-M33: use rate 10%
- System/Bus/Clock: use rate 50%
- GE3D\*1: use rate 40%
- VSP\*2: use rate 40%
- DSI\*3: use rate 75%
- DDR(LPDDR4X): use rate 40%
- ADC: use rate 30%
- SD: use rate 30%
- xSPI: use rate 10%

UseCase3

Use case assuming the below condition

- Cortex-A55 (4Core): use rate 55%
- Cortex-M33: use rate 10%
- System/Bus/Clock: use rate 50%
- GE3D\*1: use rate 65%
- VSP\*2: use rate 80%
- DSI\*3: use rate 75%
- LVDS: use rate 90%
- DDR(LPDDR4X): use rate 40%
- ADC: use rate 30%
- Gbit-Ether: use rate 30%
- xSPI: use rate 10%

## 1.1.3.2 Boot

| Item | Description  |
|------|--|
| Boot | <ul style="list-style-type: none"><li>● Selectable boot from Arm Cortex-A55 or Arm Cortex-M33</li><li>● CA55 boot<ul style="list-style-type: none"><li>– Boot Mode 0: Booting from eSD</li><li>– Boot Mode 1: Booting from eMMC 3.3 V</li><li>– Boot Mode 2: Booting from a serial flash memory connected to the xSPI bus space 3.3 V</li><li>– Boot Mode 3: Booting from SCIF download</li><li>– Boot Mode 4: Booting from USB download</li><li>– Boot Mode 5: Booting from eMMC 1.8 V</li><li>– Boot Mode 6: Booting from a serial flash memory connected to the xSPI bus space 1.8 V</li></ul></li><li>● CM33 boot<ul style="list-style-type: none"><li>– Boot Mode 2: Booting from a serial flash memory connected to the xSPI bus space 3.3 V</li><li>– Boot Mode 3: Booting from SCIF download</li><li>– Boot Mode 6: Booting from a serial flash memory connected to the xSPI bus space 1.8 V</li></ul></li></ul> |

# USB3.2 & PCI EXPRESS GEN3

## USB3.2:

Table 6.4-2 Supported Speed Types

| Function        | Speed Type                    |                         |                          |                         |                         |
|-----------------|-------------------------------|-------------------------|--------------------------|-------------------------|-------------------------|
|                 | Super Speed Plus<br>(10 Gbps) | Super Speed<br>(5 Gbps) | High Speed<br>(480 Mbps) | Full Speed<br>(12 Mbps) | Low Speed<br>(1.5 Mbps) |
| Host Controller | ✓                             | ✓                       | ✓                        | ✓                       | ✓                       |

 **10 Gbps**

## PCI Express Specification (Compliant with the PCI Express Base Specification 4.0)

- PCI Express Gen1 (2.5 GT/s)/Gen2 (5.0 GT/s)/Gen3 (8.0 GT/s)
- Root Complex (RC) / Endpoint (EP) Applications, Type 0/1 Configuration Register
- Lane implementation x2 / x1 × 1ch

 **2 lane, 8 GT/s**

# GIGABIT ETHERNET

---

Some TSN features are supported:

IEEE 802.1Qav — Credit-Based Shaper (CBS) for traffic shaping

IEEE 802.1Qat — Stream Reservation Protocol (SRP)

IEEE 802.1AS — Time Synchronization protocol for timing and sync across nodes (based on IEEE 1588-2008)

IEEE 1588-2008 support (with nanosecond timer per channel, master/slave mode)

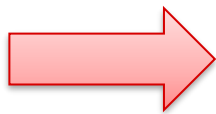
– RGMII and MII (GMII is not supported.)

# GPU

---

## 1.1.3.4 Graphics Unit

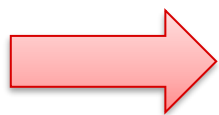
| Item                      | Description   |
|---------------------------|---|
| 3D Graphics Engine (GE3D) | <ul style="list-style-type: none"><li>• Arm Mali-G52 630 MHz</li><li>• 64 Kbytes L2 cache</li><li>• Vulkan 1.2 supported</li><li>• OpenGL ES™ 1.1, 2.0, and 3.2 supported</li><li>• OpenCL 2.0 full profile supported</li></ul> |



**30GFLOPS**

### 1.1.3.9 Camera Interface

| Item  | Description  |
|---|--|
| MIPI CSI-2 Interface with camera image processing (CRU) | <ul style="list-style-type: none"><li>• Number of lanes: 1, 2, or 4 lanes</li><li>• Maximum bandwidth: 2.1 Gbps per lane</li><li>• Support for the throughput up to FullHD RAW12 60 fps</li><li>• Support for 4 virtual channels selected from VC0 to VC15</li><li>• Support for input data formats:<ul style="list-style-type: none"><li>• YUV422 8 bits or 10 bits</li><li>• RGB444, RGB555, RGB565, RGB666, RGB888</li><li>• RAW6, RAW7, RAW8, RAW10, RAW12, RAW14, RAW16, RAW20</li><li>• YUV420 8-bits or 10-bits (image processing not supported)</li><li>• Legacy YUV420 8-bits (image processing not supported)</li><li>• YUV420 8-bits or 10-bits (chroma shifted pixel sampling) (image processing not supported)</li></ul></li><li>• User defined byte-based data</li><li>• The other formats from the MIPI CSI-2 interface can also be output without image processing.</li><li>• Generic long packet data types 1 to 4</li><li>• User defined 8-bit data types 1 to 8</li></ul> |



**FHD 60fps**

# RZ/G3E VIDEO CODEC GUIDE

## MAXIMUM PERFORMANCE & 4K VIDEO USAGE

### ✓ RZ/G3E Video Codec Performance

RZ/G3E has H.265/264 Encode & Decode with multiple streams support.

Maximum performance is below, and number of streams depends on resolution and frame-rate.

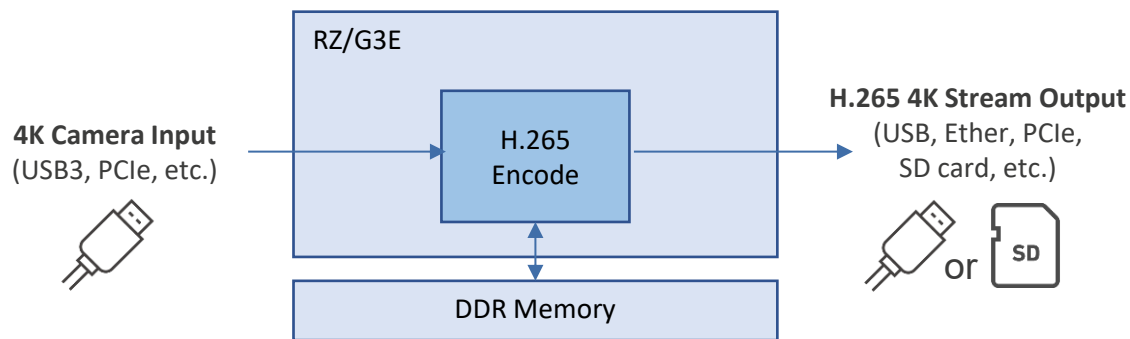
- H.265 : up to 4K 30fps x 1 stream
- H.264 : up to FHD 30fps x 1 stream

### ✓ H.265 4K Video Usage

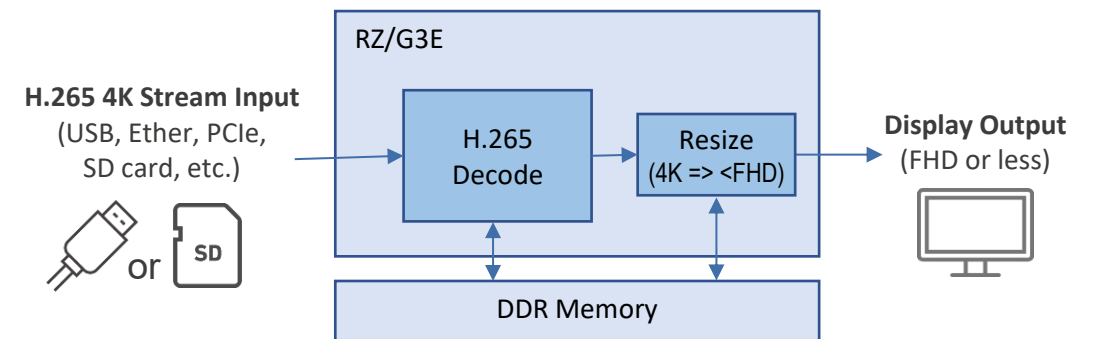
RZ/G3E camera input & display output (MIPI & LVDS) supports up to FHD class resolution.

In order to use 4K codec, some ingenuity will be required.

- For 4K encode, please use USB3 or PCIe interface for camera input.
- After 4K decode, please resize from 4K to FHD resolution or less for display output.



H.265 4K Encode Use case



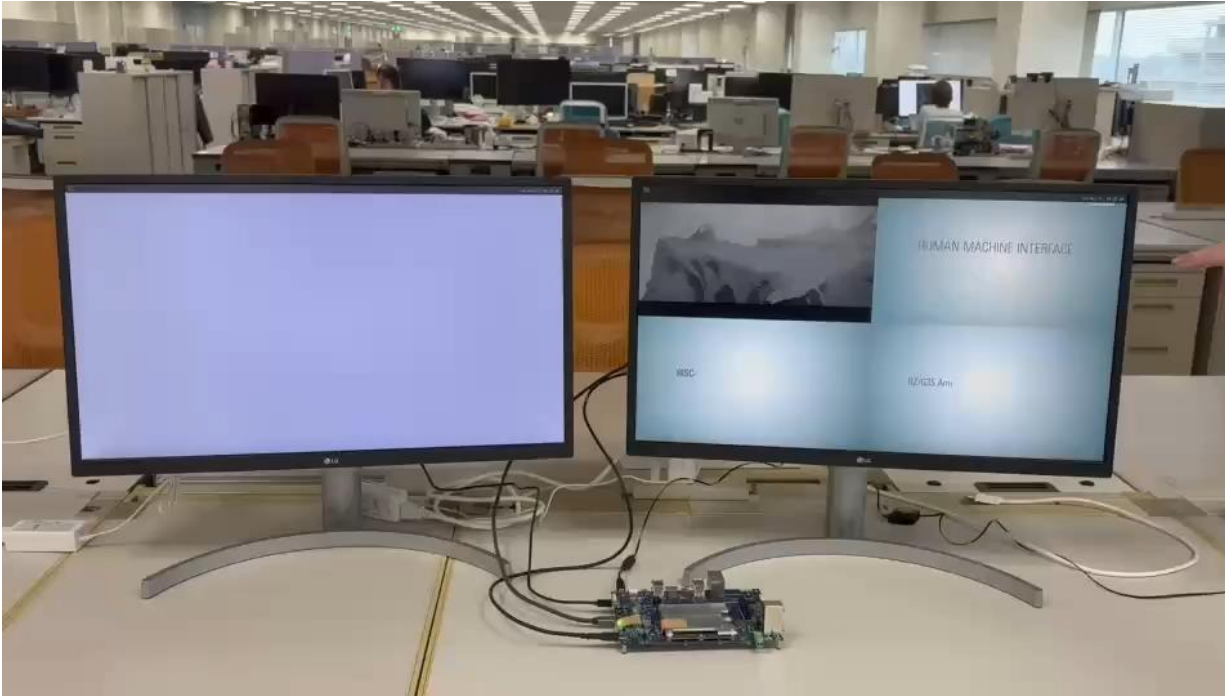
H.265 4K Decode Use case

Table 9.1-1 Variation of Display Output

| Pattern     | LVDS0  | LVDS1  | Parallel               | MIPI-DSI                | The Number of Output Displays |
|-------------|--|--|------------------------|-------------------------|-------------------------------|
|             | Up to 1366×768, 60 fps<br>Up to 1280×800, 60 fps | Up to 1366×768, 60 fps<br>Up to 1280×800, 60 fps |                        |                         |                               |
|             | Dual-link: Up to 1920×1200, 60 fps               |  | Up to 1280×800, 60 fps | Up to 1920×1200, 60 fps |                               |
| Pattern 1-0 | ✓ (from LCDC0)                                   | —  | —                      | —                       | 1                             |
| Pattern 1-1 | —  | ✓ (from LCDC1)                                   | —                      | —                       |                               |
| Pattern 1-2 | —  | —  | ✓ (from LCDC1)         | —                       |                               |
| Pattern 1-3 | —  | —  | —                      | ✓ (from LCDC1)          |                               |
| Pattern 1-4 | —  | —  | —                      | ✓ (from LCDC0)          |                               |
| Pattern 1-5 | ✓ Dual-link (from LCDC0)                         |  | —                      | —                       |                               |
| Pattern 2-1 | ✓ (from LCDC0)                                   | ✓ (from LCDC1)                                   | —                      | —                       | 2                             |
| Pattern 2-2 | ✓ (from LCDC0)                                   | —  | ✓ (from LCDC1)         | —                       |                               |
| Pattern 2-3 | ✓ (from LCDC0)                                   | —  | —                      | ✓ (from LCDC1)          |                               |
| Pattern 2-4 | ✓ Dual-link (from LCDC0)                         |  | ✓ (from LCDC1)         | —                       |                               |
| Pattern 2-5 | ✓ Dual-link (from LCDC0)                         |  | —                      | ✓ (from LCDC1)          |                               |
| Pattern 2-6 | —  | —  | ✓ (from LCDC1)         | ✓ (from LCDC0)          |                               |

# RZ/G3E DEMO

# H.264/265 MULTI STREAMING AND MULTI DISPLAY DEMO



- Multi-stream and Multi-display demo
- RZ/G3E can support Multi-stream decoding and Multi-display at Full-HD/60fps via MIPI-DSI and Dual LVDS.

(Left display)

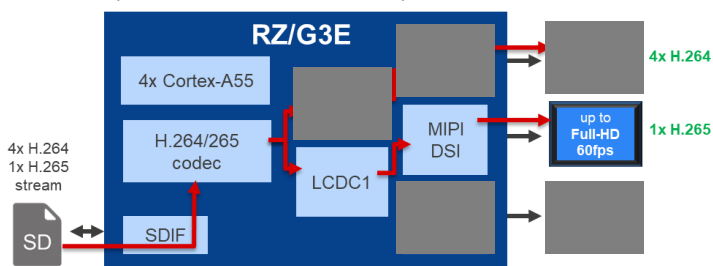
Decode one stream by **H.265** at **Full-HD/60fps**

(Right display)

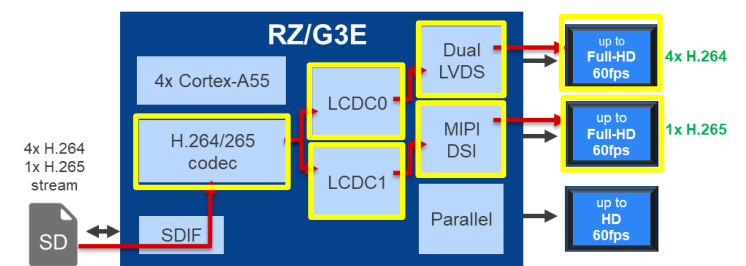
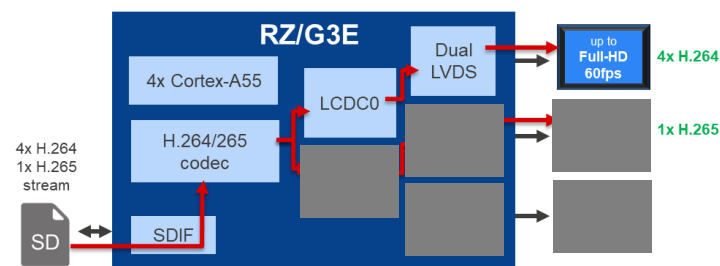
Decode four streams by **H.264** at **Full-HD/60fps**

**Operating the both processing simultaneously!!**

(Operation in left hand)



(Operation in right hand)



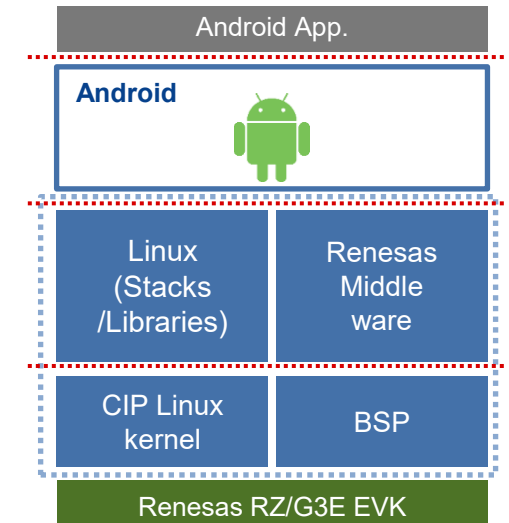
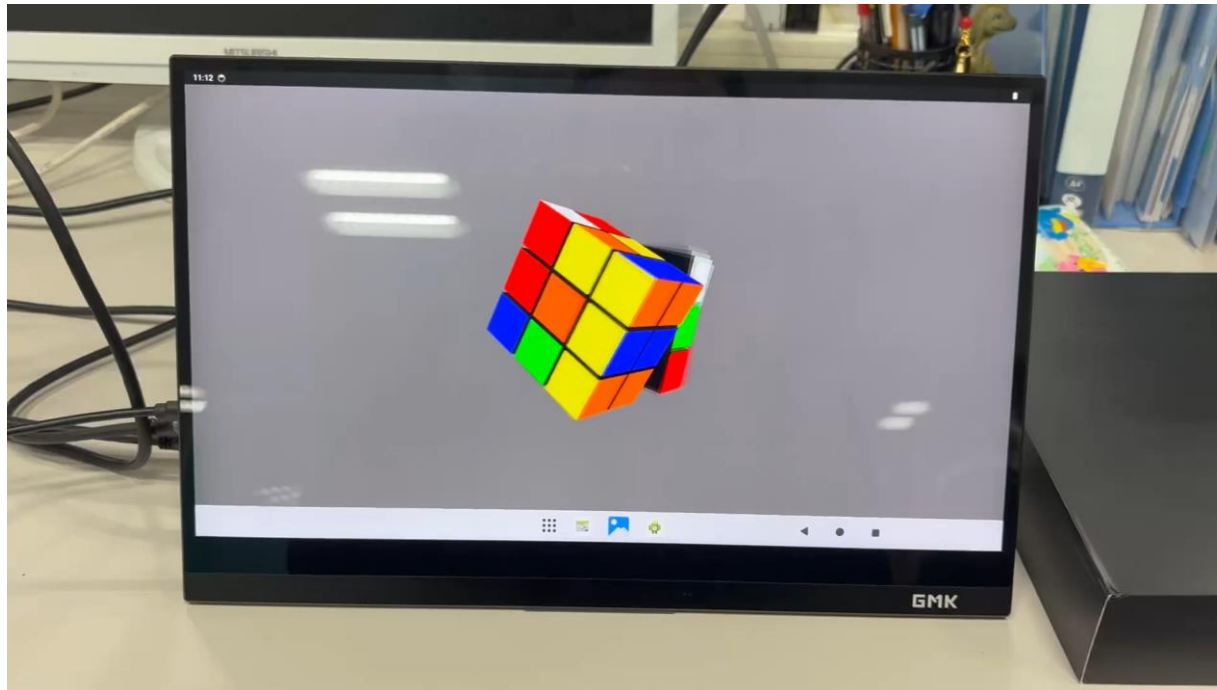
# ANDROID 3D DEMO



## ■ Solution overview

The RZ/G application framework implements the Android UI used in mobile devices with embedded devices. A development environment provided free of charge from AOSP (Android Open Source Project) and Android engineers around the world can be used as development resources.

| Group | Version    | Target Device | Linux Kernel | Status    |
|-------|------------|---------------|--------------|-----------|
| RZ/G3 | Android 14 | RZ/G3E        | 6.1          | Available |



- : RZ/G Verified Linux Package for 64bit kernel (VLP 64)
- : RZ/G VLP 64 Evaluation target Layer

*Android is a trademark of Google LLC.  
The Android robot is a reproduction or modification of a work created and provided by Google and is used in accordance with the terms set forth in the Creative Commons Attribution 3.0 License.*

# RZ/G3E HMI PARTNER

# Qt Group Qt Creator

EASY-TO-USE 3D-CAPABLE DESIGN TOOL

|                 |   |
|-----------------|---|
| AMERICAS        | ● |
| EUROPE          | ● |
| JAPAN           | ● |
| CHINA           | ● |
| TAIWAN          | ● |
| ASEAN/ ANZ/ IND | ● |
| KOREA           | ● |



## Key Features

- Includes Qt Framework, a comprehensive set of libraries optimized for cross-platform development and ready-made functionality and Qt Design Studio Professional
- Use Qt Creator IDE to write software in C++, QML, JavaScript, Python, and others
- Compile source code into native code, allowing for protection of the source code and intellectual property, test and debug applications in emulator
- Integrates to preferred version control systems and with GitHub Copilot
- Use the performance analyzer to identify bottlenecks using visual representations of your CPU and RAM
- Quick start-up with Boot to Qt for RZ/G2L and RZ/G3E

## Target Markets and Applications

- All HMI segments
  - Smart Home
  - Building automation
- Industrial automation
  - Instrument panels
  - Infotainment
- Medical
  - Safety critical environments

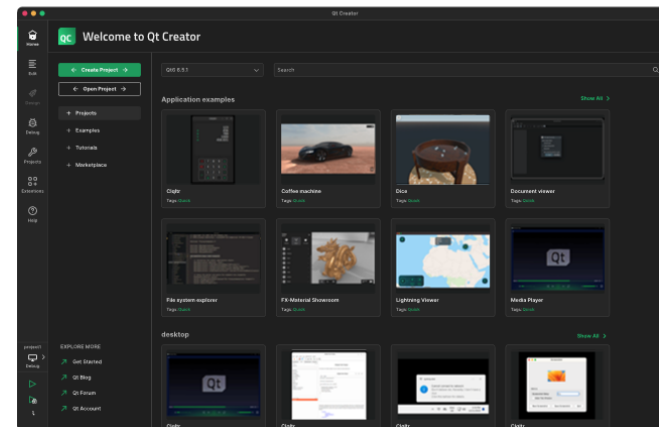


Develop a single cross-platform code base using one integrated toolset. With the most complete set of libraries for UI development, business logic, and machine-to-machine communication, write less code quickly with an extensible IDE and easy-to-use APIs. Well-tested libraries to improve your code quality, shrink your code base, reduce testing burden, and debug visually for improved code stability. It's available for [RZ/G2L](#) and **RZ/G3E** with support for 3D, web camera and multimedia from [here](#) and expanding to other [RZ Family MPUs](#).

● Supported  
● Not supported

### Included Developer Tools:

- Creator IDE
- Visual Studio tools
- Design Studio Professional
- Compilers
- Configuration tools
- Debugging tools
- Deployment tools
- Localization and i18n tools
- QML Live
- Profiling tools
- Python Wizard
- Script Compilers



[Qt Design Studio | Renesas](#) (TBD)

[Qt Design Studio - UI Development Tool for Applications & Devices](#)

# CRANK AMETEK STORYBOARD

## EMBEDDED GUI DEVELOPMENT FRAMEWORK



|                 |   |
|-----------------|---|
| AMERICAS        | ● |
| EUROPE          | ● |
| JAPAN           | ● |
| CHINA           | ● |
| TAIWAN          | ● |
| ASEAN/ ANZ/ IND | ● |
| KOREA           | ● |

### Key Features

- **Accelerated UI Development:** Provides powerful development capabilities with low coding benefits. Create GUIs from scratch or import files directly from popular design tools, such as Figma, Photoshop, Illustrator and Sketch. Re-import changed design files without causing a complete teardown of code
- **Purpose-built for Collaboration:** Front-end design is decoupled from the back-end logic, enabling developers and designers to work in parallel without impacting each others' work
- **Integrated Testing Framework:** Makes the testing process more efficient. Integrate with Jenkins for an automated testing process
- **Project Scalability:** Create UIs optimized for a wide range of hardware types using a single tool and easily port them from one Renesas platform to another

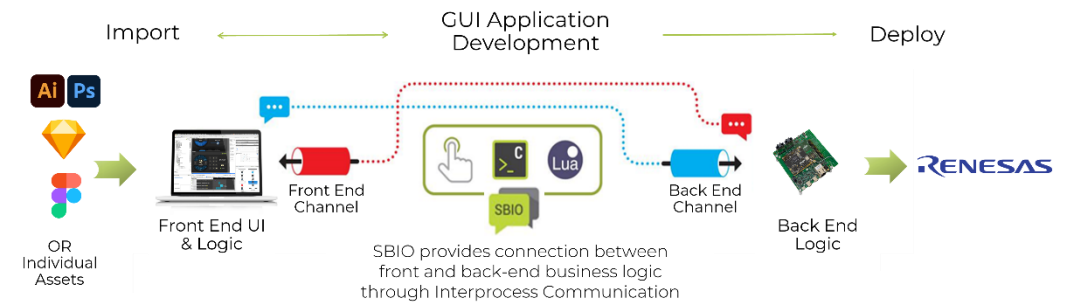
### Target Markets and Applications

- Industrial controls
- Home appliances
- Point-of-Sale terminals
- Smart home / IoT
- Consumer electronics
- Automotive / Infotainment
- Smart building
- Medical
- E-Bike
- Wearables
- Kiosks



Storyboard is an embedded GUI development framework for creating engaging HMI applications with exceptional user experiences. Its unique decoupled architecture makes it simple to develop, test, and make changes to HMI applications at any point during development, enabling development teams to refine the application without disrupting already completed work. Storyboard supports the [RA Family MCUs](#), [RZ/A Series MPUs](#), and [RZ/G Series MPUs](#). Download demonstration software at [Crank AMETEK website](#).

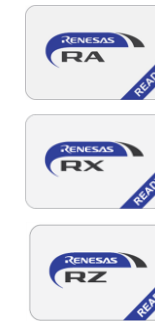
● Supported  
● Not supported



[CRANK | AMETEK® - Storyboard | Renesas](#)  
[Download demo images for Renesas hardware](#)

# Tara System Embedded Wizard

HIGH-PERFORMANCE GUI SOFTWARE WITH MINIMAL MEMORY FOOTPRINT



|                 |   |
|-----------------|---|
| AMERICAS        | ● |
| EUROPE          | ● |
| JAPAN           | ● |
| CHINA           | ● |
| TAIWAN          | ● |
| ASEAN/ ANZ/ IND | ● |
| KOREA           | ● |

● Supported  
● Not supported

## Key Features

- Modern and user-friendly WYSIWYG authoring tool
- Generation of source code optimized for selected target system
- Ready-to-use widgets, effects, animations, layout functions, vector graphic rendering, etc.
- High-efficient code and minimum memory footprint
- No (RT)OS is required, GUIs can even run on bare metal
- Current supporting [RX261](#), [RX63](#), [RX65N](#), [RX72N](#), [RA4M2](#), [RA4M2](#), [RA6M3](#), [EK-RA8D1](#), [RZ/A Series](#), [RZ/G2L](#), [RZ/G3E](#) and [RH850](#).

## Target Markets and Applications

- Consumer Electronics
- Medical
- Home Appliances
- Industrial
- Automotive

Embedded Wizard is a GUI technology that enables the customer to create platform-independent and high-performance graphical user interfaces (GUI), even on resource-constrained microcontrollers. We are driven by the idea to provide a comfortable workflow for embedded systems. Embedded Wizard supports customers in the realization of their GUI projects by simplifying development efforts for [RX Family](#), [RA Family](#) MCUs and [RZ Family](#) MPUs.



[Tara Systems Embedded Wizard | Renesas](#)  
[Simplify Your GUI Development - Embedded Wizard](#)

**SOM/SBC PARTNER**

**FRANCHISED BY AVNET SILICA**

# FRANCHISED BY AVNET SILICA

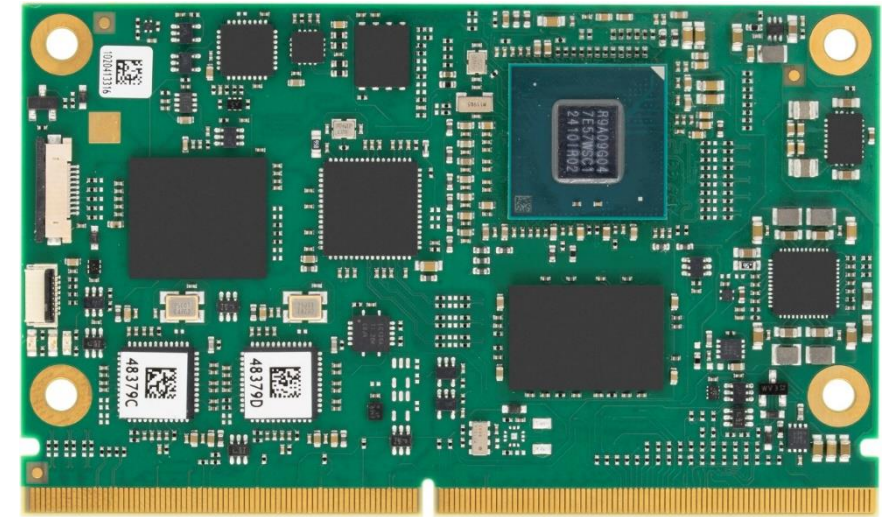
| Platform / Formfactor |   | SMARC   | OSM   | Compact SBC<br>RPI-like SBC   | Community / Proprietary / Special   |
|-----------------------|---|---|---|---|---|
|                       |   |  |  |    |  |
| RZ/G2UL               | 1x CA55, CM33                             | Tria: <a href="#">RZ/G2UL SMARC</a>   |   |   | SolidRun: <a href="#">RZ/G2UL SoM</a>   |
| RZ/G2LC               | 2x (1x) CA55, CM33, 3D-GPU                |   |   | SolidRun: <a href="#">RZ/G2LC SBC</a>   | SolidRun: <a href="#">RZ/G2LC SoM</a>   |
| RZ/G2L                | 2x (1x) CA55, CM33, 3D-GPU, H.264         | Tria: <a href="#">RZ/G2L SMARC</a>  |   | SolidRun: <a href="#">RZ/G2L IIoT SBC</a><br>SolidRun: <a href="#">RZ/G2L SBC Pro</a> | SolidRun: <a href="#">RZ/G2L SoM</a>  |
| RZ/G2E                | 2x CA53, CR7, 3D-GPU, H.264/265           |   |   |   | Engicam: <a href="#">RZ/G2E EDIMM</a>   |
| RZ/G3S                | 1x CA55, 2x CM33                          |   |   |   |   |
| RZ/G3E                |   | Tria: <a href="#">RZ/G3E SMARC</a>  |   |   | SolidRun: <a href="#">RZ/G3E SoM under development</a>                              |
| RZ/V2L                | 2x (1x) CA55, CM33, 3D-GPU, H.264, DRP-AI | Tria: <a href="#">RZ/V2L SMARC</a>  |   | Tria: <a href="#">RZ/V2L SBC</a><br>SolidRun: <a href="#">RZ/V2L SBC</a>              | SolidRun: <a href="#">RZ/V2L SoM</a>  |
| RZ/V2N                | 4x CA55, DRP-AI, ISP, 2x MIPI-CSI         |   |   |   | SolidRun: <a href="#">RZ/V2N SoM</a>  |
| RZ/V2H                | 4x CA55, 2x CR8, DRP-AI, 4x MIPI-CSI      |   |   |   | Engicam: <a href="#">RZ/V2H SoM</a>   |
| RZ/A3UL               | 1x CA55, CM33                             |   |   |   |   |
| RZ/Five               | Andes AX45MP                              |   |   |   |   |

# TRIA SM2S-G3E

## SMARC 2.2 Module based on RZ/G3E

### Key Specifications

|                     |   |
|---------------------|---|
| CPU                 | Renesas RZ/G3E with up to 4x Cortex-A55 up to 1.8GHz + Cortex-M33 |
| Memory & Storage    | LPDDR4 with inline ECC, eMMC                                      |
| Video In            | MIPI CSI-2 camera interface                                       |
| Video Out           | SC/DC LVDS, MIPI-DSI, HDMI  |
| Interfaces          | 2xGbit Ethernet, 2xUSB3.0, 4xUSB2.0                               |
| Connectivity        | SDIO, CAN-FD, I2S, GPIO, UART, SPI, I2C                           |
| Additional Features | Arm Mali-G52 GPU, Arm Ethos-U55 NPU, 4k VPU                       |
| Formfactor          | SMARC™ Short Size   |
| Temp Range          | -40°C ... 85°C  |
| Size                | 82 mm x 50 mm   |
| Power               | Single 5V power supply  |



### Highlight

- Single-sided PCB design for optimized cost
- HDMI option for compatibility with competition

Learn more for detailed description and additional features:

<https://www.tria-technologies.com/product/tria-sm2s-g3e/>

# TIA RZ/V2H System on Module

Small form factor AI Vision solution

## Key Specifications

|                     |   |
|---------------------|---|
| CPU                 | RZ/V2H<br>4x Cortex-A55, up to 1.8 GHz<br>2x Cortex-R8, up to 800 MHz<br>1x Cortex-M33, up to 200 MHz |
| Memory & Storage    | Up to 16 GB LDDR4x<br>Starting from 8GB eMMC  |
| Video In            | 4x MIPI-CSI 4-lane  |
| Video Out           | 1x MIPI-DSI 4-lane  |
| Interfaces          | UART, SPI, I2C, CAN Bus, GPIOs, JTAG, PCIe, others  |
| Connectivity        | 1x Gbe with PHY + 1x RGMII interface, dedicated SDIO for WiFi/BT                                      |
| Additional Features | USB 2.0, USB 3.2  |
| Formfactor          | Engicam TIA form factor for AI Vision   |
| Temp Range          | -40°C, + 85°C (CPU TJ +125°)  |
| Size                | 35 x 55 mm  |
| Power               | Single +5 Vdc   |
| Solution Code       | WS854   |

**ENGICAM**  
EMBEDDED SOLUTIONS



## Highlight

- Powerful RENESAS® RZ/V2H processor with AI accelerator and GPU
- Suitable for autonomous robots, machine vision and advanced graphics applications

Learn more for detailed description and additional features:

<https://www.engicam.com/vis-prod/TIA-RZ-V2H/TIA-RZV2H>

# DEVELOPMENT ENVIRONMENT

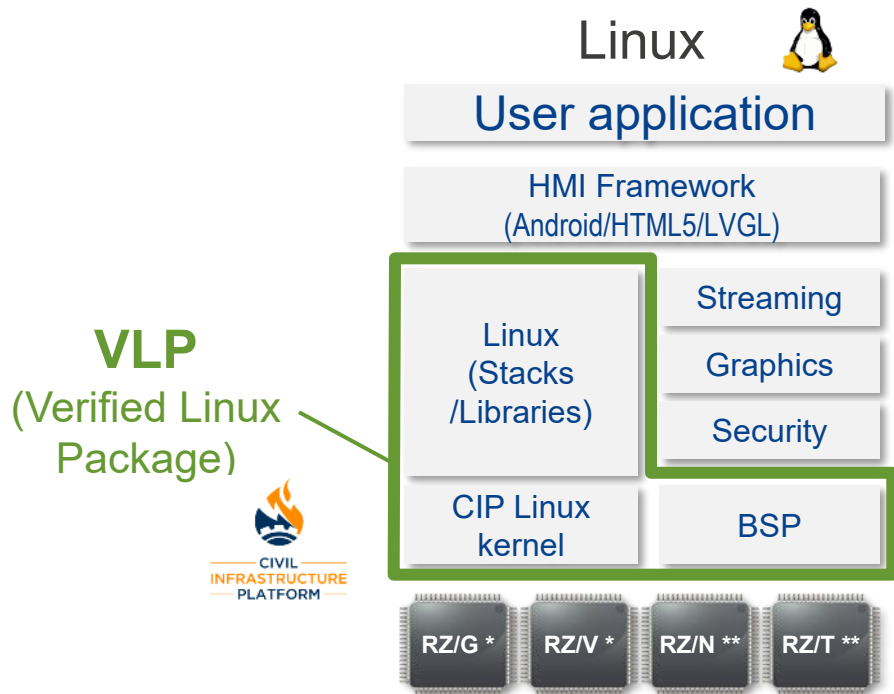
# SCALABLE & COMPATIBLE S/W PLATFORM

## RZ FAMILY SOFTWARE SUPPORTS MULTI-OS ON MULTI-CPU-CORE

- Verified Linux Package (VLP) and Flexible Software Package (FSP) bring benefit of compatibility and scalability among Renesas MPU/MCU products to customers

### Verified Linux Package (VLP)

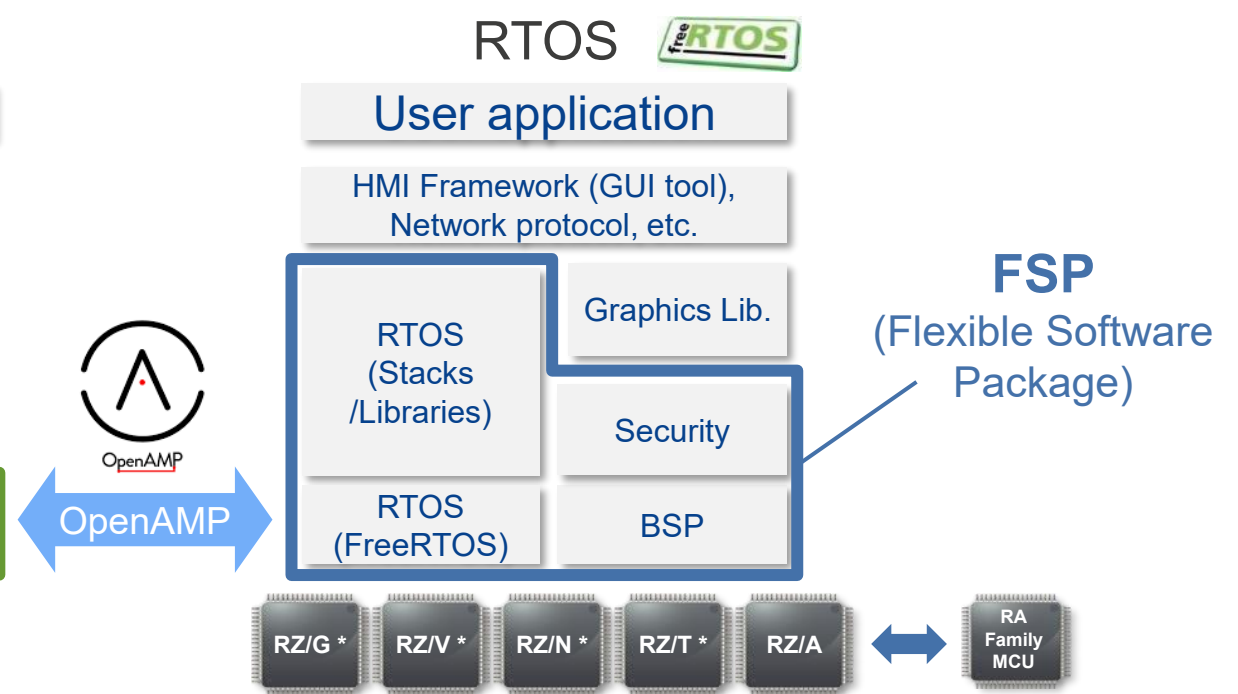
Linux S/W platform based on CIP Linux and common S/W libraries, which are verified by Renesas.



CIP: Civil Infrastructure Platform, BSP: Board Support Package

### Flexible Software Package (FSP)

Common S/W platform for Renesas MPU and MCU, which provides configurability by GUI tool.



Compatibility with RA MCU

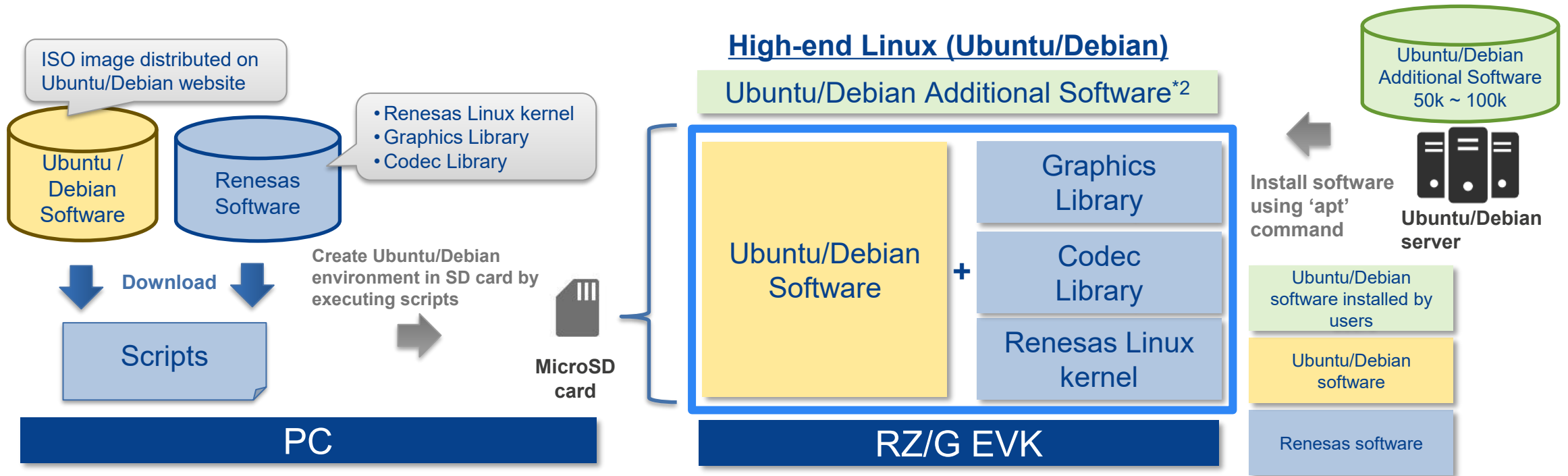
# LINUX SOLUTIONS

- **Linux BSP Plus** : For experts who want to start development with the latest LTS kernel
- **VLP** : For users who require super long-term Linux kernel maintenance
- **SDK** : For Linux beginners who want to start application software development quickly

|                     | <b>NEW</b><br>Linux BSP Plus | VLP                   | SDK                   |
|---------------------|------------------------------|-----------------------|-----------------------|
| Target users        | Expert                       | Expert                | <i>Beginner</i>       |
| Kernel Support Term | 2years                       | <b><i>10years</i></b> | <b><i>10years</i></b> |
| Kernel Update       | <b><i>Every year</i></b>     | Every 2 years         | Every 2 years         |
| Yocto Update        | <b><i>Every 2year</i></b>    | No                    | No                    |
| Verification Level  | Low                          | <b><i>High</i></b>    | <b><i>High</i></b>    |
| Maintenance cycle   | none                         | 6~12 month            | 6~12 month            |

# OVERVIEW OF UBUNTU AND DEBIAN FOR RZ MPU LINUX

For customers who want to build Ubuntu and Debian environments on EVK, we provide documentation and scripts to help you build your environment\*1



- Target Device:  
RZ/G2L, RZ/G2LC, RZ/G2UL,  
RZ/G3E, RZ/V2H

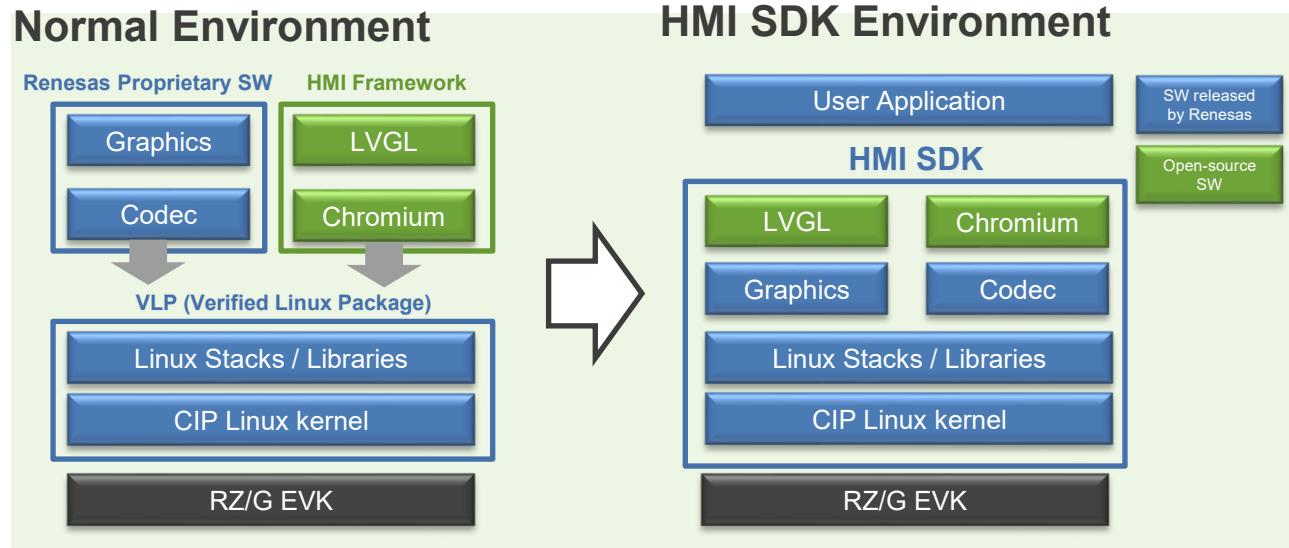
\*1 It is not an Ubuntu/Debian software package.  
\*2 Not covered by Renesas Support.

- Learn more about our solutions ▼  
[Ubuntu and Debian for RZ MPU Linux](#)
- Click here for the download link for the software package ▼  
[Evaluation Board Kit \(EVK\) and Software - Ubuntu and Debian for RZ MPU Linux](#)

# HMI SDK SOLUTION

PROVIDES LINUX HMI APPLICATION DEVELOPMENT ENVIRONMENT FOR THE RZ/G EVALUATION BOARD KIT (EVK)

- It is a solution that includes the software necessary for the development of HMI application programs, such as graphics libraries and HMI frameworks, in a single package
- The Quick and Easy environment makes application development easier



## Easy-to-Use

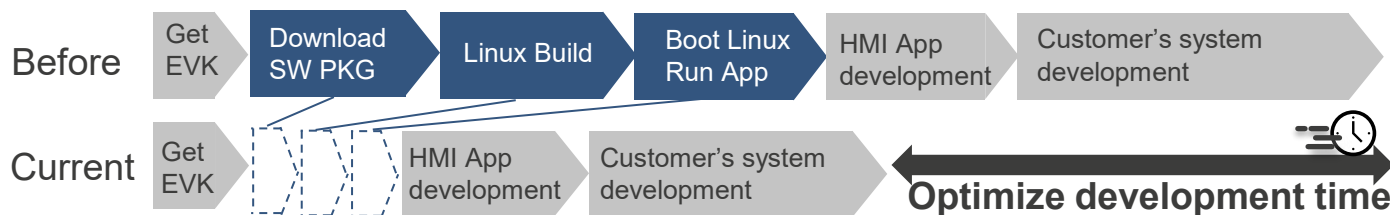
The environment necessary for HMI development is prepared in an all-in-one package, making it easy for Linux beginners to develop.

## Free of Charge

All software included in this SDK can be used free of charge.

## Ready-to-Use

GUI framework\*<sup>1</sup> and libraries that achieve both intuitive operability and high expressiveness are included as standard.

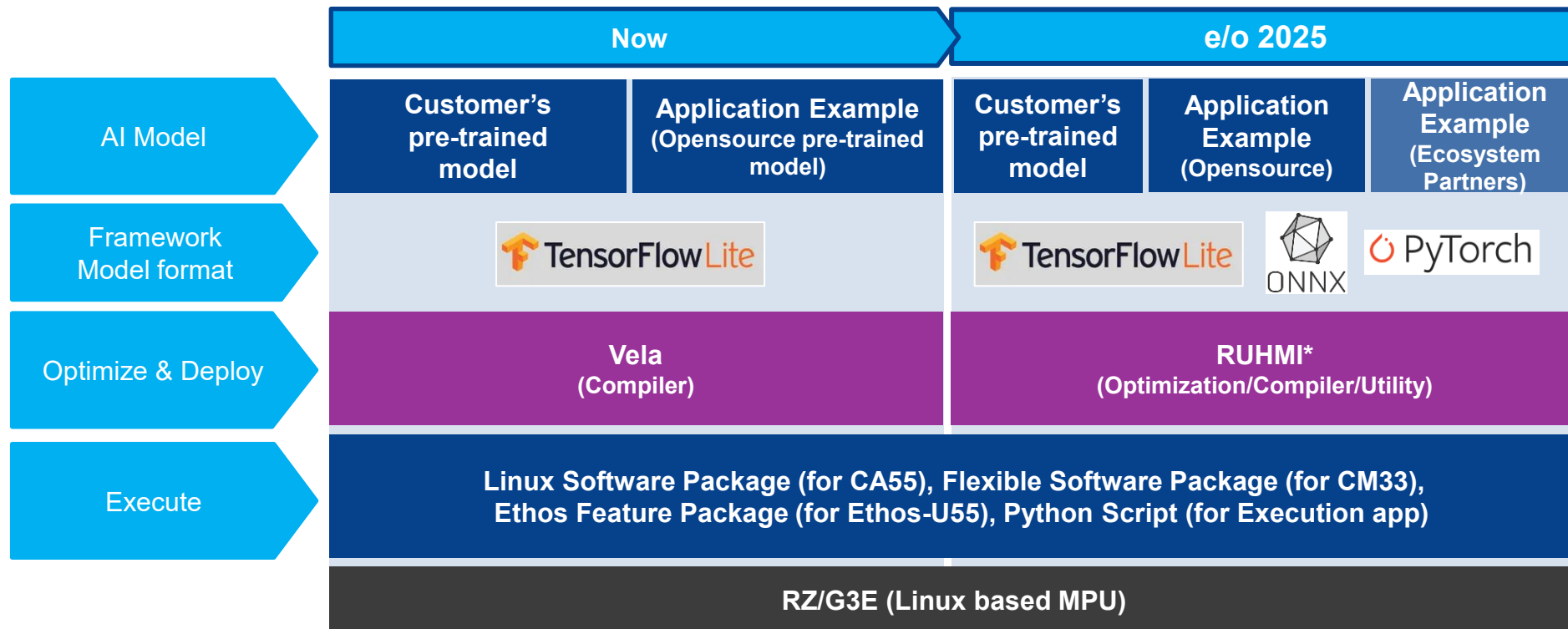


Click here for HMI SDK tutorial video [RZ/G2L Get Started with HMI SDK](#)

\*1 The GUI frameworks included in this SDK are LVGL and Chromium. LVGL is the GUI framework that is suited for non-GPU products, while Chromium is good GUI framework for products with GPU.

# RZ/G3E AI COMPILER WORKFLOWS

- ✓ For AI model format, Google TensorFlowLite is supported. Plan to expand ONNX / PyTorch in future.
- ✓ Currently we use the Vela compiler provided by Arm for AI deployment on Ethos. Plan to integrate it into RUHMI.
- ✓ Linux software package, Multi-OS package, Ethos feature package and Python script are already available for RZ/G3E Ethos AI evaluation.

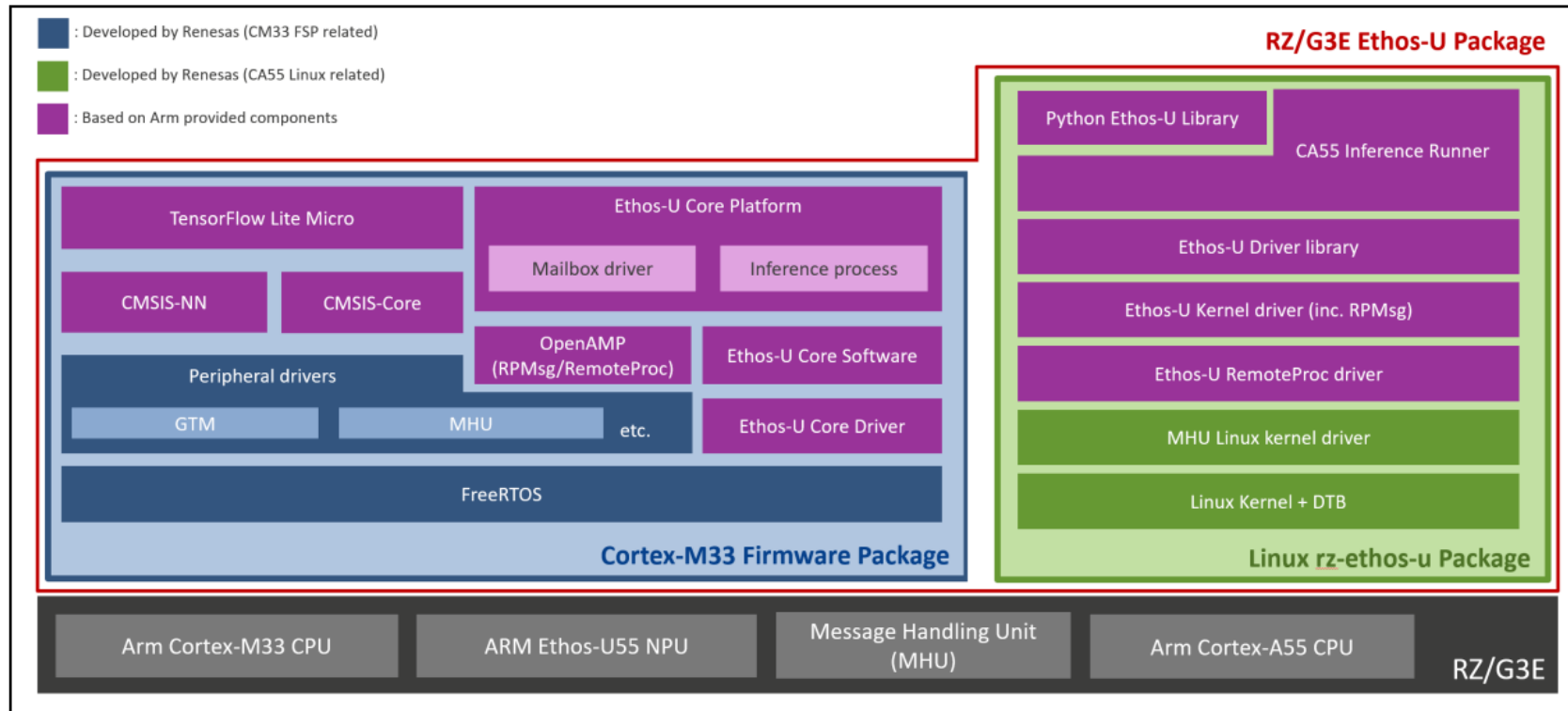


\*Already available for RA8P1



# RZ/G3E

## Getting Started with Arm Ethos-U on Renesas RZ/G3E



Ethos AppNote & SW Package available on request (Not on Website yet)

Figure 1: Software architecture of Ethos-U support for RZ/G3E

# RZ/G3 SECURITY SOLUTION CONCEPT

- The following security features are available with RZ/G3E Security Package:

| Functions                                  |                                 | RZ/G3E Secure Product |
|--|---------------------------------|-----------------------|
| Trust zone (Trusted Execution Environment) |                                 | ✓                     |
| Boot protection : Secure boot              |                                 | ✓                     |
| Secure firmware update                     |                                 | ✓                     |
| Secure debug                               |                                 | ✓                     |
| Cryptography assistance                    | Security IP (Trusted Secure IP) | ✓                     |
|  | Armv8-A Cryptographic Extension | ✓                     |



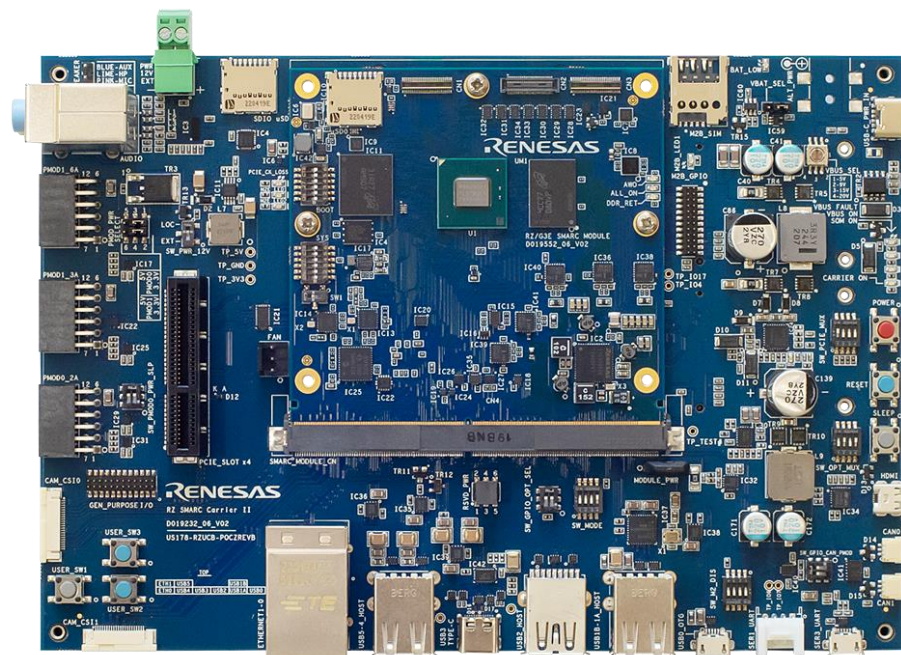
Candidates for certification



- All RZ/G3E products support security. (Secure product only)

# DEV KITS/EVAL BOARDS

RZ/G3E Evaluation Board Kit  
(RZ/G3E SMARC v2.1.1 Module Board + Carrier Board)  
Part Number : RTK9947E57S01000BE



Design data (layout, schematics, gerber-files, BoM) available FOC from our website:

[RZ/G3E SMARC Module Design Data](#)

## Module board (Dimension: 82 mm x 82mm )

- Processor: RZ/G3E (R9A09G047E57GBG)
- Main Memory: 4GB LPDDR4X 3200
- QSPI NOR FLASH: 16MB (AT25QL128A)
- eMMC Memory: 64GB
- External Storage: micro SD x2
- A/D Converter Interface x8
- JTAG connector
- PMIC (RAA215300)

## Carrier board (Dimension: 190mm x 130mm )

- Gigabit Ethernet x2
- USB2.0 Micro B OTG
- USB2.0 Type-A x2
- USB3.2 Type-A
- USB3.2 Type-C
- MIPI CSI-2 Camera interface x2
- Micro HDMI
- MIPI-DSI/LVDS interface x2
- uSD interface
- Mono speaker interface
- Stereo headphone, Mic. and Aux. interfaces
- CAN interface x2
- PCIe Gen3 4-lane Slot
- M.2 Key E interface
- Module supply current monitor
- USB-Type C power input

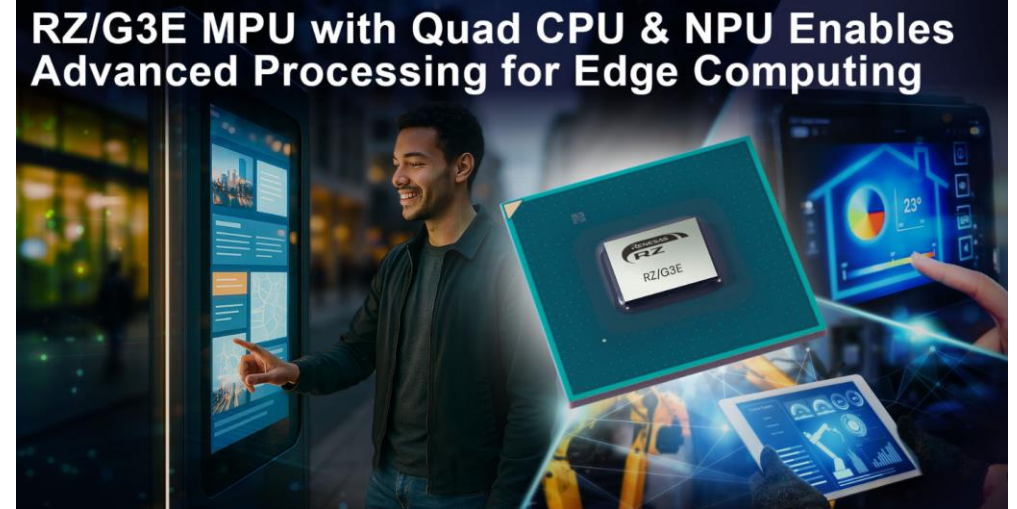
# RZ/G3E GROUP PART NUMBER

| Series | Group  | Security | Core# | Micro NPU | Part number              | CPU                          | Package/Remark                          |   |
|--------|--------|----------|-------|-----------|--------------------------|------------------------------|---|---|
| RZ/G   | RZ/G3E | Secure   | Quad  | Ethos U55 | R9A09G <b>047E58</b> GBG | 4x Cortex-A55, 1x Cortex-M33 | FCBGA: 21x21mm,<br>625pins, 0.8mm pitch |   |
|        |        |          |       | --        | R9A09G <b>047E48</b> GBG |                              |   |   |
|        |        |          | Dual  | Ethos U55 | R9A09G <b>047E38</b> GBG | 2x Cortex-A55, 1x Cortex-M33 |   |   |
|        |        |          |       | --        | R9A09G <b>047E28</b> GBG |                              |   |   |
|        |        |          | Quad  | Ethos U55 | R9A09G <b>047E57</b> GBG | 4x Cortex-A55, 1x Cortex-M33 |   | FCBGA: 15x15mm,<br>529pins, 0.8mm pitch |
|        |        |          |       | --        | R9A09G <b>047E47</b> GBG |                              |   |   |
|        |        |          | Dual  | Ethos U55 | R9A09G <b>047E37</b> GBG | 2x Cortex-A55, 1x Cortex-M33 |   |   |
|        |        |          |       | --        | R9A09G <b>047E27</b> GBG |                              |   |   |

# KEY TAKEAWAYS

# KEY TAKEAWAYS

- High performance **1.8 GHz Quad-core Cortex-A55: 21.6k DMIPS**
- **Ethos-U55 NPU: 512GOPS**, controlled by Cortex-M33, off-loading Quad-Core Cortex-A55
- **ARM Mali G52 GPU: 30 GFLOPS**
- Video encode/decode: H.264 FHD 60fps, **H.265 4k30fps**
- Display interfaces: **LVDS (dual-link), MIPI-DSI, and Parallel Interface**, enabling output of **two independent images**
- **PCIe Gen3, 2 lane (8GT/s) and USB3.2 Gen2 (10Gbps)**, for 5G communications required for Edge Computing
- Low-power modes to realize both “**minimizing standby power**” and “**fast Linux resume**” for HMI application
- Multiple Linux software packages: **Linux BSP Plus (Mainline)**, VLP (10 year support), Multi-OS, Android
- **Tj = -40 to 125° C**





# Thank you

**Start & End your week...  
... with talking to your**



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Bier



Johannes  
Brücker



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Lacatena



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