

# Linux Interface Specification Device Driver SD/MMC

User's Manual: Software

RZ/G2L Group, RZ/V2L Group, RZ/V2N Group,  
RZ/G3E Group and RZ/Five

All information contained in these materials, including products and product specifications, represents information on the product at the time of publication and is subject to change by Renesas Electronics Corp. without notice. Please review the latest information published by Renesas Electronics Corp. through various means, including the Renesas Electronics Corp. website (<http://www.renesas.com>).

## Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
6. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.

7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION ("Vulnerability Issues"). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev. 1.12 Jul 2025)

## Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan

[www.renesas.com](http://www.renesas.com)

## Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

## Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:  
[www.renesas.com/contact/](http://www.renesas.com/contact/).

## General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

### 1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

### 2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

### 3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

### 4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

### 5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

### 6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.).

### 7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

### 8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

# How to Use This Manual

## 1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the hardware functions and electrical characteristics of the MPU. It is intended for users designing application systems incorporating the MPU.. It is intended for users developing software incorporating the processors. A basic knowledge of software development and Linux systems is necessary in order to use this document.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to the RZ/G2L Group, RZ/V2L Group, RZ/V2N Group, RZ/G3E Group and RZ/Five Group. Make sure to refer to the latest versions of these documents. The newest versions of the documents listed may be obtained from the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
User's manual for Hardware	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and operation description  Note: Refer to the application notes for details on using peripheral functions.	RZ/G2L Group User's Manual: Hardware	---
		RZ/V2L Group User's Manual: Hardware	---
		RZ/Five Group User's Manual: Hardware	---
		RZ/V2N Group User's Manual: Hardware	---
		RZ/G3E Group User's Manual: Hardware	---
User's manual for Software	Description of SD/MMC Linux interface Specification	Linux interface Specification – SD/MMC	This user's manual
Application Note	Information on using peripheral functions and application examples Sample programs Information on writing programs in assembly language and C	Available from Renesas Electronics Web site.	
Renesas Technical Update	Product specifications, updates on documents, etc.		

2. Notation of Numbers and Symbols

3. Register Notation

#### 4. List of Abbreviations and Acronyms

Abbreviation	Full Form
bps	bits per second
CRC	Cyclic Redundancy Check
DMA	Direct Memory Access
eMMC	Embedded multi-media card
I/O	Input/Output
MMC	Multi-media card
SD	Secure digital
SDIO	Secure digital Input/Output
VCC	Voltage common collector
VCCQ	Output stage logic power voltage

# Table of Contents

1. Overview.....	1
1.1 Overview .....	1
1.2 Function .....	1
1.3 Connected Port .....	3
1.4 Reference.....	4
1.4.1 Standard.....	4
1.4.2 Related Documents.....	4
1.5 Restrictions .....	4
1.6 Notice .....	4
2. Terminology.....	5
3. Operating Environment.....	6
3.1 Hardware Environment .....	6
3.2 Module Configuration.....	7
3.3 State Transition Diagram .....	7
4. External Interface.....	8
4.1 GPIO Customization Interface .....	9
4.1.1 Setting of Pins .....	9
4.1.1.1 Data and Control Pins .....	9
4.1.2 Card Power Control.....	12
4.1.3 Card Detection .....	12
4.1.4 Mechanical Write Protect Switch.....	13
4.1.5 Voltage Switch.....	14
4.2 Error Codes.....	16
4.3 Transfer Mode Setting (DMA/PIO).....	16
4.4 DIP-Switch and Macro Setting.....	16
5. Integration.....	18
5.1 Directory Configuration .....	18
5.2 Integration Procedure .....	18
5.3 Option Setting .....	18
5.3.1 Module Parameters .....	18
5.3.2 Kernel Parameters .....	18

## 1. Overview

### 1.1 Overview

This manual explains the driver module (this module) that controls the SD card/MMC interfaces on RZ/G Series, RZ/V Series and RZ/Five Series. Detailed explanation is skipped because the interface of this module is based on Linux.

Note: Currently, this device is supported in two kernel versions v5.10 and v6.1 with the information below:

- v5.10: RZ/G2L Group, RZ/V2L Group and RZ/Five.
- v6.1: RZ/G2L, RZ/G2LC, RZ/V2N and RZ/G3E.

### 1.2 Function

This module transmits/receives data to/from the SD card/MMC interfaces on RZ/G2L Group, RZ/V2L Group, RZ/Five Group, RZ/V2N Group and RZ/G3E Group.

The following table lists the functions of this module.



**Table 1-1 Driver Function<sup>1</sup>**

function	support status
SD Memory Card	SD, SDHC, SDXC <sup>2</sup> support
SDIO Card	Support
eMMC	Support
Transfer mode	(1) SD/SDIO: 1bit, 4bit (2) eMMC: 1bit, 4bit, 8bit
Bus speed mode	(1) SD/SDIO - Support: Default Speed(DS), High Speed(HS), and UHS-I (SDR104 / SDR50 / SDR25 / SDR12 / DDR50) (2) eMMC - Support: Backward-compatible, high-speed, HS200 support
DMA function	Internal DMAC support
Card power control	Support <sup>3</sup>
Card Detection(CD)	Support <sup>3</sup>
Card Detection(DAT3)	Not support
Write Protection	Not support
SPI mode	Not support
SD Mechanical Write Protect Switch	Support <sup>3</sup>
SD CPRM Security	Not support
SDIO CMD52 During Data Transfer(C52PUB)	Not support
SDIO Data Transfer Abort(IOABT)	Not support
SDIO Read Wait(RWREQ)	Not support
SDIO Wake Up	Not support
SDIO Suspend/Resume	Not support
eMMC Boot operation	Support
eSD Boot operation	Support (except RZ/Five)

<sup>1</sup> Aggressively clock gating to substitute in RuntimePM.

<sup>2</sup> SDXC memory cards that are formatted with the exFAT cannot be mounted because BSP standard file system does not support the exFAT.

<sup>3</sup> This function corresponds to the GPIO customization interface in the device-dependent. Please refer to 4.1 for details.

### 1.3 Connected Port

This module supports SD/MMC ports on RZ/G2L, RZ/G2LC, RZ/G2UL, RZ/V2L, RZ/Five, RZ/V2N Evaluation Board Kit and RZ/G3E SMARC Evaluation Board Kit.

**Table 1-2 Connected ports on (RZ/G2L, RZ/G2LC, RZ/G2UL and RZ/V2L) Evaluation Board Kit**

channel	connected to	support status	Remark
SDHI0 (MMC0)	High Speed Connector (CN7)	Yes	-
SDHI1	SD Card Connector (CN8)	Yes	-

**Table 1-3 Connected ports on RZ/V2N Evaluation Board Kit**

Channel	Connected to	Support status	Remark
SDHI0 (MMC0)	eMMC card or uSD Card Slot (uSD0)	Yes	Both eMMC and uSD
SDHI1	uSD Card Slot (uSD1)	Yes	
SDHI2	-	No	No interface support

**Table 1-4 Connected ports on RZ/G3E SMARC Evaluation Board Kit**

Channel	Connected to	Support status	Remark
SDHI0 (MMC0)	eMMC card or uSD Card Slot (uSD0)	Yes	Both eMMC and uSD
SDHI1	uSD Card Slot (uSD1)	Yes	
SDHI2	uSD Card Slot (uSD2)	Yes	

## 1.4 Reference

### 1.4.1 Standard

The following table shows the standard that this module corresponds.

**Table 1-5 Standard**

Reference No.	Issue	Title	Edition	Date
-	SD Card Association	SD Specifications Part 1 Physical Layer Simplified Specification	Version 4.10	Jan. 22, 2013
-	SD Card Association	SD Specifications Part E1 SDIO Simplified Specification	3.00	Feb. 25, 2011
JESD84-B51	JEDEC STANDARD Multi-Media Card Association	Embedded Multi-Media Card (eMMC) Electrical Standard (5.1)	5.1	Feb. 2015

### 1.4.2 Related Documents

There is no document related to this module.

## 1.5 Restrictions

None.

## 1.6 Notice

None.

## 2. Terminology

The following table shows the terminology related to this module.

**Table 2-1 Terminology**

Terms	Explanation
MMC	Multi-Media Card This media corresponds to the standard of the removable disk which was established in 1998 by Sun Disk and Siemens jointly.
eMMC	Embedded Multi-Media Card
SD	Secure Digital This media corresponds to the standard of the removable disk which was established in 1999 by Panasonic, Sun Disk and Toshiba jointly.
SDIO	Secure Digital Input/Output This media corresponds to I/O interface standard of SD card which uses the specifications of the physical shape and the electrical feature. It can use a SD card socket. There is a card with wireless LAN or a digital camera function.
DMA	Direct Memory Access
DMAC	DMA Controller
SDHI	SD card host interface H/W module
SPI	Serial Peripheral Interface
CPRM	Content Protection for Recordable Media
GPIO	General-purpose I/O

## 3. Operating Environment

### 3.1 Hardware Environment

The following table shows the hardware needed to use this module.

**Table 3-1 Hardware Environment (RZ/G2L and RZ/V2L)**

Name	Version	Manufacturer
RZG2L Evaluation Board Kit	SMARC module: v01 Carrier board: v03	Renesas Electronics Europe GmbH
RZG2LC Evaluation Board Kit	SMARC module: v01 Carrier board: v03	Renesas Electronics Europe GmbH
RZG2UL Evaluation Board Kit	SMARC module: v01 Carrier board: v03	Renesas Electronics Europe GmbH
RZV2L Evaluation Board Kit	SMARC module: v01 Carrier board: v03	Renesas Electronics Europe GmbH
RZ/Five Evaluation Board Kit	SMARC module: v01 Carrier board: v03	Renesas Electronics Europe GmbH

**Table 3-2 Hardware Environment (RZ/V2N and RZ/G3E)**

Name	Product number
RZ/V2N Evaluation Kit	RTK0EF0186C03000BJ
RZ/G3E SMARC Evaluation Board Kit	RTK9947E57S01000BE

## 3.2 Module Configuration

The following figure shows the configuration of this module.

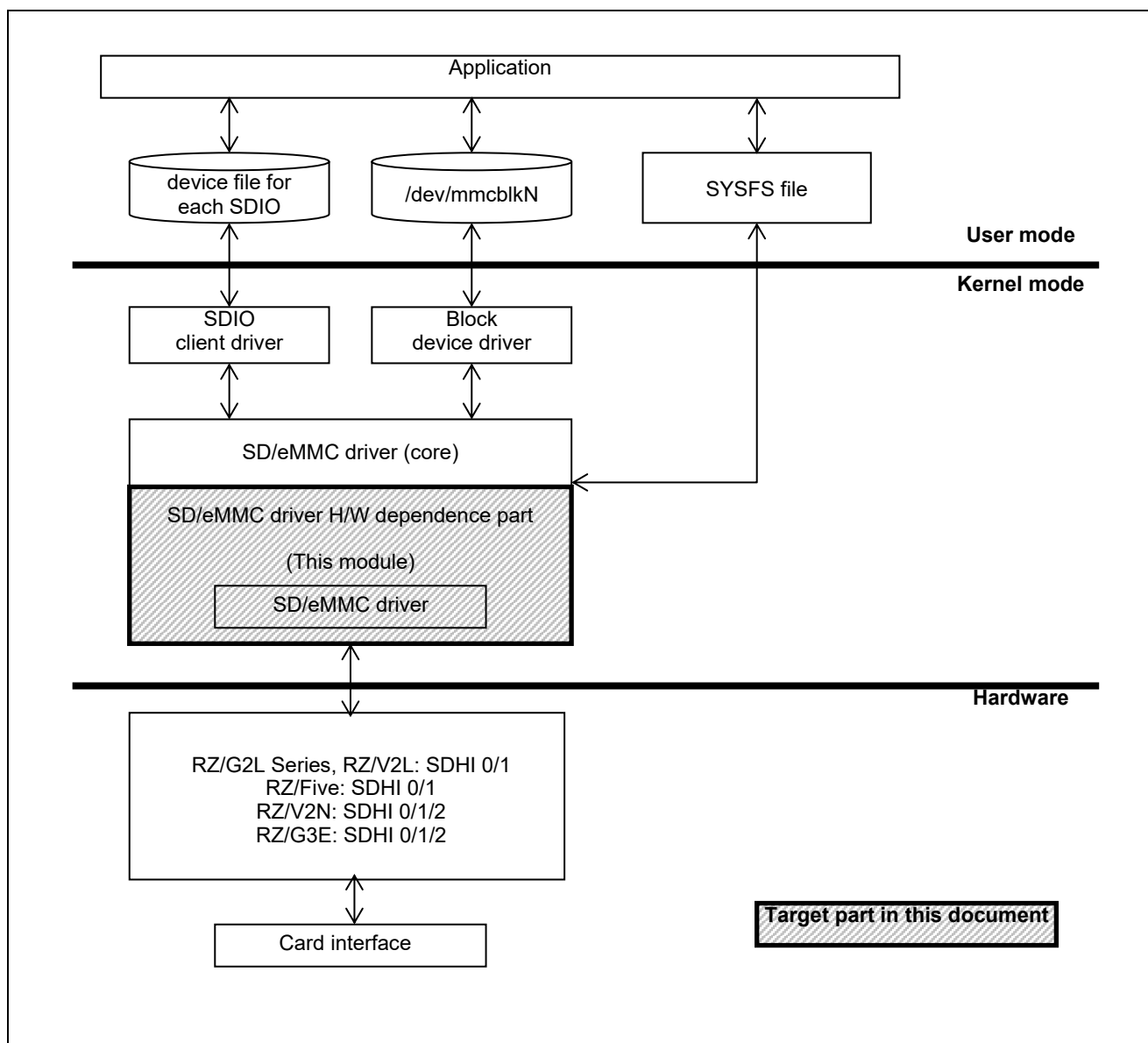


Figure 3-1 Module Configuration

## 3.3 State Transition Diagram

There is no state transition diagram for this module.

## 4. External Interface

Detailed explanation is skipped because the external interface of this module is based on Linux.

Device node of this module is described below.

**Table 4-1 SDHI Device Node**

Channel	Device node	Major number	Minor number
SDHIx	/dev/mmcblkN <sup>4</sup>	179	0~96

In addition, the device node of SDIO might be different according to SDIO card to use.

ex) SDIO UART card to use

/dev/ttySDIO0

---

<sup>4</sup> The numerical value might be different according to the system. (ex, /dev/mmcblk0)

## 4.1 GPIO Customization Interface

This module uses the interface that can be controlled via "Card Power Control", "Card Detection", "Mechanical Write Protect Switch", and "Voltage Switch" by GPIOs. The GPIO interface can be used when you register GPIO to device tree file in the device-dependent part.

RZ/V2N and RZ/G3E do not support Pin Voltage Switching function from Pin control so create a device tree property to check the support of this function. If Pin Voltage Switching function support is unavailable, ignore the pinctrl setting and just change the voltage of Vccq.

The following table shows the GPIO interface and properties of this module.

**Table 4-2 GPIO Customization Interface**

Function	Interface	Property
Card Power Control	mmc_regulator_set_ocr	vmmc-supply
Card Detection	mmc_gpio_get_cd	cd-gpios
Mechanical Write Protect Switch	mmc_gpio_get_ro	wp-gpios
Voltage Switch	regulator_set_voltage	vqmmc-supply

### 4.1.1 Setting of Pins

#### 4.1.1.1 Data and Control Pins

Depend on SoC, data and control pins of SDHI can be multiplexed or dedicated pins

- Figure below is devicetree bindings for multiplexed pins definition:

```
* SW_SDIO_M2E:
*
*   0 - Smarc SDIO signal is connected to uSD1
*   1 - Smarc SDIO signal is connected to M.2 Key E connector

#if (!SW_SDIO_M2E)
    sdhi1_pins: sd1 {
        sd1_mux {
            pinmux = <RZV2H_PORT_PINMUX(1, 4, 8)>; /* QSD1_CD */
        };

        sd1_data {
            pinmux = <RZV2H_PORT_PINMUX(G, 2, 1)>, /* QSD1_DAT0 */
                    <RZV2H_PORT_PINMUX(G, 3, 1)>, /* QSD1_DAT1 */
                    <RZV2H_PORT_PINMUX(G, 4, 1)>, /* QSD1_DAT2 */
                    <RZV2H_PORT_PINMUX(G, 5, 1)>; /* QSD1_DAT3 */
        };
    };
#endif
```



```

        sd1_ctrl {
            pinmux = <RZV2H_PORT_PINMUX(G, 0, 1)>, /* QSD1_CLK */
                <RZV2H_PORT_PINMUX(G, 1, 1)>; /* QSD1_CMD */
        };
    };
#endif

```

**Figure 4–1 RZ/G3E SDHI channel 1 multiplexed pins with SDIO\_M2E**

- Figure below is devicetree bindings for dedicated pins definition:

```

sdhi0_pins: sd0emmc {
    sd0-emmc-ctrl {
        pins = "SD0_CLK", "SD0_CMD";
        renesas,output-impedance = <3>;
    };

    sd0-iovs {
        pins = "QSD0_IOVS";
        renesas,output-impedance = <3>;
    };

    sd0-emmc-data {
        pins = "QSD0_DAT0", "QSD0_DAT1", "QSD0_DAT2", "QSD0_DAT3",
            "QSD0_DAT4", "QSD0_DAT5", "QSD0_DAT6", "QSD0_DAT7";
        renesas,output-impedance = <3>;
    };

    sd0-emmc-rst {
        pins = "SD0_RSTN";
        renesas,output-impedance = <3>;
    };
};

```

**Figure 4–2 RZ/G3E eMMC dedicated pins**

With

"SD0\_RSTN", "SD0\_CLK", "SD0\_CMD", "QSD0\_IOVS", "QSD0\_DAT0", "QSD0\_DAT1", "QSD0\_DAT2",  
"QSD0\_DAT3", "QSD0\_DAT4", "QSD0\_DAT5", "QSD0\_DAT6", "QSD0\_DAT7"

from file: *drivers/pinctrl/renesas/pinctrl-rzg2l.c*

```
static struct rzg2l_dedicated_configs rzg3e_dedicated_pins[] = {
.....

    { "SD0_CLK", RZG2L_SINGLE_PIN_PACK(0x9, 0, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR)) },
    { "SD0_CMD", RZG2L_SINGLE_PIN_PACK(0x9, 1, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },
    { "SD0_RSTN", RZG2L_SINGLE_PIN_PACK(0x9, 2, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR)) },
    { "QSD0_PWEN", RZG2L_SINGLE_PIN_PACK(0x9, 3, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR)) },
    { "QSD0_IOVS", RZG2L_SINGLE_PIN_PACK(0x9, 4, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR)) },
    { "QSD0_DAT0", RZG2L_SINGLE_PIN_PACK(0xa, 0, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },
    { "QSD0_DAT1", RZG2L_SINGLE_PIN_PACK(0xa, 1, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },
    { "QSD0_DAT2", RZG2L_SINGLE_PIN_PACK(0xa, 2, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },
    { "QSD0_DAT3", RZG2L_SINGLE_PIN_PACK(0xa, 3, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },
    { "QSD0_DAT4", RZG2L_SINGLE_PIN_PACK(0xa, 4, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },
    { "QSD0_DAT5", RZG2L_SINGLE_PIN_PACK(0xa, 5, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },
    { "QSD0_DAT6", RZG2L_SINGLE_PIN_PACK(0xa, 6, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },
    { "QSD0_DAT7", RZG2L_SINGLE_PIN_PACK(0xa, 7, (PIN_CFG_IOLH_RZV2H | PIN_CFG_SR |
                                                PIN_CFG_IEN | PIN_CFG_PUPD)) },

};
```

### 4.1.2 Card Power Control

The Card Power Control GPIO is driven by the fixed voltage regulator driver and enables *mmc\_regulator\_set\_ocr* control API. Binding of the driver and GPIO pin must be specified in board-specific device tree.

The following paragraph shows an example of device tree binding of this GPIO pin.

```
/ {
    vmmc_sdhi1: regulator-vcc-sdhi1 {
        compatible = "regulator-fixed";

        regulator-name = "SDHI1 Vmmc";
        regulator-min-microvolt = <3300000>;
        regulator-max-microvolt = <3300000>;
        gpios = <&pinctrl RZG2L_GPIO(39, 2) GPIO_ACTIVE_HIGH>;
        enable-active-high;
    };

    ...

};
&sdhi1 {
    ...
    vmmc-supply = <&vmmc_sdhi1>;
    ...
};
```

Figure 4–3 Configuration Examples for Card Power Control

### 4.1.3 Card Detection

The Card Detection enables *mmc\_gpio\_get\_cd* control API. Binding of the driver and GPIO pin must be specified in board-specific device tree.

The following paragraph shows an example of device tree binding of this GPIO pins

```
sdhi1_pins: sd1 {
    ...

    sd1_mux_uhs {
        pinmux = <RZG2L_PORT_PINMUX(19, 0, 1)>; /* SD1_CD */
    };

    ...
};
```

Figure 4–4 Configuration Examples for Card Detection

#### 4.1.4 Mechanical Write Protect Switch

The Mechanical Write Protect Switch enables *mmc\_gpio\_get\_ro* control API. Biding for this GPIO must be specified in board-specific device tree.

The following paragraph shows an example of device tree binding of this GPIO pin.

```
&sdhi1 {  
    ...  
    ..  
    wp-gpios = <&pinctrl RZG2L_GPIO(0, 3) GPIO_ACTIVE_HIGH>;  
    ...  
    ...  
}
```

**Figure 4–5 Configuration Examples for Write Protection**

Note: Input LOW logic to this GPIO pin will enable Write Protection, and input HIGH logic will disable it (default HIGH). However, this change will not apply to the card already inserted, until it is removed and inserted again.

#### 4.1.5 Voltage Switch

The Voltage Switch GPIO of SDHI is driven by the regulator GPIO driver and enables *regulator\_set\_voltage* control API. Binding of the driver and GPIO pin must be specified in board-specific device tree.

The following paragraph shows an example of device tree binding of this GPIO pin.

```
/ {
    vccq_sdhi1: regulator-vccq-sdhi1 {
        compatible = "regulator-gpio";

        regulator-name = "SDHI1 VccQ";
        regulator-min-microvolt = <1800000>;
        regulator-max-microvolt = <3300000>;

        gpios = < &pinctrl RZG2L_GPIO(39, 1) GPIO_ACTIVE_HIGH>;
        gpios-states = <1>;
        states = <3300000 1 1800000 0>;
    };
    ...
};

...

&sdhi1 {
    pinctrl-0 = <&sdhi1_pins>;
    pinctrl-1 = <&sdhi1_pins_uhs>;
    pinctrl-names = "default", "state_uhs";

    vmmc-supply = <&reg_3p3v>;
    vqmmc-supply = <&vccq_sdhi1>;
    ...
};
```

**Figure 4–6 Configuration Examples for Voltage Switch (SDHI)**

The Voltage Switch GPIO of eMMC is driven by fixed voltage regulator driver. Binding of the driver and GPIO pin must be specified in board-specific device tree.

The following paragraph shows an example of device tree binding of this GPIO pin.

```

/ {
    reg_1p8v: regulator0 {
        compatible = "regulator-fixed";
        regulator-name = "fixed-1.8V";
        regulator-min-microvolt = <1800000>;
        regulator-max-microvolt = <1800000>;
        regulator-boot-on;
        regulator-always-on;
    };

    reg_3p3v: regulator1 {
        compatible = "regulator-fixed";
        regulator-name = "fixed-3.3V";
        regulator-min-microvolt = <3300000>;
        regulator-max-microvolt = <3300000>;
        regulator-boot-on;
        regulator-always-on;
    };
    ...
};

&sdhi0 {
    pinctrl-0 = <&sdhi0_emmc_pins>;
    pinctrl-1 = <&sdhi0_emmc_pins>;
    pinctrl-names = "default", "state_uhs";

    vmmc-supply = <&reg_3p3v>;
    vqmmc-supply = <&reg_1p8v>;
    bus-width = <8>;
    mmc-hs200-1_8v;
    non-removable;
    fixed-emmc-driver-type = <1>;
    status = "okay";
};

```

**Figure 4-7 Configuration Examples for Voltage Switch (eMMC)**

**Notes:** When a 1.8V fixation amplitude SDIO card (and so on) is used, please set *vqmmc-supply* property as 1.8V amplitude for SDHI node in device tree. When this configuration is set, a 3.3V amplitude card will not be able to detect.

## 4.2 Error Codes

This module returns the error that is detected by SDHI in the following error code from H/W dependence part of SD driver to core part of SD driver.

**Table 4-3 Error Codes**

Detection error	Error code	Description
ERR6	-ETIMEDOUT	Response timeout error
ERR3	-EBUSY -EINVAL -ENOMEM	Data timeout (except response timeout) error
ERR2	-EINTR	END error
ERR1	-EILSEQ	CRC error

## 4.3 Transfer Mode Setting (DMA/PIO)

To change transfer mode of PIO and DMA, make the following setting with kernel configuration.

```
Device Drivers --->
  <*> MMC/SD/SDIO card support --->
    --- MMC/SD/SDIO card support
      <*> Renesas SDHI SD/SDIO controller support
        < > DMA for SDHI SD/SDIO controllers using SYS-DMAC
        -* DMA for SDHI SD/SDIO controllers using on-chip bus mastering
        [ ] Renesas SDHI PIO transfer mode setting
```

“Renesas SDHI PIO transfer mode setting” select Yes or No according to the following.

- When switching the transfer mode from DMA to PIO, say Y here.
- When switching the transfer mode from PIO to DMA, say N here.

## 4.4 DIP-Switch and Macro Setting

On the RZ/G2L and RZ/V2L board, eMMC or uSD device can be selected to connect on sdhi0 channel interface depending on **EMMC** macro setting in board devicetree file (*arch/arm64/boot/dts/renesas/rzg2l-smarc-som.dtsi*)

- In eMMC case: define **EMMC** as 1
- In uSD case: define **EMMC** as 0

On the RZ/G2LC board, eMMC or uSD device can be selected to connect on sdhi0 channel interface depending on **SW\_SD0\_DEV\_SEL** macro setting in board devicetree file (*arch/arm64/boot/dts/renesas/r9a07g044c2-smarc.dts*)

- In eMMC case: define **SW\_SD0\_DEV\_SEL** as 1
- In uSD case: define **SW\_SD0\_DEV\_SEL** as 0

On the RZ/G2UL and RZ/Five board, eMMC or uSD device can be selected to connect on sdhi0 channel interface depending on **SW\_SD0\_DEV\_SEL** macro setting in board devicetree file (*arch/arm64/boot/dts/renesas/r9a07g043u11-smarc.dts*)

- In eMMC case: define **SW\_SD0\_DEV\_SEL** as 1
- In uSD case: define **SW\_SD0\_DEV\_SEL** as 0

**Note:** To enable uSD card connected on SDHI0 channel on RZ/G2L series, RZV2L and RZ/Five board SW1[2] should be at position ON

On the RZ/V2N board, eMMC or uSD device can be selected to connect on sdhi0 channel interface depending on `eMMC_SD_SEL` macro setting in board devicetree file (`arch/arm64/boot/dts/renesas/r9a09g056n44-evk.dts`)

- In eMMC case (connect eMMC sub-board to CN15): define `eMMC_SD_SEL` as 1
- In eSD case (connect eMMC sub-board to CN15): define `eMMC_SD_SEL` as 0

On the RZ/G3E board, eMMC or uSD device can be selected to connect on sdhi0 channel interface depending on `SW_SD0_DEV_SEL` macro setting in board devicetree file (`arch/arm64/boot/dts/renesas/r9a09g047e57-smarc.dts`)

- In eMMC case: define `SW_SD0_DEV_SEL` as 0
- In uSD case: define `SW_SD0_DEV_SEL` as 1

**Note:** To enable uSD card connected on SDHI0 channel on RZ/G3E board SW4[1] should be at position ON



## 5. Integration

### 5.1 Directory Configuration

The directory configuration is described below.

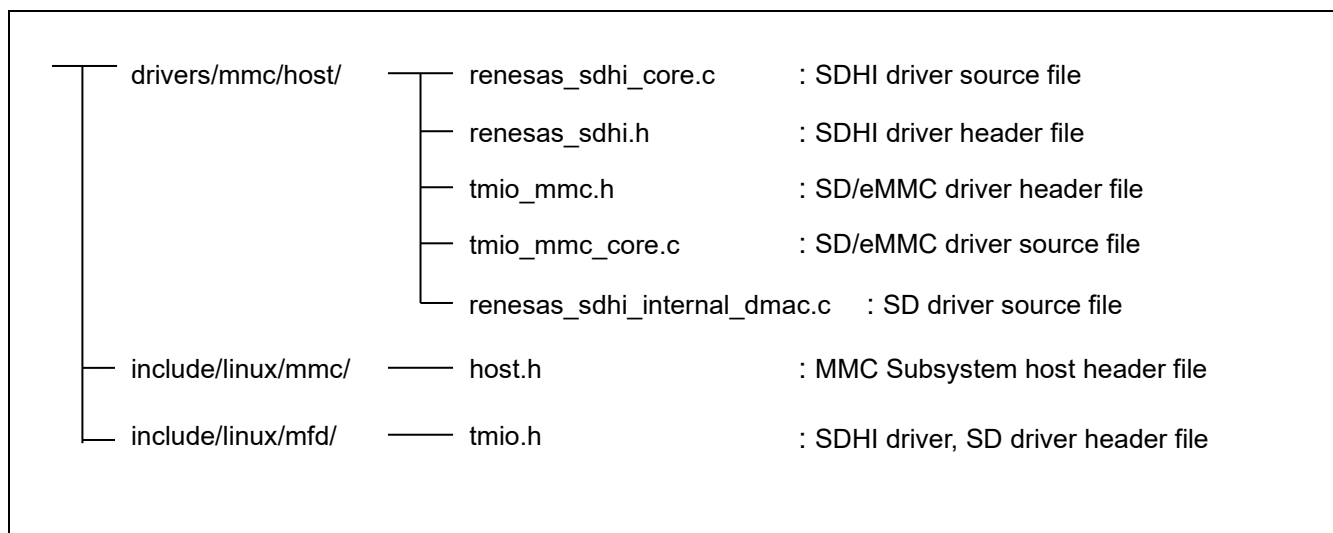


Figure 5-1 Directory Configuration

### 5.2 Integration Procedure

To enable the function of this module, make the following setting with kernel configuration.

```

Device Drivers --->
  <*> MMC/SD/SDIO card support --->
    --- MMC/SD/SDIO card support
      <*> Renesas SDHI SD/SDIO controller support
        < > DMA for SDHI SD/SDIO controllers using SYS-DMAC
        -* DMA for SDHI SD/SDIO controllers using on-chip bus mastering
  
```

### 5.3 Option Setting

#### 5.3.1 Module Parameters

There are no module parameters.

#### 5.3.2 Kernel Parameters

There are no kernel parameters.

REVISION HISTORY	Linux Interface Specification Device Driver SD/MMC User's Manual: Software
------------------	-------------------------------------------------------------------------------

Rev.	Date	Description	
		Page	Summary
0.50	Apr. 30, 2021	—	First Edition issued
1.0	Jul. 15, 2021	—	No modification, keep version to keep consistent with other documents
1.1	Sep. 15, 2021	—	Merge RZ/G2L driver manual with RZ/V2L
1.2	Feb. 15, 2022	—	Add RZ/G2LC, RZ/G2UL device
1.3	Mar. 31, 2022	—	Update information of new VLP.
1.4	May. 31, 2022	—	No modification, keep version to keep consistent with other documents
1.5	Jun. 24, 2022	—	Update information of RZ/Five.
1.6	Sep. 16, 2022	—	Update information
1.7	Dec. 15, 2022	—	Update information
1.8	Mar. 15, 2023	—	No modification, keep version to keep consistent with other documents
1.9	Mar. 31, 2025	2, 7, 9, 10	Update eSD Boot operation, node for Figure 3-1, vmc-supply regulator node, change to use pinmux for CD function.
1.10	May 30, 2025	1, 2, 13	<ul style="list-style-type: none"> <li>- Add MPU information support for both kernel versions v5.10 and v6.1.</li> <li>- Correct typo transfer mode in Table 1-1</li> <li>- Update PIO mode only support for v5.10</li> </ul>
1.11	Jun 30, 2025	—	Add RZ/V2N information
1.12	Jul. 22, 2025	—	Add RZ/G3E information, PIO mode now supports for both v5.10 and v6.1

---

Linux Interface Specification Device Driver SD/MMC  
User's Manual: Software

Publication Date: Rev. 1.12 Jul. 22, 2025

Published by: Renesas Electronics Corporation

---

RZ/G2L Group, RZ/V2L Group, RZ/V2N Group,  
RZ/G3E Group and RZ/Five



Renesas Electronics Corporation