

Linux Interface Specification Device Driver USB3.2 Host

User's Manual: Software

RZ/V2N Group, RZ/V2H Group and RZ/G3E Group

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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. A basic knowledge of electric circuits, logical circuits, and MPUs is necessary in order to use this manual.

The manual comprises an overview of the product; descriptions of the CPU, system control functions, peripheral functions, and electrical characteristics; and usage notes.

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/V2N Group, RZ/V2H Group and RZ/G3E 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/V2N Group User's Manual: Hardware	---
		RZ/G3E Group User's Manual: Hardware	---
		RZ/V2H Group User's Manual: Hardware	---
User's manual for Software	Description of USB Host Linux interface Specification	Linux Interface Specification Device Driver USB3.2 Host	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	Description
BSP	Board Support Package
CPRM	Content Protection for Recordable Media
DMA	Direct Memory Access
DMAC	DMA Controller
EHCI	Enhanced Host Controller Interface
GPL	GNU General Public License
LGPL	GNU Lesser General Public License
MTD	Memory Technology Device
NCQ	Native Command Queuing
OHCI	Open Host Controller Interface
OSS	Open Source Software
USB	Universal Serial Bus
VLP	Verified Linux Package
xHCI	Extensible Host Controller Interface

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1. Overview

1.1 Overview

This manual explains the driver module (this module) that controls the USB 3.2 Host controller on RZ/V2N Group, RZ/V2H Group and RZ/G3E Group.

- Support for super-speed plus (10 Gbps), super-speed (5 Gbps), high-speed (480 Mbps), full-speed (12Mbps), and low-speed (1.5 Mbps) transfer.
- Support for all transfer types: isochronous, interrupt, control, and bulk.
- Support for isochronous and interrupt high-band transfer.
- Compliant with the eXtensible Host Controller Interface(xHCI) Specification for USB.

1.2 Function

This module controls the USB 3.2 Host controller on RZ/V2N, RZ/V2H, RZ/G3E transmits/receives data to/from the USB device.

The function of this module is based on eXtensible Host Controller Interface (xHCI) of standard Linux.

- USB memory device support
- USB keyboard device support
- USB mouse device support

1.3 Connected Port

Connected USB 3.2 ports on the RZ/V2N, RZ/G3E and RZ/V2H boards are described in below tables.

Table 1-1 Connected Port (RZ/V2N)

Port No.	Standard	Connector	Content
0	USB3.2 Host	USB1B-1A_HOST	Type A connector

Note: All the information on the above table is used for RZ/V2N.

Table 1-2 Connected Port (RZ/G3E)

Port No.	Standard	Connector	Content
0	USB3.2 Host	USB2_HOST	Type A connector

Note: All the information on the above table is used for RZ/G3E.

Table 1-3 Connected Port (RZ/V2H)

Port No.	Standard	Connector	Content
0	USB3.2 Host	USB1B-1A_HOST	Type A connector
1	USB3.2 Host	USB1B-1A_HOST	Type A connector

Note: All the information on the above table is used for RZ/V2H.

1.4 Reference

1.4.1 Standard

Table 1-4 Standard (RZ/V2N, RZ/V2H, RZ/G3E)

Reference No.	Issue	Title	Edition	Date
-	USB Implementers Forum, Inc	Universal Serial Bus 3.0 Specification	Rev.1.0	Jun. 6, 2011

1.4.2 Related Documents

There is no document related to this module.

1.5 Restrictions

There is no restriction in this module.

2. Terminology

The following table shows the terminology related to this module.

Table 2-1 Terminology

Terms	Explanation
USB	Universal Serial Bus
HCD	Host Controller Driver
xHCI	eXtensible Host Controller Interface

3. Operating Environment

3.1 Hardware Environment

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

Table 3-1 Hardware Environment

Name	Product number
RZ/V2N Evaluation Board Kit V1.0	RTK0EF0186C03000BJ
RZ/V2N Evaluation Board Kit V2.0	RTK0EF0186C03001BJ
RZ/G3E Evaluation Board Kit	RTK9947E57S01000BE
RZ/V2H Evaluation Board Kit	RTK0EF0168C04000BJ

3.2 Module Configuration

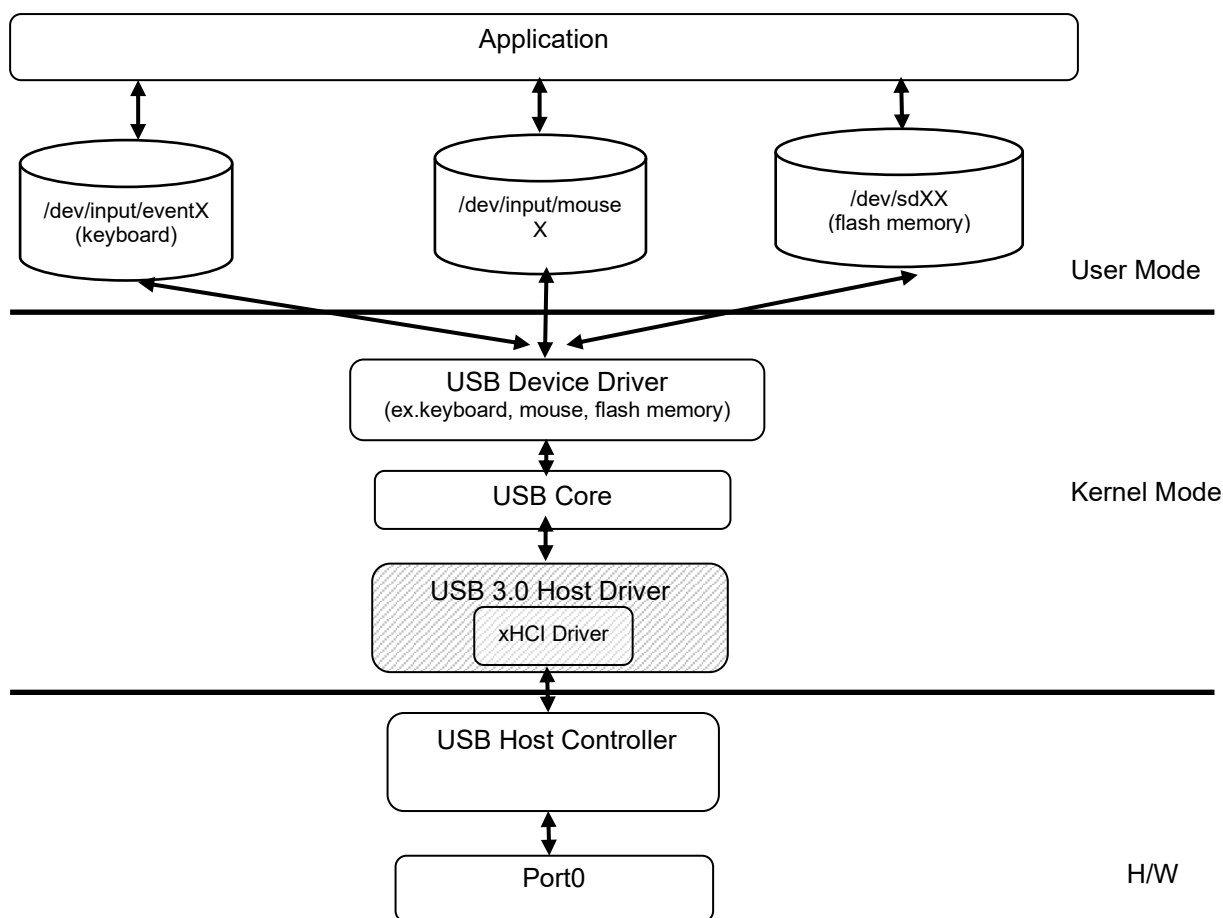


Figure 3-1 Modules Configuration (RZ/V2N, RZ/G3E)

Note: All the information in the above diagram is used for RZ/V2N and RZ/G3E

Board	Port 0
RZ/V2N	USB1B-1A_HOST
RZ/G3E	USB2_HOST

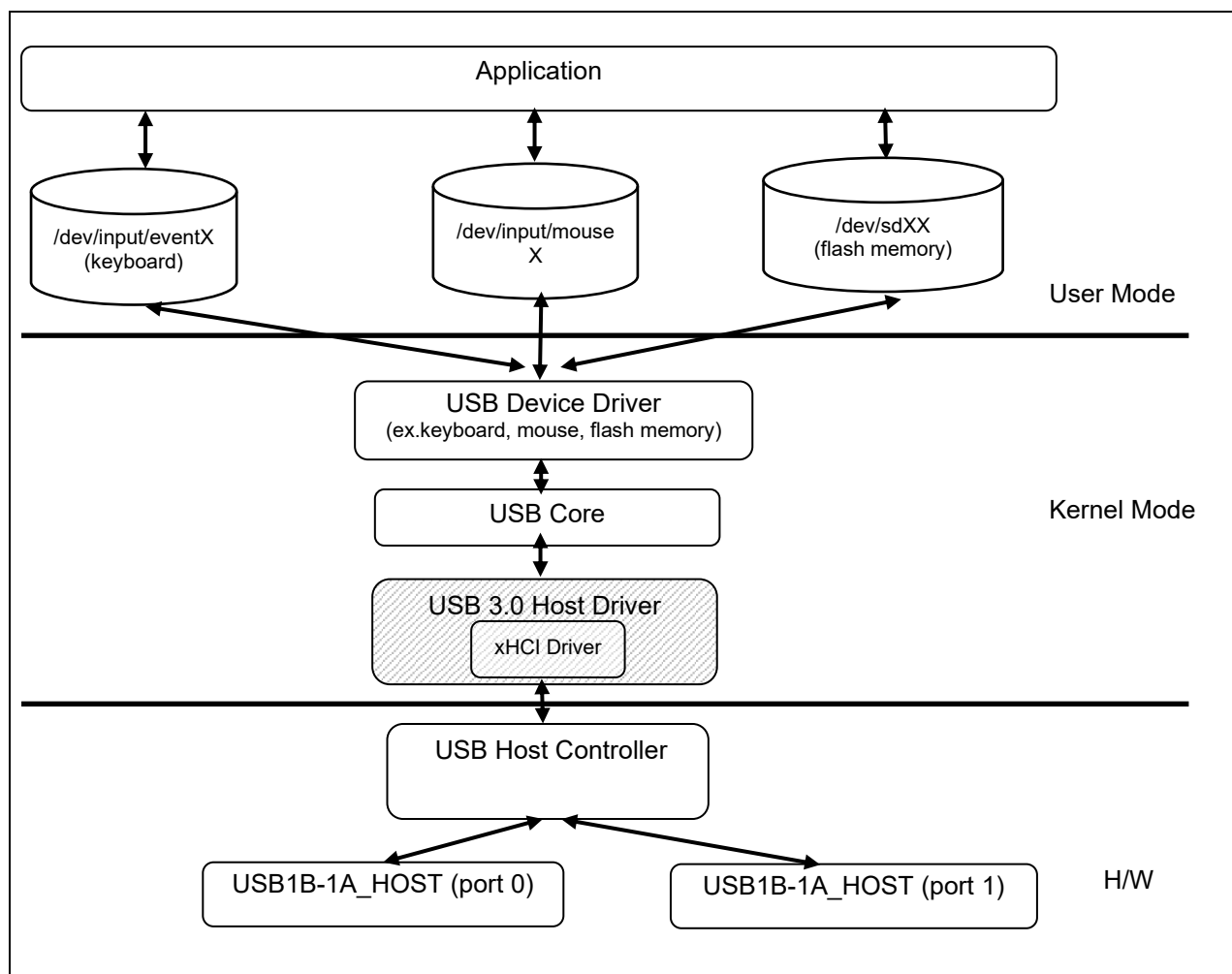


Figure 3-2 Modules Configuration (RZ/V2H)

3.3 State Transition Diagram

The following table shows the state transition of this module.

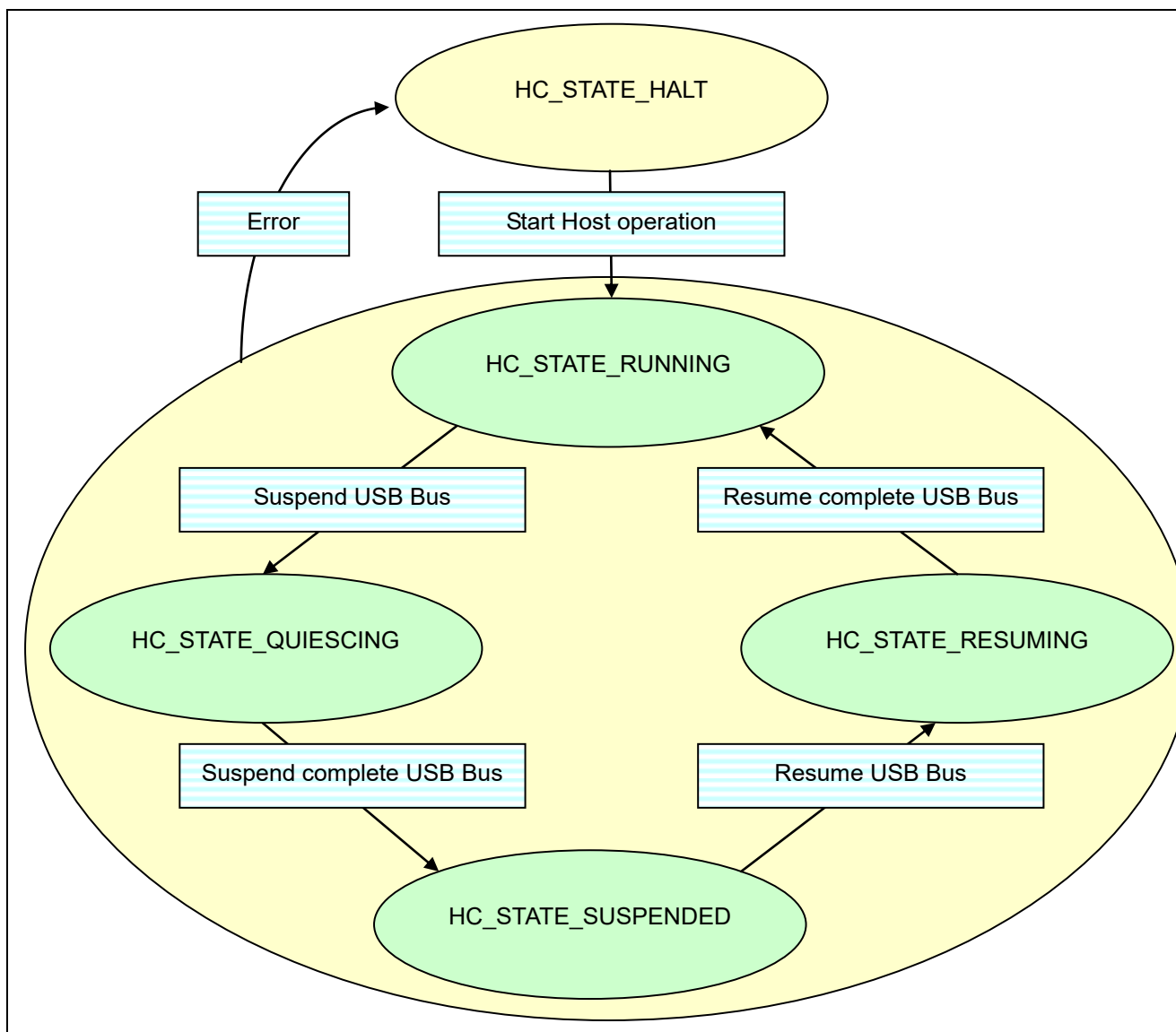


Figure 3-3 State Transition Diagram (RZ/V2N, RZ/G3E, RZ/V2H)

4. External Interface

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

Device node of this module is shown below.

Table 4-1 Device Node (RZ/V2N, RZ/V2H, RZ/G3E)

Device	Channel	Device node	Major number	Minor number
Keyboard	0	/dev/input/eventX *	13	64 - 66
Mouse	0	/dev/input/mouseX1	13	32 - 33
USB memory	0	/dev/sdX1	8	0 - 1

Note: * The numerical value may differ according to the system. (ex, /dev/input/event0).

5. Integration

5.1 Directory Configuration

The directory configuration is shown below.

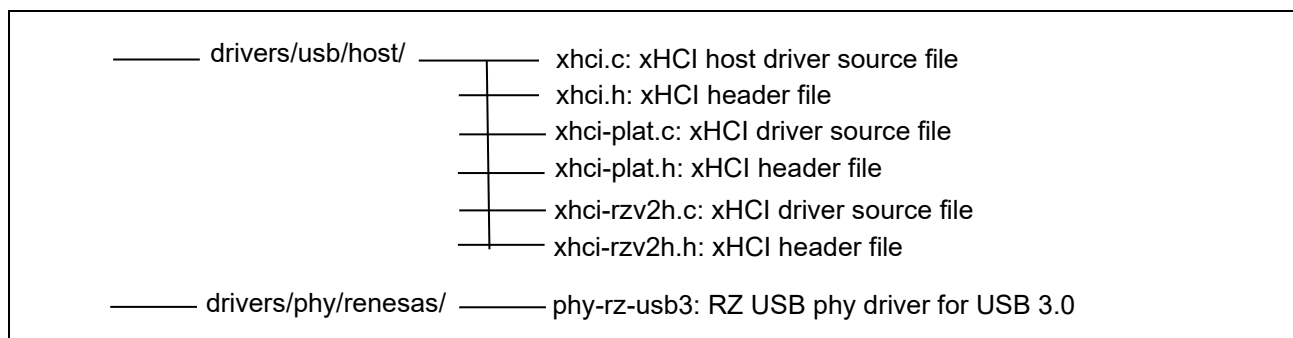


Figure 5-1 Directory Configuration (RZ/V2N, RZ/V2H, RZ/G3E)

5.1.1 Device tree definition

Below figure lists the necessary properties to support USB 3.2 host in RZ/V2N Evaluation Board Kit.

```

usb3_phy0: usb-phy@15870000 {
    compatible = "renesas,usb3-phy-r9a09g056",
                "renesas,rz-usb3-phy";
    reg = <0 0x15870000 0 0x10000>;
    clocks = <&cpg CPG_MOD 0xb0>,
            <&cpg CPG_CORE R9A09G056_USB3_0_REF_ALT_CLK_P>,
            <&cpg CPG_CORE R9A09G056_USB3_0_CLK_CORE>;
    power-domains = <&cpg>;
    resets = <&cpg 0xaa>;
    #phy-cells = <0>;
    status = "disabled";
};
xhci0: usb@15850000 {
    compatible = "renesas,rzv2n-xhci";
    reg = <0 0x15850000 0 0x10000>;
    interrupts = <GIC_SPI 759 IRQ_TYPE_LEVEL_HIGH>;
    clocks = <&cpg CPG_MOD 0xaf>,
    clock-names = "reg";
    power-domains = <&cpg>;
    resets = <&cpg 0xaa>;
    phys = <&usb3_phy0>;
    phy-names = "usb0";
    status = "disabled";
}
  
```

Figure 5-2: Enable USB3.2 host device nodes (r9a09g056.dtsi)

Note: All the information in above device tree is used for RZ/V2N.

Below figure lists the necessary properties to support USB 3.2 host in RZ/G3E Evaluation Board Kit.

```
usb3_phy: usb-phy@15870000 {
    compatible = "renesas,usb3-phy-r9a09g047",
                "renesas,rz-usb3-phy";
    reg = <0 0x15870000 0 0x10000>;
    clocks = <&cpg CPG_MOD 0xb0>;
    power-domains = <&cpg>;
    resets = <&cpg 0xaa>;
    #phy-cells = <0>;
    status = "disabled";
};
xhci: usb@15850000 {
    compatible = "renesas,rzg3e-xhci";
    reg = <0 0x15850000 0 0x10000>;
    interrupts = <GIC_SPI 759 IRQ_TYPE_LEVEL_HIGH>;
    clocks = <&cpg CPG_MOD 0xaf>;
    clock-names = "reg";
    power-domains = <&cpg>;
    resets = <&cpg 0xaa>;
    phys = <&usb3_phy>;
    phy-names = "usb";
    status = "disabled";
};
```

Figure 5-3: Enable USB3.2 host device nodes (r9a09g047.dtsi)

Note: All the information in above device tree is used for RZ/G3E.

Below figure lists the necessary properties to support USB 3.2 host in RZ/V2H Evaluation Board Kit.

```
usb3_phy0: usb-phy@15870000 {
    compatible = "renesas,usb3-phy-r9a09g057",
                "renesas,rz-usb3-phy";
    reg = <0 0x15870000 0 0x10000>;
    clocks = <&cpg CPG_MOD 0xb0>;
    power-domains = <&cpg>;
    resets = <&cpg 0xaa>;
    #phy-cells = <0>;
    status = "disabled";
};
usb3_phy1: usb-phy@15880000 {
    compatible = "renesas,usb3-phy-r9a09g057",
                "renesas,rz-usb3-phy";
    reg = <0 0x15880000 0 0x10000>;
    clocks = <&cpg CPG_MOD 0xb2>;
    power-domains = <&cpg>;
    resets = <&cpg 0xab>;
    #phy-cells = <0>;
    status = "disabled";
};
```



```

xhci0: usb@15850000 {
    compatible = "renesas,rzv2h-xhci";
    reg = <0 0x15850000 0 0x10000>;
    interrupts = <GIC_SPI 759 IRQ_TYPE_LEVEL_HIGH>;
    clocks = <&cpg CPG_MOD 0xaf>;
    clock-names = "reg";
    power-domains = <&cpg>;
    resets = <&cpg 0xaa>;
    phys = <&usb3_phy0>;
    phy-names = "usb0";
    status = "disabled";
};

xhci1: usb@15860000 {
    compatible = "renesas,rzv2h-xhci";
    reg = <0 0x15860000 0 0x10000>;
    interrupts = <GIC_SPI 764 IRQ_TYPE_LEVEL_HIGH>;
    clocks = <&cpg CPG_MOD 0xb1>;
    clock-names = "reg";
    power-domains = <&cpg>;
    resets = <&cpg 0xab>;
    phys = <&usb3_phy1>;
    phy-names = "usb1";
    status = "disabled";
};

```

Figure 5-4: Enable USB3.2 host device nodes (r9a09g057.dtsi)

Note: All the information in above device tree is used for RZ/V2H.

Below figure enables the necessary properties to support USB 3.2 host in RZ/V2N Evaluation Board Kit.

```

&xhci0 {
    pinctrl-0 = <&usb30_pins>;
    pinctrl-names = "default";

    memory-region = <&global_cma>;
    status = "okay";
};
&usb3_phy {
    status = "okay";
};

```

Figure 5-5: Enable USB 3.2 Host (r9a09g056n48-rzv2n-evk.dts)

Below figure enables the necessary properties to support USB 3.2 host in RZ/G3E Evaluation Board Kit.

```
&xhci {
    pinctrl-0 = <&usb3_pins>;
    pinctrl-names = "default";

    memory-region = <&global_cma>;
    status = "okay";
};

&usb3_phy {
    status = "okay";
};
```

Figure 5-6: Enable USB 3.2 Host (rzg3e-smarc.dtsi)

Below figure enables the necessary properties to support USB 3.2 host in RZ/V2H Evaluation Board Kit.

```
&usb3_phy0 {
    status = "okay";
};

&usb3_phy1 {
    status = "okay";
};

&xhci0 {
    pinctrl-0 = <&usb30_pins>;
    pinctrl-names = "default";

    memory-region = <&global_cma>;
    status = "okay";
};

&xhci1 {
    pinctrl-0 = <&usb31_pins>;
    pinctrl-names = "default";

    memory-region = <&global_cma>;
    status = "okay";
};
```

Figure 5-7: Enable USB 3.2 Host (rzv2h-evk-common.dtsi)

5.2 Integration Procedure

5.2.1 Kernel Configuration

To enable the functions of this module, make the following setting with Kernel Configuration.

```
Device Drivers --->
  [*] USB support ---->
    <*> Support for Host-side USB
    ...
    *** USB Host Controller Drivers ***
    <*> xHCI HCD (USB 3.0) support
    <*> Generic xHCI driver for a platform device
    -* xHCI support for Renesas RZ/V2H SoC
    ...
Device Drivers --->
  [*] PHY Subsystem ---->
    <*> Renesas R-Car generation 3 USB 3.0 PHY driver
    < > Renesas RZ USB 3.0 PHY driver
```

Figure 5-8: Kernel configuration for this module (RZ/V2N, RZ/V2H, RZ/G3E)

The following shows an example of integration of standard USB class drivers.

```
Device Drivers --->
  [*] SCSI device support ---->
    -* SCSI device support
    ...
    [ ] legacy /proc/scsi/ support
    *** SCSI support type (disk, tape, CD-ROM) ***
    <*> SCSI disk support

Device Drivers --->
  [*] USB support ---->
    *** NOTE: USB_STORAGE depends on SCSI but BLK_DEV_SD may ***
    *** also be needed; see USB_STORAGE Help for more info ***
    <*> USB Mass Storage support

Device Drivers --->
  Input device support ---->
    <*> Event interface

Device Drivers --->
  HID support ---->
    <*> Generic HID driver
    USB HID support ---->
      <*> USB HID transport layer
```

Figure 5-9: Kernel configuration for standard USB class drivers (RZ/V2N, RZ/V2H, RZ/G3E)

5.2.2 USB Attached SCSI (UAS)

UAS is a protocol used to move data to and from USB storage devices such as HDDs, SSDs and thumb drives. It uses the standard SCSI command set to provide faster transfers compared to the older USB Mass Storage Bulk-Only Transport (BOT) drivers.

Currently, in Renesas RZ Linux, it is supported as a kernel module named `uas`.

If your USB storage device supports SCSI protocol, please insert this kernel module to detect and increase higher performance.

Below is example command to insert this kernel module in runtime:

```
$ modprobe uas.ko
```

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 USB3.2 Host User's Manual: Software
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Rev.	Date	Description	
		Page	Summary
1.00	Jun. 30, 2025	—	First Edition issued
1.01	Jul. 22, 2025	1-3	Add RZ/G3E overview, name board, product number and connected port.
		5	Update Modules Configuration for RZ/G3E
		6-7, 11	Update information about RZ/G3E
		9 – 10	Update Figure 5-2: Add usb3_phy0 device node Add figure 5-3: Add USB3.2 host device nodes. Add figure 5-5: Enable USB 3.2 Host for RZ/G3E.
1.02	Dec. 19, 2025	-	Update information about RZ/V2H
		14	Add chapter “5.2.2 USB Attached SCSI (UAS)” to describe new protocol support.
1.03	Mar. 27, 2025	4	Add product number for RZ/V2N Version 2.
		9	Update information for Devicetree of RZ/V2N.

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