User's Manual

CONFIDENTIAL

Linux Interface Specification Device Driver USB 2.0 Host

User's Manual: Software

R-Car H3/M3/M3N/E3/D3 Series

Renesas Electronics
www.renesas.com

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How to Use This Manual

- **[Readers]**
  This manual is intended for engineers who develop products which use the R-Car H3/M3/M3N/E3/D3 processor.

- **[Purpose]**
  This manual is intended to give users an understanding of the functions of the R-Car H3/M3/M3N/E3/D3 processor device driver and to serve as a reference for developing hardware and software for systems that use this driver.

- **[How to Read This Manual]**
  It is assumed that the readers of this manual have general knowledge in the fields of electrical
  — Engineering, logic circuits, microcontrollers, and Linux.
  → Read this manual in the order of the CONTENTS.
  — To understand the functions of a multimedia processor for R-Car H3/M3/M3N/E3/D3
  → See the R-Car H3/M3/M3N/E3/D3 User's Manual.
  — To know the electrical specifications of the multimedia processor for R-Car H3/M3/M3N/E3/D3
  → See the R-Car H3/M3/M3N/E3/D3 Data Sheet.

- **[Conventions]**
  The following symbols are used in this manual.
  Data significance: Higher digits on the left and lower digits on the right
  Note: Footnote for item marked with Note in the text
  Caution: Information requiring particular attention
  Remark: Supplementary information
  Numeric representation: Binary ... ××××, 0b××××, or ××××B
  Decimal ... ××××
  Hexadecimal ... 0x×××× or ××××H
  Data type: Double word … 64 bits
  Word … 32 bits
  Half word ... 16 bits
  Byte ... 8 bits

Table of Contents

1. Overview

1.1 Overview

This manual explains the driver module (this module) that controls the USB 2.0 Host controller on R-Car H3/M3/M3N/E3/D3.

1.2 Function

This module controls the USB 2.0 Host controller on R-Car H3/M3/M3N/E3/D3, transmits/receives data to/from the USB device.

The function of this module is based on OHCI, EHCI of standard Linux.

Port 0 and 3 (R-CarH3-SiP System Evaluation Board Salvator-XS only) are used as an OTG device in combination with the USB 2.0 Function controller. This module supports only role swap not using Host Negotiation Protocol (HNP). No support for Session Request Protocol (SRP).

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

1.3 Connected Port

This module supports multiple USB ports on R-Car H3-SiP/M3-SiP System Evaluation Board while it only supports one USB port on R-Car E3/D3 System Evaluation Board.

Table 1-1 Connected Port (R-Car H3)

Port No.	Standard	Connector No.	Content
0	USB2.0 Host/Function	CN9	Type micro AB connector
1	USB2.0 Host	CN10 Lower Part	Type A connector
2	USB2.0 Host	CN10 Upper Part	Type A connector
3	USB2.0 Host/Function	CN37	Type micro AB connector (R-CarH3-SiP System Evaluation Board Salvator-XS only)

Note: In R-CarH3-SiP System Evaluation Board Salvator-X and Salvator-XS, please set up SW15 (Pin 3 side). According to the specification of the System Evaluation Board, the power supply is up to 200 mA. If the required power is above 200 mA, please set it to Pin 1 side.
In R-CarH3-SiP System Evaluation Board Salvator-XS, please set up SW31 (Pin 1, 2 OFF / Pin 3, 4, 5, 6 ON).

Table 1-2 Connected Port (R-Car M3/M3N)

Port No.	Standard	Connector No.	Content
0	USB2.0 Host/Function	CN9	Type micro AB connector
1	USB2.0 Host	CN10 Lower Part	Type A connector

Note: In R-CarM3-SiP/M3N-SiP System Evaluation Board Salvator-X and Salvator-XS, please set up SW15 (Pin 3 side). According to the specification of the System Evaluation Board, the power supply is up to 200 mA. If the required power is above 200 mA, please set it to Pin 1 side.

Table 1-3 Connected Port (R-Car E3)

Port No.	Standard	Connector No.	Content
0	USB2.0 Host/Function	CN9	Type micro AB connector

Note: In R-CarE3 System Evaluation Board, please set up SW15 (Pin 3 side). According to the specification of the System Evaluation Board, the power supply is up to 200 mA. If the required power is above 200 mA, please set it to Pin 1 side.

Table 1-4 Connected Port (R-Car D3)

Port No.	Standard	Connector No.	Content
0	USB2.0 Host/Function	CN9	Type A connector

1.4 Reference

1.4.1 Standard

The following table shows the document related to this module.

Table 1-5 Standard (R-Car H3/M3/M3N/E3/D3)

Reference No.	Issue	Title	Edition	Date
-	USB Implementers Forum, Inc	Universal Serial Bus Specification	Rev.2.0	Apr. 27, 2000

1.4.2 Related Documents

The following table shows the document related to this module.

Table 1-6 Related Documents (R-Car H3/M3/M3N/E3/D3)

Reference No.	Issue	Title	Edition	Date
-	Renesas Electronics	R-Car Series, 3rd Generation User's Manual: Hardware	Rev.2.20	Jun. 30, 2020
-	Renesas Electronics	R-CarH3-SiP/M3-SiP/M3N-SiP System Evaluation Board Salvator-XS Hardware Manual	Rev.2.04	Jul. 17, 2018
-	Renesas Electronics	R-CarH3-Sip System Evaluation Board Salvator-X Hardware Manual RTP0RC7795SIPB0011S	Rev.1.09	May. 11, 2017
-	Renesas Electronics	R-CarM3-SiP System Evaluation Board Salvator-X Hardware Manual RTP0RC7796SIPB0011S	Rev.0.04	Oct. 3, 2016
-	Renesas Electronics	R-CarE3 System Evaluation Board Ebisu Hardware Manual RTP0RC77990SEB0010S	Rev.0.03	Apr. 11, 2018
-	Renesas Electronics	R-CarE3 System Evaluation Board Ebisu-4D (E3 board 4xDRAM) Hardware Manual	Rev.1.01	Jul. 19, 2018
-	Renesas Electronics	R-CarD3 System Evaluation Board Hardware Manual RTP0RC77995SEB0010S	Rev.1.20	Jul. 25, 2017

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
OHCI	Open Host Controller Interface
EHCI	Enhanced Host Controller Interface
OTG	On-The-GO
ADP	Attach Detection Protocol
HNP	Host Negotiation Protocol
SRP	Session Request Protocol

3. Operating Environment

3.1 Hardware Environment

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

Table 3-1 Hardware specification (R-Car H3/M3/M3N/E3/D3)

Name	Version	Manufacture
R-CarH3-SiP System Evaluation Board Salvator-X	-	Renesas Electronics
R-CarM3-SiP System Evaluation Board Salvator-X	-	Renesas Electronics
R-CarH3-SiP/M3-SiP/M3N-SiP System Evaluation Board Salvator-XS	-	Renesas Electronics
R-CarE3 System Evaluation Board Ebisu	-	Renesas Electronics
R-CarE3 System Evaluation Board Ebisu-4D	-	Renesas Electronics
R-CarD3 System Evaluation Board Draak	-	Renesas Electronics

3.2 Module Configuration

The following figure shows the configuration of this module.

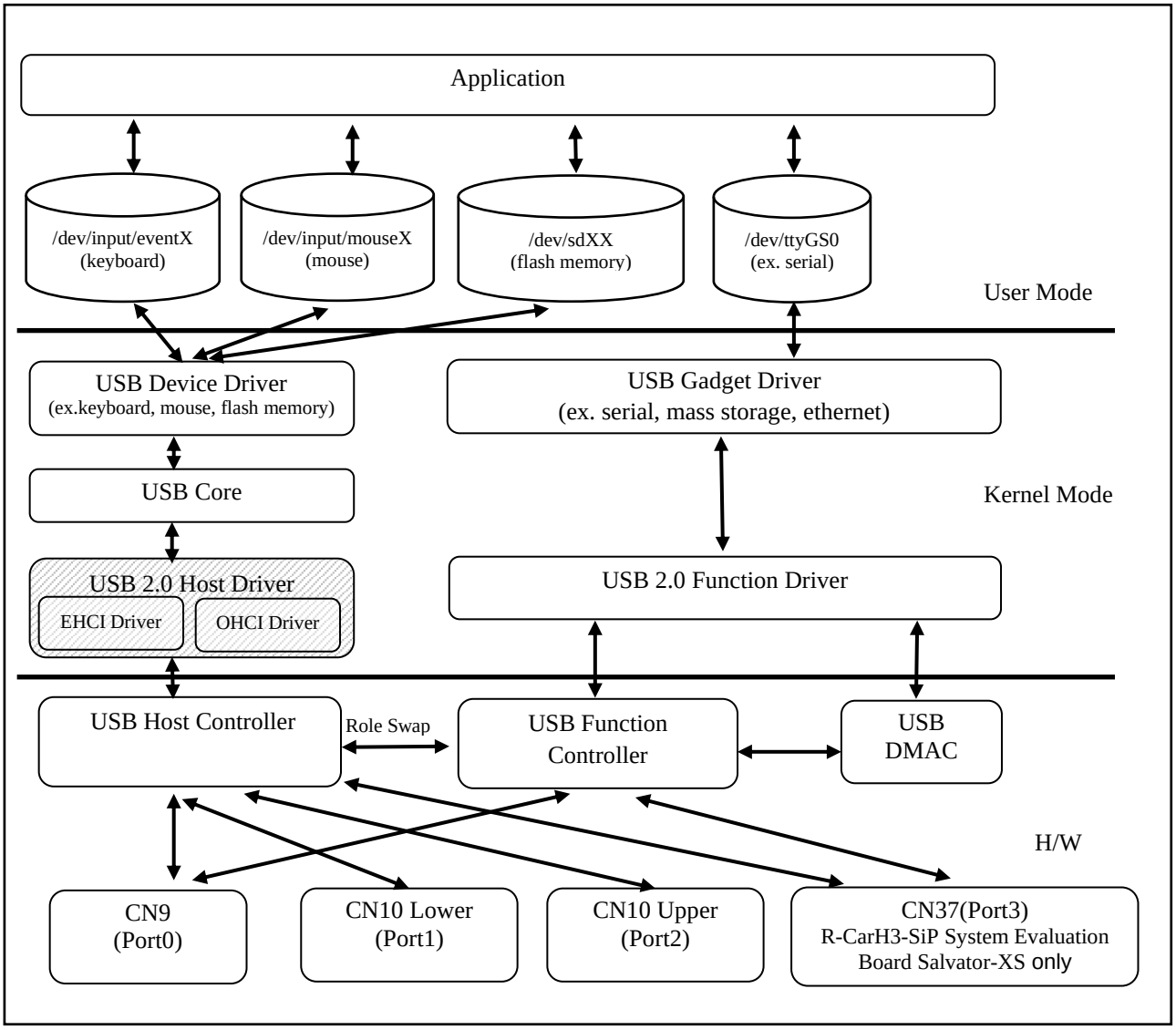

Figure 3-1 Modules Configuration (R-Car H3)

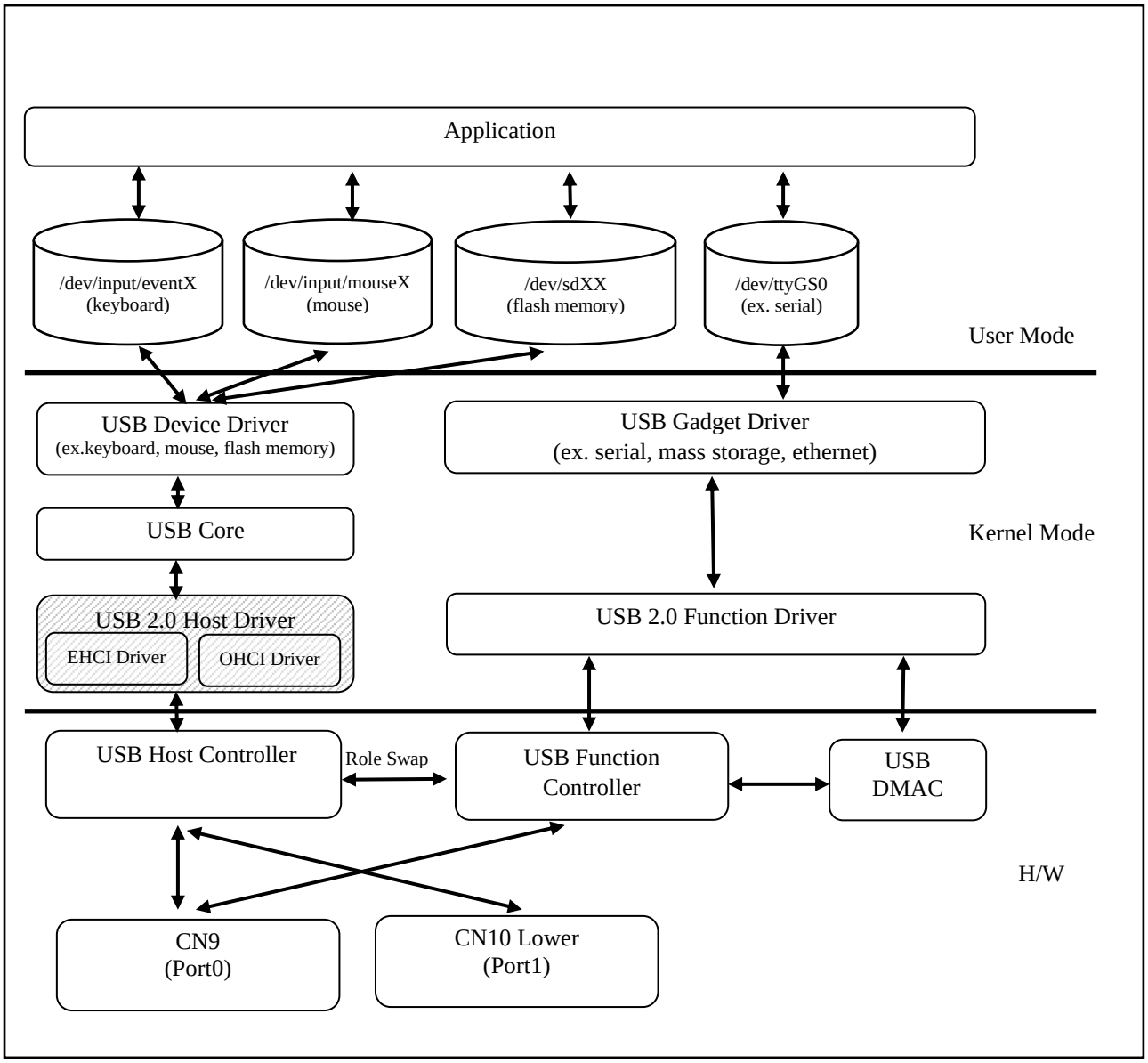

Figure 3-2 Modules Configuration (R-Car M3/M3N)

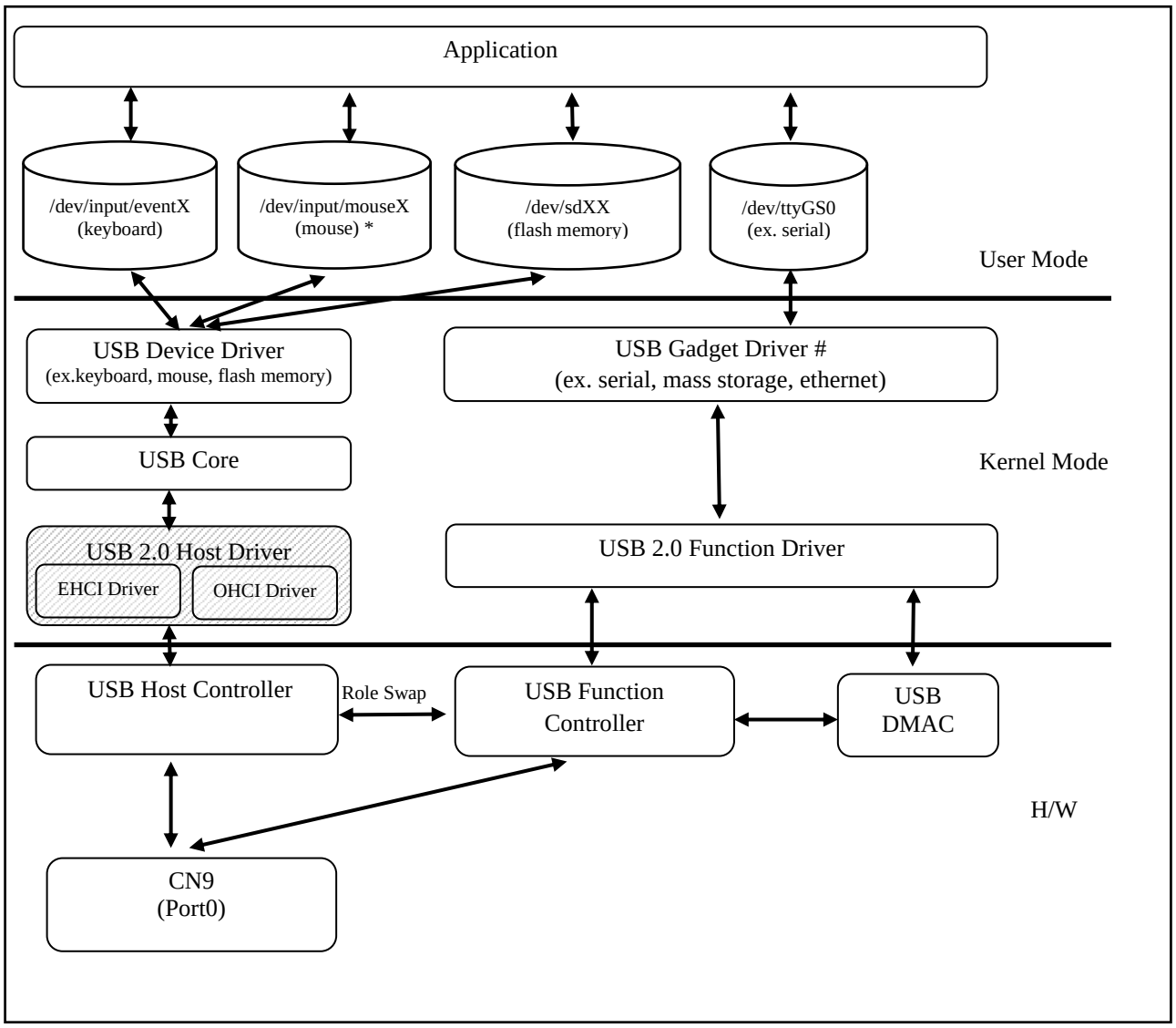

Figure 3-3 Modules Configuration (R-Car E3/D3)

3.3 State Transition Diagram

The following table shows the state transition of this module.

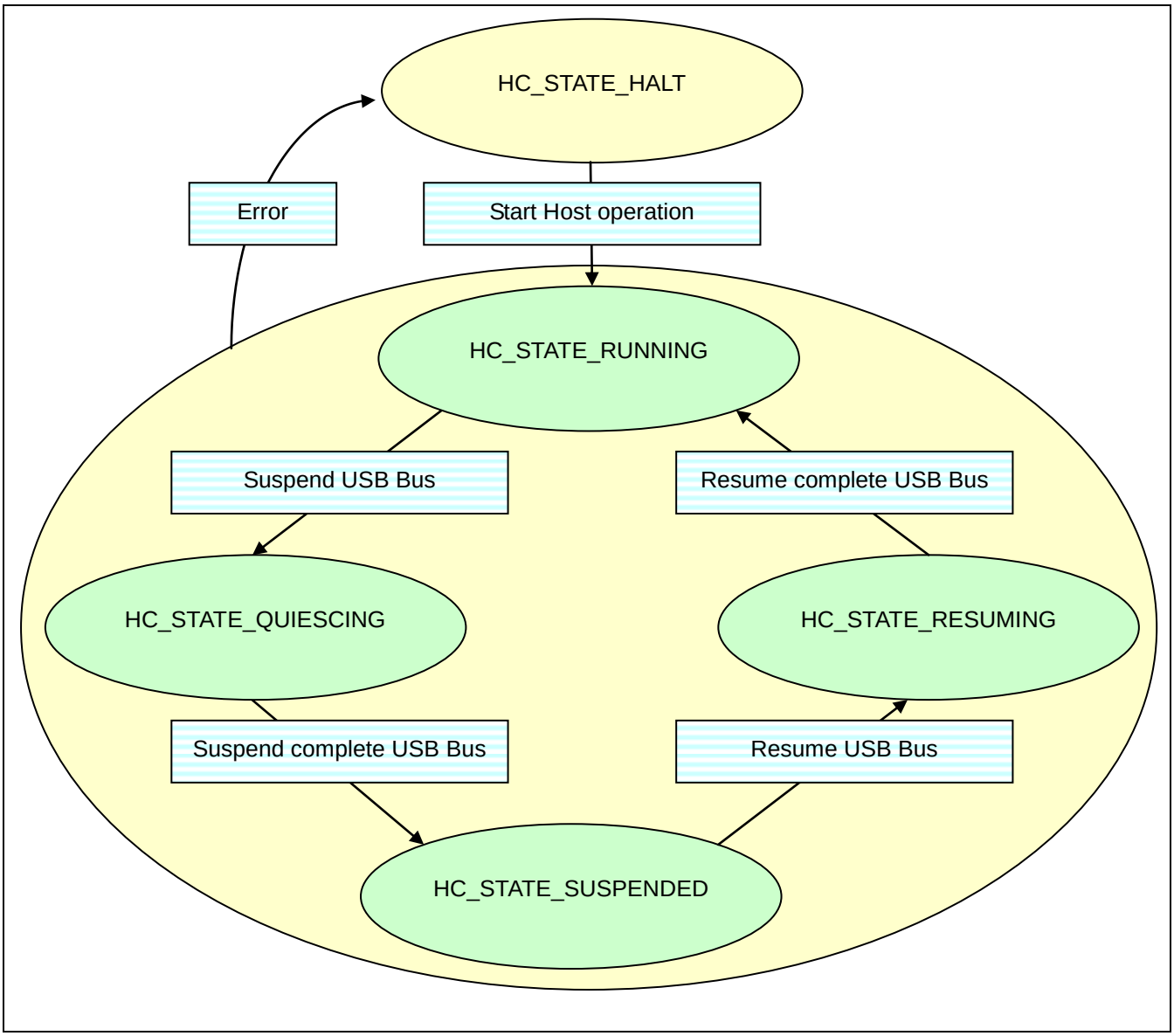

Figure 3-4 State Transition Diagram (R-Car H3/M3/M3N/E3/D3)

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 (R-Car H3)

Device	Channel	Device node	Major number	Minor number
Keybord	0 – 3	/dev/input/eventX*	13	64 – 67
Mouse	0 – 3	/dev/input/mouseX1	13	32 – 35
USB memory	0 – 3	/dev/sdX1	8	0 – 47

Note: * The numerical value may differ according to the system. (ex, /dev/input/event0)
A channel 3 is R-CarH3-SiP System Evaluation Board Salvator-XS.

Table 4-2 Device Node (R-Car M3/M3N)

Device	Channel	Device node	Major number	Minor number
Keybord	0 – 1	/dev/input/eventX*	13	64 - 65
Mouse	0 – 1	/dev/input/mouseX1	13	32 - 33
USB memory	0 – 1	/dev/sdX1	8	0 - 47

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

Table 4-3 Device Node (R-Car E3/D3)

Device	Channel	Device node	Major number	Minor number
Keyboard	0	/dev/input/eventX*	13	64 $
Mouse	0	/dev/input/eventX1#	13	64 $
USB memory	0	/dev/sdX1	8	0 - 47

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

In Linux Kernel v4.14, “Mouse interface” support is not enabled by default and hence /dev/input/mouseX1 device node will not be populated by default. Rather the mouse is detected as /dev/input/eventX device node similar to keyboard.

$ The Minor number will be incremented starting from 64 if more than one input device is connected at a time.

5. Integration

5.1 Directory Configuration

The directory configuration is shown below.

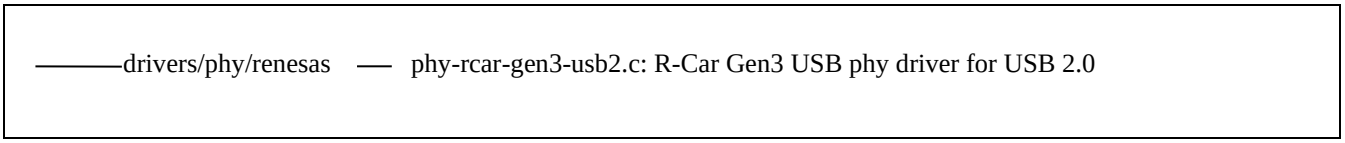

Figure 5-1 Directory Configuration (R-Car H3/M3/M3N/E3/D3)

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 ***
                <*>  EHCI HCD (USB 2.0) support
                [*]      Root Hub Transaction Translators
                ...
                <*>  Generic EHCI driver for a platform device
                ...
                <*>  OHCI HCD (USB 1.1) support
                ...
                <*>  Generic OHCI driver for a platform device
                ...
Device Drivers  --->
                PHY Subsystem ----->
                <*>  Renesas R-Car generation 3 USB 2.0 PHY driver
```

Figure 5-2 Kernel configuration for this module (R-Car H3/M3/M3N/E3/D3)

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 5-3 Kernel configuration for standard USB class drivers (R-Car H3/M3/M3N/E3/D3)

5.2.2 Integration of a USB gadget driver

The example of integration of a USB gadget driver is shown below.

Please perform the following setup, when you integrate Mass Storage Gadget.

Please enable (input "Y") the following item in "USB Gadget Support".

```
Device Drivers    --->
    [*]   USB support ----->
        <*> USB Gadget support ----->
            <M>    USB Gadget precomposed configurations
            <M>    Mass Storage
```

Figure 5-4 Kernel configuration for USB Mass Storage Gadget driver

5.3 Option Setting

5.3.1 Module Parameters

There are no module parameters.

5.3.2 Kernel Parameters

There are no kernel parameters.

6. USB 2.0 OTG Interface

This module supports USB 2.0 OTG. This module supports only role swap not using Host Negotiation Protocol (HNP). No support for Session Request Protocol (SRP). In R-CarH3-SiP/M3-SiP/E3-SiP System Evaluation Board, please set up SW15 (Pin 3 side). According to the specification of the System Evaluation Board, the power supply is up to 200 mA. If the required power is above 200 mA, please set SW15 to Pin 1 side. In R-CarH3-SiP System Evaluation Board Salvator-XS, please set up SW31 (Pin 1, 2 OFF / Pin 3, 4, 5, 6 ON).

6.1 Role Swap usage

System Evaluation Board 2 units were Board(A) and Board(B), and initially to act as a Host to Board(A),
then how to switch to Function is as follows.

1.Board (A) (B), both to enable functionality of the USB Host and USB Function (for example, USB Mass Storage Gadget).

An attention is needed to use USB gadget driver. Insmod loads USB gadget driver to USB2.0 CN9 port first.

If USB2.0 CN37 port is used, a dummy gadget driver load is needed for USB2.0 CN9 port.

An example of setting USB Mass Storage Gadget driver to USB2.0 CN37 is as follows.

```
insmod g_xxx.ko --- (USB2.0 CN9 is associated 1st gadget)
insmod g_mass_storage.ko--- (USB2.0 CN37 is associated 2nd gadget)
```

2. Connect as follows.

Board(A) – Micro-A plug – usb cable – Micro -B plug – Board(B)

or

Board(A) – Micro- B plug – OTG cable(Micro-B - A) – Micro-B cable(A - Micro B) – Micro - B plug – Board(B)

3. In Board (A) and run the following command.

In the case of port0:

```
echo peripheral > /sys/devices/platform/soc/ee080200.usb-phy/role
```

In the case of port3:

```
echo peripheral > /sys/devices/platform/soc/ee0e0200.usb-phy/role
```

4. In Board (B) and run the following command.

In the case of port0:

```
echo host > /sys/devices/platform/soc/ee080200.usb-phy/role
```

In the case of port3:

```
echo host > /sys/devices/platform/soc/ee0e0200.usb-phy/role
```

5.Board (A) is Function, Board (B) will be switched to the Host.

Please note that Board(A) must input the following command if you want the board to act as a Host again. (even if you disconnect the usb cable, since id state may be the same, the Board(A) keeps to act as Function.)

In the case of port0:

```
echo host > /sys/devices/platform/soc/ee080200.usb-phy/role
```

In the case of port3:

```
echo host > /sys/devices/platform/soc/ee0e0200.usb-phy/role
```

REVISION HISTORY	Linux Interface Specification Device Driver USB 2.0 Host User's Manual: Software

Rev.	Date	Description	
		Page	Summary
0.1	Sep. 25, 2015	—	New creation.
0.2	Mar. 18, 2016	1, 2,11	1.2 Function 1.5 Restrictions 6 USB 2.0 OTG Interface Add description of OTG.
0.3	Apr. 15, 2016	All	Add R-Car M3 support.
		2	Update related documents.
0.4	Aug. 5, 2016	2	Update related documents.
		1, 4, 5, 12	Add OTG supports only HNP.
		10	Add IPMMU setting.
0.5	Dec. 16, 2016	1	1.3 Connected Port Add the power supply of the System Evaluation Board.
		11	5.2.2 IPMMU Setting Rename r8a7795 to r8a7795-es1.
0.5	Dec. 16, 2016	13	6.1 Role Swap usage Update Role Swap usage.
0.6	Mar. 15, 2017	1, 5, 8	1.2 Function, 1.3 Conneted port Figure 3-1, Table 4-1 Add port 3(CN37).
		2, 3	1.4.2 Related Documents, 3.1 Hardware Environment Update related documents.
		11, 12, 13	5.2.2 IPMMU Setting Add r8a7795. Add ipmmu_mm change.
		15	6.1 Role Swap usage Add connection pattern.
0.7	Jun. 14, 2017	2	Update related documents.
1.00	Aug. 8, 2017	All	Update document format.
1.01	Oct. 24, 2017	All	Add R-Car M3N support.
		2	Update related documents.
		11, 14	5.2.2 IPMMU Setting Add r8a77965.
1.50	Jan. 29, 2018		Delete IPMMU setting.
		11	Update "Integration of a USB gadget driver".
		12, 13	Add port 3(CN37)
1.51	Mar. 28, 2018	All	Add R-Car E3 support.
		1	Added Table 1-2 Connected Port (R-Car E3)
		2	Updated Table 1-4 Related Documents for R-Car E3
		4	Updated Table 3.1 Hardware specification for R-Car E3
		7	Added Fig 3.3 Module configuration for R-Car E3
		9	Added Device node for R-Car E3
		13	Added attention when using USB gadget
1.52	Jun. 27, 2018	1, 13	Change SW31 setting for USB2.0 channel 3 on Salvator-XS

Rev.	Date	Description	
		Page	Summary
1.53	Oct. 22, 2018	2	Update related documents.
2.00	Dec. 25, 2018	1, 2	Correct SW15 setting for all evaluation boards
		2	Update Related documents
		4	Update Hardware environment
		13	Update SW15 setting for OTG mode
		-	Update Address List
2.01	Apr. 17, 2019	2	Update related documents.
		-	Update Address List.
		13	Delete unnecessary part relating USB3.0
2.50	Apr. 21, 2021	All	Add R-Car D3 support.
		1	Add Table 1-4 Connected Port (R-Car D3).
		2	Update Table 1-6 Related Documents for R-Car D3.
		4	Update Table 3-1 Hardware specification for R-Car D3.
		7	Update Figure 3-3 Modules Configuration for R-Car D3.
		9	Update Table 4-3 Device Node for R-Car D3.
		-	Update Address List.
3.00	Dec. 10, 021	-	Add Kernel v5.10.41 support

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Colophon 7.0

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Colophon 3.1

Linux Interface Specification
Device Driver
USB 2.0 Host

Renesas Electronics Corporation