

RX Family

USB Host Communications Device Class Driver for USB Mini Firmware Using Firmware Integration Technology

Introduction

This application note describes USB Host Communication Device Class Driver (HCDC), which utilizes Firmware Integration Technology (FIT). This module operates in combination with the USB Basic Mini Host and Peripheral Driver. It is referred to below as the USB HCDC FIT module.

Target Device

RX111 Group
RX113 Group
RX231 Group
RX23W Group

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Related Documents

1. USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note (Document number.R01AN2166)
 2. Universal Serial Bus Revision 2.0 specification
<http://www.usb.org/developers/docs/>
 3. USB Class Definitions for Communications Devices Revision 1.2
 4. USB Communications Class Subclass Specification for PSTN Devices Revision 1.2
<http://www.usb.org/developers/docs/>
 5. RX111 Group User's Manual: Hardware (Document number .R01UH0365)
 6. RX113 Group User's Manual: Hardware (Document number.R01UH0448)
 7. RX231 Group User's Manual: Hardware (Document number .R01UH0496)
 8. RX23W Group User's Manual: Hardware (Document number .R01UH0823)
- Renesas Electronics Website
<http://www.renesas.com/>
 - USB Devices Page
<http://www.renesas.com/prod/usb/>

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1. Overview

The USB HCDT FIT module, when used in combination with the USB-BASIC-F/W FIT module, operates as a USB host communications device class driver (HCDT). The HCDT conforms to the PSTN device subclass abstract control model of the USB communication device class specification (CDC) and enables communication with a CDC peripheral device.

This module supports the following functions.

1. Checking of connected devices
2. Implementation of communication line settings
3. Acquisition of the communication line state
4. Data transfer to and from a CDC peripheral device

1.1 Please be sure to read

Please refer to the document (Document number: R01AN2166) for *USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note* when creating an application program using this driver.

This document is located in the "**reference_documents**" folder within this package.

1.2 Note

This driver is not guaranteed to provide USB communication operation. The customer should verify operation when utilizing it in a system and confirm the ability to connect to a variety of different types of devices.

1.3 Limitations

This driver is subject to the following limitations.

1. Suspend is not supported when data transfer is in progress. Confirm that data transfer has completed before executing suspend.
2. Use of compound USB devices with CDC class support is not supported.

1.4 Terms and Abbreviations

APL	: Application program
CDC	: Communications devices class
HCD	: Host control driver of USB-BASIC-FW
HCDT	: Host communication devices class
HCDT	: Host device class driver (device driver and USB class driver)
IDE	: Integrated Development Environment
MGR	: Peripheral device state manager of HCD
RSK	: Renesas Starter Kits
USB	: Universal Serial Bus
USB-BASIC-FW	: USB Basic Mini Host and Peripheral Driver

1.5 USB HCDT FIT module

User needs to integrate this module to the project using `r_usb_basic_mini`. User can control USB H/W by using this module API after integrating to the project.

2. Software Configuration

Table 2-1 lists the modules, and Figure 2-1 shows a block diagram of HCDC.

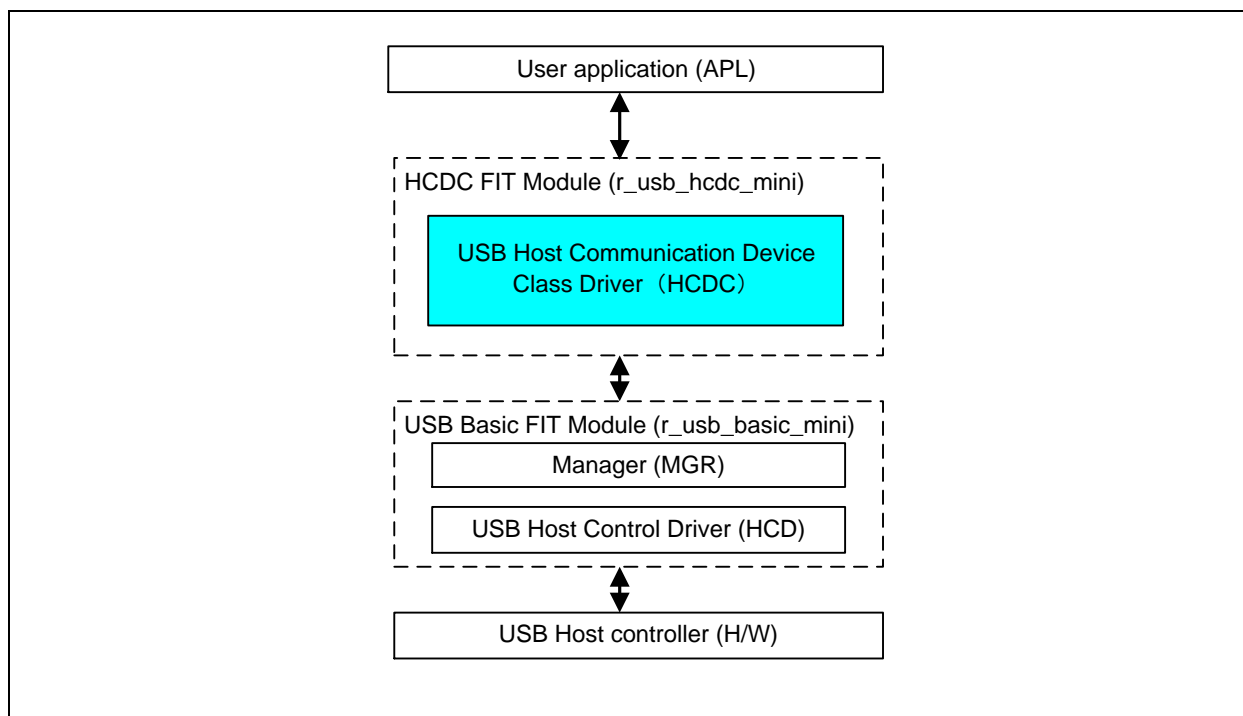


Figure 2-1 Software Module Structure

Table 2-1 Modules

Module	Description
APL	User application program. Created by customer.
HCDC	Requests CDC requests command and the data transfer from APL to HCD .
MGR	Enumerates the connected devices and starts HCDC. Also performs device state management.
HCD	USB host H/W control driver.

3. API Information

This Driver API follows the Renesas API naming standards.

3.1 Hardware Requirements

This driver requires your MCU support the following features:

- USB

3.2 Software Requirements

This driver is dependent upon the following packages:

- r_bsp
- r_usb_basic_mini

3.3 Operating Confirmation Environment

Table 3-1 shows the operating confirmation environment of this driver.

Table 3-1 Operation Confirmation Environment

Item	Contents
C compiler	Renesas Electronics C/C++ compiler for RX Family V.3.01.00 (The option "-lang=C99" is added to the default setting of IDE)
	GCC for Renesas RX 4.08.04.201902 (The option "-std=gnu99" is added to the default setting of IDE)
	IAR C/C++ Compiler for Renesas RX version 4.12.01
Endian	Little Endian, Big Endian
USB Driver Revision Number	Rev.1.12
Using Board	Renesas Starter Kit for RX111 Renesas Starter Kit for RX113 Renesas Starter Kit for RX231 Renesas Solution Starter Kit for RX23W

3.4 Usage of Interrupt Vector

Table 3-2 shows the interrupt vector which this driver uses.

Table 3-2 List of Usage Interrupt Vectors

Device	Contents
RX111	USBIO Interrupt (Vector number: 36) / USBR0 Interrupt (Vector number: 90) USB D0FIFO0 Interrupt (Vector number: 36) / USB D1FIFO0 Interrupt (Vector number: 37)
RX113	
RX231	
RX23W	

3.5 Header Files

All API calls and their supporting interface definitions are located in r_usb_basic_mini_if.h and r_usb_hcdc_mini_if.h.

3.6 Integer Types

This project uses ANSI C99 "Exact width integer types" in order to make the code clearer and more portable. These types are defined in *stdint.h*.

3.7 Compile Setting

For compile settings, refer to chapter 8, **Configuration** in this document and chapter "Configuration" in the document (Document number: R01AN2166) for *USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note*.

3.8 ROM / RAM Size

The follows show ROM/RAM size of this driver.

1. CC-RX (Optimization Level: Default)

	Checks arguments	Does not check arguments
ROM size	18.4K bytes (Note 3)	18.2K bytes (Note 4)
RAM size	5.3K bytes	5.3K bytes

2. GCC (Optimization Level: -O2)

	Checks arguments	Does not check arguments
ROM size	21.6K bytes (Note 3)	21.4K bytes (Note 4)
RAM size	5.1K bytes	5.1K bytes

3. IAR (Optimization Level: Medium)

	Checks arguments	Does not check arguments
ROM size	15.5K bytes (Note 3)	15.3K bytes (Note 4)
RAM size	3.7K bytes	3.7K bytes

Note:

1. ROM/RAM size for BSP and USB Basic Driver is included in the above size.
2. The above is the size when specifying RX V2 core option.
3. The ROM size of "Checks arguments" is the value when `USB_CFG_ENABLE` is specified to `USB_CFG_PARAM_CHECKING` definition in `r_usb_basic_mini_config.h` file.
4. The ROM size of "Does not check arguments" is the value when `USB_CFG_DISABLE` is specified to `USB_CFG_PARAM_CHECKING` definition in `r_usb_basic_mini_config.h` file.

3.9 Argument

For the structure used in the argument of API function, refer to chapter "**Structures**" in the document (Document number: R01AN2166) for *USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note*.

3.10 Adding the FIT Module to Your Project

This module must be added to each project in which it is used. Renesas recommends the method using the Smart Configurator described in (1) or (3) or below. However, the Smart Configurator only supports some RX devices. Please use the methods of (2) or (4) for RX devices that are not supported by the Smart Configurator.

- (1) Adding the FIT module to your project using the Smart Configurator in e² studio

By using the Smart Configurator in e² studio, the FIT module is automatically added to your project. Refer to "Renesas e² studio Smart Configurator User Guide (R20AN0451)" for details.

- (2) Adding the FIT module to your project using the FIT Configurator in e² studio

By using the FIT Configurator in e² studio, the FIT module is automatically added to your project. Refer to "Adding Firmware Integration Technology Modules to Projects (R01AN1723)" for details.

- (3) Adding the FIT module to your project using the Smart Configurator in CS+

By using the Smart Configurator Standalone version in CS+, the FIT module is automatically added to your project. Refer to “Renesas e² studio Smart Configurator User Guide (R20AN0451)” for details.

- (4) Adding the FIT module to your project on CS+

In CS+, please manually add the FIT module to your project. Refer to “Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826)” for details.

4. Target Peripheral List (TPL)

For the structure used in the argument of API function, refer to chapter " **How to Set the Target Peripheral List (TPL)**" in the document (Document number: R01AN2166) for *USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note*.

5. Communication Device Class (CDC), PSTN and ACM

This software conforms to the Abstract Control Model (ACM) subclass of the Communication Device Class specification, as specified in detail in the PSTN Subclass document listed in “Related Documents”.

The Abstract Control Model subclass is a technology that bridges the gap between USB devices and earlier modems (employing RS-232C connections), enabling use of application programs designed for older modems.

5.1 Basic Functions

The main functions of HCD are as follows.

1. Verify connected devices
2. Make communication line settings
3. Acquire the communication line state
4. Transfer data to and from the CDC peripheral device

5.2 Abstract Control Model Class Requests - Host to Device

This driver supports the following class requests.

For the class request processing, refer to chapter “**USB Class Requests**” in the document (Document number: R01AN2166) for *USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note*.

Table 5-1 CDC Class Requests

Request	Code	Description
SendEncapsulatedCommand	0x00	Transmits an AT command as defined by the protocol used by the device (normally 0 for USB).
GetEncapsulatedResponse	0x01	Requests a response to a command transmitted by SendEncapsulatedCommand.
SetCommFeature	0x02	Enables or disables features such as device-specific 2-byte code and country setting.
GetCommFeature	0x03	Acquires the enabled/disabled state of features such as device-specific 2-byte code and country setting.
ClearCommFeature	0x04	Restores the default enabled/disabled settings of features such as device-specific 2-byte code and country setting.
SetLineCoding	0x20	Makes communication line settings (communication speed, data length, parity bit, and stop bit length).
GetLineCoding	0x21	Acquires the communication line setting state.
SetControlLineState	0x22	Makes communication line control signal (RTS, DTR) settings.
SendBreak	0x23	Transmits a break signal.

For details concerning the Abstract Control Model requests, refer to Table 11, “Requests - Abstract Control Model” in “USB Communications Class Subclass Specification for PSTN Devices”, Revision 1.2.

The following describes the class request data formats supported by this class driver software.

5.2.1 SendEncapsulatedCommand

The SendEncapsulatedCommand data format is shown in Table 5-2.

Table 5-2 SendEncapsulatedCommand Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0x21	SEND_ENCAPSULATED_COMMAND(0x00)	0x0000	0x0000	Data length	Control protocol command

Note: Items such as AT commands for modem control are set as Data, and wLength is set to match the length of the data.

5.2.2 GetEncapsulatedResponse

The GetEncapsulatedResponse data format is shown Table 5-3.

Table 5-3 GetEncapsulatedResponse Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0x21	GET_ENCAPSULATED_RESPONSE (0x01)	0x0000	0x0000	Data length	The data depends on the protocol.

Note: The response data to SendEncapsulatedCommand is set as Data, and wLength is set to match the length of the data.

5.2.3 SetCommFeature

The SetCommFeature data format is shown Table 5-4.

Table 5-4 SetCommFeature Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0x21	SET_COMM_FEATURE (0x02)	Feature Selector Note	0x0000	Data length	Status Either the country code or the Abstract Control Model idle setting/multiplexing setting for Feature Selector.

Note: Shown in Table 4.6 Feature selector Settings.

5.2.4 GetCommFeature Data Format

The GetCommFeature data format is shown below.

Table 5-5 GetCommFeature Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0x21	GET_COMM_FEATURE (0x03)	Feature Selector Note	0x0000	Data length	Status Either the country code or the Abstract Control Model idle setting/multiplexing setting for Feature Selector.

Note: Shown in Table 4.6 Feature selector Settings.

A Feature selector setup is shown in Table 5-6. The Status format at the time of ABSTRACT_STATE is shown in Table 5-7.

Table 5-6 Feature Selector Settings

Feature Selector	Code	Targets	Length of Data	Description
RESERVED	0x00	None	None	Reserved
ABSTRACT_STATE	0x01	Interface	2	Selects the setting for Abstract Control Model idle state and signal multiplexing.
COUNTRY_SETTING	0x02	Interface	2	Selects the country code in hexadecimal format, as defined by ISO 3166.

Table 5-7 Status Format when ABSTRACT_STATE Selected

Bit Position	Description
D15 to D2	Reserved
D1	Data multiplexing setting 1: Multiplexing of call management commands is enabled for the Data class. 0: Multiplexing is disabled.
D0	Idle setting 1: No endpoints of the target interface accept data from the host, and data is not supplied to the host. 0: Endpoints continue to accept data and it is supplied to the host.

5.2.5 ClearCommFeature

The ClearCommFeature data format is shown Table 5-8.

Table 5-8 ClearCommFeature Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0x21	CLEAR_COMM_FEATURE (0x04)	Feature Selector Note	0x0000	0x0000	None

Note: Shown in Table 4.6 Feature selector Settings.

5.2.6 SetLineCoding

The SetLineCoding data format is shown Table 5-9.

Table 5-9 SetLineCoding Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0x21	SET_LINE_CODING (0x20)	0x0000	0x0000	0x0000	Line Coding Structure See Table 5-10, Line Coding Structure Format

Line Coding Structure Format is shown Table 5-10.

Table 5-10 Line Coding Structure Format

Offset	Field	Size	Value	Description
0	dwDTERate	4	Number	Data terminal speed (bps)
4	bCharFormat	1	Number	Stop bits 0 - 1 stop bit 1 - 1.5 stop bits 2 - 2 stop bits
5	bParityType	1	Number	Parity 0 - None 1 - Odd 2 - Even 3 - Mask 4 - Space
6	bDataBits	1	Number	Data bits (5, 6, 7, 8)

5.2.7 GetLineCoding

The GetLineCoding data format is shown Table 5-11.

Table 5-11 GetLineCoding Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0xA1	GET_LINE_CODING (0x21)	0x0000	0x0000	0x0007	Line Coding Structure See Table 5-10 , Line Coding Structure Format

5.2.8 SetControlLineState

The SetControlLineState data format is shown below.

Table 5-12 SetControlLineState Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0x21	SET_CONTROL_LINE _STATE (0x22)	Control Signal Bitmap See Table 5-13, Control Signal Bitmap Format	0x0000	0x0000	None

Table 5-13 Control Signal Bitmap

Bit Position	Description
D15 to D2	Reserved
D1	DCE transmit function control 0 - RTS OFF 1 - RTS ON
D0	Notification of DTE ready state 0 - DTR OFF 1 - DTR ON

5.2.9 SendBreak

The SendBreak data format is shown below.

Table 5-14 SendBreak Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0x21	SEND_BREAK (0x23)	Break signal output duration	0x0000	0x0000	None

5.3 ACM Notifications from Device to Host

The class notifications supported and not supported by the software are shown Table 5-15.

Table 5-15 CDC Class Notifications

Notification	Code	Description	Supported
NETWORK_CONNECTION	0x00	Notification of network connection state	No
RESPONSE_AVAILABLE	0x01	Response to GET_ENCAPSLATED_RESPONSE	Yes
SERIAL_STATE	0x20	Notification of serial line state	Yes

5.3.1 SerialState

The SerialState data format is shown below.

Table 5-16 SerialState Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0xA1	SERIAL_STATE (0x20)	0x0000	0x0000	0x0000	UART State bitmap See Table 5-17, UART State bitmap Format

UART State bitmap format is shown Table 5-17.

Table 5-17 UART State bitmap Format

Bits	Field	Description
D15 to D7		Reserved
D6	bOverRun	Overflow error detected
D5	bParity	Parity error detected
D4	bFraming	Framing error detected
D3	bRingSignal	INCOMING signal (ring signal) detected
D2	bBreak	Break signal detected
D1	bTxCarrrier	Data Set Ready: Line connected and ready for communication
D0	bRxCarrrier	Data Carrier Detect: Carrier detected on line

5.3.2 ResponseAvailable

The ResponseAvailable data format is shown below.

Table 5-18 ResponseAvailable Data Format

bmRequestType	bRequest	wValue	wIndex	wLength	Data
0xA1	RESPONSE_AVAILABLE (0x01)	0x0000	0x0000	0x0000	None

6. USB Host Communication Device Class Driver (HCD) (HCDC)

6.1 Basic Functions

This software conforms to the Abstract Control Model subclass of the communication device class specification.

The main functions of HCDC are to:

1. Send class requests to the CDC peripheral
2. Transfer data to and from the CDC peripheral
3. Receive communication error information from the CDC peripheral

6.2 Structure / Union

The following structure or union is defined in *r_usb_hcdc_mini_if.h*.

6.2.1 HCDC Request Structure

Table 6-1 describes the “UART settings” parameter structure used for the CDC requests *SetLineCoding* and *GetLineCoding*.

Table 6-1 usb_hcdc_linecoding_t Structure

Type	Member	Description	Remarks
uint32_t	dwdte_rate	Line speed	Unit: bps
uint8_t	bchar_ormat	Stop bits setting	
uint8_t	bparity_type	Parity setting	
uint8_t	bdata_bits	Data bit length	

Table 6-2 describes the “UART settings” parameter structure used for the CDC requests *SetControlLineState*.

Table 6-2 usb_hcdc_controllinestate_t Structure

Type	Member	Description	Remarks
uint16_t (D1)	brts:1	Carrier control for half duplex modems 0 - Deactivate carrier, 1 - Activate carrier	
uint16_t (D0)	bdtr:1	Indicates to DCE if DTE is present or not 0 - Not Present, 1 - Present	

Table 6-3 describes the “AT command” parameter structure used for the CDC requests *SendEncapsulatedCommand* and *GetEncapsulatedResponse*.

Table 6-3 usb_hcdc_encapsulated_t Structure

Type	Member	Description	Remarks
uint8_t	*p_data	Area where AT command data is stored	
uint16_t	wlength	Size of AT command data	Unit: byte

Table 6-4 describes the “Break signal” parameter structure used for the CDC requests *SendBreak*.

Table 6-4 usb_hcdc_breakduation_t Structure

Type	Member	Description	Remarks
uint16_t	wtime_ms	Duration of Break	Unit: ms

6.2.2 CommFeature Function Selection Union

Table 6-5 and Table 6-6 describe the “Feature Selector” parameter structure used for the CDC requests *SetCommFeature* and *GetCommFeature*, and Table 6-7 describes the parameter union.

Table 6-5 usb_hcdc_abstractstate_t Structure

Type	Member	Description	Remarks
uint16_t	rsv1:14	Reserved	
uint16_t	bdms:1	Data Multiplexed State	
iomt16_t	bis:1	Idle Setting	

Table 6-6 usb_hcdc_countrysetting_t Structure

Type	Member	Description	Remarks
uint16_t	country_code	Country code in hexadecimal format as defined in [ISO3166],	

Table 6-7 usb_hcdc_commfeature_t Union

Type	Member	Description	Remarks
usb_hcdc_abstractstate_t	abstract_state	Parameter when selecting Abstract Control Model	
usb_hcdc_countrysetting_t	country_setting	Parameter when selecting Country Setting	

6.2.3 CDC Notification Format

Table 6-8 and Table 6-9 describe the data format of the CDC notification.

Table 6-8 Response_Available notification format

Type	Member	Description	Remarks
uint8_t	bmRequestType	0xA1	
uint8_t	bRequest	RESPONSE_AVAILABLE(0x01)	
uint16_t	wValue	0x0000	
uint16_t	wIndex	Interface	
uint16_t	wLength	0x0000	
uint8_t	Data	none	

Table 6-9 Serial_State notification format

Type	Member	Description	Remarks
uint8_t	bmRequestType	0xA1	
uint8_t	bRequest	SERIAL_STATE(0x20)	
uint16_t	wValue	0x0000	
uint16_t	wIndex	Interface	
uint16_t	wLength	0x0002	
uint16_t	Data	UART State bitmap	Refer to Table 6-10

The host is notified of the “*SerialState*” when a change in the UART port state is detected. Table 6-10 describes the structure of the UART State bitmap.

Table 6-10 usb_hcdc_serialstate_t Structure

Type	Member	Description	Remarks
uint16_t (D15-D7)	rsv1:9	Reserved	
uint16_t (D6)	bover_run:1	Overrun error detected	
uint16_t (D5)	bparity:1	Parity error detected	
uint16_t (D4)	bframing:1	Framing error detected	
uint16_t (D3)	bring_signal:1	Incoming signal (Ring signal) detected	
uint16_t (D2)	bbreak:1	Break signal detected	
uint16_t (D1)	btx_carrier:1	Line connected and ready for communication	Data Set Ready
uint16_t (D0)	brx_carrier:1	Carrier detected on line	Data Carrier Detect

7. API Functions

For API used in the application program, refer to chapter "**API Functions**" in the document (Document number: R01AN2166) for *USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note*.

8. Configuration (r_usb_hcdc_mini_config.h)

Please set the following according to your system.

Note:

Be sure to set *r_usb_basic_mini_config.h* file as well. For *r_usb_basic_mini_config.h* file, refer to chapter "**Configuration**" in the document (Document number: R01AN2166) for *USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note*.

1. Setting CDC class

Specify the device class ID of the CDC device to be connected.

```
#define      USB_CFG_HCDC_IFCLS      USB_CFG_CDC          // CDC class supported device
#define      USB_CFG_HCDC_IFCLS      USB_CFG_VEN          // Vendor class device
```

Note:

With regard to the USB serial conversion device in the marketplace, the device class ID may be the Vendor class. Check the CDC device specifications before use. If the device class is Vendor class, then set *USB_CFG_VEN*.

2. Setting pipe to be used

Set the pipe number to use for data transfer.

(1). Bulk IN/OUT transfer

Set the pipe number (PIPE1 to PIPE5) to use for Bulk IN/OUT transfer. Do not set the same pipe number.

```
#define      USB_CFG_HCDC_BULK_IN      Pipe number (USB_PIPE1 to USB_PIPE5)
#define      USB_CFG_HCDC_BULK_OUT     Pipe number (USB_PIPE1 to USB_PIPE5)
```

(2). Interrupt IN transfer

Set the pipe number (PIPE6 to PIPE9) to use for Interrupt IN transfer. Do not set the same pipe number. If the USB Hub is being used, then PIPE9 cannot be set as the following definitions.

```
#define      USB_CFG_HCDC_INT_IN       Pipe number (USB_PIPE6 to USB_PIPE9)
```

9. Creating an Application

Refer to the chapter “**Creating an Application Program**” in the document (Document number: R01AN2166) for *USB Basic Mini Host and Peripheral Driver (USB Mini Firmware) using Firmware Integration Technology Application Note*.

Website and Support

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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Dec 1, 2015	—	First edition issued
1.01	Jun 1, 2015	—	RX231 is added in the target device.
1.02	Dec 28, 2015	—	Upgrading of this USB driver by upgrading of "USB Basic Mini Firmware (R01AN2166)".
1.10	Nov 30, 2018	—	<ol style="list-style-type: none">1. Supporting Smart Configurator.2. The following chapter is added.<ol style="list-style-type: none">(1). 8. Configuration (r_usb_hcdc_mini_config.h)3. The following chapters are changed.<ol style="list-style-type: none">(1). 3. API Information(2). 7. API Functions(3). 9. Creating an Application4. The following chapters are deleted. "How to Register Class Driver", "System Resources", "Task ID and Priority Setting".
1.11	May 31, 2019	—	Support GCC compiler and IAR compiler.
1.12	Jun 30, 2019	—	RX23W is added in the target device.

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. 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

Access to reserved addresses is prohibited.

- The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.

5. Differences between Products

Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

- The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the 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.

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