RZ/A1H Group

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USB Host Mass Storage Class Driver (HMSC)

Introduction

This application note describes USB Host Mass Storage Class Driver (HMSC). This driver operates in combination with the USB Basic Host Driver (USB-BASIC-F/W). It is referred to below as the HMSC.

Target Device

RZ/A1H Group

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

Related Documents

1. Universal Serial Bus Revision 2.0 specification
2. USB Mass Storage Class Specification Overview Revision 1.1
3. USB Mass Storage Class Bulk-Only Transport Revision 1.0
   http://www.usb.org/developers/docs/
4. RZ/A1H Group,RZ/A1M Group User's Manual: Hardware (Document No.R01UH0403EJ)
5. RZ/A1H Group USB Host and Peripheral Interface Driver (Document No.R01AN3291EJ)
6. RZ/A1H Group Downloading Program to NOR Flash Memory Using ARM® Development Studio 5 (DS-5™) Semihosting Function (for GENMAI) (Document No.R01AN1957EJ)
7. RZ/A1H Group I/O definition header file (Document No.R01AN1860EJ)
8. RZ/A1H Group Example of Initialization (for GENMAI) (Document No.R01AN1864EJ)

Renesas Electronics Website
http://www.renesas.com/
USB Device Page
http://www.renesas.com/prod/usb/

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1. Overview

The HMSC, when used in combination with the USB-BASIC-F/W, operates as a USB host mass storage class driver (HMSC).
The HMSC comprises a USB mass storage class bulk-only transport (BOT) protocol. When combined with a file system and storage device driver, it enables communication with a BOT-compatible USB storage device.
Note that this software uses the FatFs.

This module supports the following functions.

- Checking of connected USB storage devices (to determine whether or not operation is supported).
- Storage command communication using the BOT protocol.
- Support for SFF-8070i (ATAPI) USB mass storage subclass.
- Maximum 4 USB storage devices can be connected.

1.1 Please be sure to read

It is recommended to use the APIs described in the document (Document No: R01AN3291EJ) when creating an application program using this driver.
That document is located in the "reference_documents" folder within the package.
[Note]

a. The document (Document No: R01AN3291EJ) also provides how to create an application program using the APIs described above.
b. If the APIs described in the document (Document No: R01AN3291EJ) are used, there is no need to use the API described in “6.2. **FSI API**”, “7.4, **HMSDD API Function**” and “8.6. **HMSC API**” of this document of this document.

1.2 Operation Confirmation Conditions

The operation of the USB Driver module has been confirmed under the conditions listed in Table 1.1.

Table 1.1 Operation Confirmation Conditions

Item	Description
MCU	RZ/A1H
Operating frequency (Note)	CPU clock (Iφ): 400 MHz
	Image-processing clock (Gφ): 266.37 MHz
	Internal bus clock (Bφ): 133.33 MHz
	Peripheral clock 1 (P1φ): 66.67 MHz
	Peripheral clock 0 (P0φ): 33.33 MHz
Operating voltage	Power supply voltage (I/O): 3.3 V
	Power supply voltage (internal): 1.8 V
Integrated development environment	ARM Integrated Development Environment
	• ARM Development Studio (DS-5™) Version 5.16
	IAR Integrated Development Environment
	• IAR Embedded Workbench for ARM Version 7.40
Compiler	ARM C/C++ Compiler/Linker/Assembler Ver.5.03 [Build 102]
	KPIT GNUARM-RZ v14.01
	IAR C/C++ Compiler for ARM 7.40
Operating mode	Boot mode 0
	(CS0-space 16-bit booting)
Communication setting of terminal software	Communication speed: 115200 bps
	Data length: 8 bits
	Parity: None
	Stop bit length: 1 bit
	Flow control: None
Board	GENMAI board
	R7S72100 CPU board (RTK772100BC00000BR)
Device (Functions used on the board)	Serial interface (D-sub 9-pin connector)
	USB1 connector, USB2 connector

1.3 Limitations

This module is subject to the following restrictions

1. Structures are composed of members of different types (Depending on the compiler, the address alignment of the structure members may be shifted).
2. Additional limitations apply to HMSDD. See section 7 for details.

Terms and Abbreviations

APL	:	Application program
BOT	:	Mass storage class Bulk Only Transport
cstd	:	Prefix of function and file for Peripheral & Host Common Basic (USB low level) F/W
FSL	:	FAT File System Library
HCD	:	Host Control Driver of USB-BASIC-F/W
HDCD	:	Host Device Class Driver (device driver and USB class driver)
HSTD	:	Function & File for Host Basic (USB low level) F/W
HUBCD	:	Hub Class Smple Driver
MGR	:	Peripheral device state manager of HCD
non-OS	:	USB basic firmware for non-OS based system
PP	:	Pre-processed definition
RSK	:	Renesas Starter Kits
Scheduler	:	Used to schedule functions, like a simplified OS.
Scheduler Macro	:	Used to call a scheduler function (non-OS)
Task	:	Processing unit
USB-BASIC-F/W	:	USB Basic Host Driver for RZ/A1H Group (non-OS)
USB	:	Universal Serial Bus

2. Software Configuration

HDCD (Host Device Class Driver) is the all-inclusive term for HMSDD (Host Mass Storage Device Driver) and HMSCD (USB Host Mass Storage Class Driver).
Figure 2-1 shows the HMSC software block diagram, with HDCD as the centerpiece. Table 2.1 describes each module.

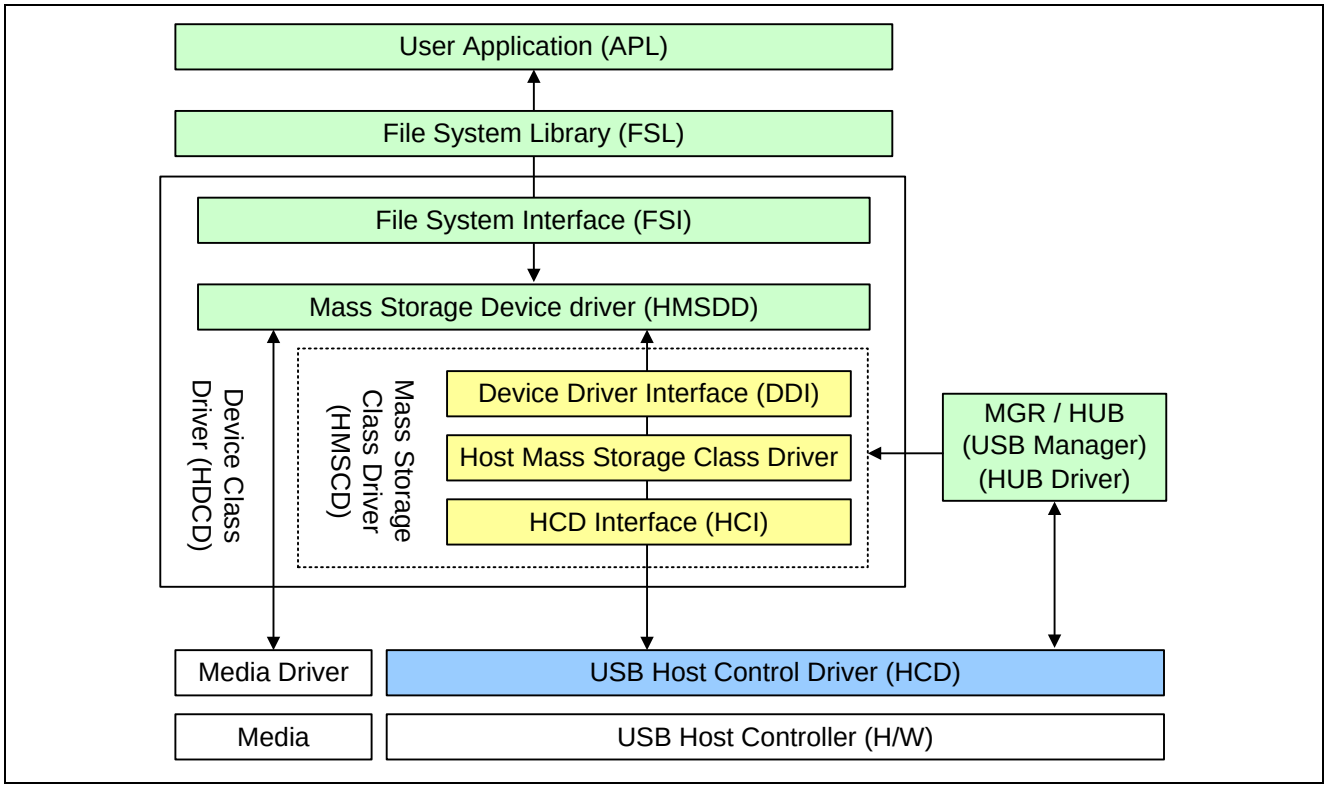

Figure 2-1 Software Block Diagram

Table 2.1 Module

Module	Description
APL	Calls FSL functions to implement storage functionality. Created by the customer to match the system specifications.
FSL	FAT file system with specifications defined by the user.
FSI	FSL-HMSDD interface functions. They should be modified to match FSL.
HMSDD	To be created (modified) by the customer to match the storage media.
DDI	HMSDD-HMSCD interface functions. They should be modified to match the storage media interface of HMSDD.
HMSCD	The USB host mass storage class driver. It appends BOT protocol information to storage commands and sends requests to HCD. It also manages the BOT sequence. The storage commands should be added (modified) by the customer to match the system specifications. SFF-8070i (ATAPI) is supported in the example code.
HCI	HMSCD-HCD interface functions.
MGR/HUB	Enumerates the connected devices and starts HMSCD. Also performs device state management.
HCD	USB host hardware control driver.
Media Driver	Driver for non-USB storage devices.

3. System Resources

The resources used by HMSC are listed below.

Table 3-1 Task Information

Function Name	Task ID	Priority	Description
usb_hmsc_Task	USB_HMSC_TSK	USB_PRI_3	Mass storage task
usb_hmsc_StrgDriveTask	USB_HSTRG_TSK	USB_PRI_3	HMSDD task

Table 3-2 Mailbox Information

Mailbox Name	Using Task ID	Task Queue	Description
USB_HMSC_MBX	USB_HMSC_TSK	FIFO order	For HMSCD
USB_HSTRG_MBX	USB_HSTRG_TSK	FIFO order	For HMSDD

Table 3-3 Memory Pool Mailbox Information

Memory Pool Name	Task Queue	Memory Block (note)	Description
USB_HMSC_MPL	FIFO order	40byte	For HMSC
USB_HSTRG_MPL	FIFO order	40byte	For HDCD

Note: The maximum number of memory blocks for the entire system is defined in USB_BLKMAX. The default value is 20.

4. Target Peripheral List（TPL）

When using a USB host driver (USB-BASIC-F/W) and device class driver in combination, it is necessary to create a target peripheral list (TPL) for each device driver.
For details on the TPL, refer to “How to Set a Targeted Peripheral List” in the Application Note of the USB Host and Peripheral Interface Driver (Document No: R01AN3291EJ).

5. Accessing USB Storage Devices

FSI (File System Interface) converts sector numbers to logical block addresses and sector counts to transfer data sizes. From the drive number, HMSDD determines if a USB storage device is being accessed. HMSCD converts drive numbers to unit numbers and accesses USB storage devices via HCD according to the BOT protocol.
Figure5-1 shows the USB storage device access sequence.

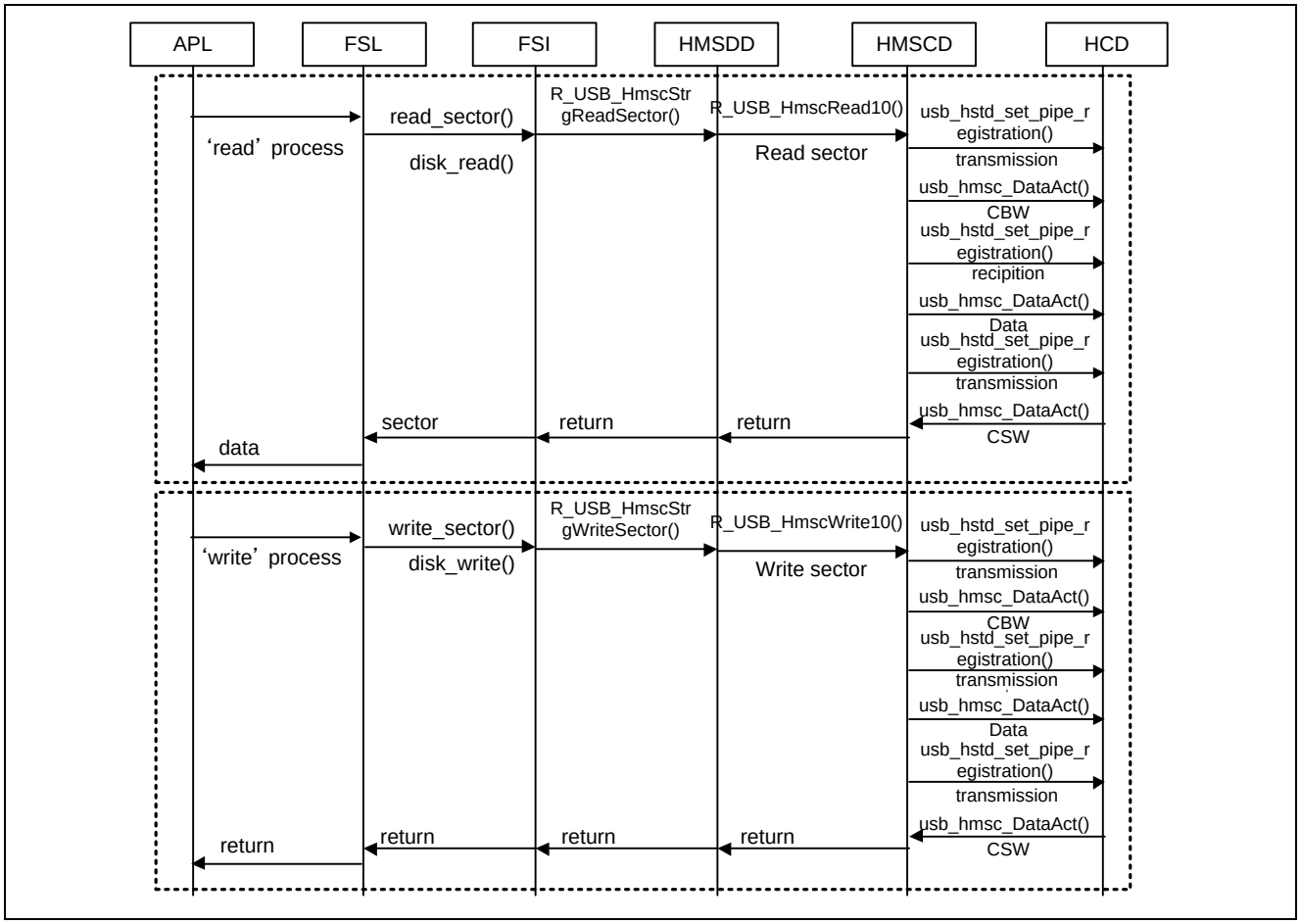

Figure5-1 USB Storage Device Access Sequence

6. File System Interface (FSI)

6.1 Functions and Features

Create the FSL to match the specifications of the interface.

6.2 FSI API

Table 6.1 lists the functions of the sample FSI.

[Note]

If you want to use the API, which is described in USB Host and Peripheral Interface Driver (Document No: R01AN3291JJ), in the application program, you do not need to use the following API.

Table 6.1 FSI Functions

Function Name	Description
disk_read	Read data
disk_write	Write data
R_usb_hmsc_WaitLoop	Wait for completion of DATA READ / DATA WRITE (For non-OS)
dev_open	Mount a drive (TFAT is not in use)
dev_close	Unmount a drive (TFAT is not in use)

7. Host Mass Storage Device Driver (HMSDD)

HMSDD, the “device driver”, is called by FAT when using HMSCD. HMSDD selects a storage device depending on a given drive number.

7.1 Limitation

- Maximum 4 USB storage devices can be connected.
- USB storage devices with a sector size of 512 bytes can be connected.
- A device that does not respond to the READ_CAPACITY command operates as a device with a sector size of 512 bytes.
- Some devices may be unable to be connected (because they are not recognized as storage devices).

7.2 Logical Unit Number (LUN)

If a device does not respond to a GetMaxUnit request and the unit count is undetermined, the device operates with a unit count setting of 0. HMSCD creates USB packets according to the BOT specification. The CBWCB field (storage command) of the data packet is created according to the SCSI specification. The LUN field settings in the bCBWLUN field of the CBW packet and in the storage command are listed in.Table 7.1.

Table 7.1 LUN Field Settings

	bCBWLUN Field	LUN Field in Command
usb_ghmsc_MaxLUN = 0	0	0
usb_ghmsc_MaxLUN = other than 0	Unit number	0

7.3 Changing Logical Block Addresses

Under the BOT specification, information is read and written according to logical block addresses. The data size is specified as the number of bytes of information that are read or written.
The logical block address is calculated from the sector number and offset sector number. The transfer size is calculated from the sector count and sector size.

Logical block address = logical sector number + offset sector number

Transfer size = sector count * sector size

7.4 HMSDD API Function

Table 7.2 lists the function of HMSDD.

[Note]

If you want to use the API, which is described in USB Host and Peripheral Interface Driver (Document No: R01AN3291JJ), in the application program, you do not need to use the following API.

Table 7.2 HMSDD functions

Function Name	Description
R_USB_HmscStrgDriveTask()	Gets the storage device information
R_USB_HmscStrgDriveSearch()	Searchs the accessible drive
R_USB_HmscStrgReadSector()	Reads data.
R_USB_HmscStrgWriteSector()	Writes data.
R_USB_HmscStrgUserCommand()	Issues storage command.
R_USB_HmscAllocDrvno()	Allocates the drive number.
R_USB_HmscFreeDrvno()	Frees the drive number
R_USB_HmscRefDrvno()	Refers the drive number

7.4.1 R_USB_HmscStrgDriveTask

Storage drive task

Format

void R_USB_HmscStrgDriveTask(void)

Argument

— —

Return Value

— —

Description

This API does the processing to get the storage device information by sending SFF-8070i (ATAPI) command to the storage device..

Notes

1. Please call this function from the application program

Example

```
void usb_hapl_mainloop(void)
{
   while(1)
   {
      R_usb_cstd_Scheduler();

      if(USB_FLGSET == R_usb_cstd_CheckSchedule())
      {
            R_usb_hstd_HcdTask((USB_VP_INT)0);
            R_usb_hstd_MgrTask((USB_VP_INT)0);
            R_usb_hhub_Task((USB_VP_INT)0);
            R_usb_hmsc_Task((USB_VP_INT)0)
            R_usb_hmsc_StrgDriveTask();
      }
                  :
   }
}
```

7.4.2 R_USB_HmscStrgDriveSearch

Searchs the accessible drive

Format

USB_ER_t R_USB_HmscStrgDriveSearch(USB_UTR_t *ptr, uint16_t addr, USB_CB_t complete)

Argument

*ptr	Pointer to USB_UTR_t structure
addr	USB address
complete	Callback function

Return Value

USB_DONE	Normal end
USB_ERROR	Error end

Description

This API checks the follows by sending the class request (GetMaxLun) and SFF-8070i (ATAPI) command to USB device which is specified in the argument (addr).

1. The number of unit of the storage device
2. Accesible the drive

The callback function which is specified in the argument (complete) is called whencompleting the drive searching.

Notes

2. Please call this function from the class driver or the FAT library I/F function.
3. Please set the following members of USB_UTR_t structure.

USB_REGADR_t	ipp	: USB register base address
uint16_t	ip	: USB IP Number

Example

```
/* Callback function */
void usb_hmsc_StrgCommandResult( USB_UTR_t *mess, uint16_t data1, uint16_t data2 )
{
        :
}

void usb_hmsc_SampleAplTask(void)
{
        :
    R_USB_HmscStrgDriveSearch(mess, addr,(USB_CB_t)&usb_hmsc_StrgCommandResult);
        :
}
```

7.4.3 R_USB_HmscStrgReadSector

Read Sector Information

Format

USB_ER_t R_USB_HmscStrgReadSector(USB_UTR_t *ptr, uint16_t side, uint8_t *buff, uint32_t secno, uint16_t seccnt, uint32_t trans_byte))

Argument

ptr	Pointer to USB_UTR_t structure
side	Drive number
buff	Pointer to read data storage area
secno	Sector number
seccnt	Sector count
trans_byte	Transfer data length

Return Value

USB_DONE	Normal end
USB_ERROR	Error end

Description

Reads the sector information of the drive specified by the argument.
An error response occurs in the following cases.

1. When the sector information could not be read successfully from the storage device.

Notes

1. Please call this function from FAT library I/F function.
2. Please set the following members of USB_UTR_t structure.

USB_REGADR_t	ipp	: USB register base address
uint16_t	ip	: USB IP Numbe

Example

```
int read_sector(USB_UTR_t *ptr, int side, unsigned char *buff, unsigned long secno,
              long seccnt)
{
              :
    error = R_USB_HmscStrgReadSector(ptr, (uint16_t)side, buff, secno, (uint16_t)seccnt,
               trans_byte);

    if( error == USB_ERROR )
    {
              :
       return (-1);
    }
    return (0);
}
```

7.4.4 R_USB_HmscStrgWriteSector

Write Sector Information

Format

USB_ER_t R_USB_HmscStrgWriteSector(USB_UTR_t *ptr, uint16_t side, uint8_t *buff, uint32_t secno, uint16_t seccnt, uint32_t trans_byte))

Argument

ptr	Pointer to USB_UTR_t structure
side	Drive number
buff	Pointer to write data storage area
secno	Sector number
seccnt	Sector count
trans_byte	Transfer data length

Return Value

USB_DONE	Normal end
USB_ERROR	Error end

Description

Writes the sector information of the drive specified by the argument.
An error response occurs in the following cases.

1. When the sector information could not be read successfully from the storage device.

Notes

1. Please call this function from FAT library I/F function.
2. Please set the following members of USB_UTR_t structure.

USB_REGADR_t	ipp	: USB register base address
uint16_t	ip	: USB IP Numbe

Example

```
int write_sector(USB_UTR_t *ptr, int side, unsigned char *buff, unsigned long secno,
              long seccnt)
{
            :
    error = R_usb_hmsc_StrgWriteSector(ptr, (uint16_t)side, buff, secno,
              (uint16_t)seccnt, trans_byte);

    if( error == USB_ERROR )
    {
            :
       return (-1);
    }
    return (0);
}
```

7.4.5 R_USB_HmscStrgUserCommand

Issue Storage Command

Format

uint16_t R_USB_HmscStrgUserCommand(USB_UTR_t *ptr, uint16_t side, uint16_t command , uint8_t *buff, USB_CB_t complete)

Argument

*ptr	Pointer to USB_UTR_t structure
side	Drive number
command	Command to be issued
*buff	Data pointer
complete	Callback function

Return Value

USBC_DONE	Normal end
USBC_ERROR	Error end

Description

This function issues the storage command specified by the given argument, to the HMSC driver. The callback function which is specified in the argument (complete) is called when completing the issued storage command. Here are the storage commands supported:

Storage commands	Description
USB_ATAPI_TEST_UNIT_READY	Check status of peripheral device
USB_ATAPI_REQUEST_SENCE	Get status of peripheral device
USB_ATAPI_INQUIRY	Get parameter information of logical unit
USB_ATAPI_MODE_SELECT6	Specify parameters
USB_ATAPI_PREVENT_ALLOW	Enable/disable media removal
USB_ATAPI_READ_FORMAT_CAPACITY	Get formattable capacity
USB_ATAPI_READ_CAPACITY	Get capacity information of logical unit
USB_ATAPI_MODE_SENSE10	Get parameters of logical unit

Notes

Please call this function from the application program and the class driver.

Please set the following members of USB_UTR_t structure.

USB_REGADR_t	ipp	: USB register base address
uint16_t	ip	: USB IP Number

Example

```
/* Callback function */
void  strgcommand_complete(USB_UTR_t *mess, uint16_t data1, uint16_t data2)
{
            :
}
 void  usb_smp_task(void)
 {
    :
  /* Issuing TEST_UNIT_READY */
  R_USB_HmscStrgUserCommand(ptr, side, USB_ATAPI_TEST_UNIT_READY, buf,
(USB_CB_t)complete);
    :
 }
```

7.4.6 R_USB_HmscAllocDrvno

Allocates the driver number

Format

uint16_t R_USB_HmscAllocDrvno(uin16_t ipno, uint16_t devadr)

Argument

ipno	USB module number
devadr	Device address of MSC device

Return Value

–	Drive number

Description

This function allocate the drive number to the connected MSC device. c

Notes

1. The user can specifies the drive number which is allocated by this API in the argument of FAT API.
2. Specifies USB module number which MSC device is connected to in the argument "*ipno*".

USB Module	USB Module Number
USB0	USB_IP0
USB1	USB_IP1

Example

```
void usb_smp_task(void)
{
            :
    /* Allocates the drive number */
    drvno = R_USB_HmscAllocDrvno(USB_IP1, devadr);
            :
}
```

7.4.7 R_USB_HmscFreeDrvno

Frees the driver number

Format

void R_USB_HmscFreeDrvno(uint16_t drvno)

Argument

drvno Drive number

Return Value

— —

Description

This function frees the drive number which is specified by the argument.

Notes

Specifies USB module number which MSC device is connected to in the argument "*ipno*".

USB Module	USB Module Number
USB0	USB_IP0
USB1	USB_IP1

Example

```
void usb_smp_task(void)
{
          :
   /* Frees the drive number */
   R_USB_HmscFreeDrvno(drvno);
          :
}
```

7.4.8 R_USB_HmscRefDrvno

Refers the driver number

Format

void R_USB_HmscRefDrvno(uint16_t ipno, uint16_t devadr)

Argument

ipno	USB module number
devadr	Device address

Return Value

–	Drive number

Description

This function refers the drive numer based on USB module number and the device address which are specified by the argument.

Notes

–

Example

```
void usb_smp_task(void)
{
          :
   /* Frees the drive number */
   R_USB_HmscRefDrvno(drvno);
          :
}
```

8. USB Mass Storage Class Driver (HMSCD)

8.1 Functions and Features

HMSCD executes storage command communication, if the USB storage devices are ready to operate. The BOT protocol is used, which encapsulates the storage commands as they pass through USB.
MSCD comprises three layers: HMSDD interface (DDI functions), HCD interface (HCI functions), and HMSCD itself.
HMSCD supports storage commands necessary for accessing USB storage devices and sample storage commands.
HMSCD has the following features.

- Support for USB mass storage class BOT.
- Support for SFF-8070i (ATAPI) and SCSI USB mass storage subclasses.
- Sharing of a single pipe for IN/OUT directions or multiple devices.

8.2 Issuing Requests to HMSCD

The interface functions described below (Table 8.4and Table 8.5) are used when accessing USB storage devices.
HMSCD sends notification of results in response to requests from a higher layer in the return value of the registered callback function...

8.3 HMSCD Structures

Table 8.1 and Table 8.2 show the contents of the HMSCD structures.

Table 8.1 USB_MSC_CBW_t Structure

	Member Name	Description	Remarks
uint32_t	dCBWSignature	CBW Signature	0x55534243: USBC
uint32_t	dCBWTag	CBW Tag	Tag corresponding to CSW
uint8_t	dCBWDTL_Lo	CBW Data Transfer Length	Data length of transmit/receive data
uint8_t	dCBWDTL_ML		
uint8_t	dCBWDTL_MH		
uint8_t	dCBWDTL_Hi		
uint8_t	bmCBWFlags	CBW Direction	Data transmit/receive direction
uint8_t	bCBWLUN	Logical Unit Number	Unit number
uint8_t	bCBWCBLength	CBWCB Length	Command length
uint8_t	CBWCB[16]	CBWCB	Command block

Table 8.2 USB_MSC_CSW_t Structure

	Member Name	Description	Remarks
uint32_t	dCSWSignature	CSW Signature	0x55534253: USBS
uint32_t	dCSWTag	CSW Tag	Tag corresponding to CBW
uint8_t	dCSWDataResidue_Lo	CSW DataResidue	Data length used
uint8_t	dCSWDataResidue_ML		
uint8_t	dCSWDataResidue_MH		
uint8_t	dCSWDataResidue_Hi		
uint8_t	bCSWStatus	CSW Status	Command status
uint8_t	dummy	Dummy	Even number adjustment

8.4 USB Host Control Driver Interface (HCI) Functions

HCI is the interface function between HMSCD and HCD.
HCI uses the HMSCD area to send and receive messages.
Note that two devices cannot be enumerated (or accessed) simultaneously.

8.5 Device Driver Interface (DDI) Functions

DDI is the interface function between HMSDD and HMSCD.
DDI functions comprise the HMSCD start function, end function, check connected device function, and sample storage command functions.

8.6 HMSC API

Application programming interface description for HMSCD

[Note]

If you want to use the API, which is described in USB Host and Peripheral Interface Driver (Document No: R01AN3291JJ), in the application program, you do not need to use the following API.

Table 8.3 HMSCD Functions

	Function Name	Description
1	R_USB_HmscGetDevSts()	Returns HMSCD operation state.
2	R_USB_HmscDriverStart()	HMSC driver start processing.

Table 8.4 HCI Functions

	Function Name	Description
1	R_USB_HmscGetMaxUnit()	Get_MaxUnit request execution.
2	R_USB_HmscMassStorageReset()	MassStorageReset request execution.

Table 8.5 DDI Functions

	Function Name	Description
1	R_USB_HmscClassCheck()	Checks the descriptor table of the connected device to determine whether or not HMSCD can operate.
2	R_USB_HmscRead10()	Issues the READ10 command.
3	R_USB_HmscWrite10()	Issues the WRITE10 command.

8.6.1 R_USB_HmscGetDevSts

Returns HMSCD operation state

Format

uint16_t R_USB_HmscGetDevSts(uint16_t drvno)

Argument

drvno Drive number

Return Value

usb_ghmsc_AttSts USB_HMSC_DEV_ATT (Attach)
USB_HMSC_DEV_DET (Detach)

Description

Returns the HMSCD operation state.

Note

1. Please call this function from the user application program or the class driver.
2. Specifies the driver number which is allocated by *R_usb_hmsc_alloc_drvno* function in the argument "*drvno*".

Example

```
void  usb_smp_task(USB_UTR_t *ptr)
{
    :
  /* Checking the device state */
  if(R_USB_HmscGetDevSts(drvno) == USB_HMSC_DEV_DET)
  {
    /* Detach processing */

  }
    :
}
```

8.6.2 R_USB_HmscTask

Host Mass Storage Class task

Format

void	R_USB_HmscTask(void)

Argument

—	—

Return Value

—	—

Description

This function is a task for HMSCD.
This function controls BOT.

Note

1. Please call this function from a loop that executes the scheduler processing for non-OS operations.
2. Please refer to the chapter "Operation Flow in Static State" in the Basic F/W application note for more information about this loop.

Example

```
void  usb_smp_mainloop(void)
{
  while(1)
  {
  /* Scheduler processing */
  R_usb_cstd_Scheduler();
  /* Checking flag */
  if(USB_FLGSET == R_usb_cstd_CheckSchedule())
  {
       :
    R_USB_HmscTask();
       :
  }
    :
}
```

8.6.3 R_USB_HmscDriverStart

HMSC driver start

Format

void	R_USB_HmscDriverStart(USB_UTR_t *ptr)

Argument

*ptr	Pointer to USB Transfer structure

Return Value

—	—

Description

This function sets the priority of HMSC driver task.
The sent and received of message are enable by the priority is set.

Note

1. Call this function from the user application program during initialization.
2. Please set the following member of USB_UTR_t structure.

USB_REGADR_t	ipp	: USB register base address
uint16_t	ip	: USB IP Number

Example

```
void usb_hstd_task_start( void )
{
  USB_UTR_t  *ptr;
    :
  ptr->ip = USB_HOST_USBIP_NUM;   /* USB IP No */
  ptr->ipp = R_usb_cstd_GetUsbIpAdr( ptr->ip );  /* USB IP base address */
    :
  R_USB_HmscDriverStart( ptr );      /* Host Class Driver Task Start Setting */
    :
}
```

8.6.4 R_USB_HmscGetMaxUnit

Issue GetMaxLUN request.

Format

USB_ER_t R_USB_HmscGetMaxUnit(USB_UTR_t *ptr, uint16_t addr, USB_CB_t complete)

Argument

*ptr	Pointer to USB_UTR_t structure
addr	Device address
complete	Callback function

Return Value

USB_E_OK	GET_MAX_LUN issued
USB_E_ERROR	GET_MAX_LUN not issued
USB_E_QOVR	GET_MAX_LUN not issued

Description

This function issues the GET_MAX_LUN request and gets the maximum storage unit count. The callback function which is specified in the argument (complete) is called when completing this request.

Note

1. Please call this function from the user application program or the class driver.
2. Please set the following members of USB_UTR_t structure.

USB_REGADR_t	ipp	: USB register base address
uint16_t	ip	: USB IP Number

Example

```
void  usb_smp_task(USB_UTR_t *ptr)
{
  USB_ER_t   err;
    :
  /* Getting Max unit number */
  err = R_USB_HmscGetMaxUnit(mess, addr, (USB_CB_t)usb_hmsc_StrgCheckResult);
  if(err == USB_E_QOVR)
  {
    /* Error processing */
  }
    :
}
```

8.6.5 R_USB_HmscMassStorageReset

Issue Mass Storage Reset request.

Format

USB_ER_t R_USB_HmscMassStorageReset(USB_UTR_t *ptr, uint16_t drvnum, USB_CB_t complete)

Argument

*ptr	Pointer to USB_UTR_t structure
drvnum	Drive number
complete	Callback function

Return Value

USB_E_OK	MASS_STORAGE_RESET issued
USB_E_ERROR	MASS_STORAGE_RESET not issued
USB_E_QOVR	MASS_STORAGE_RESET not issued

Description

This function issues the MASS_STORAGE_RESET request and cancels the protocol error.
The callback function which is specified in the argument (complete) is called when completing this request.

Note

1. Please call this function from the user application program or the class driver.
2. Please set the following members of USB_UTR_t structure.

USB_REGADR_t	ipp	: USB register base address
uint16_t	ip	: USB IP Number

Example

```
void  usb_smp_task(USB_UTR_t *ptr)
{
  USB_ER_t  err;
    :
  /* Cansel the protocol error */
  err = R_USB_HmscMassStorageReset(ptr, drvnum, (USB_CB_t)usb_hmsc_CheckResult);
  if(err == USB_E_QOVR)
  {
   /* Error processing */
  }
    :
}
```

8.6.6 R_USB_HmscClassCheck

Compare connected device with interface descriptor

Format

void R_USB_HmscClassCheck(USB_UTR_t *ptr, uint16_t **table)

Argument

*ptr	Pointer to USB_UTR_t structure
**table	Not used

Return Value

—	—

Description

Checks the device count and drive count, and analyzes the interface descriptor table. Confirms that the items listed below match HMSCD, and reads the serial number if the operation is possible. Updates the pipe information table with information from the bulk endpoint descriptor table (endpoint address, max. packet size, etc.).
Interface descriptor information check
- bInterfaceSubClass = USB_ATAPI / USB_SCSI
- bInterfaceProtocol = USB_BOTP
- bNumEndpoint > USB_TOTALEP

String descriptor information check
Serial number of 12 or more characters (warning indication in case of error)
Endpoint Descriptor information check
- bmAtributes = 0x02 (bulk endpoint required)
- bEndpointAdress (endpoints required for both IN and OUT)

One of the following check results is returned as Table [3].
- USB_DONE: HMSCD operation possible
- USB_ERROR: HMSCD operation not possible

Note

1. In application program, register this API as the callback function by setting this API in the member *classcheck*.
2. The result of USB receiving processing is set to the argument "*ptr" of this function.
3. The maximum connectable storage device count is defined by USB_MAXSTRAGE. (Refer to r_usb_hmsc_define.h)
4. The maximum operable drive count is defined by USB_MAXDRIVE.(Refer to r_usb_hmsc_define.h)

Example

```
void  usb_hapl_registration(USB_UTR_t *ptr)
{
    :
  /* Driver check */
  driver.classcheck   = &R_USB_HmscClassCheck;
    :
}
```

8.6.7 R_USB_HmscRead10

Issue a READ10 command

Format

uint16_t	R_USB_HmscRead10(USB_UTR_t *ptr, uint16_t side, uint8_t *buff, uint32_t secno, uint16_t seccnt, uint32_t trans_byte)

Argument

*ptr	Pointer to USB_UTR_t structure
side	Drive number
*buff	Read data area
secno	Sector number
seccnt	Sector count
trans_byte	Transfer data length

Return Value

–	Error code

Description

Creates and executes the READ10 command.
When a command error occurs, the REQUEST_SENSE command is executed to get error information.

Note

1. Please call this function from the user application program or the class.driver.
2. Please set the following members of USB_UTR_t structure.

USB_REGADR_t	ipp	: USB register base address
uint16_t	ip	: USB IP Number

Example

```
void  usb_smp_task(USB_UTR_t *ptr)
{
  uint32_t  result;
    :
  /* Issuing READ10 */
  result = R_USB_HmscRead10(ptr, side, buff, secno, seccnt, trans_byte);
  if(result != USB_HMSC_OK)
  {
    /* Error Processing */
  }
    :
}
```

8.6.8 R_USB_HmscWrite10

Issue a WRITE10 command

Format

uint16_t R_USB_HmscWead10(USB_UTR_t *ptr, uint16_t side, uint8_t *buff, uint32_t secno, uint16_t seccnt, uint32_t trans_byte)

Argument

*ptr	Pointer to USB_UTR_t structure
side	Drive number
*buff	Write data area
secno	Sector number
seccnt	Sector count
trans_byte	Transfer data length

Return Value

–	Error code

Description

Creates and executes the WRITE10 command.
When a command error occurs, the REQUEST_SENSE command is executed to get error information.

Note

1. Please call this function from the user program or the class driver.
2. Please set the following members of USB_UTR_t structure.
   USB_REGADR_t ipp : USB register base address
   uint16_t ip : USB IP Number

Example

```
void  usb_smp_task(USB_UTR_t *ptr)
{
  uint32_t  result;
    :
  /* Issuing WRITE10 */
  result = R_USB_HmscWrite10(ptr, side, buff, secno, seccnt, trans_byte);
  if(result != USB_HMSC_OK)
  {
    /* Error processing */
  }
    :
}
```

9. Sample Application

9.1 Application Specifications

The main functions of the HMSC sample application (hereafter APL) are as follows.

1. The APL performs the enumeration and drive recognition processing on an MSC device.
2. After completion of 1 above, the APL writes the file 'hmscdemo.txt' to the MSC device once.
3. After writing the above file, the APL repeatedly reads the file 'hmscdemo.txt'.
4. By using a USB Hub, the APL can perform the above processing 1 through 3 on up to four MSC devices.

[Note]

1. If the MSC device where the file 'hmscdemo.txt' is stored is connected, that file is overwritten.
2. The APL displays the log on the terminal software upon device connection, completion of the drive recognition processing, and device detachment.
3. For setting the terminal software, see "Table 1.1 Operation Confirmation Conditions".

9.2 Application Processing

The APL comprises two parts: initial setting and main loop. The following gives the processing summary for each part.

9.2.1 Initial Setting

In the initial setting part, the initial setting of the USB controller and the initialization of the application program are performed.

9.2.2 Main Loop

This main loop controls the program using the return values from the R_USB_GetEvent function and state variables. The return values of the R_USB_GetEvent function are used for the USB event management such as attach and detach. File write/read is performed on the MSC device based on the state checked with the state variable.

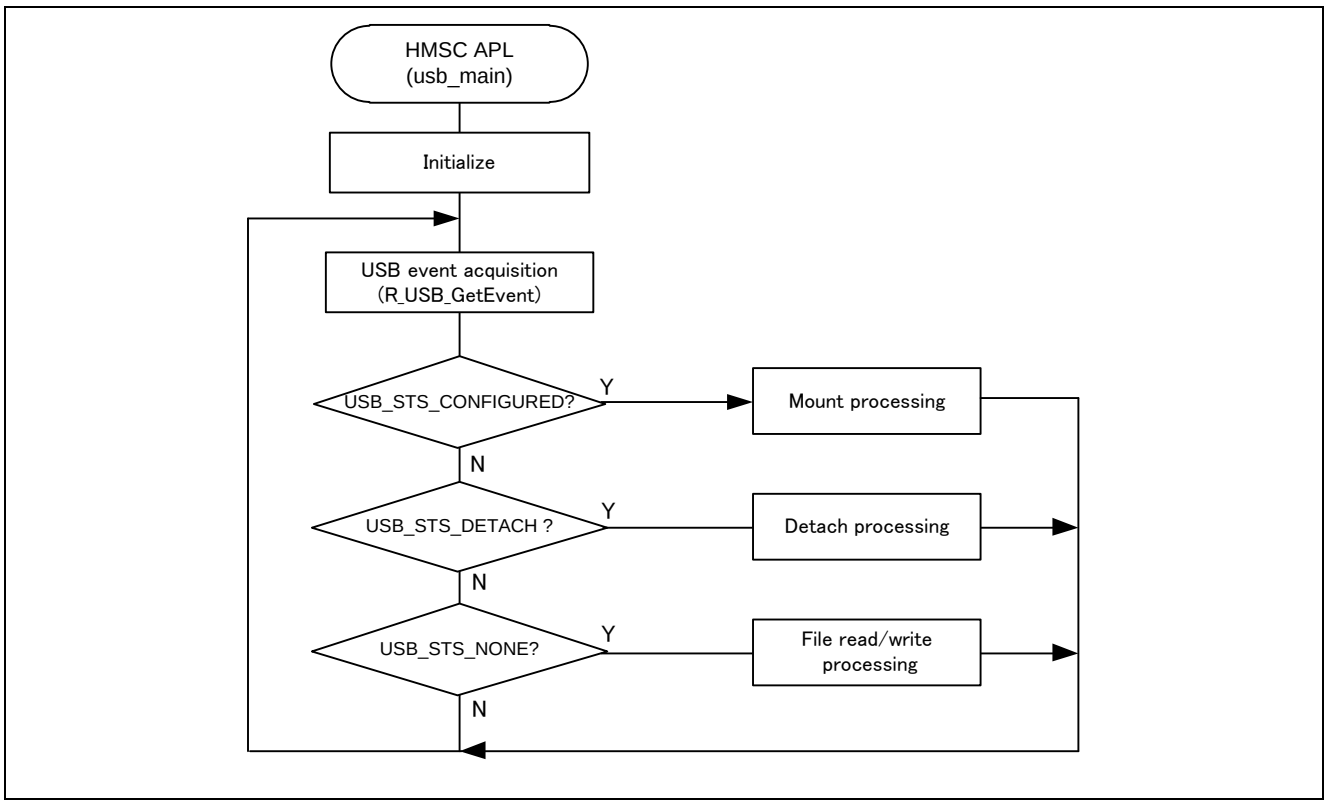

Figure 9-1 Main Loop

1) **Mount processing (USB_STS_CONFIGURED)**

When the R_USB_GetEvent function is called after the MSC device is attached to the GENMAI board and the enumeration and drive recognition processing is completed, USB_STS_CONFIGURED is set for the return value. After the application program checks that USB_STS_CONFIGURED has been set for the return value and performs the Mount processing, then it assigns STATE_FILE_WRITE to the state management variable to perform the file write/read processing.

2) **File write/read processing (USB_STS_NONE)**

When the R_USB_GetEvent function is called with no USB-related event, USB_STS_NONE is set for the return value. The application program checks that USB_STS_NONE has been set for the return value and then performs the following. This application program performs the file write/read on up to four MSC devices using the USB Hub. Management of each MSC device is executed with its device address using the state management variable.

a. When the state management variable is STATE_FILE_WRITE
   Performs the file write processing on an MSC device using the FAT API. After completion of the file write, assigns STATE_FILE_READ to the state management variable.
b. When the state management variable is STATE_FILE_READ
   Performs the file read processing on an MSC device using the FAT API. After completion of the file read, the file read processing is continued until the MSC is detached.

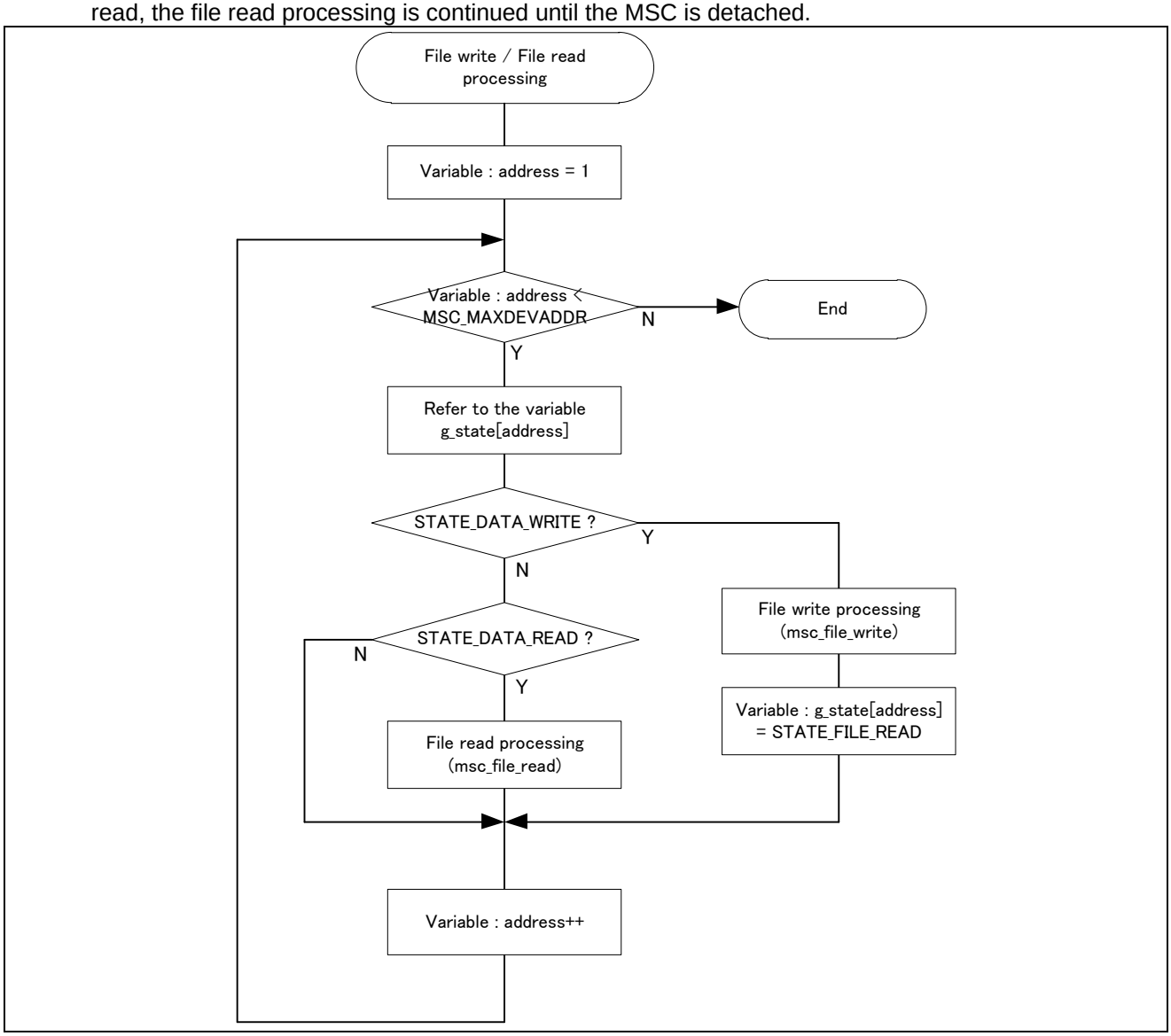

Figure 9-2 File read/write processing

3) **Detach processing (USB_STS_DETACH)**

If the R_USB_GetEvent is called after the MSC device has been detached from the GENMAI board, then USB_STS_DETACH will be the return value. After the application program checks that USB_STS_DETACH has been set for the return value, then it assigns STATE_DETACH to the state management variable.

10. Setup

10.1 Hardware

Figure 10-1 shows an example operating environment for the HMSC. Refer to the associated instruction manuals for details on setting up the evaluation board and using the emulator, etc.

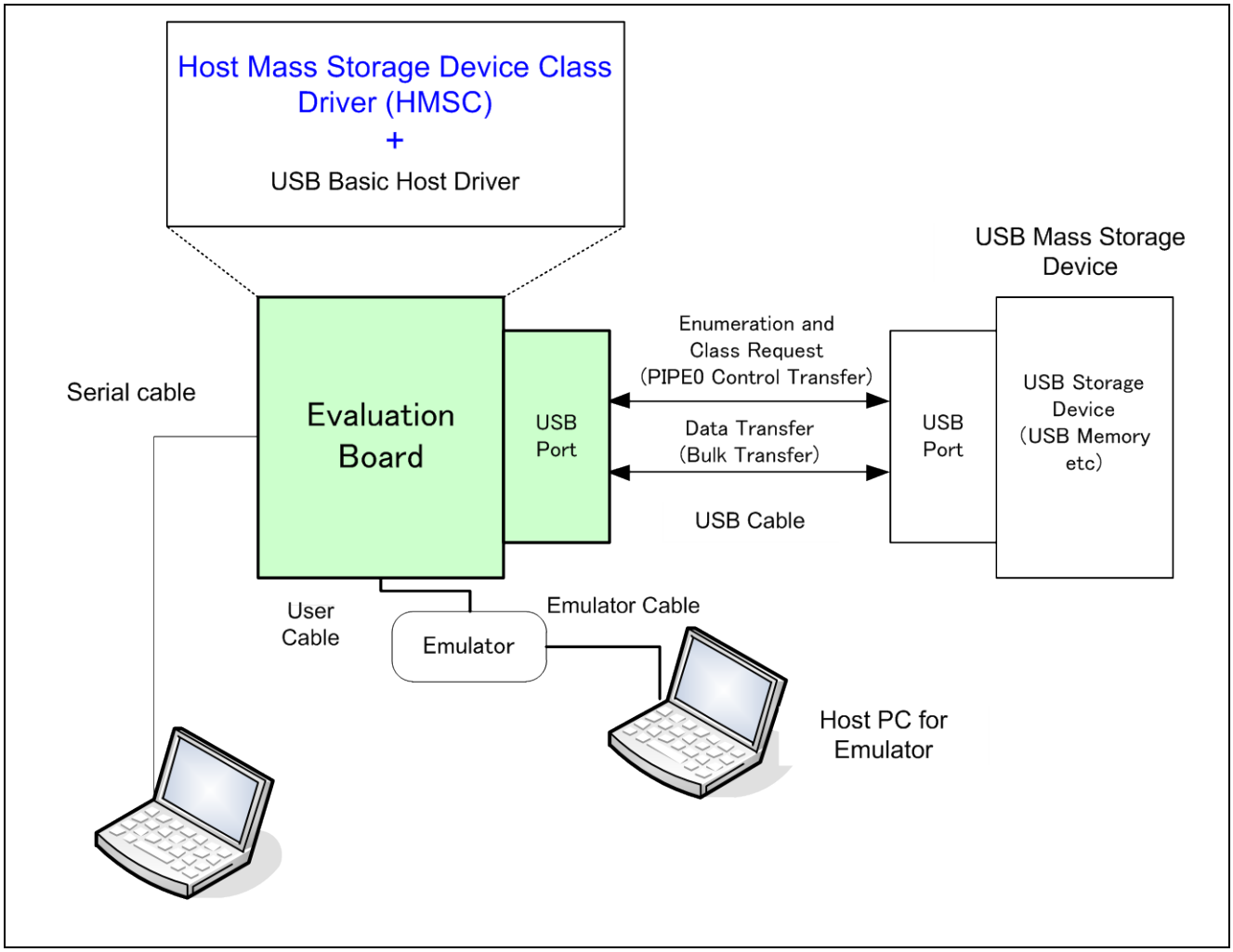

Figure 10-1 Example Operating Environment

Website and Support

Renesas Electronics Website
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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Sep.01.2016	—	First edition issued
1.10	Sep.30.2016	—	Since the USB-BASIC-F / W has been revised, the version up

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU 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 an MPU or MCU 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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