# RX Family

## M3S-TFAT-Tiny Memory Driver Interface Module

## Firmware Integration Technology

### Introduction

This Application Note describes the M3S-TFAT-Tiny Memory Driver Interface module which uses Firmware Integration Technology (FIT). This module uses as memory driver interface to combine RX Family Open source FAT filesystem M3S-TFAT-Tiny FIT(TFAT FIT) with each memory drivers. In this document, this module is referred to as the TFAT driver FIT module.

Please refer to the following URL to know the details about FIT Modules.

https://www.renesas.com/en-us/solutions/rx-applications/fit.html

This Application Note provides the driver interface corresponding to USB and SD memory card and USB Mini. Please use with following FIT Modules.

| Function | Product | Website |
|---|---|---|
| File system<br>(*1) | TFAT FIT<br>(R20AN0038) | http://www.renesas.com/mw/tfat-rx |
| USB Drive<br>(*2) | USB Basic Host and Peripheral Driver<br>USB Host Mass Storage Class Driver | http://www.renesas.com/driver/usb |
| SD memory card Drive<br>(*2) | SD memory card Driver | https://www.renesas.com/driver/rtm0rx0000dsdd |
| USB Mini Drive<br>(*2) | USB Basic Mini Host and Peripheral Driver (USB Mini Firmware)<br>USB Host Mass Storage Class Driver for USB Mini Firmware | http://www.renesas.com/driver/usb |

*1 This is required.
*2 One module is required.

### Target Device

- RX Family

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

### Target Compilers

- Renesas Electronics C/C++ Compiler Package for RX Family
- GCC for Renesas RX

IAR C/C++ Compiler for Renesas RX

For details of the confirmed operation contents of each compiler, refer to “5.1 Operation Confirmation Environment".

## Related Documents

- RX Family Board Support Package Module Using Firmware Integration Technology (R01AN1685)
- RX Family Open Source FAT File System [M3S-TFAT-Tiny] Module Firmware Integration Technology (R20AN0038)
- RX Family SD Mode SD Memory Card Driver Firmware Integration Technology(R01AN4233)
- RX Family USB Host Mass Storage Class Driver (HMSC) Firmware Integration Technology(R01AN2029)
- RX Family USB Host Mass Storage Class Driver for USB Mini Firmware Firmware Integration Technology(R01AN2169)
- RX Family System Timer Module Firmware Integration Technology(R20AN0431)

## Contents

# 1. Overview

## 1.1 This Application Note

This Application describes memory driver interface combines TFAT FIT and each memory drivers. This Module can change the target of memory driver using config file.

The APIs provided by this module are called by TFAT FIT. It is no need to call by user.

The drive number controlled in TFAT FIT and the drive number controlled in USB/SD memory card driver are not equal. Therefore, this module has the conversion table for drive. Initial value can be configured, please refer to the section 2.6 if you change this as dynamic.

## 1.2 Structure of application note

### 1.2.1 Structure of application note

This application note includes files below.

**Table 1.1 Structure of application note**

| file/folder name | description |
|---|---|
| r20an0335ej0200-rx-tfat.pdf | Application note |
| FITModules | |
| driver_rx_v2.00.xml | FIT plug-in XML |
| driver_rx_v2.00_extend.mdf | Smart Configurator setting File |
| driver_rx_v2.00.zip | FIT plug-in ZIP |
| configuration (r_config) | |
| driver_rx_config.h | configuration file(default) |
| FIT Module (driver_rx) | |
| document(doc) | |
| English(en) | |
| r20an0335ej0200-rx-tfat.pdf | Application note (English) |
| Japanese(ja) | |
| r20an0335jj0200-rx-tfat.pdf | Application note (Japanese) |
| configuration refer reference (ref) | |
| driver_rx_config_reference.h | configuration file(template) |
| source code(src) | |
| readme (readme.txt) | readme |
| r_tfat_driver_rx_if.h | Header file |

### 1.2.2 Structure of software

This product works with the TFAT FIT, the system timer module FIT, and various device driver FITs.

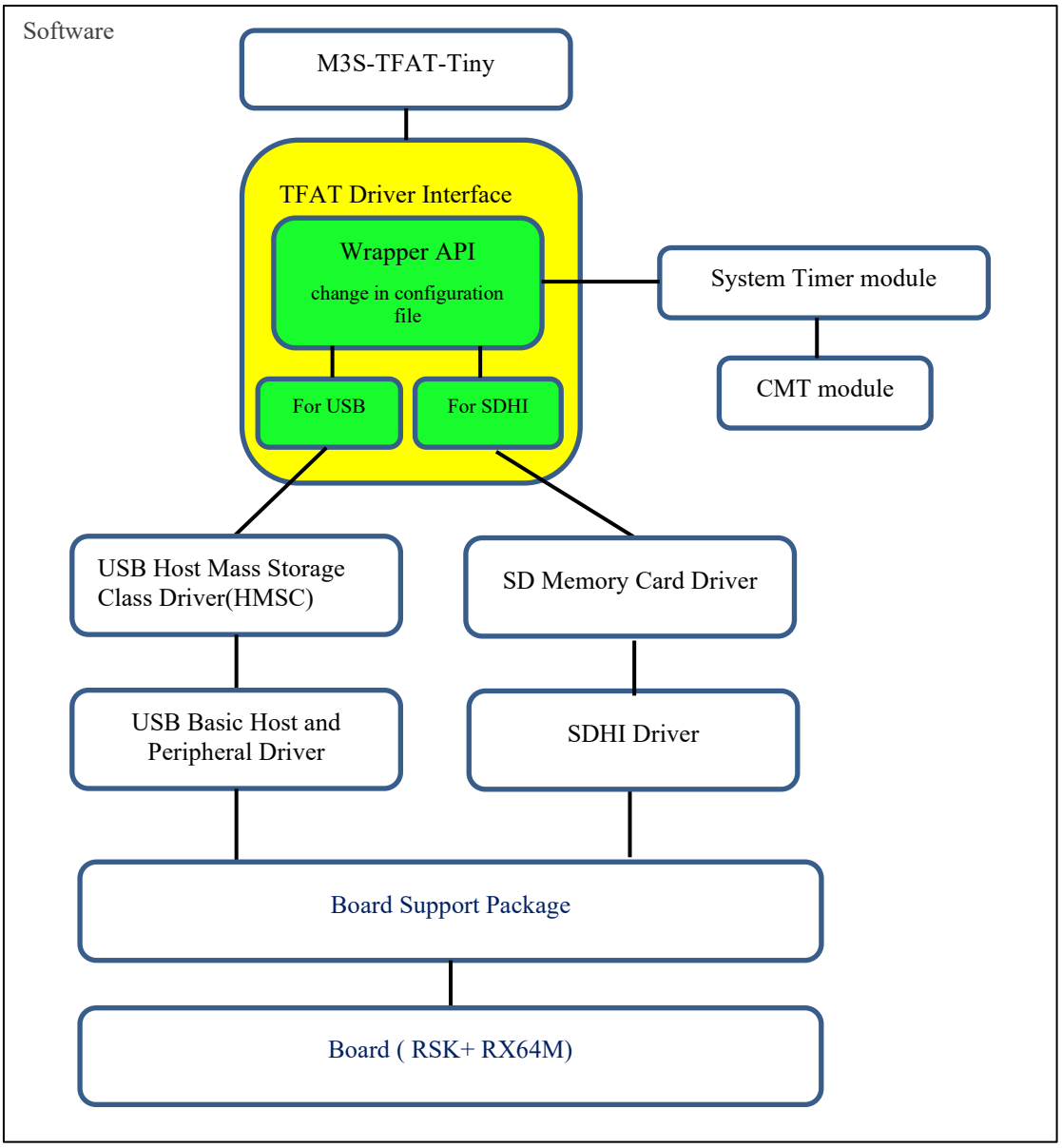


**Fig.1-1 Application Structure (RSK RX64M)**

**Table 1.2 Using FIT Modules version**

| Product | version |
|---|---|
| Board Support Package (BSP) | 5.50 |
| M3S-TFAT-Tiny | 4.00 |
| USB Driver<br>USB Basic Host and Peripheral Driver<br>USB Host Mass Storage Class Driver | <br>1.30<br>1.30 |
| SD Memory Card Driver<br>SD Memory Card Driver<br>SDHI Driver | <br>3.00<br>2.06 |
| USB Basic Host and Peripheral Driver (USB Mini Firmware)<br>USB Host Mass Storage Class Driver for USB Mini Firmware. | 1.11<br>1.11 |
| System Timer module<br>System timer module<br>CMT module | <br>1.01<br>4.31 |

## 1.3 API Overview

Table 1.3 shows the API Functions for this driver.

**Table 1.3 API Functions**

| Function | Functional Overview |
|---|---|
| disk_initialize | Initialize disk drive. |
| disk_status | Get the information about disk drive status. |
| disk_read | Read the data from disk. |
| disk_write | Write the data to disk. |
| disk_ioctl | Control the drive. |
| get_fattime | Get the time information. |
| drv_change_alloc | Change the relating of TFAT module drive number and memory driver drive number. |

# 2. API Information

## 2.1 Hardware Requirements

The microcontroller used must support the following functionality.

- USB
- SDHI
- CMT

## 2.2 Software Requirements

This FIT Module is dependent on the following packages:

- r_bsp(Rev. 5.50 or more)
- r_tfat_rx (Rev.4.00 or more)
- r_usb_hmsc (Rev.1.30 or more)
- r_usb_hmsc_mini
- r_sdmemory_rx (Rev.3.00 or more)
- r_sys_time_rx (Rev.1.01 or more)

The kind of memory driver to use can be set in driver_rx_config.h.

SD memory cards and USBs can be used at the same time.

The target device of this module is dependent on the target device of each memory drivers.

## 2.3 Supported Toolchain

The supported toolchains of this module is depend on the toolchains of each memory drivers.

## 2.4 Header Files

All API calls and their supporting interface definitions are located in "r_tfat_driver_rx_if.h". Build-time configuration options are selected or defined in the file "r_tfat_driver_rx_config.h".

## 2.5 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”.

## 2.6 Configuration Overview

The configuration options in this module are specified in "r_tfat_driver_rx_config.h”. The option names and setting values are listed in the table below.

| Configuration options in r_tfat_driver_rx_config.h | |
|---|---|
| #define<br>TFAT_USB_DRIVE_NUM<br>- Default value = (0) | The number of drives for USB.<br>Please set (0) if user does not use USB. |
| #define<br>TFAT_SDMEM_DRIVE_NUM<br>- Default value = (0) | The number of drives for SD memory card.<br>Please set (0) if user does not use SD memory card. |
| #define<br>TFAT_USB_MINI_DRIVE_NUM<br>- Default value = (0) | The number of drives for USB Mini.<br>Please set (0) if user does not use USB Mini. |
| #define<br>TFAT_DRIVE_ALLOC_NUM_i<br>i = 0-9<br>- Default value = (TFAT_CTRL_NONE) | This config allocates the device for each drive number.<br>The drive for USB = (TFAT_CTRL_USB)<br>The driver for SD memory card =(TFAT_CTRL_SDMEM)<br>The driver for USB Mini =(TFAT_CTRL_USB_MINI)<br>The driver for “not using” = (TFAT_CTRL_NONE)<br><br>This module uses these parameters for relating the drive number for TFAT FIT with the drive number of memory driver. The drive number is allocated ascending order. Please refer to the section 3.7 drv_change_alloc if user change this in dynamic. |
| #define<br>RI600V4_MUTEX_ID_FOR_TFAT_<br>DRIVE_ALLOC_NUM_i<br>i = 0~9<br>- Default value = (0) | When using RI600V4, input the mutex ID created by RI600V4 configuration.<br>This mutex is used by TFAT APIs to obtain the reentrancy (file/directory exclusive access) on a drive (logical volume).<br>Please set (0) if not use RI600V4 or the memory drive. Duplication with ID “0” is allowed.<br>Please set (1 to 255) for mutex ID if use RI600V4 and the memory drive. Duplication with ID for other using drives is not allowed. |

## 2.7 Code Size

The sizes of ROM, RAM and maximum stack usage associated with this module are listed below. Information is listed for a single representative device of the RX200 Series, and RX600 Series, respectively.

The ROM (code and constants) and RAM (global data) sizes are determined by the build-time configuration options described in 2.6, Configuration Overview.

The values in the table below are confirmed under the following conditions.

Module Revision: r_tfat_driver_rx rev.2.00

Compiler Version: Renesas Electronics C/C++ Compiler Package for RX Family V3.02.00

(The option of "lang = c99" is added to the default settings of the integrated development environment.)

GCC for Renesas RX 8.3.0.201904

(The option of "-std=gnu99" is added to the default settings of the integrated development environment.)

IAR C/C++ Compiler for Renesas RX version 4.13.1

(The default settings of the integrated development environment.)

Configuration Options: Default settings

**ROM, RAM and Stack Code Sizes**

| Device | Category | Memory Used | | |
|---|---|---|---|---|
| | | Renesas Compiler | GCC | IAR Compiler |
| RX113 | ROM(Note) | 7,046 bytes | 4,096 bytes | 8,239 bytes |
| | RAM(Note) | 32 bytes | 36 bytes | 32 bytes |
| | STACK (Note) | 144 bytes | - | 288 bytes |
| RX231 | ROM(Note) | 6,788 bytes | 13,840 bytes | 7,920 bytes |
| | RAM(Note) | 30 bytes | 32 bytes | 30 bytes |
| | STACK (Note) | 144 bytes | - | 288 bytes |
| RX65N | ROM(Note) | 7,069 bytes | 14,231 bytes | 8,284 bytes |
| | RAM(Note) | 32 bytes | 36 bytes | 32 bytes |
| | STACK (Note) | 144 bytes | - | 288 bytes |

Note . The sizes of ROM, RAM, and stack of TFAT FIT is included.

## 2.8 Arguments

Please use definition of drive number when calling TFAT FIT.

```
typedef enum
{
   TFAT_DRIVE_NUM_0 = 0x00,
   TFAT_DRIVE_NUM_1,
   TFAT_DRIVE_NUM_2,
   TFAT_DRIVE_NUM_3,
   TFAT_DRIVE_NUM_4,
   TFAT_DRIVE_NUM_5,
   TFAT_DRIVE_NUM_6,
   TFAT_DRIVE_NUM_7,
   TFAT_DRIVE_NUM_8,
   TFAT_DRIVE_NUM_9,
}TFAT_DRV_NUM;
```

## 2.9 Return Values

Return values are defined in "diskio.h" in TFAT FIT module.

```
/* Disk Status Bits (DSTATUS) */
typedef uint8_t DSTATUS;
```

- #define STA_NOINIT 0x01 /* Drive not initialized */
- #define STA_NODISK 0x02 /* No medium in the drive */
- #define STA_PROTECT 0x04 /* Write protected */

```
/* Results of Disk Functions */
typedef enum
{
        RES_OK = 0,     /* 0: Successful */
        RES_ERROR,      /* 1: R/W Error */
        RES_WRPRT,      /* 2: Write Protected */
        RES_NOTRDY,     /* 3: Not Ready */
        RES_PARERR      /* 4: Invalid Parameter */
} DRESULT;
```

## 2.10 Adding the FIT Module to Your Project

This module must be added to each project in which it is used. Renesas recommends using “Smart Configurator” described in (1) or (3). However, “Smart Configurator” only supports some RX devices. Please use the methods of (2) or (4) for unsupported RX devices.

(1) Adding the FIT module to your project using “Smart Configurator” in e$^2$ studio
By using the “Smart Configurator” in e$^2$ studio, the FIT module is automatically added to your project. Refer to “Renesas e$^2$ studio Smart Configurator User Guide (R20AN0451)” for details.

(2) Adding the FIT module to your project using “FIT Configurator” in e$^2$ studio
By using the “FIT Configurator” in e$^2$ 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 “Smart Configurator” on CS+
By using the “Smart Configurator Standalone version” in CS+, the FIT module is automatically added to your project. Refer to “Renesas e$^2$ studio Smart Configurator User Guide (R20AN0451)” for details.

(4) Adding the FIT module to your project in 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.

# 3. API Functions

These functions are called TFAT module, these functions calls lower layer functions according to the configuration. 4 Local API explains lower functions.

**Table 3.1 Functions List**

| Function Name | Function Overview |
|---|---|
| disk_initialize | Initialize disk drive |
| disk_status | Get disk status |
| disk_read | Read sectors |
| disk_write | Write sectors |
| disk_ioctl | Control device dependent features |
| get_fattime | Get current time |
| drv_change_alloc | Change the relating of TFAT module drive number with memory driver drive number. |

## 3.1 disk_initialize

The disk_initialize function is called to initializes the storage device.

### format

```
#include "ff.h"
DSTATUS disk_initialize (
  BYTE pdrv           /* [IN] Physical drive number */
);
```

### Parameters

pdrv

Physical drive number to identify the target device. Always zero at single drive system.

### Return Values

This function returns the current drive status flags as the result. For details of the drive status, refer to the disk_status function.

### Properties

Prototyped in file “ff.h”.

## 3.2 disk_status

The disk_status function is called to inquire the current drive status.

### format

```
DSTATUS disk_status (
  BYTE pdrv     /* [IN] Physical drive number */
);
```

### Parameters

pdrv

Physical drive number to identify the target device. Always zero at single drive system.

### Return Values

The current drive status is returned in combination of status flags described below. FatFs refers only STA_NOINIT and STA_PROTECT.

STA_NOINIT
: Indicates that the device has not been initialized and not ready to work. This flag is set on system reset, media removal or failure of disk_initialize function. It is cleared on disk_initialize function succeeded. Any media change that occurs asynchronously must be captured and reflect it to the status flags, or auto-mount function will not work correctly. If the system does not support media change detection, application program needs to explicitly re-mount the volume with f_mount function after each media change.

STA_NODISK
: Indicates that no medium in the drive. This is always cleared at fixed disk drive. Note that FatFs does not refer this flag.

STA_PROTECT
: Indicates that the medium is write protected. This is always cleared at the drives without write protect function. Not valid if STA_NODISK is set.

### Properties

Prototyped in file “ff.h”.

### Description

None.

### Example

None.

### Special Notes:

None.

### Description
This function initializes the storage device and put it ready to generic read/write. When the function succeeded, STA_NOINIT flag in the return value is cleared.

Remarks: This function needs to be under control of FatFs module. Application program MUST NOT call this function, or FAT structure on the volume can be broken. To re-initialize the filesystem, use f_mount function instead.

### Example
None.

### Special Notes:
None.

## 3.3 disk_read

The disk_read function is called to read data from the sector(s) of storage device.

### format
```
#include "ff.h"
DRESULT disk_read (
  BYTE pdrv,      /* [IN] Physical drive number */
  BYTE* buff,     /* [OUT] Pointer to the read data buffer */
  DWORD sector,   /* [IN] Start sector number */
  UINT count      /* [IN] Number of sectros to read */
);
```

### Parameters
pdrv

Physical drive number to identify the target device.

buff

Pointer to the first item of the byte array to store read data. Size of read data will be the sector size * count bytes.

sector

Start sector number in 32-bit logical block address (LBA).

count

Number of sectors to read.

### Return Values

RES_OK (0)

The function succeeded.

RES_ERROR

An unrecoverable hard error occured during the read operation.

RES_PARERR

Invalid parameter.

RES_NOTRDY

The device has not been initialized.

### Properties

Prototyped in file “ff.h”.

### Description

Read/write operation to the generic storage devices, such as memory card, hadddisk and optical disk, is done in unit of block of data bytes called sector. FatFs supports the sector size in range of 512 to 4096 bytes. When FatFs is configured for fixed sector size (FF_MIN_SS == FF_MAX_SS, this is the most case), the read/write function must work at that sector size. When FatFs is configured for variable sector size (FF_MIN_SS < FF_MAX_SS), the sector size of medium is inquired with disk_ioctl function immediately following disk_initialize function succeeded.

There are some considerations about the memory addres passed via buff. It is not that always aligned to word boundary because the argument is defined as BYTE*. The unaligned transfer request can occure at direct transfer. If the bus architecture, especially DMA controller, does not allow unaligned memory access, it should be solved in this function. If it is the case, there are some workarounds described below to avoid this issue.

Convert word transfer to byte transfer with some method in this function. - Recommended.

On the f_read() calls, avoid long read request that includes a whole of sector. - Any direct transfer never occures.

On the f_read(fp, dat, btw, bw) calls, make sure that (((UINT)dat & 3) == (f_tell(fp) & 3)) is true. - Word alignment of buff is guaranteed.

Also the memory area may be out of reach in DMA. This is the case if it is in tightly coupled memory which is usually used for stack. Use double buffered transfer, or avoid to define any file I/O buffer includes FatFs and FIL structure as local variables where on the stack.

Generally, a multiple sector read request must not be split into single sector transactions to the storage device, or read throughput gets worse.

### Example

None.

### Special Notes:

None.

## 3.4 disk_write

The disk_write function is called to write data to the sector(s) of storage device.

### format

```
DRESULT disk_write (
  BYTE pdrv,         /* [IN] Physical drive number */
  const BYTE* buff, /* [IN] Pointer to the data to be written */
  DWORD sector,      /* [IN] Sector number to write from */
  UINT count         /* [IN] Number of sectors to write */
);
```

### Parameters

pdrv

Physical drive number to identify the target device.

buff

Pointer to the first item of the byte array to be written. The size of data to be written is sector size * count bytes.

sector

Start sector number in 32-bit logical block address (LBA).

count

Number of sectors to write.

### Return Values

RES_OK (0)

The function succeeded.

RES_ERROR

An unrecoverable hard error occured during the read operation.

RES_PARERR

Invalid parameter.

RES_NOTRDY

The device has not been initialized.

### Properties
Prototyped in file “ff.h”.

### Description
The specified memory address is not that always aligned to word boundary because the argument is defined as BYTE*. For more information, refer to the description of disk_read function.

Generally, a multiple sector write request (count > 1) must not be split into single sector transactions to the storage device, or the file write throughput will be drastically decreased.

FatFs expects delayed write function of the disk control layer. The write operation to the media does not need to be completed at return from this function by what write operation is in progress or data is only stored into the write-back cache. But write data on the buff is invalid after return from this function. The write completion request is done by CTRL_SYNC command of disk_ioctl function. Therefore, if a delayed write function is implemented, the write throughput of the filesystem will be improved.

Remarks: Application program MUST NOT call this function, or FAT structure on the volume can be collapsed.

### Example
None.

### Special Notes:
This function is not needed when FF_FS_READONLY = 1.

## 3.5 disk_ioctl

The disk_ioctl function is called to control device specific features and miscellaneous functions other than generic read/write.

### format

```
DRESULT disk_ioctl (
  BYTE pdrv,      /* [IN] Drive number */
  BYTE cmd,       /* [IN] Control command code */
  void* buff      /* [I/O] Parameter and data buffer */
);
```

### Parameters

pdrv
Physical drive number to identify the target device.

cmd
Command code.

buff
Pointer to the parameter depends on the command code. Do not care if the command has no parameter to be passed.

### Return Values

RES_OK (0)

The function succeeded.

RES_ERROR

An error occured.

RES_PARERR

The command code or parameter is invalid.

RES_NOTRDY

The device has not been initialized.

### Properties
Prototyped in file “ff.h”.

### Description
The FatFs module requires only five device independent commands described below.

**Table 3.2 independent commands**

| Command | Describe |
|---|---|
| CTRL_SYNC | Make sure that the device has finished pending write process. If the disk I/O module or storage device has a write-back cache, the cached data marked dirty must be written back to the media immediately. Nothing to do for this command if each write operation to the media is completed within the disk_write function. |
| GET_SECTOR_SIZE | Returns number of available sectors on the drive into the DWORD variable pointed by buff. This command is used by f_mkfs and f_fdisk function to determine the volume/partition size to be created. Required at FF_USE_MKFS = 1. |
| GET_SECTOR_COUNT | Returns sector size of the device into the WORD variable pointed by buff. Valid return values for this command are 512, 1024, 2048 and 4096. This command is required only if FF_MAX_SS > FF_MIN_SS. When FF_MAX_SS = FF_MIN_SS, this command is never used and the device must work at that sector size. |
| GET_BLOCK_SIZE | Returns erase block size of the flash memory media in unit of sector into the DWORD variable pointed by buff. The allowable value is 1 to 32768 in power of 2. Return 1 if the erase block size is unknown or non flash memory media. This command is used by only f_mkfs function and it attempts to align data area on the erase block boundary. Required at FF_USE_MKFS = 1. |
| CTRL_TRIM | Informs the device the data on the block of sectors is no longer needed and it can be erased. The sector block is specified by a DWORD array {<start sector>, <end sector>} pointed by buff. This is an identical command to Trim of ATA device. Nothing to do for this funcion is not supported or not a flash memory device. FatFs does not check the result code and the file function is not affected even if the sector block was not erased well. This command is called on remove a cluster chain and in the f_mkfs function. Required at FF_USE_TRIM = 1. |

### Example
None.

### Special Notes:
The disk_ioctl function is not needed when FF_FS_READONLY = 1 and FF_MAX_SS = FF_MIN_SS.

## 3.6 get_fattime

The get_fattime function is called to get the current time.

### format

```
DWORD get_fattime (void);
```

### Parameters

None,

### Return Values

Currnet local time shall be returned as bit-fields packed into a DWORD value. The bit fields are as follows:

bit31:25
Year origin from the 1980 (0..127, e.g. 37 for 2017)

bit24:21
Month (1..12)

bit20:16
Day of the month (1..31)

bit15:11
Hour (0..23)

bit10:5
Minute (0..59)

bit4:0
Second / 2 (0..29, e.g. 25 for 50)

### Properties

Prototyped in file “ff.h”.

### Description

The get_fattime function shall return any valid time even if the system does not support a real time clock. If a zero is returned, the file will not have a valid timestamp.

### Example

None.

### Special Notes:

This function is not needed when FF_FS_READONLY = 1 or FF_FS_NORTC = 1.

## 3.7 drv_change_alloc

The drv_change_alloc function changes a drive's allocation. This function has nothing to do with FatFs and is a unique API of Renesas.

### format

```
DRESULT drv_change_alloc(TFAT_DRV_NUM tfat_drv, uint8_t dev_type,
                         uint8_t dev_drv_num );
```

### Parameters

RES_OK (0)

The function succeeded.

RES_PARERR

The specified value of tfat_drv is invalid.

### Return Values

tfat_drv

Th physical drive number for TFAT FIT.

dev_type

The device define type (TFAT_USB_DRIVE_NUM, TFAT_SDMEM_DRIVE_NUM, or TFAT_USB_MINI_DRIVE_NUM).

dev_drv_num

The drive number/device channel for device driver.

### Properties

Prototyped in file "r_tfat_driver_rx_if.h".

### Description

The drive used for TFAT FIT is specified by the TFAT_DRIVE_ALLOC_NUM_i definition in r_tfat_driver_rx_config.h, and the drive number for TFAT FIT is associated with the drive number of the memory driver.

Drive numbers for memory drivers are automatically assigned in ascending order.

Use this function if you want to change the association dynamically.

### Example

None.

### Special Notes:

None.

# 4. Local API

For USB, SD memory card, and USB Mini functions are prepared. Each function calls own memory driver functions.

## 4.1 For USB

Table 4.1.1. Functions are called when Section 2.6 Configuration Overview TFAT_USB_DRIVE_NUM and TFAT_DRIVE_ALLOC_NUM_i(i=0-9) have the settings “TFAT_CTRL_USB”.

**Table 4.1.1 Functions List**

| Function name | Function Overview |
|---|---|
| usb_disk_initialize | Initialize disk drive |
| usb_disk_read | Read sectors |
| usb_disk_write | Write sectors |
| usb_disk_ioctl | Control device dependent features |
| usb_disk_status | Get disk status |

**Table 4.1.2 Other Functions List**

| Function name | Function Overview |
|---|---|
| R_usb_hmsc_WaitLoop | Wait for read and write |

### 4.1.1 usb_disk_initialize

This function initialize the disk drive.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DSTATUS usb_disk_initialize (uint8_t pdrv);
```

#### Parameters

| | | |
|---|---|---|
| pdrv | input | Specifies the initialize drive number. |

#### Return Value

| | |
|---|---|
| TFAT_RES_OK | Normal termination. |
| Other than TFAT_RES_OK | DSTATUS Status of the disk after function execution as explained in section 2.9 Return Values. |

#### Description

This API does not call USB driver initialize function because of USB driver limitation (1 time call is only accepted). Please call USB driver initialize function in user program.

### 4.1.2 usb_disk_read

This function reads the data from disk.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DRESULT usb_disk_read (   uint8_t   pdrv ,
                          uint8_t   *buff ,
                          uint32_t  sector ,
                          uint8_t    count
);
```

#### Parameters

| | | |
|---|---|---|
| pdrv | input | Specifies the physical drive number. |
| buff | output | Pointer to the read buffer to store the read data. A buffer of the size equal to the number of bytes to be read is required. |
| sector | input | Specifies the start sector number in logical block address (LBA). |
| count | input | Specifies number of sectors to read. The value can be 1 to 255. |

#### Return Value

| | |
|---|---|
| DRESULT | Result of the function execution as explained in section 2.9 Return Values. |

#### Description

This function reads the data from disk drive. The position of read data is specified using this function argument.

### 4.1.3 usb_disk_write

This function writes the data to the disk.

#### Format

```
   #include "r_tfat_drv_if_dev.h"
   DRESULT usb_disk_write (    uint8_t    pdrv ,
                               uint8_t    *buff ,
                               uint32_t   sector ,
                               uint8_t     count
 );
```

#### Parameters

| | | |
|---|---|---|
| pdrv | input | Specifies the physical drive number. |
| buff | input | Pointer to the data to be written. |
| sector | input | Specifies the start sector number in logical block address (LBA). |
| count | input | Specifies number of sectors to write. The value can be 1 to 255. |

#### Return Value

| | |
|---|---|
| DRESULT | Result of the function execution as explained in section 2.9 Return Values. |

#### Remark

This function writes the data to the disk drive. The position of write data is specified using this function argument.

### 4.1.4 usb_disk_ioctl

This function controls the drive.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DRESULT usb_disk_ioctl (  uint8_t   pdrv ,
                          uint8_t   cmd ,
                          void      *buff

);
```

#### Parameters

| | | |
|---|---|---|
| pdrv | input | Specifies the physical drive number. |
| cmd | input | Specifies the command code. The command code will always be 0. |
| buff | input | Pointer should always be a NULL pointer. |

#### Return Value

| | |
|---|---|
| DRESULT | Result of the function execution as explained in section 2.9 Return Values. |

#### Description

The disk_ioctl function is used only by the f_sync function amongst all the TFAT FIT functions. Users who do not plan to use f_sync function in their applications can skip the implementation for this particular driver interface function.

For users who wish to use f_sync function in their applications, this particular driver interface function will have to be implemented. This driver function should consist of the code to finish off any pending write process. If the disk i/o module has a write back cache, the dirty sector must be flushed immediately. The f_sync function will perform a save operation to the unsaved data related to the fileobject passed as argument.

### 4.1.5 usb_disk_status

This function gets the information about disk drive.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DSTATUS usb_disk_status (uint8_t  pdrv );
```

#### Parameters

| | | |
|---|---|---|
| pdrv | input | Specifies the physical drive number. |

#### Return Value

| | |
|---|---|
| TFAT_RES_OK | Normal termination. |
| Other than TFAT_RES_OK | DSTATUS Status of the disk after function execution as explained in section 2.9 Return Values. |

#### Description

This function should consist of the code that checks the disk and returns the current disk status. The disk status can have any of the three values as explained in section 2.9 Return Values. The disk status can be returned by updating the return value with the macros related to disk status.

### 4.1.6 R_usb_hmsc_WaitLoop

This function waits the data read/write.

#### Format

```
void  R_usb_hmsc_WaitLoop (void );
```

#### Parameters

None.

#### Return Value

None.

#### Description

Please refer to the USB driver document for details.

## 4.2 For SD Memory Card

Table 4.2.1. Functions are called when Section 2.6 Configuration Overview TFAT_SDMEM_DRIVE_NUM and TFAT_DRIVE_ALLOC_NUM_i (i=0-9) have the settings “TFAT_CTRL_SDMEM”.

**Table 4.2.1 List of Functions**

| Function Name | Outline |
|---|---|
| sdmem_disk_initialize | Initialize disk drive |
| sdmem_disk_read | Read sectors |
| sdmem_disk_write | Write sectors |
| sdmem_disk_ioctl | Control device dependent features |
| sdmem_disk_status | Get disk status |

[Notice about SD memory card

This module does not execute mount process and VDD power supply process. Please refer to the SD memory card module document and please implement.

### 4.2.1 sdmem_disk_initialize

This function initializes the disk drive.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DSTATUS sdmem_disk_initialize (uint8_t drive);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the initialize drive number. |

#### Return Value

| | |
|---|---|
| TFAT_RES_OK | Normal termination. |
| Other than TFAT_RES_OK | DSTATUS Status of the disk after function execution as explained in section 2.9 Return Values. |

#### Description

This function does not execute the SD memory card driver initialize. Please implement SD memory card initialize code in user code.

### 4.2.2 sdmem_disk_read

This function reads the data from disk.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DRESULT sdmem_disk_read  (     uint8_t    drive ,
                               uint8_t   *buffer ,
                               uint32_t   sector_number ,
                               uint8_t    sector_count
);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the physical drive number. |
| buffer | output | Pointer to the read buffer to store the read data. A buffer of the size equal to the number of bytes to be read is required. |
| sector_number | input | Specifies the start sector number in logical block address (LBA). |
| sector_count | input | Specifies number of sectors to read. The value can be 1 to 255. |

#### Return Value

DRESULT Result of the function execution as explained in section 2.9 Return Values.

#### Description

Read data from SD memory.

### 4.2.3 sdmem_disk_write

This function writes the data to the disk.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DRESULT sdmem_disk_write (     uint8_t    drive ,
                               uint8_t    *buffer ,
                               uint32_t   sector_number ,
                               uint8_t    sector_count
);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the physical drive number. |
| buffer | input | Pointer to the data to be written. |
| sector_number | input | Specifies the start sector number in logical block address (LBA). |
| sector_count | input | Specifies number of sectors to write. The value can be 1 to 255. |

#### Return Value

DRESULT Result of the function execution as explained in section 2.9 Return Values.

#### Description

Writes the data to the SD memory.

### 4.2.4 sdmem_disk_ioctl

This function controls the drive.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DRESULT sdmem_disk_ioctl (     uint8_t  drive ,
                               uint8_t  command ,
                               void      *buffer
);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the physical drive number. |
| command | input | Specifies the command code. The command code will always be 0. |
| buffer | input | Pointer should always be a NULL pointer. |

#### Return Value

| | |
|---|---|
| DRESULT | Result of the function execution as explained in section 2.9 Return Values. |

#### Description

The sdmem_disk_ioctl function is used only by the f_sync function amongst all the TFAT FIT functions. Users who do not plan to use f_sync function in their applications can skip the implementation for this particular driver interface function.

This module does not implement.

### 4.2.5 sdmem_disk_status

This function gets the disk drive status.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DSTATUS sdmem_disk_status (uint8_t  drive
);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the physical drive number. |

#### Return Value

| | |
|---|---|
| TFAT_RES_OK | Normal termination. |
| Other than TFAT_RES_OK | DSTATUS Status of the disk after function execution as explained in section 2.9 Return Values. |

#### Description

This function should consist of the code that checks the disk and returns the current disk status. The disk status can have any of the three values as explained in section 2.9 Return Values. The disk status can be returned by updating the return value with the macros related to disk status.

This module does not implement.

## 4.3 For USB Mini

Table 4.1.1. Functions are called when Section 2.6 Configuration Overview TFAT_USB_MINI_DRIVE_NUM and TFAT_DRIVE_ALLOC_NUM_i(i=0-9) have the settings “TFAT_CTRL_USB_MINI”.

**Table 4.3.1 Functions List**

| Function name | Function Overview |
|---|---|
| usb_mini_disk_initialize | Initialize disk drive |
| usb_mini_disk_read | Read sectors |
| usb_mini_disk_write | Write sectors |
| usb_mini_disk_ioctl | Control device dependent features |
| usb_mini_disk_status | Get disk status |

**Table 4.3.2 Other Functions List**

| Function name | Function Overview |
|---|---|
| R_usb_mini_hmsc_WaitLoop | Wait for read and write |

### 4.3.1 usb_mini_disk_initialize

This function initialize the disk drive.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DSTATUS usb_mini_disk_initialize (uint8_t drive);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the initialize drive number. |

#### Return Value

| | |
|---|---|
| TFAT_RES_OK | Normal termination. |
| Other than TFAT_RES_OK | DSTATUS Status of the disk after function execution as explained in section 2.9 Return Values. |

#### Description

This API does not call USB driver initialize function because of USB driver limitation (1 time call is only accepted). Please call USB driver initialize function in user program.

### 4.3.2 usb_mini_disk_read

This function reads the data from disk.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DRESULT usb_mini_disk_read (       uint8_t   drive ,
                                   uint8_t   *buffer ,
                                   uint32_t  sector_number ,
                                   uint8_t    sector_count
);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the physical drive number. |
| buffer | output | Pointer to the read buffer to store the read data. A buffer of the size equal to the number of bytes to be read is required. |
| sector_number | input | Specifies the start sector number in logical block address (LBA). |
| sector_count | input | Specifies number of sectors to read. The value can be 1 to 255. |

#### Return Value

| | |
|---|---|
| DRESULT | Result of the function execution as explained in section 2.8. |

#### Description

This function reads the data from disk drive. The position of read data is specified using this function argument.

### 4.3.3 usb_mini_disk_write

This function writes the data to the disk.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DRESULT usb_mini_disk_write (     uint8_t    drive ,
                                  uint8_t    *buffer ,
                                  uint32_t   sector_number ,
                                  uint8_t     sector_count
);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the physical drive number. |
| buffer | input | Pointer to the data to be written. |
| sector_number | input | Specifies the start sector number in logical block address (LBA). |
| sector_count | input | Specifies number of sectors to read. The value can be 1 to 255. |

#### Return Value

| | |
|---|---|
| DRESULT | Result of the function execution as explained in section 2.9 Return Values. |

#### Description

This function writes the data to the disk drive. The position of write data is specified using this function argument.

### 4.3.4 usb_mini_disk_ioctl

This function controls the drive.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DRESULT usb_mini_disk_ioctl (        uint8_t  drive ,
                                     uint8_t  command ,
                                     void      *buffer
);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the physical drive number. |
| command | input | Specifies the command code. The command code will always be 0. |
| buffer | input | Pointer should always be a NULL pointer. |

#### Return Value

| | |
|---|---|
| DRESULT | Result of the function execution as explained in section 2.9 Return Values. |

#### Description

The usb_mini_disk_ioctl function is used only by the f_sync function amongst all the TFAT FIT functions. Users who do not plan to use f_sync function in their applications can skip the implementation for this particular driver interface function.

For users who wish to use f_sync function in their applications, this particular driver interface function will have to be implemented. This driver function should consist of the code to finish off any pending write process. If the disk i/o module has a write back cache, the dirty sector must be flushed immediately. The f_sync function will perform a save operation to the unsaved data related to the fileobject passed as argument.

### 4.3.5 usb_mini_disk_status

This function gets the information about disk drive.

#### Format

```
#include "r_tfat_drv_if_dev.h"
DSTATUS usb_mini_disk_status (uint8_t drive);
```

#### Parameters

| | | |
|---|---|---|
| drive | input | Specifies the physical drive number. |

#### Return Value

| | |
|---|---|
| TFAT_RES_OK | Normal termination. |
| Other than TFAT_RES_OK | DSTATUS Status of the disk after function execution as explained in section 2.9 Return Values. |

#### Description

This function should consist of the code that checks the disk and returns the current disk status. The disk status can have any of the three values as explained in section 2.9 Return Values. The disk status can be returned by updating the return value with the macros related to disk status.

### 4.3.6 R_usb_mini_hmsc_WaitLoop

This function waits the data read/write.

#### Format

```
void  R_usb_mini_hmsc_WaitLoop (void );
```

#### Parameters

None.

#### Return Value

None.

#### Description

Please refer to the USB driver document for details.

# 5. Appendices

## 5.1 Confirmed Operation Environment

This section describes operation confirmation environment for TFAT driver FIT.

**Table 5.1 Confirmed Operation Environment (Rev.1.05 for SD Memory Card Driver and USB Mini Driver)**

| Item | Contents |
|---|---|
| Integrated development environment | Renesas Electronics e$^2$ studio V6.3.0 |
| C compiler | Renesas Electronics C/C++ Compiler Package for RX Family V2.08.00 |
| | Compiler option: The following option is added to the default settings of the integrated development environment.<br>-lang = c99 |
| Endian | Big endian/little endian |
| Revision of the module | Rev.1.05 |
| Board used | Renesas Starter Kit+ for RX64M (product No.:R0K50564MSxxxxx)<br>Renesas Starter Kit for RX231 (product No.:R0K505231Sxxxxx) |
| RTOS | None |

**Table 5.2 Confirmed Operation Environment (Rev.1.05 for USB Driver)**

| Item | Contents |
|---|---|
| Integrated development environment | Renesas Electronics e$^2$ studio V7.3.0 |
| C compiler | Renesas Electronics C/C++ Compiler Package for RX Family V3.01.00 |
| | Compiler option: The following option is added to the default settings of the integrated development environment.<br>-lang = c99 |
| Endian | Big endian/little endian |
| Revision of the module | Rev.1.05 |
| Board used | Renesas Starter Kit+ for RX64M (product No.:R0K50564MSxxxxx) |
| RTOS | None |

**Table 5.3 Confirmed Operation Environment (Rev. 2.00)**

| Item | Contents |
|---|---|
| Integrated development environment | Renesas Electronics e$^2$ studio Version 7.7.0<br>IAR Embedded Workbench for Renesas RX 4.13.1 |
| C compiler | Renesas Electronics C/C++ Compiler Package for RX Family V3.02.00<br>Compiler option: The following option is added to the default settings of the integrated development environment.<br>-lang = c99 |
| | GCC for Renesas RX 8.3.0.201904<br>Compiler option: The following option is added to the default settings of the integrated development environment.<br>-std=gnu99 |
| | IAR C/C++ Compiler for Renesas RX version 4.13.1<br>Compiler option: The default settings of the integrated development environment. |
| Endian | Big endian/little endian |
| Revision of the module | Rev.2.00 |
| Board used | Renesas Starter Kit+ for RX72M (product No.: RTK5572Mxxxxxxxxxx) |
| RTOS | FreeRTOS V10.0.00<br>RI600V4 V1.06.00 |

## 5.2 Troubleshooting

(1) Q: I have added the FIT module to the project and built it. Then I got the error: Could not open source file "platform.h".

A: The FIT module may not be added to the project properly. Check if the method for adding FIT modules is correct with the following documents:

- Using CS+:

  Application note "Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826)"

- Using e$^2$ studio:

  Application note "Adding Firmware Integration Technology Modules to Projects (R01AN1723)"

When using this FIT module, the board support package FIT module (BSP module) must also be added to the project. Refer to the application note "Board Support Package Module Using Firmware Integration Technology (R01AN1685)".

(2) Q: I have added the FIT module to the project and built it. Then I got an error for when the configuration setting is wrong.

A: The setting in the file “r_tfat_driver_rx_config.h” may be wrong. Check the file “r_tfat_driver_rx_config.h”. If there is a wrong setting, set the correct value for that. Refer to 2.6 Configuration Overview for details.

## 6. Reference Documents

User's Manual: Hardware
The latest versions can be downloaded from the Renesas Electronics website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Electronics website.

User's Manual: Development Tools
RX Family C/C++ Compiler CC-RX User's Manual (R20UT3248)
The latest version can be downloaded from the Renesas Electronics website.

## Related Technical Updates

This module reflects no technical updates.

## Revision History

| Rev. | Date | Description | |
|---|---|---|---|
| | | Page | Summary |
| 1.00 | Dec 01, 2014 | - | First edition issued |
| 1.01 | Jan 05, 2015 | - | Added support MCUs. |
| 1.02 | Jun 30, 2015 | - | Added support MCU RX231. |
| 1.03 | Oct 01, 2016 | - | Added support RX family. |
| 1.04 | Jun 29, 2018 | - | 1.2.2 Fig.1-1 Added System timer and CMT modules.<br>1.3 Added API Overview<br>2.6 Changed SD memory card define name.<br>2.7 Added Code Size<br>3.6 Modified get_fattime() description.<br>4.2.1-4.2.5 Changed API name.<br>5 Added Appendices<br>6 Added Reference Documents |
| 1.05 | Dec 14, 2018 | - | Revision up by USB driver supporting RTOS. |
| 2.00 | Feb. 25, 2020 | - | Supported the following compilers.<br>- GCC for Renesas RX<br>- IAR C/C++ Compiler for Renesas RX<br>Supported the following RTOS.<br>- FreeRTOS<br>- RI600V4<br>Removed "R_TFAT_" from the function names. |

# 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.

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