

# RX Family

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## Web server using the embedded TCP/IP M3S-T4-Tiny Module Firmware Integration Technology

### Introduction

This application note explains Web server using the embedded TCP/IP M3S-T4-Tiny Module (hereafter Web server).

Web server is provided as Firmware Integration Technology (FIT) Module. Please refer to the URL to know FIT outline.

<http://www.renesas.com/products/mpumcu/rx/rx100/index.jsp#fit>

Web server is used by combining the following middleware products.

Function	Middleware Product	Web Page* <sup>1</sup>
TCP/IP	M3S-T4-Tiny (hereafter T4)	<a href="http://www.renesas.com/mw/t4">http://www.renesas.com/mw/t4</a>
File system	M3S-TFAT-Tiny	<a href="http://www.renesas.com/mw/tfat">http://www.renesas.com/mw/tfat</a>
MMC driver	M3S-MMCSLBR1M* <sup>2</sup>	<a href="http://www.renesas.com/mw/tfat">http://www.renesas.com/mw/tfat</a> <a href="http://www.renesas.com/mw/tfs">http://www.renesas.com/mw/tfs</a>
MMC extensions	Middleware Evaluation board* <sup>3</sup>	<a href="http://www.renesas.com/mw/tfat">http://www.renesas.com/mw/tfat</a> <a href="http://www.renesas.com/mw/tfs">http://www.renesas.com/mw/tfs</a> <a href="http://www.renesas.com/mw/s2">http://www.renesas.com/mw/s2</a> <a href="http://www.renesas.com/mw/dtmf">http://www.renesas.com/mw/dtmf</a>
USB driver	USB driver	<a href="http://www.renesas.com/driver/usb">http://www.renesas.com/driver/usb</a>

Notes: 1. The items with multiple page references can be downloaded from the related middleware sites.

There are no differences between the downloadable application notes themselves.

2. The SD(less 2GB size) card that has compatible command for MMC is available on this software.

3. The middleware evaluation board must be produced by the user based on these application notes.

Since each of these middleware packages are independent, they can be combined freely if the user implements interface programs. For example, the file system can be replaced by another file system, or the MMC driver can be replaced with a USB driver.

Furthermore, since the web server program itself contains no program code that depends on the microcontroller, it can be easily ported to another microcontroller simply by replacing the TCP/IP software stack with one for the other microcontroller.

We prepared sample programs for each CPU board included in [the Renesas Starter Kit](#). For more information, see Renesas Starter Kit for sample application notes.

sample application notes	document number	website
Application example using T4 (DHCP/DNS/FTP/HTTP) Firmware Integration Technology	R20AN0314EJ0100_rx_t4	<a href="http://www.renesas.com/mw/t4">http://www.renesas.com/mw/t4</a>

### Target Device

RX62N, RX63N, RX64M

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## 1. Outline

This web server is an application that operates over TCP/IP, can be accessed from an ordinary web browser, and provides functions for transferring content stored on the web server to web browsers using TCP/IP.

### 1.1 System Structure

Show System Structure Example.

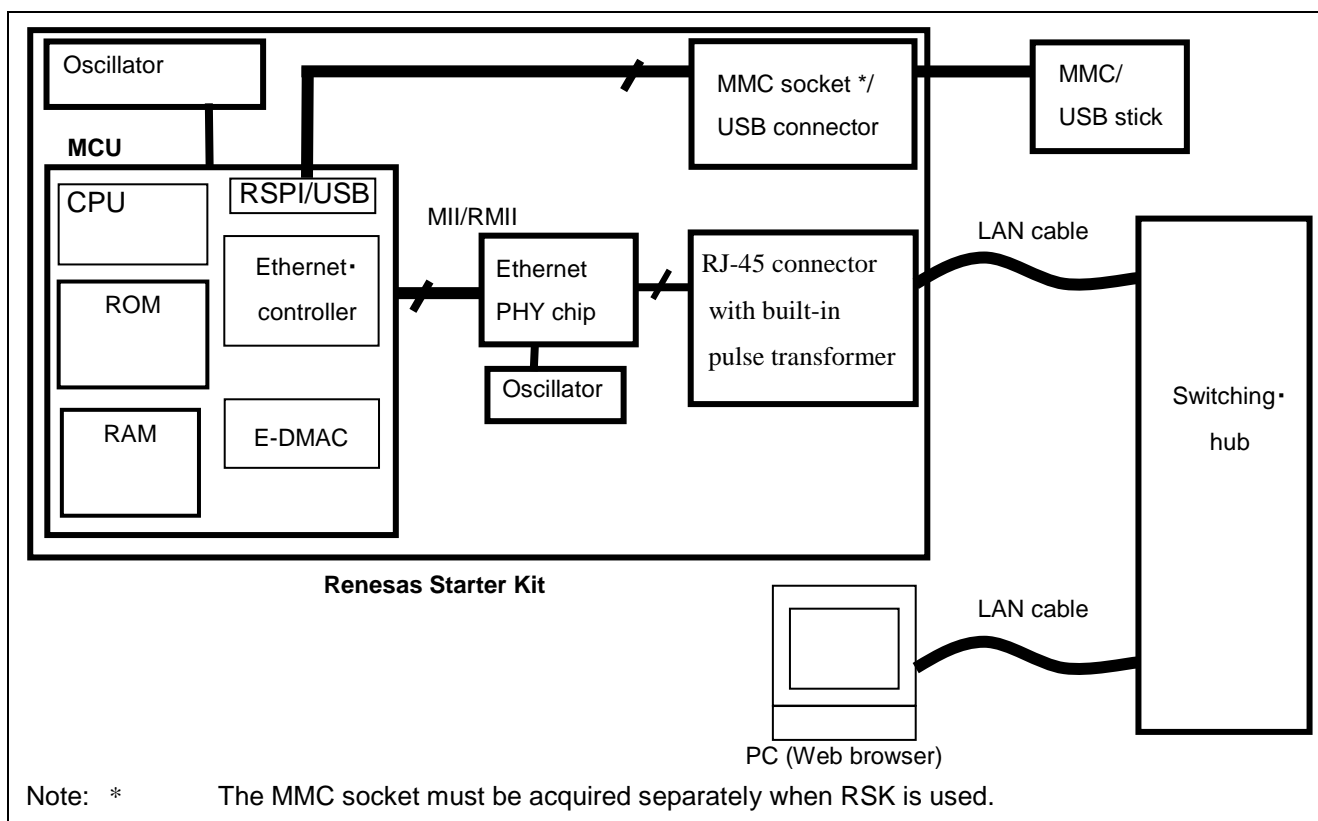


Figure 1 System Structure Example

1.2 Software Structure

1.2.1 In case MMC driver or in case USB driver

Show Software Structure Example in case MMC driver or in case USB driver.

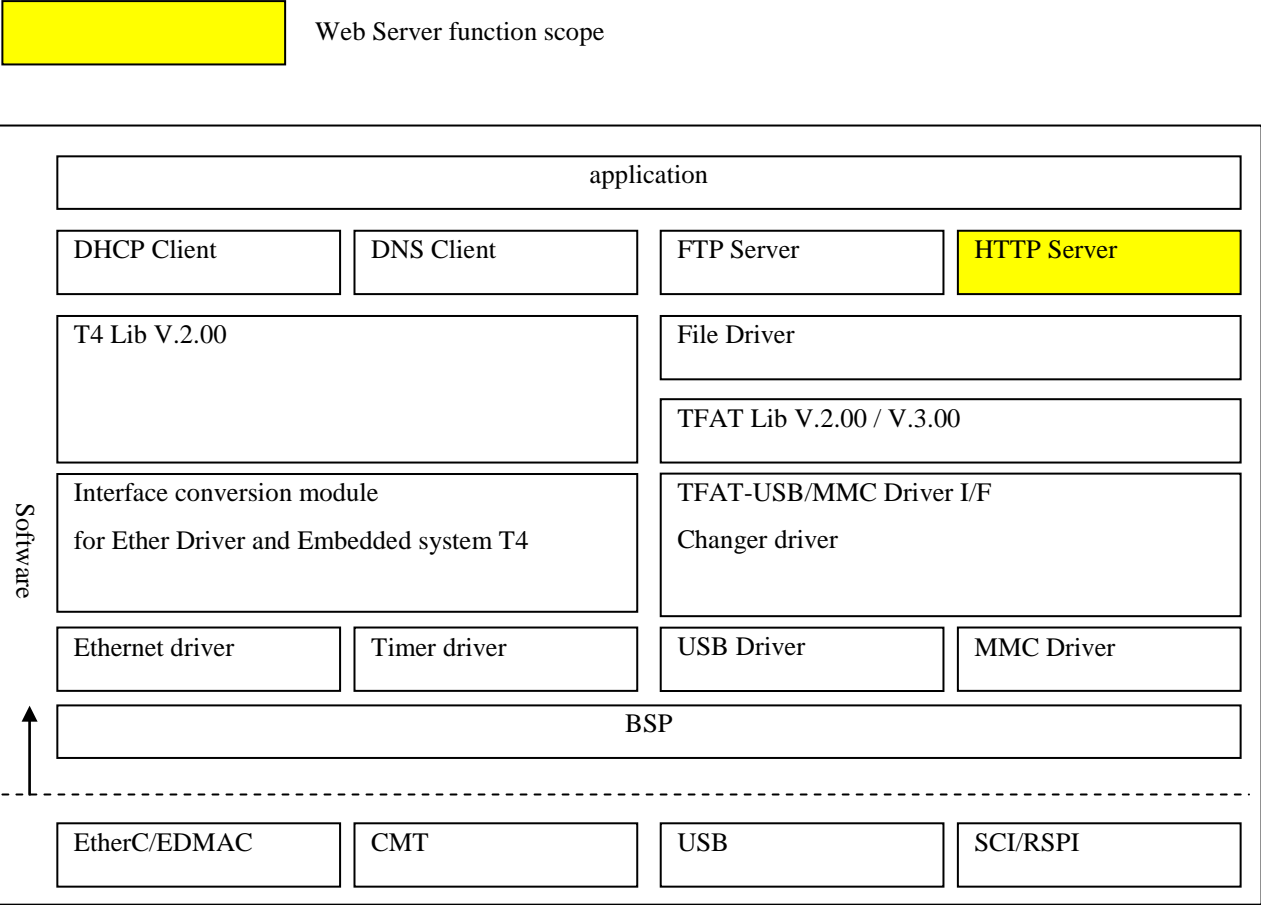
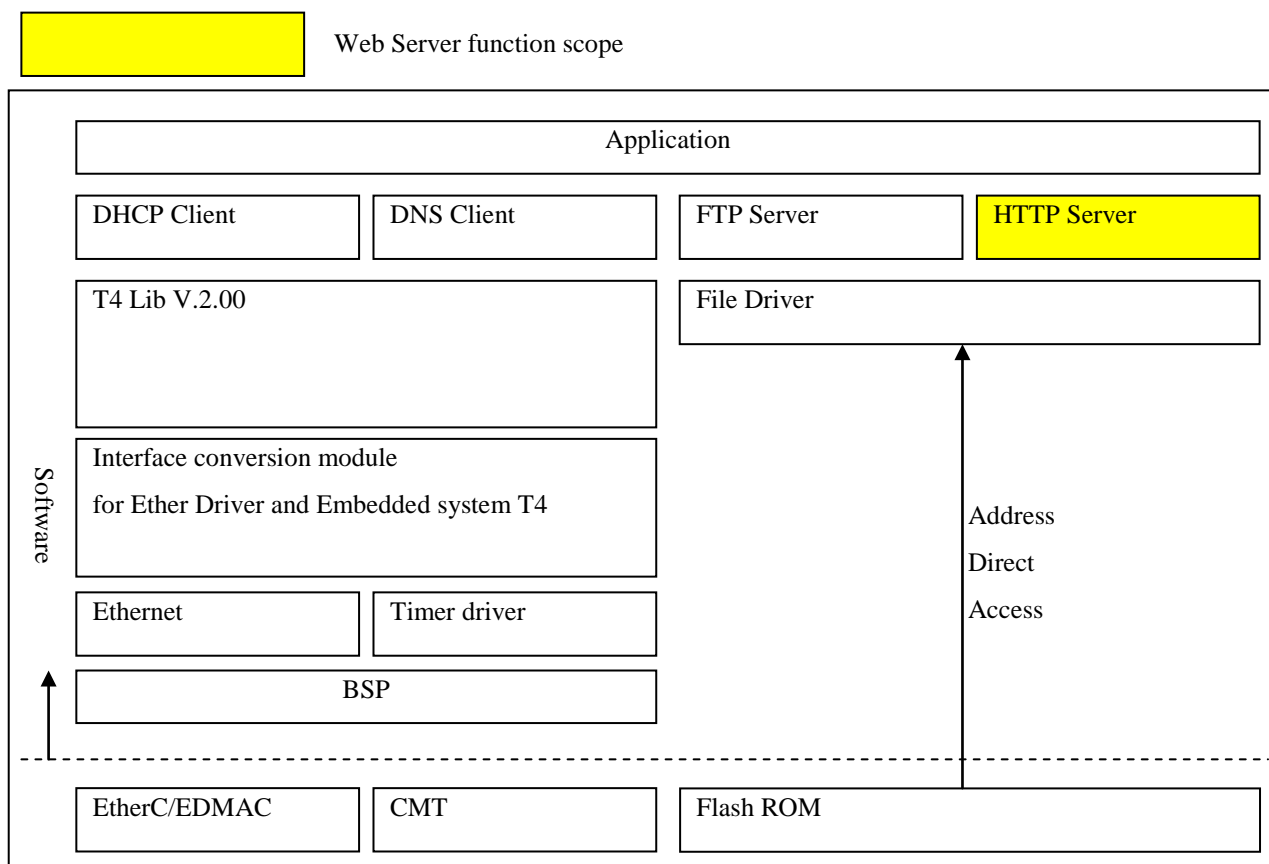


Figure 2 Software Structure Example (in case, store the web contents to MMC/USB memory)

### 1.2.2 In case internal ROM

Show Software Structure Example in case internal ROM.



**Figure 3 Software Structure Example (in case internal ROM)**

### 1.3 CGI function

This Web server has easily implementation CGI (Common Gateway Interface) function. CGI is way to execute user program on Web server under the Web browser request. This Web server can call the CGI functions that corresponds to the URL. The CGI functions can be set in config file.

## 2. API Information

### 2.1 Hardware Requirements

None

### 2.2 Software Requirements

This module is dependent upon the following packages:

r\_t4\_rx

### 2.3 Supported Toolchains

This library is tested and working with following toolchains:

Renesas RX Toolchain v.2.01.00

### 2.4 Limitations

This program uses stdio.h, stdlib.h, string.h, and ctype.h. Specify stdio, stdlib, string, and ctype as compiler options when compiling user programs.

### 2.5 Header Files

All API calls are accessed by including a single file " r\_t4\_http\_server\_rx\_if.h " which is supplied with this software's project code.

### 2.6 Configuration Overview

All configurable options that can be set at build time are located in the file "r\_t4\_http\_server\_rx\_config.h". A summary of these settings are provided in the following table:

**Table 2 Configuration options**

Configuration options in <i>r_t4_http_server_rx_config.h</i>	
<pre>#define HTTPD_VERSION_CODE ※Default value is " "Renesas Embedded Web Server/1.03" .</pre>	<p>Server header field.</p> <p>The data stored in the server header field transmitted to the web browser during communication with the web browser can be specified.</p>
<pre>#define ROOT_DIR ※Default value is " "(NULL literal) " .</pre>	<p>Root directory.</p> <p>Which directory in external memory is seen as the root directory can be specified.</p> <p>Example :</p> <pre>#define ROOT_DIR "" #define ROOT_DIR "user" #define ROOT_DIR "user/root_dir"</pre>
<pre>#define INDEXES ※Default value is " 1" .</pre>	<p>Displaying or not displaying an index page.</p> <p>The behavior when a directory is specified from the web browser can be specified.</p> <p>When set to 1, the directory contents are returned as the response.</p> <p>When set to 0, the file specified as the <code>DEFAULT_FILE_NAME</code> is returned as the response.</p>
<pre>#define DEFAULT_FILE_NAME ※Default value is " "index.htm" .</pre>	<p>File returned as response when do not display index page is specified</p> <p>This file is the response when <code>INDEXES</code> is set to 0.</p> <p>A "404 Not Found" response is returned if the specified file cannot be found.</p>
<pre>#define MAX_EXTENSION ※Default value is " 15" .</pre>	<p>The number of corresponding content-type.</p> <p>This is the max number of a list of the file extensions stored in external memory.</p>
<pre>#define EXTENSION_TYPE_TABLE_LIST ※Default value is " {"def", "application/octet-stream"},\ {"htm", "text/html"},\ {"txt", "text/plain"},\ {"exe", "application/octet-stream"},\ {"com", "application/octet-stream"},\ {"jpg", "image/jpeg"},\ {"gif", "image/gif"},\ {"png", "image/png"},\ {"zip", "application/octet-stream"},\ {"mp3", "audio/mpeg"},\ {"wav", "Naudio/x-wav"},\ {"dat", "application/octet-stream"},\ {"xls", "application/vnd.ms-excel"},\ {"doc", "application/msword"},\ {"cgi", "text/html"},\ " .</pre>	<p>Corresponding content-type</p> <p>This is a list of the file extensions stored in external memory.</p> <p>If a file with an extension not defined here is transferred, the system will respond to that file with the settings for the extension defined at the head of the list.</p>
<pre>#define MAX_CGI_FILE ※Default value is " 1" .</pre>	<p>The number of registered CGI file</p>
<pre>#define CGI_FILE_NAME_TABLE_LIST Default value is " {"cgi_smpl.cgi", NULL}, " .</pre>	<p>The table includes CGI file name and corresponding internal function CGI</p>
<pre>#define LF_CODE ※Default value is " "\r\n" .</pre>	<p>New line code used for index page generation.</p>
<pre>#define HTTP_TCP_CEP_NUM</pre>	<p>Maximum number of clients that can be accepted at the same time</p>



※Default value is " 4" .	This value must be set to match the number of sockets defined in config_tcpudp.c
#define HTTP_START_TCP_CEP ※Default value is " 0" .	The offset value of starting position of the communication endpoint in "config_tcpudp.c".
#define HTTP_MAX_FILE_LIST ※Default value is " 16" .	Maximum number of files that can be displayed on the index page Set this value so that BODY_BUF_SIZE is not exceeded.
#define RCV_BUF_SIZE ※Default value is " 1024" .	Reception buffer size
#define HDR_BUF_SIZE ※Default value is " 1460" .	Header file transmission buffer size
#define BODY_BUF_SIZE ※Default value is " 2048" .	Body field transmission buffer size

## 2.7 Adding Library to Your Project

Please refer to the Adding Firmware Integration Technology Modules to Projects "r01an1723eu0110\_rx.pdf".

### 3. API Functions

#### 3.1 R\_httpd

This function manages the sockets required for HTTP communication.

##### Format

```
void R_httpd(void)
```

##### Parameters

None

##### Return Value

None

##### Properties

Prototyped in file "r\_t4\_http\_server\_rx\_if.h".

##### Description

The application calls this function periodically. This function manages the sockets required for HTTP communication. This function only performs socket management; communication itself is performed automatically by T4 as driven by interrupts.

##### Reentrant

No

##### Special Notes

None

### 3.2 R\_httpd\_pending\_release\_request

The function that is called when application would like to release the CGI pending

#### Format

```
void R_httpd_pending_release_request(ID cepid)
```

#### Parameters

cepid	input	communication endpoint ID
-------	-------	---------------------------

#### Return Value

None

#### Properties

Prototyped in file "r\_t4\_http\_server\_rx\_if.h".

#### Description

Application calls this function when release the CGI pending

Please refer to the section 5.1.cgi\_sample\_function.

#### Reentrant

No

#### Special Notes

None

### 3.3 R\_T4\_HTTP\_SERVER\_GetVersion

This function returns the version number of Web server.

#### Format

```
uint32_t      R_T4_HTTP_SERVER_GetVersion(void)
```

#### Parameters

None

#### Return Value

Version number of Web server

#### Properties

Prototyped in file “r\_t4\_http\_server\_rx\_if.h”.

#### Description

Returns the version of this module. The version number is encoded such that the top two bytes are the major version number and the bottom two bytes are the minor version number.

For example, version ‘4.25’, the return value is ‘0x00040019’.

#### Reentrant

Yes

#### Special Notes

This function is inlined using the “#pragma inline” directive in “r\_http\_server.c”.

## 4. User-Defined Function Reference

### 4.1 File I/O

The web server calls these functions. The user must code the processing performed by these functions appropriately for the file system used. Also, the web server can use this data structure to acquire information from external memory.

**Table 4 User-Defined function for File I/O Table**

Name	Function
change_dir()	Change current directory
file_close()	Close file
file_delete()	Delete file
file_open()	Open file
file_read()	Read file
file_rename()	Rename file
file_exist()	Confirm exit file
file_write()	Write file
get_file_info()	Get file information
get_file_list_info()	Get file list information
get_file_size()	Get file size
make_dir()	Make directory
remove_dir()	Remove directory

The gray out function is not used this sample program.

#### 4.1.1 Data structure

##### 【Date Information Structure】

```
typedef struct date_info_{
    uint16_t    year;                // 2011, 2012, ...
    uint8_t     month[4];            // Jan, Feb, Mar, ...
    uint8_t     day;                 // 1-31
    uint8_t     ay_of_the_week[4];   // Sun, Mon, Tus, ...
    uint16_t    hour;                // 0-23
    uint16_t    min;                 // 0-59
    uint16_t    sec;                 // 0-59
}DATE_INFO;
```

##### 【File List Structure】

```
typedef struct file_list_ {
    uint8_t     file_name[13];
    uint32_t     file_size;
    uint32_t     file_attr;
    DATE_INFO    date_info;
}FILE_LIST;
```

##### 【Macro Definition】

```
#define FILE_WRITE        0x10
#define FILE_READ         0x01
#define FILE_ATTR_RDO0x01 /* Read only */
#define FILE_ATTR_HID0x02 /* Hidden */
#define FILE_ATTR_SYS0x04 /* System */
#define FILE_ATTR_VOL0x08 /* Volume label */
#define FILE_ATTR_DIR0x10 /* Directory */
#define FILE_ATTR_ARC0x20 /* Archive */
```

### 4.1.2 change\_dir

#### Description

This function sets current directory using specified argument. The argument specifies directory path in full path. Information of current directory is managed in each communication endpoint.

#### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t change_dir(uint8_t *dir_path);
```

#### Parameters

dir_path	input	Pointer to directory path
----------	-------	---------------------------

#### Return Value

-1	No directory to change
0	Normal completion

#### Remark

There are two cases. The argument "dir\_path" has '/' termination and does not have. Please adjust for user file system.

### 4.1.3 file\_close

#### Description

This function closes the file corresponding to the ID specified by the argument and discards the file management information.

#### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t file_close(int32_t file_id);
```

#### Parameters

file_id	input	ID value of the file to close
---------	-------	-------------------------------

#### Return Value

-1	Error
0	Normal completion

#### Remark

None

#### 4.1.4 file\_delete

##### Description

This function deletes the file corresponding to the ID specified by the argument. The specification of file is full path from root directory.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t file_delete(uint8_t *file_path);
```

##### Parameters

file_path	input	pointer to file path to delete
-----------	-------	--------------------------------

##### Return Value

-1	Error
0	Normal completion

##### Remark

None

#### 4.1.5 file\_open

##### Description

This function opens the file specified in its argument in exclusive read mode and saves file management information independently. It also specifies an ID value for this file management information as the return value so that the web server can reference the saved file management information by ID. The saved file management information must be saved until this ID value is passed to the file close function.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t file_open(uint8_t *file_path, uint8_t mode_flag);
```

##### Parameters

file_path	input	pointer to file path to open
mode_flag	input	Mode value of file open (FILE_WRITE or FILE_READ)

##### Return Value

-1	Error
0 and positive integer	The ID value for the opened file

##### Remark

The file opened state must be maintained until the corresponding ID value is passed to the file close function.



#### 4.1.6 file\_read

##### Description

This function reads the file corresponding to the ID value passed as an argument and advances the file pointer by the amount read. The file pointer is recorded in the file management information for each ID value and is maintained until the file close function is called.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"

int32_t file_read(int32_t file_id, uint8_t *buf, int32_t read_size);
```

##### Parameters

file_id	input	ID value of the file to read
buf	output	Storage area for the file data read
read_size	input	Size of file to read

##### Return Value

-1	Error
0 and positive integer	Data size of receiving

##### Remark

None

#### 4.1.7 file\_rename

##### Description

This function renames the file specified first argument to second argument. These arguments are specified in full path from root directory.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"

int32_t file_rename(uint8_t *old_name, uint8_t *new_name);
```

##### Parameters

old_name	input	pointer to target file name
new_name	input	pointer to after file name

##### Return Value

-1	Error
0	Normal completion

##### Remark

None

#### 4.1.8 file\_exist

##### Description

This function verifies the file or directory existing. The argument is specified in full path from root directory.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t file_exist(uint8_t *file_path);
```

##### Parameters

file_path	input	Pointer to file or directory path
-----------	-------	-----------------------------------

##### Return Value

-1	Not exist
0	Exist

##### Remark

None

#### 4.1.9 file\_write

##### Description

This function writes the file corresponding to the ID value passed as an argument and advances the file pointer by the amount write. The file pointer is recorded in the file management information for each ID value and is maintained until the file close function is called.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t file_write(int32_t file_id, uint8_t *buf, int32_t write_size);
```

##### Parameters

file_id	input	ID value of the file to write
buf	input	Storage area for the file data write
write_size	input	Size of the file to write

##### Return Value

-1	Error
0	Normal completion

##### Remark

None

#### 4.1.10 get\_file\_info

##### Description

This function reads the file management information for the file corresponding to the ID value specified as an argument and writes the file date information to a date information structure.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t get_file_info(int32_t file_id, DATE_INFO *date_info);
```

##### Parameters

file_id	input	ID value of the file to read
date_info	output	pointer to information of date structure to store

##### Return Value

-1	Error
0	Normal completion

##### Remark

None

#### 4.1.11 get\_file\_list\_info

##### Description

This function writes the file list stored at the directory path specified as an argument to a file list structure.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t get_file_list_info(uint8_t *dir_path, FILE_LIST *file_list, uint32_t num_file_list, int32_t read_index);
```

##### Parameters

dir_path	input	pointer to directory path to read
file_list	output	pointer to file list to store. This function stores '\0' to end of structure
num_file_list	input	Max number of file list to read at one time
read_index	input	Index of read starting

##### Return Value

-1	Error
0 and positive integer	Number of file

##### Remark

In case return value is smaller than num\_file\_list, it's the end of file list. In case return value is same value num\_file\_list, there is the data continuing. When this function needs continuing data, this function is called with 0 and positive integer with in read\_index.

There are two cases. The argument "dir\_path" has '/' termination and does not have. Please adjust for user file system.

#### 4.1.12 get\_file\_size

##### Description

This function reads the file management information for the file corresponding to the ID value specified as an argument and returns the file size.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t get_file_size(int32_t file_id);
```

##### Parameters

file_id	input	ID value of the file to read
---------	-------	------------------------------

##### Return Value

-1	Error
0 and positive integer	File size

##### Remark

None

#### 4.1.13 make\_dir

##### Description

This function makes the directory. The argument is specified in full path from root directory.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t make_dir(uint8_t *dir_path);
```

##### Parameters

dir_path	input	pointer to file path to make
----------	-------	------------------------------

##### Return Value

-1	Error
0	Normal completion

##### Remark

There are two cases. The argument "dir\_path" has '/' termination and does not have. Please adjust for user file system.

#### 4.1.14 remove\_dir

##### Description

This function removes the directory. The argument is specified in full path from root directory.

##### Usage

```
#include <stdint.h>
#include "r_file_driver.h"
int32_t remove_dir(uint8_t *dir_path);
```

##### Parameters

dir_path	input	pointer to file path to remove
----------	-------	--------------------------------

##### Return Value

-1	Error
0	Normal completion

##### Remark

There are two cases. The argument "dir\_path" has '/' termination and does not have. Please adjust for user file system.

## 4.2 System Timer

Web server calls these functions. User defines system timer.

**Table 5 User-Defined function for system timer Table**

Name	Function
get_sys_time()	Get pointer to system time

### 4.2.1 Data structure

【system time structure】

```
typedef struct sys_time_  
{  
    uint32_t sec;  
    uint32_t min;  
    uint32_t hour;  
    uint32_t day;  
    uint32_t month;  
    uint32_t year;  
}SYS_TIME;
```

### 4.2.2 get\_sys\_time

#### Description

This function gets pointer to system time.

#### Usage

```
#include <stdint.h>  
  
#include "r_t4_http_server_rx_config.h"  
  
SYS_TIME      *get_sys_time( void );
```

#### Parameters

None

#### Return Value

Pointer to system time

#### Remark

Please specify the variable for system timer.

## 5. Sample CGI Function

### 5.1 cgi\_sample\_function

#### Description

CGI function that is defined as CGI\_FILE\_NAME\_TABLE\_LIST in "r\_t4\_http\_server\_config.h"

The second element (cgi function pointer) of CGI\_FILE\_NAME\_TABLE\_LIST will be called when web browser requests the defined cgi file URL. And next, HTTPd will call cgi function.

HTTPd behavior will be changed by the return value.

case: Normal termination

CGI process finishes in this function.

case: Internal error

CGI process errors occur in this function.

case: CGI pending

CGI process does not finish in this function. The third element (cgi function pointer) of CGI\_FILE\_NAME\_TABLE\_LIST will be called when user will call R\_httpd\_pending\_release\_request() in finishing CGI process.

#### Usage

```
#include "r_t4_itcpip.h"
```

```
#include "r_http_server_config.h"
```

```
#include "r_t4_http_server_rx_if.h"
```

```
ER cgi_sample_function(ID cepid, void *res_info);
```

#### Parameters

cepid	input	The Communication Endpoint ID that is requested CGI function execution.
res_info	input	(HTTPD_RESOURCE_INFO*)res_info->param
		The parameter from Web browser request.
	output	(HTTPD_RESOURCE_INFO*)res_info->res.body
		HTML strings as response
	output	(HTTPD_RESOURCE_INFO*)res_info->res.body_size
		HTML strings length as response

#### Return Value

-1	Internal Error
-2	CGI pending
0	Normal completion

#### Remark

None

## Website and Support

Renesas Electronics Website

<http://www.renesas.com/>

Inquiries

<http://www.renesas.com/contact/>

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## Revision History

Rev.	Date	Description	
		Page	Summary
1.03	May.09.14	—	Corresponded to FIT Modules.
1.02	Apr.28.14	—	Corresponded to RX63N MCU. Corresponded to simple CGI function. Add web server runs by only internal ROM.
1.01	Sep.27.12	3	Add information about USB stick
1.00	Apr.12.11	—	First edition issued

## 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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#### **Renesas Electronics America Inc.**

2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.  
Tel: +1-408-588-6000, Fax: +1-408-588-6130

#### **Renesas Electronics Canada Limited**

1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada  
Tel: +1-905-898-5441, Fax: +1-905-898-3220

#### **Renesas Electronics Europe Limited**

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: +44-1628-585-100, Fax: +44-1628-585-900

#### **Renesas Electronics Europe GmbH**

Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

#### **Renesas Electronics (China) Co., Ltd.**

Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

#### **Renesas Electronics (Shanghai) Co., Ltd.**

Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

#### **Renesas Electronics Hong Kong Limited**

Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2265-6688, Fax: +852 2886-9022/9044

#### **Renesas Electronics Taiwan Co., Ltd.**

13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan  
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

#### **Renesas Electronics Singapore Pte. Ltd.**

80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

#### **Renesas Electronics Malaysia Sdn.Bhd.**

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

#### **Renesas Electronics Korea Co., Ltd.**

12F., 234 Teheran-ro, Gangnam-Ku, Seoul, 135-920, Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5141