RX Family

Open Source FAT File System [M3S-TFAT-Tiny] Module Firmware Integration Technology

R20AN0038EJ0303
Rev.3.03
Oct 01, 2016

Introduction

This application note explains about RX Family Open Source FAT Filesystem M3S-TFAT-Tiny (hereafter TFAT Library) using Firmware Integration Technology (FIT).

TFAT Library is no relation to Microsoft Transaction-Safe FAT File System (TFAT).

Library build is needed for TFAT setting changing(ex. Long file name on/off feature).If user needs to change the settings, the library build environment(with source code) is needed. If user needs this one, please contact customer support (http://www.renesas.com/contact/).

Target Device

RX Family

Contents

1. Outline

TFAT Library is FAT File system software library that concerned about low-memory usage.

The TFAT library was made based on FatFs. Please refer to the User's Manual to know the relation about source code version.

What is FatFs?

FatFs is the File system module for the small embedded system. Fat Fs is developed by ChaN Software. FatFs is provided as non-payment for embedded system. Please refer to the Website below for more details.

http://elm-chan.org/fsw/ff/00index_e.html

1.1 Specification of library

1.1.1 Specification of TFAT library

Following are some of the main specifications of the TFAT library.

Table 1.1 Specification of TFAT library

item	specifications
Base program	Fatfs (R0.09b)
Supported FAT Type	FAT16, FAT32
Filename Support	8.3 format (8 lettered filename & 3 lettered extension) s
Filesystem format function	None
Number of drives supported	1
Logical Sector size	512byte

1.1.2 Structure of software stack

Following are structure of software stack of the TFAT library.

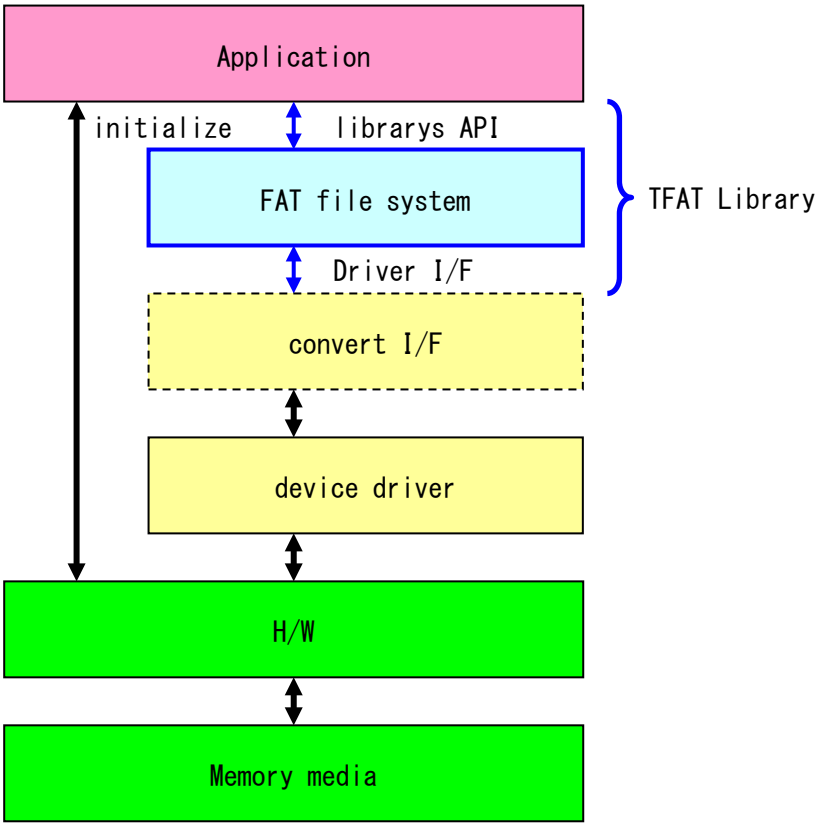

Figure 1-1 structure of software stack of the TFAT library

1.1.3 Compiler option for generating library

Library file is built with the following compiler option.

- TFAT Library file for the RX600 series (big endian)
  -cpu=rx600 -endian=big -include="$(WORKSPDIR)\..\pub_include"
  -output=obj="$(CONFIGDIR)\$(FILELEAF).obj" –nologo

- TFAT Library file for the RX600 series (little endian)
  -cpu=rx600 -include="$(WORKSPDIR)\..\pub_include" -output=obj="$(CONFIGDIR)\$(FILELEAF).obj"
  -nologo

- TFAT Library file for the RX200 series (big endian)
  -cpu=rx200 -endian=big -include="$(WORKSPDIR)\..\pub_include"
  -output=obj="$(CONFIGDIR)\$(FILELEAF).obj" –nologo

- TFAT Library file for the RX200 series (little endian)
  -cpu=rx200 -include="$(WORKSPDIR)\..\pub_include" -output=obj="$(CONFIGDIR)\$(FILELEAF).obj"
  -nologo

1.1.4 Version information

TFAT library has version information as strings. User can access this version information to use extern variable defined in header file.

define: extern const mw_version_t R_tfat_version;

TFAT library has version information showed below.

— RX200 Big endian
- compiler_version = 0x1020100
- library_info = "M3S-TFAT-Tiny version 3.03 for RX200 BIG endian.(Feb 19 2016, 18:52:49)"

— RX200 Little endian
- compiler_version = 0x1020100
- library_info = "M3S-TFAT-Tiny version 3.03 for RX200 LITTLE endian.(Feb 19 2016, 18:52:55)"

— RX600 Big endian
- compiler_version = 0x1020100
- library_info = "M3S-TFAT-Tiny version 3.03 for RX600 BIG endian.(Feb 19 2016, 18:52:41)"

— RX600 Little endian
- compiler_version = 0x1020100
- library_info = "M3S-TFAT-Tiny version 3.03 for RX600 LITTLE endian.(Feb 19 2016, 18:53:01)"

1.1.5 ROM size / RAM size / Stack size

TFAT library requires ROM/RAM/Stack size as below.

Table 1.2 ROM/RAM size

Section (Section name)	size	
	RX600	RX200
ROM (P , C)	About 5.1KB	About 5.1KB
RAM (B)	6byte	6byte

Table 1.3 stack size

API function name	stack size (No memory driver software)[byte]		stack size (with MMC driver(*) software)[byte]		stack size (with MMC driver(*) and USB driver software)[byte]
	RX600	RX200	RX600	RX200	RX600
R_tfat_f_mount	4	4	4	4	4
R_tfat_f_open	172	172	320	320	596
R_tfat_f_close	60	60	208	208	412
R_tfat_f_read	84	84	232	232	444
R_tfat_f_write	120	120	268	268	464
R_tfat_f_lseek	100	100	248	248	456
R_tfat_f_truncate	88	88	236	236	444
R_tfat_f_sync	52	52	200	200	404
R_tfat_f_opendir	132	132	280	280	524
R_tfat_f_readdir	80	80	228	228	508
R_tfat_f_getfree	96	96	244	244	452
R_tfat_f_stat	152	152	300	300	556
R_tfat_f_mkdir	172	172	320	320	596
R_tfat_f_unlink	152	152	300	300	596
R_tfat_f_chmod	152	152	300	300	556
R_tfat_f_utime	148	148	296	296	552
R_tfat_f_rename	188	188	336	336	640
R_tfat_f_forward	76	76	224	224	440

Note: Stack size is dependent on user-defined function.

At least one variable of the structure FATFS is always required for FileSystem Work Area allocation. The FIL and DIR structures will be needed as per the requirement. The number of FIL variables needed is equal to the number of files that will be opened simultaneously by the user. If two files are to be opened simultaneously, then two FIL structure variables will be needed resulting in total memory consumption of 32 x 2 = 64 Bytes. Likewise will be the case with DIR and other structure variables.

Table 1.4 structure size

Structure	Memory for one structure variable [byte]
FATFS	560
FIL	36
DIR	20
FILINFO	24

1.1.6 Performance

The access time that TFAT library reads/write memory card is below.

Table 1.5 Performance

	Test Condition	Time
RX210	Time to write 1MByte data file. (File Open , Data write ,File close)	About 4 Sec
	Time to read 1MByte data file. (File Open , Data read ,File close)	About 2.6 Sec
RX610	Time to write 1MByte data file. (File Open , Data write ,File close)	About 3.4 Sec
	Time to read 1MByte data file. (File Open , Data read ,File close)	About 2.7 Sec
RX62N	Time to write 1MByte data file. (File Open , Data write ,File close)	About 2.7 Sec
	Time to read 1MByte data file. (File Open , Data read ,File close)	About 1.8 Sec

Detail of test condition is below.

Table 1.6 Measurement condition

	Detail of Test Condition	Contents
RX210	CPU Clock(ICLK)	50MHz
	Peripheral Clock(PCLKB)	25MHz
	Memory	Transcend MMC 256MB
	FAT type	FAT32
	Driver software	Renesas MMC driver
	Source data area when data write.	Internal ROM
	Destination data area when data read.	Internal RAM
RX610	CPU Clock(ICLK)	100MHz
	Peripheral Clock(PCLK)	50MHz
	Memory	Transcend MMC 256MB
	FAT type	FAT32
	Driver software	Renesas MMC driver
	Source data area when data write.	Internal ROM
	Destination data area when data read.	Internal RAM
RX62N	CPU Clock(ICLK)	96MHz
	Peripheral Clock(PCLK)	48MHz
	Memory	Transcend MMC 256MB
	FAT type	FAT32
	Driver software	Renesas MMC driver
	Source data area when data write.	Internal ROM
	Destination data area when data read.	Internal RAM

1.2 Usage of Libraries

Please include a library file and a header file in a project.

RX200 series and RX100 series uses TFAT library for RX200. RX600 series and RX700 series uses TFAT library for RX600.

TFAT library does not contain the driver of a memory media (SD card and a USB memory). Please prepare the driver of a memory media by the user side in accordance with the hardware of use.

Please set the driver of a memory media by Memory driver interface of TFAT library. Please refer to a user's manual about Memory driver interface.

2. API Information

2.1 Hardware Requirements

None

2.2 Software Requirements

None

2.3 Supported Toolchains

This library is tested and working with following toolchains:
Renesas RX Toolchain V2.04.01

2.4 Limitations

Library is using the following standard function

memset memcmp memcpy

2.5 Header Files

All API calls are accessed by including a single file " r_tfat_lib.h " which is supplied with this software's project code.

Build-time configuration options are selected or defined in the file "r_tfat_rx_config.h"

2.6 Configuration Overview

All configurable options that can be set at build time are located in the file "r_tfat_rx_config.h".

2.7 Adding Library to Your Project

Please refer to the Adding Firmware Integration Technology Modules to Projects (r01an1723eu0111_rx.pdf, for e^2 studio) or the Adding Firmware Integration Technology Modules to CS+ Projects (r01an1826ej0102_rx.pdf).

Lib folder has all TFAT Libraries for RX Family. If user implements using the scheme that is explained in this document, all TFAT Libraries will be linked for building. Please remove the Libraries excluding your needing libraries.

3. API(Library) Functions

TFAT Library uses the following APIs.

Table 3.1 API(Library) Functions

API	Outline
R_tfat_f_mount	Register/Unregister a work area
R_tfat_f_open	Open/Create a file
R_tfat_f_close	Close a file
R_tfat_f_read	Read file
R_tfat_f_write	Write file
R_tfat_f_lseek	Move read/write pointer, Expand file size
R_tfat_f_truncate	Truncate file size
R_tfat_f_sync	Flush cached data
R_tfat_f_opendir	Open a directory
R_tfat_f_readdir	Read a directory item
R_tfat_f_getfree	Get free clusters
R_tfat_f_stat	Get file status
R_tfat_f_mkdir	Create a directory
R_tfat_f_unlink	Remove a file or directory
R_tfat_f_chmod	Change attribute
R_tfat_f_utime	Change timestamp
R_tfat_f_rename	Rename/Move a file or directory
R_tfat_f_forward	Forward file data to the stream directly

Please refer to the User's Manual if you needs datails. (r20uw0078ej0301_tfat.pdf)

4. Library version information

Ver	change
3.03	Updated version number with the xml file revision.
3.02	Updated version number.
3.01	Updated version number.
3.00	V.2.00→V.3.00 can use Multidrive feature.

Website and Support

Renesas Electronics Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/contact/

Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
3.03	Oct.01.2016	−	Corresponded to RX family. Updated the xml file for FIT.
3.02	May.01.2015	—	Corresponded to RX231. Updated the xml file for FIT.
3.01	Dec.28.2014	—	Corresponded to RX71M/RX113. Updated the xml file for FIT.
3.00	Apr 01, 2014	—	FIT Module correspondence
1.03	Nov 30, 2013	—	Changed the base version of the open source into V0.09b from V0.06.
1.02	Nov 08, 2013	—	Changed document title Changed the structure of sections Added Fatfs copyright to library source
1.01	Sep 01, 2012	—	RX210 correspondence
1.00	Oct 08, 2010	—	First edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

   Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

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

4. Clock Signals

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

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

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

   — The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
3. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.
   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc.
   Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

RENESAS

SALES OFFICES

Renesas Electronics Corporation

http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

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
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

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 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

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 1207, 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 India Pvt. Ltd.
No.777C, 100 Feet Road, HALII Stage, Indiranagar, Bangalore, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

Colophon 5.0