RL78 Family

R20AN0159EJ0103
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Open Source FAT File System M3S-TFAT-Tiny: Introduction Guide

Introduction

This document explains the usage of the Open Source FAT File System M3S-TFAT-Tiny for RL78 Family V.2.01 Release 00 (hereafter referred to as "TFAT library") along with a sample program.

Please refer to the User's Manual to understand how to use the software library. User's Manual is in this application note.

And, we prepared Sound Playback/Record demonstration software for the YRDKRL78G14 as sample application program for TFAT Library.

Please refer to the following URL for details.

http://www.renesas.com/products/tools/middleware_and_drivers/tiny_soft/adpcm/m3s_s2_tiny/app_notes.jsp

(Document NO.: R20AN0194)

Target Device

RL78/G14

Contents

1. Structure of application note

This application note includes files below.

Table 1 Structure of application note

name	description
r20an0159ej0103_rl78_tfat.pdf	Introduction Guide (this document)
Workspace (workspace)	
Document (doc)	
English (en)	
r20uw0078ej0200_tfat.pdf	User's Manual
r20an0159ej0103_rl78_tfat.pdf	Introduction Guide (this document)
Japanese (ja)	
r20uw0078jj0200_tfat.pdf	User's Manual
r20an0159jj0103_rl78_tfat.pdf	Introduction Guide
IAR (IAR)	
Library (lib)	
tfat_rl78_core_s2_m.r87 tfat_rl78_core_s3_m.r87	TFAT library (Device / Code model / Data model) RL78 core S2 - Unspecified / Far / Near RL78 core S3 - Unspecified / Far / Near
r_tfat_lib.h	Library header file
r_stdint.h	Integer type define header file
r_mw_version.h	Version number definition file
Library generation environment (make_lib)	
Library source directory (src)	
Public Include header directory (pub_include)	
Build environment directory (tfat_rl78_iar)	
CubeSuite+ (Cubesuite+)	
Library (lib)	
tfat_rl78.lib	TFAT Library file (Medium model)
r_tfat_lib.h	Library header file
r_stdint.h	Integer type define header file
r_mw_version.h	Version number definition file
Library generation environment (make_lib)	
Library source directory (src)	
Public Include header directory (pub_include)	
Build environment directory (tfat_rl78)	
Sample program (sample)	
Sample program for RL78/G14 with MMC driver (TFAT_sample_RL78_with_MMC)	
Reference(ref)	
r20ut0684ej0010_rl78g14.pdf	RL78/G14 64pin CPU board Circuit Diagram
r20ut0685jj0010_rl78g15.pdf	RL78/G14 64pin CPU board User's Manual (Japanese)
r20ut0685ej0010_rl78g15.pdf	RL78/G14 64pin CPU board User's Manual (English)
Schematic_Design__RL78_Middleware_Evaluation_Board-V3_2.pdf	Middleware Evaluation Board Circuit Diagram

2. Specification of library

2.1 Specification of TFAT library

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

Table 2 Specification of TFAT library

item	specifications
Base program	Fatfs (R0.06)
Supported FAT Type	FAT12, FAT16, FAT32
Filename Support	8.3 format (8 lettered filename & 3 lettered extension) Long file name format is not supported.
Number of drives supported	1
Logical Sector size	512byte
Filesystem format function	None

2.2 Structure of software stack

Following are structure of software stack of the TFAT library.

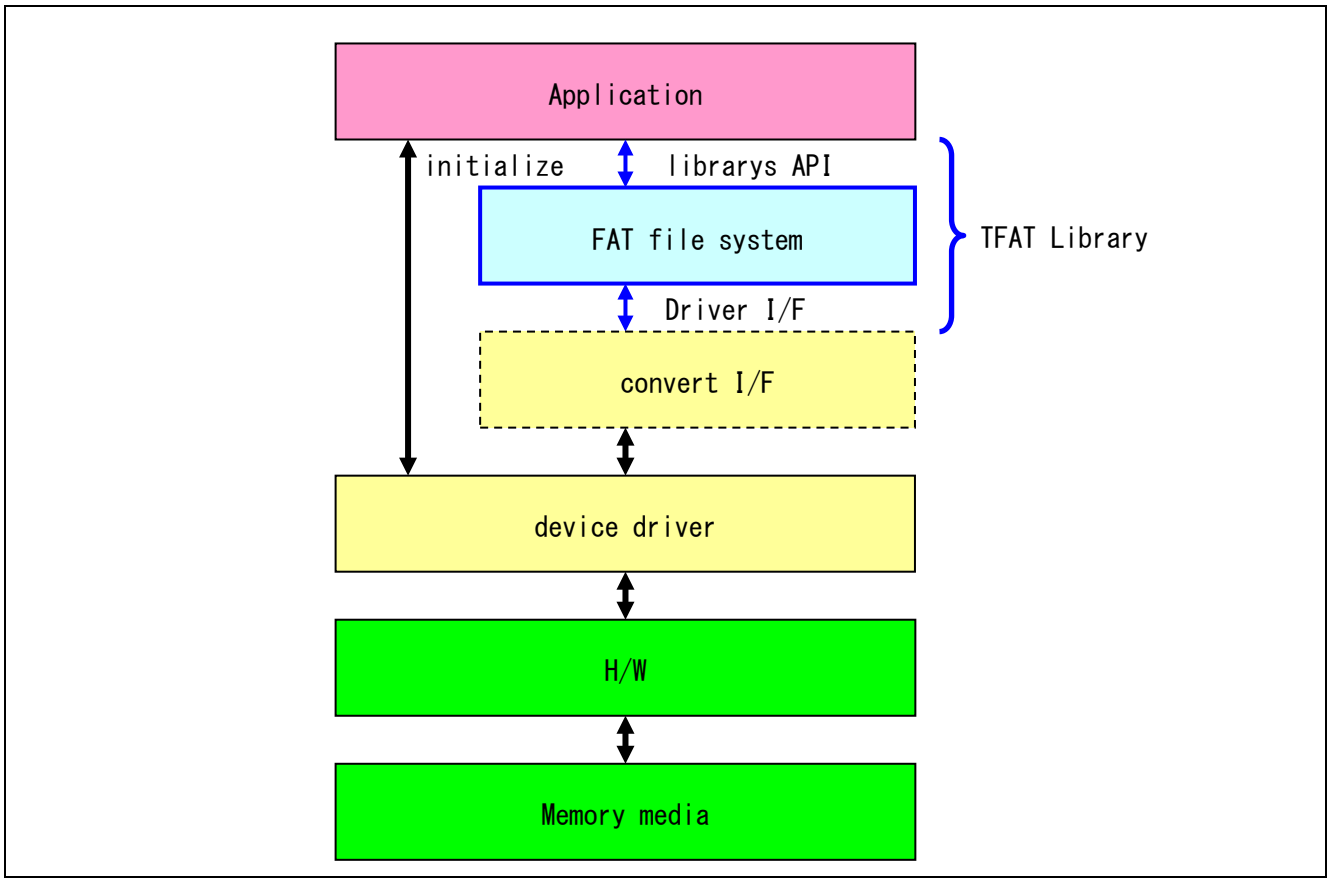

Figure 2-1 structure of software stack of the TFAT library

3. For CubeSuite+

3.1 Development environment

TFAT library can run with this development environment below.

[Software tools]

- Integrated Development Environment
  CubeSuite+ V2.02.00
- C compiler
  CubeSuite+ CA78K0R V1.70

[Debug tools]

- Emulator debugger
  E1 emulator

[Board]

- RL78/G14 64pin CPU Board Renesas type : R0K50104LC000BR
- Middleware Evaluation Board Renesas (Please refer to Appendix)

3.2 Compiler option for generating library

Library file is built with compile option. It changed the following options from the default option.

Add debug information : No(-ng)
Output common object file for various devices : Yes(-common)

3.3 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.

"M3S-TFAT-Tiny version 2.01 for RL78 (S2, MEDIUM).(Sep 11 2014, 20:29:07)"

3.4 ROM size / RAM size / Stack size

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

Table 3 ROM/RAM size

kind	size
ROM (CSEG)	about 12.7KB
RAM (DSEG)	4byte
Stack size [Note]	about 200byte

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 4 structure size

Structure	Memory for one structure variable [byte]
FATFS	558
FIL	32
DIR	18
FILINFO	22

3.5 Performance

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

Table 5 Performance

	Test Condition	Time
Rl78/G14	Time to write 1MByte data file. (File Open , Data write ,File close)	About 4.8 Sec
	Time to read 1MByte data file. (File Open , Data read ,File close)	About 1.8 Sec

Detail of test condition is below.

Table 6 Measurement condition

	Detail of Test Condition	Contents
RL78/G14	CPU Clock(fCLK)	32MHz
	Memory	Transcend MMC 256MB
	FAT type	FAT32
	Cluster size	2048byte
	Driver software	Renesas MMC driver (R20AN0158JJ0101)
	Source data area when data write.	Internal ROM (Mirror area)
	Destination data area when data read.	Internal RAM

3.6 Notes

- Library is using the following standard function.
  memset memcmp memcpy
- This library corresponds Medium model.
  When user use othe memory models with TFAT library, please re-build the library that corresponds to user memory models, using library build environment included in the package.

4. For IAR Embedded Workbench

4.1 Development environment

TFAT library can run with this development environment below.

[Software tools]

-Integrated Development Environment and C compiler

IAR Embedded Workbench for Renesas RL78 version 1.40.2

-Code Gererator tool

Applilet3 for RL78 V1.05.00 Renesas

[board]

The sample program that uses TFAT-IAR version is in the following Application note.

Document title: Sound Playback/Compression demonstration software for RL78/G14 CPU board
(Document number: R20AN0194)

Please download the sample code clicking following URL.

http://www.renesas.com/products/tools/middleware_and_drivers/tiny_soft/adpcm/m3s_s2_tiny/app_notes.jsp

4.2 Compiler Option

This product is specifically built for RL78 with the following compiler options:

```
tfat_rl78_core_s2_m.r87:
   --core rl78_1 --code_model far --data_model near
   --near_const_location rom0 -e -Oh --library_module

tfat_rl78_core_s3_m.r87:
   --core rl78_2 --code_model far --data_model near
   --near_const_location rom0 -e -Oh --library_module
```

4.3 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.

・tfat_rl78_core_s2_m.r87:

"M3S-TFAT-Tiny version 2.01 for RL78 (IAR, S2, code_model=far, data_model=near).(Sep 11 2014, 20:31:29)"

・tfat_rl78_core_s3_m.r87:

"M3S-TFAT-Tiny version 2.01 for RL78 (IAR, S3, code_model=far, data_model=near).(Sep 11 2014, 20:31:46)"

4.4 ROM size / RAM size / Stack size

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

Table 7 ROM/RAM size

kind	size
ROM (CSEG)	about 12KB
RAM (DSEG)	4byte
Stack size [Note]	about 200byte

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 8 structure size

Structure	Memory for one structure variable [byte]
FATFS	558
FIL	32
DIR	18
FILINFO	22

4.5 Performance

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

Table 9 Performance

	Test Condition	Time
Rl78/G14	Time to write 1MByte data file. (File Open , Data write ,File close)	About 5.5 Sec
	Time to read 1MByte data file. (File Open , Data read ,File close)	About 2.0 Sec

Detail of test condition is below.

Table 10 Measurement condition

	Detail of Test Condition	Contents
RL78/G14	CPU Clock(fCLK)	32MHz
	Memory	Transcend MMC 256MB
	FAT type	FAT32
	Cluster size	2048byte
	Driver software	Renesas MMC driver (R20AN0158JJ0101)
	Source data area when data write.	Internal ROM (Mirror area)
	Destination data area when data read.	Internal RAM

4.6 Notes

- Library is using the following standard function.
  memset memcmp memcpy
- This library corresponds Code model = Far, Data model = Near.
  When user use other memory models with TFAT library, please re-build the library that corresponds to user memory models, using library build environment included in the package.

5. Usage of Libraries

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

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.

6. Sample program

6.1 Outline

The sample program is project for CubeSuite+ with RL78/G14 64pin CPU board. And Sample programs include the project that implements MMC driver.

Please refer to the following for more information about MMC driver.

http://japan.renesas.com/products/tools/middleware/tiny_soft/tfat/m3s_tfat_tiny/app_notes.jsp

Document No. : R20AN0158

6.2 Sample software execution

If a sample program is run , FAT filesystem is initialized first. A sample program writes 2 KB of text data in a memory media. And a sample program displays an execution result on LED.

Table 11 Explanation of LED display

LED1	LED2	Explanation
ON	OFF	Program running
OFF	ON	Error occurred
ON	ON	Execution successful

The sample data for file read / write is stored in the r_data_file.c. The data is stored in an array of 2048 elements giving a total size of 2 KB (2048 Bytes). The data array consists of the text string "Renesas," written repeatedly. If required, the user can modify this array and the corresponding macro `FILESIZE`.

6.3 Flow

Flow of a sample program is shown below.

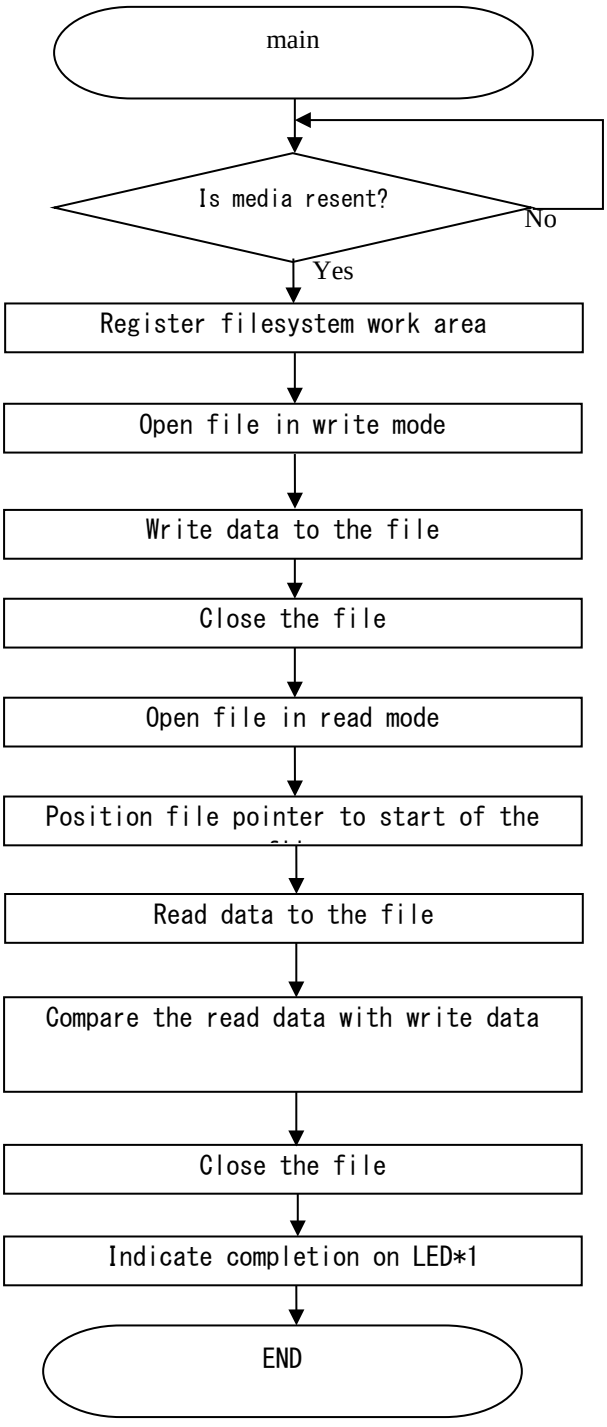

Figure 4-1 Flow of sample program

Appendix. Middleware Evaluation Board

This appendix explains the information about the Middleware Evaluation Board. Please design original circuit to refer to this appendix.

1. The connection of a CPU board and Middleware Evaluation Board

The following list shows connection when user operates sample program with CPU board and Middleware Evaluation Board.

Use	**CPU board** Application Header / Microcontroller Header / Jumper		**Middleware Evaluation Board**	
	Pin No.	**Header name**	**Pin No.**	**Header name**
Power supply (3.3V)	JA1-3	CON_3V3	JA1-3	3V3
GND	JA1-4	GROUND	JA1-4	GND-3V3
MMC CLK	JA1-15	IO0	JA1-15	MMC-SCK
MMC Data output	JA1-17	IO2	JA1-17	MMC-TXD
MMC Data input	JA1-16	IO1	JA1-16	MMC-RXD
MMC CardDetect	JA2-21	TI00	JA2-21	MMC-CardDetect
MMC CS	JA2-20	TO05	JA2-20	MMC-CS
PWM output	JA1-23	SW3-INT4	JA1-23	PWM
Microphone input	JA1-9	ANI2	JA1-9	AD

2. Adjust parts on RL78/G14 CPU Board

Sample code that is included this application note is confirmed working on CPU board and Middleware evaluation board. Please adjust each part on CPU board like below.

- Remove R60, Implement R63, for MMC connection
- Remove R52, Implement R55, for MMC connection
- Remove R71, Implement R74, for MMC connection
- Remove R51, Implement R54, for PWM connection
- Implement JA1, JA2 connector, for Middleware evaluation board connection
- Implement R21, for Middleware evaluation board 3.3 power supply
- Short J13 (2-3), for select regulator output
- Open J10, for select regulator output 3.3V power supply
- Short JP1 (on Middleware evaluation board) to PWM-center

3. Circuit Schematic

Please show the circuit schematic of Middleware Evaluation Board in ref folder.

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.03	Sep 01, 2014	—	Supported IAR Embedded Workbench.
1.02	Nov 08, 2013	—	Changed document title Changed the structure of sections Added Fatfs copyright to library source
1.01	Jan 31, 2013	—	Product structure is changed. C hanged into ZIP download form from installer form. Change of development environment Compiler version is corrected Correction of library stack size Performance is added. Change of written contents of appendix The connection information on a memory card conversion board and RL78/G14 CPU board is added. A wiring schematic view and RL778/G14 CPU board appearance photograph are added.
1.00	Mar.31.12	—	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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