RL78 Family

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 (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.

RL78/G14 Sound Playback/Compression Demonstration for RL78/G14 CPU Board - Sample Code | Renesas
(Document NO.: R20AN0194)

Target Device

RL78/G14, RL78/G23

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

Contents

1. Structure of application note

This application note includes files below.

Table 1 Structure of application note

name	description
r20an0159xx0201-rl78-tfat <DIR>	Sample code folder
Workspace (workspace) <DIR>	
Document (doc) <DIR>	
English (en) <DIR>	
r20uw0078ej0200-tfat.pdf	User's Manual
r20an0159ej0201-rl78-tfat.pdf	Introduction Guide (this document)
Japanese (ja) <DIR>	
r20uw0078jj0200-tfat.pdf	User's Manual
r20an0159jj0201-rl78-tfat.pdf	Introduction Guide
libsrc <DIR>	
tfat <DIR>	
src <DIR>**)**	Library Source Dir
r_TinyFAT.c	Library Source file
r_TinyFAT.h	Library header file
r_version.c	Version data define file
include <DIR>	Include File Dir
r_tfat_lib.h	Library header file
r_stdint.h	Integer type define header file
r_mw_version.h	Version data header file

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.

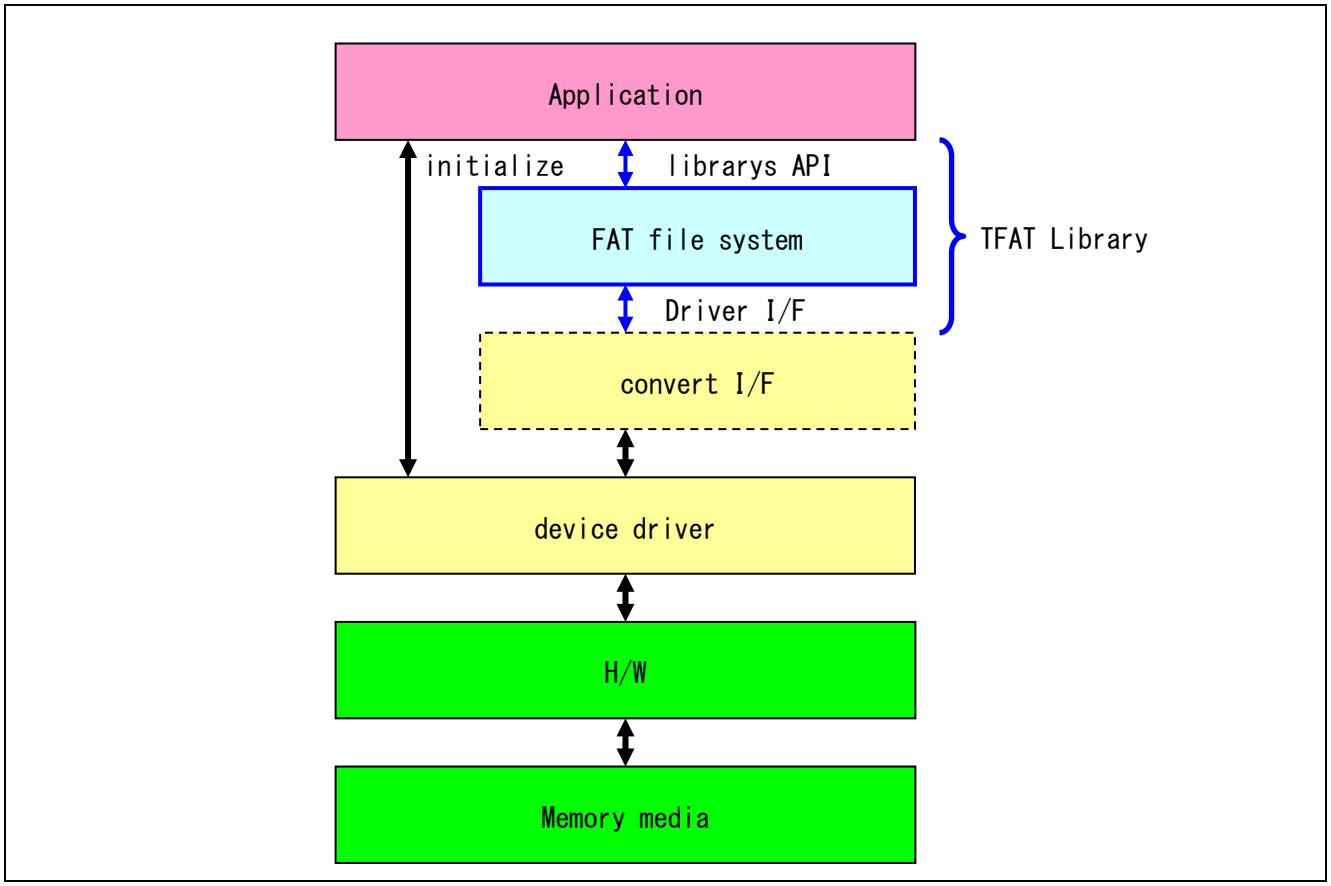

Figure 2-1 structure of software stack of the TFAT library

3. Development environment

TFAT library can run with this development environment below.

When user develops, choose newer version than below.

3.1 CC-RL (C compiler)

-Integrated Development Environment

CS+ for CC V8.05.00
e^2 studio 2021-04 (21.4.0)

-C compiler

CC-RL V1.10.00

-Code Gererator tool

(CS+) : Renesas Smart Configurator for RL78 V1.00.00.04

(e^2 studio) : Renesas Smart Configurator for RL78 21.4.0.v20210315-0928

3.1.1 Version information

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

define: extern const mw_version_t R_tfat_version;

3.1.2 ROM size / RAM size / Stack size

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

Table 3 ROM/RAM size

kind	size
ROM(.textf .const)	about 9KB
RAM(.bss)	4byte
Stack size [Note]	about 230byte

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

3.1.3 Performance

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

Table 5 Performance

	Test Condition	Time
RI78/G14	Time to write 1MByte data file. (File Open , Data write ,File close)	About 4.1 Sec
	Time to read 1MByte data file. (File Open , Data read ,File close)	About 2.0 Sec
RI78/G23	Time to write 1MByte data file. (File Open , Data write ,File close)	About 4.7 Sec
	Time to read 1MByte data file. (File Open , Data read ,File close)	About 2.1 Sec

Detail of test condition is below.

Table 6 Measurement condition

	Detail of Test Condition	Contents
RL78/G14	CPU Clock(fCLK)	32MHz
	Memory	Transcend SD 2GB
	FAT type	FAT32
	Cluster size	2048byte
	Driver software	Renesas MMC driver (R20AN0158EJ0101)
	Source data area when data write.	Internal ROM (Mirror area)
	Destination data area when data read.	Internal RAM
RL78/G23	CPU Clock(fCLK)	32MHz
	Memory	Transcend SD 2GB
	FAT type	FAT32
	Cluster size	2048byte
	Driver software	Renesas MMC driver (R20AN0158EJ0200)
	Source data area when data write.	Internal ROM (Mirror area)
	Destination data area when data read.	Internal RAM

3.1.4 Notes

- Library is using the following standard function.
  memset memcmp memcpy

3.2 IAR C/C++ Compiler for Renesas RL78 (C compiler)

TFAT library can run with this development environment below.

-Integrated Development Environment and C compiler

IAR Embedded Workbench for Renesas RL78 version 4.21.1

-C compiler

IAR C/C++ Compiler for RL78 version : 4.20.1.2260 (4.20.1.2260)

-Code Gererator tool

Renesas Smart Configurator for RL78 Version: 1.0.1

3.2.1 Version information

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

define: extern const mw_version_t R_tfat_version;

3.2.2 ROM size / RAM size / Stack size

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

Table 7 ROM/RAM size

kind	size
ROM (Code)	about 7.5KB
RAM (Data)	0byte
Stack size [Note]	about 220byte

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

3.2.3 Performance

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

Table 9 Performance

	Test Condition	Time
RI78/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
RI78/G23	Time to write 1MByte data file. (File Open , Data write ,File close)	About 4.5 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 (R20AN0158EJ0101)
	Source data area when data write.	Internal ROM (Mirror area)
	Destination data area when data read.	Internal RAM
RL78/G23	CPU Clock(fCLK)	32MHz
	Memory	SanDisk SD 2GB
	FAT type	FAT32
	Cluster size	2048byte
	Driver software	Renesas MMC driver (R20AN0158EJ0200)
	Source data area when data write.	Internal ROM (Mirror area)
	Destination data area when data read.	Internal RAM

3.2.4 Notes

- Library is using the following standard function.
  memset memcmp memcpy

3.3 LLVM for Renesas RL78 (C compiler)

-Integrated Development Environment

e^2 studio 2022-07 (22.7.0)

-C compiler

LLVM for Renesas RL78 10.0.0.202207

-Code Gererator tool

(e^2 studio) : Renesas Smart Configurator for RL78 22.7.0.v20220620-0602

3.3.1 Version information

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

define: extern const mw_version_t R_tfat_version;

3.3.2 ROM size / RAM size / Stack size

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

Table 11 ROM/RAM size

kind	size
ROM(.textf .const)	about 11KB
RAM(.bss)	4byte
Stack size [Note]	about 212byte

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 12 structure size

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

3.3.3 Performance

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

Table 13 Performance

	Test Condition	Time
RI78/G23	Time to write 1MByte data file. (File Open , Data write ,File close)	About 3 Sec
	Time to read 1MByte data file. (File Open , Data read ,File close)	About 2.5 Sec

Detail of test condition is below.

Table 14 Measurement condition

	Detail of Test Condition	Contents
RL78/G23	CPU Clock(fCLK)	32MHz
	Memory	Team microSD 2GB
	FAT type	FAT32
	Cluster size	2048byte
	Driver software	Renesas MMC driver (R20AN0158EJ0201)
	Source data area when data write.	Internal ROM (Mirror area)
	Destination data area when data read.	Internal RAM

3.3.4 Notes

- Library is using the following standard function.
  memset memcmp memcpy

3.4 Sample project

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.

RL78/G14 Sound Playback/Compression Demonstration for RL78/G14 CPU Board - Sample Code | Renesas

4. 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.

5. Library version information

Ver	change
2.03	Supported LLVM. M3S-TFAT-Tiny: Included in the installation guide [R20AN0159EJ0201].
2.02	Supported CC-RL. M3S-TFAT-Tiny: Included in the installation guide [R20AN0159EJ0104].
2.01	M3S-TFAT-Tiny: Included in the installation guide [R20AN0159EJ0103].
2.00	M3S-TFAT-Tiny: Included in the installation guide [R20AN0159EJ0102].

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
2.01	Nov 09, 2022	10	Supported LLVM Added LLVM for Renesas RL78 to 3. Development environment.
2.00	Jul 14, 2021	—	Delete CS+ for CA,CX Supported e^2 studio. Supported RL78/G23 Changed the library provision form from Lib. Format to C source.
1.04	Oct 01, 2015	—	Changed CubeSuite+ to CS+ for CA,CX Supported CS+ for CC. Deleted sample program.
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 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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