SH-2A

R20AN0190EJ0101
Rev.1.01
Nov 08, 2013

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 the SH-2A V.2.00 Release 01 (hereafter referred to as "TFAT library") along with a sample program.

Target Device

SH-2A, SH2A-FPU

Contents

1. Structure of application note

This application note includes files below.

Table 1.1 Structure of application note

name	description
r20an0190ej0101_sh2a_tfat.pdf	Introduction Guide (this document)
Workspace (workspace)	
Document (doc)	
English (en)	
r20uw0078ej0200_tfat.pdf	User's Manual
r20an0190ej0101_sh2a_tfat.pdf	Introduction Guide (this document)
Japanese (ja)	
r20uw0078jj0200_tfat.pdf	User's Manual
r20an0190jj0101_sh2a_tfat.pdf	Introduction Guide
Library (lib)	
tfat_sh2a.lib	Library file for SH-2A
tfat_sh2afpu.lib	Library file for SH2A-FPU
r_tfat_lib.h	Library header file
r_stdint.h	Integer type define header file
r_mw_version.h	Library version information define header file
Library generation environment (make_lib)	
Library source directory (src)	
r_TinyFAT.c	Library source
r_version.c	Library source
r_TinyFAT.h	Library source
Public Include header directory (pub_include)	
r_tfat_lib.h	Library header file
r_stdint.h	Integer type define header file
r_mw_version.h	Library version information define header file
tfat_sh2a	Build environment directory for SH-2A
tfat_sh2afpu	Build environment directory for SH2A-FPU
Sample program (sample)	
TFAT_sample_SH7216_with_MMC	Sample program for SH7216 with MMC driver by High-performance Embedded Workshop

2. Specification of library

2.1 Specification of TFAT library

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

Table 2.1 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.

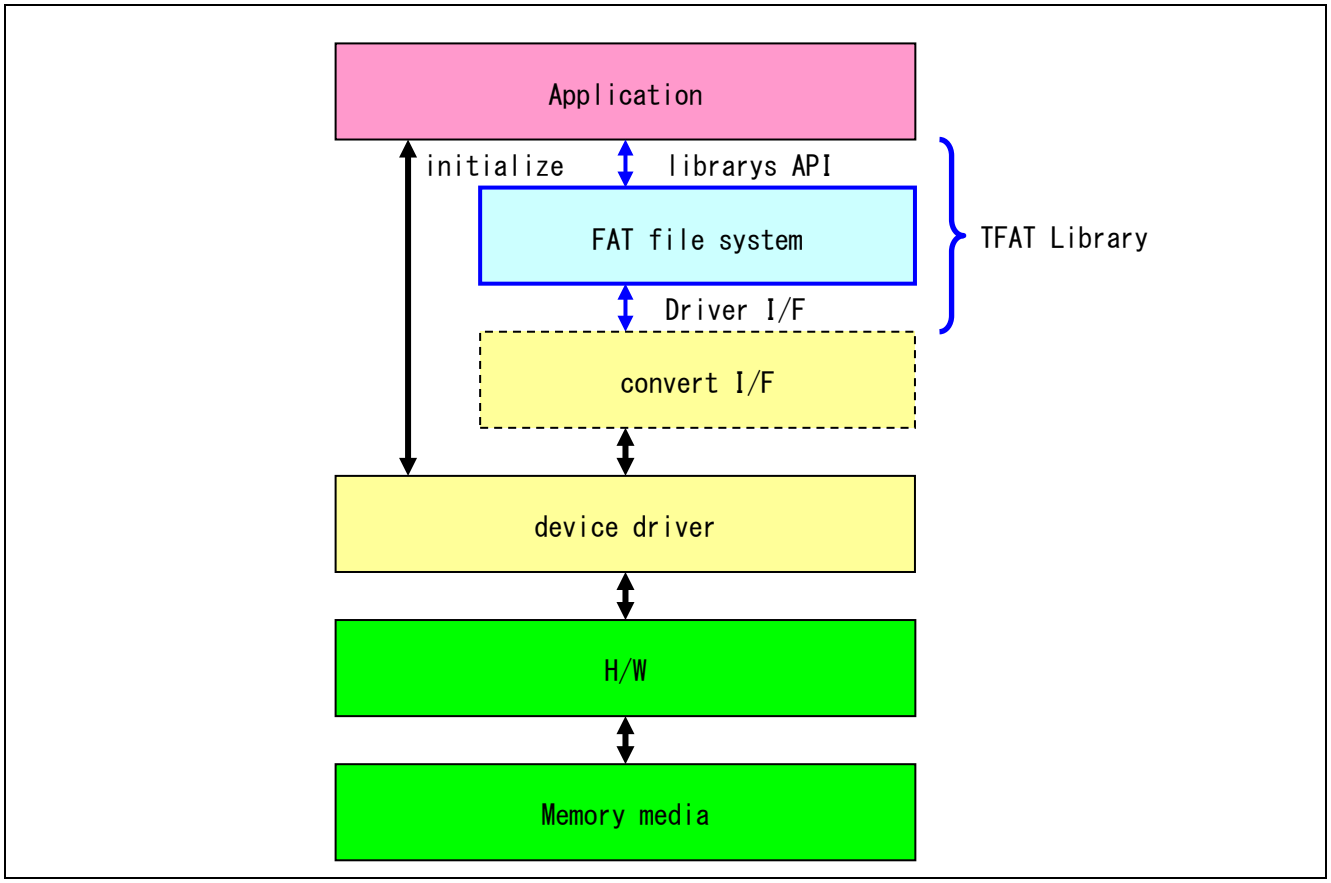


Figure 2-1 structure of software stack of the TFAT library

2.3 Development environment

TFAT library can run with this development environment below.

[Software tools]

- Integrated Development Environment
  High-performance Embedded Workshop V.4.09.00.007
- C compiler
  SuperH Family C/C++ Compiler Package V.9.04 Release 01

[Debug tools]

- Emulator debugger
  E10A-USB emulator
- Emulator software
- E10A-USB Emulator software V.3.04 Release 01

[Board]

- SH7216 CPU Board Renesas type : R0K572167C001BR
- Middleware Evaluation Board Renesas (Please refer to Appendix)

2.4 Compiler option for generating library

Library file is built with the following compiler option.

- TFAT Library file for the SH-2A
  -cpu=sh2a -include="$(WORKSPDIR)\..\pub_include" -object="$(CONFIGDIR)\$(FILELEAF).obj" -gbr=auto -chgincpath -errorpath -global_volatile=0 -opt_range=all -infinite_loop=0 -del_vacant_loop=0 -struct_alloc=1 -nologo
- TFAT Library file for the SH2A-FPU
  -cpu=sh2afpu -include="$(WORKSPDIR)\..\pub_include" -object="$(CONFIGDIR)\$(FILELEAF).obj" -gbr=auto -chgincpath -errorpath -global_volatile=0 -opt_range=all -infinite_loop=0 -del_vacant_loop=0 -struct_alloc=1 -nologo

2.5 Version information

The TFAT library stores the version information as a character string. This variable can be accessed by using the following extern declaration (this is already defined in the library header).

Declaration: extern const mw_version_t R_tfat_version;

The following data is stored for the library in this product.

```
extern const mw_version_t R_tfat_version;

Library file for SH-2A:
  "M3S-TFAT-Tiny version 2.00 for SH-2A.(Aug 23 2012, 11:17:27)"

Library file for SH2A-FPU:
  "M3S-TFAT-Tiny version 2.00 for SH2A-FPU.(Aug 23 2012, 11:17:29)"
```

2.6 ROM size / RAM size / Stack size

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

Table 2.2 ROM/RAM size

Section (Section name)	size
ROM (P , C)	About 8.4KB
RAM (B)	6byte

Table 2.3 stack size

API function name	stack size (No memory driver software)[byte]	stack size (with MMC driver(*) software)[byte]
R_tfat_f_mount	0	0
R_tfat_f_open	216	408
R_tfat_f_close	68	260
R_tfat_f_read	116	308
R_tfat_f_write	152	344
R_tfat_f_lseek	108	300
R_tfat_f_truncate	100	292
R_tfat_f_sync	60	252
R_tfat_f_opendir	148	340
R_tfat_f_readdir	100	292
R_tfat_f_getfree	108	300
R_tfat_f_stat	168	360
R_tfat_f_mkdir	236	448
R_tfat_f_unlink	168	364
R_tfat_f_chmod	168	360
R_tfat_f_utime	164	356
R_tfat_f_rename	228	420
R_tfat_f_forward	88	280

Note: Please refer to chapter 4 for the details of the MMC driver.

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 36 x 2 = 72 Bytes. Likewise will be the case with DIR and other structure variables.

Table 2.4 structure size

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

2.7 Performance

This list shows below writing time and the reading time for file of the case using the TFAT library.

Table 2.5 Measurement contents

Measurement contents	Time required
Time required of 1MB file writing (File Open , Data write ,File close)	About 4 Sec
Time required of 1MB file reading (File Open , Data read ,File close)	About 3 Sec

Table 2.6 shows measurement condition

Table 2.6 Measurement condition

Outline	Contents
CPU Clock(ICLK)	200MHz
Peripheral Clock(PCLK)	50MHz
Used memory media	Transcend MMC 256MB
FAT type	FAT32
Used driver software	Renesas MMC driver (R01AN0039JJ0100)
Source area of the data writing	Internal ROM
Destination area of the data reading	Internal RAM

2.8 Notes

Library is using the following standard function.

memset memcmp memcpy

3. 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.

4. Sample program

4.1 Outline

The sample program is project for High-performance Embedded Workshop with SH7216 CPU board (hereafter referred to as "CPU board"). And Sample programs include the project that implements MMC driver.

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

http://www.renesas.com/products/mpumcu/superh/sh7216/Application_Notes.jsp

- Document No. : R01AN0039EJ0100
- Document Title. : SH7216 Group Accessing MultiMediaCard Using the Renesas Serial Peripheral Interface

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

The page to show below is shown in Japanese.

http://japan.renesas.com/products/mpumcu/superh/sh7216/Application_Notes.jsp

- Document No. : R01AN0039JJ0100

4.2 Sample software execution

When the program is run, a FAT file system working area is registered on the media card. A file is created on the media card and 2K bytes of text data is written to a file. After that, the file is closed. To verify the written data, the file is opened again in read mode. The whole contents of the file are read and compared to the data in the program's write buffer. Whether or not that data matches is indicated in the LEDs on the CPU board.

Table 4.1 Explanation of LED display

LED1(PE12)	LED2(PE13)	Explanation
ON	OFF	Program running
OFF	ON	Error occurred
ON	ON	Execution successful

Data for reading and writing files is defined in the r_data_file.c header file. As a default, the character string "Renesas" is written repeatedly. The total amount of data written is 2K bytes (2048 bytes). If required, this data and the corresponding macro FILESIZE may be edited.

4.3 Flow

Flow of a sample program is shown below.

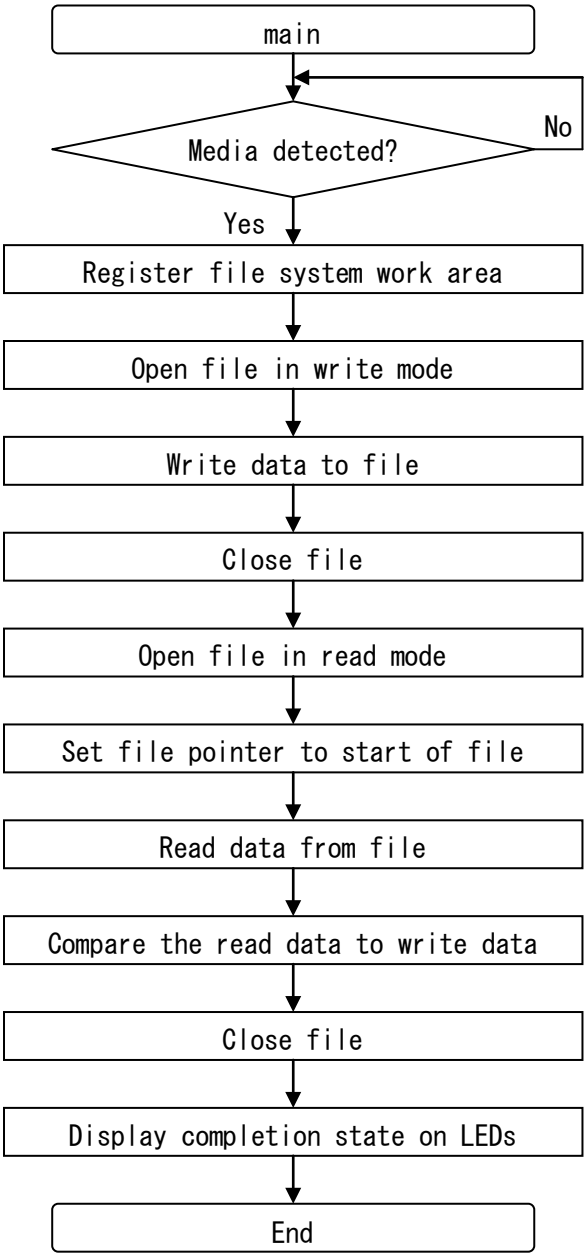


Figure 4-1 Flow of sample program

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 (*1).

Use	**CPU board** Application Header / Microcontroller Header / Jumper		**Middleware Evaluation Board(*2)**	
	Pin No.	**Header name**	**Pin No.**	**Header name**
Power supply (3V)	H6	-	JA1-3	3V3
GND	J9	GND	JA1-4	GND-3V3
MMC CLK	JN2-9	TCLKA	JA2-10	SCK1
MMC Data Output	JP2-1(*3)	-	JA2-6	TXD1
MMC Data Input	JP3-1(*4)	-	JA2-8	RXD1
MMC CardDetect Signal	JN1-16	PA19	JA1-16	IO1
MMC CS Signal	JN2-11	TCLKC	JA1-15	IO0

(*1) Middleware Evaluation Board is designed suitable for RX610 Renesas Starter kit.
Please connect each pins if user attaches Middleware Evaluation Board to CPU Board.

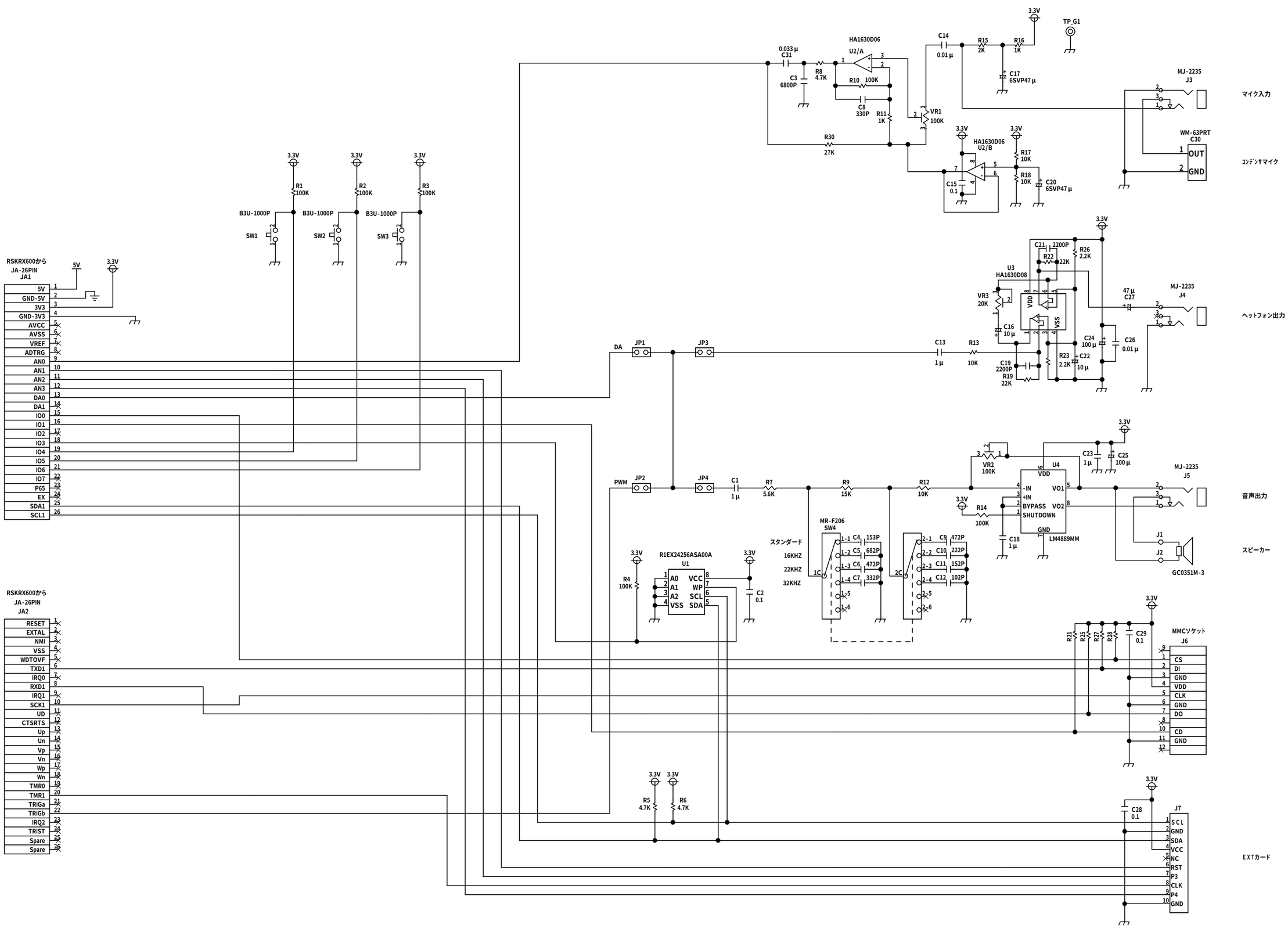
(*2) Middleware Evaluation Board name is shown in Japanese in the circuit schematic.

(*3) JP2-1 is jumper connected with JP2-2 before shipment. When you run a sample program, please remove a jumper,

(*4) JP3-1 is jumper connected with JP3-2 before shipment. When you run a sample program, please remove a jumper,

2. Circuit Schematic

Next page shows the circuit schematic of Middleware Evaluation Board.



Title	RX600用デモ基板		Note {NOTE}
Size A3	DOC NO. {DOCNO}	Revision {REV}	
RX600用デモ基板変更.schfile	2010/09/14 11:39:12	{SHNO}	

Website and Support

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

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

Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.01	Nov 08, 2013	—	Changed document title Changed the structure of sections Added Fatfs copyright to library source
1.00	Sep 20, 2012	—	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 accord 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 type 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.

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.
2880 Scott Boulevard Santa Clara, CA 95050-2554, 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: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

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: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei, 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.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

Colophon 2.2