RL78 Family

SPI mode MultiMediaCard Driver: Introduction Guide

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Introduction

This manual shows the software configuration of MultiMediaCard device driver for the RL78 family and how to use it.

And, we prepared Sound Playback/Compression demonstration software for the YRDKRL78G14 as sample application program for this driver software.

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/G13, RL78/G14

Contents

1. Summary

1.1 Purpose

The purpose is to provide an interface that connects RL78 family MCU to MultiMediaCard (hereafter referred to as "MMC") in SPI mode.

This manual provides information to create the application.

1.2 Function Description

This device driver (hereafter referred to as "MMC driver") is software that enables communication with MMC by RL78 family. This software achieves accessing to MMC using SPI mode in 3-lines serial array unit that is RL78 Family peripherals.

MMC driver

- Reference MMCA System Specifications; Version 3.2
- This is only used in MMC SPI mode
- This is a block type device driver that defines one sector as 512Byte.
  The commands of READ_MULTIPLE_BLOCK and WRITE_MULTIPLE_BLOCK are used.
  As for cards that not support aforesaid two MULTIPLE_BLOCK commands, it is operated by commands of READ_SINGLE_BLOCK and WRITE_SINGLE_BLOCK.
- It supports multiple devices controlled by CS signals.
- It is independent of OS.
- MMC driver in this manual: SPI mode MultiMediaCard Driver for RL78 Family V.1.03 Release 00

1.3 File configuration

Table 1 MMC driver product files

Directory Configuration <Directory name> ,File name	Reference
\doc <DIR>	**Document Directory**
r20an0158ej0103_rl78_mmc.pdf	Application Note (This manual)
\mmc_driver <DIR>	**MMC Driver Source Program Directory**
\com <DIR>	**Common Function Directory**
r_mtl_com.c	Common Function (logging function)
r_mtl_com2.h	Common Header file
r_mtl_endi.c	Common Function (endian function)
r_mtl_mem.c	Common Function (standard library function)
r_mtl_str.c	Common Function (standard library function)
r_mtl_tim.c r_mtl_tim.h	Common Function (software loop timer)
r_stdint.h	Integer type definitions header file
\ rl78_32MHz <DIR>	**Definitions Directory for 32MHz Operation(For CS+ for CA,CX)**
r_mtl_com.h	Definitions Header file
\ rl78_24MHz <DIR>	**Definitions Directory for 24MHz Operation(For CS+ for CA,CX)**
r_mtl_com.h	Definitions Header file
\ rl78_20MHz <DIR>	**Definitions Directory for 20MHz Operation(For CS+ for CA,CX)**
r_mtl_com.h	Definitions Header file
\ rl78_32MHz_CCRL <DIR>	**Definitions Directory for 32MHz Operation(For CS+ for CC)**
r_mtl_com.h	Definitions Header file
\ rl78_24MHz_CCRL <DIR>	**Definitions Directory for 24MHz Operation(For CS+ for CC)**
r_mtl_com.h	Definitions Header file
\ rl78_20MHz_CCRL <DIR>	**Definitions Directory for 20MHz Operation(For CS+ for CC)**
r_mtl_com.h	Definitions Header file
\ rl78_32MHz_IAR <DIR>	**Definitions Directory for 32MHz Operation (For IAR)**
r_mtl_com.h	Definitions Header file
\ rl78_24MHz_IAR <DIR>	**Definitions Directory for 24MHz Operation (For IAR)**
r_mtl_com.h	Definitions Header file
\ rl78_20MHz_IAR <DIR>	**Definitions Directory for 20MHz Operation (For IAR)**
r_mtl_com.h	Definitions Header file

Directory Configuration <Directory name> ,File name	Reference
\ mmc <DIR>	**Directory of Device Driver for MMC**
r_mmc.h	Common Header File
r_mmc_io.c r_mmc_io.h	I/O Module for SPI Mode
r_mmc_mmc.c	MMC Module for SPI Mode
r_mmc_sub.c r_mmc_sub.h	Sub Module for SPI Mode
r_mmc_usr.c	API for SPI Mode
r_mmc_mcu_pragma.h	Header file for pragma define MMC driver
\ rl78 <DIR>	**Directory of RL78 Family**
rl78g14_csi <DIR>	**Communication module using SPI mode MMC driver (For CS+ for CA,CX)**
r_mmc_sfr.h.	Individual definitions of SFR header file
r_mmc_user_config.h	User definitions header file
rl78g14_csi_ccrl <DIR>	**Communication module using SPI mode MMC driver (For CS+ for CC)**
r_mmc_sfr.h.	Individual definitions of SFR header file
r_mmc_user_config.h	User definitions header file
rl78g14_csi_iar <DIR>	**Communication module using SPI mode MMC driver (For IAR)**
r_mmc_sfr.h.	Individual definitions of SFR header file
r_mmc_user_config.h	User definitions header file

2. Program type definitions

This section gives the details about the type definitions used in the program.

DataType	Typedef
unsigned char	uint8_t
unsigned short	uint16_t
unsigned long	uint32_t
signed char	int8_t
signed short	int16_t
signed long	int32_t
int16_t	natural_int_t
uint16_t	natural_uint_t

3. Device Driver

3.1 Device driver function details

Initialization function

Function Name	Function description
R_mmc_Init_Driver ()	Slot initialization process

Function of device control

Function Name	Function description
R_mmc_Init_Slot()	Slot initialization process
R_mmc_Detach()	Slot stop process
R_mmc_Chk_Detect()	Insertion check process

Data access control function

Function Name	Function description
R_mmc_Read_Data()	Data reading process
R_mmc_Write_Data()	Data writing process
R_mmc_Get_MmcInfo()	MMC information obtaining process

Command list of internal use

Command index	Name of command
CMD0	GO_IDLE_STATE
CMD1	SEND_OP_COND
CMD9	SEND_CSD
CMD10	SEND_CID
CMD12	STOP_TRANSMISSION
CMD13	SEND_STATUS
CMD17	READ_SINGLE_BLOCK
CMD18	READ_MULTIPLE_BLOCK
CMD24	WRITE_BLOCK
CMD25	WRITE_MULTIPLE_BLOCK
CMD58	READ_OCR
CMD59	CRC_ON_OFF

Note: User needs to respond to unsupported commands

3.2 Function details

3.2.1 Initialization process of driver (R_mmc_Init_Driver)

clause	detail
Function Name	void R_mmc_Init_Driver(void)
Argument	None
Function	Initialize driver. Initialize SFR for card control. The following process is done in every slot. (1) Open card control port. (2) Initialize card control RAM. Execute once when the system starts up.
Return Value	None

3.2.2 Initialization of card slot (R_mmc_Init_Slot)

clause	detail
Function Name	int16_t R_mmc_Init_Slot(uint8_t SlotNo)
Argument	uint8_t SlotNo : Slot number
Function	Initialize card slot. Initialize card control RAM. Initialization of card. Execute when card insertion is detected.
Return Value	Returns initialization result. MMC_OK : Successful operation MMC_ERR_PARAM : Parameter error MMC_ERR_HARD : Hardware error MMC_ERR_CRC : CRC error MMC_ERR_IDEL : Idle state error MMC_ERR_OTHER : Other error

3.2.3 Card slot stop process (R_mmc_Detach)

clause	detail
Function Name	int16_t R_mmc_Detach(uint8_t SlotNo)
Argument	uint8_t SlotNo : Slot number
Function	Process when removing card from designated slot. -Initialize card control SFR. -Open card control port. -Initialize card control RAM. Execute when card removal is detected.
Return Value	Returns removal result. MMC_OK : Successful operation MMC_ERR_PARAM : Parameter error

3.2.4 Card insertion checking process (R_mmc_Chk_Detect)

clause	detail
Function Name	int16_t R_mmc_Chk_Detect(uint8_t SlotNo, uint8_t* pDetSts)
Argument	uint8_t SlotNo : Slot number uint8_t *pDetSts : Buffer pointer for card insertion condition
Function	Check the condition of card being inserted. If returns "MMC_OK", The port status of card detecting will be in buffer 'pDetSts'. — MMC_TRUE :The port status of card detecting is active — MMC_FALSE:The port status of card detecting Non is non-active Cannot remove chattering in this process. Remove chattering in upper system if needed. Recommend confirming card insertion by periodic polling.
Return Value	Returns the check result. MMC_OK : Successful operation MMC_ERR_PARAM : Parameter error

3.2.5 Data reading process (R_mmc_Read_Data)

clause	detail
Function Name	int16_t R_mmc_Read_Data(uint8_t SlotNo, uint32_t BlkNo, uint32_t BlkCnt, uint8_t *pData, uint8_t Mode)
Argument	uint8_t SlotNo : Slot number uint32_t BlkNo : Block number to start readout uint32_t BlkCnt : Number of readout blocks uint8_t *pData : Pointer to the area where the data which is read must be stored uint8_t Mode : Transfer mode of reading data
Function	Readout the data from card by block (512byte) Readout the data in the designated number of blocks from the designated block. Choose MMC_MODE_NORMAL(transfers data to the designated buffer 'pData'.) in "Mode". The readout from MMC is possible among MMC information handed from R_mmc_Get_MmcInfo() function only when card classification (MmcInfo.Card) is not 'MMC_CARD_UNDETECT'. Maximum block number is 'pMmcInfo.MaxBlkNum' from the "R_mmc_Get_MmcInfo()" function. Maximum number of blocks is 'pMmcInfo.MaxBlkNum' +1.
Return Value	Returns the result of reading. MMC_OK : Successful operation MMC_ERR_PARAM : Parameter error MMC_ERR_HARD : Hardware error MMC_ERR_CRC : CRC error MMC_ERR_OTHER : Other error

3.2.6 Data writing process (R_mmc_Write_Data)

clause	detail	
Function Name	int16_t R_mmc_Write_Data(uint8_t SlotNo, uint32_t BlkNo, uint32_t BlkCnt, uint8_t *pData, uint8_t Mode)	
Argument	uint8_t SlotNo	: Slot number
	uint32_t BlkNo	: Block number to start writing
	uint32_t BlkCnt	: Number of writing blocks
	uint8_t *pData	: Pointer to the area where the data which is written must be stored
	uint8_t Mode	: Transfer mode of writing data
Function	Write the data to card by block (512byte). Write the data in the designated number of blocks to the designated block. Choose MMC_MODE_NORMAL (This is a mode that transfers data from the designated buffer 'pData') in "Mode". The transfers to MMC is possible among MMC information handed from R_mmc_Get_MmcInfo() function only when card classification (MmcInfo.Card) is not 'MMC_CARD_UNDETECT'. Maximum block number is 'pMmcInfo.MaxBlkNum' from the "R_mmc_Get_MmcInfo()" function. Maximum number of blocks is 'pMmcInfo.MaxBlkNum' +1.	
Return Value	Returns the result of writing.	
	MMC_OK	: Successful operation
	MMC_ERR_PARAM	: Parameter error
	MMC_ERR_HARD	: Hardware error
	MMC_ERR_WP	: Write-protection error
	MMC_ERR_OTHER	: Other error

3.2.7 Card information obtaining process (R_mmc_Get_MmcInfo)

clause	detail
Function Name	int16_t R_mmc_Get_MmcInfo(uint8_t SlotNo, MMC_INFO* pMmcInfo)
Argument	uint8_t SlotNo : Slot number MMC_INFO *pMmcInfo : Buffer pointer for card information
Function	It returns MMC information. The buffer 'pMmcInfo' holds card information. • pMmcInfo.Card : Card types — MMC_CARD_UNDETECT : Card not detected — MMC_CARD_MMC : MMC — MMC_CARD_OTHER : Other card • pMmcInfo.WProtect : Write-protection status — MMC_NO_PROTECT : Write-protection cancel — bit1: MMC_W_PROTECT_SOFT : Software write-protection pMmcInfo.MemSize : Card capacity(byte) pMmcInfo.MaxBlkNum : Maximum block number of the media When 'pMmcInfo.MemSize' is 0xFFFFFFFF, 'pMmcInfo.MaxBlkNum' +1 inidicates the number of the media and the size is ('pMmcInfo.MaxBlkNum'+1)*512.
Return Value	Returns the result of obtaining card information. MMC_OK : Successful operation MMC_ERR_PARAM : Parameter error MMC_ERR_OTHER : Other error

3.3 Data Structure

Data structure is showed as follow.

Definition of Card Information Data Structure

```
typedef struct {
  uint8_t    Card;            /* Card type                    */
  uint8_t    WProtect;        /* Write-protection status      */
  uint32_t   MemSize;         /* Card capacity                */
  uint32_t   MaxBlkNum;       /* The number of the max blocks */
} MMC_INFO;
```

3.4 Definitions

Definitions are showed as follow.

```
/*----------- Definitions of return value ------------*/
#define MMC_OK              (int16_t)( 0)       /* Successful operation     */
#define MMC_ERR_PARAM       (int16_t)(-1)       /* Parameter error          */
#define MMC_ERR_HARD        (int16_t)(-2)       /* Hardware error           */
#define MMC_ERR_CRC         (int16_t)(-3)       /* CRC error                */
#define MMC_ERR_WP          (int16_t)(-4)       /* Write-protection error   */
#define MMC_ERR_MBLKCMD     (int16_t)(-5)       /* Multi-block command error*/
#define MMC_ERR_IDLE        (int16_t)(-6)       /* Idle state error         */
#define MMC_ERR_OTHER       (int16_t)(-7)       /* Other error              */

/*--------------- Definitions of flag ----------------*/
#define MMC_TRUE            (uint8_t)0x01       /* Flag "ON"                */
#define MMC_FALSE           (uint8_t)0x00       /* Flag "OFF"               */

/*------------- Definition of card type --------------*/
#define MMC_CARD_UNDETECT   (uint8_t)0x00       /* Card is not found        */
#define MMC_CARD_MMC        (uint8_t)0x01       /* MMC                      */
#define MMC_CARD_OTHER      (uint8_t)0xFF       /* Other card               */

/*------ Definitions of write-protection status ------*/
#define MMC_NO_PROTECT      (uint8_t)0x00       /* None setting             */
#define MMC_W_PROTECT_SOFT  (uint8_t)0x02       /* Software write-protection*/
```

4. Setup Examples

The following example is for the usage of RL78/G14. Please refer to the section 4.3 if you need the information about porting to RL78/G13.

4.1 r_mtl_XXX : Variable Data Setup Example

This section is for setting the resources of each user system

The setting should be made in the [/**SET**/] comment of each file.

An excerpt of each file is provided with detailed comments.

4.1.1 r_mtl_com.h

This file is a common header file.

r_mtl_com.h is prepared for each MCU and system clock settings.

Please select using directory for your environment.

If these are not suitable for your environment, please make directory and setting files for your environment.

MCU - System clock	Include Directory (source directory)
RL78/ G14 – 32MHz (for CS+ for CA, CX)	\com\ rl78_32MHz
RL78/ G14 – 24MHz (for CS+ for CA, CX)	\com\ rl78_24MHz
RL78/ G14 – 20MHz (for CS+ for CA, CX)	\com\ rl78_20MHz
RL78/ G14 – 32MHz (for CS+ for CC)	\com\ rl78_32MHz_CCRL
RL78/ G14 – 24MHz (for CS+ for CC)	\com\ rl78_24MHz_CCRL
RL78/ G14 – 20MHz (for CS+ for CC)	\com\ rl78_20MHz_CCRL
RL78/ G14 – 32MHz (for IAR)	\com\ rl78_32MHz_IAR
RL78/ G14 – 24MHz (for IAR)	\com\ rl78_24MHz_IAR
RL78/ G14 – 20MHz (for IAR)	\com\ rl78_20MHz_IAR

(1) Define the software loop timer

— When using the loop timer, include following header file.
The loop timer process is used for waiting duration of device driver.
The following is an example of the setting when using the software loop timer.
And please define the macro that is suitable for your system clock in r_mtl_tim.h. In case, running RL78 in 32MHz, "MTL_TIM_RL78__32MHz_noWait" should be defined.

```
/* When not using the loop timer, put the following 'include' as comments.  */
#define MTL_TIM_RL78__32MHz_noWait

#include "r_mtl_tim.h"
```

(2) Define Endian type

— Little endian should be selected in RL78 Family

```
#define MTL_MCU_LITTLE              /* Little Endian          */ /** SET **/
```

(3) Specify type of user standard library

— Specify the type of standard library in the user system.
When using the library bundled with the compiler for the processes stated below, add the listed define definitions as comments.
When using the optimized library, define the optimized library.

```
/* Specify the type of user standard library.                              *//** SET **/
/* When using the compiler-bundled library for the following processes,    *//** SET **/
/* put the following 'define' as comments.                                 *//** SET **/
/* memcmp()/memmove()/memcpy()/memset()/strcat()/strcmp()/strcpy()/strlen()*//** SET**/
#define MTL_USER_LIB                /* use optimized library              */ /** SET**/
```

4.1.2 r_mtl_tim.h

When including r_mtl_tim.h, it is enable.

The value depends on clock frequency and wait of MCU.

Set the software timer to be used for internal operations.

If there are no "define" that is suitable for user system, user has to make own "define".

The following count value is actual measurement value.

```
/* Define the counter value for the timer.                                 */
/* Specify according to the user MCU, clock and wait requirements.         */
/*                                                                         */
/* Set the reference value to 10% more than the actual calculated value.   */
/*=========================================================================*/

/*=========================================================================*/
#ifdef MTL_TIM_RL78__32MHz_noWait
/* Setting for 32.0MHz no wait */
#define MTL_T_1US       3               /* loop Number of 1us   */ /** SET **/
#define MTL_T_2US       8               /* loop Number of 2us   */ /** SET **/
#define MTL_T_4US      17               /* loop Number of 4us   */ /** SET **/
#define MTL_T_5US      21               /* loop Number of 5us   */ /** SET **/
#define MTL_T_10US     44               /* loop Number of 10us  */ /** SET **/
#define MTL_T_20US     90               /* loop Number of 20us  */ /** SET **/
#define MTL_T_30US    136               /* loop Number of 30us  */ /** SET **/
#define MTL_T_50US    227               /* loop Number of 50us  */ /** SET **/
#define MTL_T_100US   456               /* loop Number of 100us */ /** SET **/
#define MTL_T_200US   913               /* loop Number of 200us */ /** SET **/
#define MTL_T_300US  1370               /* loop Number of 300us */ /** SET **/
#define MTL_T_400US  1827               /* loop Number of 400us */ /** SET **/
#define MTL_T_1MS    4572               /* loop Number of 1ms   */ /** SET **/
#endif

#ifdef MTL_TIM_RL78__24MHz_noWait
/* Setting for 24.0MHz no wait */
(omit)
#endif

#ifdef MTL_TIM_RL78__20MHz_noWait
/* Setting for 20.0MHz no wait */
(omit)
#endif
```

4.2 MMC Driver : Variable Data Setup Example

This section is for setting the resources of each user system.

The setting should be made in the [/**SET**/] comment of each file.

An excerpt of each file is provided with detailed comments.

4.2.1 r_mmc.h(Common header file)

(1) Define number of slots (devices) and slot number

— Specify number of slots (devices) and slot number.

```
/*  Define number of required card slots. (1-N slots)                              */
/*  Define slot number in accordance with the number of card slots to be connected.  */
/*---------------------------------------------------------------------------------*/
/* Define number of slots (devices). */
#define MMC_SLOT_NUM       1                   /* 1slots              */ /** SET **/

/* Define slot number. */
#define MMC_SLOT0             0                /* Slot 0              */ /** SET **/
#define MMC_SLOT1             1                /* Slot 1              */ /** SET **/
```

(2) Define use of single block commands with SPI mode

— Do not make any changes.

```
/* When use the card which does not support a multi-block command, please define it.      */
/* Use single block commands in the case of the card which does not support multiple block */
/* commands.                                                                              */
#define MMC_SBLK_CMD          /* Support single block commands     */  /** SET **/
```

(3) Define card type

— Define MMC_SUPPORT_MMC.

```
/*---------------------------------------------------------------------------*/
/*  Please define the media to support.                                      */
/*---------------------------------------------------------------------------*/
#define MMC_SUPPORT_MMC                     /* MMC             */ /** SET **/
```

4.2.2 r_mmc_user_setting.h (User Definition Header file)

(1) Selecting MUC

r_mmc_user_config.h is prepared for each MCU. Please include r_mmc_user_config.h in directory that is suitable for user system.

MCU – Communication Module	Include Directory (source directory)
RL78G14 – CSI (For CS+ for CA, CX)	\mmc\rl78\rl78g14_csi
RL78G14 – CSI (For CS+ for CC)	\mmc\rl78\rl78g14_csi_ccrl
RL78G14 – CSI (For IAR)	\mmc\rl78\rl78g14_csi_iar

(2) “define” for channel number of communication unit

Please define MMC_SAU_UNIT for communication unit that user uses.

Please define MMC_SAU_CHANNEL for communication unit channel number.

In case, using SAU0-channel CSI00 or channel CSI10, user has to select using pins. Please select MMC_CSI_PIN for pins that user uses.

```
/* Serial Array Unit(SAU) Select ( 0 or 1 )*/
#define MMC_SAU_UNIT            1                   /** SET **/
/* SAU Channel Select ( 0 or 1 or 2 or 3 ) */
#define MMC_SAU_CHANNEL         1                   /** SET **/
/* CSI PIN select  ( 'A' or 'B' ) */
#define MMC_CSI_PIN             'A'                 /** SET **/

/*
                                  ||         Select Port          |
-----------+-----------+----------++---------------------------------+
  MMC_SAU_ |  MMC_SAU_ | MMC_CSI_ ||    SI    |   SCK    |    SO    |
  UNIT     |  CHANNEL  | PIN      ||  Select  |  Select  |  Select  |
   Value   |   Value   |  Value   ||   port   |   port   |   port   |
===========+===========+==========++=========+==========+==========+
     0     |     0     |    'A'   ||   P50    |   P30    |   P51    |
(=Use SAU0)|           |----------++---------+----------+----------+
           |(=Use CSI00)|   'B'   ||   P16    |   P55    |   P17    |
           +-----------+----------++---------+----------+----------+
           |     1     | (invalid) ||   P74    |   P75    |   P73    |
           |(=Use CSI01)|          ||         |          |          |
           +-----------+----------++---------+----------+----------+
           |     2     |    'A'   ||   P03    |   P04    |   P02    |
           |           |----------++---------+----------+----------+
           |(=Use CSI10)|   'B'   ||   P81    |   P80    |   P82    |
          -+-----------+----------++---------+----------+----------+
           |     3     | (invalid) ||   P11    |   P10    |   P12    |
           |(=Use CSI11)|          ||         |          |          |
-----------+-----------+----------++---------+----------+----------+
     1     |     0     | (invalid) ||   P14    |   P15    |   P13    |
(=Use SAU1)|(=Use CSI20)|          ||         |          |          |
           +-----------+----------++---------+----------+----------+
           |     1     | (invalid) ||   P71    |   P70    |   P72    |
           |(=Use CSI21)|          ||         |          |          |
           +-----------+----------++---------+----------+----------+
           |     2     | (invalid) ||   P143   |   P142   |   P144   |
           |(=Use CSI30)|          ||         |          |          |
           +-----------+----------++---------+----------+----------+
           |     3     | (invalid) ||   P53    |   P54    |   P52    |
           |(=Use CSI31)|          ||         |          |          |
-----------+-----------+----------++---------+----------+----------+*/
```

(3) Define control ports

— Please define the macro for DETECT(detecting card insertion) pins or CS(card select) pins suitable for user's circuit.

— When DETECT pin is not connect, comment out MMC_DETECT0_CONNECTION macro.

```
/*-----------------------------------------------------------------------*/
/*  Define the control port.                                             */
/*-----------------------------------------------------------------------*/
#define MMC_CS0_PORTNO          0             /* CS0 Port No. */  /** SET **/
#define MMC_CS0_BITNO           5             /* CS0 Bit  No. */  /** SET **/

/* Please define the MMC_DETECT0_CONNECTION macro when the MMC slot Card
detect pin connect to MCU. */
#define MMC_DETECT0_CONNECTION       /* DETECT0 Port Connection */ /** SET **/

#if defined(MMC_DETECT0_CONNECTION)
#define MMC_DETECT0_PORTNO      0          /* DETECT0 Port No. */ /** SET **/
#define MMC_DETECT0_BITNO       0          /* DETECT0 Bit  No. */ /** SET **/
#endif /* #if defined(MMC_DETECT0_CONNECTION) */


#if (MMC_SLOT_NUM > 1)

#define MMC_CS1_PORTNO                       /* CS1 Port No. */  /** SET **/
#define MMC_CS1_BITNO                        /* CS1 Bit  No. */  /** SET **/


#define MMC_DETECT1_CONNECTION       /* DETECT1 Port Connection */ /** SET **/

#if defined(MMC_DETECT1_CONNECTION)
#define MMC_DETECT1_PORTNO                /* DETECT1 Port No. */ /** SET **/
#define MMC_DETECT1_BITNO                 /* DETECT1 Bit  No. */ /** SET **/
#endif /* #if defined(MMC_DETECT0_CONNECTION) */
```

(4) Definition of detecting communication timeout

— This macro can omit detecting timeout during communication.
If user omits detecting timeout, please define “MMC_NOCHK_TIMEOUT”. If this macro is defined, processing speed would be increased, but there is a possibility program stops when abnormal communication status occurs. If user does not omit this macro definition, please set time to this macro.

- Setting time unit using MMC_T_CSI_WAIT macro. Please select setting macro from r_mtl_tim.h.
- Please define transmit timeout time using MMC_CSI_TX_WAIT macro.
- Please define reception timeout time using MMC_CSI_RX_WAIT macro.
- Setting values of each timeout time macro are [timeout time/unit].

```
/*-------------------------------------------------------------------------*/
/* Macro "MMC_NOCHK_TIMEOUT" omits detecting timeout during communication.  */
/* If user omits detecting timeout, please define this macro.              */
/* If this macro is defined, processing speed would be increased.          */
/*-------------------------------------------------------------------------*/
#define MMC_NOCHK_TIMEOUT  /* No Check Communication Timeout   */ /** SET **/

/*-------------------------------------------------------------------------*/
/* If MMC_NOCHK_TIMEOUT would be not defined, please set timeout time.     */
/* MMC_T_CSI_WAIT is unit of measuring timeout.                            */
/* Please select value from "r_mtl_tim.h"                                  */
/* Please set value of (timeout time/unit) to MMC_CSI_TX_WAIT(transmitting) */
/* and MMC_CSI_RX_WAIT(receiving).                                         */
/*-------------------------------------------------------------------------*/
/* CSI transmit&receive completion waiting polling time   */
#define MMC_T_CSI_WAIT   (natural_uint_t)MTL_T_1US                 /** SET **/

/* CSI transmission completion waiting time 50000 * 1us = 50ms */
#define MMC_CSI_TX_WAIT  (natural_uint_t)50000                     /** SET **/
/* CSI receive completion waiting time  50000 * 1us = 50ms */
#define MMC_CSI_RX_WAIT  (natural_uint_t)50000                     /** SET **/
```

(5) Define resources

— The data transfer depends on MCU resource for use with.
Select one of the following for use as your system.

```
/*-------------------------------------------------------------------------*/
/*  Define the combination of the MCU's resources.                         */
/*-------------------------------------------------------------------------*/
//#define MMC_OPTION_1   /* CSI                          */ /** SET **/
#define MMC_OPTION_2   /* CSI + CRC calculation circuit  */ /** SET **/
```

(6) Define bit rate

— As for transfer speed setting, it is necessary to meet tODLY of both Identification mode and Data Transfer mode in spec.
In addition, it is necessary to meet tOD (100kHz <= tOD <= 400kHz) at Identification mode and tPP (0.1MHz <= tPP <= 20MHz (*)) at Data Transfer mode.
The frequency of tOD and tPP mean the frequency of SCLK in this device driver.
As for maximum frequency, make a confirmation of each MCU datasheet.

- MMC_FCLK_PRESCALER_SELECT macro
  This macro sets fMCK using fCLK(source of clock). Setting value is reflected to PRSm3 - PRSm0 bit.
  Please set the value “0-15” to MMC_FCLK_PRESCALER_SELECT macro.
- MMC_OPERATION_CLK_SELECT macro
  This macro selects fMCK for each channel (max 4 channel) of SAU(Serial Array Unit). Setting value is reflected to CKSmn bit in SMSm register.
  Please sets any values (0 or 1) to MMC_OPERATION_CLK_SELEC macro.
- MMC_UBRG_IDENTIFICATION macro
  This macro sets transfer clock when user uses “Identification mode”. Setting value is reflected to upper 7bit in SDRmn register, and becomes transfer clock (fTCLK) from divided fMCK. Please set “0-63” to MMC_UBRG_IDENTIFICATION macro.

- MMC_UBRG_D_TRANSFER macro
  This macro sets transfer clock when user uses “Transfer mode”. Setting value is reflected to upper 7bit in SDRmn register, and becomes transfer clock (fTCLK) from divided fMCK. Please set “0-63” to MMC_UBRG_D_TRANSFER macro.

- MMC_CLK_D_TRANSFER macro
  Please set frequency of “Transfer mode” to MMC_CLK_D_TRANSFER macro. The setting value is used for checking “NAC Cycles”.

— This section shows example of setting for communication baud rate

- fCLK=32MHz(HOCO) , (fMCK=16MHz,) fTCLK=8MHz
  Please define baud rate in r_mmc_user_config.h. Example is below.

```
/*-----------------------------------------------------------------------------------------*/
/* Define the value of the bit rate register according to a communication baud rate.      */
 (omit)
/* fCLK = 32MHz , fMCK = 16MHz , fTCLK = 8MHz */
#define MMC_FCLK_PRESCALER_SELECT 1              /* SPSm.PRSmk[3:0]                */  /** SET **/

#define MMC_OPERATION_CLK_SELECT  0              /* select SMRm.CKmX 0:CKm0  1:CKm1*/  /** SET **/

#define MMC_UBRG_IDENTIFICATION  (uint8_t)19     /* BRR identification mode setting*/  /** SET **/
/*                                       ++----------------- 400KHz               */  /** SET **/
#define MMC_UBRG_D_TRANSFER      (uint8_t)0      /* BRR data Transfer mode setting */  /** SET **/
/*                                       ++----------------- 8.0MHz               */  /** SET **/
#define MMC_CLK_D_TRANSFER  (uint32_t)8000000 /* Data Transfer mode clock frequency */  /** SET **/
```

- fCLK=24MHz(HOCO) , (fMCK=24MHz,) fTCLK=12MHz
  Please define baud rate in r_mmc_user_config.h. Example is below.

```
/*-----------------------------------------------------------------------------------------*/
/* Define the value of the bit rate register according to a communication baud rate.      */
 (omit)
/* fCLK = 24MHz , fMCK = 24MHz , fTCLK = 12MHz */
#define MMC_FCLK_PRESCALER_SELECT 0              /* SPSm.PRSmk[3:0]                */  /** SET **/

#define MMC_OPERATION_CLK_SELECT  0              /* select SMRm.CKmX 0:CKm0  1:CKm1*/  /** SET **/

#define MMC_UBRG_IDENTIFICATION   (uint8_t)29    /* BRR identification mode setting*/  /** SET **/
/*                                        ++---------------- 400KHz               */  /** SET **/
#define MMC_UBRG_D_TRANSFER       (uint8_t)0     /* BRR data Transfer mode setting */  /** SET **/
/*                                        ++---------------- 12.0MHz              */  /** SET **/
#define MMC_CLK_D_TRANSFER (uint32_t)12000000 /* Data Transfer mode clock frequency*/  /** SET **/
```

- fCLK=20MHz(XIN) , (fMCK=20MHz,) fTCLK=10MHz
  Please define baud rate in r_mmc_user_config.h. Example is below.

```
/*-----------------------------------------------------------------------------------------*/
/* Define the value of the bit rate register according to a communication baud rate.      */
 (omit)
/* fCLK = 20MHz , fMCK = 20MHz , fTCLK = 10MHz */
#define MMC_FCLK_PRESCALER_SELECT 0              /* SPSm.PRSmk[3:0]                */  /** SET **/

#define MMC_OPERATION_CLK_SELECT  0              /* select SMRm.CKmX 0:CKm0  1:CKm1 */  /** SET **/

#define MMC_UBRG_IDENTIFICATION   (uint8_t)24    /* BRR identification mode setting */  /** SET **/
/*                                        ++---------------- 400KHz               */  /** SET **/
#define MMC_UBRG_D_TRANSFER       (uint8_t)0     /* BRR data Transfer mode setting  */  /** SET **/
/*                                        ++---------------- 10.0MHz              */  /** SET **/
#define MMC_CLK_D_TRANSFER (uint32_t)10000000 /* Data Transfer mode clock frequency*/  /** SET **/
```

4.3 Scheme of porting to RL78/G13

The different exist in only section 4.2.2 (1) and (2).

If you needs the other information, please refer to the section 4.1 and 4.2.

This section explains for section 4.2.2 [“define” for channel number of communication unit].

r_mmc_user_config.h and r_mmc_sfr.h needs to change.

Please rename the include directory about section 4.2.2 [Selecting MUC].

4.3.1 r_mmc_user_config.h

Communication unit channel number and usable pins combinations are different in each MCU type and number of pins.

[User’s Manual Hardware] section “Serian Array Unit” explains communication unit (MMC_SAU_UNIT) and communication unit channel number (MMC_SAU_CHANNEL), CSI channel combination.

Please update following table.

```
------------+------------+-----------++--------------------------------+
  MMC_SAU_  |  MMC_SAU_  | MMC_CSI_  ||    SI     |   SCK    |    SO    |
  UNIT      |  CHANNEL   | PIN       ||  Select  |  Select  |  Select  |
   Value    |   Value    |  Value    ||   port   |   port   |   port   |
============+============+===========++==========+==========+==========+
     0      |     0      |    'A'    ||   P50    |   P30    |   P51    |
(=Use SAU0) |            |-----------++----------+----------+----------+
            |(=Use CSI00)|    'B'    ||   P16    |   P55    |   P17    |
            +------------+-----------++----------+----------+----------+
            |     1      | (invalid) ||   P74    |   P75    |   P73    |
            |(=Use CSI01)|           ||          |          |          |
            +------------+-----------++----------+----------+----------+
            |     2      |    'A'    ||   P03    |   P04    |   P02    |
            |            |-----------++----------+----------+----------+
            |(=Use CSI10)|    'B'    ||   P81    |   P80    |   P82    |
           -+------------+-----------++----------+----------+----------+
            |     3      | (invalid) ||   P11    |   P10    |   P12    |
            |(=Use CSI11)|           ||          |          |          |
------------+------------+-----------++----------+----------+----------+
     1      |     0      | (invalid) ||   P14    |   P15    |   P13    |
(=Use SAU1) |(=Use CSI20)|           ||          |          |          |
            +------------+-----------++----------+----------+----------+
            |     1      | (invalid) ||   P71    |   P70    |   P72    |
            |(=Use CSI21)|           ||          |          |          |
            +------------+-----------++----------+----------+----------+
            |     2      | (invalid) ||   P143   |   P142   |   P144   |
            |(=Use CSI30)|           ||          |          |          |
            +------------+-----------++----------+----------+----------+
            |     3      | (invalid) ||   P53    |   P54    |   P52    |
            |(=Use CSI31)|           ||          |          |          |
------------+------------+-----------++----------+----------+----------+*/
```

```
For example, RL78/G13 32pin type product table as below.
------------+------------+-----------++--------------------------------+
  MMC_SAU_  |  MMC_SAU_  | MMC_CSI_  ||    SI    |   SCK    |    SO    |
  UNIT      |  CHANNEL   | PIN       ||  Select  |  Select  |  Select  |
   Value    |   Value    |  Value    ||   port    |   port   |   port   |
============+============+===========++==========+==========+==========+
     0      |     0      | (invalid) ||   P11    |   P10    |   P12    |
 (=Use SAU0)|(=Use CSI00)|           ||          |          |          |
            +------------+-----------++----------+----------+----------+
            |     1      |    ---    ||   ---    |   ---    |   ---    |
            +------------+-----------++----------+----------+----------+
            |     2      |    ---    ||   ---    |   ---    |   ---    |
            +------------+-----------++----------+----------+----------+
            |     3      | (invalid) ||   P50    |   P30    |   P51    |
            |(=Use CSI11)|           ||          |          |          |
------------+------------+-----------++----------+----------+----------+
     1      |     0      | (invalid) ||   P14    |   P15    |   P13    |
(=Use SAU1) |(=Use CSI20)|           ||          |          |          |
            +------------+-----------++----------+----------+----------+
            |     1      |    ---    ||   ---    |   ---    |   ---    |
------------+------------+-----------++----------+----------+----------+*/
Allocation port to SI, SCK, SO information is shown in RL78/G13 User's Manual
section 1 outline.
```

- 30, 32-pin products

Unit	Channel	Used as CSI	Used as UART	Used as Simplified I^2C
0	0	CSI00	UART0	IIC00
	1	–		–
	2	–	UART1	–
	3	CSI11		IIC11
1	0	CSI20	UART2 (supporting LIN-bus)	IIC20
	1	–		–

Figure 1 Allocation of communication function (Quotes from RL78/G13 User's Manual rev3.10)

```
Please update communication unit channel definition fitting to user circuit.
This example, CSI20 channel is used.

/* Serial Array Unit(SAU) Select ( 0 or 1 )*/
#define MMC_SAU_UNIT            1                   /** SET **/
/* SAU Channel Select ( 0 or 1 or 2 or 3 ) */
#define MMC_SAU_CHANNEL         0                   /** SET **/

In RL78/G13 32 pin product, one-pair pins are allocated for CSI channel.
"#define MMC_CSI_PIN" is not necessary.
```

4.3.2 r_mmc_sfr.h

This section explains about select port settings.

Target of changings are following 12 defines. Please unchanged for others.

1. #define MMC_CSI_UNIT
   Setting for CSI unit number. (“m” of CSImn)
   For example, CSI20 -> “2”

2. #define MMC_CSI_CHANNEL
   Setting for CSI channel number (“n” of CSImn)
   For example CSI20 -> “0”

3. #define MMC_DATAI_PORTNO
   Setting for port number about allocate as data input line(SI)
   For example P14 -> “1”

4. #define MMC_DATAI_BITNO
   Setting for bit number about allocate as data input line (SI)
   For example P14 -> “4”

5. #define MMC_CLK_PORTNO
   Setting port number about allocate as CLOCK line (SCK)
   For example P15 -> “1”

6. #define MMC_CLK_BITNO
   Setting bit number about allocate as CLOCK line (SCK)
   For example P15 -> “5”

7. #define MMC_DATAO_PORTNO
   Setting port number about allocate as data output line (SO)
   For example P13 -> “1”

8. #define MMC_DATAO_BITNO
   Setting bit number about allocate as data output line (SO)
   For example P13 -> “3”

9. #define MMC_CSI_SIR_CLEAR
   This is setting value to clear the serial flag clear trigger register (SIR)
   Clear flag when set bit to target bit.
   FECT bit (framing error flag clear trigger) is limited about valid unit/channel combination. Please refer to the MCU User’s Manual.
   Please set “7” when FECT bit is available combination.
   Please set “3” when FECT bit is unavailable combination.

5. Method for connecting to MCU and MCU resource for use with

5.1 MCU resource for use with

This software controls as follows:

Data input/output is controlled by clock synchronous serial I/O (internal clock).

Allocate CMOS output port and set CMOS output of the clock synchronous serial I/O in order to perform high-speed processing.

Please do CMOS output setting.

The transmission control detects the space of the transmission buffer, and use a transmission interrupt request bit without using an interrupt. Therefore, I set it about an interrupt as follows.

- Set “1” (disable interrupt process)
- Connect Card CS# pin to RX Port and control it by RX general port setting.

Resources	RL78/G14
SCI (clocked synchronous mode)	M
CRC calculation circuit	R
Port for CS#: 1port/Card	M
Port for Card detection: 1port/Card	R
Port for Power Control: 1port/Card	M

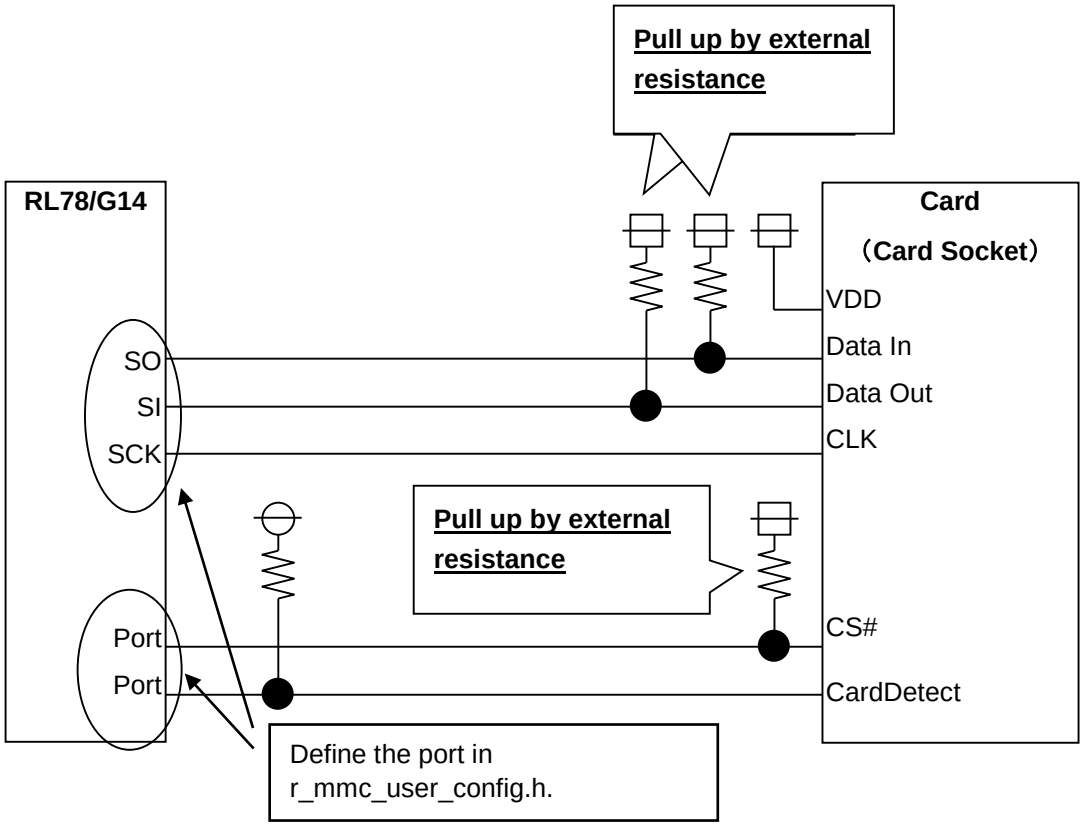
M: mandatory

R: recommended (high-speed processing is enabled when unique resource of RL78 is used)

5.2 Method for connecting to MCU

An example of connecting to RL78/G14 is showed.

In case of other RL78 family MCUs, the same connection is made



Power control circuit for card is required to control inserting and removing.

(power control circuit is not described).

Supply power to the card after detection of insertion.

Cut off the power supply to a card before removing.

In case of using multiple cards in the same SPI bus, assigne CS# port/CardDetect port for each card.

6. Notes for Application Development

6.1 Notes for use

- Configure the software according to the hardware.
- Remove card after deactivation, setting signals between MCU and card into Hi-z and cutting off power supply to card.
- In case that insertion/removable circuit is not realized, inserting/removing card might cause the power source to be unstable and reset MCU.

6.2 Development environment

Requirement items

When user develops, choose newer version than below.

6.2.1 CS+ for CA, CX

[Software]

-Integrated Development Environment

CS+ for CA,CX V3.00.01

-C compiler

CA78K0R V1.71

6.2.2 CS+ for CC

[Software]

-Integrated Development Environment

CS+ for CC V3.01.00

-C compiler

CC-RL V1.01

6.2.3 IAR Embedded Workbench

[Software]

-Integrated Development Environment and C compiler

IAR Embedded Workbench for Renesas RL78 version 2.10.1

-Code Gererator tool

Applilet3 for RL78 V1.09.00 Renesas

[board]

The sample program that uses MMC driver-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

6.3 Notes for embedding

6.3.1 Files for includding

Include "r_mmc.h" and "r_mtl_com.h" when embedding this device driver.

It is necessary for include to do "r_mtl_com.h" first.

6.3.2 Note of configuration (r_mmc_user_config.h)

- Note of select “B” for MMC_CSI_PIN macro
  User can change CSI channel (CSI00, CSI01) according to the number of pins of MCU. MMC_CSI_PIN macro can select using pins but if user select “B”, user has to set the PIOR0 resister.

6.3.3 Limitation of program

Program sets SAUmEN bit to “1” (enable) when program starts communication, but the program does not set “0” (disable) when program finishes communication. Please set “0” (disable) if necessary.

6.4 ROM size / RAM size / Stack size

MMC driver requires ROM/RAM/Stack size as below.

6.4.1 CS+ for CA, CX

ROM size : about 9KByte

RAM size : about 1KByte (*)

Stack size : about 120byte

6.4.2 CS+ for CC

ROM size : about 7KByte

RAM size : about 1KByte (*)

Stack size : about 100byte

6.4.3 IAR Embedded Workbench

ROM size : about 7KByte

RAM size : about 1KByte (*)

Stack size : about 80byte

(*) 512 bytes for each necessary to writing and reading from upper layer program are included.

6.5 Notes on insertion/removal of the card

Enable to detect the insertion or removal of the card using the function "R_mmc_Chk_Detect()" with the card detection pins, which comes with the card connector.

Therefore, it is recommended to detect the insertion or removal of the card by software polling.

The driver returns an error when the card is removed in a data transmission eventually.

However, the driver may not return an error when the card is removed momentary in a data transmission in case of the following conditions:

- Data transmission is operated properly when no response error from the card occurs, because the driver cannot detect the insertion or removal of the card by software polling.
- The driver may recognize the completion of writing to the card when the card is inserted or removed momentary in writing stage. This is because of the specification that a writing completion will be detected by "H" signal of DetaIn pin. DataIn pin is pulled up.

Please avoid this problem by the system hardware such as a hardware interrupt control and polling period time etc.

6.6 Note of the Hi-z setting processing of the port about the exclusion and adding of the card

In the insertion of the card, Please insert card after having set CS#, DataIn, DataOut, and Clock terminal in Hi-z. Please supply the power supply to a card afterwards.

In the extraction of the card, after the power supply supply stop to a card, after the power supply supply stop to a card, please extract a card, after having set CS#, DataIn, DataOut, and Clock terminal in Hi-z.

The CS#, DataIn, DataOut, CLK terminal of the card is assigned to CSI or a port terminal of MCU, but does not process Hi-z by this driver because the case that the port is assigned to other resources is expected.

Therefore, please make the Hi-z processing of the MCU terminal in the high rank side in the exclusion and adding of the card.

7. MMC Driver Information

Ver	change	Release date
1.03	・Supported CS+ for CC. ・Deleted MMC_OPTION_3 and MMC_OPTION_4 from r_mmc_user_config.h	Oct.01.2015
1.02	Add information about porting to RL78/G13.	Apr.01.2015
1.01	Supported IAR Embedded Workbench. Added config settings for the case that detect pin is not connected to MCU.	Sep.01.14
1.00	first release	Mar.31.12

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.03	Oct.01.2015	-	Changed CubeSuite+ to CS+ for CA,CX Supported CS+ for CC. Deleted sample program. Deleted description that is communication using DTC function.
1.02	Apr.01.2015	-	Add information about porting to RL78/G13.
1.01	Sep.01.2014	-	Release with V.1.01 Release 00
1.00	Mar.31.2012	-	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.

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