

RX230 Group, RX231 Group

Initial Settings and Usage Procedure of RTC Battery Backup Function

Summary

This application note describes the initial settings and usage procedure of the battery backup function incorporated into RX230 Group and RX231 Group MCUs, utilizing Firmware Integration Technology (FIT) module APIs.

For details of the specifications of the RX230 Group and RX231 Group, refer to RX230 Group, RX231 Group User's Manual: Hardware.

Target Devices

RX230 Group and RX231 Group 64- and 100-pin package products

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

Related Application Notes

Application notes related to this application note are listed below. Consult them in conjunction with this application note.

- Firmware Integration Technology User's Manual (R01AN1833)
- RX Family Adding Firmware Integration Technology Modules to Projects (R01AN1723)
- RX Family Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826)
- RX Family Board Support Package Module Using Firmware Integration Technology (R01AN1685)
- RX231 Group Renesas Starter Kit Sample Code (e² studio for CC-RX) (R01AN3137)
- RX Family Battery Backup Function Module Firmware Integration Technology (R01AN2796)
- RX Family Flash Module Using Firmware Integration Technology (R01AN2184)
- RX231 Group Renesas Starter Kit User's Manual (R20UT3027EG)
- Renesas Starter Kit for RX231 CPU Board Schematics (R20UT3026EG)

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1. Overview

1.1 About this Application Note

The battery backup function uses a dedicated battery backup power supply (VBATT) to ensure that the RTC's clock function continues to operate even if the VCC power supply is interrupted. In the operation example described below, time information from the RTC is displayed on an LCD panel, allowing confirmation that the RTC continues to operate when in the battery backup state.

The operating conditions of the sample program are described in (1) to (6) below, and the VCC and VBATT states are listed in Table 1.1.

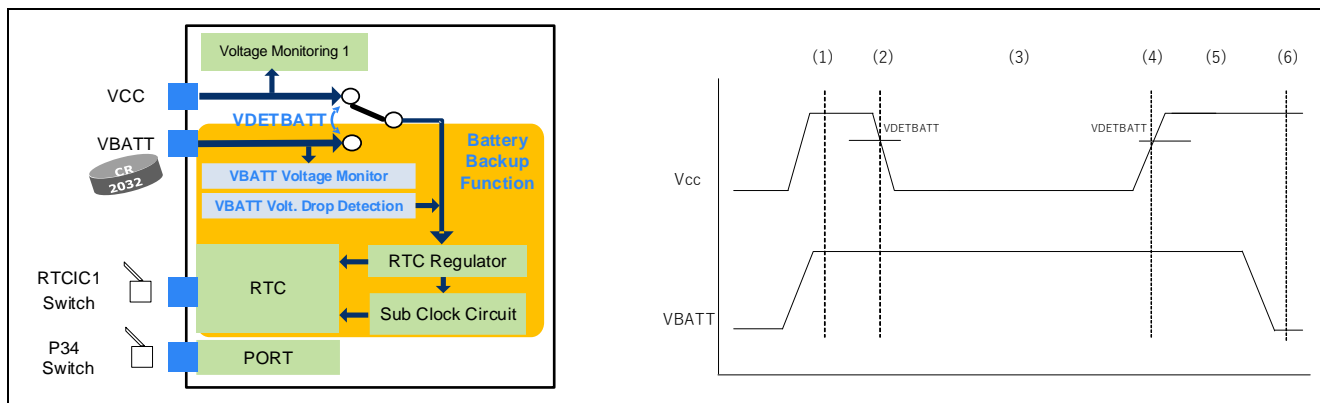


Figure 1.1 Battery Backup Function

(1) Power-on (VCC on and VBATT on)

The RTC operates, and time information is displayed on the LCD.

(2) Automatic switch to VBATT at VCC drop (VCC on → off, VBATT on)

When the VCC power supply drops below the monitoring voltage (3.10V), the time information and switch (connected to P34 pin) press count are stored in the data flash.

When the VCC power supply drops still further and reaches $V_{DET BATT} \pm 0.1 \text{ V}$ (typ.), the power supply of the RTC sub-clock switches automatically to the VBATT power supply. The LCD that displays the time information goes blank.

(3) VBATT voltage drop detection (VCC off, VBATT on)

During battery backup, RTC operation continues. During this period, if battery voltage drops below 1.8V, RTC operation is not guaranteed and `VBATRLVDETF` bit set to 1. By checking this bit, we can confirm whether VBATT voltage dropped below 1.8V.

Also, time information is captured using the RTCIC1 pin (rising-edge input).

(4) VCC recovery (VCC off → on, VBATT on)

When VCC recovers to $V_{DET BATT} + \pm 0.1 \text{ V}$ (typ.), use of the VCC power supply resumes.

`VBATTSR.VBATRLVDETF` is checked. If the value is 1, VBATT is determined to be less than 1.8 V and the RTC is initialized.

(5) Power supply recovery (VCC on, VBATT on)

If VBATT hasn't dropped below 1.8V, after VCC recovery, the elapsed time is updated, and the latest time information is displayed on the LCD.

(6) VBATT pin voltage monitor function (VCC on, VBATT on → off)

When VBATT is less than `Vdetvbt` (is set to 2.2 V), a VBATT pin voltage drop detection interrupt is generated and a voltage drop alert is displayed on the LCD.

Table 1.1 Operating Conditions

	VCC/VBATT State	Voltage Monitor 0 Reset (Vdet0)	VBATT Pin Voltage Drop Detection Interrupt (Vdetvbt)	RTC Count Operation	LCD Display	Data Saved (RAM, Time Information)	RTC Initialization	Input Capture
(1)	(initial state) Vcc = On (active) Vbatt = On	No generated	Enable	Operating	Yes	No	Yes	Enable
(2)	Vcc = On ⇒ Off, Vbatt = On ⇒ On (switch to battery)	Generated	No	Operating	Turn off	Saved	No	Enable
(3)	Vcc = Off, Vbatt = On (battery active)	On hold	No	Operating (No if VBATT below 1.8V)	No	Saved	No	Enable (inputted)
(4)	Vcc = Off ⇒ On, (switch to VCC) Vbatt = On	Released	No	Operating	Turn on	Saved	No (Yes if VBATT below 1.8V detected)	Enable
(5)	Vcc = On (VCC active) Vbatt = On	Not generated	Enable	Operating	Yes	Saved	No	Enable
(6)	Vcc = On Vbatt = On ⇒ Off (battery depleted)	Not generated	Generated	Operating	Yes	Saved	No	Enable

A system flowchart of the sample program is shown below.

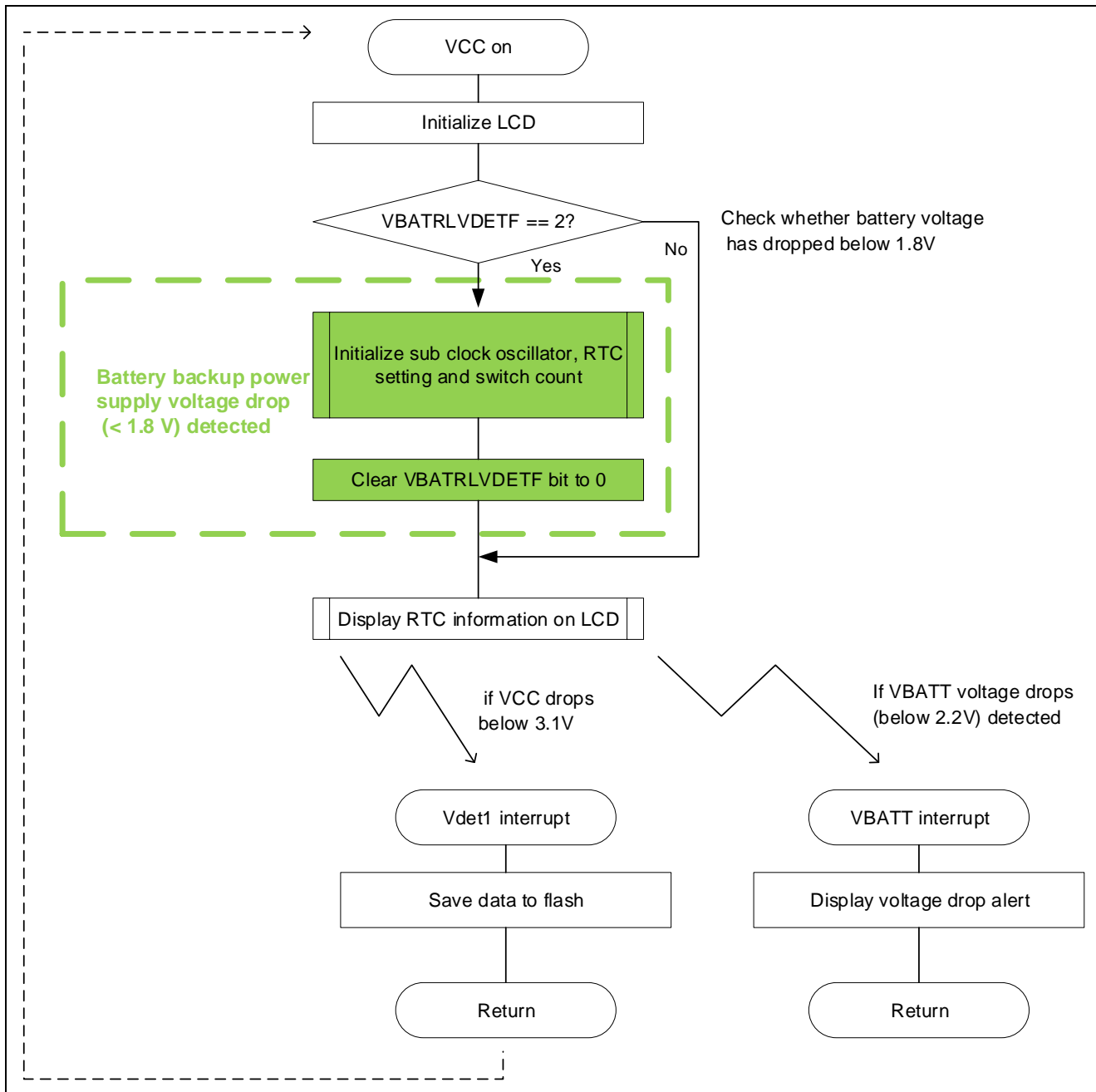


Figure 1.2 System Flowchart

1.2 Operating Environment

Table 1.2, Operating Environment, shows the environment in which the operation of the sample program was confirmed.

Table 1.2 Operating Environment

Item	Description
MCU used	R5F52318ADFP (RX231 Group)
Board used	Renesas Starter Kit for RX231 (product number: R0K505231S000BE)
CPU operating frequency	Refer to 2.3, Clock Settings.
Integrated development environment	Renesas Electronics e ² studio Version 7.5.0
C compiler	Renesas Electronics C/C++ Compiler Package for RX Family V.3.01.00
Emulator	E1
Endian order	Little-endian

The sample program uses FIT modules to control battery backup function and programming of the flash memory. LCD display software uses the sample code provided with the RSK board, and the drivers of other functions than battery backup and flash programming are generated using Smart Configurator (SC). Note that in the sample program, R_Config_RTC_Create function call, which is generated for RTC battery backup operation by SC, r_cg_hardware_setup.c file is deleted.

```

void R_Systeminit(void)
{
    /* Enable writing to registers related to operating modes, LPC, CGC and
    software reset */
    SYSTEM.PRCR.WORD = 0xA50FU;

    /* Enable writing to MPC pin function control registers */
    MPC.PWPR.BIT.BOWI = 0U;
    MPC.PWPR.BIT.PFSWE = 1U;

    /* Initialize clocks settings */
    R_CGC_Create();

    /* Set peripheral settings */
    R_Config_PORT_Create();
    R_Config_CMT0_Create();
    R_Config_LVD1_Create();
    R_Config_SCI8_Create();
    R_Config_RTC_Create(); ← Deleted.
  
```

Figure 1.3 Modification of r_cg_hardware_setup.c

Table 1.3 lists the FIT modules used, Table 1.4 list the sample code provided with RSK board, and Table 1.5 lists the SC components. For details of the LCD display software, refer to RX231 Group: Renesas Starter Kit Sample Code (e² studio for CC-RX) (R01AN3137EG0200).

Table 1.3 FIT Module

Type	Application Note Title (Document No.)	FIT Module Name	Revision
BSP	RX Family Board Support Package Module Using Firmware Integration Technology (R01AN1685)	r_bsp_rx	5.20
Device driver	RX Family Battery Backup Function Module Firmware Integration Technology (R01AN2796)	r_vbatt_rx	1.03
	RX Family Flash Module Using Firmware Integration Technology (R01AN2184)	r_flash_rx	4.00

Table 1.4 Sample Code

Type	Application Note Title (Document No.)	Revision
Sample Code	RX231 Group Renesas Starter Kit Sample Code (e ² studio for CC-RX) (R01AN3137)	2.00

Table 1.5 SC Components

Type	Component Name	Module Name	Revision
Device driver	Realtime clock	RTC	1.30
	Compare match timer	CMT0	1.70
	Voltage detection circuit	LVD1	1.50
	Ports	PORT	1.70
	SPI clock synchronous mode	SCI8	1.50

2. Hardware

2.1 Overview of Renesas Starter Kit for RX231 (RSK)

Excerpted from RSKRX231 manual

Quick Start Renesas Starter Kit for RX231

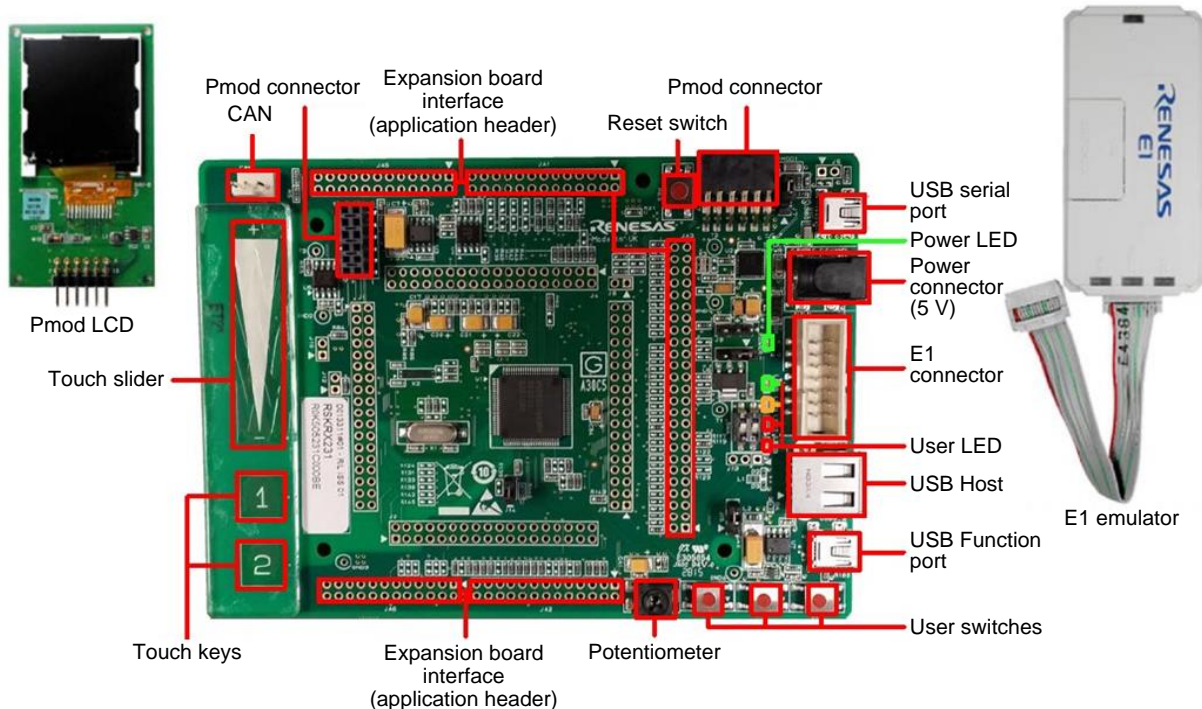


Figure 2.1 RSKRX231

2.2 Pins Used

The MCU pins used are listed below.

Table 2.1 Related Pins

Pin Name	I/O	Description
PC7	Output	SCI8 transmit
PC5	Output	SCI8 clock
P31	Input	RTC input capture (RTCIC1)
P34	Input	Switch input (SW2)
P33	Output	LCD control
PE3	Output	LCD control
PE4	Output	LCD control
PE7	Output	LCD control

2.3 Clock Settings

Table 2.2, Clock Settings, lists the clocks used by the sample program.

Table 2.2 Clock Settings

Name	Operating Frequency	Clock Source	Frequency Dividing Ratio	Multiplication Factor
Main clock	8 MHz	Implemented externally	—	—
Subclock	32.768 kHz	Implemented externally	—	—
High-speed on-chip oscillator (HOCO)	Stopped	—	—	—
Low-speed on-chip oscillator (LOCO)	Stopped	—	—	—
IWDT on-chip oscillator	Stopped	—	—	—
PLL circuit	54 MHz	Main clock	2	13.5
USB clock	48 MHz	Main clock	2	12
System clock (ICLK)	54 MHz	PLL	1	—
Peripheral clock A (PCLKA)	54 MHz	PLL	1	—
Peripheral clock B (PCLKB)	27 MHz	PLL	2	—
Peripheral clock D (PCLKD)	27 MHz	PLL	2	—
Flash interface clock (FCLK)	27 MHz	PLL	2	—

2.4 LCD Panel

The LCD panel (Pmod specification) included with the RSK is used.

2.5 Hardware Modifications

To confirm the operation of the sample program, modifications were made to the RSK to enable battery backup operation.

2.5.1 VBATT Connection

The RX231 RSK board is provided with jumper J10 to allow confirming operation of the battery backup function. However, jumper J10 is not mounted on the board when it is shipped from the factory and VBATT pin is connected to VCC by resistor R86. It is therefore necessary to make the following modifications.

1. Remove resistor R86.
2. Solder resistor R85 to the board.
3. Solder a pin header (two-pin) to the board in the jumper J10 location.

For reference when performing modifications, see Figure 2.2, Excerpt from RSKRX231 User's Manual, and Figure 2.3, VBATT Circuit Detail Excerpted from RSKRX231 CPU Board Schematics.

Reference	Explanation	Fit	DNF	Related Ref.
Board_5V	Connects 5V power rail to Board_5V.	R80	-	U4, U5, U8, U10, U12
SD_3V3	Connects Board_VCC to SD_3V3	R20	-	U3
CON_3V3	Connects CON_3V3 to Board_VCC.	R21	-	JA1.3
	Disconnects CON_3V3 from Board_VCC.	-	R21	-
Board_3V3	Connects Board_VCC to Board_3V3.	R214	-	U1(USB0VBUS), PMOD1
Board_VCC	Connects Board_VCC to UC_VCC.	R55/J8.1-2	-	U1(VCC, AVCC0, VREFH0, VREFH)
	Enables current probe for MCU current consumption.	J8.Open	R55	U1(VCC, AVCC0, VREFH0, VREFH)
VBATT	Connects UC_VCC to VBATT. (Battery Backup function used)	R86	R85	-
	Disconnects UC_VCC from VBATT. (Battery Backup function unused)	R85	R86	J10
UC_VCC	Connects UC_VCC to 3.3V power rail.	R55/J8.1-2	-	U1(VCC)
	Disconnects UC_VCC from 3.3V power rail.	J8.Open	R55	-
VCCUSB	Connects UC_VCC to U1 VCC_USB pin. (UC_VCC: 3.3V)	R140, R139/J14.1-2	-	U1(VCC_USB)
	Disconnects UC_VCC from U1 VCC_USB pin. (UC_VCC: 5V)	-	R140, R139, J14.Open	-

Table 6-4: Power Supply Option Links (2)

Figure 2.2 Excerpt from RSKRX231 User's Manual

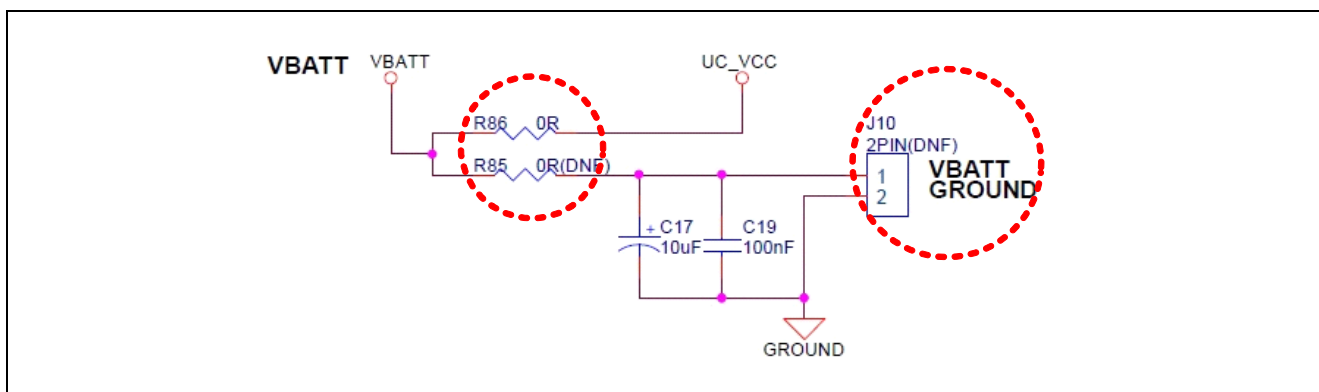


Figure 2.3 VBATT Circuit Detail Excerpted from RSKRX231 CPU Board Schematics

2.5.2 RTCIC1 Input

The RX231 RSK board is designed SW1 for IRQ1 (RTCIC1) input and it is set to “pull-up by VCC.” It is therefore necessary to make the following modifications.

1. Remove resistor R271.
2. Connect IRQ1 to VBATT battery through an external switch.
3. When the switch is turned on, VBATT is connected to IRQ1.

For reference when performing modifications, see Figure 2.4, RTCIC1 Circuit Detail Excerpted from RSKRX231 CPU Board Schematics.

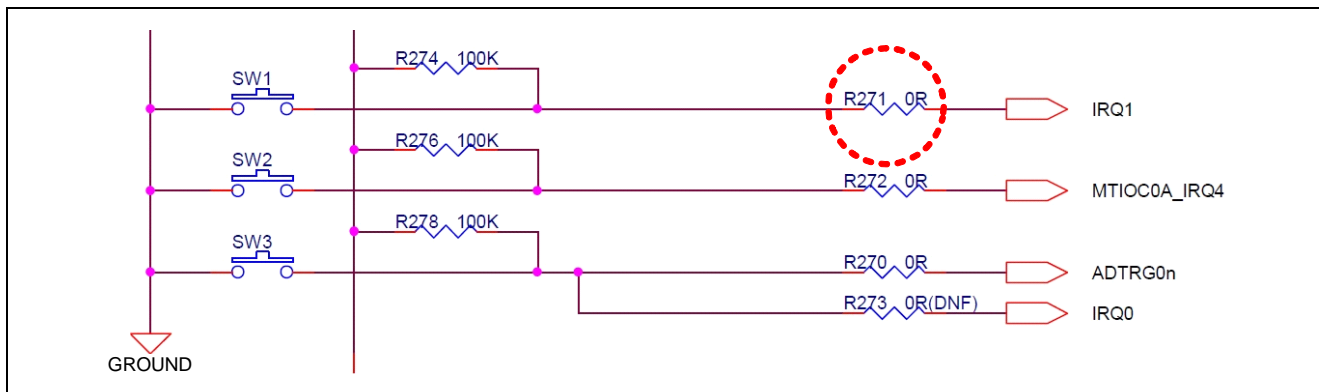


Figure 2.4 RTCIC1 Circuit Detail Excerpted from RSKRX231 CPU Board Schematics

3. Software

The configuration and functions of the software referenced in this application note are described below. The folder containing the files generated automatically by the FIT modules and SC is `smc_gen`, which is in the `src` folder.

3.1 FIT Modules

The folders containing the FIT modules used by the sample program are listed below.

Table 3.1 FIT Module Folders

Folder Name	Module Name	Description
<code>r_bsp</code>	Board support package module	Supplies code for the MCU and the board used.
<code>r_vbat_rx</code>	Battery backup module	Supplies battery backup control functionality.
<code>r_flash_rx</code>	Flash control module	Supplies control functionality and drivers for flash programming.
<code>r_config</code>	FIT header files	Header files of FIT modules used

Note: For the configuration and functions of the various FIT modules, refer to the specifications of each module.

3.2 SC Components

The folders containing the SC components used by the sample program are listed below.

Table 3.2 SC Component Folders

Folder Name	Component Name	Description
<code>Config_RTC</code>	Realtime clock module	Supplies control functionality and drivers for the realtime clock.
<code>Config_CMT0</code>	Compare match timer module	Supplies control functionality and drivers for the compare match timer.
<code>Config_LVD1</code>	Voltage detection circuit module	Supplies control functionality and drivers for the voltage detection circuit.
<code>Config_PORT</code>	Port module	Supplies control functionality and drivers for the port.
<code>Config_SCI8</code>	SPI clock synchronous communication module	Supplies control functionality and drivers for the SPI clock synchronous communication.
<code>general</code>	SC header files	Header files of SC components used

Note: For the configuration and functions of the various SC components, refer to the description of each component in Smart Configurator User's Manual: RX API Reference (R20UT4360).

3.3 File Composition

The file configuration of the software referenced in this application note is described below.

Files, including components of FIT modules, generated automatically by the integrated development environment are omitted.

Table 3.3 User Files

Folder Name	File Name	Description	Remarks
<code>src</code>	<code>main.c</code>	Main processing source file	Created by user
	<code>r_okaya_lcd.c</code>	LCD display software	RSK sample code
	<code>ascii.c</code>	ASCII data file for LCD display	RSK sample code

Note: The `smc_gen` folder in the `src` folder contains files generated automatically by FIT modules and the SC environment.

3.4 Option-Setting Memory Settings

Table 3.4, Option-Setting Memory Settings, lists the option-setting memory settings used by the sample program.

Table 3.4 Option-Setting Memory Settings

Bit	Symbol	Bit Name	Function	Setting Value
b1, b0	VDSEL[1:0]	Voltage detection 0 level select bits	2.51 V is selected.	10b
b2	LVDAS	Voltage detection 0 circuit start bit	Voltage monitoring 0 reset is enabled after a reset.	0

3.5 Constants

None.

3.6 Variables

Table 3.5, Global Variables, lists the global variables used by the sample program.

Table 3.5 Global Variables

Type	Variable Name	Description
struct	rtc_calendarcounter_value_t	Year/month/day/hour/minute/second structure
uint8_t	batty_err	Battery state
	sw_counter	Switch push count
	g_rtc_interrupt	RTC interrupt generated indication

3.7 Functions Used

Table 3.6, User Functions, lists the functions referenced in the user file (main.c).

Table 3.6 User Functions

Function Name	Outline
main()	System main function
display_time ()	Display time information.
display_info ()	Display battery and switch states.
backup_time()	Write time information to the data flash.
flash_Init()	Erase the data flash and perform blank checking.

The functions used in the sample code of each FIT/SC modules are listed below.

Table 3.7 SC Module Functions

Function Name	Outline	Contained in File
R_VBATT_Open ()	Initialize battery backup.	r_vbatt_rx.c
R_VBATT_GetStatus ()	Get battery backup status.	r_vbatt_rx.c
R_Config_RTC_Create ()	Initialize RTC.	Config_RTC.c
R_Config_RTC_Start	Start RTC.	Config_RTC.c
R_Config_RTC_Set_CalendarCounterValue ()	Set RTC information.	Config_RTC.c
R_Config_RTC_Get_CalendarCounterValue ()	Get RTC information.	Config_RTC.c
R_Config_RTC_Get_CalendarTimeCaptureValue1()	Get RTC capture value.	Config_RTC.c
R_Config_LVD1_Start()	Start LVD1.	Config_LVD1.c
R_Config_LVD1_Stop()	Stop LVD1	Config_LVD1.c
R_FLASH_Open()	Initialize flash.	r_flash_rx.c
R_FLASH_Write()	Program flash.	r_flash_rx.c
R_FLASH_Erase()	Erase flash.	r_flash_rx.c
R_FLASH_BlankCheck()	Run flash blank check.	r_flash_rx.c

3.8 Function Specifications

User setting functions are described below. For information on FIT module functions, refer to the specifications of the relevant module.

3.8.1 main

Table 3.8 main Function

Item	Details
Function Name	main()
Outline	System main function
Declaration	void main(void)
Description	Controls initial module settings and the system overall.
Functions called	display_time () display_info () flash_Init () R_Config_LVD1_Start() R_LCD_Init() R_LCD_Display() R_FLASH_Open() R_Config_RTC_Create() R_Config_RTC_Set_CalendarCounterValue() R_Config_RTC_Start() R_VBATT_Open() R_VBATT_GetStatus()
Arguments	—
Return value	—

3.8.2 flash_Init

Table 3.9 flash_Init Function

Item	Details
Function Name	flash_Init ()
Outline	Erases data flash to store RTC information
Declaration	void flash_Init (void)
Description	Erases block 0 of data flash and performs blank checking.
Functions called	R_FLASH_Erase () R_FLASH_BlankCheck ()
Arguments	—
Return value	—

3.8.3 display_time

Table 3.10 display_time Function

Item	Details
Function Name	display_time ()
Outline	Display time information function
Declaration	void display_time (uint8_t)
Description	Reads time information from the RTC and displays it on the LCD.
Functions called	R_Config_RTC_Get_CalendarTimeCaptureValue1 () R_Config_RTC_Get_CalendarCounterValue () R_LCD_Display ()
Arguments	Display start line count
Return value	—

3.8.4 display_info**Table 3.11 display_info Function**

Item	Details
Function Name	display_info ()
Outline	Display battery/switch state function
Declaration	void display_info (uint8_t)
Description	Displays the battery and switch states on the LCD.
Functions called	R_LCD_Display ()
Arguments	Display start line count
Return value	—

3.8.5 backup_time**Table 3.12 backup_time Function**

Item	Details
Function Name	backup_time ()
Outline	Save time information function
Declaration	void backup_time (void)
Description	Reads time information from the RTC and stores it in the data flash.
Functions called	R_Config_RTC_Get_CalendarCounterValue () R_FLASH_Write () R_Config_LVD1_Stop()
Arguments	—
Return value	—

4. Flowcharts

Flowcharts of the functions used by the user file described in this application note are shown below.

4.1 main Function: main()

Figure 4.1 is a flowchart of the main processing routine.

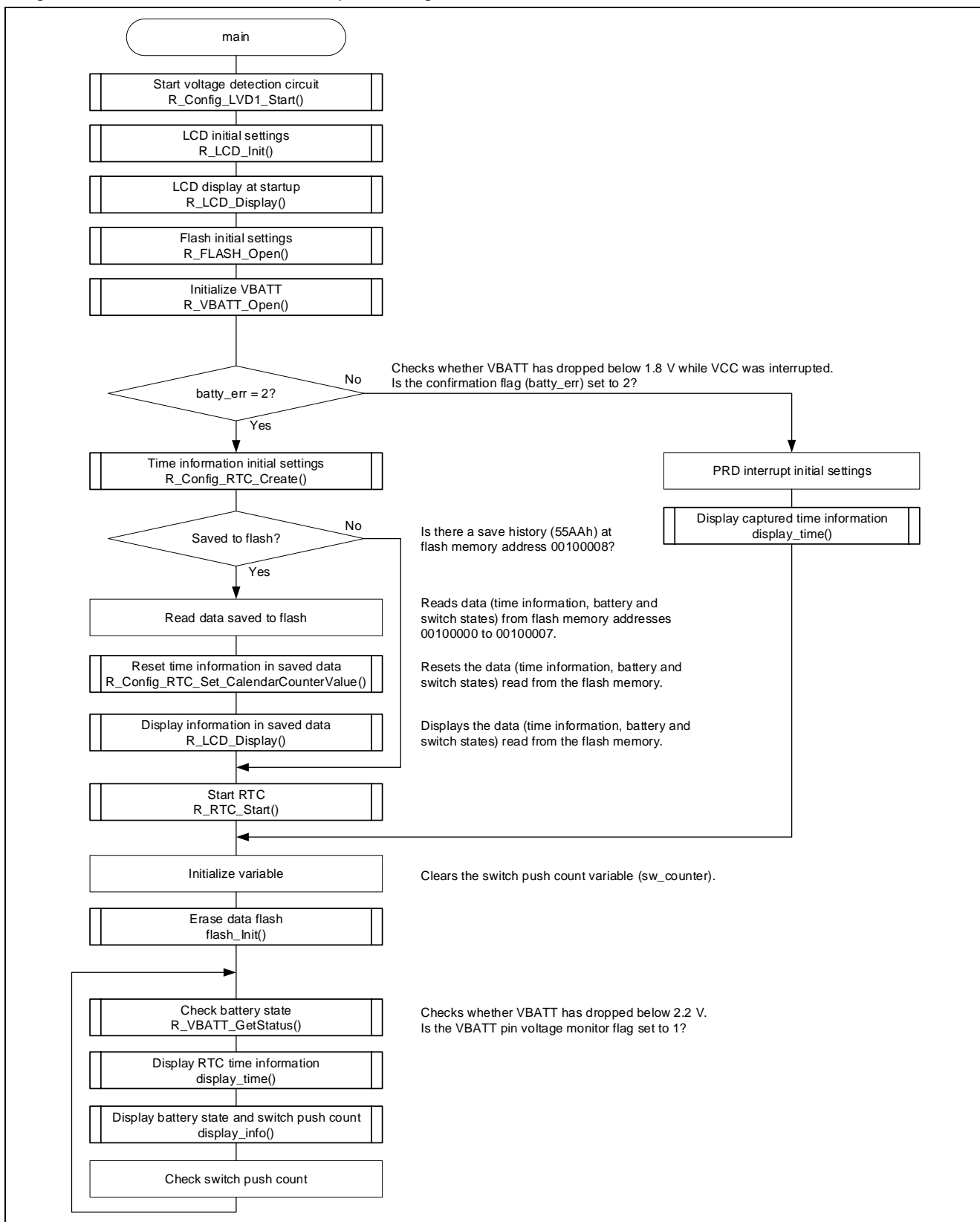


Figure 4.1 main Function

4.2 Erase Data Flash Function: flash_Init ()

Figure 4.2 is a flowchart of the function for erasing the data flash.

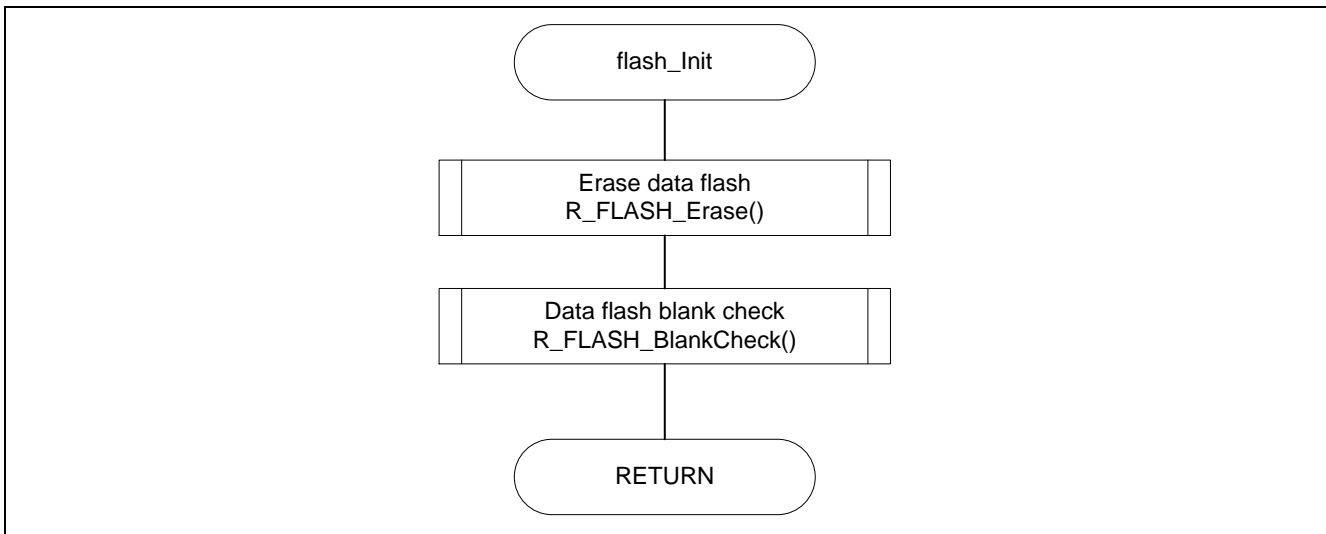


Figure 4.2 Erase Data Flash Function

4.3 Display Time Information Function: display_time()

Figure 4.3 is a flowchart of the function for displaying time information on the LCD.

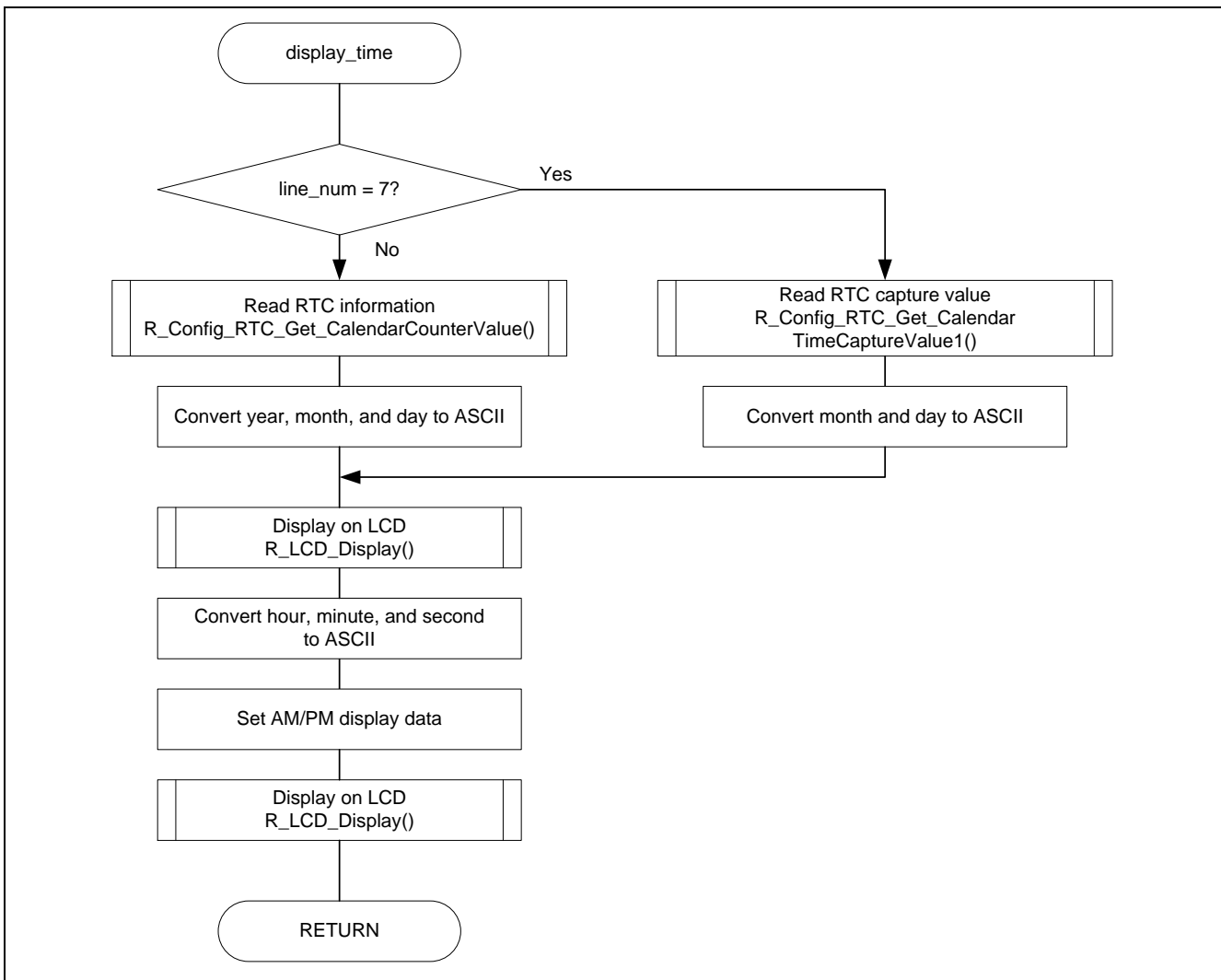


Figure 4.3 Display Time Information Function

4.4 Battery Status and Switch Push Count Display Function: display_time()

Figure 4.4 is a flowchart of the function for displaying the battery status and switch push count on the LCD.

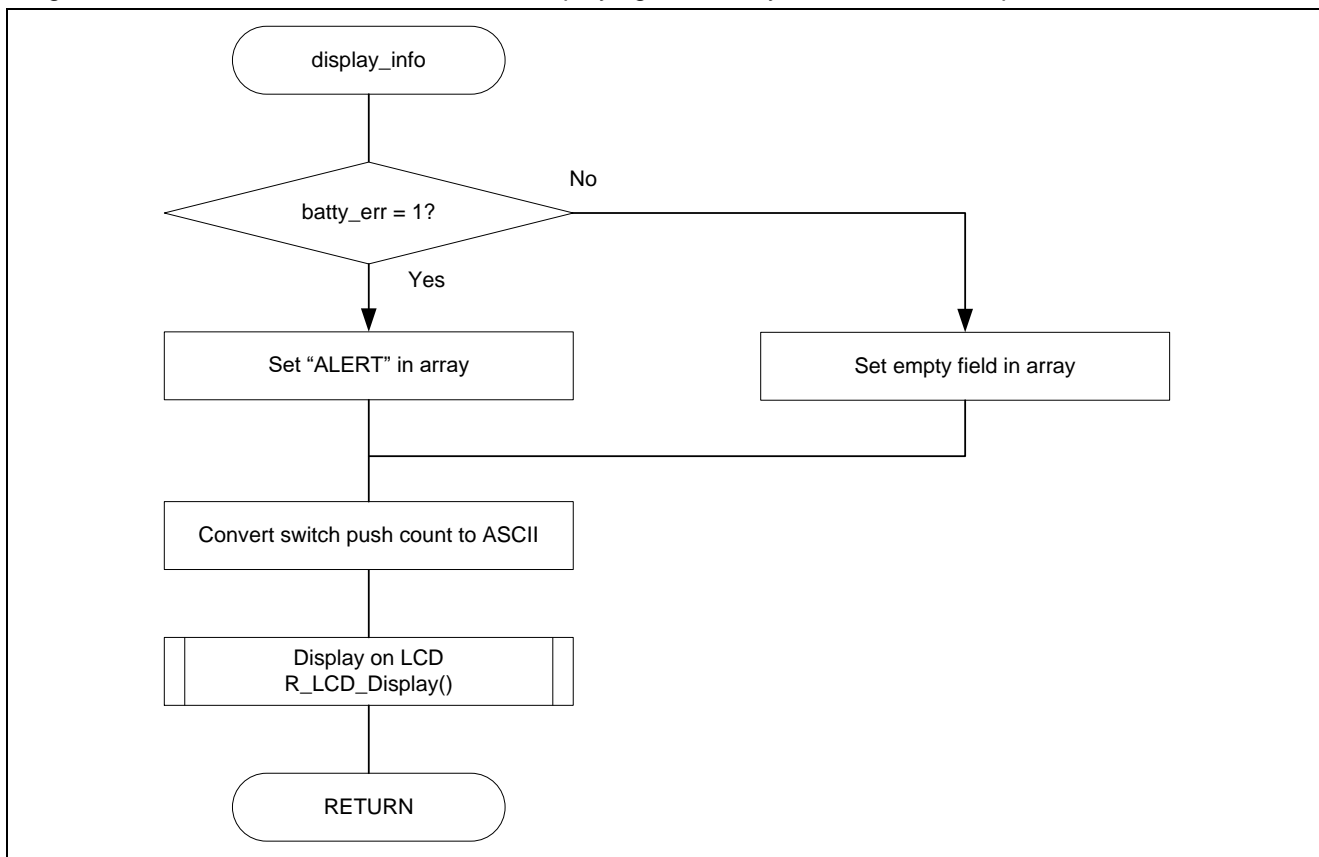


Figure 4.4 Battery Status and Switch Push Count Display Function

4.5 Save Time Information Function: backup_time()

Figure 4.5 is a flowchart of the function for saving time information to the data flash (Vdet1 interrupt processing).

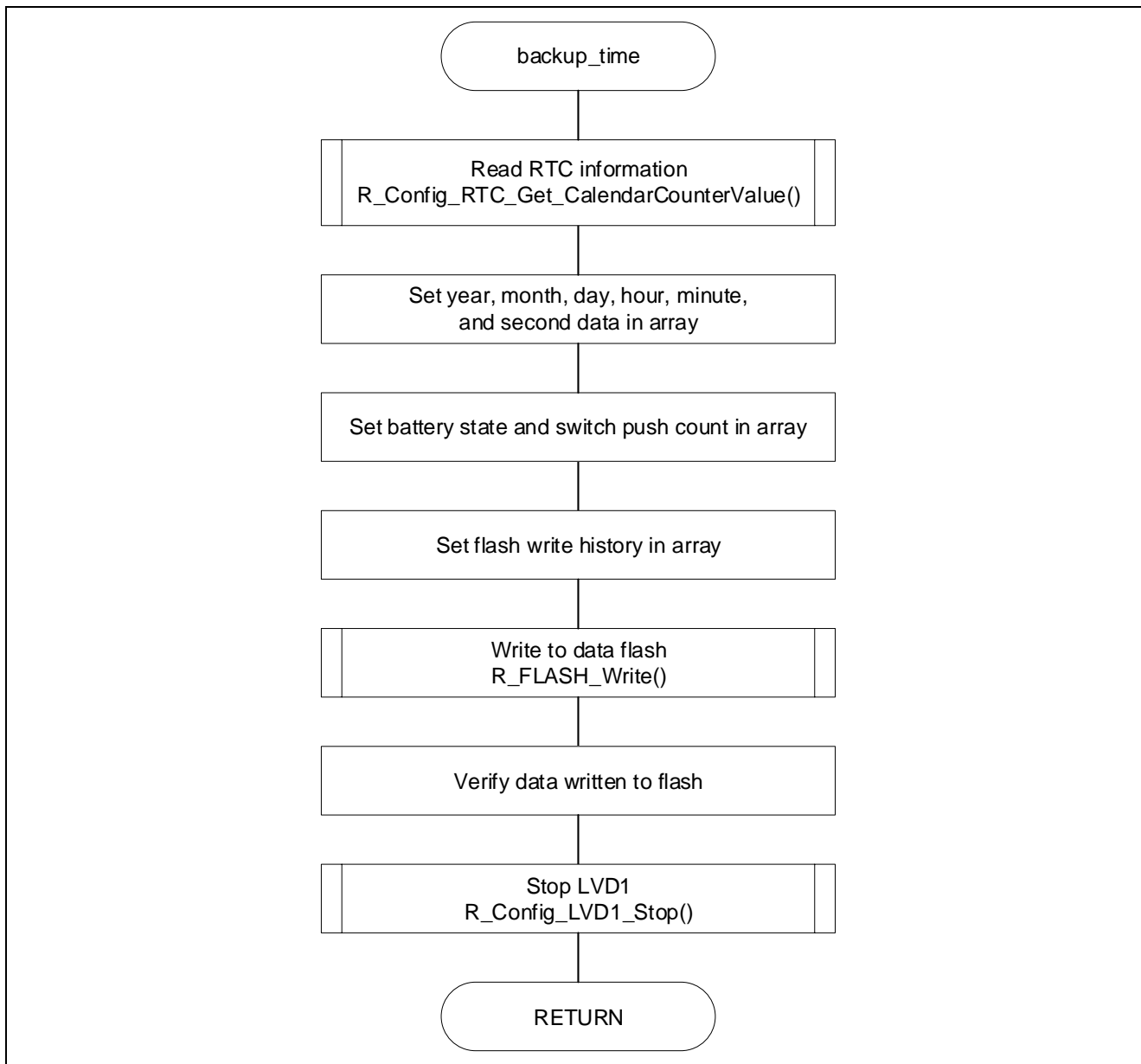


Figure 4.5 Save Time Information Function

5. LCD Display and RTC Input Capture Operation

5.1 LCD Display

The sample program displays data information on the LCD screen as described as below.

- Time information: year/month/day and hour/minute/second
- VBATT drop alert and switch push count
- RTC input capture time information: month/day and hour/minute/second
- Flash save data: year/month/day, hour/minute/second, VBATT drop alert/switch push count

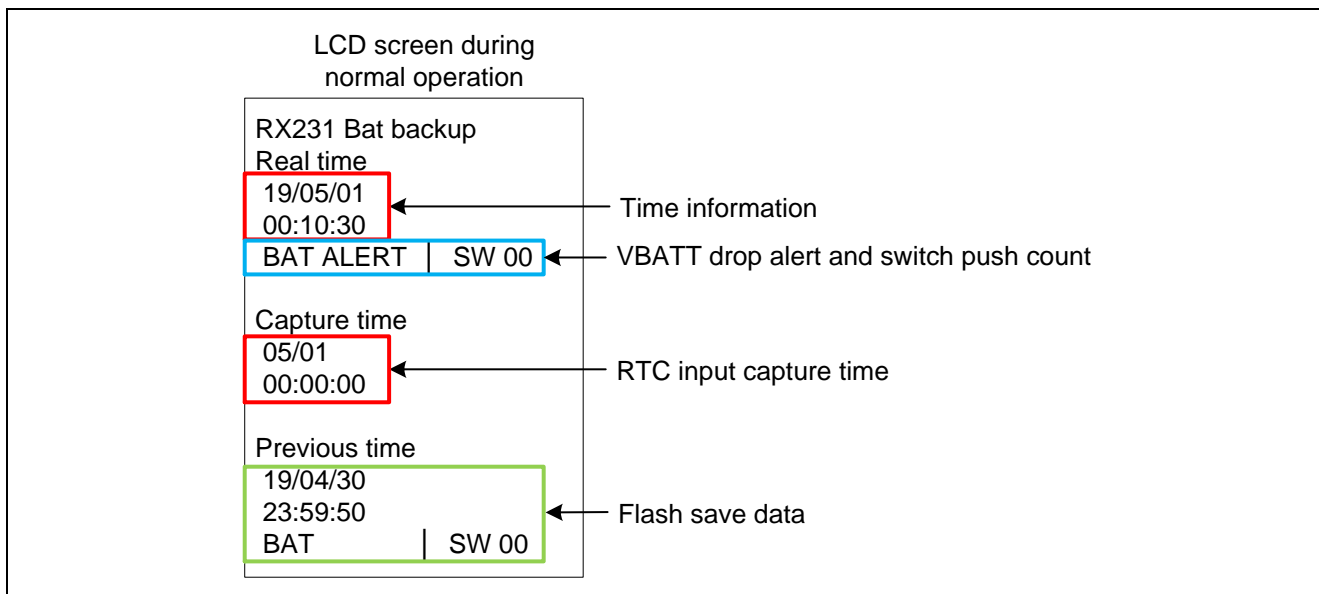


Figure 5.1 Display Setting

5.1.1 Execution During Battery Backup Operation

1. After VCC and VBATT are turned on, the LCD displays the time counting every second. The battery state and the number of times SW2 has been pressed are also displayed.

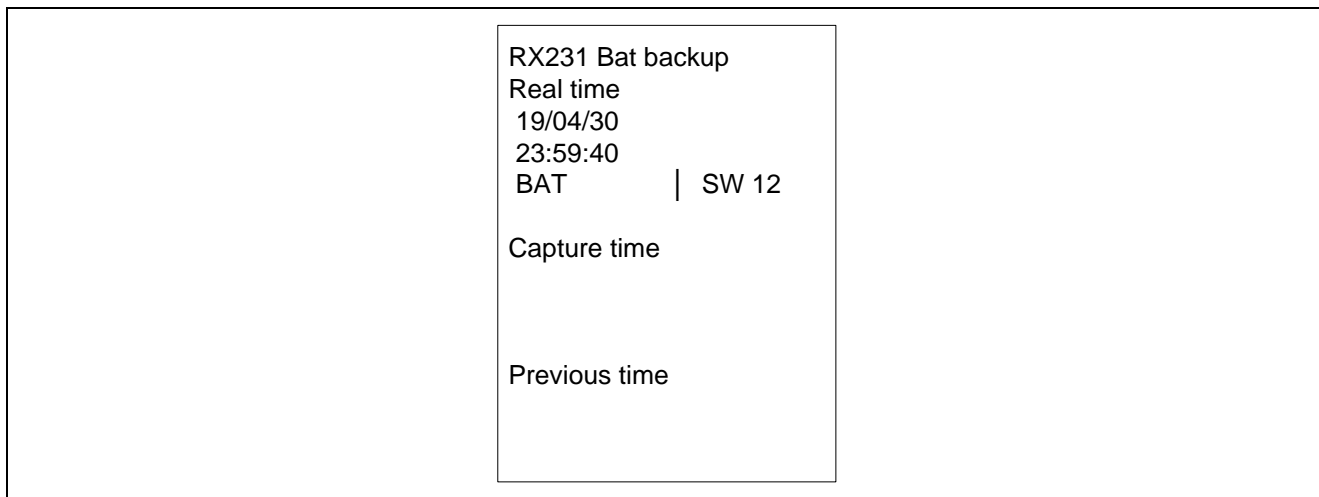


Figure 5.2 Display During Normal Operation (After power-on reset)

2. When VCC drops, the time information is saved to the data flash, and the power supply switches from VCC to VBATT. At this point, the LCD goes blank.
3. During battery backup operation, the RTC continue operating and the time information is updated. When the RTCIC1 input switch (external) is turned on, the time is captured in the RTC.
4. When VCC recovers, the power supply switches from VBATT to VCC, and the time information is again displayed on the LCD once every second. The RTC input capture time information also is displayed.

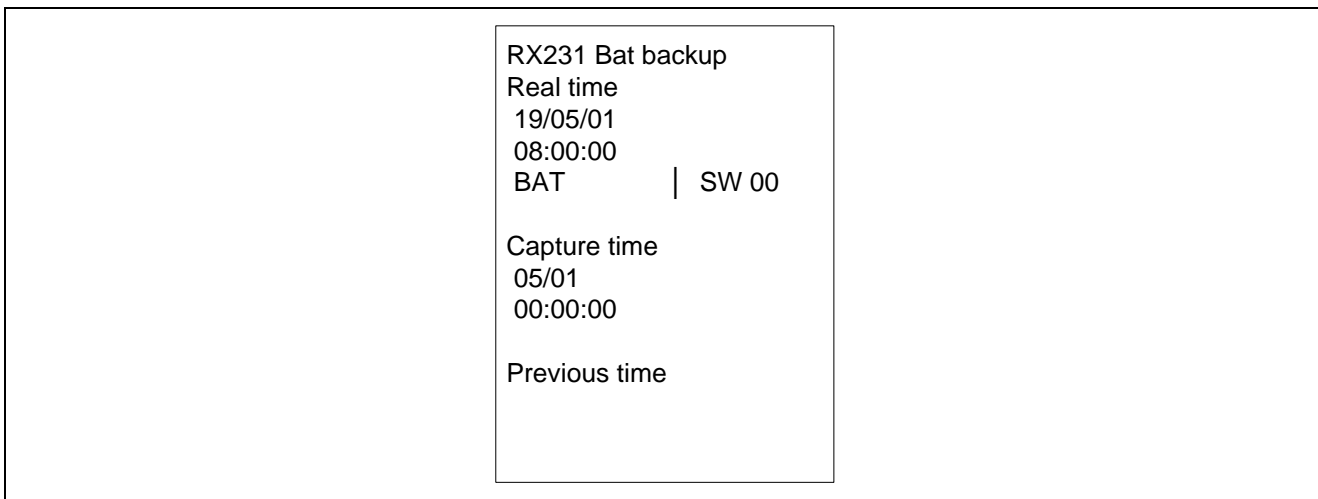


Figure 5.3 Display After VCC Recovery

5. When VBATT drops below 2.2V while VCC is on, an alert is displayed.

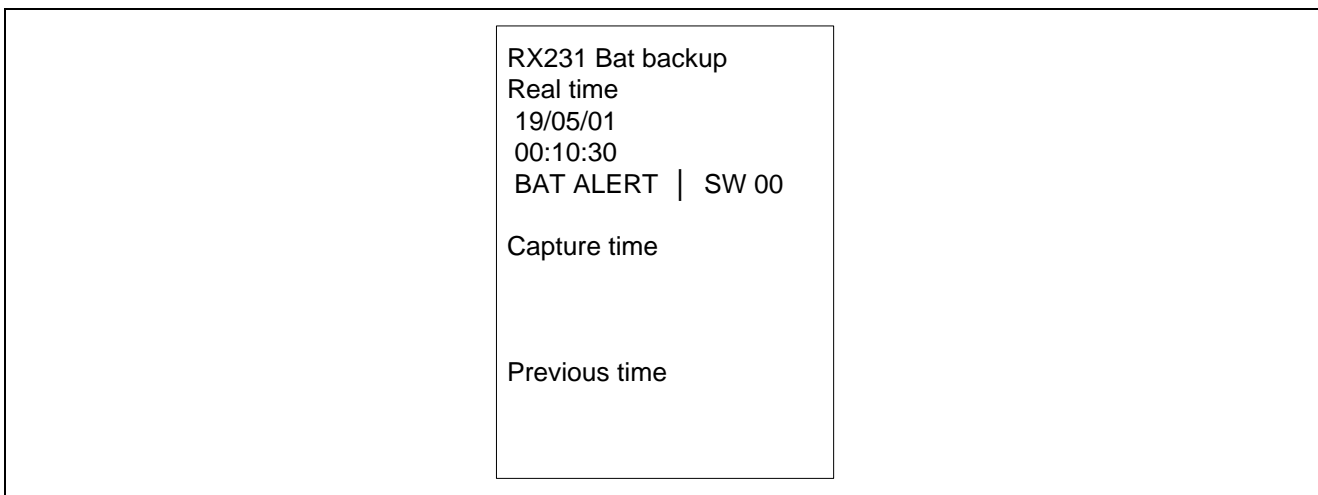


Figure 5.4 Alert Display When VBATT Drops

5.1.2 Battery Backup Operation Disruption

If VCC is turned on after VCC and VBATT were cut off, the time information and SW2 push count saved at the previous time VCC dropped is displayed on the LCD screen.

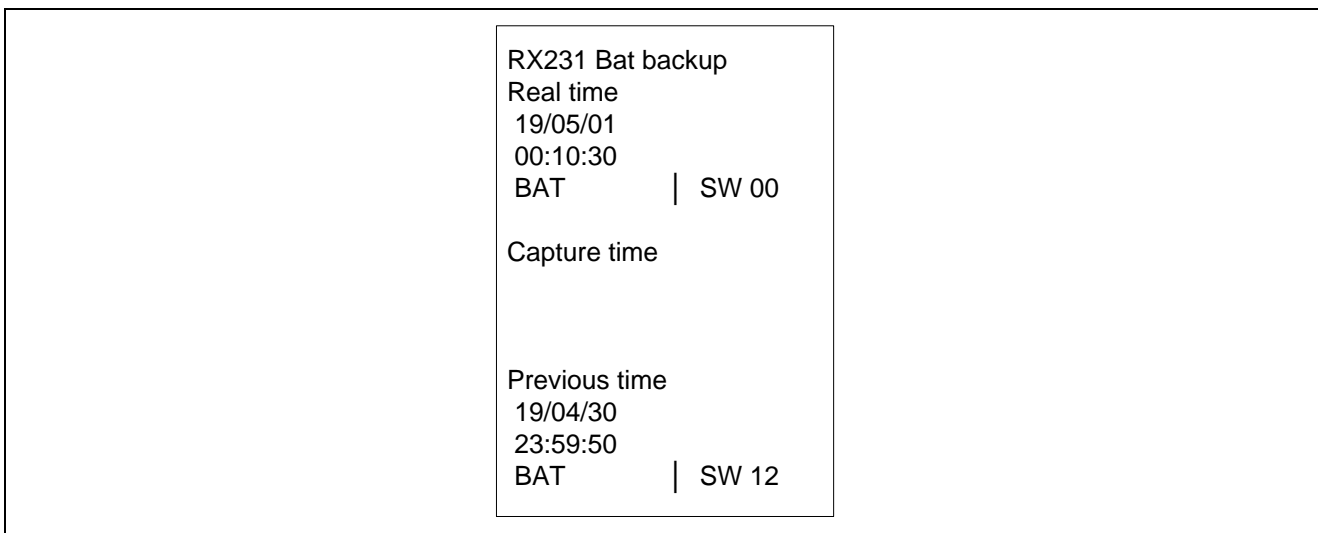


Figure 5.5 Display when VCC Recovery after VCC and VBATT Disruption

5.2 RTC Input Capture Operation

P30~32 pin can be used as peripheral functions such as serial communication, and RTC input capture function. Setting operation function should be done during MCU is powered by VCC.

Moreover, during VCC powers, all functions multiplexed can be used. However, after power was switched to VBATT, only RTC input capture function can continue to operate. This means if these pins are set to other functions that RTC input capture during VCC power, after switching to VBATT, those function cannot continue to operate, and pin states become Hi-Z. Therefore, in case battery backup function is used and P30~32 is not used, it is recommended to set them in input mode and connect to VSS via a resistor.

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Aug. 20, 2019	—	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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(Rev.4.0-1 November 2017)

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