R8C/M12A Group

A/D Converter in Repeat Sweep Mode

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Abstract

This document describes the setting method to perform A/D conversion on analog voltage using the R8C/M12A Group A/D converter in repeat sweep mode.

Product

MCU: R8C/M12A Group

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

Contents

1. Specifications

A/D conversion is performed on analog voltage input from two analog input pins using the A/D converter in repeat sweep mode. A/D converted values are stored to the variables in the A/D conversion interrupt handling.

Table 1.1 lists the Peripheral Function and Its Application. Figure 1.1 shows a Block Diagram.

Table 1.1 Peripheral Function and Its Application

Peripheral Function	Application
A/D converter	Perform A/D conversion on analog input voltage.

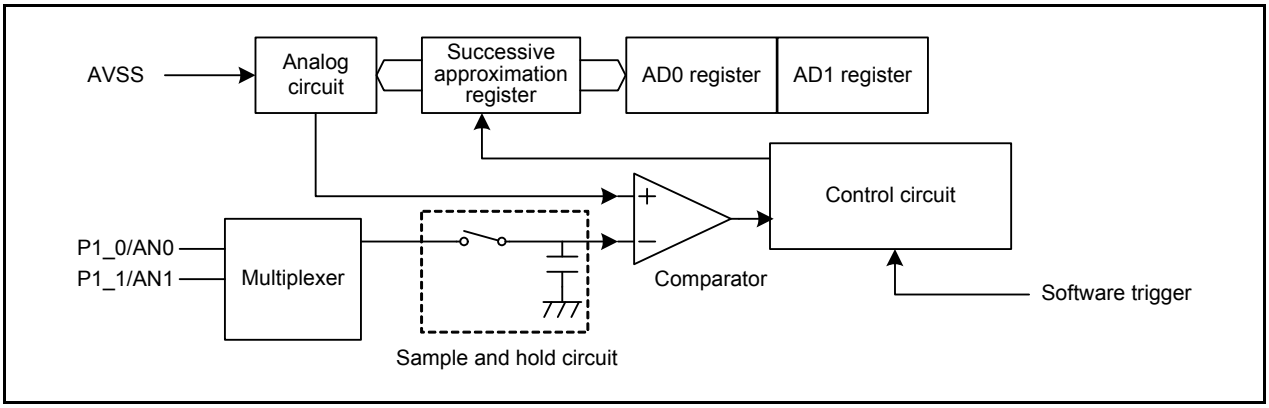


Figure 1.1 Block Diagram

2. Operation Confirmation Conditions

The sample code accompanying this application note has been run and confirmed under the conditions below.

Table 2.1 Operation Confirmation Conditions

Item	Contents
MCU used	R8C/M12A Group
Operating frequencies	High-speed on-chip oscillator clock: 20 MHz (typical) CPU clock (fs): 20 MHz System clock (f): 20 MHz
Operating voltage	5.0 V (2.7 to 5.5 V)
Integrated development environment	Renesas Electronics Corporation High-performance Embedded Workshop Version 4.07
C compiler	Renesas Electronics Corporation M16C Series, R8C Family C Compiler V.5.45 Release 01
	Compile options -D__UART0__ -c -finfo -dir "$(CONFIGDIR)" -R8C (Default setting is used in the integrated development environment)

3. Hardware

3.1 Pins Used

Table 3.1 lists the Pins Used and Their Functions.

Table 3.1 Pins Used and Their Functions

Pin Name	I/O	Function
P1_0/AN0	Input	A/D converter input (AN0)
P1_1/AN1	Input	A/D converter input (AN1)

4. Software

4.1 Operation Overview

A/D conversion is alternately performed on analog voltage input from AN0 and AN1 using the A/D converter in repeat sweep mode.

Settings

- Use pins P1_0/AN0 and P1_1/AN1 for analog input.
- Use repeat sweep mode for the A/D operating mode.
- Use fAD for the A/D conversion clock.
- Use a software trigger for the A/D conversion start condition.
- Use the A/D conversion interrupt.

(1) Perform the initial setting of the A/D converter.
(2) Set the ADST bit in the ADCON0 register to 1 (A/D conversion started) to start A/D conversion.
(3) When A/D conversion on analog voltage input from AN0 and AN1 is completed, the ADF bit in the ADICSR register automatically becomes 1 (interrupt request). When the ADIE bit in the ADISCR register is 1 (interrupt enabled), an A/D conversion interrupt is generated. The converted results on voltage input from AN0 is transferred to the AD0 register and the converted results on voltage input from AN1 is transferred to the AD1 register.
(4) Store the A/D converted value to the variable in the A/D conversion interrupt handling.
(5) Wait for the A/D conversion interrupt again.

Figure 4.1 shows the Timing Diagram in Repeat Sweep Mode.

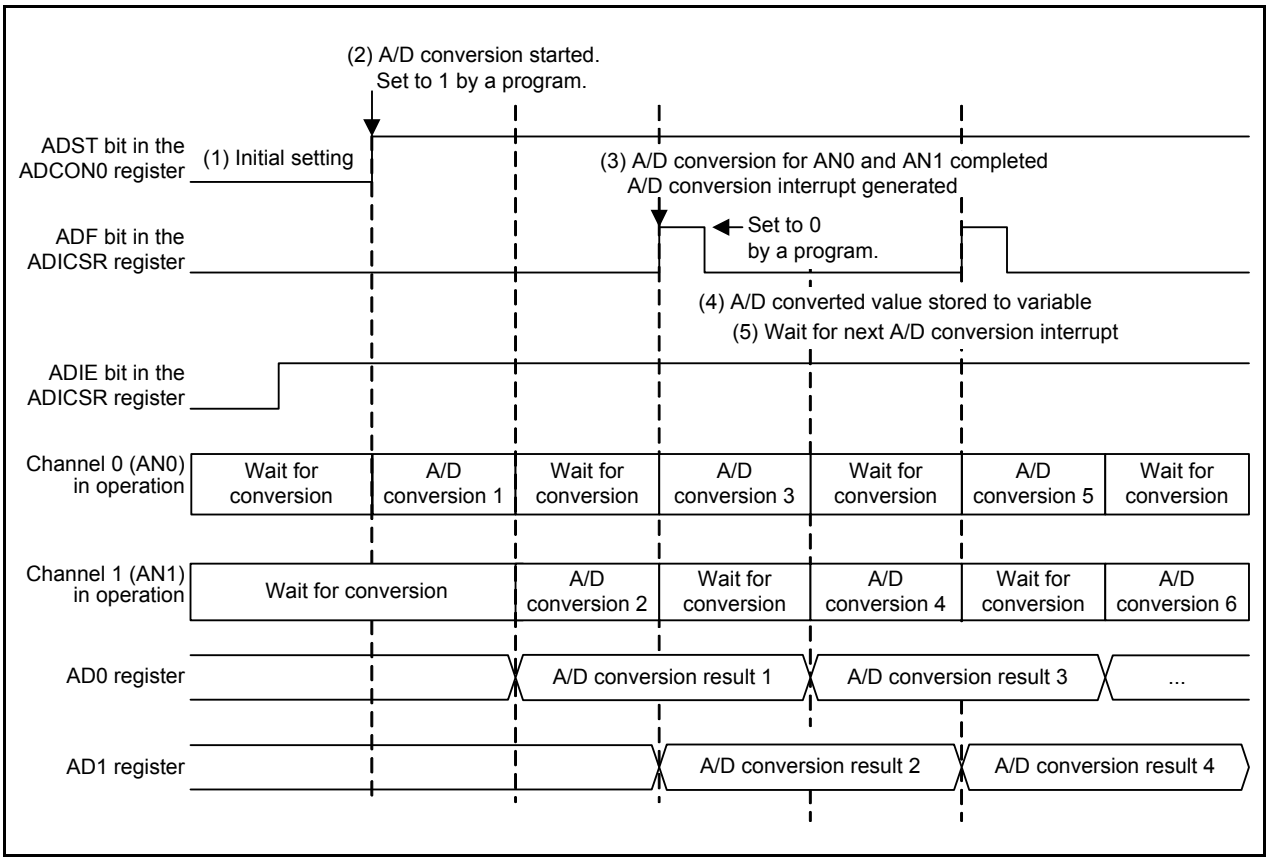


Figure 4.1 Timing Diagram in Repeat Sweep Mode

4.2 Required Memory Size

Table 4.1 lists the Required Memory Size.

Table 4.1 Required Memory Size

Memory Used	Size	Remarks
ROM	193 bytes	In the r01an0374_src.c module
RAM	4 byte	In the r01an0374_src.c module
Maximum user stack usage	13 bytes	
Maximum interrupt stack usage	4 bytes	

The required memory size varies depending on the C compiler version and compile options.

4.3 Variable

Table 4.2 lists the Global Variable.

Table 4.2 Global Variable

Type	Variable Name	Contents	Function Used
unsigned short	ad_data[2]	A/D converted result	_ad_converter

4.4 Functions

Table 4.3 lists the Functions.

Table 4.3 Functions

Function Name	Outline
mcu_init	System clock setting
ad_init	Initial setting of A/D converter
_ad_converter	A/D conversion interrupt handling

4.5 Function Specifications

The following tables list the sample code function specifications.

mcu_init	
Outline	System clock setting
Header	None
Declaration	void mcu_init(void)
Explanation	Set the system clock.
Argument	None
Returned value	None
Remark	—

ad_init	
Outline	Initial setting of A/D converter
Header	None
Declaration	void ad_init(void)
Explanation	Perform initial setting to use the A/D converter in repeat sweep mode.
Argument	None
Returned value	None
Remark	—

_ad_converter	
Outline	A/D conversion interrupt handling
Header	None
Declaration	void_ad_converter(void)
Explanation	Store the A/D converted value to the variable in repeat sweep mode.
Argument	None
Returned value	None
Remark	—

4.6 Flowcharts

4.6.1 Main Processing

Figure 4.2 shows the Main Processing.

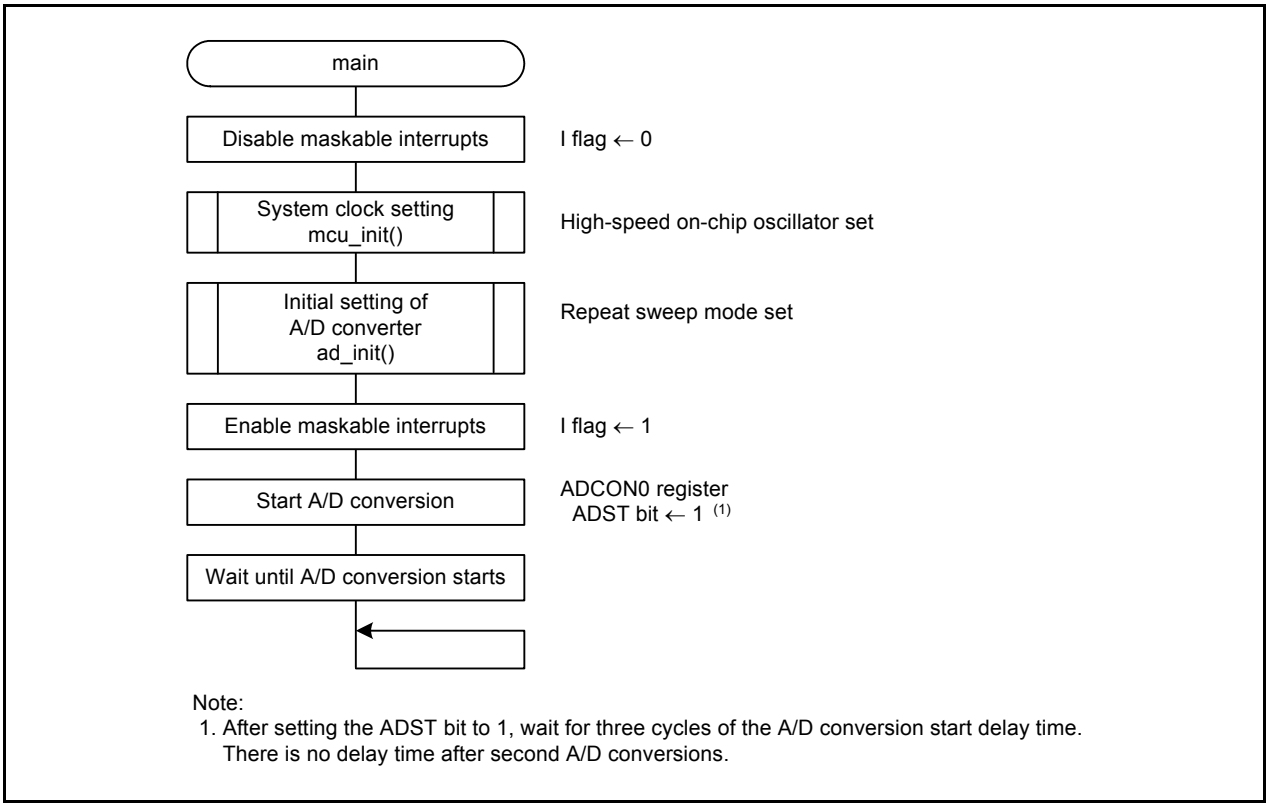


Figure 4.2 Main Processing

4.6.2 System Clock Setting

Figure 4.3 shows the System Clock Setting.

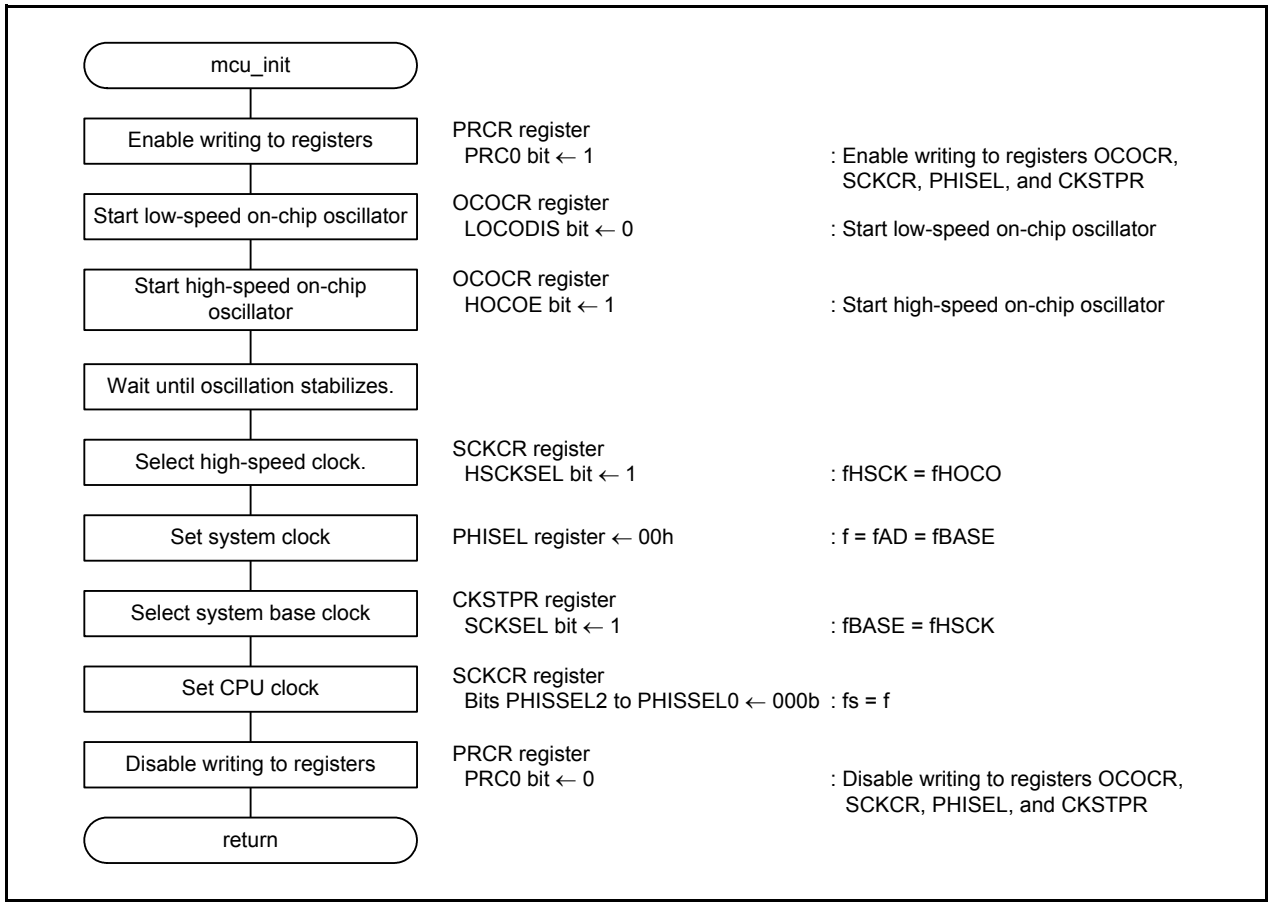
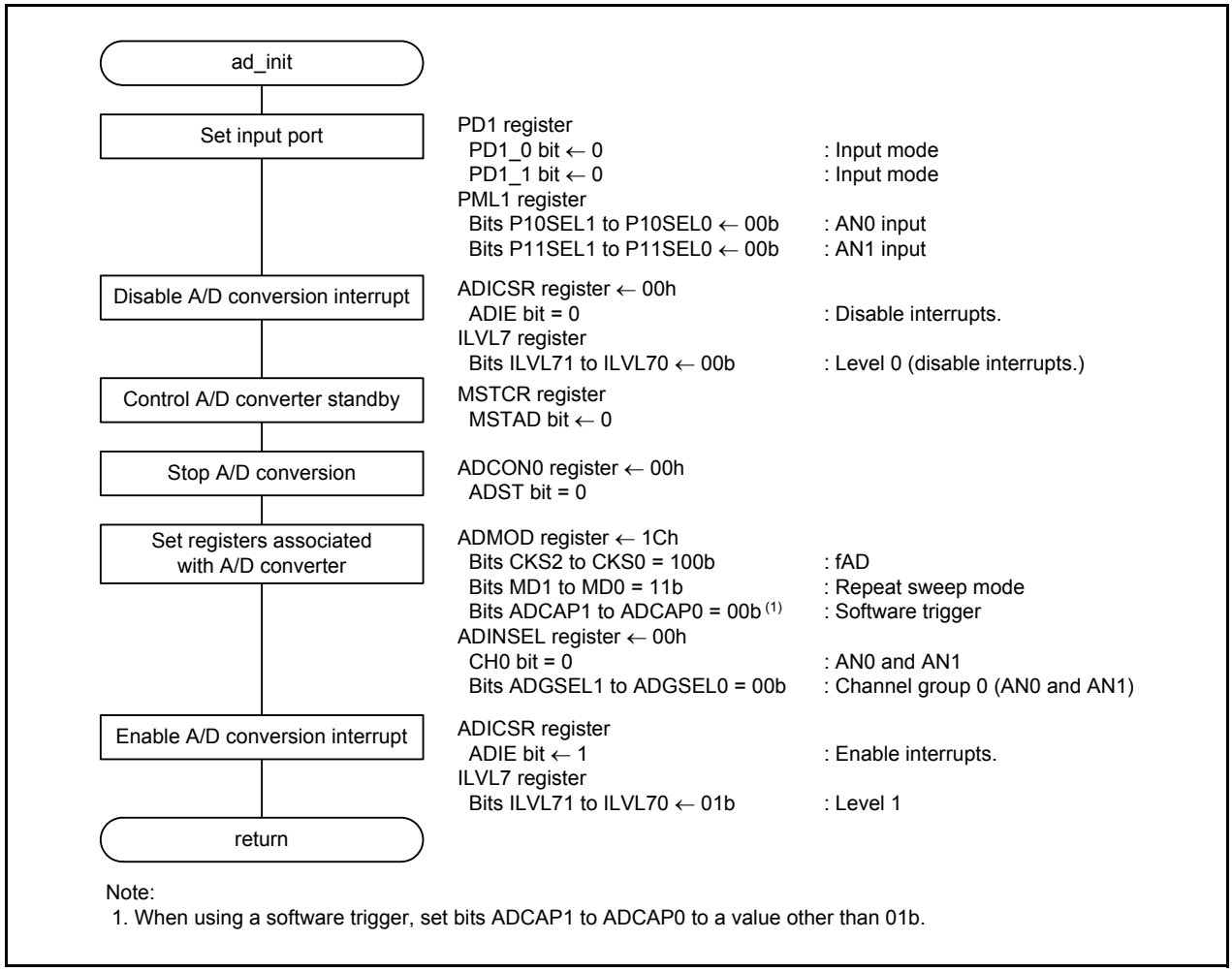


Figure 4.3 System Clock Setting

4.6.3 Initial Setting of A/D Converter

Figure 4.4 shows the Initial Setting of A/D Converter.



Note:
1. When using a software trigger, set bits ADCAP1 to ADCAP0 to a value other than 01b.

Figure 4.4 Initial Setting of A/D Converter

4.6.4 A/D Conversion Interrupt Handling

Figure 4.5 shows the A/D Conversion Interrupt Handling.

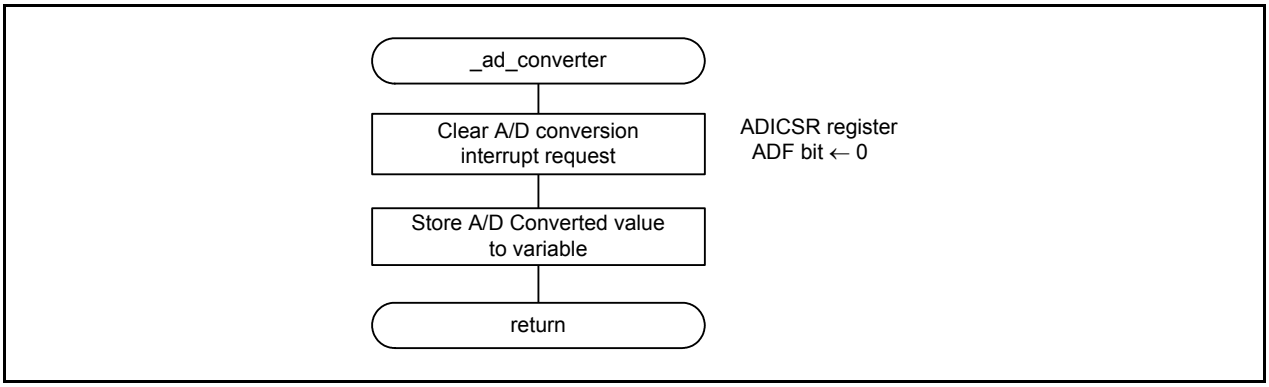


Figure 4.5 A/D Conversion Interrupt Handling

5. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

6. Reference Documents

R8C/M12A Group User's Manual: Hardware Rev.1.00
The latest version can be downloaded from the Renesas Electronics website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Electronics website.

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Revision History	R8C/M12A Group A/D Converter in Repeat Sweep Mode

Rev.	Date	Description	
		Page	Summary
1.00	May 23, 2011	—	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 manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

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 one with a different part number, confirm that the change will not lead to problems.

   — The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.

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