RX210 and RX220 Groups

Setting the A/D Converted Value Addition Function

R01AN1199EJ0101
Rev.1.01
July 1, 2014

Abstract

This application note describes the setting method of the A/D converter value addition function in the RX210 and RX220 Groups.

Products

RX210 and RX220 Groups

When using the code presented in this application note with a different microcontroller, modify the code according to the specifications of that microcontroller and test the code thoroughly.

Contents

1. Specifications

The sample code sets the number of A/D conversion executions to 4 times and performs A/D conversion every 10 ms. After each set of 4 conversions, the average of the A/D conversion values is calculated and stored in RAM.

Table 1.1 lists the peripheral functions used and their applications, and figure 1.1 presents an overview of the sample code.

Table 1.1 Peripheral Functions Used and Their Applications

Peripheral function	Application
Compare match timer (CMT)	Main period creation
12-bit A/D converter (S12AD)	A/D conversion

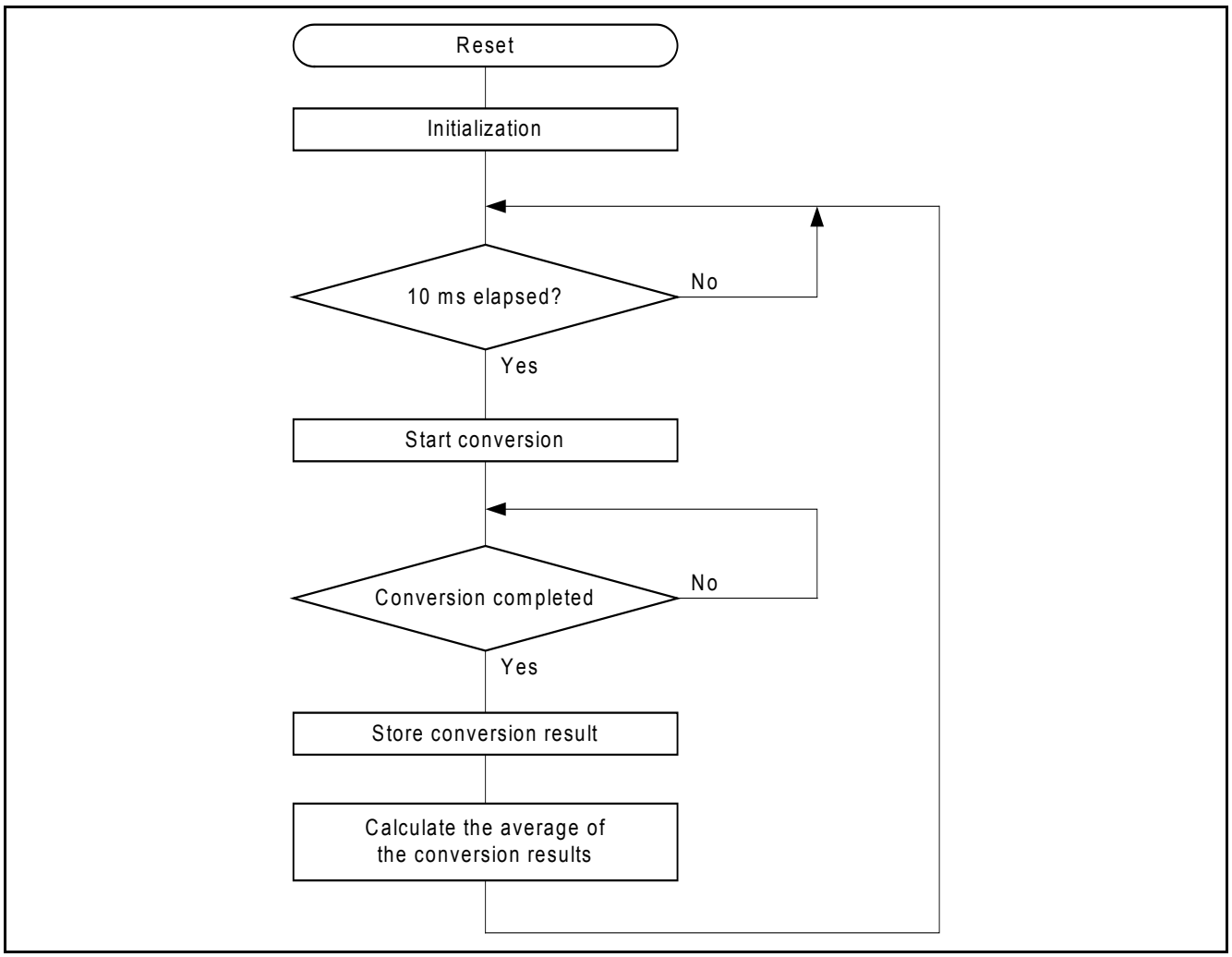

Figure 1.1 Sample Code Overview

2. Confirmed Operating Condition

Operation of the sample code in this application note has been verified under the following conditions.

Table 2.1 Confirmed Operating Condition

Item	Description
Microcontroller used	R5F52108ADFP (RX210 Group)
Operating frequency	Main clock: 20.0 MHz Sub-clock: 32.768 kHz PLL: Main clock divided by 2 and multiplied by 10 System clock (ICLK): 50 MHz (PLL divided by 2) Peripheral module clock B (PCLKB): 25 MHz (PLL divided by 4)
Operating voltage	5.0 V is supplied from E1.
Integrated development environment	Renesas Electronics Corporation High-performance Embedded Workshop Version 4.09.00.007
C compiler	RX Family C/C++ Compiler V.1.02
	-cpu=rx200 -output=obj="$(CONFIGDIR)\$(FILELEAF).obj" -debug –nologo (The integrated development environment default settings are used.)
iodefine.h version	Version 1.0B
Endian order	Little endian
Operating mode	Single-chip mode
Processor mode	Supervisor mode
Sample code version	Version 1.00
Board used	Renesas Starter Kit for RX210 (Product number: R0K505210C000BE)

3. Reference Application Notes

For additional information associated with this document, refer to the following application notes.

- RX210 Group Initial Setting Rev.1.00 (R01AN1002EJ)
- RX220 Group Initial Setting Rev. 1.10 (R01AN1494EJ)

The initial setting functions in the reference application notes are used in the sample code in this application note. The revision numbers of the reference application notes are current as of when this application note was made. However the latest version is always recommended. Visit the Renesas Electronics Corporation website to check and download the latest version.

4. Hardware

4.1 Pin Used

Table 4.1 lists the Pin Used and Its Function.

Table 4.1 Pin Used and Its Function

Pin	I/O	Function
P40/AN000	Input	A/D conversion

5. Software

5.1 Operational Overview

With using the A/D converted value addition function, A/D conversion is performed four times in succession and each converted result is added and stored in the A/D data register. A/D conversion is performed every 10 ms which is the main routine cycle created with CMT. The value in the A/D data register is stored in the RAM to calculate the average.

Figure 5.1 shows the timing chart.

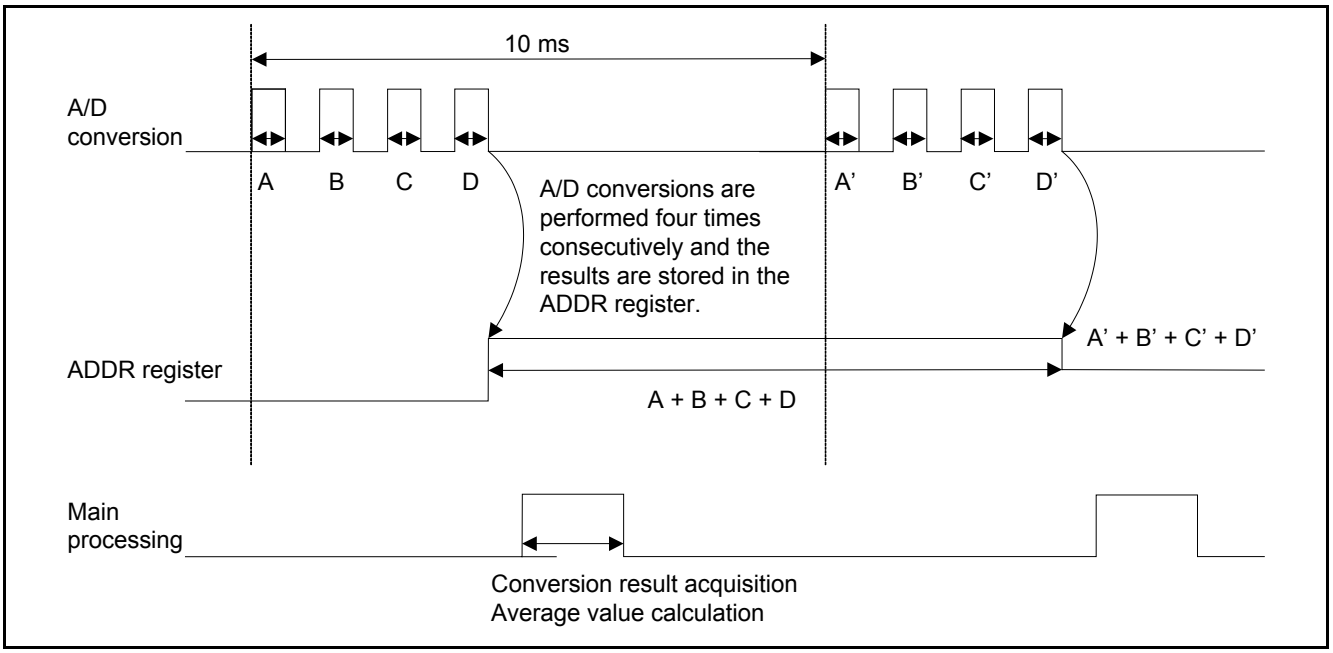

Figure 5.1 Timing Chart

5.2 File Structure

Table 5.1 lists the files used for the sample code. Note that the files generated automatically by the integrated development environment are not shown.

Table 5.1 File Structure

File	Overview	Remarks
main.c	Main processing	
non_existent_port_init.c	Nonexistent port initialization	
non_existent_port_init.h	External reference include header for nonexistent port initialization	
clock_init.c	Clock initialization	
clock_init.h	External reference include header for clock initialization	

5.3 Option Settings Memory

Table 5.2 lists the states of the option settings memory used by the sample code. Set these locations to appropriate values for your user system as required.

Table 5.2 Option Settings Memory Set by the Sample Code

Symbol	Address	Set value	Description
OFS0	FFFF FF8Fh – FFFF FF8Ch	FFFF FFFFh	Stops IWDT after a reset Stops WDT after a reset
OFS1	FFFF FF8Bh – FFFF FF88h	FFFF FFFFh	Disables voltage monitoring resets after a reset Disables HOCOC operation after a reset
MDES	FFFF FF83h – FFFF FF80h	FFFF FFFFh	Little endian (in single-chip mode)

5.4 Variables

Table 5.3 lists the global variables.

Table 5.3 Global Variables

Type	Name	Description	Function
unsigned short	sum_ad	Stores the A/D conversion results for the A/D converter value addition function	main()
unsigned short	ave_ad	Stores the average of four A/D conversion results for the A/D converter value addition function	main()

5.5 Functions

Table 5.4 lists the functions.

Table 5.4 Functions

Function	Description
main	Main processing
port_init	Port initialization
non_existent_port_init	Nonexistent port initialization
clock_init	Clock initialization
peripheral_init	Peripheral function initialization
ad_init	S12AD initialization
cmt_init	CMT initialization

5.6 Function Specifications

This section lists the specifications of the functions in the sample code.

main	
Overview	Main processing
Header	None
Declaration	void main(void)
Description	Performs an A/D conversion every 10 ms and calculates the average value.
Arguments	None
Return values	None

port_init	
Overview	Port initialization
Header	None
Declaration	void port_init(void)
Description	Initializes the ports.
Arguments	None
Return values	None

non_existent_port_init	
Overview	Nonexistent port initialization
Header	non_existent_port_init.h
Declaration	void non_existent_port_init(void)
Description	Initializes the nonexistent ports.
Arguments	None
Return values	None
Remarks	For details on this function, refer to the Initial Setting application note for the product used. Nonexistent ports may need to be initialized for some products depending on their pin numbers. This processing is not required for products that are included in the RSK used by this system.

clock_init	
Overview	Clock initialization
Header	clock_init.h
Declaration	void clock_init(void)
Description	Initializes the clocks.
Arguments	None
Return values	None
Remarks	For details on this function, refer to the Initial Setting application note for the product used.

peripheral_init	
Overview	Peripheral function initialization
Header	None
Declaration	void peripheral_init(void)
Description	Initializes the used peripheral functions.
Arguments	None
Return values	None

ad_init	
Overview	S12AD initialization
Header	None
Declaration	void ad_init(void)
Description	Initializes the S12AD. • Single scan mode • A/D converter value addition function
Arguments	None
Return values	None

cmt_init	
Overview	CMT initialization
Header	None
Declaration	void cmt_init(void)
Description	Initializes the CMT. • 10 ms period
Arguments	None
Return values	None

5.7 Flowcharts

5.7.1 Main Processing

Figure 5.2 shows the flowchart for the main processing.

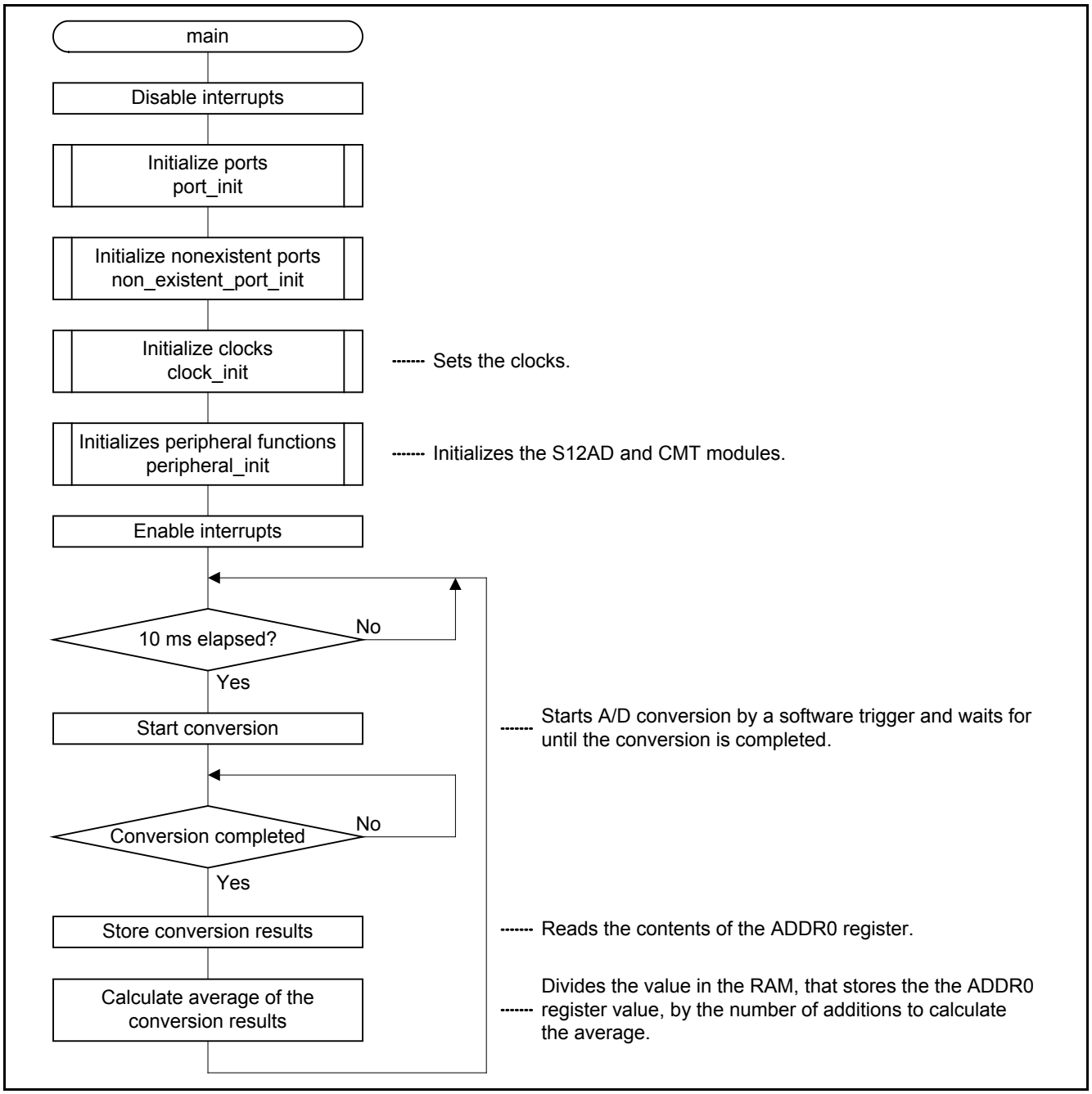

Figure 5.2 Main Processing

5.7.2 Port Initialization

Figure 5.3 shows the flowchart for port initialization.

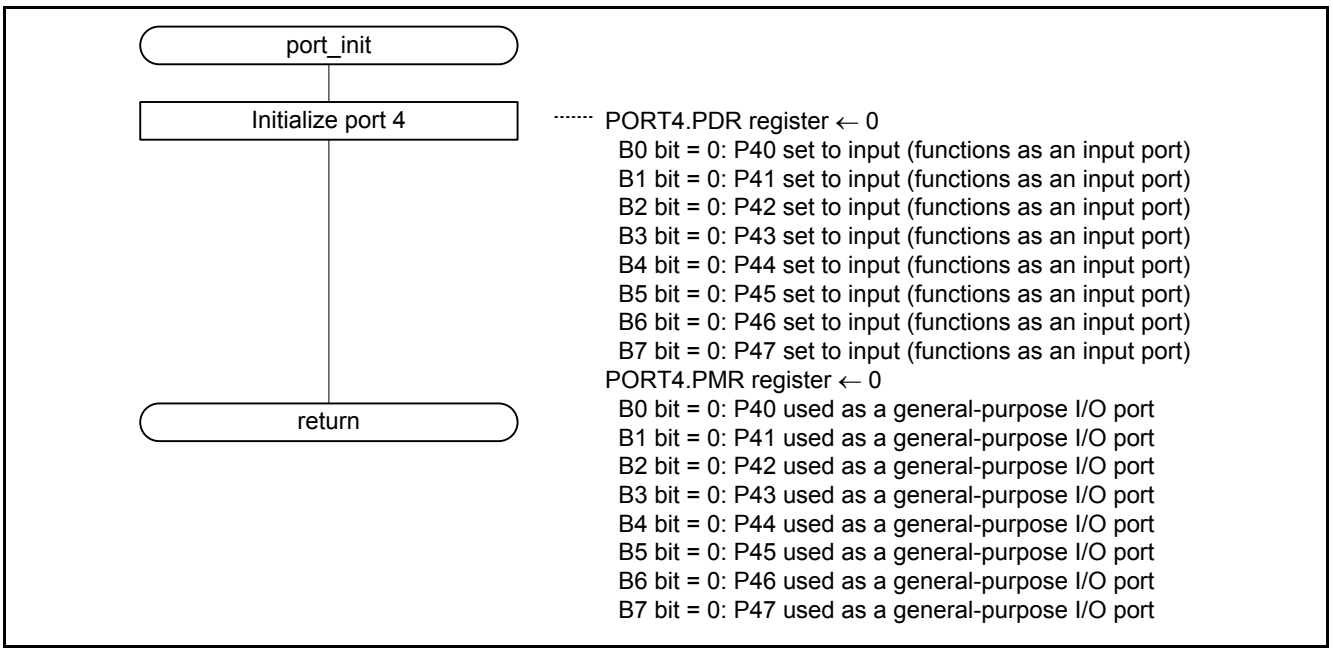

Figure 5.3 Port Initialization

5.7.3 Peripheral Function Initialization

Figure 5.4 shows the flowchart for peripheral function initialization.

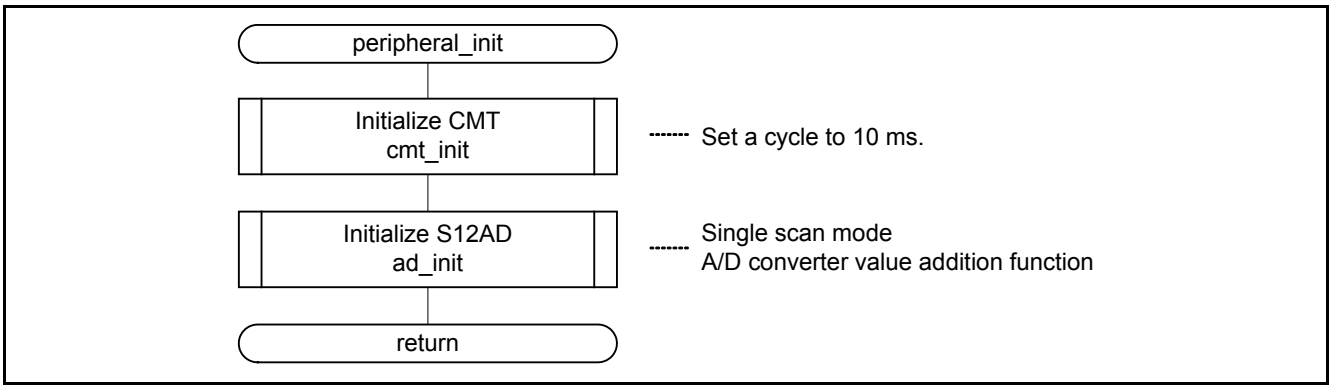

Figure 5.4 Peripheral Function Initialization

5.7.4 S12AD Initialization

Figure 5.5 shows the flowchart for S12AD initialization.

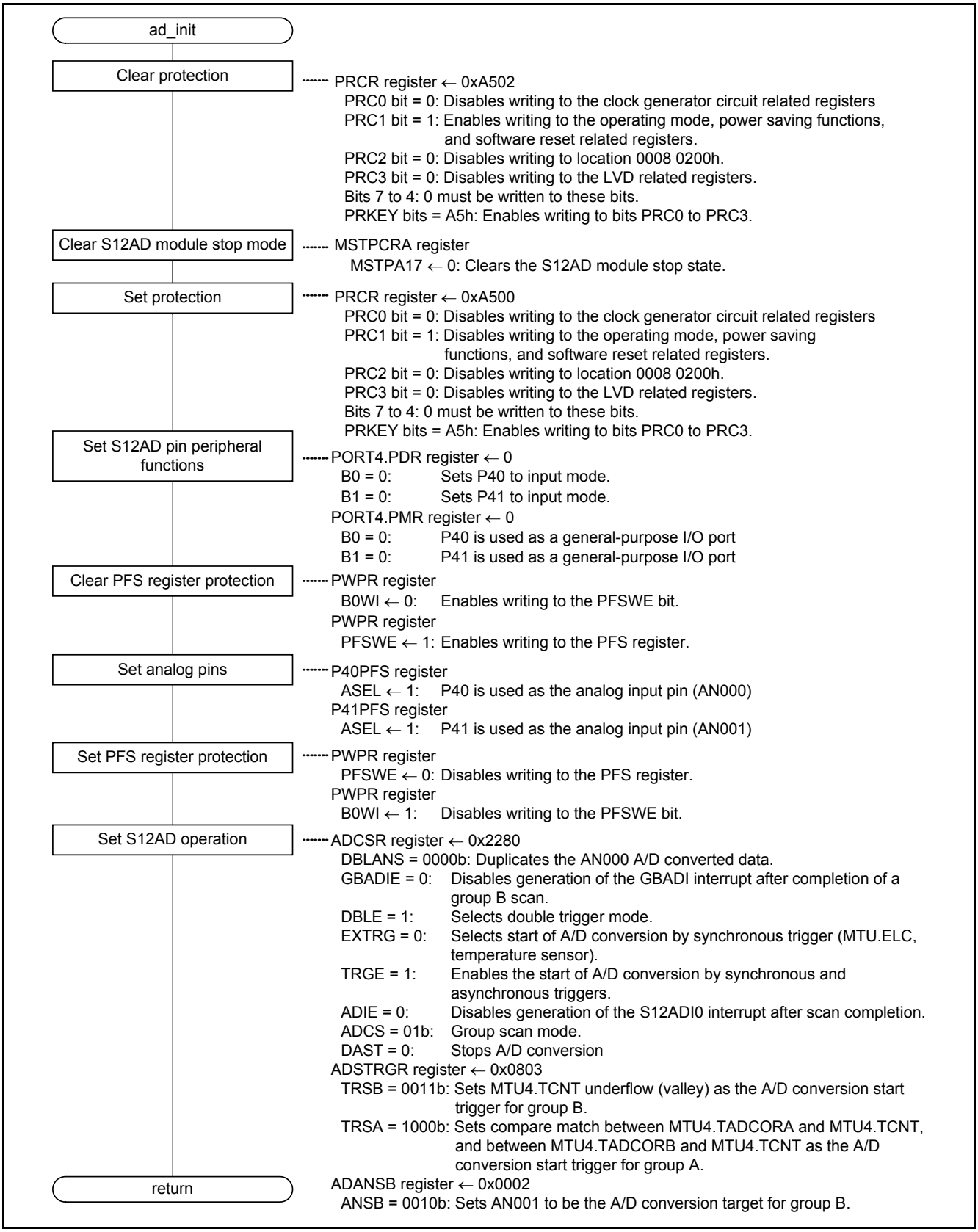

Figure 5.5 S12AD Initialization

5.7.5 CMT Initialization

Figure 5.6 shows the flowchart for CMT initialization.

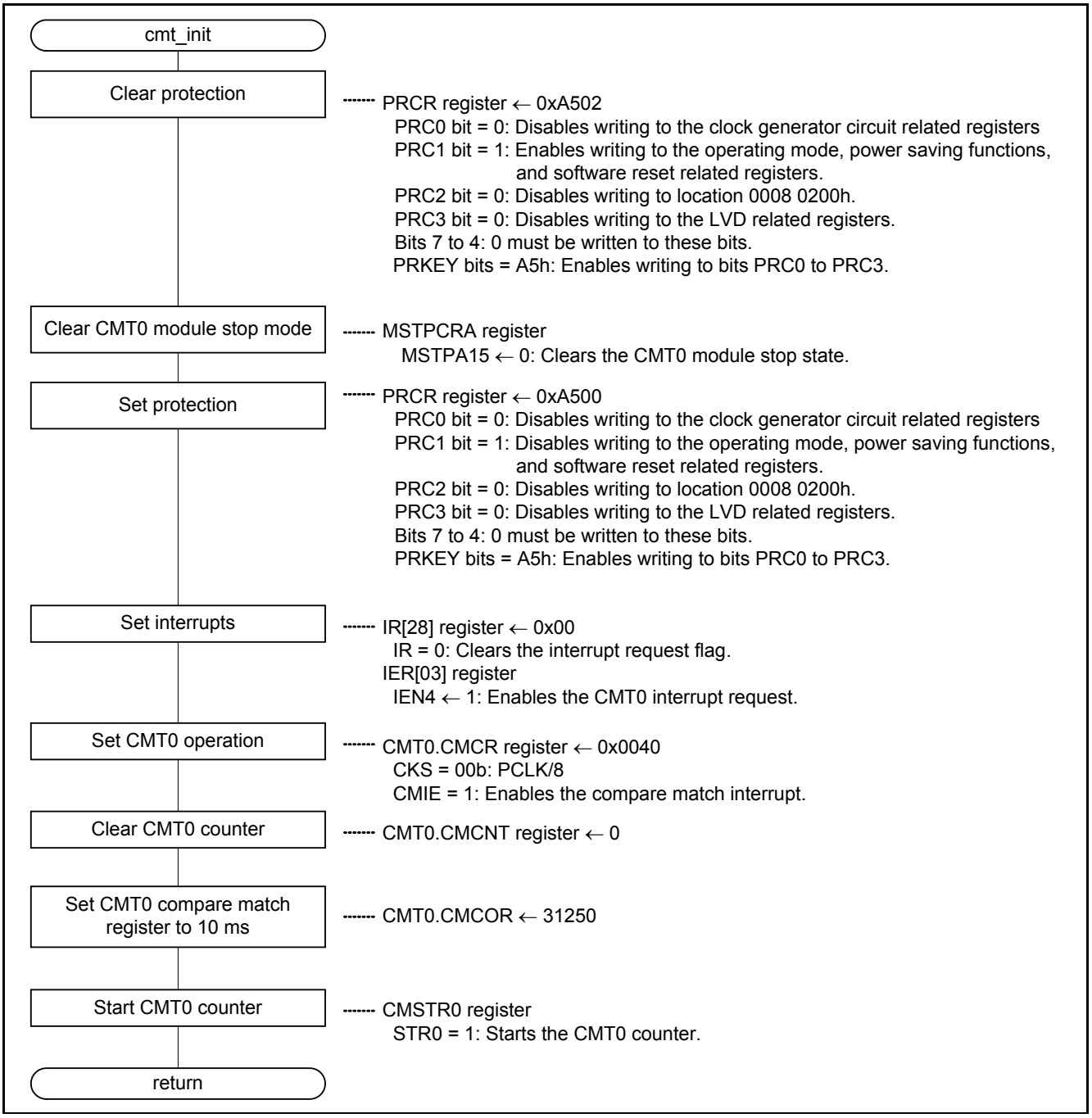

Figure 5.6 CMT Initialization

6. Applying This Application Note to the RX220 Group

The sample code accompanying this application note has been confirmed to operate with the RX210 Group. To make the sample code operate with the RX220 Group, use this application note in conjunction with the RX220 Group Initial Setting application note.

To use this application note with the RX220 Group, modify the main.c file accompanying this application note as shown steps (1) to (5) below, and then refer to "4. Applying the RX210 Group Application Note to the RX220 Group" in the RX220 Group Initial Setting application note.

(1) Change the #include for "iodefine.h" to "../iodefine.h".

(2) Add a #include for "r_init_stop_module.h".

(3) Change the #includes for "clock_init.h" and "non_existent_port_init.h" to "r_init_clock.h" and "r_init_non_existent_port.h", respectively.

```
38  ************************************************************
39  * History      : Feb.15,2012 Ver. 1.00 First Release
40  ************************************************************
41  #include    <machine.h>
42  #include    "../iodefine.h"
43  #include "r_init_clock.h"
44  #include "r_init_stop_module.h"
45  #include "r_init_non_existent_port.h"
46
```

(4) Add a call for the R_INIT_StopModule() function in the main function.

(5) Change the calls for "non_existent_port_init()" and "clock_init()" in the main function to calls for "R_INIT_NonExistentPort()" and "R_INIT_Clock()", respectively.

```
73  * Calling Functions    : sfr_init() : Sfr Setting
74  *""FUNC COMMENT END""*****************************************
75  void main(void)
76  {
77      /* ---- Disable maskable interrupts ---- */
78      clrpsw_i();
79      /* ---- Initialize ports ---- */
80      port_init();
81
82      R_INIT_StopModule();
83      /* ---- Initialize non-existent ports ---- */
84      R_INIT_NonExistentPort();
85      /* ---- Initialize the clock ---- */
86      R_INIT_Clock();
87      /* ---- Initialize peripheral functions ---- */
88      peripheral_init();
89      /* ---- Disable maskable interrupts ---- */
90      setpsw_i();
91
92      while(1){
93          while(IR(CMT0,CMI0) == 0);
94          IR(CMT0,CMI0) = 0;
95
```

7. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

8. Reference Documents

User's Manual: Hardware
RX210 Group User's Manual: Hardware Rev.1.50 (R01UH0037EJ)
RX220 Group User's Manual: Hardware Rev.1.10 (R01UH0292EJ)
The latest versions can be downloaded from the Renesas Electronics website.

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

C compiler manual
RX210 C Compiler Package, Version 1.02
C Compiler User's Manual, Revision 1.00
(Download the latest version of this manual from the Renesas Electronics Corporation web site.)

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REVISION HISTORY	RX210 and RX220 Groups Application Note Setting the A/D Converted Value Addition Function

Rev.	Date	Description	
		Page	Summary
1.00	Sep. 25, 2012	—	First edition issued
1.01	July 1, 2014	1	Products: Added the RX220 Group.
		4	3. Reference Application Notes: Added the RX220 Group Initial Setting application note.
		7	Modified the description of reference application note in the following functions: non_existent_port_init and clock_init.
		13	6. Applying This Application Note to the RX220 Group: Added.
		14	8. Reference Documents: Added the RX220 Group User's Manual: Hardware.

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 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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