RL78/G10

Automatic Hand Soap Dispenser

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Introduction

This application note explains how to realize automatic hand soap dispenser using RL78/G10.

Target Device

RL78/G10

When applying the sample program covered in this application note to another microcontroller, modify the program according to the specifications of the microcontroller and conduct an extensive evaluation of the modified program.

Contents

1. Specifications

In this application note, when the automatic hand soap dispenser is turned on, RL78/G10 will be stop mode. The STOP mode is canceled with every 50ms of 12-bit interval timer, then the human sensor detects the hand. When the hand is detected, the battery voltage is checked. If the battery voltage is less than 4.8V(lower limit of motor drive voltage), the buzzer will alert you for 2 seconds and return to STOP mode. When the battery voltage is 4.8V or more, the LED blinks and the motor is driven to discharge the hand soap for 2 seconds. Then return to STOP mode.

Figure 1.1 shows the system configuration outline.

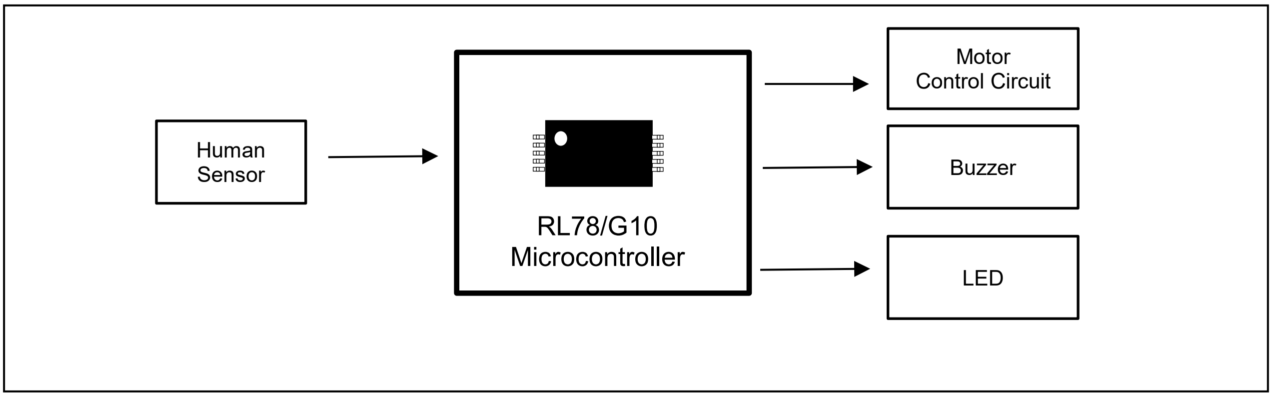

Figure 1.1 the system configuration

1.1 DC Motor

In this application note, the rotation speed of the fan motor is controlled by changing the duty ratio of the PWM output. In order to suppress power losses in fan driving, a power MOSFET capable of fast switching and with a low ON-resistance is used. When actually building a circuit, the design should satisfy the electrical characteristics of the model used.

1.2 Human Sensor

This application system uses a module with a pyroelectric infrared sensor (hereinafter called a human sensor). According to the specifications, the system begins to monitor all around the sensor at some seconds after power on and changes the output level of the signal to low when an object of approximately 35°C such as a human move. When preparing application circuits, make sure to design them to satisfy the electrical characteristics.

2. Operation Check Conditions

The sample code contained in this application note has been checked under the conditions listed in the table below.

Table 2.1 Operation Check Conditions

Item	Description
Microcontroller used	RL78/G10 (R5F10Y47ASP)
Operating frequency	• High-speed on-chip oscillator (HOCO) clock: 1.25 MHz • CPU/peripheral hardware clock: 1.25 MHz
Operating voltage	3.3 V (can run on a voltage range of 2.7 V to 5.5 V) SPOR operation: Max 2.90 V at rise(2.76~3.02V) Min 2.84 V at fall(2.70~2.96V)
Integrated development environment (CS+)	CS+ for CC V6.01.00 from Renesas Electronics Corp.
C compiler (CS+)	CC-RL V1.06.00 from Renesas Electronics Corp.
Integrated development environment (e^2 studio)	e^2 studio V5.1.0.022 from Renesas Electronics Corp.
C compiler (e^2 studio)	CC-RL V1.06.00 from Renesas Electronics Corp.

Caution: The code in this application note applies only to the RL78/G10 (R5F10Y47ASP).

3. Hardware Descriptions

3.1 Hardware Configuration

Figure 3.1 shows an example of the hardware configuration for the system described in this application note.

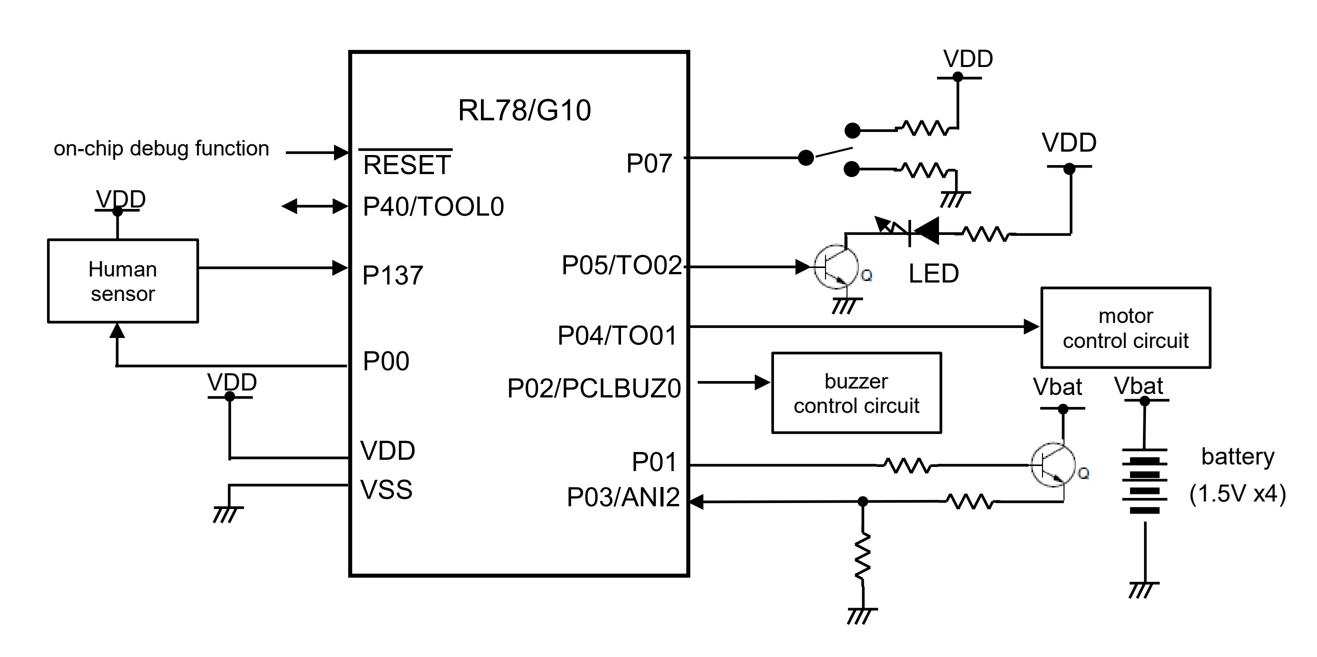

Figure 3.1 the hardware configuration

Notes: 1. The above figure is a simplified circuit image for showing the outline of the connections. The actual circuit should be designed so that the pins are handled appropriately and that the electrical characteristics are satisfied (input-only ports should be each connected to V_{DD} or V_{SS} via a resistor).

2. V_{DD} must be equal to or greater than the reset release voltage (V_{SPOR}) specified with SPOR.

3.2 List of Pins used

Table 3.1 lists the pins used and their functions.

Table 3.1 Pin Used and Their Functions

Pin Name	I/O	Description
P137	Input	Signal input from human sensor
P07	Input	Selection of hand soap discharge amount(P07=H:Many,P07=L:Few)
P05/TO02	Output	LED drive
P04/TO01	Output	Fan drive
P03/ANI2	Input	Battery voltage measurement
P02/PCLBUZ0	Output	Buzzer alarm
P01	Output	Battery voltage measurement circuit control
P00	Output	Human sensor power control

4. Software Descriptions

4.1 Operation Summary

When the hand soap auto dispenser is turned on, the RL78/G10 enters the STOP mode. The STOP mode is canceled with every 50ms of 12-bit interval timer interrupt, then the human sensor detects the hand. When the human sensor output level (P137 input voltage level) is low, it is determined that a hand has been detected.

When a hand is detected, the battery voltage is checked using an A/D converter. If the battery voltage is less than 4.8V (lower limit of motor drive voltage), the buzzer will alert you for 2 seconds and return to STOP mode. When the battery voltage is 4.8V or more, the LED blinks and the motor is driven to discharge the hand soap for 2 seconds. Then return to STOP mode.

4.2 List of Option Byte Setting

Table 4.1 shows the option byte settings.

Table 4.1 Option Byte Settings

Address	Setting	Description
000C0H	11101001B	Disables the watchdog timer. (Stops counting after the release from the reset state.)
000C1H	11110111B	SPOR detection voltage: 2.90 V at fall; 2.84 V at rise
000C2H	11111101B	HOCO: 1.25 MHz
000C3H	10000101B	Enables the on-chip debugger.

4.3 List of Variables

Table 4.2 lists the global variables.

Table 4.2 Global Variables

Type	Variable Name	Contents	Function Used
uint8_t	g_count	Timer counter	r_tau0_channel3_interrupt()
uint8_t	g_edge	Hand detection flag	main()
uint16_t	g_adc_ResultT	A/D conversion result	main()

4.4 List of Functions (Subroutines)

lists the functions (subroutines).

Function (Subroutine) Name	Outline
R_MAIN_UserInit[note]	User application initialization
R_ADC_Start	A/D converter start
R_ADC_Get_Result()	Function of getting temperature data
R_ADC_Stop()	A/D converter stop
R_PCLBUZ0_Start()	Buzzer alarm start
R_PCLBUZ0_Stop()	Buzzer alarm stop
R_TAU0_Channel0_Start()	PWM output start and LED flashing start
R_TAU0_Channel0_Stop()	PWM output stop and LED flashing stop
R_TAU0_Channel3_Start()	Buzzer alarm time and discharge time start
R_TAU0_Channel3_Stop()	Buzzer alarm time and discharge time stop

Note These functions are automatically generated by the integrated development environment.

4.5 Function Specifications

This section gives the specifications of the functions used in the sample program.

[Function Name] R_MAIN_UserInit	
Synopsis	User Application Initialization
Header	r_cg_macrodriver.h r_cg_userdefine.h
Declaration	void R_MAIN_UserInit(void)
Explanation	Performs initialization necessary for the operation of the application.
Arguments	None
Return value	None
Remarks	None

[Function Name] R_ADC_Start	
Synopsis	A/D converter conversion start
Header	r_cg_macrodriver.h r_cg_adc.h r_cg_userdefine.h
Declaration	void R_ADC_Start(void)
Explanation	Enables A/D converter conversion.
Arguments	None
Return value	None
Remarks	None

[Function Name] R_ADC_Get_Result	
Synopsis	Temperature data get
Header	r_cg_macrodriver.h r_cg_adc.h r_cg_userdefine.h
Declaration	void R_ADC_Get_Result (void)
Explanation	A/D converter result
Arguments	None
Return value	None
Remarks	None

[Function Name] R_ADC_Stop	
Synopsis	A/D converter conversion stop
Header	r_cg_macrodriver.h r_cg_adc.h r_cg_userdefine.h
Declaration	void R_ADC_Stop(void)
Explanation	Enables A/D converter conversion.
Arguments	None
Return value	None
Remarks	None

[Function Name] R_PCLBUZ0_Start	
Synopsis	Buzzer alarm start
Header	r_cg_macrodriver.h r_cg_pclbuz.h r_cg_userdefine.h
Declaration	void R_PCLBUZ0_Start(void)
Explanation	Buzzer alarm start.
Arguments	None
Return value	None
Remarks	None

[Function Name] R_PCLBUZ0_Stop	
Synopsis	Buzzer alarm stop
Header	r_cg_macrodriver.h r_cg_pclbuz.h r_cg_userdefine.h
Declaration	void R_PCLBUZ0_Stop(void)
Explanation	Buzzer alarm stop.
Arguments	None
Return value	None
Remarks	None

[Function Name] R_TAU0_Channel0_Start	
Synopsis	Timer array unit channel0 start
Header	r_cg_macrodriver.h r_cg_tau.h r_cg_userdefine.h
Declaration	void R_TAU0_Channel0_Start (void)
Explanation	Timer array unit channel0 start
Arguments	None
Return value	None
Remarks	None

[Function Name] R_TAU0_Channel0_Stop	
Synopsis	Timer array unit channel0 stop
Header	r_cg_macrodriver.h r_cg_tau.h r_cg_userdefine.h
Declaration	void R_TAU0_Channel0_Stop (void)
Explanation	Timer array unit channel0 stop
Arguments	None
Return value	None
Remarks	None

[Function Name] R_TAU0_Channel3_Start	
Synopsis	Timer array unit channel3 start
Header	r_cg_macrodriver.h r_cg_tau.h r_cg_userdefine.h
Declaration	void R_TAU0_Channel3_Start (void)
Explanation	Timer array unit channel3 start
Arguments	None
Return value	None
Remarks	None

[Function Name] R_TAU0_Channel3_Stop	
Synopsis	Timer array unit channel3 stop
Header	r_cg_macrodriver.h r_cg_tau.h r_cg_userdefine.h
Declaration	void R_TAU0_Channel3_Stop (void)
Explanation	Timer array unit channel3 stop
Arguments	None
Return value	None
Remarks	None

[Function Name] main	
Synopsis	Main function
Header	—
Declaration	Main processing function for the sample codes
Explanation	None
Arguments	None
Return value	None

4.6 Flowcharts

Figure 4.1 shows an overall flow of the sample program described in this application note.

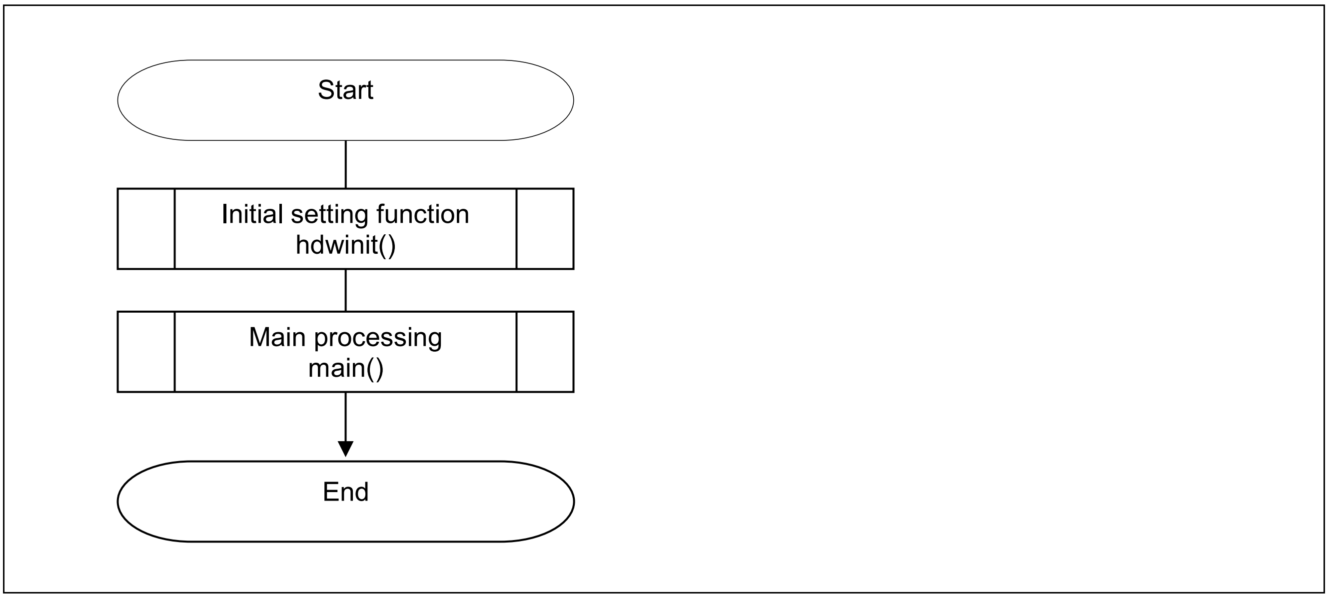

Figure 4.1 the overall flow

4.6.1 Initial Setting Function

Figure 4.2 shows the flowchart of the initial setting function.

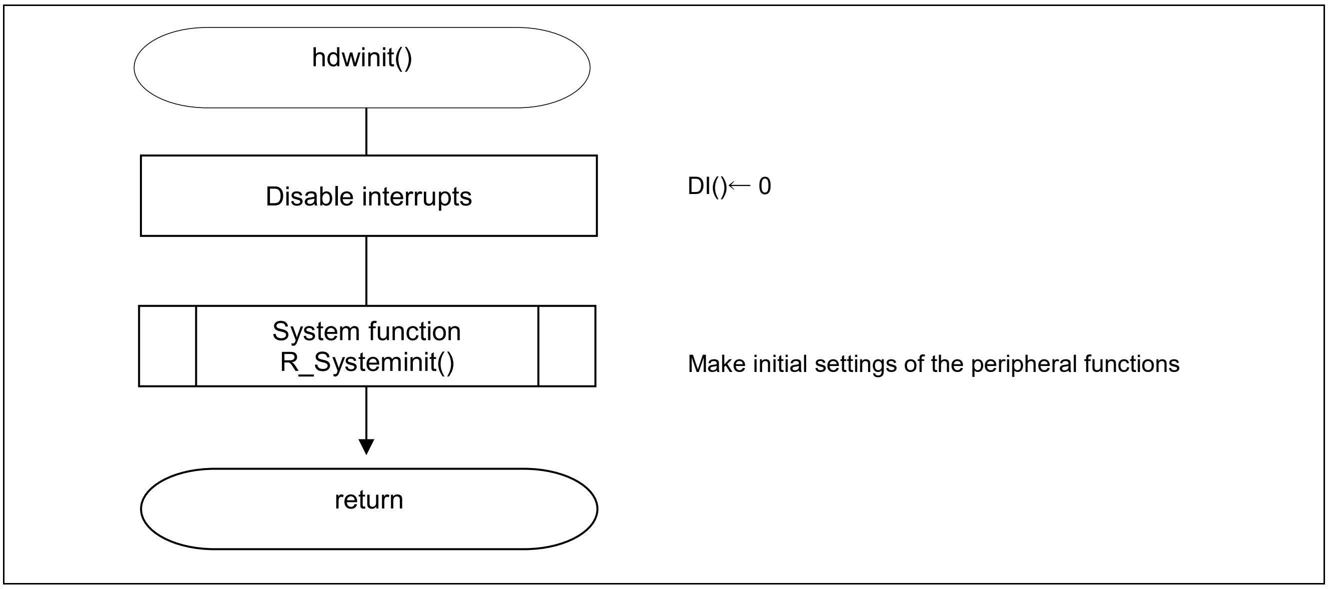

Figure 4.2 Initial Setting Function

4.6.2 System Function

Figure 4.3 shows the flowchart of the system function.

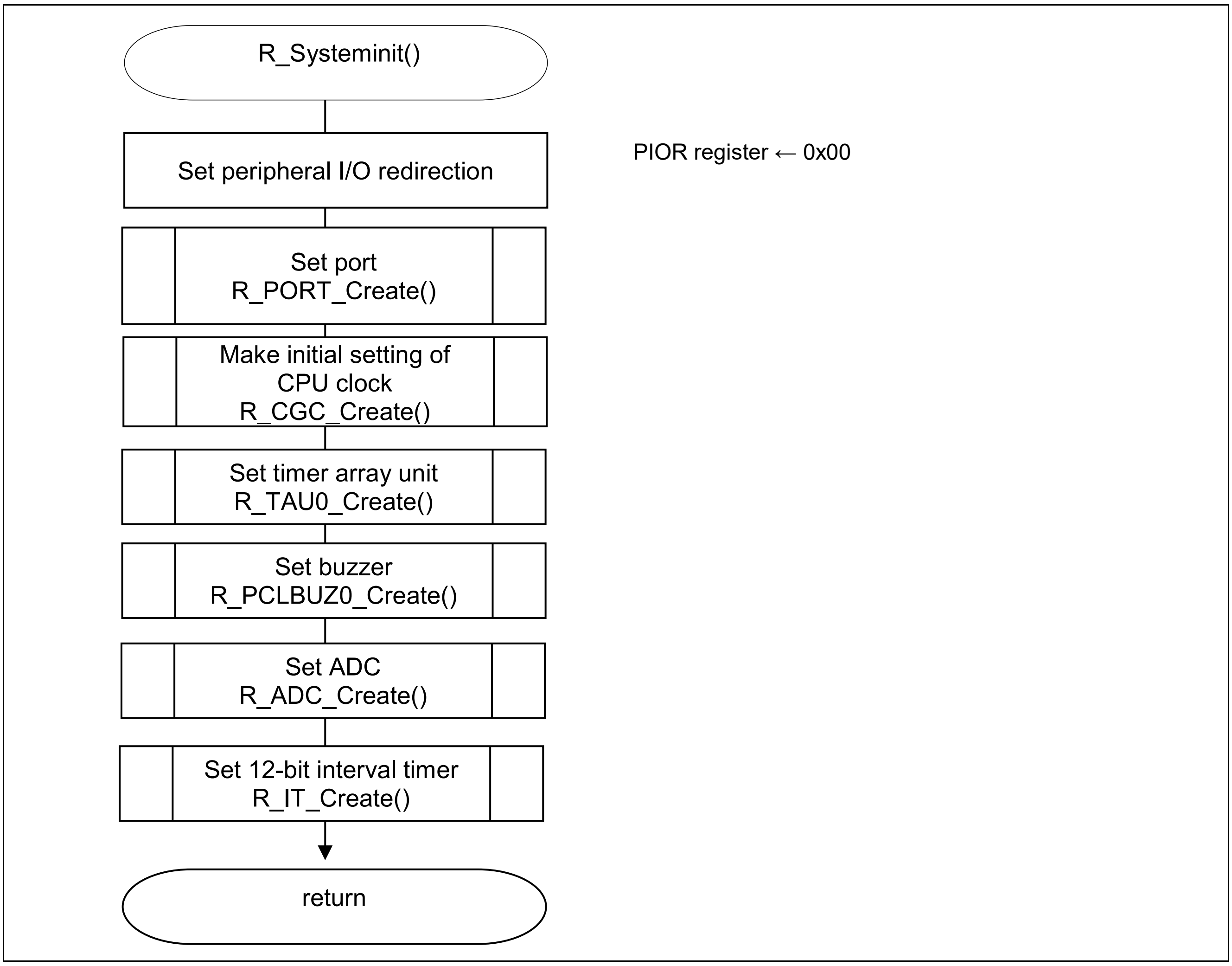

Figure 4.3 System Function

4.6.3 I/O Port Setup

Figure 4.4 shows the flowchart for setting up the I/O ports.

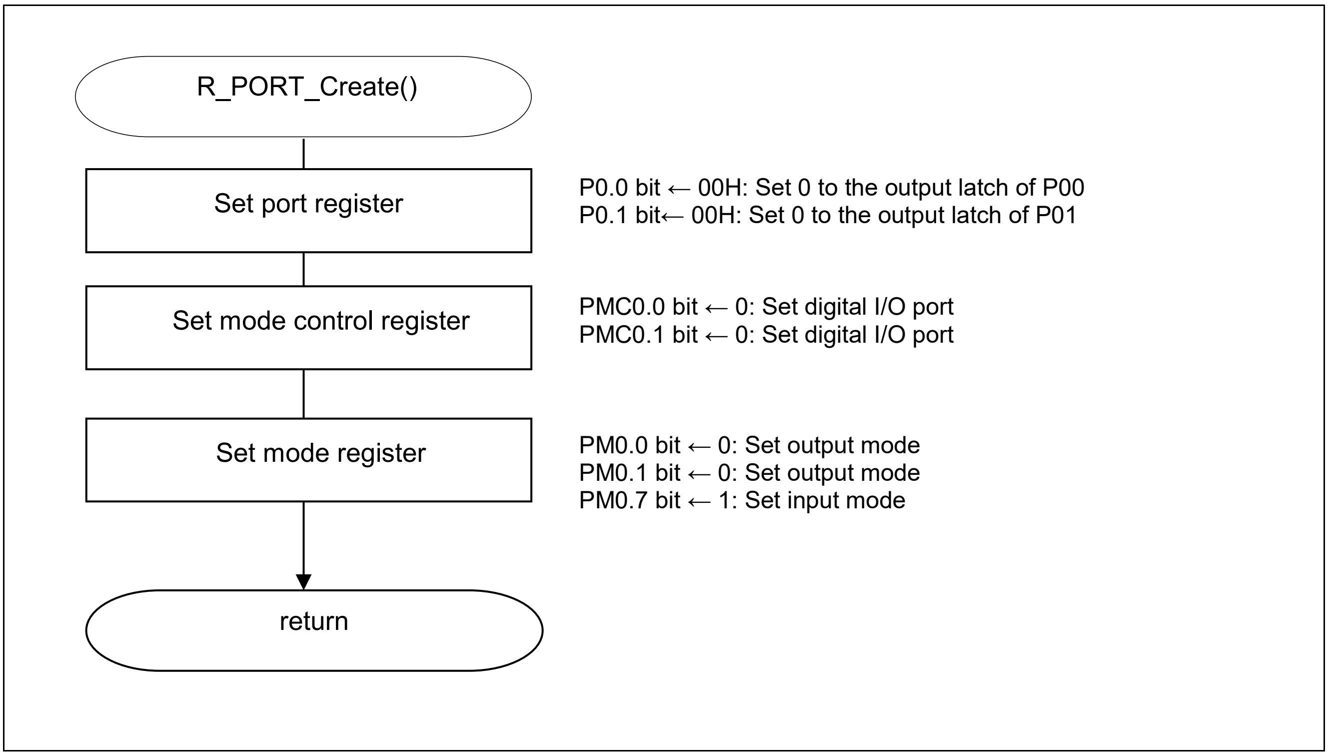

Figure 4.4 I/O Port Setup

Notes: 1. For details on register setting when using the ports as the alternate functions of the peripheral functions, refer to the RL78/G10 User's Manual: Hardware.

2. Provide proper treatment for unused pins so that their electrical specifications are observed. Connect each of unused input-only ports to V_{DD} or V_{SS} via a separate resistor.

4.6.4 CPU Clock Setup

Figure 4.5 shows the flowchart for setting up the CPU clock.

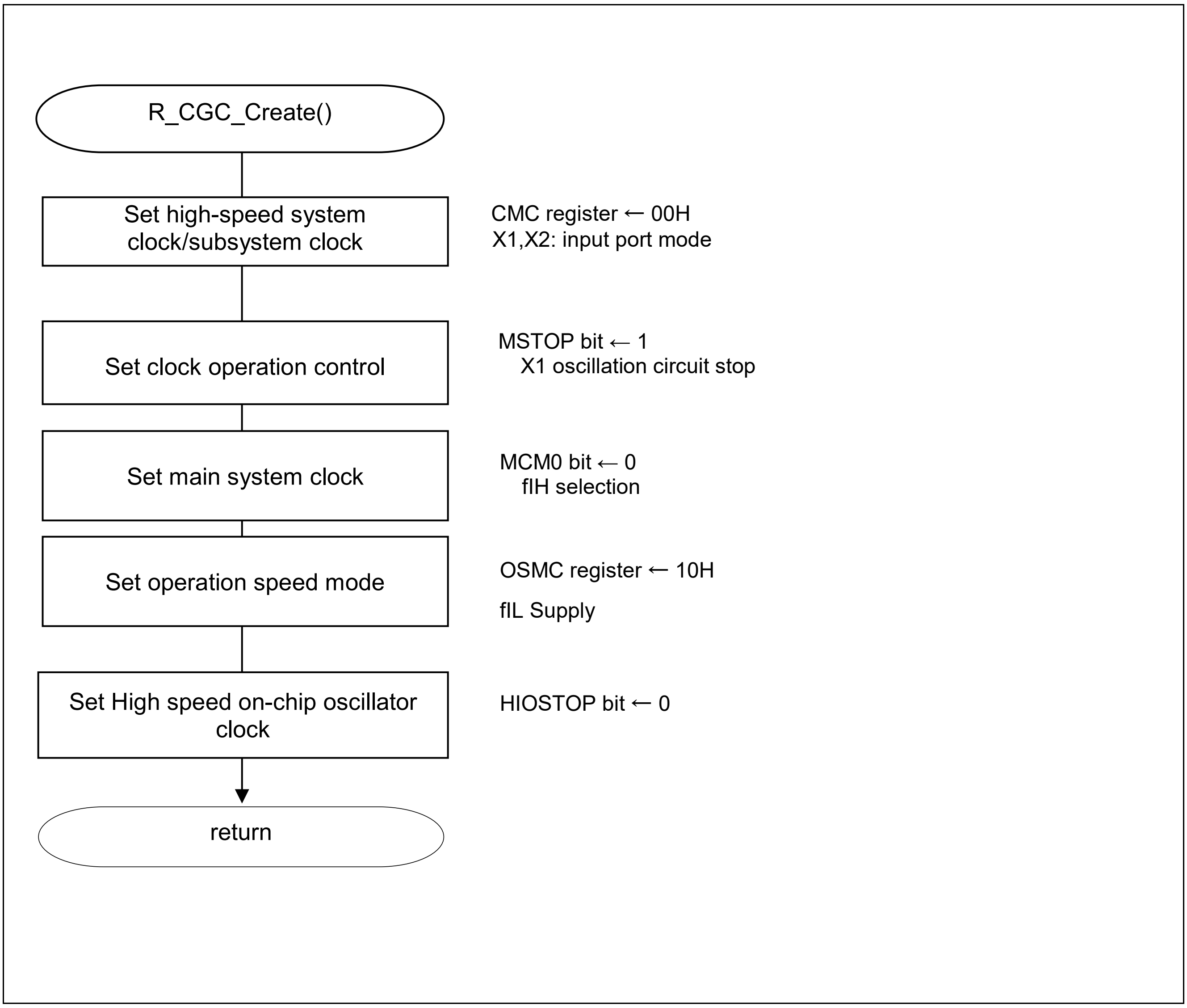

Figure 4.5 CPU Clock Setup

4.6.5 Timer array unit setup

Figure 4.6,Figure 4.7shows the flowchart for setting up the timer array unit setup.

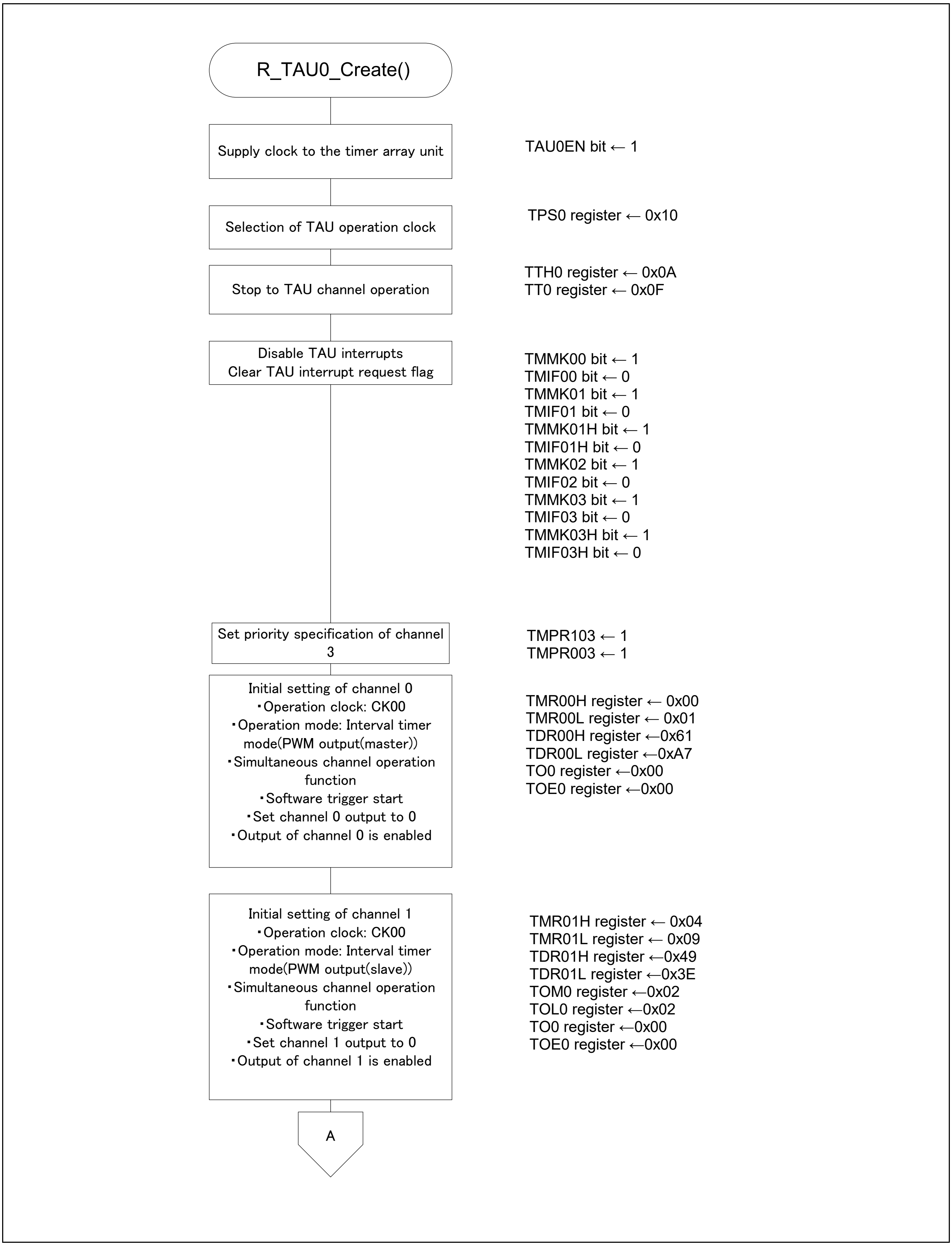

Figure 4.6 the timer array unit setup (1/2)

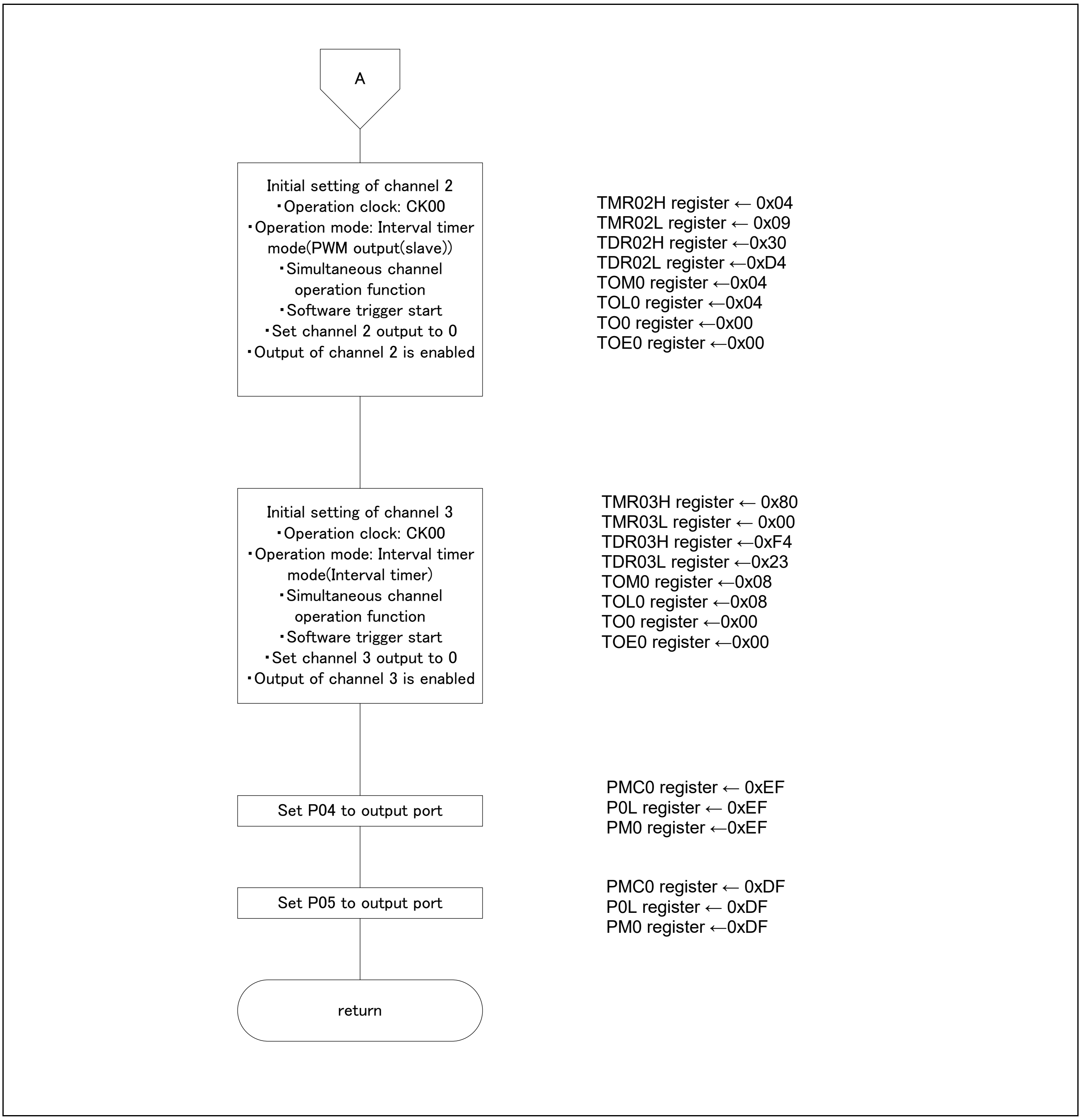

Figure 4.7 the timer array unit setup (2/2)

4.6.6 Buzzer alarm setup

Figure 4.8 shows the flowchart for setting up the buzzer alarm setup.

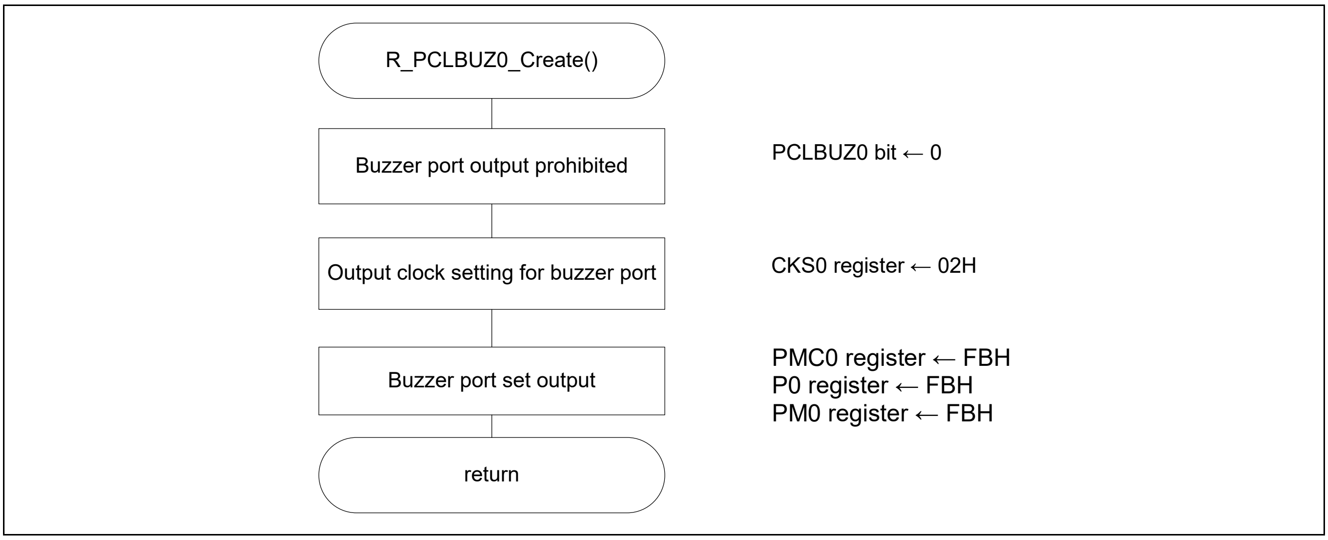

Figure 4.8 Buzzer alarm setup

4.6.7 A/D converter Setup

Figure 4.9 shows the flowchart for setting up the A/D converter.

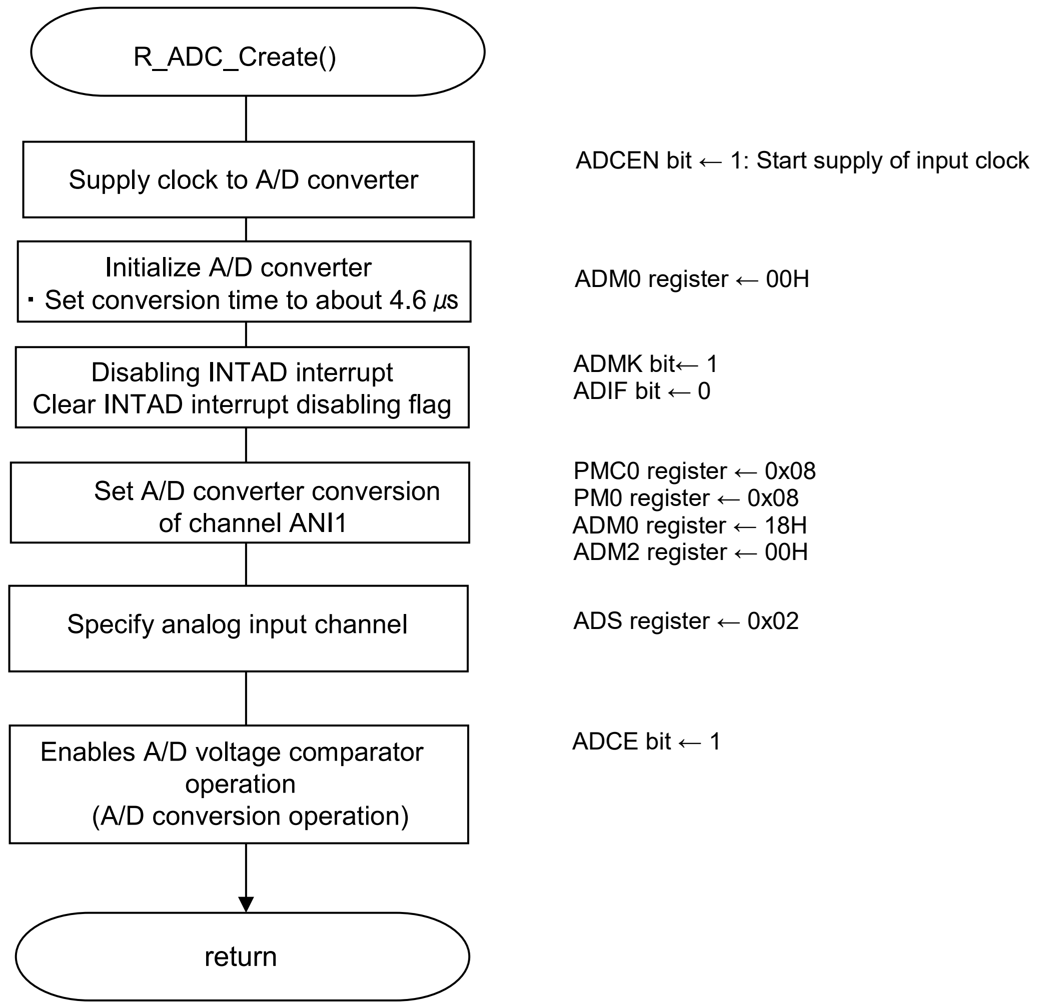

Figure 4.9 A/D Converter Setup

4.6.8 12-bit interval timer setup

Figure 4.10 shows the flowchart for setting up the 12-bit interval timer setup.

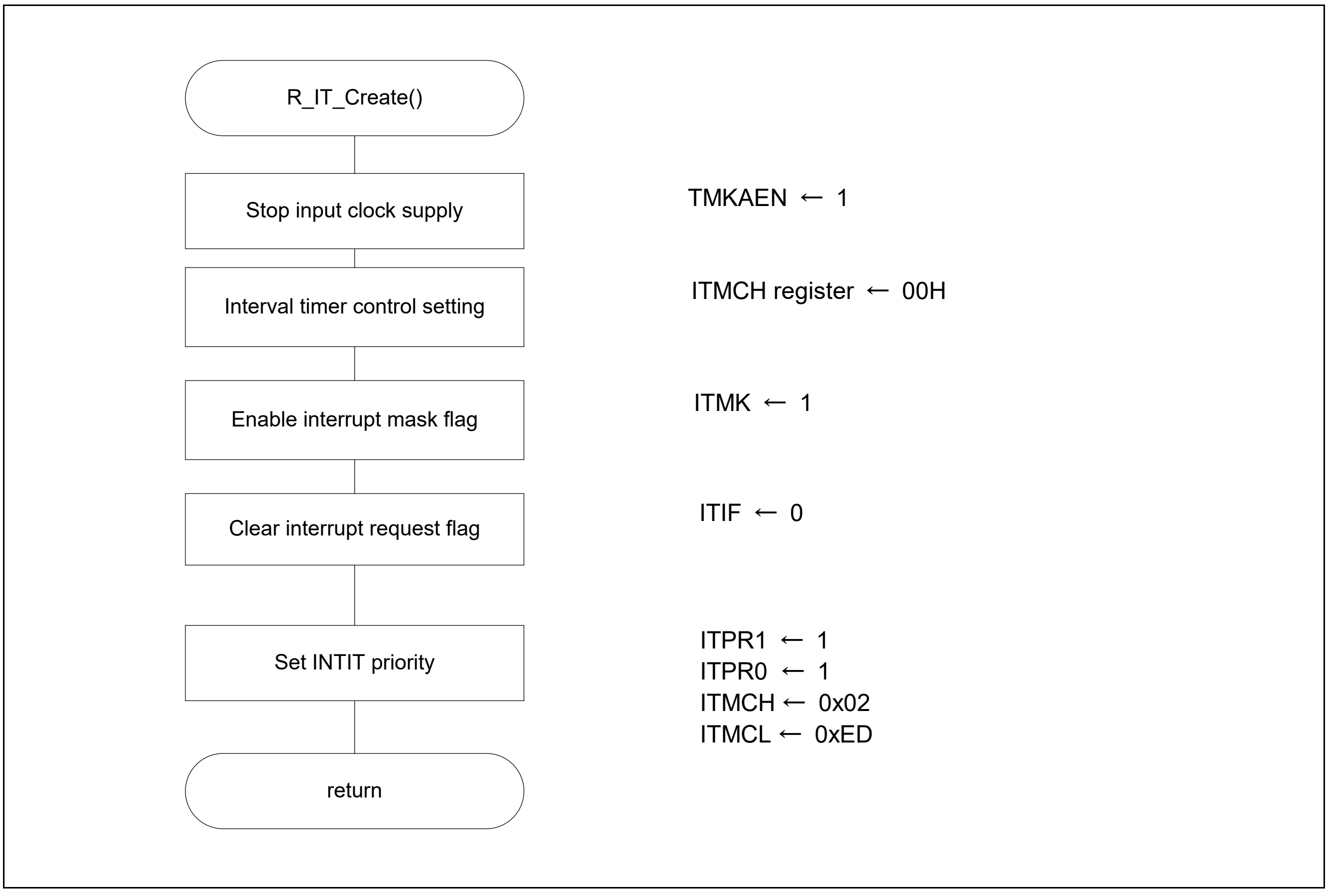

Figure 4.10 12-bit Interval timer Setup

4.6.9 Main Processing

Figure 4.11 shows the flowchart of the main processing.

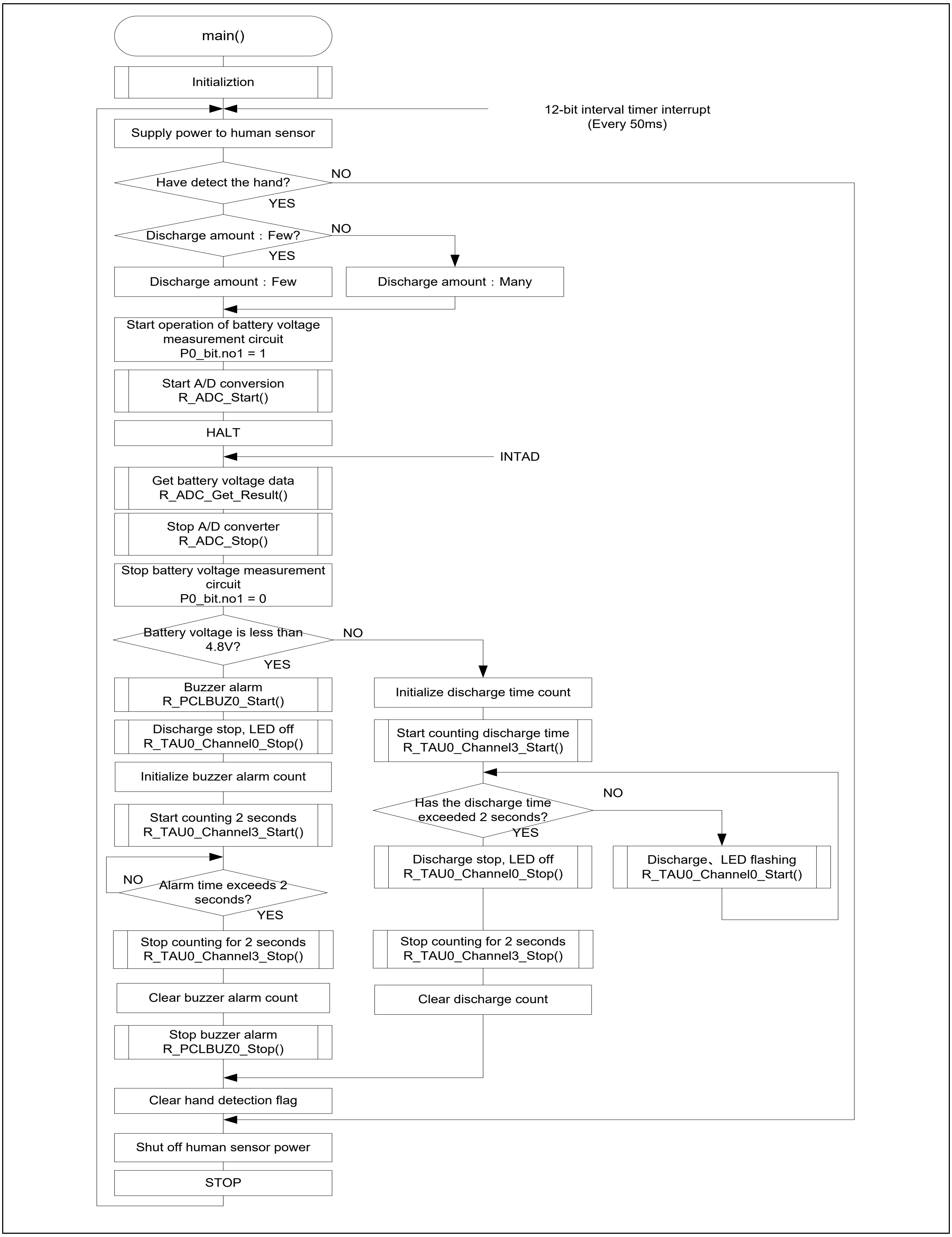

Figure 4.11 Main Processing

4.6.10 Initialization Function

Figure 4.12 shows the flowchart for setting the initialization.

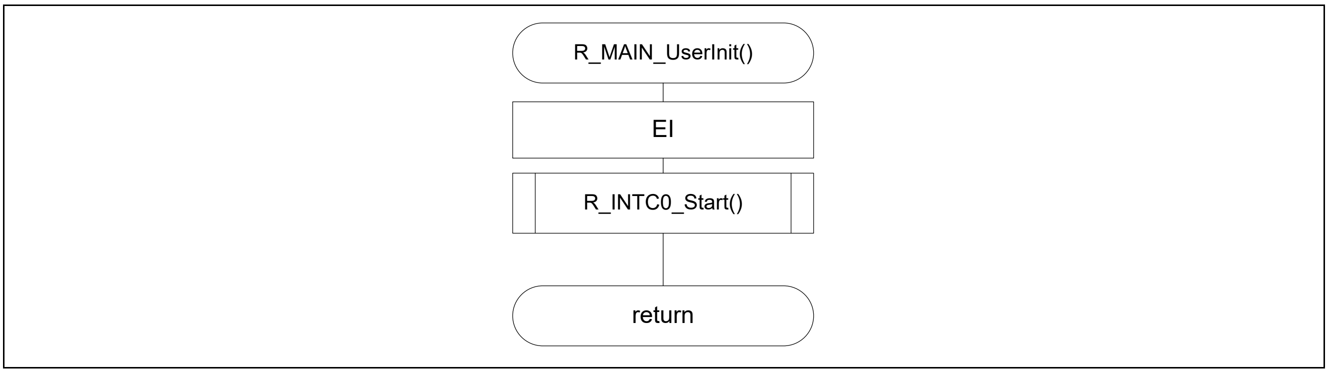

Figure 4.12 Initialization Function

4.6.11 12-bit interval timer start Setting

Figure 4.13 shows the flowchart for setting the 12-bit interval timer start.

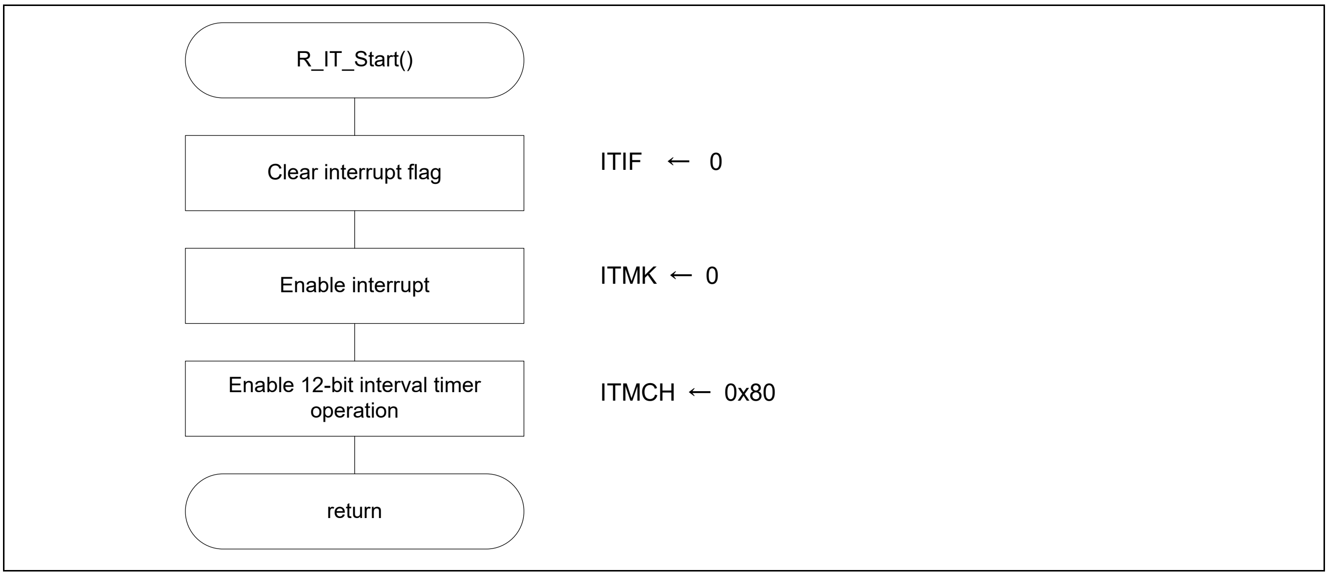

Figure 4.13 12-bit Interval timer

4.6.12 12-bit interval timer interrupt

Figure 4.14 shows the flowchart for setting the 12-bit interval timer interrupt.

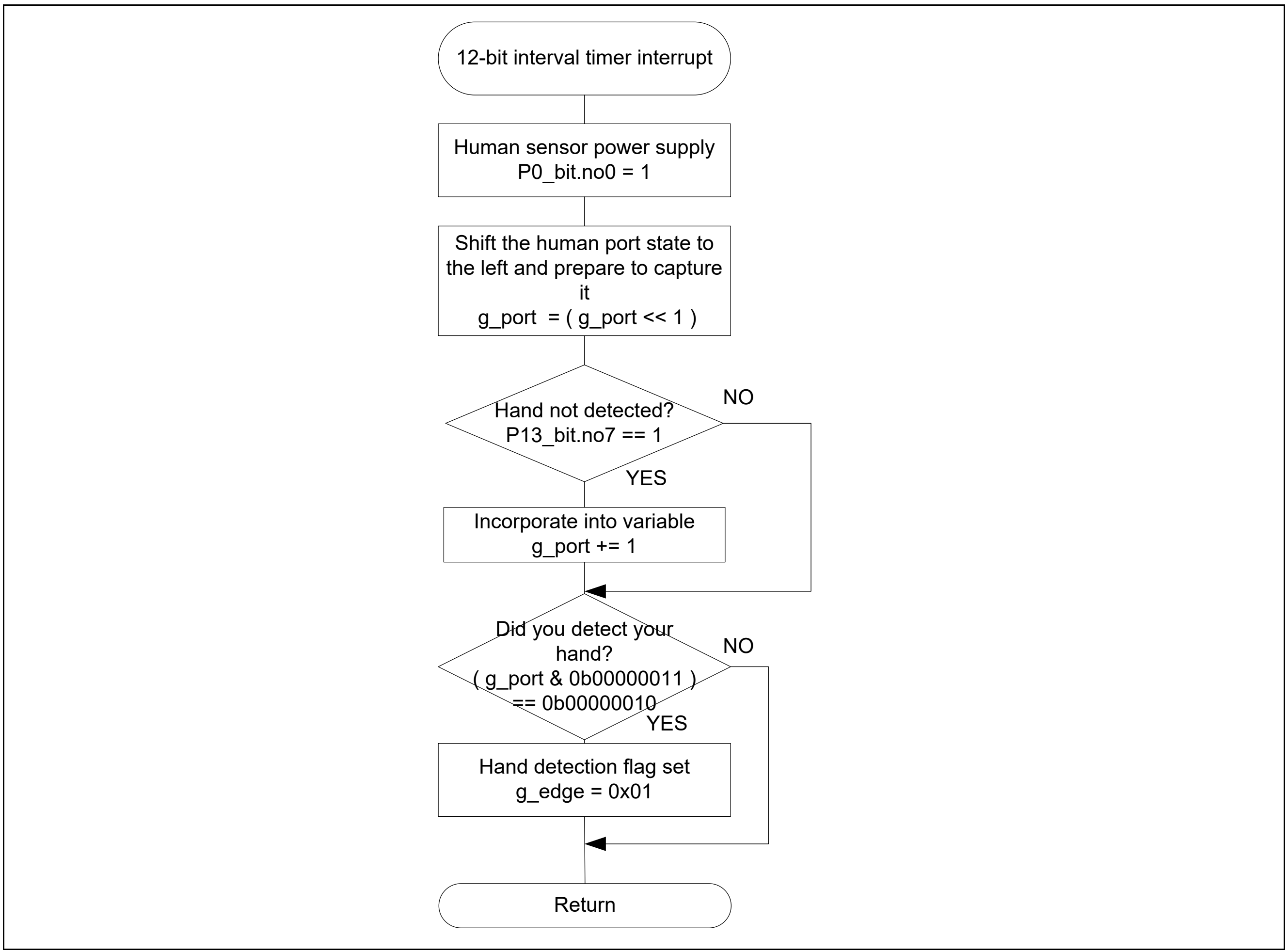

Figure 4.14 12-bit interval timer interrupt

4.6.13 A/D Conversion Start Setting

Figure 4.15 shows the flowchart for setting the A/D conversion start.

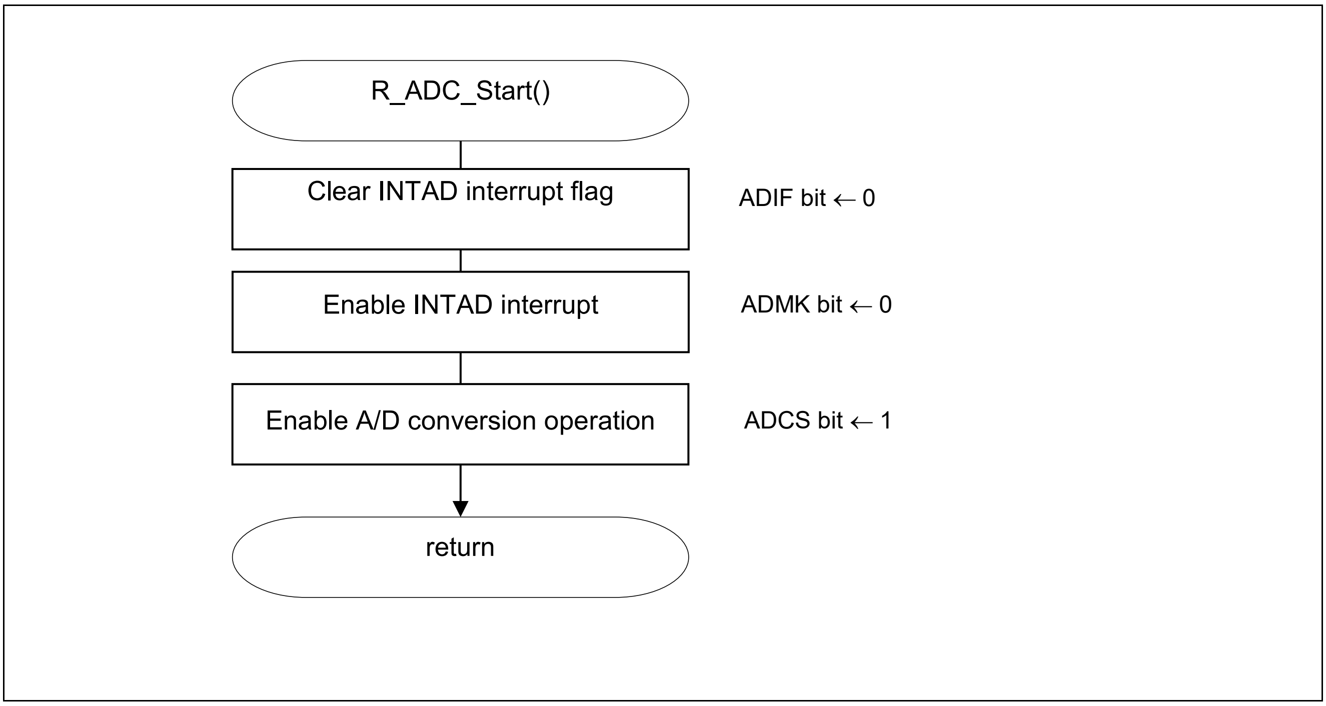

Figure 4.15 A/D Converter Operation Start Setting

4.6.14 Obtaining battery voltage

Figure 4.16 shows the flowchart for obtaining battery voltage.

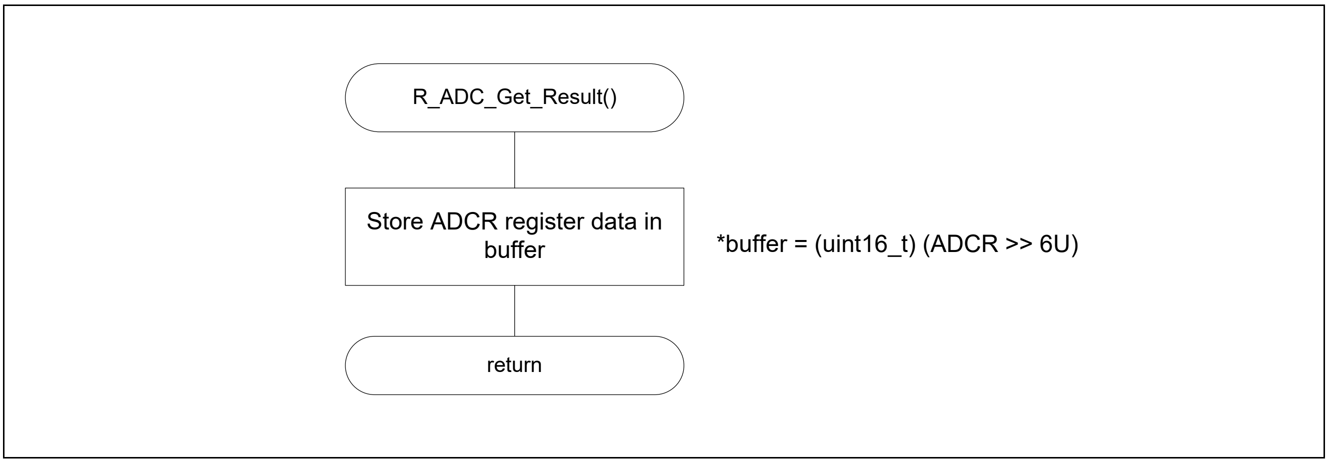

Figure 4.16 Obtaining battery voltage

4.6.15 A/D Conversion Stop Setting

Figure 4.17 shows the flowchart for A/D conversion stop setting.

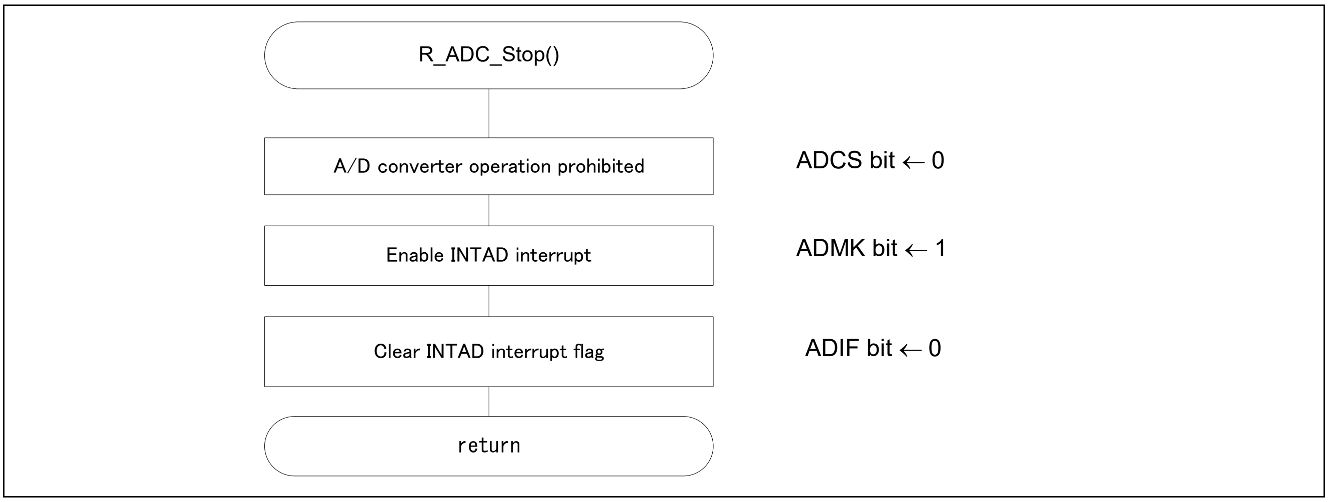

Figure 4.17 A/D conversion stop

4.6.16 Timer array unit channel 0 operation start

Figure 4.18 shows the flowchart for timer array unit channel 0 operation start.

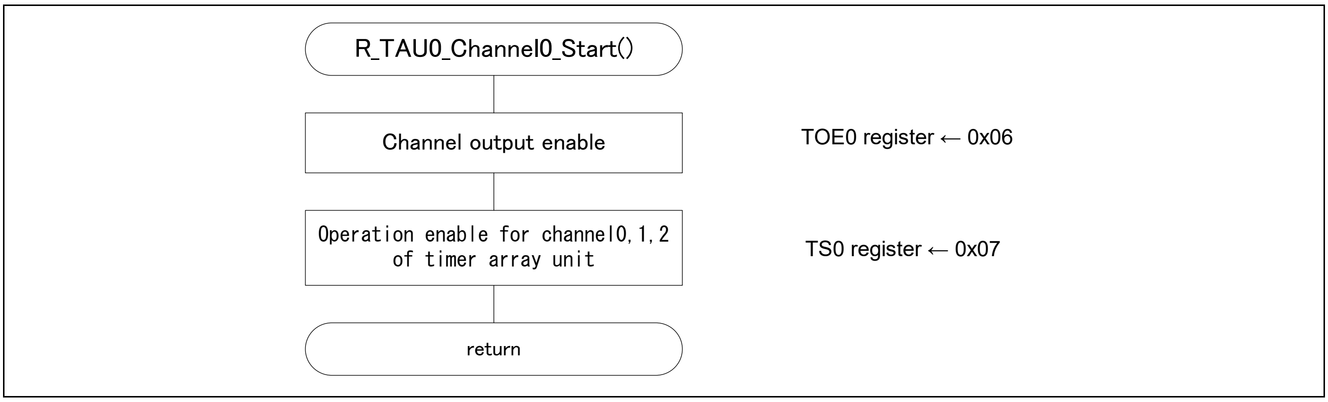

Figure 4.18 Timer array unit channel 0 operation start

4.6.17 Timer array unit channel 0 operation stop

Figure 4.19 shows the flowchart for timer array unit channel 0 operation stop.

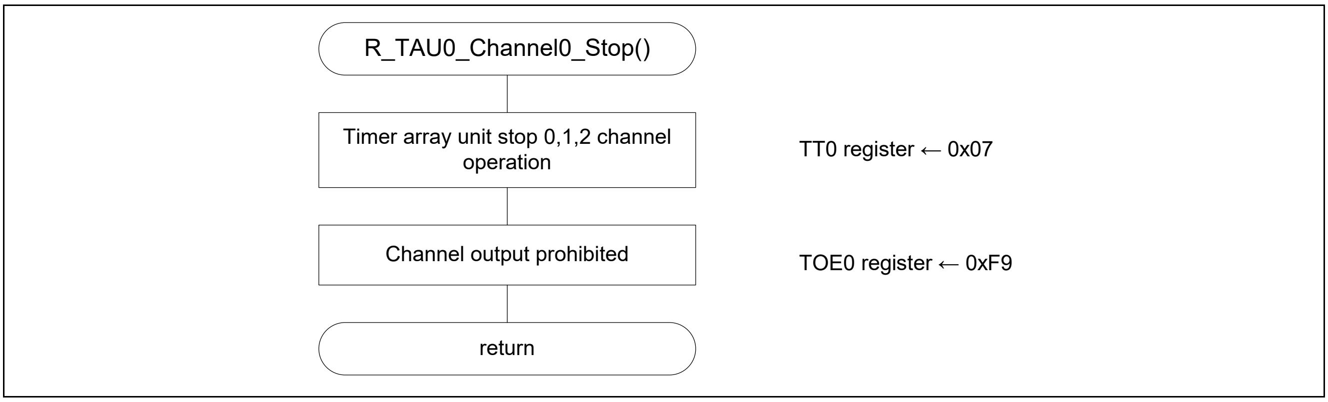

Figure 4.19 Timer array unit channel 0 operation stop

4.6.18 Timer array unit channel 3 operation start

Figure 4.20 shows the flowchart for timer array unit channel 3 operation start.

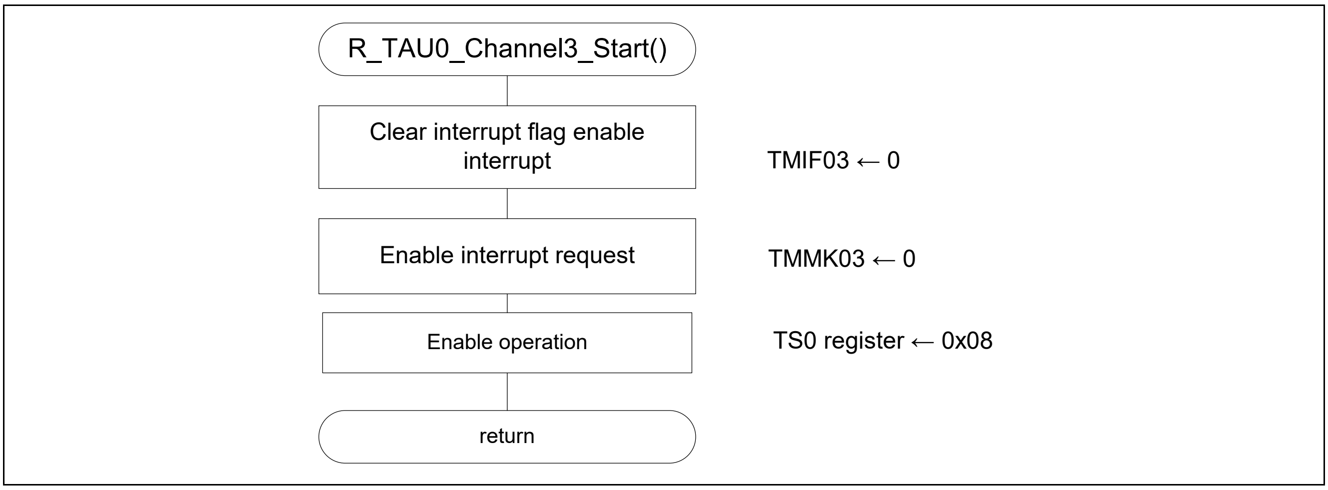

Figure 4.20 Timer array unit channel 3 operation start

4.6.19 Timer array unit channel 3 operation stop

Figure 4.21 shows the flowchart for timer array unit channel 3 operation stop.

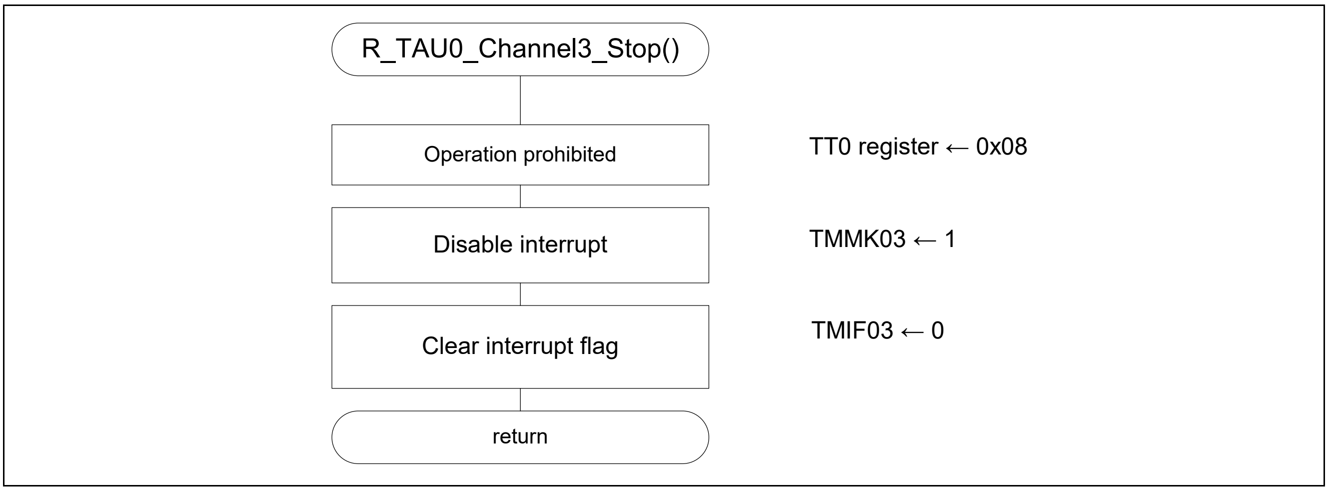

Figure 4.21 Timer array unit channel 3 operation stop

4.6.20 Buzzer alarm start

Figure 4.22 shows the flowchart for buzzer alarm start.

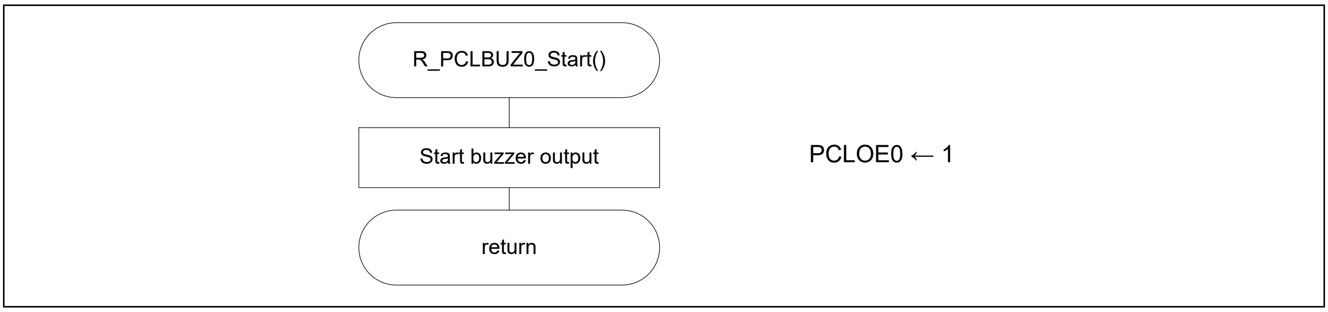

Figure 4.22 Buzzer alarm start

4.6.21 Buzzer alarm stop

Figure 4.23 shows the flowchart for buzzer alarm stop.

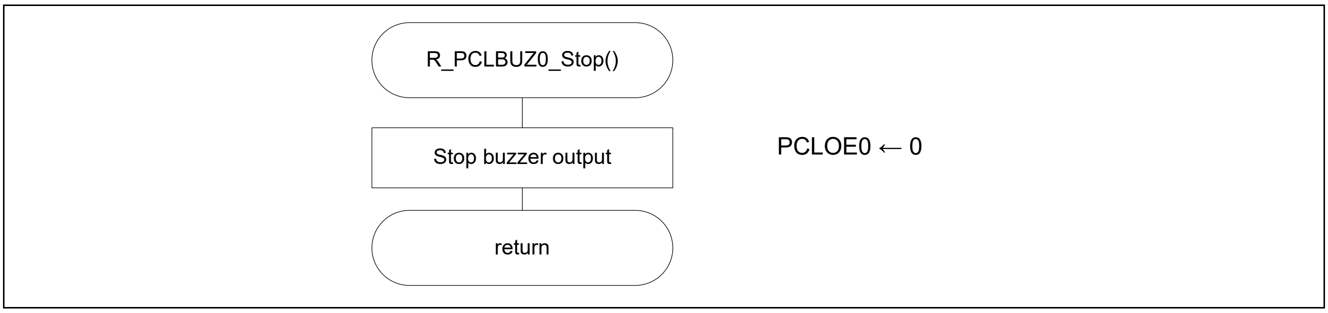

Figure 4.23 Buzzer alarm stop

Website and Support

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

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

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Sep.30.2019	-	-

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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