
RL78/L12

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Multi-Cycle Computer for Bicycles

Introduction

This application note explains a method of realization of a bicycle multicycle computer using RL78/L12.

Target Device

RL78/L12

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

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1. Specifications

When turned on, this application displays the initial state (clock display 00:00).

Each time the MODE button is pressed down, the display on the monitor is changed from clock, riding time, speed, travel distance to total travel distance. Table 1.1 shows how the items are displayed on the LCD monitor.

Table 1.1 MODE Button Depression Count, Displayed Items, and Display on LCD Monitor

MODE Button Depression Count	Displayed Item	Main Display on LCD Monitor, Unit, (auxiliary displays)
0	Clock * 24-hour format display	00:00, Hour:Minute, (none)
1	Riding time * Initialized by pressing down the RESET button	00:00, Hour:Minute, (top row: T, bottom row: none)
2	Speed * Updated every second	00.00, km/h, (top row: none, bottom row: KMH)
3	Travel distance * Initialized by pressing down the RESET button	00.00, km, (top row: none, bottom row: KM)
4	Total travel distance * Up to 9999 km	00 00, km, (top row: T, bottom row: KM)

Note: Pressing down the MODE button five times returns the mode to clock display mode.

Each time the SET button is pressed down, the mode is changed from clock setting (hour), clock setting (minute), wheel circumference setting (thousands place), wheel circumference setting (hundreds place), wheel circumference setting (tens place), wheel circumference setting (ones place) to clock. In each setting mode, pressing down the MODE button increases the number, and pressing down the SET button saves the number and shifts the mode to the next setting mode. The wheel circumference is measured in mm. The LCD part currently being set blinks.

Detecting no interrupt signal from the reed switch for 300 seconds, the RL78/L12 enters STOP mode.

Table 1.2 shows the relationship between the SET button depression count, setting modes, and display on the LCD monitor.

Table 1.2 SET Button Depression Count, Setting Modes, and Display on LCD Monitor

SET Button Depression Count	Setting Mode	Display Range on LCD Monitor (auxiliary displays)
1	Clock setting (hour)	0 to 23 (none)
2	Clock setting (minute)	0 to 59 (none)
3	Wheel circumference setting (thousands place)	0 to 9 (MM)
4	Wheel circumference setting (hundreds place)	0 to 9 (MM)
5	Wheel circumference setting (tens place)	0 to 9 (MM)
6	Wheel circumference setting (ones place)	0 to 9 (MM)

Note 1. Pressing down the SET button seven times changes the mode from setting mode to clock display mode.

Note 2. Pressing down the MODE button beyond the display range on the LCD monitor returns the number to 0.

Figure 1.1 shows the system configuration outline.

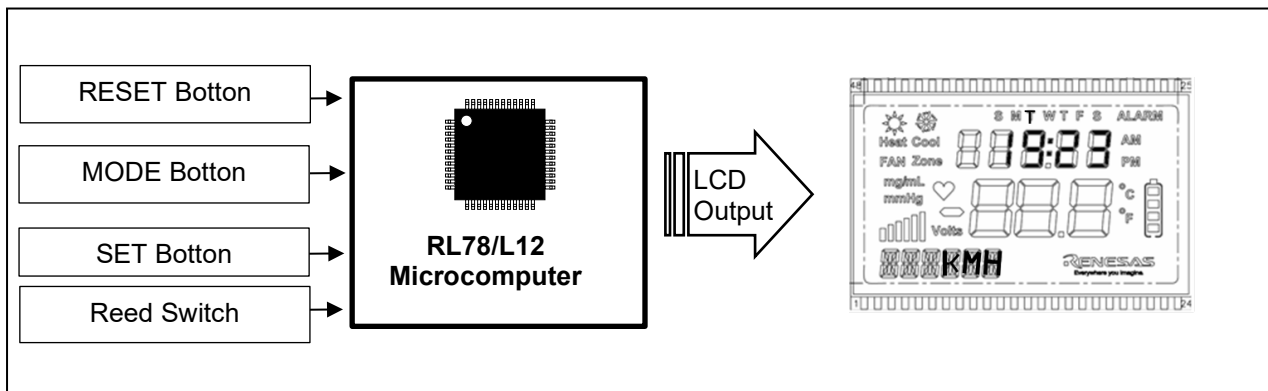


Figure 1.1 System Configuration Outline

1.1 Reed Switch

This application uses a reed switch to obtain the number of rotations of the wheel. When the magnetic field is created along the axis of the reed switch, both ends of the reed switch are electrically connected. The number of rotations of the wheel is measured by using this operation.

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	RL78/L12(R5F10RLC)
Operating frequencies	<ul style="list-style-type: none"> High-speed on-chip oscillator (HOCO) clock: 4MHz CPU/peripheral hardware clock: 4MHz
Operating voltage	3.3 V (operating range 1.6 V to 5.5V) LVD operation (V_{LVD}): At power on TYP. 1.67V (1.64V~1.70V) At power off TYP. 1.63V (1.60V~1.66V)
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)	e2studio V5.1.0.022 from Renesas Electronics Corp.
C compiler (e ² studio)	CC-RL V1.06.00 from Renesas Electronics Corp.
Board used	RSKRL78/L12 R0K5010RLC001BR
LCD module	RSK LCD APP V2 R0K0APPBDB030BE <ul style="list-style-type: none"> 48 pins, 176 segments 1/4 duty cycle 4COM 4.2 V operation, 1/3 bias Viewing direction 6 o'clock, reflective positive display

Caution: The code in this application note applies only to the RL78/L12 (64 pins: R5F10RLC).

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.

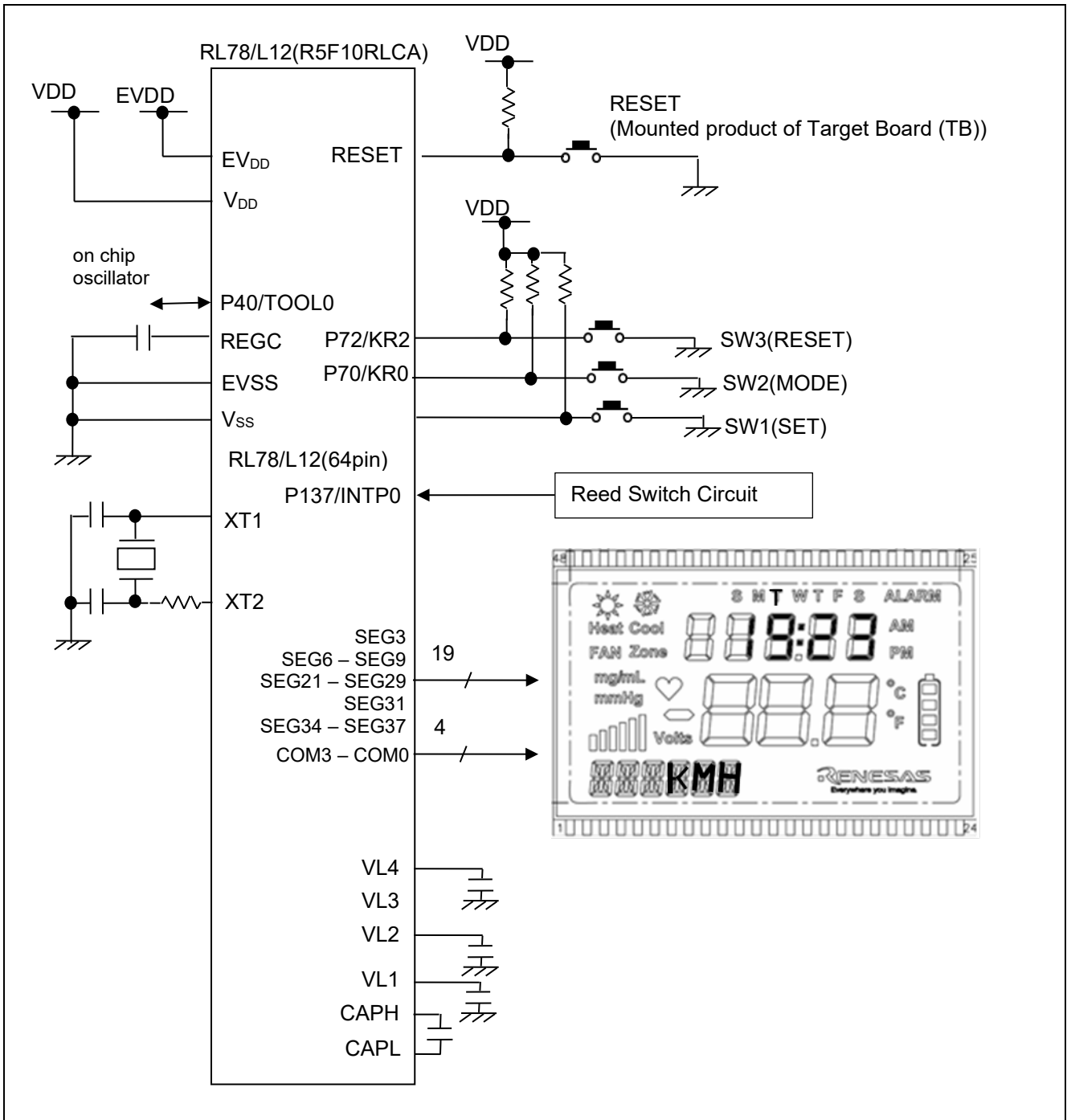


Figure 3.1 Hardware Configuration

Cautions:

1. The above figure is simplified to show an overview of the hardware connection. When designing and implementing an actual circuit, provide proper pin treatment and make sure that the hardware's electrical specifications are met (connect the input-only ports separately to V_{DD} or V_{SS} via a resistor).
2. V_{DD} must be held at not lower than the reset release voltage (V_{LVD}) that is specified as LVD.

Table 3.1 shows a list of pin connections of the RL78/L12 to the LCD module and the LCD module board.

Table 3.1 List of Pin Connections of RL78/L12 to LCD Module and LCD Module Board

LCD Module Pin No.	RL78/L12 Pin Name (Pin No.)	LCD Module Pin No.	RL78/L12 Pin Name (Pin No.)
14	SEG3 (41)	17	SEG6 (38)
18	SEG7 (37)	19	SEG8 (36)
20	SEG9 (35)	30	SEG21 (17)
31	SEG22 (4)	32	SEG23 (3)
33	SEG24 (2)	34	SEG25 (1)
35	SEG26 (64)	36	SEG27 (63)
37	SEG28 (62)	38	SEG31 (59)
41	SEG34 (56)	42	SEG35 (55)
43	SEG36 (54)	44	SEG37 (53)
48	SEG29 (61)		

Figure 3.2~Figure 3.4 shows the connection diagram for symbols and segment (SEG) pins.

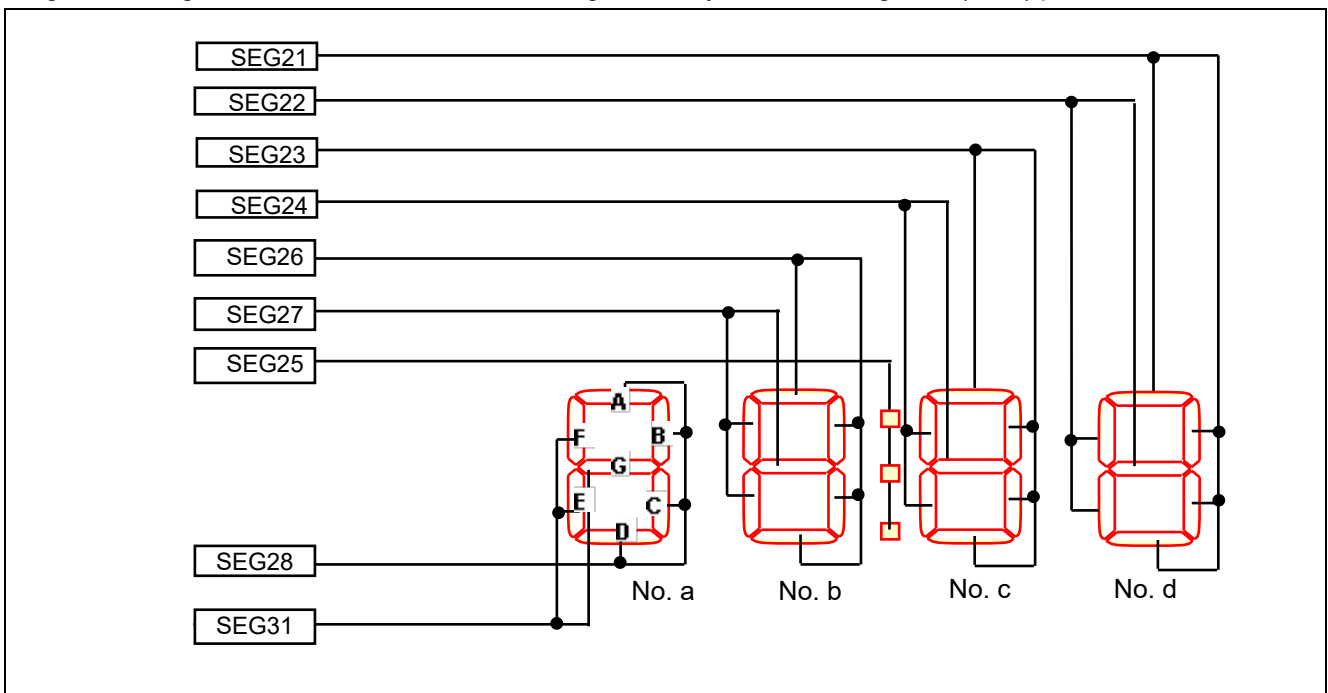


Figure 3.2 Connection Diagram for Common and Dot

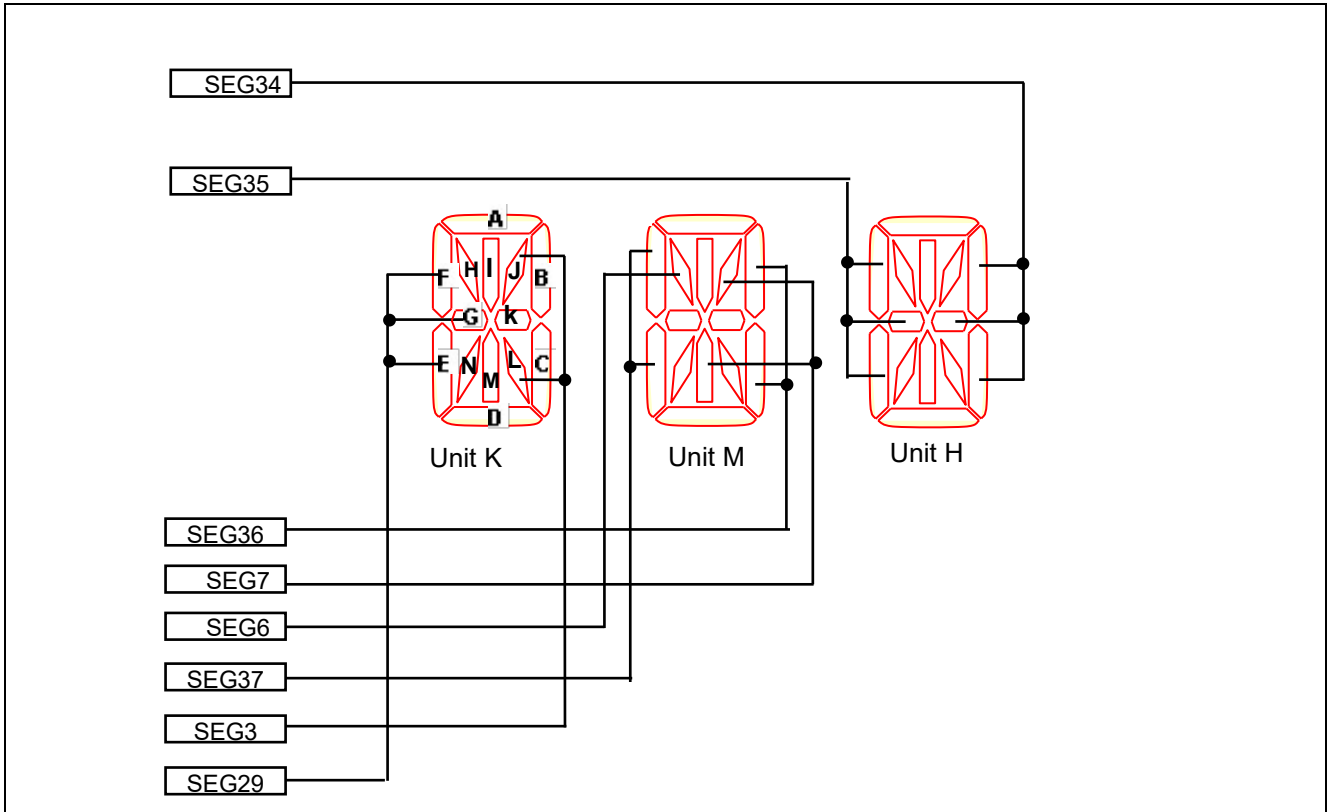


Figure 3.3 Connection Diagram for Unit (K,M,H) and Segment

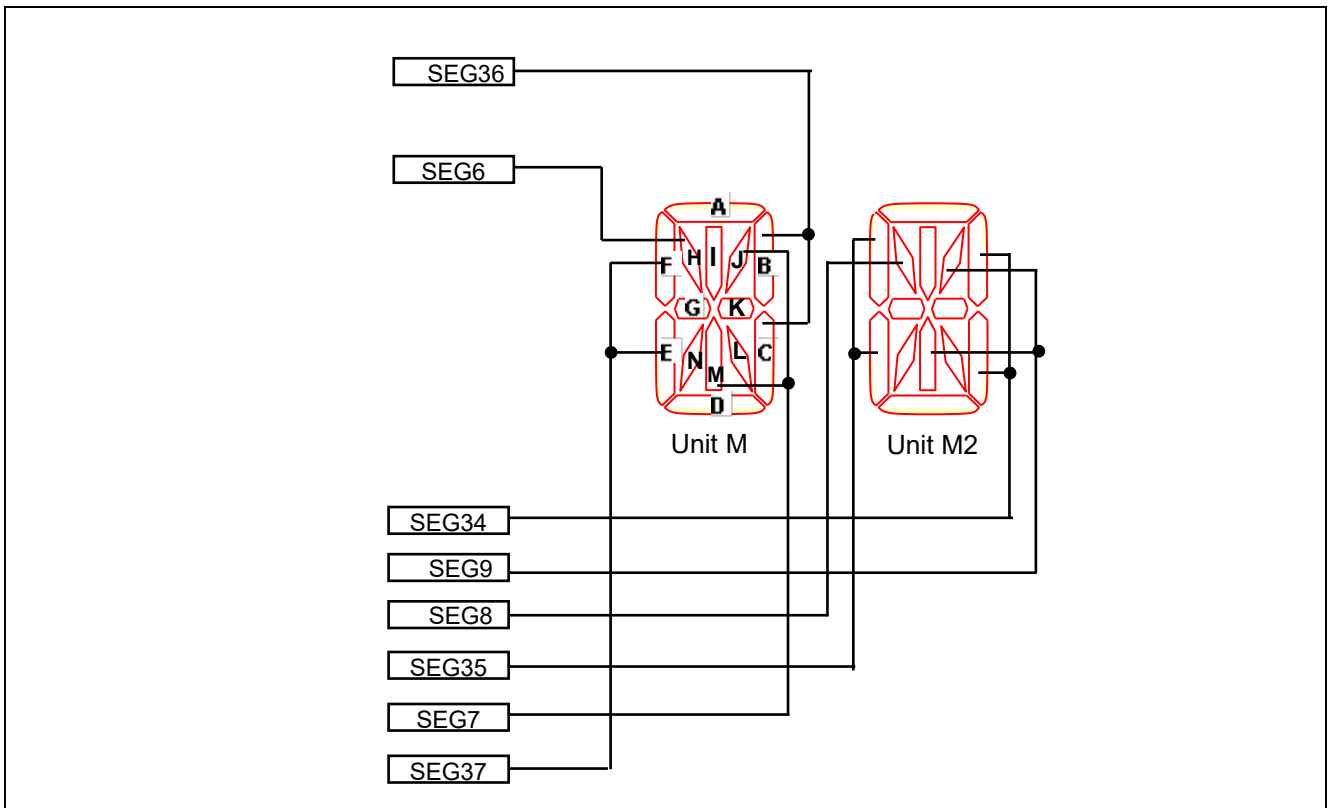


Figure 3.4 Connection Diagram for Unit (M,M2) and Segment

Note: The unit M in Figure3.3 and Figure3.4 is common.

Table 3.2 shows a list of correspondences between LCD display data segments (SEG) and common outputs (COM).

Table 3.2 List of Correspondences between LCD Display Data Segments (SEG) and Common Outputs (COM)

LCD Display Data Segment (SEG)	Address	COM3	COM2	COM1	COM0
		bit3	bit2	bit1	bit0
SEG3	F0403H	—	J of unit K	—	L of unit K
SEG6	F0406H	H of unit M	—	—	—
SEG7	F0407H	—	J of unit M	M of unit M	—
SEG8	F0408H	H of unit M2	—	—	—
SEG9	F0409H	—	J of M2	M of unit M2	—
SEG21	F0415H	A of No. d	B of No. d	C of No. d	D of No. d
SEG22	F0416H	F of No. d	G of No. d	E of No. d	—
SEG23	F0417H	A of No. c	B of No. c	C of No. c	D of No. c
SEG24	F0418H	F of No. c	G of No. c	E of No. c	—
SEG25	F0419H	Dot	colon	Riding time or Total travel distance display T	—
SEG26	F041AH	A of No. b	B of No. b	C of No. b	D of No. b
SEG27	F041BH	F of No. b	G of No. b	E of No. b	—
SEG28	F041CH	A of No. a	B of No. a	C of No. a	D of No. a
SEG29	F041DH	—	F of Unit K	G of Unit K	E of Unit K
SEG31	F041FH	F of No. a	G of No. a	E of No. a	—
SEG34	F0422H	—	B of Unit H, B of Unit M2	K of Unit H	C of Unit H, C of Unit M2
SEG35	F0423H	—	F of Unit H, F of Unit M2	G of Unit H	E of Unit H, E of Unit M2
SEG36	F0424H	—	B of Unit M	—	C of Unit M
SEG37	F0425H	—	F of Unit M	—	E of Unit M

Note —: Not used in this application.

Table 3.3 show register settings for time display data.

Table 3.3 Register Settings for time Display Data

No. a	Register Setting							
	SEG31 (F041FH)				SEG28 (F041CH)			
No. b	SEG26 (F041AH)				SEG27 (F041BH)			
No. c	SEG23 (F0417H)				SEG24 (F0418H)			
No. d	SEG21 (F0415H)				SEG22 (F0416H)			
Bit position	bit3	bit2	bit1	bit0	bit3	bit2	bit1	bit0
Segment	A	B	C	D	F	G	E	0
0 display	1	1	1	1	1	0	1	0
1 display	0	1	1	0	0	0	0	0
2 display	1	1	0	1	0	1	1	0
3 display	1	1	1	1	0	1	0	0
4 display	0	1	1	0	1	1	0	0
5 display	1	0	1	1	1	1	0	0
6 display	1	0	1	1	1	1	1	0
7 display	1	1	1	0	1	0	0	0
8 display	1	1	1	1	1	1	1	0
9 display	1	1	1	1	1	1	0	0

3.2 List of Pins to be Used

Table 3.4 lists the pins to be used and their functions.

Table 3.4 Pins to be Used and Their Functions

Pin Name and Function	Input/Output	Description
P71/KR1	Input	Detects depression of the SET button.
P70/KR0	Input	Detects depression of the MODE button.
P72/KR2	Input	Detects depression of the RESET button.
P137/INTP0	Input	Receives the signal from the reed switch circuit.
P40/TOOL0	Input	For on-chip debugging
SEG3, SEG31, SEG29 SEG6 to SEG9 SEG21 to SEG28 SEG34 to SEG37	Output	Segment signals for the LCD controller/driver
COM0 to COM3	Output	Common signals for the LCD controller/driver

4. Description of the Software

4.1 Operation Outline

This application uses: the reed switch to obtain the number of rotations of the wheel; the controller/driver to display clock, riding time, speed, travel distance, and total travel distance; the interrupt to detect depression of the buttons; and the interval timer to prevent chattering caused by button depression.

4.2 List of Option Byte Settings

Table 4.1 shows the option byte settings.

Table 4.1 Option Byte Settings

Address	Setting	Description
000C0H/010C0H	11101111B	Disables the watchdog timer. (Stops counting after the release from the reset state.)
000C1H/010C1H	00011111B	LVD detection voltage(V_{LVD}) TYP. 1.67V (1.64V~1.70V)at fall TYP. 1.63V (1.60V~1.66V)at rise
000C2H/010C2H	00101011B	LV mode, HOCO: 4MHz
000C3H/010C3H	10000100B	Enables the on-chip debugger.

4.3 List of Constants

Table 4.2 lists the constants that are used in this sample program.

Table 4.2 Constants for the Sample Program (1/2)

定数名	設定値	内容
LCD_DATA_NONE	0x0000	LCD no display data
LCD_DATA_0	0x0A0F	LCD display data (0)
LCD_DATA_1	0x0006	LCD display data (1)
LCD_DATA_2	0x060D	LCD display data (2)
LCD_DATA_3	0x040F	LCD display data (3)
LCD_DATA_4	0x0C06	LCD display data (4)
LCD_DATA_5	0x0C0B	LCD display data (5)
LCD_DATA_6	0x0E0B	LCD display data (6)
LCD_DATA_7	0x080E	LCD display data (7)
LCD_DATA_8	0x0E0F	LCD display data (8)
LCD_DATA_9	0x0C0F	LCD display data (9)
LCD_DATA_COLON	0x02	LCD display data (:)
LCD_NUM_DATA_FONT_COUNT	0x0C	LCD display data number
LCD_DATA_NONE_INDEX	0x0A	LCD index of display data (none)
LCD_DATA_COLON_INDEX	0x0B	LCD index of display data (colon)
TIME_HOUR_MAX	0x24U	Maximum count value of the clock's hours
TIME_MINUTE_MAX	0x60U	Maximum count value of the clock's minutes
DECIMAL_BCD_MAX	0x10U	Maximum every value of wheel circumference
PRESS_NO	1U	Button not pressed
PRESS	0U	Button pressed
KEY_SET	P7_bit.no1	SET Button
KEY_MODE	P7_bit.no0	MODE Button

Table 4.3 Constants for the Sample Program (2/2)

KEY_RESET	P7_bit.no2	RESET Button
SET_COUNT_MAX	7U	Maximum number of times SET button is pressed
MODE_COUNT_MAX	5U	Maximum number of times MODE button is pressed
TEN_SECOND_COUNT	30U	300s count value
SWITCH_ALL_OFF	0x00	Button not pressed
SET_SWITCH_ON	0x01	SET button is pressed
MODE_SWITCH_ON	0x02	MODE button is pressed
LCD_POSITION_HOUR_HIGH_ABCD_S YMBOL	&SEG28	LCD display data-address (No. a: A, B, C, D)
LCD_POSITION_HOUR_HIGH_EFG_SY MBOL	&SEG31	LCD display data-address (No. a: E, F, G)
LCD_POSITION_HOUR_LOW_ABCD_SY MBOL	&SEG26	LCD display data-address (No. b: A, B, C, D)
LCD_POSITION_HOUR_LOW_EFG_SYN MBOL	&SEG27	LCD display data-address (No. b: E, F, G)
LCD_POSITION_COLON	&SEG25	LCD display data-address (:)
LCD_POSITION_MINUTE_HIGH_ABCD_ SYMBOL	&SEG23	LCD display data-address (No. c: A, B, C, D)
LCD_POSITION_MINUTE_HIGH_EFG_S YMBOL	&SEG24	LCD display data-address (No. c: E, F, G)
LCD_POSITION_MINUTE_LOW_ABCD_ SYMBOL	&SEG21	LCD display data-address (No. d: A, B, C, D)
LCD_POSITION_MINUTE_LOW_EFG_S YMBOL	&SEG22	LCD display data-address (No. d: E, F, G)
LCD_POSITION_UNIT_M2_H_SYMBOL	&SEG8	LCD display data-address (H of Unit M2)
LCD_POSITION_UNIT_M2_JM_SYMBOL	&SEG9	LCD display data-address (J, M of Unit M2)
LCD_POSITION_UNIT_M2_BC_SYMBOL	&SEG34	LCD display data-address (B, C of Unit M2)
LCD_POSITION_UNIT_M2_EF_SYMBOL	&SEG35	LCD display data-address (E, F of Unit M2)
LCD_POSITION_UNIT_K_JL_SYMBOL	&SEG3	LCD display data-address (J, L of Unit K)
LCD_POSITION_UNIT_K_EFG_SYMBOL	&SEG29	LCD display data-address (E, F, G of Unit K)
LCD_POSITION_UNIT_M_H_SYMBOL	&SEG6	LCD display data-address (H of Unit M)
LCD_POSITION_UNIT_M_JM_SYMBOL	&SEG7	LCD display data-address (J, M of Unit M)
LCD_POSITION_UNIT_M_BC_SYMBOL	&SEG36	LCD display data-address (B, C of Unit M)
LCD_POSITION_UNIT_M_EF_SYMBOL	&SEG37	LCD display data-address (E, F of Unit M)
LCD_POSITION_UNIT_H_BCK_SYMBOL	&SEG34	LCD display data-address (B, C, K of Unit H)
LCD_POSITION_UNIT_H_EFG_SYMBOL	&SEG35	LCD display data-address (E, F, G of Unit H)

4.4 List of Variables

Table 4.4 lists the static variables that are used in this sample program.

Table 4.4 static Variables

Type	Variable Name	Description	Function Used
uint8_t	g_switch_status	Button depression state	main()
uint16_t	g_FontData[]	LCD data	main()
uint32_t	g_wheel_size	Wheel circumference	main()
uint32_t	g_wheel_count.current_count	Number of rotations of a wheel	main()
uint32_t	g_interval_time	Current time	main()
uint32_t	g_total_time	Riding time	main()
uint32_t	g_total_hour	Hours of riding time	main()
uint32_t	g_total_minute	Minutes of riding time	main()
uint32_t	g_SPD	Speed	main()
uint16_t	g_DST	Travel distance	main()
uint16_t	g_ODO	Total mileage	main()
uint8_t	g_hour	Hour of clock	main()
uint8_t	g_minute	Minute of clock	main()
uint8_t	g_sys_flag.Bit.set_flag	SET button depression flag	main()
uint8_t	set_switch	SET button state	main()
uint8_t	mode_switch	MODE button state	main()
uint16_t	wheel_size_thousand	Thousands place of wheel circumference	main()
uint16_t	wheel_size_hundred	Hundreds place of wheel circumference	main()
uint16_t	wheel_size_ten	Tens place of wheel circumference	main()
uint16_t	wheel_size_one	Ones place of wheel circumference	main()

4.5 List of Functions (Subroutines)

Table 4.5 summarizes the functions (subroutines) that are used in this sample program.

Table 4.5 Functions (Subroutines)

Function (subroutine) Name	Description
R_MAIN_UserInit ^{Note}	Initializes the user application.
R_LCD_Set_VoltageOn1 ^{Note}	Starts LCD step-up circuit operation.
R_LCD_Start ^{Note}	Enables display on LCD.
R_LCD_Stop ^{Note}	Stops display on LCD.
R_MAIN_GetSwitchStatus	Obtains the button depression state.
R_INTC0_Start ^{Note}	Starts the external interrupt.
R_KEY_Start ^{Note}	Starts the key interrupt.
R_RTC_Set_ConstPeriodInterruptOn ^{Note}	Obtains the RTC count value.
r_rtc_operation_start ^{Noet}	Starts RTC operation.
R_MAIN_LcdDisplayTime	Displays the clock.
R_MAIN_LcdDisplayTotalTime	Displays the riding time.
R_MAIN_LcdDisplaySPD	Displays the speed.
R_MAIN_LcdDisplayDST	Displays the travel distance.
R_MAIN_LcdDisplayODO	Displays the total travel distance.
R_MAIN_LcdHourBlink	Blinks the hour of clock.
R_MAIN_LcdMinuteBlink	Blinks the munit of clock.
R_MAIN_LcdLengthThousandBlink	Blinks the wheel circumference (thousands place).
R_MAIN_LcdLengthHundredBlink	Blinks the wheel circumference (hundreds place).
R_MAIN_LcdLengthTenBlink	Blinks the wheel circumference (tens place).
R_MAIN_LcdLengthOneBlink	Blinks the wheel circumference (ones place).
R_MAIN_Delay1ms	Prevents chattering.
r_main_seg_data_set	Sets segment data.
r_main_bcd_inc	Processes BCD data addition.
R_TAU0_Channel0_Start	Starts timer array unit channel 0.
R_TAU0_Channel1_Start	Starts timer array unit channel 1.
R_TAU0_Channel0_Stop	Stops timer array unit channel 0.
r_intc0_interrupt	Processes the external interrupt (INTP0).
r_tau0_channel0_interrupt	Processes the timer array unit channel 0 interrupt (1s).
r_tau0_channel1_interrupt	Processes the timer array unit channel 1 interrupt (1s).

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

4.6 Function Specifications

The following tables list the sample code function specifications.

[Function Name] R_MAIN_UserInit	
Outline	User application initialization
Header	r_cg_macrodriver.h r_cg_userdefine.h
Declaration	void R_MAIN_UserInit(void)
Description	Initializes the peripheral functions necessary for using application.
Arguments	None
Return Value	None
Remarks	None

[Function Name] R_LCD_Set_VoltageOn1	
Outline	LCD step-up circuit operation start processing
Header	r_cg_macrodriver.h r_cg_lcd.h r_cg_userdefine.h
Declaration	void R_LCD_Set_VoltageOn1(void)
Description	Starts LCD step-up circuit operation (VLCON = 1).
Arguments	None
Return Value	None
Remarks	None

[Function Name] R_LCD_Start	
Outline	LCD display enable processing
Header	r_cg_macrodriver.h r_cg_lcd.h r_cg_userdefine.h
Declaration	void R_LCD_Start (void)
Description	Enables LCD display (LCDON = 1).
Arguments	None
Return Value	None
Remarks	None

[Function Name] R_LCD_Stop	
Outline	LCD display stop processing
Header	r_cg_macrodriver.h r_cg_lcd.h r_cg_userdefine.h
Declaration	void R_LCD_Stop(void)
Description	Stops LCD display.
Arguments	None
Return Value	None
Remarks	None

[Function name] R_INTC0_Start	
Outline	Interrupt start
Header	r_cg_macrodriver.h r_cg_intc.h r_cg_userdefine.h
Declaration	void R_INTC0_Start (void)
Description	Enable interrupt start
Arguments	None
Return Value	None
Remarks	None

[Function Name] R_KEY_Start	
Outline	Key interrupt start
Header	r_cg_macrodriver.h r_cg_intc.h r_cg_userdefine.h
Declaration	void R_KEY_Start (void)
Description	Enable key interrupt start
Arguments	None
Return Value	None
Remarks	None

[Function Name] R_RTC_Set_ConstPeriodInterruptOn	
Outline	Get real time data
Header	r_cg_macrodriver.h r_cg_rtc.h r_cg_userdefine.h
Declaration	void R_RTC_Set_ConstPeriodInterruptOn (void)
Description	Get real time data
Arguments	None
Return Value	None
Remarks	None

[Function Name] r_rtc_operation_start	
Outline	Real time operation start
Header	r_cg_macrodriver.h r_cg_rtc.h r_cg_userdefine.h
Declaration	void r_rtc_operation_start (void)
Description	Real time operation start
Arguments	None
Return Value	None
Remarks	None

[Function Name] r_tau0_channel0_interrupt	
Outline	Timer interrupt
Header	r_cg_macrodriver.h r_cg_timer.h r_cg_userdefine.h
Declaration	void r_tau0_channel0_interrupt(void)
Description	Timer array unit channel 0 interrupt
Arguments	None

Return Value	None
Remarks	None

[Function Name] r_tau0_channel1_interrupt	
Outline	Timer array unit channel 1 interrupt
Header	r_cg_macrodriver.h r_cg_timer.h r_cg_userdefine.h
Declaration	void r_tau0_channel1_interrupt(void)
Description	Timer array unit channel 1 interrupt
Arguments	None
Return Value	None
Remarks	None

[Function Name] main	
Outline	Main function
Header	—
Declaration	Main processing function for the sample codes
Description	None
Arguments	None
Return Value	None

4.7 Flowcharts

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

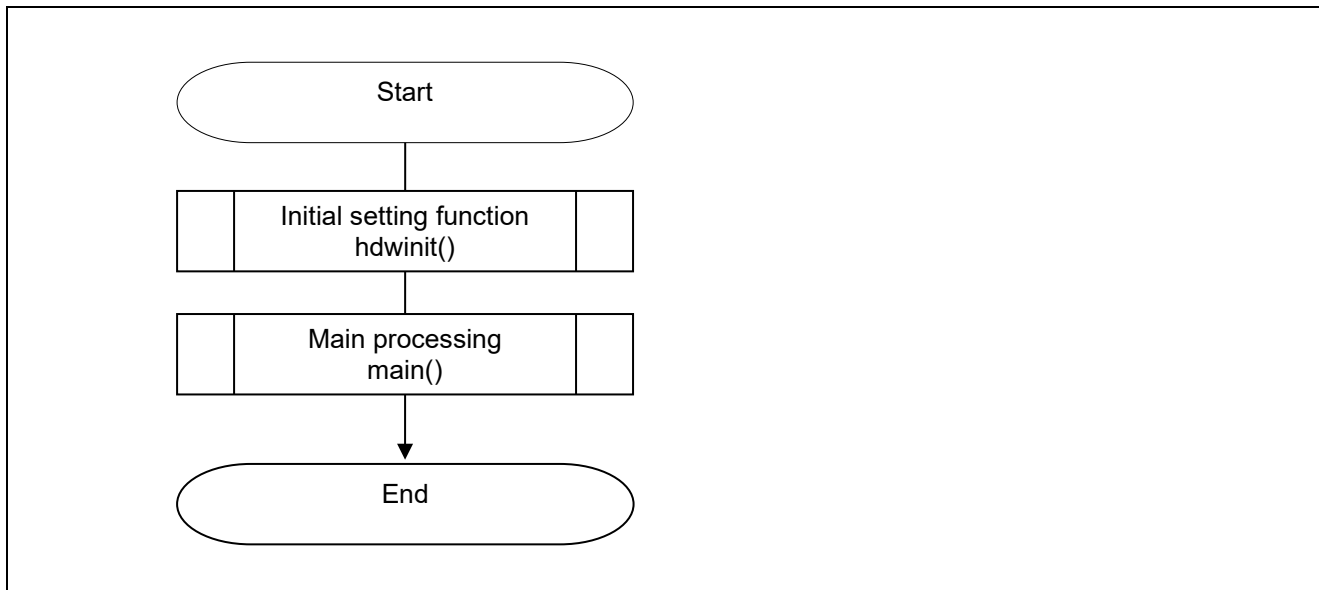


Figure 4.1 the hardware configuration used for this application

4.7.1 Initial Setting Function

Figure 4.2 shows the flowchart of the initial setting function.

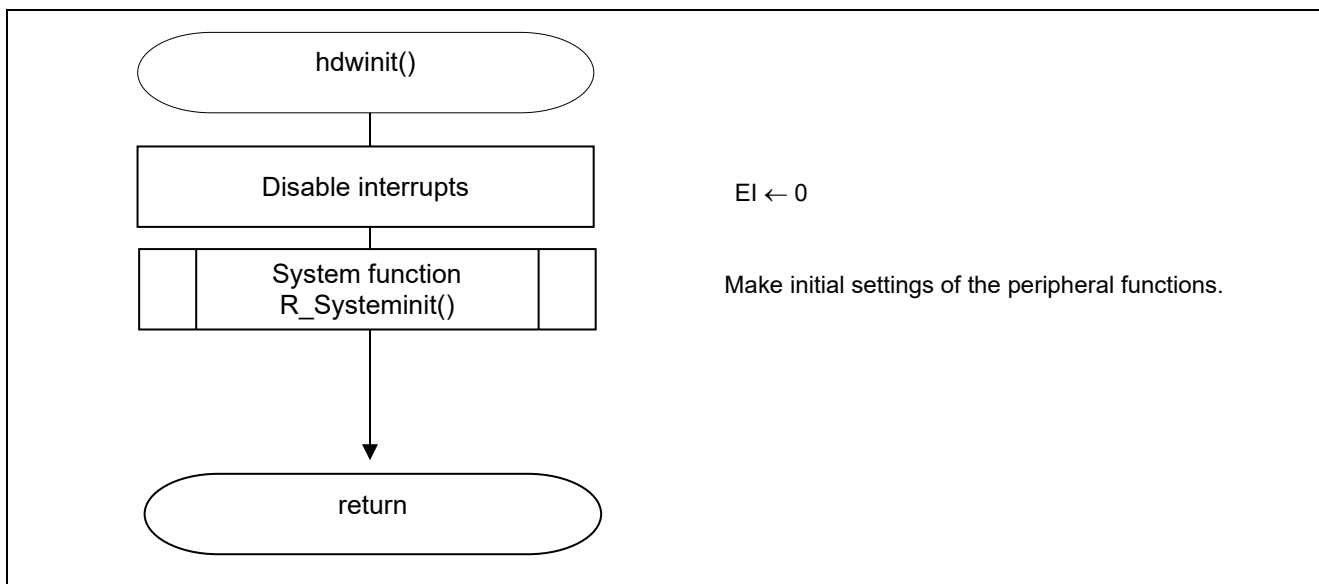


Figure 4.2 Initial Setting Function

4.7.2 System Function

Figure 4.3 shows the flowchart of the system function.

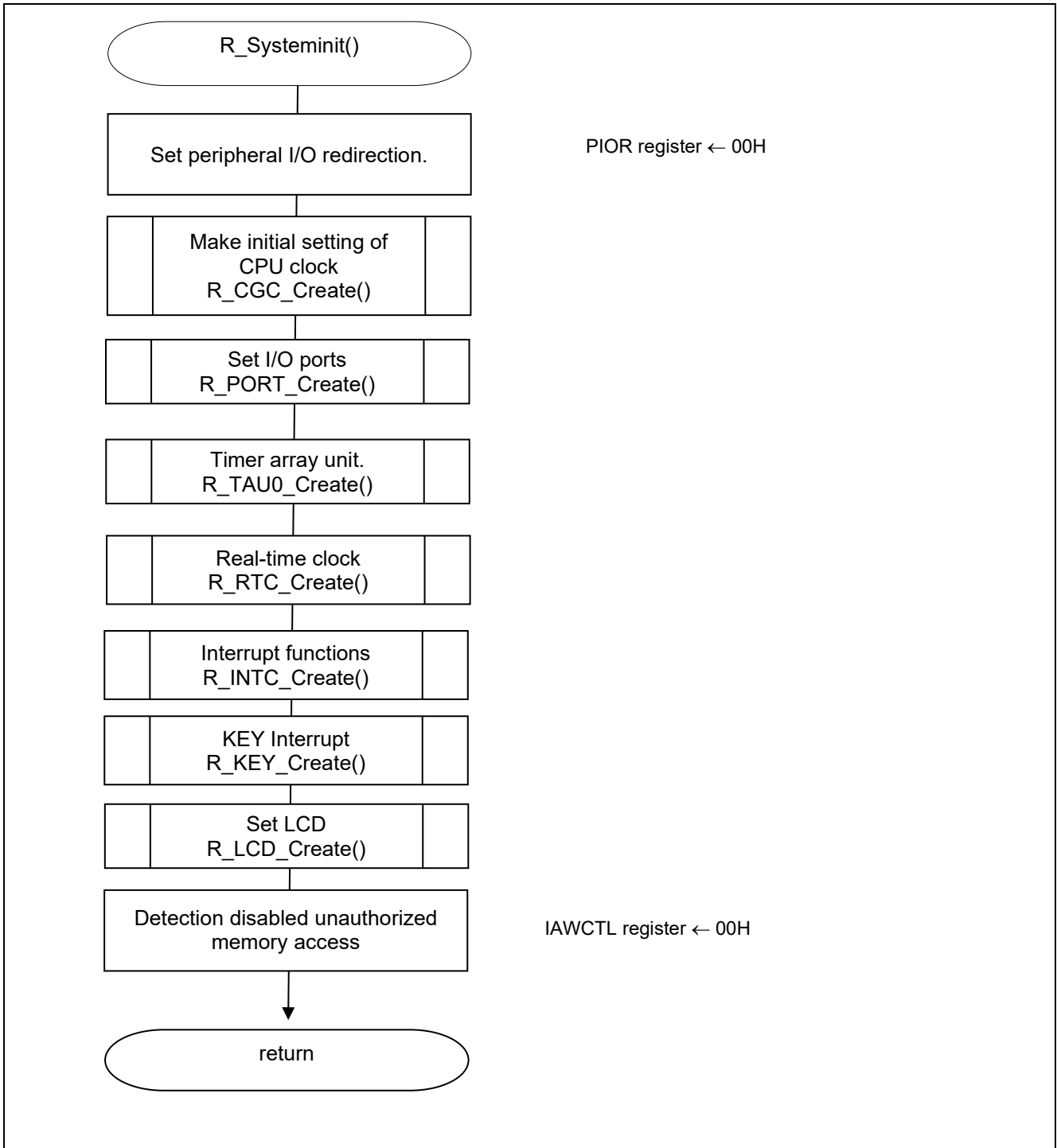


Figure 4.3 System Function

4.7.3 CPU clock Setting

Figure 4.4 shows the flowchart for the CPU clock setting.

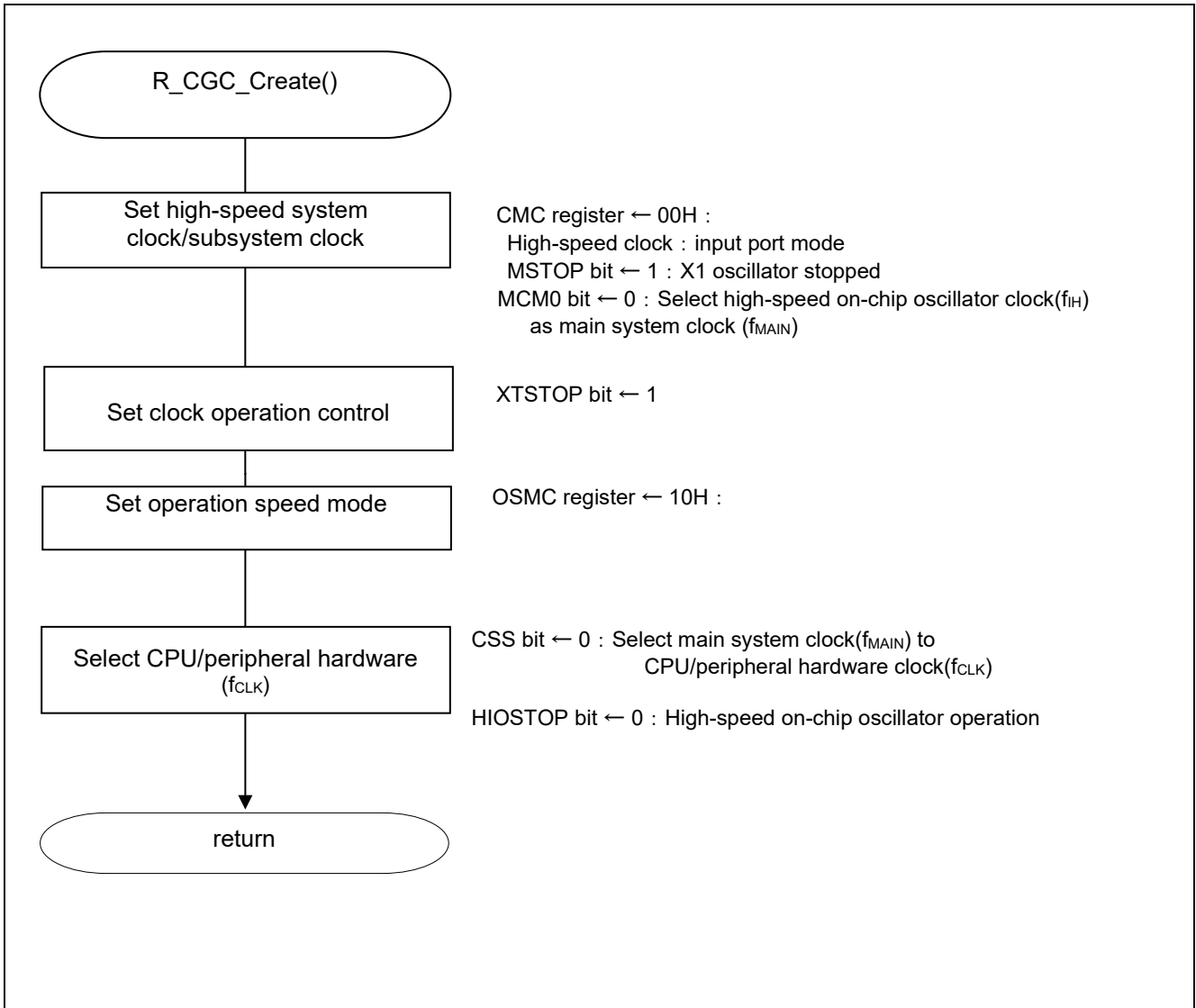


Figure 4.4 the CPU clock setting

4.7.4 I/O Port Setup

Figure 4.5 shows the flowchart for setting up the I/O ports.

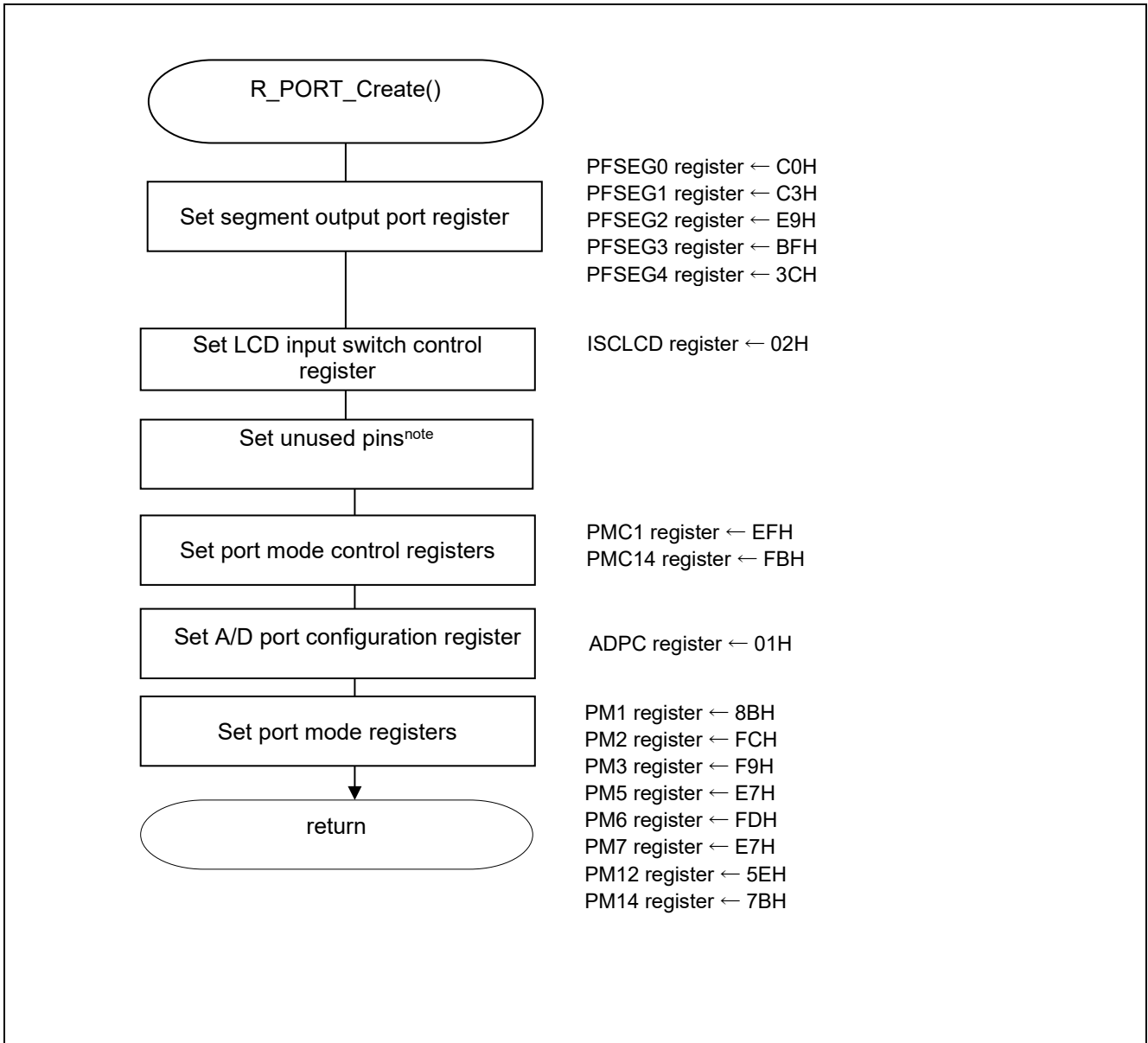


Figure 4.5 I/O Port Setup

Notes: 1. For details on register setting when using the ports as the alternate functions of the peripheral functions, refer to the RL78/L12 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 VDD or VSS via a separate resistor.

4.7.5 Timer array unit

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

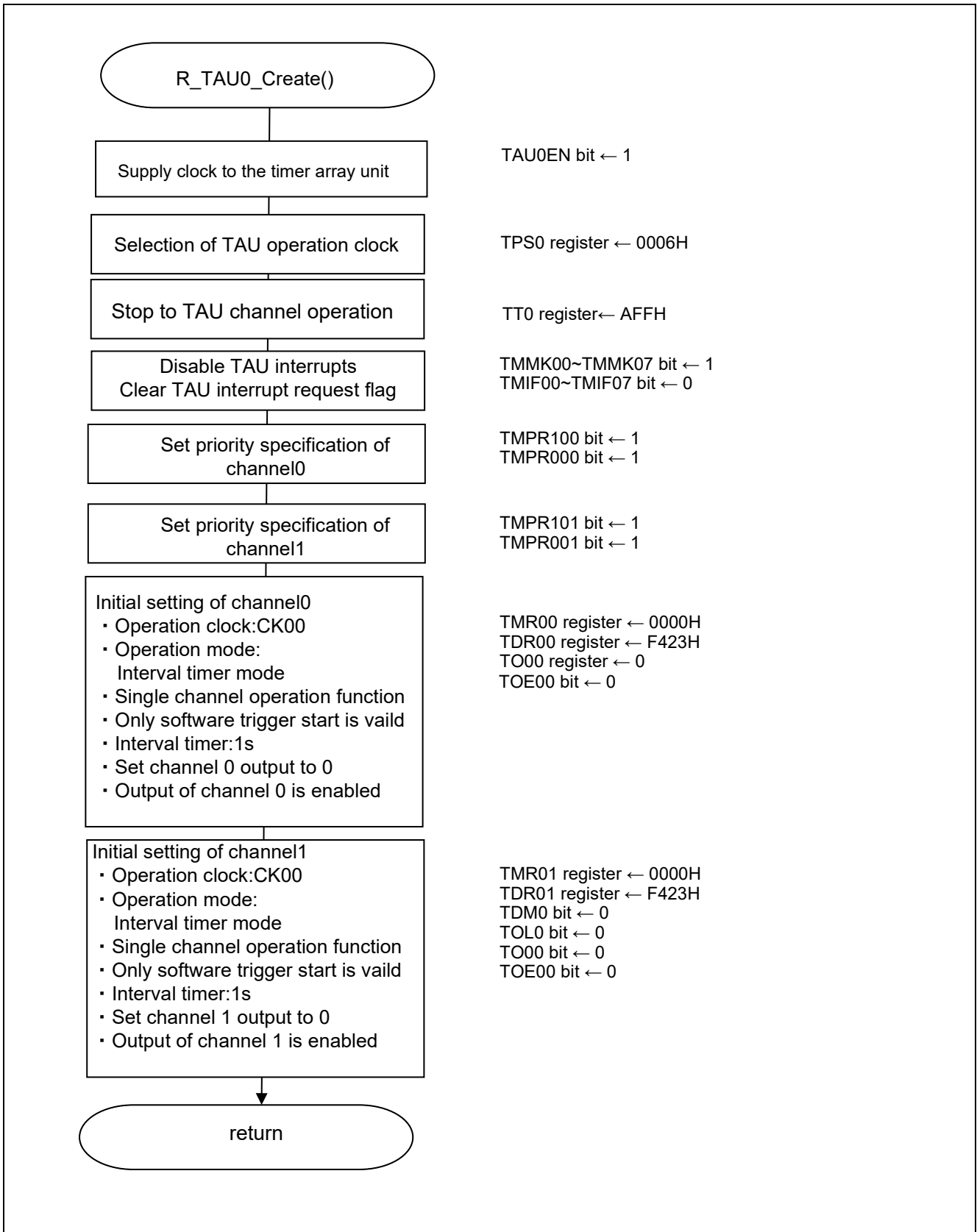


Figure 4.6 setting up the timer array unit

4.7.6 Real-Time Clock

Figure 4.7 shows the flowchart for setting up the real-time clock.

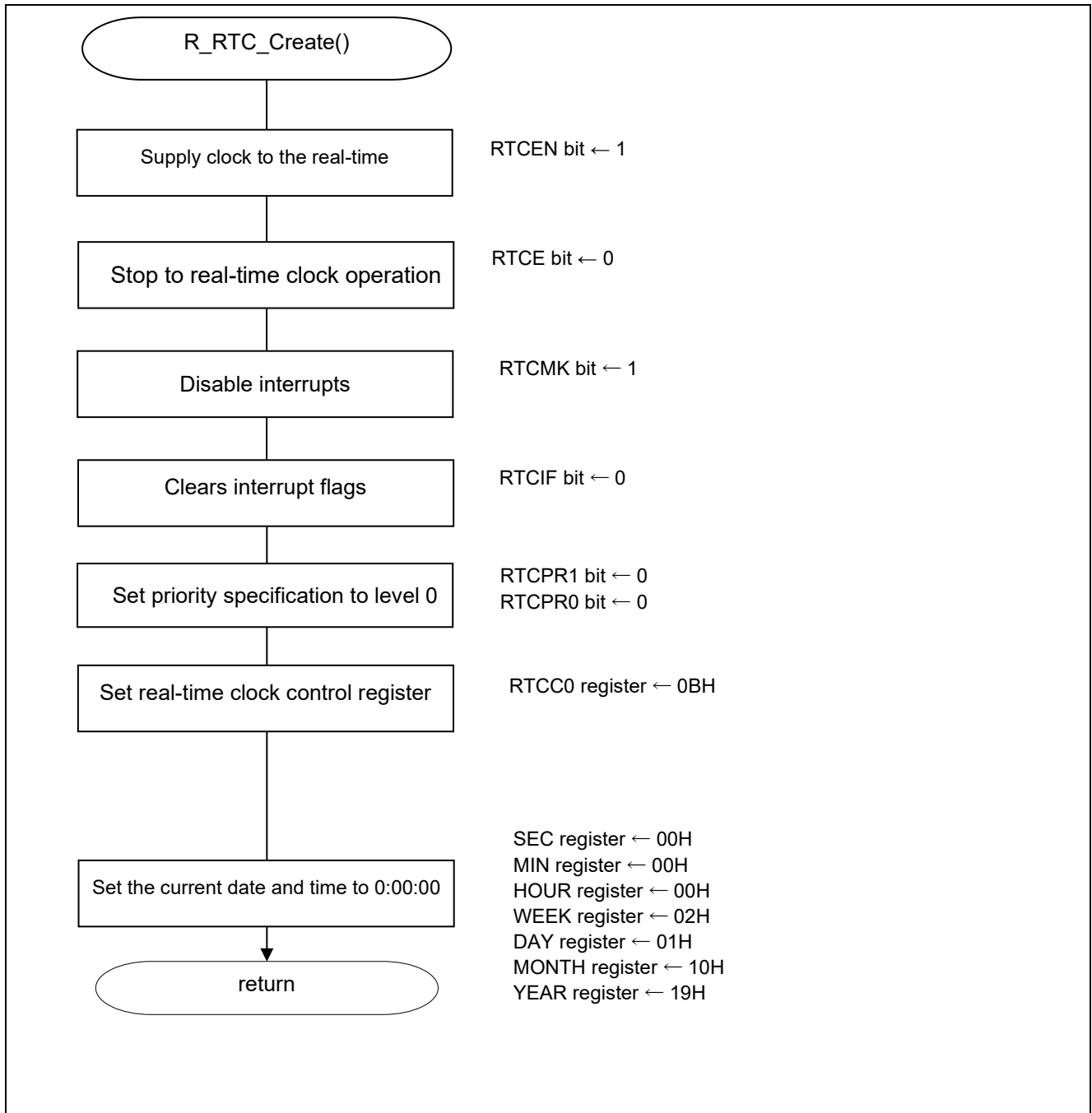


Figure 4.7 setting up the real-time clock

4.7.7 Interrupt setting

Figure 4.8 shows the flowchart for setting up the Interrupt.

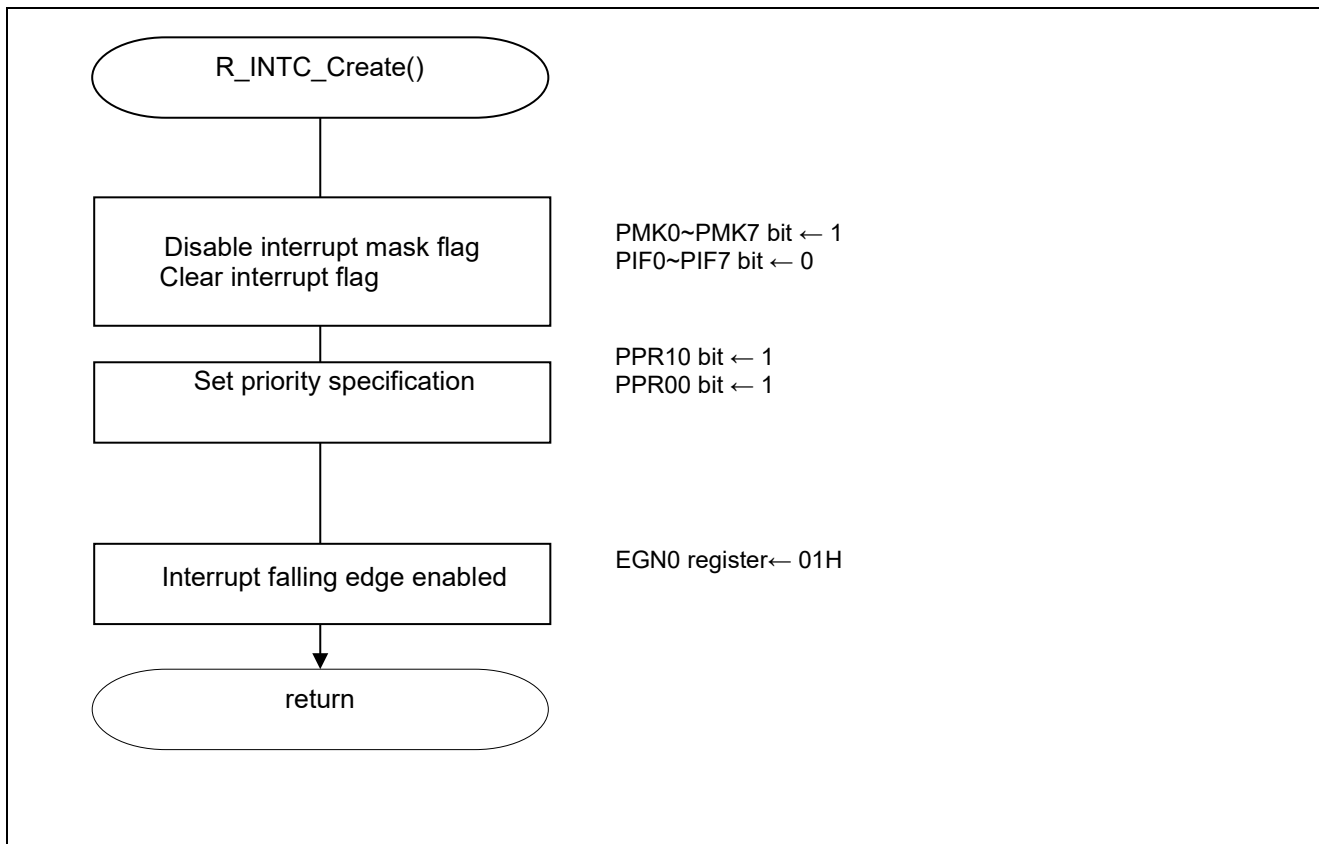


Figure 4.8 Interrupt setting

4.7.8 Key Interrupt setting

Figure 4.9 shows the flowchart for setting up the Key Interrupt.

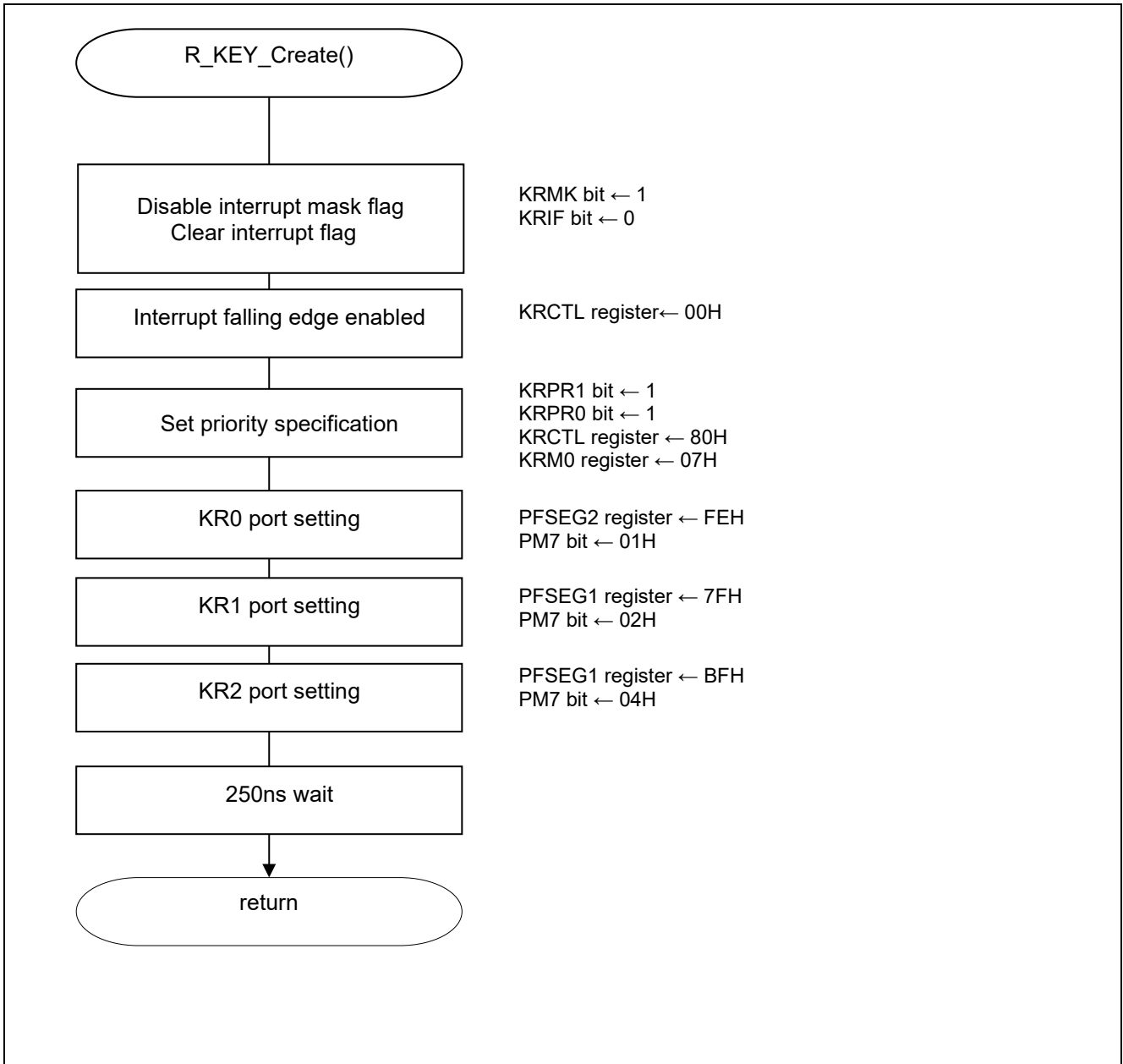


Figure 4.9 Key Interrupt setting

4.7.9 LCD Controller/Driver Setting

Figure 4.10, Figure 4.11 show the flowcharts for setting the LCD controller/driver.

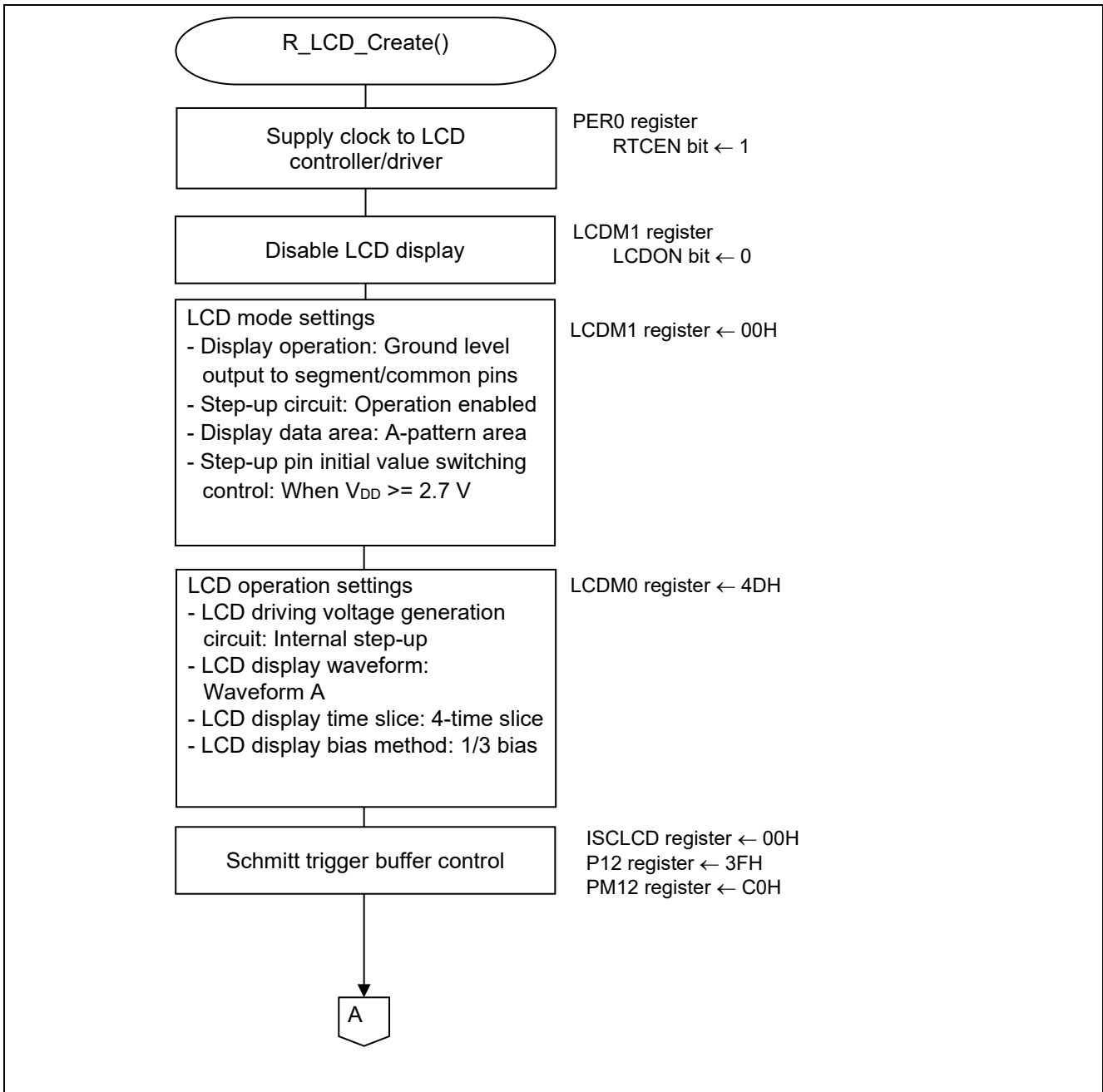


Figure 4.10 LCD Controller/Driver Setting (1/2)

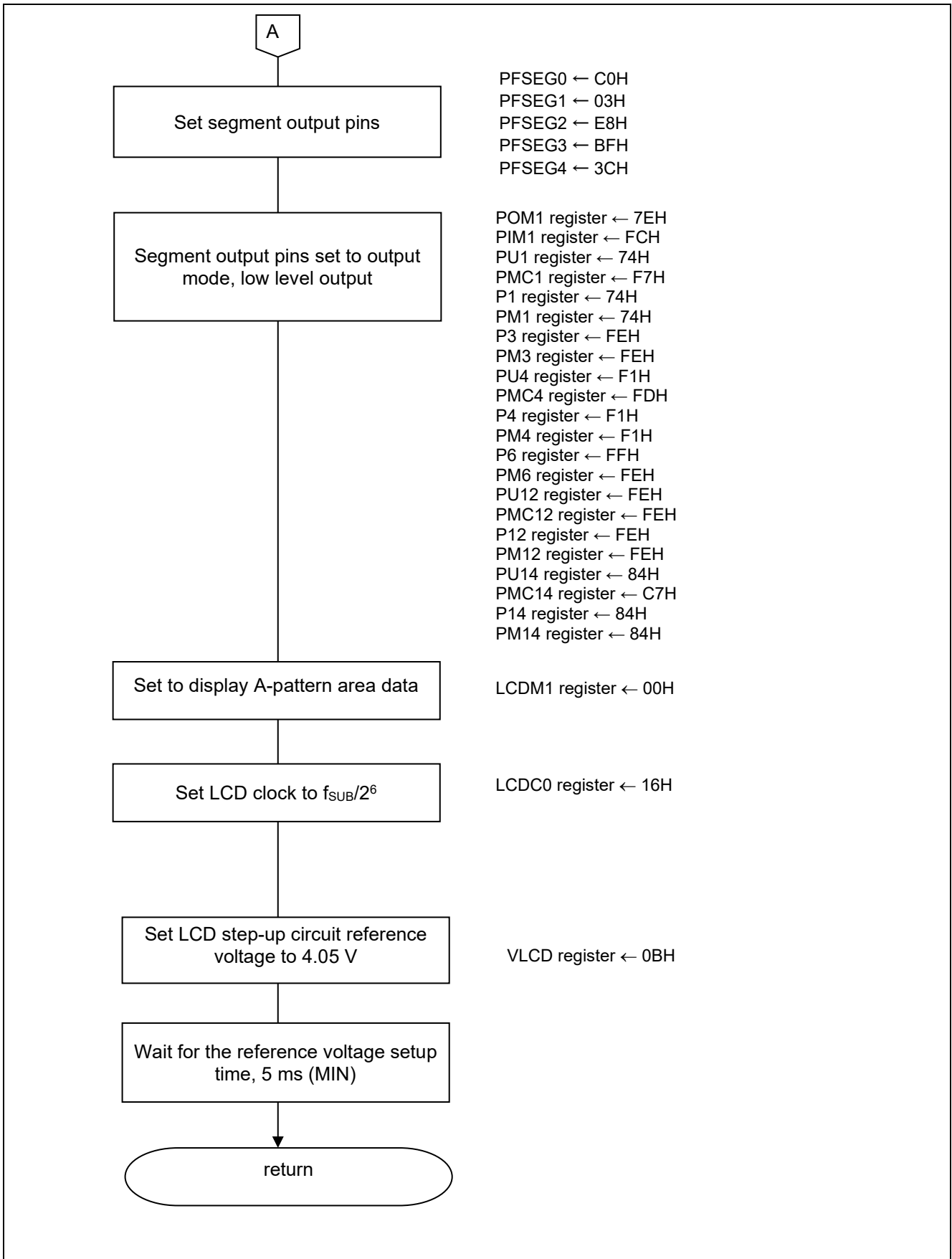


Figure 4.11 LCD Controller/Driver Setting (2/2)

4.7.10 Main Processing

Figure 4.12 shows the flowchart for the main processing.

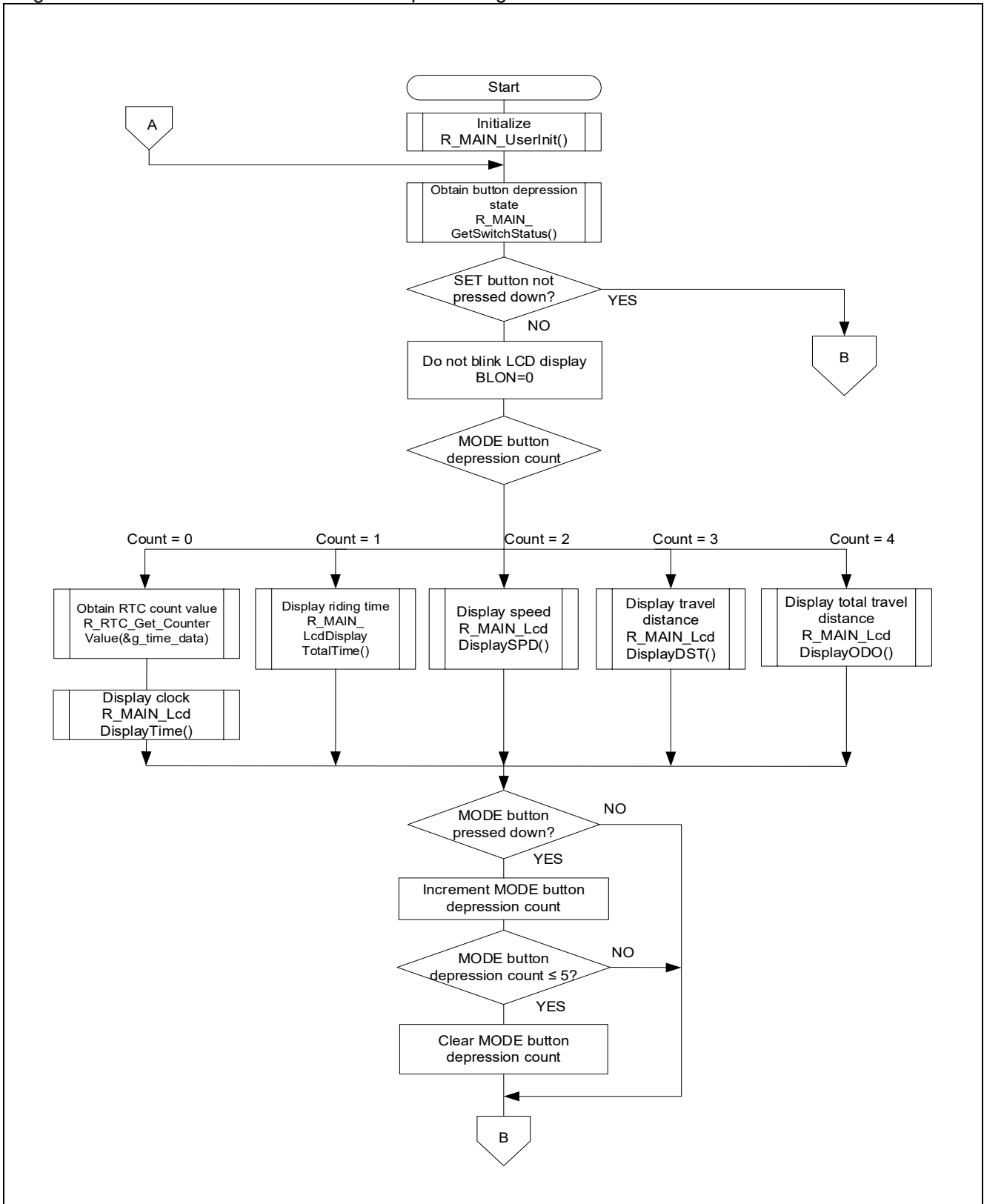


Figure 4.12 Main Processing(1/3)

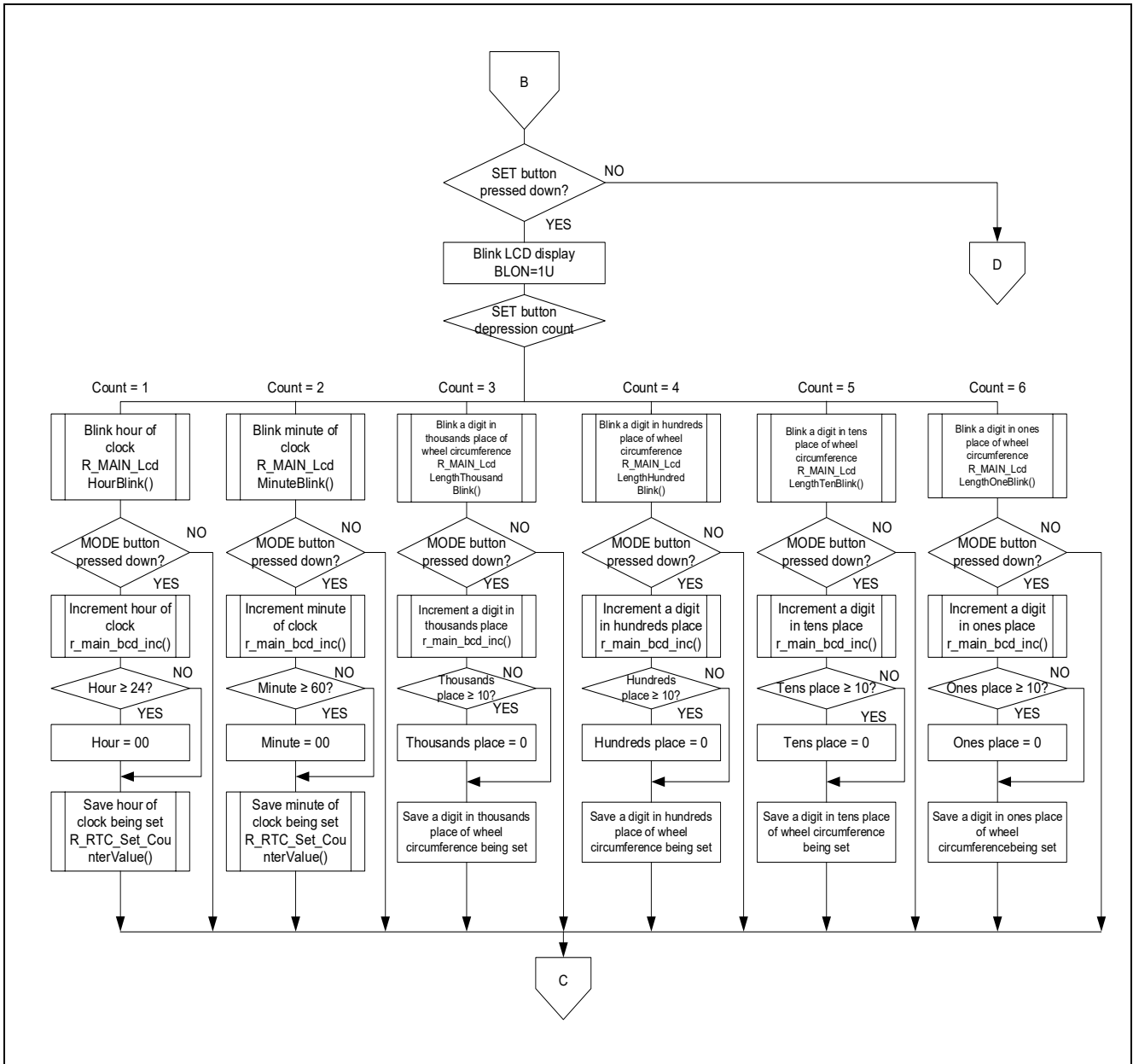


Figure 4.13 Main Processing (2/3)

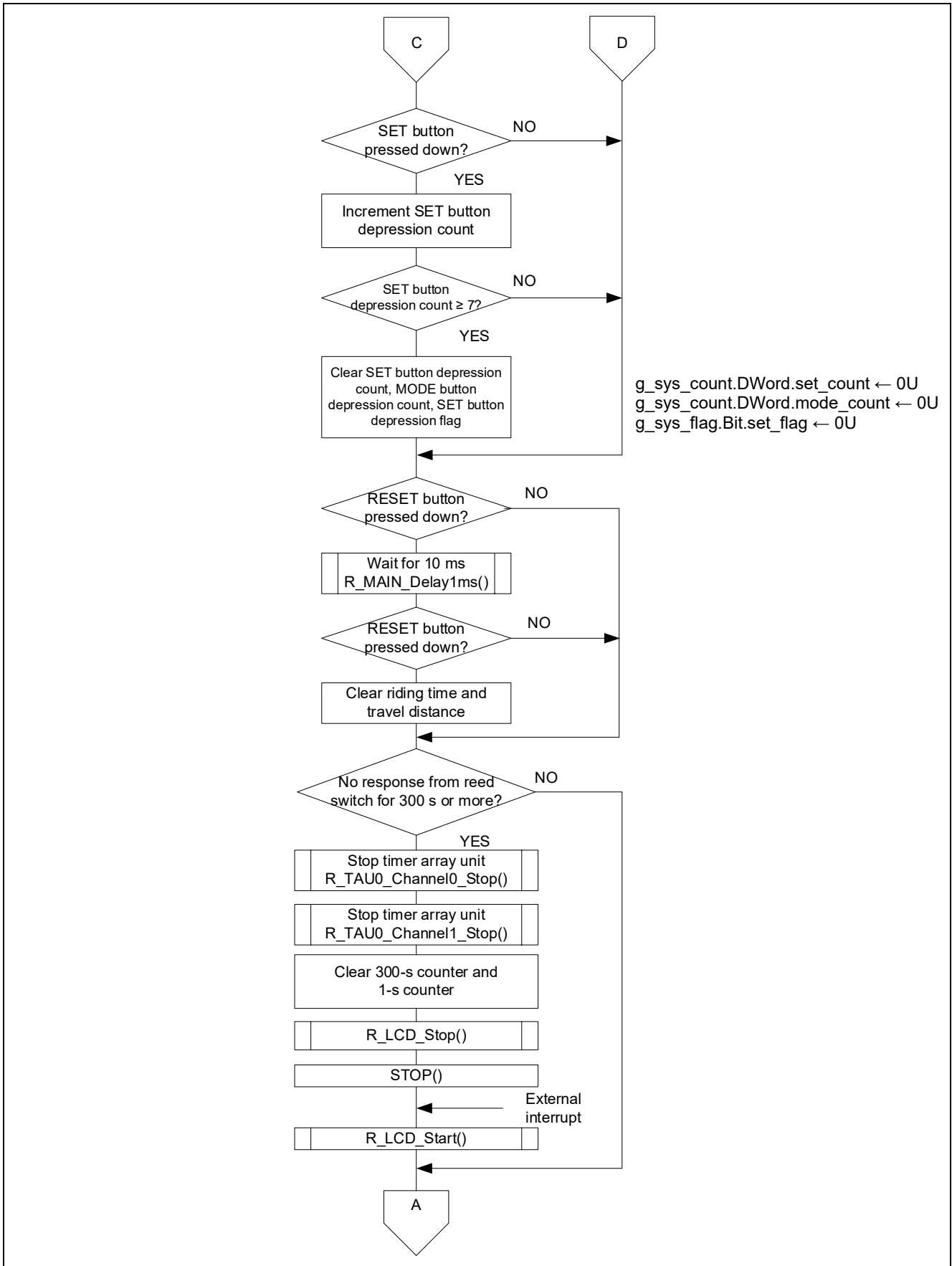


Figure 4.14 Main Processing (3/3)

4.7.11 LCD Initialization Display Setting

Figure 4.15 shows the flowchart for setting the LCD initialization display.

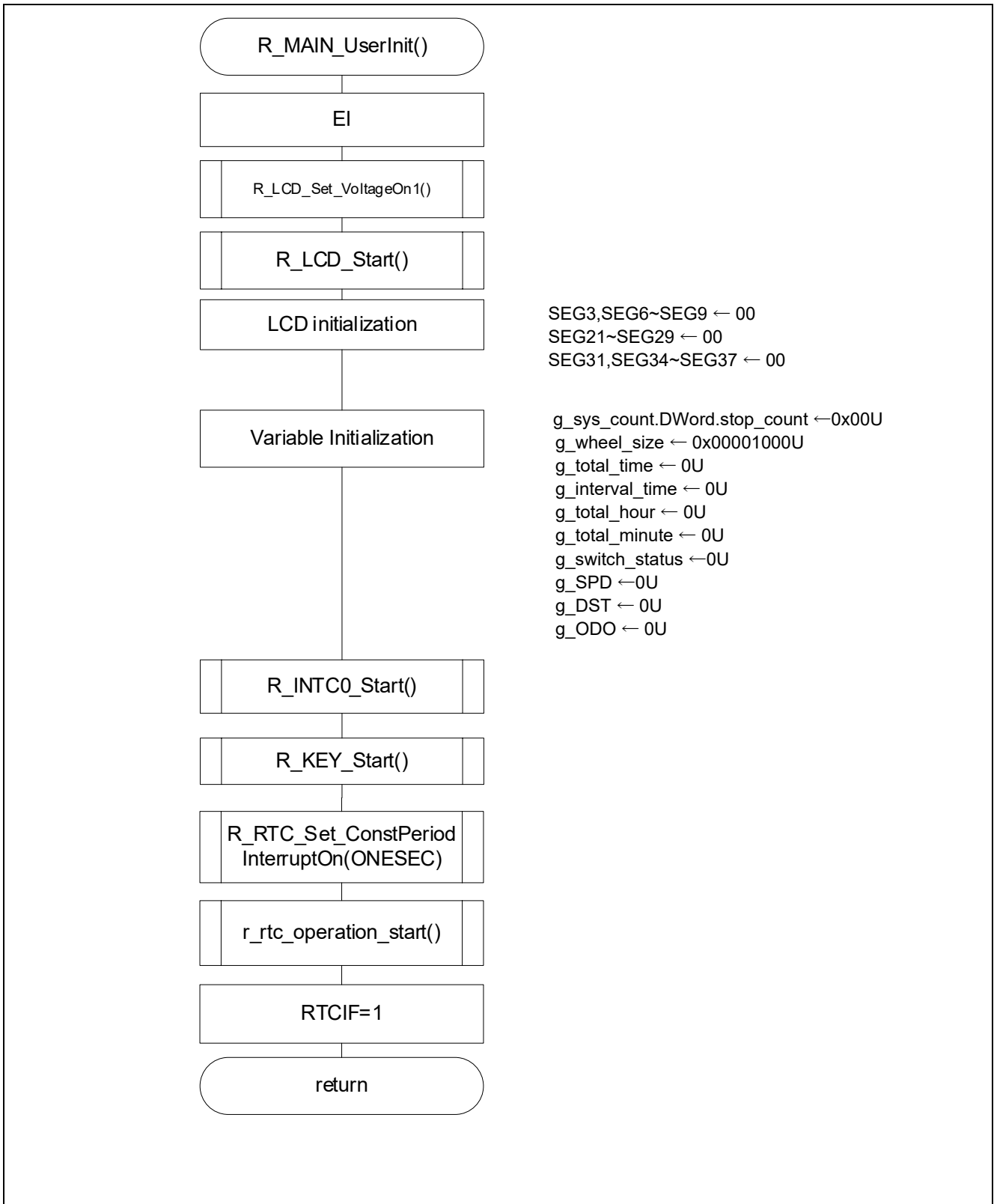


Figure 4.15 LCD Initialization Display Setting

4.7.12 LCD Step-Up Circuit Operation Start Processing

Figure 4.16 shows the flowchart for LCD step-up circuit operation start processing.

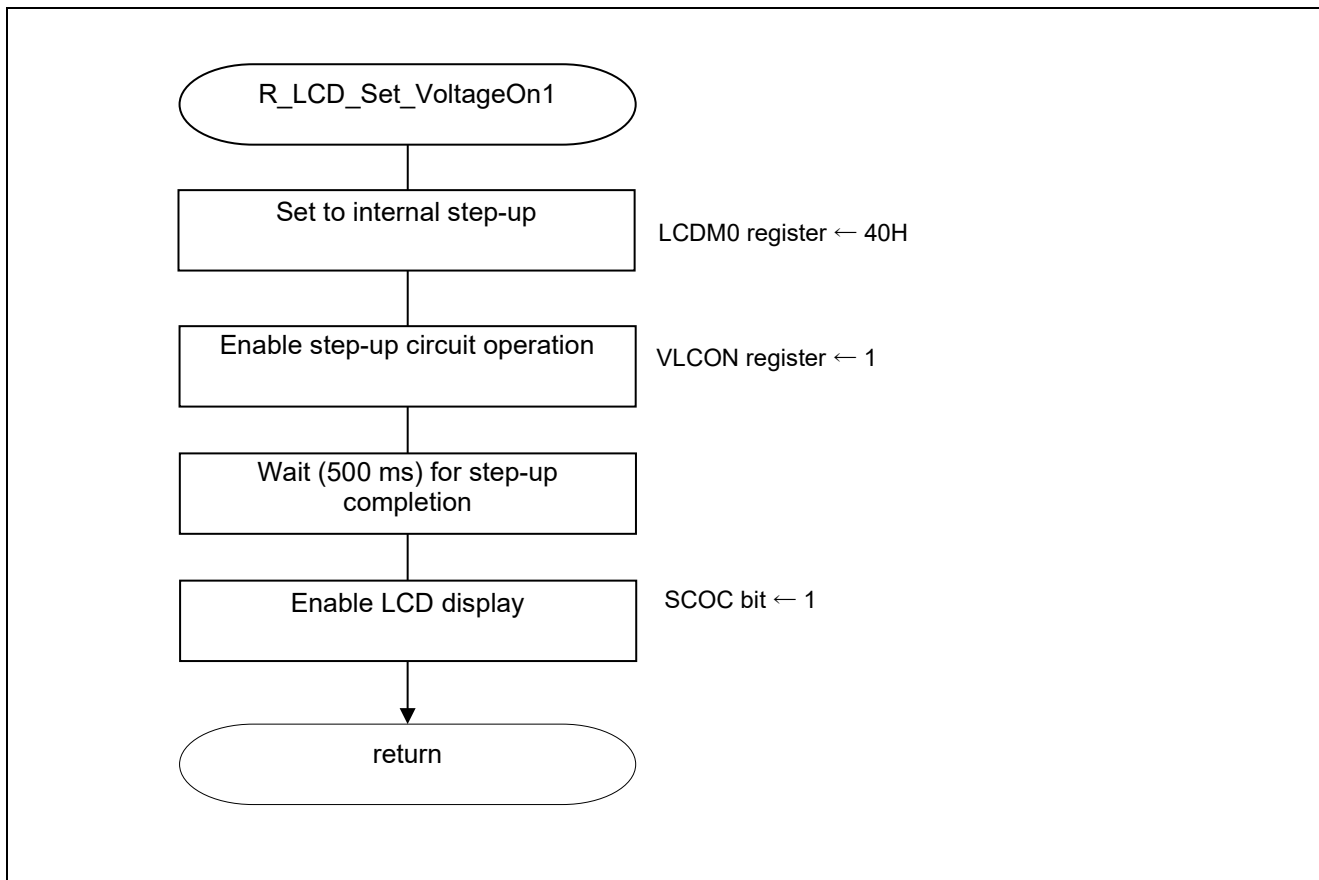


Figure 4.16 LCD Step-Up Circuit Operation Start Processing

4.7.13 INTP0 Operation Start Processing

Figure 4.17 shows the flowchart for INTP0 operation start processing.

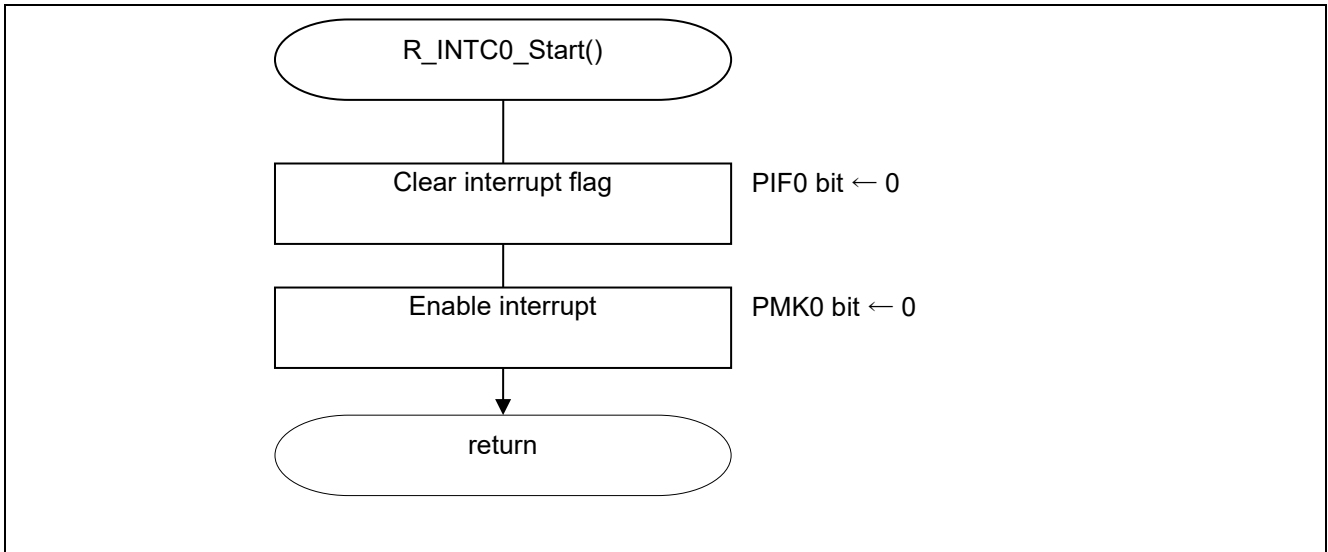


Figure 4.17 INTP0 operation start processing

4.7.14 Key Interrupt Operation Start Processing

Figure 4.18 shows the flowchart for Key Interrupt operation start processing.

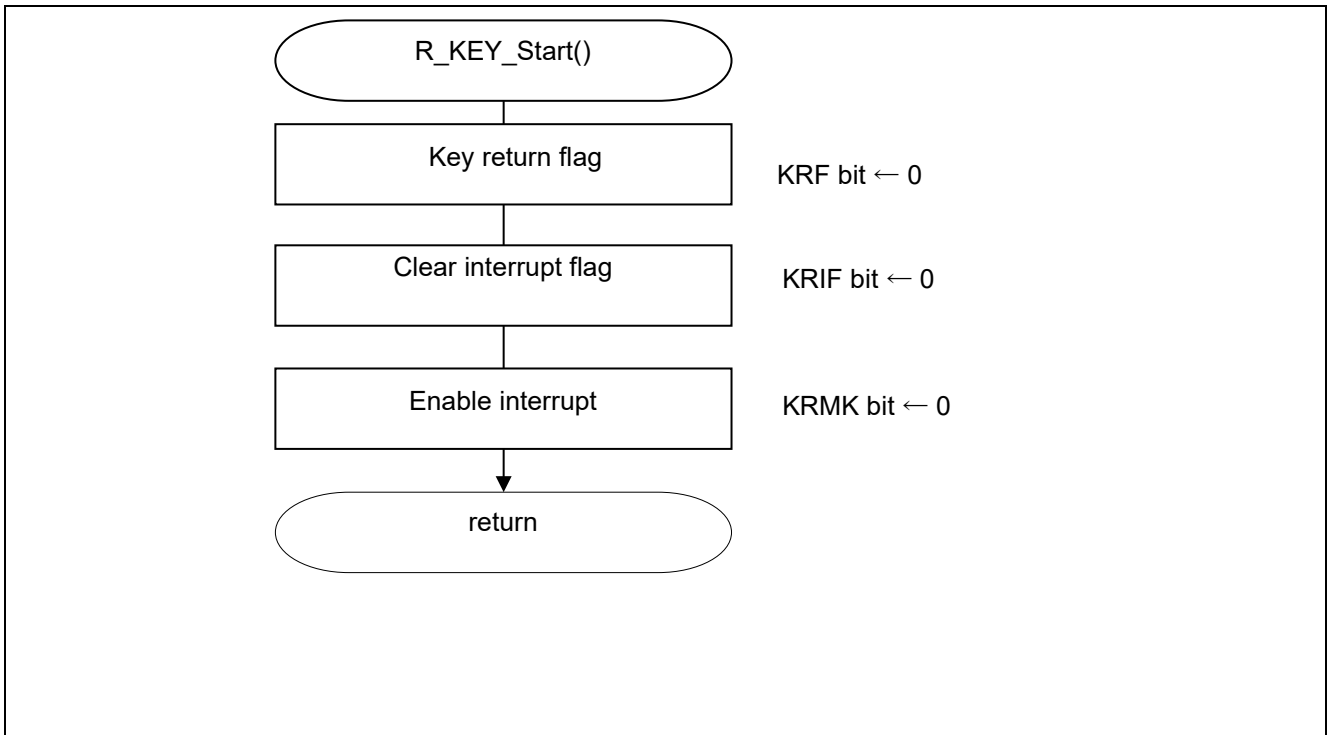


Figure 4.18 Key Interrupt operation start processing

4.7.15 Enabling RTC Constant-Period Interrupt

Figure 4.19 shows the flowchart for enabling the RTC constant-period interrupt.

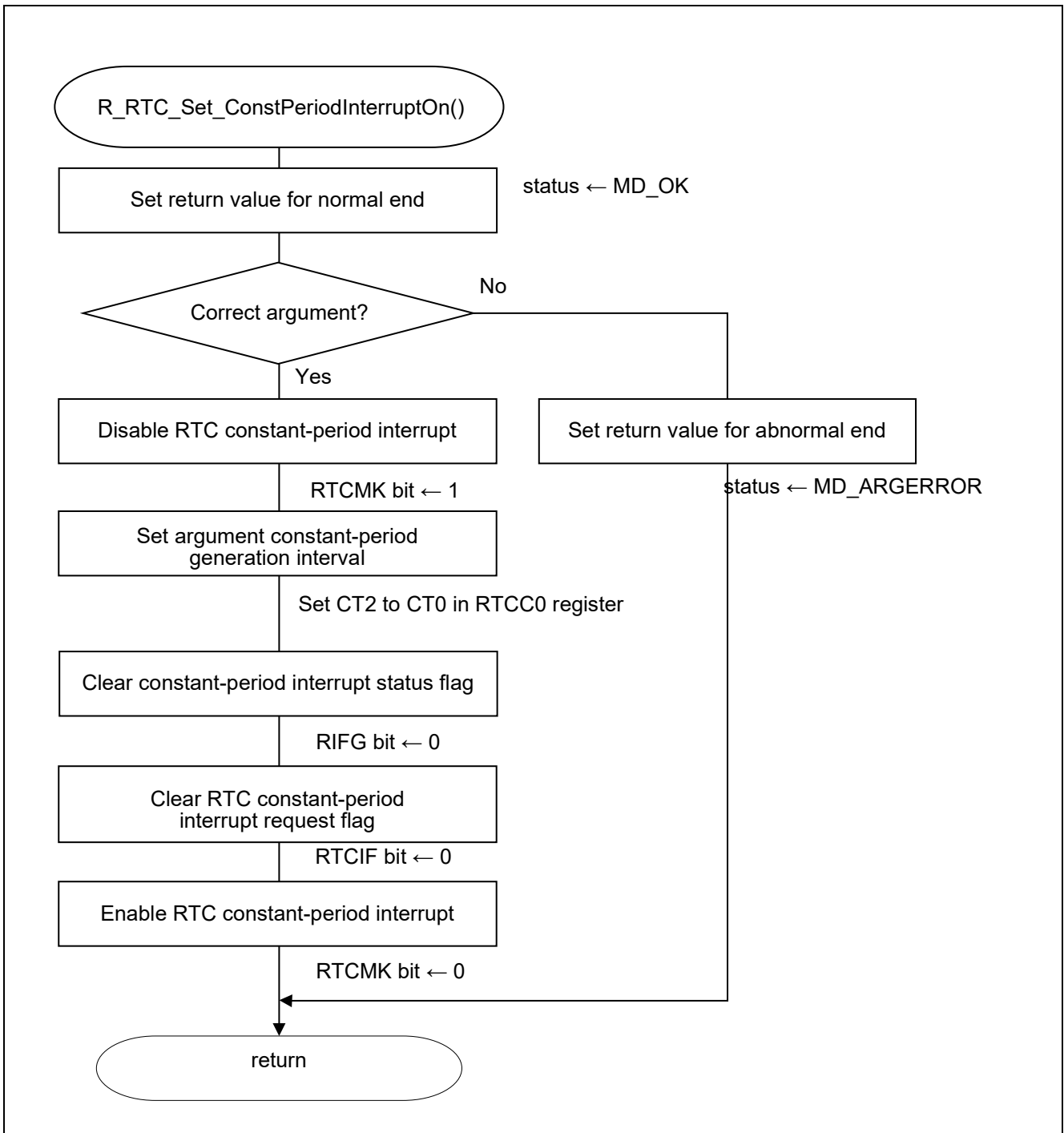


Figure 4.19 Flowchart for Enabling RTC Constant-Period Interrupt

4.7.16 Starting RTC Operation

Figure 4.20 shows the flowchart for starting the RTC operation.

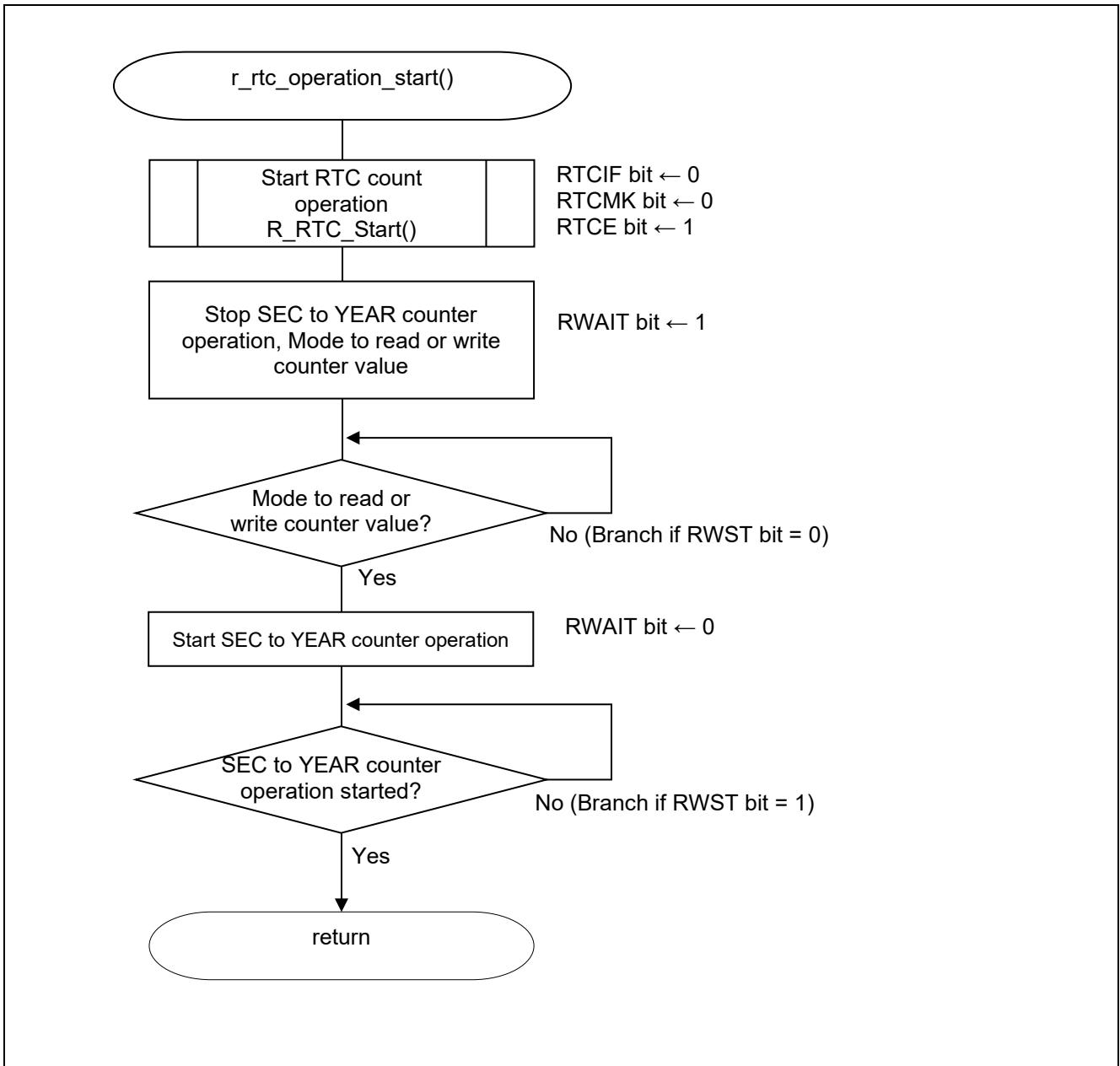


Figure 4.20 Flowchart for Starting RTC operation

4.7.17 Checking Button Depression State

Figure 4.21 shows the flowchart for checking the button depression state.

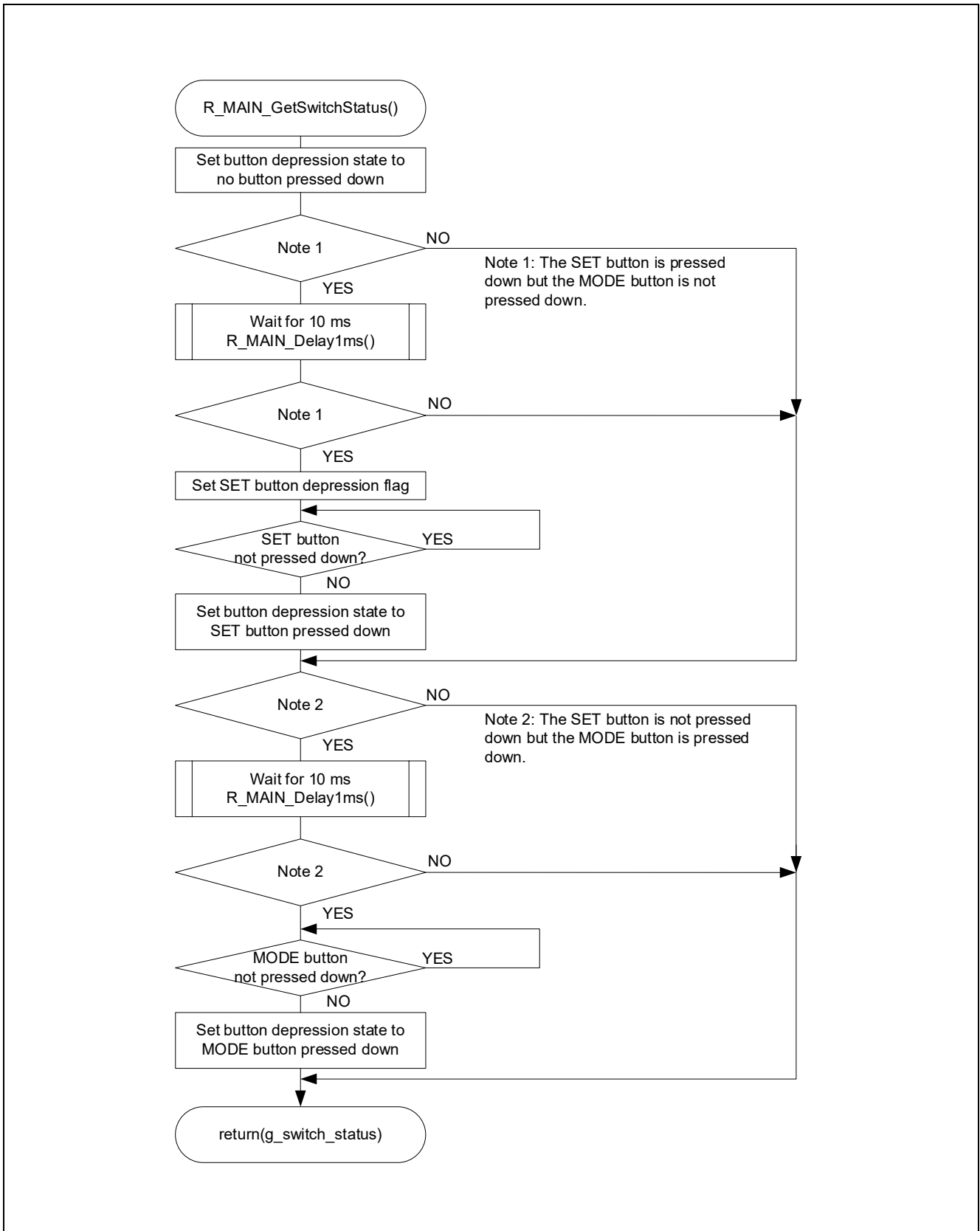


Figure 4.21 Flowchart for Checking Button Depression State

4.7.18 Wait time processing for Chattering prevention

Figure 4.22 shows the flowchart for the wait time processing for chattering prevention.

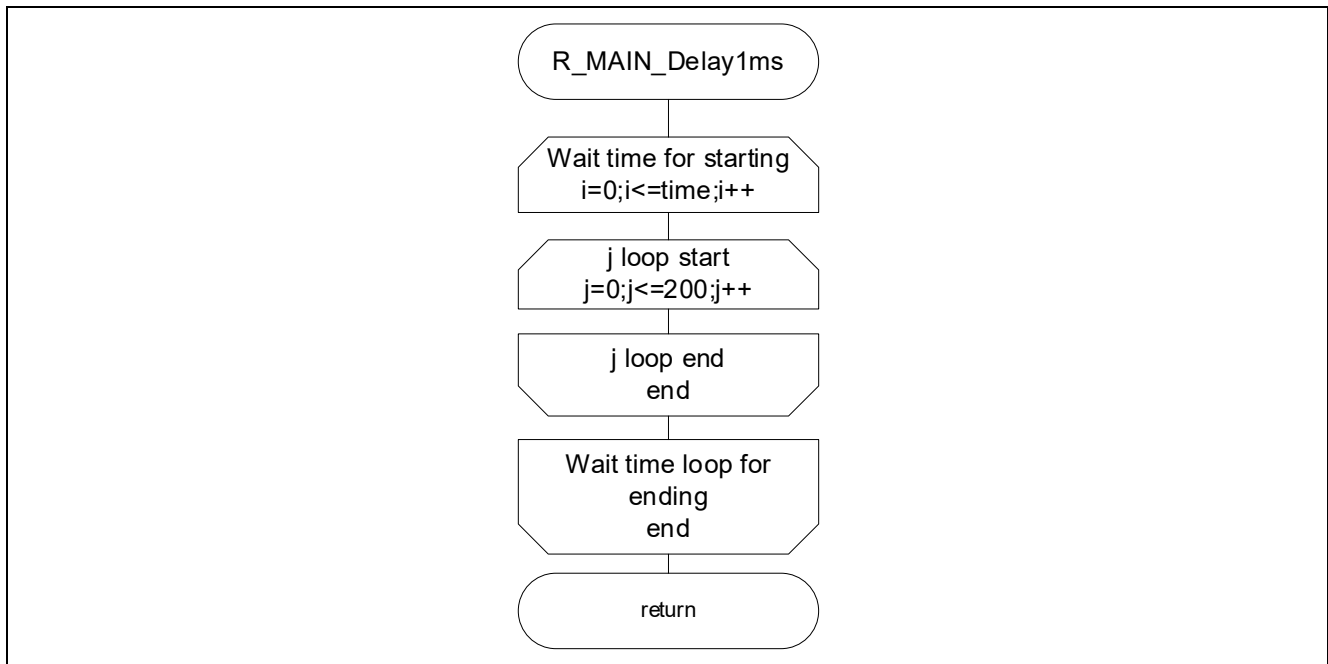


Figure 4.22 wait time processing for chattering prevention

4.7.19 RTC Read

Figure 4.23 shows the flowchart for the RTC read.

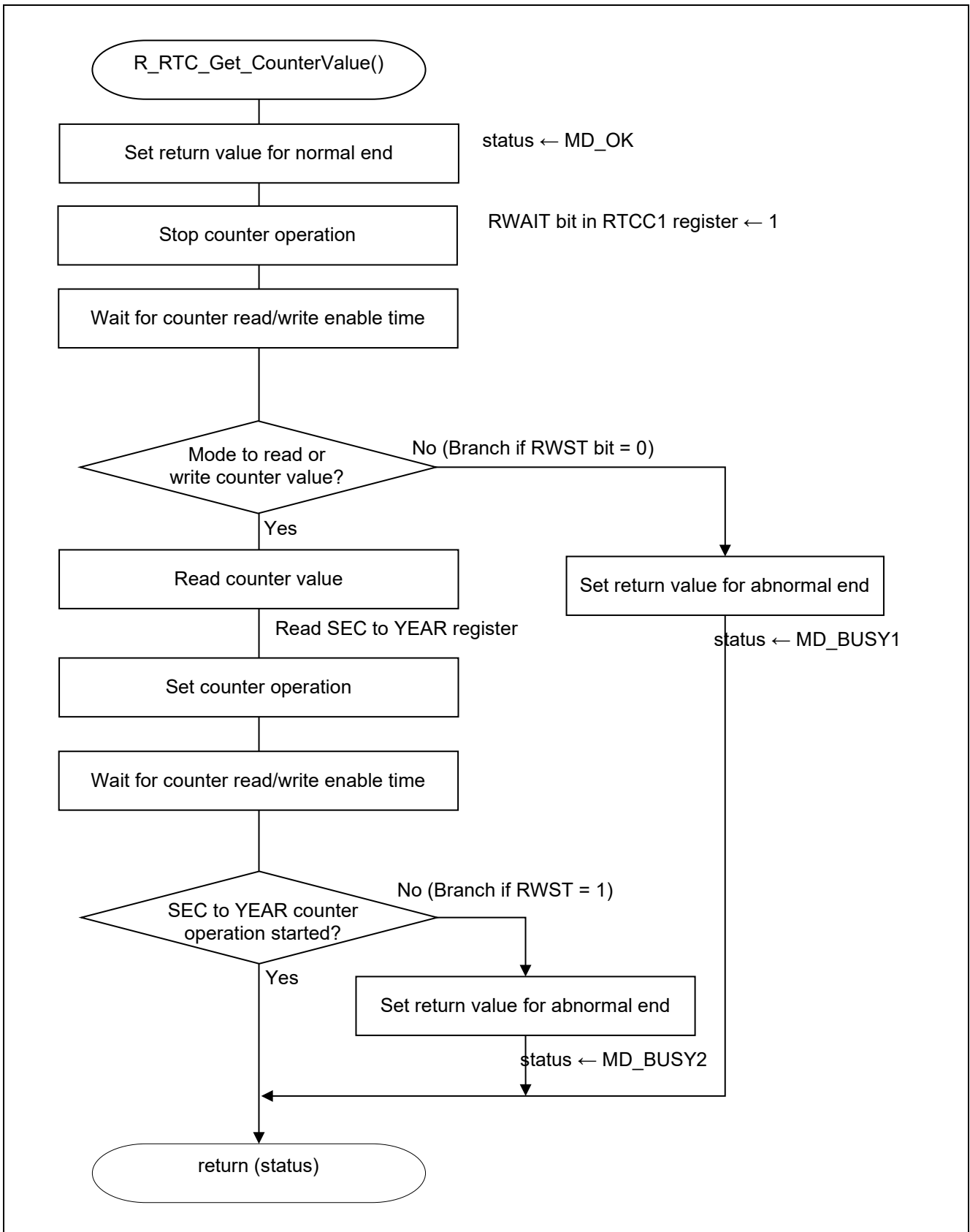


Figure 4.23 Flowchart for RTC Read

4.7.20 LCD Clock Display

Figure 4.23 shows the flowchart for the LCD clock display.

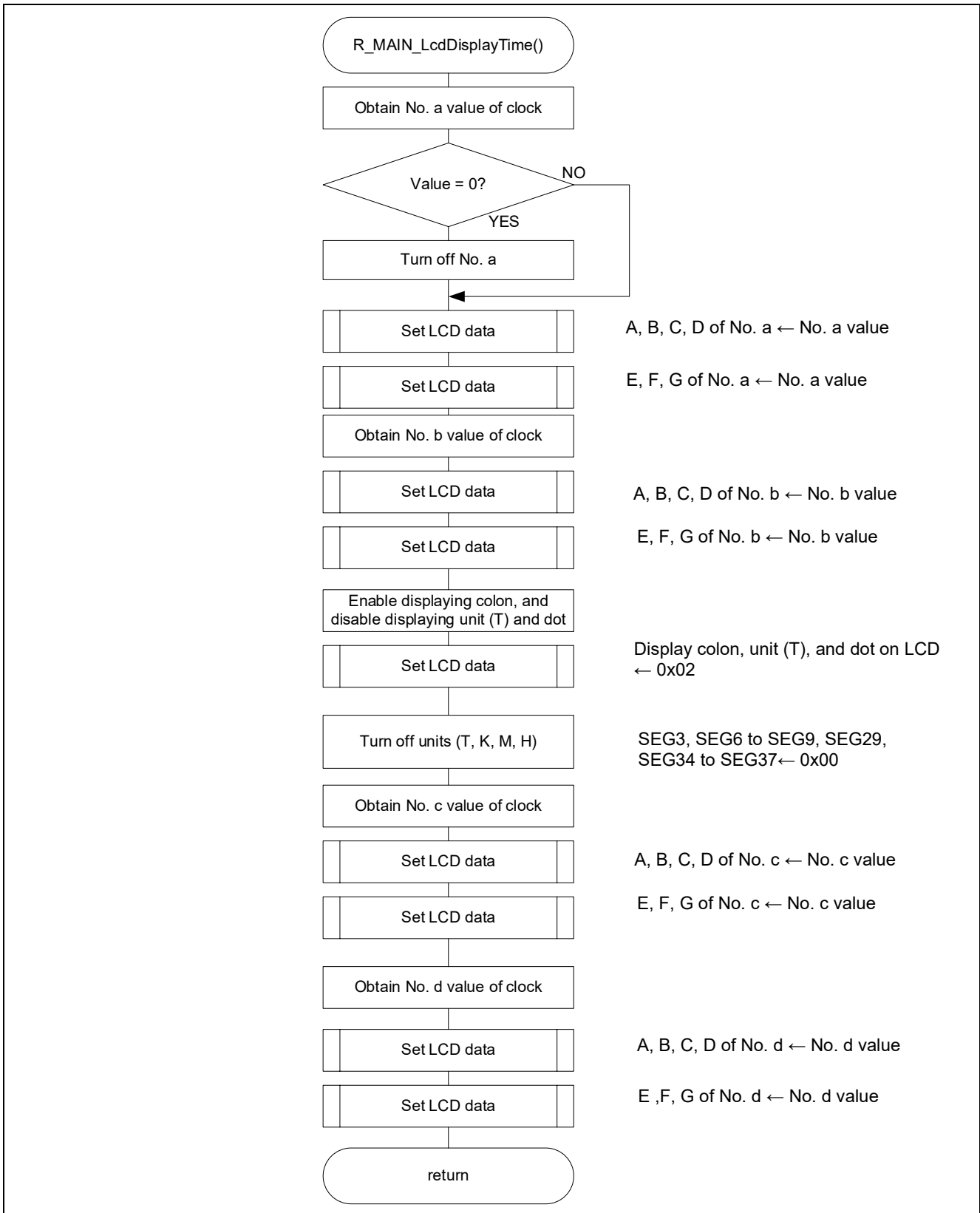


Figure 4.24 Flowchart for LCD Clock Display

4.7.21 LCD Riding time Display

Figure 4.25 shows the flowchart for the LCD riding time display.

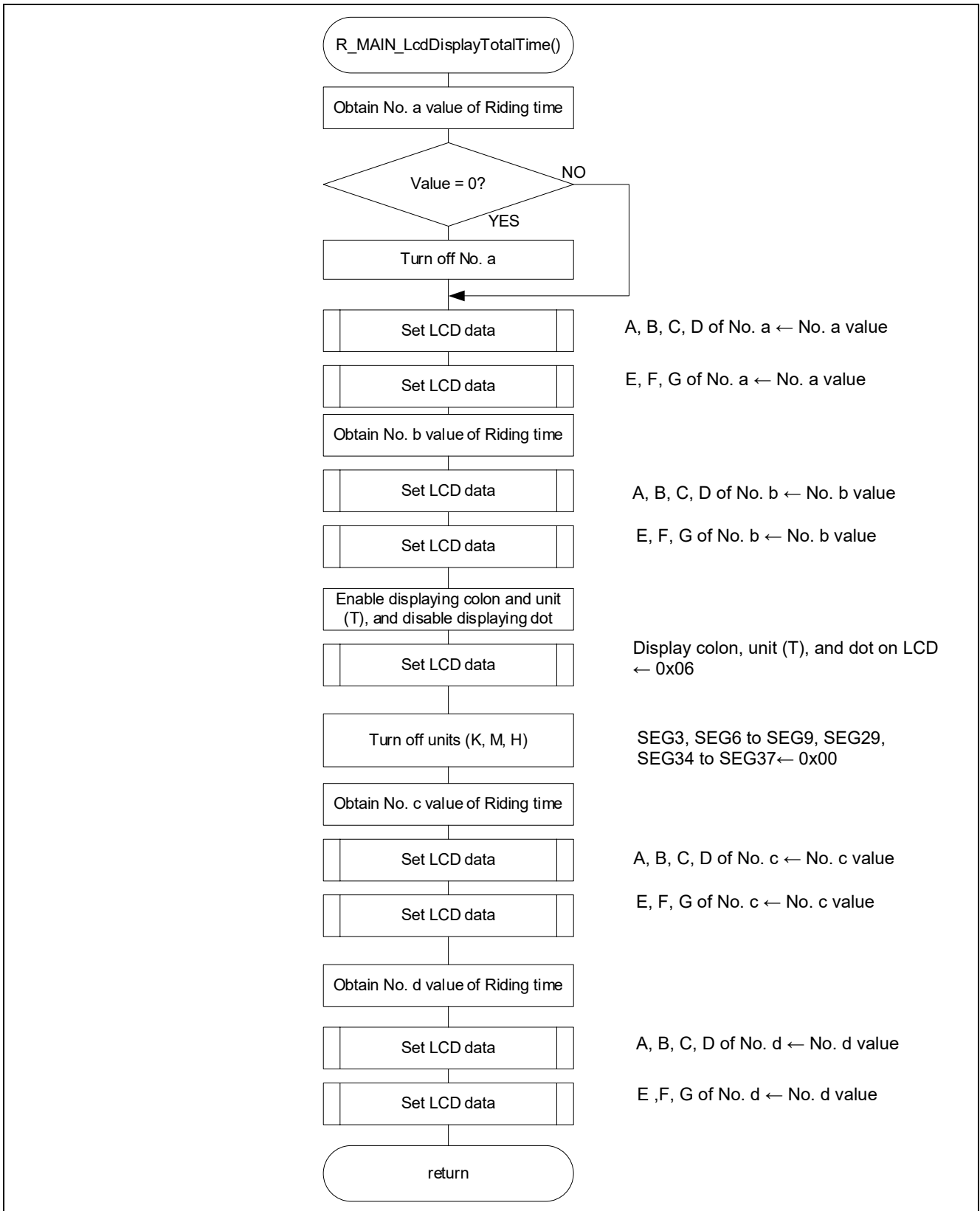


Figure 4.25 Flowchart for LCD riding time Display

4.7.22 LCD Speed Display

Figure 4.25 shows the flowchart for the LCD Speed display.

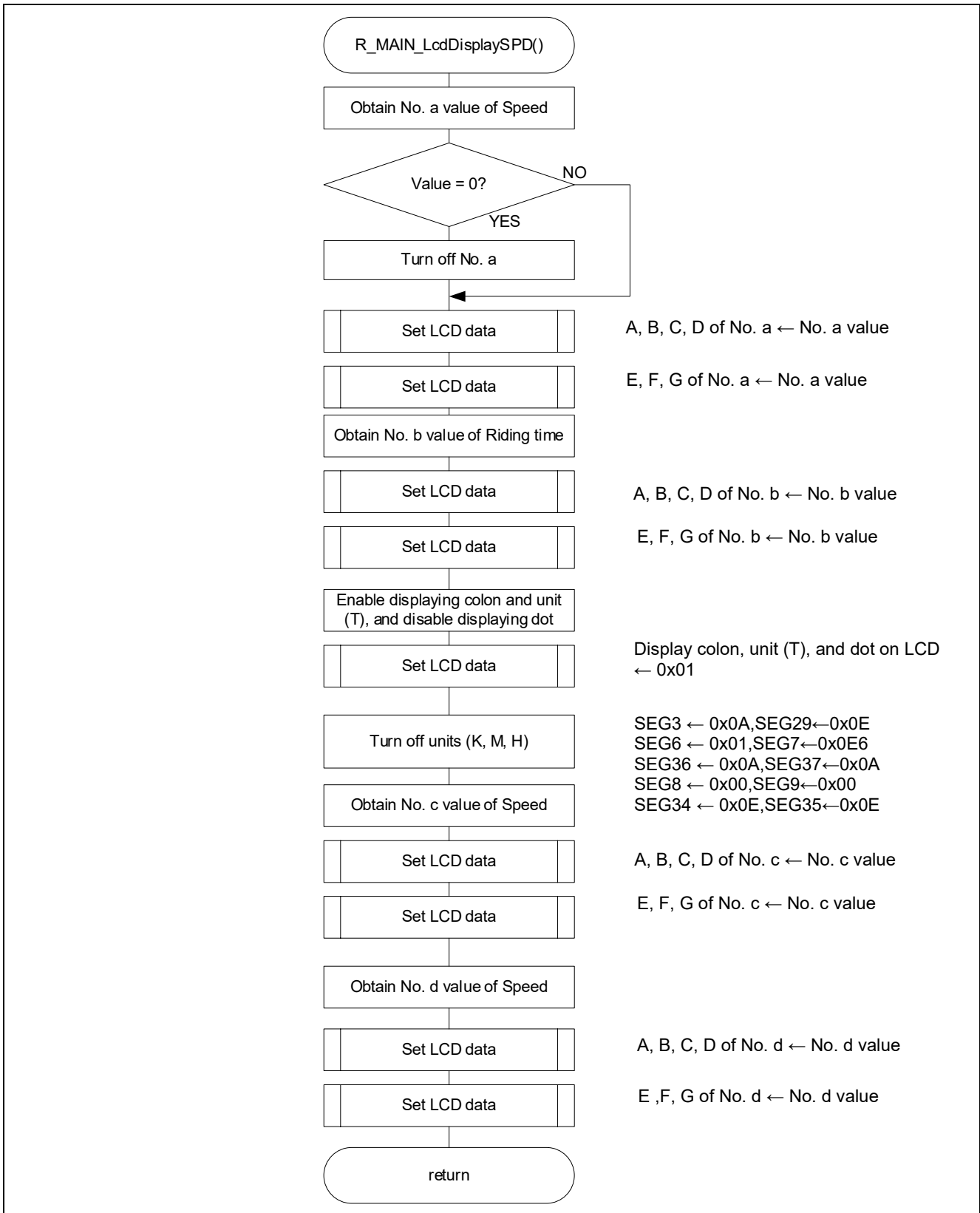


Figure 4.26 Flowchart for LCD Speed Display

4.7.23 LCD Travel distance Display

Figure 4.24 shows the flowchart for the LCD travel distance display.

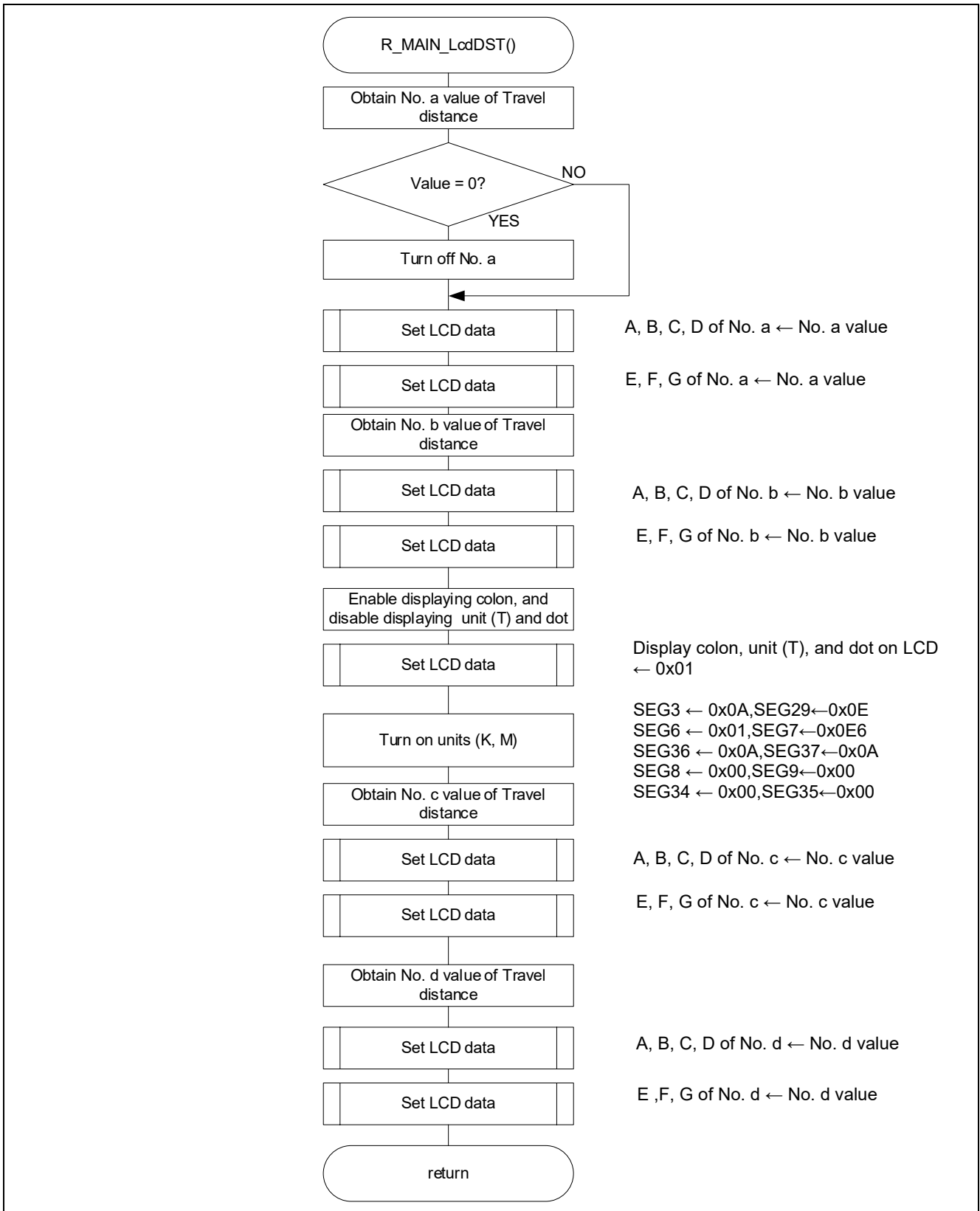


Figure 4.27 Flowchart for LCD travel distance Display

4.7.24 LCD Total Travel distance Display

Figure 4.28 shows the flowchart for the LCD total travel distance display.

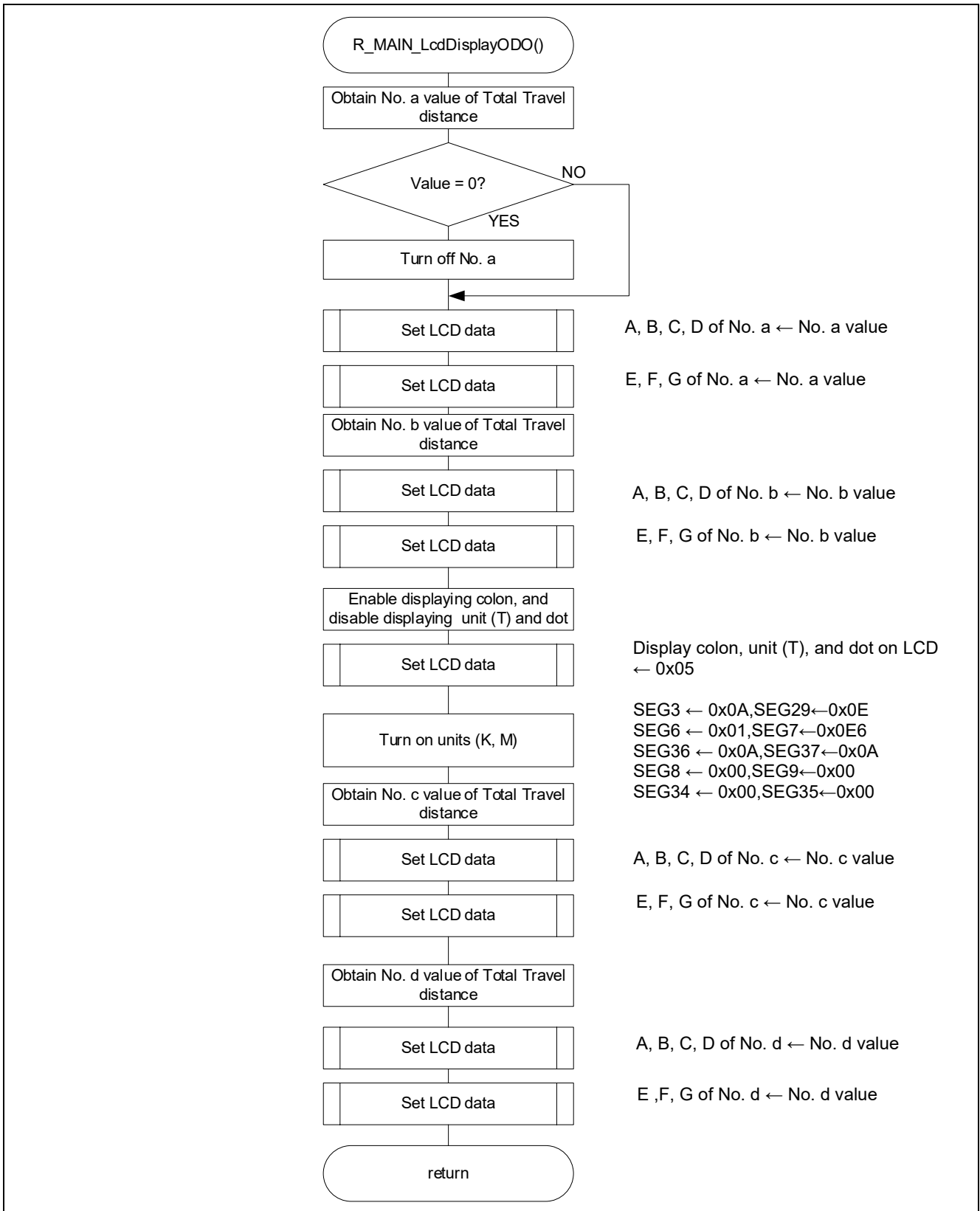


Figure 4.28 Flowchart for LCD total travel distance Display

4.7.25 Clock (hour) Blinking on LCD

Figure 4.29 shows the flowchart for the clock (hour) blinking on LCD.

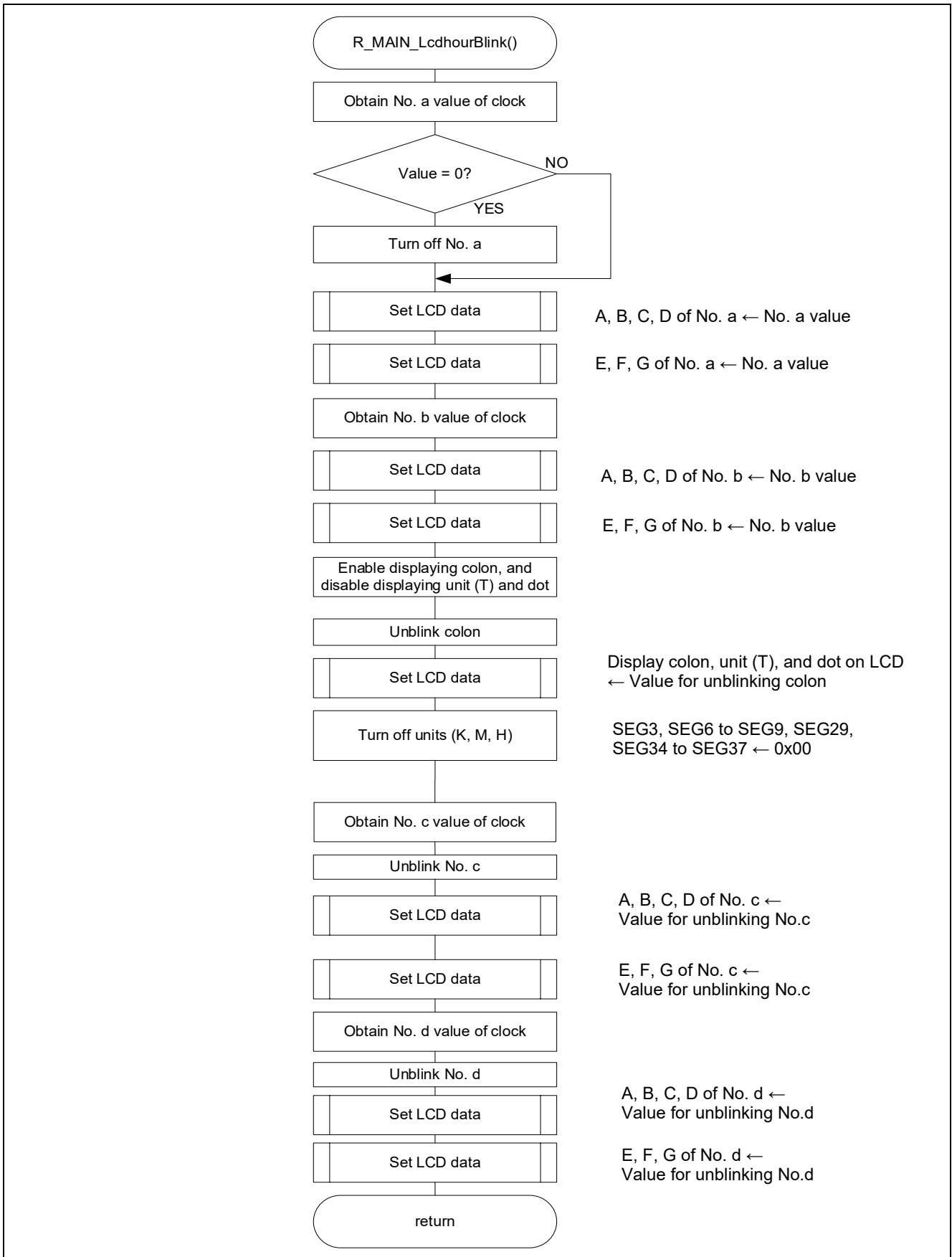


Figure 4.29 Flowchart for Clock (Time) Blinking on LCD

4.7.26 Clock (Minute) Blinking on LCD

Figure 4.30 shows the flowchart for the clock (Minute) blinking on LCD.

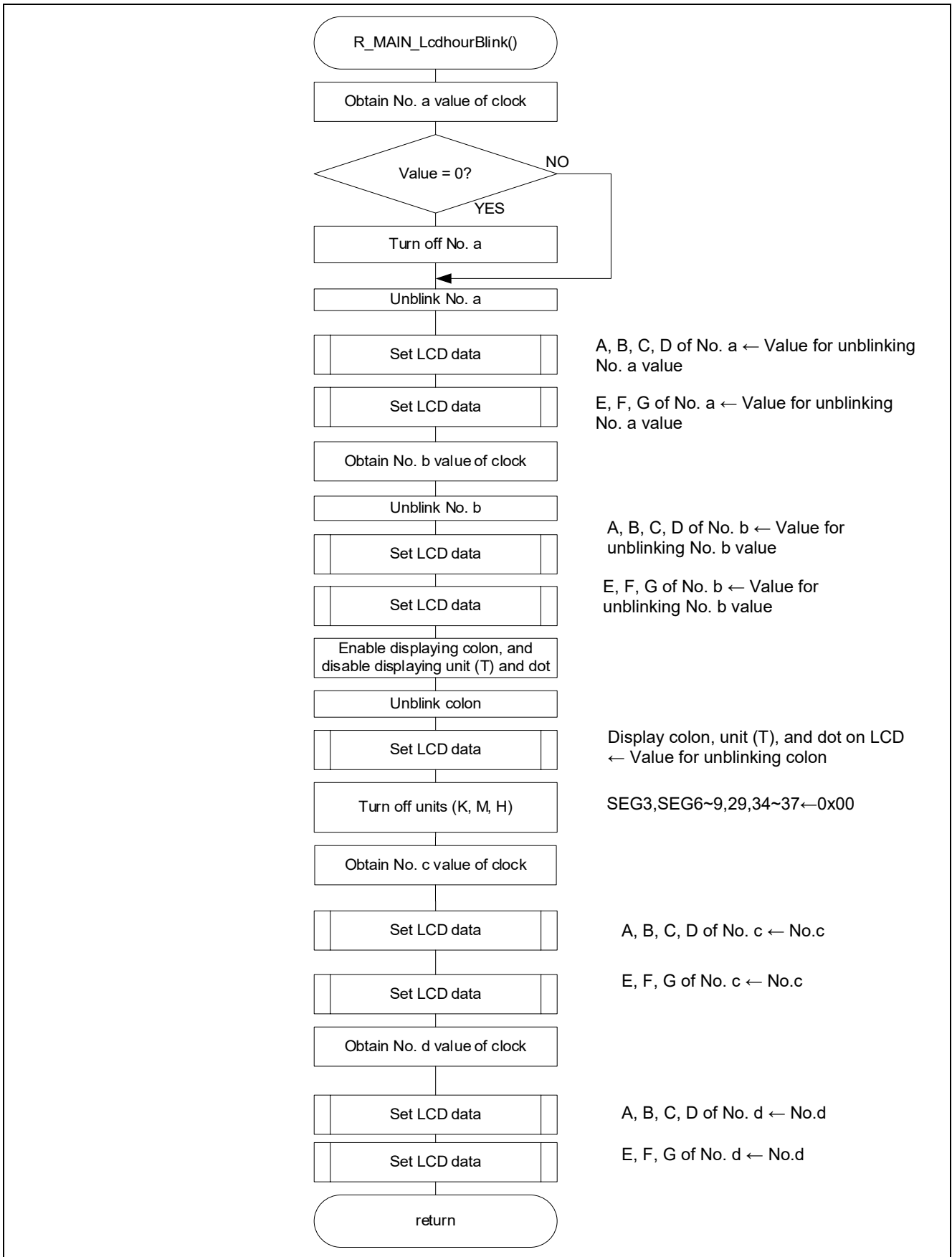


Figure 4.30 Flowchart for Clock (Minute) Blinking on LCD

4.7.27 Wheel circumference (thousands place) Blinking on LCD

Figure 4.31 shows the flowchart for the Wheel circumference (thousands place) blinking on LCD.

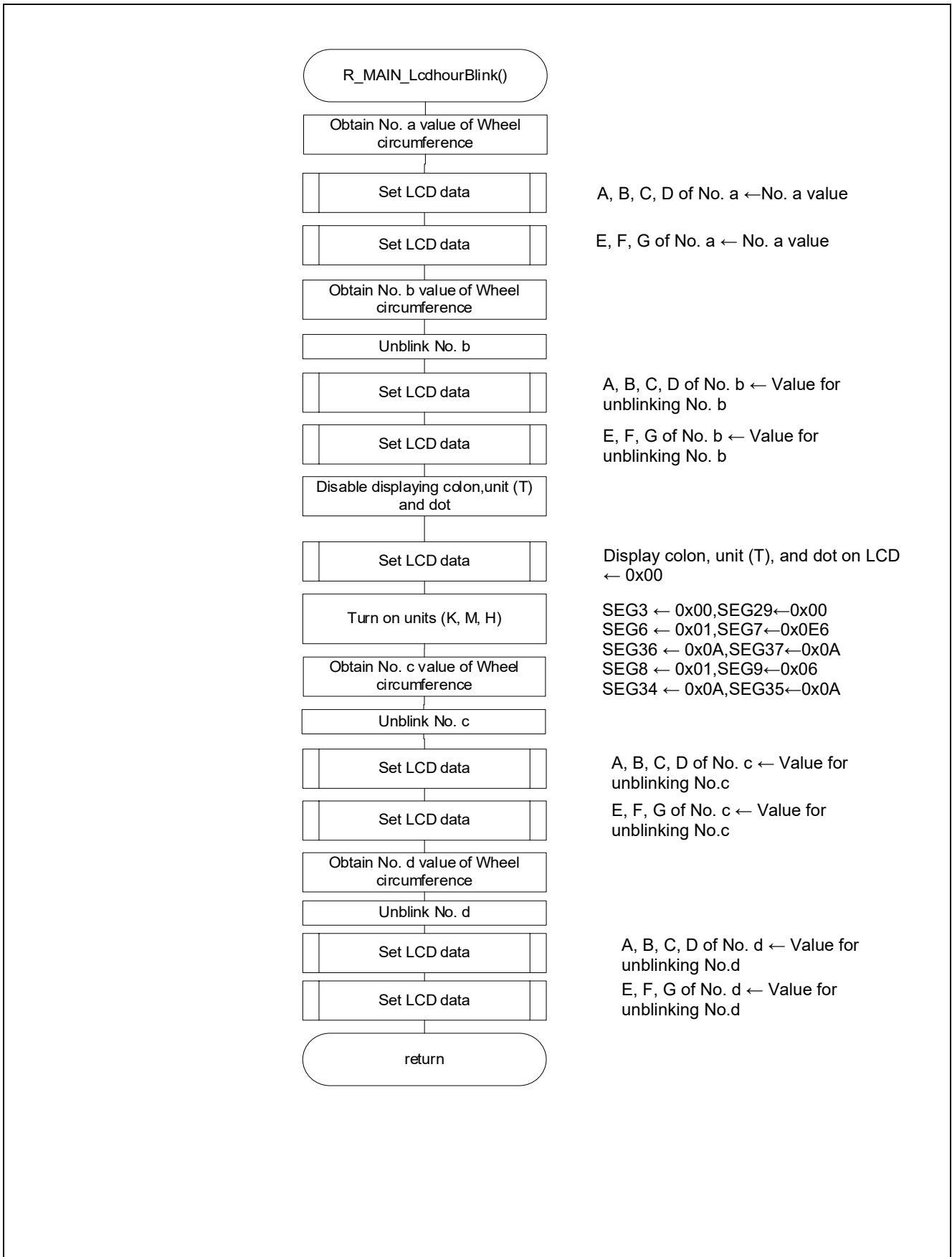


Figure 4.31 Flowchart for Wheel circumference (thousands place) Blinking on LCD

4.7.28 Wheel circumference (hundreds place) Blinking on LCD

Figure 4.32 shows the flowchart for the Wheel circumference (hundreds place) blinking on LCD.

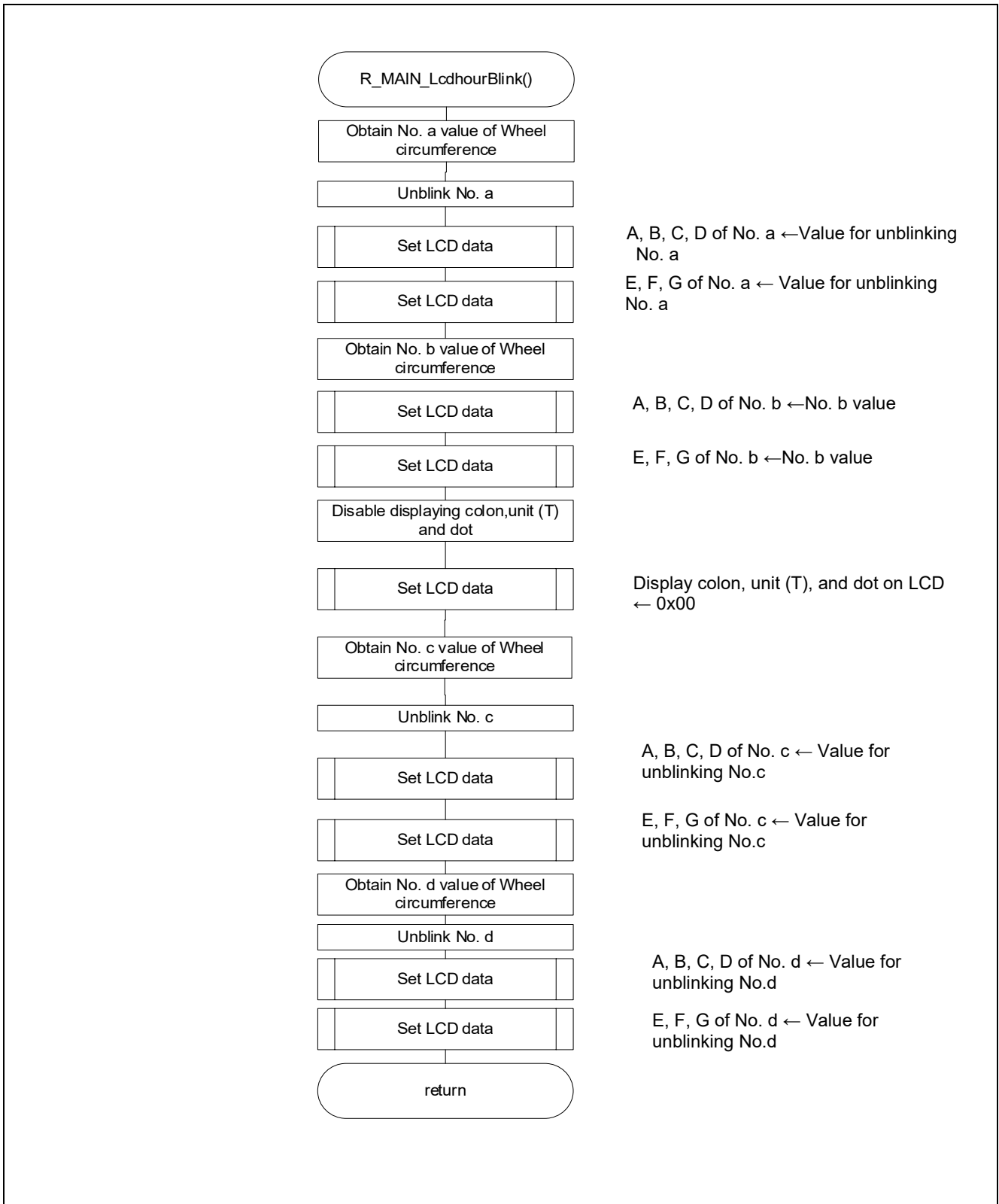


Figure 4.32 Flowchart for Wheel circumference (hundreds place) Blinking on LCD

4.7.29 Wheel circumference (tens place) Blinking on LCD

Figure 4.33 shows the flowchart for the Wheel circumference (tens place) blinking on LCD.

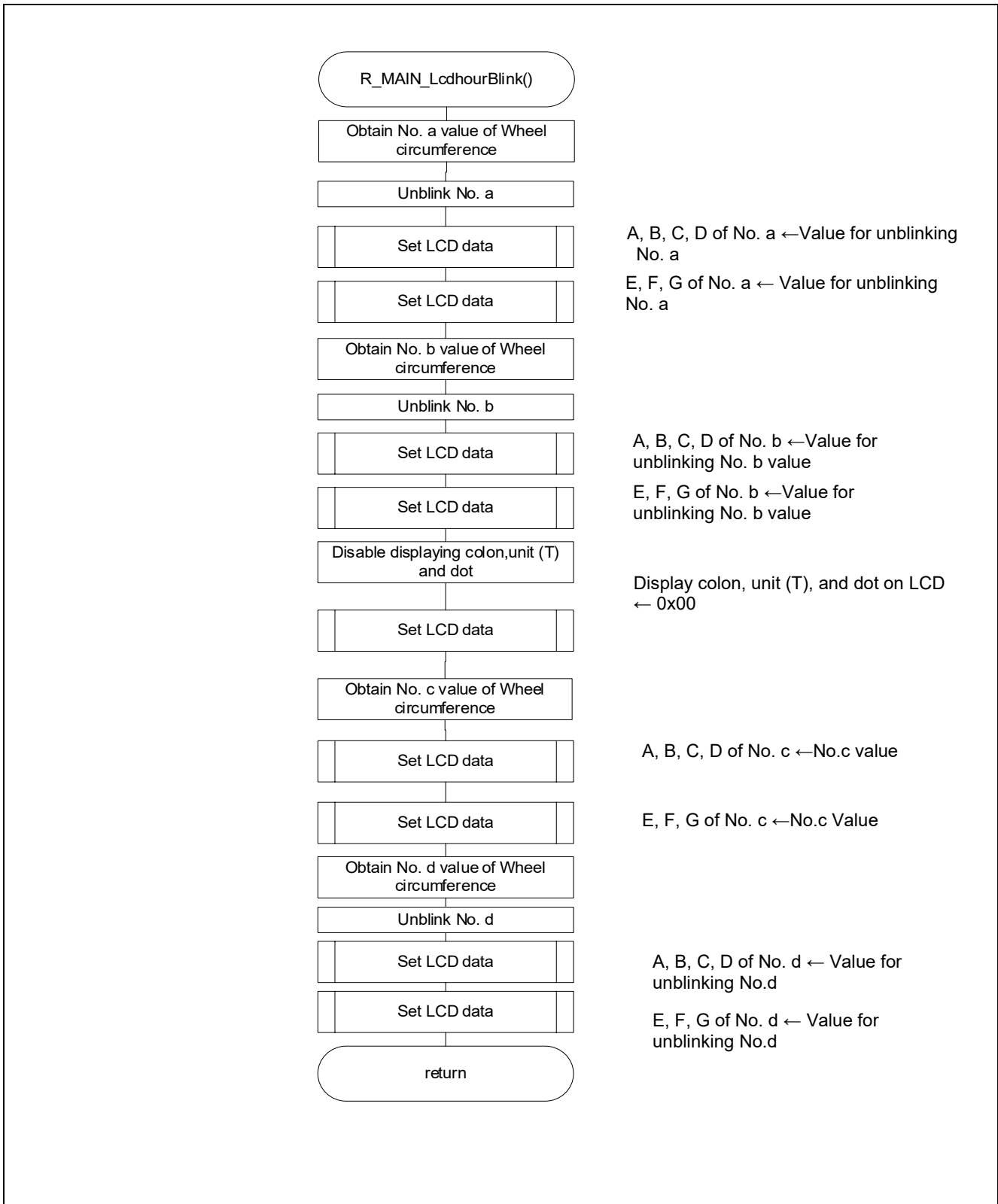


Figure 4.33 Flowchart for Wheel circumference (tens place) Blinking on LCD

4.7.30 Wheel circumference (ones place) Blinking on LCD

Figure 4.34 shows the flowchart for the Wheel circumference (ones place) blinking on LCD.

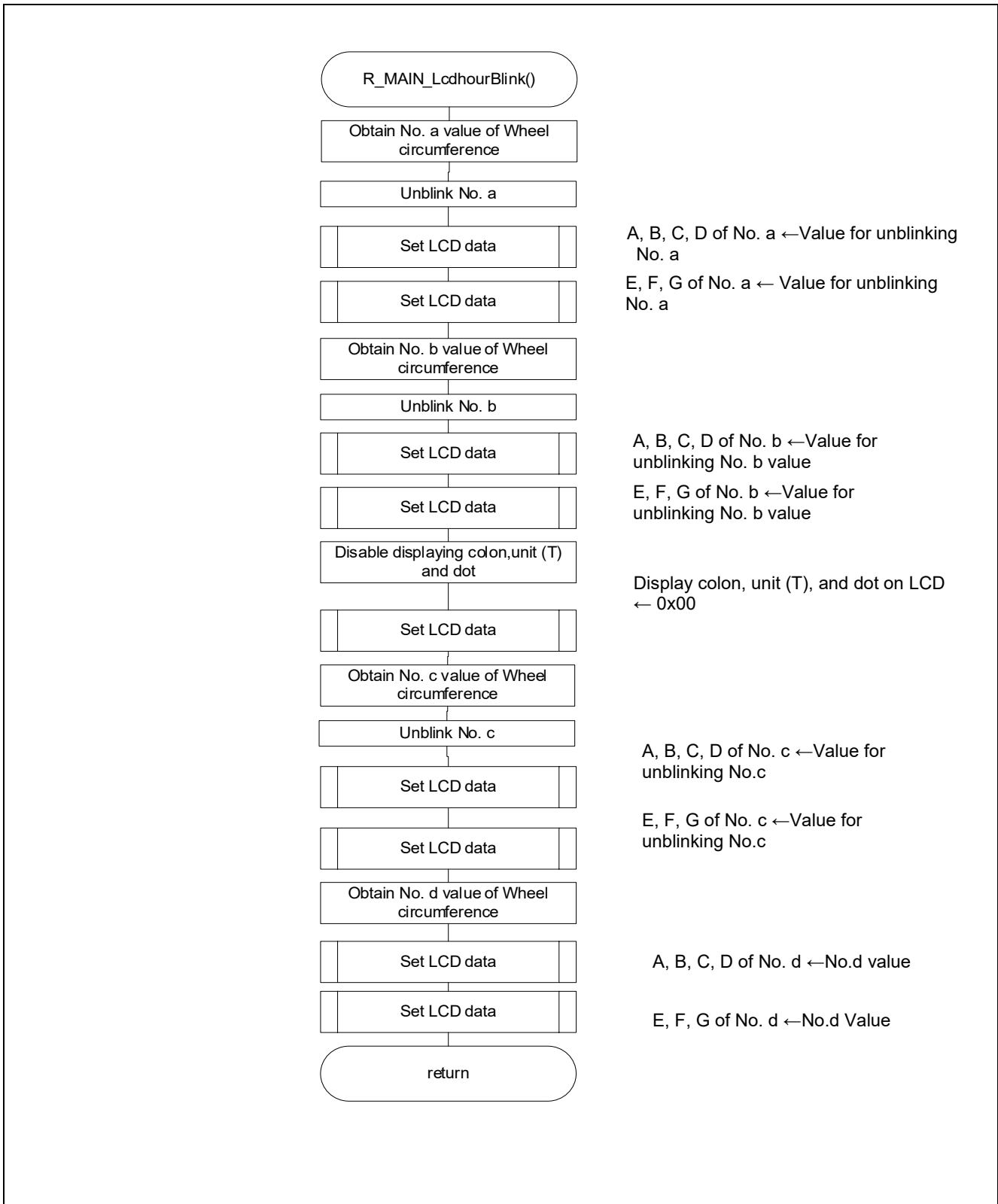


Figure 4.34 Flowchart for Wheel circumference (ones place) Blinking on LCD

4.7.31 LCD Data Setting

Figure 4.35 shows the flowchart for the LCD data setting.

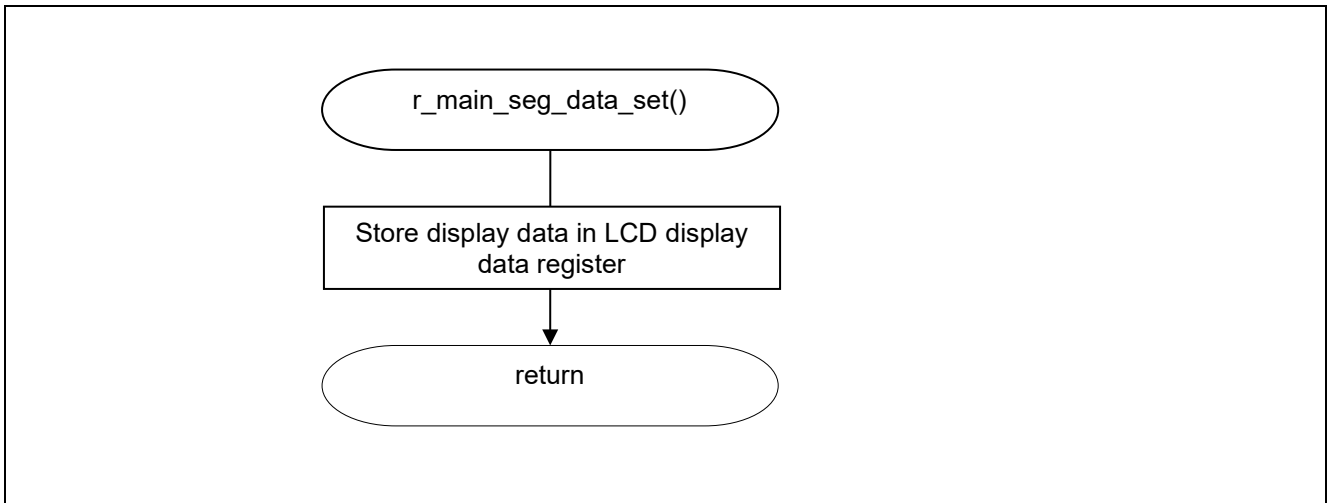


Figure 4.35 Flowchart for LCD Display Data Setting

4.7.32 BCD Data Addition

Figure 4.36 shows the flowchart for the BCD data addition.

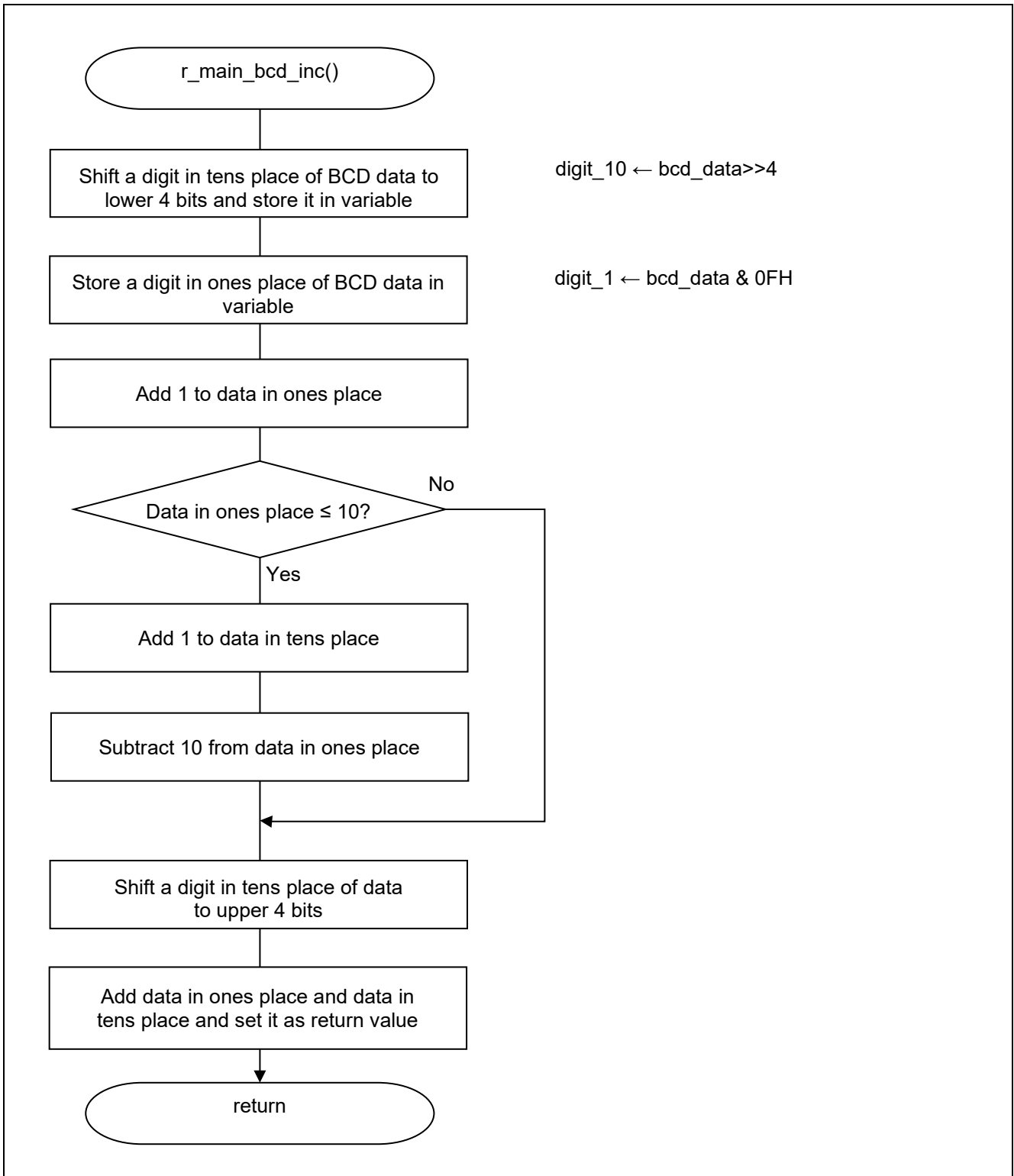


Figure 4.36 Flowchart for BCD Data Addition

4.7.33 External Interrupt Processing

Figure 4.37 shows the flowchart for the external interrupt processing.

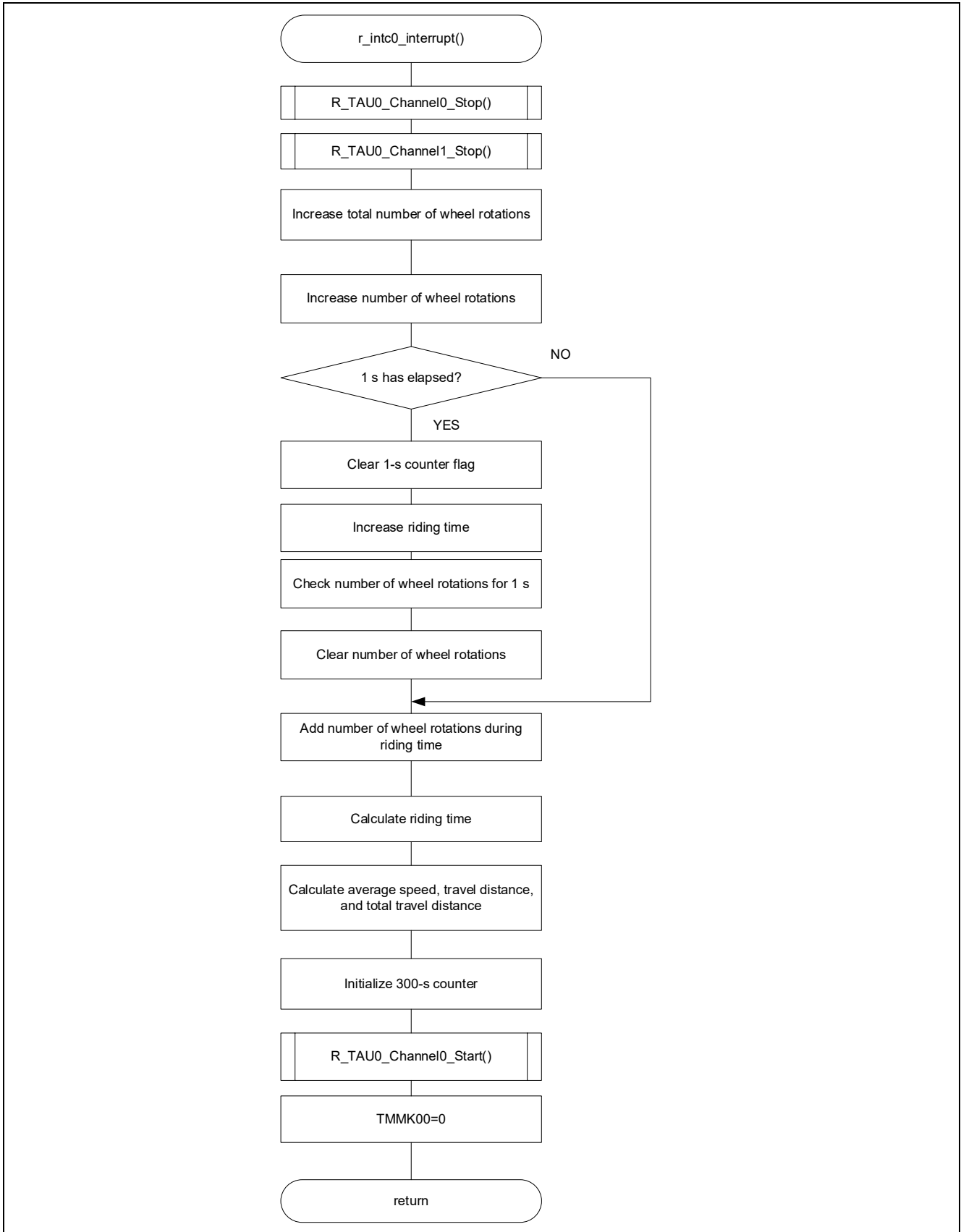


Figure 4.37 Flowchart for external interrupt processing

4.7.34 Interval Timer Interrupt Processing (Timer Array Unit Channel 0))

Figure 4.38 shows the flowchart for the interval timer interrupt processing.

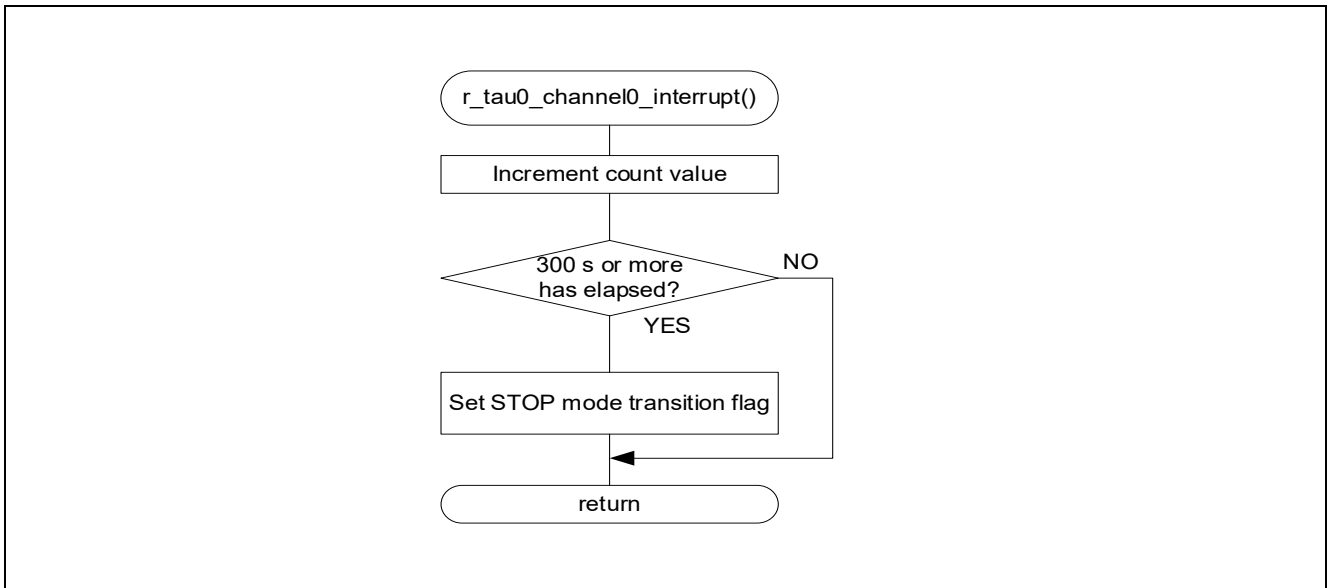


Figure 4.38 Flowchart for Interval Timer Interrupt Processing (channel 0)

4.7.35 Interval Timer Interrupt Processing (Timer Array Unit Channel 1))

Figure 4.39 shows the flowchart for the interval timer interrupt processing.

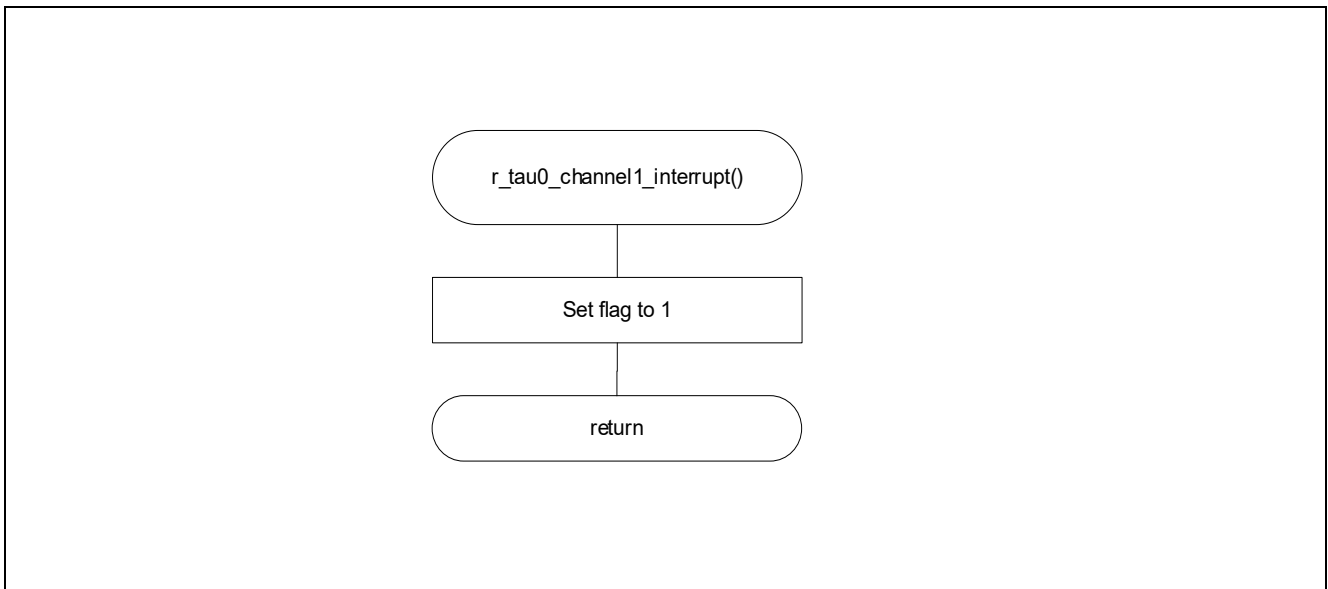


Figure 4.39 Flowchart for Interval Timer Interrupt Processing (channel 1)

4.7.36 Timer array unit (channel 0) operation start

Figure 4.40 shows the flowchart for the timer array unit (channel 0) operation starting.

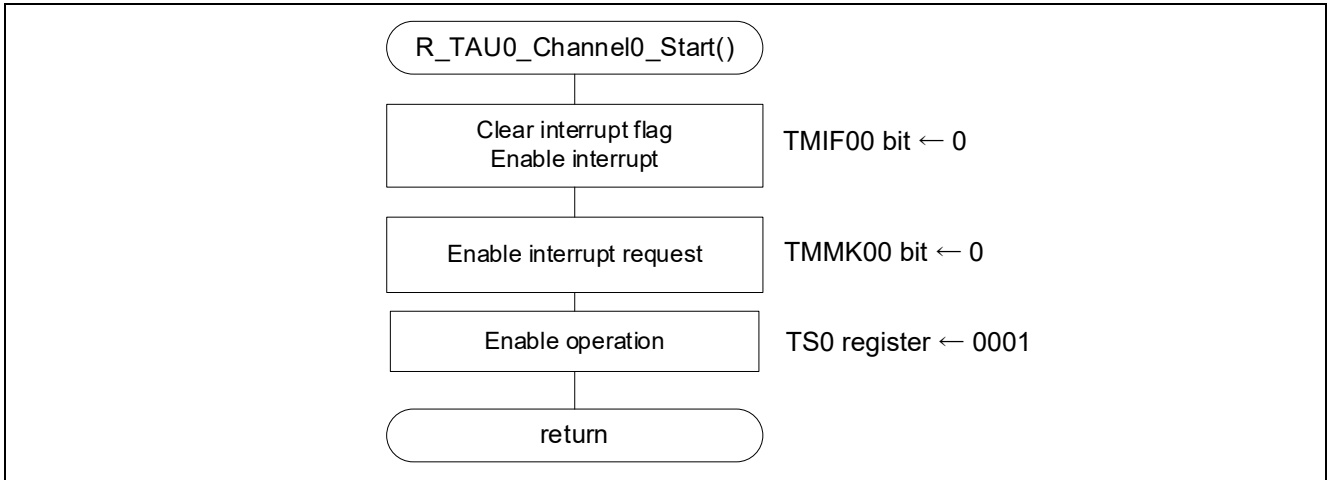


Figure 4.40 Timer array unit (channel 0) operation starting

4.7.37 Timer array unit (channel 1) operation start

Figure 4.41 shows the flowchart for the timer array unit (channel 1) operation starting.

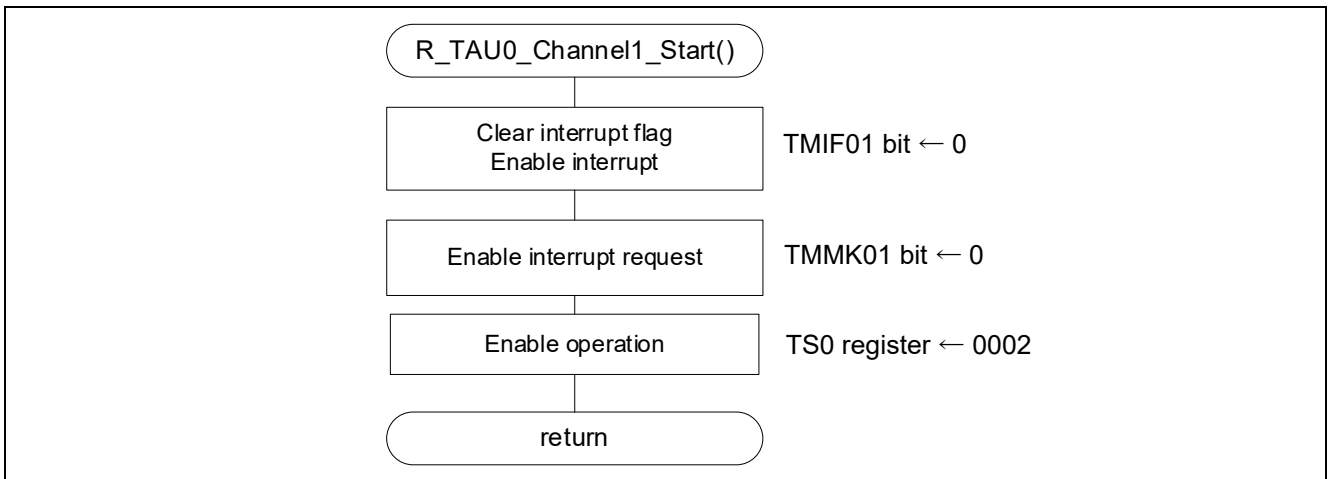


Figure 4.41 Timer array unit (channel 1) operation starting

4.7.38 Timer array unit (channel 0) operation stop

Figure 4.42 shows the flowchart for the timer array unit (channel 0) operation stopping.

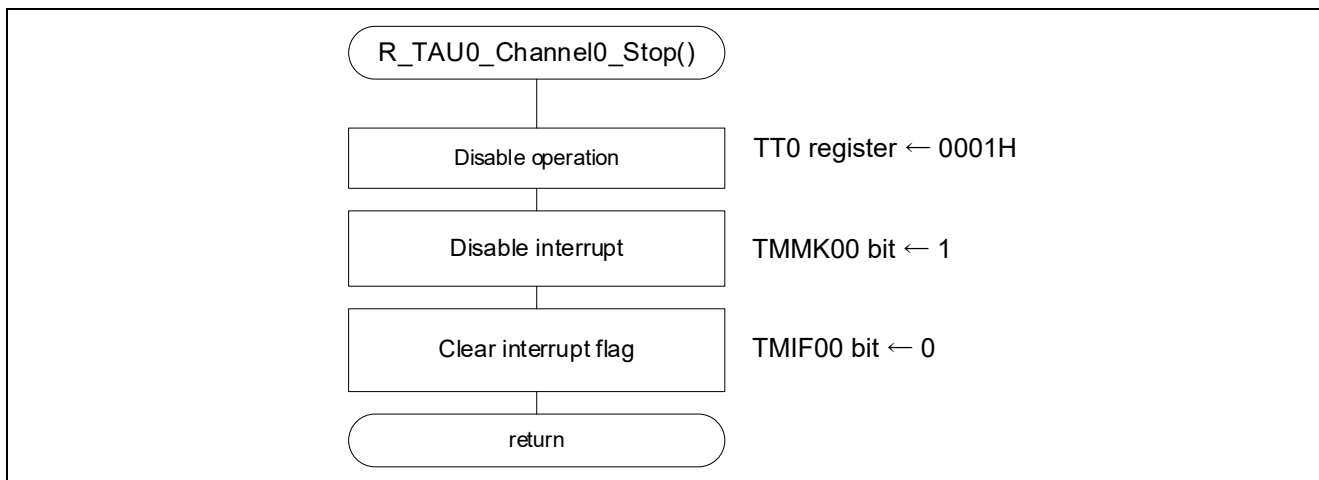


Figure 4.42 timer array unit (channel 0) operation stopping

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	2020/5/15	-	-

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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