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4559 Group

LCD Display Function

1. Abstract

This document shows an example of how to set the LCD display function of the 4559 group of Renesas microcomputers and an application example for using the LCD display function.

2. Introduction

The application example explained in this document applies for use with the microcomputers and under the conditions described below.

- Microcomputer : 4559 group
- Oscillator frequency : 32.768 kHz as sub-clock f(XCIN), however
- System clock : Used in through mode (not frequency divided)

Please note that the sample program for the 4559 group may somewhere in it manipulate the bits of unused functions for reasons of bit arrangement in the control registers. The values of these bits in a user system should be set to suit the usage condition of the system.

3. Related Registers

3.1 LCD Control Register L1

Table 3.1 shows the bit configuration of LCD Control Register L1.

For write to the register L1, first set a value in the register A and then use the TL1A instruction.

Furthermore, the TAL1 instruction may be used to transfer the content of register L1 to the register A.

Table 3.1 Bit Configuration of LCD Control Register L1

LCD Control Register L1		When reset: 0000_2		When powered down: State retained		R/W TAL1/TL1A
$L1_3$	LCD power supply internal dividing resistor select bit Note 2	0	2r × 3, 2r × 2			
		1	r × 3, r × 2			
$L1_2$	LCD control bit	0	Stop (turned off)			
		1	Start			
$L1_1$ $L1_0$	LCD duty cycle/bias select bit	$L1_1$	$L1_0$	Duty cycle	Bias	
		0	0	Use prohibited	Use prohibited	
		0	1	1/2	1/2	
		1	0	1/3	1/3	
		1	1	1/4	1/3	

Note 1: The letter R denotes “readable,” and the letter W denotes “writable.”
Note 2: When 1/3 bias is selected, a “x3” resistor is used; when 1/2 bias is selected, a “x2” resistor is used.

3.2 LCD Control Register L2

Table 3.2 shows the bit configuration of LCD Control Register L2.

For write to the register L2, first set a value in the register A and then use the TL2A instruction.

Table 3.2 Bit Configuration of LCD Control Register L2

LCD Control Register L2		When reset: 0000_2		When powered down: State retained	W TL2A
$L2_3$	SEG_0/V_{LC3} pin function select bit Note 2	0	SEG_0		
		1	V_{LC3}		
$L2_2$	SEG_1/V_{LC2} pin function select bit Note 3	0	SEG_1		
		1	V_{LC2}		
$L2_1$	SEG_2/V_{LC1} pin function select bit Note 3	0	SEG_2		
		1	V_{LC1}		
$L2_0$	LCD power supply internal dividing resistor control bit	0	Enables internal dividing resistor		
		1	Disables internal dividing resistor		

Note 1: The letter W denotes “writable.”
Note 2: When SEG_0 pin is selected, V_{LC3} is connected to VDD internally in the chip.
Note 3: When SEG_1 and SEG_2 pins are selected, always be sure to use the internal dividing resistor.

3.3 LCD Control Register L3

Table 3.3 shows the bit configuration of LCD Control Register L3.

For write to the register L3, first set a value in the register A and then use the TL3A instruction.

Table 3.3 Bit Configuration of LCD Control Register L3

LCD Control Register L3		When reset: 1111_2		When powered down: State retained	W TL3A
$L3_3$	$P2_3$/SEG_{27} pin function select bit	0	SEG_{27}		
		1	$P2_3$		
$L3_2$	$P2_2$/SEG_{26} pin function select bit	0	SEG_{26}		
		1	$P2_2$		
$L3_1$	$P2_1$/SEG_{25} pin function select bit	0	SEG_{25}		
		1	$P2_1$		
$L3_0$	$P2_0$/SEG_{24} pin function select bit	0	SEG_{24}		
		1	$P2_0$		

Note 1: The letter W denotes “writable.”

3.4 LCD Control Register C1

Table 3.4 shows the bit configuration of LCD Control Register C1.

For write to the register C1, first set a value in the register A and then use the TC1A instruction.

Table 3.4 Bit Configuration of LCD Control Register C1

LCD Control Register C1		When reset: 1111_2		When powered down: State retained	W TC1A
$C1_3$	$P0_3$/SEG_{19} pin function select bit	0	SEG_{19}		
		1	$P0_3$		
$C1_2$	$P0_2$/SEG_{18} pin function select bit	0	SEG_{18}		
		1	$P0_2$		
$C1_1$	$P0_1$/SEG_{17} pin function select bit	0	SEG_{17}		
		1	$P0_1$		
$C1_0$	$P0_0$/SEG_{16} pin function select bit	0	SEG_{16}		
		1	$P0_0$		

Note 1: The letter W denotes “writable.”

3.5 LCD Control Register C2

Table 3.5 shows the bit configuration of LCD Control Register C2.

For write to the register C2, first set a value in the register A and then use the TC2A instruction.

Table 3.5 Bit Configuration of LCD Control Register C2

LCD Control Register C2		When reset: 1111_2		When powered down: State retained	W TC2A
$C2_3$	$P1_3$/SEG_{23} pin function select bit	0	SEG_{23}		
		1	$P1_3$		
$C2_2$	$P1_2$/SEG_{22} pin function select bit	0	SEG_{22}		
		1	$P1_2$		
$C2_1$	$P1_1$/SEG_{21} pin function select bit	0	SEG_{21}		
		1	$P1_1$		
$C2_0$	$P1_0$/SEG_{20} pin function select bit	0	SEG_{20}		
		1	$P1_0$		

Note 1: The letter W denotes “writable.”

3.6 LCD Control Register C3

Table 3.6 shows the bit configuration of LCD Control Register C3.

For write to the register C3, first set a value in the register A and then use the TC3A instruction.

Table 3.6 Bit Configuration of LCD Control Register C3

LCD Control Register C3		When reset: 1111_2		When powered down: State retained	W TC3A
$C3_3$	$P3_3$/SEG_{31} pin function select bit	0	SEG_{31}		
		1	$P3_3$		
$C3_2$	$P3_2$/SEG_{30} pin function select bit	0	SEG_{30}		
		1	$P3_2$		
$C3_1$	$P3_1$/SEG_{29} pin function select bit	0	SEG_{29}		
		1	$P3_1$		
$C3_0$	$P3_0$/SEG_{28} pin function select bit	0	SEG_{28}		
		1	$P3_0$		

Note 1: The letter W denotes “writable.”

3.7 Timer Control Register W3

Table 3.7 shows the bit configuration of Timer Control Register W3.

For write to the register W3, first set a value in the register A and then use the TW3A instruction.

Furthermore, the TAW3 instruction may be used to transfer the content of register W3 to the register A.

Table 3.7 Bit Configuration of Timer Control Register W3

Timer Control Register W3		When reset: 0000_2		When powered down: State retained	R/W TAW3/TW3A
$W3_3$	Timer 3 count source select bit	0	X_{CIN} input		
		1	Prescaler output (ORCLK) divided by 2		
$W3_2$	Timer 3 control bit	0	Stop (initial state)		
		1	Start		
$W3_1$	Timer 3 count value select bit	$W3_1$	$W3_0$	Count value	
		0	0	Generates underflow every 8,192 counts	
		0	1	Generates underflow every 16,384 counts	
$W3_0$		1	0	Generates underflow every 32,768 counts	
		1	1	Generates underflow every 65,536 counts	

Note 1: The letter R denotes “readable,” and the letter W denotes “writable.”

3.8 Timer Control Register W4

Table 3.8 shows the bit configuration of Timer Control Register W4.

For write to the register W4, first set a value in the register A and then use the TW4A instruction.

Furthermore, the TAW4 instruction may be used to transfer the content of register W4 to the register A.

Table 3.8 Bit Configuration of Timer Control Register W4

Timer Control Register W4		When reset: 0000_2	When powered down: State retained	R/W TAW4/TW4A
$W4_3$	Timer LC control bit	0	Stop (state retained)	
		1	Start	
$W4_2$	Timer LC count source select bit	0	Bit 4 of timer 3 ($T3_4$)	
		1	System clock (STCK)	
$W4_1$	CNTR pin output auto control circuit select bit	0	Deselects CNTR pin output auto control circuit	
		1	Selects CNTR pin output auto control circuit	
$W4_0$	CNTR pin input count edge select bit	0	Falling edge	
		1	Rising edge	

Note 1: The letter R denotes “readable,” and the letter W denotes “writable.”

Note 2: : Unused bits during LCD display function setting.

4. Application Example for the LCD Display Function

4.1 LCD Display

The LCD display function permits display of up to 4 common × 32 segment = 128 pixels to be controlled.

Point : Data can easily be displayed on LCD using the LCD display function.

Specification : Data is displayed on LCD at a 1/4 duty cycle and 1/3 bias using the LCD display panel that is shown as an example below. The frame frequency is set to 85.3 Hz using timer LC for the LCD clock source, bit 4 of timer 3 for the timer LC clock source and the sub-clock f(XCIN) = 32.768 kHz for the timer 3 clock source, respectively. In the sample program, a string “M34559” is displayed on the LCD panel shown below.

Figure 4.1shows an example of an LCD display panel. Figure 4.2 shows an example of RAM arrangement for LCD display. Figure 4.3 shows an example of a segment arrangement for an LCD display panel. Figure 4.4 shows an example of how to set the registers for LCD display.

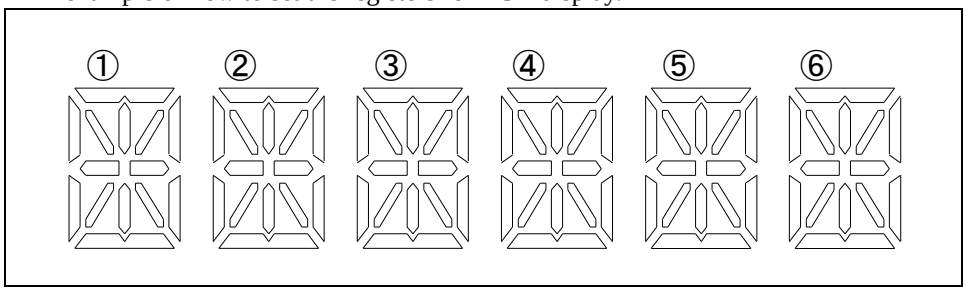

Figure 4.1 Example of an LCD Display Panel

Register Z	1															
Register X	0				1				2				3			
bit / Register Y	3	2	1	0	3	2	1	0	3	2	1	0	3	2	1	0
8	SEG0	SEG0	SEG0	SEG0	SEG8	SEG8	SEG8	SEG8	SEG16	SEG16	SEG16	SEG16	SEG24	SEG24	SEG24	SEG24
9	SEG1	SEG1	SEG1	SEG1	SEG9	SEG9	SEG9	SEG9	SEG17	SEG17	SEG17	SEG17	SEG25	SEG25	SEG25	SEG25
10	SEG2	SEG2	SEG2	SEG2	SEG10	SEG10	SEG10	SEG10	SEG18	SEG18	SEG18	SEG18	SEG26	SEG26	SEG26	SEG26
11	SEG3	SEG3	SEG3	SEG3	SEG11	SEG11	SEG11	SEG11	SEG19	SEG19	SEG19	SEG19	SEG27	SEG27	SEG27	SEG27
12	SEG4	SEG4	SEG4	SEG4	SEG12	SEG12	SEG12	SEG12	SEG20	SEG20	SEG20	SEG20	SEG28	SEG28	SEG28	SEG28
13	SEG5	SEG5	SEG5	SEG5	SEG13	SEG13	SEG13	SEG13	SEG21	SEG21	SEG21	SEG21	SEG29	SEG29	SEG29	SEG29
14	SEG6	SEG6	SEG6	SEG6	SEG14	SEG14	SEG14	SEG14	SEG22	SEG22	SEG22	SEG22	SEG30	SEG30	SEG30	SEG30
15	SEG7	SEG7	SEG7	SEG7	SEG15	SEG15	SEG15	SEG15	SEG23	SEG23	SEG23	SEG23	SEG31	SEG31	SEG31	SEG31
COM	COM3	COM2	COM1	COM0	COM3	COM2	COM1	COM0	COM3	COM2	COM1	COM0	COM3	COM2	COM1	COM0

Figure 4.2 Example of RAM Arrangement for LCD Display

Register Z	1											
Register X	0				1				2			
bit / Register Y	3	2	1	0	3	2	1	0	3	2	1	0
8	①-d	①-c	①-b	①-a	③-d	③-c	③-b	③-a	⑤-d	⑤-c	⑤-b	⑤-a
9	①-h	①-g	①-f	①-e	③-h	③-g	③-f	③-e	⑤-h	⑤-g	⑤-f	⑤-e
10	①-k	①-j		①-i	③-k	③-j		③-i	⑤-k	⑤-j		⑤-i
11	①-n	①-l		①-m	③-n	③-l		③-m	⑤-n	⑤-l		⑤-m
12	②-d	②-c	②-b	②-a	④-d	④-c	④-b	④-a	⑥-d	⑥-c	⑥-b	⑥-a
13	②-h	②-g	②-f	②-e	④-h	④-g	④-f	④-e	⑥-h	⑥-g	⑥-f	⑥-e
14	②-k	②-j		②-i	④-k	④-j		④-i	⑥-k	⑥-j		⑥-i
15	②-n	②-l		②-m	④-n	④-l		④-m	⑥-n	⑥-l		⑥-m
COM	COM3	COM2	COM1	COM0	COM3	COM2	COM1	COM0	COM3	COM2	COM1	COM0

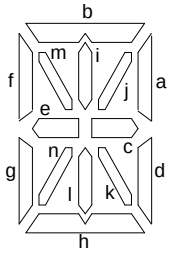

Figure 4.3 Example of a Segment Arrangement for an LCD Display Panel

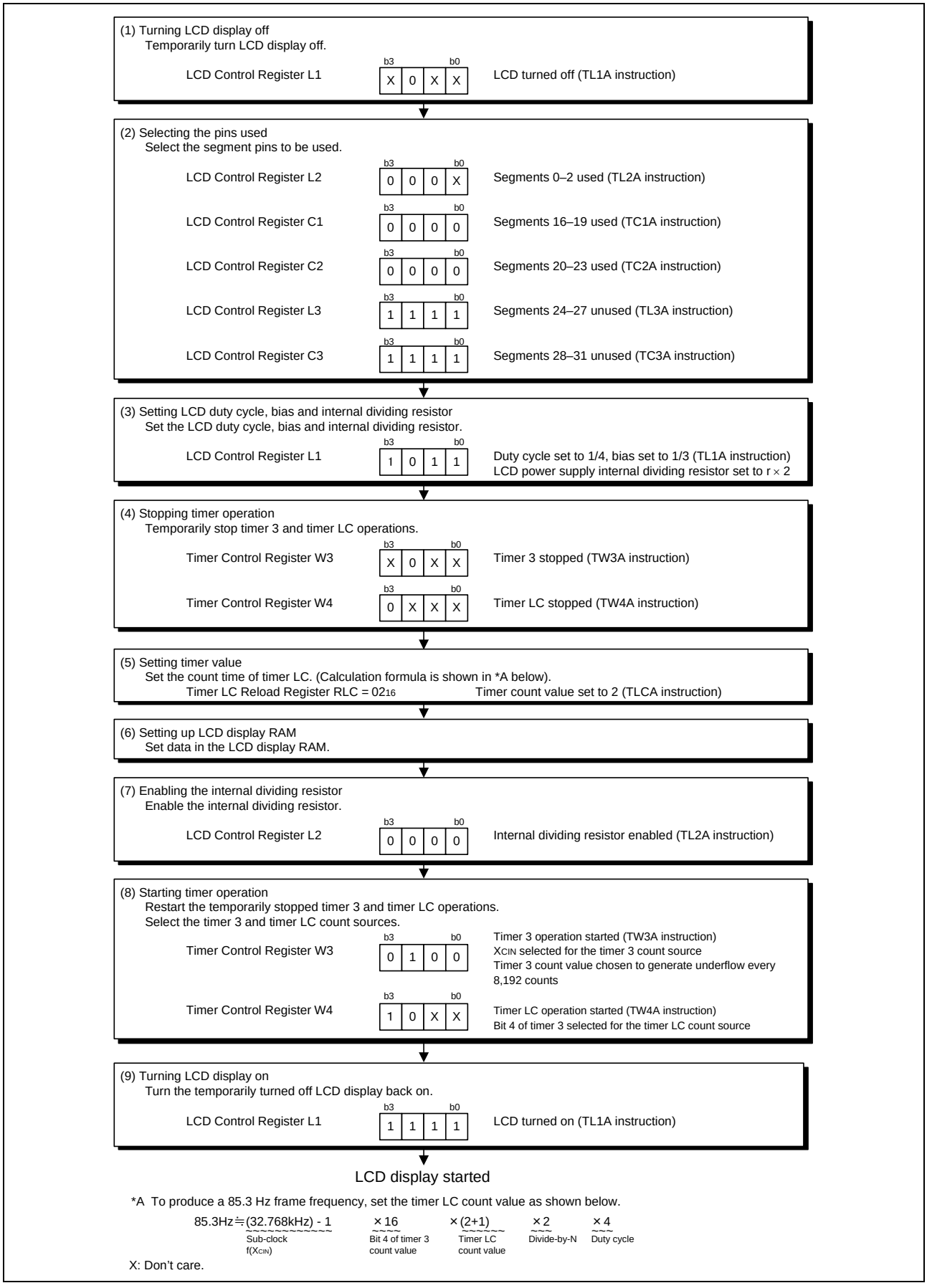

Figure 4.4 Example of LCD Display Setting

5. Sample Programs

Sample programs are available from the Renesas Technology Web site. To download one, click the screen menu "Application Note" on the left side of 4559 group Web page.

6. Reference Documents

Data sheet
4559 Group Data Sheet

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Revision history	4559 GroupLCD Display Function Application Note

Rev.	Date	Description	
		Page	Points
1.00	2006.11.01	–	First edition issued

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