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M32C/85 Group

7-Segment LED Display (Dynamic Lighting Method)

1. Abstract

This application note describes how to use the dynamic lighting method for the 7-segment LED display.

2. Introduction

This application note is applied to the following condition:
Applicable MCU:M32C/85 Group

The program on this application note can also be used when operating other microcomputers within the M16C Family, provided they have the same SFR (Special Function Registers) as the M32C/85 Group. However, some functions may have been modified. Refer to each device's hardware manual for details. Use functions covered in this application note only after careful evaluation.

3. Detailed Description

How to display the dynamic lighting LED is as follows:

A) Two ports for DIGIT output and eight ports for SEGMENT output are used.
DIGIT output: low active, P10 to P11
SEGMENT output: low active, P00 to P07

B) The DIGIT output switches between the active LED1 and LED2, shown in Figure 1 on page 2, every 1 ms. A variable digit controls the DIGIT output. Timer A timer mode is used for 1-ms measurement.

C) The SEGMENT output controls display patterns on LED1 and LED2. High-order 8 bits of a variable seg_data are output to LED1. Low-order 8 bits are output to LED2. The variable seg_data increments every 1 sec. Timer A0 underflow count is used in Timer A1 event counter mode for 1-sec measurement.

The sample program on page 4 may manipulate bits assigned to unused functions due to SFR configuration. The bit settings must be changed depending on your system.

Table 1 lists the assigned pins.

Table 1. Assigned Pin

Pins	Input/Output	Low Active or High Active	Functions
P10	Output	Low Active	DIGIT Output for LED1
P11	Output	Low Active	DIGIT Output for LED2
P00	Output	Low Active	SEGMENT Output for a
P01	Output	Low Active	SEGMENT Output for b
P02	Output	Low Active	SEGMENT Output for c
P03	Output	Low Active	SEGMENT Output for d
P04	Output	Low Active	SEGMENT Output for e
P05	Output	Low Active	SEGMENT Output for f
P06	Output	Low Active	SEGMENT Output for g
P07	Output	Low Active	SEGMENT Output for h

Figures 1 and 2 show LED block diagrams.

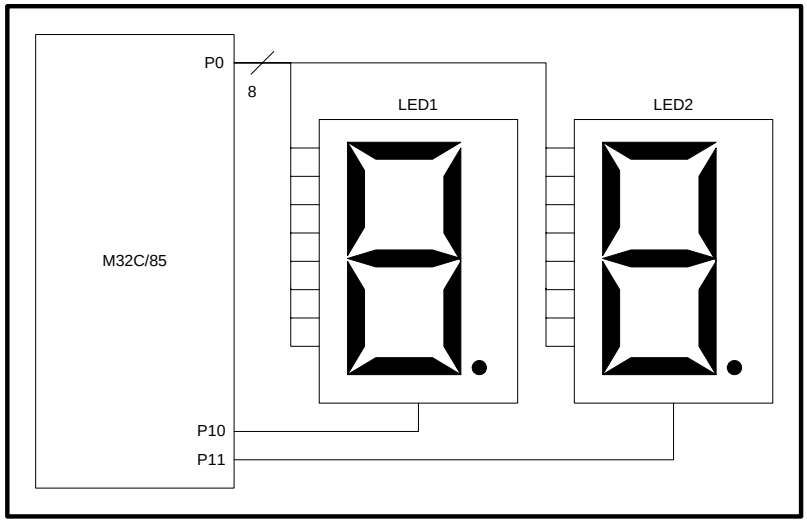

Figure 1. LED Block Diagram (1)

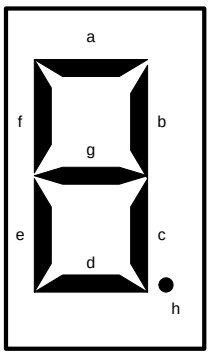

Figure 2. LED Block Diagram (2)

Figure 3 shows a flowchart to configure register settings.

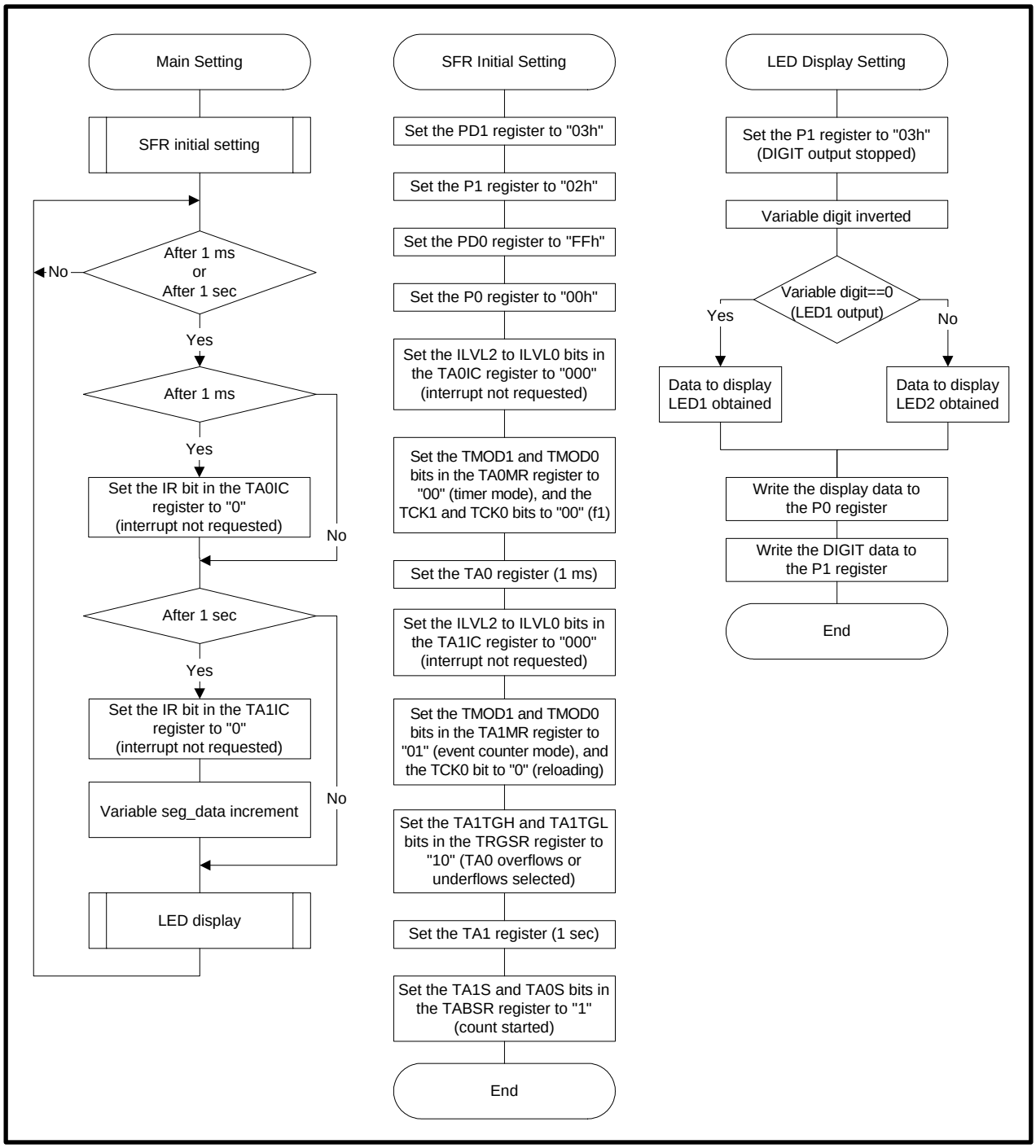

Figure 3. Register Setting Configuration

4. Sample Program

```
/*""FILE COMMENT""*********************************************************
* System Name    : M32C/85 Program Collection
* File Name      : rjj05b0720_src.c
* Version        : 1.00
* Contents       : 7-segment LED display (Dynamically turn on)
* Customer       :
* Model          :
* Order          :
* CPU            : M32C/85 Group
* Compiler       : NC308WA (V.5.20 Release 1)
* OS             : Nothing
* Programmer     :
* Note           :
************************************************************************
* Copyright,2005 RENESAS TECHNOLOGY CORPORATION
* AND RENESAS SOLUTIONS CORPORATION
************************************************************************
* History    : 2005.2.28 Ver 1.00
*""FILE COMMENT END""*****************************************************/

/***************************************/
/*    include file                     */
/***************************************/
#include "sfr32c85.h"

/***************************************/
/*    define                           */
/***************************************/
typedef unsigned char    UCHAR;

/***************************************/
/*   RAM                               */
/***************************************/
UCHAR seg_data = 0;                 /* display data                    */

/***************************************/
/*   Declaration of function prototype */
/***************************************/
void main(void);
void sfr_init(void);                    /* Initial setting of SFR registers */
void seg_disp(void);                    /* LED indication                   */

/***************************************/
/*    main                             */
/***************************************/
void main(void) {
    sfr_init();                         /* Initial setting of SFR registers */
```

```
    while(1){                       /* Main processing                  */
        while((ir_ta0ic == 0) && (ir_ta1ic == 0)) {
        }
        if (ir_ta0ic == 1) {
            ir_ta0ic = 0;
        }
        if (ir_ta1ic == 1) {
            ir_ta1ic = 0;
            seg_data++;
        }

        seg_disp();                 /* LED indication                   */
    }
}

/****************************************/
/*     Initial setting of SFR registers         */
/****************************************/
void sfr_init(void) {

    /* LED port setting */
    pd1 = 0x03U;                    /* Digit port direction output      */
    p1  = 0x02U;                    /* Digit = LED1                     */
    pd0 = 0xff;                     /* Segment port direction output    */
    p0  = 0x00U;                    /* Segment initial                  */

    /* Timer setting */
    ta0ic = 0x00;
    /* Interrupt control register                                       */
    /* 00000000B                                                        */
    /*        +++---- (ILVL2-ILVL0):Interrupt priority level            */
    /*                    000:Interrupt disabled                        */

    ta0mr = 0x00;
    /* Timer A0 mode register                                           */
    /* 00000000B                                                        */
    /* ||      ++---- (TMOD1-TMOD0):Operation mode select bit           */
    /* ||                  00: Timer mode                               */
    /* ++---------- (TCK1-TCK0):Count source select bit                 */
    /*                    *00:f1                                        */
    /*                     01:f8                                        */
    /*                     10:f2n                                       */
    /*                     11:fc32                                      */

    ta0 = 30000U-1U;                /* 1msec   @30MHz, f1               */

    ta1ic = 0x00;
    ta1mr = 0x01;
    /* Timer A1 mode register                                           */
```

```
    /* 00000000B                                                    */
    /*   | || ++---- (TMOD1-TMOD0):Operation mode select bit        */
    /*   | ||           01:Event counter mode                       */
    /*   | |+------- (MR1):Count polarity select bit                */
    /*   | |            0:Counts falling edges of an external signal */
    /*   | +-------- (MR2):Inc/Dec switching cause select bit        */
    /*   |            0:Setting of the UDF regster                  */
    /*   +---------- (TCK0):Count opration type select bit          */
    /*               0:Reloading                                    */

    trgsr = 0x02;
    /* Setting trigger select register                              */
    /* 00000010B                                                    */
    /*         ++----- (TA1TGH-TA1TGL):Timer A1 event/trigger select bit */
    /*               10:TA0 underflow is selected                   */

    ta1 = 1000U-1U;                 /* 1msec * 1000 = 1sec        */

    tabsr = 0x03;
    /* Count start flag                                             */
    /* 00000011B                                                    */
    /*         | |                                                  */
    /*         |+---- (TA0S):Timer A0 Count start flag              */
    /*         |          1:Starts counting                         */
    /*         +----- (TA1S):Timer A1 Count start flag              */
    /*               1:Starts counting                              */

}

/*****************************************/
/*   LED indication                      */
/*****************************************/
#define seg_a    0xfeU
#define seg_b    0xfdU
#define seg_c    0xfbU
#define seg_d    0xf7U
#define seg_e    0xefU
#define seg_f    0xdfU
#define seg_g    0xbfU
#define seg_h    0x7fU

void seg_disp(void) {

    static UCHAR digit = 0;

    static const UCHAR digit_data [2] = {0x02,0x01};
                                /* digit select data              */
```

```
    static const UCHAR SEGdata_table[16] = {
        0xffU &seg_a &seg_b &seg_c &seg_d &seg_e &seg_f          , /* "0" */
        0xffU          &seg_b &seg_c                             , /* "1" */
        0xffU &seg_a &seg_b          &seg_d &seg_e          &seg_g , /* "2" */
        0xffU &seg_a &seg_b &seg_c &seg_d                   &seg_g , /* "3" */
        0xffU          &seg_b &seg_c                 &seg_f &seg_g , /* "4" */
        0xffU &seg_a          &seg_c &seg_d          &seg_f &seg_g , /* "5" */
        0xffU &seg_a          &seg_c &seg_d &seg_e &seg_f &seg_g , /* "6" */
        0xffU &seg_a &seg_b &seg_c                  &seg_f          , /* "7" */
        0xffU &seg_a &seg_b &seg_c &seg_d &seg_e &seg_f &seg_g , /* "8" */
        0xffU &seg_a &seg_b &seg_c &seg_d          &seg_f &seg_g , /* "9" */
        0xffU &seg_a &seg_b &seg_c          &seg_e &seg_f &seg_g , /* "A" */
        0xffU                  &seg_c &seg_d &seg_e &seg_f &seg_g , /* "B" */
        0xffU &seg_a                  &seg_d &seg_e &seg_f          , /* "C" */
        0xffU          &seg_b &seg_c &seg_d &seg_e          &seg_g , /* "D" */
        0xffU &seg_a                  &seg_d &seg_e &seg_f &seg_g , /* "E" */
        0xffU &seg_a                         &seg_e &seg_f &seg_g   /* "F" */
    };

    UCHAR i;

    p1 = 0x03U;                     /* Digit output off                 */

    digit ^= 1U;

    if (digit == 0) {               /* LED1 output                      */
        i = SEGdata_table[seg_data>>4];
    } else {                        /* LED2 output                      */
        i = SEGdata_table[seg_data & 0x0fU];
    }
    p0  = i;                        /* output segment ports             */

    p1 = digit_data[digit];         /* Digit change                     */
}
```

5. Reference

Hardware Manual

M32C/85 Group Hardware Manual Rev.1.03
(Use the latest version on the home page: http://www.renesas.com/en/m16c)

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REVISION HISTORY

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		Page	Summary
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