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2010年4月1日  
瑞萨电子公司

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## H8/300L SLP 系列

### 静态驱动的液晶显示

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#### 要点

使用 H8/38024 系列的段型 LCD 控制电路、LCD 驱动器以及电源电路进行 LCD 显示。

#### 动作确认器件

H8/38024

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### 1. 说明

- (1) 使用 H8/38024 系列的段型 LCD 控制电路、LCD 驱动器以及电源电路进行 LCD 显示。
- (2) 使用 1 个公共信号和 32 个段信号，以静态进行显示。
- (3) 本例子的液晶模块连接和液晶显示的例子如图 1 所示。

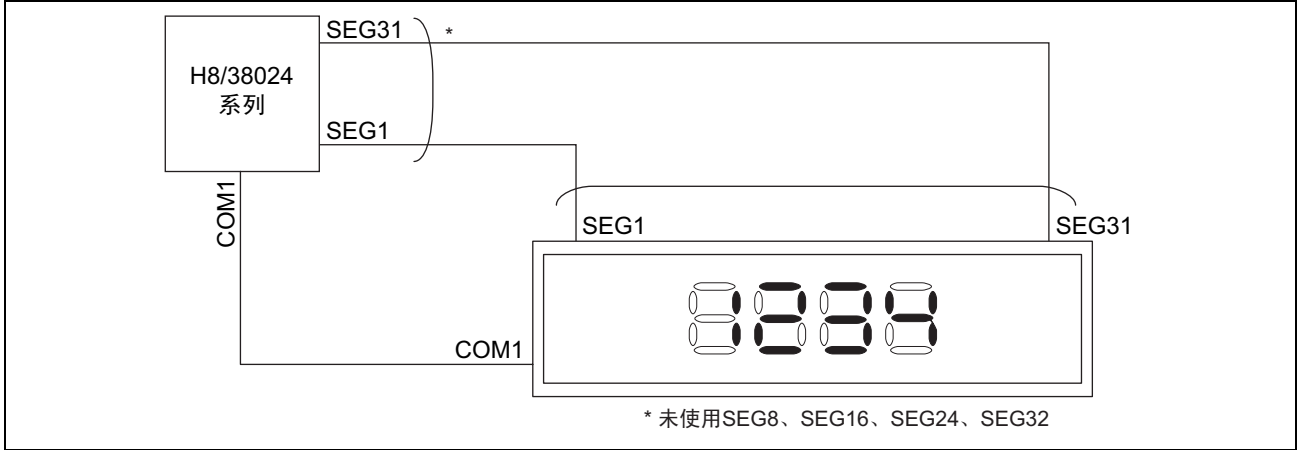


图 1 液晶显示的例子

### 2. 使用功能的说明

- (1) 本例子使用 LCD 控制器/驱动器进行液晶显示，LCD 控制器/驱动器的特征如下所示：
  - 显示容量
    - (a) 占空比：静态  
~ 内部驱动器：32SEG
    - (b) 占空比：1/2  
~ 内部驱动器：32SEG
    - (c) 占空比：1/3  
~ 内部驱动器：32SEG
    - (d) 占空比：1/4  
~ 内部驱动器：32SEG
  - LCD RAM 容量：8 × 16 字节（128）
  - 可字存取 LCD RAM
  - 可将段输出管脚以每 4 个管脚用作端口
  - 可根据占空比而不使用的公共输出管脚用作公共双缓冲器（用于并联）
  - 能以待机模式以外的运行模式显示
  - 可选择 11 种帧频
  - 内置电源分压电阻，供给 LCD 驱动电源
  - 通过模块待机模式，可将未使用时的单模块设定为待机模式
  - 可通过软件选择 A 波形或者 B 波形

(2) 本例子使用的 LCD 控制器/驱动器的框图如图 2 所示。

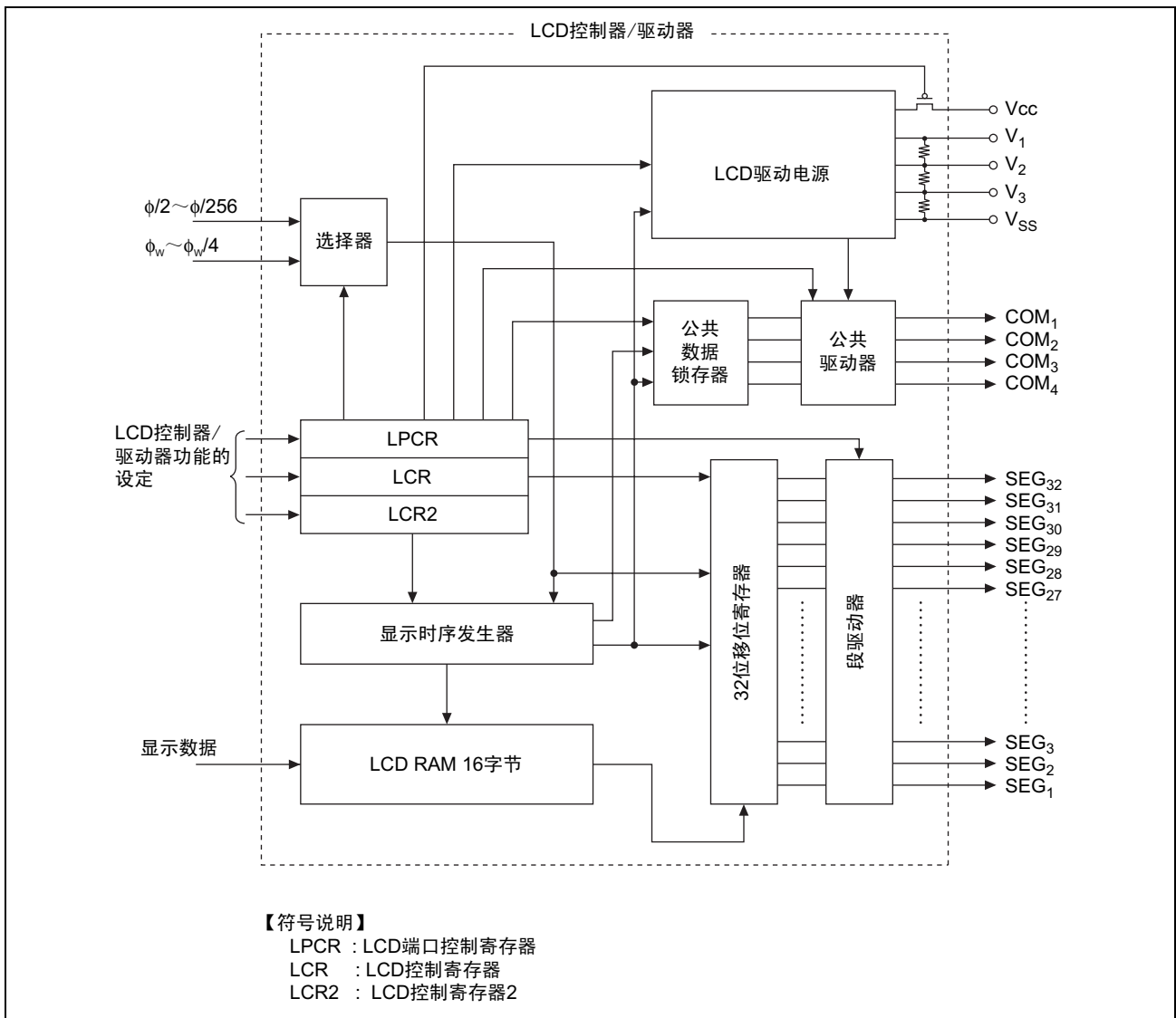


图 2 LCD 控制器/驱动器的框图

(3) 表 1 说明 LCD 控制器/驱动器的各种功能。

表 1 LCD 控制器/驱动器的功能

LCD 端口控制寄存器 (LPCR)	
功能	LPCR 是 8 位可读写寄存器, 选择占空比、LCD 驱动器和管脚功能。复位时, LPCR 被初始化为 H'00。
LCD 控制寄存器 (LCR)	
功能	LCR 是 8 位可读写寄存器, 控制 LCD 驱动电源的 ON/OFF 和显示数据以及选择帧频。复位时, LCR 被初始化为 H'80。
LCD 控制寄存器 2 (LCR2)	
功能	LCR2 是 8 位可读写寄存器, 控制 A 波形/B 波形的转换。复位时, LCR2 被初始化为 H'60。
段输出管脚 (SEG32~SEG1)	
功能	是液晶的段驱动管脚, 与全部端口兼用, 可设定为可编程。
公共输出管脚 (COM4~COM1)	
功能	是液晶的公共驱动的管脚, 在静态或 1/2 占空比时可并联管脚。
LCD 电源管脚 (V1、V2、V3)	
功能	用于外接旁路电容和使用外部电源电路。
LCD RAM	
功能	设定显示数据。另外, LCD RAM 和显示段的关系因占空比而不同。在设定了显示时所需的寄存器群之后, 通过和通常的 RAM 同样的指令将数据写到对应占空比的部分, 如果显示为 ON, 就自动开始显示。在设定 RAM 时能使用字/字节存取指令。

(4) 本例子使用 4 位 7 段 LCD 进行静态驱动的液晶显示。本例子使用的 4 位 7 段 LCD 的段信号和公共信号的对应图如图 3 所示。

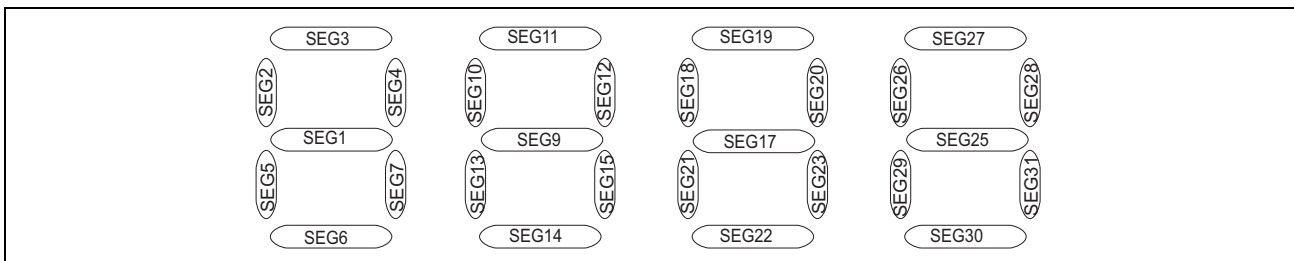


图 3 本例子使用的 4 位 7 段 LCD 的段信号的对应图

(5) 静态驱动时的 LCD RAM 映像如图 4 所示。

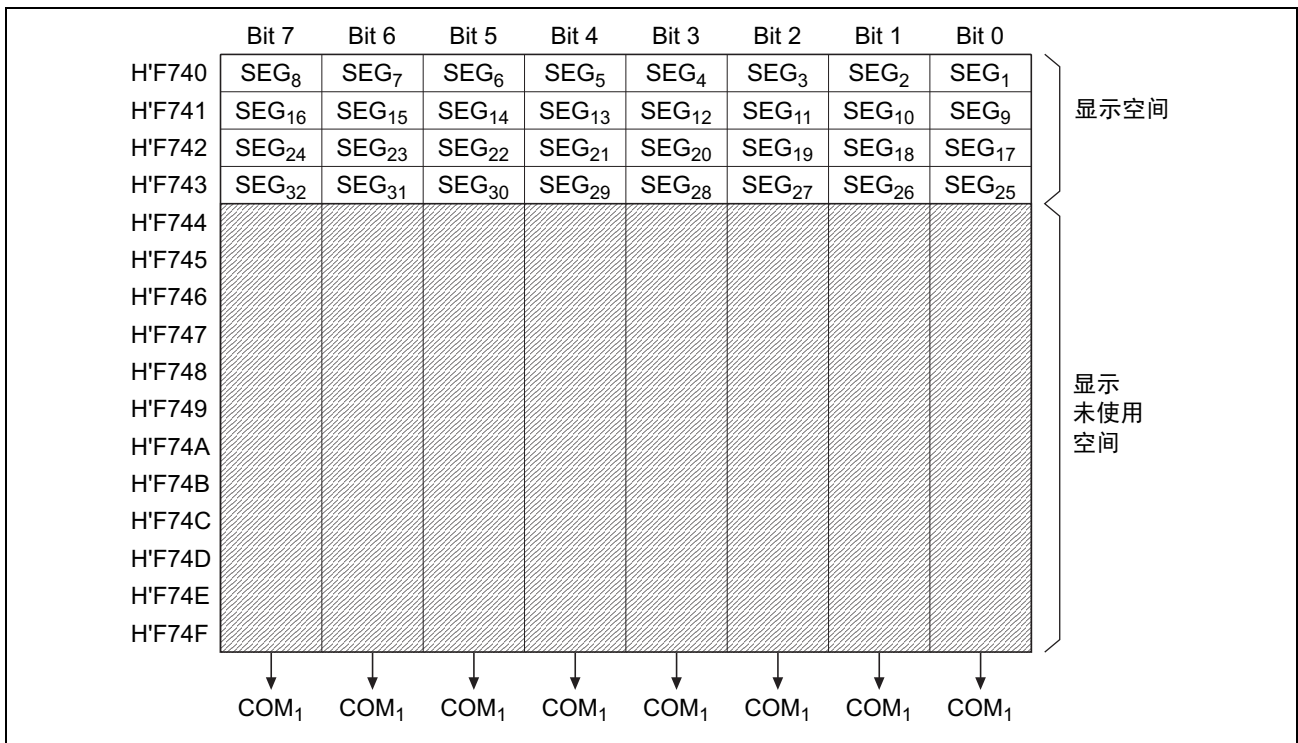


图 4 静态驱动时的 LCD RAM 映像

(6) 本例子使用的 4 位 7 段 LCD 显示和 LCD RAM 设定值的关系如图 5 所示。如图 5 所示，通过设定 LCD RAM，将"1234"显示在 4 位 7 段 LCD。

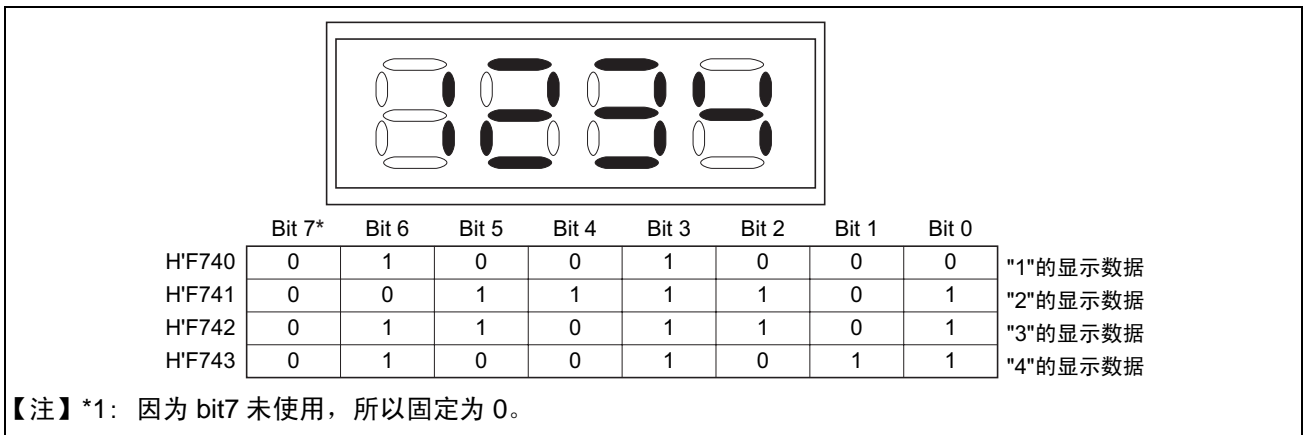


图 5 LCD 显示和 LCD RAM 设定值的关系

(7) 对应 4 位 7 段 LCD 的 SEG1 ~ SEG7 的 LCD RAM 的关系如图 6 所示。如图 6 所示，如果给对应 0 ~ 7 的 LCD RAM 位置"1"，LCD 就显示；如果清"0"，LCD 就不显示。

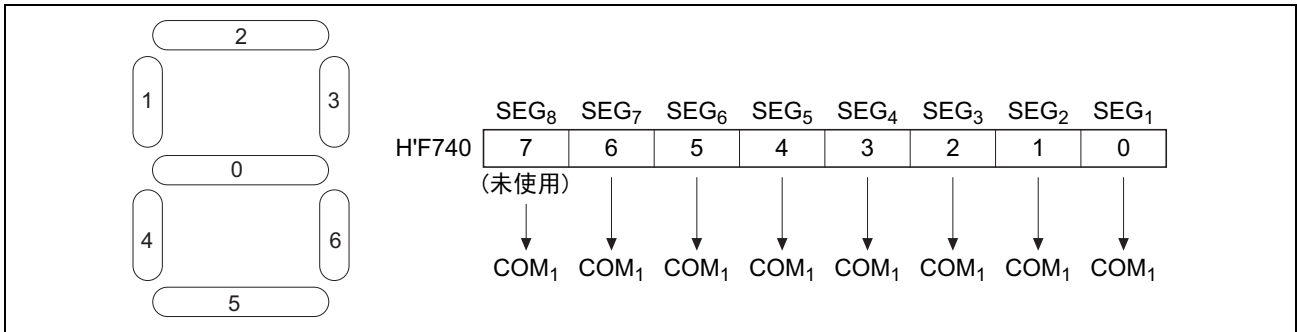


图 6 对应 LCD 的显示/不显示的 LCD RAM 设定值的关系

(8) 4 位 7 段 LCD 的 SEG1 ~ SEG7 显示和显示数据的例子如表 2 所示。

表 2 显示数据的例子

符号	显示	地址	显示数据							
		H'F740	0	0	0	0	0	0	0	0
-		H'F740	0	0	0	0	0	0	0	1
0		H'F740	0	1	1	1	1	1	1	0
1		H'F740	0	1	0	0	1	0	0	0
2		H'F740	0	0	1	1	1	1	0	1
3		H'F740	0	1	1	0	1	1	0	1
4		H'F740	0	1	0	0	1	0	1	1
5		H'F740	0	1	1	0	0	1	1	1
6		H'F740	0	1	1	1	0	1	1	1
7		H'F740	0	1	0	0	1	1	1	0
8		H'F740	0	1	1	1	1	1	1	1
9		H'F740	0	1	1	0	1	1	1	1
A		H'F740	0	1	0	1	1	1	1	1
B		H'F740	0	0	1	1	0	0	1	1
C		H'F740	0	0	1	1	0	1	1	0
D		H'F740	0	1	1	1	1	0	0	1
E		H'F740	0	0	1	1	0	1	1	1
F		H'F740	0	0	0	1	0	1	1	1



(9) 在本例子中的功能分配如表 3 所示。

表 3 功能分配

功能	功能分配
LPCR	选择占空比、LCD 驱动器和管脚功能。
LCR	进行 LCD 驱动电源 ON/OFF 控制、显示数据的控制和帧频的选择。
LCR2	控制 A 波形/B 波形的转换。
SEG <sub>31</sub> ~SEG <sub>25</sub> SEG <sub>23</sub> ~SEG <sub>17</sub> SEG <sub>15</sub> ~SEG <sub>9</sub> SEG <sub>7</sub> ~SEG <sub>1</sub>	用作段驱动管脚。
COM1	用作公共驱动管脚。
LCD RAM	设定 LCD 的显示数据。

3. 运行说明

(1) 说明进行 LCD 显示的软件的各种设定。

(a) 占空比的选择

能通过 DTS1、DTS0 从静态、1/2 占空比、1/3 占空比以及 1/4 占空比中选择占空比。

(b) 段驱动器的选择

能通过 SGS3~SGS0 选择使用的段驱动器。

(c) 帧频的选择

能通过设定 CKS3~CKS0 选择帧频。请按照 LCD 显示屏的指定选择帧频。

(d) A 波形、B 波形的选择

能通过 LCDAB 选择使用的 LCD 波形是 A 波形还是 B 波形。

(2) 运行说明如图 7 所示。

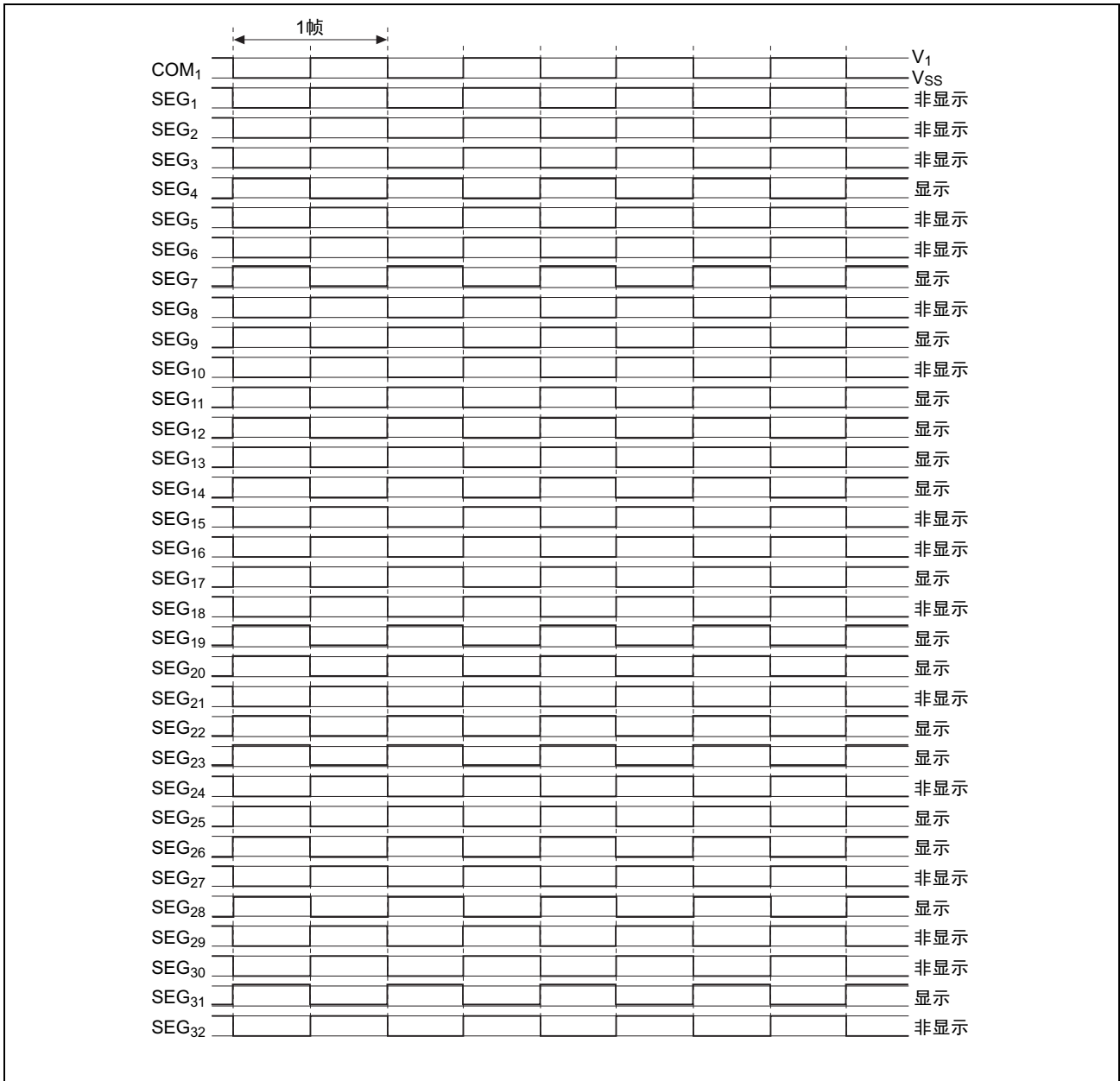


图 7 运行说明

#### 4. 软件说明

##### (1) 模块说明

本例子的模块如表 4 所示。

表 4 模块说明

模块名	标号名	功能
主程序	main	初始设定 LCD RAM、LCD 控制器/驱动器，允许中断，控制 LCD 显示。

##### (2) 参数说明

本例子不使用参数。

##### (3) 使用内部寄存器的说明

本例子使用的内部寄存器如表 5 所示。

表 5 使用内部寄存器的说明

寄存器名		说明	地址	设定值
LPCR	DTS1, DTS0	LCD 端口控制寄存器（占空比选择 1、0） ~通过 DTS1 和 DTS0 的组合，选择静态、1/2、1/3、1/4 占空比中的一项。 : 当 DTS1="0"、DTS0="0"时，选择静态。 : 当 DTS1="0"、DTS0="1"时，选择 1/2 占空比。 : 当 DTS1="1"、DTS0="0"时，选择 1/3 占空比。 : 当 DTS1="1"、DTS0="1"时，选择 1/4 占空比。	H'FFC0 位 7 位 6	DTS1 = 0 DTS0 = 0
	CMX	LCD 端口控制寄存器（公共功能选择） ~为了增大公共驱动能力，选择是否从因占空比而未被使用的公共管脚输出相同波形。 : 当 CMX="0"时，根据占空比而不使用的多个公共管脚不输出相同波形 : 当 CMX="1"时，根据占空比而不使用的多个公共管脚输出相同波形	H'FFC0 位 5	"0"

表 5 使用内部寄存器的说明 (续)

寄存器名		说明	地址	设定值
LPCR	SGS3 SGS2 SGS1 SGS0	LCD 端口控制寄存器 (段驱动器选择) ~为了设定帧频, 选择时钟。 : 当 SGS3="0"、SGS2="0"、SGS1="0"、SGS0="0"时, SEG32~SEG1 管脚用作端口 : 当 SGS3="0"、SGS2="0"、SGS1="0"、SGS0="1"时, SEG32~SEG1 管脚用作端口 : 当 SGS3="0"、SGS2="0"、SGS1="1"、SGS0="*"时, SEG32~SEG25 管脚用作段驱动器, SEG24~SEG1 管脚用作 端口 : 当 SGS3="0"、SGS2="1"、SGS1="0"、SGS0="*"时, SEG32~SEG17 管脚用作段驱动器, SEG16~SEG1 管脚用作 端口 : 当 SGS3="0"、SGS2="1"、SGS1="1"、SGS0="*"时, SEG32~SEG9 管脚用作段驱动器, SEG8~SEG1 管脚用作端 口 : 当 SGS3="1"、SGS2="*"、SGS1="*"、SGS0="*"时, SEG32~SEG1 管脚用作段驱动器。	H'FFC0 位 3 位 2 位 1 位 0	SGS3 = 1 SGS2 = 0 SGS1 = 0 SGS0 = 0
LCR	PSW	LCD 控制寄存器 (LCD 驱动电源 ON/OFF 控制) ~在低功耗模式不使用 LCD 显示并且使用外部电源的情况下, 能将 LCD 驱动电源置为 OFF 状态。当 ACT 为 "0" 并且在待机模式的情 况下, LCD 驱动电源与本位无关处于 OFF 状态。 : 当 PSW="0"时, LCD 驱动电源处于 OFF 状态 : 当 PSW="1" 时, LCD 驱动电源处于 ON 状态	H'FFC1 位 6	"1"
	ACT	LCD 控制寄存器 (显示功能的开始) ~选择是否使用 LCD 控制器/驱动器。通过将本位清 "0", LCD 控制 器/驱动器停止运行。另外, 与 PSW 的值无关, LCD 驱动电源处 于 OFF 状态。但是保持寄存器的内容。 : 当 ACT="0"时, LCD 控制器/驱动器停止运行 : 当 ACT="1"时, LCD 控制器/驱动器运行	H'FFC1 位 5	"1"
	DISP	LCD 控制寄存器 (显示数据的控制) ~DISP 选择是显示 LCD RAM 的内容还是显示与 LCD RAM 内容 无关的空白数据。 : 当 DISP="0"时, 显示空白数据 : 当 DISP="1"时, 显示 LCD RAM 数据	H'FFC1 位 4	"1"

【注】\*: Don't Care

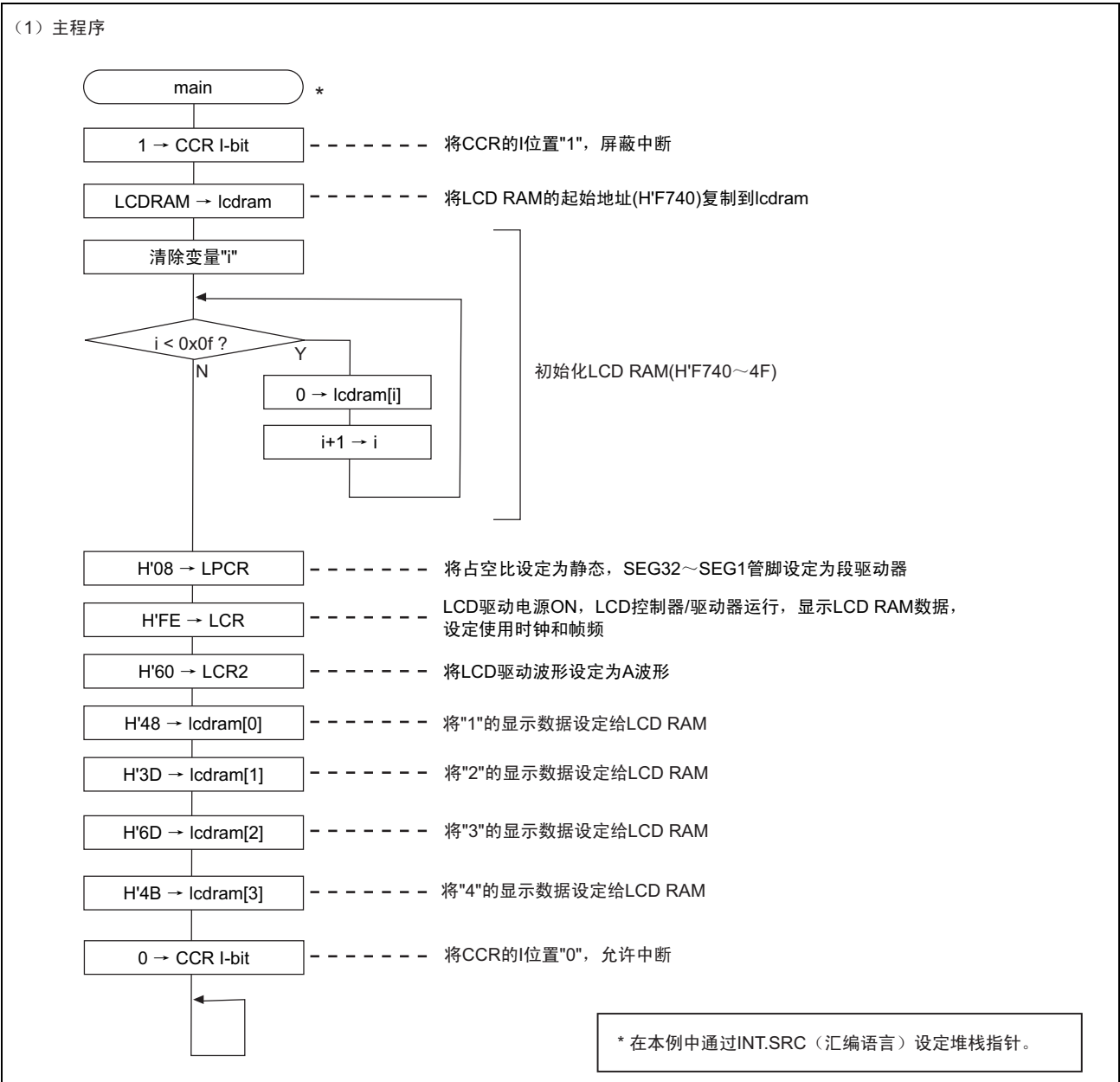
表 5 使用内部寄存器的说明 (续)

寄存器名		说明	地址	设定值
LCR	CKS3 CKS2 CKS1 CKS0	LCD 控制寄存器 (帧频选择 3~0) ~为了设定帧频, 选择时钟。 : 当 CKS3="0"、CKS2="*"、CKS1="0"、CKS0="0"时, 选择 $\phi_w$ 为使用时钟 : 当 CKS3="0"、CKS2="*"、CKS1="0"、CKS0="1"时, 选择 $\phi_w/2$ 为使用时钟 : 当 CKS3="0"、CKS2="*"、CKS1="1"、CKS0="*"时, 选择 $\phi_w/4$ 为使用时钟 : 当 CKS3="1"、CKS2="0"、CKS1="0"、CKS0="0"时, 选择 $\phi/2$ 为使用时钟 : 当 CKS3="1"、CKS2="0"、CKS1="0"、CKS0="1"时, 选择 $\phi/4$ 为使用时钟 : 当 CKS3="1"、CKS2="0"、CKS1="1"、CKS0="0"时, 选择 $\phi/8$ 为使用时钟 : 当 CKS3="1"、CKS2="0"、CKS1="1"、CKS0="1"时, 选择 $\phi/16$ 为使用时钟 : 当 CKS3="1"、CKS2="1"、CKS1="0"、CKS0="0"时, 选择 $\phi/32$ 为使用时钟 : 当 CKS3="1"、CKS2="1"、CKS1="0"、CKS0="1"时, 选择 $\phi/64$ 为使用时钟 : 当 CKS3="1"、CKS2="1"、CKS1="1"、CKS0="0"时, 选择 $\phi/128$ 为使用时钟 : 当 CKS3="1"、CKS2="1"、CKS1="1"、CKS0="1"时, 选择 $\phi/256$ 为使用时钟	H'FFC1 位 3 位 2 位 1 位 0	CKS3 = 1 CKS2 = 1 CKS1 = 1 CKS0 = 0
	LCR2	LCDA B	LCD 控制寄存器 2 (控制 A 波形/B 波形的转换) ~选择 LCD 的驱动波形是 A 波形还是 B 波形。 : 当 LCDAB="0"时, LCD 由 A 波形驱动 : 当 LCDAB="1"时, LCD 由 B 波形驱动	H'FFC2 位 7

【注】\*: Don't Care

(4) 使用 RAM 的说明  
 本例子不使用 RAM。

5. 流程图



## 6. 程序清单

### 6.1 INIT.SRC (程序清单)

```

        .EXPORT  _INIT
        .IMPORT  _main
;
        .SECTION P, CODE
        _INIT:
        MOV.W   #'FF80, R7
        LDC.B   #'10000000, CCR
        JMP     @_main
;
        .END

```

```

/*****/
/*                                     */
/* H8/300L Super Low Power Series      */
/*   -H8/38024 Series-                 */
/* Application Note                     */
/*                                     */
/* 'Liquid Crystal Display             */
/*   -Static Drive, Internal Driver-'   */
/*                                     */
/* Function                             */
/* : LCD Controller / Driver           */
/*                                     */
/* External Clock : 10MHz               */
/* Internal Clock : 5MHz                */
/* Sub Clock      : 32.768kHz           */
/*                                     */
/*****/

#include <machine.h>

/*****/
/* Symbol Definition                   */
/*****/
struct BIT {
    unsigned char  b7:1;    /* bit7 */
    unsigned char  b6:1;    /* bit6 */
    unsigned char  b5:1;    /* bit5 */
    unsigned char  b4:1;    /* bit4 */
    unsigned char  b3:1;    /* bit3 */
    unsigned char  b2:1;    /* bit2 */
    unsigned char  b1:1;    /* bit1 */
    unsigned char  b0:1;    /* bit0 */
};

#define  LPCR      *(volatile unsigned char *)0xFFC0 /* LCD Port Control Register */
#define  LCR       *(volatile unsigned char *)0xFFC1 /* LCD Control Register      */
#define  LCR2     *(volatile unsigned char *)0xFFC2 /* LCD Control Register 2   */
#define  LCDRAM   *(volatile unsigned char *)0xF740 /* LCD RAM                   */

/*****/
/* Function define                      */
/*****/
extern void INIT ( void ); /* SP Set */

```

```

void      main ( void );

/*****
/* Vector Address          */
/*****
#pragma section    V1          /* VECTOR SECTOIN SET          */
void (*const VEC_TBL1[])(void) = {
    INIT          /* 00 Reset          */
};
#pragma section          /* P          */
/*****
/* Main Program          */
/*****
void main ( void )
{
    int i;
    unsigned char *lcdram;

    set_imask_ccr(1);          /* Interrupt Disable          */

    lcdram = LCDRAM;
    for ( i = 0; i < 0x0F; i++ ){          /* Initialize LCD RAM          */
        lcdram[i] = 0;
    }

    LPCR = 0x08;          /* Static ,Select SEG32-SEG1          */
    LCR = 0xFE;          /* LCD ON          */
    LCR2 = 0x60;

    lcdram[0] = 0x48;          /* "1" */
    lcdram[1] = 0x3d;          /* "2" */
    lcdram[2] = 0x6d;          /* "3" */
    lcdram[3] = 0x4b;          /* "4" */

    set_imask_ccr(0);          /* Interrupt Enable          */

    while (1) {
        ;
    }
}

```

连接地址的指定

段名	地址
CV1	H'0000
P	H'0100



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### 修订记录

Rev.	发行日	修订内容	
		页	修订要点
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