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1. **Abstract**

   This document describes a program for 7-segment LED display (dynamic lighting).

2. **Introduction**

   The application example described in this document applies to the following MCU and parameter(s):

   - **MCU: R8C/25 Group**

   This program can be used with other R8C/Tiny Series MCUs which have the same special function registers (SFRs) as the R8C/25 Group. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.
3. Application Example Description

The 7-segment LED display specifications are as follows:

(1) The 7-segment LEDs are set for dynamic lighting. The LED display uses 12 ports in total - four ports for COM output and eight ports for SEG output.
   
   **COM output**: “L” active, P0_4 to P0_7  
   **SEG output**: “H” active, P1_0 to P1_7

(2) The COM output is set to serial active output every 5 ms and controlled by the variable `com`.
   
   Timer RA is used to measure 5 ms.

(3) The SEG output allows the values (0 to 9 and A to F) in the variable `seg_data` to be converted and output from the display pattern data table (SEGdata_table).

This sample program may include operations of unused bit functions for the SFR bit layout. Set these values according to the operating conditions of the user system.
## 3.1 Pin Usage

### Table 3.1 Pin Usage and Functions

<table>
<thead>
<tr>
<th>Pin</th>
<th>I/O</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0_4</td>
<td>Output</td>
<td>COM output 0</td>
</tr>
<tr>
<td>P0_5</td>
<td>Output</td>
<td>COM output 1</td>
</tr>
<tr>
<td>P0_6</td>
<td>Output</td>
<td>COM output 2</td>
</tr>
<tr>
<td>P0_7</td>
<td>Output</td>
<td>COM output 3</td>
</tr>
<tr>
<td>P1_0</td>
<td>Output</td>
<td>7-segment LED output A</td>
</tr>
<tr>
<td>P1_1</td>
<td>Output</td>
<td>7-segment LED output B</td>
</tr>
<tr>
<td>P1_2</td>
<td>Output</td>
<td>7-segment LED output C</td>
</tr>
<tr>
<td>P1_3</td>
<td>Output</td>
<td>7-segment LED output D</td>
</tr>
<tr>
<td>P1_4</td>
<td>Output</td>
<td>7-segment LED output E</td>
</tr>
<tr>
<td>P1_5</td>
<td>Output</td>
<td>7-segment LED output F</td>
</tr>
<tr>
<td>P1_6</td>
<td>Output</td>
<td>7-segment LED output G</td>
</tr>
<tr>
<td>P1_7</td>
<td>Output</td>
<td>7-segment LED output H</td>
</tr>
</tbody>
</table>

![LED Display Diagram](image)

Figure 3.1 LED Display
### 3.2 Memory Usage

#### Table 3.2 Memory Usage

<table>
<thead>
<tr>
<th>Memory Usage</th>
<th>Size</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROM</td>
<td>262 bytes</td>
<td>In main.c module</td>
</tr>
<tr>
<td>RAM</td>
<td>5 bytes</td>
<td>In main.c module</td>
</tr>
<tr>
<td>Maximum user stack usage</td>
<td>9 bytes</td>
<td>main function: 3 bytes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sfr_init function: 3 bytes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>seg_disp function: 6 bytes</td>
</tr>
<tr>
<td>Maximum interrupt stack usage</td>
<td>0 bytes</td>
<td>Unused</td>
</tr>
</tbody>
</table>

Memory usage varies depending on the C compiler version and the compile option.
The above applies under the following conditions:
- C compiler: M16C/60, 30, 20, 10, Tiny, R8C/Tiny Series Compiler V.5.40 Release 00
- Compile option: -c -finfo; NOTE: -dir “$CONFIGDIR” -R8C

NOTE: Unavailable in the R8C/Tiny-exclusive free version.

#### Table 3.3 RAM Usage and Definition

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Type</th>
<th>Size</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>com</td>
<td>unsigned char</td>
<td>1 byte</td>
<td>COM output counter</td>
</tr>
<tr>
<td>seg_data[4]</td>
<td>unsigned char</td>
<td>4 bytes</td>
<td>LED display data</td>
</tr>
</tbody>
</table>
4. Flowchart

4.1 Main Function

```
main()
  asm("FCLR I")
  prc0 ← 1
  cm14 ← 0
  fra2 ← 0x00
  fra00 ← 1

Repeat (i <= 255)
  i++;

fra01 ← 1

cm16 ← 0
  cm17 ← 0
  cm06 ← 0
  prc0 ← 0

SFR initial setting processing
  sfr_init()

asm("FSET I")

No
  ir_traic = 1?
  Yes
  traic ← traic & 0xF7

7-segment LED display processing
  seg_disp()

Yes

Disable interrupt

Disable system control register protect

Start low-speed on-chip oscillator oscillation

High-speed on-chip oscillator clock divided-by-2 mode

Start high-speed on-chip oscillator oscillation

Wait until oscillation becomes stable

Select high-speed on-chip oscillator

No main clock division

Enable CM16, CM17

System control register protect

SFR initial setting processing
  (port initial setting/timer RA setting)

Enable interrupt

Timer RA Wait for request (5 ms)

Timer RA Clear interrupt request flag

7-segment LED display processing
```
4.2 SFR Initial Setting Processing

4.2.1 SFR Initial Setting Processing 1

```
<table>
<thead>
<tr>
<th>sfr_init()</th>
</tr>
</thead>
<tbody>
<tr>
<td>p0 ← p0</td>
</tr>
<tr>
<td>p1 ← 0x00</td>
</tr>
<tr>
<td>prc2 ← 1</td>
</tr>
<tr>
<td>pd0 ← pd0</td>
</tr>
<tr>
<td>pd1 ← 0xFF</td>
</tr>
<tr>
<td>tstart_tracr ← 0</td>
</tr>
</tbody>
</table>

No: tcstf_tracr = 0? 
| Yes |
| traic ← 0x00 |
| tstop_tracr ← 1 |
| trapre ← 125 - 1 |
| tra ← 100 - 1 |
| tedgsel_traioc ← 0 |
| topcr_traioc ← 0 |
| toena_traioc ← 0 |
| tipf0_traioc ← 0 |
| tipf1_traioc ← 0 |
| tmod0_tramr ← 0 |
| tmod1_tramr ← 0 |
| tmod2_tramr ← 0 |

1 |
```

Port P0_4 to P0_7 initial setting
Port P1_0 to P1_7 initial setting
Disable port P0 direction register protect
Port P0_4 to P0_7: Set to output ports
Port P1_0 to P1_7: Set to output ports
Stop timer RA operation
Disable timer RA interrupt
Initialize registers TRAPRE and TRA, and bits TSTART and TCSTF in TRACR register
Underflow period: Set to 5 ms (40 MHz × f2 × f8 × 125 × 100 = 5 ms)
Set to 0 in timer mode.
Set to 0 in timer mode.
Set to 0 in timer mode.
Set to 0 in timer mode.
Set to 000 in timer mode.
4.2.2 SFR Initial Setting Processing 2

1

- \( tck0\_tramr \leftarrow 1 \)
- \( tck1\_tramr \leftarrow 0 \)
- \( tck2\_tramr \leftarrow 0 \)
- \( tckout\_tramr \leftarrow 0 \)
- \( tstart\_tracr \leftarrow 1 \)

Timer RA count source: \( f8 \)
Supply count source
Start timer RA operation

\( tcsf\_tracr = 1? \)

\( \text{Yes} \)

\( \text{return} \)

\( \text{No} \)
### 4.3 7-Segment LED Display Processing

```
seg_disp()

p0 ← p0 | 0xF0
com++

com = 4?
  Yes
    com ← 0
  No

i ← seg_data[com] & 0x0F
p1 ← SEGdata_table[i]
p0 ← p0 & MAT_OUT_data[com]
return
```

- **COM output off**
- **Increment COM output counter**
- **Determine whether COM output counter is maximum**
- **Increment COM output counter**
- **Acquire display data**
- **Display 7-segment LEDs**
- **COM output**
5. Sample Programming Code

A sample program can be downloaded from the Renesas Technology website. To download, click “Application Notes” in the left-hand side menu of the R8C/Tiny Series page.

6. Reference Documents

Hardware Manual
R8C/25 Group Hardware Manual
The latest version can be downloaded from the Renesas Technology website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Technology website.
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<th>Page</th>
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