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April 1st, 2010
Renesas Electronics Corporation

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M16C/65 Group
Operation of SI/O3,4

1. Abstract

In transmitting data in this mode, choose functions from those listed in Table 1. Operations of the circled items are described below.

2. Introduction

This application note is applied to the M16C/65 group microcomputers.

This application note can be used with other M16C Family MCUs which have the same special function registers (SFRs) as the above group. Check the manual for any modifications to functions. Careful evaluation is recommended before using the program described in this application note.
3. Chosen functions

Table 1. Chosen functions

<table>
<thead>
<tr>
<th>Item</th>
<th>Set-up</th>
<th>Item</th>
<th>Set-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer clock source</td>
<td>O</td>
<td>Internal clock (f1SIO/f2SIO/f8SIO/f32SIO)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>External clock (CLKi pin)</td>
<td>Used</td>
</tr>
<tr>
<td>Transfer format</td>
<td>O</td>
<td>LSB first</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MSB first</td>
<td></td>
</tr>
<tr>
<td>SOUTi initial value set function</td>
<td></td>
<td>SOUTi output control function (SOUTi status after transmission)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Last bit level retained</td>
</tr>
</tbody>
</table>

4. Operation

(1) Transfer begins upon writing the SI/Oi transmit data. The transmit data is sent out from the SOUTi pin synchronously with falling edges of the transfer clock.

(2) When SOUT finishes sending one byte of data, the interrupt request bit is set to “1”.

(3) When the SM26 bit or the SM27 bit in the S34C2 register is set to “1” (last bit level retained), after the transfer is completed, SOUT holds the last data.

Note:

• Data can only be written to the SI/Oi transmit/receive register (i = 3, 4; addresses 0270h, 0274h) when the device is idle neither sending nor receiving data.
Figure 1 shows the operation timing.

Example of wiring

Microcomputer

Receiver side IC

CLKi

CLK

SOUTi

SIN

Example of operation

(1) Transmission enabled

T \cdot 5 \cdot CLk (Max)

(2) Transmission is complete

(3) High-impedance

Internal clock

SI/Oi transmit/receive register write signal

SM26, SM27 = 0
(high-impedance)

SM26, SM27 = 1
(last bit level retained)

SI/Oi output SOUTi

SI/Oi input SINi

SI/Oi interrupt request bit

“1”

“0”

\( T_{CLK} = 2 \frac{n + 1}{f_i} \)

f_i: frequency of BRGi count source (f_{SISO}, f_{SISO}, f_{SISO}, f_{SISO})

n: value set to SiBRG

(\( i = 3, 4 \))

Cleared to “0” when interrupt request is accepted, or cleared by software

Figure 1. Operation timing of transmission in SI/O3, 4 mode
## 5. Set-up procedure

### Clearing the protect (set to write-enabled state)

<table>
<thead>
<tr>
<th>b7</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Protect register [Address 000Ah]  
PRCR  
Enables writing to port P9 direction register (address 03F3h) and SI/Oi control register (i=3, 4) (addresses 0272h and 0276h)  
1 : Write-enabled

### Setting SI/Oi bit rate generator (i = 3, 4)

<table>
<thead>
<tr>
<th>b7</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

SI/Oi bit rate generator (i = 3, 4) [Address 0273h, 0277h]  
SiBRG (i = 3, 4)  
Can be set to 00h to FFh (Note 1)

#### Setting SI/Oi transmit/receive control register (i = 3, 4) (Note 1)

<table>
<thead>
<tr>
<th>b7</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

SI/Oi transmit/receive control register (i = 3, 4) [Address 0272h, 0276h]  
SiC (i = 3, 4)  
Internal synchronous clock select bit  
b7 b0  
0 0 : Selecting f1SIO or f2SIO  
0 1 : Selecting f3SIO  
1 0 : Selecting f32SIO  
1 1 : Do not be set  
Si/Oi output disable bit  
0 : SOUT output  
Si/Oi port select bit  
1 : SOUT output, CLK function  
CLK polarity select bit  
0 : Transmit data is output at falling edge of transfer clock and receive data is input at rising edge  
1 : Transmit data is output at rising edge of transfer clock and receive data is input at falling edge  
Transfer format select bit  
0 : LSB first  
Synchronous clock select bit  
1 : Internal clock  
SOUT initial value set bit (Effective when bit 6 = 0)  
0 : L output  
1 : H output

**Note 1:** Be sure to set the protect register and SI/Oi control register successively.

### Setting SI/Oi transmit/receive register (i = 3, 4)

<table>
<thead>
<tr>
<th>b7</th>
<th>b0</th>
</tr>
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<tbody>
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<td>1</td>
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</table>

SI/Oi transmit/receive register (i = 3, 4) [Address 0270h, 0274h]  
SiTRR (i=3, 4)  
Can be set to 00h to FFh (Note 1)

**Note 1:** Write to SI/Oi bit rate generator when transmission/reception is halted.  
Use the MOV instruction to write into the SiBRG register.

### Writing transmit data

<table>
<thead>
<tr>
<th>b7</th>
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SI/Oi transmit/receive register (i=3, 4) [Address 0270h, 0274h]  
SiTRR (i=3, 4)  
Setting transmission data (Note 1)

**Note 1:** Write to SI/Oi transmit/receive register when transmission/reception is halted.  
Write the value into the SiTRR register each time 1-byte data is received, even when data is only received.
Setting SI/O 34 register 2

### SI/O 34 control register 2 [Address 0278h]
- **S34C2**
  - **Reserved bit**
  - Set to “0”
  - **No register bit**
  - If necessary, set to “0”. Read as undefined value
- **SI/O3, SI/O4 before-division clock select bit**
  - 0 : \( f_1 \)
  - **No register bit**
  - If necessary, set to “0”. Read as undefined value
- **SOUT3 output control bit (Note 1)**
  - **SOUT3 status after transmission**
  - 0 : High-impedance
  - 1 : Last bit level retained
- **SOUT4 output control bit (Note 1)**
  - **SOUT4 status after transmission**
  - 0 : High-impedance
  - 1 : Last bit level retained

**Note 1:** Bits SM26 and SM27 are valid when the SMi3 bit in registers S3C and S4C are set to “1” (SOUT, CLK).

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### Diagram:
- **SI/Oi interrupt request bit**
  - 0
  - 1
- **Transfer the next data**
6. **Reference**

Hardware manual
- M16C/65 Group Hardware Manual
  (Use the most recent version of the document on the Renesas Technology Web site.)

Technical news/Technical update
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### Revision

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<th>Rev.</th>
<th>Issue date</th>
<th>Revised</th>
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<td>Point</td>
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