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Introduction

This document should be used for reference when implementing control of the HN58X25xxx Series serial EEPROM manufactured by Renesas Technology Corp., using the clock synchronous serial communication interface (hereafter referred to as SI/O) of the M16C family manufactured by Renesas Technology Corp.

The some M16C MCU incorporates an exclusive clock synchronous serial I/O. The HN58X25xxx Series serial EEPROM can be controlled through the exclusive clock synchronous serial I/O and software.

This document describes sample programs for controlling the HN58X25xxx Series serial EEPROM by using the exclusive clock synchronous serial I/O.

Target Device

The application examples described in this document are applicable when the following MCU and condition are used.

- MCU : M16C family
- Condition : Exclusive clock synchronous serial I/O is used
- Software Version : Ver.1.01

The programs can be executed by any M16C family MCU with the SI/O. Note however that since some functions may be altered by function addition, etc., the functions should be confirmed against the MCU manual.

Be sure to perform evaluation sufficiently when using this application note.

Contents

1. Control Method for HN58X25xxx Series Serial EEPROM ................................................................. 2
2. Sample Programs ................................................................................................................................. 6
1. Control Method for HN58X25xxx Series Serial EEPROM

1.1 Overview of Operation

Control of the HN58X25xxx Series serial EEPROM is implemented by using the exclusive clock synchronous serial I/O in the M16C.

The sample programs execute the following control operations.

- Connects the S# pin of the serial EEPROM to an M16C port and controls it using output of the M16C general port.
- Controls data input/output by the exclusive clock synchronous serial I/O (using the internal clock).

Assign the exclusive clock synchronous serial I/O pins for which CMOS output is possible and set the CMOS output to them, in order to implement the high-speed operation.

Refer to the data sheets of the MCU and serial EEPROM and specify a usable clock frequency.

The connection method is described below.

---

**Figure 1.1 Serial EEPROM Connection Example**
1.2 Signal Timing Generation of Exclusive clock synchronous serial I/O

Signals are generated at the following timing to satisfy the serial EEPROM timing.

- Transmission from MCU to serial EEPROM: Transmit data output at fall of transfer clock
- Reception from serial EEPROM to MCU: Receive data input at rise of transfer clock
- Transfer in MSB-first

The CLK pin level is high when transfer is not taking place.

Figure 1.2 Timing for Exclusive clock synchronous serial I/O of M16C

Check the data sheets of the MCU and serial EEPROM for the maximum clock frequency that can be used.

1.3 Control of S# Pin of Serial EEPROM

The S# pin of the serial EEPROM is connected to an M16C port and controlled using output of the M16C general port.

The period from the falling edge of the S# pin (port of M16C) of the serial EEPROM to the falling edge of the C pin (CLK of M16C) is controlled by inserting software wait cycles.

The period from the rising edge of the C pin (CLK of M16C) to the rising edge of the S# pin (port of M16C) is controlled by inserting software wait cycles.

Check the data sheet of the serial EEPROM and set the software wait time according to the system.

1.4 Processing after function operating

When function processing is begun, S# pin (Port of M16C) of EEPROM is set to high level first by setting the port function, and, next, C pin (CLK of M16C) of EEPROM is set to high level. Next, SI/O function is enabled and exclusive clock synchronous I/O mode is set. Command codes etc. are output using SI/O function after S# pin (Port of M16C) of EEPROM is set to low level.

After function processing is finished, S# pin (Port of M16C) of EEPROM is set to high level first and, next, SI/O function is disabled. Then the function is changed to general port, and Port/CLK/SOUT pins are set to high level.

1.5 MCU Hardware Resources in Use

The hardware resources to be used are shown below.

Table 1.1 Hardware Resources in Use

<table>
<thead>
<tr>
<th>Resource in Use</th>
<th>Number of Used Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusive clock synchronous serial I/O</td>
<td>One channel (essential)</td>
</tr>
<tr>
<td>Port (for control of the S# pin of serial EEPROM)</td>
<td>One port (essential)</td>
</tr>
</tbody>
</table>
1.6 M16C SFR (Peripheral Device Control Register) Setting - Exclusive Clock Synchronous Serial I/O and Interrupt control Register

The way to transmit and receive data of exclusive clock synchronous serial I/O is as follows.

- The data transmission is started by writing transmit data to the Transmit/Receive Register.
- The reception of data is started by writing dummy data to the Transmit/Receive Register.
- In order to control the data transmission/reception, transmit interrupt request bit is used. Transfer completion is detected by a change of interrupt request bit value. The setting is as follows.
  - Set the interrupt priority level to 000b (Level 0; Interrupt disable).
  - Set the transmit interrupt cause select bit to 0 (No data present in transmit buffer).

Set up the exclusive clock synchronous serial I/O as shown below to satisfy the serial EEPROM specifications/timing.

1.6.1 M16C/62P

An example of setting based on the register descriptions in the M16C/62P Group Hardware Manual Rev. 2.41 is shown in the table below.

S4C register of SI/O4 can be written to by the next instruction after setting the PRC2 bit in the PRCR register to 1.

Also Port control register of SIN4, SOUT4 and CLK4 can be written to by the next instruction after setting the PRC2 bit in the PRCR register to 1.

Don’t use SI/O3. (SI/O3 is only for data transmission.)

Table 1.2 Exclusive clock synchronous serial I/O Mode Settings

<table>
<thead>
<tr>
<th>Register</th>
<th>Bit</th>
<th>Function and Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4TRR</td>
<td>7 to 0</td>
<td>Set the transmit data in these bits. The receive data is read from these bits.</td>
</tr>
<tr>
<td>S4BRG</td>
<td>7 to 0</td>
<td>Set the transfer speed in these bits. Clock frequency that can transfer data is different depending on the MCU.</td>
</tr>
<tr>
<td>S4C</td>
<td>SM41 to SM40</td>
<td>Select the count source of UiBRG register in these bits.</td>
</tr>
<tr>
<td></td>
<td>SM42</td>
<td>Write 0 to this bit. (SOUT4 output)</td>
</tr>
<tr>
<td></td>
<td>SM43</td>
<td>Write 1 to this bit. (SOUT4 output)</td>
</tr>
<tr>
<td></td>
<td>SM44</td>
<td>Write 0 to this bit. Transmit data is output at falling edge of transfer clock and receive data is input at rising edge.</td>
</tr>
<tr>
<td></td>
<td>SM45</td>
<td>Write 1 to this bit. (MSB first)</td>
</tr>
<tr>
<td></td>
<td>SM46</td>
<td>Write 0 to this bit. (Internal clock)</td>
</tr>
<tr>
<td></td>
<td>SM47</td>
<td>Write 1 to this bit. (High)</td>
</tr>
</tbody>
</table>

The setting example of interrupt control register is shown in the table below.

Table 1.3 Interrupt Control Register Settings

<table>
<thead>
<tr>
<th>Register</th>
<th>Bit</th>
<th>Function and Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4IC</td>
<td>ILVL2 to ILVL0</td>
<td>Write 000b to these bits. (Level 0: Interrupt is disabled.)</td>
</tr>
<tr>
<td></td>
<td>IR</td>
<td>If this bit is 1, Interrupt is requested. Write 0 to this bit according to the needs.</td>
</tr>
</tbody>
</table>
1.6.2 M16C/29

An example of setting based on the register descriptions in the M16C/29 Group Hardware Manual Rev. 1.00 is shown in the table below.

S4C of SI/O4 register can be written to by the next instruction after setting the PRC2 bit in the PRCR register to 1.

Also Port control register of SIN4, SOUT4 and CLK4 can be written to by the next instruction after setting the PRC2 bit in the PRCR register to 1.

### Table 1.4 Exclusive clock synchronous serial I/O Mode Settings

<table>
<thead>
<tr>
<th>Register</th>
<th>Bit</th>
<th>Function and Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiTRR</td>
<td>7 to 0</td>
<td>Set the transmit data in these bits. The receive data is read from these bits.</td>
</tr>
<tr>
<td>SiBRG</td>
<td>7 to 0</td>
<td>Set the transfer speed in these bits. Clock frequency that can transfer data is different depending on the MCU.</td>
</tr>
<tr>
<td>SIC</td>
<td>SM1 to SM0</td>
<td>Select the count source of SiBRG register in these bits.</td>
</tr>
<tr>
<td></td>
<td>SM2</td>
<td>Write 0 to this bit. (SOUT4 output)</td>
</tr>
<tr>
<td></td>
<td>SM3</td>
<td>Write 1 to this bit. (SOUT4 output)</td>
</tr>
<tr>
<td></td>
<td>SM4</td>
<td>Write 0 to this bit. Transmit data is output at falling edge of transfer clock and receive data is input at rising edge.</td>
</tr>
<tr>
<td></td>
<td>SM5</td>
<td>Write 1 to this bit. (MSB first)</td>
</tr>
<tr>
<td></td>
<td>SM6</td>
<td>Write 0 to this bit. (Internal clock)</td>
</tr>
<tr>
<td></td>
<td>SM7</td>
<td>Write 1 to this bit. (High)</td>
</tr>
</tbody>
</table>

The setting example of interrupt control register is shown in the table below.

### Table 1.5 Interrupt Control Register Settings

<table>
<thead>
<tr>
<th>Register</th>
<th>Bit</th>
<th>Function and Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIC</td>
<td>ILVL2 to ILVL0</td>
<td>Write 000b to these bits. (Level 0: Interrupt is disabled.)</td>
</tr>
<tr>
<td></td>
<td>IR</td>
<td>If this bit is 1, Interrupt is requested. Write 0 to this bit according to the needs.</td>
</tr>
</tbody>
</table>
2. Sample Programs

Two or more of the same devices can be connected to the serial bus and controlled.

The sample programs execute the following:

- Data read processing
- Data write processing
- Write-protection processing through software protection
- Status read processing

2.1 Overview of Software Operations

The operations roughly described below are performed.

1. The driver initialization processing acquires the resources to be used by the driver and initializes them.
   - At this point, control signals (Port/CLK/SOUT) connected to the serial EEPROM come to high.
2. Function calls perform the following operations.
   - The signals of pins connected to the serial EEPROM output to make serial EEPROM inactive state.
   - Execute the processing of each function.
   - Control signals (Port/CLK/SOUT) connected to the serial EEPROM come to high.
2.2 Detailed Description of Functions

2.2.1 Driver Initialization Processing

<table>
<thead>
<tr>
<th>Function Name</th>
<th>EEPROM driver initialization processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arguments</td>
<td>void eep_Init_Driver(void)</td>
</tr>
<tr>
<td>Return Values</td>
<td>None</td>
</tr>
<tr>
<td>Operations</td>
<td>• Initializes the EEPROM driver.</td>
</tr>
<tr>
<td></td>
<td>• Initializes the SFR for EEPROM control.</td>
</tr>
<tr>
<td></td>
<td>• Performs the following processing for each device.</td>
</tr>
<tr>
<td></td>
<td>(a) Initializes the EEPROM control RAM.</td>
</tr>
<tr>
<td></td>
<td>• Call this function once at system activation.</td>
</tr>
<tr>
<td>Notes</td>
<td>None</td>
</tr>
</tbody>
</table>

Start

1. `eep_Set_Interrupt_1()`: Sets the interrupt.
2. `eep_Init_Sfr()`: Initializes S/I/O-related registers.
3. `eep_Init_Ram(DevNo)`: Clears the used RAM.

End
2.2.2 Write-Protection Setting Processing

<table>
<thead>
<tr>
<th>Function Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write-protection setting processing</td>
<td>signed short eep_Write_Protect(unsigned char DevNo, unsigned char WpSts)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DevNo ; Device number</td>
<td>unsigned char</td>
</tr>
<tr>
<td>WpSts ; Write-protection setting data</td>
<td>unsigned char</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Return Values</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPROM_OK ; Successful operation</td>
<td>Returns the write-protection setting result.</td>
</tr>
<tr>
<td>EEPROM_ERR_PARAM ; Parameter error</td>
<td></td>
</tr>
<tr>
<td>EEPROM_ERR_OTHER ; Other error</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Makes the write-protection setting.</td>
<td></td>
</tr>
<tr>
<td>Set the write-protection setting data (WpSts) as follows:</td>
<td></td>
</tr>
<tr>
<td>EEP_WP_NONE ; No protection</td>
<td></td>
</tr>
<tr>
<td>EEP_WP_UPPER_QUART ; Upper-quarter protection setting</td>
<td></td>
</tr>
<tr>
<td>EEP_WP_UPPER_HALF ; Upper-half protection setting</td>
<td></td>
</tr>
<tr>
<td>EEP_WP_WHOLE_MEM ; Whole memory protection setting</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Notes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

Start

- eep_Set_Interrupt_2(): Sets the interrupt.

- eep_Init_Port(DevNo): S#=H, C=H, D=H, Q: Input mode

- EEPROM_EI(): Enables the SI/O and set SI/O parameters.

- eep_Write_StsReg(DevNo,&StsReg): Writes to the status register.

- eep_Init_Sfr(): Initializes SI/O-related SFR.

End
### 2.2.3 Data Read Processing

<table>
<thead>
<tr>
<th>Function Name</th>
<th>Data read processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>signed short</td>
<td>eep_Read_Data(DevNo, RAddr, RCnt, pData)</td>
</tr>
</tbody>
</table>

#### Arguments

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>unsigned char</td>
<td>DevNo</td>
<td>Device number</td>
</tr>
<tr>
<td>unsigned short</td>
<td>RAddr</td>
<td>Read start address</td>
</tr>
<tr>
<td>unsigned short</td>
<td>RCnt</td>
<td>Number of bytes to be read</td>
</tr>
<tr>
<td>unsigned char FAR*</td>
<td>pData</td>
<td>Read data storage buffer pointer</td>
</tr>
</tbody>
</table>

#### Return Values

- EEP_OK: Successful operation
- EEP_ERR_PARAM: Parameter error
- EEP_ERR_HARD: Hardware error
- EEP_ERR_OTHER: Other error

#### Operations

- Reads data from EEPROM in bytes.
- Reads data from the specified address for the specified number of bytes.

#### Notes

- The maximum write address is EEPROM size – 1.

---

```
Start

eep_Set_Interrupt_2(): Sets the interrupt.

↓

eep_Init_Port(DevNo): S#=H, C=H, D=H, Q: Input mode

↓

EEP_SIO_EI(): Enables the SI/O and set SI/O parameters.

↓

EEP_SET_CS(Dev, EEP_LOW): S#=L

mtl_wait_lp(): Software wait

↓

eep_Cmd_READ(RAddr): Command issuance

mtl_wait_lp() Software wait

↓

eep_XXX_DataIn(): Data read

↓

mtl_wait_lp(): Software wait

↓

EEP_SET_CS(Dev, EEP_HI): S#=H

eep_Init_Sfr(): Initializes SI/O-related SFR.

End
```
2.2.4 Data Write Processing

<table>
<thead>
<tr>
<th>Function Name</th>
<th>Data write processing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>signed short eep_Write_Data(unsigned char DevNo, unsigned short WAddr, unsigned short WCnt, unsigned char FAR* pData)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>unsigned char DevNo ; Device number</td>
</tr>
<tr>
<td>unsigned short WAddr ; Write start address</td>
</tr>
<tr>
<td>unsigned short WCnt ; Number of bytes to be written</td>
</tr>
<tr>
<td>unsigned char FAR* pData ; Write data storage buffer pointer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Return Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns the write result.</td>
</tr>
<tr>
<td>EEP_OK ; Successful operation</td>
</tr>
<tr>
<td>EEP_ERR_PARAM ; Parameter error</td>
</tr>
<tr>
<td>EEP_ERR_HARD ; Hardware error</td>
</tr>
<tr>
<td>EEP_ERR_WP ; Write-protection error</td>
</tr>
<tr>
<td>EEP_ERR_OTHER ; Other error</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Writes data to EEPROM in bytes.</td>
</tr>
<tr>
<td>• Writes data from the specified address for the specified number of bytes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• EEPROM can be written to only when write-protection has been canceled.</td>
</tr>
<tr>
<td>• The maximum write address is EEPROM size – 1.</td>
</tr>
</tbody>
</table>

In a write to the serial EEPROM, address translation is performed and the page rewrite method is used.

```
Start

eep_Set_Interrupt_2(): Sets the interrupt.

eep_Init_Port(DevNo): S#=H, C=H, D=H, Q: Input mode

EEP_SIO_EI(): Enables the SI/O and set SI/O parameters.

eep_Read_StsReg(Dev, &StsReg): Confirms write-protection.

   Writes page calculation processing.

eep_Write_Page(DevNo, Waddr, AbyteCnt, pData): Writes.

EEP_SET_CS(Dev, EEP_HI) - S#=H
eep_Init_Sfr(): Initializes SI/O-related registers.

End
```
### 2.2.5 Status Read Processing

<table>
<thead>
<tr>
<th>Function Name</th>
<th>Status read processing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arguments</strong></td>
<td>signed short eep_Read_Status(unsigned char DevNo, unsigned char * pStatus)</td>
</tr>
<tr>
<td><strong>Arguments</strong></td>
<td>unsigned char DevNo ; Device number</td>
</tr>
<tr>
<td><strong>Arguments</strong></td>
<td>unsigned char FAR* pStatus ; Read status storage buffer</td>
</tr>
<tr>
<td><strong>Return Values</strong></td>
<td>Returns the status register acquisition result.</td>
</tr>
<tr>
<td><strong>Return Values</strong></td>
<td>EEP_OK ; Successful operation</td>
</tr>
<tr>
<td><strong>Return Values</strong></td>
<td>EEP_ERR_PARAM ; Parameter error</td>
</tr>
<tr>
<td><strong>Return Values</strong></td>
<td>EEP_ERR_HARD ; Hardware error</td>
</tr>
<tr>
<td><strong>Return Values</strong></td>
<td>EEP_ERR_OTHER ; Other error</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Reads the status.</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Reads from the status register.</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>The following information is stored in the read status storage buffer (pStatus).</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Memory size ≤ 512 bytes</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Bits 7 to 4: Reserved (All 1)</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Bits 3, 2: BP1, BP0 00: No protection</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>01: Upper-qSI/Oer protection</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>10: Upper-half protection</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>11: Whole memory protection</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Bit 1: WEL 0: Write disabled</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>1: Write enabled</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Bit 0: WIP 1: During write operation</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Memory size &gt; 512 bytes</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Bit 7: SRWD 0: Status register can be changed</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>1: Status register cannot be changed</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Bits 6 to 4: Reserved (All 0)</td>
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<td><strong>Operations</strong></td>
<td>Bits 3, 2: BP1, BP0 00: No protection</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>01: Upper-qSI/Oer protection</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>10: Upper-half protection</td>
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<td><strong>Operations</strong></td>
<td>Bit 1: WEL 0: Write disabled</td>
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<tr>
<td><strong>Operations</strong></td>
<td>1: Write enabled</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>Bit 0: WIP 1: During write operation</td>
</tr>
</tbody>
</table>

| Notes | None |
2.3 Return Value Definition

#define EEP_OK    (short)( 0)  /* Successful operation  */
#define EEP_ERR_PARAM (short)(-1)  /* Parameter error  */
#define EEP_ERR_HARD  (short)(-2)  /* Hardware error    */
#define EEP_ERR_WP    (short)(-3)  /* Write-protection error */
#define EEP_ERR_OTHER (short)(-4)  /* Other error     */

Start

- eep_Set_Interrupt_2(): Sets the interrupt.

- eep_Init_Port(DevNo): S#=H, C=H, D=H, Q: Input mode

- EEPROM_EI(): Enables the SI/O and set SI/O parameters.

- eep_Read_StsReg(DevNo,&StsReg) : Reads status register.

- eep_Init_Sfr(): Initializes SI/O-related SFR.

End
2.4 User Setting Examples

Setting examples when using the Renesas Technology MCU M16C29 are shown below.

The location where a setting should be made is indicated by the comment of /* SET */ in each file.

2.4.1 eep.h

(1) Definition of the number of devices used and device numbers

Specify the number of devices to be used and assign a number for each device.

In the example below, one device is used and 0 is assigned as the device number.

When using three or more, eep_io.h needs to be modified in addition to this file.

```c
/*----------------------------------------------------------------------------------*/
/* Define the number of the required serial EEPROM devices.(1 to N devices) */
/* Define the device number in accordance with the number of serial EEPROM devices */
/* to be connected. */
/*----------------------------------------------------------------------------------*/
/* Define number of devices */
#define EEP_DEV_NUM   1  /* 1 device */
/* Define No. of slots */
#define EEP_DEV0    0  /* Device 0 */
#define EEP_DEV1    1  /* Device 1 */
```

(2) Definition of device used

Specify the device to be used.

In the example below, 4k bits device is used.

```c
/*------------------------------------------------------------------*/
/* Define the serial EEPROM device. */
/*------------------------------------------------------------------*/
#define EEP_SIZE_002K   /*   2kbit (256 Byte) */
#define EEP_SIZE_004K   /*   4kbit (512 Byte) */
#define EEP_SIZE_008K   /*   8kbit ( 1kByte) */
#define EEP_SIZE_016K   /*  16kbit ( 2kByte) */
#define EEP_SIZE_032K   /*  32kbit ( 4kByte) */
#define EEP_SIZE_064K   /*  64kbit ( 8kByte) */
#define EEP_SIZE_128K   /* 128kbit (16kByte) */
#define EEP_SIZE_256K   /* 256kbit (32kByte) */
```
(3) Definitions the way of interrupt setting of SI/O.

Define the way of transmit interrupt control process.
This software controls the transmission processing by disabling the Interrupt Priority Select Bits and utilizing Interrupt Request Bit (IR) in Interrupt Control Register of SI/O.
The method of the interrupt disabling can be selected by the following three ways.
Select one of them according to the system.

Case 1. Set in the upper system and not setting in the device driver.
    #define EEP_IC_SETTING0 should be validated.
Case 2. Set when the device driver is initialized – in executing “eep_Init_Driver()”.
    #define EEP_IC_SETTING1 should be validated.
Case 3. Set when SI/O transfer – in executing “eep_Read_Data()”, “eep_Write_Data()”.
    #define EEP_IC_SETTING2 should be validated.

Case 2 and 3 can be validated at the same time.

Precaution
The followings are the interrupt setting sequence when the above Case 2 and/or 3 are selected:
1. Disable interrupt (DI)
2. Disable the Interrupt Priority Select Bits and clear the Interrupt Request Bit (IR) of Interrupt Control Register for UART.
3. Enable interrupt (EI)

Be careful when interrupts enable flag (I flag) is managed by a higher system.
2.4.2 eep_sfr.h

Rename from eep_sfr.h.xxx (the header corresponding to the MCU) to eep_sfr.h and use it.

In the example below, the M16C/29 is used.

The sample program of M16C/29 shows a description example in which SI/O3 is used as the resource of the clock synchronous serial I/O. No setting needs to be modified when the above resource is used.

(1) SI/O resource

/*----------------- SIO definitions -----------------*/
#define EEP_SIO_STIC s3ic  /* SIO interrupt control register */
#define EEP_SIO_BUF s3trr  /* SIO transmit/receive buffer register */
#define EEP_SIO_BRG s3brg  /* SIO bit rate register */
#define EEP_SIO_SIC s3c    /* SIO transmit/receive control register 0*/
#define EEP_SIO_NEXT ir_s3ic /* SIO complete flag */

If another resource is used, make additions or modify the above program. Accordingly, also make additions or modify the /* SI/O setting */ definition with reference to section 1.6, M16C SFR (Peripheral Device Control Register) Setting - Exclusive Clock Synchronous serial I/O.
2.4.3 eep_io.h

Rename from eep_io.h.xxx (the header corresponding to the MCU) to eep_io.h and use it.
In the example below, the M16C/29 is used.

(1) Definition of control ports of MCU used

Specify the control ports of the MCU to be used.
In the example below, SIN, SOUT, CLK, and S# of the clock synchronous serial I/O are assigned.
When two devices are connected, make a definition regarding CS1.
When using three or more, eep.h needs to be modified in addition to this file.

#ifndef EEPROM_H
#define EEPROM_H

#define EEP_P_Sbau   prc2  /* Port9 write-protection register */
#define EEP_P_DATAO   p3_1  /* EEP DataOut */
#define EEP_P_DATAI   p3_2  /* EEP DataIn */
#define EEP_P_CLK    p3_0  /* EEP CLK */
#define EEP_D_DATAO   pd3_1  /* EEP DataOut */
#define EEP_D_DATAI   pd3_2  /* EEP DataIn */
#define EEP_D_CLK    pd3_0  /* EEP CLK */
#define EEP_P_CS0    p3_3  /* EEP CS0 (Negative-true logic) */
#define EEP_D_CS0    pd3_3  /* EEP CS0 (Negative-true logic) */
#if (EEP_DEV_NUM > 1)
#define EEP_P_CS1    p3_4  /* EEP CS1 (Negative-true logic) */
#define EEP_D_CS1    pd3_4  /* EEP CS1 (Negative-true logic) */
#endif /* #if (EEP_DEV_NUM > 1) */
#endif /* #define EEPROM_H */

#endif /* ifndef EEPROM_H */

/ * Define the control port. */

#define EEP_P_Sbau   prc2  /* Port9 write-protection register */
#define EEP_P_DATAO   p3_1  /* EEP DataOut */
#define EEP_P_DATAI   p3_2  /* EEP DataIn */
#define EEP_P_CLK    p3_0  /* EEP CLK */
#define EEP_D_DATAO   pd3_1  /* EEP DataOut */
#define EEP_D_DATAI   pd3_2  /* EEP DataIn */
#define EEP_D_CLK    pd3_0  /* EEP CLK */
#define EEP_P_CS0    p3_3  /* EEP CS0 (Negative-true logic) */
#define EEP_D_CS0    pd3_3  /* EEP CS0 (Negative-true logic) */
#if (EEP_DEV_NUM > 1)
#define EEP_P_CS1    p3_4  /* EEP CS1 (Negative-true logic) */
#define EEP_D_CS1    pd3_4  /* EEP CS1 (Negative-true logic) */
#endif /* #if (EEP_DEV_NUM > 1) */
2.4.4 mtl_com.h (Common Header File)

Rename from mtl_com.h.xxx (the header corresponding to the MCU) to mtl_com.h and use it.

In the example below, the M16C/29 is used.

(1) Definition of OS header file

This software is an OS-independent program.
In the example below, the OS is not used. (The system call of MR30 is not used.)

/* In order to use wai_sem/sig_sem/dly_tsk for microITRON (Real-Time OS)-compatible, */
/* include the OS header file that contains the prototype declaration. */
/* When not using the OS, put the following 'define' and 'include' as comments. */
//#define MTL_OS_USE /* Use OS */
//#include <RTOS.h> /* OS header file */
//#include "mtl_os.h"

(2) Definition of header file specifying common access area

Include the header file in which the MCU registers are defined.
This file needs to be included because it is mainly used by the device driver for controlling the ports.
In the example below, the M16C/29 header file is included. Include the header file in accordance with the MCU.

/* In order to use definitions of MCU SFR area, */
/* include the header file of MCU SFR definition. */
#include "sfr29.h" /* definition of MCU SFR */

(3) Definition of loop timer

Include the header file below if software timer is used.
It is mainly used as wait time of device driver.
When software timer is not used, the define statement below should be a comment.
In the example below, software timer is used.

/* When not using the loop timer, put the following 'include' as comments. */
#include "mtl_tim.h"
(4) Definition of endian type

This is the setting of FAT file system library for M16C family.
Specify the little endian if M16C family is used.
/* When using M16C or SuperH for Little Endian setting, define it. */
/* When using other MCUs, put 'define' as a comment. */
#define MTL_MCU_LITTLE /* Little endian */

(5) The fast processes of mtl_endi.c

When Little Endian is specified and it is defined, it performs the fast processes of 'mtl_endi.c'.
/* When using M16C, define it. */
/* It performs the fast processes of 'mtl_endi.c'. */
#define MTL_ENDI_HISPEED /* Uses the high-speed function. */

(6) Specification of standard library type used

Specify the standard library type used. When the processing below is used in the library provided with the compiler, the define statement below should be a comment.
The optimized library enabling high-speed processing is prepared.
The following example shows the standard library set with the compiler.

/* Specify the standard library type used. */
/* When the processing below is used in the library provided with the compiler, */
/* compiler, the define statement below should be a comment. */
/* memcmp() / memcpy() / memset() / strcat() / strcmp() / strcpy() / strlen() */
#ifndef MTL_USER_LIB /* Optimized library usage */

(7) Definition of RAM area accessed by processing group used

Define the RAM area to be accessed by the user process group.
Standard functions and efficient operations for processes are applied.
If neither of them is defined, error is output when software is compiled.
M16C/62P and M16C/29 is possible to define either MTL_MEM_FAR or MTL_MEM_NEAR.
The following is a definition example of MTL_MEM_NEAR when M16C/60, M16C/30, M16C/20 or R8C is used.

/* Define the RAM area to be accessed by the user process. */
/* Efficient operations for standard functions and processes are applied. */
#ifndef MTL_MEM_FAR /* Supports Far RAM area of M16C/60 */
#define MTL_MEM_NEAR /* Supports Near RAM area. (Others) */

Set only the above define statement and do not make any other modifications.
2.4.5 mtl_tim.h

(1) Definition of software timer

Set the internal software timer used.

The following reference values are obtained at 20-MHz operation without wait.

The setting should be made in accordance with the system.

/* Define the counter value for the timer. */
/* Specify according to the user MCU, clock and wait requirements. */
/* Setting for 20MHz no wait */

#define MTL_T_1US    1      /* loop Number of 1us */
#define MTL_T_2US    2      /* loop Number of 2us */
#define MTL_T_4US    5      /* loop Number of 4us */
#define MTL_T_5US    6      /* loop Number of 5us */
#define MTL_T_10US   13     /* loop Number of 10us */
#define MTL_T_20US   27     /* loop Number of 20us */
#define MTL_T_30US   40     /* loop Number of 30us */
#define MTL_T_50US   68     /* loop Number of 50us */
#define MTL_T_100US  137    /* loop Number of 100us */
#define MTL_T_300US  413    /* loop Number of 300us */
#define MTL_T_400US  ( MTL_T_200US * 2 ) /* loop Number of 400us */
#define MTL_T_1MS    1381   /* loop Number of 1ms */
2.5 Usage Notes
The sample programs show the following description example as the resource of the exclusive clock synchronous serial I/O.

(1) Description example of SI/O3 sample program is shown in M16C/29.
(2) Description example of SI/O4 sample program is shown in M16C/62P.

When using another resource, set the software in accordance with the hardware.

2.6 Notes at Embedment
To embed the sample programs, include eep.h.

2.7 Usage of Another M16C Family MCU
Usage of another M16C family MCU is supported easily.

The following files must be prepared.

(1) I/O module common definition equivalent of eep_io.h.xxx
Define the I/O pins to be used with reference to the SFR header of the MCU used.

(2) SFR common definition equivalent of eep_sfr.h.xxx
Define the SI/O to be used with reference to the SFR header of the MCU used.

(3) Header definition equivalent of mtl_com.h.xxx
Create and define a header for the MCU used.

Create the above files with reference to the provided programs.

In addition, specify the created header in eep_io.h, eep_sfr.h, and mtl_com.h.
### 2.8 File Configuration

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<td>Directory for common functions</td>
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<td>Various definitions for common functions</td>
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<td>mtl_com.c</td>
<td>Various definitions for common functions</td>
</tr>
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<td>Common file</td>
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<td>mtl_os.c</td>
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<td>Sample program for operation verification. Use this for operation verification.</td>
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<td>common.c</td>
<td>Various definitions for common functions</td>
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Revision Record

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