Outlines

This application note is a reference material for developing products using I2C interface (I2C) functions of M3H Group(1).
This document helps the user check operation of the product and develop its program.

Target sample program: I2C_EEPROM
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1. Preface

This sample program is used to check the operation of I2C communication function. TMPM3H6 writes to I2C EEPROM and read from I2C EEPROM is executed by terminal software on the host PC via USB-UART.

Structure diagram of Sample program
2. Reference Document

- Datasheet
  TMPM3H group (1) datasheet Rev2.0 (Japanese edition)
- Reference manual
  I2C interface (I2C-B) Rev2.0 (Japanese edition)
- Other reference document
  TMPM3H Group Peripheral Driver User Manual (Doxygen)

3. Function to Use

<table>
<thead>
<tr>
<th>IP</th>
<th>Channel</th>
<th>Port</th>
<th>Function / operation mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>I2C interface</td>
<td>ch0</td>
<td>PC0 (SCL)</td>
<td>I2C mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PC1 (SDA)</td>
<td></td>
</tr>
<tr>
<td>Asynchronous communication</td>
<td>ch0</td>
<td>PA1 (UT0TXDA)</td>
<td>UART mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA2 (UT0RXD)</td>
<td></td>
</tr>
</tbody>
</table>

4. Target Device

The target devices of application note are as follows.

<table>
<thead>
<tr>
<th>TMPM3H6FWFG</th>
<th>TMPM3H6FUFG</th>
<th>TMPM3H6FSFG</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMPM3H6FWDFG</td>
<td>TMPM3H6FUDFG</td>
<td>TMPM3H6FSDFG</td>
</tr>
<tr>
<td>TMPM3H5FWFG</td>
<td>TMPM3H5FUFG</td>
<td>TMPM3H5FSFG</td>
</tr>
<tr>
<td>TMPM3H5FWDFG</td>
<td>TMPM3H5FUDFG</td>
<td>TMPM3H5FSDFG</td>
</tr>
<tr>
<td>TMPM3H4FWUG</td>
<td>TMPM3H4FUUG</td>
<td>TMPM3H4FSUG</td>
</tr>
<tr>
<td>TMPM3H4FWFG</td>
<td>TMPM3H4FUFG</td>
<td>TMPM3H4FSFG</td>
</tr>
<tr>
<td>TMPM3H3FWUG</td>
<td>TMPM3H3FUUG</td>
<td>TMPM3H3FSUG</td>
</tr>
<tr>
<td>TMPM3H2FWDUG</td>
<td>TMPM3H2FUDUG</td>
<td>TMPM3H2FSDUG</td>
</tr>
<tr>
<td>TMPM3H2FWQG</td>
<td>TMPM3H2FUQG</td>
<td>TMPM3H2FSQG</td>
</tr>
<tr>
<td>TMPM3H1FWUG</td>
<td>TMPM3H1FUUG</td>
<td>TMPM3H1FSUG</td>
</tr>
<tr>
<td>TMPM3H1FPUG</td>
<td>TMPM3H0FSDUG</td>
<td>TMPM3H0FMDUG</td>
</tr>
</tbody>
</table>

* This sample program operates on the evaluation board of TMPM3H6FWFG.
If other function than the TMPM3H6 one is checked, it is necessary that CMSIS Core related files (C startup file and IO header file) should be changed properly.
The BSP related file is dedicated to the evaluation board (TMPM3H6). If other function than the TMPM3H6 one is checked, the BSP related file should be changed properly.
5. Conditions for Correct Operation

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used microcontroller</td>
<td>TMPM3H6FWFG</td>
</tr>
<tr>
<td>Used board</td>
<td>TMPM3H6FWFG Evaluation Board</td>
</tr>
<tr>
<td>(Product of Sensyst)</td>
<td></td>
</tr>
<tr>
<td>Unified development environment</td>
<td>IAR Embedded Workbench for ARM 8.11.2.13606</td>
</tr>
<tr>
<td>Terminal software</td>
<td>μVision MDK Version 5.24.2.0</td>
</tr>
<tr>
<td>Sample program</td>
<td>V1100</td>
</tr>
</tbody>
</table>

For purchasing the board, refer to the following homepage. ([http://www.chip1stop.com/](http://www.chip1stop.com/))
6. Evaluation Board Setting

The following pin connections should be done on the evaluation board.

<table>
<thead>
<tr>
<th>CN5</th>
<th>Use</th>
<th>Through-hole No.</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>UART (RXD)</td>
<td>9-10</td>
<td></td>
<td>Connection</td>
</tr>
<tr>
<td>UART (TXD)</td>
<td>11-12</td>
<td></td>
<td>Connection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CN9</th>
<th>Use</th>
<th>Through-hole No.</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>I2C (SCL)</td>
<td>1-2</td>
<td></td>
<td>Connection</td>
</tr>
<tr>
<td>I2C (SDA)</td>
<td>3-4</td>
<td></td>
<td>Connection</td>
</tr>
</tbody>
</table>

7. Operation of Evaluation Board

Connect the PC with the USB_UART terminal of the evaluation board with a USB cable. After start-up the terminal software (Tera Term), performs communication setting on the terminal software. Press the reset button on the evaluation board. Communication starts according to command input. For details of command input operation, refer to the sample program main operation.
8. Outline of I²C Interface function

The I2C can operate as a transceiver circuit of 1ch (SCL, SDA) in 1 unit circuit.

8.1. Clock Supply

When using I2C, please set a clock enabling bit corresponding with the fsys supply on/off register A ([CGFSYSENA]) or B ([CGFSYSENB]) and fc supply on/off register ([CGFCEN]) as “1” (clock supply). Please refer to “Clock Control and Operation Mode” of the reference manual for the details.
9. Sample Program

Enter the command (write or read) on the terminal software.
In the case of the write command, the input character is saved in the I2C EEPROM.
In the case of the read command, it reads the data saved in the I2C EEPROM and displays it in the terminal software.

9.1. Initialization

The following initialization is done after power is supplied.
The port setting is executed after the initialization of each clock setting, the watchdog timer setting and the clock setting.

9.2. Sample program main operation

After the initialization operation, shift to the main function and perform the following initialization:

1. Initialization of BSP (Board Support Package)
2. Initialization of variables
3. Initialize the application
4. Initialization of I2C for EEPROM
5. Main control of sample program

After the above processing, perform the following operations on PC terminal software (Tera Term).
"Command>" is displayed on Tera Term. Enter write or read command according to the following format.

"write" command: The input character should be stored to I2C EEPROM (0x0 address).
"read" command: I2C EEPROM (0x0 address) is read and displayed on the Tera Term.

Command format:
write_.command
write_.X X: Any character
read_.command
read

<table>
<thead>
<tr>
<th>Used memory</th>
<th>I2C EEPROM: 24FC256-I/SN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used port</td>
<td>SCL: PC0 and SDA: PC1</td>
</tr>
</tbody>
</table>
9.3. Output Example of Sample Program

When the sample program operates, the command results are shown as follows;
9.3.1. Setting Example of Terminal Software

The operation of the terminal software (Tera Term) has been checked with the following settings.

![Terminal Software Settings](image)
9.4. Operating Flow of Sample Program

The operating flows of the sample program are shown in the following:
Creation and Initialization

EEPROM_i2c_init() → bsp_i2c

Instance address, sda, scl

Register allocation

CG: FSYSENA
IPENA02 (PortC): Clock supply
IPENA03 (I2C): Clock supply

Port:
I2C0SCL, I2C0SDA setting

Port C:
IPENA02 (PortC)
IPENA03 (I2C)

I2C_deinit(Instance address)

I2C_frequency(100KHz)

I2C_get_clock_setting (Instance address)

frequency = I2C_get_clock_setting();

I2C_init(Instance address)

result = I2C_init(); success

result = EEPROM_i2c_init();
"write" command processing

result: strncmp()
In the case of "write":

EEPROM_I2C_WritePage
(Transmission data and transmission Byte count)

Transmission data generation
Byte0 : Address High Byte
Byte1 : Address Low Byte
Byte2~n : Data

I2C_write
(Instance handle, Slave address, Transmission data,
Transmission Byte count, and stop = 1)

ref
I2C_start

ref
I2C_byte_write(Slave address)

Loop[1, Transmission Byte count]

ref
I2C_byte_write(Transmission data)

Opt
[stop = 1]

ref
I2C_stop

Transmission Byte count = I2C_write()

Terminal: Display
Write data is displayed.
"read" command processing

**Result: strncmp()**

In the case of "read":

**Transmission data generation**
- Byte0: Address High Byte
- Byte1: Address Low Byte

**i2c_write**
- (Instance handle, Slave address, Transmission data, Transmission Byte count 2, and stop = 0)

**i2c_read**
- (Instance handle, Slave address, Reception data, Reception Byte count, and stop = 1)

**Loop**
- [1, Reception Byte count - 1]

**Opt**
- [stop=1]

**Terminal: Display**
- Read data is displayed.

**Ref**
- Refer to "i2c_write" part in "write" command procedure.
I²C start procedure

```c
i2c_start(Instance handle)
```

result = i2c_start(); Successful.

Start = 1*
(Only Internal information update)
I²C write procedure

```
I²C byte write

bsp_i²c

i²c

I²C clear int status

I²C start condition

alt

I²C start condition (Instance handle and Slave address)

I²C write data (Instance handle and Transmission data)

Loop [with I²C interrupt request]

I²C int status

I²C clear int status

I²C get ack

ACK result = I²C byte write
```

---

**I²C write procedure**

1. **I²C byte write** (Instance handle and Transmission data)
2. **I²C clear int status** (Instance handle)
3. **I²C start condition** (Instance handle and Slave address)
   - **alt** [start=1]
   - **alt** [start=0]
4. **I²C write data** (Instance handle and Transmission data)
5. **Loop [with I²C interrupt request]**
   - **I²C int status** (Instance handle)
   - **I²C clear int status**
6. **I²C get ack** (Instance handle)
   - **ACK result = I²C byte write**: ACK
I2C read procedure

1. `i2c_byte_read(Instance handle)`

2. `I2C_int_status(Instance handle)`

3. `I2C_write_data(Instance handle, Dummy data 0)`

4. `I2C_write_data(-)`

5. `I2C_clear_int_status(-)`

6. `I2C_clear_int_status(-)`

7. `Loop [with I2C interrupt request]`
I2C stop procedure

i2c_stop(Instance handle)

I2C_stop_condition(Instance handle)

Loop(BUSY)

i2c_stop()

I2C status=I2C_status_busy():

I2C_status_busy(Instance handle)

I2C_stop_condition():

i2c_stop(Instance handle)
10. Precaution

When using the sample program with CPU other than TMPM3H6, please check operation sufficiently.

11. Revision History

<table>
<thead>
<tr>
<th>Rev</th>
<th>Date</th>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2018-03-08</td>
<td>-</td>
<td>First release</td>
</tr>
</tbody>
</table>
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