Outlines

This application note is a reference material for developing products using the Master/Slave function in 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_MASTER_SLAVE
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1. Preface

This sample program is used to check the operation of the I2C communication function. Data transmission and reception by I2C Master / Slave is performed 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(1) 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 (I2C0SCL) PC1 (I2C0SDA)</td>
<td>I2C mode</td>
</tr>
<tr>
<td>Asynchronous communication</td>
<td>ch0</td>
<td>PA1 (UT0TXDA) PA2 (UT0RXD)</td>
<td>UART mode</td>
</tr>
</tbody>
</table>

4. Target Device

The target devices of application note are as follows.

| TMPM3H6FWFG | TMPM3H6FUFG | TMPM3H6FSFG |
| TMPM3H6FUDFG | TMPM3H6FUUG | TMPM3H6FSDFG |
| TMPM3H5FWFG | TMPM3H5FUFG | TMPM3H5FSFG |
| TMPM3H5FUDFG | TMPM3H5FUUG | TMPM3H5FSDFG |
| TMPM3H4FWUG | TMPM3H4FUUG | TMPM3H4FSUG |
| TMPM3H4FUDFG | TMPM3H4FUUG | TMPM3H4FSFG |
| TMPM3H3FWUG | TMPM3H3FUUG | TMPM3H3FSUG |
| TMPM3H2FWUDG | TMPM3H2FUDUG | TMPM3H2FSUDG |
| TMPM3H2FUDUG | TMPM3H2FUDUG | TMPM3H2FSQG |
| TMPM3H1FUUG | TMPM3H1FUUG | TMPM3H1FSUG |
| TMPM3H1FUG  | TMPM3H0FSDUG | TMPM3H0FMDUG |

* 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

- Used microcontroller: TMPM3H6FWFG
- Used board: TMPM3H6FWFG Evaluation Board (Product of Sensyst)
- Unified development environment: IAR Embedded Workbench for ARM 8.11.2.13606
- Terminal software: Tera Term V4.96
- Sample program: V1100

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

The following pin connections should be done on the evaluation board. Two evaluation boards are used for Master and Slave. There are three kinds of connection as follows.

<table>
<thead>
<tr>
<th>Common to board A and board B</th>
<th>CN5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>Through-hole No.</td>
</tr>
<tr>
<td>UART (RXD)</td>
<td>9-10</td>
</tr>
<tr>
<td>UART (TXD)</td>
<td>11-12</td>
</tr>
</tbody>
</table>

Connection between CN in board A
- Connect “CN9 No.2” and “CN12 No.32”
- Connect “CN9 No.4” and “CN12 No.34”

Connection between boards
- Connect “board A CN9 No.2” and “board B CN9 No.2”
- Connect “board A CN9 No.4” and “board B CN9 No.4”

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

According to the command input in the terminal software, Master and Slave are operated.

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. Initialize the application
3. Initialization of the I2C interfaces for Master and Slave.

After the above processing, perform the following operations on PC terminal software (Tera Term).
"Command>" is displayed on Tera Term.
The command "slave" should be set to the board which should be used as Slave.
The command "write" or "read" should be input to the board which should be used as Master.
When "write" is input, the slave address and the transmission data are displayed for the Master board. And the address and the reception data are displayed for the Slave one.
When "read" is input, the slave address and the transmission/reception data are displayed for the Master board. The address and the reception/transmission data are displayed for the Slave one.
For the displayed image, refer to Section 9.3 “Output Example of Sample Program”.

9.3. Output Example of Sample Program

When the sample program operates, the command results are shown as follows;

Master

<table>
<thead>
<tr>
<th>Command</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>write</td>
<td></td>
</tr>
<tr>
<td>master</td>
<td></td>
</tr>
<tr>
<td>t:00</td>
<td>00</td>
</tr>
<tr>
<td>t:10</td>
<td>01</td>
</tr>
<tr>
<td>t:20</td>
<td>02</td>
</tr>
<tr>
<td>t:30</td>
<td>08</td>
</tr>
</tbody>
</table>

Slave

<table>
<thead>
<tr>
<th>Command</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>slave</td>
<td></td>
</tr>
<tr>
<td>s:00</td>
<td></td>
</tr>
<tr>
<td>r:00</td>
<td></td>
</tr>
<tr>
<td>r:10</td>
<td></td>
</tr>
<tr>
<td>r:20</td>
<td></td>
</tr>
<tr>
<td>r:30</td>
<td></td>
</tr>
</tbody>
</table>

slave

<table>
<thead>
<tr>
<th>Command</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>s:00</td>
<td></td>
</tr>
</tbody>
</table>
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]

- **Port:** COM9
- **Baud rate:** 115200
- **Data:** 8 bit
- **Parity:** none
- **Stop:** 1 bit
- **Flow control:** none
- **Transmit delay:** 0 msec/char, 0 msec/line

![Terminal Setup]

- **Terminal size:** 80 x 24
- **Expand Terminal Size to Window Size:** checked
- **Receive:** AUTO
- **Transmit:** CR+LF
- **Answerback:** VT100
- **Local echo:** checked
- **Auto switch (VT<->TEK):** unchecked
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()**

- **i2c_api**
  - i2c_init (Instance address, sda, scl)

**CG: FSYSENA**
- FSYSENA02 (PortC) Enable
- FSYSENA20 (I2C) Enable

**Port:**
- I2C0SCL and I2C0SDA settings

**Register assignment**

**I2C_reset()**

- I2C_reset(Instance address)

**I2C_frequency(100KHz)**

- I2C_get_clock_setting(Instance address)

**I2C initial setting**

- result = I2C_init():Successful
"write" command procedure

In the case of "write":

- `ts_i2c_master_non_blocking_write()`

Result: `strncmp()`

Terminal display:
Write data is displayed.
**slave** command procedure

Terminal display
Read data is displayed.

```c
TS_i2c_set_slave_mode()

i2c_slave_address
(Instance handle, Slave address)

result = strncmp
In the case of "slave",

ref
i2c_stop
[stop=1]

opt
[stop=1]

ref
i2c_slave_transfer_asynch
(Instance handle, Transmission buffer address, Transmission Byte count,
Reception buffer address, Reception Byte count, Slave address, stop = 1)

TS_i2c_slave_non_blocking_receive()
```
i2c_api

reset_asynch(Instance handle)

i2c

I2C_start_condition(Instance handle, Slave address)

I2C_clear_int_status(Instance handle)

I2C_int_status(Instance handle)

ACK result = i2c_transfer_asynch(); I2C_ACK

Loop[2C interrupt request is present.]

i2c_transfer_asynch
(Instance handle, Transmission buffer address, Transmission Byte count, Reception buffer address, Reception Byte count, Slave address, stop = 1)
i2c_stop(Instance handle)

i2c_stop_condition(Instance handle)

Loop[BUSY]

i2c_status_busy(Instance handle)

i2c_stop()
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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