M3H Group(1)
Application Note
Serial Peripheral Interface
(TSPI-B)

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

Target sample program: TSPI_FLASH
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1. Preface

This sample program is used to check the operation of TSPI communication function. It writes data to SPI EEPROM and reads data from SPI EEPROM through USB-UART interface on the terminal software on the host PC.

Structure diagram of Sample program

**Application Layer**

- Board Support Package (bsp.c/.h)
  - Main (main.c)
  - UART (uart_io.c/.h)
  - Serial Flash (spi_flash.c/.h)

**Driver Layer**

- UART (txz_uart.c/txz_uart.h)
- CG (txz_cg.c/.h)
- TSPI (txz_tspi.c/txz_tspi.h)

**H/W**

- UART
- CG
- Serial Flash
2. Reference Document

- Datasheet
  TMPM3H group (1) datasheet Rev2.0 (Japanese edition)
- Reference manual
  Serial peripheral interface (TSPi-B) Rev2.1 (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>Serial peripheral</td>
<td>ch1</td>
<td>PP0 (TSP1CLK)</td>
<td>SPI mode</td>
</tr>
<tr>
<td>interface</td>
<td></td>
<td>PP1 (TSP1TXD)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PP2 (TSPIRXD)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PL6 (TSP1CS0)</td>
<td></td>
</tr>
<tr>
<td>Asynchronous</td>
<td>ch0</td>
<td>PA1 (UT0TXDA)</td>
<td>UART mode</td>
</tr>
<tr>
<td>communication</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>
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<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 I/O 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. Operation confirmation condition

Used microcontroller    TMPM3H6FWFG
Used board            TMPM3H6FWFG Evaluation Board (Product of Sensyst)
Unified development environment    IAR Embedded Workbench for ARM 8.11.2.13606
Unified development environment    μVision MDK Version 5.24.2.0
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.

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

<table>
<thead>
<tr>
<th>CN9</th>
<th>Use</th>
<th>Through-hole No.</th>
<th>Setting</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>TSPI (FSS)</td>
<td>43-44</td>
<td>Connection</td>
</tr>
<tr>
<td></td>
<td>TSPI (CLK)</td>
<td>45-46</td>
<td>Connection</td>
</tr>
<tr>
<td></td>
<td>TSPI (DO)</td>
<td>47-48</td>
<td>Connection</td>
</tr>
<tr>
<td></td>
<td>TSPI (DI)</td>
<td>49-50</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 activating the terminal software (Tera Term), the PC performs communication setting. Push the reset button on the evaluation board.
8. Outline of Serial Peripheral Interface

TSPI (synchronous serial communication) can select SPI and SIO formats, and the clock can be selected between Clock master and Clock slave. So it has four modes to operate. 1 unit circuit operates as 1 channel transmission and reception circuit (TSPlxTXD, TSPlxRXD, TSPlxSCK, SPIxCS0/1/2/3, and TSPlxCSIN).

8.1. Clock Supply

When TSPI is used, the corresponding clock enable bits should be set to “1” (Clock supply) in fsys supply stop register A ([CGFSYSENA]), fsys supply stop register B ([CGFSYSENB]), and fc supply stop register ([CGFCEN]).

For the details, refer to “Clock Control and Operation Mode” in Reference manual.

When stopping supply of a clock, please check that TSPI has stopped ([TSPlxCRC]<TSPIE>=0 (TSPI control)).

Moreover, also when you change operational mode to STOP1/STOP2, please check that TSPI has stopped.
9. Sample Program

Enter the command (write or read) on the terminal software.
When the "write" command is executed, the input character is stored to I2C EEPROM. When the "read" command is executed, the data stored in I2C EEPROM is read 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 do the following initialization.
1: Initialization of BSP (Board Support Package)
2: Initialization of variables
3: Initialization of application
4: Initialization of board
5: Initialize the driver
6: Erase SPI FLASH
7: Main control of sample program

After the above processing, perform the following operations on PC terminal software (Tera Term).
"Command>" is displayed in Tera Term.
The “write” or “read” command should be input according to the following format.
"write" command: The input character is stored to SPI EEPROM (Address 0x0).
"read" command: SPI EEPROM (Address 0x0) is read and the read data is displayed through Tera Term.
Command format:

```
write_command
write_X               X: Any character
read_command
read
```

<table>
<thead>
<tr>
<th>Used memory</th>
<th>SPI EEPROM: M25P16-VMN6TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used port</td>
<td>FSS:PL6, CLK:PP0, DO:PP1, DI:PP2</td>
</tr>
</tbody>
</table>
9.3. Output Example of Sample Program

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

![Command Output Example](image_url)
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
- **Receive:** AUTO
- **Transmit:** CR+LF
- **Local echo**
- **Answerback:** VT100
- **Auto switch (VT<->TEK)**
9.4. Operating Flow of Sample program

The operating flows of the sample program are shown as follows.

![Diagram of Operating Flow]

- **Main**
- **Loop**
- **Creation and Initialization**
- **Command processing**
**Creation and Initialization**

- **BSP initialization**
- **RAM initialization**
- **Application initialization**
- **Driver initialization**

**Status initialization**

- **Serial Flash-Erase**
  - **Sector 0 erase**
    - **MEM_Write_Mode** (Instance handle, SPI_FLASH_WRITE_ENABLE)
      - `result = MEM_Write_Mode(-):Successful`
    - **MEM_SEC_ERASE** (Instance handle, Start address of Erase sector)
      - `result = MEM_SEC_ERASE(-):Successful`
    - **Loop**
      - **MEM_R_STATUS** (Instance handle, Storage destination of Reception data)
        - `result = MEM_R_STATUS(-):Successful`
      - **spi_flash**
      - **tspi**

**RAM initialization**

- **Application initialization**
- **Driver initialization**

**Status initialization**

- **Serial Flash-Erase**
  - **Sector 0 erase**
    - **MEM_Write_Mode** (Instance handle, SPI_FLASH_WRITE_ENABLE)
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      - **tspi**

**RAM initialization**

- **Application initialization**
- **Driver initialization**

**Status initialization**

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      - `result = MEM_Write_Mode(-):Successful`
    - **MEM_SEC_ERASE** (Instance handle, Start address of Erase sector)
      - `result = MEM_SEC_ERASE(-):Successful`
    - **Loop**
      - **MEM_R_STATUS** (Instance handle, Storage destination of Reception data)
        - `result = MEM_R_STATUS(-):Successful`
      - **spi_flash**
      - **tspi**
Command processing

Input data == “write” ?

YES

ref
write

Input data == “read” ?

YES

ref
Read

Command error message display
MEM_Write_Mode
(Instance handle, SPI_FLASH_WRITE_ENABLE)

result = MEM_Write_Mode(): Successful

MEM_Write_Asynch
(Instance handle, Address, Storage destination of Write data, Data count)

result = MEM_Write_Asynch(): Successful

Terminal display
Write data is displayed.

result = tspi_master_write(): Successful

TPZ_SUCCESS

result = tspi_master_transfer(): Successful

[result = TXZ_SUCCESS]

transmit_handler
(ID number, result)

send.state == SEND_SUCCESS
loop

if result is TXZ_SUCCESS, SEND_SUCCESS is set in send.state

if result is not TXZ_SUCCESS, SEND_FAILURE is set in send.state
MEM_Read_BYTE_Asynch
(Instance handle, Address, Storage destination of Read data)

result = tspi_master_transfer(); Successful

result = tspi_master_read(); Successful

result = MEM_Read_BYTE_Asynch(); Reception data count

Terminal display
Read data is displayed.

Serial Flash Erase
Sector 0 erase

For information on erasing Serial Flash, see Creation and Initialization.
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>2018-03-09</td>
<td>-</td>
<td>First release</td>
</tr>
</tbody>
</table>
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