Outlines

This application note is a reference material for developing products using the serial peripheral interface (TSPI) functions of M3H Group (2). This document helps the user check operation of the product and develop its program.

Target sample program: TSPI_ChToCh
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1. Preface

This sample program is for checking the operation of the TSPI communication function. The sample program sends and receives data using 2ch SPI.

Structure diagram of Sample program
2. Reference Document

- Datasheet
  TMPM3H group (2) datasheet Rev2.0 (Japanese edition)
- Reference manual
  Serial peripheral interface (TSPI-B) Rev2.1 (Japanese edition)
- Other reference document
  TMPM3H(2) 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>PB2 (TSPI1SCK)</td>
<td>SPI mode (Slave)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PB4 (TSPI1RXD)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PB5 (TSPI1CS0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ch2</td>
<td>PT1 (TSPI2CS0)</td>
<td>SPI mode (Master)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PT2 (TSPI2SCK)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PT3 (TSPI2TXD)</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>TMPM3HQFDHG</th>
<th>TMPM3HQFZFG</th>
<th>TMPM3HQFYFG</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMPM3HPFDHG</td>
<td>TMPM3HPFZFG</td>
<td>TMPM3HPFYFG</td>
</tr>
<tr>
<td>TMPM3HNFDHG</td>
<td>TMPM3HNFZFG</td>
<td>TMPM3HNFYFG</td>
</tr>
<tr>
<td>TMPM3HNFDDFG</td>
<td>TMPM3HNFZDFG</td>
<td>TMPM3HNFYDFG</td>
</tr>
<tr>
<td>TMPM3HMFDHG</td>
<td>TMPM3HMFZFG</td>
<td>TMPM3HMFYFG</td>
</tr>
</tbody>
</table>

* This sample program operates on the evaluation board of TMPM3HQFDHG.
  If other function than the TMPM3HQ 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 (TMPM3HQ). If other function than the TMPM3HQ one is checked, the BSP related file should be changed properly.
5. Operation confirmation condition

<table>
<thead>
<tr>
<th>Used microcontroller</th>
<th>TMPM3HQFDFG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used board</td>
<td>TMPM3HQFDFG Evaluation Board (Product of Sensyst)</td>
</tr>
<tr>
<td>Unified development environment</td>
<td>IAR Embedded Workbench for ARM 8.11.2.13606</td>
</tr>
<tr>
<td></td>
<td>μVision MDK Version 5.24.2.0</td>
</tr>
<tr>
<td>Terminal software</td>
<td>Tera Term V4.96</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/)
6. Evaluation Board Setting

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

<table>
<thead>
<tr>
<th>Board function</th>
<th>Through hole No.</th>
<th>Through hole No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB UART conversion</td>
<td>53 : PA1</td>
<td>54 : USB_TXD</td>
</tr>
<tr>
<td>USB UART conversion</td>
<td>55 : PA2</td>
<td>56 : USB_RXD</td>
</tr>
<tr>
<td>SPI communication (Inter-channels)</td>
<td>7 : PT1</td>
<td>31 : PB5</td>
</tr>
<tr>
<td>SPI communication (Inter-channels)</td>
<td>9 : PB5</td>
<td>37 : PB2</td>
</tr>
<tr>
<td>SPI communication (Inter-channels)</td>
<td>11 : PT3</td>
<td>33 : PB4</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.

Communication starts according to command input.

For details of command input operation, refer to the sample program main operation.
8. Outline of Serial Peripheral Interface

TSPI (Serial Peripheral Interface) has four operation modes as SPI/SIO mode, and the clock master/clock slave mode.

One channel/unit which is built-in TSPIxTXD, TSPIxRXD, TSPIxSCK, TSPIxCS0, TSPIxCS1, TSPIxCS2, TSPIxCS3, and TSPIxCSIN can be transmit and receive circuit.

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 (TSPIxCR0<TSPIE>=0 (TSPI control)).

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

It transmits and receives the character string "TOSHIBA" using TSPI of 2 ch, and displays the received data on the Tera Term.

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 port (for TSPI)
5: Main control of sample program

The "command>" is displayed on Tera Term, so if you want to send, enter "write". When the "write" command is input, the character string "TOSHIBA" is sent, and the display of Tera Term returns to the "command>".
To view the received data, enter "read". When the "read" command is input, it reads the received data, displays the received data and the "command>" on the Tera Term.
9.3. Output Example of Sample Program

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

```
command > write
command > read
read data > TOSHIBA
command >
```
9.3.1. Setting Example of Terminal Software

The operation of the terminal software (Tera Term) has been checked with the following settings.
9.4. Operating Flow of Sample program

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

- **Main**
  - Creation and Initialization
  - Start-up
  - Loop [No processing error]
    - Waiting for input command
    - Command processing
    - Data transmission
Creation and Initialization

- BSP initialization
- RAM initialization
- Application initialization
- Status initialization

Application initialization

- UART Application Initialization
- TSPI transmission channel Initialization
- TSPI receive channel Initialization
TSPI transmission channel initialization

BSP (Application)  

Get channel for TSPI transmission

bsp_get_tspi_tx_ch  
tspi_init

TSPI (Driver)

TSPI receive channel initialization

BSP (Application)  

Get TSPI reception channel

bsp_get_tspi_rx_ch  
tspi_init

TSPI (Driver)
"getchar" is retargeted to "getc", and the characters are input one by one.

Receive data extraction
Command processing

- Input data == “write”?
  - YES: Data transmission
  - NO: Command error message display

- Input data == “read”?
  - NO: Receive data display

TSPI (Driver)

Receive data buffer setting

tspi_master_read
(TSPI reception instance address, received data storage address, retry count)

tspi_master_read(-)
Send

`tspi_irq_handler_transmit` (Instance address for TSPI transmission)

`tspi_master_transfer` (TSPI transmission instance address, transmission data storage destination address)

`tspi_irq_handler_transmit` (-)

[send completely]

Registration transmission handler
(TSPI transmission instance address, transmission result)

Store transmission results

Registration send handler (-)

`tspi_irq_handler_transmit` (-)
10. Precaution

When using the sample program with CPU other than TMPM3HQ, 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>2018-05-22</td>
<td>-</td>
<td>First release</td>
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</table>
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