Outline

This application note is a reference material for developing products using the real-time clock (RTC) function of M3H Group (2). This document helps the user check operation of the product and develop its program.

Target sample program: RTC_UART
## Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outline</td>
<td>1</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>2</td>
</tr>
<tr>
<td>1. Preface</td>
<td>3</td>
</tr>
<tr>
<td>2. Reference Document</td>
<td>4</td>
</tr>
<tr>
<td>3. Function to Use</td>
<td>4</td>
</tr>
<tr>
<td>4. Target Device</td>
<td>4</td>
</tr>
<tr>
<td>5. Operation confirmation condition</td>
<td>5</td>
</tr>
<tr>
<td>6. Evaluation Board Setting</td>
<td>6</td>
</tr>
<tr>
<td>7. Outline of RTC function</td>
<td>6</td>
</tr>
<tr>
<td>8. Sample Program</td>
<td>7</td>
</tr>
<tr>
<td>8.1. Initialization</td>
<td>7</td>
</tr>
<tr>
<td>8.2. Sample program main operation</td>
<td>7</td>
</tr>
<tr>
<td>8.3. Output Example of Sample Program</td>
<td>8</td>
</tr>
<tr>
<td>8.3.1. Setting Example of Terminal Software</td>
<td>8</td>
</tr>
<tr>
<td>8.4. Operating Flow of Sample Program</td>
<td>9</td>
</tr>
<tr>
<td>8.5. Setting Modification of Displayed Time Information</td>
<td>18</td>
</tr>
<tr>
<td>9. Precaution</td>
<td>19</td>
</tr>
<tr>
<td>10. Revision History</td>
<td>19</td>
</tr>
<tr>
<td>RESTRICTIONS ON PRODUCT USE</td>
<td>20</td>
</tr>
</tbody>
</table>
1. Preface

This sample program is a sample program for checking the operation of the RTC's clock function. The time values is displayed on the terminal software on the host PC via USB-UART.

Structure diagram of Sample program
2. Reference Document

- Datasheet
  TMPM3H group (2) datasheet Rev2.0 (Japanese edition)
- Reference manual
  Real time clock (RTC-A) 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>Real time clock</td>
<td>-</td>
<td>-</td>
<td>Clock function</td>
</tr>
<tr>
<td>Asynchronous serial</td>
<td>ch0</td>
<td>PA1 (UT0TXDA)</td>
<td>Asynchronous communication with PC</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.

| TMPM3HQFDFG | TMPM3HQPZFG | TMPM3HQFYFG |
| TMPM3HPFDFG | TMPM3HPFZFG | TMPM3HPFYFG |
| TMPM3HNFDFG | TMPM3HNFZFG | TMPM3HNFYFG |
| TMPM3HNFDFG | TMPM3HNFZDFG | TMPM3HNFYDFG |
| TMPM3HMFDFG | TMPM3HMDFZFG | TMPM3HMFYFG |

* This sample program operates on the evaluation board of TMPM3HQFDFG. 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>Component</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used microcontroller</td>
<td>TMPM3HQFDFG</td>
</tr>
<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>Unified development environment</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>

Evaluation board (TMPM3HQFDFG Evaluation Board) (Top view)

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>CN12</th>
<th>Board function</th>
<th>Through hole No.</th>
<th>Through hole No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>USB UART conversion</td>
<td>53 : PA1</td>
<td>54 : USB_TXD</td>
</tr>
<tr>
<td></td>
<td>USB UART conversion</td>
<td>55 : PA2</td>
<td>56 : USB_RXD</td>
</tr>
</tbody>
</table>

7. Outline of RTC function

The real time clock (RTC) is a clock function to which even the calendar corresponding to a leap year can respond.

At counting a low speed clock (fs), a 1Hz clock is generated and it operates. Clock correction function can adjust clock progress and delay due to low speed oscillator error. The alarm function can output a pulse from ALARM_N pin or output an interrupt request by detecting coincidence of the time and the clock which was set up beforehand.

The main RTC function is as follows:
- Clock function
- Alarm function

This sample program can check the operation of the clock function.
8. Sample Program

The sample program displays year / month / date / time and day of the week in terminal software. RTC uses 1Hz interrupt and the clock function. Time information is displayed on the terminal software via USB-UART.

8.1. Initialization

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

8.2. 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 driver
3: Initialize the application

At the above setting, port, clock, timer, UART are initialized. The time setting is done by this sample program. Year/Month/Date/Day/Time/ are set (initialized).

After the settings complete, this program starts the clock. The date and time are acquired from the clock register at the timing of the 1Hz periodic interrupt. The time values are transferred via UART ch0 to PA1/2 pins (UT0TXDA/UT0RXD) and displayed by the terminal software.

For the details of the register setting, refer to an appropriate reference manual.
8.3. Output Example of Sample Program

When this sample program operates, the content in the clock register is displayed, as shown in the following figure.
The followings are the output of the default value of the sample program.

8.3.1. Setting Example of Terminal Software

The operation of the terminal software (Tera Term) has been checked with the following settings.
8.4. 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 procedure errors]
  - Time information output
  - Stop
  - End and Deletion
Creation and Initialization

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

Driver initialization

- T32A Driver initialization
Although initialization setting of 32-bit timer event counter of TMPM3H is done, it is not used in actual operation of this sample program.

**Application initialization**

- Timer Application initialization
- UART Application initialization
- Horloge Application initialization

**T32A Driver initialization**

- BSP (Application)
- Acquisition of Timer channel for 1-ms timer
Horologe Application initialization

Horologe instance handle=horol_initialize(-)

Assignment of RTC register address

rtc_init(RTC instance address)

rtc_clock_set_leap (RTC instance handle: Leap year setting)

rtc_set_hour_notation (RTC instance handle: 12/24-hour display)

rtc_clock_set_hour (RTC instance handle: Hour)

rtc_clock_set_month (RTC instance handle: Month)

rtc_clock_set_date (RTC instance handle: Date)

rtc_clock_set_day (RTC instance handle: Day)

rtc_set_int_source (RTC instance handle: 1Hz interrupt)

Horologe instance handle=horol_initialize(-)

Horologe initial setting starts.

horol_initialize(Storage of Horologe initial setting)

Horologe (Application)

RTC (Application)

[24-hour display]

rtc_clock_set_hour_24 (RTC instance handle: Hour)

[12-hour display]

rtc_clock_set_hour_12 (RTC instance handle: AMPM and Hour)

rtc_clock_set_min (RTC instance handle: Minute)

rtc_clock_set_sec (RTC instance handle: Second)

rtc_set_int_source (RTC instance handle: 1Hz interrupt)
Horologe Application stop

- **horol_stop** (Horologe instance address)
- **EXCEPTION disable**
  - **INTRTC_IRQn**
- **rtc_disable_int** (RTC instance address)
- **rtc_clock_disable** (RTC instance address)
- **bsp_irq_rtc_disable()**
- **horol_stop()**

**Stop**

- **ref** Horologe Application stop
- **ref** Timer Application stop

---

**Horologe Application**

**RTC** (Application)

**BSP** (Application)
Horologe Application end

- horol_finalize
  (Horologe instance address)

  horol_finalize(-)

- rtc_deinit
  (RTC instance address)

  Release of RTC register
  address assignment

  ref
  Horologe Application stop

T32A Driver end

- Release of Register address
  assignment for 1-ms timer channel
8.5. Setting Modification of Displayed Time Information

When the time information is changed, change the setting value in RTC: main.c

<table>
<thead>
<tr>
<th>Item</th>
<th>Modified location</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFG_HOROL_HOUR_NOTATION</td>
<td>(RTC_HOUR_NOTATION_24)</td>
<td>24-hour display setting</td>
</tr>
<tr>
<td>CFG_HOROL_CENTURY</td>
<td>((uint8_t)21)</td>
<td>Year setting</td>
</tr>
<tr>
<td>CFG_HOROL_YEAR</td>
<td>((uint8_t)17)</td>
<td>Setting of 2 least significant digits of the year</td>
</tr>
<tr>
<td>CFG_HOROL_MONTH</td>
<td>(RTC_MONTH_JAN)</td>
<td>Month setting</td>
</tr>
<tr>
<td>CFG_HOROL_DATE</td>
<td>((uint8_t)1)</td>
<td>Date setting</td>
</tr>
<tr>
<td>CFG_HOROL_DAY</td>
<td>(RTC_DAY_SUNDAY)</td>
<td>Day setting</td>
</tr>
<tr>
<td>CFG_HOROL Meridiem</td>
<td>(RTC_MERIDIEM_AM)</td>
<td>AM/PM setting</td>
</tr>
<tr>
<td>CFG_HOROL_HOUR</td>
<td>((uint8_t)0)</td>
<td>Hour setting</td>
</tr>
<tr>
<td>CFG_HOROL_MIN</td>
<td>((uint8_t)0)</td>
<td>Minute setting</td>
</tr>
<tr>
<td>CFG_HOROL_SEC</td>
<td>((uint8_t)0)</td>
<td>Second setting</td>
</tr>
</tbody>
</table>

The initial values of the time has been set to “Sunday, January 01, 2017 00:00:00” in this sample program. Any time values can be set by modifying each item value.

For the modification conditions and the range of each item value, refer to “bsp rtc.h file” in ¥Project¥Examples¥BSP¥TMPM3HQ_eval¥src folder. The modification range of each item is written there.
9. Precaution

When using the sample program with CPU other than TMPM3HQ, please check operation sufficiently.

10. 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>2018-05-18</td>
<td>-</td>
<td>First release</td>
</tr>
</tbody>
</table>
Toshiba Corporation and its subsidiaries and affiliates are collectively referred to as "TOSHIBA". Hardware, software and systems described in this document are collectively referred to as "Product".

- TOSHIBA reserves the right to make changes to the information in this document and related Product without notice.

- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.

- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before customers use the Product, create designs including the Product, or incorporate the Product into their own applications, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application with which the Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.

- PRODUCT IS NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS OR SYSTEMS THAT REQUIRE EXTRAORDINARILY HIGH LEVELS OF QUALITY AND/OR RELIABILITY, AND/OR A MALFUNCTION OR FAILURE OF WHICH MAY CAUSE LOSS OF HUMAN LIFE, BODILY INJURY, SERIOUS PROPERTY DAMAGE AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE"). Except for specific applications as expressly stated in this document, Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, devices related to electric power, and equipment used in finance-related fields. IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT. For details, please contact your TOSHIBA sales representative.

- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.

- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.

- ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.

- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.

- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. TOSHIBA ASSUMES NO LIABILITY FOR DAMAGES OR LOSSES OCCURRING AS A RESULT OF NONCOMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS.