M3H Group(2)  
Application Note  
Oscillation Frequency Detector  
(OFD-A)

Outlines
This application note is a reference material for developing products using the Oscillation Frequency Detector (OFD) function of M3H Group (2). This document helps the user check operation of the product and develop its program.

Target sample program: OFD_LED
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1. Preface

This sample program is used to check the operation of the OFD function. The frequency of a selected clock signal can be monitored by the Oscillation Frequency Detector and checked if it is in the normal range or not.

Structure diagram of Sample program
2. Reference Document
- Datasheet
  TMPM3H group (2) datasheet Rev2.0 (Japanese edition)
- Reference manual
  Oscillation Frequency Detector (OFD-A) Rev2.1 (Japanese edition)
- Other reference document
  TMPM3H(2) Group Peripheral Driver User Manual (Doxygen)

3. Target Device

<table>
<thead>
<tr>
<th>IP</th>
<th>channel</th>
<th>port</th>
<th>Function / operation mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillation Frequency Detector</td>
<td>-</td>
<td>-</td>
<td>Detection of an abnormal clock frequency</td>
</tr>
<tr>
<td>32-bit timer event counter</td>
<td>Timer A ch0</td>
<td>-</td>
<td>Interval timer</td>
</tr>
<tr>
<td>Input and Output ports</td>
<td>-</td>
<td>PK4 (Output Port) PK5 (Output Port)</td>
<td>Output</td>
</tr>
</tbody>
</table>

4. Target Device

The target devices of application note are as follows.

<table>
<thead>
<tr>
<th>TMPM3HQFDFG</th>
<th>TMPM3HQFZFG</th>
<th>TMPM3HQFYFG</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMPM3HPFDFG</td>
<td>TMPM3HPFZFG</td>
<td>TMPM3HPFYFG</td>
</tr>
<tr>
<td>TMPM3HNFDFG</td>
<td>TMPM3HNFZFG</td>
<td>TMPM3HNFYFG</td>
</tr>
<tr>
<td>TMPM3HNFDDFG</td>
<td>TMPM3HNFZDFG</td>
<td>TMPM3HNFYDFG</td>
</tr>
<tr>
<td>TMPM3HMFDFG</td>
<td>TMPM3HMFZFG</td>
<td>TMPM3HMFYFG</td>
</tr>
</tbody>
</table>

* 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>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>Unified development environment</td>
<td>μVision MDK Version 5.24.2.0</td>
</tr>
<tr>
<td>Sample program</td>
<td>V1100</td>
</tr>
</tbody>
</table>

![Evaluation board (TMPM3HQFDFG Evaluation Board) (Top view)](image)

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>Board function</th>
<th>Through hole No.</th>
<th>Through hole No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LED (D10)</td>
<td>33 : PORT_LED0</td>
<td>34 : PK4</td>
</tr>
<tr>
<td></td>
<td>LED (D9)</td>
<td>35 : PORT_LED1</td>
<td>36 : PK5</td>
</tr>
</tbody>
</table>

7. Outline of OFD Function

The oscillation frequency detection circuit (OFD) is a function that detects an abnormal state of the clock. It measures the external high-speed oscillation (fEHOSC) or high-speed clock (fc) based on the internal reference clock (fIHOSC1). If an oscillation or clock frequency is out of the specified range, a reset signal occurs.
8. Sample Program

The status of the output of the Oscillation Frequency Detector is shown on the LED’s. When the frequency is in the normal region, LED (D10) blinks. When the frequency is not in the normal region, LED (D9) lights.

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

OFD reset flag is cleared. The settings of GPIO’s for the LED’s are done. Timer setting is done. This sample program uses Timer-A ch0. 1-second interval for the LED lighting is generated by the timer.

The OFD setting is done after the other settings complete. The detection frequency range should be set. The abnormal frequency status can be detected by acquiring [OFDSTAT] value.

8.3. OFD Setting Change

When the frequency range of the OFD is changed in the sample program, the following items should be changed properly.

```c
#define OFD_LOWER_COUNT ((uint32_t)0x1CDU)
#define OFD_HIGHER_COUNT ((uint32_t)0x23EU)
#define OFD_LOWER_COUNT_EXTERNAL ((uint32_t)0x45U)
#define OFD_HIGHER_COUNT_EXTERNAL ((uint32_t)0x56U)
```

The detected frequency range can be changed by updating those setting values. For the calculation method for the setting values, refer to Reference manual.
8.4. Operating Flow of Sample Program

The operating flows of the sample program are shown in the following;
Start-up

Driver initialization

Application initialization

[\text{RSTFLG1}]OF DRSTF==1?

YES

OFD setting

OFDRSTF clear

LED control
Driver initialization

ref T32A Driver initialization

T32A Driver initialization

bsp_get_timer_ch(BSPTimer)

Channel number = bsp_get_timer_ch(-)

t32a_mode_init(Instance address)

timer_initialize(Timer instance address)

result = timer_initialize(-):Successful

result = t32a_mode_init(-):Successful

result = t32a_timer_init(-):Successful

Acquisition of Timer channel for 1-ms timer
Application initialization

Timer Application initialization

LED Application initialization

[1, Count of used LED's]

LED Application initialization

GPIO (Application)

led_initialize(LED instance address)

led_initialize(-)

gpio_write_bit(GPIO instance address, Group, Number, DATA, LED initial setting value)
OFD setting

- REG_OFDWEN_enable(Register base address)
- REG_OFDRST_Disable(Register base address)
- REG_OFDMON1_set(Register base address)
- REG_OFDMX0_set(Register base address, Setting value)
- REG_OFDMN0_set(Register base address, Setting value)
- REG_OFDMX1_set(Register base address, Setting value)
- REG_OFDMN1_set(Register base address, Setting value)
- REG_OFDEN_enable(Register base address)

Loop

OFDBUSY==0

WAIT

Opt

FRQERR==0

errflag = 0

REG_OFDRST_enable(Register base address)

REG_OFDWEN_disable(Register base address)

FRQERR==1

errflag = 1

REG_OFDRST_enable(Register base address)
LED control

err_flag == 0

No OFD errors

LED10 Blink
LED9 Lights-off

led_turn_on

err_flag == 1

OFD error detection

LED10 Lights-off
LED9 Lights-on

led_turn_on
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>2018-05-16</td>
<td>-</td>
<td>First release</td>
</tr>
</tbody>
</table>
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