M3H Group(1)
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(1).
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 (1) datasheet Rev2.0 (Japanese edition)
- Reference manual
  Oscillation Frequency Detector (OFD-A) 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>Oscillation Frequency</td>
<td>-</td>
<td>-</td>
<td>Detection of an abnormal clock frequency</td>
</tr>
<tr>
<td>Detector</td>
<td></td>
<td></td>
<td></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>PB4 (Output Port)</td>
<td>Output</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PB5 (Output Port)</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>
</thead>
<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>TMPM3H3FWUG</td>
<td>TMPM3H3FUUG</td>
<td>TMPM3H3FSUG</td>
</tr>
<tr>
<td>TMPM3H2FWUG</td>
<td>TMPM3H2FUUG</td>
<td>TMPM3H2FSUG</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 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. 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
- **Sample program**: V1100

Evaluation board (TMPM3H6FWFG 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>CN5</th>
<th>Use</th>
<th>Through-hole No.</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LED (D10)</td>
<td>27-28</td>
<td>Connection</td>
</tr>
<tr>
<td></td>
<td>LED (D9)</td>
<td>29-30</td>
<td>Connection</td>
</tr>
</tbody>
</table>

7. Outline of OFD Function

The Oscillation Frequency Detector (OFD) is used to detect abnormal status of the clock. The target clock is selected between External high-speed clock ($f_{EHOSC}$) and High-speed clock ($f_c$). The frequency of the selected clock is measured by using the built-in reference clock ($f_{IHOSC2}$). If the frequency is out of the set range, the internal reset signal is generated.
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.

#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 as follows.

Main

- BSP initialization
- RAM initialization
- Start-up
Start-up

- Driver initialization
- Application initialization

[RSTFLG1](OF DRSTF==1?)

- OFD setting
- LED control

YES

OFDRSTF clear
Driver initialization

ref T32A Driver initialization

**T32A Driver initialization**

**BSP (Application)**

- `bsp_get_timer_ch(BSPTimer)`
  - Channel number = `bsp_get_timer_ch(-)`

- `t32a_mode_init(instance address)`
  - `result = t32a_mode_init(-): Successful`

- `timer_initialize(Timer instance address)`

- `result = timer_initialize(-): Successful`

- `t32a_timer_init(Instance address)`
  - `result = t32a_timer_init(-): Successful`

**Acquisition of Timer channel for 1-ms timer**
Application initialization

ref Timer Application initialization

loop
[1, Count of used LED's]

ref LED Application initialization

LED Application initialization

LED Initial setting creation

led_initialize (LED instance address)

GPIO (Application)

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

err_flag == 1

OFD error detection

LED10 Lights-off
LED9 Blink

opt

led
(Application)

ofd
(Application)

led_turn_on
9. Precaution

When using the sample program with CPU other than TMPM3H6, 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>2018-03-02</td>
<td>-</td>
<td>First release</td>
</tr>
</tbody>
</table>
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