Outlines

This application note is a reference material for developing products using the voltage detection circuit (LVD) function of M3H Group (2).
This document helps the user check operation of the product and develop its program.

Target sample program: LVD-DEMO
# Table of Contents

Outlines ................................................................................................................................................. 1
Table of Contents .................................................................................................................................. 2
1. Preface .............................................................................................................................................. 3
2. Reference Document ........................................................................................................................ 4
3. Target Device .................................................................................................................................... 4
4. Target Device .................................................................................................................................... 4
5. Operation confirmation condition ...................................................................................................... 5
6. Evaluation Board Setting ................................................................................................................... 6
7. Operation of Evaluation Board .......................................................................................................... 6
8. Outline of LVD Function .................................................................................................................... 6
9. Sample Program ............................................................................................................................... 7
   9.1. Initialization ....................................................................................................................................... 7
   9.2. Sample program main operation ....................................................................................................... 7
   9.3. LVD Setting Change ......................................................................................................................... 7
   9.4. Operating Flow of Sample Program .................................................................................................. 8
10. Precaution ..................................................................................................................................... 15
11. Revision History ............................................................................................................................ 15
RESTRICTIONS ON PRODUCT USE ................................................................................................ 16
1. Preface

This sample program is used to check the operation of the LVD function. The result of the voltage detection is shown by the lighting or the blink of the LED's when the power is supplied.

Structure diagram of Sample program
2. Reference Document

- Datasheet
  TMPM3H group (2) datasheet Rev2.0 (Japanese edition)
- Reference manual
  Voltage detection circuit (LVD-A) Rev1.2 (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>Voltage detection</td>
<td>-</td>
<td>-</td>
<td>Detection of Power supply voltage</td>
</tr>
<tr>
<td>Input and output port</td>
<td>-</td>
<td>PK4 (Output Port) PK5 (Output Port)</td>
<td>Output</td>
</tr>
<tr>
<td>32-bit timer event counter</td>
<td>Timer A ch0</td>
<td>-</td>
<td>Interval timer</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>TMPM3HNFDFF</td>
<td>TMPM3HNFDFF</td>
<td>TMPM3HNFDFF</td>
</tr>
<tr>
<td>TMPM3HMFDFF</td>
<td>TMPM3HMFDFF</td>
<td>TMPM3HMFDFF</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

- Used microcontroller: TMPM3HQFDFG
- Used board: TMPM3HQFDFG 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 (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>Board function</th>
<th>Through hole No.</th>
<th>Through hole No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED (D10)</td>
<td>33 : PORT_LED0</td>
<td>34 : PK4</td>
</tr>
<tr>
<td>LED (D9)</td>
<td>35 : PORT_LED1</td>
<td>36 : PK5</td>
</tr>
</tbody>
</table>

CN18: External power should be supplied to No2 pin.

7. Operation of Evaluation Board

The LVD detection result is shown by the LED lighting or blink.
CN18 JP should be removed. The external power should be supplied to Pin 2 (the central pin).
The power voltage is lower than the set LVD value: LED (D10) blinks.
The power voltage is higher than the set LVD value: LED (D9) lights.
DVDD5 voltage status can be checked by the LED lighting or blink.

8. Outline of LVD Function

The voltage detection circuit (LVD) generates an interrupt request or an internal reset signal when it detects a lower voltage than the preset value or a higher voltage than the other preset one.
A voltage detection circuit supervises the voltage of DVDD5.
The reference voltage which occurred in the reference voltage generating circuit is compared with the output of the detection voltage made from DVDD5. Detection voltage can be chosen.
According to a comparison result, interrupt/reset selection output control circuit outputs reset or interrupt.
9. Sample Program

An external power should be supplied to the DVCC (CN18) pin on the board. The LED lighting or blink shows the result of the comparison of the output of the voltage detection circuit with the preset voltage.

9.1. Initialization

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

9.2. Sample program main operation

The setting of 1-ms interrupt timer is done. The setting of the LED control is done. The LVD setting is done. In this sample program, the detection voltage and the release voltage have been set to 4.0V and 4.05V, respectively.

The voltage detection status of the LVD should be checked. The power voltage should be compared with the detection and the release voltages. When the detected power voltage is higher than the set LVD value, LED (D9) lights. Check the voltage detection status of the LVD at 1-ms intervals and continue lighting if the result is the same.

When the detected power voltage is lower than the set LVD value, LED (D10) blinks. The voltage detection status of the LVD should be checked, and the blink continues when the result is the same.

9.3. LVD Setting Change

When the value of the comparison voltage in the LVD is changed in the sample program, the following should be done. Change the setting of init_LVD in lvd.c. Example: TSB_LVD->CR |= (uint8_t)LVD_VOLTAGE_44; Detection results with threshold of 4.4 V and LED operation can be changed.
9.4. Operating Flow of Sample Program

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

Driver initialization

Application initialization

LVD setting

LED control
Driver initialization

ref T32A Driver initialization

---

T32A Driver initialization

bsp_get_timer_ch(BSPTimer)

Channel number = bsp_get_timer_ch(-)

result = timer_initialize(-): Successful

t32a_mode_init(Instance address)

result = t32a_mode_init(-): Successful

t32a_timer_init(Instance address)

Acquistion 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 Initialize

initialized

GPIO
(Application)

led_initialize
(LED instance address)

led_initialize(-)

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

```c
TSB_LVD->CR &= (uint8_t)LVD_DISABLE; /* LVD Disable */
TSB_LVD->CR |= (uint8_t)LVD_VOLTAGE_40; /* 4.0V */
TSB_LVD->CR |= (uint8_t)LVD_SEL_RESET; /* RESET */
TSB_LVD->CR &= (uint8_t)LVD_OUT_DISABLE; /* Output Disable */
```

```c
TSB_LVD->CR |= (uint8_t)LVD_ENABLE; /* LVD Enable */
```
Acquisition of LVD status value

8 continuously acquired status values are the same.

The acquired status value is not the same as the previous one.

Count reset
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>2018-05-17</td>
<td>-</td>
<td>First release</td>
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</tbody>
</table>
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