GigaDevice Semiconductor Inc.

Arm® Cortex®-M3/4 32-bit MCU

应用笔记
AN008
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1. 简介

GD32 系列 MCU 当前版本产品在使用 Deep-sleep 模式时有一个限制。如果用户使能了一些非唤醒源的中断，当用户使用 Deep-sleep 模式时，无论使用 WFI 指令还是 WFE 指令，都会存在一个比较严重的风险，当 MCU 进入 Deep-sleep 模式后，可能永远无法被目标唤醒信号（中断或事件）唤醒。
2. 解决方案

为了规避这个风险，用户需要替换表 2-1. GD 标准库中的原始函数中的 pmu_to_deepsleepmode 函数中字体加粗的代码，这个函数一般在 GD32 标准中命名为“gd32fxxx_pmu.c”方式。

用户需要根据使用的 MCU 型号，用下面对应的代码替换。

<table>
<thead>
<tr>
<th>param[in]</th>
<th>ldo</th>
</tr>
</thead>
<tbody>
<tr>
<td>arg</td>
<td>PMU_LDO_NORMAL: LDO normal work when pmu enter deepsleep mode</td>
</tr>
<tr>
<td>arg</td>
<td>PMU_LDO_LOWPOWER: LDO work at low power mode when pmu enter deepsleep mode</td>
</tr>
<tr>
<td>param[in]</td>
<td>deepsleepmodecmd:</td>
</tr>
<tr>
<td>arg</td>
<td>WFI_CMD: use WFI command</td>
</tr>
<tr>
<td>arg</td>
<td>WFE_CMD: use WFE command</td>
</tr>
<tr>
<td>param[out]</td>
<td>none</td>
</tr>
<tr>
<td>retval</td>
<td>none</td>
</tr>
</tbody>
</table>

```c
void pmu_to_deepsleepmode(uint32_t ldo, uint8_t deepsleepmodecmd)
{
    /* clear stbmod and ldolp bits */
    PMU_CTL &= ~(uint32_t)(PMU_CTL_STBMOD | PMU_CTL_LDOLP);

    /* set ldolp bit according to pmu_ldo */
    PMU_CTL |= ldo;

    /* set sleepdeep bit of Cortex-M4 system control register */
    SCB->SCR |= SCB_SCR_SLEEPDEEP_Msk;

    /* select WFI or WFE command to enter deepsleep mode */
    if(WFI_CMD == deepsleepmodecmd){
        __WFI();
    }else{
        __SEV();
        __WFE();
        __WFE();
    }

    /* reset sleep deep bit of Cortex-M4 system control register */
    SCB->SCR &= ~(uint32_t)SCB_SCR_SLEEPDEEP_Msk;
}
```
关于 deep-sleep 模式的使用说明

2.1. 用于 GD32F10x / F20x / F30x / F403 系列库的替换代码

表 2-2. 用于 GD32F10x / F20x / F30x / F403 系列的替换代码

```c
{  
  static uint32_t reg_snap[4];

  reg_snap[0] = REG32(0xE000E010);
  reg_snap[1] = REG32(0xE000E100);
  reg_snap[2] = REG32(0xE000E104);
  reg_snap[3] = REG32(0xE000E108);

  REG32(0xE000E010) &= 0x00010004;
  REG32(0xE000E180) = 0xFF7FF83D;
  REG32(0xE000E184) = 0xBFFFF8FF;
  REG32(0xE000E188) = 0xFFFFFFFF;

  /* select WFI or WFE command to enter deepsleep mode */
  if(WFI_CMD == deepsleepmodecmd){
    __WFI();
  }else{
    __SEV();
    __WFE();
  }  
  REG32(0xE000E010) = reg_snap[0];
  REG32(0xE000E100) = reg_snap[1];
  REG32(0xE000E104) = reg_snap[2];
  REG32(0xE000E108) = reg_snap[3];
}
```
关于 deep-sleep 模式的使用说明

2.2. 用于 GD32F1x0 / F3x0 系列库的替换代码

表 2-3. 用于 GD32F1x0 / F3x0 系列的替换代码

```c
{  static uint32_t reg_snap[4];

    reg_snap[0] = REG32(0xE000E010);
    reg_snap[1] = REG32(0xE000E010);
    reg_snap[2] = REG32(0xE000E104);
    reg_snap[3] = REG32(0xE000E108);

    REG32(0xE000E010) &= 0x00010004;
    REG32(0xE000E180) = 0XB7FFEF19;
    REG32(0xE000E184) = 0XFFFBFF;
    REG32(0xE000E188) = 0XFFFFFFFF;

    /* select WFI or WFE command to enter deepsleep mode */
    if(WFI_CMD == deepsleepmodecmd){
        __WFI();
    }else{
        __SEV();
        __WFE();
        __WFE();
    }

    REG32(0xE000E010) = reg_snap[0];
    REG32(0xE000E100) = reg_snap[1];
    REG32(0xE000E104) = reg_snap[2];
    REG32(0xE000E108) = reg_snap[3];
}
```
2.3. 用于 GD32F40x 系列库的替换代码

表 2-4. 用于 GD32F40x 系列的替换代码

```c
{
    static uint32_t reg_snap[4];

    reg_snap[0] = REG32(0xE000E010);
    reg_snap[1] = REG32(0xE000E100);
    reg_snap[2] = REG32(0xE000E104);
    reg_snap[3] = REG32(0xE000E108);

    REG32(0xE000E010) &= 0x00010004;
    REG32(0xE000E180) = 0xFF7FF83D;
    REG32(0xE000E184) = 0xBFFFF8FF;
    REG32(0xE000E188) = 0xFFFFFFFF;

    /* select WFI or WFE command to enter deep sleep mode */
    if(WFI_CMD == deepsleepmodecmd){
        __WFI();
    }else{
        __SEV();
        __WFE();
        __WFE();
    }

    REG32(0xE000E010) = reg_snap[0];
    REG32(0xE000E100) = reg_snap[1];
    REG32(0xE000E104) = reg_snap[2];
    REG32(0xE000E108) = reg_snap[3];
}
```
关于 deep-sleep 模式的使用说明

3. 版本历史

表 3-1. 版本历史

<table>
<thead>
<tr>
<th>版本号</th>
<th>说明</th>
<th>日期</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>首次发布</td>
<td>2021 年 11 月 30 日</td>
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