NUC240 使用ADC量测 AV_{DD}

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

代码简述	本范例代码使用内部 ADC 量测出 Bandgap 电压，推算出 AV_{DD} 。
BSP 版本	NUC230_240_Series_BSP_CMSIS_V3.01.001
开发平台	NuEdu-EVB-NUC240 v1.0

1 功能介绍

1.1 简介

IC的内部的Band-Gap(1.25V)电压是稳定的，可以用来当做ADC的参考电压。在本范例程序，使用ADC信道7，该信道为测量内部参考电压，也就是内部Band-Gap电压。只需要测到Band-Gap电压对应的ADC值，就可以反推到电源电压的值AV_{DD}。

1.2 原理

已知

V_{BG} : 内部 Band-gap 电压。NUC240系列V_{BG}值为 1.25 V。

V_{BGM}: Band-gap A/D 转换结果

V_{REF} = AV_{DD}

根据

$$\frac{V_{BGM}}{4096} = \frac{V_{BG}}{V_{REF}}$$

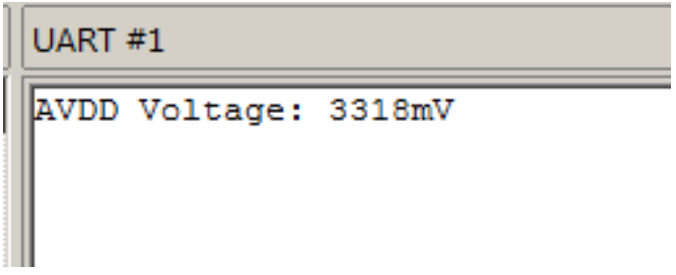
我们可以使用公式

$$AV_{DD} = V_{REF} = \frac{1.25 \times 4096}{V_{BGM}}$$

推算出AV_{DD}的电压。

1.3 执行结果

编译项目并进入除错模式执行代码，串口窗口UART #1将打印出AV_{DD}电压值。



2 代码介绍

2.1 读取 ADC 值

GetAVDDCodeByADC () 函式用来读取ADC值。

```
uint32_t GetAVDDCodeByADC(void)
{
    uint32_t u32Count, u32Sum, u32Data;

    /* Enable ADC module clock */
    CLK_EnableModuleClock(ADC_MODULE);

    /* ADC clock source is 22.1184MHz, set divider to 7, ADC clock is 22.1184/7 MHz */
    CLK_SetModuleClock(ADC_MODULE, CLK_CLKSEL1_ADC_S_HIRC, CLK_CLKDIV_ADC(22));

    /* Configure ADC: single-end input, single scan mode, enable ADC analog circuit. */
    ADC_Open(ADC, NULL, ADC_ADCR_ADMD_SINGLE, BIT7);

    /* Configure the analog input source of channel 7 as internal band-gap voltage */
    ADC_CONFIG_CH7(ADC, ADC_ADCHER_PRESEL_INT_BANDGAP);

    /* Power on ADC */
    ADC_POWER_ON(ADC);

    /* Clear conversion finish flag */
    ADC_CLR_INT_FLAG(ADC, ADC_ADF_INT);

    /* Enable ADC conversion finish interrupt */
    ADC_EnableInt(ADC, ADC_ADF_INT);
    NVIC_EnableIRQ(ADC_IRQn);

    g_u8ADF = 0;
    u32Sum = 0;

    /* sample times are according to ADC_SAMPLE_COUNT definition */
    for (u32Count = 0; u32Count < ADC_SAMPLE_COUNT; u32Count++)
    {
        /* Delay for band-gap voltage stability */
        CLK_SysTickDelay(1000);
```

```
        /* Start A/D conversion */
        ADC_START_CONV(ADC);

        u32Data = 0;

        /* Wait conversion done */
        while (g_u8ADF == 0);

        g_u8ADF = 0;

        /* Get the conversion result */
        u32Data = ADC_GET_CONVERSION_DATA(ADC, 7);

        /* Sum each conversion data */
        u32Sum += u32Data;
    }

    /* Disable ADC interrupt */
    ADC_DisableInt(ADC, ADC_ADF_INT);

    /* Disable ADC */
    ADC_POWER_DOWN(ADC);

    /* Return the average of ADC_SAMPLE_COUNT samples */
    return (u32Sum >> 7);
}
```

2.2 计算 AV_{DD}电压值

GetAVDDVoltage()函式使用$V_{BGM} = \frac{V_{BG} \times 4096}{V_{REF}}$公式去计算 AV_{DD}电压值。

```
uint32_t GetAVDDVoltage(void)
{
    uint32_t u32ConversionResult;
    uint64_t u64MvAVDD;

    /* Calculate Vref by using conversion result of VBG */
    u32ConversionResult = GetAVDDCodeByADC();

    /* u32ConversionResult = VBG * 1024 / Vref, Vref = AVDD */
```

```
    /* => AVDD = VBG * 4096 / u32ConversionResult */
    u64MvAVDD = (VBG_VOLTAGE << 12) / (uint64_t)u32ConversionResult;

    return (uint32_t)u64MvAVDD;
}
```

3 软件与硬件环境

- 软件环境
  - BSP 版本
    - NUC230_240 Series BSP CMSIS v3.01.001
  - IDE 版本
    - Keil uVersion 4.74
- 硬件环境
  - 电路组件
    - NuEdu-EVB-NUC240 V1.0

4 目录信息

- EC_ NUC240_ADC_Measure_AVDD_V1.00
  - Library — Sample code header and source files
    - CMSIS — Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
    - Device — CMSIS compliant device header file
    - NuEdu — Library for NuEdu-SDK-NUC240 board
  - SampleCode
    - ExampleCode — Source file of example code

5 如何执行范例程序

1. 根据目录信息章节进入ExampleCode 路径中的KEIL文件夹，双击 NUC240_ADC_Measure_AVDD.uvproj.
2. 进入编译模式接口
   a. 编译
   b. 下载代码至内存
   c. 进入 / 离开除错模式
3. 进入除错模式接口
   a. 执行代码

6 修订纪录

Date	Revision	Description
Nov. 1, 2019	1.00	1. 初始发布

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