

M480 EADC最快采样范例

NuMicro® 32位系列微控制器范例代码介绍

文件信息

应用简述	本范例代码通过使用多个 EADC 采样模块采样同一路 EADC 通道实现最快 EADC 采样
BSP 版本	M480_BSP_CMSIS_V3.05.004
开发平台	NuMaker-PFM-M487 V3.0

The information described in this document is the exclusive intellectual property of Nuvoton Technology Corporation and shall not be reproduced without permission from Nuvoton.

Nuvoton is providing this document only for reference purposes of NuMicro microcontroller and microprocessor based system design. Nuvoton assumes no responsibility for errors or omissions.

All data and specifications are subject to change without notice.

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

1. 概述

本范例代码通过使用多个 EADC 采样模块采样同一路 EADC 通道实现最快 EADC 采样。

1.1 原理

M480 系列的 EADC 通道有两种类型，分别是快速通道和慢速通道。其中通道 10~15 是快速通道，通道 0~9 是慢速通道。快速通道的最大采样率可达 5.14MSPS，慢速通道的最大采样率为 2.14MSPS。超过采样频率限制，将引起错误的转换结果。

为了得到最快的采样速率，本范例采用 8 个 EADC 模块采样同一个 EADC 快速通道，通过 PDMA 将采样完成的数据搬移到指定 buffer，且在第 4 个采样模块采样完成，后续模块还在采样的过程中，就触发已经转换完成的模块用于下一轮转换。

关于 EADC 的详细功能描述，请参考 M480 的技术参考手册。

1.2 执行结果

本范例代码为了测量 EADC 实际采样率，在采样开始时，会将 PB5 置低；在采样结束时，会将 PB5 置高。通过示波器抓取 PB5 的低电平时间，即可知道实际的采样率。

本范例采样 1024 次，花费时间 (199us) 如图 1-1 所示。

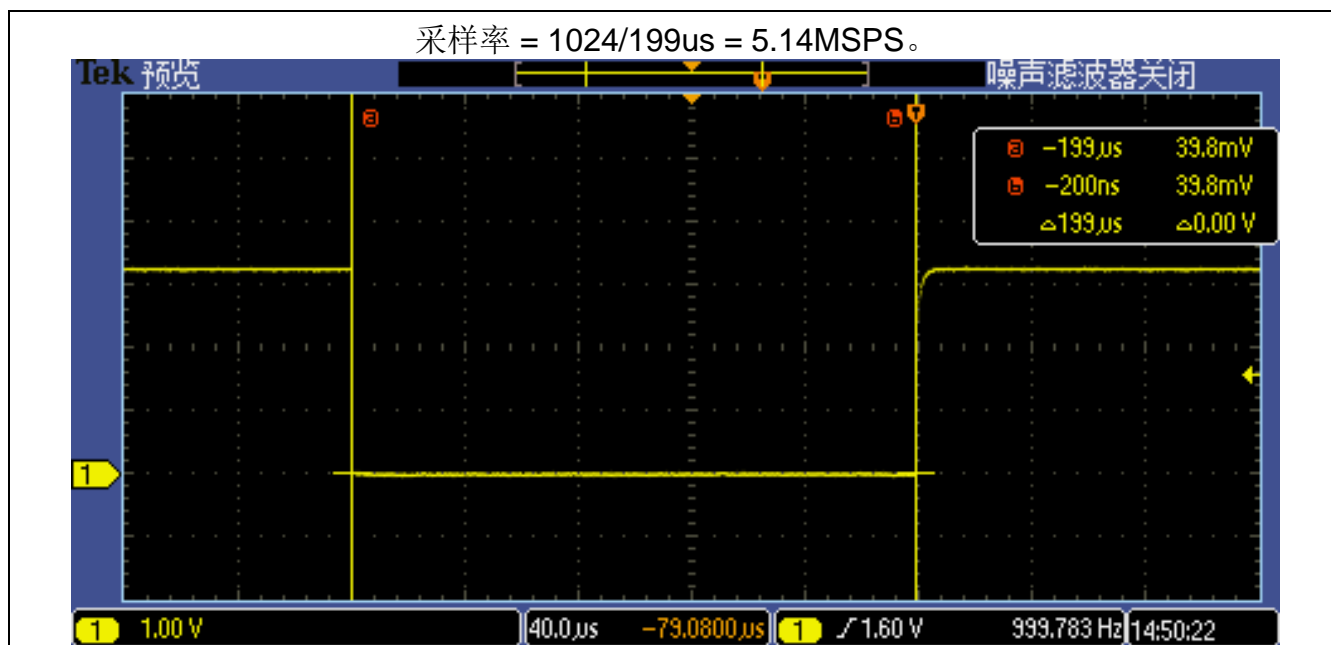


图 1-1 采样时间

若想查看 EADC 的采样数据，可在仿真模式下，将存储数据的数组 g_u16ConversionData 加载到 Memory1 窗口，如图 1-2 所示。

Memory 1												
Address:		g_u16ConversionData										
0x2000003C:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x20000054:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x2000006C:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x20000084:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x2000009C:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x200000B4:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x200000CC:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x200000E4:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x200000FC:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x20000114:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x2000012C:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x20000144:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x2000015C:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x20000174:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x2000018C:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x200001A4:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x200001BC:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x200001D4:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
0x200001EC:	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000

图 1-2 EADC 采样数据

2. 代码介绍

采用 0~7，8 个 EADC 采样模块采样同一个 EADC 通道 10，且在第 4 个采样模块采样完成，后续模块还在采样的过程中，就触发已经转换完成的模块用于下一轮转换。

```
void EADC_Init()
{
    /* Set input mode as single-end and enable the A/D converter */
    EADC_Open(EADC, EADC_CTL_DIFFEN_SINGLE_END);

    /* Configure the sample 0 module for analog input channel 10 and enable ADINT0 trigger source */
    EADC_ConfigSampleModule(EADC, 0, EADC_ADINT0_TRIGGER, 10);
    /* Configure the sample 1 module for analog input channel 10 and enable ADINT0 trigger source */
    EADC_ConfigSampleModule(EADC, 1, EADC_ADINT0_TRIGGER, 10);
    /* Configure the sample 2 module for analog input channel 10 and enable ADINT0 trigger source */
    EADC_ConfigSampleModule(EADC, 2, EADC_ADINT0_TRIGGER, 10);
    /* Configure the sample 3 module for analog input channel 10 and enable ADINT0 trigger source */
    EADC_ConfigSampleModule(EADC, 3, EADC_ADINT0_TRIGGER, 10);

    /* Configure the sample 4 module for analog input channel 10 and enable ADINT0 trigger source */
    EADC_ConfigSampleModule(EADC, 4, EADC_ADINT0_TRIGGER, 10);
    /* Configure the sample 5 module for analog input channel 10 and enable ADINT0 trigger source */
    EADC_ConfigSampleModule(EADC, 5, EADC_ADINT0_TRIGGER, 10);
    /* Configure the sample 6 module for analog input channel 10 and enable ADINT0 trigger source */
    EADC_ConfigSampleModule(EADC, 6, EADC_ADINT0_TRIGGER, 10);
    /* Configure the sample 7 module for analog input channel 10 and enable ADINT0 trigger source */
    EADC_ConfigSampleModule(EADC, 7, EADC_ADINT0_TRIGGER, 10);

    /* Clear the A/D ADINT0 interrupt flag for safe */
    EADC_CLR_INT_FLAG(EADC, EADC_STATUS2_ADIF0_Msk);

    /* Enable the sample module 4 interrupt */
    EADC_ENABLE_SAMPLE_MODULE_INT(EADC, 0, BIT4);
}
```

通过 PDMA 将采样完成的数据搬移到 g_u16ConversionData 。

```
void PDMA_Init()
{
    /* Configure PDMA peripheral mode form EADC to memory */
    /* Open Channel 2 */
    PDMA_Open(PDMA, BIT2);

    /* Transfer width is half word(16 bit) and transfer count is EADC_SAMPLE_COUNT */
    PDMA_SetTransferCnt(PDMA, 2, PDMA_WIDTH_16, EADC_SAMPLE_COUNT);

    /* Set source address as EADC data register(no increment) and destination address as
    g_u16ConversionData array(increment) */
    PDMA_SetTransferAddr(PDMA, 2, (uint32_t)&EADC->CURDAT, PDMA_SAR_FIX,
    (uint32_t)g_u16ConversionData, PDMA_DAR_INC);

    /* Select PDMA request source as ADC RX */
    PDMA_SetTransferMode(PDMA, 2, PDMA_EADC0_RX, FALSE, 0);

    /* Set PDMA as single request type for EADC */
    PDMA_SetBurstType(PDMA, 2, PDMA_REQ_SINGLE, PDMA_BURST_4);

    /* Enable EADC PDMA transfer */
    EADC_ENABLE_PDMA(EADC);

    /* Enable PDMA Interrupt */
    PDMA_EnableInt(PDMA, 2, PDMA_INT_TRANS_DONE);
    NVIC_EnableIRQ(PDMA_IRQn);
}
```

3. 软件与硬件需求

3.1 软件需求

- BSP 版本
 - M480_BSP_CMSIS_V3.05.004
- IDE 版本
 - Keil uVersion 4.74

3.2 硬件需求

- 电路组件
 - NuMaker-PFM-M487 V3.0
- 示意图

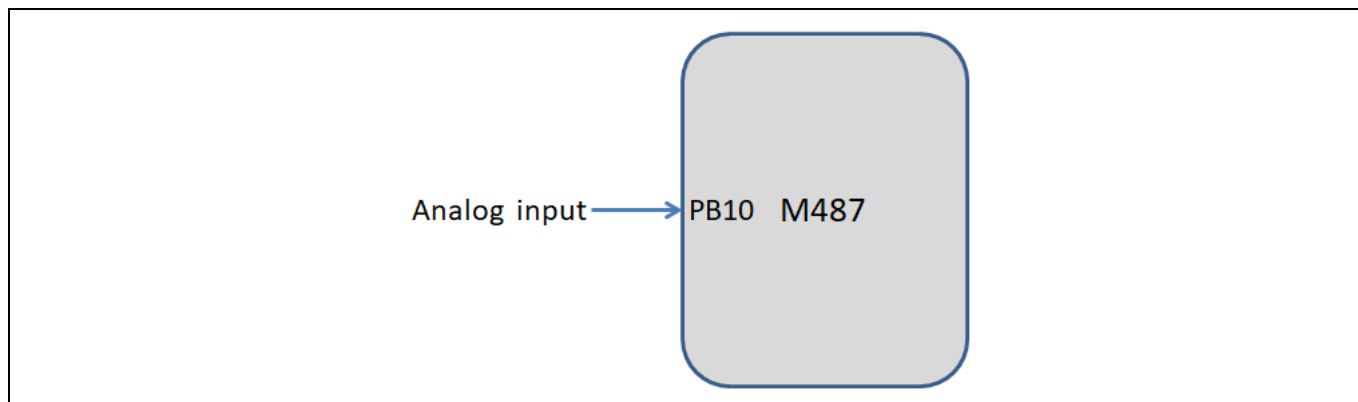


图 3-1 示意图

4. 目录信息








 EC_M480_EADC_Max_Sample_Frequency_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
 StdDriver	All peripheral driver header and source files
 SampleCode	
 ExampleCode	Source file of example code

图 4-1 目录信息

5. 范例程序执行

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 *EADC_Max_Sample_Frequency.uvproj*。
2. 进入编译模式界面
 - 编译
 - 下载代码至内存
 - 进入 / 离开仿真模式
3. 进入仿真模式界面
 - 执行代码

6. 修订纪录

Date	Revision	Description
2023.06.05	1.00	初始发布。

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.

Please note that all data and specifications are subject to change without notice.
All the trademarks of products and companies mentioned in this datasheet belong to their respective owners.