

## M480 EADC最快採樣範例

NuMicro® 32位系列微控制器範例代碼介紹

### 文件資訊

應用簡述	本範例代碼通過使用多個 EADC 採樣模組採樣同一路 EADC 通道實現最快 EADC 採樣
BSP 版本	M480_BSP_CMSIS_V3.05.004
開發平台	NuMaker-PFM-M487 V3.0

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## 1. 概述

本範例代碼通過使用多個 EADC 採樣模組採樣同一路 EADC 通道實現最快 EADC 採樣。

### 1.1 原理

M480 系列的 EADC 通道有兩種類型，分別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。快速通道的最大採樣速率可達 5.14MSPS，慢速通道的最大採樣速率為 2.14MSPS。超過採樣頻率限制，將引起錯誤的轉換結果。

為了得到最快的採樣速率，本範例採用 8 個 EADC 模組採樣同一個 EADC 快速通道，通過 PDMA 將採樣完成的資料搬移到指定 buffer，且在第 4 個採樣模組採樣完成，後續模組還在採樣的過程中，就觸發已經轉換完成的模組用於下一輪轉換。

關於 EADC 的詳細功能描述，請參考 M480 的技術參考手冊。

### 1.2 執行結果

本範例代碼為了測量 EADC 實際採樣速率，在採樣開始時，會將 PB5 置低；在採樣結束時，會將 PB5 置高。通過示波器抓取 PB5 的低電平時間，即可知道實際的採樣速率。

本範例採樣 1024 次，花費時間（199us）如圖 1-1 所示。

採樣速率 =  $1024/199\mu s = 5.14\text{MSPS}$ 。

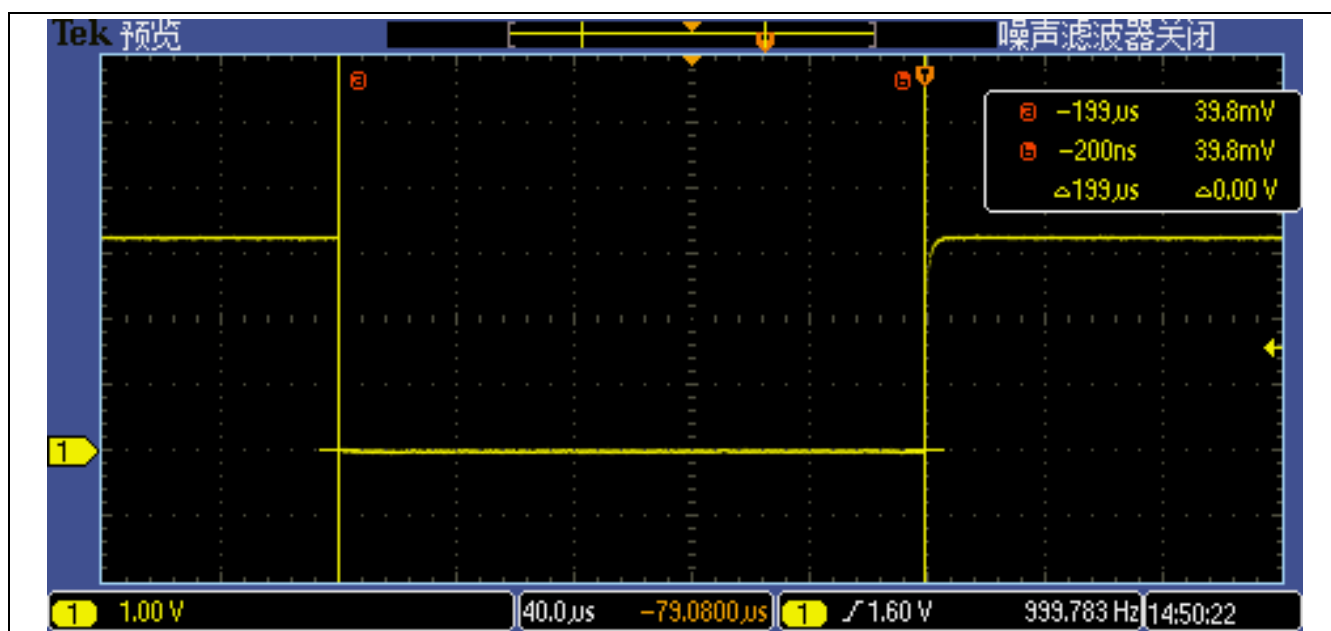


圖 1-1 採樣時間

若想查看 EADC 的採樣資料，可在仿真模式下，將存儲資料的陣列 g\_u16ConversionData 載入到 Memory1 視窗，如圖 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

圖 1-2 EADC 採樣資料

## 2. 代碼介紹

採用 0~7，8 個 EADC 採樣模組採樣同一個 EADC 通道 10，且在第 4 個採樣模組採樣完成，後續模組還在採樣的過程中，就觸發已經轉換完成的模組用於下一輪轉換。

```
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);
}
```

通過 PDMA 將採樣完成的資料搬移到 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. 軟體與硬體需求

#### 3.1 軟體需求

- BSP 版本
  - M480\_BSP\_CMSIS\_V3.05.004
- IDE 版本
  - Keil uVersion 4.74

#### 3.2 硬體需求

- 電路元件
  - NuMaker-PFM-M487 V3.0
- 示意圖

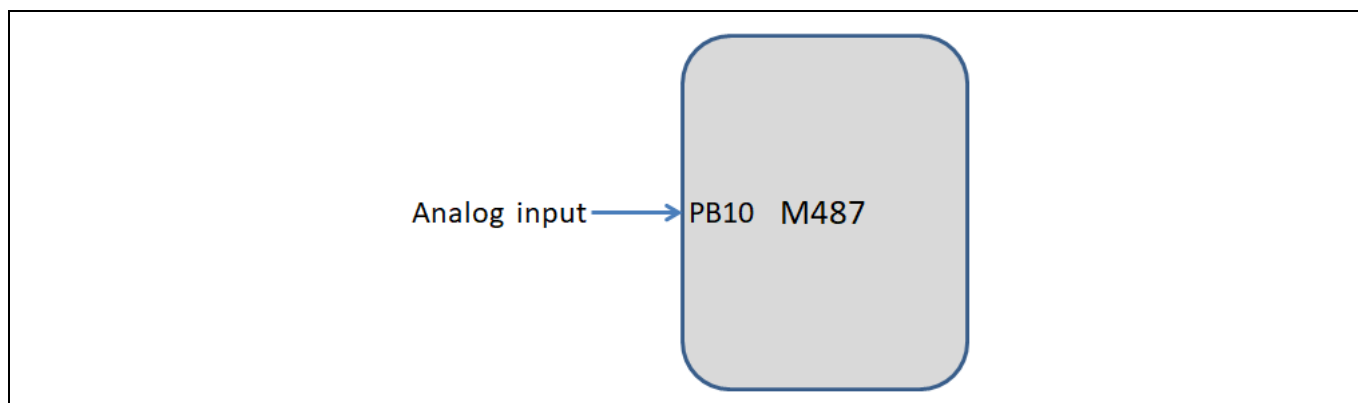


圖 3-1 示意圖

## 4. 目錄資訊








	EC_M480_EADC_Max_Sample_Frequency_V1.00	
	Library	Sample code header and source files
	CMSIS	Cortex <sup>®</sup> Microcontroller Software Interface Standard (CMSIS) by Arm <sup>®</sup> Corp.
	Device	CMSIS compliant device header file
	StdDriver	All peripheral driver header and source files
	SampleCode	
	ExampleCode	Source file of example code

圖 4-1 目錄資訊

## 5. 範例程式執行

1. 根據目錄資訊章節進入 ExampleCode 路徑中的 KEIL 資料夾，雙擊 *EADC\_Max\_Sample\_Frequency.uvproj*。
2. 進入編譯模式介面
  - 編譯
  - 下載代碼至記憶體
  - 進入 / 離開除錯模式
3. 進入除錯模式介面
  - 執行代碼



## 6. 修訂紀錄

Date	Revision	Description
2023.06.05	1.00	初始發布。

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