GigaDevice Semiconductor Inc.

GD32W51x_F5HC 软件开发指南

应用笔记

AN319

1.0 版本

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目录

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1. 简介

本应用笔记专为 GD32W51x_F5HC 系列 MCU 编写，旨在对该系列芯片的外设资源进行功能示例和使用注意事项说明，帮助用户快速掌握 GD32W51x_F5HC 系列 MCU 的软件开发方法与实践。本文档适用型号参考*表 1-1. 适用产品*。

表 1-1. 适用产品

类型	型号
MCU	GD32W51x_F5HC 系列

注意：本应用手册仅作参考，若与用户手册或数据手册内容有冲突，以用户手册或数据手册为准。

2. 模块使用说明

2.1. 系统及存储器架构（SYSTEM）

2.1.1. Boot 方式选择和配置

启动时，使用BOOT0和BOOT1引脚选择引导存储器地址。

BOOT0值可以来自BOOT0引脚，也可以来自EFUSE_CTL寄存器中EFBOOT0位的值，以便在需要时释放GPIO引脚。

BOOT1值可以来自PA14引脚，也可以来自EFUSE_CTL寄存器中EFBOOT1位的值，以便在需要时释放GPIO引脚。

表 2-1. BOOT0 模式（仅适用于 GD32F5HCxx 系列）

EFUSE_CTL		FMC_OBR1		BOOT0 PC8引脚	BOOT0
SWBOOT0	EFBOOT0	SWBOOT0	nBOOT0		
0	-	1	-	0	0
0	-	1	-	1	1
0	-	0	1	-	0
0	-	0	0	-	1
1	0	-	-	-	0
1	1	-	-	-	1

表 2-2. BOOT0 模式（仅适用于 GDW515xx 系列）

SWBOOT0	EFBOOT0	BOOT0 PC8 引脚	BOOT0
0	-	0	0
0	-	1	1
1	0	-	0
1	1	-	1

表 2-3. BOOT1 模式（仅适用于 GD32F5HCxx 系列）

EFUSE_CTL		FMC_OBR1		BOOT1 PA14引脚	BOOT1
SWBOOT1	EFBOOT1	SWBOOT1	nBOOT1		
0	-	1	-	0	0
0	-	1	-	1	1
0	-	0	1	-	0
0	-	0	0	-	1
1	0	-	-	-	0
1	1	-	-	-	1

表 2-4. BOOT1 模式（仅适用于 GDW515xx 系列）

SWBOOT1	EFBOOT1	BOOT1 PA14 引脚	BOOT1
0	-	0	0

SWBOOT1	EFBOOT1	BOOT1 PA14 引脚	BOOT1
0	-	1	1
1	0	-	0
1	1	-	1

TrustZone®使能和失能时的引导地址分别参考*表2-5. TrustZone®失能时引导模式，TZEN=0*和*表2-6. TrustZone®使能时引导模式，TZEN=1*。当EFUSE_CTL寄存器中的EFBOOTLK位置1时，根据BOOT1和BOOT0选择引导存储器地址。

表 2-5. TrustZone®失能时引导模式，TZEN=0

EFBOOTLK	BOOT0	BOOT1	引导地址	引导区域
0	0	-	0x08000000	SIP Flash
0	1	0	0x0BF40000	Bootloader / ROM
0	1	1	0x0A000000	SRAM0
1	0	-	0x08000000	SIP Flash
1	1	-	0x0BF40000	Bootloader / ROM

当TrustZone®通过TZEN位使能，启动空间必须位于安全区域。

表 2-6. TrustZone®使能时引导模式，TZEN=1

GSSACMD == 8'hc(1)	EFBOOTLK	BOOT0	BOOT1	EFSB	引导地址	引导区域
0	0	0	-	0	0x0C000000	SIP Flash
0	0	0	-	1	0X0FF84000	secure boot
0	0	1	0	-	0x0FF80000	GSSA
0	0	1	1	-	0x0E000000	SRAM0
-	1	0	-	0	0x0C000000	SIP Flash
-	1	0	-	1	0X0FF84000	secure boot
-	1	1	-	-	0x0FF80000	GSSA
1	0	-	-	-	0x0FF80000	GSSA

注：（1）当GSSACMD位域为0x0C时表示1，否则表示0。

复位释放时，BOOTx (x = 0/1)的值（来自引脚或 EFBOOTx 位）被锁存。用户可以设置 BOOTx 值来选择所需的引导模式。从 Standby 模式退出时，也会对 BOOTx 引脚或 EFBOOTx 位（取决于 EFUSE_CTL 寄存器中 EFBOOTLK 和 SWBOOTx 位的值）进行重新采样。因此，它们必须在 Standy 模式下保持所需的引导模式配置。启动延迟后，在释放处理器复位之前完成了引导区域的选择。

2.2. 模数转换器（ADC）

2.2.1. ADC 使用注意事项

GD32F5HCxx 系列和 GD32W515xx 系列的 ADC 模块的注意事项如下：

(1) ADC 外部通道数增加

GD32F5HCxx 系列相比于 GD32W515xx 系列新增 3 个外部通道 ADC_IN12, ADC_IN13, ADC_IN14。

(2) ADC 内部通道使能配置

GD32W515xx 系列可以通过配置 ADC_CCTL 寄存器的 TSVREN 位同时使能 ADC 通道 9（温度传感器）和通道 10（内部参考电压）。

表 2-7. GD32W515xx 系列 ADC 内部通道配置

```
/* ADC temperature and vref enable */
adc_internal_channel_config(ADC_CHANNEL_INTERNAL_TEMP_VREF, ENABLE);
…
```

GD32F5HCxx 系列可以通过配置 ADC_CCTL 寄存器的 TSVEN 位单独使能 ADC 通道 9（温度传感器），配置 ADC_CCTL 寄存器的 INREFEN 位单独使能 ADC 通道 10（内部参考电压）。

表 2-8. GD32F5HCxx 系列 ADC 内部通道配置

```
/* ADC temperature enable */
adc_internal_channel_config(ADC_CHANNEL_INTERNAL_TEMPSENSOR, ENABLE);
/* ADC vref enable */
adc_internal_channel_config(ADC_CHANNEL_INTERNAL_VREFINT, ENABLE);
…
```

(3) GD32F5HCxx 系列 ADC 注入序列增加 DMA 功能

GD32F5HCxx 系列增加注入序列 DMA 搬运功能。可以通过设置 ADC_CTL1 寄存器的 IDMA 位来使能，用于传输注入序列多个通道的转换结果。ADC 在注入序列的一个通道转换结束后产生一个 DMA 请求，DMA 接受到请求后可以将转换的数据从 ADC_IDATA 寄存器传输到用户指定的目的地址。同时 GD32F5HCxx 系列增加注入数据寄存器溢出中断和相应的标志位。

表 2-9. GD32F5HCxx 系列 ADC 注入序列 DMA 搬运配置

```
/* ADC DMA function enable */
adc_dma_mode_enable(ADC_INSERTED_CHANNEL);
…
/* initialize DMA single data mode */
dma_single_data_parameter.periph_addr          = (uint32_t)(&ADC_IDATA);
dma_single_data_parameter.periph_inc           = DMA_PERIPH_INCREASE_DISABLE;
dma_single_data_parameter.memory0_addr         = (uint32_t)(&adc_value);
dma_single_data_parameter.memory_inc           = DMA_MEMORY_INCREASE_ENABLE;
dma_single_data_parameter.periph_memory_width  = DMA_PERIPH_WIDTH_16BIT;
dma_single_data_parameter.direction            = DMA_PERIPH_TO_MEMORY;
dma_single_data_parameter.number               = 4U;
dma_single_data_parameter.priority             = DMA_PRIORITY_HIGH;
dma_single_data_mode_init(DMA1, DMA_CH3, &dma_single_data_parameter);
dma_channel_subperipheral_select(DMA1, DMA_CH3, DMA_SUBPERI0);
…
```

(4) GD32F5HCxx 系列 ADC 增加转换数据锁存功能

GD32F5HCxx 系列 ADC 拥有 4 个锁存数据寄存器，ADC_LDATAx（x=0…3），可以在常规或注入序列通道转换完成后锁存数据。

通过配置 ADC_LDCTL 寄存器中的 SEQSELx（x=0…3）位来决定是从常规序列还是从注入序列中选择要锁存的数据，通过配置 COVSELx 位则选择要锁存的序列中的哪个转换结果。

表 2-10. GD32F5HCxx 系列 ADC 数据锁存配置与读取

```
/*   ADC latch data source config */
adc_latch_data_source_configADC_LATCH_DATA_0, ADC_ROUTINE_CHANNEL, 0);
adc_latch_data_source_config(ADC_LATCH_DATA_1, ADC_ROUTINE_CHANNEL, 1);
adc_latch_data_source_config(ADC_LATCH_DATA_2, ADC_INSERTED_CHANNEL, 0);
adc_latch_data_source_config(ADC_LATCH_DATA_3, ADC_INSERTED_CHANNEL, 1);
…
/* get the ADC0 routine channel conversion value */
adc_value[0] = adc_latch_data_read(ADC0, ADC_LATCH_DATA_0);
adc_value[1] = adc_latch_data_read(ADC0, ADC_LATCH_DATA_1);
…
/* get the ADC0 inserted channel conversion value */
adc_value[2] = adc_latch_data_read(ADC0, ADC_LATCH_DATA_2);
adc_value[3] = adc_latch_data_read(ADC0, ADC_LATCH_DATA_3);
…
```

ADC_LDATAx（x=0…3）寄存器默认存储注入序列的第 x 次转换结果。

表 2-11. GD32F5HCxx 系列 ADC 锁存数据寄存器默认读取注入序列数据

```
/* read ADC inserted sequence data register */
inserted_data[0] = adc_latch_data_read(ADC_LATCH_DATA_0);
inserted_data[1] = adc_latch_data_read(ADC_LATCH_DATA_1);
inserted_data[2] = adc_latch_data_read(ADC_LATCH_DATA_2);
inserted_data[3] = adc_latch_data_read(ADC_LATCH_DATA_3);
…
```

2.3. TrustZone 保护控制器组（TZPCU）

具体内容参见*《AN103 GD32W51x 系列 TrustZone 开发指南》*、*《AN300 Trustzone 工程在 Embedded Builder 下开发及中断介绍》*。

2.4. GD32W515xx 系列和 GD32F5HCxx 系列之间的模块差异

具体内容参见*《AN299 GD32F5HC 与 GD32W515 系列间的差异》*。

3. 版本历史

表 3-1. 版本历史

版本号.	说明	日期
1.0	首次发布	2026 年 3 月 31 日

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