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2010年4月1日
瑞萨电子公司

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38D5 群

执行 STP 指令的注意事项

1. 要点

本篇资料介绍了 38D5 群单片机执行 STP 指令的注意事项。

2. 说明

该应用说明适用于以下 MCU 和参数：

适用的 MCU：38D5 群

振荡频率：12MHz

关于 SFR 寄存器的配置，此参考程序可能包含一些对未使用功能位的操作。请用户根据系统的使用情况设置这些位的值。

3. 内容

3.1 停止模式时 MCU 的状态

停止模式是功耗最小的模式。在停止模式时，主时钟、子时钟和片内时钟全部停止振荡。因此，CPU 时钟和外围功能时钟也停止，并且依靠这些时钟运行的 CPU 和外围功能都停止。内部 RAM 的内容和 IO 管脚状态都保持进入停止模式前的状态。

表 1 停止模式下 Icc 电流值

停止模式 Icc	QzROM 版			Flash 版			单位
	最小	典型	最大	最小	典型	最大	
Ta=25°C		0.1	1		0.6	3.0	μA
Ta=85°C			10		1.0		μA

3.2 停止模式解除后的运行模式

MCU 从停止模式返回时的运行模式、时钟振荡方式取决于 OSCSEL (CNVss) 管脚的状态。CPUM 的 bit3、5、6、7 和 CPUM2 的 bit0 根据 OSCSEL 管脚的状态被强制改变。

表 2 从停止模式返回后的时钟振荡方式

MCU	QzROM 版		Flash 版
OSCSEL(CNVss)管脚状态	OSCSEL="H"	OSCSEL="L"	CNVss="L"
主时钟	振荡	停止	停止
子时钟	由 CPUM 决定 (bit4)	由 CPUM 决定 (bit4)	由 CPUM 决定 (bit4)
片上时钟	停止	振荡	振荡
系统时钟 φ	f(XIN)/8	f(OCO)/32	f(OCO)/32

3.3 使用相关功能模块的注意事项

3.3.1 定时器 1 和定时器 2

当停止模式解除时，在经过振荡稳定等待时间后，系统时钟 φ 才被提供给 CPU。这个等待时间由定时器 1 和定时器 2 设定的值确定。所以，必须在执行 STP 指令前将生成振荡稳定等待时间的值写到定时器 1 锁存器和定时器 2 的锁存器。

注1: 为了避免在等待过程中触发中断，必须将定时器 1 和定时器 2 的中断允许位设定为禁止状态。

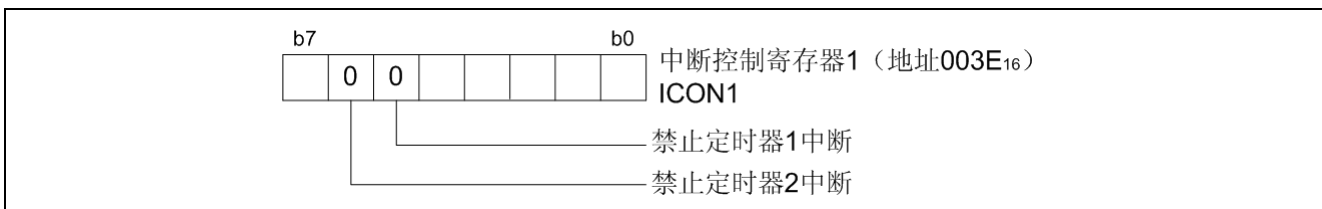


图 1 禁止定时器 1、2 中断

注2: 执行 STP 指令后, 预先设定在定时器 1 锁存器和定时器 2 锁存器中的值被自动装入定时器 1 和定时器 2。定时器 1 的计数源被强制连接到定时器 1 的分频器, 并且定时器 2 的计数源被强制设定为定时器 1 的下溢。此时, 定时器 1、定时器 2 的模式寄存器除 bit7 和 bit6 外, 全部被清“0”。定时器 1234 的分频选择寄存器的内容不改变。

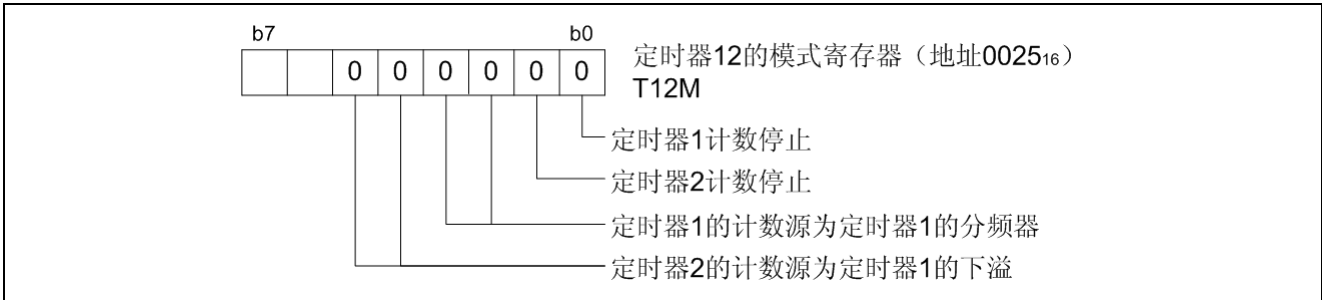


图 2 定时器 12 的模式寄存器状态

注3: 定时器 1、定时器 2 参数设定参考值 (定时器 1、定时器 2 分别为低 8 位和高 8 位)
 当 OSCSEL=L 时, 为 0005₁₆ 以上
 当 OSCSEL=H 时, 为 01FF₁₆ 以上

3.3.2 监视定时器的控制寄存器

监视定时器的控制寄存器的 bit6 是 STP 指令功能选择位。当此位为“0”时, 如果执行 STP 指令, 就转移到停止模式。当此位为“1”时, 如果执行 STP 指令, 就产生内部复位。一旦将此位改写为“1”, 就不能通过程序改写为“0”。复位后, 此位的值为“0”。

- 注1:** 在停止模式解除的等待期间 (用定时器 1 和定时器 2 设定的时间), 监视定时器也进行计数, 所以不能让监视定时器在此期间发生下溢。
- 注2:** 如果通过监视定时器的计数源选择位 2 选择内部振荡器, 内部振荡器就被强制振荡而不能停止。必须将此时的 STP 指令功能选择位设定为“1”。

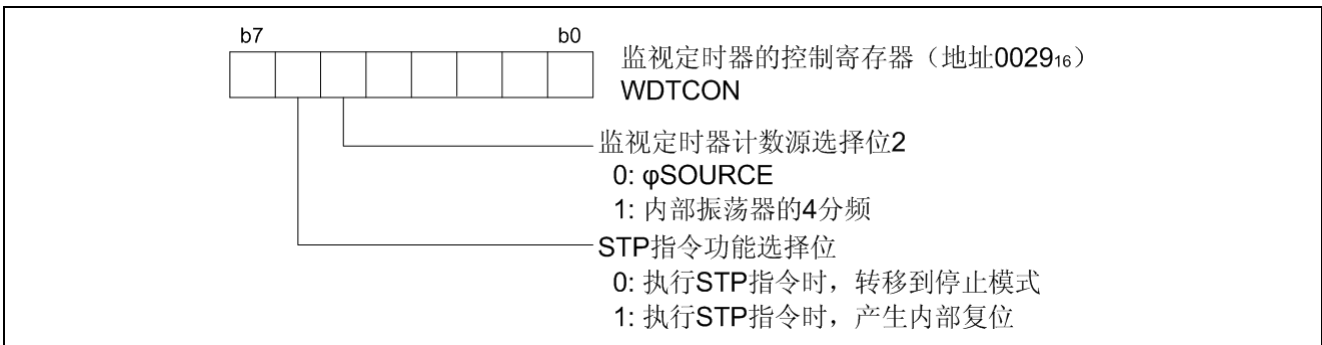


图 3 监视定时器的控制寄存器

3.3.3 外部中断

外部中断能解除停止模式。如果使用外部中断解除停止模式，则必须在进入停止模式前将中断控制器中相应的中断允许位设置为“1”。可用于解除停止模式的外部中断如下表 3 所示。

表 3 外部中断

中断源	中断向量地址		产生中断请求的条件
	高位	低位	
INT0 (INT00 或者 INT01)	FFFB16	FFFA16	当检测到 INT0 输入的上升沿或者下降沿时
INT1 (INT10 或者 INT11)	FFF916	FFF816	当检测到 INT1 输入的上升沿或者下降沿时
INT2	FFF716	FFF616	当检测到 INT2 输入的上升沿或者下降沿时
键输入 (键唤醒)	FFF516	FFF416	在端口 P20~23、P44~47 输入电平的逻辑与的下降沿时
CNTR0	FFE316	FFE216	当检测到 CNTR0 输入的上升沿或者下降沿时
CNTR1	FFE116	FFE016	当检测到 CNTR1 输入的上升沿或者下降沿时

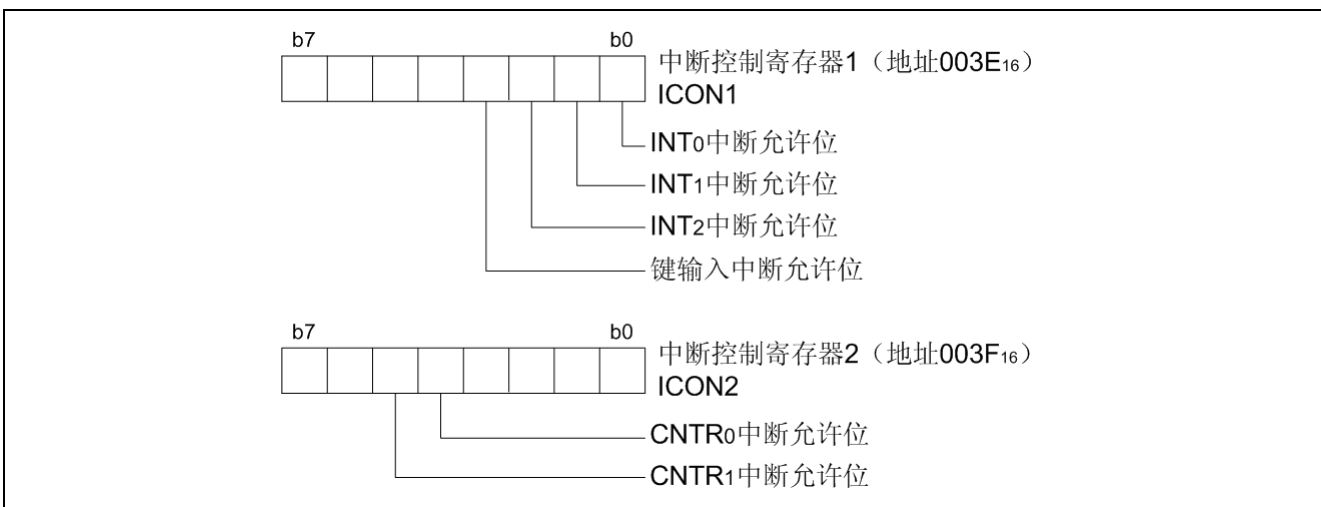


图 4 中断控制寄存器

注：本篇资料例程使用 CNTR0 中断解除停止模式。

3.3.4 LCD 驱动控制寄存器

执行 STP 指令后，LCD 允许位 (LCD 模式寄存器的 bit4) 被改变为“0”，LCD 显示功能关闭。从停止模式返回后，如果要使用 LCD 显示功能，必须将 LCD 允许位置“1”。

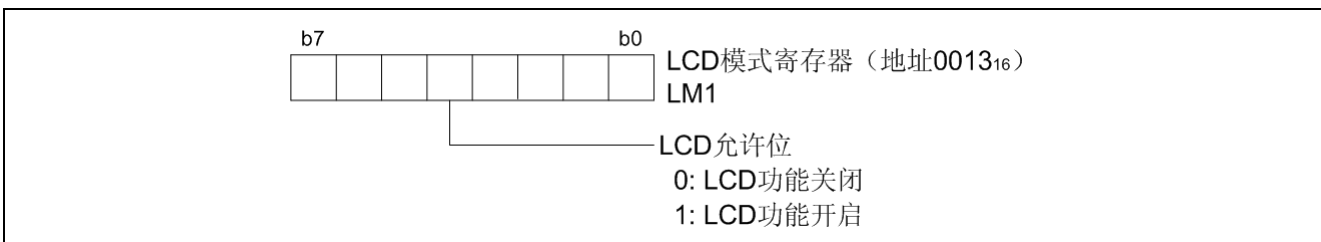


图 5 LCD 模式寄存器 1

3.3.5 A/D 转换

ADKEY 功能是判断输入到 ADKEY 管脚的模拟输入电压的功能。ADKEY 功能可以解除停止模式。

注1: 如果要使用 ADKEY 功能，必须在将 ADKEY 选择位设定为“1”后将 ADKEY 允许位设定为“1”。



图 6 AD 控制寄存器

注2: 在停止模式，如果将 V_{IL}(0.7×V_{CC}-0.5)以下的电压输入到 ADKEY 管脚，系统就从停止模式返回。

注3: 不能在 A/D 转换期间执行 STP 指令或 WIT 指令。

3.3.6 时钟模式转换

在进行内部振荡器模式、X_{IN} 模式和低速模式之间转换时，必须通过程序生成各自的振荡稳定等待时间，在振荡充分稳定后进行转换。

注1: 模式之间的转移必须遵循系统时钟的状态转移图。

注2: 本篇资料例程中，系统从停止模式返回后，运行模式从内部振荡器模式转换为 X_{IN} 模式。等待 X_{IN} 振荡稳定时间为 10ms，由定时器 1 和定时器 2 设定。

4. 软件流程图

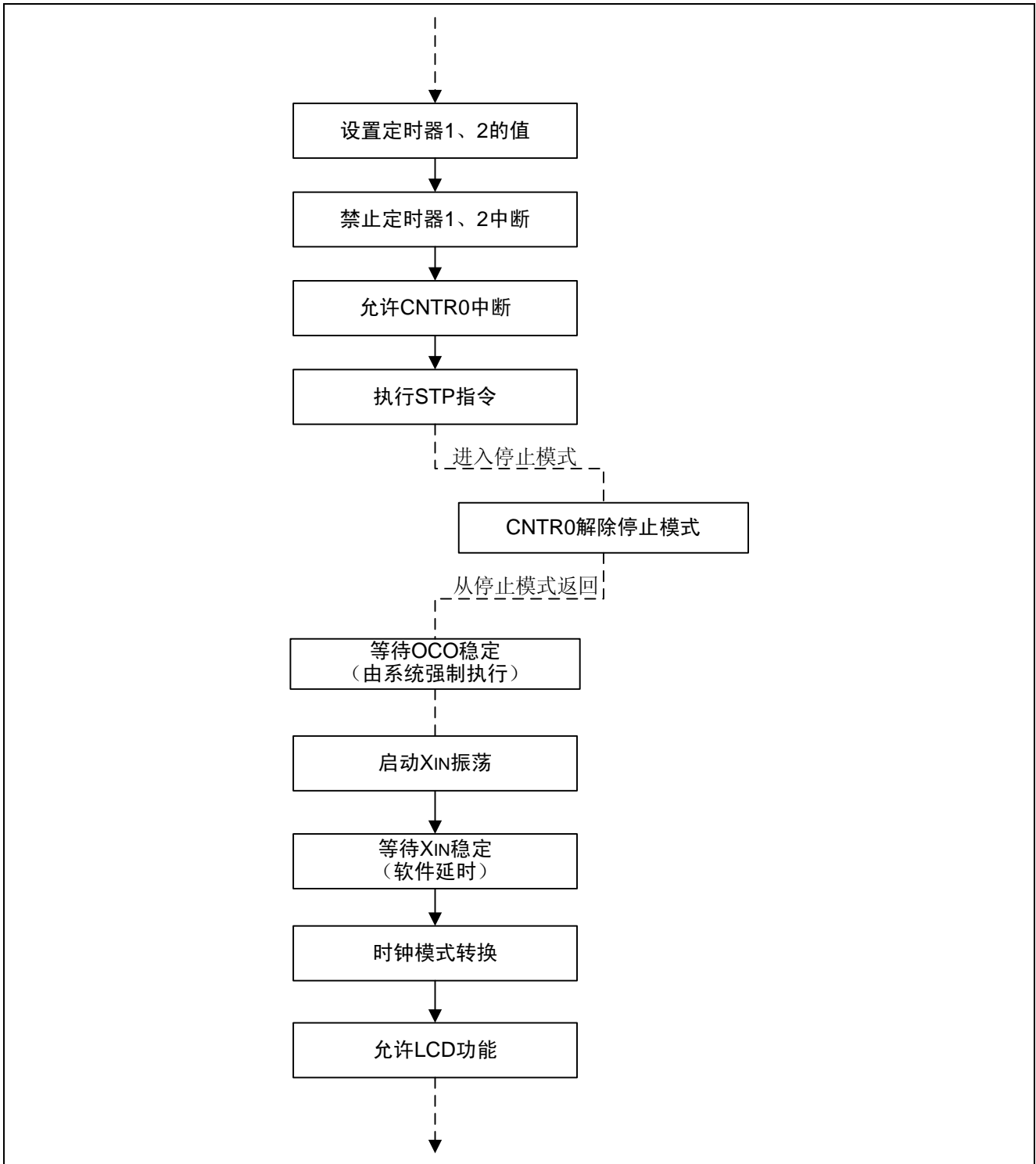


图 7 软件流程图

5. 参考例程

// 这是一段执行 STP 以及停止模式解除后的参考程序
 // 当从停止模式返回时, OSCSEL="L"
 // 采用外部中断 CNTR0 使停止模式解除
 // 由于 SFR 位的配置关系, 此程序可能包含一些对未使用功能位的操作, 请根据实际情况设置这些位的值。

```

disable_interrupt();    // 禁止中断

T1STP    = 1;          // 定时器 1 计数停止
T2STP    = 1;          // 定时器 2 计数停止
PRE1234  = 0x00;
T1       = 0x01-1;    // 设置定时器 1 的值
T2       = 0x06-1;    // 设置定时器 2 的值
IE_T1    = 0;          // 禁止定时器 1 中断
IE_T2    = 0;          // 禁止定时器 2 中断
IR_CNTR0 = 0;          // 清零 CNTR0 中断请求位
IE_CNTR0 = 1;          // 允许 CNTR0 中断 (外部中断使 MCU 从停止模式解除)

enable_interrupt();    // 允许中断
enter_stop_mode();    // 进入停止模式
disable_interrupt();    // 禁止中断

CM5      = 0;          // 启动 XIN 振荡

T1STP    = 1;          // 定时器 1 计数停止
T1STP    = 1;          // 定时器 2 计数停止
PRE1234  = 0x00;      // 设置 t1、t2 等待 XIN 振荡稳定的 10ms
T1       = 0x82-1;    // 设置定时器 1 的值
T2       = 0x09-1;    // 设置定时器 2 的值
IR_T2    = 0;          // 清零定时器 2 中断请求位
T1STP    = 0;          // 定时器 1 计数开始
T2STP    = 0;          // 定时器 2 计数开始

while(IR_T2 == 0){}    // 等待 10ms
T1STP    = 1;          // 定时器 1 计数停止
T2STP    = 1;          // 定时器 2 计数停止

CPUM     = 0x4c;      // 系统时钟转换到主时钟

LME      = 1;          // 允许 LCD 功能
    
```

6. 参考文献

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38D5 群数据手册

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Rev.	发行日	修订内容	
		页	要点
1.00	2007.10.10	—	初版发行
1.01	2008.03.17	8	更新咨询邮箱地址, 修改硬件手册名称

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 - 2) 植埋于人体使用的装置。
 - 3) 用于治疗（切除患部、给药等）的装置。
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