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AN205380

FR, MB91460, Regulator Control

This application note describes the functionality of the Regulator Control and gives some examples.

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1 Introduction

This application note describes the functionality of the Regulator Control and gives some examples.

1.1 Key Features

- MAIN-Regulator and SUB-Regulator
- MAIN-Regulator RUN/STANDY status readable
- Main-Regulator can be enabled or disabled during Sub-RUN and STOP/STOP with RTC running
- Selectable SUB-Regulator output voltage

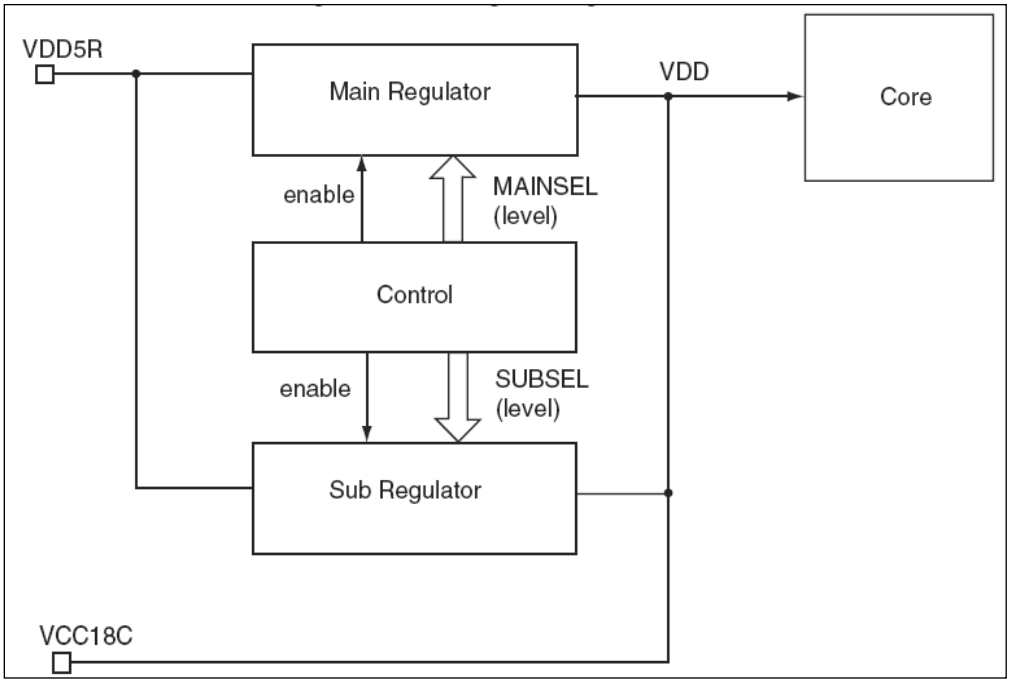
2 Regulator Control

The Basic Functionality of Regulator Control

2.1 Block Diagram

Figure 1 shows the internal block diagram of the Regulator Control.

Figure 1. Regulator Control block diagram



2.2 Registers

2.2.1 Regulator Control Register (REGCTR)

Table 1. REGCTR

Bit No.	Name	Explanation	Value	Operation
7-5	–	*Reserved*	-	-
4	MSTBO	Main Regulator Standby Output	0	Main regulator is in RUN mode
			1	Main regulator is in STANDBY mode
3-2	–	*Reserved*	-	-
1	MAINKPEN	Main Regulator enable in STOP state	0	Main regulator disabled in STOP state
			1	Main regulator enabled in STOP state
0	MAINDSBL	Main Regulator disable in Sub-RUN state	0	Main regulator enabled in Sub-RUN state
			1	Main regulator disabled in Sub-RUN state

2.2.2 Regulator Select Register (REGSEL)

Table 2. REGSEL

Bit No.	Name	Explanation	Value	Operation
7-6	–	Reserved	-	-
5,4	FLASHSEL, MAINSEL	Flash memory supply mode and Main Regulator supply mode	0,0	Flash memory and Main Regulator operation mode is 1.8V
			1,1	Flash memory and Main Regulator operation mode is 1.9V
3-0	SUBSEL	Sub-regulator voltage level	0,0,0,0	1.2V ± 0.1V
			0,0,0,1	1.3V ± 0.1V
			0,0,1,0	1.4V ± 0.1V
			0,0,1,1	1.5V ± 0.1V
			0,1,0,0	1.6V ± 0.1V
			0,1,0,1	1.7V ± 0.1V
			0,1,1,0	1.8V ± 0.1V
			0,1,1,1	1.9V ± 0.1V

2.3 Operation

The Main regulator is on by default in all modes except STOP and STOP with RTC running. The Sub regulator voltage levels would be only effective if the Main regulator is switched off (although one should take adequate measures before switching off the Main regulator). As the name suggests the Sub Regulator can be used in SUB RUN or SUB SLEEP modes. But it should be noted that Sub Regulator can't be used in these modes if the frequency of operation is RC 2MHz. This is because the Sub Regulator can't source the requisite power at this frequency. There is also a constraint that the flash memory can't be used while the Sub Regulator is being used. This is again because Sub Regulator can't source the requisite power to access flash.

Table 3. Regulator Operation Modes

Sr. No	Device Mode	Sub Mode	Used Regulator	Main Regulator Status	Sub Regulator Status	Constraints
1	RESET	INIT	MAIN	On 1.8V (Default) or 1.9V selectable by RGSEL	Off	SUB Regulator is designed for the lower power consumption hence it can't be used in this mode which requires more power.
2	RUN	PLL	MAIN	On 1.8V (Default) or 1.9V selectable by RGSEL	Off	SUB Regulator is designed for the lower power consumption hence it can't be used in this mode which requires more power.
		2MHz	MAIN			

Sr. No	Device Mode	Sub Mode	Used Regulator	Main Regulator Status	Sub Regulator Status	Constraints
3	SUB RUN	32kHz RC100kHz	MAIN or SUB	On 1.8V (Default) or 1.9V selectable by RGSEL Can be switched off using MAINDSBL bit of REGCTR	On Level configurable by SUBSEL bits of RGSEL	The code which does the switching from Main Regulator to SUB regulator should be executed from RAM as the flash won't be accessible after switching to SUB regulator. After switching back to MAIN Regulator one should poll the MSTBO bit of REGCTR and if it is 1 then only one should start executing code from flash again.
		RC2MHz	MAIN	On 1.8V (Default) or 1.9V selectable by RGSEL	Off	SUB Regulator can't be used since it would not be able to support the power requirements at 2MHz.
4	SLEEP	PLL 2MHz	MAIN MAIN	On 1.8V (Default) or 1.9V selectable by RGSEL	Off	SUB Regulator is designed for the lower power consumption hence it can't be used in this mode which requires more power.
5	SUB SLEEP	32kHz RC100kHz	MAIN or SUB	On 1.8V (Default) or 1.9V selectable by RGSEL Can be switched off using MAINDSBL bit of REGCTR	On Level configurable by SUBSEL bits of RGSEL	The code which does the switching from Main Regulator to SUB regulator should be executed from RAM as the flash won't be accessible after switching to SUB regulator. After switching back to MAIN Regulator one should poll the MSTBO bit of REGCTR and if it is 1 then only one should start executing code from flash again.
		RC2MHz	MAIN	On 1.8V (Default) or 1.9V selectable by RGSEL	Off	SUB Regulator cant be used since it would not be able to support the power requirements for all the active peripheral at 2MHz.
6	RTC	4MHz 32kHz RC100kHz RC2MHz	SUB	Off by default Can be switched on by setting MAINKPEN bit of REGCTR to 1	On by default Level configurable by SUBSEL bits of RGSEL	SUB Regulator is used since it can support the power requirements for all the active peripherals (RTC and CAN can be only active) at all these frequencies.
7	STOP	STOP STOP+HIZ	SUB	Off by default Can be switched on by setting MAINKPEN bit of REGCTR to 1	On by default Level configurable by SUBSEL bits of RGSEL	SUB Regulator is used since it can support the power requirements for all the active peripherals (RTC and CAN can be only active) at all these frequencies.

3 Regulator Control Examples

Examples for Regulator Control

3.1 Using Sub Regulator in SUB SLEEP Mode

The following example demonstrates to use the Sub Regulator in the SUB SLEEP Mode. It should be noted that this function should be located and executed from RAM as the FLASH memory is not accessible after the Main Regulator is disabled.

```
#pragma segment CODE = IRAM
void SetSubSleepMode (void)
{
    /* Set the MCU in the SUB-RUN Mode 32kHz*/
    . . .
    . . .
    . . .
    REGSEL_SUBSEL = 3;     // Set the Sub Regulator voltage to 1.5V
    REGCTR_MAINDSBL = 1;   // Disable Main regulator in Sub-RUN state
    STCR_SLEEP = 1;        // Go to SLEEP Mode

    /* In SLEEP Mode, any interrupt would cause the MCU to come out of the
       SLEEP Mode */
    __asm(" NOP ");        // Recovered from SUB-SLEEP Mode
    __asm(" NOP ");

    REGCTR_MAINDSBL = 0;       // Re-enable Main Regulator in Sub-RUN state
    while (1 != REGCTR_MSTBO); // Wait for the Main regulator to return to
          // RUN Mode
    /* Now one can set the MCU back to original operation mode such as RUN-PLL
*/
    . . .
    . . .
}
#pragma segment CODE
```

One should also set the define I_RAM to ON in order to instruct the linker to copy code in the section IRAM from FLASH to Instruction RAM.

```
;=============================================================================
; 4.4  Copy code from Flash to I-RAM
;=============================================================================
;
#set    I_RAM       ON        ; <<< select  if  code  in  section IRAM
;                                    should be copied
```

Please refer the application note mcu-an-300087 for more details about Flash to RAM copy.

Here the code which actually sets the MCU to the SUB RUN mode before going to SUB SLEEP mode and similarly the code which sets the MCU back in the original operation mode is not discussed because it out of the scope of this application note.

4 Additional Information

Information about CYPRESS Microcontrollers can be found on the following Internet page:

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Document History

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**	-	NOFL	06/12/2008	First Version; MPi
*A	5134064	NOFL	02/11/2016	Converted Spansion Application Note “MCU-AN-300096-E-V10” to Cypress format
*B	5872500	AESATMP9	09/04/2017	Updated logo and copyright.
*C	6070279	NOFL	02/18/2018	Sunset Review Migrated to new template Updated links

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