AN204425

FM3 Microcontroller Temperature Correction Method for High-Speed CR Oscillator

Associated Part Family:	Series Name	Product Number
	MB9B520M	MB9BF521K/522K/524K/521L/522L/524L/521M/522M/524M
	MB9B320M	MB9BF321K/322K/324K/321L/322L/324L/321M/322M/324M
	MB9B120M	MB9BF121K/122K/124K/121L/122L/124L/121M/122M/124M

High-speed CR oscillators mounted to FM3 products can adjust the offset of the frequency and reduce the frequency fluctuation due to the temperature by setting the trimming function.

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1 Introduction

2 Preface

High-speed CR oscillators mounted to FM3 products can adjust the offset of the frequency and reduce the frequency fluctuation due to the temperature by setting the trimming function.

The high-speed CR trimming function is composed of the frequency trimming setting unit and the temperature trimming setting unit and has the functions below:

Frequency Trimming Setting Unit

The frequency offset of high-speed CR can be adjusted by writing the trimming value in the frequency trimming register (MCR_FTRM).

The setting value to the frequency trimming register can be calculated from the count value within a fixed period by using the input capture or the base timer.

Temperature Trimming Setting Unit

the temperature correction of high-speed CR can be executed by writing the trimming value in temperature trimming register (MCR_TTRM).

This application note explains the method of the temperature correction for the high-speed CR trimming.

For the frequency correction method, see "CHAPTER2-2 High-speed CR Trimming" in 'FM3 Family Peripheral Manual'.

3 Temperature Correction Method for High-speed CR Oscillator

3.1 High-speed CR Oscillator Temperature Trimming Method

The error of the high-speed CR clock due to the temperature variation can be corrected by writing trimming data value in the temperature trimming setting register (MCR_TTRM).

For the data to be written to the temperature trimming setting register (MCR_TTRM), use the value stored in "Temperature trimming data area" of the flash memory when shipped from the factory or use the value of the TTRMM bit of CR trimming data mirror register (CRTRMM).

Regarding the address of “Temperature trimming data area”, refer to the “MB9AB40N/A40N/340N/140N/150R/MB9B520M/320M/120M series flash programming manual”.

3.2 High-speed CR Trimming Function Setting Procedure Example

The example of the setting procedure for the temperature correction is shown below.

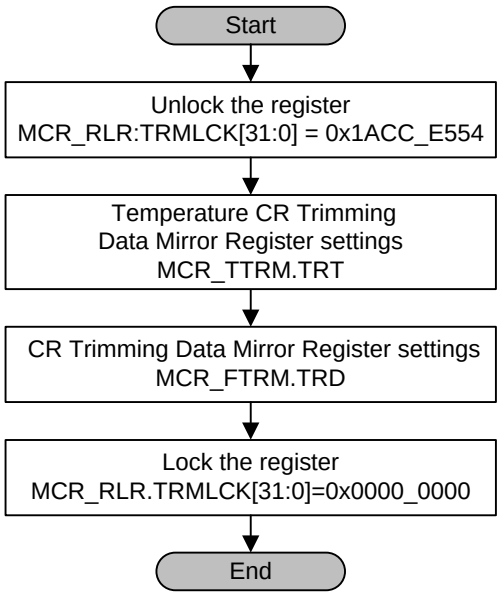
1. Write "0x1ACCE554" in TRMLCK [31:0] bits of high-speed CR oscillation register write protect register (MCR_RLR), and release the lock of frequency trimming setting register (MCR_FTRM)/temperature trimming setting register (MCR_TTRM).

2. Set the trimming data to the TRT bit of temperature trimming setting register (MCR_TTRM).

3. Set the TRD bit of frequency trimming setting register (MCR_FTRM).

4. Write the value of "other than 0x1ACCE554" in TRMLCK[31:0] bits of high-speed CR oscillation register write protection register (MCR_RLR), and lock the frequency trimming setting register (MCR_FTRM)/temperature trimming setting register (MCR_TTRM).

Figure 1. Frequency/Temperature Trimming Data Setting

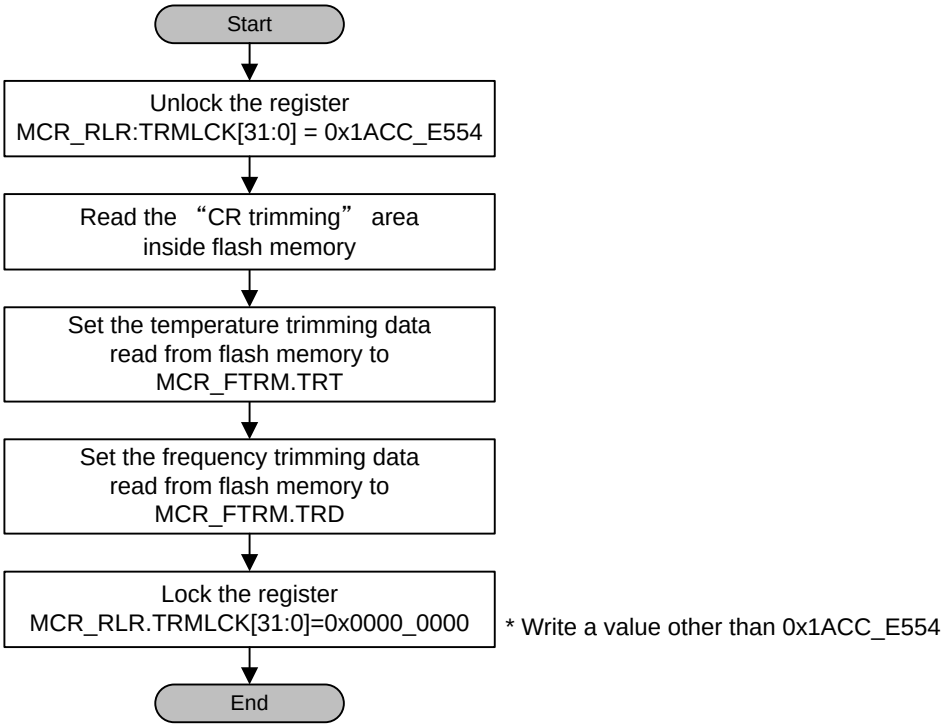


* Write a value other than 0x1ACC_E554

3.3 Example of Use Procedures for CR Trimming Area Stored Data in Flash Memory

The procedure example of reading the trimming data stored in “CR trimming area” of the flash memory and setting them to the frequency trimming setting register and the temperature trimming setting register is shown in Figure 2 as follows.

Figure 2. Procedure Example of Using Temperature Trimming Data Area Stored Data



Note: For the address of "Temperature Trimming data area", see “"MB9AB40N/A40N/340N/140N/150R/MB9B520M/320M/120M Series Flash Programming Manual”.

3.4 High-speed CR Oscillation/Temperature Trimming Setting Register (MCR_TTRM)

The MCR_TTRM register sets the temperature trimming value.

This section explains the resistor configuration and functions.

Register Configuration

bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Field	Reserved															
Attribute	-															
Initial value	-															

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field	Reserved											TRT[4:0]				
Attribute	-											R/W				
Initial value	-											01111				

Register Functions

[bit31:5] Reserved: Reserved bits
"0" is always read.
Writing is ignored.

[bit4:0] Temperature Trimming Setting Bits

Bit4:0	Description
Writing	This bit corrects the frequency fluctuation due to the temperature. Write the value which is read from the temperature trimming bit stored area in the flash memory. For the value written to the temperature trimming setting bits, see "2.1 High-speed CR Oscillator Temperature Trimming Setting".
Reading	The set value is read. For the initial value, "0b01111" is read.

Note: - This register is not initialized by software reset.

Note: - To obtain the frequency trimming data, be sure to make the setting of this register in advance.

3.5 Register Map

For the register map of the high-speed CR trimming function, see Table 1.

Table 1. High-speed CR Trimming Function Register Map

0x4002_E000	Register			
+ Address	+3	+2	+1	+0
0x000	-	-	-	MCR_PSR[B,H,W] ------01
0x004	-	-	MCR_FTRM[B,H,W] ------10 00000000	
0x008	-	-	-	MCR_TTRM[B,H,W] ---01111
0x00C	MCR_RLR[W] 00000000 00000000 00000000 00000001			
0x010 - 0x0FC	-	-	-	-

3.6 Usage Precautions

Data stored in “CR Trimming” area

In “CR Trimming” area, the frequency/temperature trimming data defined at shipping from the factory. For addresses of “CR Trimming” area, see the following manual.
“ MB9AB40N/A40N/340N/140N/150R/MB9B520M/320M/120M Flash Programing Manual”
By erasing the data in the flash memory, the data in “CR Trimming” area are also erased. To use the data in “CR Trimming” area after erasing the data in the flash memory, save the data in “CR Trimming” area to a different area such as RAM area etc. before erasing the data.
Or, erase the sectors in areas other than “CR Trimming” area.

Oscillation Frequency Accuracy of High-speed CR Oscillator

Be sure to set either high-speed CR oscillation temperature trimming setting register (MCR_TTRM) or high-speed CR oscillation frequency trimming setting register (MCR_FTRM) for the product supporting the temperature correction function Because the accuracy of high-speed CR oscillator described in the data sheet cannot be guaranteed when both registers are not set with the product supporting the temperature correction function.

4 Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	_	YUIS	02/08/2013 to 01/31/2014	Initial Release Company name and layout design change
*A	5034368	YUIS	12/03/2015	Converted Spansion Application Note AN706-00064 to Cypress format
*B	5868612	YSAT	08/31/2017	Adapted new cypress logo

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