

## Application Note

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# **N32G43x&N32L43x&N32L40x    Series    MSI    Frequency Trimming Application Notes**

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### **Introduction**

This document describes the MSI frequency trimming method, Convenient for users to adjust the frequency of MSI according to their actual needs during normal use.

This document is applicable to N32G43x&N32L43x&N32L40x series products of National Technology.

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## 1 Overview

After the multi-speed internal(MSI) RC oscillator of N32G43x&N32L43x&N32L40x is packaged by the packaging factor or there may be a frequency offset problem after users produce reflow.For example,the maxium deviation that may occur after reflow is about 2% of the nominal value.Because MSI frequency offset issues may cause problems with the operation of peripherals using MSI as a clock source,it is necessary to correct the frequency of MSI.

## 2 MSI trimming tutorial

### 2.1 Multi-speed internal (MSI) RC oscillator electrical characteristics

Table 2-1 MSI oscillator characteristics <sup>(1)</sup>

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$f_{MSI}$	Range 0	MSI Frequency after Factory calibration, done at $V_{DD} = 3.3V$ and $T_A = 27^\circ C$	-	100	-	KHz
	Range 1		-	200	-	KHz
	Range 2		-	400	-	KHz
	Range 3		-	800	-	KHz
	Range 4		-	1	-	MHz
	Range 5		-	2	-	MHz
	Range 6		3.96 <sup>(4)</sup>	4 <sup>(4)</sup>	4.1 <sup>(4)</sup>	MHz
$\Delta_{TEMP} (MSI)^{(2)}$	MSI oscillator frequency drift over temperature	$T_A = 0$ to $85^\circ C$	-	$\pm 1\% @ 4M$ $\pm 1.2\% @ 100k$	-	%
		$T_A = -40$ to $105^\circ C$	-	$\pm 2\% @ 4M$ $\pm 3\% @ 100k$	-	%
$\Delta_{VDD}(MSI)^{(2)}$	MSI oscillator frequency drift over $V_{DD}$ (reference is 3 V)	Range 0, $V = 1.8V_{DD}$ to $3.6V$	-	0.5 / - 1.5	-	%
		Range 6, $V = 1.8V_{DD}$ to $3.6V$	-	0.5 / - 5	-	%
$t_{SU}(MSI)^{(3)}$	MSI oscillator start-up time	Range 0 /100k	-	20	-	us
		Range 1 /200k	-	12	-	us
		Range 2 /400k	-	8	-	us
		Range 3 /800k	-	6	-	us
		Range 4 /1M	-	10	-	us
		Range 5 /2M	-	7	-	us
		Range 6 /4M	-	6	-	us
$I_{DD}(MSI)^{(3)}$	MSI oscillator power consumption	Range 0 /100k	-	1.0	-	uA
		Range 1 /200k	-	1.2	-	uA
		Range 2 /400k	-	1.8	-	uA
		Range 3 /800k	-	3.2	-	uA
		Range 4 /1M	-	6	-	uA
		Range 5 /2M	-	9	-	uA
		Range 6 /4M	-	16	-	uA

- $V_{DD} = 3.3V$ ,  $T_A = -40 \sim 105^\circ C$  unless otherwise specified.
- This deviation range is the deviation of the oscillator after calibration;
- Guaranteed by design, not tested in production.
- After Reflow, the frequency will drift, and the maximum drift value is about 2.0%.

## 2.2 Function Description

Function Prototype: void RCC\_MSI\_Trimming\_Auto(void);

This function allows automatic trimming MSI without human intervention, mainly used to eliminate MSI frequency offset problems caused by packaging plants during the packaging process.

Parameter Description: none

Return Value Description: none

Function Prototype: void RCC\_MSI\_Trimming\_Value\_Get\_Manual(uint8\_t\* p\_value);

This function can obtain the coarse and fine tuning values of the current MSI.

Parameter Description:

p\_value[0]: return the current MSI coarse turning value, ranging from 0x00 to 0x0F

p\_value[1]: return the current MSI fine turning value, ranging from 0x00 to 0x0F

Return Value Description: none

Function Prototype: MSI\_TRIM\_STATE RCC\_MSI\_Trimming\_Manual(MSI\_TRIM\_MODE mode, \ MSI\_TRIM\_DIRECTION dir, uint8\_t value);

This function can be used to manually and controllably adjust the MSI frequency mainly to eliminate the MSI frequency offset problem caused during the reflow process of chip placement production.

Parameter Description:

Parameter mode: MSI\_TRIM: select coarse turning MSI\_OPT: select fine turning

Parameter type: MSI\_INC: increase MSI frequency MSI\_DEC: decrease MSI frequency

Parameter value: Trimming value range to be changed 0x00~0x0F

Note: The sum of the value of value parameter and the coarse or fine tuning values obtained through the function void RCC\_MSI\_Trimming\_Value\_Get\_Manual(uint8\_t\* p\_value) cannot be greater than 0x0F

Return Value Description: MSI\_TRIM\_STATE can be of the following enumeration types

MSI\_TRIM\_SUCCESS: MSI frequency turning succeeded

MSI\_TRIM\_ERROR\_MODE: Incorrect mode parameter passed in

MSI\_TRIM\_ERROR\_DIR: Incorrect frequency turning direction parameter passed in

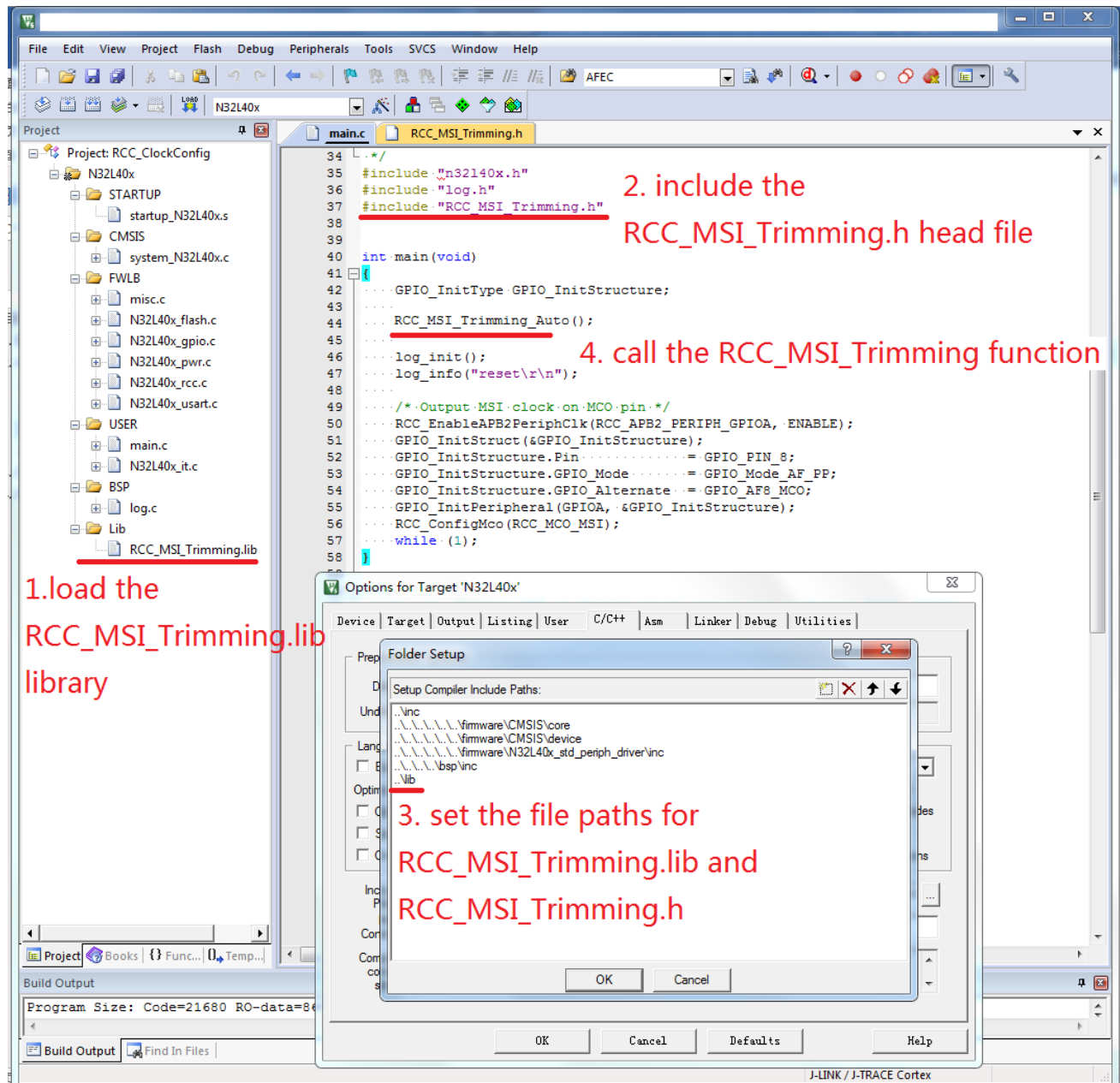
MSI\_TRIM\_ERROR\_VALUE: Incorrect value parameter passed in

## 2.3 Using tutorials

Steps for using the RCC\_MSI\_Trimming.lib library.

1. Load RCC\_MSI\_Trimming.lib to enter the project.
2. Include the trimming.h header file.
3. Set the file paths for RCC\_MSI\_Trimming.lib and RCC\_MSI\_Trimming.h
4. Call the RCC\_MSI\_Trimming function to complete the MSI trimming work.

Figure 1-1 Step for using the RCC\_MSI\_Trimming.lib library



## 2.4 Using Demo

Refer to chapter 2.2 to configure the project using the demo, to facilitate the observation of MSI frequency, Configure MCO the enable MSI output in the program.

Figure 1-2 MCO output MSI frequency

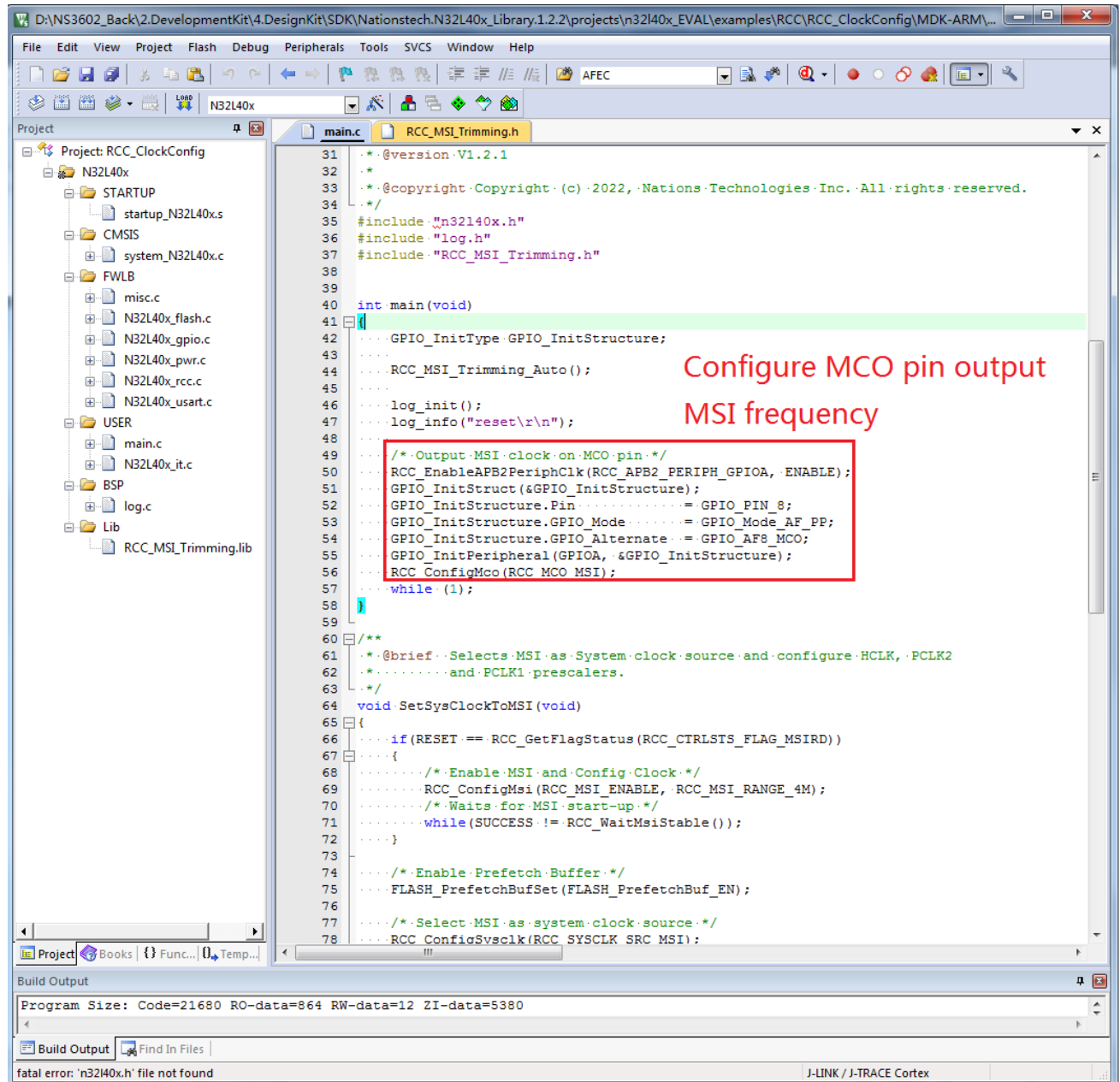
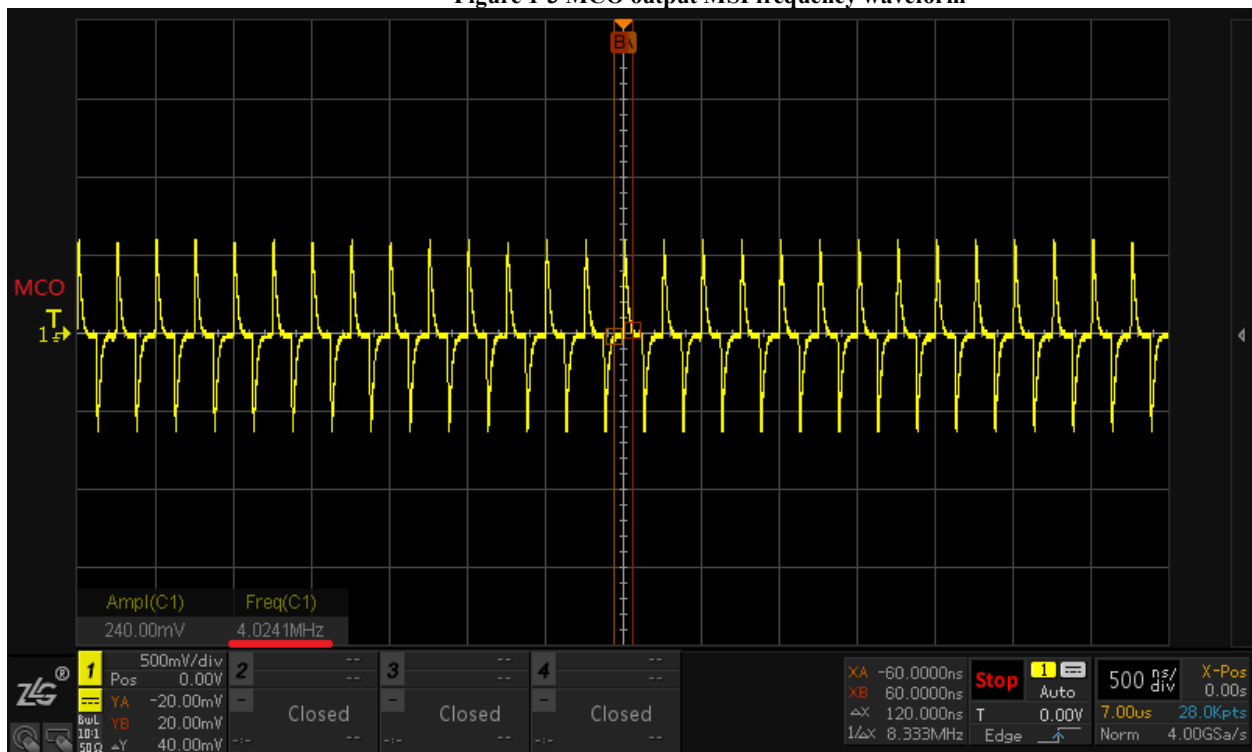


Figure 1-3 MCO output MSI frequency waveform



By measuring the MCO output pin through an oscilloscope, it can be seen that the frequency after MSI trimming is 4.02MHz



### 3 Version history

Version	Date	Note
V1.0	2023-03-15	Create the document

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