

Application note

N32G430 series HSI Trim application note

Introduction

In practical product applications, HSI (High-Speed Internal) clocks are frequently used. However, when the accuracy of the HSI clock is insufficient, if left unaddressed, some modules may fail to function properly. In such cases, calibration of the HSI becomes necessary.

This document outlines the process of calibrating the HSI using a HSE (High-Speed External) crystal or a LSE (Low-Speed External) crystal, aiming to adjust the HSI frequency to an appropriate range.

This document applies to the N32G430 series of NSING Technologies.

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1. HSI TRIM introduction

The HSI (High Speed Internal) clock signal is generated by an internal 8MHz RC oscillator, which can be directly used as the system clock or divided by 2 to serve as the input for the PLL. The HSI RC oscillator offers the convenience of providing a system clock without requiring any external components. It's startup time is shorter than HSE (High Speed External) crystal oscillator. Nevertheless, due to its relatively poor frequency accuracy, calibration is necessary for proper operation.

This document introduces the calibration of the HSI (High Speed Internal) clock using either the HSE (High Speed External) clock or the LSE (Low Speed External) clock.

2. Instructions for Using HSI TRIM

In the application note project, the macro definitions "HSI_TRIM_BY_HSE" and "HSI_TRIM_BY_LSE" are used to select whether HSE or LSE will be employed for HSI calibration.

If HSE is chosen for HSI calibration, the HSI_Triming_By_HSE function is utilized to capture the HSE/128 frequency using TIM2 (Timer Input Capture), subsequently calibrating the HSI. The default HSE frequency is 8MHz.

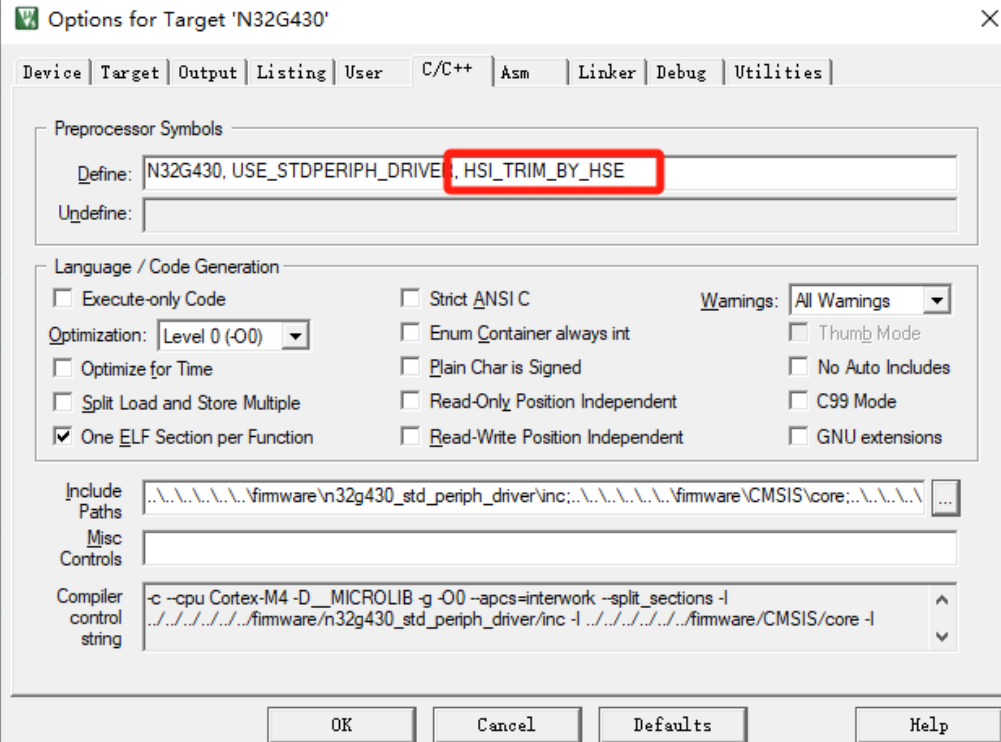
If LSE is selected for HSI calibration, the HSI_Triming_By_LSE function is utilized to capture the LSE frequency using TIM2 (Timer Input Capture), subsequently calibrating the HSI. The default LSE frequency is 32.768KHz.

Additionally, within the application note project, a configuration is set up to output the HSI frequency through pin PA8, allowing for the capture of the HSI frequency using an oscilloscope. If HSE or LSE fails to start, or if the calibration attempts exceed a predetermined limit, the function will return a failure status.

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75  ....GPIO_InitStructure.GPIO_Alternate...= GPIO_NO_AF;
76  ....GPIO_Peripheral_Initialize(GPIOA, &GPIO_InitStructure);
77  ....
78  ....GPIO_InitStructure.Pin.....= GPIO_PIN_8;
79  ....GPIO_InitStructure.GPIO_Mode.....= GPIO_MODE_AF_PP;
80  ....GPIO_InitStructure.GPIO_Alternate...= GPIO_AF9_MCO;
81  ....GPIO_Peripheral_Initialize(GPIOA, &GPIO_InitStructure);
82  ....
83  ....RCC_MCO_Source_Config(RCC_CFG_MCO_HSI);
84  ....
85  ....GPIO_Pins_Set(GPIOA, GPIO_PIN_7);
86
87  #ifdef HSI_TRIM_BY_HSE
88  ....result...= HSI_Trimming_By_HSE();
89  #endif
90  #ifdef HSI_TRIM_BY_LSE
91  ....result...= HSI_Trimming_By_LSE();
92  #endif
93
94  ....if(result...= FAILED)
95  {
96  ....GPIO_Pins_Reset(GPIOA, GPIO_PIN_7);
97  ....log_info("HSI-TRIM-test-failed\r\n");
98  }
99  ....else
100 {
101 ....GPIO_Pins_Reset(GPIOA, GPIO_PIN_7);
102 ....log_info("HSI-TRIM-test-passed\r\n");
103 }
104
105 ....while(1)
106 {
107 }
108 }

```



2.1 HSI TRIM Procedure

The HSI calibration process using HSE follows these steps:

1. Configure the system clock source to HSI_PLL.
2. Enable the HSE clock source and wait for it to stabilize. If a timeout occurs, return a failure.
3. Wait for a period to ensure that the HSE clock source is running stably.
4. Configure TIM2 to capture and calculate the HSE/128 frequency through TIM2 Channel 4.
5. Adjust the HSI trim value based on the measured HSE/128 frequency deviation.
6. If the measured HSI frequency deviation remains significant, repeat steps 4 and 5 until the measured HSI frequency falls within the acceptable deviation range. If a timeout occurs, return a failure.
7. Upon completion of HSI calibration, exit the calibration process.

The HSI calibration process using LSE follows these steps:

1. Configure the system clock source to HSI_PLL.
2. Enable the LSE clock source and wait for it to stabilize. If a timeout occurs, return a failure.
3. Wait for a period to ensure that the LSE clock source is running stably.
4. Configure TIM2 to capture and calculate the LSE frequency through TIM2 Channel 2.
5. Adjust the HSI trim value based on the measured LSE frequency deviation.
6. If the measured HSI frequency deviation remains significant, repeat steps 4 and 5 until the measured HSI frequency falls within the acceptable deviation range. If a timeout occurs, return a failure.
7. Upon completion of HSI calibration, exit the calibration process.

3. Version history

Version	Date	Modify
V1.0.0	2023-11-12	Create a document

4. Notice

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