

## User Guide

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### N32G43x\_N32L40x\_N32L43x Series PLL user guide

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#### Introduction

The N32G43x, N32L40x and N32L43x series of microcontrollers from NSING are equipped with a built-in PLL (Phase-Locked Loop) module, which provides a clock for the system.

This document aims to help users correctly use the PLL of the N32G43x, N32L40x and N32L43x series and improve the operational stability of the PLL.

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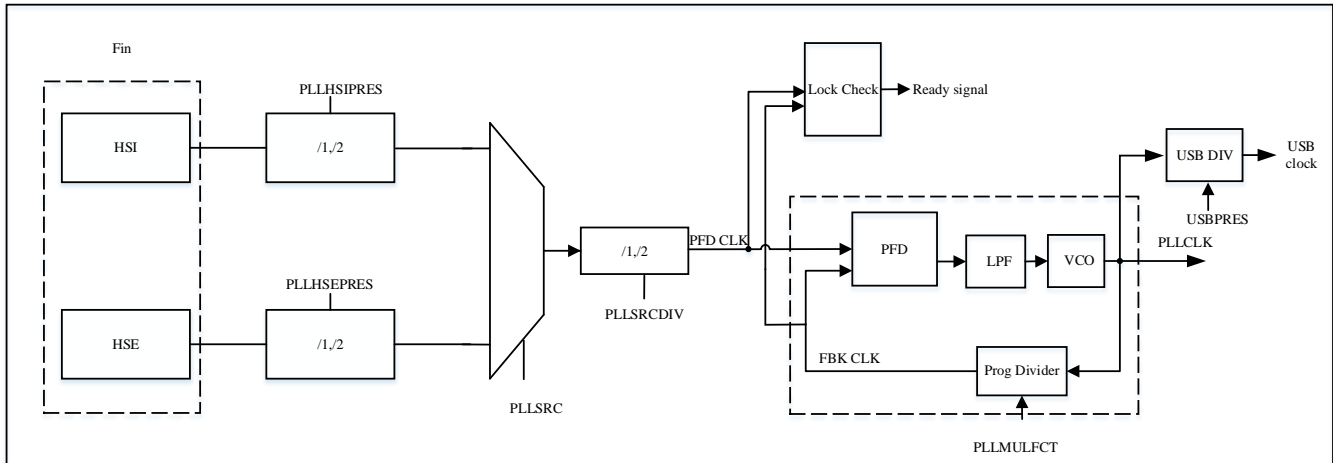
## 1. Overview of PLL in N32G43x N32L40x and N32L43x series

### 1.1 PLL features

- Input frequency range of  $F_{in}$ : 4 MHz to 32 MHz
- Input frequency range of PFD: 4 MHz to 32 MHz
- Output frequency range:
  - N32G43x series: 32 MHz to 108 MHz
  - N32L40x series: 32 MHz to 64 MHz
  - N32L43x series: 32 MHz to 108 MHz
- Reference clock options:
  - HSI clock
  - HSE clock
- Power supply voltage: 1.8V-3.6V
- The PLL multiplication factor must be 8 or greater to ensure loop stability

### 1.2 Basic Working Principle of PLL

The PLL of the N32G43x, N32L40x and N32L43x series integrate a Phase Frequency Detector (PFD), Charge Pump (CP), Low-Pass Filter (LPF), Voltage-Controlled Oscillator (VCO) and other related modules. All basic building blocks as well as fully programmable frequency dividers are integrated within the core. The maximum output frequency of the PLL in the N32G43x and N32L43x series can reach 108MHz, while that of the N32L40x series can reach 64MHz. They support an operating voltage range of 1.8V to 3.6V and an ambient temperature range of -40°C to 105°C.



## 2. N32G43x N32L40x N32L43x series PLL working mode

Table 2-1 PLL working mode

MCU power mode	PLL clock source		RCC_CTRL.PLEN	RCC_CFG.PLLSRC
Run mode	HSI	PLLHSIRE=0	1	0
	HSI/2	PLLHSIRE=1	1	0
	HSE	PLLHSERES=0	1	1
	HSE/2	PLLHSERES=1	1	1
Sleep mode	HSI	PLLHSIRE=0	1	0
	HSI/2	PLLHSIRE=1	1	0
	HSE	PLLHSERES=0	1	1
	HSE/2	PLLHSERES=1	1	1
LP-RUN mode	-	-	0	-
LP-Sleep mode	-	-	0	-
STOP2 mode	-	-	0	-
STANDBY mode	-	-	0	-

### 3. Precautions for Using PLL in N32G43x N32L40x N32L43x Series

#### 3.1 PLL Configuration Process

1. Configure the PLL clock source, selecting HSI, HSI/2, HSE, or HSE/2 as the PLL clock source.
2. Configure the PLL multiplication factor.
3. Enable the PLL.
4. Wait for the PLL ready flag.
5. Switch the system clock to PLL.

Note: The PLL configuration cannot be dynamically modified. If it is necessary to modify the PLL configuration while the PLL is operating as the system clock source, the system clock source must first be switched to HSE or HSI. After the switch is completed, disable the PLL, and then execute the above configuration process (steps 1, 2, 3, 4, 5).

#### 3.2 PLL Clock Sources

Reference clock for PLL PFD:

When PLLSRC=0, we select the HSI clock as the reference clock for the PLL, and its frequency is calculated as follows:

$$f_{pfd} = \frac{f_{HSI}}{PLLHSIPRE + 1}$$

When PLLSRC=1, we select the HSE clock as the reference clock for the PLL, and its frequency is calculated as follows:

$$f_{pfd} = \frac{f_{HSE}}{PLLHSEPRE + 1}$$

Note: The PFD clock frequency range is 4 MHz ~ 32 MHz.

#### 3.3 PLL Output Frequency

The PLL multiplication factor can be configured by setting RCC\_CFG.PLLMULFCT[4:0]. The multiplication factor "M" is as follows:

00000: PLL input clock  $\times 2$

00001: PLL input clock  $\times 3$

00010: PLL input clock  $\times 4$

.....

11101: PLL input clock  $\times 30$

11110: PLL input clock  $\times 31$

11111: PLL input clock  $\times 32$

Note: The PLL multiplication factor must be 8 or greater to ensure loop stability.

The PLL output frequency depends on the PFD frequency and the multiplication factor:

$$f_{PLL} = M * f_{pfd}$$

Note: The PLL output frequency range of N32G43x and N32L43x series is 32 MHz ~ 108 MHz, The PLL output frequency range of N32L40x series is 32 MHz ~ 64 MHz.

### 3.4 USB Clock Frequency

The USB clock frequency is 48MHz. The USB frequency is derived through PLL frequency division, with divisor factors of 1, 1.5, or 2. Therefore, when using USB, the PLL frequency must be 48MHz, 72MHz, or 96MHz; otherwise, the USB device will not function properly. Due to the high precision requirements of the USB clock, an external HSE must be used as the PLL clock source. If no HSE is available, a crystal-less mode must be employed. For details, refer to the application note “AN\_N32G43x\_N32L43x\_N32L40x\_USB\_Xtal\_Less Application Note”.

## 4. Version History

Version	Date	Changes
V1.0.0	2025.08.08	Initial release



## 5. Notice

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