Application Note

N32G43x/N32L43x/N32L40x series low-power application notes

Introduction

In the embedded product development process, there are sometimes scenarios where batteries are needed. In this scenario, it is hoped that the battery can maintain a longer service life, so low power consumption settings are necessary. This document mainly aims at the above application scenarios of the MCU series products of Nations Technologies, and instructs users how to use the MCU of Nations Technologies, and realize the control of battery power consumption by implementing the MCU into different low-power modes through the PWR module.

This document only applies to Nations Technologies MCU products, currently supported product series are N32G43x series, N32L43x series, N32L40x series.

NSING Technologies Pte. Ltd.
Add: NSING, Teletech Park #02-28, 20 Science Park Road,
Singapore 117674
Tel: +65 69268090
Email: sales@nsing.com.sg

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Singapore 117674
Tel: +65 69268090
Email: sales@nsing.com.sg

1 Power supply system

As the power control module of the whole device, the main function of the PWR is to control the MCU into different power mode and can be wake up by other events or interruptions. Supports RUN, LOW-POWER RUN, SLEEP, LOW-POWER SLEEP, STOP2, STANDBY mode, The power consumption of different modes can refer to the data sheet.

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Add: NSING, Teletech Park #02-28, 20 Science Park Road,
Singapore 117674
Tel: +65 69268090
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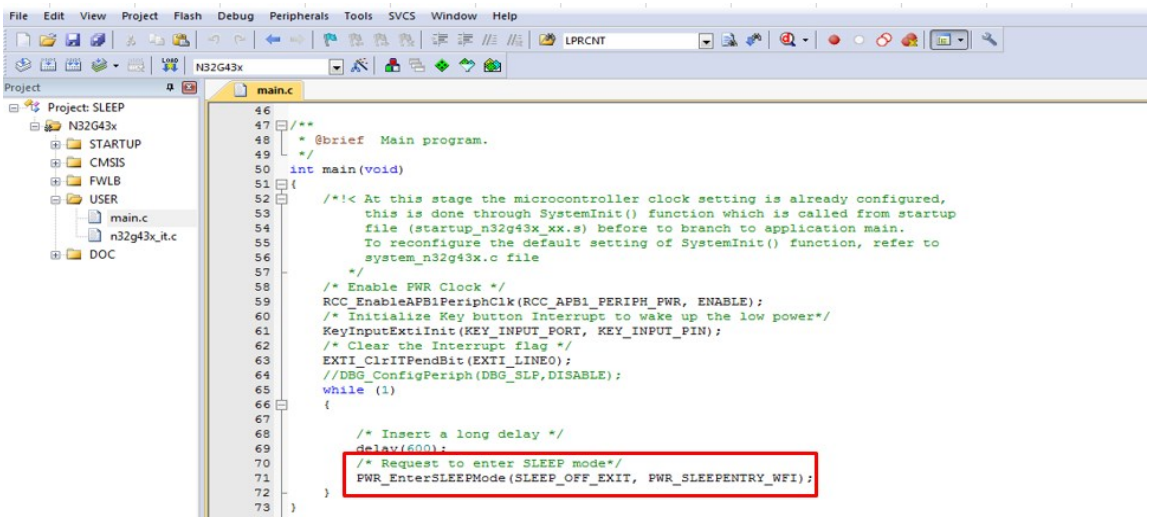
2 Set to enter SLEEP mode

Open the SLEEP project in SDK, and the part in the circle in Figure 2-1 is the API function to enter SLEEP, which can be downloaded to the development board after compilation.

Figure 2-1 SLEEP enters Settings



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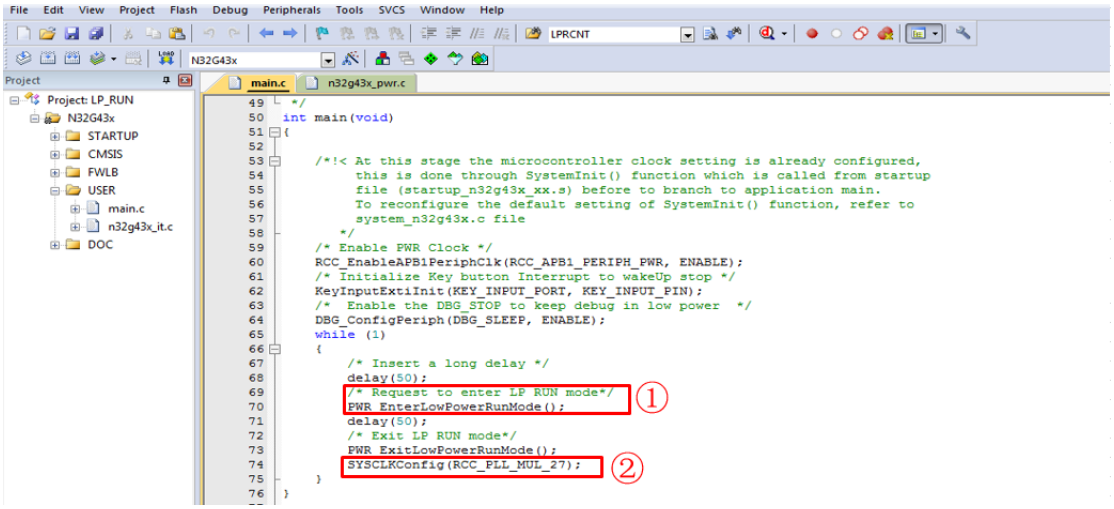
3 Set to enter LOW POWER RUN mode

Open the LP RUN project in SDK. The part ① in the circle in Figure 3-1 is the API function that enters LOW POWER RUN and sets the system clock to MSI. The part ② in the circle in Figure 3-1 is the high-speed clock that switches the system clock back to the system when exiting LP RUN mode. Note the system clock must be changed during the mode switchover. Therefore, you need to reconfigure peripherals based on the actual clock source, for example, the serial port.

Figure 3-1 LP RUN enter Settings



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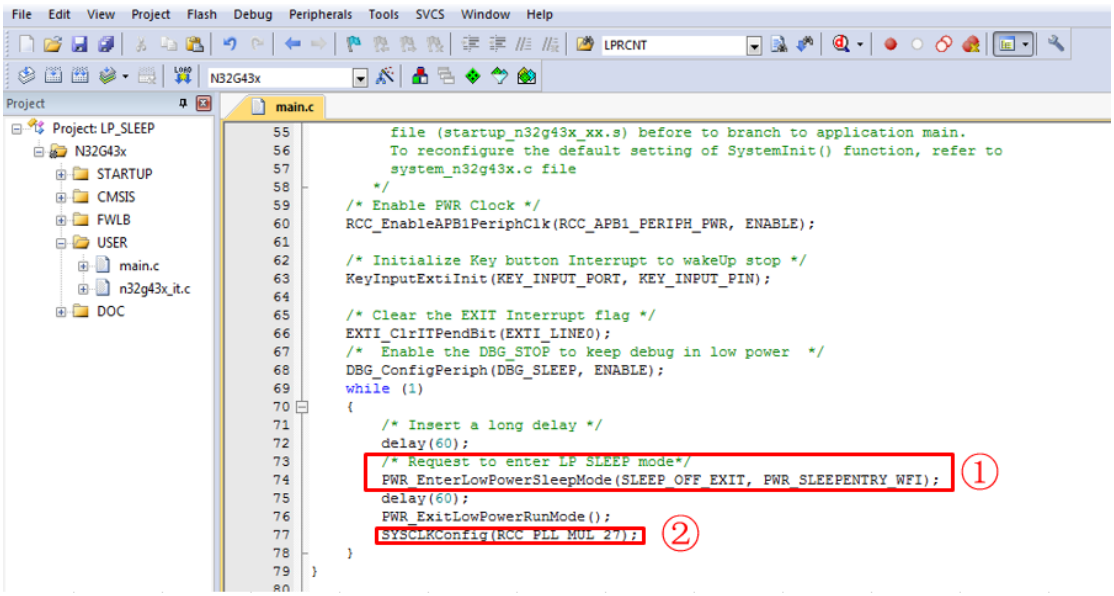
4 Set to enter LOW POWER SLEEP mode

Open the LP SLEEP project in SDK. The part ① in the circle in Figure 4-1 is the API function to enter LOW POWER SLEEP, which sets the system clock to MSI. The part ② in the circle in Figure 4-1 is the high-speed clock that switches back to the system clock when exiting LP SLEEP mode. In this mode, pay attention to the system clock change. Therefore, you need to reconfigure peripherals based on the actual clock source.

Figure 4-1 LP SLEEP enter Settings



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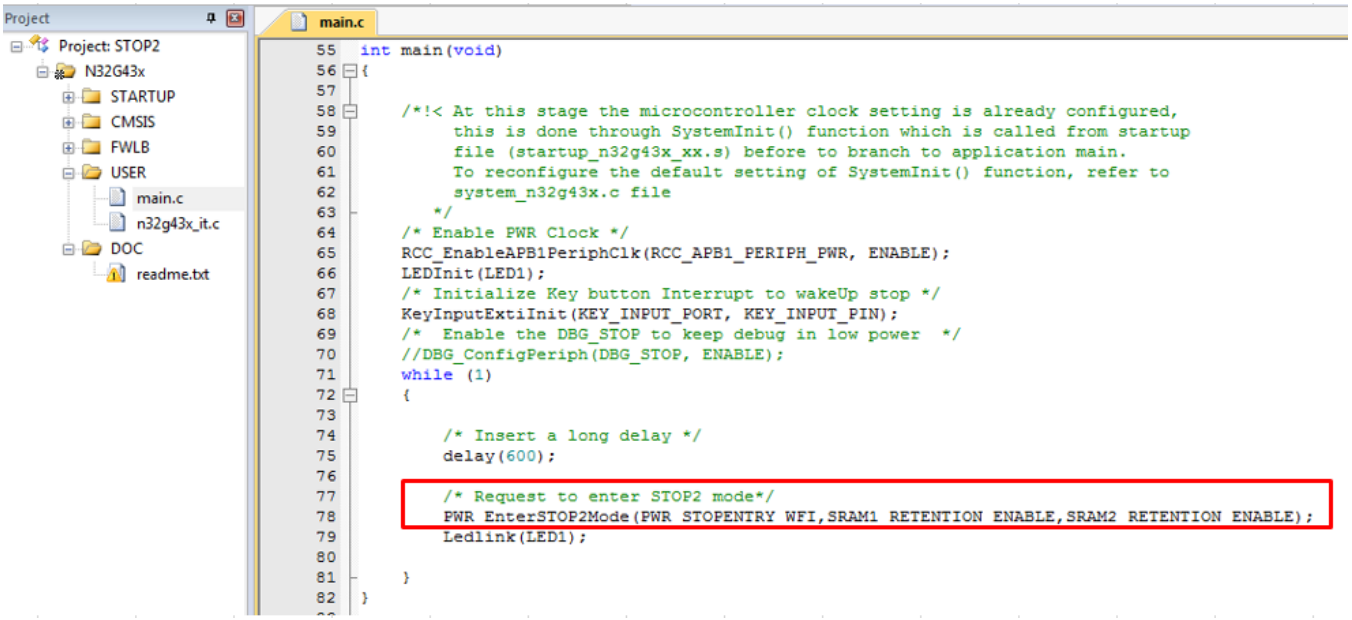
Email: sales@nsing.com.sg

5 Set to enter STOP2 mode

STOP2 mode is based on the Cortex-M4F deep sleep mode, and all the core digital logic areas are powered off.Main voltage regulator (MR) is off, HSE/HSI/MSI/PLL is off. CPU registers are maintained, LSE/LSI works optionally, all GPIO is maintained, and peripheral I/O multiplexing is not maintained. SRAM1 and SRAM2 optional maintained, except for working peripheral modules, most peripheral register data will be lost, 80 byte backup registers are maintained.

Open the STOP2 project in SDK. The part in the circle in Figure 5-1 is the API function to enter STOP2, which will set the interruption to enter STOP2 and whether SRAM1 and SRAM2 need to be maintained. The user can define it according to the corresponding macro. In addition, please refer to the section "SRAM Configuration in STOP2 Mode" for how to configure SRAM data.

Figure 5-1 STOP2 enter Settings



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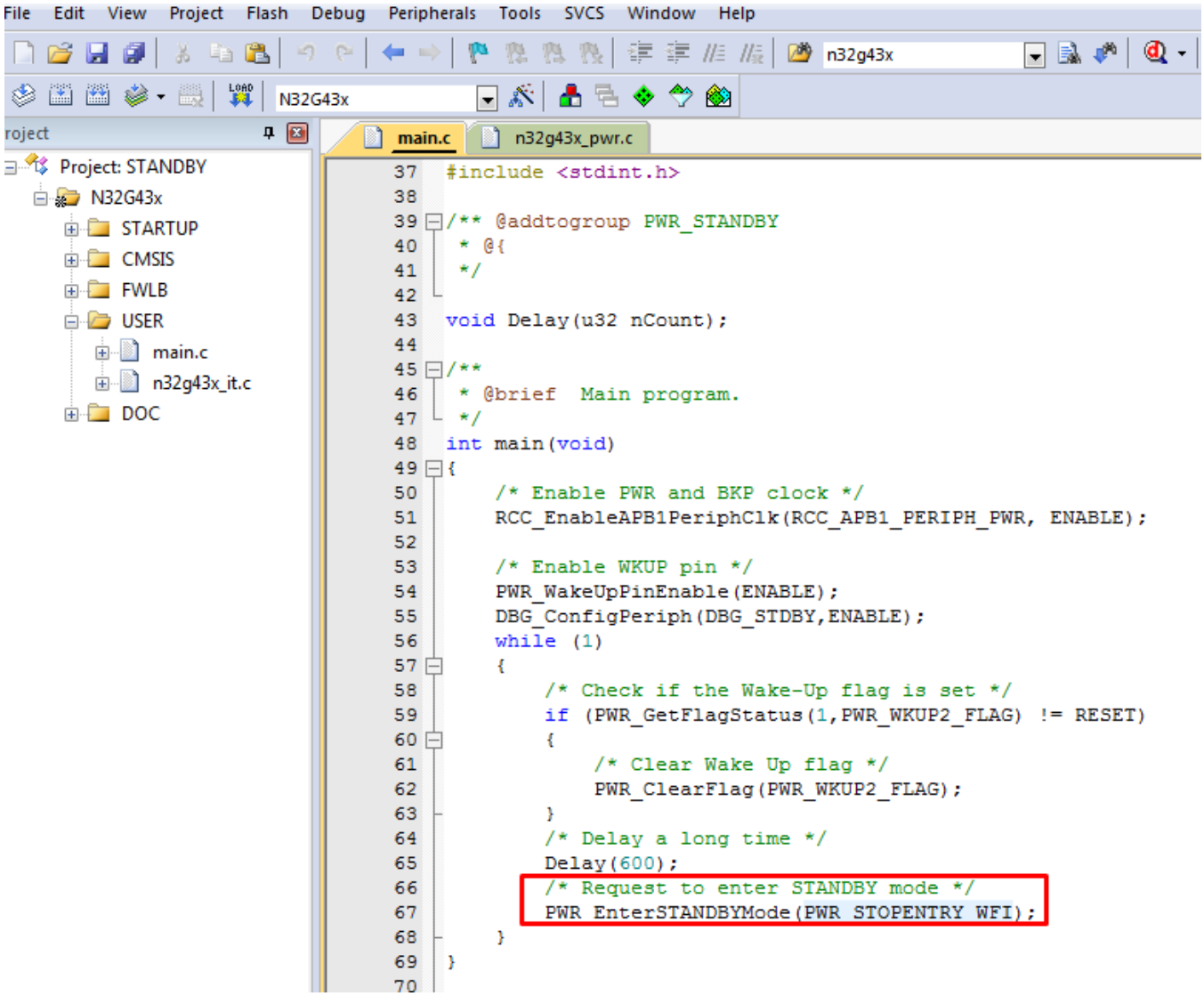
6 Set to enter STANDBY mode

In STANDBY mode, the current consumption is low.Internal voltage regulator is turned off, PLL and RC oscillator of HSI and HSE crystal oscillator are also turned off, only LSE and LSI can choose the working mode; After entering STANDBY mode, register contents will be lost, SRAM2 is optional maintained, and the standby circuit still works.

Open the STANDBY project in the SDK, and the part in the circle in Figure 6-1 is the API function that enters the STANDBY. This function sets the interrupt to enter the STANDBY, and only some special pins can work in the STANDBY mode (PC13/PC14/PC15). For wake up, just turn on the corresponding pin wake up.

Figure 6-1 STANDBY enter Settings



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7 SRAM configuration in STOP2 mode

7.1 SRAM data configuration

When entering STOP2, the default content in SRAM1/SRAM2 will be lost, that is, after the MCU wakes up from STOP2 mode, the variables need to be re-initialized to ensure that the data conforms to the programmer's intention. If you want to keep the global variables in SRAM before entering STOP2, then Can be configured as shown in Figure 7-1:

Figure 7-1 SRAM1/SRAM2 maintain configuration

```
/**
 * @brief  Main program.
 */
int main(void)
{
    /*!< At this stage the microcontroller clock setting is already configured,
         this is done through SystemInit() function which is called from startup
         file (startup_n32l43x_xx.s) before to branch to application main.
         To reconfigure the default setting of SystemInit() function, refer to
         system_n32l43x.c file
    */
    /* Initialize USART,TX: PA9 RX: PA10*/
    log_init();
    log_info("\r\n MCU Reset!\r\n");
    /* Enable PWR Clock */
    RCC_EnableAPB1PeriphClk(RCC_APB1_PERIPH_PWR, ENABLE);
    LEDInit(LED1_PORT, LED1_PIN);
    /* Initialize Key button Interrupt to wakeUp stop2 */
    KeyInputExtiInit(KEY_INPUT_PORT, KEY_INPUT_PIN);
    /* Enable the DBG_STOP to keep debug in low power  */
    DBG_ConfigPeriph(DBG_STOP, ENABLE);
    while (1)
    {
        /* Insert a long delay */
        delay(600);
        log_info("\r\n MCU Prepare Enter Stop2 Mode Core Stop Run \r\n");
        /* Request to enter STOP2 mode*/
        PWR_EnterSTOP2Mode(PWR_STOPENTRY_WFI,PWR_CTRL3_RAM1RET|PWR_CTRL3_RAM2RET);
        SetSysClockToPLL(108000000,SYSCLK_PLLSRC_HSE_PLLDIV2);
        log_info("\r\n MCU Run In Run Mode Sysclock From PLL(108MHz) \r\n");
        LEDBlink(LED1_PORT,LED1_PIN);
    }
}
```

Enter STOP2 and SRAM1/SRAM2 keep

7.2 Variable definition to SRAM

If you don't need to keep all SRAM and need to keep some variables, you can assign a variable to SRAM1 or SRAM2 to meet the requirements.

For example, use the instruction "uint8_t xxxx __attribute__ ((at(address)));" or "uint8_t * xxxx = (uint8_t*) address;", where "xxxx" is the variable name, and the variable type can be 8-bit, 16-bit, 32-bit Bit, "address" is the address range in SRAM, (0x20000000~0x20008000). If multiple variables need to be defined in SRAM, you can use the scatter file to divide an area and define the variables in this area.

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8 Conclusion

Although there are many modes of low power mode, users only need to call the relevant API functions to achieve the desired mode. Due to different low power consumption, it is the power supply of different areas and corresponding different clock sources that are turned off. Therefore, users should fully consider the current state and whether the clock needs to be initialized when waking up.

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9 Version history

Version	Date	Note
V1.0	2020.8.16	New document
V1.1	2022.7.6	1. Delete the description of electrical characteristics in low power mode 2. Delete the PD mode and introduce the configuration

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10 Disclaimer

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