RE01 256KB Group Transition from EXFPWON to MINPWON VBB Software Standby Mode Sample Code (Low Level Code)

Power-Saving Functions Transition between EXFPWON Mode and MINPWON VBB Software Standby Mode

Introduction

This application note explains sample code that transitions from EXFPWON to MINPWON VBB software standby (SSTBY) mode and also returns from the SSTBY, without using RE01 256KB Group CMSIS driver function.

In this sample code, the registers of Peripheral modules are directly accessed.

This sample code is intended for users who need to:

- Improve performance by eliminating overhead code included in the driver.
- Reduce ROM/RAM size.
- Develop simple, easy-to-understand code.

Target Device

RE01 256KB Group

Contents

1. Specifications

This sample code performs as follows. The operation conditions of the sample code is shown in Table 1-1. Refer to Figure 1-1 about transition path in detail.

1. After reset release, set the system clock to MOSC 32MHz, the LED Note flashes three times, and transition to EXFPWON mode (state-1).
2. The sample code turns off the LED Note and transitions to MINPWON VBB SSTBY mode (state-2).
3. When IRQ4 interrupt occurs, caused by pressing SW2 during SSTBY mode, return to the operation mode before transition (state-1) and turns on the LED Note.
4. Repeat the 2 and 3 transitions by pressing SW2.

Note: By changing the main_cfg.h file settings, the control of the LED can be disabled and remove the current flowing to LED.

Table 1-1 The operation conditions of the sample code

Item	**state-1** **(In the operation mode before transition to SSTBY)**	**state-2** **(In SSTBY mode)**
Oscillation Clock	MOSC SOSC Note	SOSC Note
System clock (ICLK)	MOSC 32MHz	Stopped
Power supply mode	EXFPWON mode	MINPWON mode
Power control mode	NORMAL mode	VBB mode
Low power mode	- (OPE mode)	SSTBY mode
LED status	ON	OFF

Note: MOSC low consumption oscillation function is set to enable, SOSC noise filter is set to disabled and SOSC drive capability is set to Low CL for reducing power consumption.

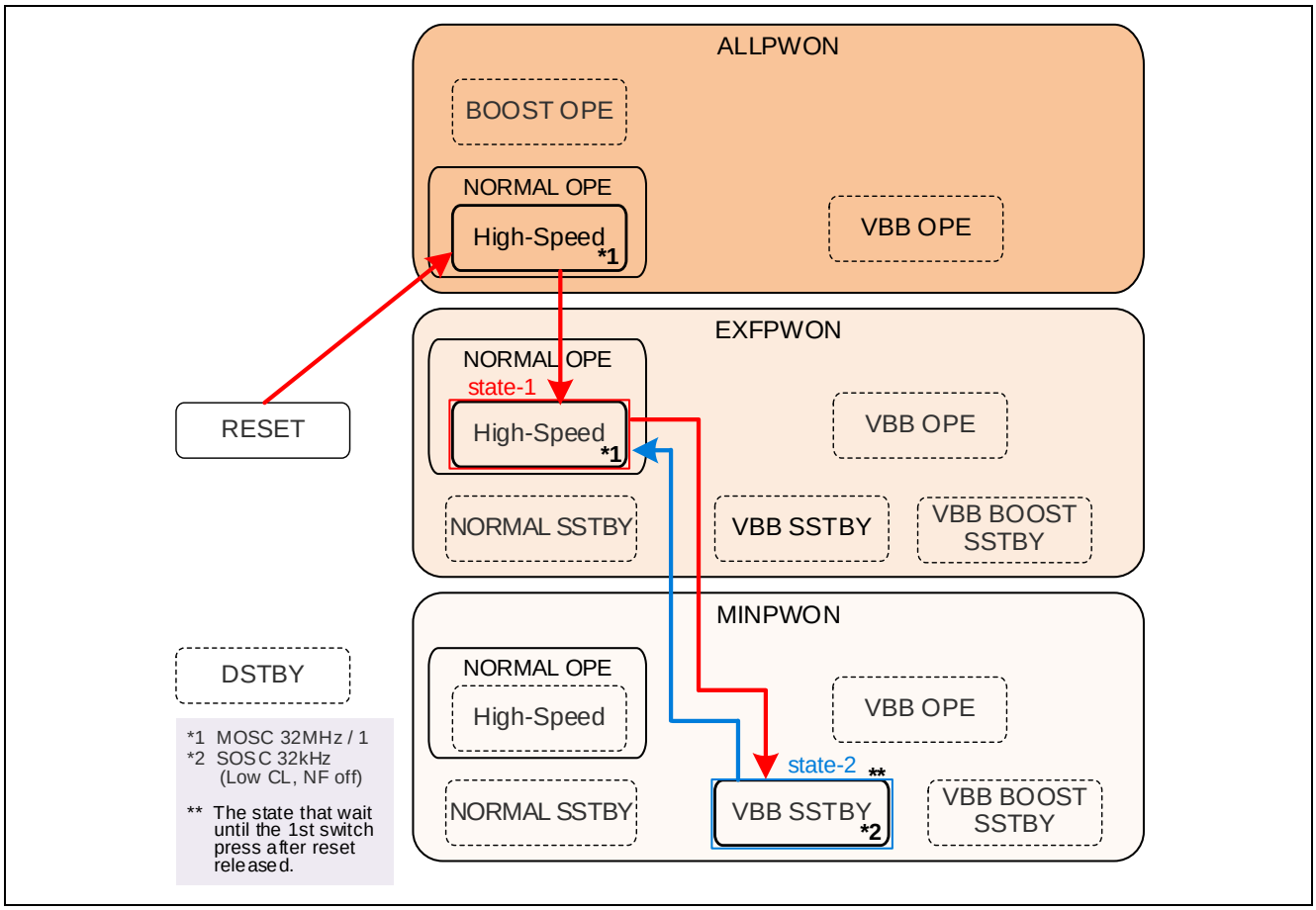

Figure 1-1 Transition path

1.1 Sample Code Information

This application note includes a sample code project shown below.

r01an5358_re_lpm_LLCode.zip

Table 1-2 Sample Code Information

Item	Description	Remarks
Interrupt	IRQ4 (Use P508)	SW2 input
Pin	P210	LED0 control
Development Environment (IDE, Compiler)	IDE: IAR Embedded Workbench® for Arm® Version 8.40.2 C Compiler : IAR C/C++ Compiler for Arm® Version 8.40.2.214	-
	IDE: Renesas e² studio 2020-07 C Compiler : GCC Arm® Embedded Version 6.3.1.20170620GNU 6-2017-q2-update	-
Target Board	Evaluation Kit RE01 256KB (RTK70E0118CXXXXXBJ)	-
CMSIS Driver Package Version	Rev1.00	-

1.2 File Configuration

Table 1-3 lists the files added / modified from RE01 256KB Group CMSIS Driver Package for the sample code.

Table 1-3 Files added or changed in the sample code

Name	Outline	Remarks
main.c	Main processing	-
main_cfg.h	Constants used in sample code	Added file
nop.c	NOP processing	Added file
nop.h	Definition of NOP processing function	Added file
r_core_cfg.h	The setting of Main-clock oscillator (MOSC)	Low consumption oscillation function : Enable
	The setting of Middle-speed on-chip oscillator (MOCO)	Stop (Disable)
	The setting of Low-speed on-chip oscillator (LOCO)	Stop (Disable)
	The setting of System Clock Source	Select the Main-clock oscillator
r_system_cfg.h Note	The IRQ event link numbers used in this sample code are set in this file	IRQ event channel of IRQ4 : 4
pin.c	The pin setting used in this sample code	P508 : IRQ4

Note: For interrupt settings in r_system_cfg.h, see the section “6.3 Interrupt Control” in RE01 1500KB, 256KB Group Getting Started Guide to Development Using CMSIS Package (R01AN4660).

Revision History

Rev.	Date	Description	
		Page	Summary
0.40	Feb.28.2020	-	First edition issued
0.80	May.11.2020	3	Changed due to the target board was change to Evaluation Kit RE01 256KB. Table 1-2 Sample Code Information Pins : P510 -> P210 Remarks: LED2 -> LED0 Target board : RE01 256KB Simple Board -> Evaluation Kit RE01 256KB(RTK70E0118CXXXXXBJ)
		3	Changed due to the CMSIS Driver Package Rev0.80. Table 1-2 Sample Code Information Added CMSIS Driver Package Version : Rev0.80
1.00	Jun.25.2020	3	Updated the e^2 studio version. Table 1-2 Sample Code Information Development Environment IDE : e^2 studio Version 7 -> e^2 studio 2020-07
			Changed due to the CMSIS Driver Package Rev1.00. Table 1-2 Sample Code Information CMSIS Driver Package Version : Rev0.80 -> Rev1.00

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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