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# H8/300L

## Transition Between Different Power Down Modes (PowerDown)

### Introduction

The H8/300L Super Low Power (SLP) series of 8-bit microcontrollers offer 8 different power modes to enable efficient power management and lower power dissipation.

The stages of power mode available in SLP series are:

i) Active (high-speed) mode,

ii) Active (medium-speed) mode,

iii) Subactive mode,

iv) Sleep (high-speed) mode,

v) Sleep (medium-speed) mode,

vi) Subsleep mode,

vii) Standby mode, and

viii) Watch mode.

The Application Note provides an easy and quick method for programmer to understand and use the code, to transit from one mode to another. The code can also be easily ported to other MCU series. The detail of each transition can be found in each respective transition Application Note.

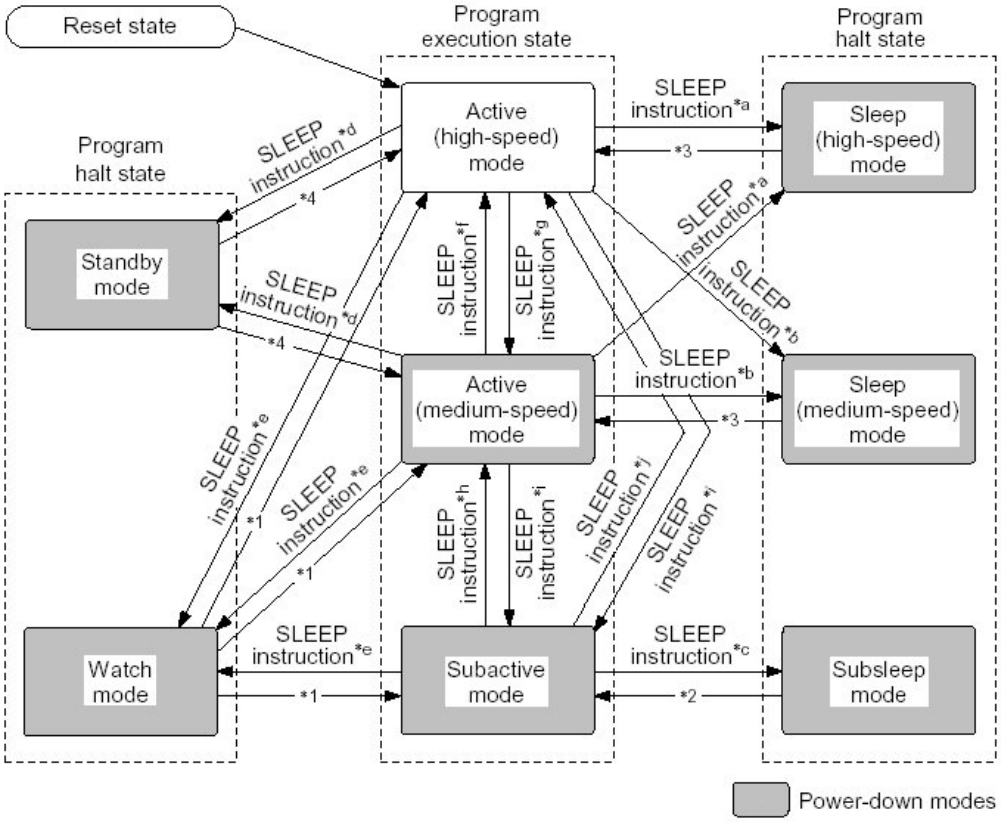
### Target Device

H8/300L Super Low Power (SLP) series – H8/38024

## Contents

## 1. Power Down Mode

The figure below illustrates the transitions among the 8 operation modes available in SLP series.




All the SLEEP instructions are stated from *a to *e as the figure above. For example, to transit Active (high-speed) mode to Sleep (high-speed) mode, SLEEP instruction *a is executed. In the sample program, the routine for transition *a is ModeA(), the routine for transition *b is ModeB(), and so on.*(Please refer to the Hardware Manual for detail about the Mode Transition Condition and Interrupt sources.)*

A transition between different modes cannot be made to occur simply because an interrupt request is generated. Make sure that interrupt handling is performed after the interrupt is accepted.

## 2. Function Overview

```
void ActiveHiToSleepHi()
void ActiveHiToSleepMedium()
void ActiveHiToStandby()
void ActiveHiToWatch()
void ActiveHiToActiveMedium()
void ActiveHiToSubactive()

void ActiveMediumToSleepHi()
void ActiveMediumToSleepMedium()
void ActiveMediumToStandby()
void ActiveMediumToWatch()
void ActiveMediumToActiveHi()
void ActiveMediumToSubactive()

void SubactiveToWatch()
void SubactiveToSubsleep()
void SubactiveToActiveMedium()
void SubactiveToActiveHi()
```

These functions contain the various SLEEP instructions needed to transit among the operation modes. (Please refer to the Hardware Manual for the mode(s) needed). The name of the function indicates the transition of the operation modes. For example, function void ActiveHiToSleepMedium() indicates that the transition from Active(high-speed) mode to Sleep (medium-speed) mode with SLEEP instruction ModeE(please refer to the figure in INTRODUCTION section).

`void ModeA()`

This is the routine for transition from

i) Active(high-speed) mode to Sleep(high-speed) mode

ii) Active(medium-speed) mode to Sleep(high-speed) mode

`void ModeB()`*1

This is the routine for transition from

i) Active(high-speed) mode to Sleep(medium-speed) mode

ii) Active(medium-speed) mode to Sleep(medium-speed) mode

`void ModeC()`

This is the routine for transition from

i) Subactive mode to Subsleep mode

`void ModeD()`

This is the routine for transition from

i) Active(high-speed) mode to Standby mode

ii) Active(medium-speed) mode to Standby mode

`void ModeE()`

This is the routine for transition from

i) Active(high-speed) mode to Watch mode

ii) Active(medium-speed) mode to Watch mode

iii) Subactive mode to Watch mode

`void ModeF()`

This is the routine for transition from

i) Active(medium-speed) mode to Active(high-speed) mode

`void ModeG()`*2

This is the routine for transition from

i) Active(high-speed) mode to Active(medium-speed) mode

`void ModeH()`*2

This is the routine for transition from

i) Active(medium-speed) mode to Active(high-speed) mode

`void ModeI()`*2

This is the routine for transition from

i) Active(high-speed) mode to Subactive mode *(Direct Transfer)*

ii) Active(medium-speed) mode to Subactive mode

`void ModeJ()`*2

This is the routine for transition from

i) Subactive mode to Active(high-speed) mode *(Direct Transfer)*

*Notes:*

**1 Emulator will only show Sleep when transitioning to Sleep(medium-speed)mode. To verify it, use an interrupt source to awaken Sleep(medium-speed) mode. After awaken by the interrupt source, it should transit to Active(medium-speed) mode.*

**2 The CPU can execute programs in three modes: active(high-speed) mode, active(medium-speed) mode and subactive mode. A direct transfer mode is a transition among these three modes without the stopping of the program execution. Interrupt Enable register 2 (IENR2) must be enabled in order to enables the direct transfer interrupt.*

## 3. Sample Code

```
/*************************************************************************/
This is an example program to implement the transitions among the power-down
modes in the SLP series.

This sample program is based on H8/38024. Minor changes might be needed on the
system control register(SYSCR1 & SYSCR2) if you are using other
microcontroller of SLP family.Please refer to the Hardware Manual for details.

The CPU can execute programs in three modes: active(high-speed) mode,
active(medium-speed) mode and subactive mode. A direct transfer mode is a
transition among these three modes without the stopping of the program
execution.

Interrupt Enable register 2 (IENR2) must be enable in order to enable the
direct transfer interrupt.

/*************************************************************************/

/* Transitions Among Various Power-down Modes*/

//Transition from Active(high-speed) mode to Sleep(high-speed) mode
void ActiveHiToSleepHi()
{
 ModeA();
}

//Transition from Active(medium-speed) mode to Sleep(high-speed) mode
void ActiveMediumToSleepHi()
{
 ModeA();
}

//Transition from Active(high-speed) mode to Sleep(medium-speed) mode
void ActiveHiToSleepMedium()
{
 ModeB();
}

//Transition from Active(medium-speed) mode to Sleep(medium-speed) mode
void ActiveMediumToSleepMedium()
{
  ModeB();
}


//Transition from Subactive mode to Subsleep mode
void SubactiveToSubsleep()
{
 ModeC();
}
```

```
//Transition from Active(high-speed) mode to Standby mode
void ActiveHiToStandby()
{
  ModeD();
}

//Transition from Active(medium-speed) mode to Standby mode
void ActiveMediumToStandby()
{
 ModeD();
}

//Transition from Active(high-speed) mode to Watch mode
void ActiveHiToWatch()
{
 ModeE();
}

//Transition from Active(medium-speed) mode to Watch mode
void ActiveMediumToWatch()
{
 ModeE();
}

//Transition from Subactive mode to Watch mode
void SubactiveToWatch()
{
 ModeE();
}

//Transition from Active(medium-speed) mode to Active(high-speed) mode
void ActiveMediumToActiveHi()
{
 ModeF();
}

//Transition from Active(high-speed) mode to Active(medium-speed) mode
void ActiveHiToActiveMedium()
{
 ModeG();
}

//Transition from Subactive mode to Active(medium-speed) mode
void SubactiveToActiveMedium()
{
 ModeH();
}



//Transition from Active(high-speed) mode to Subactive mode
void ActiveHiToSubactive()
{
ModeI();
```

```
}

//Transition from Active(medium-speed) mode to Subactive mode
void ActiveMediumToSubactive()
{
 ModeI();
}

//Transition from Subactive mode to Active(high-speed) mode
void SubactiveToActiveHi()
{
 ModeJ();
 }

/*Mode Transition Setting

  //TMA : |---|---|---|---|TMA3|TMA2|TMA1|TMA0|
  //Bits 7 to 5 are reserved; only 0 can be written to these bits
  //Bit 4 is reserved; it is always read as 1 and cannot be modified
  //Bits 3 to 0 : TMA3 to TMA0 : Internal Clock Select

  //SYSCR1 : |SSBY|STS2|STS1|STS0|LSON|---|MA1|MA0| : |1|0|0|0|0|1|1|1|
  //SSBY : Software Standby
  //Bits 6 to 4 : STS2 to STS0 : Standby Timer Select
  //LSON : Low Speed On Flag
  //Bit 2 is reserved; it is always read as 1 and cannot be modified


  //SYSCR2 : |---|---|---|NESEL|DTON|MSON|SA1|SA0| : |1|1|1|1|0|0|0|0|
  //Bits 7 to 5 are reserved; they are always read as 1 and cannot be modified
  //NESEL : Noise Elimination Sampling Frequency
  //DTON : Direct Transfer On Flag
  //MSON : Medium Speed On Flag
  //Bits 1 & 0 : SA1 & SA0 : Subactive Mode Clock Select

*/

void ModeA()
{
 //LSON = 0, MSON = 0, SSBY = 0, TMA3 = X, DTON = 0
 P_SYSCR1.BYTE=0x77;
 P_SYSCR2.BYTE=0xF0;
 delay(3);
 sleep();
 }

void ModeB()
{
  //LSON = 0, MSON = 1, SSBY = 0, TMA3 = X, DTON = 0
  P_SYSCR1.BYTE=0x77;
  P_SYSCR2.BYTE=0xF4;
  delay(3);
  sleep();
}
```

```
void ModeC()
{
  //LSON = 1, MSON = X, SSBY = 0, TMA3 = 1, DTON = 0
  P_TMRA.TMA.BYTE = 0x1F;
  P_SYSCR1.BYTE=0x7F;
  P_SYSCR2.BYTE=0xF2;
  delay(3);
  sleep();
}

void ModeD()
{
  //LSON = 0, MSON = X, SSBY = 1, TMA3 = 0, DTON = 0
  P_TMRA.TMA.BYTE = 0x17;
  P_SYSCR1.BYTE=0xF7;
  P_SYSCR2.BYTE=0xF0;
  delay(3);
  sleep();
}


void ModeE()
{
  //LSON = X, MSON = X, SSBY = 1, TMA3 = 1, DTON = 0
  P_TMRA.TMA.BYTE = 0x1F;
  P_SYSCR1.BYTE=0xF7;
  P_SYSCR2.BYTE=0xF0;
  delay(3);
  sleep();
}

void ModeF()
{
  //LSON = 0, MSON = 0, SSBY = 0, TMA3 = X, DTON = 1
  P_SYSCR1.BYTE=0x77;
  P_SYSCR2.BYTE=0xF8;
  delay(3);
  sleep();
}

void ModeG()
{
 //LSON = 0, MSON = 1, SSBY = 0, TMA3 = X, DTON = 1
 P_SYSCR1.BYTE=0x77;
 P_SYSCR2.BYTE=0xFC;
 delay(3);
 sleep();
}

void ModeH()
```

```
{
  //LSON = 0, MSON = 1, SSBY = 1, TMA3 = 1, DTON = 1
  P_TMRA.TMA.BYTE = 0x1F;
  P_SYSCR1.BYTE=0xF7;
  P_SYSCR2.BYTE=0xFC;
  delay(3);
  sleep();
}

void ModeI()
{
 //LSON = 1, MSON = X, SSBY = 1, TMA3 = 1, DTON = 1
 P_TMRA.TMA.BYTE = 0x1F;
 P_SYSCR1.BYTE=0xFF;
 P_SYSCR2.BYTE=0xF8;
 delay(3);
 sleep();
 }

void ModeJ()
 {
  //LSON = 0, MSON = 0, SSBY = 1, TMA3 = 1, DTON = 1
  P_TMRA.TMA.BYTE = 0x1F;
  P_SYSCR1.BYTE=0xF7;
  P_SYSCR2.BYTE=0xF8;
  delay(3);
  sleep();
  }
```

## Reference

1. *H8/38024 Series Basic Edition of On-Chip Peripheral Functions (Application Examples)*, http://www.hitachisemiconductor.com/sic/jsp/japan/eng/products/mpumcu/816bit/superlow/38024/38024appli1_e.html#

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