M3H Group(1)
Application Note
Clock Control and Operation Mode
(CG-M3H(1)-D)

Outlines

This application note is a reference material for developing products using clock control and operation mode (CG) functions of M3H Group(1).
This document helps the user check operation of the product and develop its program.

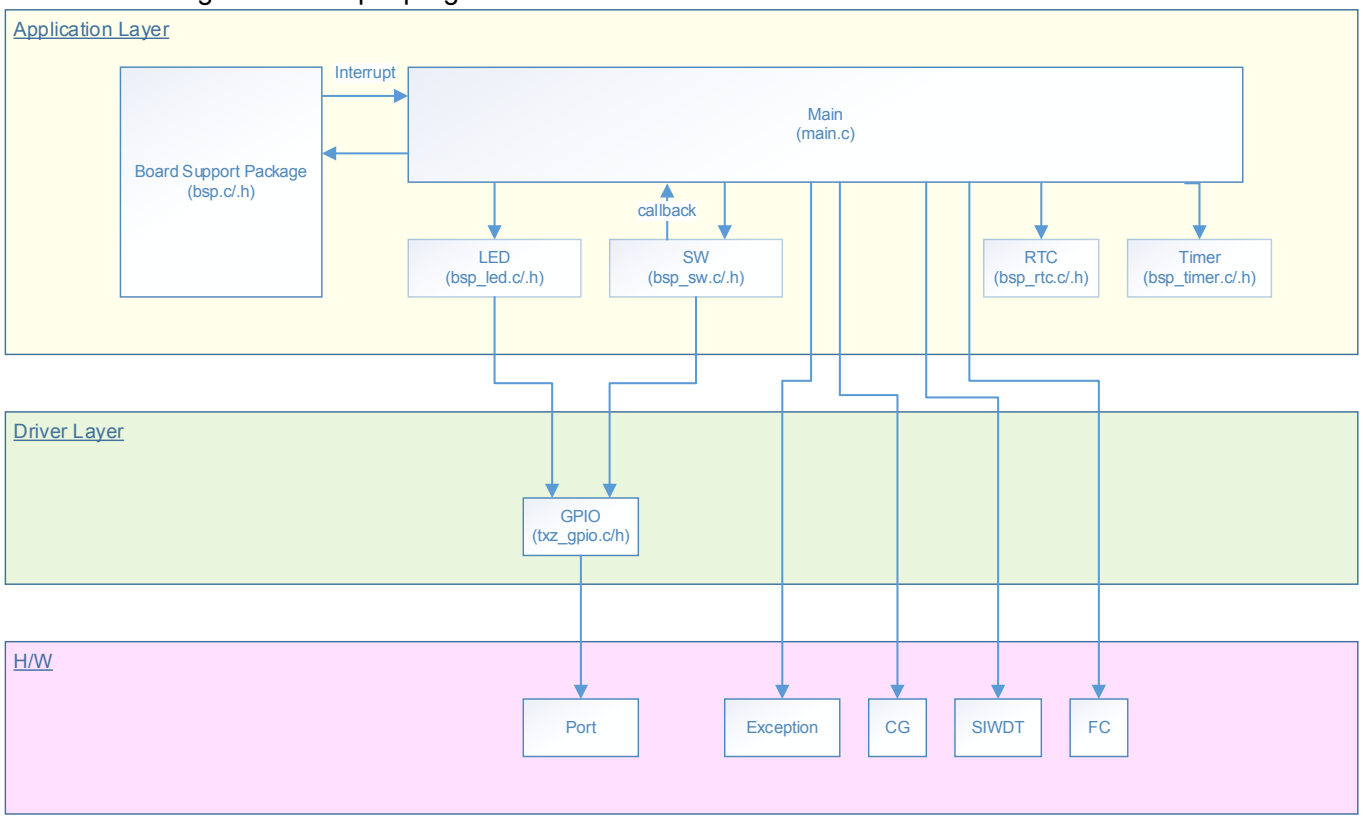
Target sample program: CGRST

Table of Contents

1. Preface

CG function sets the clock gear, the prescaler clock selection, the warm-up interval of the oscillator, and others.
This sample program operates on the evaluation board. The operation mode can be changed from Normal mode to Low power mode by controlling Push switch on the evaluation board. The operation mode state can be checked with the LED.

Structure diagram of Sample program



2. Reference Document

- Datasheet
  TMPM3H group (1) datasheet Rev2.0 (Japanese edition)
- Reference manual
  Clock Control and Operating Mode (CG-M3H(1)-D) Rev2.0 (Japanese edition)
- Other reference document
  TMPM3H Group Peripheral Driver User Manual (Doxygen)

3. Function to Use

IP	channel	port	Function / operation mode
Clock control	–	–	System clock control/Mode switching
Input and output port	–	PN1 (Input Port) PN2 (Input Port) PN3 (Input Port)	Mode switching
	–	PB4 (Output Port) PB5 (Output Port) PB6 (Output Port) PB7 (Output Port)	LED lighting control terminal
Real time clock	–	–	Low Power Mode Timeout

4. Target Device

The target devices of application note are as follows.

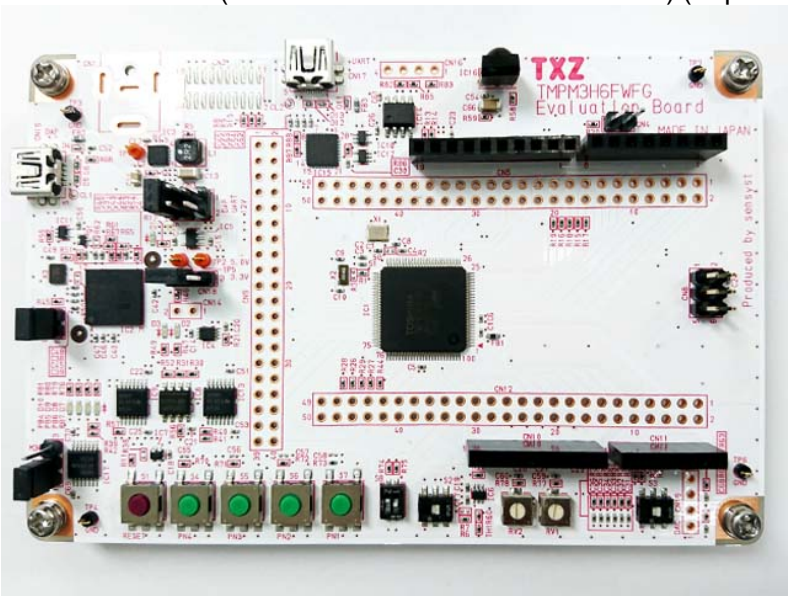
TMPM3H6FWFG	TMPM3H6FUFG	TMPM3H6FSFG
TMPM3H6FWDFG	TMPM3H6FUDFG	TMPM3H6FSDFG
TMPM3H5FWFG	TMPM3H5FUFG	TMPM3H5FSFG
TMPM3H5FWDFG	TMPM3H5FUDFG	TMPM3H5FSDFG
TMPM3H4FWUG	TMPM3H4FUUG	TMPM3H4FSUG
TMPM3H4FWFG	TMPM3H4FUFG	TMPM3H4FSFG
TMPM3H3FWUG	TMPM3H3FUUG	TMPM3H3FSUG
TMPM3H2FWDUG	TMPM3H2FUDUG	TMPM3H2FSDUG
TMPM3H2FWQG	TMPM3H2FUQG	TMPM3H2FSQG
TMPM3H1FWUG	TMPM3H1FUUG	TMPM3H1FSUG
TMPM3H1FPUG	TMPM3H0FSDUG	TMPM3H0FMDUG

* This sample program operates on the evaluation board of TMPM3H6FWFG.
If other function than the TMPM3H6 one is checked, it is necessary that CMSIS Core related files (C startup file and I/O header file) should be changed properly.
The BSP related file is dedicated to the evaluation board (TMPM3H6). If other function than the TMPM3H6 one is checked, the BSP related file should be changed properly.
This sample program uses the RTC function.
Because TMPM3H1 and TMPM3H0 are not supported with RTC, operation check with this sample program can not be executed.

5. Operation confirmation condition

Used microcontroller TMPM3H6FWFG
Used board TMPM3H6FWFG Evaluation Board (Product of Sensyst)
Unified development environment IAR Embedded Workbench for ARM 8.11.2.13606
Unified development environment μVision MDK Version 5.24.2.0
Sample program V1100

Evaluation board (TMPM3H6FWFG Evaluation Board) (Top view)



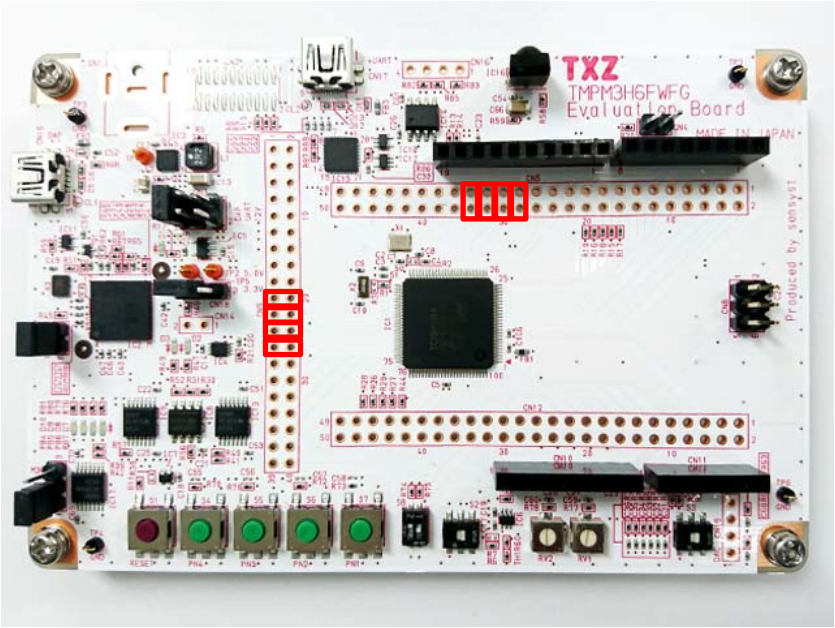
For purchasing the board, refer to the following homepage. (http://www.chip1stop.com/)

6. Evaluation Board Setting

The following pin connections should be done on the evaluation board.

CN5		
Use	Through-hole No.	Setting
LED (D10)	27-28	Connection
LED (D9)	29-30	Connection
LED (D8)	31-32	Connection
LED (D7)	33-34	Connection

CN9		
Use	Through-hole No.	Setting
Push SW (S4)	19-20	Connection
Push SW (S5)	21-22	Connection
Push SW (S6)	23-24	Connection
Push SW (S7)	25-26	Connection



7. Operation of Evaluation Board

The initial mode is the Normal mode.
After the reset is deasserted, the controller operates in the Normal mode. The LED on PB4 blinks.
The mode can be changed to one of the Low power modes by the Push switch.

IDLE	S7: Port N1
STOP1	S6: Port N2
STOP2	S5: Port N3

The LED's show the current operating mode.
The LED blinking pattern depends on an operating mode, shown as follows:-

Normal mode		: Port B4 (Blink)
Low power mode	IDLE:	Port B5 (LED On)
	STOP1:	Port B6 (LED On)
	STOP2:	Port B7 (LED On)

LED blink frequency

Normal mode:	LED On for 1 second -> LED Off for 1 second, and it repeats.	
Low power mode	IDLE:	LED On
	STOP1:	LED On
	STOP2:	LED On

The controller enters one of the Low power modes. Then, the operation mode changes to the Normal mode after the following RTC setting interval elapses.
RTC setting interval: 1 minute

8. Outline of clock control function

The operation mode consists of the Normal mode and the Low power modes. The power consumption can be saved by transition of the operation modes according to the application.

The clock control available are shown as follows:

- System clock control
  As the source of the system clock, the internal high speed oscillation clock and the external high speed oscillation clock (connection of a crystal oscillator or a clock input) can be used.
- Prescaler clock control
  Each peripheral function has a prescaler to divide the clock φT0.

The clock function has the following operation modes.

- Normal mode
- Low power mode (3 modes)
  IDLE/STOP1/STOP2

Operating mode	Name	Description
Normal mode	Normal	Normal operation.
Low power mode	IDLE	CPU stops. Peripheral functions can operate.
	STOP1	System clock stops. Low frequency clock can operate.
	STOP2	System clock stops. Power supply for the internal circuits is shut down.

The operation mode can be changed by the Push switch in this sample program. And the operation mode is shown by the LED blinking pattern.

9. Sample Program

The port input signal from the Push switch is a trigger to change to the Low power mode (IDLE/STOP1/STOP2).
A corresponding LED turns on at the transition to the Low power mode.
The operation mode of the CPU shift to normal mode by RTC interrupt.

9.1. Initialization

The following initialization is done after power is supplied.
The port setting is executed after the initialization of clock setting.

9.2. Sample program main operation

This sample program executes the reset setting, the timer initialization, the LED initialization, and the Push switch setting initialization.
After each initialization completes, CG function changes the operating mode according to the following conditions.

Operation in the Normal mode (LED: Blink on PB4)
Change to a Low power mode by the Push switch.
LED On (PB4 to PB7) shows the operating mode (4 modes). The operating mode in the sample program can be checked by using the LED's.

When the operating mode is changed to a Low power mode by the Push switch, the following operations are executed.

The mode timeout is set according to RTC alarm setting condition (1 minute in this sampling program).
After the alarm setting interval elapses, the operating mode is changed to the Normal mode by the alarm interrupt.

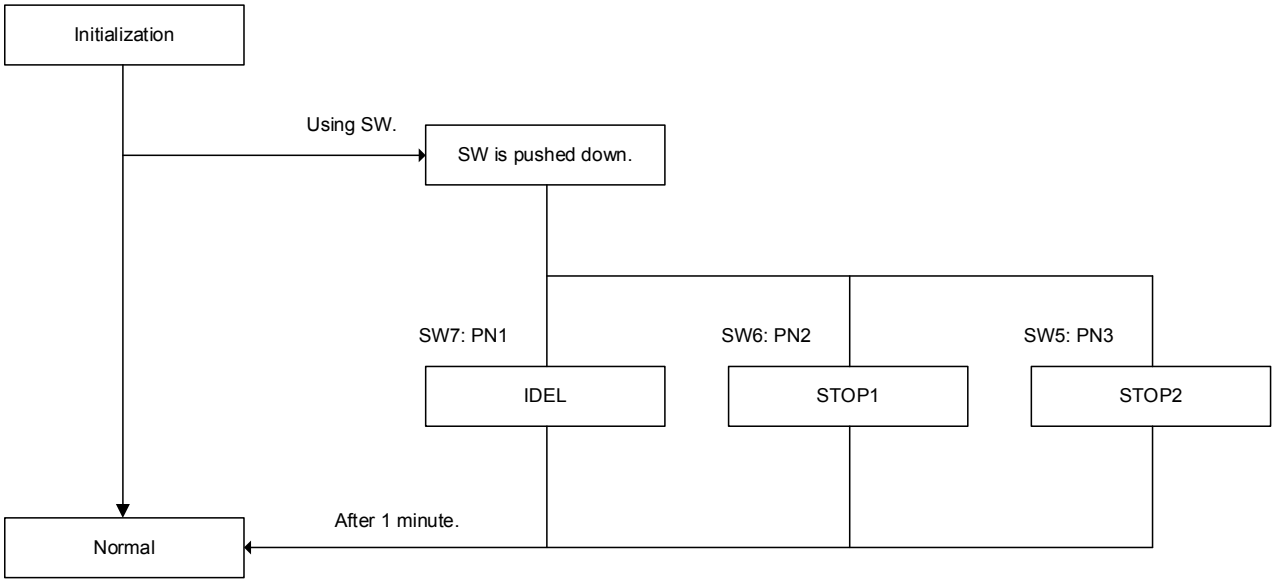
The direct transition between Low power modes is invalid in this sample program. The transition should be done via the Normal mode.

* The RTC function executes the calendar initialization (Sunday, January 01, 2017 00:00:00) and sets the alarm time.

The alarm time can be set for a day, a date, an hour, and a minute

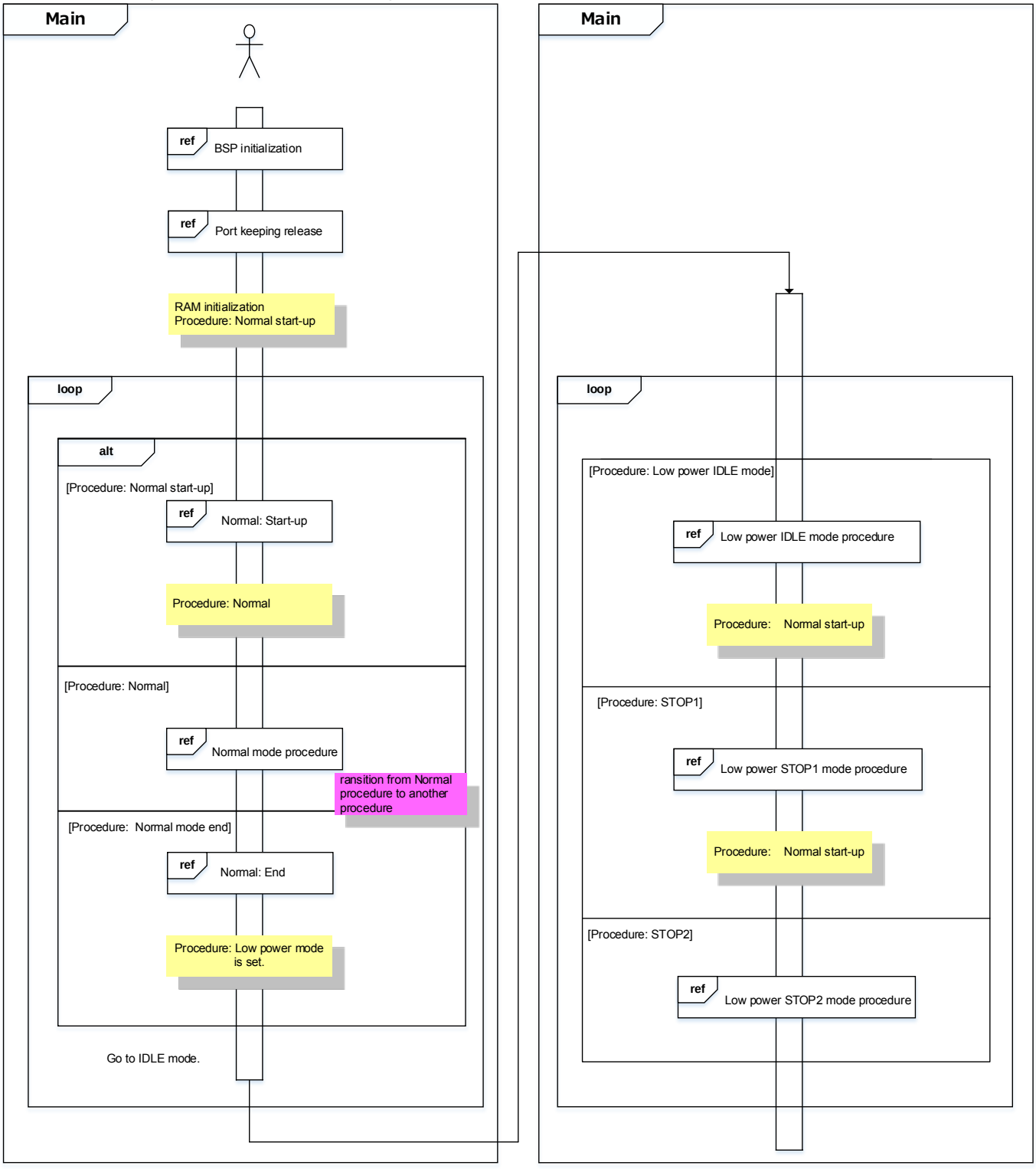
9.3. Operating Mode Switching

The mode switching can be done by setting the GND level selectively to the PORT pins (PN1 to PN3) in this sample program.
After power is supplied or the reset is deasserted, the microcontroller enters the Normal state.
The low power mode is switched to the Normal mode after the RTC alarm setting interrupt is executed.
The interval of the RTC alarm interrupt has been set to 1 minute in this sample program.

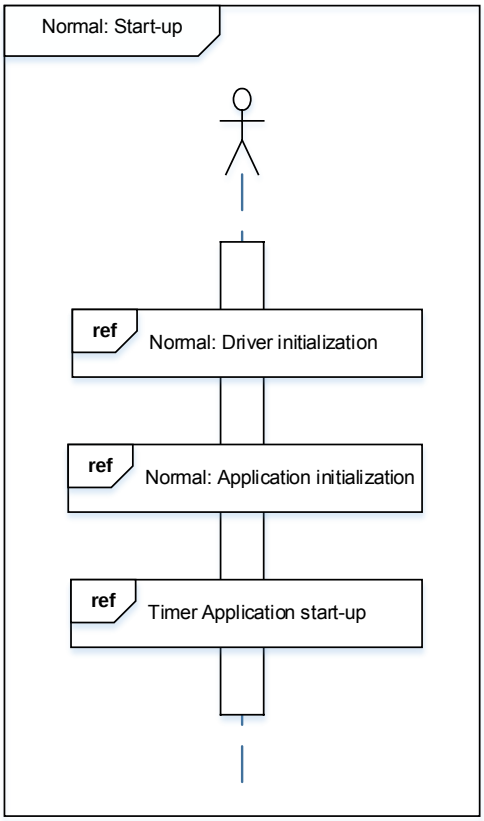


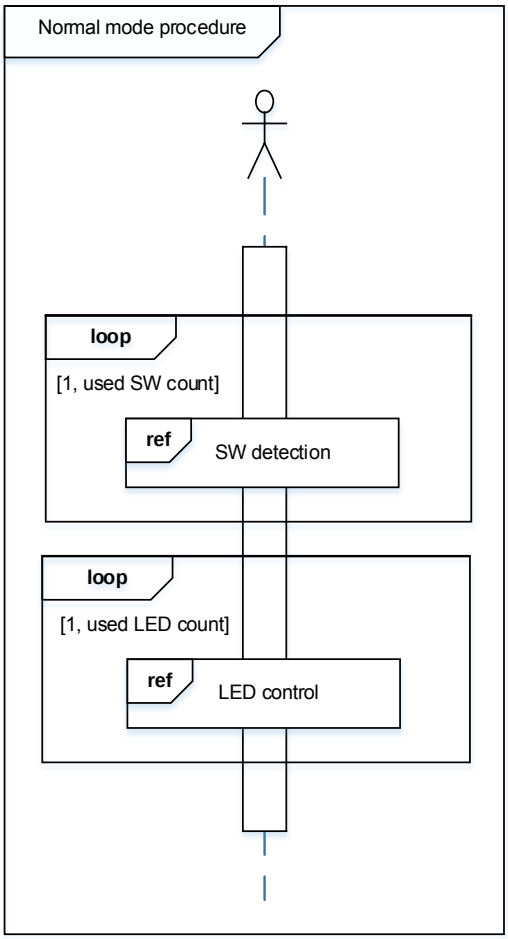
9.4. Operating Flow of Sample Program

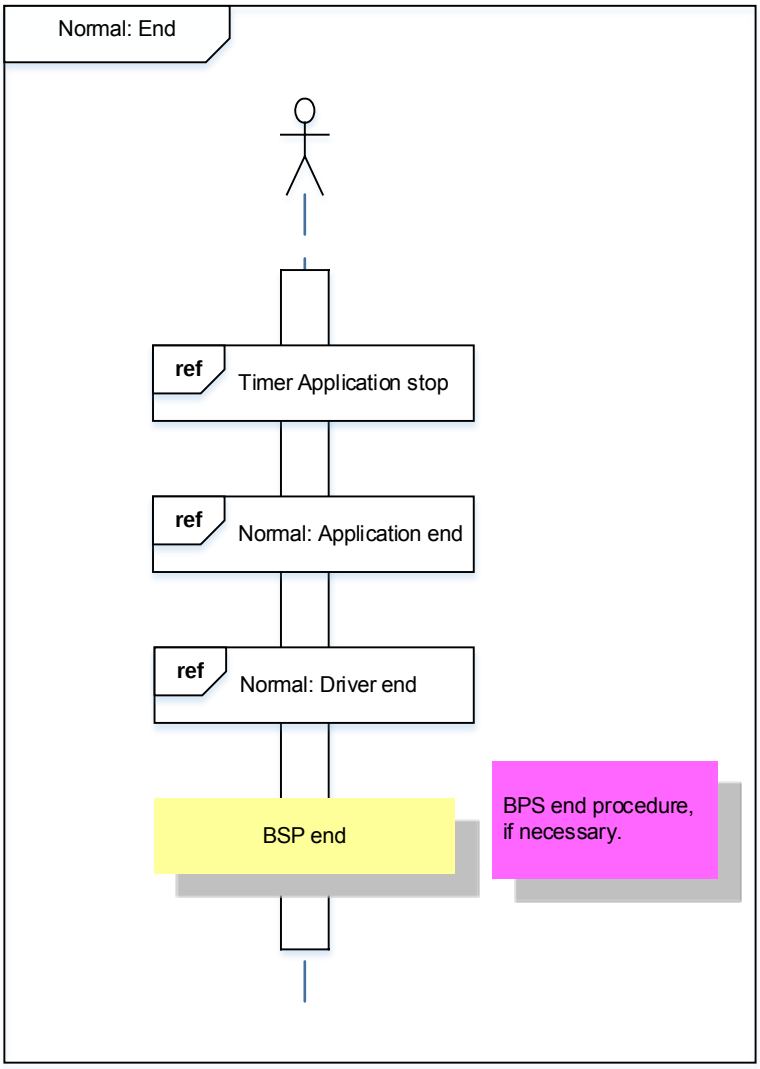
The operating flows of the sample program are shown as follows.



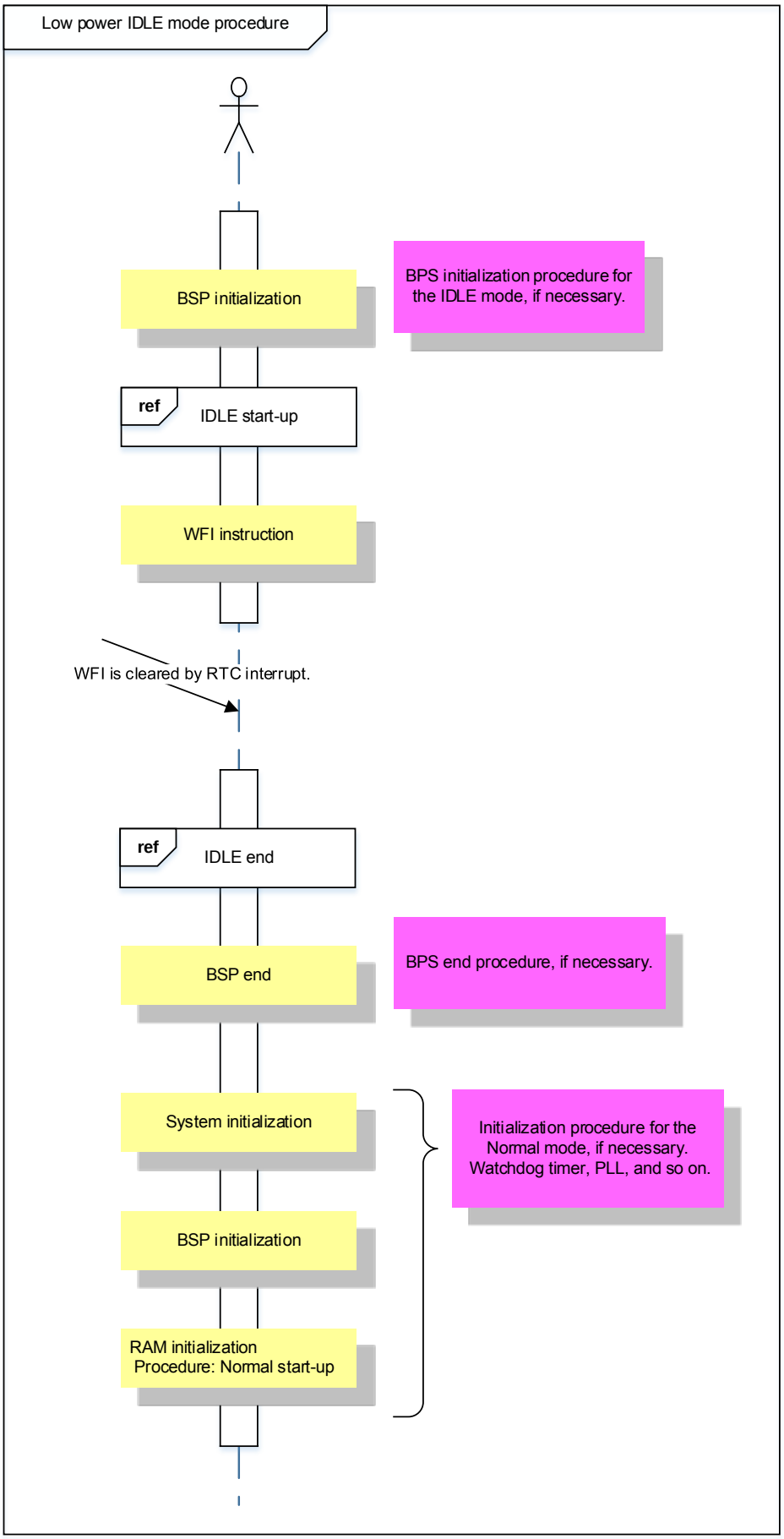
Normal mode

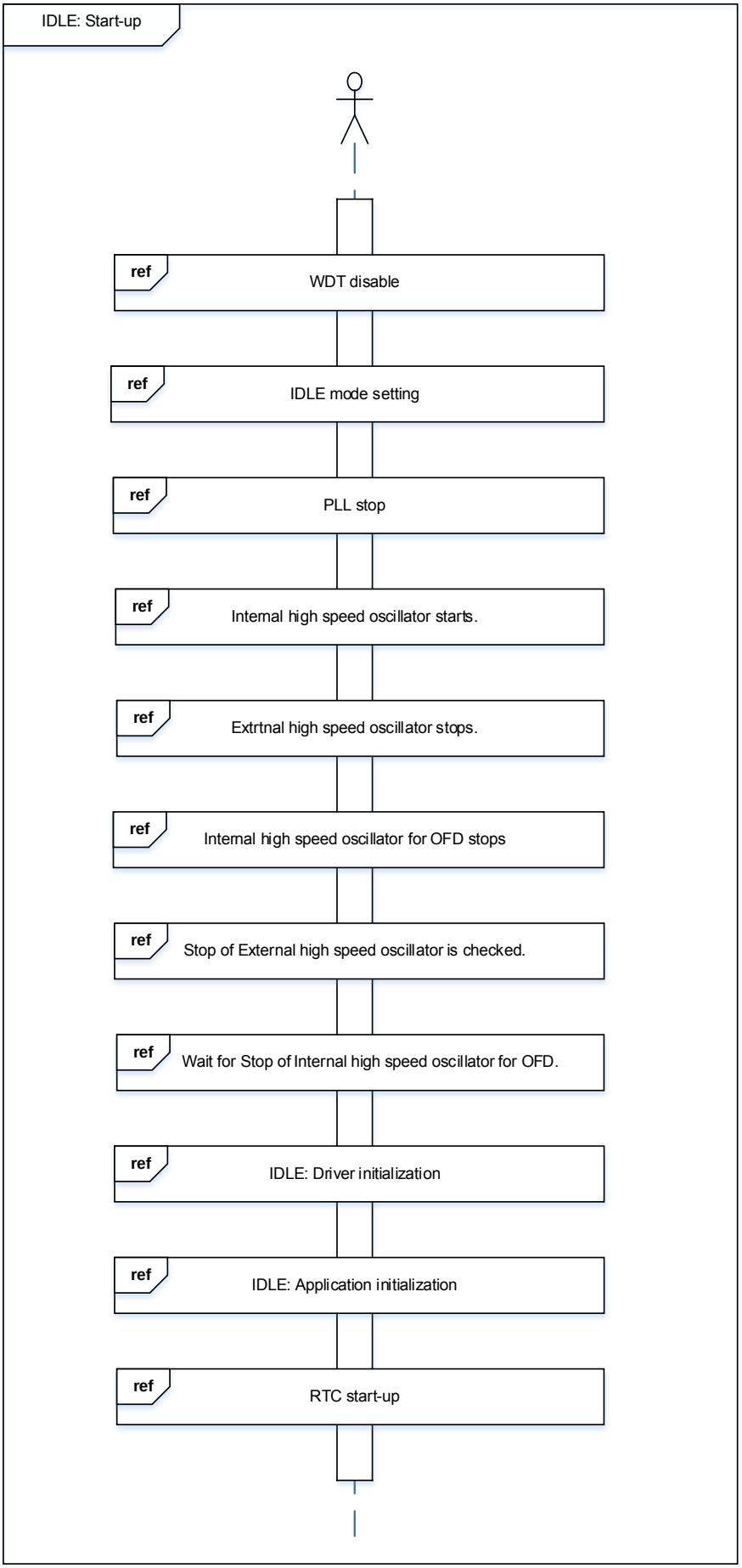

Normal: Start-up
ref
Normal: Driver initialization
ref
Normal: Application initialization
ref
Timer Application start-up

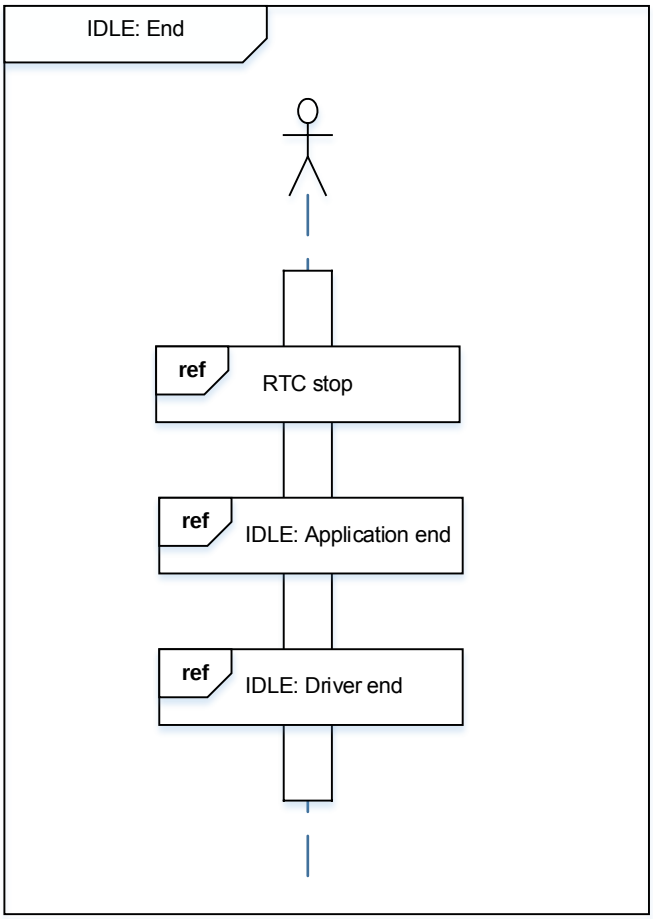

Normal mode procedure
loop
[1, used SW count]
ref
SW detection
loop
[1, used LED count]
ref
LED control


Normal: End
ref
Timer Application stop
ref
Normal: Application end
ref
Normal: Driver end
BSP end
BPS end procedure,
if necessary.

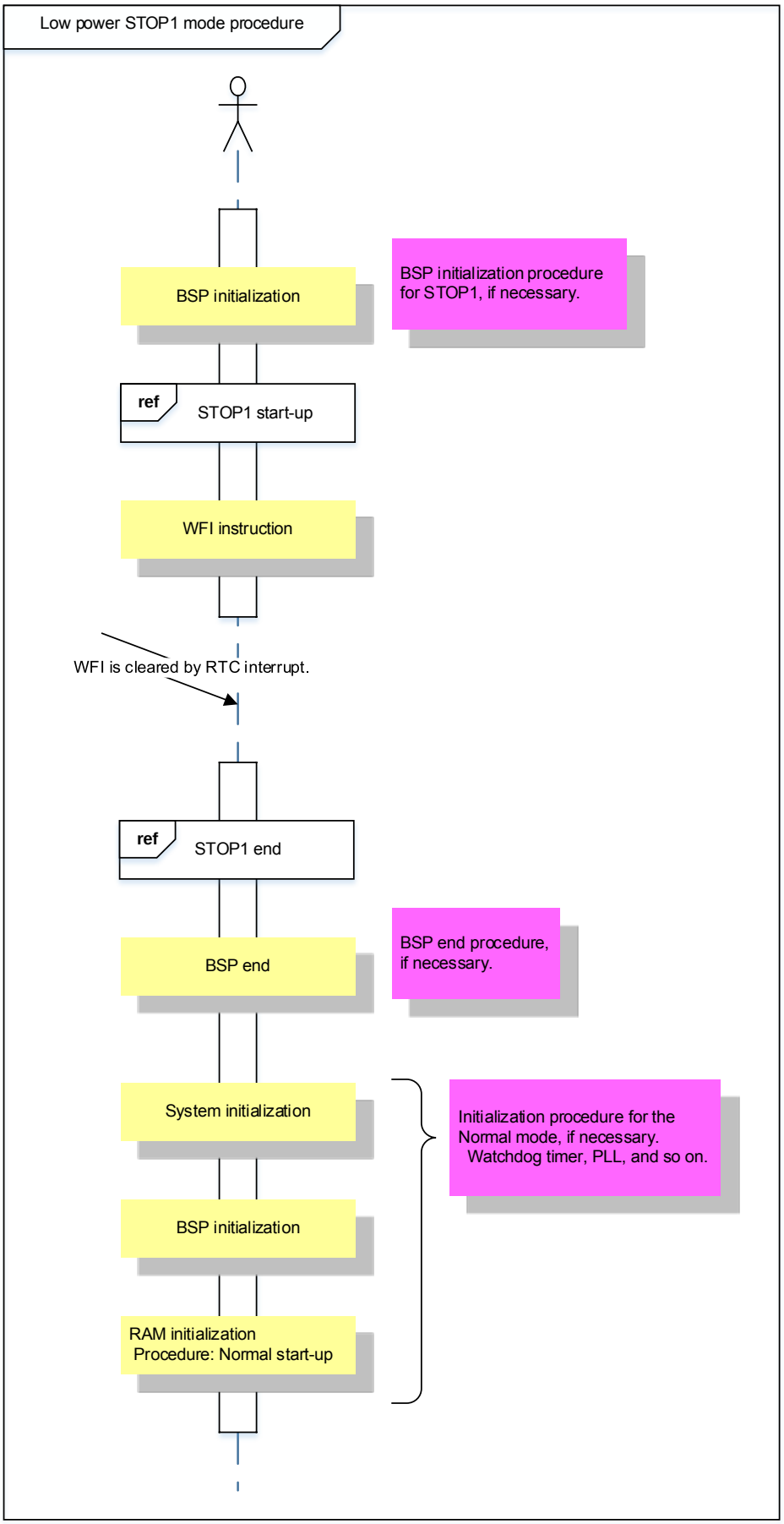
IDLE mode

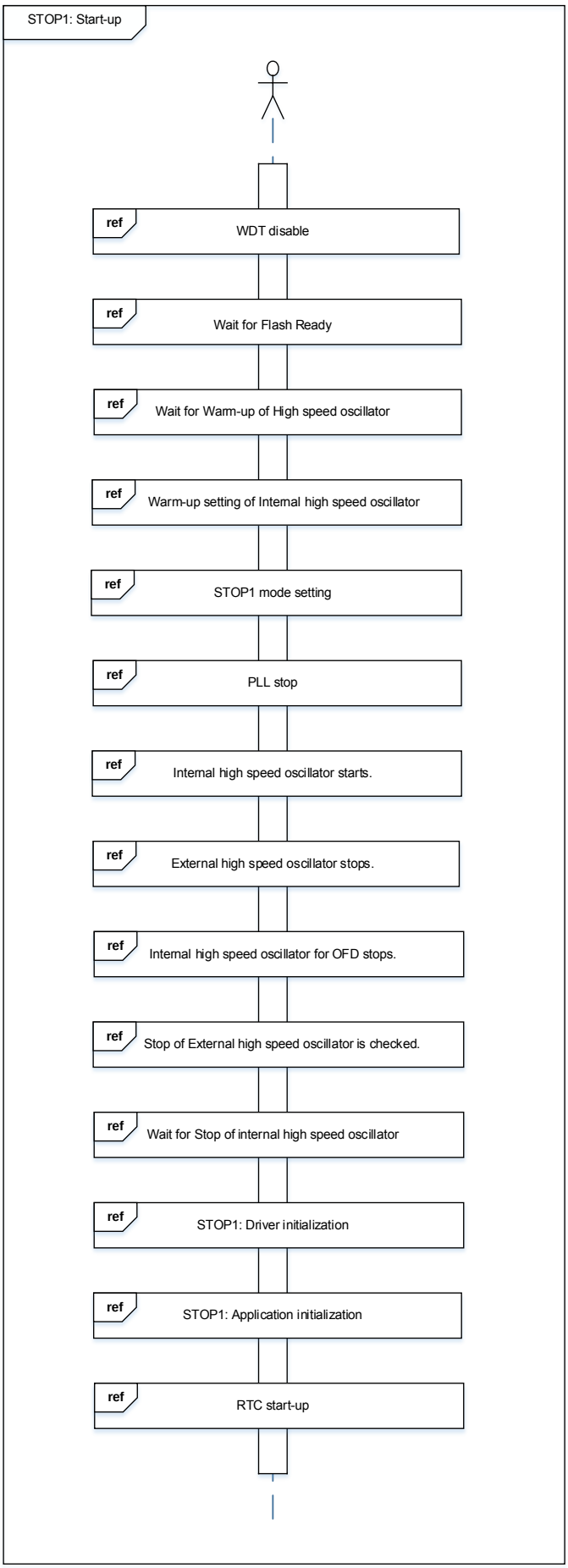

Low power IDLE mode procedure
BSP initialization
BPS initialization procedure for the IDLE mode, if necessary.
ref
IDLE start-up
WFI instruction
WFI is cleared by RTC interrupt.
ref
IDLE end
BSP end
BPS end procedure, if necessary.
System initialization
Initialization procedure for the Normal mode, if necessary. Watchdog timer, PLL, and so on.
BSP initialization
RAM initialization
Procedure: Normal start-up

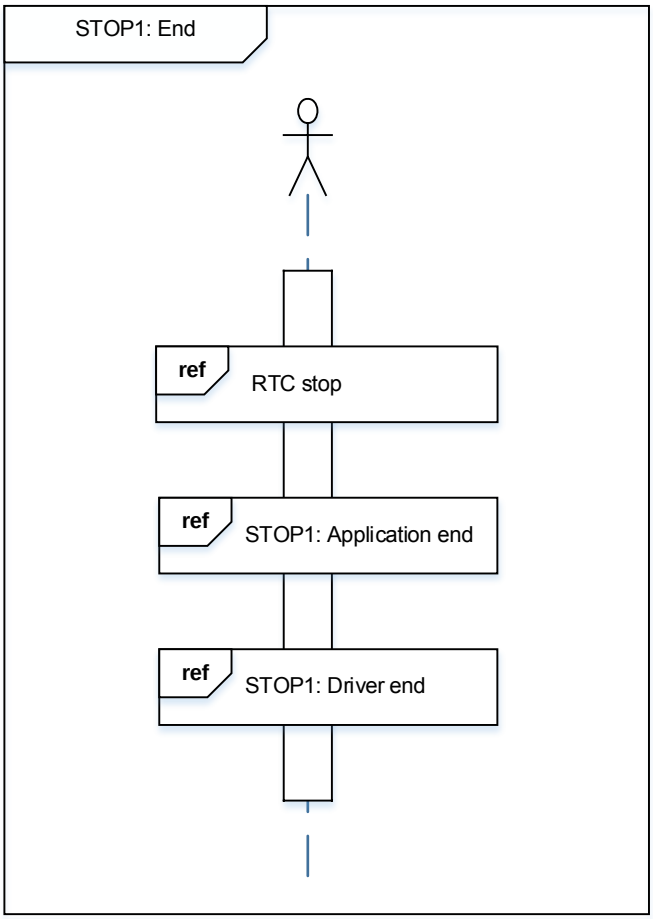

IDLE: Start-up
ref
WDT disable
ref
IDLE mode setting
ref
PLL stop
ref
Internal high speed oscillator starts.
ref
Extrtnal high speed oscillator stops.
ref
Internal high speed oscillator for OFD stops
ref
Stop of External high speed oscillator is checked.
ref
Wait for Stop of Internal high speed oscillator for OFD.
ref
IDLE: Driver initialization
ref
IDLE: Application initialization
ref
RTC start-up


IDLE: End
ref
RTC stop
ref
IDLE: Application end
ref
IDLE: Driver end

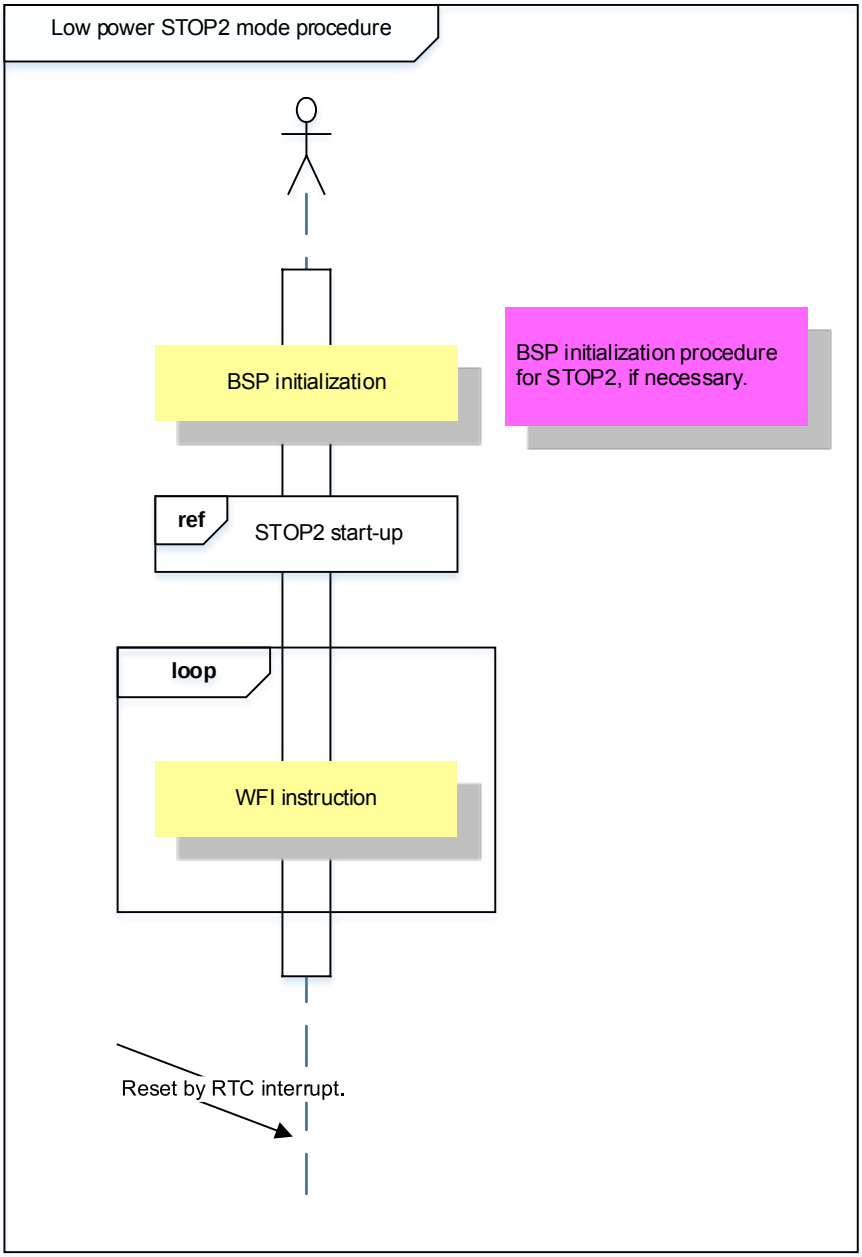
STOP1 mode

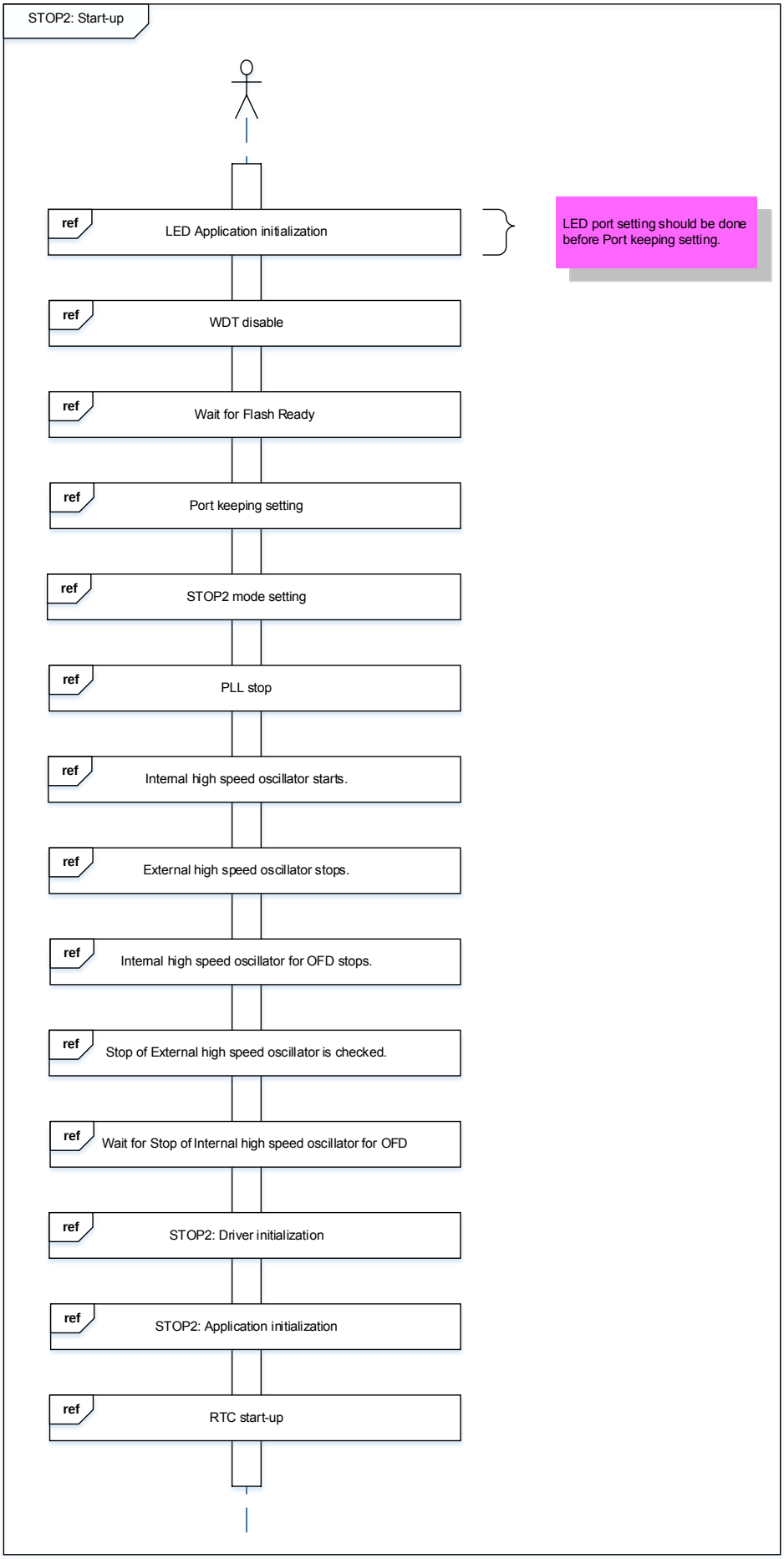

Low power STOP1 mode procedure
BSP initialization
BSP initialization procedure for STOP1, if necessary.
ref
STOP1 start-up
WFI instruction
WFI is cleared by RTC interrupt.
ref
STOP1 end
BSP end
BSP end procedure, if necessary.
System initialization
Initialization procedure for the Normal mode, if necessary. Watchdog timer, PLL, and so on.
BSP initialization
RAM initialization
Procedure: Normal start-up


STOP1: Start-up
ref
WDT disable
ref
Wait for Flash Ready
ref
Wait for Warm-up of High speed oscillator
ref
Warm-up setting of Internal high speed oscillator
ref
STOP1 mode setting
ref
PLL stop
ref
Internal high speed oscillator starts.
ref
External high speed oscillator stops.
ref
Internal high speed oscillator for OFD stops.
ref
Stop of External high speed oscillator is checked.
ref
Wait for Stop of internal high speed oscillator
ref
STOP1: Driver initialization
ref
STOP1: Application initialization
ref
RTC start-up


STOP1: End
ref
RTC stop
ref
STOP1: Application end
ref
STOP1: Driver end

STOP2 mode


Low power STOP2 mode procedure
BSP initialization
BSP initialization procedure for STOP2, if necessary.
ref
STOP2 start-up
loop
WFI instruction
Reset by RTC interrupt.


STOP2: Start-up
ref
LED Application initialization
LED port setting should be done before Port keeping setting.
ref
WDT disable
ref
Wait for Flash Ready
ref
Port keeping setting
ref
STOP2 mode setting
ref
PLL stop
ref
Internal high speed oscillator starts.
ref
External high speed oscillator stops.
ref
Internal high speed oscillator for OFD stops.
ref
Stop of External high speed oscillator is checked.
ref
Wait for Stop of Internal high speed oscillator for OFD
ref
STOP2: Driver initialization
ref
STOP2: Application initialization
ref
RTC start-up

10. Precaution

When using the sample program with CPU other than TMPM3H6, please check operation sufficiently.

11. Revision History

Rev	Date	Page	Description
1.0	2018-03-22	–	First release

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