

**M4K Group (1)**  
**Application Note**  
**Clock Control and Operation Mode**  
**(CG-M4K (1)-A)**

**Outlines**

This application note is a reference material for developing products using the clock control and the operation mode (CG) functions of M4K Group (1).

The release of the low power mode is done by an external interrupt.

This document helps the user check operation of the product and develop its program.

Target sample program: CGRST\_EXINT\_M4K4A

**Table of Contents**

Outlines .....	1
Table of Contents .....	2
1. Preface .....	4
2. Reference Document .....	4
3. Function to Use .....	4
4. Target Device .....	4
5. Operation Confirmation Condition .....	5
6. Evaluation Board Operation .....	5
7. Sample Program .....	6
7.1. Structure Diagram of Sample Program .....	6
7.2. Startup Routine .....	6
7.3. Main Operation .....	6
7.4. Operation Mode Switching .....	7
7.5. Operating Flow of Sample Program .....	8
8. Points to Remember on Handling of Sample Programs .....	27
9. Revision History .....	27
RESTRICTIONS ON PRODUCT USE .....	28

Arm and Keil are registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

All other company names, product names, and service names mentioned herein may be trademarks of their respective companies.

### 1. Preface

This sample program changes the operating mode according to the control of a push switch. LED's show the operation mode on the evaluation board.

The operation mode can be changed from the NORMAL mode to the Low power mode (IDLE/STOP1). It is triggered by a port input signal of the switch.

When the operation mode transits to the Low power mode, a corresponding LED turns on, which confirms the transition is successful.

The operation mode returns to the NORMAL mode when an external interrupt is detected during the Low power mode.

### 2. Reference Document

1. Datasheet  
 TPM4K Group (1) datasheet Rev2.0 (Japanese edition)
2. Reference manual  
 Clock Control and Operation Mode (CG-M4K(1)-A) Rev2.0 (Japanese edition)  
 Input/Output Ports (PORT-M4K(1)) Rev2.0 (Japanese edition)  
 Exception (EXCEPT-M4K(1)) Rev1.0 (Japanese edition)
3. Application note  
 M4K Group (1) Application Note Startup (CMSIS System & Clock Configuration) Rev1.0
4. Other reference document  
 TPM4KxA Group Peripheral Driver User Manual (Doxygen) V1.0.4.0

### 3. Function to Use

IP	Channel	Port	Function/Operation mode
Clock Control and Operation Mode	—	—	System clock control/Mode change
Input/Output Ports	—	PL0 (Input port)	Input
		PL1 (Input port)	
		PA1 (INT09)	External interrupt
	—	PL2 (Output port)	Output
		PL3 (Output port)	
		PJ4 (Output Port)	

### 4. Target Device

The target devices of this application note are as follows;

TMPM4K4FYAUG	TMPM4K4FWAUG	TMPM4K4FUAUG	TMPM4K4FSAUG
TMPM4K4FYAFG	TMPM4K4FWAFG	TMPM4K4FUAFG	TMPM4K4FSAFG
TMPM4K2FYADUG	TMPM4K2FWADUG	TMPM4K2FUADUG	TMPM4K2FSADUG
TMPM4K1FYAUG	TMPM4K1FWAUG	TMPM4K1FUAUG	TMPM4K1FSAUG
			TMPM4K0FSADUG

\* This sample program operates on the evaluation board of TMPM4K4FYAUG.

If other function than the TMPM4K4 one is checked, it is necessary that CMSIS Core related files (the startup file and I/O header file) should be changed properly.

Additionally, the name of microcontroller which is set to the project should be changed.

The BSP related file is dedicated to the evaluation board (TMPM4K4FYAUG). If other function than the TMPM4K4 one is checked, the BSP related file should be changed properly.

## 5. Operation Confirmation Condition

Used microcontroller	TMPM4K4FYAUG
Used board	TMPM4K4 evaluation board (Product of ESP-kikaku Co. Ltd.)
Integrated development environment	IAR Embedded Workbench for ARM 8.22.2
Integrated development environment	Arm® Keil® MDK Version 5.24.2.0
Sample program	v1.0.0

## 6. Evaluation Board Operation

An external input pin and the SW1 should be connected on the evaluation board to generate an interrupt. They should be connected with a jumper wire and others.

NORMAL mode

The LED1 blinks.

IDLE mode

The operation mode transits to the IDLE mode by setting the PL0 to Low. The LED2 turns on.

STOP1 mode

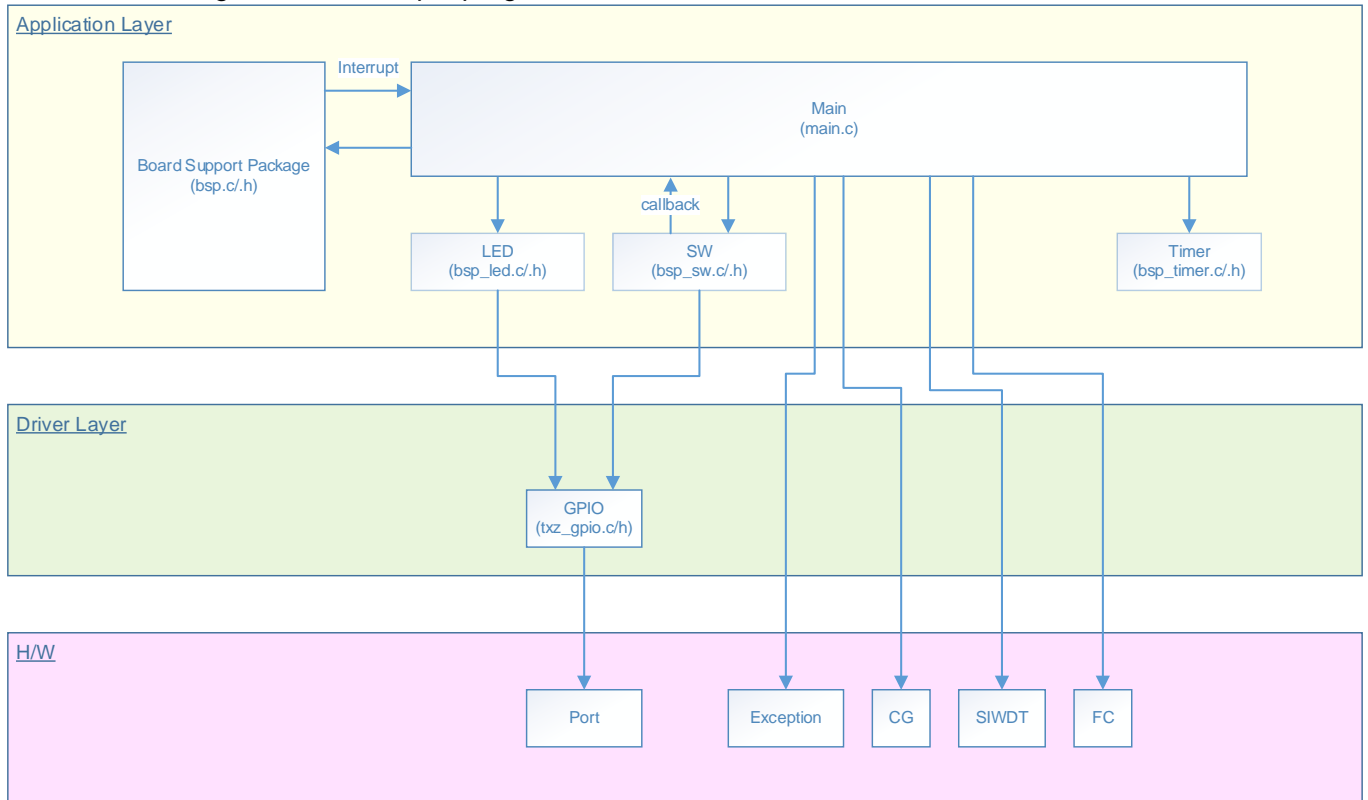
The operation mode transits to the STOP1 mode by setting the PL1 to Low. The LED3 turns on.

The operation mode returns to the NORMAL mode by setting the PA1 to Low.

## 7. Sample Program

### 7.1. Structure Diagram of Sample Program

The structure diagram of the sample program is shown below.



### 7.2. Startup Routine

The following initialization is done after power is supplied.

The initialization of each clock setting and the initialization of the watchdog timer setting are done.

### 7.3. Main Operation

The initialization of the BSP (Board Support Package) is done.

The reset flag is cleared.

The settings of the LED's and the switches are done as the setting of the variables.

After each initialization setting completes, the sample program executes the main operation.

The sample program sets the timer as the driver initialization.

The 1-ms timer setting, the LED setting, and the Push switch setting are done as the application initialization.

The mode switching is done by the Push switches.

S\_SW1 switch; Transition to the IDLE mode

S\_SW2 switch: Transition to the STOP1 mode

The operation mode of the sample program can be checked using the LED's.

In the NORMAL mode, the LED D1 blinks.

It repeats 1-second lighting and 1-second lights-out.

In the IDLE mode, the LED D2 lights.

In the STOP1 mode, the LED D3 lights.

When the operation mode transits to the Low power mode by the Push switch, the following operation is done.

When the INT09 interrupt is detected, the operation mode returns to the NORMAL mode.

The direct transition between the different Low power modes is not supported by this sample program.

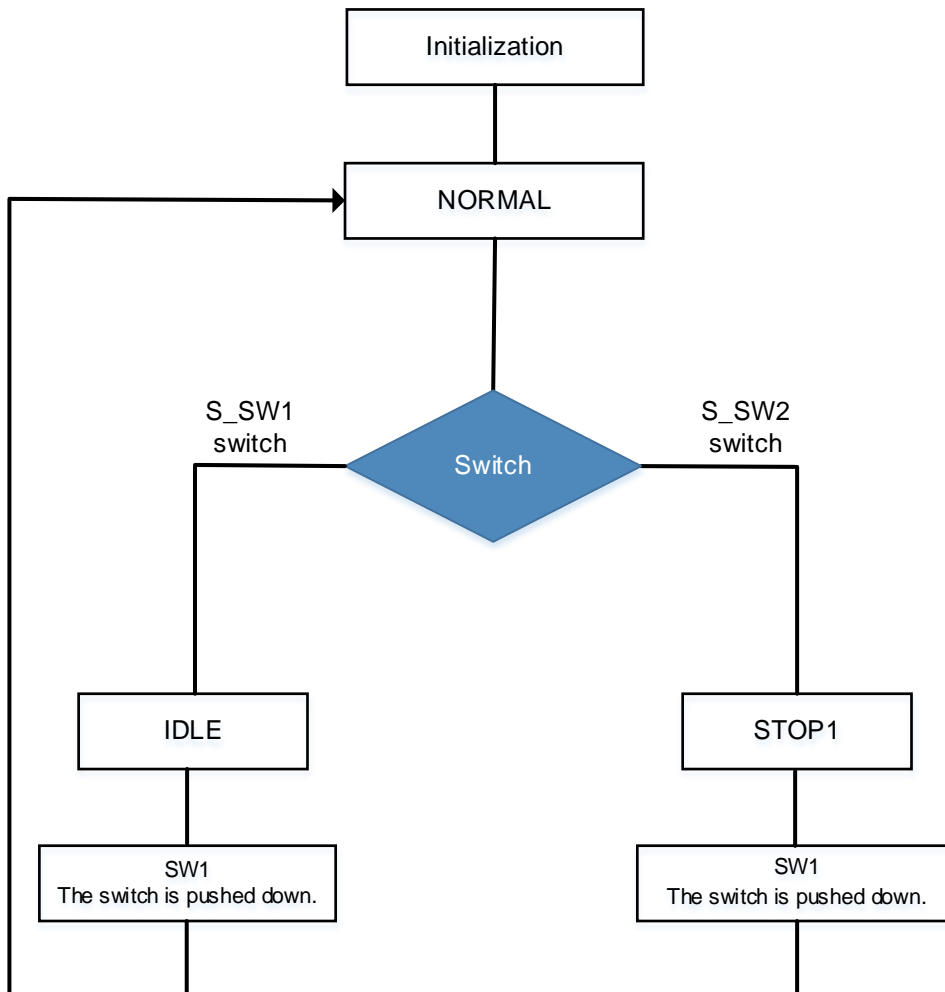
The transition to the Low power mode should be done via the NORMAL mode.

### 7.4. Operation Mode Switching

When either of the PORT pin (the switch S\_SW1 or S\_SW2) is set to GND in this sample program, the operation mode switches to a Low power mode.

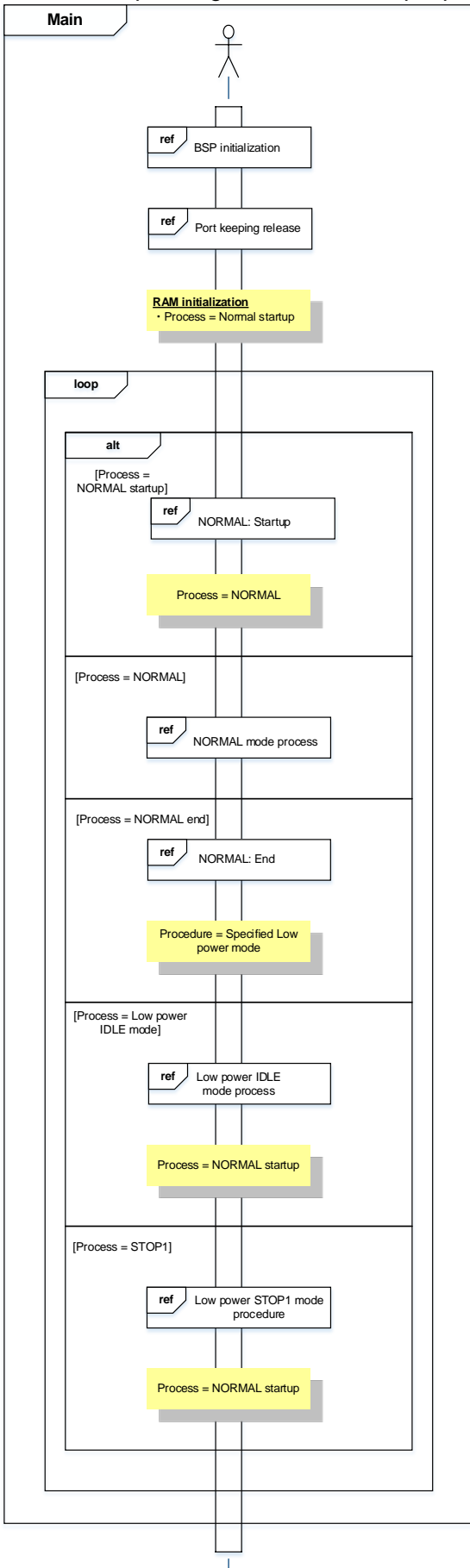
After power is supplied or the reset is done, the microcontroller enters the NORMAL state.

The operation mode returns to the NORMAL mode by an interrupt generated by the Push switch SW1 (INT09).

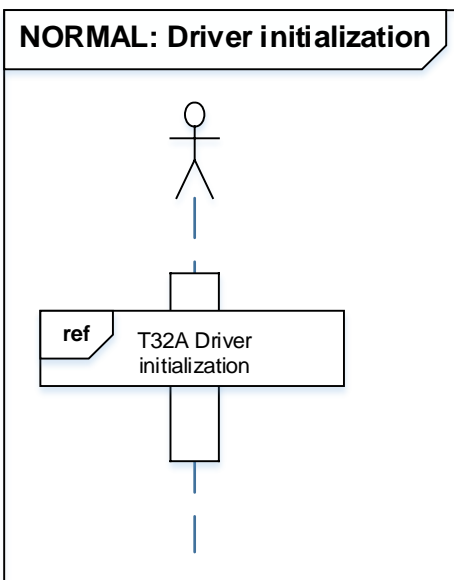
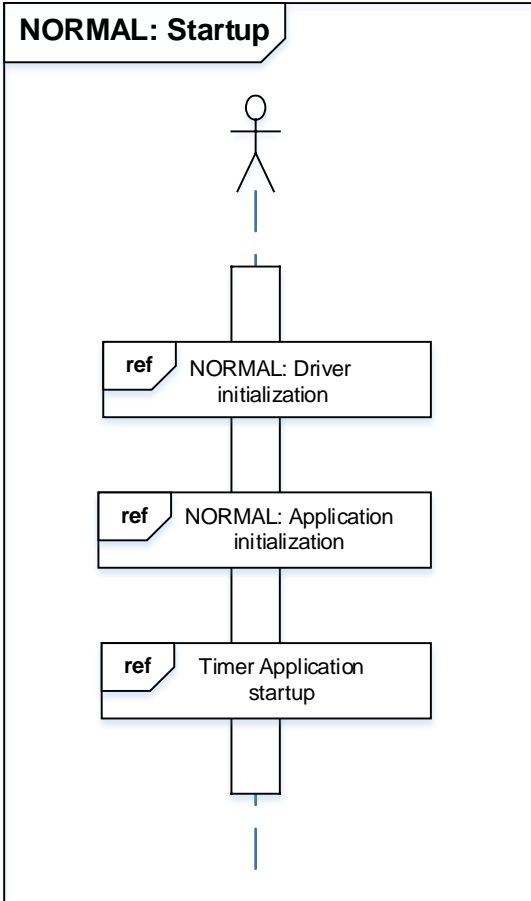


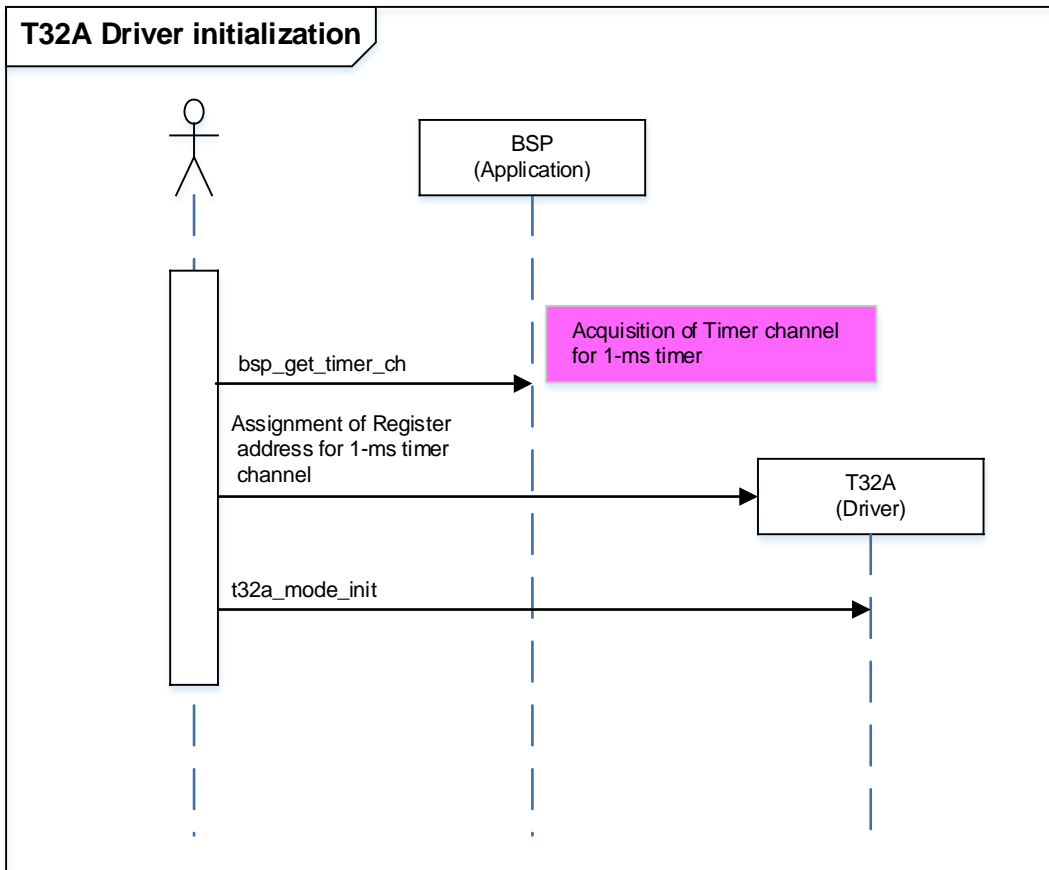
## 7.5. Operating Flow of Sample Program

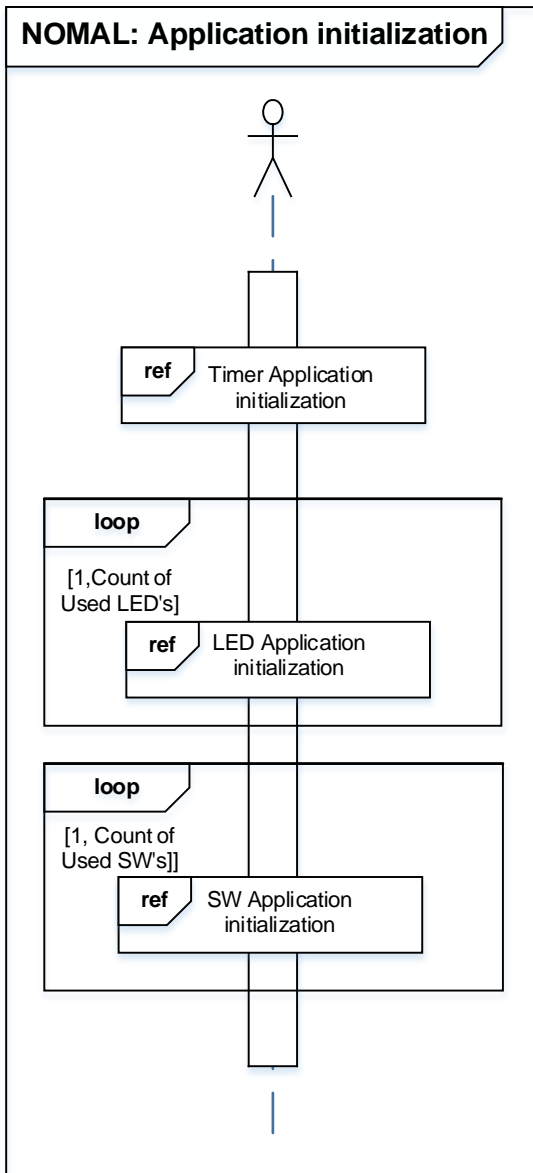
The basic operating flows of the sample program are shown in the following;

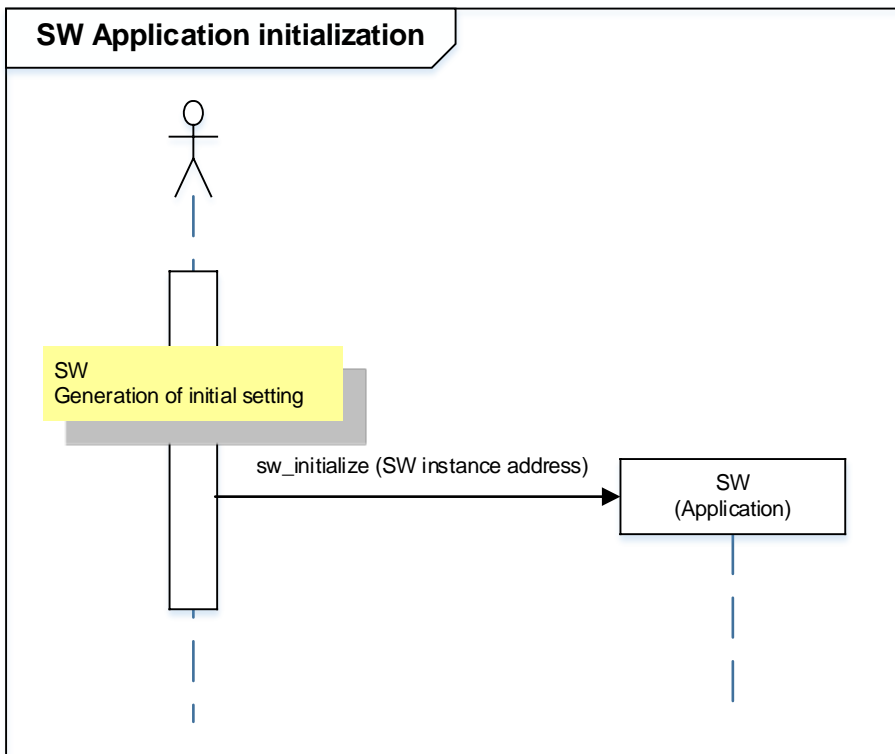
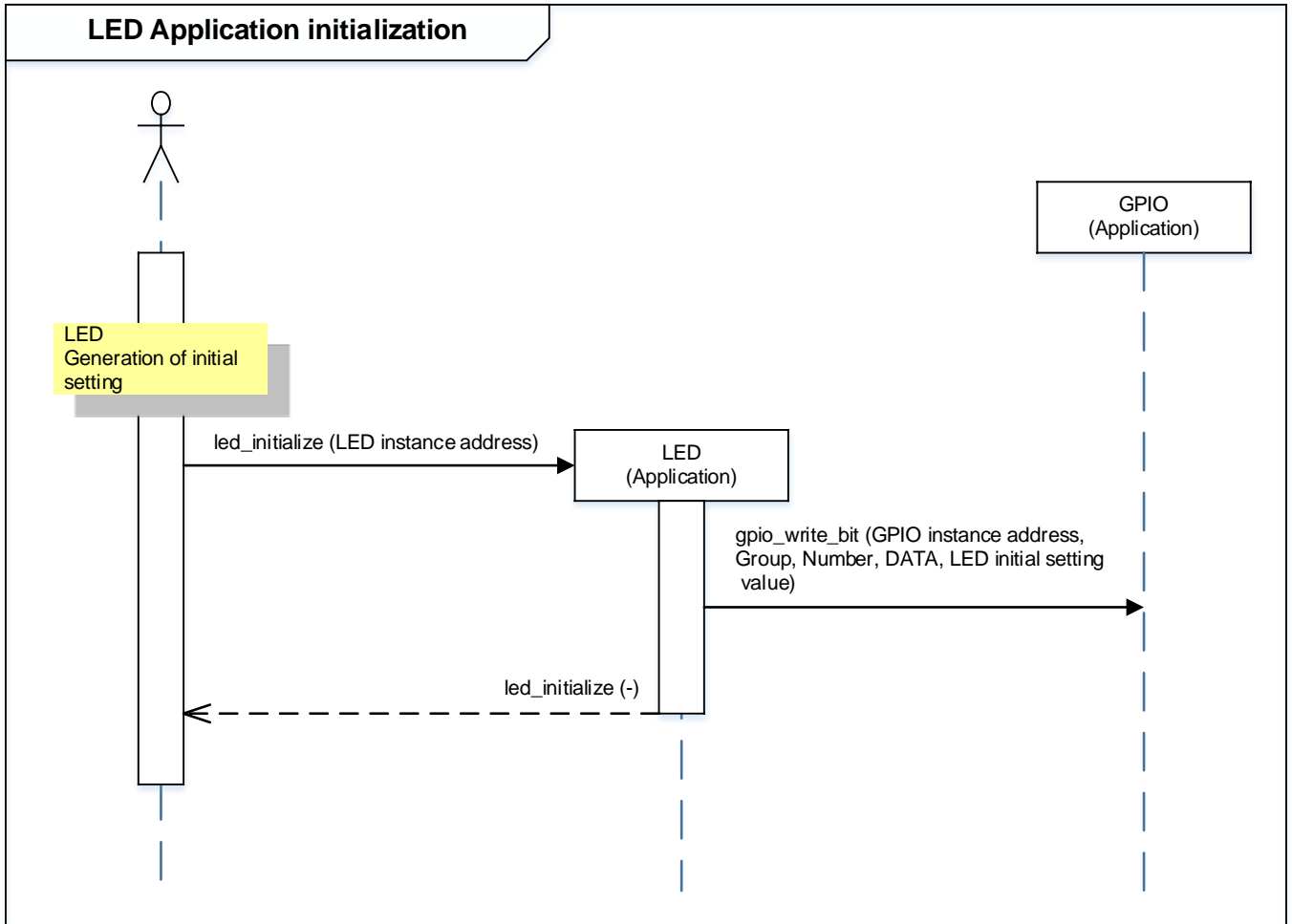


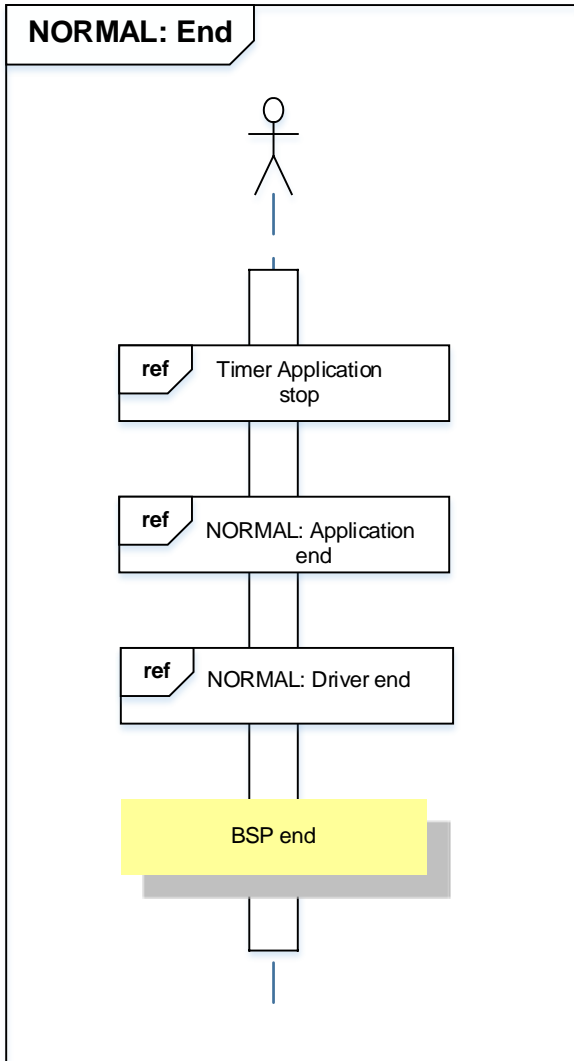


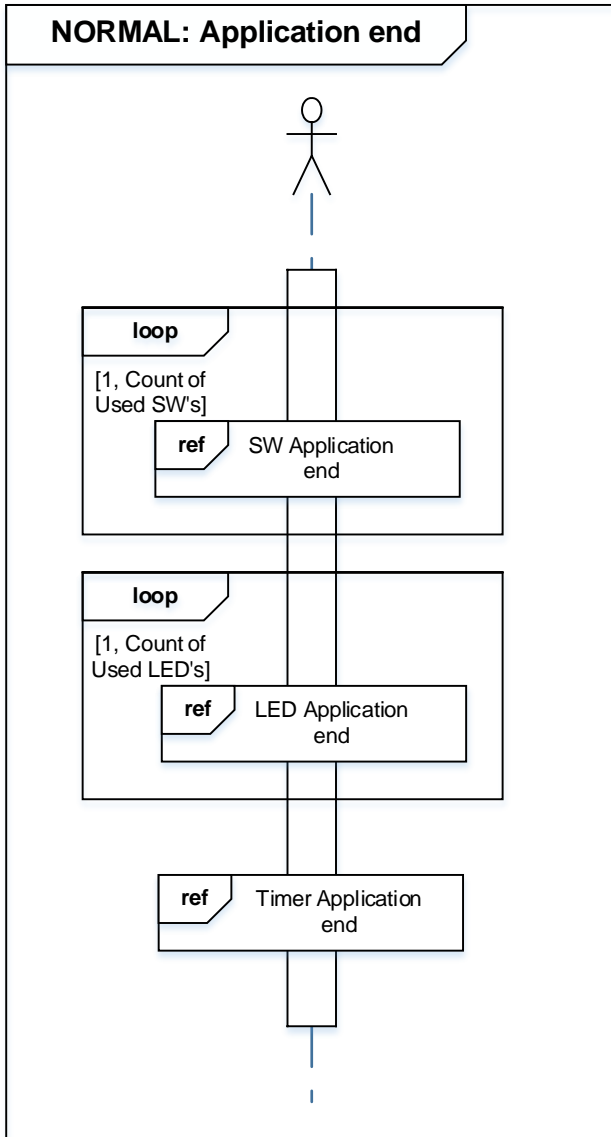


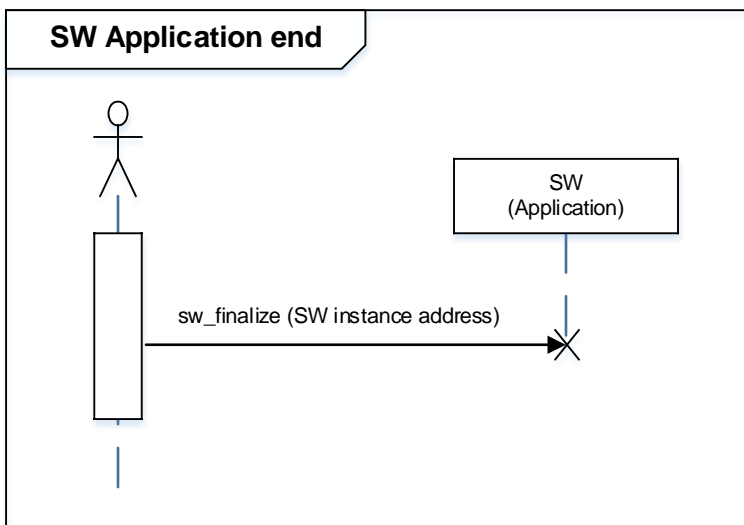
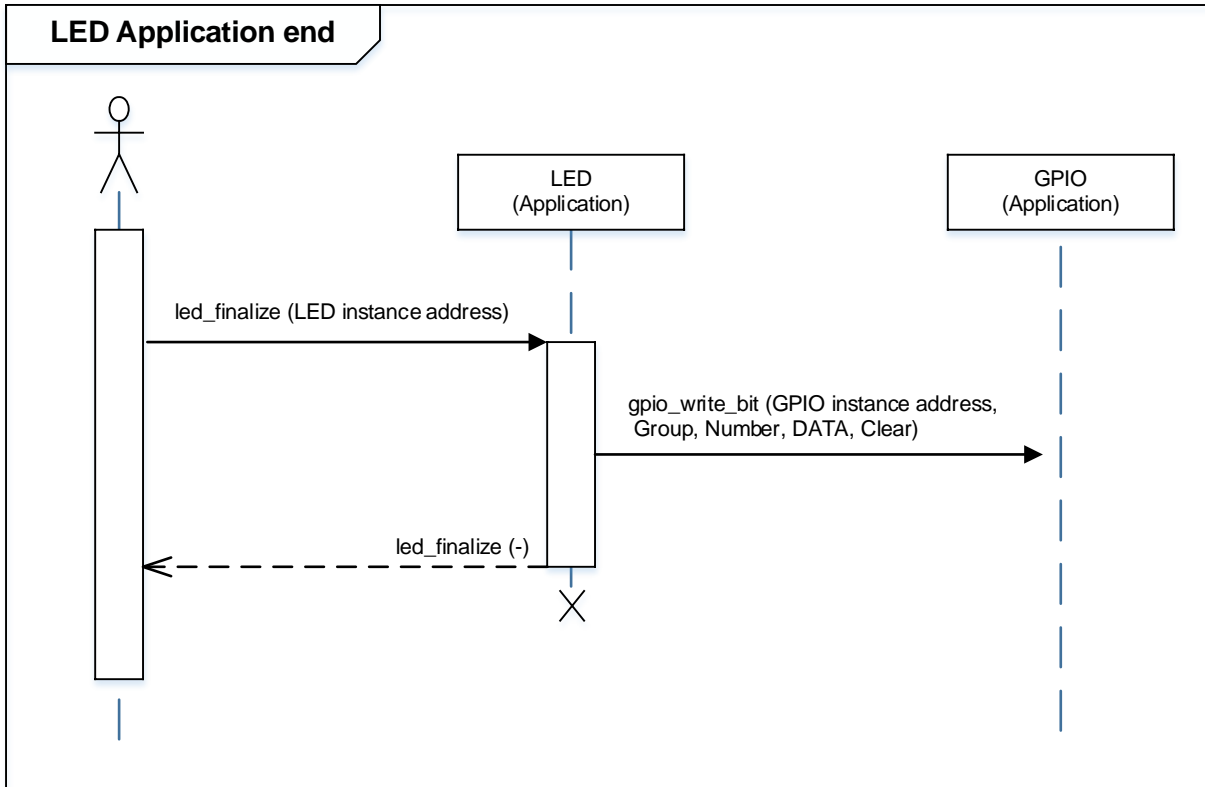


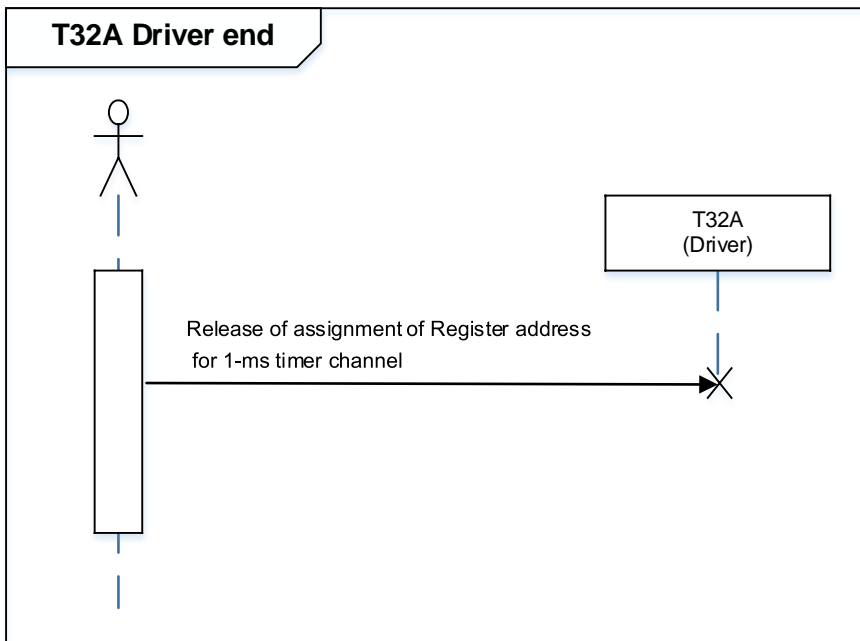
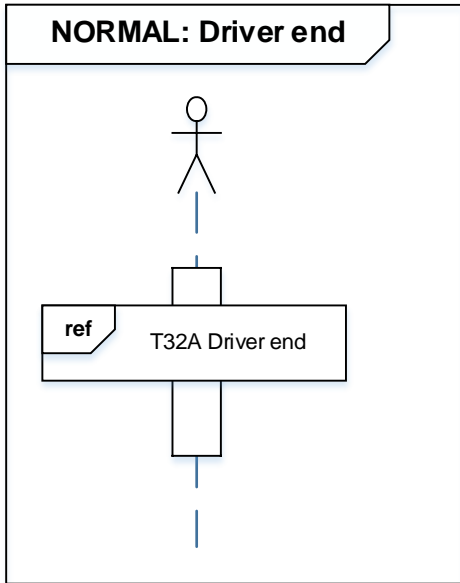




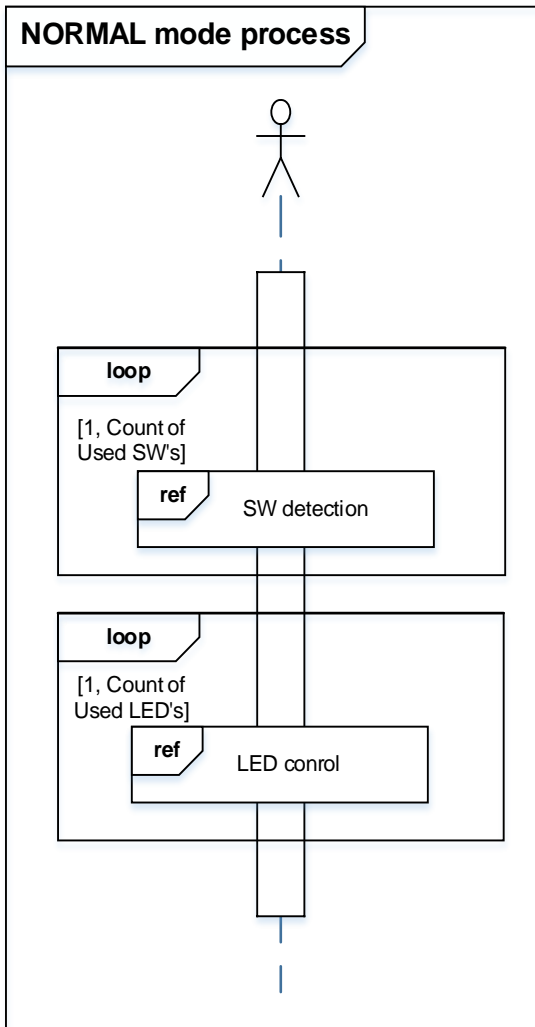


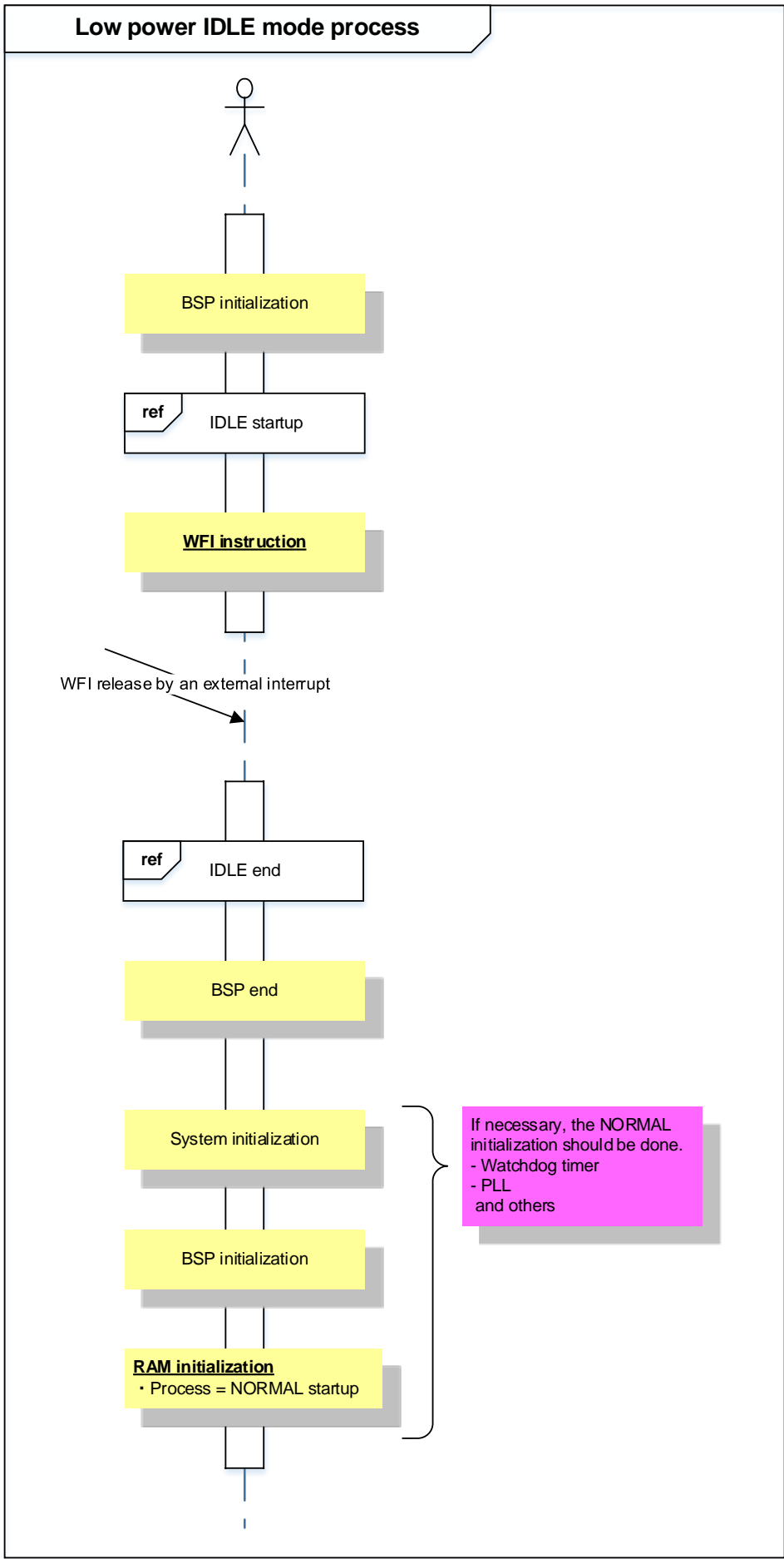


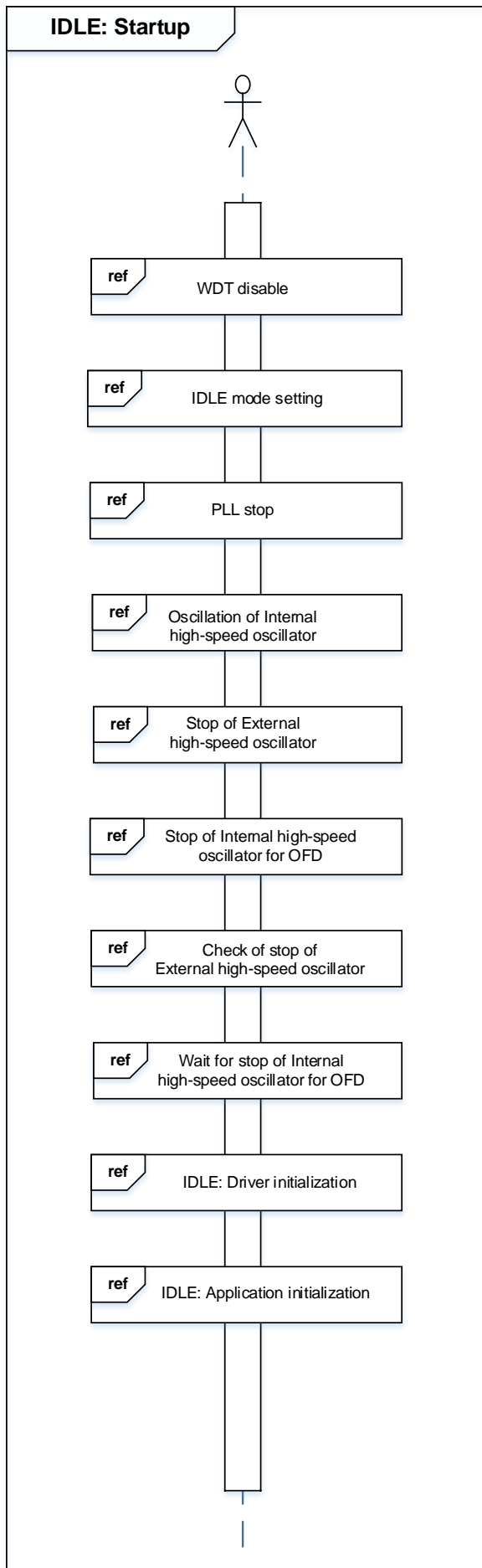


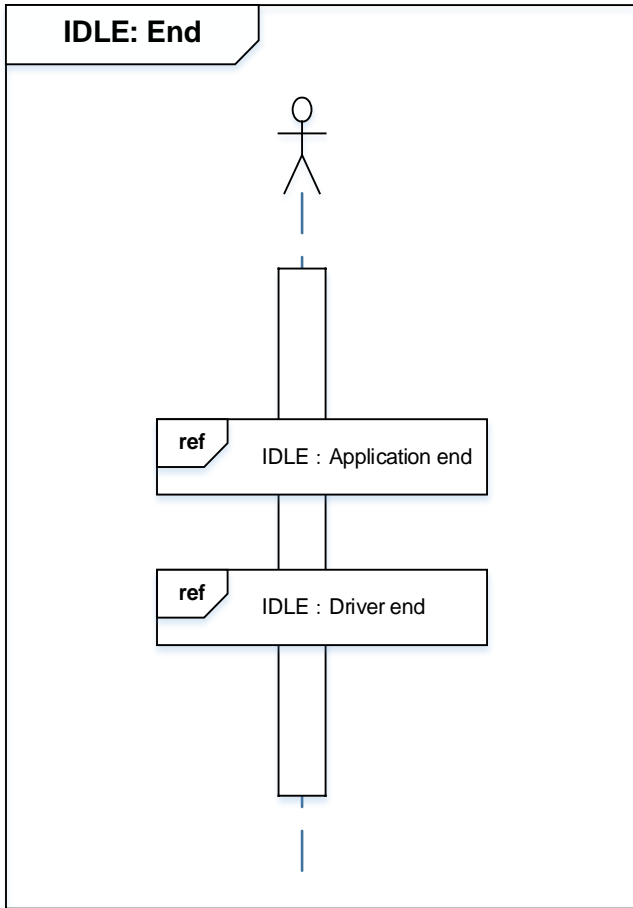


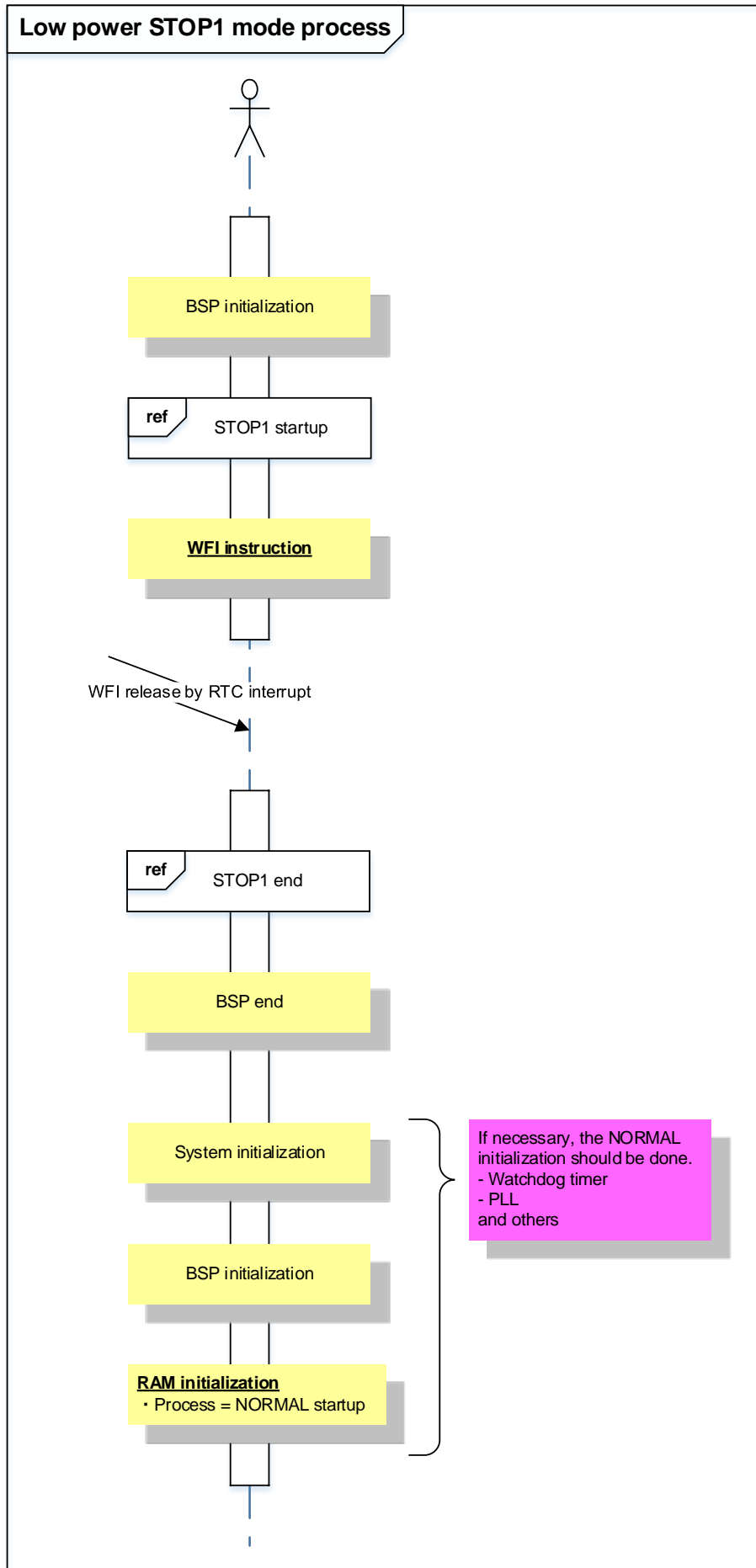


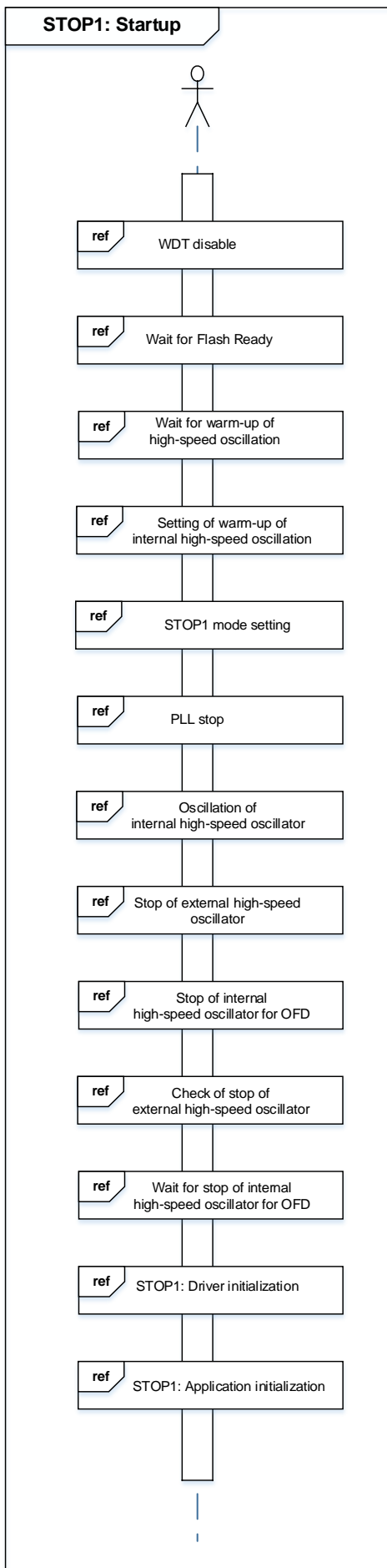


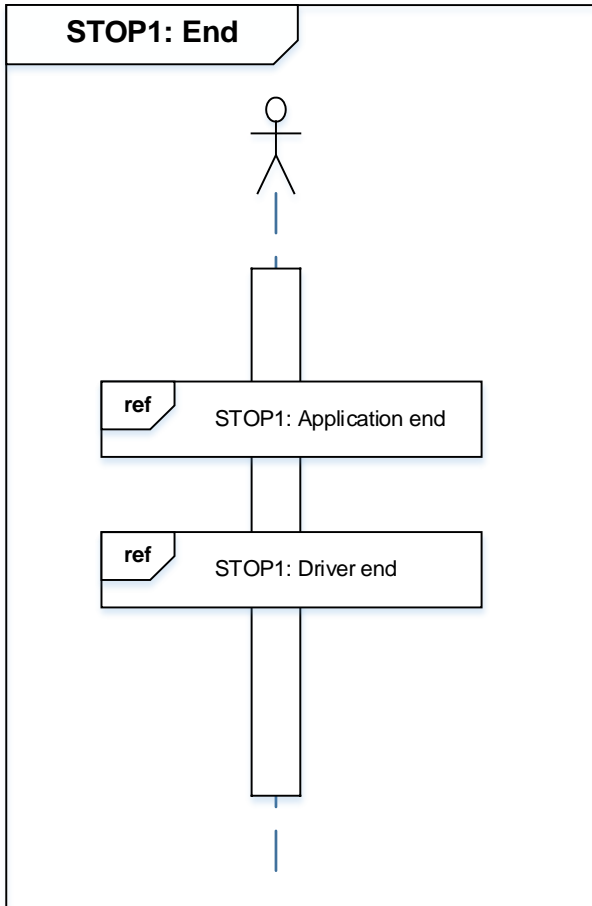


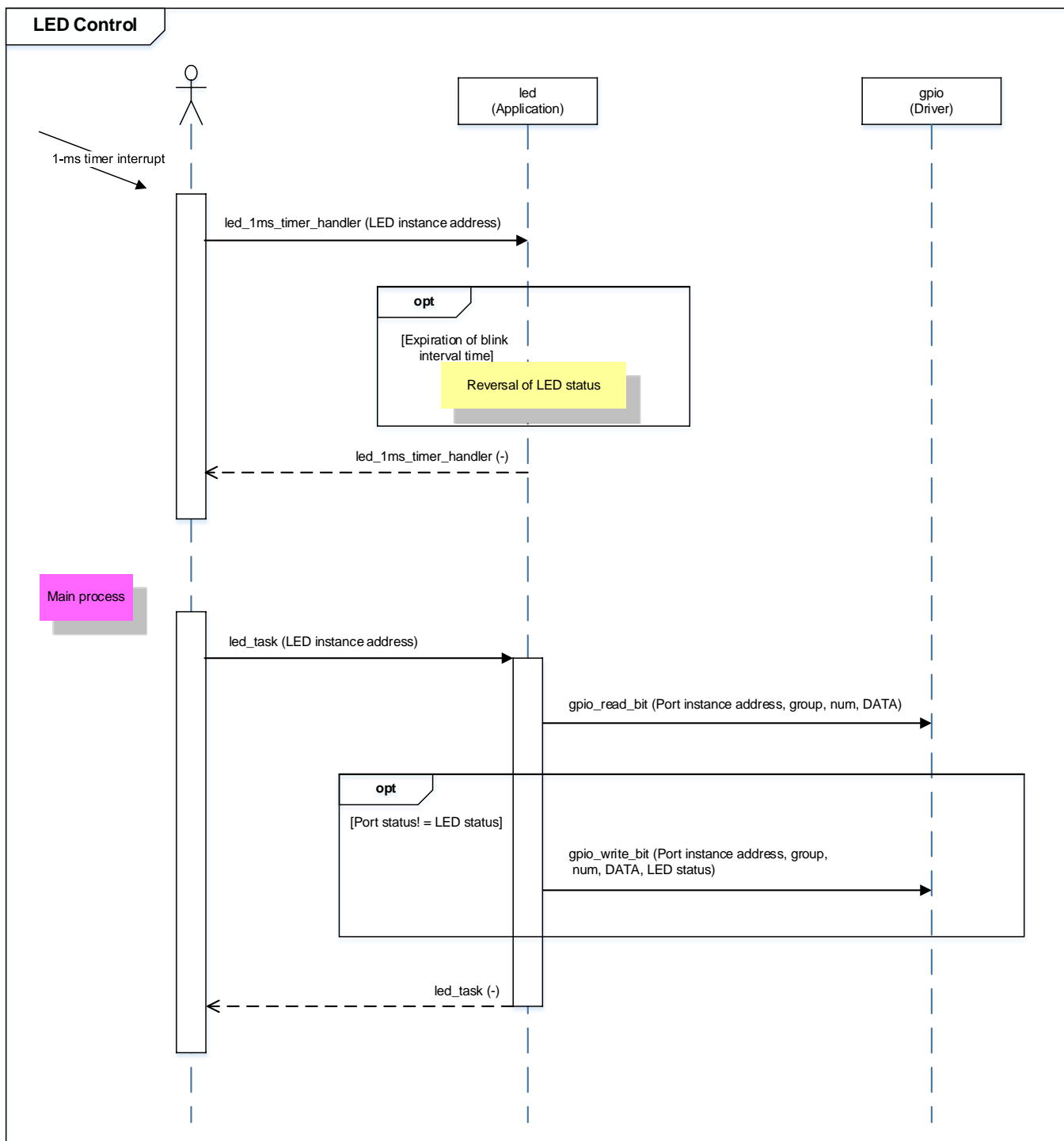




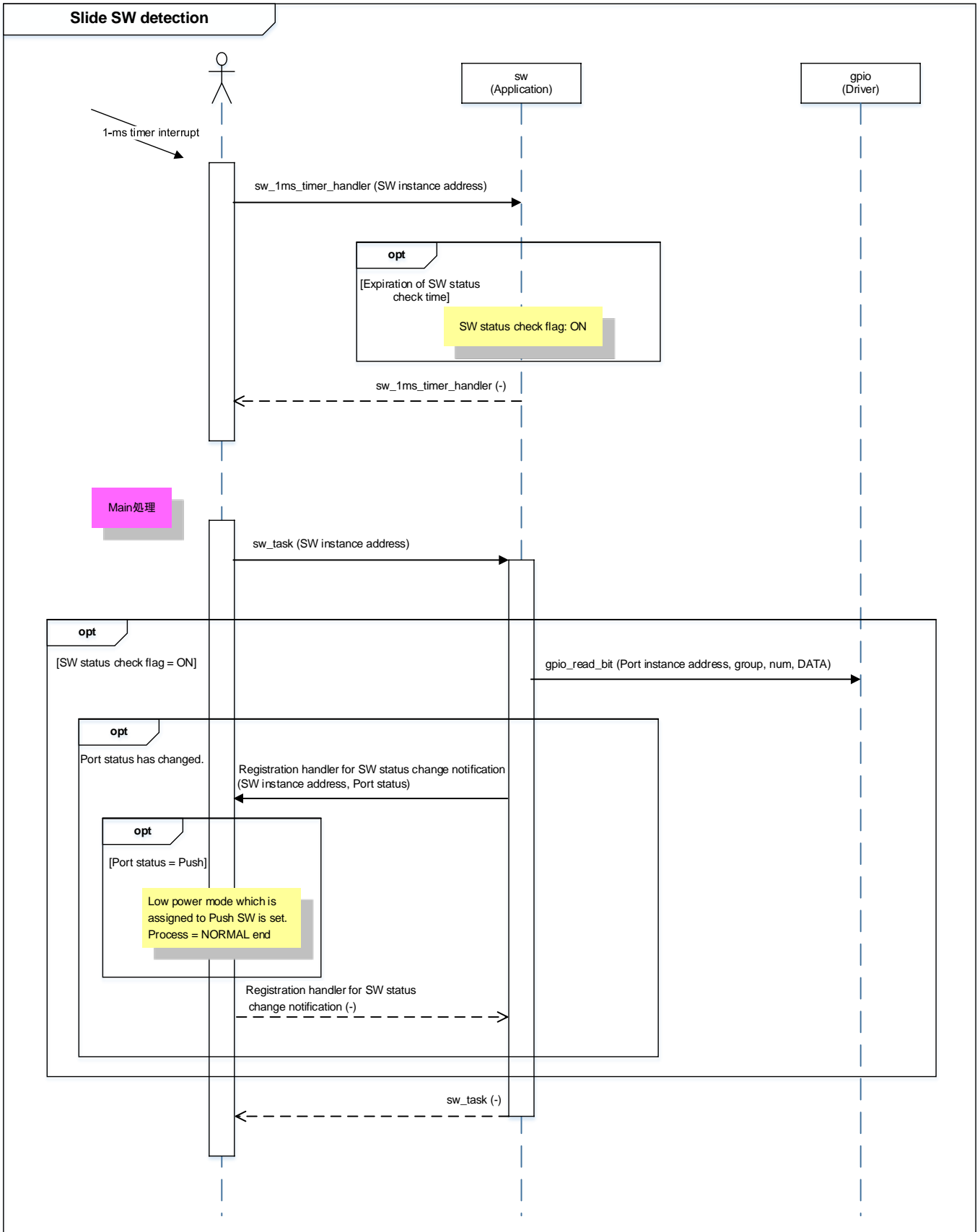


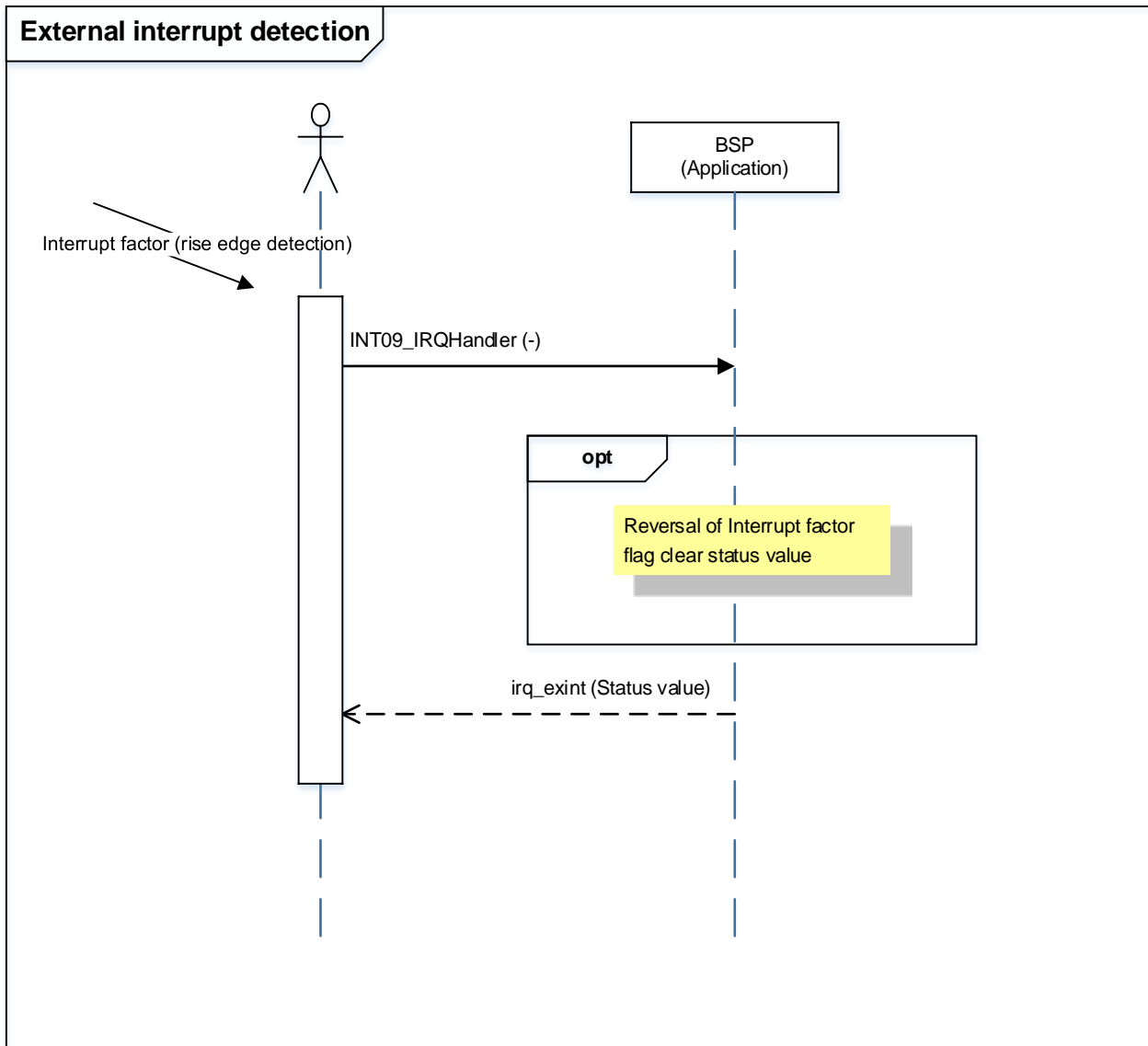












## 8. Points to Remember on Handling of Sample Programs

When using the sample program with other than “Operation Confirmation Condition” please check the operation sufficiently.

## 9. Revision History

Revision	Date	Description
1.0	2019-10-08	First release

### RESTRICTIONS ON PRODUCT USE

Toshiba Corporation and its subsidiaries and affiliates are collectively referred to as "TOSHIBA". Hardware, software and systems described in this document are collectively referred to as "Product".

- TOSHIBA reserves the right to make changes to the information in this document and related Product without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before customers use the Product, create designs including the Product, or incorporate the Product into their own applications, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application with which the Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. **TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.**
- **PRODUCT IS NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS OR SYSTEMS THAT REQUIRE EXTRAORDINARILY HIGH LEVELS OF QUALITY AND/OR RELIABILITY, AND/OR A MALFUNCTION OR FAILURE OF WHICH MAY CAUSE LOSS OF HUMAN LIFE, BODILY INJURY, SERIOUS PROPERTY DAMAGE AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE").** Except for specific applications as expressly stated in this document, Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, lifesaving and/or life supporting medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, and devices related to power plant. **IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT.** For details, please contact your TOSHIBA sales representative or contact us via our website.
- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.
- **ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.**
- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.
- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. **TOSHIBA ASSUMES NO LIABILITY FOR DAMAGES OR LOSSES OCCURRING AS A RESULT OF NONCOMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS.**