

M4K Group (1)
Application Note
Voltage Detection Circuit
(LVD-B)

Outlines

This application note is a reference material for developing products using the Voltage detection circuit (LVD) function of M4K Group (1).

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

Target sample program: LVD-DEMO

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1. Preface

This sample program is used to check the operation of the LVD.
The voltage value of the external power supply is detected. The lighting and the lights-out of the LED are controlled by the result of the comparison with a preset voltage value.

2. Reference Document

1. Datasheet
TMPM4K Group (1) datasheet Rev2.0 (Japanese edition)
2. Reference manual
Voltage Detection Circuit (LVD-B) Rev2.0 (Japanese edition)
Input/Output Ports (PORT-M4K(1)) Rev2.0 (Japanese edition)
32-bit Timer Event Counter (T32A-B) Rev3.0 (Japanese edition)
3. Application note
M4K Group (1) Application Note Startup (CMSIS System & Clock Configuration) Rev1.0
4. Other reference document
TMPM4KxA Group Peripheral Driver User Manual (Doxygen) V1.0.4.0

3. Function to Use

IP	Channel	Port	Function/Operation mode
Voltage detection circuit	—	—	Voltage detection of a power supply
32-bit Timer Event Counter	ch0	—	Interval timer
Input/Output Ports	—	PJ0 (Output Port)	Output
	—	PJ2 (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

After the program is written to the evaluation board, the board should be disconnected with the PC to shut down the power supply of the USB.

The jumper connection between JP1 and JP4 should be removed.

An external power should be supplied on JP5.

The setting value of the voltage detection is 4.0 V in the sample program.

The voltage of the external power supply should start with a voltage which is less than the setting value.

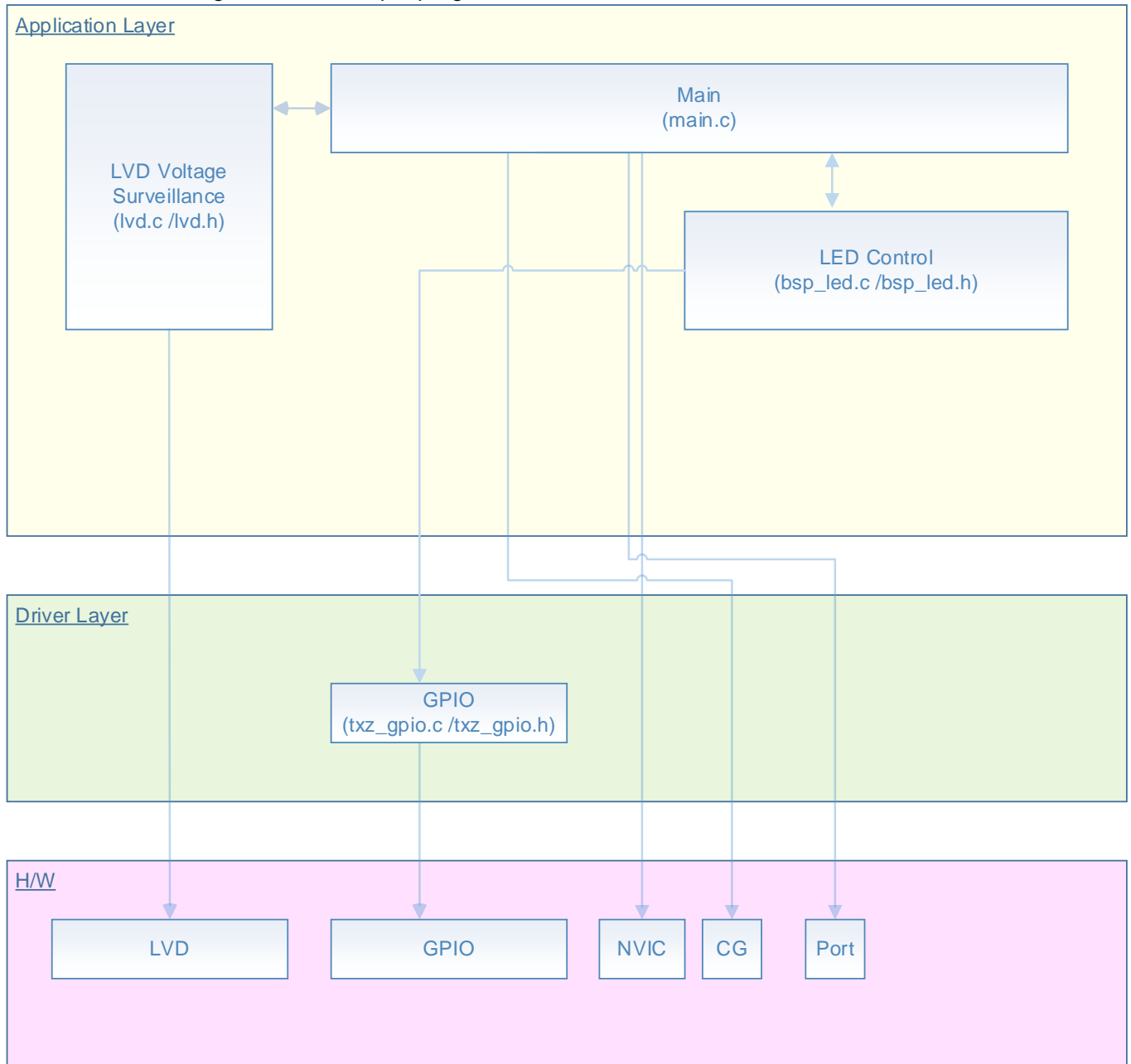
When the applied voltage is changed, and the voltage becomes the detected voltage or more, the LED (D2) lights. After the LED (D2) lights once, when the voltage becomes the setting value or more, the LED (D2) lights and the LED (D1) lights out.

When the voltage is less than the setting value, the LED (D1) blinks and the LED (D2) lights out.

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 is done.
- The initialization of the variables is done.
- The initialization of the Timer driver is done.
- The initialization of the LED and the initialization of the Timer are done as the initialization of the application software.

The timer should be started. And the setting of the LVD should be done.

The initial value of the LVD setting is as follows;

Output control: Output disable

Detection voltage: 4.0 V

Voltage detection status: The power supply voltage is the detection voltage or more.

The power supply voltage starts with the voltage which is less than the detection voltage and it is increased. Then, the status changes.

The power supply voltage is checked whether the voltage is more than the detection voltage or less. The result can be confirmed using the voltage detection status.

When the power supply voltage is the detection voltage or more, the LED (D2) lights and the LED (D1) lights out.

When the power supply voltage is less than the detection voltage, the LED (D1) blinks and the LED (D2) lights out.

7.4. Change of LVD Setting

When the detection voltage of the LVD is changed in the sample program, the following should be modified.

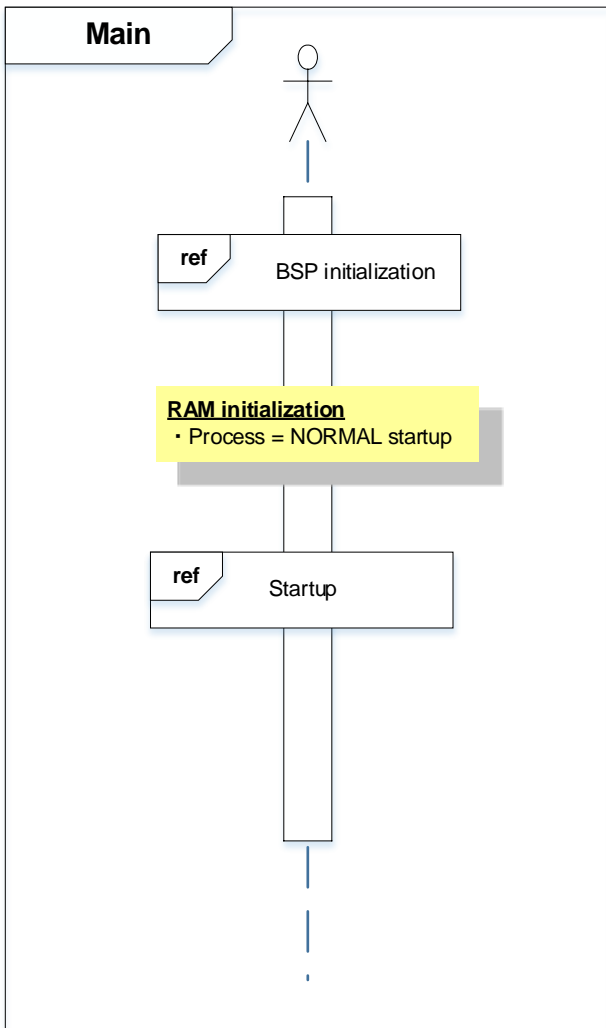
The "init_LVD" setting in "lvd.c" should be changed.

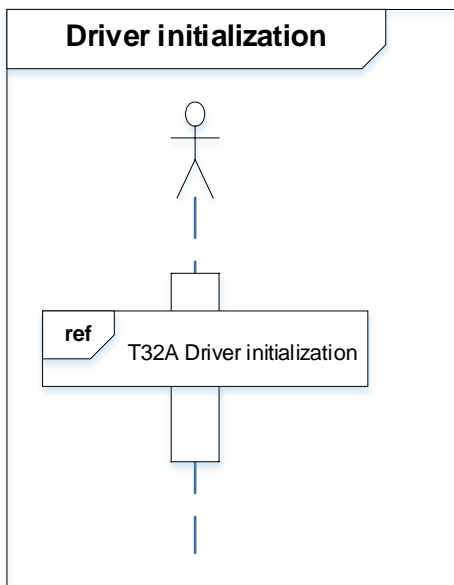
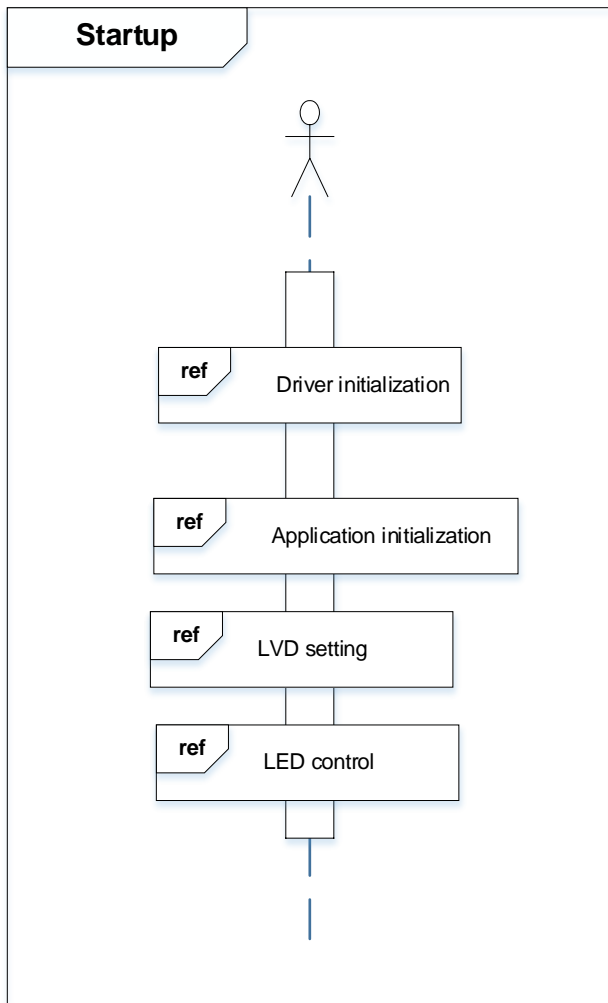
Example: `TSB_LVD->CR |= (uint8_t) LVD_VOLTAGE_44;`

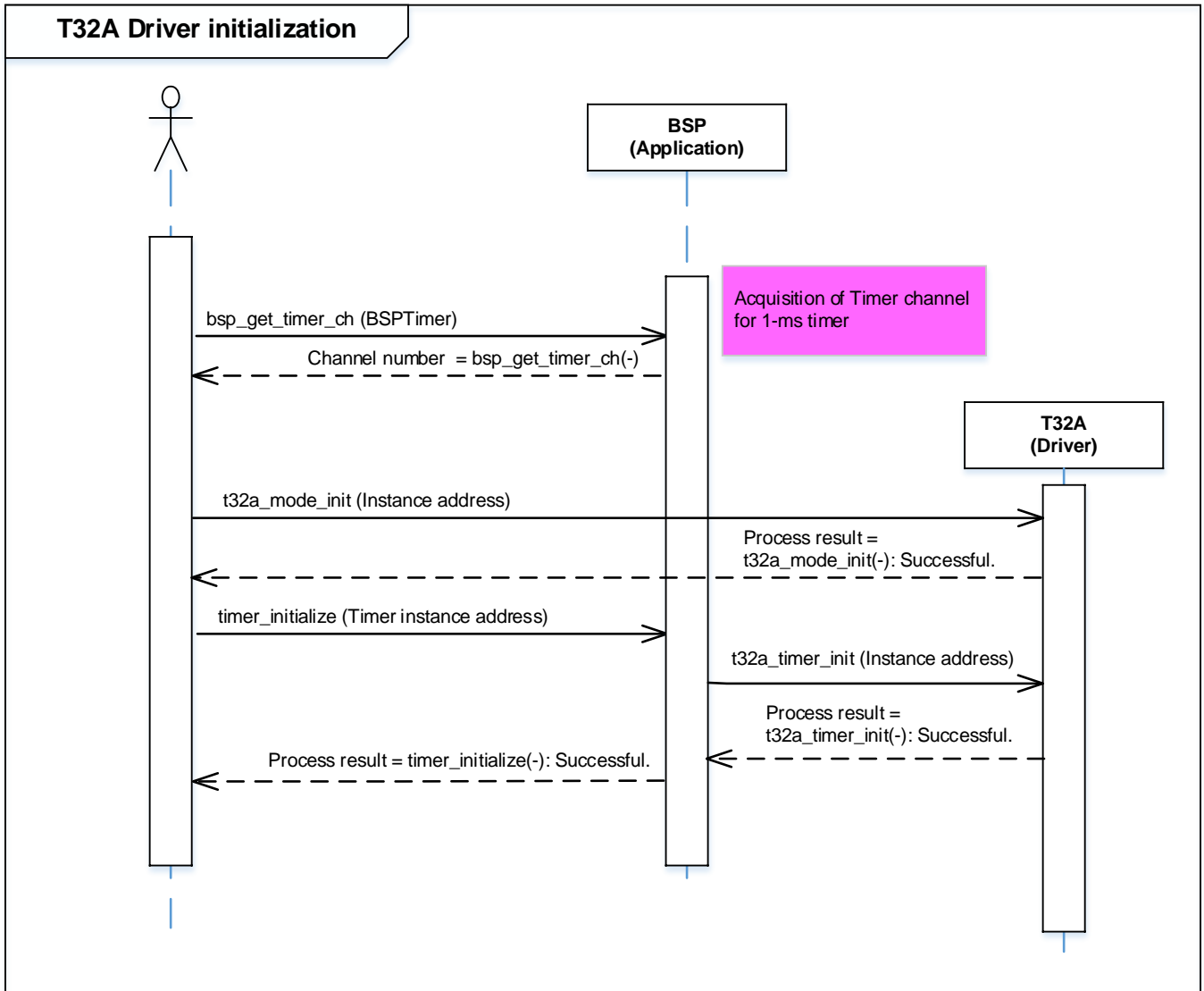
This changes the threshold voltage to 4.4 V and the corresponding LED operation depends on the voltage.

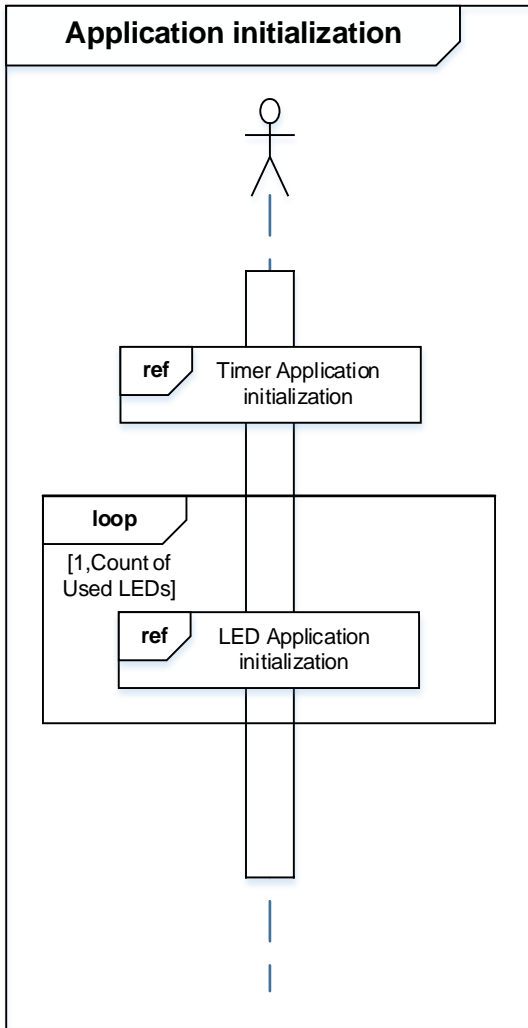
7.5. Operating Flow of Sample Software

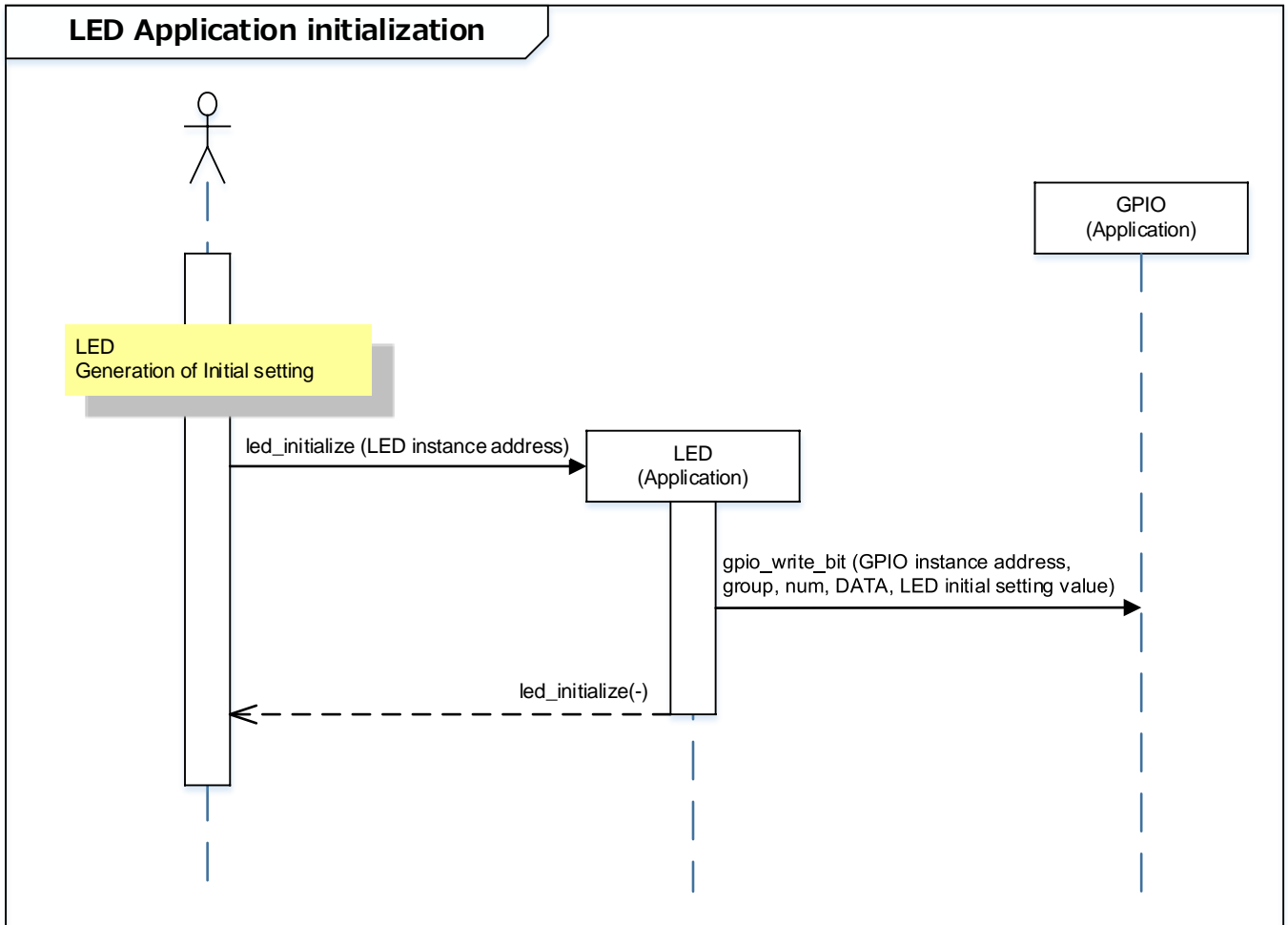
The basic operating flows of the sample program are shown in the following;

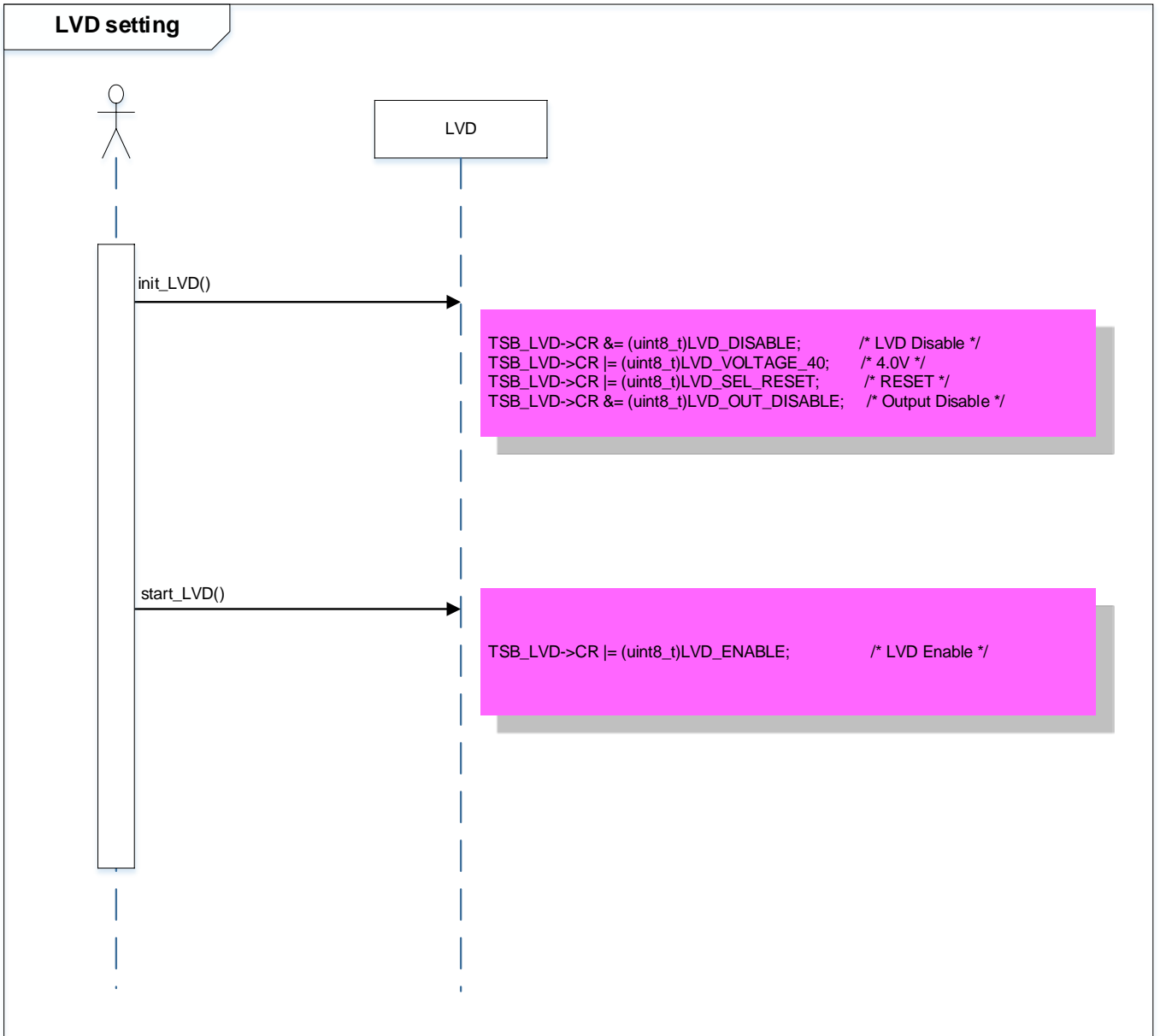


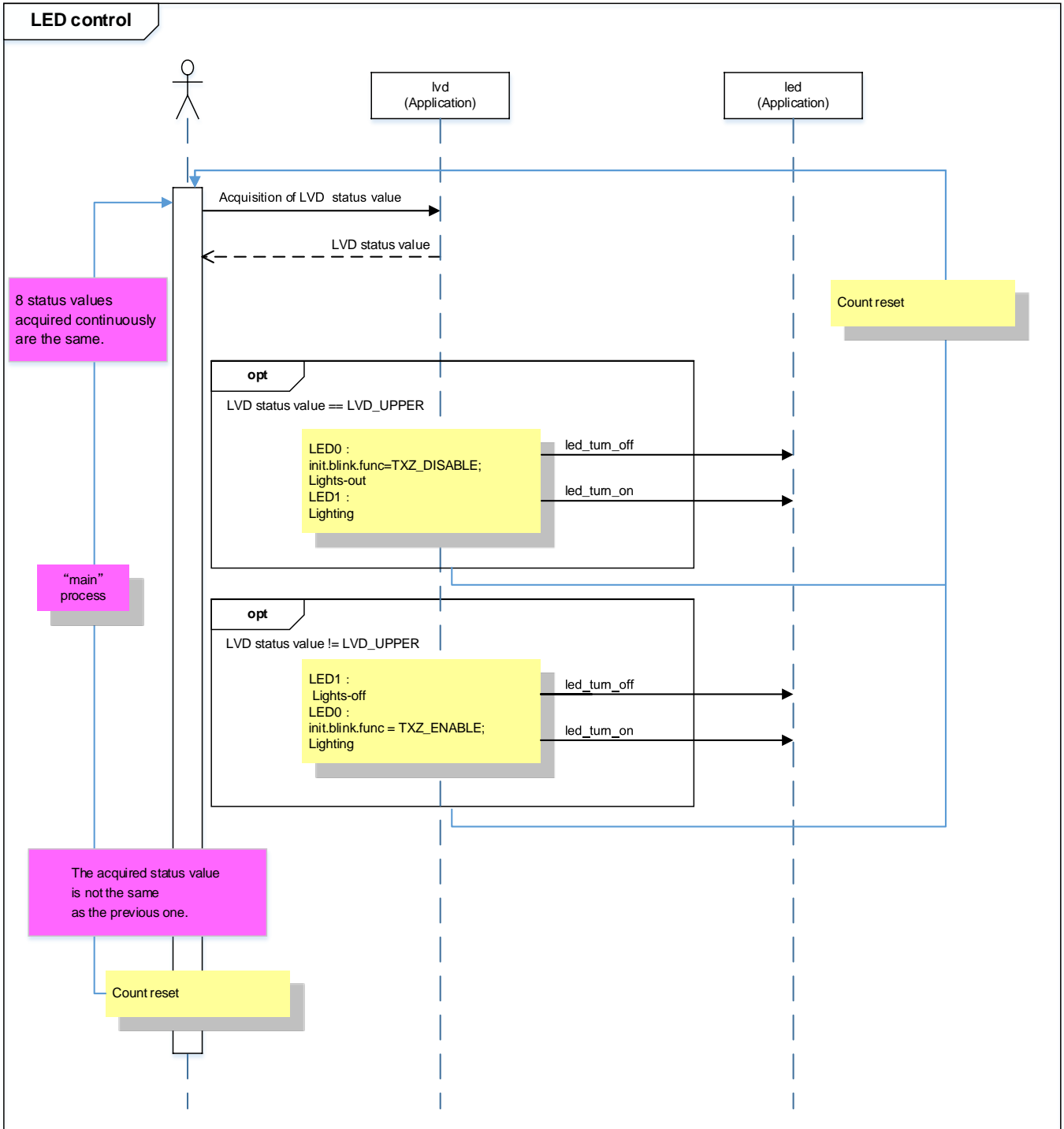












8. Points to Remember on Handling of Sample Programs

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

9. Revision History

Revision	Date	Description
1.0	2019-10-15	First release

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