M3H Group(1)
Application Note
32-bit Timer Event Counter
(T32A-B)
Interval Timer Function

Outlines

This application note is a reference material for developing products using the interval timer function in the 32-bit timer event counter(T32A) function of M3H Group(1).
This document helps the user check operation of the product and develop its program.

Target sample program : Timer_LED

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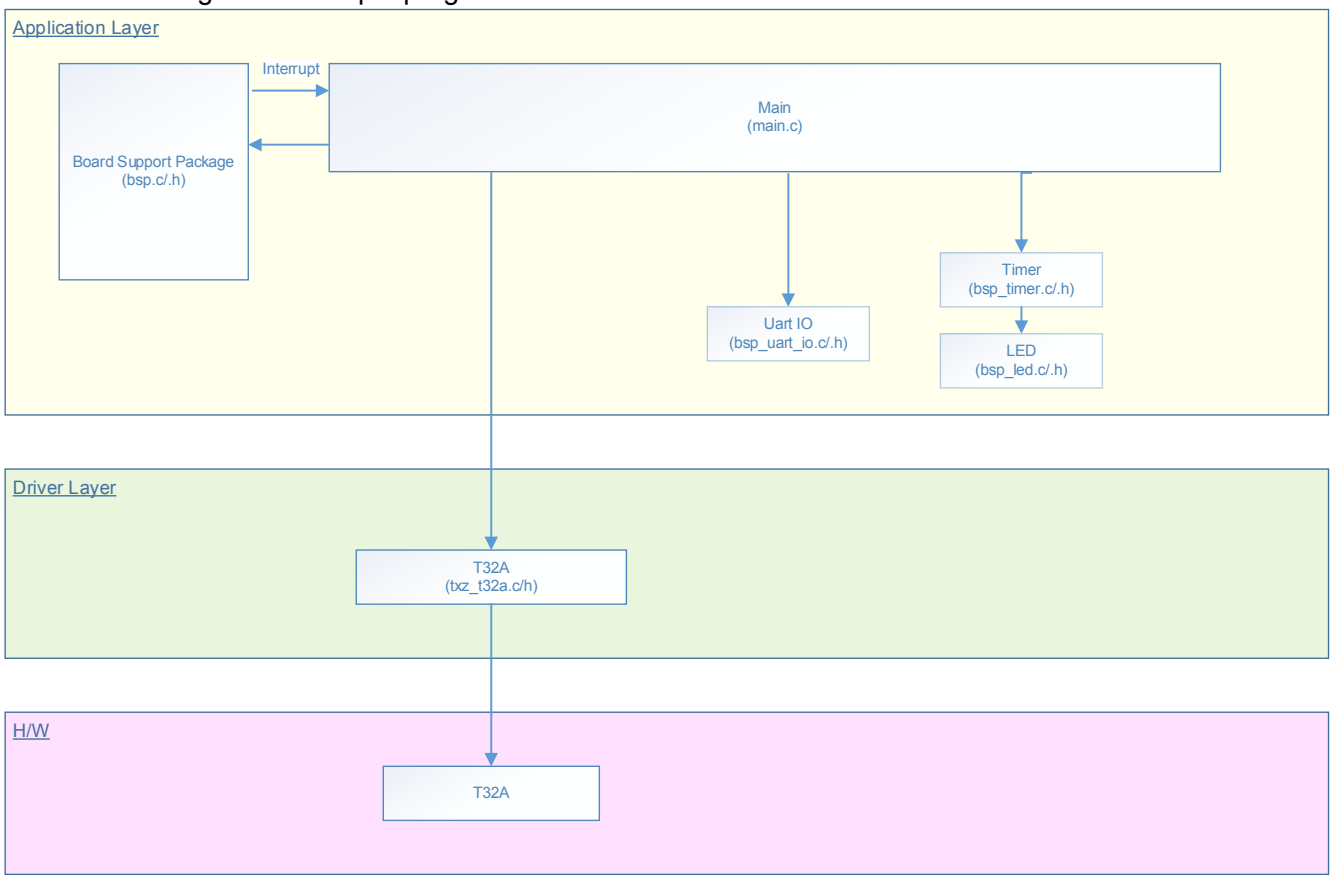
1. Preface

This sample program uses Timer A to control LEDs' lighting.
Lighting and lights-off of an LED can be switched by Push switch.

Structure diagram of Sample program



2. Reference Document

- Datasheet
  TMPM3H group (1) datasheet Rev2.0 (Japanese edition)
- Reference manual
  32-bit timer/event counter (T32A-B) Rev2.1 (Japanese edition)
- Other reference document
  TMPM3H(1) Group Peripheral Driver User Manual (Doxygen)

3. Function to Use

IP	Channel	Port	Function/Operation mode
32-bit timer event counter	Timer A ch0	-	Interval timer
Input or output port	-	PN1 (Input Port) PN2 (Input Port)	Input
	-	PB4 (Output Port) PB5 (Output Port) PB6 (Output Port) PB7 (Output Port)	Output
Asynchronous serial communication circuit	ch0	PA1 (UT0TXDA) PA2 (UT0RXD)	Asynchronous communication with PC

4. Target Device

The target devices of application note are as follows.

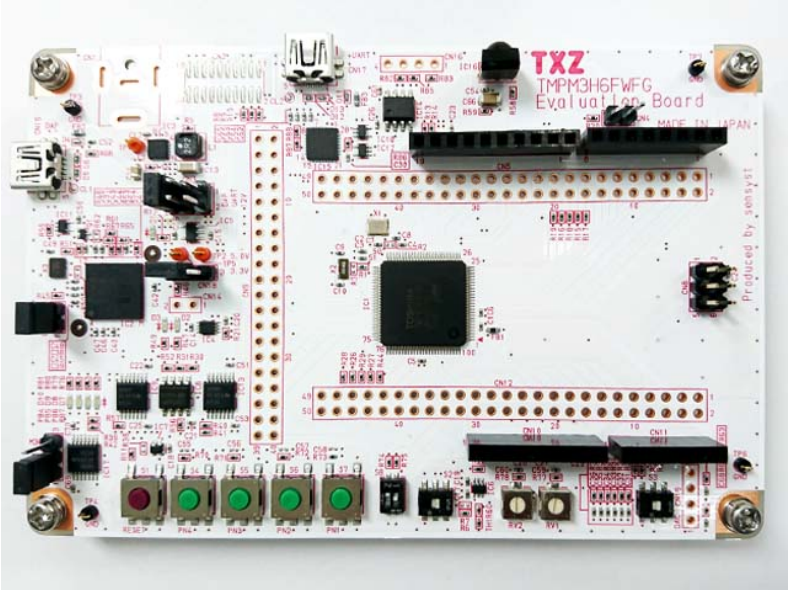
TMPM3H6FWFG	TMPM3H6FUFG	TMPM3H6FSFG
TMPM3H6FWDFG	TMPM3H6FUDFG	TMPM3H6FSDFG
TMPM3H5FWFG	TMPM3H5FUFG	TMPM3H5FSFG
TMPM3H5FWDFG	TMPM3H5FUDFG	TMPM3H5FSDFG
TMPM3H4FWUG	TMPM3H4FUUG	TMPM3H4FSUG
TMPM3H4FWFG	TMPM3H4FUFG	TMPM3H4FSFG
TMPM3H3FWUG	TMPM3H3FUUG	TMPM3H3FSUG
TMPM3H2FWDUG	TMPM3H2FUDUG	TMPM3H2FSDUG
TMPM3H2FWQG	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.

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
Terminal software Tera Term V4.96
Sample program V1100

Evaluation board (TMPM3H6FWFG Evaluation Board) (Top view)



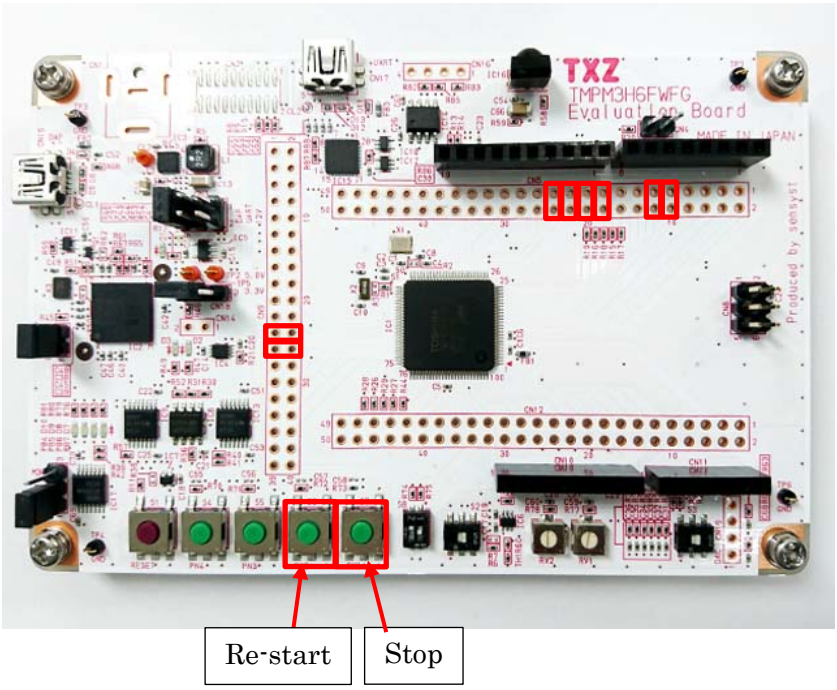
For purchasing the board, refer to the following homepage. (http://www.chip1stop.com/)

6. Evaluation Board Setting

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

CN5		
Use	Through-hole No.	Setting
UART (RXD)	9-10	Connection
UART (TXD)	11-12	Connection
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 (S6)	23-24	Connection
Push SW (S7)	25-26	Connection



7. Operation of Evaluation Board

Push Switch can switch the lighting and the lights-off.

Key	Function
PN1 (S7) SW	LED blink stop
PN2 (S6) SW	LED blink re-start

8. Outline of Timer Event Counter (T32A) function

T32A is composed two 16-bit timer that can be used Timer A and Timer B. Also it can use Timer C that is connected Timer A and Timer B as 32-bit timer. When use Timer C, Timer A and Timer B cannot be used.

The T32A have an interval timer, event counter, input capture, 2-phase counter input, PPG output, Synchronous Start, and Trigger start/stop functions.

The timer has the following functions;
16-bit timer: Timer A and Timer B
32-bit timer: Timer C

9. Sample Program

The sample program uses a timer to cycle on and off the LED every second.
The stop and re-start of the function are controlled by the Push Switch.

9.1. Initialization

The following initialization is done after power is supplied.
The PORT setting is executed after the initialization of each clock setting and the clock setting.
The main operation of the sample program is done after every initialization completes.

9.2. Sample program main operation

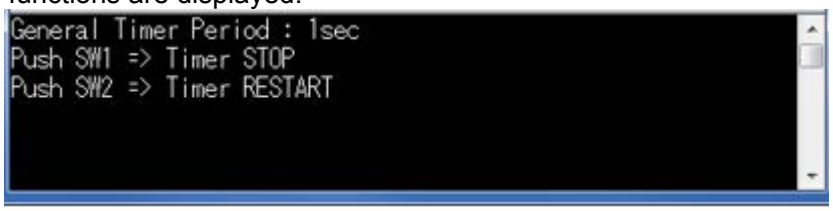
The timer settings in this sample program should be done.
The ch0 of Timer A is used.
UART ch0 setting and LED setting should be done.
The corresponding port of a used LED should be set, and the lighting time is set to the timer.
This sample program assigns PB4 to PB7 to OUTPUT for LED lighting.
The setting value in the timer for the lighting and lights-off times are predetermined as 1-ms, respectively, which is defined as the following;

```
p_timer->init.interval = 1000
```

The lighting time has been set precisely as the followings;
Timer A generates 1-ms interval.
After 1000 times of the 1-ms interval are counted, the LED is lit.
In this manner, 1-second intervals for the lighting and the lights-off are generated, respectively.
The timer operation starts after every setting completes.

9.3. Output Example of Sample Program

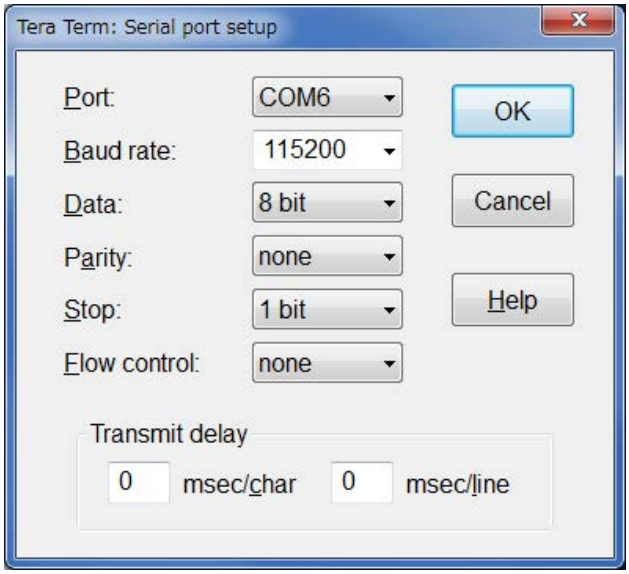
After the sample program starts to operate, LED blink interval and the definition of the Push Switch functions are displayed.

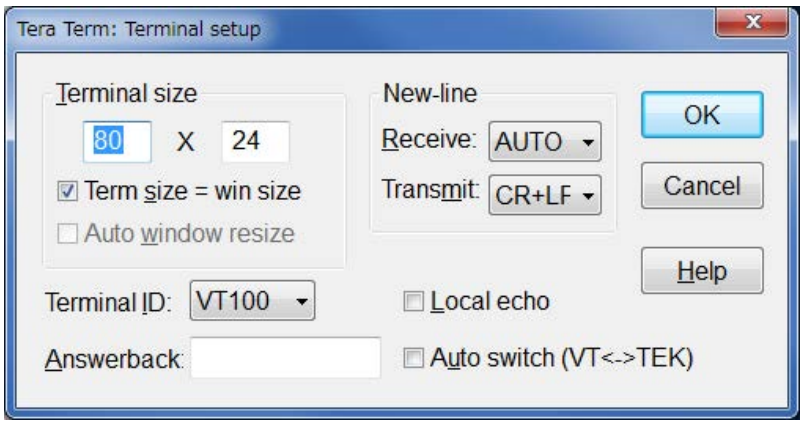


The displayed image has been specified by “printf”.
If “General Timer Period” is changed, the real setting time is different from the displayed data.

9.3.1. Setting Example of Terminal Software

The operation of the terminal software (Tera Term) has been checked with the following settings.





9.4. Timer setting change

The change of the timer setting time can be done as the followings.
Timer data change
Count-up count change

Timer data change
“static TXZ_Result driver_initialize(void)” in “main” function is used to set.
p_timer->init.interval = 1000
The above sets 1 ms.
If “1000 (1 µs*1000)” is changed, the blink time is modified.

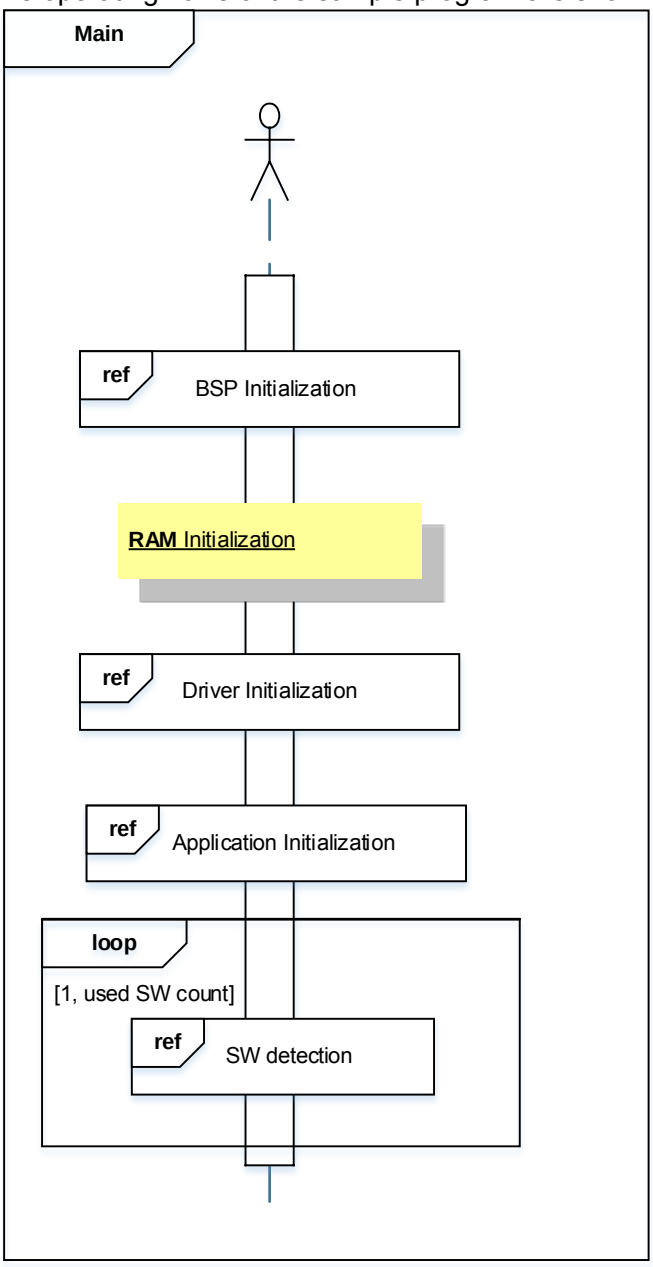
Count-up count change
“static void timer_interval_handler(uint32_t id)” in “main” function is used to set.

```
if(count < 1000) {      /* 1ms * 1000 = 1sec LED on */
        count++;
        on = 1;
    }else if((count >= 1000) && (count < 2000)){    /* 1ms * 1000 = 1sec LED off */
        count++;
        on = 0;
```

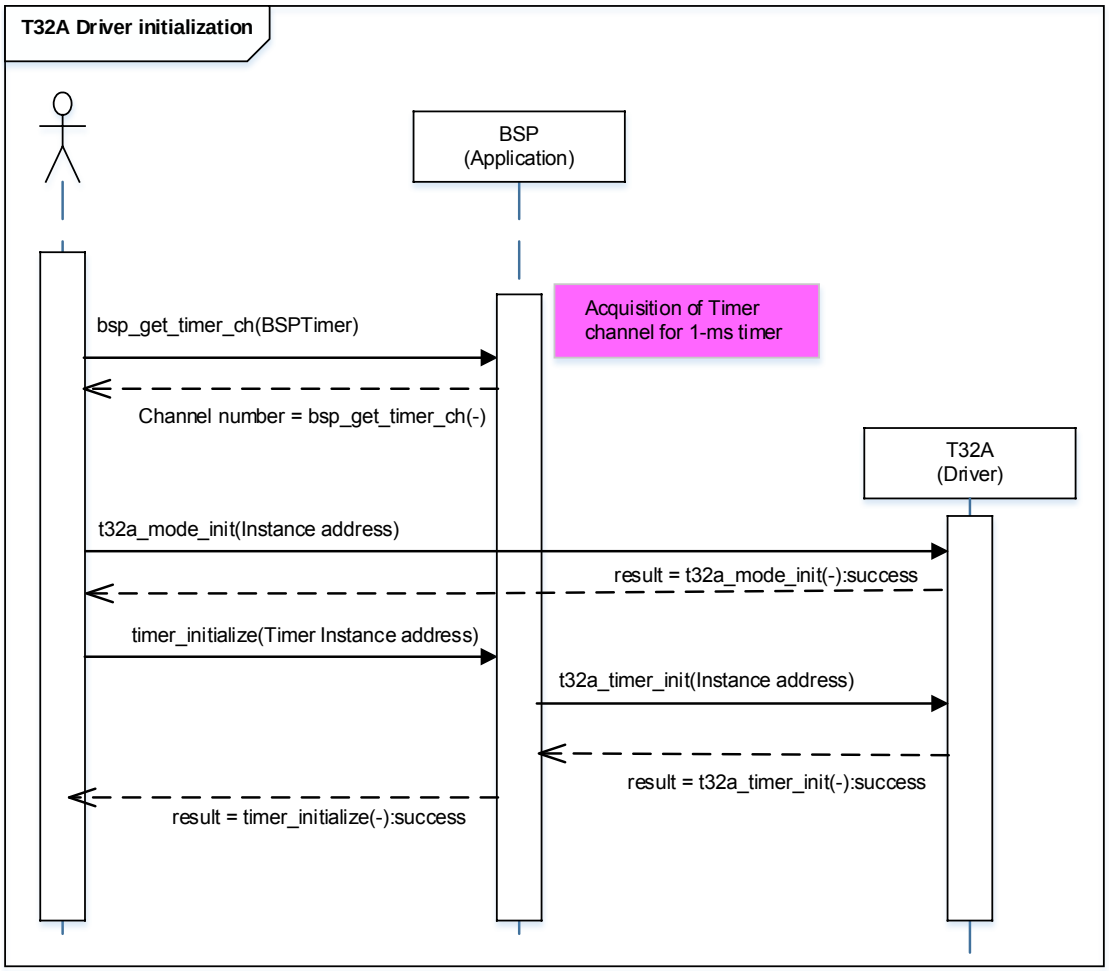
If the count value above is changed, the blink time is modified.

9.5. Operating Flow of Sample Program

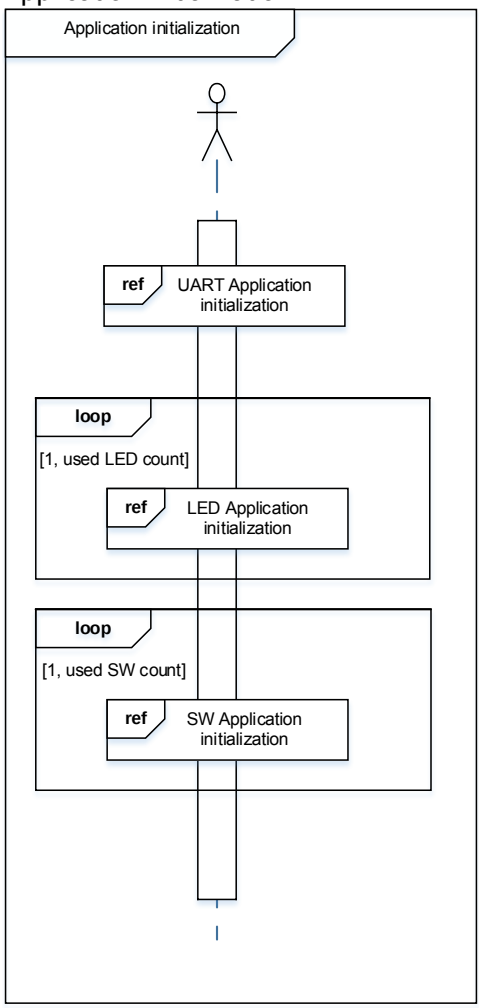
The operating flows of the sample program are shown as follows.

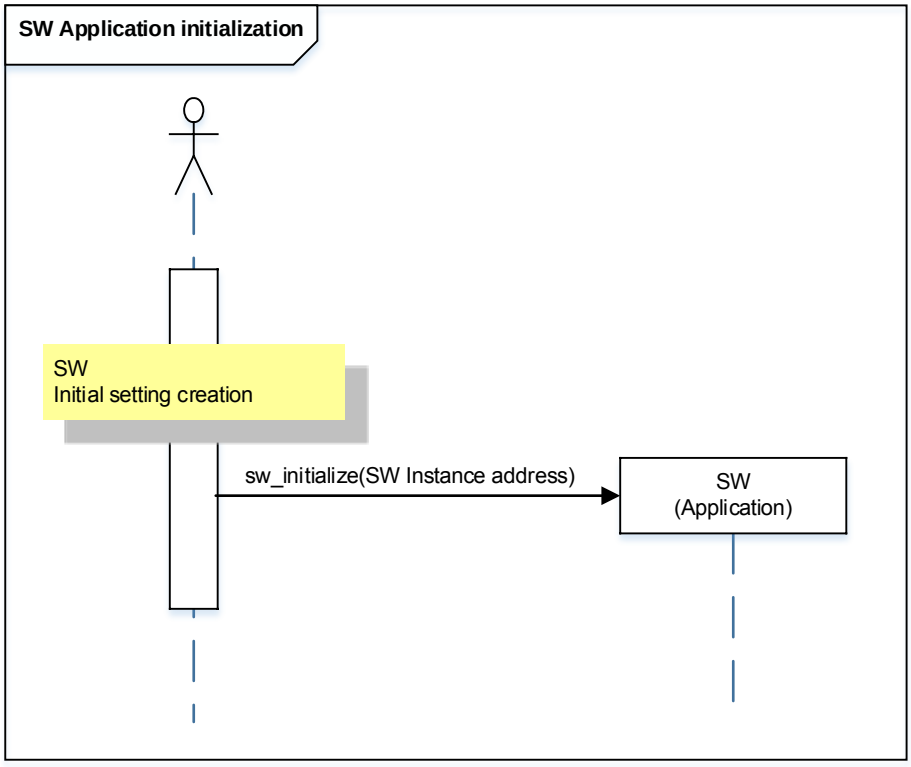


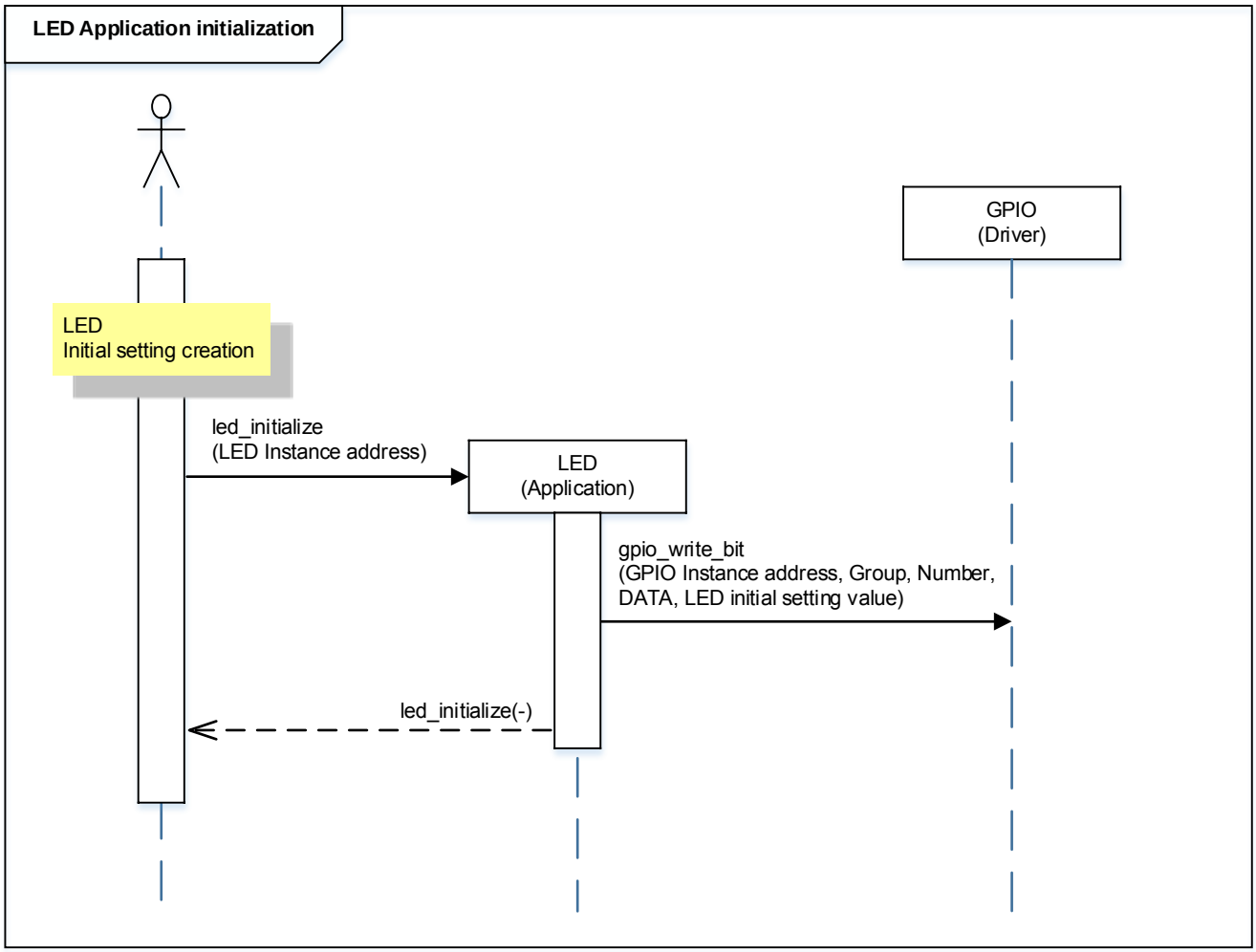
Driver initialization



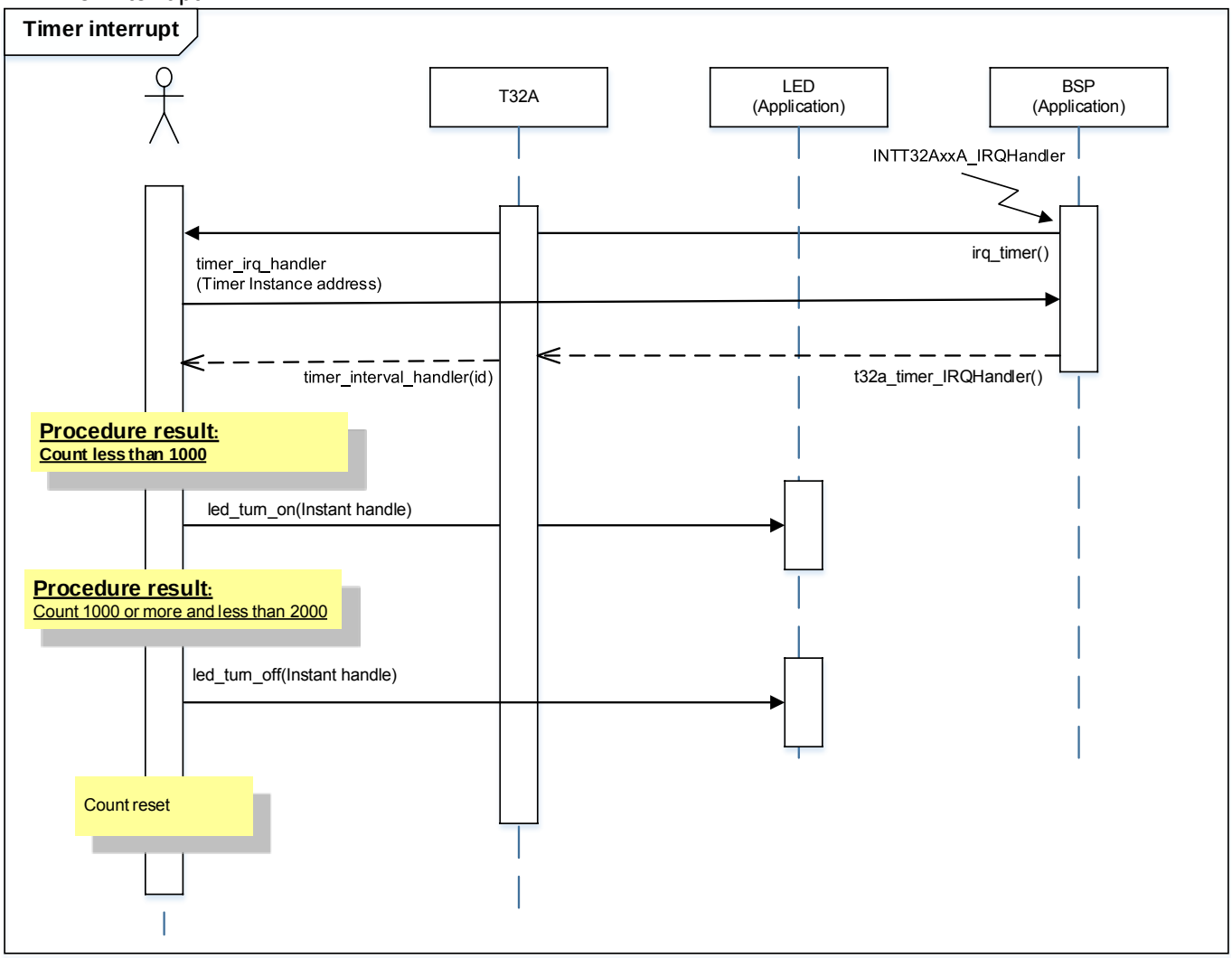
Application initialization



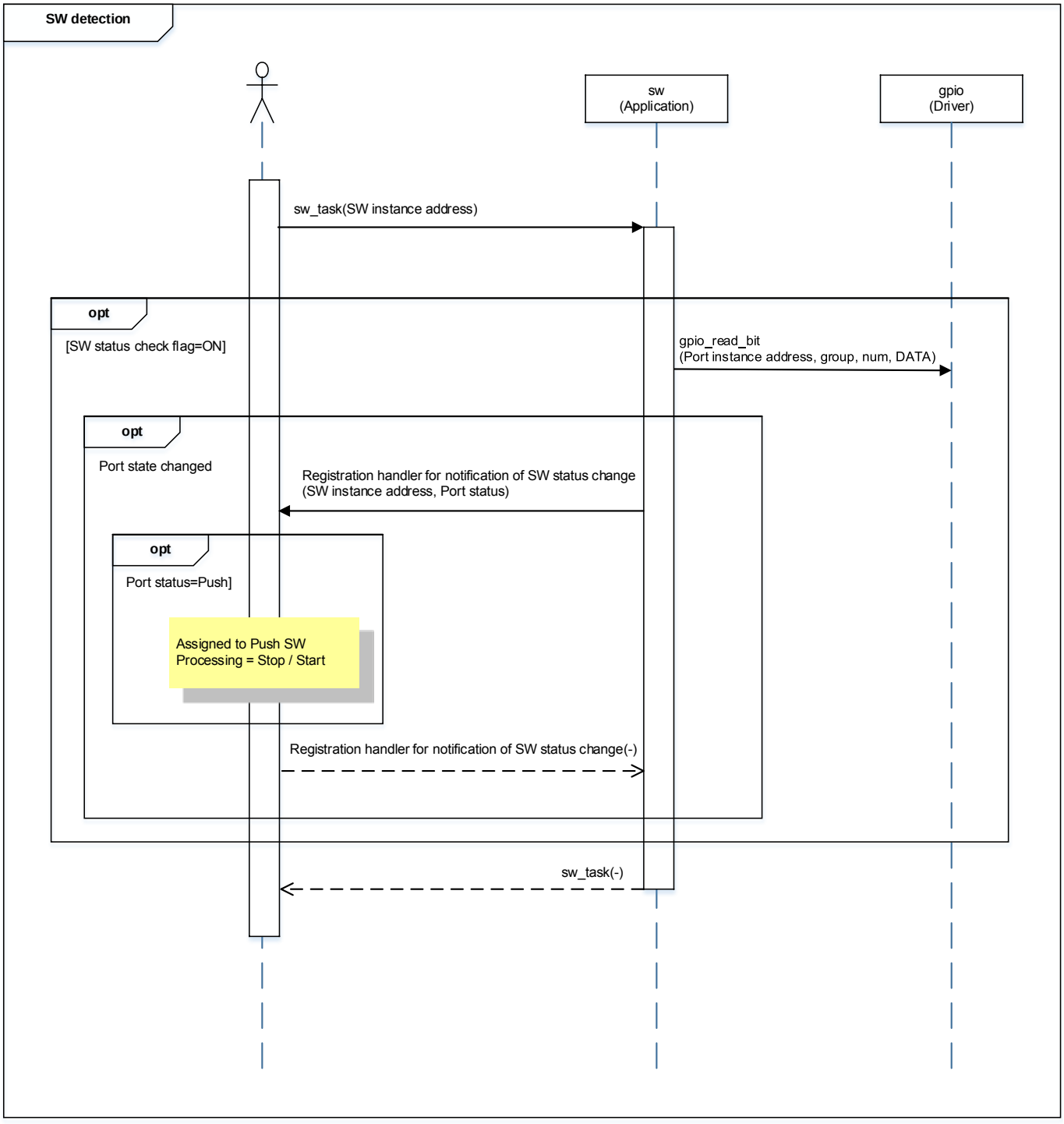



LED Application initialization
GPIO
(Driver)
LED
Initial setting creation
led_initialize
(LED Instance address)
LED
(Application)
gpio_write_bit
(GPIO Instance address, Group, Number,
DATA, LED initial setting value)
led_initialize(-)

Timer interrupt



SW detection



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	2018-03-08	-	First release

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