

**M3H Group(1)**  
**Application Note**  
**Remote Control Signal Preprocessor**  
**(RMC-A)**

**Outlines**

This application note is a reference material for developing products using remote control signal processor (RMC) function of M3H Group(1).

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

Target sample program: RMC\_UART

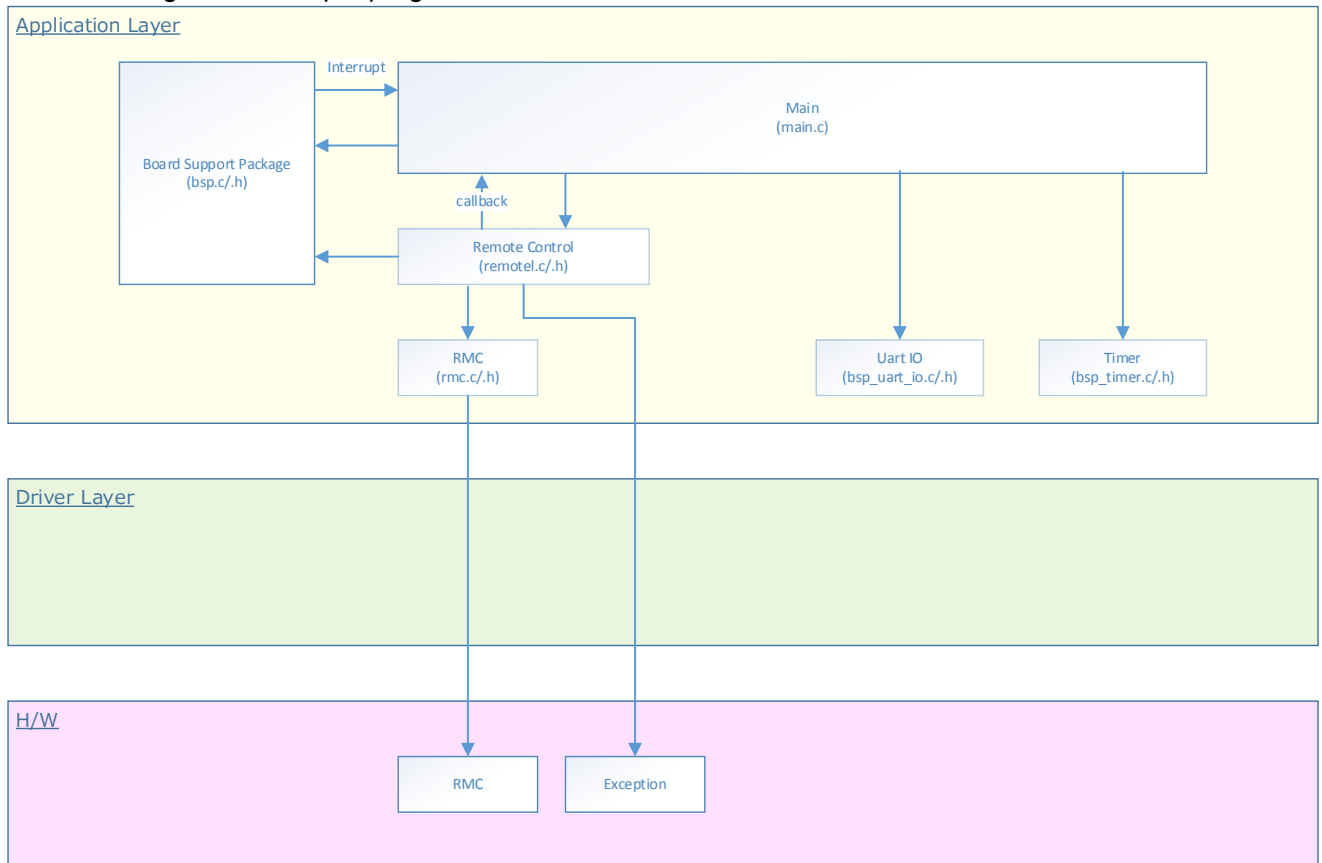
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### 1. Preface

This sample program receives the remote control signal whose carrier wave is removed, using the remote control signal preprocessor (RMC).  
The received signal is displayed on the terminal software.

#### Structure diagram of Sample program



## 2. Reference Document

- Datasheet  
    TMPM3H group (1) datasheet Rev2.0 (Japanese edition)
- Reference manual  
    Remote Control Signal Preprocessor (RMC-A) Rev2.0 (Japanese edition)
- Other reference document  
    TMPM3H(1) Group Peripheral Driver User Manual (Doxygen)

## 3. Function to Use

IP	channel	port	Function / operation mode
Remote Control Signal Preprocessor	-	PB1 (RXIN0)	Circuit to receive the remote control signal
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.

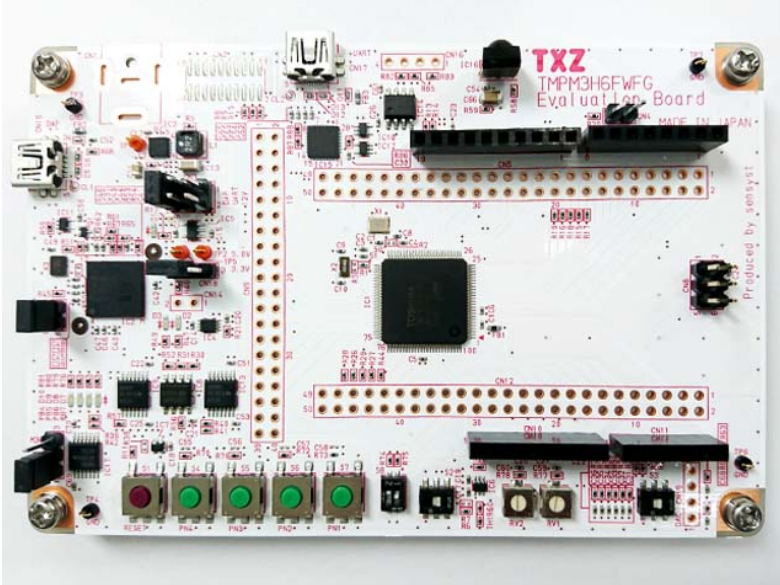
If other function than the TMPM3H6 one is checked, it is necessary that CMSIS Core related files (C startup file and IO header file) should be changed properly.

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    TPM3H6FWFG  
Used board                TPM3H6FWFG Evaluation Board (Product of Sensyset)  
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 (TPM3H6FWFG Evaluation Board) (Top view)

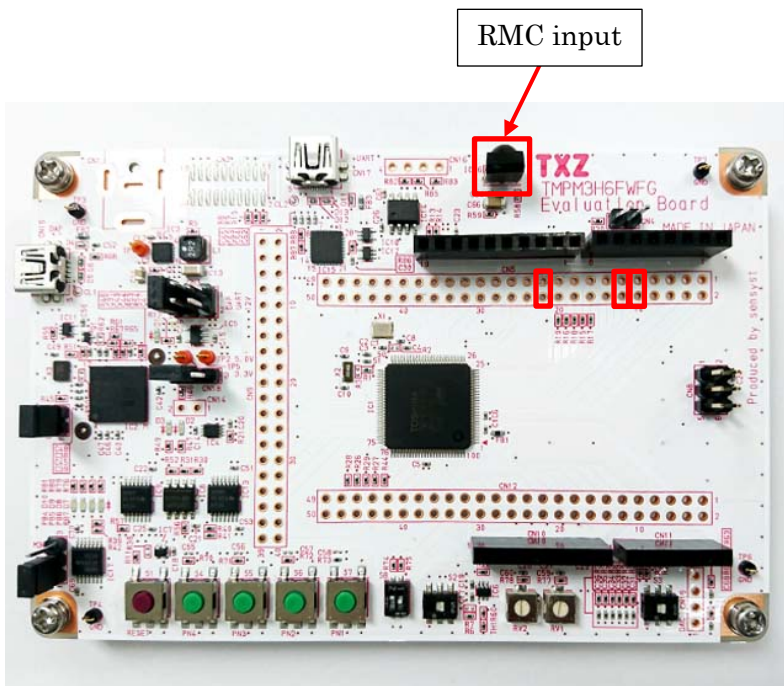


For purchasing the board, refer to the following homepage. (<http://www.chip1stop.com/>)

## 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
RMC input (IC16)	21-22	Connection



## 7. Operation of Evaluation Board

RMC: The remote control signal should be input to PB1.  
The input signal is output to the terminal software (Tera Term).

The reception format is compatible with NEC format or AEHA (Association for Electric Home Appliances) format.

## 8. Outline of RMC function

Remote control signal preprocessor (hereafter referred to as RMC) receives a remote control signal of which carrier is removed. Please refer to a bottom for the list of functions.

Function category	Function	Operation
The reception of the remote control signal	Sampling clock	A sampling clock can be selected from either low frequency clock (32.768kHz) or Timer output.
	Noise filter	Noise canceling time can be adjusted. (15 phases)
	Leader detection	Detection is possible at the cycle of a reader, and a setup of Low width. >Without the leader in a state of the leader waiting. >Begin in leaders only for Low width. >Fixed phase method in a period.
	Data reception	A maximum of 72 bits of reception are possible. >Two kinds of data bit 0/1 judgments allow. (1) Judgment by the threshold setting. (2) Judgment by the falling edge interrupt.
	Interrupt	Generating of each remote control interruption(INTRMCx) is controllable. > Leader detection interrupt. > Falling edge interrupt. > Maximum data bit cycle interrupt. > Low width detection interrupt

### 8.1. Reception of Remote Control Signal

The sampling of remote control signal is performed by the low speed clock (fs: 32.768 kHz.) or timer output (TBxOUT).

As for the signal input by RXINx, a signal performed noise reduction of through a noise filter circuit is input into a reception control circuit.

## 9. Sample Program

The 16-bit custom code, the 8-bit data code, and the reversed 8-bit data code which are received by RMC are transferred to the terminal software through USB-UART interface.

This sample program will receive in NEC format and AEHA (Association for Electric Home Appliances) format.

### 9.1. Initialization

The following initialization is done after power is supplied.

The GPIO setting is executed after the initialization of each clock setting, the watchdog timer setting and the clock setting.

### 9.2. Sample program main operation

The driver is initialized.

UART settings are done.

The remote controller settings are done. The low-speed clock is used in this sample program.

The main procedure is executed after every setting completes.

The remote control circuit starts to operate. It receives remote control signals and transfers the reception result to the terminal software.

In this sample program, the format of the reception result is as follows;

Custom Code (16 bits) + Data Code (16 bits)

Remote control receiver	RPM7138-R
Port of TMPM3H6	PB1:RXINO



### 9.3. Output Example of Sample Program

The following example is that the result of the data reception from the remote controller is transferred to the terminal software.

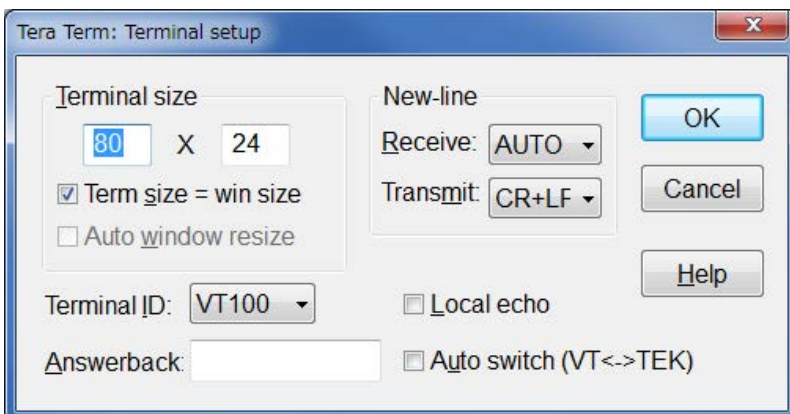
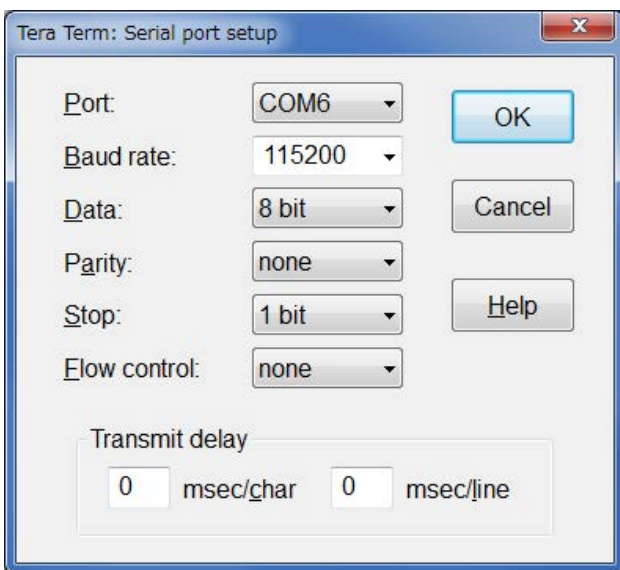
Custom Code (Customer Code) and Data Code are displayed



```
Customer Code
=>00000010:0x02
=>11111101:0xFD
Data Code
=>00100000:0x20
=>11011111:0xDF
```

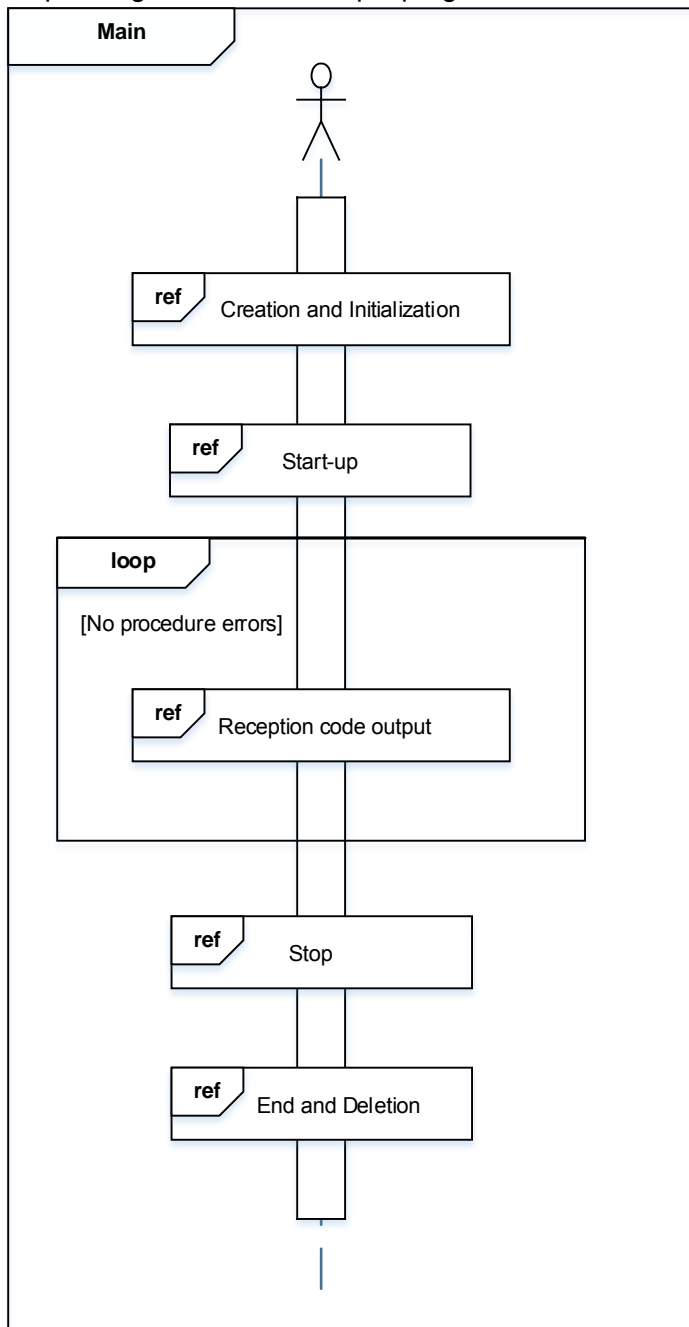
#### 9.3.1. Setting Example of Terminal Software

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

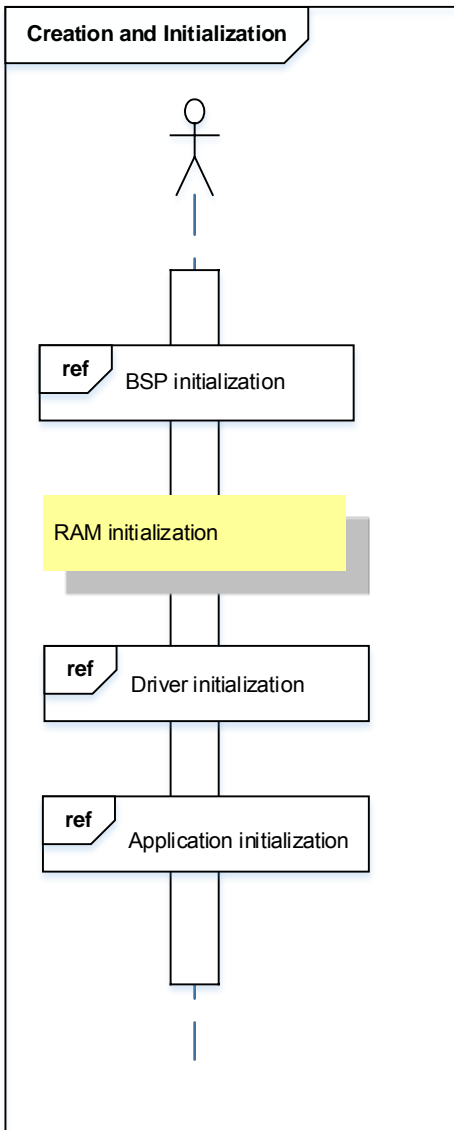


### 9.4. Operating Flow of Sample Program

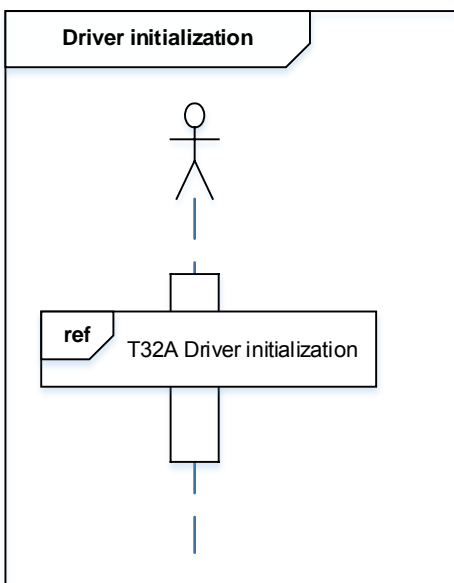
The operating flows of the sample program are shown as follows.



### Initialization

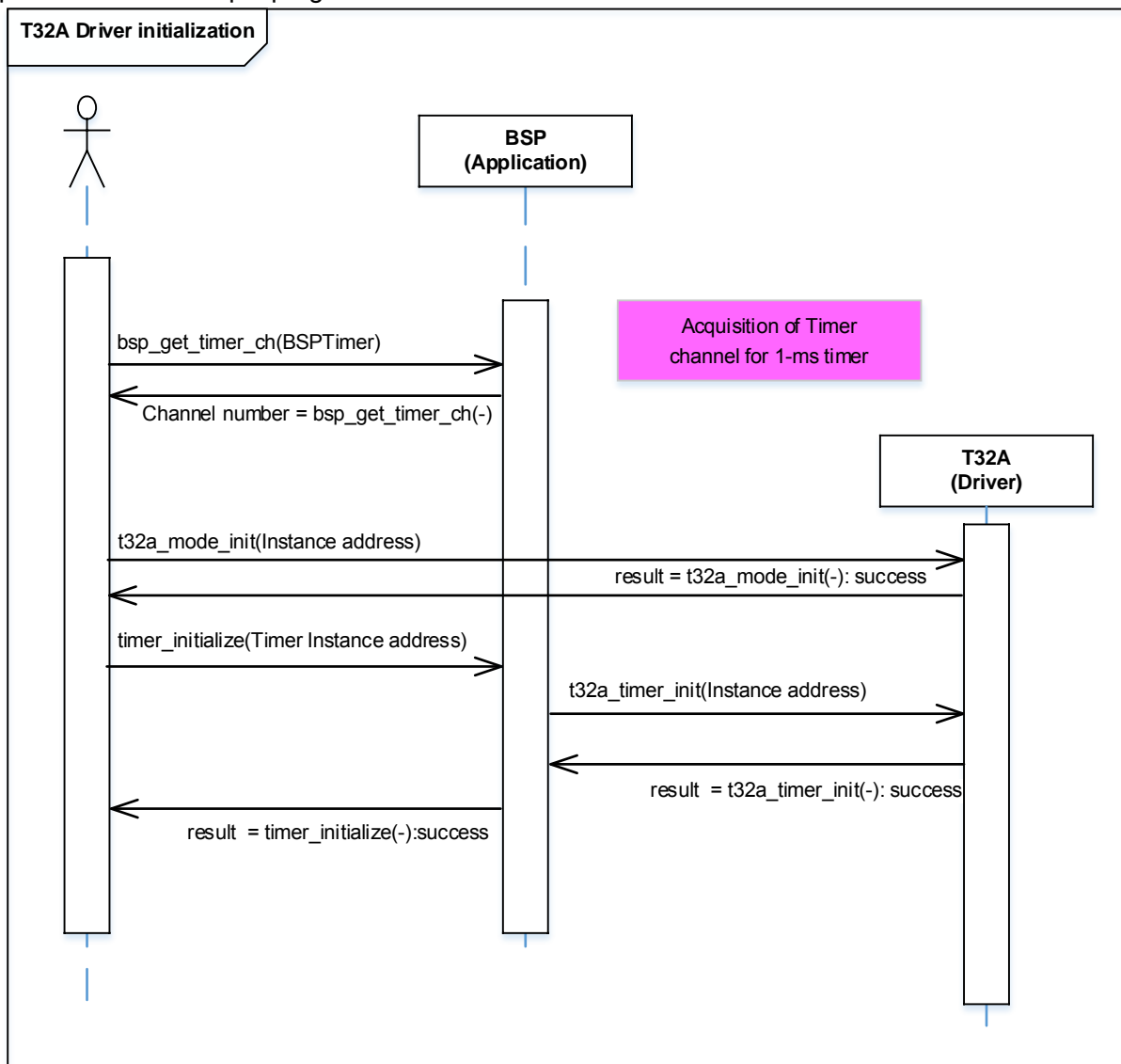


### Driver initialization

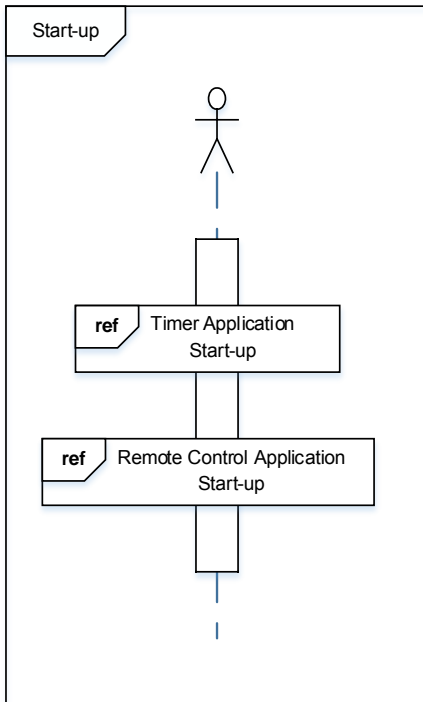


### T32A Driver initialization

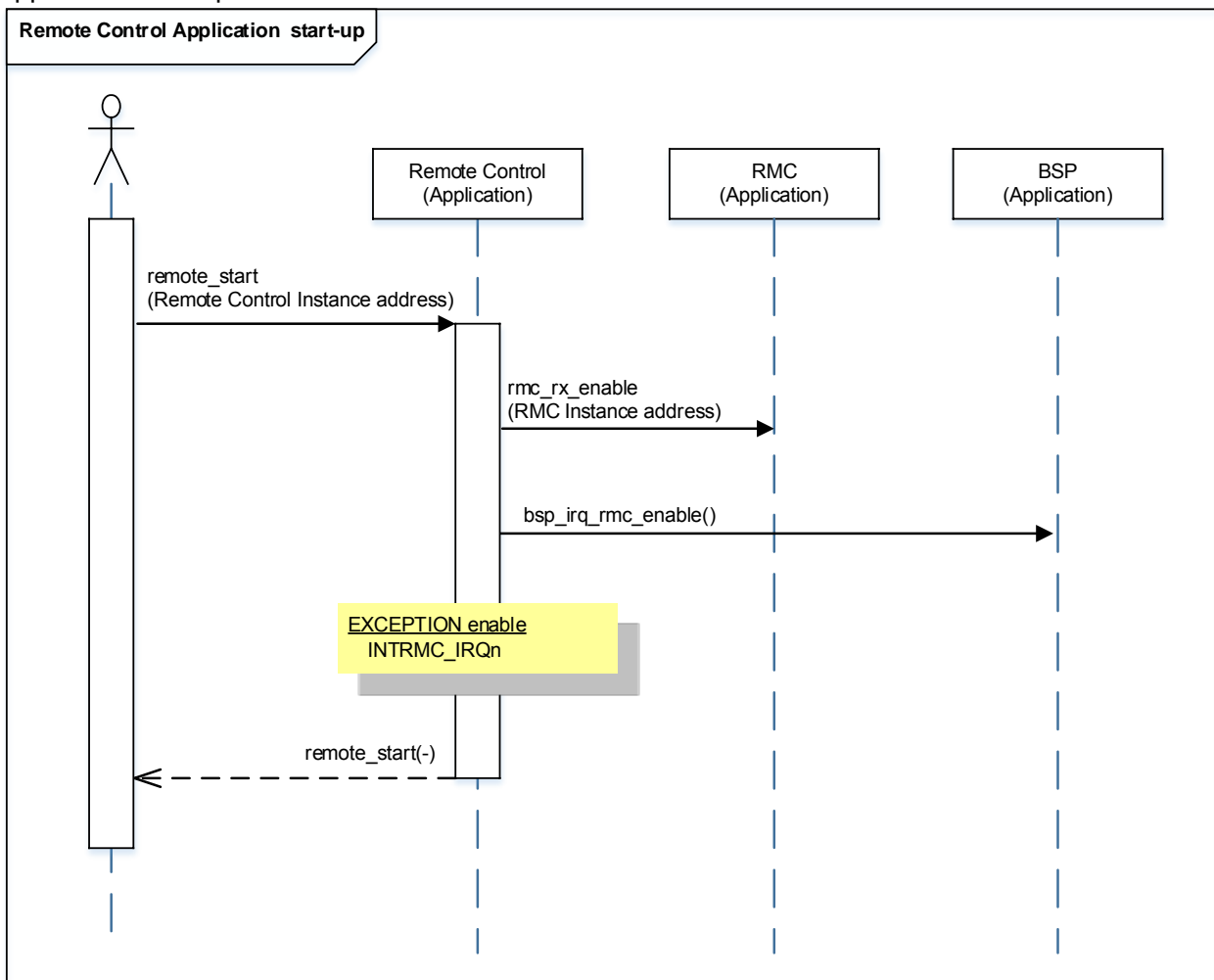
Although initialization setting of 32-bit timer event counter of TMPM3H is done, it is not used in actual operation of this sample program.



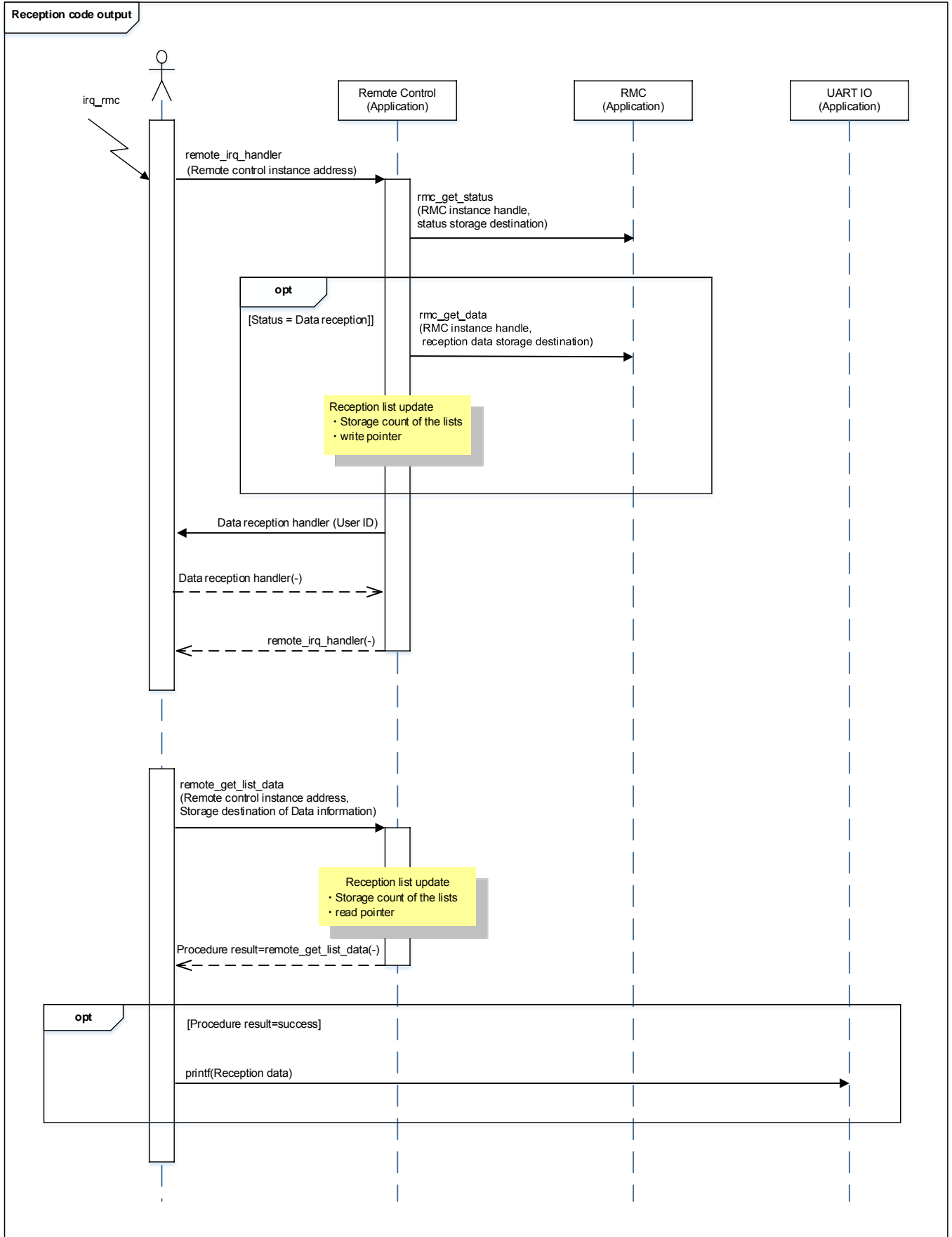
### Start-up



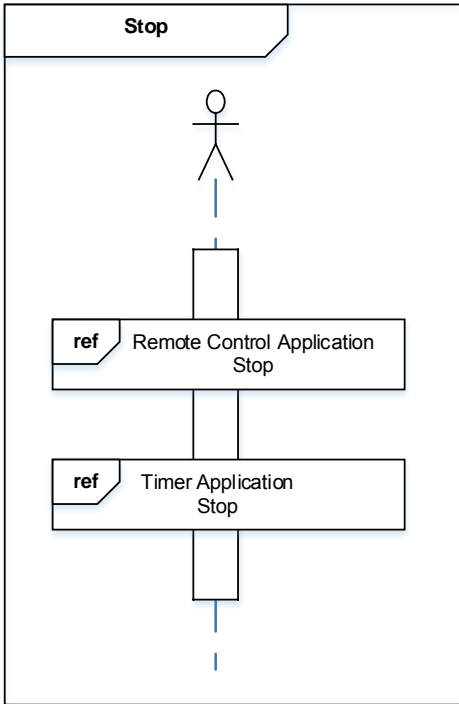
### Application start-up



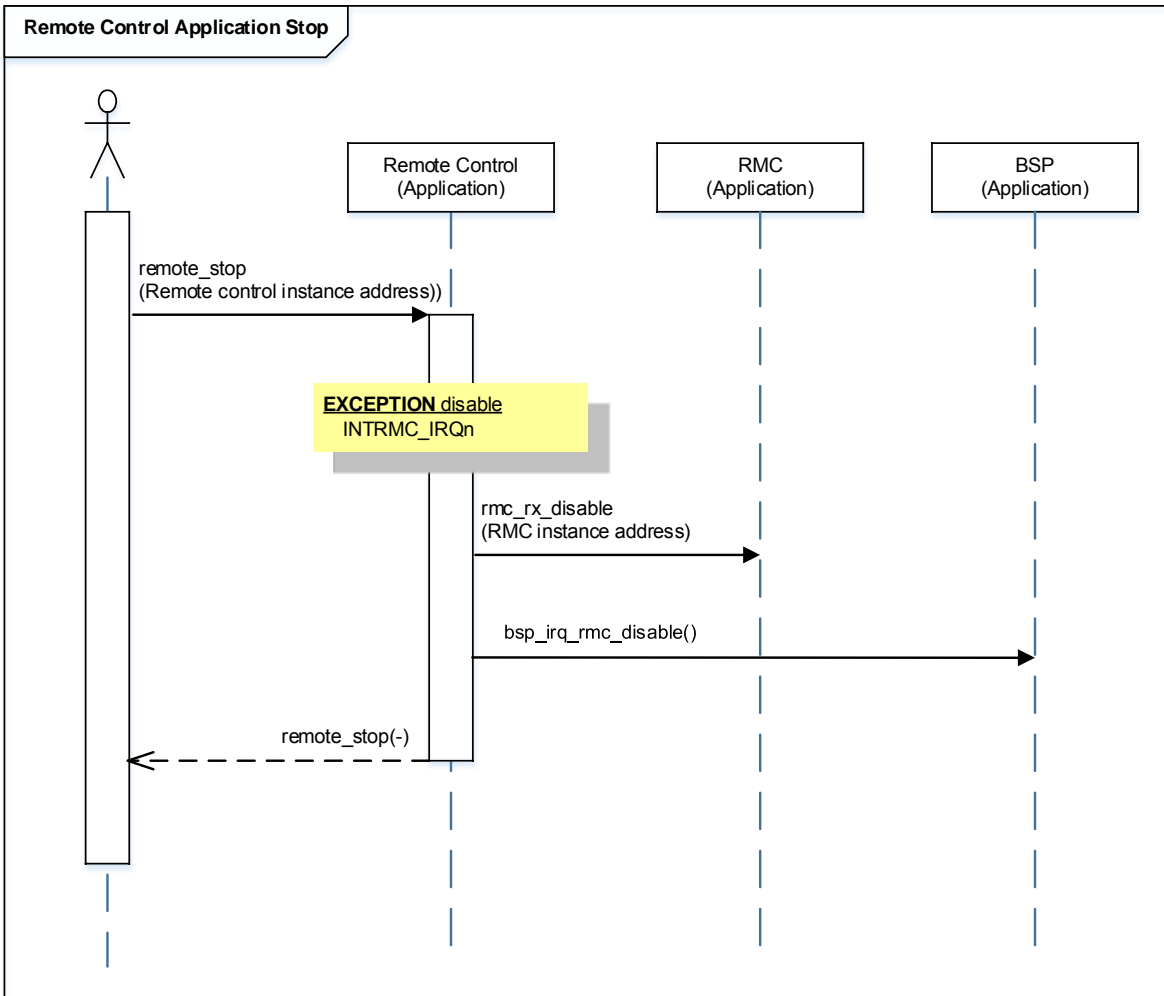
### Reception code output



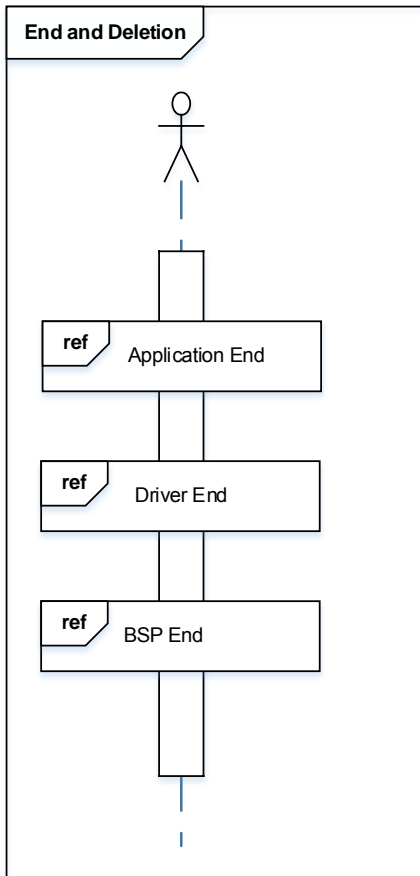
## Stop



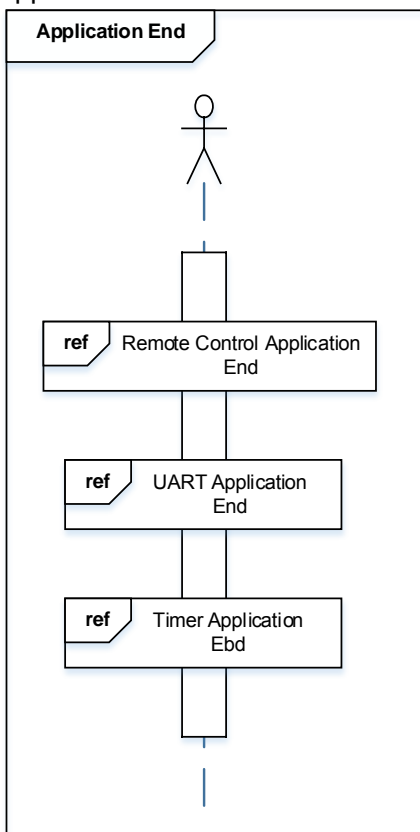
## Application stop



End

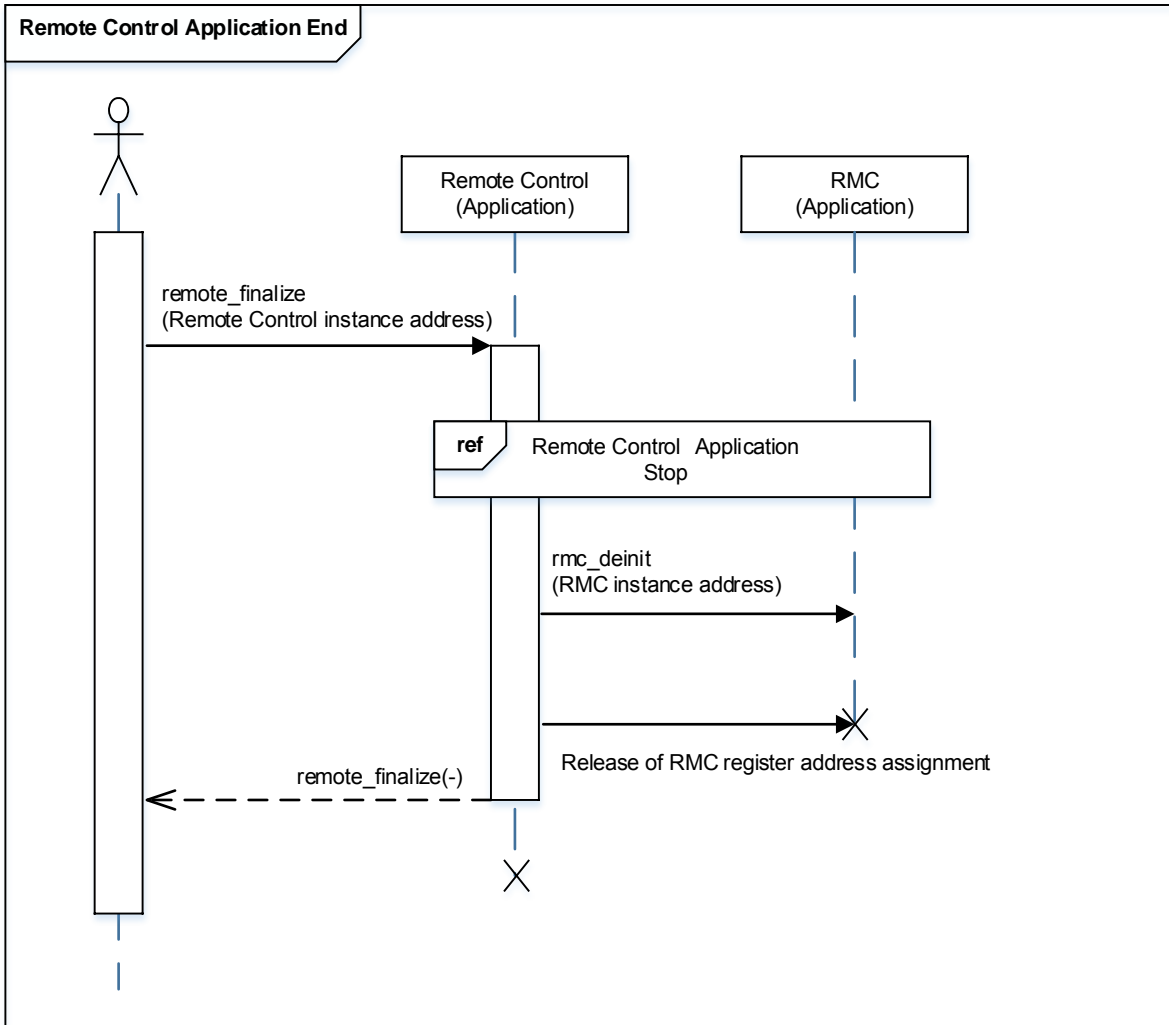


Application end

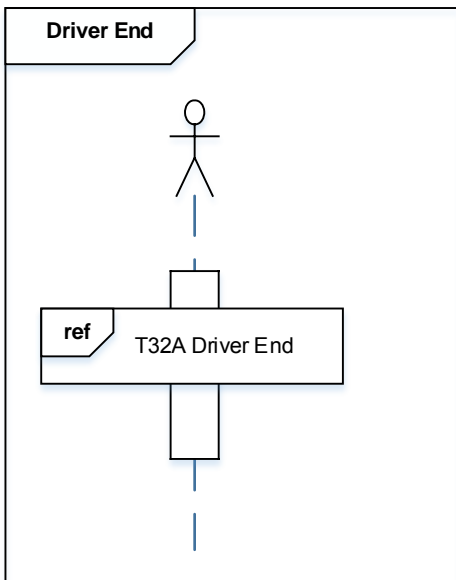




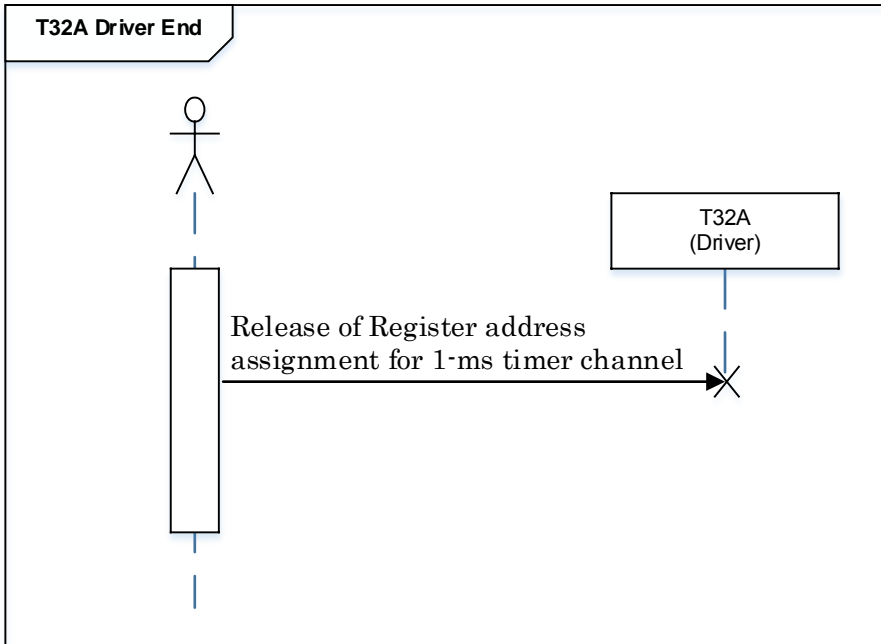
### Remote control application end



### Driver end



### T32A Driver end



## 10. Precaution

When using the sample program with CPU other than TPM3H6, please check operation sufficiently.

## 11. Revision History

Rev	Date	Page	Description
1.0	2018-03-09	-	First release

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