

M3H Group(1)
Application Note
Asynchronous Serial
Communication Circuit
(UART-C)
DMA

Outlines

This application note is a reference material for developing products using the asynchronous serial communication circuit (UART with DMA) functions of M3H Group(1).
This document helps the user check operation of the product and develop its program.

Target sample program: UART_Echo_DMA

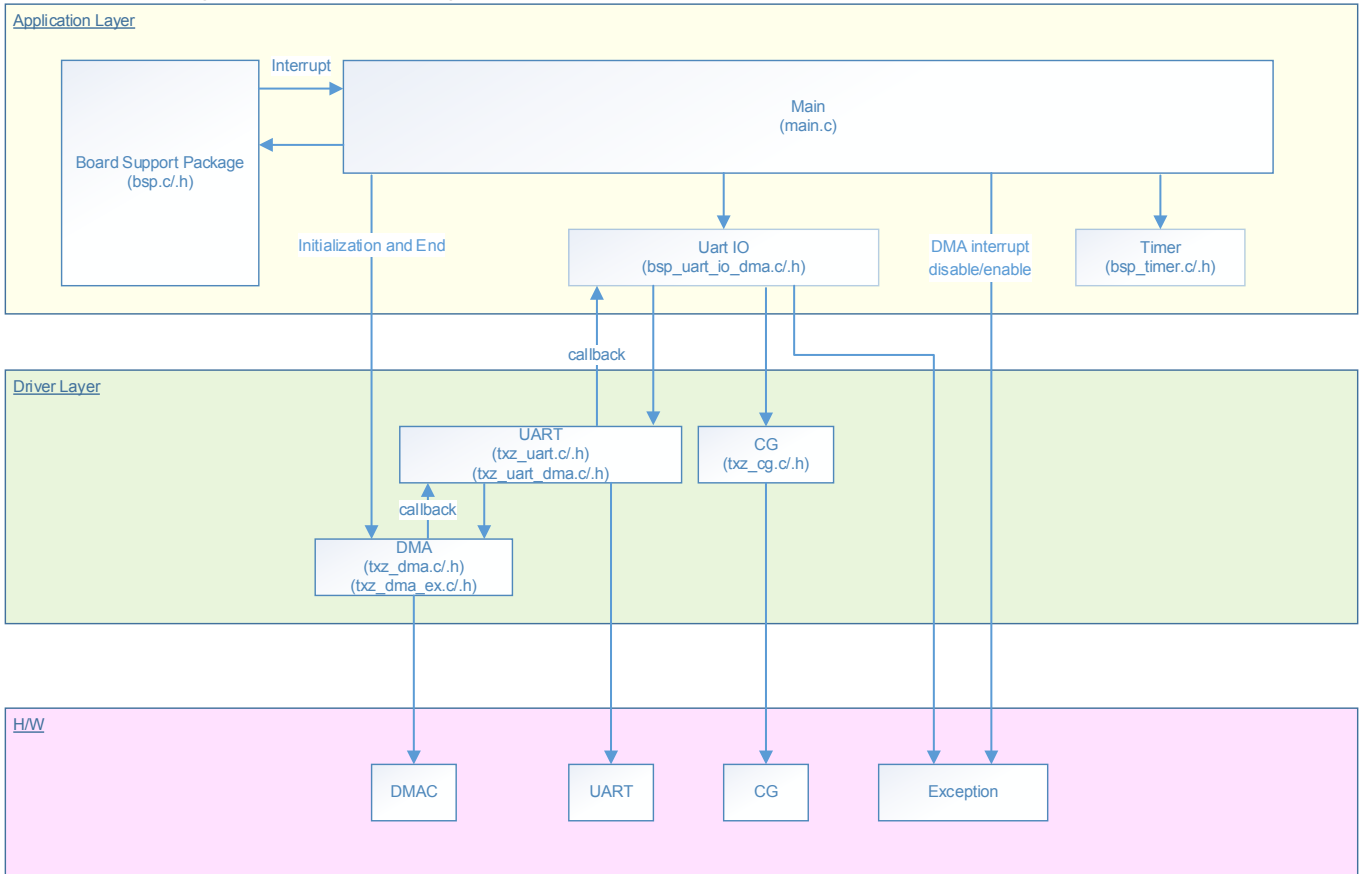
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1. Preface

This sample program is used to check the operation of the function of the UART communication with DMA. A command is input on the PC terminal and the echo-back of the command is done through the USB-UART interface.

Structure diagram of Sample program



2. Reference Document

- Datasheet
 TMPM3H group (1) datasheet Rev2.0 (Japanese edition)
- Reference manual
 Asynchronous serial communication circuit (UART-C) Rev2.0 (Japanese edition)
 DMA controller (DMAC-B) Rev1.2 (Japanese edition)
 Product Information (PINFO-M3H(1)) 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
Asynchronous communication	ch0	PA1 (UT0TXDA) PA2 (UT0RXD)	UART mode
DMAC	ch10 ch11	-	Single normal transfer

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

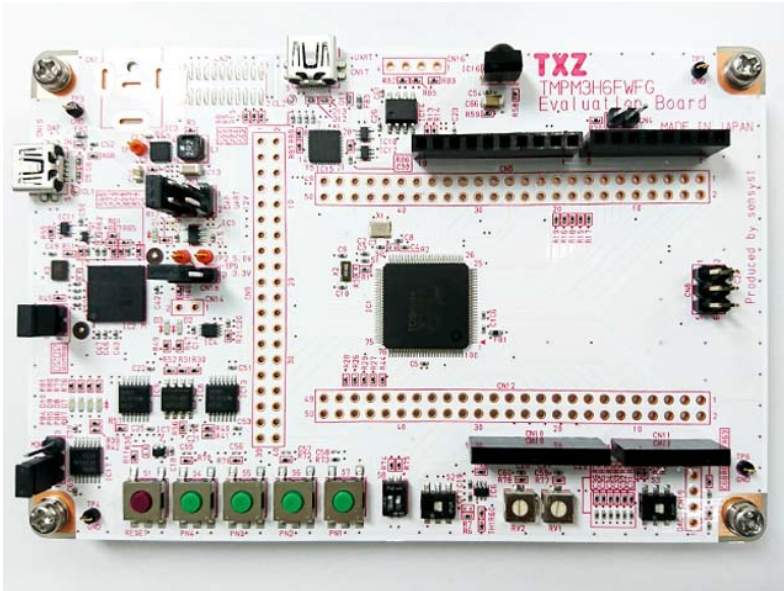
* This sample program operates on the evaluation board of TMPM3H6FWFG.

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 Sensystr)
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

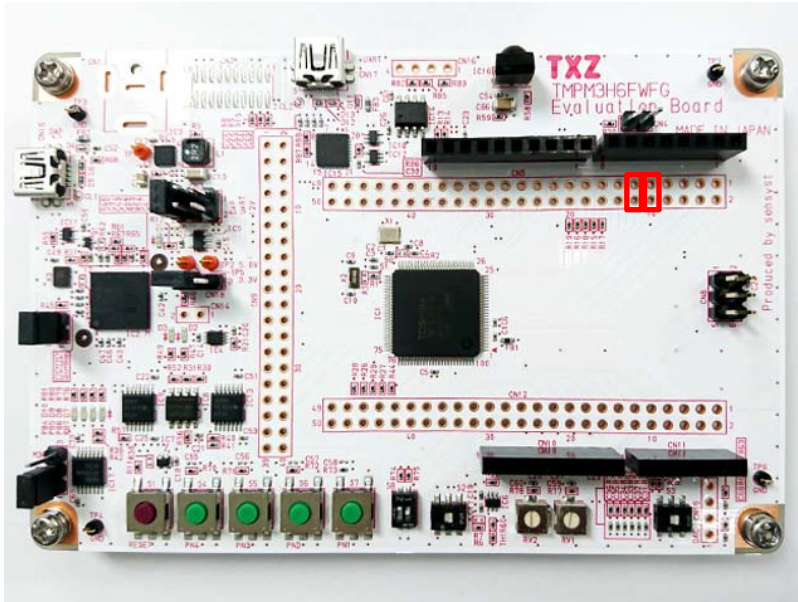


For purchasing the board, refer to the following homepage. (<http://www.chip1stop.com/>)

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



7. Operation of Evaluation Board

The USB_UART pin on the evaluation board and the PC should be connected with a USB cable. After the PC starts up the terminal software (Tera Term), the communication settings should be done. The reset button should be pushed down on the evaluation board. The following operations should be done on the PC terminal software (Tera Term).

1. Initial status display
"Input =" on the display requests a user to input proper characters.
2. Character input
User should input proper characters. Then, "Enter" should be pushed down.
3. Echo-back output
After "Echo=" on the display, the input characters are displayed.
4. When the character count exceeds the maximum count;
"Input Error !!" is displayed.

Used port	TXD:PA1, RXD:PA2
-----------	------------------

8. Outline of UART Interface Function

The asynchronous serial communication circuit (UART) can operate as a transmission / reception circuit of 1 channel (UTxTXDA / UTxTXDB / UTxRXD) per unit. The following is a list of functions.

Function classification	Function	Operation explanation
Baud rate control	Frequency dividing of prescaler	Selectable from 1/1 to 1/512 of the $\Phi T0$ frequency.
	Baud rate generator	N dividing or $N + (64 - K) / 64$ (N = 1 to 65535 and K = 0 to 63) dividing of the source clock frequency are possible.
Data format	Data length	Selectable 7, 8, or 9-bit.
	Parity	Parity control: Enable or disable selection Parity type: Even or odd parity is selectable
	Stop bit length	Selectable 1-bit or 2-bit.
	Data transfer order	Selectable LSB first or MSB first.
	Data signal inversion	Inversion control of the input and output data signal. Selectable disabled or enabled.
Transmission / reception control	FIFO storage stages	Reception: 8 stages Transmission: 8 stages
	Noise cancelling function	Reception: Noise cancelling function is enabled or disabled for UTxRXD.
	Error detection	Reception: Parity error, Framing error, Break error, Overrun error Transmission: Break error, Trigger transmission error
	Handshake function	Transmission / reception control by handshake with UTxCTS_N / UTxRTS_N signal is possible.
	Wake-up function	Serial link operation using the wakeup function in the 9-bit mode is possible.
Interlocking control	Interrupt	Reception interrupt, Transmission interrupt, and Error interrupt.
	DMA request	Reception DMA request: Burst transfer or Single transfer Transmission DMA request: Burst transfer or Single transfer
Special control	Half clock mode (Transmission / reception)	Transmission and reception with half width of "0" width of the normal UART waveform is possible.
	Loopback function (Test function)	The transmission data is connected to the reception data and the loopback test is possible.
	Software reset	Initialization can be done by software.

UTxTXDA can be exchanged for UTxRXD and UTxCTS_N can be exchanged for UTxRTS_N, too. This is done by a port setting. Refer to "Input/Output Ports" of the reference manual.

8.1. Clock Supply

When you use UART, please set an applicable clock enable bit to "1" (clock supply) in fsys supply stop register A and B (**[CGFSYSENA]**, **[CGFSYSENB]**), fsys supply stop register (**[CGFCEN]**).

Please refer to "Clock Control and Operation Mode" of the reference manual for the details.

When attempting to stop supplying the clock, make sure to check whether the UART is stopping. Note that when the MCU enters STOP mode, make sure to check whether the UART is stopping as well.

9. Sample Program

The data transferred from the terminal software is echoed back.

9.1. Initialization

The following initialization is done after power is supplied.

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

9.2. Sample program main operation

Each clock setting and the PORT setting are executed as the initialization of BSP (Board Support Package).

The DMA clear procedure is done after the clock and PORT settings.

The timer interrupt setting and the DMA setting are done as the initialization of the driver.

After those settings complete, the UART setting is done for the DMA.

DMAC ch10 is assigned to the data reception channel, and DMAC ch11 is assigned to the data transmission channel.

After all settings complete, the timer starts. Then the DMA operation starts.

The DMAC receives the input data after "Input =" on the terminal software through the UART interface. The data is stored to a memory.

After that, the data stored in this memory is transferred by DMAC control and data is output to the terminal software.

For DMA transfer, reception is single transfer and transmission is burst transfer.

9.3. Output Example of Sample Program

When you run the sample program, the result of the command is output as follows.

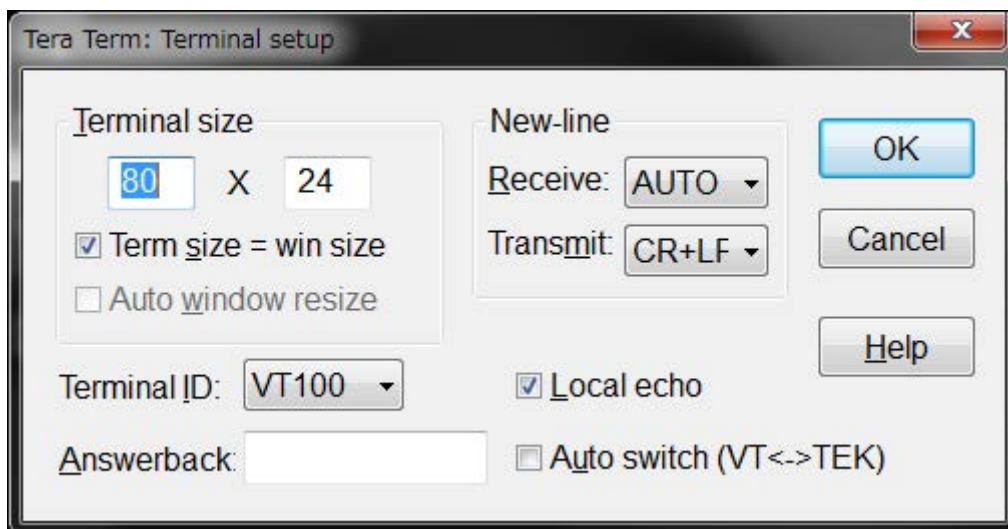
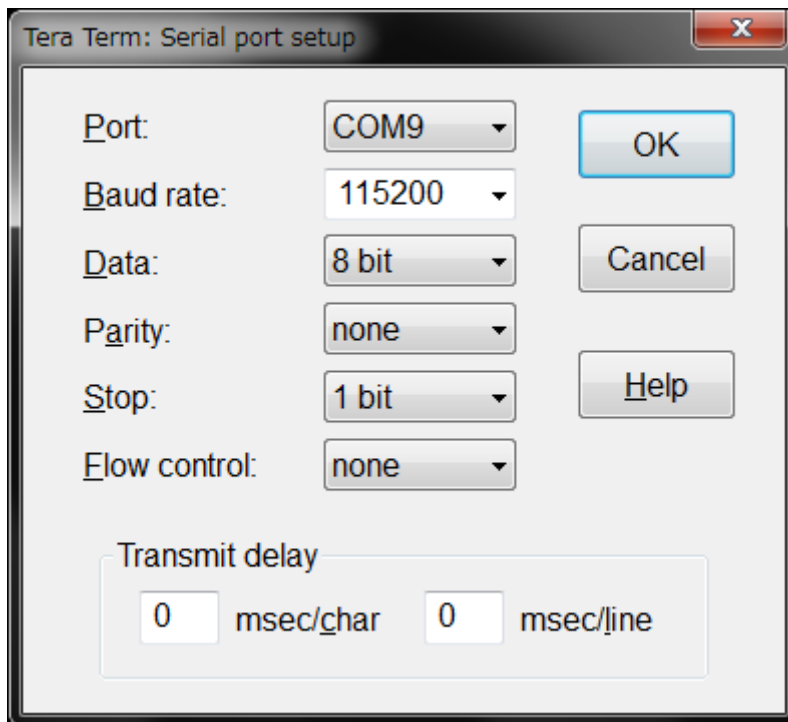


```
COM9 - Tera Term VT
File Edit Setup Control Window Help
Input = 123456
Echo = 123456
Input = 01234567890123456789012345678901

Input Error !!
Input = Echo =
Input =
```

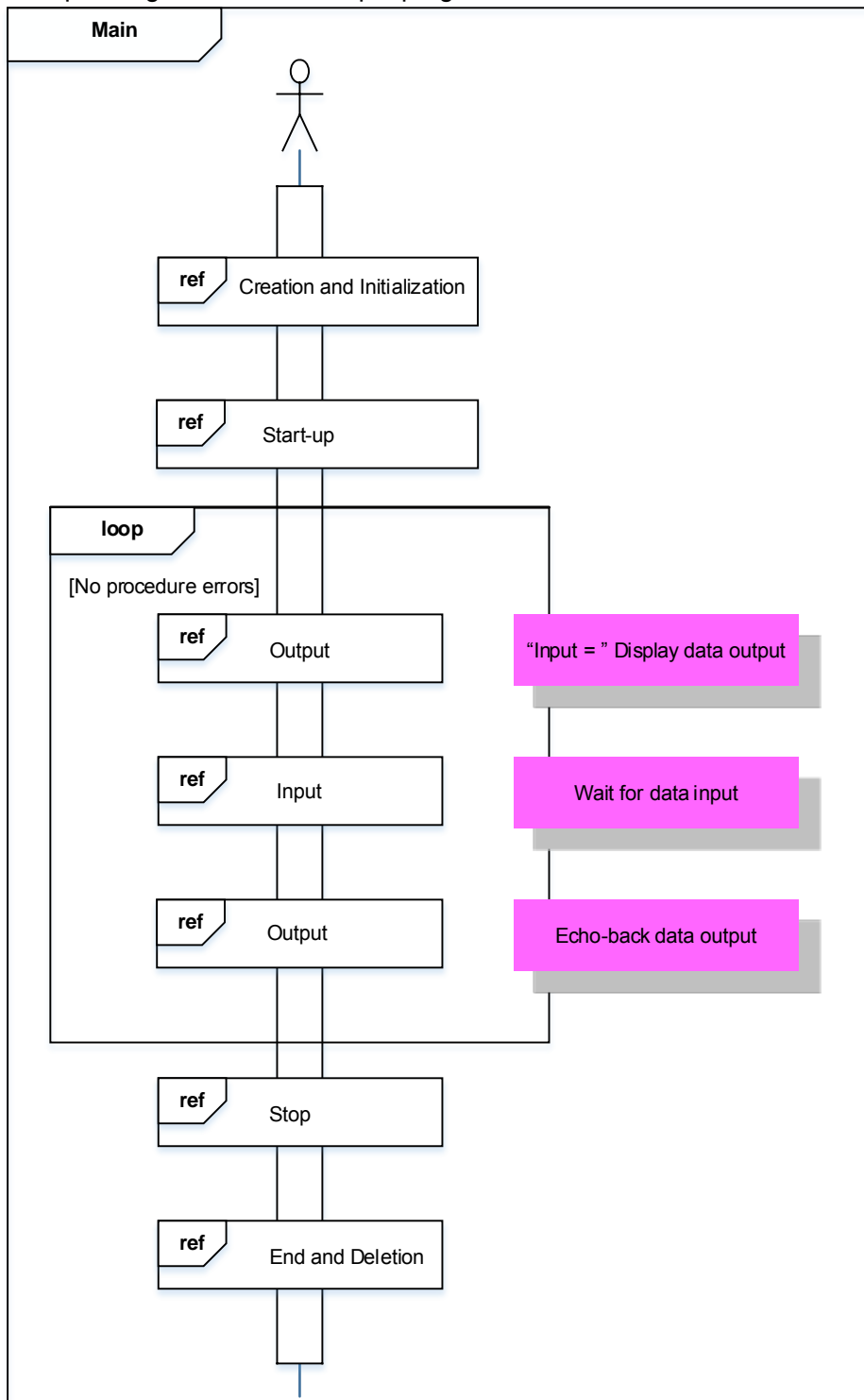

9.3.1. Setting Example of Terminal Software

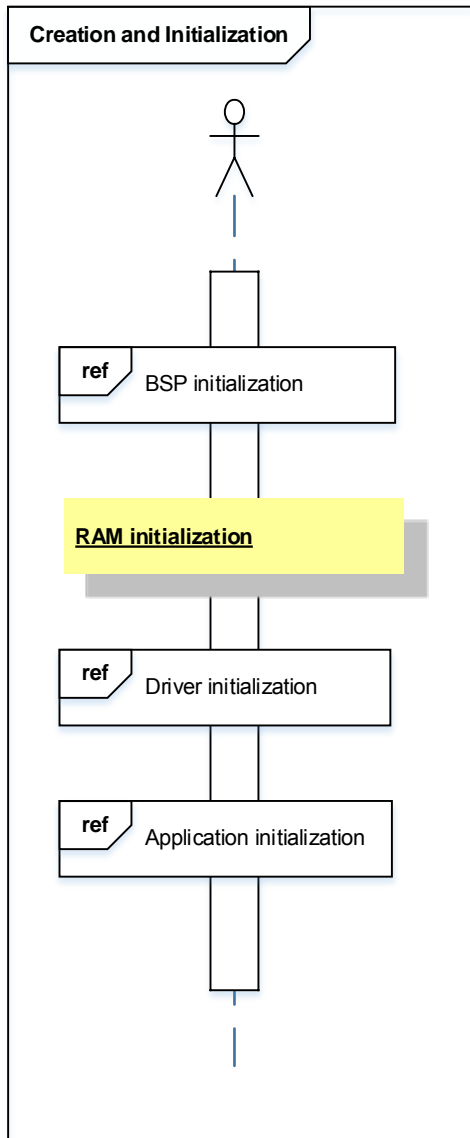
The operation of the terminal software (Tera Term) has been checked with the following settings.

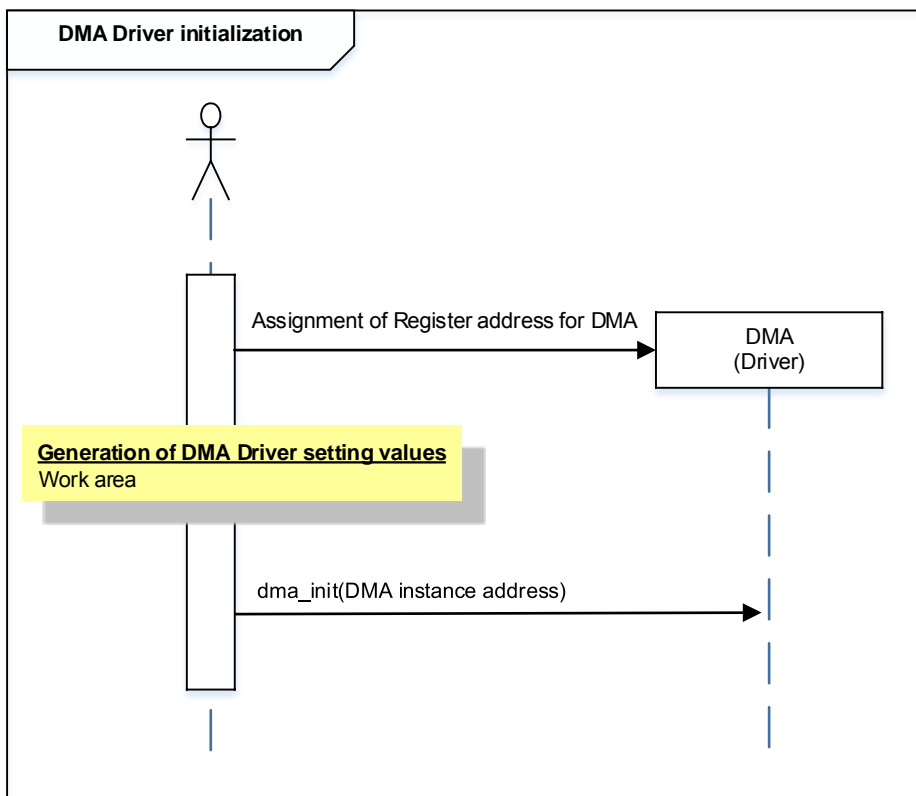
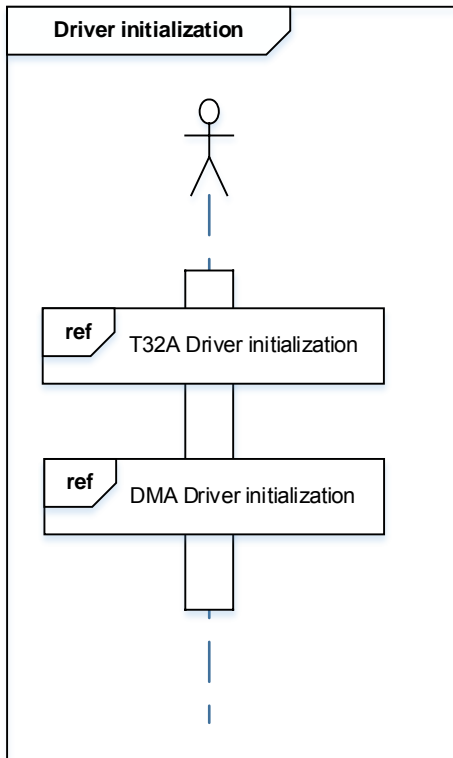


9.4. Operating Flow of Sample Program

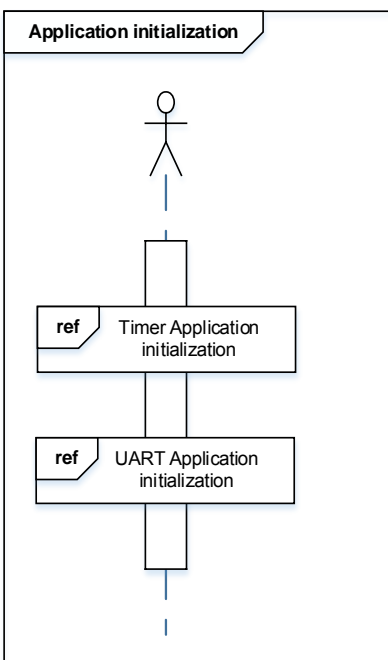
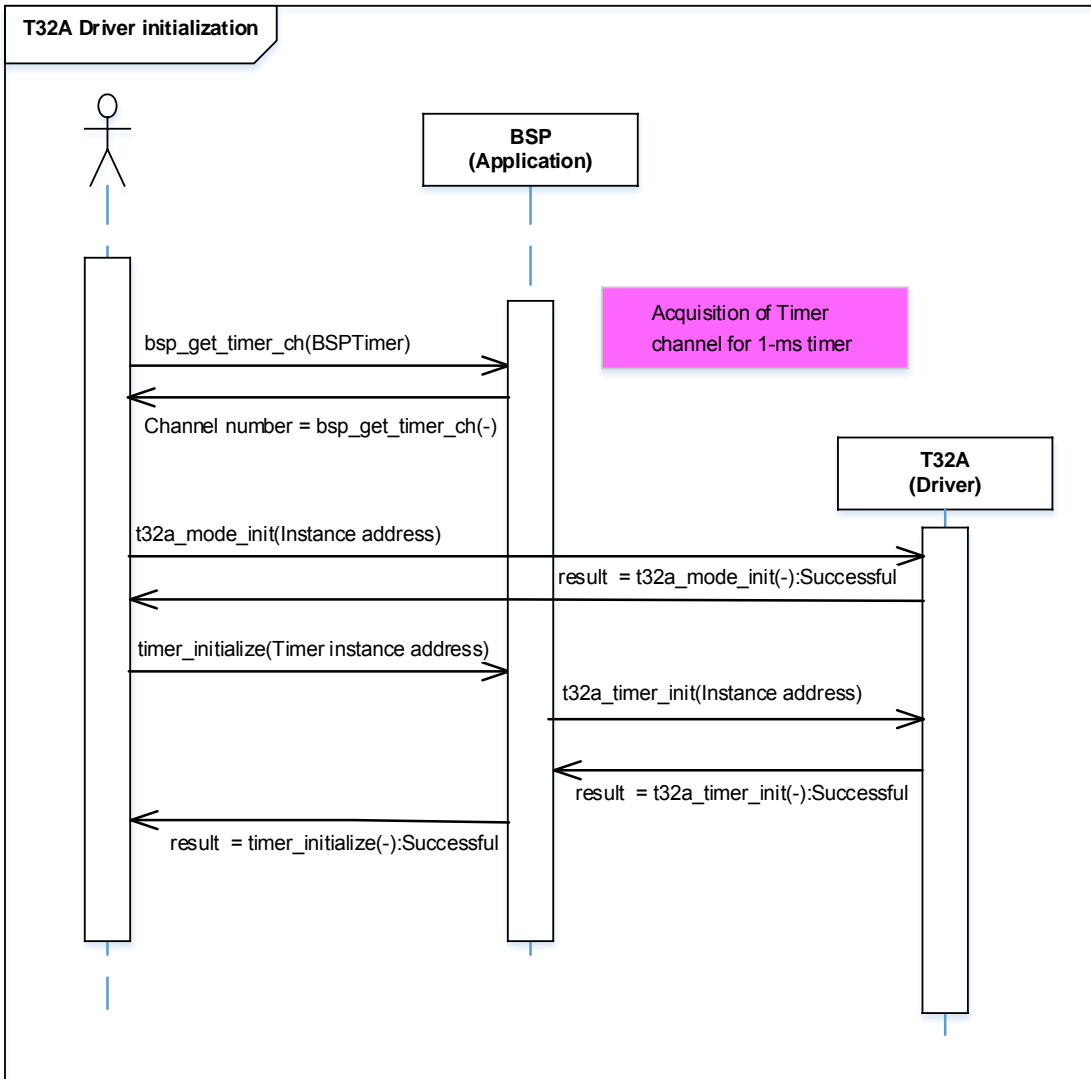
The operating flows of the sample program are shown as follows.

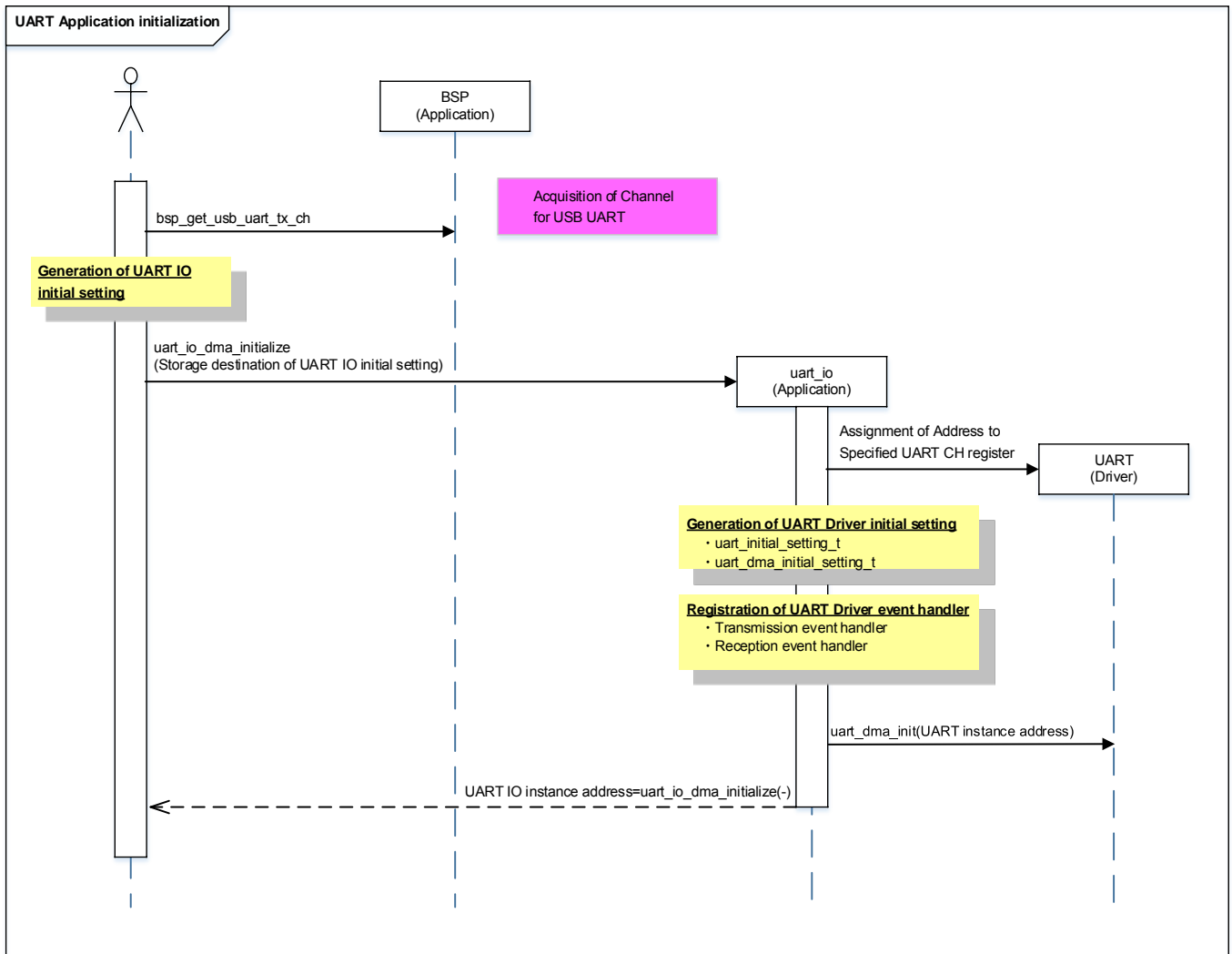


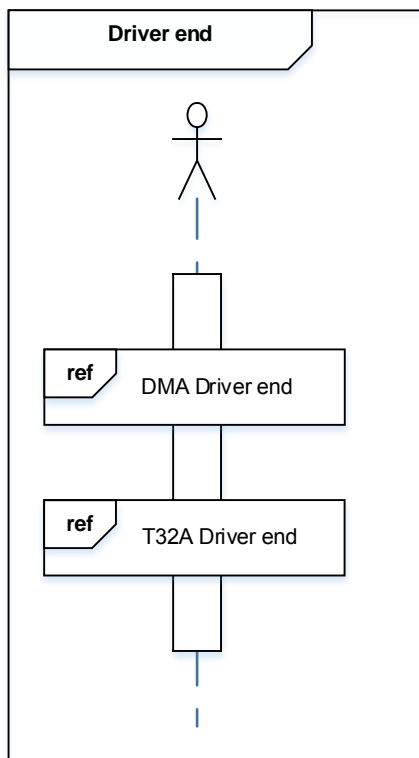
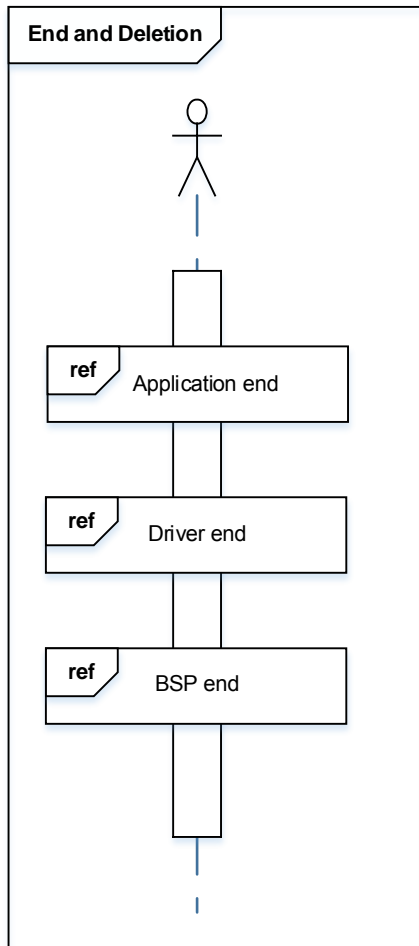


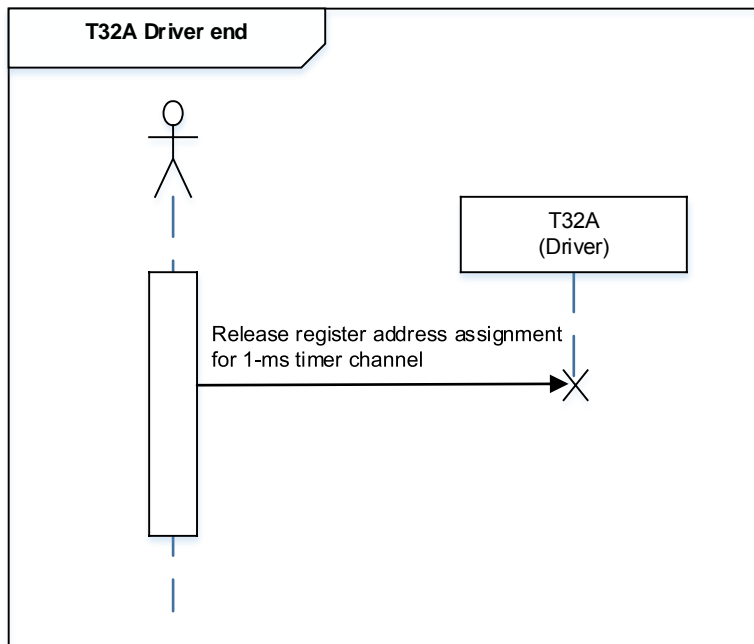
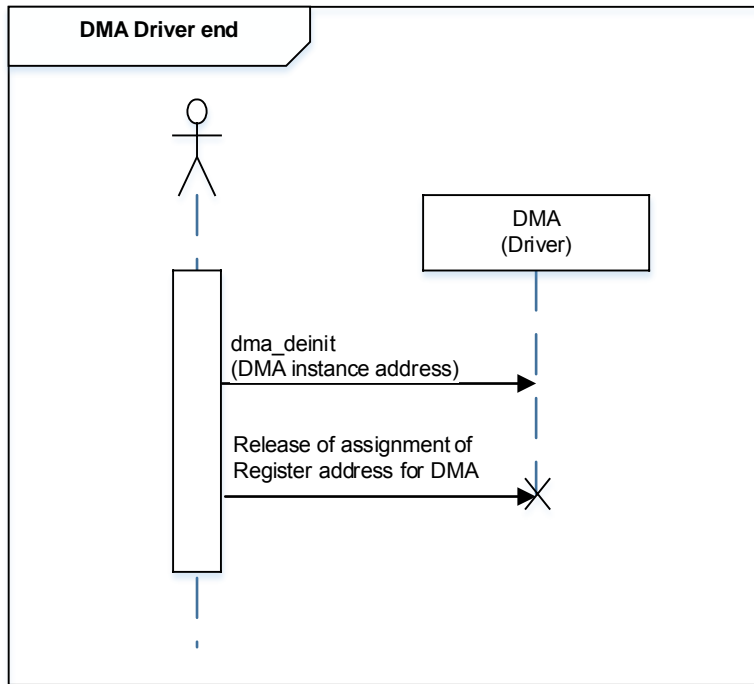


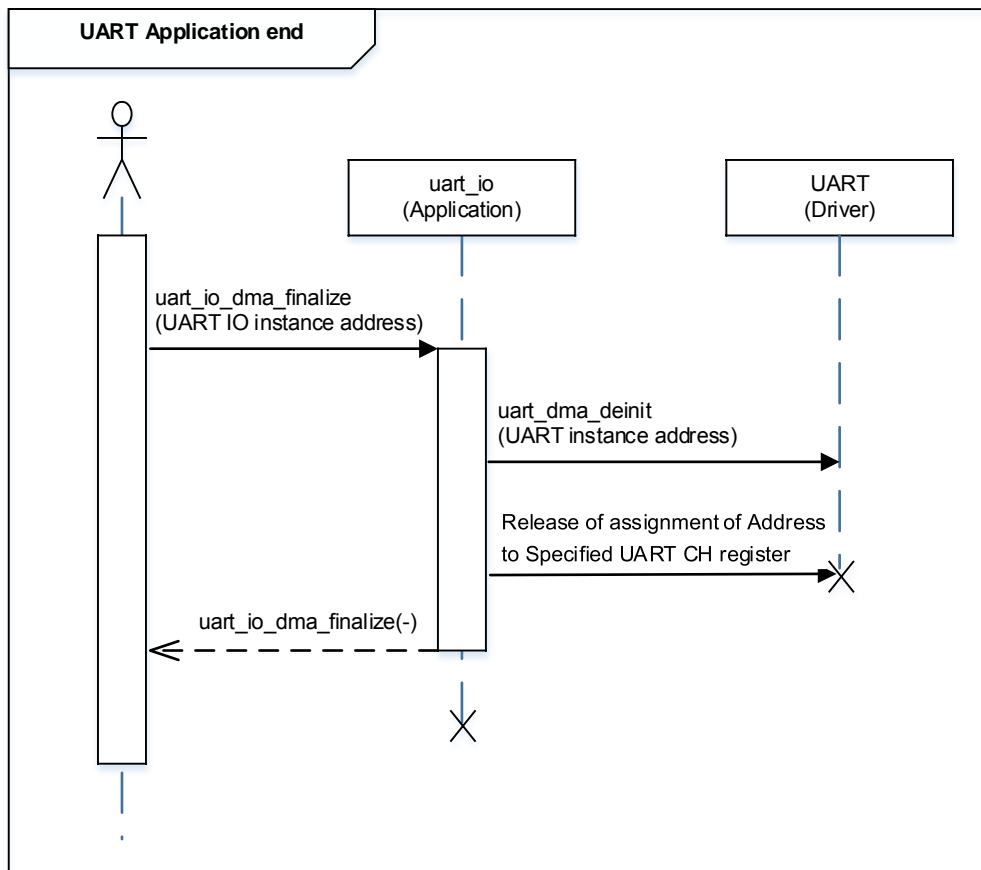
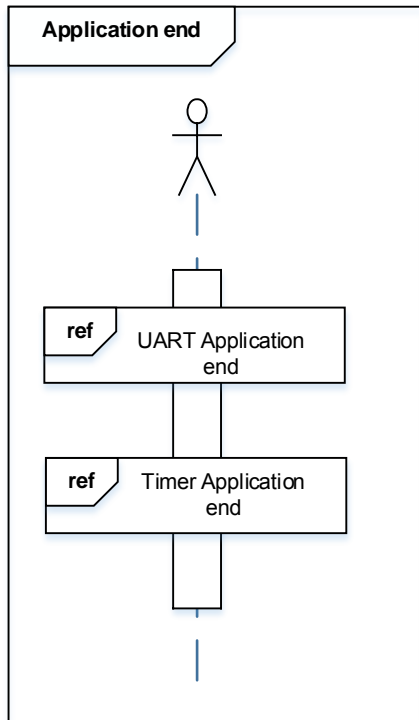
Although initialization setting of 32-bit timer event counter of TMPM3H is done, it is not used in actual operation of this sample program.

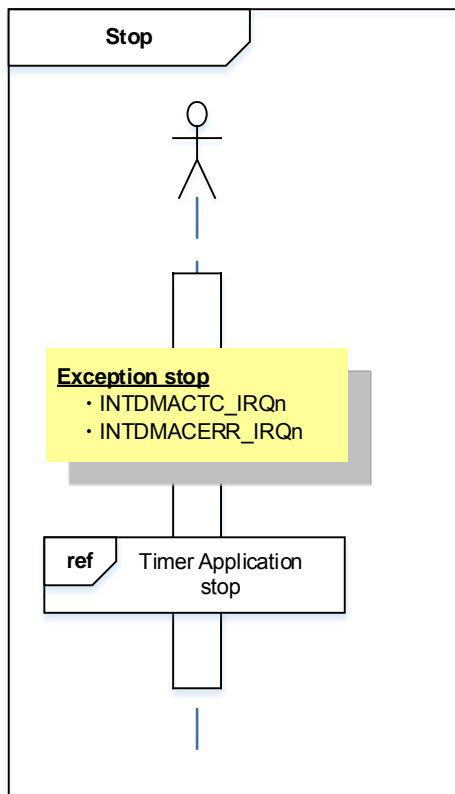
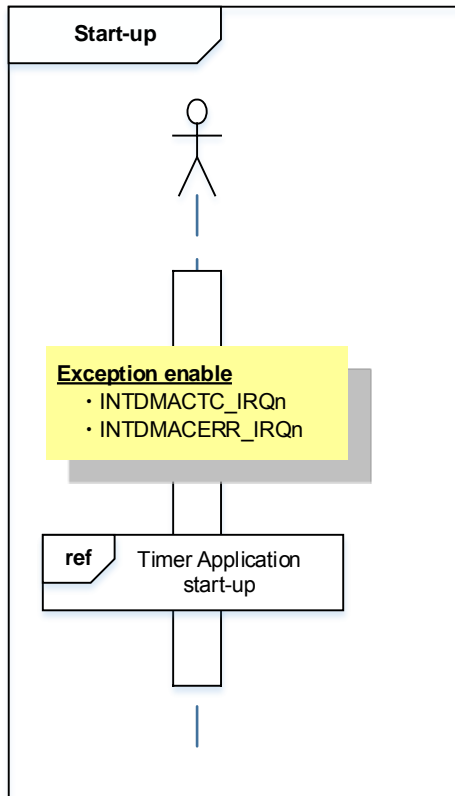


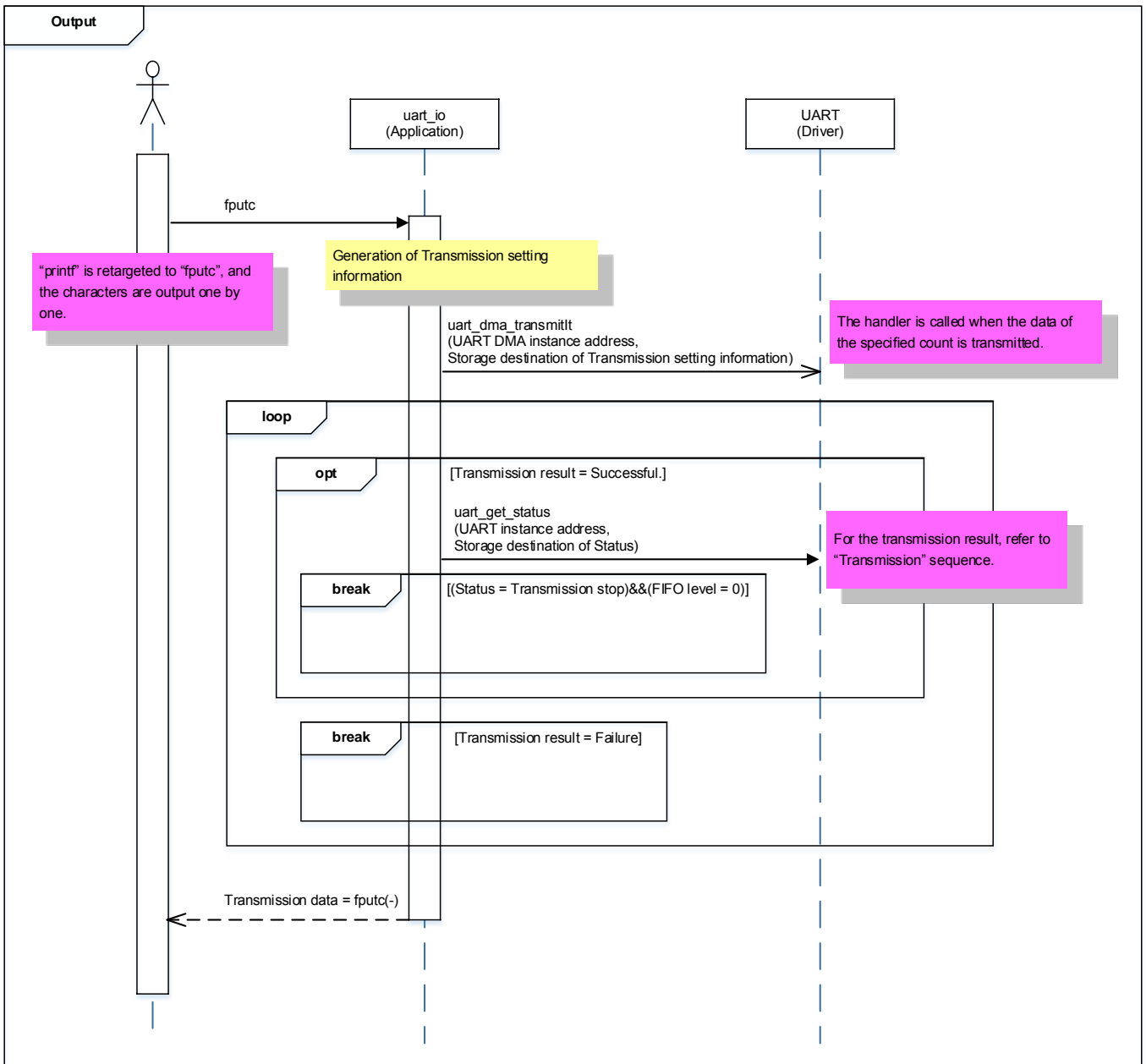


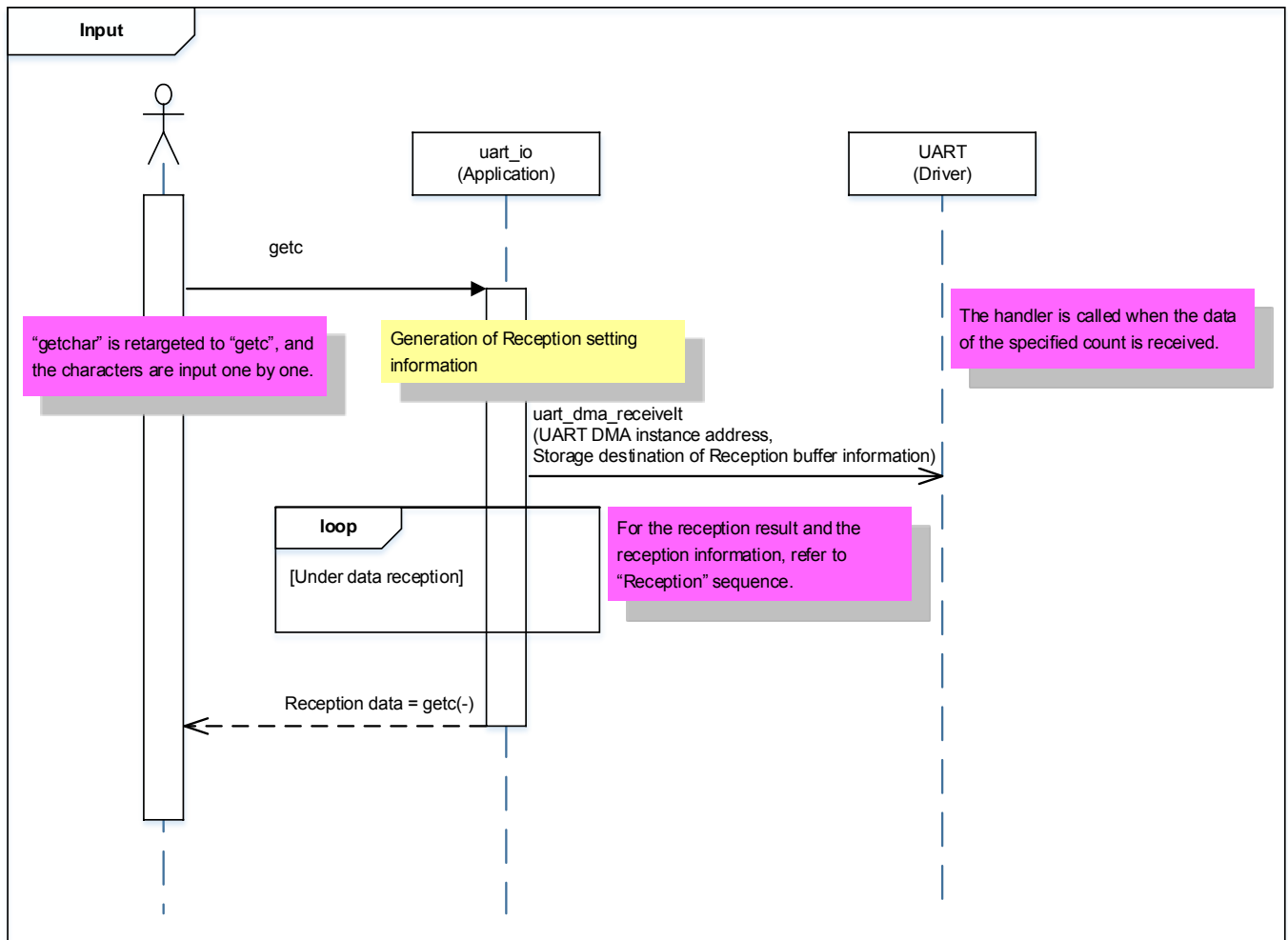


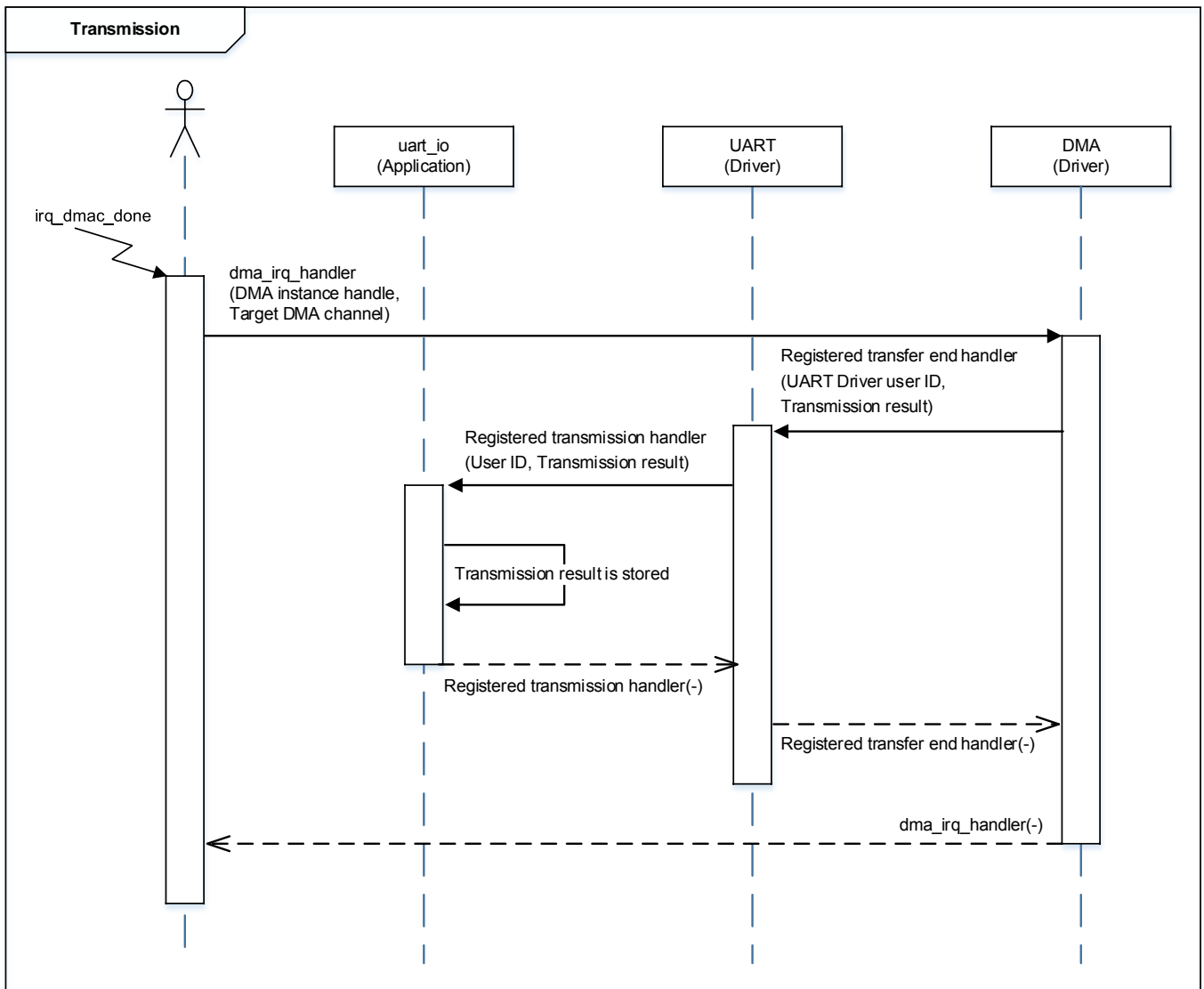


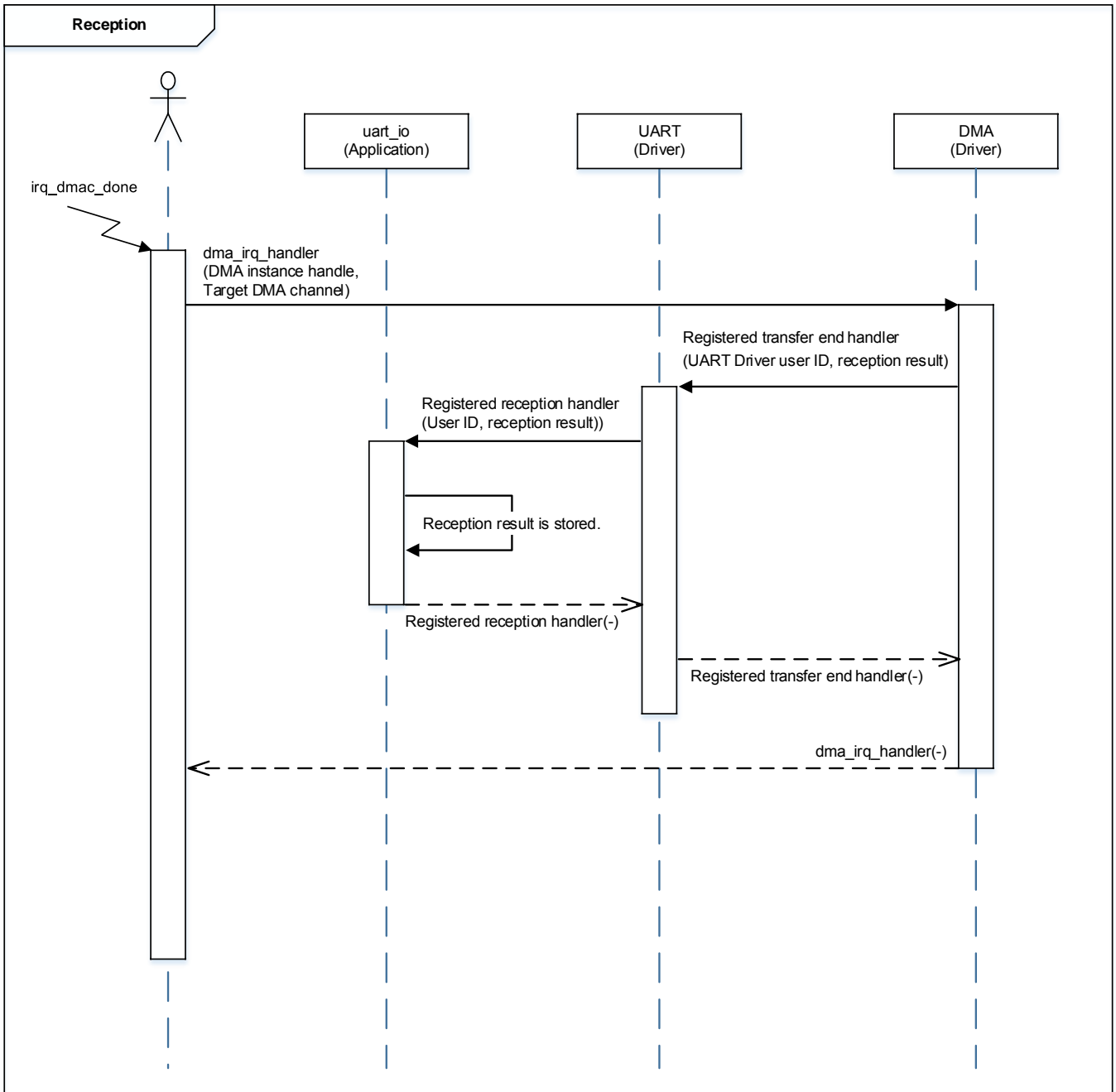












10. Precaution

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

11. Revision History

Rev	Date	Page	Description
1.0	2018-03-15	-	First release

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