

M4K Group (1)
Application Note
I²C Interface
(I2C-B)
MASTER/SLAVE

Outlines

This application note is a reference material for developing products using the Master/Slave function of the I2C interface (I2C) of M4K Group (1).

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

Target sample program: I2C_MASTER_SLAVE

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1. Preface

This sample program is used to check the operation of the Master/Slave function of the I²C interface. Two evaluation boards are used. The Slave board is controlled by the commands which are input to the Master board.

Commands are input from the terminal software to set one of the two evaluation boards to the Slave mode. The Master evaluation board controls the Slave board.

2. Reference Document

1. Datasheet
 TPM4K Group (1) datasheet Rev2.0 (Japanese edition)
2. Reference manual
 I²C Interface (I2C-B) Rev3.0 (Japanese edition)
 Asynchronous Serial Communication Circuit (UART-C) Rev3.0 (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
I ² C interface	ch0	PB0 (I2C0SDA) PB1 (I2C0SCL)	I ² C mode
Asynchronous Serial Communication Circuit	ch0	PK0 (UT0RXD) PK1 (UT0TXDA)	UART mode

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
Terminal software	Tera Term V4.96
Sample program	v1.0.0

6. Evaluation Board Operation

Two evaluation boards are necessary.
PC and the USB_UART are connected for communication with the terminal software.
The sample program should be written to each board.

Evaluation boards:

Evaluation board A: TMPM4K4 evaluation board
Evaluation board B: TMPM4K4 evaluation board

The following pins should be connected between the evaluation boards.

Each I²C pin should be connected.

Evaluation board A: PB0 (I2C0SDA) – Evaluation board B: PB0 (I2C0SDA)

Evaluation board A: PB1 (I2C0SCL) – Evaluation board B: PB1 (I2C0SCL)

The Master board can control the Slave board using the connections above.

When the sample program is executed, both evaluation boards start up in the Master mode.

“slave” command is input to one of the boards. Then, the board enters the Slave mode.

For the details of the operation of a command input, refer to “Main Operation”.

The Slave board is controlled by the commands of the Master board.

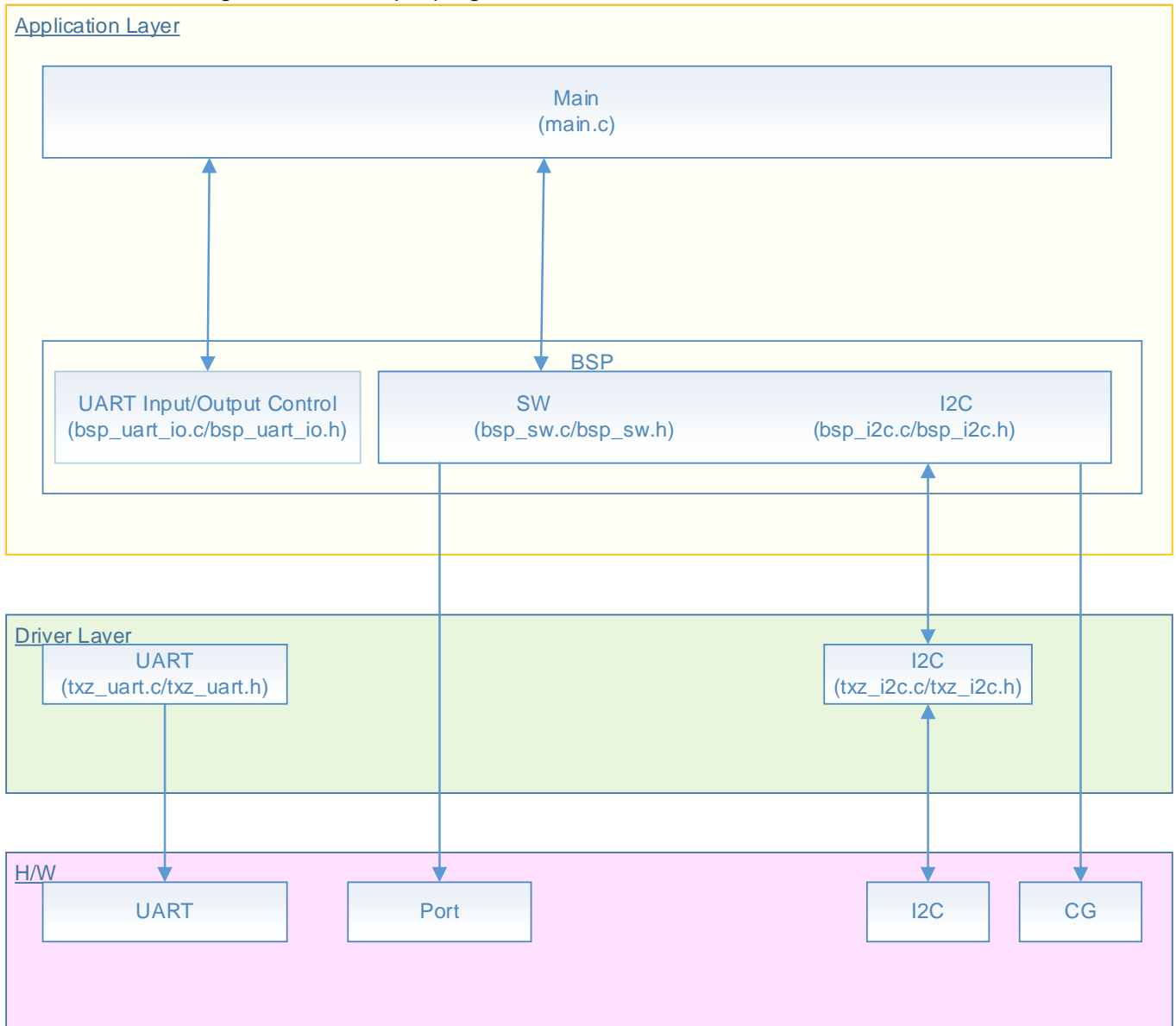
When “write” command is input to the Master board, the Master is set to data transmission and the Slave is set to data reception.

When “read” command is input to the Master board, the Master is set to data reception and the Slave is set to data transmission.

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 UART and the enable of the UART interrupt are done as the initialization of the application software.

The initialization of the I²C is done.

The sample program waits for the input of a command to the terminal software.

The I²C Master function or the I²C Slave function in the microcontroller can be executed by the input of proper characters according to the command format.

The Master mode is changed to the Slave mode by a Slave command. The command can be input when the I²C is in the Master mode.

Command format

"command[_parameter1][parameter2]"

The byte count of the parameter2 depends on a command.

A space should be inserted between the command and the parameter1.

The slave_address in the parameter1 and the transmission data in the parameter2 should be input continuously.

There are 3 ways for a command input of data transmission and reception.

- Only a command.
- Command + slave_address
- Command + slave_address + Transmission data

The data size of transmission and reception of the sample program is 4 bytes.

"read" command transmits and receives 2-byte transmission data + 2-byte reception data in the Master and 2-byte reception data + 2-byte transmission data in the Slave.

When "read" command is followed by a parameter, the parameter should be 2-byte transmission data from the Master.

The sample program waits for a command after data transmission or reception has completed. This process repeats.

Command	Description	Parameter (hex)		Example input
		1: Address	2: Transmission data	
write w	Data transmission	slave_address "XX"	Transmission data: 4 bytes "XX""XX""XX""XX"	"write" "write B0" "write B011223344" "w"
read r	Data transmission + Data reception	slave_address "XX"	Transmission data: 2 bytes "XX""XX"	"read" "read B0" "read B05566" "r"
slave	Chang to Slave mode	slave_address "XX"	-	"slave" "slave B0"

Note1) "XX" is a hexadecimal number. "12" should be input for "0x12".

Note2) A command without any assignment of a parameter is accepted.

Note3) "w" and "r" commands are the commands without any parameters.

Note4) After the log of the Slave mode is issued 10 times, the mode returns to the Master mode.

The transmission data is transmitted via a buffer. The initial value of the buffer is as follows;

Master transmission data (The data is changed by the Parameter2 (Transmission data) input assignment.)

tx[0]: 00, tx[1]: 01, tx[2]: 02, and tx[3]: 03

Slave transmission data (Fixed.)

tx[0]: 80 and tx[1]: 81

The data transmitted from the Slave by the "read" command is not changed.

7.4. Output Example of Terminal Software

When the sample program is executed, the command input and the result are displayed as shown in the following figures.

[Basic log information]

"I2C0" shows the used channel in the I²C interface.

"sa B0" shows the reception-wait Slave address.

"tx[]" and "rx[]" show a transmission data and a reception data, respectively.

Example of Master output log

```
I2C TEST - I2C0
-----
| I2C master mode |
-----
command >
```

Example of Slave output log

```
I2C TEST - I2C0
-----
| I2C master mode |
-----
command > slave
-----
| I2C slave mode |
-----
slave
sa    B0
```

```
command > write
master
sa    B0
tx[0] 00
tx[1] 01
tx[2] 02
tx[3] 03
command >
```

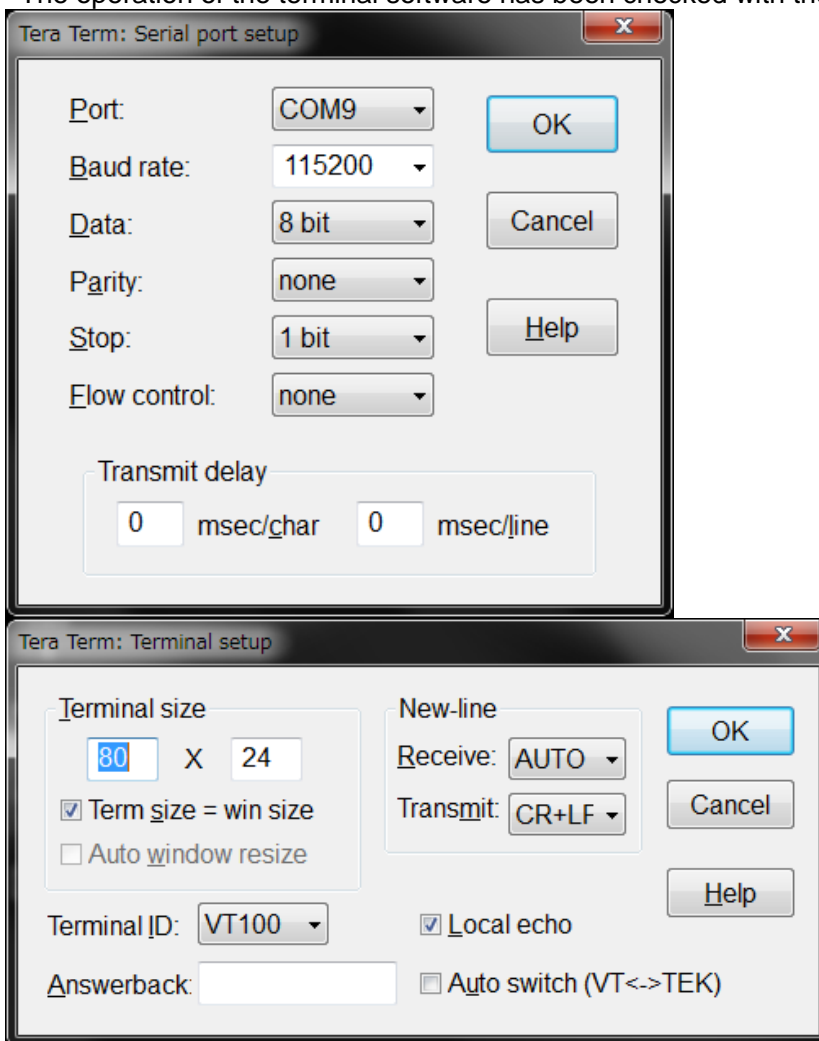
```
slave
sa    B0
rx[0] 00
rx[1] 01
rx[2] 02
rx[3] 03
slave
sa    B0
```

```
command > read
master
sa    B0
tx[0] 00
tx[1] 01
rx[0] 80
rx[1] 81
command >
```

```
slave
sa    B0
rx[0] 00
rx[1] 01
tx[0] 80
tx[1] 81
slave
sa    B0
```

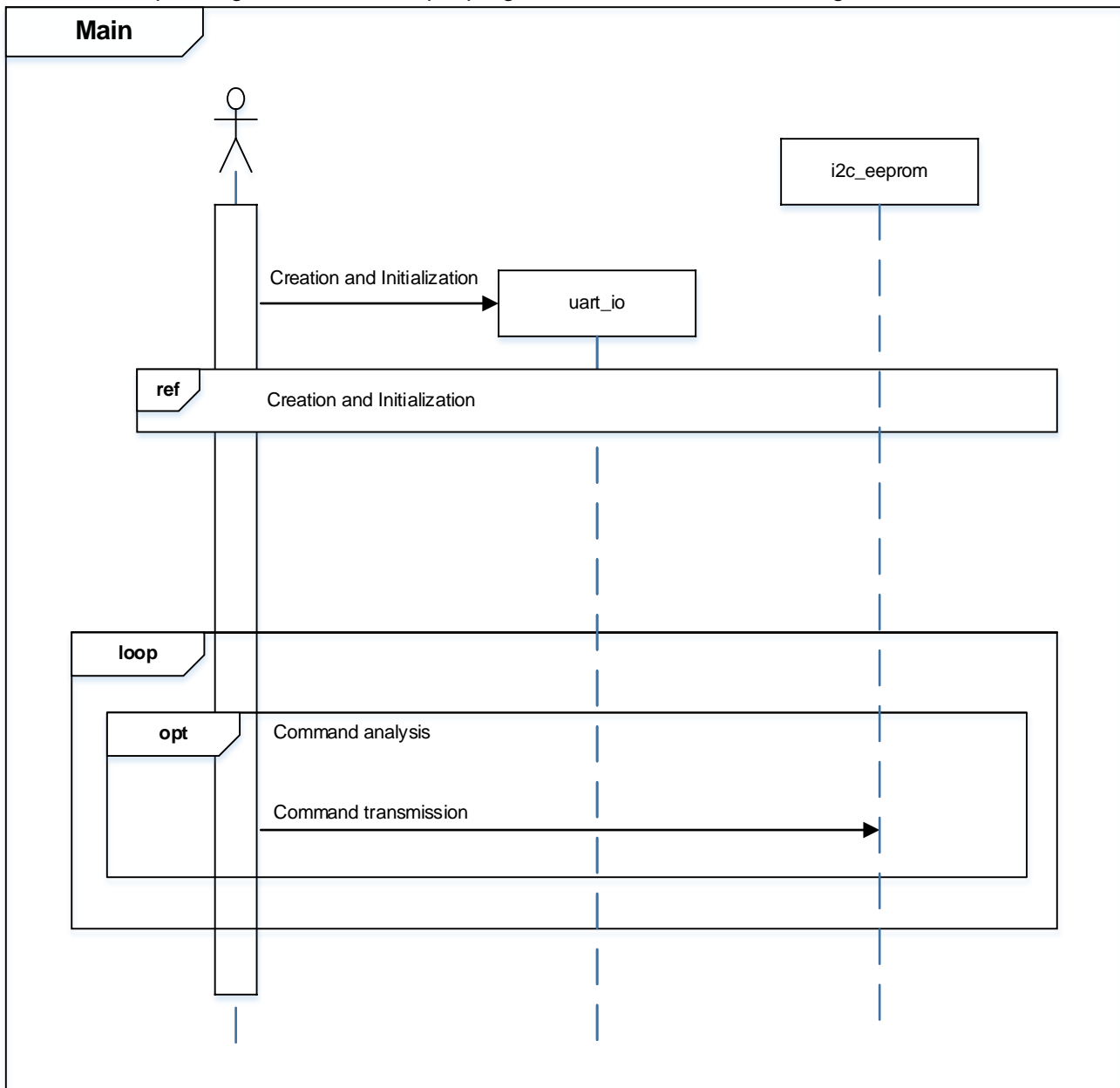

7.4.1. Setting Example of Terminal Software

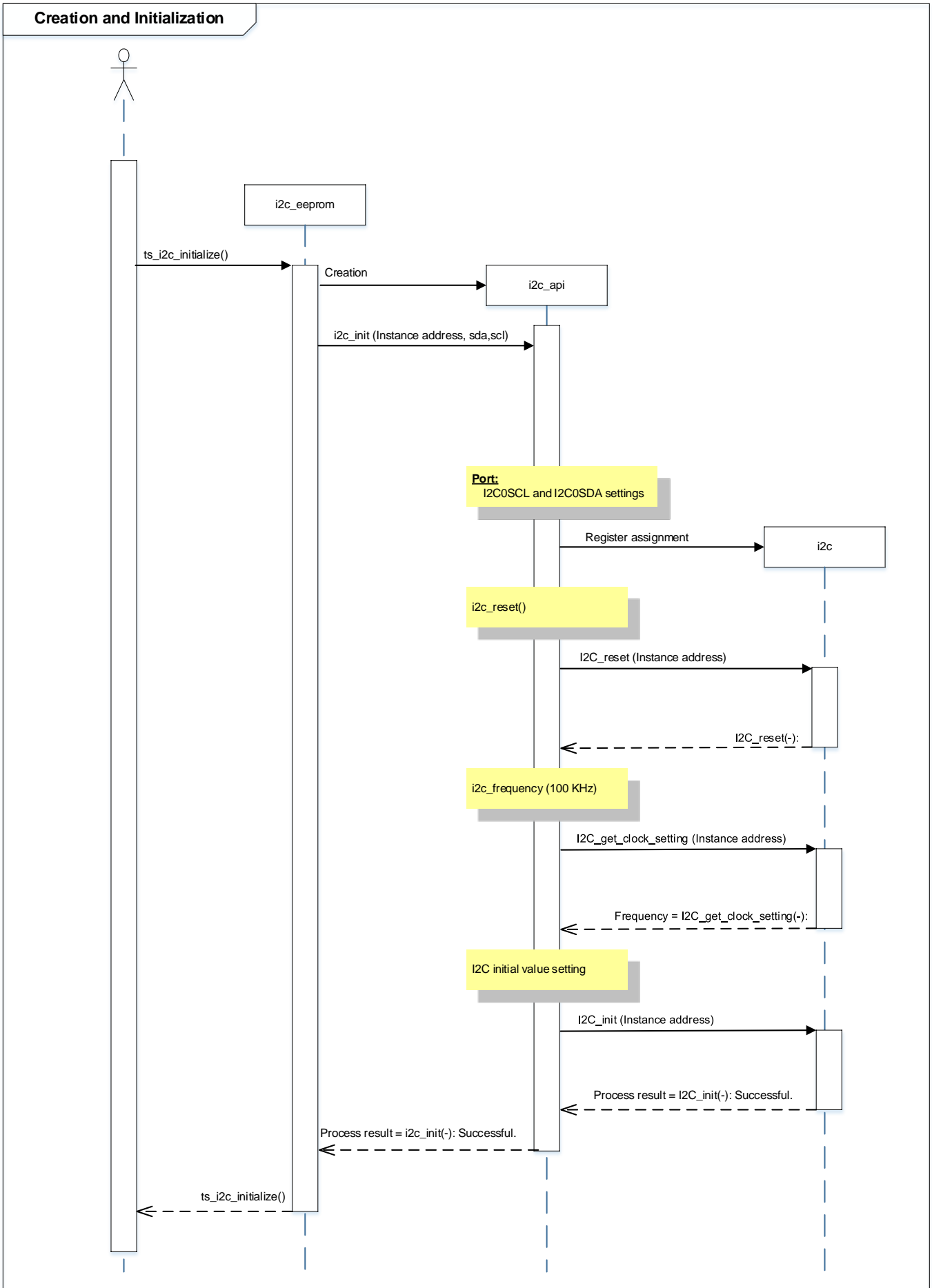
The operation of the terminal software has been checked with the following settings.

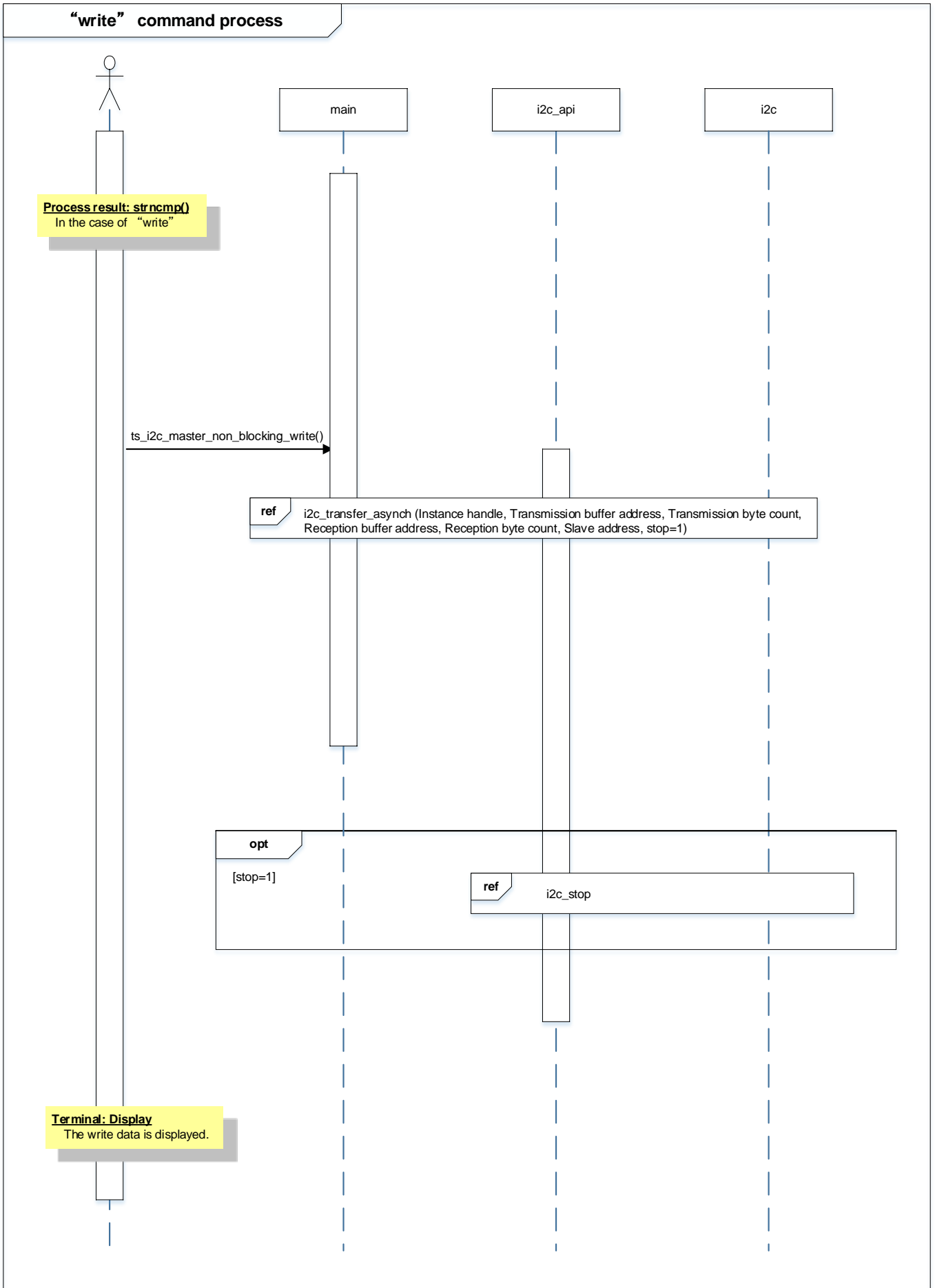


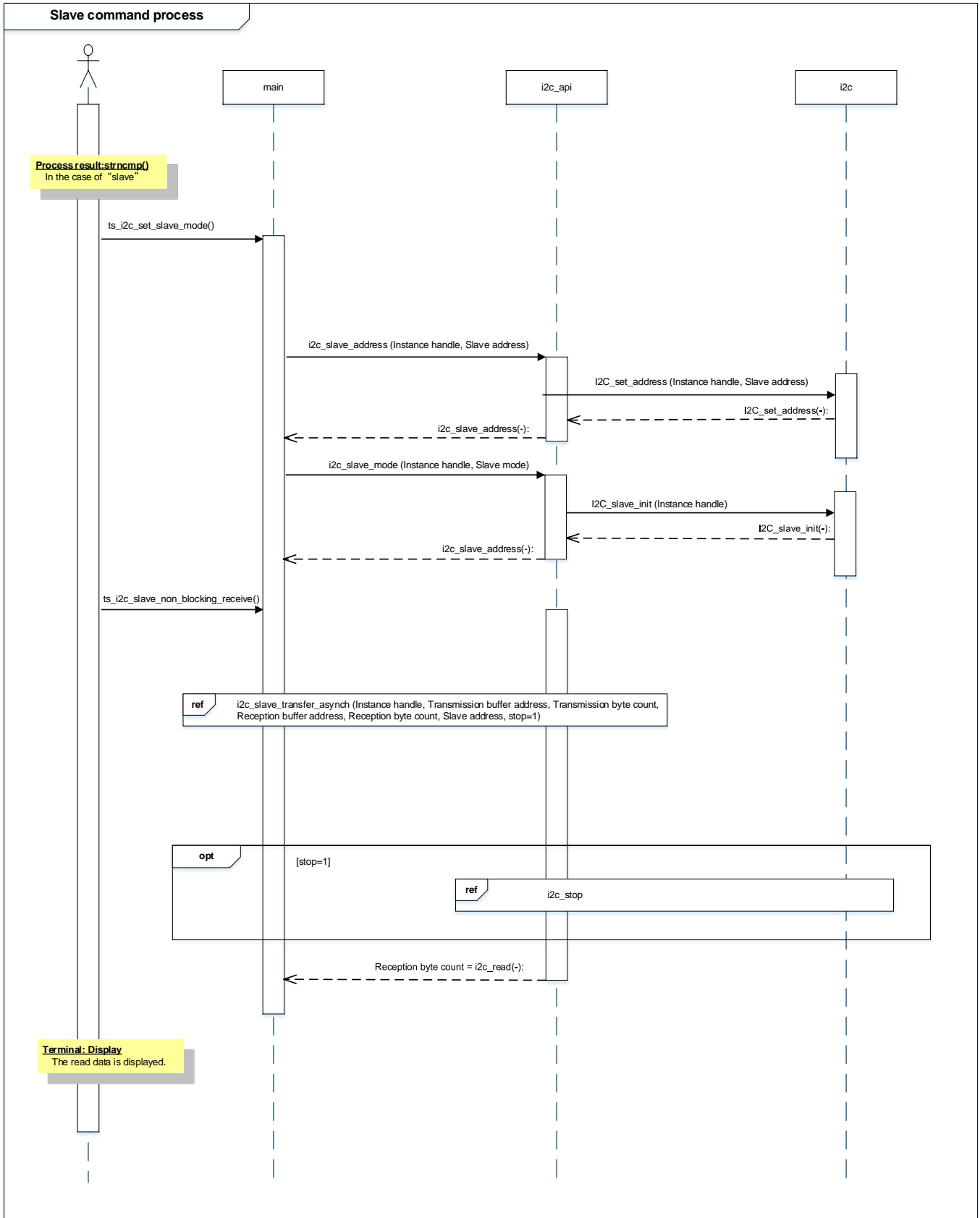
7.5. Operating Flow of Sample Program

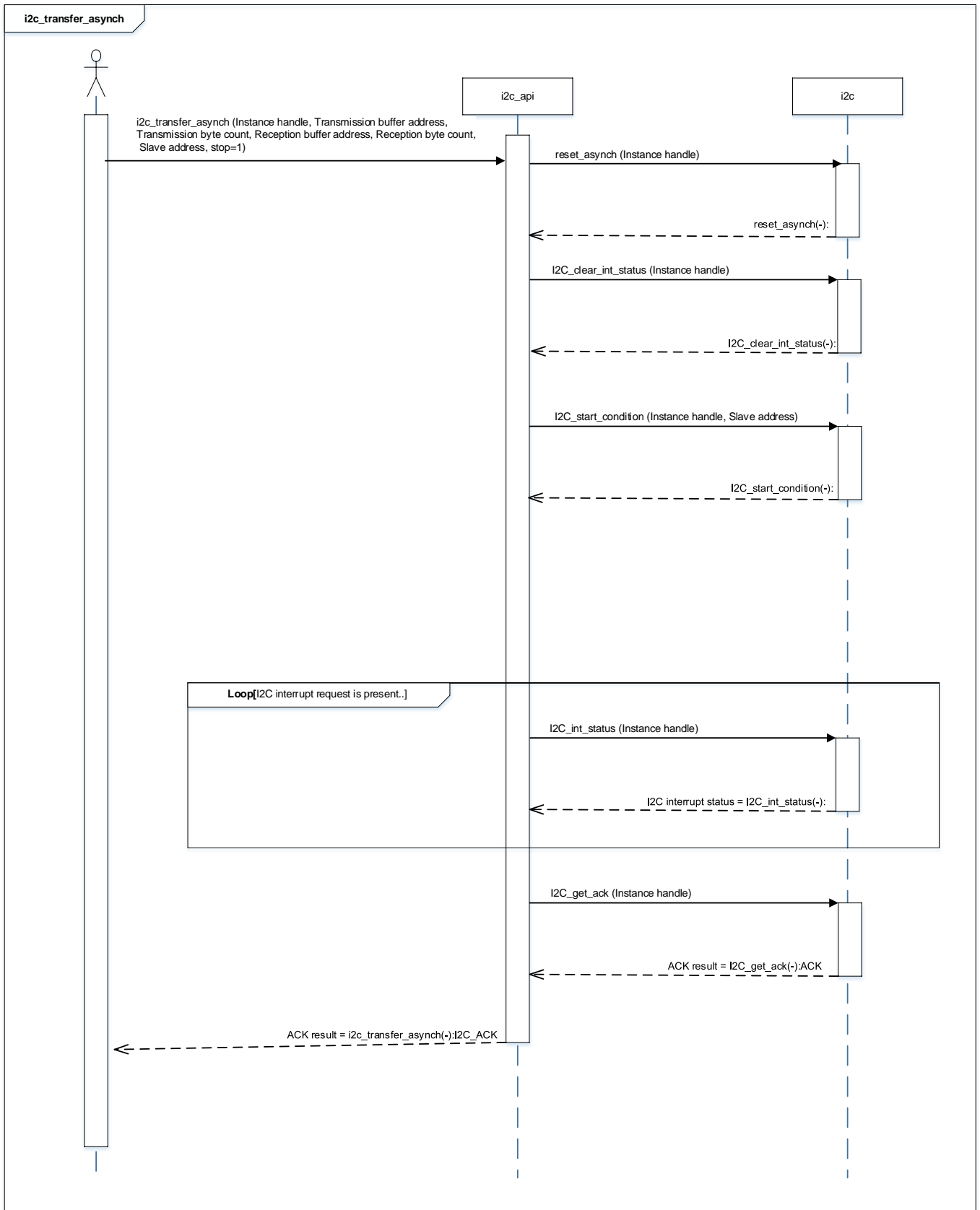
The basic operating flows of the sample program are shown in the following;

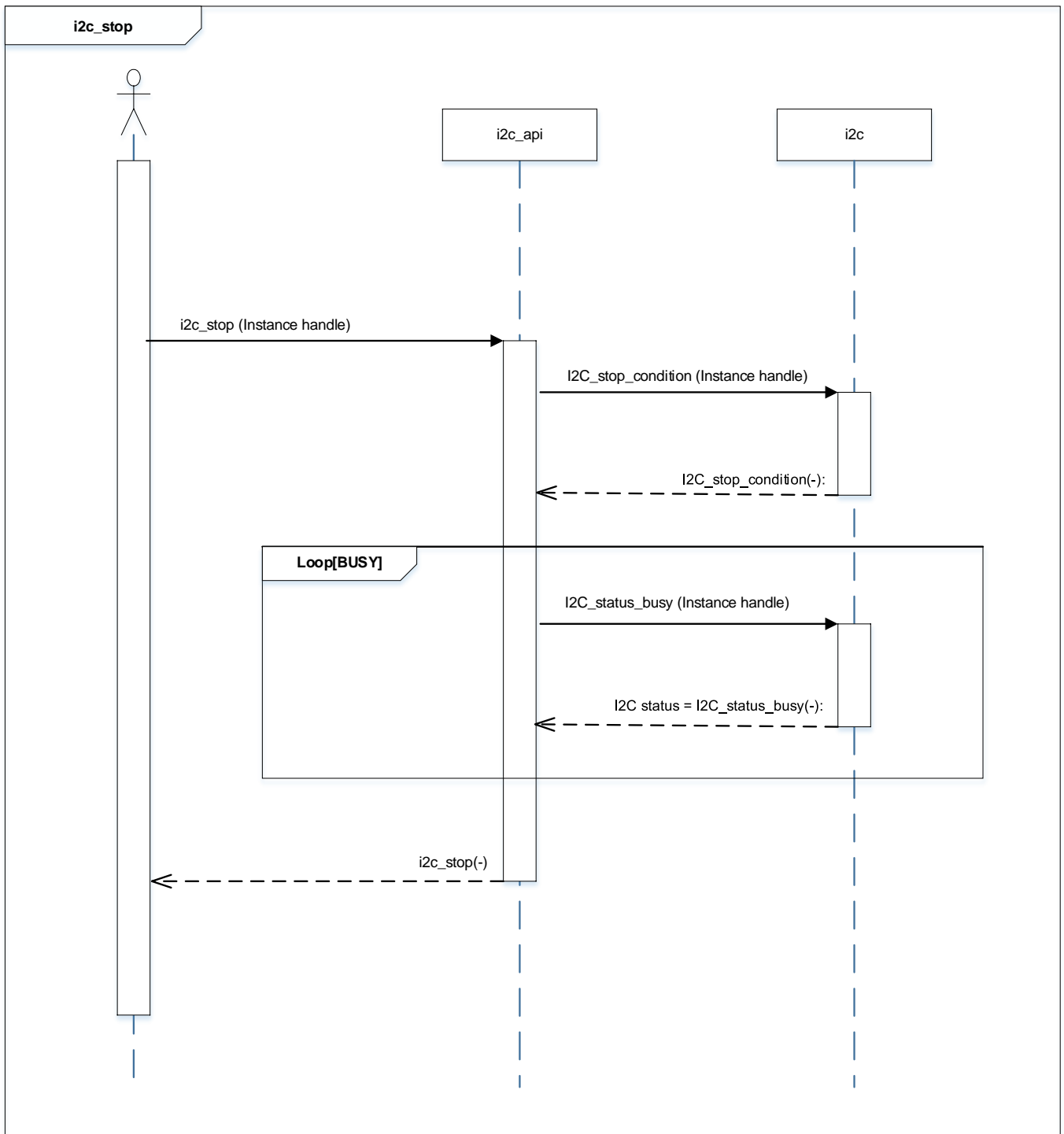












8. Points to Remember on Handling of Sample Programs

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

9. Revision History

Revision	Date	Description
1.0	2019-10-15	First release

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