

M3H Group (1)
Application Note
Trimming Circuit
(TRM-A)

Outlines

This application note is a reference material for developing products using the trimming circuit (TRM) function of M3H Group (1).

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

Target sample program: TRMOSC

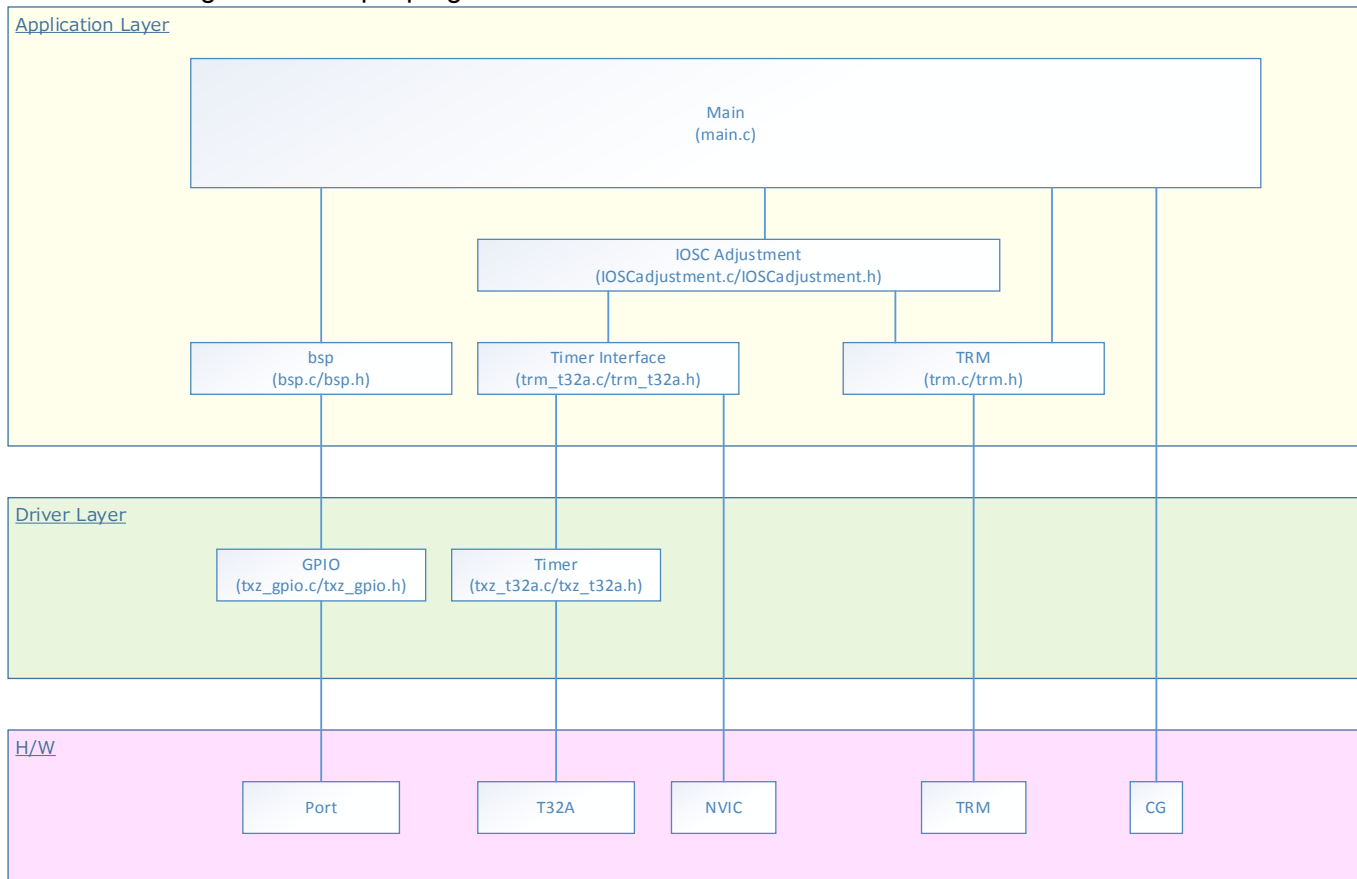
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1. Preface

This sample program is used to check the operation of the trimming function.
 This sample program executes the calculation of the frequency error of the internal oscillator, and sets a corresponding adjustment value to the internal oscillation adjustment register.

Structure diagram of Sample program



2. Reference Document

- Datasheet
 TMPM3H group (1) datasheet Rev2.0 (Japanese edition)
- Reference manual
 Trimming circuit (TRM-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
Asynchronous communication	ch0	PA1 (UT0TXDA) PA2 (UT0RXD)	UART mode
Trimming circuit	-	-	-
32-bit timer event counter	ch0	PA0 (T32A00OUTA)	Pulse wave output
	ch4	-	Interval timer and Capture
	ch2	PR1 (T32A02INA0)	External clock input

4. Target Device

The target devices of this 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.

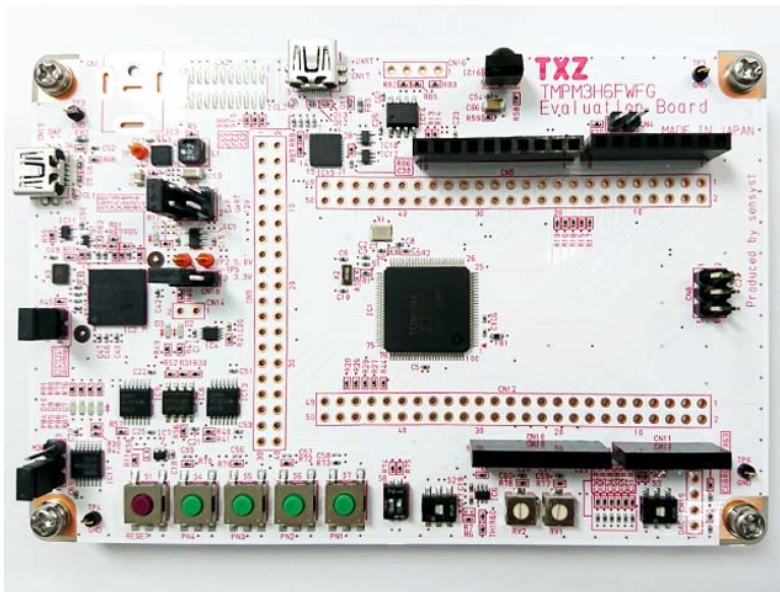
If other function than the TMPM3H6 one is checked, it is necessary that CMSIS Core related files (C startup file and I/O header file) should be changed properly.

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. Conditions for Correct Operation

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

Evaluation board (TMPM3H6FWFG Evaluation Board) (Top view)



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

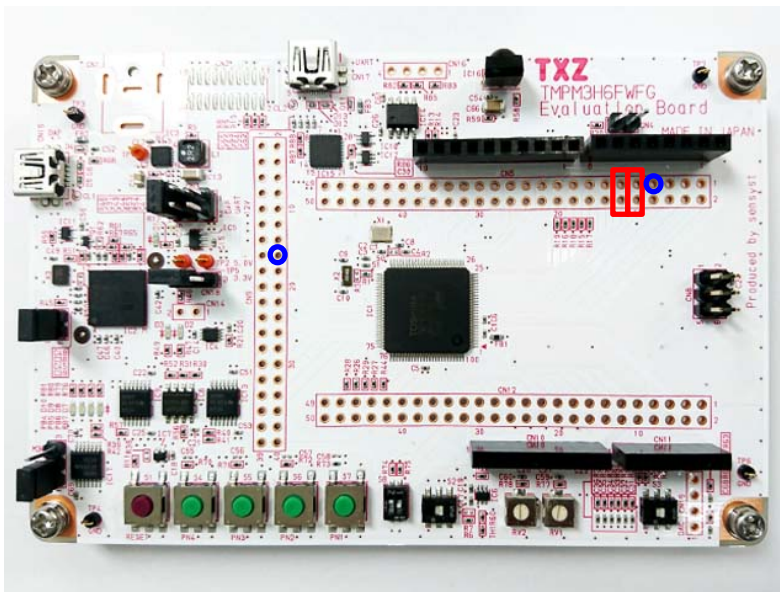
6. Evaluation Board Setting

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
PORT(Output)	7	-

When an external clock is input, the following connector should be used.

CN9		
Use	Through-hole No.	Setting
PORT(Input)	16	-



7. Operation of Evaluation Board

The USB_UART pins on the evaluation board should be connected to the PC with a USB cable. The PC executes the communication setting after start-up of the terminal software (Tera Term). The reset button should be pushed down on the evaluation board.

After the completion of the trimming procedure, it should be checked that a 5-MHz pulse wave outputs on the PA0 port.

8. Outline of Trimming Circuit Function

The trimming circuit (TRM) can adjust the frequency for an internal oscillator.
The lists of functions are as follows.

Function Classification	Function	Operation
Frequency adjustment of the internal oscillator	Target oscillator	Internal High Speed Oscillator 1 (IHOSC1)
	Adjustment range	Coarse trimming -18.8 to +30.4 % (Average 0.8 % step) Fine trimming -0.8 to +0.7 % (0.1 % step)
	Monitor function	The reading of the initial trimming level is possible
Protection	Protection function	Incorrect writing is prevented

8.1. Clock Supply

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

For the details, refer to "Clock control and operation mode" in Reference manual.

9. Sample Program

This sample program executes adjustment of the frequency of the internal oscillator using the trimming circuit (TRM) in TPM3H6FWFG.

The low-speed clock (32.768 kHz) or an external clock are available as the reference clock.

The reference clock is selected by "TRMOSC_LOSC" in the macro "txz_sample_def.h".

Low-speed clock (32.768 kHz): TRMOSC_LOSC should be enabled.

External clock: TRMOSC_LOSC should be disabled.

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

After the initialization, the "main" function is executed, and the following initialization is done.

1. BSP (Board Support Package) initialization
2. Initialization of the external low-speed oscillator
3. Trigger selector initialization
4. Application initialization
5. T32A initialization (Interval timer output setting)
6. T32A initialization (Capture setting)
7. Initialization of the trimming control register (for debugging)
8. Trimming procedure starts.

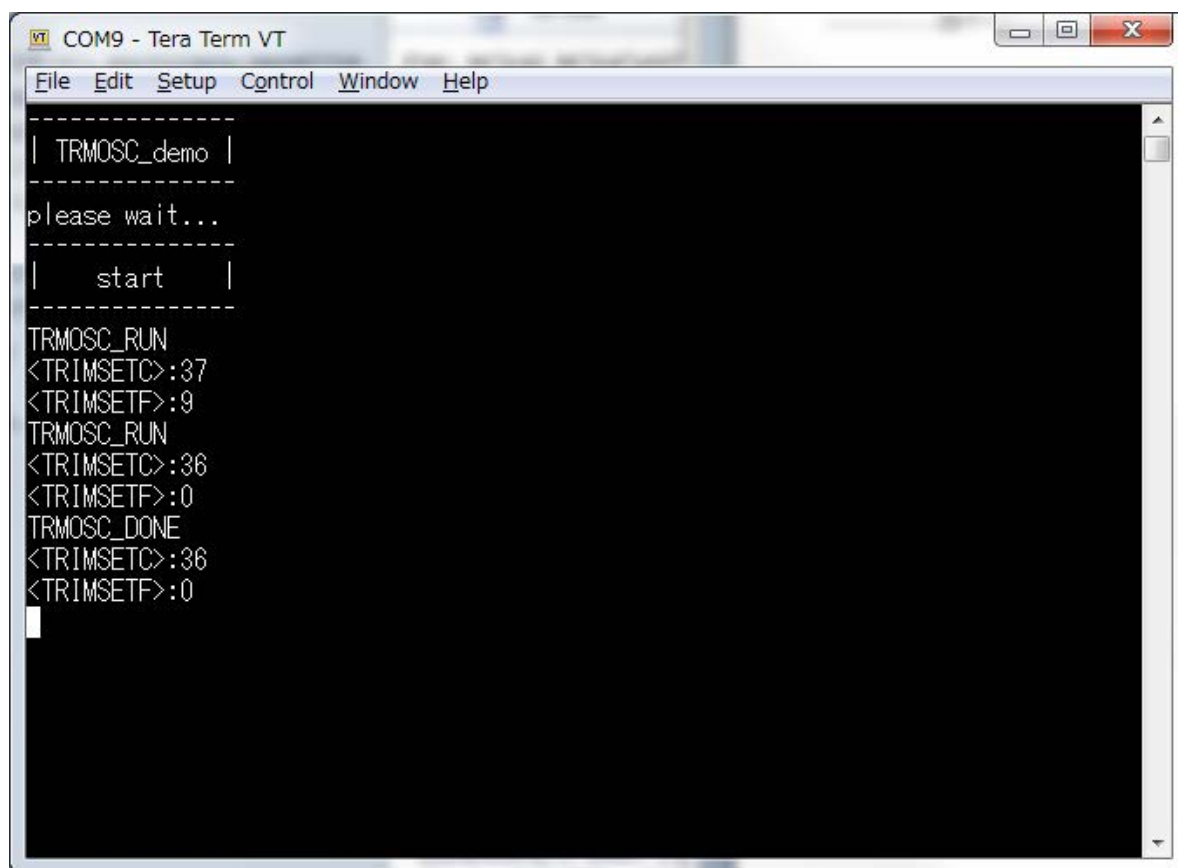
The adjustment procedure for the internal oscillator starts. The adjustment value is set to the register and the result of the procedure is issued. Then the infinite loop procedure executes.

The adjustment procedure completes when TRMOSC_DONE is issued to the terminal software.

When Initial trimming value is issued to the terminal software, the adjustment procedure completes and the adjustment value is the same one at shipment.

9.3. Output Example of Sample Program

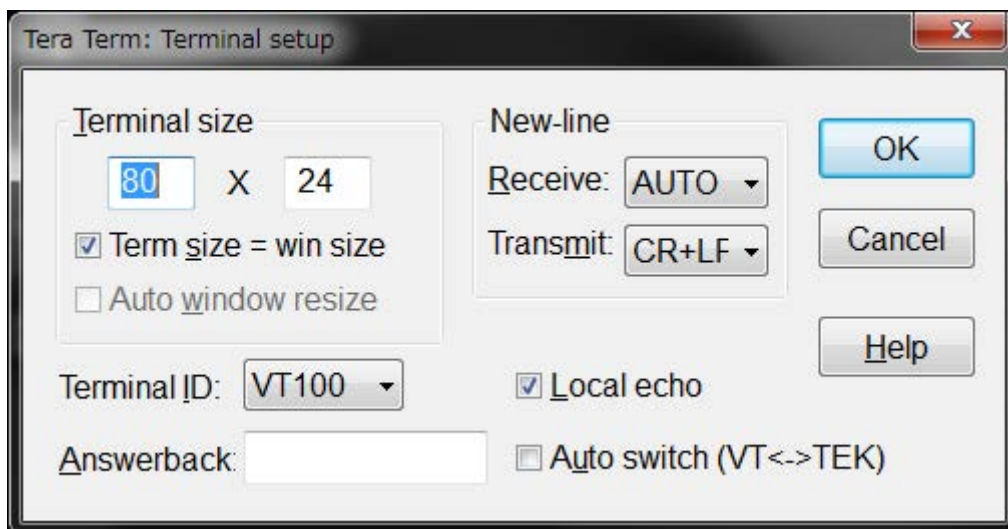
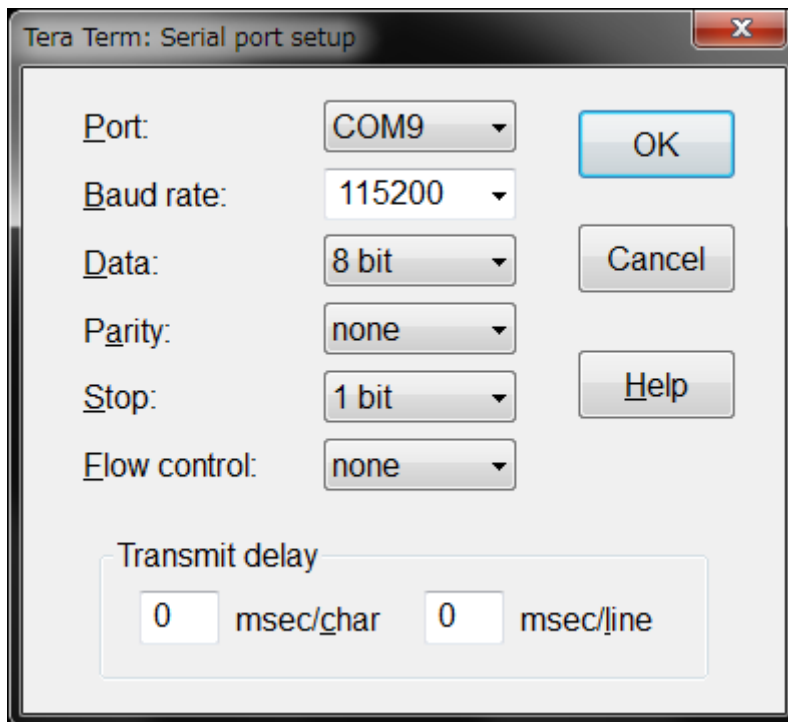
When the sample program operates, the command results are shown as follows;



```
COM9 - Tera Term VT
File Edit Setup Control Window Help
-----
| TRMOSC_demo |
-----
please wait...
-----
| start |
-----
TRMOSC_RUN
<TRIMSETC>:37
<TRIMSETF>:9
TRMOSC_RUN
<TRIMSETC>:36
<TRIMSETF>:0
TRMOSC_DONE
<TRIMSETC>:36
<TRIMSETF>:0
```

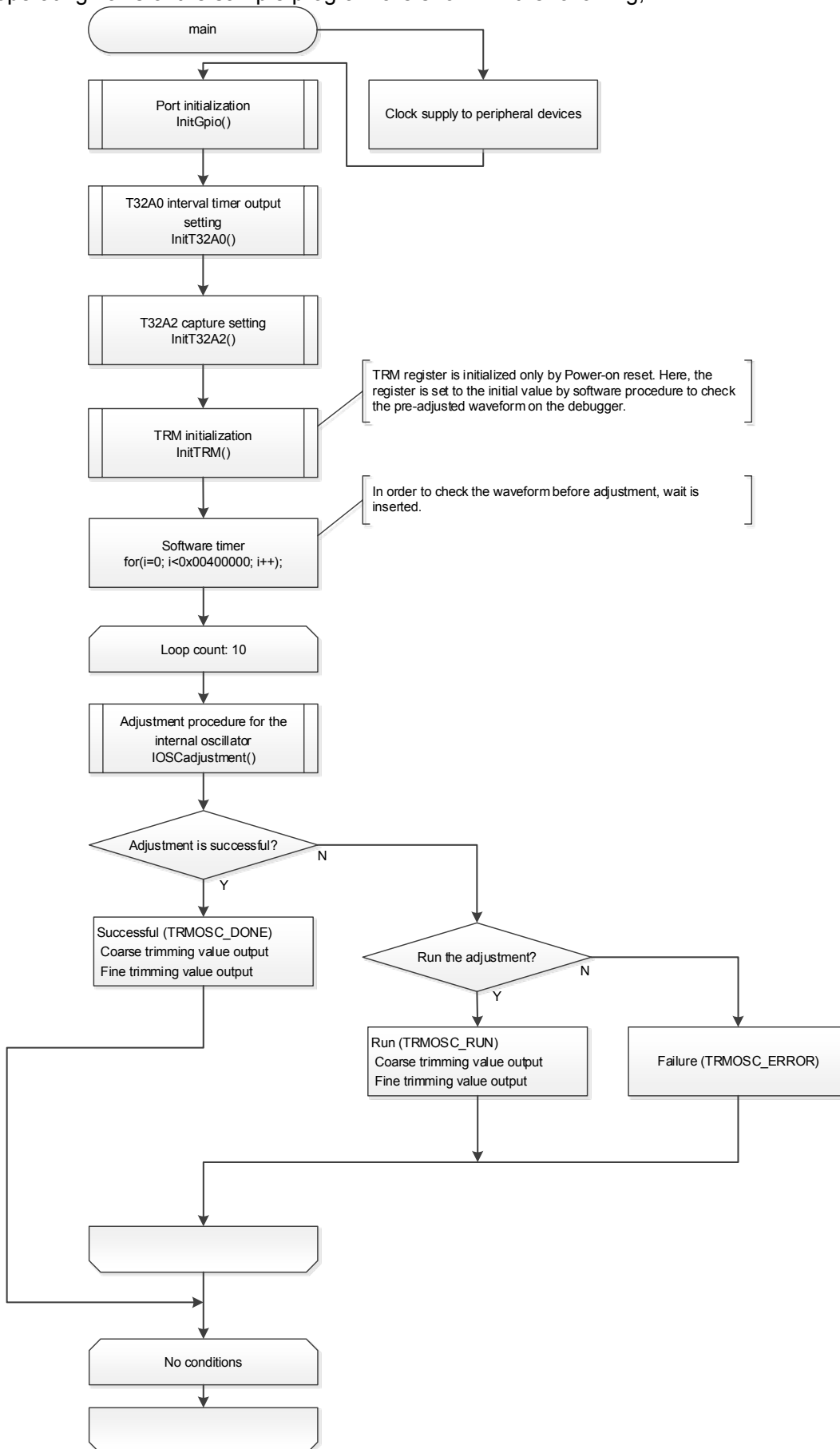
9.3.1. Setting Example of Terminal Software

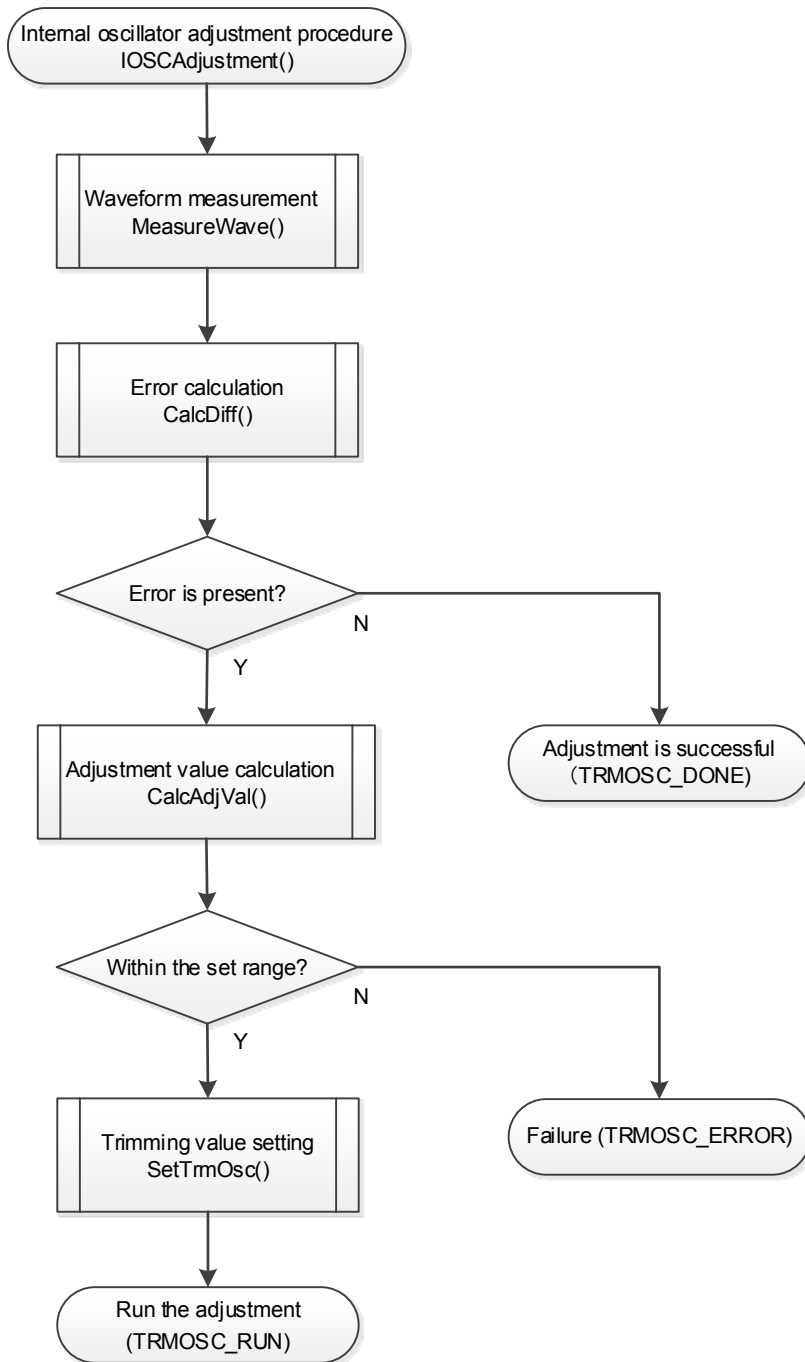
The operation of the terminal software (Tera Term) has been checked with the following settings.



9.4. Operating Flow of Sample Program

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





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	2018-03-29	-	First release

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