R8C/33T group

workbench4 manual

REJ05B1364-0103
Rev.1.03
Jun. 23, 2011

Summary

Touch panel microcomputer R8C/33T group builds hardware (SCU: sensor control unit) that perceives the contact of the human body by measuring the stray capacity generated between the touch electrode and the human body into.

In this application note, we explain the operation of R8C/3xT Workbench4 (Hereinafter, the Workbench4 is simply called Workbench). In addition, this application note gives descriptions on Version 4.60 or a later version.

Target device

R8C/3xT

Contents

1. Installation 2
2. To connect to the target board through Communication port 4
3. To connect to the target board through High-performance embedded Workshop 10
4. To connect to the target board through I/F board 19
5. About ChipID 27
6. Function explanation 30
7. Touch sensor adjustment using Workbench 72
8. The restrictions about the change of the R8C/3xT S/W driver 98
9. Notes 101

Website and Support 102

Revision Record 102

General Precautions in the Handling of MPU/MCU Products 103

1. Installation

1.1 Outline

This paragraph explains the method of installing Workbench.

1.2 System requirement

The system requirement for Workbench is shown below.

Table 1-1 System requirement

OS	Remarks
Windows XP (32 bit version)	Since Service Pack 2 Physical memory 256 MB or more is recommended. Since Windows installer 3.1 The Administrator authority is necessary for the installation.
Windows Vista (32 bit version)	Since Service Pack 2 The physical memory 1 GB or more is recommended.
Windows 7 (32 bit version)	The physical memory 1 GB or more is recommended. 64 bit version is not supported.

1.3 Installation

Carry out “Setup-english.msi”, and install Workbench according to the instructions of the Setup wizard.

1.4 Attention in the use on Windows Vista or Windows 7

1.4.1 Description

When you start Workbench on Windows Vista or Windows 7, the OS may requests you to be logged on as a member of the Administrators group; that is, you cannot run them on the OS by user rights.

This problem arises when you are logged on as a member of the Administrators group and make the settings for running Workbench on Windows Vista or Windows 7 by using the Compatibility tab. In this case Workbench cannot be connected to the target board through High-performance Embedded Workshop, and a main function becomes unusable.

Figure 1-1 Request for Administrator group

1.4.2 Workarounds

To avoid the problem, use either of the following ways: Re-setting items in the Compatibility tab of the program's Properties dialog box.

a) Right-click the shortcut of Workbench to open the Properties dialog box.

b) In the Compatibility tab, clear the following two check boxes:

- Run This Program in Compatibility Mode
- Run the Program as an Administration

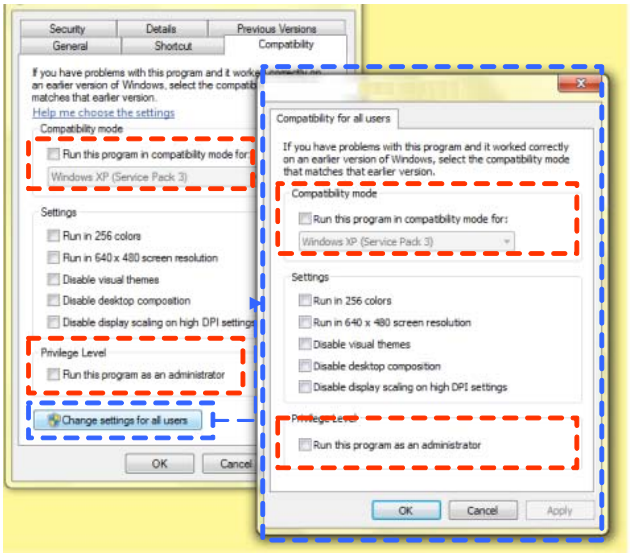


Figure 1-2 The changes of property of Workbench's shortcut

2. To connect to the target board through Communication port

The procedure to connect a target board to Workbench with Communication port (COM port) is as follows.

2.1 Connection with the target board

According to the interface between a target board and a PC, the target board is connected to the PC with a serial cable or USB cable.

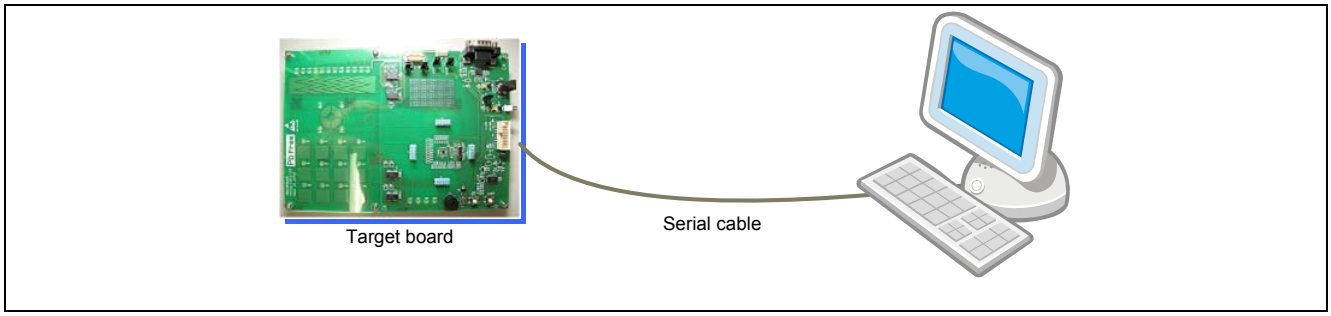


Figure 2-1 Connection between a target board and a PC using a serial cable

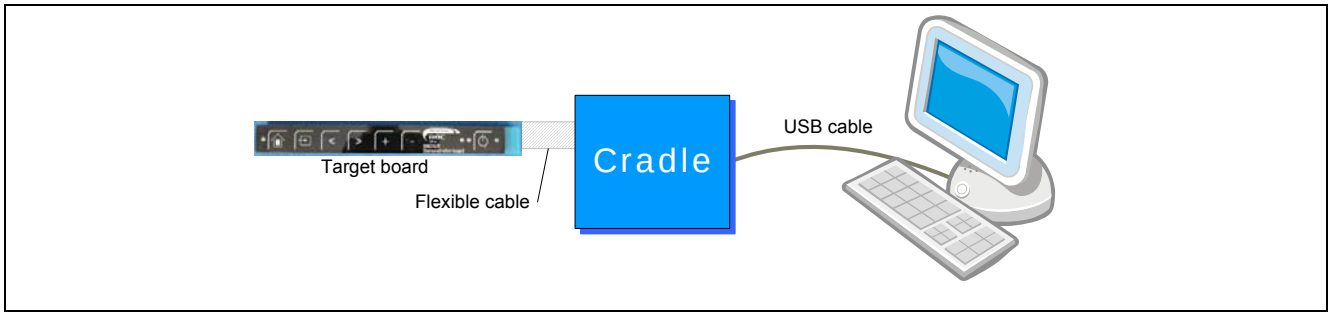


Figure 2-2 Connection between a target board and a PC using the Cradle board

Caution; using the cradle board:

Because the cradle board is not equivalent to suspend/resume, please note as follows.

> When you restart or suspend/resume PC connecting the cradle board with USB, reset the cradle board by pushing the reset switch of the cradle board after PC starts.

2.2 Confirmation of the COM port

Confirm COM port to use in device manager beforehand. When you use a USB to Serial port converter, install the driver software.

2.3 COM Port configuration starting

Select “Connect” menu ([Communication] - [Connect]) or click the toolbar button ( ) to wakeup COM port configuration.

Refer to [6.2.1 COM Port configuration] about the controls of “COM port configuration”.

Refer to [2.9 COM port settings for R8C/3JT Demonstration set(TV-type)] for various setting such as baudrate at the connection between R8C/3JT Demonstration set(TV-type) and Workbench through the Cradle board.

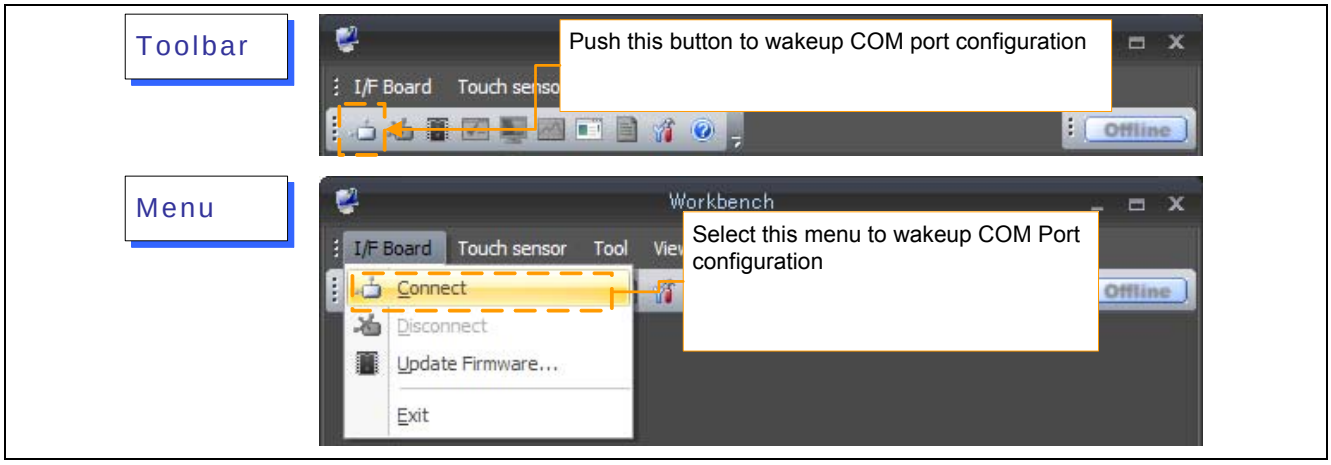


Figure 2-3 the method of starting COM Port configuration

2.4 COM port setting

Choose COM port to use for the communication with the target board.

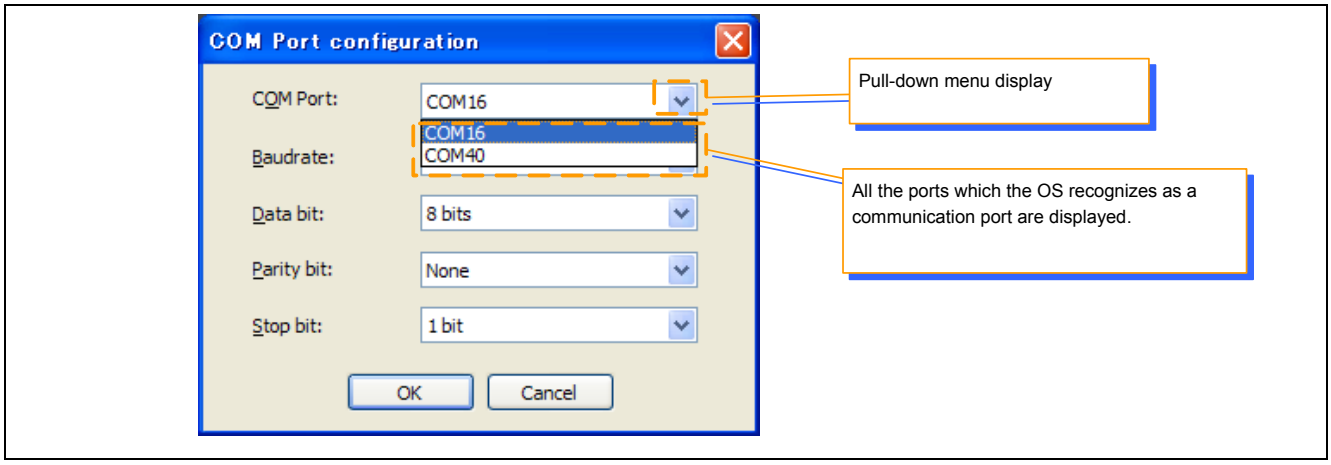


Figure 2-4 COM port selection

2.5 Baudrate setting

Choose a baudrate at the time of communication between the target board and Workbench.

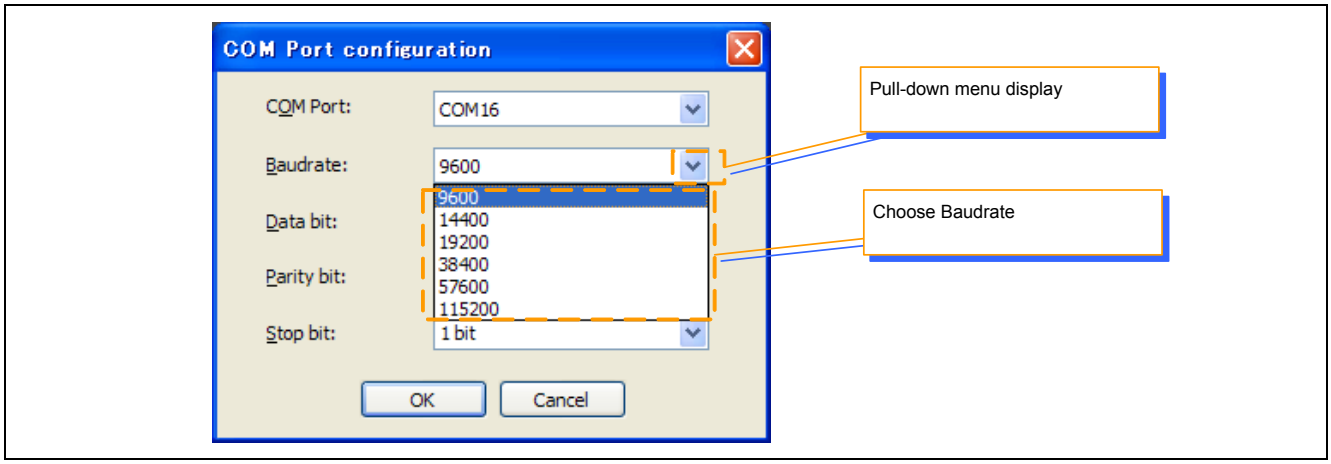


Figure 2-5 Baudrate selection

2.6 Data bit setting

Choose a data bit at the time of communication between the target board and Workbench.

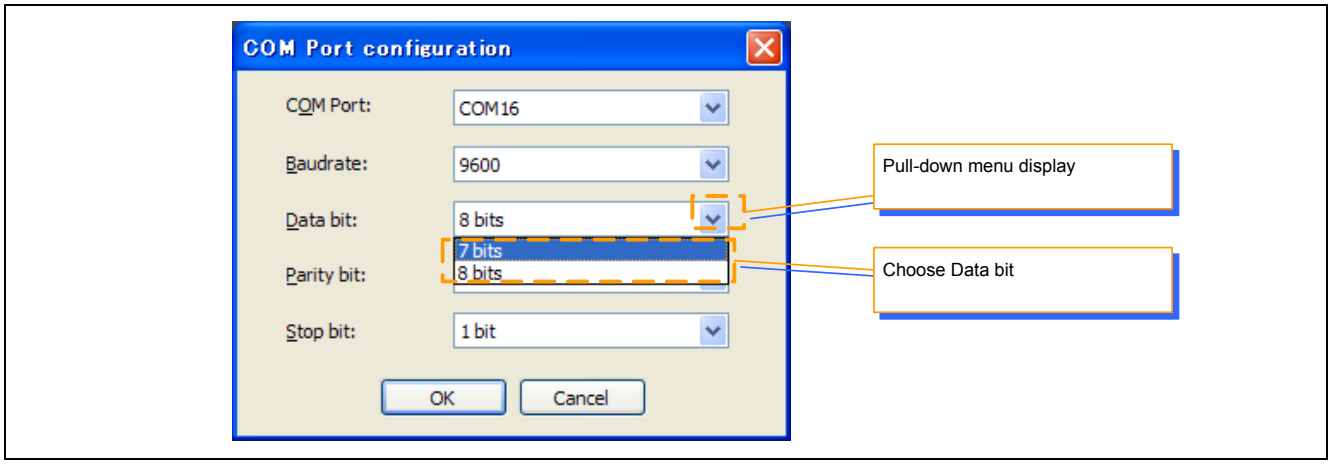


Figure 2-6 Data bit selection

2.7 Parity bit setting

Choose a parity bit at the time of communication between the target board and Workbench.

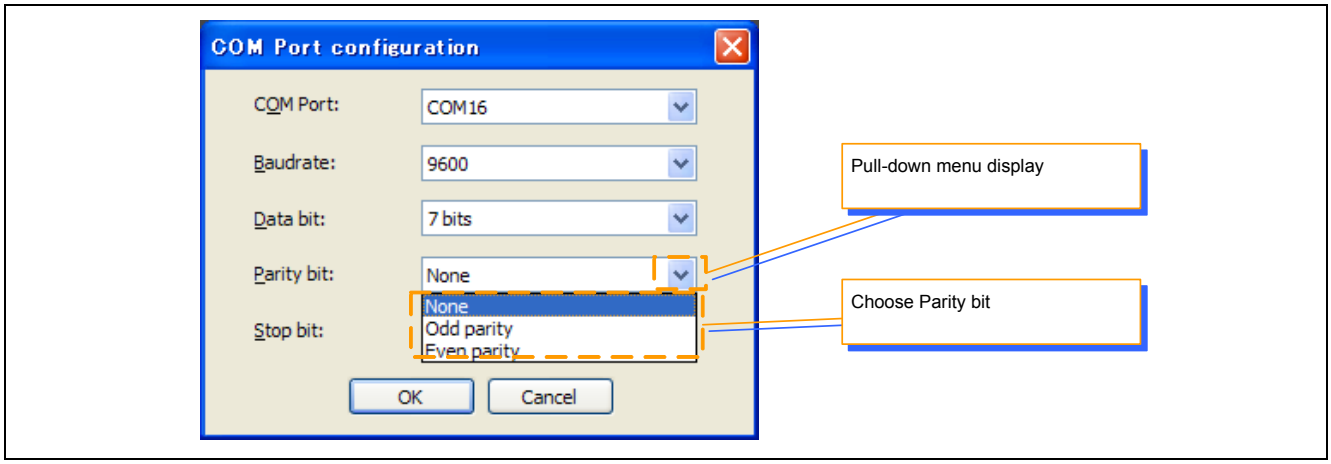


Figure 2-7 Data bit selection

2.8 Stop bit setting

Choose a stop bit at the time of communication between the target board and Workbench.

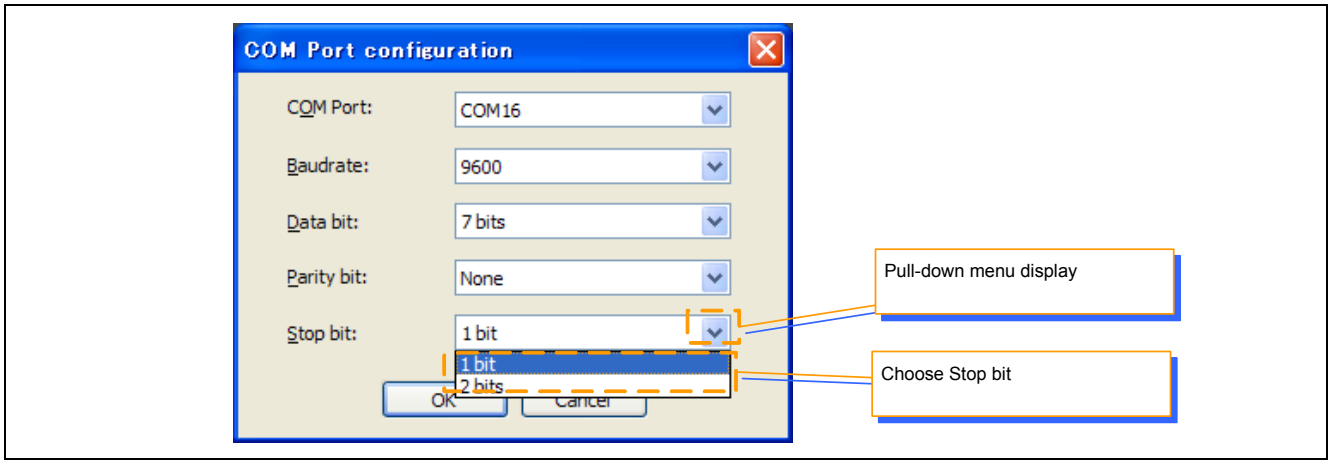


Figure 2-8 Stop bit selection

2.9 COM port settings for R8C/3JT Demonstration set(TV-type)

COM port settings to connect between R8C/3JT Demonstration set(TV-type) and workbench through the Cradle board is as follows.

Table 2-1 COM port setting for R8C/3JT Demonstration set(TV-type)

Item	Value
COM Port	Choose COM port assigned to the Cradle board. (1)
Baudrate	38400
Data bit	8 bits
Parity bit	None
Stop bit	1 bit

Notes: Confirm Device manager to check which COM port assigned to the cradle board.

The setting example of the COM Port configuration is as follows.

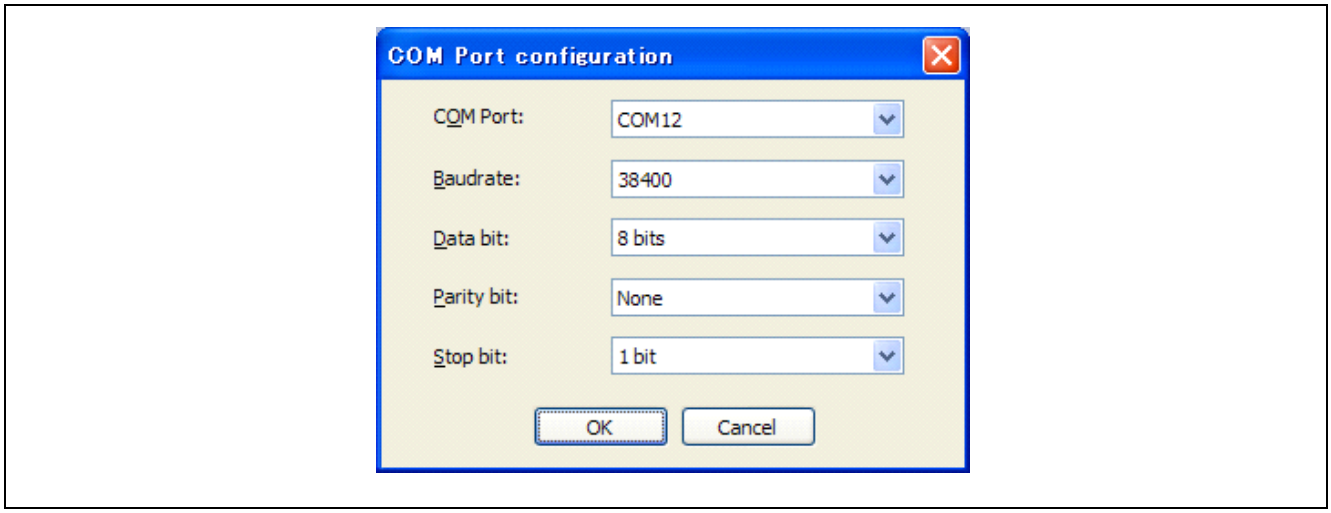


Figure 2-9 The setting example of COM port settings for R8C/3JT Demonstration set(TV-type)

2.10 Connect / Disconnect

Start the connection with the target board by pushing [OK] button of COM port configuration after setting according to "2.2 Confirmation of the COM port" - "2.8 Stop bit setting".

When the connection with the target board succeeds, Communication state is displayed with “Online”.

When the connection with the target board fails, confirm the settings according to "2.2 Confirmation of the COM port" - "2.8 Stop bit setting".

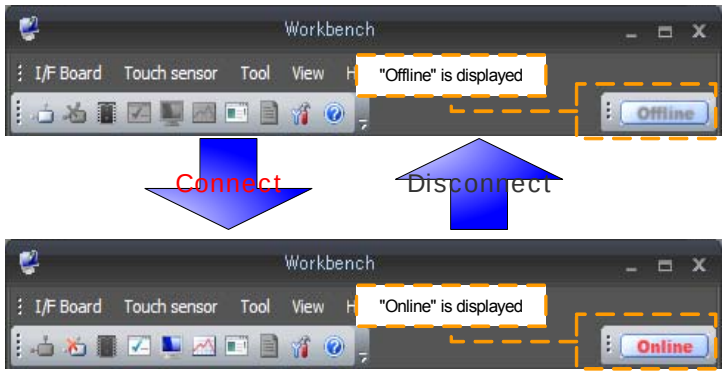


Figure 2-10 The status of connection with target board

Select “Disconnect” menu ([Communication] - [Disconnect]) or click the toolbar button ( ) to disconnect with target board.

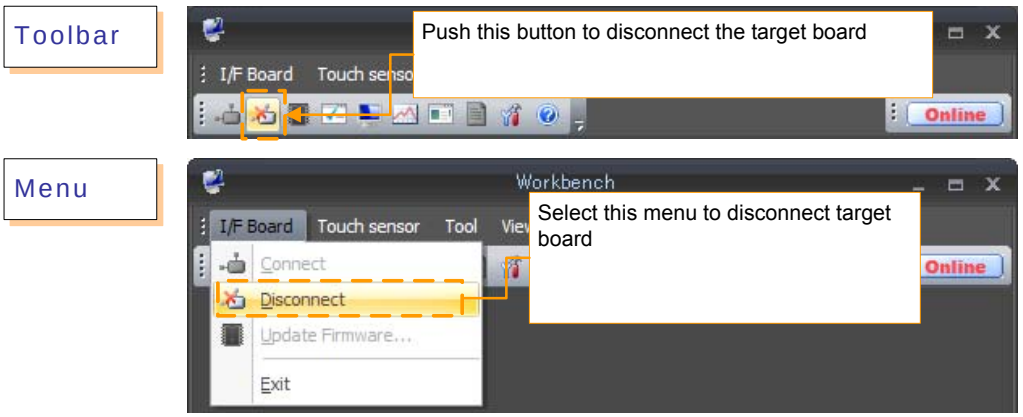


Figure 2-11 The method of disconnection with target board

3. To connect to the target board through High-performance embedded Workshop

Workbench provides the method of the connection to the target board through High-performance Embedded Workshop (HEW) in addition to the method of the connection to the target board using the I/F board. The I/F board need not be connected when connecting to the target board through HEW.

Hereafter, it explains the procedure from connecting to the target board through HEW to monitoring the count value of the touch sensor using Workbench.

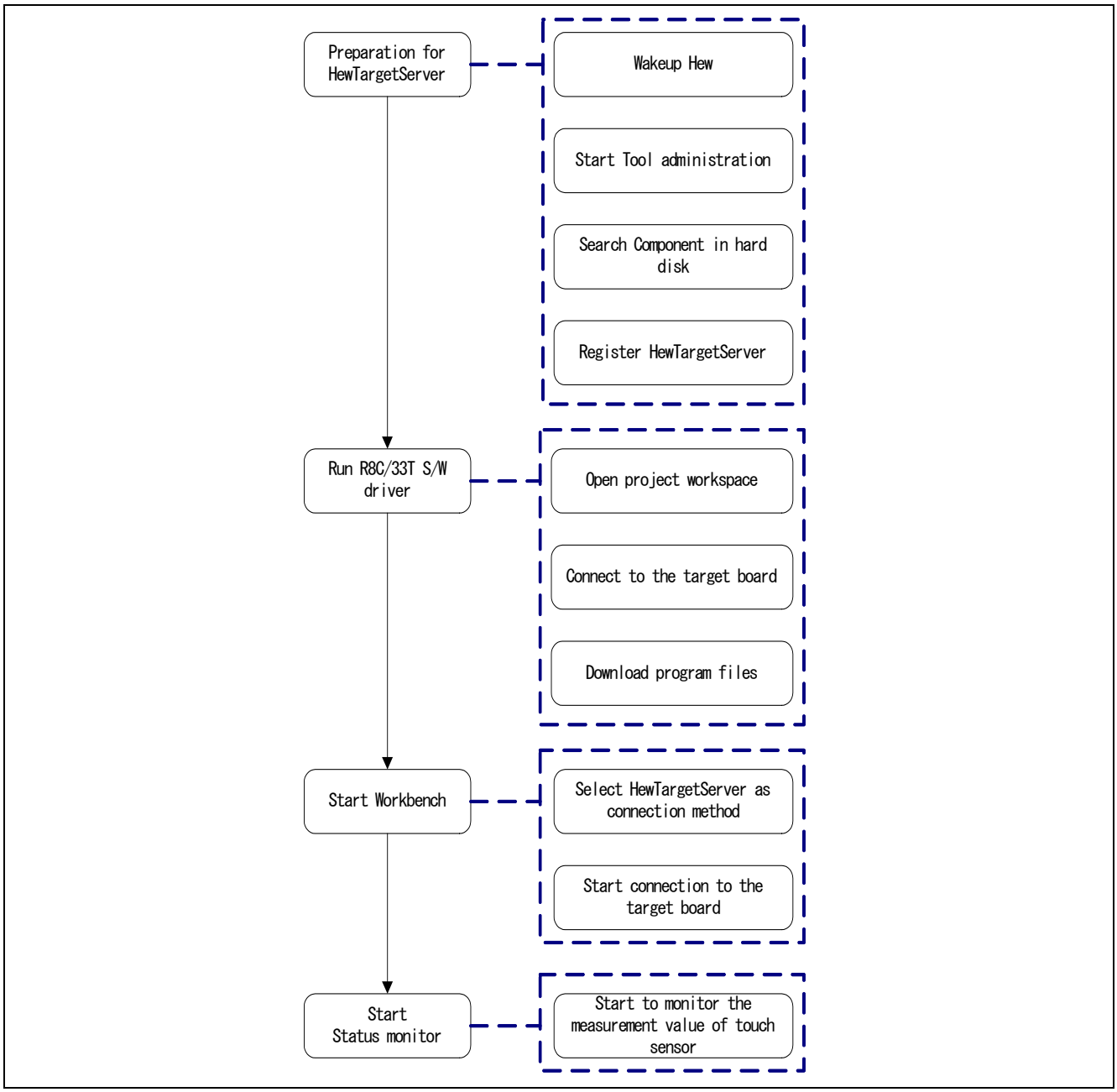


Figure 3-1 Procedure for connecting Workbench with target board through HEW

3.1 Preparation for HewTargetServer

Start HEW and register “HewTargetServer” using the “Administration”.

“Administration” button of "Welcome!" window is pressed, and the “Tools administration” is displayed.

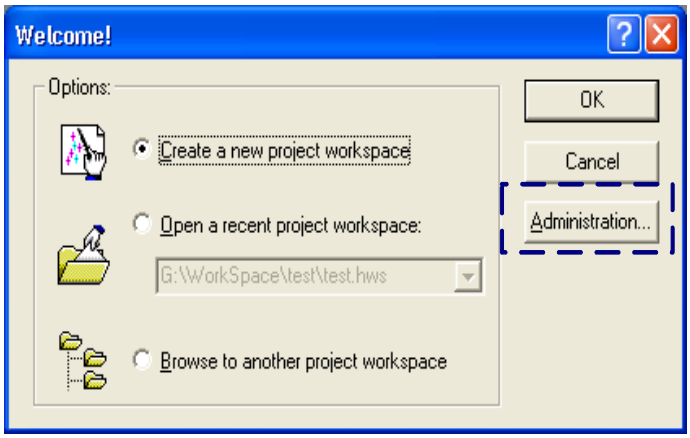


Figure 3-2 HEW start

"Search disk" button is pressed, and "Search disk for components" window is started.

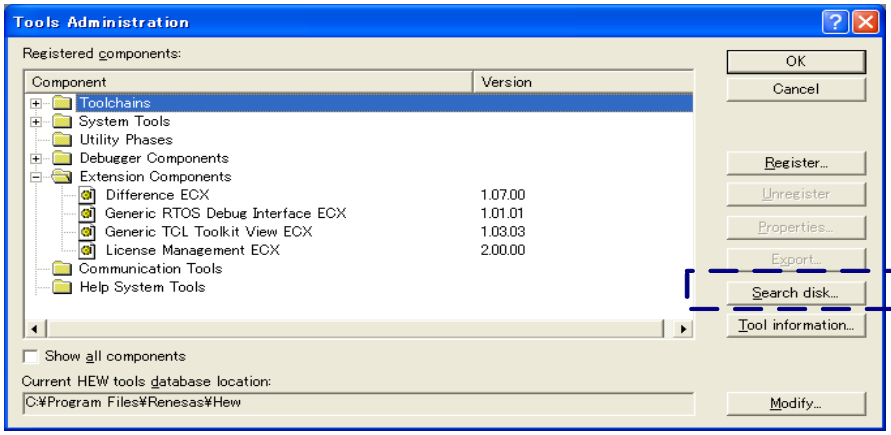


Figure 3-3 Tools Administration

The “Start” button is pressed, and the component is retrieved. HewTargetServer displayed in “ Located components” is selected as a result of the retrieval, the “Register” button is pressed, and “HewTargetServer” is registered.

The “Close” button is pressed, and the “Search disk for components” is closed.

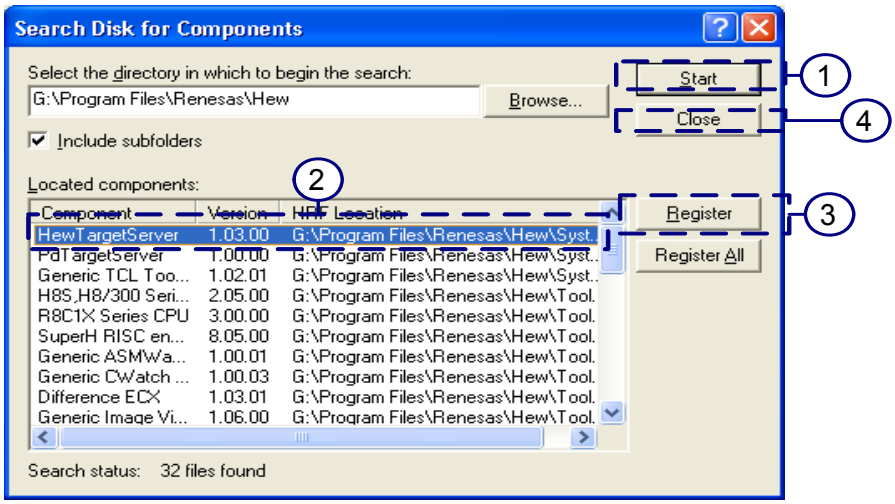


Figure 3-4 Search disk for components

It is confirmed that “HewTargetServer” is registered in “Extension Components”.

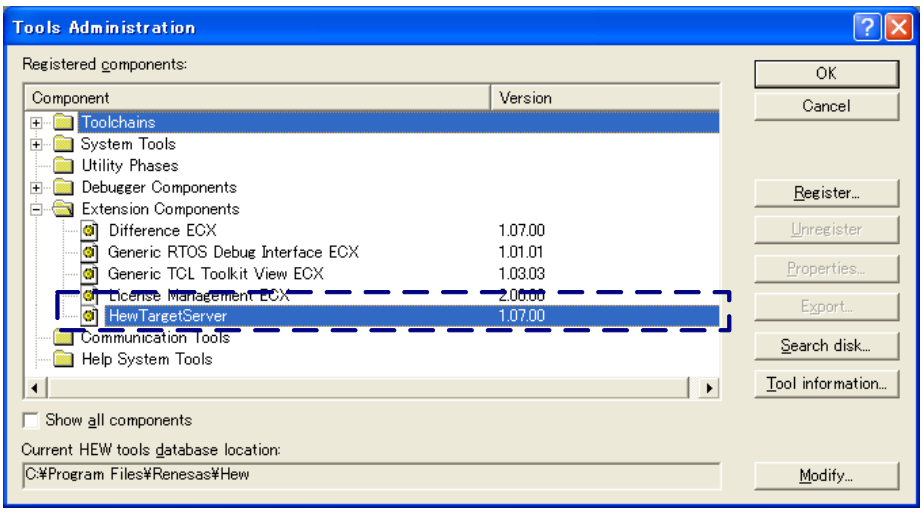


Figure 3-5 Registration confirmation of HewTargetServer

3.2 The R8C/3xT S/W driver's execution

R8C/33T S/W driver's project workspace is opened. The build doing and the download module are prepared if necessary.

3.2.1 Connection with the target board

The connection of HEW and the target board begins. Select the “Mode” in the “Emulator Setting” excluding "Program Flash". In case of selection “Program Flash”, it is impossible for Workbench to start “Status monitor” and “Setup parameters” because Workbench cannot recognize the R8C/33T S/W driver’s execution.

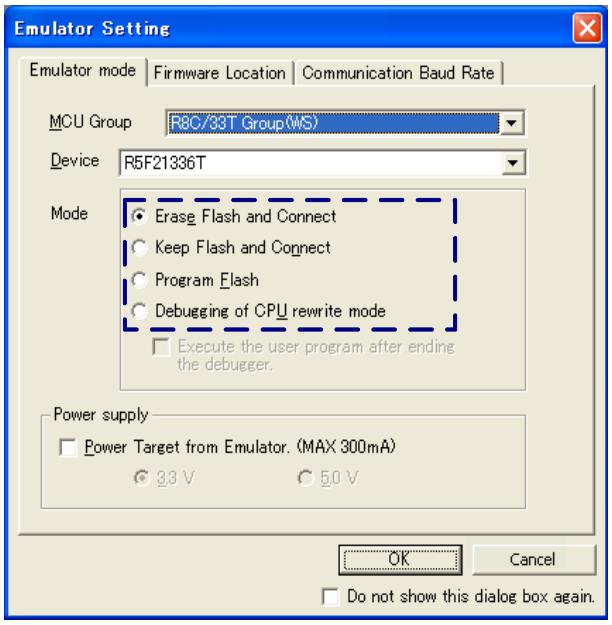


Figure 3-6 Emulator mode setting

The “Communication Baud Rate” strongly recommends a high baud rate to be used as much as possible. The performance of the monitor using “Status monitor” is expected to fall greatly when the baud rate is low.

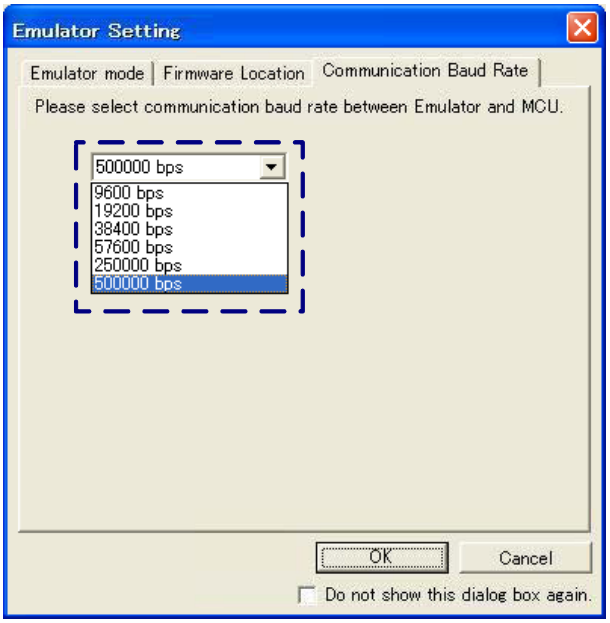


Figure 3-7 Emulator communication baud rate setting

3.2.2 Program download and execution

Download all programs and data and execute the program. The automatic update function is strongly recommended to be invalidated when RAM monitor of HEW is used after the program is executed. CPU resource of PC is consumed when the automatic renewal is made effective, and it is expected to influence the performance of Workbench greatly.

3.3 Start Workbench

3.3.1 Selection of connection method

When Workbench is started for the first time, the following window is displayed. Select “Hew Target Server”, and Press “OK” button.

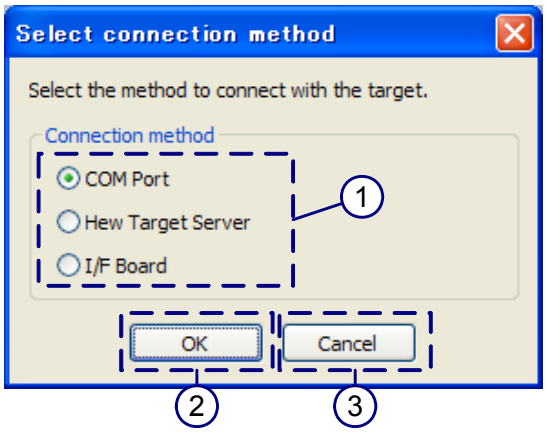


Figure 3-8 Selection of connection method

Table 3-1 Controls

No	Control	Remarks
1	Connection method	The function to select the method connection to the target board is offered. - COM Port Workbench connects the target board through COM port. - Hew Target Server Workbench connects the target board through HEW. - I/F Board Workbench connects the target board using the I/F board.
2	OK	Workbench connects to the target board by the selected connection method, and “Select connection method” is closed.
3	Cancel	It is considered that Hew Target Server was selected, Workbench connects to the target board through HEW, and “Select connection method” is closed.

3.3.2 Connection beginning

When “Connect” menu is selected in main window of Workbench, “HEW connection” is displayed and the state of HEW is confirmed. A flag icon on the left of “Program running” changes into green and Workbench starts the connection to the target board, when R8C/33T S/W driver is running.

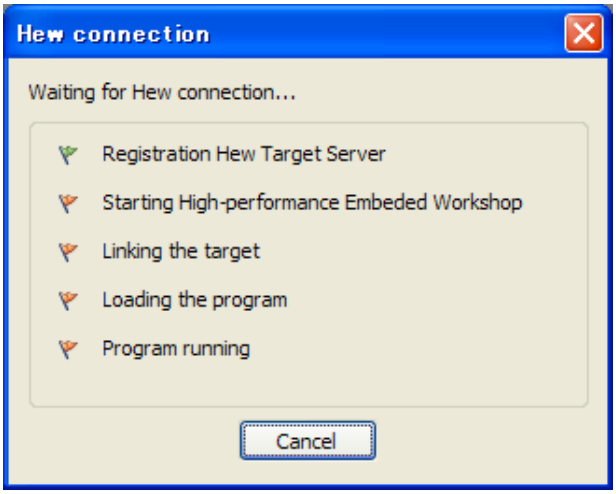


Figure 3-9 HEW connection

The Communication state changes to “Online” in the main window of Workbench when the connection is completed.

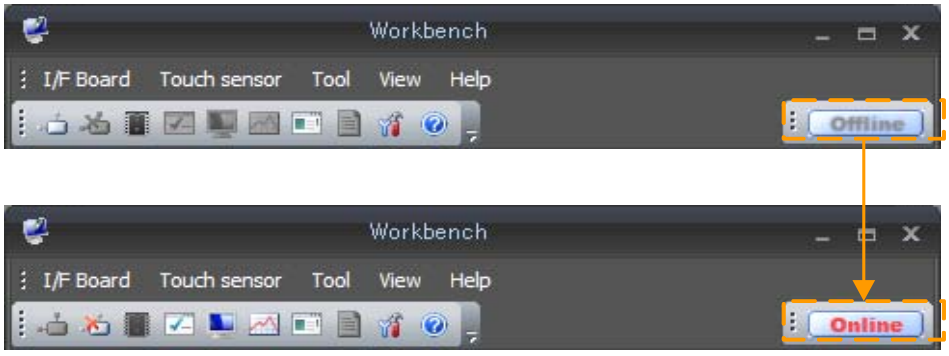


Figure 3-10 Communication state

3.3.3 Start Status monitor

Start “Status monitor” by the menu or the toolbar button of Workbench. The start method offers two kinds of the following.

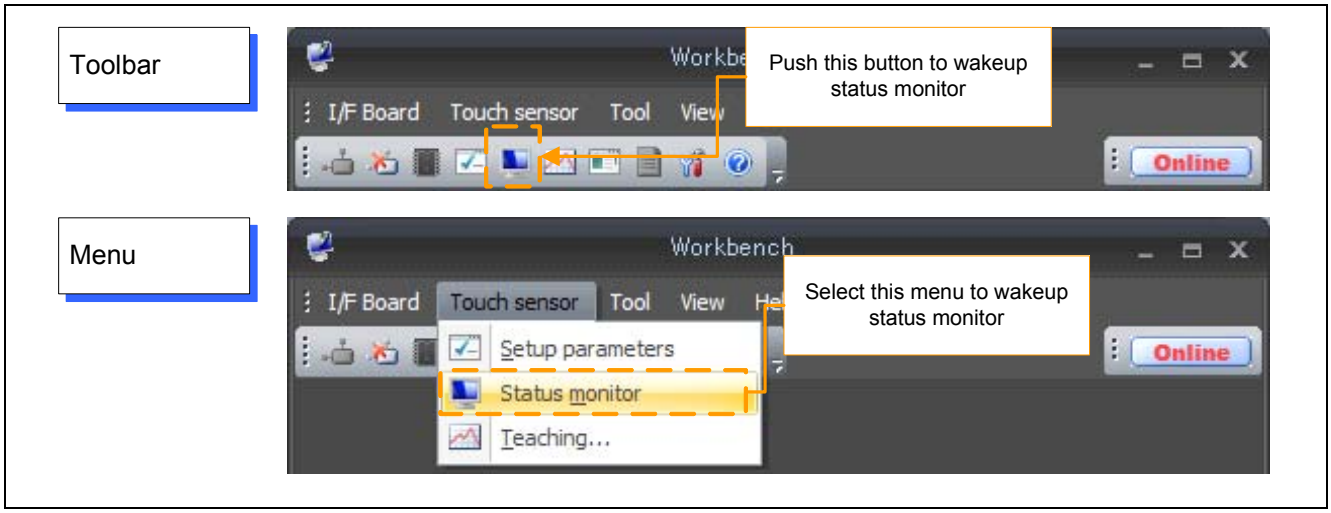


Figure 3-11 the method of starting “Status monitor”

3.3.4 Monitor beginning

Press “Start” button, and the monitor of the count value of the touch sensor in “Status monitor” is begun.

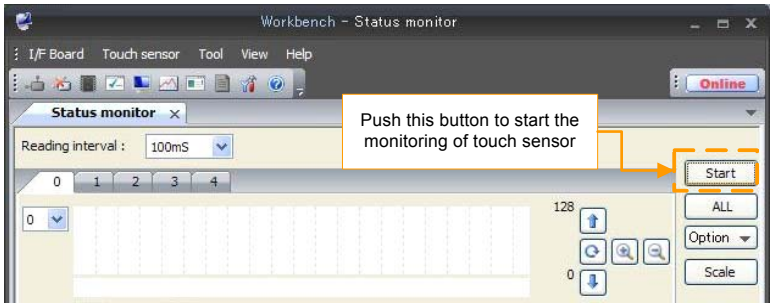


Figure 3-12 Monitor beginning

The count value of touch sensor is displayed in the graph as follows.

Figure 3-13 Status monitor window

4. To connect to the target board through I/F board

This chapter shows the procedure that Workbench connects with the target board through I/F board.

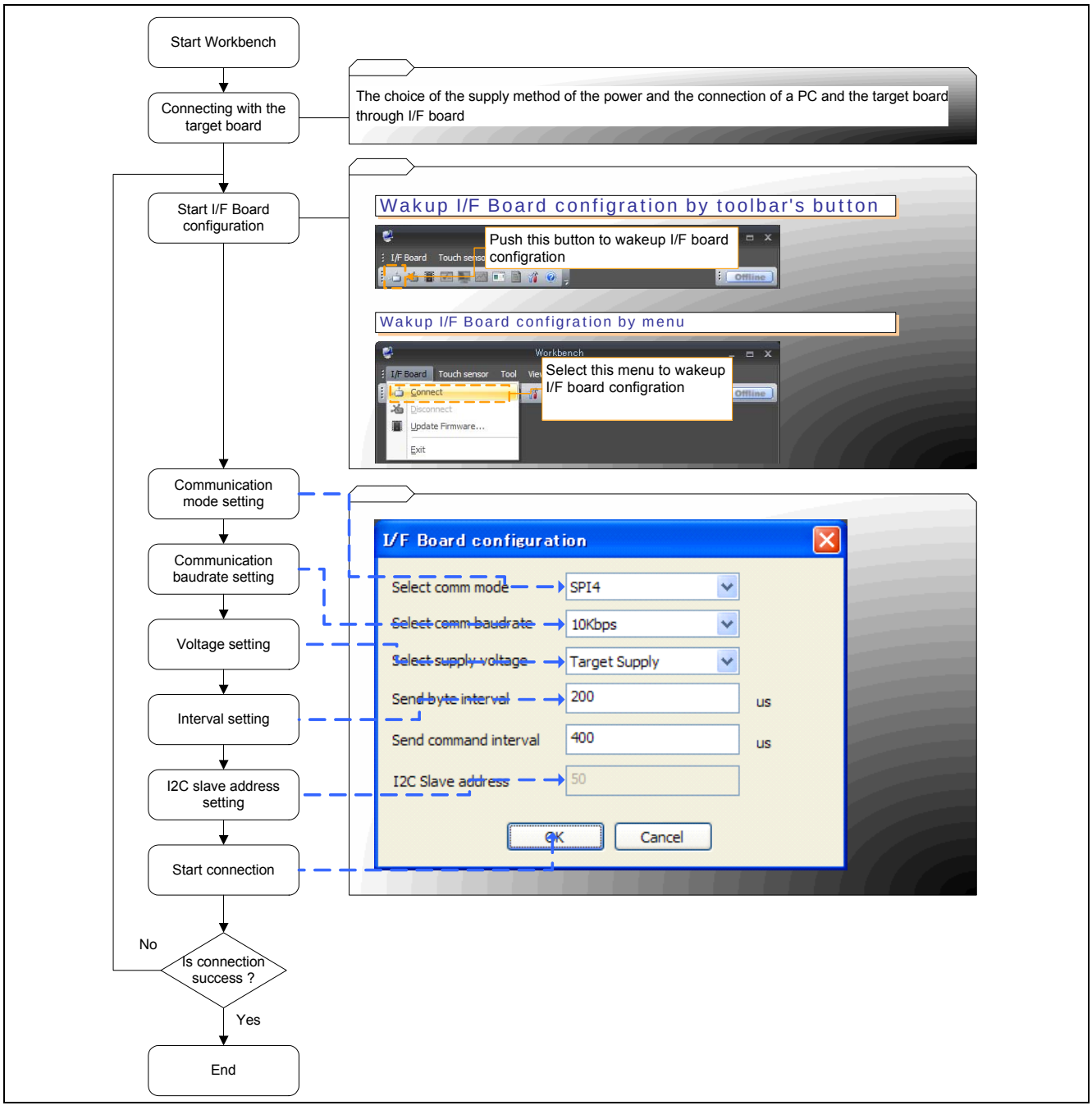


Figure 4-1 Procedure to connect Workbench to the target board through I/F board

4.1 Connecting with the target board

There are three possible power supply configurations for the target board. Insure only one supply method is used at one time

4.1.1 Using Power Supply Circuit on the target board

When the power is equipped with a power supply circuit, the power is supplied from the target board to the I/F board through the flat cable.

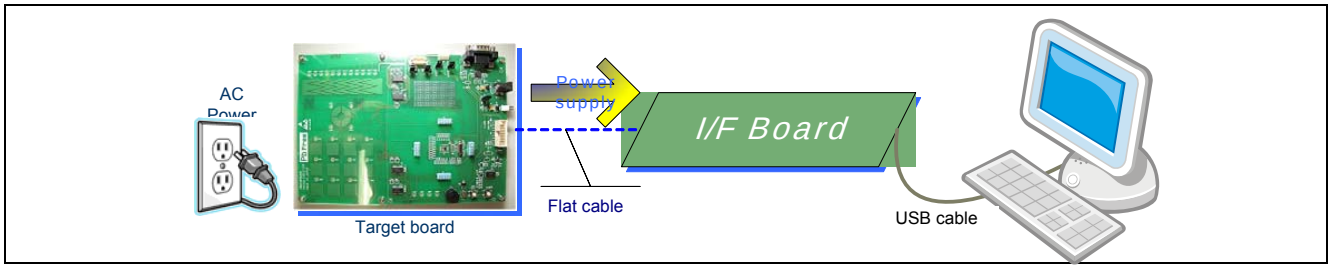


Figure 4-2 The example using the power supply circuit on the target board

4.1.2 Using USB Bus Power

When there is no power supply on the target board and the power is not supplied from the external power supply, the USB bus power is supplied from the I/F board to the target board through the flat cable. Select “USB 3.3V Supply” or “USB 5V Supply” in I/F board configuration.

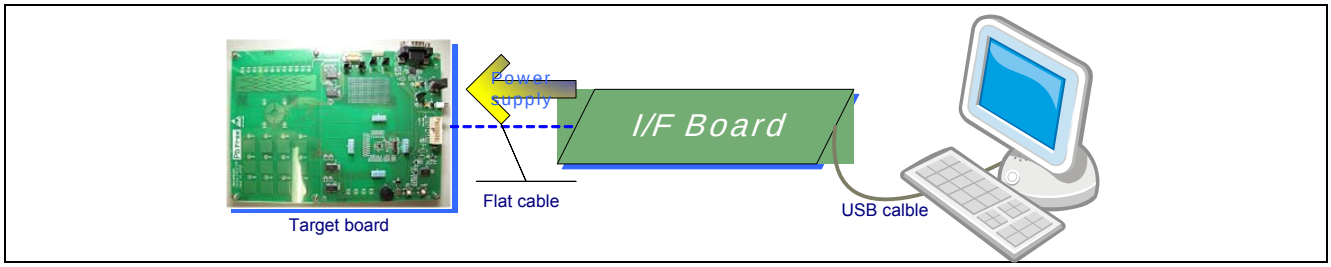


Figure 4-3 The example of power supply from the USB port

4.1.3 Using Power Supply Controller

When the power is supplied from Power Supply controller, connect “Ext. Power” on I/F board with Power Supply Controller. The power-supply voltage must be in the range of 3.0V - 5.0V.

Select “I/F board Ext. Supply” in I/F board configuration.

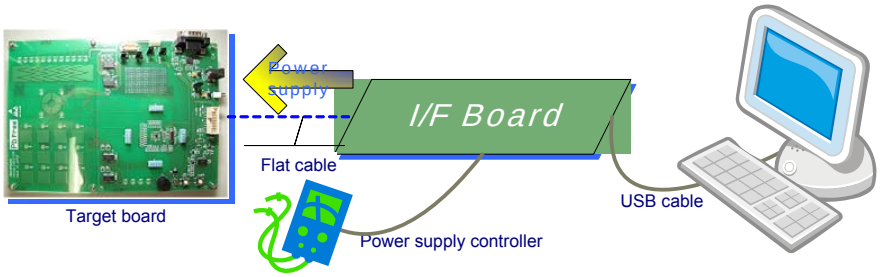


Figure 4-4 The example which supplies a power from Power supply controller

4.2 I/F Board configuration starting

Select “Connect” menu ([Communication] - [Connect]) or click the toolbar button ( ) to wakeup I/F board configuration.

Refer to [6.2.2 I/F Board configuration] about the controls of “I/F board configuration”.

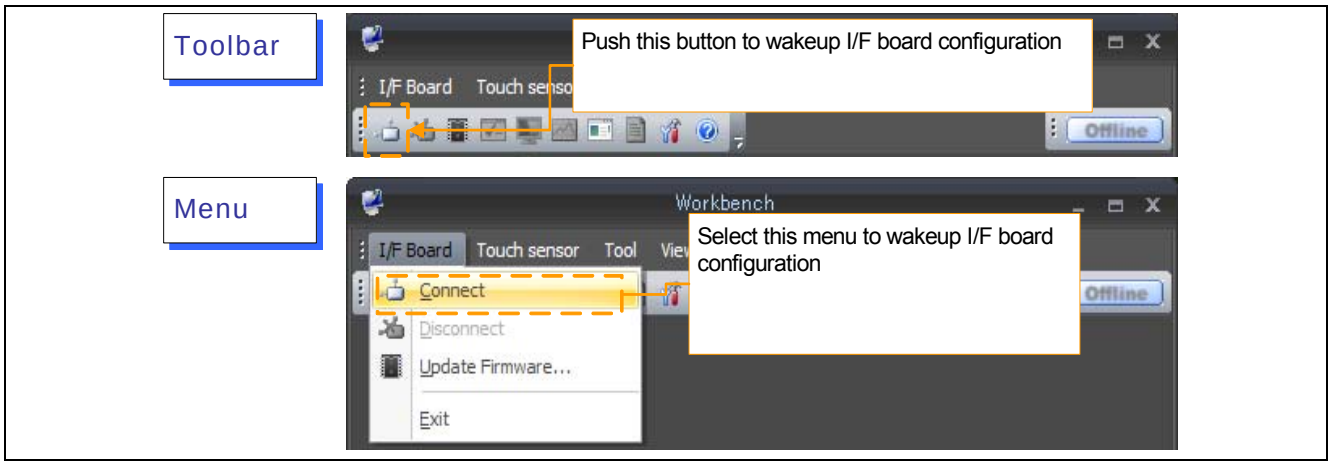


Figure 4-5 The method of starting I/F Board configuration

4.3 Communication mode setting

Select “Communication mode” of target board and I/F board.

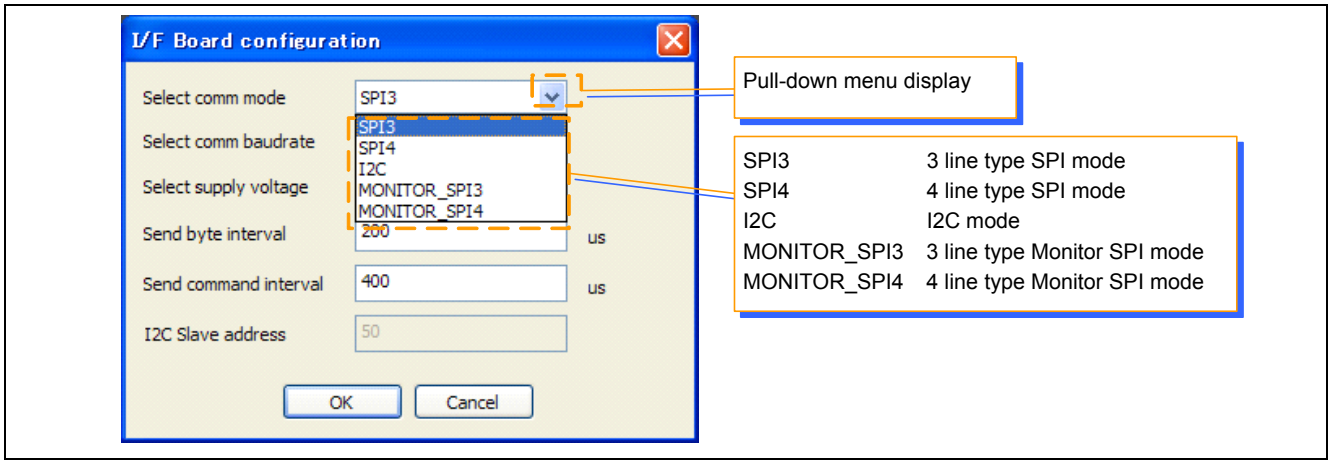


Figure 4-6 Communication mode selection

4.4 Communication baudrate setting

Select the communication baudrate of target board and I/F board.

The communication baudrate is different in a choice according to communication mode.

4.4.1 SPI3 or SPI4 mode

When the communication mode is SPI3 or SPI4, choose the communication baudrate as follows.

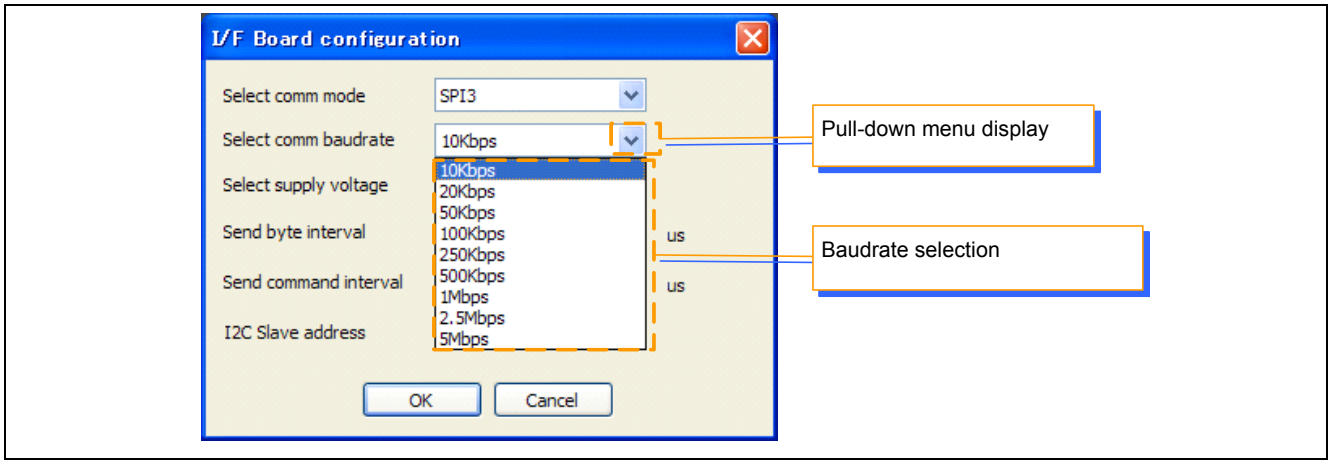


Figure 4-7 Communication baudrate(for SPI3/SPI4) selection

4.4.2 I2C mode

When communication mode is I2C, choose the communication baudrate as follows.

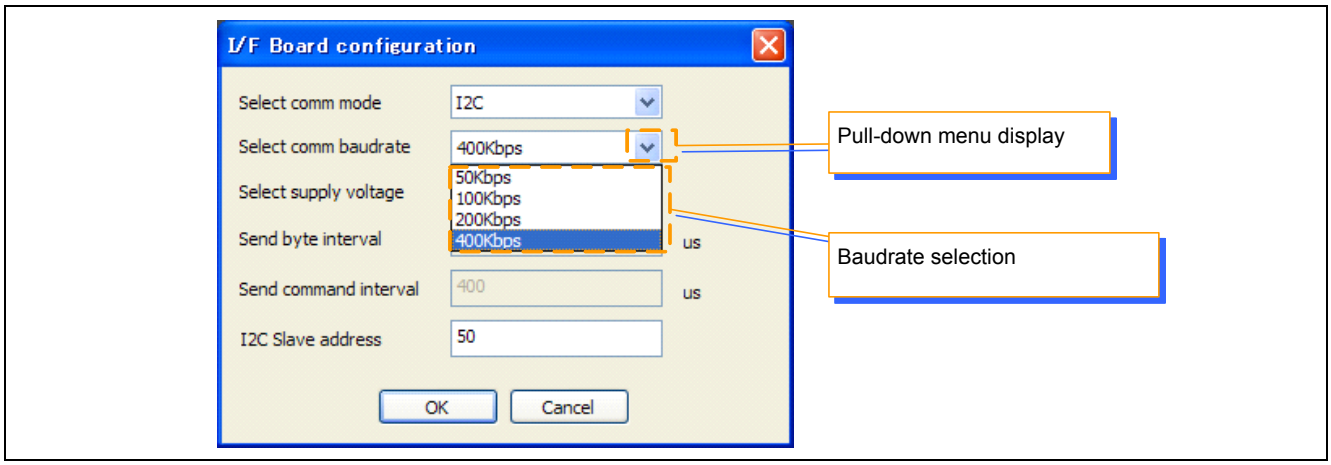


Figure 4-8 Communication baudrate(for I2C) selection

4.5 Power supply

Select the Power supply as follows.

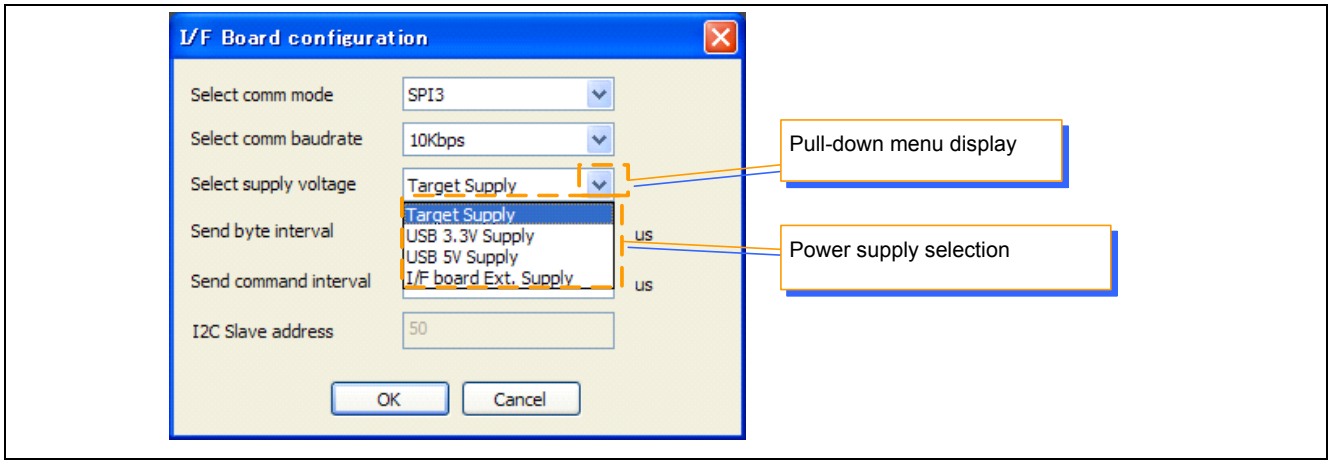


Figure 4-9 The method of supply power selection

4.6 Communication timing

Set the communication time of target board and I/F board. When the communication mode is SPI3 or SPI4, the timing is able to set. The setting items are as follows.

- Send byte interval

  Timing setting to transmission data at interval

- Send command interval

  Timing setting to transmission command at interval

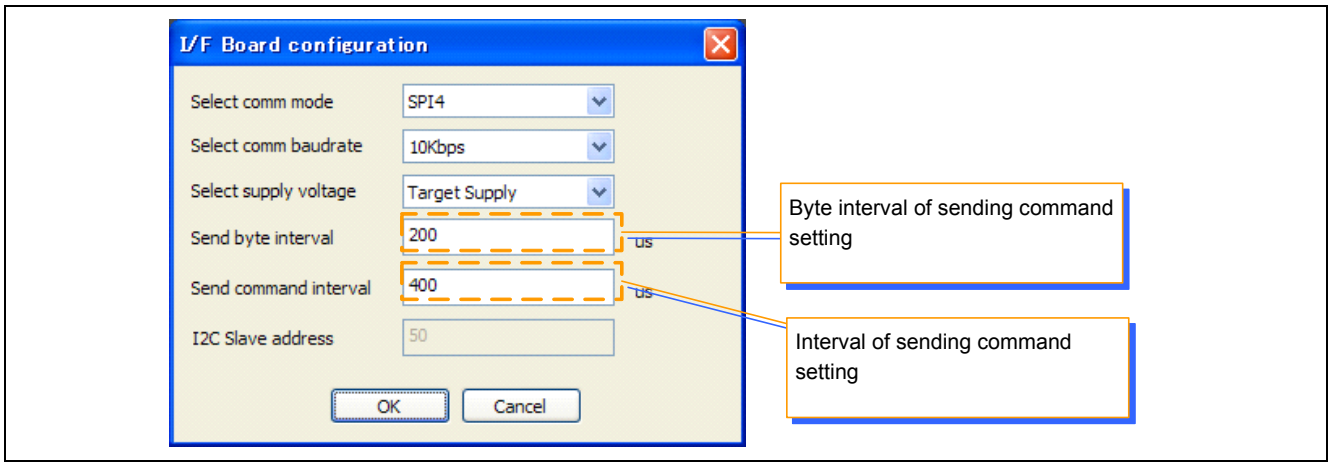


Figure 4-10 Communication timing setting

4.7 I2C slave address

Set the I2C slave address. When the communication mode is I2C, the I2C slave address is able to set.

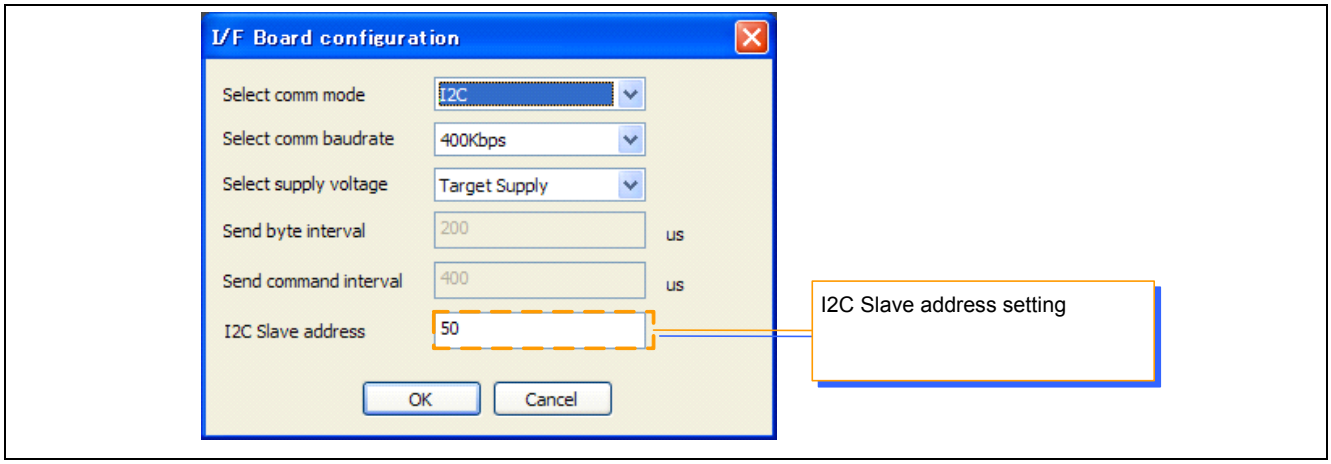


Figure 4-11 I2C Slave address setting

4.8 Connect / Disconnect

Start the connection with the target board by pushing [OK] button of I/F Board configuration after setting according to "4.1.1 Using Power Supply Circuit on the target board" - "4.7 I2C slave address ".

When the connection with the target board succeeds, Communication state is displayed with “Online”.

When the connection with the target board fails, confirm the settings according to "4.1.1 Using Power Supply Circuit on the target board" - "4.7 I2C slave address ".

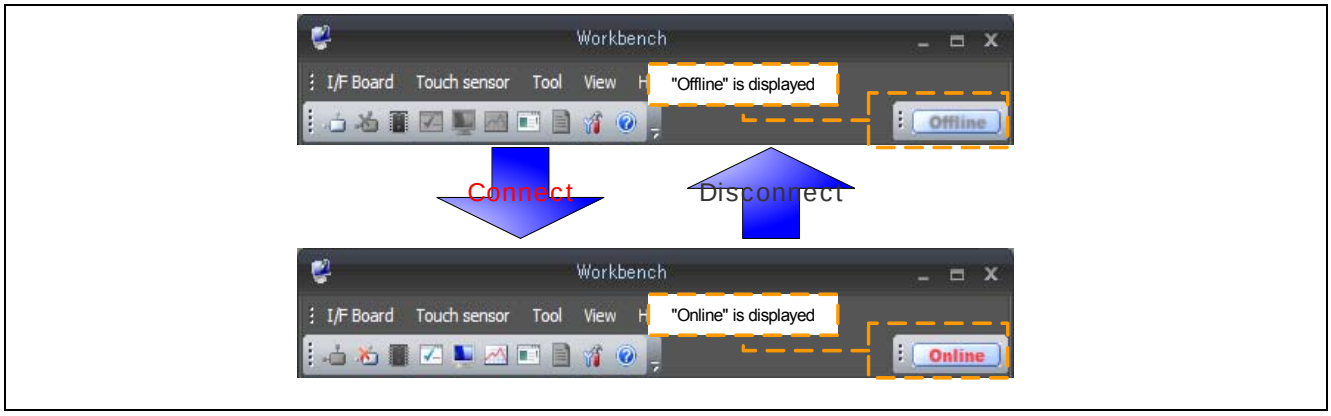


Figure 4-12 The status of connection with target board

Select “Disconnect” menu ([I/F Board] - [Disconnect]) or click the toolbar button ( ) to disconnect with target board.

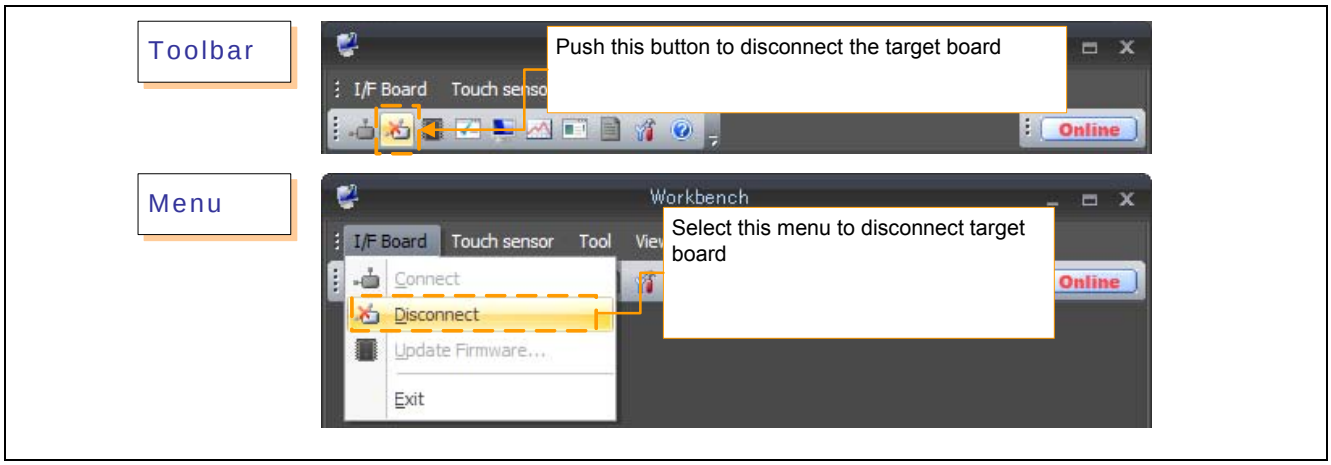


Figure 4-13 The method of disconnection with target board

5. About ChipID

Workbench acquires the following information from ChipID defined in R8C/3xT S/W driver.

- Number of channels
- Communication command version
- Supported demonstration board

Set ChipID according to the following contents properly.

Caution

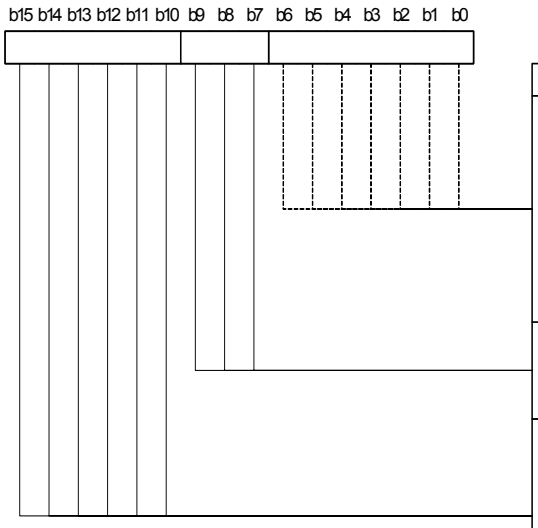
When ChipID is not set properly, connection error is occurred or Board-image that user do not aim is displayed in Status monitor.

The use of each channel is acquired from Channel enable bit defined in the R8C/3xT S/W driver.

Caution

When the channel which does not work as a touch key is not set for invalidity, calibration in Teaching is not finished.

Size of ChipID is 16 bits, and bit15 - bit10 defines a supporting demonstration board, and bit6 - bit0 expresses the maximum number of touch channel. In addition, bit9 - bit7 expresses the version of communication command used at the connecting through COM port or USB I/F board. Bit pattern of ChipID is as follows.



Bit name	Bit	Function
Number of channels (b6 - b0)	b0	Set the maximum number of a channel using as a touch key. Range of the number is as follows. 0 < Number of channels < 36
	b1	
	b2	
	b3	
	b4	
	b5	
	b6	
Communication command version (b9 - b7)	b7	Set the version number of communication command.
	b8	
	b9	
Board image selection bit (b15 - b10)	b10	Set the number of demonstration board or evaluation board. 100000b: R8C/33T Demonstration board 010000b: R8C/33T Touch board 001000b: R8C/3JT Demonstration board(TV) 000100b: R8C/3JT Demonstration board(Mobile)
	b11	
	b12	
	b13	
	b14	
	b15	

Figure 5-1 Bit pattern of ChipID

(1) Maximum channel number (b6 - b0)

A range of the maximum channel number is from 1 to 22. When the maximum channel number is not in the range, Workbench cannot connect to the target board.

(2) Communication command version (b9 - b7)

This bits expresses the version of the communication command to be used for the connection between Workbench and the target board.

(3) Board image selection bit (b10 - b15)

Workbench displays an image in imitation of a demonstration board in Status monitor according to the Board image selection bit. The values of Board image selection bit that Workbench supports now are as follows.

Table 5-1 The values of Board image selection bit

Board image selection bit						Demonstration board
15	14	13	12	11	10	
1	0	0	0	0	0	R8C/33T Demonstration board
0	1	0	0	0	0	R8C/33T Touch board (Evaluation board)
0	0	1	0	0	0	R8C/3JT Demonstration board (TV type)
0	0	0	1	0	0	R8C/3JT Demonstration board (Mobile type)
0	0	0	0	1	0	R8C/38T-A Evaluation board
Others						General purpose

The images corresponding to each value are as follows.

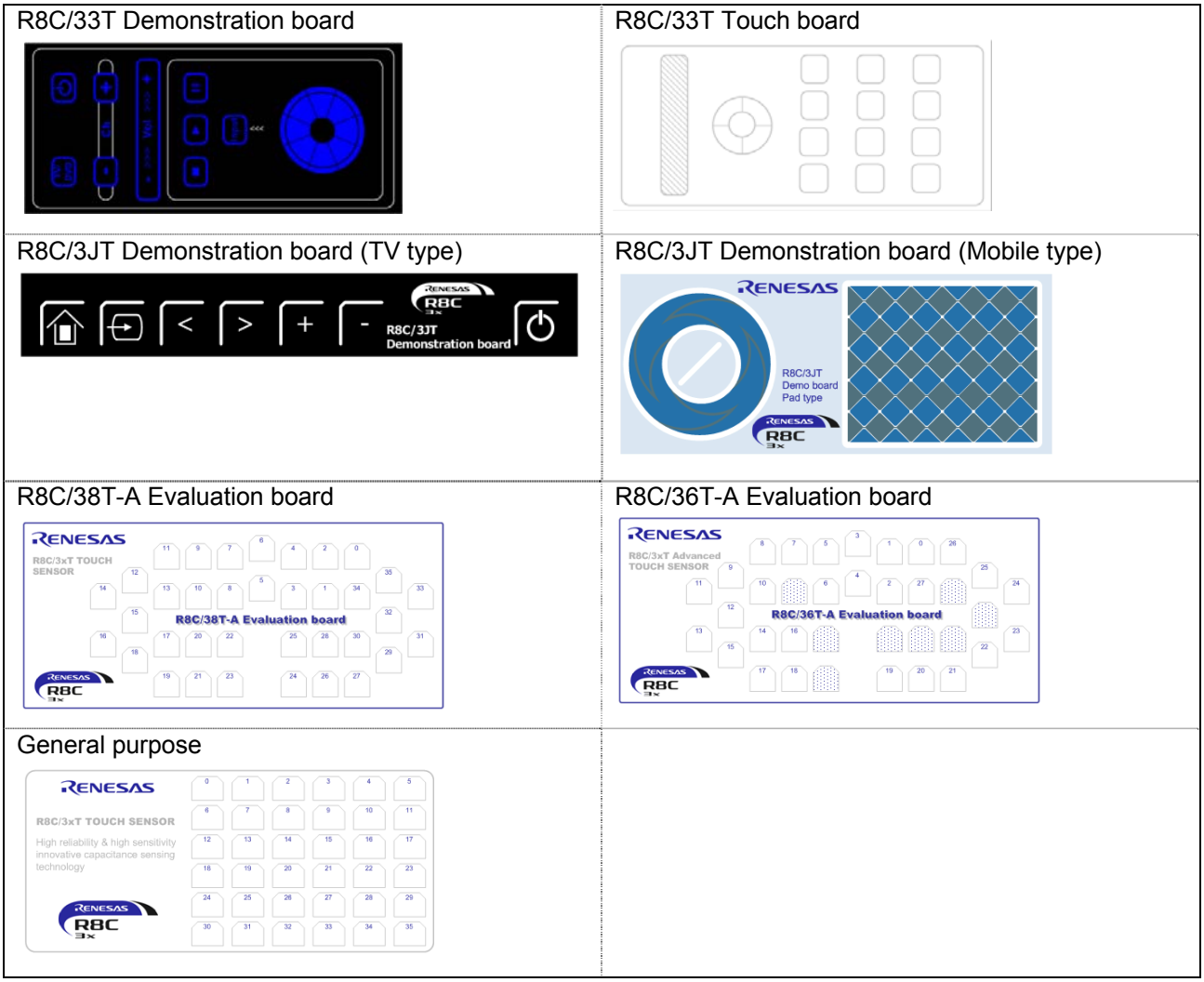
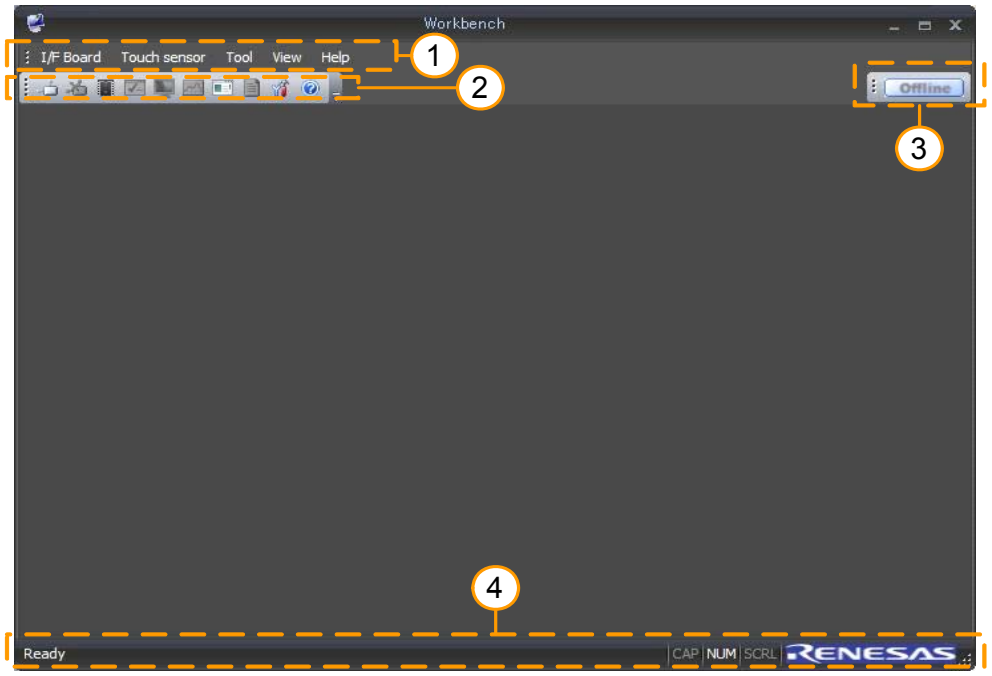


Figure 5-2 The demonstration / Evaluation board images

6. Function explanation

The main window of Workbench is shown as follow.



The explanation of the control is as follows.

Table 6-1 Controls

No	Control	Remarks
1	Menu	Refer to “6.1 Menu/toolbar explanation” for the details.
2	Toolbar	Refer to “6.1 Menu/toolbar explanation” for the details.
3	Communication state	The connection with the target board is shown. Offline non-connecting to the target board Online connecting to the target board
4	Status bar	The menu and the toolbar are displayed and when the point is done, the mouse displays a detailed explanation etc. of the function to do the point.

6.1 Menu/toolbar explanation

The explanation concerning the button in the menu and the toolbar is shown below.

Table 6-2 Menu

Menu		Toolbar	Function
Communication	Connect		Workbench starts the connecting to the target board. Refer to “6.2 Connection to the target ” for the details.
	Disconnect		Workbench finishes the connecting to the target board.
	Update firmware		The firmware of the I/F board is updated. Refer to “6.3 I/F board firmware update” for the details.
	Exit	-	Workbench is closed.
Touch sensor	Setup parameters		“Setup parameters” is started. Refer to “6.4 Setup parameters” for the details.
	Status monitor		“Status monitor” is started. Refer to “6.5 Status monitor” for the details.
	Teaching		The “Teaching” wizard is begun. Refer to “”6.6 Teaching for the details.
Tool	Circuit constants		The “Circuit constants” wizard is begun. Refer to “6.7 Circuit constants” for the details.
	Option		The option is set. Refer to “6.8 Option setting” for the details.
View	Toolbars and Docking windows	-	The toolbar is set.
	Status bar	-	Display/non-display of Status bar is switched.
	Skin select	-	The application externals are switched.
Help	About Workbench		“About Workbench” is displayed. Refer to “6.9 Version information” for the details.

6.2 Connection to the target board

6.2.1 COM Port configuration

COM port and communication baudrate, etc. are set in “COM port configuration” when connecting to the target board using COM port.

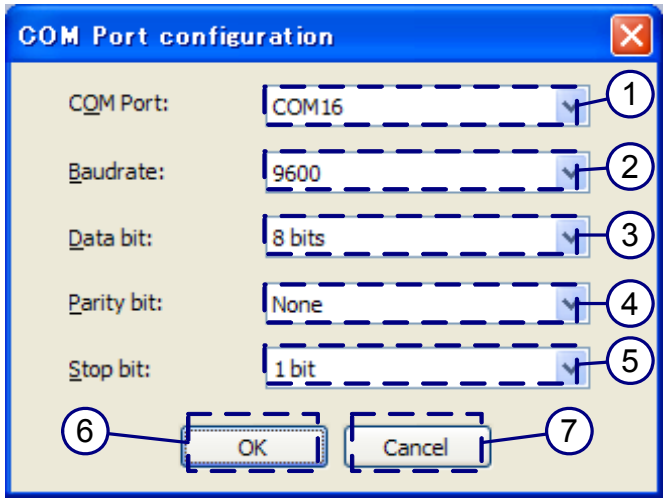


Figure 6-1 COM Port configuration

The explanation of the control is as follows.

Table 6-3 Controls

No	Control	Remarks
1	COM Port	The function to select a COM port from the pull-down menu is offered. Refer to “(1) COM port” for the details.
2	Baudrate	The function to select communication baud rate from the pull-down menu is offered. Refer to “(2) Communication baud rate” for the details.
3	Data bit	The function to select Data bit from the pull-down menu is offered. Refer to “(3) Data bit” for the details.
4	Parity bit	The function to select Parity bit from the pull-down menu is offered. Refer to “(4) Parity bit” for the details.
5	Stop bit	The function to select Stop bit from the pull-down menu is offered. Refer to “(5) Stop bit” for the details.
6	OK	The communication to the I/F board is begun.
7	Cancel	The communication to the I/F board is canceled.

(1) COM port

Choose COM port.

(2) Communication baud rate

Choose the communication baud rate among the following values.

9600, 14400, 19200, 38400, 57600

(3) Data bit

Choose a data bit among 7 bits or 8 bits.

(4) Parity bit

Choose parity bit among the following values.

None:	Parity bit is not used.
Odd parity:	Odd parity is used.
Even parity:	Even parity is used.

(5) Stop bit

Choose stop bit among 1 bit or 2 bits.

6.2.2 I/F Board configuration

The communicate mode and the communication baud rate, etc. are set in “I/F Board configuration” when connecting to the target board using the I/F board.

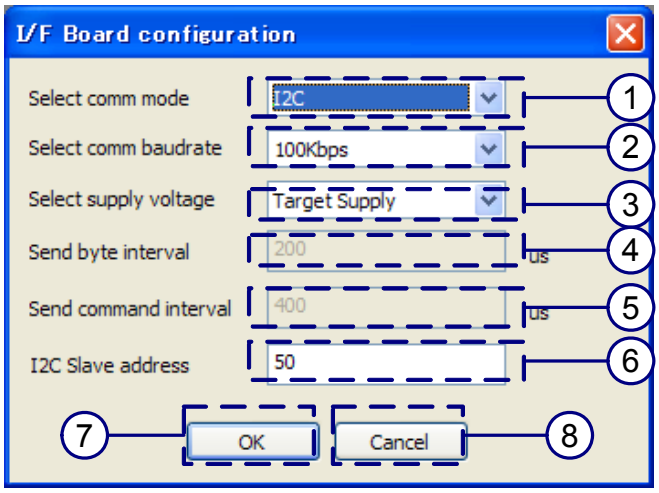


Figure 6-2 I/F Board configuration

The explanation of the control is as follows.

Table 6-4 Controls

No	Control	Remarks
1	Select comm mode	The function to select the communication mode from the pull-down menu is offered. Refer to “(1) Communication mode” for the details.
2	Select comm baudrate	The function to select the communication baud rate corresponding to the communicate mode is offered. Refer to “(2)Communication baud rate” for the details.
3	Select supply voltage	The function to select the method of the power supply of the I/F board is offered. Refer to “(3)Method of power supply” for the details.
4	Send byte interval	The function to set the transmission interval of data is offered. Refer to “(4)Interval of transmission data” for the details.
5	Send command interval	The function to set the transmission interval of the command is offered. Refer to “(5)Interval of transmission command” for the details.
6	I2C Slave address	The function to set the slave address when communication mode is I2C mode is offered. Refer to “(6)Slave address” for the details.
7	OK	The communication to the I/F board is begun.
8	Cancel	The communication to the I/F board is canceled.

(1) Communication mode

The communication method is selected from the following values.

- SPI3

  Three line type SPI mode
- SPI4

  Four line type SPI mode
- I2C

  I2C mode

(2) Communication baud rate

The communication baud rate is selected from the following values.

- SPI3 or SPI4 mode

  10 Kbps、20 Kbps、50 Kbps、100 Kbps、250 Kbps、500 Kbps、1M Kbps、2.5 Kbps、5 Kbps
- I2C mode

  50 Kbps、100 Kbps、200 Kbps、400 Kbps

(3) Method of power supply

The method of the power supply to the target board is selected as follows.

- Target Supply

  The power supply circuit on the target board is used.
- USB 3.3V Supply

  The universal serial bus port supplies 3.3V.
- USB 5V Supply

  The universal serial bus port supplies 5.0V.
- I/F Board Ext. Supply

  It supplies power from the stabilizing supply.

(4) Interval of transmission data

The transmission interval of data is set.

(5) Interval of transmission command

The transmission interval of the command is set.

(6) Slave address

When the communication mode is I2C, the slave address is input. When the communicate mode is not I2C, it is not possible to input.

6.2.3 HEW connection

"HEW connection" monitors the state of HEW until starting connection to the target board in case of connecting to the target board through HEW.

"HEW connection" is closed when entering the state that HEW can be communicated, and the communication with HEW is begun.

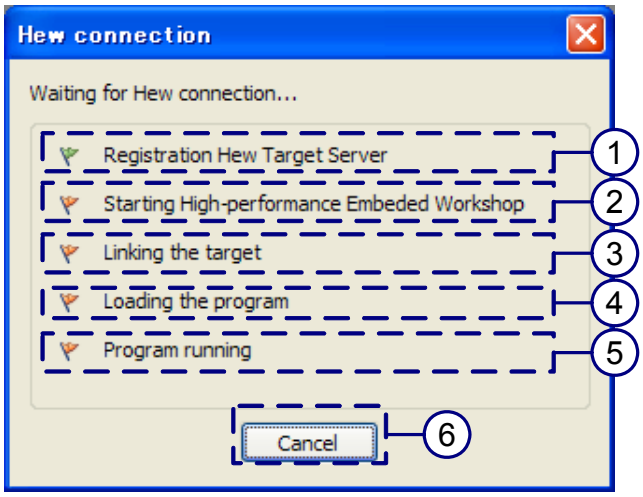


Figure 6-3 HEW connection

The explanation of the control is as follows.

Table 6-5 Controls

No	Control	Remarks
1	Registration Hew Target Server	Whether Hew Target Server can be used is checked. It is shown to be able to use Hew Target Server when the flag icon is green.
2	Starting High-performance Embedded Workshop	Whether HEW starts is checked. It is shown that HEW starts when the flag icon is green.
3	Linking the target	The connection with the target board is displayed. It is shown that HEW connects to the target board when the flag icon is green.
4	Loading the program	The end status of the program download is displayed. It is shown to complete the download of the program when the flag icon is green.
5	Program running	The running state of the program is displayed. It is shown that the program is executing it when the flag icon is green.
6	Cancel	The status check of HEW is interrupted, and "HEW connection" is closed.

6.3 I/F board firmware update

The function to update the firmware of the I/F board is offered. This function is enabled to be used in case of the connection with the target board through I/F board.

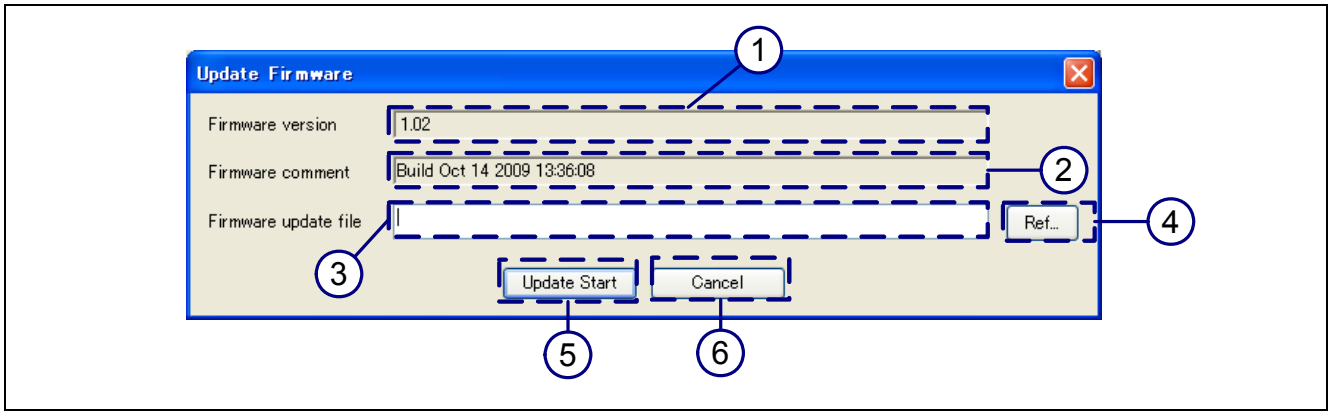


Figure 6-4 Update Firmware

The explanation of the control is as follows.

Table 6-6 Controls

No	Control	Remarks
1	Firmware version	The version number of a present firmware is displayed.
2	Firmware comment	The comment on a present firmware is displayed.
3	Firmware update file	The function to input the firmware file to be updated is offered. Input it in the full path when you input directly the firmware file with the keyboard etc. When the firmware file is selected by "Ref" button pressing, the full path of the selected firmware file is displayed.
4	Ref	"File selection" window is displayed
5	Update Start	The firmware of the I/F board is updated with the selected firmware file.
6	Cancel	“Update Firmware” is closed.

6.4 Setup parameters

The function to set various parameters of the touch sensor is offered.

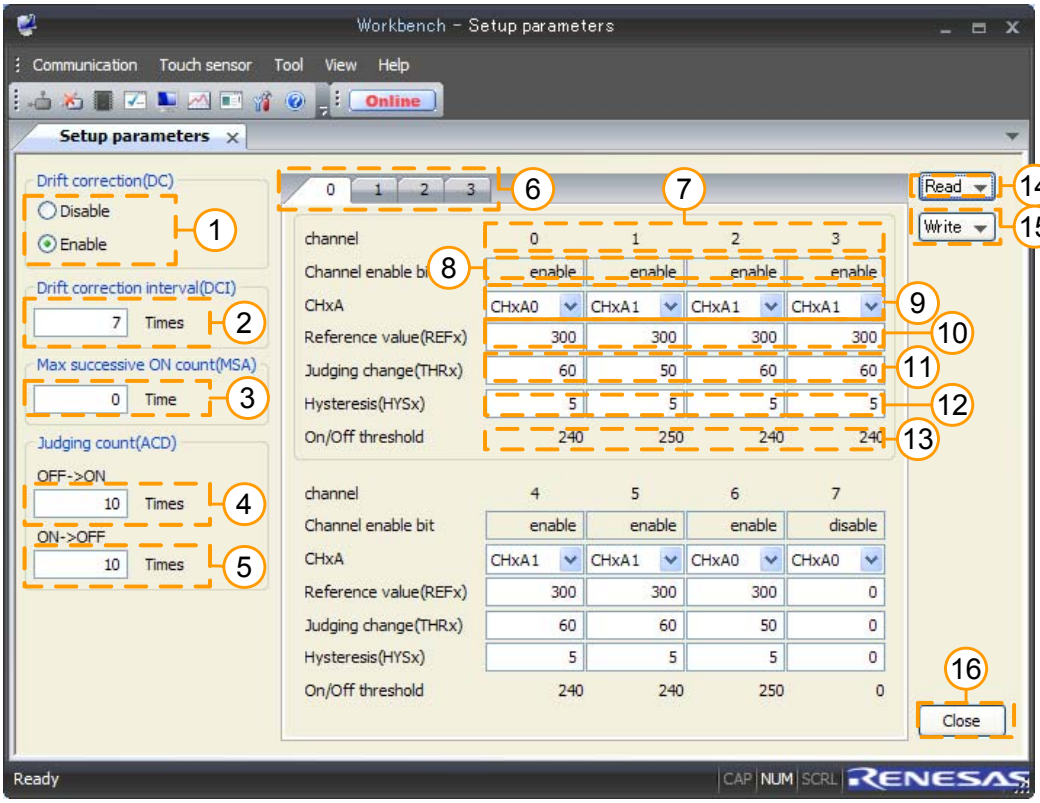


Figure 6-5 Setup parameters

The explanation of the control is as follows.

Table 6-7 Controls

No	Control	Remarks
1	Drift correction (DC)	Select enable/disable of the drift correction. Refer to "(1) Drift correction (DC)" for the details.
2	Drift correction interval(DCI)	Set the interval of the drift correction. Refer to "(2)Drift correction interval (DCI)" for the details
3	Max successive ON count(MSA)	Set the continuous maximum number of times of the touch judgment. Refer to "(3)Max successive ON count (MSA)" for the details.
4	Judging count(ACD) OFF -> ON	Set the accumulation judgment count (Off -> On). Refer to "(4)Judging count (ACD)" for the details.
5	Judging count(ACD) ON -> OFF	Set the accumulation judgment count (On -> Off). Refer to "(4)Judging count (ACD)" for the details.
6	Channel group	Switch the channel group.
7	Channel	The channel number is displayed.
8	Channel enable bit	The state of a pertinent channel (enable/disable) is displayed. The change in the state is improper.
9	CHxA	Select CHxA among CHxA0 and CHxA1. When a target board does not support a function of CHxA selection, this control always displays "CHxA".
10	Reference count value (REFx)	Set the count value at non-touch.
11	Judging change (THRx)	Set count value difference.
12	Hysteresis (HYSx)	Set the hysteresis value when returning from touch to non-touch is offered.
13	On/Off threshold	Threshold count value for judgement of touch or not is displayed. This value is calculated by REFx - THRx of the pertinent channel.
14	Read	Select a method to read the parameter of touch sensor. Refer to "(5)Read" for the details.
15	Write	Select a method to write the parameter of touch sensor. Refer to "(6)Write" for the details.
16	Close	"Setup parameters" is closed.

(1) Drift correction (DC)

Effective/invalidity of the drift correction is selected from the following values.

- Disable

  The drift correction is invalidated.

- Enable

  The drift correction is effectively done.

(2) Drift correction interval (DCI)

The drift is corrected every measurement for the number of times that is multiplier value of 2 with a set value.

When “5” is set, the drift correction is done at each of the 32 measurements.

(3) Max successive ON count (MSA)

When the touch is continuously judged for set value ×64 times, the judgment is compulsorily no-touch, and the drift correction is done.

When "0" is input, this setting becomes invalid.

(4) Judging count (ACD)

- OFF -> ON

  When the count value falls the threshold count value for judgement of touch or not N times,

  judgement process for touch or not judges that a touch electrode is touched. (N is a set value)

- ON -> OFF

  When the count value exceeds the threshold count value for judgement of touch or not N times,

  judgement process for touch or not judges that a touch electrode is non-touched. (N is a set value)

(5) Read

The following menu provides a function to read the parameter of the touch sensor from R8C/3xT , parameter file or “Select parameter file”.

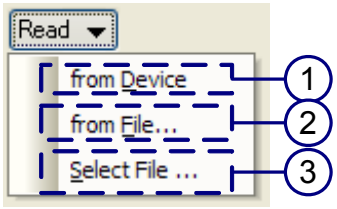


Figure 6-6 Read menu

The explanation of the control is as follows.

Table 6-8 Controls

No	Control	Remarks
1	from Device	The parameter maintained with R8C/3xT is read, and it reflects it in “Setup parameters”.
2	from File	The parameter file is selected, the parameter of this file is read, and it reflects it in “Setup parameters”.
3	Select File	“Select Parameter File” is displayed. Refer to “6.4.1 Parameter file selection” for the details.

(6) Write

The following menu provides a function to write the parameter of the touch sensor to R8C/3xT or parameter file.

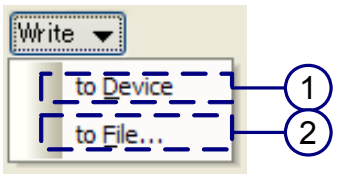


Figure 6-7 Write menu

The explanation of the control is as follows.

Table 6-9 Controls

No	Control	Remarks
1	to Device	The parameter displayed in “Setup parameters” is written to R8C/3xT.
2	to File	The parameter displayed in “Setup parameters” is written to parameter file.

6.4.1 Parameter file selection

The function to manage the parameter file preserved in the past is offered.

When the parameter file is saved, the parameter file registered automatically to “Select Parameter File”.

It is possible to register a parameter file to this window, and to cancel the registration.

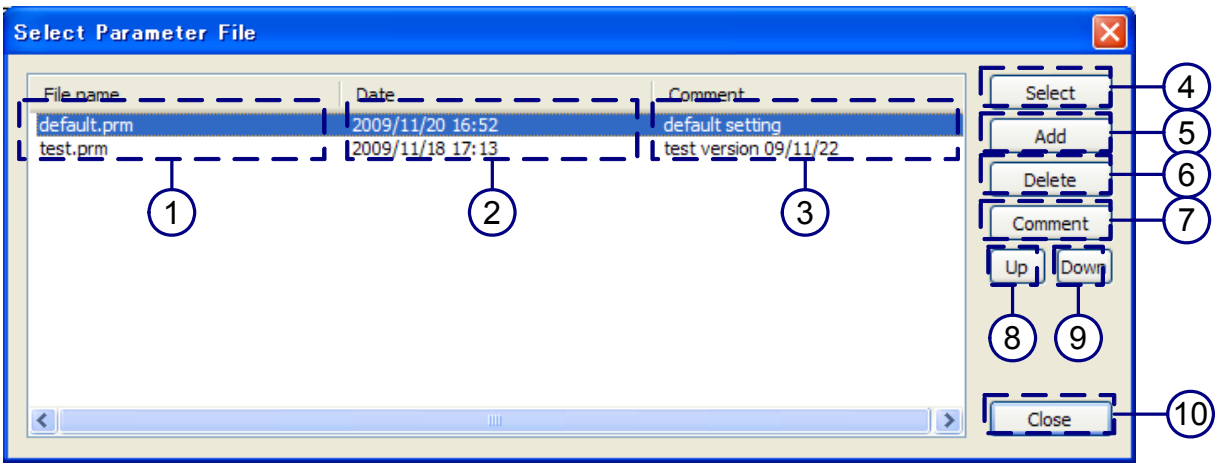


Figure 6-8 Select Parameter File

The explanation of the control is as follows.

Table 6-10 Controls

No	Control	Remarks
1	File name	The file name of the parameter file is displayed.
2	Date	The date of update of the parameter file is displayed.
3	Comment	The comment related to the parameter file is displayed. The comment is edited with “Edit comment”. Refer to “6.4.2 Comment edit” for the details.
4	Select	The selected parameter file is read.
5	Add	The parameter file is registered.
6	Delete	The registration of the parameter file is released. The parameter file is not deleted.
7	Comment	Edit comment is displayed, and the comment on the selected parameter file is edited. Refer to “6.4.2 Comment edit” for the details.
8	Up	The position where the selected parameter file is displayed is raised up.
9	Down	The position where the selected parameter file is displayed is lowered below.
10	Close	“Select Parameter File” is closed.

6.4.2 Comment edit

The function to edit the comment related to the parameter file is offered. 32 characters or less (For one byte character) can be edited.

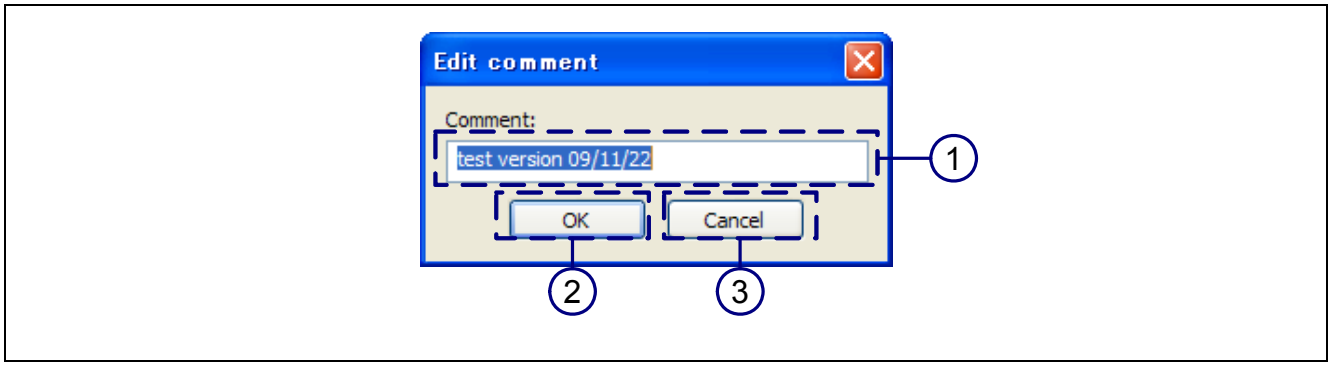


Figure 6-9 Select Parameter File

The explanation of the control is as follows.

Table 6-11 Controls

No	Control	Remarks
1	Comment	The function to input a comment is offered.
2	OK	The content of the edit is assumed to be effective, and this window is closed.
3	Cancel	The content of the edit is assumed to be invalid, and this window is closed.

6.5 Status monitor

The function to monitor the count values of the touch sensor in real time is offered.

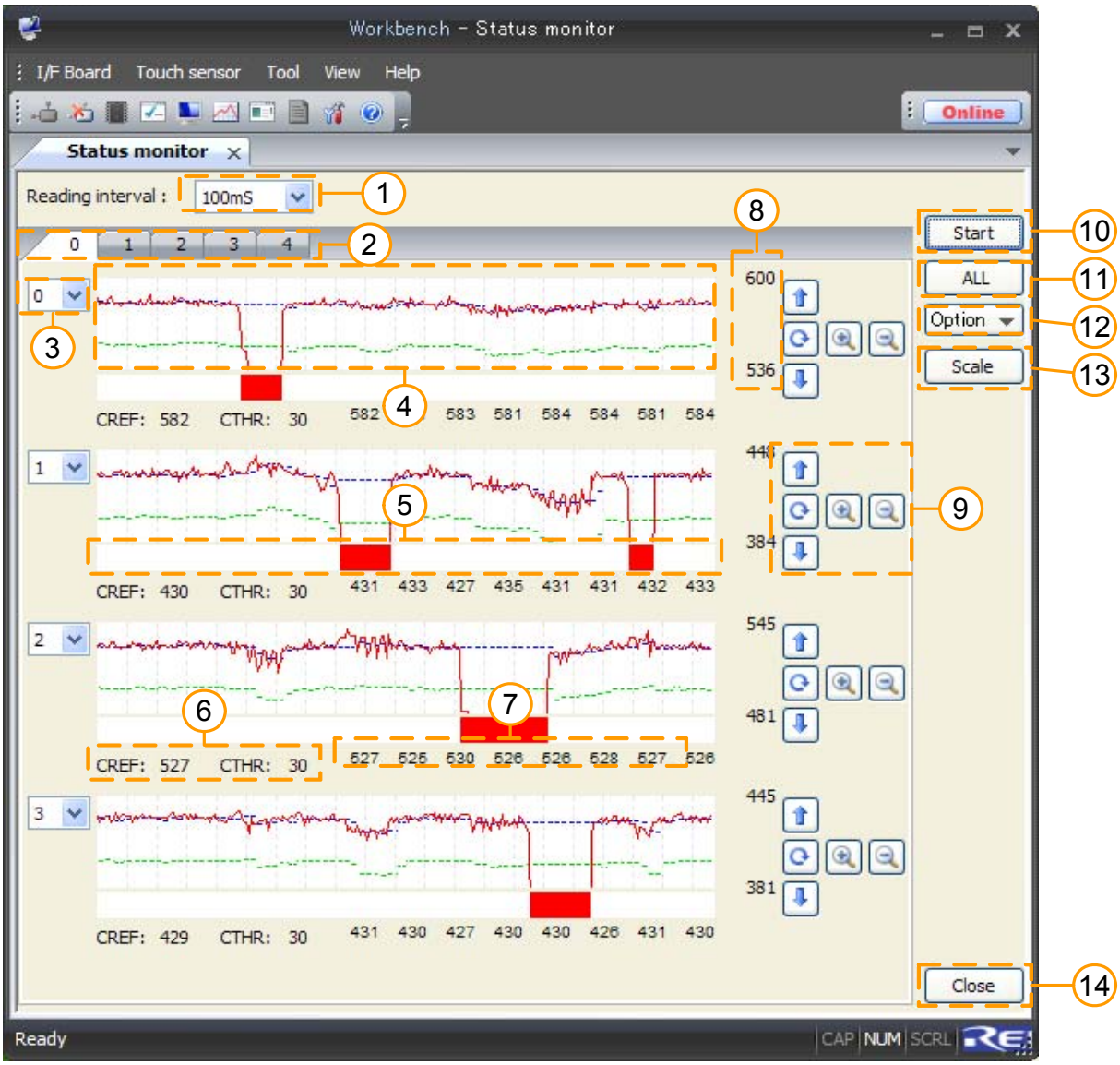


Figure 6-10 Status monitor

The explanation of the control is as follows.

Table 6-12 Controls

No	Control	Remarks
1	Reading interval	Select a interval time of communication between Workbench and the Target board. The interval time is as follows. 50ms、100ms、200ms、500ms、1sec
2	Channel group switch	The function to switch the channel group is offered.
3	Channel switch	Select the channel number.
4	Graphical representation	Reference count value, Count values, and Threshold count value for judgement of touch or not is displayed. Reference count value (CREFx) Threshold count value for judgement of touch or not (CREFx - CTHRx) Count value
5	Touch judgment result	When touch is judged, a red belt is displayed.
6	CREF/CTHR	A present current reference count value is displayed in CREF. CTHR displays THRx set in “Setup parameters”.
7	History of Count value	Count value for the past eight times is displayed. A value of the left edge is the latest.
8	Display range	A present display range in the graph area is displayed.
9	Adjustment button	The display range in the graph area is adjusted.
10	Start	The measurement begins or the measurement stops.
11	ALL	The display position is adjusted in all channels so that a present count value may become a center.
12	Option	The display form in the graph and the function to display of the option window and to switch are offered. Refer to “6.5.1 Option menu” for the details.
13	Scale	The Scale setting of the Option window is displayed. Refer to “6.8.2 Scale Option” for the details about the Scale setting.
14	Close	This window is closed.

6.5.1 Option menu

The function that monitoring mode and “Board image”/”Log control” switches from the following menu is offered.

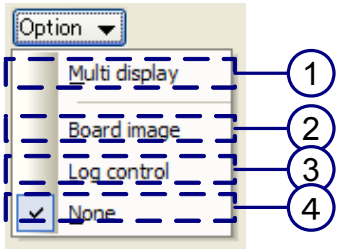


Figure 6-11 Option menu

The explanation of the control is as follows.

Table 6-13 Controls

No	Control	Remarks
1	Multi display	The function to switch the graphical representation is offered. The state of the graphical representation can be distinguished according to the check mark, and Multi display is assumed to be off (There is no check mark) in the standard.
2	Board image	The function to display the board image is offered. The selection of “Board image”, “Log control”, and None is exclusion. A present selection is distinguished by displaying the check mark. Refer to “6.5.4 Board image” for the details about the board image.
3	Log control	The function to display the log control is offered. The selection of “Board image”, “Log control”, and None is exclusion. A present selection is distinguished by displaying the check mark. Refer to “6.5.5 Log control” for the details about the log control.
4	None	The function non-to display “Board image”/”Log control” is offered. The selection of “Board image”, “Log control”, and None is exclusion. A present selection is distinguished by displaying the check mark.

6.5.2 Single monitor mode

It is a standard graph mode. One display area of each channel is occupied.

6.5.3 Multi monitor mode

It is a graph mode that displays two or more channels in one display area.

Eight channels or less can be displayed.

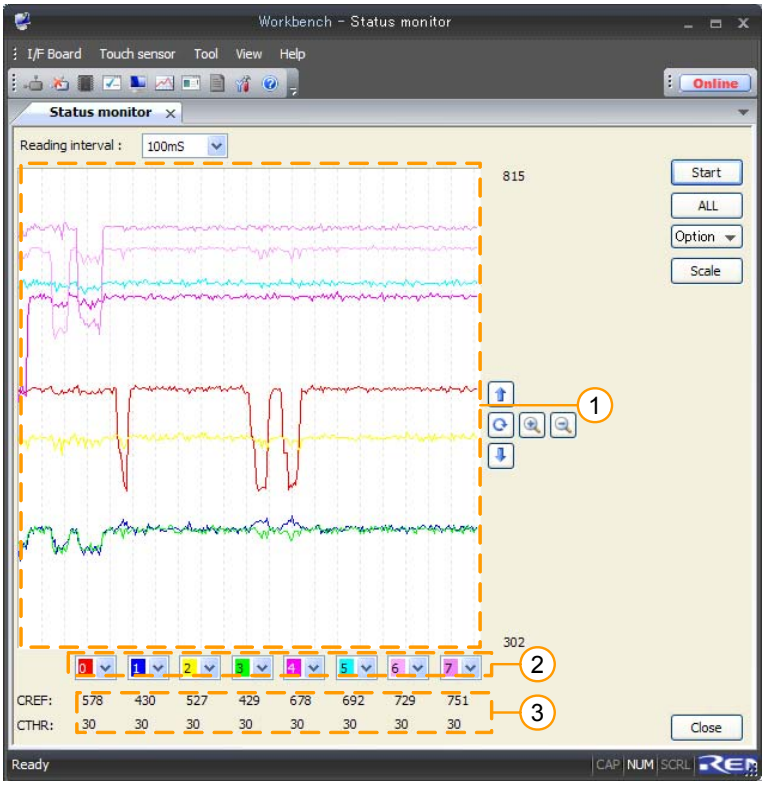


Figure 6-12 Status monitor - Multi monitor

The explanation of the control is as follows.

Table 6-14 Controls

No	Control	Remarks
1	Graphical representation	All channels have been selected by the channel switch are displayed. The displayed graph is only a count value of the channel that has been selected. The color in the graph corresponds to the color of the channel switch.
2	Channel switch	It changes the channel.
3	CREF、CTHR	A present current reference count value is displayed in CREF. CTHR displays THRx set with “Setup parameters”.

6.5.4 Board image

Workbench displays a image of the target board under a graph area, and reproduces the On/Off of the key by updating the LED image corresponding to each touch channel according to results of touch judgement process.

Workbench is able to displays either Board image or Log control.

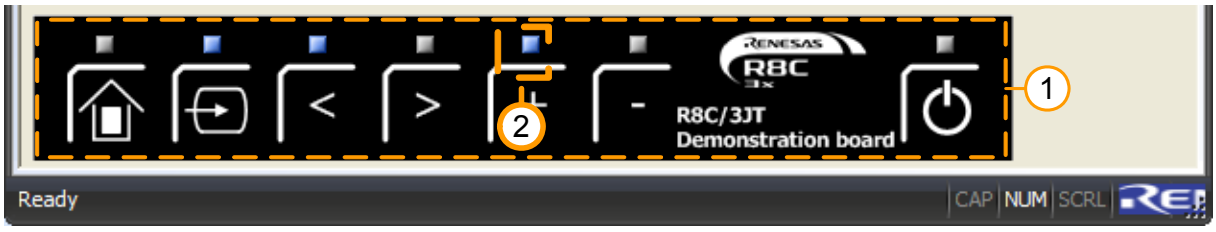


Figure 6-13 Status monitor - Board image

The explanation of the control is as follows.

Table 6-15 Controls

No	Control	Remarks
1	Image of the target board	The image of an acrylic panel of the target board is displayed.
2	Touch image	Touch / non-touch of the channel is displayed.

6.5.5 Log control

Various data acquired from the target board like the count value and the current reference count value, etc. is preserved in the file, and the function to reproduce the file is offered. The above-mentioned file is named a log file from now on.

The log file is preserved by Comma Separated Value.

You must not edit a log file to use for Log playing. Because the number of letters of each entry is fixed for Log playing. Note that the error like the character number disagreement etc. of each entry might occur when log plating by the edited log file.

Workbench is able to displays either Board image or Log control.

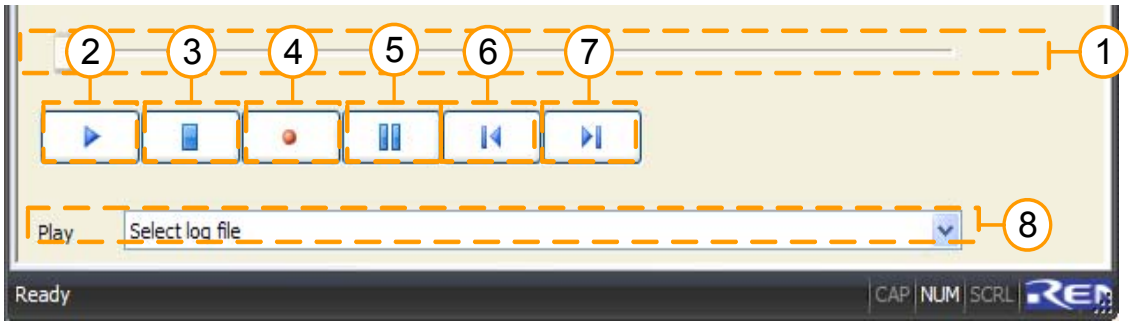


Figure 6-14 Status monitor - Log control

The explanation of the control is as follows.

Table 6-16 Controls

No	Control	Remarks
1	Slider	The function to specify the playing position when reproducing is offered. After the graphical representation is cleared when the playing position is changed by the slider operation, the display of the graph is restarted.
2	Play button	The playing of the log file under the selection begins. This button is not able to push during real-time monitoring.
3	Stop button	The log playing and the log record are stopped.
4	Record button	The log record begins.
5	Pause button	The log playing is paused. When restarting, push he “Play button”.
6	Rewind button	The playing log is rewound. When returning to the head of the log, the playing is started from the first.
7	Fast-forwarding button	The playing speed of the log is improved. It returns to a normal playing speed again by the press of “Fast-forwarding button”
8	Play list	The file list of the log recorded in the past is displayed. The displayed number of files is four or less. The log file that doesn't exist in the list is able to select by the "Reference" in the last of the list.

6.6 Teaching

Teaching is a function to automatically set the reference count value and hysteresis and Threshold count value for judgement of touch or not.

6.6.1 Procedure

The procedure of the teaching is shown below.

Table 6-17Teaching procedure

No	Procedure	Content	Details
1	Teaching beginning	Teaching Start page	The “Teaching” wizard is begun. The “Next” button is pressed.
2	Channel setting	calibration Channel setting	自動調整するチャンネルを設定する。
3	Measurement	Parameter reading	The “Next” button is pressed according to the instruction of the window and the parameter is read.
4		Measurement beginning	The “Next” button is pressed according to the instruction of the window and the measurement begins.
5		Measurement	It touches three times or more all effective keys. When all effective keys touch three times or more, it comes to be able to push the “Next” button.
6		Parameter writing	The “Next” button is pressed according to the instruction of the window, and the parameter is written.
7	End option	Setup parameters start option setting	"Display Setup parameters to confirm the result" is checked. The “Finish” button is pressed, and the “Teaching” wizard is closed.
8	Parameter confirmation		“Setup parameters” starts after the “Teaching” wizard is closed. The parameter is read from the target board, and the result of “Teaching” is confirmed.

6.6.2 Start page

The “Teaching” wizard's beginning is shown.

When “Teaching” is continued, “Next” is pressed.

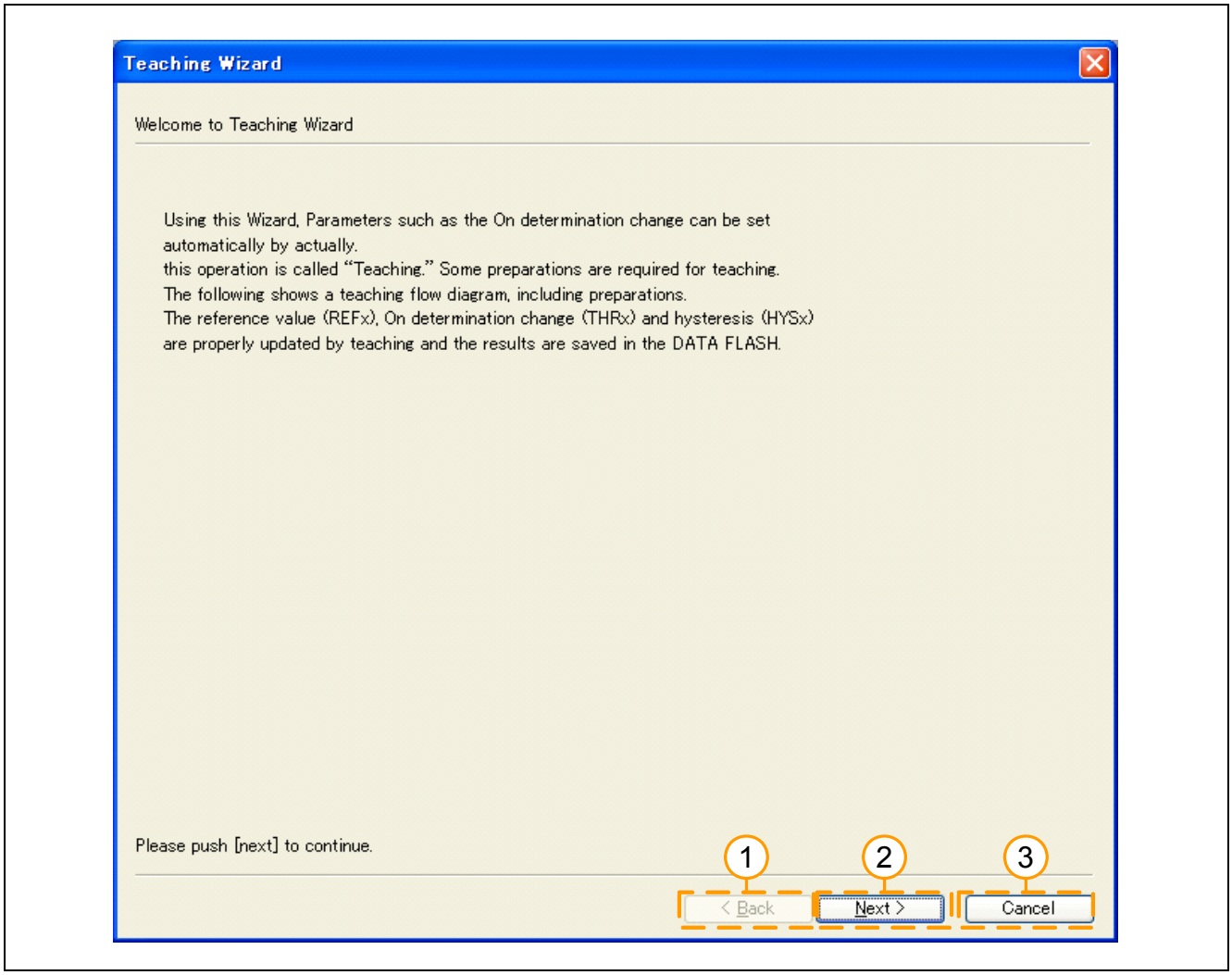


Figure 6-15 Teaching page 1

The explanation of the control is as follows.

Table 6-18 Controls

No	Control	Remarks
1	Back	It is not possible to select this control at any time.
2	Next	It moves to the subsequent page.
3	Cancel	“Teaching” is closed.

6.6.3 Setup calibration channel page

A function to set the channels to calibrate is offered.

When "R8C/33T Demonstration Board" is used as a target board, the initial state becomes the setting to adjust only the touch key except the slider and wheel.

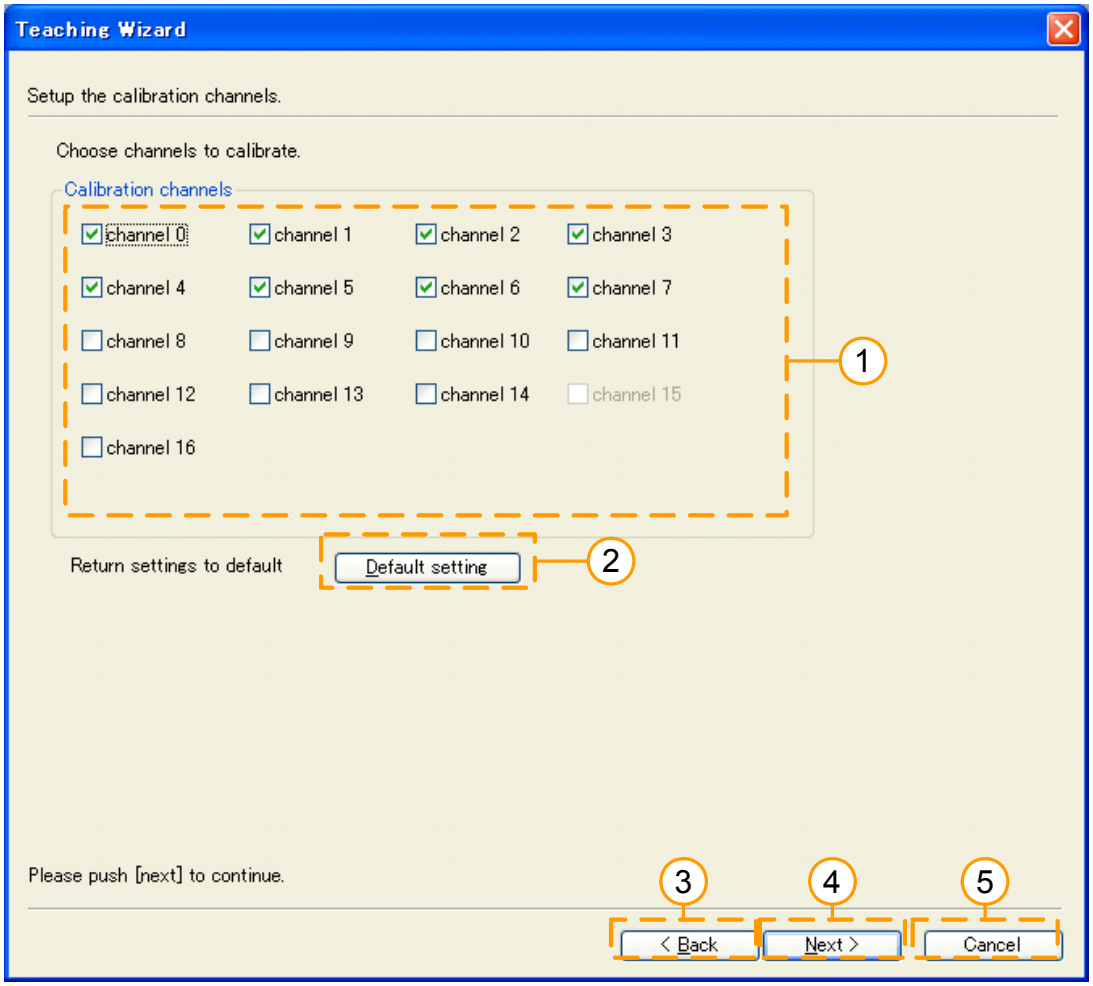


Figure 6-16 Teaching page 2

The explanation of the control is as follows.

Table 6-19 Controls

No	Control	Remarks
1	Calibration channels	Channels to calibrate is set. Checked channels becomes a target of the automatic calibration.
2	Default setting	Setting of Calibration channels is returned to initial state.
3	Back	It returns to the previous page or step. Refer to “6.6.4.1 Operation guide” for the details.
4	Next	It changes to the subsequent page or the step. Refer to “6.6.4.1 Operation guide” for the details.
5	Cancel	“Teaching” is closed.

6.6.4 Teaching page

The function to write the touch detection and the teaching result of reading the parameter necessary for “Teaching” such as REFx and THRx and the key is offered.

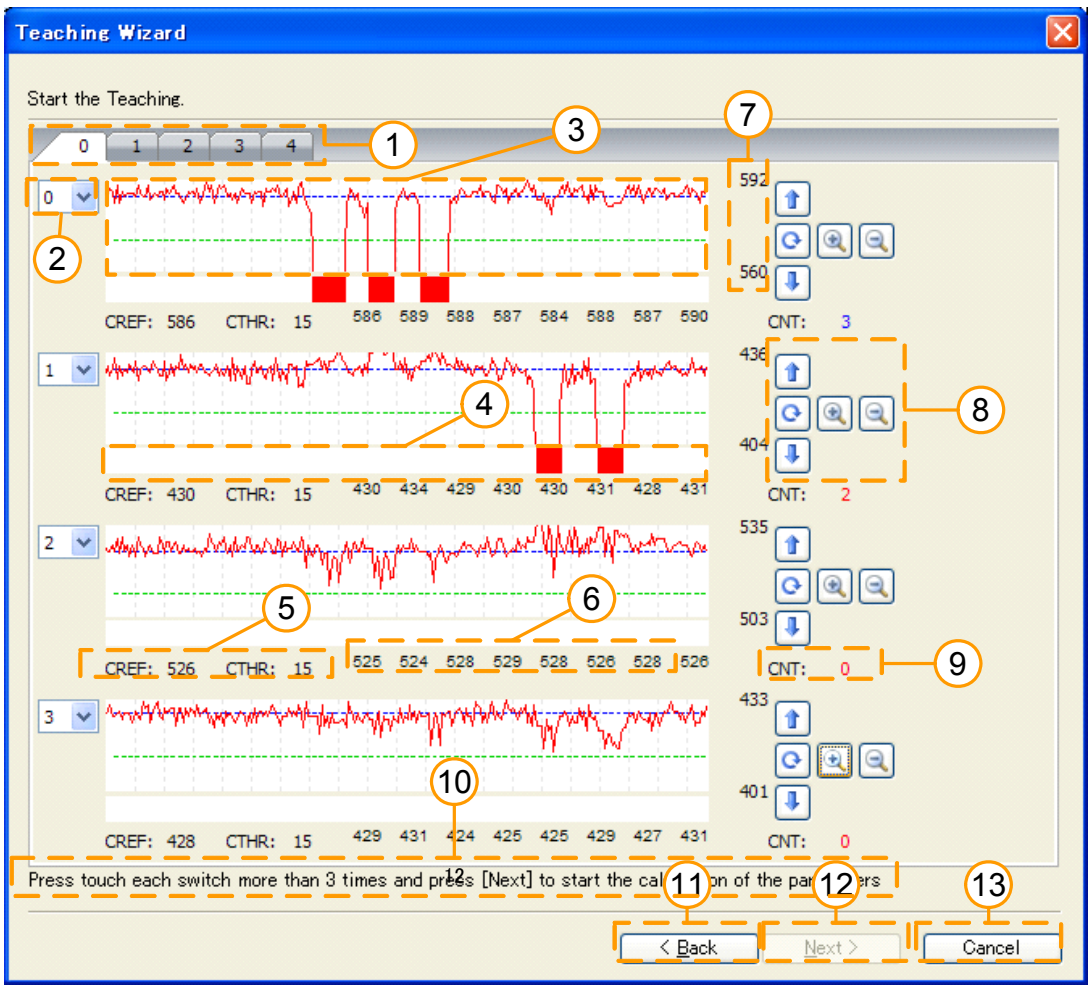


Figure 6-17 Teaching page 3

The explanation of the control is as follows.

Table 6-20 Controls

No	Control	Remarks
1	Channel group switch	The function to switch the channel group is offered.
2	Channel switch	The function to switch the channel group is offered.
3	Graphical representation	Current reference count values, count values, and Threshold count value for judgement of touch or not is displayed. Reference count value (CREFx) Threshold count value for judgement of touch or not (CREFx - CTHRx) Count value
4	Touch judgment result	When touch is judged, a red belt is displayed.
5	CREF/CTHR	Current reference count value (CREF) and threshold value (CTHR) is displayed
6	History of measurements	Count value for the past eight times is displayed. A value of the left edge is the latest.
7	Display range	A present display range in the graph area is displayed.
8	Adjustment button	The display range in the graph area is adjusted.
9	Touch judgment frequency	The number of times touched an electrode is displayed. When plural channels are touched at the same time, the number of times is not updated.
10	Guide	The operation guide is displayed. Refer to “6.6.4.1 Operation guide” for the details.
11	Back	It returns to the previous page or step. Refer to “6.6.4.1 Operation guide” for the details.
12	Next	It changes to the subsequent page or the step. Refer to “6.6.4.1 Operation guide” for the details.
13	Cancel	“Teaching” is closed.

6.6.4.1 Operation guide

The guide is updated according to a present step.

The step advances, and retreats by the Back button pressing by the Next button pressing.

Table 6-21 Relation between operation guide and step

No	Step	Operation guide
1	Parameter reading	Press [Next] to read parameters from device.
2	Teaching beginning standby	Press [Next] to start the calibration.
3	Teaching is being executed.	Press touch each switch more than 3 times and press [Next] to start the calculation of the parameters.
4	Parameter writing	Press [Next] to write the parameters to device.

It returns to “Teaching” page 1 when the Back button is pressed it is reading of the step the parameter.

It changes to Teaching page 3 after writing of the parameter when the step presses the Next button when the parameter is written.

6.6.5 End option page

The function to set the end option to confirm the Teaching result is offered.

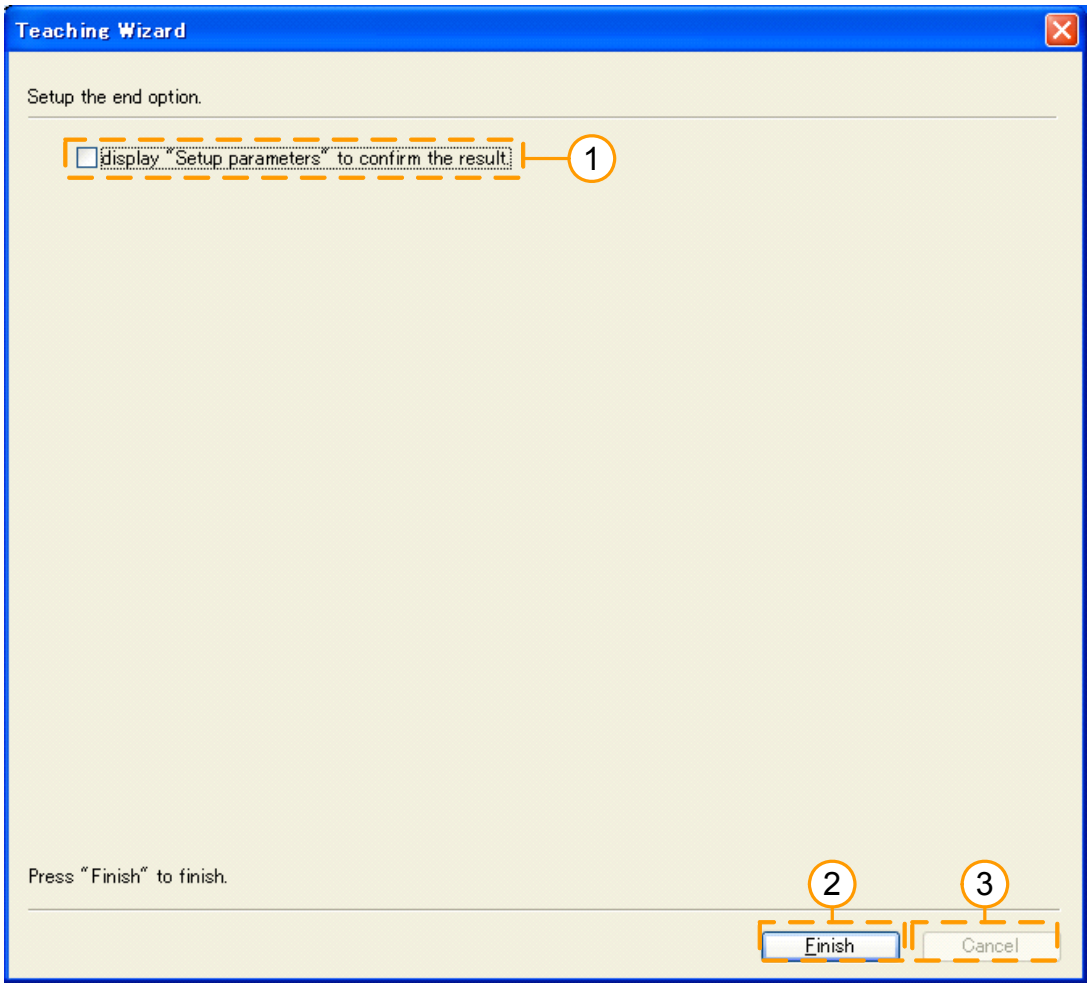


Figure 6-18 Teaching page 4

The explanation of the control is as follows.

Table 6-22 Controls

No	Control	Remarks
1	display “Setup parameters" to confirm the result	After “Teaching” is closed, “Setup parameters” is started when checking this control.
2	Finish	“Teaching” is finished.
3	Cancel	It is not possible to select this control at any time.

6.7 Circuit constants

When a sample board of the touch sensor is made, the capacitor of the electrostatic capacity measurement circuit and the value of resistance is calculated.

The function that navigates the calculation is offered.

6.7.1 Start page (Page 1)

The Circuit constants wizard is begun. When the wizard is continued, “Next” is pressed.

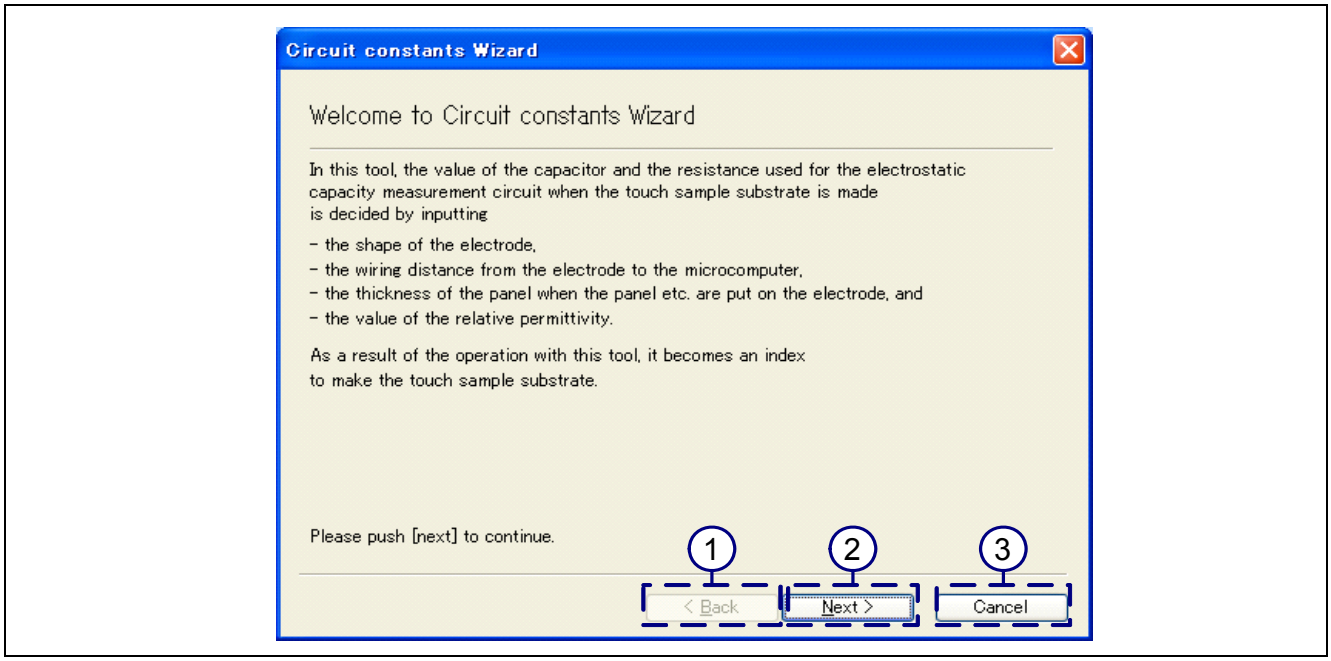


Figure 6-19 Circuit constants page 1

The explanation of the control is as follows.

Table 6-23 Controls

No	Control	Remarks
1	Back	It is not possible to select this control at any time.
2	Next	It moves to the subsequent page.
3	Cancel	The “Circuit constants” wizard is closed.

6.7.2 Selection of electrode geometry (Page 2)

The function to select the electrode geometry is offered.

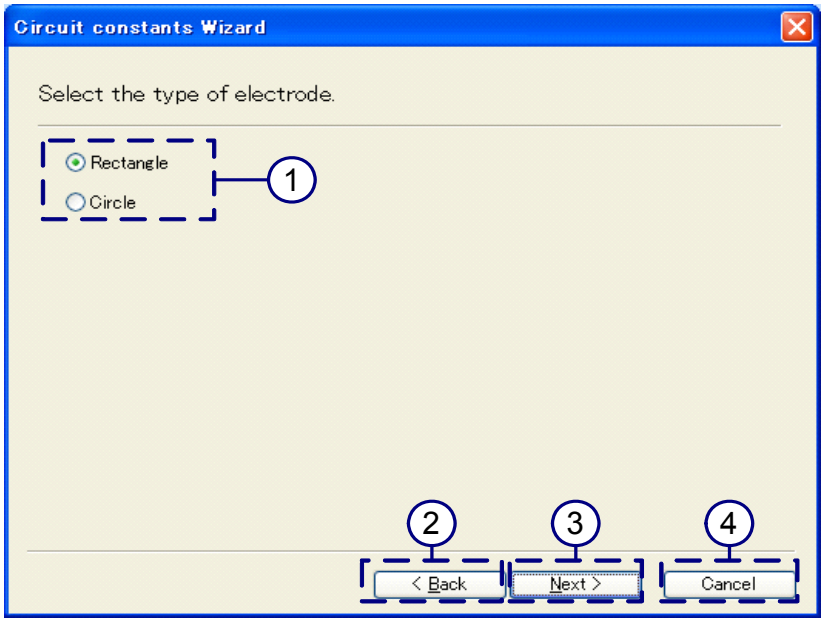


Figure 6-20 Circuit constants page 1

The explanation of the control is as follows.

Table 6-24 Controls

No	Control	Remarks
1	Rectangle / Circle	The function to select the electrode geometry is offered. Rectangle: The electrode geometry is a square. Circle: The electrode geometry is circle.
2	Back	It moves to Page 1.
3	Next	It moves to the following page according to the setting of the electrode geometry.
4	Cancel	The “Circuit constants” wizard is closed.

6.7.3 Input of wiring length from size of electrode and pin of R8C/3xT to electrode (Page 3)

The function to input the wiring length from the size of the electrode and the pin of R8C/3xT to the electrode is offered according to the electrode geometry selected in Page 2.

6.7.3.1 The electrode geometry is a quadrangle.

When the electrode geometry is selected the square, the wiring length from the size of the electrode and the pin of R8C/3xT to the electrode is input in this page.

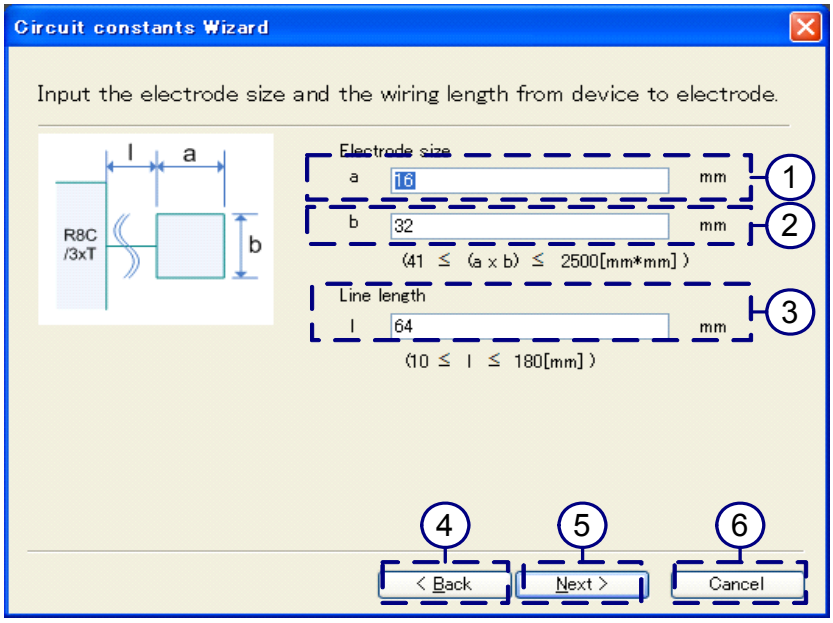


Figure 6-21 Circuit constants page 3 (The electrode geometry is a square).

The explanation of the control is as follows.

Table 6-25 Controls

No	Control	Remarks
1	a	The function to input the width of the electrode is offered. The input value is assumed to be a numerical value within the following ranges. 16 ≤ (a x b) ≤ 2500
2	b	The function to input the height of the electrode is offered. The input value is assumed to be a numerical value within the following ranges. 16 ≤ (a x b) ≤ 2500
3	l	The function to input the wiring distance is offered. The input value is assumed to be a numerical value within the following ranges. 10 ≤ l ≤ 180
4	Back	It moves to Page 2.
5	Next	It moves to Page 4 according to the setting of the electrode geometry.
6	Cancel	The “Circuit constants” wizard is closed.

6.7.3.2 The electrode geometry is circle.

When the electrode geometry is selected circle, the wiring length from the size of the electrode and the pin of R8C/3xT to the electrode is input in this page.

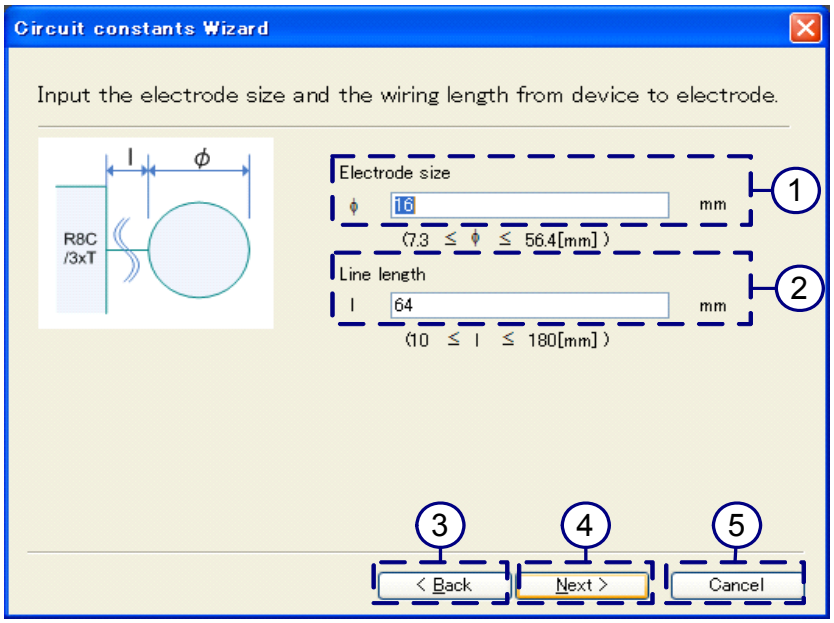


Figure 6-22 Circuit constants page 3 (The electrode geometry is Circle).

Table 6-26 Controls

No	Control	Remarks
1	ϕ	The function to input the thickness of the surface panel is offered. The input value is assumed to be a numerical value within the following ranges. $4.6 \leq \phi \leq 56$
2	l	The function to input the wiring distance is offered. The input value is assumed to be a numerical value within the following ranges. $10 \leq l \leq 180$
3	Back	It moves to Page 3.
4	Next	It moves to Page 4 according to the setting of the electrode geometry.
5	Cancel	The “Circuit constants” wizard is closed.

6.7.4 Thickness of surface panel and input (Page 4) of relative permittivity

The function to input the thickness and the relative permittivity of the surface panel is offered.

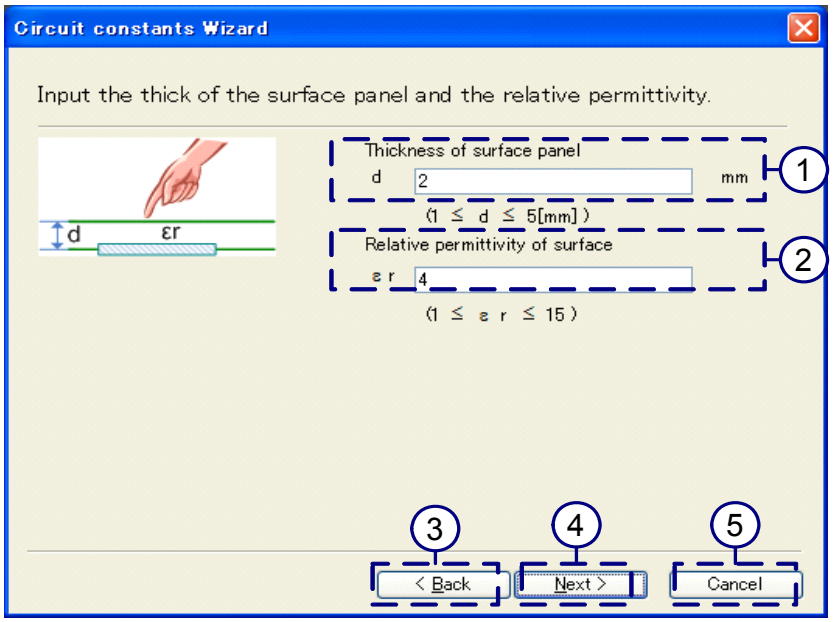


Figure 6-23 Circuit constants page 4

The explanation of the control is as follows.

Table 6-27 Controls

No	Control	Remarks
1	d	The function to input the thickness of the surface panel is offered. The input value is assumed to be a numerical value within the following ranges. 1 ≤ d ≤ 5
2	ε r	The function to input the relative permittivity is offered. The numerical value of the input value within that range is stomach k. 1 ≤ ε r ≤ 15
3	Back	It moves to Page 3.
4	Next	It moves to Page 5 according to the setting of the electrode geometry.
5	Cancel	The “Circuit constants” wizard is closed.

6.7.5 Confirmation of input value (Page 5)

The input value is confirmed on this page according to the electrode geometry selected in Page 2.

The numerical value that corresponds by the Back button is corrected when there is incompleteness in the input value.

If there is no problem in the input value, the “Next” button is pressed, and the operation result is confirmed.

6.7.5.1 The electrode geometry is a quadrangle.

When the electrode geometry selects the square, the input value is confirmed on this page.

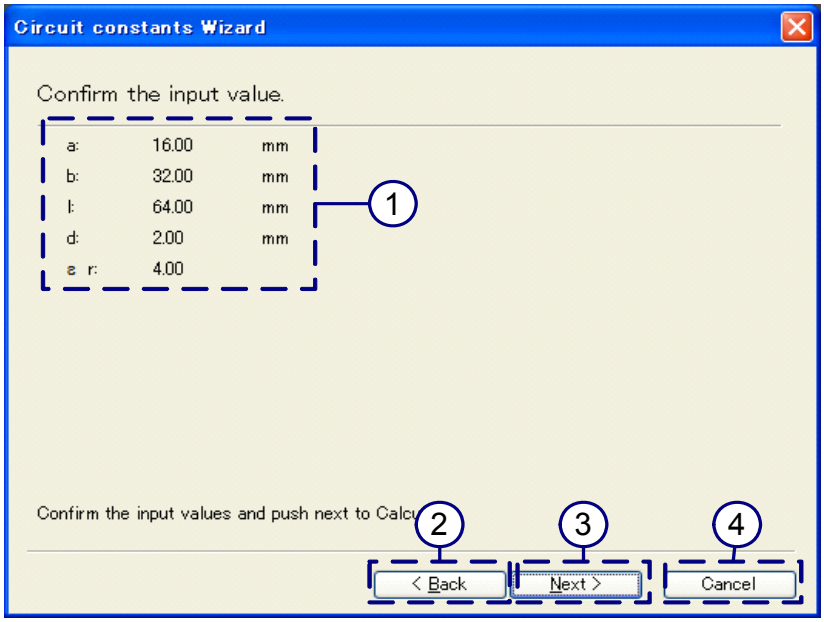


Figure 6-24 Circuit constants page 5 (The electrode geometry is a square).

The explanation of the control is as follows.

Table 6-28 Controls

No	Control	Remarks
1	a、b、l、d、ε r	Each value of a, b, l, d, and εr is displayed.
2	Back	It moves to Page 4.
3	Next	It moves to Page 6.
4	Cancel	The “Circuit constants” wizard is closed.

6.7.5.2 The electrode geometry is Circle.

When the electrode geometry selects circle, the input value is confirmed on this page.

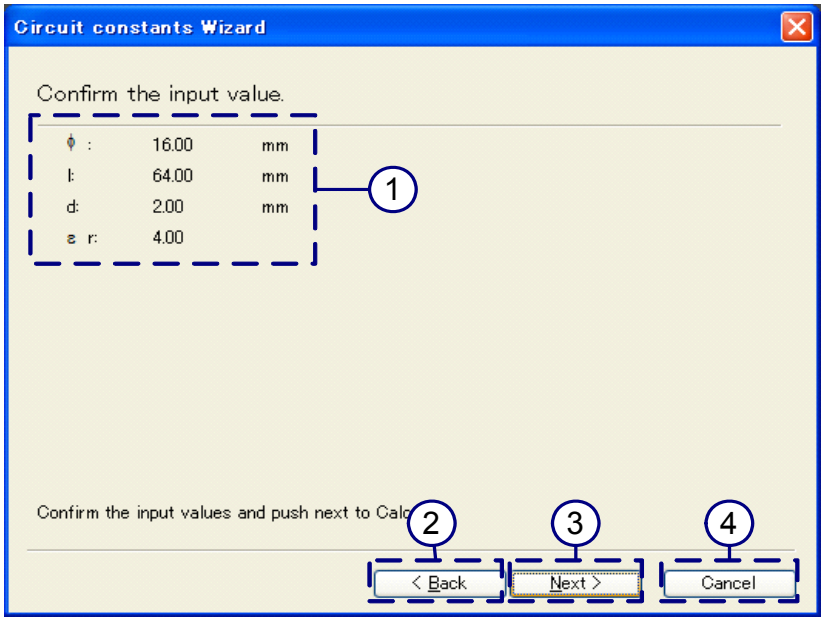


Figure 6-25 Circuit constants page 5 (The electrode geometry is Circle).

The explanation of the control is as follows.

Table 6-29 Controls

No	Control	Remarks
1	ϕ、l、d、ε r	Each value of φ, l, d, and εr is displayed.
2	Back	It moves to Page 4.
3	Next	It moves to Page 6.
4	Cancel	The “Circuit constants” wizard is closed.

6.7.6 Operation result (Page 6)

The operation result is displayed.

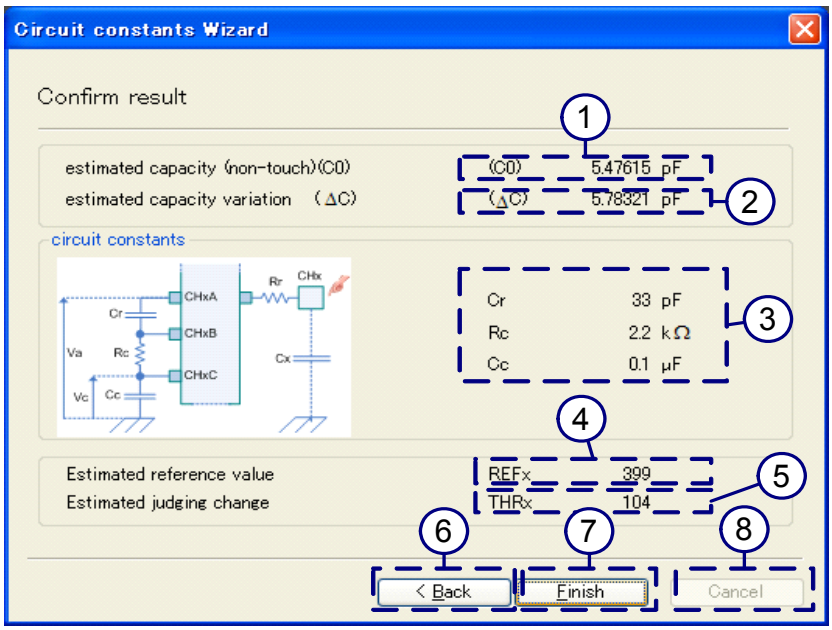


Figure 6-26 Circuit constants page 6

The explanation of the control is as follows.

Table 6-30 Controls

No	Control	Remarks
1	C0	Electrostatic capacity of the electrode at non-touch is shown.
2	ΔC	An increase in the electric capacity when touching is shown.
3	Cr、Rc、Cc	The constant values of parts around the external are shown.
4	REFx	The reference count value is shown.
5	THRx	Count value difference is shown.
6	Back	It moves to Page 5.
7	Finish	The “Circuit constants” wizard is finished.
8	Cancel	It is not possible to select this control at any time.

6.8 Option setting

The function to set the option of Workbench is offered.

Category of option is classified into three (General, Scale), and the category is switched by the tab.

6.8.1 General Option

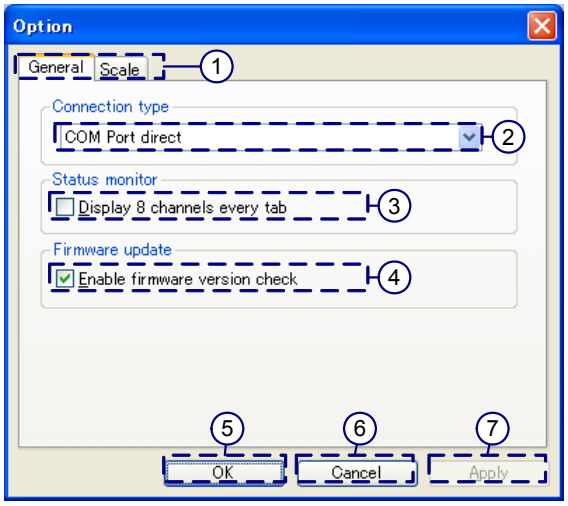


Figure 6-27 Option - General

The explanation of the control is as follows.

Table 6-31 Controls

No	Control	Remarks
1	Tab	General, Scale are switched.
2	Connection type	The function to select the connection method with the target board is offered. - When “Hew Target Server" is checked, it connects it with the target board by way of HEW. - When “Hew Target Server" is not checked, it connects it with the target board by way of the I/F board.
3	Status monitor	The number of channels displayed in one tab in “Status monitor” is set. - When “Display 8 channels every tab” is checked, the number of channels displayed in one tab is assumed to be eight. - When “Display 8 channels every tab" is not checked, the number of channels displayed in one tab is assumed to be four.
4	Firmware update	Permission or prohibition of downgrading firmware in the I/F board is set. - When “Enable firmware version check” is checked, the down grade of the firmware is prohibited. - When “Enable firmware version check” is not checked, the down grade of the firmware is permitted.
5	OK	A present set content is assumed to be effective, and “Option” is closed.
6	Close	A present set content is annulled, and “Option” is closed.
7	Apply	A present set content is assumed to be effective without closing “Option”.

6.8.2 Scale Option

The function to set the display area in the graph of the count value is offered. The display area sets the upper bound value and the lower bound value of each channel.

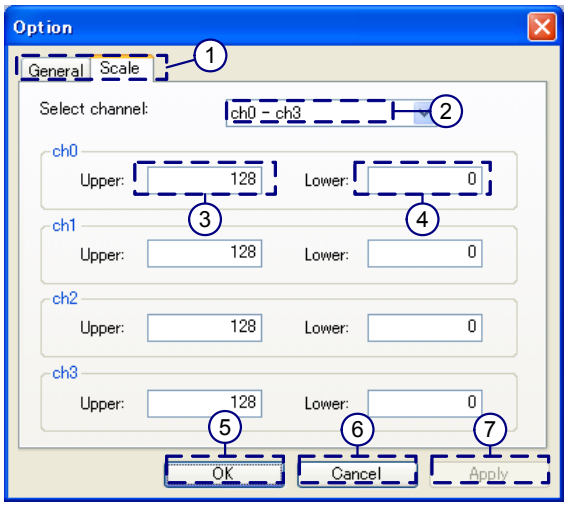


Figure 6-28 Option - Scale

The explanation of the control is as follows.

Table 6-32 Controls

No	Control	Remarks
1	Tab	General, Scale are switched.
2	Select channel	The channel group that displays it is selected.
3	Upper	The function to input the upper bound value of the display area of the corresponding channel is offered.
4	Lower	The function to input the lower bound value of the display area of the corresponding channel is offered.
5	OK	A present set content is assumed to be effective, and “Option” is closed.
6	Close	A present set content is annulled, and “Option” is closed.
7	Apply	A present set content is assumed to be effective without closing “Option”.

6.9 Version information

Version information on Workbench is displayed.

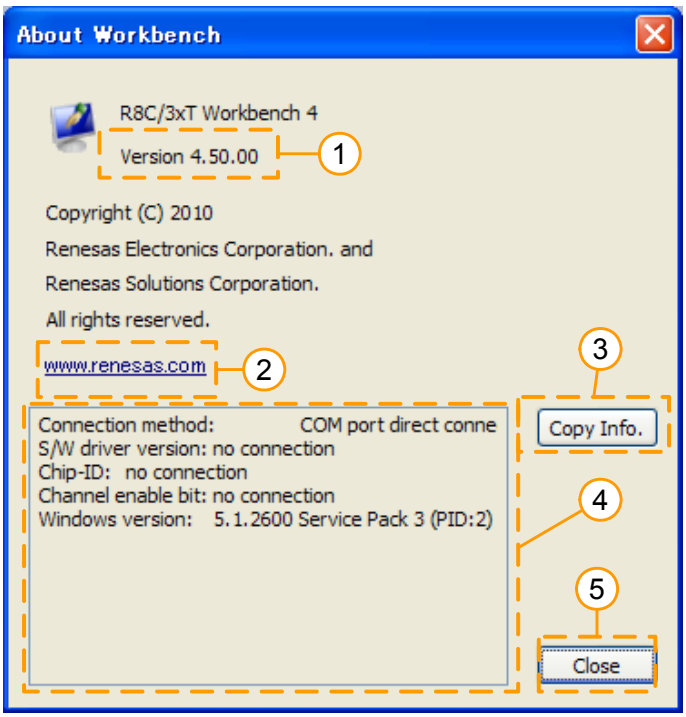


Figure 6-29 About Version

The explanation of the control is as follows.

Table 6-33 Controls

No	Control	Remarks
1	Workbench version	Workbench version is displayed.
2	URL	When clicking, the homepage of Renesas Electronics is displayed by a predetermined Web browser.
3	Copy info.	Contents in the detail information is copied to the clip board.
4	Detail information	Information such as S/W driver version and Chip-ID is displayed. Refer to “6.9.1 Detail information” for details.
5	Close	“About Workbench” is closed.

6.9.1 Detail information

According to a method to be connected to the target board, the following information is displayed.

Table 6-1 Detail information

Information type	Contents
Connection method	The connection method with the target board is displayed as follows. COM port: "COM port direct connection" Through HEW: "Hew Target Server" Through I/F board: "I/F board"
HEW version	Version of HEW is displayed in case of connection through HEW. "system busy" is displayed during monitoring by Status monitor.
S/W driver version	Version of S/W driver is displayed. "no connection" is displayed in case of non connection with the target board. "system busy" is displayed during monitoring by Status monitor. "undefined" is displayed when S/W driver which does not support the version command is used.
I/F board firmware version	Version of I/F board control firmware is displayed in case of connection through I/F board. "system busy" is displayed during monitoring by Status monitor.
I/F board firmware comment	Comments of I/F board control firmware is displayed in case of connection through I/F board. "system busy" is displayed during monitoring by Status monitor.
S/W driver status	The status of S/W driver is displayed in case of connection through HEW.
Chip-ID	Chip-ID defined in S/W driver is displayed. "no connection" is displayed in case of non connection with the target board.
Channel enable bit	Channel enable bits defined in S/W driver is displayed. "no connection" is displayed in case of non connection with the target board.
Windows version	Windows version is displayed.

7. Touch sensor adjustment using Workbench

This chapter explains the adjustment of the touch sensor according to [Figure 7-1 Adjustment flow chart] using Workbench.

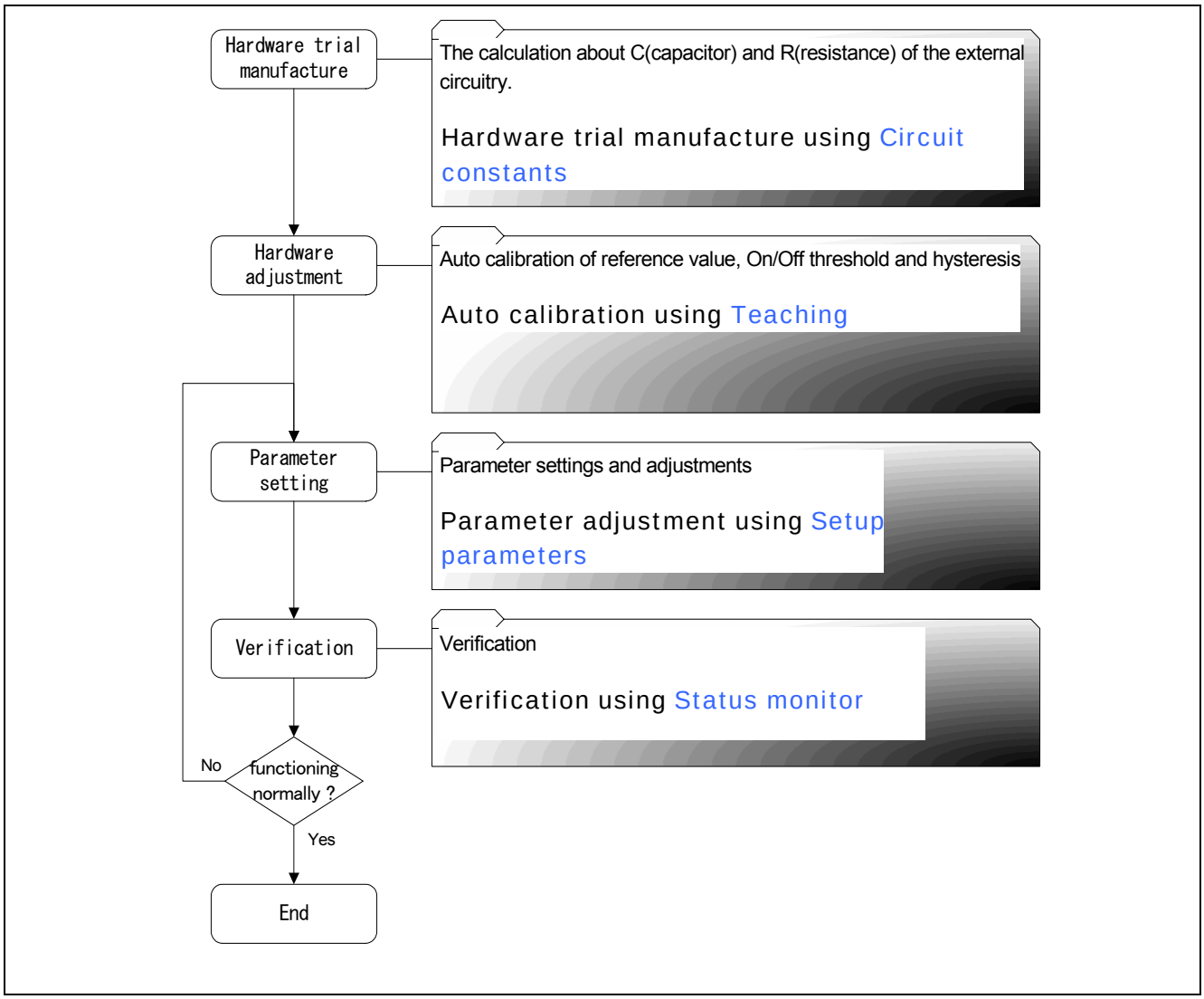


Figure 7-1 Adjustment flow chart

7.1 Hardware trial manufacture using Circuit constants

Circuit constants calculates Capacitor and Resistance to use for a capacitance measurement circuit on producing the sample board using the touch sensor.

Refer to [6.7 Circuit constants] about the controls of circuit constants wizard.

7.1.1 Circuit constants operation procedures

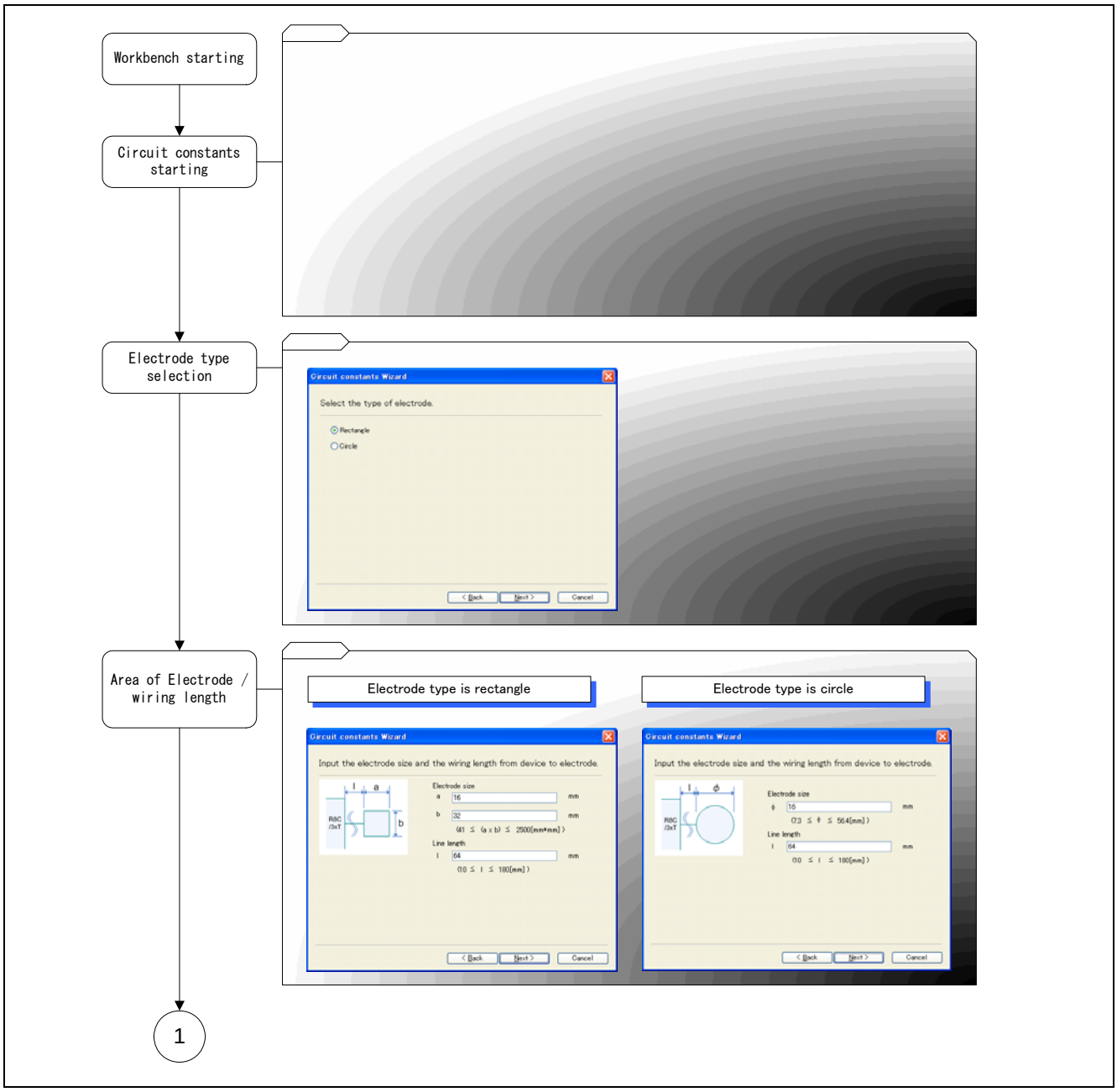


Figure 7-2 Circuit constants operation procedures (1/2)

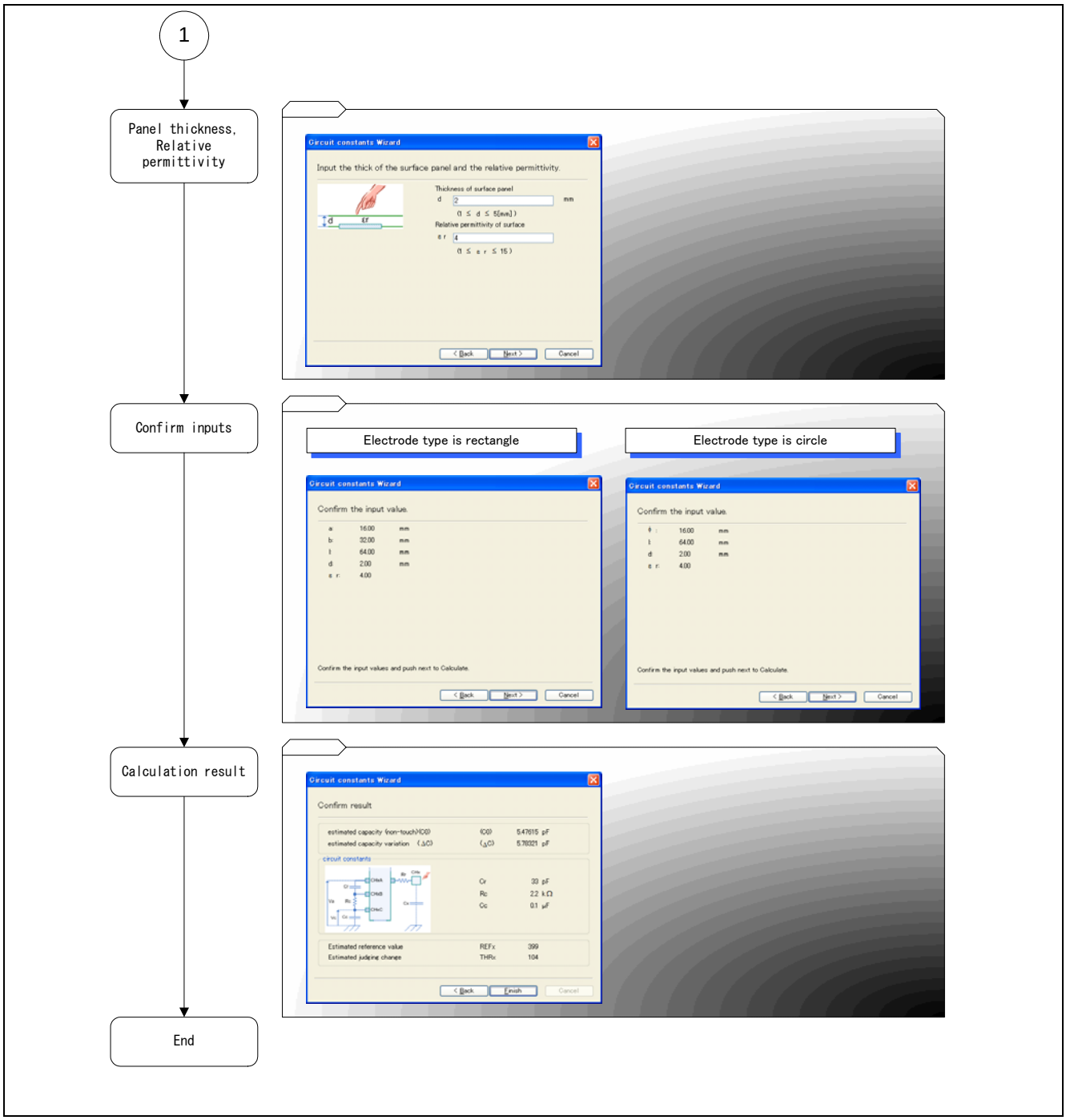


Figure 7-3 Circuit constants operation procedures (2/2)

7.1.2 Circuit constants wizard starting

Select “Circuit constants” menu ([Tool] - [Circuit constants]) or Click toolbar button ( ) to wakeup the circuit constants.

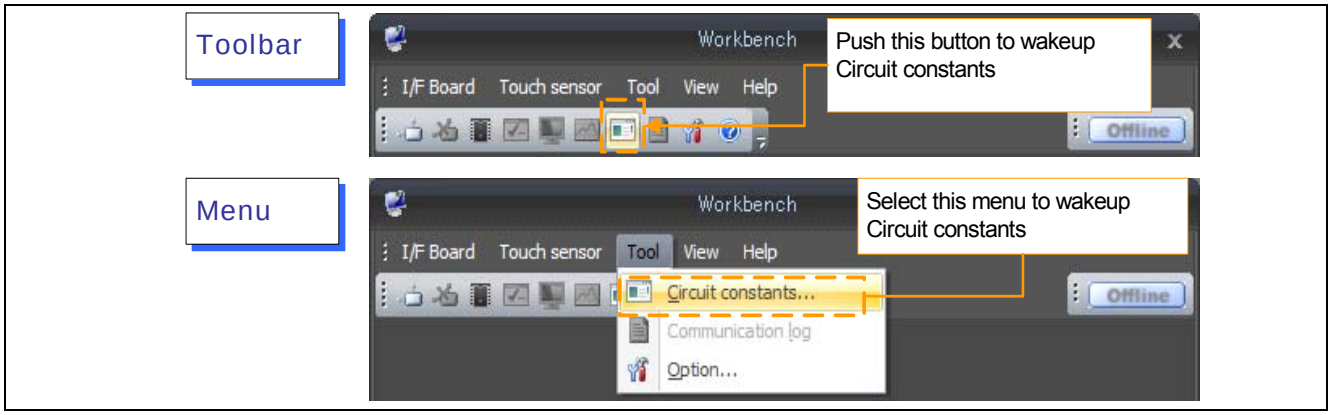


Figure 7-4 Circuit constants starting

7.1.3 Electrode type selection

Select the electrode type among rectangle and the circle.

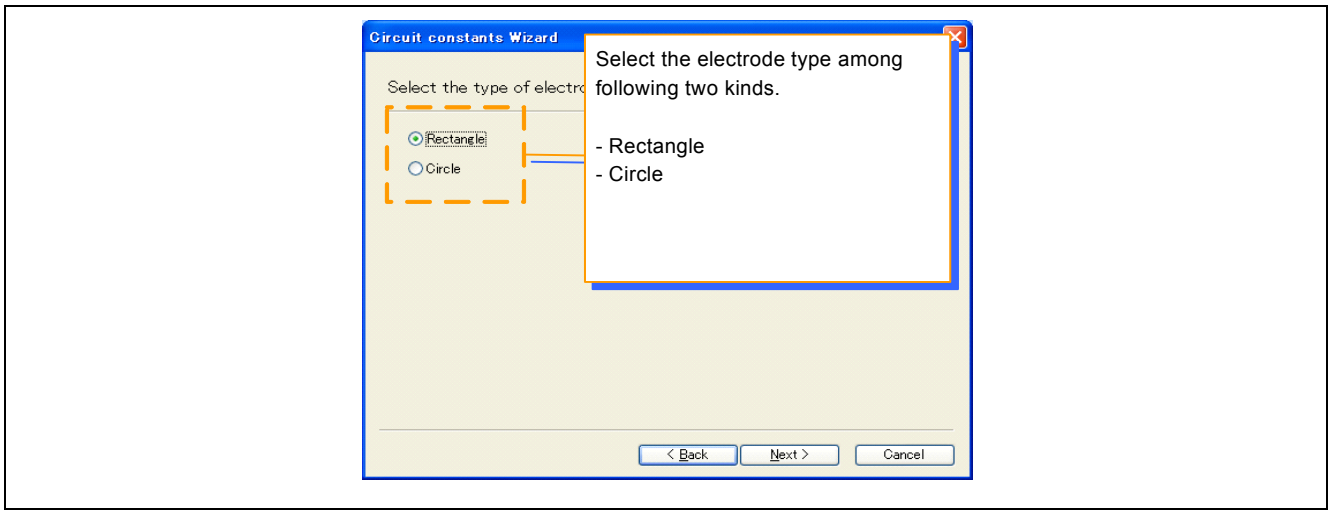


Figure 7-5 Electrode type selection

7.1.4 The area of electrode / wiring length

Input the width and height or a diameter of the electrode and wiring distance according to an electrode shape, because the detection of the touch changes by the area of the electrode and wiring distance from an electrode to R8C/3xT.

7.1.4.1 Electrode type is rectangle

(1) Width and Height of electrode

Input width (a) and height (b) of an electrode satisfying the following.

$16 \leqq (a \times b) \leqq 2500$

(2) Wiring length

Input length (l) of wiring from an electrode to R8C/3xT satisfying the following.

$10 \leqq l \leqq 180$

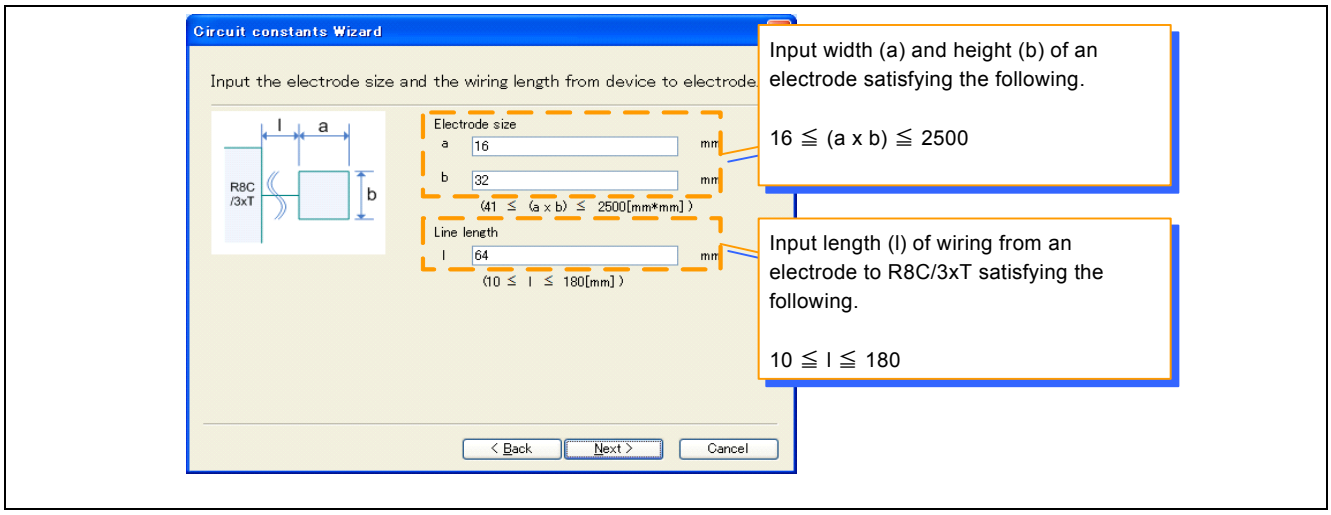


Figure 7-6 Width and Height of the electrode, wiring length settings

7.1.4.2 Electrode type is circle

(1) Diameter

Input the diameter(φ) of electrode satisfying the following.

$4.6 \leqq \phi \leqq 56$

(2) Wiring length

Input length (l) of wiring from an electrode to R8C/3xT satisfying the following.

$10 \leqq l \leqq 180$

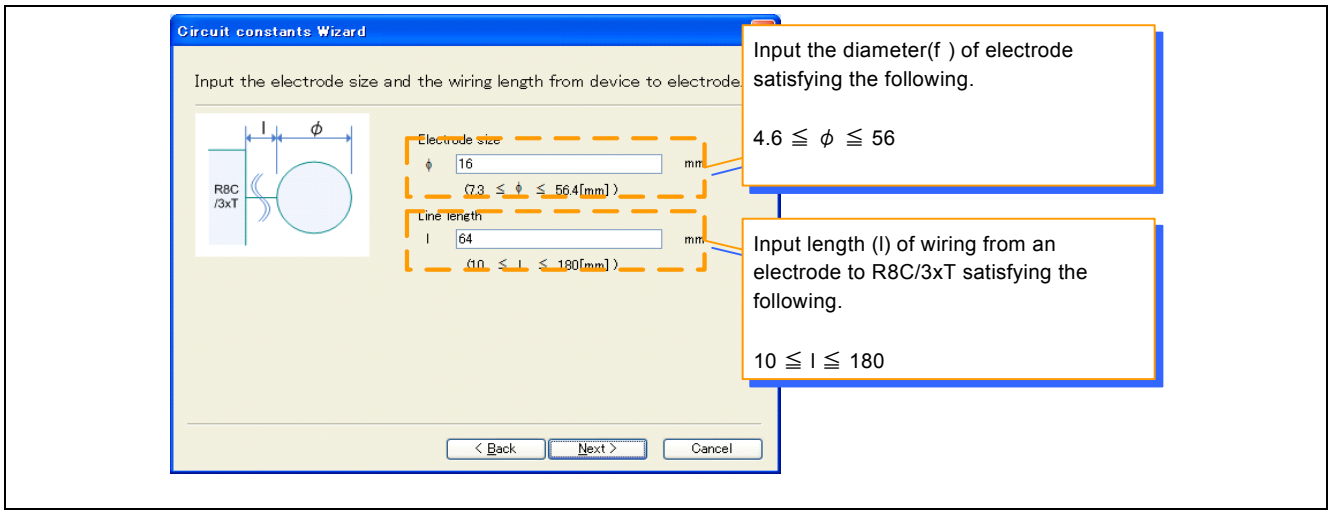


Figure 7-7 Diameter of the electrode, wiring length settings

7.1.5 Thickness and Relative permittivity of the panel

In general, the electrode is put a panel made by acrylic or glass and is used.

Thickness (d) and Relative permittivity (εr) of the panel have to be input to influence the detection of the touch.

The thickness of the panel must satisfy the following.

$$1 \leqq d \leqq 5$$

The relative permittivity of the panel must satisfy the following

$$1 \leqq \varepsilon r \leqq 15$$

For reference, a relative permittivity every material is shown in [Table 7-1 Relative permittivity].

Table 7-1 Relative permittivity

No	Material	Relative permittivity
1	Glass	5.4 - 9.9
2	Acrylic	3.2 - 4.6
3	Wood	2.5 - 7.7
4	Rubber	2.0 - 3.5
5	Paper	2.0 - 2.6

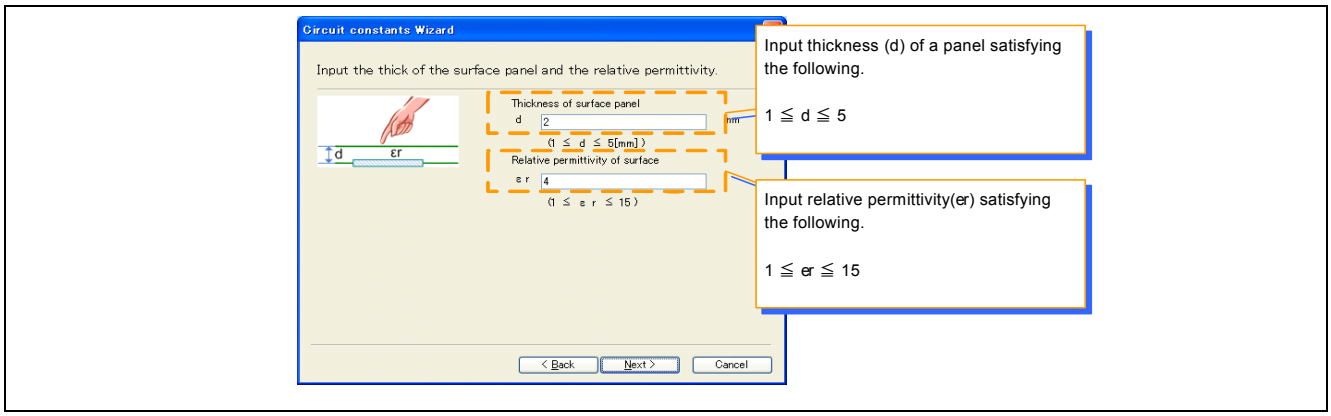


Figure 7-8 Thickness and Relative permittivity of the panel settings

7.1.6 Confirmation of the input values

Confirm the input value. When there is an error in a displayed value, come back to the page inputting the value, and revise the value.

7.1.6.1 Electrode type is rectangle

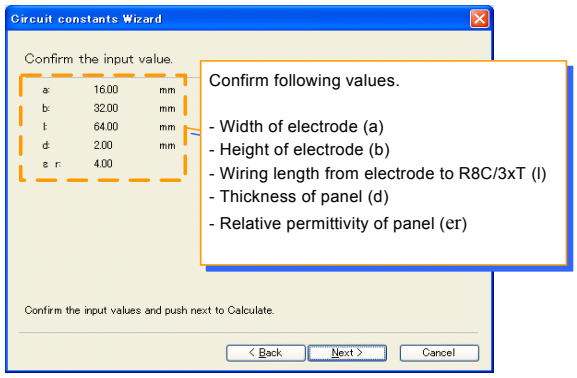


Figure 7-9 Confirmation of the input value (Electrode type is rectangle)

7.1.6.2 Electrode type is circle

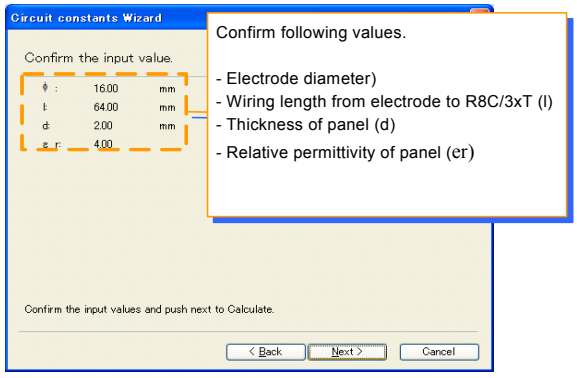


Figure 7-10 Confirmation of the input value (Electrode type is circle)

7.1.7 Result of calculation

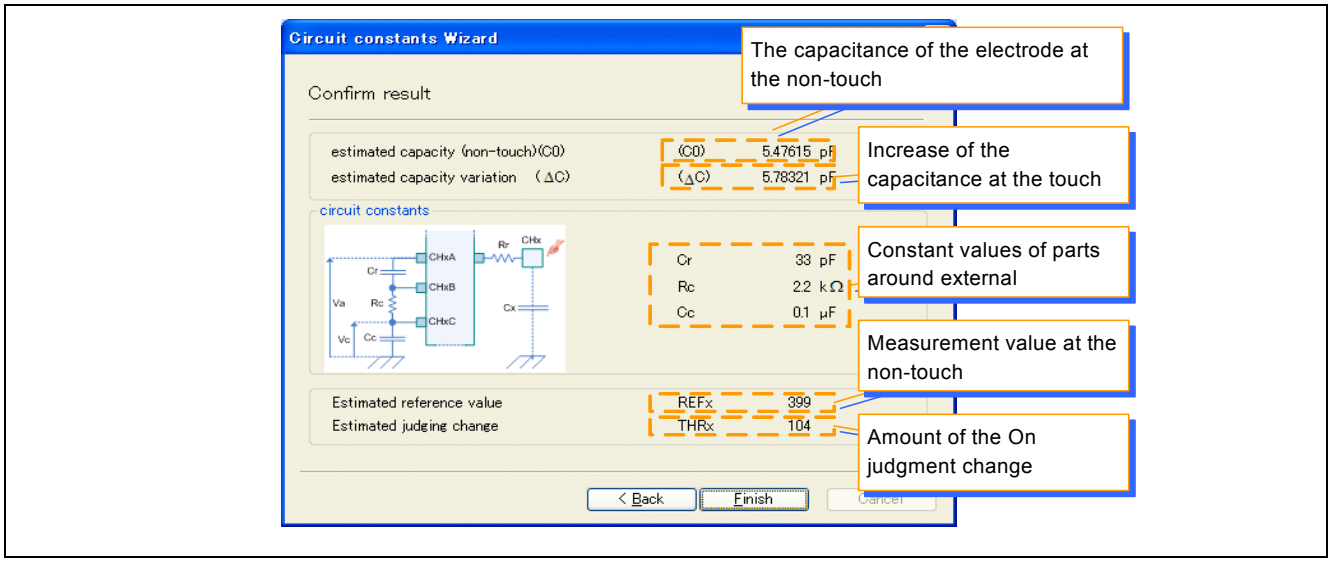


Figure 7-11 Result of calculation

7.2 Auto calibration using Teaching

Teaching calculates reference count value(REFx), Threshold count value for judgement of touch or not (THRx), Hysteresis(HYSx) by really touching an electrode and writes REFx and THRx, HYSx to the DATA FLASH

Refer to [6.6 Teaching] about the controls of circuit constants wizard.

7.2.1 Teaching operation procedures

Teaching operation procedures is as follows.

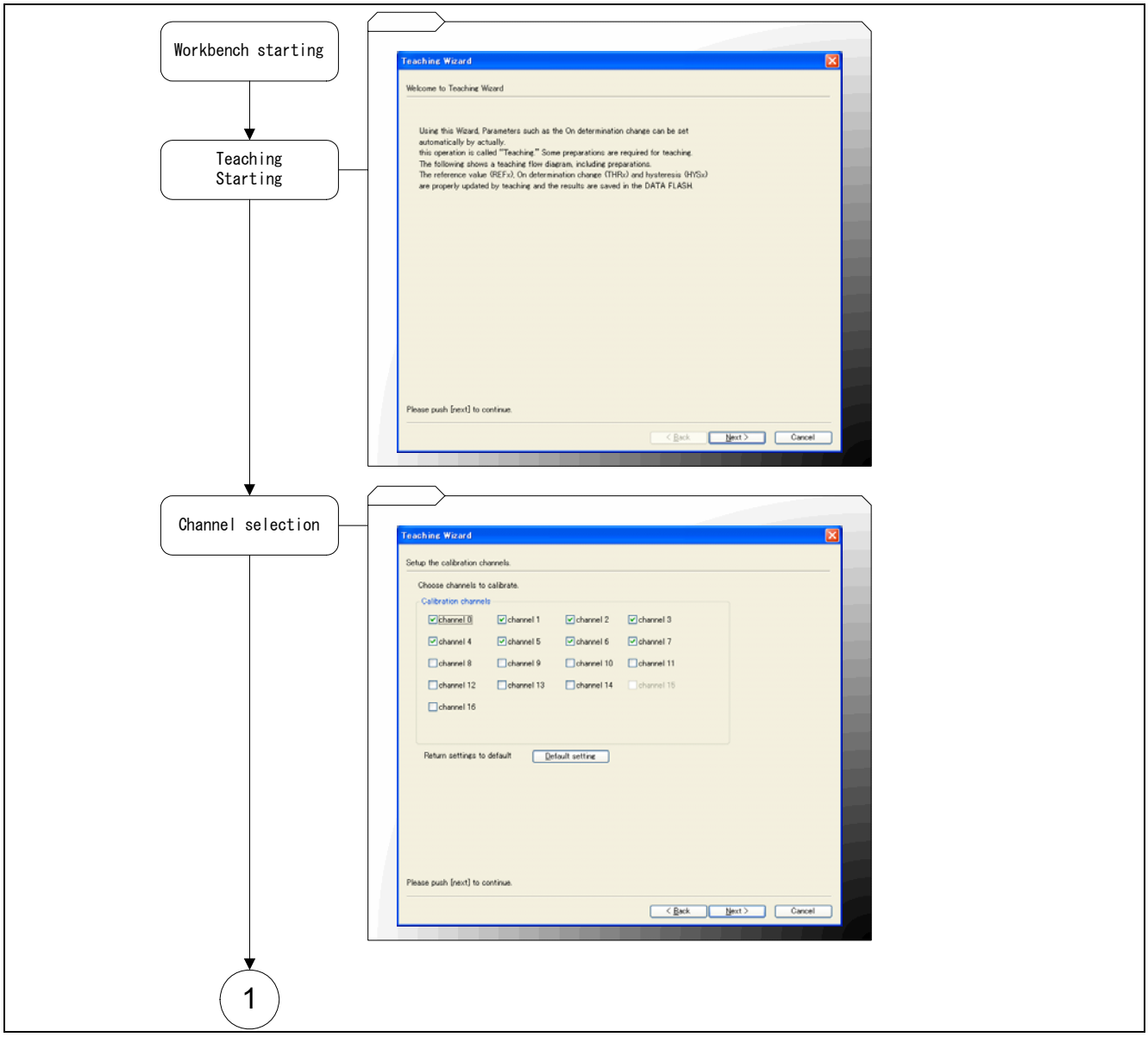


Figure 7-12 Teaching operation procedures (1/2)

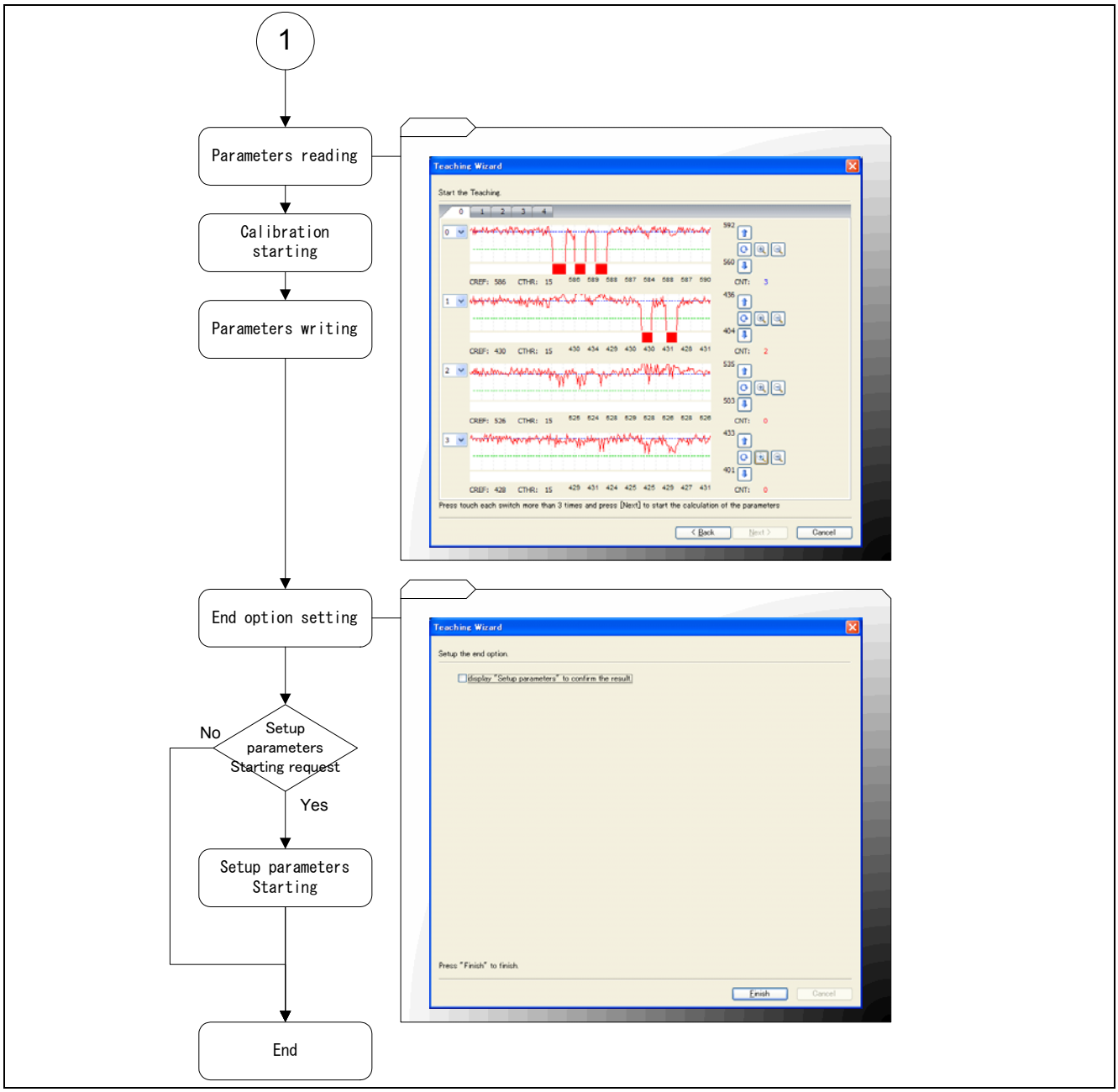


Figure 7-13 Teaching operation procedures (2/2)

7.2.2 Teaching wizard starting

Select “Teaching” menu ([Touch sensor] - [Teaching]) or Click toolbar button ( ) to wakeup the Teaching.

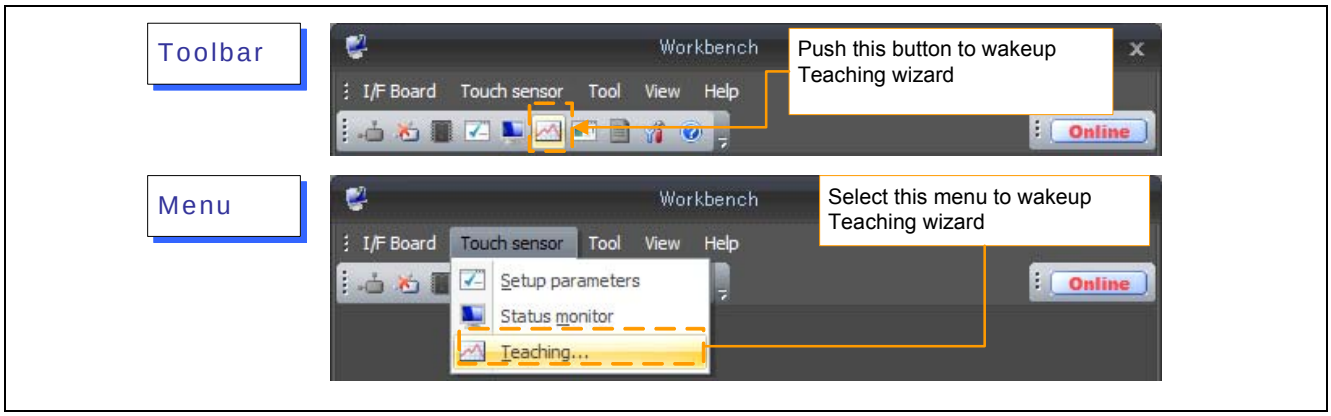


Figure 7-14 Teaching starting

7.2.3 Channel selection

Set channels to calibrate. Don’t check the channel assigned to slider or wheel.

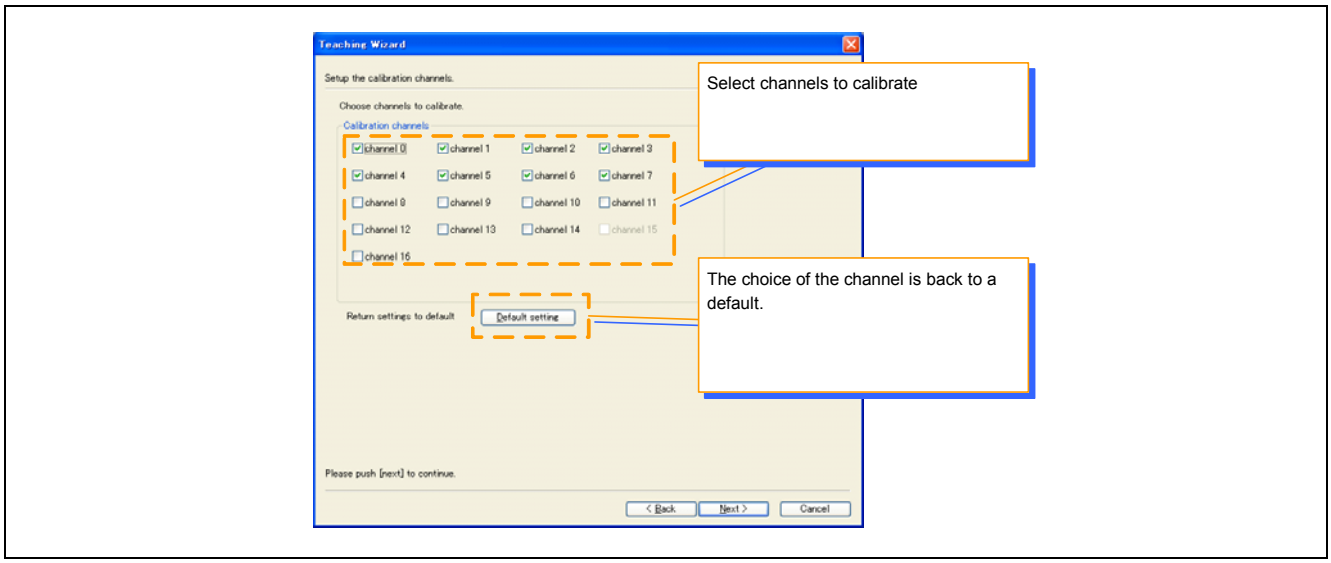


Figure 7-15 Channel selection

7.2.4 Parameter reading

The parameters are read by the press of [Next]. An operation guide of this wizard page is as follows.

"Press [Next] to read parameters from device."

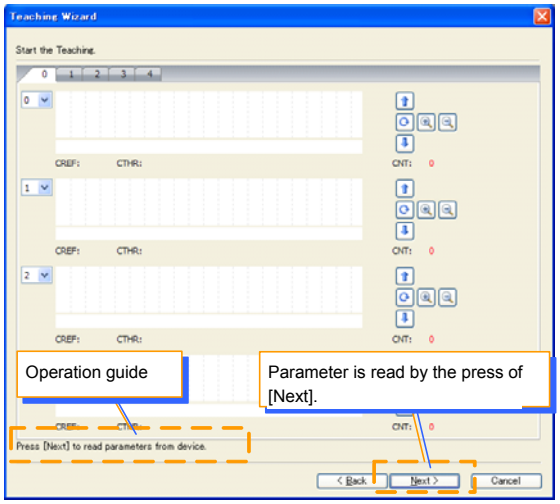


Figure 7-16 Parameter reading

7.2.5 Start the calibration

The calibration is started by the press of [Next]. An operation guide of this wizard page is as follows.

"Press [Next] to start the calibration."

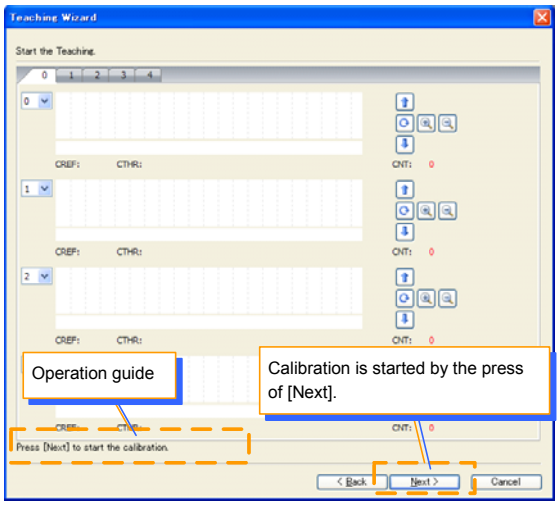


Figure 7-17 Start the calibration

7.2.6 Stop the calibration

When the channels to calibrate is touched three times, [Next] button become in condition to be able to push. Workbench calculates the parameters to write to the touch sensor by the press of [Next].

If the calculation is failed, retry the calibration by the press of [Back].

When the calculation succeeds, the following message is displayed.

Figure 7-18 Teaching success message

7.2.7 Parameter writing

The parameter is written to the DATA FLASH by the press of [Next]. An operation guide of this wizard page is as follows.

"Press [Next] to write the parameters to device."

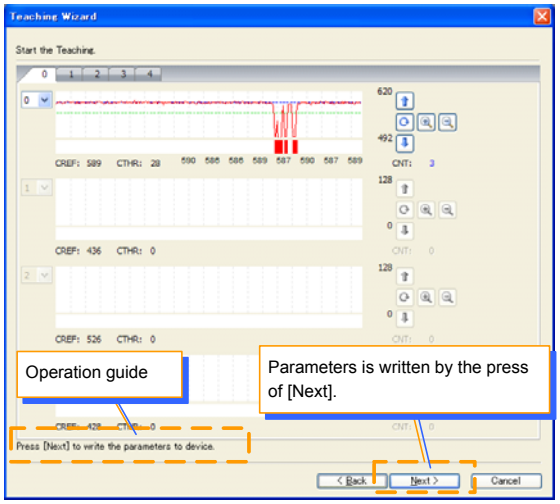


Figure 7-19 Parameter writing

When the writing to the DATA FLASH is completed, the following message is displayed.

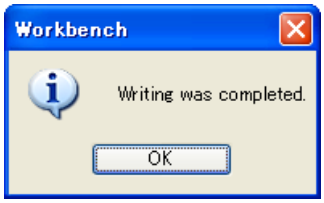


Figure 7-20 Parameter writing success message

7.2.8 End option

Set the option whether starting Setup parameters or not after the finish of Teaching.

Teaching is finished by the press of [Finish] and when the End option is enable, Setup parameter is started.

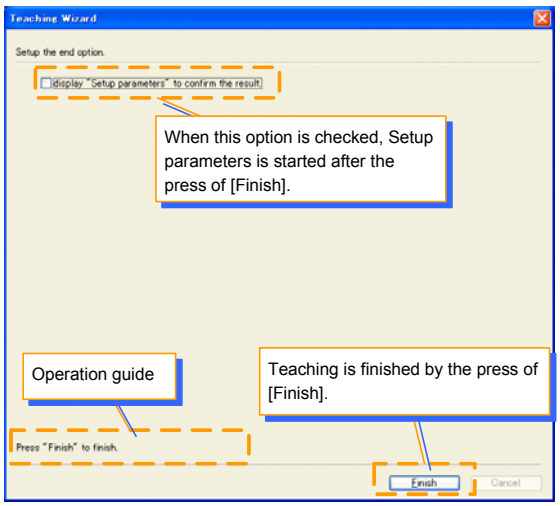


Figure 7-21 End option

7.3 Parameters adjustment using Setup parameters

7.3.1 Setup parameters starting

Select “Setup parameters” menu ([Touch sensor] - [Setup parameters]) or click the toolbar button ( ) to wakeup the Setup parameters.

Refer to [6.4 Setup parameters] about the controls of Setup parameters.

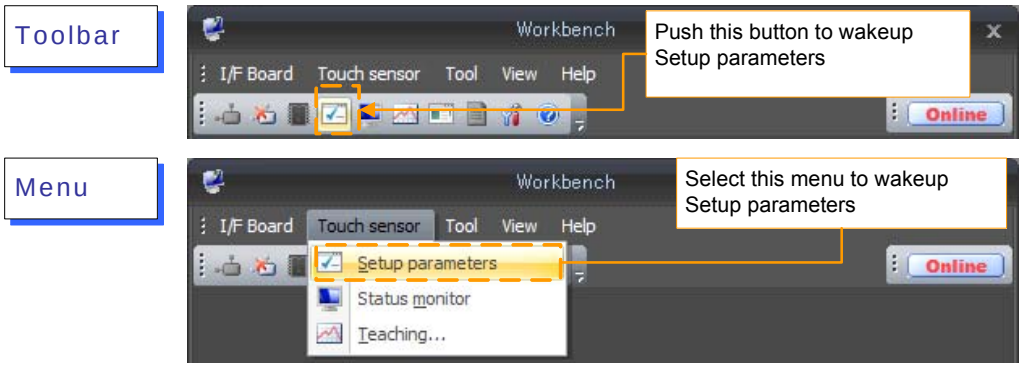


Figure 7-22 Setup parameters starting

The screen of Setup parameters is as follows.

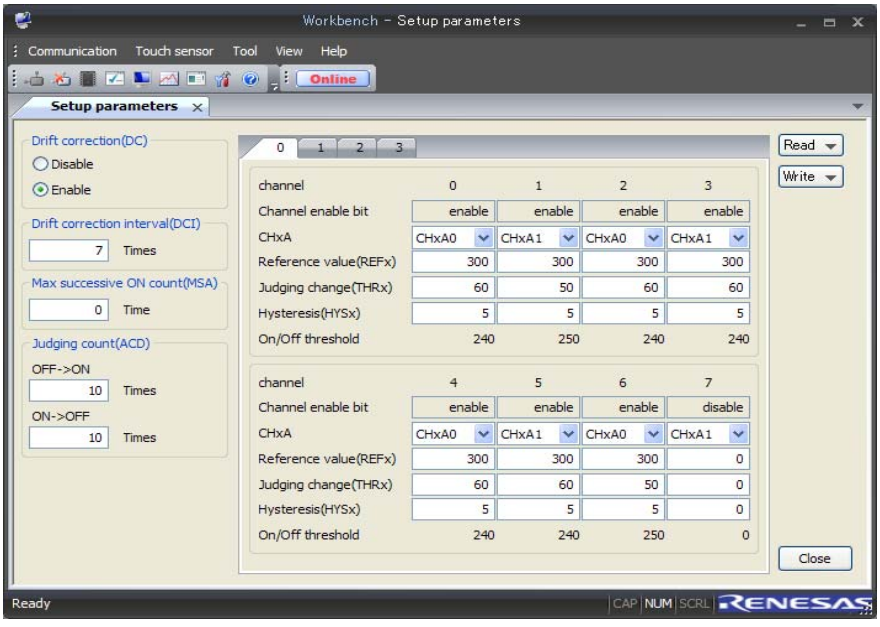


Figure 7-23 Setup parameters

7.3.2 Common parameters

The common parameters of channels located to the left side of Setup parameters are as follows.

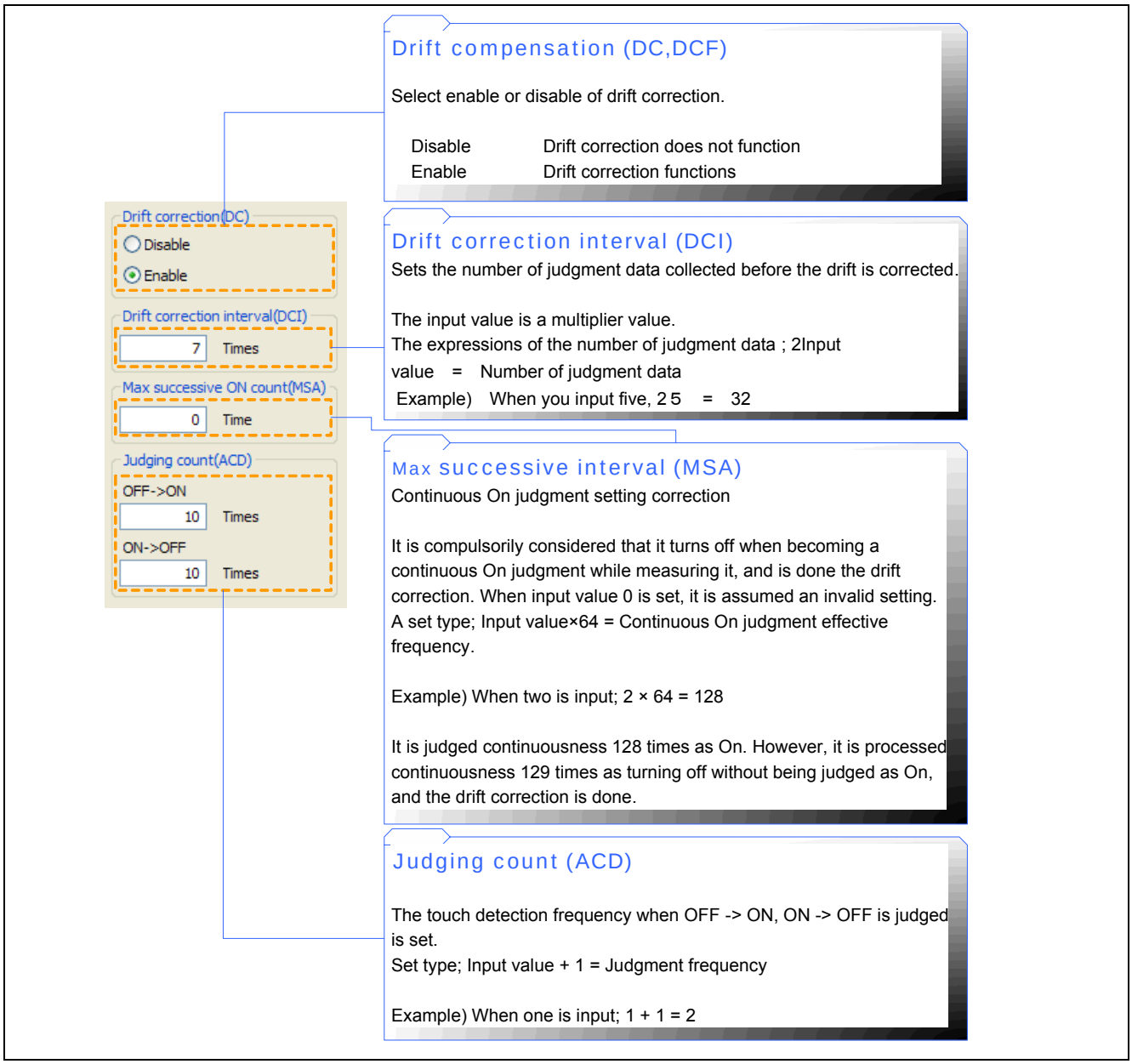


Figure 7-24 Common parameters

7.3.3 Drift correction

The reference count value is determined by finding the average of the previous 32 non-touch samples. Therefore, the drift is measured and used to compensate the reference count value, too, when the measurement count value changes gradually. Compensation for the threshold level and hysteresis are compensated at regular intervals.

When a touch is judged due by a large change of the measurement count value and the total counts has not yet reached 32, the total of the measurement count value is set to 0. The reference count value is also not changed.

This function to update the reference count value is called the "Drift correction".

[Figure 7-25 Drift correction for the reference count value] shows the process to which the reference count value is updated with a gradual change of the measurement count value.

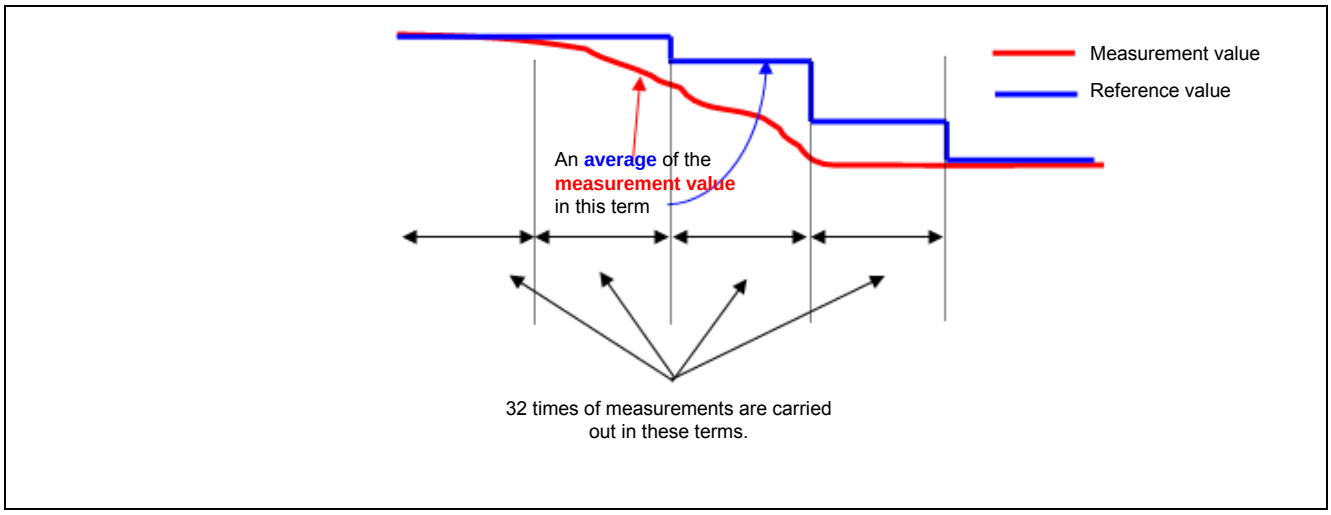


Figure 7-25 Drift correction for the reference count value

[Figure 7-26 The timing of drift correction] shows the process of the reference count value when the measurement count value changes and it is judged that it touches.

Because the measurement count change exceeded the threshold, the measurement count value is judged as a touch in A point.

Therefore, 32 measurement count value addition that in process starting at B and ending at C is interrupted by A point. The addition result is annulled, the reference count value is not updated, and the last value is maintained.

When the measurement count value rises and it is judged non-touch in A' point, the measurement count value is added starting from D again. The 32nd addition is complete at E and the reference count value is updated.

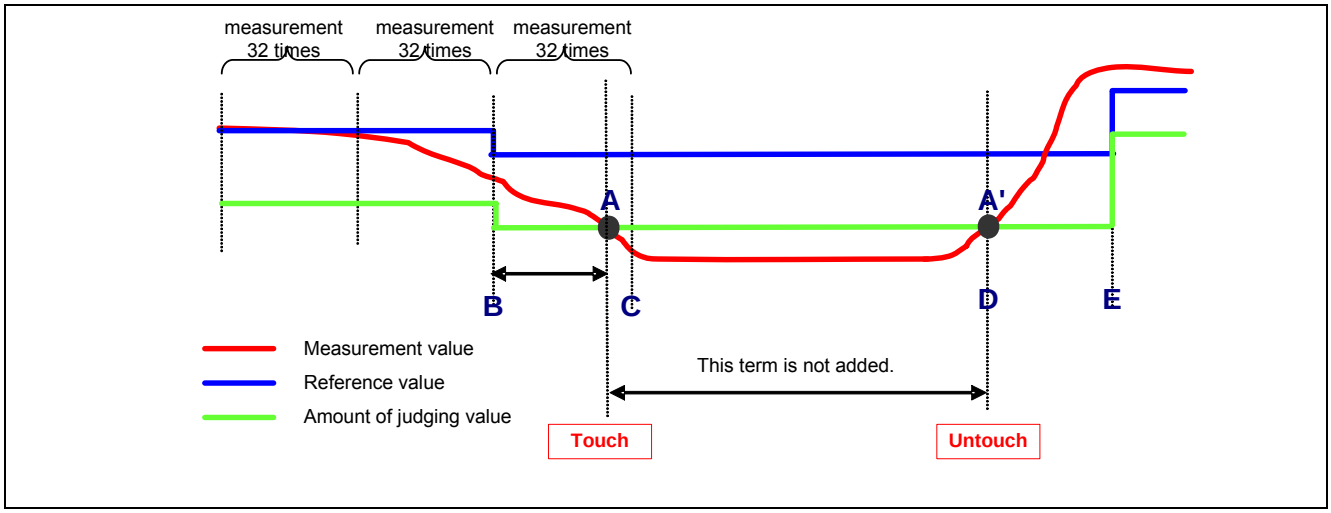


Figure 7-26 The timing of drift correction

7.3.4 Hysteresis

Hysteresis can be independently set for each channel determines the value the measurement must return to before a non-touch measurement is judged.

[Figure 7-27 Hysteresis] shows figure of hysteresis.

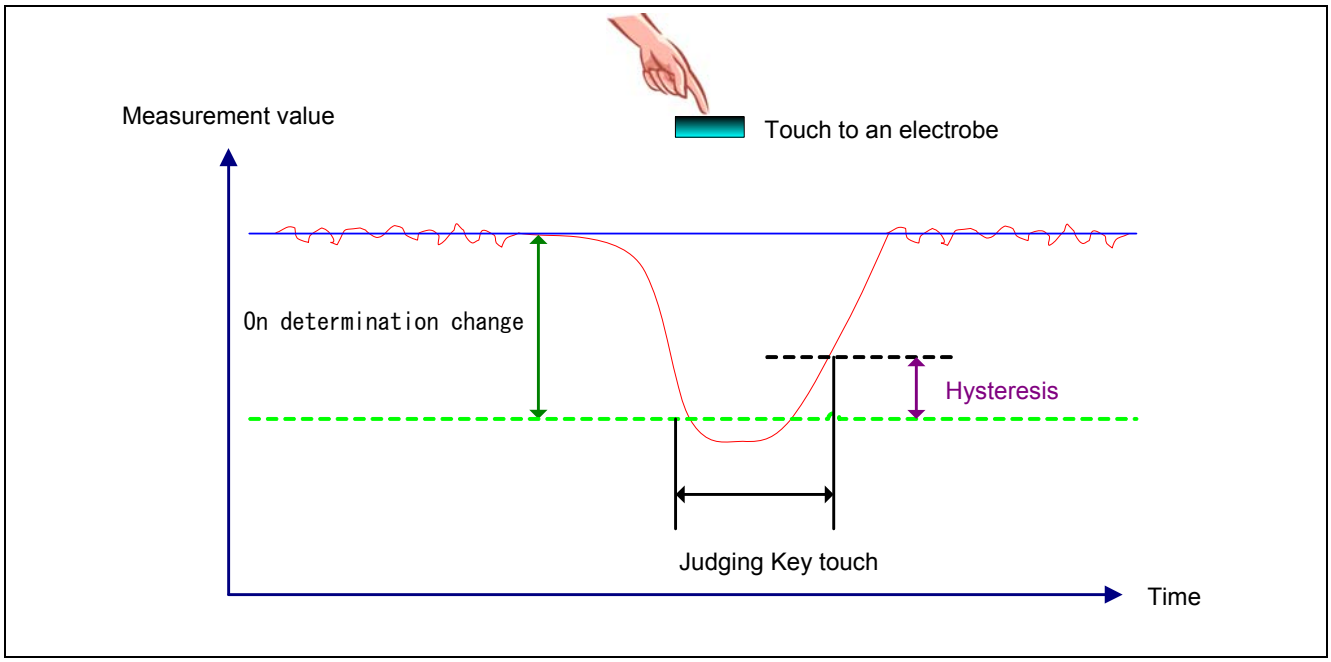


Figure 7-27 Hysteresis

Count value < Current reference count value - Count value difference -> Touch detection

Count value > Current reference count value - Count value difference + Hysteresis -> Non-touch from touch

7.3.5 Parameters for each channels

Parameters for each channels are as follows.

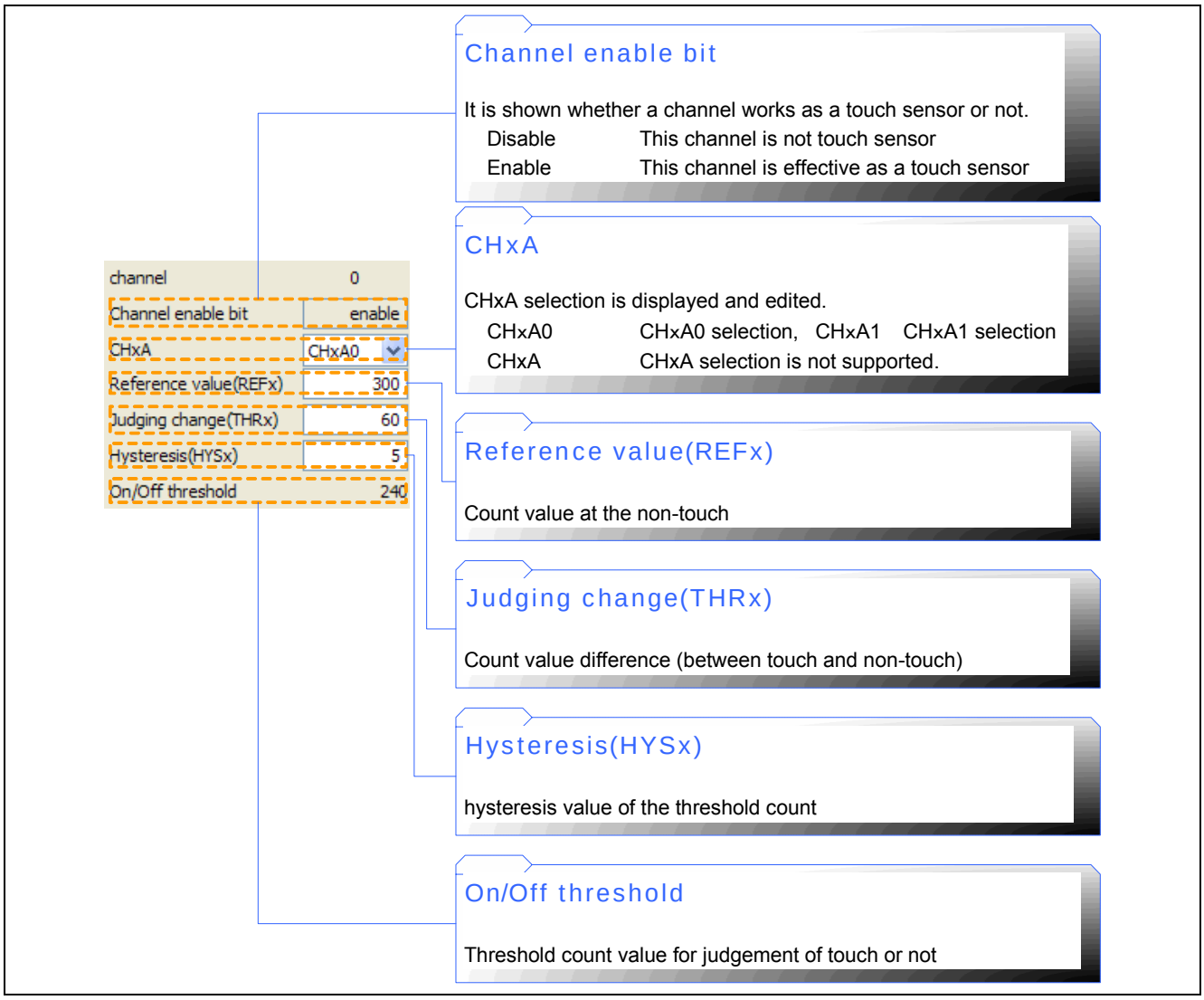


Figure 7-28 Parameters for each channels

7.4 Verification using Status monitor

7.4.1 Status monitor starting

Select “Status monitor” menu ([Touch sensor] - [Status monitor]) or click the toolbar button ( ) to wakeup the Status monitor.

Refer to [6.5 Status monitor] about the controls of Status monitor.

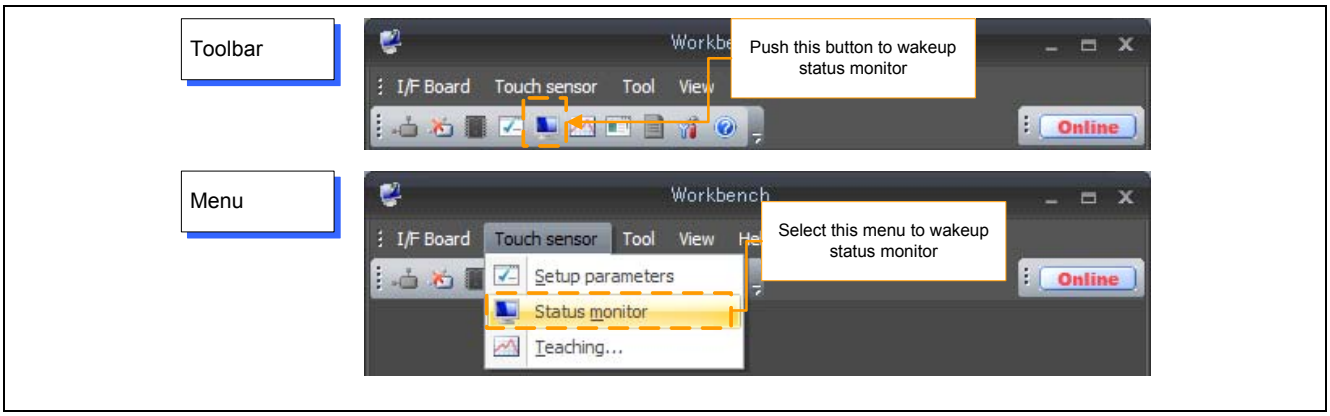


Figure 7-29 Status monitor starting

The screen of Status monitor is as follows.

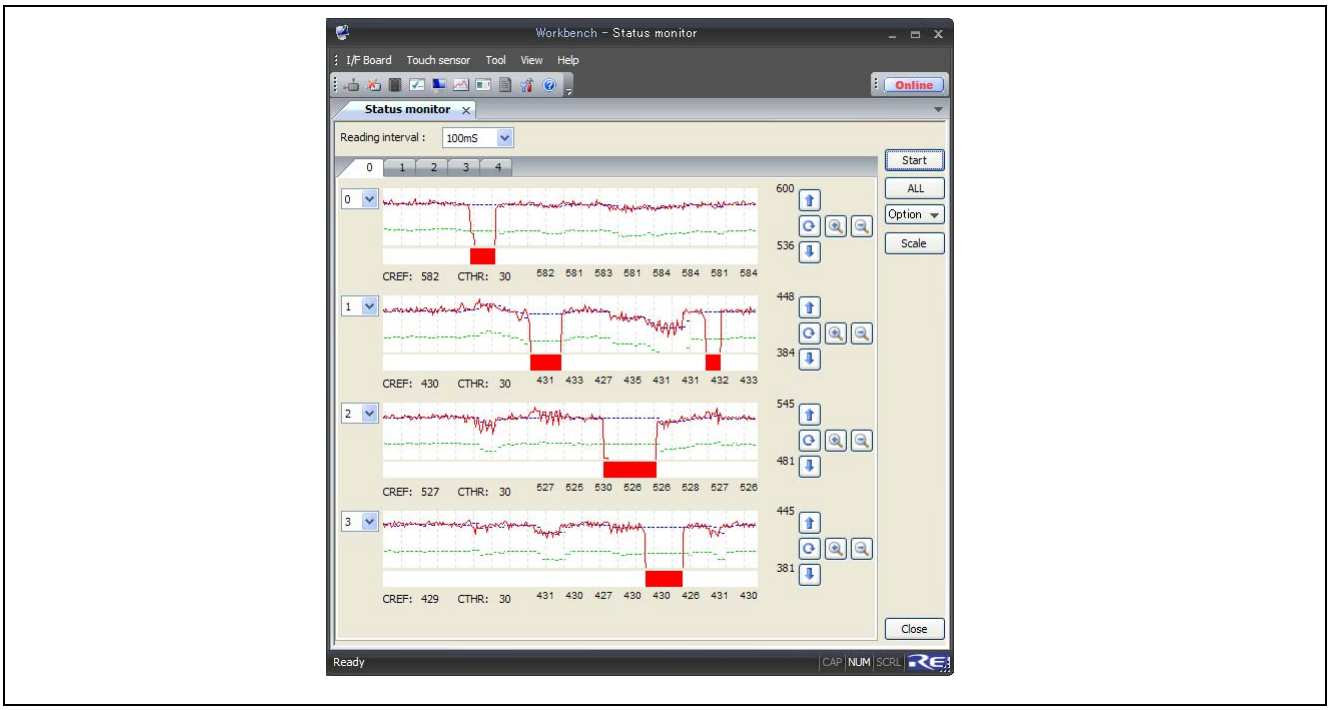


Figure 7-30 Status monitor

7.4.2 Graph explanation

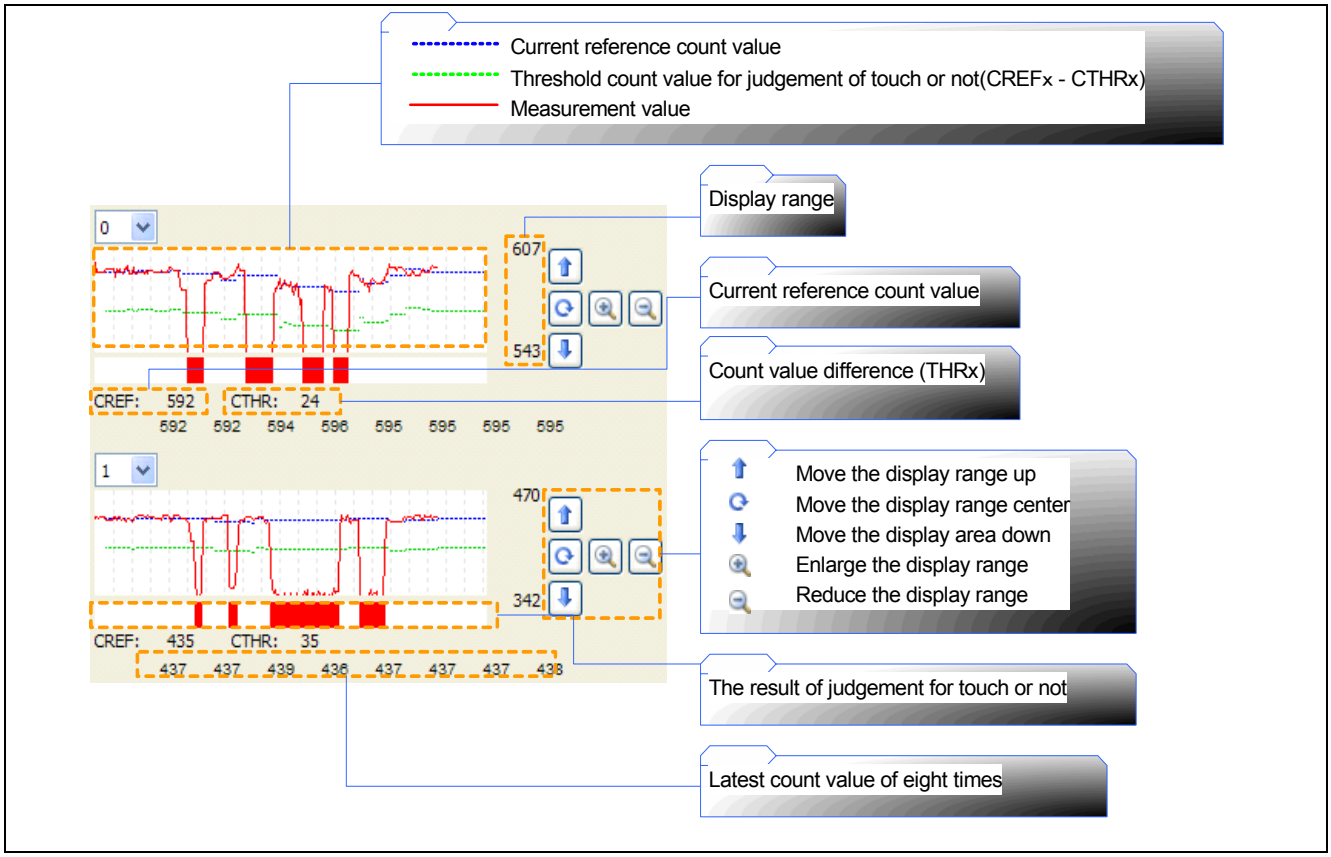


Figure 7-31 Detail explanation of graph display

7.4.3 Viewpoint of the graph

7.4.3.1 The graph of touch detection

[Figure 7-32 Graph at the touch detection] is a graph that channel 0 is touched.

When count value (red line) fall below the Threshold count value for judgement of touch or not (green dotted line), the touch detection is done. A red bar is displayed under the measurement graph as a sign that has been detected.

The information to be able to read from the graph is as follows.

- Reference count value : 588 counts, Threshold count value for judgement of touch or not: 527 counts
- Touch frequency : 1, Touch detection frequency : 1
- There is no drift correction due to noise or adjacent channel touch

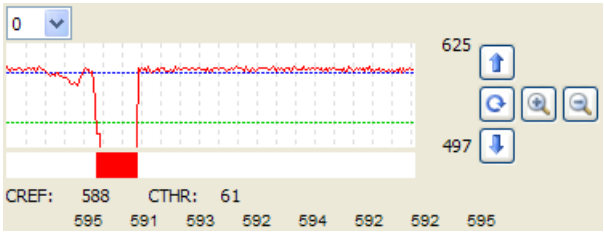


Figure 7-32 Graph at the touch detection

7.4.3.2 The graph of Non-touch detection

[Figure 7-33 Graph at the non-touch detection] is a graph where the a touch is shown as for channel 0. However, the touch detection is not judged because measurements do not fall below the ON/OFF threshold (green dotted line).

The information to be able to read from the graph is as follows.

- Reference count value : 590 counts, Threshold count value for judgement of touch or not : 470 counts
- Touch frequency: 4, Touch detection frequency : 0
- There is no drift correction due to noise or adjacent channel touch.

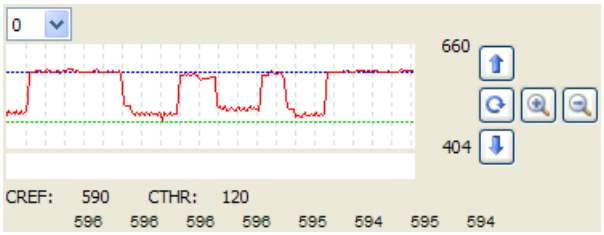


Figure 7-33 Graph at the non-touch detection

7.4.3.3 The graph of drift correction

[Figure 7-34 Graph of drift correction] is a graph where the situation is a finger is brought close to channel 2 . The reference count value (blue dotted line) and the ON/OFF threshold (green dotted line) are adjusted by the drift correction.

The information to be able to read from the graph is as follows.

- Reference count value : 594 counts, Threshold count value for judgement of touch or not : 570 counts
- Touch frequency : 0, Touch detection frequency : 0
- There is a drift correction due to noise or adjacent channel touch.

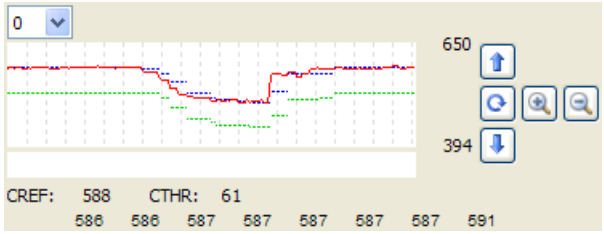


Figure 7-34 Graph of drift correction

8. The restrictions about the change of the R8C/3xT S/W driver

The restrictions about the change of the R8C/3xT S/W driver in case of connection with the target board through HEW is as follows.

Refer to application note "Interface specifications of touch detection driver and Workbench" (R01AN0295JJ0100 Rev. 1.00) for the details.

8.1 The restrictions about the change of S/W driver for R8C/33T Demonstration Board

When the following variable is deleted, Workbench cannot connect to the target board.

Therefore, the following variable must be defined by all means. In addition, do not change the definition of typedef (__FLASH_IMG__, __EX_DATA__, __SCU_IN_DATA__, UH, UB) in conjunction with the following variables.

(1) touch_control.h

The following variable surrounded in comment "prohibit change area" assumes all changes impossibility and do not change the macro definition REAL_VAL. In addition, refer to the application note "Interface specifications of touch detection driver and Workbench" when you change MAX_CH.

```
#define MAX_CH                17    /* Mounting CH val MAX */
   :
   : omission
   :
#define REAL_VAL(VAL) (VAL & 0x7fffu)
   :
   : omission
   :
//------------>>[ prohibit change area
TOUCH_EXTERN __SCU_IN_DATA__ Scudata[MAX_CH];// SCU measured value (DTC
forwarding address)
TOUCH_EXTERN __EX_DATA__    BDATA;// OnOff final result (monitor parameter)
TOUCH_EXTERN UH   Ncount[MAX_CH];// Measuring result (monitor parameter)
TOUCH_EXTERN UH   Nref[MAX_CH];  // reference value (monitor parameter)
TOUCH_EXTERN UH   pSETUP;        // not use in future
TOUCH_EXTERN UH   pMEAS;         // not use in future
TOUCH_EXTERN UH   Slp;           // next use in future
TOUCH_EXTERN __FLASH_IMG__ PRM;  // last data for touch
TOUCH_EXTERN UB HewSvr_write_req;// Data Flash writing request from Workbench
PC App
TOUCH_EXTERN UB HewSvr_mode;     // Hew mode flag (0: I/F board, 1: Hew mode)
//------------<<] prohibit change area
```

(2) touch_control.c

The initial value of the following variable is modifiable. Refer to the application note “Interface specifications of touch detection driver and Workbench” for the details.

```
//##----- tbl
const UH Chip_ID[] = { DF_CHIPID };
   :
   : omission
   :
const __EX_DATA__ Mes_Ena = {
     {0xff,    // DATA_L,  Measurement enable M,L
      0x7f,    // DATA_M,  Measurement enable Dummy,H
      0x01,    // DATA_H,  Measurement enable M,L
      0x00},   // BDummy,  Measurement enable Dummy,H
};             // Measurement Enable (Ch21～16,15～8,7～0)
```

8.2 The restrictions about the change of S/W driver for R8C/3JT Evaluation Board

When the following variable is deleted, Workbench cannot connect to the target board.

Therefore, the following variable must be defined by all means. In addition, do not change the structure and union (__EX_DATA__, __FLASH_IMG__) in conjunction with the following variable.

(1) 3JT_data.c

About “Ncount”, “BDATA”, “Nref”, do not change order to define.

```
unsigned short Ncount[MAX_CH];/* Measuring result (monitor parameter)*/
union __EX_DATA__ BDATA;      /* OnOff final result (monitor parameter) */
unsigned short Nref[MAX_CH];  /* reference value (monitor parameter) */
   :
   : omission
   :
struct __FLASH_IMG__ PRM;/* The structure to arrange for the RAM arrangement
*/
union __EX_DATA__ Mes_Ena;/* Measurement Enable (Ch21～16,15～8,7～0) */
   :
   : omission
   :
// kishi 追加09/09/17
unsigned short Chip_ID;       // chip ID
unsigned short pSETUP;        //
unsigned short pMEAS;         //
unsigned short Slp;           //
   :
   : omission
   :
///// for HEW Workbench ////////////////////////////////
unsigned short HewSvr_write_req; /* Data Flash writing request from Workbench
PC App */
unsigned short HewSvr_mode;   /* Hew mode flag (0: I/F board, 1: Hew mode) */
////////////////////////////////////////////////////////
```

(2) 3JT.h

Refer to the application note “Interface specifications of touch detection driver and Workbench” when you change MAX_CH.

```
#define MAX_CH                22    /* Mounting CH val MAX */
```

(3) 3JT_int.c

Do not change macro definition REAL_VAL.

```
#define  REAL_VAL(VAL)  (VAL & 0x7fff)
```

9. Notes

Notes when connecting with the target board through HEW are shown below.

- Do not start HEW more than two.

  HewTargetServer might not respond when two or more HEW starts. Start only one HEW when you use Workbench by way of HEW.

- About communication baud rate when HEW and target board are connected

  The communication baud rate set when the target board and the communication begin with HEW : as long as there is no special reason.

  The maximum value is strongly recommended to be used.

- About automatic renewal of RAM monitor of HEW

  The performance of Workbench decreases greatly to consume CPU resource when the automatic renewal of RAM monitor is made effective. When Workbench is used by way of HEW, the automatic renewal of RAM monitor is strongly recommended to be invalidated.

- About edit of Log file

  The format of Log file is CSV. For the log playing, the size of entry is defined. When "000001" is updated by the edit in "1", it becomes the factor of the error generation. When the log file is edited, an original log file is recommended to make the copy in another folder etc. , and not to be updated.

Website and Support

Renesas Electronics Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/inquiry

Revision Record

		Description	
Rev.	Date	Page	Summary
1.00	Dec. 04, 2009	—	First edition issued
1.01	Apr. 28, 2010	P.12	3. To connect to the target board through I/F board - New addition
		P.44	5.6.3 Setup calibration channel page - New addition
		P.64	6 Touch sensor adjustment using Workbench - New addition
		P.90	7 The restrictions about the change of the R8C/3xT S/W driver - New addition
1.02	Jan. 17, 2011	P.3	2. To connect to the target board through Communication port - New addition
		P.30	6.2.1 COM Port configuration - New addition
		P.68	6.9 Version information - Specifications is changed.
		-	Specification of Communication log is deleted.
1.03	Jun. 23, 11	P.2	1.2 1.2 System requirement - Windows 2000 is deleted - Windows 7 (32 bit version) is added.
		P.3	1.4 Attension in the use on Windows Vista or Windows 7 - New addition
		P.27	5. About ChipID - Specification of ChipID is changed.
		P.38	6.4 Setup parameters - CHxA selection is supported
		P.49	6.5.4 Board image - Figure 6-13 is changed.
		P.59	6.7 Circuit constants - Images of application is updated.
		P.73	7.1 Hardware trial manufacture using Circuit constants - Images of application is updated.
		P.88	7.3 Parameters adjustment using Setup parameters - Images of application is updated.

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins
   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.
   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.
2. Processing at Power-on
   The state of the product is undefined at the moment when power is supplied.
   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.
3. Prohibition of Access to Reserved Addresses
   Access to reserved addresses is prohibited.
   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.
4. Clock Signals
   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.
   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.
5. Differences between Products
   Before changing from one product to another, i.e. to one with a different type number, confirm that the change will not lead to problems.
   — The characteristics of MPU/MCU in the same group but having different type numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different type numbers, implement a system-evaluation test for each of the products.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.
   - "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.
   - "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.
   - "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

RENESAS

SALES OFFICES Renesas Electronics Corporation http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
7F, No. 363 Fu Shing North Road Taipei, Taiwan, R.O.C.
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
1 harbourFront Avenue, #06-10, keppel Bay Tower, Singapore 098632
Tel: +65-6213-0200, Fax: +65-6278-8001

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

Colophon 1.0