

Analogue Waveform Signal Capturing Program

K2 / CAPTURE K2Sprint / CAPTURE

Instruction Manual

Limitation of K2 Sprint/CAPTURE

- Available input channels are limited to maximum 2 channels.

Type of Document : Instruction Manual

System Applied : K2/K2Sprint
Software <CAPTURE> later than Version 10.0.0

Japanese Edition

Version	Date	Contents
1.0.0	2004.03.05	First Edition
1.0.1	2004.04.02	Correction of a misprint
3.0.0	2005.03.31	Additional description of “Repetitive save setting”
3.1.0	2005.09.16	Additional description of “Transmissibility of CH.”
3.1.1	2005.09.22	Additional description of operation setting “Transmissibility display unit” Correction of “Max. capturing length”
4.0.0	2006.06.27	Additional description of “Offset”.
4.1.0	2007.01.25	Additional description of CSV loading function for channel sensitivity
4.2.0	2008.01.18	Additional description of a new function, Realtime waveform graph
6.0.0	2010.10.21	Applied to Windows7
10.0.0	2013.08.09	Renewal of screen display, modification of the upper limit of the number of FFT lines, modified description of test files, modified description of input channels

English Edition

Version	Date	Contents
1.0.1	2004.04.02	First Edition, Correction of a misprint
3.0.0	2005.04.06	Additional description of “Repetitive save setting”
3.1.1	2006.01.13	Additional description of “Transmissibility of CH.” Additional description of operation setting “Transmissibility display unit” Correction of “Max. capturing length”
4.0.0	2006.06.27	Additional description of “Offset”.
4.1.0	2007.06.01	Additional description of CSV loading function for channel sensitivity
4.2.0	2008.01.22	Additional description of a new function, Realtime waveform graph
6.0.0	2010.11.05	Applied to Windows7
10.0.0	2013.08.09	Renewal of screen display, modification of the upper limit of the number of FFT lines, modified description of test files, modified description of input channels

Contents

Chapter 1	Outline of the System	1-1
1.1	Specifications	1-1
1.1.1	CAPTURE	1-1
Chapter 2	Operation System of K2 Applications	2-1
2.1	Outline	2-1
2.2	Measurement Condition File	2-2
Chapter 3	Basic Operation	3-1
3.1	Example 1 : Data Capturing (Manual Trigger)	3-1
3.2	Example 2 : Data Capturing (Internal Trigger)	3-14
Chapter 4	Test Definition	4-1
4.1	Outline	4-1
4.2	Capture Condition	4-1
4.2.1	Sampling Frequency	4-2
4.2.2	Realtime waveform time	4-2
4.2.3	Capture Time	4-2
4.2.4	Max. Observation Frequency	4-3
4.2.5	Trigger Source	4-3
4.2.5.1	Trigger Level	4-5
4.2.5.2	Trigger Slope	4-5
4.2.6	Trigger Delay	4-5
4.2.7	Input Channel	4-6
4.2.8	Input sensitivity loading	4-7
Chapter 5	Post Processing	5-1
5.1	Waveform Edit	5-1
5.1.1	Scalar calculation	5-2
5.1.1.1	Calculation	5-2
5.1.1.2	Calculation value	5-2
5.1.1.3	Setting Method	5-3
5.1.2	Edging	5-5
5.1.2.1	Edging Width	5-5
5.1.2.2	Peak level	5-5
5.1.3	Data length change	5-6
5.1.3.1	Processing type	5-6
5.1.3.2	Data Length	5-7
5.1.3.3	Data Position	5-7
5.1.3.4	Objective Region	5-8
5.1.4	Filtering	5-9
5.1.4.1	Type of Filter	5-9
5.1.4.2	Filter Characteristics	5-9
5.1.4.3	Frequency resolution	5-10

5.1.4.4 Cut-off frequency.....	5-10
5.1.4.5 Filter order.....	5-10
5.1.4.6 Filter slope.....	5-10
5.1.5 Frequency conversion(Freq. Conversion).....	5-11
5.1.5.1 Signal frequency conversion	5-11
5.1.5.1.1 Signal frequency conversion ratio(Signal freq. conversion ratio).....	5-12
5.1.5.2 Sampling frequency conversion.....	5-12
5.1.5.2.1 Auto-setting.....	5-12
5.1.5.2.2 Do not operate the filtering	5-12
5.1.5.2.3 Sampling frequency	5-13
5.1.6 Offset.....	5-15
5.2 PSD Analysis	5-16
5.2.1 Specifying of Frequency Lines	5-16
5.2.2 Frequency Lines and Frequency Resolution.....	5-17
5.3 Transmissibility of CH.	5-18
5.4 To use the data as a Reference of K2/SHOCK, K2/RANDOM.....	5-21
Chapter 6 Supplemental Remarks	6-1
6.1 Repetitive save setting.....	6-1
6.2 Set Up.....	6-3

Chapter 1 Outline of the System

1.1 Specifications

K2/CAPTURE dedicated software for K2 digitizes analog waveform signals and captures them as waveform data. And, PSD Analysis of waveform data acquired can be operated.

Both of the waveform data acquired and PSD data obtained by analysis are saved as a file of CSV format.

The saved CSV file data can be used as below :

- Waveform data is usable as a Reference Waveform of SHOCK
- PSD data is usable as a Reference PSD of RANDOM.

1.1.1 CAPTURE

- | | | |
|------------------------------------|---|--------------------------|
| (1) Sampling Frequency : | Max. 51200Hz | |
| | (However, it may be limited by conditions.) | |
| (2) Data Length : | Max. 5000K points | |
| | (However, it may be limited by conditions.) | |
| (3) Number of PSD Analysis Lines : | Max. 25600 lines | |
| (4) Number of Channels : | Max. 64 ch. | |
| | (However, it may be limited by conditions.) | |
| (5) Analysis/Display Data : | Acquired Waveform Data and its PSD Data | |
| (6) Data Save : | as CSV format | |
| (7) Trigger : | Trigger Source | Manual/Internal/External |
| | Trigger Delay | can be specified |
| | Trigger Level | can be specified |
| | Trigger Slope | can be specified |

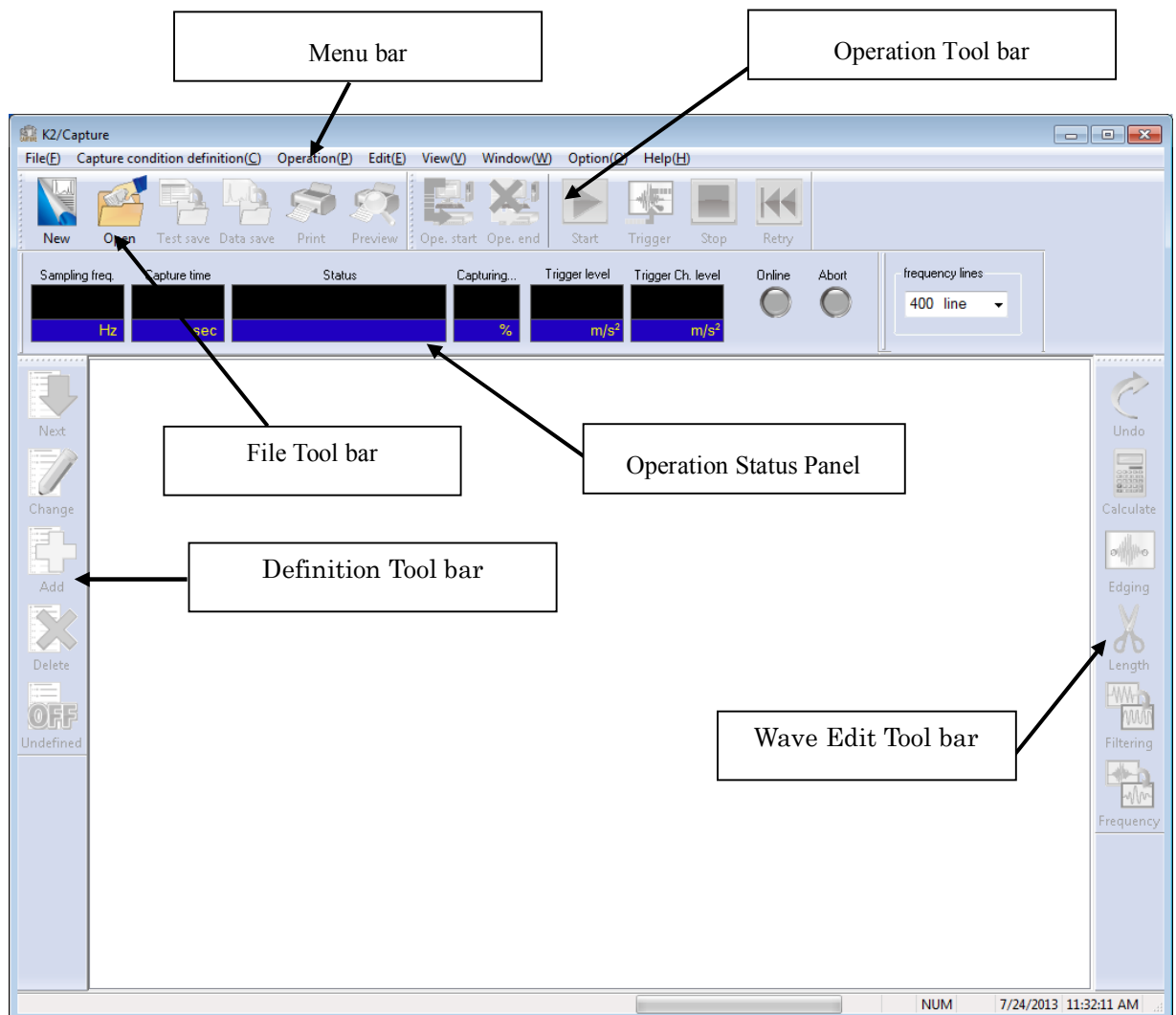
Chapter 2 Operation System of K2 Applications

2.1 Outline

In K2Application, operation after booting up is executed by using a keyboard and a mouse. When this application is started, a window shown as below appears.

All the names of menu in this application are displayed in Menu bar. Each menu is to be opened by clicking on its name and available commands appears as a list.

The commands used frequently are displayed as icons in each Tool bar. A command is executed or a dialog box corresponding to the command is opened when the icon is clicked. Operation status of K2 Controller is displayed in Status bar. The state during the excitation operation is displayed in Operation Status Panel.



K2 Application Window

2.2 Measurement Condition File

In K2 Application, the information required to measurement is saved in a specified file named to 'Measurement Condition File'.

Following types of data are contained in 'Measurement Condition File'.

- Measurement Condition File: The file created in Ver10.0.0.0 or later
 K2CAPTURE (*.cap2)
 The file created before Ver10.0.0.0
 K2CAPTURE (*.cap)
- Graph Data File : The file created in Ver10.0.0.0 or later (*.vdf2)
 The file created before Ver10.0.0.0 (*.vdf)
- Environment setting File

(I/O Module Configuration Information, Excitation System Information, Input channel Information) : SystemInfo.Dat2

Note 1) Saved in '\IMV\K2_2nd' on System Drive. Deleting inhibited

In K2 of the version before Ver.10.0.0.0, there are saved in '\IMV\K2' on System Drive.

In K2 of the version before Ver.6.0.0.0, there are saved in the Windows folder.

Note 2) If the K2 version is upgraded to Ver10.0.0.0 or later ones from previous ones, the environment setting file will be automatically converted to the format for Ver10.0.0.0 and later ones during installation.

Chapter 3 Basic Operation

3.1 Example 1 : Data Capturing (Manual Trigger)

<Example>

To simulate the vibration at transportation, the vibration data which is recorded in the container of trucks used for transportation by a data recorder is acquired and analyzed to PSD.

Each condition is described as below ;

[Capture / Analysis Condition]

Capture Time : 20 seconds

Sampling Frequency : 5120 Hz

Higher frequency components of the objective vibration is to be observed up to 2000 Hz. Frequency Range should be set to be equal to or larger than this value.

Refer to 4.2.1 Sampling Frequency, Chapter 4 about the relation of Sampling Frequency and Frequency Range.

Max. Observation Frequency : 2000 Hz

Frequency Range is specified here.

Frequency Lines of PSD : 400

Lower frequency components of the objective vibration is to be observed down to 5 Hz. Here, Frequency Lines are selected to make the Frequency Resolution of PSD as equal as this value.

Refer to 5.2.3 Frequency Lines and Frequency Resolution, Chapter 5 about the relation of Frequency Lines and Frequency Resolution.

[Information of Data Recorder to be used]

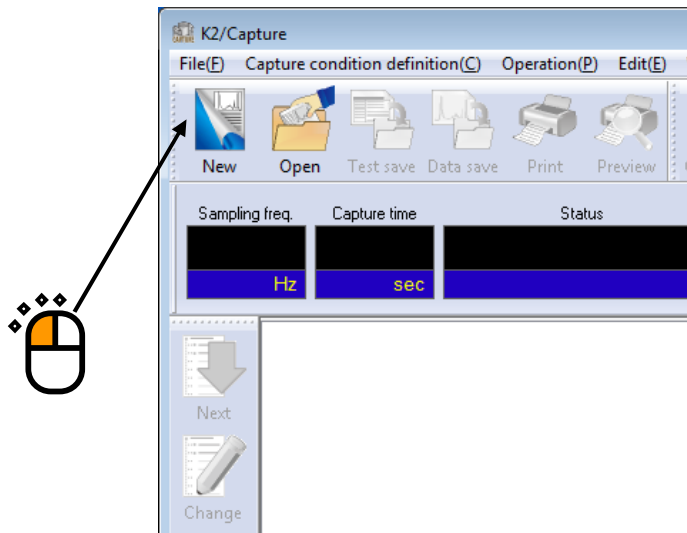
Output sensitivity of Data Recorder is set to 5 mV/(m/s²).

And this information has already registered in Input Environment Information (in this example, as ch.1 of 'SysInp01').

<Procedure>

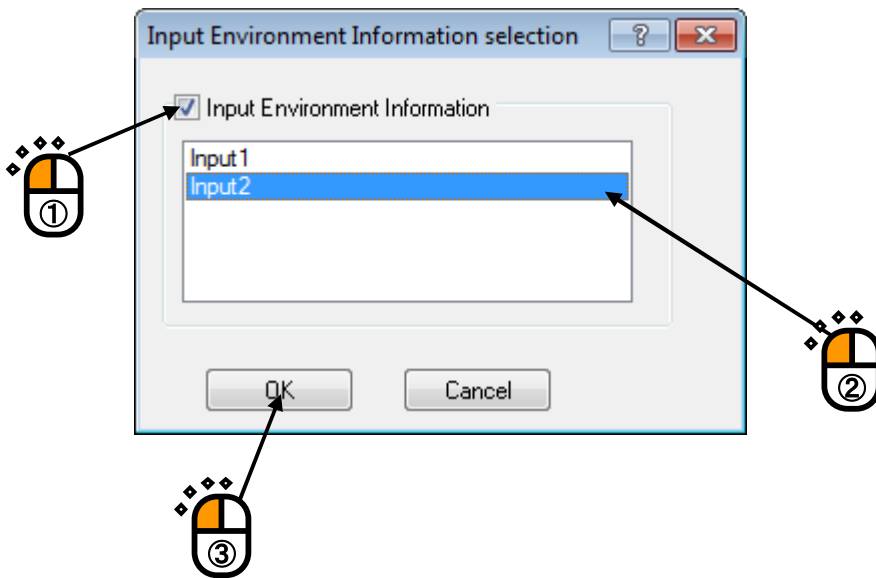
<Step 1>

Press the [New] button.



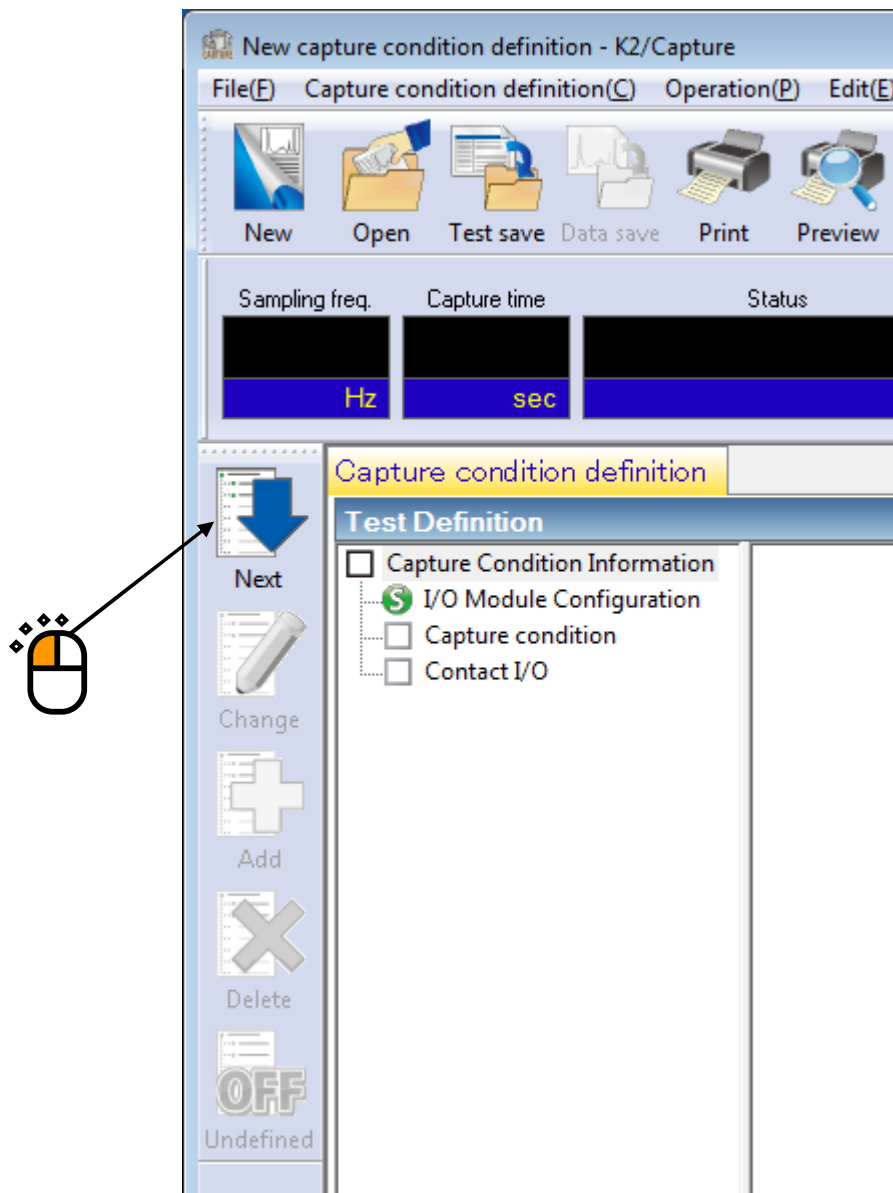
<Step 2>

Select one of Input Environment Information and press [OK].



<Step 3>

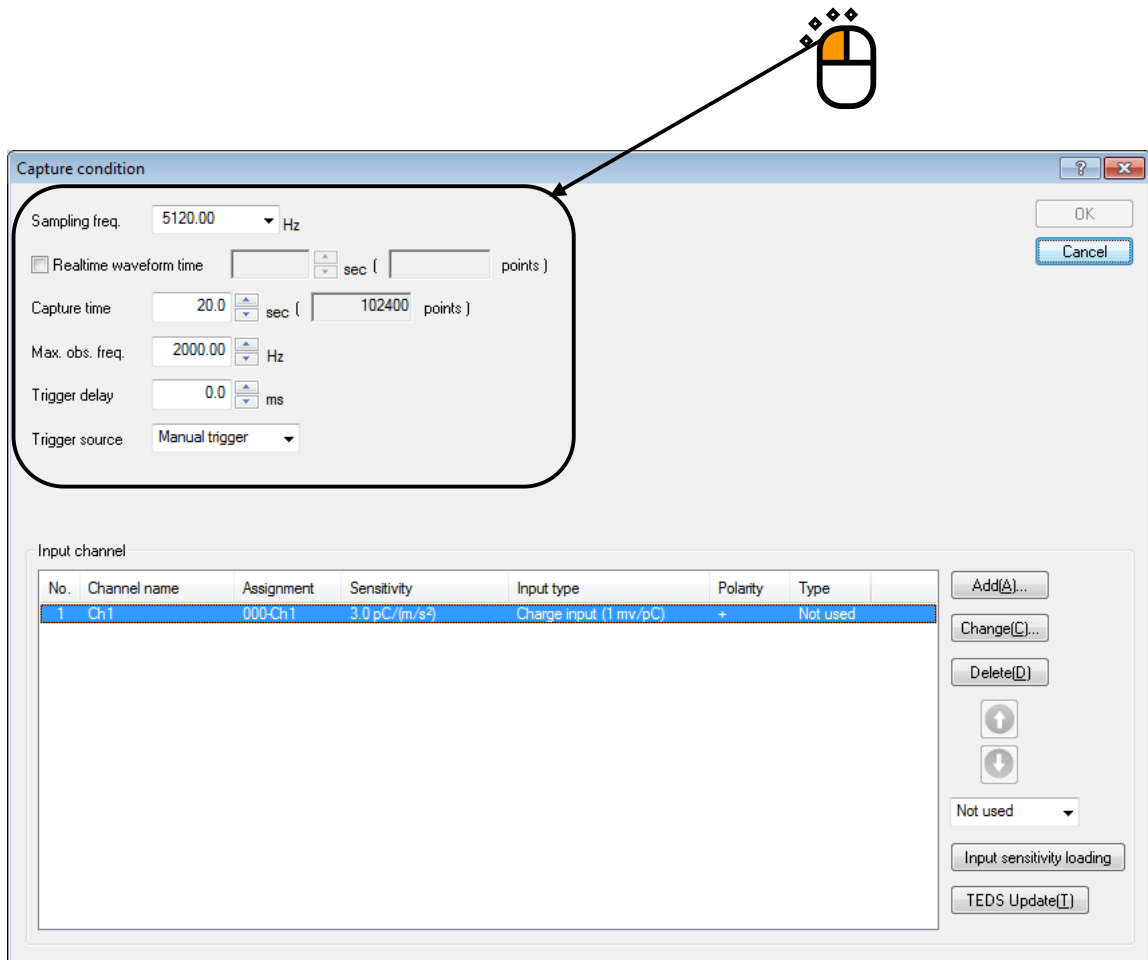
Press the [Go to the next definition] button.



<Step 4>

Capturing Conditions are described as below.

- Sampling Frequency : 5120 Hz
- Capture Time : 20 seconds
- Max. Observation Frequency : 2000 Hz
- Trigger Delay : 0 ms
- Trigger Source : Manual



<Step 5>

Select 'Ch.1'. Check the check box of 'use' and press the 'OK' button.

The screenshot shows the 'Capture condition' dialog box. It contains several input fields and a table for input channels. Three mouse cursor icons with numbers 1, 2, and 3 are pointing to specific elements: 1 points to the 'Ch1' channel name, 2 points to the 'Capture' dropdown menu, and 3 points to the 'OK' button.

Sampling freq. 5120.00 Hz

Realtime waveform time sec (points)

Capture time 20.0 sec (102400 points)

Max. obs. freq. 2000.00 Hz

Trigger delay 0.0 ms

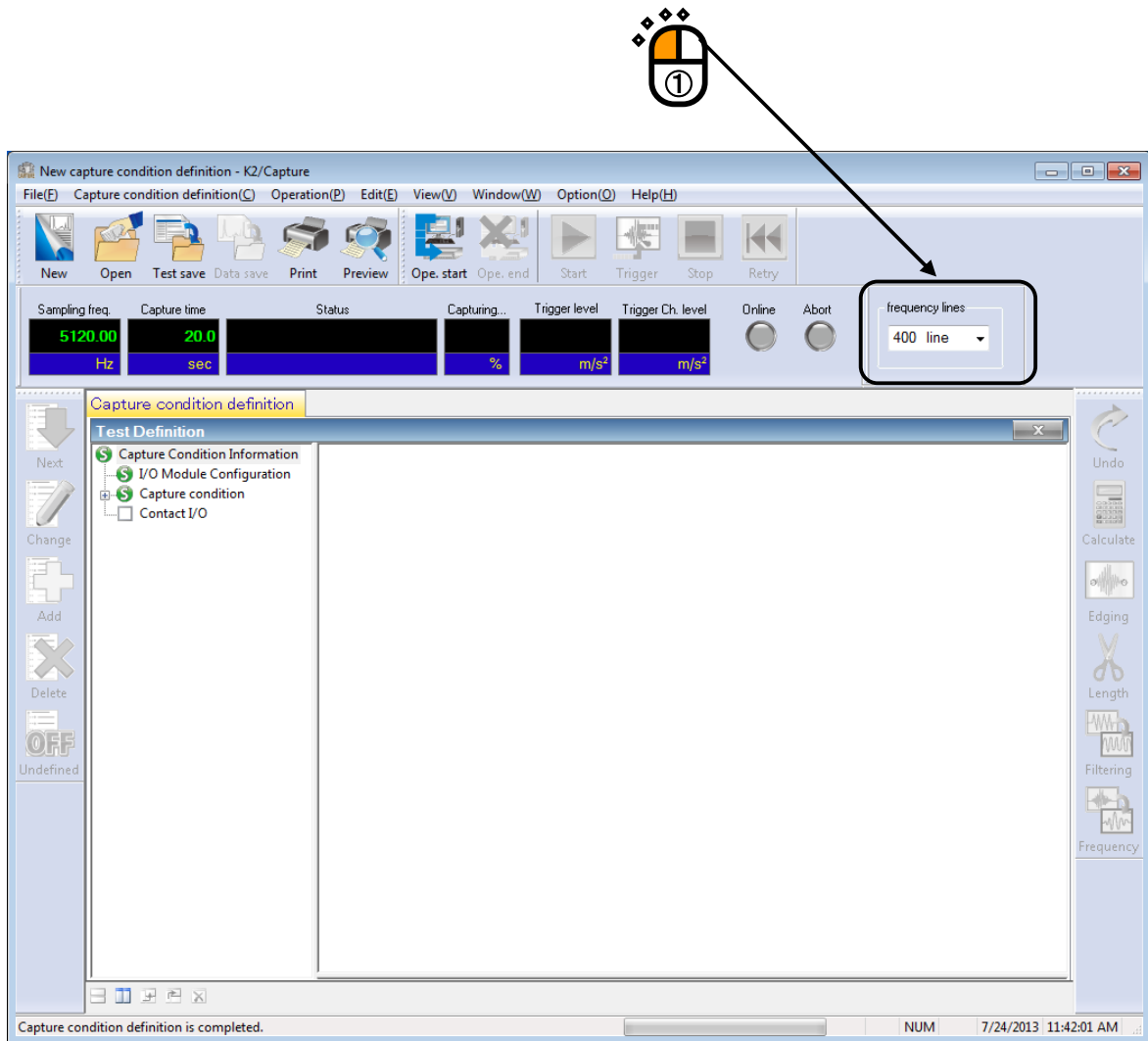
Trigger source Manual trigger

No.	Channel name	Assignment	Sensitivity	Input type	Polarity	Type
1	Ch1	000-Ch1	3.0 pC/(m/s ²)	Charge input (1 mv/pC)	+	Capture

Buttons: Add(A)..., Change(C)..., Delete(D), Capture (dropdown), Input sensitivity loading, TEDS Update(I)

< Step6 >

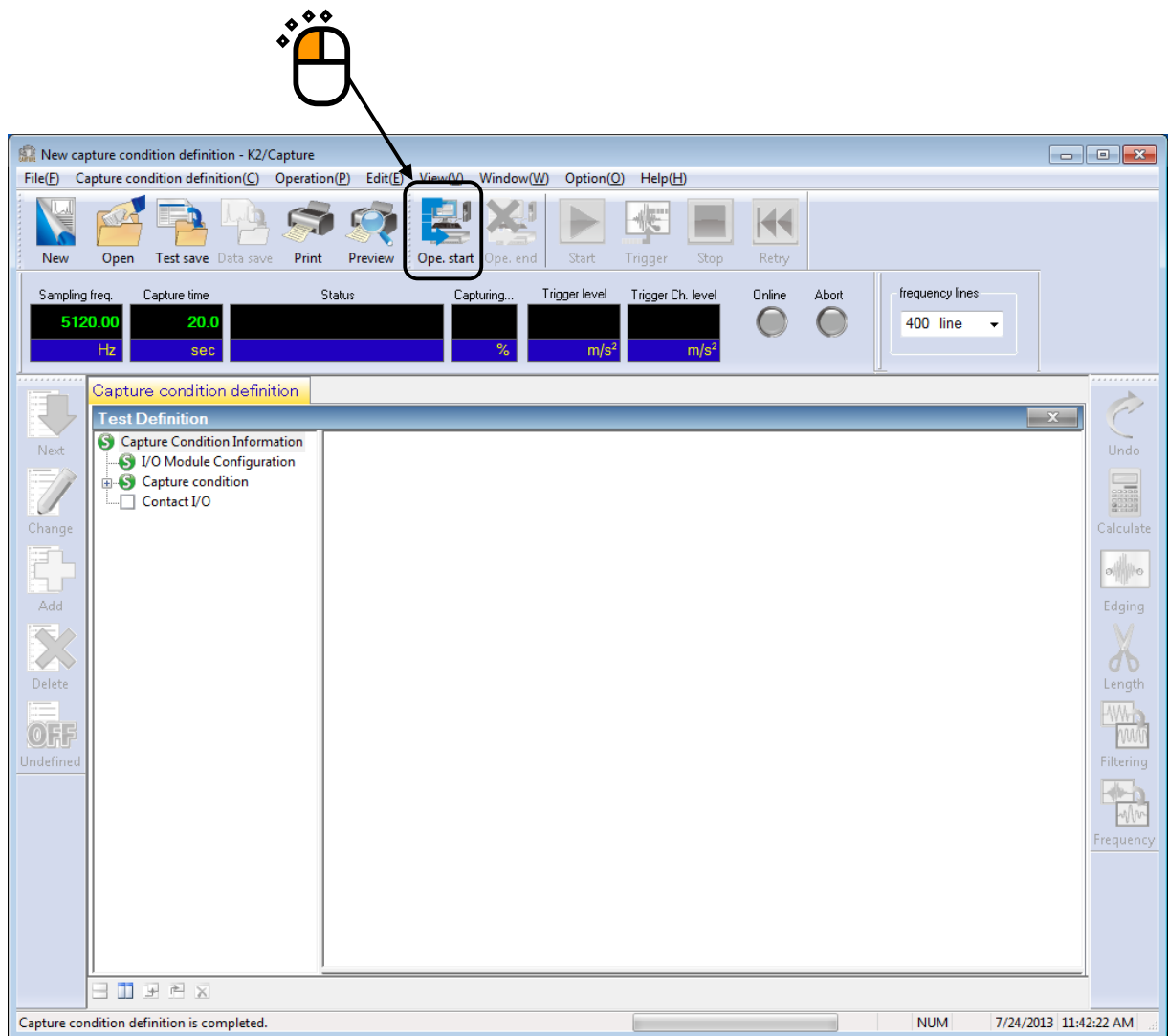
Set PSD Analysis Condition in the dialog of Set Up to 400.
The definition is completed.



<Operation>

<Step 1>

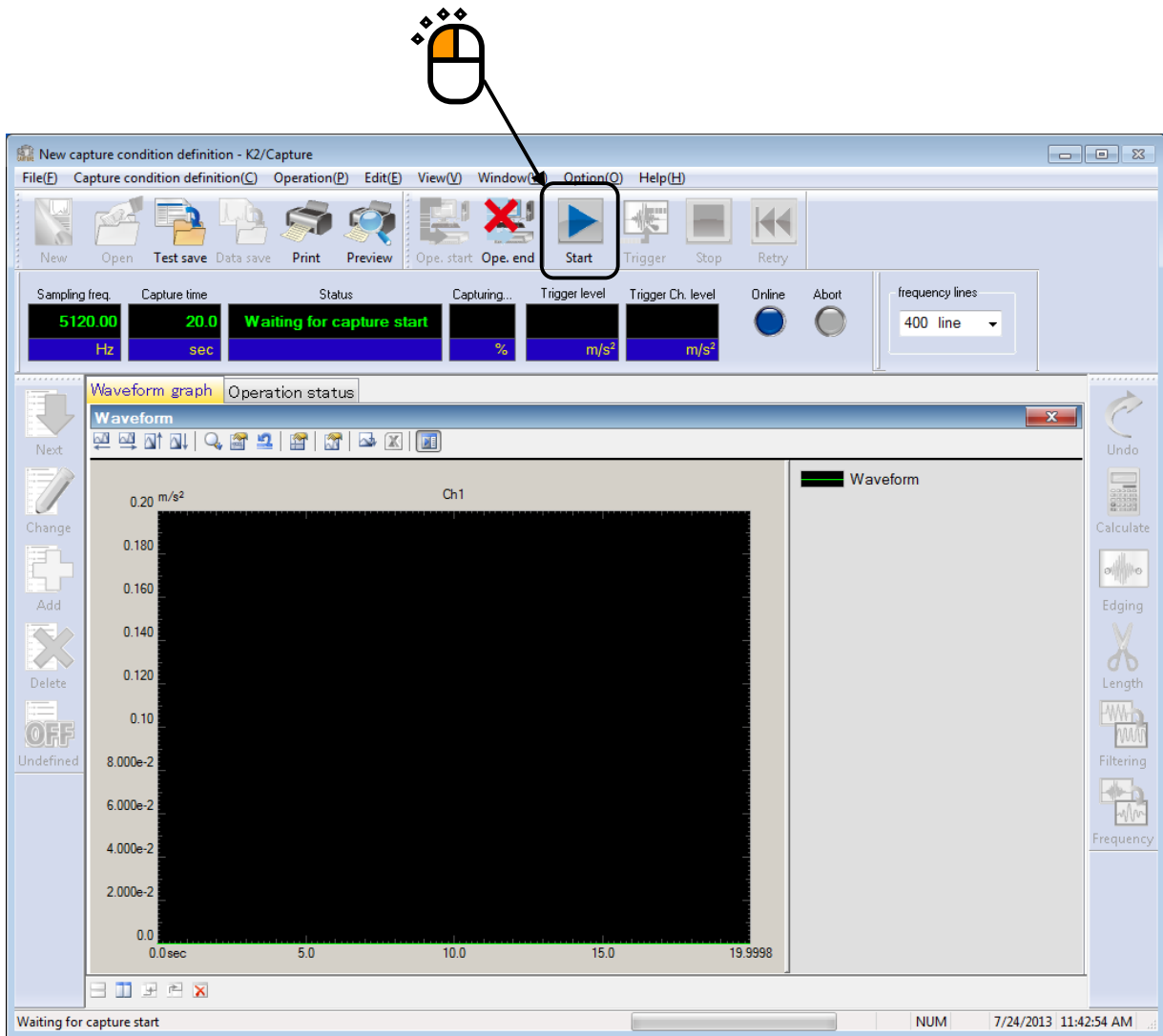
Press the [Operation] button.



<Step 2>

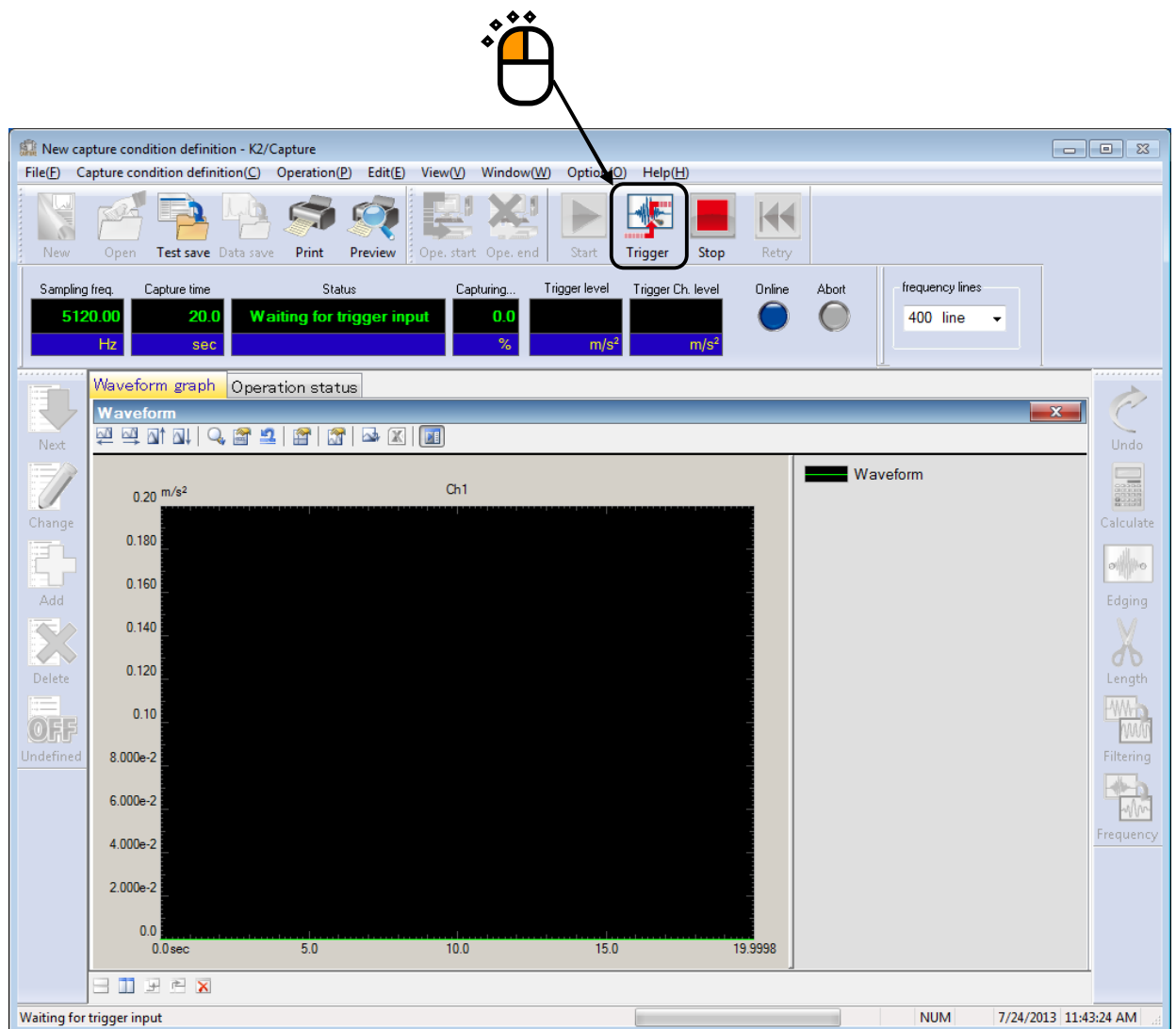
Press the [Capture] button.

When [Capture] is selected, the system proceeds to the state of waiting for Trigger start in Manual.



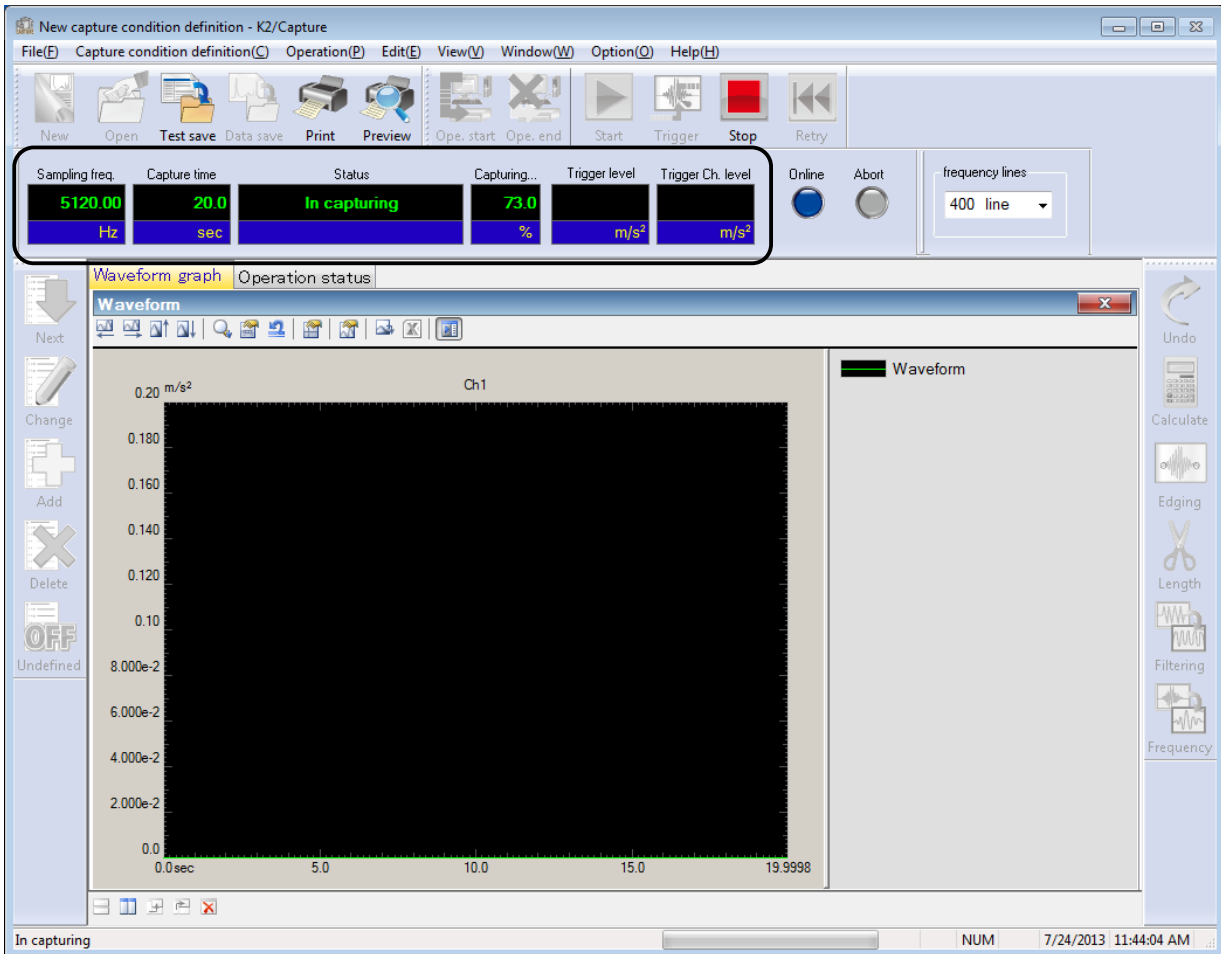
<Step 3>

When the [Trigger] button is pressed, the capturing of waveform is started.



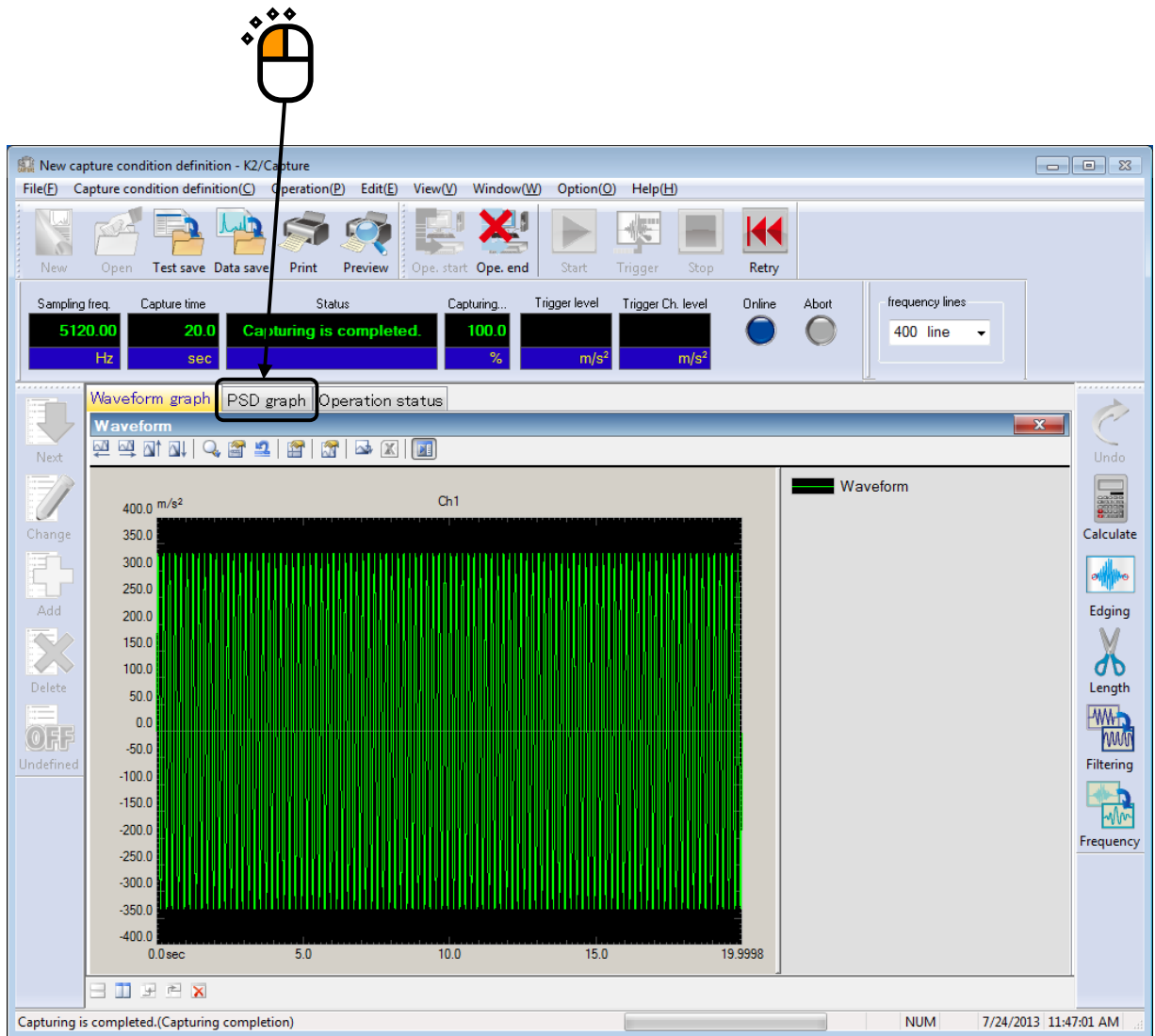
<Step 4>

In capturing of waveform data, the status of capturing operation is displayed in Operation Status Bar.



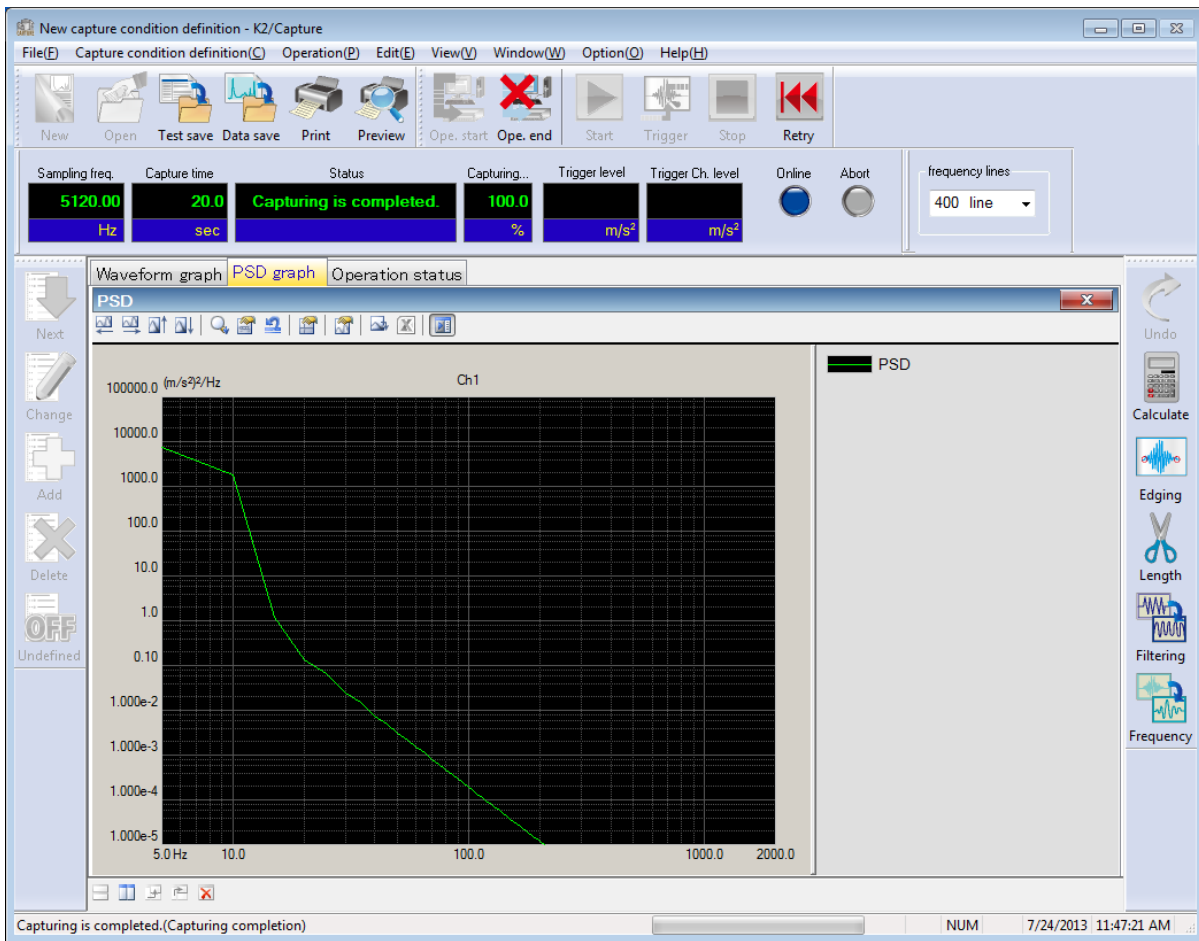
<Step 5>

When the capturing of waveform is completed, PSD Analysis are operated automatically.
Select the page tag of PSD.



< Step6 >

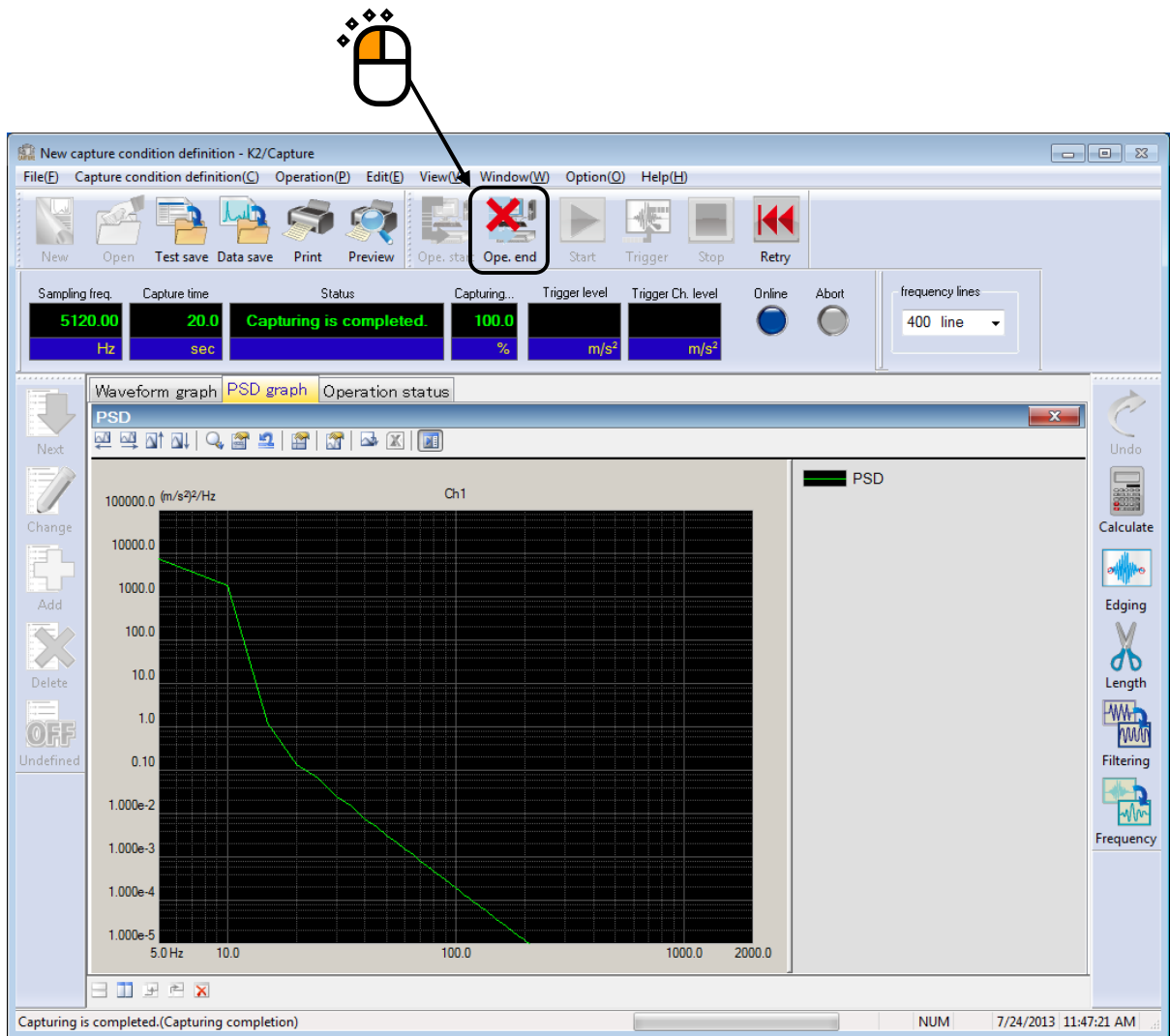
PSD Graph is displayed.



<Step7>

PSD data converted to CSV File can be usable as a reference waveform of K2/RANDOM. Refer to 5.3 Using the data as a Reference of K2/SHOCK, K2/RANDOM, Chapter 5 about the details.

Press the button [Exit] to stop the measurement.



3.2 Example 2 : Data Capturing (Internal Trigger)

<Example>

To simulate a falling test by using a shaker, the shock waveform which is generated on a package of specimen at falling is acquired by a pickup attached.

In this case, the acceleration value of shock waveform at falling is expected within 300 m/s^2 .

Each conditions are described as below ;

[Capture / Analysis Condition]

Capture Time : 5 seconds

Sampling Frequency : 5120 Hz

Higher frequency components of the objective vibration is to be observed up to 2000 Hz. Frequency Range should be set to be equal to or larger than this value.

Refer to 4.2.1 Sampling Frequency, Chapter 4 about the relation of Sampling Frequency and Frequency Range.

Max. Observation Frequency : 2000 Hz

Frequency Range is specified here.

Trigger Condition : When the increasing level of acceleration waveform reaches 10 m/s^2 , Trigger is to be operated. And the data is started to be recorded at 100 ms before the Trigger event, so that the shock waveform data can be acquired properly.

[Information of Data Recorder to be used]

Sensitivity of Acceleration pickup is set to $3 \text{ pC}/(\text{m/s}^2)$.

And this information has already registered in Input Environment Information (in this example, as Ch.2 of 'SysInp01'). Input type of Ch.2 is specified as 'Charge input (10mV/pC)'.

According to the specified items as in the above, the conditions are set as below ;

Full-scale of Input Range : 333.33 m/s^2

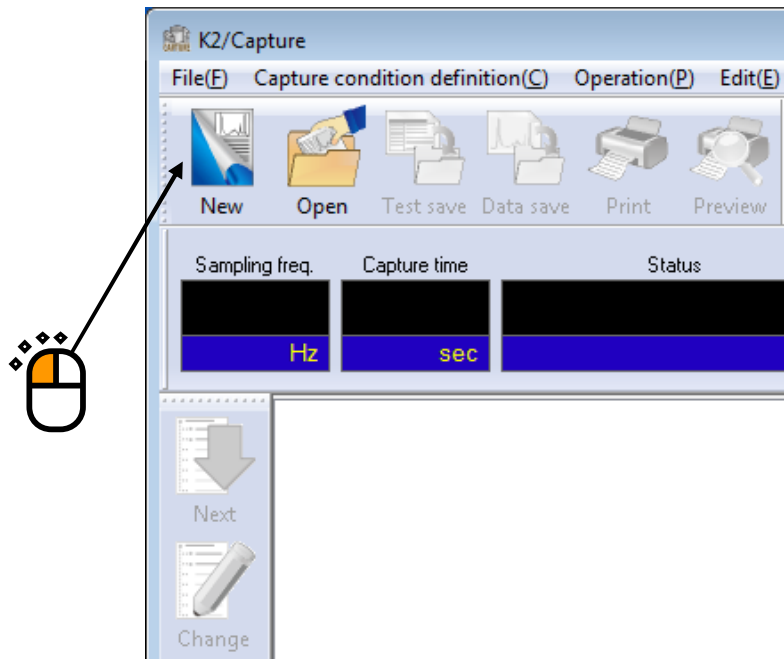
Trigger Level 10 m/s^2 : 3 % for full-scale

Refer to 4.2.4.1 Trigger Level, Chapter4 about the calculation of Trigger Level.

<Procedure>

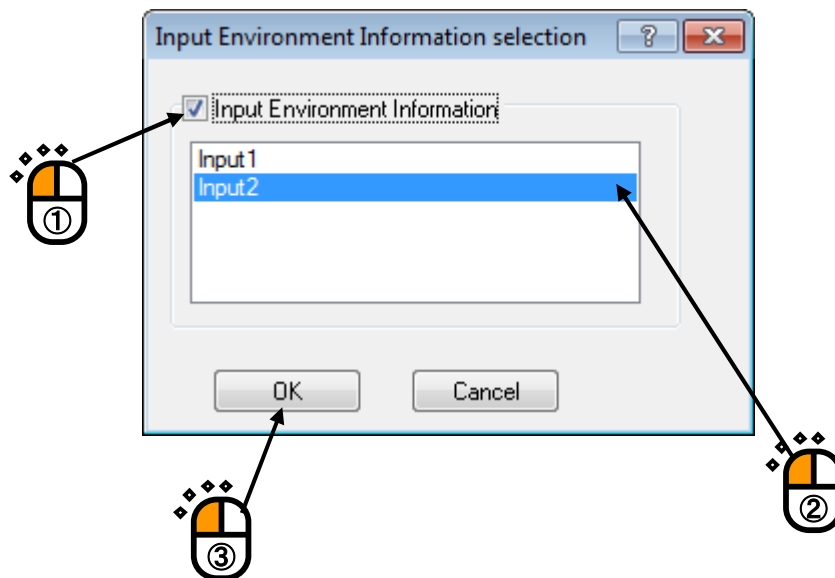
<Step 1>

Press the [New] button.



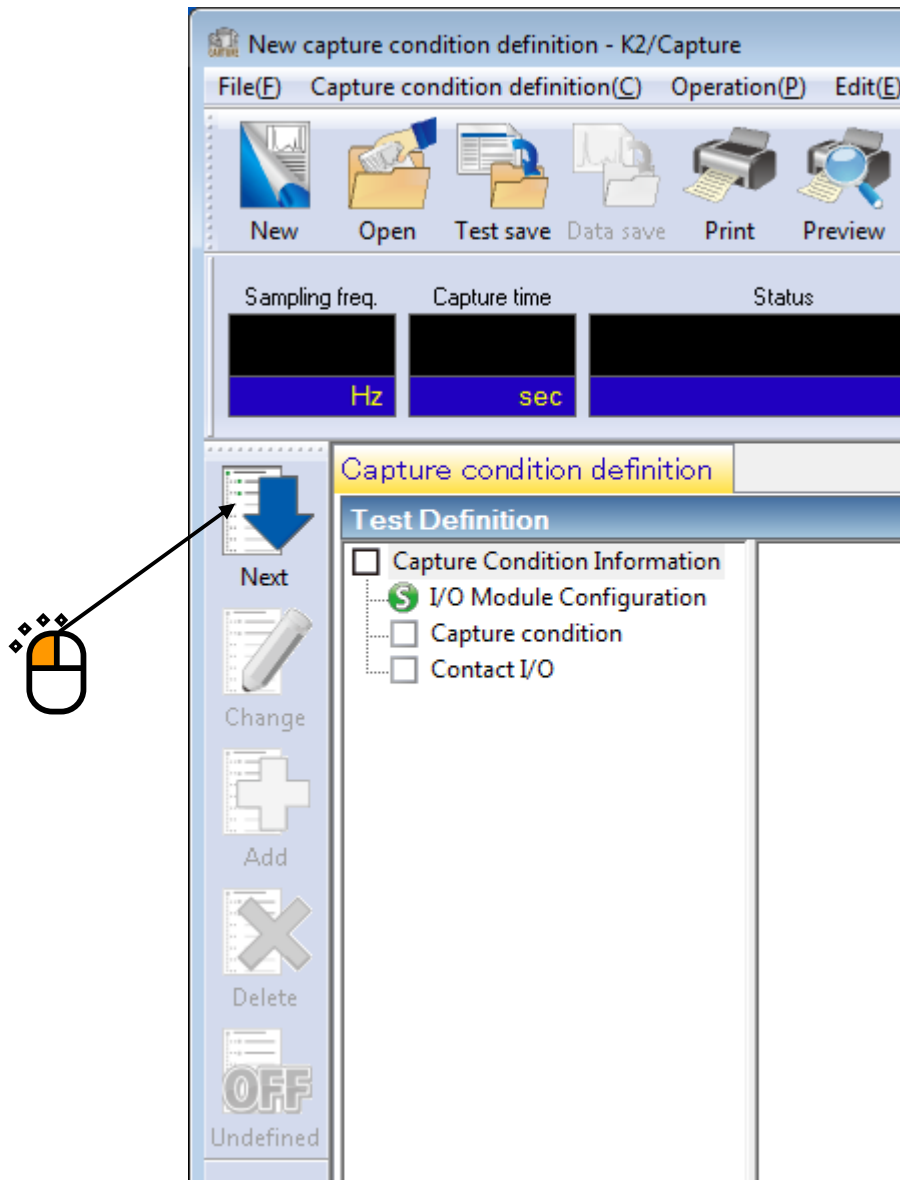
<Step 2>

Select one of Input Channel Information and press [OK].



<Step 3>

Press the [Go to the next definition] button.



<Step 4>

Capturing Conditions are described as below.

- Sampling Frequency : 5120 Hz
- Capture Time : 5 seconds
- Max. Observation Frequency : 2000 Hz
- Trigger Delay : -100 ms
- Trigger Source : Internal
- Trigger Level : 3 % (10 m/s²)
- Trigger Slope : +



Capture condition

Sampling freq. 5120.00 Hz

Realttime waveform time

Capture time 5.0 sec (25600 points)

Max. obs. freq. 2000.00 Hz

Trigger delay -100.0 ms

Trigger source Internal trigger

Trigger level 3.0 %

Trigger slope +

Input channel

No.	Channel name	Assignment	Sensitivity	Input type	Polarity	Type
1	Ch1	000-Ch1	3.0 pC/(m/s ²)	Charge input (1 mv/pC)	+	Capture
2	Ch2	000-Ch2	3.0 pC/(m/s ²)	Charge input (1 mv/pC)	+	Capture

Add(A)...

Change(C)...

Delete(D)

↑

↓

Capture

Input sensitivity loading

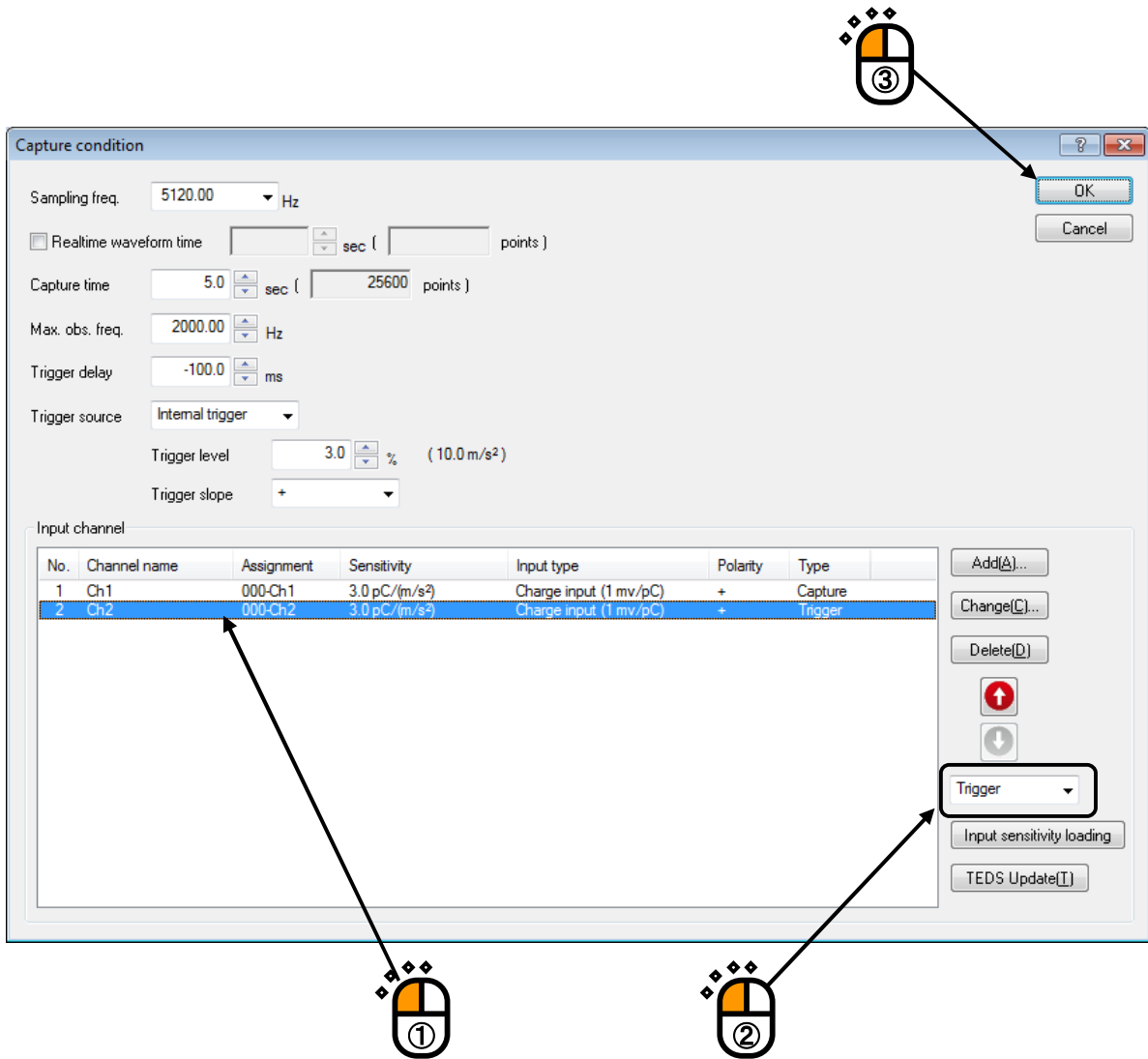
TEDS Update[I]

OK

Cancel

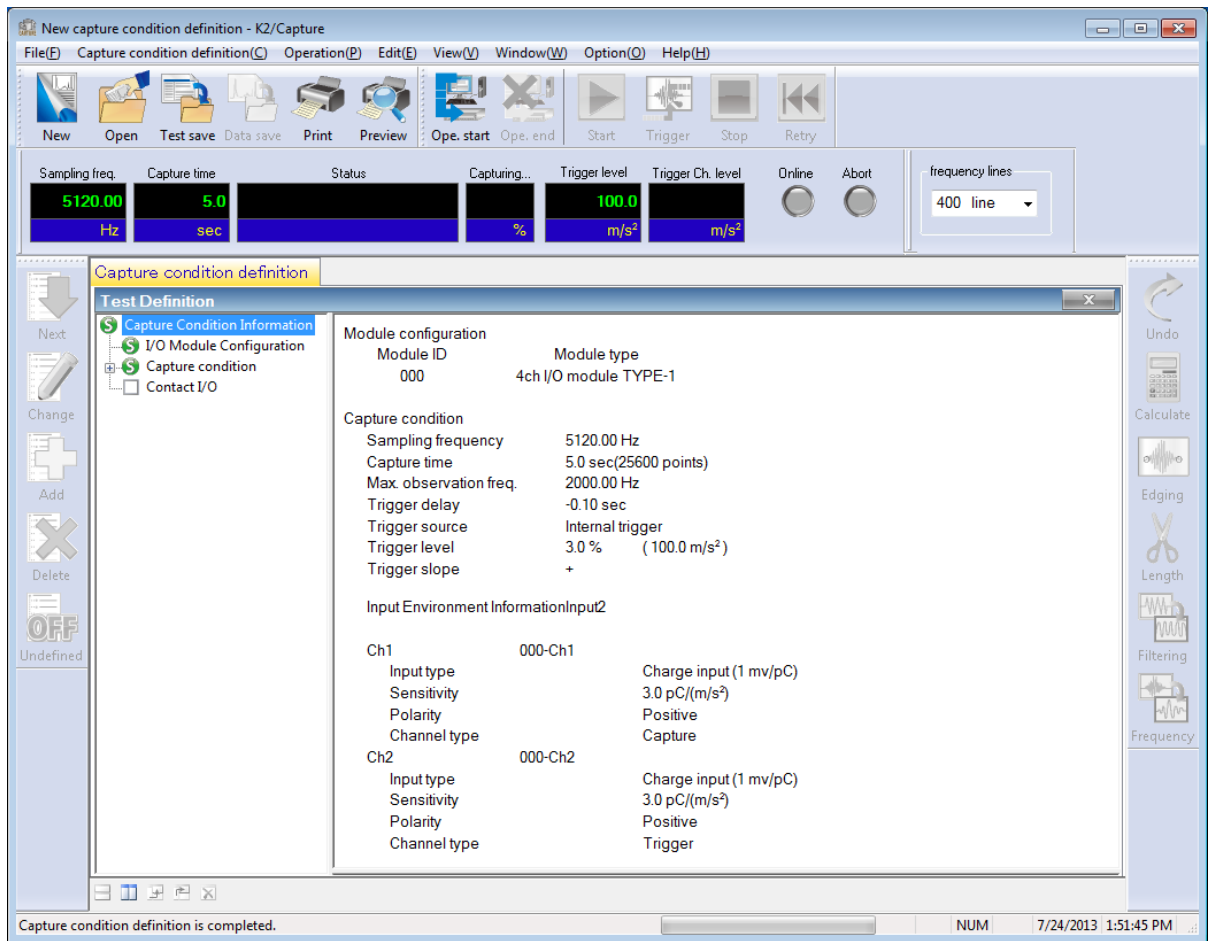
<Step 5>

Select 'Ch.2'. Select the 'Trigger'. Then, press the 'OK' button.



<Step 6>

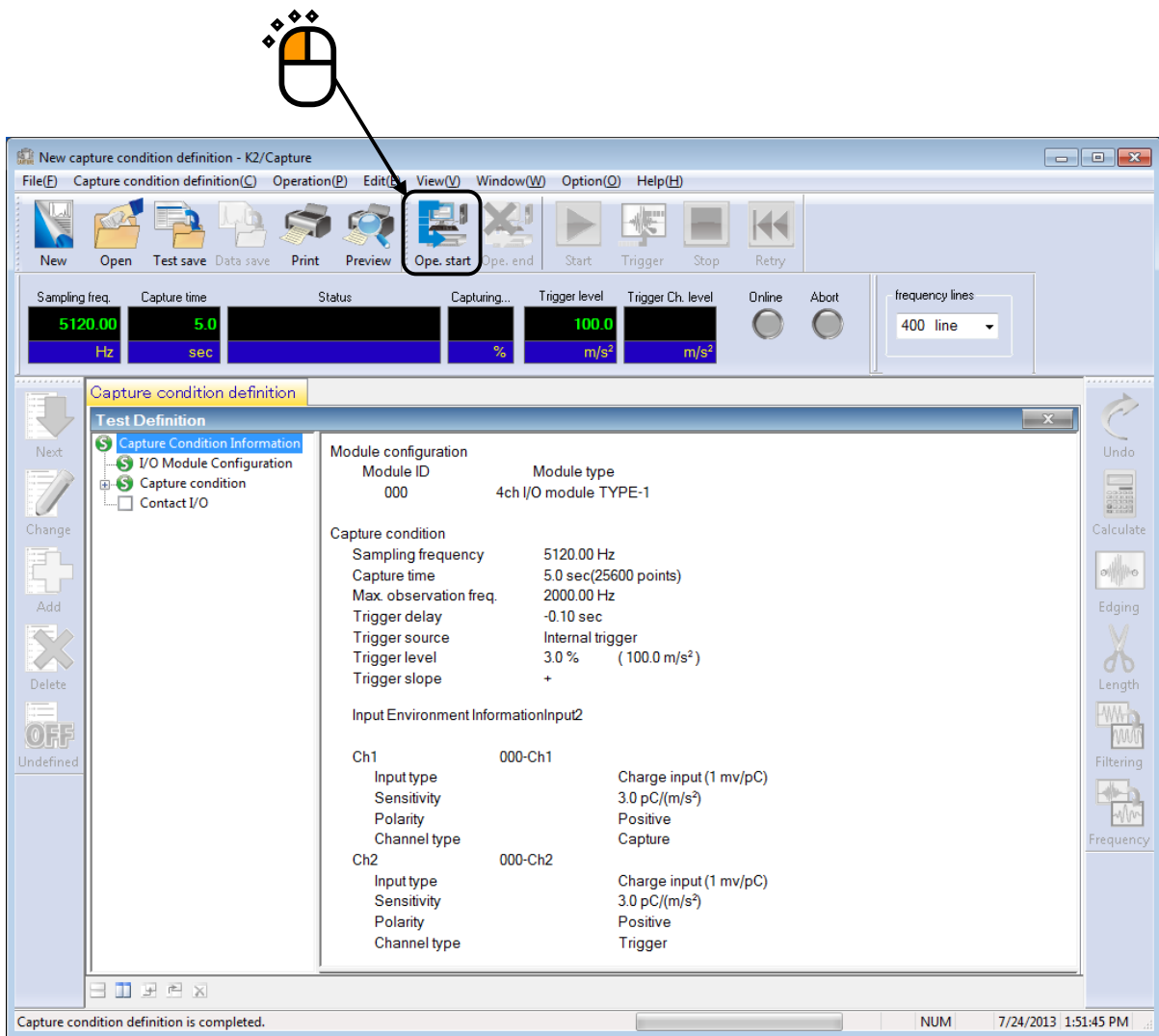
The definition is completed.



<Operation>

<Step 1>

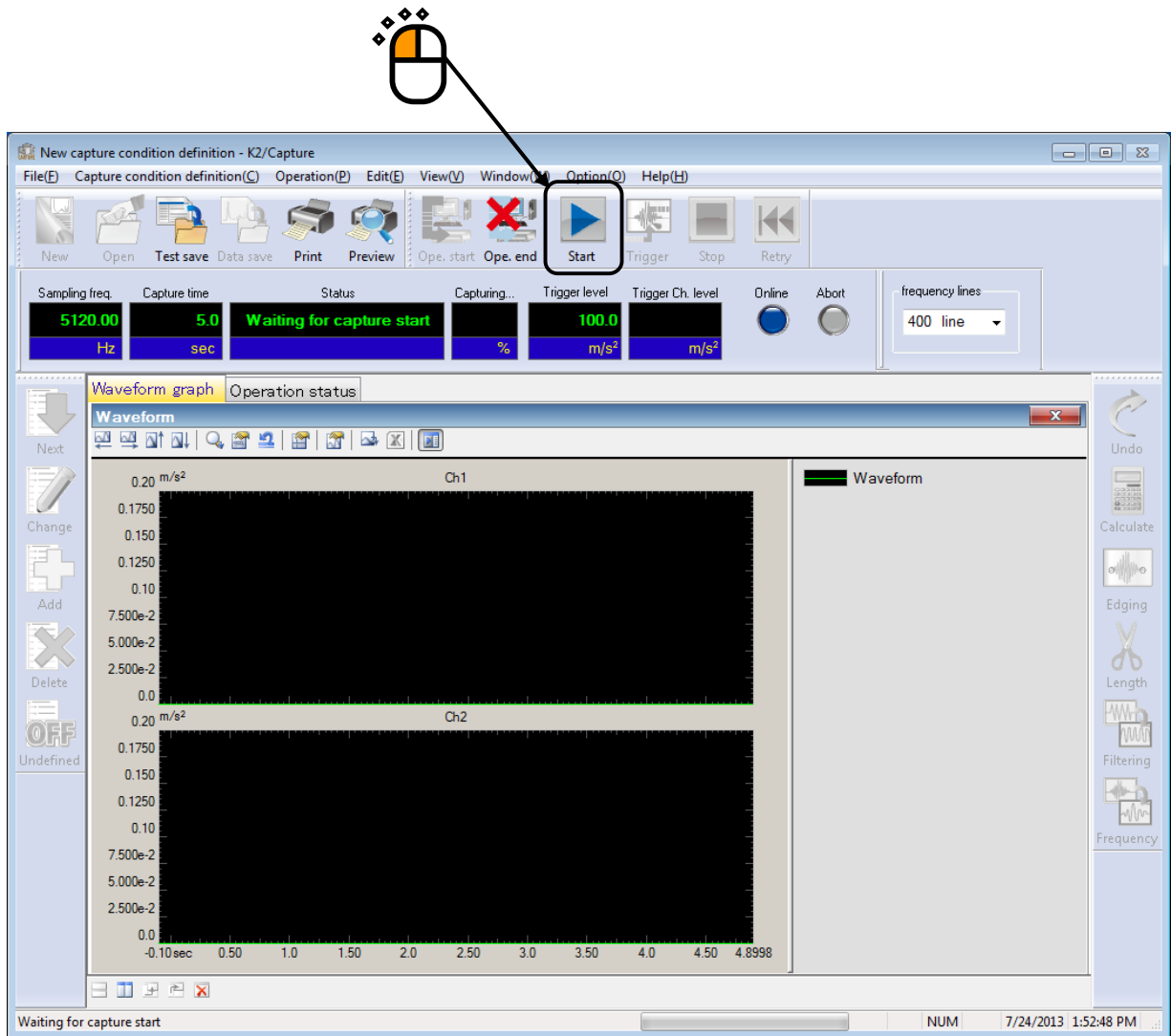
Press the [Operation] button.



<Step 2>

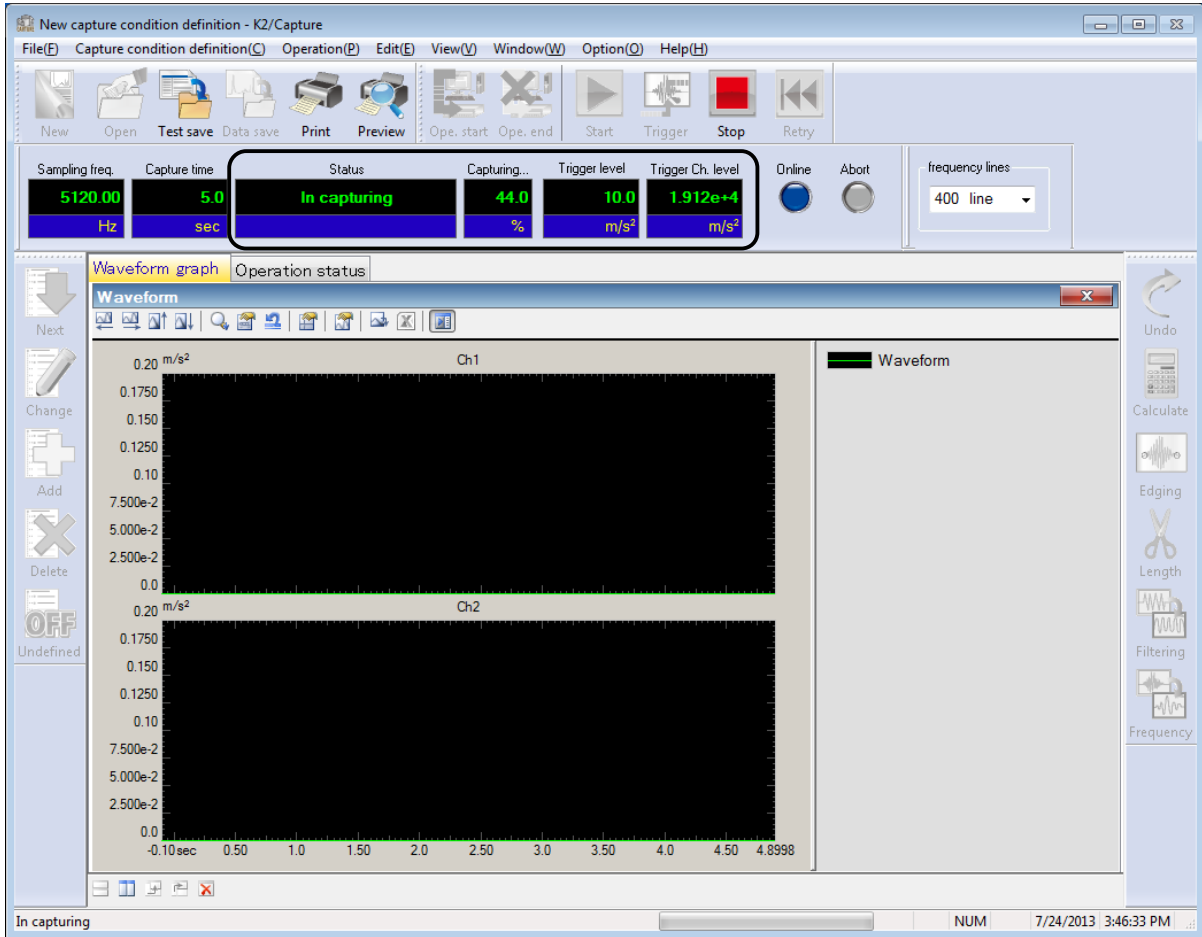
Press the [Capture] button.

When [Capture] is selected, the system proceeds to the state of waiting for Trigger start.



<Step 3>

In the state of waiting for Trigger start, the status of response level at the trigger channel is displayed in Operation Status Bar. When Trigger condition is satisfied, capturing of waveform is available to be operated.



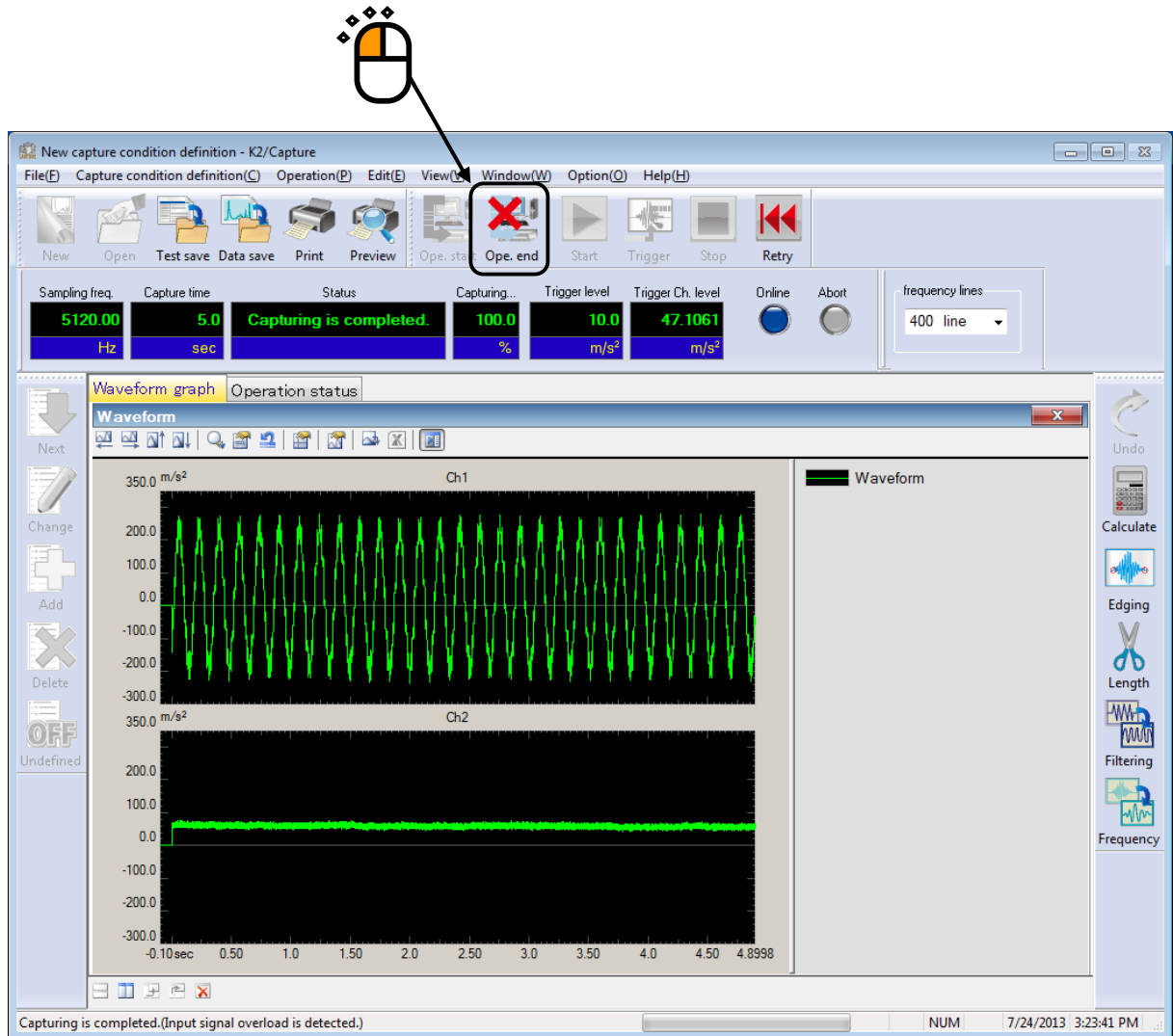
<Step4>

<Step 5>

When the capturing of waveform is completed, PSD Analysis and Editing of waveform are available to be operated.

Captured data converted to CSV File can be usable as a reference waveform of K2/SHOCK. Refer to 5.3 Using the data as a Reference of K2/SHOCK, K2/RANDOM, Chapter 5 about the details.

Press the button [Exit] to stop the measurement.



Chapter 4 Test Definition

4.1 Outline

Information for Capture Condition is defined.

A set of items defined in Capture Condition is saved in a file of specified format, Measurement Condition File.

Measurement operation can be executed only by loading the saved file when information of capture is defined and saved as a Capture Condition File.

4.2 Capture Condition

Capture Condition is defined.

Capture condition

Sampling freq. 5120.00 Hz

Realtime waveform time 2.0 sec (10240 points)

Capture time 20.0 sec (102400 points)

Max. obs. freq. 2000.00 Hz

Trigger delay 0.0 ms

Trigger source Manual trigger

Input channel

No.	Channel name	Assignment	Sensitivity	Input type	Polarity	Type
1	Ch1	000-Ch1	2.950 pC/(m/s ²)	Charge input (1 mv/pC)	+	Capture
2	Ch2	000-Ch2	3.050 pC/(m/s ²)	Charge input (1 mv/pC)	+	Not used
3	Ch3	000-Ch3	3.010 pC/(m/s ²)	Charge input (1 mv/pC)	+	Not used
4	Ch4	000-Ch4	3.0 pC/(m/s ²)	Charge input (1 mv/pC)	+	Not used

Add(A)...

Change(C)...

Delete(D)

↑

↓

Capture

Input sensitivity loading

TEDS Update(I)

4.2.1 Sampling Frequency

(1) Meaning

This item is for specifying the time interval (Sampling Frequency f_s) when the captured analog signal is digitalized.

Cut-off Frequency of low-pass anti-aliasing filter is automatically defined by being connected with Frequency Range f_{max} as below. (However, this setting is possible to be changed.)

Frequency Range f_{max} has the following relation to Sampling Frequency f_s ;

$$f_{max} = f_s / 2.56 \text{ [Hz]}$$

Frequency components exceeding over the Frequency Range f_{max} are cut off in the process of low-pass filter. The value of f_s should be set properly so that f_{max} includes the frequency components of input signal to be captured.

4.2.2 Realtime waveform time

(1) Meaning

This item is for setting the realtime waveform display for use and the length of time to be displayed. It displays the captured waveform in real time like as an oscilloscope for the specified time length.

The captured input waveform is displayed as a realtime waveform graph when this item is activated.

Realtime waveform graph has its time scale (display time) differ from the waveform graph. So the time is needed to be specified.

Realtime waveform graph is available to begin from the status of waiting for capturing start. Using this item, the operation of capturing start or capturing completion is available while observing the input waveform.

Realtime waveform graph is displayed by selecting Graph among the items of Window in the menu bar. This setting can be done in the status of waiting for capturing start. Then the dialog of Graph type selection appears. Select the item of Realtime waveform and specify an input channel to be displayed.

4.2.3 Capture Time

(1) Meaning

This item is for specifying the time T for capturing an input signal.

Waveform signal is sampled for the value of Sampling Frequency set previously and converted to a digital data. Data Length N (number of captured data) in this process is calculated as below ;

$$N = T \text{ [sec]} \times f_s \text{ [Hz]}$$

The maximum Data Length to be captured is up to **5000K points**.

So the maximum Capture Time T_{max} to be acquired is obtained as below;

$$T_{\max} [\text{sec}] = 5120000 / f_s [\text{Hz}]$$

4.2.4 Max. Observation Frequency

(1) Meaning

This item is for specifying the set value of Cut-off Frequency f_c of anti-aliasing filter (LPF) in the input channel.

Usually the set value must be equal to the set value of Control Frequency Range f_{\max} which is determined by Sampling Frequency f_s . However, you can set the observation frequency to a value less than f_{\max} if necessary.

To process signals exactly in the band within the fixed Frequency Range f_{\max} , the band must be restricted to the input signals using LPF in order to prevent aliasing. So, this system also restricts the band using a high-performance analog processing system and a digital filter.

Usually, it is reasonable that f_c meets f_{\max} . However, the function of LPF is very useful when the frequency components of the input waveform data are much lower than f_{\max} and larger ones than the frequency components must be removed in the observation of the captured data.

Denoting the observation Frequency as f_{obs} , the possible set value of f_{obs} is as follows ;

$$0.1 \leq f_{\text{obs}} \leq f_{\max}$$

This filtering is processed in digital.

4.2.5 Trigger Source

(1) Meaning

This item is for specifying a trigger source which starts to capture a waveform.

1. Manual

This is a manual trigger for starting to capture a waveform. When [Start] in Operation Tool bar is pressed, the [Trigger] button is set to valid. Data capturing is started by pressing the [Trigger] button.

Namely, the data capturing is started based on a specified delay time condition as the time origin (0 ms) when [Trigger] is pressed.

2. Internal

This is an internal trigger for capturing data based on a defined delay time as the time origin when the input signal waveform meets the preset trigger condition while this system monitors the input signal to the trigger channel.

When 'Internal' is defined, the conditions as below must be specified ;

- Trigger Level
- Trigger Slope
- Trigger Channel

3. External

This is an external trigger for ordering to capture a waveform by contact signal.
Refer to Instruction Manual Common Part about the specification of Contact I/O Signal.

4.2.5.1 Trigger Level

(1) Meaning

This item is valid only when 'Internal' is defined in Trigger Source.

Threshold of signal level to be triggered is specified.

Threshold is set by the percentage to full-scale (10V) of input range.

Trigger Levels expressed in capturing unit are calculated according to the input types of Trigger Channel as below ;

A : Sensitivity of input channel [mV/Capturing Unit] or [pC/ Capturing Unit].

B : Trigger Level expressed by the percentage for full-scale [%]

Input Type	Full-scale (Capturing Unit)	Trigger Level (Capturing Unit)
Voltage Input(AC)	10000/A	100R/A
Voltage Input (DC)	10000/A	100R/A
Charge Input(1mV/pC)	10000/A	100R/A
Charge Input (10mV/pC)	1000/A	10R/A
IEPE Input*	10000/A	100R/A

* IEPE input is enabled with the TYPE II hardware.

4.2.5.2 Trigger Slope

(1) Meaning

This item is valid only when 'Internal' is defined in Trigger Source.

This item is for setting of the increasing/decreasing condition of signal level to be triggered.

Plus(+) : Trigger is activated only when the signal is increasing.

Minus(-) : Trigger is activated only when the signal is decreasing.

Both(\pm) : Independent of the increasing/decreasing status of signal level, Trigger is activated when the signal level exceeds over the Trigger Level.

4.2.6 Trigger Delay

(1) Meaning

The item specifies how much milliseconds [msec] before and after the time origin meeting the Trigger condition becomes valid and the sampling data can be recorded as capture data.

For example, in the case of '10 msec', the data of length T from the point 10 msec after the trigger point is valid (Post-trigger).

In the case of '-10 msec', the data of length T from the point -10 msec before the trigger point is valid (Pre-trigger).

The time origin of capture data is Trigger time.

The setting range of Trigger Delay is provided as below ;

- Capture Time / 2 ~ + Capture Time / 2

4.2.7 Input Channel

The input channels to be used are set in the definition dialog of Input Channel.

Two setting methods of input channels are available in this system ;

Set the input channel for each Test Definition

Set the Input Channel Information

[Add] A new input channel is added.

[Change] The definition contents of an input channel are changed.

[Delete] A selected input channel is deleted from the registration.

[Up] [Down] The registered order of an input channel is corrected. However, the registered order has not much meaning than the order of graph display.

[Not used] The channel is not used.

[Capture] The channel is used as a monitor channel.

[Trigger] The channel is used as a trigger channel. This item is valid only when 'Internal' is defined in Trigger Source.

[TEDS Update] The input sensitivity is set from the connected TEDS corresponding IEPE sensor automatically. The function is enabled with the TYPEII hardware.

4.2.8 Input sensitivity loading

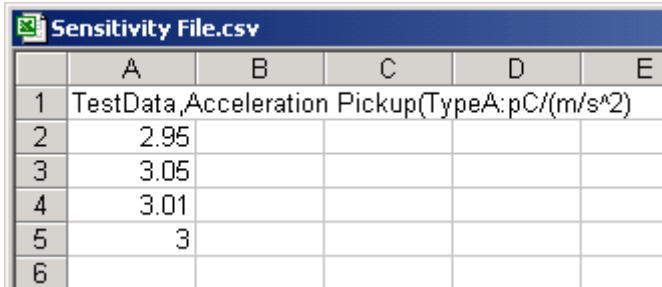
The [Input sensitivity loading] button is for loading the sensitivity data directly from the sensitivity data file of CSV format in the dialog of Input Channel Configuration.

File format : the file format to be loaded is displayed as ;

1st line : comments

2nd line and below : sensitivity data

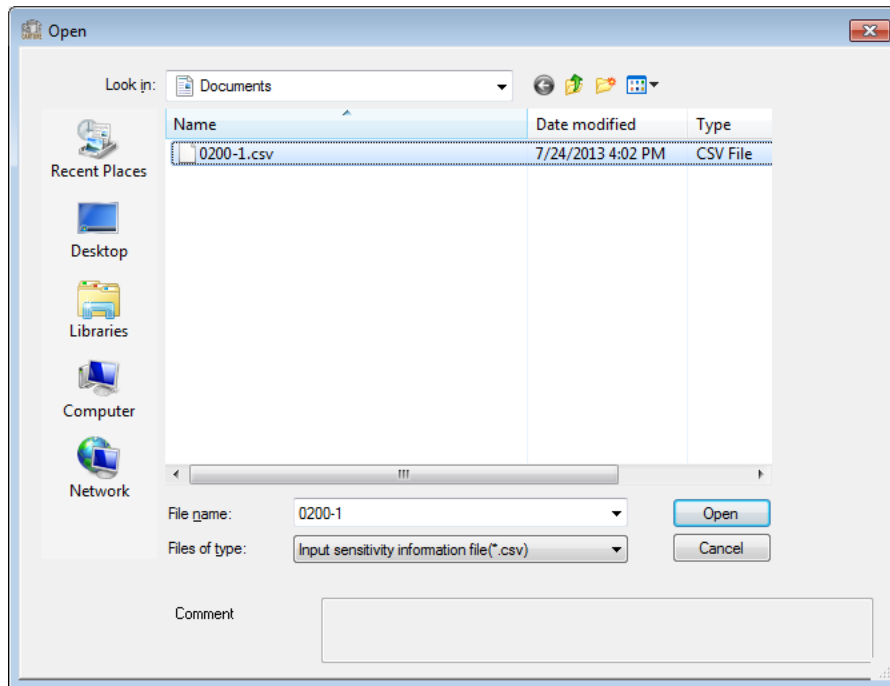
For example, the data of “n line, 1st column” is described as below ;



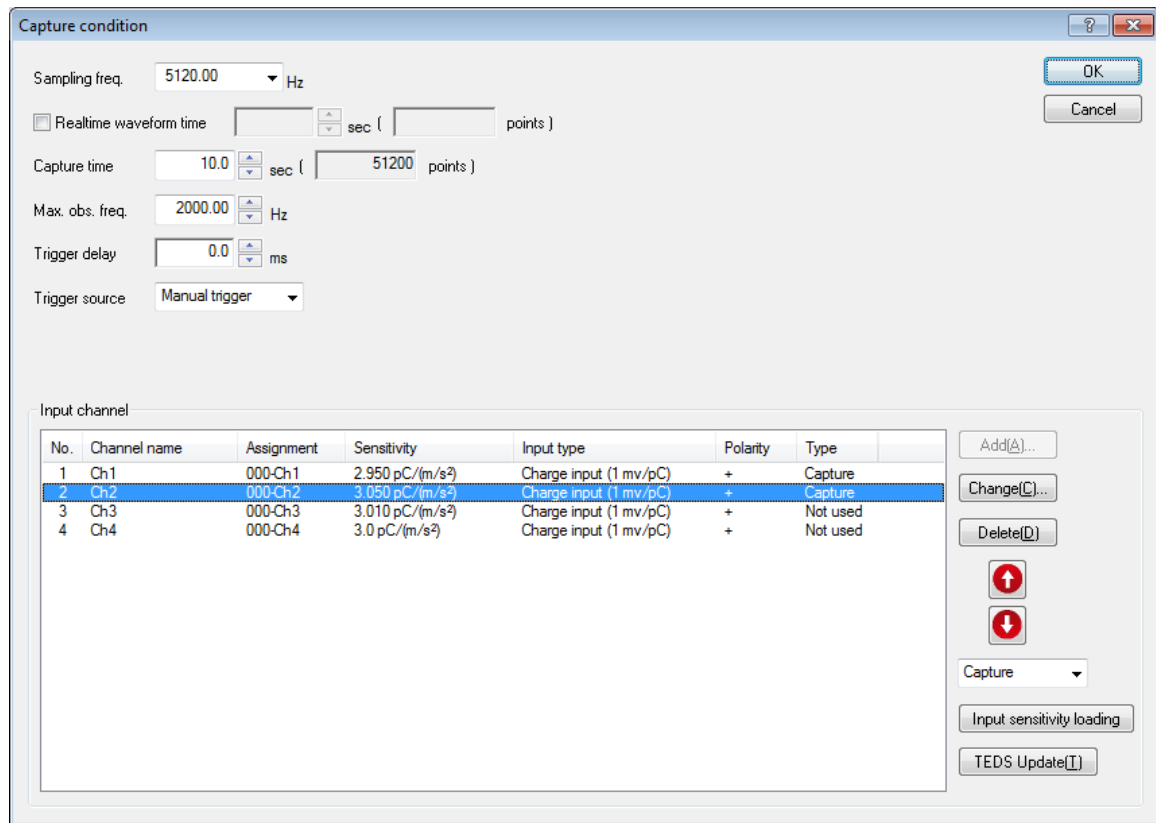
	A	B	C	D	E
1	TestData,Acceleration Pickup(TypeA:pC/(m/s^2)				
2	2.95				
3	3.05				
4	3.01				
5	3				
6					

The operation method of sensitivity data loading is ;

The dialog appears when the [Input sensitivity loading] button is pressed in Input Channel Configuration.



Select a file and press [Open] to load the input sensitivity data.



Note) The loaded input sensitivity data is automatically allocated to the channels in order. Therefore, the sensitivity data will not be allocated for the rest of channels when the number of channels is more than the number of sensitivity data. And the reverse case, the sensitivity data allocating is stopped when all the data is loaded for all the channels.

Input sensitivity data file needs to be closed when it is loaded. Loading operation is impossible to execute while the file is opened.

Chapter 5 Post Processing

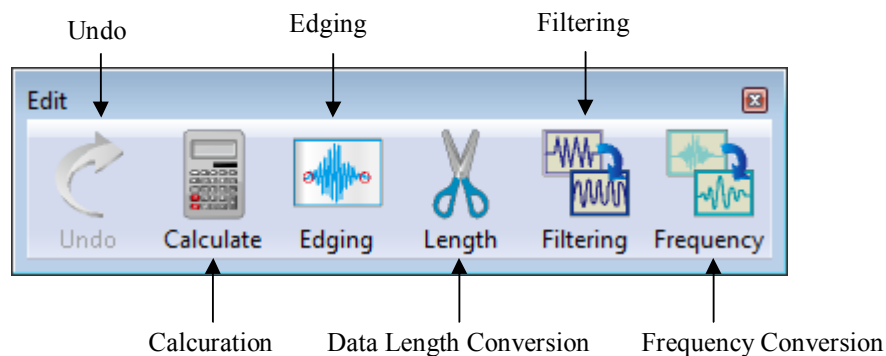
5.1 Waveform Edit

Data editing processings, such as ‘Cut-off the unnecessary frequency range’, ‘Cut-off the unnecessary portion of waveform’, are operated for the captured waveform.

Available editing functions are listed as below ;

- Calculation between two waveforms
- Processing of beginning/ending edge (Edging)
- Data Length Conversion
- Filtering
- Frequency Conversion

When the [Undo] button in Edit Tool Bar is pressed, the processing given to the data is cancelled and the system returns to the previous state.



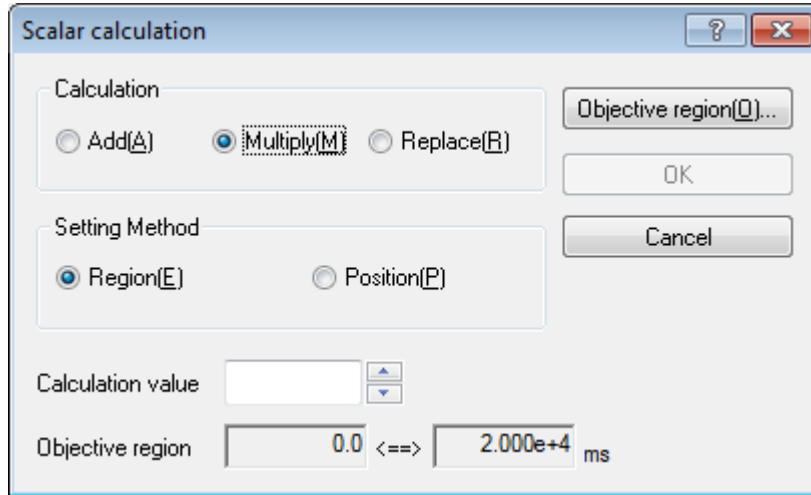
Waveform data of all the input channels captured can be used as the objective for editing processing. Also, the editing result is reflected to the result of PSD Analysis when PSD Analysis is operated.

Some processings of editing are necessary when the captured waveform is used as a Reference Waveform (Measured Waveform) in K2/SHOCK. The editing processing can be operated in K2/SHOCK because K2/SHOCK has the same function of editing processing.

5.1.1 Scalar calculation

This item is for setting of the calculation between numeral values of the waveform data loaded.

When [Scalar calculation] is pressed in the edit tool bar, the definition dialog of Scalar calculation appears as below ;



5.1.1.1 Calculation

(1) Meaning

This item defines the calculation type between the waveform data and numeric value.

- Add

The defined quantity is uniformly added to the current waveform data.

- Multiply

The waveform data is transformed in proportion to the defined multiplier.

- Replace

The current waveform data is replaced by the defined value.

5.1.1.2 Calculation value

(1) Meaning

This item defines the value to be calculated.

When the calculation type is specified to 'Multiply', this item is set to the untitled value. When the type is specified to 'Add' or 'Replace', the unit must be the same as that of the current waveform data.

5.1.1.3 Setting Method

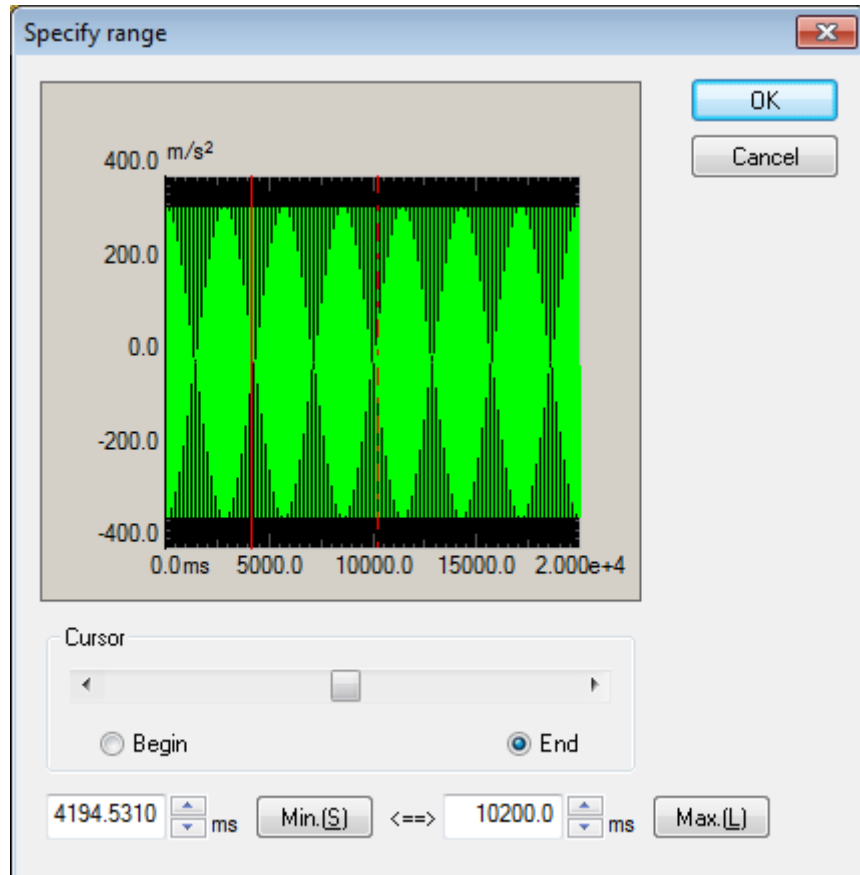
(1) Meaning

This item defines the objective range to be calculated.

- Region

To specify the objective region of the calculation by defining the beginning point and ending point.

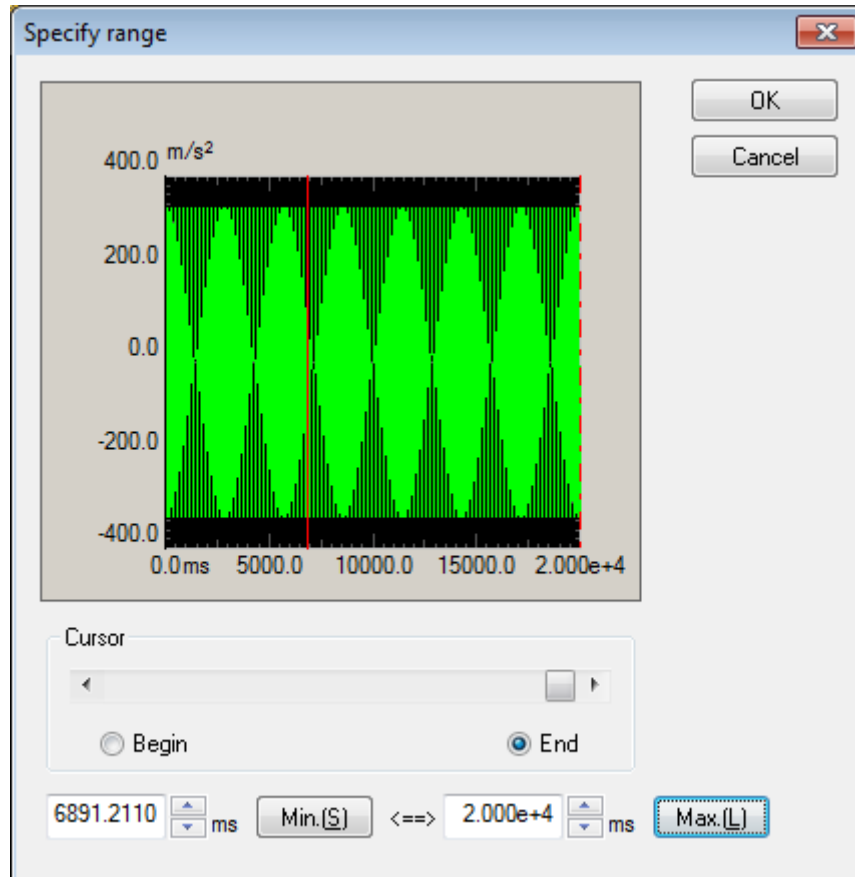
Select [Objective region] to display the dialog as below. And define the beginning and the ending points that become the objects for calculation.



- Position

Only the data of the specified time position is the objective data of the calculation. Namely, only the data for one point on the specified time axis is processed by the calculation.

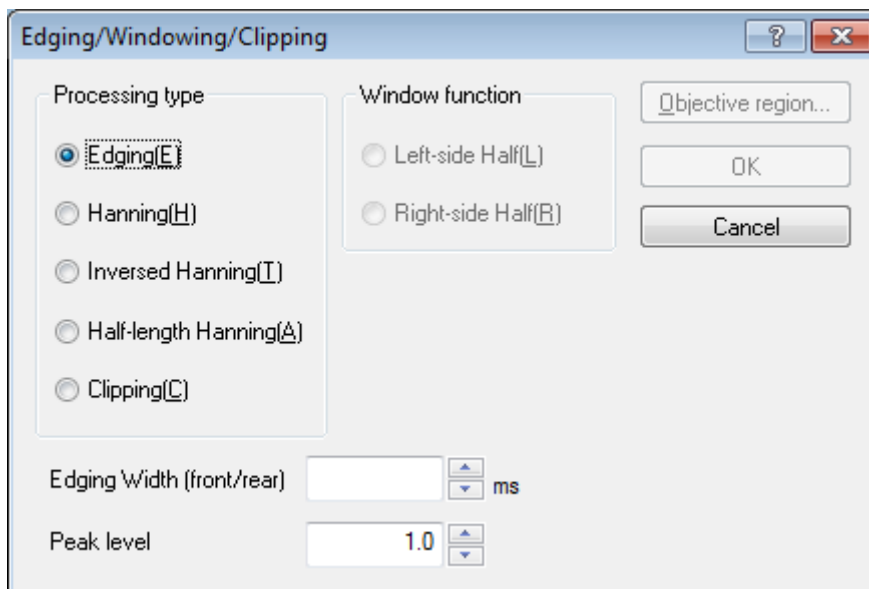
When [Objective position] is selected, the dialog as below appears. And define the position of the objects for calculation.



5.1.2 Edging

This item is for operating the edging process that achieves to smooth the loaded waveform data at the beginning/ending edge to zero. Half-length Hanning Windowing is used in this process.

When [Edging] button is pressed in the edit tool bar, the definition dialog of Edging appears as below.



5.1.2.1 Edging Width

(1) Meaning

This item is for specifying of the time for edging T_e .

Windowing by Half-length Hanning is operated to time data from the beginning to the ending edge.

5.1.2.2 Peak level

(1) Meaning

This item is for specifying the Peak level of Half-length Hanning to be used.

The default value of this item is '1'.

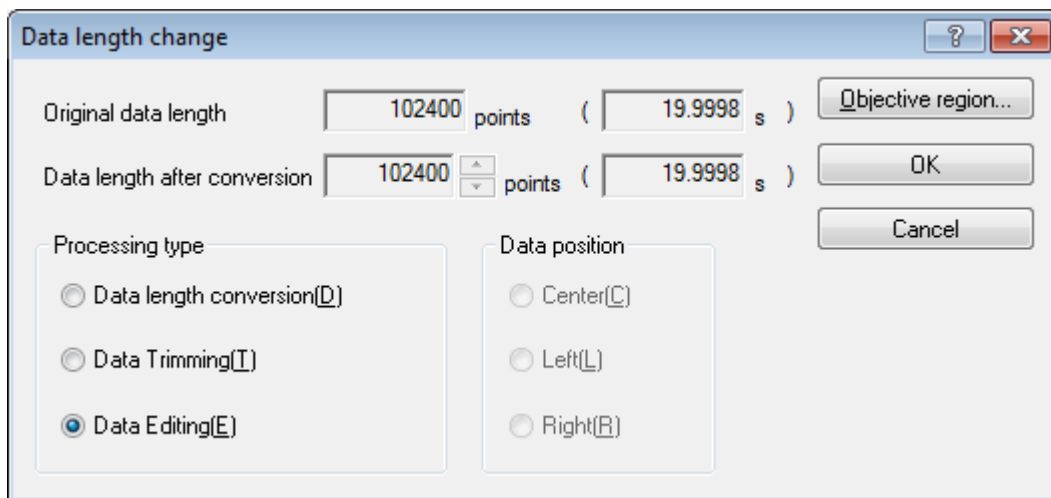
5.1.3 Data length change

This item is for changing the waveform data length.

Data Length of the waveform data should not exceed over the maximum Data Length usable in K2. When this condition is not satisfied, the data is needed to be edited by cutting off unnecessary part of data and reducing the Data Length.

The editing processing can be operated in K2/SHOCK because K2/SHOCK has the same function of this editing processing.

Select [Data length change] in the edit tool bar. The definition dialog of Data length change as below appears.



5.1.3.1 Processing type

(1) Meaning

When Data Length of waveform data is converted, the following methods are available ;

- Data length conversion

The desired Data length which will be converted from the current data length is specified. Data Length can be increased or decreased from the current data length.

- Data trimming

The data in the specified region is trimmed from the objective waveform data and the rest is used as a new waveform data.

Data Length is decreased from the current data length.

- Data editing

The data in the specified region is trimmed from the objective waveform data and the trimmed part is used as a new waveform data.

Data Length is decreased from the current data length.

5.1.3.2 Data Length

(1) Meaning

This item is specified only when Processing type is specified as Data length conversion and is defined a new Data Length R'.

In this item, the waveform data of a new Data Length is generated, while Sampling frequency fs is kept unchanged.

In other words, the Frame Time T increases or decreases in proportion to the Data Length as follows ;

$$T = R' / fs [s] \quad R' : \text{A new Data Length}$$

- The old Data Length R > The new Data Length R' ;

Part of the old data is discarded in proportion to the decrease of the Frame Time T (the discarded area depends on the defined data position stated later).

- The old Data Length R < The new Data Length R' ;

Zero data is added to the old data in proportion to the increase of the Frame Time T (the added area depends on the defined data position stated later).

5.1.3.3 Data Position

(1) Meaning

This item should be inputted only when the Processing type is 'Data length conversion' and this item defines the reference position for changing the waveform data, led by changing the data length.

- Center

The data is increased or decreased with keeping the center of the old data as a base. The data is added or discarded uniformly on the right and the left.

- Left

The data is increased or decreased with keeping the left end of the old data fixed. The data is added or discarded from its right end.

- Right

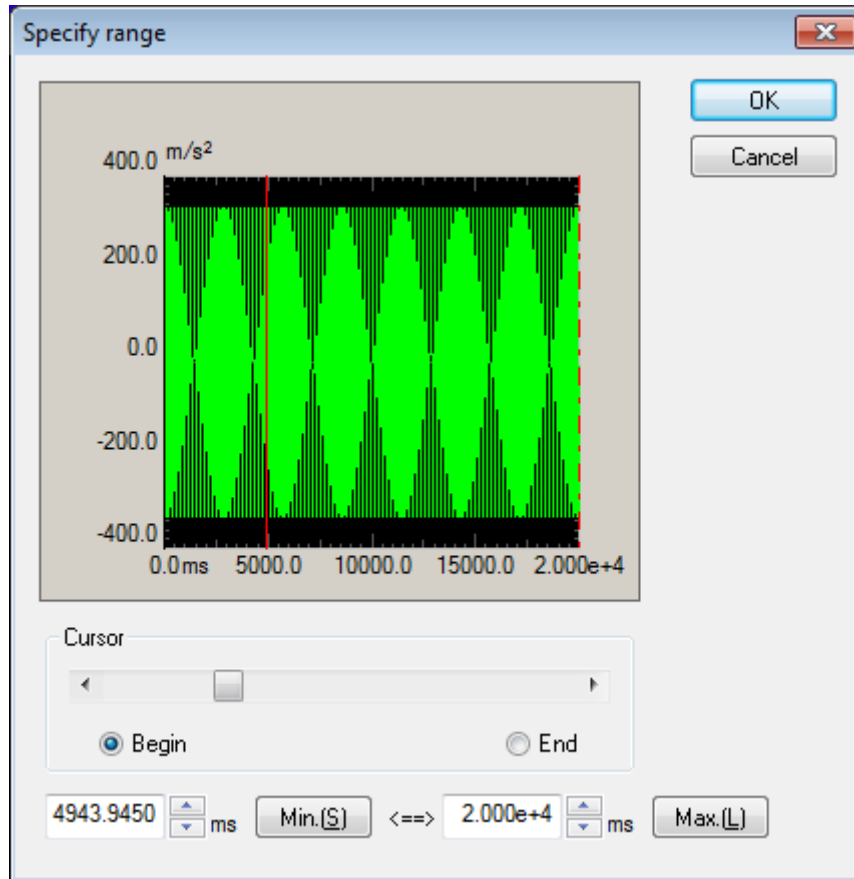
The data is increased or decreased with keeping the right end of the old data fixed. The data is added or discarded from its left end.

5.1.3.4 Objective Region

(1) Meaning

This item is valid only when 'Data trimming' or 'Data editing' is set in Processing type.

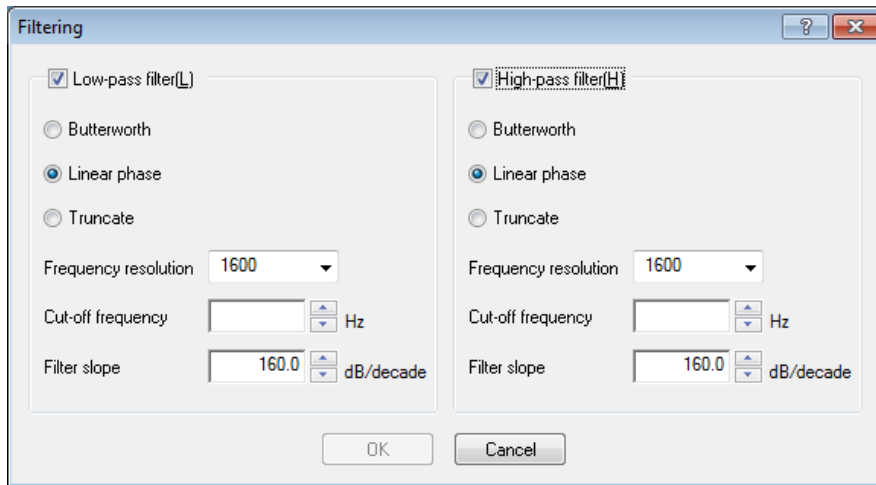
When [Objective Region] is pressed, the dialog box for setting of objective region appears.



5.1.4 Filtering

This item is for operating of Filtering to the waveform data loaded.

The definition dialog of Filtering as below appears by pressing [Filtering] button in the edit tool bar.



5.1.4.1 Type of Filter

(1) Meaning

Type of Filter is selected.

- Low-pass filter

In this type, the low frequency component of waveform data is passed.

- High-pass filter

In this type, the high frequency component of waveform data is passed.

5.1.4.2 Filter Characteristics

(1) Meaning

Filter Characteristic is selected. Generally, the default setting of 'Linear Phase' is used.

- Butterworth

Nth-order Butterworth Filter.

How to specify the order N is described after the next clause.

- Linear phase

The Linear Filter cuts the components without giving any non-linear phase change to the input signal.

This system adopts the specifications that the slope at the attenuation band can be defined without changing the phase in all the frequency elements at all.

- Truncate

The characteristics of the Frequency range which is the object for the filter processing is truncated to zero bounded by the specified cut-off frequency f_c . The phase characteristics are the same as the 'Linear Phase' in the previous clause.

5.1.4.3 Frequency resolution

(1) Meaning

The frequency resolution is specified to carry out Fourier Transform and Inverse Fourier Transform by FFT technique for the filter processing of the waveform data. Therefore, the input lower Cut-off frequency f_c is determined when frequency resolution is specified.

5.1.4.4 Cut-off frequency

(1) Meaning

This item specifies the Cut-off frequency for Filtering.

The possible lower value f_{c_min} is determined by the Sampling frequency f_s of the objective waveform data of the Filtering process and the frequency resolution L as follows.

$$f_{c_min} = \Delta f \text{ [Hz]} \quad \Delta f = f_{max}/L, \quad f_{max} = f_s/2.56$$

5.1.4.5 Filter order

(1) Meaning

This item is defined only when 'Butterworth' is specified for Filter Characteristics. The order N is inputted that specifies the Cut-off Characteristics of the Filter.

5.1.4.6 Filter slope

(1) Meaning

This item is defined only when Filter Characteristic is 'Linear Phase'. The Slope of the attenuation transient band characteristics S [dB/decade] that is correspondent to the order of the Filter is specified.

When this item is defined, Filtering process according to the following formula is executed within the objective range.

$$A'(f) \begin{cases} = A(f) & \Delta f \leq f < f_c \\ = A(f)/(f / f_c)^{S/20} & f_c \leq f \leq f_{max} \end{cases}$$

$A(f)$ Amplitude value

5.1.5 Frequency conversion(Freq. Conversion)

The process of Frequency conversion is operated to the waveform data loaded.

There are two functions as below ;

① Signal frequency conversion

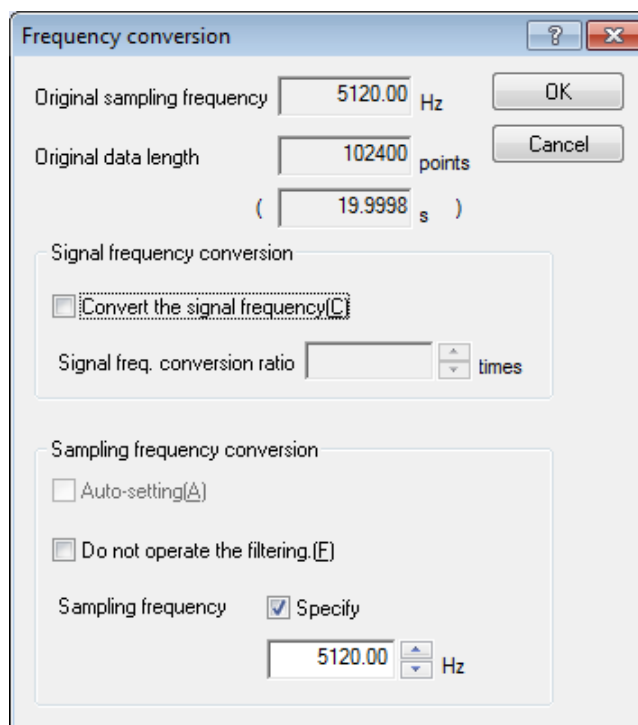
When in such a case that vibration test is simulated with a model, the signal frequency of a measured waveform data has to be converted as the original measured data is not suitable for the use. This function is for such need.

② Sampling frequency conversion

As the measurement condition of the waveform data does not meet that of the K2 Application, a new data is made adding some changes to the waveform data.

Sampling frequency of waveform data should be ‘the one usable in K2’. When this condition is not satisfied, the value of Sampling frequency is needed to be corrected by operating the process ②.

When [Freq. conversion] is pressed in the edit tool bar, the definition dialog of Frequency conversion as below is displayed.



5.1.5.1 Signal frequency conversion

This item is for converting the Signal Frequency of the waveform data itself. In general, it is necessary to convert the Sampling frequency in this case, too. To execute this function, select the check box [Convert the signal frequency].

5.1.5.1.1 Signal frequency conversion ratio(Signal freq. conversion ratio)

(1) Meaning

This item is for specifying the signal frequency conversion ratio of the waveform data. When the signal frequency is converted, the Sampling frequency is also needed to be converted, in general. The operation is described later.

5.1.5.2 Sampling frequency conversion

This item is for converting the Sampling frequency of the waveform data. (Process ②)

5.1.5.2.1 Auto-setting

(1) Meaning

This item is defined only when the signal frequency is converted.

As mentioned above, when the signal frequency of the waveform data is converted, it is also necessary to convert Sampling frequency. However, in this case, Sampling frequency is automatically set to meet the set value of the signal frequency. Sampling frequency is determined according to the following rules ;

- ① Calculate a provisional Sampling frequency fs' from the signal frequency ratio.

$$fs' = b \cdot fs \quad b : \text{Signal frequency conversion ratio}$$

- ② Determine a Sampling frequency fs' which is closest to fs' and can be used in the K2 Application over fs' .

5.1.5.2.2 Do not operate the filtering

(1) Meaning

When Sampling frequency conversion is carried out, this system executes a sequence of digital processing by the necessary combination of Decimation / Interpolation that is mentioned in the next clauses. At this time, the Low-pass Filter processing is achieved at each stage during the process, according to the general rule of Decimation / Interpolation.

This Low-pass Filtering process is very legitimate when using the waveform data made by capturing an existing analog signal rationally.

On the other hand, in such a case when the waveform data is generated or defined in completely digital manner neglecting the Nyquist's Theorem, the usage of the LPF in the process may not suitable to fit the 'requirement'.

This item is provided for such a case. When it is defined, frequency conversion is achieved by a simple linear interpolation without using the rational Decimation / Interpolation method.

However, when carrying out this item (Do not operate the filtering), Signal

frequency conversion cannot be operated.

5.1.5.2.3 Sampling frequency

(1) Meaning

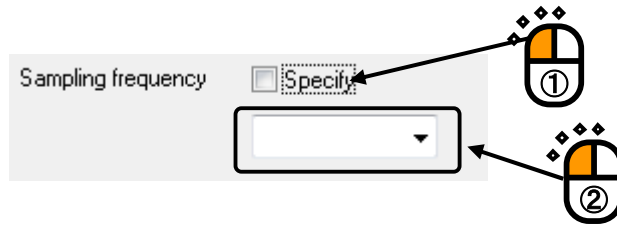
This item defines a new Sampling frequency fs' .

Sampling frequency available in K2 is selected by the procedures as below ;

<Procedures>

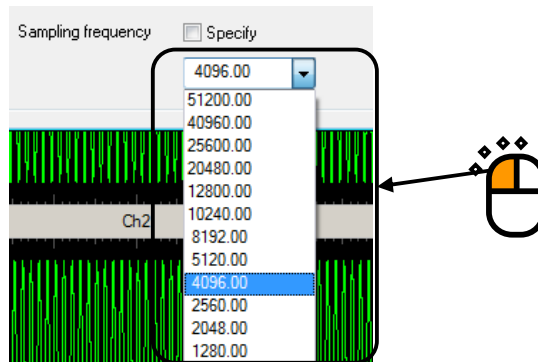
<Step 1>

Uncheck check box of 'Specify' and press the input area of Sampling frequency.



<Step 2>

Sampling frequencies available in K2 are listed. Select a proper value for Sampling frequency from the list.



In this item, the waveform data in which Sampling frequency is changed from fs to fs' is produced keeping the frame time ($T = R/fs$) unchanged (the data length R is subject to the same change as fs).

The sampling time interval Δt increases or decreases in inverse proportion to the change in fs as follows ;

$$\Delta t' = 1 / fs'$$

Example : Conversion by the factor $1/2$;

Sampling frequency is halved so the time interval Δt is doubled. A new data itself will be produced to give a coarser sampling of the same time length of the waveform. In order words, in every two contiguous data, only one data is left, and other sampling points of the old data are useless and discarded. But if this simple method

is done straightforwardly, some unexpected distortion will be produced.

In this system, through the digital processing by a Decimator, a new waveform data item consisting of only the frequency components less than f_{max} ($f_{max} = f_s'/2.56$) : the new f_{max} has no frequency components included in the old f_{max} frequency band.

Example : Conversion by the factor 2 ;

Sampling frequency is doubled, so the time interval Δt is halved. A new data item will be produced to give a more finely-grained sampling of the same time length of the waveform.

In other words, a sampling point is added between each pair of sampling points, which creates new data.

In this system, through digital processing by an Interpolator, a new waveform data consisting of frequency components less than the old f_{max} is produced using the new Sampling frequency f_s' . So some frequency components are not added to the new f_{max} frequency band from the old f_{max} .

In contrast, in an easier way, for example, when an intermediate data is produced by linear interpolation from two data points, the high-frequency components that are never observed in the original measurement may be added to the new f_{max} frequency band unnoticed.

This clause is about the process when the previous item is not set to 'Do not operate the filtering', and for the case of setting to 'Do not operate the filtering', Frequency conversion is executed according to the logic of the simple linear interpolation.

When the converted Data Length R' exceeds over the maximum Data Length usable in K2, Data Length should be edited by Data length change.

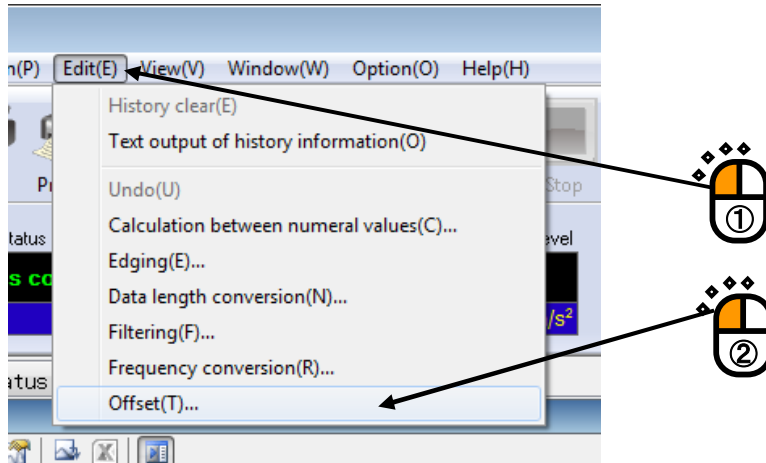
5.1.6 Offset

This item is for offsetting the acquired waveform data.

<Procedures>

<Step 1>

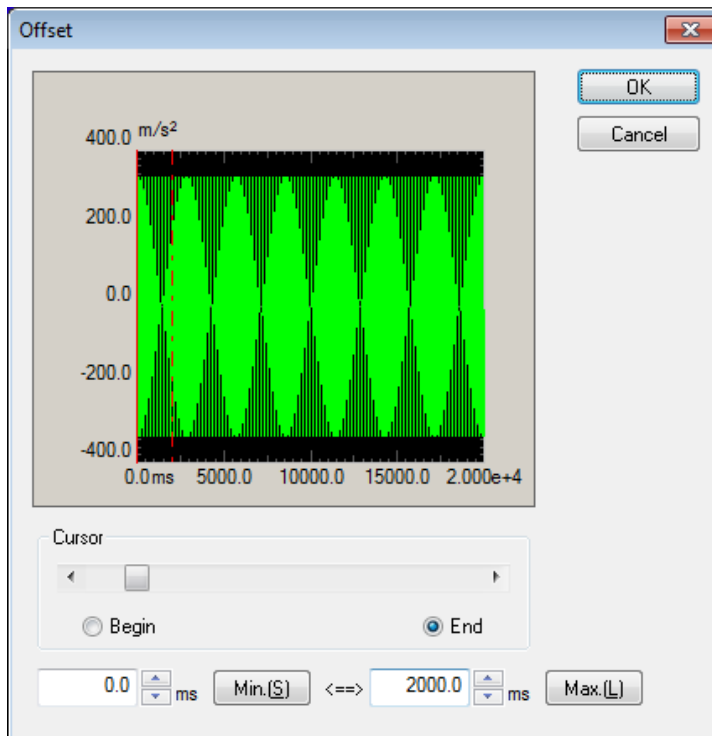
Select “Edit” in the menu bar and click on “Offset” among the listed items below.



<Step 2>

Specify the range of waveform to be offset. The average value of the specified range is calculated as the offset quantity.

Offset quantity is calculated for each input channel.



<Step 3>

Press [OK] in the display of Step 2. Then, the offset quantity is taken off from the waveform data of each input channel.

5.2 PSD Analysis

This item is for operating PSD Analysis of a captured waveform.

The objective data for analysis is specified as a whole waveform data.

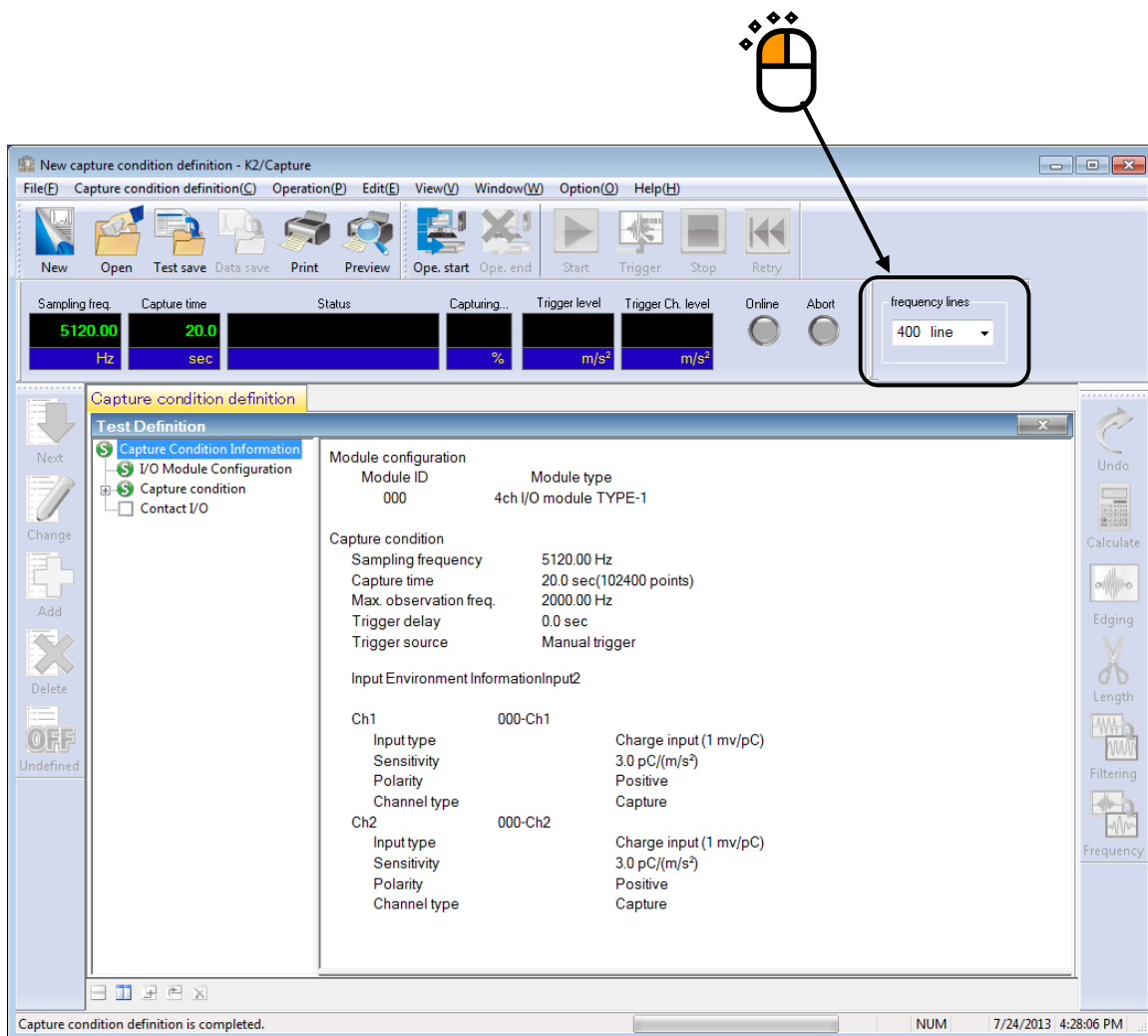
PSD Analysis is operated as below ;

The waveform data for the FFT frame length is extracted by Hanning window. And this extracted waveform data is operated by overlapping process for 50 %.

The obtained PSD data can be used as a Measured Reference PSD of K2/RANDOM

5.2.1 Specifying of Frequency Lines

Number of Frequency Lines for PSD Analysis is specified in 'PSD frequency lines'.



5.2.2 Frequency Lines and Frequency Resolution

When the waveform data for 1 frame length (for N points) is operated by FFT, the complex spectrum data for N/2 line is obtained in the frequency region. Frequency Lines mean the number of valid measured data (which is counted from the lower frequency side) with concerning about the influence of aliasing.

The relation between Frequency Lines L and the number of points N is described as below ;

$$L = N / 2.56$$

Frequency Resolution Δf which shows the density of control on the frequency axis is determined when Frequency Lines is defined. The relation between these items is described as below ;

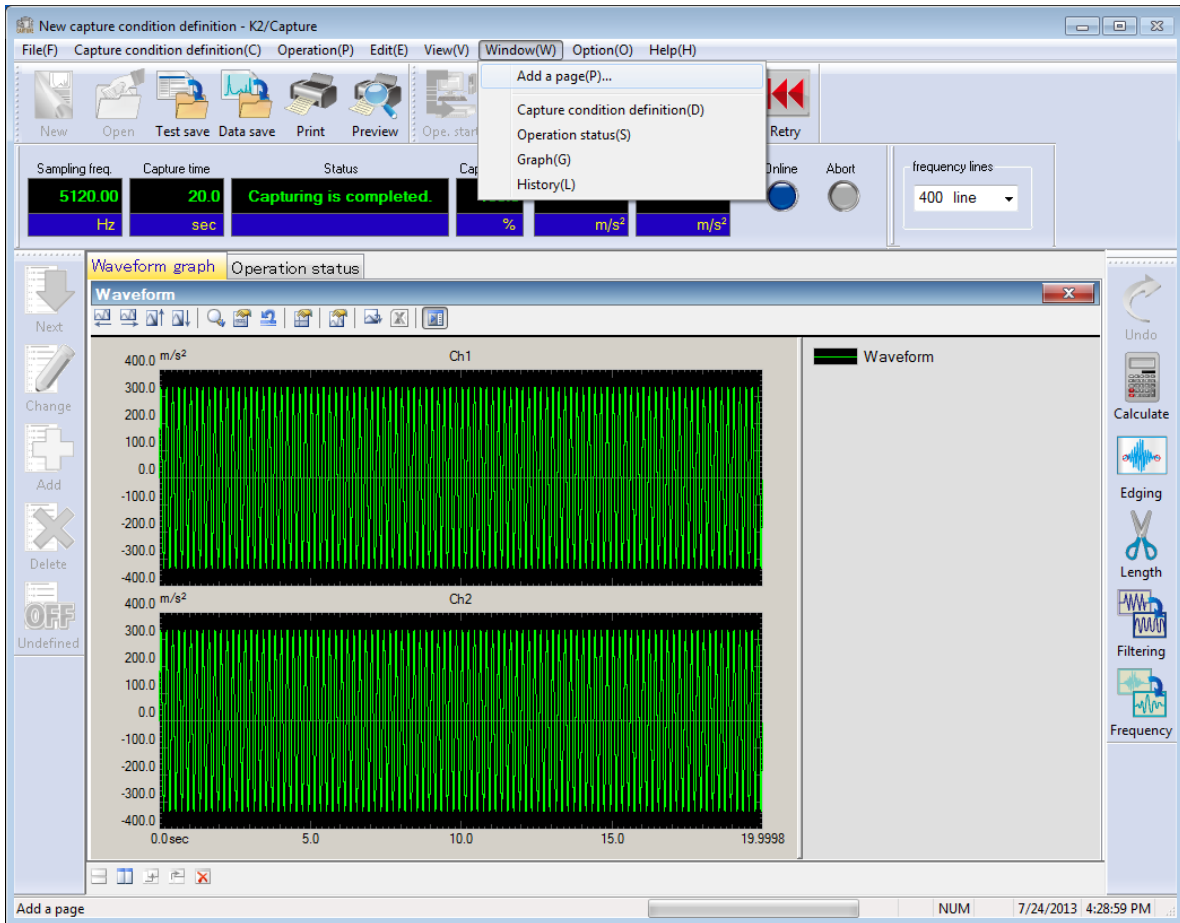
$$\Delta f = f_{\max} / L (= f_s / N)$$

Also, Frame Time T (time for N points of waveform data) has the following relation to Frequency Resolution Δf .

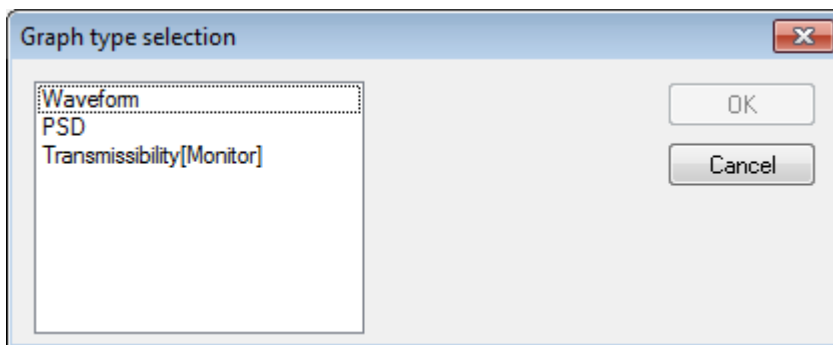
$$T = 1 / \Delta f \quad [\text{sec}]$$

5.3 Transmissibility of CH.

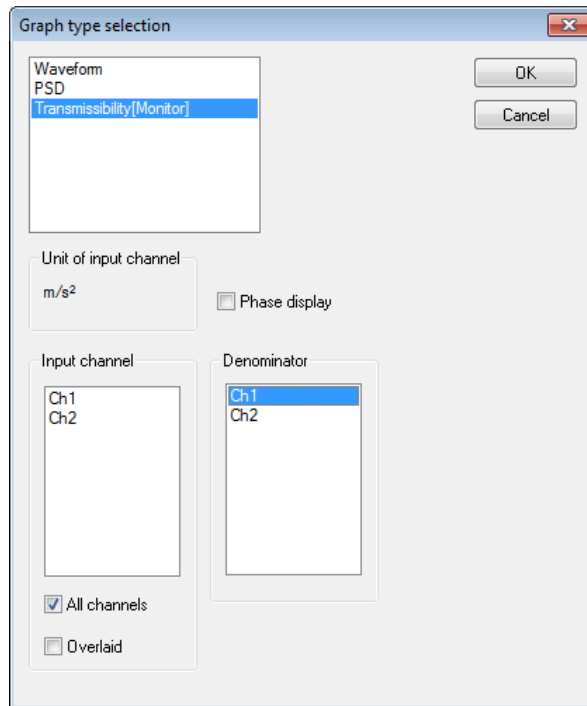
This item is for calculate and display the transmissibility of a channel from the acquired waveform.
Add a display page by selecting [Add a page] among the 'Window' menu.



Select [Graph] among the 'Window' menu. The dialog as below is displayed.

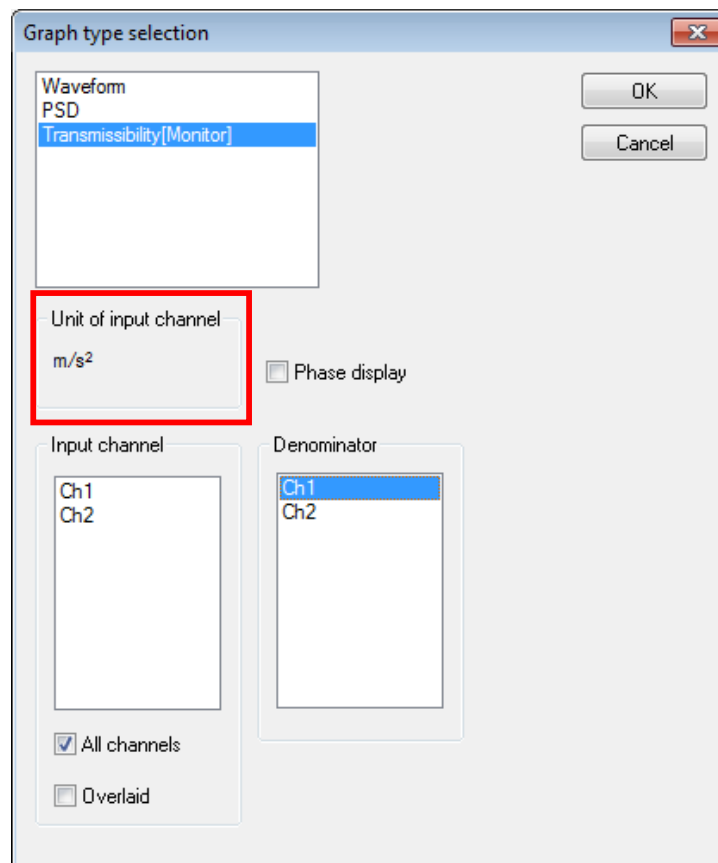


Select 'Transmissibility [Monitor]' in this dialog. The setting items as below appear.

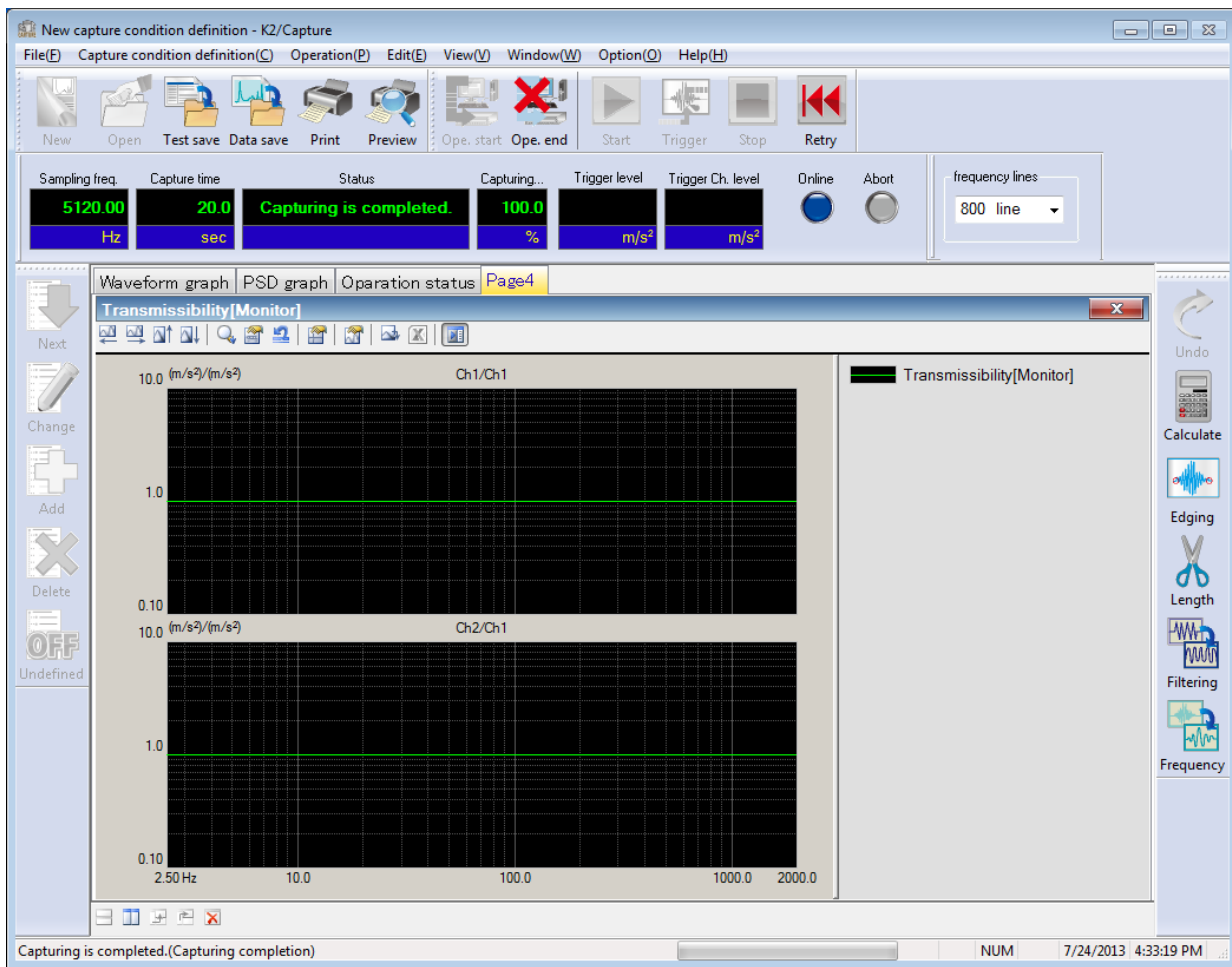


In this dialog, select the reference data ('ch1' is selected in this example). Also, click and check the box of [Phase] to display the phase if necessary. Press [OK] to calculate the transmissibility by the frequency lines and to display it in a graph.

However, the transmissibility can only be displayed by the same physical quantity. The input channel unit is available to select when the various physical quantities are existing at the same time.



The example of transmissibility display is shown below.



5.4 To use the data as a Reference of K2/SHOCK, K2/RANDOM

It is necessary that the following operations are executed when a captured waveform or an analyzed PSD data is used as a reference data of K2/SHOCK or K2/RANDOM.

1) Operation by K2/CAPTURE

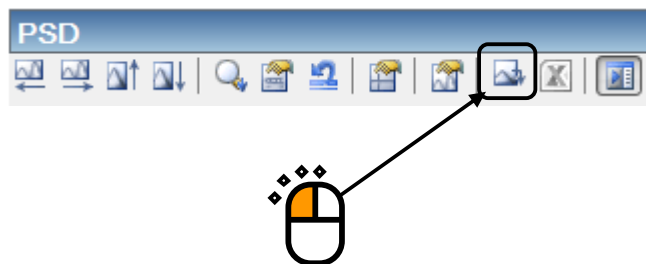
<Step 1>

Display a captured waveform or a PSD data to be used as a reference data as a graph.

Refer to 4.3 Graph Operation, Chapter 4 in K2/Common Part Instruction Manual about the operation procedures of graph display.

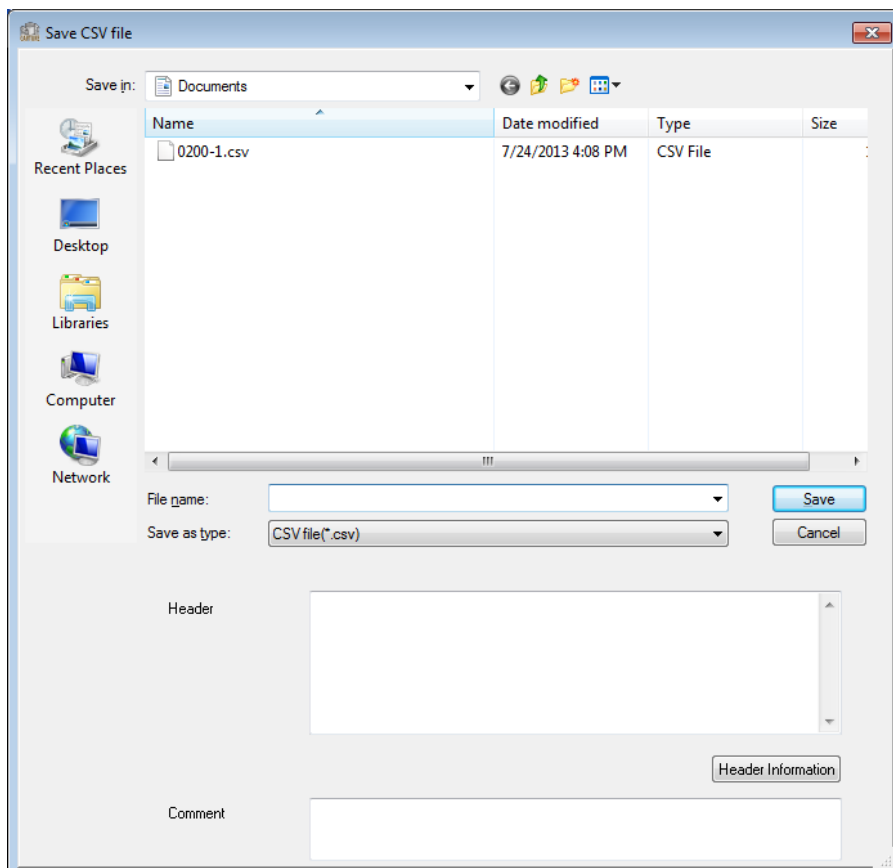
<Step 2>

Press the convert button, then convert the data which is displayed to CSV data and save.



When Press the 'Save button', show the data save window.

Specify the file name, then press the 'Save button'.



2) Operation by K2/SHOCK or K2/RANDOM

Press the [CSV File Selection] or [Loading a CSV File] button at the loading of data file of measured waveform or measured PSD. Then, load the CSV data file saved in the procedure 1).

Edit processing of data can be operated if necessary.

Refer to the corresponding part of each instruction manual about the details.

K2/SHOCK : 5.3 Measured Waveform Definition, Chapter 5

K2/RANDOM : 4.4.1.2 Measured PSD Definition, Chapter 4

Chapter 6 Supplemental Remarks

6.1 Repetitive save setting

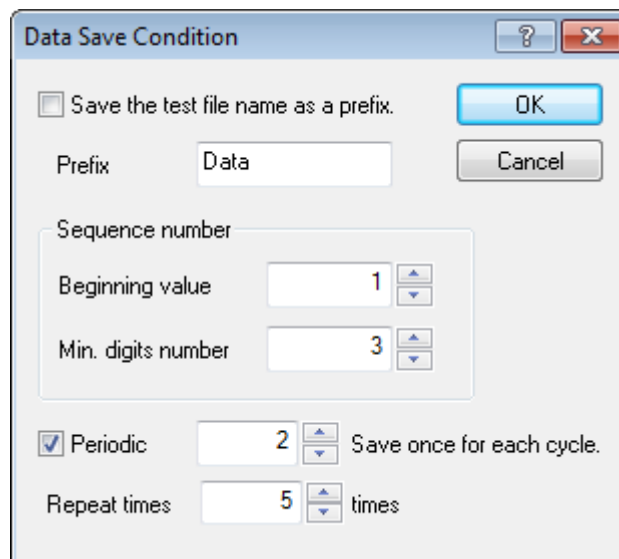
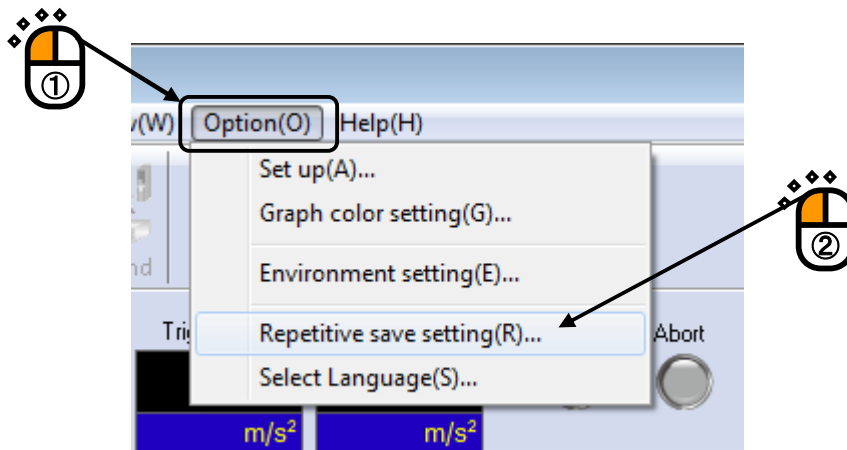
The continuous acquisition of data can be executed by defining of Repetitive save setting.

The system proceeds to the waiting state for trigger automatically for the specified repeat times after completing the data acquisition. The acquired data is saved automatically at each specified period.

K2 system saves all of the measured data in operation to one binary file (*.VGF).

<Operation procedure>

Select the item of “Option” in menu bar. The dialog box of “Data Save Condition” is opened by selecting “Repetitive save setting”.



Each save condition is described ;

The items as below are available when the check box of “Periodic” is selected.

1. Save the Test file name as a prefix.

Common words can be attached at the beginning of data file name. The saved name of data can be changed by canceling this item.

2. Sequence number

The data file attached by a prefix is saved with sequential serial number.

Beginning value : Set the beginning number.

e.g.) In case of setting as ‘1’ => Data01.VDF

Min. digits number : Set the number of digits for sequential serial number.

e.g.) In case of setting as ‘2’ => Data01.VDF

3. Periodic save once for each cycle #

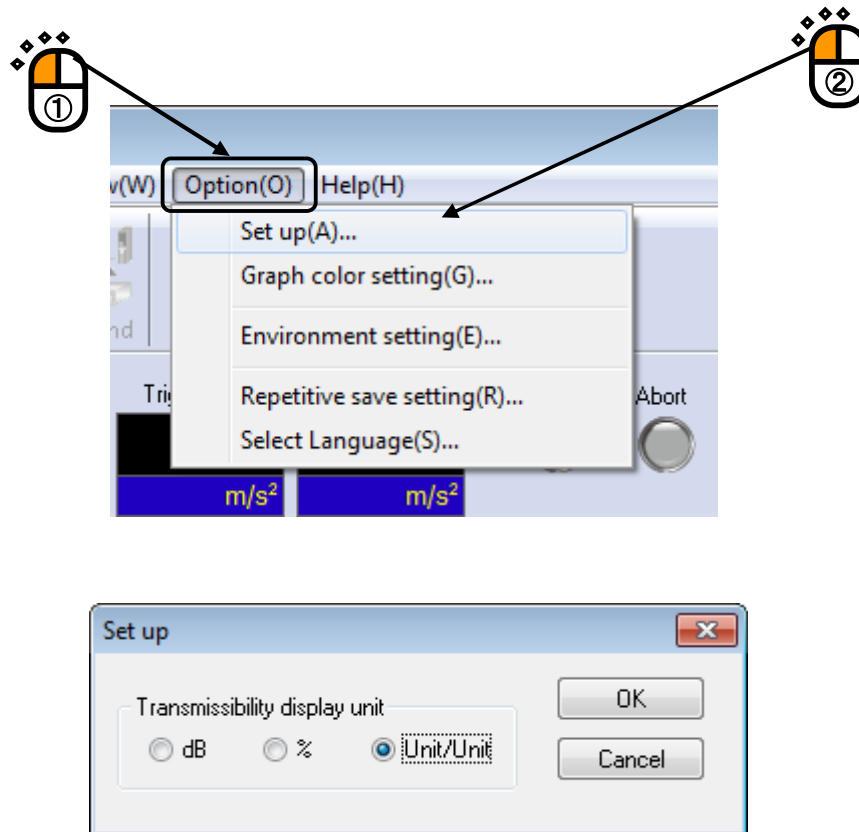
Repeat times for acquiring the data and period for data saving are specified.

For example, in case of setting as [Periodic save once for each cycle ‘1’, Repeat times ‘5’] ; the excitation data is acquired for 5 times automatically at each repetitive operation when the specified trigger condition is satisfied. Also, the first, third and fifth data are saved as data file among the acquired data automatically.

6.2 Set Up

<Procedures>

Select [Option] in the menu bar and click [Set up]. A dialog of 'Set up' appears.



[Transmissibility display unit]

This item is for selecting the display unit of amplitude value in Transmissibility Graph.

This unit selected in this item is valid only for the transmissibility graphs calculated from the two data giving the same unit.

In case that the transmissibility graph is calculated from the two data having different units, the display unit of amplitude always appears as 'Unit/Unit'.

Index

A	
Amplitude	5-10
B	
Basic Operation	3-1
C	
Calculation between numeral values	5-1
Capture Time.....	3-1, 3-4, 3-14, 3-17, 4-2, 4-6
CSV File	3-13, 3-23, 5-22
Cut-off frequency	5-10
D	
Data editing	5-6, 5-8
Data Length.....	1-1, 4-2, 5-1, 5-7
Data length change	5-6, 5-14
Data length conversion	5-1, 5-6, 5-7
Do not operate the filtering	5-12
E	
Edging.....	5-1, 5-5
Editing.....	3-23
F	
Filtering.....	5-1, 5-9, 5-10, 5-12, 5-14
Frequency conversion.....	5-1, 5-11, 5-14
Frequency resolution	3-1, 5-10, 5-17
G	
Graph Data File	2-2
I	
Input channel.....	4-2
Input channel.....	2-2
Input Channel.....	3-14, 3-15, 4-6
Input Enviroment.....	3-1, 3-2
Input Range	3-14
Input sensitivity loading.....	4-7
K	
K2/RANDOM	3-13, 3-23, 5-21, 5-22
K2/SHOCK	3-13, 3-23, 5-1, 5-6, 5-21, 5-22
M	
Max. Observation Frequency	3-1, 3-4, 3-14, 3-17, 4-3
O	
Offset	5-15

Operation Status Panel.....	2-1
P	
Peak level.....	5-5
Processing type.....	5-7, 5-8
PSD Analysis	1-1, 3-6, 3-11, 3-23, 5-1, 5-16
R	
Realtime waveform time.....	4-2
Repetitive save setting	6-1
S	
Sampling frequency.....	1-1, 3-1, 3-14, 4-2, 4-3, 5-13
Sampling frequency conversion	5-11, 5-12
Save	1-1
Scalar calculation	5-2
Set Up	6-3
Signal frequency conversion.....	5-11, 5-13
Signal frequency conversion ratio.....	5-12
T	
Transmissibility display unit.....	6-3
Transmissibility of CH.	5-18
Trigger	1-1, 3-1, 3-4, 3-8, 3-9, 3-14, 3-17, 3-18, 3-21, 3-22, 4-3, 4-5, 4-6
Trigger Delay	1-1, 3-4, 3-17, 4-5
Trigger Level.....	1-1, 3-14, 3-17, 4-3, 4-5
Trigger Slope.....	1-1, 3-17, 4-3, 4-5
Trigger Source.....	1-1, 4-3, 4-5, 4-6
Type of Filter	5-9
W	
Waveform Edit.....	5-1