Sine Vibration Control System

K2
K2Sprint

Multi-Sweep Sine Option
Instruction Manual

Limitation of K2Sprint/SINE

• Maximum numbers of usable input channel are ‘2’ channels.

• Option of LIMIT CONTROL can not be added.

IMV CORPORATION

Type of Document : Instruction Manual

System Applied : K2/K2Sprint

Software <Multi-Sweep Sine> later than Version 20.2.0

To use this application, the following software is required:

Multi-Sweep Sine Option

English Edition

Version	Date	Contents
10.0.0	2013.11.29	First edition
13.0.0	2017.03.10	Change of “Data save condition” screen
13.5.0	2017.10.02	Addition of description of loop check detailed settings
14.3.0	2019.04.19	Additional description of “Safety check”, modified description of Data save condition, correction of misprints
20.2.0	2021.03.17	Change the maximum number of spot elements to 64.

CONTENTS

Chapter 1 Multi-Sweep Sine

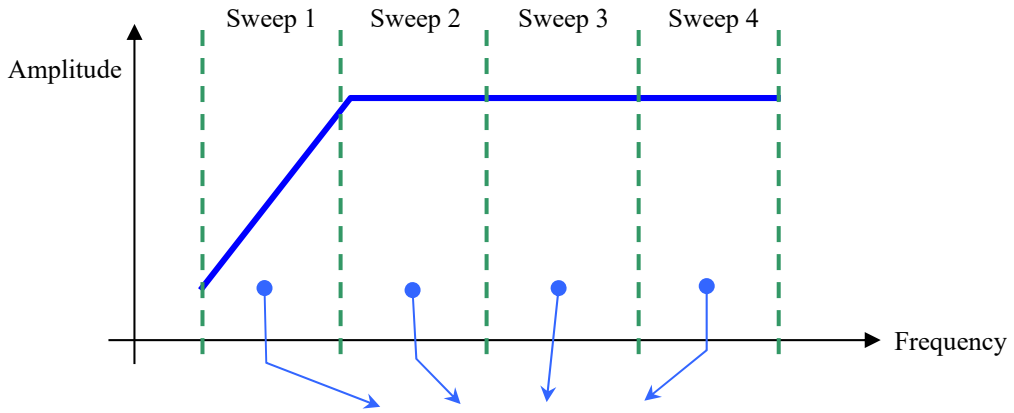
1.1 Outline

K2/Multi-Sweep Sine is the optional software for K2/SINE.

Multi-Sweep Sine test is mainly intended to shorten the time of Sine tests, enabling several different sweep tests to be simultaneously executed. This application supports the following three types of tests.

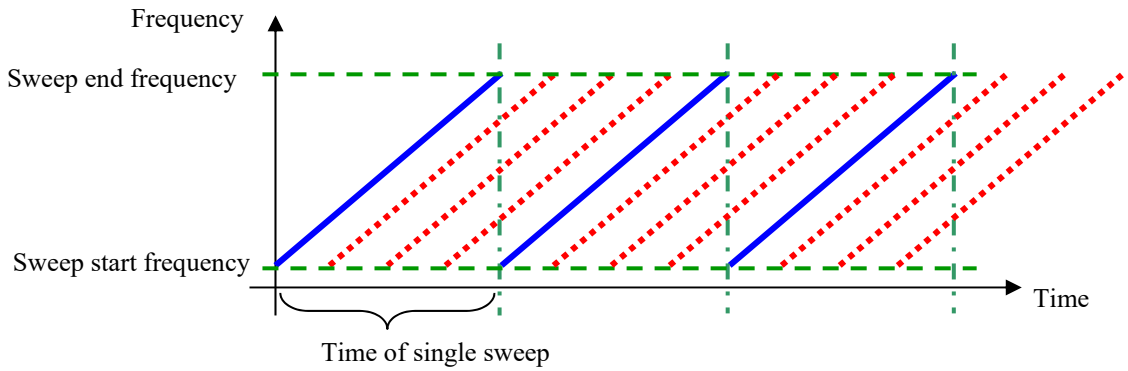
(a) Multiple frequency sweep

This test type simultaneously executes sweep tests for each band by equally dividing the reference profile frequency band. The following is an example of four divided frequency bands. In this case, sweep tests are executed simultaneously in these four sections, so that the test time can be shortened to one fourth in comparison with ordinary Sine tests.



(b) Time delayed sweep

This test type executes a reference profile sweep test several times at a specified time interval. The following figure shows a conceptual image of the relationship between time and sweep frequency. In case of a standard Sine test, a next sweep test will start after the previous one is completed as indicated by the solid line. With this test type, however, sweep tests will start at specified time intervals to execute several sweeps simultaneously.



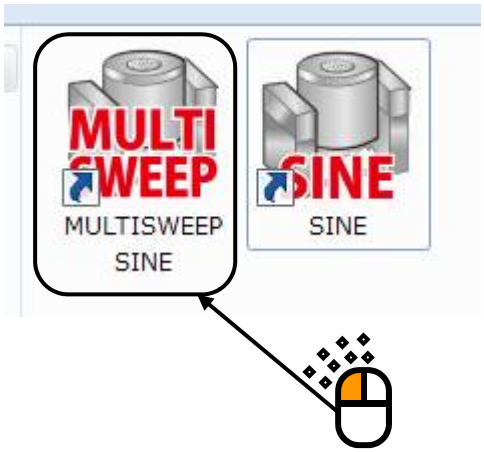
(c) Multi Spot

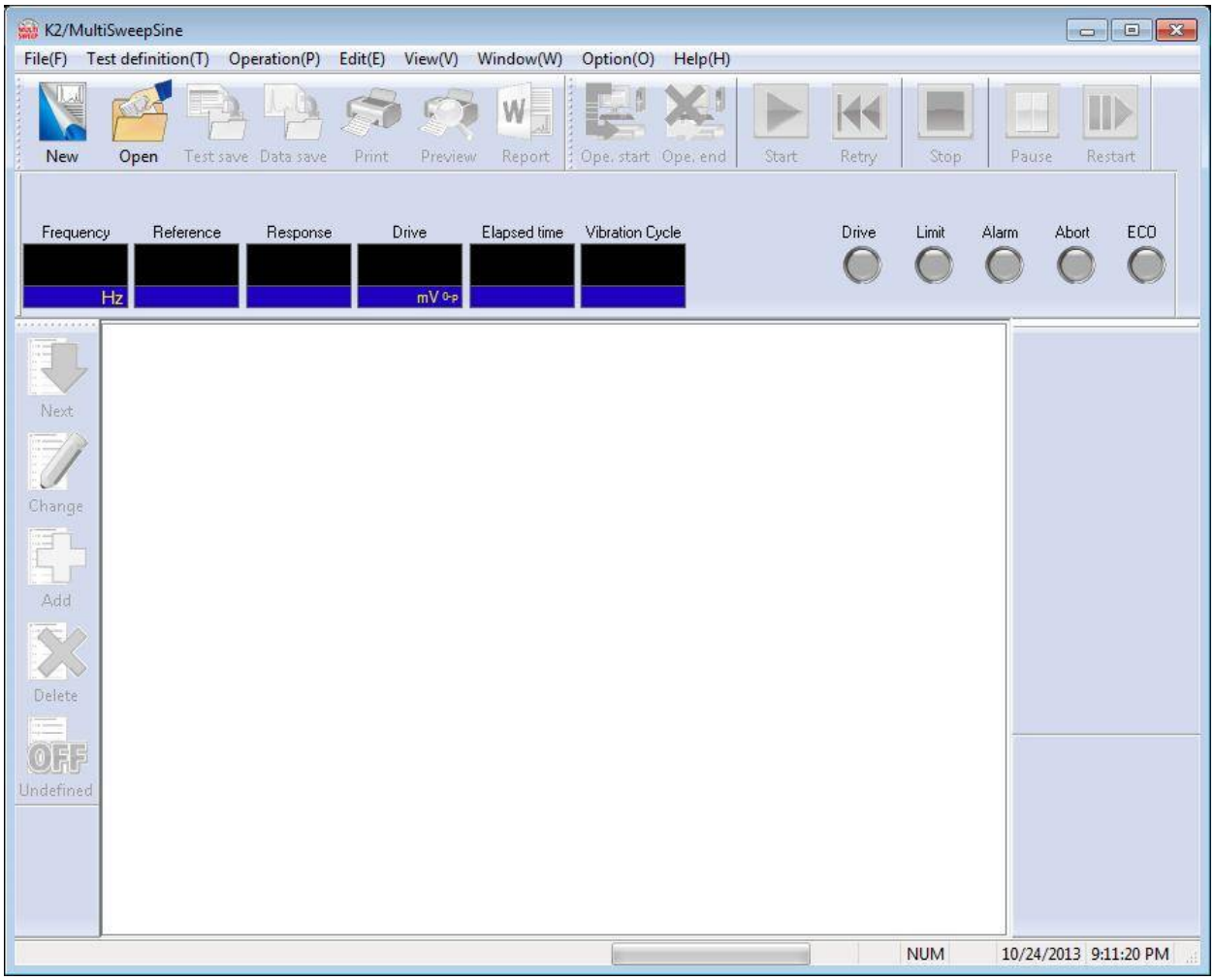
This test type executes excitation simultaneously at several fixed frequencies. As a conceptual image, several standard sine spot tests are executed simultaneously for each factor.

1.2 Staring procedure

Unlike other general optional software, the “K2/Multi-Sweep Sine” option is provided as an independent application. Note that “K2/Multi-Sweep Sine” is an application different from the standard K2/SINE application.

To start the K2/Multi-Sweep Sine application, double-click on the “MULTISWEEP SINE” icon. Then, the “K2/Multi-Sweep Sine” window will open.





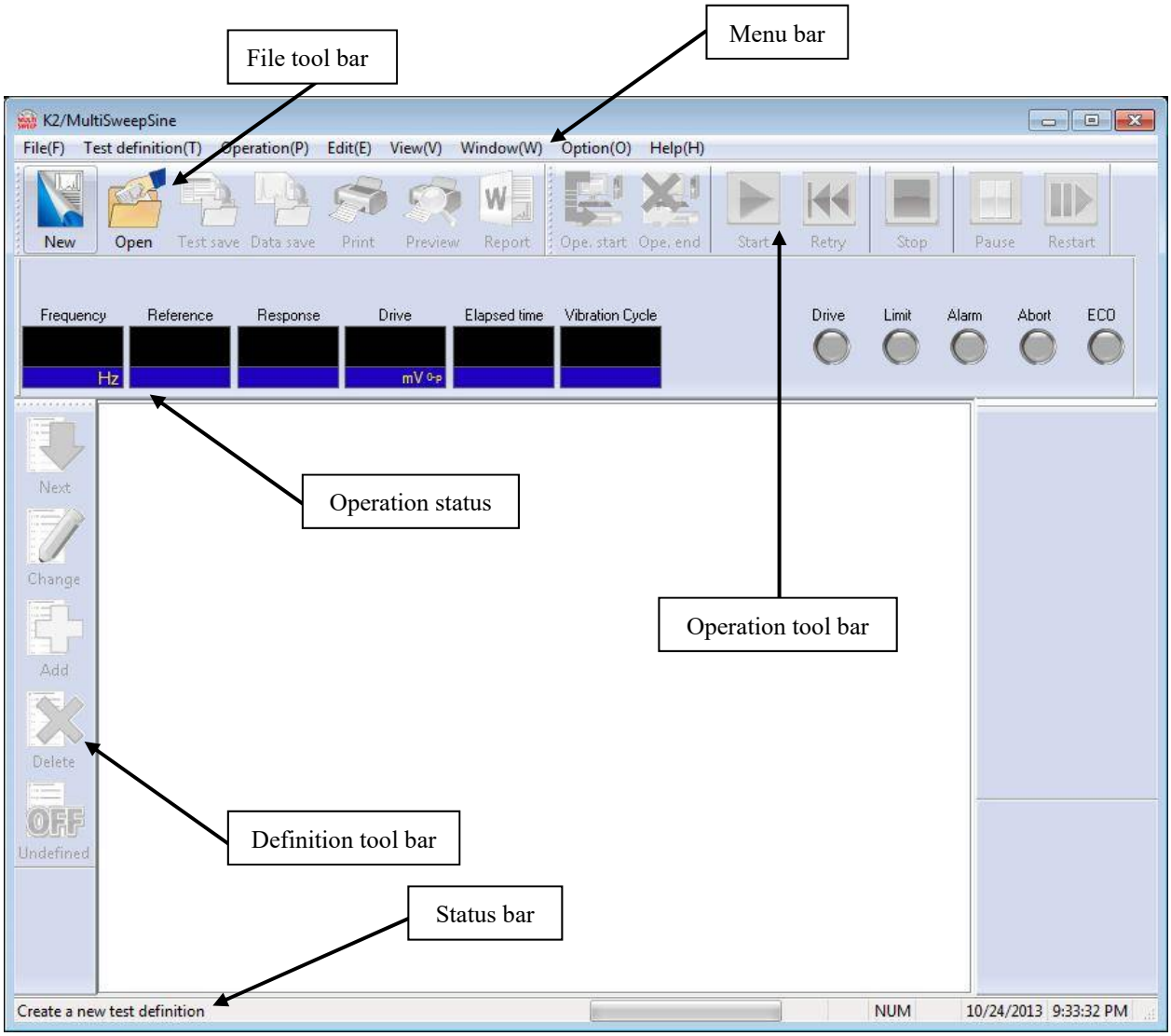
1.3 Basic operation system

After startup, the “Multi-Sweep Sine” option can be also operated with 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 operation status panel shows status of the currently executed excitation test. Unlike the ordinary Sine test, the “Multi-Sweep Sine” application shows a tab to display operation status for each sine wave, since this application controls several sine waves.



Multi-Sweep Sine Window

1.4 Test file

The “Multi-Sweep Sine” application stores information required to test operations in a specified file, which is called “Test file”.

Following kinds of Test file are available in this system.

Necessary Test Files for test operation

- Test Definition File: Multiple frequency sweep (*.fds2),
  Time delayed sweep (*.tis2),
  Multi Spot (*.msp2)
- Graph Data File: (*.vdf2)
- Environment setting File
  (I/O Module Configuration Information, Excitation System Information, Input Environment Information): SystemInfo.dat2
  Note) Saved in ‘¥IMV¥K2_2nd’ on System Drive. Deleting inhibited.

Test file to be created when required

- File to be created during registration of graph color setting file: (*.gci2)

1.5 Setting items

The following are setting items for each test typeof Multi-Sweep Sine test. Only reference settings are specific to this application, while others are the same setting items. Most of the setting items are the same as those used for the ordinary Sine tests. For details, refer to "Chapter 3: Test Definition".

Table 1-1 Test Type and Information on Definition

Setting information \ Test type	Multiple frequency sweep	Time delayed sweep	Multi Spot
(1) I/O module configuration	○	○	○
(2) Excitation system information	○	○	○
(3) Fundamental/Control definition	○	○	○
(4) Excitation system settings	○	○	○
(5) Multiple frequency sweep Reference	○	–	–
(6) Time delayed sweep Reference	–	○	–
(7) Multi Spot Reference	–	–	○
(8) Input channel	○	○	○
(9) Data save condition	○	○	○
(10) Safety check	○	○	○

A set of information on completed "Test" definition can be stored in a file of a specified format, as "test file".

Once test definition information is stored as a test file, you can execute a test simply by loading the test file.

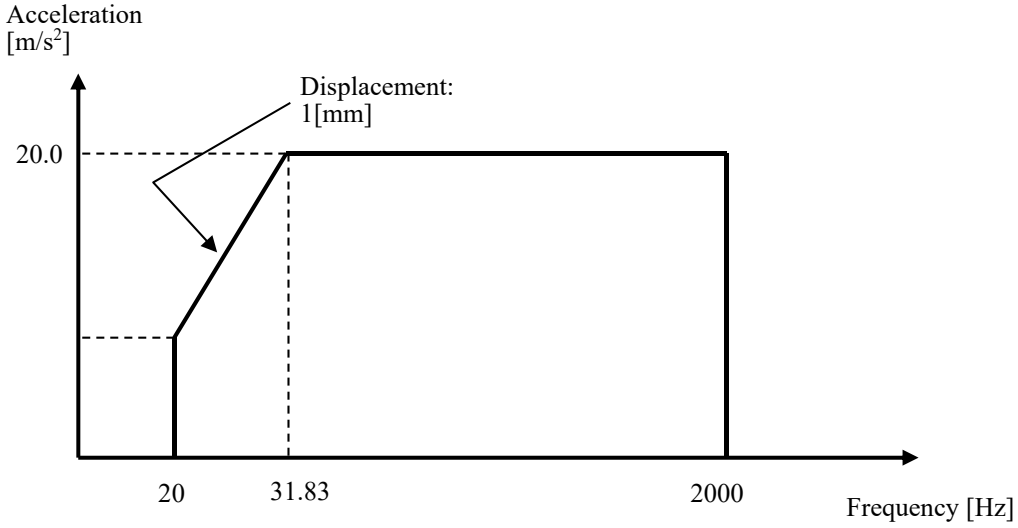
Chapter 2 Basic Operation

2.1 Multiple frequency sweep

<Example>

Assume execution of the following Multiple frequency sweep test.

[Reference pattern]



[Bandwidth division]

Number of divisions: 4 Sweep 1: 20[Hz] to 63.3[Hz]

Sweep 2: 63.3[Hz]–200[Hz]

Sweep 3: 200[Hz]–632.5[Hz]

Sweep 4: 632.5[Hz]–2000[Hz]

[Test time]

Sweep rate: 1[octave/min]

The times of double sweep: 32[double-sweep]

Sweep start frequency: 20[Hz]

[Information of sensors to be used]

Two acceleration pickups of piezoelectric: one is used for control and another for monitor.

ch1.: for control, sensitivity 3[pC/(m/s^2)]

ch2.: for monitor, sensitivity 3[pC/(m/s^2)]

However, these channels must be registered in Input environment information (in this example, 'IMVTEST'). Also, the rating information of excitation system has already been registered in Excitation system information (in this example, 'Test').

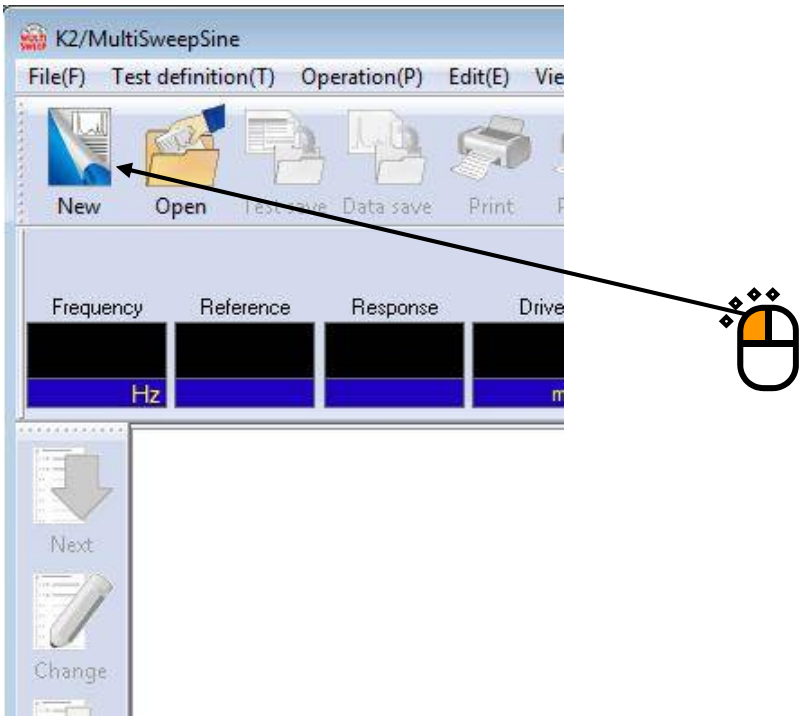
[Information of specimen]

Specimen mass : 10[kg]

<Procedures>

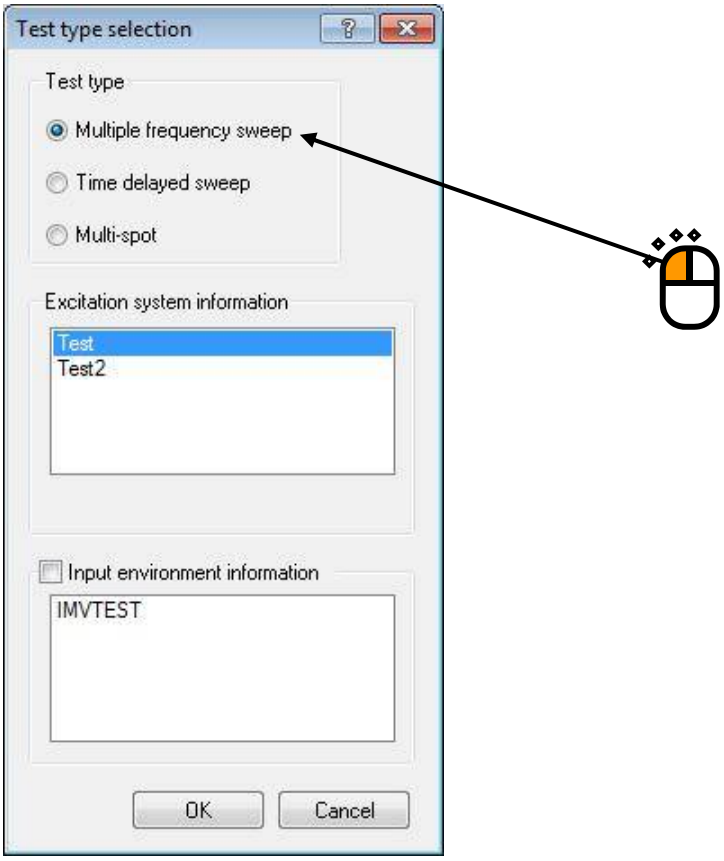
<Step 1>

Press the [New] button to start new definition.



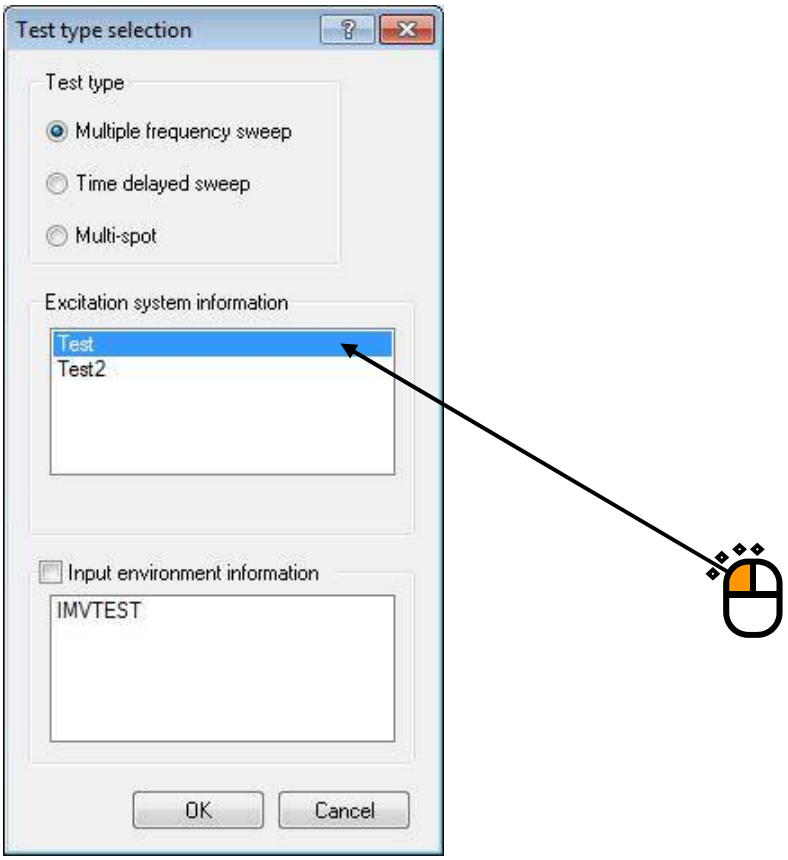
<Step 2>

Select “Multiple frequency sweep” in “Test type”.



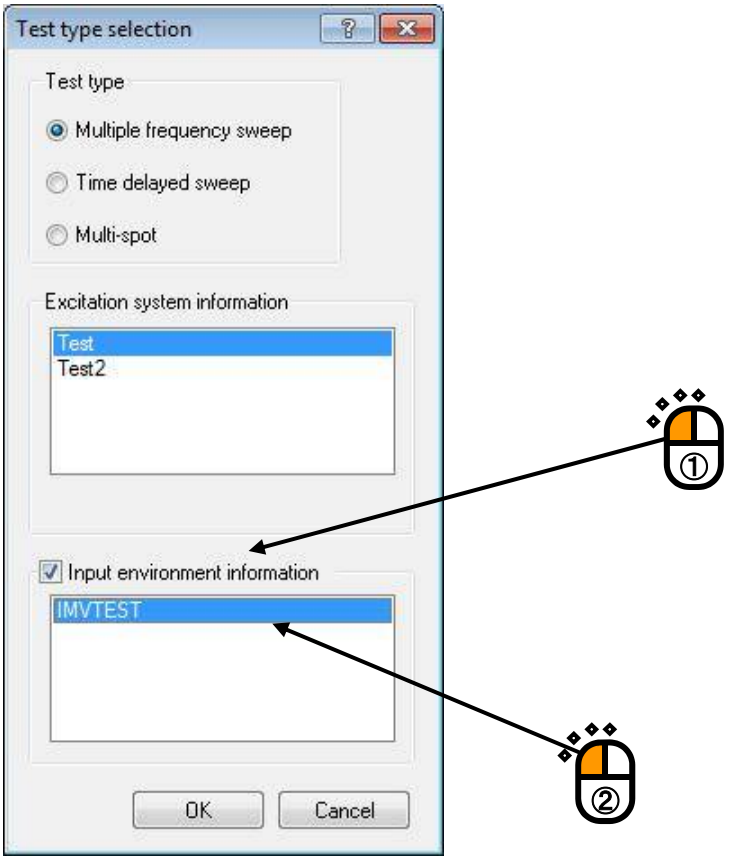
<Step 3>

Select an excitation system from the list of “Excitation system information”.



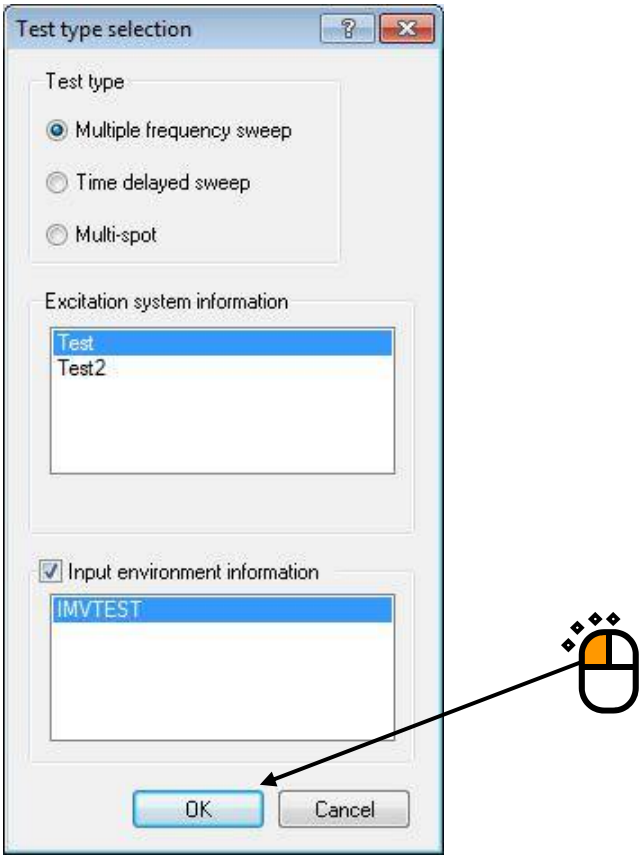
<Step 4>

Select “Input channel” information.



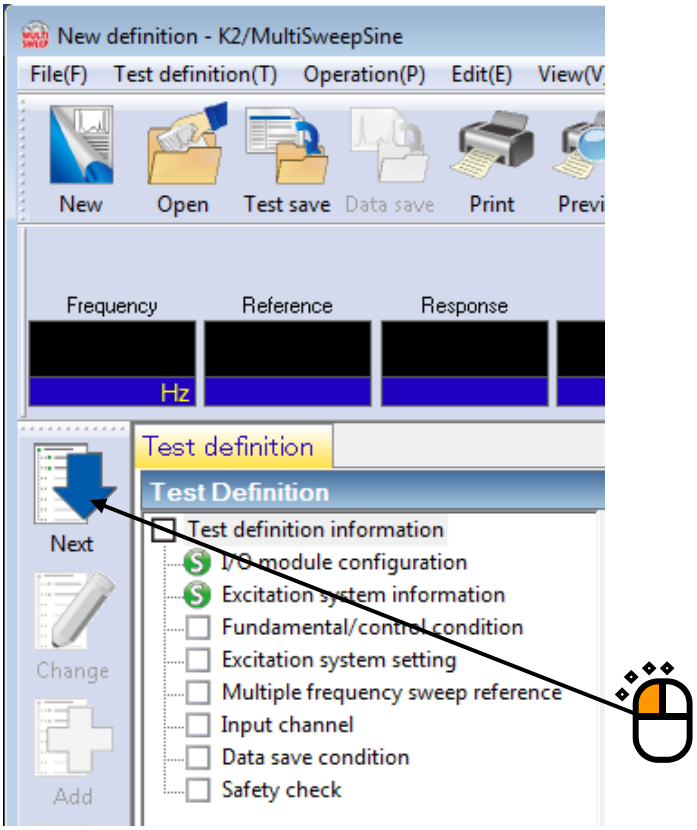
<Step 5>

Press the [OK] button.



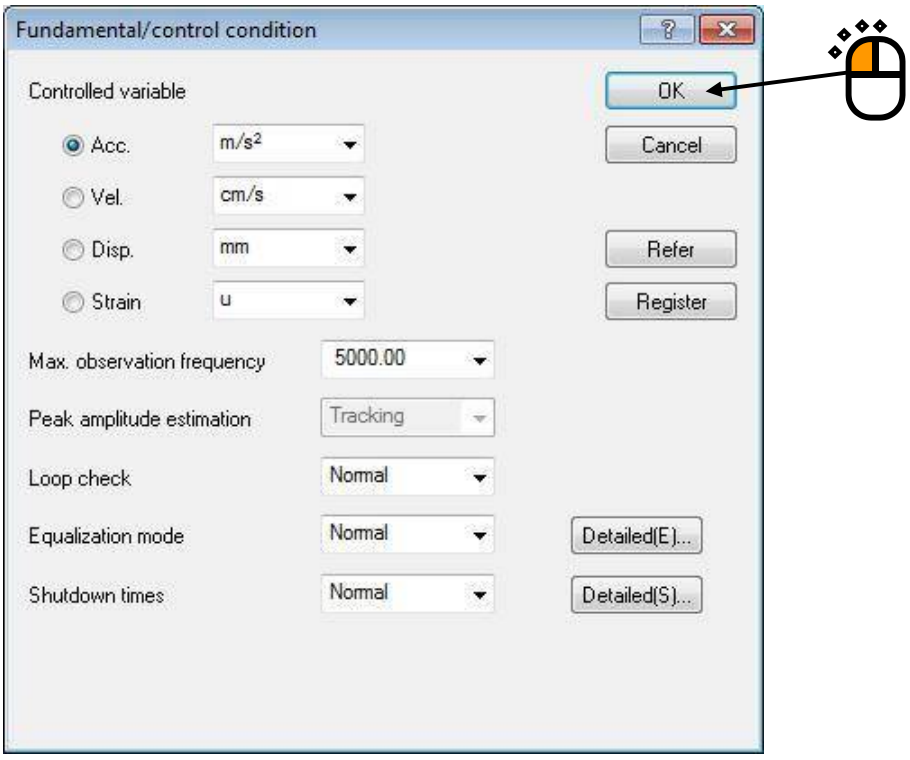
<Step 6>

Press the [Next] button to go to the next definition.



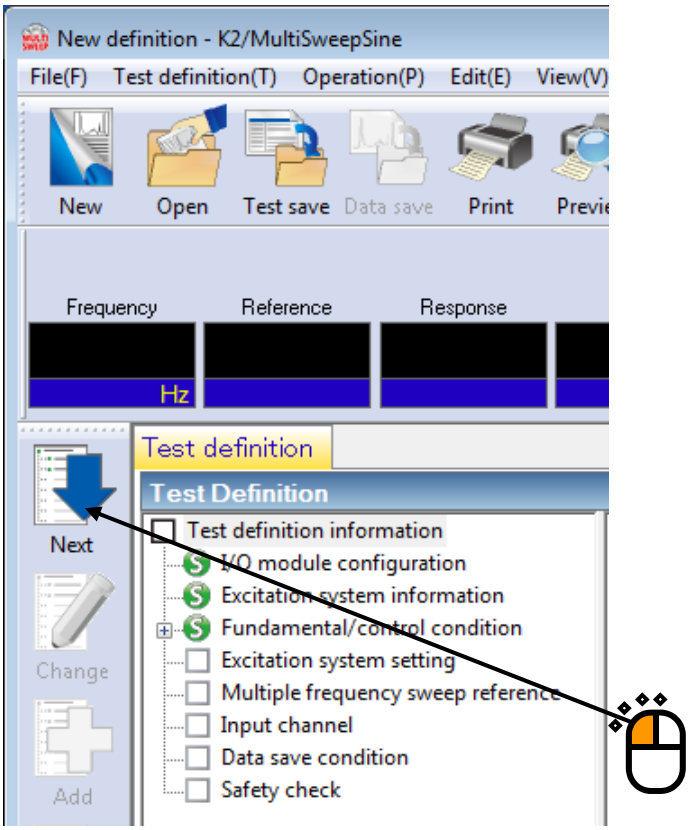
<Step 7>

The “Fundamental/Control definition” window opens. Press the [OK] button.



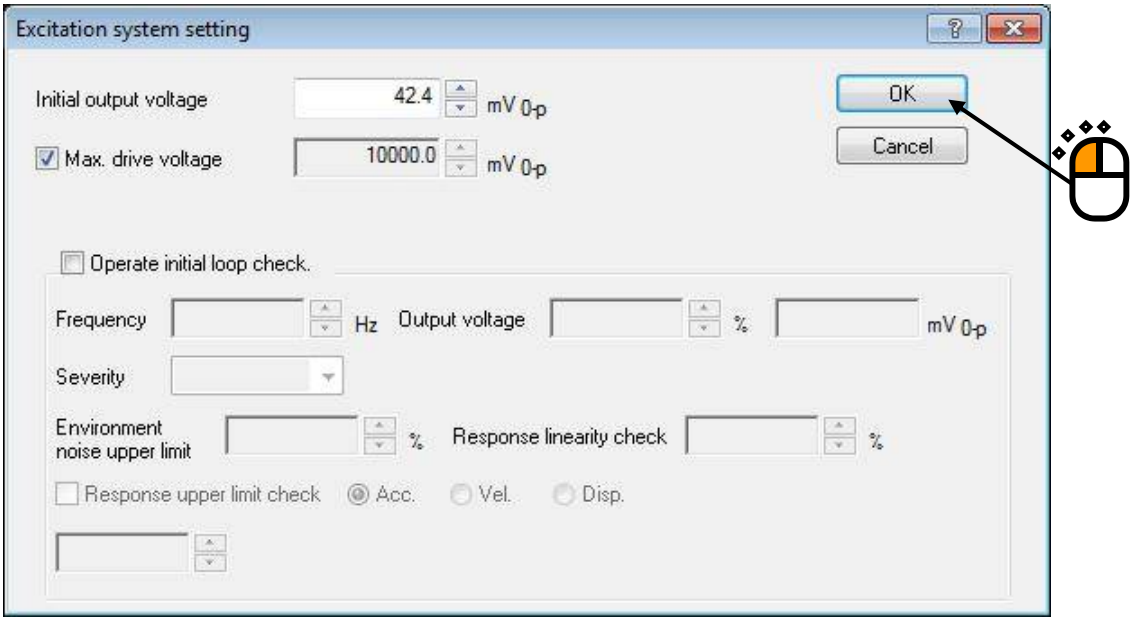
<Step 8>

Press the [Next] button to go to the next definition.



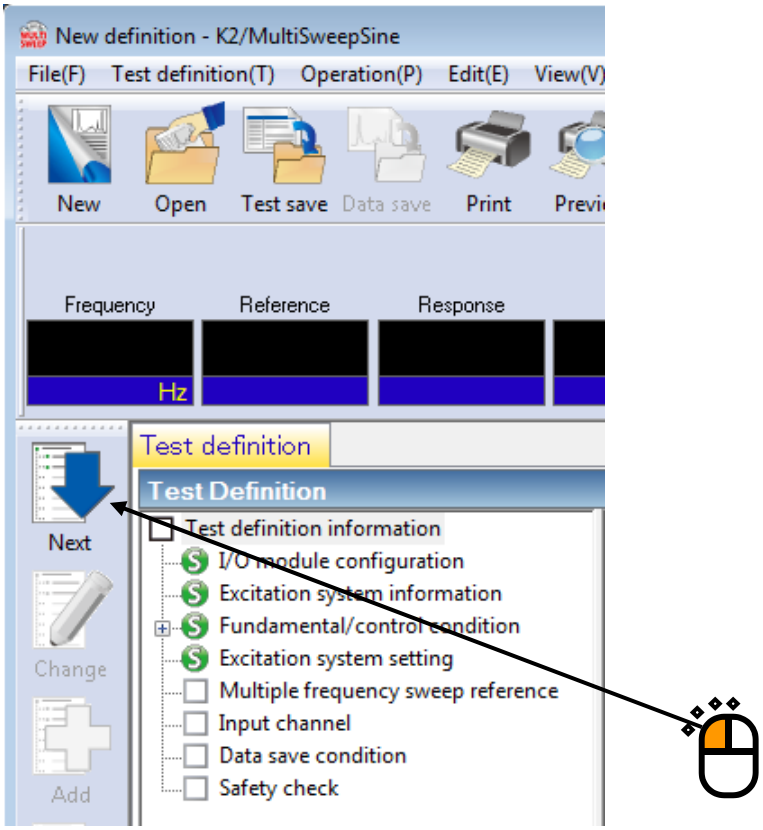
<Step 9>

The “Excitation system settings” window opens. Press the [OK] button.



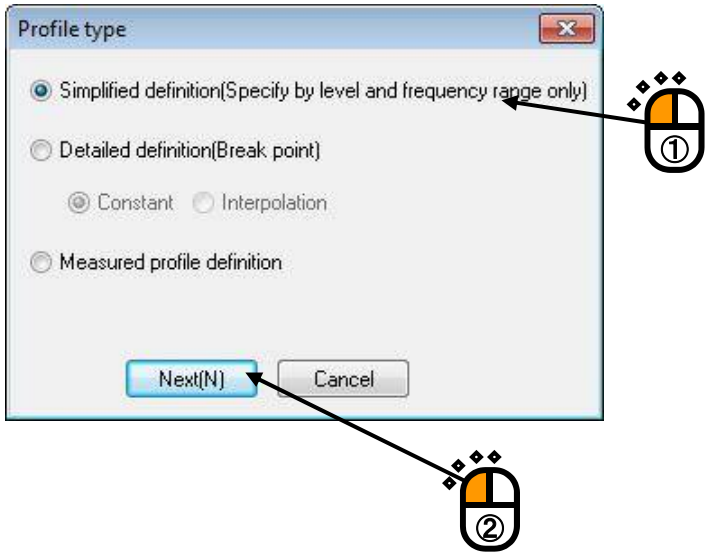
<Step 10>

Press the [Next] button to go to the next definition.



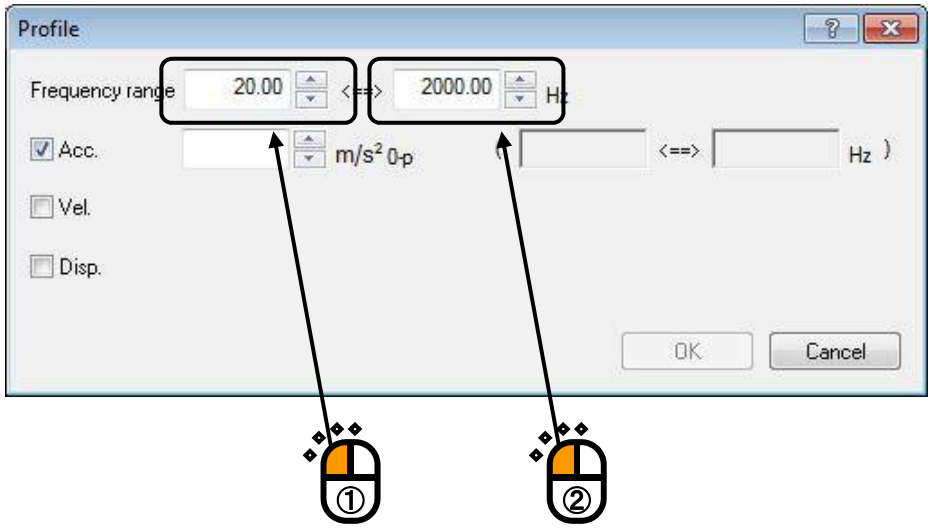
<Step 11>

The “Profile type” window opens. Select “Simple definition (by level and frequency range only)”, and press the [Next] button.



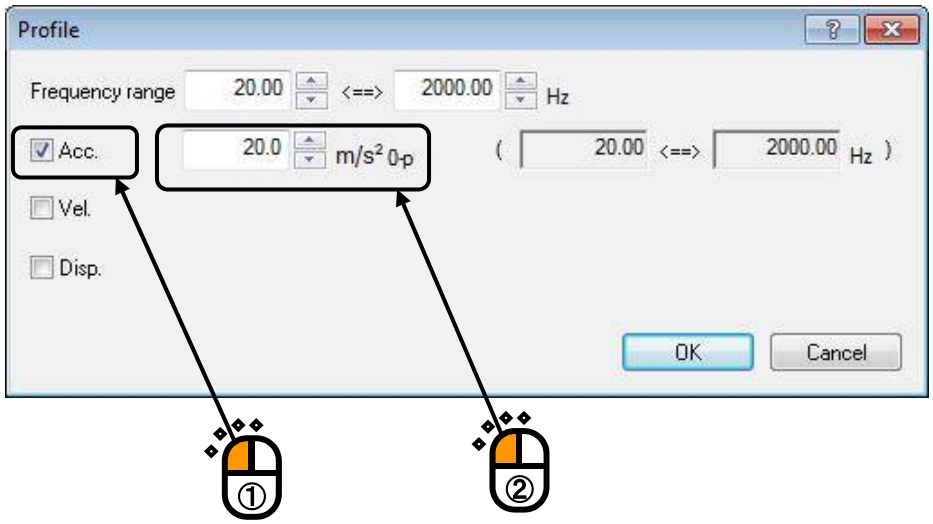
<Step 12>

The “Profile” window opens. Enter “20 [Hz]” for the low frequency range, and enter “2000 [Hz]” for the high frequency range.



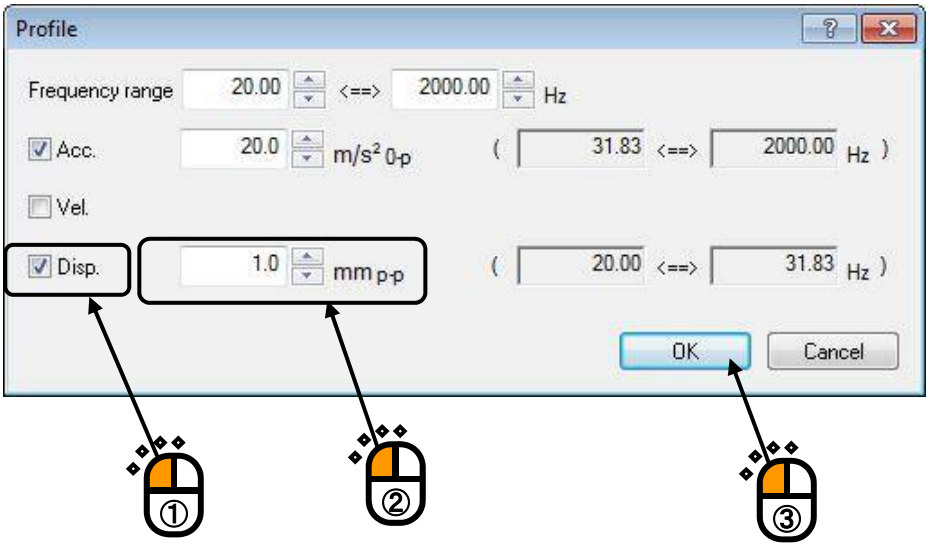
<Step 13>

Make sure that the “Acceleration” checkbox is checked, and enter “20 [m/s^2]”.



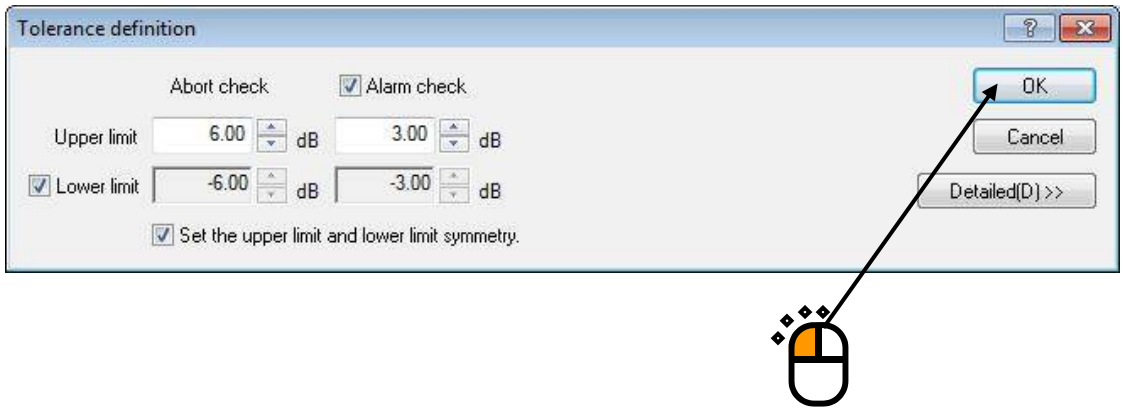
<Step 14>

Check the “Displacement” checkbox, enter “1 [mm]”, and press the [OK] button.



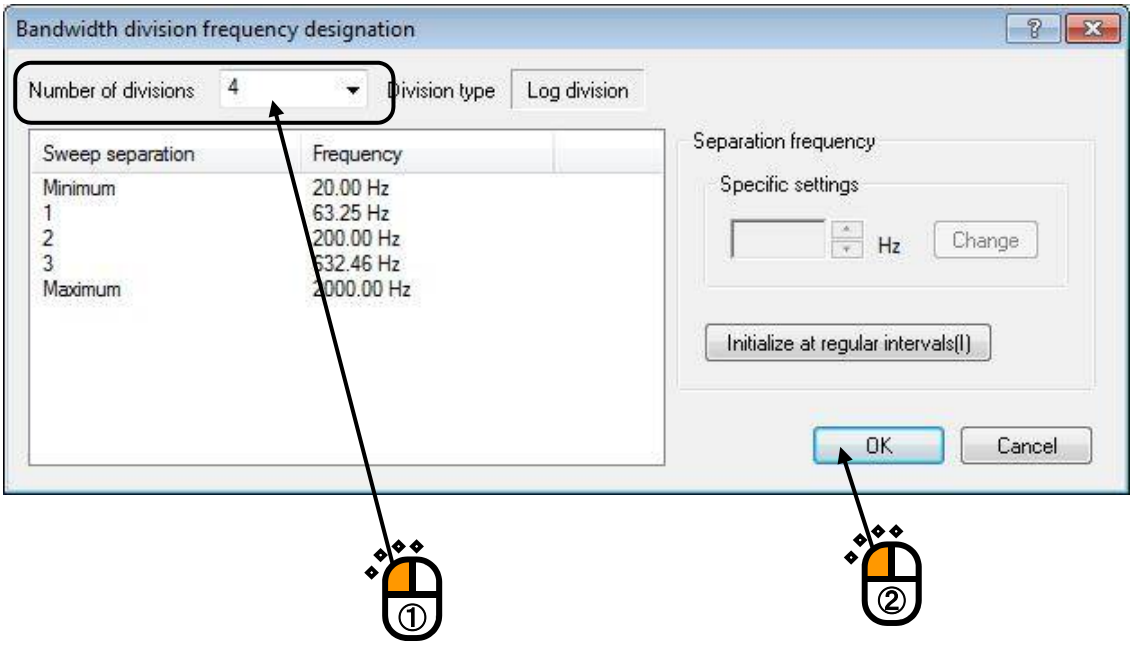
<Step 15>

The “Tolerance definition” window opens. Press the [OK] button.



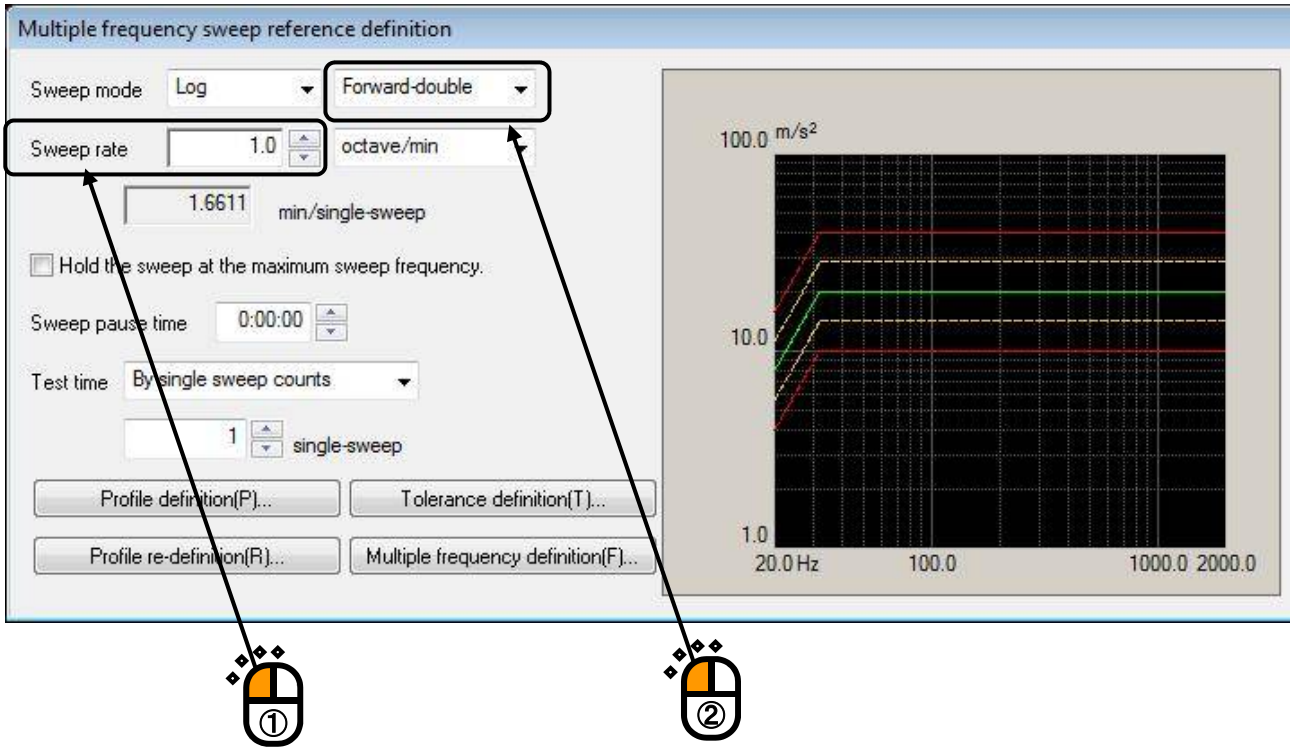
<Step 16>

The “Bandwidth division frequency designation” window opens. Select “4” for “Number of divisions”, and press the [OK] button.



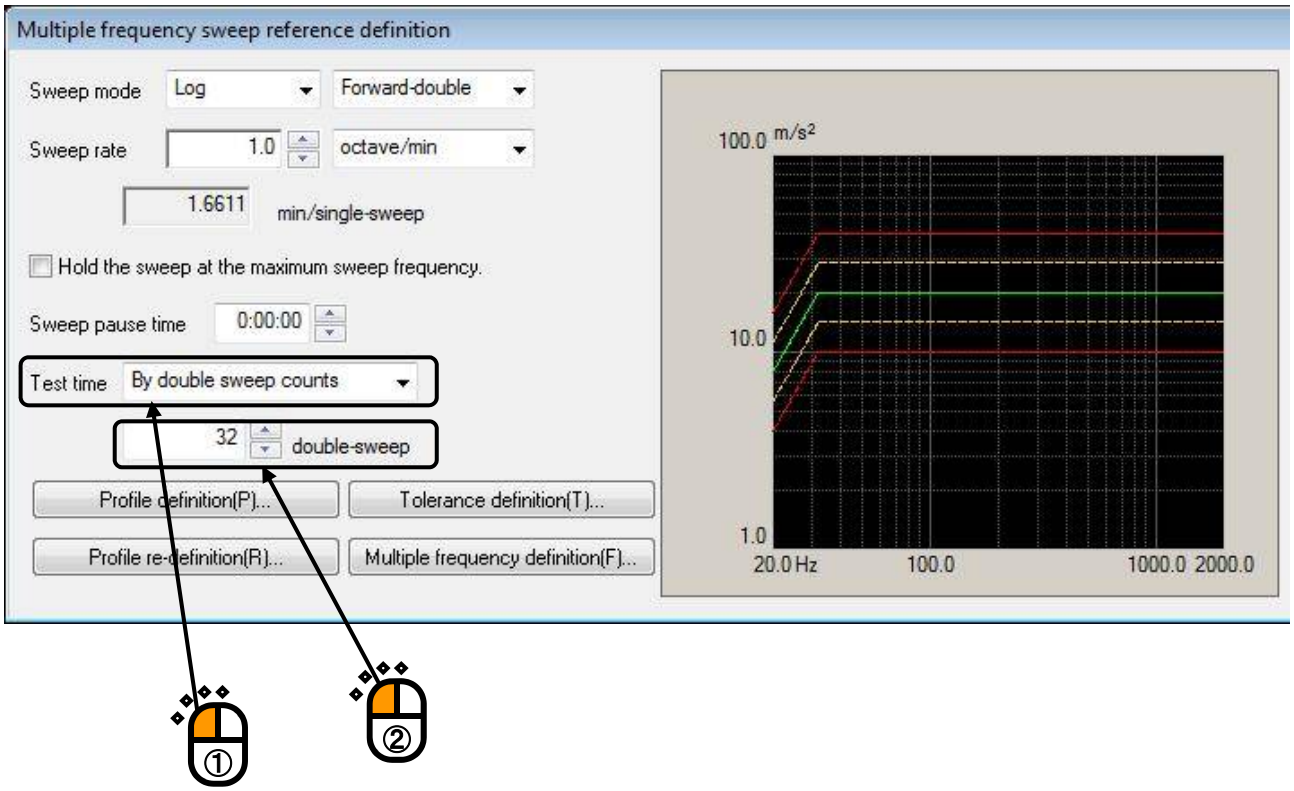
<Step 17>

The “Multiple frequency sweep reference” window opens. To set the sweep rate at “1 [octave/min]”, enter “1”. To execute double sweep, select “Forward - Double”.



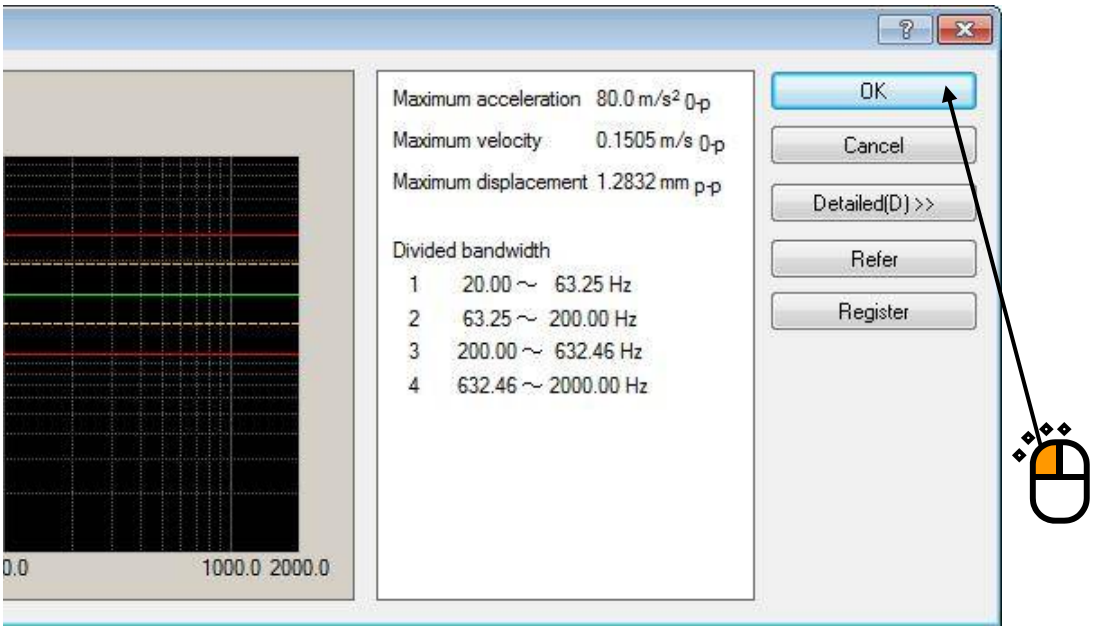
<Step 18>

Select “By double sweep count” for test time. Set “32 [double-sweep]” for double sweep count.



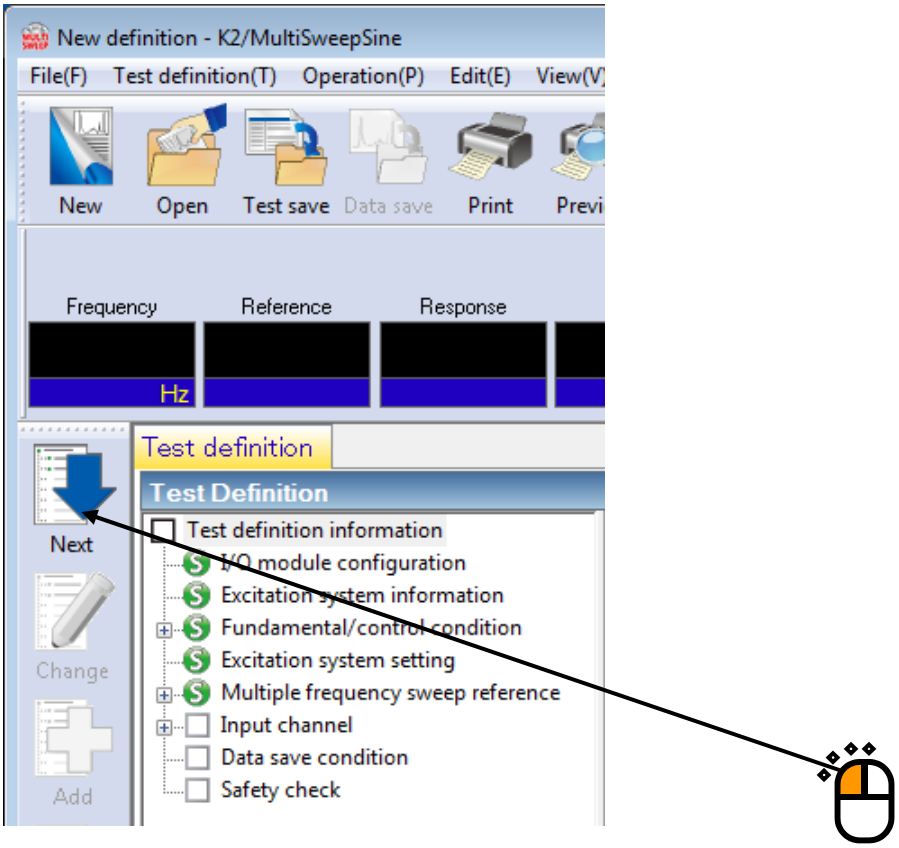
<Step 19>

Press the [OK] button.



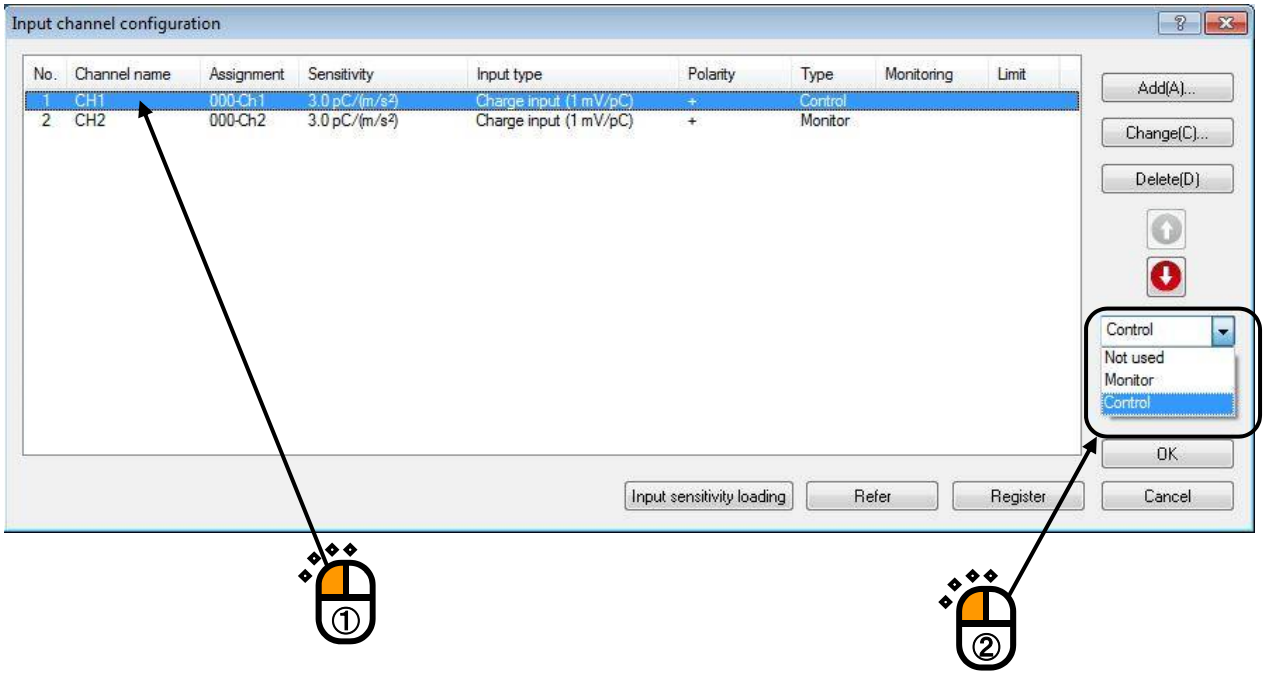
<Step 20>

Press the [Next] button to go to the next definition.



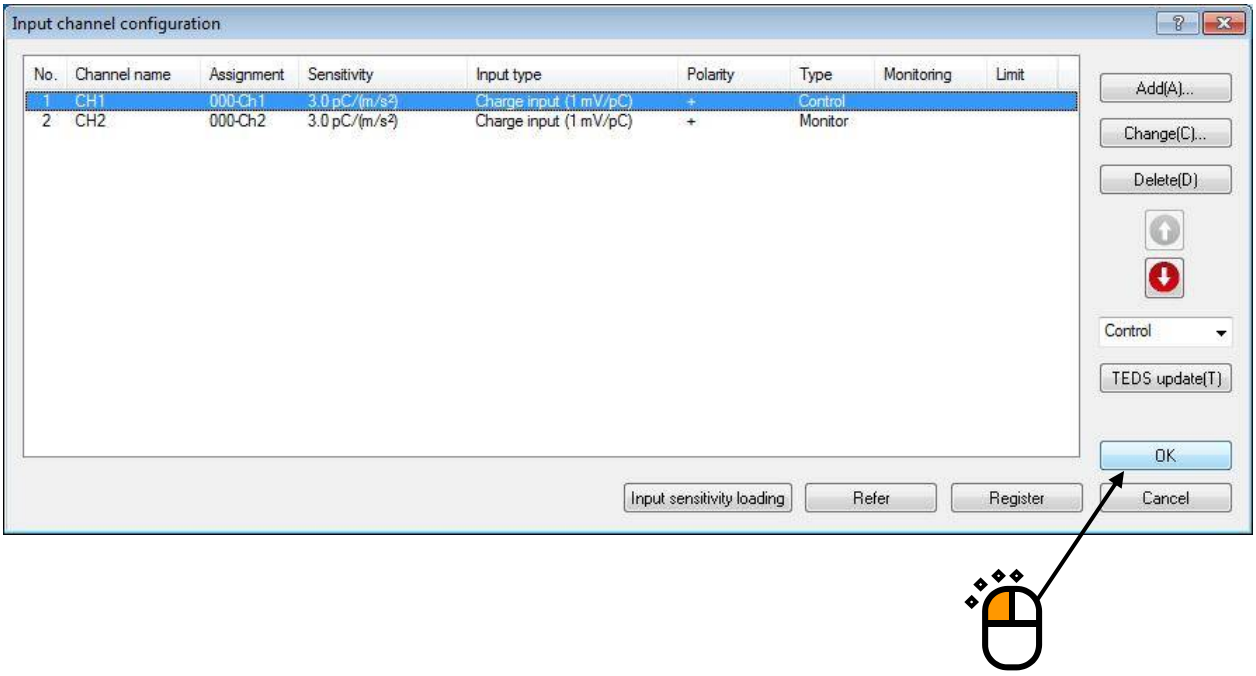
<Step 21>

The “Input channel config” window opens. Select “ch1”, and set “Control” for “Type”. Also, select “ch2”, and select “Monitor”.



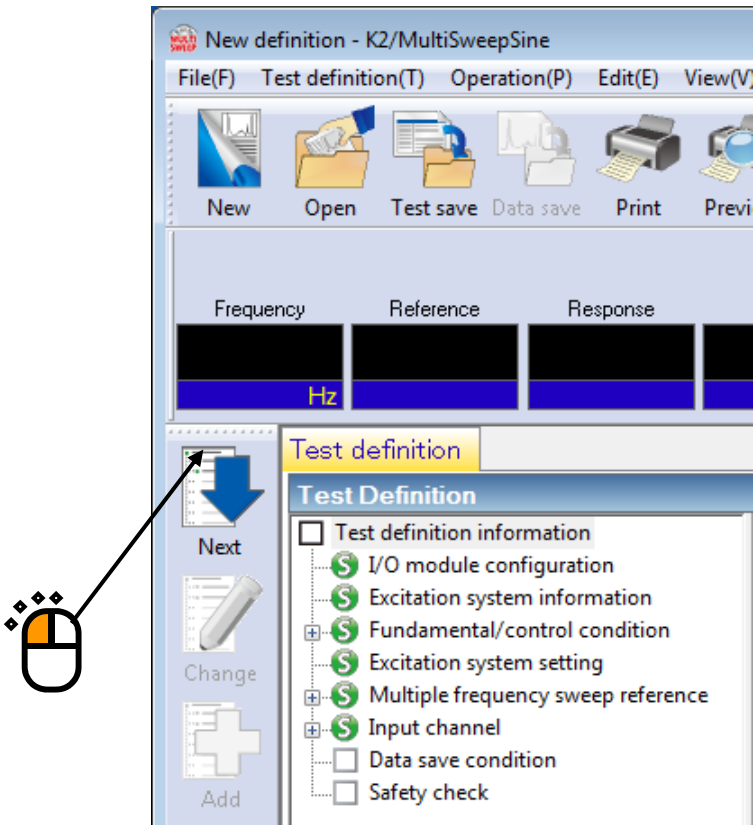
<Step 22>

Press the [OK] button.



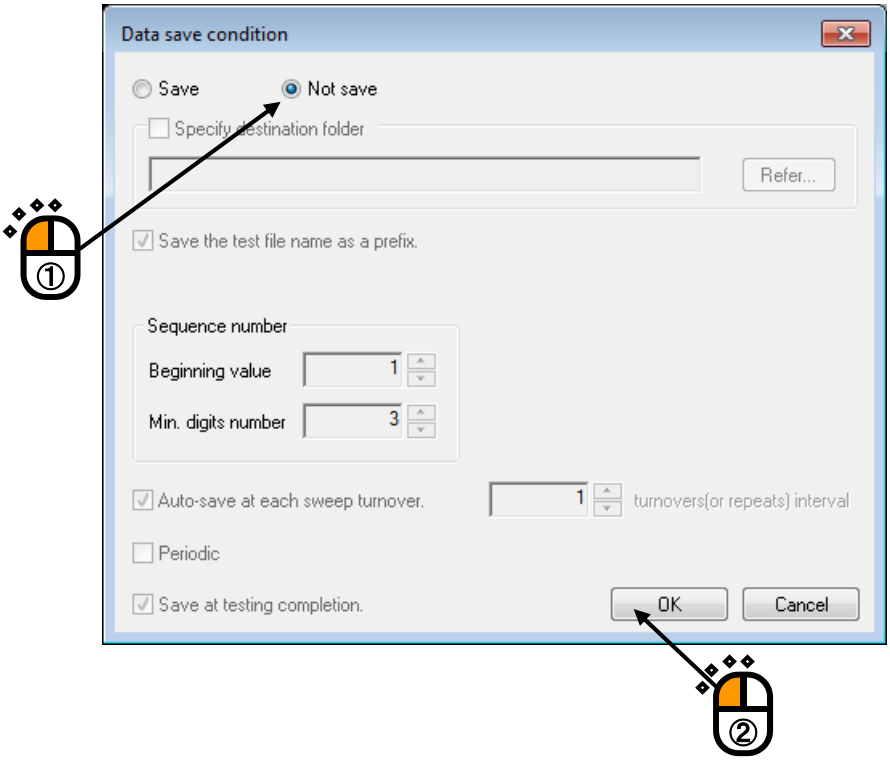
<Step 23>

Press the button of [Next].



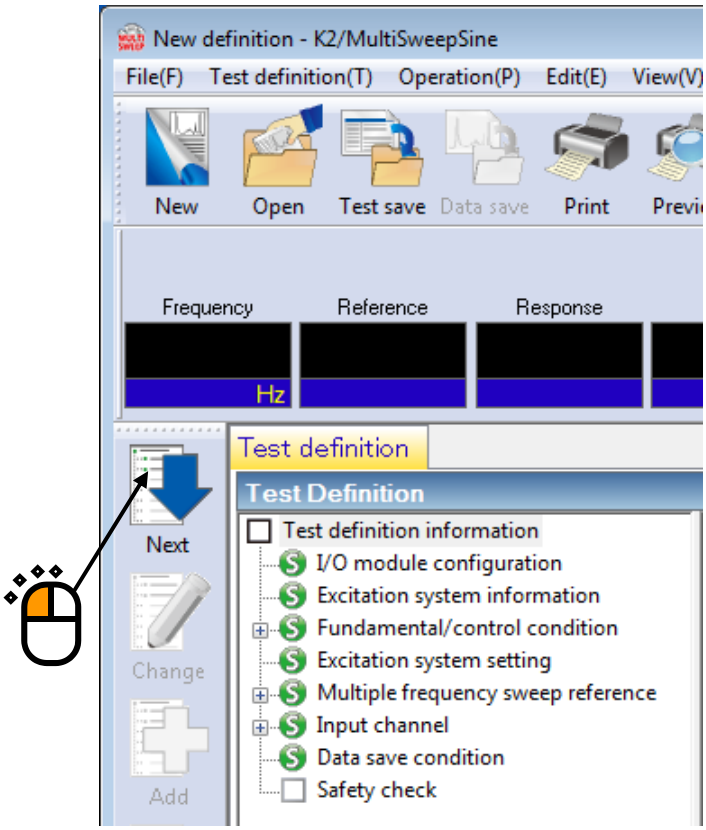
< Step24 >

Select ‘Not save’ and press the button of [OK].



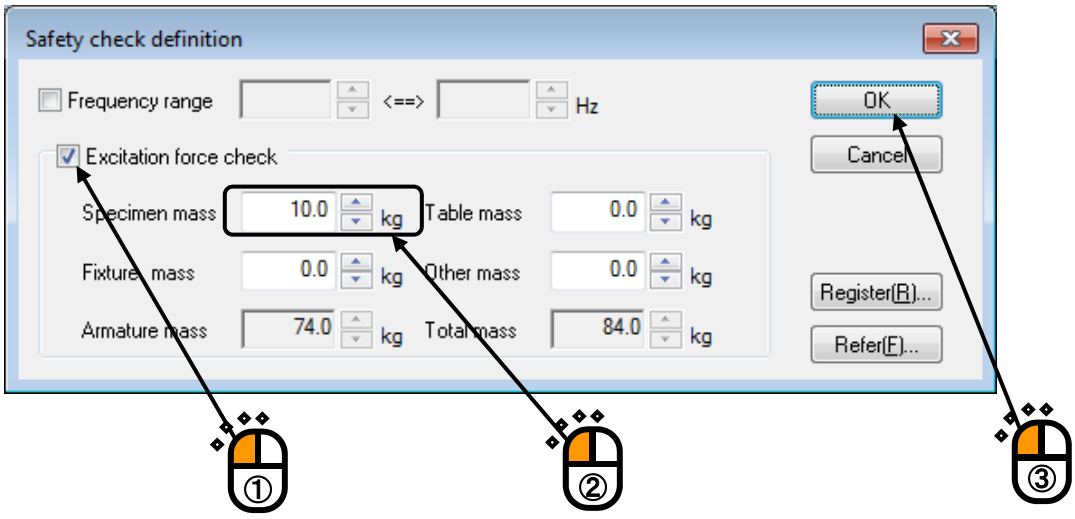
< Step25 >

Press the button of [Next].



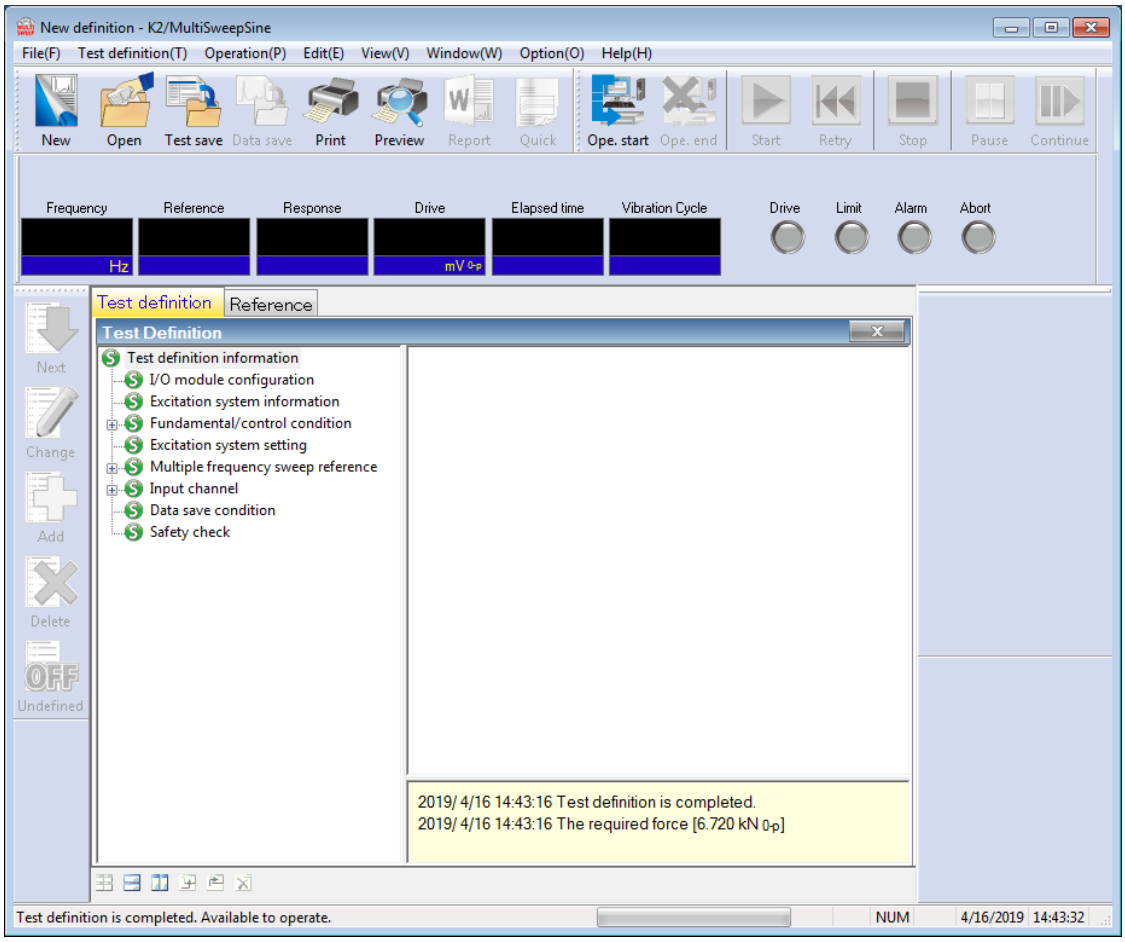
< Step26 >

Select ‘Excitation force check’ and input the value as ‘Specimen mass : 10 [kg]. And press the button of [OK].



< Step27 >

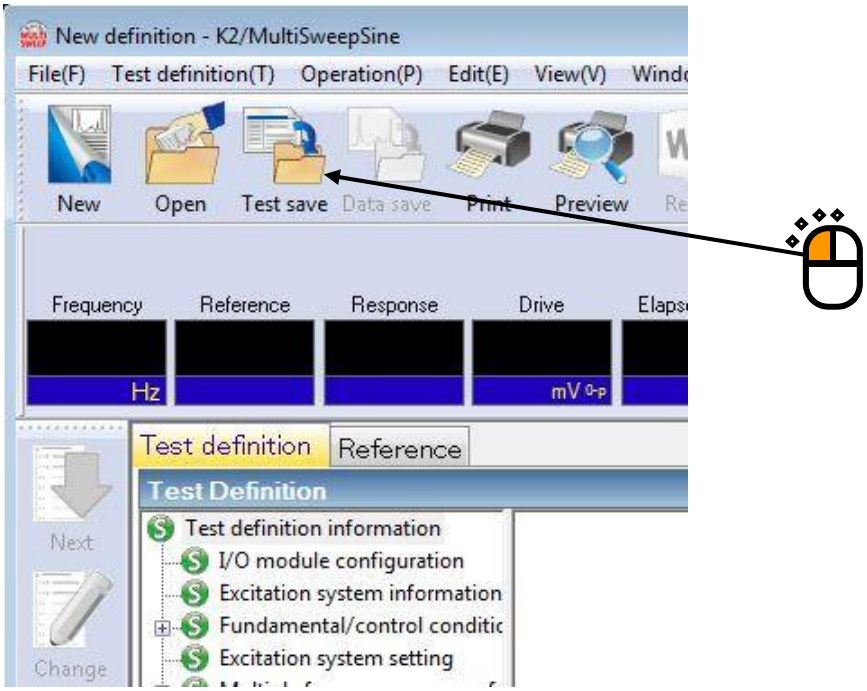
The definition is completed.



<Save test>

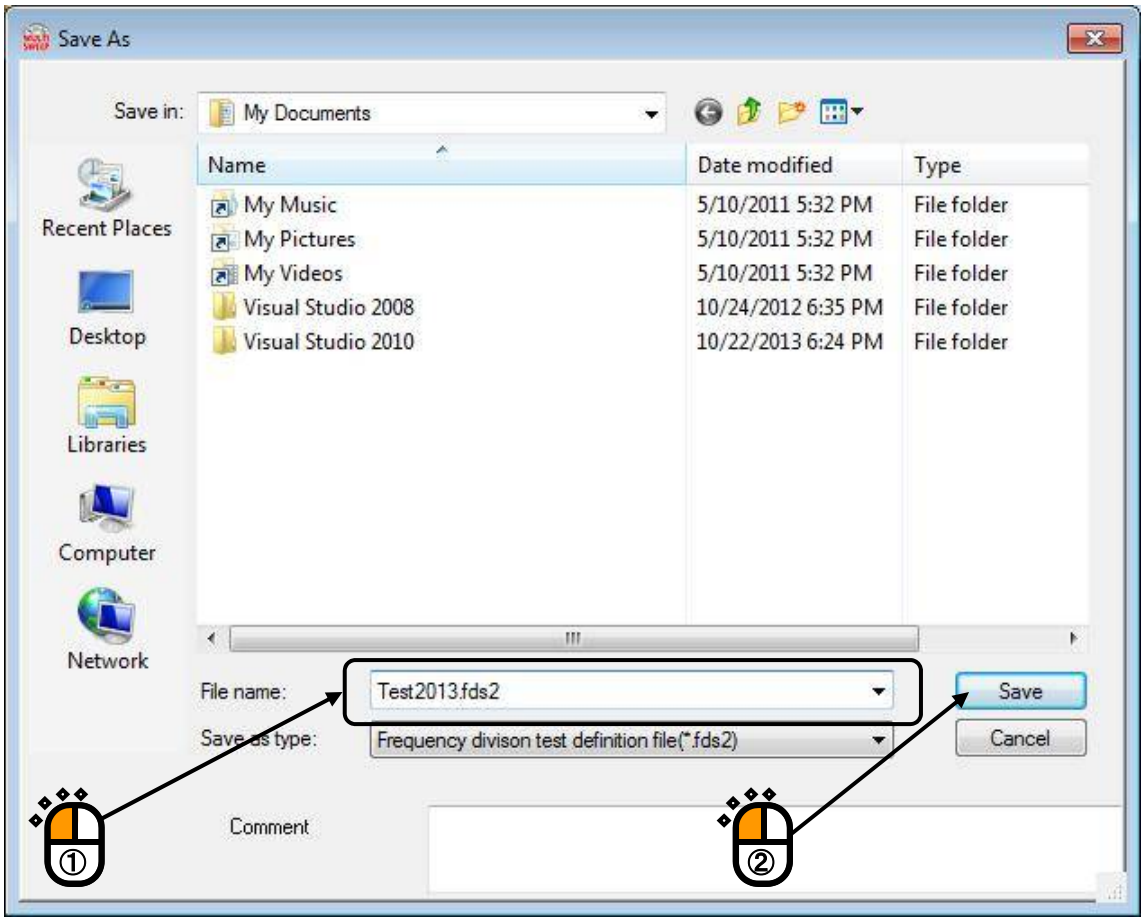
<Step 1>

Press the [Save] button.



<Step 2>

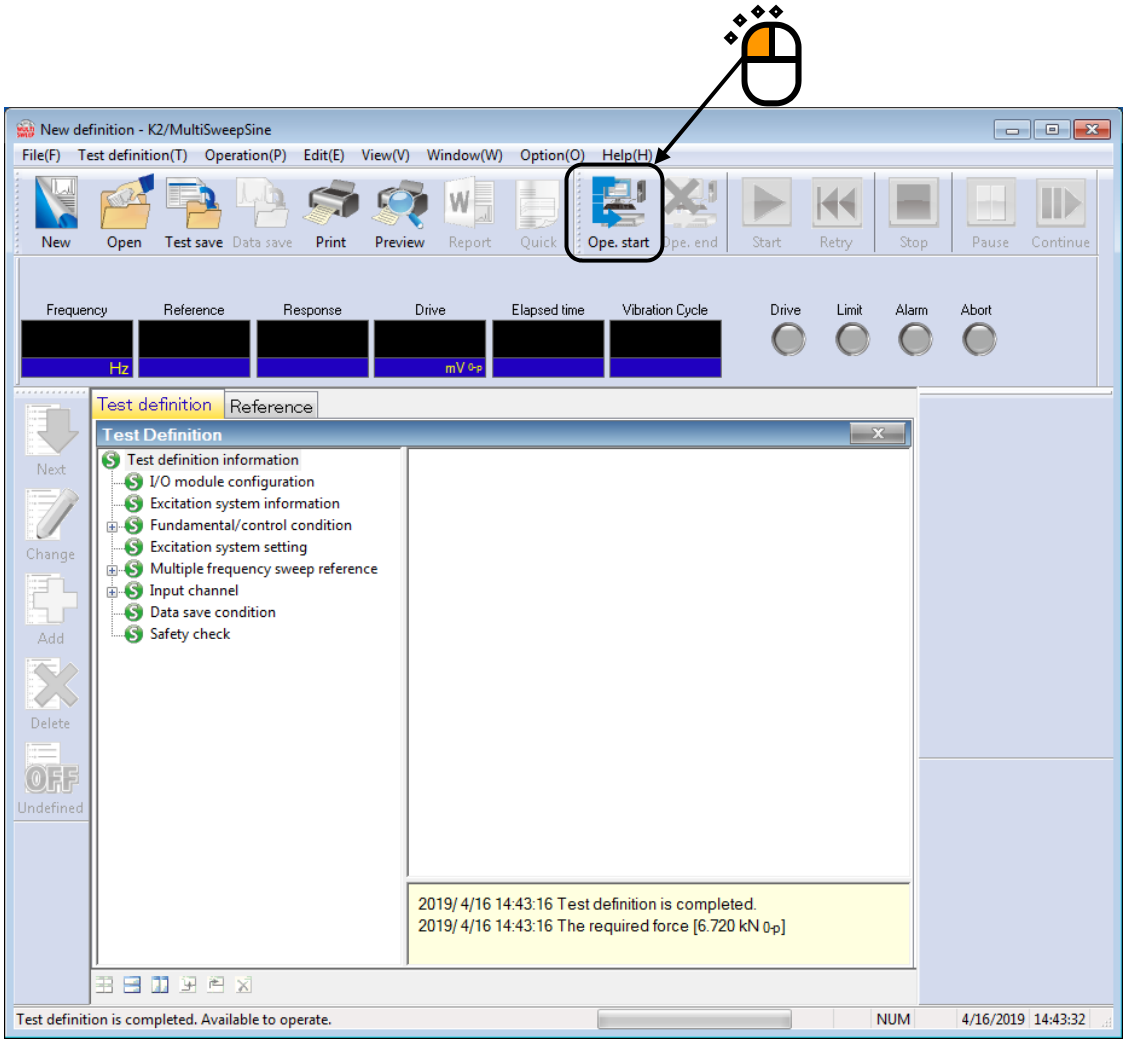
Input a name in 'File name' and press the [Save] button.



<Operation of test>

<Step 1>

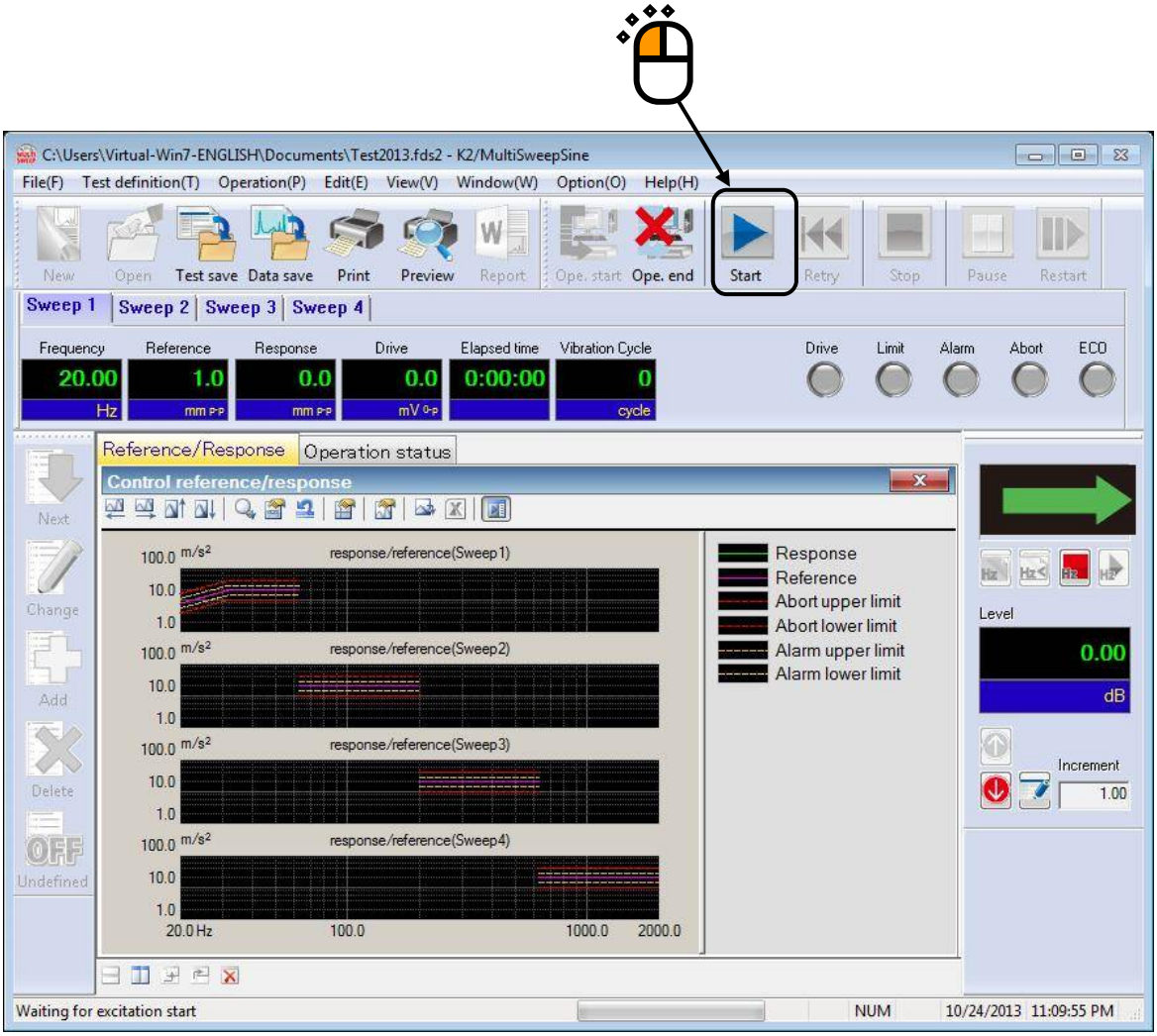
Press the [Ope. start] button. The system shifts from the “Test definition” mode to the “Test operation” mode.



<Step 2>

Press the [Start] button.

Pressing the [Start] button automatically starts initial loop check (if definition is completed), initial measurement and initial equalization, and executes a test at the initial excitation level (in this example, “0 [dB]”).

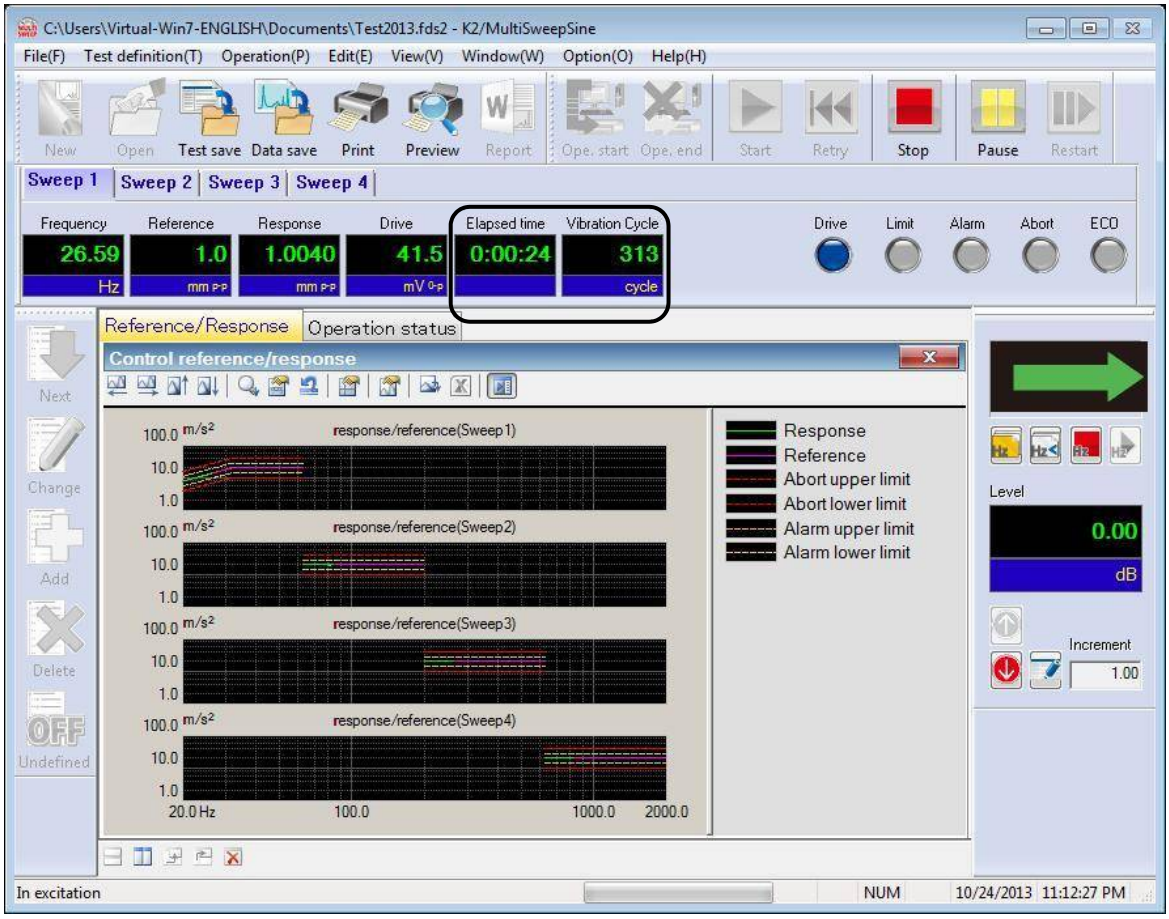


In this example, four sweeps are separately displayed in the graphs for individual frequency bands in one frame. Otherwise, one sweep can be displayed in one graph, or four sweeps can be displayed in one graph.

<Step 3>

After the initial equalization is completed, excitation is executed at the initial excitation level (in this example, “0” [dB]), and sine sweep starts.

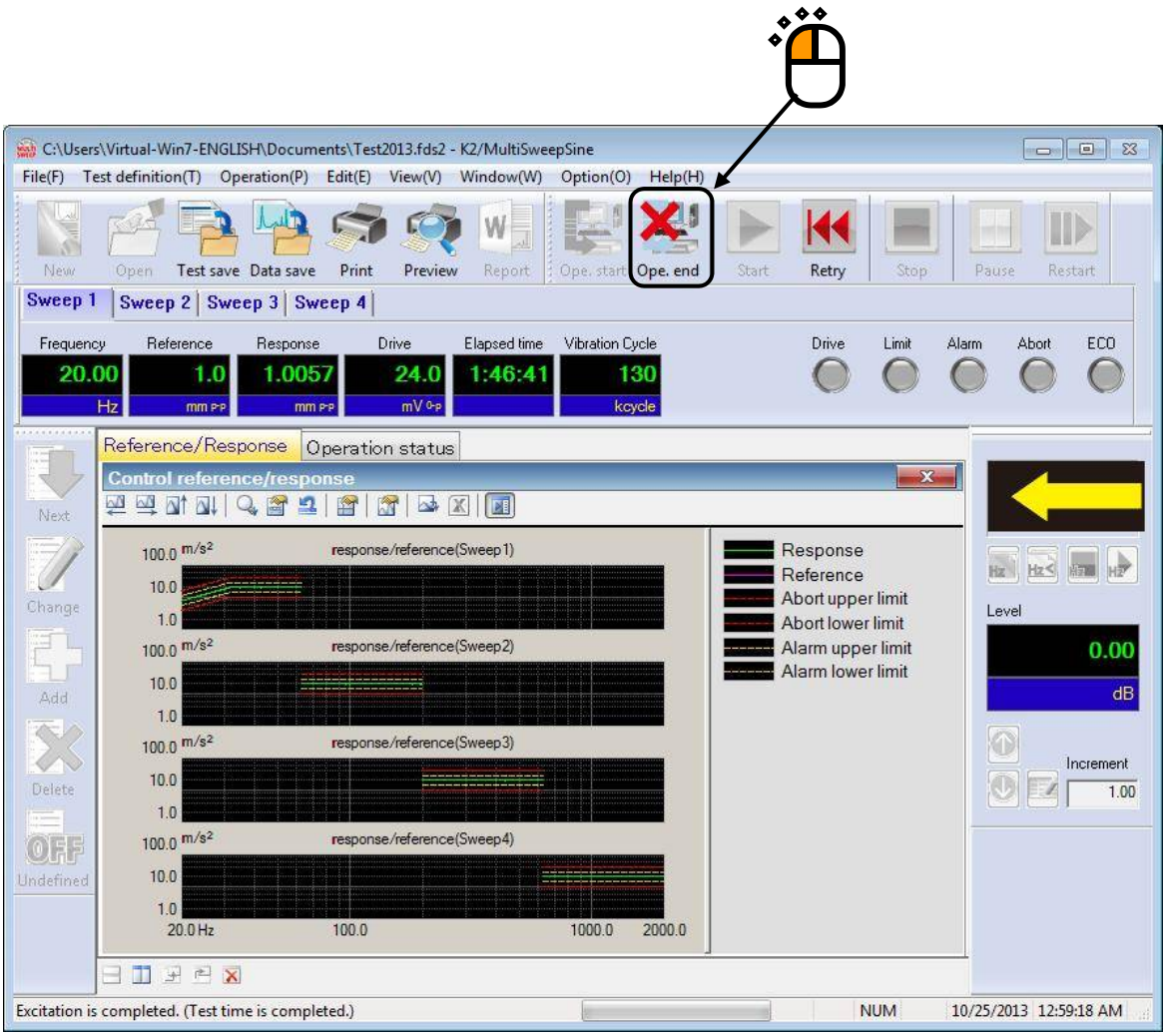
Count of test elapse time (including vibration count) will start simultaneously when sweep starts. Note that test time is counted only when excitation level is “0 [dB]”.



<Step 4>

Test operation is completed when the test time passed.

The system returns to the test definition mode by pressing the [Ope. end] button.

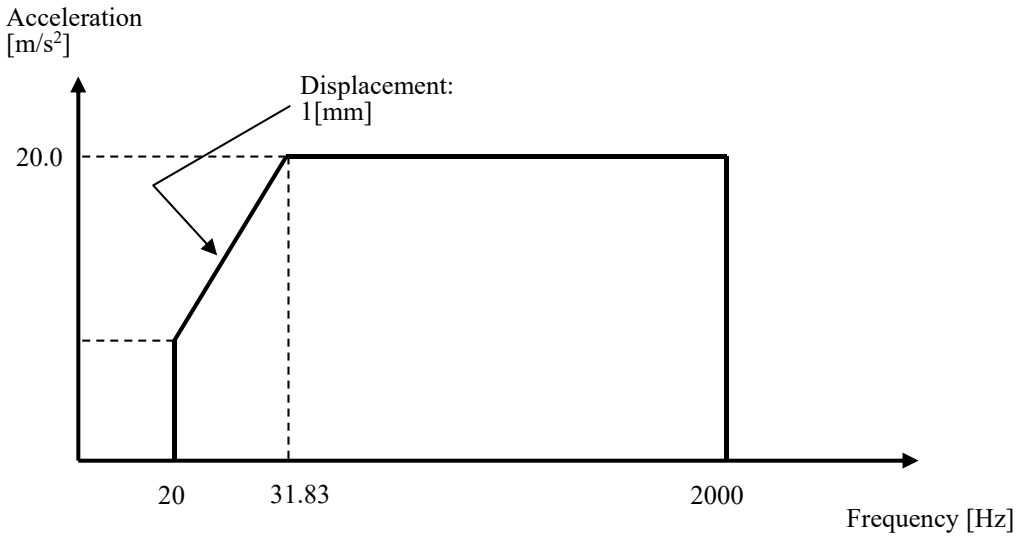


2.2 Time delayed sweep

<Example>

Assume execution of the following Time delayed sweep test.

[Reference pattern]



[Time delayed sweep]

Number of simultaneous sweeps: 4

[Test time]

Sweep rate: 1 [octave/min]

Single sweep count: 8 [single-sweep]

Sweep start frequency: 20 [Hz]

[Information of sensors to be used]

Two acceleration pickups of piezoelectric: one is used for control and another for monitor.

Ch. 1: for control, sensitivity 3[pC/(m/s^2)]

Ch. 2: for monitor, sensitivity 3[pC/(m/s^2)]

However, these channels must be registered in Input environment information (in this example, 'IMVTEST').

Also, the rating information of excitation system has already been registered in Excitation System information (in this example, 'Test').

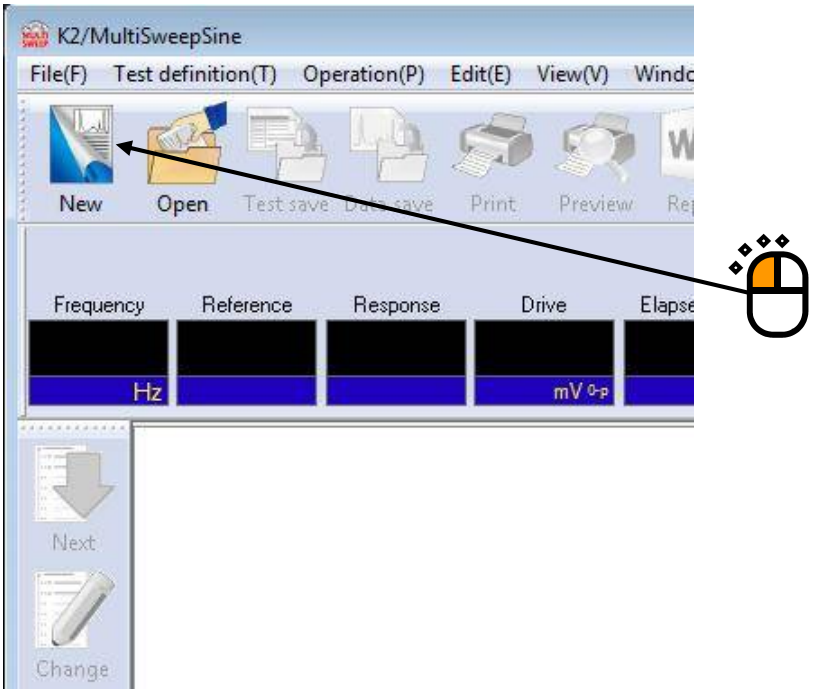
[Information of specimen]

Specimen mass : 10[kg]

<Procedures>

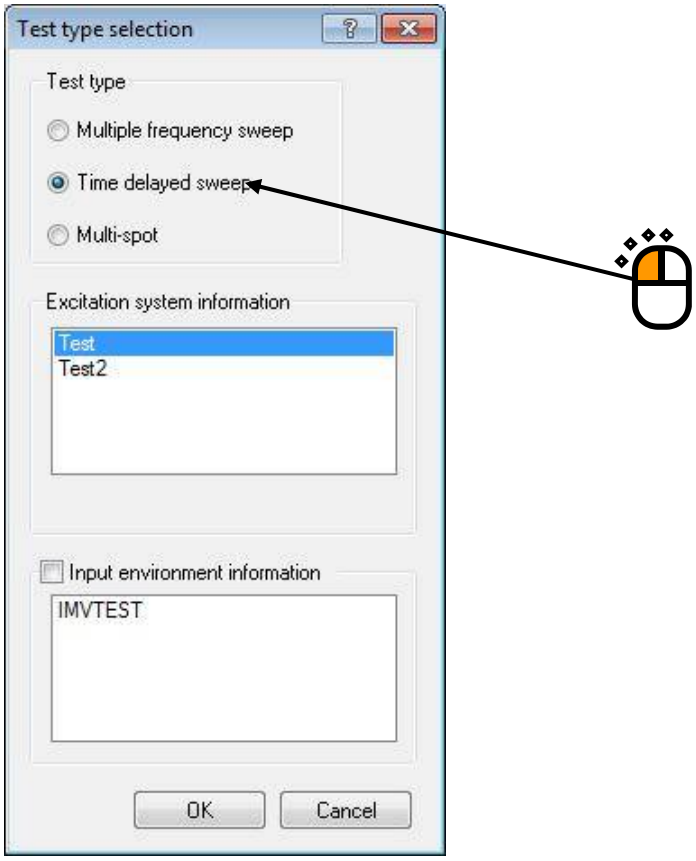
<Step 1>

Press the [New] button to start new definition.



<Step 2>

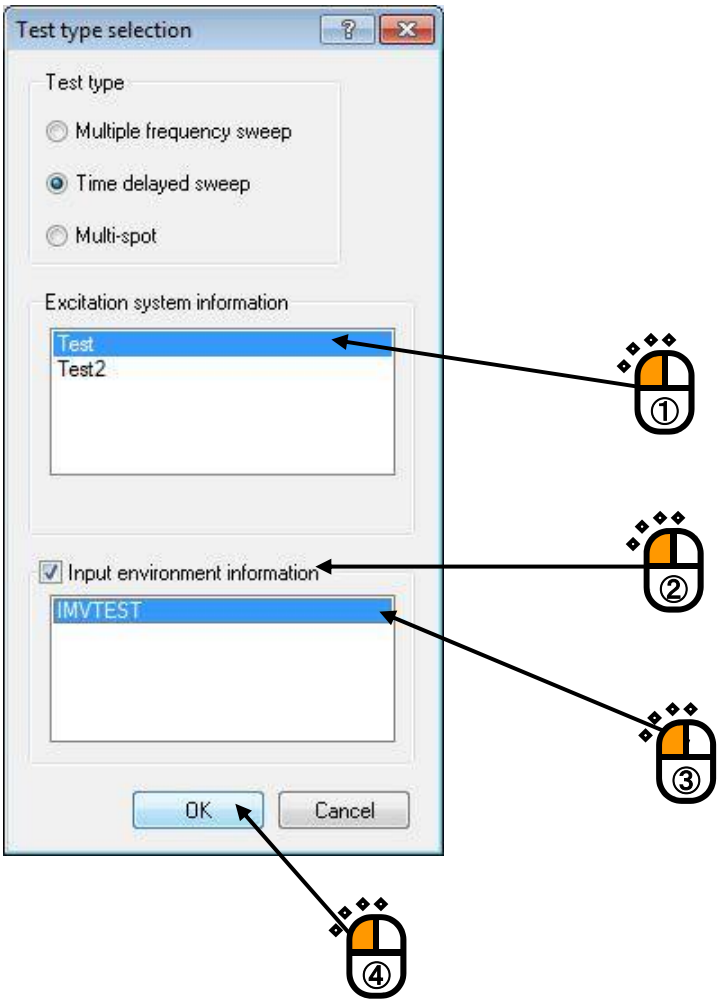
Select “Time delayed sweep” for “Test type”.



<Step 3>

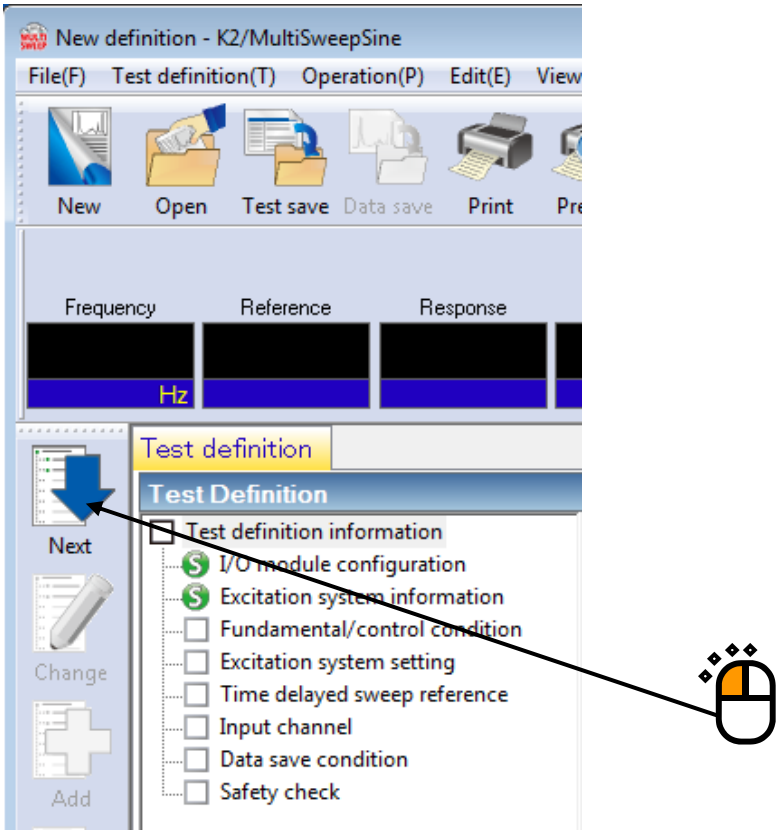
Select an excitation system from the list of “Excitation system information”, and select “Input channel” information.

Press the [OK] button.



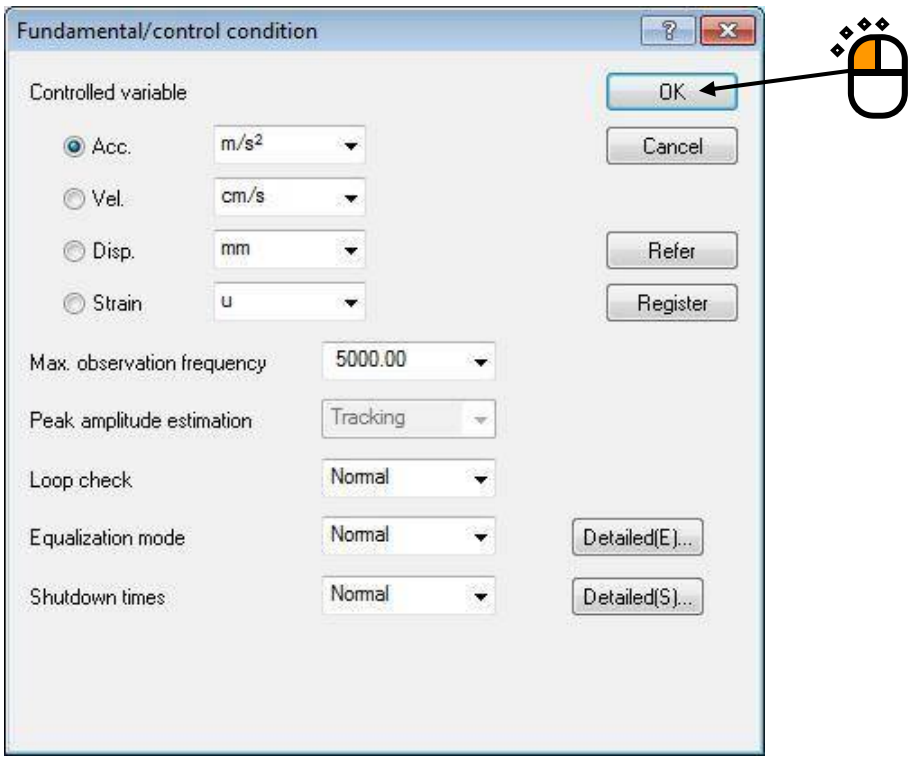
<Step 4>

Press the [Next] button to go to the next definition.



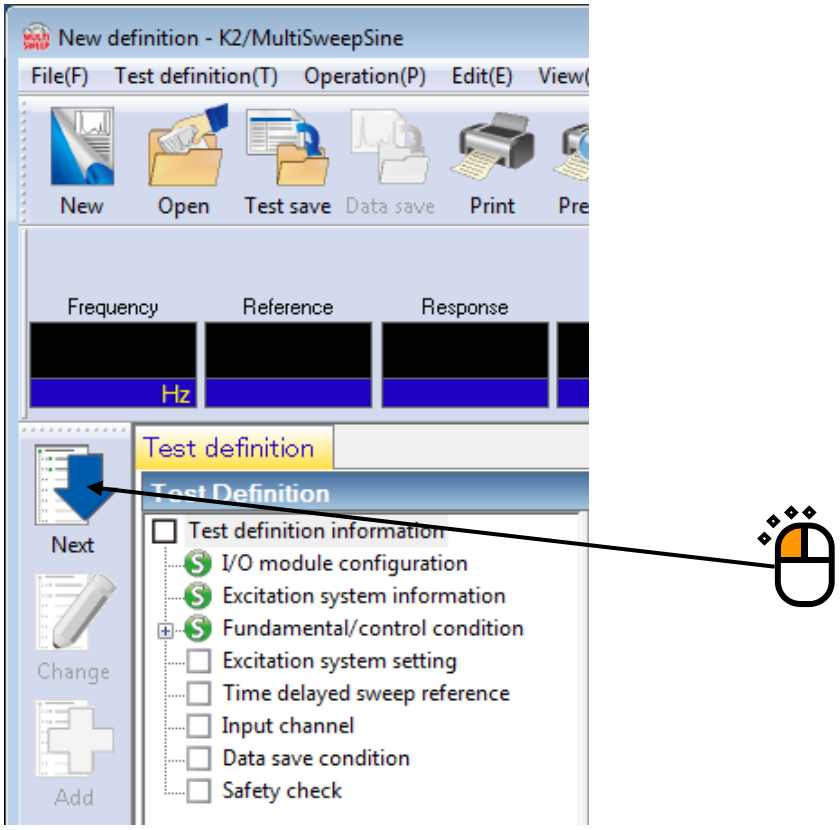
<Step 5>

The “Fundamental/Control definition” window opens. Press the [OK] button.



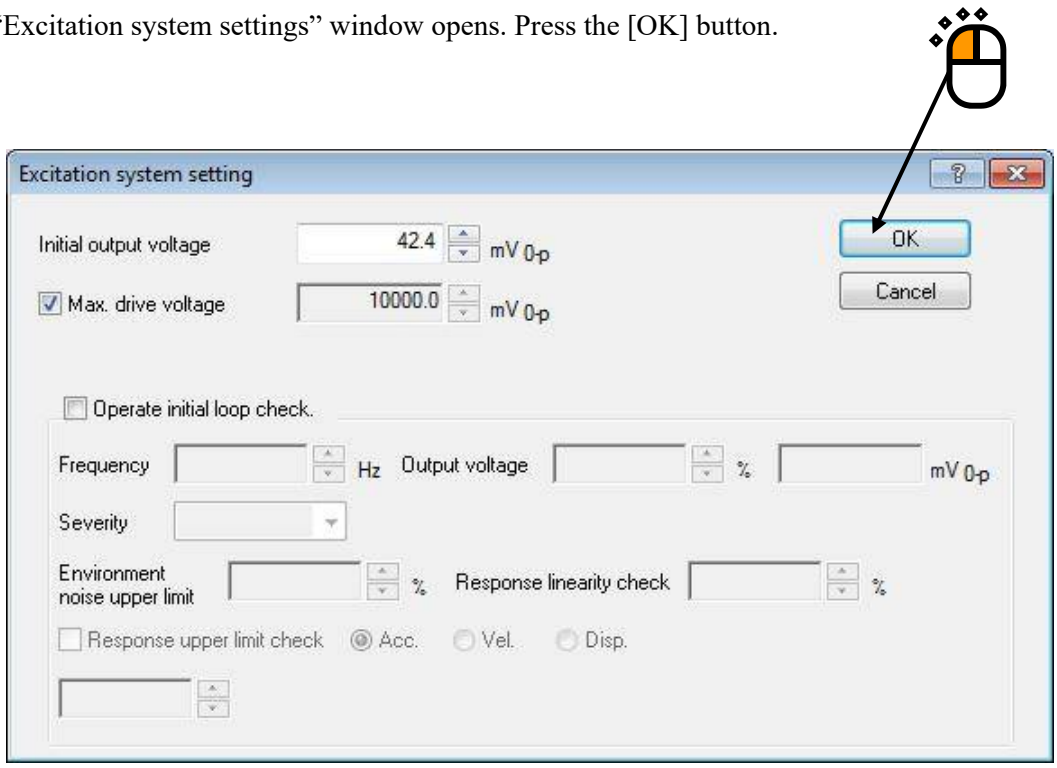
<Step 6>

Press the [Next] button to go to the next definition.



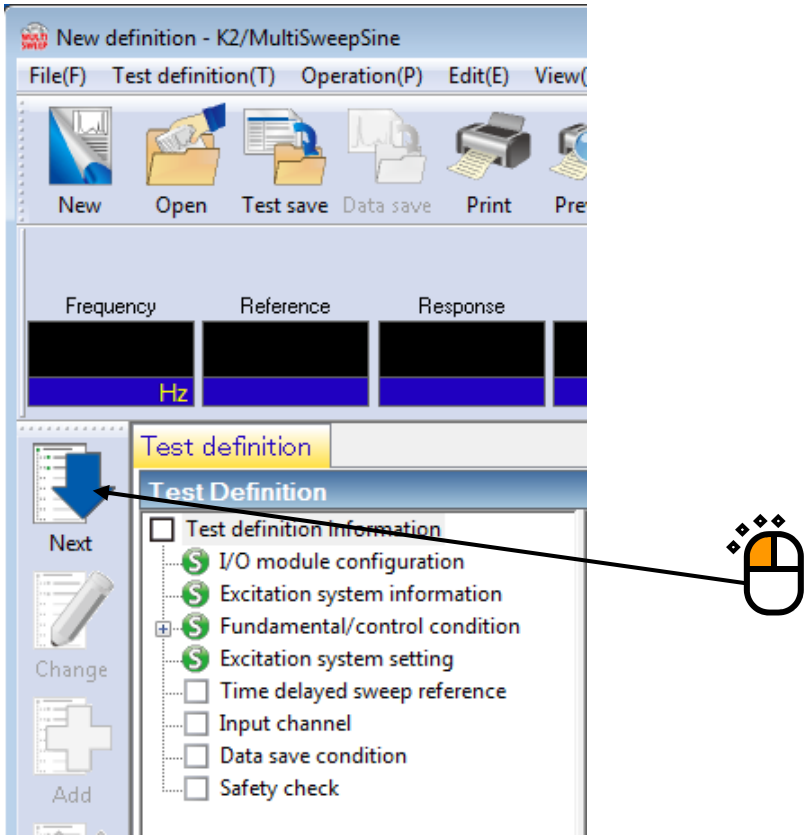
<Step 7>

The “Excitation system settings” window opens. Press the [OK] button.



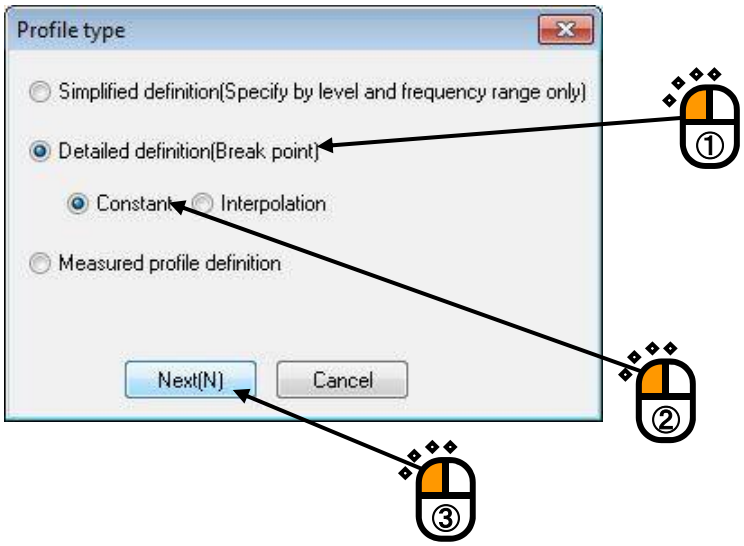
<Step 8>

Press the [Next] button to go to the next definition.



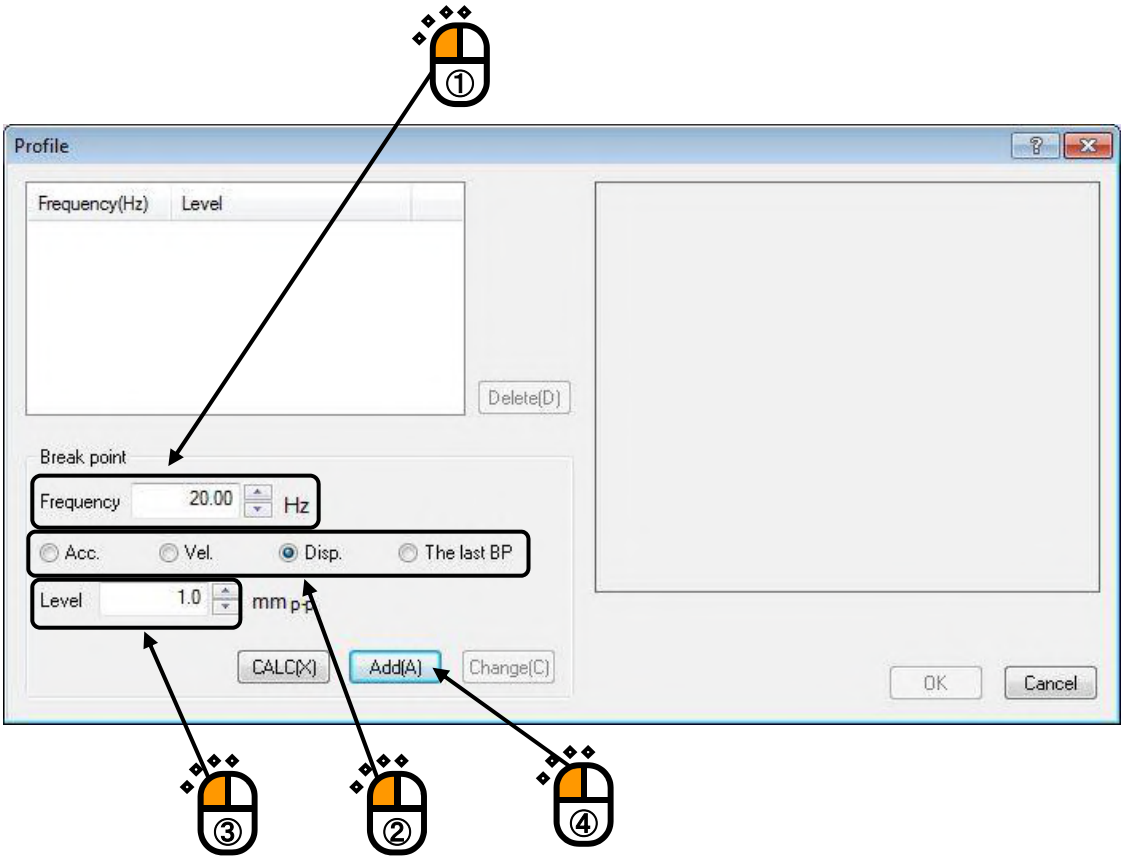
<Step 9>

The “Profile type” window opens. Select “Detailed definition (Break point)” and “Constant”, and press the [Next] button.



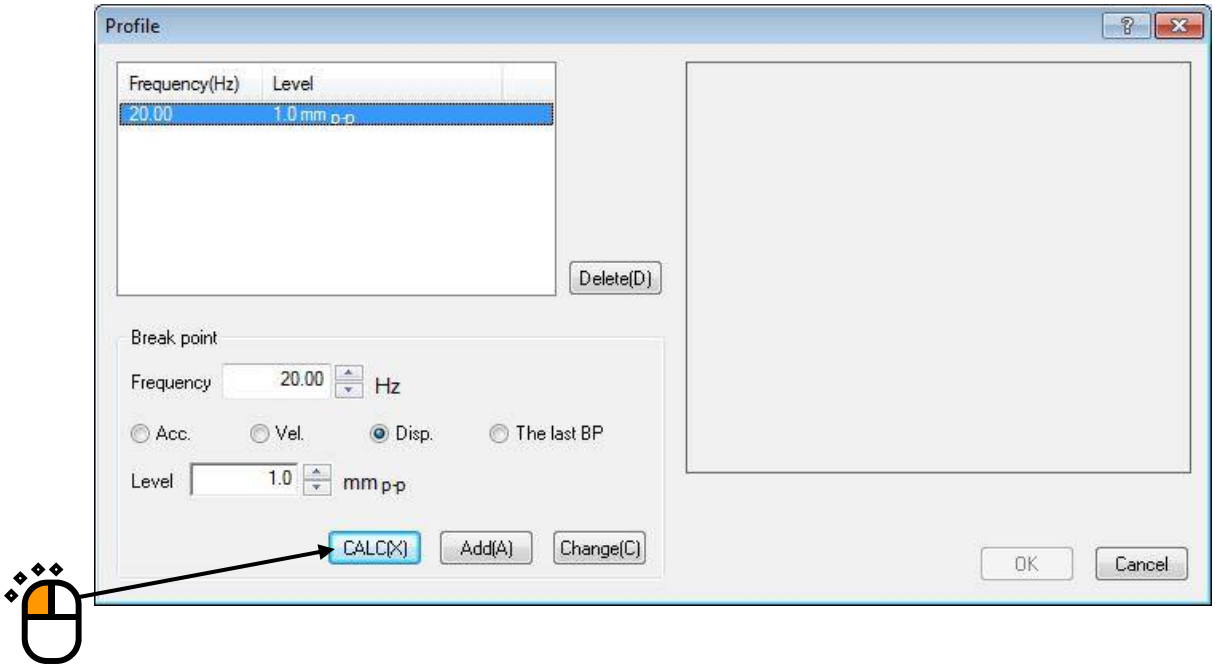
<Step 10>

The “Profile definition” window opens. Enter “20 [Hz]” for break point frequency, and select “Displacement” for “Type”. Enter “1 [mm]” for “Level”, and press the [Add] button.



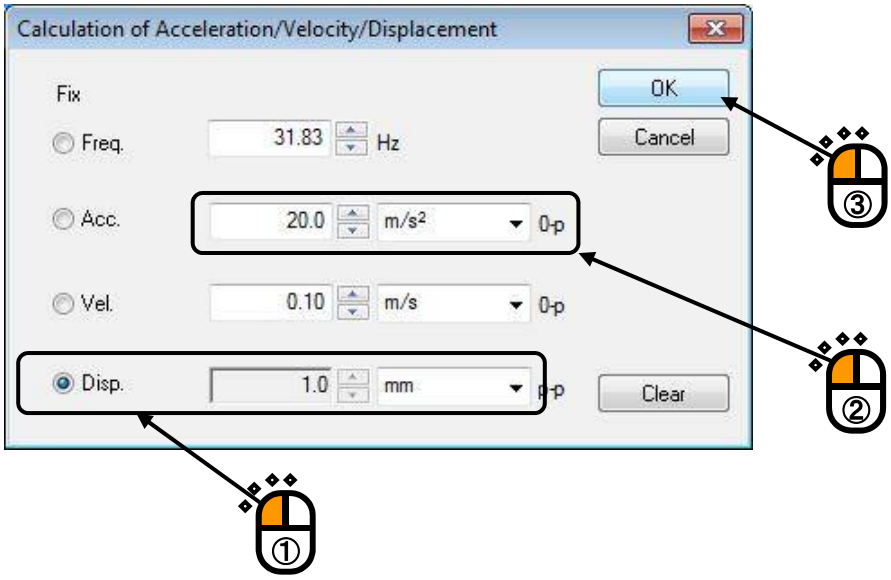
<Step 11>

To determine the break point frequency at which displacement becomes 1 [mm] at acceleration of 20 [m/s^2], press the [CALC] button.



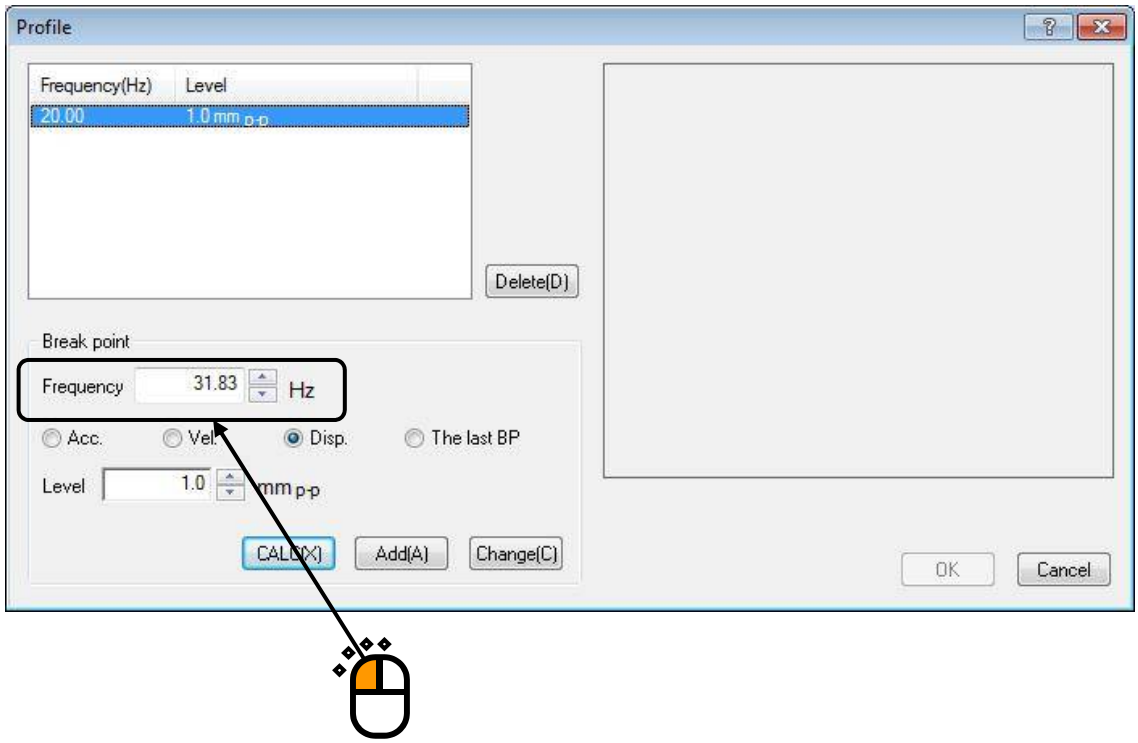
<Step 12>

Make sure that the “Displacement” radio button is checked in “Fixed”, and the “Displacement” set value is “1 [mm]. Then, enter “20 [m/s^2]” for “Acceleration”, and press the [OK] button.



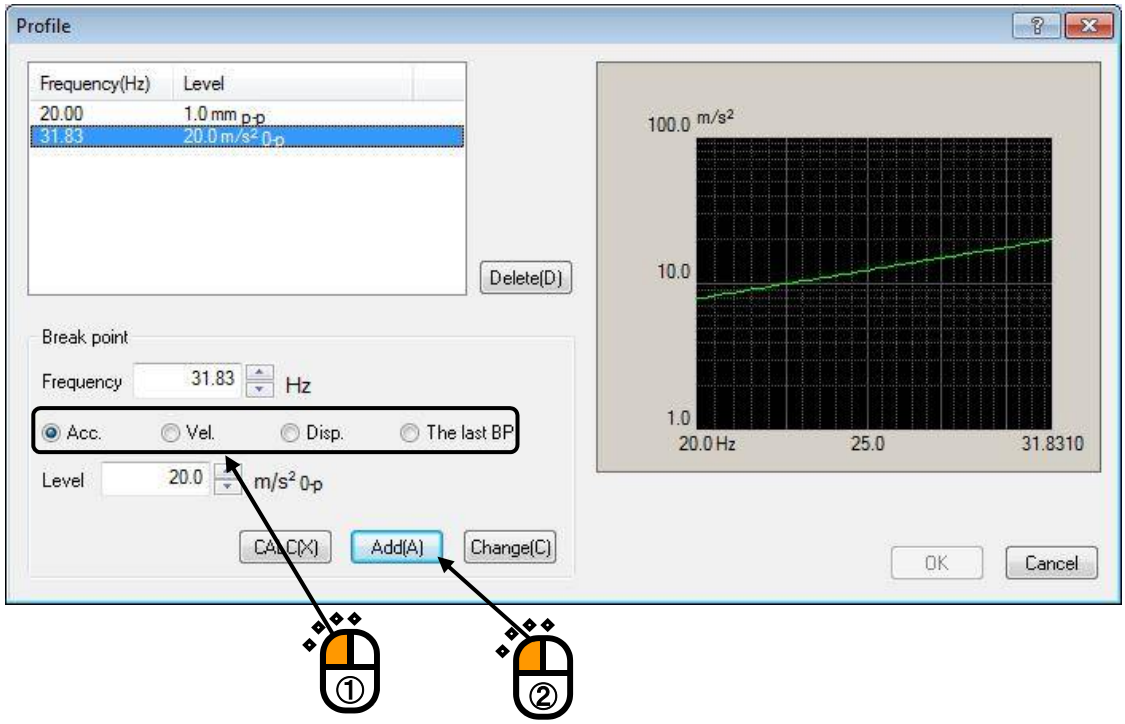
<Step 13>

The “Profile definition” window is displayed as below, indicating that the break point frequency that provides 1 [mm] displacement at 20 [m/s^2] acceleration is 31.83 [Hz].



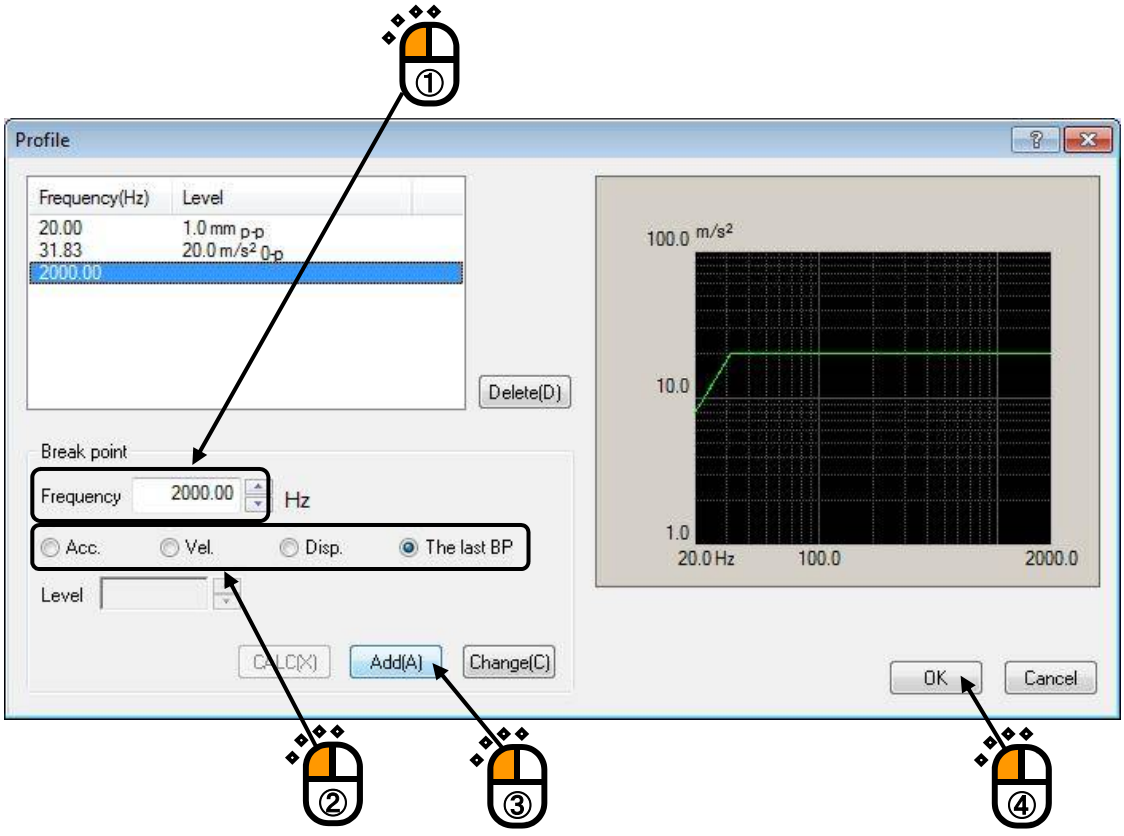
<Step 14>

Change “Type” to “Acceleration” and press the [Add] button.



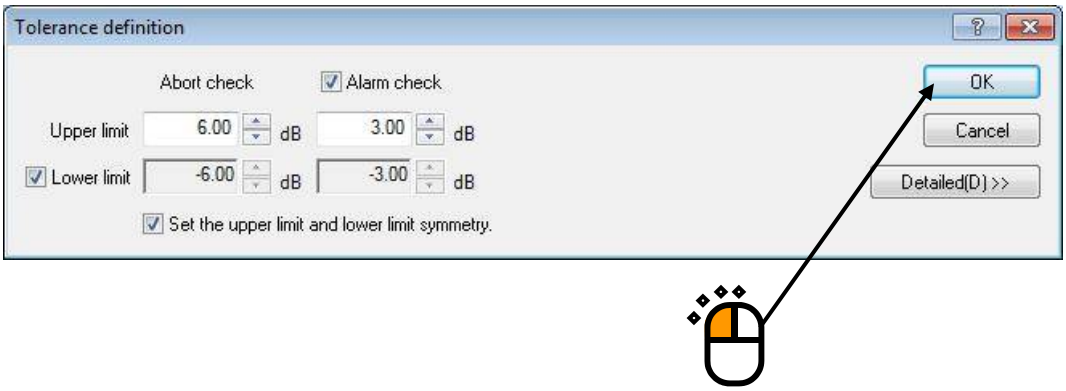
<Step 15>

Enter “2000 [Hz]” for break point frequency, select “Final BP” for “Type”, and press the [Add] button. Then, press the [OK] button.



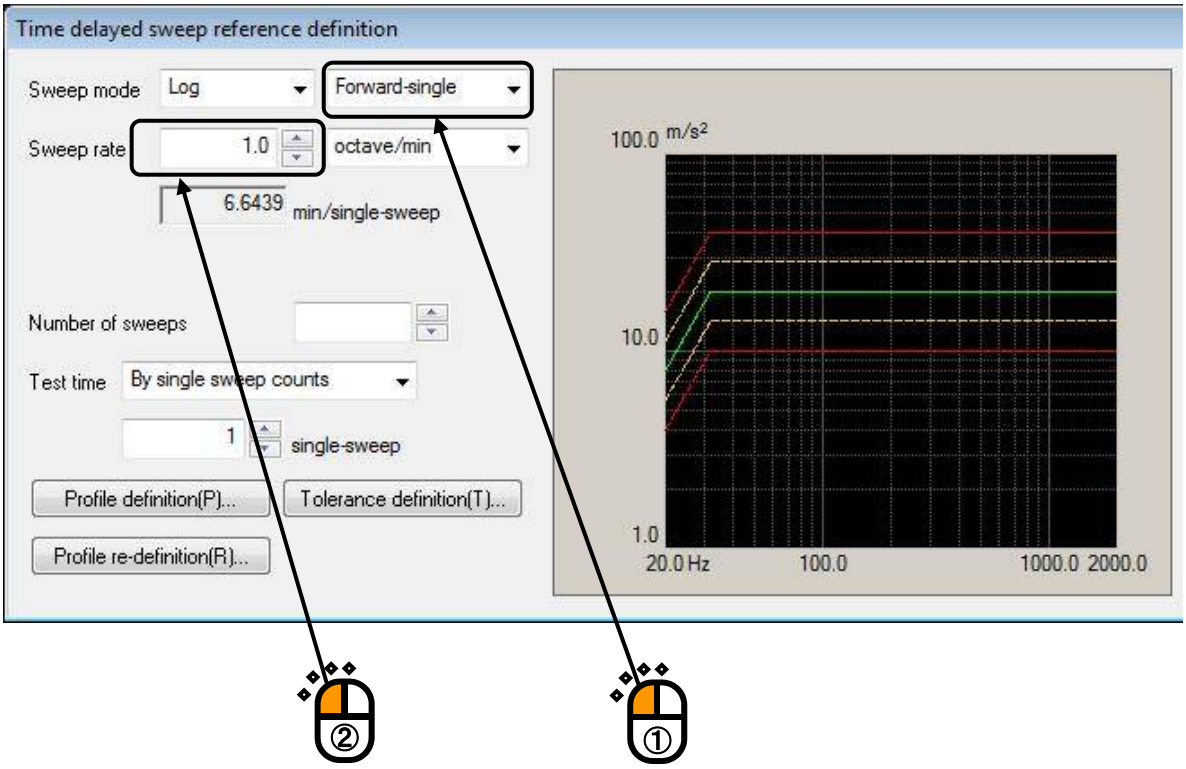
<Step 16>

The “Tolerance definition” window opens. Press the [OK] button.



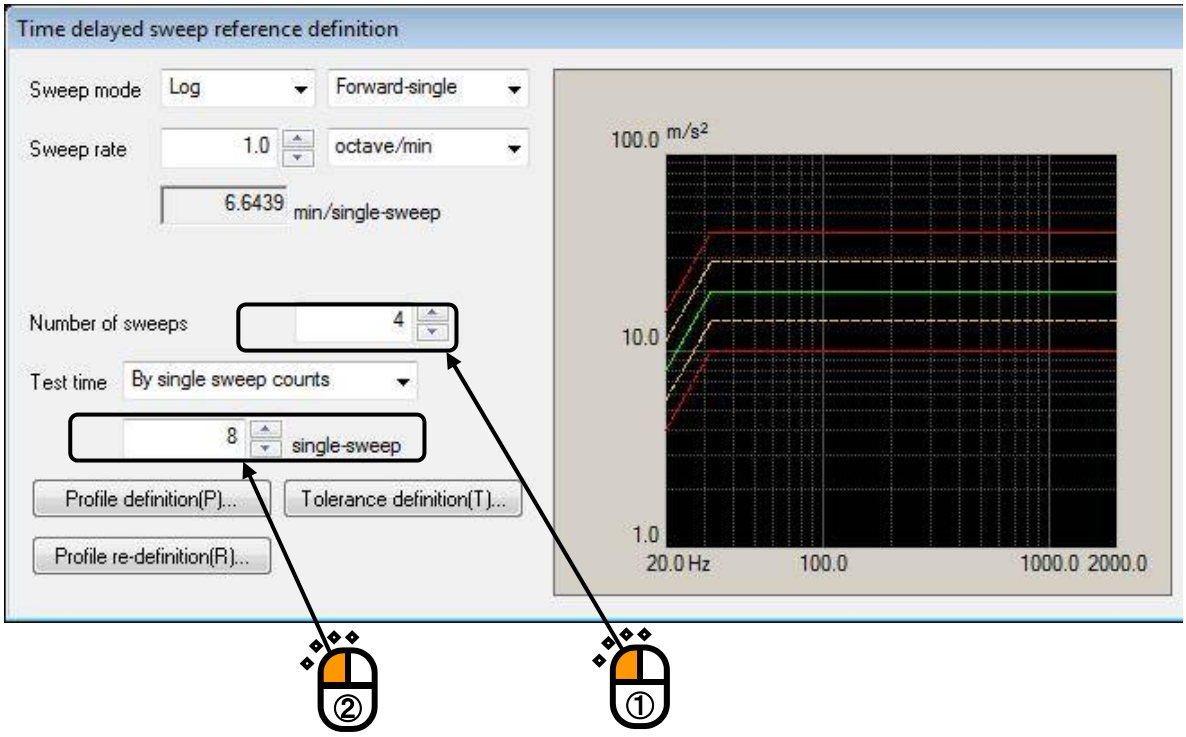
<Step 17>

The “Time delayed sweep reference definition” window opens. Make sure that “Forward - Single” is selected, and enter “1” to set the sweep rate at “1 [octave/min]”.



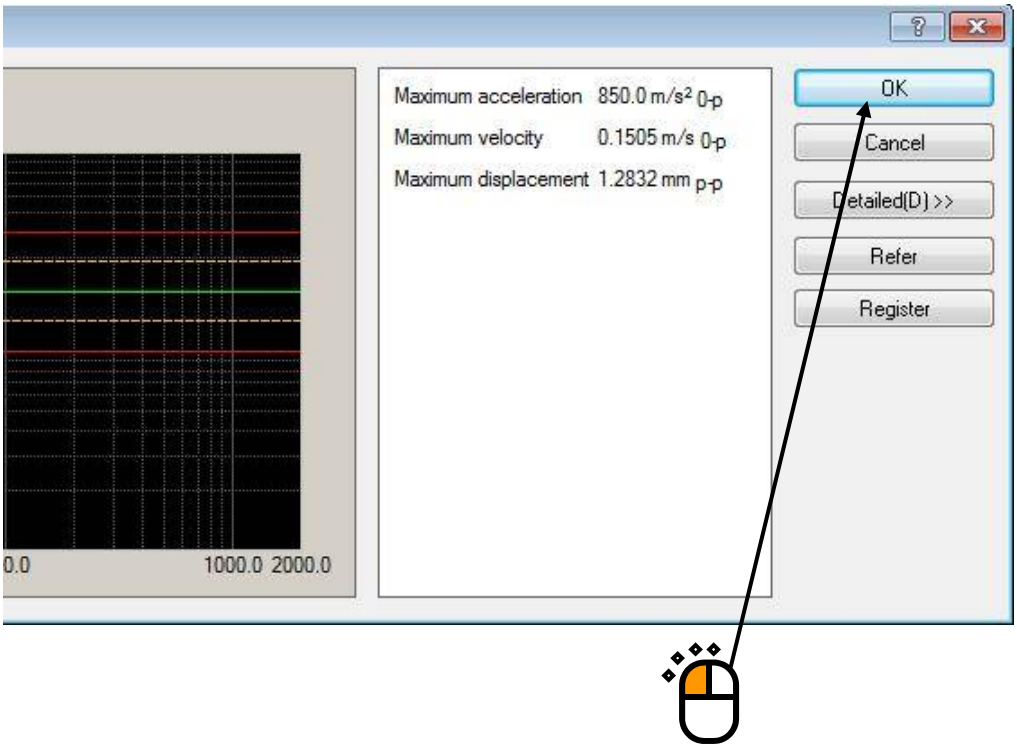
<Step 18>

Enter “4” for “Number of simultaneous sweeps”, and select “8 [single-sweep]” for sweep count.



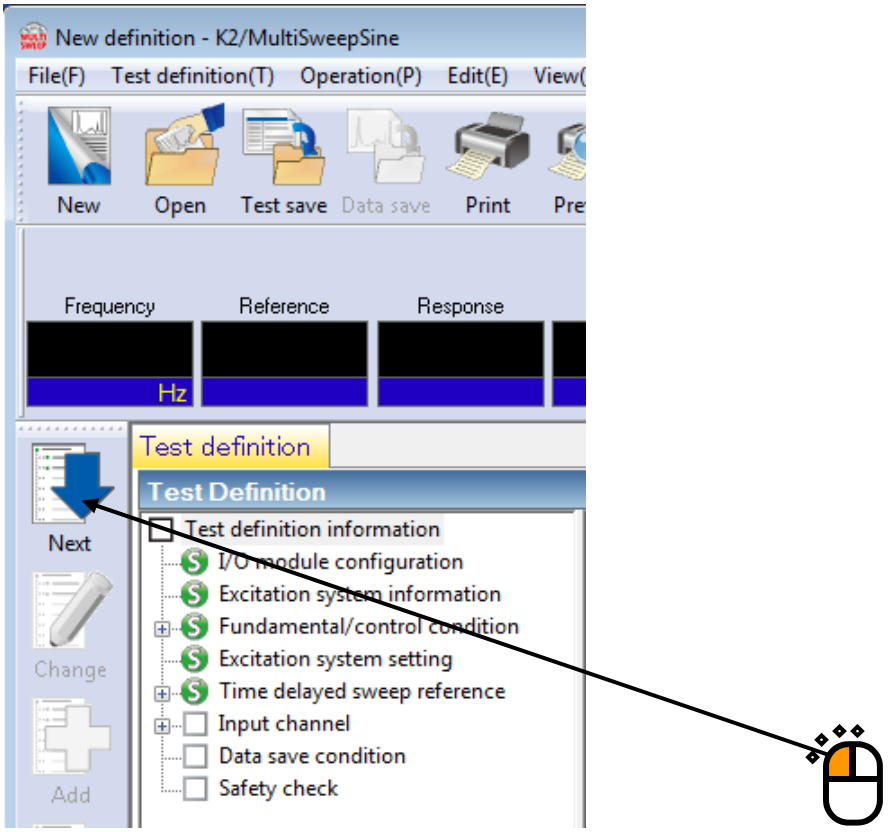
<Step 19>

Press the [OK] button.



<Step 20>

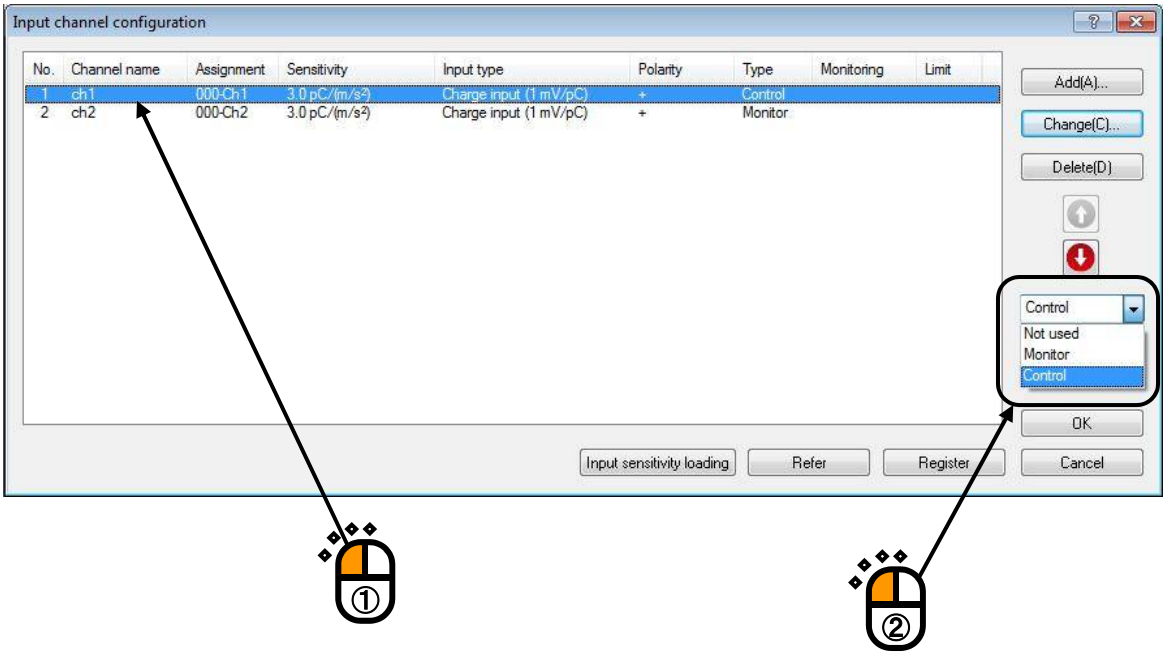
Press the [Next] button to go to the next definition.



<Step 21>

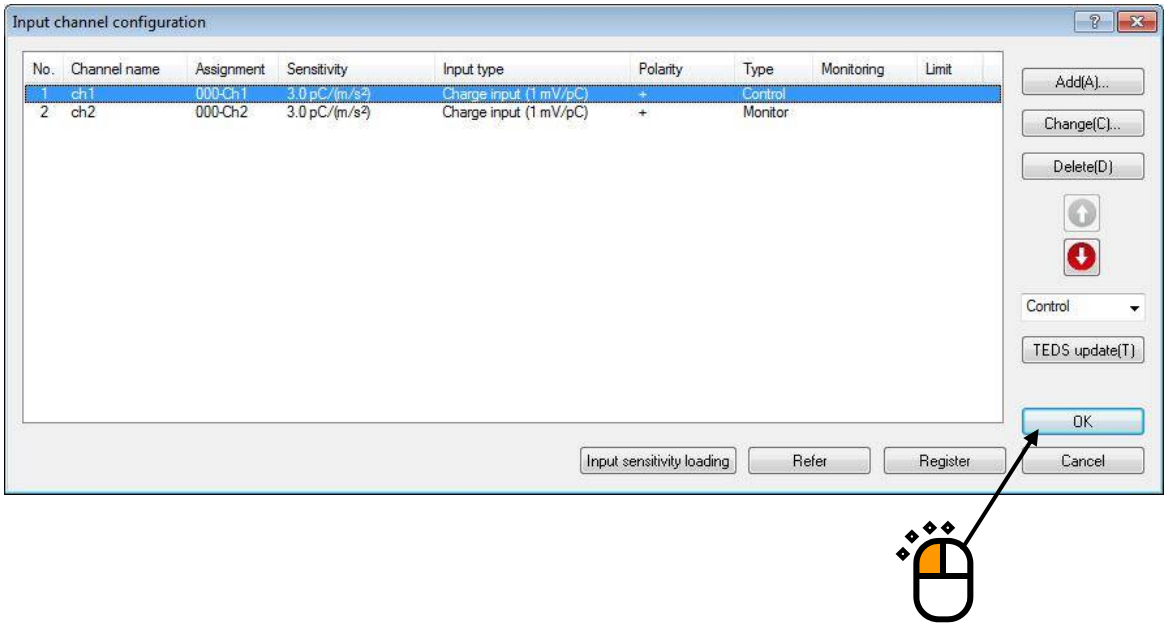
The “Input channel config” window opens. Select “ch1”, and set “Control” for “Type”.

Also, select “ch2”, and select “Monitor”.



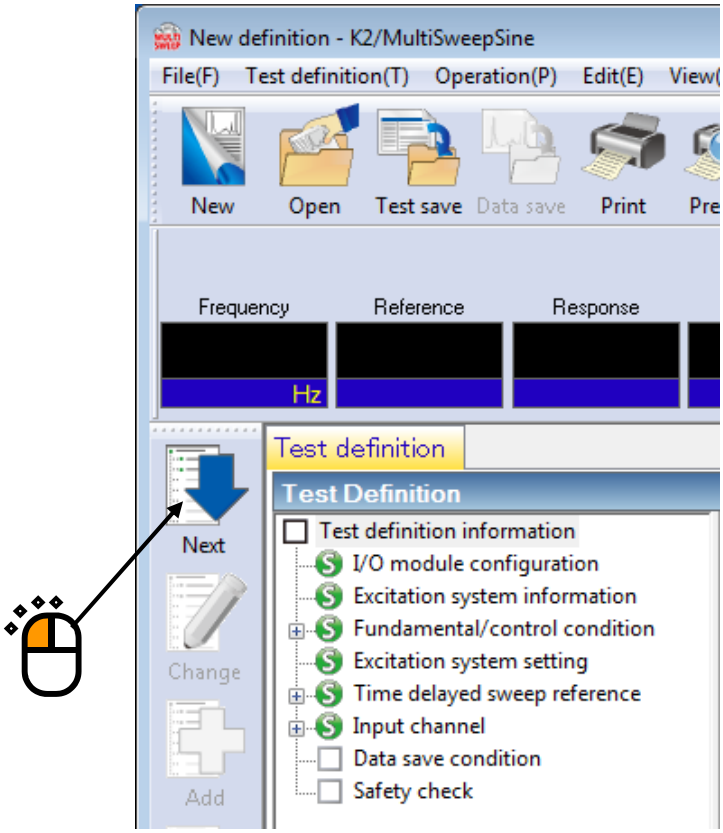
<Step 22>

Press the [OK] button.



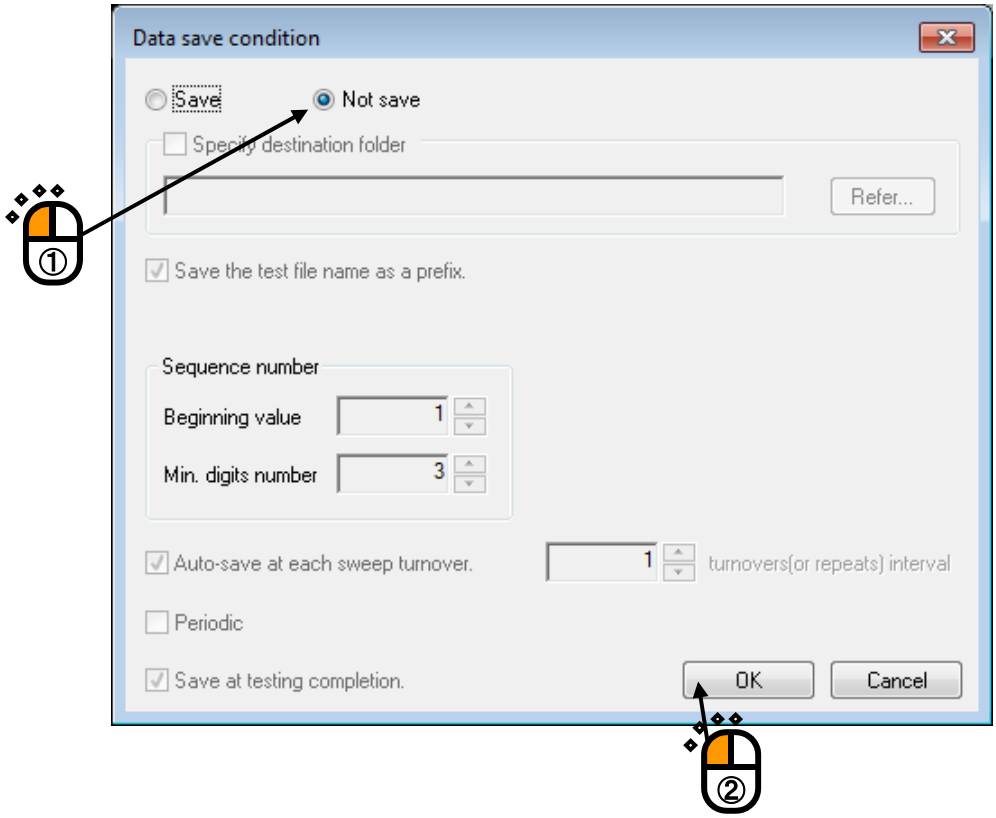
<Step 23>

Press the button of [Next].



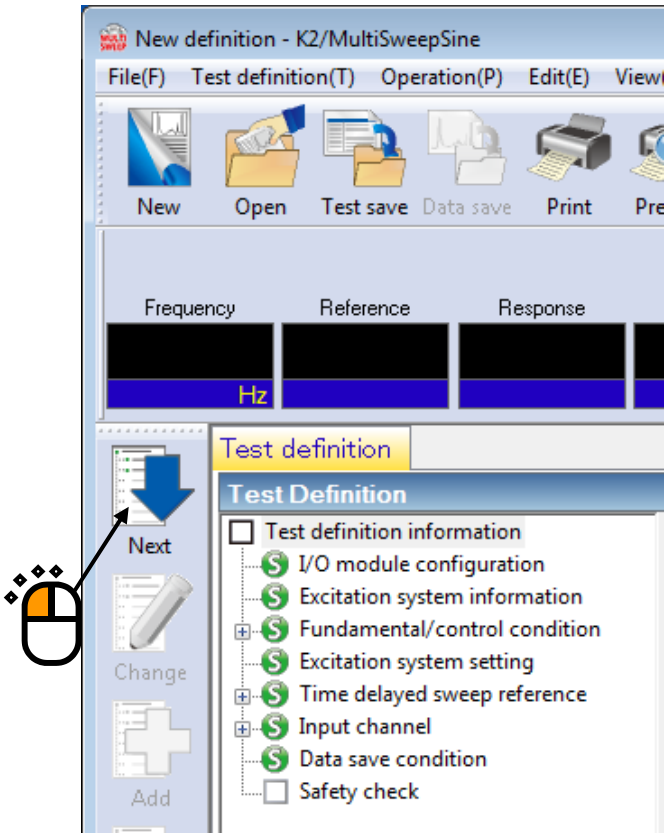
< Step24 >

Select ‘Not save’ and press the button of [OK].



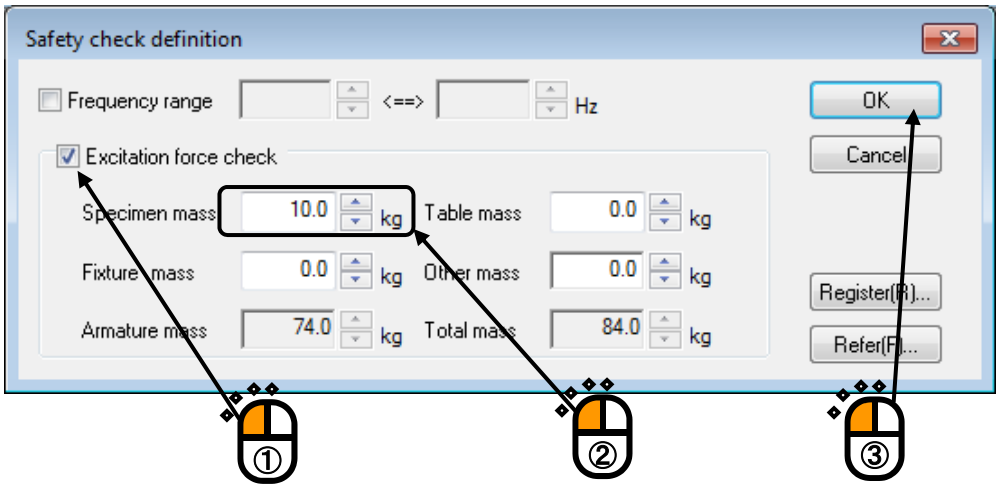
< Step25 >

Press the button of [Next].



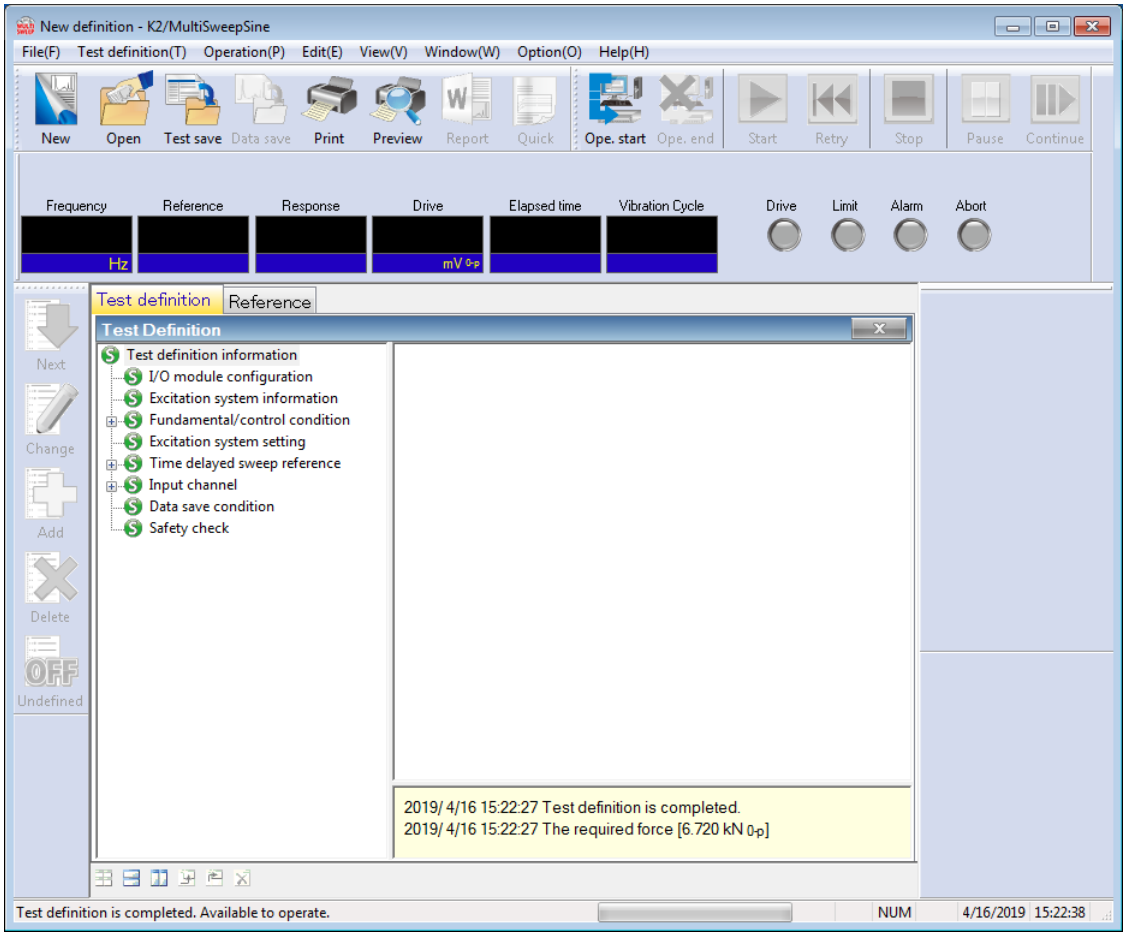
< Step26 >

Select ‘Excitation force check’ and input the value as ‘Specimen mass : 10 [kg]. And press the button of [OK].



< Step27 >

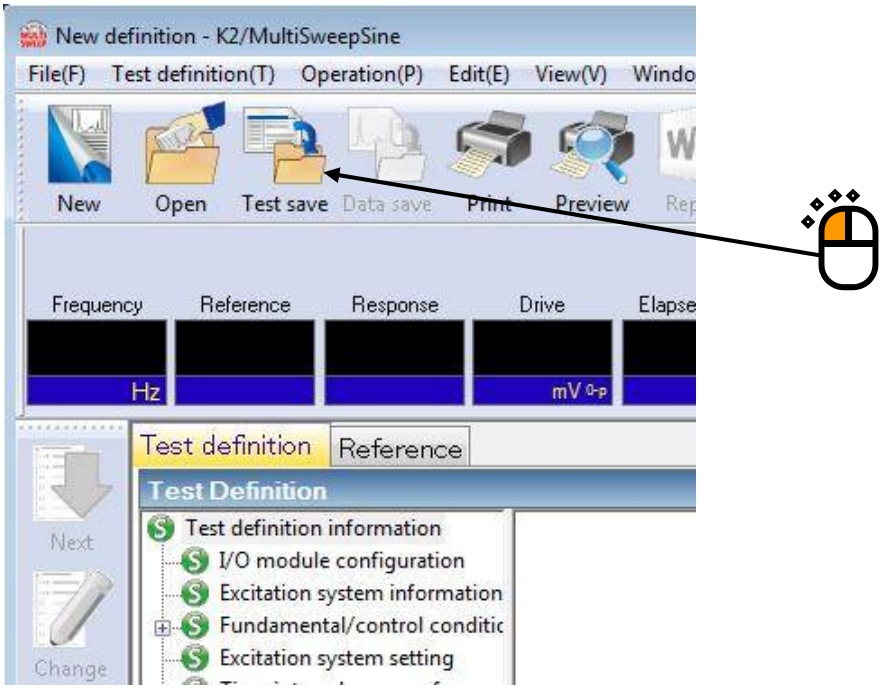
The definition is completed.



<Save of test>

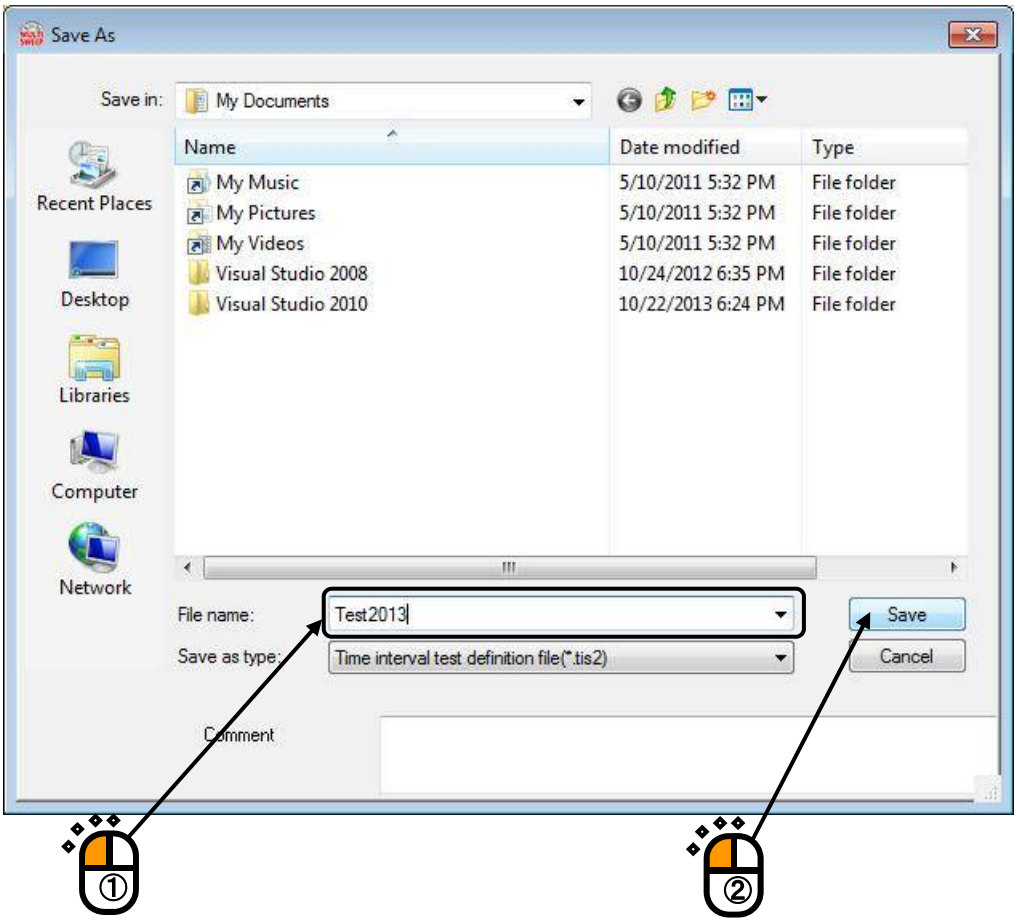
<Step 1>

Press the [Save] button.



<Step.2>

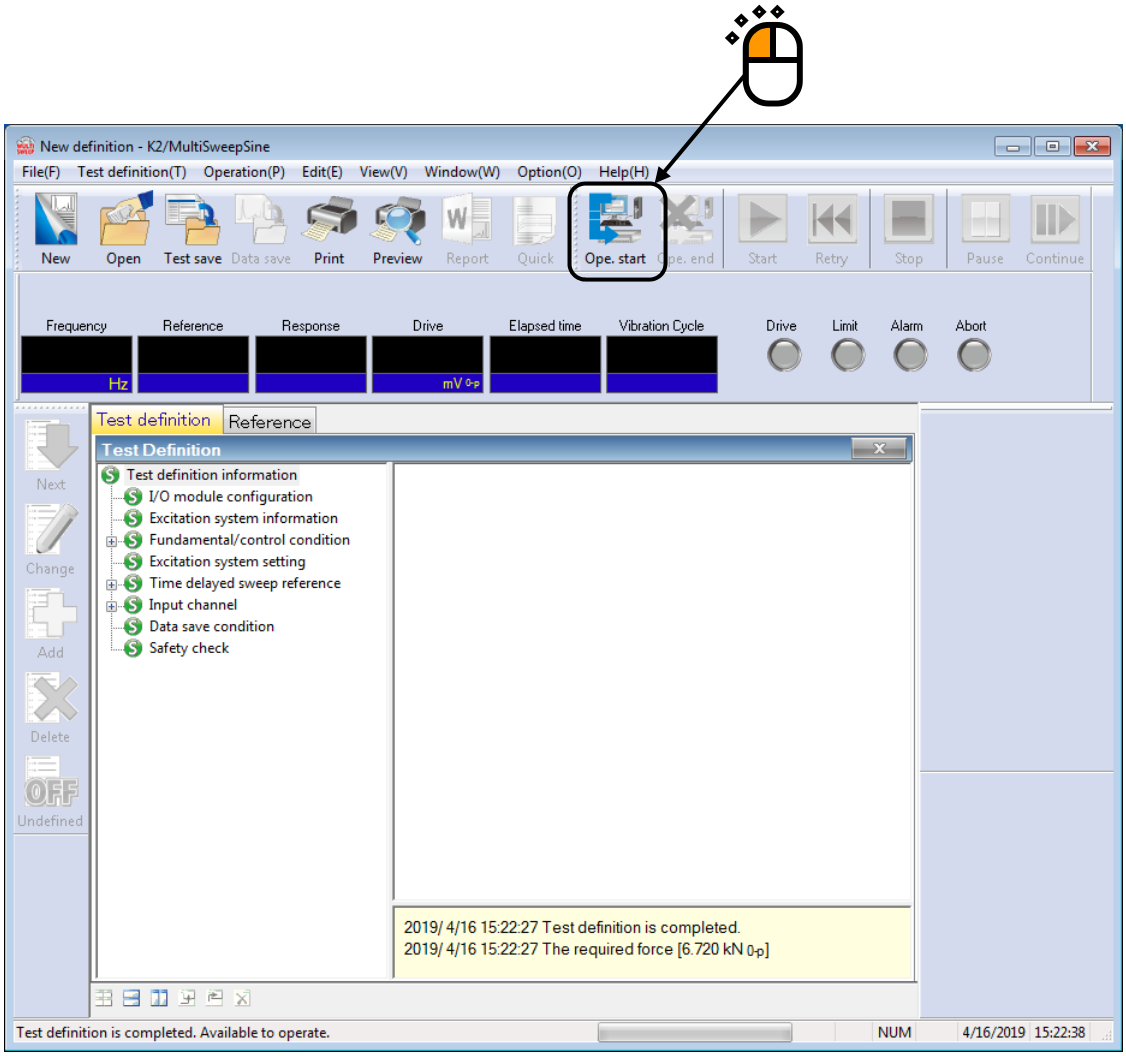
Input a name in 'File name' and press the [Save] button.



<Operation of test>

<Step 1>

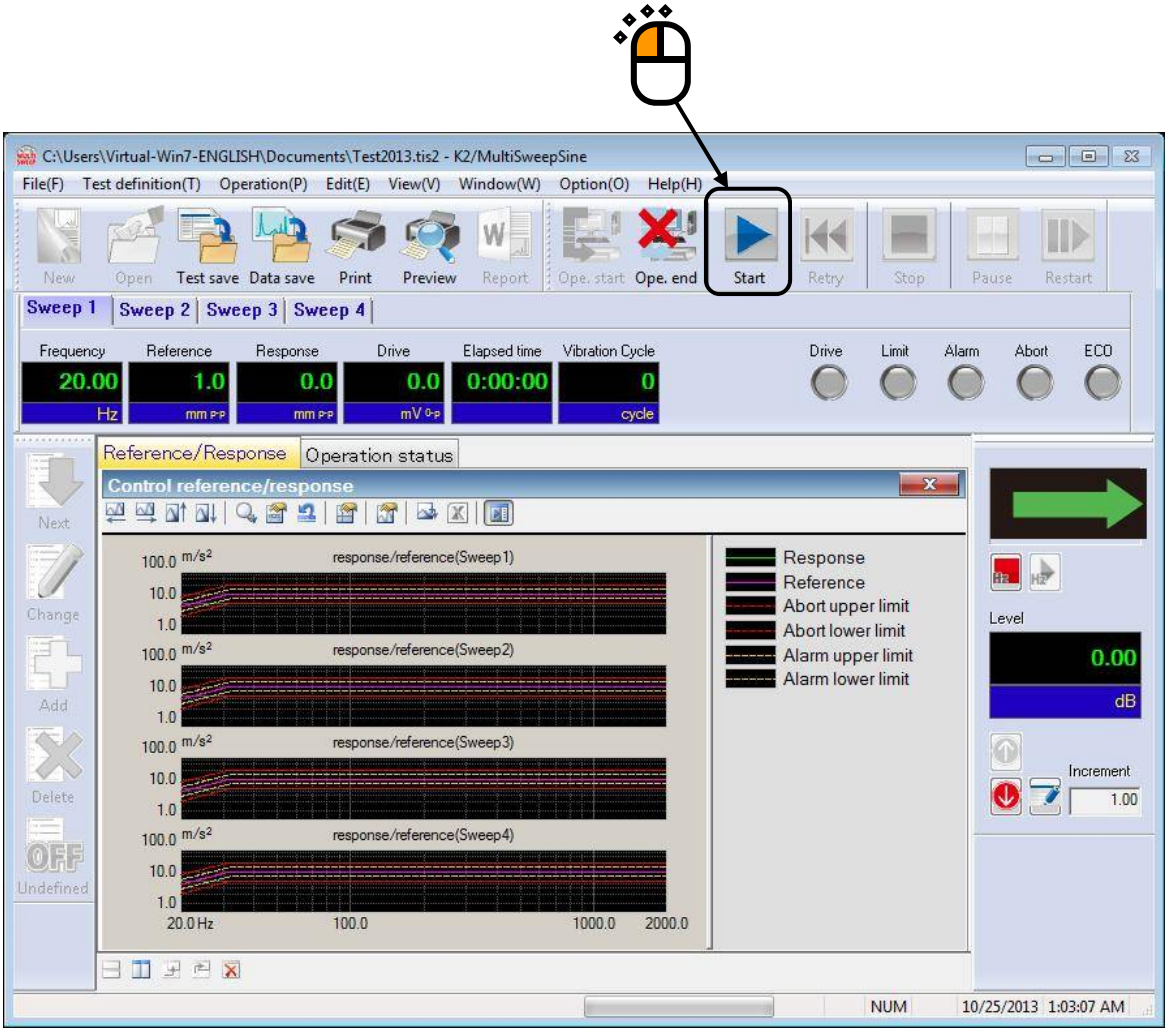
Press the button of [Ope. start]. The system shifts from the “Test definition” mode to the “Test operation” mode.



<Step 2>

Press the [Start] button.

Pressing the [Start] button automatically starts initial loop check (if definition is completed), initial measurement and initial equalization, and executes a test at the initial excitation level (in this example, “0 [dB]”).



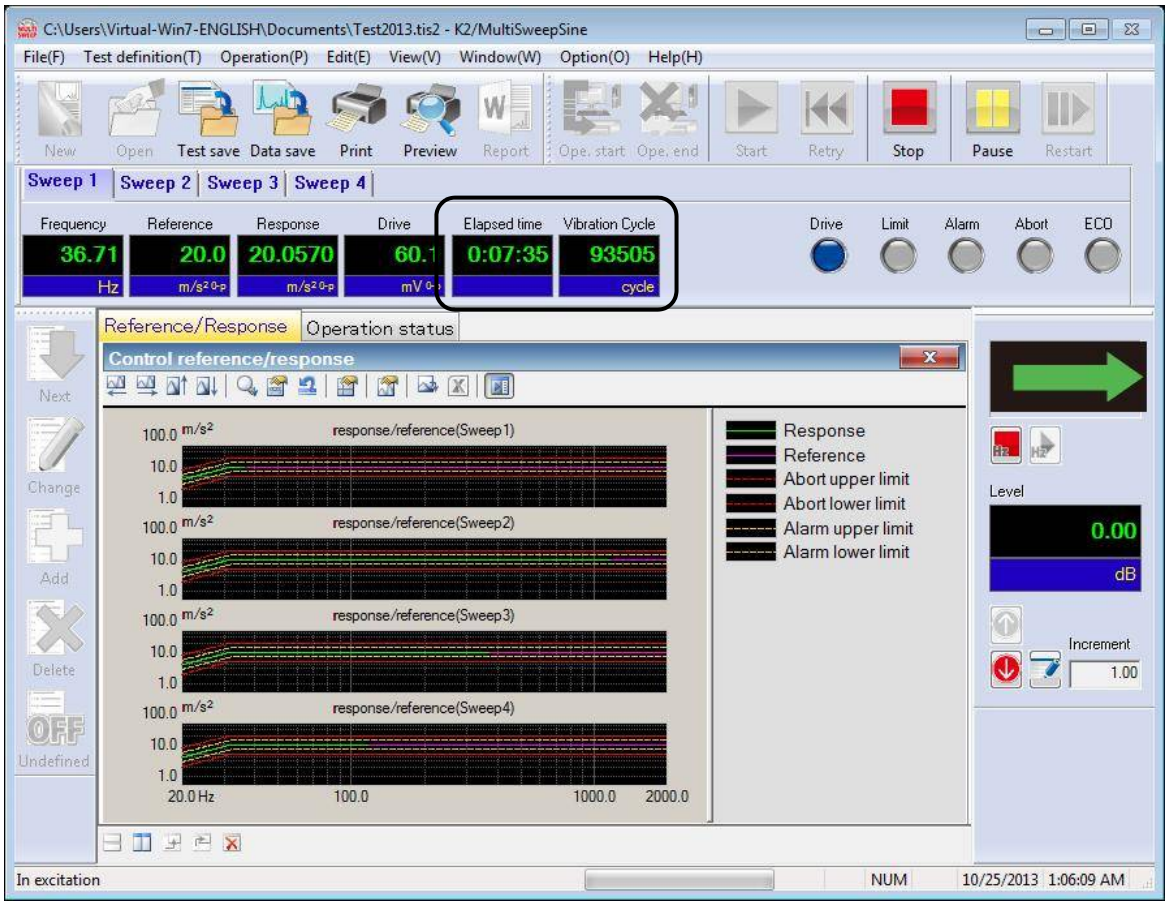
In this example, four sweeps are separately displayed in the graphs for individual frequency bands in one frame. Otherwise, one sweep can be displayed in one graph, or four sweeps can be displayed in one graph.

<Step 3>

After the initial equalization is completed, excitation is executed at the initial excitation level (in this example, “0” [dB]), and sine sweep starts in sequence from the first one.

Count of test elapse time will start simultaneously when the first sweep starts, and continues until the final sweep is completed. Note that test time is counted only when excitation level is “0 [dB]”.

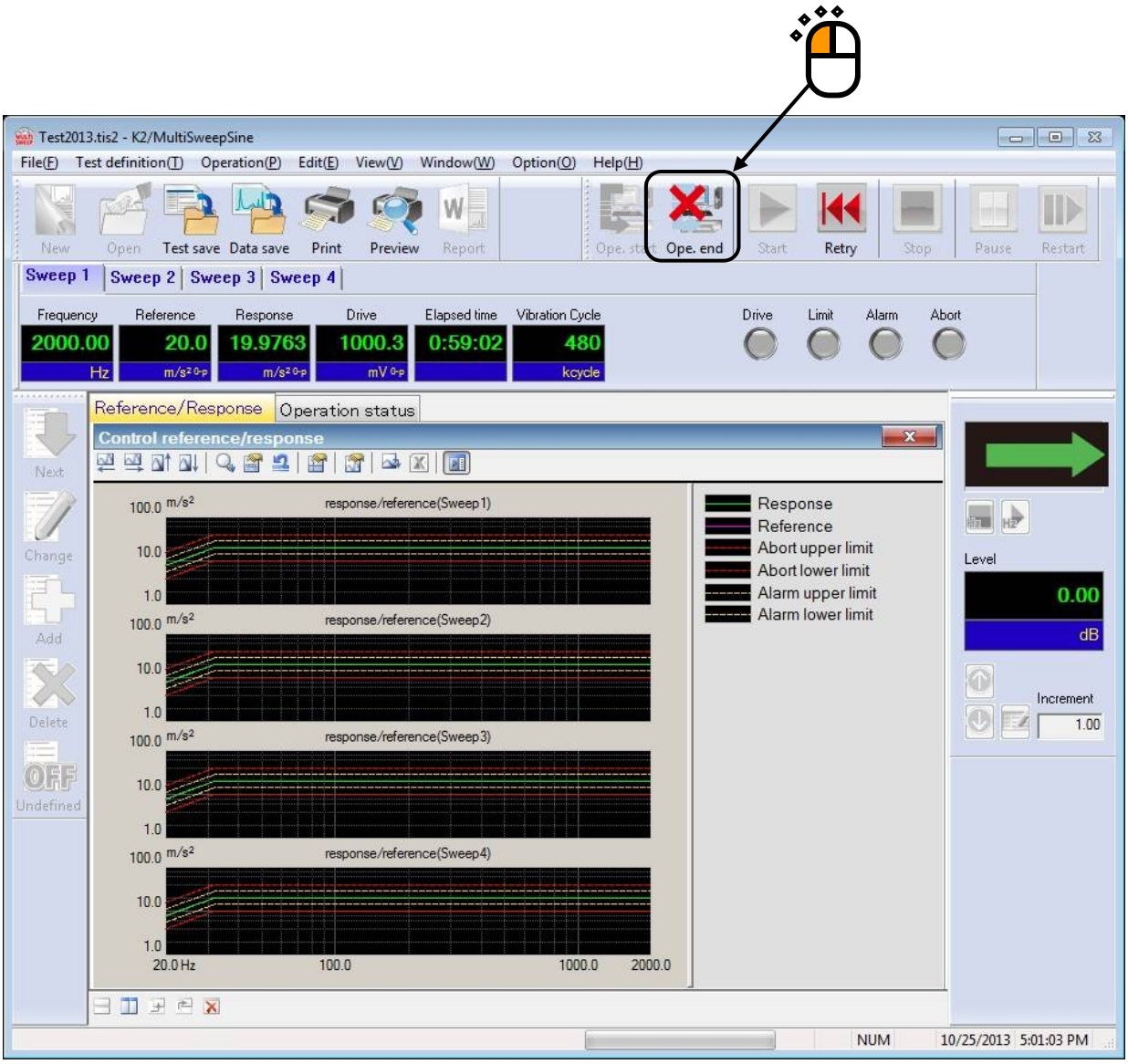
Vibration count is executed for each sweep.



<Step 4>

Test operation is completed when the test time passed.

The system returns to the test definition mode by pressing the [Ope. end] button.



2.3 Multi spot

<Example>

Assume execution of the following Multi Spot test.

[Reference pattern]

The relation of Frequency and Level in the following list specifies a spot. These elements are simultaneously subject to test.

No	Frequency	Level
1	100[Hz]	30[m/s^2 0-p]
2	20[Hz]	5[mm p-p]
3	200[Hz]	1[cm/s 0-p]

[Test time]

Test time : 1 [hour]

[Information of sensors to be used]

Two acceleration pickups of piezoelectric: one is used for control and another for monitor.

Ch. 1: for control, sensitivity 3[pC/(m/s^2)]

Ch. 2: for monitor, sensitivity 3[pC/(m/s^2)]

However, these channels must be registered in Input environment information(in this example, 'IMVTEST').

Also, the rating information of excitation system has already been registered in Excitation system information (in this example, 'Test').

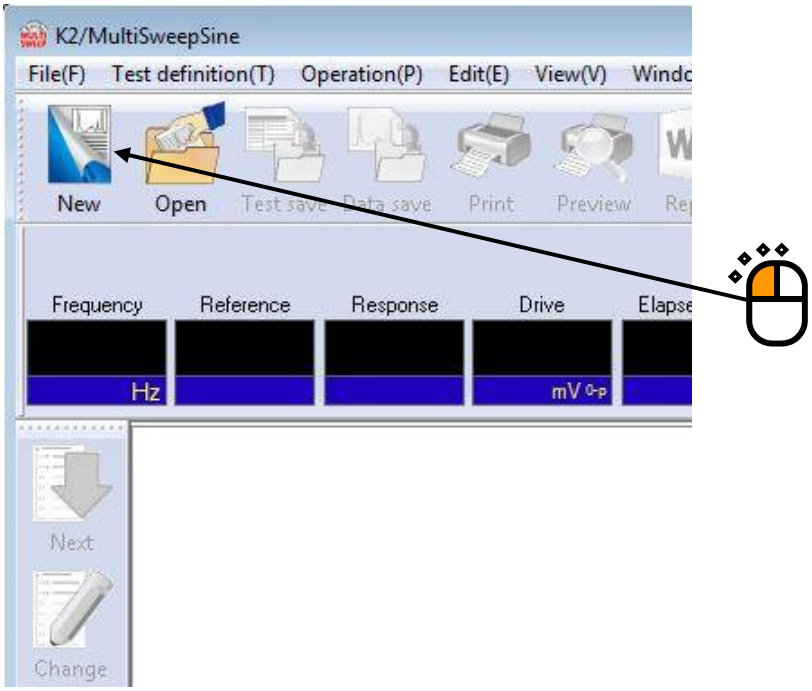
[Information of specimen]

Specimen mass : 10[kg]

<Procedures>

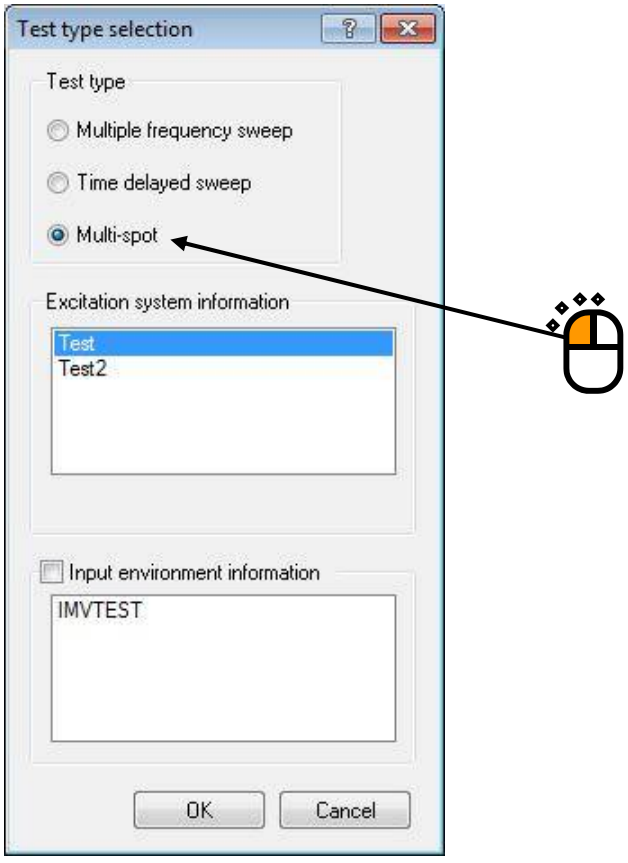
<Step 1>

Press the [New] button to start new definition.



<Step 2>

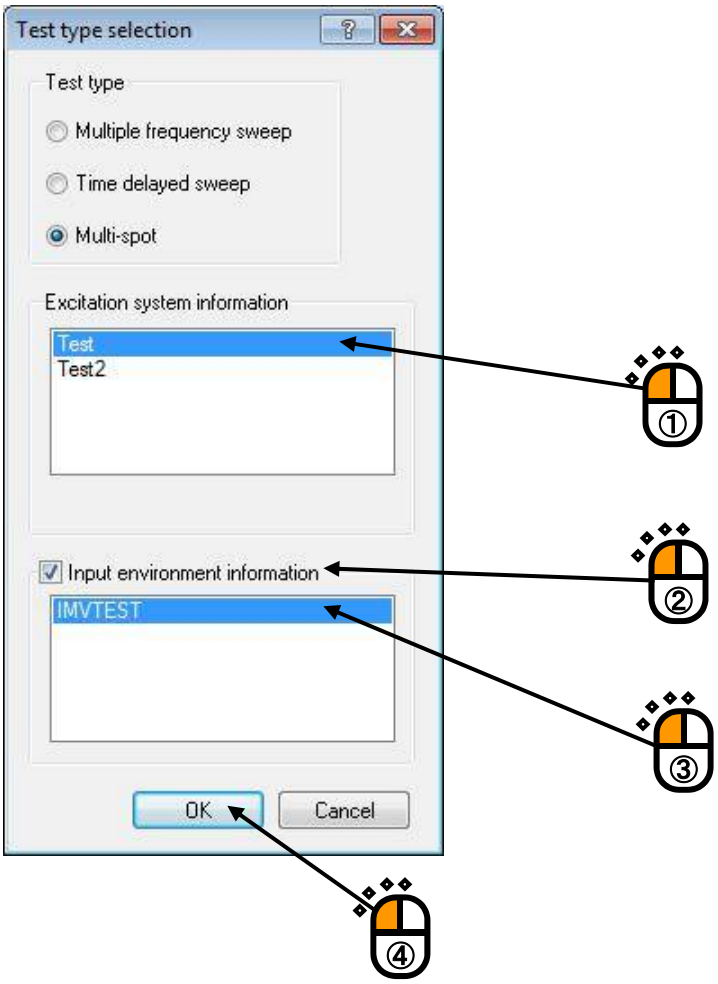
Select “Multi spot” for “Test type”.



<Step 3>

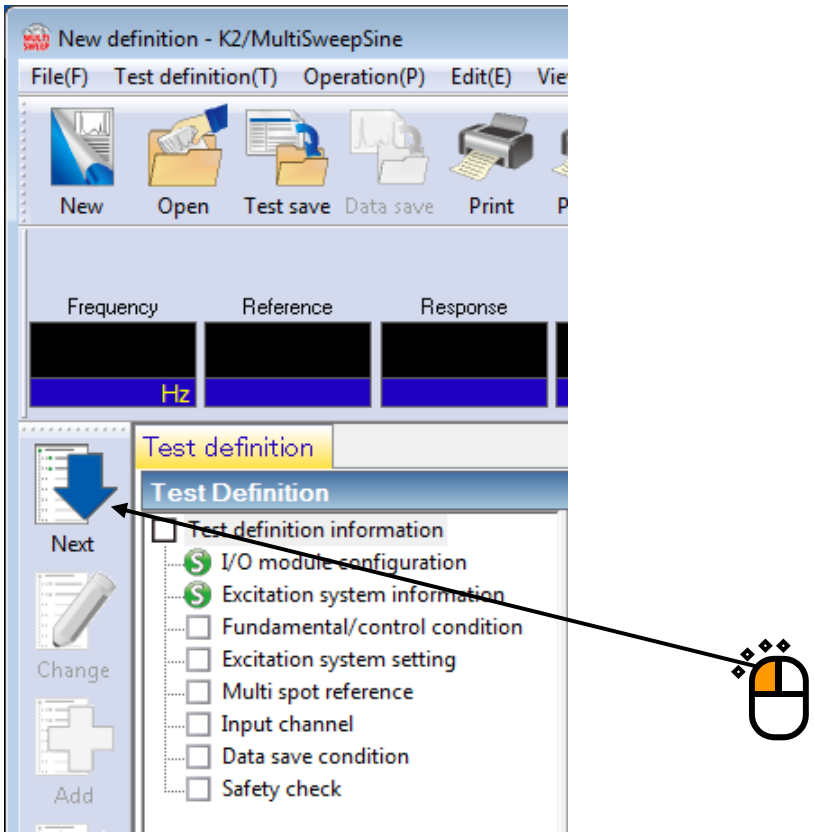
Select an excitation system from the list of “Excitation system information”, and select “Input channel” information.

Press the [OK] button.



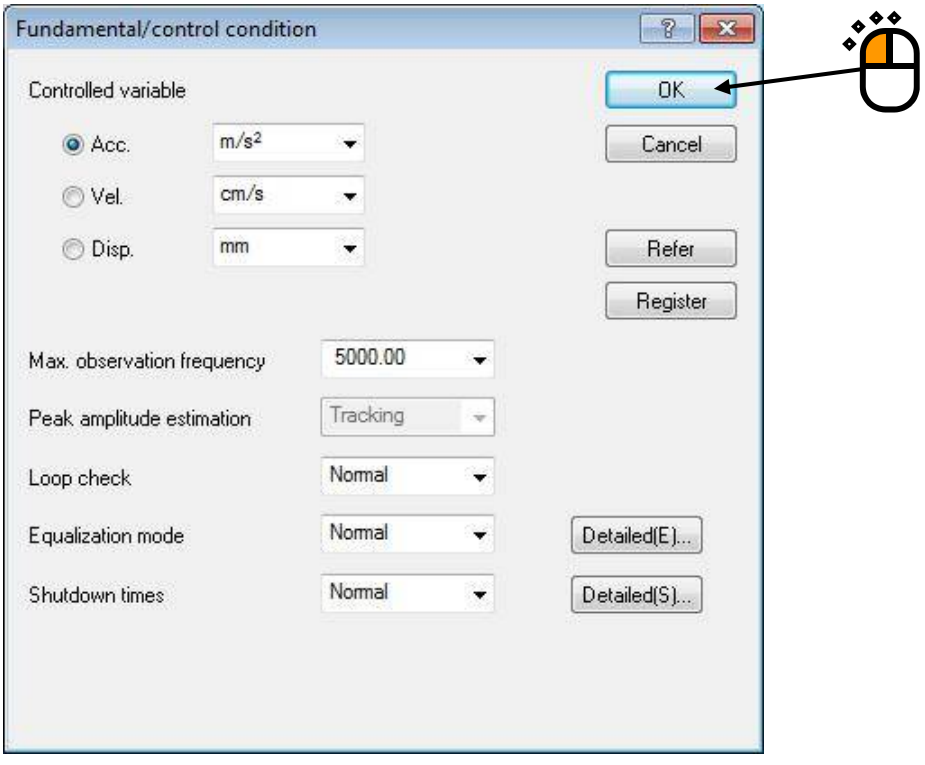
<Step 4>

Press the [Next] button to go to the next definition.



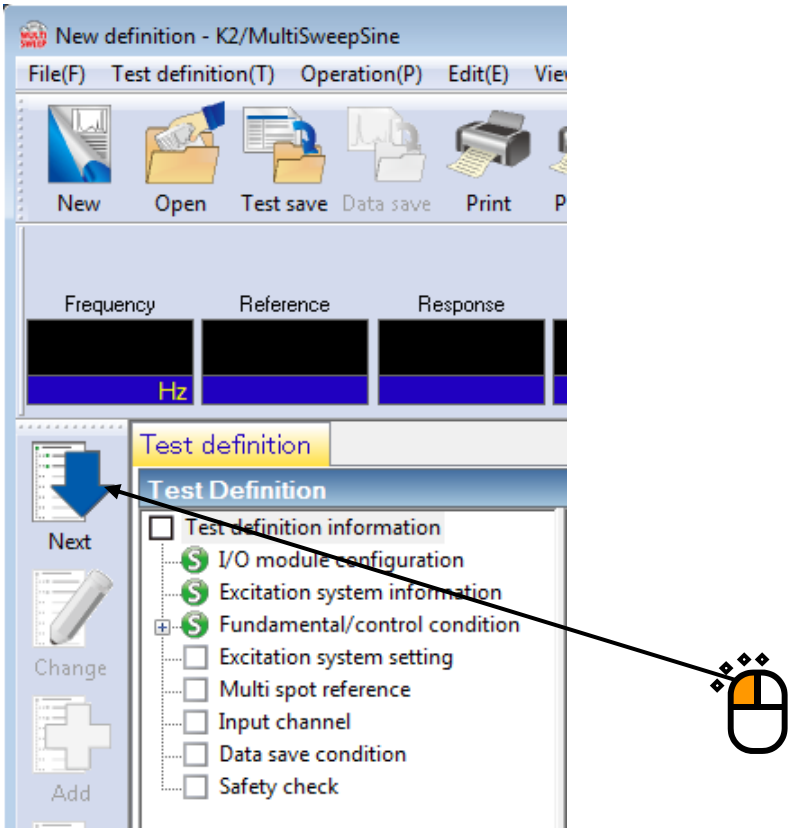
<Step 5>

The “Fundamental/Control definition” window opens. Press the [OK] button.



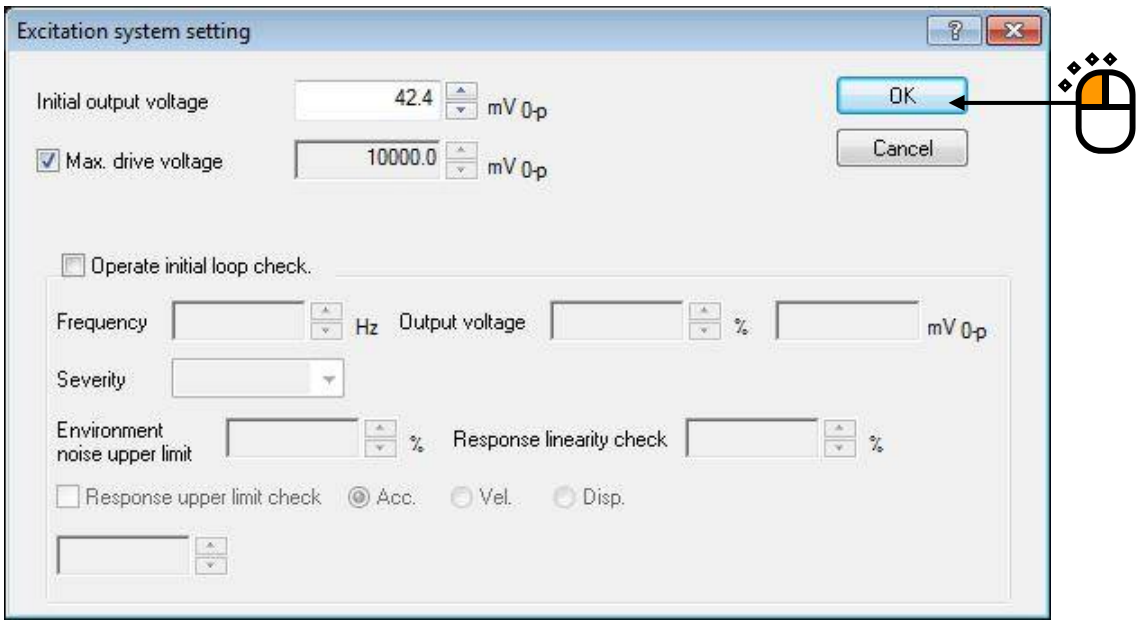
<Step 6>

Press the [Next] button to go to the next definition.



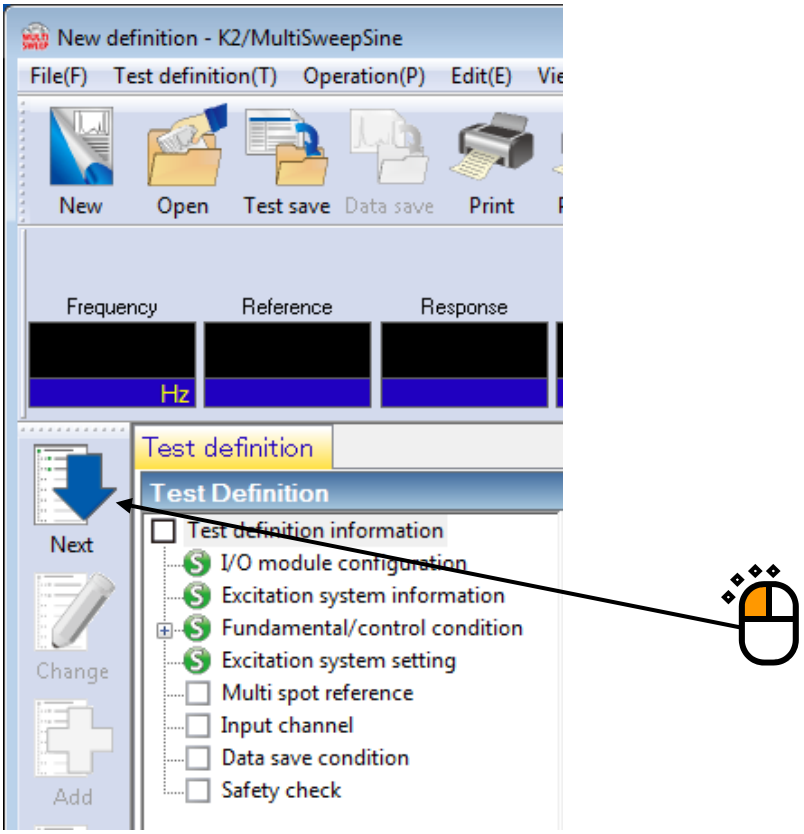
<Step 7>

The “Excitation system settings” window opens. Press the [OK] button.



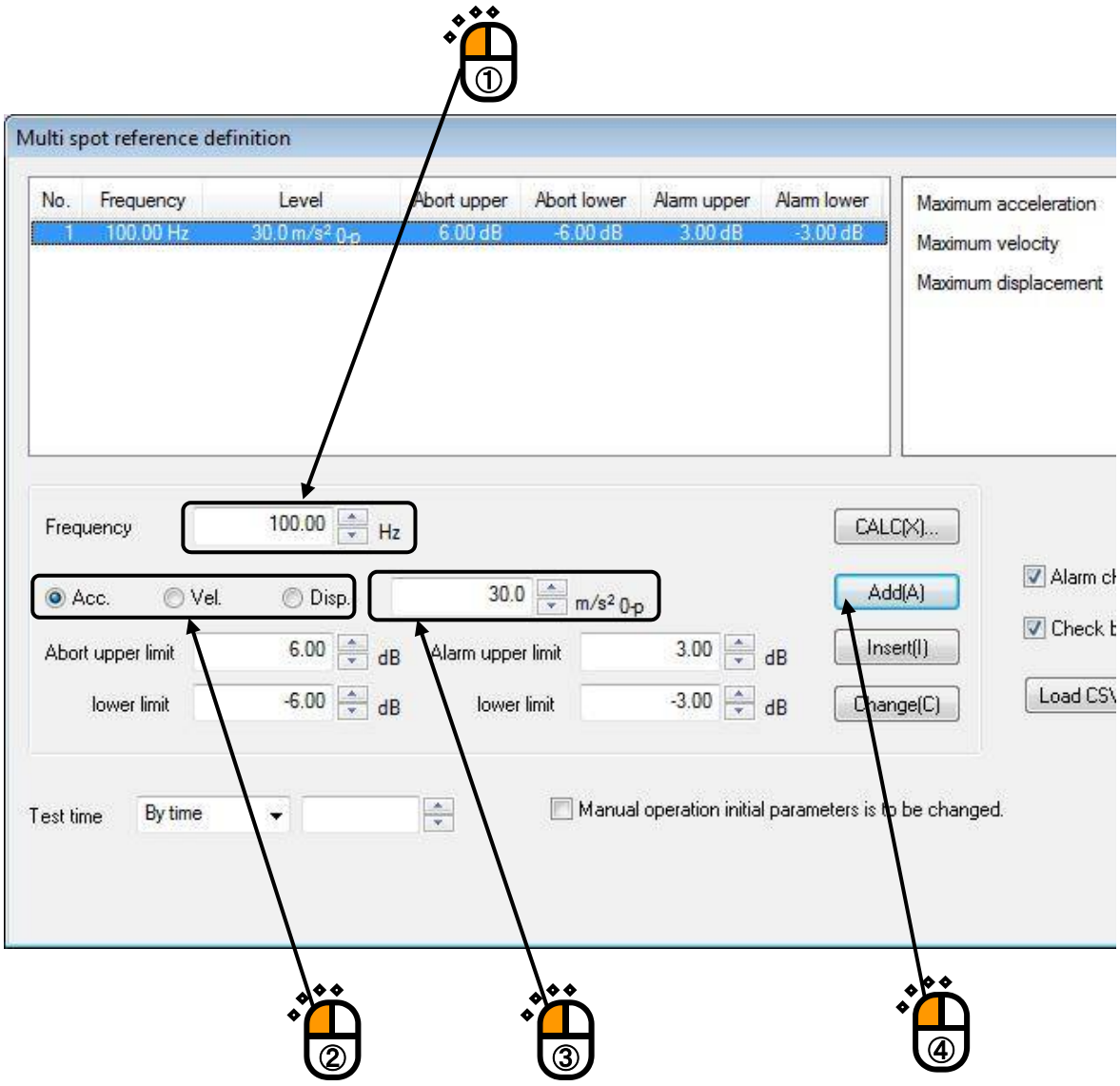
<Step 8>

Press the [Next] button to go to the next definition.



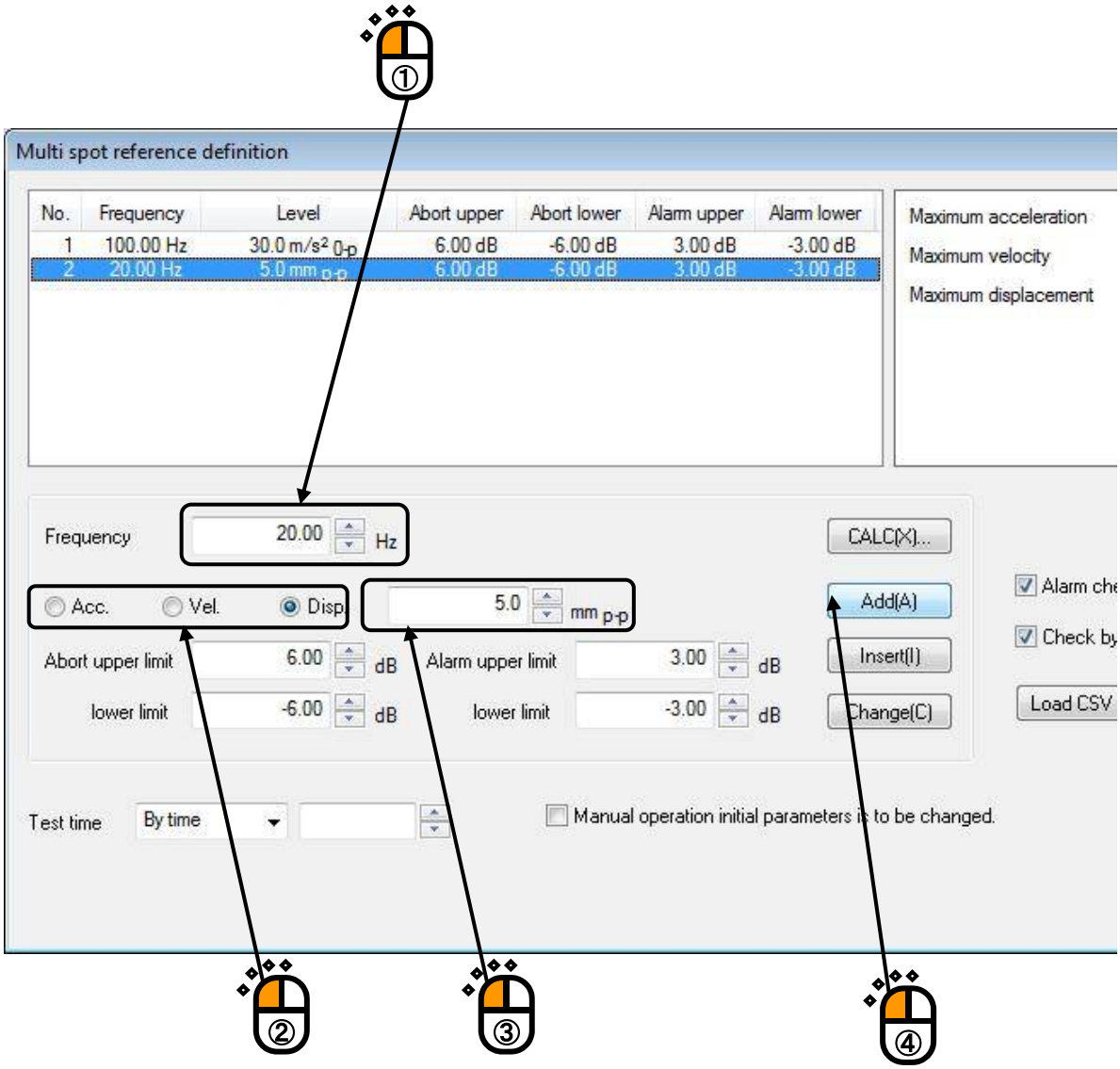
<Step 9>

The “Multi spot reference definition” window opens. Specify elements for the first spot. Enter “100 [Hz]” for “Frequency”, and select “Acceleration” for “Type”. Enter “30 [m/s^2]” for “Level”, and press the [Add] button.



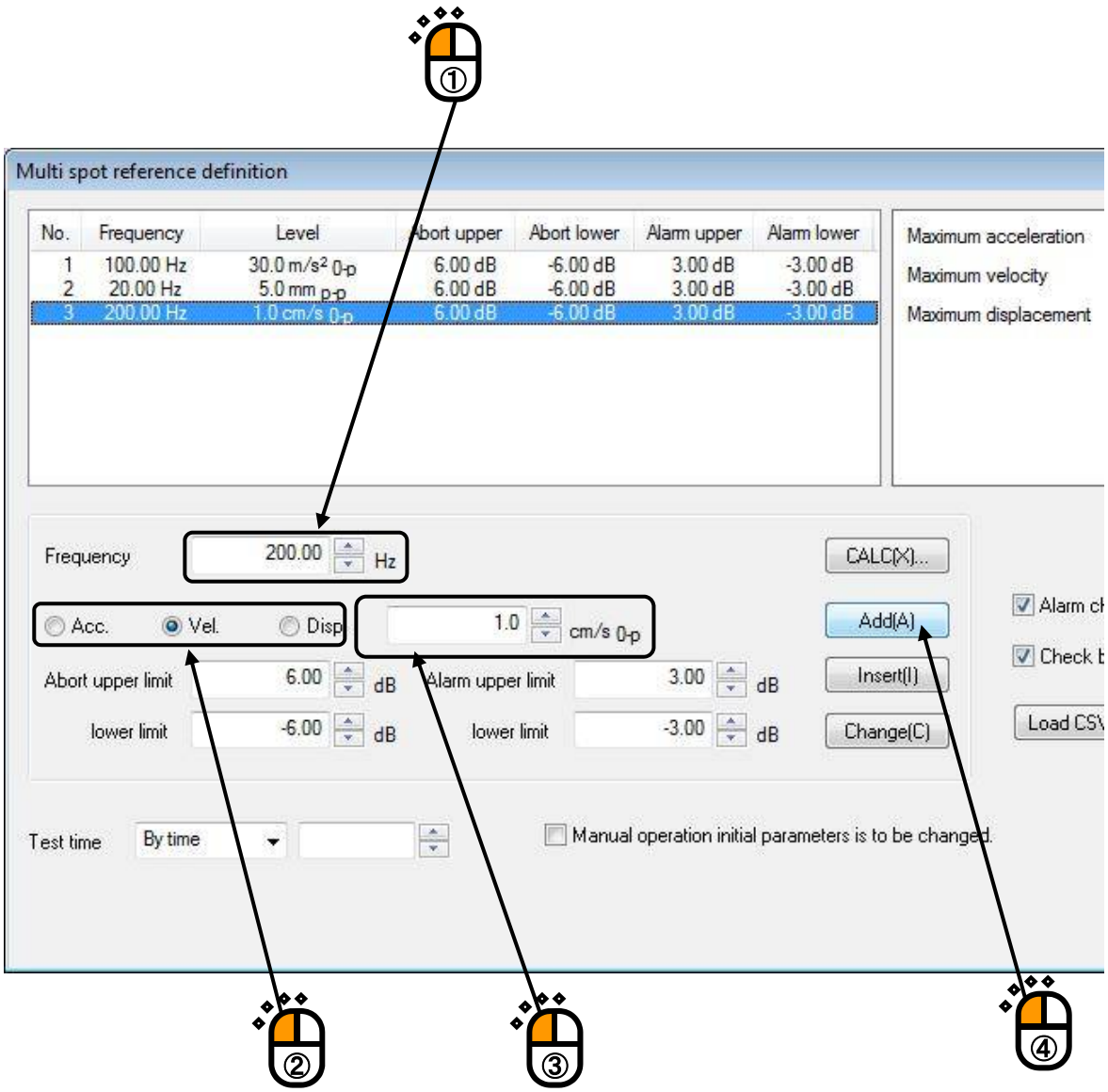
<Step 10>

Specify elements for the second spot. Enter “20 [Hz]” for “Frequency”, and select “Displacement” for “Type”. Enter “5 [mm]” for “Level”, and press the [Add] button.



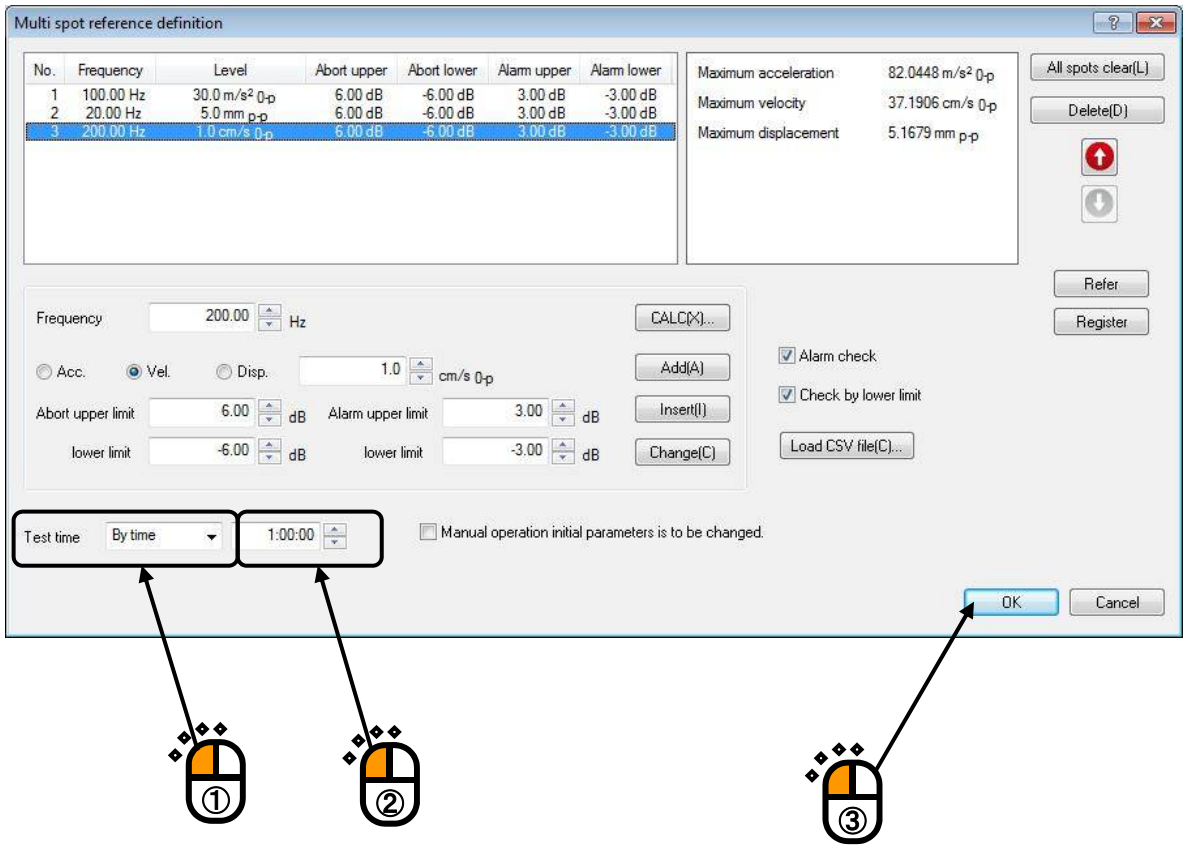
<Step 11>

Specify elements for the third spot. Enter “200 [Hz]” for “Frequency”, and select “Velocity” for “Type”. Enter “1 [cm/s]” for “Level”, and press the [Add] button.



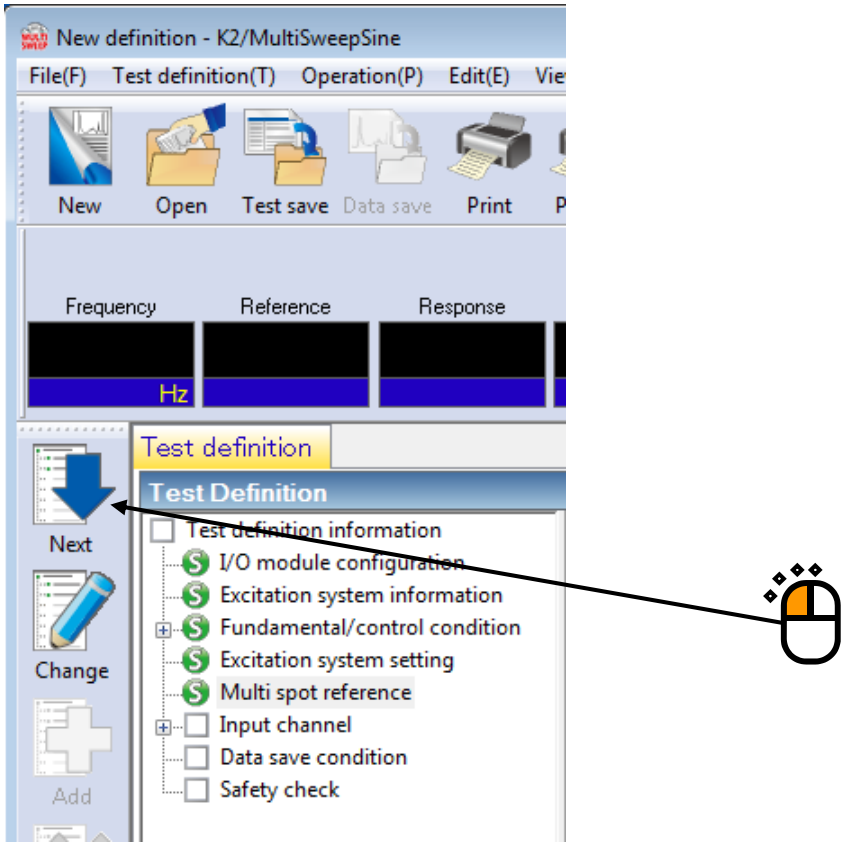
<Step 12>

Make sure that “By time” is selected for test time. Enter “1 [hour]” for the set value, and press the [OK] button.



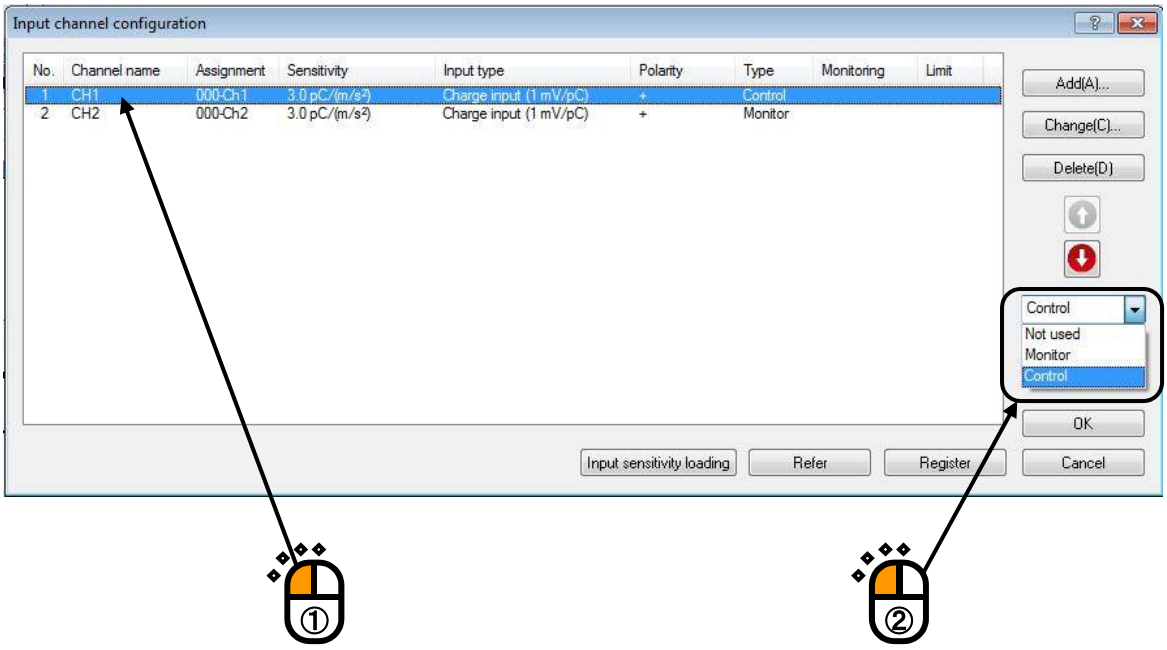
<Step 13>

Press the [Next] button to go to the next definition.



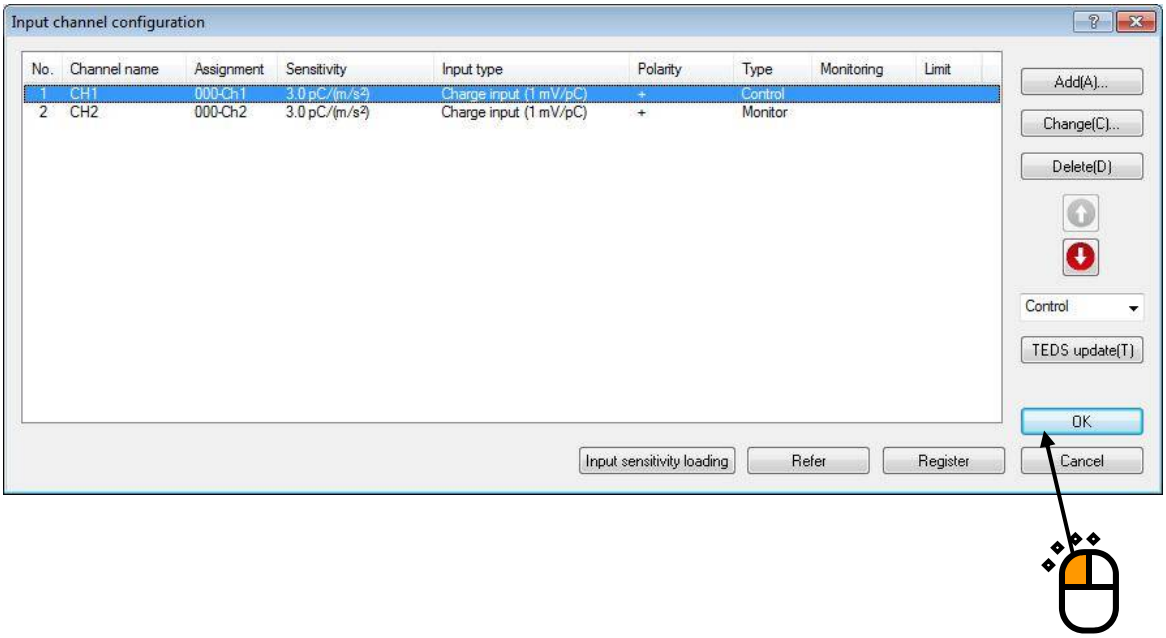
<Step 14>

The “Input channel config” window opens. Select “ch1”, and set “Control” for “Type”. Also, select “ch2”, and select “Monitor”.



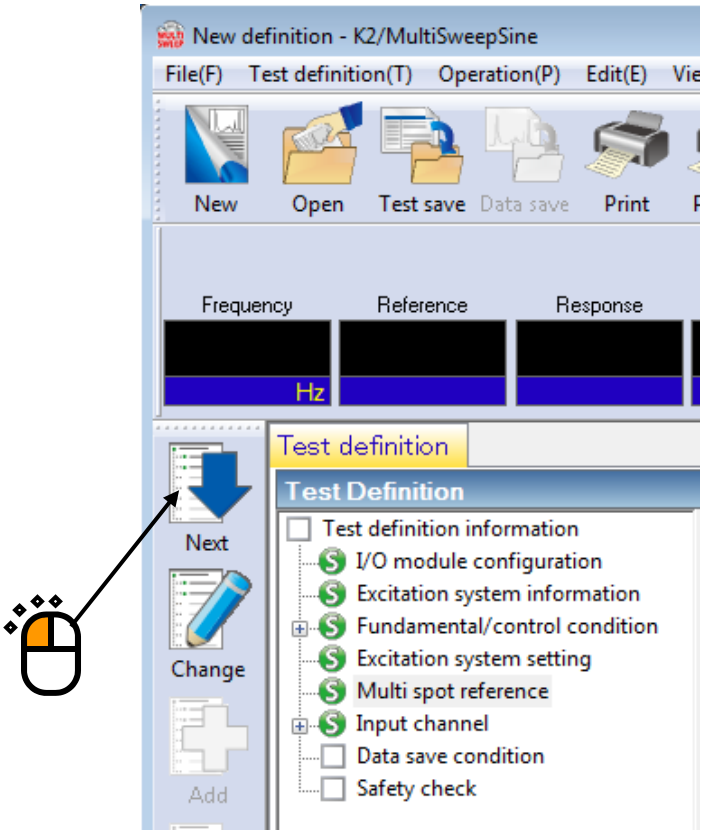
<Step 15>

Press the [OK] button.



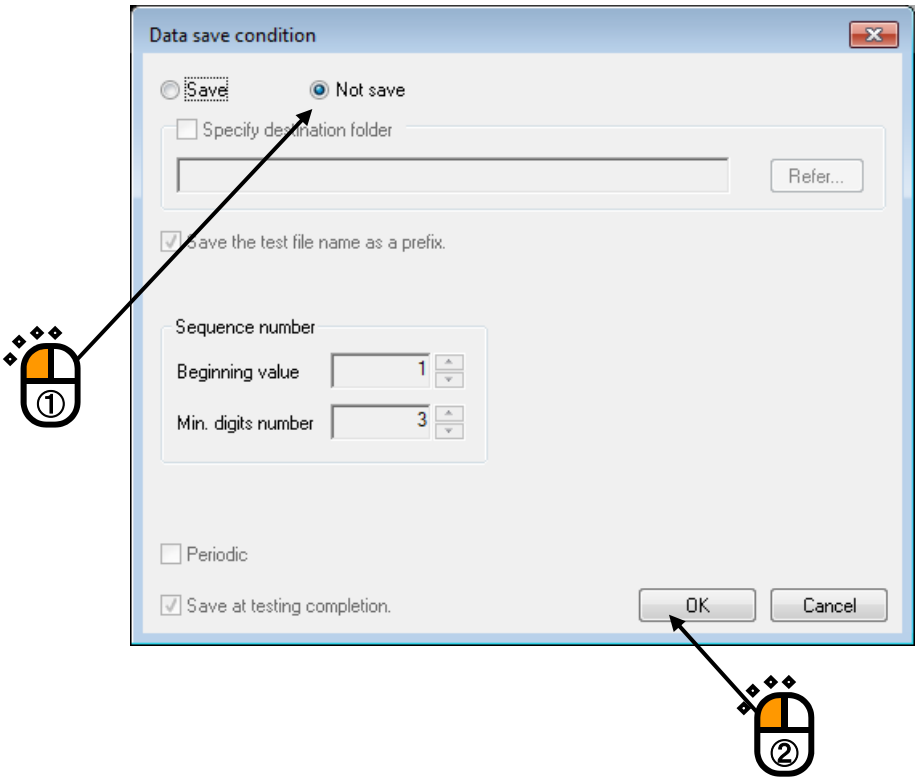
<Step 16>

Press the button of [Next].



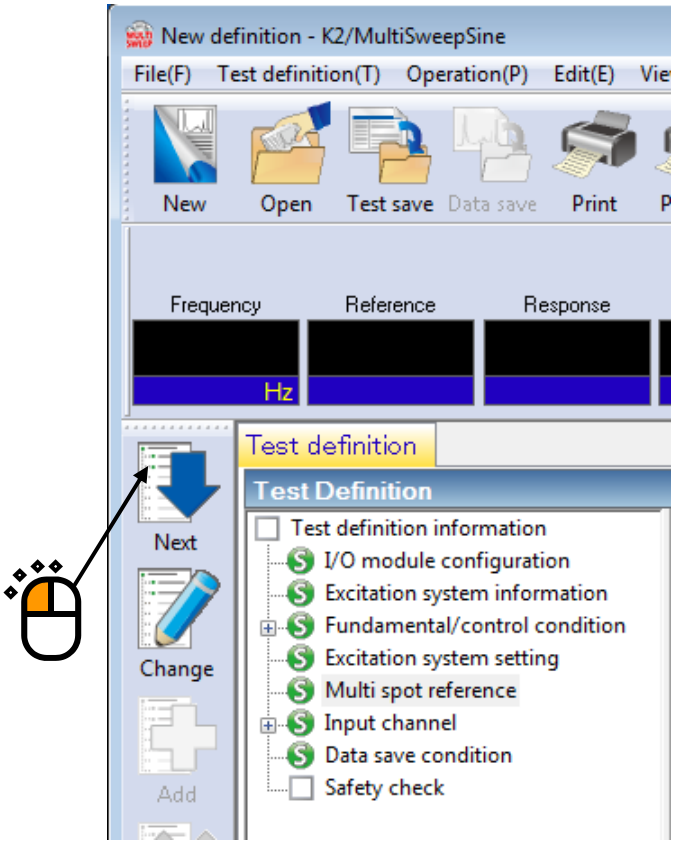
< Step17 >

Select ‘Not save’ and press the button of [OK].



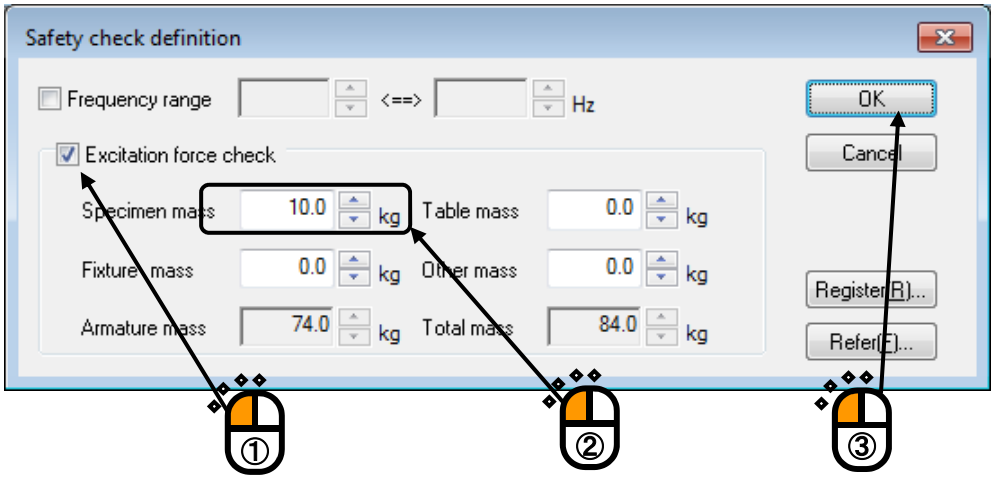
< Step18 >

Press the button of [Next].



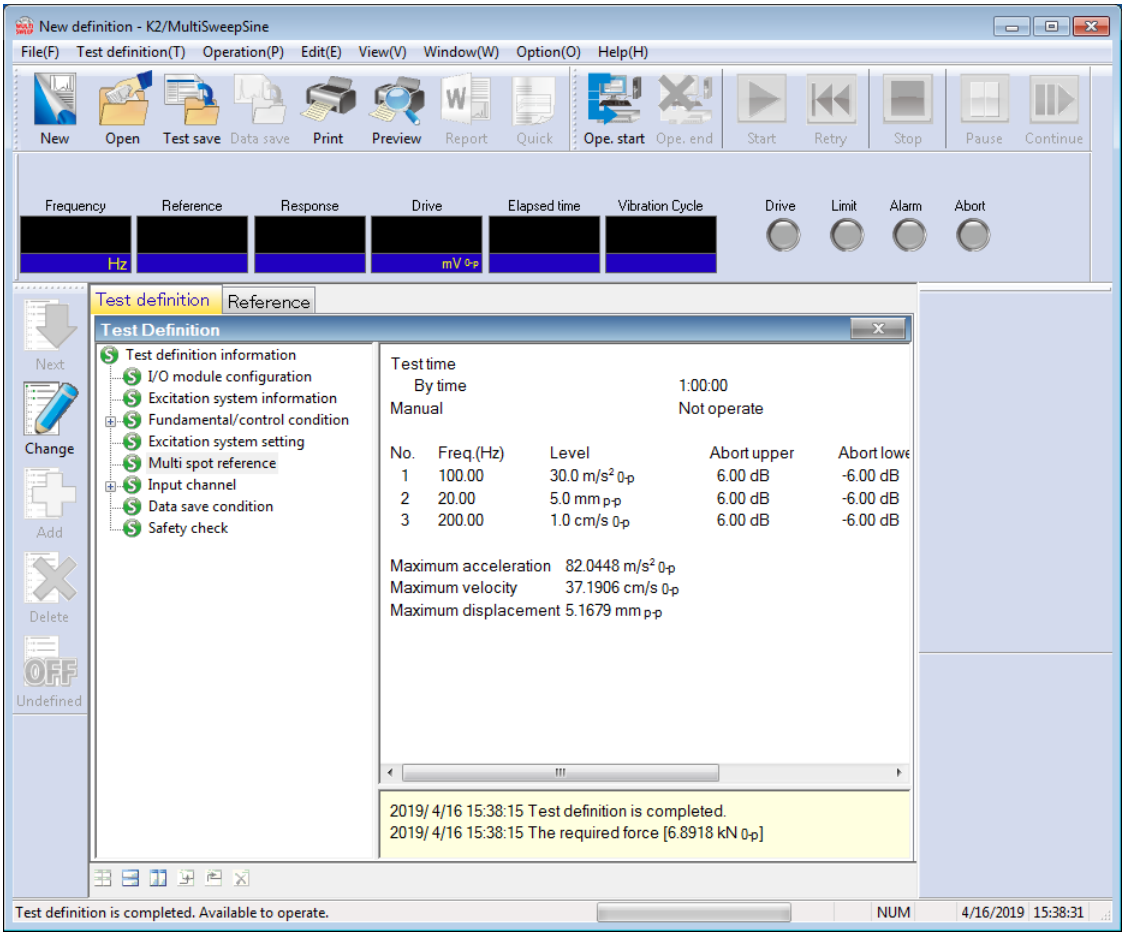
< Step19 >

Select ‘Excitation force check’ and input the value as ‘Specimen mass : 10 [kg]. And press the button of [OK].



< Step20 >

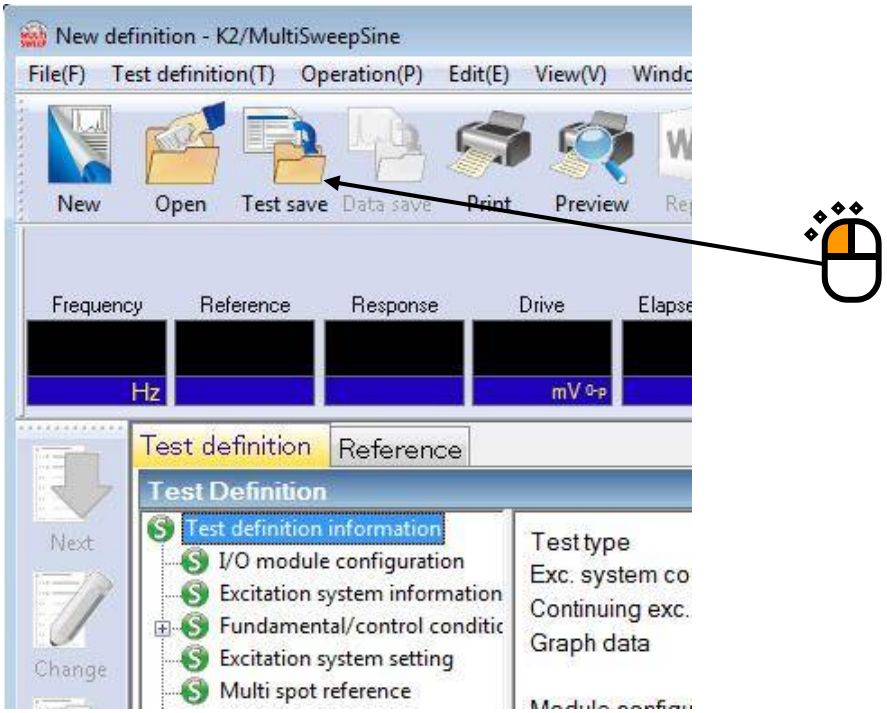
The definition is completed.



<Save of test>

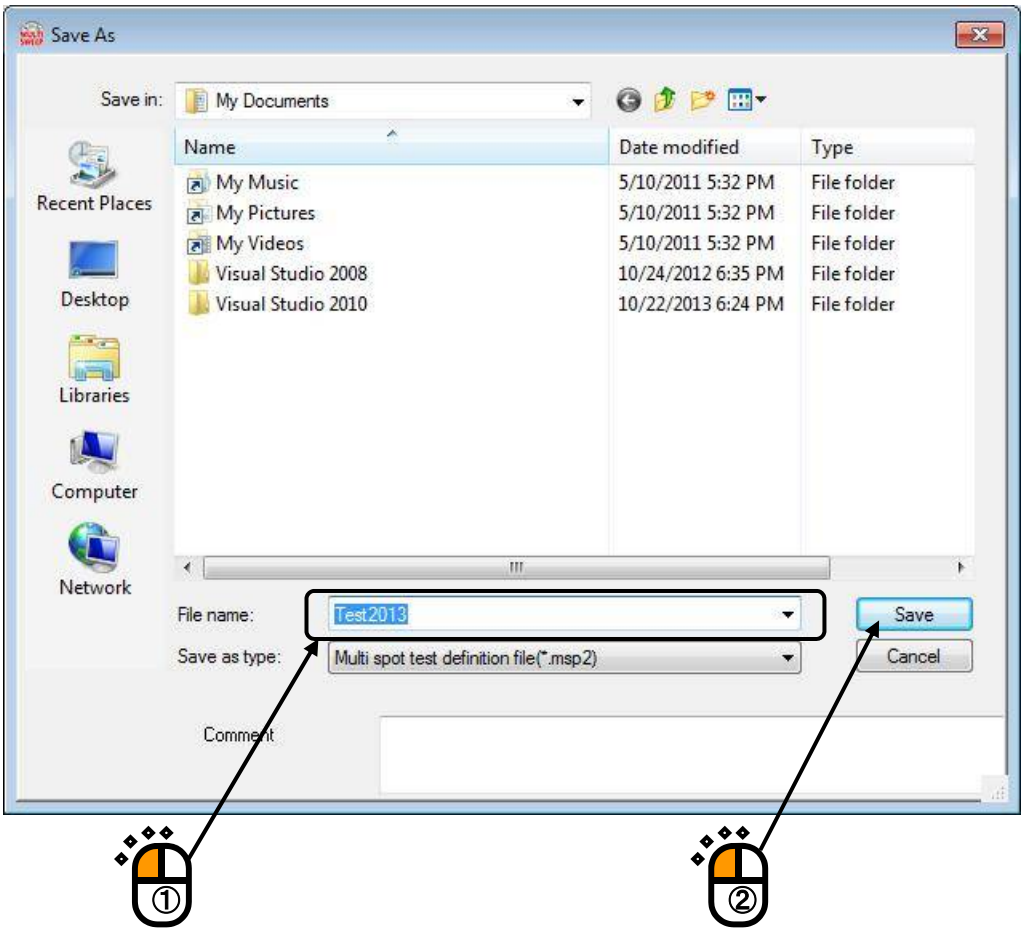
<Step 1>

Press the [Save] button.



<Step 2>

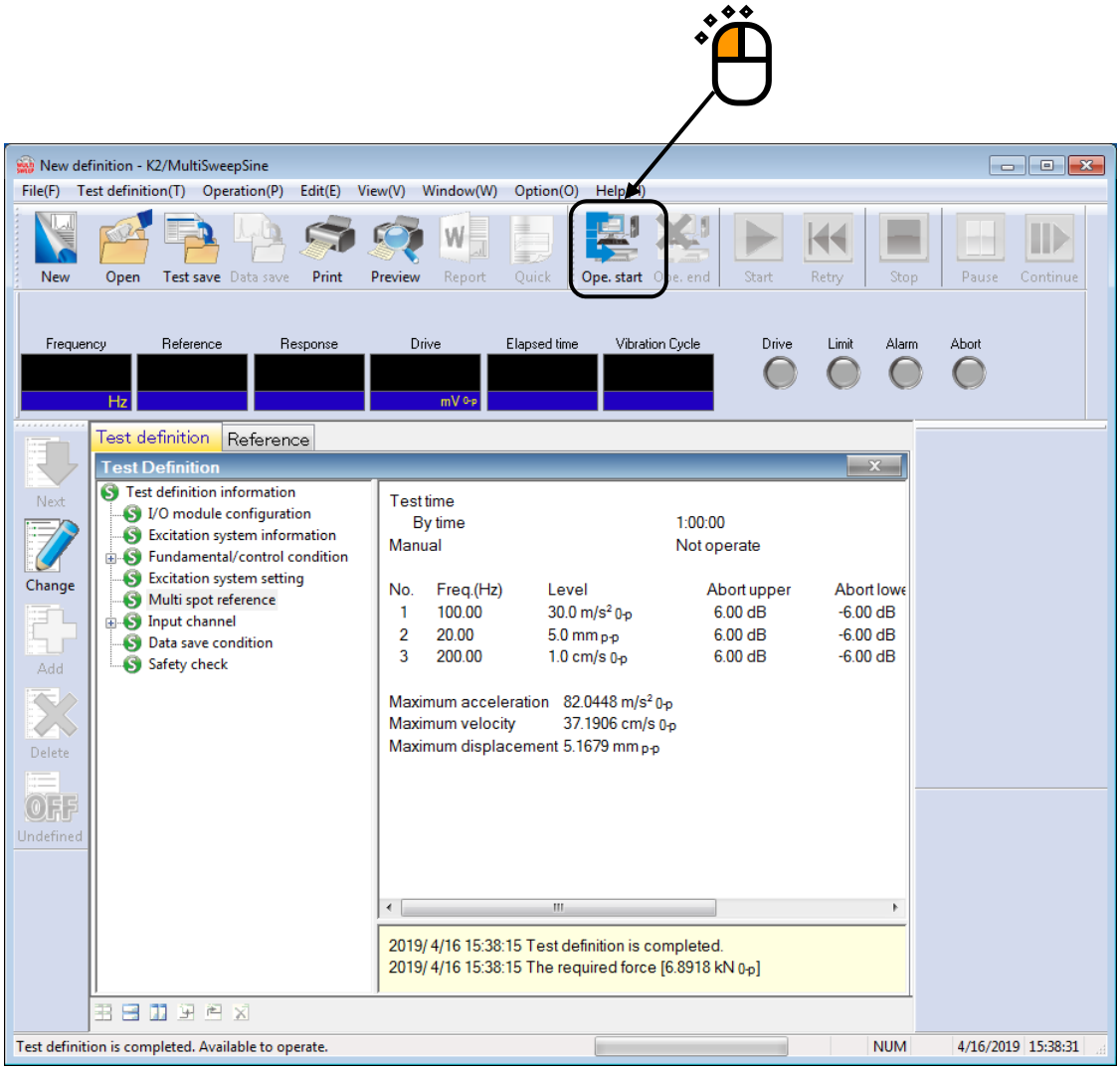
Input a name in 'File name' and press the [Save] button.



<Operation of test>

<Step 1>

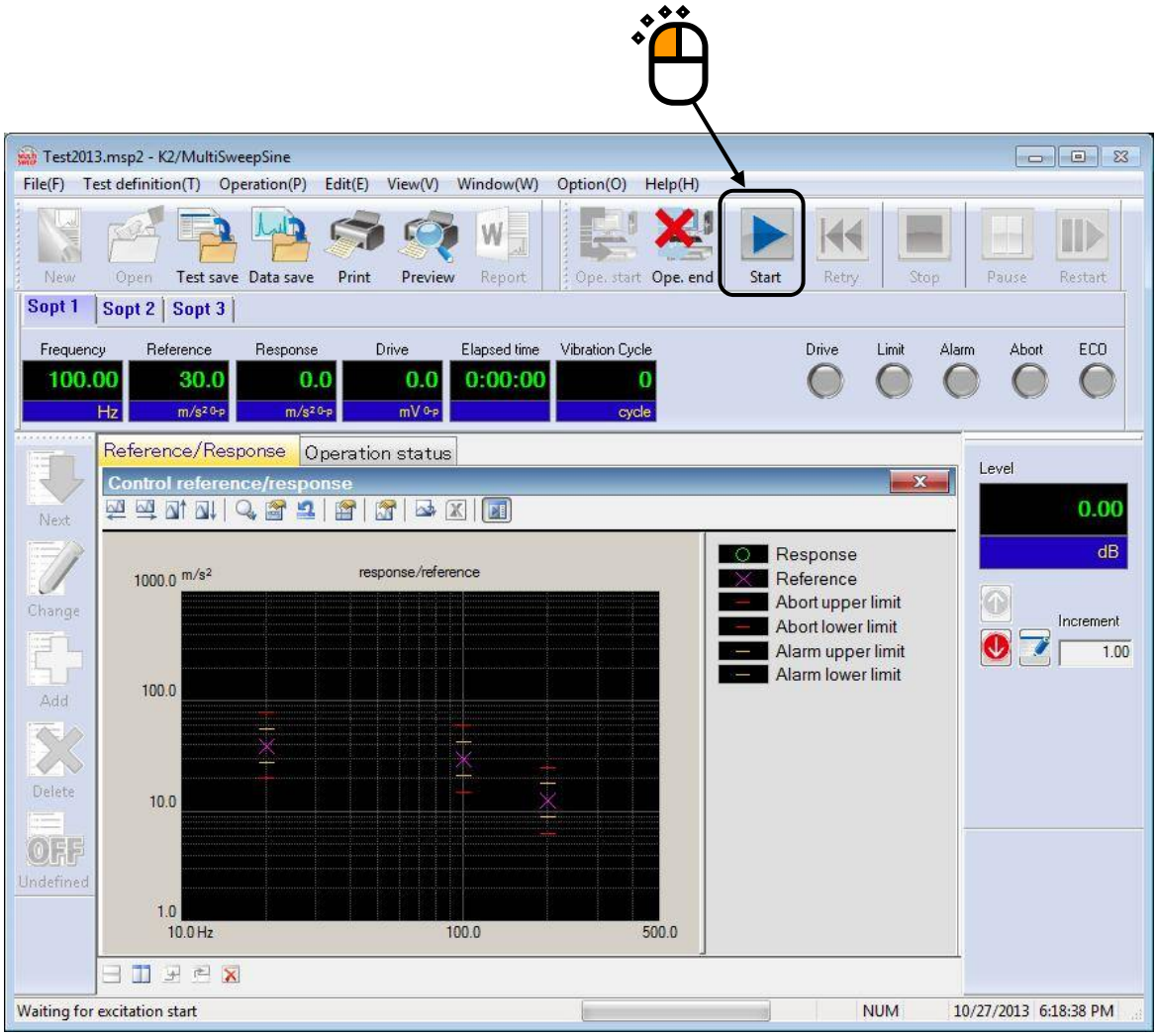
Press the [Ope. start] button. The system shifts from the “Test definition” mode to the “Test operation” mode.



<Step 2>

Press the [Start] button.

Pressing the [Start] button automatically starts initial loop check (if definition is completed), initial measurement and initial equalization, and executes a test at the initial excitation level (in this example, “0 [dB]”).

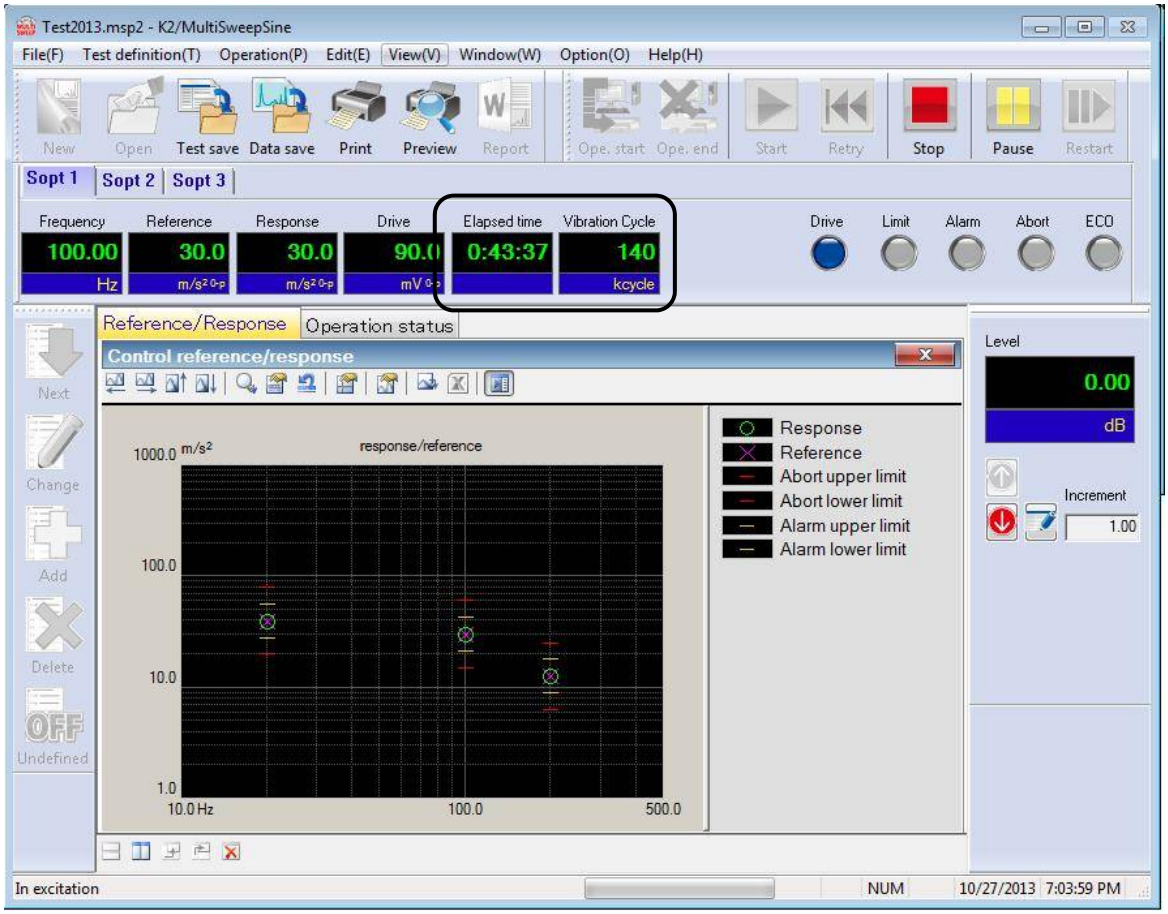


<Step 3>

After the initial equalization is completed, excitation is executed at the initial excitation level (in this example, “0” [dB]), and tests will simultaneously start for all spot elements.

Count of test elapse time will start after the initial equalization for all spot elements. Note that test time is counted only when excitation level is “0 [dB]”.

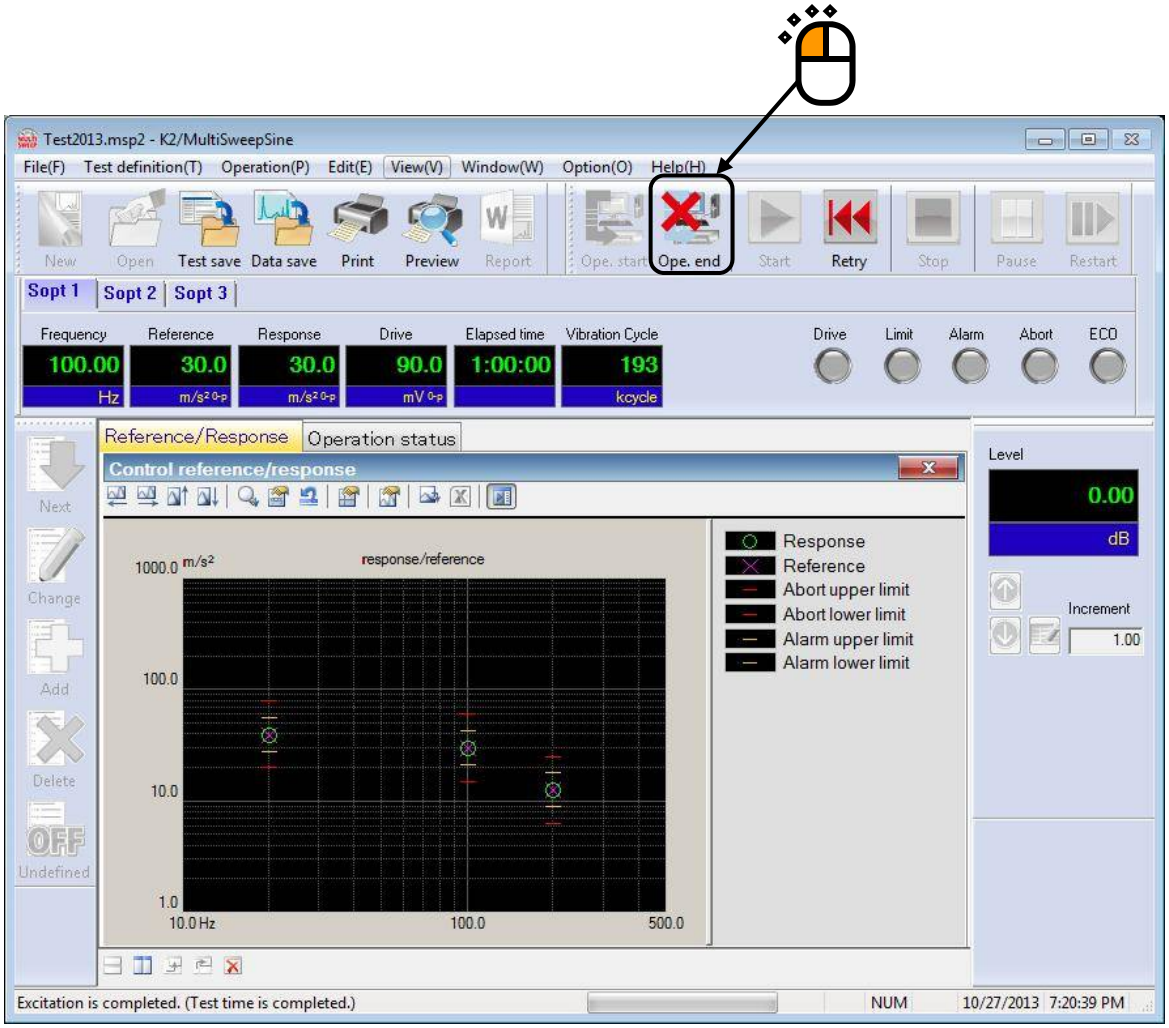
Vibration count is executed for each spot.



<Step 4>

At expiration of the test time, the test ends.

Pressing the [Ope. end] button restores the system to the test definition mode.



Chapter 3 Test Definition

3.1 Outline

In this system, the series of necessary information to operate a test is called “Test”.

It is necessary to define a ‘Test’ at first for the test operation when a specified test is wanted to be operated.

“Test” of the Multi-Sweep Sine system is based on standard Sine tests. In principle, because of the same configuration of definitions, many setting items are the same as those for the standard tests, except for control reference settings.

This chapter describes “Test” definition items different from those of the standard Sine system, and items that need precautions in test operation with the Multi-Sweep Sine system.

“Test” of the Multi-Seep Sine system comprises three types: “Multiple frequency sweep”, “Time delayed sweep”and “Multi spot”.

Table 3-1 shows the items different from those of the standard Sine system for each test type. Specifically, “Control reference” setting items for each test type are different from those of the standard Sine system.

Other setting items for each test type are almost same as those for the standard items.

Table.3-1 Differences from standard Sine system

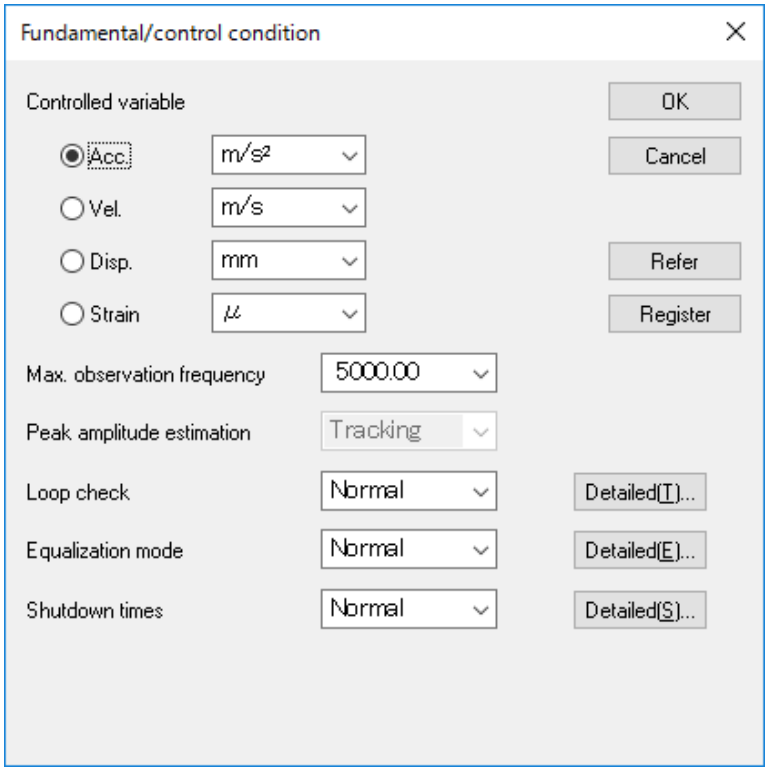
Test Type / Setting Information	Multiple frequency sweep	Time delayed sweep	Multi spot
(1) I/O Module Configuration	Same as the standard Sine system.		
(2) Excitation System Information	Same as the standard Sine system.		
(3) Fundamental/Control Condition	There are differences in peak amplitude estimation method settings. There are differences in loop check setting items.		
(4) Excitation System Setting	In principle, same as the standard Sine system.		
(5) Control Reference	Set Multiple frequency sweep reference.	Set Time delayed sweep reference.	Set multi spot reference.
(6) Input Channel	Same as the standard Sine system.		
(7) Data Save Condition	In principle, same as the standard Sine system.		
(8) Safety check	Same as the standard Sine system.		

Information of Test completely defined is to be saved in a file as a specified format of ‘Test file’

Test operation can be executed by loading a file in which the information of Test defined beforehand is saved as a Test file.

3.2 Fundamental/control condition

Control condition of K2 controller is defined.



Unlike the standard Sine system, the peak amplitude estimation method of the Multi-Sweep Sine system has fixed at “Tracking”. This chapter also describes precautions for operation of the Multi-Sweep Sine system in terms of each setting item.

For details of each setting item, refer to “4.2 Fundamental/Control Condition” of the K2/SINE Instruction Manual.

3.2.1 Max. observation frequency

(1) Meaning

This item is for setting of the maximum frequency (Max. observation frequency fmax) that is used by this system.

With the Multi-Sweep Sine system, calculation load is larger than that for the standard Sine system, because this system controls several sweeps.

Therefore, if the large calculation load causes difficulties in test operation, set this item (Max. observation frequency) as small as possible.

3.2.2 Peak amplitude estimation

(1) Meaning

This item specifies the method for calculating the amplitude (peak value) of the control channel response signal waveform. With the Multi-Sweep Sine system, it is fixed to “Tracking”.

The tracking method allows only fundamental wave components to be extracted from the response signal waveform, and sets the amplitude (peak value) of the waveform as the amplitude estimation value of the response signal. The fundamental waveform component extraction mechanism of this system is based on Fourier integral operation with the drive signal frequency in real time relative to the response signal, which provides higher accuracy than the method using an analog tracking filter.

The Multi-Sweep Sine system executes excitation of several sine waves simultaneously. However, as described above, the tracking method of this system can estimate a peak value at arbitrary frequency, enabling sine waves with different frequencies to be individually controlled.

The settings of the peak amplitude estimation method described here are relative to the response of each control channel for calculation of control response. However, in the same manner as the standard Sine system, you can arbitrarily set the peak amplitude estimation method for monitor response of each input channel. (Refer to input channel configuration.)

3.2.3 Loop check

(1) Meaning

This item is for specifying of the strictness of the criteria for monitoring abnormal events in the control loop during control operation using the loop check function.

Also, the Multi-Sweep Sine system provides two types of loop check: “initial loop check” and “control loop check” In principle, loop check is applied to the control channel. Also, the monitor channel for monitoring the monitor level is subject to loop check.

In the same manner as the standard Sine system, this system allows you to select the error detection judgment criteria for loop check from three levels: “Strict”, “Standard”, “Rough” and the numerical setting method that allows setting of an arbitrary parameter value can be selected.

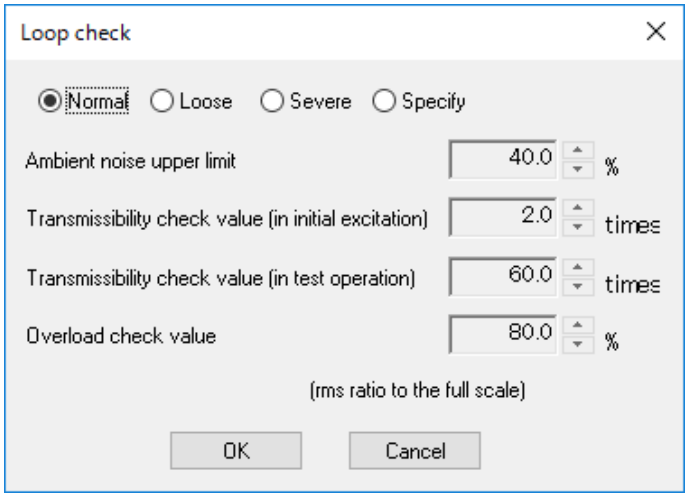
If it is inevitable that the “Standard” setting causes loop check to be aborted depending on the settings of a high sweep rate and a large number of sine waves under simultaneous excitation, as well as depending on the specimen’s characteristics, the “Rough” setting should be selected.

With the Multi-Sweep Sine system, peak value estimation becomes difficult when the number of sine waves increases, causing variations in estimated value. Furthermore, with influence of the specimen’s characteristics, peak value estimation becomes more difficult, and possibility of abortion becomes high. Particularly, this tendency is found with Time delayed sweep test. Also, in this case, the “Rough” setting may be required.

Even a specimen with excellent linearity involves variations in frequency response depending on resonance characteristics, so that change of control loop gain is substantially inevitable in sine wave sweep tests. The change rate is expressed as a function of sweep rate. Therefore, note that the “Rough” setting may be required when the sweep rate is high.

To the loop check setting items of Multi-Sweep Sine, “Ambient noise upper limit “, not provided with normal Sine, is added. This setting item is **intended for specifying the allowable upper limit of the ambient noise (environmental noise) ratio of “Loop check at control state“.** Set value is specified by the ratio of ambient noise to the response level at the initial measurement. If the measured ambient noise exceeds the specified value, the test is aborted. Note that “Ambient noise upper limit“ in the excitation system setting definition is provided, it specifies the allowable upper limit of the environmental noise ratio to the response at the initial loop check.

Other setting items are identical to those of SINE. For details, refer to “4.2.4 Loop check” of the instruction manual for K2/SINE.



3.2.4 Equalization mode

(1) Meaning

This item is for specifying the response speed of the digital feed-back control system composed in this system, when the level control is executed by controlling the drive output level to make the response amplitude estimation value coincide with the value given as the reference level. In the testing which is difficult to control with general setting parameters, applicable setting of this item should not be decided alone. The setting of this item is much related to the sweep rate.

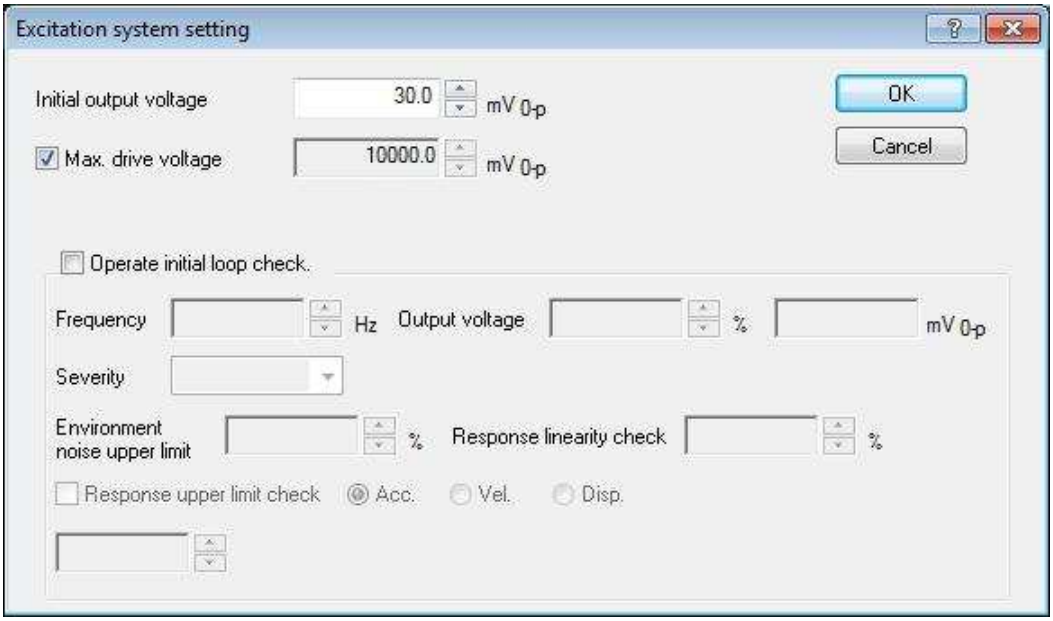
With the Multi-Sweep Sine system, three types of settings (“Steep”, “Standard” and “Moderate”) and the numerical setting method that allows setting of an arbitrary parameter value can be selected, as those for the standard Sine system. Meaning and usage of each item are the same as those of the standard Sine system. In principal, “Standard” should be selected.

Generally, since this system estimates a sine wave peak value at arbitrary frequency during simultaneous excitation of several sine waves, a long analysis time results in preferable results. For the above reason, the analysis time for the two types of tests, i.e. “Time delayed sweep” and “Multi spot” is generally set longer than that of the standard Sine system, although the control speed is reduced.

Also, when the number of sine waves is increased, variations in response amplitude estimation value become large, and loop check may be frequently aborted. In this case, the “Moderate” setting may be effective.

3.3 Excitation system setting

The items of Excitation/Output system for control are defined.



In principle, these setting items are the same as those of the standard Sine system, excepting some items eliminated from the standard Sine system.

Regarding each item, precautions for operation of the Multi-Sweep Sine system are described below.

For details of each setting item, refer to “4.3 Excitation system setting” of the K2/SINE Instruction Manual.

3.3.1 Initial output voltage

(1) Meaning

‘Initial output voltage’ is the voltage that outputted to the shaker at first in control operation.

Also, the Multi-Sweep Sine system starts control at this drive voltage whenever it starts excitation from the drive stop status.

Note) Initial output voltage should be set to an applicable value to the shaker.

3.3.2 Max. drive voltage

(1) Meaning

This item is for setting of the value of Maximum drive voltage of this system.

With the Multi-Sweep Sine system, a composite wave of several sine waves is output as a drive signal. If the peak value of this signal becomes higher than the set value of this parameter, the test will be aborted.

3.3.3 Initial loop check

(1) Outline

This system provides two types of loop check: “initial loop check” and “control loop check”. This parameter specifies whether to enable or disable the initial loop check before start of control operation.

With the Multi-Sweep Sine system, the initial loop check also comprises a series of processing: After measurement of environment noise, the system executes loop check at specified pre-check voltage, and proceeds to system gain measurement while executing excitation at specified frequency and voltage levels.

Initial loop check is executed with a sine wave at specified single frequency regardless of the setting for excitation with several sine waves, in the same manner as the standard Sine system.

Note that the Multi-Sweep Sine system is different from the standard Sine system, in terms of the following two points:

(a) To execute continuous excitation in Time delayed sweep test, this system regularly executes “initial loop check”. For the initial loop check, each check parameter is automatically set as follows:

Particularly, note that the settings of “frequency” and “output voltage” will be automatically changed to “sweep start frequency” and “initial output voltage” respectively, although these items have already been defined.

Execution of initial loop check	ON (Enables check)	OFF (Disables check)
Frequency [Hz]	Sweep start frequency	Sweep start frequency
Output voltage [%]	Initial output voltage	Initial output voltage
Check standard	Check with the value defined for initial loop check	Check with the standard value for initial loop check
Response upper limit value check	Check with the value defined for initial loop check	Disabled

(b) K2/SINE executes the ambient noise measurement only when the “Initial loop check” is executed. K2/Multi-Sweep Sine system executes the ambient noise measurement in the “Loop check at control state” regardless of the execution or non-execution of the “Initial loop check”. The criterion value of ambient noise in the event that the “Initial loop check” is executed is the value defined for this setting item. The criterion value of ambient noise of “Loop check at control state” is the value defined in “3.2.3 Loop check” of the Fundamental/control condition.

3.4 Control reference

This item is for setting of the control reference, and the testing pattern is decided by this item.

For definition of this item, this system provides different methods among individual test types, since a specific definition format is required for each test type. However, control reference definition is based on the test types of the standard Sine system, which is mostly the same as those of the standard Sine system, excepting that some items are added to the Multi-Sweep Sine system.

Multi-Sweep Sine test types	Test types of Standard Sine system as bases
Multiple frequency sweep test	Continuous sweep test Refer to "4.4.1 Sweep test" of the K2/SINE Instruction Manual.
Time delayed sweep test	
Multi spot test	Refer to "4.4.2 Spot test" of the K2/SINE Instruction Manual.

Fundamental setting items for control reference are as follows:

- Reference pattern (Control reference frequency and control reference level)
- Test time (Excitation time)
- Abort/alarm check level

For sweep tests, definition of the above items is as follows: "reference pattern" should be defined by profile, "abort/alarm check level" should be defined by tolerance definition, and "test time" should be defined by number of sweeps, etc. For spot tests, the above four items should be defined as spot elements.

As items for the Multi-Sweep Sine system, a number of divisions of frequency bandwidth should be defined for "Multiple frequency sweep" test, and a number of simultaneous sweeps should be defined for "Time delayed sweep" test.

For "Multi spot" test, all defined spot elements are simultaneously subject to excitation. (No additional items are required.)

Although the standard Sine system provides the "drive reference" function, it is not supported by the Multi-Sweep Sine system.

Refer to the description of each Test type about the detailed definition method.

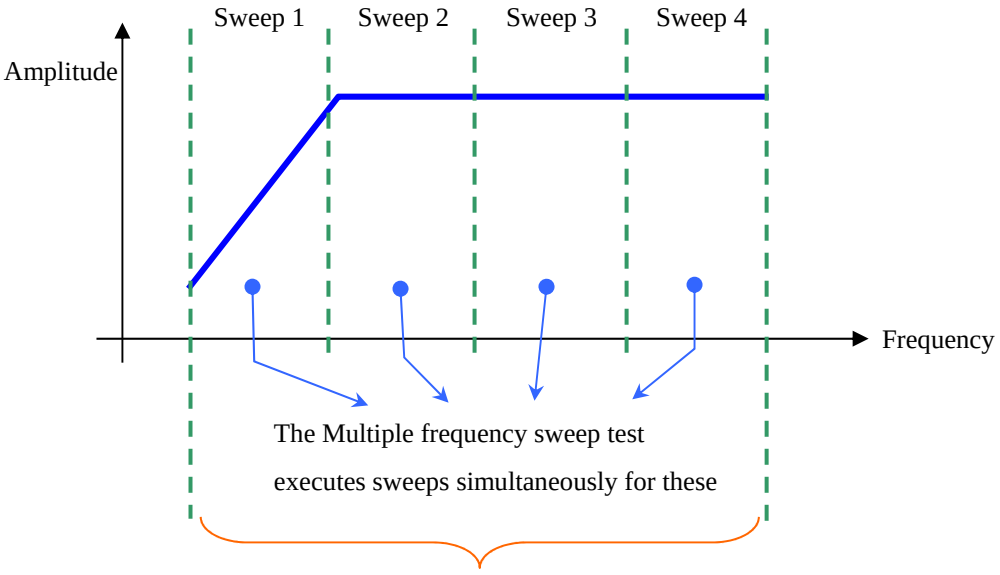
3.4.1 Multiple frequency sweep test

(1) Outline

This item defines control reference for Multiple frequency sweep test.

The sweep test, as a basis of the Multiple frequency sweep test, is the conventional test method that has been most commonly used for sine wave vibration tests, which controls sine waves while continuously changing frequency according to specified conditions.

The test method of Multiple frequency sweep test is the same as that of the standard test, except for a difference that the Multiple frequency sweep test executes simultaneous sweeps with several sine waves for each divided frequency bandwidth, while the standard sweep test executes a frequency sweep with a single sine wave.



The standard sweep test executes a sweep for the whole frequency band with a single sine wave.

The principal definition items for Multiple frequency sweep test control reference are classified into the following four categories:

- Items related to sweep conditions and test time
- Items related to reference pattern
- Items related to control response alarm/abort check
- Bandwidth division frequency designation

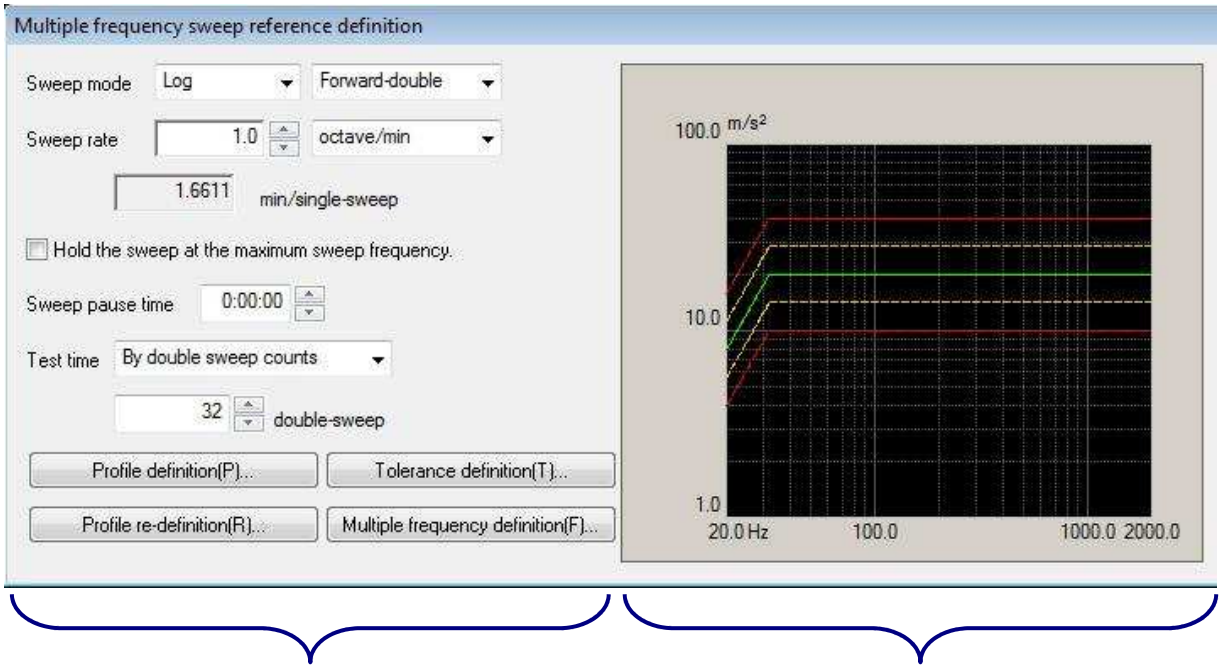
The items related to sweep conditions and test time include sweep mode, sweep direction, sweep rate, sweep pause time and test time.

Reference pattern is defined by profile. The profile specifies the whole frequency bandwidth.

Control response alarm/abort check is defined by tolerance.

Bandwidth division frequency designation is an item newly added to the Multi-Sweep Sine system. This item specifies frequency division bandwidths.

The above control reference is defined in the dialog below.



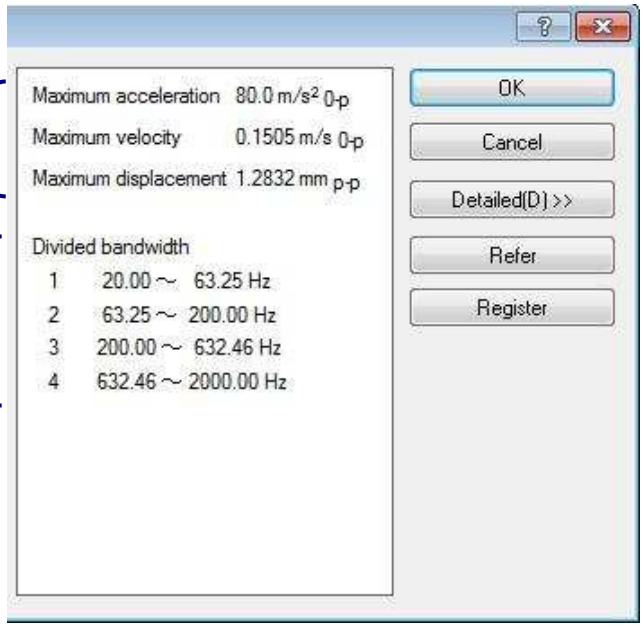
Frequency reference setting item

Whole frequency band profile

The system calculates the maximum value based on the reference definition settings, and compares the maximum value with the rated value to judge whether the test result is acceptable or not.

If the control value is set to “acceleration”, “velocity” or “displacement”, the maximum values of these three physical quantities are displayed.

Bandwidth to divide the reference profile



Operation button

In principle, the setting items are the same as those of the standard Sine system, except for "Bandwidth division frequency designation", as listed below.

Setting item	Comparison with K2/SINE continuous sweep test
Sweep mode	Same as K2/SINE. Refer to "4.4.1.1" of the Instruction Manual.
Sweep direction	Same as K2/SINE. Refer to "4.4.1.2" of the Instruction Manual.
Sweep rate	In principle, same as K2/SINE. Refer to "4.4.1.3" of the Instruction Manual.
Sweep fixed at maximum sweep frequency	Same as K2/SINE. Refer to "4.4.1.4" of the Instruction Manual.
Sweep pause time	Same as K2/SINE. Refer to "4.4.1.5" of the Instruction Manual.
Test time	In principle, same as K2/SINE. Refer to "4.4.1.8" of the Instruction Manual.
Profile definition	Same as K2/SINE. Refer to "4.4.1.6" and "4.4.4 Profile definition" of the Instruction Manual.
Tolerance definition	Same as K2/SINE. Refer to "4.4.1.7" and "4.4.5 Tolerance definition" of the Instruction Manual.
Bandwidth division frequency designation	Newly added item

3.4.1.1 Sweep rate

(1) Outline

The Multi-Sweep Sine system also supports two types of methods for setting a sweep rate: “setting by time required for one sweep”, and “Setting by sweep rate”.

The setting units are the same as those of the standard Sine system, as listed below:

Sweep rate setting method	Log. sweep	Linear sweep
(a) Setting by time required for one sweep	min/Single-Sweep	min/Single-Sweep
(b) Setting by sweep rate	octave/min	Hz/sec

For Multiple frequency sweep, the system executes sweep in each bandwidth at the sweep rate specified by this item. Although it is assumed that individual bandwidths are different, the relationship between the sweep rate and the time required for one sweep in the specified setting method is shown below.

(a) Setting by time required for one sweep

The system calculates a sweep rate by applying the time specified for the widest bandwidth. The system executes sweep in each bandwidth by using the calculated sweep rate. This value is displayed as sweep rate (ratio of frequency change to time change) at the bottom of the setting area of the definition screen.

(b) Setting by sweep rate

The system executes sweep in each bandwidth by using the specified sweep rate. The sweep time is displayed under the specified rate. The time is calculated from the rate specified for the widest frequency band.

As described above, we can assume a case where all sweeps are not simultaneously completed depending on individual bandwidths. In this case, note that the sweep return and end timing is delayed until all sweeps reach the sweep pause frequency. If one sweep has reached the sweep pause frequency earlier and must wait for other sweep to reach the pause frequency, excitation continues at the sweep pause frequency.

3.4.1.2 Profile definition

(1) Outline

This item is for setting of the break point definition of control reference. For Multiple frequency sweep, break points for the whole bandwidth should be defined.

For details of profile definition, refer to “4.4.4 Profile Definition” of the K2/SINE Instruction Manual.

3.4.1.3 Test time

(1) Outline

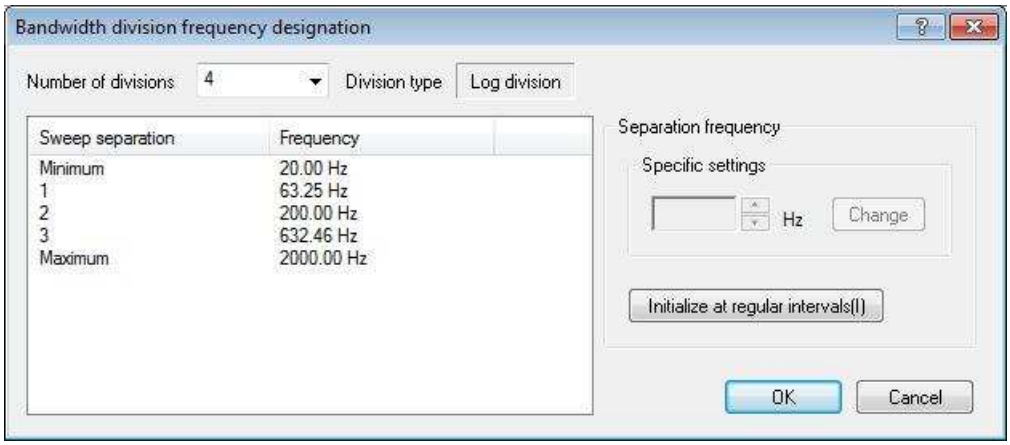
This item is for setting of the operation time of a test. The Multi-Sweep Sine system provides the following methods for setting a test time: “By single sweep count”, “By double sweep count”,“By time” and “Infinite”.

This system does not support the setting method of “by vibration cycle”, although it can be selected with the standard Sine system.

3.4.1.4 Bandwidth division frequency designation

(1) Outline

This item specifies the frequencies to divide the whole bandwidth that has been defined in reference profile. Once a “number of divisions” is defined, the system automatically calculates and sets the frequencies to separate each bandwidth. Each separation frequency setting can be changed to an arbitrary value.



3.4.1.4.1 Number of divisions

(1) Meaning

Select a number of divisions of the frequency bandwidth that has been defined in reference profile.

Up to 16 divisions can be selected.

Once this parameter is set, the system automatically calculates and sets separation frequencies at equal intervals depending on the sweep mode.

3.4.1.4.2 Separation frequency

(1) Meaning

This parameter specifies frequencies that separate each frequency bandwidth. The system automatically calculates separation frequencies, which can be changed to arbitrary values.

To change a frequency that has been automatically calculated, select it from the list, change it to an arbitrary value, and press the [Change] button. The separation frequencies should be set in ascending order from the minimum value, and adjacent ones should not be close to each other.

3.4.1.4.3 Initialize at regular intervals

(1) Meaning

The system automatically calculates and re-configures each separation frequency by the selected number of divisions so that they are arranged at equal intervals depending on the sweep mode.

3.4.2 Time delayed sweep test

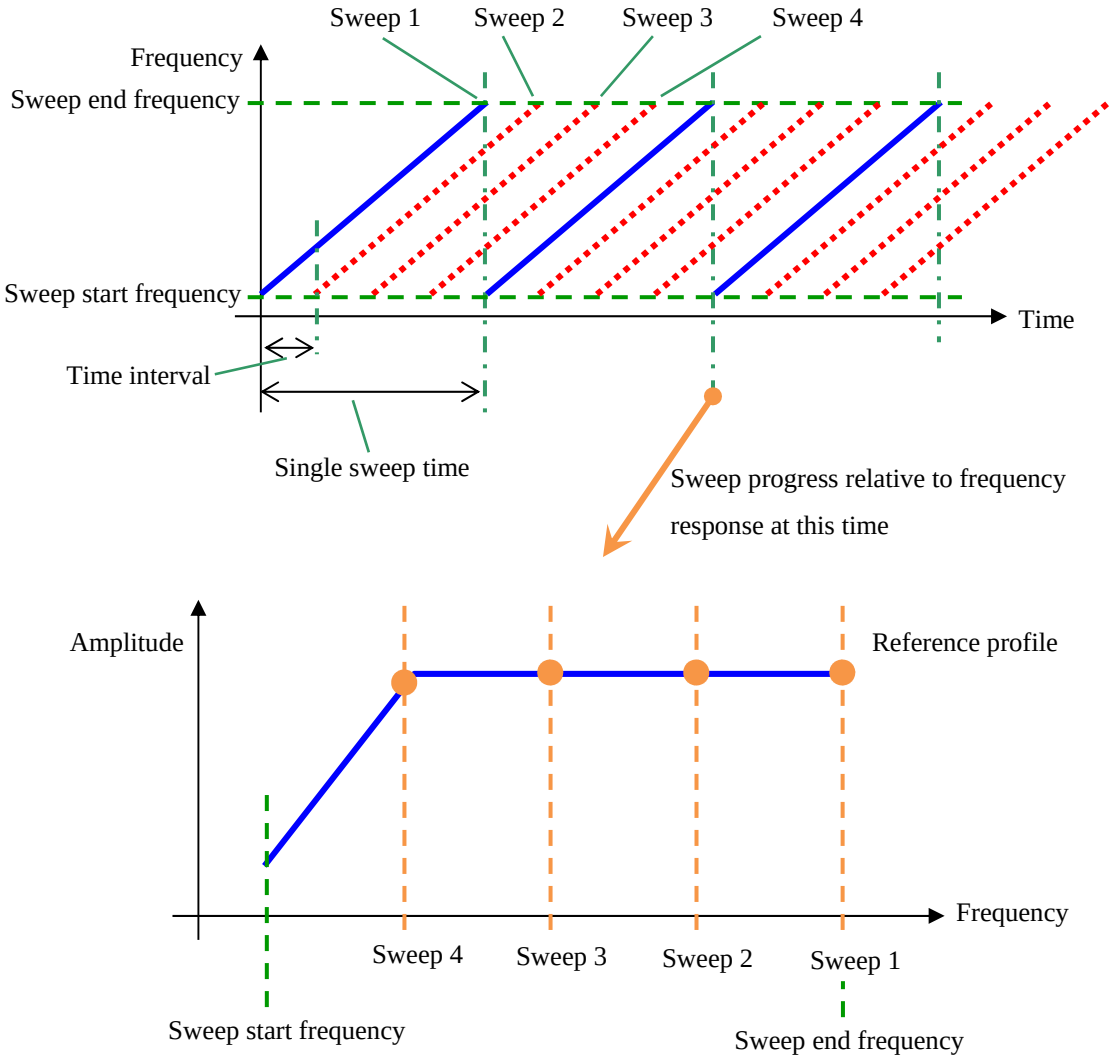
(1) Outline

This item defines control reference for Time delayed sweep test.

Time interval test, as well as Multiple frequency sweep test, is based on the continuous sweep test that controls a sine wave while continuously changing frequency.

Therefore, Time delayed sweep test procedure is the same as that for the standard sweep test, excepting for the following point: The standard sweep test executes a frequency sweep with a single sine wave, but the Time delayed sweep test starts sweeps at specified time intervals (time interval) so that sweeps are simultaneously executed with several sine waves.

A conceptual image of the relationship between time and sweep frequency is shown below. In case of the standard Sine test, a next sweep will start after the previous one is completed as indicated by the solid line. For Time delayed sweep test, however, the system executes sweeps simultaneously by starting sweeps at specified time intervals.



The principal items for Time delayed sweep test control reference definition are classified into the following four categories:

- Items related to sweep conditions and test time
- Items related to reference pattern
- Items related to control response alarm/abort check
- Number of simultaneous sweeps

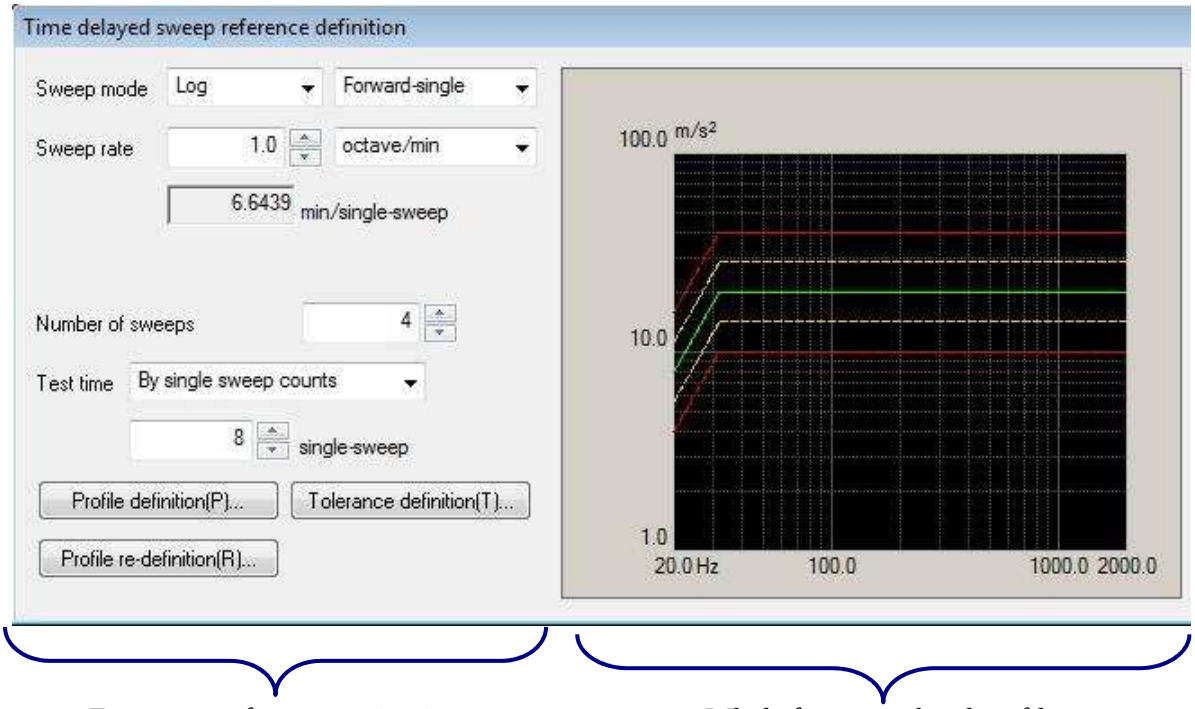
The items related to sweep conditions and test time include sweep mode, sweep direction, sweep rate, sweep pause time and test time.

Reference pattern is defined by profile.

Control response alarm/abort check is defined by tolerance.

“Number of simultaneous sweeps” is the time newly added to the Multi-Sweep Sine system. This item specifies a number of sweeps to be simultaneously executed. Sweep time interval is automatically determined by the setting of number of simultaneous sweeps.

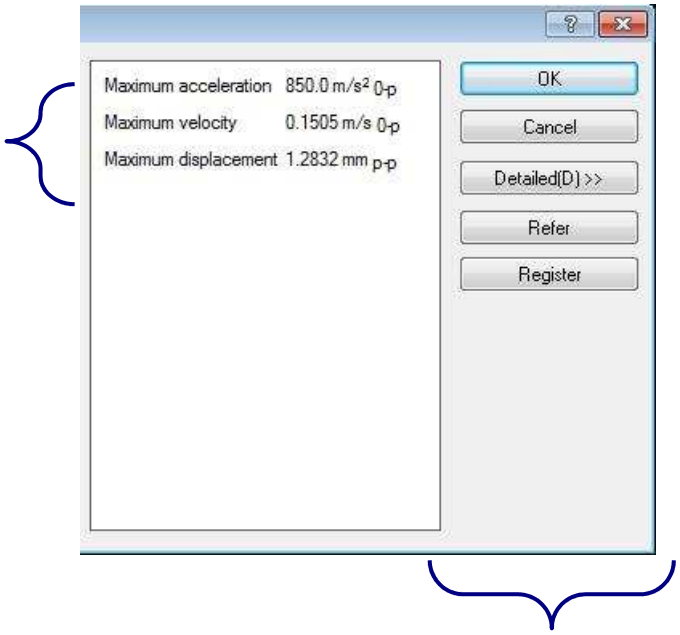
The above control reference is defined in the dialog below.



Frequency reference setting item

Whole frequency band profile

The system calculates the maximum value based on the reference definition settings, and compares the maximum value with the rated value to judge whether the test result is acceptable or not.
If the control value is set to “acceleration”, “velocity” or “displacement”, the maximum values of these three physical quantities are displayed.



In principle, the setting items are the same as those of the standard Sine system except for “number of simultaneous sweeps”, as listed below.

Setting item	Comparison with K2/SINE continuous sweep test
Sweep mode	Same as K2/SINE. Refer to “4.4.1.1” of the Instruction Manual.
Sweep direction	Only “Single” can be set. “Double” cannot be set. Refer to “4.4.1.2” of the Instruction Manual.
Sweep rate	Same as K2/SINE. Refer to “4.4.1.3” of the Instruction Manual.
Test time	In principle, same as K2/SINE. Refer to “4.4.1.8” of the Instruction Manual.
Profile definition	Same as K2/SINE. Refer to “4.4.1.6” and “4.4.4 Profile definition” of the Instruction Manual.
Tolerance definition	Same as K2/SINE. Refer to “4.4.1.7” and “4.4.5 Tolerance definition” of the Instruction Manual.
Number of simultaneous sweeps	Newly added item

For Time delayed sweep test, settings of “Sweep fixed at maximum sweep frequency” and “Sweep pause time” settings are disabled.

3.4.2.1 Sweep direction

(1) Outline

Even with the Multi-Sweep Sine system, a test cannot be executed with sweep frequencies being crossed. Therefore, for Time delayed sweep test, only “single sweep” can be defined, but the “double sweeps” setting is disabled. Either “Forward – single” or “Backward – single” should be selected.

Because operation for “Double sweeps” is disabled, the “sweep reverse” function is not available with the “Manual Operation Box”.

3.4.2.2 Test time

(1) Outline

This item specifies a test operation time. The Multi-Sweep Sine system provides the following methods for setting a test time: “By single sweep count”, “By time” , and “Infinite”.

Settings of “By double sweep count” and “By vibration cycle” are not available, although these items can be selected with the standard Sine system.

3.4.2.3 Number of simultaneous sweeps

(1) Meaning

This item specifies a number of sweeps to be simultaneously executed. Up to 16 sweeps can be set.

The system automatically calculates a time interval between individual sweeps based on the settings of this item (number of simultaneous sweeps) and “sweep rate”. For a setting of time interval shorter than 5 seconds, there is limitation so that the definition cannot be completed. In this case, try to correct the following setting so that the time interval becomes 5 seconds or longer:

- Reduce the number of sweeps.
- Lower the sweep rate.

These setting changes are also effective in case where “frequency overlap” error occurs during operation.

3.4.3 Multi spot test

(1) Outline

This item defines control reference for multi spot test.

For the spot test of the standard Sine system as a basis of the multi spot test, the excitation frequencies and reference levels should be specified in advance, and the Sine system executes excitation in sequence according to the specified conditions. In the spot test, sweep is not executed.

On the other hand, for the multi spot test, the procedure of setting several frequencies and reference levels is the same as the above method. However, it is different in that the multi spot test executes excitation simultaneously at all spots according to combinations of the frequencies and reference levels, while the standard spot test executes excitation in sequence.

Also, for the multi spot test, excitation frequencies and reference levels should be directly specified. The control reference is defined by a set of frequency, reference level and alarm/abort level. With this system, the control reference is called “spot element”. However, since this system executes excitation simultaneously, time setting is not required for each element. Specifically, note that the stay time setting for the standard spot test is eliminated, but “test time” setting is required as well as for other tests.

Spot elements : ① Frequency
② Reference level
③ Alarm/Abort level

Since the multi spot test executes excitation simultaneously at each spot, the order of spot element definition is meaningless. The order of each spot definition is free, as well as that for the standard spot tests. However, a difference from the standard spot test is that definition of a spot element with frequency close to that of other spot element is disabled.

Also, for the multi spot test, if the “definition unit” is “Acceleration/Velocity/Displacement”, the reference level setting unit can be selected from “Acceleration/Velocity/Displacement” for each spot.

Assuming that a “n-th” spot element is expressed as “SP#n”, for example, the SP#1 setting can be “Acceleration:100 m/s^2 at 200 Hz”, and the SP#2 setting can be “Displacement: 20 mm at 10 Hz”.

The maximum allowable number of spot elements is 64.

As described above, the multi spot test needs “Test time” setting, as well as other tests. Although the standard spot tests can be repeated for a series of defined spots by the specified number of cycles, the multi spot test executes excitation simultaneously for all elements, so that the repeat function is meaningless and eliminated.

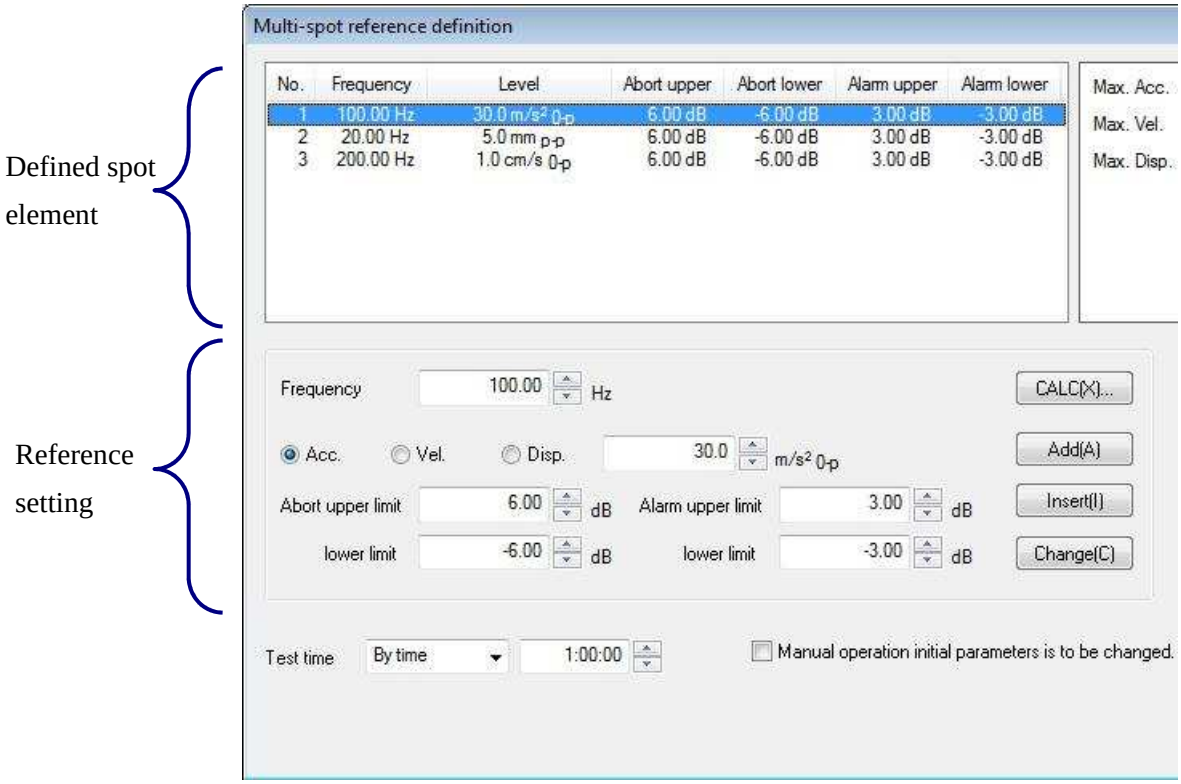
3.4.3.1 Multi spot reference definition

(1) Meaning

This item is for defining the spot element. Up to 64 spot elements can be registered.

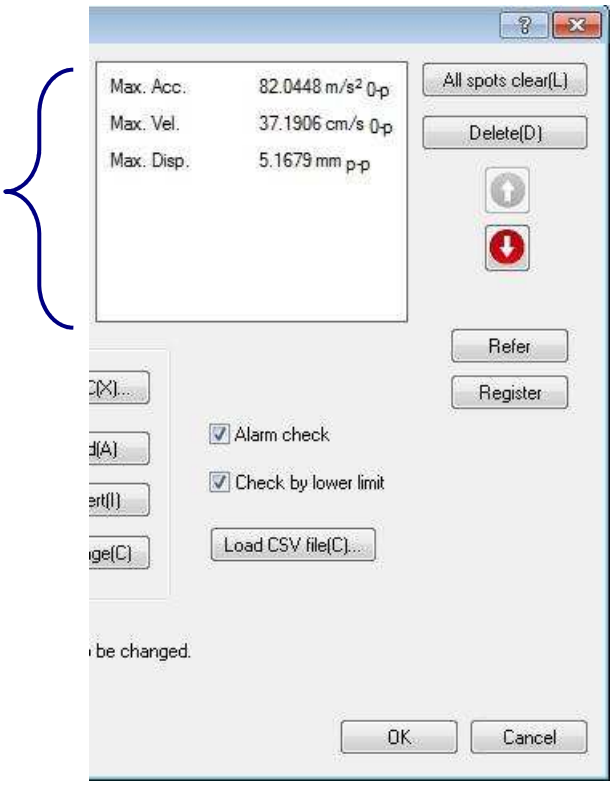
In principle, the multi spot test setting items are the same as those of the standard Sine system, except for addition of “Test time” setting item or deletion of some other items.

For details of each item, refer to “4.4.2 Spot test” of the K2/SINE Instruction Manual.



The system calculates the maximum value based on the reference definition settings, and compares the maximum value with the rated value to judge whether the test result is acceptable or not.

If the control value is set to “acceleration”, “velocity” or “displacement”, the maximum values of these three physical quantities are displayed.



3.4.3.1.1 Test time

(1) Meaning

This item specifies a test operation time.

This system provides the following two types of methods for setting a test time.

1. By time

Specify an excitation time.

At elapse of the specified time, the test ends.

For setting of the test time, the following two methods are available.

For example, to set the test time at “1 hour”:

- Enter “3600” (setting by second).
- Enter “1:0:0” (by separating “hour, minute, second” with colon (:))

2. Infinite

“Infinite” means that no test end condition is specified by this item.

If “Infinite” is selected, this system continues excitation according to the specified conditions until a stop command or equivalent operation is executed.

3.5 Input channel

3.5.1 Outline

Definition of the input channels of the Multi-Sweep Sine system is the same as that for the standard tests.

Refer to "4.5 Input Channel" of the K2/SINE Instruction Manual.

The input channels are provided in the following two types:

- Control channels
- Monitor channels

In this system, all of the used input channels are defined as Monitor channels.

Therefore, Control channels also have the function as Monitor.

Control channels are important one of which response signals are controlled to meet with the control reference given beforehand.

The physical quantity controlled by each Control channel must have the same dimension. However, when the controlled variable is specified as one among Acceleration/Velocity/Displacement, the physical quantity of the Control channel can be selected arbitrary to the one among Acceleration/Velocity/Displacement. (The control unit specified in Fundamental/Control definition decides the graph of Control channel.)

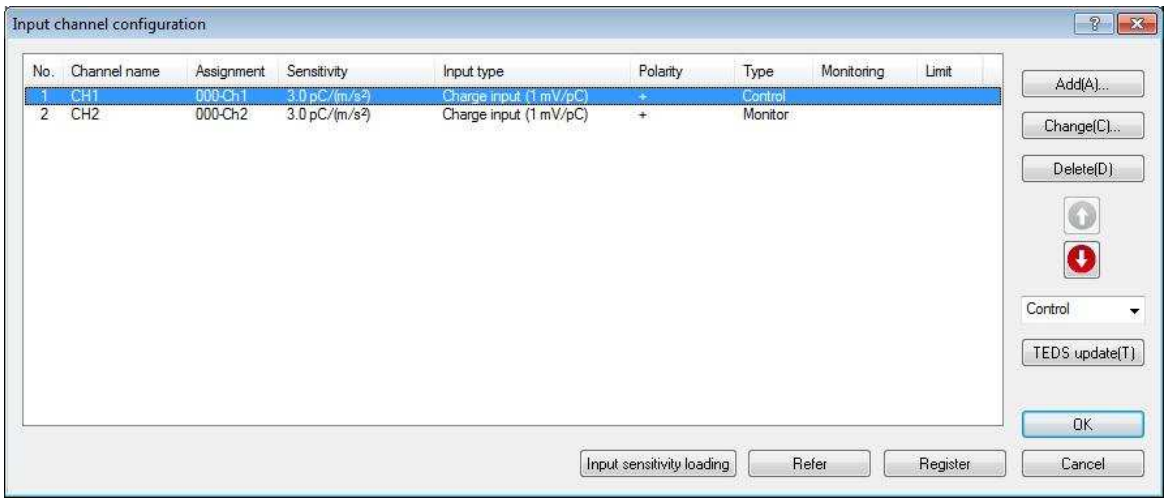
3.5.2 Input channel

Input channels to be used are defined in the dialog of Input Channel.

There are two methods of input channel definition as below:

Define the input channel at each Test Definition.

Define the input environment information.



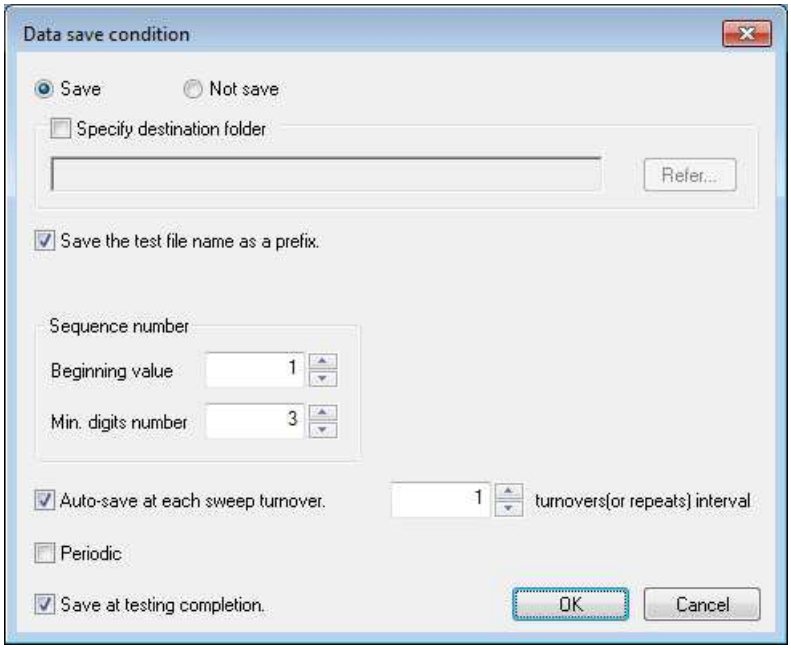
3.6 Data save condition

3.6.1 Outline

This function is for setting of each item for saving the data measured in a test operation to the hard disc.

With the Multi-Sweep Sine system, all data that have been measured during test are saved in one binary file (*.vdf2), as the data of the standard Sine system can be saved.

However, the data that can be saved are those measured “during test” only. Data during “initial measurement” and “initial equalization” cannot be saved.



3.6.2 Save condition of data

In principle, data save conditions of the Multi-Sweep Sine system are the same as those for the standard Sine tests.

For details of each setting item, refer to “4.7 Data Save Condition” of the K2/SINE Instruction Manual.

For “Multiple frequency sweep” test, data will be saved at the sweep pause timing, as the data of the standard Sine system are saved. However, note that sweep pause timing means a time when all sweeps reach the pause frequency.

If “Save at each pause timing” is specified for “Time delayed sweep” test, the system saves data at the timing when any sweep reach the pause frequency while several sweeps are under excitation.

For “multi spot” test, the item of “Save at each pause timing” is not provided.

3.7 Operation status

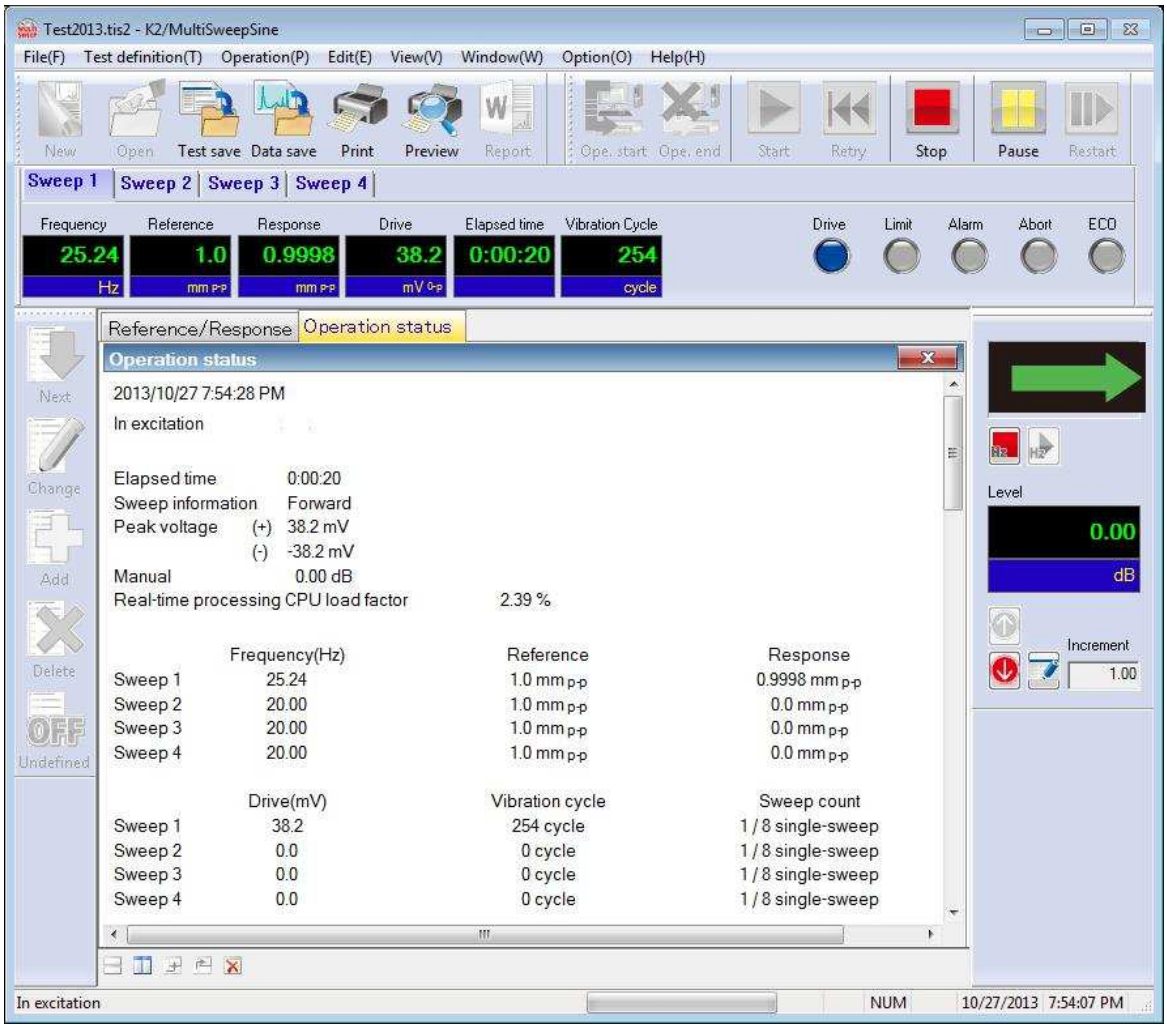
(1) Meaning

Various information concerning with the excitation operation is displayed.

The window of Operation status is opened by selecting the commands [Window] – [Operation status] in the menu bar.

In principle, the items and conditions displayed with the Multi-Sweep Sine system are the same as those of the standard Sine system.

For details of each display item, refer to "4.8 Operation Status" of the K2/SINE Instruction Manual.



In comparison with the standard Sine system, additional items and different items of this system are as follows:

(a) Display for each sweep/spot

Frequency, reference/response level and check result are displayed for each sweep and each spot.

(b) Peak voltage

This item is newly added to the Multi-Sweep Sine system.

A drive signal is composition of several sine waves. This item indicates a peak voltage of the drive signal. Both positive and negative values of the peak voltage are displayed.

(c) Drive

This item indicates a drive output voltage for each sweep and each spot. It is different from the above peak voltage.

The ratio of the drive output voltage required for the current control loop to the maximum drive voltage (called “ratio to limit”) is displayed for each sweep and each spot.

(d) Sweep

For Time delayed sweep, a sweep count is displayed at each sweep.

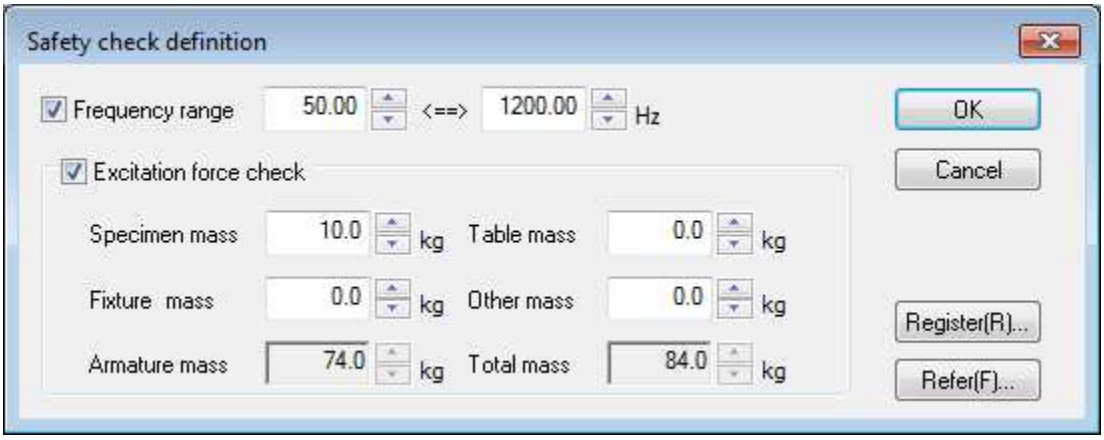
(e) Input channel data

In principle, the input channel data are the same as those of the standard Sine system, except for that the data is displayed for each sweep by each channel.

For “phase” data, if the control value is “acceleration”, “velocity” or “displacement” and observation physical quantity is “acceleration”, “velocity” or “displacement”, an asterisk (*) mark is displayed beside the target physical quantity to identify the phase.

3.8 Safety check

3.8.1 Outline



The system has the feature of Rating check*[1] to evaluate whether the defined test can be performed on the excitation system as a protective feature. The safety check expands this protective feature and makes it possible to use the excitation system more safely.

(1) Excitation force check

This check is made to evaluate whether the excitation force required for the test is held within the excitation system rating.

The excitation force F required for the test is calculated with the formula shown below.

F = M a

a: peak value of reference acceleration

M: Total mass

The total mass M is the sum of “Specimen mass, Table mass, Fixture mass and Other mass” entered in this dialog box and the “Armature mass” specified in the system rating information.

The excitation force check is effective only if the controlled variables were the acceleration, velocity and displacement.

(2) Frequency range check

This check is made to evaluate whether the frequency range of reference is within the usable frequency range.

Although there is a similar protective feature of “control frequency range” setting in the excitation system information, this is a feature to perform this check for each test.

While the usable frequency range for the excitation system is defined, it may be limited depending on the characteristics of specimen and fixture etc.. Use this feature in such cases.

[Refer] : The registered definition contents of Safety check is loaded and used.

[Register] : The defined contents of Safety check is saved and registered as a file.

*1 Feature of standard rating check

1) This check is made to evaluate whether the reference level is held within the excitation system rating. If the controlled variables were the acceleration, velocity and displacement, the check is made for the three variables.
2) If a “control frequency range” was specified in the excitation system information, a check is made to evaluate whether the frequency range of reference is within the “control frequency range.”

Note)

When specimen and/or fixture is attached to the armature, it may occur that the required acceleration level can not be reproduced within the usable frequency range because of resonance or anti-resonance of the attached specimen and / or fixture.

Chapter 4 Supplemental Explanation

4.1 Error messages

In principle, error messages of this system are based on those of the standard Sine system.

For details of each message, refer to "Chapter 5: Messages and Meanings" of the K2/SINE Instruction Manual.

This section describes meanings of the messages newly added to the Multi-Sweep Sine system and additional precautions.

Message	Meaning/Action
Aborted by Abort Check.	(Meaning) The test operation is aborted for an error detected by various abort checks in operation. The content of error is displayed in Operation status. With the Multi-Sweep Sine system, the message of "C) Excess clip detection" is displayed, in addition to "A) Tolerance check error" and "B) Output voltage upper limit value error". A) Tolerance check error [1] [2] [3] [6] [7] [8] [9] The test operation is aborted for an error detected by various Tolerance checks. B) Output voltage upper limit value error [2] [3] [4] [5] [6] [7] [8] [9] An output voltage higher than the "maximum drive voltage" of the excitation system settings was requested during test, resulting in abortion of the test. C) Excess clip detection [2] [3] [6] [7] [8] [9] The peak value of the composite drive signal output voltage was higher than "maximum drive voltage", resulting in abortion of the test. (Action) Check the following points at first. • Mistake in system cabling • Incorrect definition of I/O channel information, such as sensitivity and input format. • Cable disconnection • Incorrect installation of the pickups After checking the points in the above, the treatments for each error are to be done according to the specified numbers.

Message	Meaning/Action
Aborted by Abort Check.	[1] Change the set value of Tolerance. [2] Change the setting of equalization mode in Fundamental/Control definition. [3] Change the setting of amplitude estimation method in Fundamental/Control definition. [4] Set the loop check in Fundamental/Control definition to 'Loose'. [5] Re-check a limitation on "Maximum drive voltage" of excitation system settings , if it has been defined. [6] Re-check the definition of number of sine waves. [7] Re-check of Control point. [8] Re-check the pickups used in the system. [9] Re-check the pattern of the test. [10] Re-check the construction of fixture.
Sweep frequency overlap was detected.	(Meaning) Different sweep frequencies are close to each other, or the same value in Time delayed sweep, resulting in abortion of the test. This item is newly added to the Multi-Sweep Sine system. (Action) Although the time interval between different sweeps is set larger than 5 seconds in test definition, the system needs a time longer than the time interval for initial equalization, etc. Re-check the settings of "number of simultaneous sweeps" and "sweep rate" in Time delayed sweep definition.
Test is aborted by too much loading of CPU.	(Meaning) Test operation is aborted because too much loading is detected in operation. (Action) • Exit form the other applications than K2 executed by the system when they are used. • Decrease the value of Max. Observation Frequency in Fundamental/Control definition. • Decrease the numbers of channel to be used. • Re-check the number of sine waves. Check the above points.

4.2 Timer

The Multi-Sweep Sine system also enables various operations such as level change and sweep stop operations during execution of tests. The relationship between operations and time counts are listed below:

Condition			
Multiple frequency sweep test Time delayed sweep test	Level : Lower than 0 dB	Time	Not counted
		Vibration	Not counted
		Sweep	Counted
	Sweep Pause	Time	Counted
		Vibration	Counted
Multi spot test	Level : Lower than 0 dB	Time	Not counted
		Vibration	Not counted

Also, the dependence of the judgment of Test Time completion on the excitation level are described as below.

When the judgment of Test Time completion depends on the excitation level, the Test Time is not counted by setting of the excitation level to lower than 0 dB and the testing operation cannot be completed.

Condition		Judgment of Test Time completion
Multiple frequency sweep test Time delayed sweep test	Test Time specified by Sweep Counts	Independent of Level
	Test Time specified by Time	Dependent on Level
Multi spot test		Dependent on Level

4.3 Set up

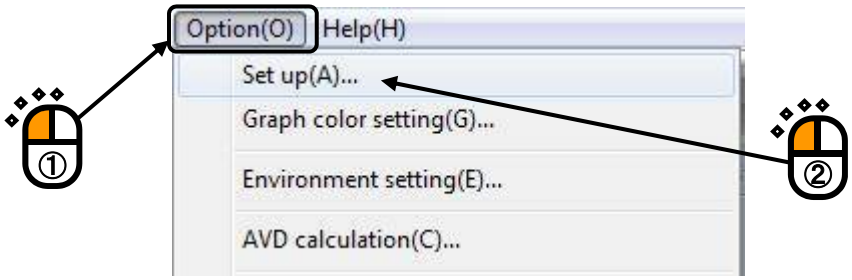
In principle, the setting items are the same as those of the standard Sine system, although some items are eliminated.

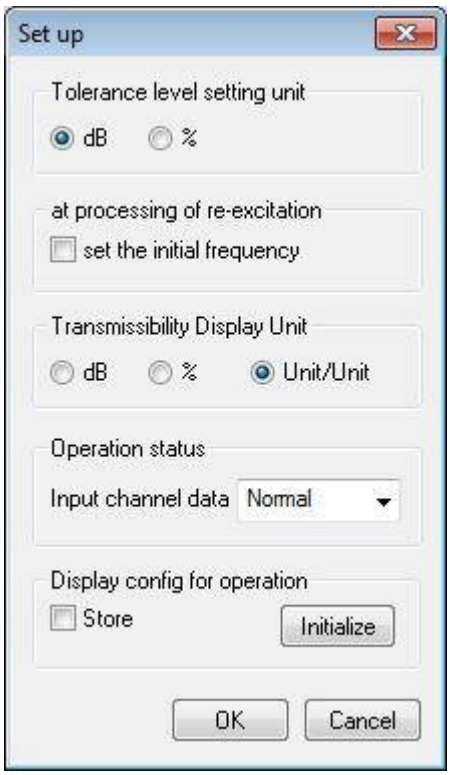
For details of each setting item, refer to "6.2 Set Up" of the K2/SINE Instruction Manual.

This section descries newly added items.

<Procedures>

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





<Display config in operation >

Once the "Save" checkbox is checked, the system automatically saves the screen configuration such as number of pages and graph types displayed at the end of test operation. The saved screen configuration will be reflected when the next test is executed.

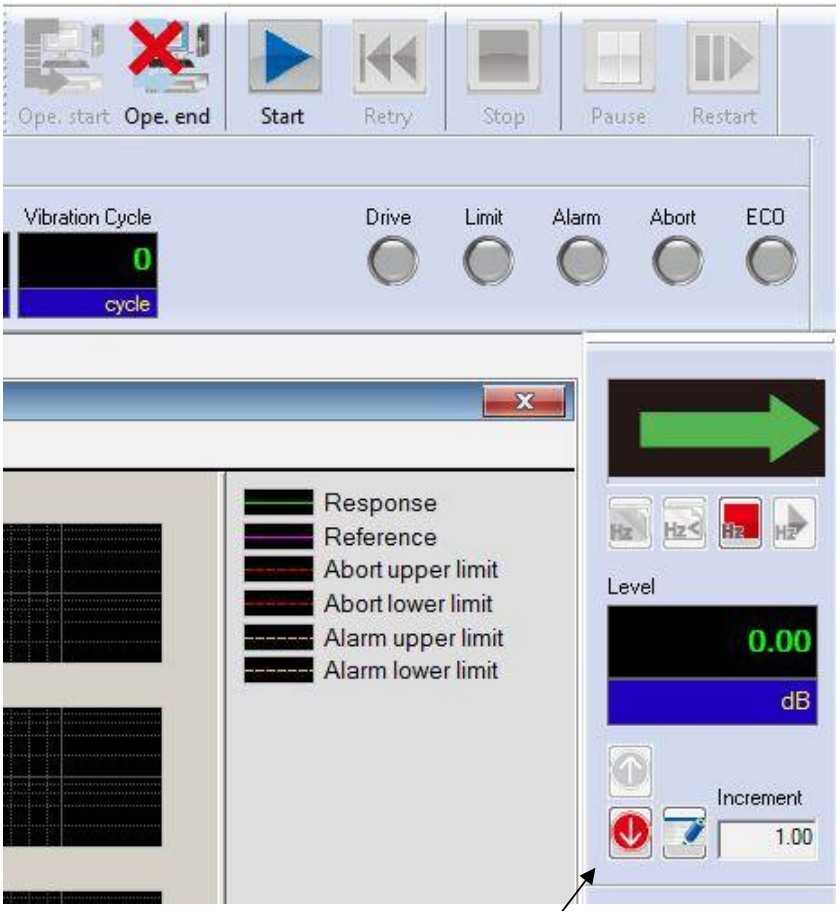
However, if the system has saved a graph specific to a test type and proceeds to a different test type, the relevant pages and graphs will be cleared.

To reset the screen configuration to the initial status, press the [Initialize] button .

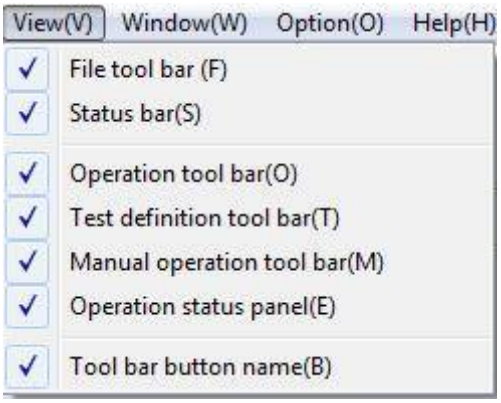
4.4 Manual operation

Control Reference can be changed during the excitation operation by using Manual operation tool bar.

Usually, “Manual operation tool bar” is displayed at the right side of operation window.

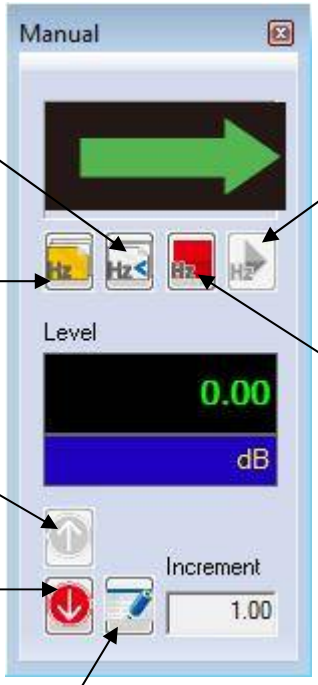


If the tool bar is not displayed, select [View] and click [Manual operation tool bar].



<Description of each item (Multiple frequency sweep)>

Pressing this button reverses the sweep direction. The number of sweeps is counted when sweep returns at the maximum or minimum frequency of control reference settings.



Pressing this button resets sweep fixed status.

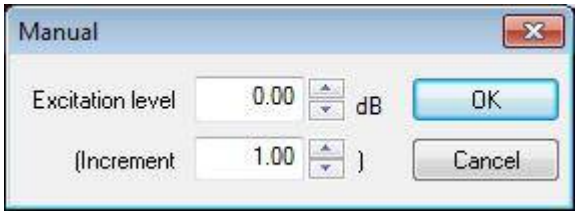
Pressing this button skips sweep to the beginning of the next one.

Pressing this button increases the excitation level by the specified increment/decrement value.

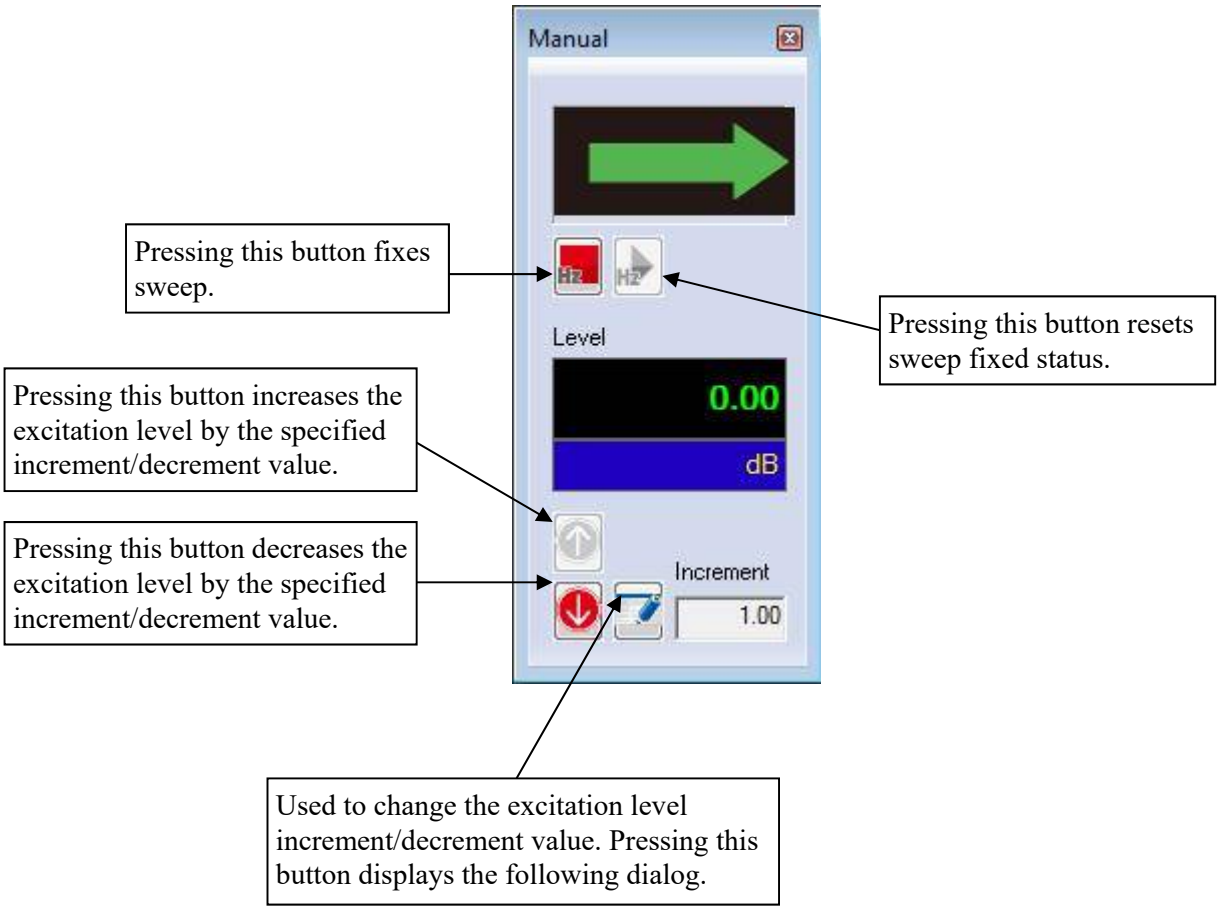
Pressing this button fixes sweep.

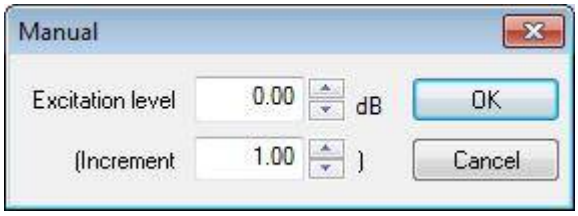
Pressing this button decreases the excitation level by the specified increment/decrement value.

Used to change the excitation level increment/decrement value. Pressing this button displays the following dialog.

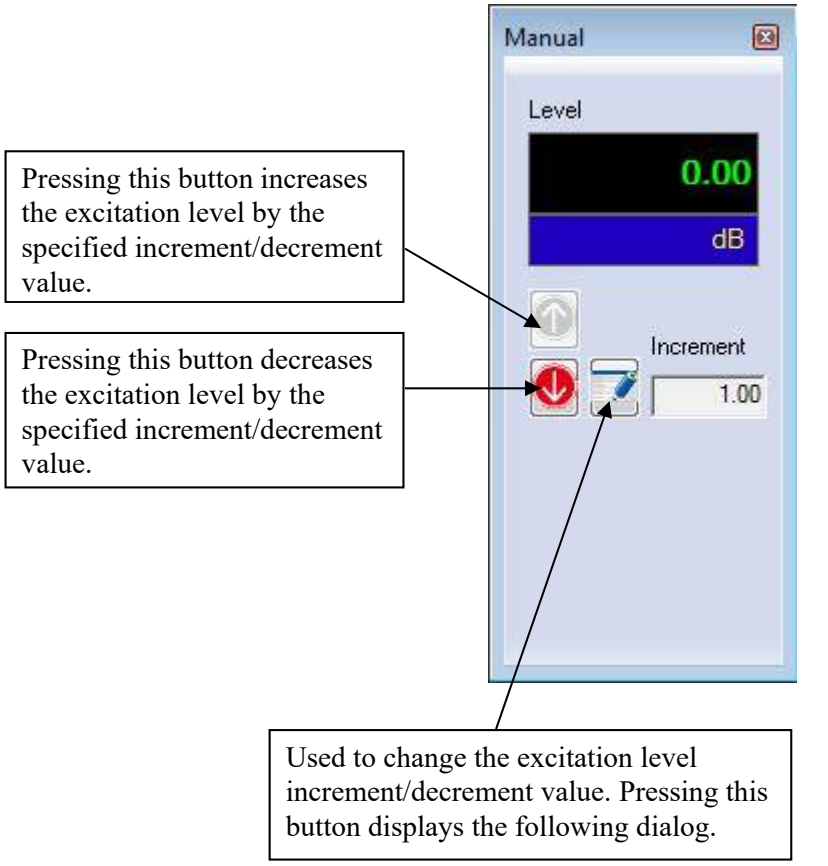


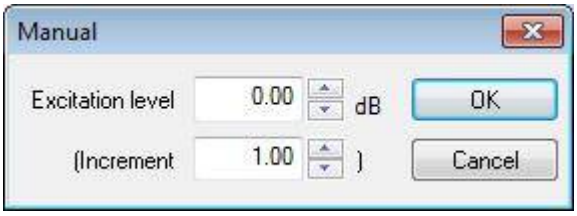
<Description of each item (Time delayed sweep)>





<Description of each item (Multi spot)>





4.5 Rating check

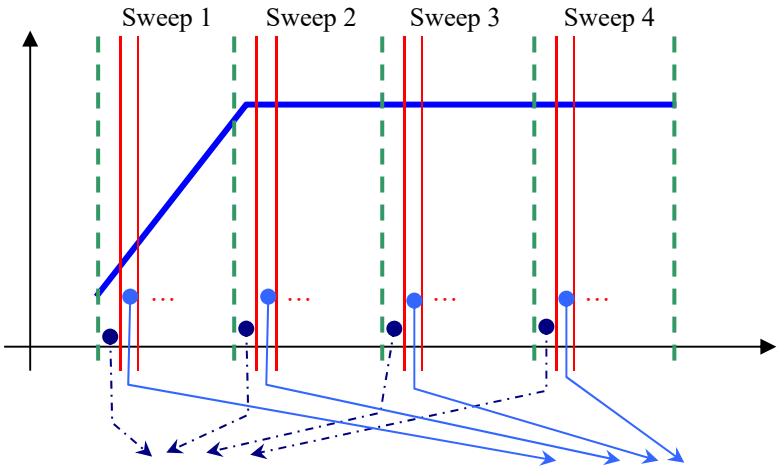
Before start of excitation, the system executes rating check by comparing the maximum value of reference definition with the maximum rated value of the system, in order to check if excitation is enabled according to the test definition settings.

Since the standard Sine system executes excitation with a single sine wave, the maximum value can be easily calculated from the reference definition settings.

On the other hand, since the Multi-Sweep Sine system executes excitation with several sine waves, the system must calculate the maximum value by adding the maximum peak values of individual sine waves. The method to calculate the maximum value for each test type is described below.

a) Multiple frequency sweep

Since the sweep operation is executed at the same sweep rate in each divided bandwidth, the system divides each frequency bandwidth into sub-sections with the same frequency width, and sums up the amplitude values of individual sub-sections. While shifting the sub-section of each frequency bandwidth, the system repeats the same calculation in sequence. The largest value among the amplitude sum results is defined as the maximum reference value, which is to be compared with the rated value. The conceptual image of calculation of the maximum reference value is as follows:



The system sums up amplitude values of these

While shifting the sub-sections subject to calculation, the system executes the same calculation. After repetition of this calculation, the largest value among the sum results is defined as the maximum reference value.

b) Time delayed sweep

The reference profile is divided into the bandwidths by the number of simultaneous sweeps, and calculates the maximum reference value in the same manner as that for Multiple frequency sweep.

c) Multi spot

The system calculates the maximum reference value simply by adding the reference value for each element.

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