K2
Vibration Controller

IMV CORPORATION

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IMV CORPORATION

K2
Vibration Controller

Common hardware supports all types of vibration test.

The K2 controller provides the precision and repeatability required to test with confidence during both product development and series production. The K2 hardware and software has been developed in-house, giving IMV full design control of this important part of a vibration system.
The K2 system offers enhanced functions and operability based on the most advanced technologies and incorporating feedback from our customers.

Contents

■ K2

Input channels : up to 64

Excitation modes and options:
Sine / sine dwell / amplitude dwell/ multi-sine
Random / sine on random / random on random
Shock (traditional shock forms, sine beat/burst, tracing data measured) / SRS / measuring data acquisition / sequential control for combining several excitation modes) / limit channels for sine and random

Controller rack for up to 3 slide-in modules
(here 8 input channels and 4 input and 4 output channels)

Hardware

Main Enclosure	
Number of Slots	3 (Expandable by connecting additional slave units)
AC Power	Single-phase AC, 100V-240V (auto-selected)
Expansion	Additional units can be interconnected (Providing support for large-scale systems)
External Communication	Contact I/O (for emergency stop)
Ambient Conditions	0-40℃, below 85% RH, non-condensing
Dimensions	W430×H100×D340mm (excluding connectors etc.)
Mass	Approximately 6.0kg

8-channel Input Module (option)	
Number of Channels	8
Input Connector	BNC
Input Signal	Charge, Voltage, IEPE
Charge Amplifier Sensitivity	1.0mV/pC or 10mV/pC
Charge Amplifier Cut-off	0.32Hz
Maximum Input	Charge input ±10000pC or ±1000pC Voltage input : ±10000mV IEPE input : ±10000mV
Sampling Frequency	51.2kHz maximum
Voltage Input Coupling	AC or DC
AC Coupling Cut-off	0.1Hz
CCLD Amplifier(IEPE)	+24VDC, 3.5mA
TEDS(IEPE)	Version 0.9, Version 1.0
A/D Converter	Type : ΔΣ Resolution : 24-bit Dynamic range : 117dB Digital filter : Pass-band ripple ±0.001dB : Stop-band attenuation 110dB

4-Channel Input and 4-Channel Output Module (standard)	
●Input Section	
Number of Channels	4
Input Connector	BNC
Input Signal	Charge, Voltage, IEPE
Charge Amplifier Sensitivity	1.0mV/pC or 10mV/pC
Charge Amplifier Cut-off	0.32Hz
Maximum Input	Charge input ±10000pC or ±1000pC Voltage input : ±10000mV IEPE input : ±10000mV
Sampling Frequency	51.2kHz maximum
Voltage Input Coupling	AC or DC
AC Coupling Cut-off	0.1Hz
CCLD Amplifier(IEPE)	+24VDC, 3.5mA
TEDS(IEPE)	Version 0.9, Version 1.0
A/D Converter	Type : ΔΣ Resolution : 24-bit Dynamic range : 117dB Digital filter : Pass-band ripple ±0.001dB : Stop-band attenuation 110dB
●Output Section	
Number of Channels	4 (One channel is reserved for drive output)
Output Connector	BNC
Output Signal	Voltage
Maximum Output	±10000mV
Sampling Frequency	51.2kHz maximum
D/A Converter	Type : ΔΣ Resolution : 24-bit Dynamic range : 120dB Digital filter : Pass-band ripple ±0.005dB : Stop-band attenuation 75dB

■ K2 Sprint

While inheriting all of the performance and features of K2, K2 Sprint offers improved cost-effectiveness with 2-channel hardware. K2 Sprint is best-suited to single monitor-channel operation.

Differences from K2	• Input 2 channels (No expansion) • Output 2 channels (No expansion)

Dimensions : Approx. (345 x 210 x 40) mm
Mass : Approx. 6 kg

Excitation modes and options:
Sine / sine dwell / amplitude dwell / multi-sine
Random/ sine on random / random on random
Shock (traditional shock forms, sine beat/burst, tracing data measured) / SRS / measuring data acquisition / sequential control for combining several excitation modes)

K2

BNC Inputs with monitor output, charge, voltage, IEPE, TED ±10 V, max. 51.2 kHz, 24-bit	BNC Outputs ±10 V, max. 51.2 kHz, 24-bit

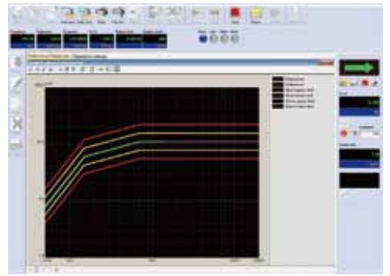
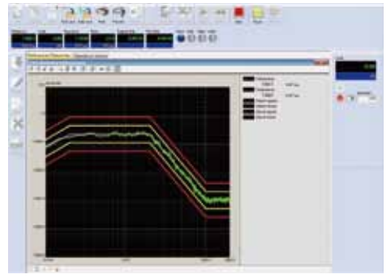
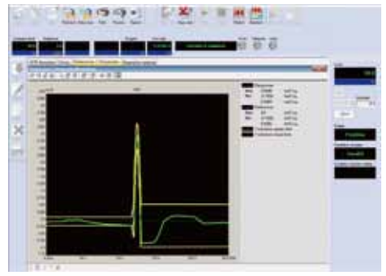
8 digital inputs and outputs each	Sockets for PCIe cable Cable (length: approx. 1.5 m) and card for PC are part of the delivery	On/off switch Mains connection Power supply unit is part of the delivery

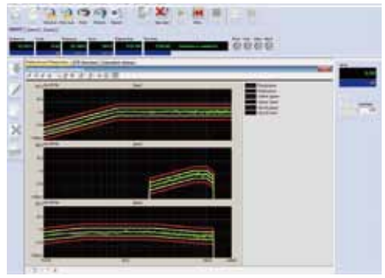
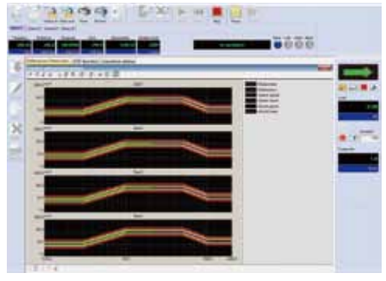
K2 Sprint

2x BNC Inputs with monitor output, charge, voltage, IEPE, TED ±10 V, max. 51.2 kHz, 24-bit	2x BNC Outputs ±10 V, max. 51.2 kHz, 24-bit

8 digital inputs and outputs each	Sockets for PCIe cable (Cable and card for PC are part of the delivery)	On/off switch Mains connection Power supply unit is part of the delivery

Software

Basic Software	Specifications	Optional software
SINE 	• **Control Algorithm** Continuous closed-loop control of true rms level • **Control Frequency Range** 0.1~20000Hz • **Control Dynamic Range** More than 114dB • **Operation Modes** 1) Continuous sweep, Spot, Manual 2) Closed-loop, Open-loop • **Measurement Method** Average, RMS, Tracking • **Multiple-Channel Control Modes** Average control, Maximum control, Minimum control • **Input Channels** Maximum 64 * Specifications may be affected by other conditions	• **R_DWELL: Resonance Dwell** Resonance is detected by measuring the phase difference between the control point and the response signal from a resonant part of the item under test. The test frequency is controller to maintain resonance as the structure fatigues. After holding at the resonance for a pre-defined duration, sweeping can be resumed, until the next resonance is detected. • **A_DWELL: Amplitude Dwell** A transmissibility plot is taken from two points on the structure under test and resonances listed. A sine test can then be run at each resonant frequency, with tracking of the resonance by either amplitude or phase. • **LIMIT CONTROL** Response channels can be specified as limit control channels. If the level on a limit control channel would exceed its limit, the test level is reduced accordingly. • **Multi Sweep Sine** A traditional wide-band sine sweep is divided into several narrower-band sine sweeps, which when added together combine to cover the original wide band. Running the narrow band sweeps in parallel significantly reduces the test time required.
RANDOM 	• **Control Algorithm** Closed-loop control of PSD within each spectral line • **Control Frequency Range** 20 kHz maximum • **Number of Control Lines** Maximum 25600 lines • **Control Dynamic Range** More than 94dB • **Loop Time** 200ms (fmas=2000Hz, at L=400line) • **Multiple-Channel Control Modes** Average control, Maximum control, Minimum control • **Input Channels** Maximum 64 * Specifications may be affected by other conditions	• **SOR: Sine on Random** Random vibration and sine vibration frequencies are combined. Sine vibration can be swept. • **ROR: Random on Random** Broad-band random combined with sweeping or non-sweeping narrow-band random overlaid. • **PSD LIMIT: PSD limit control** Response channels can be specified as limit control channels. If the PSD on a limit control channel would exceed its limit, the test level is reduced over that range of frequencies to keep with the limit level.
SHOCK 	• **Control Algorithm** Finite-length waveform controlled by feed forward method • **Control Frequency Range** Maximum 20000Hz • **Number of Control Lines** Maximum 25600 lines • **Control Dynamic Range** More than 84dB • **Type of Reference Waveform** Classical shock waveform (Half-sine, Haversine, Saw-tooth, Triangle, Trapezoid etc.), Sine beat waveform, Measured waveform etc. • **Input Channels** Maximum 64 * Specifications may be affected by other conditions	• **LONG WAVEFORM** The length of a reference waveform is 16K points as standard. This can be increased to 200K points by adding the LONG WAVEFORM option. At a sampling frequency of 512Hz for example, this produces approximately 6.5 minutes of waveform, compared to the standard length of approximately 30 seconds. • **MEGAPOINT** A further increase in waveform duration can be obtained by adding the MEGAPOINT option to the LONG WAVEFORM option. This increases the record length to 5000K points, about 163 minutes at 512-Hz sampling rate. • **SRS: Shock Response Spectrum** SRS (Shock Response Spectrum) can execute the test in which the test condition and evaluation are conducted not based on waveform itself, but on SRS analysis. With standard shock test selected, SRS analysis of response waveform is also possible.

Basic Software	Specifications	Optional Software
BMAC 	• **Control Algorithm** Finite-length waveform controlled by feed forward method • **Control Frequency Range** Maximum 20000Hz • **Number of Control Lines** Maximum 25600 lines • **Control Dynamic Range** More than 84dB • **Type of Reference Waveform** Classical shock waveform (Half-sine, Haversine, Saw-tooth, Triangle, Trapezoid etc.), Sine beat waveform, Measured waveform etc. • **Length of Reference Waveform** Maximum 5000k points • **Input Channels** Maximum 32 • **Output Channel** Maximum 32 * Specifications may be affected by other conditions	• **ENDURANCE2** A drive file created in K2/BMAC can be used to run a durability test. Multiple drive files may be combined to create an equivalent of complex real-life vibrations.
Multi RANDOM 	• **Control Algorithm (Three modes of control)** 1) PSD of random signal closed loop control by spectrum density for each frequency segment 2) Real-time waveform controlled by feed forward method 3) Monitoring and minimising of cross-axis component • **Control Frequency Range** Maximum 10000Hz • **Number of Control Lines** Maximum 3200 lines • **Control Dynamic Range** More than 90dB • **Loop Time** 450ms (3-input, 3-output control, 120 DOF, fmax = 2000 Hz, L = 200 line cross-talk information averaging times = 8 times/loop) • **Multiple-Channel Control Modes** Average control, Maximum control, Minimum control • **Input Channels** Maximum 64 (Maximum of 32 control channels) • **Output Channel** Maximum 16 * Specifications may be affected by other conditions	• **PSD LIMIT CONTROL** If a response point is specified to be a limit control channel, the level of PSD doesn' t exceed the specified PSD level in the test.
Multi SINE 	• **Control Algorithm (Three modes of control)** 1) Amplitude: Continuous closed-loop control of true rms level 2) Phase: Real-time waveform controlled by feed forward method 3) Monitoring and minimising of cross-axis component • **Control Frequency Range** 0.1~10000Hz • **Frequency Resolution** Better than 10^{-4} of frequency • **Control Dynamic Range** More than 114dB • **Operation Modes** 1) Continuous sweep, Spot test 2) Control and monitoring in various physical units • **Estimation Method** Average, RMS, Tracking • **Multiple-Channel Control Modes** Average control, Maximum control, Minimum control • **Input Channels** Maximum 64 (Main control channel is Maximum 32Chs) • **Output Channel** Maximum 16 * Specifications may be affected by other conditions	• **LIMIT CONTROL** If a response point is specified to be a limit control channel, the level of that response point will not exceed the level specified in the test.

Common optional software	Outline		
CAPTURE: Analogue waveform signal data program	Provides analogue waveform signal capture, saved data can then be used as the reference of SHOCK, BMAC waveform controls or Random vibration PSD control.	• Sampling Frequency • Data Length • Input Channel • Waveform edit/analysis function	51.2kHz maximum Maximum 5000k points Maximum 64 Filtering,Frequency transfer processing,PSD transfer,Transmissibility ratio between channels
SCHEDULER:Test scheduler	Pre-defined tests can be executed in sequence.		
Integrated Control System	Signals are available from K2 to control a climatic chamber, synchronising thermal and vibration tests.		

■ Brief Guide – Stroboscope Port

Depending on the K2 hardware configuration, the K2 Vibration Controller has several output channels (standard: 4 channels). Whereas in most configurations one output is directly connected to the power amplifier of the shaker system, the other outputs can be configured for other purposes, for example, the following:

- Simultaneous actuation of several shakers (multi-shaker control)
- For sine tests, as a DC output voltage proportional to:
  - the current excitation frequency,
  - any input signal
  - the present drive voltage.
- Output of a constant sinusoidal voltage whose frequency represents the current excitation frequency of the sine test.

The configuration of the output channels will be described below by the example of controlling a stroboscope.

1. Calling the Auxiliary Output Setup

Open a project in the K2 software, click on the "Aux. output" menu item and then click on the " Change" button (Figure 1).

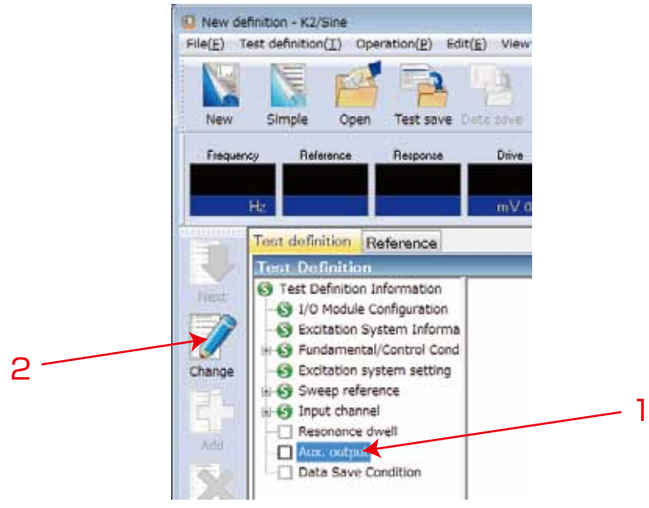


Figure 1: Open the Auxiliary Output Setup

2. Configuration of the output channels

At first check the tick box for "OSC Out is outputted" (arrow 3, Figure 2) in the Auxiliary Output Setup. This defines that the Controller provides a constant sinusoidal voltage whose frequency corresponds to the current excitation frequency of the sine test.

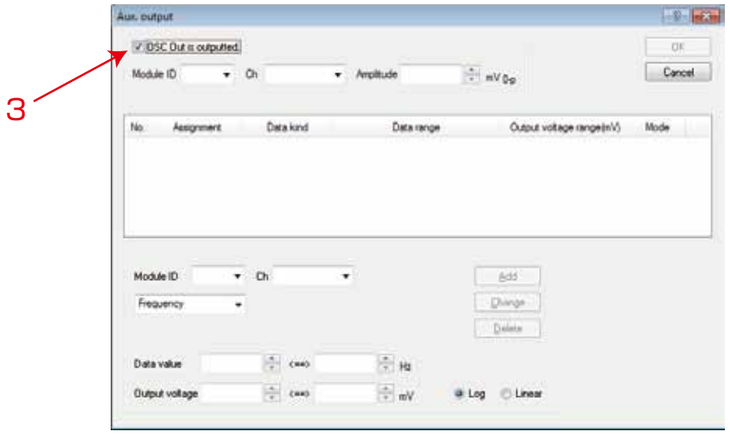


Figure 2: Enable the OSC output

Next, in "Module ID", select the ID number of the K2 plug-in card which contains the output channels (see arrow 4, Figure 3).The default is Module ID "000".

Then define the channel for the output of the sine voltage (see arrow 5, Figure 3).

Finally, set the level of the voltage output at "Amplitude" (see arrow 6, Figure 3).
The amplitude can be set between 0.1 and 10,000 mV (0-peak).

Click "OK" (arrow 7). The stroboscope output is now enabled.
If you want to disable the output, uncheck the "OSC Out is outputted" box (see arrow 3, Figure 2).

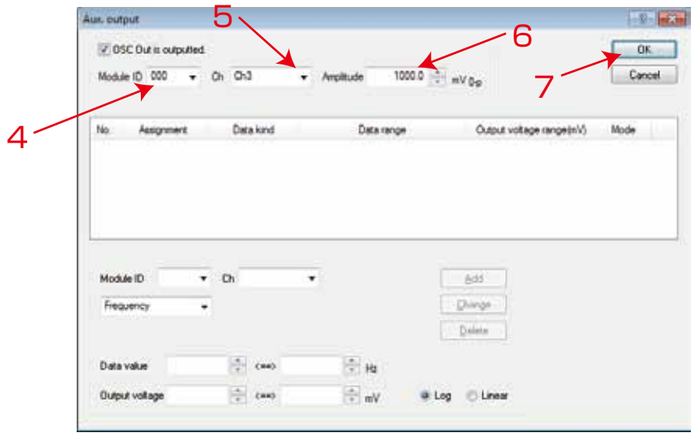


Figure 3: Configuration of the OSC output

■ Brief Guide – Digital I/O

The Controller can communicate with other devices (such as a climate chamber) via the digital I/O (or Contact I/O) of the K2. All inputs and outputs can be configured individually.

In certain situations, instruction can be sent via the outputs (e.g., Test completed -> Turn off climate chamber). On the other hand, the Controller can receive instructions (e.g., Climate chamber at specified temperature -> Start vibration test).

The digital I/O are located on a 50-pin connector at the rear of the Controller (see Figure 1).

25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
STOP+	O8A	O7A	O6A	O5A	O4A	O3A	O2A	O1A	O8B	O7B	O6B	O5B	O4B	O3B	O2B	O1B	I8-	I7-	I6-	I5-	I4-	I3-	I2-	I1-
STOP−	O8A	O7A	O6A	O5A	O4A	O3A	O2A	O1A	O8B	O7B	O6B	O5B	O4B	O3B	O2B	O1B	I8-	I7-	I6-	I5-	I4-	I3-	I2-	I1-
50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26

Figure 1: Digital I/O ´s K2

The way in which the digital inputs and outputs can be configured for the user's needs will be explained briefly in the following.

1. Opening the Digital I/O Setup

Open the Digital I/O Setup by clicking on the "Options" button in the K2 software after opening a project and then select the "Environment setting" menu item (see Figure 2)

Then choose the "Excitation System" you want to use in the "System Information setting" window (Figure 3, arrow 3) and click on "Change" (arrow 4).

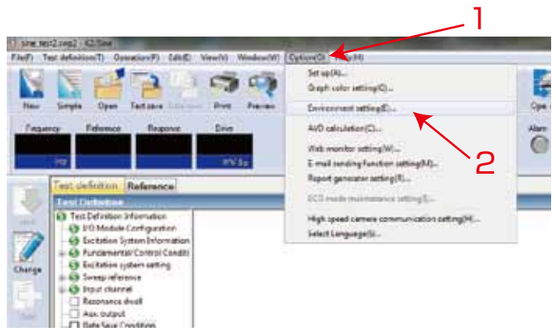


Figure 2: Opening the Digital I/O Setup

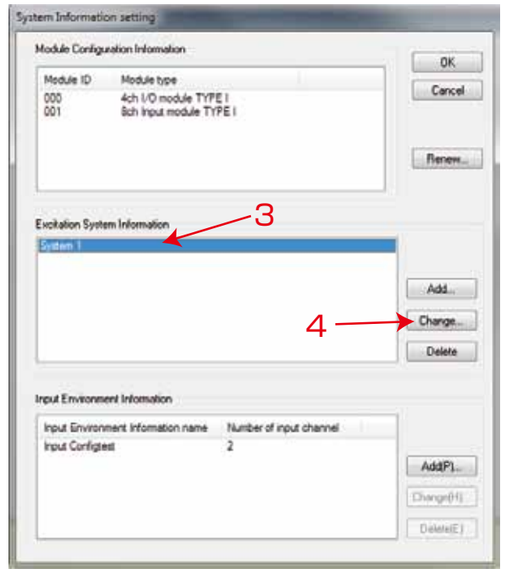


Figure 3: Select the "Excitation System"

Open the menu in which to define the digital inputs and outputs by clicking on “Contact I/O Information – Define” (Figure 4, arrow 5). The panel shown by Figure 5 opens.

Figure 4: Excitation System Information

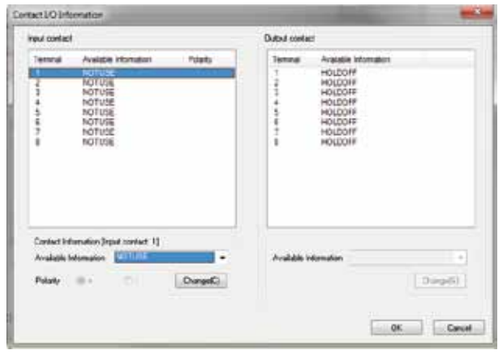


Figure 5: Digital I/O configuration menu

2. Configuring the digital inputs and outputs

For configuring the individual digital inputs and outputs, select the input or output you want to configure (Figure 6, arrow 6) and pick the option you require (arrow 7).

You can also set the polarity (+ or -) of the digital inputs.

When a task has been assigned to the digital input, click on “Change“ (Figure 7, arrow 8) to confirm it.

To define the digital outputs, proceed in the manner described for digital inputs.

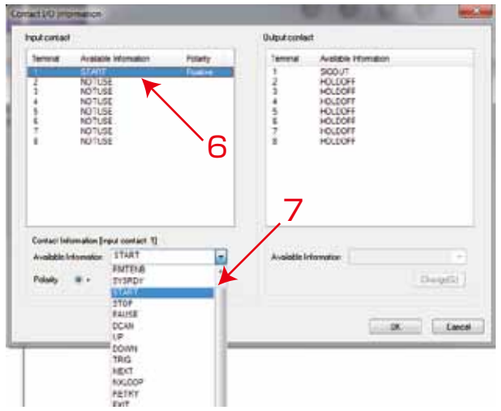


Figure 6: Configure the digital I/Os

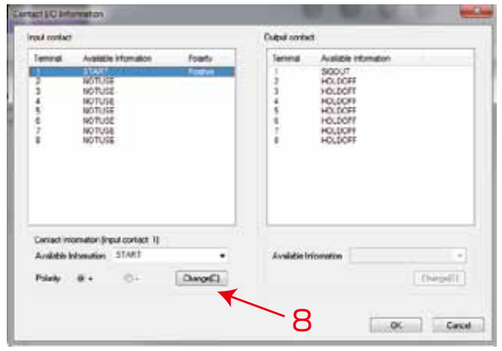


Figure 7: Configure the digital I/O

3. Settings and pin configuration of digital inputs and outputs

For settings and pin configurations of the digital inputs and outputs, please refer to the “K2 COMMON PART MANUAL.pdf“. Section 1.5 ”Hardware Specifications”, Sub-section ”1.5.1 Specifications”, Section ”External Input/Output Part”

4. Loading the digital I/O configuration into a current project

When you have changed the configuration of the digital inputs and outputs within an available project, load the change into that project.
Click on ”File“ and on “Another Excitation System Information loading“ (see Figure 8, arrow 9).

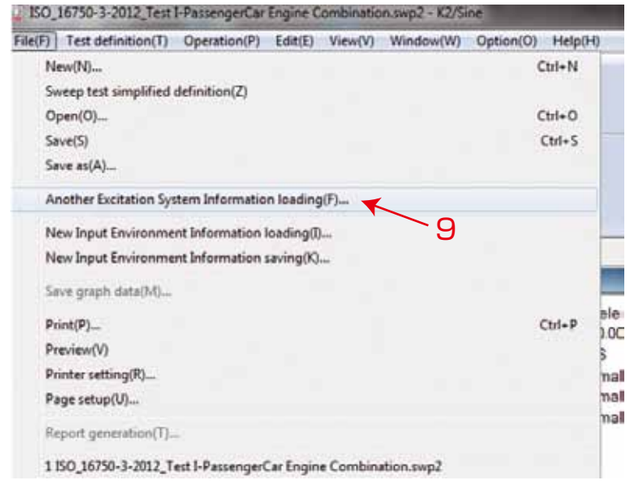


Figure 8: Load the digital I/O configuration in a project

5. Loading the digital I/O configuration into a new project

If you want to use the previously configured digital I/O in a new project, open the previously defined “Excitation system Information“ at the start of the project definition (see Figure 9).

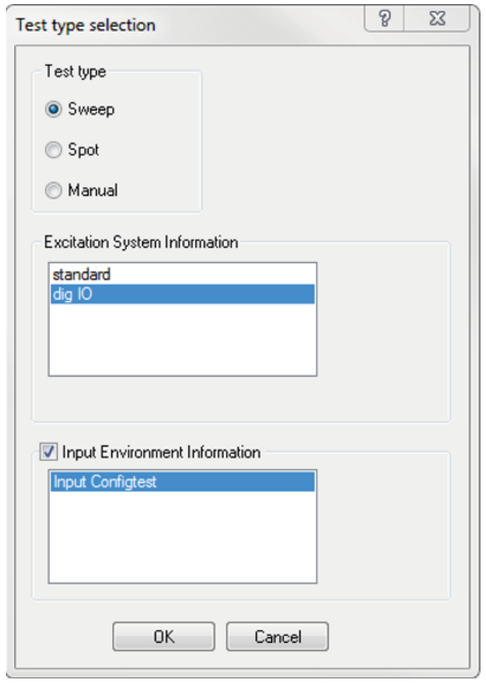


Figure 9: Select the Excitation system at the project definition

■ Brief Guide – Web Monitor

The operator can monitor the progress of a test on the K2 Vibration Controller from a second, remote PC on the network via the Web Monitor function.

Additional software is not needed. Data displayed by the K2 is saved regularly as a file in HTML format (on the network) and can be viewed on another computer with a conventional browser.

Note: The purpose of the Web Monitor is to watch a test from another PC. Direct intervention in the test (e.g., test start, test stop) requires different (remote control) software tools.

To use the Monitor function of the K2, the operator PC and also the PC monitoring the test should be running on the same network.

The configuration and use of the Web Monitor function is described below.

1. Step: Open the Web Monitor Setup

Open a project, click on "Option" in the K2 software and select the "Web monitor setting" menu item (see Figure 1).

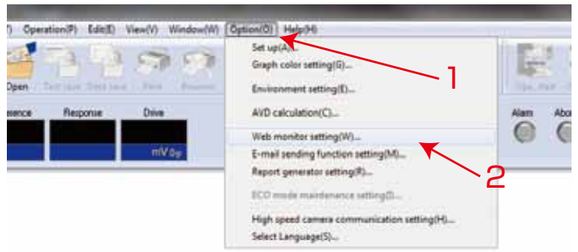


Figure 1: Open the Web Monitor Setup

2. Step: Configure the Web Monitor

Next the Web Monitor must be enabled. To do this, check the "Assert Web monitor" box (see Figure 2, arrow 3). Now you can define the name and the place where the HTML file will be saved. Click on "Path name change" (arrow 4).
In "HTML file update interval" you can specify the time interval in which a new image of the K2 operator display will be generated automatically (arrow 5).
If the "Add auto-updating function to HTML" box (arrow 6) is enabled, the browser updates automatically after the time intervals entered in "Auto-updating interval". This ensures that the most recent image is displayed automatically in each case.

3. Step: Displays of the HTML file in the browser

If you want to display the saved HTML file with the screen data of the browser, copy the file path in the address line of your browser (see Figure 3).

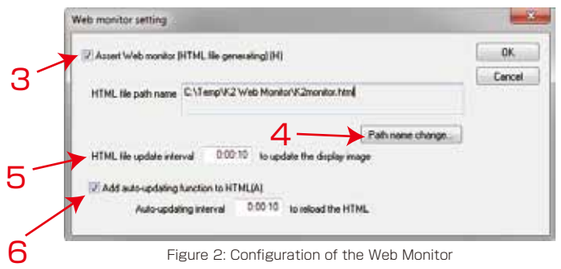


Figure 2: Configuration of the Web Monitor

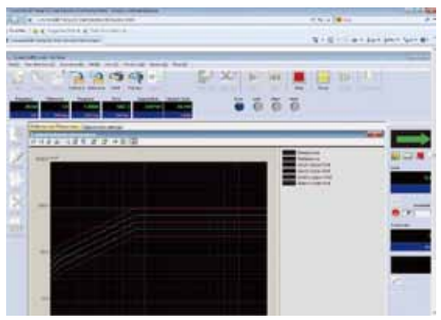


Figure 3: Display of the HTML file in the browser window

■ Brief Guide – E-Mail Function

The email function of the IMV K2 Vibration Controller can inform the operator of certain events in connection with a vibration test, even when he is not at the machine. In this way, the operator can be informed of the scheduled end or an unscheduled stop of the test.

This helps avoid situations in which the operator starts a test, leaves the lab and finds when he returns in the evening that the test was aborted half-way through because a sensor failed for example.

To use the email function of the K2, you need a PC with an internet link, plus the following:
- Access to a mail server
- An email address
- Email software

The configuration and use of the email function will be described in the following.

1. Step: Open the email setup

Open a project in the K2 software, click on the "Options" button and select the "E-Mail sending function setting" item (see Figure 1).

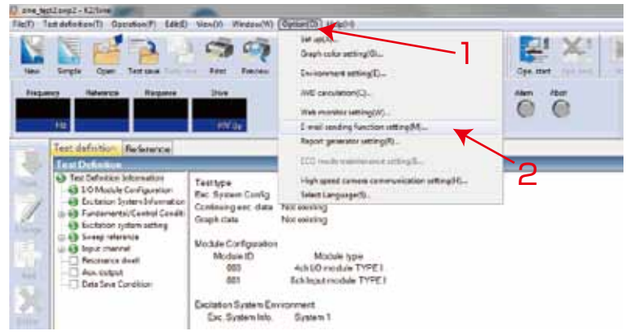


Figure 1: Open the Email Setup

2. Step: Configure the email sending function

Enable the email sending function (arrow 3) in step 2, and define sender and recipient.
Enable the email sending function by checking the "Assert E-Mail sending function" box. Then enter the sender's mail address in "E-Mail Address" and define a subject for the message in "Subject" (arrow 4).
Next you can define one or several recipients of the message (arrow 5). For this, enter the email addressee's name in "Name" and the email address in "E-Mail Address".
Then add the contact to the mailing list by clicking on "Add" (arrow 6).

If you want to add several addressees to the list, repeat the above procedure for each additional addressee (see Figure 3).
You can define the final list of mail addressees by checking the box in front of each name (arrow 7).

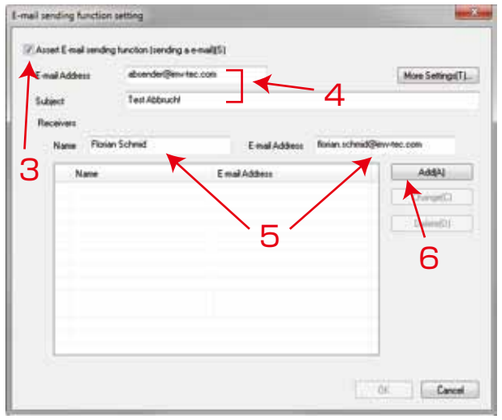


Figure 2: Define sender and recipient

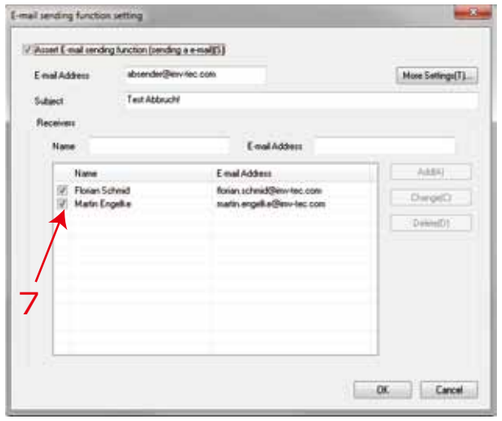


Figure 3: Define the mail recipients

3. Step: Define the email server

As a last step, define the email server for outgoing mails. For this, click on "More Settings" (see Figure 4, arrow 8) in the email sending function setting window.

Enter the settings of your mail server in the window that opens (see Figure 5). The following should be entered:

- The mail server address,
- The port number,
- The type of access (with or without log-in data),
- And log-in data, if required.

Clicking on "OK" twice (in the server settings and in the general email settings) completes the configuration of the email sending function. The system will now send emails automatically at the end of the test or when it is aborted.

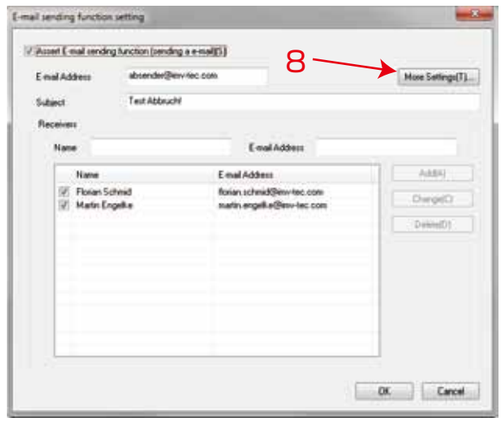


Figure 4: Open the mail server setup

Figure 5: Mail server settings

■ Brief Guide – Report Generator

At the end of a test, the Report Generator function of the K2 Vibration Controller automatically generates a report with the test results.

For the Report function, certain test results, or meta data, are linked by word bookmarks in a template. To facilitate the use of the Report Generator, IMV includes a template file in the software that only needs to be linked to the required results.

The user can also define their own templates or change the IMV template. How to change the predefined template is explained in Section 5 of this Brief Guide.

To use the Report Generator function of the K2 the following requirements must be met:

- PC with Microsoft® Word of the following versions:
  Microsoft® Word 2003, Microsoft® Word 2007, Microsoft® Word 2010, or Microsoft® Word 2013.

The configuration and use of the Report Generator function is described in the following.

1. Open the Report Generator Setup

Open a project in the K2 software and click on the "Options" button; select the "Report generator setting" item (see Figure 1).

2. Define the Report Template

At first, select the Report Template in the Report Generator Setup (see Figure 2). Do this by clicking on the "Corresponding" button (arrow 3).

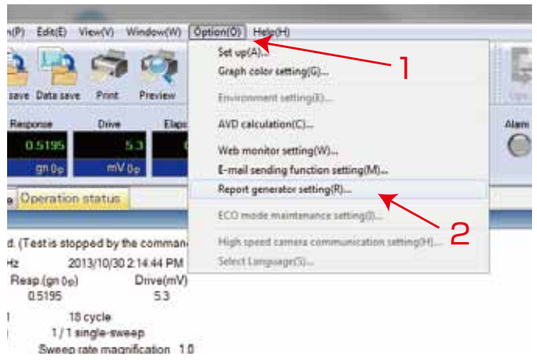


Figure 1: Open the Report Generator Setup

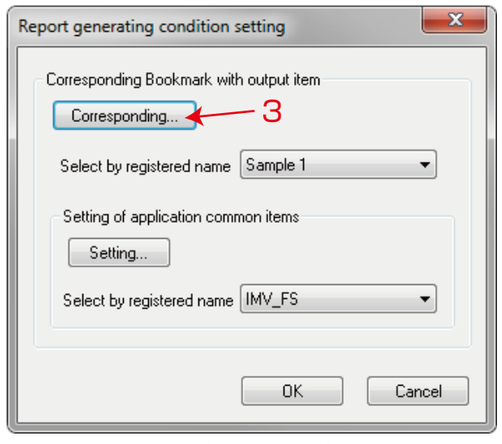


Figure 2: Report Generator Setup

In the "Corresponding Bookmark" window that opens, click on the "Select" button (arrow 4) to select the required Word Template file. To use the report Generator in K2, the Template file should have the format *.dot (Word 97 to 2003 template).

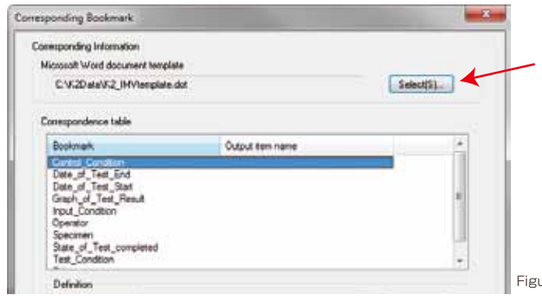


Figure 3: Select the Template file

3. Assign the test results and meta data to the Report template

The assignment of the test results and meta data to the Report template will be explained by an example. The entry of meta data is explained in detail in chapter 4.

The template "K2_IMVtemplate.dot" provided by IMV can be viewed and changed in the directory "C:\K2Data\K2_IMVtemplate.dot". The bookmarks defined there occur again in the" Correspondence table" (arrow 5).

To assign data to a bookmark, the bookmark should at first be highlighted in the "Correspondence table" (arrow 6). Then assign the data which will later be displayed in the respective category in the Report in the "Output item name" menu item (arrow 7). When the data has been selected, confirm by clicking on the "Change" button in the "Correspondence table" (arrow 8).

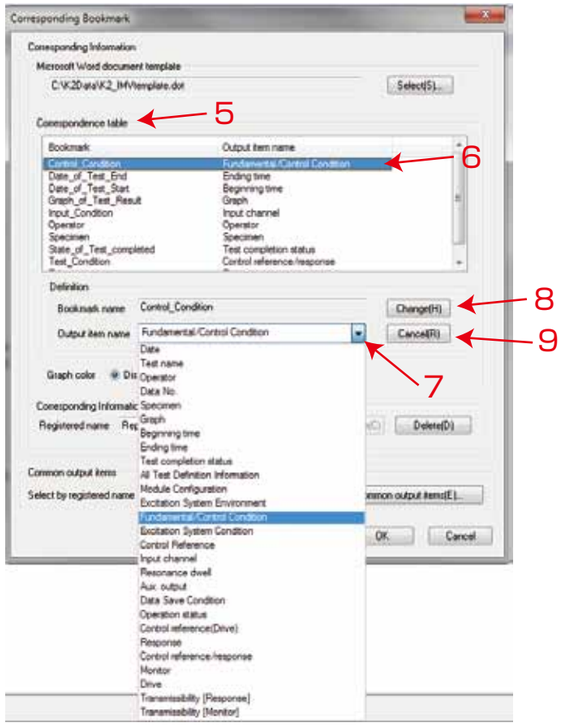


Figure 4: Linking the test results

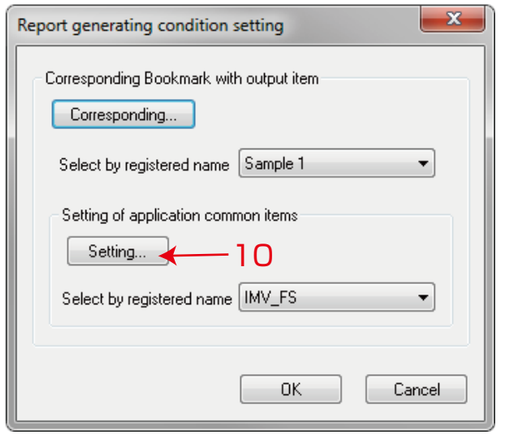
If you want to undo a link of bookmark and data, select the data in the "Correspondence table" and click on the "Cancel" button (arrow 9) to delete the link.
Note: The options for assigning data to bookmarks (output items) vary from application to application (Sine, Random, ···).

4. Entering meta data

Meta data describes the general conditions of a test such as the date on which the test was performed, the name of the operator, etc.

Some of the links of data to bookmarks described in chapter 3 can be meta data (e.g., operator, test name, ···).
If you want to make entries in these fields, open the "Report setup" described in chapter 1 (Option -> Report generator setting). In the window that opens, click on the "Setting" button under " Setting of application common items" (arrow 10).

You can enter meta data of the relevant test which will be included in the Report, in the "Setting of application common items" (see Figure 6).



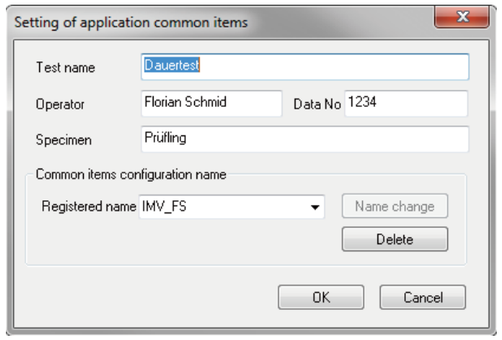


Figure 6: Entry of meta data

Figure 5: Report generator setup

5. Changing the predefined Report template

The template "K2_IMVtemplate.dot" provided by IMV can be changed if needed. For example, another corporate logo can be inserted or new text fields defined.

To do this, open the above file at: "C:\K2Data\K2_IMVtemplate.dot".

For example, if you want to add a new bookmark, click on "Add " -> "Bookmark" in Microsoft® Word 2010 (see Figure 7).

When the new bookmark has been named and added, save it as Word document (as *.dot file, Word 97 to 2003 template).
Once you have defined the new template in the K2 software, you can select the new or modified template in the K2 software as described in Section 2. The newly generated bookmarks can be found in the associated "Correspondence list" (see Figure 8, "New_Bookmark"), to which you can now assign data.

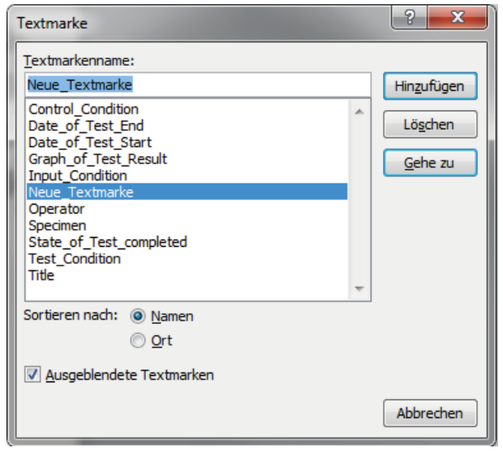


Figure 7: Generation of new text fields in the Report template

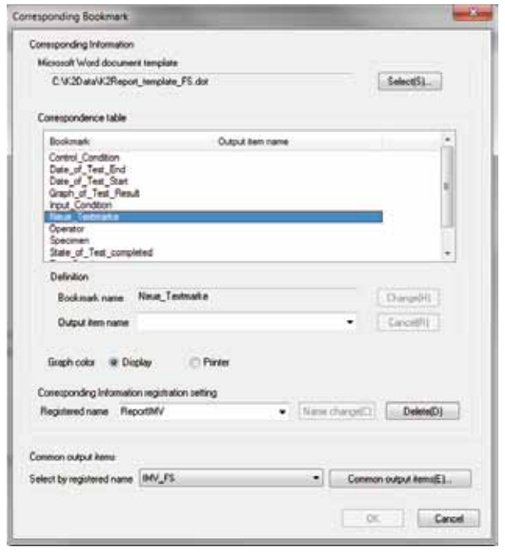


Figure 8: New bookmark in the Report template

■ Brief Guide – Manual Shock Tests

The K2 offers several options for performing shock tests in a controlled manner, e.g., by defining the number and level of each shock and the number of iterations:

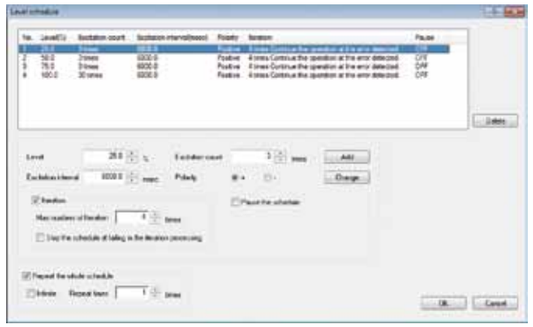
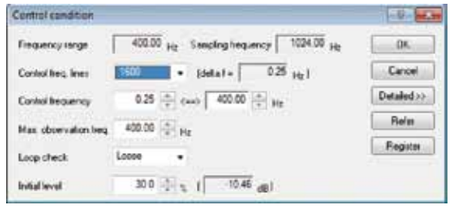


Figure 1: Define the test sequence

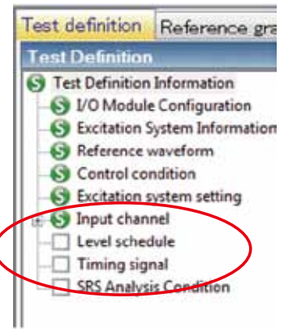
In many cases it is helpful to verify the test sequence by manual procedure.
Proceed as follows; for example:

1. Set the parameters as required in the Control dialogue. The parameter deltaf (i.e., the ratio of the frequency range and the selected number of lines) defines the length of the time window for the shock pulse and thereby the maximum repetition rate of the shock. The time between pulses cannot be shorter than the time window.



The time interval in repetitive excitation is defined as following formula.
Case 1: FFT points > Reference waveform points
(FFT points- Reference waveform points)*1000 / Sampling frequency [ms]
Case 2: FFT points <= Reference waveform points 0 [ms]
Here, FFT points is defined as 2.56* lines.

2. The scheduler should be non-defined:



3. The test can be started when all other parameters have been defined (Key: F2)
4. Define the transmission function (Key: F7 or click on Start)
5. Then start the operation of the test.
For this, press key: F7 or click on Start again – the Controller displays the shock pulse with the preset level (typically 30% at the beginning). Then start a shock pulse by pressing F7 once more.
6. The next shock can be realised by clicking on "Iteration". The K2 output (generation of the drive signal) is optimised to reduce errors.

Repeat the iterations as long as the deviation from the reference signal is larger than required.
Once the acceleration response signal accurately follows the reference signal then other levels and pause durations between the shocks can be specified in the next step.

7. When the system is ready for the next shock, you can open the manual input:

8. Here you can define the level, the polarity and the number/ interval of the shocks:

In addition, you can define the criteria for the end of the shock tests in "Excitation stop timer".

In addition, you can stop excitation automatically if response changes during repetitive excitation by using "Monitoring at the maximum value".

■ Brief Guide – Sine Control Parameters

The meaning of the control parameters for sine tests will be explained below.
The standard settings can be used for most applications:

- Normal (standard setting)
- Soft (the feedback signal slowly updates the drive signal – typically, for example, with servo-hydraulic actuators)
- Sharp (the feedback signal quickly updates the drive signal – control may lack stability particularly with sharp resonances)

Despite that, some test setups may require a manual setting such as when strong non-linear resonances occur or when the test specimen starts "rattling" (non-linear feedback signal).

Vibration cycle for analysis / Max. analysis time / Min. analysis time

This parameter defines the analysis time to estimate the response level.
Different values can be set to the three frequency range(low frequency, middle frequency, high frequency).
e.g., 1000 ms / 900 ms – distinctly increases the time for updating the control loop and requires a high value for "Control sharpness" (e.g., 60 %).

To stabilize the control loop in a non-linear response of the test setup, the Max. / Min. analysis time can be set, e.g., to 1000 ms / 500 ms – in which case the setting of Control sharpness, should be smaller, e.g., 25 %.

Control sharpness

Updates of the transmission function (feedback signal/drive signal) become faster when higher values are set.

Control ratio by error

e.g., 100 % - allows faster update of the drive signal in case of deviation in the acceleration feedback signal. A high value increases the sensitivity of the control loop to non-linear behaviour. For non-linear test items, a significantly lower value, e.g., 5%, is recommended. Can be set 0% when the test specimen "rattles" – in which case control will be linear.

Control lower limit by error (decrease)

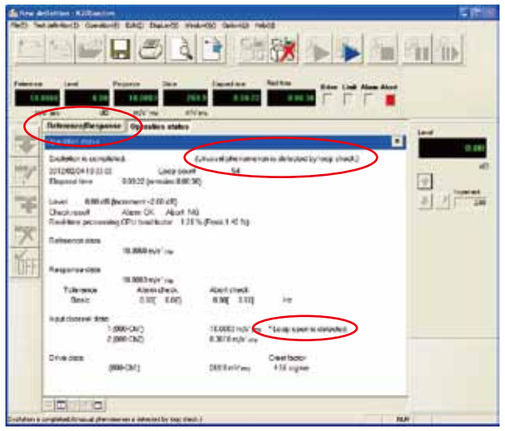
e.g., 9 dB – allows a higher value when the drive signal is changed. At the same time, the value of the "Control upper limit by error" should be small (e.g., 0.01 dB). Here as well: high values can cause instability of the control loop, in which case small values should be set for Lower and Upper limit by error, e.g., 0.1 dB.

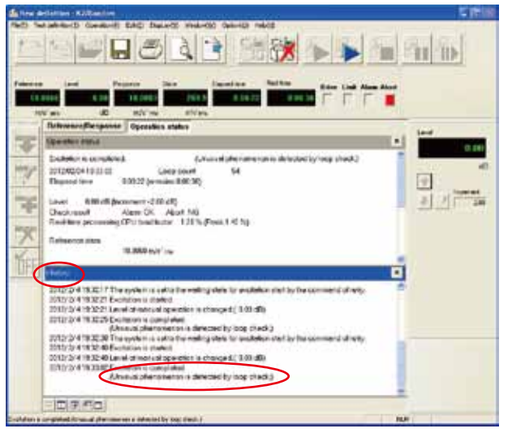
Level rapidness / Level rapidness upper limit/ Level rapidness lower limit

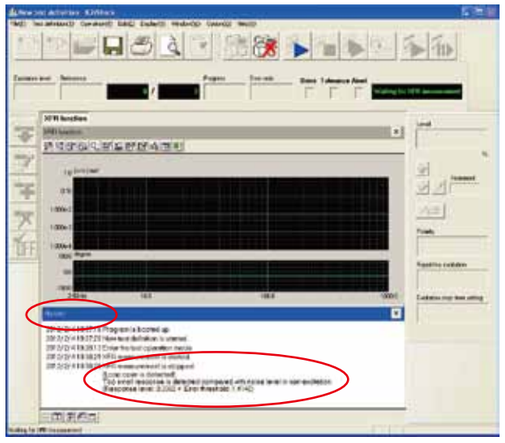
This parameter defines the maximum drive level change rate.
Different values can be set to the three frequency range(low frequency, middle frequency, high frequency).
e.g., 10 dB/sec reduces the rate of change of the drive signal level.

■ Major error and solution

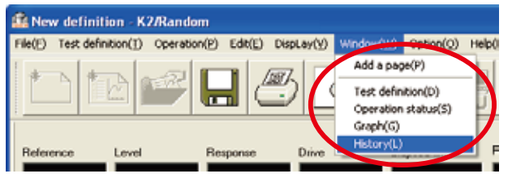
If error occurs during test, check “Operation status” and “History window”. Detail information is displayed in these windows.





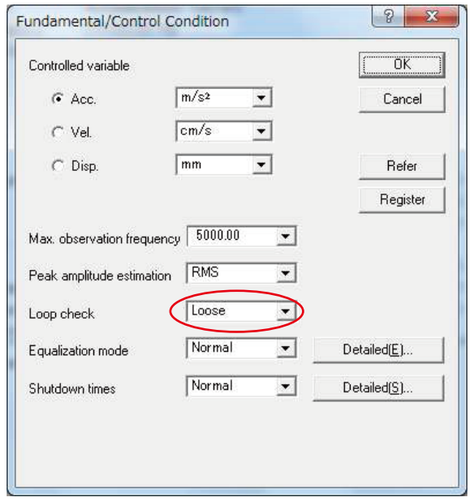
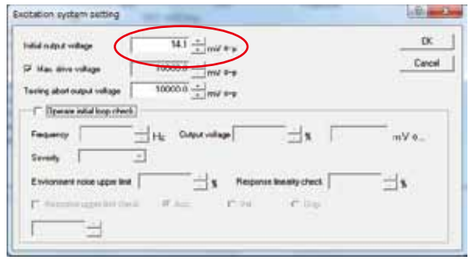
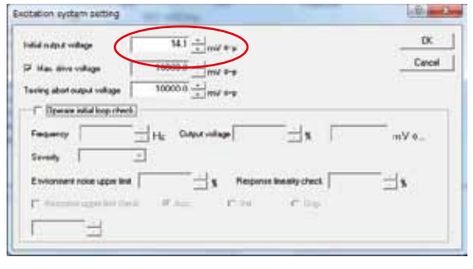


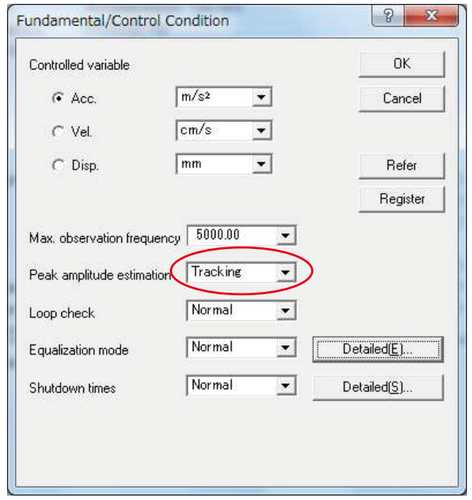
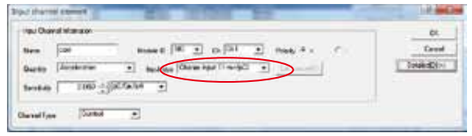
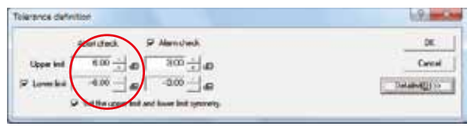
“Operation status” and “History window” can be displayed by [Window] menu command.

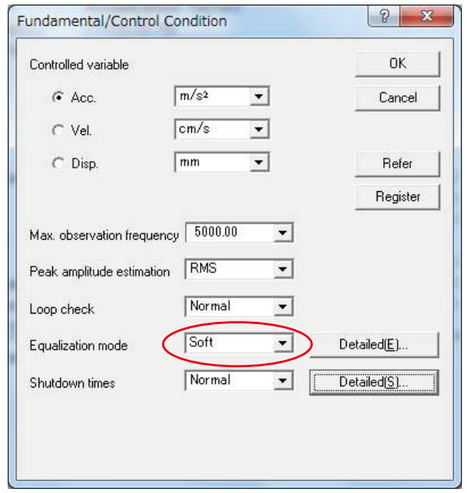
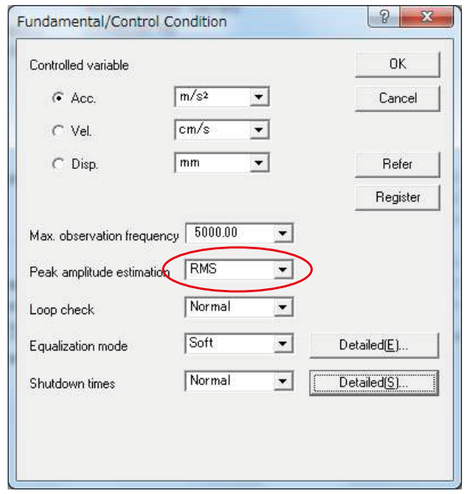
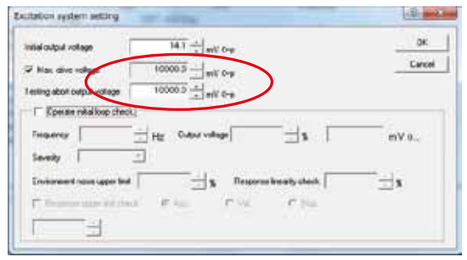


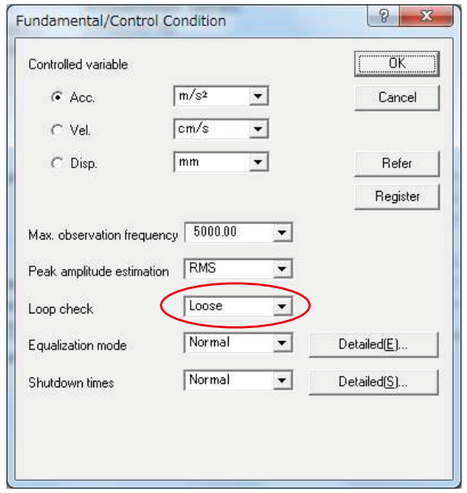
1. K2/SINE

Message	Meaning/Action
Unusual phenomenon is detected in loop check.	Meaning The test operation is aborted due to the error in Initial loop check. The detail about the error is displayed at the input channel in which an error detected in Operation status. A) Too much Environment noise is detected. [1] [2] Too small response in Initial loop check or too much noise in non-excitation is judged as an unusual phenomenon. B) Loop open is detected. [1] [2] [4] Sudden decrease of response characteristics is judged as an unusual phenomenon in operation. C) Too much response is detected. [1] [3] [5] [6] Sudden increase of response characteristics is judged as an unusual phenomenon in operation. D) Overload is detected. [1] [5] [6] A signal having an exceeded level over the maximum input value of the hardware (at voltage input : ±10V, at charge input : ±10000pC or ±1000pC, at IEPE input) is inputted to the input channel.

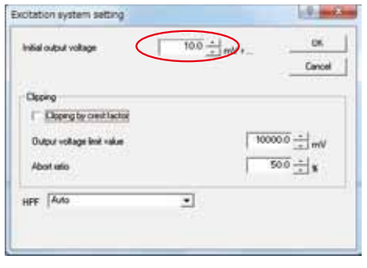
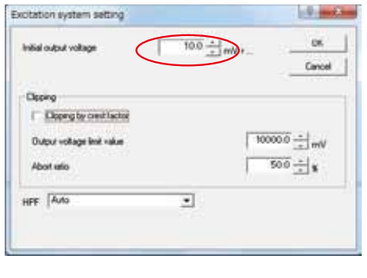
Message	Meaning/Action
Unusual phenomenon is detected in loop check.	Action Check the following points at first. · Mistake in system cabling · Incorrect definition of I/O channel information, such as sensitivity and input type · Cable disconnection · Incorrect installation of the pickups · Unusual condition of the excitation system · Unusual condition of the specimen After checking the points in the above, the treatments for each error are to be done according to the specified numbers. [1] Set the Loop check in Fundamental/Control Condition to‘Loose’.  [2] Increase the value of initial output voltage in Excitation System setting.(If error occurred in Initial measurement or in Initial equalization)  [3] Decrease the value of initial output voltage in Excitation System setting.(If error occurred in Initial measurement or in Initial equalization) 

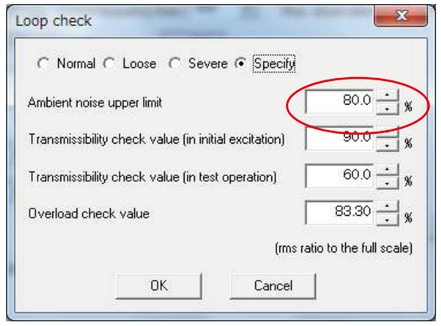
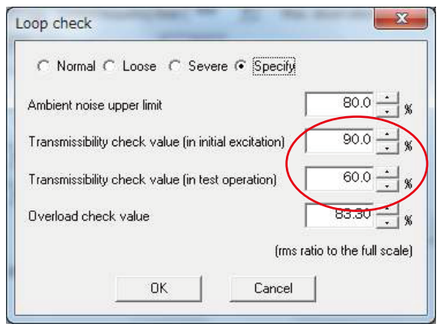
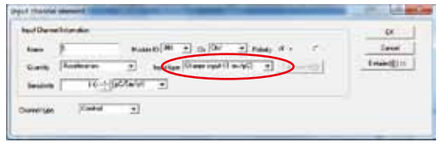
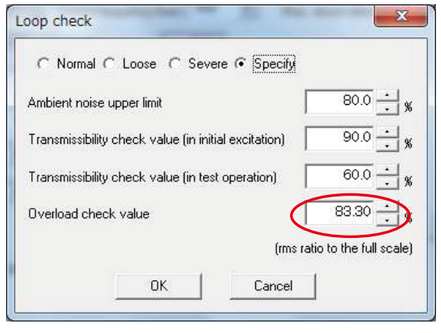
Message	Meaning/Action
Unusual phenomenon is detected in loop check.	[4] Set the amplitude estimation method in Fundamental Condition to 'Tracking' (If error occurred in Initial measurement or in Initial equalization) This setting is useful to low frequency excitation(lower than 10Hz)  [5] At charge input, set the input type of input channel to 'Charge Input(1mV/pC)'.  [6] Change the sensor to lower sensibility one.
Test is 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. 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 limit value error [2] [3] [4] [5] [6] [7] [8] [9] The test operation is aborted for requiring of the output voltage exceeding over the 'Output voltage limit value' of Excitation System setting in operation. **Action** Check the following points at first. · Mistake in system cabling · Incorrect definition of I/O channel information, such as sensitivity and input type · 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. [1] Change the set value of Tolerance. 

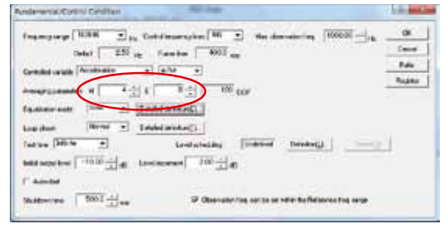
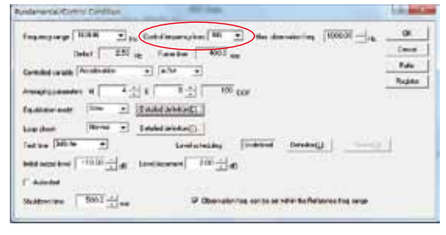
Message	Meaning/Action
Test is aborted by Abort check.	[2] Change the setting of equalization mode in Fundamental Condition.  [3] Change the setting of amplitude estimation method in Fundamental Condition.  [4] Change the setting of output voltage limit value in Excitation System setting. 

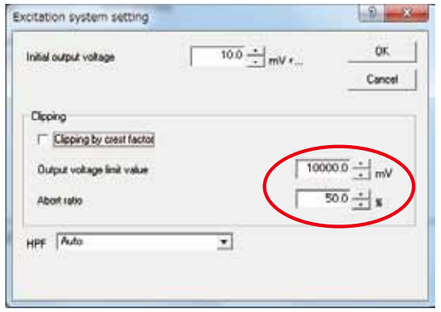
Message	Meaning/Action
Test is aborted by Abort check.	[5] Set the loop check in Fundamental Condition to 'Loose'.  [6] Recheck of Control point. [7] Recheck the pickups used in the system. [8] Recheck the pattern of the test. [9] Recheck the construction of fixture.
·Failed in initialization. ·Hardware error	Meaning An error is detected in initialization of I/O unit executed prior to the test operation. An error is detected in the PC or I/O unit. Action · The power of I/O unit is not set ON. · Between the PC and I/O unit is not connected. · Incorrect connection of I/O unit board. · Incorrect connection of K2 I/F board. · Device driver is not installed correctly. Check the above points and retry the testing operation for several times.
The license required for operating the program is not found.	Meaning An error is detected in K2 Protect information check. Action · Incorrect license information · Malfunction of USB port of the PC connected to the protect devise. · Incorrect connection of the protect devise. Check the above points and retry the testing operation for several times.
·Test is aborted by CPU overload. ·Test is stopped by I/O DMA buffer overrun.	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. · Disable unnecessary Windows function such as Power Options, Windows tasks and visual effects. · Decrease the value of Max. Observation Frequency in Fundamental Condition. · Decrease the numbers of channel to be used. Check the above points and reboot PC and retry the testing operation for several times.

2. K2/RANDOM

Message	Meaning/Action
Unusual phenomenon is detected in loop check.	Meaning The test operation is aborted due to the error in Initial loop check. The detail about the error is displayed at the input channel in which an error detected in Operation status. A) Too much environment noise is detected. [1] [2] [4] Too small response in Initial loop check or too much noise in non-excitation is judged as an unusual phenomenon. B) Loop open is detected. [1] [2] [5] Sudden decrease of response characteristics is judged as an unusual phenomenon in operation. C) Too much response is detected. [1] [3] [5] Sudden increase of response characteristics is judged as an unusual phenomenon in operation. D) Overload is detected. [1] [6] [7] [8] A signal having an exceeded level over the maximum input value of the hardware (at voltage input : ±10V, at charge input : ±10000pC or ±1000pC, at IEPE input : ±10V) is inputted to the input channel. Action Check the following points at first. · Mistake in system cabling · Incorrect definition of I/O channel information, such as sensitivity and input type · Cable disconnection · Incorrect installation of the pickups · Unusual condition of the excitation system · Unusual condition of the specimen After checking the points in the above, the treatments for each error are to be done according to the specified numbers. [1] Set the Loop check in Fundamental/Control Condition to 'Loose'.  [2] Increase the value of initial output voltage in Excitation System setting.(If error occurred in Initial measurement or in Initial equalization)  [3] Decrease the value of initial output voltage in Excitation System setting.(If error occurred in Initial measurement or in Initial equalization) 

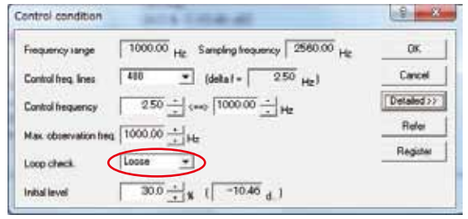
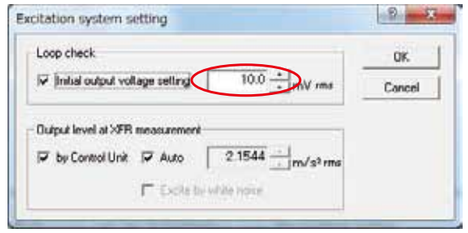
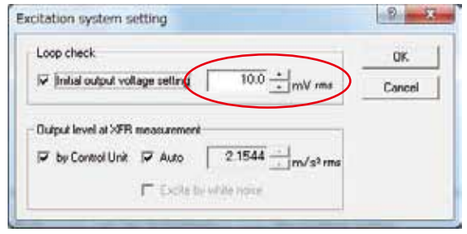
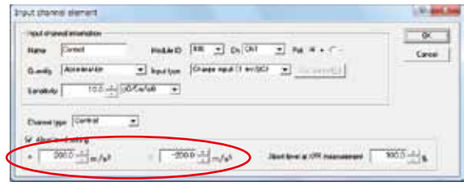
Message	Meaning/Action
Unusual phenomenon is detected in loop check.	[4] Set the Loop check to 'Specify' and increase the Ambient noise upper limit value in Fundamental/Control Condition.  [5] Set the Loop check to 'Specify' in Fundamental/Control Condition and set as follows. ·If error occurred in Initial measurement or in Initial equalization Increase the value of 'Transmissibility check value (ininitial excitation)'. ·If error occurred in excitation Increase the value of 'Transmissibility check value (intest operation)'.  [6] At charge input, set the input type of input channel to 'Charge Input(1mV/pC)'.  [7] Change the sensor to lower sensibility one. [8] Set the Loop check to 'Specify' and increase the Overload check value in Fundamntal/Control Condition. Note: This treatment is done only for not aborting test operation, when the response signal is over the input range a little. In this case, the controlling and measuring has some difficulties for an accuracy. 

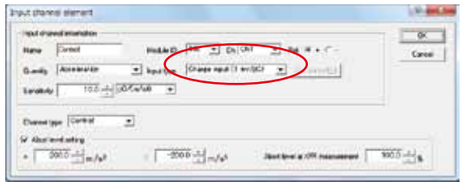
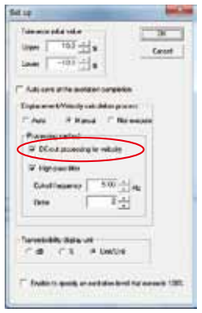
Message	Meaning/Action
Test is aborted by Abort check.	**Meaning** The test operation is aborted for an error detected by various abort checks in operation. The content of error is displayed in Operation status. A) Test is aborted by Abort check. [1] [2] [3] [4] [6] [7] [8] [9] The test operation is aborted for an error detected by various Tolerance checks. B) Test is aborted by Abort check[Drive]. [5] [6] [7] [8] [9] The test operation is aborted for requiring of the output voltage exceeding over the 'Output voltage limit value' of Excitation System setting in operation. **Action** Check the following points at first. · Mistake in system cabling · Incorrect definition of I/O channel information, such as sensitivity and input type · 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. [1] Change the set value of Tolerance.  [2] Change the setting of Equalization Mode in Fundamental/Control Condition.  [3] Change the setting of Averaging Parameters in Fundamental/Control Condition.  [4] Change the setting of Control frequency lines in Fundamental/Control Condition. 

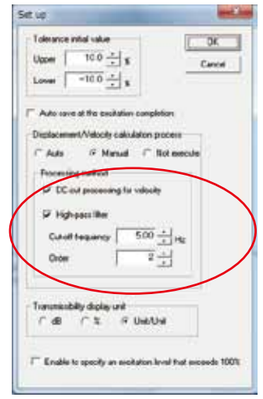
Message	Meaning/Action
	[5] Change the setting of Output voltage limit value and the Abort ratio in Excitation System Setting.  [5] Recheck of Control point. [6] Recheck the pickups used in the system. [7] Recheck the pattern of the test. [8] Recheck the construction of fixture.
Failed in initialization.	Same as SINE (See P17)
The license required for operating the program is not found.	Same as SINE (See P17)
Hardware error	Same as SINE (See P17)
·Test is aborted by CPU load. ·Test is stopped by I/O DMA buffer overrun.	Same as SINE (See P17)

3. K2/SHOCK

Message	Meaning/Action
·XFR measurement is stopped.	**Meaning** The test operation is aborted due to the error in Initial loop check or XFR measurement. The detail about the error is displayed in History window. A) Too much ambient noise. [1] [2] [4] [5] Too small response in Initial loop check or too much noise in non-excitation is judged as an unusual phenomenon. B) Loop open is detected. [1] [2] Sudden decrease of response characteristics is judged as an unusual phenomenon in operation. C) Too much response is detected. [1] [3] [4] [5] [6] [7] Sudden increase of response characteristics is judged as an unusual phenomenon in operation. D) Too small linearity is detected. [1] [2] Non-linearity of response characteristics is judged as an unusual phenomenon in operation. E) XFR measurement is aborted because the level is exceeding over the abort level of input channel. [3] [4] [5] [6] [7] **Action** Check the following points at first. · Mistake in system cabling · Incorrect definition of I/O channel information, such as sensitivity and input type · Cable disconnection · Incorrect installation of the pickups · Unusual condition of the excitation system · Unusual condition of the specimen After checking the points in the above, the treatments for each error are to be done according to the specified numbers.

Message	Meaning/Action
	[1] Set the Loop check in Control Condition to 'Loose'.  [2] Increase the value of initial output voltage in Excitation System setting.  [3] Decrease the value of initial output voltage in Excitation System setting.  [4] Increase the abort level of input channel at XFR measurement.  [5] Increase the abort level of input channel. Note: This treatment is done only for not aborting test operation. Operate with great attention. 

Message	Meaning/Action
	[6] At charge input, set the input type of input channel to 'Charge Input(1mV/pC)'.  [7] Change the sensor to lower sensibility one.
·Reference acceleration is exceeding over the system rating. ·The velocity calculated from reference acceleration is exceeding over the system rating. ·The displacement calculated from reference acceleration is exceeding over the system rating.	Meaning The test operation is impossible because reference waveform is exceeding over the system rating. (Velocity/displacement is calculated only by a simple process of integral. Note that the displacement/velocity waveform calculated from acceleration waveform must be treated as a reference.) Action Check the reference waveform. · Acceleration [1] Decrease the value of reference waveform level. · Velocity [1] Decrease the value of reference waveform level. [2] Use "DC-cut processing for Velocity" of Displacement/Velocity Calculation Process in Set up of option menu. Note: This treatment can be used only when theoretical reference velocity level is no problem obviously. Operate with great attention.  · Displacement [1] Decrease the value of reference waveform level. [2] Use "DC-cut processing for Velocity" of Displacement/Velocity Calculation Process in Set up of option menu. Note: This treatment can be used only when theoretical reference velocity level is no problem obviously. Operate with great attention. 

Message	Meaning/Action
	[3] Use "High-pass Filtering" of Displacement/Velocity Calculation Process in Set up of option menu. Note: This treatment can be used only when theoretical reference velocity level is no problem obviously. Operate with great attention. 
Failed in initialization	Same as SINE (See P17)
The license required for operating the program is not found.	Same as SINE (See P17)
Hardware error	Same as SINE (See P17)
·Input DMA buffer overrun ·Output DMA buffer overrun	Same as SINE (See P17)