High **dynamic range** (120 dB) and **32 bit converter** for accurate results

Dynamic Range

K2 117dB
K2+ 120dB

A/D Converter

K2 24 bit
K2+ 32 bit
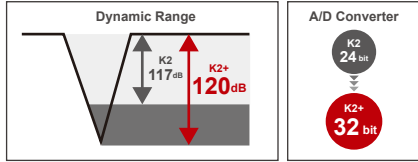
Connect by **TCP/IP interface Built in CPU,** for stand-alone mode and high reliability

PC for K2+

Control K2+ via LAN

The TCP Server enables other devices to be linked for remote operation.

Laptop PC   Tablet   PLC
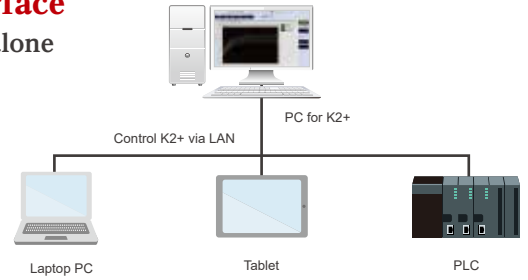
Works with SMART-, **ECO-replacement amplifiers**

The Integrated Shaker Manager (ISM-EM) technology incorporated within the ECO-shaker system automatically controls the power amplifier output, field level and blower speed to achieve the maximum efficiency under all test conditions.

ISM-EM +

Vibration controller

Control for maximum efficiency

Power amplifier

Field current → Vibration generator

Drive signal

Optimised for test level → Blower
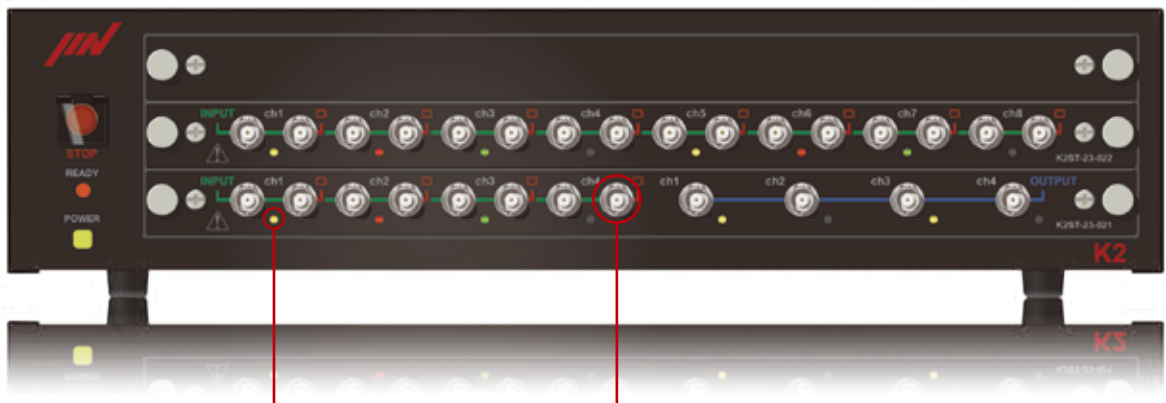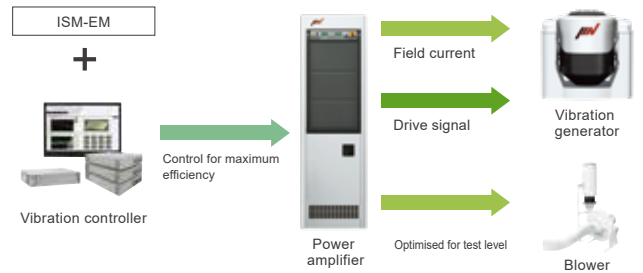
Channel Status and configuration **indicated by LED colour**

[Input]
- 🟢 Green: Charge input channel
- 🔵 Blue: IEPE input channel
- White: Voltage input channel (include Differential)
- 🔴 Red(Flush): Input channel error (ex. Loop check error)

[Output]
- 🟢 Green: Control drive output
- 🔵 Blue: Aux.output (SINE, RANDOM), Timing signal output (SHOCK)

Provides **parallel monitor** terminals

The parallel terminals allow easy connection of additional measurement equipment

Oscilloscope/FFT

Datalogger
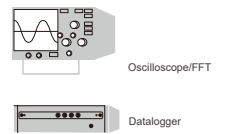
Includes the latest **Soft-clipping** technology (Random)

A clipping function that can reduce the peak value of the output voltage without affecting control performance.

Drive signal

Clipping

Response PSD

Conventional

Soft-clipping
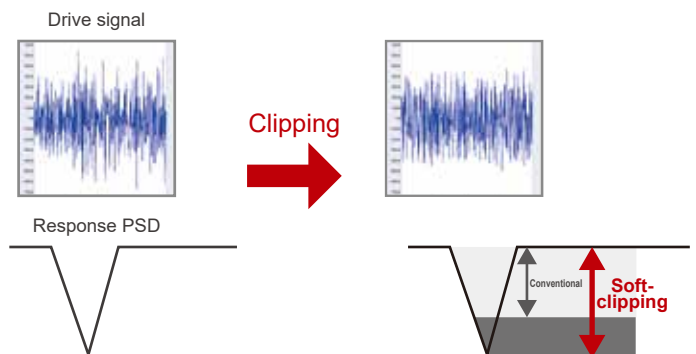
Supports Charge, IEPE, TEDS accelerometers and many other sensors

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■ Basic Software

Sine

Three types of tests are available in K2+/Sine.

◆ Sweep test
The sweep test is the most popular testing method used in sine vibration tests. In this test, the system executes sine vibration control by changing the frequency continuously according to the specified conditions.

◆ Spot test
A spot test is a test in which the specified frequency and the reference level are specified in advance, and the excitation of the specified conditions is performed sequentially.

◆ Manual test
A manual test is a special test run by manual operation only. Control reference conditions can be changed during test operation.

■ Specifications

◆ Control Algorithm
Continuous closed-loop control of true rms level

◆ Control Frequency Range
0.1 - 20000 Hz

◆ Control Dynamic Range
More than 120 dB

◆ 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 20

*Specifications may be affected by other conditions.

■ Optional Software

◆ 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 controlled in order 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 is likely to 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.

*These features will be released soon.
Please contact your local distributors for more information.
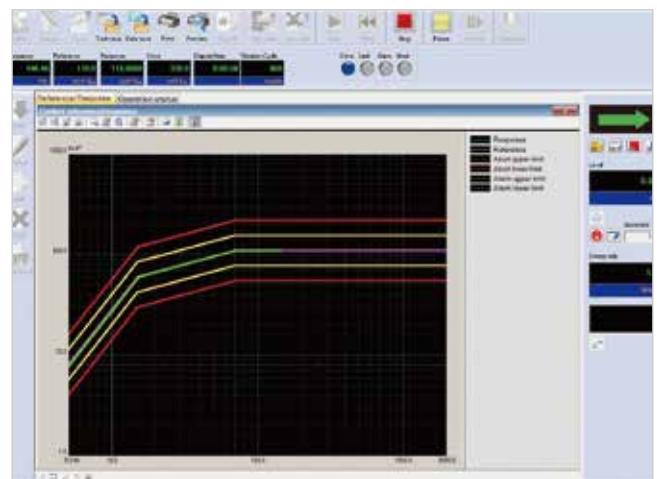
■ Basic Software

Random

One types of tests are available in K2+/Random.

◆ Random test
　A vibration test using random vibration.

■ Specifications

◆ Control Algorithm
　Closed-loop control of PSD within each spectral line

◆ Control Frequency Range
　Maximum 20000 Hz

◆ Number of Control Lines
　Maximum 25600 lines

◆ Control Dynamic Range
　More than 98 dB

◆ Loop Time
　200 ms (fmas=2000 Hz, at L=400 line)

◆ Multiple-Channel Control Modes
　Average control, Maximum control, Minimum control

◆ Input Channels
　Maximum 20

*Specifications may be affected by other conditions.

■ Optional Software

◆ SOR test
　An SOR test is a vibration test composed by adding random vibration to sine vibration simultaneously. It is possible for sine vibration to be swept in this test.

◆ ROR test
　An ROR test is a vibration test composed by superimposing a stationary broadband random vibration with a narrow band random vibration that is swept according to given sweep conditions.

◆ EXTENDED ROR
　The extended ROR makes it possible to execute an ROR test with greater freedom when defining separate NBR references.

◆ PSD LIMIT: PSD limit control
　Response channels can be specified as limit control channels. If the PSD on a limit control channel is likely to exceed its limit, the test level is reduced over that range of frequencies to keep within the limit level.

◆ Soft-Clipping
　A clipping function that can reduce the peak value of the output voltage without affecting control performance.

◆ Non-Gaussian*
　A vibration testing method which precisely reproduces non-Gaussian vibrations, for example transportation vibrations, with large spikes.
　*This feature will be released soon. Please contact your local distributors for more information.

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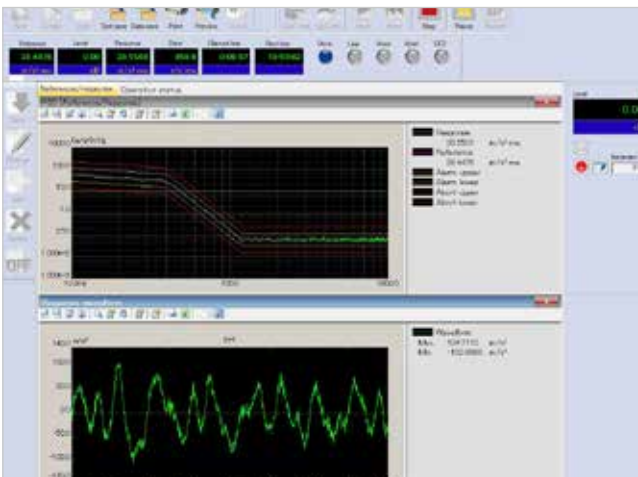
■ Basic Software

Shock

Two types of tests are available in K2+/Shock.

◆ Shock test
A shock test for replicating the finite arbitrary reference waveform given in a digital format by using it as the control reference value.
Ex) Classical shock waveform, Sine beat, replicating a measured waveform test

◆ SRS shock test *SRS option is necessary
Shock test for replicating the excitation of the generated reference waveform data with a given reference SRS. The result is judged by SRS analysis.

■ Optional Software

◆ LONG WAVEFORM
The standard length of a reference waveform is 16 K points. This can be increased to 200 K points by adding the LONG WAVEFORM option. At a sampling frequency of 512 Hz 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 5000 K points, about 163 minutes at 512 Hz sampling rate.

◆ SRS: Shock Response Spectrum
SRS (Shock Response Spectrum) can execute a test in which the test condition and evaluation are conducted not based on the waveform itself, but on SRS analysis. With standard shock test selected, SRS analysis of the response waveform is also possible.

■ Specifications

◆ Control Algorithm
Finite-length waveform controlled by feed forward method

◆ Control Frequency Range
Maximum 20000 Hz

◆ Number of Control Lines
Maximum 25600 lines

◆ Control Dynamic Range
More than 98 dB

◆ Type of Reference Waveform
Classical shock waveform (Half-sine, Haversine, Saw-tooth, Triangle, Trapezoid etc.), Sine beat waveform, Measured waveform etc.

◆ Input Channels
Maximum 20

*Specifications may be affected by other conditions.
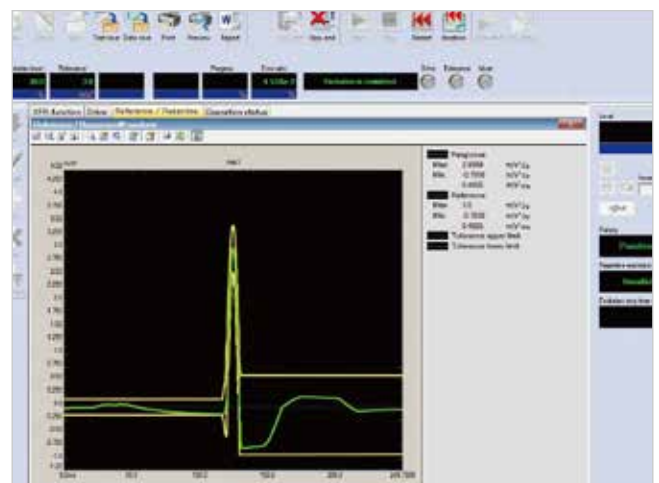
■ MIMO Software for Multiple Shakers*

Multi Sine

Two types of tests are available in K2/Multi Sine.

◆ Sweep test
The sweep test is the most popular testing method used in sine vibration tests. In this test, the system executes sine vibration control by changing the frequency continuously according to the specified conditions.

◆ Spot test
Spot test is a test which the specified frequency and the reference level are specified in advance, and the excitation of the specified conditions is sequentially performed.

■ Specifications

◆ 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 - 10000 Hz

◆ Frequency Resolution
Better than 10^{-4} of frequency

◆ Control Dynamic Range
More than 114 dB

◆ 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

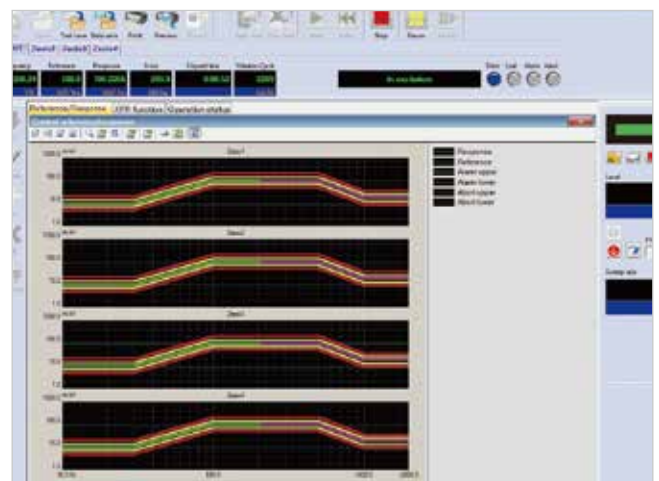### ◆ Input Channels
Maximum 20

◆ Output Channels
Maximum 12

* Specifications may be affected by other conditions

■ Optional Software

◆ 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.

*These features will be released soon.
Please contact your local distributors for more information.

■ **MIMO Software for Multiple Shakers***

Multi Random

One type of test is available in K2/Multi Random.

◆ Random test
   A vibration test using random vibration.

■ **Specifications**

◆ 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 10000 Hz

◆ Number of Control Lines
   Maximum 3200 lines

◆ Control Dynamic Range
   More than 90 dB

◆ Loop Time
   450 ms (3-input, 3-output control, 120 DOF, fmax =
   2000 Hz, L = 200 line cross-talk information averag
   ing times = 8 times/loop)

◆ Multiple-Channel Control Modes
   Average control, Maximum control, Minimum control

◆ Input Channels
   Maximum 20

◆ Output Channels
   Maximum 12
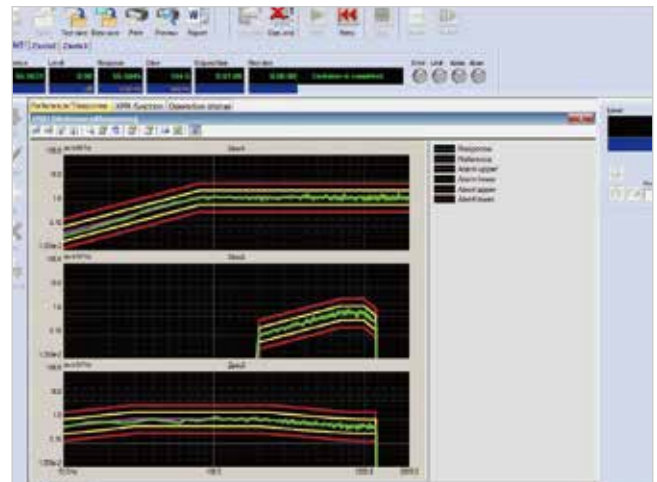
* Specifications may be affected by other conditions

■ **Optional Software**

◆ PSD LIMIT: PSD limit control
   Response channels can be specified as limit
   control channels. If the PSD on a limit control
   channel is likely to exceed its limit, the test
   level is reduced over that range of frequen-
   cies to keep with the limit level.

◆ Non-Gaussian
   A vibration testing method which precisely
   reproduces non-Gaussian vibrations, for
   example transportation vibrations, with large
   spikes.

*This feature will be released soon.
Please contact your local distributors for more information.

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■ **MIMO Software for Multiple Shakers***

BMAC

Three types of tests are available in K2/Shock.

◆ **Shock test**
A shock test for replicating the finite arbitrary reference waveform given in a digital format by using it as the control reference value.
Ex) Classical shock waveform, Sine beat, replicating measured waveform tests

◆ **SRS shock test** *SRS option is necessary
A shock test for replicating the excitation of the generated reference waveform data with a given reference SRS. The result is judged by SRS analysis.

◆ **Endurance test**
Endurance test by repeating the excitation as stated above.

■ Specifications

◆ Control Algorithm
Finite-length waveform controlled by feed forward method

◆ Control Frequency Range
Maximum 20000 Hz

◆ Number of Control Lines
Maximum 25600 lines

◆ Control Dynamic Range
More than 84 dB

◆ 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 5000 k points

◆ Input Channels
Maximum 20

◆ Output Channels
Maximum 12

* Specifications may be affected by other conditions

*This feature will be released soon.
Please contact your local distributors for more information.

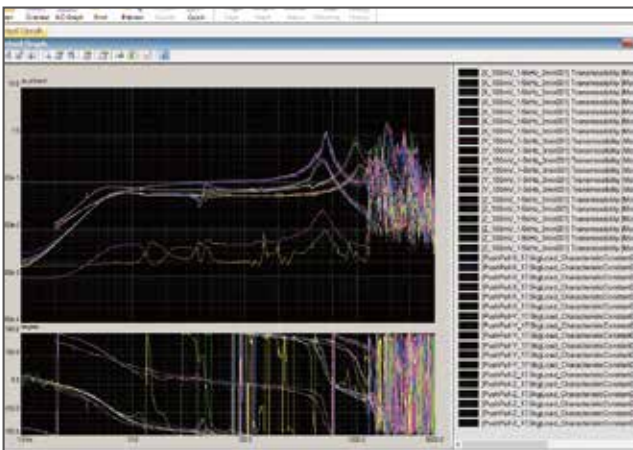■ **Free Software for generating reports**

K2+ DataViewer

This is the software that displays the data files of test results saved after Sine, Random and Shock tests. It can be used for the display of test conditions and results graphs or for comparison between past test data (overlapping display) or generation of reports.
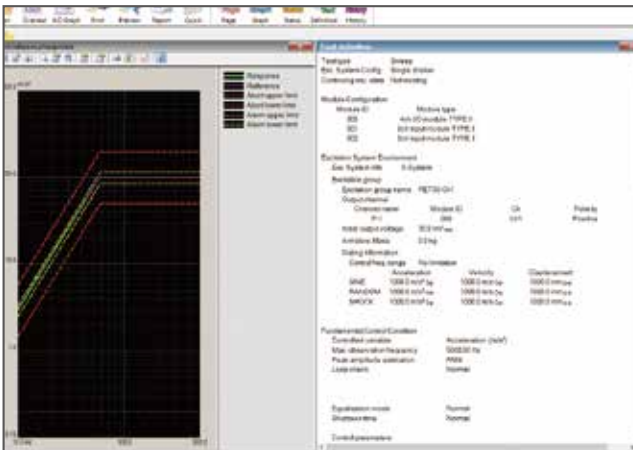
Test condition, result graph
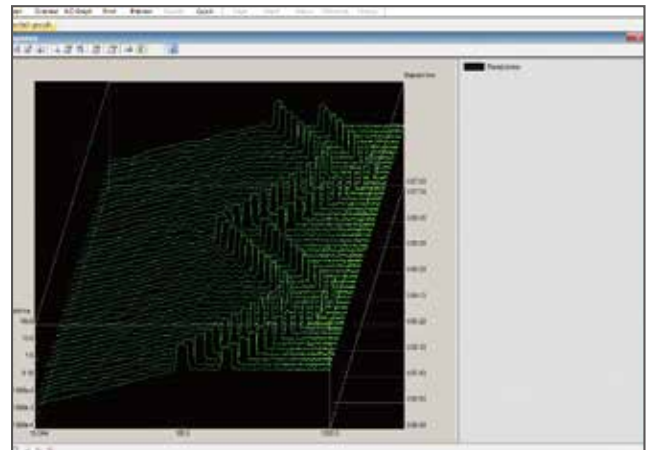
3D graph

Overlapping display

Report

■ **System Requirement**

［Supported OS］
Windows 10 (64bit), Windows 7 (32bit/64bit)

［Memory］
RAM of more than 512 MB is recommended

［Hard Disk］
Free space of more than 200 MB is required

Application site

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■ Optional Software

Test standards   * Standard for A-series and K-series

Test files are automatically generated upon selection of the test conditions defined by the test standard. Minimizing control error is key for a good vibration control system, which is why we have included major vibration standards in the K2+ Quick Launcher software option. The operator doesn't have to worry about choosing the wrong profile.

*Please refer to the following for the test standards.
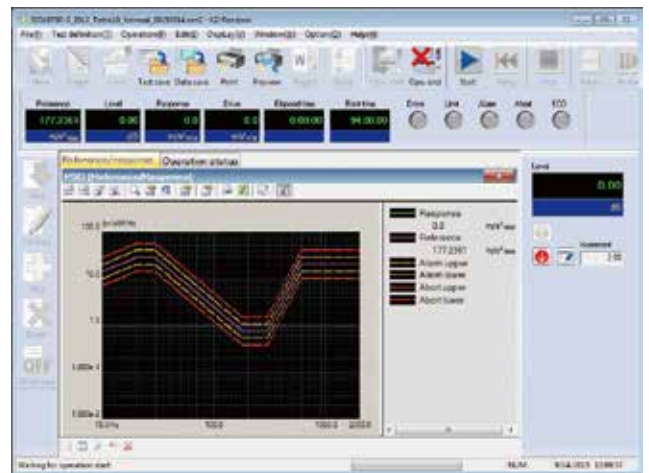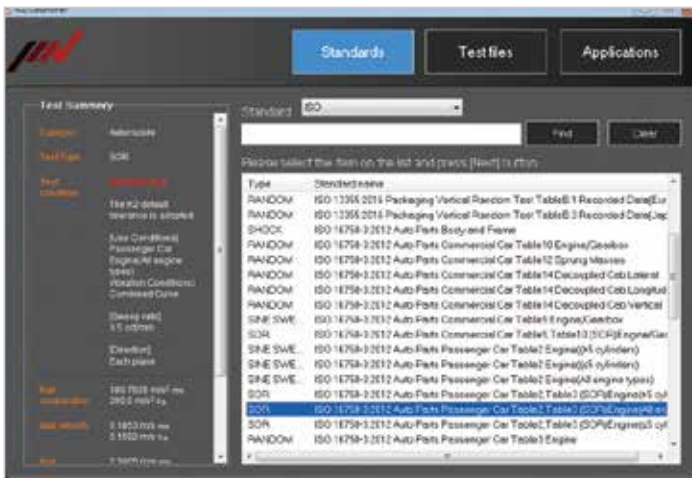
[Optional Standards]

The main test standards stored in the Launcher software (Ver 14.5.0.0 onwards) are as follows as of July 2020. The Launcher software is an option for K2+.

JIS C 60068	Sine, Random, Shock
JIS D 1601	Automotive parts simulated long-life test
JIS E 4031	Railway vehicle parts functional test, Simulated long-life test
JIS Z 0200	Transportation test
JIS Z 0232	Transportation test（Random）
JASO D 014	Automotive parts functional test
ASTM	Transportation test
UN	Lithium-ion battery test recommended by UN
ISO16750	Automotive parts test
ISO12405	Electric vehicle
IEC60068	Sine, Random, Shock
IEC62660	Random, Shock for secondary lithium-ion cells of electric vehicles
ISTA	Transportation test
IEC61373	Railway vehicle parts functional test
ISO13355	Transportation test（Random）
ISO4180	Transportation test
ISO19453	Electric vehicle parts

*An additional cost is incurred for version upgrade.
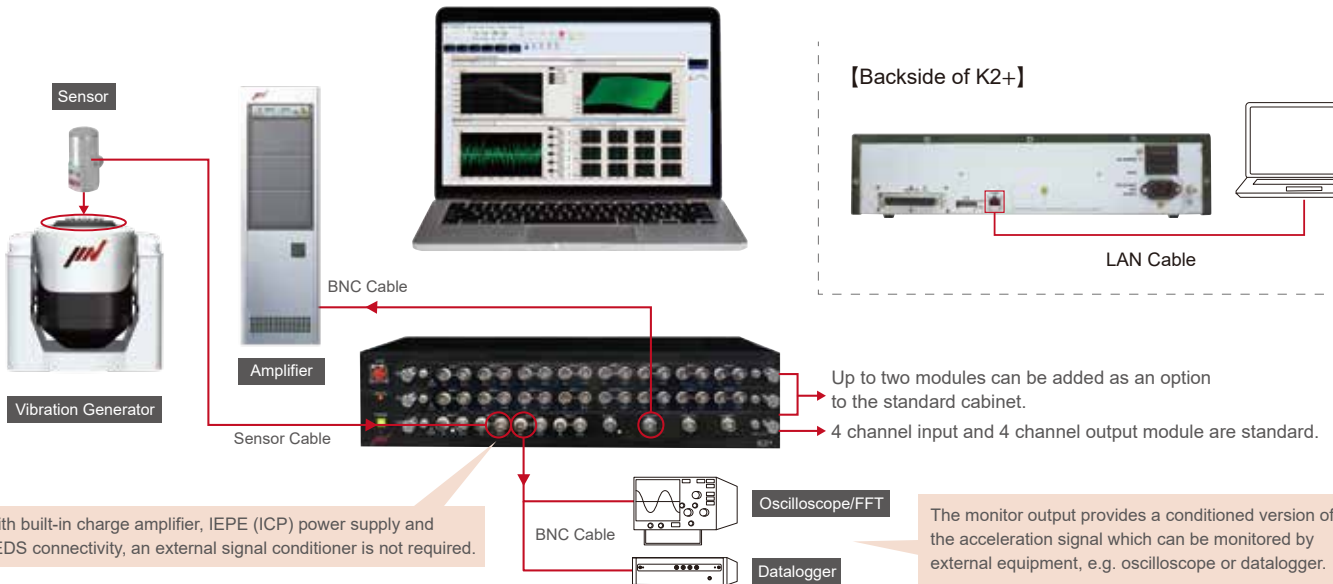
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■ Example for a system composition using the new K2+ vibration controller

* For USB connection, a conversion cable with a communication speed of 1 Gbps or higher is required.

【Backside of K2+】

LAN Cable

PC

BNC Cable

Sensor

Vibration Generator

Amplifier

Sensor Cable

Up to two modules can be added as an option to the standard cabinet.

4 channel input and 4 channel output module are standard.

With built-in charge amplifier, IEPE (ICP) power supply and TEDS connectivity, an external signal conditioner is not required.

BNC Cable

Oscilloscope/FFT

Datalogger

The monitor output provides a conditioned version of the acceleration signal which can be monitored by external equipment, e.g. oscilloscope or datalogger.

■ Hardware Specifications

Main Enclosure	
Number of Slots	3
AC Power	Single-phase AC, 100 V-240 V (auto-selected)
External Communication	Contact I/O (for emergency stop)
Ambient Conditions	0-40°C, below 85% RH, non-condensing
Dimensions	W430 × H100 × D383 mm (not including projecting parts)
Mass	Approximately 7.0 kg

Minimum Specifications of PC
- One LAN port Gigabyte ethernet port and Gigabyte ethernet cable
  * For USB connection, a conversion cable with a communication speed of 1 Gbps or higher is required.
- Microsoft Windows 10 Pro (64 bit) or Windows 10 IoT Enterprise (64 bit)*.
- Memory required (for 8 input channels) 4 GB or more
- DVD-ROM Drive (required for installation)
- One USB port (necessary for protect device)
- Resolution of monitor and PC required 1280 x 1024 or more
- * Recommended OS and memory vary depending on software, options, number of I/O channels, etc.

*Please note that optional software "Program K2+" used for vibration controller K2+ also requires Japanese government export license (E/L).

		4-channel Input and 4-channel Output Module (standard)	8-channel Input Module (option)
Input Section	Number of Channels	4	8
	Input Connector	BNC	
	Input Signal	Charge, Voltage (Single-ended/Differential), IEPE	
	Charge Amplifier Sensitivity	1.0 mV/pC or 10 mV/pC	
	Charge Amplifier Cut-off	0.32 Hz	
	Maximum Input — Charge Input	±10000 pC or ±1000 pC	
	Maximum Input — Voltage Input	±10000 mV	
	Maximum Input — IEPE input	±10000 mV	
	Sampling Frequency	102.4 kHz maximum	
	Voltage Input Coupling	AC or DC	
	AC Coupling Cut-off	0.1 Hz	
	CCLD Amplifier (IEPE)	+24 VDC, 3.5 mA	
	TEDS (IEPE)	Version 0.9, Version 1.0	
	A/D Converter — Type	ΔΣ	
	A/D Converter — Resolution	32 bit	
	A/D Converter — Dynamic range	121 dB	
	A/D Converter — Digital filter	Pass-band ripple: +0.001, -0.06 dB, Stop-band attenuation: 85 dB	
Output Section	Number of Channels	4 (One channel is reserved for drive output)	
	Output Connector	BNC	
	Output Signal	Voltage	
	Maximum Output	±10000 mV	
	Sampling Frequency	102.4 kHz maximum	
	D/A Converter — Type	ΔΣ	
	D/A Converter — Resolution	32 bit	
	D/A Converter — Dynamic range	120 dB	
	D/A Converter — Digital filter	Pass-band ripple: ±0.005 dB, Stop-band attenuation: 100 dB	

*The specifications and design are subject to change without notice.
**some of the K2+ options and features need to be purchased separately.

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