

# Premax



Vibration Transducer / Vibrometer Calibration System  
Technical Specification

System Overview

ECS medium frequency sensor calibration system based on ECI-9102 or ECI-9108 programmable calibrator, is designed for calibrating accelerometer, velocity transducer and vibration meter, bearing vibration meter, foundation pile movement meter, sensitivity, frequency response characteristic and amplitude linearity, transverse sensitivity. The frequency range is up to 20,000Hz. The system use vibration comparison method for calibration, and adopts automatic close-loop control to measure the frequency and level of reference transducer and transducer to be calibrated, and then compute the sensitivity and amplitude linearity, plot the curve of frequency response, generate the calibration report and so on.

The Calibration System is mainly used in metrology research institute, vibration scientific research laboratory, manufacturer of transducer and vibration meter etc.

**Features**

- ✧ Precisely calibrate the different types of accelerometer, velocity transducer displacement transducer and vibration meter, for example voltage type, charge type, IEPE and TEDS
- ✧ Fast and accurate calibration of sensitivity, frequency response characteristic and amplitude linearity, transverse sensitivity
- ✧ Back to back comparison calibration
- ✧ Frequency Range: 1Hz-10kHz, dependent on shaker and transducer.
- ✧ Low extension uncertainty, e.g. At 160Hz reference frequency and 100m/s<sup>2</sup> reference acceleration, the uncertainty <1%
- ✧ Frequency response support calibration methods of sine sweep, step sine, random excitation, etc. .
- ✧ Professional calibration/calibration software realizes the close-loop control of the shaker. After user setup the calibration procedure, the system will go into the procedure of calibration.
- ✧ After calibration, the system generates the calibration report, the content includes the sensitivity, amplitude linearity and frequency response characteristic
- ✧ Shoulder-by-shoulder method: can calibrate several transducers simultaneously
- ✧ substitution method/calibration: cancel the most uncertainty caused by the shaker distortion and error for measuring devices.

**Reference standard and calibration rules**

- ✧ ISO 16063-21:2003 Methods for the calibration of vibration and shock transducers – Part 21:Vibration calibration by comparison to a reference transducer
- ✧ Vibration and shock transducer calibration method, section 21: vibration comparison calibration
- ✧ JJG 134-2003 electromagnetic velocity transducer.
- ✧ JJG 233-2008 piezoelectric accelerometer
- ✧ JJG 676-2000 working vibration meter
- ✧ JJG 930 -1998 foundation pile movement meter calibration rules
- ✧ JJG 644-2003 vibration displacement sensor
- ✧ JJF 1371-2012 acceleration rolling bearing vibration meter calibration rules.
- ✧ JJF 1185-2007 velocity rolling bearing vibration meter calibration rules

**Applications**

- ✧ Vibration transducer, vibration meter, bearing vibration meter, vibration meter and foundation pile movement meter. Transducer types: support voltage, charge, IEPE, TEDS, etc. .
- ✧ **Accurately calibrate all kinds of accelerometer, velocity transducer, displacement transducer, vibration meter, bearing vibration meter, vibration meter and foundation pile movement meter**

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System Parameters

Model	ECI-9102	ECI-9108
Input Channel	2 voltage channels	8 voltage channels
Drive channel	1	1
<a href="#">Mechanic parameters</a>		
dimensions (mm)	362×278×79	455×355×92
Weight (kg)	2.5	3.5
<a href="#">Electrical parameters</a>		
Power	88 to 264 Volts, 47 to 63 Hz, auto-match	
power consumption	30W	45W
electromagnetic	comply with CE standard	
<a href="#">Environment parameters</a>		
Temp	14 to 122 °F / -10 to 50 °C	
Humidity	20% to 90% RH non-condensing (40 °C)	
<a href="#">Link</a>		
OS	Microsoft Windows XP/7	
Port	USB 2.0	

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Performance

**Outputs**

Output channels: 1 Drive output channel  
 Port Type: BNC  
 Voltage Range:  $\pm 10V_{PEAK}$   
 DAC Resolution: 24-bit  
 Output Impedance:  $30\Omega$   
 Max. Output:  $MAX.30mA_{PEAK}$   
**Dynamic Range: 100dB**  
 Filtering: An analog filter plus a 160 dB/octave digital filter  
 Amplitude Precision: 0.1% (@1kHz, 1V input)  
 Frequency accuracy: 0.001%  
 Harmonic distortion  $< -95dB$  (@1kHz, 5th order harmonic wave)

**Inputs**

Input channels: 2 or 8 input channels  
 BNC Port Type: BNC  
 Input Range:  $\pm 10 V_{PEAK}$   
 Input protection:  $\pm 36 V_{PEAK}$   
 Resolution: 24-Bit ADC  
 Impedance:  $220k\Omega$   
**Dynamic Range: 120dB (Fs)**  
 **$>80dB$  ( JIG 834-2006 "dynamic signal analysis" calibration rules )**  
 Anti-alias filter: analog anti-alias filter plus digital filter, stopband attenuation larger than 160dB/Oct  
 Coupling: AC difference, AC ground, DC difference, DC ground and IEPE  
 IEPE constant flow source: built-in(+24V/+4mA)  
 Amplitude Precision: 0.5%FS  
 Frequency Precision: 0.001%  
 Harmonic distortion:  $< -100dB$  (@1kHz, 5th order harmonic wave)  
 Channel matching: amplitude  $\pm 0.05dB$ , phase  $\pm 0.5$  degree, (DC~20kHz)  
 SNR:  $>100dB$  (@1kHz, 1V input)  
 Channels crosstalk  $< -105dB$

System Software

**Calibration Functions**

- ✧ Accelerometer Calibration
- ✧ Velocity Transducer Calibration
- ✧ Displacement Transducer Calibration
- ✧ Vibration Meter Calibration
- ✧ Bearing Vibration Calibration
- ✧ Foundation pile movement meter

**Auxiliary Functions**

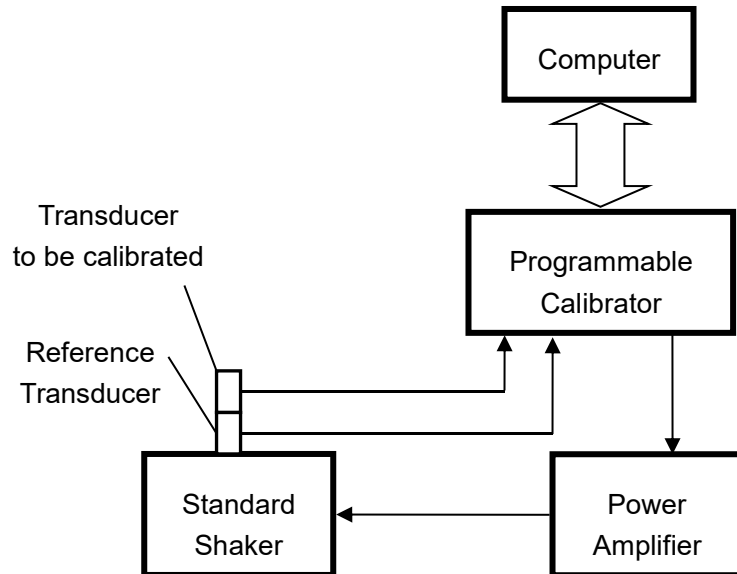
- ✧ Substitution Method
- ✧ Equipment Calibration
- ✧ **Dynamic Signal Analysis**

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System Components

A Calibration System consists of following parts:

- ✧ Standard shaker
- ✧ Amplifier
- ✧ ECON MI-2004 condition amplifier
- ✧ ECI-9102 or ECI-9108 programmable calibrator
- ✧ Standard transducer
- ✧ Transducer/ Calibration Software
- ✧ Computer



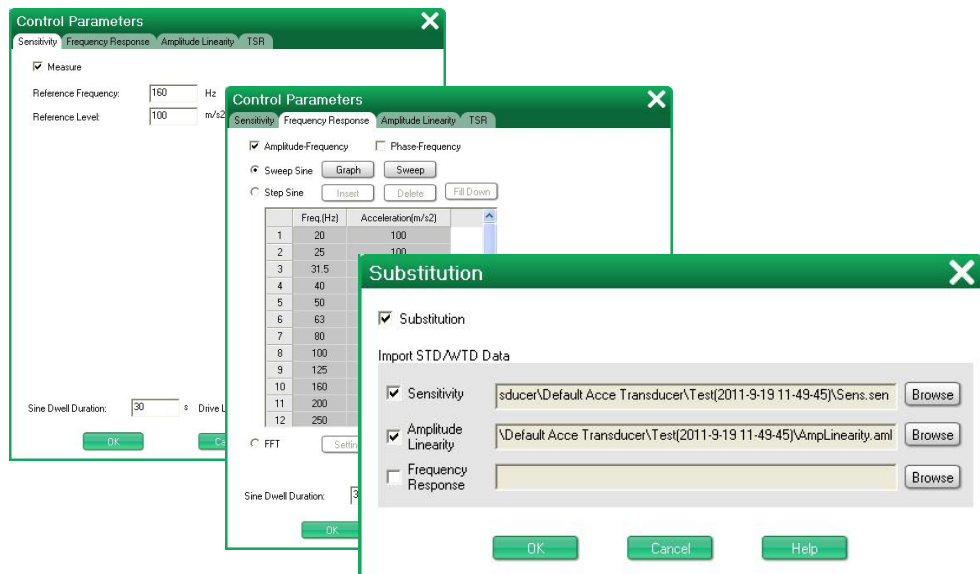
In the course of calibration, programmable calibrator generates standard sine signal required for calibrating, then the signal through the power amplifier drive the standard shaker. The output signal from standard transducer will be as a closed-loop control signal, while the output signal from transducer to be calibrated will be as a feedback signal to the programmable calibrator, then the programmable calibrator makes calculation, drawing curves on the data, and then displayed on the computer screen.

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Acceleration Transducer Calibration

- ✧ Adopts vibration calibration method by comparison to a reference transducer, traceability to national standard GB/T 20485.21-2007 (ISO 16063-21:2003)
- ✧ Enable to calibrate various types of vibration transducers: Piezoelectric transducers, IEPE transducers, voltage type transducer, charge type transducer and so on.
- ✧ ECI-9108 is able to calibrate an array of 7 transducers simultaneously
- ✧ Calibration items: sensitivity, amplitude linearity, frequency response and Transverse Sensitivity Ratio
- ✧ Calibration methods: Non-Substitution and Substitution calibration (optional). Substitution calibration can store/import the test data of reference standard transducer to working standard transducer to prolong the service life of standard transducer.
- ✧ The reference frequency that can be set in reference sensitivity calibration. For example 160Hz, 80Hz or any frequency between 1Hz-10kHz
- ✧ Methods of frequency response calibration: swept sine, step sine or FFT method
  - For swept sine, sine test profile and sweep rate can be customized, the Frequency range 1Hz-20Hz; Max. Number of analysis line 4096; User can choose linear or logarithmic sweep, and customize the sweep frequency.
  - For step sine, test frequency points, its level and dwell time can be customized. User can set up to 4096 discrete points between 1Hz-20Hz
  - For FFT method, RMS, frequency range, sampling frequency etc. can be customized, to complete the calibration process of frequency response.
- ✧ Amplitude linearity calibration in the reference frequency point can define 7-32 level values of acceleration measurement, to calibrate the amplitude linearity.
- ✧ Transverse sensitivity ratio calibration can set the reference frequency points, reference levels and dwell time.
- ✧ Measuring uncertainty, depending on the ability of employed shaker and reference transducer
- ✧ Calibration modes: regular calibration and extension points
- ✧ Frequency range: 1Hz-10 KHz, depending on the ability of employed shaker and reference transducer
- ✧ Safety: shaker limit, drive limit, open-loop check and manual abort
- ✧ Detailed WORD or PDF format report includes sensitivity, amplitude linearity and frequency response characteristic curve, etc.

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Velocity Transducer

- ✧ Adopts vibration calibration method by comparison to a reference transducer, traceability to national standard GB/T 20485.21-2007 (ISO 16063-21:2003)
- ✧ Reference: JJJ 134-2003 electromagnetic velocity transducer calibration rules
- ✧ Enable to calibrate various types of vibration transducers: Piezoelectric transducers, IEPE transducers, voltage type transducer, charge type transducer and so on.
- ✧ Calibration items: sensitivity, amplitude linearity, frequency response, Dynamic Range, Transverse Sensitivity Ratio and Acceptable Maximum Acceleration
- ✧ Method of frequency response calibration: step sine and sweep sine.
  - For swept sine, sine test profile and sweep rate can be customized, the Frequency range 1Hz-20Hz; Max. Number of analysis line 4096; User can choose linear or logarithmic sweep, and customize the sweep frequency.
  - For step sine, test frequency points, its level and dwell time can be customized. User can set up to 4096 discrete points between 1Hz-20Hz.
- ✧ Measuring uncertainty, depending on the ability of employed shaker and reference transducer
- ✧ Calibration modes: regular calibration and extension points
- ✧ Frequency range: 1Hz-10 kHz, depending on the ability of employed shaker and reference transducer
- ✧ Safety: shaker limit, drive limit, open-loop check and manual abort
- ✧ Quick and accurate complete all calibrations
- ✧ Detailed WORD or PDF format report includes sensitivity, amplitude linearity and frequency response characteristic curve, etc.

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	Freq(Hz)	Velocity(cm/s)
1	20	1
2	25	1
3	31.5	1
4	40	1
5	50	1
6	63	1
7	80	1
8	100	1
9	125	1
10	160	1
11	200	1
12	250	1
13	315	1
14	400	1

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## Displacement transducer calibration

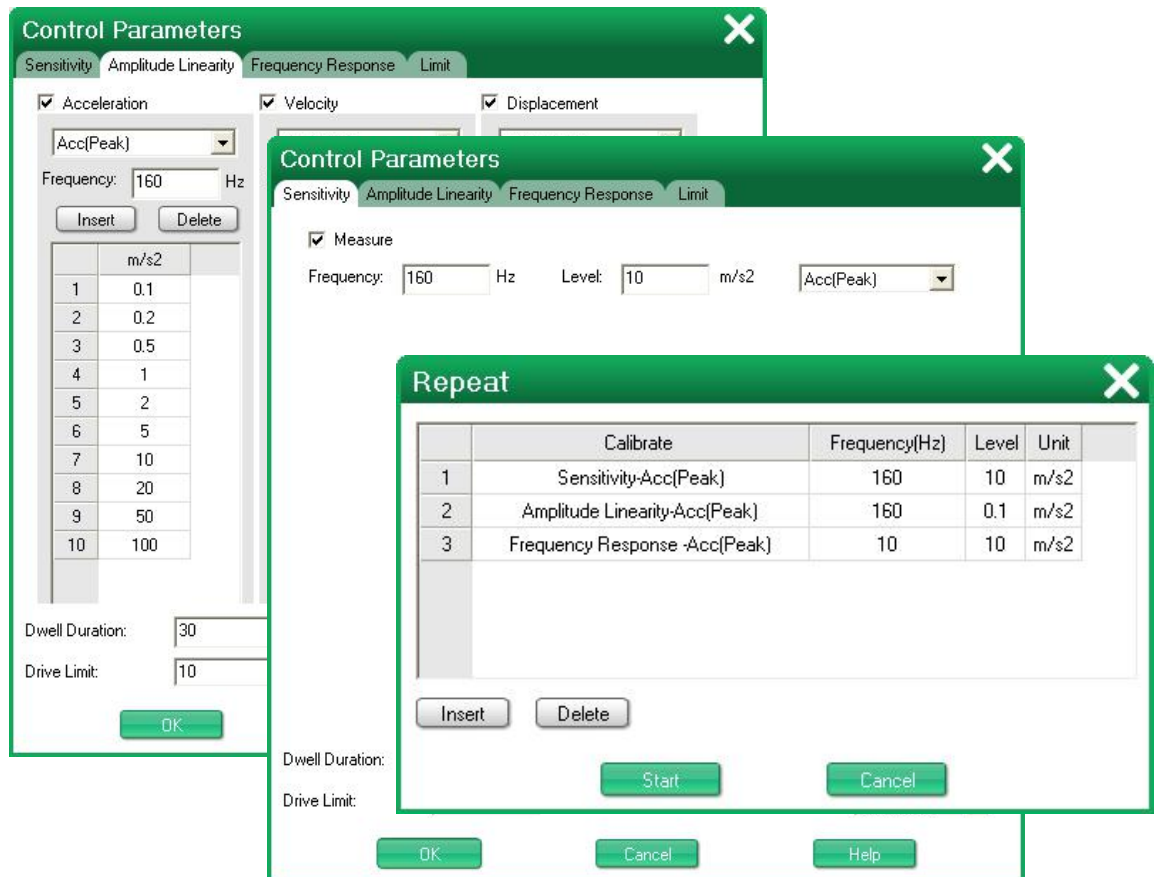
- ✧ Adopts vibration calibration method by comparison to a reference transducer, traceability to national standard GB/T 20485.21-2007 (ISO 16063-21:2003)
- ✧ Reference: JJG 644-2003 displacement displacement transducer.
- ✧ Enable to calibrate various types of vibration transducers: Piezoelectric transducers, IEPE transducers, voltage type transducer, charge type transducer and so on.
- ✧ Calibration items: sensitivity, amplitude linearity, frequency response, Dynamic Range, Transverse Sensitivity Ratio and Acceptable Maximum Acceleration
- ✧ Method of frequency response calibration: step sine and sweep sine.
  - For swept sine, sine test profile and sweep rate can be customized, the Frequency range 1Hz-20Hz; Max. Number of analysis line 4096; User can choose linear or logarithmic sweep, and customize the sweep frequency.
  - For step sine, test frequency points, its level and dwell time can be customized. User can set up to 4096 discrete points between 1Hz-20Hz.
- ✧ Measuring uncertainty, depending on the ability of employed shaker and reference transducer
- ✧ Calibration modes: regular calibration and extension points
- ✧ Frequency range: 1Hz-10 kHz, depending on the ability of employed shaker and reference transducer
- ✧ Safety: shaker limit, drive limit, open-loop check and manual abort
- ✧ Quick and accurate complete all calibrations
- ✧ Detailed WORD or PDF format report includes sensitivity, amplitude linearity and frequency response characteristic curve, etc.



Vibration Meter Calibration

- ✧ Adopts vibration calibration method by comparison to a reference transducer, traceability to national standard GB/T 20485.21-2007 (ISO 16063-21:2003)
- ✧ Reference: JJJ 644-2000 displacement displacement transducer calibration rules
- ✧ Enable to calibrate various types of vibration transducers: Piezoelectric transducers, IEPE transducers, voltage type transducer, charge type transducer and so on.
- ✧ Calibration items: sensitivity, amplitude linearity and frequency response
  - The sensitivity can be acceleration sensitivity, velocity sensitivity or displacement sensitivity, the rated amplitude and frequency can be customized, the amplitude can be single peak, double peaks or effective value.
  - Frequency response calibration contains acceleration, velocity and displacement, and customers can define the calibration level and frequency points
  - Amplitude linearity calibration contains acceleration, velocity and displacement, and customers can define the calibration frequency and level points
  - Compare All calibration parameters with shaker limit and indicate the overrun parameters
  - Allow re-calibrating: the calibration items (steps) and calibration parameters can be customized
- ✧ Measuring uncertainty, depending on the ability of employed shaker and reference transducer
- ✧ Frequency range: 1Hz-10 KHz, depending on the ability of employed shaker and reference transducer
- ✧ Safety: shaker limit, drive limit, open-loop check and manual abort
- ✧ Quick and accurate complete all calibrations
- ✧ Detailed WORD or PDF format report includes sensitivity, amplitude linearity and frequency response characteristic curve, etc.

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## Bearing Vibration Meter Calibration

- ✧ Adopts vibration calibration method by comparison to a reference transducer, traceability to national standard GB/T 20485.21-2007 (ISO 16063-21:2003)
- ✧ Reference: JJF 1371-2012 acceleration transducer rolling bearing vibration meter calibration rules; JJF 1185-2007 velocity transducer rolling bearing vibration meter calibration rules.
- ✧ Enable to calibrate various types of vibration transducers: Piezoelectric transducers, IEPE transducers, voltage type transducer, charge type transducer and so on.
- ✧ Calibration items: sensitivity, amplitude linearity and frequency response.
  - The sensitivity can be acceleration sensitivity, velocity sensitivity or displacement sensitivity, the rated amplitude and frequency can be customized, the amplitude can be single peak, double peaks or effective value.
  - Frequency response calibration items: acceleration and velocity, rated effective amplitude level and frequency can be customized.
  - Amplitude linearity calibration contains acceleration, velocity and displacement, and customers can define the calibration frequency and level points
  - Electric case frequency response calibration items: acceleration and velocity. User can choose sweep test and step test, the velocity bearing vibration meter can test in low frequency, intermediate frequency and high frequency, the rated frequency points can be customized.
  - Compare All calibration parameters with shaker limit and indicate the overrun parameters
  - Allow re-calibrating: the calibration items (steps) and calibration parameters can be customized
- ✧ Measuring uncertainty, depending on the ability of employed shaker and reference transducer
- ✧ Frequency range: 1Hz-10 kHz, depending on the ability of employed shaker and reference transducer
- ✧ Safety: shaker limit, drive limit, open-loop check and manual abort
- ✧ Quick and accurate complete all calibrations
- ✧ Detailed WORD or PDF format report includes sensitivity, amplitude linearity and frequency response characteristic curve, etc.

## Foundation Pile Movement meter calibration

- ✧ Adopts vibration calibration method by comparison to a reference transducer, traceability to national standard GB/T 20485.21-2007 (ISO 16063-21:2003)
- ✧ Reference: JJF 1371-2012 foundation pile movement meter calibration rules
- ✧ Enable to calibrate various types of vibration transducers: Piezoelectric transducers, IEPE transducers, voltage type transducer, charge type transducer and so on.
- ✧ Calibration items: sensitivity, amplitude linearity, frequency response, dynamic range, system noise and amplitude gain, which can be calibrated with acceleration, velocity, dynamic force and displacement transducer.
- ✧ Methods of frequency response calibration: swept sine, step sine or FFT method
  - For swept sine, sine test profile and sweep rate can be customized, the Frequency range 1Hz-20Hz; Max. Number of analysis line 4096; User can choose linear or logarithmic sweep, and customize the sweep frequency.
  - For step sine, test frequency points, its level and dwell time can be customized. User can set up to 4096 discrete points between 1Hz-20Hz.
- ✧ Measuring uncertainty, depending on the ability of employed shaker and reference transducer
- ✧ Frequency range: 1Hz-10 KHz, depending on the ability of employed shaker and reference transducer
- ✧ Safety: shaker limit, drive limit, open-loop check and manual abort
- ✧ Quick and accurate complete all calibrations
- ✧ Detailed WORD or PDF format report includes sensitivity, amplitude linearity and frequency response characteristic curve, etc.

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## Dynamic Signal Analysis

- ✧ Signal Processing
  - Time Signal analysis: time domain sampling, self-correlation analysis, cross-correlation analysis, trajectory chart, oscilloscope, waterfall chart, strain window.
  - Frequency Domain: FFT, self-power spectrum, cross-power spectrum, frequency response function, correlation function, polar coordinates, octave analysis, cepstrum.
  - statistics analysis: histogram ( amplitude distribution chart, showing the probability density and probability distribution)
  - Channel calculation: first integral, second integration, first derivative, second derivative.
- ✧ Time domain sampling: Max. Sample rate 192kHz, Max. sampling points 8192
- ✧ Frequency domain analysis: Max. Analysis frequency band 75kHz
- ✧ Averaging: uneven, exponential averaging, linear averaging, peak averaging, peak averaging, N frame peak maintaining
- ✧ Window: Rectangle, Hanning, Hamming, Exponential, Bartlett, Welch, Tukey, Blackman, Blackman Maximum, Blackman Minimum, Flat-Top, Kaiser-Bessel
- ✧ Signal source: DC, sine, square wave, triangle wave, white noise, pulse, whistle, pink noise, linear sweep, logarithm sweep, step sine, pseudorandom, blasting random, formation random, sine overlay signal, etc. .
- ✧ Signal display
  - Time signal: show the Max. Min. Effective and average value of the input signal.
  - Cursor: signal cursor, double cursor, the X1, Y1, X2, Y2 value of the cursor position, and calculate the corresponding POWER,  $\Delta$ RMS.
  - Peak/valley value cursor: find the Peak or valley and mark.
  - Harmonic wave cursor: mark harmonic wave, and calculate the harmonic wave distortion.

Ordering Guide

**System Hardware**

No.	Module	Detail
1	ECI-9102	<b>Two channels ECI-9102</b> programmable calibrator
2	ECI-9108-8	<b>8 Channels ECI-9108-8</b> programmable calibrator
3	ECI-91EX01	Add 1 analog input channel( channels up to 8)
4	ACC-9100	Standard accessories: power cable, USB cable, installation CD, user manual, calibration file CD and certificate
5	MI-2004	<b>high precision condition amplifier</b>
6	<b>Intermediate frequency standard shaker</b>	<b>intermediate frequency standard shaker VE4110C / amplifier VSA-L180B</b> Rated sine force: 100N(peak), frequency range: 5-10,000Hz, rated frequency range:20-5,000Hz, Max. Acceleration (no load): 30g, Max. Displacement: 10 mm(Pk-Pk), Max. Velocity: 1.5m/s
7		<b>Intermediate frequency standard shaker VE4110MC/ amplifier VSA-L180A</b> Rated sine force: 100N (Pk). Frequency range: 5-7500Hz, rated frequency range: 20-5,000Hz, Max. Acceleration (no load): 35g, Max. Displacement: 12mm (Pk-Pk), Max. Velocity: 1.5 m/s
8		<b>Intermediate frequency standard shaker B&amp;K4808/ amplifier VSA-L180B</b> Rated sine force: 112 N (Pk), frequency range: 5-10,000Hz, rated frequency range: 20-5,000Hz, Max. Acceleration( no load): 70g, Max. Displacement: 12.7 mm(Pk-Pk), Max. Velocity: 1.4 m/s
9		<b>Intermediate frequency standard shaker/ amplifier B&amp;K2719</b> Rated sine force: 112 N (Pk), frequency range: 5-10,000Hz, rated frequency range: 20-5,000Hz, Max. Acceleration( no load): 70g, Max. Displacement: 12.7 mm(Pk-Pk), Max. Velocity: 1.4 m/s
10		<b>Intermediate frequency standard shaker VE4120MC/ amplifier VSA-L500A</b> Rated sine force: 200 N (Pk), frequency range: 5-6500Hz, rated frequency range: 20-5,000Hz, Max. Acceleration( no load): 50g, Max. Displacement: 12 mm(Pk-Pk), Max. Velocity: 1.5 m/s
11		<b>Dynmix 6135C</b> Sensitivity: 10mV/g, range: 500g. Frequency range: 5~10000Hz, rated frequency: 20-5,000Hz, transverse sensitivity ratio <3%, working temp: -51-94 °C weight 85g, 10-32 thread screw, with 3 meter connection cable
12	<b>Standard Transducer</b>	<b>Dytran 3120B</b> IEPE type, 10 mV/g, range 500g, frequency response 10-10000Hz(±2%), weight 85g, temp range: -51~93 °C
13		<b>B&amp;K 8305</b> Sensitivity: 1.25pC/g, range: 1000g. Frequency range: 0.2~4400Hz, rated frequency: 20-2,000Hz, transverse sensitivity ratio <2%, working temp: -74-200 °C weight 40g, 10-32 thread screw, with 3 meter

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		connection cable
14		<b>Endevco 2270</b> Sensitivity: 2.2pC/g, range: 1000g. Frequency range:2~20000Hz, rated frequency: 20-2,000Hz, transverse sensitivity ratio <3%, working temp: -54-177 °C weight 40g, 10-32 thread screw, with 3 meter connection cable

Ordering Guide

Software

No.	Module	Detail
1	9411	<b>Accelerometer sensitivity calibration</b>
2	9411-01	Transverse sensitivity (require 9411)
3	9411-02	Substitution method (require 9411)
4	9412	<b>Frequency response( step sine)</b> include frequency response( 1-10000Hz, amplitude characteristic, phase frequency characteristic)
5	9412-01	<b>Frequency response( swept sine)</b> include frequency response( 1-10000Hz, amplitude characteristic, phase frequency characteristic)
5	9412-02	<b>Frequency response(wide band random FFT method)</b> include frequency response( 1-10000Hz, amplitude characteristic, phase frequency characteristic)
6	9412-03	Frequency response can extend to 20000Hz, require 9412 or 9412-01/02
7	9413	<b>Amplitude linearity</b> (require 9411)
8	9421	<b>Velocity transducer sensitivity calibration</b> ( including transverse sensitivity, dynamic range, Max acceleration)
9	9424	<b>Alias characteristic</b> ( need 9421)
10	9425	<b>Resistance frequency characteristic</b> (need 9421)
11	9431	<b>Vibration meter calibration</b>
12	9441	<b>Displacement transducer calibration</b>
13	9451	<b>Bearing Vibration meter calibration</b>
14	9461	<b>Foundation pile movement meter calibration</b>
15	7711	<b>Dynamic signal analysis</b>

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