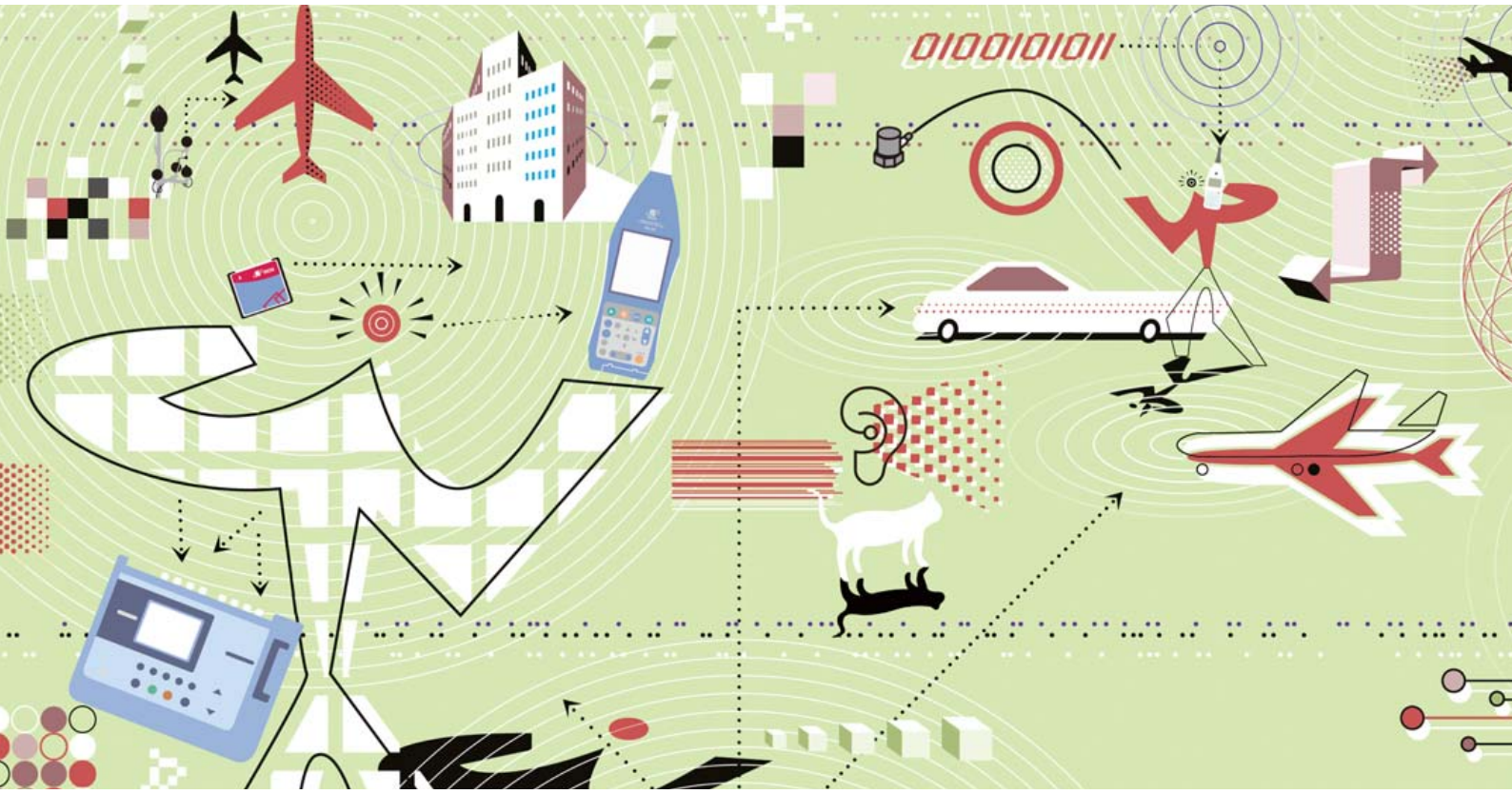
RION

Sound and Vibration



RION S&V Measuring Instruments General Catalog

2008 ► 2009

JCSS Accredited Calibration Laboratory for Acoustic Measuring Instruments

The Quality Assurance Department of RION Co., Ltd.has gained accreditation by the JCSS (Japan Calibration Service System) as an MRA (Mutual Recognition Arrangement) compliant operator in the category of acoustic measuring instruments (accreditation number JCSS 0197). JCSS is operated by the accreditation body (IA Japan) which is a signatory to the Asia Pacific Laboratory Accreditation Cooperation (APLAC) as well as the International Laboratory Accreditation Cooperation (ILAC). Being recognized as an international MRA compliant JCSS operator means that RION can issue calibration certificates bearing the ILAC MRA compliant JCSS symbol for acoustic measuring instruments (sound level meters, measurement microphones, sound calibrators). Calibration certificates with the ILAC MRA compliant JCSS symbol are recognized worldwide in countries belonging to the ILAC.

JCSS Compliant Acoustic Measuring Instruments ■ Sound Level Meters ■ Measurement Microphones ■ Sound Calibrators

ilac-MRA IAJapan JCSS 0197 JCSS

RION Co., Ltd. is recognized by the JCSS which uses JIS Q 17025 (ISO/IEC 17025) as an accreditation standard and bases its accreditation scheme on ISO/IEC 17011. JCSS is operated by the accreditation body IAJapan which is a signatory to the Asia Pacific Laboratory Accreditation Cooperation (APLAC) as well as the International Laboratory Accreditation Cooperation (ILAC). The Quality Assurance Department of RION Co., Ltd. is an international MRA compliant JCSS operator with the accreditation number JCSS 0197.

Designated Manufacturer According to the Japan Measurement Law

RION Co., Ltd. is a designated manufacturer according to the Japan Measurement Law, category for special measurement equipment (sound level meters and vibration level meters). A designated manufacturer is officially recognized as having excellent manufacturing facilities as well as effective quality control systems. Such a manufacturer is allowed to carry out product testing corresponding to national certification testing, based on the Japan Measurement Law test regulations. Products which pass such a test receive a seal that certifies compliance with the required standards. The seal has the same legal status as an official certification seal, and means that the measurement device can be used for commercial transactions and authentication.

Designation dates and designation numbers

- Sound level meters　Designation date: May 13, 1998,　Designation number: 341301
- Vibration level meters　Designation date: March 6, 2000, Designation number: 351301

ISO Certification

ISO 14001 certification

In 1999, RION Co., Ltd. obtained ISO 14001 certification for its environment management system, and is keeping the certification current (ISO 14001: 2004).

ISO 9001 certification

In 1993, RION Co., Ltd. obtained ISO 9001 certification for its quality management system, and is keeping the certification current (ISO 9001: 2000).

CE marking

Products that carry the CE mark can be marketed in the European Economic Area.

※The CE mark is a self-certification by the manufacturer, asserting that the item fully meets the requirements of all relevant European Directives.

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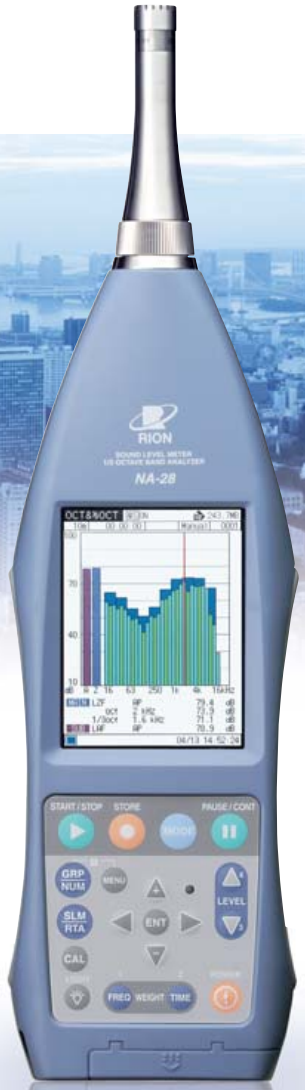
Sound Level Meter



Simultaneous real-time octave band and 1/3 octave band analysis
Simple operation combined with high performance
Optimized features for on-site use

Sound Level Meter (Class 1) and 1/3 octave band real-time analyzer

NA-28 CE

Type certification number (the Japan Measurement Law): SLF061

CF-CARD **Memory card compatible model**
For details, see "Memory Card" on page 12.

- Sound level meter and filter functions for octave band and 1/3 octave band analysis, compliant with international standard requirements
- Simultaneous real-time octave band and 1/3 octave band analysis capability
- Direct storage of measurement result data on CompactFlash (CF) memory card
  USB port also supports use of unit as removable disk. Optional infrared remote control allows convenient operation from a distance.

Specifications

Applicable standards			Sound level meter: Sound Level Meter according to the Japan Measurement Law JIS C 1509-1: 2005 Class 1, JIS C 1513: 2002 Class 1, JIS C 1514: 2002 Class 1, IEC 61672-1: 2002 Class 1, IEC 61260: 1995 Class 1, ANSI S1.4-1983 Type 1, ANSI S1.43-1997 Type 1, ANSI S1.11-2004 Class 1
Measurement functions			Simultaneous main channel and sub channel measurement, both in sound level meter mode and analyzer mode. Frequency weighting and time weighting characteristics can be set separately for main channel and sub channel.
	Measurement items		Simultaneous measurement of following items, with selected time weighting and frequency weighting characteristics: L_p, L_{eq}, L_E, L_{max}, L_{min}, L_N, L_p or $L_{eq,\ 1sec}$ For sub channel in sound level meter mode, one of following items can be selected: L_{peak}, L_{tm5}
Linearity range (according to JIS, IEC)			25 dB to 140 dB
Measurement level range			A weighting: 25 dB to 130 dB, C weighting: 33 dB to 130 dB, Z weighting: 38 dB to 130 dB
Measurement frequency range			10 Hz to 20 kHz
Analysis frequency range	Octave analysis		16 Hz to 16 kHz (max. 8 kHz during simultaneous octave and 1/3 octave band analysis)
	1/3 octave analysis		12.5 Hz to 20 kHz (max. 12.5 kHz during simultaneous octave and 1/3 octave band analysis)
Correction functions	Windscreen correction		Compensation of frequency characteristics for standard compliance when windscreen is mounted. On/off selection from menu screen.
	Diffuse sound field correction		Compensation of frequency characteristics for standard compliance (ANSI S1.4) in diffuse sound fields. On/off selection from menu screen.
Storage			Sound level and processing results are stored by Manual store or Auto store in internal memory or on CF card. Internal memory has 1 block. One of Manual store, Auto store 1, or Auto store 2 can be selected.
	Manual store		Manual recording of measurement results per address together with measurement start time
	Auto store		Continuous recording of measurement results at selected time intervals. 4 types of markers can be set to identify events that occur while recording. Pause does not function during auto-store.
		Auto 1	Maximum measurement time: 1 000 hours (when using CF card; for internal memory, see below)
			Sound level meter mode: Continuous store of L_p, L_{eq}, L_{max}, L_{min} as 1 set on CF card at 100 ms intervals (sub channel results cannot be stored) Sampling cycle: 100 ms (L_p, L_{eq}, L_{max}, L_{min}) only; internal memory storage capacity: max. 3 hours
			Analyzer mode: Continuous store of band level and all-pass time-weighted sound level L_p on CF card Main channel: All-pass value and band level values, Sub channel: All-pass value only Sampling cycle: 1 ms to 1 sec, $L_{eq,\ 1s}$; internal memory storage capacity: max.10 000 data sets (2.7 hours for 1 sec or $L_{eq,\ 1s}$)
		Auto 2	Sound level meter mode: Continuous recording on CF card of Main channel and sub-channel all-pass measurement values, together with measurement start time, for each measurement time interval
			Analyzer mode: Continuous recording on CF card of Main channel band levels and all-pass values and sub-channel all-pass values, together with measurement start time, for each measurement time interval
			Data capacity: Internal memory max. 1 000 data sets, CF card max. 300 000 data sets
Inputs/Outputs			AC output, DC output, comparator output, external trigger input, USB port, infrared remote control sensor
Power requirements			Four IEC R14P (size C) batteries (16 hours operation with alkaline batteries) or external power supply (AC adapter NC-94A, supplied)
Temperature/humidity range for operation			−10 °C to +50 °C, 10 % to 90 % RH
Dimensions, Weight			331 (H) × 89 (W) × 51 (D) mm, approx. 730 g (including batteries)

Options

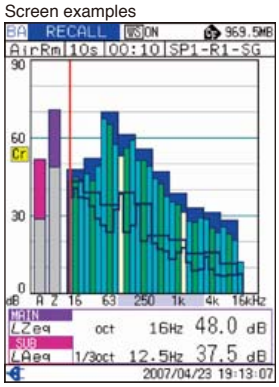
Remote Control Unit	NA-27RC1	Thermal Printer Paper	P-112-30 (10 rolls)
Memory Card (CF card*1)	128 MB, 256 MB, 1 GB, 2 GB	USB Mini B-B Cable	CC-97 (for printer connection)
USB Printer	BL-112UI	Microphone Extension Cable*2	EC-04 (2 m and up)

*1 Use RION supplied cards for assured operation *2 Max. extension cable length for the Japan Measurement Law compliance is 35 meters.

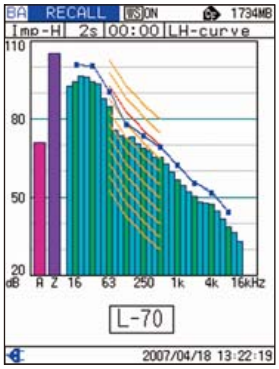
Building Acoustic Card
NX-28BA

- Enables use of NA-28 for building acoustics measurements of airborne sound insulation and impact sound insulation (D value, L value etc.) as well as N/NC value measurement and reverberation time measurement
- Enables NA-28 to perform JIS and ISO compliant measurement and calculation of evaluation ratings
- Result data are stored as text files, and an Excel macro allows evaluation index calculation
- Combination with Waveform Recording Card NX-28WR allows simultaneous recording of sound pressure waveform at time of measurement

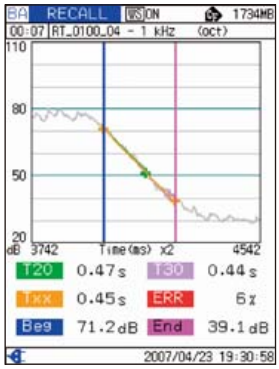
Screen examples



Overlay display of background noise measurement



Measurement result for floor impact sound insulation (heavy impact source)



Reverberation time decay curve

Specifications

Analysis modes	Real-time octave analysis, real-time 1/3 octave analysis Simultaneous real-time octave and 1/3 octave analysis (sound level meter mode not available)
Measurement items (depending on measurement mode)	Time-weighted sound level L_p, time-averaged sound level L_{eq}, maximum of time-weighted sound level L_{max}
Measurement types	Airborne sound insulation between rooms, measurement of floor impact sound insulation (standard light impact source), measurement of floor impact sound insulation (standard heavy impact source), room environmental sound level (N value or NC value), reverberation time, airborne sound insulation of facade elements and facades, sound level from service equipment

Waveform Recording Card
NX-28WR

- Adds recording capability to NA-28
- Allows simultaneous recording of sound pressure waveform along with sound pressure level while performing frequency analysis with NA-28
- Recorded data are in uncompressed WAVE format that can be handled by generic software*
- Use of various waveform analysis applications possible

＊Depending on the sampling frequency, some software applications may not support direct import. For such software, a sampling frequency converter or other suitable tool should be used. For details, contact RION distributors.

Sampling frequency settings and recording times on CF card

	128 MB	256 MB	1 GB	2 GB
48 kHz	15 m	30 m	2 h 10 m	4 h 40 m
24 kHz	30 m	1 h	4 h 20 m	9 h 20 m
12 kHz	1 h	2 h 10 m	8 h 50 m	18 h 50 m
64 kHz	10 m	20 m	1 h 40 m	3 h 30 m
32 kHz	20 m	50 m	3 h 20 m	7 h
16 kHz	50 m	1 h 40 m	6 h 40 m	14 h 10 m

Actual times may differ slightly depending on the number of files.

Specifications

Sampling frequencies	
Simultaneous analysis	48 kHz, 24 kHz, 12 kHz
Sound level meter, octave band analysis, 1/3 octave band analysis	64 kHz, 32 kHz, 16 kHz
Frequency weighting characteristics	Z weighting (flat response, fixed)
Recording functions	
Event mode	Level recording, interval recording, manual recording
Total mode	Total recording
Combined use with Building Acoustic Card (NX-28BA)	
Insulation and impact sound measurement	Total recording
Reverberation time measurement	Total recording with pretrigger (1 sec)

Playback and analysis are not possible with NA-28 only.

Display and analyze data recorded with NX-28WR in various software applications

Waveform processing software
DA-20PA1


Octave band analysis screen (example)

Specifications

Waveform	
Display functions	Scaled time axis, RMS, time percentile sound level, equivalent continuous sound level, sound exposure level
FFT analysis	
Number of sampling points	64 to 32,768 points
Display function	Power spectrum (differential & integral calculus available for spectrum area)
Octave band analysis	
Applicable standard	JIS C 1514 (IEC 61260) Class 1
Analysis frequency range	1/1 octave band: 0.5 Hz to 8 kHz (15 bands) 1/3 octave band: 0.4 Hz to 16 kHz (47 bands)

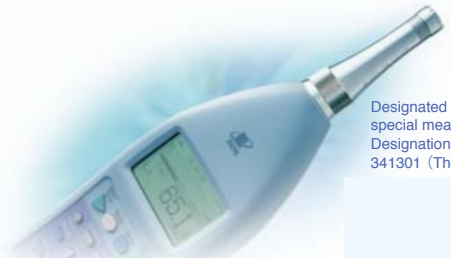
Recommended environment

CPU	Intel Pentium 4, 2 GHz or above
RAM	512 MB or more
HDD	10 GB free space or more
Supported operating systems	Microsoft Windows 2000/XP

Waveform analysis software CAT-WAVE

For specifications, see page 28.

Sound Level Meter



Designated manufacturer of
special measurement equipment
Designation number:
341301 (The Japan Measurement Law)

Simple Operation, Wide Range of Sound Measurement Applications

- **JIS and IEC compliant**
- **Versatile array of optional program cards**
- **Real sound monitoring, real-time octave band and 1/3 octave band analysis, FFT analysis and many other functions can be implemented**
- **Result data of automatic measurement can be saved directly on memory card (CF card)**

CF-CARD **Memory card compatible model**
For details, see
"Memory Card" on page 12.

Sound Level Meter (Class 1)
NL-32 CE

Optional Card

CF-CARD
(128 MB, option)

Sound Level Meter (Class 1)
NL-31 CE

Optional Card

CF-CARD
(128 MB, option)

Specifications	Sound Level Meter (Class 1) NL-32	Sound Level Meter (Class 1) NL-31	Sound Level Meter (Class 2) NL-22	Sound Level Meter (Class 2) NL-21	Sound Level Meter (Class 2) NL-20
Applicable standard	Sound Level Meter according to the Japan Measurement Law JIS C 1509-1 (IEC 61672-1) Class 1		Sound Level Meter according to the Japan Measurement Law JIS C 1509-1 (IEC 61672-1) Class 2		
Measurement functions (main processing)	Simultaneous measurement of all items, with selected time weighting and frequency weighting: Sound level L_p, equivalent continuous sound level L_{eq}, sound exposure level L_E, maximum sound level L_{max}, minimum sound level L_{min}, percentile sound level L_N (5 freely selectable values)				
Measurement functions (sub processing)	In addition to main processing items, one of the following can be selected for simultaneous processing: Peak sound pressure level L_{peak}, C-weighted peak sound pressure level L_{Cpeak}, C-weighted equivalent continuous sound pressure level L_{Ceq}, power average of maximum sound pressure level in a given interval L_{Atm5}, impulse sound pressure level L_{AI}, impulse equivalent continuous sound pressure level L_{AIeq} *L_{Atm5}, L_{AI}, and L_{AIeq} are only available when A-weighting is selected for main processing *L_{Ceq} is only available when A-weighting or Z-weighting (flat response) is selected for main processing				———
Linearity range	28 dB to 138 dB				
Measurement level range	A-weighting: 28 dB to 130 dB, C-weighting: 33 dB to 130 dB, Z-weighting (flat response): 38 dB to 130 dB, C-weighing peak sound pressure level: 55 dB to 141 dB, Z-weighting (flat response) peak sound pressure level: 60 dB to 141 dB				
Measurement frequency range (including microphone)	20 Hz to 20 000 Hz		20 Hz to 8 000 Hz		
Frequency weighting characteristics	A-weighting, C-weighting, Z-weighting (flat response)				
Time weighting characteristics	F (Fast), S (Slow), I (Impulse) (Impulse is available only for sub processing)				F (Fast), S (Slow)
Memory	Manual store in internal memory or on memory card (selectable), Auto store when memory card is inserted				Store in internal memory only
Manual store	Store sound level, processed values, store time, processing start time in internal memory or on memory card (max. 100 data sets)				Manual store only
Auto store 1	Continuously store sound level (every 100 ms, 200 ms, 1 s) or L_{Aeq} (every 1 s) on memory card, with timer function				
Auto store 2	Continuously store main and sub processing values and processing start time information at preset measurement intervals on memory card, with timer function				
Power requirements	Four IEC R6 (size AA) batteries, AC adapter (Option: NC-34, NC-98B)				
Dimensions, Weight	Approx. 260 (H) × 76 (W) × 33 (D) mm, approx. 400 g (including batteries)				

Options

Microphone Extension Cable*	EC-04 (2 m and up)	Printer Cable (for DPU-414)	CC-93
All-weather Windscreen Set	WS-03E	AC Adapter (100 V AC)	NC-34
Printer	DPU-414	AC Adapter (100 to 240 V AC)	NC-98B

*Max. extension cable length for the Japan Measurement Law compliance is 35 meters.

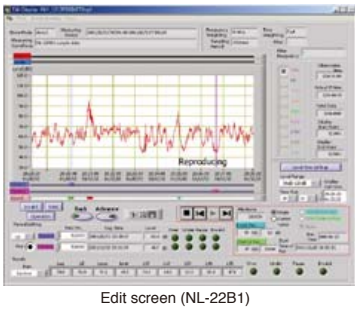
Management Software

NL-22 Management Software

NL-22PB1 for NL-32/31/22/21
With real sound monitoring support *

*Real sound monitoring not available with NL-31/21.
*Manually stored data cannot be used.
*Supported operating systems: Microsoft Windows Me/2000/XP

- Supports playback of real sound recorded with Real Sound Monitor Card NX-22J, as well as data deletion, recalculation, and other functions



Edit screen (NL-22B1)

- Supports import of auto store data from memory card for measurement data display, editing, daily and weekly report creation, text file output, and printing

Daily report screen

Sound Level Meter (Class 2)
NL-22 CE

Optional Card

CF-CARD
(128 MB, option)

Sound Level Meter (Class 2)
NL-21 CE

Optional Card

CF-CARD
(128 MB, option)

Sound Level Meter (Class 2)
NL-20 CE

Program Card

Real Sound Monitor Card
NX-22J

Adds real sound monitor function to sound level meter*1

Allows event recording (above a certain threshold) or interval recording (at preset intervals) during sound level measurement. By using the NL-22 Management Software, various data processing functions can be performed while listening to the recorded sound.

*1 Real sound data are intended for aural classification of sound events. The data cannot be used for frequency analysis or similar.

1/1, 1/3 Octave Real-Time Analysis Card
NX-22RT

Adds 1/1, 1/3 octave real-time analyzer function to sound level meter*2

Supported standard:
JIS C 1514 (IEC 61260) Class 1
Measurement modes:
L_P, L_{eq}, L_E, L_{max} (select one processing function)
Frequency analyzer bands:
Octave band filters: 16 Hz to 8 kHz
1/3 octave band filters: 12.5 Hz to 16 kHz
Memory:
Max. 100 data per file
Number of files: max. 100
AC/DC output:
Voltage always corresponds to L_P value, regardless of selected measurement type

FFT Analysis Card
NX-22FT

Adds FFT analyzer function to sound level meter*2

Frequency span:
2 kHz, 5 kHz, 10 kHz, 20 kHz
Time window types:
Rectangular, Hanning
Number of analysis lines:
400
Zoom ratio:
×1, ×2, ×4
Processing:
Instantaneous, linear average, maximum value
Memory:
Max. 100 data per file
Number of files: max. 50

*2 NX-22RT and NX-22FT cannot be used in sound level meter or during auto store.

1/1, 1/3 Octave Filter Card
NX-21SA

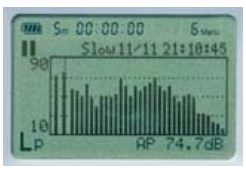
Adds frequency band switching analyzer function to sound level meter

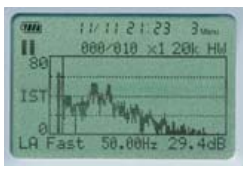
Supported standard:
JIS C 1514 (IEC 61260) Class 1
Frequency analyzer bands:
Octave band filter:
16 Hz to 8 kHz
1/3 octave band filter:
12.5 Hz to 16 kHz
(NL-21 to 10 kHz)
AC/DC output:
For selected frequency band

Universal Filter Card
NX-21VA
(1/3 octave band steps)

Adds high-pass filter and low-pass filter function to sound level meter

3rd order High-pass filter:
10 Hz to 12.5 kHz
(NL-21 to 8 kHz)
3rd order low-pass filter:
10 Hz to 12.5 kHz
(NL-21 to 8 kHz)
AC/DC output:
For selected frequency band





Supported models

NL-32/22	NL-32/22	NL-32/22	NL-32/22/31/21	NL-32/22/31/21

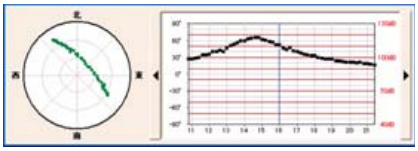
※NL-20 does not support program cards.

Sound Level Meter (Environmental Sound Monitor)

All required functions for automated measurement systems in a sturdy and compact enclosure designed for easy maintenance and portability

Environmental Sound Monitor
NA-37

Sound source direction vector data display, using Aircraft Noise Identifier Unit



Aircraft direction vector data

- Multiple interfaces for flexible data collection via LAN, public telecom line, leased analog line, USB memory etc.
- High-capacity internal memory provides ample long-term data storage capability (1 month or more)
- Optional internal GPS module provides automatic time correction and position information
- Internal battery with auto-shutdown and auto restart functions assures operation also during power failure

Monitor aircraft noise for compliance with the new Japan environmental regulations*

(* Environmental Directive 114, amended December 2007)

Aircraft Noise Processing Program
NX-37B

- In addition to conventional WECPNL evaluation, Lden contours according to the new Japan environmental regulations can be calculated
- Noise event detection and automatic aircraft noise identification capability
- Simultaneous recording of real sound, triggered by noise event (using optional Real Sound Monitor Software NX-37WR)

Evaluation result display (noise other than aircraft)

Evaluation result display (aircraft)

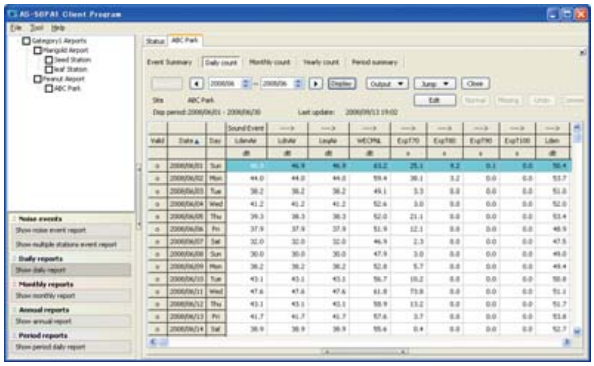
Real sound recording Program
NX-37WR (Factory-installed option)

- Selectable MP3 format (for long-term recording) or PCM format (for re-analysis)
- Internal memory can hold more than 1 month's worth of files (MP3 format, event duration 5 seconds, 1 000 events per day)

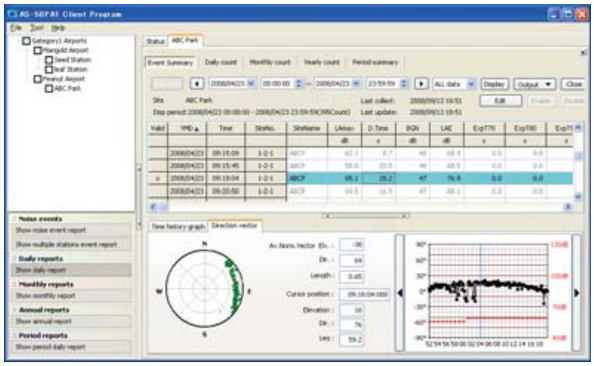
Aircraft Noise Data Processing Application Software
AS-50PA1

- Compile, save, edit, and view data measured with NX-37B
- Locate noise event details for specific events and reproduce actual sound data with a few simple steps
- Create daily, monthly, and yearly reports
- Output compiled result data in CSV format for later report creation (NA-35/36/37)

＊Supported operating systems: Microsoft Windows 2000/XP/Vista



Daily report screen



Event compilation screen

NA-37 Related Products

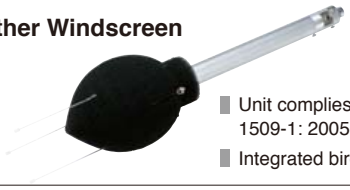
Sound Level Meter (Class 1)
NA-83 CE

- Complies with requirements of IEC 61672-1 Class 1, JIS C 1509-1: 2005 Class 1 (also when using a microphone extension cable up to 35 meters, and an all-weather windscreen)

Outdoor microphone
MS-11
Supplied with NA-83

- Incorporates a sound source for calibration and a heater for continuous long-term outdoor use

All-Weather Windscreen
WS-13



- Unit complies with requirements of IEC 61672-1 Class 1, JIS C 1509-1: 2005 Class 1 also when using this windscreen
- Integrated bird spike prevents bird-related problems

Aircraft Noise Identification Unit
AN-37/37R

- 3-axis microphone system allows determination of incident sound direction
- Detection microphone spacing of 25 cm results in compact dimensions and easy installation
- Aircraft radar signal reception capability provides additional identification data and enables counting of aircraft numbers (AN-37R)

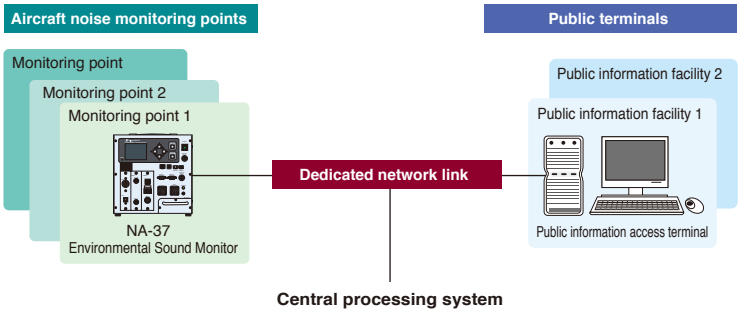
AN-37/37R

Patent numbers | 2050578 Aircraft flying position detection system, 2050582 Aircraft flying position detection system, 1809192 Aircraft noise identification system

System Application Examples

Aircraft noise online monitoring system

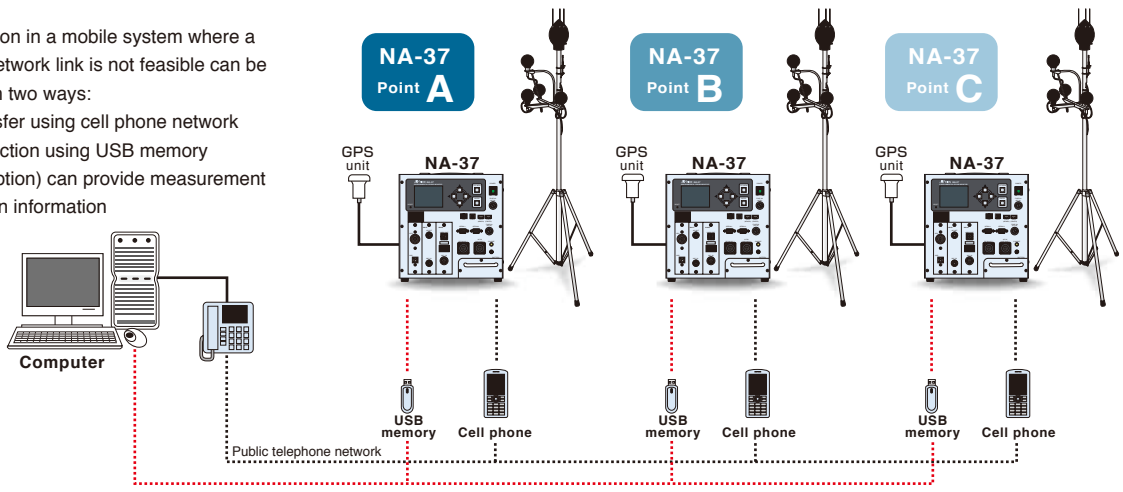
- Multiple NA-37 units installed at different points are linked via a VPN (Virtual Private Network) or other means. Measurement data are handled by a central processing system which implements real-time noise level display, statistical processing, log processing and other tasks.
- Information-providing servers can display real-time information on public system terminals.



Mobile measurement point monitoring system

- Data collection in a mobile system where a dedicated network link is not feasible can be performed in two ways:
  - Data transfer using cell phone network
  - Data collection using USB memory
- GPS unit (option) can provide measurement point position information

Monitoring system configuration example using temporary connection



Sound Level Meter (Sound Level Meter, Sound Level Meter Unit)

For a wide range of high-precision acoustic measurements

Measuring Amplifier
NA-42 (without microphone)

- Supports connection of low-noise microphones UC-34P and UC-57 as well as microphones UC-29/54 and others allowing measurement up to 100 kHz

Specifications

Measurement functions	Sound pressure level Lp, maximum sound level Lmax, peak sound pressure level Lpeak
Measurement frequency range	1 Hz to 100 kHz (main unit characteristics)
Frequency weighting characteristics	A, C, FLAT
Time weighting characteristics	F (Fast), S (Slow), I (Impulse)
External filter input/output connector	BNC connector
Power requirements	Four IEC R14 (size C) batteries, AC adapter (NC-98B, supplied)
Dimensions, Weight	171 (H) × 120 (W) × 236 (D) mm, approx. 1.8 kg (not including batteries)

Options

7P Microphone Extension Cable*	EC-04 (2 m and up)
External Input Adapter	UA-01
Interface Cable	5WKR4030

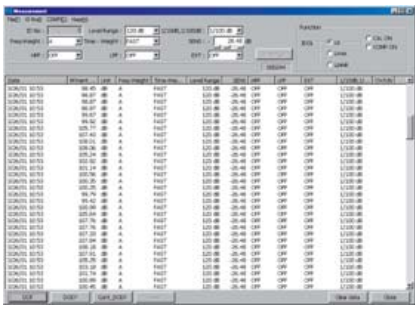
*Max. extension cable length for the Japan Measurement Law compliance is 15 meters.

- Allows connection of various microphones and preamplifiers to fit different measurement requirements
- Sound pressure level, sound level maximum, peak sound pressure level measurement modes (selectable)
- Measurement value display to two decimal values or one decimal value (selectable). Parameter information also shown.
- AC and DC output, serial communication function, comparator output function allow flexible configuration of various measurement or monitoring systems

Management Software
NA-42PB1

- Allows measurement parameter setup and measurement control of NA-42S or NA-42 via commands from a computer, and import of measurement data for display
- Imported measurement data can be converted and stored as CSV format files

*Supported operating systems: Microsoft Windows Me/2000/XP



Build flexible measurement systems for simultaneous measurement of sound and vibrations

Sound Level Meter Unit
UN-14 CE

Front View Rear View

- Sound Level Meter Unit UN-14 and Vibration Meter Unit UV-15 can be linked in a measurement system with up to 16 channels
- Supports connection of measurement microphones and various preamplifiers (with TEDS compliant input etc.)
- Display shows parameters, measurement value, and bar graph indication
- Linking with Interface Unit UV-22 allows setup and control from a computer, and transfer of measurement values
- Backlit LCD and LED warning indicators
- Optional CF-27 base allows JIS standard rack mounting
- Can be powered from AC adapter or Battery Pack Unit BP-17

Specifications

Inputs	7-pin input connector	For measurement microphone or preamplifier (max. input voltage ±10 V) (excl. UC-34P connection) Microphone bias voltage +30 V, +60 V, +200 V
	BNC connector	For CCLD compliant microphone or preamplifier (24 V 4 mA) For TEDS compliant microphone (24 V 4 mA)
Frequency weighting characteristics		A, C, Z (JIS C 1509-1 Class 1, IEC 61672 Class 1 electrical characteristics)
Measurement level range		A: 30 dB to 128 dB (using UC-59, NH-17) C: 36 dB to 128 dB (using UC-59, NH-17) Z: 41 dB to 128 dB (using UC-59, NH-17) (HPF 20 Hz, LPF 20 kHz)
Frequency range		1 Hz to 80 kHz (20 Hz to 40 kHz ±0.5 dB) (1 Hz to 80 kHz ±3 dB)
Time weighting characteristics		F, S, 10 ms (JIS C 1509-1 Class 1 electrical characteristics)
Power requirements		9 V to 15 V DC, suitable AC adapter NC-97 (for up to 10 units), NC-99 (for up to 16 units) Battery Pack Unit BP-17, Cigarette plug adapter CC-82 (option, up to 16 units*) *Depending on car battery capacity
Dimensions, Weight		150 (H) × 36 (W) × 179 (D) mm (not including protruding parts), approx. 500 g

Options

7P Microphone Extension Cable*	EC-04 (2 m and up)
BNC-BNC Coaxial Cable	EC-90A (2 m and up)

AC Adapter	NC-97
AC Adapter	NC-99

Interface Unit
UV-22 (Option)

Battery Unit
BP-17 (Option)

For details, see page 22.23

Condenser Microphones UC Series

- 1 inch type microphones are suitable for measurement also of very low sound pressure levels, but upper measurement frequency is limited to a few over 10 kHz.
- 1/2 inch and 1/4 inch type microphones are suitable for measurement of high frequencies and high sound pressure levels.

Model	UC-27	UC-32P	UC-34P	UC-30	UC-31	UC-33P	UC-52	UC-53A	UC-59	UC-57	UC-29	UC-54
Suitable preamplifier	NH-06A	NH-06A	NH-34 supplied	NH-04A/ 05A/12A	NH-04A/ 05A/12A	NH-04A/ 05A/12A	NH-17/ 17A/22	NH-17/ 17A/22	NH-17/ 17A/22	NH-17/ 17A/22	NH-05A (using UA-12)	NH-17/ 17A/22 (using UA-12)
Nominal diameter	1 inch			1/2 inch							1/4 inch	
Frequency response	Sound field	Sound pressure	Sound field	Sound field	Sound field	Sound pressure	Sound field	Sound field	Sound field	Sound field	Sound field	Sound field
Measurement frequency range (Hz)	5 to 12 500	5 to 9 000	10 to 12 500	10 to 20 000	10 to 35 000	10 to 20 000	20 to 8 000	10 to 20 000	10 to 20 000	10 to 16 000	＊2 20 to 100 000	＊2 20 to 100 000
Bias voltage (V)	200	200	200	200	200	200	0	0	0	0	200	0
Sensitivity level (dB re 1 V/Pa) ＊1	−26.5	−27	−21	−25.5	−37	−38	−33	−28	−27	−22	−47	−48
Capacitance (pF)	54	56	—	17	20	20	19	12	13	14	6	4
Maximum input sound pressure level (dB) (Linearity tolerance ± 0.3 dB)	152	154	—	144	160 ＊4	160	150	151	148	132 ＊4	164 ＊4	164
Inherent noise level (dB)	12	13	2	20	26	28	24	20	18	13	42	45
Temperature coefficient (dB/ °C)	−0.005	−0.008	—	−0.007	−0.007	−0.009	−0.008	+0.005	within ± 0.35 dB (at 1 kHz) ＊3	within ± 0.45 dB (at 250 Hz) ＊3	−0.01	within ± 0.7 dB (at 250 Hz) ＊3
Diaphragm	Titanium alloy										Titanium	
Dimensions (mm)	dia.23.8x21.0	dia.23.8x21.0	dia.23.8x131	dia.13.2x15.0	dia.13.2x13.2	dia.13.2x13.2	dia.13.2x12.0	dia.13.2x12.5	dia.13.2x14.3	dia.13.2x13.5	dia.7.0x10.0	dia.7.0x10.0

＊1 Representative value for 1 kHz ＊2 UC-29/54 frequency range refers to microphone without grid. ＊3 −10°C to +50°C referenced to 23°C ＊4 Distortion 3%

Preamplifiers NH Series

- Faithful transmission of voltage signal generated by microphone to subsequent amplifier stages
- Versatile preamplifier lineup allows choosing the best combination of diameter and microphone type
- NH-22T preamplifier is TEDS compliant

Model	NH-06A	NH-04A	NH-12A	NH-17	NH-17A	NH-22	NH-22T	NH-05A
Suitable microphones	UC-27/32P	UC-30/31/33P	UC-30/31/33P	UC-52/53A/ 54＊1/57/59	UC-52/53A/ 54＊1/57/59	UC-52/53A/54＊1/57/59 (constant current drive) 2 mA to 4 mA	UC-52/57/59 (constant current drive) 2 mA to 4 mA	UC-29 ＊1 UC-30/31/33P
Nominal diameter	1 inch	1/2 inch, 1/4 inch ＊1						1/2 inch, 1/4 inch
Input impedance (GΩ)	3	3	3	3	3	5	5	10
Input capacitance (pF)	0.3	0.25	0.25	0.8	0.8	0.8	0.8	0.2
Measurement frequency range (Hz)	5 to 100 000	10 to 100 000	10 to 100 000	10 to 100 000	10 to 100 000	10 to 100 000	10 to 100 000	10 to 100 000
Bias voltage (V)	200	200	200	0	0	0	0	200
Gain (dB), representative value	−0.1 (54 pF)	−0.2 (17 pF)	−0.2 (17 pF)	−0.6 (12 pF)	−0.6 (12 pF)	−0.6 (12 pF)	−0.6 (12 pF)	−0.5 (6 pF) (using UV-12)
A-weighted inherent noise level (dB)	12 (UC-27)	19 (UC-30)	19 (UC-30)	18 (UC-53A)	18 (UC-53A)	18 (UC-53A)	18 (UC-59)	42 (UC-29)
Output impedance (Ω)	100 or less	100 or less	100 or less	300 or less	300 or less	approx. 120	approx. 120	100 or less
Cable type	EC-04 series (7P)		1.5 m integrated (7P)	5 m integrated (7P)	EC-04 series (7P)	EC-90 series (BNC)	EC-90 series (BNC)	EC-04 series (7P)

＊1 Using UA-12

Sound Level Meter

Optional accessories (For Sound Level Measurement)

114 dB/250 Hz calibration sound source

Pistonphone

NC-72A

- Suitable for RION microphones including 1 inch, 1/2 inch, and 1/4 inch diameter types and similar-diameter types such as the MR-103
- Unit is powered by alkaline or manganese batteries and rated for 13 hours of continuous use, giving a battery life of about two years if used for 1 to 2 minutes a day

Specifications

Applicable standards	JIS C 1515: 2004 (IEC 60942: 2003) Class LS/C JIS C 1515: 2004 (IEC 60942: 2003) Class 1/C (when using supplied barometer)
Nominal sound pressure level	114 dB, sound pressure level tolerance ±0.15 dB (101.325 kPa)
Frequency	250 Hz ±1 %
Distortion	2.5 % or less
Temperature range	−10 °C to +55 °C
Humidity range	10 % to 90 % RH (no condensation)
Dimensions, Weight	Approx. 60 (H) × 170 (W) × 40 (D) mm, approx. 740 g (including batteries)

Compensation for atmospheric pressure not required

Sound Calibrator

NC-74 CE

- Compact, lightweight, convenient sound calibrator fully suitable for calibration of Sound level meters (Class 1)
- Powered from two size AA alkaline batteries giving more than 30 hours continuous operation at room temperature
- Automatic compensation function for atmospheric pressure changes

Specifications

Applicable standards	JIS C 1515: 2004 Class 1, IEC 60942: 2003 Class 1
Compatible microphones	1 inch, 1/2 inch types
Nominal sound pressure level	94 dB ±0.3 dB
Nominal frequency	1 000 Hz
Dimensions, Weight	Approx. 49 (H) × 80 (W) × 74 (D) mm, approx. 200 g (including batteries)

Reduce adverse effects of wind noise

Windscreens

WS-10

WS-03

Type	Model
Windscreen for 1/2 inch microphones	WS-10
Windscreen for 1 inch microphones	WS-01
Windscreen for 1/4 inch microphones	WS-05
All-weather windscreen (top part)	WS03S01
All-weather windscreen mounting adapter (for EC-04)	WS03051
All-weather windscreen mounting adapter (for EC-15)	WS03071
All-weather windscreen mounting adapter (for NA-29 series, separate type)	WS03072

For stationary sound level measurement

Tripods

ST-80

ST-81

Type	Model	Lowest position (mm)	Highest position (mm)	Weight (g)
Sound level meter tripod (compatible with extension rod)	ST-80	570	1 460	1 500
Extension rod (for ST-80)	ST-80-100	1 170	1 960	610
All-weather windscreen tripod	ST-81	1 350	2 150	3 200
Compact tripod	5SLIK	400	1 150	580

Memory Card (CompactFlash Card)

Commercially available memory cards (CompactFlash cards) may differ in specifications even among identical models from the same manufacturer.
When using RION equipment designed to handle memory cards, operation is guaranteed only when using memory cards from RION.

Type	Model
128 MB memory card	MC-12CF1
256 MB memory card	MC-25CF1
1 GB memory card	MC-10CF2
2 GB memory card	MC-20CF2

Reduction of wind noise for tunnel experiment

Nose Cones

1 inch Nose Cones
(For UC-27, UC-32P)

UA-30

UA-30

UA-31

1/2 inch Nose Cones
(For UC-30, UC-31)

UA-31

External power supply for sound level meters and vibration meters

Battery Pack

BP-21

- Holds four IEC R20 (size D) batteries
- Provides double battery life of IEC R14 (size C) or four times the battery life of IEC R6 (size AA) batteries

Specifications

Dimensions, Weight	80 (H) × 170 (W) × 50 (D) mm, approx. 1.1 kg

Sound Level Meter Selection Examples

1 Environmental noise

Application	Models	See page
General-purpose measurement	NL/NA series	4, 6, 7, 10
Sound level recording	NL/NA series + DA-40/20, LR series	4, 6, 7, 10, 30 to 32
	NL/NA series (internal memory/memory card) + Management Software	4, 6, 7, 10
Frequency analysis 1/1 Octave Band, 1/3 Octave Band Analysis	NA-28, NL-21/22/31/32 + Filter Card	4, 6, 7
	NL/NA series + SA-29/30	4, 6, 7, 10, 29
	DA-40 + CAT-WAVE, DA-20 + DA-20PA1	30, 31
Real sound recording・Data processing	NL-22/32 + NX-22J + NL-22PB1	6, 7
Monitoring	NA-37 + WS-13	8, 9

2 Architectural acoustics

Application	Models	See page
A-weighted sound pressure level measurement	NL/NA series	4, 6, 7, 10
Frequency analysis	NA-28, NL-21/22/31/32 + Filter Card	4, 6, 7
Performance testing	SA-29/30	29

3 Others

Application	Models	See page
Ultrasound, high sound pressure measurement	NA-42 + UC-29/54/31 + NH series	10, 11
Low sound pressure level measurement	NA-42 + UC-34 + NH-34	10, 11
Coupler, diffuse sound field measurement	NA-42 + UC-32P/33P + NH series	10, 11
Comparator	NL-21/22/31/32, NA-42	6, 7,10
Acoustic analysis	NL-22/32 + NX-22FT	6, 7
	SA-78	28
Quality management	NL/NA series	4, 6, 7, 10
Calibration	NC-72A/74	12
Anechoic Chamber, Sound-Proof Chamber	AR series, NR series	34

Condenser Microphone Selection Examples

1 Normal measurement

UC-52/UC-53A/UC-59

UC-52 is a microphone designed for use with Class 2 sound level meters, and UC-53A/59 for use with Class 1 sound level meters. These are electret microphones which do not require a bias voltage.

2 Measurement of low-level sounds

UC-27/UC-57

UC-27 is a 1 inch microphone that can measure sound pressure levels down to about 20 dB, and UC-57 is a 1/2 inch type rated for 22 dB. This is suitable for use in quiet environments. UC-27 requires a 200 V bias voltage, but UC-57 is an electret microphone which operates without external bias voltage.

3 Measurement of extremely low-level sounds

UC-34P (with Preamplifier NH-34)

UC-34 is a 1 inch microphone specially designed to make measurements in very quiet environments, with sound pressure levels as low as a few decibels. The dedicated preamplifier NH-34 is required to achieve flat frequency response and to provide the 200 V bias voltage required by the microphone.

4 Measurement of high-level sounds

UC-31/UC-29/UC-54*

UC-31 is a low-sensitivity 1/2 inch microphone that can handle sound pressure levels in excess of 150 dB. UC-29/UC-54 is similar, but it has a nominal 1/4 inch diameter. UC-31 and UC-29 require a 200 V bias voltage.
*UC-54: no bias voltage required.

5 Measurement extending to ultrasonic range

UC-31/UC-29

To make measurements of sounds including high-frequency components above 20 kHz, the same UC-31 (1/2 inch) and UC-29 (1/4 inch) microphones as for high-level measurements can be used.
Response of UC-31 extends to about 35 kHz, while UC-29/UC-54 goes up as high as 100 kHz.

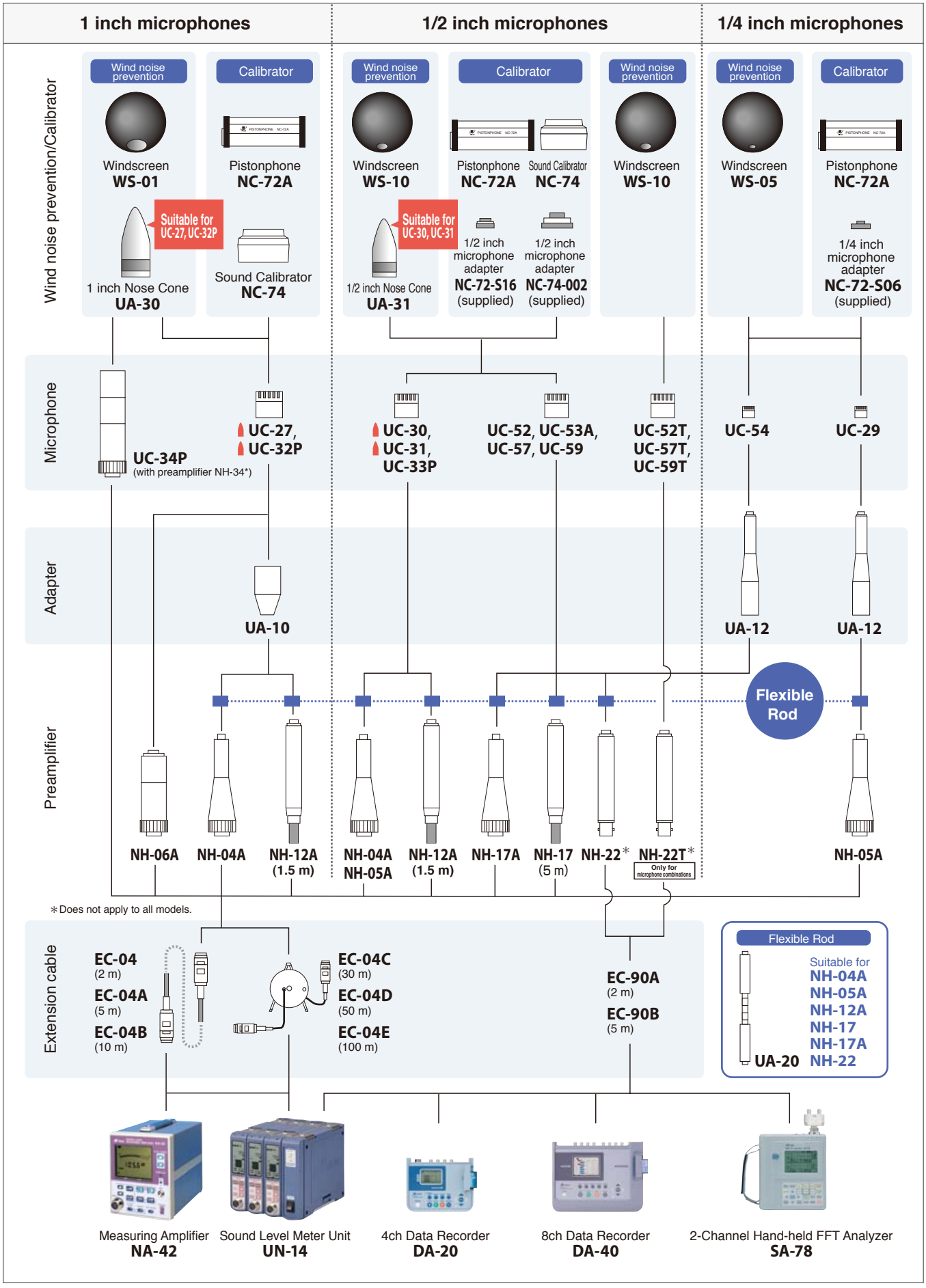
6 Coupler and random sound field measurements

UC-32P/UC-33P

UC-32P (1 inch) and UC-33P (1/2 inch) microphones are designed for acoustic measurements with the microphone mounted to a coupler, measurements in diffuse sound fields such as in a reverberation room, and similar applications. The microphones require a 200 V bias voltage.

Sound Level Meter

Measurement Microphone Combination Examples



CF-CARD **Memory card compatible model**
For details, see "Memory Card" on page 12.

Sound Level Meter Connection Examples

AC adapter

AC Adapter **NC-98B/34**

Battery Pack **BP-21**

AC Adapter **NC-94A**

AC Adapter **NC-98B**

AC Adapter **NC-97/99**

Battery Unit **BP-17**

Sound level meter

Meter with integrated microphone

Sound Level Meter **NL-20**

Sound Level Meter **NL-21/31**

CF-CARD

Sound Level Meter **NL-22/32**

CF-CARD

Sound Level Meter **NA-28**

CF-CARD

Meter with separate microphone option

＊For details, see "Condenser Microphone Combination Examples" on page 15.

Measuring Amplifier **NA-42**

Sound Level Meter Unit **UN-14**

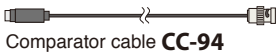
Interface Unit **UV-22**

Connection cable

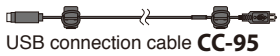
Serial communication cable **CC-92A** → Computer

Printer cable **CC-93** → Printer

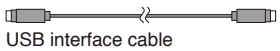
BNC-RCA cable **CC-24** → Peripheral device with BNC connector



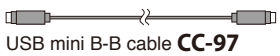
Comparator cable **CC-94** → External decice



USB connection cable **CC-95** → Computer



USB interface cable → Computer

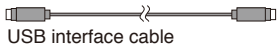


USB mini B-B cable **CC-97** → Printer (USB)

BNC-RCA cable **CC-24** → Peripheral device with BNC connector

Interface cable **5WKR4030** → Computer

BNC-BNC cable **NC-39A** → Peripheral device with BNC connector



USB interface cable → Computer

LAN cable → Computer

Peripheral equipment

Computer

Computer

＊For information on software for various measurements, see the respective sound level meter page.

Printer

Printer **DPU-414**

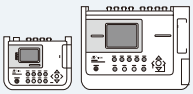
USB Printer **BL-112UI**

External device

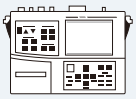
Rotating light, alarm etc.

Peripheral device with BNC connector

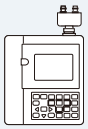
Level Recorder **LR-07**



Data Recorder **DA-20/40**



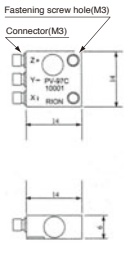
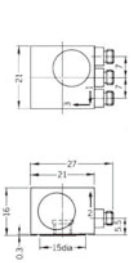
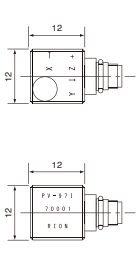
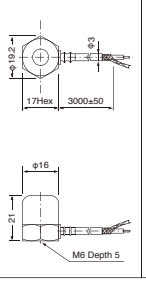
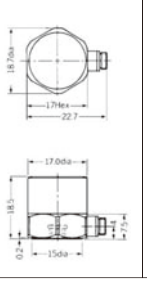
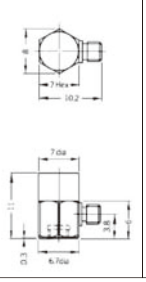
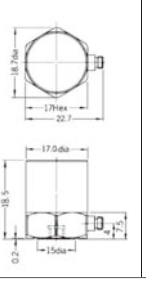
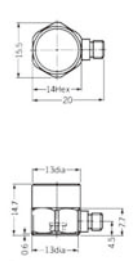
1/3 Octave Band Real-Time Analyzer **SA-29/30**

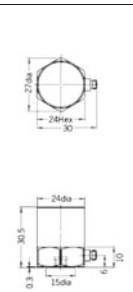
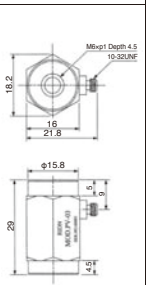
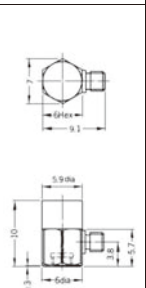
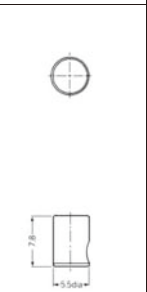
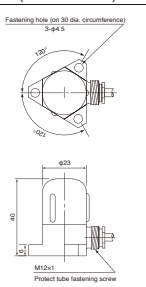
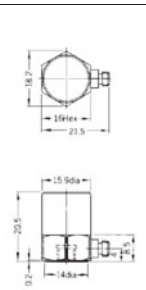
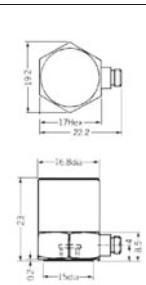
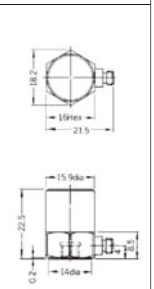


2-Channel Hand-held FFT Analyzer **SA-78**

Vibration Meter (Piezoelectric Accelerometers, Servo Accelerometers, Other)

Piezoelectric Accelerometers

Type	Tri-axial type			With integrated amplifier			General-purpose	
EXternal view								
	PV-97C	**PV-93**	**PV-97I**	**PV-40**	**PV-41**	**PV-90I**	**PV-85/86**	**PV-94/95**
Principle	Shear	Shear	Shear	Compression	Shear	Shear	Shear	Shear
Weight g	4.7	30	8	60	23	1.8	23	9
Charge sensitivity pC/(m/s²)*1	0.12	0.831	—	—	—	—	6.42	0.714
Voltage sensitivity mV/(m/s²)*1	—	—	1.1	5.1	1.02	0.44	—	—
Vibration frequency range (±1 dB) Hz*2	1 to 15 000 (Z) 1 to 10 000 (X・Y)	1 to 8 000 (2-axis) 1 to 4 000 (1·3)	1 to 7 000 (Z)*4 1 to 5 000 (X・Y)	10 to 6 000	3 to 10 000	3 to 20 000	1 to 7 000	1 to 10 000
Mounting resonance frequency kHz*2	—	—	—	40	50	60	24/21	36
Temperature range for use °C	−50 to +160	−50 to +160	−20 to +125	−10 to +80	−20 to +100	−20 to +100	−50 to +160	−50 to +160
Supplied cable	VP-51L×3	VP-51C	VP-51W	Direct-mount cable 3 m (no connector)	VP-51A	VP-51L	VP-51A	VP-51A
Dimensions mm								

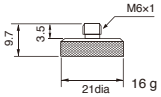
Type	High-output	Standard	Compact / Lightweight		Waterproof insulation	High-temperature		
EXternal view								
	PV-87	**PV-03**	**PV-90B**	**PV-08A**	**PV-10B**	**PV-44A**	**PV-63**	**PV-65**
Principle	Shear	Compression	Shear	Shear	Compression	Compression	Shear	Shear
Weight g	115	38	1.2	0.7	120	29	28	26
Charge sensitivity pC/(m/s²)*1	40	0.47	0.18	0.102	—	7.65	4.59	7.14
Voltage sensitivity mV/(m/s²)*1	—	—	—	—	5.1	—	—	—
Vibration frequency range (±1 dB) Hz*2	1 to 3 000	20 to 1 000 (±1 %) Secondary calibration range.	1 to 25 000	1 to 25 000	3 to 8 000	1 to 10 000	1 to 8 000	1 to 9 000
Mounting resonance frequency kHz*2	9	30	70	52	24	28	26	25
Temperature range for use °C	−50 to +160	−50 to +200	−50 to +160	−50 to +160	−20 to +100	−50 to +260	−20 to +300	−50 to +260
Supplied cable	VP-51A	VP-51A	VP-51L	VP-51J 38 cm*3	Direct-mount cable 5 m (no connector)	VP-51B	VP-51I	VP-51B
Dimensions mm								

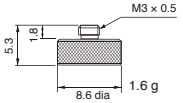
*1 Representative value; actual value is noted on calibration sheet supplied with accelerometer. *2 Representative value when mounted on flat surface according to standard mounting method.
*3 To extend cable run, VP-52A and VP-51A are required. *4 Max. 100°C, max. 1000 m/s²

Note ● The piezoelectric element in a piezoelectric accelerometer may be damaged by excessive shock. Do not drop the accelerometer, and handle the magnetic attachment with care.

Attachments

BNCAdapter
VP-52C


Magnet Attachment
VP-53S


Magnet Attachment
VP-53T


For active control systems sensor applications

Servo Accelerometer

LS-40C

Servo Accelerometer

LS-10C

- Capable of measurement in the ultra-low frequency range from gravitational acceleration (DC) to about 100 Hz with flat frequency response
- Sensitivity and phase characteristics remain flat down to DC, suitable for seismographic measurements as well as measurements on large structures in control systems, architecture, civil engineering, and machine tool applications
- Dedicated power supply LF-20 enables direct connection of accelerometer output to FFT analyzer, data recorder or similar device
- LS-10C can be directly connected to Vibration Meter VM-83

Specifications LS-40C

Maximum measurable acceleration	±20 m/s²
Voltage sensitivity	0.5 V/(m/s²) ±1 % (DC)
Measurement frequency range	DC to 100 Hz (±10 %)
Power supply voltage	±15 V DC (±11 V to ±18 V)
Temperature/humidity range for operation	−20 °C to +60 °C, max. 85% RH
Dimensions, Weight	37 (H) x 37 (W) x 40 (D) mm, approx. 230 g (including cable)

Specifications LS-10C

Maximum measurable acceleration	±30 m/s²
Voltage sensitivity	0.3 V/(m/s²) ±1 % (DC)
Measurement frequency range	DC to 100 Hz (±10 %)
Power supply voltage	±15 V DC (±11 V to ±18 V)
Temperature/humidity range for operation	−20 °C to +60 °C, max.85 %RH
Dimensions, Weight	37 (H) x 37 (W) x 40 (D) mm, approx. 220 g (including cable)

Servo Accelerometer Power Supply

LF-20

- Dedicated power supply for servo accelerometers
- Continuous operation with three LS-40C units approx. 50 hours, with three LS-10C units approx. 100 hours (using alkaline batteries)

Specifications

Supplied voltage		±15 V
Output sensitivity	Using LS-40C	0.5 V/(m/s²)
	Using LS-10C	0.3 V/(m/s²)
Power requirements		Six IEC R20 (size D) batteries, AC adapter (NC-10, option)
Dimensions, Weight		140 (H) × 240 (W) × 120 (D) mm, approx. 2.7 kg

Reference accelerometer for comparative calibration of various accelerometers

Reference Piezoelectric Accelerometer

PV-03

- Specially designed piezoelectric element and internal construction assure high resistance to external noise, unlike other compression type accelerometers. Flat response and excellent thermal characteristics are assured.
- Only reference accelerometer made in Japan capable of using the back to back principle for comparative calibration with a wide range of accelerometers

Specifications

Charge sensitivity	0.47 pC/(m/s²) (80 Hz)
Measurement frequency range	20 Hz to 1 000 Hz (±1 %), 5 Hz to 10 000 Hz (+10, −1 %)
Maximum measurable acceleration	5 000 m/s²
Dimensions, Weight	Approx. 16 (hexagonal width across flats) x approx. 29 (H) mm, approx. 38 g

Suitable for mounting on industrial machinery for monitoring applications

Piezoelectric Accelerometer

PV-17B

- Compact, lightweight, low-cost type

Specifications

Charge sensitivity	6.1 pC/(m/s²) (80 Hz)
Measurement frequency range	1 Hz to 5 000 Hz (±1 dB)
Maximum measurable acceleration	4 000 m/s²
Dimensions, Weight	Approx. 17 (hexagonal width across flats) x approx. 18.5 (H) mm, approx. 27 g

For calibration of accelerometers and vibration meters on-site

Calibration Exciter

VE-10 CE

- Single-frequency (sine wave) reference vibration source for calibrating piezoelectric accelerometers and vibration meters or vibration measurement systems using accelerometers
- Small size and light weight make the unit easy to carry, and battery powered operation is convenient for mobile use
- Servo circuit enables calibration of accelerometers of up to 70 grams

Specifications

Exciter frequency	159.2 Hz±1 %
Exciter acceleration	10 m/s² (RMS) ±3 %
Exciter velocity	10 mm/s (RMS) ±4 %
Exciter displacement	10 μm (RMS) ±5 %
Dimensions, Weight	Approx. dia.51×134 (H) mm, approx. 600 g (including batteries)

For dynamic force measurements

Force Pickup

PF-31

- Designed for connection to charge amplifier for dynamic force measurements
- Converts force acting on quartz element into an electrical signal
- Small dimensions, light weight, sturdy construction

Specifications

Charge sensitivity	4 pC/N (80 Hz)
Measurement frequency range	2 Hz to 10 000 Hz (±1 dB)
Measurable force range	0.01 N to 5 000 N
Dimensions, Weight	Approx. 18 (hexagonal width across flats) x approx. 15 (H) mm, approx. 23 g

For mechanical impedance measurements

Impedance Head

PF-60A

- Integrated accelerometer and force pickup configured as impedance head
- Unit is inserted between vibrator and specimen, and excitation is applied. Signals from accelerometer and force pickup are input to an analyzer for determining mechanical impedance.

Specifications

Charge sensitivity	Accelerometer	3.20 pC/ N (80 Hz)
	Force sensor	260 pC/N (80 Hz)
Measurement frequency range		1 Hz to 10 000 Hz (±1dB)
Maximum measurable acceleration		5 000 m/s²
Maximum measurable force		1 000 N
Dimensions, Weight		Approx. 16 (hexagonal width across flats) x approx. 32 (H) mm, approx. 37 g

Vibration Meter Preamplifier

VP-26A

Vibration Meter Preamplifier

VP-26C

For extension between accelerometer and vibration meter

- Prevents sensitivity degradation by accelerometer cable
- Prevents increase in external noise
- Suitable for low-output accelerometers

Specifications

	VP-26A	VP-26C
Frequency range	0.16 Hz to 30 kHz	1 Hz to 25 kHz
Sensitivity	1 mV/pC	1 mV/pC

Extension examples

Piezoelectric accelerometer → **VP-26A (6-pin)** → Extension cable **EC-02S series** → Vibration Meter VM-83/UV-15

Piezoelectric accelerometer → **VP-26C (7-pin)** → Extension cable **EC-04 series** → Vibration Meter VM-82/VA-11 series

Vibration Meter (Vibration Level Meter, 3-Axis Vibration Meter)

Twin LCD panels for wide range of vibration measurements

Vibration Level Meter

VM-53A

Designated manufacturer of special measurement equipment
Designation number: 351301

Type certification number: W-031
(the Japan Measurement Law)

CF-CARD **Memory card compatible model**
For details, see
"Memory Card" on page 12.

- Vibration level meter compliant with the Japan Measurement Law and JIS C 1510: 1995
- Designed for measuring ground vibrations to evaluate vibration pollution. Vibration levels measurement can be weighted according to human vibration sensitivity characteristics. Also suitable for measurement of minute vibrations in structural objects.
- Support for long-term automated measurements provided by sophisticated auto store and timer functions, and the capability to store measurement data in internal memory and on Compact Flash memory cards (with VM-53A)
- Separate X, Y, Z signal outputs, an interface for connection to a printer or computer, plus comparator output functions make the VM-53/53A suitable for a wide range of measurement system applications.

Vibration Level Meter

VM-53

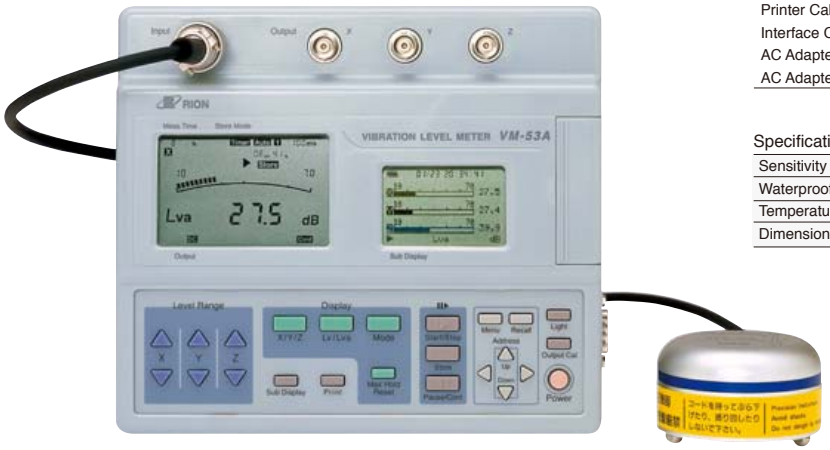
Type certification number: W-031
(the Japan Measurement Law)

Common specifications for VM-53/53A

Applicable standards	Vibration Level Meter according to the Japan Measurement Law JIS C 1510: 1995
Measurement functions	Vibration level (L_v), vibration acceleration level (L_{va}), maximum value hold
Processing functions	Power average (L_{eq}), percentile level (L_5, L_{10}, L_{50}, L_{90}, L_{95}), maximum level (L_{max}), minimum level (L_{min}); calculated for a selected axis or all 3 axes
Measurement frequency range	Vibration level 1 Hz to 80 Hz, vibration acceleration level 1 Hz to 80 Hz
Measurement level range	Vibration level L_v 25 dB to 120 dB (Z axis), vibration level L_v 30 dB to 120 dB (X/Y axis) Vibration acceleration level L_{va} 30 to 120 dB
Manual store (CF card/internal memory)	Vibration level (L_v) or vibration acceleration level (L_{va}) at store point and processing values (L_{veq}, L_{max}, L_{min}, L_5, L_{10}, L_{50}, L_{90}, L_{95}) are saved. When measurement mode is Max Hold, maximum level and processing values are saved.
Auto store 1	Continuous store of vibration level (L_v) or vibration acceleration level (L_{va}) Store sampling 100 ms or 1 s, selectable Timer start/stop time setting function
Auto store 2	Continuous store of processing values (L_{veq}, L_{max}, L_{min}, L_5, L_{10}, L_{50}, L_{90}, L_{95}) as one set of data Timer start/stop time setting function Interval store on every hour possible
Power requirements	Four IEC R14 (size C) batteries, AC adapter (NC-34, NC-98B, option), battery pack (BP-21, option)
Dimensions, Weight	Approx. 56 (H) × 200 (W) × 175 (D) mm, approx. 1 kg (including batteries)

Options

Vibration Level Meter/Vibration Accelerometer Cable	EC-02S (3 m and up)
Printer	DPU-414
Printer Cable	5WCD2320
Interface Cable	5WKR4030
AC Adapter (100 V)	NC-34
AC Adapter (100 to 240 V)	NC-98B



Specifications Tri-axial Accelerometer PV-83C (supplied)

Sensitivity	60 mV/(m/s²)
Waterproofing specifications	JIS C 0920, Class 7 (sealed)
Temperature range for operation	−10 °C to +50 °C
Dimensions, Weight	Approx. dia. 67 × 40.7 (H) mm, approx. 335 g

Supported by VM-53A only

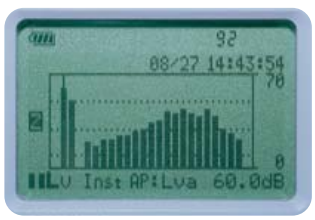
Adds 1/1 and 1/3 octave real-time analysis functions to vibration level meter

1/1 and 1/3 Octave Real-Time Analysis Card

VX-53RT

specifications

Compatible model	VM-53A
Applicable standard	JIS C 1514: 2002 Class 1
Frequency analysis bands	1/1 Octave band filter: 1 Hz to 63 Hz (7 bands), L_{va}, L_v 1/3 Octave band filter: 1 Hz to 80 Hz (20 bands), L_{va}, L_v
Measurement modes	Inst, L_{eq}, L_{max}, L_5, L_{10}, L_{50}, L_{90}, L_{95} (One measurement mode can be selected at a time)
Data store format	Text file (CSV format)



1/3 octave band analysis screen

Signal outputs for 3 directions allow connection of frequency analyzerand waveform recording on data recorder

3-Axis Vibration Meter

VM-54

- Can be used with a variety of accelerometers and vibration pickups to configure a 3-axis acceleration measurement system
- Various modes can be implemented by installing the respective software from program cards

Specifications

Inputs	3 channels(with 3-channel vibration input preamplifier)
Measurement frequency range	0.5 Hz to 5 000 Hz
Measurement mode (instantaneous 3-axis value)	Acceleration m/s²
Outputs	Separate AC outputs for 3-axis signals
Power requirements	Four IEC R14 (size C) batteries, continuous operation 16 hours
Temperature/humidity range for operation	−10 °C to +50 °C, max. 90 % RH
Dimensions, Weight	56 (H) × 200 (W) × 175 (D) mm, approx. 1 kg (including batteries)

3-ch Preamplifier

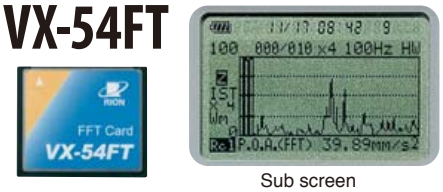
VP-80

Specifications

Input selection	Switch-selectable input (for 3 channels together)
Available settings	Charge amplifier x1: Sensitivity 1 mV/pC Charge amplifier x1/10: Sensitivity 0.1 mV/pC CCLD

FFT Analysis card

VX-54FT



Sub screen

- Functions as a memory card and allows storing FFT analysis result data in CSV format
- Supplied Excel macro makes it easy to generate a graph display from stored data (VX-54WS, VX-54WB, VX-54WH FFT analysis also supported)

Specifications

Display items	1. FFT processed spectrum display 2. Effective value (O.A.) calculated from time domain 3. O.A. value* calculated from frequency domain (FFT result) * Partial overall value for specified frequency range can also be calculated.
Display functions	Dependent on respective program card
Measurement channels	X, Y, Z (3 channels simultaneous analysis)
Window types	Hanning, Rectangular
Analysis lines	400
Processing	Instantaneous value, RMS method, maximum value
Data store function	Manual store on VX-54FT card 3-channel FFT spectrum data stored in CSV format Max. 100 data sets per file (3-channel data form 1 set) Max. 50 files

Vibration measurement system for evaluating comfort in passenger vessels and merchant vessels

Marine Vibration Card

VX-54WS

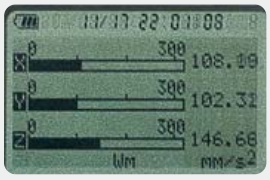
- Measure and evaluate vibrations occurring in crew and passenger accommodation sections of ships, to evaluate suitability and comfort according to ISO 6954, JIS F 0907
- Measurement system for marine vibrations consists of Tri-axial Accelerometer PV-83CW (for floor positioning, supplied), 3-Axis Vibration Meter VM-54, and Marine Vibration Card
- Measurement data can be stored on memory card (CF card)

PV-83CW (supplied)

Specifications

Applicable standards	ISO 6954: 2000, JIS F 0907: 2003
Input	Piezoelectric Accelerometer PV-83CW (tri-axial), Piezoelectric Accelerometer PV-57A (single axis, option)
Measurement frequency range	1 Hz to 80 Hz (with FLAT characteristics of PV-57A up to 1 kHz)
Frequency weighting	Wm (ISO 2631-2: 2003, bandwidth limiting characteristics)
Processing functions	RMS, max (MTVV), min
Measurement time settings	10 sec, 1 min, 2 min, 10 min

* Power requirements, temperature/humidity range for operation, dimensions and weight same as for VM-54



Graphic screen

Evaluate vibrations affecting the whole body

Whole Body Vibration Card

VX-54WB1

- Measure and evaluate vibrations as specified in ISO 2631 and JIS B 7760 regarding vibration perception
- Whole-body vibration measurement system consists of Seat Measurement Accelerometer PV-62, 3-Axis Vibration Meter VM-54, and Whole Body Vibration Card
- Measurement data can be stored on memory card (CF card)

Disc-shaped tri-axial accelerometer for whole-body vibration measurement and evaluation according to ISO 2631

Seat Accelerometer

PV-62 (option)

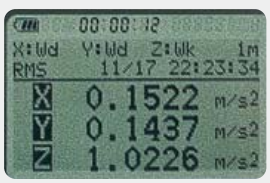
Specifications

Number of components	3 axes
Charge sensitivity	3.5 pC/(m/s²) (80 Hz)
Measurement frequency range	1 Hz to 100 Hz (±0.5 dB)
Dimensions, Weight	Approx. dia. 210 × approx. 12 (H) mm, approx. 400 g

Specifications

Applicable standards	ISO 2631-1: 1997, ISO 2631-2: 2003, ISO 8041: 2005, JIS B 7760-1: 2004, JIS B 7760-2: 2004
Input	Seat Accelerometer PV-62 (tri-axial), Piezoelectric Accelerometer PV-83CW (tri-axial)
Measurement frequency range	0.5 Hz to 80 Hz
Frequency weighting	Wk, Wd, Wb, Wc, Wj, Wm, Wg, bandwidth limiting characteristics
Processing functions	RMS, MTVV, VDV, Synthesized Value, PEAK, Crest Factor
Measurement time settings	1 sec to 30 sec in 1-sec units 1 min, 10 min, 30 min, 1 hour, 4 hours, 8 hours, 12 hours (max. 12 hours)

* Power requirements, temperature/humidity range for operation, dimensions and weight same as for VM-54



Numeric screen

Evaluate vibrations transmitted through hands and arms

Hand-Arm Vibration Card

VX-54WH

- Measure and evaluate exposure to hand-arm vibrations as specified in ISO 5349-1, ISO 5349-2, JIS B 7761-1, JIS B 7761-2
- Hand-arm vibration measurement system consists of Accelerometer PV-97C, 3-Axis Vibration Meter VM-54, and Hand-Arm Vibration Card VX-54WH
- Measurement data can be stored on memory card (CF card)

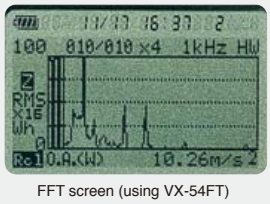
PV-97C (option)

PV-97I (option)

Specifications

Applicable standards	ISO 5349-1: 2001, ISO 5349-2: 2001, ISO 8041: 2005, JIS B 7761-1: 2004, JIS B 7761-2: 2004
Input	Piezoelectric Accelerometer PV-97C/97I (tri-axial), etc
Measurement frequency range	8 Hz to 1 000 Hz
Frequency weighting	Wh
Processing functions	RMS, MTVV, VDV, Synthesized Value, PEAK, Crest Factor
Measurement time settings	1 sec to 30 sec in 1-sec units 1 min, 10 min, 30 min, 1 hour, 4 hours, 8 hours, 12 hours (max. 12 hours)

* Power requirements, temperature/humidity range for operation, dimensions and weight same as for VM-54



FFT screen (using VX-54FT)

Vibration Meter (General-Purpose Vibration Meter/Vibration Analyzer)

Convenient 3-mode measurement for acceleration, velocity, and displacement with storage capacity for up to 1 000 data

General-Purpose Vibration Meter

VM-82 CE

- Suitable for routine maintenance, monitoring, and performance checking of rotational equipment and other industrial machinery
- LCD panel shows measurement values as numeric readout and in bar graph format
- Serial interface supports connection of optional printer or data processing using a computer

Specifications

Measurement range		(Using Shear-type Piezoelectric Accelerometer PV-57A, supplied)
	Acceleration	0.02 m/s² to 200 m/s², EQ PEAK, 1 Hz to 5 kHz
	Velocity	0.3 mm/s to 1 000 mm/s RMS 3 Hz to 1 kHz 0.1 mm/s to 1 000 mm/s RMS 10 Hz to 1 kHz
	Displacement	0.02 mm to 100 mm EQ PEAK 3 Hz to 500 Hz 0.001 mm to 100 mm EQ PEAK 10 Hz to 500 Hz
Output		AC output, DC output
Power requirements		Four IEC R6 (size AA) batteries, AC adapter (NC-34, option)
Dimensions, Weight		Approx. 167.5 (H) × 76 (W) × 35 (D) mm, approx. 320 g

Options

Piezoelectric Accelerometer	PV-55
Vibration Meter Preamplifier	VP-26C
Printer	DPU-414
Printer Cable	CC-87
Interface Cable	CC-87E
BNC-RCA Cable	CC-24

Supports connection of Servo Accelerometer LS-10C for 3-mode measurement of acceleration, velocity, and displacement

General-Purpose Vibration Meter

VM-83 CE

- Measure and evaluate vibrations using a piezoelectric accelerometer or the Servo Accelerometer LS-10C
- Display characteristics can be switched to rms, equivalent peak, and equivalent peak-to-peak, with maximum value hold and peak hold capability
- Four types of input connectors allow selection of acceleration, velocity, and displacement measurement. With optional servo accelerometer LS-10C, even very low frequency vibrations from 0.1 Hz upwards can be measured.
- Comparator function allows level evaluation

Specifications

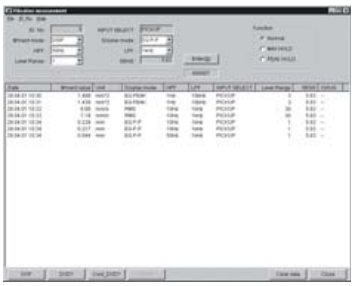
Vibration frequency range	Piezoelectric accelerometer	Acceleration	1 Hz to 20 kHz ±5 %
		Velocity	1 Hz to 3 Hz±10 %, 3 Hz to 3 kHz ±5 %
		Displacement	1 Hz to 3 Hz±20 %, 3 Hz to 500 Hz ±10 %
	Servo accelerometer	Acceleration	0.1 Hz to 100 Hz ±5 %
		Velocity	0.1 Hz to 0.3 Hz ±10 %, 0.3 Hz to 100 Hz ±5 %
		Displacement	0.1 Hz to 0.3 Hz ±20 %, 0.3 Hz to 100 Hz ±10 %
Power requirements			Four IEC R14 (size C) batteries, AC adapter (NC-98B, option)
Dimensions, Weight			171 (H) × 120 (W) × 234 (D) mm, approx. 1.8 kg

Options

Vibration level meter/vibration accelerometer cable	EC-02S series (3 m and up)
Vibration Meter Preamplifier	VP-26A
Printer	DPU-414
Printer cable	5WCD2320
Interface cable	5WKR4030

VM-83 Management Software

VM-83PB1



- Control VM-83 settings via commands sent from a computer, and import measurement data into the computer for display
- Convert imported measurement data into CSV format for saving

*Supported operating systems: Microsoft Windows ME/2000/XP

Simply press against the measurement object

Pocketable Vibration Meter(RIOVIBRO)

VM-63A CE

- Ultra compact vibration meter with integrated accelerometer. Weighs only 270g and easily fits into a pocket.
- Designed for quick and easy use in the field
- Suitable for preventive maintenance of industrial equipment, on-site quality control, product development, and many other applications

Specifications

Measurement range	Acceleration	0.1 m/s² to 199.9 m/s² Peak(RMS × √2) 10 Hz to 15 000 Hz
	Velocity	0.1 mm/s to 199.9 mm/s RMS 10 Hz to 1 000 Hz
	Displacement	0.001 mm to 1.999 mm P-P(RMS × 2 √2) 10 Hz to 1 000 Hz
Display		3 1/2 digit digital display, refresh rate once per second
Power requirements		One IEC 6F22 battery, operation approx. 25 hours
Dimensions, Weight		Approx. 185 (H) × 68 (W) × 30 (D) mm, approx. 250 g

Options

Attachment (L)	VP-53Y
Earphone (for VM-63A)	VP-37

Accurate and simple equipment diagnosis

Vibration Analyzer

VA-11 CE

CF-CARD **Memory card compatible model**
For details, see "Memory Card" on page 12.

- Portable vibration analyzer for examining machine vibrations and performing diagnostic routines on equipment
- Offers a vibration meter mode and an analyzer mode for FFT analysis. In vibration meter mode, simultaneous measurement of acceleration, velocity, and displacement is possible.
- Acceleration rms value, peak value, and crest factor can be displayed simultaneously
- In analyzer mode, power spectrum determined by FFT analysis and vibration waveform are displayed

Specifications VA-11/11C

Filters	High-pass filter	3 Hz, 10 Hz, 1 000 Hz
	Low-pass filter	1 kHz, 5 kHz, 20 kHz
Display	Vibration meter display	Acceleration, velocity, displacement (graph, numeric)
	Spectrum display	Graph display, list display
	Time waveform display	Graph only, 128 data
Memory	Manual store	500 data, any mode
	Transient store	Continuous store in analyzer mode
	Other functions	Timer store, re-analysis, measurement parameter memory
Inputs/outputs		External trigger input, serial interface, printer output

Data Collector

VA-11C CE

CF-CARD **Memory card compatible model**
For details, see "Memory Card" on page 12.

- Adds data collection function to VA-11 and comes with route management software
- Data collector function is designed for convenience and ease of use, using preset parameters and simple operation steps

Power requirements	For IEC R14 (size C) batteries, AC adapter (NC-94A, supplied)
Dimensions, Weight	174 (H) × 156 (W) × 45.7 (D) mm, approx. 770 g (including batteries)

Options

Piezoelectric Accelerometer	PV-57A
Magnet Attachment	VP-53S
Accelerometer Cable	VP-51K
Printer Cable	5WCD2320
Interface Cable	5WKR4030

Vibration Meter (Vibration Meter Unit, 2-Channel Charge Amplifier)

Flexible unit configuration allows simultaneous sound and vibration measurement

Vibration Meter Unit
UV-15 CE

Front View

Rear View

- Vibration Meter Unit UV-15 and Sound Level Meter Unit UN-14 can be linked in a measurement system with up to 16 channels
- Supports connection of piezoelectric accelerometers, accelerometers with integrated preamplifier, and TEDS compliant accelerometers
- Display shows parameters, measurement value, and bar graph indication
- Linking with Interface Unit UV-22 allows setup and control from a computer, and transfer of measurement values
- Backlit LCD and LED warning indicators
- Optional CF-27 base allows JIS standard rack mounting
- Can be powered from AC adapter or Battery Pack Unit BP-17

Specifications

Inputs	Microdot connector	For piezoelectric accelerometer (Maximum input charge 100 000 pC)
	CCLD (Constant Current Line Drive)	Accelerometer with integrated preamplifier (24 V 4 mA) Accelerometer with TEDS compliant integrated preamplifier (24 V 4 mA)
	7-pin preamp connector (Connector type PRC-03)	For piezoelectric accelerometer connected via preamplifier (VP-26A) (Maximum input voltage ±10 V)
Measurement frequency range	Acceleration (ACC)	1 Hz to 15 kHz (AC output tolerance±5 %), 0.5 Hz to 30 kHz (AC output tolerance 10 %)
	Velocity (VEL)	3 Hz to 3 kHz (AC output tolerance±5 %)
	Displacement (DISP)	3 Hz to 500 Hz (AC output tolerance±10 %)
Filters	HPF (attenuation -18 dB/oct) (−10 % drop)	3, 5, 10, 15, 20, 30, 50, 100, 150, 200 Hz, Off (User filter supported with UV-22)
	LPF (attenuation -18 dB/oct) (−10 % drop)	300, 500, 1 k, 1.5 k, 2 k, 3 k, 5 k, 10 k, 15 k, 20 kHz, Off (User filter supported with UV-22)
Power requirements		9 V to 15 V DC, suitable AC adapter NC-97 (for up to 10 units), NC-99 (for up to 16 units), Battery Pack Unit BP-17, Cigarette plug adapter CC-82 (option, up to 16 units*) *Depending on car battery capacity
Dimensions, Weight		150 (H) × 36 (W) × 179 (D) mm (not including protruding parts), approx. 500 g

Options

Piezoelectric accelerometer	Various	Vibration Meter Preamplifier	VP-26A
Accelerometer cable	Various	Vibration Level Meter/Vibration Accelerometer Cable	EC-02S (3 m and up)
BNC-BNC Cable	NC-39A		

Dedicated interface unit for UN-14 / UV-15

Interface Unit
UV-22 CE

Front View

Rear View

- USB and Ethernet interface provide flexible connectivity for controlling UN-14 and UV-15 units via commands sent from a computer
- Supplied UV-22Viewer software allows UN-14 and UV-15 setup, measurement value checking, and user-specified cutoff frequency setting for HPF and LPF (user filter*) on the computer
- Master/Slave function simplifies measurement operation when multiple UN-14/UV-15 units are connected

※2-Channel Charge Amplifier UV-16 cannot be connected.
*Can be set in 1/3 octave band steps within the specified frequency range.

Specifications

Settings control (for UN-14 and UV-15)		Input selection, sensitivity, HPF, LPF, user filter
	UN-14 only	Frequency weighting, level range, time weighting
	UV-15 only	Measurement mode, range, display characteristics
Measurement values		UN-14: instantaneous value every 100 ms, maximum value, Peak, L_{eq} UV-15: instantaneous value every 100 ms, maximum value, ±Peak
UN-14/UV-15 interface		
	Number of supported unit connections	Up to a combined total of 16 UN-14/UV-15 units
Computer interfaces		
	USB	USB 1.1 (one UV-22 per computer supported)
	USB Connector	Mini B
	Ethernet	10/100 Base-TX (one UV-22 per computer supported)
Temperature/humidity range for operation		−10 °C to 50 °C, max. 90% RH
Power requirements		9 V to 15 V DC, suitable AC adapter NC-97/NC-99, Battery Pack Unit BP-17, Cigarette plug adapter CC-82 (option, up to 16 units*) *Depending on car battery capacity
Current consumption		Approx. 240 mA (12 V DC, LAN operating))
Dimensions, Weight		150 (H) × 36 (W) × 179 (D) mm, approx. 500 g
Supplied accessories		UV-22 Viewer software x 1 (CD-ROM), USB cable

Viewer software
UV-22Viewer (supplied)

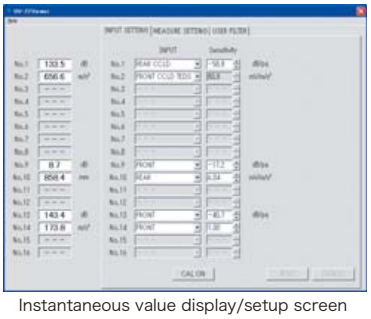
Recommended operation environment

CPU: Intel®Celeron™processor, 800 MHz or higher, or equivalent
RAM: 256 MB or more
Supported operating systems: Microsoft Windows 2000/XP/Vista

Specifications

Settings control (for UN-14 and UV-15)	Input selection, sensitivity, HPF, LPF, user filter
Measurement values (for UN-14 and UV-15)	Instantaneous value display (1-second refresh cycle)
UN-14/UV-15 interface	
Number of supported unit connections	Up to a combined total of 16 UN-14/UV-15 units
Computer interfaces	
USB	USB1.1 (one UV-22 per computer supported)
Ethernet	10/100 Base-TX (one UV-22 per computer supported)

※One computer running UV-22Viewer can control one UV-22 unit.


Instantaneous value display/setup screen

Measure machine vibrations in power stations, industrial plants, or engines and motors during product development

2-Channel Charge Amplifier
UV-16 CE

Front View

Rear View

- Designed for connection of piezoelectric accelerometers or accelerometers with integrated preamplifier
- Link the chassis of up to 16 units to create a multi-channel configuration with up to 32 channels
- Equipped with LCD panel, overload alarm LEDs, operation panel, input/output connectors, power jack, and link connector
- JIS standard rack mounting supported (max. 12 units/24 channels)
- Can be powered from an AC adapter or Battery Pack BP-17

Specifications

Inputs		Piezoelectric accelerometer Accelerometer with integrated preamplifier (24 V 4 mA)
Measurement frequency range	Acceleration (ACC)	1 Hz to 15 kHz (AC output tolerance ±5 %) 0.5 Hz to 30 kHz (AC output tolerance ±10 %)
	Velocity (VEL)	3 Hz to 3 kHz (AC output tolerance ±5 %)
	Displacement (DISP)	3 Hz to 500 Hz (AC output tolerance ±10 %)
Filters		HPF 10 Hz, LPF 1 kHz compliant with JIS B 0907: 1989 frequency response compensation filter characteristics
	HPF	OFF, 10 Hz, 20 Hz, 50 Hz
	LPF	1 kHz, 3 kHz, 10 kHz, OFF
Power requirements		9 V to 15 V DC, suitable AC adapter NC-97 (for up to 10 units), NC-99 (for up to 16 units), Battery Pack Unit BP-17, Cigarette plug adapter CC-82 (option, up to 16 units*) *Depending on car battery capacity
Dimensions, Weight		150 (H) × 36 (W) × 179 (D) mm (not including protruding parts), approx. 500 g

Options

Piezoelectric accelerometer	Various
Accelerometer cable	Various
BNC-BNC Cable	NC-39A

Option

Link to UV-15/UV-16/UN-14 to provide power for mobile measurement (Required one of sources listed below)

Battery Unit
BP-17

Front View

Rear View

- Battery power can be used to drive up to three units (AC adapter connection allows connection of 1 to 16 units)
- Holds eight IEC R14 (size C) batteries
- Continuous operation time: approx. 8 hours (with alkaline batteries, using UV-15/UN-14) approx. 17 hours (with alkaline batteries, using UV-16)

※3 linked units, ambient temperature 25 °C, with CHARGE setting, normal operation.
Actual time will differ depending on ambient conditions and operation settings.


Example for linkup with UV-15 units

AC adapter
NC-97

- 100 V to 240 V AC, 12 V DC, 3.3 A (can power up to 10 units)

AC adapter
NC-99 CE

- 100 V to 240 V AC, 12 V DC, 5 A (can power up to 16 units)

Rack Mounting Base
CF-27 (JIS compliant)

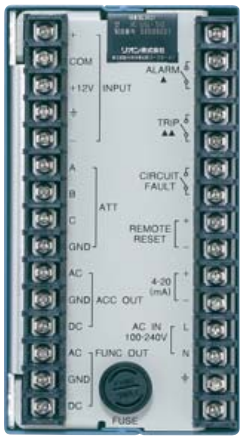
- Dimensions; 149 (H) × 480 (W) × 320 (D) mm

Vibration Meter (Vibration Monitor)

Monitor machine vibrations in power stations, industrial plants, or production facilities

Vibration Monitor
UG-50

Front View



Rear View

- Suitable for constant monitoring of machine vibrations in power stations, industrial plants, or production facilities, using piezoelectric accelerometers
- Separate main monitoring circuit (switchable to acceleration, velocity, displacement mode) and dedicated acceleration circuit. This allows combination of vibration measurement and monitoring tasks.
- Separate alarm and trip threshold vibration levels can be set for main circuit, to trigger suitable actions when levels are exceeded
- High-pass filter and low-pass filter settings can be made separately for main circuit and acceleration circuit

Specifications

Input switching	Unbalanced input 1	For piezoelectric accelerometer with integrated preamplifier
	Unbalanced input 2	For unbalanced connection via UG-20 or UG-21/UG-24
	Balanced input	For balanced connection via UG-20 or UG-21
Monitoring modes	Acceleration (m/s²)	EQ PEAK (EQ PEAK=√2×RMS)
	Velocity (mm/s)	RMS
	RMS Displacement (mm)	EQ P-P (EQ P-P=2√2×RMS)
Measurement frequency range	Acceleration	5 Hz to 30 kHz
	Velocity	5 Hz to 2 kHz
	Displacement	5 Hz to 100 Hz
Filters (main circuit)	HPF	Off (5 Hz), 10 Hz, 30 Hz, 50 Hz, 500 Hz (-3 dB)
	LPF	Off (30 kHz), 50 Hz, 100 Hz, 500 Hz, 2 kHz (-3 dB)
Filters (acceleration circuit)	HPF	Off (5 Hz), 10 Hz, 30 Hz, 50 Hz, 500 Hz (-3 dB)
	LPF	Off (30 kHz), 50 Hz, 100 Hz, 500 Hz, 2 kHz (-3 dB)
DC output voltage		+10 V (at range full-scale point)
AC output voltage		Acceleration 2 Vpeak Velocity 2 Vrms Displacement 2 Vp-p (at range full-scale point)
Alarm functions		Alarm, trip, circuit fault
Alarm output		Relay contacts close when alarm is triggered, and alarm LED lights up
Level range (main circuit, dedicated acceleration circuit)*	Relation between dedicated acceleration range and main circuit range	Main circuit: Acceleration / Velocity / Displacement; Dedicated acceleration range (Range depends on setting range of main circuit)

Main circuit			Dedicated acceleration range
Acceleration	Velocity	Displacement	
1 000	1 000	100	1 000
300	300	30	
100	100	10	100
30	30	3	
10	10	1	10
3	3	0.3	
1	1	0.1	1

Power requirements	Input voltage range	85 V to 265 V AC, 47 Hz to 440 Hz
Temperature/humidity range for operation		-10 °C to 50 °C, max. 90% RH
Dimensions, Weight		148 (H) x 80 (W) × approx. 235 (D) mm, approx. 1.5 kg

*When input charge for preamplifier UG-24 is set to 10 000 pC or higher, the above level range figures must be multiplied by 10.

For enhanced connection flexibility between piezoelectric accelerometer and vibration monitor

Preamplifier UG-20

Charge amplifier for cable runs up to 300 meters

Preamplifier UG-21

Junction box preamplifier for cable runs up to 400 meters

Junction Box UG-23

For transmission of signals from piezoelectric accelerometer with built-in preamplifier

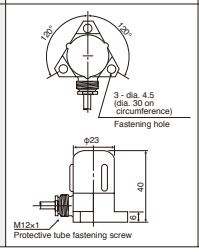
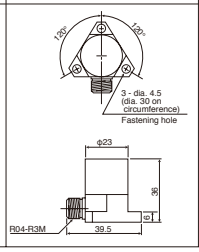
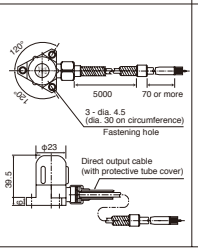
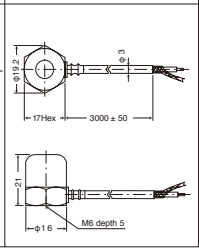
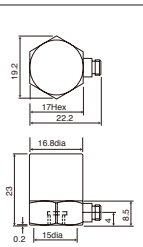
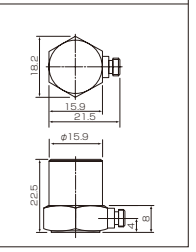
4-20 mA Isolation Unit
UG-33 4-20 mA current output
*Factory option

Rack Mount Panel
UG-90 For mounting of up to 5 units

Adds one user-definable high-pass filter and low-pass filter to main circuit

User Filter NX-50
- HPF: Setting range 3.15 Hz to 500 Hz, 1/3 octave band steps (Velocity, displacement HPF: setting range 6.3 Hz to 500 Hz)
- LPF: Setting range 50 Hz to 10 kHz, 1/3 octave band steps

Piezoelectric Accelerometers

External view and features	 Waterproof, insulated accelerometer with integrated preamplifier **PV-10B**	 Waterproof, insulated accelerometer with integrated preamplifier **PV-11**	 Waterproof, insulated accelerometer (For vibration measurements at nuclear power plants and similar; rated for gamma radiation resistance up to 1x10⁷ R) **PV-10T**	 Low-cost accelerometer with integrated preamplifier **PV-40**	 Shear-type accelerometer with high temperature resistance, light weight, and high sensitivity (Radiation resistant, suitable for use at nuclear power plants under medium and high temperatures) **PV-63**	 For machine vibration measurements at high temperature **PV-65**
Charge sensitivity pC/(m/s²) ※1	—	—	9.18	—	4.59	7.14
Voltage sensitivity mV/(m/s²) ※1	5.1	5.1	—	5.1	—	—
Measurement frequency range Hz ※2	3 to 8 000 (±1 dB) 3 to 10 000 (±2 dB)	3 to 10 000 (±1 dB)	3 to 8 000 (±1 dB) 3 to 10 000 (±2 dB)	10 to 6 000 (±1 dB) 10 to 10 000 (±3 dB)	1 to 8 000 (±1 dB) 1 to 15 000 (±3 dB)	1 to 9 000 (±1 dB)
Mounting resonance frequency kHz ※2	24	24	24	40	26	25
Temperature range for operation °C	−20 to +100	−20 to +100	−50 to +150	−10 to +80	−20 to +300	−50 to +260
Maximum measurable acceleration m/s²(peak)	500	500	2 000	500	4 000	4 000
Standard mounting method screw torque N·m ※3	M4 screw (supplied) 1.5	M4 screw (supplied) 1.5	M4 screw (supplied) 1.5	M6 screw (supplied) 3.5	M6 screw (supplied with VP-56A) 3.5	M6 screw (supplied with VP-56A) 3.5
Waterproofing specifications	JIS C 0920 Protection Class 8 (sealed), 2 atm	JIS C 0920 Protection Class 8 (sealed), 2 atm	JIS C 0920 Protection Class 8 (sealed), 2 atm	—	—	—
Cable	Integrated type, 5 m (no connector)	VP-51Q (option)	Integrated type, 5 m	Integrated type, 3 m (no connector)	VP-51I (supplied)	VP-51B (supplied)
Mass g	120	100	120	60	28	26
Dimensions (mm)						

※1 Representative value; actual sensitivity as noted on calibration chart supplied with accelerometer ※2 Representative value when using standard mounting method (※3) on flat surface

Note ● The piezoelectric ceramic element of these accelerometers can be damaged if subject to a strong shock. Take care not to drop the accelerometer, and use magnet attachments with care.

Vibration Meter Selection Examples

1 Mechanical Vibration

Specific purpose				Model	See page
Vibration measurement	Point measurement	On-site measurement		VM-63A, VM-82	20, 21
		Test chamber measurement		VM-83 + PV series	16, 20
	Multi-point measurement	Vibration meter		UV-15 + PV series	16, 22
		Charge amplifier		UV-16 + PV series	16, 23
Vibration analysis		FFT analysis		VA-11	21
				SA-78	28
		Octave analysis		SA-29/30	29
		Transfer function		SA-78	28
Equipment diagnosis	Vibration monitoring	Online		UG-50	24
		Trend management	Small-scale	VM-82	20
				VA-11C	21
			Large-scale	VA-11C	21
	Vibration diagnosis	Simple diagnosis	Vibration magnitude measurement	VM-63A, VM-82	20, 21
		Precision diagnosis	Fault analysis	VA-11 series	21
Quality management	Product quality management			VM-83 + PV series	16, 20
	Low-Frequency Micro-vibrations			LS-40C, LS-10C	17
Vibration meter calibration				VE-10, PV-03	17

2 Vibrations affecting human body

Specific purpose		Model	See page
Vibration measurement	Road traffic vibrations, construction sites, work environment	VM-53, VM-53A	18
	Marine vibration	VM-54 + VX-54WS	19
		PV-83CW	19
	Whole-body vibration	VM-54 + VX-54WB1	19
		PV-62	19
	Hand-arm vibration	VM-54 + VX-54WH	19
		PV-97C, PV-97I	16
Vibration level recording		VM-53/53A + LR-07	18, 32

Vibration Meter

Accelerometer Selection

	Piezoelectric Accelerometer	Connection cable	Vibration meter
Standard piezoelectric	Piezoelectric Accelerometer **PV-03**	Standard Cable **VP-51A**	VM-83 / UV-15 / UV-16
With integrated amplifier	Piezoelectric Accelerometer **PV-41**	Standard Cable **VP-51A**	VM-83 / UV-15 / UV-16
With integrated amplifier	Piezoelectric Accelerometer **PV-90I**	Ultra-compact Accelerometer Cable **VP-51L**	VM-83 / UV-15 / UV-16
General-purpose	Piezoelectric Accelerometer **PV-85/86**	Standard Cable **VP-51A**	VM-83 / UV-15 / UV-16
General-purpose	Piezoelectric Accelerometer **PV-94/95**	Standard Cable **VP-51A**	VM-83 / UV-15 / UV-16
Compact/lightweight	Piezoelectric Accelerometer **PV-08A**	PV-08 Cable **VP-51J**	VM-83 / UV-15 / UV-16
Compact/lightweight	Piezoelectric Accelerometer **PV-90B**	Ultra-compact Accelerometer Cable **VP-51L**	VM-83 / UV-15 / UV-16
High-output	Piezoelectric Accelerometer **PV-87**	Standard Cable **VP-51A**	VM-83 / UV-15 / UV-16
High-temperature	Piezoelectric Accelerometer **PV-44A**	Heat-resistant Cable **VP-51B**	VM-83 / UV-15 / UV-16
High-temperature	Piezoelectric Accelerometer **PV-65**	Heat-resistant Cable **VP-51B**	VM-83 / UV-15 / UV-16
High-temperature	Piezoelectric Accelerometer **PV-63**	Heat-resistant Cable **VP-51 I**	VM-83 / UV-15 / UV-16
Tri-axial type	Piezoelectric Accelerometer **PV-93**	Tri-axial Standard Cable **VP-51C**	VM-83 / UV-15 / UV-16
Tri-axial type	Piezoelectric Accelerometer **PV-97C**	Ultra-compact Accelerometer Cable **VP-51L ×3**	VM-83 / UV-15 / UV-16
Tri-axial type	Piezoelectric Accelerometer **PV-97I** (With integrated amplifier)	PV-97I Tri-axial Accelerometer Cable **VP-51W**	VM-83 / UV-15 / UV-16
Servo type	Servo Accelerometer **LS-10C**	Integrated	VM-83 / LF-20
Servo type	Servo Accelerometer **LS-40C**	Integrated	LF-20

Extension

- Preamplifier **VP-26A**
- Extension Cable
  - **EC-02S** (3 m)
  - **EC-02SB** (10 m)
  - **EC-02SD** (50 m)
  - **EC-02SE** (100 m)
- ※ UV-16 does not allow extension with Preamplifier VP-26A

Extension

- **EC-40A** (5 m)
- **EC-40B** (10 m)
- **EC-40C** (30 m)
- **EC-40D** (50 m)

General-Purpose Vibration Meter
VM-83

Vibration Meter Unit
UV-15

Interface Unit
UV-22

2-Channel Charge Amplifier
UV-16

Battery Unit
BP-17

General-Purpose Vibration Meter
VM-83

Servo Accelerometer Power Supply
LF-20

CF-CARD **Memory card compatible model**
For details, see "Memory Card" on page 12.

Vibration Meter Connection Examples

AC adapter	Vibration meter	Connection cable	Peripheral equipment

AC Adapter NC-98B/34 Series
Battery Pack BP-21

Vibration Level Meter VM-53

- Interface Cable **5WKR4030** → Computer
- Printer Cable **5WCD2320** → Printer
- BNC-BNC Cable **NC-39A** → Peripheral device with BNC connector

*For information on comparator output connection, contact RION distributors.

Vibration Level Meter VM-53A CF-CARD

- Interface Cable **5WKR4030** → Computer
- Printer Cable **5WCD2320** → Printer
- BNC-BNC Cable **NC-39A** → Peripheral device with BNC connector

*For information on comparator output connection, contact RION distributors.

AC Adapter NC-34 Series

General-Purpose Vibration Meter VM-82

- Interface Cable **CC-87E** → Computer
- Printer Cable **CC-87** → Printer
- BNC-RCA Cable **CC-24** → Peripheral device with BNC connector

Accelerometer sold separately
*For details, see "Accelerometer Selection" on page 26.

AC Adapter NC-98B

General-Purpose Vibration Meter VM-83

- Interface Cable **5WKR4030** → Computer
- Printer Cable **5WCD2320** → Printer
- BNC-BNC Cable **NC-39A** → Peripheral device with BNC connector

*For information on comparator output connection, contact RION distributors.

AC Adapter NC-97/99
Battery Unit BP-17

Vibration Meter Unit UV-15
Interface Unit **UV-22**

- USB interface cable → Computer
- LAN cable → Printer
- BNC-BNC Cable **NC-39A** → Peripheral device with BNC connector

2-Channel Charge Amplifier UV-16
Battery Unit **BP-17**

- BNC-BNC Cable **NC-39A** → Peripheral device with BNC connector

Peripheral equipment

Computer

Computer
*For information on software for various measurements, see the respective sound level meter page.

Printer

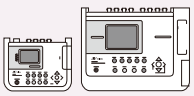
Printer **DPU-414**

External device

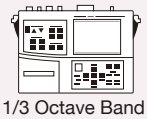
Rotating light, alarm etc.

Peripheral device with BNC connector

Level Recorder **LR-07**



Data Recorder **DA-20/40**



1/3 Octave Band Real-Time Analyzer **SA-29/30**

2-Channel Hand-held FFT Analyzer **SA-78**

Frequency Analyzer (FFT Analyzer, Acoustics and Vibration Evaluation System)

Portable FFT analyzer allows transfer function measurement in the field

CF-CARD **Memory card compatible model**
For details, see "Memory Card" on page 12.

2-Channel Hand-held FFT Analyzer

SA-78 CE

- Compact, handy 2-channel FFT analyzer designed for on-site use facilitates transfer function and other measurements
- Convenient for performing sound or vibration FFT analysis as well as octave analysis (synthesized)
- Optional Waveform Recording Card SA-78WR enables long-term time waveform recording

Specifications

Number of channels		2
Analysis frequency range		100, 200, 500, 1 k, 2 k, 5 k, 10 k, 20 k, 50 k, 80 kHz
Analysis functions		Time waveform, power spectrum, crosspower spectrum, transfer function, coherence
FFT zoom settings		101 (×1), 201 (×2), 401 (×4), 801 (×8), 1 601 (×16) lines
Averaging function	Numbers of averaging iterations	1 to 8 000
Octave synthesis	Type	Octave bands, 1/3 octave bands
Memory section (Storage media)		Compact Flash (CF) card (Use RION supplied cards for assured operation)
	Total number of data	Approx. 8 000 (×1 zoom, 128 MB card)
AC output	Connector	2.5 dia. stereo jack, output impedance 100 ohms
	Output voltage	1 Vrms at range full-scale point
Printer port	Connector	9-pin male D-sub connector, transfer principle: serial interface, 9 600 bps fixed
USB port	Connector	USB Type B female connector, transfer principle: USB 1.1
Power requirements		Four IEC R14 (size C) batteries, AC adapter (NC-98B, option)
Dimensions, Weight		174 (H) × 156 (W) × 45.7 (D) mm (not including protruding parts), approx. 840 g

Options

Waveform Recording Card	SA-78WR
Waveform Analysis Software	CAT-WAVE
BNC Adapter	VP-52C
Vibration Input Adapter	UA-03 + NH22
Vibration Meter Preamplifier	VP-26C

Waveform Recording Card

SA-78WR

- Optional software for implementing time waveform recording in SA-78
- Resulting data files can be processed using Waveform Analysis Software

Maximum recording times (using 128 MB CF card)

	100 Hz	200 Hz	500 Hz	1 kHz	2 kHz	5 kHz	10 kHz	20 kHz
1-channel recording	66 h 40 m	33 h 20 m	13 h 20 m	6 h 40 m	3 h 20 m	1 h 20 m	40 m	20 m
2-channel recording	33 h 20 m	16 h 40 m	6 h 40 m	3 h 20 m	1 h 20 m	40 m	20 m	–

※Use RION supplied cards for assured operation

Specifications

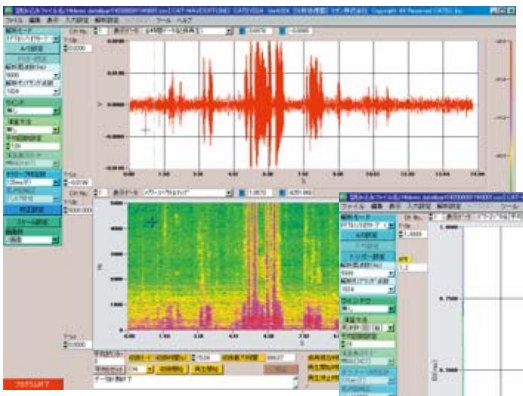
Recording media	PCMCIA standard Compact Flash (CF) card (128 MB)
Recorded data	WAVE format
Frequency range	100 Hz to 20 kHz

Waveform analysis software

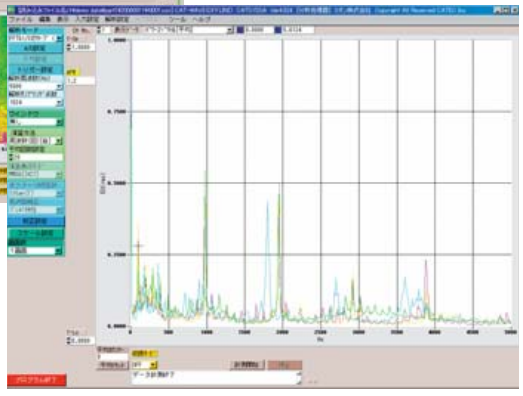
CAT-WAVE (This software is a product of Catec Inc.)

Applicable to: NX-28WR, SA-78WR, DA-20/40

- Signals recorded in WAVE file can be analyzed, and the result of analysis can be stored.
- FFT analysis or Octave analysis can be selected.



Spectrum map screen



Overlay screen

Specifications

Waveform	Display	Scaled time axis, Differential and integral calculus available
FFT analysis	Sampling points	64 to 32 768 points
	Display function	Power spectrum, Cross spectrum, Transfer function, Coherence, Power spectrum map,Octave map, Differential and calculus for spectrum area
Octave band analysis	Applicable standard	JIS C 1514 (IEC 61260) Class 1
	Frequency range	Octave band 0.5 Hz to 8 kHz (15 bands), 1/3 octave band 0.4 Hz to 10 kHz (45 bands), 1/12 octave band 0.36 Hz to 11 kHz (180 bands)

Operating enviroment requirements

CPU	Intel Core™2 Duo 2.4 GHz or more
RAM	2 GB or more
HDD	60 GB (free space) or more
DISPLAY	SXGA (1 280 × 1 024) or more
OS	Microsoft Windows XP Professional

Simultaneous octave band and 1/3 octave band analysis in 0.4 to 80 kHz* range

*High range implemented as option

1-channel type

1/3 Octave Band Real-Time Analyzer

SA-29

2-channel type

2-channel 1/3 Octave Band Real-Time Analyzer

SA-30

- Standard configuration covers frequency range from 0.4 Hz to 20 kHz, optional filter allows analysis up to 80 kHz
- Available display items include analysis results plus power average for each band, power sum, percentile level, power average of stored data, reverberation time, and more

Specifications

Applicable standard	JIS C 1513: 2002
Inputs	Preamplifier input, direct input
Analysis frequency range	0.4 Hz to 630 Hz (LOW 1), 1.6 Hz to 2.5 kHz (LOW 2), 12.5 Hz to 20 kHz (MID), 50 Hz to 80 kHz (Hi, option, one channel analysis only)
Analysis range	Dynamic range 83 dB, Display 80 dB
Time constant for time weighting	1, 10, 35, 125, 630 ms, 1 s, 10 s
Memory	Manual, Auto, Panel
Power requirements	Six IEC R20 (size D) batteries (continuous operation with alkaline batteries: 5 hours), AC adapter (NC-93, supplied)
Dimensions, Weight	Approx. 75 (H) × 297 (W) × 270 (D) mm, approx. 2.5 kg

Option

2-Channel High-Frequency Unit	SA-29-S04

Memory card (option)

* Use RION supplied cards for assured operation
* Only specially designed memory cards can be used with the SA-29/30. For details, contact RION distributors.

Recorder (Data Recorder)

8-Channel Data Recorder DA-40 and 4-Channel Data Recorder DA-20 are compact, portable products designed to record various types of electronic signals and waveform data for on-site measurement of sound and vibration. Measured data are stored on memory card (CF card) in WAVE format. Stored data can be reproduced as analog signals and directly imported into a computer for detailed waveform analysis.

8ch Data Recorder
DA-40

- Incorporates support for CCLD (Constant Current Line Drive) 2 mA, 4 mA (factory option)
- DC to 20 kHz frequency range
- Light weight: only 1.2 kg (excluding batteries)
- 180 minutes recording time (4 channels, 20 kHz x 2.4)*

*Using 4 GB memory card

CF-CARD **Memory card compatible model**
For details, see "Memory Card" on page 12.

● Maximum recording times with 4 GB CF card (approximate)
Sampling frequency: frequency range x 2.56 (2.4 also supported)

		Frequency range (Hz)					
		100	500	1 000	5 000	10 000	20 000
Number of channels	1	2133 h 20 m	426 h 40 m	213 h 20 m	42 h 40 m	21 h 20 m	10 h 40 m
	2	1066 h 40 m	213 h 20 m	106 h 40 m	21 h 20 m	10 h 40 m	5 h 20 m
	4	533 h 20 m	106 h 40 m	53 h 20 m	10 h 40 m	5 h 20 m	2 h 40 m
	8	266 h 40 m	53 h 20 m	26 h 40 m	5 h 20 m	2 h 40 m	1 h 20 m

*Actual times may differ slightly depending on number of files
*Maximum recording time per file is 744 hours
*Use RION supplied cards for assured operation

Memory cards (for DA-40)

2 GB　　4 GB

Specifications

Input section	Signal input	8 channels (BNC)
	CCLD (Constant Current Line Drive)	2 mA, 18 V (4 mA supported as factory option)
	Frequency response	DC coupling　DC to 1 Hz: ±1.0 dB, 1 Hz to 12.5 kHz: ±0.5 dB, 12.5 kHz to 20 kHz: ±1.0 dB AC coupling　1 Hz: ±1.0 dB, 1 Hz to 12.5 kHz: ±0.5 dB, 12.5 kHz to 20 kHz: ±1.0 dB
Output section	Playback output connectors	8 channels, BNC (using input connectors)
Recording section	Media	CF card [up to 4 GB (FAT32)] (Use RION supplied cards for assured operation)
Trigger section	Trigger mode	Free, single, repeat (split files in repeat mode)
Power supply section	Power requirements	Six IEC R14 (size C) batteries, AC adapter (NC-99, option), Cigarette plug adapter CC-82 (option)
Dimensions, Weight		Approx. 270 (H) × 210 (W) × 50 (D) mm, approx. 1.2 kg (not including batteries), approx. 2.0 kg (including batteries)

Options

Memory card (CF card)* 2 GB (for DA-40)	MC-20HS2
Memory card (CF card)* 4 GB (for DA-40)	MC-40HS2
AC adapter	NC-99
Comparator Cable (for NL series sound level meters)	CC-94A
BNC-BNC Coaxial Cable	EC-90 series (2 m and up)
BNC-BNC Cable	NC-39A

*Use RION supplied cards for assured operation

Provides various display and analysis functions for DA-40 data

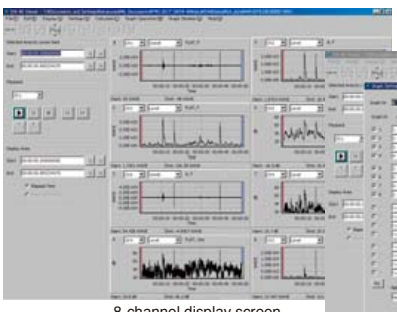
Viewer software
DA-40 Viewer (supplied)

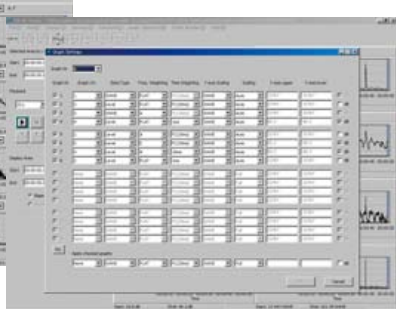
- Enables waveform display, level display, and file output (WAVE format/CSV format) using data files (WAVE format) created with DA-40

Specifications

Waveform	Display functions	Time waveform, time-weighted level, time percentile level, equivalent continuous sound pressure level, sound exposure level
	Weighting functions	Frequency weighting (A, C, G, L_V (vertical), L_V (horizontal), Wk/Wd (whole body), Wh (hand-arm), time weighting (1 ms, 10 ms, F [Fast], 630 ms, S [Slow])

*Supported operating systems:
Microsoft Windows XP Professional/Vista Business


8-channel display screen


Graph setup screen

Waveform analysis software CAT-WAVE
For specifications, see page 28

- **Analog playback signal can be processed by FFT analyzer**
- **Solid-state design without mechanical drive parts results in silent operation. Suitable also for use in environments subject to vibrations and high humidity levels.**
- **Audio memo input function**
- **Ergonomic control**

Compliant with specifications for data recorders (sound pressure level/vibration acceleration level) according to the Japan Measurement Law, Stipulation 38, Appended Table 4*
*List of equipment required for registration as Measurement Certification Business

4ch Data Recorder
DA-20 CE

- Incorporates support for CCLD (Constant Current Line Drive) 2 mA
- DC to 20 kHz frequency range
- Light weight: only 480 g (excluding batteries)
- 180 minutes recording time (2 channels, 20 kHz x 2.4)*
  *Using 2 GB memory card

CF-CARD **Memory card compatible model**
For details, see "Memory Card" on page 12.

● Maximum recording times with 2 GB CF card (approximate)
Sampling frequency: frequency range x 2.56 (2.4 also supported)

Number of channels	Frequency range (Hz) 100	500	1 000	5 000	10 000	20 000
1	1066 h 40 m	213 h 20 m	106 h 40 m	21 h 20 m	10 h 40 m	5 h 20 m
2	533 h 20 m	106 h 40 m	53 h 20 m	10 h 40 m	5 h 20 m	2 h 40 m
3	355 h 32 m	71 h 06 m	35 h 33 m	7 h 06 m	3 h 33 m	1 h 46 m
4	266 h 40 m	53 h 20 m	26 h 40 m	5 h 20 m	2 h 40 m	1 h 20 m

*Actual times may differ slightly depending on number of files
*Use RION supplied cards for assured operation

Specifications

Input section	Signal input	4ch (BNC)
	CCLD (Constant Current Line Drive)	2 mA, 18 V
	Frequency response	DC coupling DC to 1 Hz: ±1.0 dB, 1 Hz to 12.5 kHz: ±0.5 dB, 12.5 kHz to 20 kHz: ±1.0 dB AC coupling 1Hz: ±1.0 dB, 1 Hz to 12.5 kHz: ±0.5 dB, 12.5 kHz to 20 kHz: ±1.0 dB
Output section	Playback output connectors	4 channels, BNC (using input connectors)
Recording section	Media	CF card [up to 2 GB (FAT16)] (Use RION supplied cards for assured operation)
Trigger section	Trigger mode	Free, single, repeat (split files in repeat mode)
Power supply section	Power requirements	IEC R6 (size AA) batteries, AC adapter (NC-98B, option), Cigarette plug adapter CC-82 (option)
Dimensions, Weight		Approx. 140 (H) x 175 (W) x 45 (D) mm, approx. 480 g (not including batteries), approx. 800 g (including batteries)

Options

Memory card (CF card)*	128 MB, 256 MB, 1 GB, 2 GB
3-Channel Preamplifier	VP-80
4-Channel Data Recorder Remote Control Unit	DA-20RC1
AC adapter	NC-98B
Comparator Cable (for NL series sound level meters)	CC-94A
BNC-BNC Coaxial Cable	EC-90 series (2 m and up)
BNC-BNC Cable	NC-39A

*Use RION supplied cards for assured operation

Display and analyze DA-20 data with various software applications

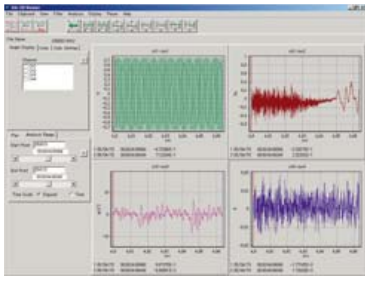
Viewer software
DA-20 Viewer (supplied)

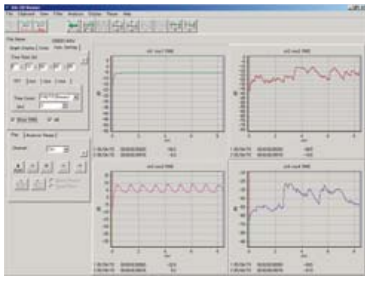
- Enables waveform display, level display, and file output (WAVE format/CSV format) using data files (WAVE format) created with DA-20

Specifications

Waveform	Display functions	Time axis zoom, RMS
	Weighting functions	Time weighting (1 ms, 10 ms, 35 ms, F [Fast], 630 ms, S [Slow])

*Supported operating systems: Microsoft Windows 2000/XP


4-channel display screen


RMS value display screen

Waveform processing software (option)
DA-20PA1

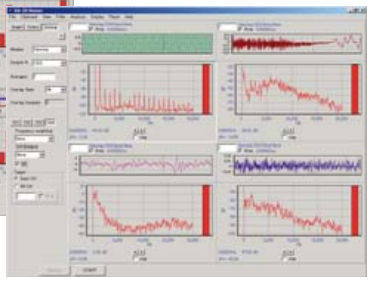
- Download measurement data (WAVE files) collected with DA-20 to a computer for display and basic analysis

Specifications

Waveform	Display functions	Time axis zoom, RMS, time percentile level, equivalent continuous sound pressure level, sound exposure level
FFT analysis	Sampling points	64 to 32 768 points
	Display	Power spectrum (Differential & integral calculus available for spectrum area)
Octave band analysis	Applicable standard	JIS C 1514 (IEC 61260) Class 1
	Analysis frequency range	1/1 octave band: 0.5 Hz to 8 kHz (15 bands) 1/3 octave band: 0.4 Hz to 16 kHz (47 bands)

*Supported operating systems: Microsoft Windows 2000/XP


Octave band analysis screen


FFT analysis screen

Recorder (Level Recorder, Printer)

Level recorder featuring simple operation

Level recorder

LR-07 Type certification number: JR-9

- Besides sound and vibration level recording, this automatic balancing level recorder is suitable for performance characteristics testing of acoustic devices and transducers, DC voltage linear recording, and more
- Paper speed control function increases feed rate while level exceeds a preset threshold, for easier reading of recorded results

Specifications

Applicable standard	JIS C 1512 : 1996
Level range	10 dB, 25 dB, 50 dB
Measurement frequency range	1 Hz to 100 000 Hz
Paper feed rate	0.01, 0.03, 0.1, 0.3, 1, 3, 10, 30 mm/s
Power requirements	Six IEC R20 (size D) batteries, AC adapter (NC-97, option), external DC input (12 V)
Dimensions, Weight	Approx. 122 (H) × 250 (W) × 325 (D) mm, approx. 3.6 kg (including batteries)

Options

Recording Paper	RP-01D (6 rolls)
Level Recorder Pen (Red)	LB-25A (set of 5)

Automatically takes up recorded data, convenient for unattended measurements

Printer

DPU-414 CE

- Produces hard copy of sound level meter, vibration meter, and vibration level meter screens, and also allows printout of numeric data
- Autoloading function makes it a snap to load and replace paper

Specifications

Printing method	Thermal serial dot printer
Temperature/humidity range for operation	0 °C to +40 °C, 30 % to 80 %RH (no condensation)
Recording paper	TP-14
Power requirements	AC adapter (NC-98B, supplied), battery pack (integrated in main unit) ※One full charge allows about 3 000 lines of character printing
Connection cable	Various (See pages 16 and 31)
Dimensions, Weight	66.5 (H) × 170 (W) × 160 (D) mm, approx. 580 g

Related Products

Check the performance characteristics of floor surface materials

Tapping Machine Light Floor Impact Sound Generator

FI-01

- Light and hard impact source imitating walking with shoes, designed for on-site use in measuring impact sound levels of flooring
- Allows checking insulation performance of floor surface materials mainly in medium and high frequency range

JIS A 1418-1: 2000 Standard Light Impact Sound Source

Specifications

Applicable standard	JIS A 1418-1
Impact cycle	100±5 ms
Hammers	Cylindrical, linear arrangement of 5 hammers spaced 10 cm apart
Hammer material	Stainless steel
Power requirements	100 V AC (50/60 Hz), approx. 80 VA
Dimensions, Weight	Approx. 260 (H) x 520 (W) x 260 (D) mm, approx. 17.5 kg

For sound insulation testing of floors in buildings

Impact Ball

YI-01

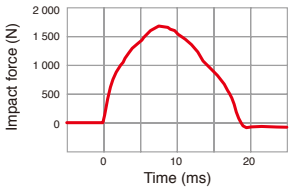
JIS A 1418-2: 2000 Standard Heavy Impact Sound Source, Impact Characteristics (2)

- Designed for sound insulation testing in lightweight structures where a standard heavy impact sound source (bang machine) with characteristics (1) would create too much impact force
- By performing a free drop from a height of 1 meter, a stable impact force of about 1 500 N (Newton) can be created
- Light mass of 2.5 kg allows for easy carrying

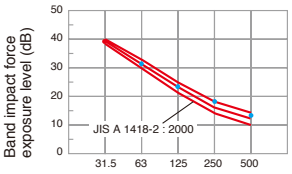
Specifications

Equivalent mass	2.5±0.1 kg
Drop height	1 m
Major rubber compound	Silicone rubber
Shape	Hollow sphere with 32 mm thick wall and 178 mm external diameter
Rebound coefficient	0.8±0.1

Impact force waveform (example)



Impact force exposure level frequency characteristics



Sound source for all kinds of acoustic measurements

Random Noise Generator

SF-06

- Generates white noise and pink noise and uses a 1/1 octave filter to produce band noise
- White noise and pink noise covers the 20 Hz to 20 kHz frequency range, and octave band noise uses center frequencies from 31.5 Hz to 8 kHz
- Applications include architectural acoustic measurements, sound absorption factor measurements in anechoic chambers, and sound insulation measurements

Specifications

Output frequency range	White noise, Pink noise (bandwidth 20 Hz to 20 kHz) Octave band noise
Output signal level	Approx. 1.0 Vrms
Output level range	0 dB to -60 dB
Octave bands	31.5 Hz to 8 kHz
Power requirements	90 to 250 V AC (50/60 Hz), approx. 20 VA
Dimensions, Weight	168(H)×198(W)×270(D)mm, approx. 3 kg

※Contact RION distributors for recommendations on suitable power amplifiers and speakers.

Easily measure the viscosity of fluids

Viscotester

VT-03F/04F

- Suitable for viscosity measurements of industrial substances such as heavy oil, paint, and adhesives, as well as for quality control in manufacturing processes of foodstuffs and other products
- Operates using the rotating cylinder principle, where a rotor turning at constant speed is inserted into the liquid to be measured. The resistance to rotor movement caused by the viscosity (torque) is measured using a special mechanism to obtain direct readings in millipascal-seconds (mPa.s) or decipascal-seconds (dPa.s).

Specifications

Model	VT-03F (for low viscosity measurement)	VT-04F (for high viscosity measurement)	
Measurement range	2 mPa.s to 300 mPa.s	0.3 dPa.s to 4 000 dPa.s	
Sample fluid capacity	Approx. 460 mL (using supplied cup A or Cup B)	No.1 or No. 2 rotor	Approx. 350 mL (using JIS compliant 300 mL beaker)
		No. 3 rotor	Approx. 170 mL (using No.3 cup) Lower rotor edge lifted about 15 mm from bottom of cup
Measurement accuracy	Within ±5 % of scale maximum	Within ±10% of scale maximum, reproducibility ±5 %	
Power requirements	IEC R6 (size AA) batteries, AC adapter (VA-05A/B, option)		
Dimensions, Weight	181 (H) × 98 (W) × 40 (D) mm (not including protruding parts), approx. 570 g (not including batteries)		

Options

Stand	VA-04

Related Products

Carefully controlled acoustic properties provide a stable and quiet environment for measurements

Anechoic Chamber (Compact Type)
AR Series

- Suitable for use in testing and developing small size precision instruments
- Wall reflections are damped for enhanced measurement accuracy
- Wedge-shaped absorber layer provides high sound absorption efficiency
- Compact dimensions and casters provide mobility
- Available as standard Type L, or Type H with higher sound insulation and absorption characteristics

Sound insulation performance (Type L)
● Measured according to JIS A 1417. Results may differ slightly, depending on construction of installation location (floor, walls, ceiling) and ambient noise level.

Frequency	(63 Hz)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Sound insulation	10 dB	15 dB	20 dB	30 dB	32 dB	35 dB	39 dB

＊Deviation −3 dB or more ＊Figures in brackets are reference values

Dimensions, Weight (Type L)

Model	External dimensions	Internal dimensions	Weight
AR-11L	960 (H) × 930 (W) × 730 (D) mm	500 (H) × 600 (W) × 400 (D) mm	90 kg
AR-22L	1 170 (H) × 1 130 (W) × 930 (D) mm	700 (H) × 800 (W) × 600 (D) mm	130 kg
AR-33L	1 380 (H) × 1 330 (W) × 1 130 (D) mm	900 (H) × 1 000 (W) × 800 (D) mm	185 kg

Knock-Down Type Anechoic Chamber
AR/P Series

- Can be assembled on site in existing buildings, which helps to keep costs low
- Enhanced sound insulation performance and additional facilities available as options
- Available as standard Type L, or Type H with higher sound insulation and absorption characteristics

Sound insulation performance (Type L/Type H)
● Measured according to JIS A 1417. Results may differ slightly, depending on construction of installation location (floor, walls, ceiling) and ambient noise level.

Frequency	(63 Hz)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Sound insulation	32 dB	39 dB	43 dB	44 dB	56 dB	62 dB	64 dB

＊Deviation −3 dB or more ＊Figures in brackets are reference values

Dimensions, Weight (Type L)

Model	External dimensions	Internal dimensions	Weight
AR.P-11L	3 010 (H) × 2 700 (W) × 2 100 (D) mm	2 160 (H) × 1 900 (W) × 1 300 (D) mm	3 400 kg
AR.P-22L	3 010 (H) × 3 600 (W) × 3 000 (D) mm	2 160 (H) × 2 800 (W) × 2 200 (D) mm	5 200 kg
AR.P-33L	3 010 (H) × 4 500 (W) × 3 900(D) mm	2 160 (H) × 3 700 (W) × 3 100 (D) mm	7 200 kg
AR.P-44L	3 010 (H) × 5 400 (W) × 4 800 (D) mm	2 160 (H) × 4 600 (W) × 4 000 (D) mm	9 500 kg

Knock-Down Type Sound-Proof Chamber
NR/P Series

- Can be assembled on site in a short time
- Suitable for many applications, including acoustic measurements of small machinery and equipment, sound-shielded environment configuration, acoustic testing, hearing level testing and more
- Enhanced sound insulation performance and additional facilities available as options
- Available as standard Type L or Type H with different sound insulation characteristics

Sound insulation performance (Type L)
● Measured according to JIS A 1417. Results may differ slightly, depending on construction of installation location (floor, walls, ceiling) and ambient noise level.

Frequency	(63 Hz)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Sound insulation	23 dB	29 dB	35 dB	41 dB	47 dB	53 dB	56 dB

＊Deviation −3 dB or more ＊Figures in brackets are reference values

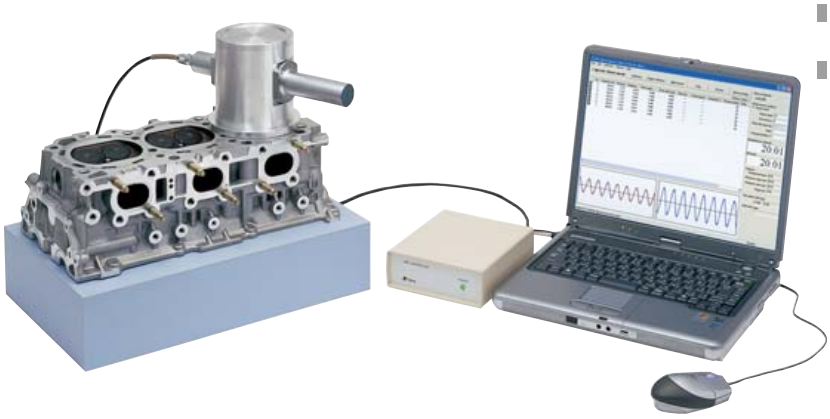
Dimensions, Weight (Type L)

Model	External dimensions	Internal dimensions	Weight
NR.P-1821L	2 310 (H) × 2 100 (W) × 1 800 (D) mm	2 000 (H) × 1 860 (W) × 1 560 (D) mm	900 kg
NR.P-2127L	2 310 (H) × 2 700 (W) × 2 100 (D) mm	2 000 (H) × 2 460 (W) × 1 860 (D) mm	1 200 kg
NR.P-2730L	2 310 (H) × 3 000 (W) × 2 700 (D) mm	2 000 (H) × 2 760 (W) × 2 460 (D) mm	1 500 kg
NR.P-3036L	2 310 (H) × 3 600 (W) × 3 000 (D) mm	2 000 (H) × 3 360 (W) × 2 760 (D) mm	1 800 kg

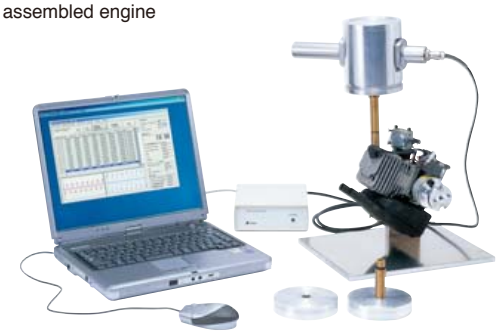
Perform precise measurements in air for any shape object

Acoustical Volume Meter

(For combustion chamber volume measurement)



- During engine manufacturing, measurement can be implemented by simply placing volumeter measurement head on engine block combustion chamber cavity
- Measurement is performed in dry conditions and requires very short time (about two seconds)
- Use of spark plug link pipe and corresponding adapter allows measurement of combustion chamber volume also on an assembled engine



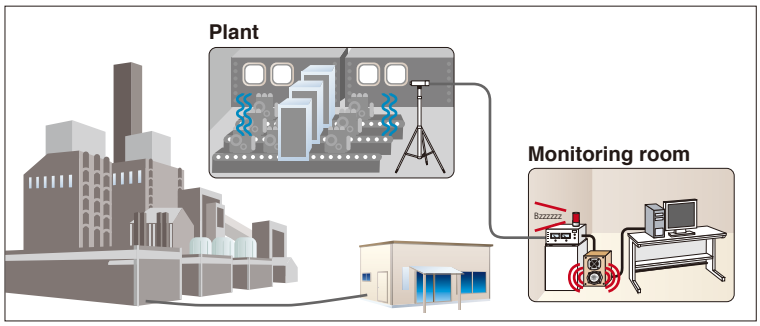
Acoustical Volume Meter

(Densimeter)

- Unlike conventional density measurements using the Archimedes principle (where the measurement object is immersed in water and buoyancy is measured), this system using an Acoustic Volumeter allows measurement in dry conditions. Volume and density can be determined quickly and easily.
- Air compression and expansion are used to measure the volume of the measurement object by acoustic principles.
- Even complex shapes can be measured accurately.
  In combination with an electronic balance (with RS-232C interface), volume and density can be measured simultaneously.

For noise measurement and monitoring at large-scale facilities such as industrial plants and power stations

Remote Noise Monitoring System



Example for Remote Noise Monitoring System setup

- Monitor noise levels in a plant or similar from a remote location
- Set noise thresholds and limit values for triggering audible or visual alarms

- Single measurement range covering 100 dB eliminates the need for range switching
- Alarm level can be set to any value within the measurement range
- Alarm response delay time can be set (alarm is triggered after noise has continuously exceeded threshold level for this interval)
- Relay contacts for operation of external equipment
- Integrated power amplifier allows monitoring of noise at measurement point

Other Products

- **Oblique incident sound absorption coefficient measurement system**
- **Multi-channel selector**
- **PWL measurement microphone tool**
- **Parabola type sound collector MY-11**
- **Omnidirectional sound-source SS-05T**

Besides the products described in this catalog, RION Co., Ltd. also has experience with systems such as listed at left. We also build custom-designed measurement systems to order.

Measuring Instrument Combinations

Before starting an acoustic or vibration measurement, three factors must be considered:

- **What kind of sound/vibration is to be measured?**
- **For what purpose?**
- **Which kind of processing is required (recording, analysis etc.)?**

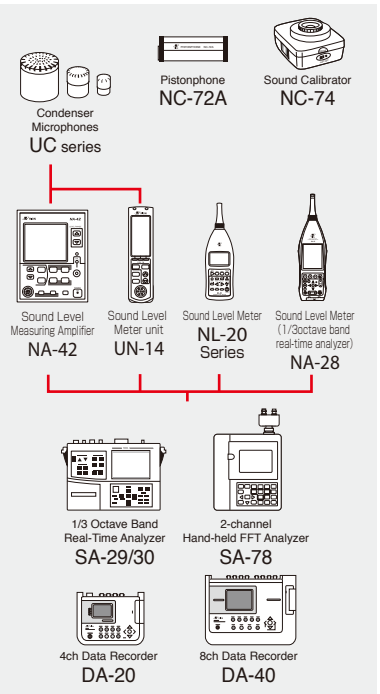
Depending on these factors, the measurement method, type of measuring instrument, and choice of peripheral equipment will differ. Selecting the right combination of products is essential for achieving accurate and reliable results. The following pages are intended to help with the selection of equipment, by describing some representative configurations and showing connection examples.

INDEX

1

Acoustic Measurement

In acoustic measurements requiring high accuracy, the basic instrument combination consists of a condenser, microphone and preamplifier. To this, other equipment, such as a frequency analyzer and data recorder, is added as needed.
The type of condenser microphone will be determined by factors such as the target sound pressure level, frequency range, and sound field conditions. (See selection examples on page 22.) The general-application Sound Level Measuring Amplifier NA-42 is suitable as an amplifier for these microphones.
Frequency analyzers come in two types: constant-ratio type real-time analyzers and constant-amplitude type FFT analyzers. In the former category, RION offers the 1/3 Octave Band Real-Time Analyzers SA-29 and SA-30, and the Precision Sound Level Meter NA-28 with the 1/3 octave band real-time analyzer function. In the FFT category, there is the 2-Channel Hand-held FFT Analyzer SA-78.



2

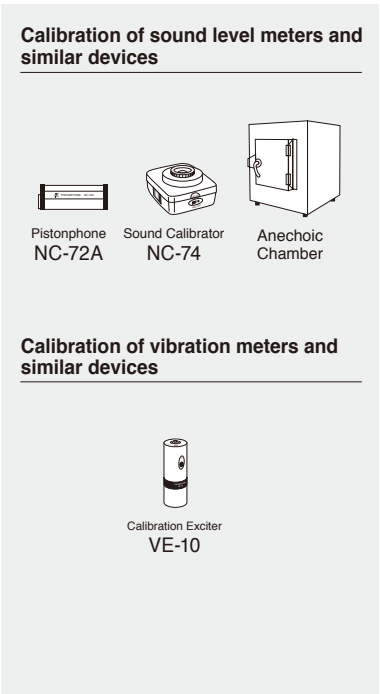
Calibration of Sound Level Meters and Vibration Meters

● Calibration of sound level meters and similar devices

For overall checking of sound level meters and acoustic measurement systems, RION offers the Sound Calibrator NC-74 (1 kHz, sound pressure level 94 dB), as well as the Pistonphone NC-72A (250 Hz, 114 dB).

● Calibration of vibration meters and similar devices

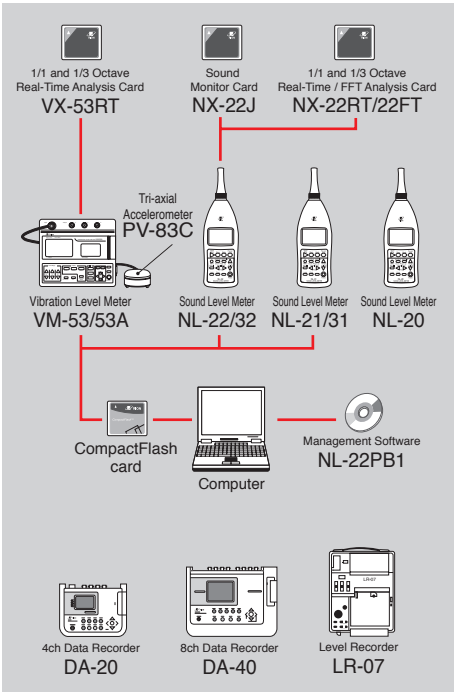
In order to make it possible for users to easily calibrate vibration meters and vibration accelerometers, RION offers the Calibration Exciter VE-10 (159.2 Hz, acceleration 10 m/s^2, velocity 10 mm/s, displacement 10 μm) .



3

Sound Level Meters and Vibration Level Meters in the Field

The basic model lineup for JIS and IEC standard compliant sound level meters is the NL series.
For on-site measurements of vibration levels, the Japan Measurement Law and JIS compliant Vibration Level Meters VM-53/53A are suitable.
The models NL-21/22/31/32 and VM-53A have a slot for CompactFlash (CF) cards which makes it possible to perform automated long-time measurements by storing sound level or vibration level data and processing results on the memory card. Stored data can be imported by the dedicated software applications NL22-PB1 for level-time display, editing, further processing, and creating daily and weekly reports.
The NL-22/32 supports use of the 1/1, 1/3 Octave Real-Time Analysis Card NX-22RT and the FFT Analysis Card NX-22FT. A Sound Monitor Card NX-22J is also available, which allows for using the Management Software NL-22PB1 to check the recorded result while re-processing data.
The VM-53A allows use of the 1/1 and 1/3 Octave Real-Time Analyzer Card VX-53RT for frequency analysis.
For recording of sound level and vibration level data, RION level recorder LR-07 is useful. Sound pressure waveform and vibration acceleration waveform information can be recorded using a data recorder (4-channel type: DA-20, 8-channel type: DA-40), allowing for later analysis with waveform processing software.



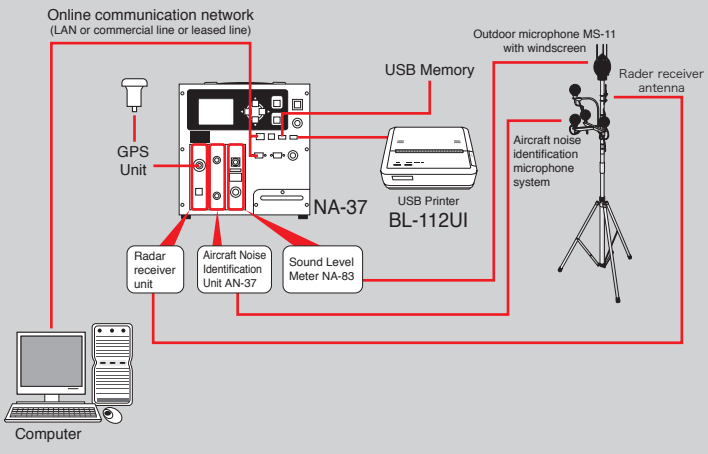
4

Sound Level Monitoring

Aircraft noise, factory noise and other types of noise that have an influence on the living environment require constant level monitoring in order to devise efficient countermeasures. For short-term monitoring, the Sound Level Meter NL-20 series along with the level recorder LR-07 and a suitable all-weather windscreen is a convenient arrangement (Figure 1).
For constant monitoring on a long-term basis, a system built around the Environmental Sound Monitor NA-37 is optimal. Such a system can use the public telephone network or another suitable online link to send data to a monitoring facility. The optional Aircraft Noise Identifier Unit AN-37 provides the capability of determining sound incident direction while the Environmental Noise Data Processing Software AS-50PA1 handles the obtained data (Figure 2).

Figure 1

Figure 2

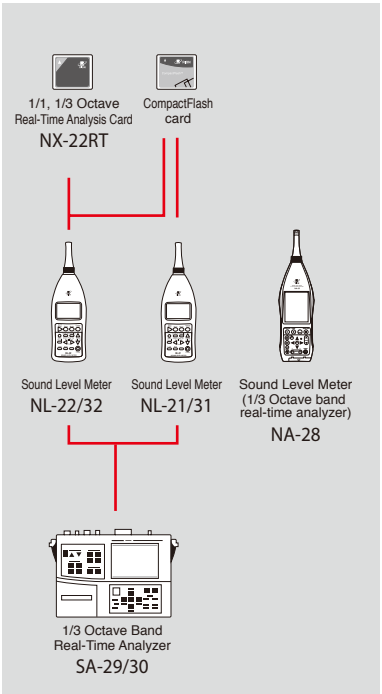


Measuring Instrument Combinations

5

Noise Measurement at Working Places

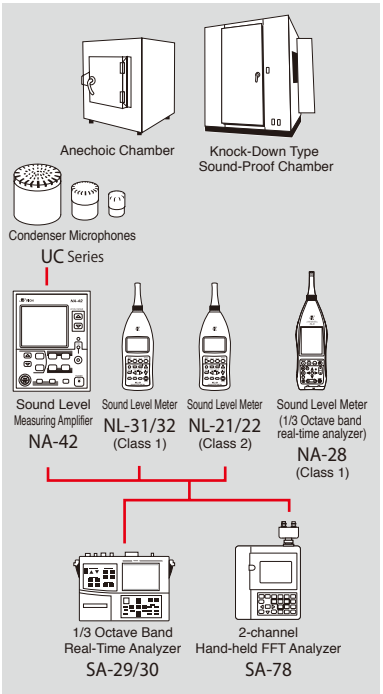
The measurement of sound exposure levels is an important prerequisite for protecting personnel working in an environment with high sound level from hearing damage. Regulations to control generation of noise at work places have come into force in many countries. For instance, The Noise Prevention Guideline issued by the Japanese Labor Ministry (currently the Health, Labor and Welfare Ministry) in 1992 provides the framework for measurement and evaluation of equivalent continuous sound pressure levels.
The Sound Level Meter NL-20 series is suitable for such measurements. When the NL-21/31 is used, the results can be stored on a CF card and later imported to a spreadsheet application for easy processing. The NL-22/32 allows use of the 1/1, 1/3 Octave Real-Time Analysis Card NX-22RT to analyze frequency ranges that are most critical for noise countermeasures. The Sound Level Meter NA-28 with the 1/3 octave band real-time analyzer function is also a highly useful tool.



6

Quality Management Based on Sound and Vibrations

Measuring the noise level and vibrations produced by machinery and other equipment can often provide valuable data for quality control. Depending on the characteristics of the measurement target, UC series microphones or PV series accelerometers are used as sensors connected to equipment such as the Sound Level Meter Unit UN-14,Vibration Meter VM-83 or Charge Amplifier UV-15/16.
When only the sound or vibration Level is to be measured, the NL-21/22, NA-42, or VM-83 with comparator function are suitable.
For purposes such as detection of abnormal noise, frequency analysis must also be performed. In such cases, the Sound Level Meter NA-28 (with 1/3 octave band analysis function) or the Octave and 1/3 Octave Band Real-Time Analyzer SA-29/30 is useful.



7

Sound-Proof Chambers, Anechoic Chambers, Echo Chambers

When performing acoustic measurements, special conditions must often be established, such as low-noise environment, semi-free sound field, free sound field, or diffuse sound field.

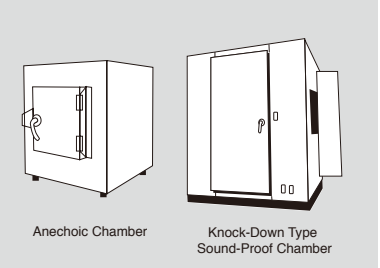
● **Low-noise environment**
Using a sound-proof chamber or box, when the sound level emitted by equipment is low, ambient noise can influence a measurement. To prevent this, place the measurement target in a sound-proof chamber or box. In some cases, using an anechoic chamber or box where the influence of reflections is minimized can also be useful.
For acoustic power level measurements according to the sound pressure method or for measuring the sound insulation characteristics of building materials, a semi-free sound field, free sound field, or diffuse sound field must be realized, according to standard stipulations. This can be achieved by using suitable RION products.

● **Semi-free sound field**
Using a semi-anechoic chamber
Except for the floor, all surfaces of such chambers are specially treated for sound absorption to minimize the influence of reflections.

● **Free sound field**
Using an anechoic chamber
All surfaces including the floor of such chambers are specially treated for sound absorption to minimize the influence of reflections.

● **Diffuse sound field**
Using an echo chamber or type I test chamber
For sound insulation measurements, JIS prescribes the use of a so-called Type I chamber which provides an environment with uniform energy distribution.

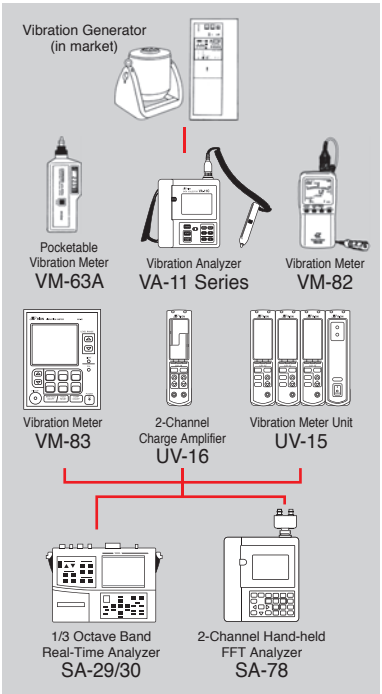
● **Insulation measurement environment**
Using a type II test chamber
This refers to a cuboid test chamber with specially adjusted reverberation times for specific frequencies.



8

Measurement of Mechanical Vibrations

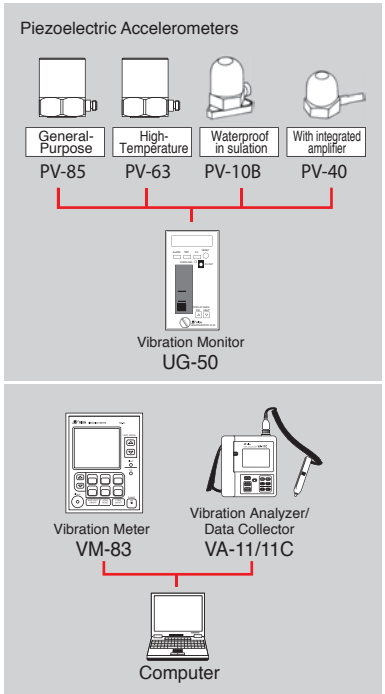
Vibration measurements are most commonly carried out using PV series piezoelectric accelerometers as the sensor providing the input signal. Because there will be considerable differences in the magnitude of vibrations, depending on the measurement object, RION offers a wide range of accelerometers with different sensitivity levels and dimensions. Velocity information can be obtained by integrating the acceleration figures. Velocity can then be converted to displacement by further integration.
The RION product lineup in the category of portable vibration meters includes the Pocketable Vibration Meter VM-63A, the Vibration Meter VM-82, and the Vibration Analyzer VA-11 with built-in FFT analysis function. In the larger stationary type unit category, RION offers. The Vibration Meter VM-83, which also supports servo accelerometers, and the UV series charge amplifiers, such as the UV-15 and UV-16, which support a multi-channel configuration for simultaneous measurement.
For vibration analysis, suitable RION products include the Vibration Analyzer VA-11, the 2-Channel Compact FFT Analyzer SA-78, and the 1/3 Octave Band Real-Time Analyzer SA-29/30.
When measuring vibration characteristics of machine parts and facilities, a vibration source is commonly used. Various types of containing, different output levels, are available to match the size of the object under test.



9

Vibration Monitoring

Vibration monitoring is an important tool for detecting symptoms of impending problems in machinery and for implementing preventive maintenance.
In the semiconductor industry and other sectors that require high accuracy manufacturing, vibration monitoring helps to improve yield and facilitates quality control. There are two basic patterns for vibration monitoring: continuous monitoring where vibration levels are automatically monitored on an ongoing basis and an alarm is triggered when a certain level is exceeded, and periodic monitoring at regular intervals combined with trend analysis designed to assess and manage the condition of the equipment.
RION offers a range of vibration accelerometers suitable for constant monitoring including general-purpose, high-temperature, water-proof and insulated types, and accelerometers with integrated preamplifiers. The Vibration Monitor UG-50 is suitable for such applications and offers the capability to output an alarm signal.
The Vibration Analyzer VA-11 and the Vibration Meter VM-83 can be connected to a computer for configuring a constant monitoring system.



10

Whole-Body Vibration Measurement

Vibrations are transmitted to the human body via the feet when standing, via the posterior when seated, and via the back when leaning on a backrest.
The influence of such vibrations on humans can be evaluated under many aspects including vibration perception, comfort, health hazards, and motion sickness. ISO 2631 specifies many different frequency compensation circuits for judging vibration depending on direction as well as rotational vibration.
ISO 2631 compliant measurements can be made by using the 3-Axis Vibration Meter VM-54 combined with the Whole Body Vibration Card VX-54WB/VX-54WB1 or Marine Vibration Card VX-54WS.
For measurement of seat vibrations and evaluation of ride quality, the Seat Measurement Accelerometer PV-62 is mounted to the measurement target and connected to the 3-Channel Preamplifier VP-80, as shown in Figure 1.
For evaluation of buildings and ride quality in ships, vibration measurement can also be carried out with the Accelerometer PV-83CW (supplied with VX-54WS), as shown in Figure 2.

Figure 1

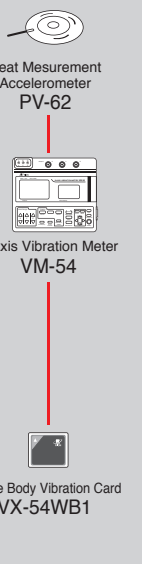
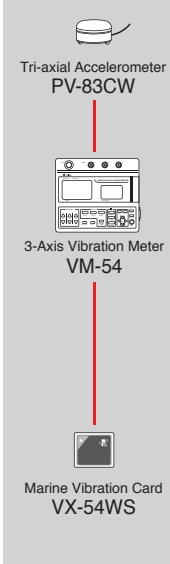


Figure 2

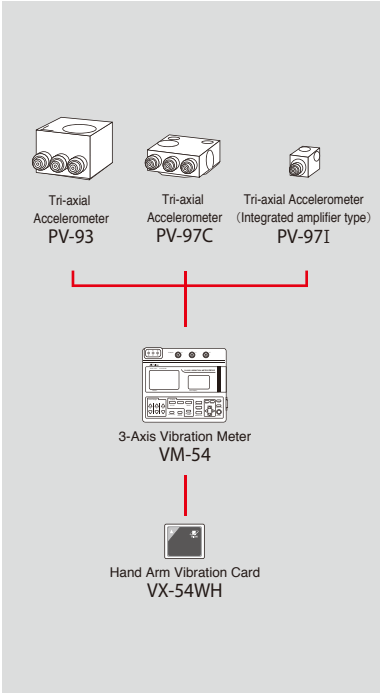


Measuring Instrument Combinations

11

Hand-arm Vibration Measurement

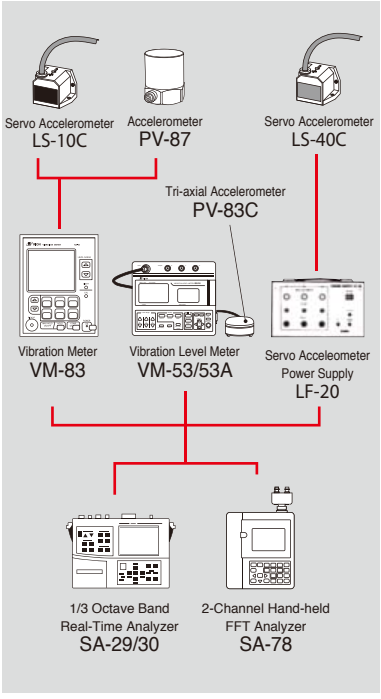
In the work environment, hand-arm vibration leading to an ailment called Raynaud's disease can pose a serious problem. This kind of vibration-related ailment, where blood circulation in the hand and fingers decreases causing them to appear white, is often due to the use of chain saws, rock drilling machines and other hand-held or hand-guided power tools that produce vibrations.
ISO 5349 compliant quantitative evaluation of such vibrations is possible by using the 3-Axis Vibration Meter VM-54 together with the Hand-Arm Vibration Card VX-54WH.
To devise measures for preventing such vibrations, the vibration exposure can be determined by a 3-axis vibration component measurement performed on the handle of the tool in question. For this purpose, the 3-Axis Accelerometer PV-93/97C/97I or multiple single-axis accelerometers PV-90B/90I are combined with the 3-Channel Preamplifier VP-80 and connected to the VM-54 in which the Hand-Arm Vibration Card VX-54WH has been installed.



12

Measurement of Low-Frequency Microvibrations

Low- level, low-frequency vibrations must be measured in various instances, such as when measuring minute floor vibrations to assess the occupation comfort of a building, checking for microvibrations in a clean room for semiconductor manufacturing or testing the efficiency of vibration damping systems for precision machinery. The Servo Accelerometer LS-10C/40C, Vibration Level Meter VM-53/53A or the high-output accelerometer PV-87 in combination with the Vibration Meter VM-83 are suitable for such purposes. It is also possible to perform frequency analysis and evaluation with the 2-Channel Compact FFT Analyzer SA-78 or 1/3 Octave Band Real-Time Analyzer SA-29/30.
The evaluation of floor vibrations uses the floor response waveform for determining vibration frequency, displacement, velocity, acceleration and attenuation constants. These are then compared to reference curves for actual evaluation. For testing the efficiency of vibration damping systems, sensors are mounted on the floor and to the mounting bed of the object under test.



NOISE AND SOUND LEVEL METERS

Sound and Noise

What is commonly called "sound" is actually vibrations of air. Various objects, when rubbed or tapped, can become sound sources. The vibration of the sound source object causes the adjacent air to vibrate and these vibrations are transmitted to the ear where they are perceived as sound.
In our everyday environment, there are many different kinds of sounds, but humans do not respond to all of these. Rather, we subjectively make decisions and focus only on certain sounds that we want to hear. Other sounds that are not important, often inconvenient or disturbing, are sounds that are undesirable or unnecessary. Such sounds are called "noise". Rather than containing certain physical properties, what defines noise is a subjective characteristic that is specific to the listener. Sound that is too loud, unpleasant, or that draws attention in a certain direction is commonly judged as noise.

Physical and Sensuous Value of Sound

The physical magnitude of sound is sound pressure, representing tiny changes in atmospheric pressure, the unit measured by Pascal (Pa). The range of sound pressure that can be detected extends from 20μPa to 200 Pa, a difference of a factor of as much as 10 million times. The loudness of a sound as perceived is proportional to the logarithmic value of the sound pressure. The sound magnitude is expressed as a sound pressure level in decibel (dB), using the smallest sound that can be heard (20μPa) as reference, and covering a range from 0 dB to 140 dB.
The sensitivity of the human ear differs depending on the frequency of the sound. The same sound pressure can be perceived differently at different frequencies. When a certain sound is perceived equal to the sound pressure level PdB at 1 kHz, the loudness level of that sound is said to be Pphon. Figure 2 shows the relationship between the loudness level of a pure tone and its frequency. The curves in this graph are called equal loudness curves. As can be seen from the graph, the physical magnitude of a sound and its subjective magnitude are not the same. Rather, there is a complex relationship between the two.

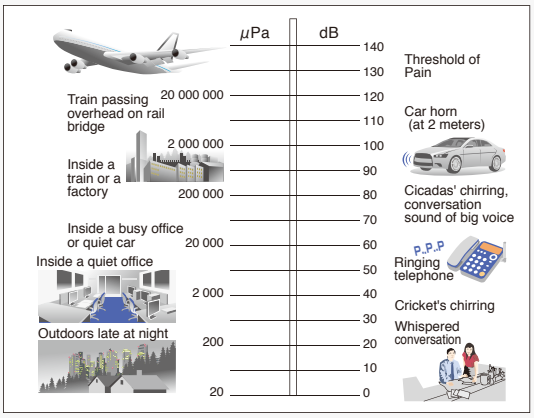


Fig. 1 Sound pressure and sound pressure level

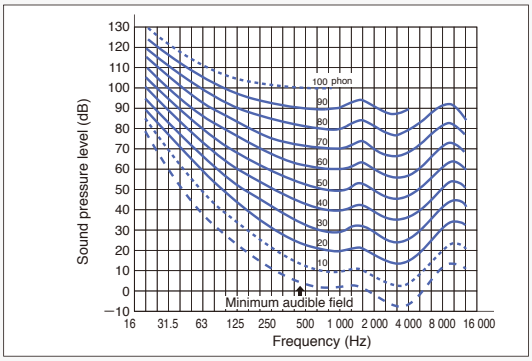


Fig. 2 Equal loudness curves of sound

Sound Level and Sound Level Meter

Sound Level Meter is a device for turning physical properties of sound into numeric values. Psychological, physiological and subjective aspects cannot be measured.
A reverse curve corresponding to the equal loudness curve at 40 phon is applied to the sound pressure (this is called "A"-frequency weighting). The resulting level is called A-weighted sound level and is expressed in dB.

What is equivalent continuous sound level L_{eq}?

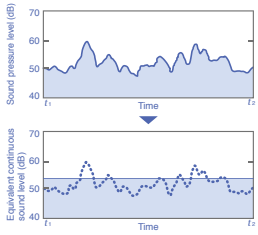
Equivalent continuous sound level L_{eq} is used for environmental noise evaluation.

Equivalent continuous sound level

The equivalent continuous sound level L_{eq} is the constant sound level which has the total sound energy equivalent to the energy of a actual fluctuating sound produced over a given period of time. As an example, consider the illustration at right. In the top graph, the sound level fluctuates from 47 to 60 dB within the time interval $t1$ to $t2$. When the total energy of this sound is equated to a constant sound level over the same period, the 53 dB value (bottom graph) is obtained.

L_{eq} measurement

The equivalent continuous sound level can be automatically calculated by a sound level meter with built-in L_{eq} function.



Sound pressure level and equivalent continuous sound level

Standards of Sound Level Meters

Sound level meters are divided into two categories: Class 1 and Class 2. There is a difference in performance between these classes. Perfomance specifications and test methods of sound level meters are specified in the international standards IEC 61672 series. Two performance categories, Class 1 and Class 2, are specified in the standard. Basically, specifications for Class 1 and Class 2 sound level meters have the same design goals and differ in the tolerance limits. Tolerance limits for Class 2 specifications are greater than, or equal to, those for Class 1 specifications.
Some common terms used having with special meanings and relating to sound level meters are listed below.

①Frequency weightings
The different sensitivity of the human ear at different frequencies is represented by the "A" and "C" weightings as shown in Figure 3. When measured with the "A" weightings, the result is close to the subjective sound level impression. When measured with the "C" weightings, the result is close to the sound pressure level (physical quantity).

②Time weightings
Sound level is obtained by averaging the signal corresponding to the sound pressure raised to the second power. Two kinds of time weightings are used, which differ in the time constant used for averaging: F (Fast, time constant 125 ms) and S (Slow, time constant 1 s). For normal noise measurements, the F-time weighting is used. In some countries, a third characteristic called Impulse is used for the measurement of impulsive and impact noise.

③Type approval and test certification (In Japan)
Type approval refers to a process by which the government tests sound level meters provided by domestic manufacturers and importers and ascertains that their construction and performance is in accordance with the stipulations of the Measurement Law. When a sound level meter model has been type approved, most items can be omitted during testing for individual product certification.

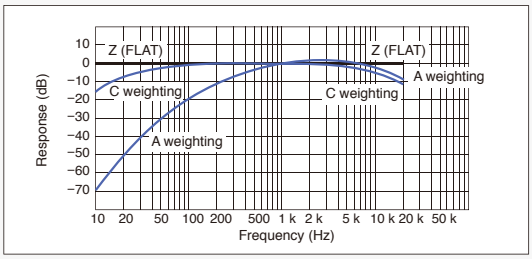


Fig. 3 Frequency weightings of sound level meters

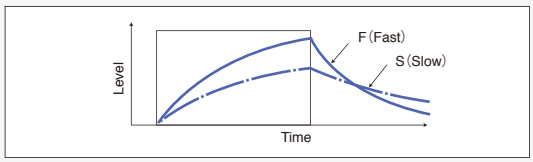


Fig. 4 Time weightings of sound level meters

Sound Level Meter Types

Many different kinds of sound level meters exist. The optimum device to be Chosen will depend on the purpose of the measurement, the required accuracy, and the data processing method that is to be employed. Some of the main categories are listed below:

①Sound Level Meter Class 1/Class 2 (applicable models:NL-32/31/22/21/20)
These are the most common types of sound level meters, whose performance are defined by the applicable standards. The difference is in accuracy.

②High-Precision Measuring Amplifier
A wide range of frequency and level range settings make this product suitable for many different measurements.

③Sound Level Meter with Analysis Functions (NA-28, NL-32/22 with NX-22RT/FT)
These are portable sound level meters with real-time analysis or FFT analysis functions.

④Environmentel Noise Monitor
This type of device performs data processing according to standards and regulations. It serves for measurements as well as for observation and monitoring of noise.

⑤Low-Frequency Sound Level Meter.
Allows G-weighted sound level measurement in conjunction with 1/3 octave real-time analysis.

⑥Sound Level Display
Designed for mounting in outdoor urban locations, this type of device can display the ambient sound level at a specific point.

Outline

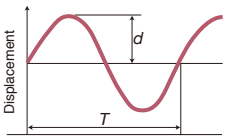
VIBRATION AND VIBRATION METERS

Importance of Vibration Measurement

Normally, vibrations arising in an industrial or residential environment are clearly an unwanted phenomenon, except in some special cases. Such unwanted vibrations are not only unpleasant to humans but they can also shorten the life of machinery, impair product quality, and cause defects and breakdowns. Sound arising from vibrations is also an environmental problem. Finding solutions to the multi-faceted problems presented by vibrations therefore is an important and pressing task.RION vibration meters are effective tools used to collect information in a wide range of fields. These include the maintenance, monitoring and testing of machinery, product design and research, quality control, noise and vibration countermeasure research, evaluation of tools and vehicles according to labor environment and hygienic regulations, vibration pollution control, and seismographic data collection and disaster prevention.

How to Measure the Magnitude of Vibrations

There are three vibration parameters which can be used to express the magnitude of vibration: displacement, velocity, and acceleration. Which of these factors is used depends on the type of vibration and the measurement objective. The relationship between them in the case of a sine wave vibration is shown in the illustration below.



Displacement amplitude: $d=v/2\pi f=a/(2\pi f)^2$
Velocity amplitude: $v=d\cdot 2\pi f=a/2\pi f$
Acceleration amplitude: $a=d(2\pi f)^2=v\cdot 2\pi f$

∗ f = 1/T (Hz), where T is period (s)

Units used for the magnitude of vibration are listed in the table below.

Displacement	mm、μm(1 μm=10^{-3} mm)
Velocity	mm/s
Acceleration	m/s^2、cm/s^2　Gal(1 Gal=1 cm/s^2)
Vibration acceleration	dB(re・10^{-5}m/s^2)：JIS

Vibration Meters for Mechanical Vibrations

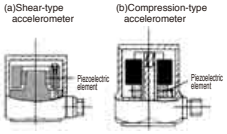
When vibration meters are used for measuring machine vibrations, a suitable accelerometer must be selected depending on the type of mechanical. Accelerometers designed for low frequencies measure low acceleration levels and, thus, are highly sensitive. However, their larger size and mass result in low resonance frequency when mounted. Accelerometers for high frequency measure high acceleration levels and are normally compact and lightweight with low sensitivity. RION offers a selection of piezoelectric accelerometers, covering a wide frequency range. By combining an accelerometer with a vibration meter that is designed to make the best use of its characteristics, a wide range of measurements can be performed with optimum efficiency.

Piezoelectric accelerometers are normally used for measuring vibrations with a frequency of more than 1 Hz. This type of accelerometer has good high-frequency characteristics and is especially suited for measuring vibrations in the upper frequency range. Major applications are vibration monitoring and diagnostic checks of mechanical installations in industrial plants. Piezoelectric accelerometers generate a certain amount of low-frequency noise when ambient temperatures change (so-called pyronoise). Depending on the application, the accelerometers must therefore be protected from temperature changes. When velocity and displacement to be used for evaluation are obtained by integrating acceleration, pyronoise will to be evaluated as integral products, pyronoise will be amplified and must therefore be given special consideration. With the exception of types containing, piezoelectric accelerometers require a charge amplifier.

What is the piezoelectric accelerometer?

Certain types of crystals will generate an electrical charge on their surface when mechanical distortion is applied. The amount of the charge is proportional to the external force given to the crystal. This phenomenon is called the piezoelectric effect, and the piezoelectric accelerometer makes use of it. This accelerometer type can be made compact and lightweight, covering a wide vibration acceleration and vibration frequency range. Accuracy and reliability are also very good, and handling is simple. Thanks to these characteristics, piezoelectric accelerometers are widely used from on-site vibration measurements to a reference accelerometer. There are two types of piezoelectric accelerometers which differ in the way the piezoelectric element is used. Figure 1 shows the two construction principles, namely a shear-type accelerometer and a compression-type accelerometer.

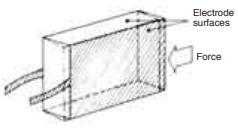
Fig. 1 Piezoelectric accelerometer types



Shear-type pickup (accelerometer)

The accelerometer is constructed in such a way that the piezoelectric element is subjected to a shear force. Sensitivity is high, which allows for small dimensions. As shown in Figure 2. pyronoise (pyroelectric output) caused by temperature changes is low, making it possible to measure low-level vibrations and vibrations in the low frequency range. This type is useful for monitoring vibrations in mechanical and buildings, and for seismometer applications.

Fig. 2 Principle of shear-type accelerometer



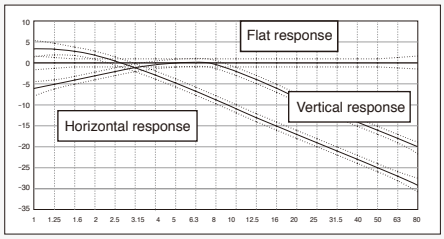
Compression-type pickup (accelerometer)

This type of accelerometer employs a weight on top of the piezoelectric element. The structure is simple and mechanical strength high, making it suitable for high acceleration levels and shock measurements.

Measurement of Vibration Pollution (Vibration Level Meter)

The evaluation of vibrations considered as environmental pollution uses the vibration level (dB), which is based on the pattern of human sensitivity to vibration. This is the same principle employed for the measurement and evaluation of sound pressure levels considered noise. Compensation according to human sensitivity characteristics is applied to the measured physical quantity (acceleration in the case of vibration pollution), and the resulting value forms the basis of evaluation.

The illustration below shows the frequency response that is stipulated by JIS C 1510 for vibration level meters.



Allowable response range for vibration level meters

Equipment Diagnosis

①Types of equipment maintenance

Depending on the importance of the equipment, there are various kinds of maintenance, required. In each case, the objective is to achieve maximum efficiency at minimum cost.

●Breakdown Maintenance (BM)

The principle here is to repair equipment when it breaks down.

●Time-Based Maintenance (TBM)

Parts are replaced at regular intervals regardless of breakdown and schedules are established for routine checks, disassembly and repairs. This is a kind of Preventive Maintenance (PM).

●Condition-Based Maintenance (CBM)

The operational condition of machinery is regularly leading to measured to determine the degree of deterioration or the existence of other factors equipment breakdown, Mechanical Checks, disassembly, repairs, and parts replacement are then carried out as a result.

This is a kind of predictive maintenance (PRM).

②Equipment diagnosis by vibration measurement

The vibration method diagnosis by vibration measurement involves measuring vibrations of the equipment in operation for early detection of problems and taking optimum countermeasures. This is effective for key equipment directly linked to manufacturing facilities, particularly rotating (machines).

③Frequency response on vibration parameter

Depending on the vibration frequency, each amplitude response of displacement, velocity and acceleration will be different.During equipment diagnosis, the following distinctions must be made; It is important to have a clear understanding of which type of vibration is likely to increase and should use an appropriate vibration parameter depending on abnormality. In some cases, both velocity and acceleration may have to be measured.

④Diagnosis methods

●Simple diagnosis

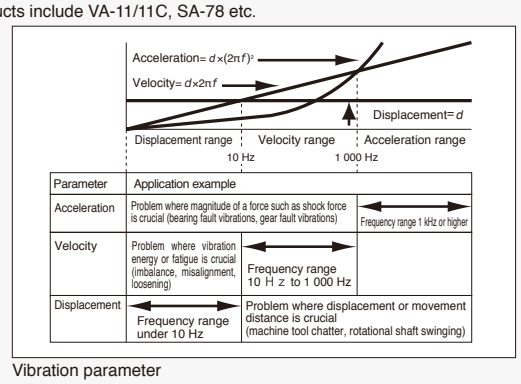
For this type of diagnosis, vibration measurements are carried out periodically by service personnel; The trend management of measurement results are then used for preventive maintenance of equipment.

Suitable products include VM-82, VM-63A, VA-11, etc.

●Precision diagnosis

Vibration signals are processed using FFT analysis or other similar techniques to identify problem areas and to initiate checks and repairs.

Suitable products include VA-11/11C, SA-78 etc.



Vibration parameter

FREQUENCY AND FREQUENCY ANALYZERS

Frequency Analysis and Frequency analyzers

Normally, sound and vibration phenomena occur with specific frequency characteristics. Multiple frequency components coexist in complex patterns. Determining the respective levels of these frequency components is called frequency analysis.
Countermeasures for noise or vibrations will not be effective over the entire frequency range. Therefore, target values and evaluation criteria must be set separately for the various frequency bands.

Frequency analysis classification

Frequency analyzers can be grouped in various categories, according to usage purpose, as listed in Table 1.

Table 1 Frequency analysis types

Purpose	Filter	Frequency analyzer
● Evaluation of sensory impact of sound and vibration ● Evaluation of countermeasures ● Materials development and evaluation	Constant ratio 1/1 octave band 1/3 octave band	SA-29/30 NA-28 NX-22RT(NL-22/32) VX-53RT(VM-53A)
● Identify noise and vibration phenomena ● Noise and vibration countermeasures ● Materials development and evaluation	Constant width FFT (narrow-band analysis)	SA-78 NX-22FT(NL-22/32) VA-11/11C

①Frequency analyzers

Devices for the frequency analysis of sound and vibrations can be divided into real-time analyzers and FFT analyzers, depending on their purpose. Figure 1 shows the analysis results of the same signal waveform processed on 1/3 octave band analysis and FFT analysis. A real-time analyzer employs a number of bandpass filters with a constant ratio (1/1,1/3,or 1/N octave bands). Frequency analysis performed with such a device serves mainly to assess the sensory impact of sound or vibration phenomena.
The FFT analyzer is calculated by constant width band. Frequency analysis performed with such a device serves mainly to assess the physical magnitude of sound or vibration phenomena.

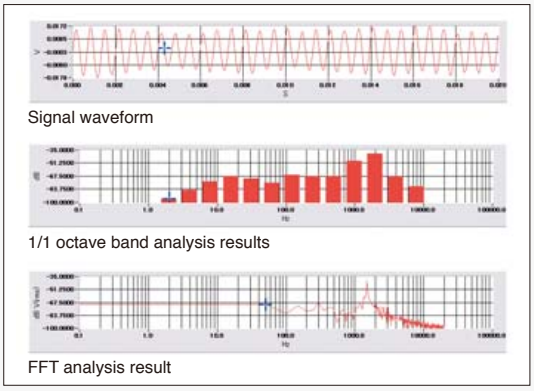


Fig.1 1/1 octave band analysis results, FFT analysis result

②Constant ratio type filter and constant width type filter

Filters used in frequency analyzers are of two types: constant ratio and constant width. In a constant ratio filter, the width of the passband varies in proportion to the center frequency while in a constant width filter, the passband width is always the same. Figure 2 illustrates the underlying principle. When a logarithmic scale is used for the frequency axis, the bandwidth of the constant ratio filter is shown as a constant, while the bandwidth of the constant width filter is shown as becoming narrower towards higher frequencies. When plotting frequency analysis results on a graph, it is therefore common to use a logarithmic frequency axis for a constant ratio ration filter and a linear scale for a fixed.

③Filter specifications

Octave band and 1/3 octave band analyzers for acoustic and vibration measurements are specified in JIS C 1513. Filter characteristics for octave band and 1/N octave band filters are specified in JIS C 1514. Internationally, the IEC 61260 is used.
The fact that filter specifications are governed by international standards means that data can be easily compared. However, for FFT analyzers there are no JIS or international standards. Therefore, different analysis results may be obtained depending on the performance and settings of the analyzer in use.

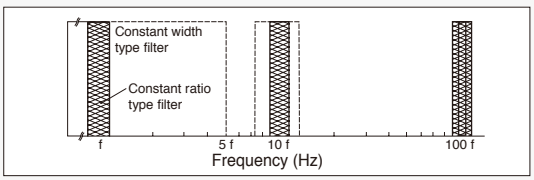


Fig. 2 Bandwidth representation for constant ratio and constant width filter on logarithmic scale

Different Ways of Using Frequency Analyzers

①Real-time analyzer

The most commonly used method for assessing the sensory impact of noise and vibration and for evaluating countermeasures is 1/1 octave and 1/3 octave analysis. Averaging can be carried out using the same frequency weighting and time weighting as the sound level meter or vibration level meter. This makes it possible to evaluate the actual impact that the noise or vibration phenomenon has on humans. The technique is used for many different tasks such as sound insulation measurements for architectural acoustics, evaluation of indoor noise, acoustic power level measurements, evaluation of building materials, sound quality evaluation, and propagation characteristics measurement.

②FFT analyzer

An FFT analyzer serves for assessing the physical aspects of sound or vibration phenomena and for devising suitable countermeasures. General applicability is good because analysis can be carried out in the time domain as well as in the frequency domain. Frequency resolution is excellent, which is essential for locating the sources of noise and vibrations, and the relationships between signals in multiple channels (for example, sound and vibration) can also be explored. FFT analyzers are extensively used in sound and vibration analysis of cars, machinery, computers, electric home appliances, etc., and in the development and evaluation of damping materials. Measurement types include mechanical impedance, mode analysis, intensity measurement, tracking analysis, propagation characteristics measurement, and sound quality measurement. FFT analyzers are indispensable tools in the fight against noise and vibrations.

FFT and Signal Processing

①FFT analyzer

The result of FFT (Fast Fourier Transform) analysis is characterized by constant bandwidth. In the input of an FFT analyzer, a low-pass filter (anti-aliasing filter) is used to remove signal components other than those of the bandwidth to be analyzed. Then, the A/D circuit converts the input into a digital signal, and time window processing is carried out. Finally, FFT processing is performed, resulting in discrete frequency analysis.

②Signal processing

The FFT analyzer can also provide amplitude information and phase information. In the time domain, this includes time waveform, auto-correlation, cross-correlation, amplitude probability density function. In the frequency domain, spectrum, dual-channel cross-spectrum, transfer function, and coherence function can be calculated. Intensity measurement, as well as 1/1 and 1/3 octave band analysis (octave synthesis), can be carried out, and mode analysis and tracking analysis for the entire system are possible.

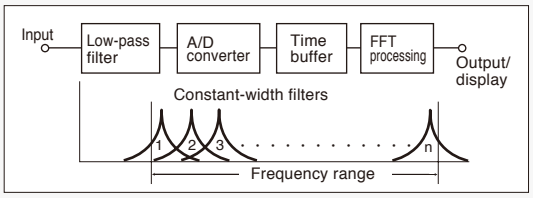
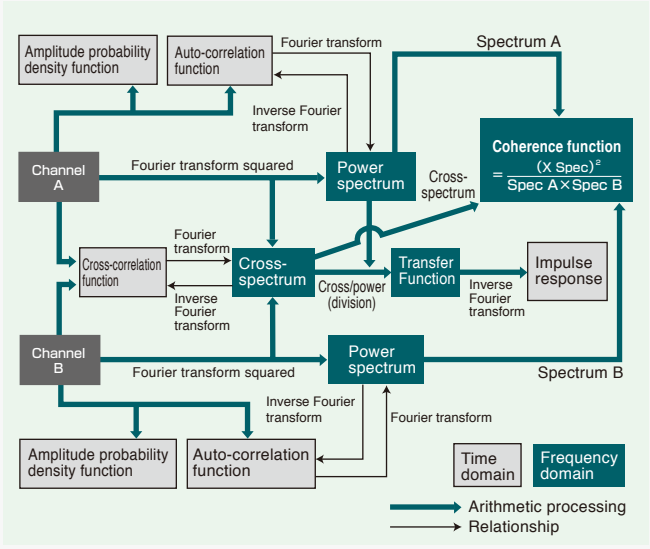


Fig. 3 FFT spectrum analyzer (spectrum analysis)

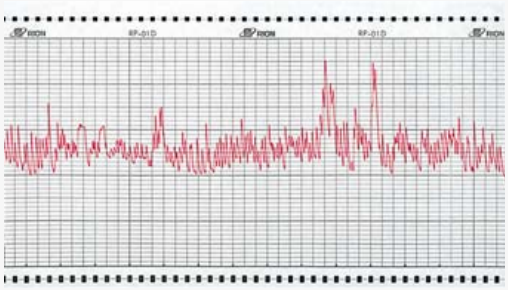
table 2 Relationship btween varioas FFT analyzer functions



RECORDING SOUND AND VIBRATION

Sound and Vibration Level Recording

①For recording the level of sound and vibrations, a device conforming to JIS C 1512 Level recorders for recording sound level and/or vibration level is used. Such a device uses the output signal of a sound level meter or vibration level meter.
The operation characteristics of the recording pen can be selected.

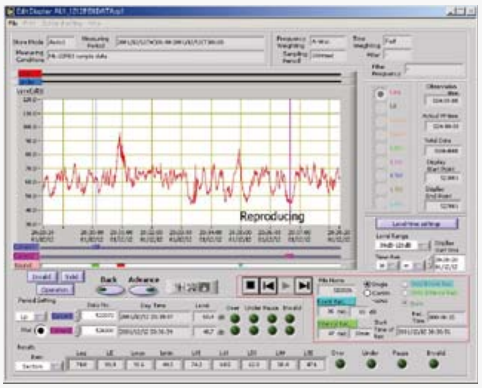


Sound level recording on Recording Paper RP-01D

②When a sound level meter or vibration level meter with integrated CompactFlash (CF) card slot is used, level data can be directly recorded on a memory card, which allows long-term recording. The data stored on the memory card can later be processed on a computer, either using dedicated software or a general application. Sound level and vibration level waveform information can be displayed and stored, Various other Functions are also possible (NL-21/31, NL-22/32, VM-53A).

	Sound level meter	Vibration level meter (3-axis)
128 MB	10.4 days	3.5 days
256 MB	20.8 days	7.1 days

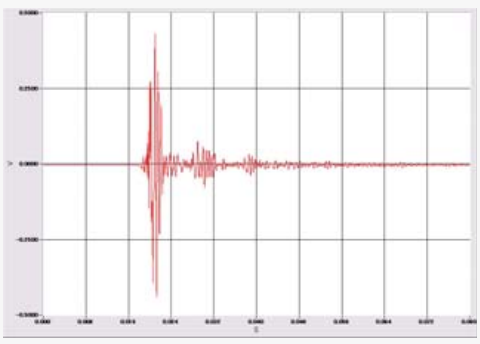
Memory card capacity and storage time for sound or vibration level (instantaneous value store every 100 ms)



NL-22 Management Software NL-22PB1

Sound and Vibration Waveform Recording

①Sound pressure waveform and vibration acceleration waveform information can be recorded for analysis making it possible to examine the transient characteristics of, for example, impulsive noise and vibration from blasting, gun fire, collision impact and other such phenomena. Waveform peak values can be measured, and frequency analysis performed.



Vibration waveform recording example (forging machine)

②Various devices for waveform recording are available, such as waveform recorders (waveform recording card SA-78WR) or data recorders. Media in common use include DAT tape and memory cards. The recorded data can be played back and post-processed with analyzer software and recorders.

③Waveform data recorded on a memory card can be displayed and analyzed using dedicated application software (such as the Waveform Analysis Software CAT-78WR). Recorded sound data (WAV files) can be played back as real sound using Media Player or other suitable software.

■ SA-78WR

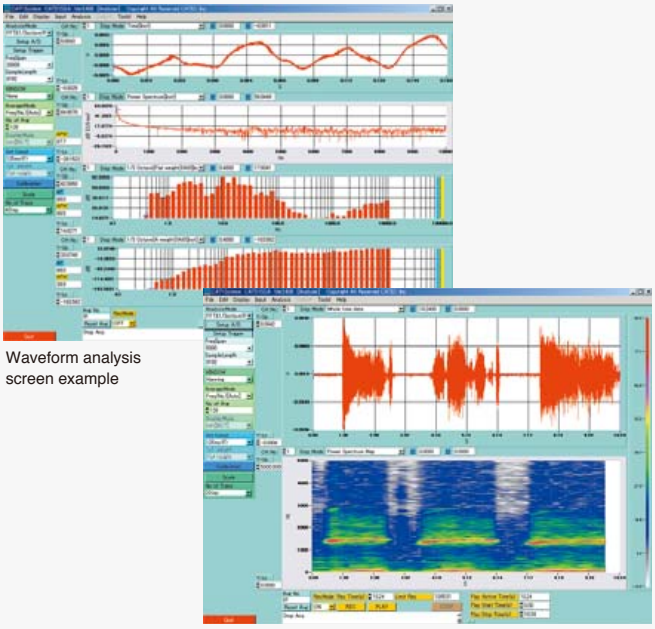
	Frequency range (Hz)							
Numbers of ch	100	200	500	1 000	2 000	5 000	10 000	20 000
1	66 h 40 m	33 h 20 m	13 h 20 m	6 h 40 m	3 h 20 m	1 h 20 m	40 m	20 m
2	33 h 20 m	16 h 40 m	6 h 40 m	3 h 20 m	1 h 40 m	40 m	20 m	—

Maximum recording times (using 128 MB CF card)
※Use only RION supplied cards for assured operation.

■ DA-20

	Frequency range (Hz)					
Numbers of ch	100	500	1 000	5 000	10 000	20 000
1	1066 h 40 m	213 h 20 m	106 h 40 m	21 h 20 m	10 h 40 m	5 h 20 m
2	533 h 20 m	106 h 40 m	53 h 20 m	10 h 40 m	5 h 20 m	2 h 40 m
3	355 h 32 m	71 h 06 m	35 h 33 m	7 h 06 m	3 h 33 m	1 h 46 m
4	266 h 40 m	53 h 20 m	26 h 40 m	5 h 20 m	2 h 40 m	1 h 20 m

Reference for maximum recording time with 2 GB CF card
Sampling frequency: frequency range × 2.56 (or 2.4)
※Use only RION supplied cards for assured operation.

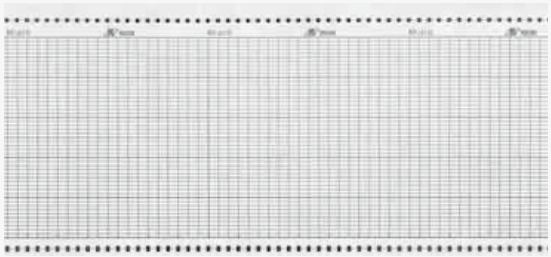


Waveform analysis screen example

Waveform analysis screen example

Sound Level/Vibration Level Measurement Paper

①Recording Paper for level Recorder
RP-01D(for 1ch)



One Point

What is percentile noise level?

These are evaluation quantities used to measure sound occurrence which is irregular and where its level fluctuates drastically.
A certain time period is considered for the measurement. When the sound level exceeds a certain level for *N* % of the time under consideration, its level is called the *N* percentile level. For example, if the measurement time is 10 minutes and 55 dB was exceeded for a total of 5 minutes, 55 dB is the 50 % percentile sound level (median value). If 55 dB was exceeded for a total of 30 seconds, 55 dB is L_5 (5 % percentile level).

What is frequency analysis?

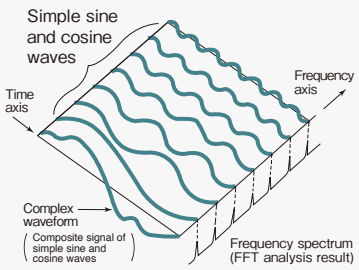
In general, sound and vibrations have complex waveforms consisting of many different frequency components. Such complex waveforms, which analyzes process into discrete frequency components in order to examine the nature of the sound or vibration is called frequency analysis. Commonly used types of frequency analysis are 1/1, 1/3 octave band analysis and FFT analysis.

What are 1/1 octave band analysis and 1/3 octave band analysis?

Our perception of the pitch of a sound is mainly determined by its frequency. The perceived difference in pitch between sounds is not proportional to the difference in frequency but to the ratio of the frequency. The bandpass filters used for frequency analysis come in two types: fixed ratio filters, where the ratio between the upper boundary frequency and lower boundary frequency of the filter is constant, and fixed width filter, where the difference between the upper boundary frequency and lower boundary frequency of the filter is constant. (For details, see page 35.) Analysis with the aim of evaluating noise normally uses fixed ratio filters (since) these can more easily be made to approximate the subjective hearing impression of humans. A frequency ratio of 2 is called an octave, and a set of filters where the upper boundary frequency is 2 times the lower boundary frequency is called a 1/1 octave bandpass filter. The nominal center frequencies of a 1/1 octave band filter are 31.5, 63, 125, 250, 500, 1 000, 2 000 Hz, and so on. In other words, adjacent filters have a ratio of 2. When detailed frequency is required, 1/3 octave filters are used, which are centered on the frequencies 31.5, 40, 50, 63, 80, 100, 125 Hz, etc. Here, the adjacent filters have a ratio of 1.25 (one third of an octave).

What is FFT (Fast Fourier Transform) analysis?

This method uses an algorithm called "Fast Fourier Transform" to divide a component signal with a seemingly irregular time cycle into a set of frequency spectrum components that make it possible to detect regularity in the signal.
FFT analysis is widely used for voice analysis, quality evaluation and fault detection in automobiles, electrical appliances and other products using acoustic and vibration signals.
Fourier Transform is named after the French mathematician Fourier (1768 to 1830) who postulated that any periodic function can be expressed as the sum of the trigonometric function. In 1965, Cooly and Tukey developed an algorithm based upon this concept and, several years later, this became available as an FFT program.



Quality Documentation

RION CO., LTD. makes available various documents certifying the quality of its products

Quality Documentation

- Test Report
- Certificate of Calibration
- Traceability Chart
- Reference Device Test Report or Certificate of Calibration

Anechoic chamber

Quality Assurance and Reliability Testing

Regarding measuring instruments, high quality and reliability mean not only free of defect or from breakdown, but the product must also return specified measurement values within a specified range and period. In other words, users of the product must always be able to place full trust in its performance as a measurement device. This is the basic tenet of RION as a measurement device manufacturer.

Besides the above quality and reliability requirements, there are various other demands that are rapidly evolving and changing the marketplace for measuring instruments. Some of the characteristics that users desire are compact size, ease of use, and versatile functionality.

In order to create products that meet these demands, RION CO.,LTD. is drawing on lengthy experience and field and reliability data accumulated over the course of many years from the design stage onwards, RION follows a systematic and well thought-out program for ensuring that our products will accomplish exactly what they are designed to. Important aspects of this process are the strict selection and management of parts and materials, extensive testing at every stage of development and production, and a thorough traceability system for ensuring compliance with national and international standards and industry norms.

Environmental test chamber for products

Absolute calibration setup for vibration accelerometers

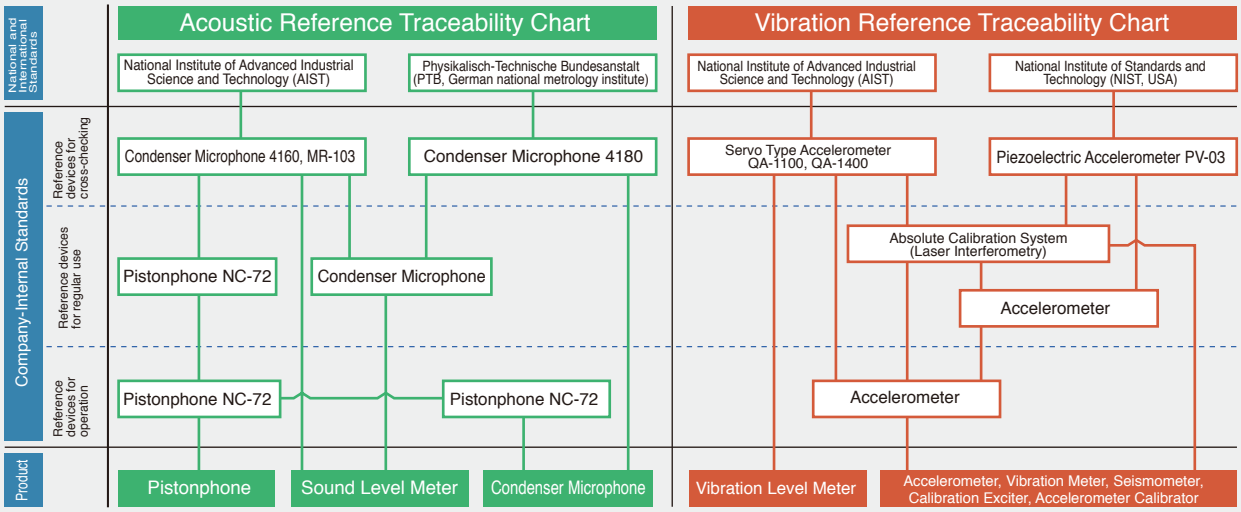
Absolute Calibration of Vibration Accelerometers

The accuracy of values used for measuring length and weight is always a concern. The same applies for the measurement of vibrations.

RION CO.,LTD. as a manufacturer of vibration meters, has, therefore, developed a system for absolute calibration of vibration accelerometers.

This system uses laser interferometry to assure high calibration accuracy. It is employed in the manufacturing process of standard accelerometers and also serves for quality control of vibration measurement devices.

In 1984, a round-robin test was carried out to determine the calibration accuracy of major research institutions around the world. Kobayasi Institute of Physical Research and RION CO., LTD. participated in this test proving the high accuracy of this calibration system.



PTB: Physikalisch-Technische Bundesanstalt
AIST: National Institute of Advanced industrial Science and Technology
NIST: National Institute of Standards and Technology

Company Outline

RSC
RION Service Center Co., Ltd.

http://www.rion-service.co.jp/

RION Service Center (RSC) was established with the express purpose of handling service and maintenance tasks for the wide range of measuring instruments produced by RION Co., Ltd, a company that boasts immense technological expertise and continues to develop advanced product technology.
RSC has three technical departments covering the fields of medical testing devices used in otolaryngology, acoustic and vibration measuring instruments including seismometers and particle counters used for measuring airborne and liquid-borne particle density. The administration department is responsible for coordinating overall operations. A separate quality assurance department has also been established, and a thorough quality management system put in place with the aim of ensuring that customers are able to benefit from the outstanding precision and accuracy of RION products for many years to come.
"True service for the 21st century" is our motto.

Foundation date: April 10, 2002
Start of operations: August 5, 2002
Capital: JPYen 30 million
Number of staff: 60
Registration and certifications:
Designated service provider for special measurement equipment
Special service provider for medical equipment
ISO 9001 Certification (JQA-QMA11621)
Locations:
Head Office and Plant
2-22-2 Hyoe, Hachioji-shi, Tokyo, Japan
Tel +81-42-632-1122 Fax +81-42-632-1140
West Japan Office
Denshikaikan Bldg, 6-8-7 Nishi-Tenma, Kita-ku, Osaka, Japan
Tel +81-6-6363-4134 Fax +81-6-6364-3673

Areas of Activity

Repair, checking, and calibration (in-house servicing)

Based on standards and procedure guidelines developed in house, we service, adjust, and calibrate products to bring them to the same condition as when shipped new.

Calibration bench

On-site servicing

For permanently installed equipment or products that cannot be moved, we offer on-site servicing.

Instrumental error testing

After performing servicing and calibration in house, we offer application services for official instrumental error testing/public certification * for sound level meters, vibration level meters, and level recorders. We follow through until the official certification is obtained.
* Performed at the request of the customer

ISO compliance documentation and inspection certificates

We issue calibration certificates and traceability charts, as well as reference device calibration and inspection certificates.
Reference equipment used for calibration is traceability certified according to national standards.

Inspection certificates for individual products

Inspection certificates for individual products are issued according to RION specifications.

Maintenance/service contracts

① Yearly maintenance contract
Based on a yearly maintenance contract, we provide periodic checks as well as emergency repair services in case of a problem.

② Spot maintenance contract
This type of contract covers a one-time maintenance procedure based on procedure manuals (specifications).

Measurement

We carry out measurements in the areas of general environmental noise, aircraft noise, sound absorption coefficient, transmission loss, and acoustic power level. Other types of sound and vibration measurements can also be arranged by consultation. All required equipment is provided.

Type 9301 sound absorption coefficient/transmission loss measurement system with Impedance tube

Custom-made cables

We manufacture cables used for RION measuring instruments to custom lengths. Cost is calculated based on cable type and length.

Kobayasi Institute of Physical Research

E-mail info@kobayasi-riken.or.jp
URL http://www.kobayasi-riken.or.jp/

Foundation Date: August 24, 1940
Chairman: Mitsuyasu Yamashita (Doctor of Engineering)
Location: 3-20-41 Higashi-Motomachi, Kokubunji, Tokyo, 185-0022 Japan Tel +81-42-321-2841

Research Facilities

The institute consists of a main building, a test chamber block for architectural acoustics, as well as eight other buildings with combined research and testing facilities. There are four test chambers for wall properties, two for floor properties, six reverberation chambers, one anechoic chamber, four semi-anechoic chambers, and one low-frequency test chamber. The building for the architectural acoustics division was constructed in commemoration of the 60th anniversary of the institute. Its research facilities are among the best in Japan and have allowed the staff to produce many outstanding results.

- **Designated by Ministry of Land,Infrastructure and Transport**
  Designated evaluation facility according to Architecture Basic Law
  (Boundary sound insulation structure)
- **Registered as measurement certifi cation facility**
  Tokyo Metropolitan, No. 549 (Sound Pressure Level)
  No. 977 (Vibration Acceleration Level)

Anechoic Room

This specially constructed room is insulated from all outside sound and vibrations. Internal surfaces are covered with 60 cm thick glass fiber blocks for sound absorption, with increasing density in deeper layers. This design ensures excellent absorption characteristics for incident sound from any angle.

Interior of test chamber

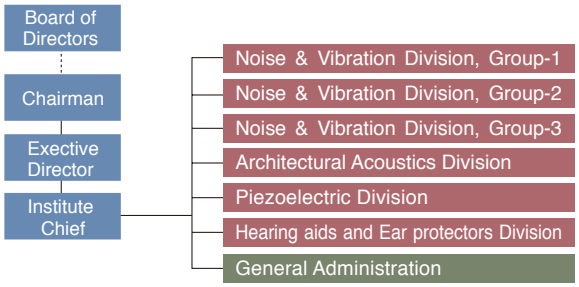
Architectural Acoustics Division Test Chamber Block

This building houses four chambers (two facing pairs) for testing sound insulation of building elements (walls) according to ISO 140-1 and 140-3, as well as two floor test chambers.The two pairs of wall test chambers use different methods for fastening the test object cassette. The two chambers which serve for floor impact sound testing have a floor base thickness of 200 mm and 150 mm respectively, to allow for testing with different structural parameters.

■ Outline of Activities

The Kobayasi Institute of Physical Research carries out basic research as well as applied research mainly in the field of acoustics. It is a non-profit organization which publishes research results, provides training for researchers, and conducts seminars. The institute also performs contract research for local and national government authorities as well as for private enterprises. Important areas of specialization are architectural acoustics, noise, vibrations, and low-frequency phenomena. The institute is fortunate in having research staff with many years of extensive experience as well as access to advanced and exceptional facilities. Over the years, many breakthroughs have been made in the measurement, analysis, prediction, and control of noise and vibrations. Insulating and damping characteristics of building materials are another important focus of activity at the center. Research is also carried out in ultrasonics and related fields, such as piezoelectric and dielectric materials.

Organization



Scale Model Experiment Chamber

This chamber is used for scale model experiments aimed at clarifying noise propagation characteristics and collecting data for noise prediction. It is a large acoustic chamber insulated from outside sound with a large, flat floor space. Except for the floor, all internal surfaces are treated with sound absorbing materials to prevent reverberation.

Company Outline

RION CO., LTD.

http://www.rion.co.jp/

RION was founded in 1944, with the aim of developing commercial products based on scientific work carried out at the Kobayasi Institute of Physical Research. Ever since its founding, RION CO.,LTD. has upheld the belief that acoustics is a science of great importance to the well-being and welfare of society. RION has continued to introduce products based on this philosophy, aimed squarely at improving quality of life. A healthy and content society is the vision that guides our activities.

RION's products comprise four main categories: "Hearing Instruments", dealing with hearing aids and equipment for hearing ability training, "Medical Equipment" for the fields of otorhinolaryngology, dermatology, and ophthalmology, "Sound and Vibration Measuring instruments", encompassing sound and vibration level meters, seismometers and related devices, and finally "Particle Counters", equipment primarily used for the measurement of air-borne and liquid-borne particles.

RION covers a wide product spectrum while remaining firmly rooted in the science of acoustics. RION products are used by individuals as well as governmental institutions, schools and universities, medical facilities, the service sector, agriculture and fishery industries, and all branches of the manufacturing industry. RION products are not only used domestically but exported to more than 60 countries all over the world. Response has been overwhelmingly positive.

RION products are tailored to the requirements and expectations of its customers. This has helped the company maintain a leading position in the industry. RION wants to use its momentum and forward-looking stance to help create a society that is truly easy to live in. The ultimate aim is to provide a safe and gratifying environment for all members of society.

Foundation Date: June 21, 1944
Capital: JPYen 1,215 million
Sales: JPYen 16,130 million (Financial year 2004)
President & CEO: Kiyotsune Inoue
Certifications (in acoustic and vibration measurement field)
ISO 9001: 2000 Certification
ISO 14001: 1996 Certification
Designated manufacturer of special measurement equipment (sound level meters)

Logo and Corporate Philosophy

The logo symbolizes confidence in the company itself and the quality of its products. Resembling the ring of a planet, the stylized ring around the "R" expresses awareness of the universe to which our environment belongs and in which RION strives for the betterment and well-being of mankind.
The coloring uses RION's traditional blue in two shades of intensity. Cyan signifies energy and vitality, and ultramarine represents intellect and style.

Other RION Products

HEARING INSTRUMENT
Rionet Hearing Instruments

Custom-made BTE Type

MEDICAL EQUIPMENT

Audiometer

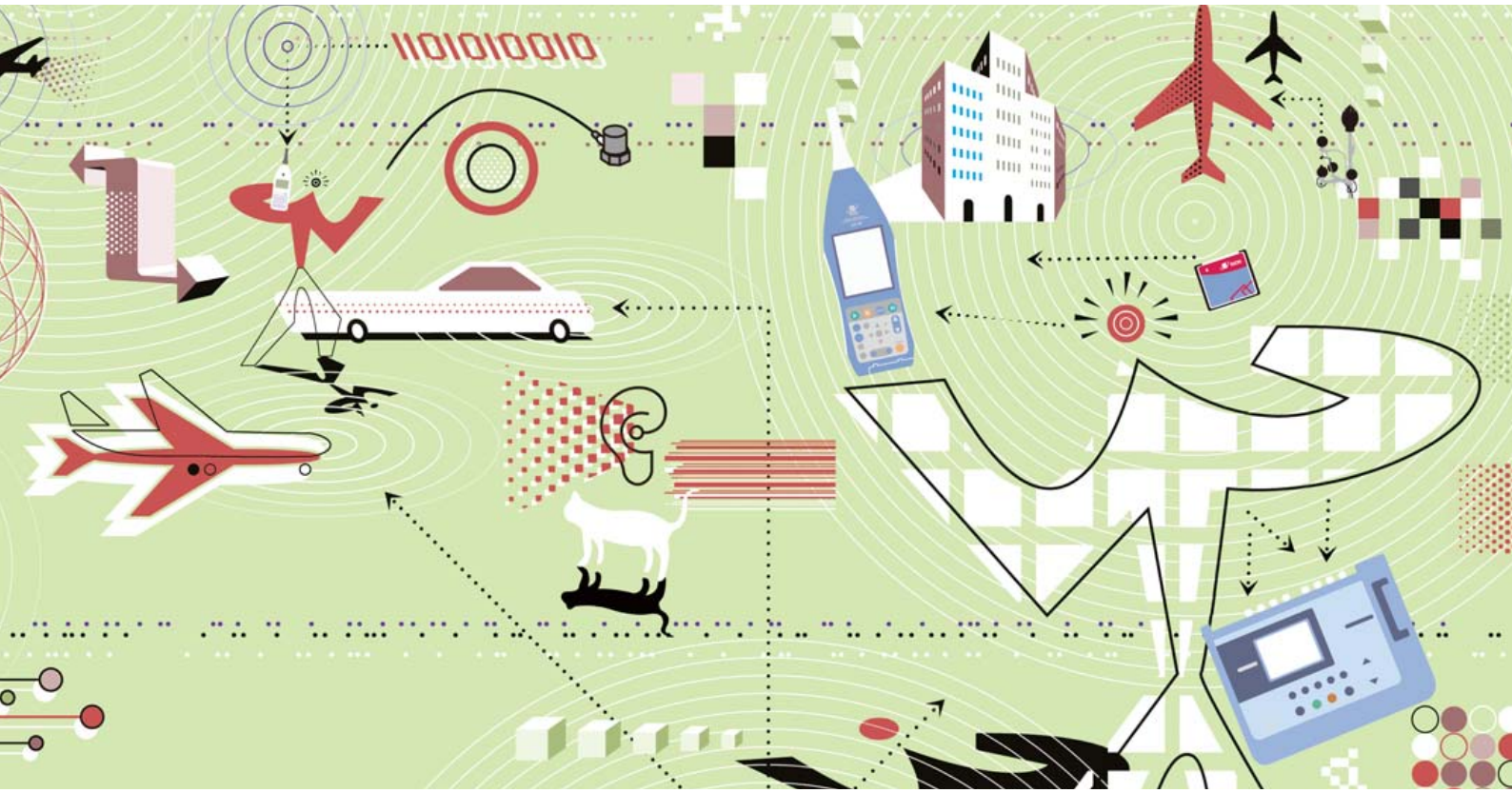
PARTICLE COUNTER

Airborne Particle Counter

Liquid-borne Particle Counter

INDEX(Model)

INDEX(Name)



http://www.rion.co.jp/english/

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∗ Specifications subject to change without notice.

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