RION

Environmental Sound Monitor
(For Aircraft Noise Measurement)

NA-37

Various functions equipment designed for the long-term Provides the automatic identification function of aircraft durability or the ease of a maintenance.

Environmental Sound Monitor

NA-37

The NA-37 system is based on the long-term experience and technology of Rion in the noise measurement field. Investigations into functions and endurance required for yearlong and automatic measurement of environmental noise, simplicity of a maintenance and reliability are fully conducted in designing process of this system. The NA-37 system provides with various functions and features such as all-weather type microphone with built-in automatic acoustic calibrator, operation and data backup with battery when power fails, long-periods data recording in PC memory card, data transfer using communication network, color LCD screen, real sound data recording, etc. Noise measurement and processing functions are completely automated. Two types of program cards, NX-37A for environmental noise measurement and NX-37B for aircraft noise measurement, are provided and can be selected in accordance with your needs.

Configuration example of an aircraft noise measurement system
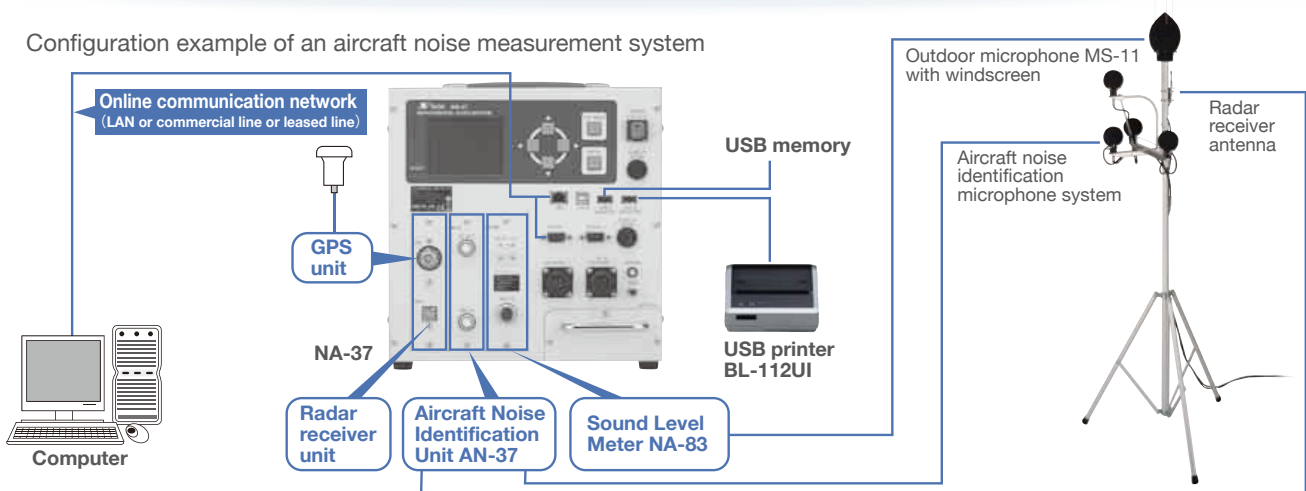
aircraft noise monitor
sound as well as

Features of NA-37

■ **Long-term data storage to built-in memory**

■ **Data transfer via LAN (at 20 times higher communication speed compared to previous model NA-36)**

■ **Copy of the data to USB flash memory** (option)

■ **Time correction which uses a GPS unit, and position information taking at the case of transfer measurement** (option)

■ **Real sound recording program NX-37WR** (factory option) **allows in two type of formats:**
  ● **MP3 (for long-term recording)**
  ● **PCM (for analysis)**

■ **Color LCD screen provides good outdoor visibility**

■ **Battery backup power supply ensures continued operation also during a power failure**

NA-37 Related Products

Sound Level Meter NA-83

The NA-83 conforms to the requirements of IEC 61672-1:2002 Class 1 (The conditions of the microphone attached the window screen and 30 m connected them with the specialized cable.)

■ CE mark, EMC directive compliant (reduction of influence on an external electromagnetic noise)

Outdoor Microphone System

Outdoor Microphone MS-11

Incorporates a sound source inside for a remote calibration and a heater to allow continuous long-term outdoor use.

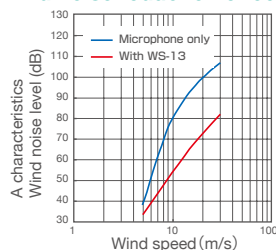### All-Weather Windscreen WS-13

The bird spike was adopted for the damage from a bird.

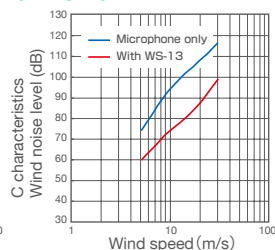MS-11   WS-13

Wind noise reduction effect of WS-13

A characteristics Wind noise level (dB) — Microphone only / With WS-13

Wind speed (m/s)

Performance of the A Frequency weighting data.

C characteristics Wind noise level (dB) — Microphone only / With WS-13

Wind speed (m/s)

Performance of the C Frequency weighting data.

Aircraft Noise Identification Unit AN-37/37R

The AN-37 discriminates moving sound source and record its sound arrival direction vector using three axial correlation method, only using acoustic signals. Detection microphone interval is only 25 cm, allowing compact dimensions and easy installation. AN-37R performs identification which received the SSR radio wave signal which an aircraft emits in addition to identification by the sound arrival directions.

Patent numbers (Japan Patent Office)

2050578 Aircraft flying position detection system
2050582 Aircraft flying position detection system
1809192 Aircraft noise identification system

Option

Carrying Case for NA-37 EF-37

Convenient for transfer of system amongsites.

Tilt type microphone stand ST-88S

Stable and rugged extension.

Maximum height overall : 4 meters
＊Photograph shows ST-88S with main and sound direction identification microphone system.

Aircraft noise measurement and identification in the vicinity of an airport.

Aircraft Noise Processing Program
NX-37B

● Detects sound events and automatically identify the aircraft noise.
● Stores data in internal memory and simultaneously processes data.
● The aircraft noise identification function using 3-axis correlation method can perform sky sound discrimination, arrival-directions range discrimination of sound, and discrimination of wind noise.
● When a noise event is detected, the measurement screen shows an aircraft symbol or car symbol, depending on the identification result.
A takeoff and landing sound event s can be distinguished by the moving direction identification function.
● Real Sound Monitor Program NX-37WR (option) can be used to record detected noise events for detailed data analysis.
● Measurement data for over one month (in vicinity of large airport) can be stored to built-in memory.
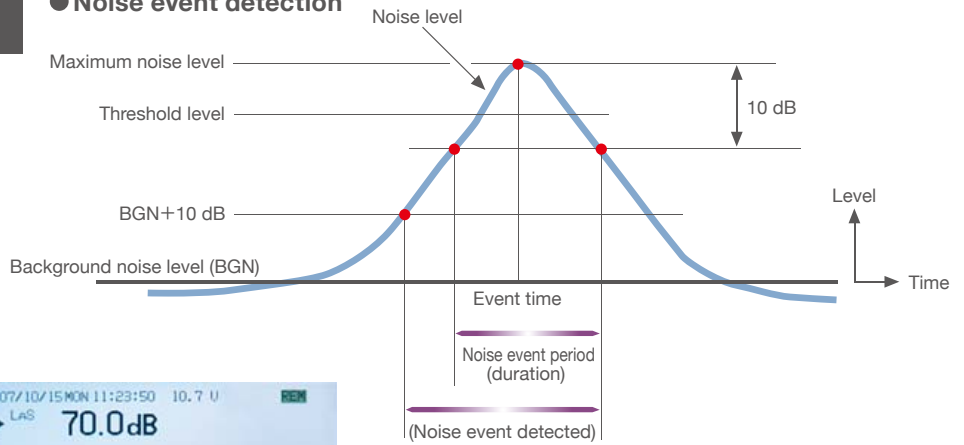
Monitoring system installed at vicinity of an airport

NX-37B

● **Noise event detection**

● **Symbols** (noise event evaluation result)

Noise event is being detected | Aircraft noise | Other surface noise

Evaluation result display (noise other than aircraft)

Evaluation result display (aircraft)

Aircraft Noise Data Processing Application Software AS-50PA1

- Collects data measured by NA-37 and allows tabulation, storing, editing, and report creation. (Supported operating systems: Windows 2000/XP/Vista)
- Data stored in built-in memory of NA-37 can be collected online via commercial line or leased line, or offline by USB memory card.
- Multiple measurement locations can be registered, and collected data can be managed in a database for tabulation and report creation.
- While viewing daily reports, simply clicking on the time of recorded noise events ,displays a vector circle diagram showing sound course tracking information, and actual sound data.
- Sound data saved as files can be played back, and tabulation data can be exported as CSV files.
- Data from NA-37 installed at a local station can be collected regularly or as required using communication line. Remote control function supports NA-37 setting change, and automatic acoustic calibration.

Aircraft Noise Data Processing Application Software screens
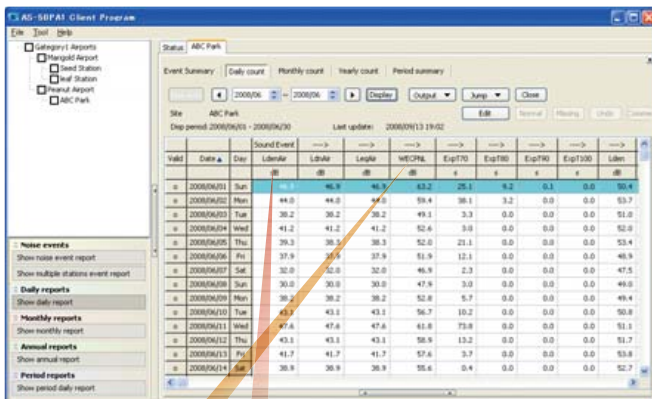
Daily report screen (example)
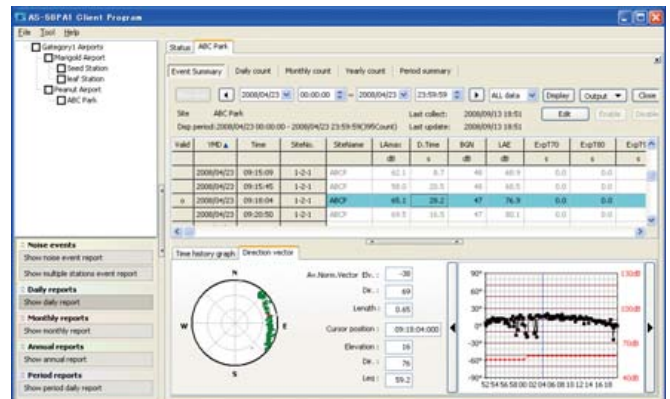
Event total screen (example)

Values for **WECPNL** (according to existing aircraft noise related environment standard) and new evaluation index **Lden** are calculated simultaneously.

Four Microphones Allow Measurement of Elevation Angle and Azimuth Angle

Aircraft Noise Identification Unit
AN-37
AN-37R (with radar reception function)

● 3-axis correlation method using acoustic signals enables the system to determine sound arrival direction.
● Mainly used for aircraft noise monitoring in the vicinity of airports. Also suitable for determining the sound source type based on sound arrival direction data.

Typical Sound source direction vector pattern data as obtained by Aircraft Noise Identification Unit (example)
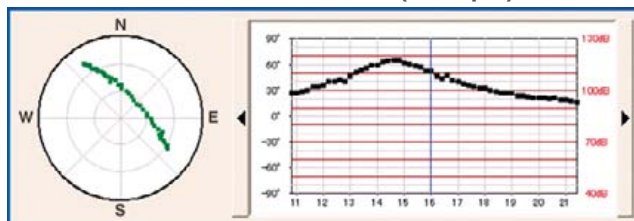
Aircraft sound case
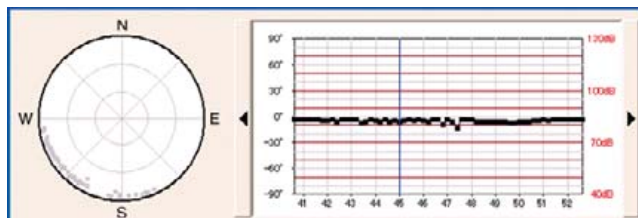
Vehicle sound case

Wind sound case

Sound level meter microphone and aircraft identification microphones system

Identification of sky sound using correlation method

Principle

Two microphones are arranged in a perpendicular position as shown in Figure 1, with the distance between the microphones expressed as d.
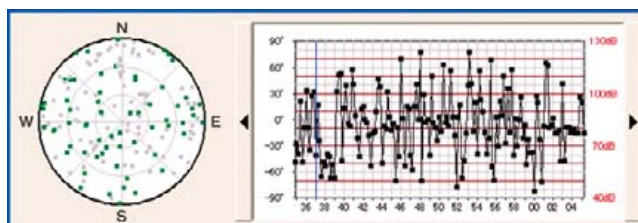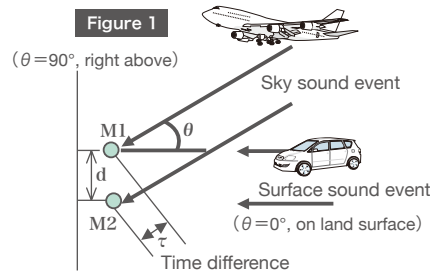When the sound from an aircraft arrives with an elevation angle θ, the following equation applies, where τ is the time difference between the arrival time of the sound at the two microphones (M1, M2), and c is the acoustic speed in air. Based on the equation, the elevation angle θ can be determined.
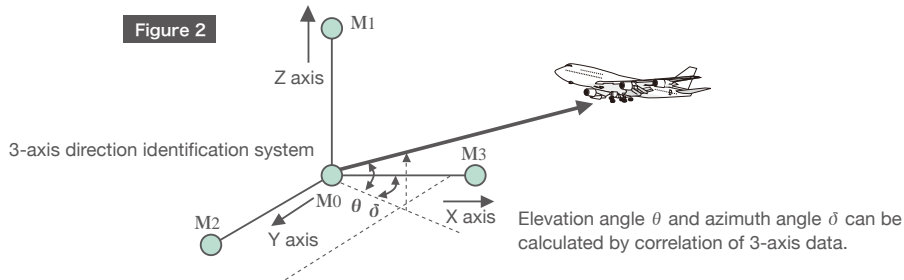
$$\tau = \frac{d}{c} \times \sin(\theta)$$

When the sound arrival direction is sufficiently steep ($\theta > 0$), the elevation angle information can be used for the identification of aircraft sound. When a sound event is detected, the tracking in elevation angle is also recorded, and events which fulfill certain specified conditions (angle threshold and angle ratio) considered as an aircraft sound events.

Figure 1

($\theta=90°$, right above)
Sky sound event
M1
θ
d
Surface sound event
M2
($\theta=0°$, on land surface)
τ
Time difference

Detection of sound arrival direction using 3-axis correlation method

As shown in Figure 2, four microphones are arranged on three orthogonal axes. This allows calculation of sound arrival direction vectors (elevation angle, azimuth angle) which can be used to identify the direction of the sound source more precisely.

Figure 2

Z axis
M1
3-axis direction identification system
M3
M0 θ δ
X axis
M2
Y axis

Elevation angle θ and azimuth angle δ can be calculated by correlation of 3-axis data.

Identification of aircraft sound using Radar signal method (AN-37R only)

Air traffic control systems constantly send radar inquiry signals to aircraft to which aircraft reply with an identification code and other information including pressure altitude data. The NA-37 can receive such response signals. The distance of approach of an aircraft is detected by receiving the intensity of a radar signal level. By comparing the signal to a certain threshold as synchronized to a sound event, identification of the sound event as aircraft is possible.
By using a combination of acoustic and radar signal detection, information of the identification can be increased, especially in acoustically complex locations where the aircraft may be intermittently blocked from other sound.

Inquiry signal
Response signal

Air traffic control radar station
NA-37
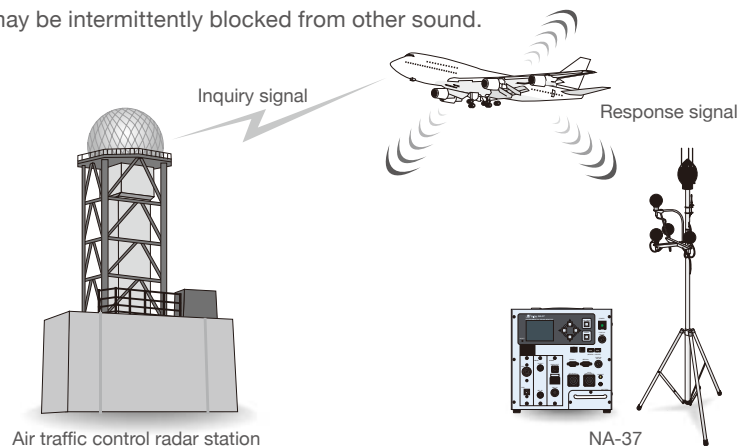
Application System Software Examples

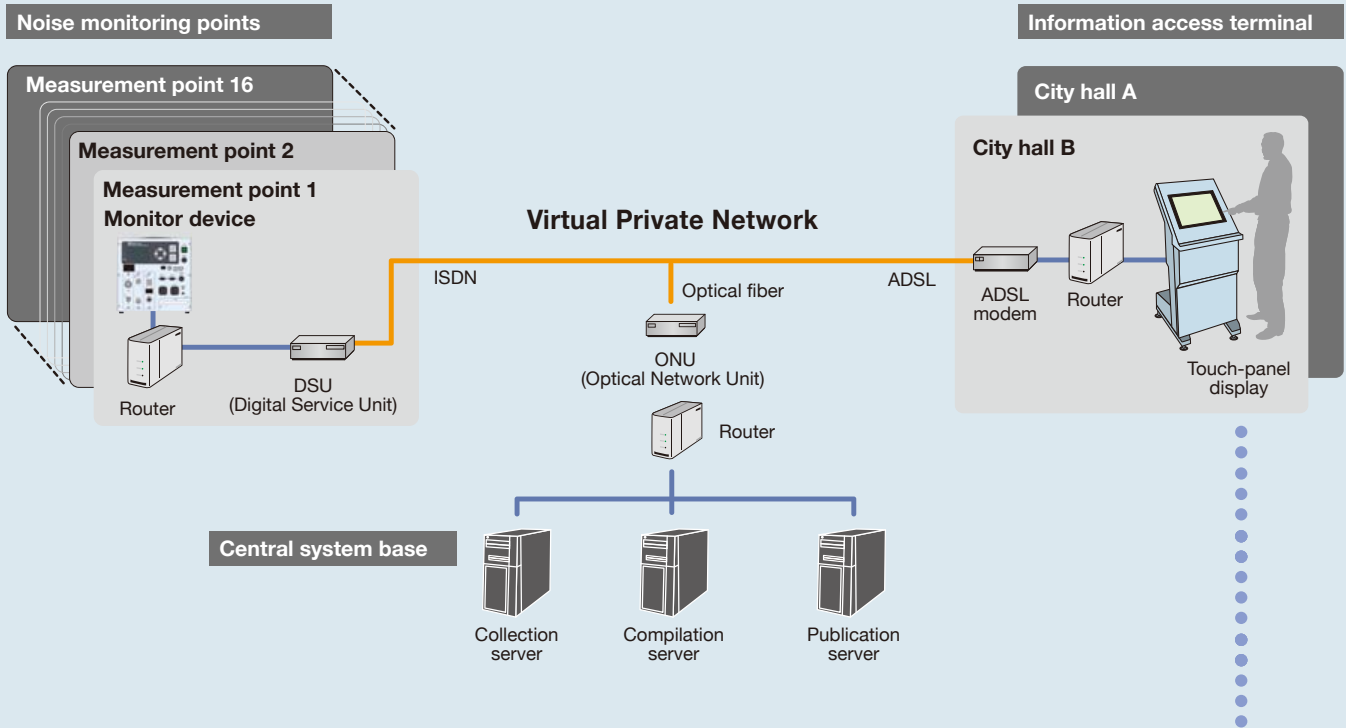## ▍ Public Display of Real-Time Noise Information System

Information disclosure of noise data may be performed as one example of application of a system which the data which has stationed the noise monitor is collected in real time, and is employed at vicinity of the airport. Instantaneous level data from all observation points are also collected on servers and used for tasks such as creating monthly reports.
System terminals can be installed at locations such as city hall and allow the display of various kinds of information. Modifying the information accessible over the Internet is also possible.
The link between data monitoring points, servers, and terminals can be established using a VPN (Virtual Private Network) for digital data exchange which allows high-speed data processing.

The server systems can run standard software applications for tasks such as database management and web data publishing. This allows the configuration of a stable and versatile system with numerous advantages.

System configuration diagram

Noise monitoring points

Information access terminal

Measurement point 16

Measurement point 2

Measurement point 1
Monitor device

Virtual Private Network

City hall A

City hall B

ISDN

Optical fiber

ADSL

ADSL modem

Router

Router

DSU
(Digital Service Unit)

ONU
(Optical Network Unit)

Router

Touch-panel display

Central system base

Collection server

Compilation server

Publication server

"Current noise levels" screen

Top screen of information access system

Information access terminal (example)

Airport Ground Noise Monitoring System

Monitoring of aircraft noise is commonly performed along the runway and at the respective end points.

However, other noises originating on the airport premises such as engine testing noise, APU (auxiliary power unit) operation noise, and taxiing noise can also be a problem for surrounding areas.

A system designed to discriminate such noise from other surface-based noise and capable of monitoring levels automatically is called an Airport Ground Noise Monitoring system.

Vector data indicating the direction to the noise source are also of great importance here, because these will allow the identification of specific sources within the operations area.
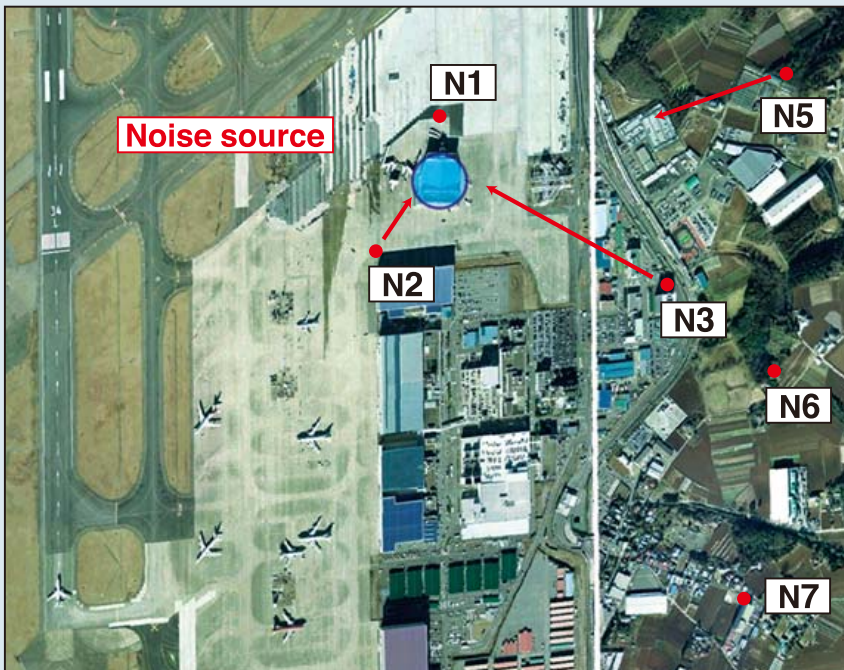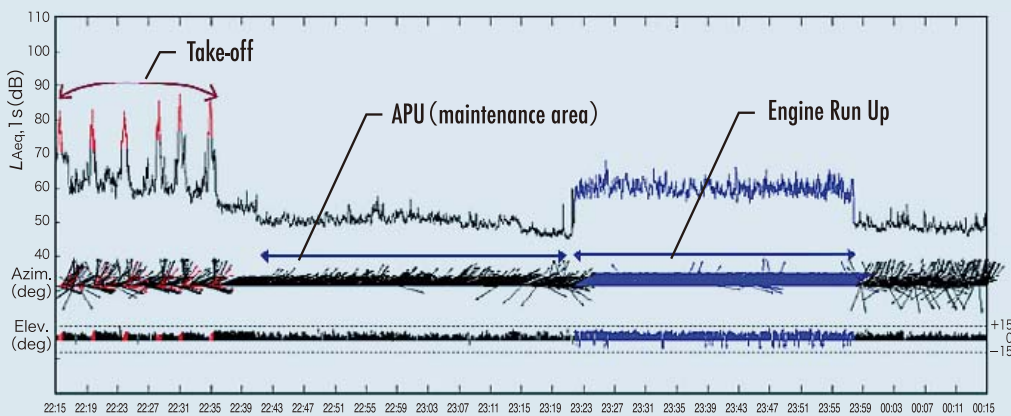

Noise source within an airport area and monitoring points

Noise Reduction Hangar
This photograph is the facility in Narita International Airport designed for noise reduction of the engine test of an aircraft.

Noise level (top) and sound source direction vector diagram

■ NA-37 Specifications

Application Standard		
	CE mark	EMC Directive 2004/108/EC EN 61326 (Class 1) EN 61000-3-2, EN 61000-3-3 Low-Voltage Directive 73/23/EEC EN 61010-1 WEEE Directive 2002/96/EC 2003/108/EC EN 50419 Electrical Appliance Safety Law
Sound level meter section		
	Model	Sound Level Meter NA-83
Display		
	Type	Semitransparent TFT color LCD with backlight
	Number of dots	320 x 240
Inputs/Outputs		
	USB A port	For program installation, data transfer to external memory, printout
	Type	Storage device class
	Number of ports	2 (USB 1.1 Full Speed)
	Printer connection	See "Printout" section
	USB B port	For maintenance setup / data transfer
	Type	Communication device class, storage device class
	Number of ports	1 (USB 1.1 Full Speed)
	LAN port	For maintenance setup / data transfer via Ethernet connection to network
	Type	TCP/IP
	Number of ports	1 10BASE-T, 100BASE-TX
	RS-232C ports	For maintenance setup / data transfer via public phone line connection to network For data retrieval/control of weather transmitter
	Number of ports	2
	Communication Type	Full duplex
	Data transfer rate	1 200／2 400／4 800／9 600／19 200／38 400／57 600／115 200 bps
	Data word length	8 bit
Data save capability		Internal memory: 256 MB for storage of calculated data and messages in specified format (expandable to 2 GB) ＊ Store data specifications, see "NX-37B" section.
Printout		A print is possible in a USB A port using an external printer (option)
	Supported printer model	BL-112UI
	Printing method	Thermal printer
	Print width	80 mm
	Printout contents	Data printing/hard copy
	Printer paper	P-112-30 (10 rolls, option)
Clock section		Accuracy: ±10 ppm or less.Format: year/month/day/hour/minute/second (with leap year correction)
Power supply section		100 to 240 V AC, external power supply: 12 V DC (10.5 to 15 V)
	Backup power supply	Sealed lead storage battery (replacement cycle 3 years; low battery voltage warning provided)
	Backup capacity	AN-37R not connected: 　approx. 2 h (NX-37WR not operating, LAN, USB not connected) 　approx. 1.5 h (NX-37WR operating, LAN, USB connected) AN-37R connected: 　approx. 45 minutes (time can be extended by connecting external DC supply)
Ambient temperature/humidity conditions for operation		−10 ℃ to +50 ℃, 10 to 90% RH (no condensation)
Ambient temperature/humidity conditions for storage		−10 ℃ to +50 ℃, 10 to 90% RH (no condensation)
Dimensions and weight		270 (H) x 270 (W) x 188 (D) mm, 7 kg
Supplied accessories		Power cord x 1, 3P-2P adapter x 1

● Options

Name	Model
All-weather windscreen	WS-13
GPS unit	NA-37-S08
GPS antenna set C	SZ-53C
USB printer	BL-112UI
USB cable (for printer connection)	USB A-B cable
USB flash memory	SLUFD2GU1UI-B
NA-37 case	EF-37
All-weather windscreen tripod	WXT510
Rack mounting flange	NA-37-S09
All-weather windscreen tripod for roof mounting	Various
AN-37 spacer (22 mm)（for ST-81)	AN-37-S09
7P microphone extension cable	Various
Identification unit extension cable	Various
Antenna extension cable	Various
GPS antenna extension cable	Various

Aircraft Noise Processing Program NX-37B

| Functions		Noise detection, aircraft noise identification (air-borne noise/surface noise, movement direction, pass-through range), evaluation value calculation (WECPNL, Lden), equivalent sound level calculation (various values)
Setup parameters		Measurement parameters, data save parameters, printing parameters, transit parameters
External equipment utilization		
	Sound level meter	Automatic level check function, level calibration (+, −), level check parameter setup (check level, tolerance)
	AN-37	Elevation angle and azimuth angle analysis for aircraft noise identification
	AN-37R	RF signal analysis for aircraft noise identificatio
	Weather transmitter	VAISARA Weather Transmitter WXT510 supported. Weather data output at noise event and at regular intervals.
	GPS	POSITION GSU-36AF(D) supported. Used for automatic time calibration and to provide measurement position information output.
	Real-sound monitor	Optional NX-37WR for real-sound recording according to trigger conditions supported
System functions		Clock, auto shutdown, auto measurement reset, battery warning, backlight auto off
Screen display and operation		
	Operation method	6 keys on main unit used for on-screen button operation
	Display language	Japanese/English
	Display contents	Basic information (current time, instantaneous sound pressure level, various warnings), latest noise event information, data list, menus
Data storage		Measurement data for at least 40 days saved in internal memory of NA-37 (with 256 MB memory, factory default data save settings, 1000 noise events per day) For real-sound data, see "NX-37WR" section.
Printing functions		Line on/off, data printing, paper feed, hard copy
Communication functions		
	LAN	Socket connection allows command transfer, FTP server capability
	RS-232C	Command transfer via telephone network or direct connection
Data transfer		Transfer of measurement data and real-sound data to USB memory (date range/continuous selectable)

Sound Level Meter NA-83

| Application Standard		IEC 61672-1：2002 Class 1, WEEE Directive, CE mark (EMC Directive 2004/108/EC EN 61326：1997 + A1：1998 + A2：2001 + A3：2003), Sound Level Meter according to the specifications, JIS C 1509-1：2005 Class 1
Measurement functions		
	Measurement items	Time-weighted sound level L_p Time-weighted maximum sound level L_{max}
	Serial communication data	L_p, L_{max}, L_{min}, L_{eq} every 100 ms
	Measurement level range	A characteristics: 28 dB to 138 dB, C characteristics: 36 dB to 138 dB, Z characteristics: 42 dB to 138 dB
	Overall linear operation range (A characteristics, 1 kHz)	28 dB to 138 dB
	Inherent noise level	A characteristics: 20 dB or less C characteristics: 28 dB or less Z characteristics: 34 dB or less
	Measurement frequency rang	20 Hz to 20 kHz
	Frequency weighting characteristics	A, C, Z
	Time weighting characteristics	F (Fast), S (Slow)
	Linear operation range	110 dB
	Single level range	Bar graph indication range 30 dB to 130 dB
	RMS detection circuit	Digital processing (sampling cycle 20.8 μs)
	Reference frequency	1 kHz
Windscreen compensation function		Frequency response compensation ensures that specifications are met also when windscreen WS-13 is mounted

Outdoor Microphone MS-11

Microphone section	1/2 inch electrets condenser microphone
Nominal outer diameter	13.2 mm
Sensitivity level (including preamplifier)	−29 dB (re 1 V/Pa at 1 kHz, in standard environment)
Built-in sound source	1 kHz (for microphone calibration), 250 Hz, 500 Hz, 4 kHz (for operation check), 114 dB (sound pressure level)
Heater	
Heater current	94 mA DC
Heater power consumption	0.9 W
Ambient temperature/humidity conditions for operation	−20 ℃ to +50 ℃, 100% RH max. (no condensation)
Ambient temperature/humidity conditions for storage	−10 ℃ to +50 ℃
Dimensions and weight	Outer diameter 16 mm x 122 mm, approx. 120 g
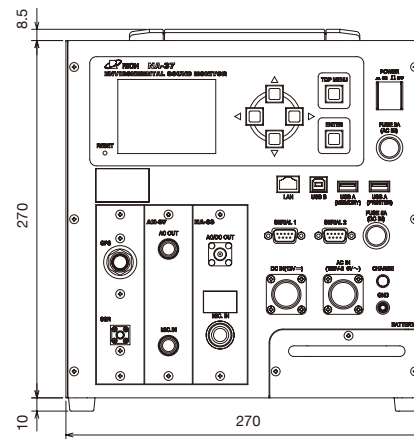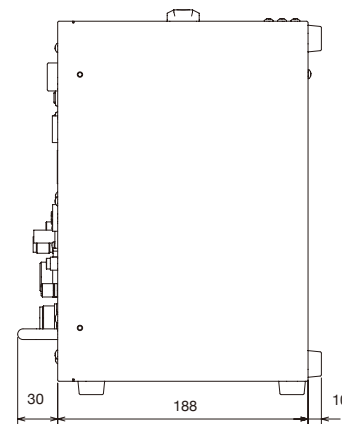
Real Sound Monitor Program NX-37WR (factory option)

Auto recording	
Noise event trigger	Recording of real sound near maximum level, linked to noise event detection
Level trigger	Recording of real sound exceeding trigger level (file split every 60 seconds) Separate trigger levels can be set for separate time periods
Interval trigger	Recording occurs at regular intervals (every 1 to 60 minutes)
Manual recording	Recording start/stop controlled by screen operation or communication commands
Recording time	
Recording time	5 to 60 seconds (including pre-trigger time) for noise event trigger, interval trigger, and manual recording
Pretrigger time	Inclusion of 0 to 5 seconds of pre-start records for noise event trigger, interval trigger, and manual recording
File creation	
Format	MP3 or PCM
Sampling frequency	48 kHz
Number of channels	1 (monaural)
Data word length	16 bits
File saving	
Limitations	Max. 2,000 files per day, max. 100 days
Memory use	Real sound data for at least 40 days saved in internal memory of NA-37 (with 2 GB memory, MP3 format, recording time 5 s, 1000 noise events per day)

Aircraft Noise Identification Unit AN-37

Input section	
Input connector	6-pin circular connector x 1
Measurement level range	45 dB to 130 dB
Measurement frequency range	100 Hz to 1500 Hz (−3 dB attenuation frequency)
A/D converter	24-bit resolution
Microphone system	
Microphone spacing	25 cm
Support frame material	Stainless steel
Pole diameter	22 mm or 32 mm
Dimensions and weight	407 (H) x 444 (W) x 331 (D) mm, 2.2 kg
Supplied accessories	Microphone (UC-52) x 4 Preamplifier x 4 Windscreen x 4 Microphone stays x 1 set

Aircraft Noise Identification Unit (With Radar Reception Capability) AN-37R (Factory Option)

Acoustic identification section	Same as AN-37
RF identification section	
Antenna	λ/4 non-directional antenna (SMA-P) Max. lead extension 35 m
Input	Antenna connector (SMA-J)
Reception frequency band	1090 MHz
Control function	Sensitivity
Supplied accessories	Antenna x 1 Antenna mounting bracket x 1 (suitable pipe diameter 22 to 32 mm) Antenna cable 3 m x 1

● **Dimensional Drawing (Unit : mm)**

Front View

Side View

● **WS-13 Structural Diagram (Unit : mm)**

Outdoor microphone MS-11
Preamplifier with built-in sound source and heater
7P microphone extension cable
Ferrite core

11

Environmental Sound Monitor

NA-37

ISO 14001 RION CO., LTD.
ISO 9 0 0 1 RION CO., LTD.

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