



Environmental Sound Monitor  
(For Aircraft Noise Measurement)

**NA-37**

# Designed for Long-term Aircraft Noise Monitoring Application. Provides Functionality, Durability and Easy Maintenance Required for Automated System.

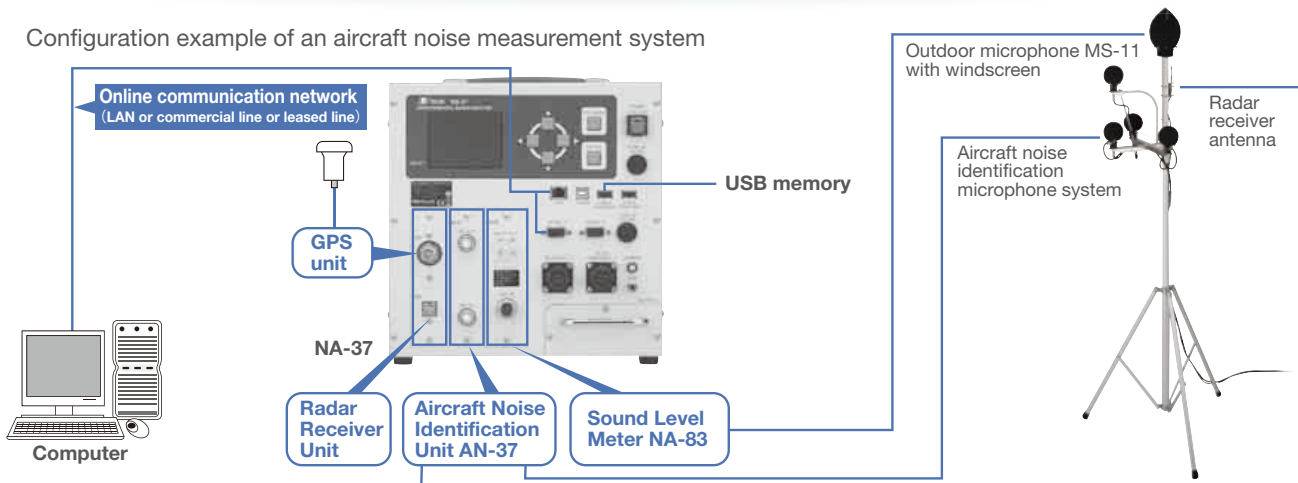
Environmental Sound Monitor

## NA-37

The NA-37 is an automated aircraft noise monitoring system. The system has a feature for reliable identification of aircraft noise, while its compact dimensions make it suitable also for mobile use. Measurement is fully automatic, and continuous 365-day all-weather operation is supported.



Configuration example of an aircraft noise measurement system



# 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

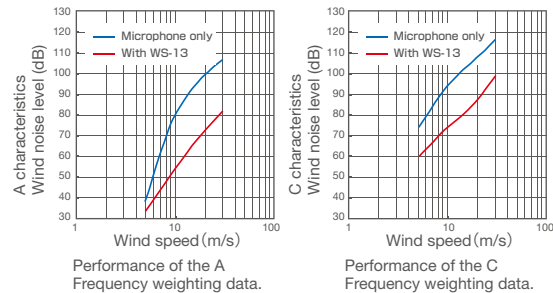
MS-11 has a built-in heater and a built-in sound source for automatic calibration, and is suitable for long-term outdoor use.

### All-Weather Windscreen WS-13

WS-13 has bird spikes to keep birds away.



### Wind noise reduction effect of WS-13



## Aircraft Noise Identification Unit AN-37/37R

The AN-37 identifies the arrival direction of each moving sound source. Distance between identification microphones is only 25cm, allowing compact dimensions and easy installation. AN-37R improves identification performance by adding SSR radio wave signal detection. And it can observe aircraft numbers.

## Features of NA-37

- Long-term data storage to internal memory
- Data transfer via LAN
- Support for data copy to USB flash drives (option)
- Support for using GPS (option) for automatic time correction and acquisition of position information useful for mobile use.
- Real sound recording program NX-37WR (factory option) allows sound recording in two format types:
  - Compressed (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

## Option

### Carrying Case for NA-37 EF-37

Useful for mobile use.



### Tilt type microphone stand ST-88S

Easy for installation and maintenance.



Maximum height overall : 4 meters

\*Photograph shows ST-88S with main and sound direction identification microphone system.

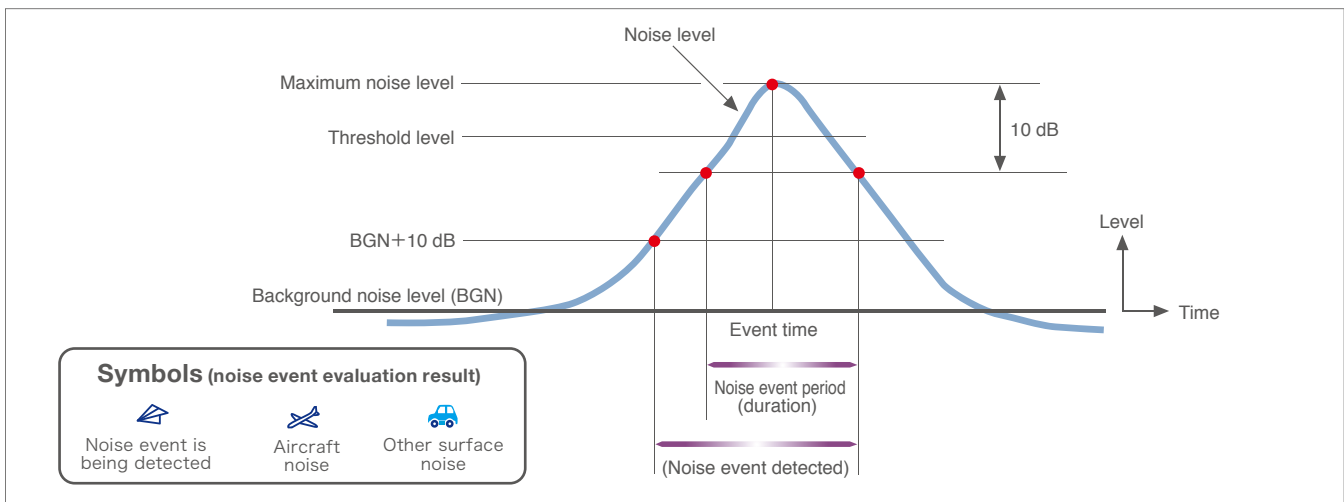
# For Aircraft Noise Measurement

## Aircraft Noise Measurement under the flight course

Aircraft Noise Processing Program NX-37B

Aircraft Noise Data Processing Application Software AS-50PA1

Aircraft noise event detection method (single noise)  
Common to NX-37B and 37C



Evaluation result display (noise other than aircraft)



Evaluation result display (aircraft)



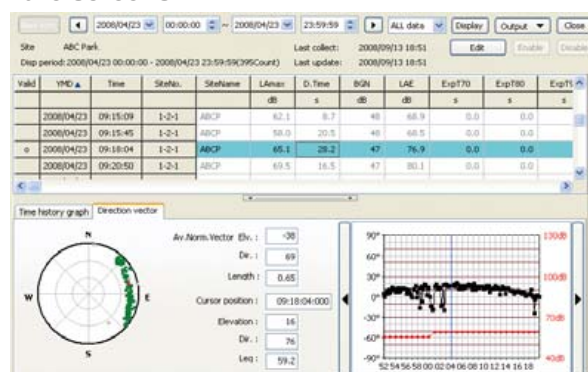
Monitoring system installed in the vicinity of an airport

## Aircraft Noise Data Processing Application (AS-50PA1) Software screens

Site: ABC Park  
Date: 2008/09/13 19:02  
Last update: 2008/09/13 19:02

Event	LegAir	Exp770	Exp780	Exp790	Exp100	Lden
Air	46.9	25.1	9.2	0.1	0.0	50.4
WECPNL	44.0	36.1	3.2	0.0	0.0	53.7
LeqAir	38.2	3.3	0.0	0.0	0.0	51.0
LeqAir	41.2	3.0	0.0	0.0	0.0	52.0
LeqAir	38.3	21.1	0.0	0.0	0.0	53.4
LeqAir	37.9	12.1	0.0	0.0	0.0	48.9
LeqAir	32.0	2.3	0.0	0.0	0.0	47.5
LeqAir	30.0	3.0	0.0	0.0	0.0	49.0
LeqAir	38.2	5.7	0.0	0.0	0.0	49.4
LeqAir	43.1	10.2	0.0	0.0	0.0	50.8
LeqAir	61.0	47.6	73.0	0.0	0.0	51.1
LeqAir	58.9	43.1	13.2	0.0	0.0	51.7
LeqAir	57.6	41.7	3.7	0.0	0.0	53.8
LeqAir	38.9	0.4	0.0	0.0	0.0	52.7

Daily report screen (example)



Event summary screen (Indicates that the aircraft is moving from north to south.)



# For Aircraft Noise and Ground Noise Measurement

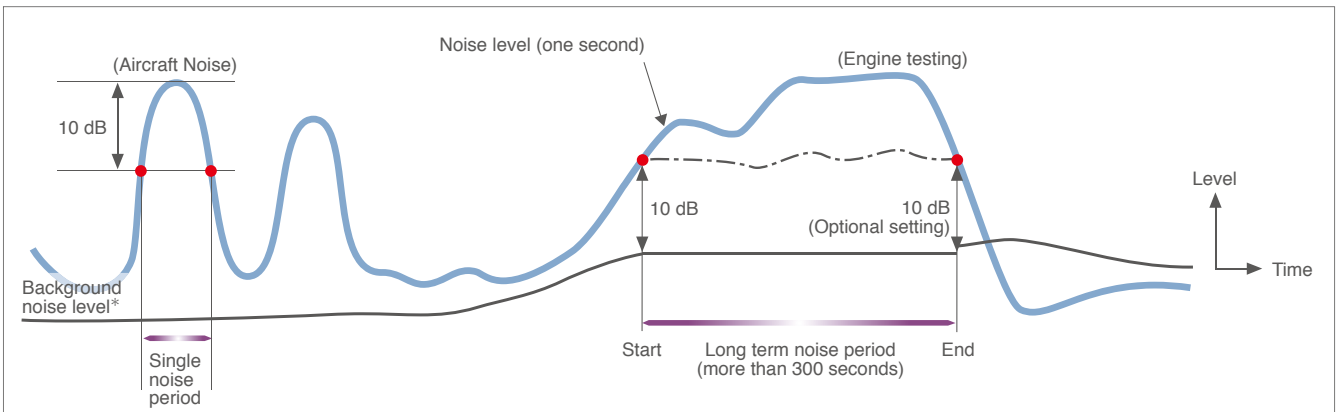
## Measurement of aircraft and ground noise in the vicinity of airports

Aircraft Noise Processing Program NX-37C

Aircraft Noise Data Processing Application Software AS-50PA2

Ground noise event detection method (long term noise event)

NX-37C



\*The fixed threshold background noise method and running statistics background noise method are used to detect the long term noise event period. The fixation method is applied in the above figure.

## Aircraft Noise Data Processing Application (AS-50PA2) Software screens

Day	LdenAir dB	LTNE dB	LdnAir dB
2010/02/28	49.6	75.6	78.2
	75.6	74.3	75.9
	69.2	65.6	66.5
	70.7	75.6	

Daily report screen

SNE	LTNE	Start date	Start time	End date	End time	SiteNo.	Site Name	Distr.	LAE	Leq	D	Time	B(NKS)
2009/04/18	20:26:36	2009/04/18	20:27:05	1-1-3	ST37	other	89.9	75.2	29.0	34.3			
2009/04/18	20:27:05	2009/04/18	20:42:10	1-1-3	ST37	other	110.0	89.8	845.0	34.3			
2009/04/18	20:42:10	2009/04/18	20:48:38	1-1-3	ST37	other	106.3	88.8	701.0	34.3			

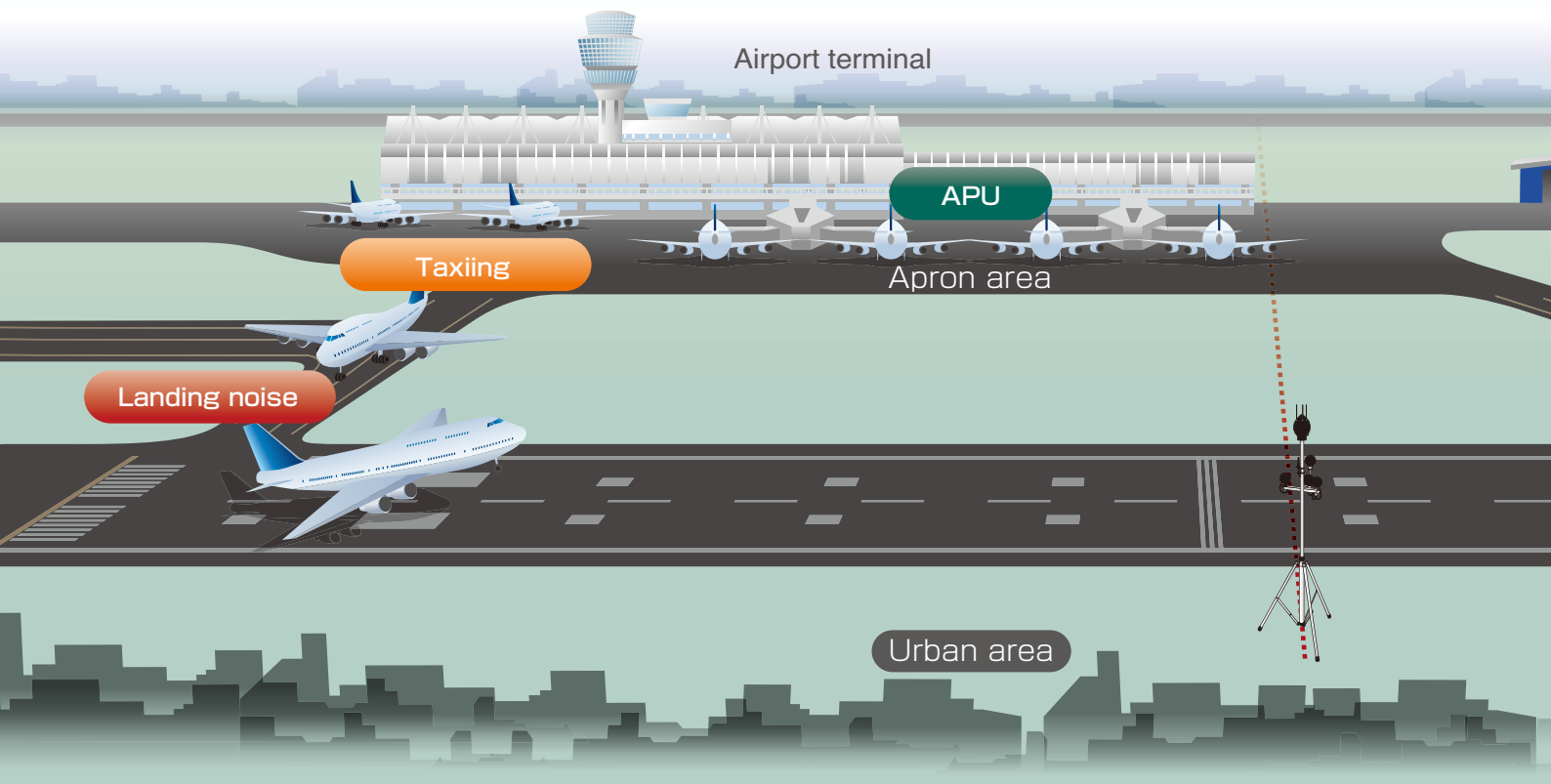
Event summary screen  
(Indicates that the noise source is located to the southwest.)

## Function comparison table

Type	Conforms to Environmental Requirements (only available in Japan)	Conforms to Aircraft Noise Measurement/Assessment Manual (only available in Japan)	Identification of Aircraft Noise	WECPNL	Lden	Aircraft Noise	Above-ground Noise
NX-37B+AS-50PA1	●	Aircraft noise only	●	●	●	●	—
NX-37C+AS-50PA2	●	●	●	●	●	●	●

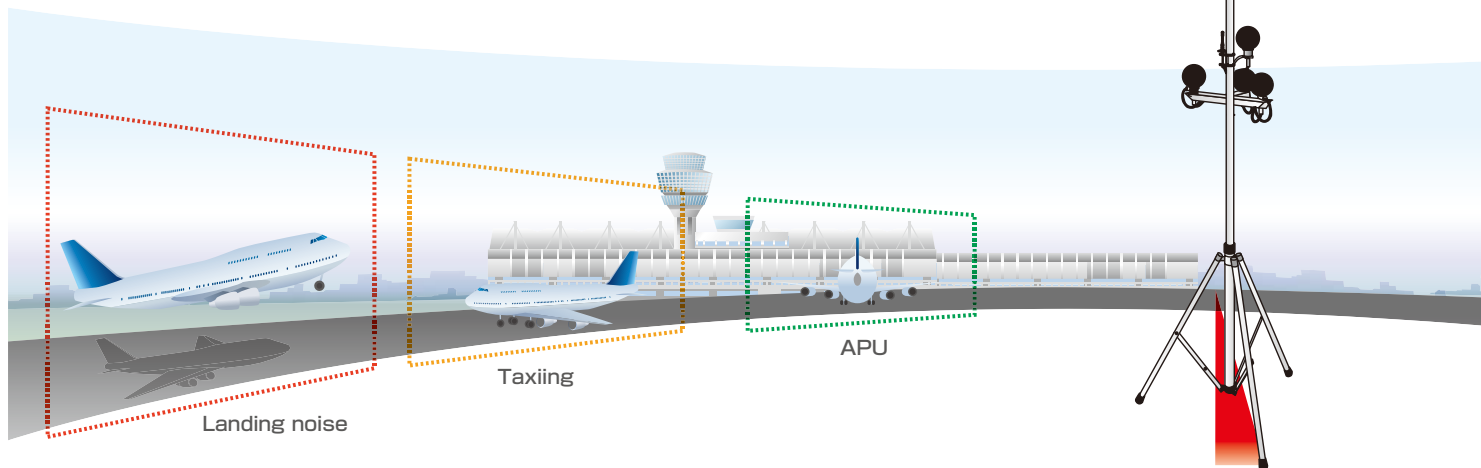
# Description of ground noise

Visualization of how ground noise is generated



## Visualization of how noise sources are identified

Use up to five window areas to distinguish aircraft noise and ground noise from other noise (noise to be excluded).



### Types of noise generated by aircraft

#### Single noise event

This is a temporary noise which occurs sporadically, such as noise caused by air travel that can be observed within the vicinity of the airport.

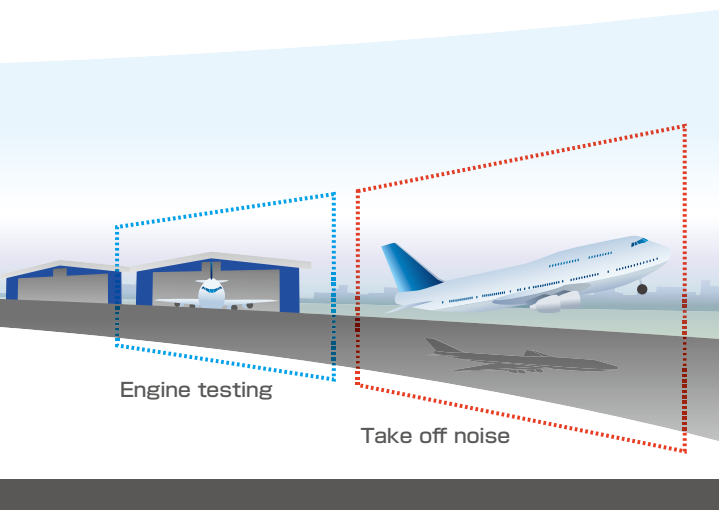
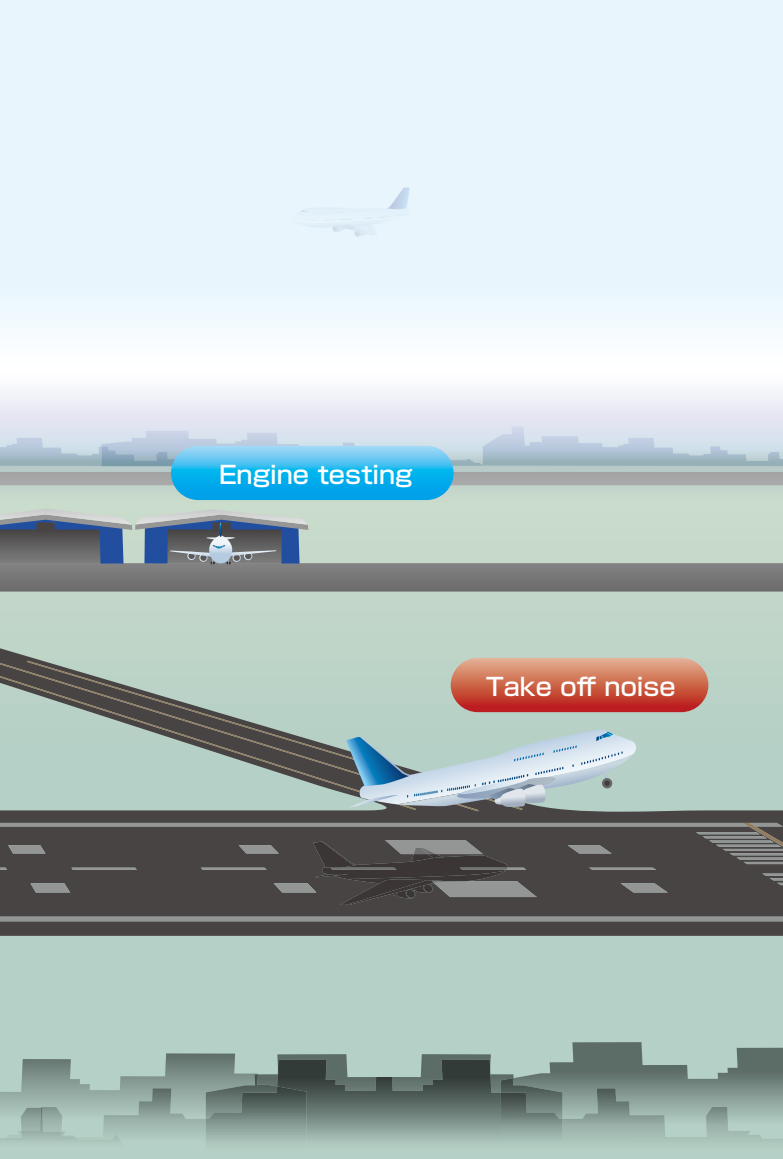
Above-ground noise produced by aircraft is also a form of single noise.

#### Long term noise event

This noise is steadily produced over a long period of time, but the noise level fluctuates greatly. Common examples are engine testing noise and the noise originating from the auxiliary power unit (APU).

### Glossary

- **Take off noise**  
This noise occurs from the time the aircraft starts to taxi out from the end of the runway to the time it reaches the middle of the runway and finally takes off.
- **Landing noise**  
This noise occurs as the aircraft descends, touches down on the runway of the airport, and then reverses the thrust direction of the engines to reduce speed as it leaves the runway.
- **Taxiing**  
Taxiing indicates the ground run of the aircraft as it travels between the tarmac and the runway.
- **Engine testing**  
This test is performed to check the operation of the aircraft engines.



● **APU**

This small engine (Auxiliary Power Unit) is mounted separately from the main aircraft engine. It is the power source used to supply compressed air, hydraulic pressure, and electric power to the aircraft while it is on the tarmac.

● **Touch and go**

This refers to increasing engine output and taking off from the ground after approaching, landing, and reducing speed on the runway as a part of an exercise for take-off and landing training.

● **Hovering**

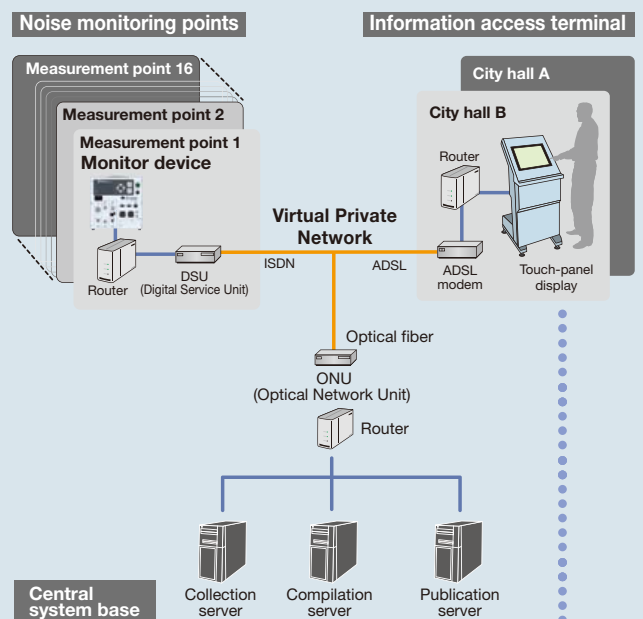
This refers to when a helicopter lifts off and remains stationary while in the air.

# Application System Software Examples

## Public Real-Time Information System

This system collects data from many NA-37 installed in the vicinity of the airport and displays quickly the noise condition in real time and stores data. 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.

### System configuration diagram



Top screen of information access system



Information access terminal (example)



"Current noise levels" screen



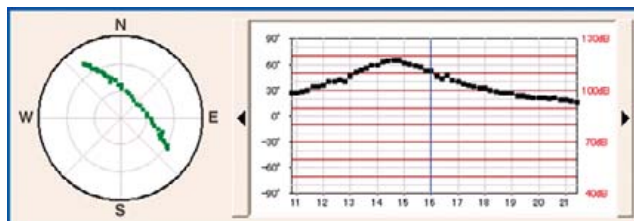
## Four Microphones Allow Measurement of Elevation Angle and Azimuth Angle

### Aircraft Noise Identification Unit AN-37

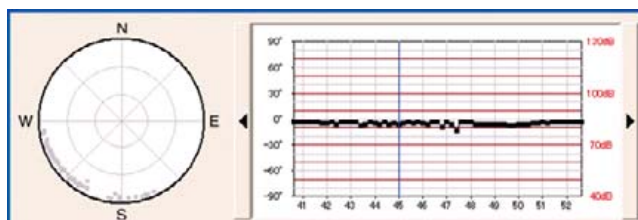
#### AN-37R (with radar receiver)

- Correlation method of 3-axis microphones using only sound signals enables the system to determine sound arrival direction.
- Mainly used as the identification system for aircraft noise monitoring in the vicinity of airports. Also suitable for determining the sound source type based on sound arrival direction.

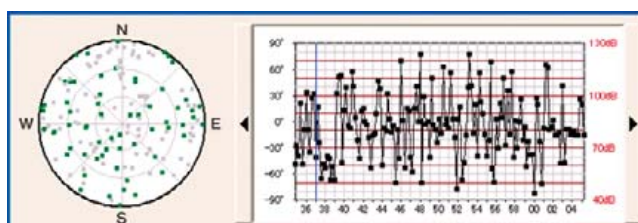
#### Typical sound source direction vector data obtained by Aircraft Noise Identification Unit



Direction vector data of Aircraft noise



Direction vector data of vehicle noise



Direction vector data of wind noise



Sound level meter microphone and aircraft identification microphones system



## Identification of sky sound using correlation method

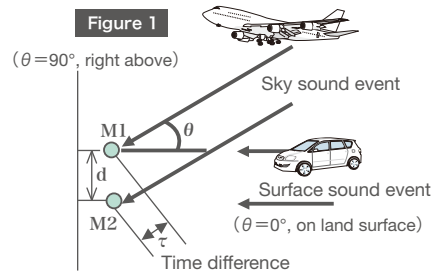
### Principle

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  $\theta$ , the following equation applies, where  $\tau$  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  $\theta$  can be determined.

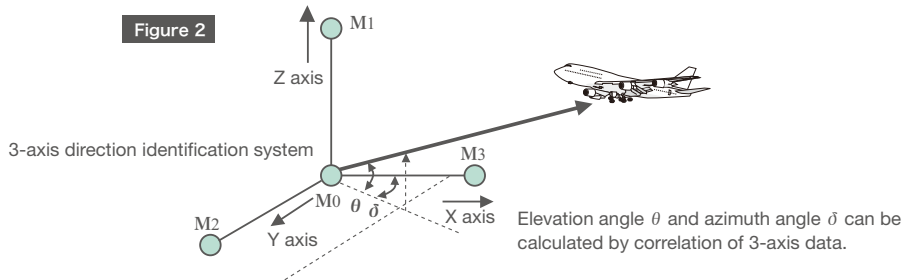
$$\tau = \frac{d}{c} \times \sin(\theta)$$

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, track of elevation angle is also recorded, and events which fulfill certain specified conditions (angle threshold and angle ratio) are considered as aircraft noises.



### Detection of sound arrival direction in 3-axis.

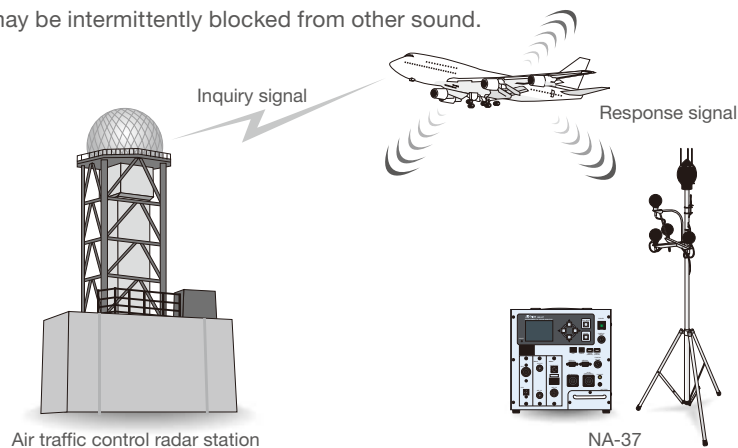
As shown in Figure 2, four microphones are arranged on three orthogonal axes. This allows calculation of sound arrival direction vectors (elevation angle, azimuth angle) which can be used to identify the direction of the sound source more precisely.



## 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.



## ■ 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/37C" section.
Clock section	Accuracy: ±10 ppm or less.Format: year/month/day/hour/minute/second (with leap year correction)
Power supply section	
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 °C to +50 °C, 10 to 90% RH (no condensation)
Ambient temperature/humidity conditions for storage	-10 °C to +50 °C, 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 flash memory	5ZSLUF00
NA-37 case	EF-37
All-weather windscreen tripod	WXT520
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/NX-37C

Functions	Noise detection, aircraft noise identification (air-borne noise/surface noise, movement direction, pass-through range), <b>Identification of above-ground noise*</b> , evaluation value calculation (WECPNL, Lden), equivalent sound level calculation (various values)
Setup parameters	Measurement parameters, data save parameters, printing parameters, transit parameters, <b>Judgment conditions for the respective window areas*</b>
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 identification
Weather transmitter	VAISARA Weather Transmitter WXT520 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	Storing in internal memory of NA-37, measured data for 40 days or more (NX-37B), <b>35 days or more (NX-37C)</b> (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)

\*Functions exclusive to NX-37C

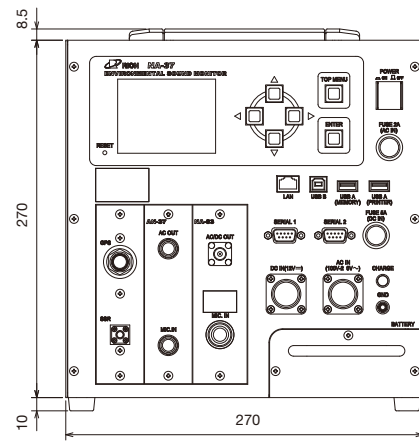
## Sound Level Meter NA-83

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 $\mu$ s)
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 °C to +50 °C, 100% RH max. (no condensation)
Ambient temperature/humidity conditions for storage	-10 °C to +50 °C
Dimensions and weight	Outer diameter 16 mm x 122 mm, approx. 120 g

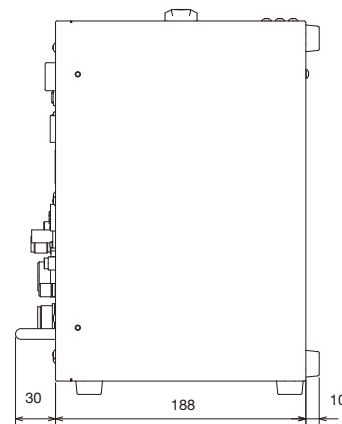
### ● Dimensional Drawing (Unit : mm)



Front View

### 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	Compressed 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, Compressed format, recording time 5 s, 1000 noise events per day)

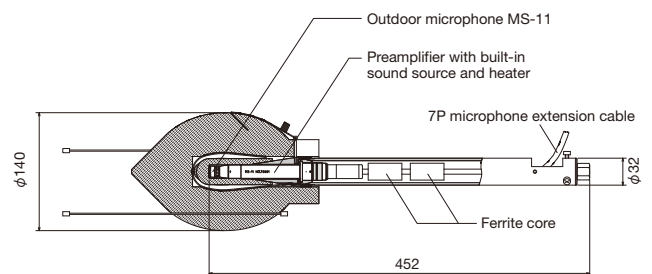


Side View

### 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 Windscreens x 4 Microphone stays x 1 set

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



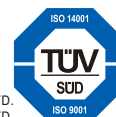
### Aircraft Noise Identification Unit (With Rader Receiver) AN-37R (Factory Option)

Acoustic identification section	Same as AN-37
RF identification section	
Antenna	$\lambda/4$ non-directional antenna (SMA-P) Max. lead extension 35 m
Input	Antenna connector (SMA-J)
Reception frequency band	1 090 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



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