INSTRUCTION MANUAL

Precision Integrating Sound Level Meter

with 1/3 octave band real-time analyzer

NA-27

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

Organization of This Manual

This manual describes the features, operation and other aspects of the Precision Integrating Sound Level Meter with 1/3 octave band real-time analyzer NA-27. If the unit is used together with other equipment to configure a measurement system, consult the documentation of all other components as well. The following pages contain important information about safety. Be sure to read and observe these in full.

This manual contains the following sections.

Outline

Gives basic information about the unit. Also contains information about items that are not covered in other sections.

Controls and Functions

Briefly identifies and explains the controls and connectors and all other parts of the unit.

Preparations

Explains how to insert the backup battery and main batteries, how to make connections, set the date and time, calibrate the unit, and use the menu screens.

Setting Measurement Parameters

Explains how set the basic parameters before starting sound pressure level measurement and analysis.

Sound Pressure Level Measurement

Explains the operation steps for performing sound pressure level measurement.

1/1-Octave and 1/3-Octave Analysis

Explains the operation steps for performing 1/1 and 1/3 octave analysis.

Data Exclusion (Back-Erase) Function

Explains how to exclude (back-erase) data from a short period before the measurement was paused.

Trigger Function

Explains how to start the sound pressure level measurement using the trigger mode.

Delayed Measurement

Explains how to perform delayed measurement.

Memory Functions

Explains how to store measurement results in the memory of the unit.

Remote Control (NA-27RC1)

Explains the names and functions of the operation buttons on the panel of the remote control.

Technical Notes

Provides information about the microphone, preamplifier, basic configuration of the sound level meter, and measurement functions.

Error Messages

Lists error message that can appear during startup, as well as suitable countermeasures.

Optional Accessories

Explains how to use the optional accessories available for the unit.

Specifications

Lists the technical specifications of the unit.

CE EMC DIRECTIVE

The NA-27 described in this manual is in conformity with the following International Standard;

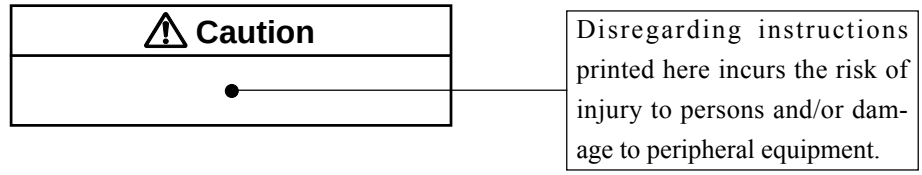
IEC 61672 - 1:2002 Class1 (Sound level meter)

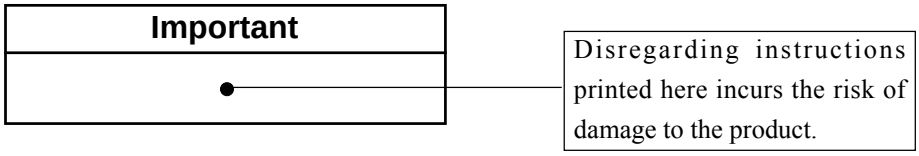
To conform to the EU requirement of the Directive 2002/96/EC on Waste Electrical and Electronic Equipment, the symbol mark on the right is shown on the instrument.

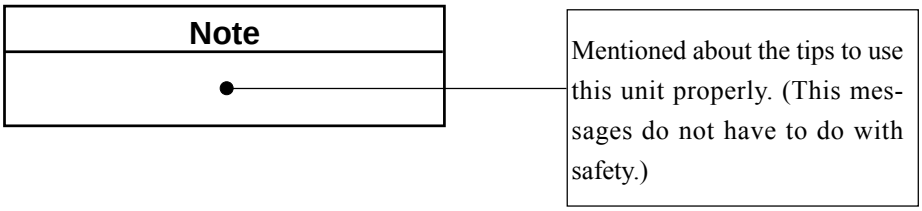
* Company names and product names mentioned in this manual are usually trademarks or registered trademarks of their respective owners.

FOR SAFETY

In this manual, important safety instructions are specially marked as shown below. To prevent the risk of death or injury to persons and severe damage to the unit or peripheral equipment, make sure that all instructions are fully understood and observed.







Precautions

- Operate the unit only as described in this manual.
- The NA-27 is a precision instrument. Protect it from shocks and vibrations. Take special care not to touch the microphone diaphragm. The diaphragm is a very thin metal film which can easily be damaged.
- Use only the microphone/preamplifier assembly with the number as shown on the name plate of the unit.
- Ambient conditions for operation of the unit are as follows: temperature range -10 to +50ºC, relative humidity 30 to 90%.

  Protect the unit from water, dust, extreme temperatures, humidity, and direct sunlight during storage and use. Also keep the unit away from air with high salt or sulphur content, gases, and stored chemicals.
- Always turn the unit off after use. Remove the batteries from the unit if it is not to be used for a long time (a week or more). When disconnecting cables, always grasp the plug and do not pull the cable.
- Before using the microphone and before putting it away, always check that the microphone grid has not become loose. If this has happened, refasten the microphone grid firmly and then use or store the microphone.
- Clean the unit only by wiping it with a soft, dry cloth or, when necessary, with a cloth lightly moistened with water. Do not use any solvents, cleaning alcohol or chemical cleaning agents.
- Do not tap the LCD panel or other surfaces of the unit with a pointed object such as a pencil, screwdriver, etc.
- Take care that no conductive objects such as wire, metal scraps, conductive plastics etc. can get into the unit.
- Do not try to disassemble or alter the unit. Otherwise type certification will become invalid. In case of an apparent malfunction, do not attempt any repairs. Note the condition of the unit clearly and contact the supplier.
- To ensure continued precision, have the unit checked and serviced at regular intervals.
- When disposing of the unit or the accessories, follow national and local regulations regarding waste disposal.

Contents

Outline

The precision integrating sound level meter NA-27 allows digital 1/1-octave and 1/3-octave analysis in real time. It conforms to legal requirements for quantity measurements and to JIS and IEC standards. Using the output signal from a single microphone, the NA-27 can determine values for different time constants and frequency weighting settings simultaneously.
In addition to conventional noise level and sound pressure level measurements, the NA-27 can also determine the following quantities:

- Equivalent continuous sound pressure level L_{eq}
- Sound exposure level L_E
- Maximum sound pressure level L_{max}
- Minimum sound pressure level L_{min}
- Percentile sound pressure level L_x
- Takt-max sound pressure level (3 or 5 s) L_{tm3}, L_{tm5} *
- Waveform peak sound pressure level L_{peak}
- Power average P_AVE
- Power sum P_SUM
- Reverberation time REVERB

* Taktmaximalpegel Mittelwert: DIN
Power averaged maximum sound pressure level in a measuring period

Measurement data can be stored in the large-capacity internal memory of the NA-27. These data can be sent to a computer, using the built-in serial port and a high-speed block transfer protocol. In addition, an optical port allows data collection and data transfer under computer control, and an infrared remote control unit is also supplied.

Processing functions in main channel and sub channel

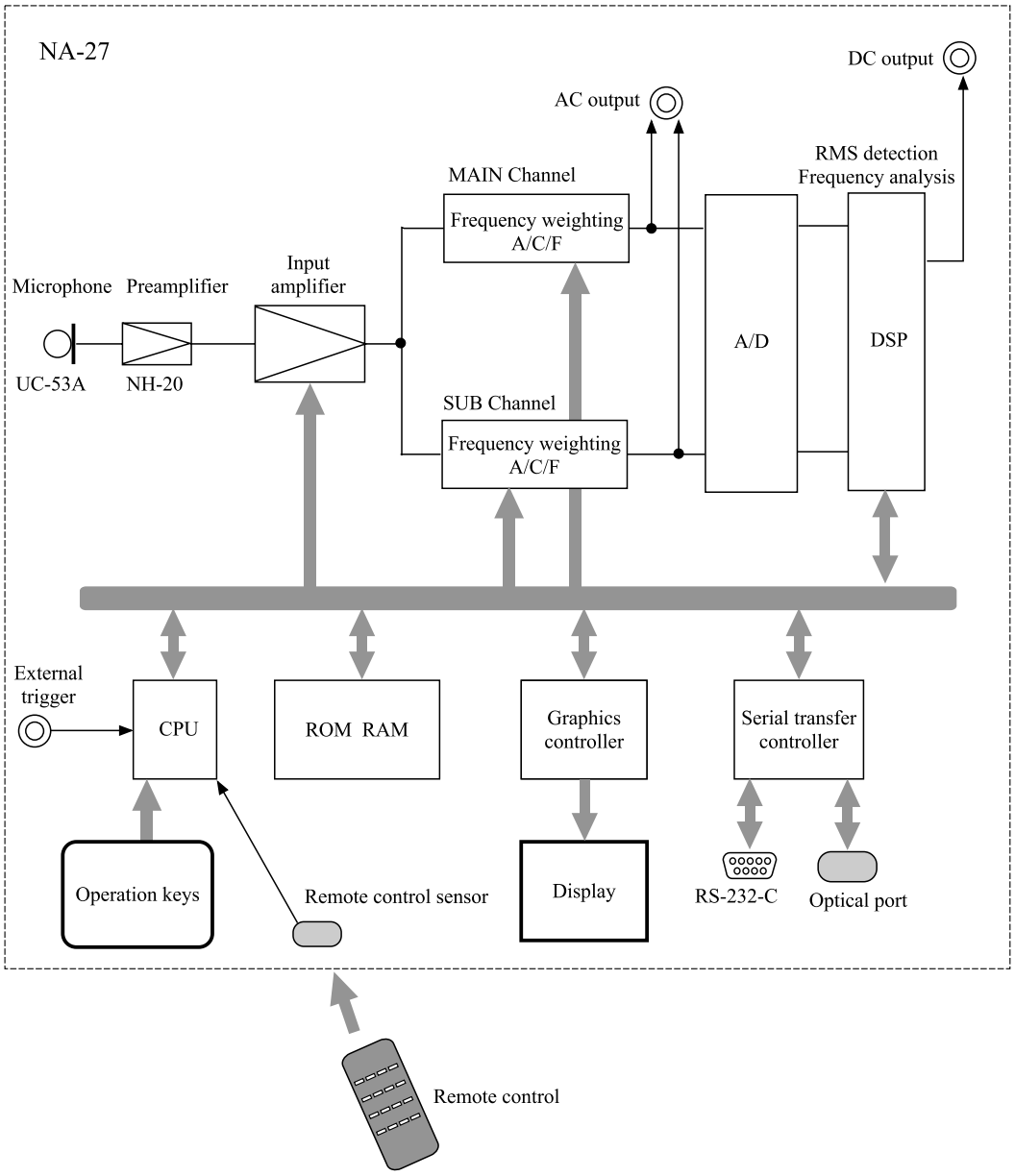
Processing Function	MAIN Channel	SUB Channel
1/1 octave, 1/3 octave analysis	available	not available
TIME WEIGHTING	FAST, SLOW, 35 ms, 10 ms	FAST, SLOW, （＊3） 35 ms, 10 ms, IMPULSE
PEAK	not available	available（＊4）
FRQ. WEIGHT	A, C, Flat	A, C, Flat （＊3）
L_p, L_{max}, L_{min}, L_{eq}, L_E （＊1）	available	available
L_{tm3}, L_{tm5}	not available	available（＊4）
L_x （＊2） （1, 5, 10, 50, 90, 95, 99）	available	available

*1 L_{max}, L_{min}, L_{eq}, L_E, L_{tm3}, L_{tm5} are calculated simultaneously from L_p sampled at 10 ms intervals.

*2 L_x values are calculated simultaneously from L_p sampled at 100 ms intervals for measurement times up to 1 h. For measurement times over 1 h, the sampling interval increases by 100 ms for every hour.

*3 Set with the SETUP menu screen.

*4 Set with the DISPLAY menu screen.



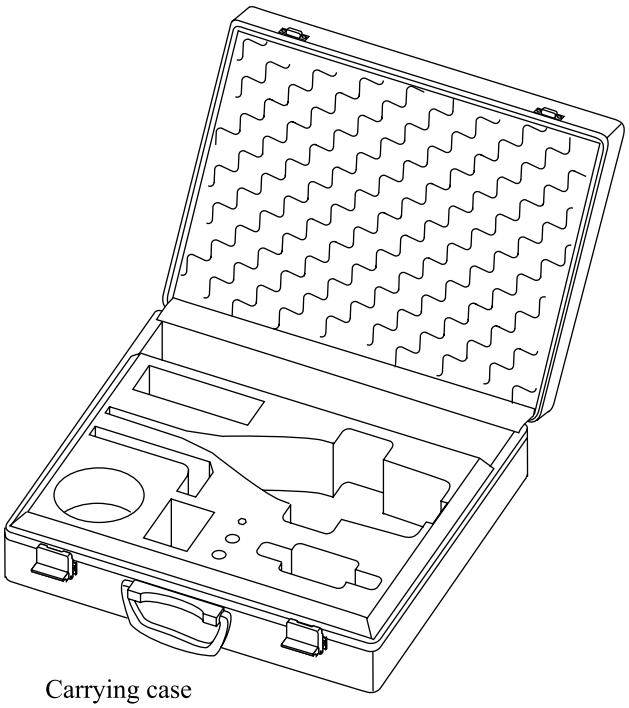
Block diagram of NA-27

Controls and Functions

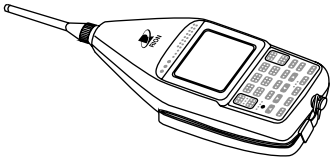
Carrying Case and Accessories

The unit is supplied with the parts listed below. Verify that all parts are complete and that there is no damage. If any parts are missing or damaged, please contact the supplier.

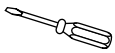
Name	Model	Q'ty
Windscreen	WS-02	1
Batteries	IEC R14P	4
Backup battery	CR-1/3N	1
Remote control unit	NA-27RC1	1
Batteries	IEC R03	2
Tripod adapter	NA-27-S05	1
Miniature screwdriver	D-62	1
Carrying case	NA-27-S04	1
Product name label	NA-27-033	1
Instruction Manual		1
Serial Interface Manual		1



Carrying case
NA-27-S04



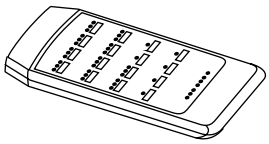
Precision sound level meter



Miniature screwdriver
D-62

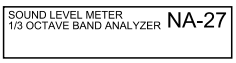
Backup battery
CR-1 / 3N

Batteries
IEC R03

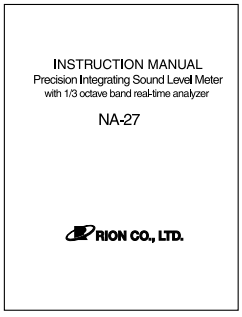


Remote control
NA-27RC1

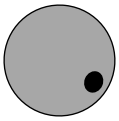
Batteries
IEC R14P



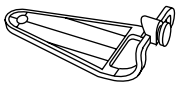
Product name label
NA-27-033



Instruction Manual
Serial Interface Manual

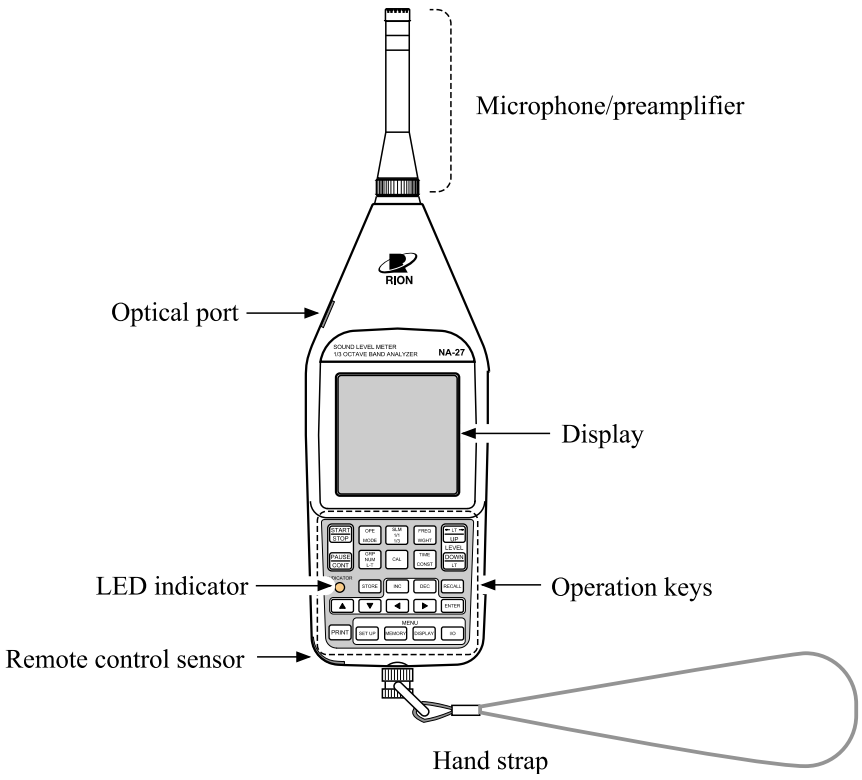


Windscreen
WS-02



Tripod adapter
NA-27- S05

Top View



Microphone/preamplifier

The microphone and preamplifier are configured as an integrated assembly. The microphone and preamplifier are labeled with a serial number which must match the number shown on the rear of the main unit. The microphone/preamplifier assembly can be removed from the sound level meter and connected via an optional extension cable, for measurements a distance.

Display

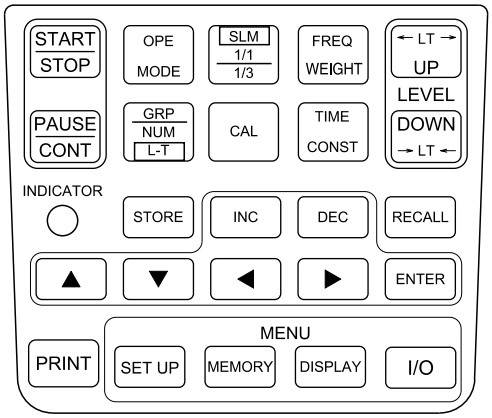
The backlit liquid crystal display has a resolution of 192 × 192 dots.

LED indicator

This indicator signals the following conditions.

Overload:	Overload occurred in the main channel.
Measurement:	Indicator flashes in 1 second intervals.
Remote control signal reception:	Indicator flashes 3 times in 0.2 to 0.3 second intervals.

Operation keys



START/STOP key

Press to start and to terminate the sound pressure level measurement (including the various processing functions). The key is also used to store data in memory.

PAUSE/CONT key

Serves to temporarily pause and resume the measurement. When the data exclusion (back-erasing) function is used, data for a certain number of seconds before the key was pressed can be excluded from processing.

OPE MODE key

Serves to call up the various processing results on the display.

For the main channel, possible display items are instantaneous value (L_p), equivalent continuous sound pressure level (L_{eq}), sound exposure level (L_E), maximum sound pressure level (L_{max}), minimum sound pressure level (L_{min}), and percentile sound pressure level (L_x). For the sub channel, the takt-max sound pressure level (L_{tm3}, L_{tm5}), and the waveform peak hold level (L_{peak}) can be displayed.

GRP/NUM/L-T key

In 1/1 octave and 1/3 octave mode, this key switches the display function between graphical and numeric indication. When showing data stored in memory, the key can be used to show the level-time indication.

SLM / 1/1 / 1/3 key

This key switches the operation mode between sound level meter (SLM), 1/1 octave analysis (1/1), and 1/3 octave analysis (1/3).

CAL key

Pressing this key activates the built-in oscillator for electrical calibration of the NA-27 or for level matching of the NA-27 and connected equipment.

FREQ WEIGHT key

Selects the frequency weighting characteristic for the main channel. Available settings are "A" weighting (A), "C" weighting (C), and flat frequency response (FLAT).
The frequency weighting characteristics for the sub channel are set with the SETUP menu screen.

TIME CONST key

Selects the time weighting (time weighting) for the main channel. Available settings are "FAST", "SLOW", "35 ms" and "10 ms". The time weighting for the sub channel is set with the SETUP menu screen.

LEVEL UP ← LT → key

Serves to select the level range. The level range cannot be set individually for the main channel and sub channel. When showing the level-time display (from data stored in the internal memory), the key serves to expand the time axis.

LEVEL DOWN → LT ← key

Serves to select the level range. The level range cannot be set individually for the main channel and sub channel. When showing the level-time display (from data stored in the internal memory), the key serves to contract the time axis.

STORE key

Serves to start and stop the store process for entering data into the memory.

RECALL key

Switches the unit between the mode for recalling data from the memory (recall mode) and the measurement data display mode (current mode).

INC, DEC keys

Serve to increase or decrease numerical values of the various menu entry items. When data are being stored into the memory or displayed from memory, the keys serve to select address numbers.

▲, ▼ keys

Serve to select items from the menu screens.

◀, ▶ keys

Serve to move the marker during frequency analysis. When a menu is displayed, the keys serve to select parameters.

ENTER key

When a menu is displayed, the key serves to accept a setting.

PRINT key

Serves to start and stop printout of the current measurement screen or of data stored in memory on a connected printer (DPU-414, CP-10, CP-11; option).

SETUP key

Pressing this key calls up the SETUP menu screen, for setting measurement parameters. Pressing the key once more returns to the measurement screen.

MEMORY key

Pressing this key calls up the MEMORY menu screen, for setting memory parameters. Pressing the key once more returns to the measurement screen.

DISPLAY key

Pressing this key calls up the DISPLAY menu screen, for setting display parameters. Pressing the key once more returns to the measurement screen.

I/O key

Pressing this key calls up the I/O menu screen, for setting input/output parameters. Pressing the key once more returns to the measurement screen.

Optical port

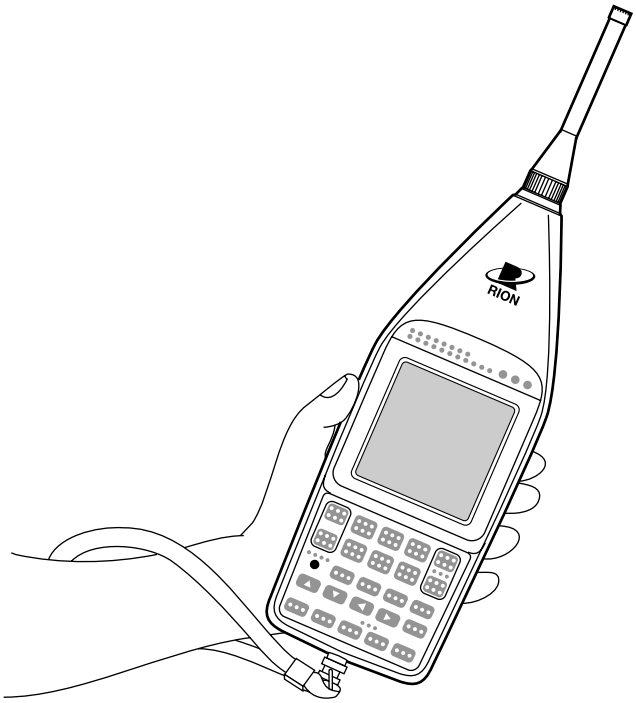
This optical port allows sending measurement data over an infrared link to a computer equipped with a suitable infrared port.

Remote control sensor

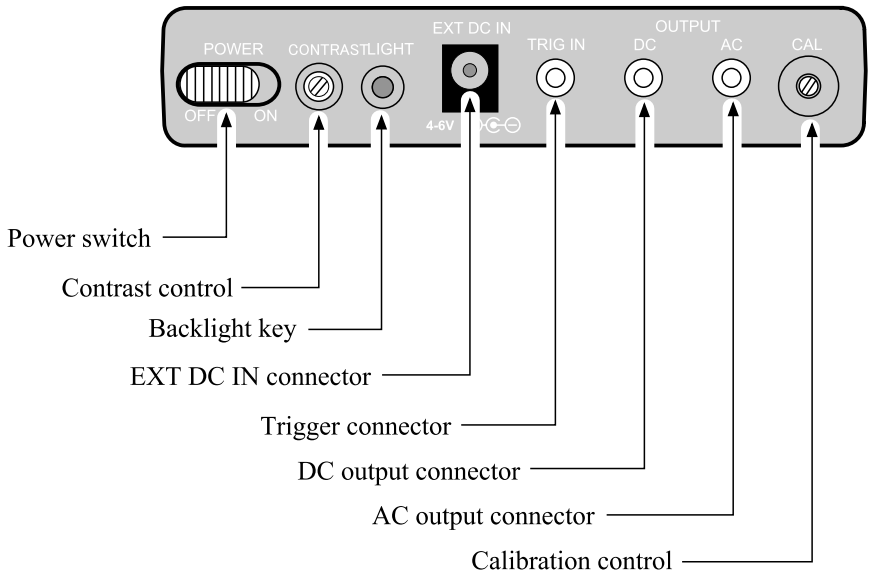
The signals from the remote control unit (NA-27RC1) are received here, allowing operation of the unit from a distance of up to 3 meters.

Hand strap

The strap should be used to safely carry the unit during field work.



Side View



Power switch

This sliding switch serves to turn the unit on and off.

Contrast control

Serves to adjust the display contrast. Use the supplied miniature screwdriver for the adjustment.

Backlight key

Pressing this key activates the display backlight. After about one minute, the backlight turns itself off automatically.

EXT DC IN connector

The optional AC adapter NC-94A can be connected here for powering the unit from an AC outlet.

Trigger input connector

Serves to control of the measurement by trigger function.

DC output connector

A DC signal corresponding to the sound pressure level is available at this output. The I/O menu screen can be used to select the main channel or sub channel for output (serves for maintenance).

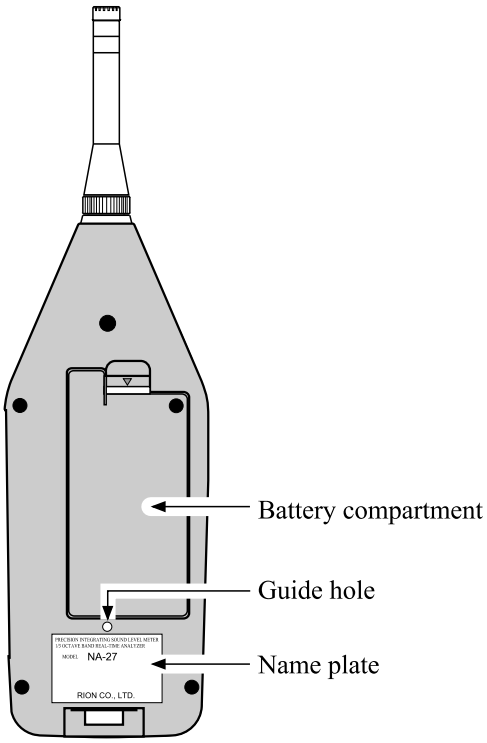
AC output connector

A frequency-weighted AC signal corresponding to the sound pressure is available at this output. This can be supplied to a level recorder such as the optional LR-04 or LR-06 or to a data recorder. By using the optional splitter adapter, a separate signal for the main channel and sub channel can be obtained.

Calibration control

Serves to carry out calibration, using the supplied miniature screwdriver.

Rear View



Battery compartment

The unit uses four main batteries (IEC R14P) and one lithium battery (CR-1/3N) for memory backup.

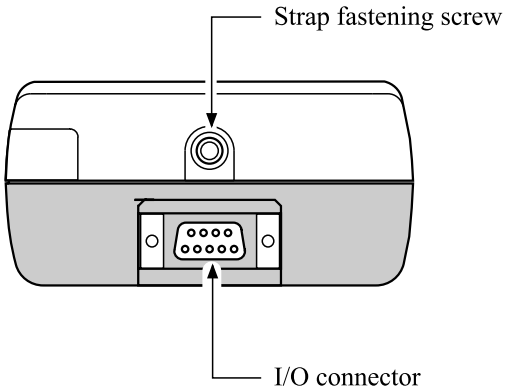
Guide hole

This hole serves to fasten the supplied tripod adapter NA-27-S05.

Name plate

The model name and type, certification number, microphone number, preamplifier number, serial number, and manufacturing date are shown here.

Bottom View



Strap fastening screw

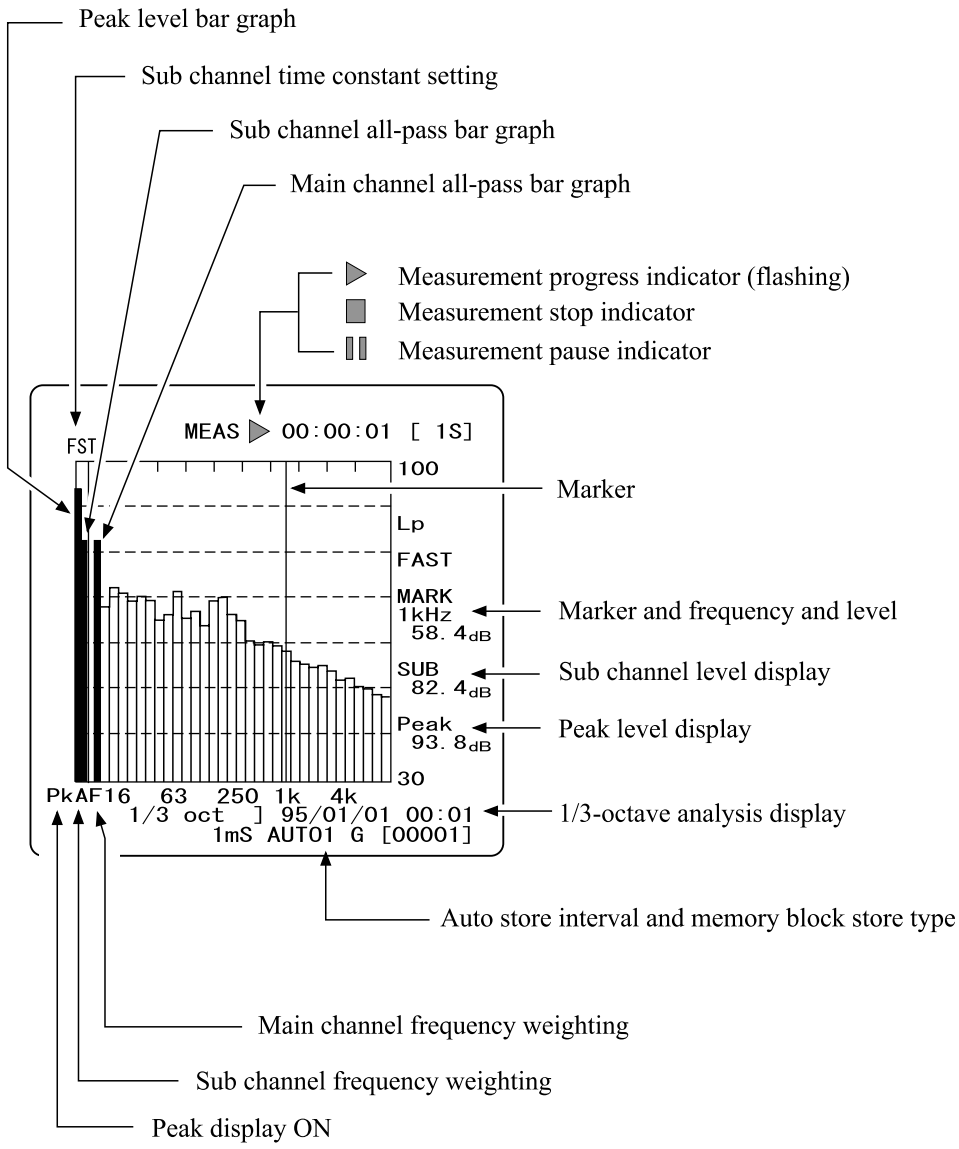
The hand strap is to be fastened here. Using the supplied tripod adapter, the unit can also be mounted on a camera tripod.

I/O connector

Serves for input and output of control signals and measurement data. A printer or computer can be connected here.

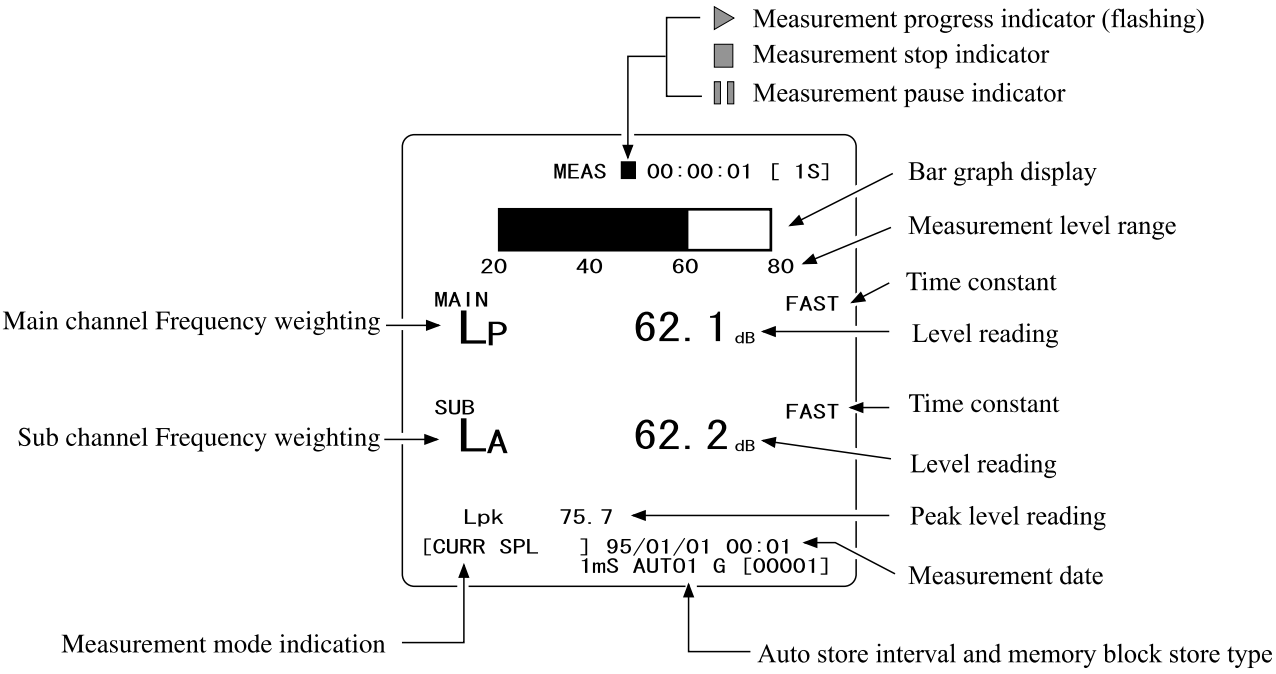
Measurement Screen

The actual appearance of the measurement screen depends on the selected measurement parameters. A representative example is shown below.



1/3-octave analysis screen

The illustration shown above may differ slightly from the actual screen display of the unit, regarding fonts, character size etc.



Sound pressure level display
(with sub channel indication)

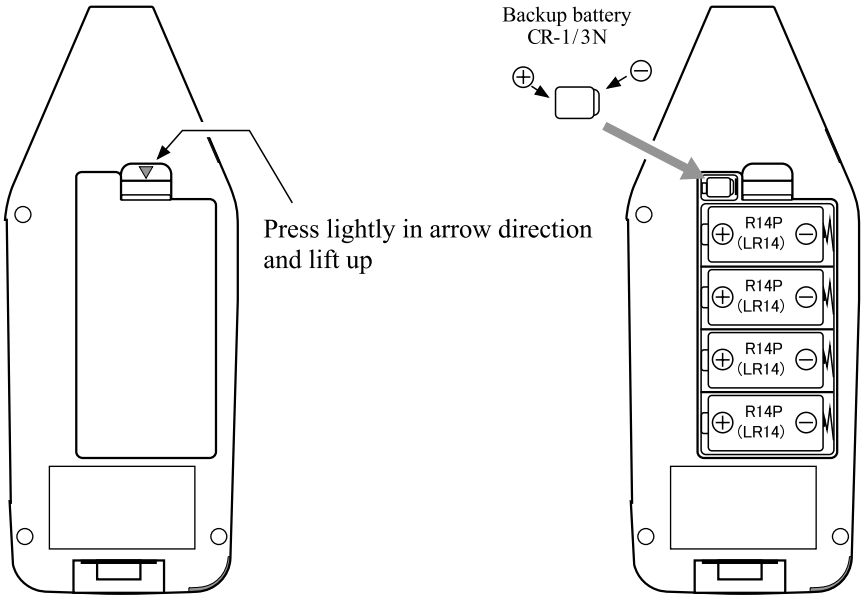
Preparations

This section describes the steps which are necessary before starting a measurement.
Be sure to set the power switch to OFF before inserting or removing batteries and connecting or disconnecting any cables.

Backup Battery

The backup battery (CR-1/3N, lithium) serves to maintain settings and data stored in memory also while the unit is turned off. In normal use, a backup battery should always be inserted. Proceed as described below.

1. Remove the cover of the battery compartment on the rear of the unit by pressing the latch in the arrow direction and lifting the cover up.
2. Insert the backup battery (CR-1/3N, lithium), with polarity as indicated in the compartment.
3. Replace the cover.



Important

The life of the backup battery is about two years. To be on the safe side, you should replace the battery every 1 to 1-1/2 years.

When the battery is removed, all stored data as well as the time and date settings are lost. If necessary, use the printer DPU-414, CP-10 or CP-11 to print out settings and data before changing the battery. After replacement, set the clock and date again, as described on page 24.

The backup battery serves to maintain stored data and to power the internal clock. Since this is not mandatory for measurements, sound pressure level measurement and frequency analysis are possible also without the backup battery.

Replacing the backup battery (lithium battery)

1. Turn power to the unit off.
2. Remove the old lithium battery.
3. Wait at least two minutes, and then insert the new lithium battery.

Note

If you insert the new battery within two minutes after removing the old battery, the unit may not operate correctly the next time it is turned on.

4. Turn power to the unit on. The unit will come on with the factory default settings (page 34).

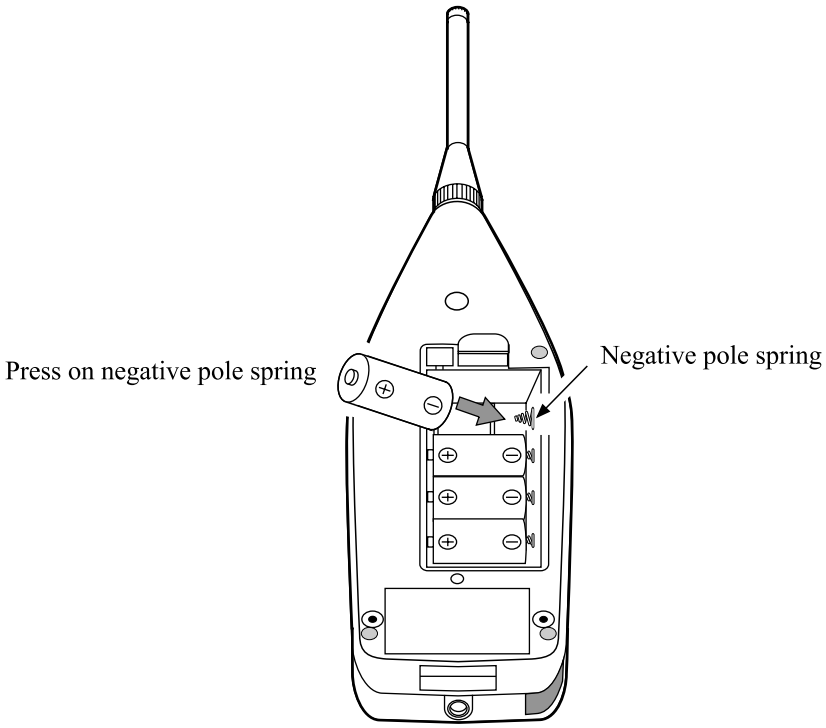
Power Supply

The unit can be powered by four IEC R14P (size C) batteries (alkaline or manganese) or the optional AC adapter.

The life of the batteries depends on various usage factors. Representative figures are shown below.
Battery life (at room temperature, 1/3-octave analysis, continuous operation)
Alkaline batteries: approx. 8 hours
Manganese batteries: approx. 4 hours

Inserting the batteries

To power the unit from batteries, insert four IEC R14P (size C) batteries into the battery compartment, paying attention to correct polarity.
When inserting a battery, press it against the spring on the negative pole side and snap the battery into place. To remove a battery, push it towards the negative pole and lift it up on the positive side.



Important

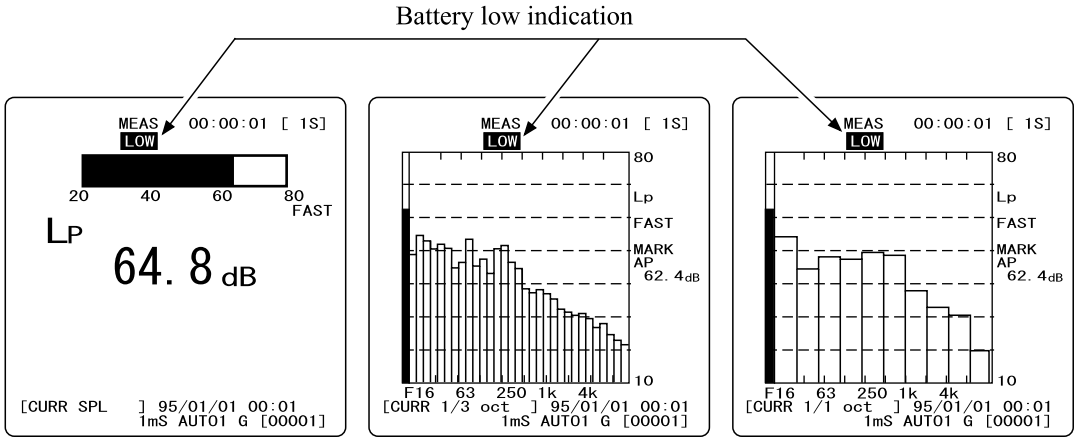
Take care not to reverse the (+) and (-) polarity when inserting a battery.

Always use four identical batteries, and replace batteries only as a set. Mixing battery types or old and new batteries can lead to damage.

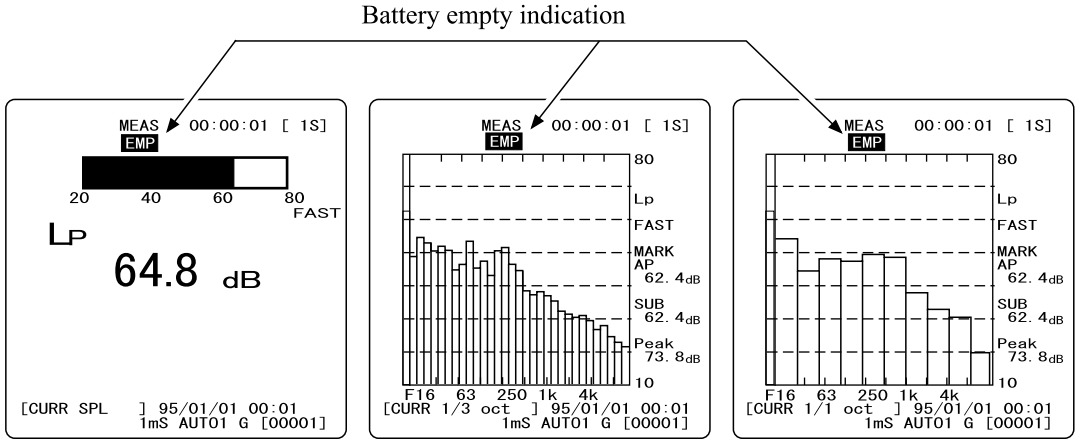
Remove the batteries from the unit if it is not to be used for a week or longer.

When the battery voltage drops near the operation limit of the unit, the indication LOW appears on the display.
In this case, replace all four batteries with fresh ones at the earliest opportunity.

When the battery voltage drops even further, the indication EMP flashes on the display. You must immediately replace all four batteries with fresh ones if you want to continue using the unit.



Sound pressure level measurement screen | 1/3-octave analysis screen | 1/1-octave analysis screen

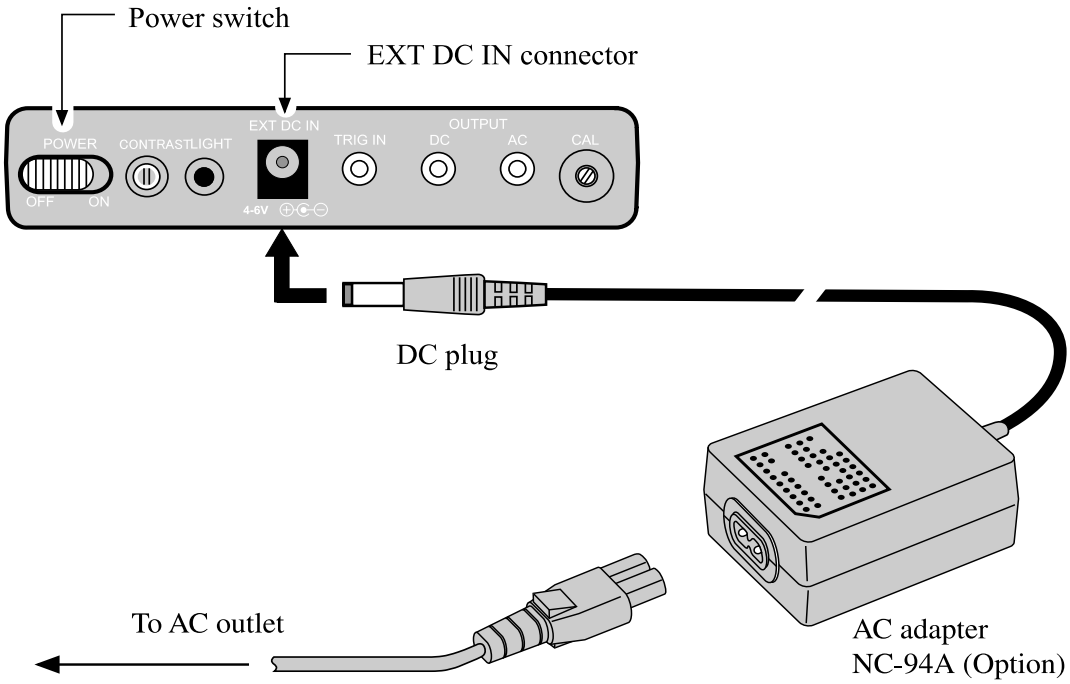


Sound pressure level measurement screen | 1/3-octave analysis screen | 1/1-octave analysis screen

For long continuous measurements, it is preferable to power the unit from the AC adapter.

AC adapter connection

To power the unit from the optional AC adapter (NC-94A), connect it as shown below.

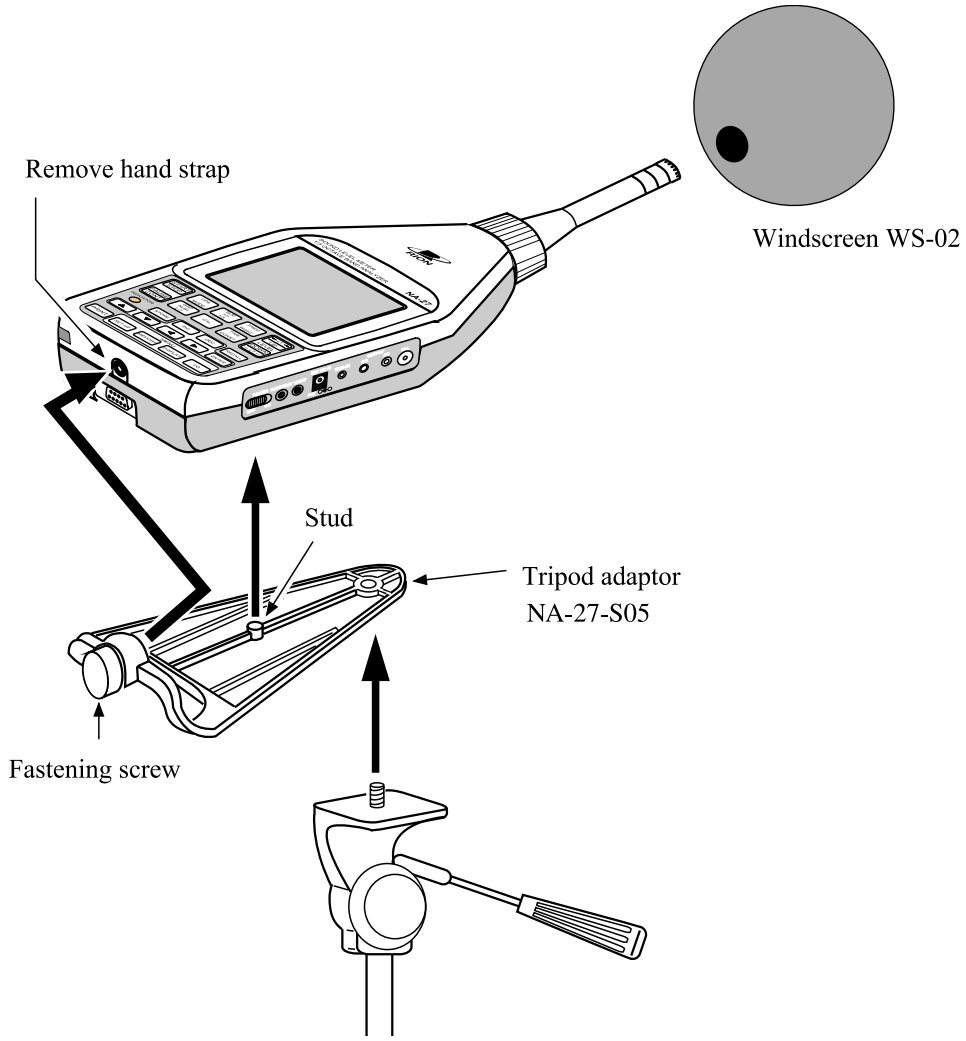


Important
Do not use any other AC adapter except the optional NC-94A to prevent the possibility of overheating and damage.

⚠ Caution
While the AC adapter is in use, do not coil or bend the power cable. Do not cover the AC adapter or power cable with paper, cloth or the like. Otherwise overheating may occur.

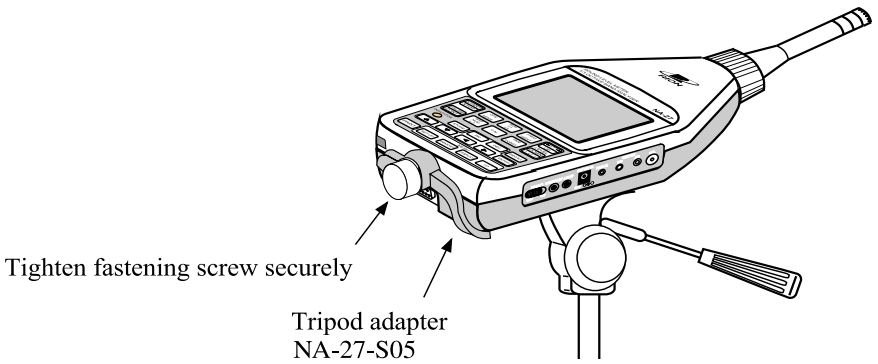
Tripod (option) Mounting

For long-term measurements, the unit can be mounted on the sound level meter tripod ST-80 (option). In this case, the supplied tripod adapter is required.
Proceed carefully, to avoid dropping the unit or tipping over the tripod.
Wind noise at the microphone can cause measurement errors. To prevent this, you should use the supplied windscreen WS-02 in cases where wind may be a problem. (For technical details, please refer to page 122.)



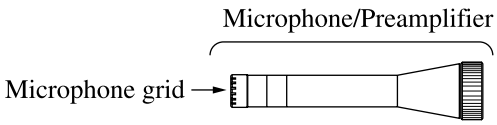
Sound level meter tripod ST-80 (option)

Insert the stud of the tripod adapter into the guide hole on the rear of the unit, and fasten the adapter securely with the fastening screw.



Sound level meter tripod ST-81 (option)

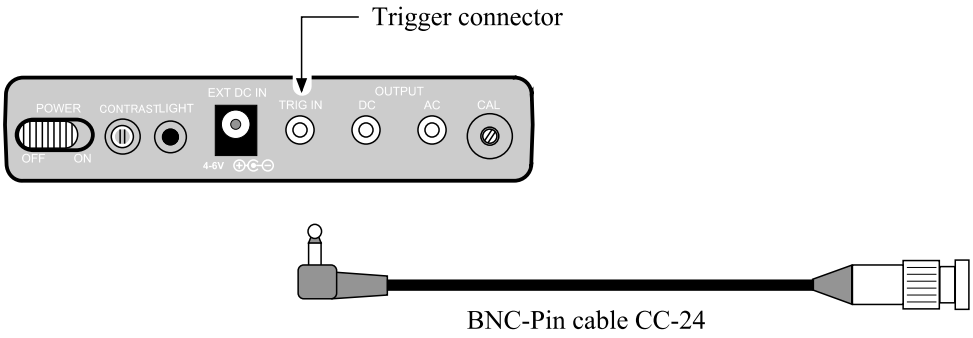
Microphone grid



Important
Never remove the microphone grid, because this can lead to damage. Before using the microphone and before putting it away, always check that the microphone grid has not become loose. If this has happened, refasten the microphone grid firmly and then use or store the microphone.

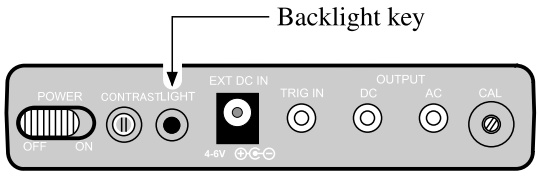
Trigger Input

An external trigger signal can be used to initiate the measurement (see page 68). Use a logic-level signal or shorten the trigger connector.



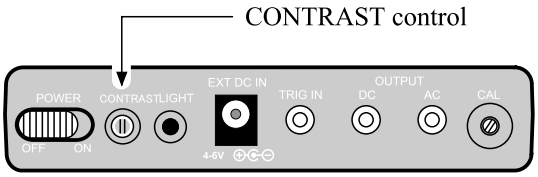
Using the Backlight

Pressing the LIGHT key on the side of the unit turns the display backlight on, making it easier to read in dark locations. The backlight shuts itself off automatically after about a minute.



Display Contrast

Using the supplied miniature screwdriver, adjust the CONTRAST control on the side of the unit for optimum readability of the display.



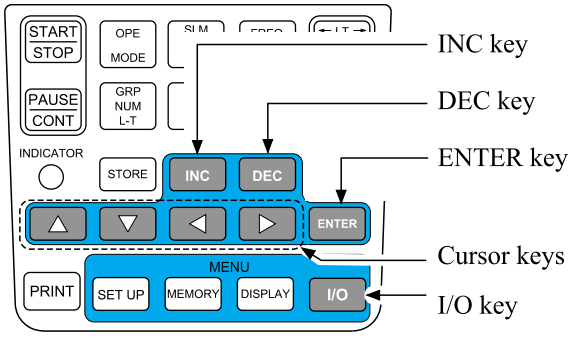
Setting the Date and Time

The NA-27 incorporates a clock which allows recording the date and time along with measurement data.

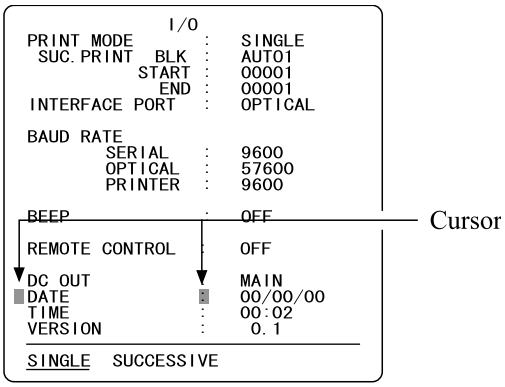
Note
The clock will stop running if power is turned off and no backup battery is inserted.

Set the date and time as described below.

1. Set the power switch on the side of the unit to ON.
   For an explanation of the display after power-on, please refer to page 43.
2. Press the I/O key.



The I/O menu screen appears.



I/O menu screen

3. Use the ▲ and ▼ keys to move the flashing cursor to the "DATE" item. The currently set date (such as 96/04/08) is shown in the bottom left corner of the screen.
4. Use the ◄ and ► keys to move the cursor to the year, month, and day field. Use the INC and DEC keys to set the numbers. Make the setting in the order year, month, day, using two digits for each field.
   Enter only the last two digits for the year.
5. When the setting is correct, press the ENTER key. The date is set and the cursor moves to the "TIME" indication.
6. Use the ◄ and ► keys to move the cursor to the hour and minute field. Use the INC and DEC keys to set the numbers. Enter the time in 24-hour notation.
7. When the setting is correct, press the ENTER key. At this point, the clock starts moving from 00 seconds.
8. Press the I/O key once more to return to the previous screen.

If no backup battery is inserted in the unit, the indication "Backup Battery Empty!!" appears after turning on the power. Insert a backup battery as described on page 16. When wishing to use the unit without a backup battery, simply press any key to make the indication disappear. In this case, the memory store function and date and time functions are not available.

If the date and time are not set, the indication "RTC Read Error!!" appears after turning on the power. In this case, use the I/O menu screen to set the date and time, as described on page 24.

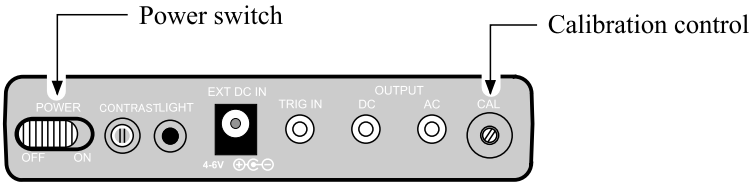
Calibration

Before starting a measurement, the NA-27 must be calibrated. There are two types of calibration, namely electrical calibration and acoustic calibration using a pistonphone. When compensation for atmospheric pressure is not required, it suffices to perform electrical calibration only.

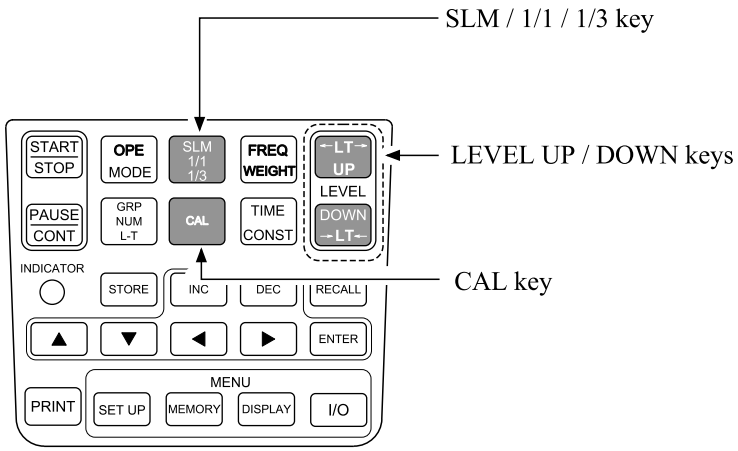
Electrical calibration

Calibration is carried out by setting the unit to the CAL mode. If the display reads 94.0 dB, calibration was completed successfully. If the reading is different, or if level calibration of connected equipment is required, perform the following steps.

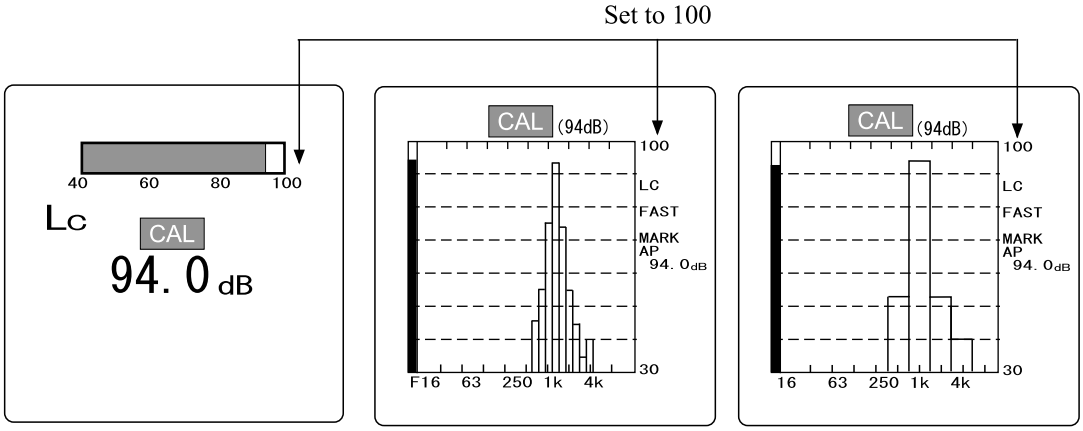
1. Set the power switch on the side of the unit to ON.



2. Use the SLM / 1/1 / 1/3 key to call up the measurement screen.
3. Press the CAL key to activate the calibration mode.
   At this point, frequency weighting is temporarily set to "C"; it will return to the original setting when the CAL key is pressed once more.
4. Use the LEVEL UP/DOWN keys to set the measurement range to 100.



If the measurement range is set to a value other than 100, the CAL indication flashes and correct calibration cannot be carried out.



CAL screen for sound level measurement

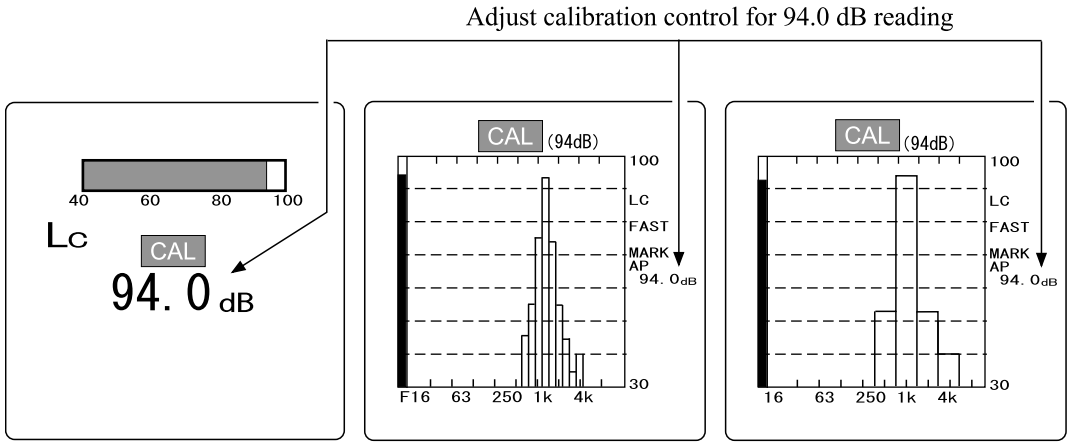
CAL screen for 1/3-octave or 1/1-octave analysis

5. Use the supplied miniature screwdriver to adjust the calibration control on the side of the unit so that the level reading is 94.0 dB.
6. Press the CAL key once more to return to the measurement screen.

Note

The calibration control is a multi-turn type. The value may not change on a single turn.

If a measurement is currently in progress (indicated by the "measurement in progress" triangle or the "pause" mark), or if a menu screen is currently shown, calibration cannot be carried out. Wait until the measurement is completed (or press the START/STOP key), or terminate the menu screen before initiating calibration.



CAL screen for sound level measurement

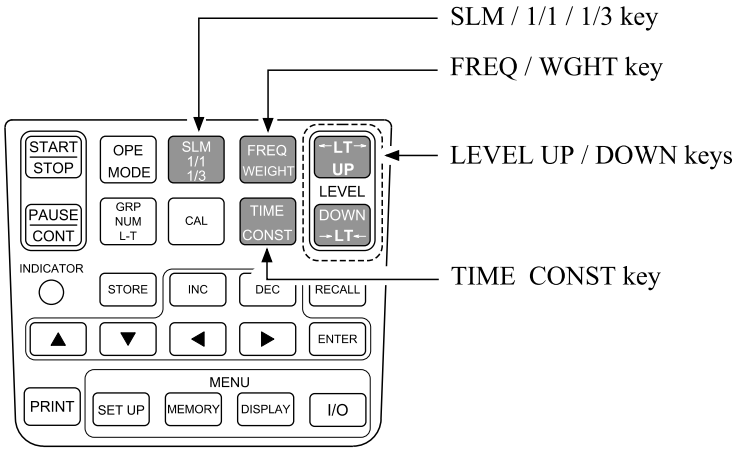
CAL screen for 1/3-octave or 1/1-octave analysis

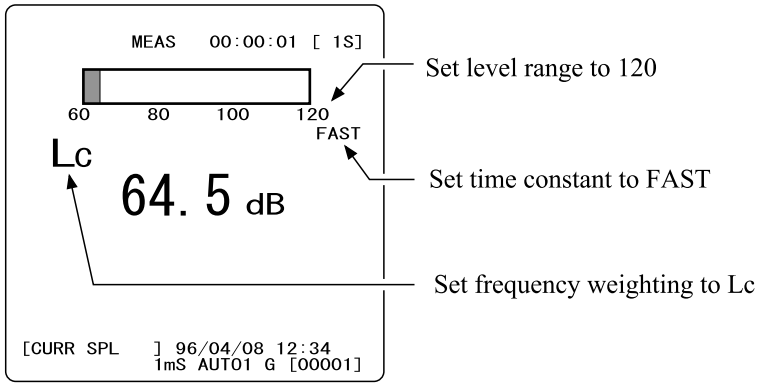
Acoustic calibration with pistonphone

For acoustic calibration, the Rion pistonphone NC-72 (option) is mounted to the microphone of the sound level meter, and adjustment is performed so that the reading of the meter is equal to the sound pressure level inside the coupler.

Important
Be very careful when inserting and removing the microphone to and from the coupler, to avoid a sudden pressure buildup which could destroy the membrane of the microphone.

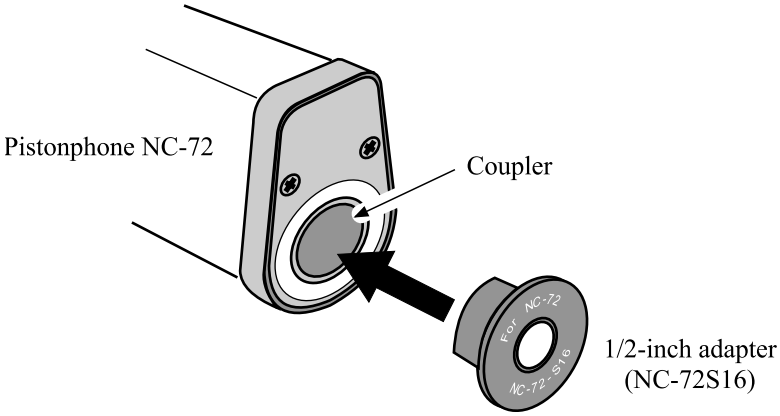
1. Turn off the pistonphone.
2. Turn on the NA-27.

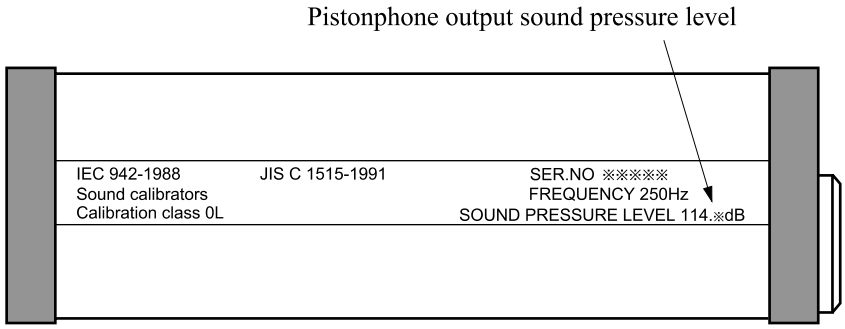




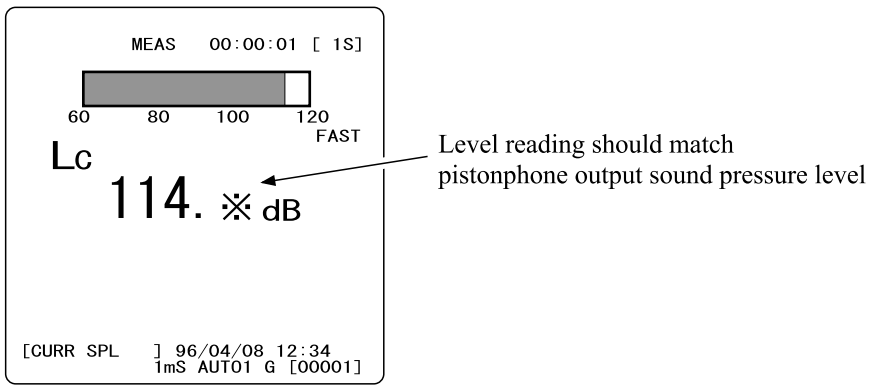
3. Press the SLM / 1/1 / 1/3 key to call up the sound pressure level measurement screen.
4. Use the FREQ/WGHT key to set frequency weighting to "C" (indication "L_c" appears on the display).
5. Use the TIME CONST key to set the time constant to "FAST".
6. Use the LEVEL UP/DOWN keys to set the level range to "120".

7. Mount the 1/2-inch adapter on the coupler of the pistonphone.
8. Insert the microphone very carefully and slowly all the way into the coupler.





9. Set the power switch of the pistonphone to ON.
10. Adjust the calibration control on the side of the NA-27 with the supplied miniature screwdriver so that the level reading matches the calibration value indicated on the pistonphone.



For information on compensation for atmospheric pressure, please refer to the instruction manual of the pistonphone.

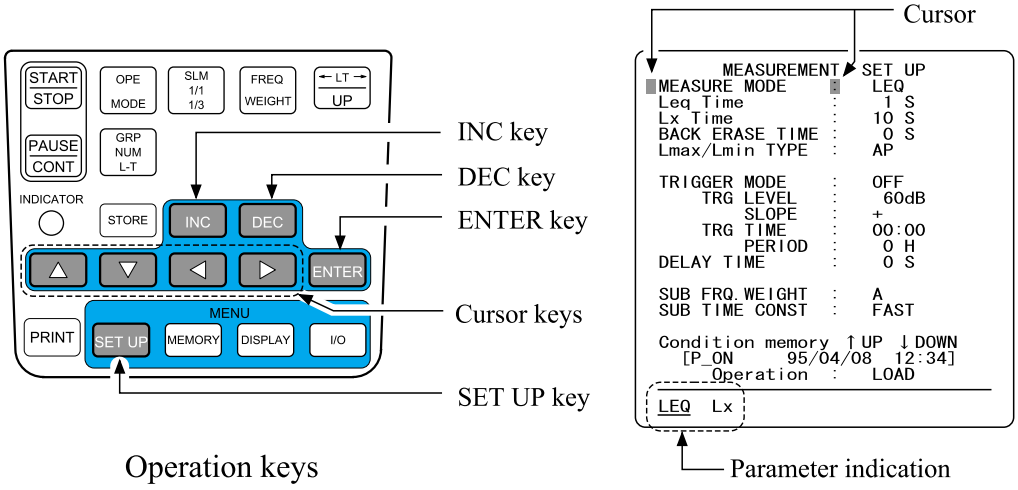
11. Turn off the pistonphone and the NA-27.
12. Remove the microphone very carefully and slowly from the coupler.

Using the Menu Screens

The NA-27 has four types of menu screens, namely SETUP, MEMORY, DISPLAY, and I/O. Basic operation principles are the same for all four screens.

The following example explains how to use the SETUP menu screen to set the L_{eq} measurement time to 10 minutes and the time constant for the sub channel to "SLOW".

1. Press the SETUP key.
   The SETUP menu screen appears.



2. Use the ▲ or ▼ key to move the cursor to the "L_{eq} Time" item.
3. The parameter indication shows "1 S" (current setting is "1 second").
   The underline indicates where a change is possible.
4. Use the INC and DEC keys to set the value to "10".
   With each push of the INC key, the value increases by 1. With each push of the DEC key, the value decreases by 1. Holding a key down causes the values to change continuously.
5. Use the ▶ key to move the underline to "S".
6. Use the INC and DEC keys to change "S" to "M".
7. Press the ENTER key. The parameter indication becomes "10M" (10 minutes), and the cursor moves to the "Lx Time" item.
8. Use the ◀ key to move the cursor to the "SUB TIME CONST" item.
9. The parameter indication shows "FAST SLOW 35ms 10ms IMPULSE" (indicating that the current setting is "FAST").
10. Use the ◀ or ▶ key to move the underline to "SLOW".

11. Press the ENTER key.
    The indication changes to "SLOW" and the cursor moves to the "Operation" item.
    The time constant of the sub channel is now set to "SLOW".
12. Press the SETUP key to return to the original screen.

Menu screen conventions

- Pressing the same menu screen key again returns to the measurement screen.
- Pressing a different menu screen key allows switching to a different menu. Pressing the new menu screen key again returns to the measurement screen.

Menu Screens

The contents of all menu screens are reproduced below. The left side always shows the setting item and the right side the parameter that can be changed. For more information on changing settings, please refer to the section about setting measurement parameters on page 36.

SETUP menu screen

MEASURE MODE	:	LEQ	Lx			
Leq Time	:	1 to 99S	1 to 99M	1 to 99H		
Lx Time	:	10 to 99S	1 to 99M	1 to 99H		
BACK ERASE TIME	:	0 to 5s				
Lmax / Lmin TYPE	:	AP	BAND			
TRIGGER MODE	:	OFF	LEVEL	EXTRN	TIME	
TRG LEVEL	:	10 to 140 dB				
SLOPE	:	-	+			
TRG TIME	:	00:00 to 23:59				
PERIOD	:	0 to 24 H				
DELAY TIME	:	0 to 10 s				
Sub Frq. Weight	:	FLAT	A	C		
Sub Time Const	:	FAST	SLOW	35ms	10ms	IMPULSE
Condition Memory	:	[0: DEFAULT]		[4: USER]		
		[1: P_ON]		[5: USER]		
		[2: USER]				
		[3: USER]				
Operation	:	LOAD	SAVE	ERASE		

MEMORY menu screen

MEMORY BLOCK		:	AUTO 1	AUTO 2	MANU	
BLOCK CLEAR		:	OFF		EXEC	
AUTO STORE TYPE		:	SINGLE		GROUP	
PERIOD		:	1 to 10 ms		10 to 990 ms	
NUM		:	FREE			
PROTECT	AUTO1	:	OFF	ON		
	AUTO2	:	OFF	ON		
	MANU	:	OFF	ON		
RECALL	CALC	:	OFF	P_AVE	P_SUM	REVERB
START ADDR		:	00001 to			
END ADDR		:	00001 to			

Directory ↑UP ↓DOWN

[AU 1:]
[AU 2:]
[001:]
[002:]
[003:]
[004:]

DISPLAY menu screen

MAIN ADD DISP		:	OFF	Lmax / Lmin	
SUB DISP		:	OFF	ON	
ADD DISP		:	OFF	Lmax / Lmin	Ltm3 / Ltm5
PEAK DISP		:	OFF	ON	
Lx SELECT	L1	:	OFF	ON	
	L5	:	OFF	ON	
	L10	:	OFF	ON	
	L50	:	OFF	ON	
	L90	:	OFF	ON	
	L95	:	OFF	ON	
	L99	:	OFF	ON	
	Lmax	:	OFF	ON	
	Lmin	:	OFF	ON	
	Leq	:	OFF	ON	

I/O menu screen

PRINT MODE		:	SINGLE	SUCCESSIVE	
SUC. PRINT BLK		:	AUTO1	AUTO2	MANU
START		:	00001 to		
END		:	00001 to		
INTERFACE PORT		:	SERIAL		OPTICAL
BAUD RATE					
SERIAL		:	4800	9600	19200 38400
OPTICAL		:	57600	115200	
PRINTER		:	4800	9600	
BEEP		:	OFF	ON	
REMOTE CONTROL		:	OFF	ON	
DC OUT		:	MAIN	SUB	
DATE		:	00 to 99 / 00 to 12 / 00 to 31		
TIME		:	00:00 to 23:59		
VERSION		:	✻.✻		

Factory Default Settings

The factory default settings for all menu screens are reproduced below. The left side shows the setting item and the right side the default parameter setting.

SETUP menu screen

MEASURE MODE	:	LEQ
Leq Time	:	1 S
Lx Time	:	10 S
BACK ERASE TIME	:	0 S
Lmax / Lmin TYPE	:	AP
TRIGGER MODE	:	OFF
TRG LEVEL	:	60 dB
SLOPE	:	+
TRG TIME	:	00:00
PERIOD	:	0 H
DELAY TIME	:	0 S
Sub Frq. Weight	:	A
Sub Time Const	:	FAST
Condition Memory	:	[0: DEFAULT] [4: USER]
		[1: P_ON] [5: USER]
		[2: USER]
		[3: USER]
Operation	:	LOAD

MEMORY menu screen

MEMORY BLOCK	:	AUTO 1
BLOCK CLEAR	:	OFF
AUTO STORE TYPE	:	SINGLE
PERIOD	:	1 mS
NUM	:	FREE
PROTECT AUTO1	:	OFF
AUTO2	:	OFF
MANU	:	OFF
RECALL CALC	:	OFF
START ADDR	:	00001
END ADDR	:	00070

Directory ↑UP ↓DOWN

[AU 1:]
[AU 2:]
[001:]
[002:]
[003:]
[004:]

DISPLAY menu screen

MAIN ADD DISP		:	OFF
SUB DISP		:	OFF
	ADD DISP	:	OFF
	PEAK DISP	:	OFF
Lx SELECT	L1	:	OFF
	L5	:	ON
	L10	:	ON
	L50	:	ON
	L90	:	ON
	L95	:	ON
	L99	:	OFF
	Lmax	:	OFF
	Lmin	:	OFF
	Leq	:	OFF

I/O menu screen

PRINT MODE		:	SINGLE
SUC. PRINT BLK		:	AUTO 1
	START	:	00001
	END	:	00001
INTERFACE PORT		:	SERIAL
BAUD RATE			
	SERIAL	:	9600
	OPTICAL	:	115200
	PRINTER	:	9600
BEEP		:	OFF
REMOTE CONTROL		:	OFF
DC OUT		:	MAIN
DATE		:	YY / MM / DD
TIME		:	HH:MM
VERSION		:	✻.✻

Setting Measurement Parameters

Before carrying out a measurement or frequency analysis with this unit, the measurement parameters must be set up as described below.

Menu screen settings

SETUP menu screen

MEASURE MODE: LEQ Lx

Selects whether to measure power (L_{eq}) or percentile values (L_x).

Leq Time: 1 to 99 S 1 to 99 M 1 to 99 H

Sets the measurement time for power measurements. Possible settings are 1 to 99 seconds in 1 second steps, 1 to 99 minutes in 1 minute steps, 1 to 99 hours in 1 hour steps.

Lx Time: 10 to 99 S 1 to 99 M 1 to 99 H

Sets the measurement time for percentile measurements. Possible settings are 10 to 99 seconds in 1 second steps, 1 to 99 minutes in 1 minute steps, 1 to 99 hours in 1 hour steps.

BACK ERASE TIME: 0 to 5 S

Sets the time for the back-erase function, by which data from a certain interval before pressing the PAUSE/CONT key can be excluded from processing. Possible settings are 1 to 5 seconds in 1 second steps. (See pages 66 to 67.)

Lmax / Lmin TYPE: AP BAND

Selects either all-pass (AP) maximum or band (BAND) maximum for L_{max}/L_{min} measurement.

AP max. mode

The frequency band levels at the point when the all-pass level became maximum or minimum within the preset measurement time are held.

BAND max. mode

The frequency band levels at the point when each band level became maximum or minimum within the preset measurement time are held.

Explanation

This example uses 10 frequency analysis results for instantaneous levels. Table 1 shows the values. The shaded data are the maximum levels for each frequency band. The framed column shows the frequency band data at the point when the all-pass level was maximum. In BAND max. mode, the shaded data will be held. In AP max. mode, the framed data will be held. Fig. 1 shows a comparison of the results.

Table 1 10 instantaneous value data (dB)

Frequency	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	BAND max.	AP max.
AP	67	69	71	65	68	72	75	*77*	74	68	*77*	*77*
16	32	30	***34***	31	28	30	31	29	30	31	***34***	29
31.5	35	***36***	33	30	31	28	30	33	32	30	***36***	33
63	47	49	***54***	50	48	47	48	50	52	48	***54***	50
125	52	56	50	48	48	54	***58***	56	51	47	***58***	***56***
250	***61***	57	53	49	51	53	54	57	55	51	***61***	57
500	50	52	55	58	54	56	61	***66***	63	59	***66***	***66***
1000	55	58	60	62	67	71	74	*77*	74	68	*77*	*77*
2000	65	67	***69***	63	61	65	67	66	62	59	***69***	66
4000	60	***63***	58	55	57	58	60	62	59	52	***63***	62
8000	53	***58***	55	51	52	53	54	56	51	48	***58***	56

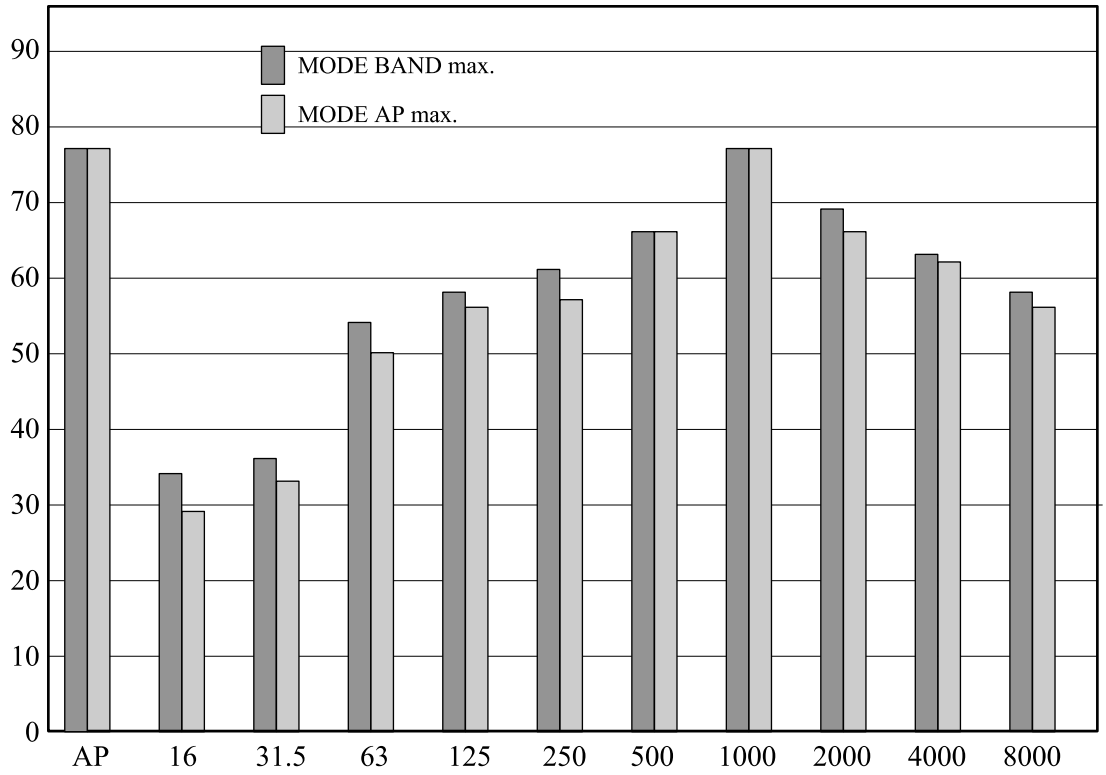


Fig. 1 Difference between AP MAX and BAND MAX mode

TRIGGER MODE: OFF LEVEL EXTRN TIME

Sets the trigger mode for starting the measurement. (See pages 68 to 73.)

- OFF: Trigger mode is disabled.
- LEVEL: Trigger level can be set from 10 to 140 dB in 1 dB steps.
- SLOPE: - or + are used to set the slope for level triggering.
- EXTRN: Selects a CMOS logic-level signal to be used as trigger, supplied to the trigger input on the side of the unit.
- TRG TIME: Can be set from 00 h 00 m to 23 h 59 m in 1 minute steps.
- PERIOD: Sets the trigger repeat interval. Can be set from 0 to 24 hours in 1 hour steps.

DELAY TIME: 0 to 10 S

Sets the delay between the point when the START/STOP key is pressed and the actual start of measurement. Can be set from 0 to 10 seconds in 1 second steps. (See page 74.)

SUB FRQ. WEIGHT: FLAT A C

Sets the frequency weighting characteristic for the sub channel.

SUB TIME CONST: FAST SLOW 35mS 10mS IMPULSE

Sets the time weighting for the sub channel.

Condition Memory: 0: DEFAULT 1: P_ON 2-5: USER

Determines the way measurement parameter settings are stored in memory.

- 0: DEFAULT: Unit is reset to default measurement parameters when turned off (except for SAVE, ERASE).
- 1: P_ON: Measurement parameters are stored when unit is turned off and reestablished when next turned on (except for SAVE, ERASE).
- 2 to 5: USER: User-selectable measurement parameter settings. Use the LEVEL UP/DOWN keys to select settings.

Operation: LOAD SAVE ERASE

Controls the measurement parameter setting memory operation.

- LOAD: Load the specified measurement parameter settings. Previously established settings are lost.
- SAVE: (USER memory only)
  Save the specified measurement parameter settings. The date and time of the save operation are also stored.
- ERASE: (USER memory only)
  Serves to erase specified measurement parameter settings.

MEMORY menu screen

MEMORY BLOCK: AUTO1 AUTO2 MANU

Selects the memory block for storing or recalling data.

BLOCK CLEAR: OFF EXEC

Serves to erase stored data.

AUTO STORE TYPE: SINGLE GROUP

Determines whether auto store data are composed of a single processing function or of all processing functions.

PERIOD: 1 to 10 ms, 10 to 990 ms

Determines the store interval for auto store. Can be set from 1 to 10 milliseconds in 1 ms steps and from 10 to 990 milliseconds in 10 ms steps.

NUM: FREE 100 to ∗∗∗

Sets the memory address number up to which storing is possible.

FREE: Memory upper limit is set as described on page 76.

100 to : Memory number is changed in steps of 100 with the INC or DEC key.

PROTECT

AUTO1: OFF ON

AUTO2: OFF ON

MANU: OFF ON

When set to ON, the respective memory area is protected from being overwritten. This serves to preserve measurement data. When PROTECT is active, BLOCK CLEAR also has no effect.

RECALL CALC: OFF P_AVE P_SUM REVERB

Selects the type of calculation to be used for the recall mode. The start address and end address are specified using START ADDR and END ADDR.

P_AVE: Power average is calculated and displayed.

P_SUM: Power sum is calculated and displayed.

REVERB: Reverb time is displayed.

START ADDR: 00001 to Analysis start address

END ADDR: 00001 to Analysis end address

To set the START ADDR and END ADDR, use the ◄ and ► keys to move the underline and then use the INC and DEC keys to set the value.

Directory		↑UP	↓DOWN
● [AU 1:	1 / 1	96 / 05 / 02	12:34:56]
[AU 2:	1 / 3	96 / 05 / 04	11:22:33]
[001:	1 / 3	96 / 05 / 10	10:10:10]
[002:	SPL	96 / 05 / 10	15:15:15]
[003:	SPL	96 / 05 / 12	17:17:15]
[004:	SPL	96 / 05 / 3	19:19:15]
			:
			:
[200:	SPL	96 / 05 / 25	15:15:15]

Indicates the type and store date and time of data in the mass memory.

The date/time is indicated as follows.

AU1, AU2: Auto store start date/time/The date/time is indicated as follows.

001 to 200: Date/time when STORE key was pressed for the respective address.

1. Use the LEVEL UP/DOWN keys to scroll the display.
2. The currently selected data block is marked with a black circle (●).
3. Move the cursor to the desired block and press the ENTER key to select the block.

DISPLAY menu screen

MAIN ADD DISP: OFF Lmax / Lmin

When "Lmax / Lmin" is selected, the maximum and minimum sound pressure level is always displayed in sound pressure level measurement mode.

SUB DISP: OFF ON

Set to ON when wishing to display sub channel readings also.

ADD DISP: OFF Lmax / Lmin Ltm3 / Ltm5

PEAK DISP: OFF ON

Selects additional items to be displayed for the sub channel.

Lx SELECT

L1:	OFF	ON
L5:	OFF	ON
L10:	OFF	ON
L50:	OFF	ON
L90:	OFF	ON
L95:	OFF	ON
L99:	OFF	ON
Lmax:	OFF	ON
Lmin:	OFF	ON
Leq:	OFF	ON

Selects the items for L_x processing. Up to five items can be selected simultaneously.

I/O menu screen

PRINT MODE: SINGLE SUCCESSIVE

Determines whether the printer (DPU-414, CP-10, CP-11) prints only one sheet or operates continuously. The "SUCCESSIVE" setting is valid only in recall mode.

SUC. PRINT BLK: AUTO1 AUTO2 MANU

Specifies the memory block for successive printing.

START: 00001 to

END: 00001 to

Specifies the start address and end address of the memory block specified for printing.

INTERFACE PORT: SERIAL OPTICAL

Selects either the serial port or the infrared optical port for I/O communication.

BAUD RATE

SERIAL: 4800 9600 19200 38400

OPTICAL: 57600 115200

PRINTER: 4800 9600

Sets the baud rate for the respective interface.

BEEP: OFF ON

Determines whether a beep tone is produced at the end of measurement and at other times.

REMOTE CONTROL: OFF ON

When wishing to use the supplied remote control (NA-27RC1), this item must be set to "ON".

DC OUT: MAIN SUB

Specifies which channel signal is supplied at the DC OUT output on the side of the unit.

DATE: ∗∗ / ∗∗ / ∗∗

TIME: ∗∗ : ∗∗

These items allow the user to specify the date and time. While the menu is displayed, the time indication does not advance.

VERSION: ∗. ∗

Sound Pressure Level Measurement

The NA-27 offers various kinds of measurements: instantaneous value (L_p, L_{max}, L_{min}, L_{peak}), power (L_{eq}, L_E, L_{tm3}, L_{tm5}), and percentile value (L_x). The maximum sound pressure level (L_{max}), minimum sound pressure level (L_{min}), and waveform peak hold (L_{peak}) refer to the instantaneous level within the measurement time. Except for the instantaneous level (L_p), the measurement applies to the preset measurement time.

Note
If measurement settings such as level range or frequency weighting were changed during pause in instantaneous value mode, the new settings will apply immediately when pause is released. If measurement settings such as level range or frequency weighting were changed after processing, the new settings will be effective only when processing the next measurement.

Power-on

When the power switch on the side of the unit is set to ON, the indication "Now selftesting!!" appears on the display. After initialization and self-test are completed (between 10 and 20 seconds), the unit is ready for operation.

If a backup battery is inserted, the unit will in principle be set to the same condition as before, except for the items shown in the table below.

Before power was turned off ⇒	When power is turned on again
Pause	Pause released
Trigger ON	Trigger standby
Store operation in progress	Store canceled
Processing in progress	Processing canceled
Recall screen	Measurement screen
Menu screen	Measurement screen
Level time screen	Measurement screen
Remote mode	Remote OFF
Calibraion mode	Measurement screen

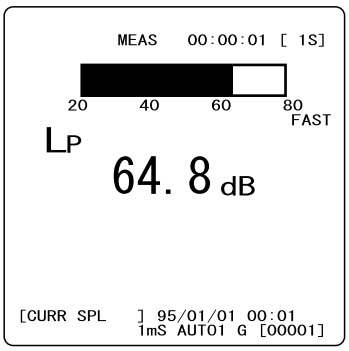
If no backup battery is inserted, the indication "Backup Battery Empty!!" appears after turning on the power. Insert a backup battery as described on page 16. When wishing to use the unit without a backup battery, simply press any key to make the indication disappear. In this case, the memory store function and date and time functions are not available.

If the date and time are not set, the indication "RTC Read Error!!" appears after turning on the power. In this case, use the I/O menu screen to set the date and time, as described on page 24.

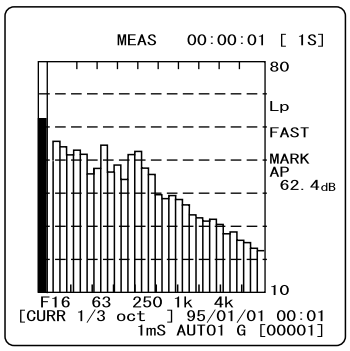
Instantaneous Sound Pressure Level Measurement (L_A, L_C, L_p)

To perform a measurement, carry out the following steps.

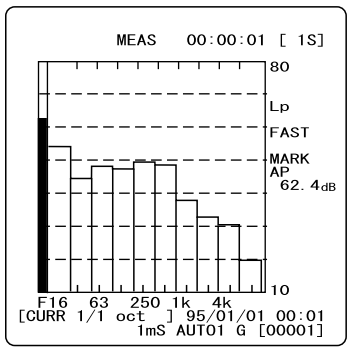
1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
   (For an explanation of the power-on procedure, refer to page 42.)



Sound pressure level measurement screen

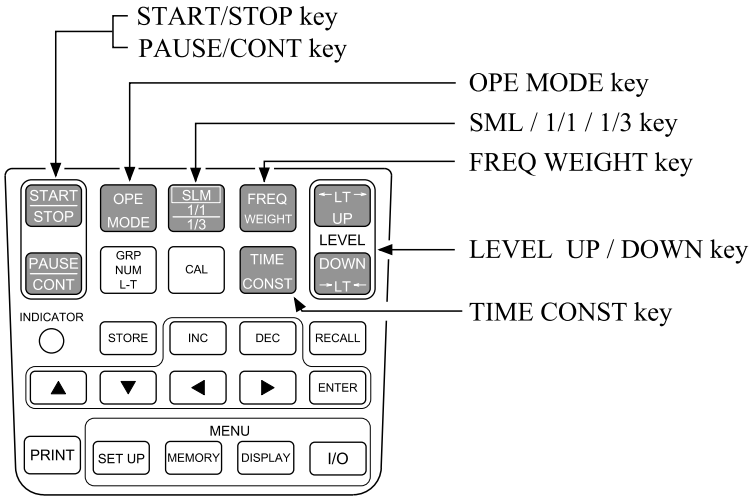


1/3-octave analysis screen



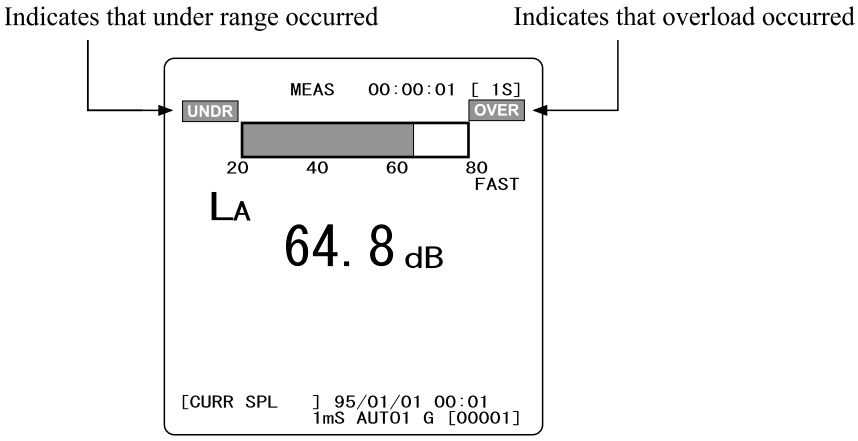
1/1-octave analysis screen

2. Press the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.



3. Use the FREQ WEIGHT key to select the desired frequency weighting setting.
   For normal sound pressure level measurements, select "A" weighting (L_A). For sound pressure level measurements with "C" weighting, select "C" (L_C). When "L_p" is selected, frequency weighting is flat.

4. Use the TIME CONST key to select the desired time constant setting.
   Normally, the "FAST" setting should be used.
5. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear (the bar graph should register to about the middle of the range).

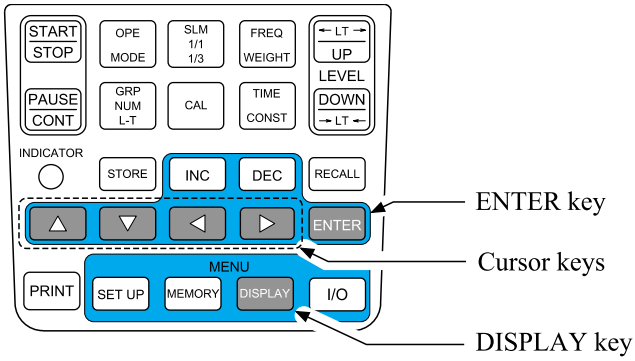


Sound pressure level measurement screen

6. The level reading shown on the display corresponds to the current noise level (sound pressure level). The reading is updated once every second.
   The PAUSE/CONT key can be used to pause the measurement, i.e. to prevent the level reading and bar graph indication from being updated. Pressing the key again resumes the measurement.

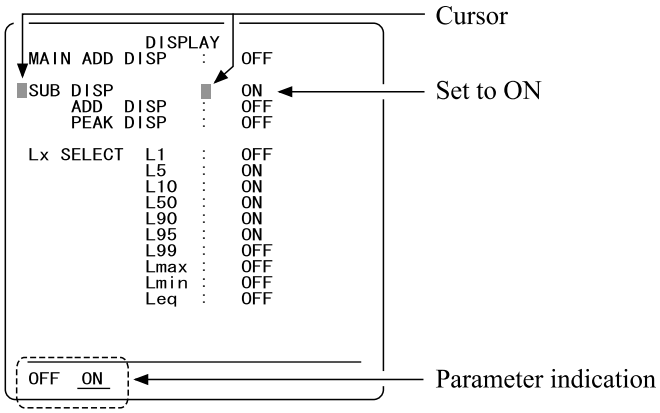
Using the sub channel

To use the sub channel, carry out the following steps.



1. Press the DISPLAY key.
   The DISPLAY menu screen appears.
2. Use the ▲ and ▼ keys to move the flashing cursor to the "SUB DISP" item.

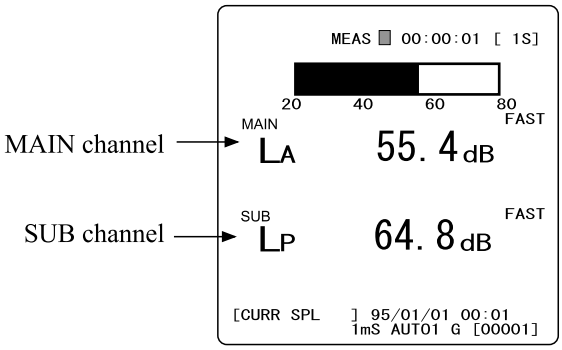
3. Use the ◄ and ► keys to set the parameter to ON.



DISPLAY menu screen

4. Press the ENTER key.
   The "SUB DISP" item is now set to ON.
   The cursor moves to the "ADD DISP" item.
5. Press the DISPLAY key to return to the measurement screen.
   The display appearance changes as shown below.

   If frequency weighting and time constant for the sub channel are set to the same values as for the main channel, the sub channel display does appear, even if set to ON.



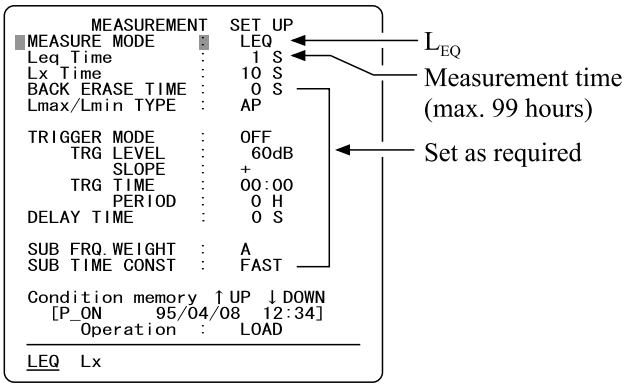
Sound level meter
measurement screen

Maximum and Minimum Sound Pressure Level Measurement (L_{max}, L_{min})

The maximum and minimum sound pressure level for a given measurement interval can be measured.

To make the measurement, carry out the following steps.

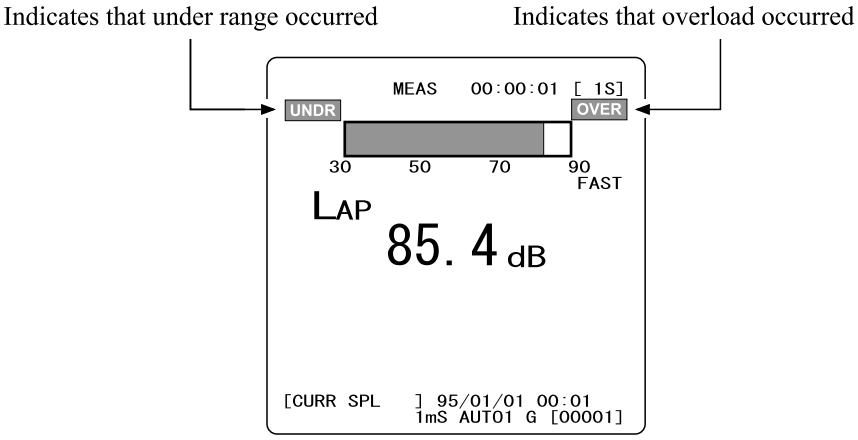
1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
   (For an explanation of the power-on procedure, refer to page 42.)
2. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)



SET UP menu screen

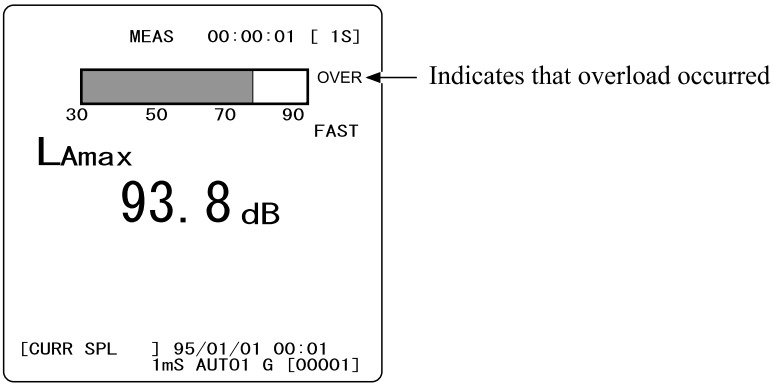
3. Set "MEASURE MODE" to "LEQ".
4. Set the measurement time with the "Leq Time" item. The maximum setting is 99 hours.
5. If desired, you can use the back-erase function (p. 66), the trigger function (p. 68), or the delayed measurement function (p. 74). For more information, please refer to the respective pages.
6. Press the SET UP key to return the measurement screen.
7. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
8. Use the FREQ WEIGHT key to select the desired frequency weighting setting.
   For normal sound pressure level measurements, select "A" weighting (L_A). For sound pressure level measurements with "C" weighting, select "C" (L_C). When "L_p" is selected, frequency weighting is flat.

9. Use the TIME CONST key to select the desired time constant setting.
   Normally, the "FAST" setting should be used.
10. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear (the bar graph should register to about the middle of the range).



Sound pressure level measurement screen

11. Press the START/STOP key.
    The LED indicator and the ▶ mark on the display start to flash, and the maximum and minimum sound pressure level measurement begins.
    When the measurement time set in step 4 has elapsed, the measurement stops automatically. When wishing to terminate the measurement earlier, press the START/STOP key.
    If an overload condition has occurred at least once during the measurement, the "OVER" indication is shown on the display.
    The display reading corresponds to the sound pressure level.
    Using the PAUSE/CONT key, you can pause and resume the level reading and bar graph display.
12. Press the OPE MODE key to display the maximum and minimum sound pressure level in turn.
    The maximum level is shown as L_{Amax} and the minimum level as L_{Amin}.



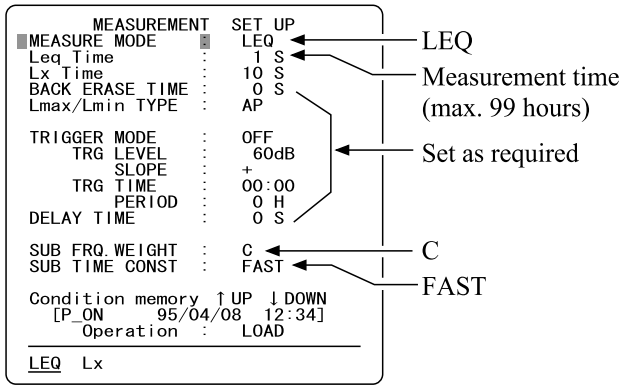
Sound pressure level measurement screen

Waveform Peak Hold Measurement (L_{peak})

The waveform peak sound pressure level for a given measurement interval can be measured. This measurement is carried out in the sub channel.

To make the measurement, carry out the following steps.

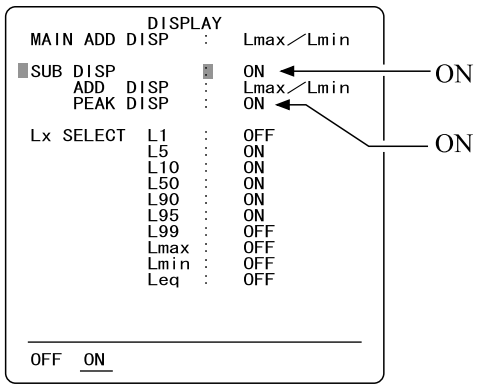
1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
   (For an explanation of the power-on procedure, refer to page 42.)
2. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)
3. Set "MEASURE MODE" to "LEQ".



SET UP menu screen

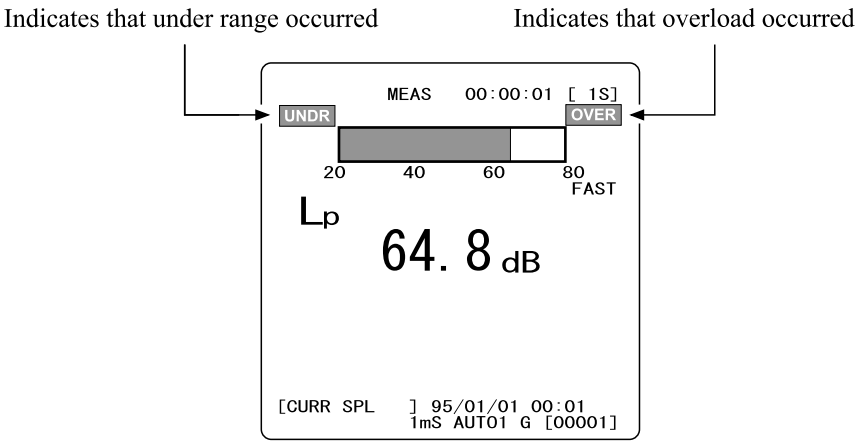
4. Set the measurement time with the "Leq Time" item. The maximum setting is 99 hours.
5. Set "SUB FRQ. WEIGHT" to "C".
6. Set "SUB TIME CONST" to the desired setting.
   Normally, the "FAST" setting should be used.
7. If desired, you can use the back-erase function (p. 66), the trigger function (p. 68), or the delayed measurement function (p. 74). For more information, please refer to the respective pages.

8. Press the DISPLAY key to bring up the DISPLAY menu screen.



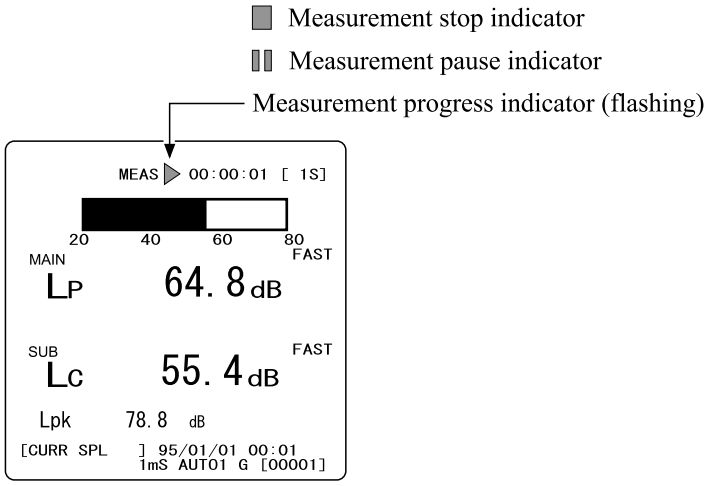
DISPLAY menu screen

9. Set "SUB DISP" to ON.
10. Set "PEAK DISP" to ON.
11. Press the DISPLAY key to return to the measurement screen.
12. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
13. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear (the bar graph should register to about the middle of the range).



Sound pressure level measurement screen

14. Press the START/STOP key.
    The LED indicator and the ▶ mark on the display start to flash, and the waveform peak hold measurement begins.



Sound pressure level measurement screen

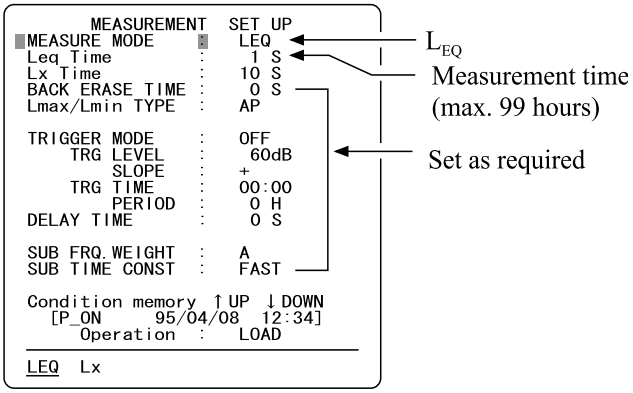
When the measurement time set in step 4 has elapsed, the measurement stops automatically. When wishing to terminate the measurement earlier, press the START/STOP key.
If an overload condition has occurred at least once during the measurement, the "OVER" indication is shown on the display.
The display reading corresponds to the noise level (sound pressure level).
Using the PAUSE/CONT key, you can pause and resume the level reading and bar graph display.

Note
Peak hold measurement is being carried out while the display is paused by PAUSE key.

Equivalent Continuous Sound Pressure Level Measurement (L_{eq})

To make the equivalent continuous sound pressure level measurement, carry out the following steps.

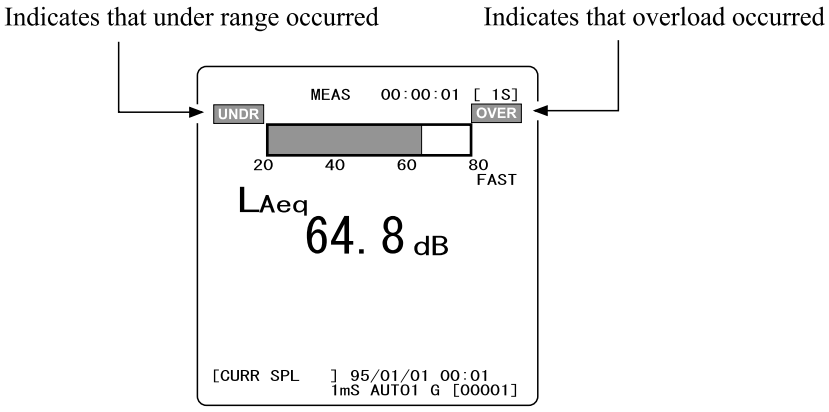
1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
   (For an explanation of the power-on procedure, refer to page 42.)
2. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)



SET UP menu screen

3. Set "MEASURE MODE" to "LEQ".
4. Set the measurement time with the "Leq Time" item. The maximum setting is 99 hours.
5. If desired, you can use the back-erase function (p. 66), the trigger function (p. 68), or the delayed measurement function (p. 74). For more information, please refer to the respective pages.
6. Press the SETUP key to return to the original screen.
7. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
8. Use the FREQ WEIGHT key to select the desired frequency weighting setting.
   For normal sound pressure level measurements, select "A" weighting (L_{Aeq}). For sound pressure level measurements with "C" weighting, select "C" (L_{Ceq}). When "L_{peq}" is selected, frequency weighting is flat.
9. Use the TIME CONST key to select the desired time constant setting.
   Normally, the "FAST" setting should be used.

10. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear (the bar graph should register to about the middle of the range).



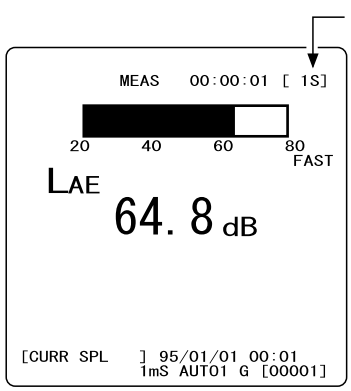
Sound pressure level measurement screen

11. Press the START/STOP key.
    The LED indicator and the ▶ mark on the display start to flash, and the equivalent continuous sound pressure level measurement begins.
    When the measurement time set in step 4 has elapsed, the measurement stops automatically. When wishing to terminate the measurement earlier, press the START/STOP key.
    If an overload condition has occurred at least once during the measurement, the "OVER" indication is shown on the display.
    The display reading corresponds to the sound pressure level.
    Using the PAUSE/CONT key, you can pause and resume the level reading and bar graph display.
12. Press the OPE MODE key to display the equivalent continuous sound pressure level (L_{Aeq}).

Sound Exposure Level Measurement (L_{AE})

To make the sound exposure level measurement, carry out the following steps. The procedure is almost identical to the equivalent continuous sound pressure level measurement.

1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
   (For an explanation of the power-on procedure, refer to page 42.)
2. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)
3. Set "MEASURE MODE" to "LEQ".
4. Set the measurement time with the "Leq Time" item. The maximum setting is 99 hours.



Sound pressure level measurement screen

5. If desired, you can use the back-erase function (p. 66), the trigger function (p. 68), or the delayed measurement function (p. 74). For more information, please refer to the respective pages.
6. Press the SETUP key to return to the original screen.
7. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
8. Use the FREQ WEIGHT key to select "A" weighting (L_{AE}).
9. Use the TIME CONST key to select the desired time constant setting.
   Normally, the "FAST" setting should be used.
10. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear (the bar graph should register to about the middle of the range).
11. Press the START/STOP key.
    The LED indicator and the ► mark on the display start to flash, and the sound exposure level measurement begins.

When the measurement time set in step 4 has elapsed, the measurement stops automatically. When wishing to terminate the measurement earlier, press the START/STOP key.

If an overload condition has occurred at least once during the measurement, the "OVER" indication is shown on the display.

The display reading corresponds to the noise level (sound pressure level).

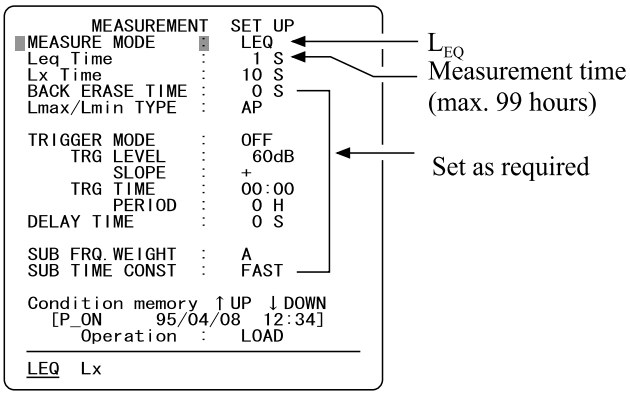
Using the PAUSE/CONT key, you can pause and resume the level reading and bar graph display.

12. Press the OPE MODE key to display the sound exposure level (L_{AE}).

Takt-Max Sound Pressure Level Measurement (L_{tm3}, L_{tm5})

To make the takt-max sound pressure level measurement, carry out the following steps. The procedure is almost identical to the equivalent continuous sound pressure level measurement.

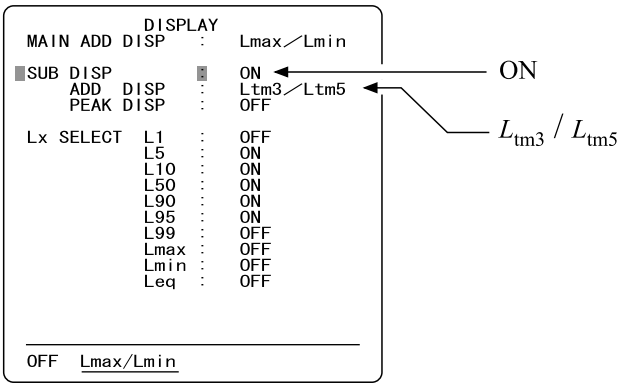
1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
   (For an explanation of the power-on procedure, refer to page 42.)
2. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)



SET UP menu screen

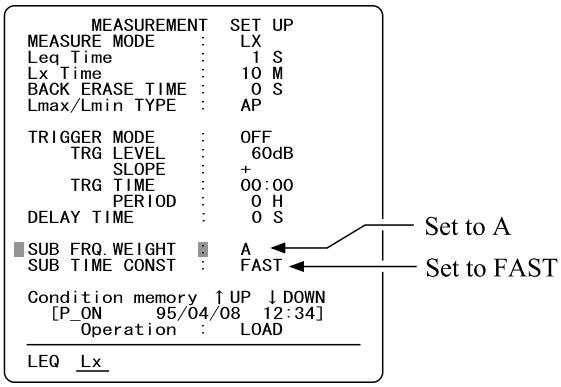
3. Set "MEASURE MODE" to "LEQ".
4. Set the measurement time with the "Leq Time" item. The maximum setting is 99 hours.
5. If desired, you can use the trigger function (p. 68), or the delayed measurement function (p. 74). For more information, please refer to the respective pages.

6. Press the DISPLAY key to bring up the DISPLAY menu screen.



DISPLAY menu screen

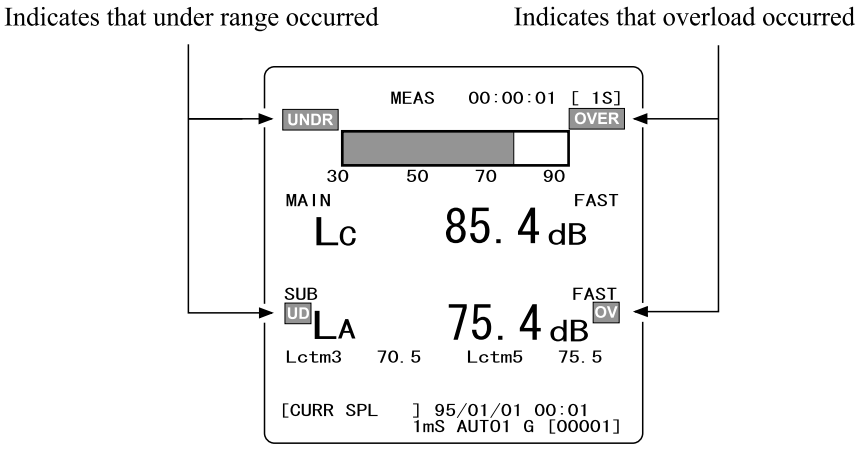
7. Set "SUB DISP" to ON and set "ADD DISP" to "Ltm3/Ltm5".
8. Press the SETUP key to call up the SETUP menu screen.



SET UP menu screen

9. Set "SUB FRQ. WEIGHT" to "A" weighting and set "SUB TIME CONST" to FAST.
10. Press the SETUP key to return to the original screen.

11. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
12. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear (the bar graph should register to about the middle of the range).



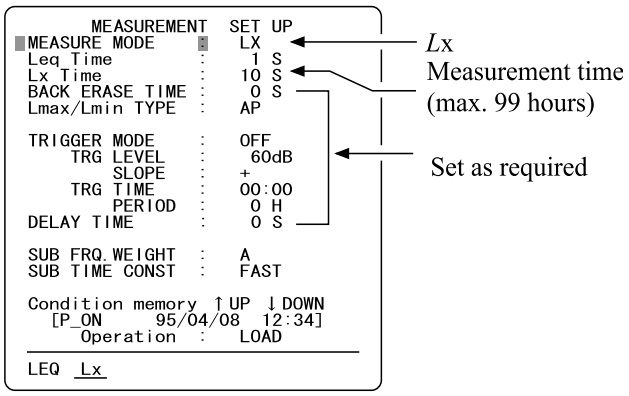
Sound pressure level measurement screen

13. Press the START/STOP key.
    The LED indicator and the ► mark on the display start to flash, and the takt-max sound pressure level measurement begins.
    When the measurement time set in step 4 has elapsed, the measurement stops automatically. When wishing to terminate the measurement earlier, press the START/STOP key.
    If an overload condition has occurred at least once during the measurement, the "OVER" indication is shown on the display.
    The display reading corresponds to the noise level (sound pressure level).
    Using the PAUSE/CONT key, you can pause and resume the level reading and bar graph display.
14. Press the OPE MODE key to display the takt-max sound pressure level (shown as Lctm3 and Lctm5 under the sub channel indication).

Percentile Sound Pressure Level Measurement (L_x)

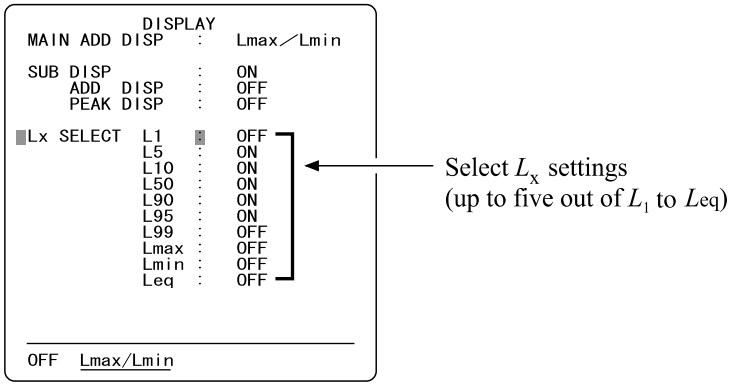
To make the percentile sound pressure level measurement, carry out the following steps. The procedure is almost identical to the equivalent continuous sound pressure level measurement.

1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
   (For an explanation of the power-on procedure, refer to page 42.)
2. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)



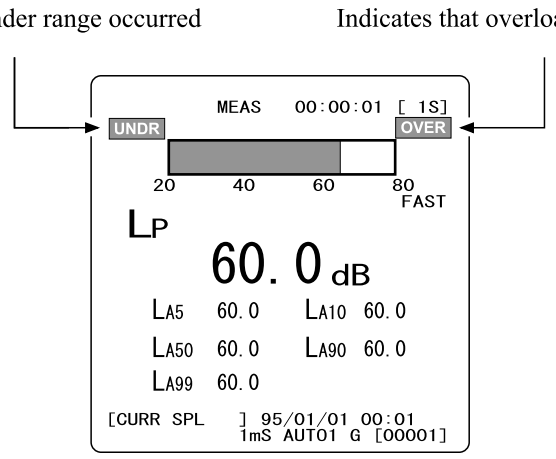
SET UP menu screen

3. Set "MEASURE MODE" to "Lx".
4. Set the measurement time with the "Lx Time" item. The maximum setting is 99 hours.
5. If desired, you can use the trigger function (p. 68), or the delayed measurement function (p. 74). For more information, please refer to the respective pages.
6. Press the DISPLAY key to bring up the DISPLAY menu screen.



DISPLAY menu screen

7. Select up to five Lx settings out of L1 to Leq. If five settings are already selected and you wish to use other settings, turn unused settings OFF first.
8. Press the DISPLAY key to return to the original screen.
9. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen. The selected five percentile levels are shown.
10. Use the FREQ WEIGHT key to set frequency weighting to "A".
11. Use the TIME CONST key to select the desired time constant setting. Normally, the "FAST" setting should be used.
12. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear (the bar graph should register to about the middle of the range).



Sound pressure level measurement screen

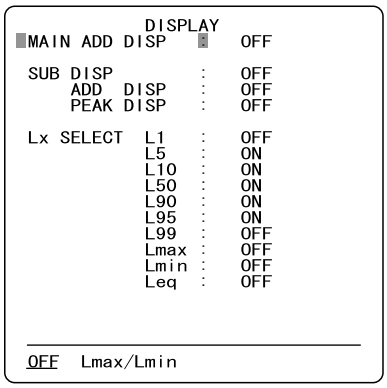
13. Press the START/STOP key.
    The LED indicator and the ► mark on the display start to flash, and the level measurement begins.
    When the measurement time set in step 4 has elapsed, the measurement stops automatically. When wishing to terminate the measurement earlier, press the START/STOP key.
    If an overload condition has occurred at least once during the measurement, the "OVER" indication is shown on the display.
    The display reading shows the percentile sound pressure level for the selected settings.
    Using the PAUSE/CONT key, you can pause and resume the level reading and bar graph display.
14. Press the OPE MODE key to display the level.

1/1-Octave and 1/3-Octave Analysis

Note
If measurement settings such as level range or frequency weighting were changed during pause in instantaneous value mode, the new settings will apply immediately when pause is released. If measurement settings such as level range or frequency weighting were changed after processing, the new settings will be effective only when processing the next measurement.

1/1-Octave and 1/3-Octave Analysis for Instantaneous Value (L_A, L_C, L_p)

To make the measurement, carry out the following steps.



DISPLAY menu screen

1. Set the power switch on the side of the unit to ON. Call up the DISPLAY menu screen by pressing the DISPLAY key, make the necessary settings, and press the DISPLAY key again to close the menu.
2. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
3. Use the FREQ WEIGHT key to select the desired frequency weighting setting.
   For normal sound pressure level measurements, select "A" weighting. For sound pressure level measurements with "C" weighting, select "C". When "L_p" is selected, frequency weighting is flat.
4. Use the TIME CONST key to select the desired time weighting setting.
   Normally, the "FAST" setting should be used.
5. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear.
6. Use the SLM / 1/1 / 1/3 key to activate the 1/1- octave analysis or 1/3-octave analysis screen.
7. The display is updated every 100 ms. Since this makes the values hard to read, use the PAUSE/CONT key to pause the bar graph, move the marker to the desired position, and read the value. Alternatively, you can also use the GRP/NUM/L-T key to activate the numeric reading.

1/1-Octave and 1/3-Octave Analysis for Maximum and Minimum Level (L_{max}, L_{min})

To make the measurement, carry out the following steps. The procedure is almost identical to the instantaneous value measurement.

1. Set the power switch on the side of the unit to ON.
   Call up the DISPLAY menu screen by pressing the DISPLAY key, make the necessary settings, and press the DISPLAY key again to close the menu.
2. Press the SETUP key to call up the SETUP menu screen, and set the required items. (For an explanation of the Lmax/Lmin type setting, refer to the explanation below.)
3. Press the SETUP key again to return to the measurement screen.
4. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
5. Use the FREQ WEIGHT key to select the desired frequency weighting setting.
   For normal sound pressure level measurements, select "A" weighting. For sound pressure level measurements with "C" weighting, select "C". When "L_p" is selected, frequency weighting is flat.
6. Use the TIME CONST key to select the desired time weighting setting.
   Normally, the "FAST" setting should be used.
7. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear.
8. Use the SLM / 1/1 / 1/3 key to activate the 1/1-octave analysis or 1/3-octave analysis screen.
9. The display is updated every 100 ms. Since this makes the values hard to read, use the PAUSE/CONT key to pause the bar graph, move the marker to the desired position, and read the value. Alternatively, you can also use the GRP/NUM/L-T key to activate the numeric reading.

Lmax/Lmin type setting

AP (All-pass maximum/all-pass minimum)

The analysis result applies to the point where the all-pass level in the processing time was maximum or minimum.

BAND (Band maximum/band minimum)

The analysis result applies to the point where the level for each frequency band in the processing time was maximum or minimum.

Factory default setting is "AP".

1/1-Octave and 1/3-Octave Analysis for Equivalent Continuous Sound Pressure Level (L_{eq})

To make the measurement, carry out the following steps. The procedure is almost identical to the instantaneous value measurement.

1. Set the power switch on the side of the unit to ON.
   Call up the DISPLAY menu screen by pressing the DISPLAY key and make the necessary settings.
2. Press the SETUP key to call up the SETUP menu screen and make the necessary settings.
3. Press the SETUP key once more to return to the original measurement screen.
4. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
5. Use the FREQ WEIGHT key to select the desired frequency weighting setting.
   For normal sound pressure level measurements, select "A" weighting. For sound pressure level measurements with "C" weighting, select "C". When "L_p" is selected, frequency weighting is flat.
6. Use the TIME CONST key to select the desired time weighting setting.
   Normally, the "FAST" setting should be used.
7. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear.
8. Use the SLM / 1/1 / 1/3 key to activate the 1/1-octave analysis or 1/3-octave analysis screen.
9. The display is updated every 100 ms. Since this makes the values hard to read, use the PAUSE/CONT key to pause the bar graph, move the marker to the desired position, and read the value. Alternatively, you can also use the GRP/NUM/L-T key to activate the numeric reading.

1/1-Octave and 1/3-Octave Analysis for Percentile Sound Pressure Level (L_X)

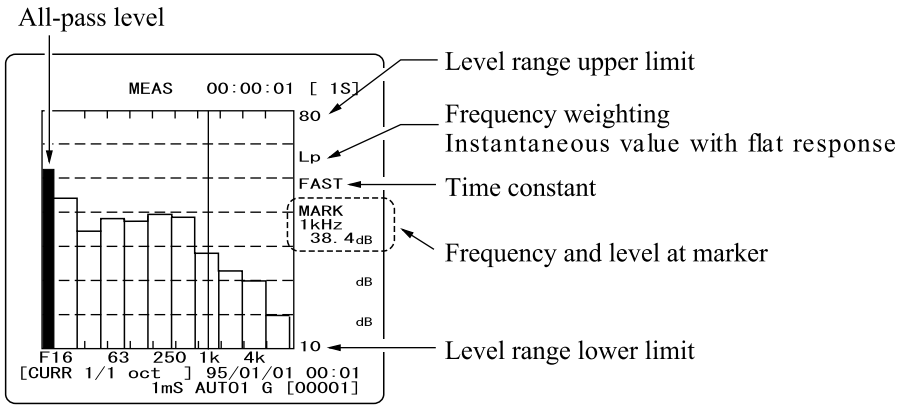
To make the measurement, carry out the following steps. The procedure is almost identical to the instantaneous value measurement.

1. Set the power switch on the side of the unit to ON.
   Call up the DISPLAY menu screen by pressing the DISPLAY key and make the necessary settings.
2. Press the SETUP key to call up the SETUP menu screen and make the necessary settings.
3. Press the SETUP key once more to return to the original measurement screen.
4. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
5. Use the FREQ WEIGHT key to select the desired frequency weighting setting.
   For normal sound pressure level measurements, select "A" weighting. For sound pressure level measurements with "C" weighting, select "C". When "L_p" is selected, frequency weighting is flat.
6. Use the TIME CONST key to select the desired time weighting setting.
   Normally, the "FAST" setting should be used.
7. Use the LEVEL UP/DOWN keys to select the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear.
8. Use the SLM / 1/1 / 1/3 key to activate the 1/1-octave analysis or 1/3-octave analysis screen.
9. The display is updated every 100 ms. Since this makes the values hard to read, use the PAUSE/CONT key to pause the bar graph, move the marker to the desired position, and read the value. Alternatively, you can also use the GRP/NUM/L-T key to activate the numeric reading.

Explanation of Analysis Screens

1/1-octave analysis

The staircase shape on the display represents the 1/1-octave analysis result. From left, the bars correspond to 16, 31.5, 63, 125, 250, 500, 1 k, 2 k, 4 k, 8 kHz. To read the levels at these frequencies, use the ◄ and ► keys to move the marker to the desired point. The frequency and level are then shown on the right of the screen under the indication "MARK".

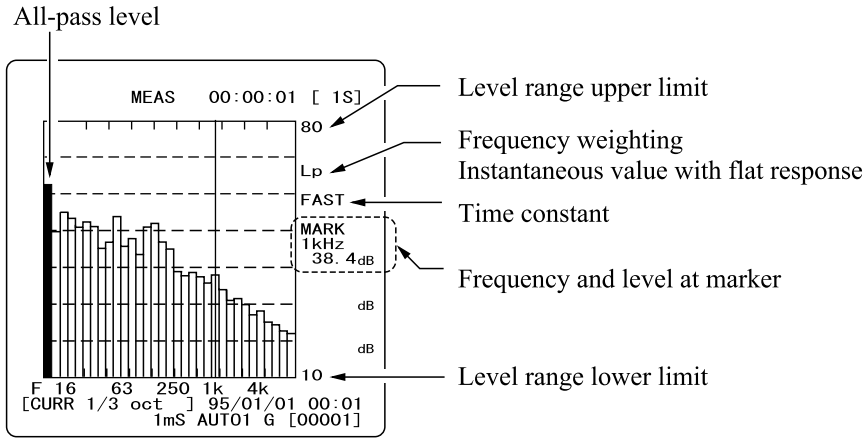


1/1-octave analysis screen

Important
The frequency range of this unit including the microphone is 20 Hz to 12500 Hz. Outside of this range, precision is not assured. Data for the 16 Hz range should therefore be used only as a general reference.

1/3-octave analysis

The staircase shape on the display represents the 1/3-octave analysis result. From left, the bars correspond to 12.5, 16, 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1 k, 1.25 k, 1.6 k, 2 k, 2.5 k, 3.15 k, 4 k, 5 k, 6.3 k, 8 k, 10 k, 12.5 kHz. To read the levels at these frequencies, use the ◀ and ▶ keys to move the marker to the desired point. The frequency and level are then shown on the right of the screen under the indication "MARK".

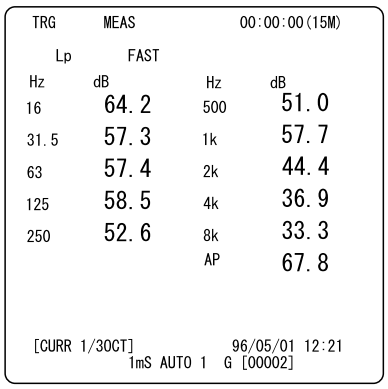


1/3-octave analysis screen

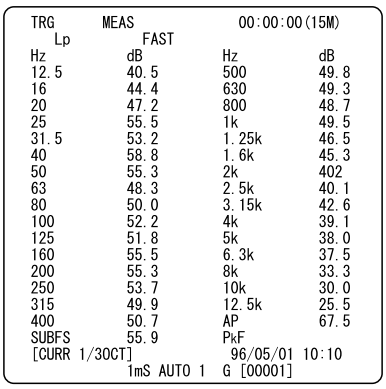
Important
The frequency range of this unit including the microphone is 20 Hz to 12500 Hz. Outside of this range, precision is not assured. Data for the 12.5 Hz and 16 Hz range should therefore be used only as a general reference.

Numeric display

Because it will be difficult to read all numeric values from the 1/1-octave and 1/3-octave screen, the numeric display function should be used for this purpose. Use the GRP/NUM/ L-T key to toggle between the graphical and numeric display. The numeric readings are shown in list format with the frequency on the left and the level on the right.



1/1-octave analysis numeric display



1/3-octave analysis numeric display

1/1-Octave and 1/3-Octave Analysis Precaution

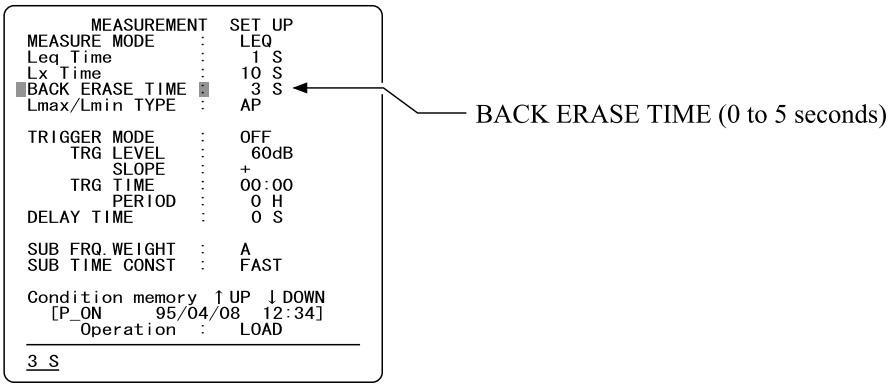
Simultaneous 1/1-octave and 1/3-octave analysis is not possible

If for example 1/1-octave analysis was carried out and the SLM / 1/1 / 1/3 key is then pushed to switch to 1/3-octave display, the displayed data are invalid except for the Lp value. The same applies when switching to 1/1-octave display after 1/3-octave analysis.

Data Exclusion (Back-Erase) Function

When a measurement is being carried out and data are being processed, the PAUSE/CONT key can be used to suspend the measurement. Normally, data up to the point at which the PAUSE/CONT key was pressed will be included in processing, but the data exclusion function makes it possible to exclude (back erase) data from an interval of 1 to 5 seconds before the key was pressed.

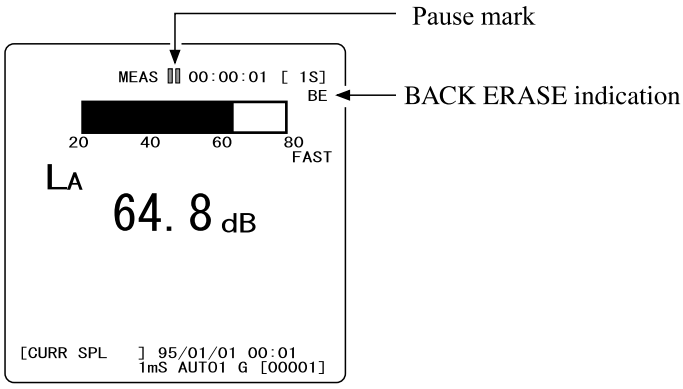
To activate the back-erase function, carry out the following steps.



SET UP menu screen

1. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)
2. Set the "BACK ERASE TIME" item to the desired value. The setting range is 0 to 5 seconds in 1 second steps.
3. Press the SETUP key once more to return to the original measurement screen.

Important
- The back-erase function is not available in statistical modes and in Ltm3 or Ltm5 mode. - The instantaneous value (Lp) display always shows the value at the pause point.



Sound pressure level measurement screen

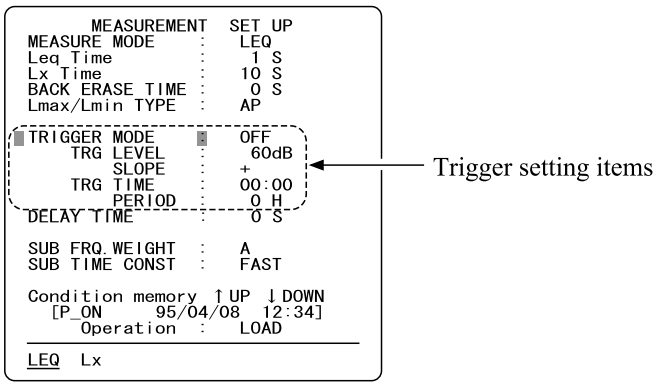
When the PAUSE/CONT key is pressed during measurement, the pause mark appears, the indication "BE" is shown on the top right of the display for about a second, and the data are back-erased. The measurement time is also reduced by the number of seconds set for the back-erase function.

If the back-erase interval is longer than the measurement time, the measurement time becomes "0".

Trigger Function

The NA-27 incorporates three kinds of trigger functions: level trigger, external trigger, and time trigger. The trigger can also be disabled completely.

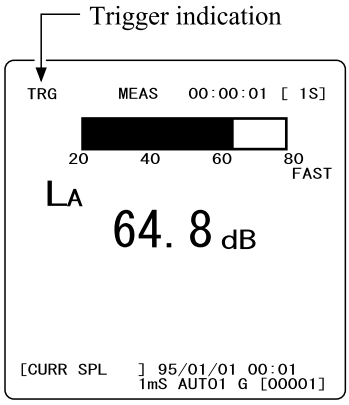
Trigger mode selection



SET UP menu screen

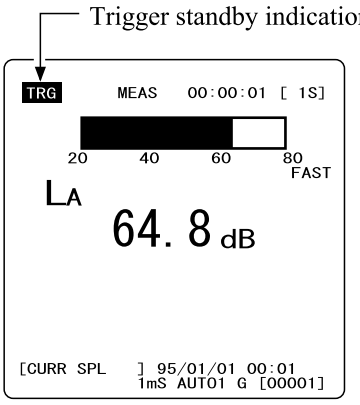
1. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)
2. Set the "TRIGGER MODE" item as desired. There are four possible settings, as listed below.
   - OFF: Trigger function is disabled.
   - LEVEL: Measurement starts when preset level conditions are met (see page 70).
   - EXTRN: An external CMOS logic-level signal (0 to 5 V) supplied to the trigger input on the side of the NA-27 serves to trigger the measurement, using the falling edge of the signal. The external trigger is also activated when the terminals of the trigger input are shorted (see page 71).
   - TIME: Measurement starts at a preset time and is repeated at preset intervals (see page 73).

When the trigger function is enabled, the indication "TRG" appears in the top left of the display.



Sound pressure level measurement screen

When the START/STOP key or the STORE key is pressed, the indication "TRG" is shown in reverse, and the unit goes into standby mode until the trigger condition is fulfilled.



Sound pressure level measurement screen

When the trigger condition is fulfilled, the "TRG" indication goes from reverse to normal, and measurement starts.

Level trigger

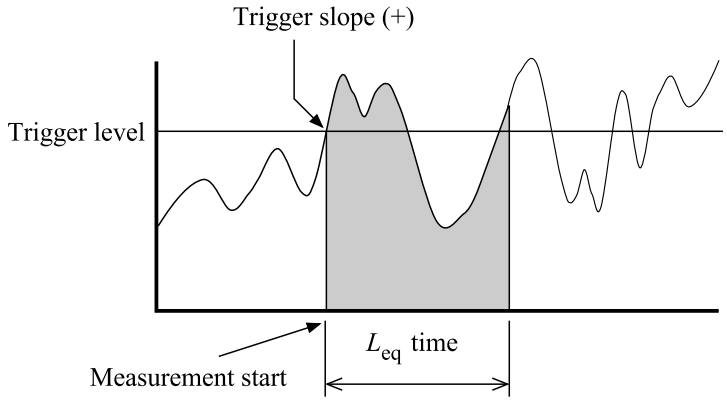
Level setting range: 10 to 140 dB in 1 dB steps

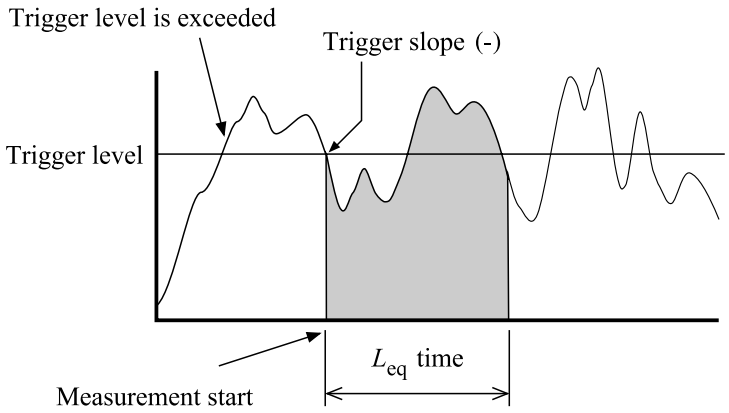
Slope: + / -

1. Set the trigger level.
2. Set the slope.

   When set to (+), the measurement starts when the input signal exceeds the trigger level.

   When set to (-), the measurement starts when the input signal, after having risen once above the trigger level, falls below the trigger level for the first time.





Note

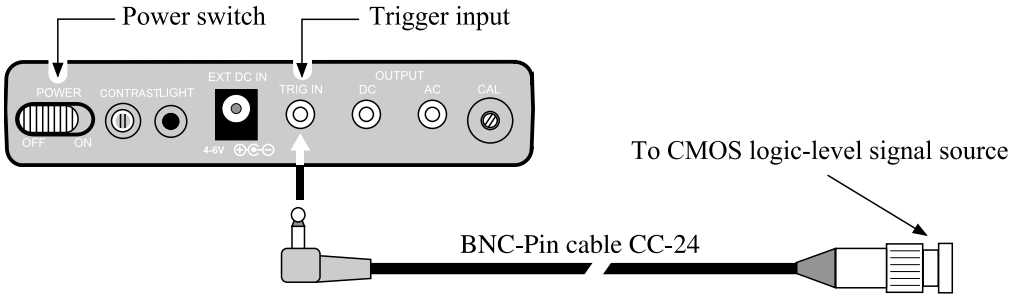
If the trigger level is set to 30 dB or lower, background noise may prevent correct trigger operation, except in special environments such as in an anechoic chamber.

External trigger

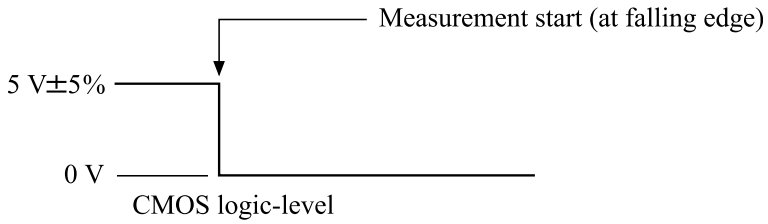
The external trigger can either be a CMOS logic-level signal supplied to the trigger input or it can be activated by shortening the trigger input terminals.

A. Using a CMOS logic-level signal

1. Set the power switch on the side of the unit to OFF and connect the trigger cable.
2. When the connection has been established, set the power switch to ON and use the SETUP menu screen to select the setting "EXTRN" for the trigger function.

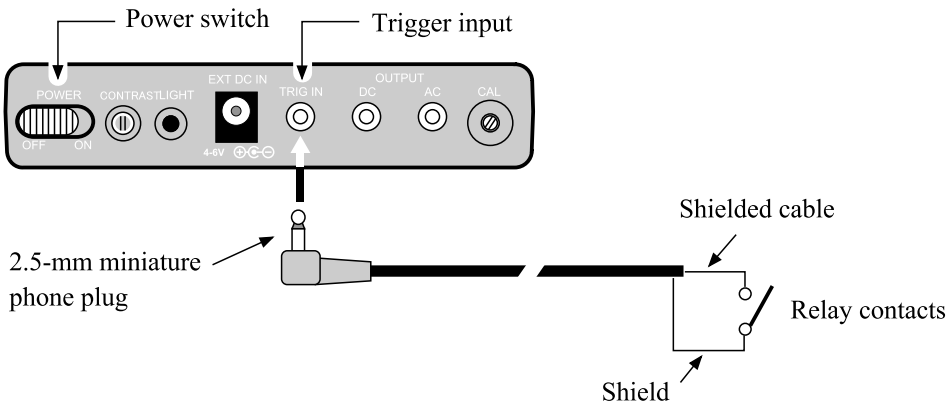


The trigger is activated at the falling edge of the logic-level signal.
Set the "High" level of the logic-level signal source to 5 V±5%.



B. Shorting the trigger input

1. Set the power switch on the side of the unit to OFF and connect the trigger cable.
2. When the connection has been established, set the power switch to ON and use the SETUP menu screen to select the setting "EXTRN" for the trigger function.



3. Use a 2.5 mm miniature phone plug and shielded cable, and configure the trigger circuit as shown above.
4. When the relay contacts close, the trigger is activated and measurement starts.

Note
The shielded cable should be no more than 2.5 meters long. The minimum interrupted current capacity of the contacts should be 50 μA or less. Do not connect the contacts to any other circuitry. The circuit should be configured as a floating (ungrounded) circuit.

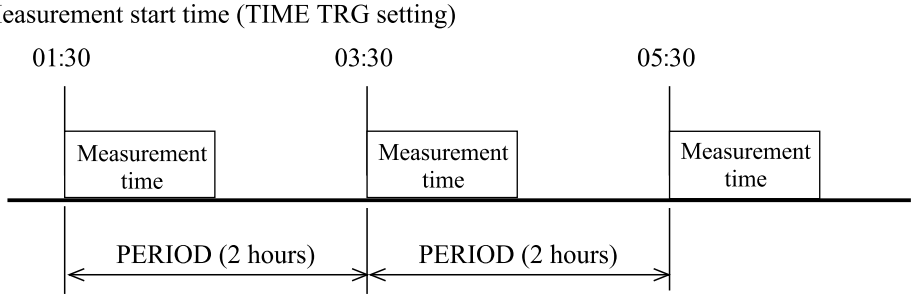
Time trigger

TIME TRG (Measurement start time): 00 h 00 m to 23 h 59 m in 1 minute steps
PERIOD (Measurement repeat interval): 0 h to 24 h in 1 hour steps

1. Set the measurement start time with the "TIME TRG" item.
2. Set the measurement repeat interval with the "PERIOD" item.

- When PERIOD is set to "0 H", the measurement is performed only once at the preset time.
- When PERIOD is set to a value smaller or equal to the measurement time, trigger events within the measurement time are disregarded.

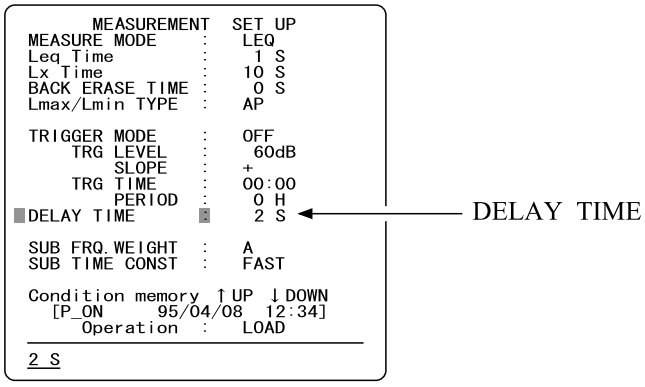
An example for the time trigger operation is shown below.
Measurement start time: 1 h 30 m
Measurement is performed every 2 hours after that.



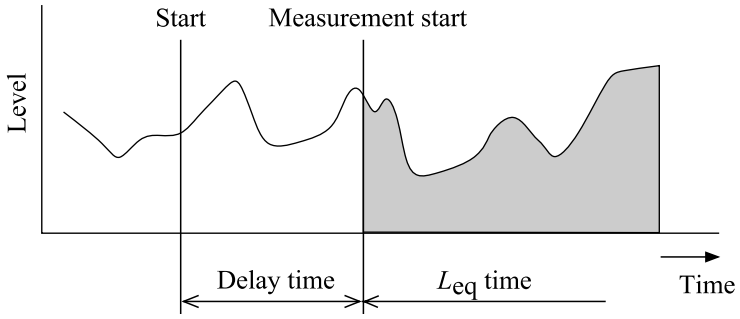
Delayed Measurement

The delayed measurement function allows the user to complete all preparations and perform the steps for measurement start, while having the actual measurement start only after a preset delay time.

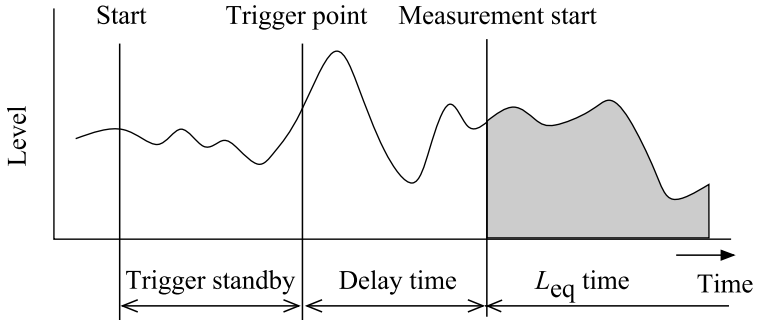
1. Press the SETUP key to call up the SETUP menu screen.
   (For an explanation of how to use the SETUP menu screen, refer to page 30.)
2. Set the "DELAY TIME" item as desired. The setting range is 0 to 10 seconds, in 1 second steps.



SET UP menu screen



If the trigger function is used concurrently, the delay time starts at the trigger point.



Memory Functions

The NA-27 incorporates a memory that allows manual and automatic storing of measurement data ("mass memory") and a separate memory for measurement parameter settings ("condition memory"). Stored measurement results can be displayed by pressing the RECALL key. To protect stored data, the mass memory can be set to read-only.

To use the memory, the backup battery must be inserted (see page 16).

MANU (manual store)

Measured instantaneous value data and processing results can be stored manually by the operator. When the STORE key is pressed, measurement data, all processing results, measurement parameter settings, and measurement date and time are stored in the currently selected address.

Up to 200 data sets can be stored in this way.

Note
If after completion of a measurement the measurement parameters (such as frequency weighting, time constant, level up/down) are changed before pressing the STORE key, there will be a mismatch between stored data and stored measurement parameter settings.

AUTO (automatic store)

There are two identical memory blocks (AUTO1, AUTO2) for automatic storing of data.

It is possible to automatically store either only the currently displayed measurement result (single store) or to simultaneously store all processing results (group store), either at specified store time intervals or at the measurement time intervals.

Single store

10000 data/block:	(sound pressure level mode)
4000 data/block:	(1/1-octave analysis mode)
2000 data/block:	(1/3-octave analysis mode)
L_p store interval:	1 to 990 ms in 1 ms steps

Group store

200 data

Store interval: measurement time interval

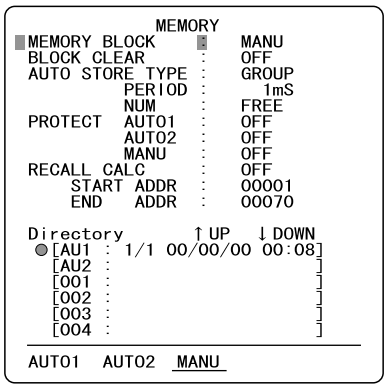
The memory upper limit can be set with the "NUM" item on the MEMORY menu screen, as described on page 39.

Manual (Sound Pressure Level Mode)

Storing data in memory

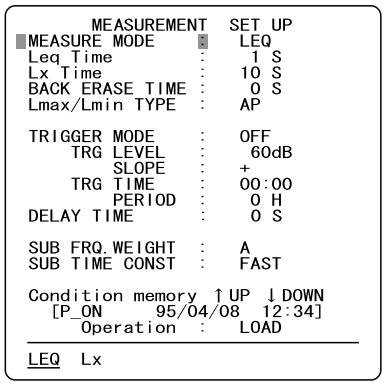
At the point where the STORE key is pressed, the current instantaneous value and the various processing results are stored in memory. The procedure is as described below.

1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
2. Press the MEMORY key to call up the MEMORY menu screen.
   (For an explanation of how to use the MEMORY menu screen, refer to page 30.)
3. Set the "MEMORY BLOCK" item to "MANU".



MEMORY menu screen

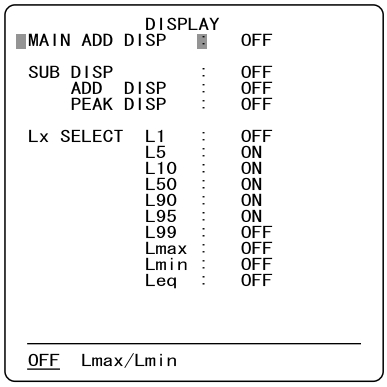
4. Press the SETUP key to call up the SETUP menu screen.



SET UP menu screen

5. Set "Leq Time", "TRIGGER MODE" and other items to the desired settings.

6. Press the DISPLAY key to call up the DISPLAY menu screen.



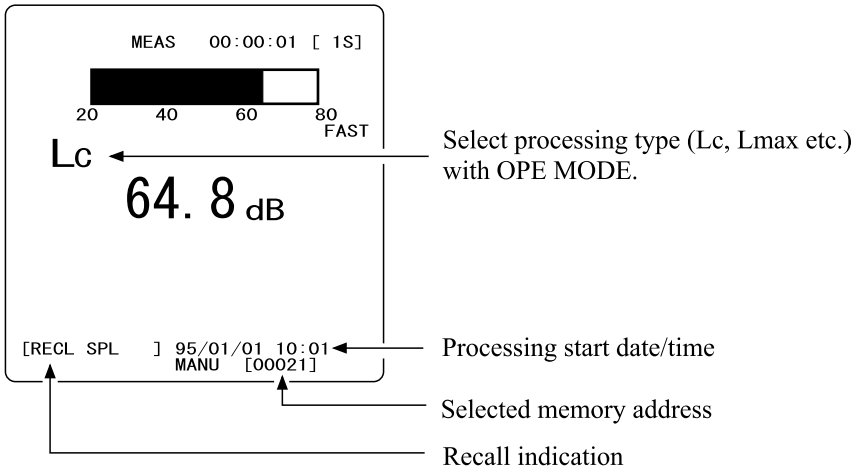
DISPLAY menu screen

7. Set "MAIN ADD DISP" and other items to the desired settings.
8. Press the DISPLAY key to return to the original measurement screen.
9. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
10. Use the INC and DEC keys to select the memory address in which to store the measurement data.
11. Press the START/STOP key to start the measurement. The measurement will start according to the trigger mode and other settings. When measurement is in progress, the ► at the top of the display and the LED indicator are flashing.
12. When the measurement is completed and the STORE key is pressed, one set of data is stored in the selected address.
    The address counter indication at the bottom right of the screen is shown in reverse, and the counter is incremented by one.
13. By repeating the procedure from step 11, more data can be stored in memory.

Reading from memory

The procedure for reading data from memory is described below.

1. Press the RECALL key.
2. Use the INC and DEC keys to select the memory address from which you want to display data.
3. Use the OPE MODE key to select the processing type for display (L_C, L_{max} etc.)

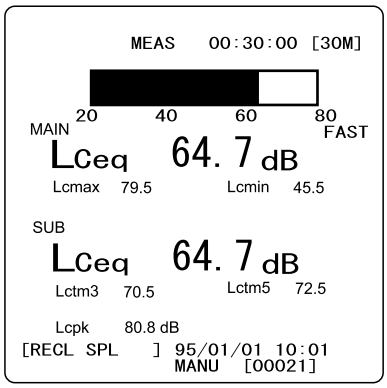


Recall screen

The date/time shown on the display is the processing start date/time.

To check the date/time when the STORE key was pressed, use the "Directory" item on the MEMORY menu screen.

An example for recalled data is shown below.

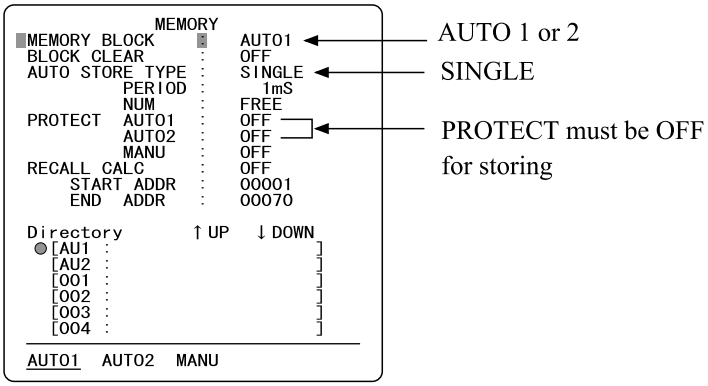


Recall screen

Auto (Sound Pressure Level Mode) Single Store

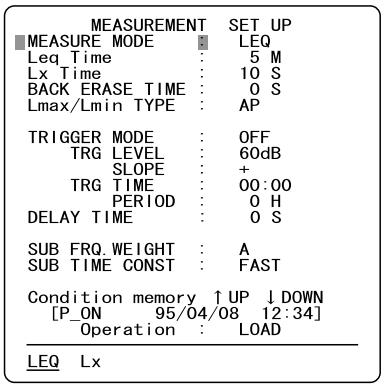
Storing data in memory

1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
2. Press the MEMORY key to call up the MEMORY menu screen.
   (For an explanation of how to use the MEMORY menu screen, refer to page 32.)



MEMORY menu screen

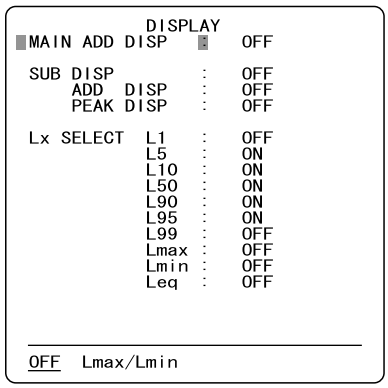
3. Set the "MEMORY BLOCK" item to "AUTO1" or "AUTO2 ".
4. Set the "AUTO STORE TYPE" to "SINGLE".
5. Press the SETUP key to call up the SETUP menu screen.



SET UP menu screen

6. Set "Leq Time", "TRIGGER MODE" and other items to the desired settings.

7. Press the DISPLAY key to call up the DISPLAY menu screen.



DISPLAY menu screen

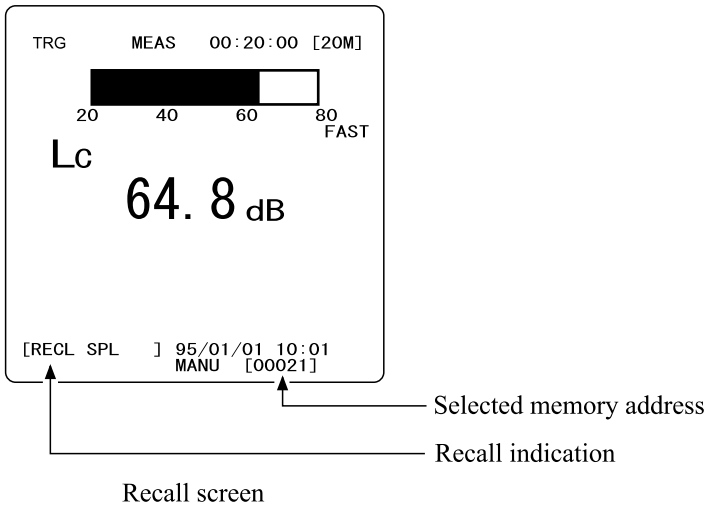
8. Set "MAIN ADD DISP" and other items to the desired settings.
9. Press the DISPLAY key to return to the original measurement screen.
10. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
11. Use the OPE MODE key, FREQ WEIGHT key, TIME CONST key, and LEVEL UP/DOWN keys to set the measurement parameters.
12. Press the STORE key to start the measurement.
    The measurement will start according to the trigger mode and other settings. When measurement is in progress, the ► at the top of the display and the LED indicator are flashing.
13. When 10000 data * have been stored, the measurement is terminated automatically. The LED indicator goes out.
14. When wishing to stop auto store earlier, press the START/STOP key or the STORE key. The store process is terminated and the unit reverts to normal measurement mode.
    Pressing the STORE key again causes the process to be repeated from step 12.

* Upper limit can be set with MEMORY menu screen.

Reading from memory

The procedure for reading data from memory is described below.

1. Press the RECALL key.
2. Use the INC and DEC keys to select the memory address from which you want to display data.



The date/time is indicated as follows.

Instantaneous values: Date/time when instantaneous value was stored.

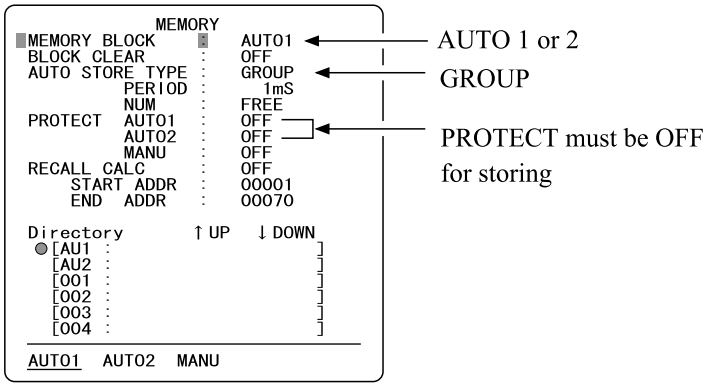
Processed values: Date/time when processing was started.

Auto (Sound Pressure Level Mode) Group Store

Storing data in memory

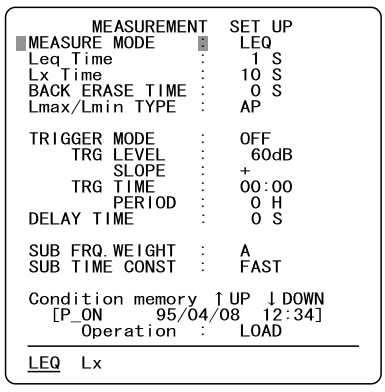
The procedure for storing data in memory is described below.

1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
2. Press the MEMORY key to call up the MEMORY menu screen.



MEMORY menu screen

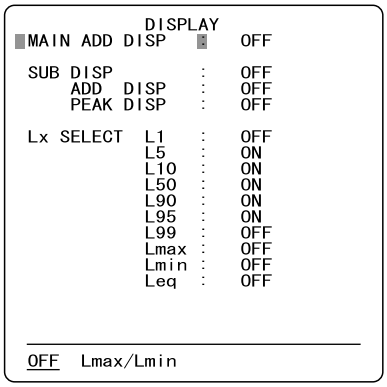
3. Set the "MEMORY BLOCK" item to "AUTO1" or "AUTO2".
4. Set the "AUTO STORE TYPE" to "GROUP".
5. Press the SETUP key to call up the SETUP menu screen.



SET UP menu screen

6. Set "Leq Time", "TRIGGER MODE" and other items to the desired settings.

7. Press the DISPLAY key to call up the DISPLAY menu screen.



DISPLAY menu screen

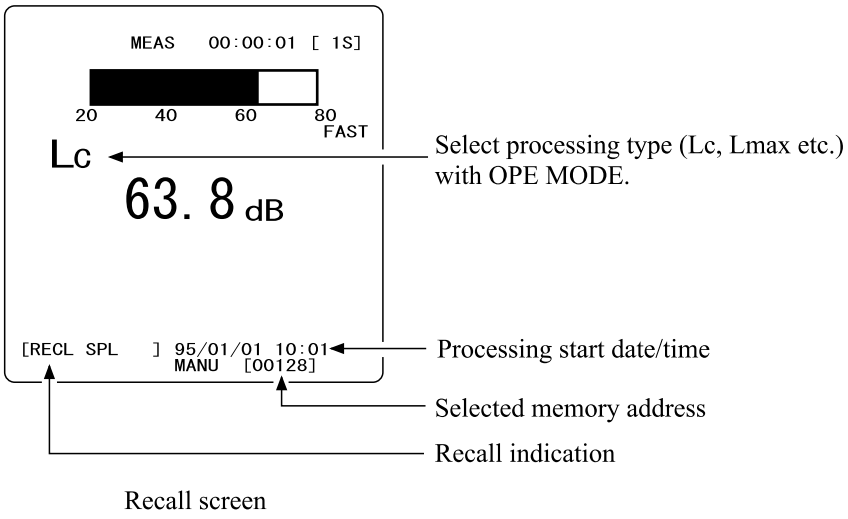
8. Set "MAIN ADD DISP" and other items to the desired settings.
9. Press the DISPLAY key to return to the original measurement screen.
10. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.
11. Use the OPE MODE key, FREQ WEIGHT key, TIME CONST key, and LEVEL UP/DOWN keys to set the measurement parameters.
12. Press the STORE key to start the measurement.
    The measurement will start according to the trigger mode and other settings. When measurement is in progress, the ► at the top of the display and the LED indicator are flashing.
    Storing begins from memory address 00001.
13. When 200 data * have been stored, the measurement is terminated automatically. The LED indicator goes out.
14. When wishing to stop auto store earlier, press the START/STOP key or the STORE key. The store process is terminated and the unit reverts to normal measurement mode.
    Pressing the STORE key again causes the process to be repeated from step 12.

* Upper limit can be set with MEMORY menu screen.

Reading from memory

The procedure for reading data from memory is described below.

1. Press the RECALL key.
2. Use the INC and DEC keys to select the memory address from which you want to display data.
3. Use the OPE MODE key to select the processing type for display (L_C, L_{max} etc.)



Recall screen

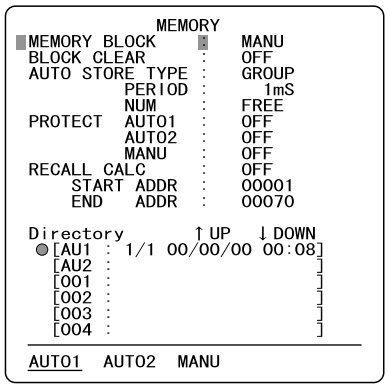
The date/time shown on the display is the processing start date/time.

Manual (Frequency Analysis Mode)

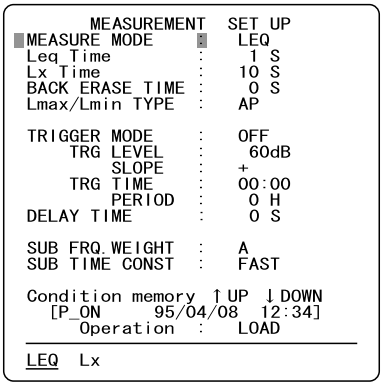
Storing data in memory

At the point where the STORE key is pressed, the current instantaneous value and the various processing results are stored in memory. The procedure is as described below.

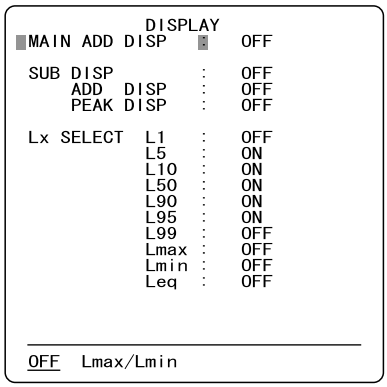
1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
2. Press the MEMORY key to call up the MEMORY menu screen.
3. Set the "MEMORY BLOCK" item to "MANU".
4. Press the SETUP key to call up the SETUP menu screen.
5. Set "Leq Time", "TRIGGER MODE" and other items to the desired settings.
6. Press the DISPLAY key to call up the DISPLAY menu screen.
7. Set "MAIN ADD DISP" and other items to the desired settings.
8. Press the DISPLAY key to return to the original measurement screen.
9. Use the SLM / 1/1 1/3 key to activate the frequency analysis screen.
10. Use the INC and DEC keys to select the memory address in which to store the measurement data.
11. Press the START/STOP key to start the measurement. The measurement will start according to the trigger mode and other settings. When measurement is in progress, the ▶ at the top of the display and the LED indicator are flashing.
12. When the measurement is completed and the STORE key is pressed, one set of data is stored in the selected address.
    The address counter indication at the bottom right of the screen is shown in reverse, and the counter is incremented by one.
13. By repeating the procedure from setup 11, more data can be stored in memory. Use the INC and DEC keys to select the memory address in which to store the measurement data.



MEMORY menu screen



SET UP menu screen



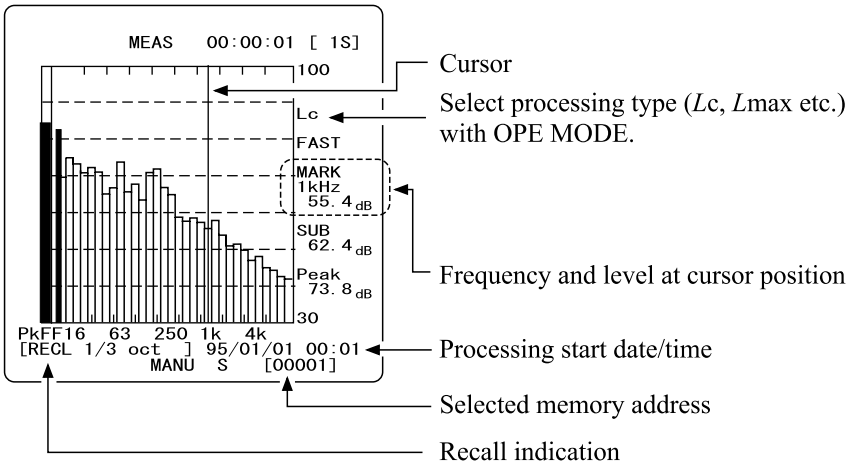
DISPLAY menu screen

Reading from memory

The procedure for reading data from memory is described below.

1. Press the RECALL key.
2. Use the INC and DEC keys to select the memory address from which you want to display data.
3. Use the OPE MODE key to select the processing type for display (L_C, L_{max} etc.).

   An example for recalled 1/3-octave analysis data is shown below.



1/3-octave analysis recall screen

   The date/time shown on the display is the processing start date/time.
   To check the date/time when the STORE key was pressed, use the "Directory" item on the MEMORY menu screen.

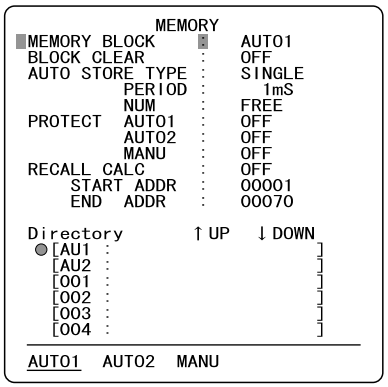
4. When moving the cursor with the ◄ and ► keys, the frequency and level displayed at the right of the screen changes.

Auto (Frequency Analysis Mode) Single Store

Storing data in memory

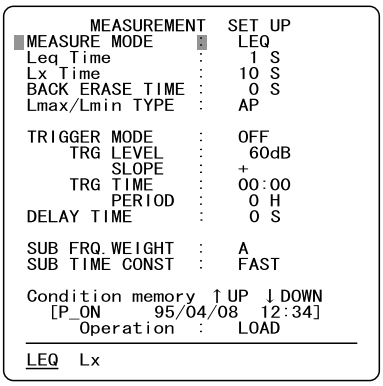
The procedure for storing data in memory is described below.

1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
2. Press the MEMORY key to call up the MEMORY menu screen.
3. Set the "MEMORY BLOCK" item to "AUTO1" or "AUTO2".
4. Set the "AUTO STORE TYPE" to "SINGLE".



MEMORY menu screen

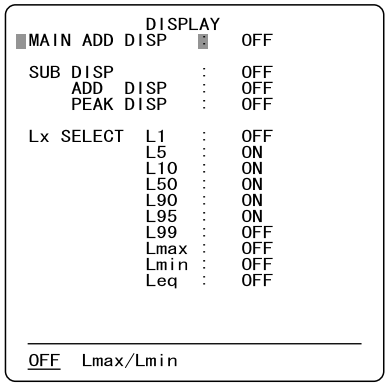
5. Press the SETUP key to call up the SETUP menu screen.



SET UP menu screen

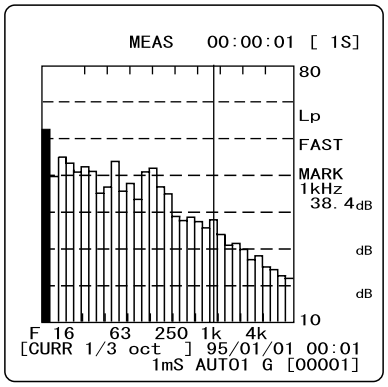
6. Set "Leq Time", "TRIGGER MODE" and other items to the desired settings.

7. Press the DISPLAY key to call up the DISPLAY menu screen.

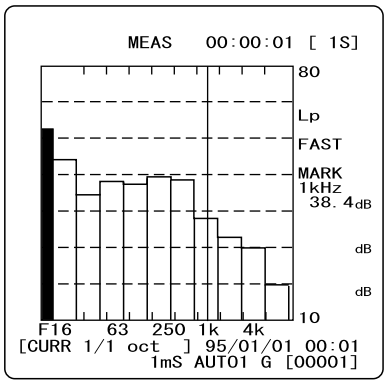


DISPLAY menu screen

8. Set "MAIN ADD DISP" and other items to the desired settings.
9. Press the DISPLAY key to return to the original measurement screen.
10. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.



1/3-octave analysis screen



1/1-octave analysis screen

11. Use the OPE MODE key, FREQ WEIGHT key, TIME CONST key, and LEVEL UP/DOWN keys to set the measurement parameters.
12. Press the STORE key to start the measurement.
    The measurement will start according to the trigger mode and other settings. When measurement is in progress, the ► at the top of the display and the LED indicator are flashing.
    Storing begins from memory address 00001.
13. When 4000 data * (for 1/1-octave analysis) or 2000 data * (for 1/3-octave analysis) have been stored, the measurement is terminated automatically.
14. When wishing to stop auto store earlier, press the START/STOP key or the STORE key. The store process is terminated and the unit reverts to normal measurement mode.

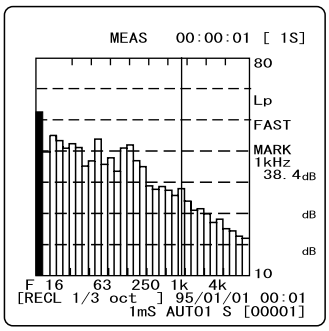
Pressing the STORE key again causes the process to be repeated from step 12.

* Upper limit can be set with MEMORY menu screen.

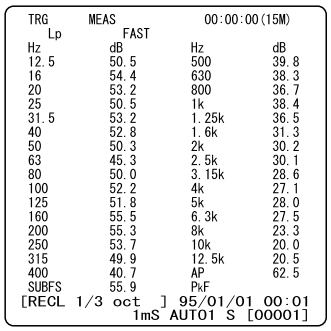
Reading from memory

The procedure for reading data from memory is described below.

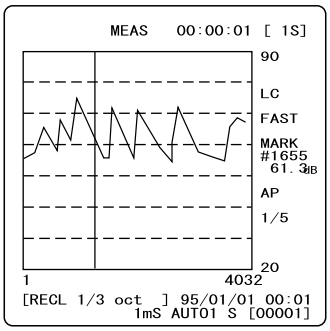
1. Press the RECALL key.
2. Use the GRP/NUM/L-T key to select the type of display.



Graphical display (GRP)

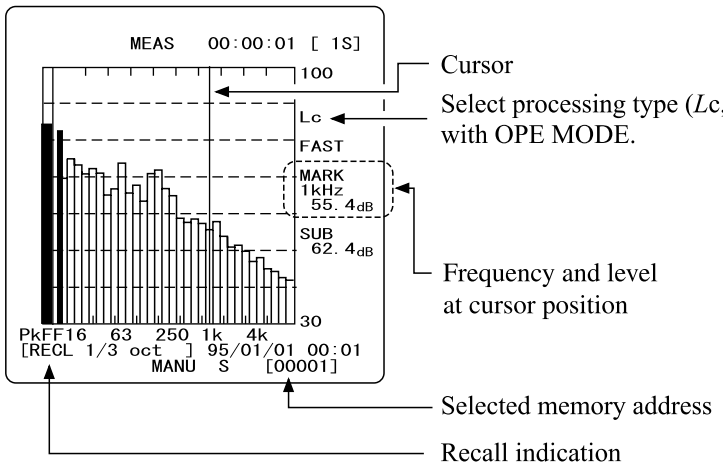


Numerical display (NUM)



Level-time display (L-T)

The graphical display contains the following information.



1/3-octave analysis recall screen

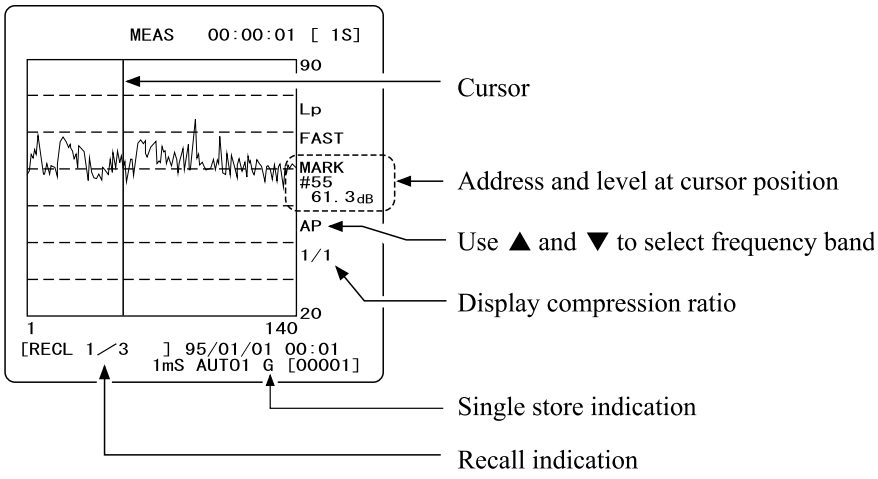
The date/time is indicated as follows.

Instantaneous values: Date/time when instantaneous value was stored.
Processed values: Date/time when processing was started.

1. Use the INC and DEC keys to select the memory address from which you want to display data.

2. When moving the cursor with the ◄ and ► keys, the frequency and level displayed at the right of the screen changes.

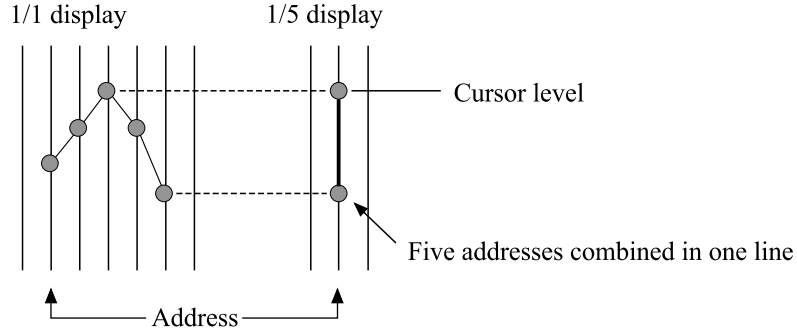
The level-time display contains the following information.



Level-time recall screen

1. Use the INC and DEC keys to select the memory address from which you want to display data.
2. Use the LEVEL UP/DOWN (←LT→/→LT←) keys to select the display compression ratio.
   Pressing the ←LT→ key widens the address range, and pressing the →LT← key narrows it down.
3. Use the ▲ and ▼ keys to select the frequency band.

When the compression ratio is 1/2 or higher, data for two or more addresses are shown at the cursor line. Address data are expressed by drawing a line from the highest to the lowest level.
When several address data are combined, the cursor shows the lowest (first) address and the highest level of the combined addresses.
An example for 1/1 and 1/5 compression is shown below.

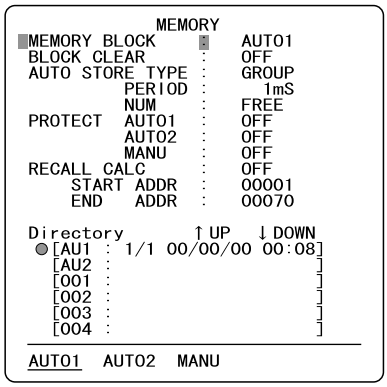


Auto (Frequency Analysis Mode) Group Store

Storing data in memory

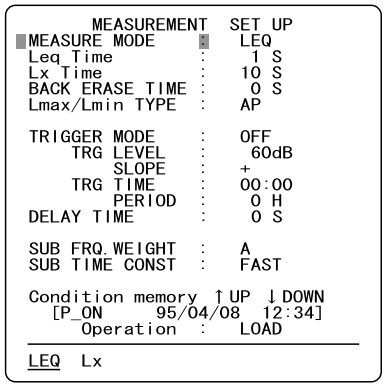
The procedure for storing data in memory is described below.

1. Set the power switch on the side of the unit to ON and wait until the measurement screen appears.
2. Press the MEMORY key to call up the MEMORY menu screen.
   (For an explanation of how to use the MEMORY menu screen, refer to page 32.)



MEMORY menu screen

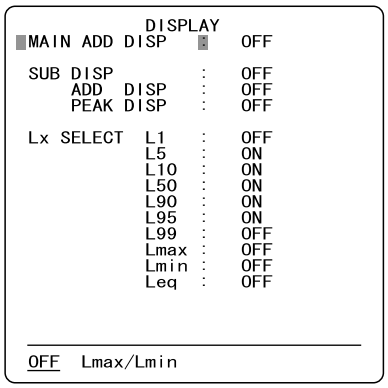
3. Set the "MEMORY BLOCK" item to "AUTO1" or "AUTO2".
4. Set the "AUTO STORE TYPE" to "GROUP".
5. Press the SETUP key to call up the SETUP menu screen.



SET UP menu screen

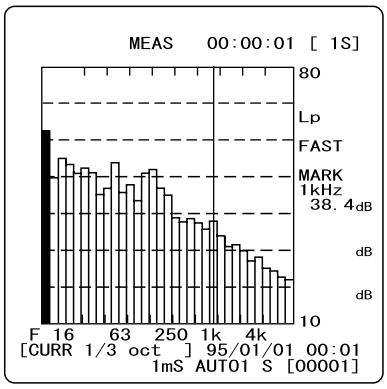
6. Set "Leq Time", "TRIGGER MODE" and other items to the desired settings.

7. Press the DISPLAY key to call up the DISPLAY menu screen.

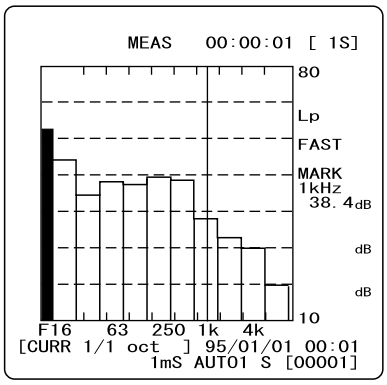


DISPLAY menu screen

8. Set "MAIN ADD DISP" and other items to the desired settings.
9. Press the DISPLAY key to return to the original measurement screen.
10. Use the SLM / 1/1 / 1/3 key to activate the sound pressure level measurement screen.



1/3-octave analysis screen



1/1-octave analysis screen

11. Use the OPE MODE key, FREQ WEIGHT key, TIME CONST key, and LEVEL UP/DOWN keys to set the measurement parameters.
12. Press the STORE key to start the measurement.
    The measurement will start according to the trigger mode and other settings. When measurement is in progress, the ► at the top of the display and the LED indicator are flashing.
    Storing begins from memory address 00001.
13. When 200 data * have been stored, the measurement is terminated automatically.
14. When wishing to stop auto store earlier, press the START/STOP key or the STORE key. The store process is terminated and the unit reverts to normal measurement mode.

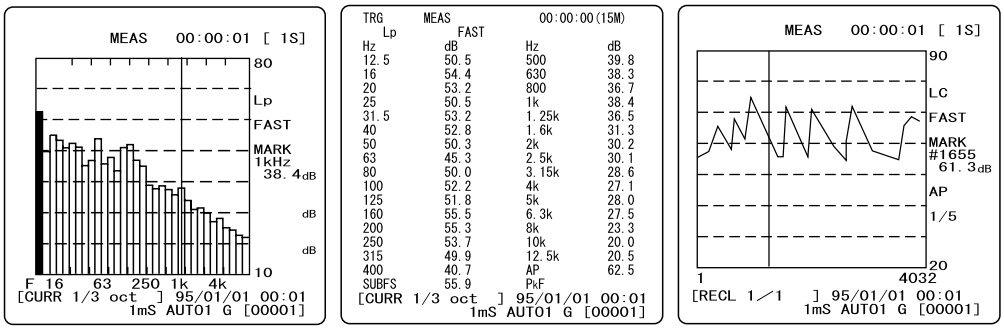
Pressing the STORE key again causes the process to be repeated from step 12.

* Upper limit can be set with MEMORY menu screen.

Reading from memory

The procedure for reading data from memory is described below.

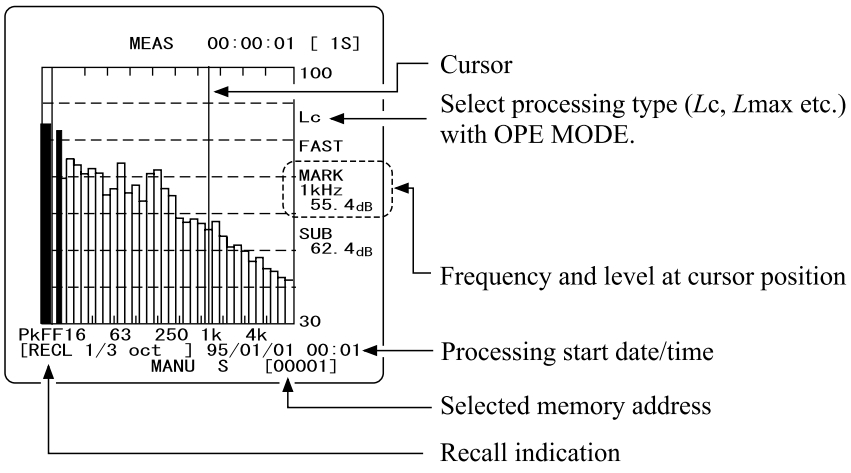
1. Press the RECALL key.
2. Use the GRP/NUM/L-T key to select the type of display.



Graphical display (GRP) Numeric display (NUM) Level-time display (L-T)

1/3-octave analysis recall screen

The graphical display contains the following information.

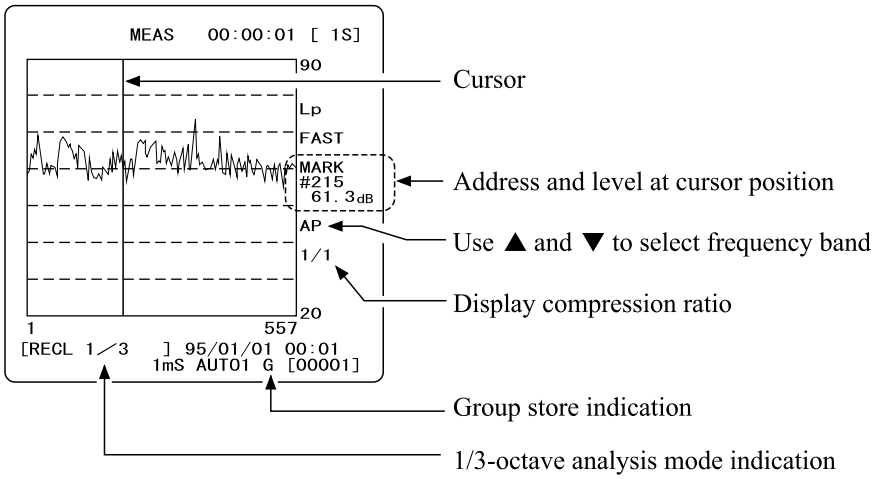


1/3-octave analysis recall screen

The date/time shown on the display is the processing start date/time.

1. Use the INC and DEC keys to select the memory address from which you want to display data.
2. Use the OPE MODE key to select the processing type for display (L_C, L_{max} etc.).
3. When moving the cursor with the ◀ and ▶ keys, the frequency and level displayed at the right of the screen changes.

The level-time display contains the following information.

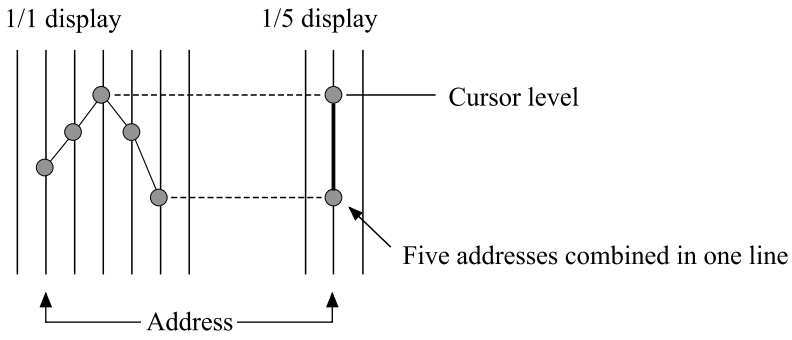


Level-time recall screen

1. Use the INC and DEC keys to select the memory address from which you want to display data.
2. Use the LEVEL UP/DOWN (←LT→/→LT←) keys to select the display compression ratio.
   Pressing the ←LT→ key widens the address range, and pressing the →LT← key narrows it down.

   When the compression ratio is 1/2 or higher, data for two or more addresses are shown at the cursor line. Address data are expressed by drawing a line from the highest to the lowest level.
   When several address data are combined, the cursor shows the lowest (first) address and the highest level of the combined addresses.

An example for 1/1 and 1/5 compression is shown below.



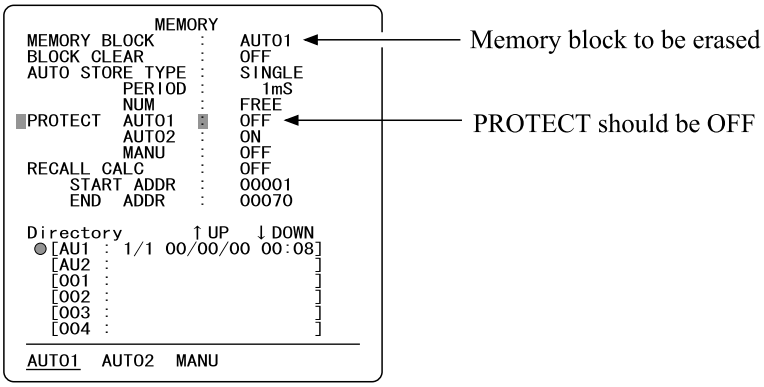
3. Use the ▲ and ▼ keys to select the frequency band.
4. Use the OPE MODE key to select the type of processing.

Erasing Data

All data stored in an address block can be erased as follows.

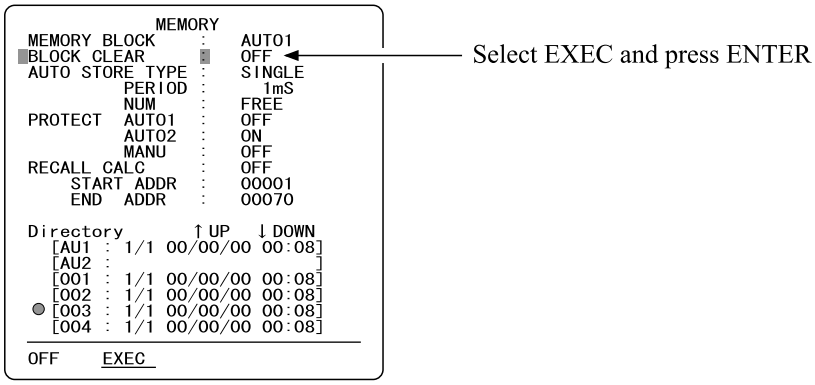
Take care not to accidentally erase data that you want to keep.

1. Press the MEMORY key to call up the MEMORY menu screen.



MEMORY menu screen

2. Select the memory block which you want to erase.
3. Set the "PROTECT" item for the memory block to OFF.



MEMORY menu screen

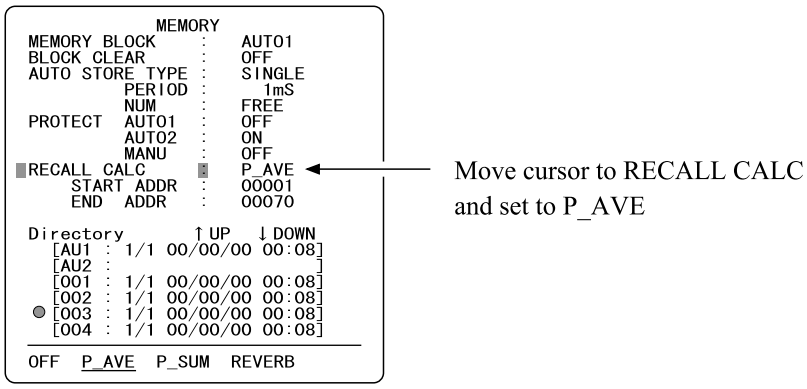
4. Move the cursor to the "BLOCK CLEAR" item.
5. Use the ◀ and ▶ keys to select EXEC.
6. Press the ENTER key to erase all data in the selected memory block.

Recall Processing

Using the recall processing function, power average (P_AVE), power sum (P_SUM), and reverb time (REVERB) can be calculated.

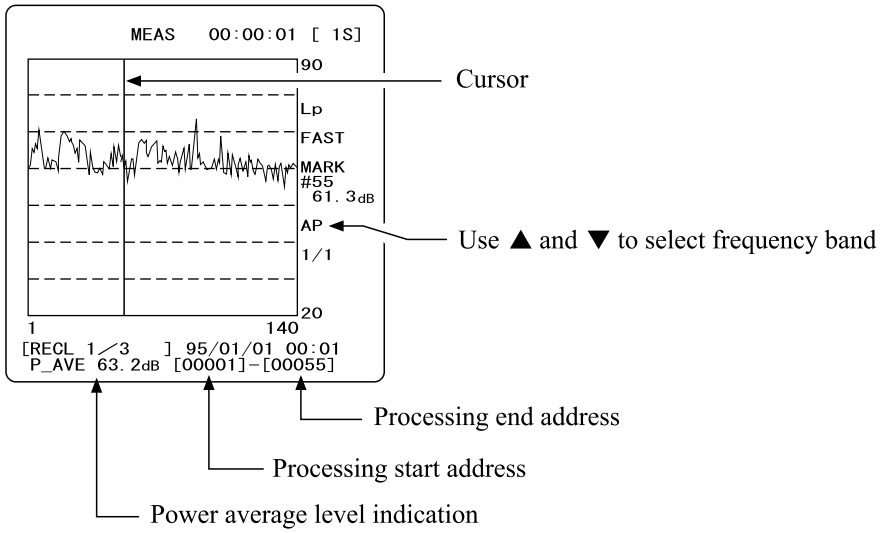
The following explanation is for power average (P_AVE), but the procedure for other functions is identical.

1. Store data using the auto store function for frequency analysis in single (p. 89) or group (p. 93) mode.
2. Press the MEMORY key to call up the MEMORY menu screen.



MEMORY menu screen

3. Move the cursor to the "RECALL CALC" item.
4. Set the item to "P_AVE".
5. Press the MEMORY key to return to the analysis screen.



Level-time recall screen

6. Use the INC and DEC keys to select the processing start address. (The left border of the screen corresponds to the processing start address.)
7. Use the ◄ and ► keys to select the processing end address.
8. The bottom of the screen shows "P_AVE ∗∗∗.∗ dB" (when power sum is selected: "P_SUM ∗∗∗.∗ dB").
   The result for power average or power sum processing (for all frequency bands together) is shown on the graphical screen or the numeric list display.
   When reverberation processing is selected, the display shows "REVERB ∗∗∗.∗ S".
   In this mode, the analysis data in the graphical screen and numeric list display are recalled data from the start address of the processing range. (The same applies when recall processing is set to OFF.)
9. When the recall screen is terminated, processing is automatically set to OFF.
   If the start address (START ADDR) and end address (END ADDR) were specified in step 4 on the MEMORY menu screen, the cursor automatically is placed on the processing end address during level-time recall display.

Remote Control (NA-27RC1)

The supplied infrared remote control (NA-27RC1) allows operating the sound level meter from a distance of up to 3 meters. The top panel of the control has buttons for controlling measurement progress and changing measurement parameter settings.

Top panel

START STOP key

Serves to start and stop the measurement.

PAUSE CONT key

Serves to pause the measurement. When the back-erase function is activated, data immediately preceding the point when the key was pressed are excluded from processing.

LEVEL UP DOWN keys

Serve to select the level range.

FAST, SLOW, 10ms keys

Serve to select the time constant for the main channel.

Lp, Leq, LE, Lmax, Lmin keys

Serve to select the measurement result display type.

STORE key

Serves to store data in the internal memory of the NA-27. The key also serves to terminate the store process.

A, C keys

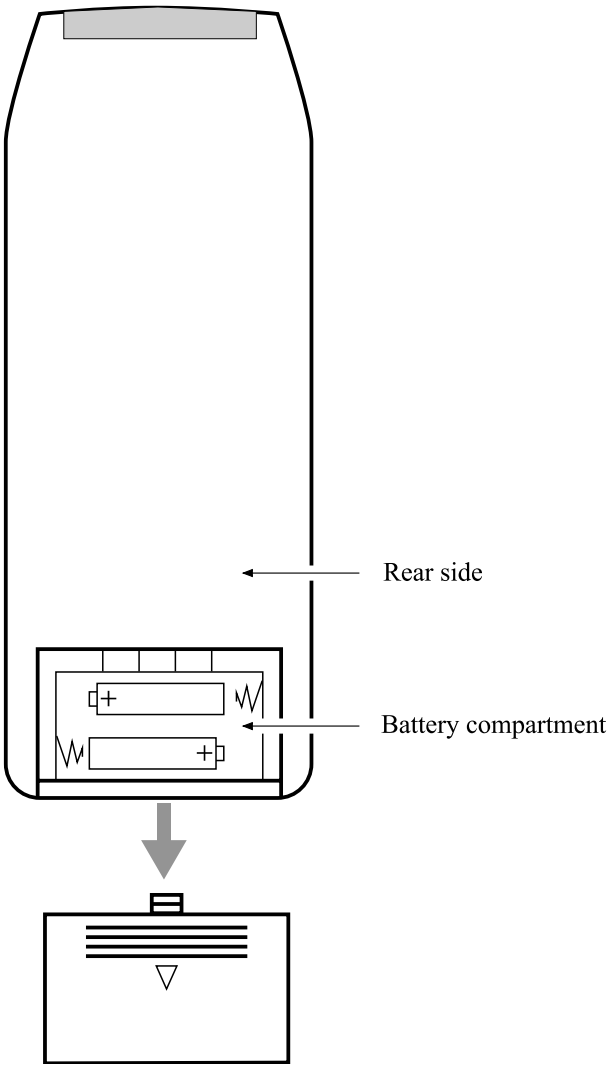
Serve to select frequency weighting for the main channel.
A: "A" characteristics
C: "C" characteristics

PRINT key

Serves to print out the display contents of the NA-27 on a connecting printer (DPU-414, CP-10, CP-11).

To use the remote control, insert two IEC R03 (size AAA) batteries in the battery compartment on the rear.

1. Push the cover of the battery compartment down in direction of the arrow mark and slide it off.
2. Insert two IEC R03 (size AAA) batteries, taking care to establish correct polarity.
3. Replace the cover of the battery compartment.



Important

Take care not to reverse the (+) and (-) polarity when inserting a battery.

Always use two identical batteries, and replace batteries only as a set. Mixing battery types or old and new batteries can lead to damage.

Remove the batteries from the unit if it is not to be used for a week or longer.

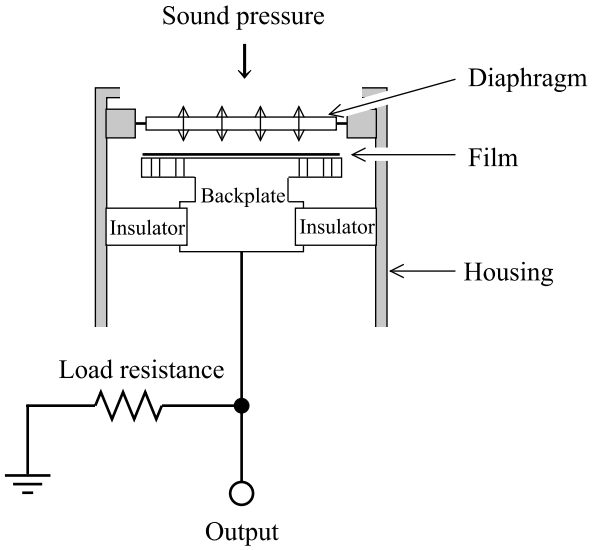
Technical Notes

Microphone

Measurements of sound pressure level can be carried out with a variety of microphone types. The precision integral sound pressure level meter NA-27 employs the prepolarized condenser microphone UC-53A that is compact and delivers stable and reliable response.

Construction and Operation Principle

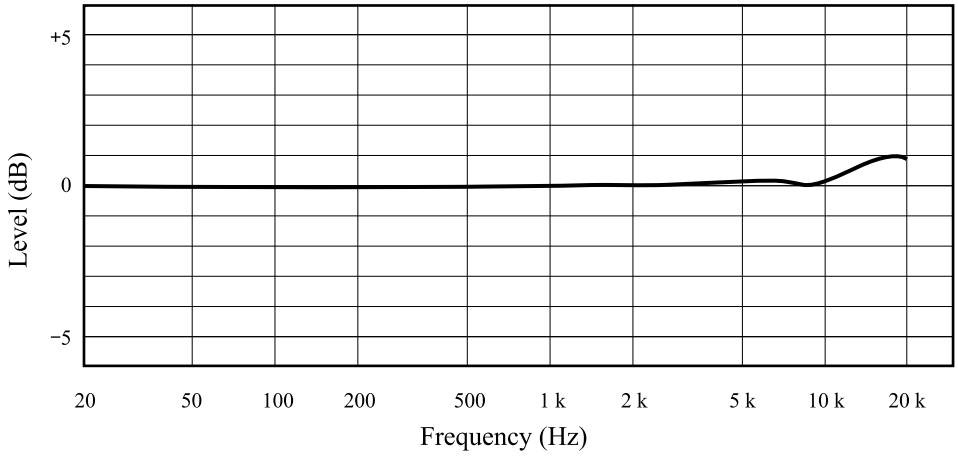
As shown in the drawing below, a prepolarized condenser microphone consists of four main parts: diaphragm, backplate, insulator, and housing. The surface of the backplate is covered by a film holding an electrical charge. When sound pressure is applied to the diaphragm, the distance between the diaphragm and the backplate changes, thereby altering the capacitance. Using a load resistor, this change can be turned into a voltage change. The frequency response as well as the temperature and humidity characteristics of an prepolarized microphone depend considerably on the type and properties of the materials used. The frequency range is determined by the resonance frequency of the diaphragm assembly.



Construction of prepolarized condenser microphone

Frequency Response

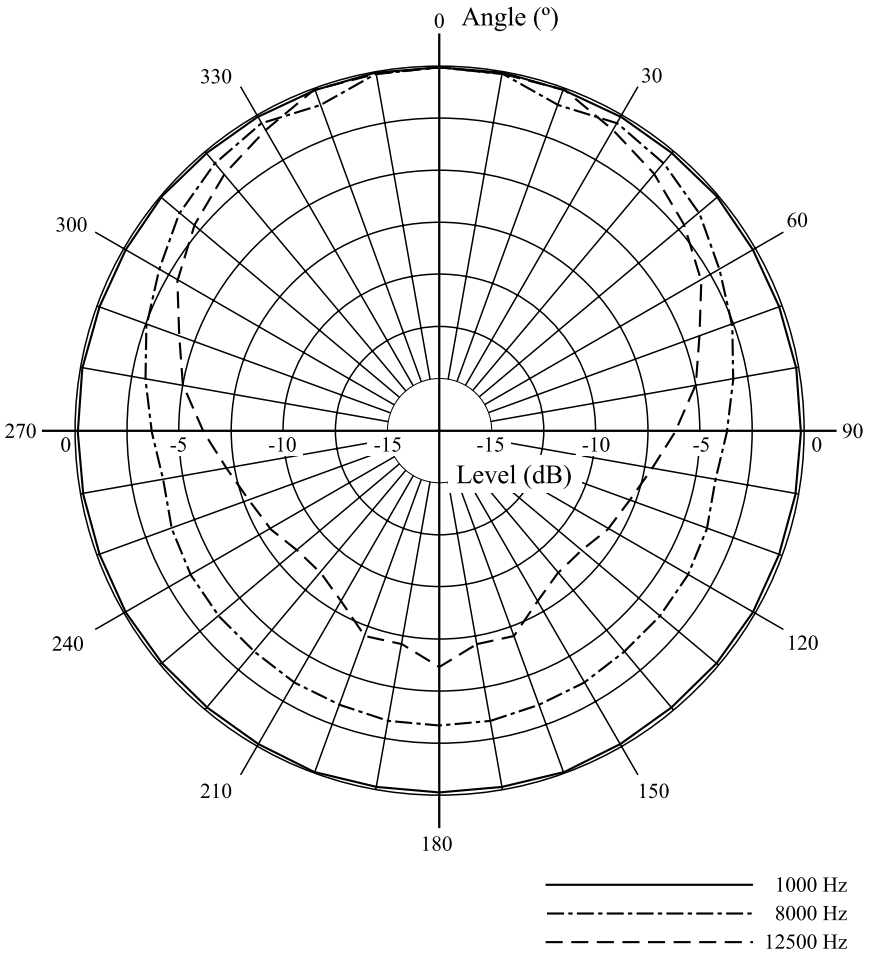
The frequency response of a sound field microphone is expressed as the frequency response in the reference direction of incidence (0º). The diagram below shows an example for the frequency response of the microphone UC-53A.



Frequency response sample of microphone UC-53A

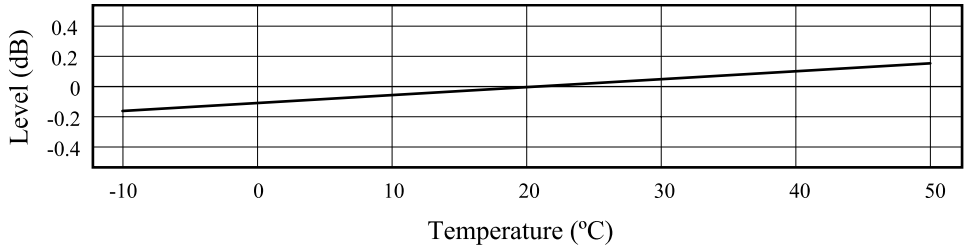
Directional characteristics

The directional characteristics of a microphone is a measure of its differing sensitivity for sound waves arriving from various angles. Since the prepolarized condenser microphone used in the NA-27 is a pressure-sensitive type, it should be equally sensitive in all directions. However, refraction and cavity effects cause a certain microphone directional characteristics at high frequencies. The diagram below shows the directional characteristics of the microphone UC-53A.



Thermal Characteristics

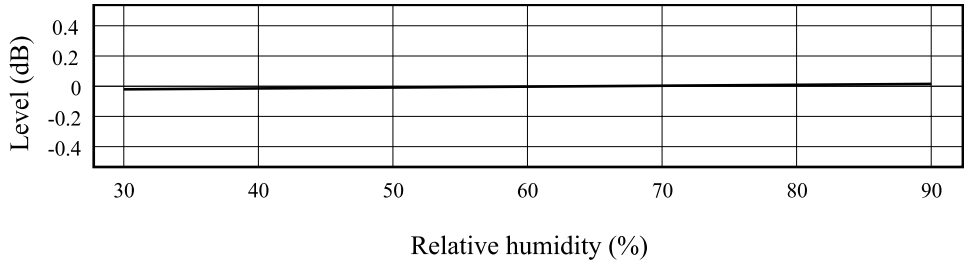
The thermal characteristics of a microphone indicate how sensitivity changes at various temperatures. This is influenced by the choice of materials and the design of the microphone. Normally, materials with a linear expansion coefficient are used. The diagrams below show the thermal characteristics of the microphone UC-53A.



Thermal characteristics (at 250 Hz)

Humidity Characteristics

The humidity characteristics of a microphone indicate how sensitivity changes at various humidity levels. The diagrams below show the microphone UC-53A.



Humidity characteristics (at 250 Hz)

Microphone (UC-53A) Specifications

Nominal diameter:	1/2 inch
Sensitivity:	-28 dB (0 dB = 1 V/Pa at 1000 Hz)
Frequency response:	10 to 20000 Hz
Capacitance:	12 pF
Diaphragm type:	Titan alloy film
Temperature coefficient:	+0.005 dB/ºC (at 250 Hz)
Humidity-dependent sensitivity change:	
	0.1 dB or less (at 250 Hz, RH below 95%, no condensation)
Dimensions:	13.2 dia. × 12.9 mm

Preamplifier

Preamplifier Requirement

Since the condenser microphone is a small-capacity transducer, it has high impedance, especially at low frequencies. Therefore a very high load resistance is required to ensure uniform response extending to the low frequency range. The relationship between the microphone capacitance and the low-range cutoff frequency can be expressed as follows.

$$f_0 = \frac{1}{2\pi \bullet Z_{in} \bullet C_m}$$

f_0: Low-range cutoff frequency (Hz)
Z_{in}: Preamplifier input impedance (Ω)
C_m: Capacitance of condenser microphone (F)

If the output of the microphone were directly routed through a long shielded cable, the capacitance between the cable conductors would cause a sharp drop in sensitivity, as is evident from the following equation.

$$M_0 = \frac{C_m}{C_m + C_c} \bullet M_s$$

M_0: Output voltage into directly connected shielded cable (V)
M_s: Output voltage in microphone open condition (V)
C_c: Cable capacitance of shielded cable (F)

For the above reasons, a preamplifier is connected directly after the microphone, to provide a low-impedance output signal.

Preamplifier Specifications

Input impedance:	3 GΩ
Output impedance:	Less than 300 Ω
Maximum output current:	2 mA

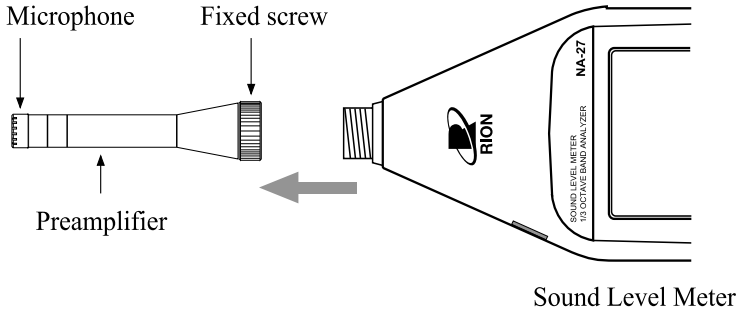
Microphone Extension Cable (EC-04 series)

To reduce measurement deviations due to refraction effects and the acoustic influence of the operator, the microphone/preamplifier assembly can be detached from the main unit and connected via an extension cable.

Optional cables are listed in the table below.

Model	Length	Model	Length
EC-04	2 m	EC-04C	30 m
EC-04A	5 m	EC-04D	50 m
EC-04B	10 m	EC-04E	100 m

1. Set the power switch to OFF.
2. Loosen the preamplifier fastening screw and separate the microphone/preamplifier assembly from the main unit.
3. Connect the extension cable to the microphone/preamplifier assembly and to the main unit.



Sound Level Meter

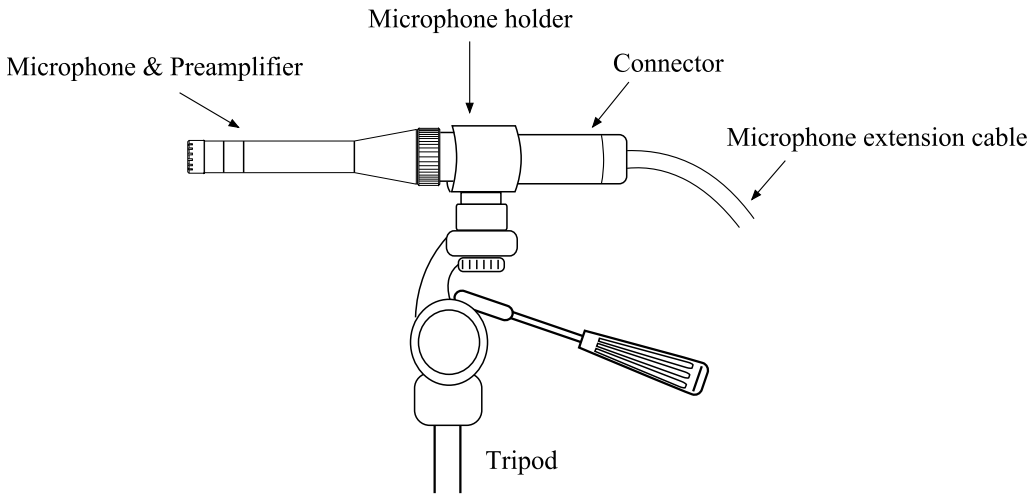
Important

Never attempt to disassemble or separate the microphone and preamplifier since this can lead to damage.

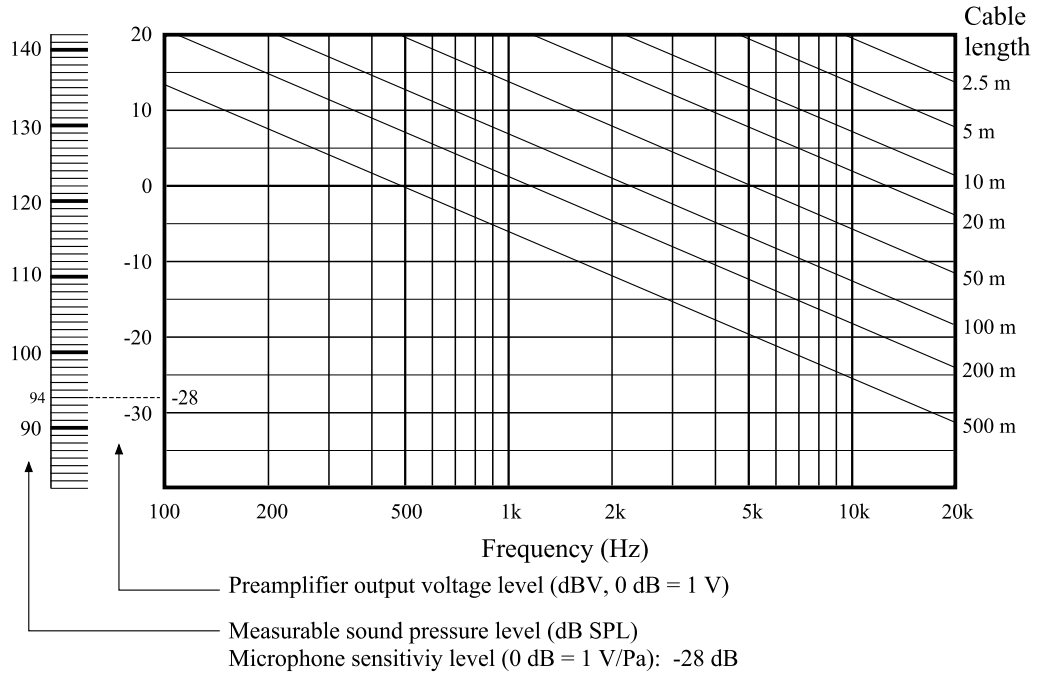
Important

With long extension cables, the cable capacitance restricts the upper measurement frequency and measurement level. For details, please refer to page 111.

4. When mounting the microphone/preamplifier on a tripod, first fasten the microphone holder (supplied with the extension cable) to the tripod. Then insert the extension cable connector into the microphone holder.



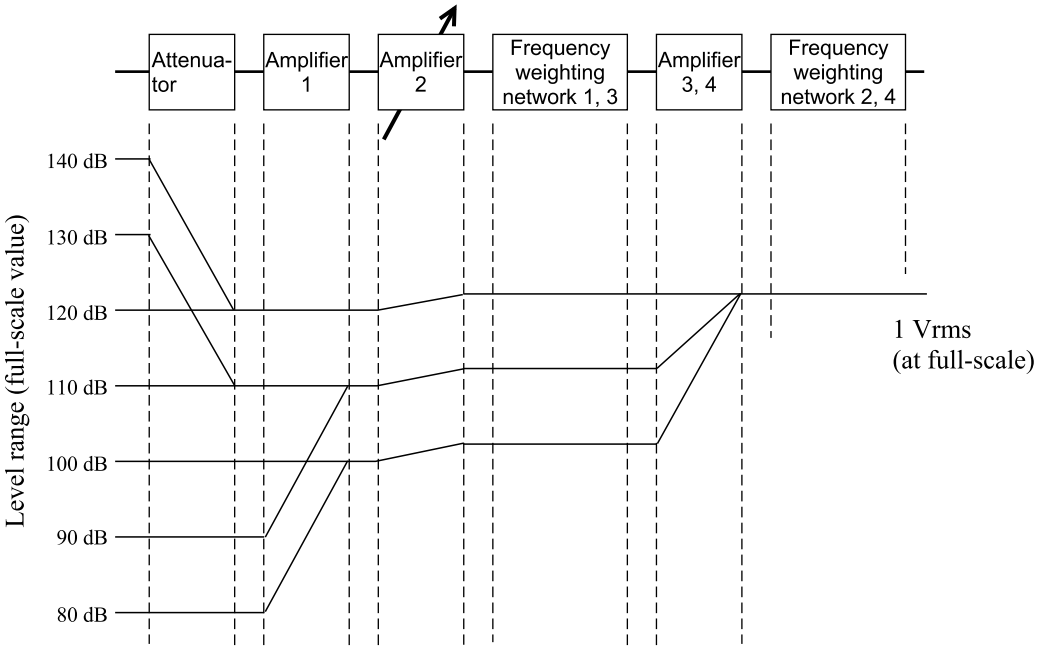
When the output of the microphone/preamplifier is routed through an extension cable, certain limitations regarding measurable sound pressure level and frequency range will apply. This is due to the influence of the cable capacitance. The longer the cable, the lower the measurable sound pressure level and the lower the frequency limit. The diagram below shows the relationship between cable length, measurable sound pressure level, and frequency.



If for example a sound pressure level of 120 dB is to be measured up to 3 kHz, an extension cable length of up to 100 meters can be used.

Amplifier Circuit Configuration

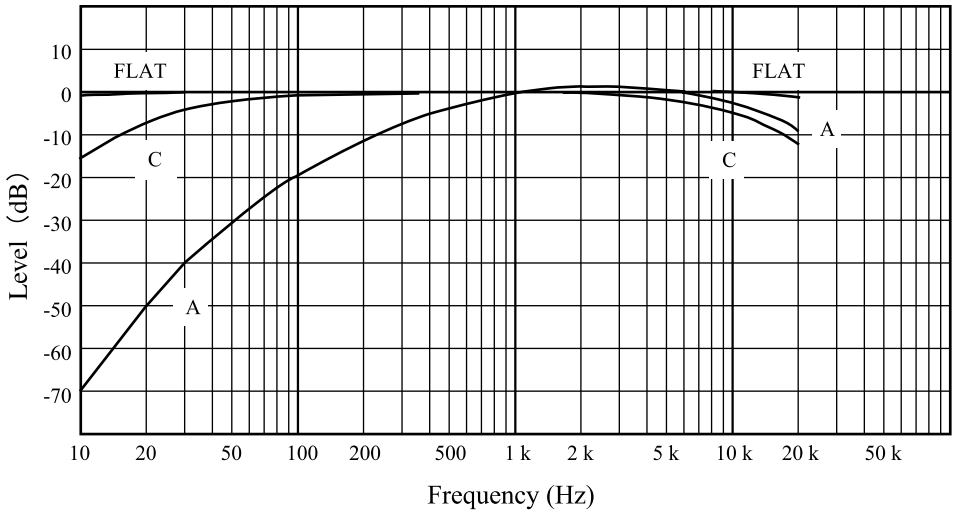
The amplifier circuit configuration and level diagram of the NA-27 are shown below. The degree of attenuation and degree of amplification depends on the level range setting.



Level diagram

Frequency Weighting Network

The NA-27 provides a choice between "A", "C" and "Flat" frequency weighting. The electrical characteristics of the weighting circuitry are as shown below.



Frequency weighting characteristics

The volume impression (loudness) of a sound depends not only on the sound pressure level, but also on the frequency. At high or low frequencies, a sound is felt to be less loud than a sound of equal level in the midrange. The "A" weighting curve compensates for this effect and produces measurement results which are close to the actual impression of loudness. For this reason, this type of frequency weighting is widely used for purposes such as sound pressure level evaluation.

With the "Flat" characteristic, frequency response is linear, which is suitable for straight sound pressure level measurements and for using the sound pressure level meter output for frequency analysis.

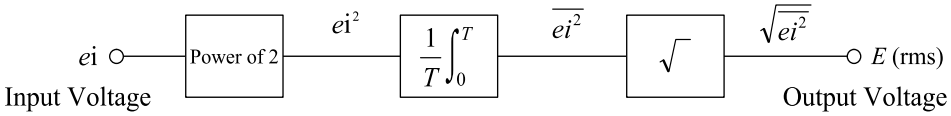
The "C" weighting curve produces almost flat response, but with a rolloff below 31.5 Hz and above 8 kHz. This is suitable for sound pressure level measurements in situations with unwanted low-frequency or high-frequency components.

RMS Detection Circuit

The sound pressure level meter uses rms detection. The effective value *E* (rms) is defined by the following equation.

$$E\,(\mathrm{rms}) = \sqrt{\frac{1}{T}\int_0^T e^2 dt}$$

The voltage e which changes over time is raised to the power of 2, and integration for the time interval T is performed. The result is divided by T and the square root is extracted. The circuit configuration for performing the above mathematical operation looks as follows.



The NA-27 performs all above processing functions in the digital domain.
For measurement and evaluation of the rms detection circuit, a signal with known crest factor is used. The crest factor is defined as crest value divided by effective value. If the signal type is known, the crest factor can be calculated precisely.
The rms detection error of the NA-27 is about ± 0.2 dB for an input signal with a crest factor of 3.

During sound pressure level measurements, the level often fluctuates drastically, which would make it difficult to evaluate readings if some kind of averaging is not applied. Sound pressure level meters therefore provide the capability for index weighting (index averaging) using the rms circuit. The parameters of this weighting process are called the dynamic characteristics, determined by the time weighting (see page 116).

Sound pressure level meters usually have a "Fast" and "Slow" setting for the time weighting. The time range that is considered for averaging is narrow in the "Fast" setting and wide in the "Slow" setting. In the "Fast" setting, the instantaneous level has a larger bearing on the displayed value than in the "Slow" setting. From the point of view of the measurement objective, the "Fast" setting is more suitable to situations with swiftly changing sound pressure level, whereas the "Slow" setting yields a more broadly averaged picture. The "Fast" setting is more commonly used, and sound pressure level or sound pressure level values given without other indication are usually made with "Fast" characteristics.

The "Slow" time weighting setting is suitable for measuring the average of noise with fairly constant levels. Aircraft noise and high-speed train noise is usually transient noise with high fluctuation, but here the "Slow" setting is used to determine the maximum level for each noise event.

The "10 ms" setting of the NA-27 results in a very short time weighting, enabling the meter to closely follow noise fluctuations.

The "Imp (Impulse)" setting enables the meter to track noise bursts of very short duration.

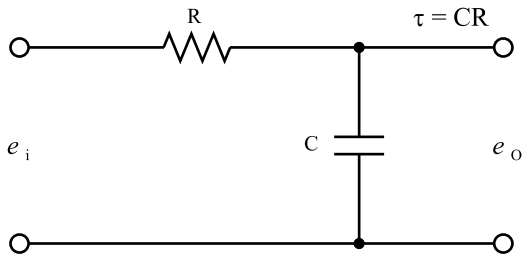
In the "Peak (Peak Hold)" condition, no averaging is carried out, and the peak value of the frequency-weighted sound pressure waveform is displayed.

Time weightings and time constant

Dynamic characteristics	Time constant	
	Rise time	Decay time
Fast	125 ms	125 ms
Slow	1 s	1 s
10 ms	10 ms	10 ms
Imp	35 ms	1.5 s

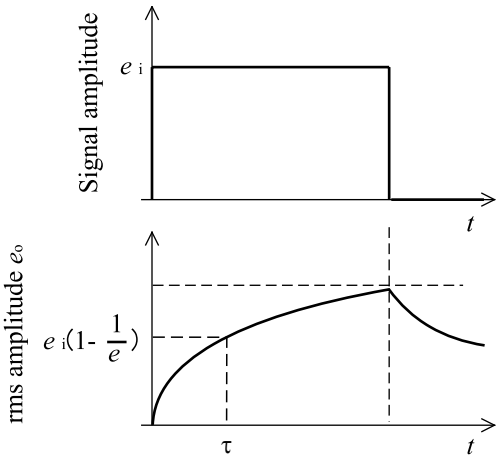
The time weighting circuit of the sound pressure level meter performs index averaging on the square of the sound pressure signal. The equivalent circuit is shown at right. τ is the time weighting, which equals CR.

e_i : Input voltage
e_O : Output voltage



Equivalent electrical circuit

The response of the index averaging circuit to a single burst signal is shown below.



Burst signal response

e_i : Input voltage (proportional to square of sound pressure)
e_O : Output voltage
e : Logarithm base
τ : Time constant
t : Time

Measurement Functions

L_{Aeq} (equivalent sound pressure level)

For a sound pressure level signal that changes over time, the L_{Aeq} (equivalent sound pressure level) is a hypothetical constant sound pressure level that has the same energy as the actually measured signal in the measurement interval. It is determined by the following equation.

$$L_{Aeq}=10\log_{10}\frac{1}{Tm}\int_{t_1}^{t_2}\frac{p_A^2(t)}{p_0^2}\,dt$$

t_1: Measurement start time
t_2: Measurement end time
Tm: Measurement time (integrated time) Tm = t_2 - t_1
p_0: Reference sound pressure 20 μPa (2×10^{-5} N / m^2)
pA(t): Instantaneous sound pressure measured with sound pressure level meter A weighting

Expressing the above equation for sound pressure level yields the following equation.

$$L_{Aeq}=10\log_{10}\frac{1}{Tm}\int_{t_1}^{t_2}10^{L_{A(t)}/10}\,dt$$

$L_{A(t)}$: Instantaneous sound pressure level

In the sound pressure level meter NA-27, this statement is used as reference, and digital processing to determine L_{Aeq} is carried out according to the following equation.

$$L_{Aeq}=10\log_{10}\frac{1}{N}\sum_{i=1}^{N}10^{L_{A(i)}/10}$$

N: Number of samples

Using the output signal of the rms detection circuit, digital processing is performed to determine the L_{Aeq} value. For this purpose, a suitable rms detection time weighting and sampling interval for L_{Aeq} processing must be chosen. In the NA-27, the sampling interval for A/D conversion is 10 ms (100 samples per second), and L_{Aeq} processing is carried out every interval. The L_{Aeq} reading can therefore be displayed already during measurement.

L_{AE} (sound exposure level)

The L_{AE} (sound exposure level) is a hypothetical constant 1-second sound pressure level having the same energy as a single-event sound pressure level measured with A weighting. It is determined by the following equation.

$$L_{AE} = 10\log_{10}\frac{1}{T_0}\int_{t_1}^{t_2}\frac{p_A^2(t)}{p_0^2}\,dt$$

t_1: Measurement start time
t_2: Measurement end time
T_0: Reference time (1 second)
p_0: Reference sound pressure 20 µPa (2×10^{-5} N / m²)
$p_A(t)$: Instantaneous sound pressure measured with sound pressure level meter A weighting

Expressing the above equation for sound pressure level yields the following.

$$L_{AE} = 10\log_{10}\frac{1}{T_0}\int_{t_1}^{t_2} 10^{L_{A(t)}/10}\,dt$$

$L_{A(t)}$: Instantaneous sound pressure level

In the sound pressure level meter NA-27, this statement is used as reference, and digital processing is carried out according to the following equation.

$$L_{AE} = 10\log_{10}\frac{1}{N_0}\sum_{i=1}^{N} 10^{L_{A(i)}/10}$$

N_0: Number of samples per second

In the NA-27, the sampling interval for A/D conversion is 10 ms (100 samples per second), and L_{AE} processing is carried out every interval. The L_{AE} reading can therefore be displayed already during measurement.

L_x (percentile sound pressure level)

The L_x (percentile sound pressure level) is the sound pressure level which was exceeded for x percent of the measurement time. The NA-27 allows the user to select five values for x (from 1 to 99, in 1-percent steps), and calculates the time percentile level for these five values simultaneously. The sampling interval for L_x processing is 100 ms (10 samples per

second), and L_x processing is carried out every interval. The L_x reading can therefore be displayed already during measurement.

L_{max}, L_{min} (maximum and minimum sound pressure level)

L_{max} is the maximum sound pressure level and L_{min} the minimum sound pressure level encountered during a measurement. In the NA-27, the sampling interval for A/D conversion is 10 ms (100 samples per second), and the L_{max} and L_{min} values since the start of the measurement are stored. Therefore the L_{max} and L_{min} readings up to the current point can be displayed already during measurement.

L_{tm3}, L_{tm5} (Takt-max sound pressure level)

For the duration of the measurement, the maximum level within a 3-second or 5-second interval is sampled and the power average is determined. L_{tm} is calculated according to the following equation.

$$L_{tm} = 10 \log_{10} \frac{1}{N} \sum_{i=1}^{N} 10^{L_m/10}$$

L_m: Maximum level within interval (3 or 5 seconds)
N: Number of samples

The number of samples is determined according to the following equation.

For L_{tm3}: $N = \dfrac{(t_2 - t_1)}{3}$

For L_{tm5}: $N = \dfrac{(t_2 - t_1)}{5}$

t_1: Measurement start time
t_2: Measurement end time

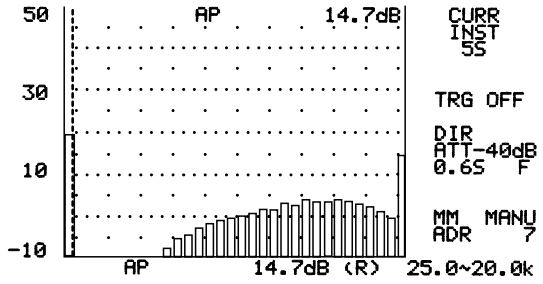
* L_{tm} is specified by DIN as "Taktmaximalpegel Mittelwert", and its meaning in English is "Power averaged maximum sound pressure level in a measuring period".

Lpeak (waveform peak hold)

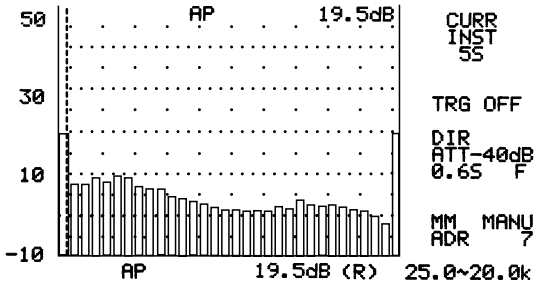
The waveform peak sound pressure level for a given measurement interval can be measured.

Noise Floor

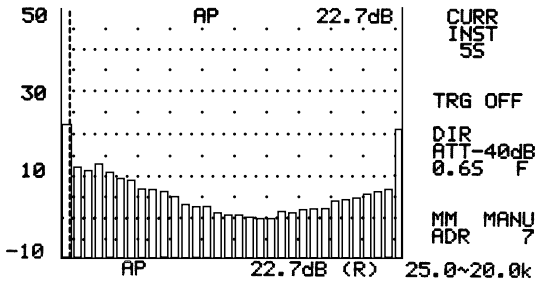
The diagrams below show the residual noise of the NA-27, in the frequency weighting "A", "C" and "Flat" positions. The measurement was made with a 1/3 octave filter and a frequency analyzer.



A weighting



C weighting



Flat response

Background Noise

When measuring a certain sound in a certain location, all other sounds present at that location except the measurement target sound are background noise (also called ambient noise or dark noise). Since the sound pressure level meter will display the combination of target sound and background noise, the amount of background noise must be taken into consideration when determining the level of the target sound.

If the difference between the meter reading in absence of the target sound and the reading with the target sound is more than 10 dB, the influence of background noise is small and may be disregarded. If the difference is less than 10 dB, the values shown in the table below may be used for compensation, to estimate the level of the target sound.

If for example the measured sound pressure level when operating a machine is 70 dB, and the background sound pressure level when the machine is not operating is 63 dB, the compensation value for the difference of 7 dB is -1 dB. Therefore the sound pressure level of the machine can be taken to be 70 dB + (-1 dB) = 69 dB.

Background noise compensation

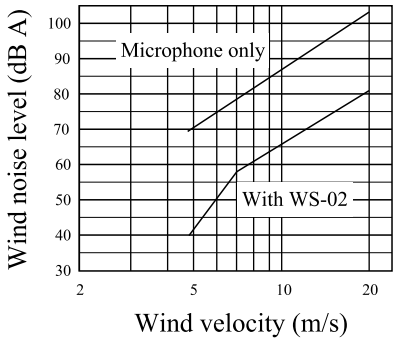
Display reading difference with and without target sound (dB)	4	5	6	7	8	9
Compensation value (dB)	-2		-1			

The above principle for compensating the influence of the background noise assumes that both the background noise and the target sound are approximately constant. If the background noise fluctuates, and especially if it is close in level to the target sound, compensation is difficult and will often be meaningless.

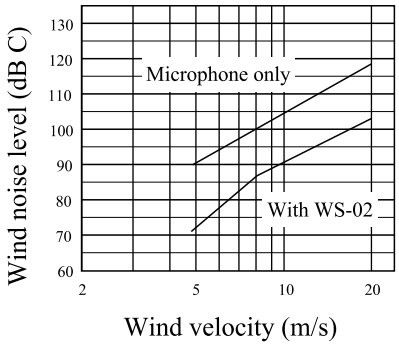
Windscreen (WS-02)

During outdoor measurements or measurement of ventilation devices, wind noise can falsify measurement results. To counter such problems, the supplied windscreen WS-02 should be mounted on the microphone. The characteristics of the WS-02 are shown below. The attenuation of wind noise produced by the windscreen is about 25 dB for sound pressure level (A weighting) and 15 dB for sound pressure level.

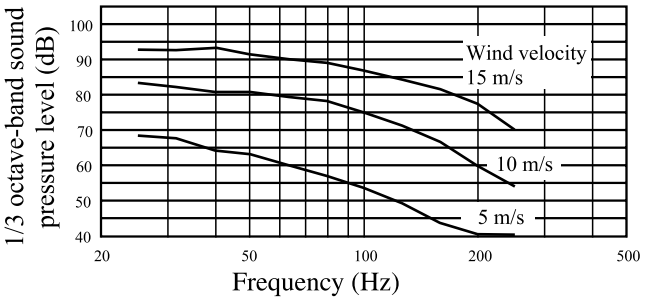
The influence of the windscreen WS-02 on the acoustic performance of the microphone is within ± 1.0 dB up to 12.5 kHz, as shown in the diagram on the next page.



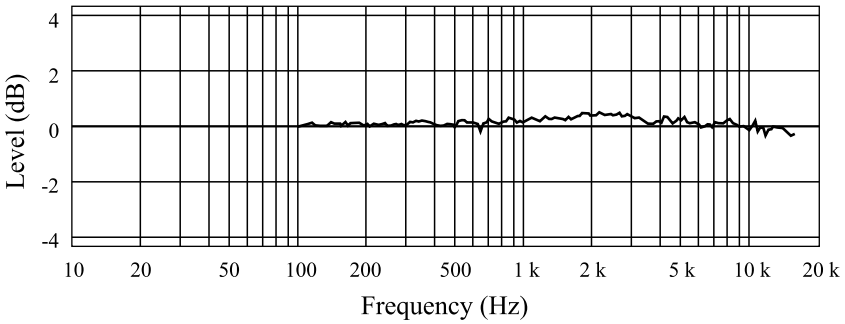
Frequency weighting A



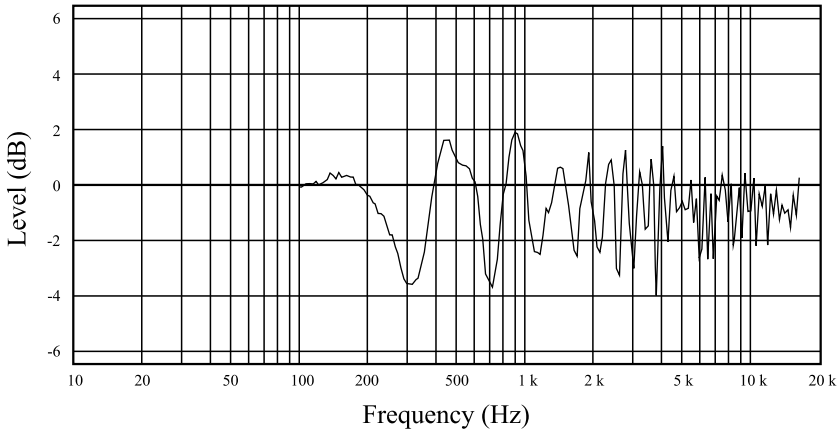
Frequency weighting C



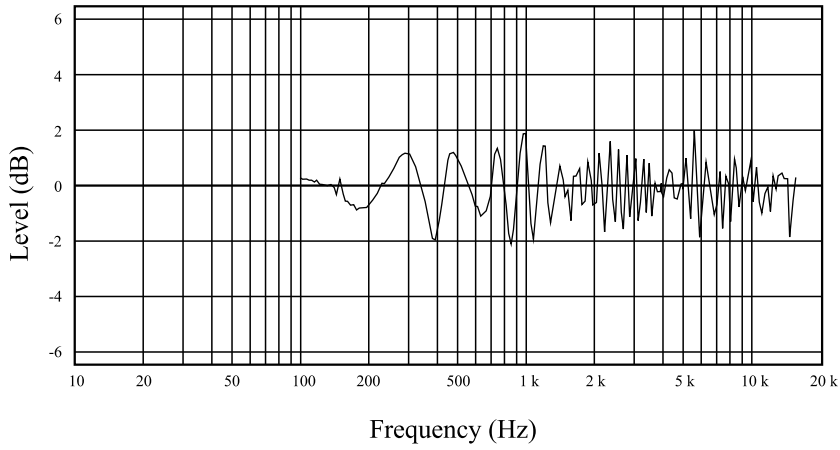
Frequency response of wind noise measured with windscreen WS-02 mounted on microphone



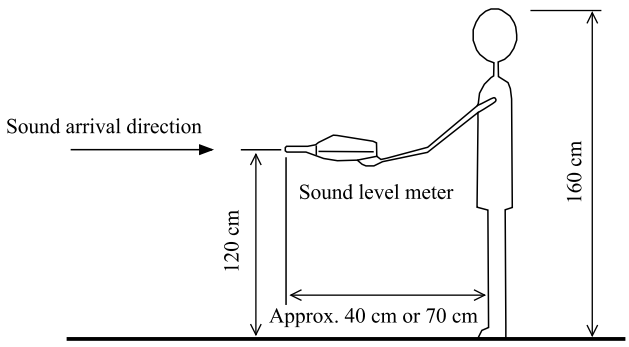
Influence of windscreen WS-02 on acoustical properties of microphone (referred to microphone response without windscreen)



Acoustical influence of sound level meter body (the distance from the top of the microphone to the operator is approx. 40 cm)



Acoustical influence of sound level meter body (the distance from the top of the microphone to the operator is approx. 70 cm)



Measurement conditions for acoustical influence of operator

I/O Connector

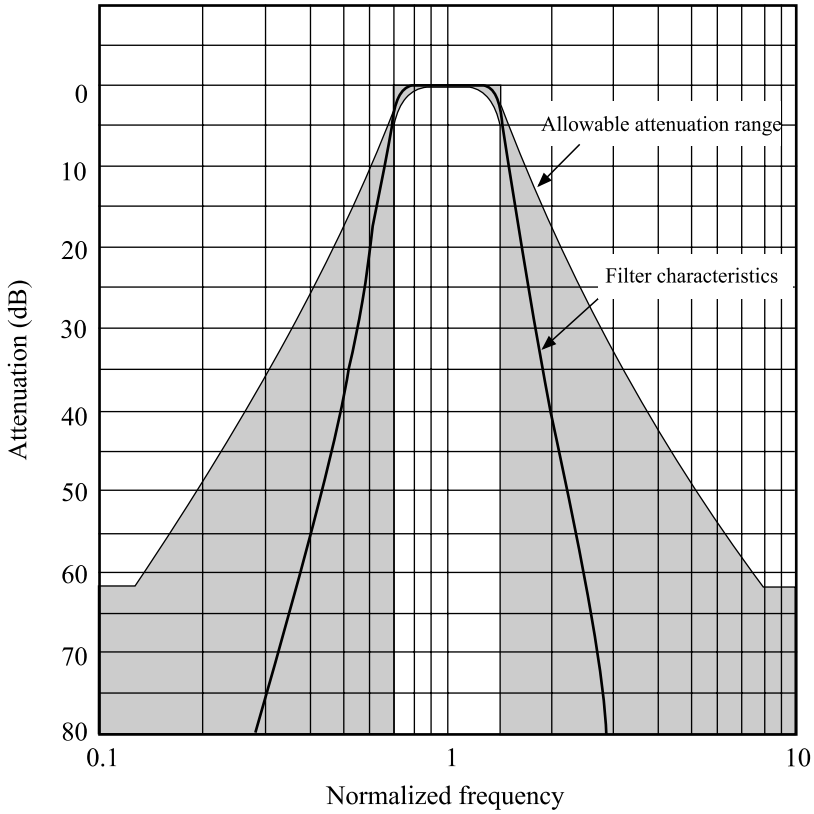
The I/O connector on the NA-27 serves for input of control signals and input/output of data. It has the following functions.

- Measurement data output to printer DPU-414, CP-10, CP-11
  (with printer cable of 25 pins, male, straight type and communication cable for IBM/AT or compatible computers)

- Communication with a computer (RS-232C interface)
  (with interface cable of 9 pins, straight type, communication cable for IBM/AT or compatible computers)

1/1-Octave Filter Characteristics

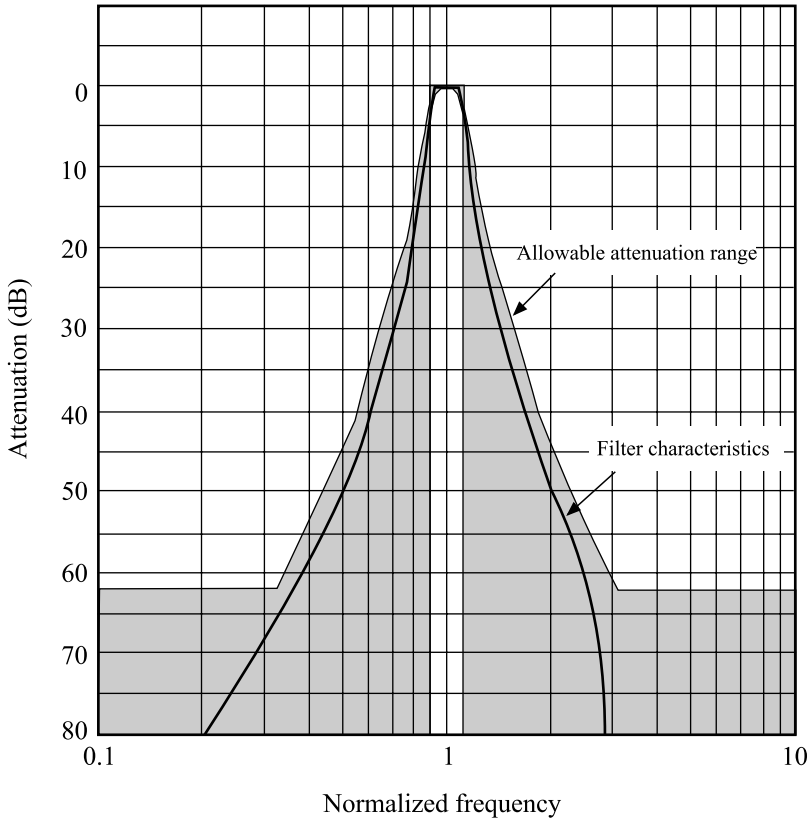
The characteristics of the 1/1-octave filter in the NA-27 correspond to the JIS C 1513-1983 Type II, ANSI S1.11 Type 1D, and IEC 1260 1995 Class 1 specifications.
The graph below shows the allowable attenuation tolerance according to JIS and the actual characteristics of the 1/1-octave filter in the NA-27.



Attenuation tolerance according to IEC 1260
and 1/1-octave band filter characteristics of NA-27

1/3-Octave Filter Characteristics

The characteristics of the 1/3-octave filter in the NA-27 correspond to the JIS C 1513-1983 Type III, ANSI S1.11 Type 1D, and IEC 1260 1995 Class 1 specifications.
The graph below shows the allowable attenuation tolerance according to JIS and the actual characteristics of the 1/3-octave filter in the NA-27.



Attenuation tolerance according to IEC 1260
and 1/3-octave band filter characteristics of NA-27

Important
The frequency range of the NA-27 is 20 Hz to 12500 Hz. Precision for data outside of this range is not assured, and data should be used only as a general reference.

Error Messages

No.	Error message	Explanation	Countermeasure
1	Calculating Now.	Item cannot be set during processing.	Wait until processing is completed.
2	AUTO STORE now.	Item cannot be set during auto store.	Wait until auto store is completed.
3	Retry after PAUSE.	Printing cannot be carried out during processing.	Press pause key or wait until processing is completed.
4	RECALL MODE !	Item cannot be set in recall mode.	Set unit to normal operation (current) mode.
5	CURRENT MODE !	Item cannot be set in normal operation (current) mode.	Set unit to recall mode.
6	STORE PROTECTED !	Store is not possible because block is protected.	Use a different block or set PROTECT to OFF in MEMORY menu screen.

Error messages are shown when the unit is turned on.

Messages 1 through 6 disappear after 3 seconds or when any key is pressed.

No.	Error message	Explanation	Countemeasure
7	Backup Battery Low ! !	Voltage of memory backup battery has dropped below alarm level.	Message disappears if any key is pressed. Replace memory backup battery.
8	Backup Battery Empty ! !	Voltage of memory backup battery has dropped below operation level.	Message disappears if any key is pressed. Replace memory backup battery immidiately.
9	Battery Empty ! !	Voltage of main batteries (IEC R14P) has dropped below operation. Note: Depending on the voltage drop condition, the unit may cease to operate without this message. If the indication LOW or EMP appears on the display, replace the main batteries.	Replace the four main batteries (IEC R14P) or use the AC adapter.
10	Store File Error ! !	An error was detected in the stored data during initialization.	Message disappears if any key is pressed. The stored data may be invalid.
11	RTC Read Error ! !	Clock function error was detected during initialization. Data or time may be invalid.	Message disappears if any key is pressed. (To set the date and time, use the I/O menu screen.)
12	Program Error ! !	System program error was detected during intialization.	Unit cannot be used. Note the condition of the unit clearly and contact the supplier.
13	DSP Program Error ! !	DSP program error was detected during initialization.	Unit cannot be used. Note the condition of the unit clearly and contact the supplier.
14	DSP Routine Error !!	DSP routine error was detected during normal operation.	Unit cannot be used. Note the condition of the unit clearly and contact the supplier.

Optional Accessories

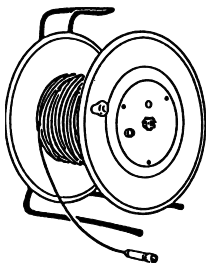
Microphone Extension Cables (EC-04 series)

To reduce measurement deviations due to refraction effects and the acoustic influence of the operator, the microphone can be detached from the unit and connected via an extension cable.

Optional cables are listed in the table below.

Type	Length	Type	Length
EC-04	2 m	EC-04C	30 m (with drum)
EC-04A	5 m	EC-04D	50 m (with drum)
EC-04B	10 m	EC-04E	100 m (with drum)

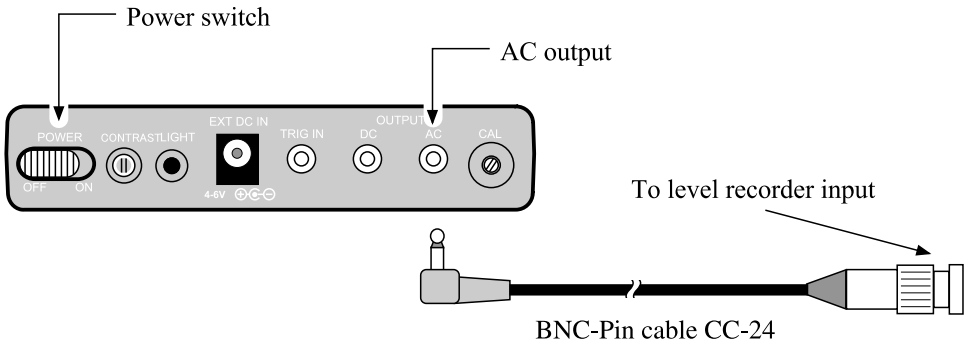
View of EC-04C, EC-04D, EC-04E with drum



Level Recorder (LR-04, LR-06)

Connection of a sound level recorder

By connecting a level recorder to the NA-27, the sound pressure level changes over time can be recorded.



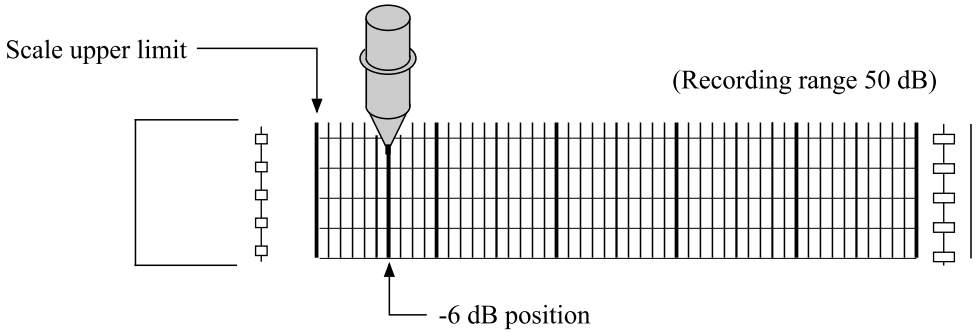
Connect the AC output on the side of the NA-27 to the level recorder, as shown above.

Recording procedure

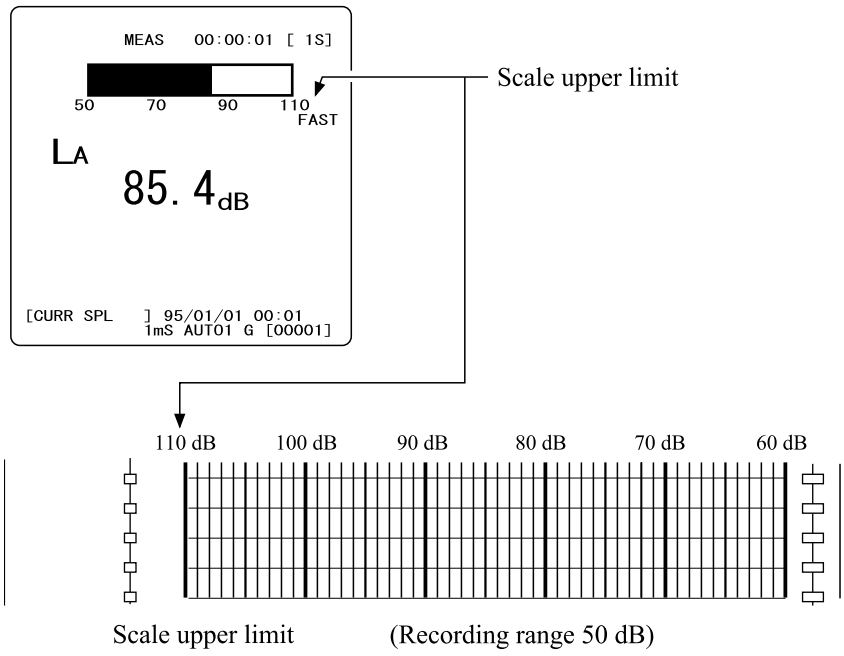
The steps for recording the sound pressure level on a level recorder are shown below.
Turn the power switch of the NA-27 on and perform the preparation steps as described in the section "Preparations" on page 16.
For information on how to operate the level recorder, refer to its instruction manual.

The description below applies to recording main channel data.

1. Press the CAL key on the NA-27 to activate the calibration mode.
2. Activate paper feed and pen operation of the level recorder.
3. Adjust the level control (Level ADJ) of the level recorder so that the pen registers -6 dB.

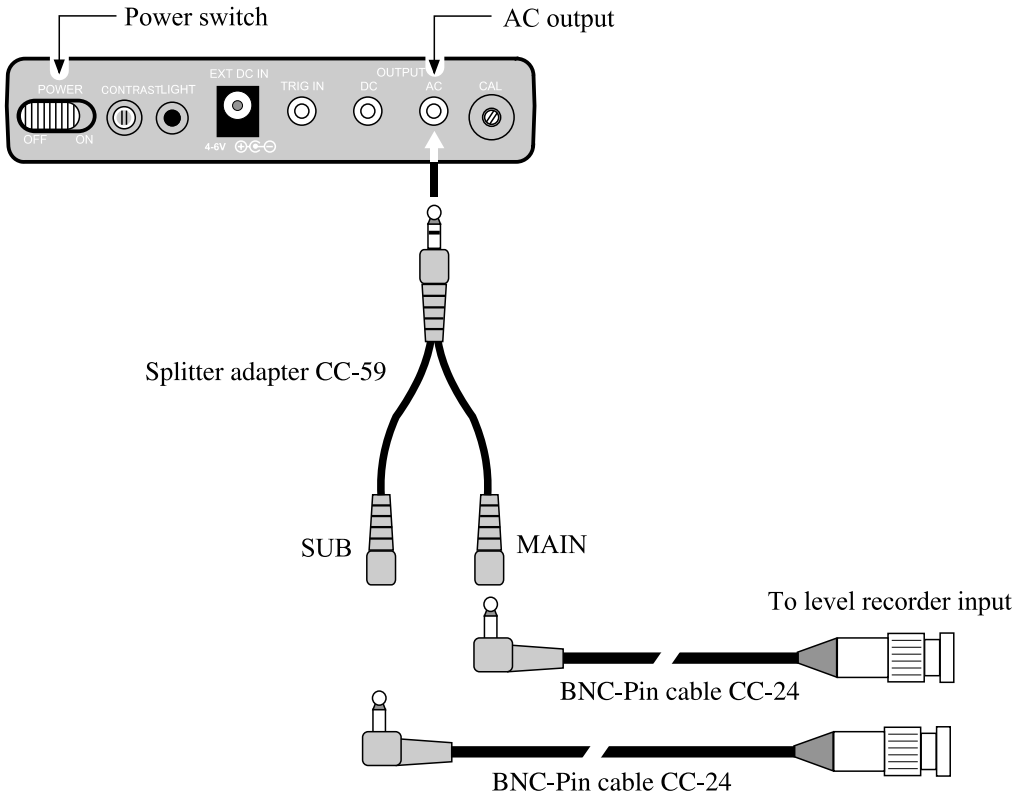


4. Press the CAL key once more to return the NA-27 to the measurement mode.
5. Use the FREQ WEIGHT key of the NA-27 to set the frequency weighting characteristics.
   The time constant should be set at the level recorder.
6. Use the LEVEL UP/DOWN keys to set the level range. Choose a setting in which the "OVER" and "UNDER" indications do not appear.



To record measurement results from the sub channel also, the optional splitter adapter CC-59 is required.

Use to two level recorders and connect them as shown below.

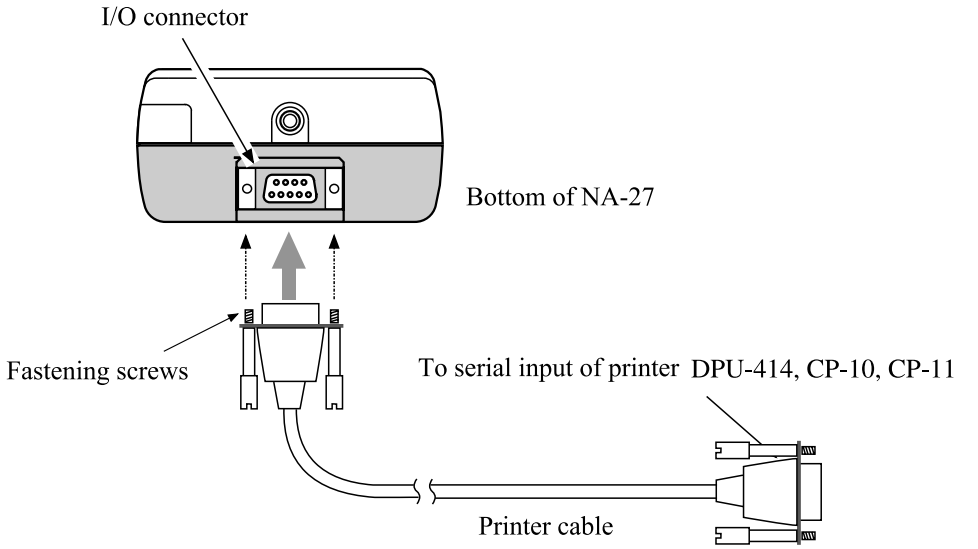


Using a Printer (DPU-414, CP-10, CP-11)

Data gained during measurement and data stored in the memory of the NA-27 can be printed out on a printer. You can also produce hard copy of the menu screens.

Connect the I/O interface on the bottom of the NA-27 to the printer (DPU-414, CP-10, CP-11), using a serial printer cable. The printer and cable are optional.

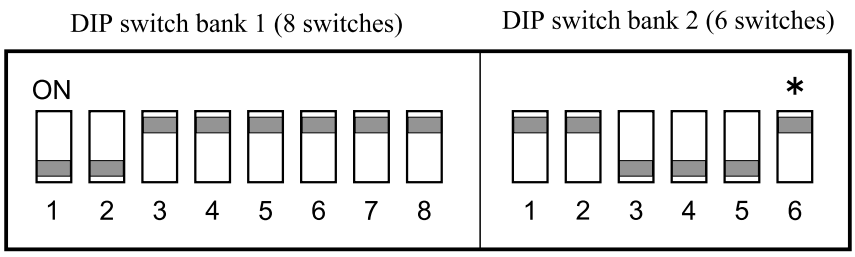
1. Set the power switches of the sound level meter and the printer to OFF.
2. Connect the printer cable and secure it with the fastening screws.



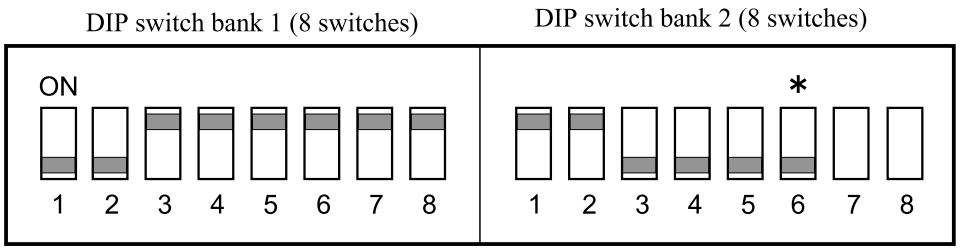
Use commonly available printer cable (25 pin, male, straight type)
(For DPU-414, conversion adapter supplied with DPU-414 must be used.)

Set the DIP switches of the printer as follows.

CP-10



CP-11



Important
The switch marked with an asterisk (switch 6 of DIP switch bank 2) serves for setting the data transfer speed. The ON position means 4800 bps and the OFF position 9600 bps. This setting must match the setting of the NA-27 (see description of I/O menu screen on page 35). Switches 7 and 8 of DIP switch bank 2 of printer CP-11 are set at the factory and should not be changed. Otherwise, correct printing may not be possible.

Setting the software DIP switches of the DPU-414

Turn on the power while holding down the ON LINE key of the DPU-414. A printout showing the current status of the printer is produced.

4800 bps		
SW-1	1	OFF
	2	ON
	3	ON
	4	OFF
	5	ON
	6	OFF
	7	ON
	8	ON
SW-2	1	ON
	2	ON
	3	ON
	4	ON
	5	ON
	6	ON
	7	ON
	8	ON
SW-3	1	ON
	2	ON
	3	OFF
	4	ON
	5	ON
	6	OFF
	7	OFF
	8	OFF

9600 bps		
SW-1	1	OFF
	2	ON
	3	ON
	4	OFF
	5	ON
	6	OFF
	7	ON
	8	ON
SW-2	1	ON
	2	ON
	3	ON
	4	ON
	5	ON
	6	ON
	7	ON
	8	ON
SW-3	1	ON
	2	ON
	3	OFF
	4	ON
	5	OFF
	6	ON
	7	ON
	8	ON

For details, please refer to the documentation of the DPU-414.

Printing measurement parameters

1. Press the key for the desired menu (SETUP, MEMORY, DISPLAY, I/O).
2. Press the PRINT key to print out the current screen.

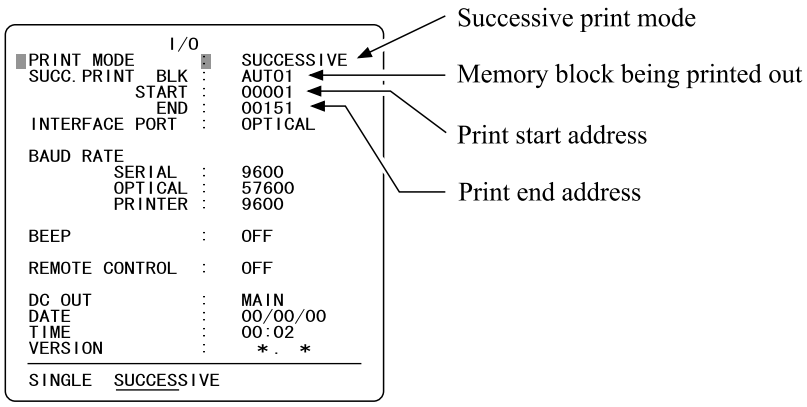
Printing the screen during measurement

Pressing the PRINT key causes a hard copy of the current screen (measured level, frequency weighting, time constant, overload conditions etc.) to be printed out.

During store, the indication "AUTO STORE Now!!" is shown on the display for several seconds. During this interval, printing is not possible.

During printing, the indication "1/1 Now Printing" is shown on the display, and the measurement screen is not updated.

Printing in recall mode

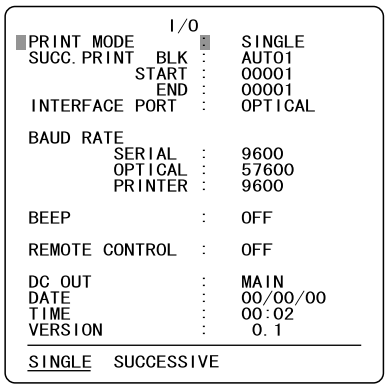


I/O menu screen

Call up the I/O menu screen and select the print mode, memory block, start address, and end address.

Printing when I/O menu is set to SINGLE

When the PRINT key is pressed, the current display is printed.

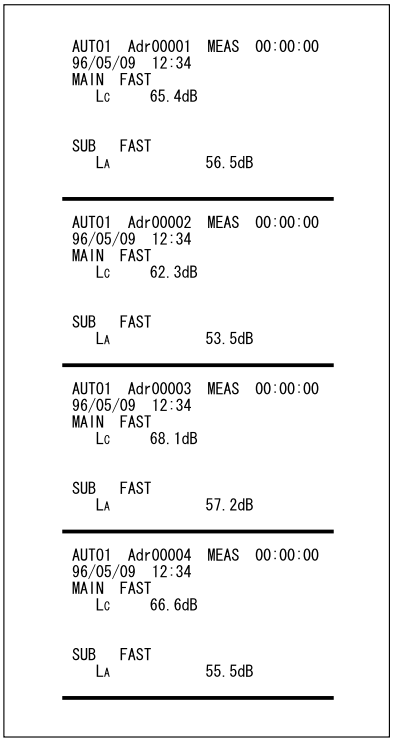


I/O menu screen

Printing when I/O menu is set to SUCCESSIVE

A. In sound level meter mode

When the PRINT key is pressed, stored numeric data and corresponding addresses are printed, as shown in the example on the right.



B. In frequency analysis mode

When the PRINT key is pressed, frequency analysis data are printed successively, from the start address to the end address. Data are printed in graphical form and numeric form for each address.

During level-time display, a hard copy of the screen is printed.

To terminate successive printing before all data have been printed, press the PRINT key once more. Printing stops when the current screen is completed.

Printing precaution
If measurement parameter settings such as FREQ WEIGHT, TIME CONST or LEVEL were changed before printing, the printout will not match the measurement parameters.

Printing in recall mode

Print mode	Stored data	Print operation
SINGLE	Irrelevant	One set of data (as shown on screen) is printed
SUCCESSIVE	AUTO single data	Stored data for one processing mode are printed for the specified address range
	AUTO group data MANU data	Stored data for all processing modes are printed for the specified address range

In normal operation (current) mode, printing is always carried out as in SINGLE mode.

An example for successive printout of data gathered with group store in a Leq processing mode is shown below.

Specifications

Applicable standards

General measurements, precision sound level meters
IEC 61672-1:2002 Class 1, IEC 61260:1995 Class1
ANSI S1.11 Type1D,
JIS C 1509-1:2005 Class1, JIS C 1514:2002 Class1, JIS C 1513:2002 Class1

IEC 60651 and IEC 60804 was withdrawn and replaced by IEC 61672-1.
JIS C 1505 was withdrawn and replaced by JIS C 1509-1.

Measurement functions

Dual measurement in main and sub channel (single input processed under two sets of parameters)
Real-time 1/1-octave analysis and 1/3-octave analysis in main channel

Processing functions

1) Instantaneous value L_p, equivalent continuous sound pressure level L_{eq}, sound exposure level L_E
2) Maximum sound pressure level L_{max}, minimum sound pressure level L_{min}
* 3) Waveform peak hold L_{peak}
* 4) Takt-max sound pressure level L_{tm3}, L_{tm5}
   Taktmaximalpegel Mittelwert: DIN
   Power averaged maximum sound pressure level in a measuring period
5) Percentile sound pressure level L_x (L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95}, L_{99})

Functions 1) through 4) are performed simultaneously. Functions marked with asterisk* are valid only for sub channel.
Function 5) allows up to five values from 1 to 99 for simultaneous processing

Measurement time

1 to 99, units: seconds, minutes, hours

Manual measurement

Continuous measurement until stop key is pressed (up to 99 hours)
In L_x processing mode, processing time must be set to 10 s or higher

Reference sound pressure level

85 dB

Reference range

50 to 110 dB (Sound level meter mode), 40 to 110 dB (frequency analysis mode)

Max. measurement level

140 dB rms, 133 dB at c.f. 3, 143 dB peak for peak hold

Noise Floor

Typical 17 dB (A) rms, max. 20 dB (A) rms

A weighting:	Less than 20 dB
C weighting:	Less than 25 dB
Flat:	Less than 30 dB

Frequency range

20 to 12500 Hz (including microphone)

10 to 20000 Hz (amplifier only)

Frequency analysis range

1/1-octave analysis:	16 to 8000 Hz
1/3-octave analysis:	12.5 to 12500 Hz

Frequency weighting

A, C, Flat

RMS detection

Digital true rms detection

Time weighting

Main channel:	Fast, Slow, 35 ms, 10 ms
Sub channel:	Fast, Slow, 35 ms, 10 ms, Impulse, Peak Hold

Level range

Sound level meter mode (display range 60 dB)

80 to 140 dB
70 to 130 dB
60 to 120 dB
50 to 110 dB
40 to 100 dB
30 to 90 dB
20 to 80 dB

Frequency analysis mode (display range 70 dB)

70 to 140 dB
60 to 130 dB
50 to 120 dB
40 to 110 dB
30 to 100 dB
20 to 90 dB
10 to 80 dB

Overload indication

"Over" indication appears at +8 dB over display full-scale value

Under range indication

"Under" indication appears at -65 dB below display full-scale value

Calibration

Electrical calibration with 1000-Hz sine wave signal from built-in oscillator

Linearity range

All-pass:	72 dB
Spectrum band:	77 dB

Pulse range

All-pass:	75 dB
Spectrum band:	80 dB

Memory

Manual and auto store mode for instantaneous value and processing results
One block for manual store and two blocks for auto store (separate)

Manual store:	Simultaneous storing of all processing results
Capacity:	200 data sets
Auto store:	Continuous storing of processing results
Single store:	Selected processing result
Capacity:	10000 data sets (sound level meter mode)
	4000 data sets (1/1-octave analysis)
	2000 data sets (1/3-octave analysis)
Store intervals:	For instantaneous value min. 1 ms, max 990 ms
	For processing results: equal to processing time

Group store: Continuous simultaneous storing of all processing results
Capacity: 200 data sets
Store intervals: Equal to processing time

Trigger

Level trigger, external trigger, time trigger (processing start conditions)
Level trigger: *** dB, + or - slope
External trigger: Logic-level falling edge
Time trigger: Start time and repeat interval settable

Delay function

Preset delay between start key push or trigger event and actual processing start
Delay time range: 0 to 10 seconds in 1-second steps

Pause function

Normal pause and back-erase pause (data for preset interval before pause key push are excluded from processing)

Display

Backlit LCD, 192 × 192 dots
Sound level meter mode
Numeric display: 4 digits, update cycle 1 s, resolution 0.1 dB
Bar graph display: 60 dB range, update cycle 0.1 s, resolution 0.5 dB
Frequency analysis mode
Numeric display: 4 digits, update cycle 0.1 s, resolution 0.1 dB
Bar graph display: 70 dB range, update cycle 0.1 s, resolution 0.5 dB
Level-time indication: min. 140 addresses, max. all addresses (compressed display)
Battery warning indication: 2-stage indication (low, empty)
Clock: year, month, day, hour, minute

Printout capability

RS-232C interface for connection of printer DPU-414 or CP-10 or CP-11, for printout of screen display and memory data
Single mode: Printout of current data or memory data
Successive mode: Continuous printout of specified address range

Microphone

1/2-inch prepolarized condenser type

Model:	UC-53A
Sensitivity:	-26.5 dB to -29.0 dB (0 dB = 1 V/Pa)

Preamplifier

NH-20

Inputs and outputs

AC output (main channel and sub channel simultaneous output)

Display full-scale point:	1 Vrms
Output impedance (main):	approx. 600 Ω
Output impedance (sub):	approx. 600 Ω
Load impedance:	10 kΩ or more

DC output (main channel and sub channel selectable from menu)

Display full-scale point:	3.5 V, 0.5 V/10 dB
Output impedance:	approx. 50 Ω
Load impedance:	10 kΩ or more

External trigger input

Serial I/O (RS-232C) interface connector: 9-pin D-SUB

Data word length:	8 bit
Stop bits:	1
Parity check:	none
Baud rate:	4800, 9600, 19200, 38400 bps
Flow control:	CTS/RTS

Infrared port (max. distance 30 cm)

Data word length:	8 bit
Stop bits:	1
Parity check:	none
Baud rate:	57600, 115200 bps
Flow control:	none

Infrared remote control sensor

Max. reception distance:	3 m

Power requirements

Four IEC R14P (size "C") batteries

Battery life (at 20ºC, 1/3-octave analysis, continuous operation)

Alkaline batteries:	approx. 8 hours
Manganese batteries:	approx. 4 hours

External DC power supply 4 to 6 V (from AC adapter NC-94A)

Current consumption (at room temperature, 1/3-octave analysis, 5 V): approx. 310 mA

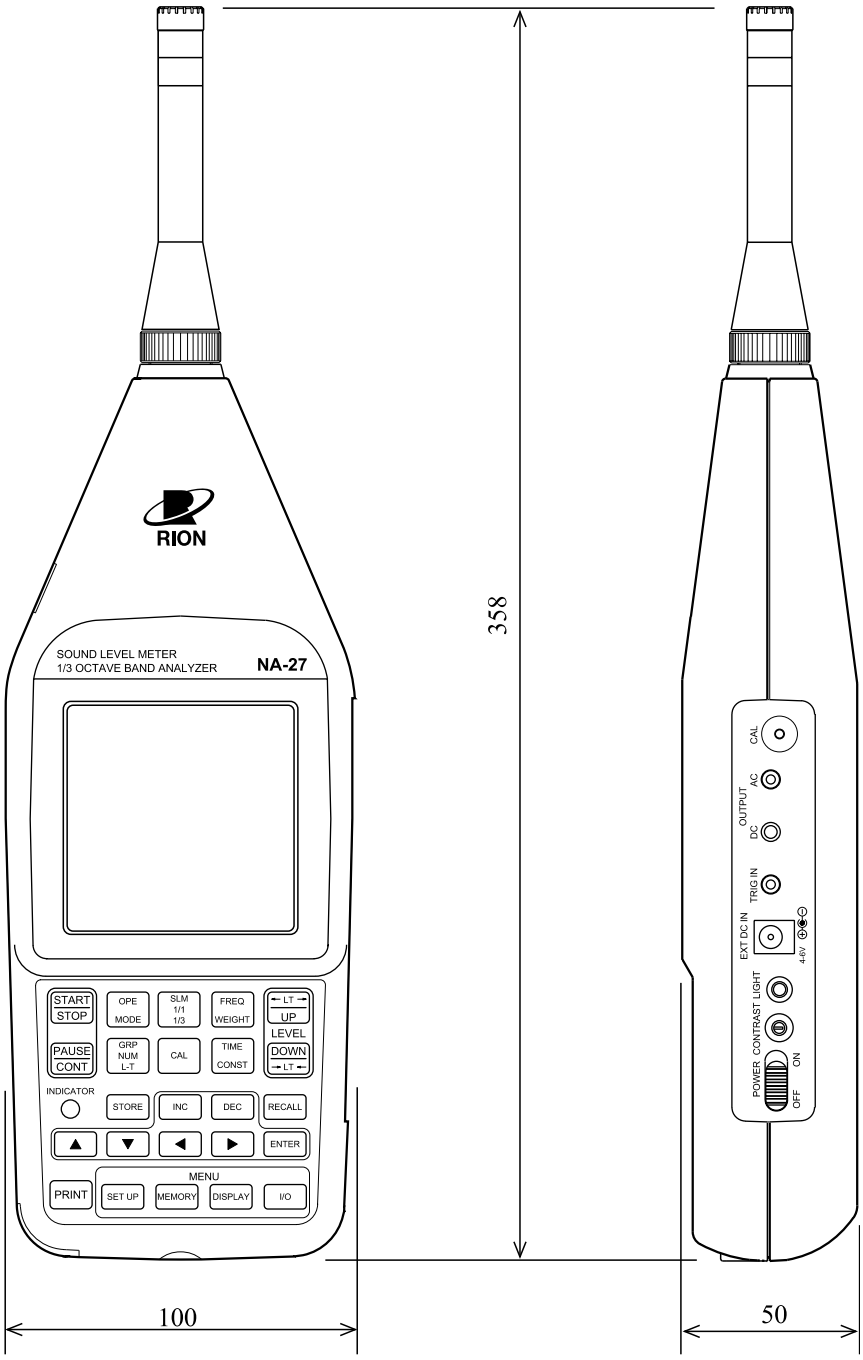
Ambient conditions	-10 to +50ºC, 30 to 90% RH
Dimensions	358 (H) × 100 (W) × 50 (D) mm
Weight	Approx. 800 g (with manganese batteries)

Supplied accessories

Carrying case	NA-27-S04	1
Windscreen	WS-02	1
Infrared remote controller	NA-27RC1	1
Miniature screwdriver	D-62	1
Tripod adapter	NA-27-S05	1
Hand strap (attached)	NA-09-058	1
Main batteries	IEC R14P	4
Remote controller batteries	IEC R03	2
Backup lithium battery	CR-1/3N	1
Product name label	NA-27-033	1
Instruction Manual		1
Serial Interface Manual		1
Inspection certificate		1

Optional equipment

Pistonphone	NC-72
Printer	DPU-414
Microphone extension cable	EC-04 series
Level recorder	LR-04, LR-06
AC adapter	NC-94A
Soft case	NA-27-026
BNC-to-Pin cable	CC-24
Splitter adapter	CC-59



Unit: mm

Dimensional Drawings

No. 41371 06-11