ZX3200

Sound Level Analyzer

User Manual

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Health and Safety Consideration

This apparatus has been designed and tested in accordance with IEC/EN 61010 – 1. This manual contains information and warnings that must be followed to ensure safe operation and to retain the apparatus in a safe condition.

Safety Usage Consideration

When using the ZX3300 Sound Level Analyzer, it is crucial to adhere to safety guidelines to prevent fire hazards or personal injury. Ensure that you fully read and understand the safety notice before use. Always operate the device only for its intended purpose and refrain from unauthorized disassembly, as tampering may lead to malfunctions or unsafe conditions. If the device begins to overheat or show signs of malfunction, immediately cease operation to avoid potential risks. For any required repairs, always contact ZXONIC rather than attempting fixes yourself. Additionally, keep the device away from heat sources, open flames, or high-temperature areas to ensure safe and optimal acoustic performance.

Revision History

Revision	Description	Revision Date
V1.0	Initial Release	July 2025

Precautions

1. **Read Before Use:** Thoroughly read this manual before using the instrument for the first time.

2. **Damage Exclusion:** Damage to the microphone diaphragm and any damage resulting from improper operation are not covered under the warranty.

3. **Battery Guidelines:** Use high-performance alkaline batteries; rechargeable batteries are not recommended. Remove the batteries when the device is not in use to prevent damages from battery leakage. Batteries are not covered under warranty.

4. **Monthly Maintenance:** Keep the instrument power on for at least 8 hours per month to recharge the internal backup battery.

5. **Repair Instructions:** If the instrument requires repair, please provide the warranty card for service.

Table of Contents

1 Overview

The ZX3200 Sound Level Analyzer utilizes digital signal processing technology and a modular design. It is characterized by a wide measurement range, low power consumption, compact size, and reliable long-term operation. The product complies with IEC 61672-1:2013 standards..

The product series is Class 1accuracy level, and can be further categorized by functionality into basic, statistical analysis, and spectral analysis models. These functionalities can be combined, allowing the instrument to perform multiple tasks with a single device. It is capable of simultaneously measuring various parameters, including exponential sound pressure level, equivalent sound level, statistical sound level, sound exposure level, and spectral sound pressure level, while also recording the sound pressure level curve over time.

This series of products is primarily used in environmental protection, occupational hygiene, industrial enterprises, and research and teaching fields to measure environmental noise, sound power levels, machine noise, and building acoustics.

2 Main Features

1. Multi-analysis functions, recording, and audio recording synchronization
2. Wide linear range exceeding 124 dB without switching range
3. Low power consumption with long battery life
4. High-resolution color display (3.5-inch, 240 x 320 pixels)
5. Large storage capacity: TF card (up to 32 GB)
6. Data stabilization time after power-on: < 1 min

Note: Data stabilization time after power-on: < 1 min

3 Main Technical Specifications

1) Instrument Model: ZX3200-1: Class 1

2) Microphone: Class 1: ZX1025S pre-polarized condenser microphone

3) Microphone and Preamplifier Sensitivity Level: -36 dB

4) Note: Sensitivity is referenced to 0 dB at 1 V/Pa. Unless otherwise specified, the indicated sensitivity is that of the standard instrument configuration.

5) Measurement Range: 18 to 144 dB(A), 30 to 144 dB(C), 40 to 144 dB(Z)

   a. Other Frequency Linear Ranges:

      i. 31.5 Hz: 18 dB(A) to 104 dB(A)

      ii. 12.5 kHz: 18 dB(A) to 140 dB(A)

   b. Note: The overall measurement range may shift depending on the sensitivity level, as shown on the instrument display.

6) Frequency Range: 10 Hz - 20 kHz

7) Intrinsic Noise:

   a. ZX1948 Preamplifier: <15 dB (A), <20 dB(C), <25 dB (Z)

   b. ZX1949 Preamplifier(optional): <12 dB (A), <20 dB (C), <25 dB(Z)

8) Frequency Weighting: Parallel A, C, Z weightings.

9) Time Weighting: Parallel F (Fast), S (Slow), I (Impulse).

   a. Accuracy: Complies with IEC 61672-1:2013 Class 1 and IEC 61260-1:2014 Class 1.

10) Data Storage: 32 MB Flash RAM, external TF card up to 32 GB.

11) Storage Capacity (Basic Analysis Function): > 2500 groups.

12) Additional Storage: 5 parameter templates, 64 measurement point names, 256 calibration records.

13) Measurement Time: 1 second to 99 hours.

14) Calendar Clock: Monthly error less than 1 minute.

15) Data Interface: RS232, USB, DC signal, AC signal, Bluetooth, DTU.

16) Display: 4.59-inch color screen, resolution 240 x 320.

17) Power Consumption (Basic Function): < 90 mA/5 V.

18) Power Supply:

a. 4 AA alkaline batteries: Up to 30 hours under basic function.

b. Optional lithium battery: 7.4 V/2 AH.

c. External power: 5 V/1 A via USB Type-C.

19) Dimensions(mm):

a. Overall : 285 × 85 × 30

b. Main Unit: 215 × 85 × 30

20) Operating Conditions:

a. Temperature Range: -10°C to 50°C

b. Relative Humidity Range: 25% to 90%

c. Atmospheric Pressure Range : 65 kPa to 108 kPa

21) Weight: 311 g.

22) Total Value Integral Function:

a. Main Measurement Indicators: Lxyi, Lxyp, Lxeq,t, Lxeq,T, Lxymax, Lxymin, Lxpeak, LAE, LC-A, SEL

b. Peak C Sound Level Measurement Range: 60 dB to 146 dB

c. Note: x represents A, C, Z; y represents F, S, I.

23) Statistics Function (optional):

a. Number of Modules: 2

b. Analysis Mode: Single or 24-hour

c. Statistical Analysis Indicators: Lxyi, Lxyp, Lxeq,T, Lxmax, Lxmin, LxN, SD, SEL

d. 24-hour Mode Analysis Indicators: Lxyi, Lxyp, Lxeq,T, Lxmax, Lxmin, LxN, SD, SEL, Ld, Ln, Ldn, etc.

e. Note 1: x represents A, C, Z; y represents F, S, I; N represents 5, 10, 50, 90, 95.

f. Note 2: Enabling Ln adds 7 additional statistical indicators.

24) 1/1 Octave Band Spectrum Analysis Function (Optional):

a. Filter Type: Parallel (real-time) octave band, G=10^(3/10)

b. Filter Center Frequencies:

c. Class 1: 16 Hz, 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz

d. Time Weighting: F and S

e. Real-time Analysis: Completes all center frequencies and A, C, Z weighting simultaneously

f. Linear Range: Over 100 dB (Z)

g. Main Measurement Indicators: Frequency band instantaneous sound pressure level (Lp), maximum sound pressure level (Max), minimum sound pressure level (Min), equivalent continuous sound pressure level (Leq,T), noise rating (NR), noise criteria (NC), speech interference level (SIL4)

25) 1/3 Octave Band Spectrum Analysis Function (Optional):

a. Filter Type: Parallel (real-time) 1/3 octave band, G=10^(3/10)

b. Filter Center Frequencies:

c. Class 1: 12.5 Hz, 16 Hz, 20 Hz, 25 Hz, 31.5 Hz, 40 Hz, 50 Hz, 63 Hz, 80 Hz, 100 Hz, 125 Hz, 160 Hz, 200 Hz, 250 Hz, 315 Hz, 400 Hz, 500 Hz, 630 Hz, 800 Hz, 1 kHz, 1.25 kHz, 1.6 kHz, 2 kHz, 2.5 kHz, 3.15 kHz, 4 kHz, 5 kHz, 6.3 kHz, 8 kHz, 10 kHz, 12.5 kHz, 16 kHz, 20 kHz, 25 kHz

d. Time Weighting: F and S

e. Real-time Analysis: Completes all center frequencies and A, C, Z weighting simultaneously, plus user-defined frequency weighting

f. Linear Range: Over 100 dB (Z)

g. Main Measurement Indicators: Frequency band instantaneous sound pressure level (Lp), maximum sound pressure level (Max), minimum sound pressure level (Min), equivalent continuous sound pressure level (Leq,T)

26) FFT Analysis Function (Optional):

a. Pre-FFT Weighting: A, C, Z weighting

b. Time Weighting: F (Fast), S (Slow)

c. FFT Analysis Lines: 2048 lines

d. Analysis Frequency Upper Limits: 28,640 Hz, 14,320 Hz, 7,160 Hz, 3,580 Hz, 1,790 Hz

e. Bandwidth per Line (Bp): 32 Hz, 16 Hz, 8 Hz, 4 Hz, 2 Hz

f. Window Functions: Flat-top, Bartlett, Hanning, and Rectangular

g. Main Measurement Indicators: Instantaneous values with fast and slow time weighting per spectral line, maximum sound pressure level (Max) per spectral line, minimum sound pressure level (Min) per spectral line, equivalent continuous sound pressure level (Leq,T) per spectral line, and measurement elapsed time (Tm)

4 Structural Features

4.1 Interface

The front of the instrument is the signal input socket, type X9-6z, shown in Figure 4.1. The pin layout for the X9-6Z socket is as follows:

Pin 1: Power
Pin 2: null
Pin 3: Signal input
Pin 4: null
Pin 5: Signal ground
Pin 6: null

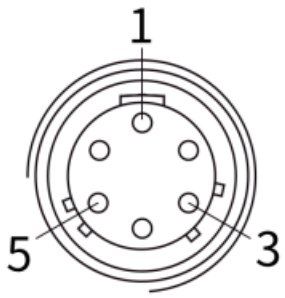


Figure 4.1: X9-6Z Socket

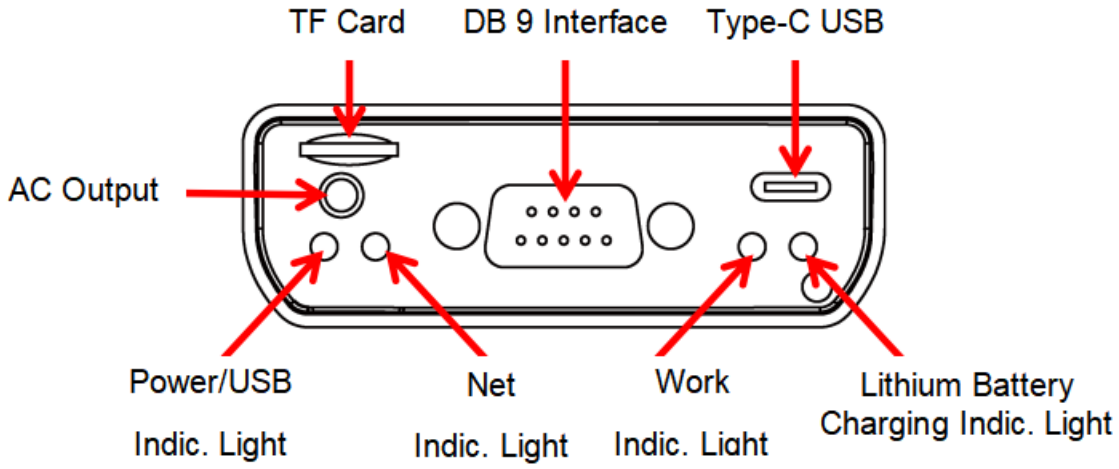
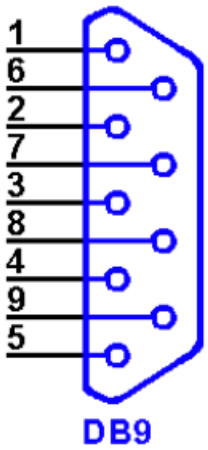


Figure 4.2: Bottom Cover Interfaces

The bottom of the instrument includes a TF card slot, a USB Type-C port, a communication interface, an AC output interface, and status indicator lights. The communication interface uses a DB9 male pin connector, with the pin definitions as follows:

1) Power (4.5V - 8V)
2) RXD
3) TXD
4) NULL
5) GND
6) PWM output
7) NULL
8) Reserved (must be left unconnected)
9) Reserved (must be left unconnected)



AC Output Interface: A 3.5mm stereo jack, with the pin definitions matching the plug configuration as shown in Figure 4.3.

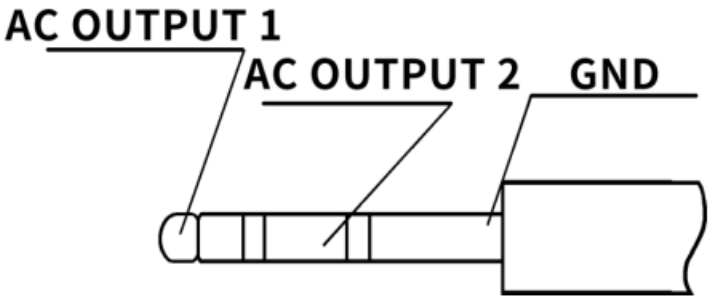


Figure. 4.3: AC output plug

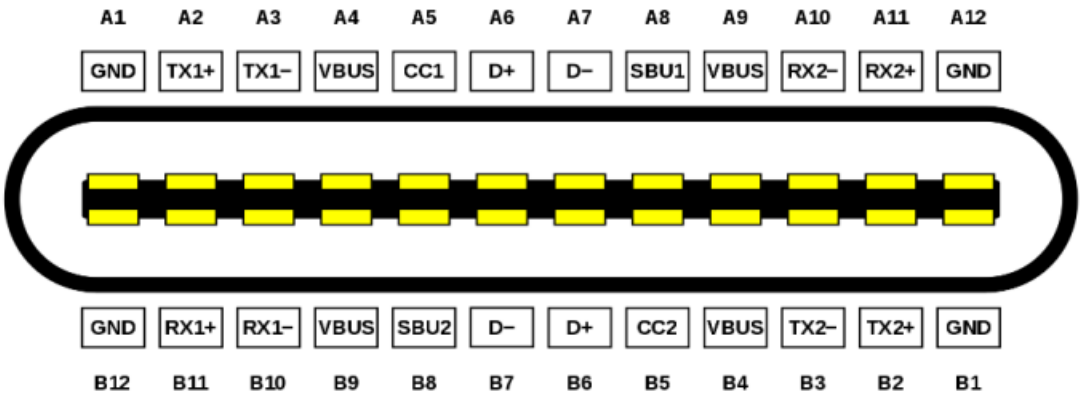


Figure 4.4: USB-Type-C_16 socket

Note: When inserting or removing components such as the preamplifier, microphone, TF card, or serial port, always ensure the instrument is powered off to prevent damage.

4.2 Buttons

Button Symbol	Button Name	Main Function
	Power/Reset	Turns on the power or resets the instrument.
	Power Off	Power Off （Note: When a measurement is being started, pressing this button will not turn off the instrument.）
	Backlight	Toggles the LCD backlight on or off.
	Delete	Deletes the current measurement result or input data.

Table 4.1 Buttons(Upper)

Button Symbol	Button Name	Main Function
	Return	Exits the current menu and returns to the previous.
	Confirm/Enter	Confirms the current operation.
	Parameter Down	Decreases the data by 1 or scrolls down through pages.
	Parameter Up	Increases the data by 1 or scrolls up through pages.
	Start/Pause	Starts the measurement when pressed once, pauses the measurement when pressed again.
	Settings	Enters the parameter settings menu.
	Cursor Left	Moves the cursor to the left.
	Cursor Right	Moves the cursor to the right.
	Cursor Up	Moves the cursor up.
	Cursor Down	Moves the cursor down.

Table 4.2: Buttons(Lower)

4.3 Indicator Lights

Name	Color	Function Description
Working	Green	Flashes every second during integration measurement, solid light indicates the measurement is paused.
Power/ USB	Dual-color	Red light indicates the instrument is powered on, green light indicates the USB is connected.
NET	Red	Solid light indicates DTU initialization failure, 1-second interval flashes indicate normal operation, 0.5-second interval flashes indicate a successful connection to the server.
Charging	Dual-color	Red light indicates charging, green light indicates fully charged. (Note: Charging module is optional.)

4.4 Key Components

1. Test Microphone Note: Avoid impact
2. Preamplifier

5 Terminology

5.1 Terms and Symbols Displayed by the Instrument

Ts	Set integration measurement time
Tm	Actual measurement elapsed time
TI	Remaining measurement time (Ts - Tm)
GPS	Global Position System
Name@:	Name of the group or measurement point, user-defined
Cur@	Current cursor position and corresponding sound level
Max@	Position and corresponding sound level of the maximum value
H:	Time period number during 24-hour automatic monitoring
24H	24-hour automatic monitoring mode
F	Fast time weighting, with a time constant of 125 ms
S	Slow time weighting, with a time constant of 1000 ms
I	Impulse time weighting, with a rise time constant of 35 ms and a fall time constant of 1500 ms

Lx	Microphone sensitivity level
LAeq	A-weighted equivalent sound level
LCeq	C-weighted equivalent sound level
LZeq	Z-weighted equivalent sound level
SEL	Sound Exposure Level = Leq + 10Log(T)
LAE	A-weighted sound exposure level
LC-A	Difference between C-weighted and A-weighted sound exposure levels
Lmax	Maximum sound pressure level
Lmin	Minimum sound pressure level
L5	5% of the sound pressure level exceeds current sound pressure level
L10	10% of the sound pressure level exceeds current sound pressure level
L50	50% of the sound pressure level exceeds current sound pressure level
L90	90% of the sound pressure level exceeds current sound pressure level
L95	95% of the sound pressure level exceeds current sound pressure level
SD	Standard deviation
Linst	Instantaneous sound pressure level
LAFp	Maximum A-weighted sound level measured within the refresh time for Fast time weighting
LASp	Maximum A-weighted sound level measured within the refresh time for Slow time weighting
LAIp	Maximum A-weighted sound level measured within the refresh time for Impulse time weighting
LAeq,t	A-weighted equivalent sound level over time t
LCFp	Maximum C-weighted sound level measured within the refresh time for Fast time weighting
LCSp	Maximum C-weighted sound level measured within the refresh time for Slow time weighting
LCIp	Maximum C-weighted sound level measured within the refresh time for Impulse time weighting
LCeq,t	C-weighted equivalent sound level over time t
LZFp	Maximum Z-weighted sound level measured within the refresh time for Fast time weighting
LZSp	Maximum Z-weighted sound level measured within the refresh time for Slow time weighting
LZIp	Maximum Z-weighted sound level measured within the refresh time for Impulse time weighting

LZeq,t	Z-weighted equivalent sound level over t second (typically t = 0.5s)
LAFi	A-weighted instantaneous sound level measured by F-time-weighting
LASi	A-weighted instantaneous sound level measured by S-time-weighting
LAIi	A-weighted instantaneous sound level measured by I-time-weighting
LCFi	C-weighted instantaneous sound level measured by F-time-weighting
LCSi	C-weighted instantaneous sound level measured by S-time-weighting
LCIi	C-weighted instantaneous sound level measured by I-time-weighting
LZFi	Z-weighted instantaneous sound level measured by F-time-weighting
LZSi	Z-weighted instantaneous sound level measured by S-time-weighting
LZIi	Z-weighted instantaneous sound level measured by I-time-weighting
Ld	Daytime equivalent sound level (6:00 to 22:00)
Ln	Nighttime equivalent sound level (22:00 to 6:00)
Ldn	Day-night equivalent sound level
LApeak	A-weighted peak sound level
LCpeak	C-weighted peak sound level
LZpeak	Z-weighted peak sound level
NR	Noise rating (international standard)
NC	Noise criterion (American standard)
SIL4	Speech interference level (rounded to the nearest whole number)
Lat	Latitude, in degrees
Lon	Longitude, in degrees
Alt	Altitude
Vel	Velocity
SMS	Short Messages
UTC	World Standard Time
GMT	Greenwich Mean Time
OCT	Octave Spectrum Analysis
GMT+8	Indicates a time zone 8 hours ahead of Greenwich Mean Time, equivalent to UTC+8
OCT	Octave band spectrum analysis
1/3 OCT	1/3 octave band spectrum analysis
SPL(A)	A-weighted sound pressure level
SPL(B)	B-weighted sound pressure level
SPL(C)	C-weighted sound pressure level

SPL(D)	D-weighted sound pressure level
SPL(Z)	Z-weighted sound pressure level
SPL(J)	User defined weighted sound pressure
SPL(U)	User defined weighted sound pressure
LEX,8h	8-hour equivalent sound pressure level
TWA	Time-weighted average sound level equivalent to an 8-hour exposure
LAVG	Average sound pressure level
DOSE	Noise dose, with values exceeding 100% indicating a limit violation
Exchange Rate	The reduction (or increase) in allowable noise level when the exposure time is doubled (or halved)
Threshold	The time-weighted sound pressure level below which measurements are excluded from TWA and LAVG calculations
Limit	The noise dose level at which an indicator light will activate when exceeded
Td	Duration
LEPN	Effective perceived noise level
Vusb	External power supply voltage
Vcc	Battery voltage (provided by an external power supply when no battery is connected)
Vbat	Backup battery voltage
	Battery level display
	Low battery warning
	External power indicator
G	GPS indicator

5.2 Definition of Common Acoustic Measurement Indicators

5.2.1 Peak Sound Pressure

The absolute value of the maximum instantaneous sound pressure within a specified time interval.

5.2.2 Peak Sound Level

The logarithm to the base 10 of the ratio of peak sound pressure to the reference sound pressure, multiplied by 20. The peak sound pressure is obtained using standard frequency weighting.

5.2.3 Time Weighting

Exponential function of time, of a specified time constant, that weights the square of a sound pressure signal

5.2.4 Time-Weighted Sound Level:

Ten times the logarithm to the base 10 of the ratio of the running time average of the time weighted square of a frequency-weighted sound-pressure signal to the square of the reference value.

Note 1: Time-weighted sound level is expressed in decibels (dB).

Note 2: For time-weighted sound level, example letter symbols are LAF, LAS, LCF, and LCS for frequency weightings A and C and time weightings F and S.

Note 3: In symbols and as an example, A-weighted and F-time-weighted sound level LAF(t) at observation time t can be represented by:

$$L_{AF}(t) = 10 \lg \left[\frac{(1/\tau_F) \int_{-\infty}^{t} p_A^2(\xi) e^{-(t-\xi)/\tau_F} d\xi}{p_0^2} \right] \quad \text{dB}$$

Where

- τF is the exponential time constant in seconds for the F time weighting.
- ξ is a dummy variable of time integration from some time in the past, as indicated by -∞ for the lower limit of the integral, to the time of observation t.
- pA(ξ) is the A-weighted instantaneous sound-pressure signal.
- p0 is the reference value of 20 μPa.

5.2.5 Time-Averaged Sound Level or Equivalent Continuous Sound Level

Ten times the logarithm to the base 10 of the ratio of the time average of the square of a frequency-weighted sound-pressure signal during a stated time interval to the square of the reference value.

Note 1: Time-averaged or equivalent continuous sound level is expressed in decibels (dB).

Note 2: In symbols and as an example, time-averaged, A-weighted sound level LAeq ,T ,is given by:

$$L_{\mathrm{Aeq},T} = 10\,\lg\left[\frac{(1/T)\int_{t-T}^{t} p_{\mathrm{A}}^2(\xi)\mathrm{d}\xi}{p_0^2}\right]\ \mathrm{dB}$$

where

– ξ is a dummy variable of time integration over the averaging time interval ending at the time of observation t;

– T is the averaging time interval;

– pA(ξ) is the A-weighted sound-pressure signal;

– p0 is the reference value of 20 μPa.

Note 3: In principle, time weighting is not involved in a determination of time-averaged sound level.

5.2.6 Sound Exposure

Time integral of the square of a frequency-weighted sound-pressure signal over a stated time interval or event of stated duration.

Note 1: Duration of integration is included implicitly in the time integral and is not always reported explicitly, although it is useful to state the nature of the event. For measurements of sound exposure over a specified time interval, duration of integration is usually reported and indicated by a suitable subscript to the letter symbol, for example as EA,1h.

Note 2: In symbols and as an example, A-weighted sound exposure EA,T is represented by:

$$E_A = \int_{t_1}^{t_2} p_A^2(t)dt$$

Where $p_A^2(t)$ is the square of the A-weighted sound-pressure signal during integration time T starting at t1 and ending at t2.

Note 3: The unit of sound exposure is pascal-squared seconds (Pa2s) if sound pressure is in pascals and running time is in seconds.

Note 4: For applications such as measurement of exposure to noise in the workplace, sound exposure in pascal-squared hours is more convenient than pascal-squared seconds.

5.2.7 Sound Exposure Level

Ten times the logarithm to the base 10 of the ratio of a sound exposure to the reference value.

Note 1: Sound exposure level is expressed in decibels (dB).

Note 2: In symbols and as an example, A-weighted sound exposure level LAE,T is related to the corresponding time-averaged, A-weighted sound level LAeq,T by

$$SEL = 10|_g \{[\int_{t1}^{t2} P_A^2(t)dt]/(p_0^2 T_0)\}$$

$$SEL = 10|_g (E_A / E_0) = L_{AT} + 10|_g (T / T_0)$$

Where

- $E_{A,T}$ is the A-weighted sound exposure in pascal-squared seconds over time interval T (see Equation (3));
- E_0 is the reference value given by $P^2_0T_0 = (20\ \mu Pa)^2 \times (1\ s) = 400\times10^{-12}\ Pa^2s$;
- T is the measurement time interval, in seconds, starting at t_1 and ending at t_2, and
- T_0 is the reference value of 1 s for sound exposure level.

Note 3: Time-averaged, A-weighted sound level $L_{Aeq,T}$ during averaging time interval T is related to the corresponding A-weighted sound exposure $E_{A,T}$, or the A-weighted sound exposure level $L_{AE,T}$, occurring within that interval by:

$$E_A = (p_0^2\ T)\ (10^{\ 0.1LAT})$$

Or

$$L_{AT} = 10\lg[\ E_A\ /\ (p_0^2\ T)\ ]\ dB = SEL - 10\lg(T/T_0)\ dB$$

5.2.8 Noise Dose

$$Dose = [C1/T1 + C2/T2 + \ldots\ldots + Cm/Tm] \times 100$$

where

- C_m is total exposure time at specified sound level;
- T_m is time allowed at each sound level.

$$Dose = 100 * 2^{(TWA-CL)/R}$$

where

- CL is criterion level, in dB;
- R is exchange rate， typically 3 or 4 or 5.

5.2.9 Time-Weighted Average Sound Pressure Level (TWA)

The constant sound level that results in the same sound exposure as the measured sound over an 8-hour period.

$$TWA = 10 * \lg[(2^{(L1-CL)/R}+.....+2^{(Ln-CL)/R}) * ts / 28800] * R/3 + CL \quad (9)$$

where

- Ln is time-weighted sound pressure level exceeding the threshold value;
- ts is sampling interval in s;
- CL is criterion level, in dB;
- R is exchange rate,Generally, typically 3 or 4 or 5;
- L_{AVG} is average sound pressure level; L_{AVG} is the average sound level measured during the measurement time:

$$L_{AVG}=TWA+R/3*10*\lg(8h/Tm)$$

where

- R——Exchange rate: Generally, the value could be 3 or 4 or 5;
- Tm——Measuring time in hours,h.

5.2.10 8-hour weekday normalized sound exposure level，Lex,8h

$$L_{ex,8h} = L_{Aeq,Te} + 10\lg(T_e/T_0)$$

where

- T_e is effective duration of the weekday;
- T_0 is reference duration (equal to 8 hours).

6 Information Specified for Measurement Purposes

1) Reference sound pressure level: 94.0 dB.

2) Reference incidence direction: Axial direction of the microphone.

3) Microphone reference point: Centre of the microphone diaphragm.

4) Correction data from sound pressure response to free-field response (reference incidence direction):

Frequency(Hz)	**1k**	**1.25k**	**1.6k**	**2k**	**2.5k**	**3. 15k**	**4k**
Correction value(dB)	0. 15	0. 2	0. 3	0.4	0.6	0. 8	1.2
Frequency (Hz)	**5k**	**6.3k**	**8k**	**10k**	**12.5k**	**16k**	**20k**
Correction value(dB)	1.75	2.45	3. 7	5.5	7.3	8. 1	10.5

5) Nominal free-field response of the instrument in the reference direction under approximate reference environmental conditions: See Appendix 1.

6) Electrical input equipment: An equivalent electrical impedance can be used for electrical signal testing with a capacitance of 20 pF and an insulation resistance greater than 1 $G\Omega$. A shielded cartridge with the equivalent electrical impedance is screwed onto the preamplifier.

7) Maximum background noise: When the monitor is placed in a low sound level sound field and when the microphone is replaced by the above-mentioned fitter and short-circuited, the maximum possible self-noise is 18 dBA.

8) Maximum permissible sound pressure level on the microphone: 146 dB.

9) Maximum peak input voltage for electrical input equipment: 7 Vpp.

10) Operating voltage range when the monitor to meet technical requirements: DC 4.5 V - DC 8.0 V.

11) Typical time required to stabilize under reference environmental conditions after environmental condition changes: At least 12 hours under reference environmental

conditions, and at least 19 hours under other environmental conditions.

7 Main Display Interface

The main display interfaces include the main menu interface, acoustic measurement interface, instrument settings interface, data retrieval interface, and instrument calibration interface.

7.1 Main Menu

Press the on/reset button for more than 2 seconds and then release, the instrument will perform a self-check. If the self-check is successful, the instrument will enter the main menu, which is displayed as follows:

Figure 7.1 Main

The main menu includes four sub-menus: Measure, Setup, Recall, and Calibration. A storage space status bar is displayed at the bottom. In this interface, you can use the cursor keys to move the cursor and press the confirm key to enter the corresponding sub-menu. The Instrument Setup sub-menu contains four additional sub-menus: Analyzer, Basic, Quick, and Template, as shown below:

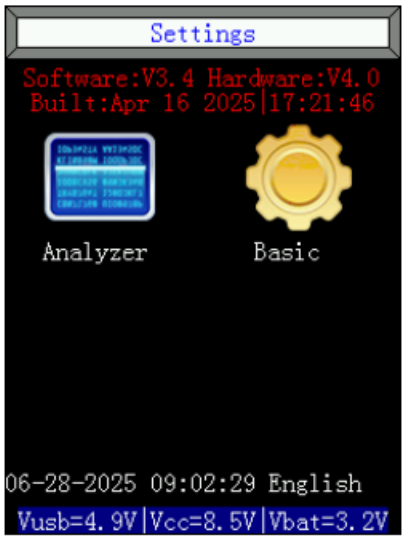


Figure 7.2 Settings

7.2 Acoustic Measurement

When the cursor is on "Measure" option, pressing the confirm key will take the instrument to the measurement and analysis interface, as shown below. The measurement and analysis interface includes the following sub-interfaces: Statistical Analysis, Total Value Integration, 1/1 Octave Band Analysis, 1/3 Octave Band Analysis, Sound Exposure Level, FFT Analysis, and Reverberation Time Measurement.

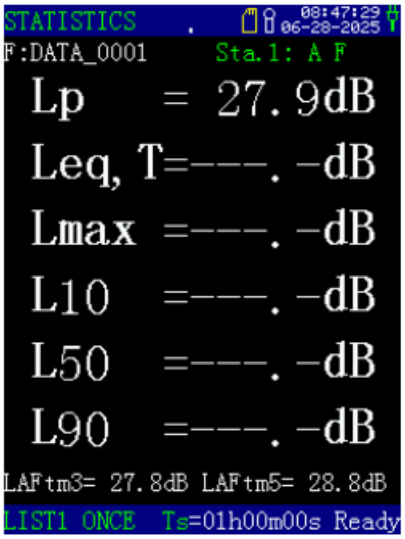


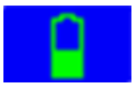
Figure 7.3 Statistics LIST1

Note: Green options indicate that the menu status can be changed using the cursor and parameter keys.

The first row within the blue background box displays, from left to right: the current analyzer mode, overload indicator or the status of the number of analyzers currently active, TF card status (optional), DTU and GPS status (optional), calendar clock, and power indicator. Moving the cursor to the "STATISTICS" option allows the menu options to be changed using the parameter up and down keys. When the power indicator shows a power plug, it indicates that the instrument is currently powered by an external power source. The black background box in the middle displays the measurement content. The bottom row within the blue background box shows, from left to right: display mode, measurement mode, measurement time, and measurement status.

The cursor keys allow the cursor to remain on positions 1, 7-9, and the parameter keys can be used to switch to other options. The possible status options that may appear in the menu bar are as follows:

No.	Display content	Meaning	Note
1	STATISTICS	Analysis mode	Displayed only if the corresponding module is installed.
	INTEGRAL	Analysis mode	
	1/1 OCT	Analysis mode	
	1/3 OCT	Analysis mode	
	DOSIMETER	Analysis mode	
	FFT analyzer	Analysis mode	
2		Indicates which analyzers are switched on and their operating status.	Colors: White indicates open, blue (without vertical lines) indicates closed, red indicates active state. Vertical lines: From left to right, they represent statistical, total value, 1/1 OCT, 1/3 OCT, sound exposure, FFT, and digital recorder.
		Indicates that the STATISTICS, LOGGING is active, INTEGRAL, DOSIMETER, FFT are on but not active, and the 1/1 OCT, 1/3 OCT are off.	
	Overload or Underload	Indicates that the instrument is in an overload or	Overload is displayed when the instrument exceeds the measurement limit; underload is displayed when it is

		underload state.	below the measurement limit.
3		TF card inserted	TF card functionality is available only if the card is installed.
		Recording function enabled	
4		DTU function enabled	Displayed if the DTU function is installed. A white light indicates no connection to the server, and a green light indicates a connection to the server.
		GPS function enabled	Displayed if the GPS function is installed. A red light indicates no location information received, and a green light indicates location information received.
5	Calendar Clock	Upper row shows hours, minutes, and seconds; lower row shows year, month, and day.	
6		Power status: Currently powered by external power.	The battery and external power can switch automatically. When the external power voltage exceeds 4.3V, the battery is disconnected and power is supplied by the external source. If the external power voltage is too low, the power supply switches to the battery without interruption.
		Power status: Currently powered by the battery, with battery level displayed.	
		Power status: Both external power and battery voltage are low.	
7	LIST	Display interface	STATISTICS, INTEGRAL, 1/1 OCT, 1/3 OCT, DOSIMETER, FFT analyzer
	ALL	Display interface	24 hour measurement interface for STATISTICS
	FIG	Display interface	STATISTICS, INTEGRAL, 1/1 OCT, 1/3 OCT, DOSIMETER, FFT analyzer
	BIG	Display interface	INTEGRAL, 1/1 OCT, 1/3 OCT,
	HUGE	Display interface	INTEGRAL

	Sim	Display interface	INTEGRAL
	Room	Display interface	1/1 OCT
8	ONCE	Measuring mode	STATISTICS
	24H	Measuring mode	STATISTICS
	LAFp, LASp, LAIp, LZFp, LZSp, LZIp, LCFp, LCSp or LCIp	Measuring indicators name	INTEGRAL
	WT.: A,C, Z	Frequency weighting	INTEGRAL, 1/1 OCT, 1/3 OCT, FFT analyzer
	Lp, Lmax, Lmin, LeqT	Measuring indicators name	1/1 OCT Room display interface
9	Ts	Set measurement time	
	Tm	Measurement time elapsed	
	Tl	Measurement time remaining	
10	Ready	Measurement not started	
	R:-(seconds)	Remaining time for voice annotation	
	W:-(seconds)	Remaining time for delayed start	
	RUN	Measurement in progress	
	END	Measurement ended	
	Pause	Measurement paused	

Table 1: Menu Bar Status and Meaning

7.2.1 STATISTICS Interface

The statistical analysis interface includes single measurement mode and 24H measurement mode. Analysis modes include INTEGRAL, 1/1 OCT (optional) and 1/3 OCT (optional), time time weighting available are F, S, and I, and frequency weighting available are A, C, and Z. The statistical measurement interface contains two groups of settings:"Sta.1" and "Sta.2". In the measurement interface, the parameters cannot be modified, but the display can be switched between the two. The parameters for "Sta.1" and "Sta.2" need to be changed in

the "Instrument" under "Analyzer" in the "Statistical Integrator" section. The content of the settings is shown in the table below:

	Available Analysis Mode	Available Frequency Weighting	Available Time Weighting	Available Center Frequency and Total Value
Sta.1	Total Value	A,C,Z	F,S,I	
	1/1 OCT (optional)	A,C,Z	F,S	Each center frequency point and total sound level with A, C, Z weighting can be selected.
Sta.2	1/3 OCT (optional)	A,C,Z	F,S	Each center frequency point and total sound level with A, C, Z, B, D, J, U weighting can be selected.

***Note*:** If the parameters for sta.1 and sta.2 are identical, the instrument will only open one statistical integrator, and it will not be possible to switch to the sta.2 interface.

7.2.1.1 ONCE Measurement Interface

In the noise measurement interface, when the measurement mode menu shows “ONCE”, the instrument enters the single measurement mode. The “ONCE” measurement interface offers two display modes: LIST and FIG.

1) LIST Measurement Interface

The list interface consists of three pages, labeled as List 1, List 2, and List 3. Each page displays six measurement indicators, showing both instantaneous values and statistical values.

- "F: DATA_0001" represents the group name (measurement point name).
- "Sta.1: AF" indicates that the current statistical sound level uses A-weighting for frequency weighting and F for time weighting. Moving the cursor here and pressing the parameter key switches to the "Sta2:ZF" measurement interface, indicating that the current statistical sound level uses Z-weighting for frequency and F for time weighting. Both "Sta.1" and "Sta.2" are activated simultaneously during measurement, and switching between them using the parameter key does not affect the measurement results.

- The middle section with a black background shows the six measurement indicators for the current frequency weighting and time weighting.
  - Under "List 1" The measurement indicators include Linst, Leq,T, Lmax, Lmin, L10, and L50, L90, shown in Figure 7.3.
  - Under "List 2" the measurement indicators include Linst, Lmin, L5, L95, SEL, and SD, shown in Figure 7.4.
  - Under “List 3” the indicators include LAFp, LASp, LCFp, LCSp, LZFp, and LZSp, shown in Figure 7.5.

Figure 7.4 Statistics LIST2

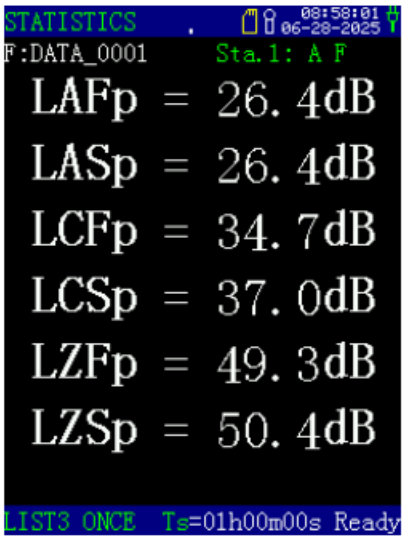


Figure 7.5 Statistics LIST3

2) FIG Measurement Interface

Moving the cursor over "List 1" or "List 2" and pressing the parameter up or down keys will take you to the graphical display interface. This interface can show both statistical distribution and cumulative distribution graphs. When measurement starts, both the statistical distribution graph and the cumulative distribution graph are updated simultaneously, with a refresh rate of every 0.5 seconds during measurement.

- Statistical Distribution Chart Display Interface

The central area shows the statistical distribution graph, with the vertical axis representing the percentage and the horizontal axis representing sound pressure levels. The horizontal axis has a dynamic range. Moving the cursor over "59dB" and pressing

the parameter key allows you to view the percentage of each sound pressure level.

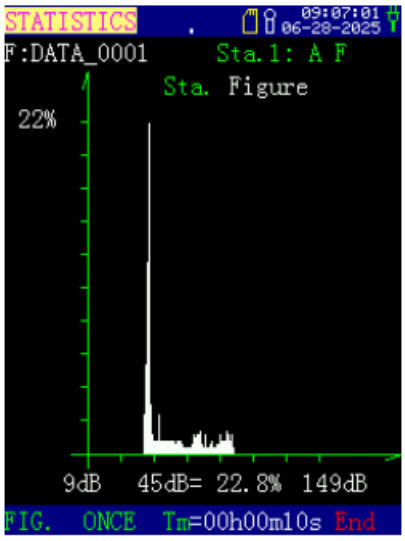


Figure 7.6 Statistics FIG

3) Cumulative Distribution Graph Display Interface

The vertical axis represents the percentage, and the horizontal axis represents sound pressure levels. The horizontal axis has a total of 140 points, with each point representing 1 dB. Moving the cursor over "59dB" and pressing the parameter key allows you to view the cumulative percentage for each sound pressure level. This method can be used to calculate any statistical sound level.

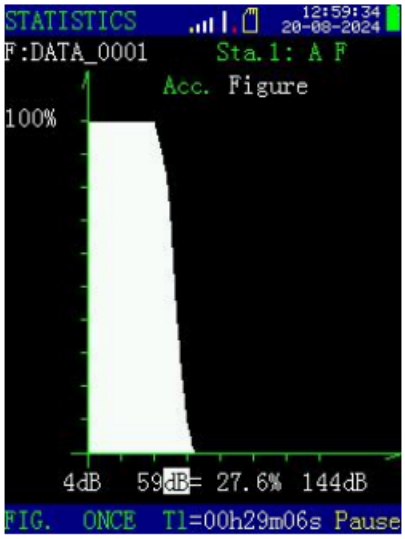


Figure 7.7

7.2.1.2 24-hour Automatic Measurement Interface

The 24-hour measurement refers to automatic measurements taken every hour on the hour, with continuous measurements occurring 24 times over a 24-hour period. The measurement duration for each hour can be set by the user, but it must be greater than 1 minute and no longer than 1 hour. If the duration is outside this range, the instrument will automatically adjust it to fall between 1 minute and 1 hour. During the 24-hour measurement, the values for Ld, Ln, and Ldn are also calculated. The 24-hour measurement mode primarily includes the List Display Interface, Full Measurement Interface, and Graph Display Interface.

1) List Measurement Interface

The central section with the black background displays the six measurement indicators under the current frequency weighting and time weighting. The indicators include Linst, Leq,T, Lmax, Ld, Ln, and Ldn. The last line of the black background displays "Start@28-03-2023 14:00:00," indicating the time when the first measurement started. "H: 01" indicates that the measurement for the 1st time period is currently in progress.

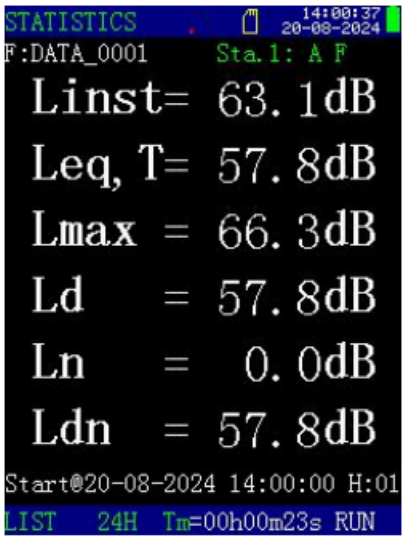


Figure 7.8

2) Full Measurement Interface

The indicators for the current column are "Time, Leq,T, Lmax, L10, L50, L90, SD," corresponding to the 24 rows of measurement data below. "[1]"indicates the first page of measurement indicators. Moving the cursor to this position and pressing the

parameter key changes it to display “[2],” with the measurement indicators changing to "Time, Leq,T, Lmin, L5, L50, L95, SD." The “---.-” section in the middle indicates that this time period has not yet been measured. The last line of the black background, in yellow font, displays "Ld= 60.8dB Ln= 0.0dB Ldn= 60.8dB H: 01," indicating that 1 time periods have been measured and providing the equivalent values for daytime (Ld), nighttime (Ln), and day-night (Ldn).

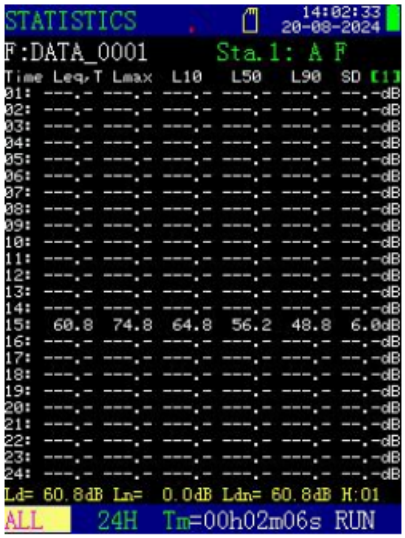


Figure 7.9

3) Graph Display Interface

The graph display interface shows the 24-hour sound pressure level distribution. The vertical axis represents sound pressure levels, and the horizontal axis represents hours, with 24 columns in total. “Leq,T” indicates that the currently displayed indicator is Leq,T. Moving the cursor to this position and pressing the parameter up or down keys allows switching to other indicators such as Lmax, Lmin, L5, L10, L50, L90, and L95.

Below the graph, "Time Leq,T Lmax Lmin L5 [1]" indicates the current page's measurement indicators. Moving the cursor to “[1]” and pressing the parameter key changes the display to "Time L10 L50 L90 L95 [2]." The row at the bottom shows the measurement data for the specified time period. Moving the cursor to time period “12” and pressing the parameter key allows you to view the measurement results for other time periods.

Figure 7.10

7.2.2 INTEGRAL Interface

In the total value integration measurement interface, there are four display modes: "Sim" for simple, "List", "BIG" for highlight, and "HUGE" for Large Text.

7.2.2.1 Simple(Sim) Mode

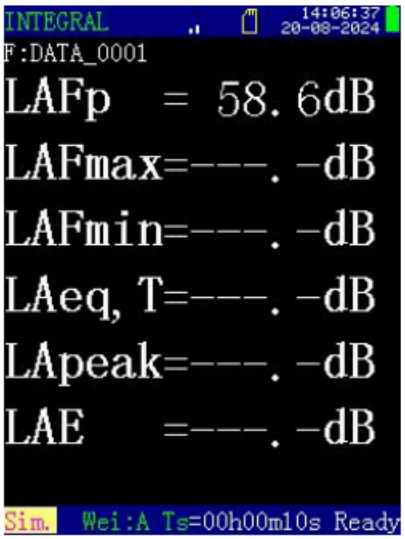


Figure 7.11

The central section shows measurement content related to the frequency weighting of the current measurement interface, as indicated in the table below:

Frequency Weighting (WT.)	Measurement Indicators
A	LAFp, LAFmax, LAFmin, LAeq,T, LApeak,LAE
C	LCFp, LCFmax, LCFmin, LCeq,T, LCpeak,LC-A
Z	LZFp, LZFmax, LZFmin, LZeq,T, LZpeak,SEL

7.2.2.2 LIST Display Interface

The measurement indicators that can be displayed in this interface are as follows:

Frequency Weighting (WT.)	Measurement Indicators
A	LAFp, LASp, LAIp, LAeq,t, LAFmax, LASmax, LAImax, LAFmin, LASmin, LAImin, LAeq,T, LApeak, LAE
C	LCFp, LCSp, LCIp, LCeq,t, LCFmax, LCSmax, LCImax, LCFmin, LCSmin, LCImin, LCeq,T, LCpeak, LC-A
Z	LZFp, LZSp, LZIp, LCeq,t, LZFmax, LZSmax, LZImax, LZFmin, LZSmin, LZImin, LZeq,T, LZpeak, SEL

The list display interface is shown as follows:

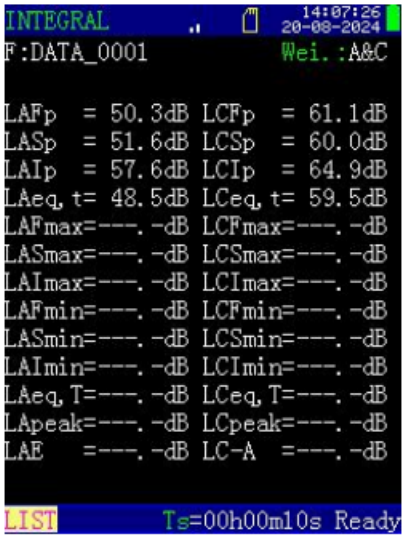


Figure 7.12

"WT.: A&C" indicates the frequency weighting in the current measurement interface, displaying indicators under both A and C weightings. Moving the cursor to the "Weighting" option and pressing the parameter key allows you to select any two weightings from A, C, and Z, with the measurement content changing accordingly.

The central area displays 26 measurement indicators for the current frequency weighting, with 13 indicators available for each frequency weighting.

7.2.2.3 Highlight(BIG) Display Interface

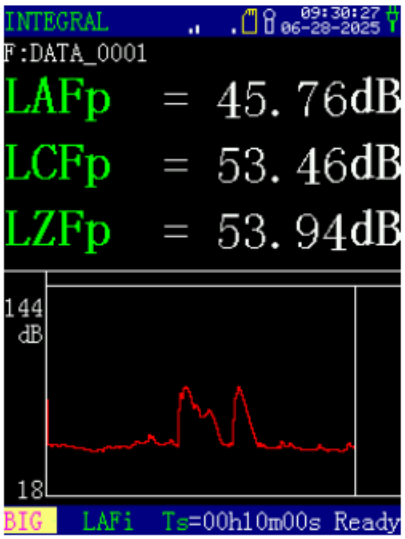


Figure 7.13

The large text in the black background shows the measurement content, displaying indicators under A, C, and Z weightings. Moving the cursor to these parameters, such as LAFp, and pressing the parameter key allows you to switch to LASp, LAIp, LAeq,t, LAFmax, LASmax, LAImax, LAFmin, LASmin, LAImin, LAeq,T, LApeak, and LAE. The measurement results are refreshed every 0.5 seconds and continuously update based on changes in environmental noise.

The graph displayed at the bottom of the screen shows the time history of instantaneous values for statistical analysis. Each graph displays approximately 20 seconds of data, with the displayed indicator corresponding to the indicator name in the blue background below. The indicator name can be specified by the user. Moving the cursor to the indicator name "LAFp" and pressing the parameter key allows you to change the sequence of the time history graph to display content for other indicators such as LASp, LAIp, LZFp, LZSp, LZIp,

LCFp, LCSp, and LCIp.

7.2.2.4 Large Text (HUGE) Interface

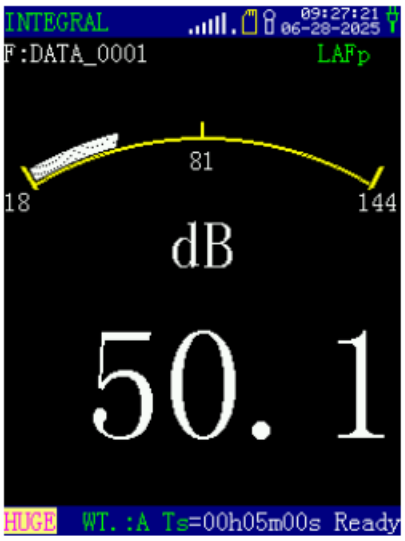


Figure 7.14

The large text in the center of the black background and the dial graphic both display the measurement results for the second row indicator name "LAFp." The data refreshes every 0.5 seconds based on environmental changes. Moving the cursor here and pressing the parameter key allows you to display other indicator names under the current frequency weighting. To display indicators for a different frequency weighting, move the cursor to the last line in the blue background labeled "WT.: A" and press the parameter key to switch to the "WT.: C" or "WT.: Z" measurement interface. The available indicator names are listed in the table below:

Frequency Weighting (WT.)	Measurement Indicators
A	LAFp, LASp, LAIp, LAeq,t, LAFmax, LASmax, LAImax, LAFmin, LASmin, LAImin, LAeq,T, LApeak, LAE
C	LCFp, LCSp, LCIp, LCeq,t, LCFmax, LCSmax, LCImax, LCFmin, LCSmin, LCImin, LCeq,T, LCpeak, LC-A
Z	LZFp, LZSp, LZIp, LZeq,t, LZFmax, LZSmax, LZImax, LZFmin, LZSmin, LZImin, LZeq,T, LZpeak, SEL

7.2.3 1/1 Octave(OCT) Band Spectrum Analysis Interface

The 1/1 Octave Band Spectrum Analysis measurement interface is accessible only when the instrument is equipped with the octave band spectrum analysis module. In the noise measurement interface, move the cursor to the analysis mode "STATISTICS", and press the parameter decrease or parameter increase key until the 1/1 Octave Band Spectrum Analysis interface is displayed. This interface offers four display modes: “LIST”, “BIG”, “FIG”, and “Room”. The 1/1 Octave Band Analysis uses a single range setting, making it more convenient to use.

7.2.3.1 1/1 Octave(OCT) Band LIST Interface

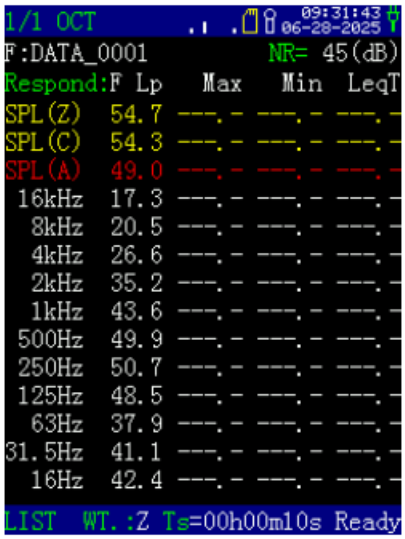


Figure 7.15

NR= 49(dB) indicates that the current NR (Noise Rating) value is 49 dB. The middle section with the black background shows 11 center frequencies and the A, C, and Z frequency-weighted sound pressure levels. The corresponding data on the right displays the Lp, Max, Min, and Leq,T values under the current frequency weighting and time weighting. The measurement results are refreshed every 0.5 seconds and continuously update according to changes in environmental noise. When no integration measurement is performed, the values for "Lmax," "Lmin," and "Leq,T" will display as "---.-".

Moving the cursor to "Respond:" and pressing the parameter key changes the time weighting from the current F (Fast) to S (Slow). Moving the cursor to "WT.:" and pressing the parameter key allows you to select one frequency weighting from A, C, or Z. Moving the

cursor to "Ts" and pressing the parameter key will display "Tm" and "T1." When the cursor is on "List," pressing the parameter increase key will enter the Graph display interface.

7.2.3.2 1/1 Octave(OCT) Band Graph(FIG) Interface

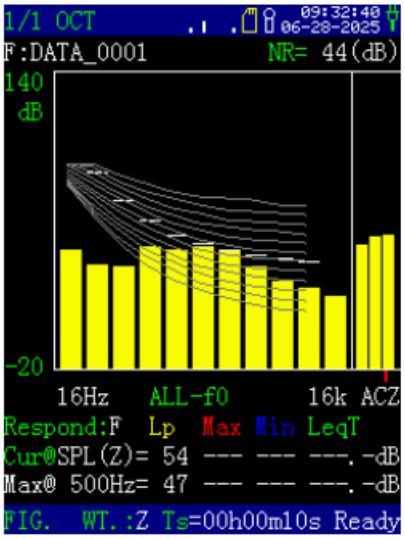


Figure 7.16

The central graph area on the black background shows the spectrum distribution for the 11 center frequencies and the A, C, and Z frequency-weighted sound pressure levels. The vertical axis's "140" indicates that the current upper limit of the graph is 140 dB. Moving the cursor here and pressing the parameter key allows adjustments in 10 dB intervals, with a maximum of 180 dB and a minimum of 10 dB above the display's lower limit, which cannot be less than 0 dB. The vertical axis's "-20" indicates that the current lower limit of the graph is -20 dB. Moving the cursor here and pressing the parameter key allows adjustments in 10 dB intervals, with a maximum of 10 dB below the display's upper limit.

The label "Lp-f0" at the center below the graph indicates that the graph currently displays the Lp values for each center frequency. Moving the cursor here and pressing the parameter key allows you to switch between displaying Lmax-f0, Lmin-f0, LeqT-f0, or ALL-f0, where "ALL" displays all four indicators simultaneously. The graph colors are adjustable and match the colors set for "Lp," "Max," "Min," and "LeqT" below the graph. You can move the cursor over "Lp," "Max," "Min," or "LeqT" and press the parameter key to change the displayed color. Moving the cursor to "Respond:" and pressing the parameter key allows you to select between F (Fast) or S (Slow) time weighting.

The line labeled "Cur@" below the graph shows the measurement content corresponding to

the cursor position on the graph for "Lp," "Max," "Min," and "LeqT." Moving the cursor here and pressing the parameter key changes the cursor position on the graph (indicated by the red bar below the graph). The last line on the black background displays "Max@63Hz," indicating that the current maximum noise frequency is at 63 Hz, followed by the measurement content for "Lp," "Max," "Min," and "LeqT" at that frequency.

"WT.:Z" indicates no pre-applied frequency weighting. Moving the cursor to "WT.: " and pressing the parameter key allows selection among A, C, or Z weighting. When A is selected, the sound pressure levels at each center frequency in the OCT analysis are adjusted with the corresponding A-weighting. Similarly, selecting C applies C-weighting.
Moving the cursor to "FIG." and pressing the parameter increase key takes you to the Highlight display interface.

7.2.3.3 1/1 Octave(OCT) Band Highlight(BIG) Interface

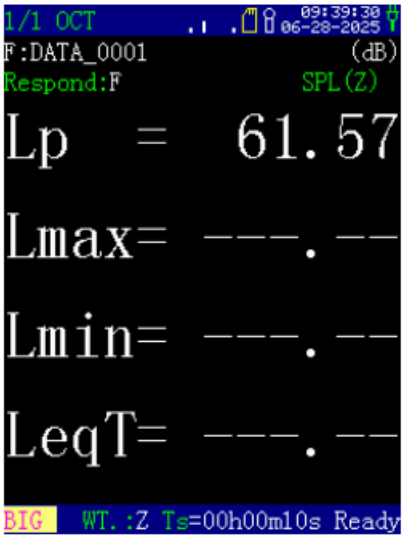


Figure 7.17

The large text in the center displays the measurement content for Lp, Max, Min, and Leq,T under SPL (A). Moving the cursor to "SPL (A)" and pressing the parameter key allows you to select one display from the 11 center frequencies and the A, C, and Z frequency-weighted sound pressure levels. Moving the cursor to "Respond:" and pressing the parameter key allows you to select between F (Fast) or S (Slow) time weighting.

"WT.: Z" indicates no pre-applied frequency weighting. Moving the cursor to "WT.:" and pressing the parameter key allows selection among A, C, or Z weighting. When A is selected, the sound pressure levels at each center frequency in the OCT analysis are adjusted with the corresponding A-weighting. Similarly, selecting C applies C-weighting.
Moving the cursor to "BIG" and pressing the parameter increase key takes you to the Indoor display interface.

7.2.3.4 1/1 Octave(OCT) Band Room Interface

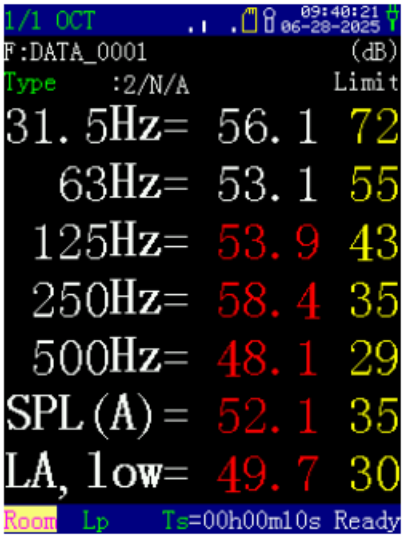


Figure 7.18

The third row labeled "Type" consists of three characters.

- The first character represents the area code, selectable from 0, 1, 2, 3, and 4.
- The second character represents the day/night option, indicated by D (Day) or N (Night).
- The third character represents the room type, selectable as A or B. "0/D/A" indicates the current standards apply to a Type 0 area, daytime, and Type A room.

Under "Limits", the standard limits for 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, and A-weighting are displayed. If the measurement results exceed the standard limits, the color changes from white to red, indicating a violation. Moving the cursor to "Room Type" and using the parameter key allows changing the area code, and the limits automatically adjust. The central area displays the Lp values for the center frequencies of 31.5 Hz, 63 Hz, 125 Hz,

250 Hz, 500 Hz, and A-weighting. Moving the cursor to the blue background "Lp" and pressing the parameter key allows entry into the measurement interface for Lp, Lmax, Lmin, or Leq,T. Other operations are similar to the “LIST” display interface.

7.2.4 1/3 Octave Band (OCT) Spectrum Analysis Interface

The 1/3 Octave Band Spectrum Analysis measurement interface is accessible only when the instrument is equipped with the 1/3 octave band spectrum analysis module. In the noise measurement interface, move the cursor to the analysis mode "STATISTICS", and press the parameter decrease or parameter increase key until the 1/3 Octave Band Spectrum Analysis interface is displayed. This interface offers four display modes: “LIST”, “BIG”, “FIG”, “Room”. The 1/3 Octave Band Analysis uses a single range setting, making it more convenient to use.

7.2.4.1 1/3 Octave Band(OCT) LIST Interface

This interface consists of three pages: List 1, List 2, and List 3.

List 1 is shown as follows:

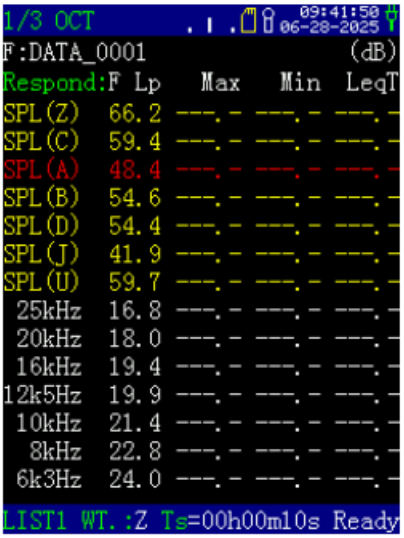


Figure 7.19

In the middle section with a black background, the display shows seven center frequencies ranging from 6.3 kHz to 25 kHz, along with the A, C, Z, B, D, J, and U frequency-weighted sound pressure levels. The corresponding data on the right shows the Lp, Max, Min, and Leq,T values under the current frequency weighting and time weighting. The last line shows

the menu options and measurement status. The measurement results are refreshed every 0.5 seconds and continuously update according to changes in environmental noise. When no integration measurement is performed, the values for "Lmax," "Lmin," and "Leq,T" are displayed as "---.-".

- "Lmax" indicates the maximum exponentially averaged value during the measurement period;
- "Lmin" indicates the minimum exponentially averaged value; and
- "Leq" indicates the integrated average result over a period of time.
- SPL(J) and SPL(U) represent user-defined frequency weighting results, which can be modified in the "Miscellaneous Settings" menu under "Basic Settings 2."

The formula for W_U is as follows:

$$W_U = 10 \log \left[\sum 10^{(Lfm+Wfm)/10} \right] \ (\text{dB})$$

The same formula applies to W_J, where Lfm represents the sound pressure level at each center frequency, and Wfm represents the weighting value at each center frequency.

The default values for user-defined frequency weightings U and J at the 35 center frequency points between 10 Hz and 25 kHz can be modified. The factory default values for these two frequency weightings are shown in the table below:

Center Frequency (Hz)	U Weighting (dB)	J Weighting (dB)	Center Frequency (Hz)	U Weighting (dB)	J Weighting (dB)
25k	0	-∞	400	0	-∞
20k	0	-∞	315	0	-∞
16k	0	-∞	250	0	-∞
12.5k	0	-∞	200	0	-10.9
10k	0	-∞	160	0	-13.4
8k	0	-∞	125	0	-16.1
6.3k	0	-∞	100	0	-19.1
5k	0	-∞	80	0	-22.5
4k	0	-∞	63	0	-26.2
3.15k	0	-∞	50	0	-30.2

2.5k	0	-∞	40	0	-34.6
2k	0	-∞	31.5	0	-39.4
1.6k	0	-∞	25	0	-44.7
1.25k	0	-∞	20	0	-50.5
1.0k	0	-∞	16	0	-∞
800	0	-∞	12.5	0	-∞
630	0	-∞	10	0	-∞
500	0	-∞			

Default Values for User-Defined Frequency Weighting

Moving the cursor to "Respond:" and pressing the parameter key changes the time weighting from the current F (Fast) to S (Slow).

"WT.: Z" indicates no pre-applied frequency weighting. Moving the cursor to "WT.:" and pressing the parameter key allows you to select among A, C, or Z. When A is selected, the 1/3 OCT analysis results at each center frequency are adjusted with the corresponding A-weighting. Similarly, selecting C applies C-weighting.

Moving the cursor to "Ts" and pressing the parameter key displays "Tm" and "T1." Moving the cursor to "List 1" and pressing the parameter increase key enters the "List 2" display interface, shown as follows:

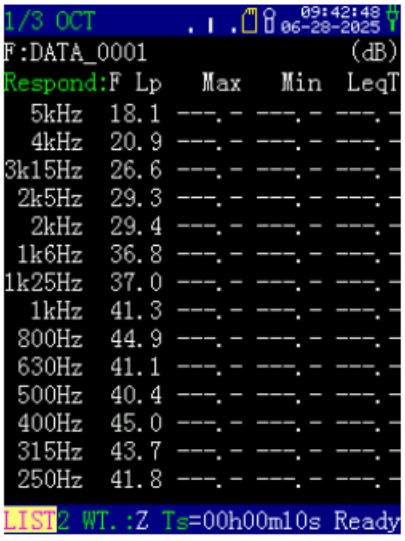


Figure 7.20

In the middle section with a black background, the display shows 14 center frequencies

ranging from 250 Hz to 5 kHz, along with the corresponding data on the right showing the Lp, Max, Min, and Leq,T values under the current frequency weighting and time weighting. Other operations are the same as in the "List 1" display interface. Moving the cursor to "List 2" and pressing the parameter increase key enters the "List 3" measurement interface, shown as follows:

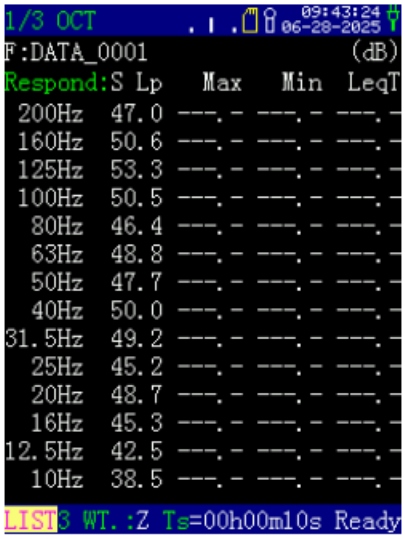


Figure 7.21

In the middle section with a black background, the display shows 14 center frequencies ranging from 10 Hz to 200 Hz, along with the corresponding data on the right showing the Lp, Max, Min, and Leq,T values under the current frequency weighting and time weighting. Other operations are the same as in the "List 1" display interface. Moving the cursor to "List 3" and pressing the parameter increase key enters the "Graph" display interface.

7.2.4.2 1/3 Octave Band(OCT) Graph(FIG) Interface

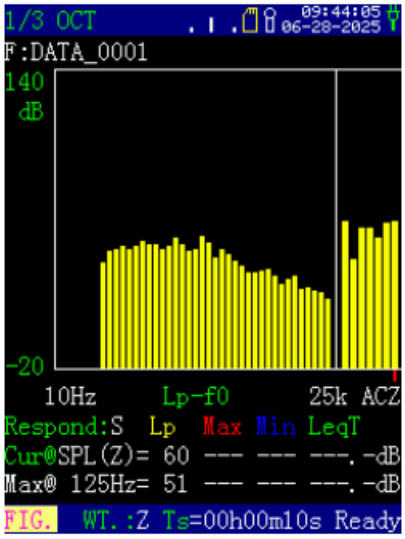


Figure 7.22

The central graph area displays the spectrum distribution for 35 center frequencies, along with the A, C, Z, B, D, U, and J frequency-weighted sound pressure levels. The "140" in the upper left corner of the graph indicates that the current display upper limit is 140 dB. Moving the cursor here and pressing the parameter key allows adjustments in 10 dB intervals, with a display range from "10 dB above the lower limit to 180 dB," and it cannot be set lower than 0 dB. The "-20" in the lower left corner of the graph indicates that the current display lower limit is -20 dB. Moving the cursor here and pressing the parameter key allows adjustments in 10 dB intervals, with a maximum setting not exceeding 10 dB below the display upper limit.

The label "Lp-f0" in the center below the graph indicates that the graph currently displays the Lp values for each center frequency. Moving the cursor here and pressing the parameter key allows you to switch between displaying Lmax-f0, Lmin-f0, LeqT-f0, or ALL-f0, where "ALL" displays all four indicators simultaneously. The graph colors are adjustable to match the "Lp," "Max," "Min," and "LeqT" indicators within the black background. The cursor can move across these indicators, and pressing the parameter key allows you to change the color of the currently displayed indicator. Moving the cursor to "Respond:" and pressing the parameter key allows you to choose between F (Fast) or S (Slow) time weighting.

The line labeled "Cur@" below the graph shows the measurement content corresponding to the cursor position on the graph for "Lp," "Max," "Min," and "LeqT." Moving the cursor here

and pressing the parameter key changes the cursor position on the graph (indicated by the yellow bar below the graph). The last line on the black background displays "Max@80Hz," indicating that the current maximum noise frequency is at 80 Hz, with the corresponding Lp, Max, Min, and Leq,T values shown to the right.

Moving the cursor to "FIG" and pressing the parameter increase key takes you to the Highlight(BIG) display interface.

7.2.4.3 1/3 Octave Band(OCT) Highlight(BIG) Interface

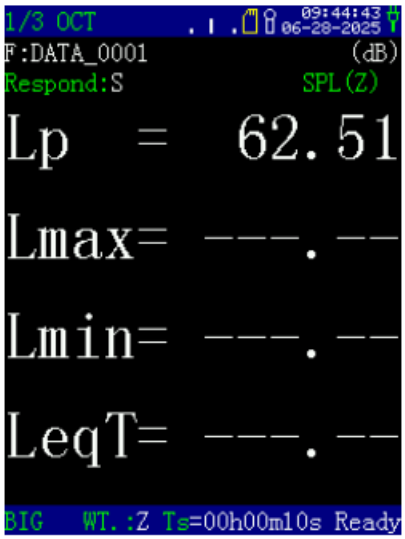


Figure 7.23

The central large text display can show the measurement content for Lp, Max, Min, and Leq,T across the 35 center frequencies and the A, C, Z, B, D, U, and J frequency-weighted sound pressure levels. The user can select any one of these to display. Moving the cursor to "SPL (A)" and pressing the parameter key allows you to choose one display option from the 35 center frequencies and the A, C, Z, B, D, U, and J frequency-weighted sound pressure levels. Moving the cursor to "Highlight" and pressing the parameter increase key takes you to the "List 1" display interface.

7.2.5 DOSIMETER(Sound Exposure Level) Measurement Interface

In the Measure interface, move the cursor to the analysis mode and press the parameter decrease or increase key to switch to the Dosimeter measurement interface. There are two display interfaces available: LIST and FIG.

7.2.5.1 Dosimeter LIST Interface

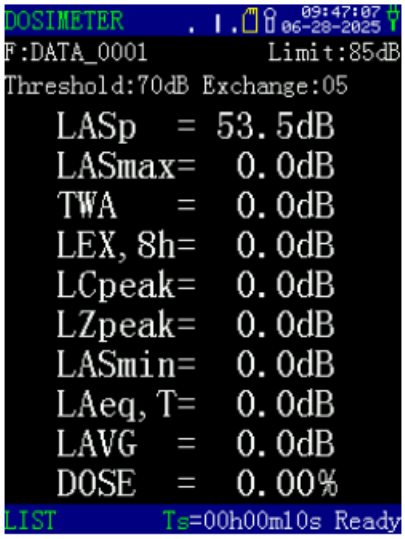


Figure 7.24

The "Limit," "Threshold," and "Exchange" can be modified in the "Analyzer" Settings. This interface displays 10 measurement indicators, including LASp, LASmax, TWA, LEX, 8h, LCpeak, LZpeak, LASmin, LAeq, T, LAVG, and DOSE. Moving the cursor to "LIST" and pressing the parameter key allows you to enter the "FIG" interface.

7.2.5.2 Dosimeter FIG Interface

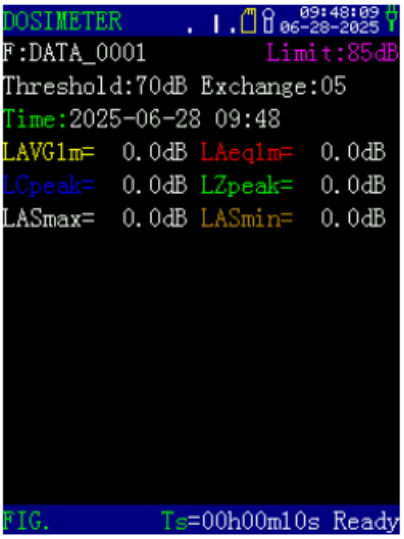


Figure 7.25

In this interface, six measurement indicators—LAVG, LAeq, LCpeak, LZpeak, LASmax, and LASmin—are displayed at 1-minute intervals for the current time. The data is refreshed every minute. Before starting the measurement, the measurement indicators remain unchanged;

After starting the measurement, the data begins to update every minute, displaying the time history graph of the six measurement indicators as shown below:

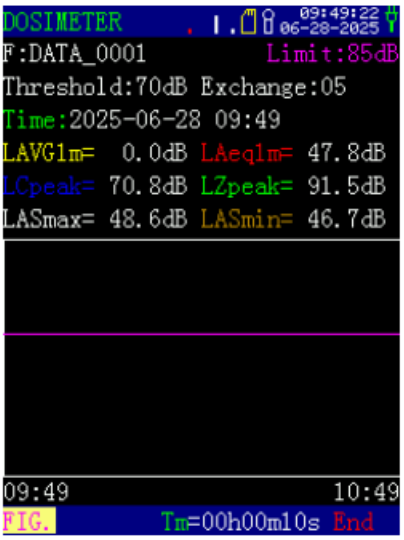


Figure 7.26

The purple horizontal line in the graph represents the set "Limit" value. The time in the lower left corner indicates the start time of the measurement, and the time in the lower right corner indicates the expected end time. The left side of the white line in the middle shows the amplitude distribution of the measurement indicators for the elapsed measurement time, while the right side represents the unmeasured portion.

7.2.6 FFT(Fast Fourier Transform) Analysis Interface

In the noise measurement interface, move the cursor to the analysis mode, and press the parameter decrease or increase key to switch to the FFT Analyzer interface. This interface offers four display modes: “LIST”, “BIG”, “FIG”, “Room”. The FFT analysis uses a single ultra-wide dynamic range, providing greater convenience and higher precision.

7.2.6.1 FFT LIST Interface

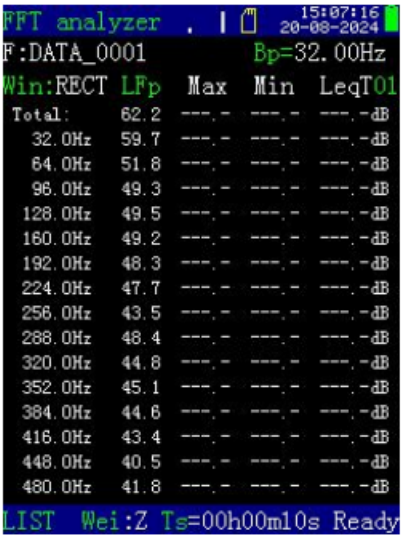


Figure 7.27

The second row labeled "Bp" represents the bandwidth. Moving the cursor here and pressing the parameter key allows you to choose from "32 Hz, 16 Hz, 8 Hz, 4 Hz, 2 Hz." Different bandwidths correspond to different measurement upper limits, as detailed in Chapter 3, under the main performance indicators for FFT.

The third row labeled "Win:" indicates the type of window function currently used for FFT

analysis. Moving the cursor here and pressing the parameter key allows you to change the window function to "Rectangular," "Flat-top," "Hanning," or "Bartlett". "LFp" indicates that the current time weighting is set to F (Fast). Moving the cursor here and pressing the parameter key allows you to switch it to S (Slow). "01" indicates that the current page is page 1 out of 56 available pages, with frequency points increasing sequentially from small to large as the page number increases. Moving the cursor here and pressing the parameter key allows you to view the values of measurement indicators for other frequency points across pages 01 to 56.

The middle section with a black background displays one total value and the weighted sound pressure levels for 895 frequency lines, distributed across 56 pages, with 16 lines displayed per page. The corresponding data on the right shows the Lp, Max, Min, and Leq,T values under the current frequency weighting and time weighting. The measurement results refresh every 0.5 seconds and continuously update according to changes in environmental noise. When no integration measurement is performed, the values for "Max," "Min," and "Leq,T" are displayed as "---.-". "Max" indicates the maximum exponentially averaged value during the measurement period; "Min" indicates the minimum exponentially averaged value; and "Leq,T" indicates the integrated average result over a period of time. The last row displays the menu options and measurement status.

Moving the cursor to "WT.:" and pressing the parameter key allows you to select one frequency weighting from A, C, or Z. Moving the cursor to "Ts" and pressing the parameter key allows you to display "Tm" and "T1." When the cursor is on "LIST", pressing the parameter key takes you to the “FIG” display interface.

7.2.6.2 FFT Figure Interface

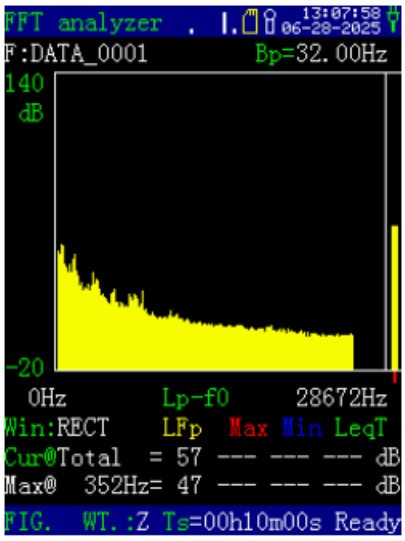


Figure 7.28

The label "Lp-f0" in the center below the graph indicates that the current graph displays the Lp values. Moving the cursor here and pressing the parameter key allows you to switch between displaying Lmax-f0, Lmin-f0, LeqT-f0, or ALL-f0, where "ALL" displays all four indicators simultaneously. The graph colors are adjustable and consistent with the colors of "LF(S)p, Max, Min, LeqT" on the black background. The cursor can move across these indicators, and pressing the parameter key allows you to change the color of the currently displayed indicator.

The "Win:" label below the graph indicates the type of window function currently used for FFT analysis. Moving the cursor here and pressing the parameter key allows you to change the window function to "Rectangular," "Flat-top," "Hanning," or "Bartlett".

The "Cur@" line below the graph shows the measurement content corresponding to the cursor position on the graph for "Lp, Max, Min, LeqT." Moving the cursor here and pressing the parameter key allows you to change the cursor position on the graph (indicated by the red bar below the graph). The last line on the black background displays "Max@64Hz," indicating that the current maximum noise frequency is at 64 Hz, followed by the measurement content for "Lp, Max, Min, LeqT" at that frequency.

7.2.7 Reverberation Time Measurement

The ZX3200 noise and vibration analyzer can measure indoor reverberation time using software that conforms to ISO3382-2:2008, using the impulse reverse integration method and the interrupted noise method.

Impulse Reverse Integration Method: This method involves performing reverse integration on the square of the impulse response to obtain the indoor sound pressure level decay curve.

Interrupted Noise Method: This method involves exciting the test space with broadband or narrowband noise, then interrupting the noise and directly recording the decay of the sound level to obtain the decay curve.

7.2.7.1 Impulse Response Interface

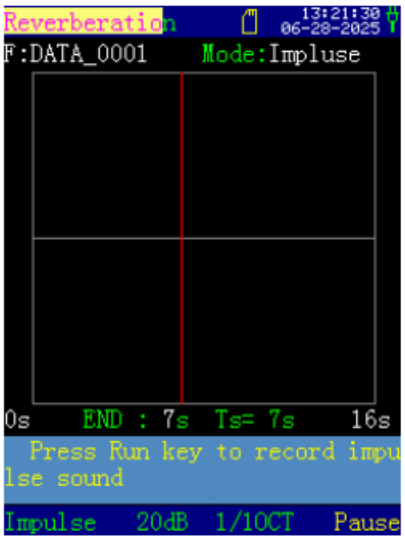


Figure 7.29

- "Impulse Response" indicates that the current function is recording the waveform.
- "Method: Impulse Reverse" indicates that the method used to obtain the decay curve is the impulse reverse integration method. Pressing the parameter increase or decrease keys allows switching to the "Interrupted Noise" method.
- "1/1 OCT" indicates that the octave band-pass filter is used for reverberation time measurement. Pressing the parameter increase or decrease keys allows switching to "1/3 OCT."

- "20 dB" indicates that the current measurement uses a 20 dB decay for calculating the reverberation time. Pressing the parameter increase or decrease keys allows switching to "30 dB."
- "TS=14s" indicates the set waveform recording time, which can be selected between 7 s and 14 s. "End: 10 s" indicates that the integration upper limit starts at the 10th second. Pressing the parameter increase or decrease keys allows changing the calculation method, filter bandwidth, decay amount, and integration upper limit.

Press the start key to begin recording the waveform, which will automatically be saved to the TF card. The display shows the impulse response waveform being recorded. Once recording is complete, as shown in the figure below, press the confirm key to start calculating the decay curve and reverberation time. After the analysis is complete, the instrument automatically switches to the reverberation time interface, and the current analysis results are automatically saved to the TF card.

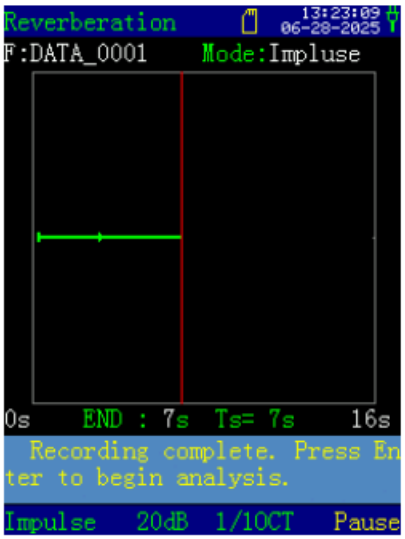


Figure 7.30

7.2.7.2 Reverberation Time Interface

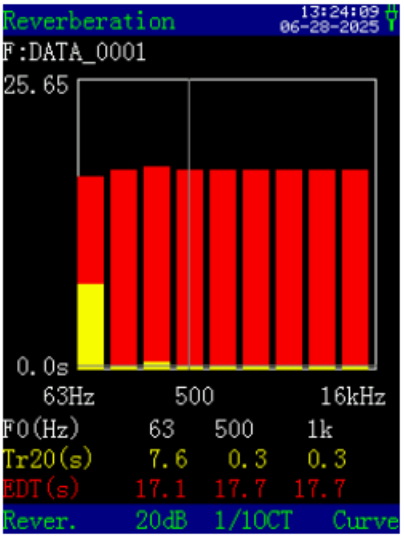


Figure 7.31

- "Reverberation Time" indicates that the current interface is the reverberation time interface.
- "Curve" indicates that the current display shows the reverberation time vs. center frequency graph.

Pressing the left or right parameter keys moves the cursor between "Reverberation Time," "1/1 OCT," "20 dB," and "Curve." Pressing the parameter increase or decrease keys allows changing the filter bandwidth. After the change, the instrument automatically recalculates the decay curve and reverberation time, which takes a few seconds during which user input is disabled. When the cursor is on "Curve," pressing the parameter increase or decrease keys switches to the reverberation time list interface.

Moving the cursor to "Reverberation Time" and pressing the parameter increase key takes you to the "Decay Curve" interface. If the decay curve has not been calculated, the instrument will automatically calculate the decay curve and reverberation time, which takes a few seconds during which user input is disabled.

7.2.7.3 Decay Curve Interface

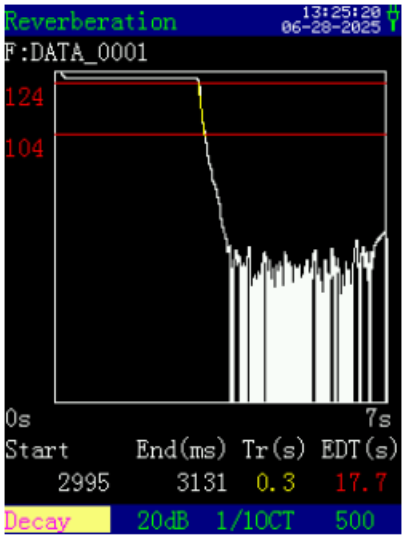


Figure 7.32

The display shows the decay curve for the specified center frequency, and the bottom row of the display shows the menu prompt. "Decay Curve" indicates that the current interface is the decay curve interface. "500" indicates that the center frequency of the currently displayed decay curve is 500 Hz. The two horizontal lines in the middle indicate the sound pressure levels at 5 dB and 25 dB decay points.

Pressing the left or right parameter keys moves the cursor between "Decay Curve," "1/3 OCT," "20 dB," and "500." Pressing the parameter increase or decrease keys allows changing the filter bandwidth and decay amount. After the change, the instrument automatically recalculates the decay curve and reverberation time, which takes a few seconds during which user input is disabled. When the cursor is on "500," pressing the up or down parameter keys allows viewing the decay curves for other center frequencies.

Moving the cursor to "Decay Curve" and pressing the parameter increase key takes you to the "Impulse Response" interface.

7.3 Instrument Setup

In the main menu, move the cursor to the "Setup" menu and press the confirm key to enter the instrument settings interface. This interface includes the Analyzer, Basic, Quick, and Template Selection interfaces, as shown in the image below:

Figure 7.33

The second row displays the software and hardware version numbers of the instrument, and the row below it shows the version date. The middle section contains four icon-based setting options. Moving the cursor to any option and pressing the confirm key will take you to the settings interface for that option.

Below the icon options are the time and language settings. The cursor can move across the year, month, day, hour, minute, and second fields, and pressing the parameter key allows you to set the calendar and clock. Moving the cursor to the language option, labeled "中文" (Chinese), and pressing the parameter key switches the display language to English.

The last row displays power information:

- **"Vusb"** shows the external power voltage.
- **"Vcc"** shows the battery voltage (if the battery is not connected, this value reflects the voltage provided by the external power source).
- **"Vbat"** shows the backup battery voltage.

7.3.1 Analyzer Setup Interface

In the Analyzer Setup interface, you can configure the settings for the STATISTICS(Statistical Integrator), INTEGRAL(Total Value Integrator), 1/1 OCT(Octave Analyzer), 1/3 OCT(Octave Analyzer), DOSIMETER(Personal Sound Exposure Meter), FFT Analyzer, and Logging(Digital Recorder). Settings for unauthorized modules are not valid.

***Note*:** Each analyzer is an optional module.

The Analyzer Settings interface consists of two pages: "Analyzer Setup 1" and "Analyzer Setup 2." You can switch between these pages by pressing the "Setup" key, as shown in the image below:

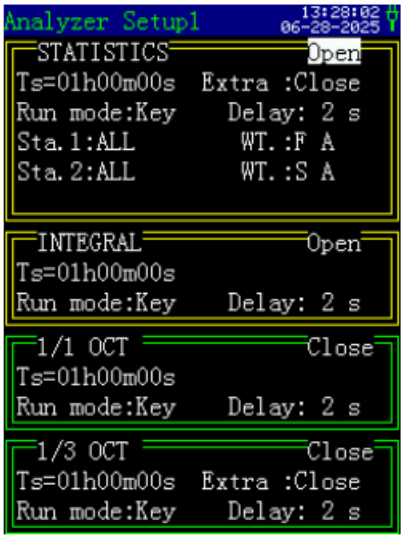


Figure 7.34

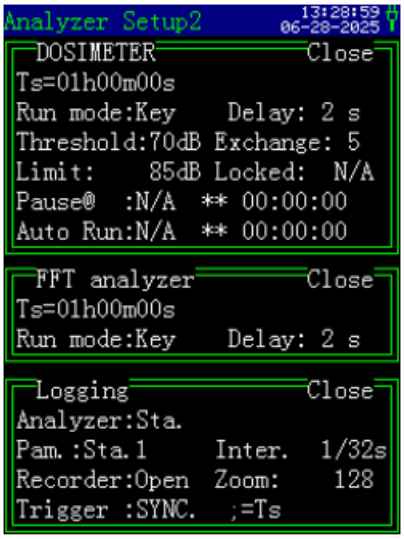


Figure 7.35

The top left of the frame is analysis mode and the top right of it is the switch to switch a module “On” or “Off” by using parameter key. In this interface, there are 4 analyzer setup options, from top to bottom: "STATISTICS" setup, "INTEGRAL” setup, "1/1 OCT" setup and "1/3 OCT" setup. Press the " Setup " button to enter the "Analyzer Setup2" interface. there are 3 analyzer setup options, from top to bottom: "DOSIMETER" setup, "FFT analyzer” setup, "Logging" setup.

The upper left corner of the double-lined box shows the analysis mode. This interface provides four analyzer setting options:

- "STATISTICS" setup, (Statistical Integrator)
- "INTEGRAL" setup, (Total Value Integrator)
- "1/1 OCT" setup, (1/1 Octave Analyzer Settings)
- "1/3 OCT" setup, (1/3 Octave Analyzer Settings)

The upper right corner of the double-lined box shows "Open," which is the switch for the corresponding analysis module. Moving the cursor here and pressing the parameter key allows you to toggle the module on or off. When the module is turned on, the color of the double-lined box turns yellow; when off, it turns green. The options within the double-lined box correspond to the settings available for the selected analysis mode.

Pressing the "Settings" key takes you to the "Analyzer Settings 2" interface. This interface provides three additional module setting options:

- "DOSIMETER" setup, (Personal Sound Exposure Meter)
- "FFT analyzer" setup, (FFT Analyzer)
- "Logging" setup, (Digital Recorder Settings)

7.3.1.1 Measurement Time Setup

"Ts=00h00m10s": This represents the preset measurement time, which can be adjusted anywhere from 1 second to 99 hours 59 minutes 59 seconds. Once this time is reached, the instrument automatically stops the measurement and saves the results. Ts=00h00m00s indicates that there is no time limit for the measurement, and it will continue until manually stopped or the device shuts down automatically.

The cursor can be moved to the hour, minute, or second positions, and the parameter keys can be used to set the measurement time within the 1-second to 99-hour range.

When the cursor is on "Ts," the parameter keys can be used to select a preset measurement time from the following options: 00h00m00s, 00h00m10s, 00h01m00s, 00h05m00s, 00h10m00s, 00h15m00s, 00h20m00s, 00h30m00s, 01h00m00s, 02h00m00s, 04h00m00s, 08h00m00s, and 24h00m00s.

Each analyzer's Ts can be independently set within the Analyzer Settings interface. If simultaneous measurement is required across analyzers, the "Multi-analyzer" option can be set to "Synchronous" in the Basic Settings. This automatically adjusts each analyzer's Ts to match the "Multi-analyzer" Ts setting.

***Note*:** If Ts or the start mode is changed in the measurement interface or the Analyzer Settings interface without accessing the Basic Settings interface, the multi-analyzer synchronization will no longer be effective.

7.3.1.2 Run Mode Setup

"Run mode": This setting determines the trigger source for starting the measurement, with options including Key, Clock, Limit, and Inter. Each module's start mode can be independently set within the Analyzer Setup interface. The table below outlines the primary uses for each trigger source:

No.	Source	Note
1	Key + Delay	Starts after pressing the key and a delay
2	Clock	Starts at a scheduled time
3	Inter.	Starts at regular intervals
4	Limit	Starts when a specified limit is exceeded

a) Key Start:

When "Key" is selected, the following is displayed:

"Delay": After pressing the "Enter" key, the measurement starts after a delay. If the delay is set to 0 seconds, the measurement starts immediately. The cursor can be moved to the delay setting, and the parameter keys can be used to select a delay between 0 and 99 seconds.

***Note*:** When the user selects another start trigger mode, the Key start mode is still valid.

The cursor can be moved to "Start Mode," and pressing the parameter decrease key will enter the timer start settings interface.

b) Clock Start:

When "Timer" start is selected, the following is displayed:

The left side shows a calendar, and the right side shows a clock. Users can set a specific time here, and when the calendar and clock reach this time, the instrument automatically starts. The cursor can be moved to the year, month, day, hour, minute, or second fields, and the parameter keys can adjust the corresponding value. If a field is set to its maximum, "**" is displayed, indicating that this field is not considered during the timer start, allowing hourly, daily, monthly, etc., starts.

In this interface, move the cursor to "Start Mode," and press the parameter decrease key to enter the threshold start settings interface.

c) Limit Start:

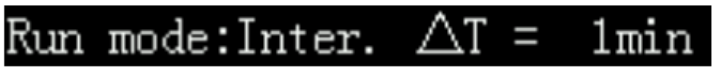
When "Threshold" start is selected, the following is displayed:

"Threshold": The instrument starts the measurement when this value is exceeded. The value can be selected between 0 and 180.

In this interface, move the cursor to "Start Mode," and press the parameter decrease key to enter the interval start settings interface.

d) Interval Start:

When "Interval" is selected, the following is displayed:



"Interval Time": The interval between each measurement start. The user can select from 1 minute, 2 minutes, 5 minutes, 10 minutes, 20 minutes, 30 minutes, or 1 hour. A 1-minute interval means the measurement starts at every whole minute, while a 5-minute interval means the measurement starts at every 5-minute mark (e.g., when the clock shows "**:*0:00" or ":*5:00").

***Note*:** If the set measurement time (Ts) is longer than the interval, the actual measurement time will follow Ts, and the start interval will be extended. For example, if the interval is set to 5 minutes and Ts is set to 6 minutes, the measurement will start at the first 5-minute mark (e.g., 08:00:00), continue for 6 minutes, and then save the results. The next measurement will start at the 10-minute mark (e.g., 08:10:00), effectively extending the start interval to 10 minutes.

7.3.1.3 Analyzer Setup

Analyzer settings include configurations for the Statistical Integrator, Total Value Integrator, 1/1 OCT(Octave Analyzer), 1/3 OCT(Octave Analyzer), and Digital Recorder. These software settings are only effective if authorized.

a) STATISTICS(Statistical Integrator) setup:

Ts and Start Mode: The settings are described in sections 7.3.1.1 and 7.3.1.2.

Additional Ln: The default percentage levels for the Statistical Integrator are L5, L10, L50, L90, and L95. If "Additional Ln" is enabled, additional percentage levels L1, L99, and five user-defined percentage levels will be added. When "Additional Ln" is enabled, an extra display interface is added to the statistical measurement interface.

The parameters for "Sta.1" and "Sta.2" are shown in the table below:

	Analysis Modes	**Frequency Weighting**	**Time Weighting**	**Centre Frequency and Total Values**
Sta.1	INTEGRAL	A, C, Z	F, S, I	
	1/1 OCT (optional)	A, C, Z	F, S	Any one indicator among 11 center frequencies and A, C, Z frequency-weighted sound pressure levels
Sta.2	1/3 OCT (optional)	A, C, Z	F, S	Any one indicator among 33 center frequencies and A, C, Z, B, D, U, J frequency-weighted sound pressure levels

b) INTEGRAL, 1/1 OCT, 1/3 OCT, FFT Analyzer Setup:

These analyzers in the Analyzer Settings interface only have Ts and Start Mode parameters. The settings and methods are described in sections 7.3.1.1 and 7.3.1.2.

c) DOSIMETER(Personal Sound Exposure Meter) Setup:

- **Threshold**: Selectable between 40 dB and 90 dB.
- **Exchange Rate**: Selectable between 3, 4, 5, and 6.
- **Limit Value**: Selectable between 70 dB and 90 dB.
- **Key Lock**: When enabled, the backlight automatically locks. To unlock, press both the parameter increase and decrease keys simultaneously.
- **Timed Pause**: Configurable by mode, day, hour, minute, second.
- **Timed Restart**: Configurable by mode, day, hour, minute, second.

Setting "Mode" to "N/A" disables timed pause or restart. Setting "Mode" to "Yes" causes the instrument to automatically pause or restart when the internal clock reaches the specified time.

d) Logging(Digital Recorder) Setup:

- **Analyzer**: Indicates the analysis mode to be recorded, including Statistical Integrator, Total Value Integrator, 1/1 Octave Analyzer, 1/3 Octave Analyzer, and Digital Recorder settings.

  ***Note*:** The options marked as selectable are only effective if authorized.
- **Indicators**: Indicates the indicators relevant to the current analysis mode. Refer to the table below for details:

Analyzer Mode	Measurement Indicators
STATISTICS	Sta.1(See Statistics setup)
	Sta.2(See Statistics setup)
	ALL (Sta.1 and Sta.2)
Integral	Any of LAFi, LASi, LAIi, LAeq, t, LCFi, LCSi, LCIi, LCeq,t, LZFi, LZSi, LZIi, LZeq,t or ALL
	All (all above indicators)
1/1 OCT	F Weighting: Any one indicator among 11 center frequencies and A, C, Z frequency-weighted sound pressure levels.
	F Weighting: All indicators.
	S Weighting: Any one indicator among 11 center frequencies and A, C, Z frequency-weighted sound pressure levels.
	S Weighting: All indicators.
1/3 OCT	F Weighting and S Weighting: Any one indicator among 33 center frequencies and A, C, Z, B, D, U, T frequency-weighted sound pressure levels.
	F Weighting: All indicators.
	S Weighting: Any one indicator among 33 center frequencies and A, C, Z, B, D, U, J frequency-weighted sound pressure levels.
	S Weighting: All indicators.

- **"Inter"**: Refers to the recording interval, which users can select between 1/32 seconds and 256/32 seconds.

- **"Recorder"**: This can be toggled on or off. It can be operated when a TF card is inserted and the option is selected.
- **"Zoom"**: Allows for appropriate magnification, making subsequent playback easier.
- **"Trigger"**: Can be synchronized with integration measurements or triggered by exceeding a threshold, after which the recording lasts for a specified duration. When set to threshold triggering, the threshold value can be configured, and the recording duration can be set from 10 seconds to 3600 seconds or 10 seconds to 57600 seconds, adjustable in 10-second increments.

7.3.2 Basic Setup Interface

The Basic Setup interface includes options for Multi-Analyzer Settings, Name Settings, Hardware Settings, Auto Power Settings, and Miscellaneous Settings. These are divided into three pages: "Basic Setup 1," "Basic Setup 2," and "Basic Setup 3." You can switch between these pages by pressing the "Setup" key.

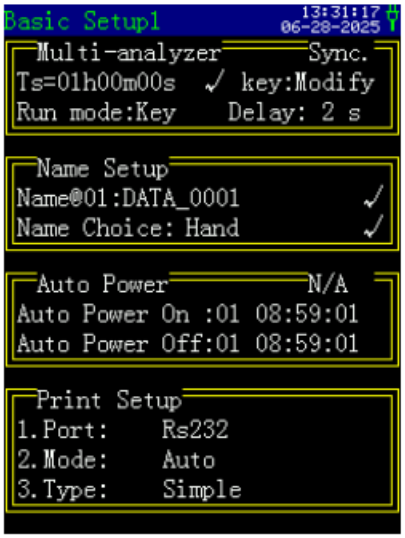


Figure 7.36

7.3.2.1 Basic Setup 1

7.3.2.1.1 Multi-Analyzer Settings

- **"Sync"**: This option indicates whether the analyzers operate synchronously. For example, if "Synchronization" is selected, pressing the start key will start measurements

across all analyzers simultaneously. If the cursor is moved here and the parameter key is pressed, it can be changed to "Asynchronous," meaning the analyzers operate independently. For example, pressing the start key will only start the analyzer in the current measurement interface.

- **"Ts"**: This indicates the measurement time. The setting method is described in section 7.3.1.1.

***Note*:** Synchronization settings have a higher priority than individual analyzer settings.

- **"Run mode"**: This indicates the trigger method for starting the measurement. Detailed information can be found in section 7.3.1.2.

7.3.2.1.2 Name Settings

- **"Name@01: DATA_0001"**: This indicates the name used when saving the current measurement results, where 01 represents the first group. This does not affect the measurement results. Moving the cursor to the group name and pressing the parameter increase or decrease key allows you to select a group name between 01 and 64.
- **"Name Choice"**: There are two options, "Hand" for manual and "Auto" for automatic. Moving the cursor here and pressing the parameter key allows you to choose between the two.
  - **"Hand"**: The group name remains as the currently set group name for each measurement.
  - **"Auto"**: The group name automatically changes after each statistical integration measurement, and the instrument can store up to 64 group names internally.

7.3.2.1.3 Auto Power Settings

- **"Auto Power On/Off"**: Options include "Valid," "Invalid," "Sun 0/1," "Civil 0/1," "Nautical 0/1," and "Astronomical 0/1." Selecting "0" means the device will power on/off at sunrise, and selecting "1" means it will power on/off at sunset.
  - If "Valid" is selected, the device will power on or off at the manually set times on the following two lines.

- If "Invalid" is selected, timed power on/off is disabled.
- If "Sun 0" is selected, the device powers on/off at the specified times below. After completion, it automatically switches to "Sun 1" and powers on/off at the specified times. After completion, it switches back to "Sun 0." This allows for two automatic power cycles daily.
- The options "Civil 0/1," "Nautical 0/1," and "Astronomical 0/1" operate similarly to "Sun 0/1."

- **"Timed Power On Time"**: The format is "Day, Hour, Minute, Second."
- **"Timed Power Off Time"**: The format is "Day, Hour, Minute, Second." When a field is set to its maximum, "**" is displayed, indicating that this field is not considered during timed startup or shutdown. The cursor keys can move the cursor left or right, and the parameter keys can modify the parameters at the cursor position.

7.3.2.1.4 Print Settings

- **"Printing Port"**: Options include Serial Port and Bluetooth.
- **"Printing Mode"**: Options are "Manual" and "Automatic." If "Manual" is selected, the measurement results will not be printed automatically after the measurement ends. If "Automatic" is selected, the results are sent to the printer for automatic printing at the end of the measurement, provided the printer is connected and powered on.
- **"Printing Format"**: Options include "Original," "Simple," "With Graphics," and "Screenshot."
  - Selecting "Original" prints only the text-based measurement results.
  - Selecting "With Graphics" prints the measurement results along with statistical distribution graphs, cumulative distribution graphs, spectrum graphs, etc.
  - Selecting "Screenshot" prints the content exactly as displayed on the current interface.
  - Selecting "Simple" prints the measurement results without graphs, instrument model, serial number, calibration data, etc.

***Note*:** When using the optional TF card feature for printing measurement results, the file save mode in Basic Settings 2 - Miscellaneous Settings must be set to save to different files.

If the results are saved in the same file, the measurement results must be exported from the TF card before printing.

7.3.2.2 Basic Setup 2

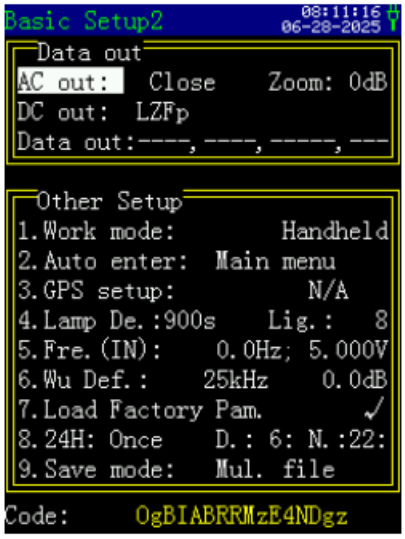


Figure 7.37

7.3.2.2.1 Data Out

- **"AC Output"**: Options include "Signal," "Sound Pressure," and "Off."
  - "Signal" outputs a fixed 1 kHz AC signal.
  - "Sound Pressure" outputs the signal received by the instrument and allows adjustment of the amplification from 0 to 42 dB in 6 dB increments.

***Note*:** The "Sound Pressure" function must be used in the measurement interface for proper operation.

- **"DC Output"**: Outputs a DC signal proportional to the selected indicator value. You can choose from indicators like LAFp, LASp, LAIp, LAeq,t, LCFp, LCSp, LCIp, LCeq,t, LZFp, LZSp, LZIp, LZeq,t, etc. The maximum output is +3.1V DC voltage.

- **"Result Output"**: Options include "WIFI," "Bluetooth," "RS232," "DTU," or "Off."

7.3.2.2.2 Other Setup

- **"Work Mode":** Options are "Online" and "Handheld." In online mode, the power-off key is disabled; in handheld mode, the instrument shuts down when the power-off key is pressed.

- **"Auto Enter":** Specifies the interface that automatically opens when the device is powered on. Options include Main Menu, Measurement Interface, Template Settings, Basic Settings, and Instrument Calibration.
- **"GPS Setup"**: If this feature is enabled, it allows control of the GPS on/off switch.
- **"Lamp De" (Backlight Timeout):** Can be set between 0 s and 990 s in 10-second intervals. A setting of 0 s keeps the backlight always on. The backlight automatically turns off if no key is pressed within the set time.
  - **"Lig" (Brightness)**: Default is 8, adjustable between 1 and 15. The higher the value, the brighter the display, and the higher the power consumption.
- **"Fre.(IN)" (Internal Calibration Frequency):** Selectable frequencies include 0.0 Hz, 4.0 Hz, 5.0 Hz, 6.3 Hz, 7.9 Hz, 10.0 Hz, 12.6 Hz, 15.8 Hz, 20.0 Hz, 25.1 Hz, 31.6 Hz, 39.8 Hz, 50.1 Hz, 63.1 Hz, 79.4 Hz, 100.0 Hz, 125.9 Hz, 158.5 Hz, 199.5 Hz, 251.2 Hz, 316.2 Hz, 398.1 Hz, 501.2 Hz, 631.0 Hz, 794.3 Hz, 1.0 kHz, 1.3 kHz, 1.6 kHz, 2.0 kHz, 2.5 kHz, 3.2 kHz, 4.0 kHz, 5.0 kHz, 6.3 kHz, 7.9 kHz, 10.0 kHz, 12.6 kHz, 15.8 kHz, 20.0 kHz, 25.1 kHz. Selecting 0.00 Hz indicates internal calibration is disabled.
  - **"Amplitude"**: Adjustable from 5 μV to 5 V, with 10 dB increments.
- **"Wu Def"(Custom Weighting):** Allows users to set custom frequency weighting. The 1/3 OCT center frequency points between 4.0 Hz and 25 kHz can be selected. The "dB" value on the right indicates the weighting level, representing the difference from the unweighted level. Negative values indicate attenuation, and positive values indicate amplification.
- **"Load Factory Pam"(Restore Factory Setting):** Moving the cursor here and pressing the confirm key restores factory settings, and a "Complete" message is displayed. Moving the cursor here and pressing the parameter key switches this option to "7. Firmware Upgrade," and pressing the confirm key again enters firmware upgrade mode.
- **"24H"(24-Hour Mode):** Options include Single and Continuous. The start times for "Day" and "Night" can be set, accommodating users in different time zones.

- **"File Save Mode":** This option appears after a TF card is inserted. You can choose between saving to the same file or different files.

7.3.2.3 Basic Setup 3

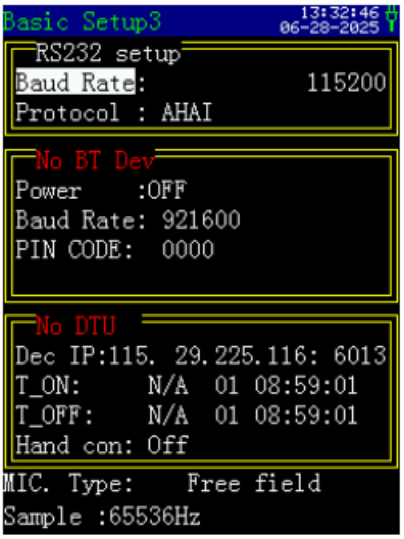


Figure 7.38

7.3.2.3.1 Serial Port Settings

- **"Baud Rate"**: Options include "9600" and "115200."
- **"Communication Protocol"**: Two protocols are available: "MODBUS" and "AHAI." For details, refer to the "ZX3200 Serial Communication Protocol Specification."

7.3.2.3.2 Bluetooth Module (Optional)

- **"Bluetooth Power"**: Options include "Master On/M," "Slave On/S," and "Off." Press the parameter increase key to turn on "Slave On (Data Transmission)" and the parameter decrease key to turn on "Master On (Bluetooth Printing)."
- **"Baud Rate"**: Options include 921600 and 115200. To change the baud rate, ensure the Bluetooth is turned on and functioning, then move the cursor to "Baud Rate," press the parameter increase/decrease key to switch baud rates, and restart the Bluetooth.
- **"Bluetooth PIN"**: The password for communication with other devices, default is 0000.

7.3.2.3.3 DTU Module (Optional)

- **"Target IP"**: Refers to the target server's IP address and port number.
- **"Scheduled On"**: Schedule the DTU to turn on at a specific day and time.
- **"Scheduled Off"**: Schedule the DTU to turn off at a specific day and time.

- **"Manual Control"**: Manually turn the DTU on or off.

7.3.2.3.4 Others

- **"Microphone Type"**: Options include Free Field (0°) and Pressure Field (90°). The sound level meter uses a free-field microphone, which should be pointed directly at the sound source (0°). In situations where the sound source can only be measured at a 90° angle, due to the directional characteristics of the microphone at high frequencies, this setting should be changed to "Pressure Field (90°)." This feature can also convert a free-field microphone into a pressure-field microphone. The impact of these options on frequency response is detailed in Appendix 2.
- **Sampling Frequency**
  - Class 1: 65536 Hz
  - Class 2: 32768 Hz

7.3.2.4 Basic Setup 4

WIFI Settings (Optional):

Press the parameter decrease key to enter AP mode, and press the parameter increase key to enter Client mode. The IP and port number can be set using the cursor and parameter keys

7.4 Data Review

When entering the "Recall" sub-menu from the main menu, the following screen is displayed:

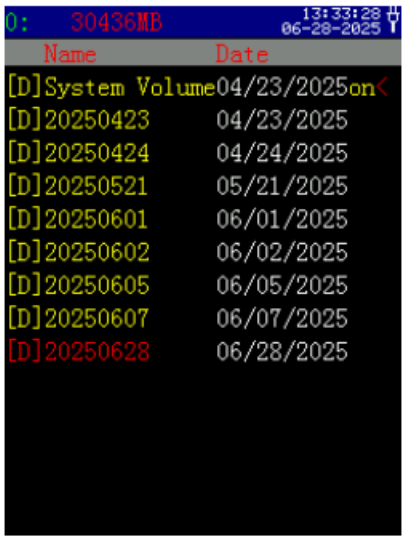


Figure 7.39

***Note*:** The list displays data in reverse chronological order.

The first column shows the group number, the second column shows the measurement point name (group name), and the third column shows the measurement date. By pressing the left or right cursor keys, you can view the elapsed time and measurement method, as shown below:

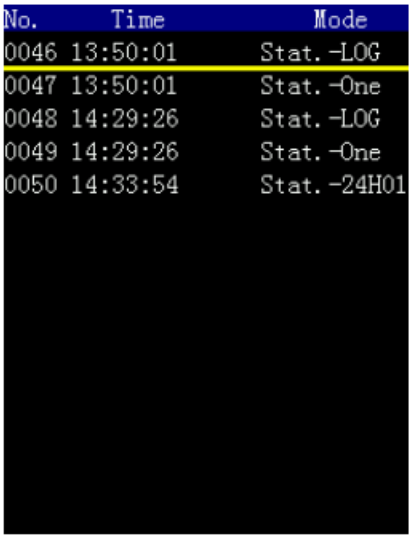


Figure 7.40

- **Cursor Keys**: Move the cursor.
- **Parameter Keys**: Move up or down to select other group numbers or flip through pages.
- **Confirm Key**: View the measurement results at the cursor location.
- **Output Key**: Print the data from the cursor location and onwards.
- **Delete Key**: Delete all measurement results stored in the instrument's memory.
- **Settings Key**: Select the data where the cursor is located; pressing it again cancels the selection. If any data is selected, pressing the delete key will delete all selected data.

7.5 Instrument Calibration

There are two interfaces: **Sound Calibration** and **Calibration Records**. The instrument can store up to 256 sound calibration records internally.

7.5.1 Sound Calibration

After entering the "Calibrate" menu from the main menu, the following is displayed:

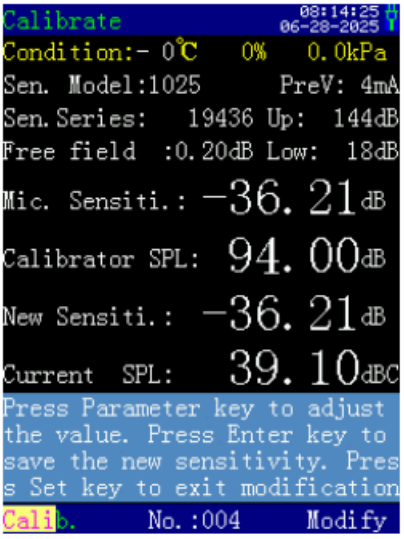


Figure 7.41

- **"Conditions"**: Displays the current environmental conditions of the instrument (optional feature).

- **"Microphone Model," "Microphone Serial Number," "Power Supply"**: These are set at the factory and cannot be modified by the user.
- **"Upper Limit"**: Based on the current microphone sensitivity, this is the upper measurement limit of the instrument, defined as the maximum measurable effective value for a 1 kHz sine wave.
- **"Lower Limit"**: Based on the current microphone sensitivity, this is the lower measurement limit of the instrument.
- **"Free-Field Correction"**: This should be set according to the type of microphone used with the instrument. The correction value for a free-field microphone is 0.2 dB, but users can modify this value if needed.
- **"Microphone Sensitivity Level"**: Indicates the sensitivity level of the microphone after the last calibration, including any attenuation from the preamplifier.
- **"Calibrator Sound Pressure Level"**: Indicates the actual sound pressure level of the sound level calibrator after verification. Users can press the settings key to modify this value.
- **"New Microphone Sensitivity Level"**: Indicates the sensitivity level of the microphone after the current calibration or manual modification.
- **"Current Sound Pressure Level"**: This value fluctuates with the environment and can switch between dBA and dBC. When using a 1 kHz frequency sound calibrator, dBA is recommended. When using a 250 Hz pistonphone, dBC is recommended.

The main key functions are as follows:

- **Start Key**: Initiates sound calibration.
- **Confirm(Enter) Key**: Saves the new sensitivity level.
- **Setup Key**: Enters parameter modification mode.

In the current mode, the cursor can only move between "Current Sound Pressure Level" and "Calibration." To manually modify the adjustable parameters mentioned above, press the settings key, and the interface changes as shown below:

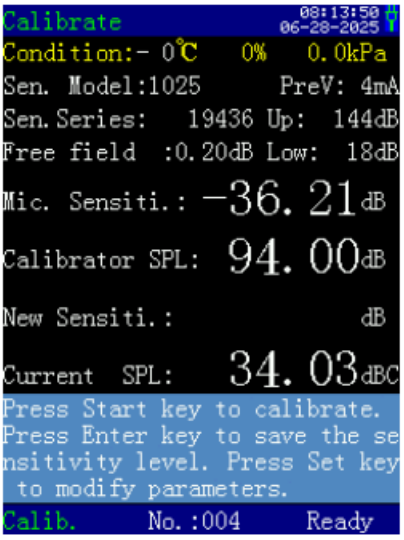


Figure 7.42

The status changes from "Ready" to "Modify." In this interface, the cursor can move and stay on "Power Supply," "Free-Field Correction," "Calibrator Sound Pressure Level," and "New Sensitivity Level." The parameter keys can be used to modify values, and the confirm key saves the changes.

When performing sound calibration, if the new sensitivity level differs by more than 3 dB from the previous one, the new sensitivity level cannot be saved. If this occurs, follow the prompts to recalibrate, or if the microphone has been replaced (and is confirmed to be functioning properly), manually set an appropriate new sensitivity level before calibrating again.

7.5.2 Calibration Records

Move the cursor to "Calib." and press the parameter key to enter the calibration records interface, as shown below:

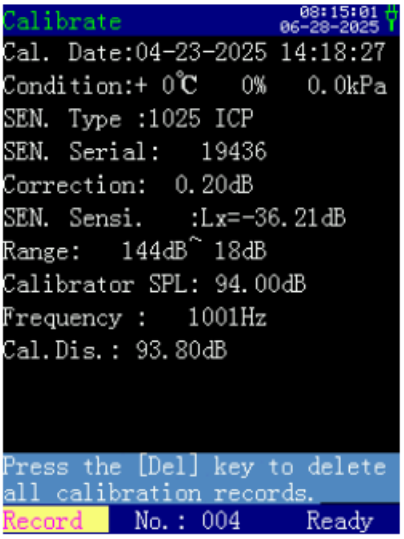


Figure 7.43

This interface displays the calibration information corresponding to the current sequence number. Move the cursor to "No."(Sequence Number) and use the parameter key to view the calibration information under other sequence numbers. The information includes calibration date, environmental conditions, microphone model, sequence number, free-field correction, microphone sensitivity level, measurement range, and sound calibrator sound pressure level.

7.5.3 TEDS Sensor Information

Move the cursor to "Calibration" and press the decrease key to enter the sensor information interface, as shown below:

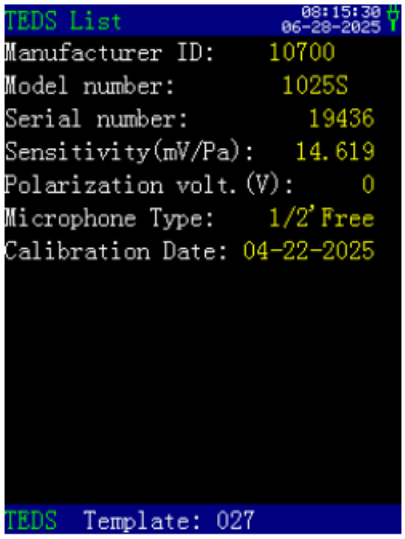


Figure 7.44

This interface displays information about the sensor currently in use by the instrument. The information includes the sensor manufacturer, sensor model, sensor serial number, sensor sensitivity, sensor polarization voltage, sensor type, and calibration time.

This translation provides a detailed explanation of the sound calibration process, how to review calibration records, and how to access sensor information on the instrument.

8 Operating Instructions

8.1 Before Use

1) Check whether the condenser microphone and preamplifier are properly installed.

2) If necessary, use a sound calibrator to calibrate the monitoring instrument.

3) The monitoring instrument should be periodically (e.g., annually) sent to a metrology department for verification to ensure the accuracy of the instrument.

4) When measuring in windy conditions, a windscreen can be used to reduce the impact of wind noise. Different windscreens can be selected by the user.

8.2 Operating Instruction

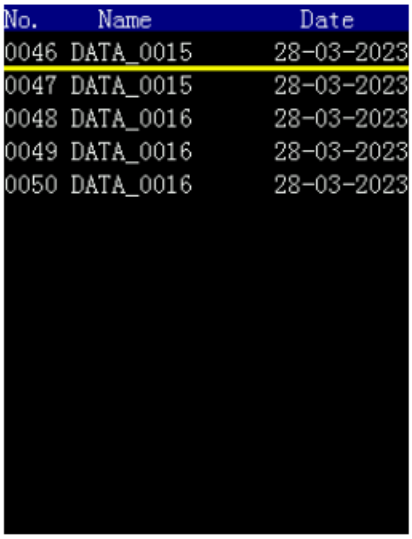
When using the instrument for the first time, the user should set the measurement time, frequency weighting, and other relevant system parameters according to the measurement requirements. Once the system parameters are set, the instrument will automatically save them and load them the next time it is used. Press the power on/reset button on the instrument, move the cursor to the "Instrument Settings" menu, and press the confirm key to enter the parameter settings.

Note: Parameter settings cannot be accessed while measurements are being taken.

Before each use, the instrument should be calibrated. Use a sound level calibrator with an accuracy of 1 or higher, attach it to the condenser microphone, turn on the instrument, enter the measurement interface, and display the Lp value. The displayed value should be within ±0.3 dB of the sound pressure level output by the sound calibrator. If it is outside this range, enter the calibration interface to perform sound calibration.

***Note*:** The instrument is calibrated using C-weighted sound pressure levels. When the calibrator's sound frequency is between 200 Hz and 1.25 kHz, no correction is needed. For frequencies outside this range, adjust the calibration sound level according to the C-weighted frequency response.

8.3 Data Review



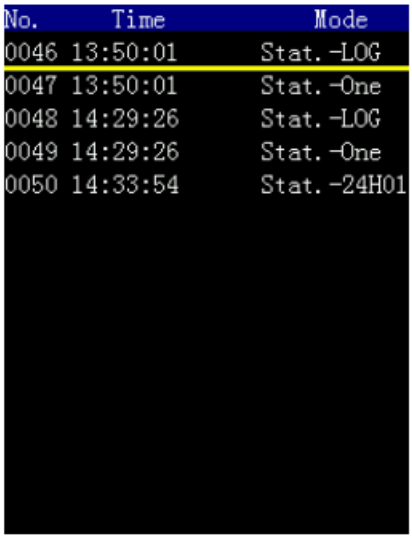


Figure 8.1 Figure 8.2

In the main menu, move the cursor to "Data Recall" and press the confirm key to enter the data review submenu. A list of all measurement results stored in the instrument is displayed. Use the parameter key to move the cursor to the group number you want to view. Press the cursor key to view information such as measurement point name, measurement date, measurement time, and measurement method. Press the confirm key to view detailed measurement results.

8.4 Data Printing

Measurement results from the instrument can be printed using an AH40 micro-printer or a thermal printer. Before printing, connect the printer to the instrument, set the corresponding print method, serial port, and baud rate. The baud rate for the AH40 micro-printer is 9600, while the thermal printer's baud rate is 115200. Turn on the printer and ensure it is properly connected.

Before printing, the instrument's print function can be set to automatic or manual. If set to automatic, the measurement results will be printed automatically after each measurement.

There are four print modes available: no graphics, simple, with graphics, and screen copy. Some analysis modes do not have graphical outputs, such as integration or personal sound exposure measurements.

Original (no graphics): The printout does not include graphical elements.

Simple: The printout does not include information such as instrument serial number, calibration date, or sensitivity information.

Copy Screen : The printout matches the current display screen.

8.5 Calibrating the Instruments

The instrument has been calibrated at the factory, but if required by measurement standards or after a period of use, it should be re-calibrated before use. Sound calibration requires a sound level calibrator of 1st class or above, with a working frequency of 1000 Hz ±3% and harmonic distortion of less than 3%. A pistonphone can also be used for calibration.

Place the sound calibrator over the microphone, turn on the sound calibrator, and press the "Enter" key to start the calibration process. Once the counter in the bottom right corner of the display stops, the calibration is complete. Press the "Enter" key again to save the newly calibrated microphone sensitivity level. If the new calibration differs by more than 3 dB from the previous one, the calibration result cannot be saved. In this case, re-calibrate or check the microphone.

If the user does not have a calibrator, they can manually input the microphone sensitivity level. Press the settings key on the instrument to enter the modification interface. Move the cursor to "New Sensitivity Level" and adjust the value using the "△" and "▽" keys. Press the "Confirm" key to save the new microphone sensitivity level.

9 Overload Indication

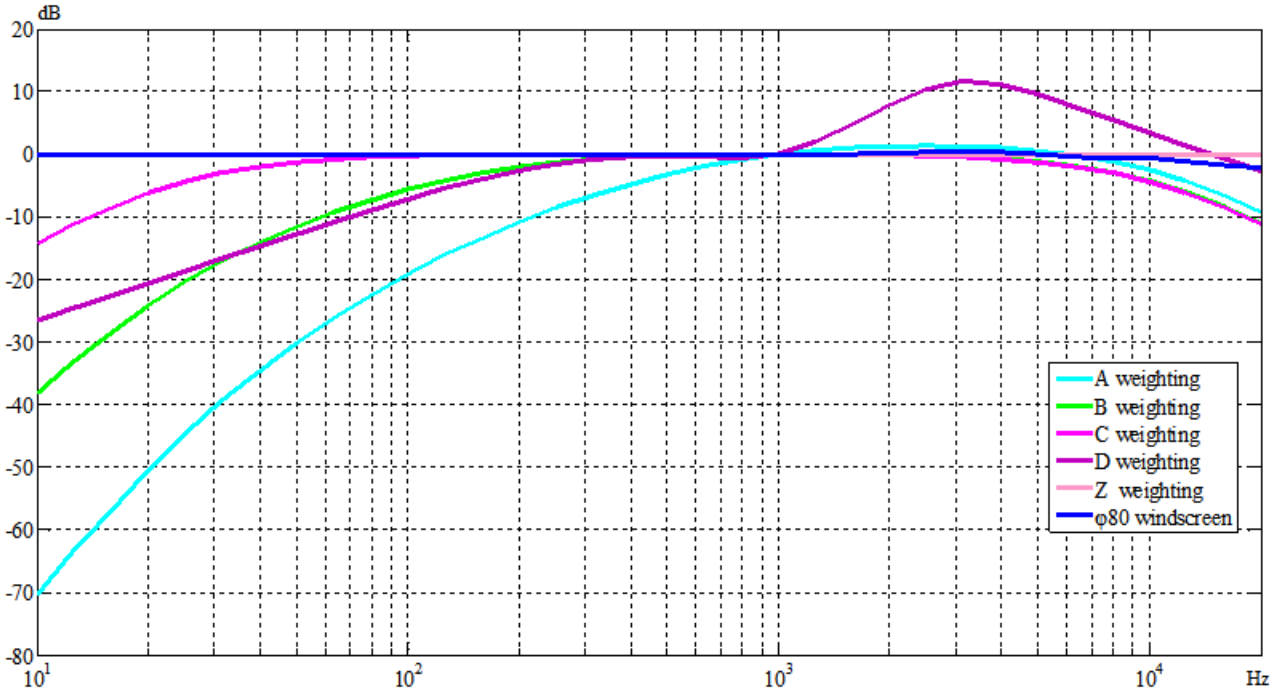
When the measured noise exceeds the instrument's measurement range, "Overload" will be displayed on the screen. The duration of the overload indication matches the duration of the overload state and is at least 1 second. If an overload occurs during statistical analysis, the overload indication will remain until the next measurement is started or the current measurement results are cleared. The overload indication is based on peak signal judgment. When the peak factor of the signal is large, the sound pressure level displayed by the instrument may be lower than the measurement limit, but overload can still occur.

Appendix 1 Directional Response

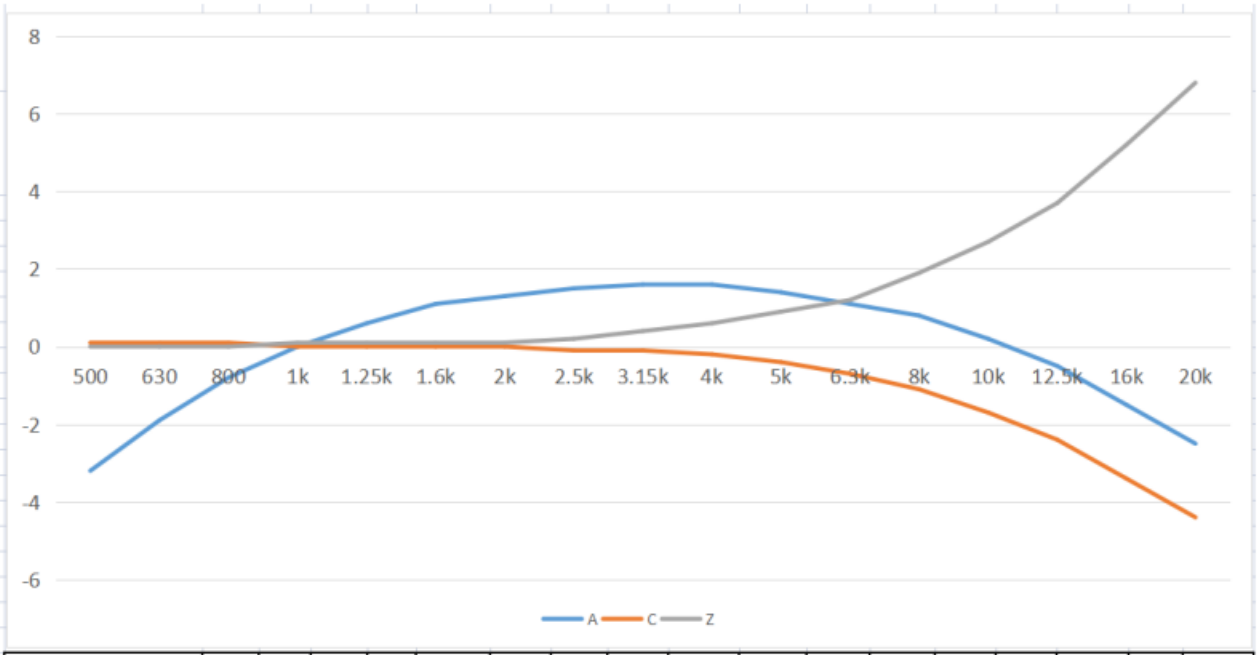
Frequency (Hz)	Maximum absolute difference in displayed sound levels at any two sound-incidence angles within ±θ° degrees from the referenced direction (dB)					
	15°	30°	45°	60°	75°	90°
500	0.3	0.1	0.2	0.2	0.1	0.3
630	0.1	0.1	0.1	0.2	0.2	0.1
800	0.1	0.1	0.1	0.3	0.2	0.1
1000	0.1	0.1	0	0.2	0.2	0.3
1250	0.3	0.4	0.2	0.1	0.2	0.1
1600	0.4	0.7	0.8	0.8	0.4	0.5
2000	0.7	0.7	0.8	0.8	0.9	1.2
2500	0.4	0.6	0.7	1.7	1.8	2.1
3150	0.4	0.3	0.9	0.6	0.5	1.1
4000	1.0	0.7	1.3	1.6	0.9	2.4
5000	1.8	1.9	2.7	3.1	4.1	2.8
6300	1.7	2.3	2.3	2.9	3.0	4.8
8000	1.1	1.0	2.0	2.7	4.0	3.7
10000	1.2	1.6	2.0	3.6	3.6	4.9
12500	0.1	0.5	1.3	3.1	3.4	4.3
16000	0.1	0	0.8	2.3	3.3	5.1
20000	0.4	0.2	1.0	3.2	5.0	8.4
Frequency (Hz)	Maximum absolute difference in displayed sound levels at any two sound-incidence angles within ±θ° degrees from the referenced direction (dB)					
	105°	120°	135°	150°	165°	180°
500	0.7	0.7	0.5	0.5	0.4	0.5
630	0.6	0.9	0.8	0.6	0.6	0.2
800	0.1	0.4	0.4	0.7	0.6	0.3
1000	0	0.4	0.8	1.3	1.1	0.5
1250	0.2	0.1	0.2	1.3	1.8	1.0
1600	0.2	0.1	0.2	1.0	1.0	2.0
2000	1.1	1.0	0.6	0.9	2.8	2.7
2500	1.9	2.2	2.0	1.5	3.2	3.6
3150	1.2	1.1	1.7	1.2	2.7	4.2
4000	1.9	1.6	0.8	1.6	1.9	2.5

5000	5.0	4.2	2.8	3.7	3.1	4.6
6300	4.0	5.4	3.0	5.0	3.2	5.3
8000	4.0	5.3	6.2	4.4	4.8	6.2
10000	7.2	5.2	7.3	6.0	7.0	8.0
12500	7.2	8.9	7.4	8.4	9.0	8.5
16000	8.8	10.0	7.0	10.0	8.7	14.3
20000	9.6	11.1	13.4	12.8	13	17.3

Appendix 2A Free-field Response

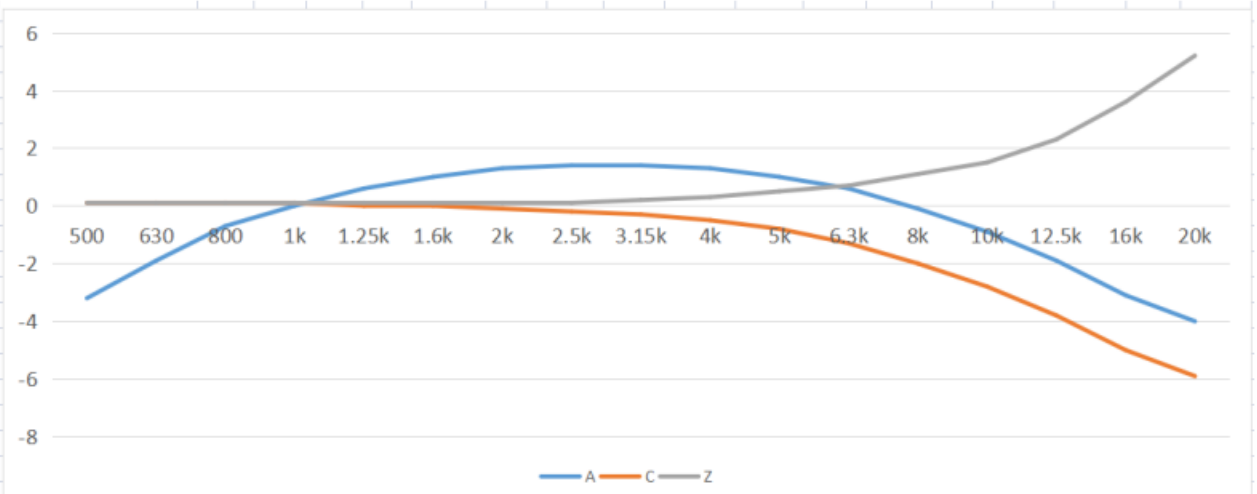


Appendix 2B Pressure-field Response



Frequency(Hz)	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
A(dB)	-3.2	-2	-0.8	0	0.6	1.1	1.3	1.5	1.6	1.6	1.4	1.1	0.8	0.2	-0.5	-2	-2.5
C(dB)	0.1	0.1	0.1	0	0	0	0	-0.1	-0.1	-0.2	-0.4	-0.7	-1.1	-1.7	-2.4	-3	-4.4
Z(dB)	0	0	0	0.1	0.1	0.1	0.1	0.2	0.4	0.6	0.9	1.2	1.9	2.7	3.7	5.2	6.8

Appendix 2C Diffuse-field Response

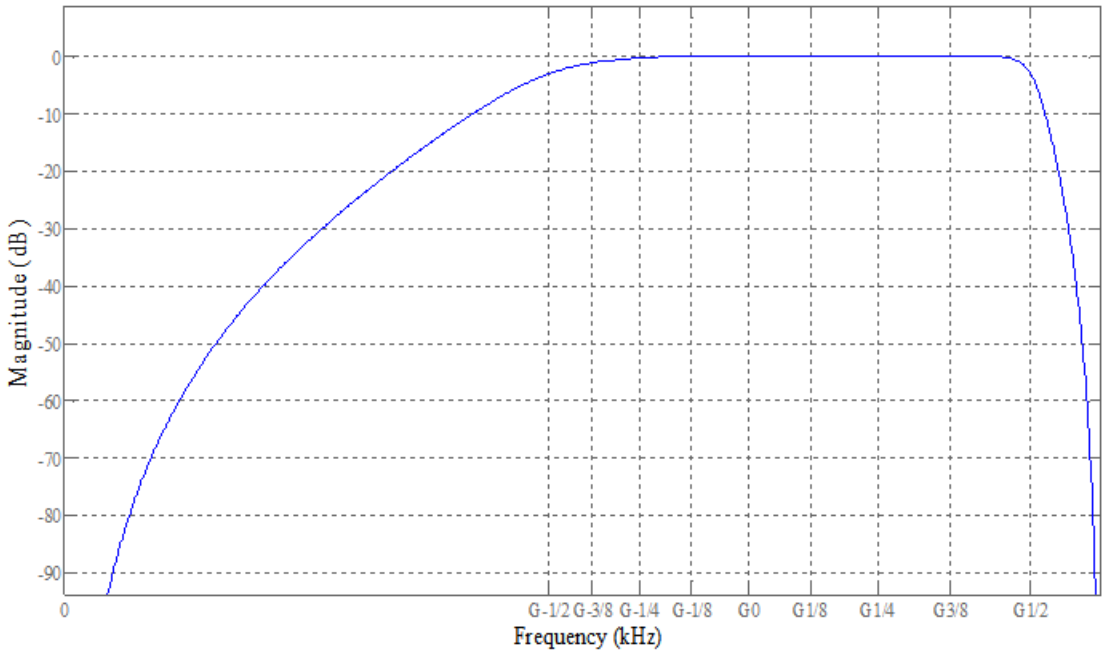


Frequency(Hz)	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
A(dB)	-3.2	-2	-0.7	0	0.6	1	1.3	1.4	1.4	1.3	1	0.6	-0.1	-0.9	-1.9	-3	-4
C(dB)	0.1	0.1	0.1	0.1	0	0	-0.1	-0.2	-0.3	-0.5	-0.8	-1.3	-2	-2.8	-3.8	-5	-5.9
Z(dB)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.5	0.7	1.1	1.5	2.3	3.6	5.2

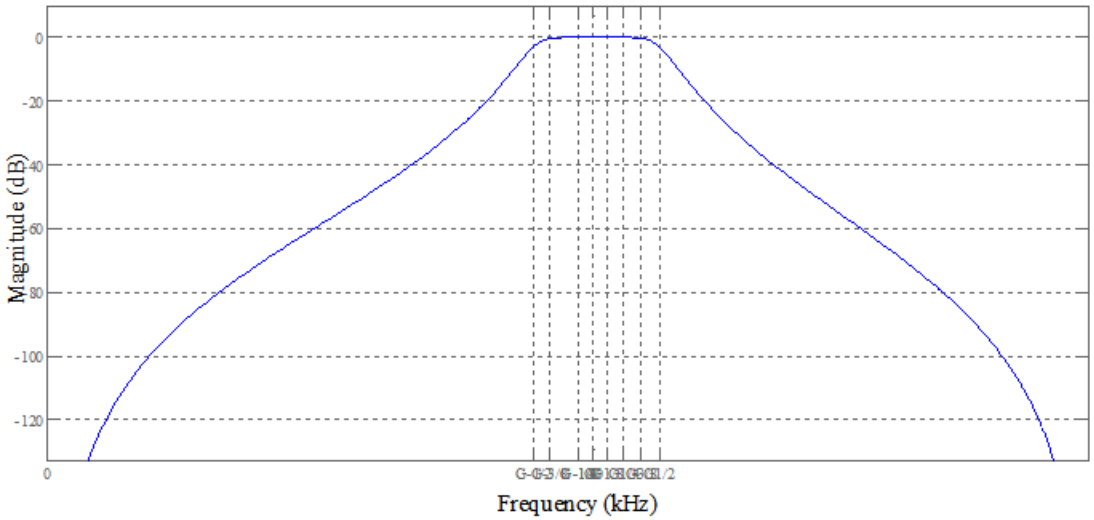
Appendix 3 Influence of Extension Cable

Frequency /Hz	5m	10m	15m	20m	30m	40m	50m
500	0	0	0	0	0	0	0
630	0	0	0	0	0	0	0
800	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0
1250	0	0	0	0	0	0	0
1600	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0
2500	0	0	0	0	0	0	0
3150	0	0	0	0	0	0	0
4000	0	0	0	0	0	0	-2
5000	0	0	0	0	0	-2	-3
6300	0	0	0	0	-2	-3	-5
8000	0	0	0	-1	-4	-5	-7
10000	0	0	0	-3	-5	-7	-9
12500	0	0	-2	-4	-7	-9	-11
16000	0	-1	-4	-6	-10	-11	-14
20000	0	-2	-6	-8	-12	-13	-16
Note:	The data in the table are, when using the extension cables of different lengths and the error is lower than 0.7dB, the D-values between the peak sound pressure level and measurement upper limit of the meter.						

Appendix 4: Filter Attenuation Characteristics

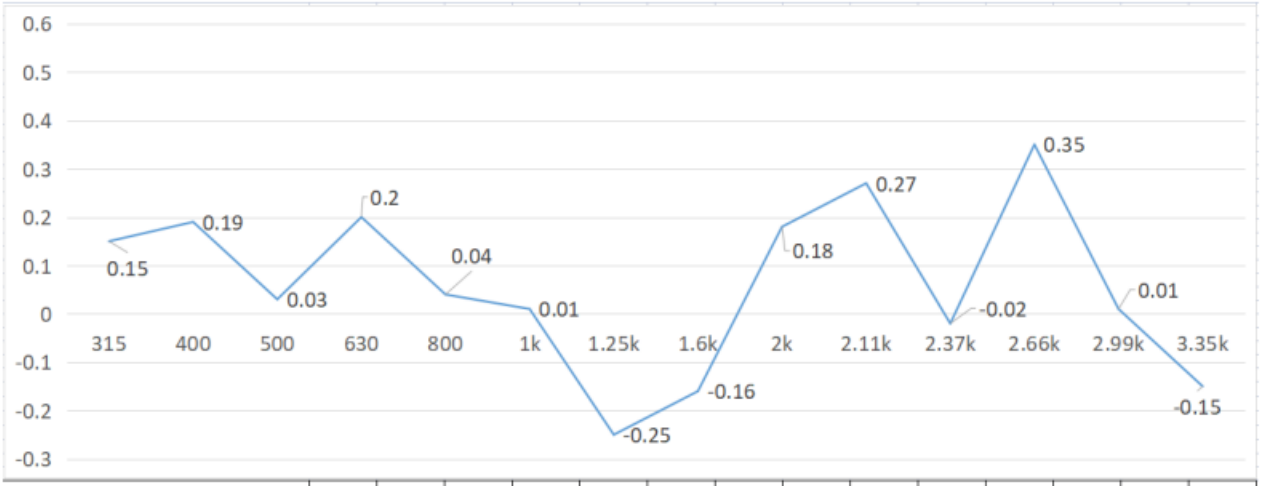


Relative attenuation of octave-band pass filter at 16kHz center frequency

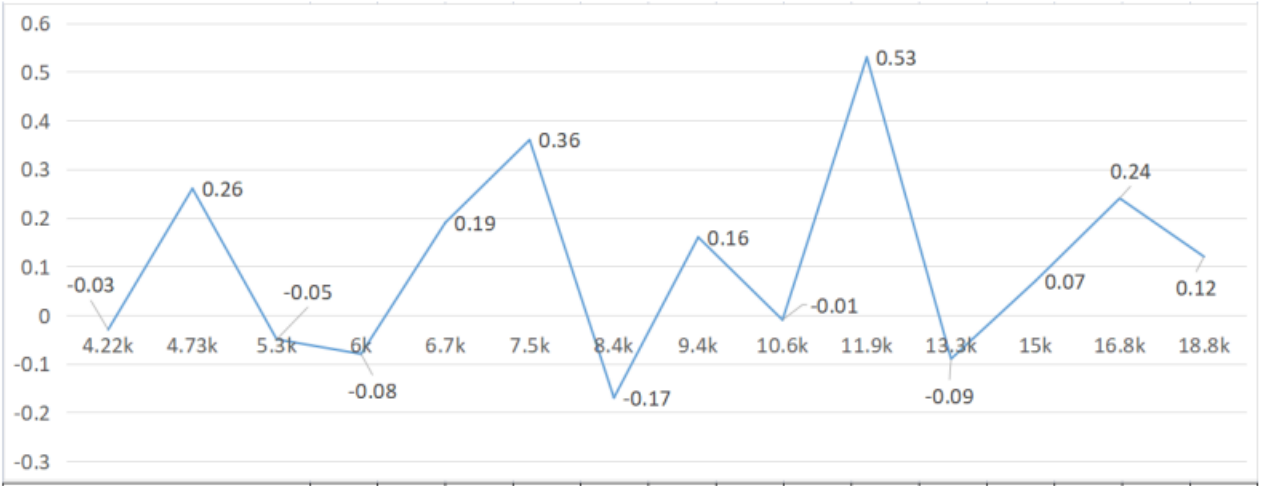


Relative attenuation of 1/3 octave-band pass filter at 12.5kHz center frequency

Appendix 5: Typical Effects of Reflections from the Instrument Housing and Diffraction Around the Microphone Under Approximate Reference Environmental Conditions



Frequency(Hz)	315	400	500	630	800	1k	1.25k	1.6k	2k	2.11k	2.37k	2.66k	2.99k	3.35k
Average Enclosure Effect	0.15	0.19	0.03	0.2	0.04	0.01	-0.25	-0.16	0.18	0.27	-0.02	0.35	0.01	-0.15



Frequency(Hz)	4.22k	4.73k	5.3k	6k	6.7k	7.5k	8.4k	9.4k	10.6k	11.9k	13.3k	15k	16.8k	18.8k
Average Enclosure Effect	-0.03	0.26	-0.05	-0.08	0.19	0.36	-0.17	0.16	-0.01	0.53	-0.09	0.07	0.24	0.12