INSTRUCTION MANUAL

2ch FFT ANALYZER

SA-78

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Organization of this manual

This manual describes the features and operation of 2ch FFT Analyzer SA-78. The following pages contain important information on safety. Be sure to read this part.

This manual contains the following chapters.

Outline

Gives basic information on the configuration and features of the unit.

Controls and Functions

Briefly identifies and explains all parts of the unit.

Preparations

Explains connections of each connector and insertion of batteries.

Measurement Screen

Explains symbols and other information that appears on the unit.

Menu List

Gives basic information of menu list on the unit.

Basic Operation

Explains basic operation of the unit.

Calibration

Explains calibration of the unit.

Averaging Function

Explains the settings of averaging function and display of the data.

Specifications

Lists the technical specifications of the unit.

CE

The product described in this manual is in conformity with the following European standards;

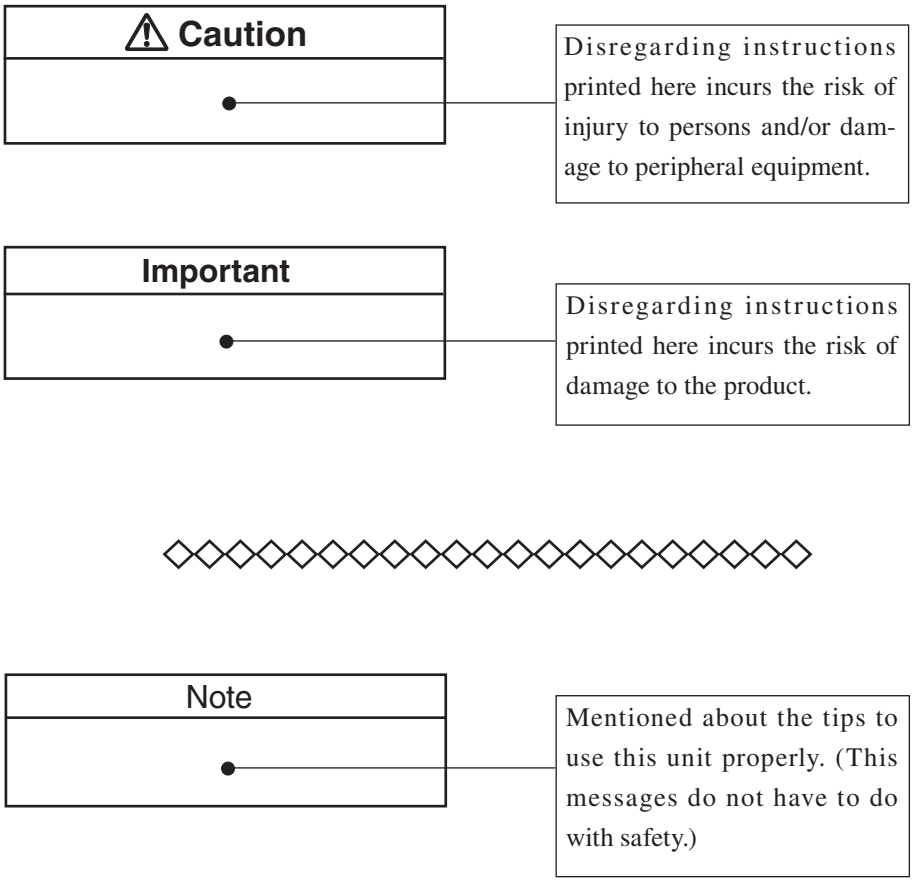
EN61000-6-2:2001
EN61000-6-3:2001

Note: CE requirements are met provided that a core filter is fitted to every cable.

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

FOR SAFETY

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



⚠ Caution

When making measurements on exposed rotating parts or power train parts of machinery, proceed with utmost care to ensure that the accelerometer or accelerometer cable do not get caught in the machine.

Precautions

- Operate the unit only as described in this manual.
- Do not touch any parts of the unit other than necessary for operation.
- Take care not to drop the unit, and protect it from shocks and vibrations.
- The permissible ambient temperature range for operation of the unit is 0 to + 40ºC. Relative humidity must be between 20% and 90%.
  Do not store or use the unit in locations where the unit may be subject to
  - splashes of water or high levels of dust,
  - air with high salt or sulphur content, or other gases or chemicals,
  - high temperature or humidity, or direct sunlight,
  - directly transmitted vibrations or shock.
- Do not forget to turn the unit off after use. Remove the batteries if the unit is not to be used for some time.
- When disconnecting cables, always hold the plug and do not pull the cable.
- To clean the unit, use only a dry cloth or a cloth lightly moistened with lukewarm water. Do not use chemical cleaning cloths, solvents or alcohol-based cleaners to prevent the possibility of deformation and discoloring.
- Do not insert any objects such as pins, metal scraps, conduction plastic etc. into any opening on the unit.
- Do not disassemble the unit or attempt internal alterations.
- Observe the following precautions after using the unit:
- In case of malfunction, do not attempt any repairs. Note the condition of the unit clearly and contact the supplier.
- When disposing of the unit or the accessories, follow national and local regulations regarding waste disposal.

Contents

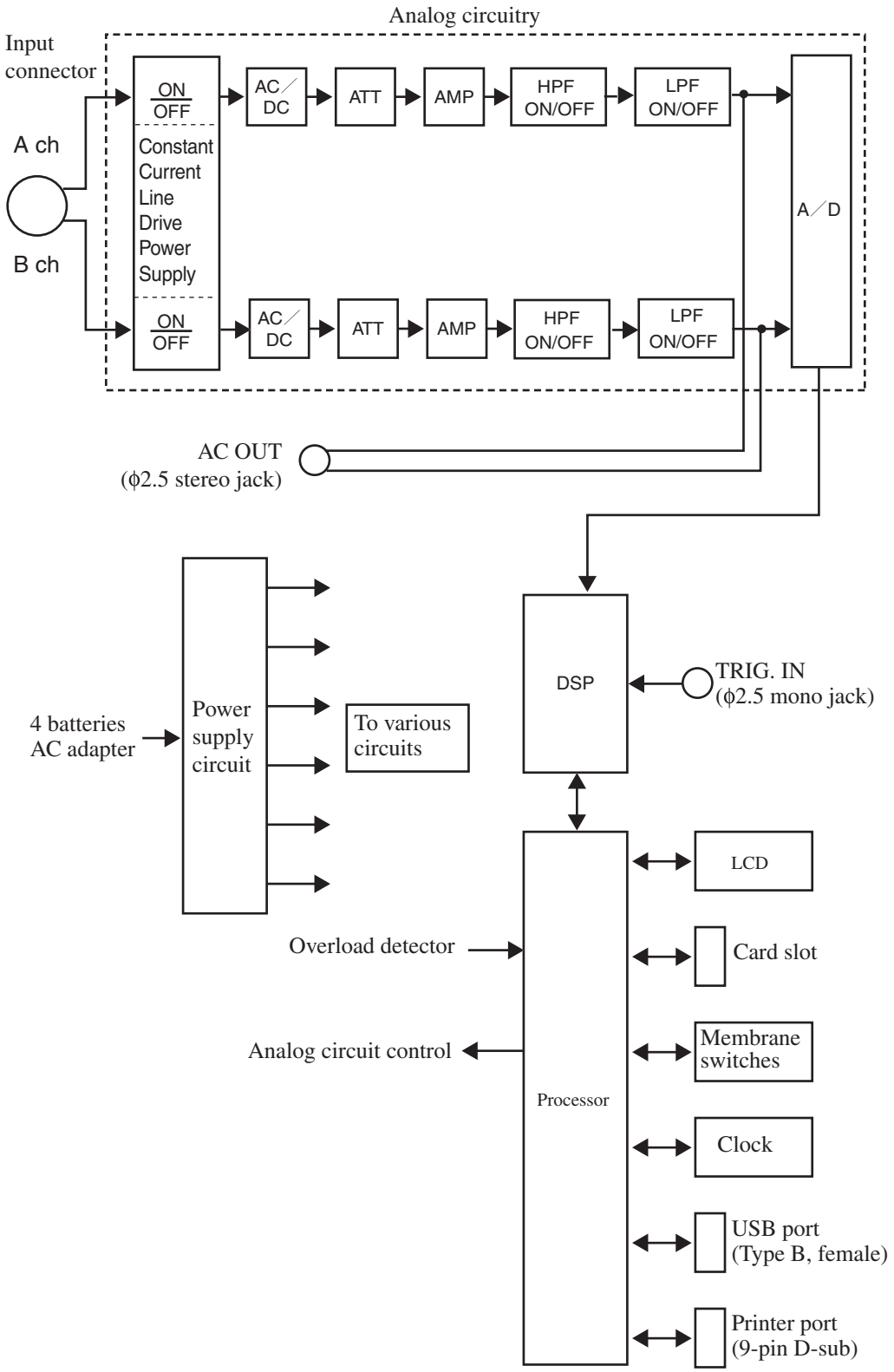
Outline

The SA-78 is a portable general-purpose FFT analyzer with two input channels. The input is configured as a 7-pin Rion standard connector which allows direct linking to a preamplifier. A supplied input conversion adapter provides two BNC connectors, and a Constant Current Line Drive power supply is also incorporated, making the SA-78 suitable for use with a wide range of equipment, including various types of sensors. The simple functionality of the unit allows quick transfer function measurement in the field. The frequency range extends to 80 kHz, making the SA-78 suitable for ultrasound, micromachine vibrations, and many other measurement applications.

A built-in port designed for connection of the DPU-414 or a similar printer is handy for producing hard copy of measurement results. A slot for memory card (CompactFlash) memory card is also provided. Measurement results stored on a memory card cannot only be redisplayed on the SA-78 later, they can also be shown on a computer. The USB interface makes connection to a computer very simple, with data transfer being handled by the supplied software.

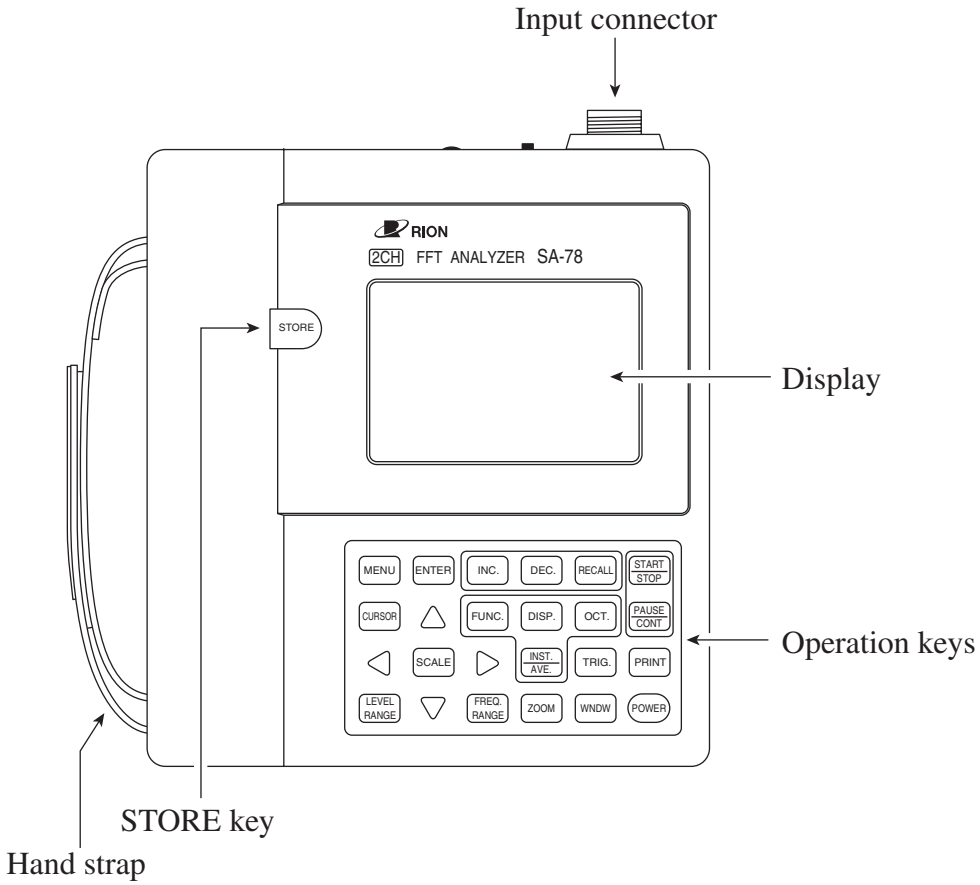
A waveform recording function is available as an option, permitting long-term waveform recording on a memory card. Because the data are stored in WAVE format, they can be imported by many other software applications for further processing.

Block Diagram



Controls and Functions

Front view



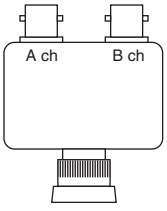
Input connector

- Direct connection

  A microphone preamplifier or vibration level meter preamplifier or similar can be connected directly to this connector. In this case, the signal is supplied to input channel A.

- Connection via BNC adapter

  The supplied 2-channel input conversion adapter fits onto the 7-pin input connector on the SA-78 and provides two BNC connectors. The signals at these connectors are supplied to channels A and B, respectively.



Display

Shows various information such as the measured waveforms, graphs, and menus.

Operation keys

These keys serve to turn the unit on and off, select measurement screens, set measurement parameters, and perform various other functions. For details, see the explanation starting on the next page.

STORE key

Serves to store data (measurement data, setting information, date and time information etc.) on memory card (CompactFlash).

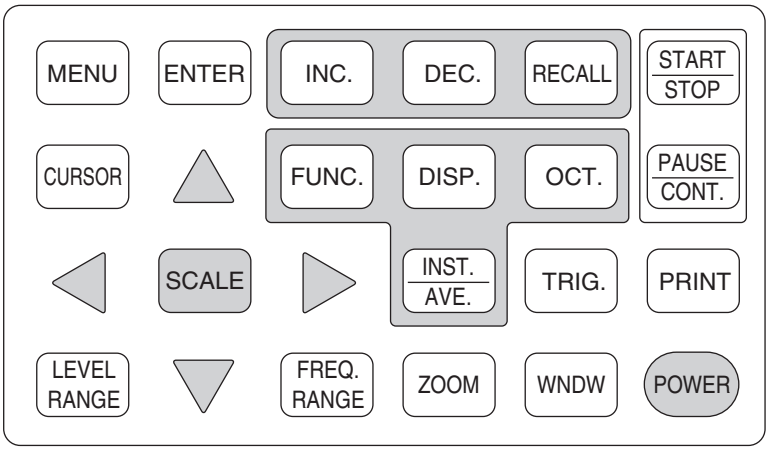
Hand strap

To prevent dropping the unit, pass your left hand through the strap.

⚠ Caution

To prevent the risk of serious injury and/or damage to equipment, do not use the hand strap when performing measurements on rotating machinery with exposed parts, on transmission gears, or similar machinery. Also take extreme care that accelerometers, accelerometer cables etc. do not get caught in such machinery.

Operation keys



MENU key

Calls up the main menu screen. Pressing the key again closes the menu.

ENTER key

Confirms (enters) a setting made on a menu screen.

Also used to make a selection from a menu.

INC. key

During measurement, this key increments the store target address (+1).

During display of measurement data from memory card (recall), the key increments the store address (+1) from which data are read.

DEC. key

During measurement, this key decrements the store target address (-1).

During display of measurement data from memory card (recall), the key decrements the store address (-1) from which data are read.

RECALL key

Press this key to call up data stored on memory card. Press the key again to return to the measurement screen.

START/STOP key

Starts/stops averaging (linear averaging, exponential averaging, peak hold).

PAUSE/CONT key

Pressing this key while a measurement screen is displayed pauses the graph data. Pressing the key during averaging pauses the averaging process. Pressing the key again resumes the previous operation.

FUNC. key

Opens and closes the function selection window. Use the ▲ and ▼ keys to select from the available 11 patterns. When wishing to select 2-channel cross power spectrum, phase, transfer function, or coherence function, the CROSS-SPEC item in the ANALYSIS menu must first be set to ON.

- TIMEa/TIMEb: Time waveform for channel A/Time waveform for channel B
- TIMEa/SPECa: Time waveform for channel A/Power spectrum for channel A
- TIMEb/SPECb: Time waveform for channel B/Power spectrum for channel B
- SPECa/SPECb: Power spectrum for channel A/Power spectrum for channel B
- XSPEC/PHASE: Cross power spectrum (between channels A and B)/Phase (between channels A and B)
- TRANS/PHASE: Transfer function (between channels A and B)/Phase (between channels A and B)
- TRANS/COH: Transfer function (between channels A and B)/Coherence (between channels A and B)
- TIMEa/TRANS: Time waveform for channel A/Transfer function (between channels A and B)
- TIMEb/TRANS: Time waveform for channel B/Transfer function (between channels A and B)
- SPECa/TRANS: Power spectrum for channel A/Transfer function (between channels A and B)
- SPECb/TRANS: Power spectrum for channel B/Transfer function (between channels A and B)

DISP. key

This key switches the display between the two functions that were selected in the function selection window. Normally, each push of the key cycles through the following settings: function 1 (single-graph display) → function 2 (single-graph display) → function 1 and function 2 (dual-graph display) → · · ·.

OCT. key

Only when FFT zoom is set to ×16, the frequency spectrum data for power spectrum (SPEC) and cross power spectrum (XSPEC) can be switched to 1/1 octave synthesized display or 1/3 octave synthesized display with this key.

In this case, the Y axis scale is automatically switched to dB.

If the PEAK LIST item in the DISPLAY (2) menu is set to ON, the display will be a numeric list display and the key has no effect.

INST./AVE. key

Toggles the type of data that are used for the graph display. INST stands for instantaneous data, and AVE for averaged data.

LEVEL RANGE key

Opens and closes the level range selection window. Use the ▲ and ▼ keys to move the highlight cursor and use the ◀ and ▶ keys to select the input level range value (-40 dB, -30 dB, -20 dB, -10 dB, 0 dB, +10 dB, +20 dB). Press the LEVEL RANGE key again to close the window.

FREQ. RANGE key

Opens and closes the frequency range selection window. Use the ◀ and ▶ keys to select the frequency range value (100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, 80 kHz). Press the FREQ. RANGE key again to close the window.

ZOOM key

Selects the FFT zoom ratio. Each push of the key cycles through the following zoom ratio settings: ×1 → ×2 → ×4 → ×8 → ×16 → · · ·.

Increasing the zoom ratio increases the frequency resolution.

WNDW key

Selects the window function. Each push of the key cycles through the following settings: RECT (Rectangular) → HANN (Hanning) → FTOP (Flat-top) → . . .

CURSOR key

When single-graph display is selected, up to two cursors can be displayed. When dual-graph display is selected, one cursor is displayed in each graph. Each push of the CURSOR key switches the number of cursors and selects separate or linked cursor action. When the power spectrum graph is displayed, the key is used to move the cursor to the overall value display.

SCALE key

This key serves to change the scale. Press scale key and the ▲, ▼, ◀, ▶ keys to enlarge (zoom-in) or reduce (zoom-out) the displayed graph.

During dual-graph display, the SCALE key controls the active cursor (shown as a solid line). When both cursors are active, the SCALE key controls both cursors together.

When you press the SCALE key again, the ▲, ▼, ◀, ▶ keys move the cursor.

▲, ▼ (Up/Down) keys

Select the cursor that is to be moved in the graph. The selected cursor is shown as a solid line.

If the SCALE key was pressed so that scale change is active, the keys serve to expand or reduce the graph area along the Y axis. The ▲ key causes enlargement (zoom-in) and the ▼ key causes reduction (zoom-out).

On a menu screen, the keys move the setting item highlight cursor up and down.

◀, ▶ (Left/Right) keys

Serve to move the cursor that is shown as a solid line in the graph.

When the graph is expanded along the X axis, moving the cursor to one of the edges of the graph moves the display by one grid in the X axis direction.

If the SCALE key was pressed so that scale change is active, the keys serve to expand or reduce the graph area along the X axis. The ▶ key causes enlargement (zoom-in) and the ◀ key causes reduction (zoom-out).

On a menu screen, the keys change the value of the setting item indicated by the highlight cursor.

TRIG. key

This key toggles the trigger function on and off. When "FREE" is shown, the trigger function is OFF. When "SNGL" (single trigger) or "REPT" (repeat trigger) is shown, the unit is in the trigger standby condition. The trigger mode can be selected with the TRIGGER menu.

PRINT key

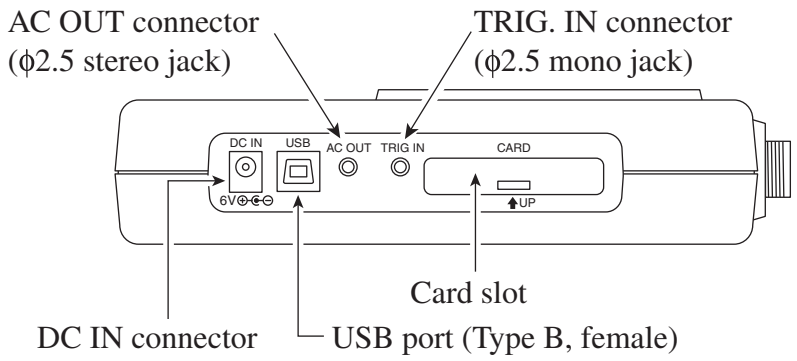
Serves to produce hard copy of the screen display contents or menu screens on the external printer DPU-414 (option). To stop printing, press the key again.

POWER key

Hold down this key for 2 seconds or more to switch the unit on or off.

When the unit is turned on, the settings that were selected when it was last turned off will be active again.

Side view



DC IN connector

The optional AC adapter (see Specifications page) can be connected here, for powering the unit from an AC outlet.

Important
Use only the specified AC adapter. Using a different AC adapter can lead to damage.

USB port (Type B, female)

Allows connecting the SA-78 to a computer using a USB cable. The supplied software can then be used for communication.

AC OUT connector (ϕ2.5 stereo jack)

This stereo connector carries the signal for channel A and channel B as an AC output.

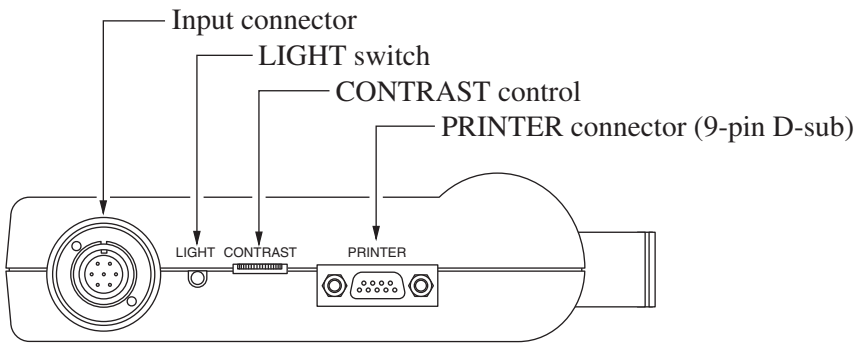
TRIG. IN connector (ϕ2.5 mono jack)

A signal for external triggering can be supplied via this jack.

Card slot

A memory card can be inserted here. The SA-78 uses memory card (CompactFlash).

Top view



Input connector

The source signal for analysis is to be connected here. This can be the signal from the preamplifier of an accelerometer or electret condenser microphone, the output of a sound level or vibration level meter, etc.

For details, see pages 18 to 22.

LIGHT switch

Pressing this switch turns the display backlight on, and pressing the switch once more turns the backlight off again. When the unit is powered from batteries, the backlight is automatically turned off after 10 minutes also when the switch is not pressed. When the unit is being powered from an AC adapter via the DC IN connector, the backlight is not turned off automatically. When the backlight is on, current consumption increases by about 40%. To conserve battery power, use the backlight only when necessary.

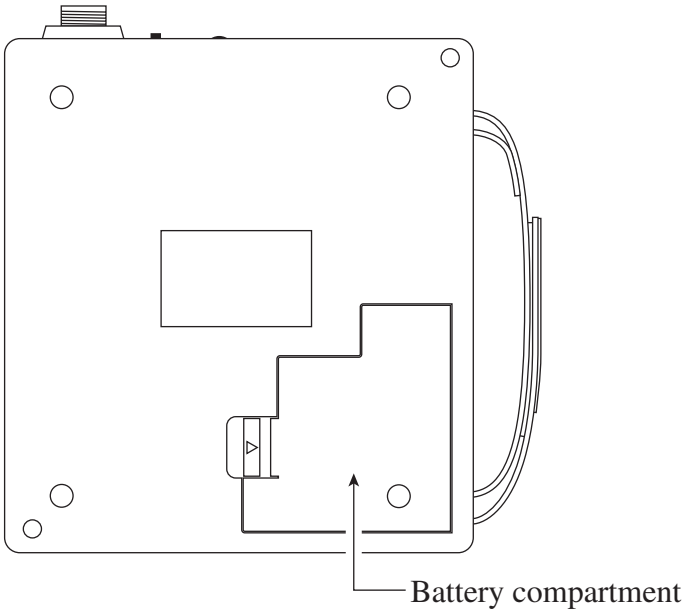
CONTRAST control

Lets you adjust the contrast of the display.

PRINTER connector (9-pin D-sub)

The optional printer DPU-414 or similar can be connected here, for producing hard copy of the display contents.

Bottom view



Battery compartment

Holds four IEC R14P (size "C") batteries.

Preparations

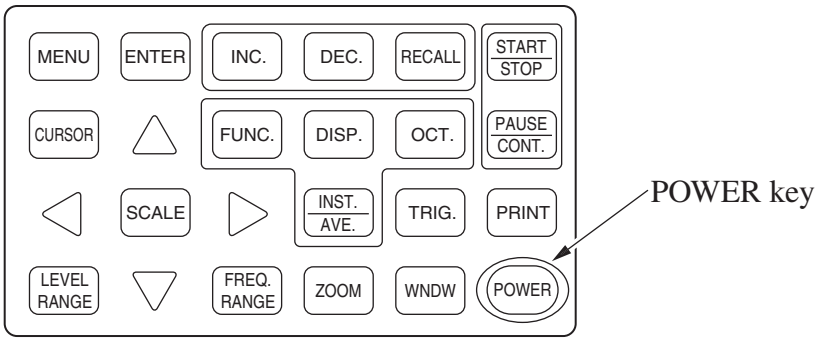
Power supply

The SA-78 can be powered from four IEC R14P (size "C") batteries (alkaline or manganese), or from an AC adapter (refer to the chapter "Specifications").

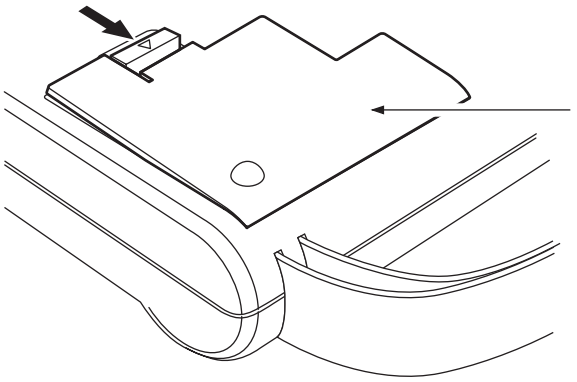
Note
Power failure backup function When an AC adapter is connected to the SA-78, power will be supplied by the adapter also if batteries are inserted. However, if power from the AC adapter is interrupted (for example due to a power line blackout), the SA-78 will automatically switch to battery operation.

Batteries

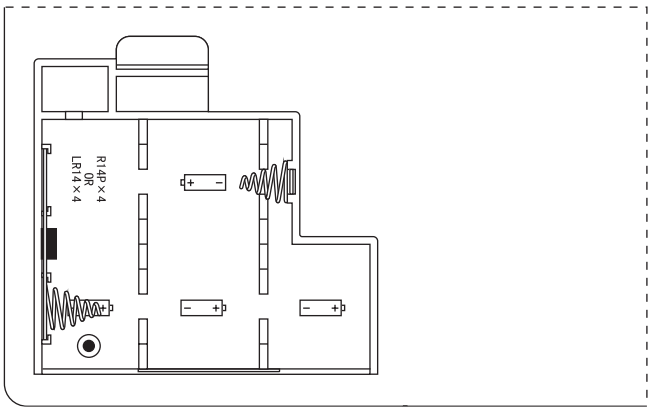
1. Always turn the power off before inserting or changing batteries. If the unit is on, press the POWER key for more than 2 seconds to turn the unit off.



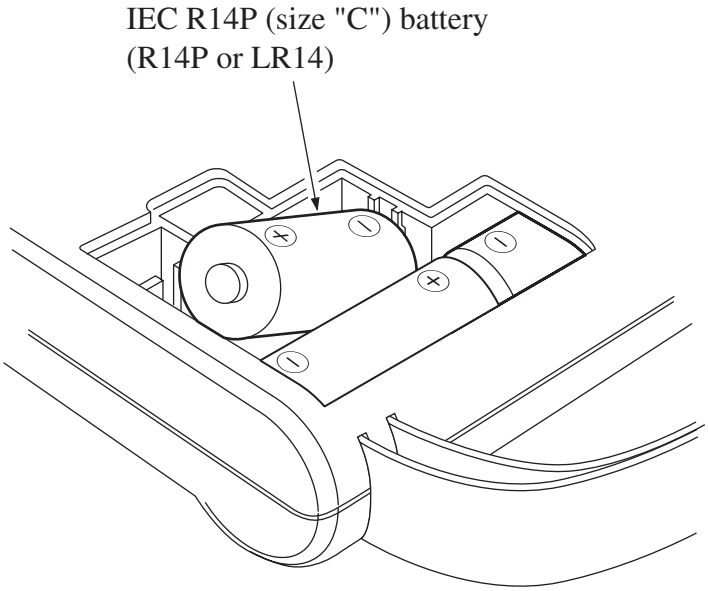
2. Remove the battery compartment lid on the bottom panel by pressing the ▽ mark in the direction of the arrow and lifting the lid.



Following illustration shows all batteries are removed from the compartment.



3. Insert four IEC R14 (size "C") batteries with correct orientation, as shown in the battery compartment.



4. Replace the battery compartment lid.

Important
Take care not to insert batteries with wrong + and - polarity. Always replace all four batteries at the same time, and do not mix different types of batteries. Otherwise damage may occur. While not using the unit, the batteries should be removed.

Note
When the unit is operating on batteries, power may not come on if the ambient temperature is lower than 10ºC (because the voltage of older batteries may have dropped below the required threshold). In such a case, replace all four batteries with fresh alkaline batteries.

Battery life will differ, depending on the battery type, usage conditions, and other factors.

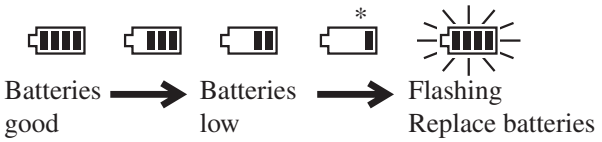
Approximate battery life at 20ºC, sensor power OFF, with backlight OFF, Print out OFF, and communications OFF is shown in the table below.

Battery life with continuous operation		
Alkaline batteries	LR14	approx. 15 hours
Manganese batteries (black)	R14P	approx. 5 hours

When the backlight is used, current consumption will increase by about 40%.

Battery capacity indicator

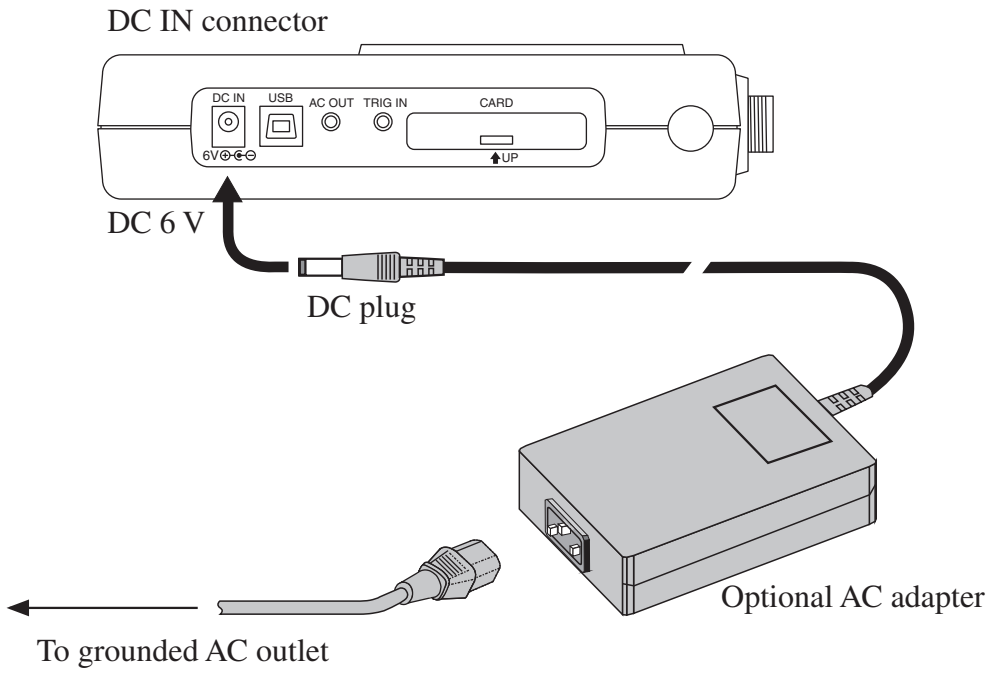
When the battery capacity indicator flashes, you should replace the batteries. Correct measurement is not possible in this condition.



When the unit is operating on manganese batteries using CCLD power supply for sensor and the battery capacity indicator is * condition, replace the batteries.

AC adapter (option)

Connect the AC adapter as shown in the illustration below.

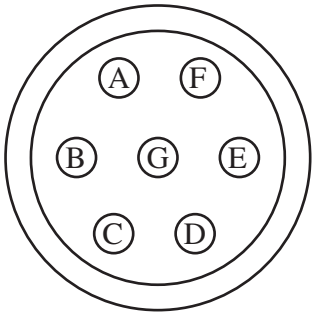


Important
Use only the specified adapter. Using a different AC adapter can lead to damage.

Connection

Input connector

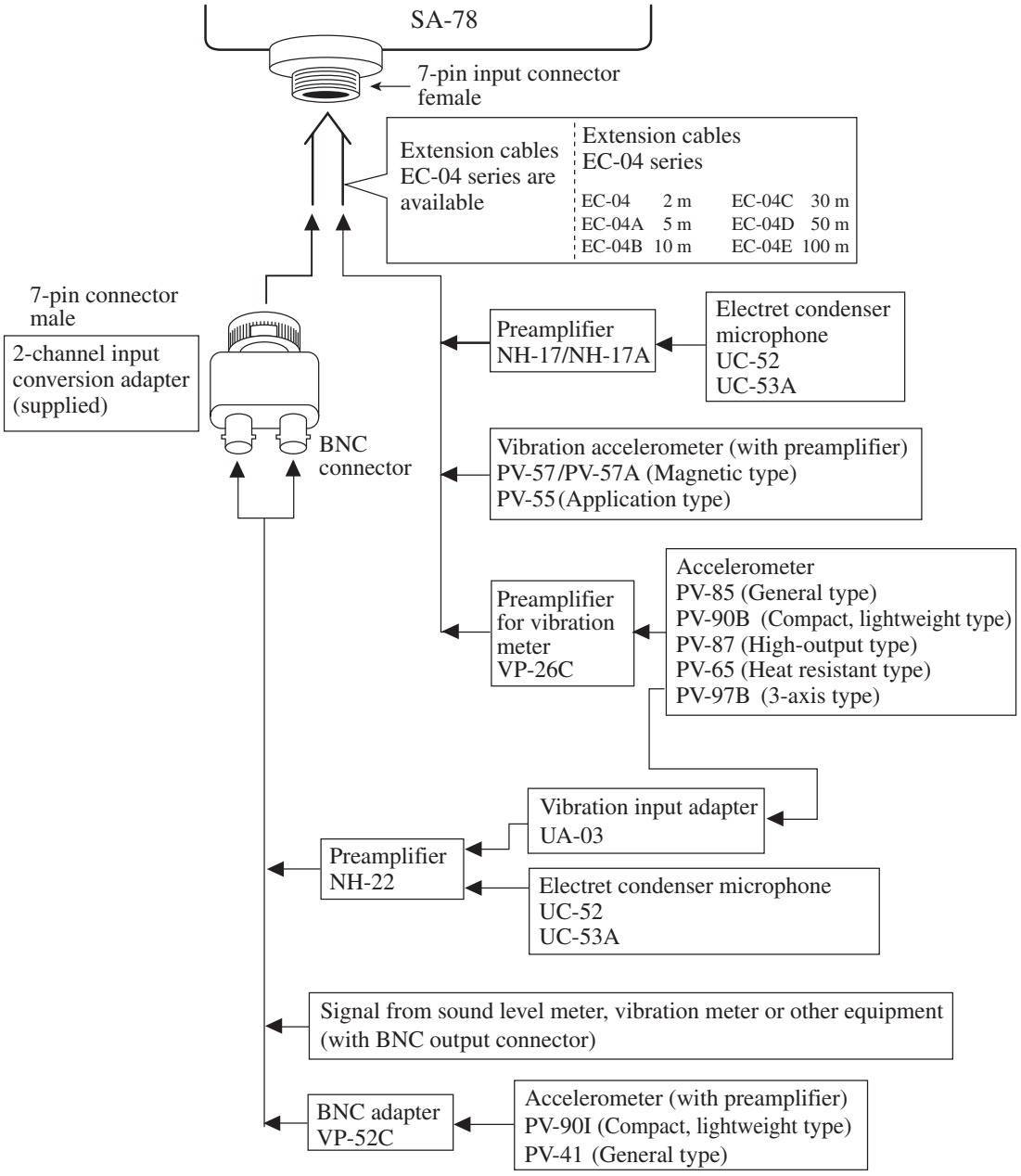
The input connector is a Tajimi Electronics connector PRC03-23A10-7F wired as shown below.



A: Preamplifier power supply (+12V)
B: Ground (A channel)
C: A channel signal input
D: Preamplifier power supply (-12V)
E: No connection
F: B channel signal input
G: Ground (B channel)

Note
A microphone or a preamplifier which needs bias voltage cannot be used.

Connection diagram

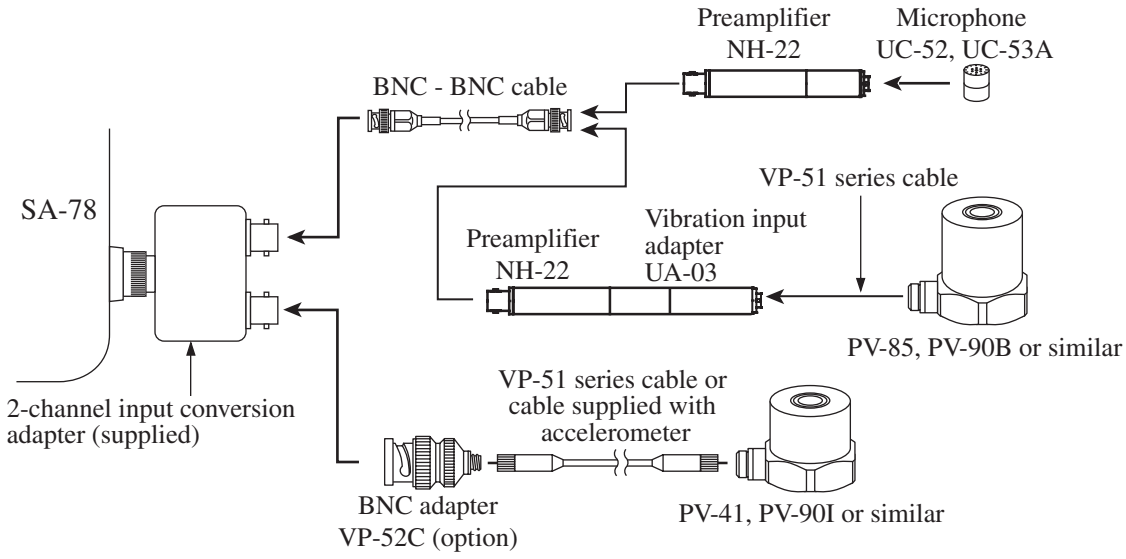


Connection example 1
Microphone or vibration accelerometer connected via BNC connector (Constant Current Line Drive sensors supported)

By using the supplied 2-channel input conversion adapter, equipment such as an accelerometer with integrated preamplifier (PV-90I, PV-41), or a combination of microphone (UC-52, UC-53A) and preamplifier (NH-22) can be connected as shown below.

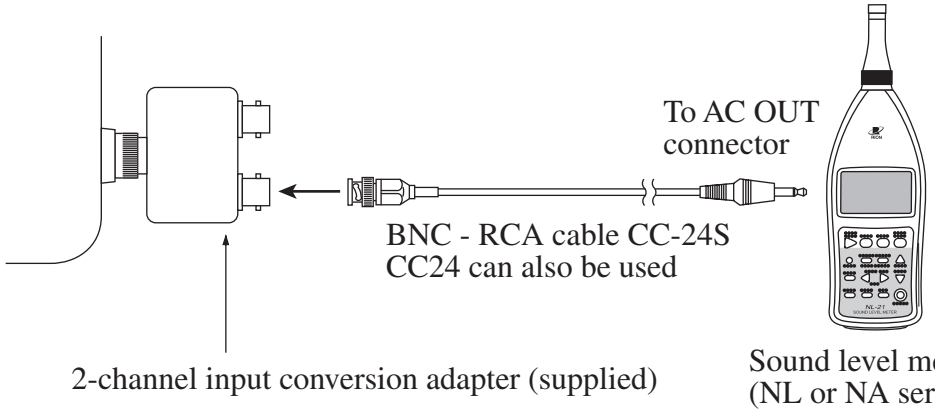
In the INPUT menu, set CCLD (Constant Current Line Drive) to ON.

Important
When a sensor or other piece of equipment that does not support Constant Current Line Drive is connected, setting CCLD in the INPUT menu to ON may damage the equipment.



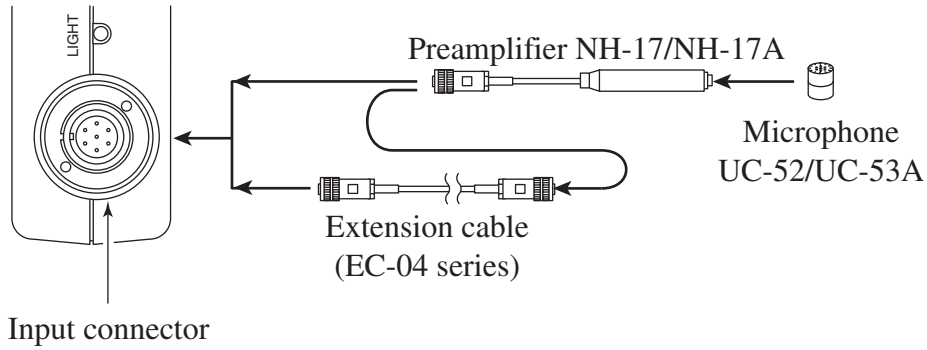
Connection example 2
AC output of sound level meter

By using the supplied 2-channel input conversion adapter, the AC output of a sound level meter (NL or NA series etc.) can be connected as shown below.



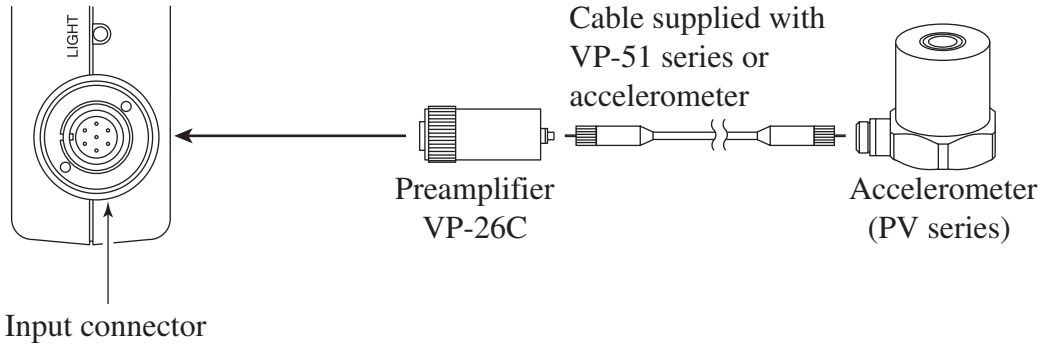
Connection example 3
Microphone

By connecting a preamplifier (NH-17/NH-17A) to the input connector, a microphone (UC-52/UC-53A) can be used. An extension cable of the EC-04 series can also be connected.



Connection example 4
Vibration accelerometer

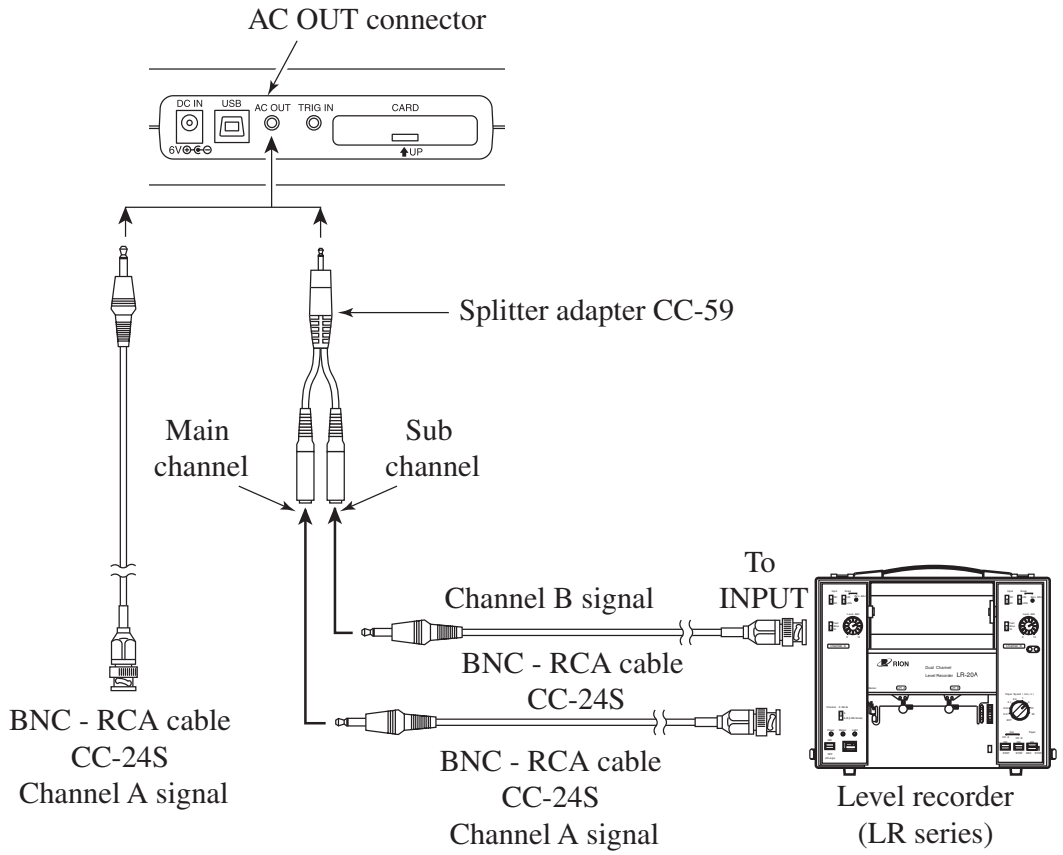
Optional vibration accelerometer (PV series) can be connected via a VP-51 series preamplifier or via the cable supplied with the accelerometer and the vibration meter preamplifier VP-26C (option).



AC OUT connector

This connector is a stereo jack which carries the signal for channel A and channel B as an AC output. The optional cable CC-24S can be used to supply this signal to a level recorder (LR-07/LR-20A) or a data recorder.

When wishing to record the output of channels A and B simultaneously, the splitter adapter CC-59 (option) is also required. When the CC-24S is connected directly, only the signal for channel A is supplied.

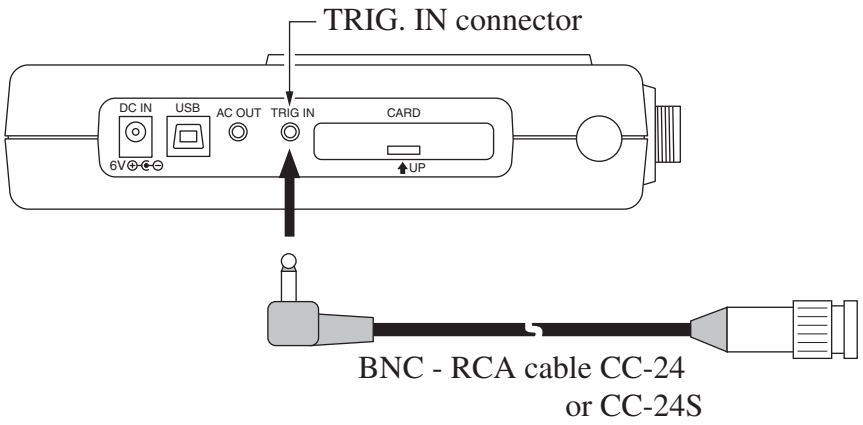


Note
The main channel of the splitter adapter CC-59 is channel A and the sub channel is channel B. The output level is 1 Vrms at the full-scale point for the chosen input signal level range.

TRIG IN connector

External trigger function is available by applying external signal to TRIG IN connector.

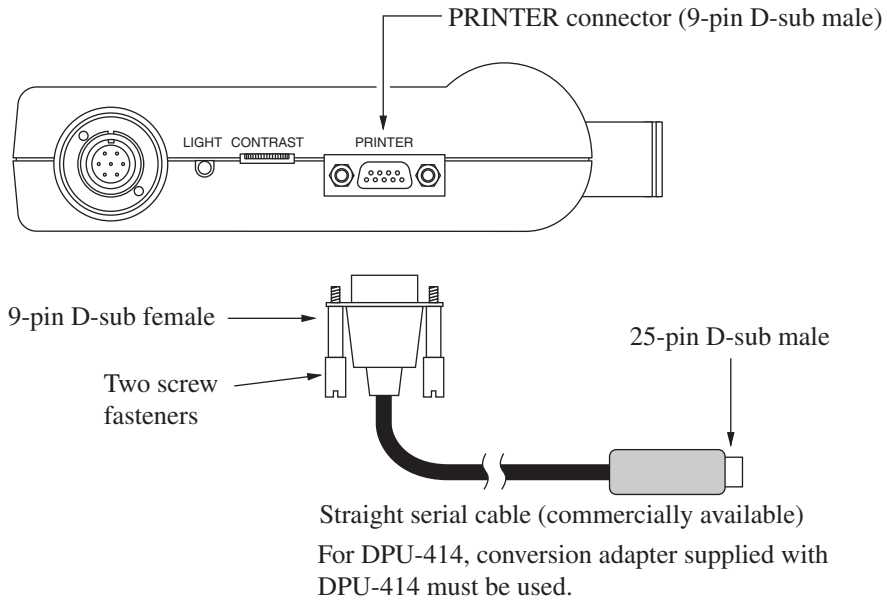
(see page 108 for trigger function)



Printer port

Use a commercially available serial cable (straight cable) to connect the I/O connector on the side of the SA-78 to the serial input of the printer (DPU-414, CP-10, CP-11).

For print function, please refer to page 117.



Setting the DIP switches of the DPU-414

Set the dip switches of the printer as shown below.

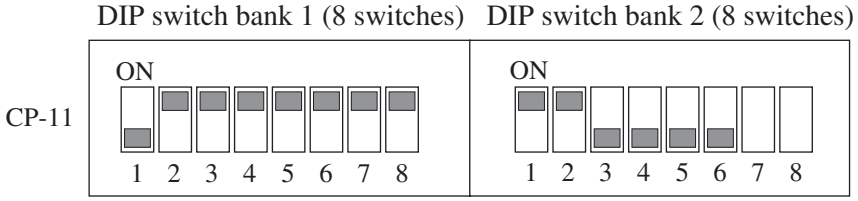
For details, please refer to the instruction manual of the DPU-414.

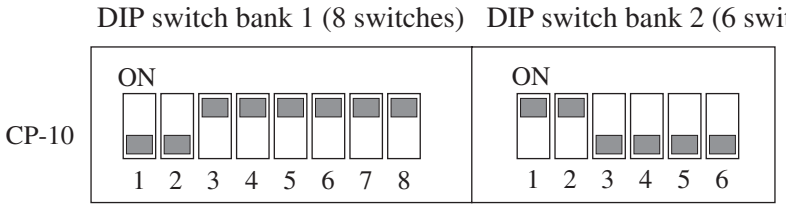
(9600 bps fixed)

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

Setting the DIP switches of the CP-11/CP-10

Set the DIP switches shown below.





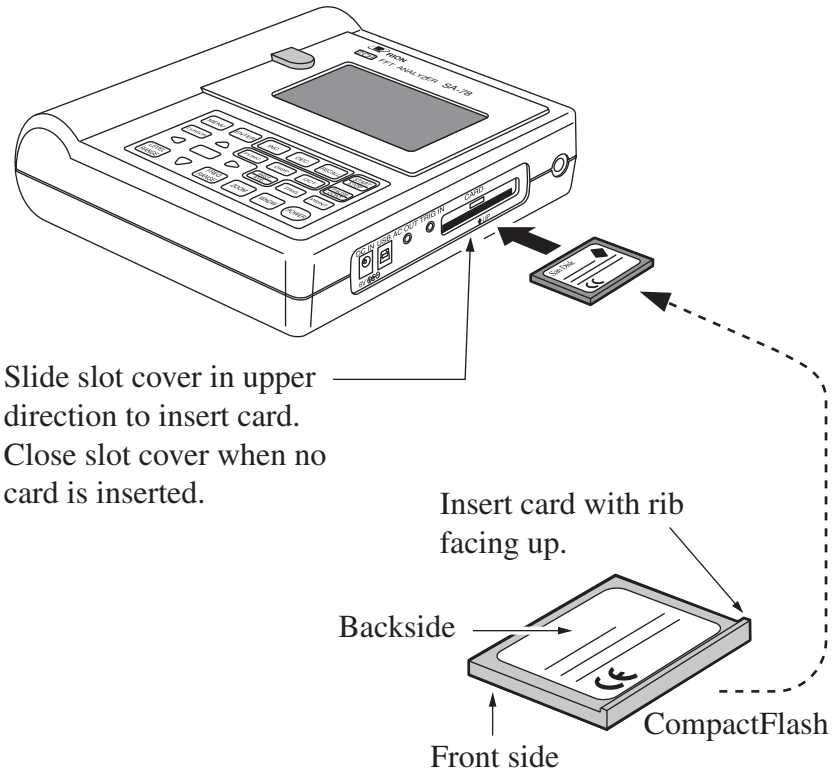
Important
Switches 7 and 8 of DIP switch bank 2 of printer CP-11 are set at the factory and should not be changed. Otherwise, correct printing may not be possible.

Card slot

When the memory card (Compact Flash) is inserted, the measurement data, setting parameters, date and time can be stored.
The data stored on the memory card are recalled in this unit or can be processed by a computer.

Card insertion

1. Turn the power off.
2. Slide slot cover in upper direction.
3. Insert the memory card firmly with rib facing up.



Removing the card

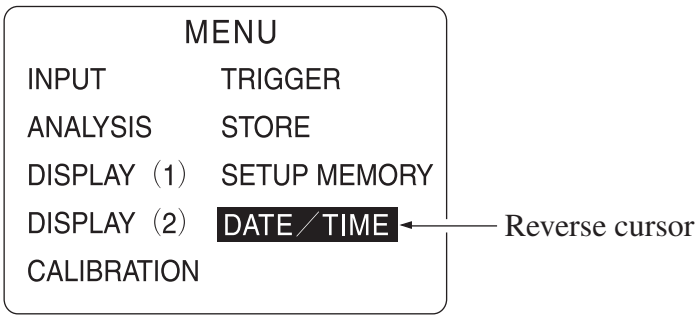
1. Turn the power off.
2. Take out the memory card by pulling the lib.
3. Cover the card slot.

Important
Always turn the power off before inserting or removing a memory card. When inserting memory card, pay attention to correct orientation. When a memory card is not used, be sure to cover the slot.

Setting the date and time

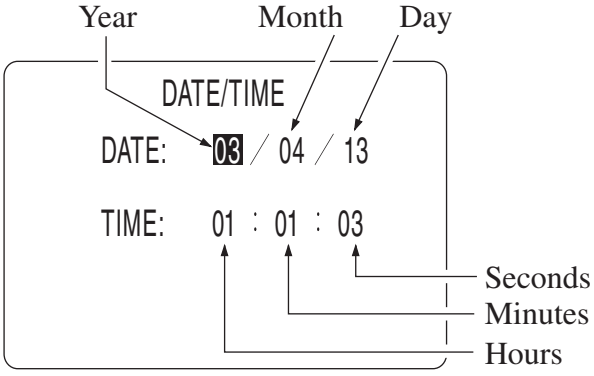
Before using the unit, set the date and time for the built-in calendar/clock. (The calendar/clock is not set at factory.)

1. Press the Power key for two or more than two seconds to turn the unit on.
2. When the measurement screen appears on the sub display, press the MENU key once to display main menu.



Main menu screen

3. Use the ▲ and ▼ keys to highlight the DATE/TIME item.
4. Press the ENTER key to call up the DATE/TIME screen.



DATE / TIME screen

5. Use the ◀ and ▶ keys to highlight the item that you want to change.
6. Use the ▲ and ▼ keys to change the numerical value. (Each brief push of the key changes the value by one increment. Keeping the key depressed results in a continuous change.)
7. Press the ENTER key after procedure 6.
8. Press the MENU key twice to return to the measurement screen.

Note
The internal clock IC may bring a time error in one minute per month at the maximum. Be sure to check the system clock before use. The internal rechargeable battery backs up the system clock while power-off. Be sure to set the system clock before use, after keeping power-off for a considerable period.

Backup battery

A rechargeable battery is built-in to back up the system clock.
The battery would be charged while power-on, and would not be charged while power-off. It needs 12 hours for a full charge.
With a full charge, the system clock will work for one and a half months.
Recharging is recommended before this period, otherwise the correct data of system clock may be lost.

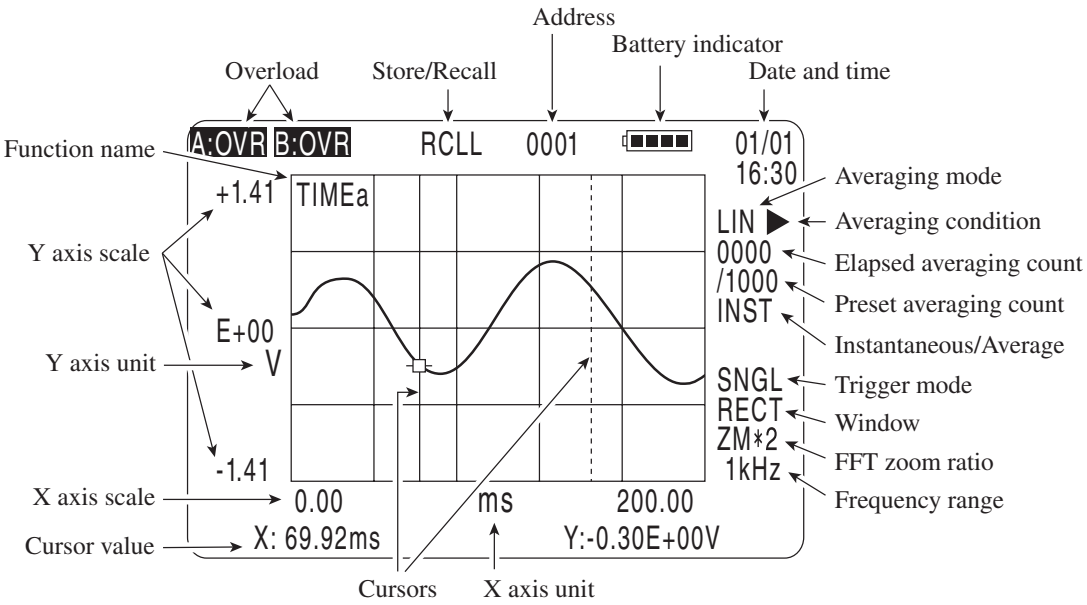
The life time of the backup battery is limited. Replacement in every five years is recommended. In such case please contact your supplier.

Note
When the backup battery is old, the data retention period will be shorter.

Important
Keeping power-on for 12 hours makes a full charge.

Measurement Screen

Single-graph display example (time waveform)



Function name

Shows the name of the selected function. This is shown only for single-graph display.

TIMEa(b)	:	Channel A (B) time waveform
SPECa(b)	:	Channel A (B) power spectrum
XSPEC	:	Cross power spectrum
TRANS	:	Transfer function
PHASE	:	Phase
COH	:	Coherence

Overload

Shows when the input signal has caused overload in the input stage.

A(B):OVR	:	Overload in channel A (B)

Store/Recall

STOR	:	Shown when data were stored on memory card.
RCLL	:	Shown when data stored on memory card are being read (recall mode).

Address

0001 to 9999: Address display

The address is specified when storing data on memory card.

Battery indicator

Shows the remaining capacity of the batteries. When this indicator flashes, replace the batteries as soon as possible.

Date and time

Shows the current date (month/day) and time (hours:minutes)

Averaging mode

Shows the averaging mode setting.

LIN	:	Linear averaging
EXP	:	Exponential averaging
PEAK	:	Maximum value hold

Averaging condition

▶	:	Averaging in progress
▮▮	:	Instantaneous data paused or averaging paused
■	:	Averaging stopped

Elapsed averaging count

Shows the number of averaging runs that have been performed.

Preset averaging count

0001 to 8000: Shows the setting selected for the AVERAGE TIMES item on the ANALYSIS menu. For exponential averaging, this corresponds to the weighting number.

Instantaneous/Average

INST	:	Instantaneous data are being shown.
AVE	:	Averaged data are being shown.

Trigger mode

FREE	:	Trigger function is set to OFF.
SNGL	:	Single-event trigger mode
REPT	:	Repeated-event trigger mode

Window

HANN : Hanning
FTOP : Flat-top
RECT : Rectangular

FFT zoom ratio

Shows the FFT zoom ratio. ×1 ×2 ×4 ×8 ×16

Frequency range

Shows the selected frequency range.

100 Hz 200 Hz 500 Hz 1 kHz 2 kHz 5 kHz
10 kHz 20 kHz 50 kHz 80 kHz

Cursors

The cursors are shown as a solid line and a broken line. The solid-line cursor can be moved, and its value is shown in the cursor value field.

Cursor value (X value, Y value)

The data at the cursor position can be read here.

When both cursors are linked in the single-graph screen (both cursors are shown as a solid line), the values shown here represent the difference between the data at both cursor points.

dX: X value difference dY: Y value difference

X axis scale

The upper limit and lower limit of the graph in the X axis direction are shown here.

X axis unit

Shows the unit of the X axis (ms, Hz, etc.).

Y axis scale

The Y axis scale is shown as a linear coordinate axis (LIN) or a dB coordinate axis.

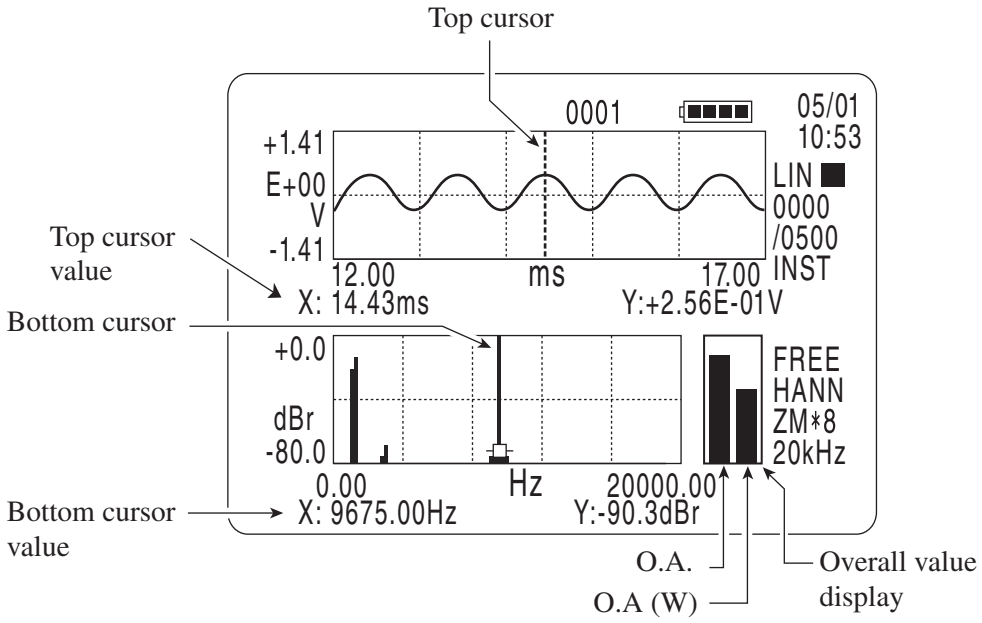
Depending on the graph function and the Y axis scale, the upper limit and lower limit of the graph in the Y axis direction are shown here.

Y axis unit

Shows the unit of the Y axis (V, dB, deg, EU = Engineering Units, etc.)

For some function settings (coherence etc.), no unit is shown.

Dual-graph display example (time waveform and power spectrum)



Function graphs

The function graphs selected with the FUNC. key are shown in the top half and bottom half of the screen. The function name is not shown in the graph. In the example shown above, the top graph is a time waveform and the bottom graph is a power spectrum.

Cursors

A cursor each is shown in the top graph and bottom graph. The cursor is shown as a solid line or a broken line. The solid-line cursor may be moved.

Cursor values (X axis value, Y axis value)

The data at the top graph cursor and the bottom graph cursor (X value, Y value) are indicated.

Overall value display

When the function graph is a power spectrum, the overall value is shown as a bar graph at the right.

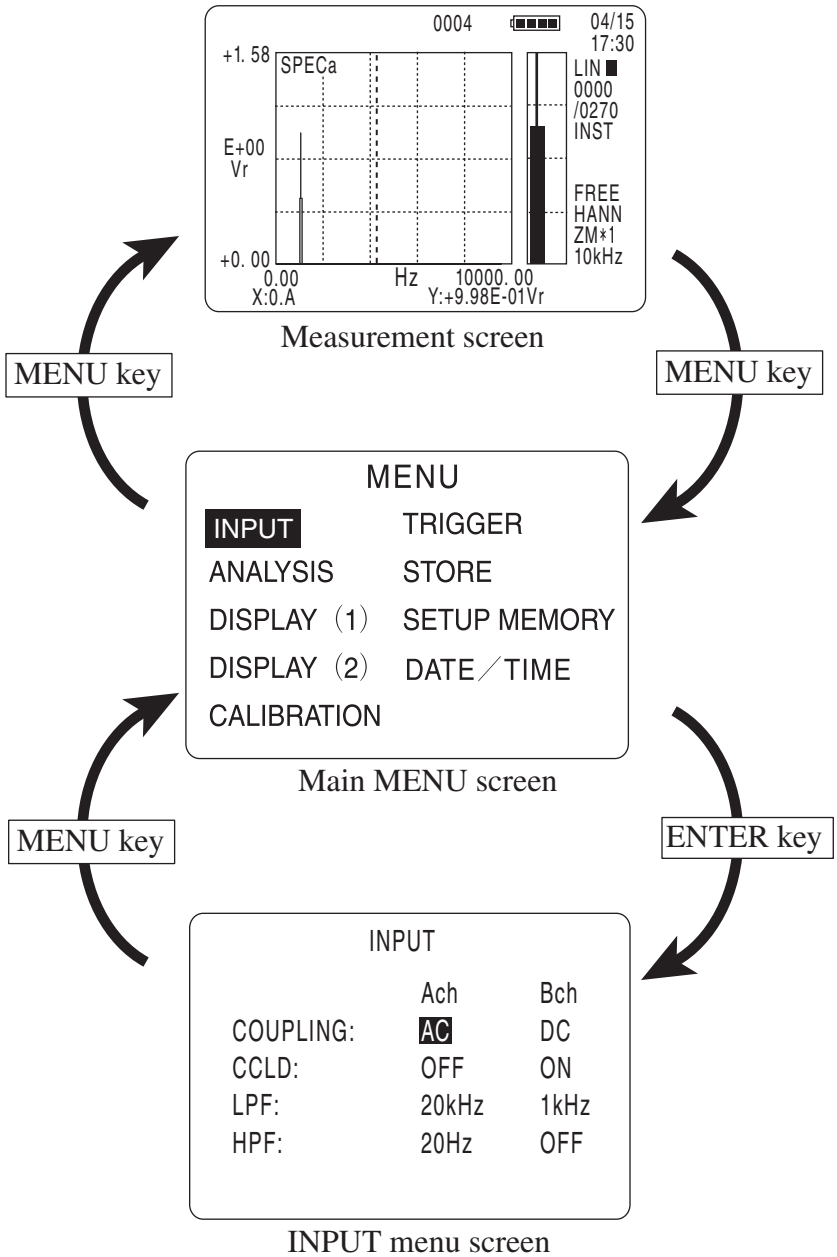
To read the overall value with the cursor, press the CURSOR key several times until it is in the overall value field.

The normal overall value without DC components is shown as the "O.A" bar graph in the left side of the overall value field. If frequency weighting has been selected in the DISPLAY (1) menu, the weighted overall value is shown as the "O.A (W)" bar graph in the right side of the overall value field.
For the two types of overall values, partial overall processing is carried out.

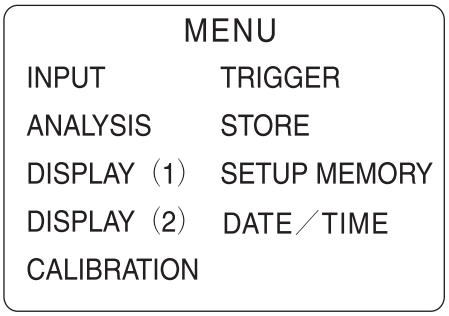
Menu List

Pressing the MENU key calls up the Main MENU screen.

Pressing the ENTER key brings up the selected menu screen.
Each menu screen allows the user to select measurement parameters to be changed.



Main MENU



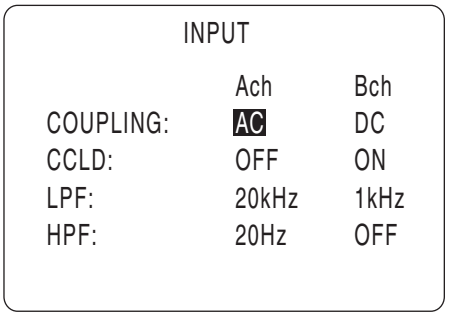
Main MENU screen

INPUT	:	Input settings (Input coupling, pre-filter)
ANALYSIS	:	Analysis settings (Cross power spectrum, averaging)
DISPLAY (1)	:	Display for analysis settings (Differential, Integral, frequency weighting, partial over all)
DISPLAY (2)	:	Display for Y-axis settings (Y-axis scale, peak list)
CALIBRATION	:	Calibration settings
TRIGGER	:	Trigger settings
STORE	:	Data file operations stored in the memory card.
SETUP MEMORY	:	Save or load settings from the memory.
DATE / TIME	:	Date and time setting

Setting procedure

1. Use the ▲ and ▼ keys to select the menu item.
2. Press the ENTER key to open the selected menu.

INPUT menu



INPUT menu screen

Set the channels A and the channel B respectively.

COUPLING : Input coupling

AC : Selects AC coupling (HPF cutoff is -3 dB at 0.5 Hz).

DC : Selects DC coupling.

CCLD : Constant Current Line Drive (sensor power supply).

OFF : The CCLD is unused.

ON : The CCLD (bias voltage:18 V, constant current 2 mA) is on. This is the setting to use when an accelerometer with integrated preamplifier is connected.

Note
When the CCLD is on, AC coupling become fixed.

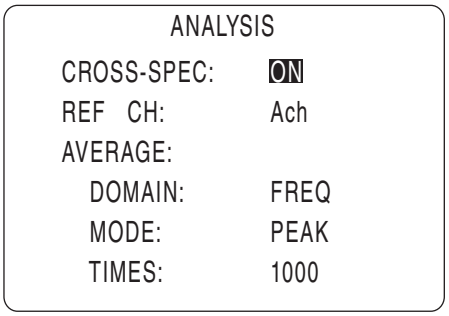
Important
When a sensor or other piece of equipment that does not support Constant Current Line Drive is connected, setting CCLD to ON may damage the equipment.
When manganese batteries are used and only one segment of the battery indicator is lit, do not use the CCLD.

LPF		:	Low-pass filter setting (-18 dB/oct. slope)
	OFF	:	Low-pass filter is unused.
	1kHz	:	1 kHz low-pass filter (-1 dB at 1 kHz) is enabled.
	20kHz	:	20 kHz low-pass filter (-1 dB at 20 kHz) is enabled.
HPF		:	High-pass filter setting (-18 dB/oct. slope)
	OFF	:	High-pass filter is unused.
	20Hz	:	20 Hz high-pass filter (-1 dB at 20 Hz) is enabled.
	100Hz	:	100 Hz high-pass filter (-1 dB at 100 Hz) is enabled.

Setting procedure

1. Use the ▲ and ▼ keys to select the menu item.
2. Use the ◀ and ▶ keys to change the setting, and then press the ENTER key to confirm the setting.

ANALYSIS menu



ANALYSIS menu screen

CROSS-SPEC : Perform channel A and B cross power spectrum, transfer function, phase, and coherence processing.

- ON : Enable processing
- OFF : No processing

REF CH : Selects the reference channel (A or B) to use for channel A and B cross power spectrum, transfer function, phase, and coherence processing.

AVERAGE

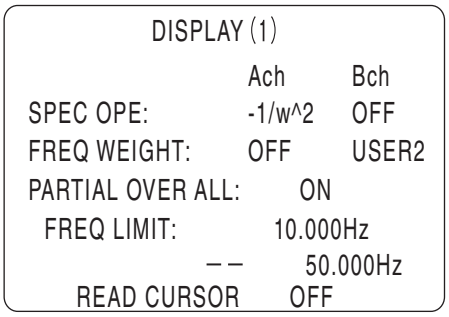
- DOMAIN : Domain for averaging
  - FREQ : Frequency domain
  - TIME : Time domain (only for linear averaging)
- MODE : Averaging mode
  - LIN : Linear averaging
  - EXP : Exponential averaging
  - PEAK : Peak hold (only for power spectrum)
- TIMES : Averaging count (1 to 8000)

Note
When performing exponential averaging, the TIMES setting is not used as the averaging count but as the value used for weighting.

Setting procedure

1. Use the ▲ and ▼ keys to select the menu item.
2. Use the ◀ and ▶ keys to change the setting, and then press the ENTER key to confirm the setting.

DISPLAY (1) menu



DISPLAY (1) menu screen

SPEC OPE : Make differentiation and integration settings for channels A and B.
The function setting applies to the power spectrum, cross power spectrum, and transfer function.

- -1/ω^2 : Double integral
- 1/jω : Integral
- jω : Differential
- -ω^2 : Two-step differential
- OFF : No differentiation or integration
(On the display, ω is shown as "w".)

FREQ WEIGHT : Frequency weighting
Spectrum data from the power spectrum are subject to frequency weighting as set here. The combined data are then used to calculate the overall value O.A (W) which is shown as a bar graph in the overall value field to the right of the power spectrum graph. Separate settings can be chosen for channels A and B. (The power spectrum data display does not reflect the frequency weighting.)

- OFF : No frequency weighting
- A : Noise level measurement "A" weighting
- USER1 : User-defined frequency weighting characteristics 1 (as read from memory card)
- USER2 : User-defined frequency weighting characteristics 2 (as read from memory card)

PARTIAL OVER ALL :

Determines whether the overall value is calculated as a normal overall value or a partial overall value.

OFF : The normal overall value is calculated. This includes all frequencies up to the top limit of the selected frequency range (except for DC components).

ON : The partial overall value for a specified frequency interval is calculated. [The partial overall setting also affects the frequency weighted overall value O.A (W).]

FREQ LIMIT : Serves to specify the a frequency interval by setting a lower and upper limit. The top row is for the lower limit (Hz) and the bottom row is for the upper limit (Hz).

Lower frequency limit :

**** Hz

Upper frequency limit :

**** Hz

READ CURSOR :

When the power spectrum is displayed as a single graph and two cursors are visible, the DISPLAY (1) menu allows specifying a frequency interval between the two cursors.

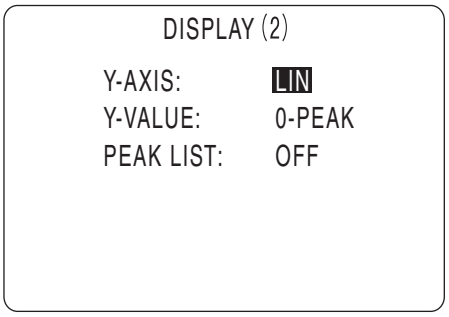
OFF : Frequency interval not specified.

EXEC : Frequency interval specified.

Setting procedure

1. Use the ▲ and ▼ keys to select the menu item.
2. Use the ◀ and ▶ keys to change the setting, and then press the ENTER key to confirm the setting.

DISPLAY (2) menu



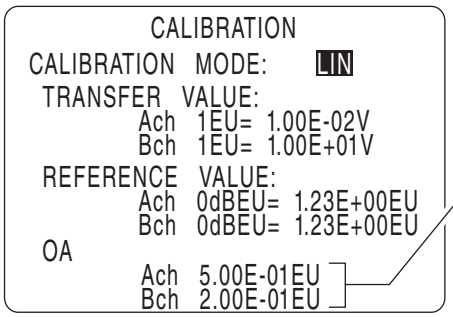
DISPLAY (2) menu screen

Y-AXIS		:	Sets the scale of the Y axis for power spectrum, cross power spectrum, and transfer function display.
	LIN	:	Linear coordinates
	dB	:	dB coordinates
Y-VALUE		:	Determines whether data on the Y axis for power spectrum and cross power spectrum are shown as rms value or as vibration amplitude (peak value).
	RMS	:	rms value "r" is appended to the unit, such as Vr, dBr, etc.
	0-Peak	:	Amplitude value ($\sqrt{2}$ × rms) Unit is shown as V, dB, etc.
PEAK LIST		:	A list of the ten highest values is shown. (Available for power spectrum, cross power spectrum, and transfer function display)
	OFF	:	Not specified
	ON	:	Specified

Setting procedure

1. Use the ▲ and ▼ keys to select the menu item.
2. Use the ◀ and ▶ keys to change the setting, and then press the ENTER key to confirm the setting.

CALIBRATION menu



CALIBRATION menu screen

Overall value reflecting the calibration settings is shown. This is not the frequency weighted overall value O.A (W).

A practical example for calibration, refer to the chapter "Calibration" (page 93).

CALIBRATION MODE :

Determines the calibration mode.

OFF : Engineering Units [EU] are not used.

LIN : The voltage value [V] is converted into Engineering Units [EU] for calibration.

dB : The voltage level value [dB V] is converted into Engineering Units [EU] for calibration.

TRANSFER VALUE :

Lets you input the calibration value.

(1) When LIN is selected as calibration mode

Enter the voltage value [V] corresponding to 1 Engineering Unit [EU]. This entry is made for each channel separately.

Ach: 1 EU = (m.mm) E (±nn) V

Bch: 1 EU = (m.mm) E (±nn) V

The input range is as follows.

m.mm : -9.99 to +9.99

nn : 0 to 37

(2) When dB is selected as calibration mode

Enter the voltage level value [dB V] corresponding to 0 Engineering Units [dB EU]. This entry is made for each channel separately.

Ach: 0 dB EU = (mmm.m) dB V

Bch: 0 dB EU = (mmm.m) dB V

The input range is as follows.

mmm.m : -999.9 to +999.9

REFERENCE VALUE

This is the Engineering Unit [EU] reference value. Enter the EU value that corresponds to 0 dB in the Engineering Unit system.

Ach: 0 dB EU = (m.mm) E (±nn) EU

Bch: 0 dB EU = (m.mm) E (±nn) EU

The input range is as follows.

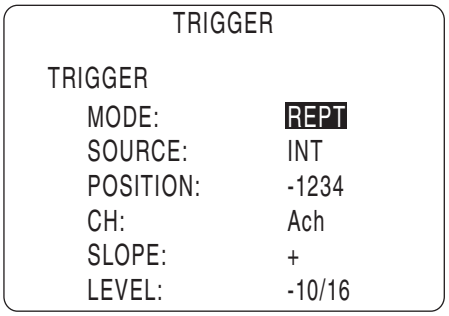
m.mm : -9.99 to +9.99

nn : 0 to 37

Setting procedure

1. Use the ▲ and ▼ keys to select the menu item.
2. Use the ◀ and ▶ keys to change the setting, and then press the ENTER key to confirm the setting.

TRIGGER menu



TRIGGER menu screen

For information on trigger functions, refer to page 108.

TRIGGER

MODE : Trigger operation mode

SNGL : Single-event trigger

REPT : Repeated-event trigger

SOURCE : Trigger source

INT : Internal trigger

EXT : External trigger

POSITION : Trigger position

Using the trigger detection point as 0, this can be set in single steps from -4096 to +4096.

CH : Channel in which the trigger is used (only valid for internal trigger)

(Ach/Bch)

SLOPE : Trigger slope (only valid for internal trigger)

\+ : Rising edge

\- : Falling edge

LEVEL : Trigger level (only valid for internal trigger)

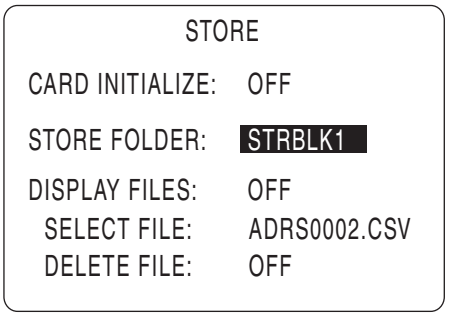
-15/16 to +15/16 :

The level can be set in steps of 1/16 of the full-range level.

Setting procedure

1. Use the ▲ and ▼ keys to select the menu item.
2. Use the ◀ and ▶ keys to change the setting, and then press the ENTER key to confirm the setting.

STORE menu



STORE menu screen

CARD INITIALIZE : Serves to initialize (format) the memory card.
This process will erase all folders and files currently on the memory card, and then create two types of folders. One folder type is for storing data and is called store block folder. There are a total of eight such folders, named "Strblk1" to "Strblk8". The other folder type is the "WEIGHT" folder. This folder serves to hold frequency compensation data files for user-defined frequency weighting.
Use the ◀ and ▶ keys to change the setting from OFF to EXEC, and then press the ENTER key. Following to the message, press OK → START key. The card initialization is executed.

STORE FOLDER : Serves to select the store block folder.
After the memory card was initialized, the default folders which can be selected are "Strblk1" to "Strblk8". More store block folders named from "Strblk9" to "Strblk99" can be created when the memory card is inserted in a computer. After such folders have been created, these can also be selected from the menu. Use the ◀ and ▶ keys to select the store block folder, and then press the ENTER key to confirm the selection.

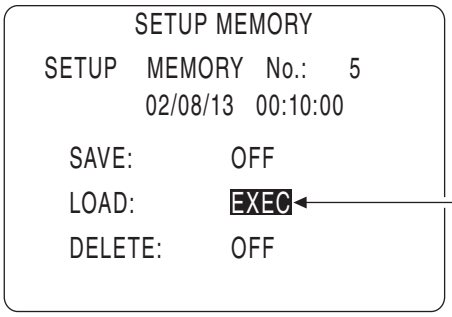
DISPLAY FILES : Serves to show a list of files.
The files in the folder specified as STORE FOLDER are shown. (If there are no files in the folder, nothing is shown.)
Use the ◀ and ▶ keys to change the OFF indication to EXEC, and then press the ENTER key. In the file list, you can use the ▲ and ▼ keys to select a file. When you press the ENTER key, that selection will be reflected in the SELECT FILE item.

SELECT FILE : Serves to select a file.
You can select a file from the folder specified as STORE FOLDER. If there is no file, only "------.CSV" is shown. Use the ◀ and ▶ keys to select the file, and then press the ENTER key to confirm the selection.

DELETE FILE : Serves to delete a file.
You can delete the file specified in SELECT FILE. Use the ◀ and ▶ keys to change the OFF indication to EXEC, and then press the ENTER key. Following to the message, press OK → START key. The card delete file is executed.

Note
For information on how to store measurement data on memory card and how to recall stored data, refer to "Recalling Stored Data" on page 133.

SETUP MEMORY menu



SETUP MEMORY menu screen

SETUP MEMORY No. :

Setup parameter memory number

The memory number is shown along with the date and time (year/month/day hours:minutes:seconds) when the data were saved.

The SETUP MEMORY No. selection range is 1 to 8. The current settings (level range, frequency range etc.) are saved under the selected number and can be recalled at any time. These settings are saved in the internal memory of the unit, not on the memory card.

Use the ◀ and ▶ keys to select the number, and then press the ENTER key to confirm the selection.

SAVE : Saves all setup parameters in the specified SETUP MEMORY number.

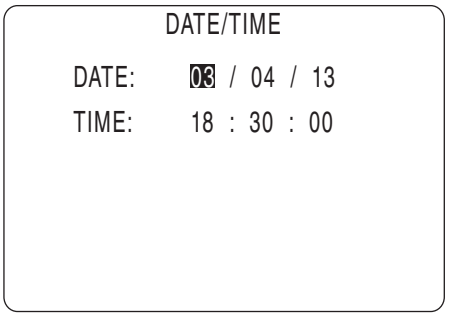
LOAD : Loads all setup parameters from the specified SETUP MEMORY number.

DELETE : Deletes all setup parameters saved under the specified SETUP MEMORY number.

Setting procedure

1. Use the ◀ and ▶ keys to change the OFF indication to EXEC, and then press the ENTER key.
2. When the confirmation message is shown, press the START/STOP key (OK) to perform the action. When wishing to cancel the action, press the PAUSE/CONT key.

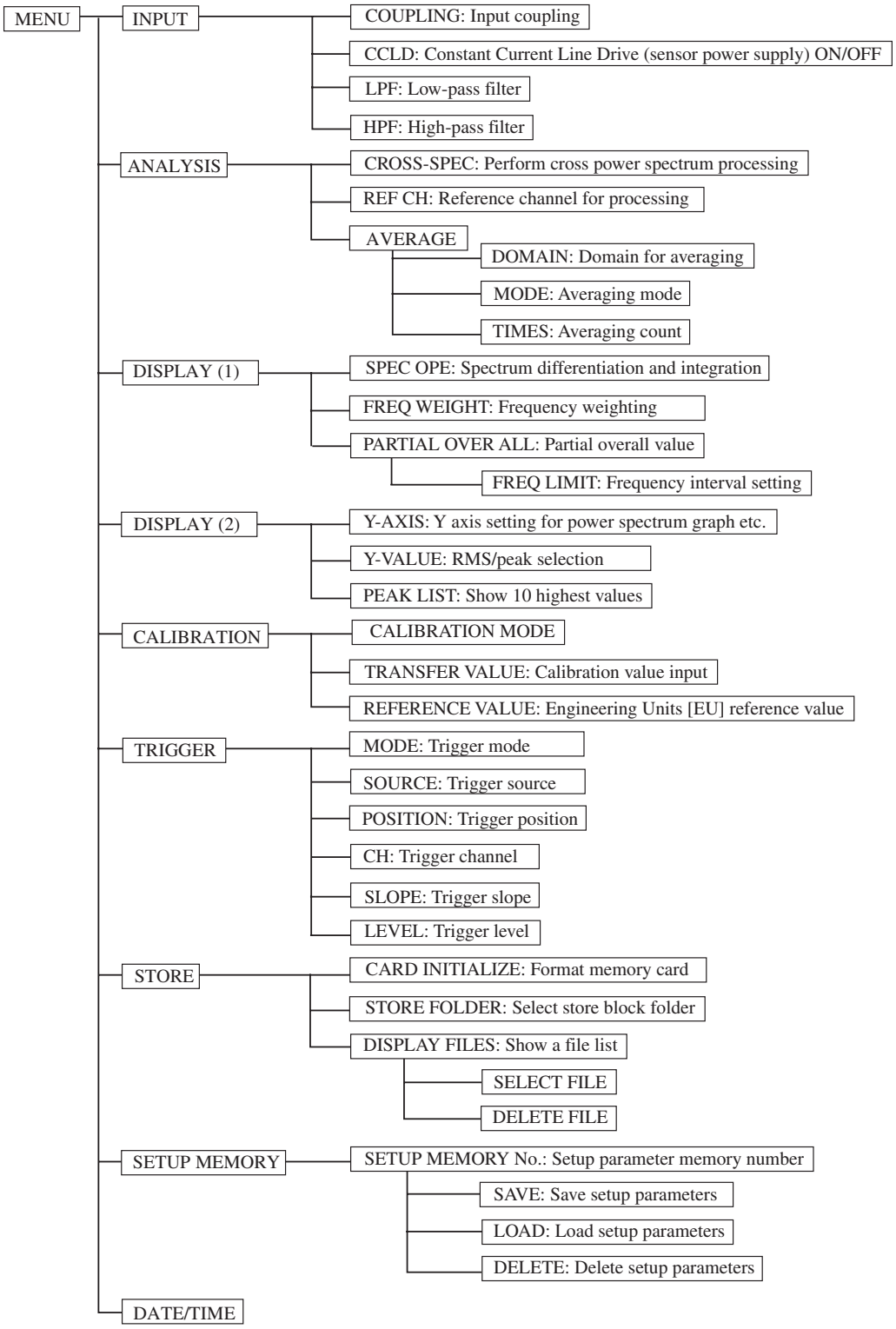
DATE/TIME menu



DATE / TIME menu screen

Serves to set the date and time.
For information on the setting procedure, refer to the section "Setting the date and time" (page 30) in the chapter "Preparations".

SA-78 menu map



Basic Operation

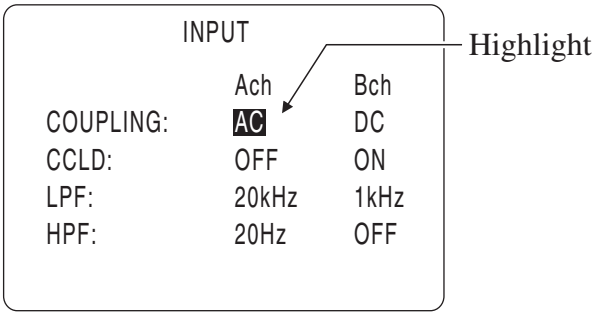
Signal input setting (channel A, channel B)

This setting is made from the INPUT menu screen.

Opening the INPUT menu screen

Press the MENU key to bring up the main menu screen.

Use the ▲ and ▼ keys to move the highlight cursor to "INPUT" and press the ENTER key. The INPUT menu screen appears. This screen lets you make the settings for each channel.



INPUT menu screen

Parameter input

Use the ▲ and ▼ keys to move the highlight cursor to the item you want to set, and then use the ◀ and ▶ keys to change the parameter. Press the ENTER key to confirm the setting.

To return to the main menu, press the MENU key.

Pressing the MENU key again returns to the measurement screen.

Setting the input coupling type (COUPLING)

Setting options: AC, DC

AC : Selects AC coupling (HPF cutoff is -3 dB at 0.5 Hz).

DC : Selects DC coupling.

CCLD (Constant Current Line Drive [sensor power supply]) setting

Setting options: OFF, ON

OFF : The Constant Current Line Drive (sensor power supply) is off. This is the setting to use when supplying a regular electrical signal to the input.

ON : The Constant Current Line Drive (sensor power supply) is on. This is the setting to use when an accelerometer with integrated preamplifier (PV-41, PV-90I etc.) is connected. A constant current power of 18 V, 2 mA is supplied.

Important
When a sensor or other piece of equipment that does not support Constant Current Line Drive is connected, setting CCLD to ON may damage the equipment.
When manganese batteries are used and only one segment of the battery indicator is lit, do not use the Constant Current Line Drive (sensor power supply).

LPF (low-pass filter) setting

Setting options: OFF, 1kHz, 20kHz

OFF : Low-pass filter is unused.

1kHz : 1 kHz low-pass filter (-1 dB at 1 kHz) is enabled.

20kHz : 20 kHz low-pass filter (-1 dB at 20 kHz) is enabled.

Both filters are analog 3rd-order Butterworth type filters with a cutoff slope of -18 dB/octave.

HPF (high-pass filter) setting

Setting options: OFF, 20Hz, 100Hz

OFF : High-pass filter is unused.

20Hz : 20 Hz high-pass filter (-1 dB at 20 Hz) is enabled.

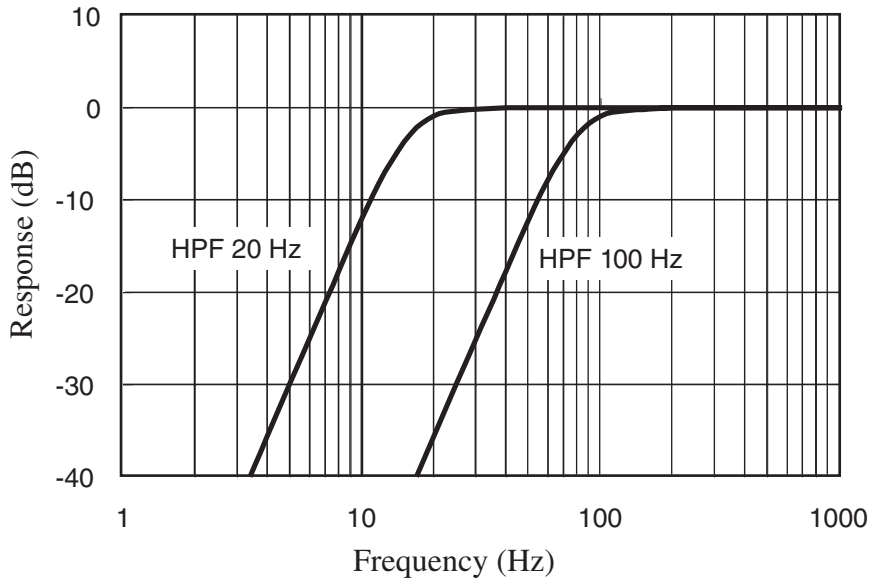
100Hz : 100 Hz high-pass filter (-1 dB at 100 Hz) is enabled.

Both filters are analog 3rd-order Butterworth type filters with a cutoff slope of -18 dB/octave.

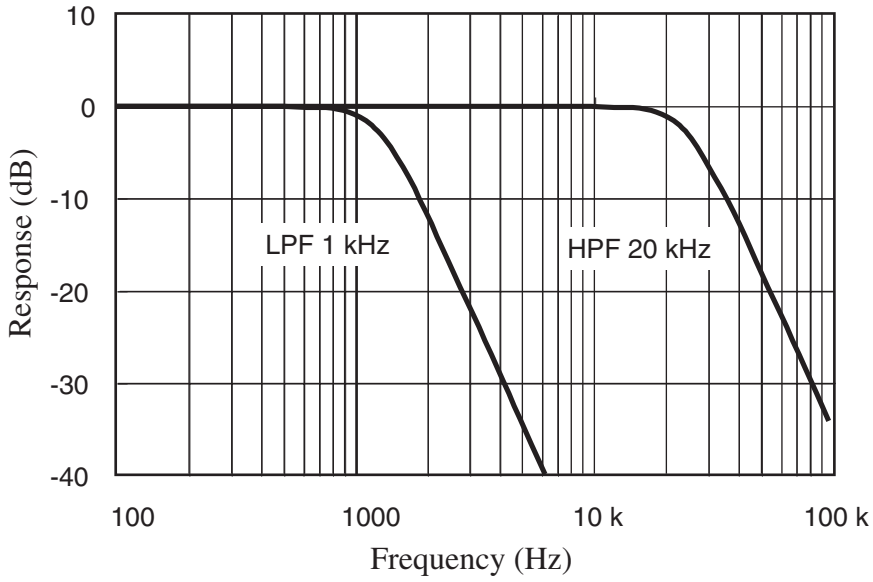
Note
The high-pass filter and low-pass filter can also be used when frequency weighting (A characteristics, user-defined characteristics) is performed for the overall value. During measurement, check the filter setting. Representative filter characteristics are shown on the next page.

Representative high-pass filter and low-pass filter characteristics

High-pass filter characteristics



Low-pass filter characteristics



Input level range setting and overload indication

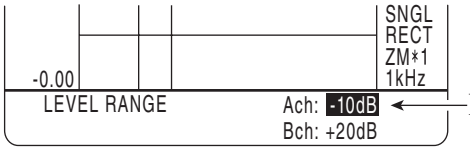
Setting the input level range

Setting options: +20 dB, +10 dB, 0 dB, -10 dB, -20 dB, -30 dB, -40 dB

Set the input level range so that it matches the level (voltage) of the input signal. The level range setting for channel A and channel B is made from the level range setting window. Use the LEVEL RANGE key to open this window.

Use the ▲ and ▼ keys to move the highlight cursor to the channel for which to make the setting (Ach = channel A, Bch = channel B). Then use the ◀ and ▶ keys to change the setting.

To close the level range setting window, press the LEVEL RANGE key again.



Level range setting window

Input level range setting and full-scale value

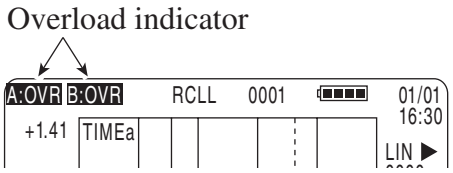
Input level range	+20 dB	+10 dB	0 dB	-10 dB	-20 dB	-30 dB	-40 dB
full-scale value (voltage V_{peak})	14.1	4.47	1.41	0.447	0.141	0.0447	0.0141

Note

The level range setting is not shown on the normal measurement screen. To check or change the setting, you must open the level range setting window.

Overload indication

If the input signal level is higher than the selected level range setting, overload occurs and the overload indicator appears, as shown below. When overload has occurred, the measurement result will not be correct. Increase the level range setting.



The SA-78 determines overload by monitoring the input signal waveform. If overload is indicated for the averaging result (AVE), this means that input signal overload has occurred at some point within the processing interval.

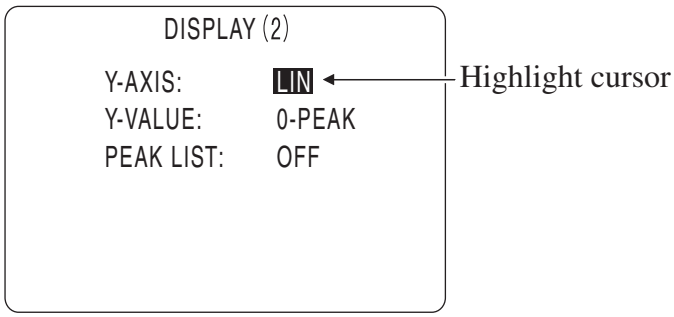
Y axis scale and Y value (rms/amplitude) setting

This setting is made from the DISPLAY (2) menu screen.

Opening the DISPLAY (2) menu screen

Press the MENU key to bring up the main menu screen.

Use the ▲ and ▼ keys to move the highlight cursor to "DISPLAY (2)" and press the ENTER key. The DISPLAY (2) menu screen appears. This screen lets you make settings for Y axis scale and Y value (rms/amplitude) to be used for power spectrum, cross power spectrum, or transfer graph display.



DISPLAY (2) menu screen

Parameter input

Use the ▲ and ▼ keys to move the highlight cursor to the item you want to set, and then use the ◀ and ▶ keys to change the parameter. Press the ENTER key to confirm the setting.

To return to the main menu, press the MENU key. Pressing the MENU key again returns to the measurement screen.

Y axis scale (Y-AXIS) setting

Setting options: LIN, dB

LIN	:	A linear coordinate system is used. Data are shown as voltage value [V] or Engineering Units [EU].
dB	:	A dB coordinate system is used. Power spectrum (SPEC), cross power spectrum (XSPEC), and transfer function (TRANS) data are shown as voltage level [dB] or Engineering Unit level [dB EU] after logarithmic conversion.

Note
The Y axis for time waveform (TIME), phase (PHASE), and coherence (COH) is always linear, regardless of this setting.

Y value (rms/amplitude) setting (for power spectrum and cross power spectrum)

Setting options: RMS, 0-PEAK

RMS : Power spectrum (SPEC), cross power spectrum (XSPEC) Y value data are shown as effective (rms) value.

Vr : Vrms

dBr : Decibel unit referenced to 1 Vrms (effective value)

0-PEAK : Y value data are shown as amplitude value (0-Peak). The amplitude value is $\sqrt{2}$ × rms.

V : Amplitude value (0-Peak)

dB : Decibel unit referenced to 1 V (amplitude value)

Note
The Y value for time waveform (TIME), phase (PHASE), transfer function (TRANS) and coherence (COH) is not affected by this setting.

Window function setting

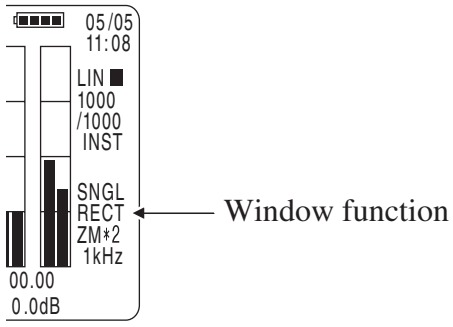
Selects the window function to apply to the sampled time waveform data.

Setting options: RECT, HANN, FTOP

RECT	:	Rectangular window
HANN	:	Hanning window
FTOP	:	Flat-top window

Use the WNDW key to make this setting.

Each push of the key cycles through the following settings: RECT → HANN → FTOP → ···.



Display screen (single-graph)

FFT zoom ratio and frequency range setting

FFT zoom ratio setting

Setting options: ×1, ×2, ×4, ×8, ×16

Use the ZOOM key to make this setting.

Each push of the key cycles through the following settings: ×1 → ×2 → ×4 → ×8 → ×16 → ×1 . . .

Frequency range setting

Setting options: 100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, 80 kHz

This setting determines the upper limit of the frequency range. The setting is made in the frequency range setting window.

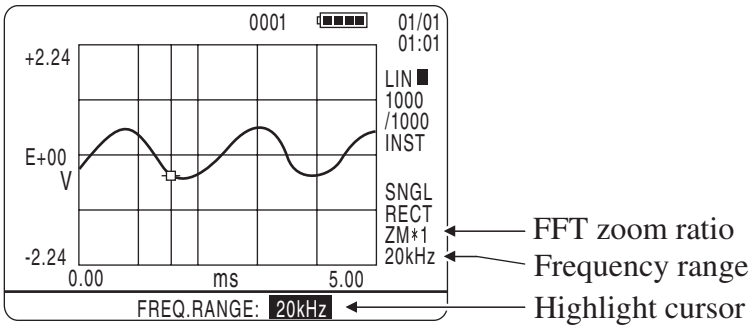
Press the FREQ.RANGE key to bring up the frequency range setting window.

Each push of the ▶ key cycles through the settings in the following order: 100 Hz → 200 Hz → 500 Hz → 1 kHz → 2 kHz → 5 kHz → 10 kHz → 20 kHz → 50 kHz → 80 kHz.

Each push of the ◀ key cycles through the settings in the opposite order.

To close the frequency range setting window, press the FREQ. RANGE key again.

Display example



Frequency range setting window

The relation between the frequency range (Fc), A/D conversion sampling frequency (Fs), and sampling cycle (Δt) is as expressed below.

$Fs = 2.56 \times Fc \quad \Delta t = 1/Fs$

(When Fc = 80 kHz, Fs = 2.4 × Fc = 192 kHz)

Input signal sampling is performed according to this principle, but the number of sampling points (Ns) per frame of display data and the number of spectrum lines (N_L) obtained by the FFT process is determined by the FFT zoom ratio (k).

FFT zoom ratio (k)	Number of sampling points (Ns)	Number of spectrum lines (N_L)
1	256	101 (108 when Fc = 80 kHz)
2	512	201 (215 when Fc = 80 kHz)
4	1024	401 (429 when Fc = 80 kHz)
8	2048	801 (857 when Fc = 80 kHz)
16	4096	1601 (1713 when Fc = 80 kHz)

The frame time (Tk) is determined by the number of sampling points (Ns) and the sampling cycle (Δt).

$Tk = Ns \times \Delta t$

The basic frequency resolution (Rk) is determined by the Frequency range (Fc) and the number of spectrum lines (N_L).

$Rk = Fc / (N_L - 1)$

A compilation of the above relations for the various frequency range settings is given in the table on the following page. Because the frame time and frequency resolution are determined by the FFT zoom ratio and the frequency range, suitable values must be chosen for the intended analysis target and the measurement purpose.

Frame time and frequency resolution at each frequency range

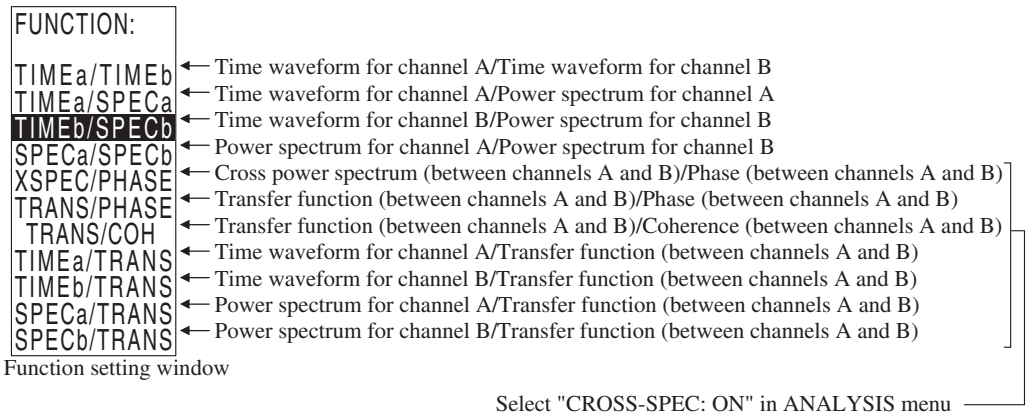
Frequency range Fc (Hz)	Sampling frequencies Fs (Hz)	Sampling cycle Δt (μs)	Frame time Tk (ms)*					Frequency resolution Rk (Hz)*				
			T1	T2	T4	T8	T16	R1	R2	R4	R8	R16
80 k	192 k	5.20833	1.33	2.67	5.33	10.67	21.33	750	375	188	93.75	46.875
50 k	128 k	7.8125	2	4	8	16	32	500	250	125	62.5	31.25
20 k	51.2 k	19.5312	5	10	20	40	80	200	100	50	25	12.5
10 k	25.6 k	39.0625	10	20	40	80	160	100	50	25	12.5	6.25
5 k	12.8 k	78.125	20	40	80	160	320	50	25	12.5	6.25	3.125
2 k	5.12 k	195.312	50	100	200	400	800	20	10	5	2.5	1.25
1 k	2.56 k	390.625	100	200	400	800	1600	10	5	2.5	1.25	0.625
500	1.28 k	781.25	200	400	800	1600	3200	5	2.5	1.25	0.625	0.3125
200	512	1953.12	500	1000	2000	4000	8000	2	1	0.5	0.25	0.125
100	256	3906.25	1000	2000	4000	8000	16000	1	0.5	0.25	0.125	0.0625

* The "k" in Tk and Rk indicates the FFT zoom ratio.

Function setting

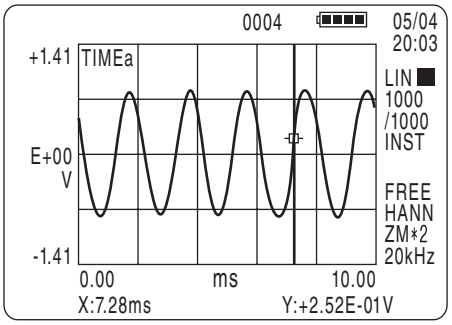
The type of function graph shown on the display is set with the function setting window. There are two types of graph display screens: single-graph display and dual-graph display.

1. Press the FUNC. key to bring up the function setting window.
2. Use the ▲ and ▼ keys to select the function display.
   If CROSS-SPEC is set to ON in the ANALYSIS menu, the cross power spectrum (XSPEC), phase (PHASE), transfer function (TRANS), and coherence (COH) between channels A and B can be selected. When CROSS-SPEC is set to OFF, these functions cannot be selected.



3. To close the function setting window, press the FUNC. key again.

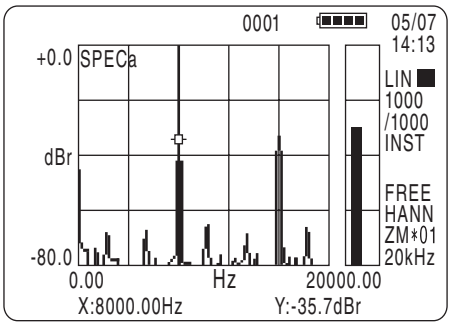
Time waveform (TIME)



X axis display unit : ms

Y axis display unit : V (amplitude value)
EU for Engineering Units

Power spectrum (SPEC)



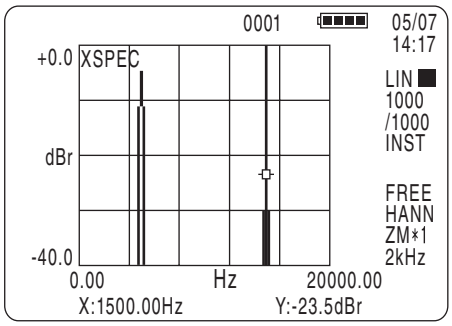
X axis display unit : Hz

Y axis display unit : V (amplitude value) or Vr (rms) for linear display
dB (0 dB = 1 V) or dBr (0 dB = 1 Vrms) for decibel display
EU, EUr, dB EU, or dB EUr for Engineering Units

Cross power spectrum, phase, transfer function, coherence

The function display is for the interrelation between channels A and B. Before using these functions, set CROSS-SPEC in the ANALYSIS menu to ON and select the reference channel with REF-CH.

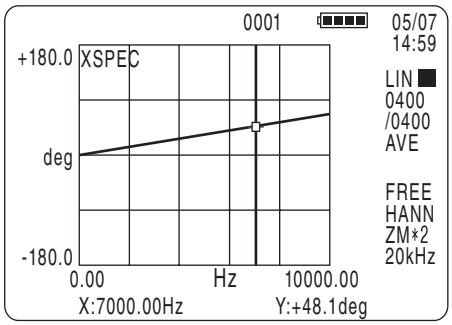
Cross power spectrum (XSPEC)



X axis display unit : Hz

Y axis display unit : V^2 (squared amplitude value) or Vr^2 (squared rms value) for linear display
dB (0 dB = 1 V)^2 or dBr (0 dB = 1 Vrms)^2 for decibel display
EU^2, EUr^2, dB EU, or dB EUr for Engineering Units

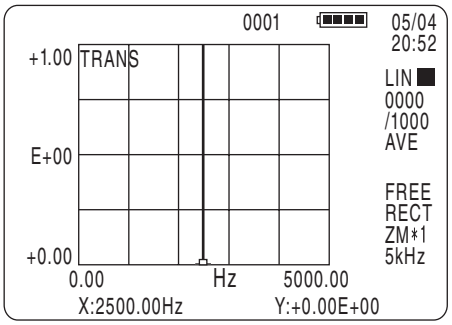
Phase (PHASE)



X axis display unit : Hz

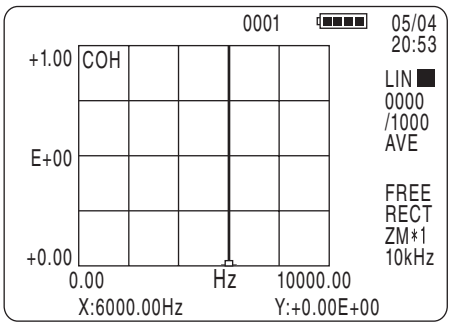
Y axis display unit : deg (degrees)

Transfer function (TRANS)



X axis display unit : Hz
Y axis display unit : No indication for linear display
dB for decibel display

Coherence (COH)



X axis display unit : Hz
Y axis display unit : No indication

Cursor operation

Cursor movement

You can move the cursor to any point in the graph and read the X value and Y value for that point.

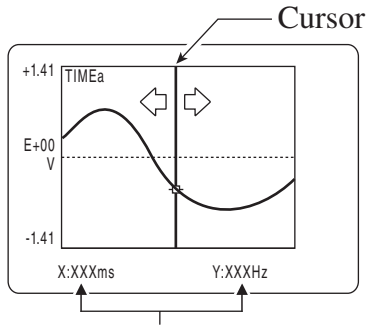
To move the cursor, use the CURSOR key and the ▼, ▲, ◀, ▶ keys. However, make sure that the SCALE key is not activated.

Note
When you press the SCALE key, the ▼, ▲, ◀, ▶ keys serve to zoom or move the display area. (see pages 81, 82 and 87.)

Up to two cursors can be displayed on the screen. When single-graph display is selected, both cursors are shown in the same graph. When dual-graph display is selected, there is one cursor each in the top graph and the bottom graph.

Single-graph display

(1) One cursor

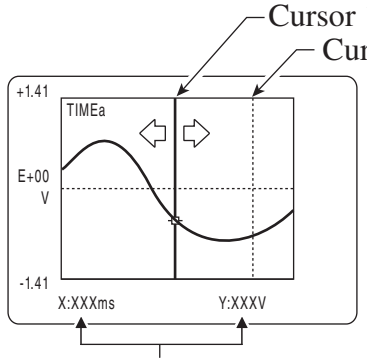


Cursor values (X value, Y value)

One solid-line cursor is shown.
Use the ◀ and ▶ keys to move the cursor.

CURSOR key pressed

(2) Two cursors (separate movement)

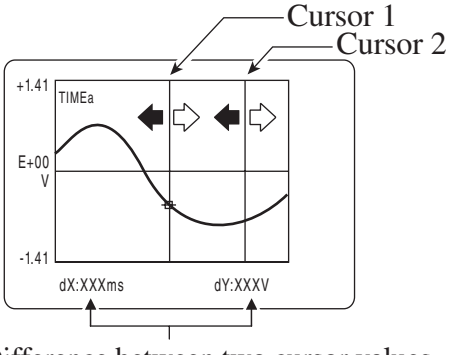


Solid-line cursor values (X value, Y value)

One solid-line cursor and one broken-line cursor are shown.
Use the ◀ and ▶ keys to move the solid-line cursor.
The broken-line cursor does not move.
Use the ▲ and ▼ keys to select the cursor. The selected cursor is shown as a solid line.

CURSOR key pressed

(3) Two cursors (linked movement)



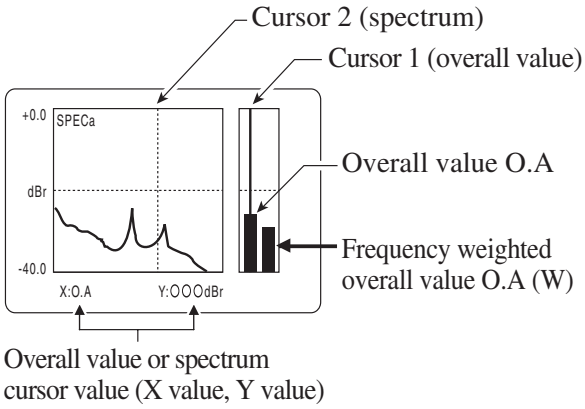
Difference between two cursor values (dX value, dY value)

Two cursors are shown.
Use the ◀ and ▶ keys to move the two cursors.

CURSOR key pressed

(Power spectrum)

(4) Two cursors (one for overall value and one for spectrum) (separate movement)



One cursor each is shown for overall value and for spectrum (solid line and broken line).

Use the ◀ and ▶ keys to move the solid-line cursor.

The broken-line cursor does not move.

Use the ▲ and ▼ keys to select the cursor (overall value cursor or spectrum cursor).

The selected cursor is shown as a solid line, and its values can be read.

CURSOR key pressed

The display returns to "(1) One cursor".

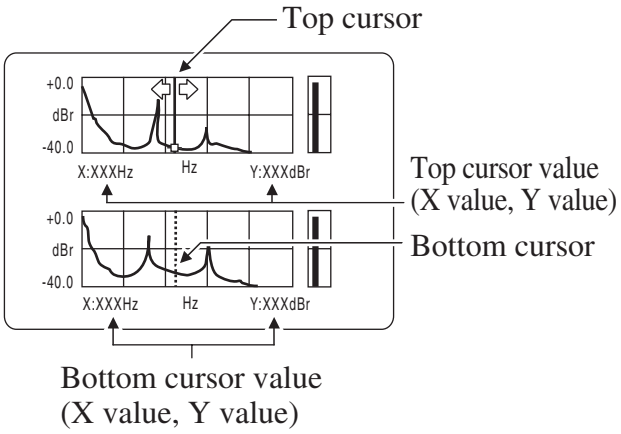
(Condition other than power spectrum)

The display returns to "(1) One cursor".

Note
Only when two cursors are linked on the single-graph display (condition (3)), the cursor value shown is the difference between the two cursor values (dX value, dY value).

Dual-graph display

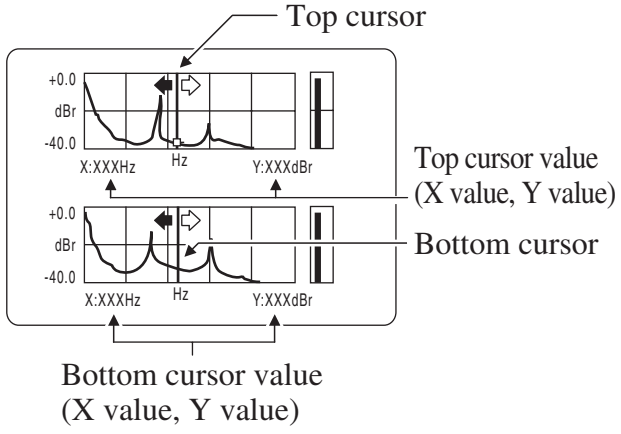
(1) Separate movement of top/bottom cursor



Two cursors are shown (solid line and broken line).
Use the ◀ and ▶ keys to move the solid-line cursor.
The broken-line cursor does not move.
Use the ▲ and ▼ keys to select the cursor (switch between the two cursors). The selected cursor is shown as a solid line.

CURSOR key pressed

(2) Linked movement of top/bottom cursor



Two cursors are shown (both as solid lines).
Use the ◀ and ▶ keys to move the two cursors.

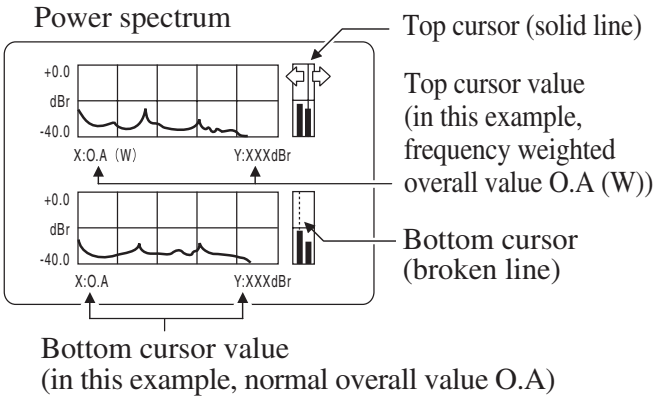
CURSOR key pressed

Go to appropriate section on next page.

(One of the graphs is power spectrum)

(3) Separate movement of top/bottom cursor

Both cursors (solid line and broken line) show the overall value.



Use the ◀ and ▶ keys to select normal overall value (O.A) or frequency weighted overall value (O.A (W)). The solid-line cursor will move.

Use the ▲ and ▼ keys to select the cursor (switch between the two cursors). The selected cursor is shown as a solid line.

⇩ CURSOR key pressed

The display returns to "(1) Separate movement of top/bottom cursor".

(None of the graphs is power spectrum)

The display returns to "(1) Separate movement of top/bottom cursor".

Note

When dual-graph display is used and one of the functions "TIMEa/SPECa", "TIMEb/SPECb", "TIMEa/TRANS", "TIMEb/TRANS" is selected, linked movement of top and bottom cursor (both cursors as solid lines) is not available.

When X axis display area was zoomed

When the cursor is positioned at the right end of the graph, pressing the ▶ key moves the X axis display area by one grid to the right. When the cursor is positioned at the left end of the graph, pressing the ◀ key moves the X axis display area by one grid to the left. For details, see the section "X axis zoom and display area shift" on page 81.

Cursor value units (X value, Y value) for readout in various functions

The cursor value (X value, Y value) readout units differ for the functions time waveform (TIME), power spectrum (SPEC), cross power spectrum (XSPEC), phase (PHASE), transfer function (TRANS), and coherence (COH).

Time waveform (TIME)

X value units : ms (time)

Y value units : V (amplitude voltage)

Example Y value : -2.46E-02V = -2.46×10^{-2} (V) = -0.0246 (V)

Power spectrum (SPEC)

X value units : Hz (frequency)

Y value units : When CALIBRATION MODE in CALIBRATION menu is set to OFF

- V : DISPLAY (2) menu settings: "Y-AXIS: LIN", "Y-VALUE: 0-PEAK"
- Vr : DISPLAY (2) menu settings: "Y-AXIS: LIN", "Y-VALUE: RMS"
- dB : DISPLAY (2) menu settings: "Y-AXIS: dB", "Y-VALUE: 0-PEAK"
- dBr : DISPLAY (2) menu settings: "Y-AXIS: dB", "Y-VALUE: RMS"

When CALIBRATION MODE in CALIBRATION menu is set to a setting other than OFF

- EU : DISPLAY (2) menu settings: "Y-AXIS: LIN", "Y-VALUE: 0-PEAK"
- EUr : DISPLAY (2) menu settings: "Y-AXIS: LIN", "Y-VALUE: RMS"
- dB EU : DISPLAY (2) menu settings: "Y-AXIS: dB", "Y-VALUE: 0-PEAK"
- dB EUr : DISPLAY (2) menu settings: "Y-AXIS: dB", "Y-VALUE: RMS"

Example Y value : +1.17E-01EU = $+1.17 \times 10^{-1}$ (EU) = 0.117 (EU)
EU stands for Engineering Unit.

Cross power spectrum (XSPEC)

X value units : Hz (frequency)

Y value units : When CALIBRATION MODE in CALIBRATION menu is set to OFF

- V^2 : DISPLAY (2) menu settings: "Y-AXIS: LIN", "Y-VALUE: 0-PEAK"
- Vr^2 : DISPLAY (2) menu settings: "Y-AXIS: LIN", "Y-VALUE: RMS"
- dB : DISPLAY (2) menu settings: "Y-AXIS: dB", "Y-VALUE: 0-PEAK"
- dBr : DISPLAY (2) menu settings: "Y-AXIS: dB", "Y-VALUE: RMS"

When CALIBRATION MODE in CALIBRATION menu is set to a setting other than OFF

- EU^2 : DISPLAY (2) menu settings: "Y-AXIS: LIN", "Y-VALUE: 0-PEAK"
- EUr^2 : DISPLAY (2) menu settings: "Y-AXIS: LIN", "Y-VALUE: RMS"
- dB EU : DISPLAY (2) menu settings: "Y-AXIS: dB", "Y-VALUE: 0-PEAK"
- dB EUr : DISPLAY (2) menu settings: "Y-AXIS: dB", "Y-VALUE: RMS"

Example Y value : +1.01E+01Vr^2 = $+1.01 \times 10^{1}$ (Vr^2) = 10.1 (Vr^2)
Vr stands for voltage rms.

Phase (PHASE)

X axis display unit : Hz (frequency)

Y axis display unit : deg (degrees)

Transfer function (TRANS)

X value units : Hz (frequency)

Y value units : When CALIBRATION MODE in CALIBRATION menu is set to OFF

- None : DISPLAY (2) menu settings: "Y-AXIS: LIN"
- dB : DISPLAY (2) menu settings: "Y-AXIS: dB"

When CALIBRATION MODE in CALIBRATION menu is set to a setting other than OFF

- None : DISPLAY (2) menu settings: "Y-AXIS: LIN"
- dB : DISPLAY (2) menu settings: "Y-AXIS: dB"

Coherence (COH)

X axis display unit : Hz (frequency)

Y axis display unit : None

X axis zoom and display area shift

Display area zoom

You can press the SCALE key to activate the scaling function and then use the ◀ and ▶ keys to enlarge or reduce the display area on the X axis.

Note
When you press the SCALE key, the values for the upper and lower limit of the graph are shown in reverse. This indicates that scaling is possible.

1. Press the SCALE key.
2. Use the ▶ key to cause enlargement (zoom-in) of the display area on the X axis.
   Use the ◀ key to cause reduction (zoom-out) of the display area on the X axis.

Display zoom ratio

The display zoom ratio is determined by the FFT zoom ratio and the type of function display data, as shown in the table below. Each push of the ▶ key increases the zoom ratio by one step.

Time waveform (TIME)

FFT zoom ratio	X axis (ms) zoom ratio
× 1	× 1 → × 2
× 2	× 1 → × 2 → × 4
× 4	× 1 → × 2 → × 4 → × 8
× 8	× 1 → × 2 → × 4 → × 8 → × 16
× 16	× 1 → × 2 → × 4 → × 8 → × 16 → × 32

Power spectrum (SPEC), cross power spectrum (XSPEC), phase (PHASE), transfer function (TRANS), coherence (COH)

FFT zoom ratio	X axis (Hz) zoom ratio
× 1	× 1
× 2	× 1 → × 2
× 4	× 1 → × 2 → × 4
× 8	× 1 → × 2 → × 4 → × 8
× 16	× 1 → × 2 → × 4 → × 8 → × 16

Each push of the ◀ key decreases the zoom ratio by one step.

Display area zoom operation example

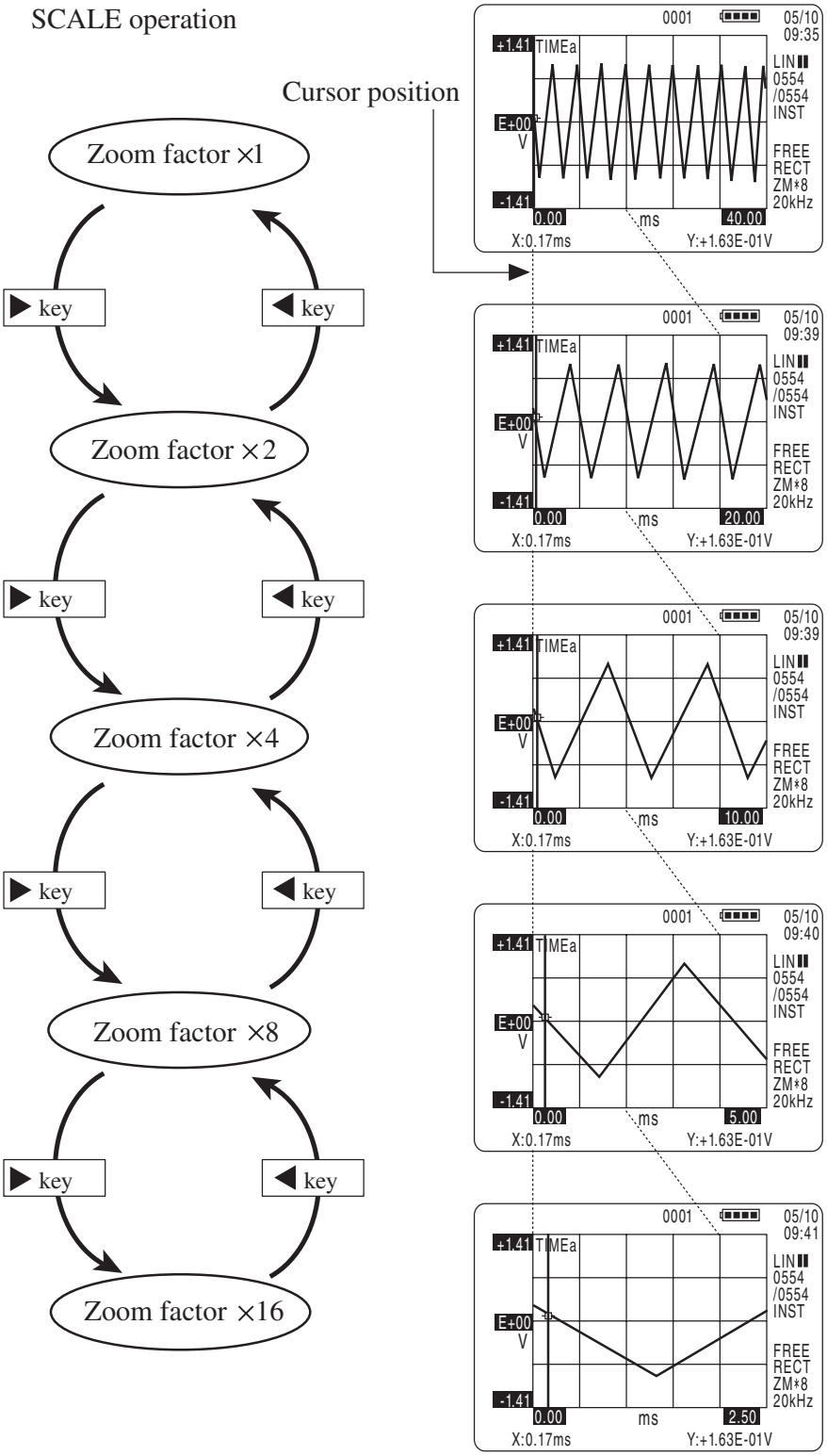
Assuming that time waveform (TIME) is selected, frequency range is 20 kHz, and FFT zoom setting is ×8, the display area can be zoomed up to ×16 (see table on page 81 and 82).

1. Press the SCALE key to activate the scaling function. The values for the upper and lower limit of the graph are shown in reverse.
2. According to the FFT zoom ratio, pressing the ▶ key changes the ratio in the following order: ×1 → ×2 → ×4 → ×8→ ×16.
3. Pressing the ◀ key changes the ratio in the following order: ×16 → ×8 → ×4 → ×2 → ×1.
4. When the desired zoom ratio is set, press the SCALE key again to deactivate the scaling function.

The next page shows the screen display examples for changing the display scale settings with the ◀ and ▶ keys.

Note
The X axis display area is enlarged from the cursor position. In the following examples, the cursor position is assumed to be at the left edge of the graph.

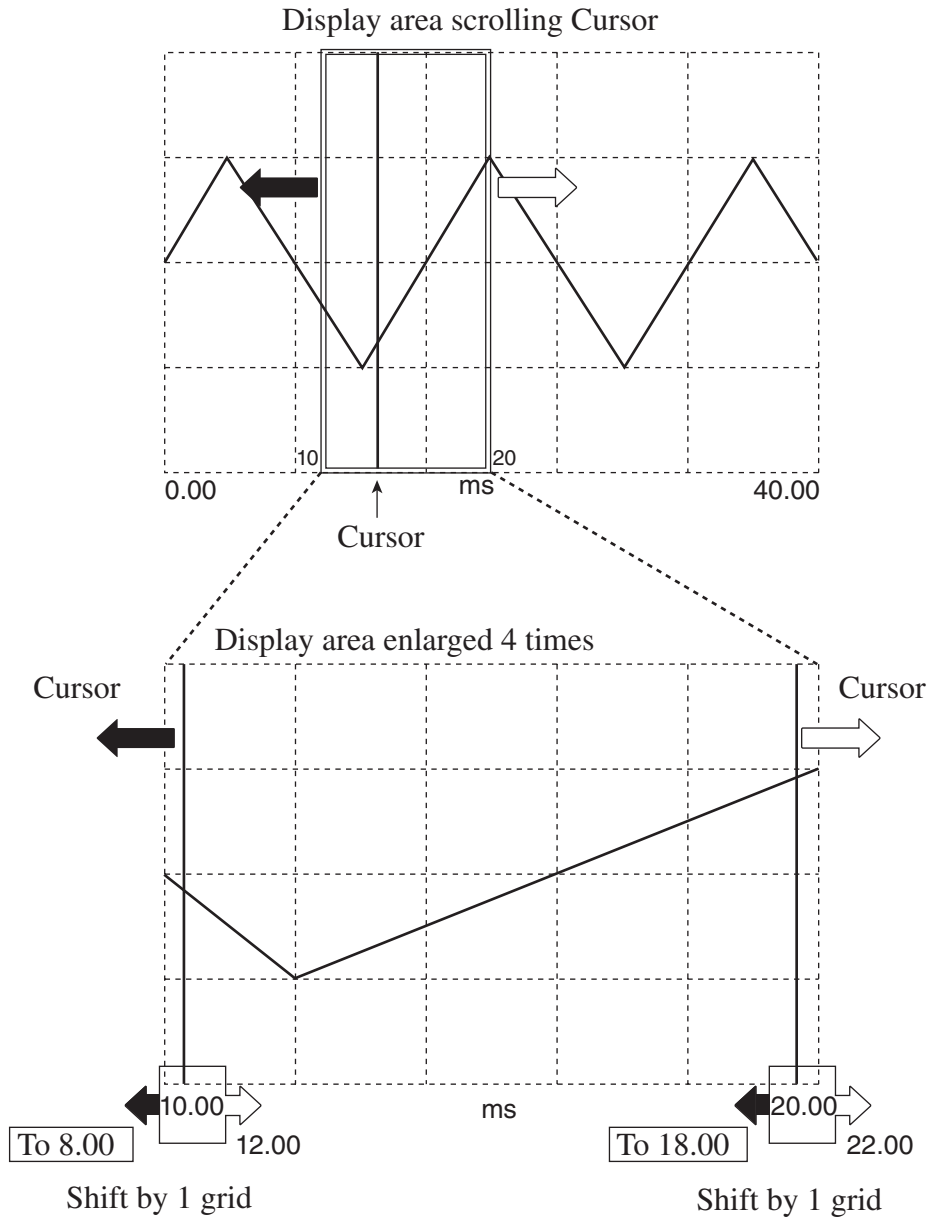
Examples of time waveform X axis display zoom



Display area shift

When the display has been zoomed to ×2 or higher, the graph cursor can be used to shift the display area along the X axis. Pressing the ▶ key moves the cursor to the right edge of the graph. Further pressing the ▶ key then moves the display by one grid (indicated by broken lines) to the right. In the same way, pressing the ◀ key moves the cursor to the left edge of the graph. Further pressing the ◀ key then moves the display by one grid to the left.

Example Time waveform, frequency range 20 kHz, FFT zoom ratio ×8



Y axis zoom and display area shift

Display area zoom

You can press the SCALE key to activate the scaling function and then use the ▲ and ▼ keys to enlarge or reduce the display area on the Y axis.

Note
When you press the SCALE key, the values for the upper and lower limit of the graph are shown in reverse. This indicates that scaling is possible.

1. Press the SCALE key.
2. Use the ▲ key to cause enlargement (zoom-in) of the display area on the Y axis.
   Use the ▼ key to cause reduction (zoom-out) of the display area on the Y axis.

Y axis zoom enlarges the display area only and it does not change the resolution.

Display zoom ratio

The display zoom ratio is determined by the type of function display data or Y axis scale settings. When Y axis scale is set to the linear, zoom ratio is shown in the table below. Each push of the ▲ key increases the zoom ratio by one step. (The scale of bottom value is always 0 and the top value is changed by the zoom ratio.)

Y axis scale is set to linear.

Display data (linear)	Display zoom ratio
Time waveform	×1 → ×2 → ×4 → ×8 → ×16 → ×32 → ×64 → ×128 → ×256 → ×512 → ×1024
Power spectrum	×1 → ×2 → ×4 → ×8 → ×16 → ×32 → ×64 → ×128 → ×256 → ×512 → ×1024
Cross power spectrum	×1 → ×2 → ×4 → ×8 → ×16 → ×32 → ×64 → ×128 → ×256 → ×512 → ×1024
Phase	×1
Transfer function	×1 → ×2 → ×4 → ×8 → ×16 → ×32 → ×64 → ×128 → ×256 → ×512 → ×1024
Coherence	×1

Display area zoom operation example

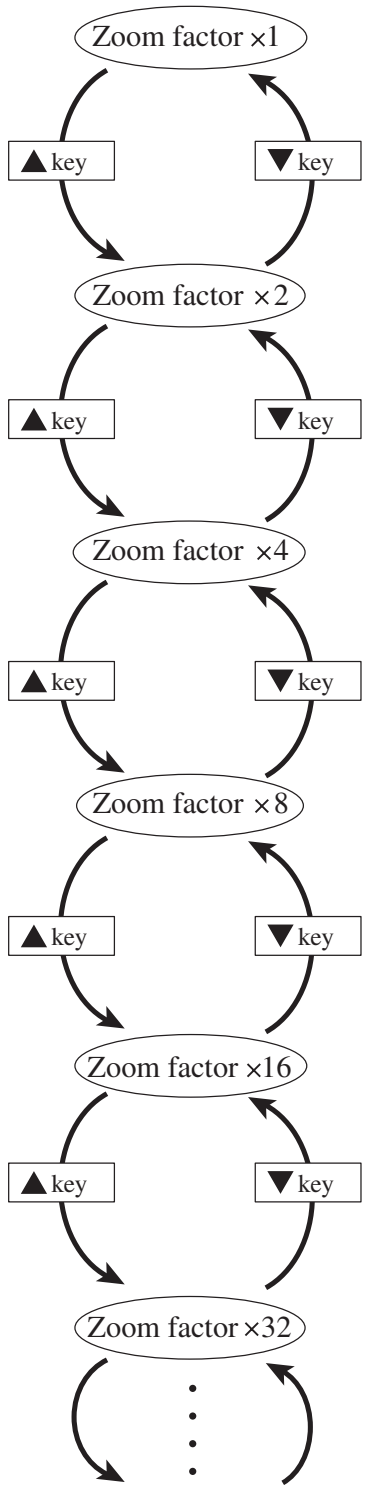
Assuming that time waveform (TIME) is selected, level range is 0 dB.
The display area can be zoomed up to ×1024 (see table on page 87).

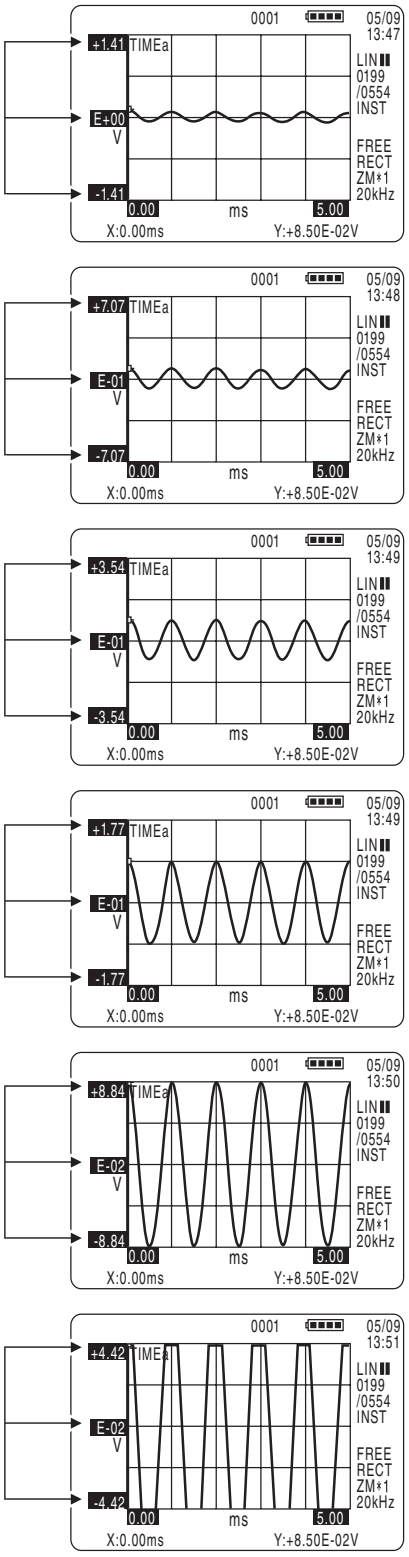
1. Press the SCALE key to activate the scaling function. The values for the upper and lower limit of the graph are shown in reverse.
2. Pressing the ▲ key changes the ratio in the following order: ×1 → ×2 → ×4 → ×8 → ×16 → ×32 → ×64 → ×128 → ×256 → ×512 → ×1024
3. Pressing the ▼ key changes the ratio in the following order: ×1024 → ×512 → ×256 → ×128 → ×64 → ×32 → ×16 → ×8 → ×4 → ×2 → ×1.
4. When the desired zoom ratio is set, press the SCALE key again to deactivate the scaling function.

Page 89 shows the screen display examples for changing the display scale settings with the ▲ and ▼ keys.

Examples of time waveform Y axis display zoom

SCALE operation





Display area shift

When the Y axis scale is set to dB (decibel) coordinates, the display area can be shifted. The display area can have a span of either 40 dB or 80 dB. As for enlargement, to move the display area, use the SCALE key and then the ▲ and ▼ keys.

When power spectrum (SPEC), cross power spectrum (XSPEC), or transfer function (TRANS) is selected and the Y axis scale is set to dB (decibel) coordinates, the ▲ and ▼ keys and the display range key have the following relationship.

▲ key: Shifts the display area over a 40 dB span

▼ key: Shifts the display area over an 80 dB span

Note
For time waveform (TIME), phase (PHASE), and coherence (COH), the Y axis scale is linear and display area shift is not available.

Display area shift procedure (for power spectrum)

The display area for the power spectrum graph depends on the selected level range.

Display area range is 40 dB

When the scaling function is enabled, each push of the ▲ key shifts the display area on the Y axis by a 40 dB span.

There are two modes for the display area range (graph lower limit - upper limit).

- (level range - 40 dB) to (level range)
- (level range - 20 dB) to (level range +20 dB)

For example, when the level range setting is 0 dB, the display range is "-40 dB to 0 dB" or "-20 dB to +20 dB". Each push of the ▲ key toggles between these two settings.

Display area range is 80 dB

When the scaling function is enabled, each push of the ▼ key shifts the display area on the Y axis by an 80 dB span.

There are seven modes for the display area range (graph lower limit - upper limit).

- (level range - 80 dB) to (level range 0 dB)
- (level range - 60 dB) to (level range +20 dB)
- (level range - 40 dB) to (level range +40 dB)
- (level range - 160 dB) to (level range -80 dB)
- (level range - 140 dB) to (level range -60 dB)
- (level range - 120 dB) to (level range -40 dB)
- (level range - 100 dB) to (level range -20 dB)

For example, when the level range setting is 0 dB, the display range is "-80 dB to 0 dB", "-60 dB to +20 dB" or "-40 dB to +40 dB"or "-160 dB to -80 dB"or "-140 dB to -60 dB"or "-120 dB to -40 dB"or "-100 dB to -20 dB". Each push of the ▼ key cycles through these settings.

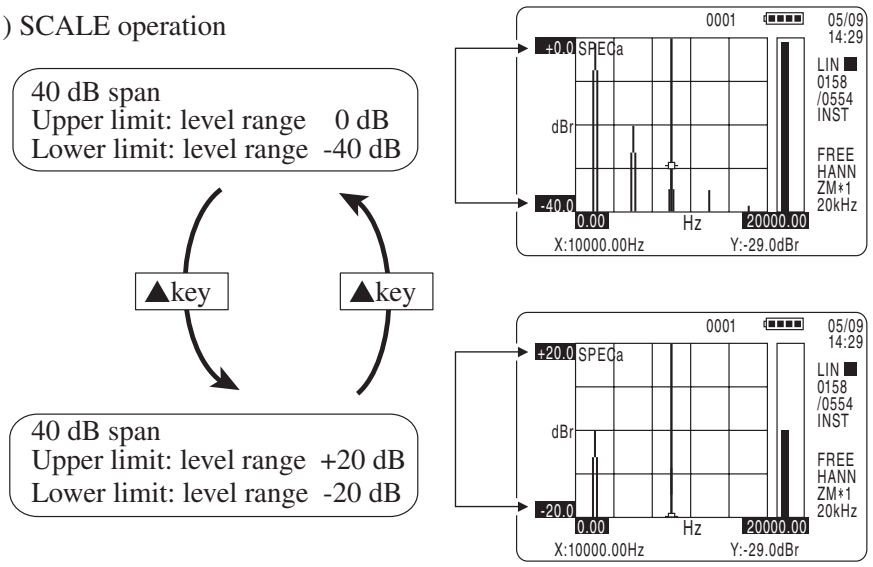
Note
When cross power spectrum is selected, the graph upper limit changes depending on the level range selected for channel A and B. When transfer function is selected, the graph upper limit changes depending on the level range selected for channel A and B and the reference channel setting.

The relation between ▲ and ▼ keys operation and the display span, as well as display area shift examples are shown below.

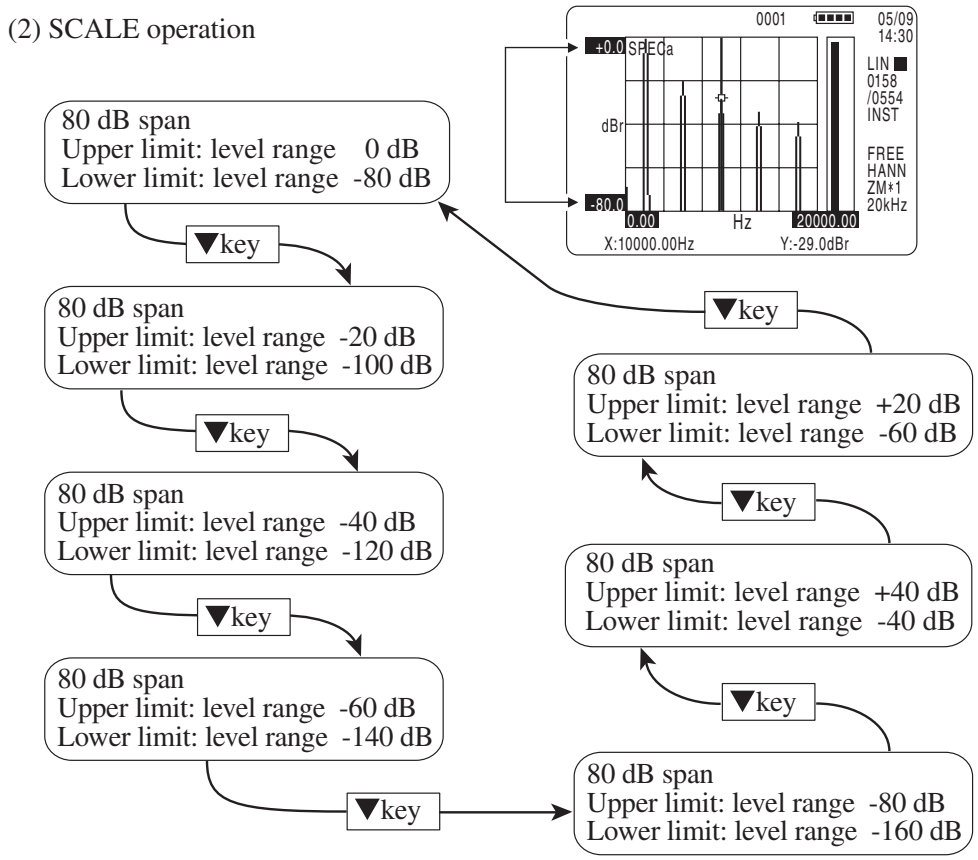
Power spectrum Y axis display area shift example (dB indication)

(Level range 0 dB)

(1) SCALE operation



(2) SCALE operation



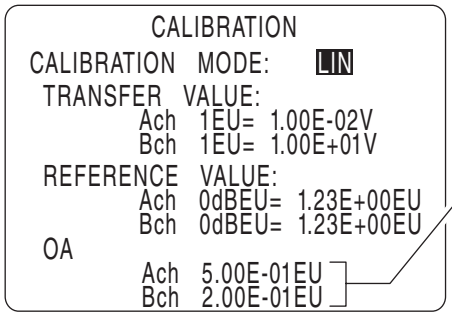
Calibration

Display value calibration is performed either with a microphone/accelerometer connected directly or via a preamplifier, or while supplying the calibration signal from a sound level meter or vibration meter or similar to the SA-78. Engineering Units [EU] are used for calibration.
Settings for calibration are made from the CALIBRATION menu.

Opening the CALIBRATION menu screen

Press the MENU key to bring up the main menu screen.

Use the ▲ and ▼ keys to move the highlight cursor to "CALIBRATION" and press the ENTER key. The CALIBRATION menu screen appears. This screen lets you make the settings for calibration of the unit.



Overall value O.A reflecting the calibration settings is shown. This is not the frequency weighted overall value O.A (W).

CALIBRATION menu screen

Parameter input

Use the ▲ and ▼ keys to move the highlight cursor to the item you want to set, and then use the ◀ and ▶ keys to change the parameter. Press the ENTER key to confirm the setting.

To return to the main menu, press the MENU key. Pressing the MENU key again returns to the measurement screen.

CALIBRATION MODE setting

Setting options: OFF, LIN, dB

OFF	:	Engineering Units [EU] are not used.
LIN	:	Engineering Unit [EU] calibration is performed by conversion from voltage value [V].
dB	:	Engineering Unit level [dB EU] calibration is performed by conversion from voltage level [dB V].

Calibration mode can be set to LIN (linear) or dB (decibel).

When LIN is selected, a calibration value corresponding to 1 EU is input as a voltage value (V) for calibration.

For example, when using a vibration accelerometer whose sensitivity is given as a voltage value (mV/(m/s^2)), select LIN.

When dB is selected, a calibration value corresponding to 0 dB EU is input as a voltage level for calibration.

For example, when using a microphone whose sensitivity is given as a voltage level "** dB (re. 1 V/Pa)", select dB.

Entering the calibration value (TRANSFER VALUE)

(1) When LIN is selected as calibration mode

Enter the voltage value [V] corresponding to 1 Engineering Unit [EU]. This entry is made for each channel separately.

Ach : 1 EU = (m.mm) E (±nn) V

Bch : 1 EU = (m.mm) E (±nn) V

The input range is as follows.

m.mm: -9.99 to +9.99 nn: 0 to 37

For example, to input -0.029, the calculation is as follows.

$-0.029 = -2.90 \times 10^{-2}$

Therefore, enter "-2.90" for m.mm and "-02" for ±nn.

(2) When dB is selected as calibration mode

Enter the voltage level value "dB V (0 dB = 1 V)" corresponding to 0 Engineering Units [dB EU]. This entry is made for each channel separately.

Ach : 0 dB EU = (mmm.m) dB V

Bch : 0 dB EU = (mmm.m) dB V

The input range is as follows.

mmm.m: -999.9 to +999.9

Entering the Engineering Unit [EU] reference value (REFERENCE VALUE):

Enter the EU value that corresponds to 0 dB in the Engineering Unit system.

For example, the reference for sound pressure level is 2×10^{-5} [Pa], and the reference for vibration level (JIS) is 10^{-5}[m/s^2]. When LIN is selected as calibration mode and decibel display [dB EU] of the calibration value is not required, or when dB is selected as calibration mode and linear display [EU] of the calibration value is not required, enter the default "$1.00 \times E^{+00}$" as reference value.

Ach : 0 dB EU = (m.mm) E (±nn) EU
Bch : 0 dB EU = (m.mm) E (±nn) EU
The input range is as follows.
m.mm: -9.99 to +9.99
nn: 0 to 37

(1) When LIN is selected as calibration mode and the measurement value is displayed as dB

The decibel display value [dB EU] can be calculated as follows.

Decibel display value [dB EU]
= 20log (linear display value [EU]/REFERENCE VALUE [EU])

For example, for a sound pressure of 1 Pa, the sound pressure level in dB is

$20\log (1/(2 \times 10^{-5})) = 93.98$ [dB EU]

(2) When dB is selected as calibration mode and the measurement value is displayed as LIN

The linear display value [EU] in the Engineering Unit system can be calculated as follows.

Linear display value [EU]
= REFERENCE VALUE [EU]) $\times 10^{(\text{decibel display value [dB EU]}/20)}$

For example, for a vibration acceleration level of 100 dB (JIS), the vibration acceleration (m/s^2) in linear notation is

$10^{-5} \times 10^{(100/20)} = 1$ [EU]

Calibration procedure examples

Example 1 Microphone connected to SA-78

The following procedure describes how to calibrate the unit using the sensitivity level given in the calibration chart for a connected microphone.

1. Open the CALIBRATION menu (see page 46).
2. Set the CALIBRATION MODE to "dB".
3. For the TRANSFER VALUE parameter, enter the calibration value corresponding to 0 dB EU as a voltage level value (dB (re. 1 V/Pa)). Refer to the open circuit sensitivity (re. 1 V/Pa) given in the calibration chart of the microphone and the gain of preamplifire (dB), and calculate the entry value as follows.

   TRANSFER VALUE (calibration value: dB) =
   (sensitivity level) + (gain of preamplifire) - 94.0

   The table below shows the gain of preamplifire available for SA-78.

Preamplifire model	Gain (dB)
NH-17/17A	-0.5
NH-22	-0.8

   Example

   Sensitivity level given in calibration chart is -27.6 dB (re. 1 V/Pa).
   When NH-17A is used, the gain of preamplifire is -0.5 dB.
   The calculation is as follows:

   -27.6 + (-0.5) - 94.0 = -122.1

   Therefore, enter "-122.1" as the TRANSFER VALUE calibration parameter (dB).

4. To read the display after calibration as a linear EU indication, enter the reference value corresponding to 0 dB EU into the REFERENCE VALUE field as required. In this case, enter "$2.00 \times E^{-05}$" as reference value. When linear EU indication is not desired, enter the default value "$1.00 \times E^{+00}$".
5. After entering the calibration value and reference value, use a pistonphone to apply sound pressure to the microphone and check the post-calibration overall value.

Example 2 Piezoelectric accelerometer connected to SA-78 via vibration input adapter (VP-26C), or accelerometer with integrated preamplifier connected directly to SA-78

The following procedure describes how to calibrate the unit using the sensitivity value given in the calibration certificate for the connected accelerometer.

1. Open the CALIBRATION menu (see page 46).
2. Set the CALIBRATION MODE to "LIN".
3. For the TRANSFER VALUE parameter, enter the calibration value corresponding to 1 EU as a voltage value [V].
   When a piezoelectric accelerometer is connected via the vibration input adapter (VP-26C), take the charge sensitivity [pC/(m/s^2)] given in the calibration certificate of the accelerometer and enter it as voltage sensitivity [mV/(m/s^2)].
   When an accelerometer with integrated preamplifier is connected, enter the voltage sensitivity [mV/(m/s^2)] given in the calibration certificate.

   Example Piezoelectric accelerometer
   Charge sensitivity given in calibration certificate is 5.62 [pC/(m/s^2)]. Read this as voltage sensitivity 5.62 [mV/(m/s^2)], and enter "5.62 × E^{-03}" as the TRANSFER VALUE calibration parameter (LIN).
4. To read the display after calibration as a vibration acceleration level (JIS) with dB indication [dB EU], enter the reference value corresponding to 0 dB EU into the REFERENCE VALUE field as required. In this case, enter "1.00 × E^{-05}" as reference value. When dB indication is not desired, enter the default value "1.00 × E^{+00}".
5. After entering the calibration value and reference value, use a vibration calibrator to apply vibration to the accelerometer and check the post-calibration overall value.

Example 3 AC OUT of sound level meter connected to input of SA-78

The following procedure describes how to calibrate the display value of the SA-78, using the calibration signal from the sound level meter.

1. First, decide on the measurement level range of the sound level meter. Then use the DISPLAY (2) menu of the SA-78 to set Y-AXIS to "dB" and Y-VALUE to "RMS" (see page 45).
2. Set the sound level meter to calibration mode.
   Set the frequency range of the SA-78 according to the frequency of the sound level meter calibration signal. Set the level range of the SA-78 to a suitable setting so that the overload indication does not appear.
3. Open the CALIBRATION menu screen of the SA-78 (see page 46).
4. Set the CALIBRATION MODE to "dB".
5. Input the calibration signal of the sound level meter. With the TRANSFER VALUE (dB) setting at the default "0.0", record the overall value shown below the CALIBRATION menu screen.
6. Use the equation shown below to calculate the calibration value and enter the result as TRANSFER VALUE.

   TRANSFER VALUE (calibration value: dB)
   = (recorded overall value) - (sound level meter calibration [CAL] value)

   Example Assuming the sound level meter calibration [CAL] value is 94.0 dB, this signal is input to the SA-78. With the TRANSFER VALUE (dB) at the default "0.0", the overall value shown below the CALIBRATION menu screen reads "-6.0 dB EUr". The calculation is as follows:

   -6.0 - 94.0 = -100.0

   Therefore, enter "-100.0" as the TRANSFER VALUE (dB).
7. To read the display after calibration as a linear EU indication, enter the reference value corresponding to 0 dB EU into the REFERENCE VALUE field as required. In this case, enter "$2.00 \times E^{-05}$" as reference value. When linear EU indication is not desired, enter the default value "$1.00 \times E^{+00}$".
8. After calibration, check the post-calibration overall value.

Example 4 AC OUT of Vibration meter connected to input of SA-78

The following procedure describes how to calibrate the display value of the SA-78, using the calibration signal from the vibration meter.

1. Set the measurement mode to "Acceleration (ACC)" and detection characteristics to "RMS". First, decide on the measurement level range of the vibration meter. Then use the DISPLAY (2) menu of the SA-78 to set Y-AXIS to "LIN" and Y-VALUE to "RMS" (see page 45).
2. Set the vibration meter to calibration mode.
   Set the frequency range of the SA-78 according to the frequency of the vibration meter calibration signal. Set the level range of the SA-78 to a suitable setting so that the overload indication does not appear.
3. Open the CALIBRATION menu screen of the SA-78 (see page 46).
4. Set the CALIBRATION MODE to "LIN".
5. Input the calibration signal of the vibration meter. With the TRANSFER VALUE (LIN) setting at the default "1.00 × E^{+00}", record the overall value shown below the CALIBRATION menu screen.
6. Use the equation shown below to calculate the calibration value and enter the result as TRANSFER VALUE.

   TRANSFER VALUE (calibration value: LIN)
   = (recorded overall value) / (vibration meter calibration [CAL] value)

   Example Assuming the vibration meter calibration [CAL] value is 10 m/s^2 RMS, this signal is input to the SA-78. With the TRANSFER VALUE (LIN) at the default "1.00 × E^{+00}", the overall value shown below the CALIBRATION menu screen reads "2.0 EU". The calculation is as follows:

   2.0 / 10 = 0.2

   Therefore, enter "2.00 × E^{-01}" as the TRANSFER VALUE (dB).
7. To read the display after calibration as a vibration acceleration level (JIS) with dB indication [dB EU], enter the reference value corresponding to 0 dB EU into the REFERENCE VALUE field as required. In this case, enter "1.00 × E^{-05}" as reference value. When dB indication [dB EU] is not desired, enter the default value "1.00 × E^{+00}".
8. After calibration, check the post-calibration overall value.

Example 5 Accelerometer connected to SA-78 via vibration input adapter UA-03 and preamplifier NH-22

The following procedure describes how to calibrate the unit using the sensitivity value given in the calibration certificate for the connected accelerometer.

1. Open the CALIBRATION menu (see page 46).
2. Set the CALIBRATION MODE to "LIN".
3. For the TRANSFER VALUE parameter, enter the calibration value corresponding to 1 EU as a voltage value [V].

   When an accelerometer is connected via the vibration input adapter UA-03 and the preamplifier NH-22, compensation must be applied to the charge sensitivity [pC/(m/s^2)] given in the calibration certificate of the accelerometer, using values such as accelerometer capacitance, cable capacitance, and preamplifier gain. The result then must be read as the voltage sensitivity.

Example

Accelerometer with charge sensitivity of 5.62 [pC/(m/s^2)] (as given in calibration certificate) and capacitance of 720 pF is connected to preamplifier NH-22 (gain -0.3 dB) via a cable (capacitance 180 pF) and adapter UA-03. The TRANSFER VALUE then is calculated as follows.

Compensated charge sensitivity = charge sensitivity pC/(m/s^2)/accelerometer capacitance pF + cable capacitance pF × 10^ (preamplifier gain/20)
= 5.62/(720+180) × 10^ (-0.3/20)
= 6.03 × 10^{-3} pC/(m/s^2)
Consequently, enter 6.03 × E^{-03} as calibration value LIN for TRANSFER VALUE.

4. To read the display after calibration as a vibration acceleration level (JIS) with dB indication [dB EU], enter the reference value of "1.00 × E^{-5}" corresponding to 0 dB EU into the REFERENCE VALUE field. When dB (dB EU) indication is not desired, enter the default value "1.00 × E^{+00}".
5. After entering the calibration value and reference value, use a vibration calibrator to apply vibration to the accelerometer and check the post-calibration overall value.

Averaging Function

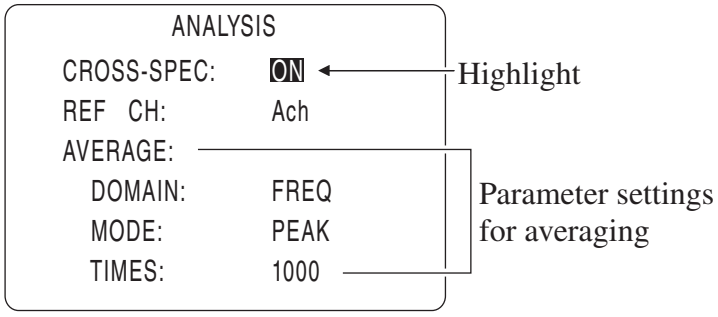
Parameter settings of averaging function

Settings for averaging function are made from the ANALYSIS menu.

Open ANALYSIS MENU screen

Pressing the MENU key brings up the MAIN MENU screen.

Use the ▲ and ▼ keys to move the highlight cursor to "ANALYSIS" and press the ENTER key. The ANALYSIS menu screen appears. This screen lets you make the settings for averaging function of the unit.



ANALYSIS menu screen

Parameter input

Use the ▲ and ▼ keys to move the highlight cursor to the item you want to set, and then use the ◀ and ▶ keys to change the parameter. Press the ENTER key to confirm the setting.

To return to the main menu, press the MENU key. Pressing the MENU key again returns to the measurement screen.

AVERAGING DOMAIN settings

Setting options: TIME, FREQ

TIME	:	Averaging is performed for TIME DOMAIN.
FREQ	:	Averaging is performed for FREQUENCY DOMAIN.

AVERAGING MODE setting

Setting options: LIN, EXP, PEAK

LIN: Linear averaging

EXP: Exponential averaging

Note
For time waveform (TIME), only LIN (linear averaging) can be selected.

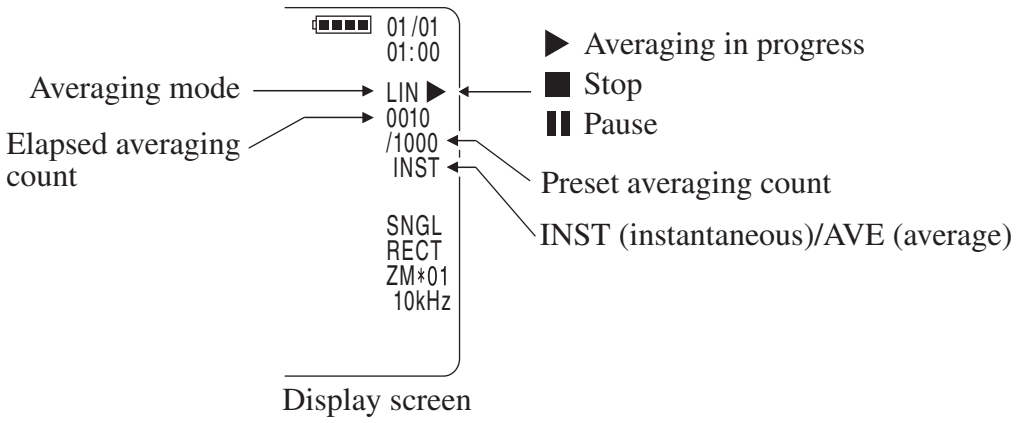
PEAK: Peak hold for frequency data of power spectrum (SPEC)

Note
PEAK (peak hold) can only be selected for power spectrum (SPEC). It is not available for time waveform (TIME), cross power spectrum (XSPEC), phase (PHASE), transfer function (TRANS), and coherence (COH).

AVERAGE TIMES setting

N = 1 to 8000: Sets the number of averaging runs. The effect of this setting differs according to the averaging mode, as shown in the table below.

Averaging mode	AVERAGE TIMES setting N: 1 to 8000
Linear averaging (LIN)	Number of frames for linear averaging $\overline{X_n} = \sum_{i=1}^{n} X_i / n$ (n: 1, 2, 3, ..., N) $\overline{X_n}$: Averaging data X_i: Instantaneous data
Exponential averaging (EXP)	Weighting for exponential averaging $\overline{X_n} = \overline{X_{n-1}} - (\overline{X_{n-1}} - X_n) / N$ $\overline{X_n}$: Averaging data X_i: Instantaneous data
Peak hold (PEAK)	Number of frames for peak hold $X_{PEAK\ HOLD}$ (n) is the maximum value of data (X_1, X_2, X_3, ..., X_n) in N frames.



Averaging processing and display of averaged data

To initiate averaging processing, press the START/STOP key. The previous averaging result is cleared, and averaging starts. To stop averaging processing, press the START/STOP key again.
Linear averaging and peak hold will stop automatically when the preset averaging count (AVERAGE TIMES) is reached. Exponential averaging is performed continuously, regardless of the averaging count setting.
You can use the PAUSE/CONT key to pause and resume processing.

The INST./AVE key can be used to switch between instantaneous data and averaged data. Each push of the key toggles between INST (instantaneous data) and AVE (averaged data).

Averaging processing table

(❍: Available × : Not available)

MODE	DOMAIN		
	Time domain	Frequency domain	
	Time waveform (TIME)	Power spectrum (SPEC)	Cross power spectrum (XSPEC), phase (PHASE), transfer function(TRANS), coherence (COH)
Linear averaging (LIN)	❍	❍	❍
Exponential averaging (EXP)	×	❍	❍
Peak hold (PEAK)	×	❍	×

When linear averaging (LIN) for the time domain is carried out, you can display the average value for the cross power spectrum (XSPEC), phase (PHASE), transfer function (TRANS), and coherence (COH) as calculated from the time waveform (TIME) average data.

Important

If one of the LEVEL RANGE, FREQ. RANGE, ZOOM, or WNDW keys is pressed after averaging processing is completed, an incorrect averaging result will be shown on the display. If the store operation is carried out in this condition, the incorrect averaging result will be stored. If one of these keys was pressed by mistake (meaning that the setting was changed), redo the averaging processing.

Note

After averaging processing, the SCALE key and ◀ and ▶ keys can be used to zoom in or out on the result. (The FFT zoom ratio must be set before processing.) For details, see "X axis zoom and display area shift" (page 81) in the "Basic Operation" section.

Trigger Function

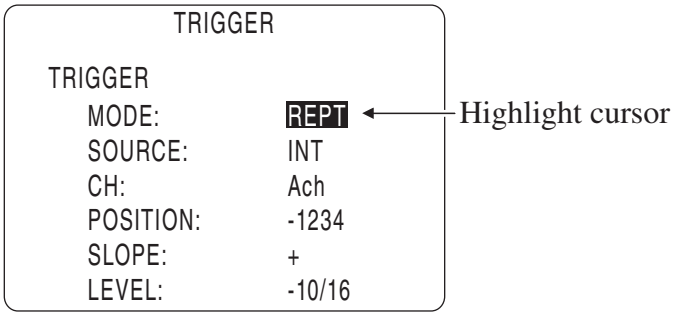
Parameter settings for trigger operation

Settings for trigger function are made from the TRIGGER menu.

Open TRIGGER menu screen

Pressing the MENU key brings up the main menu screen.

Use the ▲ and ▼ keys to move the highlight cursor to "TRIGGER" and press the ENTER key. The TRIGGER menu screen appears. This screen lets you make the settings for trigger function of the unit.



TRIGGER menu screen

Parameter input

Use the ▲ and ▼ keys to move the highlight cursor to the item you want to set, and then use the ◀ and ▶ keys to change the parameter. Press the ENTER key to confirm the setting.

To return to the main menu, press the MENU key. Pressing the MENU key again returns to the measurement screen.

TRIGGER MODE setting

Setting options: SNGL, REPT

SNGL : Single-event trigger

Pressing the TRIG. key sets the unit to the trigger standby mode. At the first occurrence of the trigger event, operation is triggered and analysis data are continuously updated afterwards. Subsequent trigger events are disregarded.

When the trigger function is used together with averaging, the first trigger event initiates averaging processing, and processing is carried out continuously afterwards. Subsequent trigger events are disregarded.

REPT : Repeated-event trigger

Each trigger event is detected. After trigger operation, the unit is in standby mode for the next trigger event.

When the trigger function is used together with averaging, the frame data at each trigger event are used as target for averaging processing. When the averaging count setting is N, trigger events are detected up to N times. After using the frame data at trigger event N for averaging processing, trigger operation stops.

Note
For more information on single-event trigger and repeated-event trigger, see "Trigger operation" on page 114.

TRIGGER SOURCE setting

Setting options: INT, EXT

INT : Internal trigger

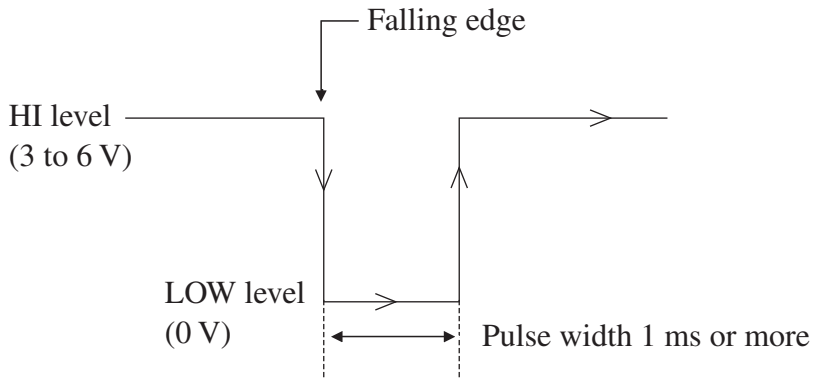
The input signal of the selected channel is used as trigger source. When this signal meets the preset trigger level and trigger slope conditions, a trigger event occurs.

EXT : External trigger

An external signal is used as trigger source. The falling edge of signal (LOW level for 1 ms or more) supplied to the TRIG IN connector causes a trigger event.

Note
For information on connecting a signal to the TRIG IN connector, refer to the "TRIG IN connector" section (page 24) in the chapter "Preparations".

External trigger input signal



Trigger channel (TRIGGER CH) setting

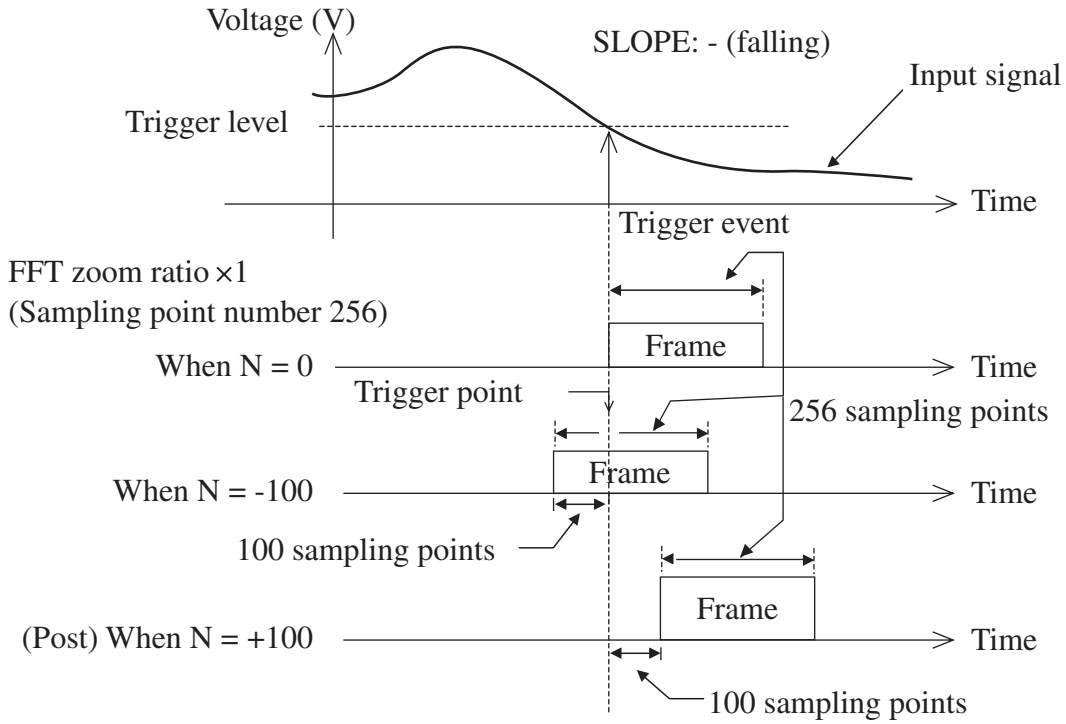
Setting options: Ach, Bch

When internal trigger source (INT) is selected, this parameter selects the channel to monitor.

TRIGGER POSITION setting

Setting options: N = -4096 (pre) to +4096 (post), increments of 1

Sets the time relation of the trigger point and the frame start point in number of sample points (N). When N is set to 0, the trigger point and frame start point are identical. A negative value for N results in pre-trigger operation, and a positive value in post-trigger operation. When averaging is performed, the point from which averaging data are handled is the sampling point specified by N.



The relation between trigger position N and the time according to the table on page 66 can be calculated as follows.

Time (μs) = sampling interval Δt (μs) × trigger position (N)

TRIGGER SLOPE setting

Setting options: +, -

When internal trigger source (INT) is selected, this parameter selects the slope type.

+	:	Trigger is activated at rising edge of input signal.
-	:	Trigger is activated at falling edge of input signal.

TRIGGER LEVEL setting

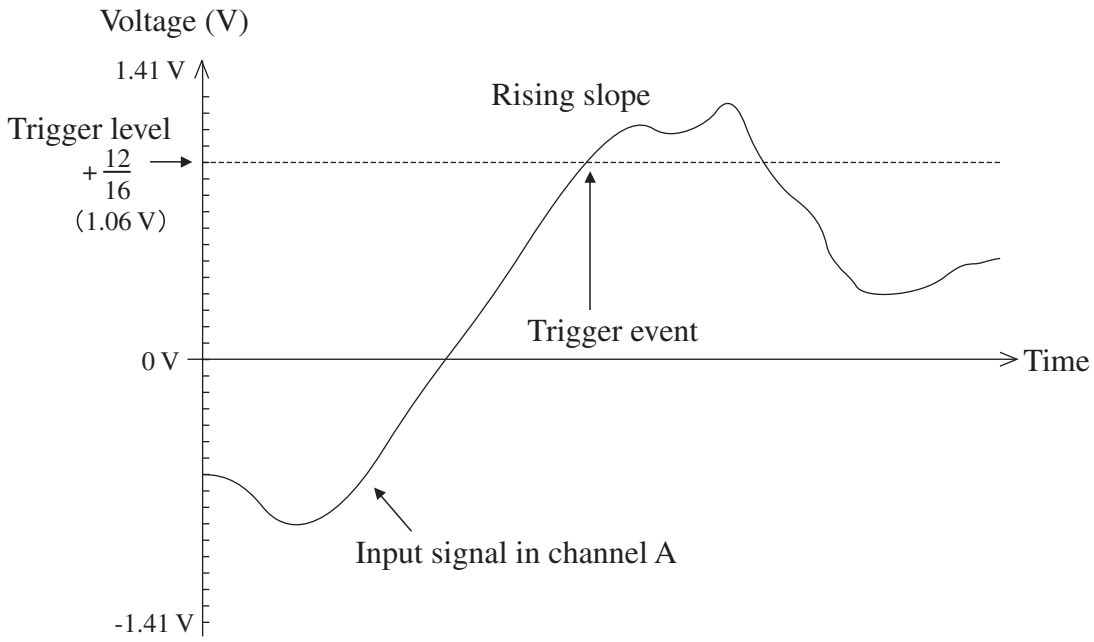
Setting options: -15/16 to +15/16, 1/16-steps

When internal trigger source (INT) is selected, this parameter sets the input signal level at which the trigger is activated.

Triggering occurs when the input signal level is ±n/16 of the selected level range (n: 0, 1, 2, · · · 15).

Trigger setting example

Level range	:	0 dB
SOURCE	:	INT
CH	:	Ach
POSITION	:	+0
SLOPE	:	+
LEVEL	:	+12/16



The trigger level setting voltage can be calculated according to the following equation.

Trigger level setting voltage
= level range full-scale value × (± n/16)

At the above trigger settings, this is
1.41 × (+12/16) = 1.06 V

Note
For information about the full-scale value of each level range, see page 60.

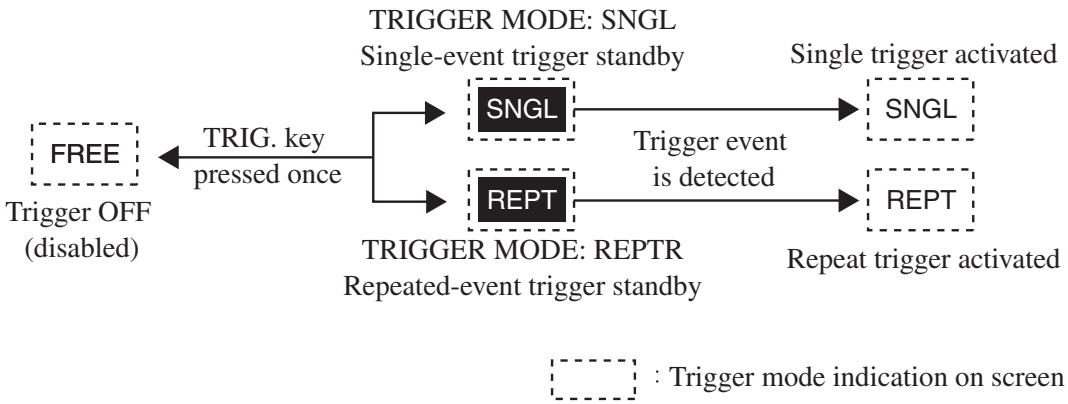
Trigger operation

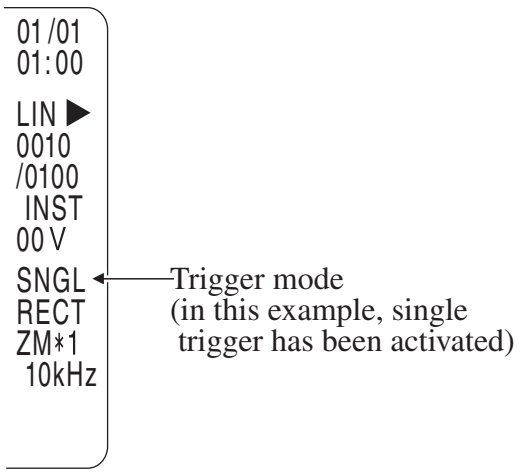
Trigger standby/activated/disabled (OFF)

After setting the trigger conditions on the TRIGGER menu screen, press the TRIG. key to set the unit to the trigger standby mode.
Pressing the TRIG. key again returns the unit to the trigger OFF condition.
Each push of the TRIG. key switches the trigger mode on the display screen as shown below.

FREE (trigger OFF) ⟷ SNGL (Single-event trigger standby)
REPT (Repeated-event trigger standby)

The trigger mode indication on screen changes as follows.

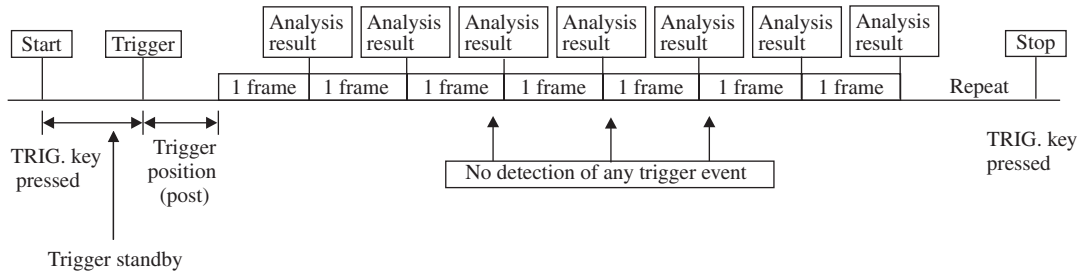




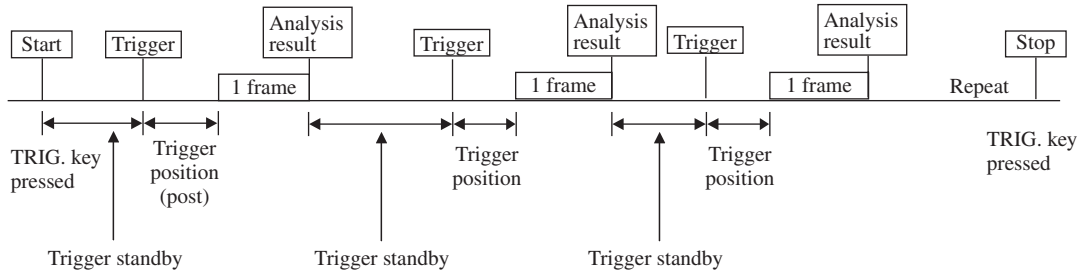
Display screen

Trigger operation: Instantaneous value (INST)

Trigger mode set to single trigger

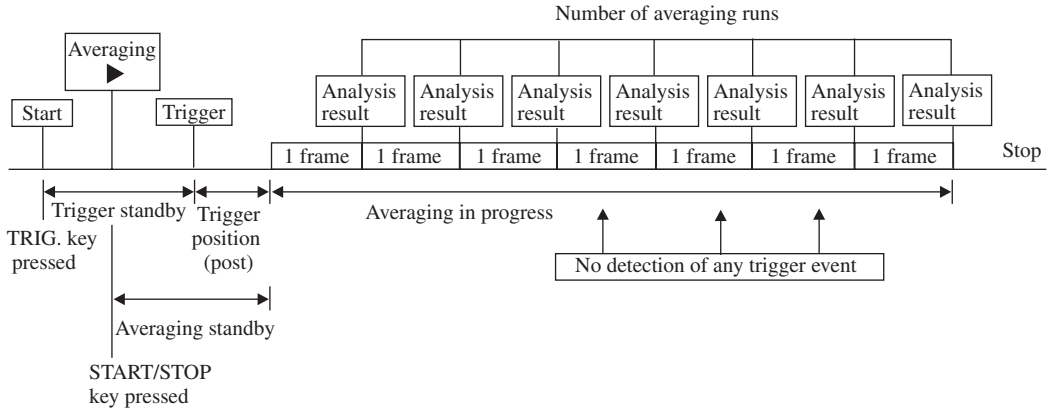


Trigger mode set to repeat trigger

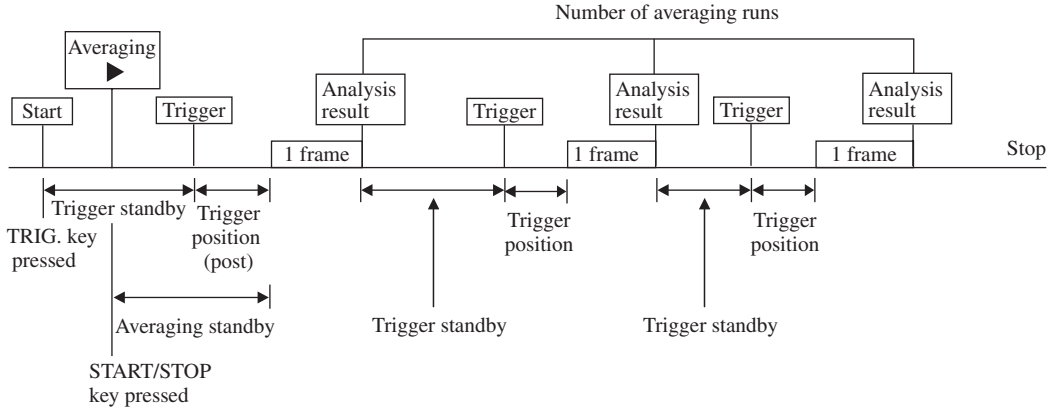


Trigger operation: Averaging (AVE)

Trigger mode set to single trigger



Trigger mode set to repeat trigger



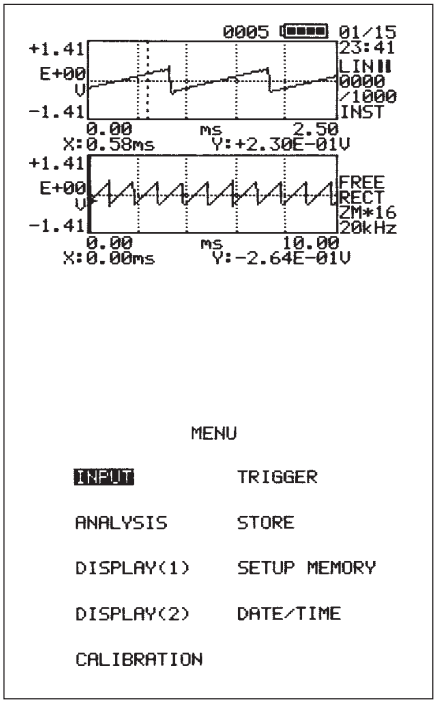
Note
When exponential averaging (EXP) is used, the number selected for AVERAGE TIMES on the ANALYSIS menu is not taken as the averaging count but as the weighting number. Processing is carried out continuously.

Printing

By connecting the printer DPU-414, CP-10, or CP-11 (optional), you can print out the currently displayed screen (analysis graph, menu screen, list display etc.).

1. Connect the SA-78 and the printer with a straight-wired RS-232C cable. For details, refer to the "Printer port" section (page 25) in the chapter "Preparations".
2. Set the printer switches. For details, see pages 26 to 27 in the chapter "Preparations" .
3. When you press the PRINT key, a hard copy of the current screen is printed. To stop printing, press the PRINT key again.

Sample printout



Note
The printer baud rate is fixed to 9600 bps.

Setting the Partial Overall Value

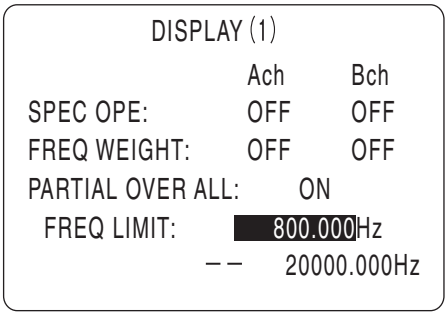
The SA-78 has a function for selecting a frequency range and then calculating the overall value within that range. The frequency range can be specified in two ways.

Specifying the frequency range by the DISPLAY (1) menu

Opening the DISPLAY (1) menu screen

Press the MENU key to bring up the main menu screen.

Use the ▲ and ▼ keys to move the highlight cursor to "DISPLAY (1)" and press the ENTER key. The DISPLAY (1) menu screen appears.



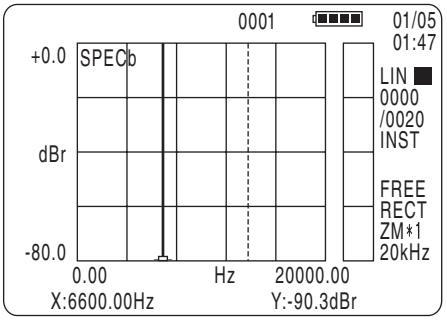
DISPLAY (1) menu screen

Frequency range setting

1. Use the ▲ and ▼ keys to move the highlight cursor to the "PARTIAL OVER ALL" parameter.
2. Use the ◀ and ▶ keys to select ON and press the ENTER key to confirm the setting.
3. Use the ▲ and ▼ keys to move the highlight cursor to the "FREQ LIMIT" parameter.
4. Use the ◀ and ▶ keys to set lower limit frequency and upper limit frequency respectively and press the ENTER key to confirm the setting.
5. Press the MENU key twice to returns to the measurement screen.

Specifying the range by displaying the single-graph power spectrum screen and using the two cursors

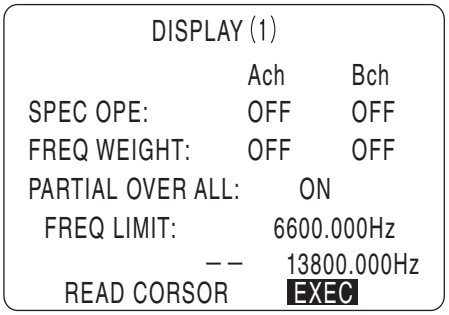
1. While the single-graph power spectrum screen is displayed, press the CURSOR key.
   A solid-line and a broken-line cursor are shown.



Single-graph power spectrum screen
(2 cursors)

2. Specify the frequency range with the two cursors.
   The solid-line cursor is the one that can be moved. You can change the target cursor with the ▲ and ▼ keys.
   Use the ◀ and ▶ keys to move the cursors to the desired frequency limits (lower and upper).
3. Open the DISPLAY (1) menu screen (see preceding page).
4. Use the ▲ and ▼ keys to move the highlight cursor to the "PARTIAL OVER ALL" parameter.
5. Use the ◀ and ▶ keys to select "ON" and press the ENTER key.
6. Use the ▲ and ▼ keys to move the highlight cursor to the "READ CURSOR" parameter.

7. Use the ◀ and ▶ keys to select "EXEC" and press the ENTER key. The frequency range specified by the two cursors is reflected by the "FREQ LIMIT" item which shows the lower and upper limits of the range.



DISPLAY (1) menu screen

8. Press the MENU key twice to return to the measurement screen.

Note
The partial overall setting is reflected by the bar graph in the left side of the overall value field. When FREQ WEIGHT is activated from the DISPLAY (1) menu, the frequency weighted overall value O.A (W) (bar graph in the right side of the overall value field) also reflects the setting.

Applying Frequency Weighting to Overall Value

After FFT processing, the frequency spectrum can be weighted for individual frequencies, with the result being reflected in the overall value. Three different frequency weighting characteristics can be selected: "A" weighting and two types of user-defined weighting characteristics (USER1 and USER2). To select the USER1 or USER2 settings, user-defined frequency compensation files must first be created in the WEIGHT folder on the memory card. These files must be named USER1.CSV and USER2.CSV, respectively.

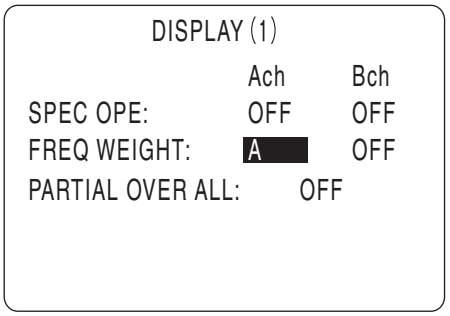
Note
For information on how to create these files, refer to the section "User-defined frequency weighting files" (page 143) in the chapter "Memory Card".

The frequency weighting setting for the overall value is made from the DISPLAY (1) menu.

Opening the DISPLAY (1) menu screen

Press the MENU key to open the main menu screen.

Use the ▲ and ▼ keys to move the highlight cursor to "DISPLAY (1)" and press the ENTER key. The DISPLAY (1) menu screen appears. Here you can set the FREQ WEIGHT item for channel A and B separately. This determines the overall value frequency weighting.



DISPLAY (1) menu screen

Selecting the frequency weighting (FREQ WEIGHT) setting

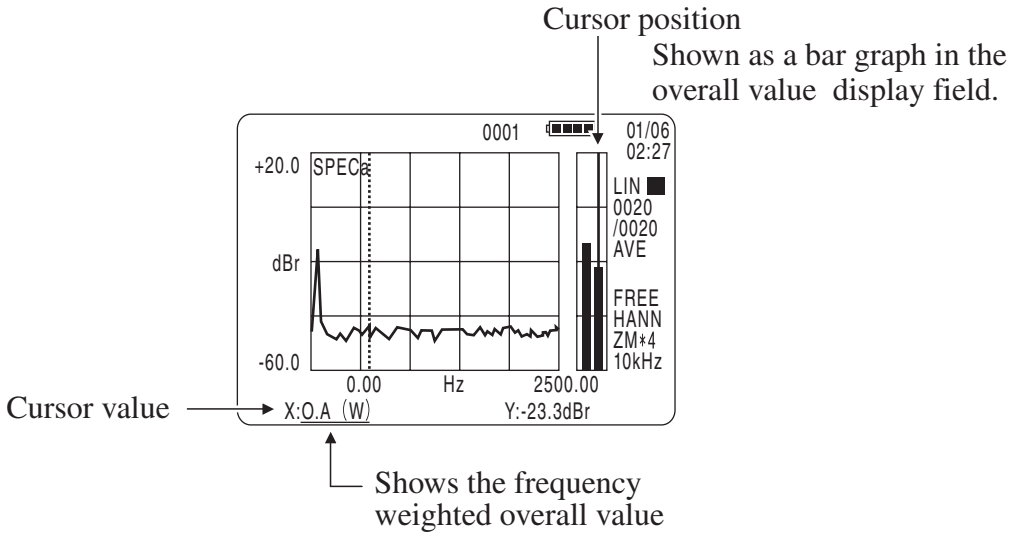
Setting options: OFF, A, USER1, USER2

OFF	:	No frequency weighting
A	:	"A" weighting characteristics
USER1	:	User-defined weighting characteristics 1
USER2	:	User-defined weighting characteristics 2

Make the desired setting for channel A and B.

1. Use the ▲ and ▼ keys to move the highlight cursor to the "FREQ WEIGHT" parameter. To make the setting for channel A, select "Ach". To make the setting for channel B, select "Bch".
2. Use the ◀ and ▶ keys to change the parameter setting.
   Each push of the ▶ key cycles through the following settings: OFF → A → USER1 → USER2. Pressing the ◀ key cycles through the settings in the reverse order.
3. Press the ENTER key to confirm the setting.
4. Press the MENU key twice to return to the measurement screen.

The frequency weighted overall value O.A (W) is shown as a bar graph in the right side of the overall value field. You can use the cursor to read the value. For information on cursor operation, refer to page 72.



Note
The frequency weighting is reflected only in the overall value. Frequency weighting has no influence on frequency spectrum processing, and the displayed frequency spectrum data therefore do not reflect frequency weighting.
Also when the 1/1 or 1/3 octave synthesized display is used, frequency weighting is not applied in any frequency band except for the overall value. (The 1/1 or 1/3 octave synthesized display uses the FFT results to create the display for each band. Internal frequency weighting processing is also applied to the FFT processing result but not to the result of the synthesis.)
When partial overall is selected, the frequency weighted overall value for the specified frequency range is output.

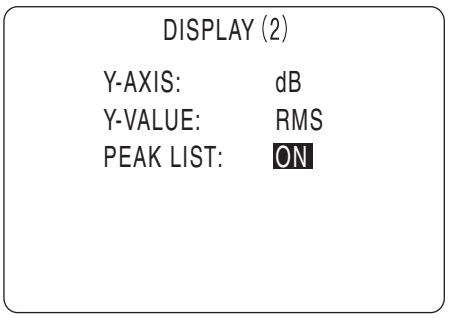
PEAK LIST Function

For the power spectrum (SPEC), cross power spectrum (XSPEC) and transfer function (TRANS) graphs, the ten highest values (highest level data for each frequency spectrum) can be displayed in list format. This is called the PEAK LIST function.
The function can be activated from the DISPLAY (2) menu.

Opening the DISPLAY (2) menu screen

Press the MENU key to open the main menu screen.

Use the ▲ and ▼ keys to move the highlight cursor to "DISPLAY (2)" and press the ENTER key. The DISPLAY (2) menu screen appears. Here you can set the PEAK LIST item.



DISPLAY (2) menu screen

Selecting the PEAK LIST setting

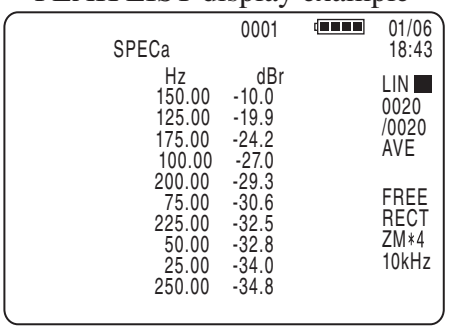
Setting options: ON, OFF

ON : Show PEAK LIST

OFF : Do not show PEAK LIST

1. Use the ▲ and ▼ keys to move the highlight cursor to the "PEAK LIST" parameter.
2. Use the ◀ and ▶ keys to change the parameter setting.
   To show the PEAK LIST, select ON.
3. Press the ENTER key to confirm the setting.
4. Press the MENU key twice to return to the measurement screen.
   PEAK LIST is displayed.

PEAK LIST display example



Note
The PEAK LIST function is not available for time waveform (TIME), phase (PHASE), and coherence (COH).
To return to the original display: Set the PEAK LIST item to OFF.

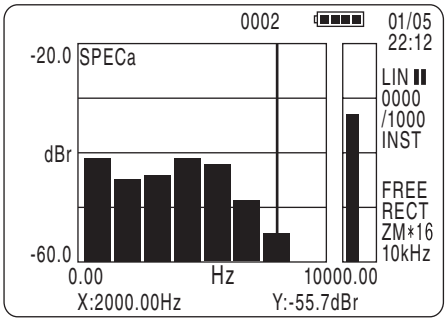
Synthesized 1/1 and 1/3 Octave Band Display

When FFT zoom ratio is set to ×16, the power spectrum (SPEC) and cross power spectrum (XSPEC) data can be processed to create a synthesized 1/1 or 1/3 octave band display.

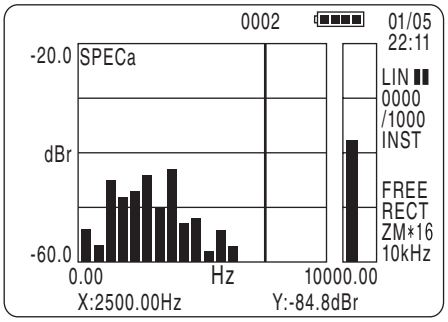
1. Use the FUNC. key to select the display function (see page 68).

Note
The 1/1 or 1/3 octave band display function is not available for time waveform (TIME), transfer function (TRANS), phase (PHASE), and coherence (COH).

2. While the power spectrum (SPEC) or cross power spectrum (XSPEC) graph is shown, press the OCT. key. Each push of the OCT. key cycles through the following settings: 1/1 octave band display → 1/3 octave band display → normal display.



Synthesized 1/1 octave display (power spectrum)



Synthesized 1/3 octave display (power spectrum)

Note
Synthesized octave band display is not possible when FFT zoom ratio is not set to ×16. If the graph Y axis scale is set to linear (LIN) when synthesized octave band display is activated, the setting is automatically switched to dB.

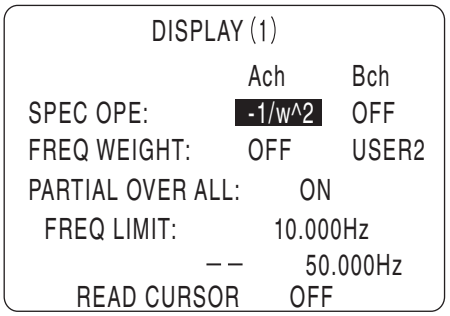
Differentiation and Integration Processing

The frequency spectrum data obtained by FFT analysis can be subject to differentiation and integration processing for the power spectrum (SPEC), cross power spectrum (XSPEC), and transfer function (TRANS) graph display. This setting is made from the DISPLAY (1) menu for channels A and B separately.

Opening the DISPLAY (1) menu screen

Press the MENU key to open the main menu screen.

Use the ▲ and ▼ keys to move the highlight cursor to "DISPLAY (1)" and press the ENTER key. The DISPLAY (1) menu screen appears. Here you can set the SPEC OPE item for channel A and B separately. This determines the differentiation and integration settings.



DISPLAY (1) menu screen

Selecting the differentiation and integration (SPEC OPE) setting

Setting options: OFF, -1/ω^2, 1/jω, jω, -ω^2

OFF	:	No differentiation or integration
-1/ω^2	:	Double integral
1/jω	:	Integral
jω	:	Differential
-ω^2	:	Two-step differential

Make the desired setting for channel A and B.

1. Use the ▲ and ▼ keys to move the highlight cursor to the "SPEC OPE" parameter. To make the setting for channel A, select "Ach". To make the setting for channel B, select "Bch".
2. Use the ◀ and ▶ keys to change the parameter setting.
   Each push of the ▶ key cycles through the following settings: OFF → -1/ω^2 → 1/jω → jω → -ω^2. Pressing the ◀ key cycles through the settings in the reverse order.
3. Press the ENTER key to confirm the setting.
4. Press the MENU key twice to return to the measurement screen.

Note

After the SPEC OPE setting has been made, the overall value is calculated from the result of the selected processing mode.

When Y-AXIS in the DISPLAY (2) menu is set to LIN, the display zoom ratio (see page 87) for power spectrum, cross power spectrum, and transfer function changes according to the SPEC OPE setting, as shown below.

SPEC OPE	Display zoom ratio
Except 1/jω, -1/jω^2	$\times 2^0 \rightarrow \times 2^1 \rightarrow \times 2^2 \cdots\cdots \rightarrow \times 2^{10}$
1/jω	$\times 2^{10} \rightarrow \times 2^{11} \rightarrow \times 2^{12} \cdots\cdots \rightarrow \times 2^{20}$
-1/jω^2	$\times 2^{20} \rightarrow \times 2^{21} \rightarrow \times 2^{22} \cdots\cdots \rightarrow \times 2^{30}$

Store Operations

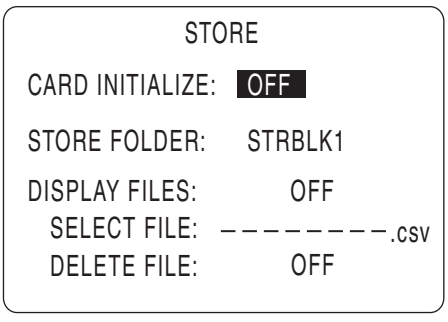
SA-78 can store the displayed data on the memory card (CompactFlash™).

Note
For details on the store procedure, refer to the chapter on "Memory Card Data" (page 135).

Important
Always turn power off before inserting or removing a memory card.

Preparation prior to data store

1. Initialize the memory card before data store.
   Initialization of memory card is made on STORE menu.
   Press the MENU key to open the main menu screen.
   Use the ▲ and ▼ keys to move the highlight cursor to "STORE" and press the ENTER key. The STORE menu screen appears.
   Use the ▲ and ▼ keys to move the highlight cursor to the "CARD INITIALIZE" parameter.
   Use the ◀ and ▶ keys to change the parameter to "EXEC" and press ENTER key to confirm the setting.



STORE menu screen

Follow the on-screen instructions and press the START/STOP key to proceed. The memory card is formatted, and eight folders named STRBLK1 to STRBLK8 are created on the card.

Note
For more information on memory card initialization, refer to the STORE menu explanation (page 50) in the "Menu List" section.

2. Select the store block folder to be used for storing data. Make this selection with the item "STORE FOLDER" on the STORE menu screen.
   Use the ▲ and ▼ keys to move the highlight cursor to "STORE FOLDER" and use the ◀ and ▶ keys to select the folder. Then press the ENTER key.

Note
The default folders are STRBLK1 to STRBLK8. More store block folders named from STRBLK9 to STRBLK99 can be created when the memory card is inserted in a computer. After such folders have been created, they can also be selected here.

3. Press the MENU key twice to return to the measurement screen.

Store operation

1. On the measurement screen, specify the address in which the data are to be stored.
   Use the INC. and DEC. keys to change the address.

Note
The INC. increments the address (+1) and the DEC. key decrements it (-1).

2. With the data to be stored being shown on the screen, press the STORE key.

   While data are being written to the memory card, the indication "STOR" appears on the display.

Note
If the selected address already contains data, a confirmation message appears. To overwrite the data, press the START/STOP key. To cancel the process, press the PAUSE key.
To prevent the STORE key click from being recorded or the confirmation message from affecting the record timing, set data store to pause before performing the store process.
The number of stored data will differ depending on the FFT zoom ratio and the frequency range setting. Consequently, the processing time for memory card write will also be different. With a frequency range of 80 kHz and an FFT zoom ratio of ×16, the write process takes about 30 seconds.

3. When data store is completed, the current address will be incremented by 1.

Note
When data are stored while two cursors are being displayed, the two cursors will be shown on top of each other on the recall screen.

Important

If one of the LEVEL RANGE, FREQ. RANGE, ZOOM, or WNDW keys is pressed after averaging processing is completed, an incorrect averaging result will be shown on the display. If the store operation is carried out in this condition, the incorrect averaging result will be stored. If one of these keys was pressed by mistake (meaning that the setting was changed), redo the averaging processing.

Note

After averaging processing, the SCALE key and ◀ and ▶ keys can be used to zoom in or out on the result. (The FFT zoom ratio must be set before processing.) For details, see "X axis zoom and display area shift" (page 81) in the "Basic Operation" section.

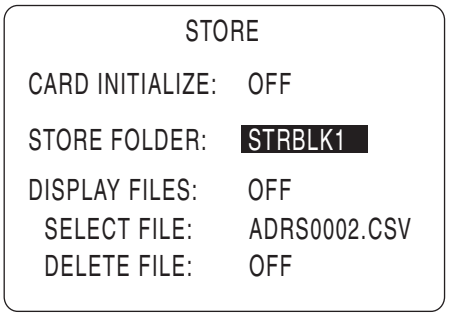
Recalling Stored Data

Data that have been stored on memory card (CompactFlash) can be recalled at any time.

To recall data, insert the memory card where the data were stored, and then perform the steps described below.

Important
Make sure that power to the SA-78 is turned off before inserting the card.

1. Select the store block folder that contains the data to recall.
   Use the STORE menu to make this selection.
   Press the MENU key to bring up the main menu screen.
   Use the ▲ and ▼ keys to move the highlight cursor to "STORE" and then press the ENTER key.
   The STORE menu screen appears.
   Use the ▲ and ▼ keys to move the highlight cursor to "STORE FOLDER".
   Use the ◀ and ▶ keys to select the folder name, and press the ENTER key.



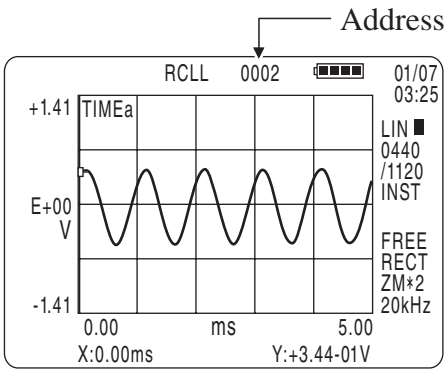
STORE menu screen

Note
The default folders which can be selected are STRBLK1 to STRBLK8. If more store block folders (STRBLK9 to STRBLK99) were created on the memory card, these can also be selected.

2. Press the MENU key twice to return to the measurement screen.
3. On the measurement screen, specify the address number from you want to read data. Use the INC. and DEC. keys to select the address.

Note
The INC. increments the address (+1) and the DEC. key decrements it (-1).

4. When you press the RECALL key, the data stored in the selected address are shown on the screen. The indication "RCLL" appears when recalled data are being shown.



Recall data display screen

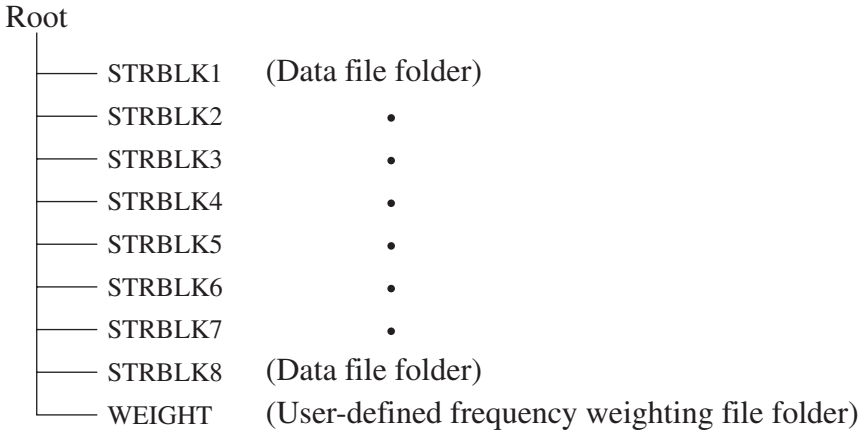
Note
If there are no data in the specified address, the message "NO Data!!" appears.
During averaging processing and during pause, the recall operation is not possible.
When data were stored while two cursors are being displayed, the two cursors will be shown on top of each other on the recall screen.
The averaging count is not recalled.

Memory Card Data

The SA-78 can store measurement data on memory card (CompactFlash). The files on the card are in MS-DOS format and can therefore be read on a computer equipped with a card slot. The files are CSV files that can be imported by most spreadsheet application software.

Folder configuration on memory card

After initializing a memory card in the SA-78, its folder structure will look as shown below.



Important
Do not change the folder structure of the memory card or change any folder or file names. Otherwise the SA-78 will no longer be able to correctly read and store data. Before using the stored data on a computer, first copy the files to the hard disk or other media in the computer.
Memory cards which have not been initialized (formatted) cannot be used.

STRBLK folder

Setup parameters and the X and Y values of two functions as selected at the SA-78 are stored. In a file, the setup parameters are recorded first as a header, followed by the function data. The file always contains data for two functions, also when the display is set to single-graph display.

Function setting	Number of stored data depending on FFT zoom ratio				
	× 1	× 2	× 4	× 8	× 16
TIMEa or TIMEb	256	512	1024	2048	4096
Other functions (frequency range 100 Hz to 50 kHz)	101	201	401	801	1601
Other functions (frequency range 80 kHz)	108	215	429	857	1713

Also if not all data are displayed on the screen due to the scale setting, the stored data files contain all data.

Stored data files

The file name of a stored data file is "ADRS****.CSV", where the **** is the 4-digit address number. The file format of the stored data employs a two-part structure: 1. Setup parameters, and 2. Function data. These are grouped as follows.

Setup parameters (header)	function data

1. Setup parameters (header)

The setup parameters that were active when the data were stored are recorded here in text format. The data for the two channels are separated by commas (2CH). At the end of each parameter, a carriage return/line feed (CR 0DH / LF 0AH) is added.

The following items are recorded.

STORE BLOCK No.,3	STORE FOLDER selection in STORE menu
ADDRESS,5	Address
STORE TIME,2002 / 8 / 27 18:49	Date and time of store action
FUNCTION,TIMEa / SPECa	Function selection made with FUNC. key
FREQ RANGE,20000	Frequency range set with FREQ. RANGE key
ZOOM,1	FFT zoom ratio set with ZOOM key
WINDOW,RECT	Window function set with WNDW key
DISPLAY,FUNC1&2	Graph display selected with DISP. key
INST / AVE,INST	Instantaneous/averaging display selected with INST./AVE. key
OCTAVE,OFF	Octave display selected with OCT. key (OFF, 1/1 OCT, 1/3 OCT)
PEAK LIST,OFF	PEAK LIST setting in DISPLAY (2) menu
LEVEL RANGE(Ach),10	Level range set with LEVEL RANGE key
LEVEL RANGE(Bch),-20	
COUPLING(Ach),DC	COUPLING setting in INPUT menu
COUPLING(Bch),AC	
CCLD(Ach),ON	Sensor power supply setting in INPUT menu
CCLD(Bch),OFF	
LPF(Ach),OFF	LPF setting in INPUT menu
LPF(Bch),20k	
HPF(Ach),OFF	HPF setting in INPUT menu
HPF(Bch),20	

(continued on next page)

CALIBRATION MODE,LIN	CALIBRATION MODE setting in CALIBRATION menu
TRANSFER VALUE (Ach),1.00E+01	TRANSFER VALUE setting in CALIBRATION menu
TRANSFER VALUE (Bch),3.00E-02	
REFERENCE VALUE (Ach),1.00E+00	REFERENCE VALUE setting in CALIBRATION menu
REFERENCE VALUE (Bch),2.00E-05	
TRIGGER,ON	Trigger ON/OFF setting made with TRIG. key
TRIGGER MODE,SNGL	TRIGGER MODE setting in TRIGGER menu
TRIGGER SOURCE,INT	TRIGGER SOURCE setting in TRIGGER menu
TRIGGER CH,Ach	TRIGGER CH setting in TRIGGER menu
TRIGGER POSITION,2048	TRIGGER POSITION setting in TRIGGER menu
TRIGGER SLOPE,+	TRIGGER SLOPE setting in TRIGGER menu
TRIGGER LEVEL, 15 _ 16	TRIGGER LEVEL setting in TRIGGER menu
CROSS-SPEC,ON	CROSS-SPEC setting in ANALYSIS menu
REF CH,Ach	REF CH setting in ANALYSIS menu
AVERAGE DOMAIN,FREQ	AVERAGE DOMAIN setting in ANALYSIS menu
AVERAGE MODE,LIN	AVERAGE MODE setting in ANALYSIS menu
AVERAGE TIMES,1000	AVERAGE TIMES setting in ANALYSIS menu
SPEC OPE (Ach),OFF	SPEC OPE setting in DISPLAY (1) menu
SPEC OPE (Bch),jw	
FREQ WEIGHT (Ach),OFF	FREQ WEIGHT setting in DISPLAY (1) menu
FREQ WEIGHT (Bch),A	
PARTIAL OVER ALL,OFF	PARTIAL OVER ALL setting in DISPLAY (1) menu
FREQ LIMIT (LOWER),10000.00	PARTIAL OVER ALL FREQ LIMIT (lower limit) setting in DISPLAY (1) menu
FREQ LIMIT (UPPER),20000.00	PARTIAL OVER ALL FREQ LIMIT (upper limit) setting in DISPLAY (1) menu
Y-AXIS,dB	Y-AXIS setting in DISPLAY (2) menu
Y-VALUE,RMS	Y-VALUE setting in DISPLAY (2) menu
CURSOR MODE,SEPARATE	Cursor mode setting made with CURSOR key (*)
CURSOR POSITION (FUNC1),0.003066	Cursor position (X value)

(continued on next page)

* "ONE CURSOR" when only one cursor is displayed. "SEPARATE" when two cursors (top and bottom) with separate movement are displayed. "COUPLE" when two cursors (top and bottom) with linked movement is displayed.

CURSOR POSITION (FUNC2),13800
X-SCALE (FUNC1),2
X-SCALE (FUNC2),1
Y-SCALE (FUNC1),1
Y-SCALE (FUNC2),0 / -80
OVER LOAD (Ach),-
OVER LOAD (Bch),OVER

X scale setting made with SCALE key and ◀ and ▶ keys

When Y scale setting made with SCALE key and ▲ and ▼ keys is dB
(When Y-AXIS setting is dB, for example 0 to -80 becomes 0/-80)
When no overload has occurred up to the store point (for AVE during averaging), "-" is entered. When overload has occurred, "OVER" is entered.

2 blank lines

(function data section follows)

2. Function data

Function data are recorded in text format in the order [FUNC1] and [FUNC2].

The basic format is as follows.

[FUNC1] (return)	X axis, Y axis label (return)	Data string (X value followed by Y value on each line)	(2 returns)
[FUNC2] (return)	X axis, Y axis label (return)	Data string (X value followed by Y value on each line)	

(return) is a 2-byte sequence consisting of carriage return CR (0DH) and line feed LF (0AH).

Data for the two channels are delimited by commas (2CH).

Some examples for files recorded with arbitrary settings follow.

Function data (example 1)

(Octave display: OFF, PEAK LIST setting: OFF, function setting: TIMEa/SPECa, FFT zoom ratio: ×1)

[FUNC1],	Label indicating the start of function 1 data
TIME (s),TIMEa (V)	TIME (s) is X axis label. TIMEa (V) is Y axis label.
0.000000,-3.01E-01	X values and Y values for TIMEa (string of 256 data)
0.000020,-4.43E-01	
.	
.	
.	(omitted)
0.004961,-4.65E-01	
0.004980,-2.35E-01	
	2 blank lines
[FUNC2],	Label indicating the start of function 2 data
FREQ (Hz),SPECa (dBEU)	FREQ (Hz) is X axis label. SPECa (dBEU) is Y axis label.
OA,-9.5	Overall value for X and Y
0.000,-56.7	X values and Y values for each frequency of SPECa (string of 101 data)
200.000,-46.9	

(continued on next page)

• • • 19800.000,-59.7 20000.000,-60.2 OAW, -9.5	(omitted) Frequency weighted overall value for X and Y

(EOF)

Function data (example 2)

(Octave display: OFF, PEAK LIST setting: ON, function setting: TIMEa/SPECa)

[FUNC1], NO DATA	Label indicating the start of function 1 data Because function 1 is TIMEa, there are no peak list data. 2 blank lines
[FUNC2], FREQ (Hz),SPECa (dBEU) 17800.000,-9.5 1200.000,-13.7 13200.000,-18.9 19800.000,-25.0 400.000,-30.2 5600.000,-42.3 7200.000,-49.9 3000.000,-53.2 800.000,-55.9 3600.000,-59.8	Label indicating the start of function 2 data FREQ (Hz) is X axis label. SPECa (dBEU) is Y axis label. String of 10 data for frequency (X value) in order of level (Y value) magnitude

(EOF)

Function data (example 3)

(Octave display: 1/1 OCT, PEAK LIST setting: OFF, function setting: TIMEa/SPECa)

[FUNC],	Label indicating the start of function 1 data
TIME(s),TIMEa(EU)	TIME (s) is X axis label. TIMEa (EU) is Y axis label.
0.000000, -8.69E+01	
0.000020, -7.86E+01	
•	
•	
•	(omitted)
0.079961, -9.52E+01	
0.079980, -9.33E+01	
[FUNC2],	2 blank lines
FREQ(Hz),SPECa (dBEU)	Label indicating the start of function 2 data
OA,-9.5	FREQ (Hz) is X axis label. SPECa (dBEU) is Y axis label.
63.000,-56.7	Overall value for X and Y
125.000,-46.9	X values and Y values for each frequency of SPECa
250.000,-33.4	(string of 8 data) (20 data for 1/3 OCT)
500.000,-26.8	
1000.000,-10.3	
2000.000,-38.6	
4000.000,-59.7	
8000.000,-60.2	
OAW,-9.5	Frequency weighted overall value for X and Y

(EOF)

User-defined frequency weighting files

The user-defined frequency weighting files must be named USER1.CSV and USER2.CSV. These files can be created by the user and should contain data for frequency weighting characteristics to be used for overall value calculation.

The file format is as shown below.
Data for the two channels are delimited by commas (2C$_H$).
At the end of each setup parameter, a 2-byte sequence consisting of carriage return CR (0D$_H$) and line feed LF (0A$_H$) must be added.

File format

FREQ RANGE,20000	Target frequency range setting
	2 blank lines
[USER WEIGHT],	Label indicating the start of frequency weighting data
FREQ (Hz),WEIGHT (dB)	FREQ (Hz) and WEIGHT (dB) are data labels.
0.000,-56.7	String of 1601 data corresponding to dB value for each frequency at FFT zoom ratio ×16
12.500,-46.9	(Figures are shown as examples)
•	
•	(omitted)
•	
19987.500,-59.7	
20000.000,-60.2	

(EOF)

Note
If the current frequency range setting and the target frequency range setting in this file are different, this user-defined frequency weighting characteristic cannot be selected.
For the frequency range from 100 Hz to 50 kHz, there are 1601 data corresponding to the dB value for each frequency at an FFT zoom ratio of ×16. For the 80 kHz frequency range, there are 1713 data. All of these data must be entered.

Default Settings

If you hold down the START key while turning on the power, the unit starts up with the default settings.

Key settings

INC.DEC.	:	Address 001
FUNC.	:	TIME a / TIMEb
DISP.	:	2 graphs
OCT.	:	Disable
INST. / AVE.	:	INST.
LEVEL RANGE	:	0 dB
FREQ. RANGE	:	20 kHz
ZOOM	:	×1
WNDW	:	RECT
TRIG.	:	FREE (OFF setting)

MENU settings

INPUT menu (Ach & Bch)

COUPLING	:	AC
CCLD	:	OFF
LPF	:	OFF
HPF	:	OFF

ANALYSIS MENU

CROSS-SPEC	:	ON
REF CH	:	Ach
AVERAGE DOMAIN	:	FREQ
AVERAGE MODE	:	LIN
AVERAGE TIMES	:	1000

DISPLAY(1) MENU

SPEC OPE	:	OFF (Ach & Bch)
FREQ WEIGHT	:	OFF (Ach & Bch)
PARTIAL OVER ALL	:	OFF
PARTIAL OVER ALL is ON		
FREQ LIMIT	:	10000.000 Hz to 20000.000 Hz
READ CURSOR	:	OFF

DISPLAY(2) MENU

Y-AXIS	:	dB
Y-VALUE	:	RMS
PEAK LIST	:	OFF

CALIBRATION MENU

CALIBRATION MODE	:	OFF
TRANSFER VALUE	:	CALIBRATION MODE is LIN 1 EU=1 V (Ach & Bch) CALIBRATION MODE is dB 0 dB EU=0 dBV (Ach & Bch)
REFERENCE VALUE	:	0 dB EU=1 EU (Ach & Bch)

TRIGGER MENU

TRIGGER MODE	:	SNGL
TRIGGER SOURCE	:	INT
TRIGGER POSITION	:	+0
TRIGGER CH	:	Ach
TRIGGER SLOPE	:	+
TRIGGER LEVEL	:	+8 / 16

STORE MENU

CARD INITIALIZE	:	OFF
STORE FOLDER	:	STRBLK1
DISPLAY FILES	:	OFF
SELECT FILE	:	According to stored files on memory card
DELETE FILE	:	OFF

SETUP MEMORY MENU

SETUP MEMORY No.	:	1
SAVE	:	OFF
LOAD	:	OFF
DELETE	:	OFF

DATE / TIME MENU

DATE	:	No setup
TIME	:	No setup

Key operation status in various modes

Mode / Key operation	Normal measurement mode			Recall	Menu Displayed
	Averaging processing stopped	Averaging processing in progress	Pause		
MENU	❍	❍	❍	❍	❍
ENTER	×	×	×	×	❍
INC.	❍	×	❍	❍	×
DEC.	❍	×	❍	❍	×
RECALL	❍	×	×	❍	×
START/STOP	❍	❍	❍	×	×
PAUSE/CONT.	❍	❍	❍	×	×
FUNC.	❍	❍	❍	×	×
DISP.	❍	❍	❍	❍	×
OCT.	❍	❍	❍	×	×
INST./AVE.	❍	❍	❍	×	×
LEVEL RANGE	❍	×	×	×	×
FREQ. RANGE	❍	×	×	×	×
ZOOM	❍	×	×	×	×
WNDW	❍	×	×	×	×
CURSOR	❍	❍	❍	❍	×
SCALE	❍	❍	❍	❍	×
▲▼◀▶	❍	❍	❍	❍	❍
TRIG.	❍	×	×	×	×
PRINT	❍	×	❍	❍	❍
POWER	❍	❍	❍	❍	❍
STORE	❍	×	❍	×	×

Specifications

Input section

Number of channels	2
Input connectors	BNC × 2 with supplied 2-channel input conversion adapter Tajimi 7-pin connector × 1 Direct connection of one microphone possible (bias-type microphones cannot be used)
Input impedance	100 kΩ
Maximum input voltage	±20 V
Input coupling type	AC or DC (for 0.5 Hz / -3 dB for AC)
Sensor drive power supply (CCLD)	2 mA, 18 V (4 mA sensors can also be connected)
Frequency range	DC to 80 kHz
Level range	-40 to +20 dB (10-dB steps)
Input filters	High-pass filter: 20 Hz, 100 Hz (-1 dB point) Low-pass filter: 1 kHz, 20 kHz (-1 dB point) (Switchable) 3rd-order Butterworth filter with -18 dB/oct. slope
Overload	Range full-scale +2 dB Overload warning indication on display
A/D converter	16 bit (sigma-delta type)
Linear operating range	Overall 85 dB (60 dB for 50 kHz range and 80 kHz range)

Analyzer section

Frequency range 100, 200, 500, 1 k, 2 k, 5 k, 10 k, 20 k, 50 k, 80 k (Hz)

Reference channel Channel A or B, selectable

Analysis functions Time waveform, power spectrum, cross power spectrum, transfer function, phase, coherence

Window types Rectangular, Hanning, Flat-top

FFT zoom settings ×1 (256 point FFT, 101 line resolution)
(108 when Fc=80 kHz)
×2 (512 point FFT, 201 line resolution)
(215 when Fc=80 kHz)
×4 (1024 point FFT, 401 line resolution)
(429 when Fc=80 kHz)
×8 (2048 point FFT, 801 line resolution)
(857 when Fc=80 kHz)
×16 (4096 point FFT, 1601 line resolution)
(1713 when Fc=80 kHz)

Averaging processing

Processing modes : linear averaging, exponential averaging, peak hold (power spectrum only)

Processing domain : time (linear averaging only), frequency

Number of averaging runs :
1 to 8000

* To perform averaging in the time domain, analysis of averaged time waveform is used.

Arithmetic frequency weighting

Types : A characteristics, 2 user-defined characteristics

Weighting target : overall value

* Individual setting for each channel possible
* User-defined characteristics are read from file with frequency compensation data (created with Excel or similar) on CompactFlash card.
* Frequency spectrum graphs are not affected by frequency weighting.

Octave synthesis
Types : 1/1 octave, 1/3 octave
Targets : power spectrum, cross power spectrum
* Only when FFT zoom ratio is set to ×16

Differentiation
Types : $-1/\omega^2$, $1/j\omega$, $j\omega$, $-\omega^2$
Targets : power spectrum, cross power spectrum, transfer function
* Individual setting for each channel possible
* FFT processing result compensation

Overall value
Normal overall value and frequency weighted overall value are calculated simultaneously. (If frequency weighting was specified, partial overall is calculated.)

Display

Display type
192 × 128 dot LCD (77.5 × 54 mm) with backlight

Number of graphs
1 or 2

Graph types

	Top graph	Bottom graph
1	Time waveform channel A	Time waveform channel B
2	Time waveform channel A	Power spectrum channel A
3	Time waveform channel B	Power spectrum channel B
4	Power spectrum channel A	Power spectrum channel B
5	Cross power spectrum	Cross power spectrum (phase)
6	Transfer function (amplitude)	Transfer function (phase)
7	Transfer function (amplitude)	Coherence
8	Time waveform channel A	Transfer function (amplitude)
9	Time waveform channel B	Transfer function (amplitude)
10	Power spectrum channel A	Transfer function (amplitude)
11	Power spectrum channel B	Transfer function (amplitude)

Peak list
Frequency and numerical value for ten highest values in selected function type are shown as list display.
* Not available for time waveform, cross power spectrum (phase), transfer function (phase) and coherence.

Number of frequency lines

101 + overall value + frequency weighted overall value

Number of time waveform display points

128

Display units X axis : Hz, ms

Y axis : V, EU, dB, dB EU, DEG (degrees)

Y axis display Linear, dB

* Linear only for time waveform, phase, and coherence.

Display zoom X axis : Depending on FFT zoom and graph type, the following range settings are possible

FFT zoom ratio	Time waveform	Other function
1	1 to 2	1
2	1 to 4	1 to 2
4	1 to 8	1 to 4
8	1 to 16	1 to 8
16	1 to 32	1 to 16

Y axis : When Y axis display is linear, the setting range is ×1 to ×1024 (Y axis lower limit fixed to 0, upper limit changes according to zoom ratio setting)
When Y axis display is dB, the setting range is ×1 to ×2 (depending on zoom ratio, one of the settings in the following table is available)

* Zoom ratio is in steps of the second power.

Y axis ratio for dB indication	Y axis upper and lower limit
(80 dB span)[1]	LRF, LRF-80
	LRF+20, LRF-60
	LRF+40, LRF-40
	LRF-20, LRF-100
	LRF-40, LRF-120
	LRF-60, LRF-140
	LRF-80, LRF-160
(40 dB span)[2]	LRF, LRF-40
	LRF+20, LRF-20

* LRF is level shift full scale.

Cursors X value and Y value readouts for cursor position.
Overall value display for power spectrum graph.
X axis zoom operates according to cursor position.
For single-graph, 2 cursors can be displayed (with X value and Y value differential readout for cursor 1 and cursor 2, cursors can also be used to specify partial overall frequency range).
Linked movement or separate movement for cursor 1 and 2 in single-graph display, or top and bottom cursor in dual-graph display.

Calibration function Calibration value setting :
When Y axis display is linear, specify voltage value [V] corresponding to 1 [EU]. When Y axis display is dB, specify voltage level [dB V] corresponding to 0 [dB EU]. (Setting can be made while checking overall value reflecting the calibration input.)

Reference setting : Specify EU value corresponding to 0 [dB EU]

Calibration value display : Show graph Y axis and cursor value according to calibration value setting

Clock function: Date and time indication

Trigger section

Trigger mode: Free-run, repeat, single

Trigger source: Internal signal level or external trigger signal

Trigger position: -4096 (pre-trigger) to +4096 (post-trigger)

Trigger slope setting: Rising edge (+) or falling edge (-)

Trigger level: -15/16 to +15/16 of range full-scale, in 1/16-steps

Memory section

Manual store

Stored data : Data shown on display when STORE key is pressed, setup parameter, date and time information

Store media : CompactFlash

Number of blocks : 8 (default), expandable to 99 (in folders created by user on card in a computer)

Total number of data : approx. 4000 (zoom ratio ×1, using supplied 64 MB card)

Recall : Call up data from any address

* Store cannot be carried out during averaging processing or during recall

Setup parameter memory

Stored data : Unit settings

Number of data : 8

Store location : Internal memory

File operations	CompactFlash initialization (deletes data on card and creates folder structure), display of files on CompactFlash, selective overwrite and erase		
Resume function	Settings established when unit is turned off are memorized and restored when unit is next turned on.		
Input/output section			
AC output	Connector type	:	ϕ2.5 stereo jack
	Output impedance	:	100 Ω
	Output voltage	:	1 Vrms at range full-scale
External trigger input			
	Connector type	:	ϕ2.5 mono jack
	Input signal	:	CMOS level falling edge remains at LOW level for 1 ms or more (HI level 3 to 6 V, LOW level 0 V)
Printer port	Connector type	:	9-pin D-sub, male
	Transfer principle	:	RS-232C, 9600 bps
	Function	:	Hard copy of display contents
	Compatible printers	:	CP-10, CP-11, DPU-414
	Cable	:	Generic straight-wired cable
USB port	Connector type	:	USB Type B, female
	Transfer principle	:	USB 1.1
	Function	:	Communication with supplied software
	Cable	:	Generic USB cable

Other specifications

Ambient conditions for operation

0 to +40ºC, 20 to 90% RH (no condensation)

Power requirements IEC R14P (size C) battery × 4 or AC adapter

Power supply voltage range:
4.5 to 6.8 V

Current consumption :
Approx. 250 mA (LCD backlight off, sensor power supply off, rated voltage 6 V)
approx. 350 mA (LCD backlight on, sensor power supply off, rated voltage 6 V)

Battery life Alkaline batteries (LR14) :
approx. 15 hours continuous operation

Manganese batteries (R14P) :
approx. 5 hours continuous operation

(at 20ºC, sensor power supply off, LCD backlight off)

Dimensions 156 (W) × 174 (H) × 45.7 (D) mm
(without protruding parts)

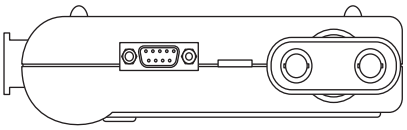
Weight Approx. 900 g
(including alkaline batteries LR14)

Supplied accessories

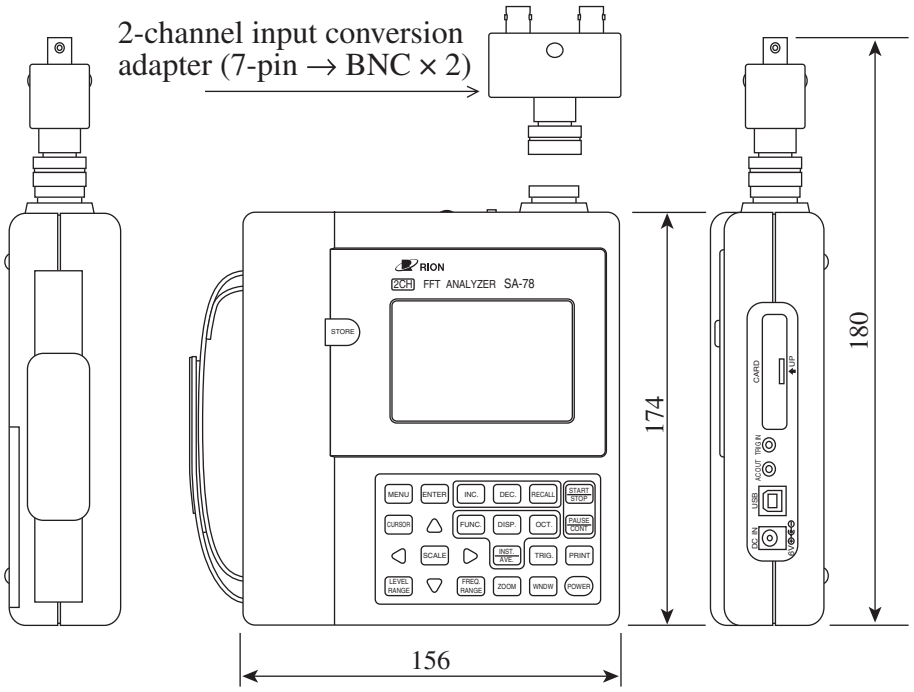
IEC LR14 (size C) battery	4
Simple instruction manual	1
Instruction manual (CD-ROM)	1
2-channel input conversion adapter (7-pin → BNC × 2)	1
CompactFlash	1
Data Monitoring Software (on Instruction Manual CD-ROM)	1
Inspection certificate	1

Optional accessories

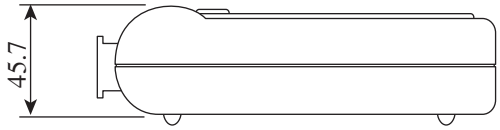
CC-24S (ϕ2.5 mono plug → BNC)	
CC-59 (ϕ2.5 stereo plug → ϕ2.5 mono jack × 2)	
AC adapter	NC-98 series
Waveform Recording Card	SA-78WR
Printer	DPU-414
Microphone	UC-52, UC-53A
Preamplifier	NH-17, NH-17A, NH-22
Accelerometer	



Top view



Side view (left) Front view Side view (right)



Bottom view

Unit: mm

Dimensional drawings

No. 37724 08-06