RT3100N/3200N Series
Input Amplifier Units
Operation Manual

NEC San-ei Instruments,Ltd

CE MARKING GENERAL INFORMATION

To our customers in Europe: RE:RT3108N/RT3208N/RT3216N RECORDERS

These products are in conformity with EMC Directive 89/336/EEC.

Conformity specifications

EN55011 (B)
EN50082-1 : IEC801-2 (ESD)
IEC801-3 (RF Field)
IEC801-4 (EFT)

EN61010-1

Caution:

In order to meet above requirements, all the amplifiers or options can not be used at this moment although we are making every effort to improve our product items and following conditions at this moment should be met for the requirements.(as of January 17, 1996).

1) Do not use other input units than the ones supplied, which were shipped before December 31, 1995.

2) Input units, which meet above requirements, are:

* DC amplifier unit RT31-144 with safety connector,
* F/V converter unit RT31-146 with safety connector,
* Zero Suppression amlifier RT31-145 with safety connect,
* Floating DC amplifier unit RT31-147 with safety connector,
* RMS converter unit RT31-149 with safety connector,
* DC amplifier with fine control RT31-148 with safety connector.
* Event amplifier unit RT31-110,
* DC Strain amplifier unit RT31-111

Note: Charge amplifier, Thermocouple unit and same input units, but different models can not be used for CE conformity recordder at this moment (as of January 17, 1996) although we are improving the specification to meet the requirements.

3) Specified input cable(RT31-162) should be used instead of the cable 0311-5158 mentioned in this operation manual when using DC amplifier unit (RT31-144), F/V converter unit (RT31-146), floating DC amplifier unit (RT31-147), zero suppression amplifier unit (RT31-145) , DC amplifier with fine control adjustment (RT31-148). and RMS converter unit (RT31-149).

4) When using event amplifier (RT31-110), specified logic probe (RT31-163) should be used instead of RT33-120 mentioned in this manual.

SECTION 1

RMS CONVERTER UNIT

CONTENTS

1.1 General Information

This unit can not only convert a sinusoidal wave but any waveform other than a sinusoidal wave into a true root-mean-square value.
The voltage of a sinusoidal wave can be measured up to 350 V AC in the range of 500 V rms/F.S.
In the case of a waveform containing a pulse, if the crest factor (the ratio of the peak value to the rms value) is greater, this unit can convert it into a true rms value, even if the peak value of the pulse is high.
In the range of 50 V rms/F.S., crest factor 8 is obtained. Therefore, a waveform, whose peak value of a pulse is up to 400 V, can be measured.
In addition, the AC coupling mode, which can eliminate the DC component of an input signal, is provided.
This unit can also be used as a DC amplifier.
Two types of the RMS converter unit are available; one is an RMS converter unit with double-deck binding posts (RT31-141) and the other is an RMS converter unit with safety terminals (RT31-153).

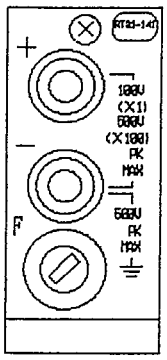
Caution:

If a voltage, which exceeds the following allowable input voltages, should be applied to the input, this may cause failure.
This unit must, therefore, be used on condition that the voltage to be applied is less than the allowable input voltage.

Allowable input voltage (DC or AC peak value)	Input range	
	RMS mode	DC mode
100 V	0.1 to 5 V rms/F.S.	0.1 to 5 V/F.S.
500 V	10 to 500 V rms/F.S.	10 to 500 V/F.S.

1.2 Input Section

1.2.1 RMS Converter Unit (RT31-141)



+, - (Input terminals):
Double-deck binding posts.
The negative terminal (-) is connected to GUARD (shielded case) inside the unit.

Allowable input voltage:
x1 : 100 V (DC or AC peak value).
x100: 500 V (DC or AC peak value).

Common-mode voltage (between +,- terminals and housing case):
500 V (DC or AC peak value).

F (fuse holder):
A fuse in installed to protect the RMS converter unit from an excessive input.
A 0.1A fuse is installed as standard.
A 10 mA fuse (0334-2105) is available for protecting an input signal source.
Caution:
The fuse for protection is provided to reduce damage to the unit as far as possible, and it is not provided to completely protect the unit itself.

Note:
A cable for signal input (0311-5107: Double-deck banana plug - Alligator clip, Length: 2 m) is available.

1.2.2 RMS Converter Unit with Safety Terminals (RT31-153)

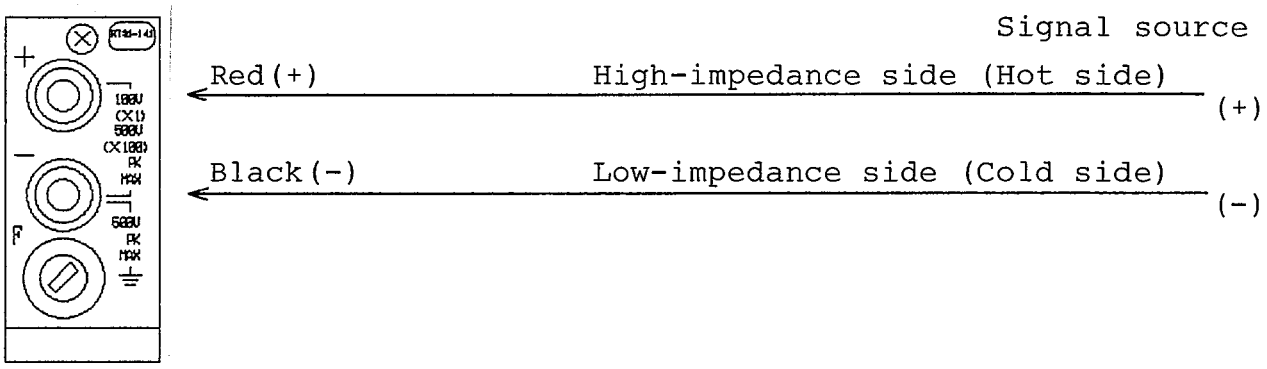
This is a modified unit where construction of its input terminal section to be connected with a signal input cable is of the safety-terminal form permitting the input terminals not to be touched directly by hand.

Other functions of this unit are exactly the same as those of the RMS converter unit (RT31-141).

1.3 Operating Instructions

1.3.1 Connection to Input Signal

In order to carry out correct measurement with less noise, the input circuit connection is very important.
Basically, connect the high-impedance side (H side: hot side) to the red (+) input terminal and the low-impedance side (L side: cold side) to the black (-) input terminal.



Especially, when a very low signal is to be recorded, observe the following points:

- ° Make an input cable as short as possible.
- ° Use a shielded cable to suppress electrostatic noise.
- ° Twist the positive and negative (+,-) insulated conductors of an input cable together to suppress electromagnetic noise.

The impedance of a signal source should be made to less than 100 ohms. Also from the standpoit of noise, etc., the lower the signal source impedance is, the better the recording will become.

Caution:

In the case of a nongrounded signal source, use this unit with the common-mode voltage signal (CMV) in less than 500 V DC or AC peak value. Use the cable whose breakdown point of insulating materials is higher than 2 kV.

1.3.2 Caution on Input Signal

① Maximum input voltage

If a voltage, which exceeds the allowable input voltage defined by each range, should be inadvertently applied to the input, the parts used inside the unit may be broken.

Care must be taken, therefore, not to exceed the following allowable input voltages in each range.

Allowable input voltage (DC or AC peak value)	Input range	
	RMS mode	DC mode
100 V	0.1 to 5 Vrms/F.S.	0.1 to 5 V/F.S.
500 V	10 to 500 Vrms/F.S.	10 to 500 V/F.S.

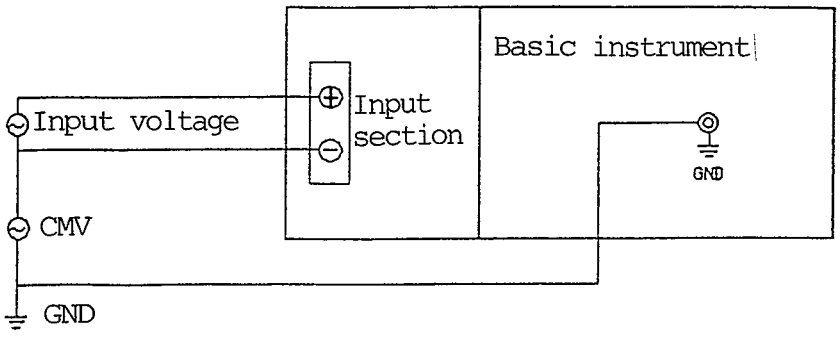
② Input impedance

The input impedance is approximately 1 MΩ.

In the ranges of 0.1 to 1 Vrms/F.S. in the RMS mode and 0.1 to 5 V/F.S. in the DC mode, however, care must be taken that if the input voltage becomes higher than approximately 11 V, the input impedance becomes approximately 10 kΩ because the protection circuit is actuated.

③ Common-mode voltage

The common-mode voltage is a voltage component which is applied in common between the ground and the two input terminals (+,-), as shown in the figure below.

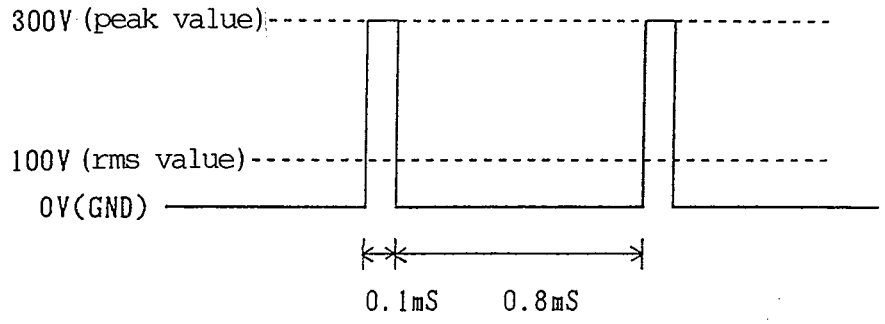


If a noise-like, pulsating common-mode voltage is applied, noise may appear on the recorded waveform because of the deteriorated common-mode rejection ratio (CMRR).
In addition, care must be taken to the common-mode voltage not to allow it to exceed the determined 500 V peak value.
Should the CMV exceed this range, this may be the cause when the unit malfunctions.

④ Crest factor

The crest factor is the ratio of the peak voltage to the rms voltage of a waveform.
For example, in the rectangular wave (peak voltage: 300V, rms voltage: 100V) shown below, its crest factor is 3.

crest factor = peak voltage (value) ÷ rms voltage (value)

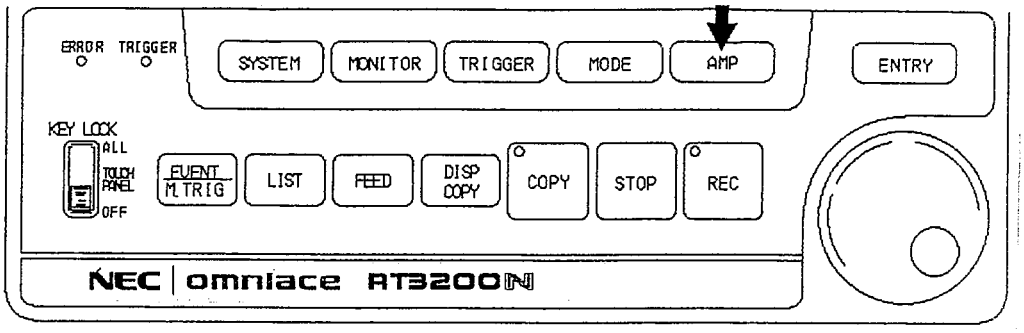


In this unit, the crest factor of the range of 0.1 to 50 Vrms/F.S. is 8.

1.4 Setting-up Procedure

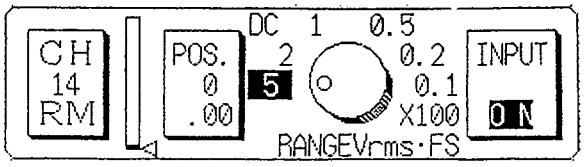
1.4.1 Display and Setting-up Procedure Performed on AMP Screen Display (AMP-1 or AMP-2 Screen Display)

Press the AMP key on the operation panel.



Display the AMP-1 or AMP-2 screen display (AMP-1 screen display for RT3108N/3208N series) by pressing the AMP key.

On the AMP screen display, the RMS converter unit is displayed, as shown in the figure below.

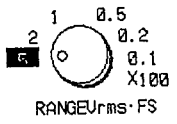
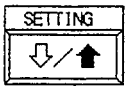


The explanation on the screen display shown above is divided into two parts; the first part deals with display images and the second part deals with setting keys.

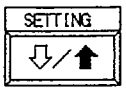
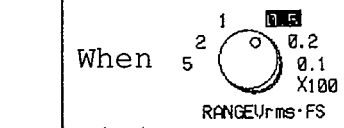
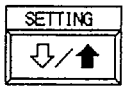
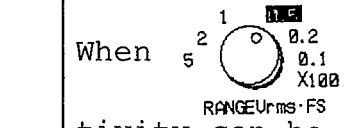
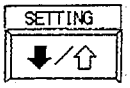
1) Display

Display	Display contents
	An input signal is sampled and displayed, and the baseline position is indicated by ◁. The display can be made up to the full-scale range for a waveform recording. The input signal corresponding to the full scale is changed when the baseline position is altered.
DC	(This indication is displayed at an upper position a little to the left from the center.) This displays the setup contents of coupling. DC: Represents DC coupling. AC: Represents AC coupling. Note: For the setting-up procedure, refer to 1.4.2 AMP Detailed Setup Screen Display and 1.4.3 AMP Setup Monitor Screen Display respectively, which will be explained later.

2) Setting keys

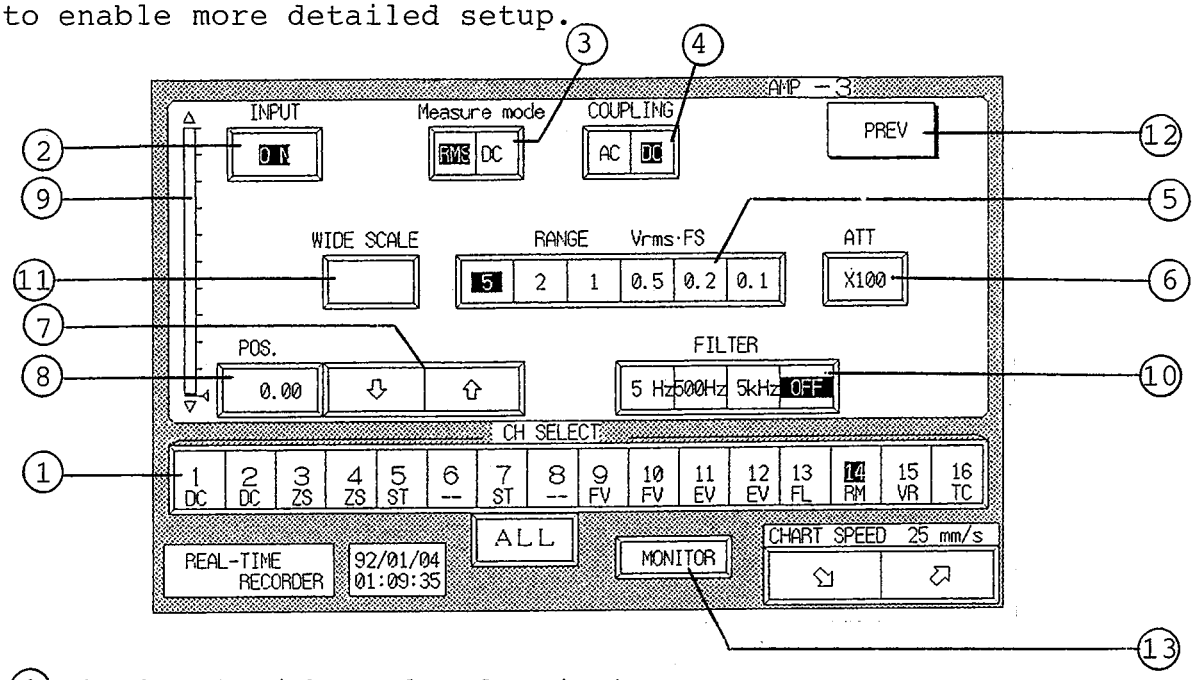
Setting keys	Display contents and setting-up procedure
	Pressing this key selects ON, OFF or GND. ON : The input to the amplifier is turned on, so that recording can be made. OFF: The input to the amplifier is turned off, so that recording is also turned off. GND: The input to the amplifier is turned off and recording is positioned on the baseline.
	Press  to change the input ranges step by step. The changing direction can be selected by  .

Setting keys	Display contents and setting-up procedure
POS. 0 .00	This key moves the baseline position of an input signal. The baseline position is a displayed or recorded position when 0 volt is inputted (with the input shortcircuited). Pressing this key moves the baseline position 10 steps by 10 steps, when the full scale is set in 100. In the initial state of the RMS converter unit, the baseline position is set in "0.00" which is recorded at a lower margin of the set record width. In the DC amplifier, the baseline position is set in "50.00" which is recorded at the middle of the set record width. Note: If a decimal fraction is present following a number of one figure (1.45), as shown in POS. 1 .45, this indicates that using the baseline fine-adjusting capability the baseline position can be set more finely than the usual 10 step-by-10 step adjustment. On this screen display, however, the fine adjustment of a baseline position cannot be made. (For the setting-up procedure of baseline fine adjustment, refer to 1.4.2 AMP Detailed Setup Screen Display and 1.4.3 AMP Setup Monitor Screen Display respectively, which will be explained later.) When POS. 1 .45 is pressed, the baseline position is shifted up and down in the usual 10-step movement, as shown in POS. 1 .45 → POS. 10 .00 → POS. 20 .00 . The changing direction can be selected by SETTING ⇩/⬆.

Setting keys	Display contents and setting-up procedure
	(This key is provided at a lower part on the AMP screen display.) This key selects the changing direction of an input range or a baseline position. When this key is pressed, the changing direction can be selected as indicated in the following: --- When  is pressed in  , the sensitivity can be changed clockwise from 500 Vrms/F.S. to 0.1 Vrms/F.S. in sequence of 0.5 → 0.2 → 0.1 → ... Note: Sensitivity cannot be changed from 0.1 Vrms/F.S. to 500 Vrms/F.S. When  is pressed, the baseline position can be changed in sequence of 0.00 → 10.00 → 20.00 → ... --- When  is pressed in  , the sensitivity can be changed counterclockwise from 0.1 Vrms/F.S. to 500 Vrms/F.S. in sequence of 0.5 → 1 → 2 → ... Note: Sensitivity cannot be changed from 500 Vrms/F.S. to 0.1 Vrms/F.S. When  is pressed, the baseline position can be changed in sequence of 0.00 → 100.00 → 90.00 → ...

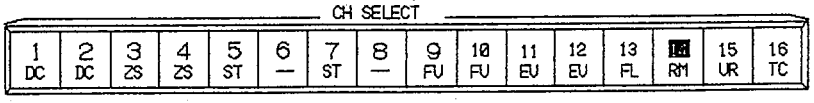
1.4.2 Setting-up Procedure on AMP Detailed Setup Display (AMP-2 or AMP-3 Screen Display)

When [CH 14 RM] (the channel number key where an RMS converter unit is incorporated) is pressed on the AMP-1 or AMP-2 screen display (on the AMP-1 screen display for RT3108N/3208N series), the AMP-3 screen display, as shown below (the AMP-2 screen display for RT3108N/3208N series) appears to enable more detailed setup.



(1) CH SELECT (channel selection)

Selects a channel to be displayed.



Press the channel key to be set and the channel number is reversely displayed as 14 and the setup screen display of the selected channel is displayed to enable each item to be set.

When [ALL] is pressed, the input units of the same type can be simultaneously set. For details, refer to 4.6 of the operation manual for the basic instrument (RT3100N/3200N).

(2) INPUT

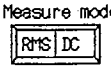
The input can be selected to ON, OFF or GND.

ON : The input to the amplifier is turned on, so that recording can be made.

OFF: The input to the amplifier is turned off, so that recording is also turned off.

GND: The input to the amplifier is turned off and recording is positioned on the baseline.

③ Measure mode (measurement mode)

Select the measurement mode by 

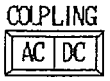
in accordance with the mode of a signal to be measured.

RMS: RMS converter mode.

DC : DC amplifier mode.

(The selected measurement mode is reversely displayed.)

④ COUPLING

Select the coupling by 

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AC: AC coupling

The DC component of a signal is canceled and only its AC component is measured.

DC: DC coupling

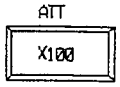
The DC and AC components of a signal are measured.

(The selected coupling is reversely displayed.)

⑤ RANGE (sensitivity) (Vrms/F.S.)

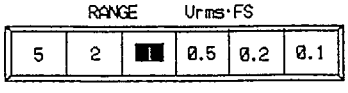
⑥ ATT (multiplying factor)

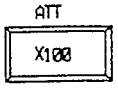
The input range can be set by ⑤ RANGE and ⑥ ATT.

When 

is pressed, the indication is changed to x1, x100 to set up the multiplying factor.

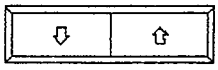
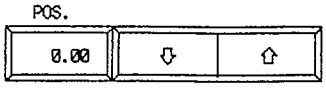
Example:

When the sensitivity and multiplying factor are set to 

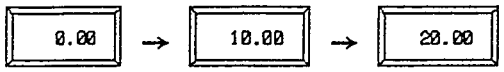


, the input range becomes 100 Vrms/F.S.

⑦ POS (baseline position)

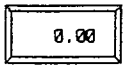
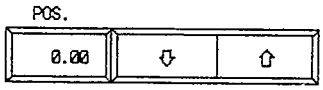
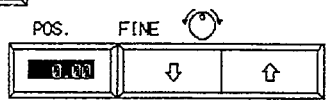
When  of 

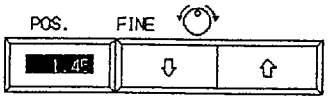
is pressed, the baseline position of an input signal moves up or down in 10 steps, as shown in



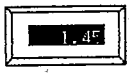
The baseline position is indicated by ◁ on the right side of ⑨ Level.

⑧ POS (fine adjustment of baseline position)

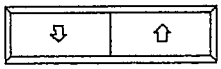
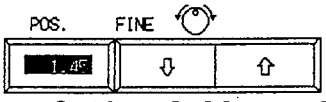
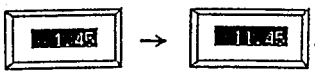
When  of  is pressed, the number is reversely displayed, as shown in 0.00 of  .

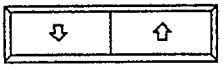
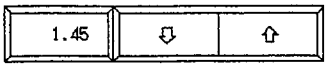
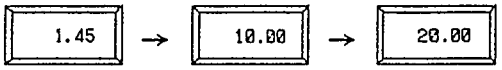
Turning the jog dial displays a decimal fraction following a number of one figure, as shown in 1.45 of  , so that the baseline position can be adjusted more finely (in 0.05 steps) than the usual 10-step adjustment.

When recording, the baseline position can be moved in 0.125 mm steps by turning the jog dial.

Pressing  again returns the reversely displayed number to the original state.

Note:

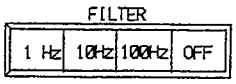
If  is pressed during the time the fine adjustment is made, as shown in  , the baseline position is moved in 1/10 steps of the full scale, while retaining the finely adjusted portion (1.45) of the baseline position, as shown in  .

If  is pressed during the time the fine adjustment is not made, as shown in  , the baseline position is moved in 1/10 steps of the full scale with the finely adjusted portion (1.45) of the baseline position canceled, as shown in  .

⑨ Level

The status of an input signal is indicated on the basis of the set baseline position.

⑩ FILTER

The low-pass filter can be selected from 

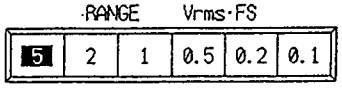
.

(The selected filter is displayed reversely in black and white.)

⑪ WIDE SCALE

When 

is pressed, 



is displayed, where a waveform of up to +500 V to -500 V can be displayed and recorded. If, however, the Measure mode ③ is set to RMS, this function is disabled.

Note:

This is not a range of 1000 V/F.S.

For instance, if the baseline position is set to 0.00 (the lowermost part), a waveform of from 0 to +500 V is only displayed and recorded.

⑫ PREV (previous page)

This selects a screen display (8-channel screen display) one page previous to the present display.

⑬ MONITOR

Pressing 

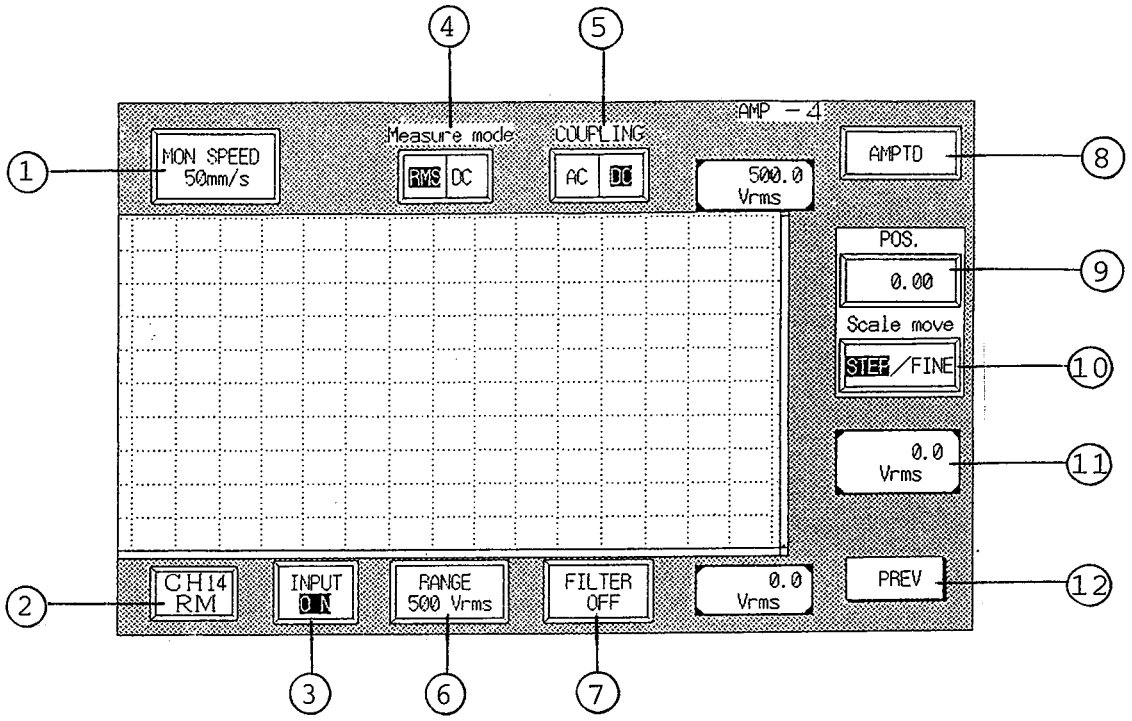
selects the AMP-4 screen display (the AMP-3 screen display for RT3108N/3208N series) to allow various settings to be simultaneously carried out, while viewing the input waveform on the waveform monitor for each channel.

In addition, the amplitude of the input waveform can be changed without changing the sensitivity.

(For details, refer to 1.4.3 Display and Setting-up Procedure on AMP Setup Monitor Screen Display, which will be explained in the following paragraph on the next page.

1.4.3 Display and Setting-up Procedure on AMP Setup Monitor Screen Display (AMP-3 or AMP-4 Screen Display)

Pressing [MONITOR] on the AMP-3 screen display (on the AMP-2 screen display for RT3108N/3208N series) displays the AMP-4 screen display (the AMP-3 screen display for RT3108N/3208N series), as shown in the figure below:



(1) MON SPEED (monitor speed)

Press [MON SPEED 50mm/s] to display [MON SPEED 50mm/s] and change monitor speeds with the jog dial.

50, 25, 10, 5, 2, 1 mm/sec
100, 50, 25, 10, 5, 2, 1 mm/min
100, 50, 25, 10, 5, 2, 1 mm/hour

(2) Channel selection

Channels to be displayed can be changed.

Press [CH14 RM] to display [CH14 PM] and change channels with the jog dial.

Pressing [CH14 PM] once again displays the monitor display of the selected channel and returns the characters displayed reversely in black and white to the original state.

③ INPUT

Pressing 

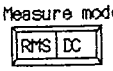
selects ON, OFF or GND.

ON : The input to the amplifier is turned on, so that recording can be made.

OFF: The input to the amplifier is turned off and recording is also turned off.

GND: The input to the amplifier is turned off and recording is positioned on the baseline.

④ Measure mode (measurement mode)

Select the measurement mode by 

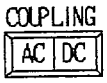
in accordance with the mode of a signal to be measured.

RMS: RMS converter mode

DC : DC amplifier mode

(The selected measurement mode is displayed reversely in black and white.)

⑤ COUPLING

Select the coupling by 

.

AC: AC coupling

The DC component of a signal is canceled and only its AC component is measured.

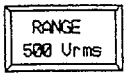
DC: DC coupling

The DC and AC components of a signal are measured.

(The selected coupling is displayed reversely in black and white.)

⑥ RANGE (sensitivity)

The input range can be set.

When 

is pressed, characters are displayed reversely in black and white, as shown in 500Vrms of 

, and the input range can be selected with the jog dial.

⑦ FILTER

The low-pass filter can be selected from 5 Hz, 500 Hz, 5 kHz and OFF

When [FILTER OFF] is pressed, characters are displayed reversely in black and white, as shown in OFF of [FILTER OFF], and the filter can be selected with the jog dial.

⑧ AMPTD (amplitude)

The amplitude of a waveform displayed on the monitor can be changed to any value in the range of x10 to x1/2 without changing sensitivity.

Press [AMPTD] to display [AMPTD] and the amplitude can be changed to any value with the jog dial.

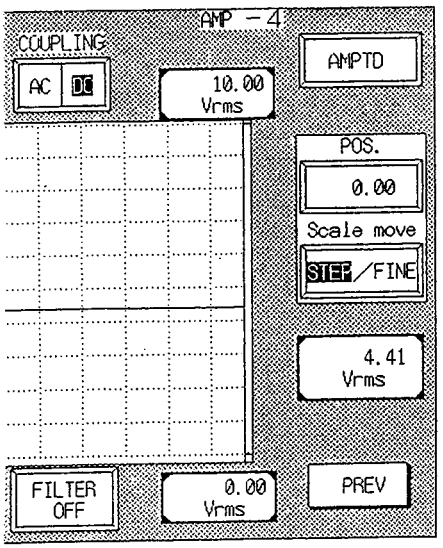
The full-scale value is displayed on [500.0 Vrms].

When the amplitude is changed, the mark "#" is displayed and that the displayed full-scale value is also changed.

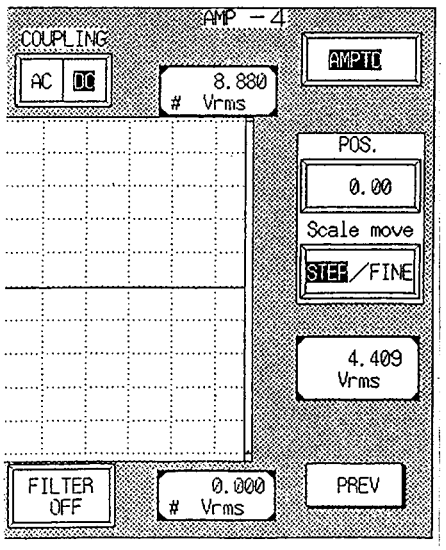
When the full-scale value is changed from "0.00 - 10.00 Vrms" to "0.000 - 8.880 Vrms", the display and recording are as shown below:

Sample display

(Before changing amplitude)
(F.S.: 0.00 - 10.00 Vrms)

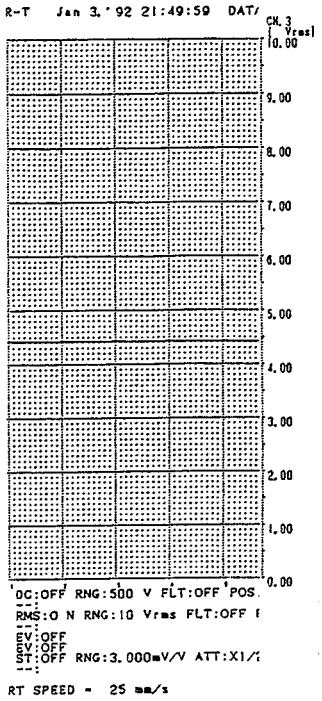


(After changing amplitude)
(F.S.: 0.000 - 8.880 Vrms)

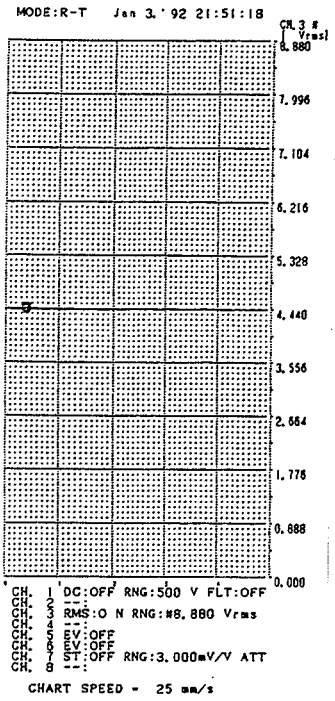


Sample recording

(Before changing amplitude)
(F.S.: 0.00 - 10.00 Vrms)



(After changing amplitude)
(F.S.: 0.000 - 8.880 Vrms)



In the sample display, the mark "#", which is displayed at the left side of the full-scale value of after changing the amplitude and, in the sample recording, which is recorded at the upper right of the scale display and at the right side of RNG of the display of setup contents, indicates that the scale mode of " 7. Setting-up of Scale and Unit on Menu 1 Screen Display (System Page 2/3)" is automatically changed to Mode 1.

For scaling, refer to 9.6 Setting-up of Scale and Unit provided on the operation manual of the basic instrument.

Note:

If the amplitude is changed, the trigger level is influenced by the changed amplitude, since it is set by % to the amplitude of a recorded waveform. After setting up the amplitude, therefore, it is necessary to set the trigger level once again.

⑨ POS (baseline position)

Press [0.00] to display [0.00].

The baseline position can be moved up or down in 0.05 steps with the jog dial, as shown in [0.00] → [0.05] → [0.10] with the full scale in 100.

The baseline position is indicated by ◀ at the right side of the waveform monitor.

The scale display is determined by selecting the Scale move ⑩.

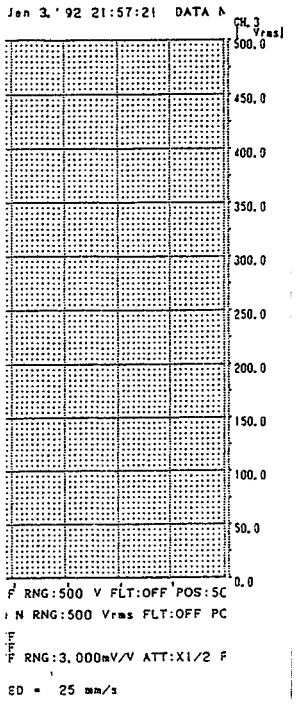
⑩ Scale move (scale movement)

The steps of movement of the scale display in a waveform recording can be selected by Scale move [STEP/FINE].

STEP: When recording, the baseline position can be moved in 0.125 mm steps. If the movement of the baseline position exceeds ±0.5 DIV, the scale display is moved 10 steps by 10 steps with the full scale in 100.

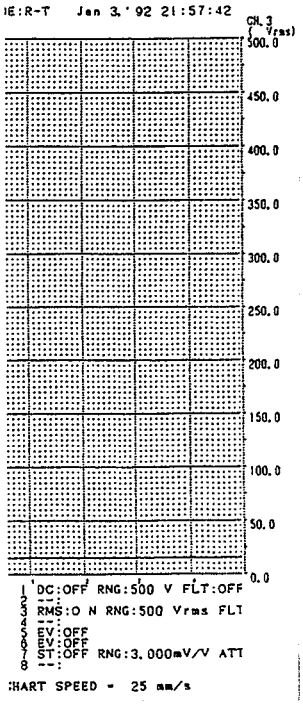
Take care that the scale display is moved by finely adjusted baseline positions, as shown below:

Sample recording
Scale display with POS set in 0.00



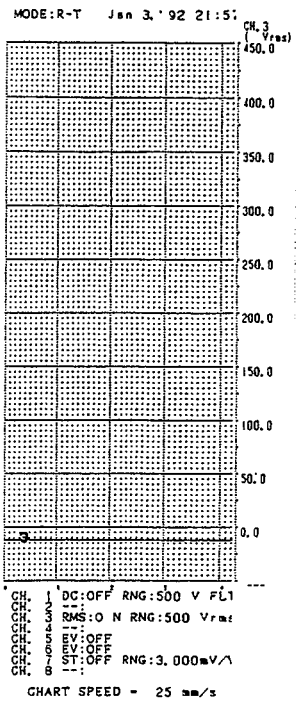
Scale display not moved

Scale display with POS set in 0.00 to 4.95

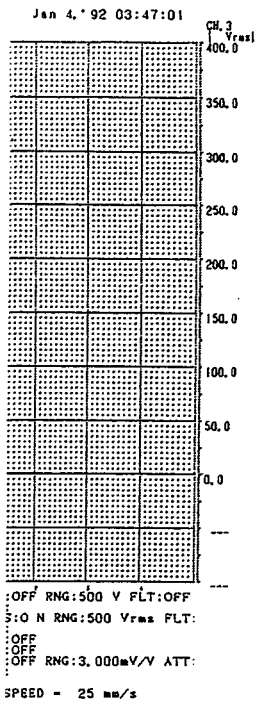


Scale display moved up by 10 steps

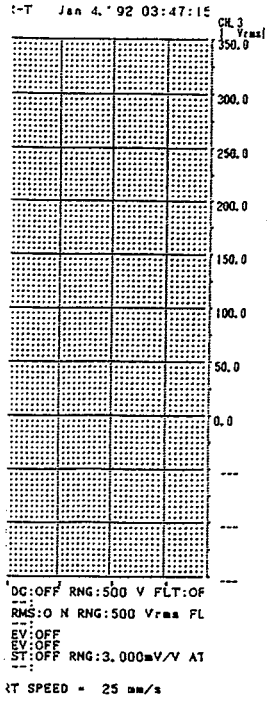
Scale display with POS set in 5.00 to 14.95



Scale display with POS set in 15.00 to 24.95

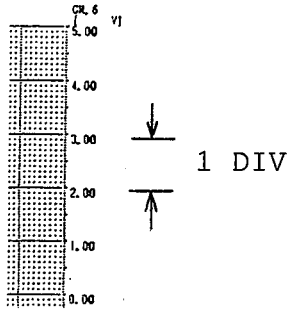


Scale display with POS set in 25.00 to 34.95



Scale display moved up by more 10 steps

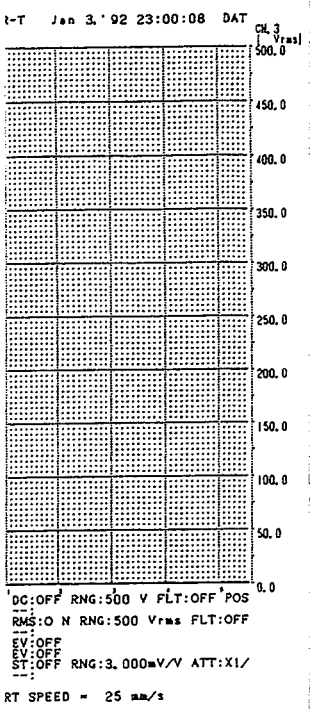
Scale display moved up by more 10 steps



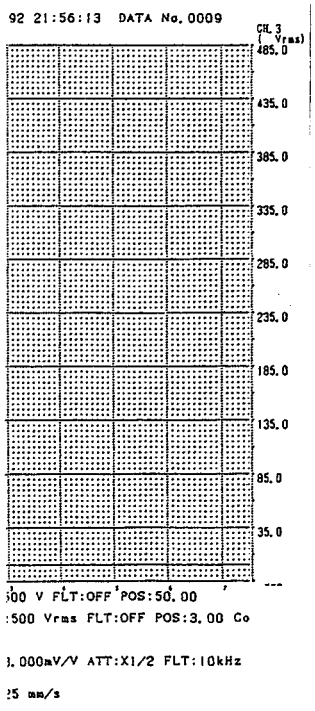
If the baseline position is moved by more than 0.5 DIV, the scale display is moved.

FINE: When recording, the baseline position can be moved in 0.125 mm steps. If the baseline position is finely adjusted in 0.05 steps with the full scale in 100, the scale display is also moved in 1/2000 steps of sensitivity at the same time with the change of baseline positions.
The scale display is moved, as shown below, when the baseline position is changed to "0.00", "3.00" and "8.00 respectively.

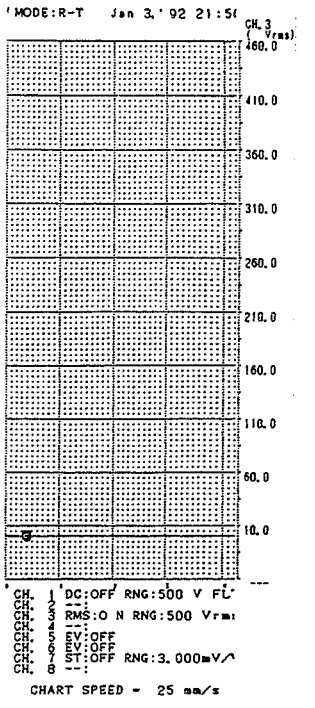
Sample recording
Scale display with POS set in 0.00



Scale display with POS set in 3.00



Scale display with POS set in 8.00



⑪ Digital display
The digital value of an input signal is displayed.

⑫ PREV (previous page)
The present screen display is changed to the AMP-3 screen display (the AMP-2 screen display for RT3108N/3208N series).

1.5 Specifications

Number of channels:
  1 input/unit.
Input system:
  Single-ended input, floating between input and output.
Measurement sensitivity and accuracy:
  RMS mode;
    0.1, 0.2, 0.5, 1, 2, 5 Vrms/F.S., x1 and x100 (12 steps).
    Accuracy; Within ±1%/F.S. (from DC, 40 to 20 kHz, and at crest factor 3 or lower).
  DC mode;
    0.1, 0.2, 0.5, 1, 2, 5 V/F.S., x1 and x100 (12 steps).
    Accuracy; Within ±0.5%/F.S.
    Direct recording of 200 V AC possible (when AMP screen display of basic instrument is set in ±500 V/F.S.).
Crest factor:
  8 max. (with ranges set from 100mVrms to 50 Vrms/F.S.).
Input impedance:
  Approx. 1 MΩ.
Allowable input voltage:
  x1 ; 100 V (DC or AC peak value).
  x100; 500 V (DC or AC peak value).
Frequency response:
  DC to 20 kHz (within +0.5, -3 dB) at DC coupling.
  1 Hz to 20 kHz (within +0.5, -3 dB) at AC coupling.
Linearity:
  Within ±0.2%/F.S.
Common-mode voltage (CMV):
  500 V (DC or AC peak value).
Common-mode rejection ratio (CMRR):
  Greater than 80 dB with input shortcircuited at 60 Hz.

Low-pass filter:

2-pole, Bessel type.

Cutoff frequency; 5 Hz, 500 Hz, 5 kHz and OFF.

Attenuation; Approx. -12 dB/OCT.

Drift:

Within ±0.5%/F.S./10°C.

A/D conversion:

Resolution; 12 bits.

Conversion time; 5 μsec max.

Conversion method; Successive comparison.

Input connector:

Double-deck binding posts (+, -) (RT31-141).

Safety terminals (+, -) (RT31-153).

Channel annotation:

Channel number, type of input unit, ON/OFF of input, filter value, measurement range and zero position.

SECTION 2

THERMOCOUPLE AMPLIFIER UNIT

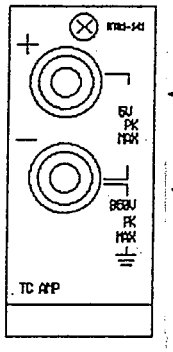
CONTENTS

2.1 Input Connection

(1) Connection

The figure below shows the input section of the thermocouple amplifier unit.

Connect the (+) input terminal (red) to the positive side (the high-impedance side of a signal source) of a thermocouple and the (-) input terminal (black) to the negative side (the low-impedance side of the signal source) of the thermocouple.



(+) High-impedance side ← Connect this to (+) of thermocouple or signal source.

(-) Low-impedance side ← Connect this to (-) of thermocouple or signal source.

Notes:

When a very low signal is to be recorded, take note of the following points:

° Make an input cable as short as possible.

° Use a shielded cable to suppress electrostatic noise.

° Twist the positive and negative (+,-) insulated conductors of an input cable together to suppress electromagnetic noise.

The impedance of a signal source should be made to less than 100 ohms.

From the standpoint of noise, etc., the lower the signal source impedance is, the better the recording will become.

(2) Take notes of the following points when this unit is used as a thermocouple amplifier:

° Connect the lead wires of a thermocouple directly to the input terminals. Or use crimp terminals (4 ϕ) of small thermal capacity.

° When connecting a thermocouple to the input terminals, do not confuse the positive lead with the negative lead.
If its lead wires are erroneously connected in polarity, a lower temperature may be recorded even if the temperature is actually high.

° When connecting a thermocouple to the input terminals, set Ref Junc (reference junction temperature compensation) to INT (internal).

For the setting-up procedure, press the SYSTEM key on the operation panel to display the MENU 2 screen display.
(Refer to 2.2 Setting-up Procedure.)

° If the reference junction temperature compensation is set to EXT (external), external reference junction temperature compensation such as zero compensation, etc., is required.

° In order to carry out stable measurement, wait more than 30 minutes for the instrument to warm up after turning on the power.

° If the input terminals are affected by direct wind and/or direct sunlight, rapid changes in temperature may occur, causing drift in the reference junction temperature compensation circuit, and an accurate recording cannot be made.

° The thermocouple amplifier unit is not suited for recording a general signal, as it incorporates a linearizer circuit.
In this case, change the type to DC AMP.

(3) Take notes of the following points when this unit is used as a DC amplifier:

° The common-mode voltage (CMV) must be less than 350 V DC or AC peak value. The insulation of the cable to be used must withstand the voltage of more than 350 V. Applying a common-mode voltage of more than 350 V may cause the unit to malfunction.

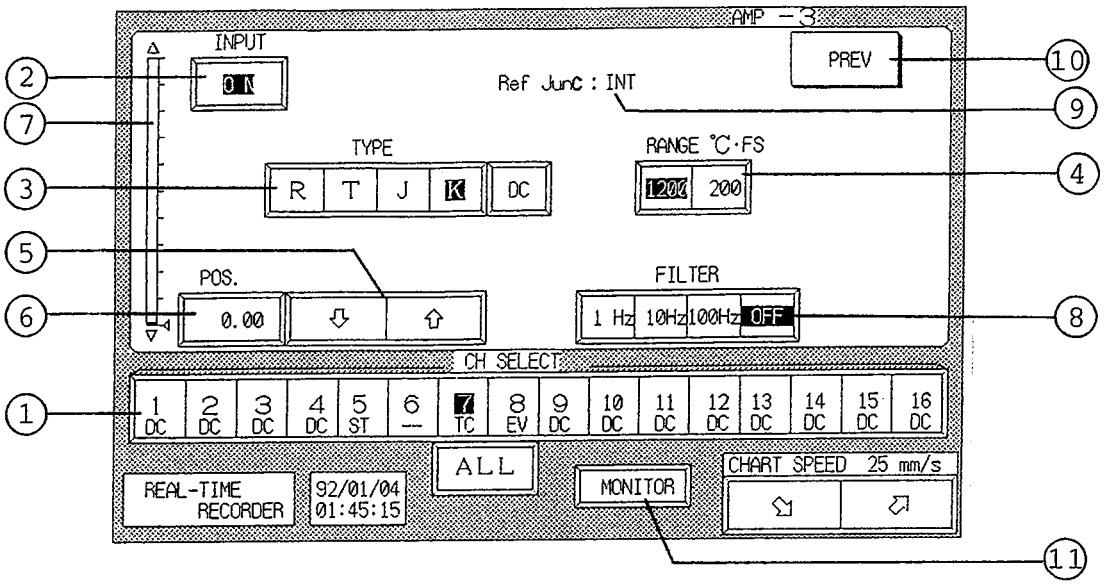
If a noise-like, pulsating common-mode voltage is applied, the common-mode rejection ratio (CMRR) becomes deteriorated and noise may appear on the recording.

° If a voltage of more than the maximum allowable input voltage (5 V DC or AC peak value) should be inadvertently applied, the parts used in this instrument may be broken. Care must be taken, therefore, not to exceed the maximum allowable input voltage. The input impedance is approximately 10 MΩ. However, if the input voltage is greater than approximately ±11 V, the protective circuit is activated, causing the input impedance to be approximately 1 kΩ. So, care must be taken.

° Take notes of the fact that the input impedance becomes approximately 1 kΩ even when the power is turned off.

2.2 Setting-up Procedure

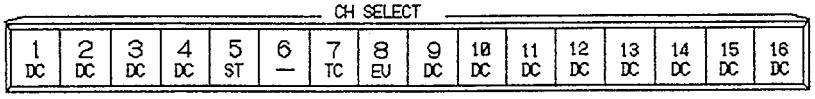
Press the [CH 7 TC] key (the channel number key where a thermocouple amplifier unit is incorporated) on the AMP-1 or AMP-2 screen display (the AMP-1 screen display for RT3108N/3208N series) to display the AMP-3 screen display (the AMP-2 screen display for RT3108N/3208N series), as shown in the figure below.



On the screen display shown above, carry out detailed setting-up procedure.

① CH SELECT (channel selection)

The channel to be displayed can be selected.



Press the channel key to be set and the channel number is displayed reversely in black and white, as shown in 1 , and the setup screen display of the selected channel will appear to enable each item to be set.

When [ALL] is pressed, the input units of the same type can be set simultaneously.

② INPUT

Pressing this key selects ON, OFF or GND.

ON : The input to the amplifier is turned on, so that recording can be made.

OFF: The input to the amplifier is turned off, so that recording is also turned off.

GND: The input to the amplifier is turned off and recording is positioned on the baseline.

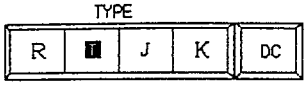
③ TYPE (type of thermocouple)

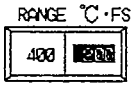
The type of a thermocouple to be used can be selected.
When the unit is used as a DC amplifier, select DC.

④ RANGE (sensitivity)

The input range of the type of a thermocouple, which has been selected in ③ , can be set.

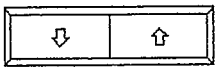
Example:

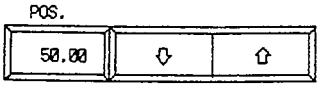
In 

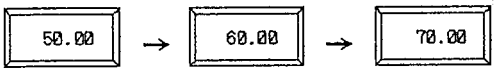


, Type T thermocouple is selected and the range is 200°C/F.S.

⑤ POS (baseline position)

When 

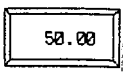
of 

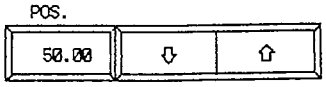
is pressed,
the baseline position of an input signal can be moved in 10 steps, as shown in 

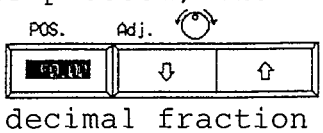
.

The baseline position is indicated by ◁ on the right side of the waveform monitor ⑦.

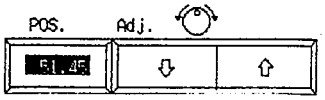
⑥ POS (fine adjustment of baseline position)

When 

of 

is pressed, the number is reversely displayed, as shown in 50.00 of 

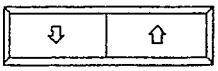
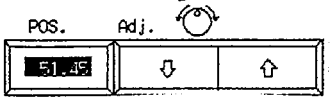
.

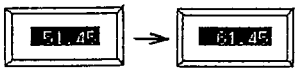
Turning the jog dial displays a decimal fraction following a number of one figure (1.45), as shown in 51.45 of 

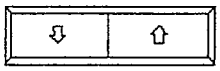
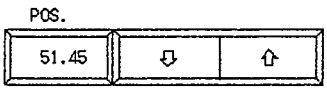
, so that the baseline position can be adjusted in 0.05 steps (in 0.125 mm pitches on a recording).

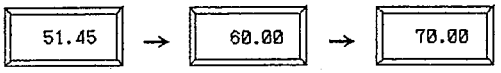
Pressing  again completes the setting-up and returns the reversely displayed number to the original state.

Note:

If  is pressed during the time the fine adjustment is made, as shown in 

, the baseline position is moved, while retaining the finely adjusted portion (1.45), as shown in  .

If  is pressed during the time the fine adjustment is not made, as shown in 

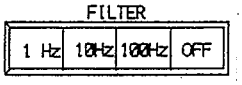
, the baseline position is moved in 1/10 steps of the full scale with the finely adjusted portion (1.45) of the baseline position canceled, as shown in 

.

⑦ Waveform monitor

The waveform operation of an input signal is displayed.

⑧ FILTER

The low-pass filter can be selected from 

.

(The selected filter is displayed reversely in black and white.)

⑨ Ref Junc (reference junction temperature compensation)

The setup contents of reference junction temperature compensation can be displayed.

For the setting-up procedure, refer to Setting-up Procedure on MENU 2 Screen Display (SYSTEM PAGE 3/3)

⑩ PREV (previous page)

This selects a screen display (8-channel screen display) one page previous to the current display.

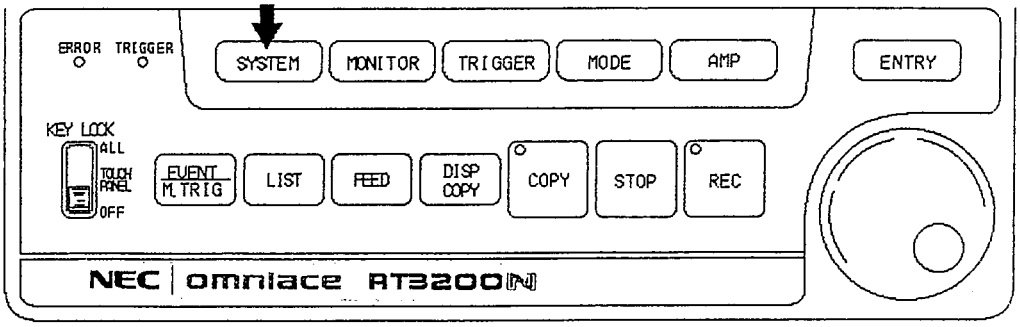
⑪ MONITOR

Pressing 

selects the AMP setup monitor screen display. (Refer to 4.7 AMP Setup Monitor Screen Display provided on the operation manual for basic instrument.)

Setting-up Procedure on MENU 2 Screen Display (SYSTEM PAGE 3/3)

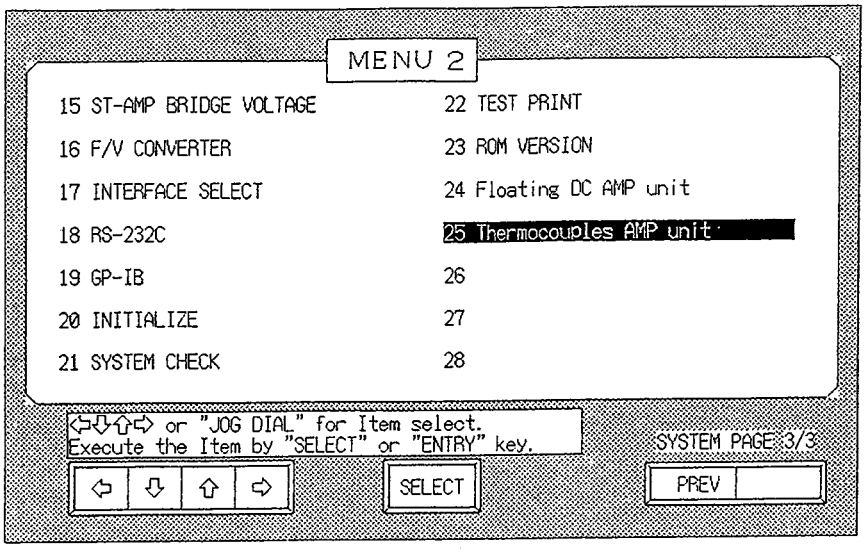
Press the SYSTEM key on the operation panel.



Press the SYSTEM key to display the following MENU 2 screen display (SYSTEM PAGE 3/3).

Note:

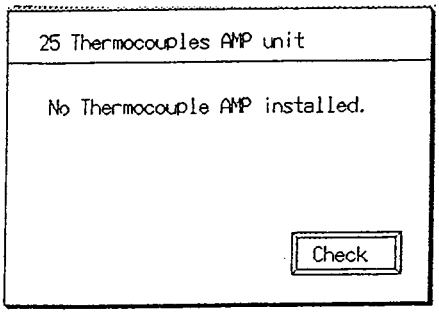
If another system page is displayed, press the NEXT to display the MENU 2 screen display (SYSTEM PAGE 3/3).



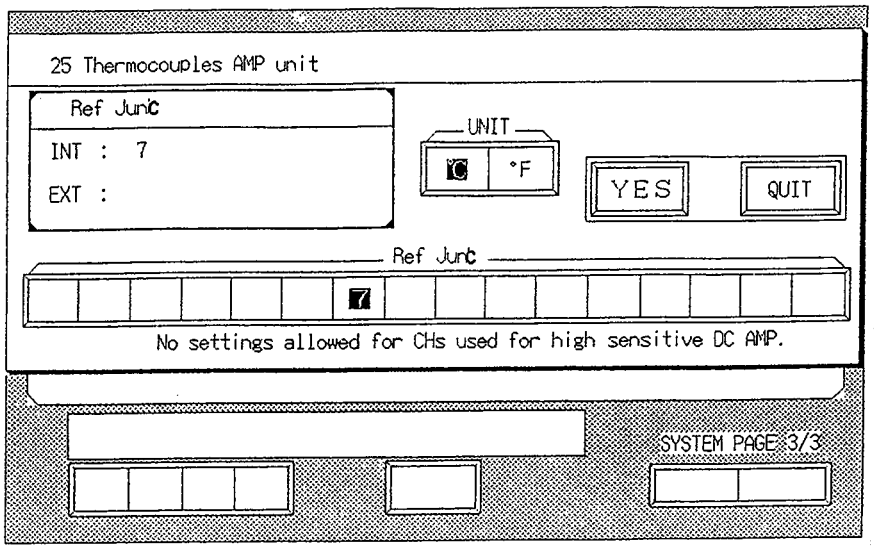
Move the black-to-white reverse display to the item of 25 Thermocouples AMP unit with ⇦ ⇩ ⇧ ⇨ on the screen display or with the jog dial. Press SELECT on the screen display or the ENTRY key on the operation panel and the screen display shown on the next page appears.

Note:

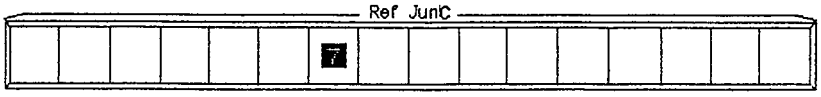
If a thermocouple amplifier unit is not installed or if it is used as a high-sensitivity DC amplifier or if no unit is displayed by limiting channels to be used, an error display shown below will appear. Since, in this case, no setup screen display appears, press the [Check] key.



Press the [ENTRY] key or [SELECT] to allow the following screen display to appear.



① Set Ref Junc (reference junction temperature compensation) to EXT (external) or INT (internal) for each channel.

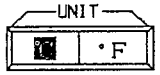


Select the channel by pressing the channel number key to be set.

If the channel is not reversely displayed such as 7, it indicates that the channel is set to EXT, and if the channel is reversely displayed such as ■, it indicates that the channel is set to INT.
The channel, where the reference junction temperature compensation is externally set, is displayed at EXT of ③.
The channel, where the reference junction temperature compensation is internally set, is displayed at INT of ③.

Note:
Only the channel, where the thermocouple amplifier unit is installed, is displayed on Ref Junc ①. In this case, however, the channel, where it is set as a high-sensitivity DC amplifier, is not displayed.

② This sets the unit of temperature to Celsius (°C) or Fahrenheit (°F).

Select the unit of temperature by pressing [℃] or [℉] of 

.

(The selected unit of temperature is displayed reversely in black and white.)

Pressing [YES] completes the setting-up and returns the current display to the MENU 2 screen display.

Pressing [QUIT] returns the current display to the MENU 2 screen display with the setting-up quitted.

2.3 Specifications (RT31-143)

Number of channels:

1 input/unit.

Input system:

Single-ended input, floating between input and output.

Applicable thermocouples:

R, T, J and K.

Measurement temperature ranges:

2 ranges for use as a thermocouple amplifier.

Type R thermocouple;

Centigrade scale display;

800°C/F.S. (0 to 800°C)

1600°C/F.S. (0 to 1600°C)

Fahrenheit scale display;

1500°F/F.S. (32 to 1472°F)

3000°F/F.S. (32 to 2912°F)

Type T thermocouple;

Centigrade scale display;

200°C/F.S. (-200 to 200°C)

400°C/F.S. (-200 to 400°C)

Fahrenheit scale display;

400°F/F.S. (-392 to 392°F)

800°F/F.S. (-392 to 752°F)

Type J thermocouple;

Centigrade scale display;

200°C/F.S. (-200 to 200°C)

1000°C/F.S. (-200 to 1000°C)

Fahrenheit scale display;

400°F/F.S. (-392 to 392°F)

2000°F/F.S. (-392 to 1832°F)

Type K thermocouple;

Centigrade scale display;

200°C/F.S. (-200 to 200°C)

1200°C/F.S. (-200 to 1200°C)

Fahrenheit scale display;
400°F/F.S. (-392 to 392°F)
2500°F/F.S. (-392 to 2192°F)

3 ranges for use as a DC amplifier.
10 mV/F.S., 20 mV/F.S. and 50 mV/F.S.

Accuracy:

For use as a thermocouple amplifier;
Within ±0.5%/F.S. for measured value.
However, within ±1%/F.S. for -200 to 0°C of 200°C/F.S. range.

For use as a DC amplifier;
Range accuracy; Within ±0.5%/F.S.
Linearity; Within ±0.2%/F.S.

Frequency response:

DC to 5 kHz (within +0.5, -3 dB).

Reference junction temperature compensation circuit:

Internally and externally selectable.
Accuracy; Within ±2°C (when temperature of input terminal section balanced).

Filter:

2-pole Bessel type.
1 Hz, 10 Hz, 100 Hz and OFF.
Attenuation; Approx. -12 dB/OCT.

Input bias current:

20 nA (mean value).

Temperature stability:

Accuracy; Within ±0.4%/F.S./10°C in ranges of 800°C/F.S. of type R thermocouple and of 200°C/F.S. of types K, T and J thermocouples.

In range of 10 mV/F.S. of DC amplifier;
Zero drift; Within ±0.3%/F.S./10°C.
Accuracy; Within ±0.1%/F.S./10°C.

Input impedance:

Approx. 10 MΩ.

Allowable input voltage:

5 V (DC or AC peak value).

Common-mode voltage (CMV):

350 V (DC or AC peak value).

Common-mode rejection ratio (CMRR):

Greater than 120 dB (with input shortcircuited and at 60 Hz).

A/D conversion:

Resolution; 12 bits.

Conversion time; 5 μsec max.

Conversion method; Successive comparison.

Input connector:

Double-deck binding post miniature terminal.

(Corresponding to 4ϕ crimp terminal)

Baseline position:

Baseline position can be adjusted in 1/10 steps on full scale. In addition, baseline position can be finely adjusted in 0.125 mm steps.

Channel annotation:

Channel number, type of input unit, input ON/OFF, filter value, measurement range and zero position.

SECTION 3

FLOATING DC AMPLIFIER UNIT

CONTENTS

1.General Information

This unit, designed with the insulation amplifier module used and with the analog circuit floated, is especially suitable for the field measurement within noisy environment.

In addition, to be possibly replaced with an electromagnetic oscillograph, input impedance can be as low as 10 kohm by switching to the contact input mode.

According to the type of input connector, two kinds of unit, floating DC amplifier unit with double-deck binding posts (RT31-140) and floating DC amplifier unit with safety terminals (RT31-147), are available.

Caution: If a voltage signal which exceeds the Allowable Input Voltage should be applied to the input, it may cause malfunction of the unit. Make sure that input signal should not exceed the Allowable Input Voltage shown as below:

1) Voltage input mode

Allowable Input Voltage	*Input Range*
100V (DC or AC peak value)	*0.1 to 5 V/FS*
500V (DC or AC peak value)	*10 to 500 V/FS*

2) Contact input mode

i) When the input impedance is set to 100 kohm

Allowable Input Voltage	*Input Range*
100V (DC or AC peak value)	*0.1 to 5 V/FS*
500V (DC or AC peak value)	*10 to 500 V/FS*

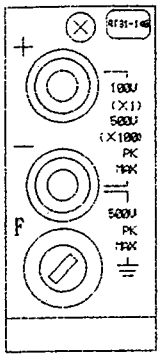
ii) When the input impedance is set to 10 kohm

Allowable Input Voltage	*Input Range*
70V (DC or AC peak value)	*0.1 to 50 V/FS*

Note: When the input impedance is set to 10 kohm, the input range is limited to the range of from 0.1 to 50 V/FS.

2. Input Section

2.1 Floating DC Amplifier Unit(RT31-140)



+,-(input terminals): Double-deck type binding posts
The (-) terminal is connected to GUARD (shielded case) inside the unit.

Allowable input voltage:

·) Voltage input mode
100V (DC or ACpeak): 0.1 to 5 V/FS
500V (DC or ACpeak): 10 to 500 V/FS

·) Contact input mode
i) Input impedance = 100 kohm
100V (DC or ACpeak): 0.1 to 5 V/FS
500V (DC or ACpeak): 10 to 500 V/FS
ii) Input impedance = 10 kohm
70V (DC or ACpeak): 0.1 to 50 V/FS

Common mode voltage:
(between +,- terminals and housing case)
500V (DC or ACpeak)

Caution: The note on the rear panel indicates the allowable input voltage in voltage input mode. When the input impedance is set to 10 kohm in contact input mode, the maximum allowable input voltage is 70 V, even when ATT is set to x100.

F (fuse holder): A fuse is incorporated to protect this unit from excessive voltage input. A standard one of 0.1 A is installed. Also a 10 mA fuse (0334-2105) is provided for protection of input signal source.

Caution: A fuse is used to lessen possible damage to the unit, but it cannot protect the unit completely.

* A signal input cable (0311-5107, with a double-deck banana plug on one end and a test clip on the other end, cable length: 2m) is available.

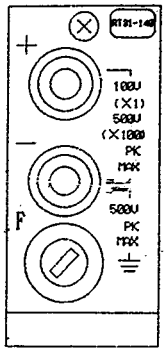
2.2 Floating DC Amplifier Unit with Safety Terminals(RT31-147)

This is a modified unit where the construction of the signal input terminals (+,-) are of the safety-terminal form permitting no direct touch of hand. Other functions of this unit are exactly the same as those of RT31-140.

3.Operation Instruction

3.1 Connection to Input Signal

In order to carry out correct measurement with less noise, the input cable connection is very important.
Basically, connect the high-impedance side (H side:hot side) to the red(+) input terminal and the low-impedance side (L side:cold side) to the black(-) input terminal.



Signal source

Red(+) high-impedance side (H side:hot side)

←——————————————————————(+)

Black(-) low-impedance side (L side:cold side)

←——————————————————————(-)

Especially when a low-level signal is to be measured, pay attention to:

a) Make the input signal cable as short as possible.
b) Use a shielded cable to suppress electrostatic noise.
c) Twist the (+) and (-) input cables together to suppress electro-magnetic noise.

The impedance of signal source should be made to less than 100 ohm. Also from the viewpoint of noise-suppression, the lower the impedance of signal source is, the better the measurement will become.

Caution: In case of a non-grounded signal source, be sure that the common mode voltage (CMV) is less than 500V(DC or AC peak value) and use cable whose breakdown point of insulating material is higher than 2kV.

3.2 Caution on Input Signal

a)Maximum input voltage

If a voltage signal which exceeds the Allowable Input Voltage should be applied to the input, it may cause malfunction of the unit. Therefore, make sure that input signal should not exceed the Allowable Input Voltage shown as below:

1) Voltage input mode

Allowable Input Voltage	Input Range
100V (DC or AC peak value)	0.1 to 5 V/FS
500V (DC or AC peak value)	10 to 500 V/FS

2) Contact input mode

i) When the input impedance is set to 100 kohm

Allowable Input Voltage	Input Range
100V (DC or AC peak value)	0.1 to 5 V/FS
500V (DC or AC peak value)	10 to 500 V/FS

ii) When the input impedance is set to 10 kohm

Allowable Input Voltage	Input Range
70V (DC or AC peak value)	0.1 to 50 V/FS

Note: When the input impedance is set to 10 kohm, the input range is limited to the range of from 0.1 to 50 V/FS.

b)Input impedance

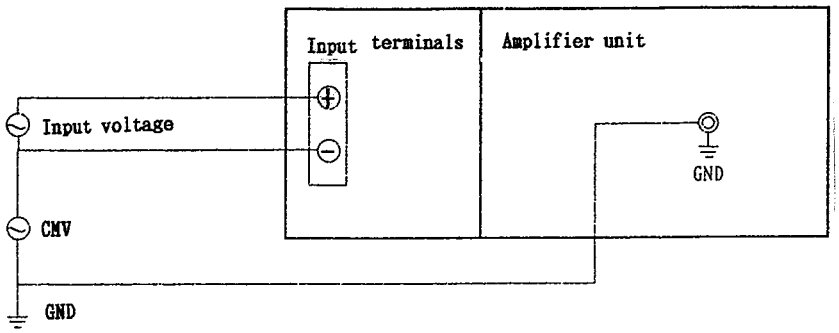
In voltage input mode, the input impedance is approximately 1 Mohm; and in contact input mode, it is approximately 100 kohm or 10 kohm. However, care should be taken that in case of 0.1 to 5 V/FS ranges, when the input voltage becomes higher than approximately 11V, the protection-circuit is actuated and the input impedance becomes to approximately 10 kohm (voltage input mode), 9 kohm and 5 kohm respectively for contact input mode with the input impedance set to 100 kohm and 10 kohm.

c)Common mode voltage (CMV)

The common mode voltage is a voltage component which is applied in common between the ground and the (+,-) input terminals.

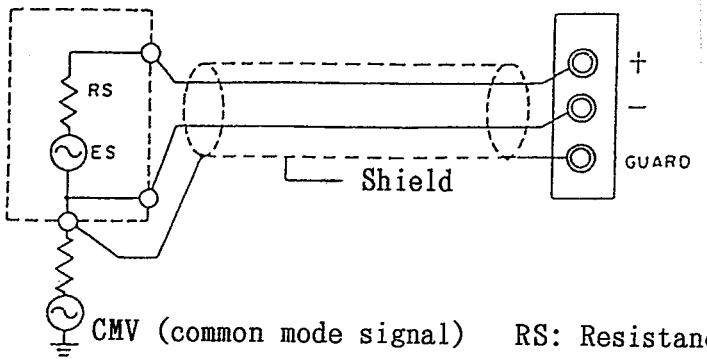
If a noise-like pulse signal is applied as common mode voltage, noise may appear on the recording waveform because of the deterioration of Common Mode Rejection Ratio (CMRR).

In addition, make sure that CMV should not exceed the determined 500V peak value which may cause malfunction of the unit.



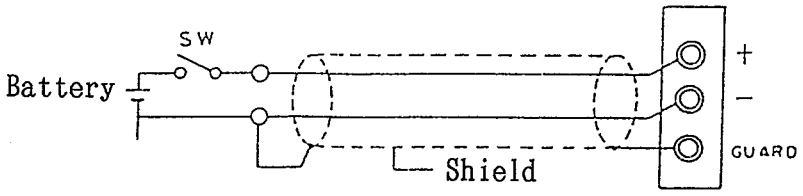
3.3 Caution on Contact Input Mode

Normally the input cables are connected to signal source as shown below when making voltage measurement.



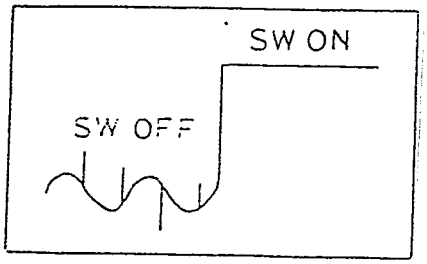
[Connection to a signal source]

Therefore, although the input impedance of this unit is as high as about 1 Mohm, the noise in the input signal is still difficult to suppress since the impedance of the signal source is quite low (usually below 100 ohm).
As shown below is a connection to measure the voltage of a battery. Take the situation when the switch is OFF as the standard, and consider the situation when the switch becomes ON and the voltage of battery is read from the change of the waveform.



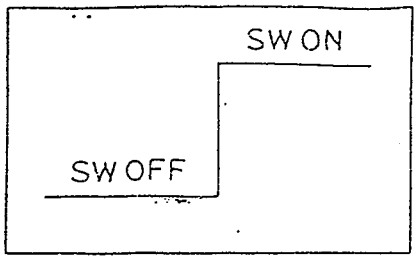
[Connection to a battery]

In the voltage input mode, turn off the switch and the input becomes open, and also because the input impedance is high, noise is extremely easy to influence the measurement.



[Waveform recording in voltage input mode]

When doing such kind of measurement in the contact input mode, it is hard to be influenced by the noise even the switch is turned OFF, since the input impedance becomes lower.

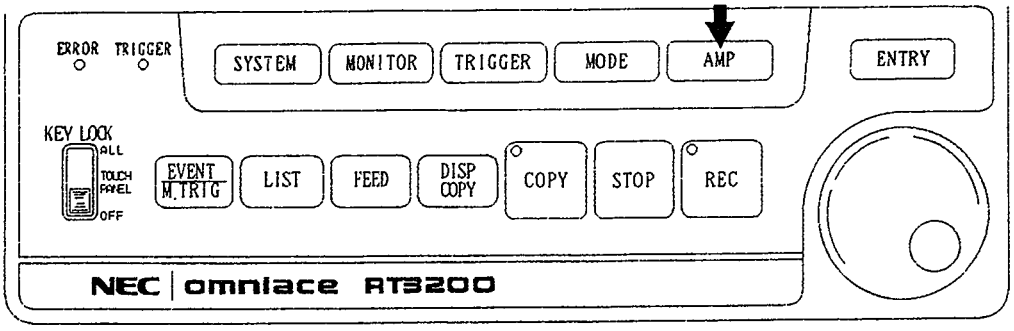


[Waveform recording in contact input mode]

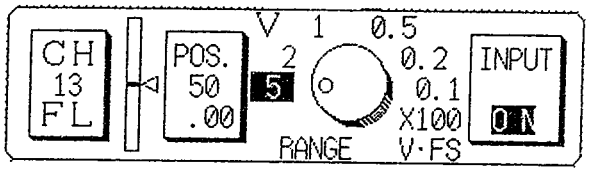
Correct measurement with less noise can be carried out by selecting the contact input mode when the input is open.
This mode is called the contact input mode since it is mainly used in measurement of signal comes from a contact point such as a switch.

4. Setting-up Procedure

4.1 Display and Setup on AMP Screen (AMP-1 or AMP-2)



Press the AMP key on operation panel and the AMP-1 or AMP-2 screen display (AMP-1 for RT3108N/3208N).
The Floating DC amplifier unit is displayed as shown below.



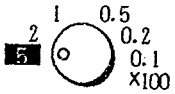
Each part of the figure is explained below:

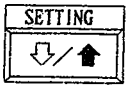
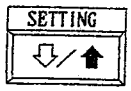
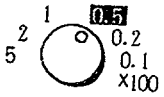
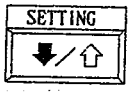
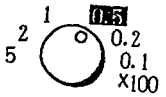
1) Display

Display	Display contents
	Input signal is sampled and displayed. The ◁ mark indicates the baseline position. The display range is the Full Scale for waveform recording. The input signal corresponding to the Full Scale is changed when baseline position is altered.
V	This letter, on the top middle position, indicates the input mode. V: voltage input mode C: contact input mode Refer to Chapter 4.4 for details.

* Baseline position: Displayed or recorded position when input is 0 Volt (short-circuited).

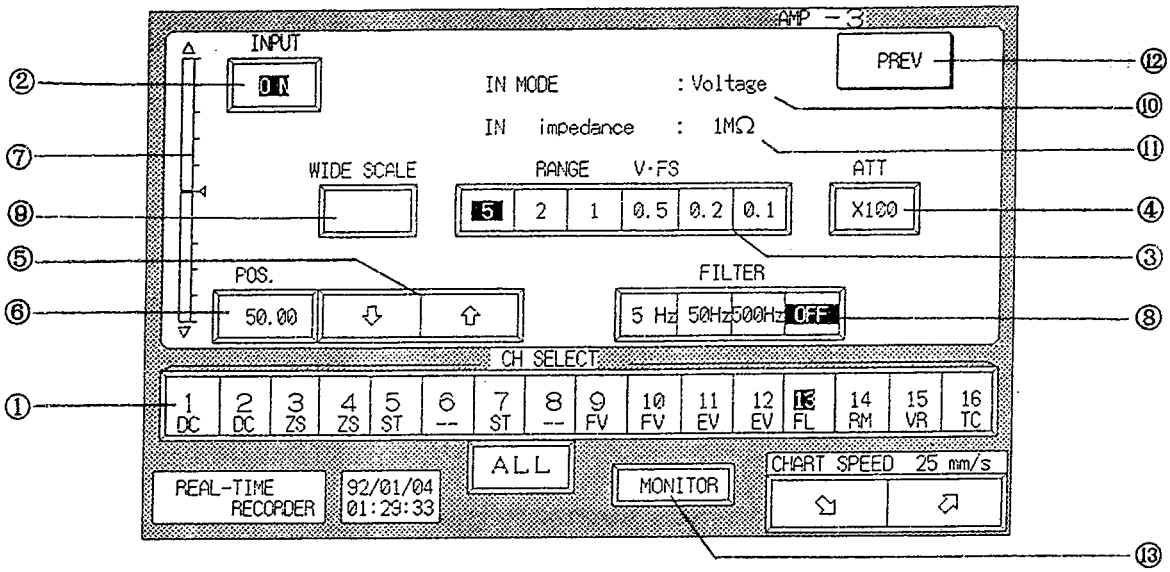
2) Setting key

Setting key	Display contents and setting procedure
	Press this key to select ON, OFF or GND. ON : Enable input to amplifier and recording OFF: Disable input to amplifier and recording GND: Disable input to amplifier, and recording is positioned on the baseline.
	Press the dial to change input range. The changing direction can be selected by SETTING ⇩/⬆ .
	Press this key to move the baseline position of input every 10 steps, when the full scale is set to be 100. The default of baseline position is set to 50.00 so that waveform will be recorded at the middle of the recording area. Note:The baseline position can be set more finely such as POS. 51 .45 by 0.05-step than by 10-step. Refer to the next screen explanation for setting procedure. However, it cannot be made on this screen. When POS. 51 .45 is pressed, the baseline position is moved in 10-step as POS. 51 .45 → POS. 60 .00 → POS. 70 .00 . The moving direction can be selected by SETTING ⇩/⬆ .

Setting key	Display contents and setting procedure
	This key, displayed at a lower part of the AMP screen, selects direction for changing input range and moving baseline position. When in  position: Press  to change input range clockwise. However, the range does not change from 0.1 V·FS to 500 V·FS. Press  to move baseline position upward. Note: When in the contact input mode with the input impedance set at 10 kohm, the input range can not be set to 500, 200, and 100 V·FS. When in  position: Press  to change input range counter-clockwise. However, the range does not change from 500 V·FS to 0.1 V·FS. Press  to move baseline position downward. Note: When in the contact input mode with the input impedance set at 10 kohm, the input range can not be set to 500, 200, and 100 V·FS.

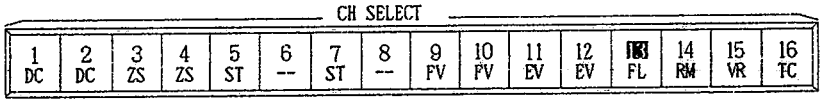
4.2 Setup on AMP Details Screen (AMP-2 or AMP-3)

Press channel number key (i.e. [CH 13 FL]), where the Floating DC Amplifier Unit is installed, on the AMP-1 or AMP-2 (AMP-1 for RT3108N/3208N) screen, the AMP-3 (AMP-2 for RT3108N/3208N) screen is displayed.



1)CH SELECT

Select a channel whose setup screen to be displayed.



Press the channel number key and the number is displayed in a reverse color, and the setup screen of this channel is displayed.

Press [ALL] to set the input units of the same type simultaneously. Refer to Chapter 4.6 of *RT3108N/RT3208N/RT3216N Operation Manual* for details.

2)INPUT

Press this key to select ON, OFF or GND.

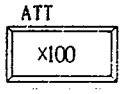
ON : Enable input to amplifier and recording

OFF: Disable input to amplifier and recording

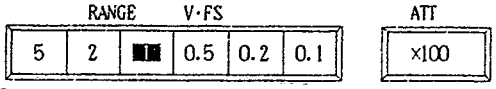
GND: Disable input to amplifier, and recording is positioned on the baseline.

3)RANGE(V·FS) *and*
4)ATT

Set the input range by RANGE key and ATT key.

Press 

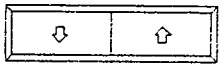
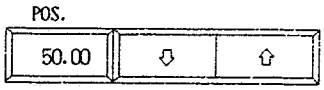
to select x1 or x100.

Setup such as 

means 100 V·FS.

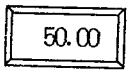
Note: When in the contact input mode with the input impedance set at 10 kohm, the input range cannot be set to 500, 200, and 100 V·FS. And an error message is displayed when such values are set.

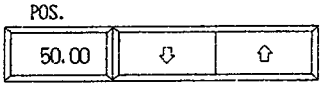
5)POS.

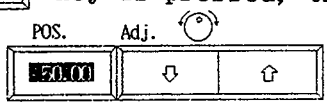
When the  of the 

key is pressed, the baseline position, which is indicated by the ◁ mark, moves in 10-step upward or downward.

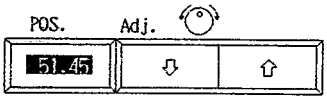
6)POS.Adj.

When the 

of the 

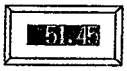
key is pressed, the color of number is reversely displayed as 

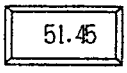
.

Rotate the jog-dial to finely adjust the baseline position to such as 51.45 in 

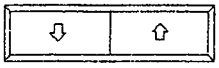
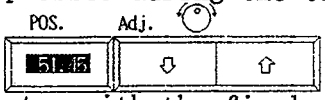
by 0.05-step.

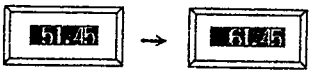
When in recording, the baseline position will be moved in 0.125mm steps on the paper by rotating the jog-dial.

Press 

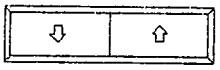
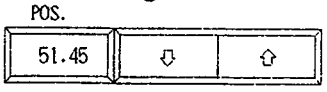
again and the display returns to 

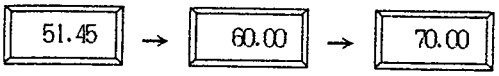
.

Note: If  is pressed during the time when fine adjustment is made, as shown in 

, the baseline position moves in 10-step with the finely-adjusted portion (1.45) remained as shown in 

.

If  is pressed during the time when fine adjustment is not made, as shown in 

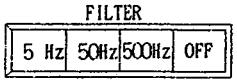
, the baseline position moves in 10-step with the finely-adjusted portion (1.45) canceled, as shown in 

.

7)LEVEL

The status of input signal is indicated on the basis of the baseline position.

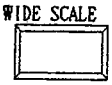
8)FILTER

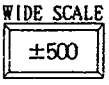
Select low-pass filter from 

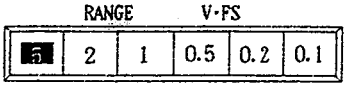
.

Selected item is displayed reversely in color.

9)WIDE SCALE

When 

is pressed, 



is displayed, and it becomes possible to monitor and record input signal from -500 V to +500 V. However, in the contact input mode with the input impedance set at 10 kohm, this function is not available. And an error message is displayed when it is used.

Caution: It does not mean a range of 1000V/FS !
For instance, if the baseline position is set at 0.00 (the bottom line), only signals from 0 to +500V can be monitored and recorded.

10)IN MODE *and*
11)IN impedance

Display the settings of the input mode and input impedance.
Refer to Chapter 4.4 for the setting method.

12)PREV

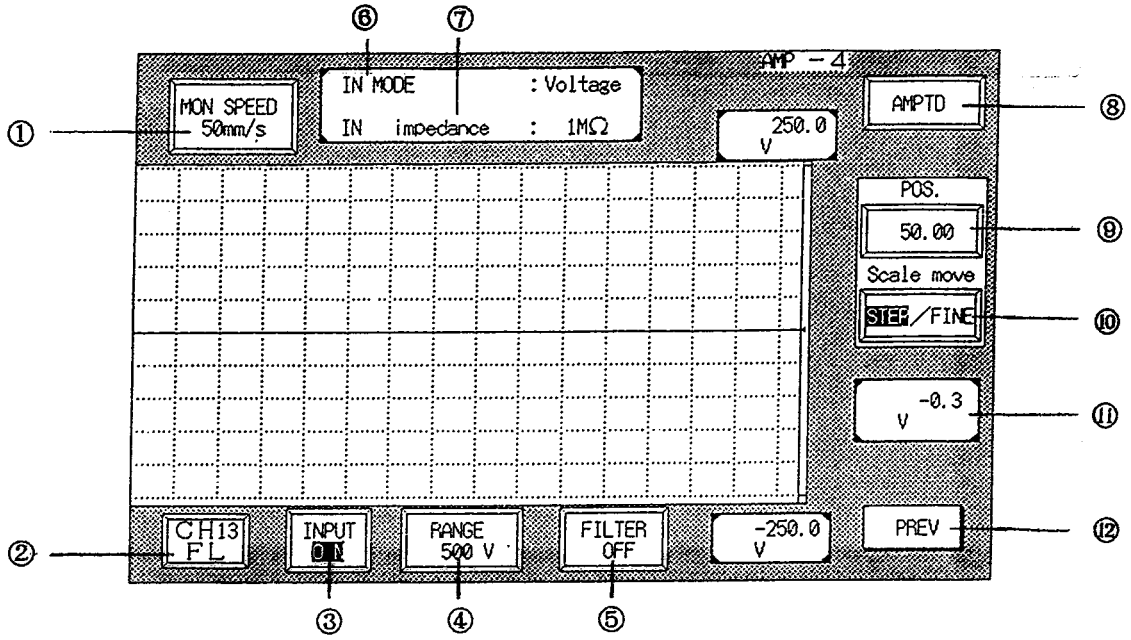
Return to the previous screen.

13)MONITOR

Proceed to the next screen, where various settings can be made while viewing the waveform of input signal. In addition, the amplitude of the waveform can be changed without changing the input range.
Refer to next chapter for details.

4.3 Display and Setup on AMP Monitor Screen (AMP-3 or AMP-4)

Press [MONITOR] key on the AMP-3 (AMP-2 for RT3108N/3208N) screen, the AMP-4 (AMP-3 for RT3108N/3208N) screen is displayed.



1)MON SPEED

Select monitor speed.

When [MON SPEED 50mm/s] is pressed, [MON SPEED 50mm/s] is displayed and then monitor speed can be selected with the jog dial.

Monitor speed: 50, 25, 10, 5, 2, 1 mm/sec
100, 50, 25, 10, 5, 2, 1 mm/min
100, 50, 25, 10, 5, 2, 1 mm/hour

2)CH SELECT

Select input channel to be monitored.

When [CH13 FL] is pressed, [CH13 FL] is displayed and then channel number can be selected with the jog dial.

Press [CH13 FL] once again to display the monitor screen of the selected channel.

3)INPUT

Press the [INPUT ON] key to select ON, OFF or GND.

ON : Enable input to amplifier and recording
OFF: Disable input to amplifier and recording
GND: Disable input to amplifier, and recording is positioned on the baseline.

4)RANGE

Select input range.

When 

is pressed, 

is displayed and then input range can be selected with jog dial.

When in the contact input mode with the input impedance set at 10 kohm, the input range cannot be set to 500, 200, and 100 V·FS.

5)FILTER

Select low pass filter from 5Hz/50Hz/500Hz/OFF.

When 

is pressed, 

is displayed and then filter can be selected with jog dial.

6)IN MODE *and*

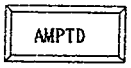
7)IN impedance

Display the settings of the input mode and input impedance.

Refer to Chapter 4.4 for the setting method.

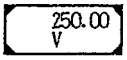
8)AMPTD

The amplitude of a waveform displayed on the screen can be changed to any value in the range of x10 to x1/2 without changing RANGE.

Press 

to display 

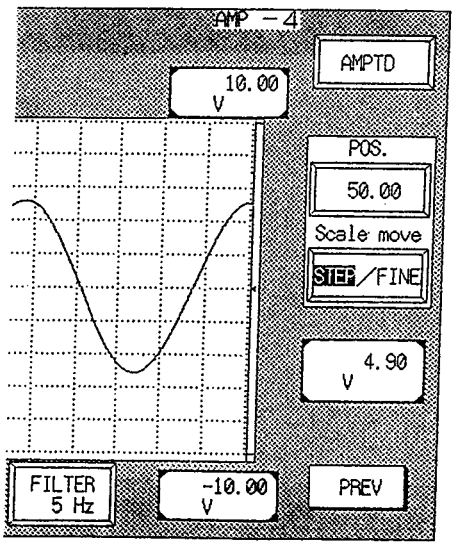
and the amplitude can be changed with jog dial.

The full scale value is indicated with 

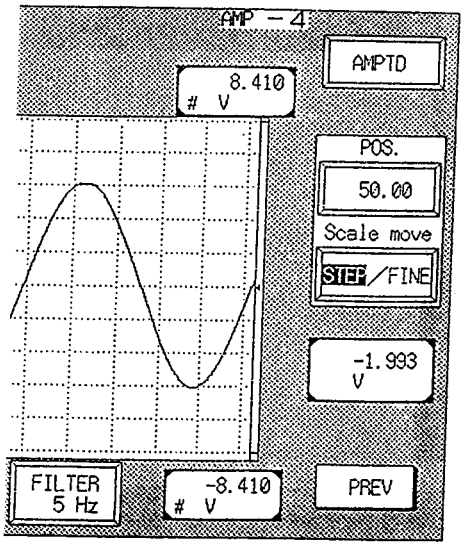
. When amplitude is changed, "#" marks are displayed and scale value is also changed.

Sample of monitoring:

Before changing amplitude
(FS: ±10.00V)

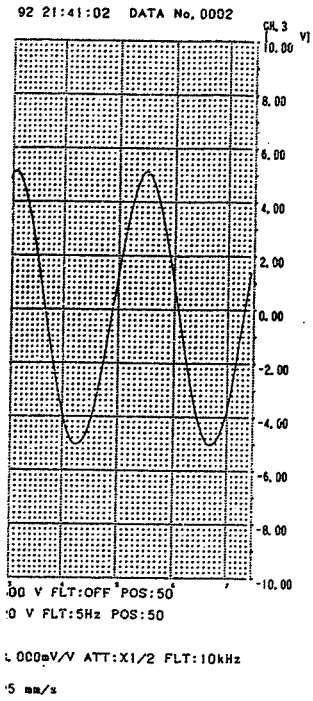


After changing amplitude
(FS: ±8.410V)

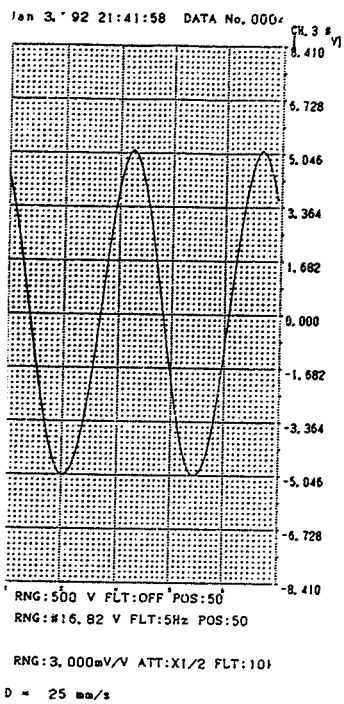


Sample of recording:

Before changing amplitude
(FS: ±10.00V)



After changing amplitude
(FS: ±8.410V)



The "#" marks, which are displayed at the left side of +8.410V and -8.410V in the sample of monitoring, at the upper right corner of +8.410V and -8.410V in the sample of recording, and at the right side of RNG in AMP seeing screen, indicates that the scale mode of 7. Setting up of Scale and Unit on MENU1 Screen(SYSTEM PAGE 2/3) is changed to "Mode 1" automatically.
For details about Scaling, refer to chapter 9.6 ("Setting-up of Scale and Unit") in *RT3108N/RT3208N/RT3216N Operation Manual.*

Note: Set the trigger level once again after changing the amplitude, because the trigger level is set by the format of percents of amplitude.

9)POS.

Press POS. [50.00] to display [50.00] .
The baseline position can be moved upward or downward in 0.05-step (FS:100) with jog dial, as shown in [50.00] → [50.05] → [50.10] .

The baseline position is indicated with ◀ at the right side of waveform.
The scale display is determined by selecting the Scale move key.

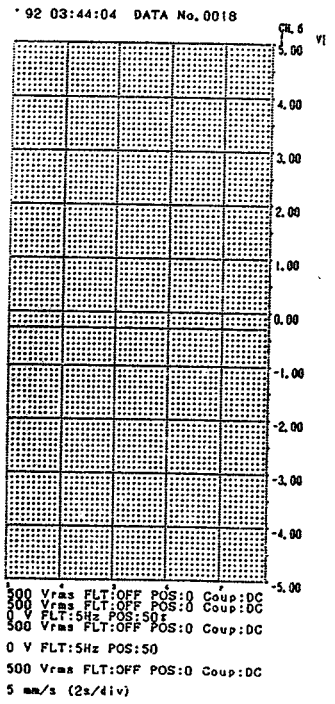
10)Scale move

The steps of scale display movement in waveform recording can be selected by Scale move [STEP/FINE] .

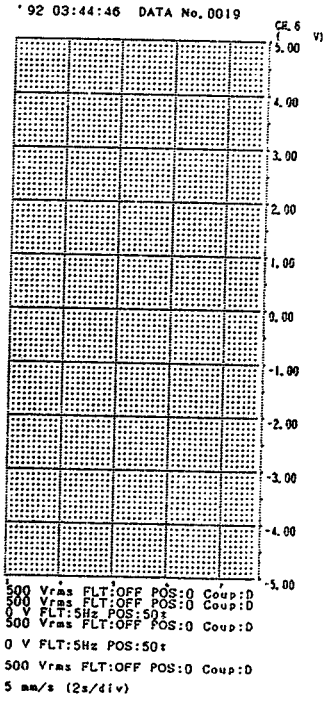
STEP: When recording, baseline position can be moved in 0.125mm steps. If the movement of baseline exceeds ±0.5DIV, the scale movement is moved in 10-step with the full scale in 100.
In the STEP mode, if an offset within ±0.5DIV is output when 0V is inputted, the output waveform can be moved to match the 0V grid line(in the middle of chart paper) with the POS. key. (Offset can be cancelled when recording)

Sample 1 of recording(offset within ±0.5DIV):

Scale display with baseline at 50.00

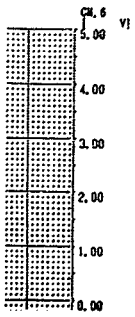


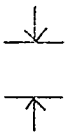
Scale display with baseline at 53.00



↑

Scale display is not moved.
(Offset is cancelled)

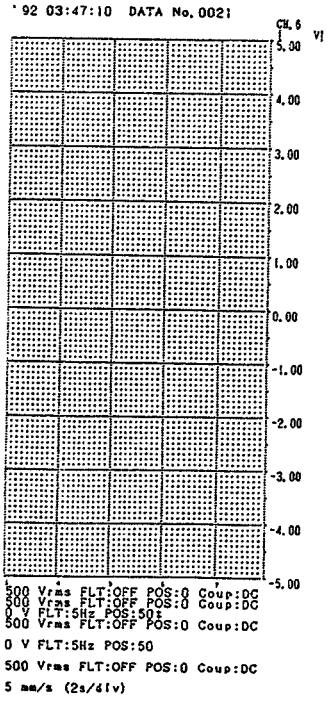




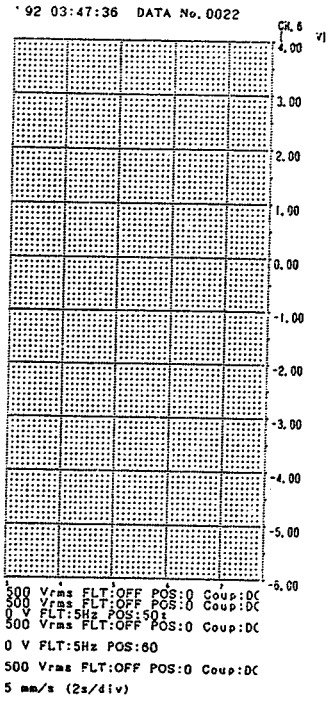
If baseline position is moved more than 0.5DIV, the scale display is moved.

Sample 2 of recording(offset beyond ±0.5DIV):

Scale display with baseline at 50.00



Scale display with baseline at 60.00



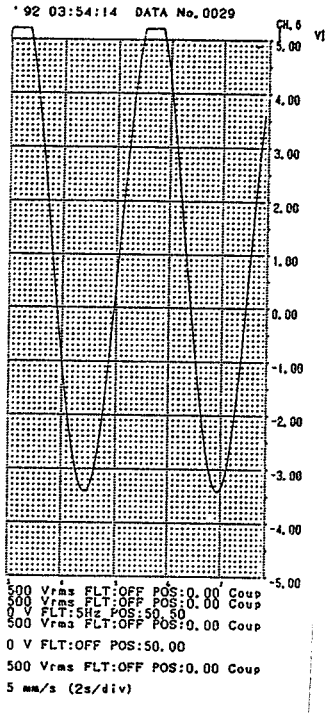
↑

Scale display is moved in 10-step

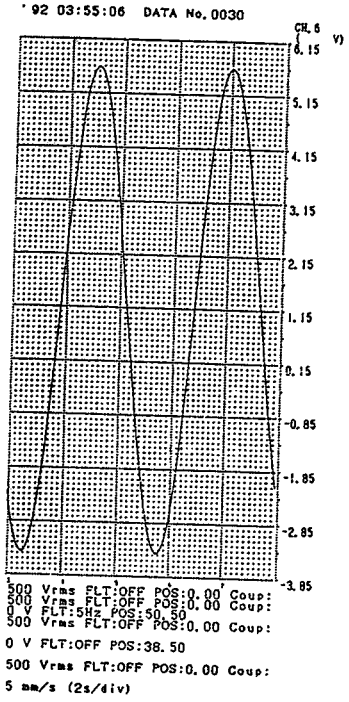
FINE: When recording, baseline position can be moved in 0.125mm steps. If the baseline position is finely adjusted in 0.05-step with the full scale in 100, the scale display is also moved in 1/2000 steps of input range with the baseline position moved meanwhile. In the FINE mode, even though the input signal is beyond the recording range, it can be recorded within the recording range with the POS key.
(Offset cannot be cancelled when recording because scale display is also moved when the baseline is moved.)

Sample of recording:

Scale display with baseline at 50.00



Scale display with baseline at 38.50

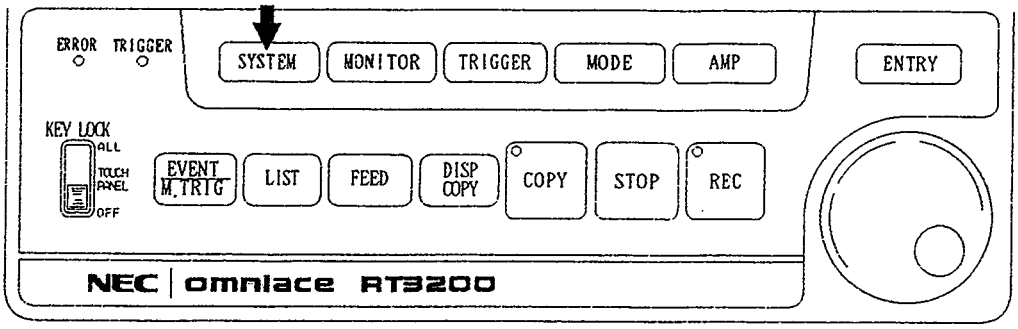


↑
Scale display is moved in 1/2000 steps of input range with the baseline position moved meanwhile.

11)Digital display
Display digital value of input signals.

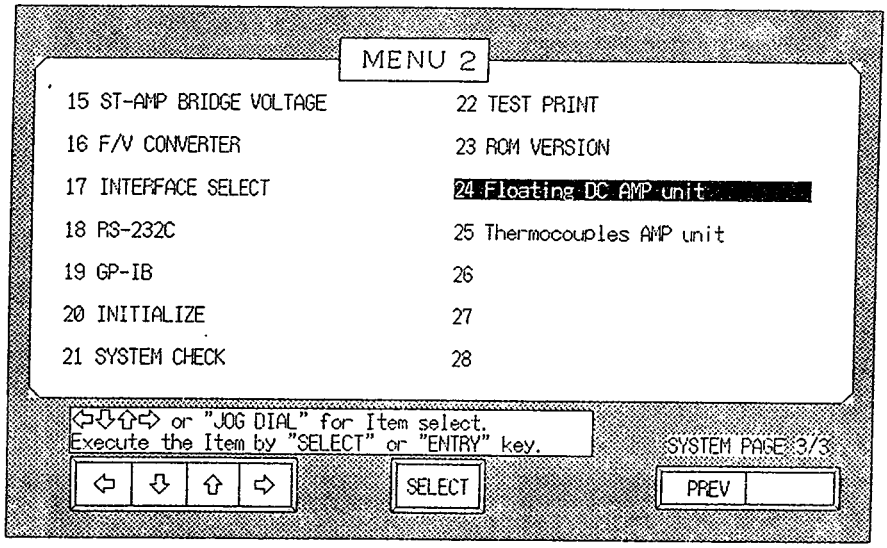
12)PREV
Return to the previous screen.

4.4 Setup of Input Mode and Impedance on MENU-2 (SYSTEM PAGE 3/3)



Press the SYSTEM key on the operation panel and the MENU-2 (SYSTEM 3/3) screen appears.

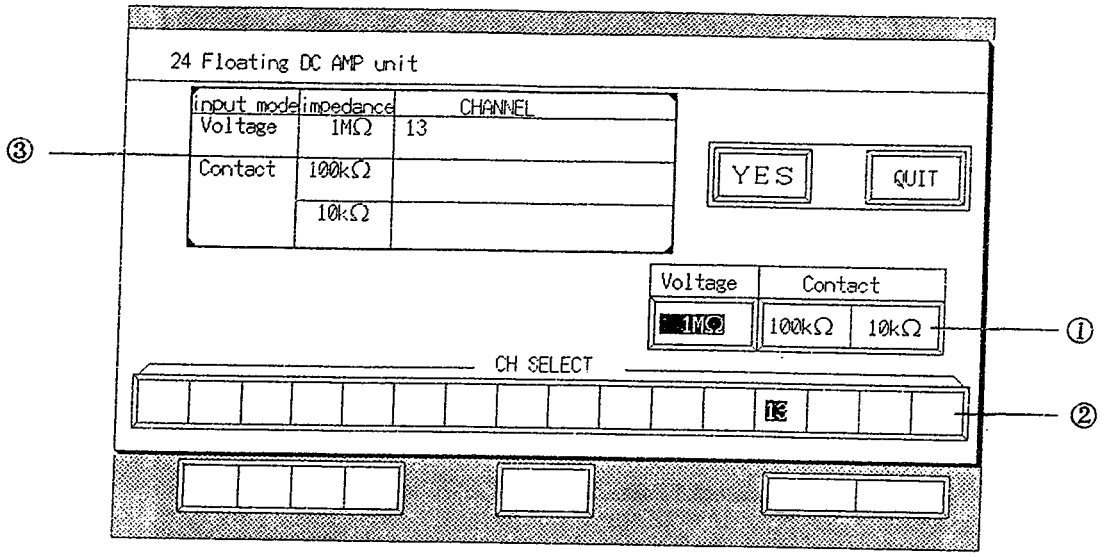
If another system page is displayed, press NEXT to display the MENU-2 (SYSTEM 3/3).



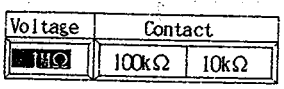
Move the cursor to the 24 Floating DC AMP unit item with the jog-dial or the ⇦ ⇩ ⇧ ⇨ on the screen.

Note: If a floating DC amplifier unit is not installed or if the unit is not displayed because of the memory limit (refer to Chapter 9.8 in the operation manual of the basic instrument), an error display appears.

Press [SELECT] on the screen display or the [ENTRY] key on the operation panel to allow the following screen to appear.



1) INPUT MODE INPUT IMPEDANCE

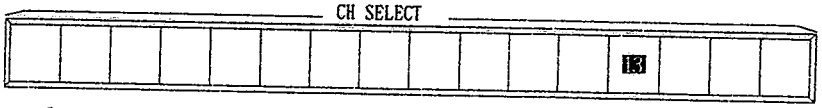
Set the input impedance by pressing the [1MΩ] key, the [100kΩ] key, or the [10kΩ] key from the 

.

The selected input impedance is displayed in a reverse color.
Select the input impedance of 1 Mohm for the voltage input mode, and 100 kohm or 10 kohm for the contact input mode.

2) AMP select

Select a channel in which a charge converter is installed.



Press the channel number key and the number is displayed in a reverse color, and the input impedance selected in (1) has been set.

Note: Only channels with floating DC amplifier units installed are displayed for selection.
For channels whose range has been set to 100, 200, or 500 V·FS, input impedance cannot be set to 10 kohm. Otherwise, an error message is displayed.

Channels whose input impedance have been set to 1 Mohm, 100 kohm and 10 kohm are listed in the box (3) respectively.

Press [YES] to confirm settings and return to MENU-2 screen.
Press [QUIT] to cancel settings and return to MENU-2 screen.

5.Specification

Number of channels:
1 input/unit

Input system:
Single-ended input, floating between input and output

Range and Accuracy:
0.1, 0.2, 0.5, 1, 2, 5 V/FS ATT: x1 and x100 (12 steps)
Accuracy: within ±0.5%FS (within ±1%FS in 500V·FS range)
Direct recording of AC200V is available in 500V·FS range.

Input impedance: (approximate value)
Voltage input mode: 1 Mohm
Contact input mode: 10 Kohm or 100 Kohm (0.1 to 50 V·FS)
100 Kohm (100 to 500 V·FS)

Allowable input voltage: (DC or AC peak value)
Voltage input mode: 100V (0.1 to 5 V·FS)
500V (10 to 500 V·FS)
Contact input mode:
When the input impedance is set to 100 kohm
100V (0.1 to 5 V·FS)
500V (10 to 500 V·FS)
When the input impedance is set to 10 kohm
70V (0.1 to 50 V·FS)

Frequency response:
DC to 10kHz (within +0.5 and -3 dB)

Linearity:
Within ±0.2%FS

Common mode voltage (CMV):
500V (DC or AC peak value)

Common mode rejection ratio (CMRR):
Greater than 100dB (when input short-circuited at 60 Hz)

Low-pass filter:
2-pole Bessel-type
fc=5Hz, 50Hz, 500Hz or OFF
Attenuation: Approx. -12dB/OCT

Drift:
Within ±0.5%FS/10°C

A/D conversion:

Resolution : 12-bit
Conversion time : 5 μs max.
Conversion method : Successive approximation

Input connector:

RT31-140: Double-deck binding posts(+,-)
RT31-147: Safety terminal(+,-)

Channel annotation:

Channel number, Type of input unit, ON/OFF of input, Filter set, Input range, Baseline position.

SECTION 4

CHARGE AMPLIFIER UNIT

CONTENTS

PREFACE

▼ Foreword

Thank you for purchasing our Charge Amplifier Unit RT31-159.

Before using this equipment, carefully read and understand this manual and also relative operation manuals for RT3108N/RT3208N/RT3216N recorders and GP-IB/RS-232C/Memory Card/Remote.

Since this manual provides information that is necessary for correct and safe operation of the Charge Amplifier Unit RT31-159 and the RT3100N/3200N series recorders, always keep this manual with the recorder for reference.

For any further information, please contact our dealer.

▼Check shipping status

If the carton is unpacked immediately after it has been brought in a warm room, particularly in cold winter time, dews may form inside the equipment and cause abnormal operation. To prevent such condensation, open the package after the equipment is adjusted to the room temperature.

This product has been checked carefully before being shipped to the customer, upon delivery, please check and verify appearance, specification, accessories of this unit. Contact our dealer in case of missing or shortage of any parts, or any shipping damage.

▼About this manual

Figures and screen displays of a RT3216N recorder are used for explanation in this manual, operations of RT3108N and RT3208N are almost the same as those of RT3216N.

▼About SI (international standard) units

Though G is not a SI unit for acceleration, it is still used for this charge amplifier since many piezoelectric acceleration sensors are specified with it.

Convert G to the SI unit (m/s^2) with the following equation.

$$1\ G = 9.80665\ m/s^2$$

▼Interchange an input unit

Refer to Chapter 3.5 in the operation manual of the basic instrument for the procedures of interchanging an input unit.

▼About interfaces

Refer to Chapter 11.5 and 11.6 in the operation manual of the basic instrument and the operation manual of GP-IB/RS-232C/Memory Card/Remote.

▼ Notice

- The contents of this manual are subject to change without prior notice.
- No part of this manual may be reproduced or altered in any form or by any means without the prior permission of NEC San-ei.
- The author and publishers have taken care in preparation of this manual, but assume no responsibility for errors or omissions.
- No liability is assumed for results obtained from use of the information, including possible errors or omissions, contained herein.

SAFETY NOTICE

▼ Use safely

Although this equipment has been designed and manufactured with concern about the safety, mistakes of operation will probably cause incidents.
To avoid such dangerous incidents, carefully read and understand this manual before using the equipment.

Observe the following notice items when using the equipment. No liability is assumed for results obtained from disobedience of these notice items.

WARNINGS are used to emphasize the notice items which will avoid hazardous incidents that could cause electric shock accidents or personal injury.

CAUTIONS are used to draw attention to the notice items which will prevent damage to the equipment.

WARNINGS:

- Electric shock and Common Mode Voltage (CMV)
  Since the outside of the miniature connector for sensor is the common of the input signal, it is extremely dangerous to touch the outside in case of a high CMV existing between the outside and the amplifier case.
  Test and verify whether the CMV is within the tolerance range before using the instrument.
  Make sure that the CMV should not exceed the 30 Vrms (42.4 Vpk) or 60 VDC.

- Connection of the input signal
  Protective earth terminal of the instrument should be grounded before it is connected to the measuring subject.
  Make sure that the CMV is within the tolerance range when the amplifier is connected to a sensor.

- Allowable Input Electric Charge
  Allowable Input Electric Charge is 50,000 pC.
  If an input exceeding 50,000 pC should be applied to the amplifier, it may cause malfunction of the amplifier.

CAUTIONS:

- Cautions on handling

  Carefully read following instructions and use this equipment properly and safely:

  1) Do not allow anyone who is not familiar with the operation to use this amplifier.

  2) Pay attention to keep the storage temperature between -10 and 70°C. Especially in summer, do not store it in the places under a long-period of sunshine or a high temperature. (e.g. in a car)

  3) Input signals that exceed the Common Mode Voltage and the Allowable Input Electric Charge may cause malfunction of the amplifier.

  4) For the reliability of this amplifier, periodical calibration (once a year) is recommended. We provide such service for a charge.

WARRANTY

Rigid quality control is enforced on our products from design through the production process. However, in case a failure should be suspected, before requesting us for repair, check for operation of the equipment, abnormal supply voltage, or wrong connection of cables, etc.
For repair request, contact our dealer in your area with the type and serial number of your equipment and detailed descriptions of the condition.
And warranty provisions are listed as follows.

Warranty Provisions

1. The warranty period is one year from the date of delivery.

2. We will repair or replace, at no cost, defective parts within the warranty period. Repair or replacement will be made at cost in the following cases:

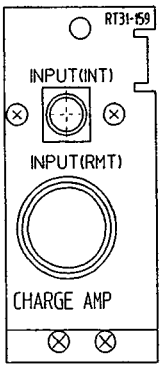
   (1) Damage or failure due to careless handling
   (2) Damage or failure due to fires, traffic accidents, earthquakes or any other natural disasters.
   (3) Damage or failure due to repairs or modifications performed by persons who are not authorized by NEC San-ei.
   (4) Failure due to use or storage under severe conditions for the equipment far beyond the prescribed operating conditions for the equipment.
   (5) Damage or failure due to transportation or relocation of the equipment after delivery.
   (6) Damage or failure after the expiry of the warranty period.
   (7) Periodical calibration.

3. Equipment manufactured by other manufacturers shall be warranted by such manufacturers.

1. General Information

Charge amplifier unit RT31-159, a plug-in input unit for RT3100N/RT3200N recorders, can perform following measurement.
Directly connected to a piezoelectric acceleration sensor, it measures the electric charge which is proportion to the acceleration, and records the result as an acceleration value, in the unit of G.
Since the sensor's sensitivity can be set directly by inputting a value of three significant digits as the calibrating value, reliable settings can be easily performed.
If the piezoelectric acceleration sensor is far from the amplifier unit, optional remote charge converters (model 5381 and 5382) can be connected to suppress noise.

2. Input Section



INPUT (INT): Miniature connector(#10-32 UNF)
Connect to a piezoelectric acceleration sensor

INPUT (RMT): NDIS strain input connector
Connect to a optional remote charge converter (model 5381, 5382)
Power of the remote charge converter is supplied from the amplifier unit.
Pin A to E are assigned as follows.

Power supply to Remote Charge Converter		Input signal		Common
Pin A	Pin C	Pin D	Pin B	Pin E
About +8	About -8V	-input	+input	common

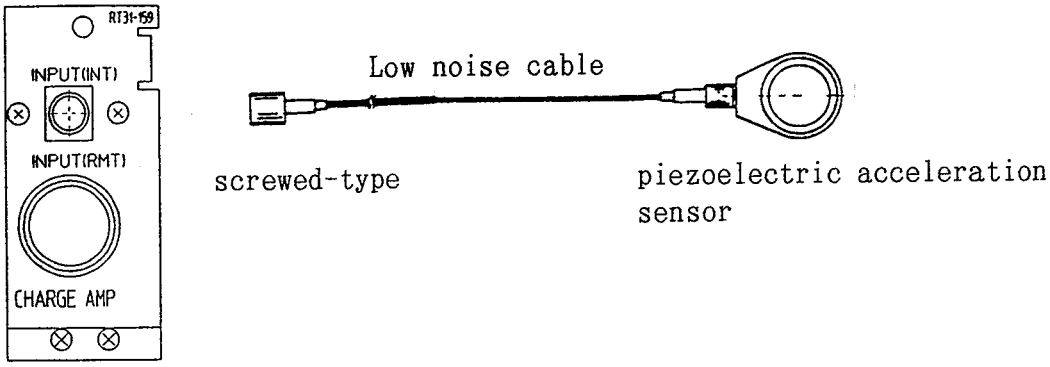
Note:
(1) Allowable Input Charge to the INPUT(INT) connector is 50,000 pC.
(2) Common Mode Voltage between the INPUT(INT) connector and the safety ground terminal is 30 Vrms (42.4 Vpeek) or 60 VDC.
(3) Never short-circuit Pin A and Pin C of the INPUT(INT) connector.

3. Connection of Input Signal

For carrying out high reliability measurement with less noise, the input cable connection is very important.
Connect the piezoelectric acceleration sensor and remote charge converter as described below.

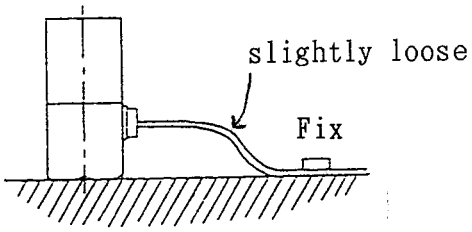
3.1 Connection of a Piezoelectric Acceleration Transducer

Connect the piezoelectric acceleration sensor to the INPUT(INT) connector.



Note:

(1) Though a low noise input cable is provided, noise may be generated if the cable is vibrated. Fix the cable as shown below.

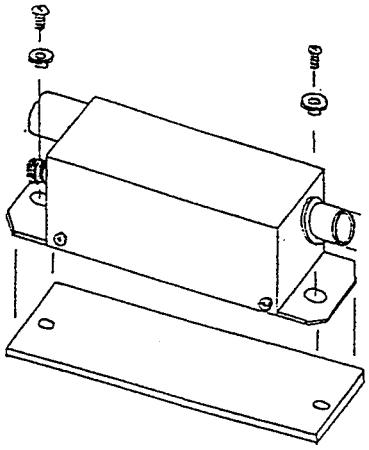


(2) From a viewpoint of noise-suppression, an excessively long input cable is not recommended.
(3) Only capacitive signal input can be connected to INPUT(INT).
(4) Dust, oil or water on the piezoelectric acceleration sensor and the INPUT(INT) connector of the amplifier may generate noise and cause unstable operation of the amplifier.

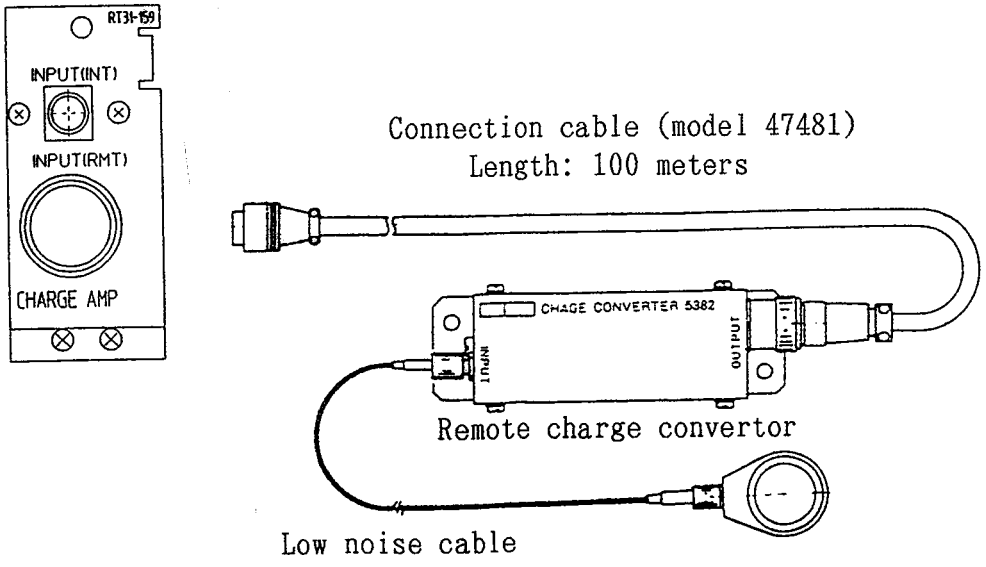
3.2 Connection of a Remote Charge Converter

When the piezoelectric acceleration sensor is distanced far from the amplifier unit, a optional remote charge converter (model 5381 and 5382) can be connected to suppress noise.

(1) Installation
Use the mounting holes to fix the converter body.
As the case of this amplifier is common-shielded, use screws to fix the converter on the supplied insulation board.



(2) Connection
Connect the output of a piezoelectric acceleration sensor to the INPUT connector of the remote charge convertor.
Connect the OUTPUT of the converter, by a dedicated connection cable (option:47481), to the INPUT(RMT) connector of the charge amplifier unit.



[Note]

(1) To maintain a high input impedance, an input protection circuit is not provided in the remote charge converter. When a signal source other than a sensor is connected, malfunction of the amplifier may occur.

(2) Common Mode Voltage between INT connector or the converter's case and the safety ground terminal of the RT3100N/3200N recorder is 30 Vrms (42.4 Vpeek) or 60 VDC.

4. Caution on Input Signal

(1)Input from a sensor

Never connect signal sources other than electric charge (voltage, etc.) to the INPUT connector for a sensor.
Allowable Input Electric Charge is 50,000 pC. If an input higher than 50,000 pC should be applied to the amplifier, it may cause malfunction of the amplifier unit.
Therefore, make sure that input signal should not exceed 50,000 pC.

(2)Common Mode Voltage (CMV)

The Common Mode Voltage is a voltage component which is applied in common between the ground and the input connector. Make sure that CMV should not exceed the determined 30 Vrms (42.4 Vpeek) or 60 VDC which may cause malfunction of the unit.
If noise-like pulsating common-mode voltage is applied, noise may appear on the recorded waveform.

5. Response to Input Signal

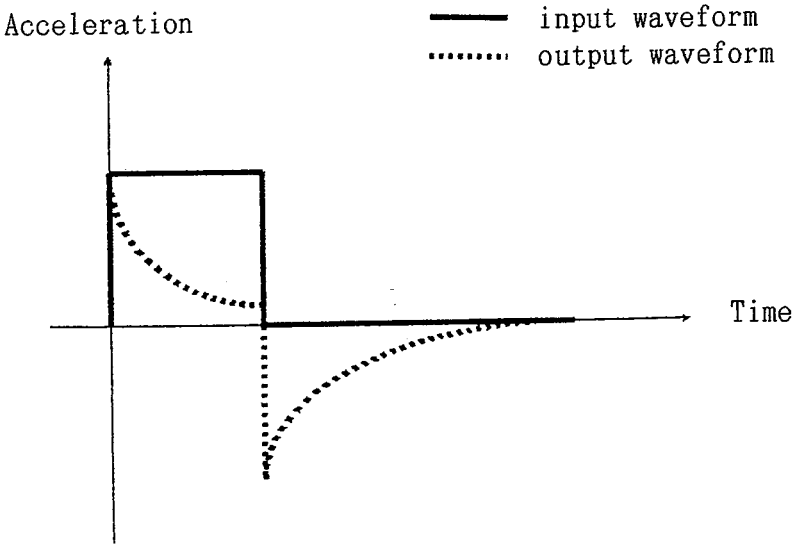
(1)About the output waveform

Immediately after the basic instrument is powered and the input cable is connected to the INPUT(INT) connector, it takes a time (according to the circuit-time-constant) to output the waveform of the input signal. During this time, an output on the baseline position is recorded. The baseline position indicates the recorded position on the chartpaper when the input level is 0 G.

(2)About the step-input

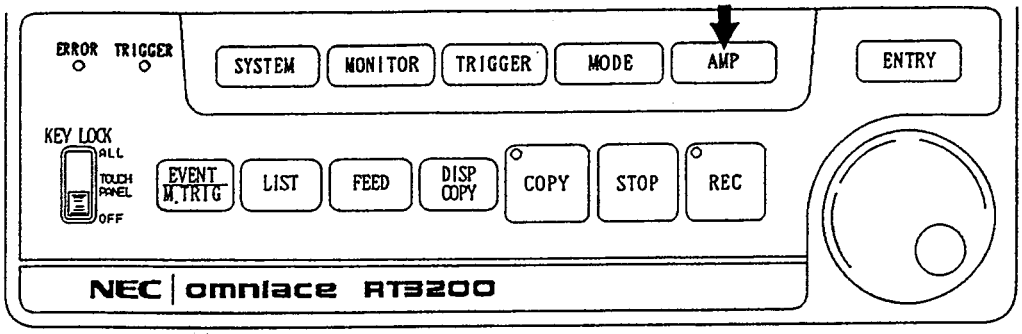
Since the charge amplifier cuts off the low frequency component, it can not measure DC components.

The response to the step-input becomes a measuring error as shown below.

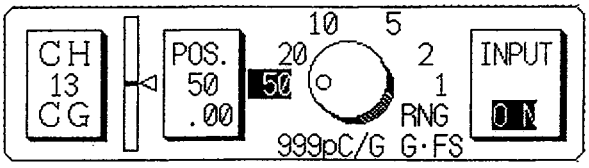


6. Setup Procedure

6.1 Display and Setup on AMP Screen (AMP-1 or AMP-2)

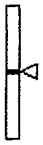


Press the AMP key on the operation panel and the AMP-1 or AMP-2 screen displays (AMP-1 for RT3108N/3208N).
The charge amplifier unit is displayed on the AMP screen as shown below.



Each part of above display and its settings is explained below:

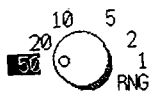
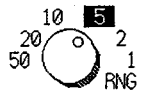
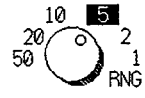
1) Display

Display	Display contents
	Input signal is sampled and displayed. The ◁ mark indicates the baseline position. The display range is upto the Full Scale for wave-form recording. The input signal corresponding to the Full Scale changes when baseline position is altered.
999 pC/G	(Shown at the bottom of the figure) Indicates the sensitivity setting value of the Piezoelectric Acceleration Sensor. * See below for the setting method.

* Baseline position: Displayed or recorded position when input is 0 G.

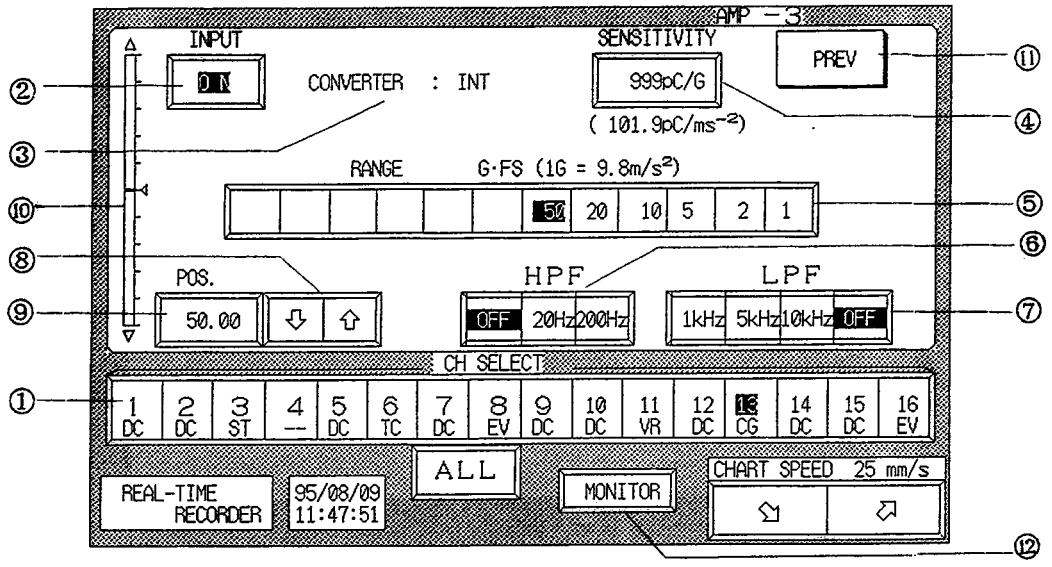
2) Setting key

Setting key	Display contents and setting procedure
	Press this key to select ON, OFF or GND. ON : Enable input to amplifier and recording OFF: Disable input to amplifier and recording GND: Disable input to amplifier, and recording is positioned on the baseline.

Setting key	Display contents and setting procedure
	Press the dial to change input range. The changing direction can be selected by SETTING ⇩/⬆.
POS. 50 .00	Press this key to move the baseline position of input every 10 steps, when the full scale is set to be 100. The default of baseline position is set to 50.00 so that waveform will be recorded at the middle of the recording area. Note:The baseline position can be set more finely such as POS. 51 .45 by 0.05-step than by 10-step. Refer to the next screen explanation for setting procedure. However, it cannot be made on this screen. When POS. 51 .45 is pressed, the baseline position is moved in 10-step as POS. 51 .45 → POS. 60 .00 → POS. 70 .00. The moving direction can be selected by SETTING ⇩/⬆.
SETTING ⇩/⬆	This key, displayed at a lower part of the AMP screen, selects direction for changing input range and moving baseline position. When in SETTING ⇩/⬆ position: Press  to change input range clockwise. (Setup range of an input range is limited according to setup value of the sensor's sensitivity.) Press POS. 50 .00 to move baseline position upward. When in SETTING ⬇/⇧ position: Press  to change input range counter-clockwise. Press POS. 50 .00 to move baseline position downward.

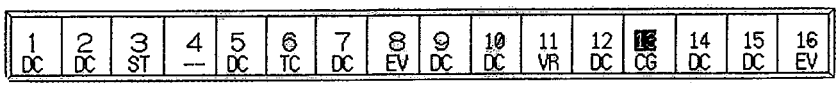
6.2 Setup on AMP Details Screen (AMP-2 or AMP-3)

Press channel number key (i.e. CH 13 CG), where the charge amplifier unit is installed, on the AMP-1 or AMP-2 (AMP-1 for RT3108N/3208N) screen , the AMP-3 (AMP-2 for RT3108N/3208N) screen is displayed.



1)CH SELECT

Select a channel to be displayed.



Press the channel number key and the number is displayed in a reverse color, and the setup screen of this channel is displayed to set the detailed items.

Press ALL to set the input units of the same type simultaneously. (Refer to Chapter 4.6 of *RT3108N/RT3208N/RT3216N Operation Manual* for details)

2)INPUT

Press this key to select ON, OFF or GND.

ON : Enable input to amplifier and recording

OFF: Disable input to amplifier and recording

GND: Disable input to amplifier, and recording is positioned on the baseline.

3)CHARGE CONVERTER

Display the type of charge convertor[Internal/Remote Charge converter].

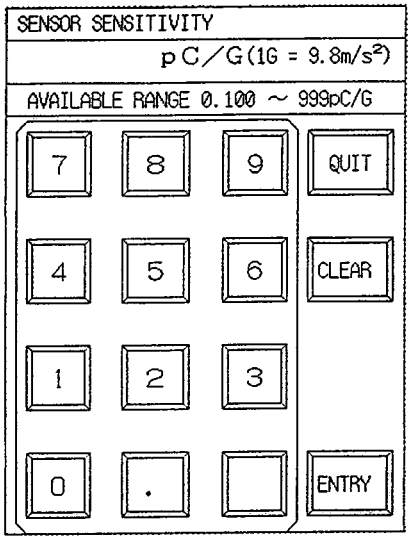
* Remote Charge converter(5381/5382) are options.
  Refer to Chapter 6.4 for its setting method.

4)SENSITIVITY

Set the sensitivity of a piezoelectric acceleration transducer.
The value in the blankets indicates the sensitivity in SI unit.
Setting ranges are shown as follows.

Charge converter	Setting range of Sensitivity
Internal	0.100 to 999 pC/G
5381 (option)	0.100 to 9.99 pC/G
5382 (option)	1.00 to 99.9 pC/G

Press [999pC/G] and a window for sensitivity-setting pops up at the right part of the screen.



Input the setting value with numerical keys. Use [CLEAR] key to erase wrong inputs.
Set value is displayed on the upper left side of the window.

Press [ENTRY] key to confirm the setting and return to the AMP setting screen.

Press [QUIT] key to cancel the sensitivity-setting and return to the AMP setting screen.

5)INPUT RANGE (G·FS)

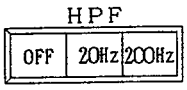
Select an input range
The equation *1 G = 9.8 m/s²* indicates the relation between G and the SI unit m/s². However, use the equation below when doing conversion.

1 G = 9.80665 m/s²

Set the input range according to setting values of (3)CHARGE CONVERTER and (4)SENSITIVITY as shown in the following chart.

Charge converter	Sensitivity	Setting range
Internal	0.100 to 0.999 pC/G 1.00 to 9.99 pC/G 10.0 to 99.9 pC/G 100 to 999 pC/G	10 to 5k G·FS 1 to 5k G·FS 1 to 500G·FS 1 to 50 G·FS
5381(option)	0.100 to 0.999 pC/G 1.00 to 9.99 pC/G	10 to 500G·FS 1 to 50 G·FS
5382(option)	1.00 to 9.99 pC/G 10.0 to 99.9 pC/G	10 to 500G·FS 1 to 50 G·FS

6)HPF

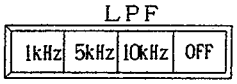
Select the high-pass filter from 

.

Selected item is displayed reversely in color.

OFF means a frequency band that begins from 0.5Hz.

7)LPF

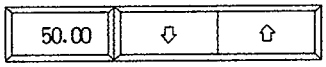
Select the low-pass filter from 

.

Selected item is displayed reversely in color.

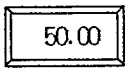
OFF means a frequency band that stops at 20kHz.

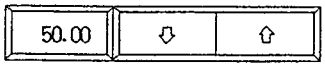
8)POS.

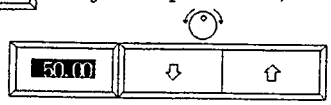
When the  of the 

key is pressed, the baseline position, which is indicated by the ◁ mark, moves in 10-step upward or downward.

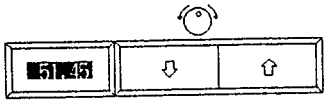
9)POS.Adj.

When the 

of the 

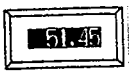
key is pressed, the color of number is reversely displayed as 

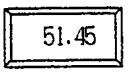
.

Rotate the jog-dial to finely adjust the baseline position to such as **51.45** in 

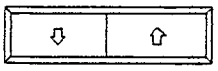
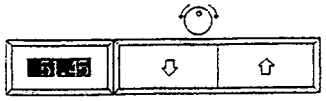
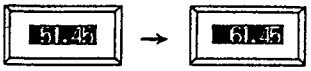
by 0.05-step.

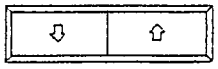
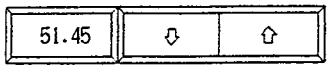
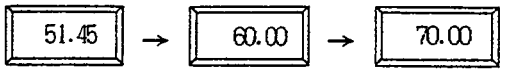
When in recording, the baseline position will be moved in 0.125mm steps on the paper by rotating the jog-dial.

Press 

again and the display returns to 

.

Note: If  is pressed during the time when fine adjustment is made, as shown in  , the baseline position moves in 1/10-step with the finely-adjusted portion (1.45) remained as shown in  .

If  is pressed during the time when fine adjustment is not made, as shown in  , the baseline position moves in 1/10-step with the finely-adjusted portion (1.45) canceled, as shown in  .

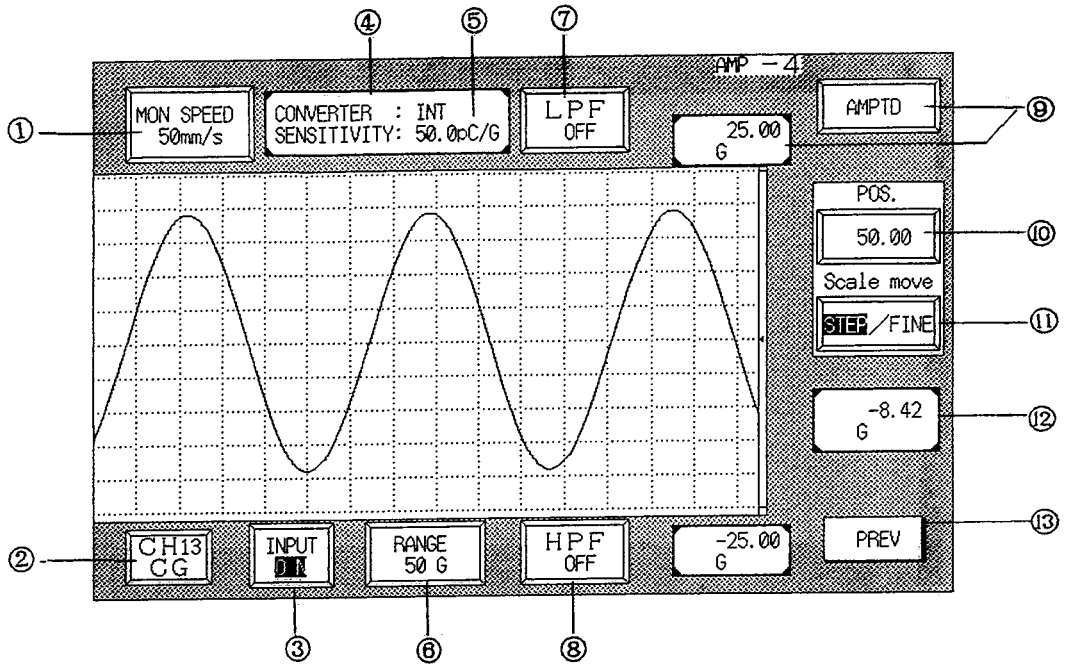
10)LEVEL
The status of input signal is indicated on the basis of the baseline position.

11)PREV
Return to the previous screen.

12)MONITOR
Proceed to the next screen, where various settings can be made while viewing the waveform of input signal. In addition, the amplitude of the waveform can be changed without changing the input range.
Refer to next chapter for details.

6.3 Display and Setup on AMP Monitor Screen (AMP-3 or AMP-4)

Press [MONITOR] key on the AMP-3 (AMP-2 for RT3108N/3208N) screen, the AMP-4 (AMP-3 for RT3108N/3208N) screen is displayed.



1)MON SPEED

Select monitor speed.

When [MON SPEED 50mm/s] is pressed, [MON SPEED] is displayed and then monitor speed can be selected with jog dial.

Monitor speed: 50, 25, 10, 5, 2, 1 mm/sec
100, 50, 25, 10, 5, 2, 1 mm/min
100, 50, 25, 10, 5, 2, 1 mm/hour

2)CH SELECT

Select input channel to be monitored.

When [CH13 CG] is pressed, [CH13 CG] is displayed and then channel number can be selected with jog dial.

Press [CH13 CG] once again to display the monitor screen of the selected channel.

3)INPUT

Press the [INPUT ON] key to select ON, OFF or GND.

ON : Enable input to amplifier and recording
OFF: Disable input to amplifier and recording
GND: Disable input to amplifier, and recording is positioned on the baseline.

4)CHARGE CONVERTER

Display the type of charge convertor[Internal/Remote Charge converter].

* Remote Charge converter(5381/5382) are options.

Refer to Chapter 6.4 for its setting method.

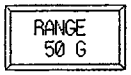
5)SENSITIVITY

Set the sensitivity of a piezoelectric acceleration transducer.

Refer to Chapter 6.2 for its setting method.

6)RANGE

Select input range.

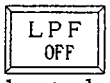
When 

is pressed, 

is displayed and then input range can be selected with jog dial.

7)LPF

Select the low-pass filter from OFF/10kHz/5kHz/1kHz.

When 

is pressed, 

is displayed and then filter can be selected with jog dial.

OFF means a frequency band that stops at 20kHz.

8)HPF

Select the high-pass filter from OFF/20Hz/200Hz.

When 

is pressed, 

is displayed and then filter can be selected with jog dial.

OFF means a frequency band that begins from 0.5Hz.

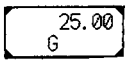
9)AMPTD

The amplitude of a waveform displayed on the screen can be changed to any value in the range of x10 to x1/2 without changing RANGE.

Press 

to display 

and the amplitude can be changed with jog dial.

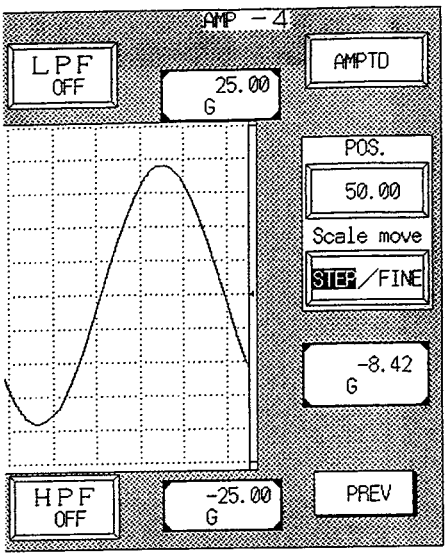
The full scale value is indicated with 

. When amplitude is changed, "#" marks are displayed and scale value is also changed.

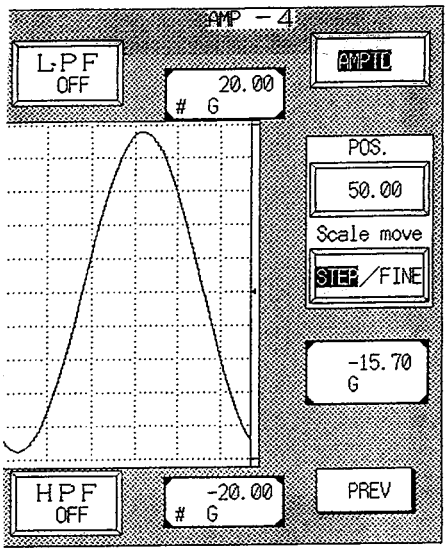
The following sample shows the monitoring and recording before and after changing the full scale from [±25.00 G] to [±20.00 G]

Sample of monitoring:

Before changing amplitude
(FS: ±25.00 G)

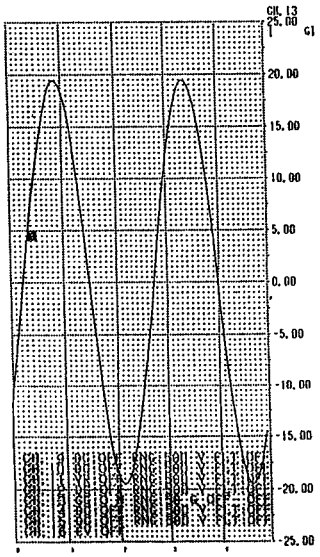


After changing amplitude
(FS: ±20.00 G)

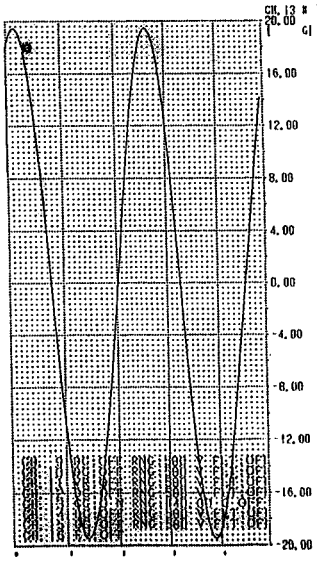


Sample of recording:

Before changing amplitude
(FS: ±25.00 G)



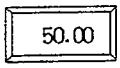
After changing amplitude
(FS: ±20.00 G)



Note:

1. The "#" marks, which are displayed at the left side of the full scales in the sample of monitoring, at the upper right corner of the full scales in the sample of recording, and at the right side of RNG in the AMP screen, indicate that the scale mode of 7. Setting-up of Scale and Unit on MENU1 Screen(SYSTEM PAGE 2/3) is changed to "Mode 1" automatically.
   For details about the scaling setting, refer to Chapter 9.6 in *RT3108N/RT3208N/RT3216N Operation Manual.*
2. Set the trigger level once again after changing the amplitude, since the trigger level is set by the format of percentage of amplitude.

10)POS.

Press 

to display 

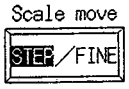
.

The baseline position can be moved upward or downward in 0.05-step (FS:100) with jog dial, as shown in 

.

The baseline position is indicated with ◀ at the right side of waveform.
The scale display is determined by selecting the Scale move key.

11)Scale move

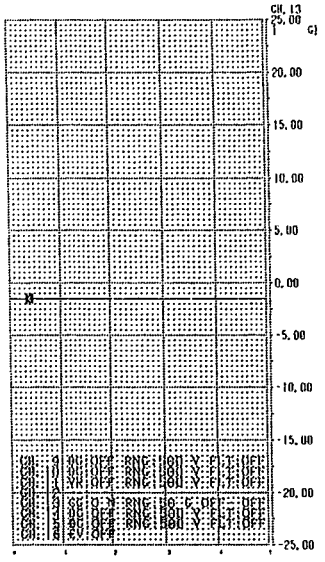
The steps of scale display movement in waveform recording can be selected by 

.

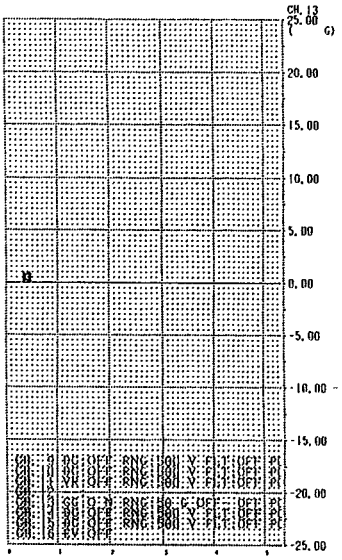
STEP: When recording, baseline position can be moved in 0.125mm steps. If the movement of baseline exceeds ±0.5DIV, the scale movement is moved in 10-step with the full scale in 100.
In the STEP mode, if an offset within ±0.5DIV is output when 0V is inputted, the output waveform can be moved to match the 0V grid line(in the middle of chart paper) with the POS. key. (Offset can be cancelled when recording)

Sample 1 of recording(offset within ±0.5DIV):

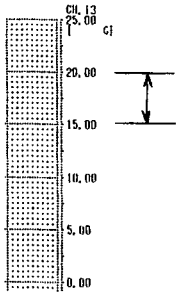
Scale display with
baseline set to 50.00



Scale display with
baseline set to 53.00



↑
Scale display is not moved.
(Offset is cancelled)

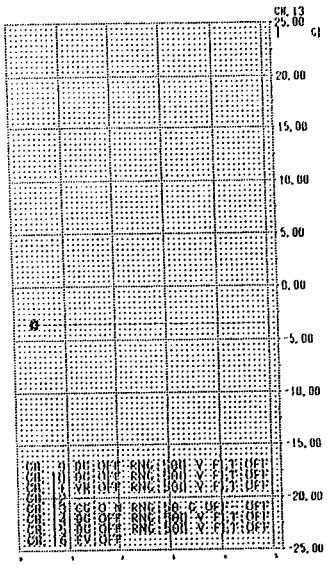


1 DIV (Amplitude set to 100 mm F.S.)

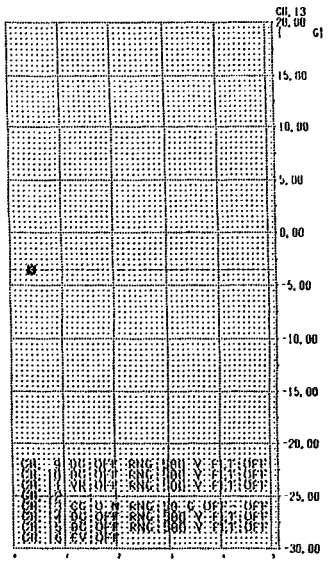
If baseline position is moved more than 0.5DIV,
the scale display is also moved.

Sample 2 of recording (offset beyond ±0.5DIV):

Scale display with
baseline set to 50.00



Scale display with
baseline set to 60.00

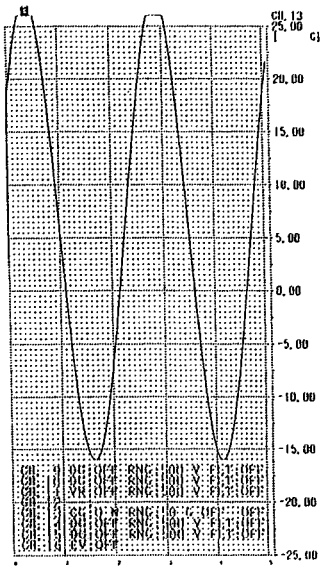


↑
Scale display is moved
in 10-step upward as it is
beyond +0.5 DIV.

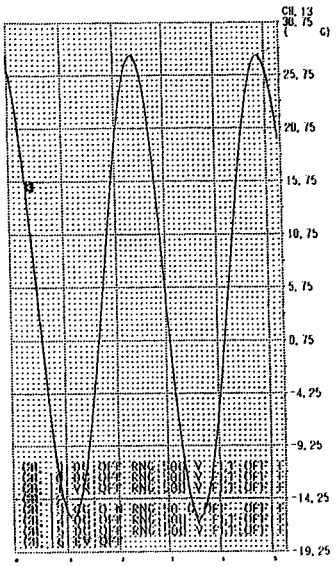
FINE: When recording, baseline position can be moved in 0.125mm steps. If the baseline position is finely adjusted in 0.05-step with the full scale in 100, the scale display is also moved in 1/2000 steps of input range with the baseline position moved meanwhile. In the FINE mode, even though the input signal is beyond the recording range, it can be recorded within the recording range with the POS. key.
(Offset cannot be cancelled when recording because scale display is also moved when the baseline is moved.)

Sample of recording:

Scale display with
baseline set to 50.00



Scale display with
baseline set to 45.50

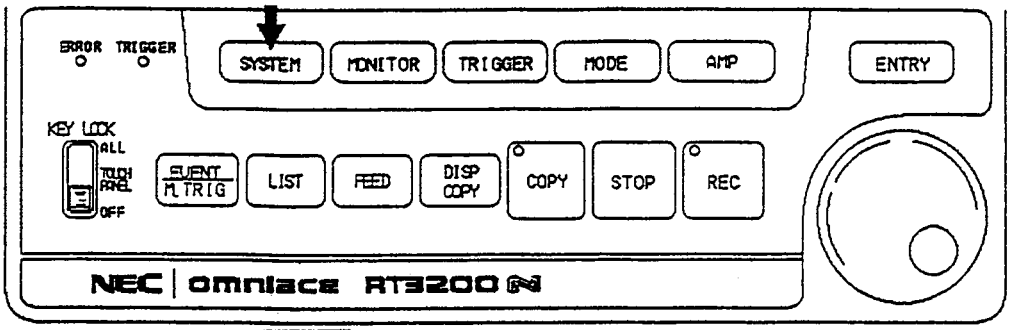


↑
Scale display is moved in 1/2000 steps of input range with the baseline position moved meanwhile.

12)Digital display
Display digital value of input signals.

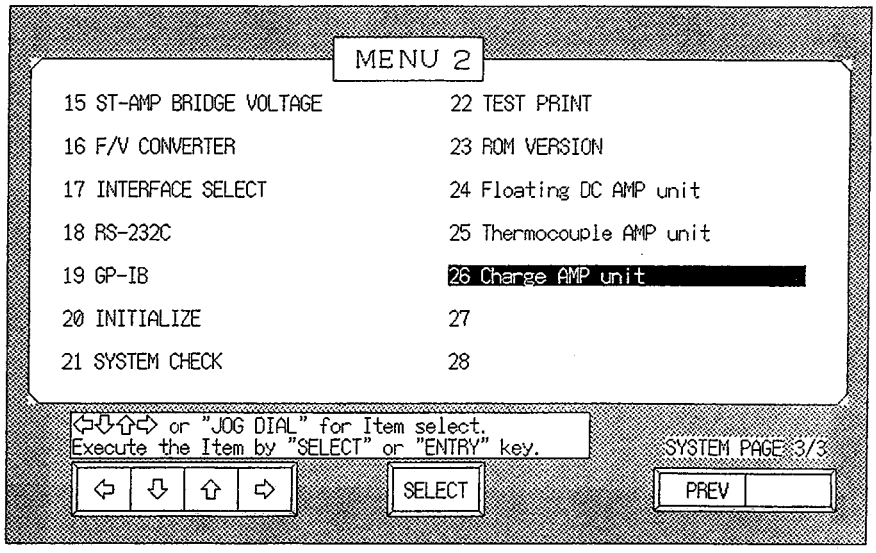
13)PREV
Return to the previous screen of AMP-3 (AMP-2 for RT3108N/3208N).

6.4 Setup of Charge Converter on MENU-2 (SYSTEM PAGE 3/3)



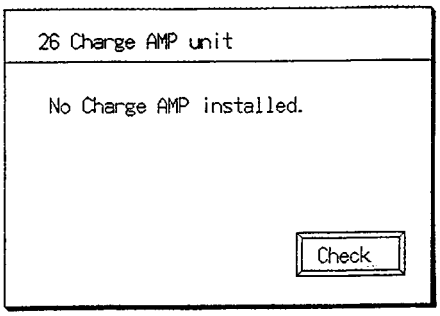
Press the SYSTEM key on the operation panel and the MENU-2 (SYSTEM 3/3) screen appears.

If another system page is displayed, press NEXT to display the MENU-2 (SYSTEM 3/3).

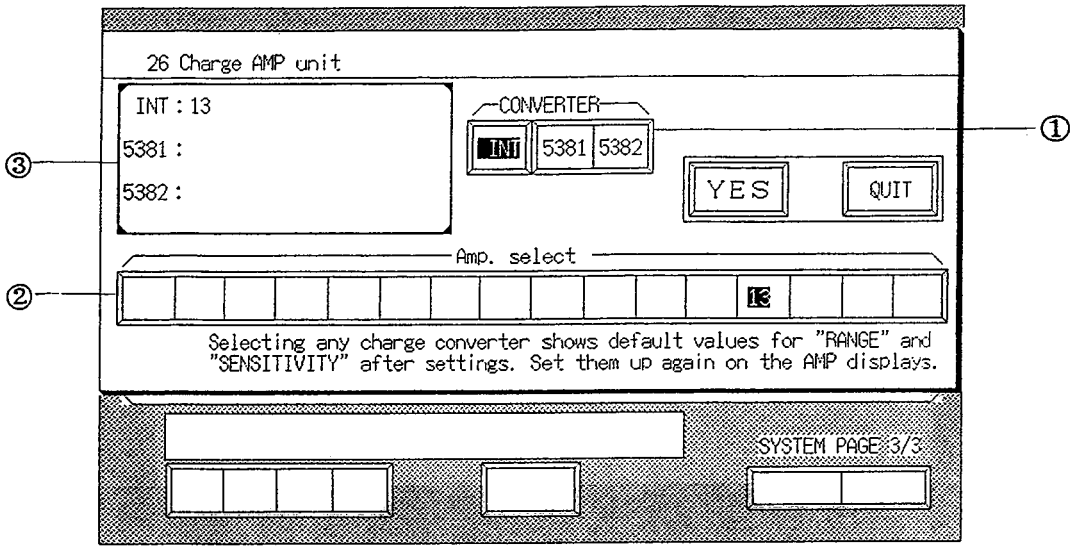


Move the cursor to the 26 Charge AMP unit item with the jog-dial or the ⇦ ⇩ ⇧ ⇨ on the screen.

Note: If a charge amplifier unit is not installed or if the unit is not displayed because of the memory limit (refer to Chapter 9.8 in the operation manual of the basic instrument), an error display appears. Press the CHECK key to confirm.

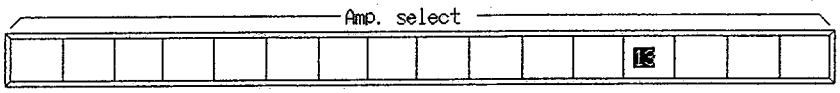


Press [SELECT] on the screen display or the [ENTRY] key on the operation panel to allow the following screen to appear.



1) CONVERTER
Select the type of charge converter from INT, 5381 and 5382.
The selected type is displayed in a reverse color.
Note: Select 5381 or 5382 (options) when they are installed.

2) AMP select
Select a channel in which a charge converter is installed.



Press the channel number key and the number is displayed in a reverse color, and the converter selected in (1) has been set.
Note: Only channels with charge amplifier units installed are displayed for selection.

Channels which have been set to INT, 5381 and 5382 are listed in the box (3) respectively.

Press [YES] to confirm settings and return to MENU-2 screen.
Press [QUIT] to cancel settings and return to MENU-2 screen.

Note: Changing of the charge converter setting affects the input range and the sensitivity as shown below.

Charge converter	Input range	Sensitivity
Internal	50 G·FS	999 pC/G
5381(option)	50 G·FS	9.99 pC/G
5382(option)	50 G·FS	99.9 pC/G

Reset the input range and the sensitivity after changing the setting of the converter.

7. Communication Commands (GP-IB/RS-232C interface)

Communication commands for GP-IB and RS-232C interfaces concerning the Charge Amplifier Unit RT31-159 are explained in this chapter.

For other commands and information about RS-232C interface unit or the optional GP-IB interface unit RT31-106, or memory card unit and remote unit, please refer to:
GP-IB/RS-232C INTERFACES·MEMORY CARD UNIT·REMOTE UNIT OPERATION MANUAL

7.1 Setting Commands

The following commands are available for setting up the input unit.

(1) SCH (Set CHannal)

[Function]
Sets the input condition.

[Input format]
SCH P1,P2,P3,P4(Delimiter)

[Parameter]
P1: Setup channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Input status
0: OFF
1: ON
2: GND
P3: Input range

1:	5kG·FS	7:	50G·FS
2:	2kG·FS	8:	20G·FS
3:	1kG·FS	9:	10G·FS
4:	500G·FS	10:	5G·FS
5:	200G·FS	11:	2G·FS
6:	100G·FS	12:	1G·FS

P4: Low-pass filter(LPF)
0: OFF
1: 10kHz
2: 5kHz
3: 1kHz

[Note]
1. The setting value of the parameter P3 is limited by the type of the charge converter and the sensitivity of sensor.
Setting out of range will cause a parameter error.

Charge converter	Sensitivity	Setting range
Internal	0.100 to 0.999 pC/G 1.00 to 9.99 pC/G 10.0 to 99.9 pC/G 100 to 999 pC/G	10 to 5k G·FS 1 to 5k G·FS 1 to 500G·FS 1 to 50 G·FS
Model 5381	0.100 to 0.999 pC/G 1.00 to 9.99 pC/G	10 to 500G·FS 1 to 50 G·FS
Model 5382	1.00 to 9.99 pC/G 10.0 to 99.9 pC/G	10 to 500G·FS 1 to 50 G·FS

2. LPF can also be set with the SCF command.

(2) SIN (Set INput of wave Amp)

[Function]
Sets ON/OFF of the input unit.

[Input format]
SIN P1,P2(Delimiter)

[Parameter]
P1: Setup channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
A for all channels
P2: Input ON/OFF
0: OFF
1: ON

[Note]
1. GND cannot be set with this command. Set it with the SCH command.
2. Setting a channel without input unit installed will cause a parameter error.
3. Setting while the recorder is in memory-recording operation will cause an execution error.

(3) SPP (Set Print Position of Amp)

[Function]
Sets the position of print base-line.

[Input format]
SPP P1,P2(Delimiter)

[Parameter]
P1: Setup channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
A for all channels
P2: Position of the base-line
0 to 10

[Explanation]
The real position of the base-line is from 0.00 to 100.00, and the SPP command sets 1/10 (from 0 to 10) of the real value. Setting with the SPP command cancels the fine-adjustment setting of the position. The SRP command sets the position with the fine-adjustment.

[Note]
1. Setting a channel without input unit installed will cause a parameter error.
2. Setting while the recorder is in memory-recording operation will cause an execution error.

(4) SRP (Set Real Print position)

[Function]
Sets the position of base-line with fine-adjustment.

[Input format]
SRP P1,P2(Delimiter)

[Parameter]
P1: Setup channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Real position of the base-line (input with ASCII characters)
0 to 2000

[Explanation]
The real position of the base-line is set between the full scale of 2000 steps.
One step in the scale of 200mm/FS or two steps in the scale of 100mm/FS means 0.1mm in the real position.
Setting with the SPP command cancels the fine-adjustment setting (10-steps full scale) of the real position after the fine adjustment setting.

[Note]
Setting a channel without an input unit installed will cause a parameter error.

(5) SCF (Set Charge amp Filter)

[Function]
Sets the LPF and HPF of the charge amplifier unit.

[Input format]
SCF P1,P2,P3(Delimiter)

[Parameter]
P1: Setup channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
A for all channels
P2: Low-pass filter(LPF)
0: OFF
1: 10 kHz
2: 5 kHz
3: 1 kHz
P3: High-pass filter(HPF)
0: OFF
1: 20 Hz
2: 200 Hz

[Explanation]
Parameters P2 and P3 can be omitted.
e.g. Input the command as "SCF P1,,P3" for HPF setting only.

[Note]
1. Omission of both P1 and P2 will cause a parameter error.
2. Setting a channel without an input unit installed or with an unit other than charge amplifier installed will cause a parameter error.

(6) SCC (Set Charge amp Converter)

[Function]
Sets charge converter (Internal/5381/5382).

[Input format]
SCC P1,P2(Delimiter)

[Parameter]
P1: Setup channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
A for all channels
P2: Charge converter
1: Internal
1: 5381(option)
2: 5382(option)

[Explanation]
Change of the type of charge converter will affect the input range and sensitivity of sensor as follows.
Use SCH or SCP command to reset these two parameters.

Charge converter	Input range	Sensitivity
Internal	50 G·FS	999 pC/G
5381(option)	50 G·FS	9.99 pC/G
5382(option)	50 G·FS	99.9 pC/G

[Note]
Setting a channel without an input unit installed or with an unit other than charge amplifier installed will cause a parameter error.

(7) SCP (Set Charge amp Pick-up)

[Function]
Sets sensitivity of sensor.

[Input format]
SCP P1,P2(Delimiter)

[Parameter]
P1: Setup channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
A for all channels
P2: Sensitivity of sensor (unit:pC/G)
0.100 to 999 (input with ASCII characters)

[Explanation]
Setting values of sensor's sensitivity allow the setting range of the input range to be limited. (Refer to SCH command.)
When the sensitivity is beyond the range of the setting, the input ranges is designed to be 50 G·FS.
The sensitivity of sensor, which is limited according to the type of charge converter, is shown below.

Charge converter	Sensitivity
Internal	0.100 to 999 pC/G
5381(option)	0.100 to 9.99 pC/G
5382(option)	1.00 to 99.9 pC/G

[Note]
Setting a channel without an input unit installed or with an unit other than charge amplifier installed will cause a parameter error.

(8) SAL (Set trigger Absolute Level)

[Function]
Directly sets a trigger level with a converted input range value. (when the trigger mode is in AND or OR mode.)

[Input format]
SAL P1,P2(Delimiter)

[Parameter]
P1: Setup channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Level (setting range of current input unit)
-5 to 5 (kG, G)

[Explanation]
This can be applied to user's scale.
Effective number of character are 9. More characters are ignored.
Other characters than number, decimal point, and "-" cause an error.
The input value is provided with a symbol and a decimal point, and the portion less than 1% of the waveform recording width is ignored.
The unit of a level depends on the input range. The selectable range varies with the value of base-line position.

[Note]
1. Setting a value exceeding the full scale causes a parameter error.
2. Setting the real-time trigger to OFF in the real-time mode causes a mode error.
3. Settings during operation cause an execution error.

7.2 Status Inquire Commands

The following commands are available for inquiring the status of the input unit from the host computer. If an error occurs after sending these commands, same number of "?" marks, corresponding to answer parameters, is returned to prevent hang-up.

(9) ICH (Inquire CHannal)

[Function]
Outputs the set condition of an input unit.

[Input format]
ICH P1(Delimiter)

[Output format]
A1,A2,A3,A4(Delimiter)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N

[Answer]
A1: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier
X: no input unit installed

A2: Input ON/OFF/GND
1: OFF
2: ON
3: GND

A3: Input range

1:	5kG·FS	7:	50G·FS
2:	2kG·FS	8:	20G·FS
3:	1kG·FS	9:	10G·FS
4:	500G·FS	10:	5G·FS
5:	200G·FS	11:	2G·FS
6:	100G·FS	12:	1G·FS

A4: Low-pass filter(LPF)
0: OFF
1: 10kHz
2: 5kHz
3: 1kHz

(10)IIP (Inquire Input/Print)

[Function]
Outputs the ON/OFF condition of input/print of a channel.

[Input format]
IIP P1(Delimiter)

[Output format]
A1(Delimiter)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N

[Answer]
A1: Input ON/OFF/GND
0: OFF
1: ON
2: GND

[Note]
Selecting a channel without an input unit installed causes a parameter error.

(11)IPP (Inquire Print Position)

[Function]
Outputs the print base-line position of the input unit.

[Input format]
IPP P1(Delimiter)

[Output format]
A1(Delimiter)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N

[Answer]
A1: Print base-line position
0 to 10

[Explanation]
The real position of the base-line is from 0.00 to 100.00, and the IPP command outputs 1/10 (from 0 to 10) of the real value.
Inquiring with the IPP command does not output the fine-adjustment portion.
The IRP command outputs the position with the fine-adjustment.

[Note]
1. Inquiring a channel without input unit installed will cause a parameter error.
2. Inquiring a channel for event amplifier unit installed will cause a parameter error.

(12)IRP (Inquire Real Print Position)

[Function]
Outputs the position of print base-line with fine-adjustment.

[Input format]
IRP P1(Delimiter)

[Output format]
A1(Delimiter)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N

[Answer]
A1: Real position of the base-line (ASCII characters)
0 to 2000

[Explanation]
The real position of the base-line is outputted with the full scale of 2000 steps.

[Note]
1. Inquiring a channel without input unit installed will cause a parameter error.
2. Inquiring a channel for event amplifier unit installed will cause a parameter error.

(13)ICF (Inquire Charge amp Filter)

[Function]
Outputs the setting status of LPF and HPF of a charge amplifier unit.

[Input format]
ICF P1(Delimiter)

[Output format]
A1,A2(Delimiter)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N

[Answer]
A1: Low-pass filter(LPF)
0: OFF
1: 10 kHz
2: 5 kHz
3: 1 kHz
A2: High-pass filter(HPF)
0: OFF
1: 20 Hz
2: 200 Hz

[Note]
Inquiring a channel without an input unit installed or with an unit other than charge amplifier installed will cause a parameter error.

(14)ICC (Inquire Charge amp Converter)

[Function]
Outputs setting of the charge converter (Internal/5381/5382).

[Input format]
ICC P1(Delimiter)

[Output format]
A1(Delimiter)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N

[Answer]
A1: Charge converter
1: Internal
1: 5381(option)
2: 5382(option)

[Note]
Inquiring a channel without an input unit installed or with an unit other than charge amplifier installed will cause a parameter error.

(15)ICP (Inquire Charge amp Pick-up)

[Function]
Outputs sensitivity of sensor.

[Input format]
ICP P1(Delimiter)

[Output format]
A1(Delimiter)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N

[Answer]
A1: Sensitivity of sensor (unit:pC/G)
0.100 to 999 (ASCII characters)

[Note]
Inquiring a channel without an input unit installed or with an unit other than charge amplifier installed will cause a parameter error.

(16)IDA (Inquire Data in ASCII format)

[Function]
Outputs input data of the current amplifier in ASCII format.
Outputs information(type and unit) of the current amplifier if Un is selected as a parameter.

[Input format]
IDA P1(Delimiter)

[Output format]
A1(Delimiter) : when one channel is selected
A1,A2,A3,...,A16(Delimiter) : when all channels are selected
A1,A2(Delimiter) : when Un is selected as a parameter

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
A for all channels
(In case of inquiring type and unit)
U1 to U16 for RT3216N
U1 to U8 for RT3108N/3208N

[Answer]

When data is read:

A1 to A16(A1 to A8 for RT3108N/3208N): ASCII data
Refer to RDA command for the data format.

When information is read:

A1: Type of input unit
- 0: not installed
- 1: DC amplifier
- 2: Event amplifier
- 3: F/V converter
- 4: DC strain amplifier
- 5: Zero suppression amplifier
- 6: Floating DC amplifier
- 7: Thermocouples amplifier
- 8: RMS converter
- 9: DC amplifier with fine control
- 10: Charge amplifier

A2: Unit
- 0: G
- 1: kG

[Note]

0 or 1 of A2 shows the natural unit of the charge amplifier.
Other values show the pre-set specific units.

2: N	5: $\mu\varepsilon$	8: kg	11: g
3: Pa	6: m/s^2	9: kgf	12: user-defined
4: mm	7: °C	10: kgf/cm^2	

[Explanation]

Like the function of a digital voltmeter, this command reads the data of the current input unit and outputs it with ASCII format.
When all channels are selected, 16 data (32 bytes, RT3216N) or 8 data (16 bytes, RT3108N/3208N) are always outputted whether input units are installed or not. However an asterisk mark(*) is sent back for the channel with no input unit installed.

(17)IDB (Inquire Data in Binary format)

[Function]

Outputs input data of the current amplifier in binary format.
Outputs information(type, unit and decimal point position) of the current amplifier if Un is selected as a parameter.

[Input format]

IDB P1(Delimiter)

[Output format]

(Upper-byte)(Lower-byte) : when one channel is selected
(Ud1)(Ld1)(Ud2)(Ld2)...(Ud16)(Ld16): when all channels are selected
A1,A2,A3(Delimiter) : when Un is selected as a parameter

[Parameter]

P1: Output channel

1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
A for all channels
(In case of inquiring type and unit)
U1 to U16 for RT3216N
U1 to U8 for RT3108N/3208N

[Answer]

When data is read:

(Upper-byte)(Lower-byte): Binary data
Refer to RDB command for the data format.

When information is read (ASCII format):

A1: Type of input unit

0: not installed
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier

A2: Unit

0: G
1: kG

A3: Position of the decimal point

[Note]

0 or 1 of A2 shows the natural unit of the charge amplifier.
Other values show the pre-set specific units.

2: N	5: $\mu\varepsilon$	8: kg	11: g
3: Pa	6: m/s^2	9: kgf	12: user-defined
4: mm	7: °C	10: kgf/cm^2	

[Explanation]

This command reads the data of the current input unit and outputs it in a binary format.
One data is outputted as two bytes, with the upper-byte first and followed by the lower-byte.
Delimiters other than EOI are not provided. (GP-IB interface)
When all channels are selected, 16 data (32 bytes, RT3216N) or 8 data (16 bytes, RT3108N/3208N) are always outputted whether input units are installed or not. However *0000h* is sent back for the channel with no input unit installed.

(18)IDD (Inquire Data Directly)

[Function]
Outputs data a in binary format of non-conversion.
Outputs information (type, range) if Un is selected as a parameter.

[Input format]
IDD P1(Delimiter)

[Output format]
(Upper-byte)(Lower-byte) : when one channel is selected
(Ud1)(Ld1)(Ud2)(Ld2)...(Ud16)(Ld16): when all channels are selected
A1,A2(Delimiter) : when Un is selected as a parameter

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
A for all channels
(In case of inquiring type and unit)
U1 to U16 for RT3216N
U1 to U8 for RT3108N/3208N

[Answer]
When data is read:
(Upper-byte)(Lower-byte): Binary data
Refer to RDD command for the data format.
When information is read (ASCII format):
A1: Type of input unit
0: not installed
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier
A2: Input range

1:	5kG·FS	7:	50G·FS
2:	2kG·FS	8:	20G·FS
3:	1kG·FS	9:	10G·FS
4:	500G·FS	10:	5G·FS
5:	200G·FS	11:	2G·FS
6:	100G·FS	12:	1G·FS

[Explanation]
This command reads the data of the current input unit and outputs it in an internal binary format. Delimiters other than EOI are not provided for GP-IB interface. When all channels are selected, 16 data (32 bytes, RT3216N) or 8 data (16 bytes, RT3108N/3208N) are always outputted whether input units are installed or not. However *0000h* is sent back for the channel with no input unit installed.

7.3 Memory Data Read Commands

The following commands are available for reading data in the recorder memory.

(19)RDA (Read Data in ASCII format)

[Function]
Outputs memory data in an ASCII format.

[Input format]
RDA P1,P2,P3(Delimiter)

[Output format]
A1,A2(Delimiter)(DATA1)(Delimiter)(DATA2)(Delimiter).....
(DATAn)(Delimiter)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Start address of data to be read
0 to final memory address
32767 in 32kWord/CH
262143 in 256kWord/CH
P3: Number of data to be read
1 to number of data to be read
Max. 32768 in 32kWord/CH
Max. 262144 in 256kWord/CH

[Answer]
A1: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier
A2: Unit
0: G
1: kG

[Note]
1. 0 or 1 of A2 shows the natural unit of the charge amplifier. Other values show the pre-set specific units.

2: N	5: $\mu\varepsilon$	8: kg	11: g
3: Pa	6: m/s^2	9: kgf	12: user-defined
4: mm	7: °C	10: kgf/cm^2	

2. The ranges of P2 and P3 depend on the division of the recorder memory. For details about memory division, refer to *Chapter 12.3 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

[Explanation]

Reads data of a channel selected by parameter P1.
When P2 and P3 are inputted, the number of data selected by P3 is read from the address indicated by P2.
If both P2 and P3 are omitted, it depends on the setting values of the recorder. (The same range as for copying)
Omission of either P2 or P3 is not allowed.
When a specific unit or a scale is set, the value, which is converted in accordance with the setting, is outputted.
Regarding the setting of specific units or scales, refer to the operation manual of the basic instrument.
In the above case, the numerical value of Answer A2 coincides with the number of a specific unit.
Output data (DATAn) is provided with symbol and decimal point.
Delimiters are outputted between data as separators.

[Note]

1. While the instrument is executing other commands, this command is not executed. This command must be executed after the execution of other commands is completed.
2. An error occurs if no effective data is in the memory.
   Before executing this command, use IMS command to check the memory condition.
3. If data is read beyond the measurable range, 0 is outputted.
4. A data write command does not provide the function of setting user scale. When it is necessary to rewrite data, do not change the unit and scale.

[Example]

To read 5 memory data of CH1 from address 0
Command: RDA 1,0,5(Delimiter)
Answer: 10,0(Delimiter)50.00(Delimiter)40.00(Delimiter)30.00
(Delimiter)20.00(Delimiter)10.00(Delimiter)

Input unit type : Charge amplifier
Physical unit : G
DATA1(address 0): 50.00 G
DATA2(address 1): 40.00 G
DATA3(address 2): 30.00 G
DATA4(address 3): 20.00 G
DATA5(address 4): 10.00 G

(20)RDB (Read Data in Binary format)

[Function]
Outputs memory data in binary format.

[Input format]
RDB P1,P2,P3(Delimiter)

[Output format]
A1,A2,A3(Delimiter)[STX](Upper DATA1)(Lower DATA1).....
...(Upper DATAn)(Lower DATAn)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Start address of data to be read
0 to final memory address
32767 in 32kWord/CH
262143 in 256kWord/CH
P3: Number of data to be read
1 to number of data to be read
Max. 32768 in 32kWord/CH
Max. 262144 in 256kWord/CH

[Answer]
A1: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier
A2: Unit
0: G
1: kG
A3: Position of decimal point (n)
Divide the data by 10^n to get the real value.

[Note]
1. Parameter (Pn) and answer (An) are in ASCII format.
2. 0 or 1 of A2 shows the natural unit of the charge amplifier.
Other values show the pre-set specific units.

2: N	5: $\mu\varepsilon$	8: kg	11: g
3: Pa	6: m/s^2	9: kgf	12: user-defined
4: mm	7: °C	10: kgf/cm^2	

3. The ranges of P2 and P3 depend on the division of the recorder memory and setting of memory capacity per channel.
For details about memory division, refer to *Chapter 12.3 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

[Explanation]

Reads data of a channel selected by parameter P1.
When P2 and P3 are inputted, as much as the number of word selected by P3 is read from the address indicated by P2. If both P2 and P3 are omitted, it depends on the setting values of the recorder. (The same range as for copying.) Omission of either P2 or P3 is not allowed.
In the data output, status of input unit is outputted with A1 to A3, and then [STX]*(02h)* code is outputted as the start mark of the data, successively the specified number of word data are outputted in a binary format. No delimiter is outputted between data.
In case of GP-IB interface, [EOI] is outputted as the last byte.
A data, an integer of one word (2-byte), is outputted with an upper-byte followed by a lower-byte.

(Upper DATAn): the upper-byte of DATAn
(Lower DATAn): the lower-byte of DATAn

Since A3 indicates the position of decimal point, divide the data by 10^n to get the real value.
Data represents a measured value with symbols (complement of 2) in 16 bits.

Example:

50 G ····· 5000 = 1388h (unit:G decimal point position: 2)
-50 G ····· -5000 = EC78h

When a specific unit or a scale is set, the value, which is converted in accordance with the setting, is outputted.
Regarding the setting of specific units or a scales, refer to the operation manual of the basic instrument.
In the above case, the numerical value of Answer A2 coincides with the number of a specific unit.

[Note]

1. While the instrument is executing other commands, this command is not executed. This command must be executed after the execution of other commands finishes.
2. An error occurs if no effective data is in the memory.
   Before executing this command, use IMS command to check the memory condition.
3. If data is read beyond the measurable range, *0000h* is sent back.
4. A data write command does not provide the function of setting user scale. When it is necessary to rewrite data, do not change the unit and scale.

[Example]

To read 5 memory data of CH1 from address 0
Command: RDB 1,0,5(Delimiter)
Answer: 10,0,2(Delimiter)[STX](13h)(88h) (0Fh)(A0h) (0Bh)(B8h) (07h)(D0h) (03h)(E8h)

Input unit type : Charge amplifier
Physical unit : G
Decimal point position: 2
DATA1(address 0)=(13h)(88h)=(1388h)=5000: 50.00 G
DATA2(address 1)=(0Fh)(A0h)=(0FA0h)=4000: 40.00 G
DATA3(address 2)=(0Bh)(B8h)=(0BB8h)=3000: 30.00 G
DATA4(address 3)=(07h)(D0h)=(07D0h)=2000: 20.00 G
DATA5(address 4)=(03h)(E8h)=(03E8h)=1000: 10.00 G

(21)RDD (Read Data Directly)

[Function]
Outputs memory data in internal format(binary).

[Input format]
RDD P1,P2,P3(Delimiter)

[Output format]
A1,A2(Delimiter)[STX](Upper DATA1)(Lower DATA1).....
...(Upper DATAn)(Lower DATAn)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Start address of data to be read
0 to final memory address
32767 in 32kWord/CH
262143 in 256kWord/CH
P3: Number of data to be read
1 to number of data to be read
Max. 32768 in 32kWord/CH
Max. 262144 in 256kWord/CH

[Answer]
A1: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier
A2: Input range

1:	5kG·FS	7:	50G·FS
2:	2kG·FS	8:	20G·FS
3:	1kG·FS	9:	10G·FS
4:	500G·FS	10:	5G·FS
5:	200G·FS	11:	2G·FS
6:	100G·FS	12:	1G·FS

[Note]
1. Parameter (Pn) and answer (An) are in ASCII format.
2. Specifying values in the ranges of P2 and P3 vary depending on the setting of division of the recorder memory.
For details about memory division, refer to *Chapter 12.3 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

[Explanation]

Reads data of a channel selected by parameter P1.
The setting of P2 and P3 are the same as that of RDB.
In the data output, status of input unit is outputted with A1 to A3, and then [STX]*(02h)* code is outputted as the start mark of the data, successively the specified number of word data are outputted in a binary format. No delimiter is outputted between data.
In case of GP-IB interface, [EOI] is outputted as the last byte.

Data is represented with symbols with the full scale in +2000 (complement of 2) in 16 bits.

Example: (input range: 5 G·FS)

```
 5 G ·····  2000 = 07D0h
-5 G ····· -2000 = F830h
 0 G ·····  0000 = 0000h
 1 G ·····  0400 = 0190h
```

When a specific unit or a scale is set, the data is outputted in the actual range of an input unit.
High speed data transfer can be provided since processing of data conversion is not performed.

[Note]

1. Since the RDD command reads data directly from the memory, it differs in format from other commands.
2. While the instrument is executing another command, this command is not executed. This command must be executed after the execution of another command stops.
3. If data is read beyond the measurable range, *0000h* is sent back.

[Example]

To read 3 memory data of CH1 from address 0
Command: RDD 1,0,3(Delimiter)
Answer: 10,10(Delimiter)[STX](07h)(D0h) (06h)(40h) (04h)(B0h)

Input unit type : Charge amplifier
Input range: 5 G·FS
DATA1(address 0)=(07h)(D0h)=(07D0h)=2000 (2000/2000*5=5.000 G)
DATA2(address 1)=(06h)(40h)=(0640h)=1600 (1600/2000*5=4.000 G)
DATA3(address 2)=(04h)(B0h)=(04B0h)=1200 (1200/2000*5=3.000 G)

7.4 Data Write Commands

Execute these commands on a host computer to write data directly into the recorder memory .
The data written into the memory can be recorded by the "Copy command" like ordinary data.

(22)WDA (Write Data in ASCII format)

[Function]
Writes data to memory in ASCII format.

[Input format]
WDA P1,P2,P3,P4(,P5)(Delimiter)(DATA1)(Delimiter)(DATA2)(Delimiter)
.....(DATAn)(Delimiter)

[Parameter]
P1: Write channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Start address to be written
0 to final memory address
32767 in 32kWord/CH
262143 in 256kWord/CH
P3: Number of data to be written
1 to number of data to be read
Max. 32768 in 32kWord/CH
Max. 262144 in 256kWord/CH
P4: Input range

P4	Input range	Data range
1:	5kG·FS	5000 to -5000
2:	2kG·FS	2000 to -2000
3:	1kG·FS	1000 to -1000
4:	500G·FS	500.0 to -500.0
5:	200G·FS	200.0 to -200.0
6:	100G·FS	100.0 to -100.0
7:	50G·FS	50.00 to -50.00
8:	20G·FS	20.00 to -20.00
9:	10G·FS	10.00 to -10.00
10:	5G·FS	5.000 to -5.000
11:	2G·FS	2.000 to -2.000
12:	1G·FS	1.000 to -1.000

P5: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier

[Note]

1. Parameter Pn is in ASCII format.
2. The ranges of P2 and P3 depend on the division of the recorder memory and setting of memory capacity per channel.
   For details about memory division, refer to *Chapter 12.3 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

[Explanation]

Writes data of a channel selected by parameter P1.
When P2 and P3 are inputted, writing is performed from the address shown by P2 to the same number of word specified by P3.
If both P2 and P3 are omitted, it depends on the setting values of the recorder. (The same range as for copying)
Omission of either P2 or P3 is not allowed.
If P4 is omitted, it is interpreted as data corresponding to the setting range of the input unit.
P5 can be omitted, as it is used for checking the type of an input unit.
Input data (DATAn) is provided with symbol and decimal point.
Delimiters or commas(,) are necessary between data as separators.

[Note]

1. Data writing does not apply to the change in setting of a specific unit or a scale.
2. If a specific unit or a scale is set at the basic instrument side, data is written by returning the setting to the internal unit according to the input unit.
3. Writing must be done with data corresponding to the input ranges.
4. While the instrument is executing another command, this command is not executed. This command must be executed after the execution of another command finishes.
5. A parameter error occurs if the type of the input unit selected by P5 differs from the type of the unit actually installed.
   In this case, data written to memory are not guaranteed if the P5 is omitted.

[Example]

To write 3 memory data of 5kG·FS range to CH1 (Charge amplifier) from address 0
Command: WDA 1,0,3,1,10(Delimiter)5000(Delimiter)4000(Delimiter)
3000(Delimiter)
Data to be written:
DATA1(address 0)=5000: 5000 G =5.000 KG
DATA2(address 1)=4000: 4000 G =4.000 KG
DATA3(address 2)=3000: 3000 G =3.000 KG

(23)WDB (Write Data in Binary format)

[Function]
Writes data to memory in binary format.

[Input format]
WDB P1,P2,P3,P4(,P5)(Delimiter)[STX](Upper DATA1)(Lower DATA1)
.....(Upper DATAn)(Lower DATAn)

[Parameter]
P1: Write channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Start address to be written
0 to final memory address
32767 in 32kWord/CH
262143 in 256kWord/CH
P3: Number of data to be written
1 to number of data to be read
Max. 32768 in 32kWord/CH
Max. 262144 in 256kWord/CH
P4: Input range

P4	Input range	Data range
1	5 kG·FS	5000 to -5000
2	2 kG·FS	2000 to -2000
3	1 kG·FS	1000 to -1000
4	500 G·FS	500.0 to -500.0
5	200 G·FS	200.0 to -200.0
6	100 G·FS	100.0 to -100.0
7	50 G·FS	50.00 to -50.00
8	20 G·FS	20.00 to -20.00
9	10 G·FS	10.00 to -10.00
10	5 G·FS	5.000 to -5.000
11	2 G·FS	2.000 to -2.000
12	1 G·FS	1.000 to -1.000

P5: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier

[Note]

1. Parameter Pn is in ASCII format.
2. Values specified by P2 and P3 vary depending on the division of the memory and setting of memory capacity per channel.
   For details about memory division, refer to *Chapter 12.3 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

[Explanation]

Writes data of a channel selected by parameter P1.
When P2 and P3 are inputted, writing is performed from the address shown by P2 to the same number of word specified by P3.
If both P2 and P3 are omitted, it depends on the setting values of the recorder. (The same range as for copying)
Omission of either P2 or P3 is not allowed.
If P4 is omitted, it is interpreted as data corresponding to the setting range of the input unit.
P5 can be omitted, as it is used for checking the type of an input unit.
A data, an integer of one word (2-byte), is outputted with an upper-byte followed by a lower-byte.

(Upper DATAn): the upper-byte of DATAn
(Lower DATAn): the lower-byte of DATAn

The input is provided with P1 to P5 and binary data string started with the [STX]*(02h)* code.

[Note]

1. Data writing does not apply to the change in setting of a specific unit or a scale.
2. If a specific unit or a scale is set at the basic instrument side, data is written by returning the setting to the internal unit according to the input unit.
3. Writing must be done with data corresponding to the input ranges.

[Example]

To write 3 memory data of 5kG·FS range to CH1 (Charge amplifier) from address 0
Command:

WDB 1,0,3,1,10(Delimiter)[STX](13h)(88h) (0Fh)(A0h) (0Bh)(B8h)

Data to be written:

DATA1(address 0)=(13h)(88h):(1388h)=5000G=5.000kG
DATA2(address 1)=(0Fh)(A0h):(0FA0h)=4000G=4.000kG
DATA3(address 2)=(0Bh)(B8h):(0BB8h)=3000G=3.000kG

(24)WDD (Write Data Directly)

[Function]
Writes data to memory in internal format(binary).

[Input format]
WDD P1,P2,P3,P4(,P5)(Delimiter)[STX](Upper DATA1)(Lower DATA1)
.....(Upper DATAn)(Lower DATAn)

[Parameter]
P1: Write channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Start address to be written
0 to final memory address
32767 in 32kWord/CH
262143 in 256kWord/CH
P3: Number of data to be written
1 to number of data to be read
Max. 32768 in 32kWord/CH
Max. 262144 in 256kWord/CH
P4: Input range

1:	5kG·FS	7:	50G·FS
2:	2kG·FS	8:	20G·FS
3:	1kG·FS	9:	10G·FS
4:	500G·FS	10:	5G·FS
5:	200G·FS	11:	2G·FS
6:	100G·FS	12:	1G·FS

P5: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier

[Note]
Values specified by P2 and P3 vary depending on the division of the memory and setting of memory capacity per channel.
For details about memory division, refer to *Chapter 12.3 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

[Explanation]

Writes data of a channel selected by parameter P1.
When P2 and P3 are inputted, writing is performed from the address shown by P2 to the same number of word specified by P3.
If both P2 and P3 are omitted, it depends on the setting values of the recorder. (The same range as for copying)
Omission of either P2 or P3 is not allowed.
If P4 is omitted, it is interpreted as data corresponding to the setting range of the input unit.
P5 can be omitted, as it is used for checking the type of an input unit.
A data, an integer of one word (2-byte), is outputted with an upper-byte followed by a lower-byte.

(Upper DATAn): the upper-byte of DATAn
(Lower DATAn): the lower-byte of DATAn

The input is provided with P1 to P5 and binary data string started with the [STX]*(02h)* code.
Data is represented with the full scale in +2000 with symbols (complement of 2) in 16 bits.

Example: (input range: 5 G·FS)

5 G ····· 2000 = 07D0h
-5 G ····· -2000 = F830h
0 G ····· 0000 = 0000h
1 G ····· 0400 = 0190h

High speed data transfer can be provided since data conversion is not performed.

[Note]

1. The data format of the WDD command is the same with that of the RDD command.
2. Data writing does not apply to the change in setting of a specific unit or a scale.
3. If a specific unit or a scale is set at the basic instrument side, data is written by returning the setting to the internal unit according to the input unit.
4. Writing must be done with data corresponding to the input ranges.

[Example]

To write 3 memory data of 5kG·FS range to CH1 (Charge amplifier) from address 0
Command:

WDD 1,0,3,1,10(Delimiter)[STX](07h)(D0h) (06h)(40h) (04h)(B0h)

Data to be written:

DATA1(address 0)=(07h)(D0h)=(07D0h)=2000 (2000/2000*5=5.000 G)
DATA2(address 1)=(06h)(40h)=(0640h)=1600 (1600/2000*5=4.000 G)
DATA3(address 2)=(04h)(B0h)=(04B0h)=1200 (1200/2000*5=3.000 G)

7.5 Data Communication by Xmodem Protocol

With RS-232C interface of this instrument, the transmission and reception of A/D data are available when using the Xmodem protocol.
Through packet transfer by Xmodem protocol, data can be transferred with a high reliability.
For the details on the Xmodem communication protocol and data packets, refer to *Chapter 12.6 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

(25)RXB (Read Xmodem in Binary format)

[Function]
Outputs memory data in Xmodem binary format.

[Input format]
RXB P1,P2,P3(Delimiter)

[Output format]
A1,A2,A3(Delimiter)
Start of communication (PACKET1)(PACKET2).....(PACKETn)

[Parameter]
P1: Output channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Start address of data to be read
0 to final memory address
32767 in 32kWord/CH
262143 in 256kWord/CH
P3: Number of data to be read
1 to number of data to be read
Max. 32768 in 32kWord/CH
Max. 262144 in 256kWord/CH

[Answer]
A1: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier
A2: Input range

1:	5kG·FS	7:	50G·FS
2:	2kG·FS	8:	20G·FS
3:	1kG·FS	9:	10G·FS
4:	500G·FS	10:	5G·FS
5:	200G·FS	11:	2G·FS
6:	100G·FS	12:	1G·FS

A3: Position of decimal point (n)

[Note]

1. Parameter (Pn) and answer (An) are in ASCII format.
2. Values specified by P2 and P3 vary depending on the division of the memory and setting of memory capacity per channel.
   For details about memory division, refer to *Chapter 12.3 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

[Explanation]

After outputting the condition of an input unit with A1 to A3, the instrument is put into the Xmodem communication mode. When the start for communication is verified by transmitting the [NAK] code from the host computer, the selected number of data items is outputted as a packet in the Xmodem format.
The parameter P1 to P3 and data in a packet are treated the same as in the RDB command.
One packet is composed of data of 128 bytes(68 words).
If a fraction occurs in the number of read data items for the packet, a [^Z]*(1Ah)* code is sent back as a deficiency.
Data in a packet, an integer of one word (2-byte), is outputted with an upper-byte followed by a lower-byte.
Since A3 indicates the position of decimal point, divide the data by 10^n to get the real value.
Data represents a measured value with symbols (complement of 2) in 16 bits.

Example:

```
 50 G ·····  5000 = 1388h (unit:G decimal point position: 2)
-50 G ····· -5000 = EC78h
```

When a specific unit or a scale is set, the value, which is converted in accordance with the setting, is outputted.
Regarding the setting of specific units or a scales, refer to the operation manual of the basic instrument.
In the above case, the numerical value of Answer A2 coincides with the number of a specific unit.

[Note]

1. While the instrument is executing another command, this command is not executed. This command must be executed after the execution of another command finishes.
2. An error occurs if no effective data is in the memory.
   Before executing this command, use IMS command to check the memory condition.
3. If data is read beyond the measurable range, *0000h* is sent back.
4. A data write command does not provide the function of setting user scale. When it is necessary to rewrite data, do not change the unit and scale.

(26)WXB (Write Xmodem in Binary format)

[Function]
Writes data to memory in Xmodem binary format.

[Input format]
WXB P1,P2,P3,P4(,P5)(Delimiter)
Start of communication (PACKET1)(PACKET2).....(PACKETn)

[Parameter]
P1: Write channel
1 to 16 for RT3216N
1 to 8 for RT3108N/3208N
P2: Start address to be written
0 to final memory address
32767 in 32kWord/CH
262143 in 256kWord/CH
P3: Number of data to be written
1 to number of data to be read
Max. 32768 in 32kWord/CH
Max. 262144 in 256kWord/CH
P4: Input range

P4	Input range	Data range
1	5 kG·FS	5000 to -5000
2	2 kG·FS	2000 to -2000
3	1 kG·FS	1000 to -1000
4	500 G·FS	500.0 to -500.0
5	200 G·FS	200.0 to -200.0
6	100 G·FS	100.0 to -100.0
7	50 G·FS	50.00 to -50.00
8	20 G·FS	20.00 to -20.00
9	10 G·FS	10.00 to -10.00
10	5 G·FS	5.000 to -5.000
11	2 G·FS	2.000 to -2.000
12	1 G·FS	1.000 to -1.000

P5: Type of input unit
1: DC amplifier
2: Event amplifier
3: F/V converter
4: DC strain amplifier
5: Zero suppression amplifier
6: Floating DC amplifier
7: Thermocouples amplifier
8: RMS converter
9: DC amplifier with fine control
10: Charge amplifier

[Note]

1. Parameter Pn is in ASCII format.
2. Values specified by P2 and P3 vary depending on the division of the memory and setting of memory capacity per channel.
   For details about memory division, refer to *Chapter 12.3 of GP-IB/RS-232C INTERFACES OPERATION MANUAL.*

[Explanation]

After inputting the condition of an input unit with P1 to P5, the instrument sends back a [NAK] code to inform that the communication protocol has been started. Then the binary data is written in the form of a packet.
The parameter P1 to P5 and data in a packet are treated the same as in the WDB command.

[Note]

1. Data writing does not apply to the change in setting of a specific unit or a scale.
2. If a specific unit or a scale is set at the basic instrument side, data is written by returning the setting to the internal unit according to the input unit.
3. Writing must be done with data corresponding to the input ranges.
4. If a fraction occurs in the final packet, the data, which exceeds the value selected by the number of data item P3, is ignored.

8. Specification

Number of channels:
1 input/unit

Input system:
For sensor:
Single-ended input, guarded floating between input and output
For remote charge converter:
Model 5381, 5382 (option)

Available sensor:
Piezoelectric acceleration sensor
Sensitivity : 0.1 to 999 pC/G (0.0102 to 101.9 pC/ms^{-2})
Maximum capacity: 10,000 pF

Allowable input electric charge:
50,000 pC maximum (inputted by sensor)

Sensitivity range:
Inputted by sensor:
3-digit setting between the following ranges
0.100 to 0.999 pC/G
1.00 to 9.99 pC/G
10.0 to 99.9 pC/G
100 to 999 pC/G

Inputted by remote charge converter:
3-digit setting between the following ranges
For Model 5381: 0.100 to 0.999 pC/G
1.00 to 9.99 pC/G
For Model 5382: 10.0 to 99.9 pC/G
100 to 999 pC/G

Frequency response:
0.5 to 20,000 Hz (within +1 and -3 dB)
(with low-pass and high-pass filters set to OFF)

Filter:
Low-pass filter : 2-pole Bessel-type
fc = 1 kHz, 5 kHz, 10 kHz (within approx. -1.6 dB)
High-pass filter: 1-pole
fc = 20 Hz, 200 Hz (within approx. -3 dB)

Input range:

For sensor:

1. Sensitivity of transducer: 0.1 to 0.999 pC/G
   10, 20, 50, 100, 200, 500, 1k, 2k, 5k G full scale
2. Sensitivity of transducer: 1 to 9.99 pC/G
   1, 2, 5, 10, 20, 50, 100, 200, 500, 1k, 2k, 5k G full scale
3. Sensitivity of transducer: 10 to 99.9 pC/G
   1, 2, 5, 10, 20, 50, 100, 200, 500 G full scale
4. Sensitivity of transducer: 100 to 999 pC/G
   1, 2, 5, 10, 20, 50 G full scale

For remote charge converter:

- Model 5381 (option)
  1. Sensitivity of sensor: 0.1 to 0.999 pC/G
     10, 20, 50, 100, 200, 500 G full scale
  2. Sensitivity of sensor: 1 to 9.99 pC/G
     1, 2, 5, 10, 20, 50 G full scale
- Model 5382 (option)
  1. Sensitivity of sensor: 10 to 99.9 pC/G
     10, 20, 50, 100, 200, 500 G full scale
  2. Sensitivity of sensor: 100 to 999 pC/G
     1, 2, 5, 10, 20, 50 G full scale

Measuring accuracy:

Within ±1.5% of full scale of the input range
Linearity: Within ±0.5% of full scale
Within ±1% of full scale for the range of 1 G full scale

Common Mode Voltage (CMV):

Maximum 30 Vrms (42.4 Vpeek) or 60 VDC

Noise:

0.05 pC peek to peek
Input terminal for sensor: 1000 pF, 1 pC/G (with 5 G full scale)

A/D conversion:

Resolution : 12 bit
Conversion time : 5 microseconds maximum

Input connector:

For sensor : miniature connector (#10-32 UNF)
For remote charge converter: NDIS strain input connector

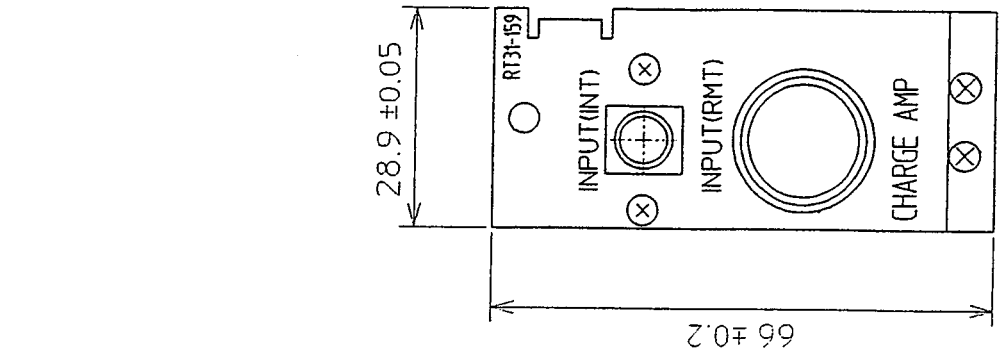
Dimensions:

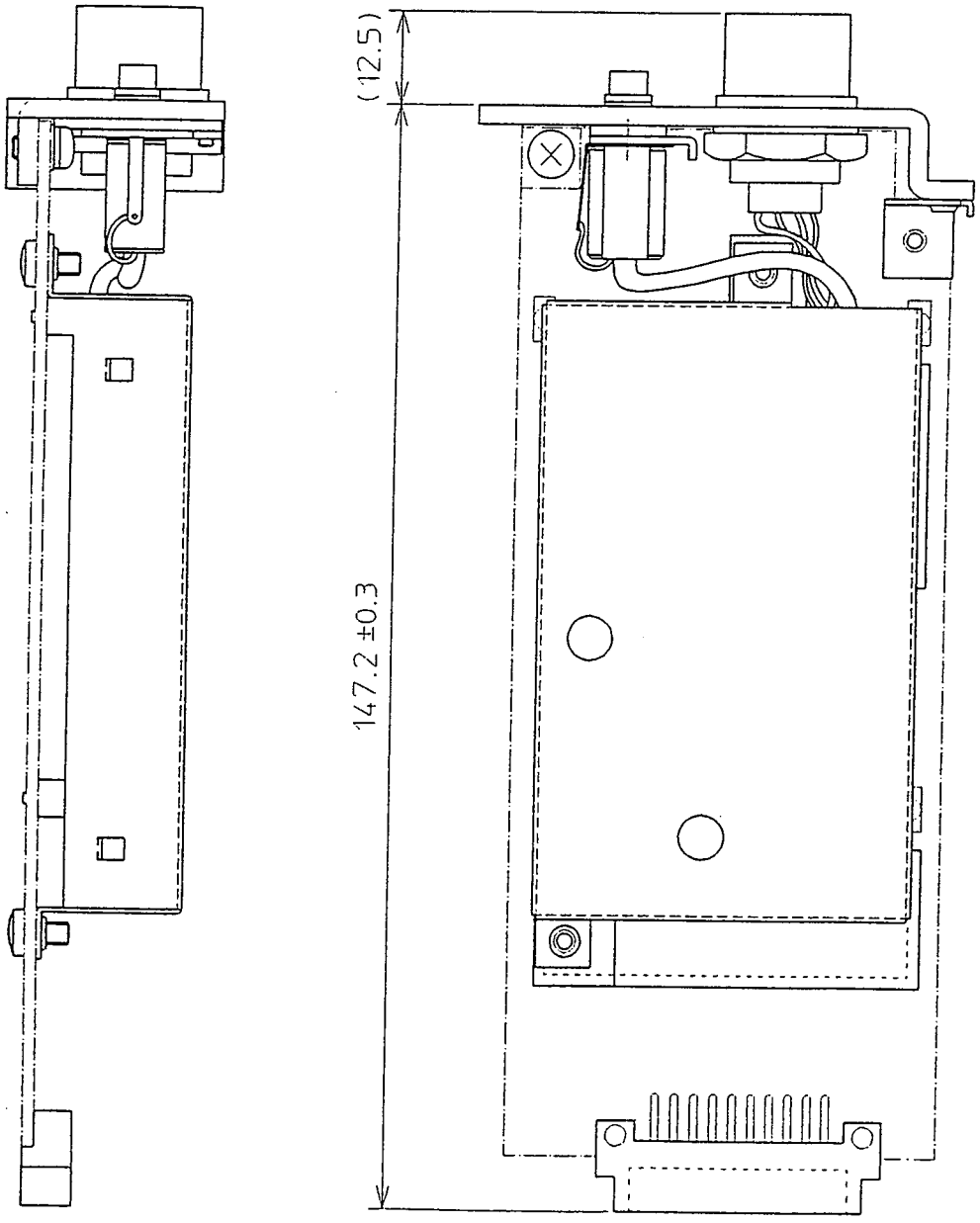
28.9 mm wide x 66.0 mm high x 159.7 mm deep, including connector

Weight:

Approximate 150 g

9. External View





SECTION 5

VARIABLE GAIN DC AMPLIFIER UNIT

CONTENTS

1.General Information

This unit is designed based on standard DC amplifier unit (RT31-109) and with the function of gain fine-adjustment(x1 to x2.5) added.
With this function, any waveform of input signal can be adjusted to match the grid line. In addition, with built-in calibration voltage applied, calibration of the voltage level of input signal is possible.

Rotate the gain fine-adjustment knob and then press the Scale cal. key, the calibration voltage will be applied automatically, and the output data and scaling will be corrected as well.

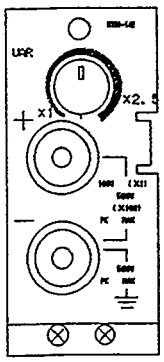
According to the type of input connector, two kinds of unit, Variable gain DC amplifier unit with double-deck binding posts (RT31-142) and Variable gain DC amplifier unit with safety terminals (RT31-148), are available.

Caution: If a voltage signal which exceeds the Allowable Input Voltage should be applied to the input, it may cause malfunction of the unit. Make sure that input signal should not exceed the Allowable Input Voltage shown as below:

Input Range	*0.1, 0.2, 0.5, 1, 2, 5V/FS*	*10, 20, 50, 100, 200, 500V/FS*
Allowable Input Voltage	*100V (DC or AC peak value)*	*500V (DC or AC peak value)*

2. Input Section

2.1 Variable Gain DC Amplifier Unit(RT31-142)



VAR knob:
Gain fine-adjustment of x1 to x2.5

+,-(input terminals):
Double-deck type binding posts
The negative terminal is connected to GUARD (shielded case) inside the unit.
Allowable input voltage:
When in x1 range: 100V (DC or AC peak value)
When in x100 range: 500V (DC or AC peak value)
Common mode voltage:
(between +,- terminals and housing case)
500V (DC or AC peak value)

* A signal input cable (0311-5107) is available.
(with a double-deck banana plug on one end and a test clip on the other end, cable length: 2m)

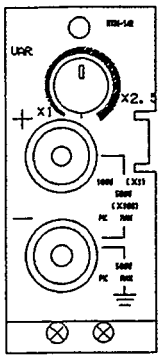
2.2 Variable Gain DC Amplifier Unit with Safety Terminals(RT31-148)

This is a modified unit where the construction of the signal input terminals (+,-) are of the safety-terminal form permitting no direct touch of hand. Other functions of this unit are exactly the same as those of RT31-142.

3.Operation Instruction

3.1 Connection to Input Signal

In order to carry out correct measurement with less noise, the input cable connection is very important.
Basically, connect the high-impedance side (H side:hot side) to the red(+) input terminal and the low-impedance side (L side:cold side) to the black(-) input terminal.



Signal source

Red(+) high-impedance side (H side:hot side)
←——————————————————————(+)

Black(-) low-impedance side (L side:cold side)
←——————————————————————(-)

Especially when a low-level signal is to be measured, pay attention to:

a) Make the input signal cable as short as possible.
b) Use a shielded cable to suppress electrostatic noise.
c) Twist the (+) and (-) input cables together to suppress electro-magnetic noise.

The impedance of signal source should be made to less than 100Ω.
Also from the viewpoint of noise-suppression, the lower the impedance of signal source is, the better the measurement will become.

Caution: In case of a non-grounded signal source, be sure that the common mode voltage (CMV) is less than 500V(DC or AC peak value) and use cable whose breakdown point of insulating material is higher than 2kV.

3.2 VAR Knob for gain fine-adjustment

Rotating the VAR knob counter-clockwise to the end makes the gain fine-adjustment to x1, and clockwise rotation makes it as higher as x2.5 or above.

Caution: Rough handling of this knob in different directions may cause failure.

3.3 Caution on Input Signal

a)Maximum input voltage

If a voltage signal which exceeds the Allowable Input Voltage should be applied to the input, it may cause malfunction of the unit. Therefore, make sure that input signal should not exceed the Allowable Input Voltage shown as below:

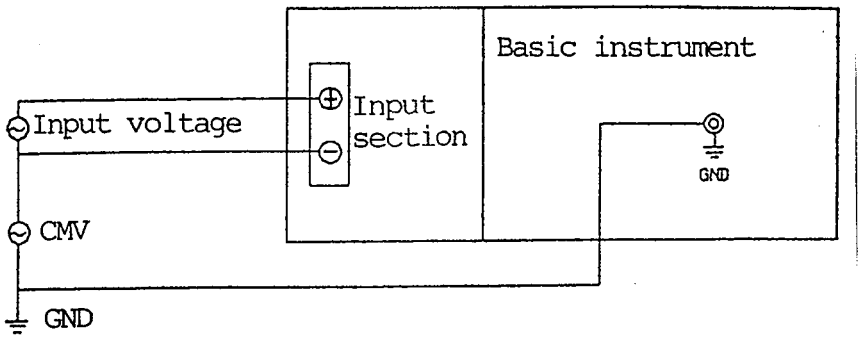
Input Range	0.1, 0.2, 0.5, 1, 2, 5V/FS	10, 20, 50, 100, 200, 500V/FS
Allowable Input Voltage	100V (DC or AC peak value)	500V (DC or AC peak value)

b)Input impedance

The input impedance is approximately 1 MΩ.
However, care must be taken that in case of 0.1 to 5 V/FS ranges, if the input voltage becomes higher than approximately 11V, the input impedance becomes to approximately 10 kΩ because of the actuating of protection-circuit.

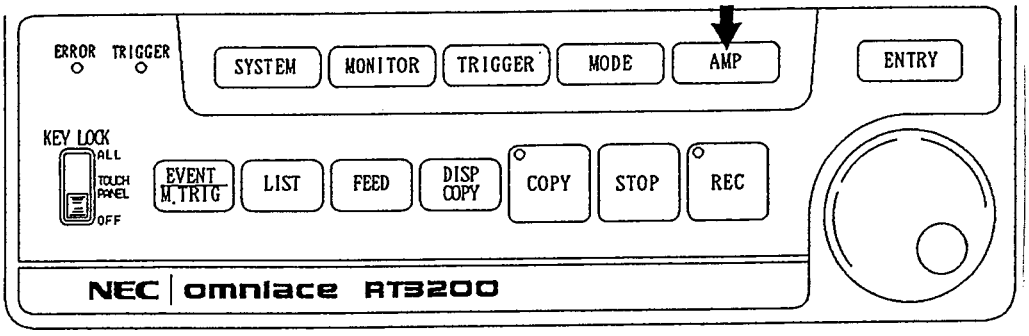
c)Common mode voltage (CMV)

The common mode voltage is a voltage component which is applied in common between the ground and the (+,-) input terminals.
If a noise-like pulse signal is applied as common mode voltage, noise may appear on the recording waveform because of the deterioration of Common Mode Rejection Ratio (CMRR).
In addition, make sure that CMV should not exceed the determined 500V peak value which may cause malfunction of the unit.

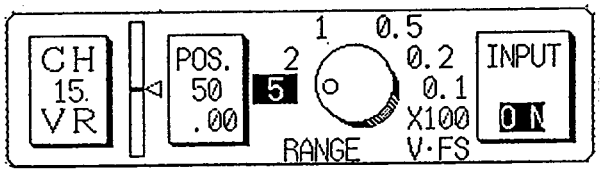


4. Setting-up Procedure

4.1 Display and Setup Procedure Performed on AMP screen Display (AMP-1 or AMP-2 Screen)



Press the [AMP] key on operation panel and the AMP-1 or AMP-2 screen display (AMP-1 for RT3108N/3208N).
The Variable gain DC amplifier unit is displayed as shown below.



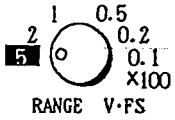
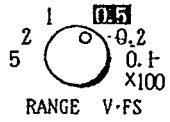
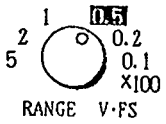
Each part of the figure is explained below:
1) Display

Display	Display contents
	Input signal is sampled and displayed. The ◁ mark indicates the baseline position. The display range is the Full Scale for waveform recording. The input signal corresponding to the Full Scale is changed when baseline position is altered.

* Baseline position: Displayed or recorded position when input is 0 Volt (short-circuited).

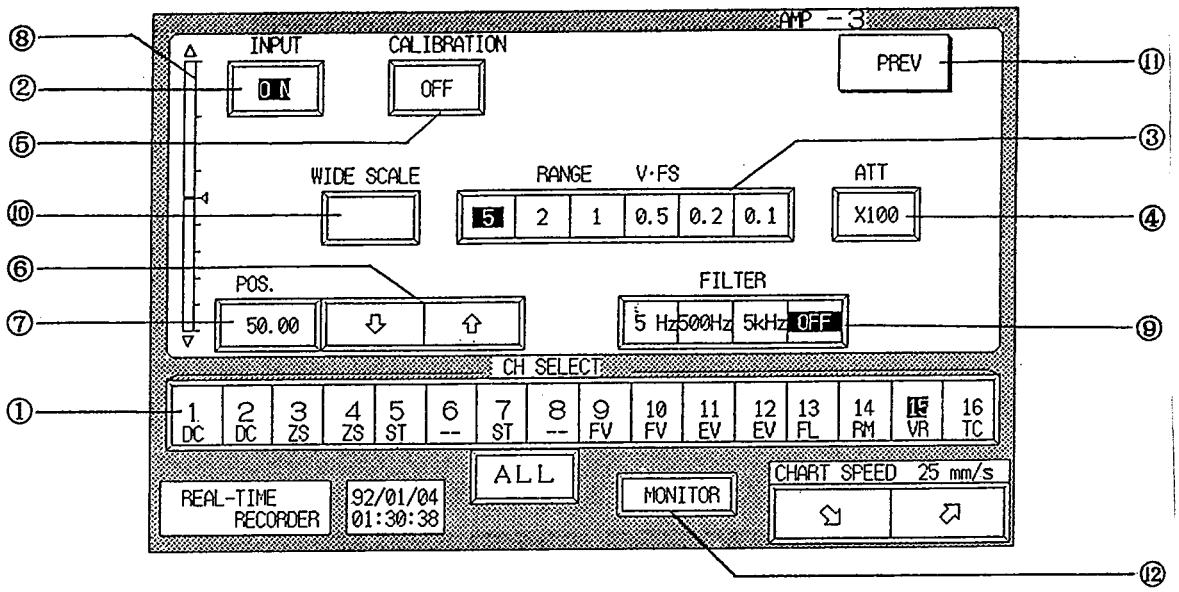
2) Setting key

Setting key	Display contents and setting procedure
	Press this key to select ON, OFF or GND. ON : Enable input to amplifier and recording OFF: Disable input to amplifier and recording GND: Disable input to amplifier, and recording is positioned on the baseline.

Setting key	Display contents and setting procedure
	Press the dial to change input range. The changing direction can be selected by SETTING ⇩/⬆.
POS. 50 .00	Press this key to move the baseline position of input every 10 steps, when the full scale is set to be 100. The default of baseline position is set to 50.00 so that waveform will be recorded at the middle of the recording area. Note:The baseline position can be set more finely such as POS. 51 .45 by 0.05-step than by 10-step. Refer to the next screen explanation for setting procedure. However, it cannot be made on this screen. When POS. 51 .45 is pressed, the baseline position is moved in 10-step as POS. 51 .45 → POS. 60 .00 → POS. 70 .00. The moving direction can be selected by SETTING ⇩/⬆.
SETTING ⇩/⬆	This key, displayed at a lower part of the AMP screen, selects direction for changing input range and moving baseline position. When in SETTING ⇩/⬆ position: Press  to change input range clockwise. Press POS. 50 .00 to move baseline position upward. When in SETTING ⬇/⇧ position: Press  to change input range counter-clockwise. Press POS. 50 .00 to move baseline position downward.

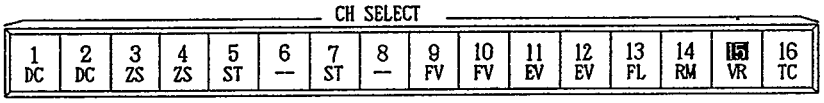
4.2 Setup Procedure on AMP Detailed Setup Display (AMP-2 or AMP-3 Screen)

Press channel number key (i.e. CH 15 VR), where the Variable gain DC Amplifier Unit is installed, on the AMP-1 or AMP-2 (AMP-1 for RT3108N/3208N) screen , the AMP-3 (AMP-2 for RT3108N/3208N) screen is displayed.



1)CH SELECT

Select a channel whose setup screen to be displayed.



Press the channel number key and the number is displayed in a reverse color, and the setup screen of this channel is displayed.

Press [ALL] to set the input units of the same type simultaneously. (Refer to Chapter 4.6 of *RT3108N/RT3208N/RT3216N Operation Manual* for details)

2)INPUT

Press this key to select ON, OFF or GND.

ON : Enable input to amplifier and recording

OFF: Disable input to amplifier and recording

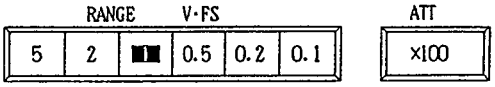
GND: Disable input to amplifier, and recording is positioned on the baseline.

3)RANGE(V · FS)

4)ATT

Set the input range by RANGE key and ATT key.

Press [ATT x100] to select x1 or x100.

Setup such as 

means 100V/FS.

5)CALIBRATION

Select ON or OFF of calibration.

Calibration voltage (equivalent to 1/5 full scale of the range) will be applied if CALIBRATION [OFF] is pressed to set calibration to ON.

Press the key again to set it to OFF.

With this calibration function, gain can be calibrated as the sample shown below.

Sample: When input range is 10V/FS, the calibration voltage becomes to 2V (1/5 of 10V).

Rotate the VAR knob and press CALIBRATION [OFF] key to set calibration to ON, if the change of voltage is 4V, then the gain is x2.

[Gain] = [Change of voltage]/[Calibration voltage]

If the change of voltage is difficult to read, set input to GND with INPUT key and then press CALIBRATION [OFF] key.

Note: Output data and scaling are incorrect after the VAR knob has been rotated. Do automatic calibration with Scale cal. key on the next screen.

6)POS.

When the [⇩][⇧] of the POS. [50.00][⇩][⇧] key is pressed, the baseline position, which is indicated by the ◁ mark, moves in 10-step upward or downward.

7)POS.Adj.

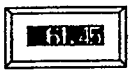
When the [50.00] of the POS. [50.00][⇩][⇧] key is pressed, the color of number is reversely displayed as POS. Adj. [50.00][⇩][⇧].

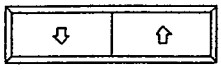
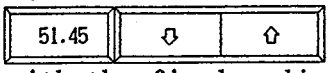
Rotate the jog-dial to finely adjust the baseline position to such as 51.45 in POS. Adj. [51.45][⇩][⇧] by 0.05-step.

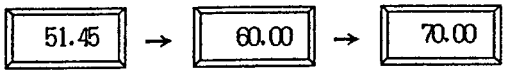
When in recording, the baseline position will be moved in 0.125mm steps on the paper by rotating the jog-dial.

Press [51.45] again and the display returns to [51.45].

Note: If [⇩][⇧] is pressed during the time when fine adjustment is made, as shown in POS. Adj. [51.45][⇩][⇧], the baseline position moves in 10-step with the finely-adjusted portion (1.45)

remained as shown in  →  .

If  is pressed during the time when fine adjustment is not made, as shown in 

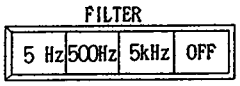
, the baseline position moves in 10-step with the finely-adjusted portion (1.45) canceled, as shown in 

.

8)LEVEL

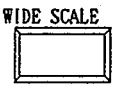
The status of input signal is indicated on the basis of the baseline position.

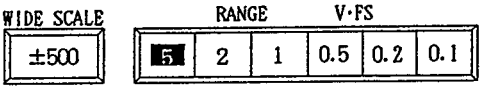
9)FILTER

Select low-pass filter from 

.
Selected item is displayed reversely in color.

10)WIDE SCALE

When 

is pressed, 

is displayed, and it becomes possible to monitor and record input signal from -500V to +500V.

Caution: It does not mean a range of 1000V/FS !
For instance, if the baseline position is set at 0.00 (the bottom line), only signals from 0 to +500V can be monitored and recorded.

11)PREV

Return to the previous screen.

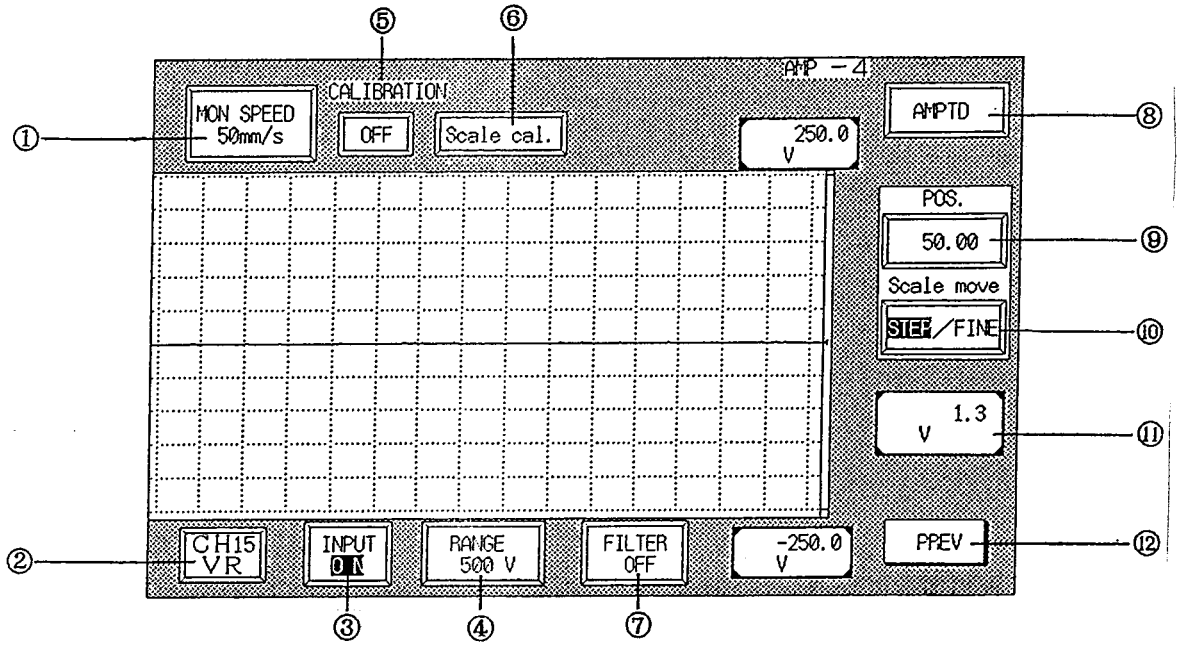
12)MONITOR

Proceed to the next screen, where various settings can be made while viewing the waveform of input signal. In addition, the amplitude of the waveform can be changed without changing the input range.
Refer to next chapter for details.

4.3 Display and Setup Procedure on AMP Setup Monitor Screen Display (AMP-3 or AMP-4 Screen)

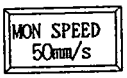
Press 

key on the AMP-3 (AMP-2 for RT3108N/3208N) screen, the AMP-4 (AMP-3 for RT3108N/3208N) screen is displayed.



1)MON SPEED

Select monitor speed.

When 

is pressed, 

is displayed and then monitor speed can be selected with jog dial.

Monitor speed: 50, 25, 10, 5, 2, 1 mm/sec
100, 50, 25, 10, 5, 2, 1 mm/min
100, 50, 25, 10, 5, 2, 1 mm/hour

2)CH SELECT

Select input channel to be monitored.

When 

is pressed, 

is displayed and then channel number can be selected with jog dial.

Press 

once again to display the monitor screen of the selected channel.

3)INPUT

Press the 

key to select ON, OFF or GND.

ON : Enable input to amplifier and recording
OFF: Disable input to amplifier and recording
GND: Disable input to amplifier, and recording is positioned on the baseline.

4)RANGE

Select input range.

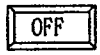
When 

is pressed, 

is displayed and then input range can be selected with jog dial.

5)CALIBRATION

Select ON or OFF of calibration.

Calibration voltage (equivalent to 1/5 full scale of the range) will be applied if CALIBRATION 

is pressed to set calibration to ON.

Press the key again to set it to OFF.

With this calibration function, gain can be calibrated as the sample shown below.

Sample: When input range is 10V/FS, the calibration voltage becomes to 2V (1/5 of 10V).

Rotate the VAR knob and press CALIBRATION 

key to set calibration to ON, if the change of voltage is 4V, then the gain is x2.

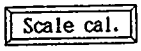
[Gain] = [Change of voltage]／[Calibration voltage]

If the change of voltage is difficult to read, set input to GND with INPUT key and then press CALIBRATION 

key.

Note: Output data and scaling are incorrect after the VAR knob has been rotated. Do automatic calibration with Scale cal. key as explained in next item.

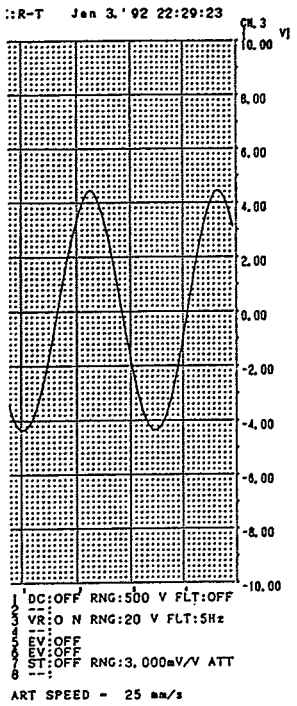
6)Scale cal.

Press 

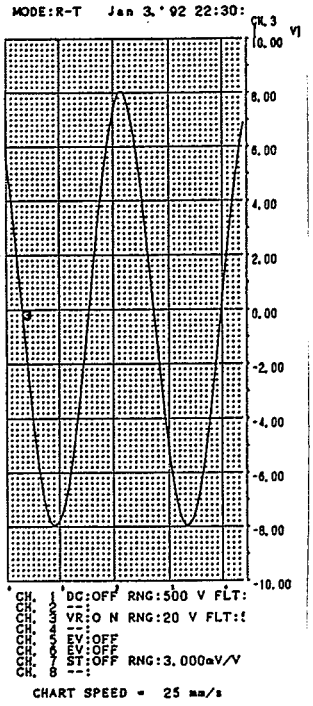
key to do calibration automatically, and output data and scaling becomes correct.

Sample of recording:

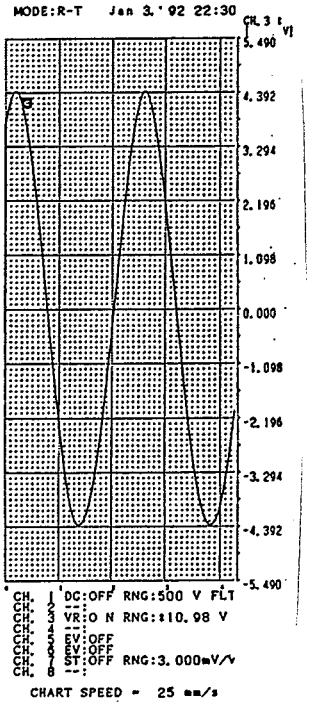
Scaling before gain fine adjustment



Scaling after gain fine adjustment



Scaling after scale calibration



7)FILTER

Select low pass filter from 5Hz/500Hz/5kHz/OFF.

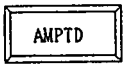
When 

is pressed, 

is displayed and then filter can be selected with jog dial.

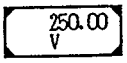
8)AMPTD

The amplitude of a waveform displayed on the screen can be changed to any value in the range of x10 to x1/2 without changing RANGE.

Press 

to display 

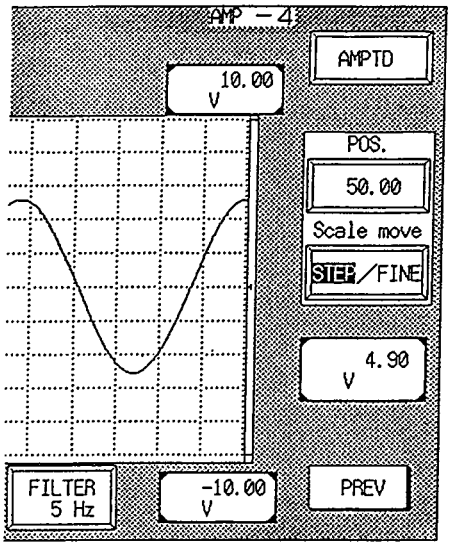
and the amplitude can be changed with jog dial.

The full scale value is indicated with 

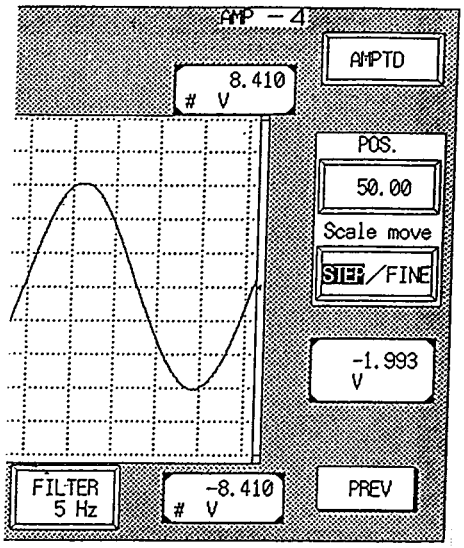
. When amplitude is changed, "#" marks are displayed and scale value is also changed.

Sample of monitoring:

Before changing amplitude
(FS: ±10.00V)

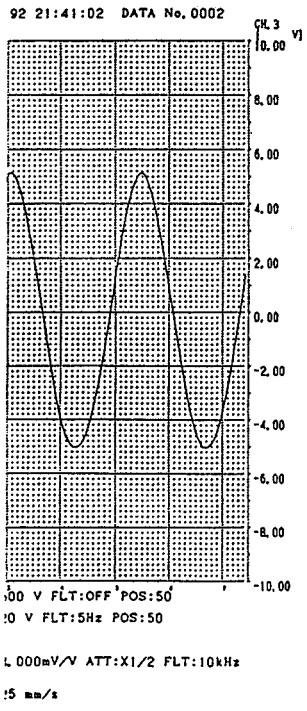


After changing amplitude
(FS: ±8.410V)

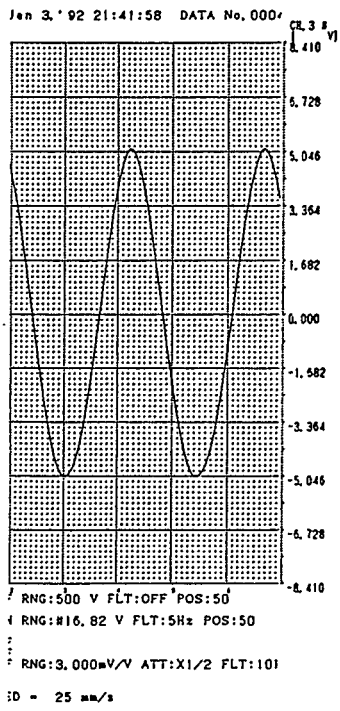


Sample of recording:

Before changing amplitude
(FS: ±10.00V)



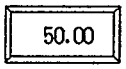
After changing amplitude
(FS: ±8.410V)



The "#" marks, which are displayed at the left side of +8.410V and -8.410V in the sample of monitoring, at the upper right corner of +8.410V and -8.410V in the sample of recording, and at the right side of RNG in AMP seeing screen, indicates that the scale mode of 7. Setting-up of Scale and Unit on MENU1 Screen(SYSTEM PAGE 2/3) is changed to "Mode 1" automatically.
For details about Scaling, refer to chapter 9.6 ("Setting-up of Scale and Unit") in *RT3108N/RT3208N/RT3216N Operation Manual.*

Note: Set the trigger level once again after changing the amplitude, because the trigger level is set by the format of percents of amplitude.

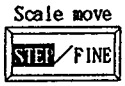
9)POS.

Press 

to display  .
The baseline position can be moved upward or downward in 0.05-step (FS:100) with jog dial, as shown in  →  →  .

The baseline position is indicated with ◀ at the right side of waveform.
The scale display is determined by selecting the Scale move key.

10)Scale move

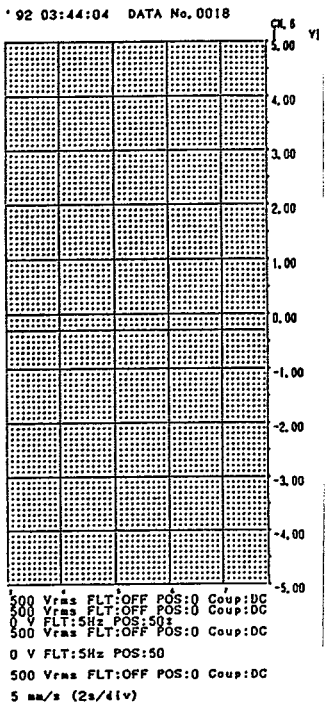
The steps of scale display movement in waveform recording can be selected by 

.

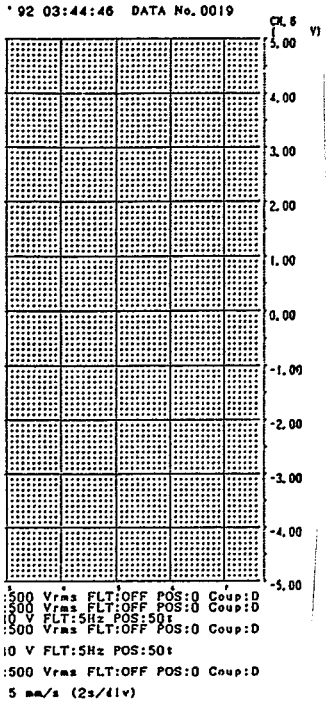
STEP: When recording, baseline position can be moved in 0.125mm steps. If the movement of baseline exceeds ±0.5DIV, the scale movement is moved in 10-step with the full scale in 100.
In the STEP mode, if an offset within ±0.5DIV is output when 0V is inputted, the output waveform can be moved to match the 0V grid line(in the middle of chart paper) with the POS. key. (Offset can be cancelled when recording)

Sample 1 of recording(offset within ±0.5DIV):

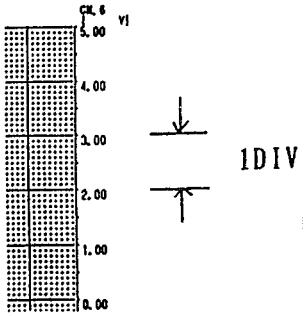
Scale display with baseline at 50.00



Scale display with baseline at 53.00



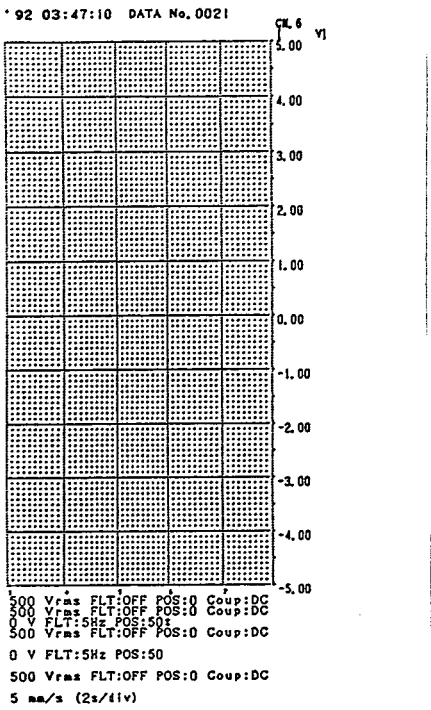
↑
Scale display is not moved.
(Offset is cancelled)



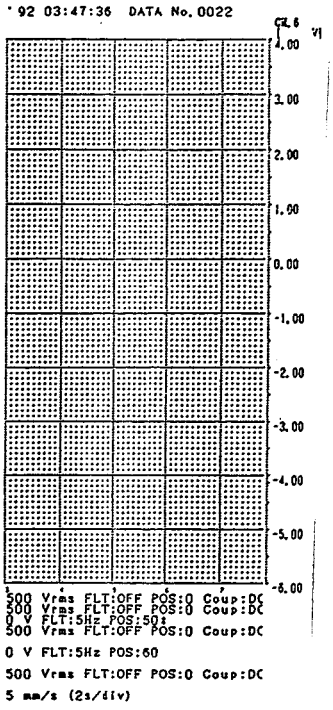
If baseline position is moved more than 0.5DIV, the scale display is moved.

Sample 2 of recording(offset beyond ±0.5DIV):

Scale display with baseline at 50.00



Scale display with baseline at 60.00

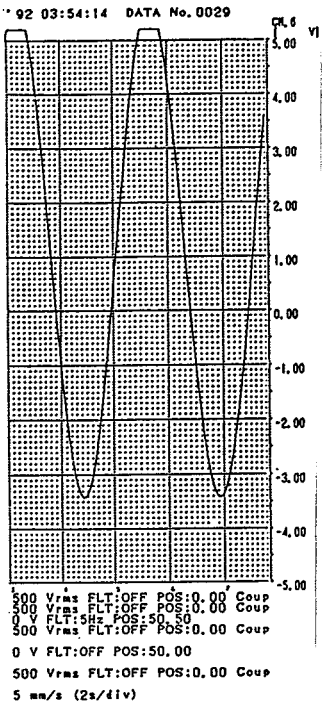


↑
Scale display is moved in 10-step

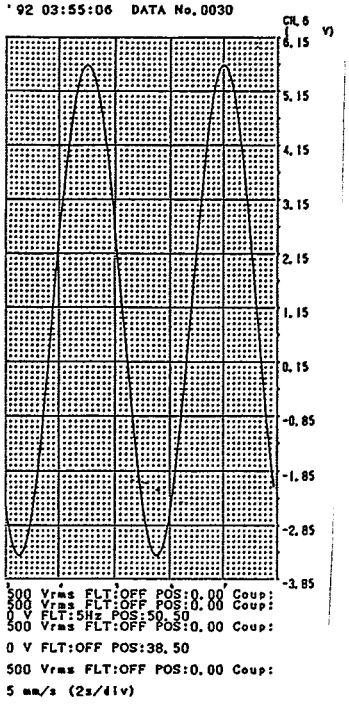
FINE: When recording, baseline position can be moved in 0.125mm steps. If the baseline position is finely adjusted in 0.05-step with the full scale in 100, the scale display is also moved in 1/2000 steps of input range with the baseline position moved meanwhile. In the FINE mode, even though the input signal is beyond the recording range, it can be recorded within the recording range with the POS. key.
(Offset cannot be cancelled when recording because scale display is also moved when the baseline is moved.)

Sample of recording:

Scale display with baseline at 50.00



Scale display with baseline at 38.50



↑

Scale display is moved in 1/2000 steps of input range with the baseline position moved meanwhile.

11)Digital display

Display digital value of input signals.

12)PREV

Return to the previous screen.

5. Specification

Number of channels:
1 input/unit

Input system:
Single-ended input, floating between input and output

Range and Accuracy: (When VAR knob is set to x1)
0.1, 0.2, 0.5, 1, 2, 5 V/FS ATT: x1 and x100 (12 steps)
Accuracy: within ±0.5%FS (within ±1%FS in 500V/FS range)
Direct recording of AC200V is available in 500V/FS range.

Calibration voltage:
Voltage equivalent to 1/5 of full scale of the input range
Accuracy: within ±0.5%FS

Gain fine-adjustment:
x1 to x2.5 or above, adjusted with the VAR knob

Input impedance:
Approx. 1 MΩ

Allowable input voltage:
When in x1 range: 100V (DC or AC peak value)
When in x100 range: 500V (DC or AC peak value)

Frequency response:
DC to 100kHz (within +0.5 and -3 dB)

Linearity:
Within ±0.2%FS

Common mode voltage (CMV):
500V (DC or AC peak value)

Common mode rejection ratio (CMRR):
Greater than 80dB (when input short-circuited at 60 Hz)

Low-pass filter:
2-pole Bessel-type
fc=5Hz, 500Hz, 5kHz or OFF
Attenuation: Approx. -12dB/OCT

Drift:
Within ±0.5%FS/10°C

A/D conversion:

Resolution : 12-bit
Conversion time : 5 μs max.
Conversion method : Successive approxiamation

Input connector:

RT31-142: Double-deck binding posts(+,-)
RT31-148: Safety terminal(+,-)

Channel annotation:

Channel number, Type of input unit, ON/OFF of input, Filter set, Input range, Baseline position.

RT3100N/3200N Series
Input Amplifier Units
Operation Manual (5691-1893)
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