Instruction Manual
Amplifier Units
For RA1000 Series

NEC San-ei Instruments, Ltd.
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INTRODUCTION

Thank you very much for purchasing the Amplifier Units, Omniace II RA1000 Series.
Prior to using the units, please carefully read the instruction manual so that you can correctly use the amplifier units. This instruction manual provides operating instruction information on the following amplifier units:

- ･2CH high-resolution DC amplifier units
- ･2CH FFT amplifier units
- ･2CH high-speed DC amplifier units
- ･2CH AC strain amplifier units
- ･Event amplifier units
- ･2CH Zero suppression amplifier units
- ･2CH TC-DC amplifier units
- ･TC-DC amplifier units
- ･F/V converter units
- ･2CH vibration & RMS amplifier units
- ･2CH DC strain amplifier units

This instruction manual is to provide information that is necessary for you to safely and correctly operate the amplifier units, Omniace II RA1000 series. Please always place this instruction manual together with the amplifier units whenever you use the units, so that you can access and refer to the manual at any time.
This instruction manual involves operating instruction information, advice and suggestions on the use of the amplifier units, RA1000 series, as well as their basic functions. For operating instruction information other than that described herein, please refer to the other instruction manuals attached hereto.
If you have questions on any descriptions of this instruction manual, please contact marketing/sales personnel of NEC San-ei

《Instruction manuals attached to this manual:》

Titles of instruction manuals	Types	Contents
Instruction Manual Mainframe For RA1000 Series	95691-2074-0000	The manual involves basic functions and operating instructions of the mainframe, RA1000 series.
Instruction Manual RS-232C, GP-IB For RA1000 Series	95691-2075-0000	Please refer to this instruction manual when you use GP-IB or RS-232C interface. Explanations for setting procedures and various commands are provided.

■ Before Using Amplifier Units:

●Instructions for unpacking

Please unpack the package, only after the temperature of the content of the package becomes almost the same as that of the unpacking room or environment. This is because, particularly when it is cold in winter, dew condensation would occur on the surface of the equipment, thus creating a possibility of equipment failure, if you unpack the package in a warm environment right after bringing it from the open air.

●Confirmation of contents

NEC San-ei is always taking the utmost care of providing customers with flawless products, including through the use of its inspection system, etc. However, please confirm that no defects can be found in appearance of the equipment upon unpacking the package. Also, please confirm that you have had all accessories in place. In addition, please check the amplifier units as to the specifications of the equipment. If, at the worst, you find any defects or lack of contents, please contact your dealer.

●Procedure of changing amplifier units

Please refer to “Chapter 6. Procedure of changing amplifier units”, when you want to change your amplifier units.

●If anything unusual happens during the use of the equipment, immediately switch off the mainframe RA1000 and disconnect it from the power source.

●If you cannot find the cause, contact your dealer or one of the service centers listed at the end of this instruction manual. Please use FAX transmission describing details of symptoms and any other information that would help.

●Contents of this instruction manual are subject to change without prior notice.

●NEC San-ei has made every effort to attain the completeness in contents of this manual. Please feel free to contact your dealer regarding any errors, omissions, questions or suggestions, if you find one.

■ Safety Considerations and Precautions - Warning and Caution

●Notes for safely using Amplifier Units

While the amplifier units have been manufactured by putting the highest priority on safety aspects, errors in handling or operating the equipment on the part of customers could lead to serious accidents. Please read carefully and comprehend thoroughly the Instruction Manual before using the amplifier units, so that such accidents can be avoided.

Please be sure to observe the descriptions hereunder when using the equipment. No warranties or assurances will be provided or implied for any injuries or damages resulting from actions not complying with the handling or operating Warnings, Cautions or alike.

The designations described below are used throughout the instruction manual to secure the safe usage and operation of the amplifier units; the meaning the designations are explained in the following:

⚠ WARNING

If any instructions in WARNING are ignored, the ignorance could lead to one or more of the following:
1. possibility of human deaths or serious injuries
2. high rate of occurrence of minor personal injuries or non-personal physical damages

⚠ CAUTION

If any instructions in CAUTION are ignored, the ignorance could lead to one or more of the following:
1. risk of human injuries
2. possibility of non-personal physical injuries not involving human injuries

⚠ WARNING

WARNING indication labels of amplifier units

●Input signal connection and permissible common mode input voltages

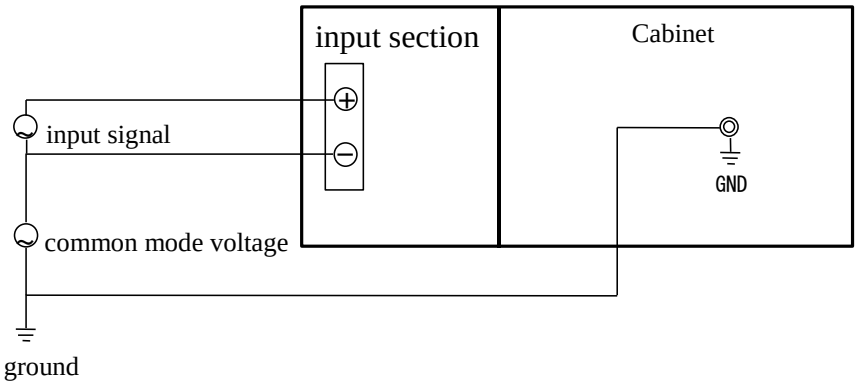
First, confirm that the mainframe is correctly and securely grounded through the protective grounding terminal, before connecting the equipment with a device to be measured. Also, be careful so that the input voltage does not exceed the permissible range of common mode input voltage, when you connect an amplifier unit with the measurement equipment.

Otherwise, it is very dangerous since your ignorance in these respects could lead to equipment failure. Be sure to use the equipment within the permissible range of common mode input voltage.

Input units	Permissible common mode input voltage
2CH high-resolution DC amplifier units 2CH FFT amplifier units 2CH high-speed DC amplifier units Event amplifier units F/V converter units 2CH vibration & RMS amplifier units 2CH Zero suppression amplifier units	**±42 VDC(in DC or in AC peak voltage) for units by itself** **※300 VAC when used with insulated BNC cables(optional item)**
2CH AC strain amplifier units 2CH DC strain amplifier units	**300 VAC**
2CH TC-DC amplifier units	**±300 V (in DC or in AC peak voltage)**
TC-DC amplifier units	**±300 V (in DC or in AC peak voltage)**

※The common mode voltage refers to the voltage commonly applied between the ground and two input term inals(+, -) as illustrated in the figure below.

Recorded waveforms may sometimes involve noise components due to degradation of common mode rejection ratio(CMRR), when impulsive common mode voltages like noise are applied.



●Input signal cable

Use by all means insulated BNC cables (optional item: signal cables 0311-5175, with a BNC connector and test clips, of 2 m long) for input connection, when the equipment is equipped with input terminals of the BNC type.

Be careful not to touch the outer shell of BNC connectors of the metallic type, since they have the negative (-) polarity potential of the signal. You would be suffered with electric shock when touching the outer shell; it is very dangerous for you to touch it.

⚠ WARNING

●Warning against electric shock and permissible input voltage

Do not touch, by any means, metallic portions of the input section, when a high voltage input signal is being applied, to avoid a risk of electric shock.

Also, it is very dangerous to apply an input voltage exceeding the range of permissible input voltages for individual amplifier units, since application of such high voltages would cause equipment failures. Use the equipment within the range of permissible input voltages listed below.

Input units	Permissible input voltages (in DC or in AC peak values)	Range and setting conditions
2CH high-resolution DC amplifier units 2CH FFT amplifier units 2CH high-speed DC amplifier units 2CH vibration & RMS amplifier units	**±100 V**	0.1,0.2,0.5,1,2,5 V-FS (in full scale)
	±500 V	10,20,50,100,200,500 V-FS (in full scale)
2CH TC-DC amplifier units TC-DC amplifier units	**±50 V**	
F/V converter units	**±100 V**	
2CH DC strain amplifier units	**±8 V**	
2CH Zero suppression amplifier units	**±100 V**	0.1,0.2,0.5,1,2 V-FS (in full scale)
	±500 V	5,10,20,50,100,200,500 V-FS (in full scale)

●Warning against electric shock and prevention of mainframe damages

Always keep blank panels inserted/mounted at individual vacant slots for input amplifier units to prevent electric shock and also to prevent the mainframe from potential damages due to foreign matter penetration.

⚠ CAUTION

●CAUTIONS for handling amplifier units

Observe the CAUTIONS described below when handling amplifier units.

Improper handling of the equipment could lead to operational errors or equipment failures.

1)The equipment shall be used only by those who completely know/understand the operating instructions for the amplifier unit as well as the mainframe.

2)Storage environment and storage methods of amplifier units:

Amplifier units shall be stored in an environment of the temperature between -10 and 70 ℃.

Particularly during summer months, avoid storing them in the direct sunlight or in such places as having a high possibility of extreme temperature rise(e.g., in an enclosed vehicle) for a long period of time.

In other aspects, electronic devices used in amplifier units are easily affected by electrostatic discharge.

Store amplifier units in places or envelopes processed against electrostatic charge/discharge, paying attention to electrostatic charging phenomena.

3)When you want to change amplifier units in the mainframe, switch off the power source of the mainframe and remove power and signal cables from the mainframe by all means, before changing them. The mainframe and amplifier units might be damaged if you change amplifier units with electrical source connected.

In addition, be careful not to touch internal electronic parts when changing amplifier units. This is because you could damage the equipment if you touch electronic parts when your body is charged with electrostatic charges. Do not touch any parts other than equipment panels when you change amplifier units, since touching any parts other than panels could lead to equipment failures.

4)Use the original packing box and crating materials, or the equivalent at the minimum, when you transport amplifier units.

5)It is recommended that you regularly calibrate the equipment so that the accuracy of amplifier units can be maintained.

The high reliability of your measurement can be maintained by regularly calibrating your equipment once a year(service available by payment).

■ Warranty Application

NEC San-ei is making every effort in maintaining a high quality control level for its products from the design to shipping phases. However, in an unlikely event of finding a symptom of failures, you should check the operational status of the equipment, the status of the electric source voltage and the connection status of various cables, before asking NEC San-ei for repair. Consult with the nearest service center or dealer for request for repair or for regular calibration of the equipment. Please do not forget to inform the equipment type, the serial number and the details of your failure.
The warranty period and the warranty terms are provided in the next section.

■ Warranty Provisions

1. Period of warranties: The period of warranties for the product is one(1) year from the time of delivery.

2. Warranties: Failures that occurred during the period of warranties are repaired free of charge in principle. The following cases, however, are subject to your payment of repair charge:

   ①damages or failures due to incorrect handling of equipment

   ②damages or failures due to fires, earthquakes, traffic accidents or any other acts of God.

   ③damages or failures caused by repairs or modification of equipment not done by NEC San-ei or any of those who are commissioned by NEC San-ei.

   ④failures due to use or storage under the environment exceeding the prescribed conditions for the equipment.

   ⑤Regular calibration

   ⑥failures or damages that occurred during transport or transfer of equipment after delivery.

3. Range of warranties: NEC San-ei is not responsible to any equipment not manufactured by NEC San-ei.

■ Designations used in this instruction manual

The following explains the meaning of designations and symbols used in this instruction manual:

designations or symbols	meaning
⚠ WANING	If any instructions in WARNING are ignored, the ignorance could lead to one or more of the following: 1. possibility of human deaths or serious injuries 2. high rate of occurrence of minor personal injuries or non-personal physical damages
⚠ CAUTION	If any instructions in CAUTION are ignored, the ignorance could lead to one or more of the following: 1. risk of human injuries 2. possibility of non-personal physical injuries not involving human injuries
NOTE	If any instructions in NOTE are ignored, the ignorance could lead to one or more of the following: 1. possibility of mal-function of equipment 2. possibility of deletion or loss of measurement data
TIPS	Descriptions under TIPS provide information on restriction or limitation for setting or other supplementary information.
☞	This sign indicates a page or pages to be referred to.
this product	The words indicate the mainframe, RA1000 series.
the memory	The words indicate the memories in the RA1000 series. Measured data are stored in "the memory" for the measurement in the memory mode and the transient mode
k(small character) K(capital character)	These are units of expressing numerical values as follows: ・The small character k like in "10 kg" indicates 1000. ・The capital character K like in "4 Kbytes of data" indicates 1024.

Individual amplifier units may sometimes be indicated by using the following designations or abbreviations in this instruction manual:

HRDCamp	2CH high-resolution DC amplifier units	AP11-101
FFTamp	2CH FFT amplifier units	AP11-102
HSDCamp	2CH high-speed DC amplifier units	AP11-103
ACSTamp	2CH AC strain amplifier units	AP11-104
EVamp	Event amplifier units	AP11-105
TCDCamp	2CH TC-DC amplifier units	AP11-106
TDCamp	TC-DC amplifier units	AP11-107
FVamp	F/V converter units	AP11-108
RMSamp	2CH vibration & RMS amplifier units	AP11-109
DCSTamp	2CH DC strain amplifier units	AP11-110
HRZSamp	2CH Zero suppression amplifier units	AP11-111

CONTENTS

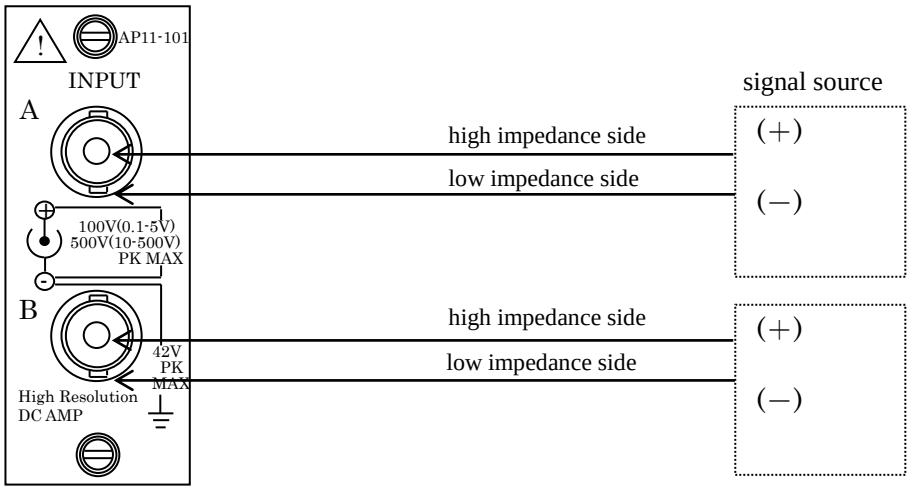
Section 1. Instructions on the use of amplifier units

1.1 2CH high-resolution DC amplifier units

1.1.1. Overview

2CH high-resolution DC amplifier units convert input signal voltages into digital data of 16 bits with high resolution. The units have a capability of conversion time of 10 μs and incorporate two(2) channels per unit, and the two channels are insulated to each other within the unit.

1.1.2. Connection with input signals



WARNING Use by all means insulated BNC cables (optional item: input signal cables 0311-5175, with a BNC connector and test clips, of 2 m long) for input connection.

The outer shell of BNC connectors of the metallic type has the negative (-) polarity potential of the input signal. Therefore, you would be suffered with electric shock by touching the outer shell while the cable is connected to a signal source. Thus, note that it is very dangerous for you to touch it.

If you need to use a BNC connector of the metallic type due to some unavoidable circumstances, confirm that the common mode input voltage is within the range of ±42 VDC(in DC or in AC peak value) through carrying out appropriate examination of the signal source.

NOTE

- Please pay attention to the following points when you want to record low level signals:
  - not to use unnecessarily long cables for input connection
  - to use shielded cables for input connection to avoid electrostatic noise
- Please keep the signal source impedance as low as possible, i.e., less than 100 ohms.
  The lower the signal source impedance, the higher the quality of measurement records.

● **Input Signals**

CAUTION

・Permissible input voltages

If you apply, by error, any voltages that are more than the permissible voltage defined for each sensitivity range, equipment failures would be induced due to breakdown of internal parts or other reasons. Do not apply input voltages exceeding the permissible voltages for individual sensitivity ranges listed in the following table:

Sensitivity ranges(V in FS)	0.1, 0.2, 0.5, 1, 2, 5	10, 20, 50, 100, 200, 500
Permissible input voltages(V)	**100 V**	**500 V**

・Input impedance

The input impedance is approximately one(1) MΩ. However, note that the input impedance will be lowered to approximately 15 kΩ, when the input voltage becomes beyond ±8 V for the sensitivity range of 0.1 - 5 V-FS(full-scale) in the DC coupling mode.

・Permissible common mode input voltages(CMV)

Use the insulated BNC cable, an optional item. In this case, confirm that the permissible common mode input voltage is no more than ±300 V in DC or in AC peak value.

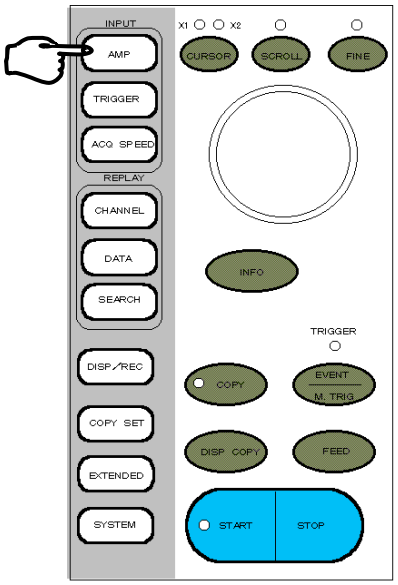
NOTE The sample speed must be set at 10 μ s step otherwise the signal waveform can not be obtained correctly.

Example : 5 μ s or 11 μ s, etc. makes the waveform distort.

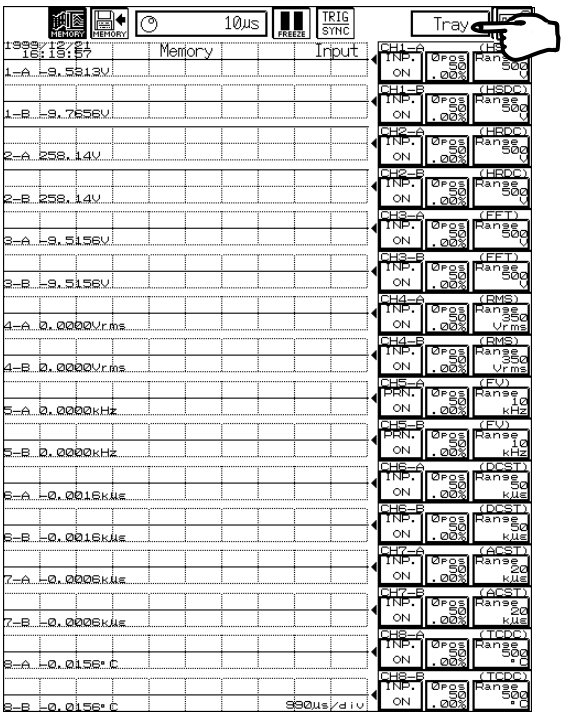
NOTE

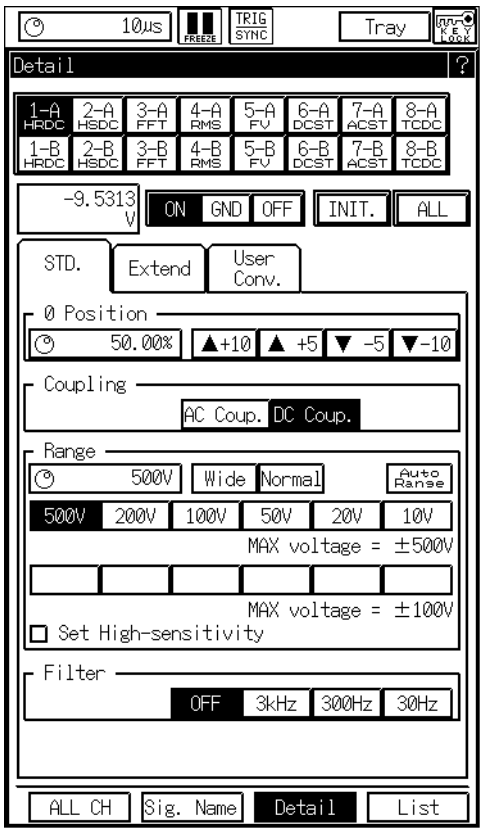
- Use cables with the insulation sheath of no less than 2 kV of withstand voltages.
- Do not apply voltages exceeding the permissible common mode input voltage, since application of such voltages would lead to malfunctions or failures of equipment. Also, note that recorded waveforms may involve noise components due to degradation of common mode rejection ratio(CMRR), when noise-like impulsive common mode voltages are applied.
- Use the equipment through keeping the input voltage within the range of -30V - +30V including the DC component, when the sensitivity range is 0.1 - 5 V-FS in the AC coupling mode.
  Note that correct measurement cannot be expected when the input voltage exceeds the voltage range mentioned above.

1.1.3. Setting for 2CH high-resolution DC amplifier units



The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.





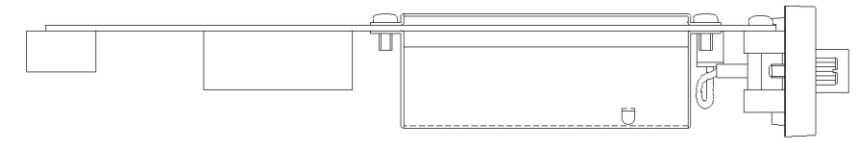
Set the equipment by selecting a channel you want.

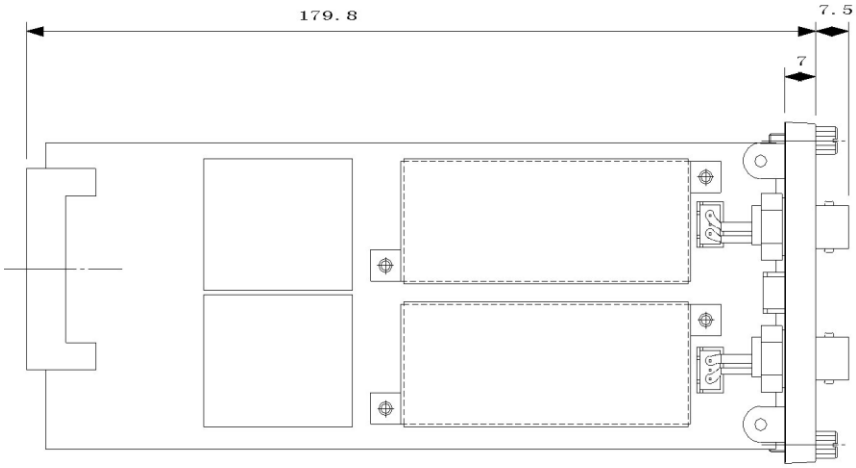
Proceed with the setting operation by following displayed instructions.
Refer to Section 3 for detailed instructions of setting procedures.

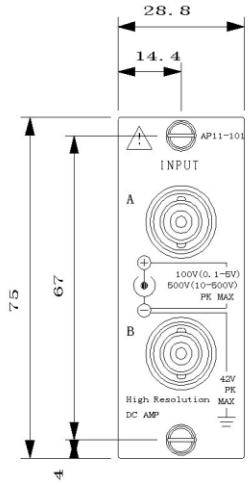
1.1.4. Specifications of 2CH high-resolution DC amplifier units(AP11-101)

Number of channels	2 channels(CHs)/unit	
Input mode	unbalanced input (Each channel is insulated to each other and also from cabinet.)	
Input coupling modes	AC coupling and DC coupling	
Sensitivity and Accuracy	Input range	0.1, 0.2, 0.5, 1, 2 and 5 V-FS (Voltages exceeding ±30V shall not be applied for the ranges 0.1 - 5 V-FS in AC coupling.) 10, 20, 50, 100, 200 and 500 V-FS For every range(i.e., ±0.1 - ±500 V-FS), fine adjustment capability and wide-scale provisions are provided.
	Accuracy	within ±0.3%・FS ***※within ±0.8%-FS for 500 V-FS***
Offset accuracy	within ±0.3%・FS ***※at 23℃ of environment temperature of mainframe operation***	
Input impedance	no less than 1 MΩ	
Permissible input voltage	±500V(DC or AC peak value) ***※±100V(DC or AC peak value) for input ranges of 0.1 - 5 V-FS***	
Permissible common mode input voltage(CMV)	±42 V (DC or AC peak value) for an amplifier unit only ***※300 VAC when an insulated BNC cable(signal cable 0311-5175) is used***	
Common mode rejection ratio(CMRR)	No less than 80 dB for frequencies DC - 60 Hz	
Frequency characteristics	For DC coupling: within the range of +0.5 dB and -3 dB for frequency range of DC - 50 kHz For AC coupling: within the range of +0.5 dB and -3 dB for frequency range of 0.3 Hz - 50 kHz	
Linearity	within ±0.1%-FS	
Low pass filter	two-pole Bessel type: 30Hz, 300Hz, 3kHz and OFF attenuation characteristics: -12 dB/oct. approximately	
Temperature stability characteristics	zero point: within ±0.02%・FS/°C range: within ±0.01%・FS/°C	
A/D conversion characteristics	resolution	16 bits
	conversion time	10 μs max.
	conversion method	serial comparison method
Input connector	insulated BNC type	
Withstand voltage	1.5 kV AC for one minute between input terminal and ground, and between channels.	
S/N ratio	-52 dB or greater (when set at Wide Range)	
Mass	about 230 g	

1.1.5 External drawings of 2CH high-resolution DC amplifier units





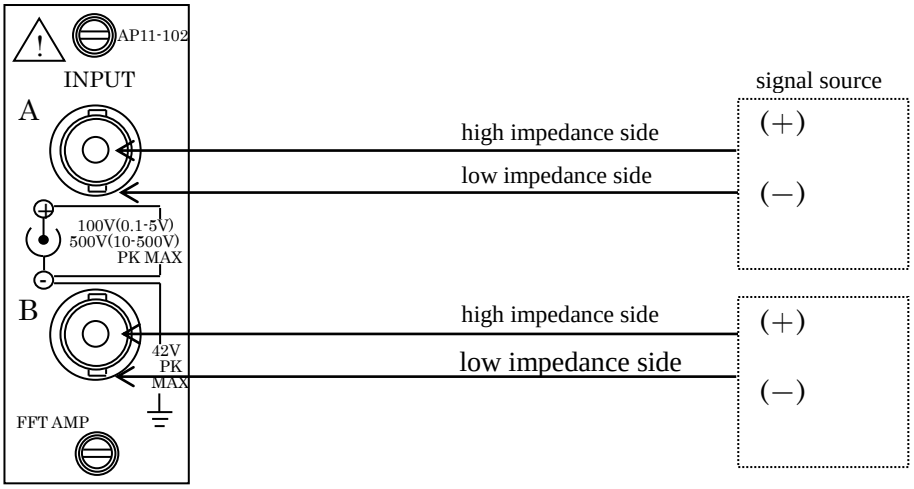


1.2. 2CH FFT amplifier units

1.2.1 Overview

2CH FFT amplifier units are used to FFT-transform output voltages of piezoelectric acceleration sensors built-in the amplifier or other piezoelectric acceleration sensors (used together with charge converters), or other input voltages. They are high-resolution DC amplifier units with anti-aliasing filters built-in.
The units have a capability of conversion time of 10 μs and incorporate two(2) channels per unit, and the two channels are insulated to each other within the unit.

1.2.2. Connection with input signals



WARNING

Use by all means insulated BNC cables (optional item: input signal cables 0311-5175, with a BNC connector and test clips, of 2 m in length) for input connection.
The outer shell of BNC connectors of the metallic type has the negative (-) polarity potential of the input signal. Therefore, you would be suffered with electric shock by touching the outer shell while the cable is connected to a signal source. Thus, note that it is very dangerous for you to touch it.
If you need to use a BNC connector of the metallic type due to some unavoidable circumstances, confirm that the common mode input voltage is within the range of ±42 VDC(in DC or in AC peak value) through carrying out appropriate examination of the signal source.

NOTE

- Please pay attention to the following points when you want to record low level signals:
  - not to use unnecessarily long cables for input connection
  - to use shielded cables for input connection to avoid electrostatic noise
- Please keep the signal source impedance as low as possible, i.e., less than 100 ohms. The lower the signal source impedance, the higher the quality of measurement records.

● **Input Signals**

CAUTION

- Permissible input voltages
  If you apply, by error, any voltages that are more than the permissible voltage defined for each sensitivity range, equipment failures would be induced due to breakdown of
  internal parts or other reasons. Do not apply input voltages exceeding the permissible voltages for individual sensitivity ranges listed in the following table:

Sensitivity ranges(V in FS)	0.1, 0.2, 0.5, 1, 2, 5	10, 20, 50, 100, 200, 500
Permissible input voltages(V)	**100 V**	**500 V**

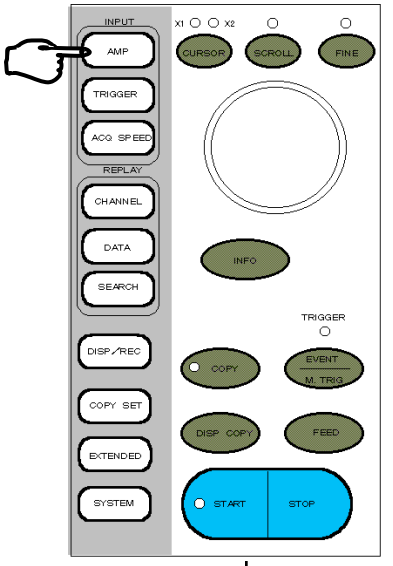
- Input impedance
  The input impedance is approximately one(1) MΩ. However, note that the input impedance will be lowered to approximately 15 kΩ, when the input voltage becomes beyond ±8 V for the sensitivity range of 0.1 - 5 V-FS(full-scale) in the DC coupling mode.
- Permissible common mode input voltages(CMV)
  Use the insulated BNC cable, an optional item. In this case, confirm that the permissible common mode input voltage is no more than ±300 V in DC or in AC peak value

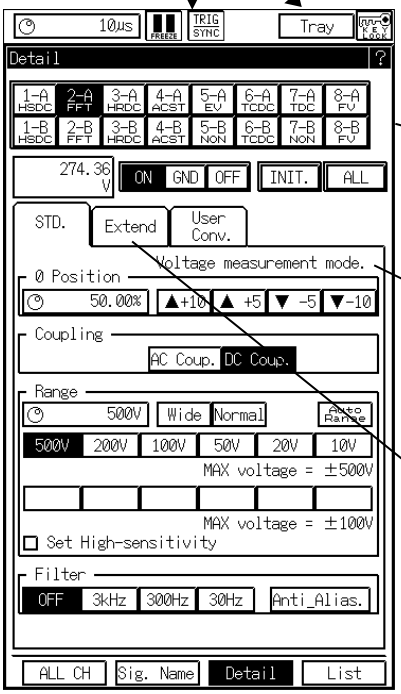
NOTE When setting the sampling speed other than 10 μs step (ex. 5 μs or 11 μs, etc.) or setting the analyzing speed of FFT mode faster than 40kHz, the signal waveform can not be obtained correctly. If you execute FFT in that condition, the suspected frequency component is displayed.

CAUTION
- In the vibration sensor mode, current of 2 mA is fed into the load from the input connector of the amplifier unit. (Voltages of more than 18 V can be exhibited at the connector.)
- Do not connect any other sensors than those which are specified for the use of this type of amplifier units. The amplifier units could be damaged if you, by error, apply voltages of ±30 V or more.

NOTE
- Use such cables that have the insulation sheath with no less than 2 kV of withstand voltages.
- Do not apply voltages exceeding the permissible common mode input voltage, since application of such voltages would lead to malfunctions or failures of equipment. Also, note that recorded waveforms may involve noise components due to degradation of common mode rejection ratio(CMRR), when noise-like impulsive common mode voltages are applied.
- Use the equipment through keeping the input voltage within the range of -30V - +30V including the DC component, when the sensitivity range is 0.1 - 5 V-FS in the AC coupling mode.
  Note that correct measurement cannot be expected when the input voltage exceeds the voltage range mentioned above.

1. 2. 3. Setting for 2CH FFT amplifier units





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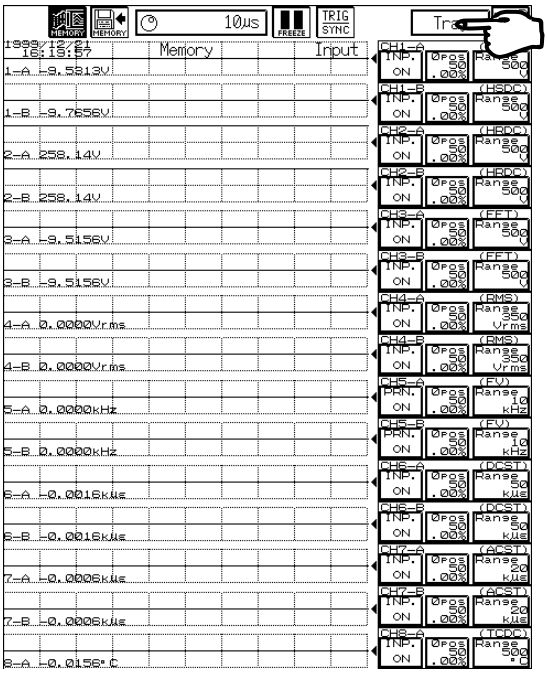


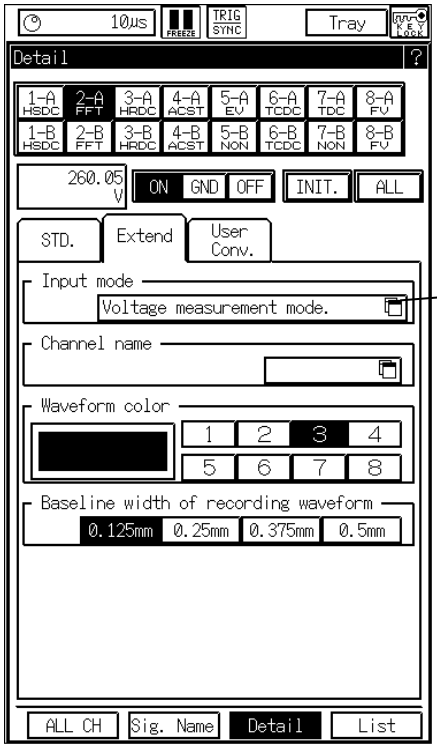
Set the equipment by selecting a channel you want.

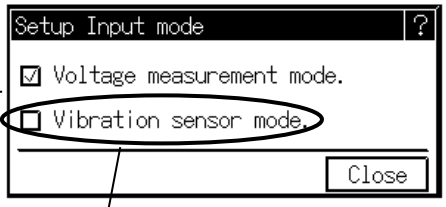
Proceed with the setting operation by following displayed instructions.
Refer to Section 3 for detailed instructions of setting procedures.

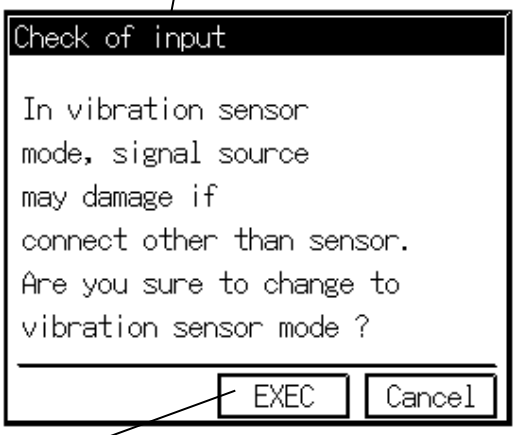
The left-hand figure shows a case of the input mode being the “Voltage measurement mode”.
You can switch and set the input mode into one of the following modes:
- Voltage measurement mode
- Vibration sensor mode(with connection of an amplifier built-in piezo-electric acceleration sensor)

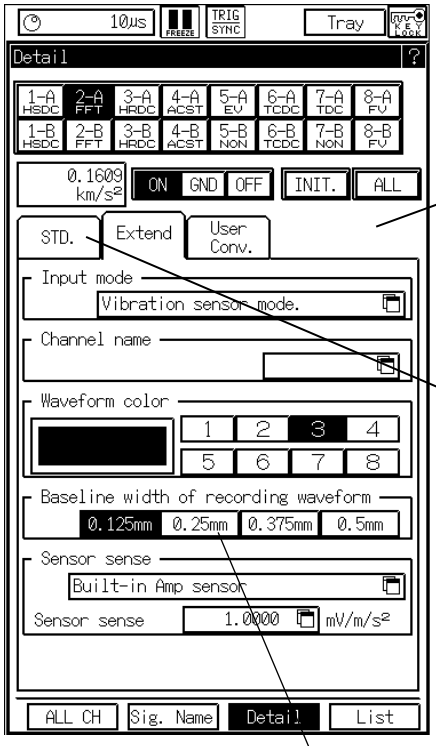
The input mode can be switched in the Extend screen.

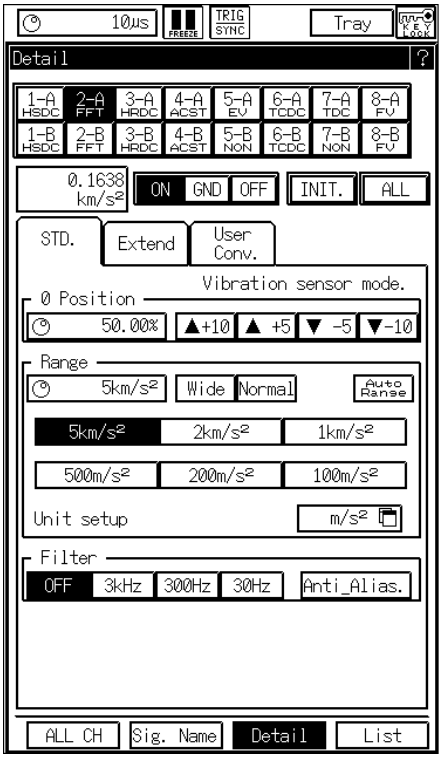
Measurement in the Vibration sensor mode





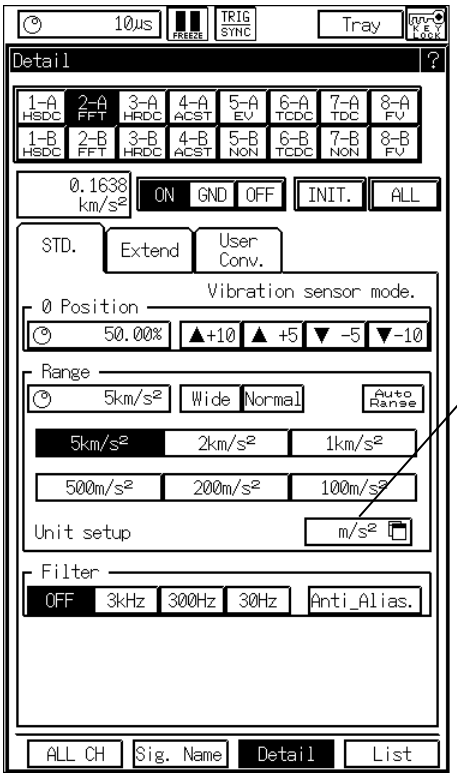






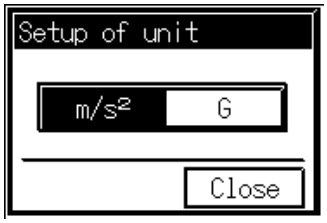
Set the oscillation sensor in this box.

Unit setting in the Vibration sensor mode

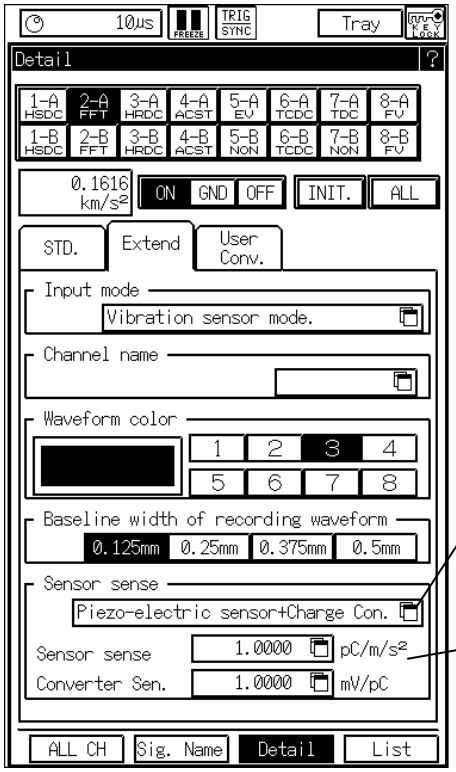


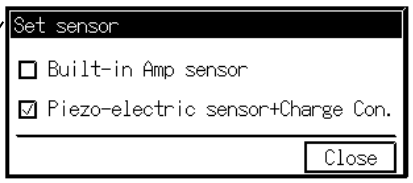
You can select and switch the unit of vibration between the following:

- m/s^2
- G



Using remote charge converters





Set the type of sensors to be connected, by selecting the one from the following:

- Sensor of the type of Built-in Amp sensor
- Piezo-electric sensor + Charge Con.

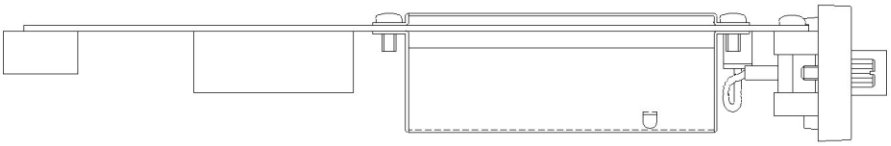
Set each of the following when you have selected to use the “Piezo-electric sensor + charge Con.”

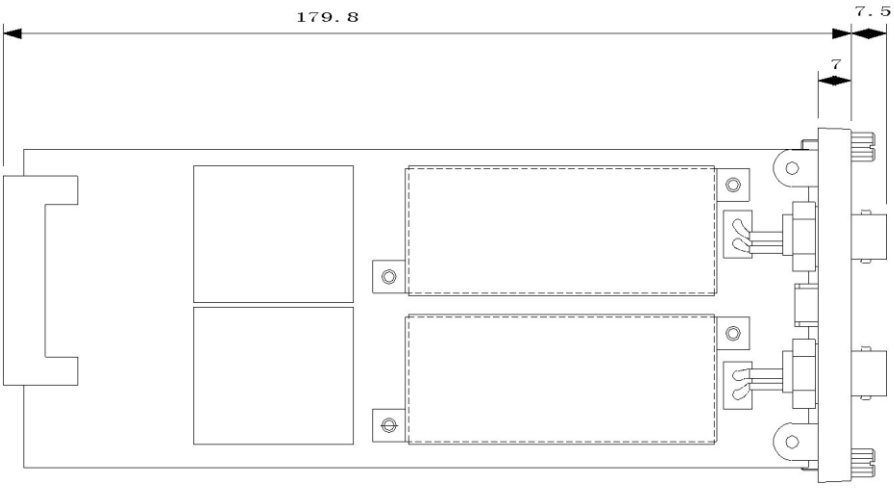
- Sensor sense
- Converter Sen.

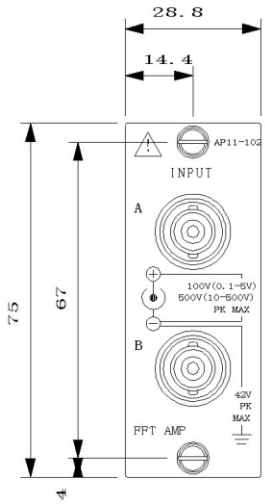
1.2.4. Specifications of 2CH FFT amplifier units(AP11-102)

Number of channels	2 channels(CHs)/unit	
Input mode	unbalanced input (Each channel is insulated to each other and also from cabinet.)	
Input coupling modes	AC coupling and DC coupling ***※AC coupling mode is used when piezoelectric acceleration sensor of the type of amplifier built-in is connected.***	
Sensitivity and Accuracy	Input range	For voltage measurement mode: 0.1, 0.2, 0.5, 1, 2 and 5 V-FS (Voltages exceeding ±30V shall not be applied for the ranges 0.1 - 5 V-FS in AC coupling.) 10, 20, 50, 100, 200 and 500 V-FS For every range(i.e., ±0.1 - ±500 V-FS), fine adjustment capability and wide-scale provisions are provided. For vibration sensor mode: 5km/s2, 2km/s2, 1km/s2, 500m/s2, 200m/s2 and 100m/s2-FS Unit can be changed to G. For every range, fine adjustment capability and wide-scale provisions are provided.
	Accuracy	within ±0.3%・FS ***※within ±0.8%-FS for 500 V-FS***
Offset accuracy	within ±0.3%・FS ***※at 23℃ of environment temperature of mainframe operation***	
Input impedance	no less than 1 MΩ	
Permissible input voltage	±500V(DC or AC peak value) ***※±100V(DC or AC peak value) for input ranges of 0.1 - 5 V-FS***	
Permissible common mode input voltage(CMV)	±42 V (DC or AC peak value) for an amplifier unit only ***※300 VAC when an insulated BNC cable(signal cable 0311-5175) is used***	
Common mode rejection ratio(CMRR)	No less than 80 dB for frequencies DC - 60 Hz	
Frequency characteristics	For DC coupling: within the range of +0.5 dB and -3 dB for frequency range of DC - 50 kHz For AC coupling: within the range of +0.5 dB and -3 dB for frequency range of 0.3 Hz - 50 kHz	
Linearity	within ±0.1%-FS	
Low pass filter	two-pole Bessel type: 30Hz, 300Hz, 3kHz and OFF attenuation characteristics: -12 dB/oct. approximately	
Anti-aliasing filter	10Hz, 20Hz, 50Hz, 100Hz, 200Hz, 500Hz, 1kHz, 2kHz, 5kHz, 10kHz, 20kHz and 40kHz descending characteristics: -72dB at 1.5fc (typical)	
Temperature stability characteristics	zero point: within ±0.02%・FS/℃ range: within ±0.01%・FS/℃	
A/D conversion characteristics	Resolution	16 bits
	conversion time	10 μs max.
	conversion method	serial comparison method
Input connector	insulated BNC type	
Sensor power supply	more than 2mA, 18V	
Withstand voltage	1.5 kV AC for one minute between input terminal and ground, and between channels.	
S/N ratio	-46 dB or greater (when set at Wide Range)	
Mass	about 240 g	

1. 2. 5. External drawings of 2CH FFT amplifier units





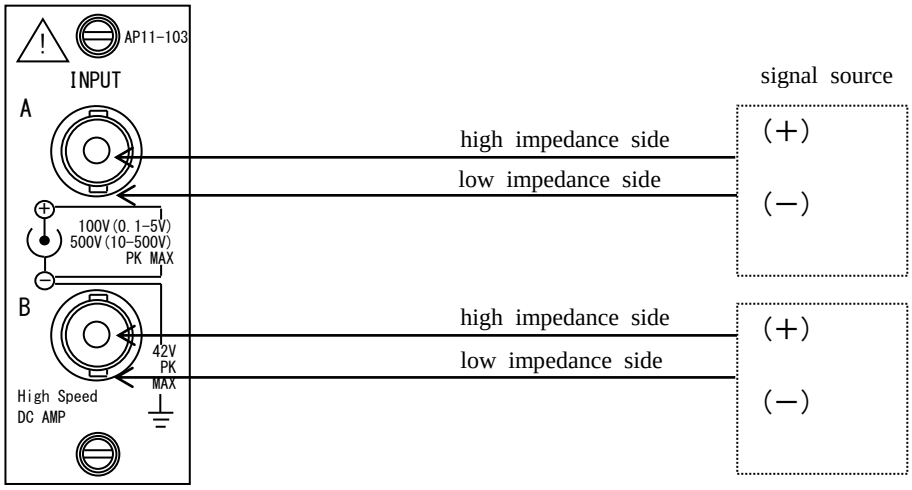


1.3. 2CH high-speed DC amplifier units

1.3.1. Overview

2CH high-speed DC amplifier units convert input analog voltages into digital signals at high speed with a sampling interval of 1μs (i.e., A/D conversion)
The units incorporate two(2) channels per unit and the two channels are insulated to each other within the unit.

1.3.2. Connection with input signals



WARNING

Use by all means insulated BNC cables (optional item: input signal cables 0311-5175, with a BNC connector and test clips, of 2 m in length) for input connection.
The outer shell of BNC connectors of the metallic type has the negative (-) polarity potential of the input signal. Therefore, you would be suffered with electric shock by touching the outer shell while the cable is connected to a signal source. Thus, note that it is very dangerous for you to touch it.
If you need to use a BNC connector of the metallic type due to some unavoidable circumstances, confirm that the common mode input voltage is within the range of ±42 VDC(in DC or in AC peak value) through carrying out appropriate examination of the signal source.

NOTE

●Please pay attention to the following points when you want to record low level signals:
- not to use unnecessarily long cables for input connection
- to use shielded cables for input connection to avoid electrostatic noise

●Please keep the signal source impedance as low as possible, i.e., less than 100 ohms.
The lower the signal source impedance, the higher the quality of measurement records.

● **Input Signals**

CAUTION

・Permissible input voltages
If you apply, by error, any voltages that are more than the permissible voltage defined for each sensitivity range, equipment failures would be induced due to breakdown of
internal parts or other reasons. Do not apply input voltages exceeding the permissible voltages for individual sensitivity ranges listed in the following table:

Sensitivity ranges(V in FS)	0.1, 0.2, 0.5, 1, 2, 5	10, 20, 50, 100, 200, 500
Permissible input voltages(V)	**100 V**	**500 V**

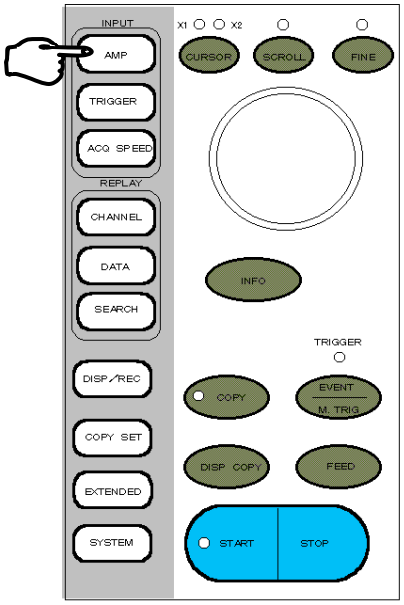
・Input impedance
The input impedance is approximately one(1) MΩ. However, note that the input impedance will be lowered to approximately 6 kΩ, when the input voltage becomes beyond ±8 V for the sensitivity range of 0.1 - 5 V-FS(full-scale) in the DC connection mode.
・Permissible common mode input voltages(CMV)
Use the insulated BNC cable, an optional item. In this case, confirm that the permissible common mode input voltage is no more than ±300 V in DC or in AC peak value.

NOTE

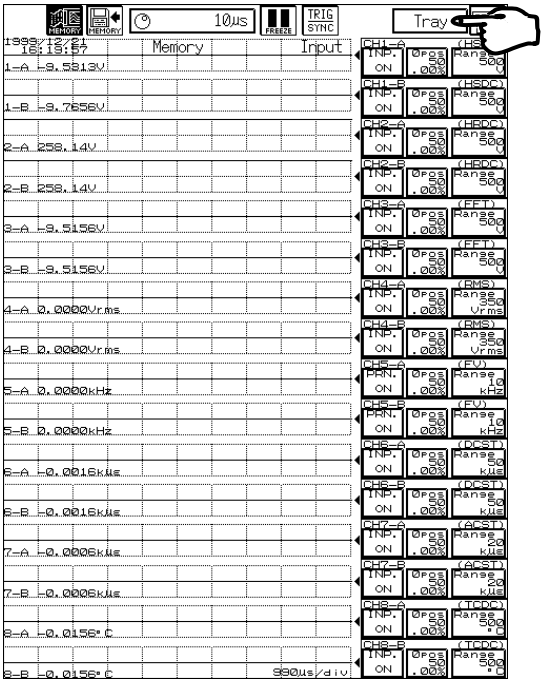
- Use cables with the insulator of no less than 2 kV of withstand voltages.
- Do not apply voltages exceeding the permissible common mode input voltage, since application of such voltages would lead to malfunctions or failures of equipment. Also, note that recorded waveforms may involve noise components due to degradation of common mode rejection ratio(CMRR), when noise-like impulsive common mode voltages are applied.
- Use the equipment through keeping the input voltage within the range of -30V - +30V including the DC component, when the sensitivity range is 0.1 - 5 V-FS in the AC coupling mode.

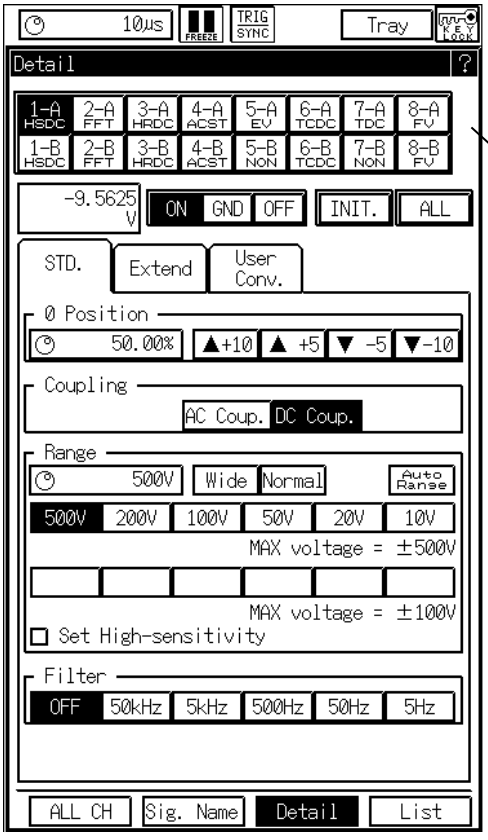
Note that correct measurement cannot be expected when the input voltage exceeds the voltage range mentioned above.

1.3.3. Setting for 2CH high-speed DC amplifier units



The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.





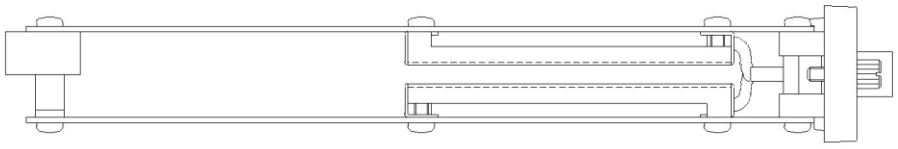
Set the equipment by selecting a channel you want.

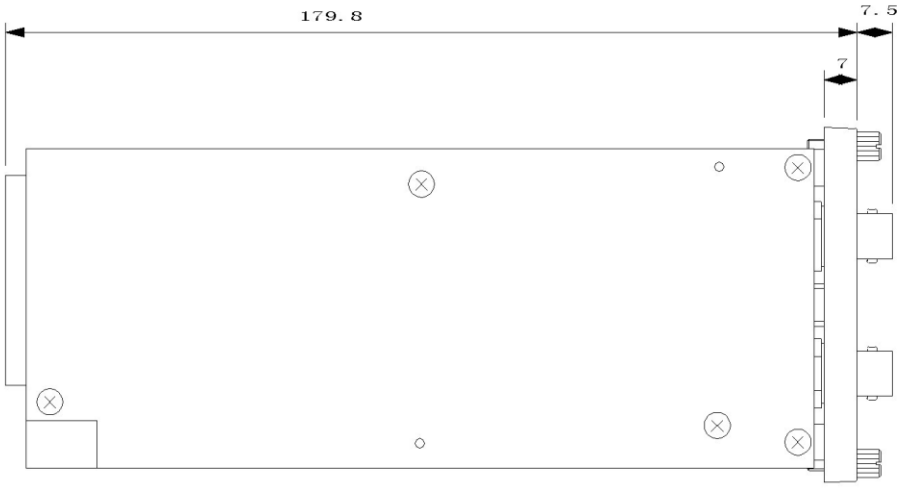
Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures.

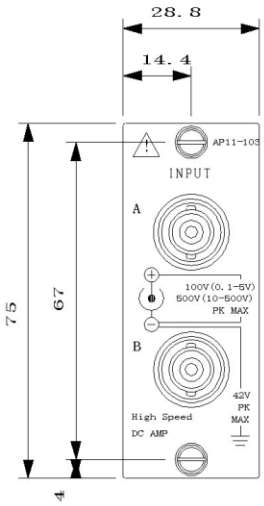
1.3.4. Specifications of 2CH high-speed DC amplifier units(AP11-103)

Number of channels	2 channels(CHs)/unit	
Input mode	unbalanced input (Each channel is insulated to each other and also from cabinet.)	
Input coupling modes	AC coupling and DC coupling	
Sensitivity and Accuracy	Input range	For voltage measurement mode: 0.1, 0.2, 0.5, 1, 2 and 5 V-FS (Voltages exceeding ±30V shall not be applied for the ranges 0.1 - 5 V-FS in AC coupling.) 10, 20, 50, 100, 200 and 500 V-FS For every range(i.e., ±0.1 - ±500 V-FS), fine adjustment capability and wide-scale provisions are provided.
	Accuracy	within ±0.5%・FS ***※ within ±1%-FS for 500 V-FS***
Offset accuracy	within ±0.5%・FS ※at 23℃ of environment temperature of mainframe operation	
Input impedance	no less than 1 MΩ	
Permissible input voltage	±500V(DC or AC peak value) ***※ ±100V(DC or AC peak value) for input ranges of 0.1 - 5 V-FS***	
Permissible common mode input voltage(CMV)	±42 V (DC or AC peak value) for an amplifier unit only ***※ 300 VAC when an insulated BNC cable(signal cable 0311-5175) is used***	
Common mode rejection ratio(CMRR)	No less than 80 dB for frequencies DC - 60 Hz	
Frequency characteristics	For DC coupling: within the range of +0.5 dB and -3 dB for frequency range of DC - 400 kHz For AC coupling: within the range of +0.5 dB and -3 dB for frequency range of 0.3 Hz - 400 kHz	
Linearity	within ±0.2%-FS	
Low pass filter	two-pole Bessel type: 5Hz, 50Hz, 500Hz, 5kHz, 50kHz and OFF attenuation characteristics: -12 dB/oct. approximately	
Temperature stability characteristics	zero point: within ±0.03%・FS/°C range: within ±0.01%・FS/°C	
A/D conversion characteristics	resolution	12 bits
	conversion time	1 μs max.
	conversion method	serial comparison method
Input connector	insulated BNC type	
Withstand voltage	1.5 kV AC for one minute between input terminal and ground, and between channels.	
S/N ratio	-46 dB or greater (when set at Wide Range)	
Mass	about 240 g	

1.3.5 External drawings of 2CH high-speed DC amplifier units







1.4. 2CH AC strain amplifier units

1.4.1. Overview

The 2CH AC strain amplifier unit is an A/D conversion unit that converts output voltages of converters of the strain gauge type or varied voltages from strain gauges connected to the input.
The unit provides high accuracy/resolution measurement with low noise due to the use of AC(alternate current) bridge source.
The units incorporate two(2) channels per unit and the two channels are insulated to each other within the unit.

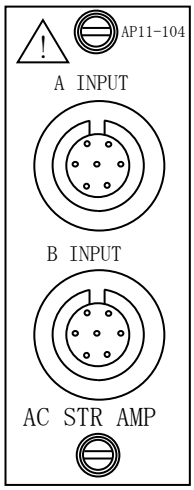
1.4.2. Connection with input signals

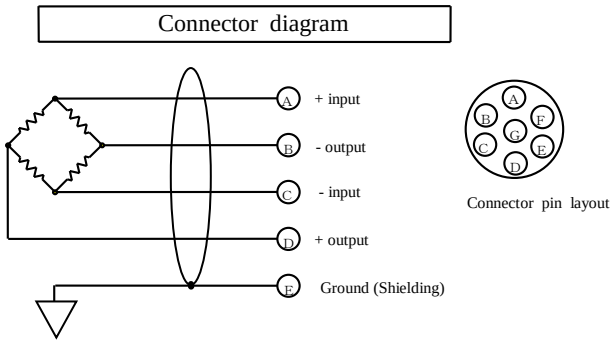
NOTE

・The AC source unit (optional item: RA11-109) must be installed in the RA mainframe, when the 2CH AC strain amplifier unit is used.

Connection instructions:

The input section of the 2CH AC strain amplifier unit is illustrated in the figure below.
The input connectors are connected to strain gauge-type converters or bridge boxes.





Correct and careful connection of the input circuit is vital to accurate and low-noise measurement.
The following describes the procedure of connecting input signals to the amplifier unit:

1) To paste strain gauges at locations to be measured.
2) To connect the strain gauges to the bridge box. Make your effort to shorten the length of connecting cables between the locations to be measured and the amplifier unit, since the shorter cables will provide the lower voltage drop due to line resistance.
3) To connect the bridge box and the converters to the input unit.

● **Notes on the use of bridge box and converters**

Please observe the following points when you use a bridge box and converters:

NOTE

・To tightly fix converters at place by referring to the converter instruction manual, since unstable fixation of the converters will lead to equipment malfunctioning and/or noise generation.
・To use converters that do not have connections between the ground (shield) terminal and any of the other terminals (A, B, C and D) of this product.
・Not to place converters and connecting cables in the environment with high electric or magnetic field.
・When the length of cables connecting this product to the bridge box or converters is large, you will have measured values substantially lower than the actual value by the amount of voltage drop of bridge source due to line resistance. The error caused by the voltage drop can be corrected by using the following table listing bridge voltage drop factors:

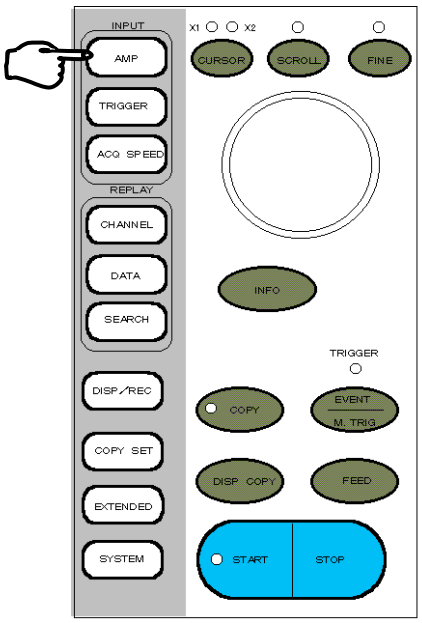
bridge voltage drop factors (approximate in %):

Bridge resistance (Ω)	length of cable between this product and bridge box (wire type: AWG20, at +20°C)			
	20 m	50 m	100 m	200 m
120	- 1.2	- 3.0	- 5.8	- 11.0
350	- 0.4	- 1.1	- 2.1	- 4.1
500	- 0.3	- 0.7	- 1.5	- 2.9
1000	- 0.1	- 0.4	- 0.7	- 1.5

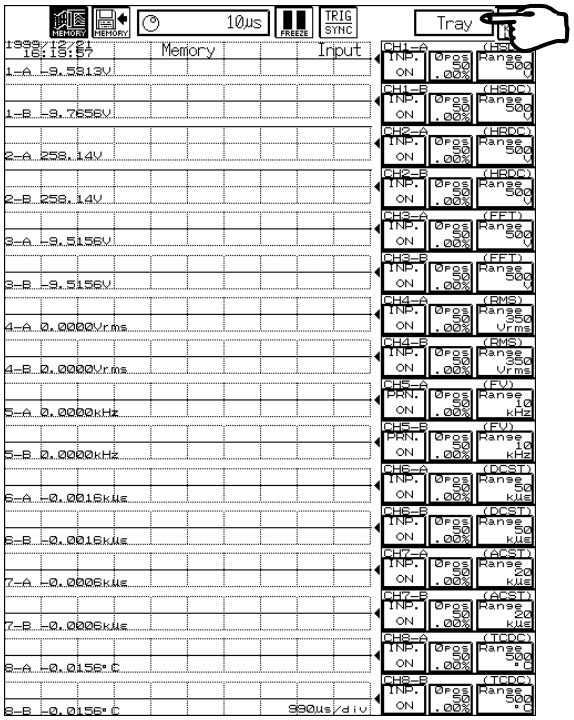
NOTE

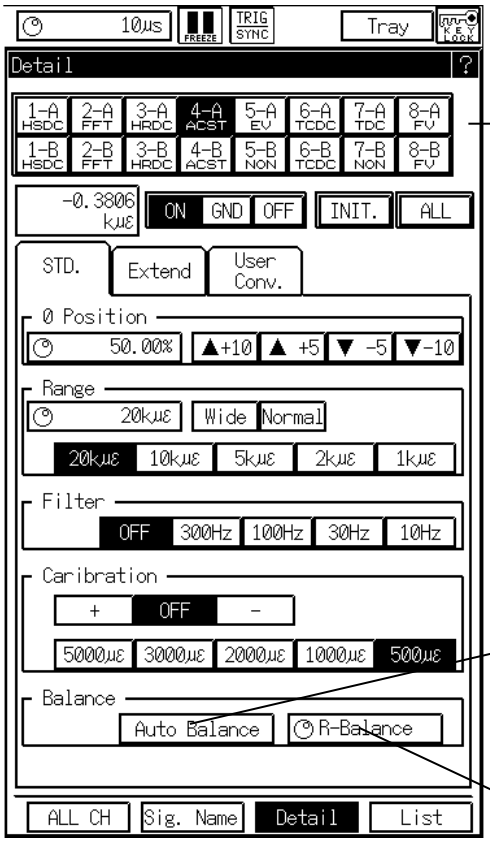
The sample speed must be set at 10 μs step otherwise the signal waveform can not be obtained correctly.
Example : 5 μs or 11 μs, etc. makes the waveform distort.

1.4.3. Setting for 2CH AC strain amplifier units



The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.





Set the equipment after selecting a channel you want.

Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures.

Calibration:
Set the calibration value and press the “+(plus mark)” button or the “- (minus mark)” button to apply calibration. The + (plus mark) and - (minus mark) buttons indicate tension and compression, respectively.

Set the button at “OFF” position during the measurement.

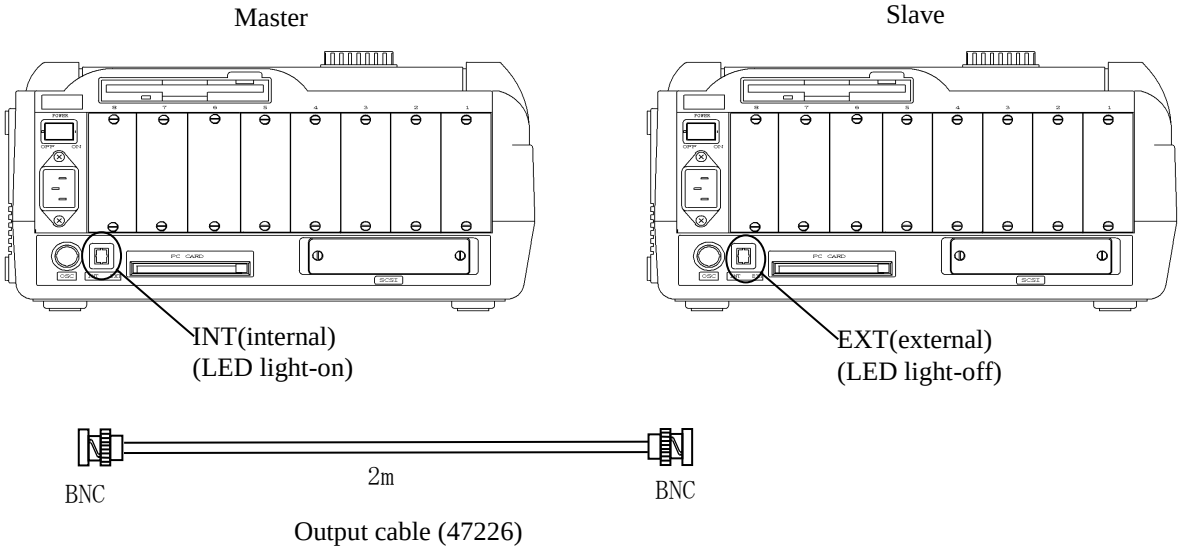
Auto Balance:
This provides automatic canceling of initial unbalance components (offset) of the bridge through automatic balancing operation by changing C and R values.

R-Balance:
This enables fine adjustment for achieving R-balancing. Normally, this is used for fine adjustment after autobalance.

1.4.4. Synchronization between AC bridge electrical source units (RA11-109)

When you use multiples of this product in parallel, you should synchronize the operation of their AC bridge electrical source units. Define one(1) of the electrical source units as a master unit for the whole system. Switch the OSC switch of the master AC bridge electrical source unit to INT position. Switch OSC switches of all the other AC bridge electrical source units (i.e., slave units) to EXT position.

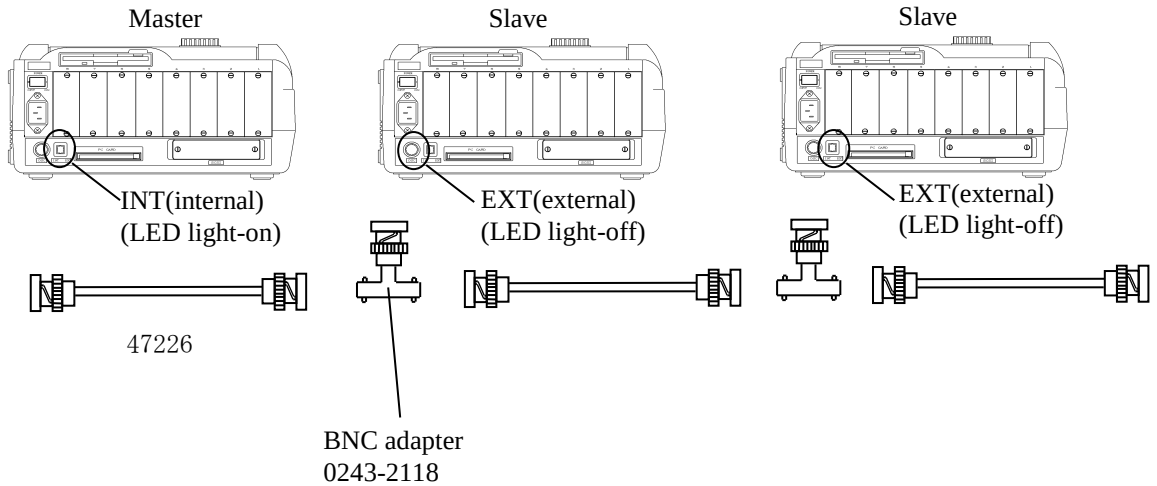
●Synchronization of two(2) AC bridge electrical source units



Output cable (47226)

●Synchronization of more than two(2) AC bridge electrical source units

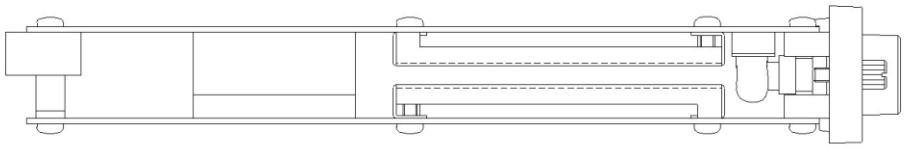
……BNC adapters (0243-2118) will be needed when you synchronize more than 2 source units.

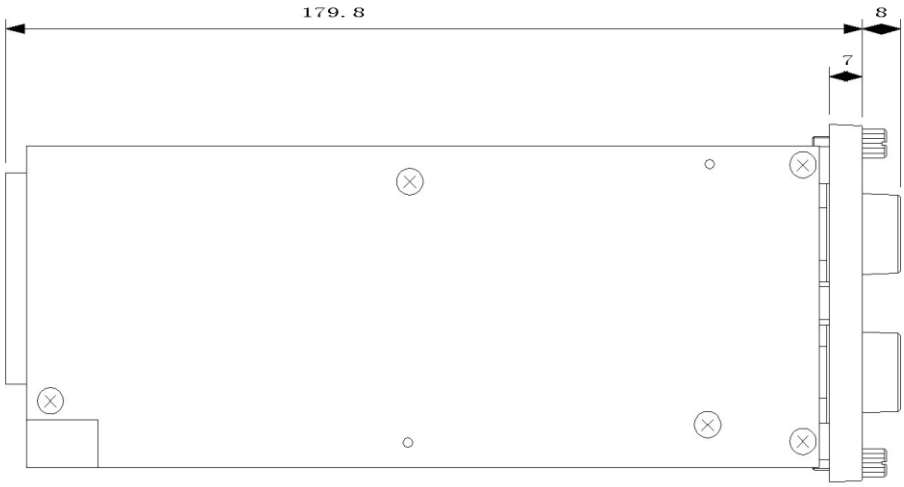


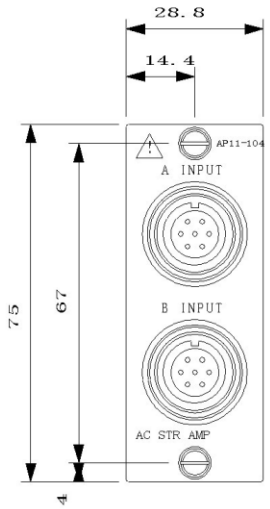
1.4.5. Specifications of 2CH AC strain amplifier units(AP11-104)

Number of channels	2 channels(CHs)/unit	
Input mode	balanced input (Each channel is insulated to each other and also from cabinet in the unit.)	
Applied strain gauge resistance	120Ω - 1 kΩ	
Gauge factor	2.0	
Bridge electrical source	sine wave, 2 Vrms, 5 kH ***※The bridge electrical source unit is a separate unit called AC bridge electrical source unit(RA11-109).*** ***Customers can in advance specify the units installed in the RA1000 series at the time of delivery as an option.***	
Auto Balance	Time required	within 1 sec./channel
	Accuracy in residual voltage	within ±0.5%・FS
Adjustable range of balancing	resistance component: within ±2%(10000x10^{-6} of strain) capacitance component: within 2000 pF	
Voltage sensitivity	at least the amount of FS(full scale) for the strain of 500x10^{-6}	
Measurement range	1k, 2k, 5k, 10k, 20k × 10^{-6} of strain	
Permissible common mode input voltage(CMV)	300 VAC	
Calibration (internal calibrator)	±500, 1k, 2k, 5k, 10k, 20k × 10^{-6} of strain Accuracy: within ±0.5 %-FS	
Frequency characteristics	within the range of +1 dB and -3 dB for frequency range of DC - 2 kHz	
Linearity	within ±0.2%-FS	
Low pass filter	two-pole Butterworth type: 10Hz, 30Hz, 100Hz, 300Hz and OFF attenuation characteristics: -12 dB/oct.	
Temperature stability characteristics	zero point: within ±0.05%・FS/°C range: within ±0.05%・FS/°C	
A/D conversion characteristics	resolution	16 bits
	conversion time	10 μs max.
	conversion method	serial comparison method
Input connector	NDIS strain input connector	
Withstand voltage	1 kV AC for one minute between input terminal and ground, and between channels.	
S/N ratio	-46 dB or greater (when set at Wide Range)	
Mass	about 285 g	

1.4.6. External drawings of 2CH AC strain amplifier units





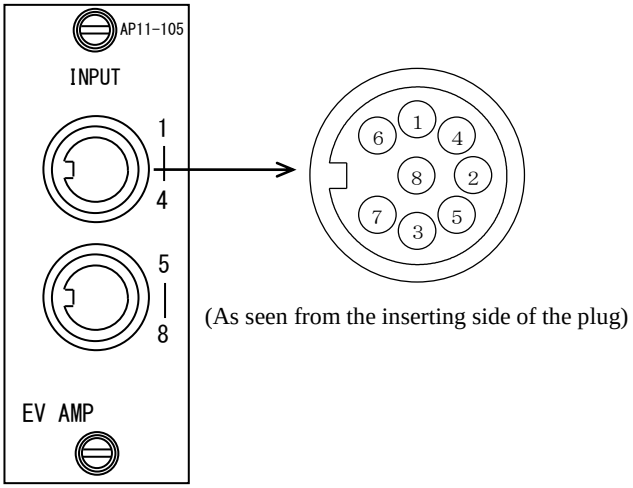


1.5. Event amplifier units

1.5.1. Overview

Event amplifier units provide status judgment information, such as that of voltage levels (H-level and L-level) and of electric contacts (open and short). One unit can have connections of up to eight(8) inputs and all inputs have a common ground.

1.5.2. Connection with input signals



(As seen from the inserting side of the plug)

Connector 1 - 4

pin number	Signal assignment
1	ch 1 input
2	ch 2 input
3	ch 3 input
4	ch 4 input
5	ground
6	+15 V output
7	not connected
8	not connected

Connector 5 - 8

Pin number	Signal assignment
1	ch 5 input
2	ch 6 input
3	ch 7 input
4	ch 8 input
5	ground
6	+15 V output
7	not connected
8	not connected

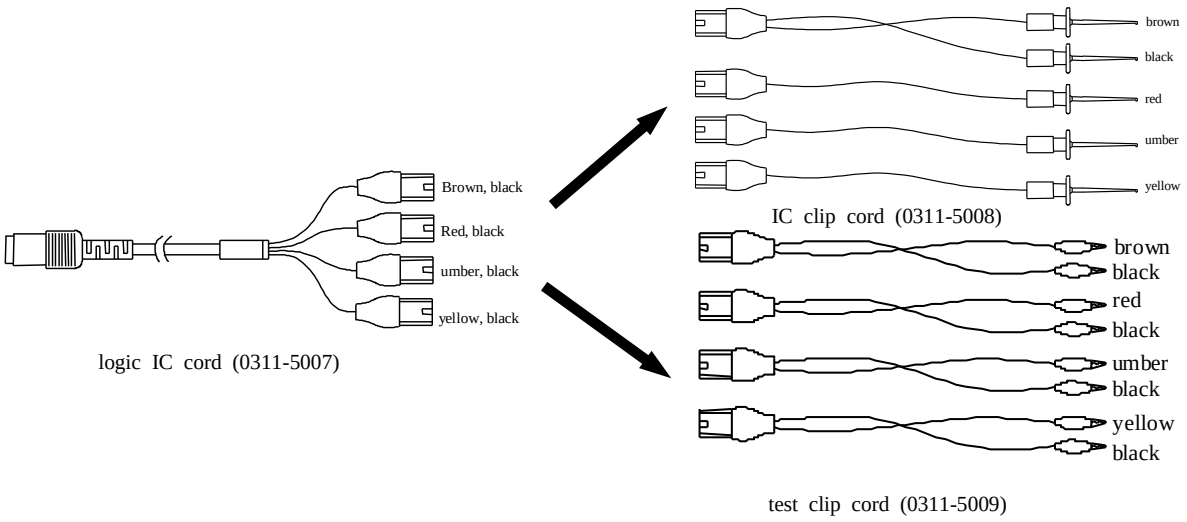
● **Input signals**

Voltage input	range of input voltage	0 - +24 V
	detection levels	H-level: more than 2.5V approximately L-level: less than 0.5 V approximately
	input current	no more than 1 ΩA
Contact input	detection levels	open: no less than 2 kΩ short: no more than 250 Ω
	load current	2 mA(MAX)

CAUTION Be careful that the input impedance will decrease up to 50 kΩ approximately if the input voltage exceeds the specified range of input voltage, when you apply voltages at the input.

● **Logic IC probes**

The logic IC probes comprise a logic IC cord, an IC clip cord and a test clip cord. Connection with the logic IC cord should be made so that both connecting and connected lines have the same color.



logic IC cord (0311-5007)

IC clip cord (0311-5008)

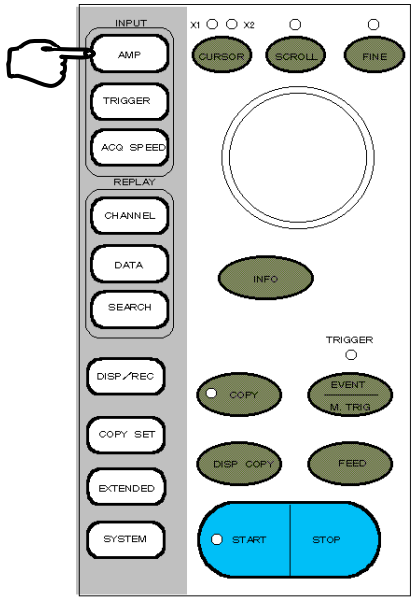
test clip cord (0311-5009)

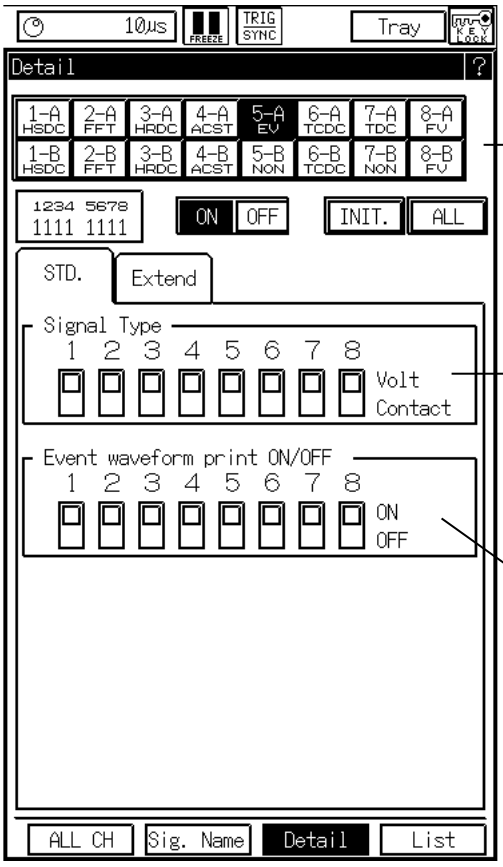
(continued from the previous page)

channel numbers within event amplifier unit		logic IC cord	IC clip cord	test clip cord
1	5	brown, black	brown, black	brown, black
2	6	red, black	red	red, black
3	7	umber, black	umber	umber, black
4	8	yellow, black	yellow	yellow, black

1.5.3. Setting for Event amplifier units

The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.





Set the equipment by selecting a channel you want.

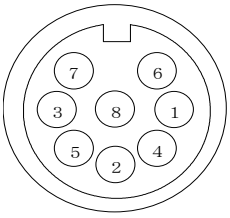
Signal Type:
Signal types for signal inputs are set for chs.1 - 8 in this box as follows:
Volt = voltage input
Contact = contact input

Event waveform print ON/OFF:
ON/OFF conditions for displays/printing are set in this box.
Note that data are recorded irrespective of ON/OFF setting status in this box.

1.5.4. Specifications of Event amplifier units(AP11-105)

<table>
<tr><td>Number of channels</td><td>8 channels(CHs)/unit</td></tr>
<tr><td>Input mode</td><td>logic input (Each channel is insulated to each other; the ground of each channel is connected commonly.)</td></tr>
<tr><td>Input signals</td><td>You can set Volt/Contact separately for each channel input.
<table>
<tr><td rowspan="2">Voltage input (Volt)</td><td>Range of input voltage</td><td>0 - +24V</td></tr>
<tr><td>Detection level</td><td>H-level(H):more than 2.5V approx.
L-level(L):less than 0.5V approx.</td></tr>
<tr><td></td><td>Input current</td><td>no more than 1μA</td></tr>
<tr><td rowspan="2">Contact input (Contact)</td><td>Detection level</td><td>short(H):no more than 250Ω
open(L):no less than 2kΩ</td></tr>
<tr><td>Load current</td><td>2 mA(max.)</td></tr>
</table></td></tr>
<tr><td>Response time</td><td>1μA
※applies when the input level “H” is +5 V or more.</td></tr>
<tr><td>Waveform recording</td><td>The thick line and the thin line are allocated for recording the logic levels of “H” and “L”, respectively.
(The “short” status of contact inputs is recorded as the “H” level.)
[Judgment of H/L levels]
H-level
L-level
The display position, inter-signal pitch, signal amplitude and baseline width can be changed for up to two(2) units when the full-scale is set 1/1.
<table>
<tr><td>display position</td><td>can be set in the range 0 - 180 mm</td></tr>
<tr><td>inter-symbol pitch</td><td>can be set in the range 2.5 - 25 mm</td></tr>
<tr><td>signal amplitude</td><td>can be set in the range 2.0 - 20 mm</td></tr>
</table></td></tr>
<tr><td>Data recording</td><td>Recordings of “1” and ”0” are made for logic levels of “H” and “L”, respectively.</td></tr>
<tr><td>X - Y recording</td><td>N/A(not applicable)</td></tr>
<tr><td>Insulation resistance</td><td>no less than 100MΩ between input terminal and ground</td></tr>
<tr><td>Withstand voltage</td><td>500 V AC for one minute between input terminal and ground</td></tr>
<tr><td>Mass</td><td>about 100 g</td></tr>
</table>

● Round DIN connector 8P XT2B-0800 (conforms to DIN45326)
(As seen from the inserting side of the plug)



Connector 1 - 4

pin number	signal assignment
1	ch 1 input
2	ch 2 input
3	ch 3 input
4	ch 4 input
5	ground
6	+15 V output
7	not connected
8	not connected

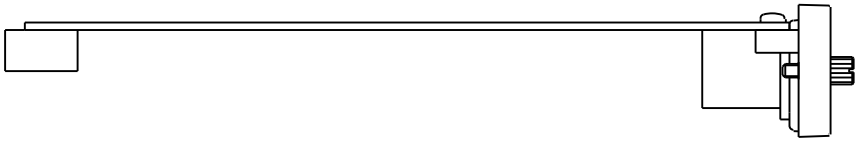
Connector 5 - 8

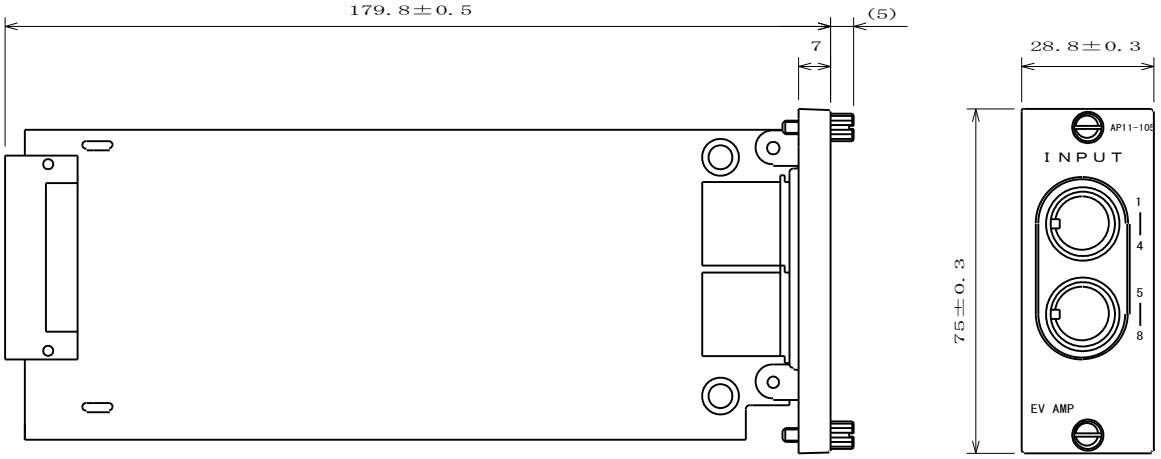
pin number	signal assignment
1	ch 5 input
2	ch 6 input
3	ch 7 input
4	ch 8 input
5	ground
6	+15 V output
7	not connected
8	not connected

<Logic IC probes-----accessory to event amplifier unit> RT36-163

<table>
<tr><td>Use</td><td>Logic IC probes are used for connection of the event amplifier unit with electronic circuits or sequence circuits for measurement of digital signals and/or relay contact signals.
<table>
<tr><th>wire color</th><th colspan="2">corresponding input channels</th></tr>
<tr><td>brown</td><td>ch.1</td><td>ch.5</td></tr>
<tr><td>red</td><td>ch.2</td><td>ch.6</td></tr>
<tr><td>umber</td><td>3ch</td><td>ch.7</td></tr>
<tr><td>yellow</td><td>4ch</td><td>ch.8</td></tr>
<tr><td>black</td><td>ground</td><td>ground</td></tr>
</table></td></tr>
<tr><td rowspan="4">Composition</td><td>logic IC cord (0311-5007)</td><td>one(1), 1.5 m long</td></tr>
<tr><td>IC clip cord (0311-5008)</td><td>four(4)/sack, 15 cm long</td></tr>
<tr><td>test clip cord (0311-5009)</td><td>four(4)/sack, 15 cm long</td></tr>
<tr><td colspan="2">The above comprises one(1) set of probe; two(2) sets are attached to each unit.</td></tr>
</table>

1.5.5. External drawings of Event amplifier units





1.6. 2CH TC-DC amplifier units

1.6.1. Overview

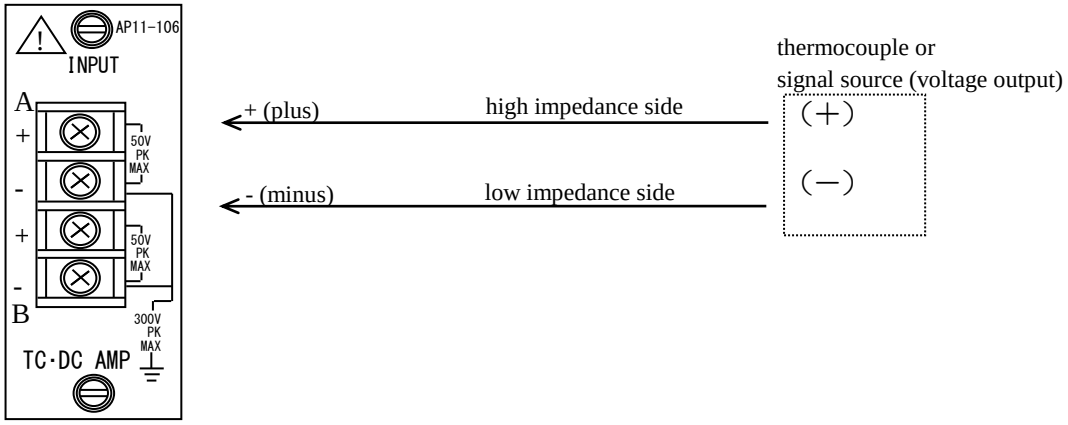
2CH TC-DC amplifier units are used to make temperature measurement by directly connecting thermocouples (R, T, J, K or W) to their input terminals. The units can also be used as DC amplifiers.
The units incorporate two(2) channels per unit and the two channels are insulated to each other within the unit.

1.6.2. Connection with input signals

● Connection instructions

It is very important to correctly connect input circuits to make accurate measurement with low noise level.
Basically, connect input circuits as shown in the following:

- Positive (+ or plus) side of input terminal (red) - high impedance side of thermocouple or signal source (i.e., H-side: hot side)
- Negative (- or minus) side of input terminal (gray) - low impedance side of thermocouple or signal source (i.e., L-side: low side)



NOTE

- Do not use unnecessarily long cables for input connection.
- Use shielded cables for input connection to avoid electrostatic noise.
- Twist the positive(+) and negative(-) lines of the input cable to avoid magnetic noise.
- Please keep the signal source impedance as low as possible, i.e., less than 100 ohms. The lower the signal source impedance, the higher the quality of measurement records that you can get.

● Notes and tips on the use of temperature/voltage (TC-DC) amplifier units:

Temperature/voltage (TC-DC) amplifier units can also be used as DC amplifiers.
The following describes some notes and tips on the use of TC-DC amplifier units as temperature amplifiers and as DC amplifiers:

Use of TC-DC amplifier units as temperature amplifiers:

CAUTION

- Directly connect the original raw wire or the compensation conductor of a thermocouple to the input terminal of the unit. Instead, you may use a crimping terminal (4 mm in diameter) with low heat capacity at the unit input terminal.
- Connect a thermocouple to the input terminal particularly paying attention to the correctness of its polarity. If wrong connection in polarity is made for a thermocouple at the unit input terminal, the recorded temperature will be lower than the actual temperature.
- When a thermocouple is directly connected to the unit input terminal, set an internal temperature compensation with a reference contact.
- When a temperature compensation with a reference contact is set externally, you will also need an external temperature compensation for the reference contact such as a zero-control scheme.
- Start your measurement at least 30 minutes after switching the power on, providing sufficient time period of equipment warm-up, so that stable measurement can be made.
- Make temperature measurement at least about 10 minutes after thermocouples have been connected.
- Accurate measurement cannot be made due to temperature gradient at the terminal section if the input terminal is directly hit by a hot wind or a cold wind. To cope with such a situation, put an enclosure around the input terminal.
- When the unit is used as a temperature amplifier, the unit is not suitable to record signals in general (i.e., voltage measurement), since a built-in linearizer is connected to the circuit. In this case, set at “Measure with V”.

Use of TC-DC amplifier units as DC amplifiers:

CAUTION

- If you apply, by error, any voltages that are more than the permissible input voltage (±50V in DC or in AC peak value), equipment failures would be induced due to breakdown of internal parts or other reasons. Do not apply input voltages exceeding the permissible voltage.
- Input impedance:
  The input impedance is approximately ten(10) MΩ at the ranges 100mV - 2V-FS in the voltage input mode (approximately one (1)MΩ at the ranges 5 - 50V-FS). However, note that the input impedance will be lowered to approximately 5 or 6 kΩ at minimum, when the input voltage exceeds ±6 V (in DC or in AC peak value).

Common notes and tips:

NOTE

- Use the unit by confirming the permissible common mode input voltages(CMV) to be no more than ±300 V (in DC or in AC peak value).
- Use such cables that have insulation sheath with no less than 2kV of withstand voltages.
- Do not apply voltages exceeding the permissible common mode input voltage, since application of such voltages would lead to malfunctions or failures of equipment. Also, note that recorded waveforms may involve noise components due to degradation of common mode rejection ratio(CMRR), when noise-like impulsive common mode voltages are applied.

NOTE

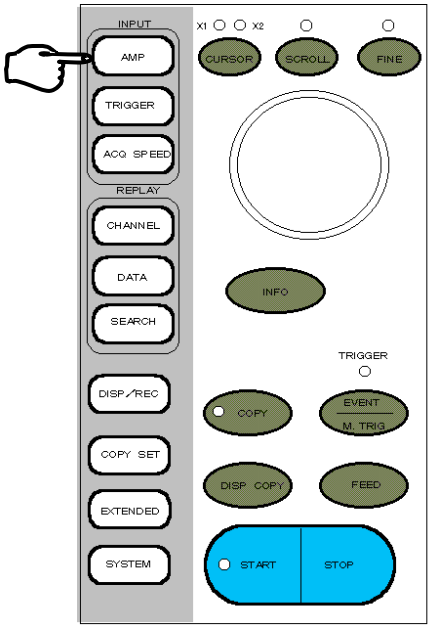
The sample speed must be set at 10 μ s step otherwise the signal waveform can not be obtained correctly.
Example : 5 μ s or 11 μ s, etc. makes the waveform distort.

TIPS

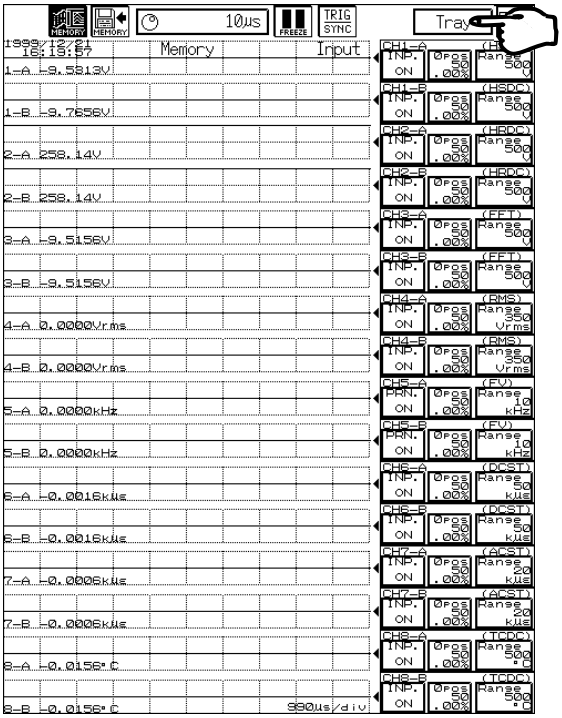
Kinds of thermocouple and the characteristics

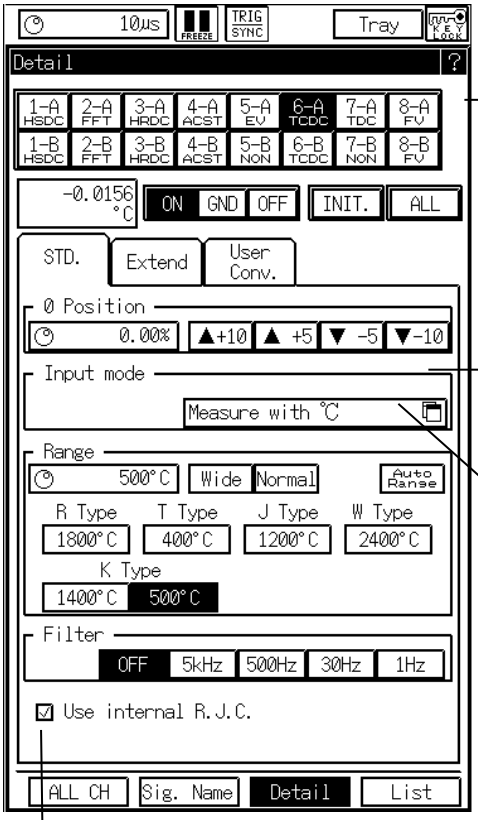
	Advantages	Disadvantages
K	Good linearity of electromotive force. Suitable to oxidied atmosphere.	Weak for reducing atmosphere. High electric resistance.
J	Cheaper than K thermocouple. High sensitivity. Nonmagnetic.	Weak for reducing atomosphere. High electric resistance.
T	Cheap and easy to get. Good low temperature characteristics. Suitable to reducing atmosphere.	Maximum operating themperature is low. Heat-conductive error is large.
R	High accuracy. Unevenness and deterioration are little. Good chemical resistance and oxidic resistance. Useable as standard.	No good linearity of electromotive force. Weak for reducing atomosphere. Impossible to measure lower temperature than 0 °C.
W	Suitable to inert-gas and hydrogenj-gas. Good characteristics in high temperature.	Not specified in JIS.

1.6.3. Setting for 2CH TC-DC amplifier units



The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.





Set the equipment after selecting a channel you want.

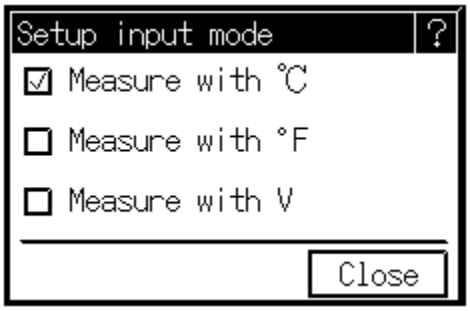
Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures that are not described herein.

Input mode:
- Measurement of temperature in degrees Celsius
- Measurement of temperature in degrees Fahrenheit
- Measurement of DC voltages

The three(3) modes above can be switched between them for measurement use.

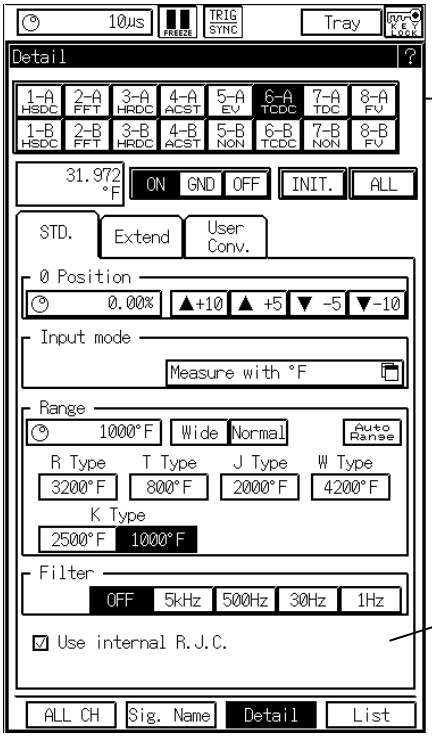
The left-hand screen shows a setting display when “Measure with °C” is set.

“Setup input mode” window



“Use internal temperature compensation for reference"
This check box is used to choose whether internal or external temperature compensation is used for the reference contact point.
As an initial condition, check this box when you want to use the unit with directly connecting thermocouples.
Do not check the box if you want to use the unit with temperature compensation of zero-control.

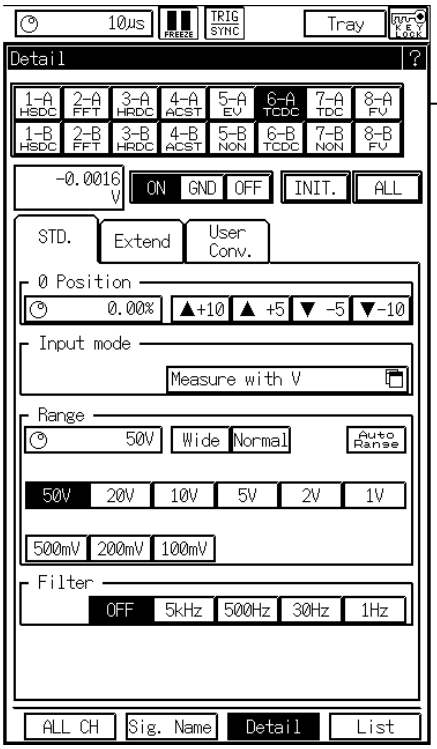
When set at temperature measurement in Fahrenheit:



Set the equipment after selecting a channel you want.
Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures that are not described herein.

"Use internal temperature compensation for reference junction"
This check box is used to choose whether internal or external temperature compensation is used for the reference contact point.
As an initial condition, check this box when you want to use the unit with directly connecting thermocouples.

When set at voltage measurement:

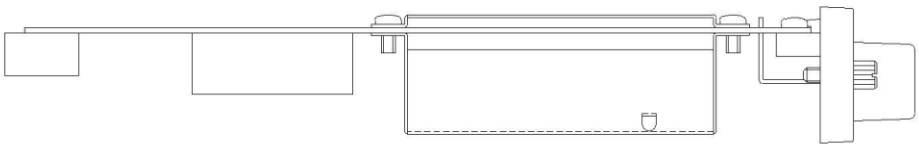


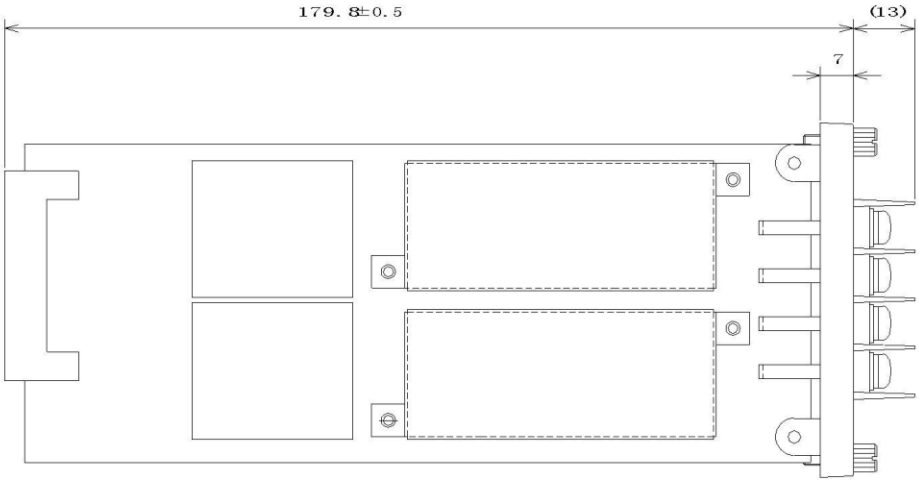
Set the equipment after selecting a channel you want.
Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures.

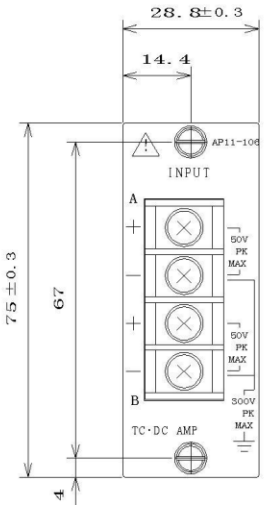
1.6.4. Specifications of 2CH TC-DC amplifier units(AP11-106)

<table>
<tr><td>Number of channels</td><td>2 channels(CHs)/unit</td></tr>
<tr><td>Input mode</td><td>unbalanced input (Each channel in the unit is insulated to each other and also from cabinet.)</td></tr>
<tr><td>Input coupling modes</td><td>DC coupling</td></tr>
<tr><td>Applicable thermocouples</td><td>R, T, J, K and W</td></tr>
<tr><td>Measurement range</td><td>Use of units as thermocouple amplifiers:
range of temperature measurement
<table>
<tr><td>range</td><td>display in Celsius</td></tr>
<tr><td>R1800</td><td>1760°C (0 - 1760°C)</td></tr>
<tr><td>T400</td><td>400°C (-200 - 400°C)</td></tr>
<tr><td>J1200</td><td>1100°C (-200 - 1100°C)</td></tr>
<tr><td>K500</td><td>500°C (-200 - 500°C)</td></tr>
<tr><td>K1400</td><td>1370°C (-200 - 1370°C)</td></tr>
<tr><td>W2400</td><td>2300°C (0 - 2300°C)</td></tr>
</table>
Equipped with fine adjustment capabilities in individual ranges
Use of units as DC amplifiers
100mV-FS, 200mV-FS, 500mV-FS
1V-FS, 2V-FS, 5V-FS, 10V-FS, 20V-FS, 50V-FS
Equipped with fine adjustment capabilities in individual ranges</td></tr>
<tr><td>Accuracy</td><td>For the use of units as thermocouple amplifiers: within ±0.5%·FS
For the use of units as DC amplifiers:
within ±0.3%·FS of range accuracy and within ±0.1%·FS of linearity</td></tr>
<tr><td>Reference contact point</td><td>switchable between internal and external compensation</td></tr>
<tr><td>Compensation accuracy for reference contact point</td><td>within ±2°C of accuracy (when temperature balance is maintained at input terminal section)</td></tr>
<tr><td>Offset accuracy</td><td>For the use of units as DC amplifiers: within ±0.3% • FS ***※at 23℃ of environment temperature of mainframe operation***</td></tr>
<tr><td>Input impedance</td><td>no less than 10 MΩ ***※approximately 1MΩ for the ranges of 5, 10, 20 and 50V-FS for use as DC amplifiers***</td></tr>
<tr><td>Permissible input voltage</td><td>±50V (in DC or in AC peak value)</td></tr>
<tr><td>Permissible common mode input voltage(CMV)</td><td>±300 V (in DC or in AC peak value)</td></tr>
<tr><td>Common mode rejection ratio(CMRR)</td><td>No less than 120 dB for frequencies DC - 60 Hz</td></tr>
<tr><td>Frequency characteristics</td><td>within the range of +0.5 dB and -3 dB for frequency range of DC - 40 kHz</td></tr>
<tr><td>Low pass filter</td><td>three-pole Bessel type:
1Hz, 30Hz, 500Hz, 5kHz and OFF
attenuation characteristics: -18 dB/oct.</td></tr>
<tr><td>Temperature stability characteristics</td><td>For the use of units as temperature amplifiers:
<table>
<tr><td>range:</td><td>within ±0.04% • FS/°C</td></tr>
</table>
For the use of units as DC amplifiers:
<table>
<tr><td>zero point:</td><td>within ±0.03% • FS/°C</td></tr>
<tr><td>range:</td><td>within ±0.01% • FS/°C</td></tr>
</table></td></tr>
<tr><td rowspan="3">A/D conversion characteristics</td><td>resolution</td><td>15 bits</td></tr>
<tr><td>conversion time</td><td>10 μs max.</td></tr>
<tr><td>conversion method</td><td>serial comparison method</td></tr>
<tr><td>Input connector</td><td>terminal base: M4</td></tr>
<tr><td>Withstand voltage</td><td>1.5 kV AC for one minute between input terminal and ground, and between channels.</td></tr>
<tr><td>S/N ratio</td><td>For use of units as DC amplifiers: -52 dB or greater (when set at Wide Range)
For use of units as thermocouple amplifiers: -60 dB or greater (when set at Wide Range, with 5kHz filter)</td></tr>
<tr><td>Mass</td><td>about 240 g</td></tr>
</table>

1.6.5. External drawings of 2CH TC-DC amplifier units





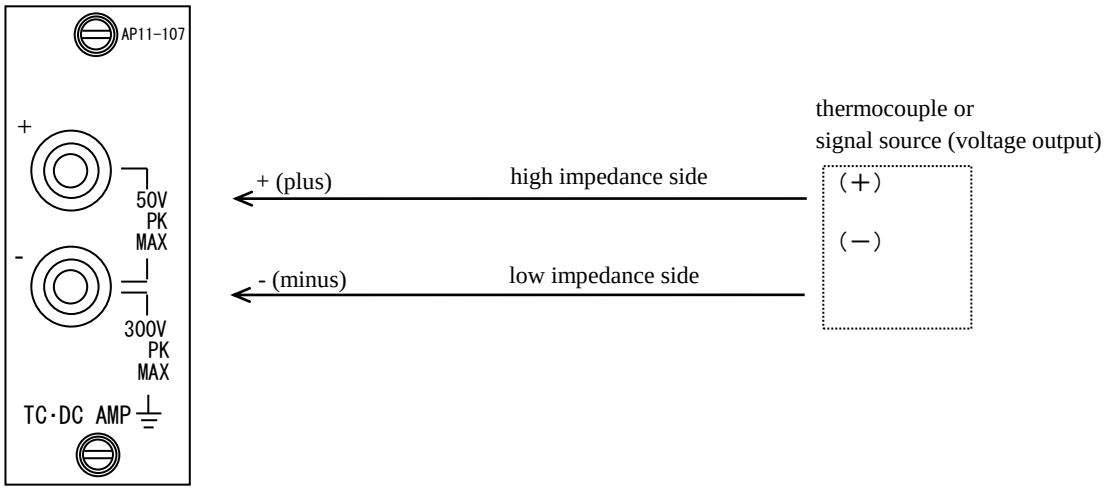


1.7. TC-DC amplifier units

1.7.1. Overview

TC-DC amplifier units are used to make temperature measurement by directly connecting thermocouples (R, T, J, K or W) to their input terminals. The units can also be used as high-sensitivity DC amplifiers.

1.7.2. Connection with input signals



NOTE

- Do not use unnecessarily long cables for input connection.
- Use shielded cables for input connection to avoid electrostatic noise.
- Twist the positive(+) and negative(-) lines of the input cable to avoid magnetic noise.
- Please keep the signal source impedance as low as possible, i.e., less than 100 ohms. The lower the signal source impedance, the higher the quality of measurement records that you can get.

● **Notes and tips on the use of temperature/voltage (TC-DC) amplifier units:**

Temperature/voltage (TC-DC) amplifier units can also be used as DC amplifiers.

The following describes some notes and tips on the use of TC-DC amplifier units as temperature amplifiers and as DC amplifiers:

Use of TC-DC amplifier units as temperature amplifiers:

⚠ CAUTION

- Directly connect the original raw wire or the compensation conductor of a thermocouple to the input terminal of the unit. Instead, you may use a crimping terminal (6 mm in diameter) with low heat capacity at the unit input terminal.
- Connect a thermocouple to the input terminal particularly paying attention to the correctness of its polarity. If wrong connection in polarity is made for a thermocouple at the unit input terminal, the recorded temperature will be lower than the actual temperature.
- When a thermocouple is directly connected to the unit input terminal, set an internal temperature compensation with a reference contact.
- When a temperature compensation with a reference contact is set externally, you will also need an external temperature compensation for the reference contact such as a zero-control scheme.
- Start your measurement at least 30 minutes after switching the power on, providing sufficient time period of equipment warm-up, so that stable measurement can be made.
- Make temperature measurement at least about 10 minutes after thermocouples have been connected.
- Accurate measurement cannot be made due to temperature gradient at the terminal section if the input terminal is directly hit by a hot wind or a cold wind. To cope with such a situation, put an enclosure around the input terminal.
- When the unit is used as a temperature amplifier, the unit is not suitable to record signals in general (i.e., voltage measurement), since a built-in linearizer is connected to the circuit. In this case, set at “Measure with V”

Use of TC-DC amplifier units as DC amplifiers:

CAUTION

- If you apply, by error, any voltages that are more than the permissible input voltage (±50V in DC or in AC peak value), equipment failures would be induced due to breakdown of internal parts or other reasons. Do not apply input voltages exceeding the permissible voltage.
- Input impedance

  The input impedance is approximately ten(10) MΩ at the ranges 100mV - 2V-FS in the voltage input mode (approximately one (1)MΩ at the ranges 5 - 50V-FS). However, note that the input impedance will be lowered to approximately 5 or 6 kΩ at minimum, when the input voltage exceeds ±6 V (in DC or in AC peak value).

Common notes and tips:

NOTE

- Use the unit by confirming the permissible common mode input voltages(CMV) to be no more than ±300 V (in DC or in AC peak value).
- Use such cables that have insulation sheath with no less than 2kV of withstand voltages.
- Do not apply voltages exceeding the permissible common mode input voltage, since application of such voltages would lead to malfunctions or failures of equipment. Also, note that recorded waveforms may involve noise components due to degradation of common mode rejection ratio(CMRR), when noise-like impulsive common mode voltages are applied.

NOTE

The sample speed must be set at 10 μ s step otherwise the signal waveform can not be obtained correctly.
Example : 5 μ s or 11 μ s, etc. makes the waveform distort.

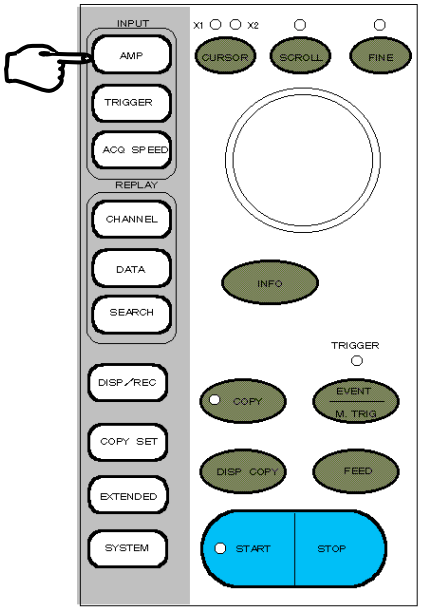
TIPS

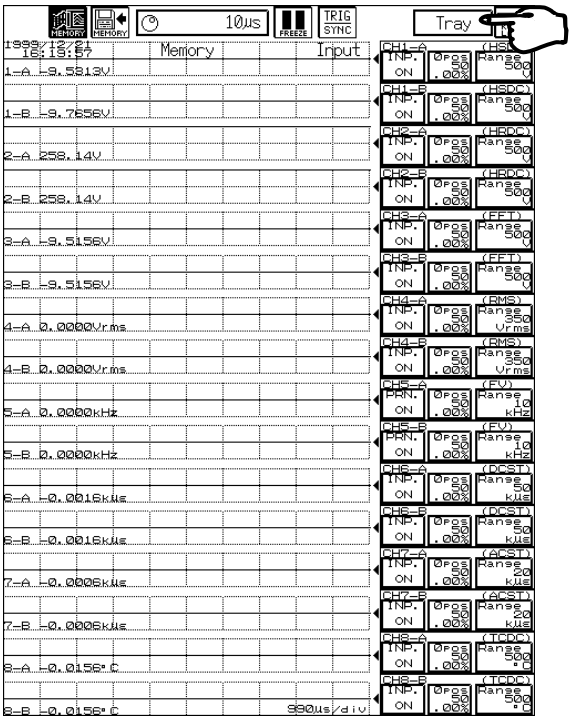
Kinds of thermocouple and the characteristics

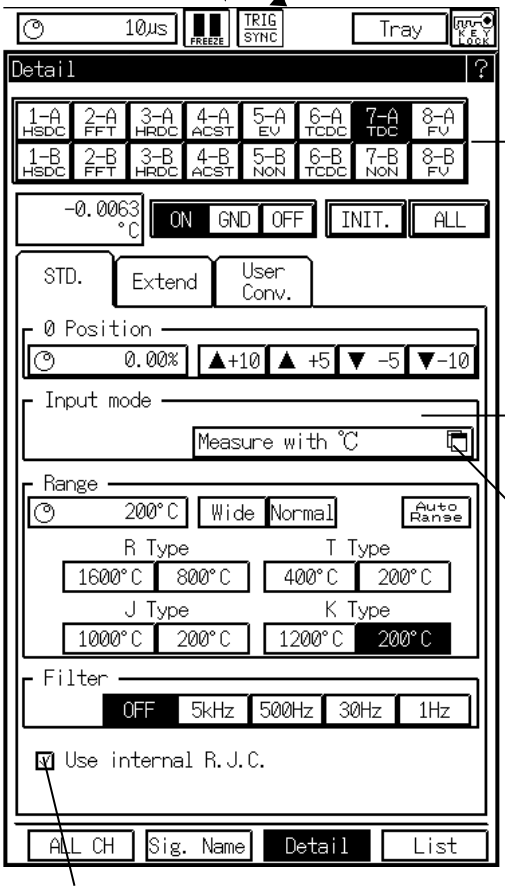
	Advantages	Disadvantages
K	Good linearity of electromotive force. Suitable to oxidied atmosphere.	Weak for reducing atmosphere. High electric resistance.
J	Cheaper than K thermocouple. High sensitivity. Nonmagnetic.	Weak for reducing atomosphere. High electric resistance.
T	Cheap and easy to get. Good low temperature characteristics. Suitable to reducing atmosphere.	Maximum operating themperature is low. Heat-conductive error is large.
R	High accuracy. Unevenness and deterioration are little. Good chemical resistance and oxidic resistance. Useable as standard.	No good linearity of electromotive force. Weak for reducing atomosphere. Impossible to measure lower temperature than 0 °C.

1.7.3. Setting for TC-DC amplifier units

The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.







Set the equipment by selecting a channel you want.

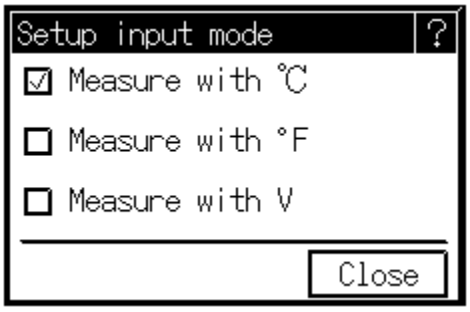
Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures that are not presented on this page.

Input mode:
- Measurement of temperature in degrees Celsius
- Measurement of temperature in degrees Fahrenheit
- Measurement of DC voltages

The three(3) modes above can be switched between them for measurement use.

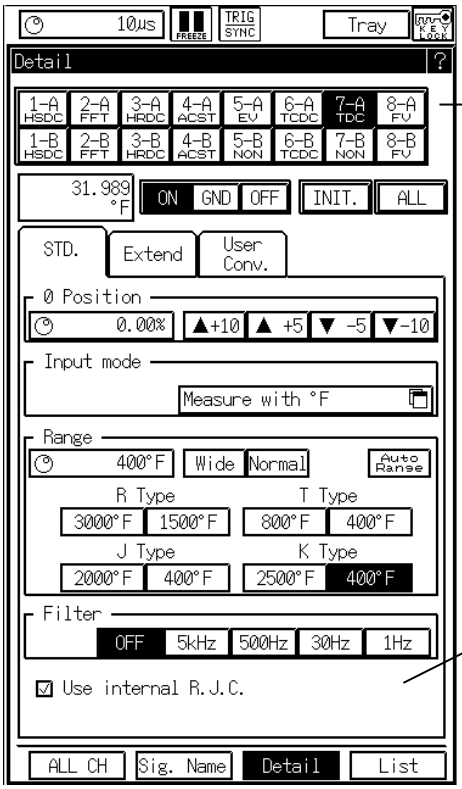
The left-hand screen shows a setting display when “Measure with ℃” is set.

“Setup input mode” window



“Use internal temperature compensation for reference junction”
This check box is used to choose whether internal or external temperature compensation is used for the reference contact point.
As an initial condition, check this box when you want to use the unit with directly connecting thermocouples.
Do not check the box if you want to use the unit with temperature compensation of zero-control.

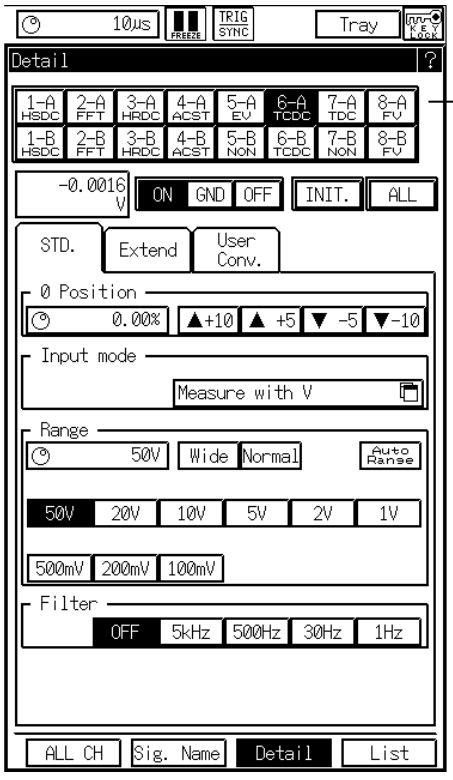
When set at temperature measurement in Fahrenheit:



Set the equipment after selecting a channel you want.
Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures that are not described herein.

"Use internal temperature compensation for reference junction"
This check box is used to choose whether internal or external temperature compensation is used for the reference contact point.
As an initial condition, check this box when you want to use the unit with directly connecting thermocouples.

When set at voltage measurement:

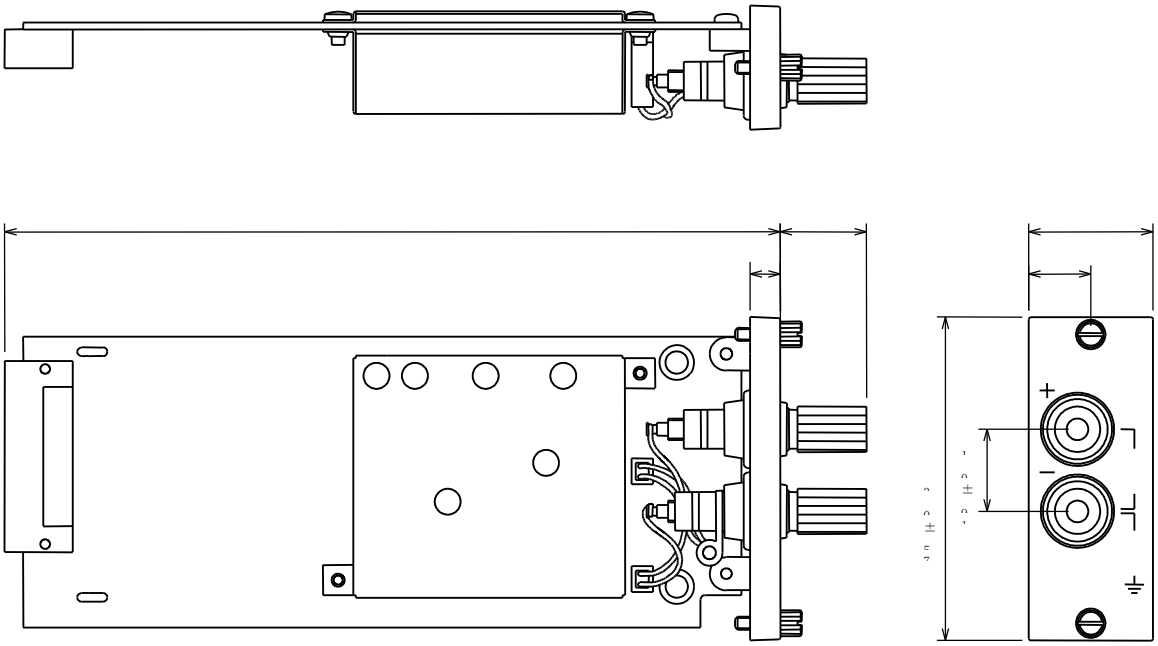


Set the equipment after selecting a channel you want.
Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures.

1.7.4. Specifications of TC-DC amplifier units(AP11-107)

<table>
<tr><td>Number of channels</td><td>1 channel(CH)/unit</td></tr>
<tr><td>Input mode</td><td>unbalanced input (The channel in the unit is insulated from cabinet.)</td></tr>
<tr><td>Input coupling mode</td><td>DC coupling</td></tr>
<tr><td>Applicable thermocouples</td><td>R, T, J and K</td></tr>
<tr><td>Measurement range</td><td>Use of units as thermocouple amplifiers:
range of temperature measurement
<table>
<tr><td>range</td><td>display in Celsius</td></tr>
<tr><td>R800</td><td>800°C (0 - 800°C)</td></tr>
<tr><td>R1600</td><td>1600°C (0 - 1600°C)</td></tr>
<tr><td>T200</td><td>200°C (-200 - 200°C)</td></tr>
<tr><td>T400</td><td>400°C (-200 - 400°C)</td></tr>
<tr><td>J200</td><td>200°C (-200 - 200°C)</td></tr>
<tr><td>J1000</td><td>1000°C (-200 - 1000°C)</td></tr>
<tr><td>K200</td><td>200°C (-200 - 200°C)</td></tr>
<tr><td>K1200</td><td>1200°C (-200 - 1200°C)</td></tr>
</table>
Equipped with fine adjustment capabilities in individual ranges
Use of units as DC amplifiers
10mV-FS, 20mV-FS, 50mV-FS, 100mV-FS, 200mV-FS, 500mV-FS
1V-FS, 2V-FS, 5V-FS, 10V-FS, 20V-FS, 50V-FS
Equipped with fine adjustment capabilities in individual ranges</td></tr>
<tr><td>Accuracy</td><td>For the use of units as thermocouple amplifiers: within ±0.5%-FS of range accuracy
※within ±1%-FS of range accuracy of -200 - 0℃ for 200℃ -FS range
For the use of units as DC amplifiers:
within ±0.5%-FS of range accuracy and within ±0.1%-FS of linearity</td></tr>
<tr><td>Frequency characteristics</td><td>within the range of +0.5 dB and -3 dB for frequency range of DC - 40 kHz</td></tr>
<tr><td>Reference contact point</td><td>switchable between internal and external compensation</td></tr>
<tr><td>Offset accuracy</td><td>For the use of units as DC amplifiers: within ±0.3%-FS ***※at 23℃ of environment temperature of mainframe operation***</td></tr>
<tr><td>Input impedance</td><td>no less than 10 MΩ ***※approximately 1MΩ for the ranges of 5, 10, 20 and 50V-FS for use as DC amplifiers***</td></tr>
<tr><td>Permissible input voltage</td><td>±50V (in DC or in AC peak value)</td></tr>
<tr><td>Permissible common mode input voltage(CMV)</td><td>±300 V (in DC or in AC peak value)</td></tr>
<tr><td>Common mode rejection ratio(CMRR)</td><td>No less than 120 dB with shorted input for 60 Hz</td></tr>
<tr><td>Compensation accuracy for reference contact point</td><td>within ±2°C of accuracy (when temperature balance is maintained at input terminal section)
※within ±1℃ at 20℃ when temperature balance is maintained at input terminal section</td></tr>
<tr><td>Low pass filter</td><td>three-pole Bessel type: 1Hz, 30Hz, 500Hz, 5kHz and OFF
attenuation characteristics: -18 dB/oct.</td></tr>
<tr><td>Temperature stability characteristics</td><td>For the ranges of 800°C for R-type and of 200°C for K, T and J types of thermocouples:
<table>
<tr><td>range</td><td>within ±0.04% • FS/°C</td></tr>
</table>
For 10mV-FS range for DC amplifiers:
<table>
<tr><td>zero point</td><td>±0.03% • FS/°C</td></tr>
<tr><td>range</td><td>±0.01% • FS/°C</td></tr>
</table></td></tr>
<tr><td rowspan="3">A/D conversion characteristics</td><td>resolution</td><td>14 bits</td></tr>
<tr><td>conversion time</td><td>10 μs max.</td></tr>
<tr><td>conversion method</td><td>serial comparison method</td></tr>
<tr><td>Input connector</td><td>conversion method</td></tr>
<tr><td>Withstand voltage</td><td>1.5 kV AC for one minute between input terminal and ground</td></tr>
<tr><td>S/N ratio</td><td>For use of units as DC amplifiers: -46 dB or greater (when set at Wide Range)
For use of units as thermocouple amplifiers: -60 dB or greater (when set at Wide Range, with 5kHz filter)</td></tr>
<tr><td>Mass</td><td>about 200 g</td></tr>
</table>

1.7.5. External drawings of TC-DC amplifier units



1.8. F/V converter units

1.8.1. Overview

F/V converters are used to convert input signal frequencies into analog voltages.

CAUTION

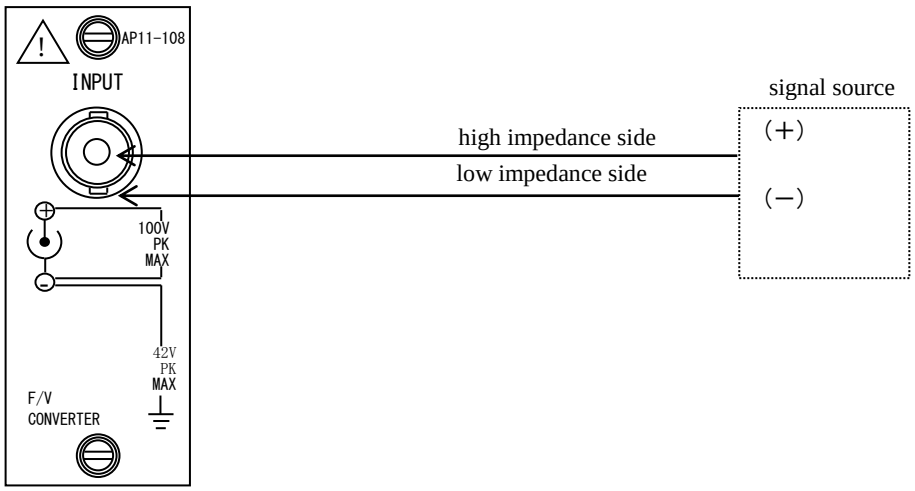
●Application of voltages of more than 100V (in DC or in AC peak value) to the input of this type of units will lead to equipment failure. Use F/V converter units always at voltages no less than 100V (in DC or in AC peak values)

1.8.2. Connection with input signals

1) Connection instructions

It is very important to correctly connect input circuits to make accurate measurement with low noise level.
Basically, connect input circuits as shown in the following:

- Positive (+ or plus) side of input terminal (red) ←high impedance side of signal source (i.e., H-side: hot side)
- Negative (- or minus) side of input terminal (gray) ←low impedance side of signal source (i.e., L-side: low side)



CAUTION

●Please pay attention to the following points when you want to record low level signals:
- not to use unnecessarily long cables for input connection
- to use shielded cables for input connection to avoid electrostatic noise

●Please keep the signal source impedance as low as possible, i.e., less than 100 ohms.
- From the point of view of noise contribution, the lower the signal source impedance, the higher the quality of measurement records that you can get.

WARNING

●Use the unit by keeping the common mode signal voltage (CMV) at no more than 300 V (in DC or in AC peak voltage), when the signal source is not grounded.
●Use such cables that have insulation sheath with withstand voltages of no less than 2 kV.

2) Input signals

WARNING

●Maximum input voltage
The maximum permissible input voltage is 100 V (in DC or in AC peak values). If you apply, by error, an input voltage exceeding 100 V (in DC or in AC peak value), this will lead to equipment failure caused by breakdown of parts that are used internal to the unit.

●Permissible common mode input voltage (CMV)

Use insulated BNC cables for input connection by all means, which may be attached as an optional item. Be careful to maintain the common mode input voltage (CMV) at no more than ±300V (in DC or in AC peak value).

Also, note that input frequencies may not always be correctly converted to analog values due to degradation of common mode rejection ratio (CMRR), when noise-like impulsive common mode voltages are applied.

Do not apply input voltages exceeding the specified permissible common mode input voltage of 300 V, peak value. This is because application of such voltages would lead to malfunctions of equipment.

●Ranges of operational input voltages and frequencies

Be careful that measurement results will involve errors if you apply input voltages that are outside the frequency range of 0.3 - 30 V, peak-to-peak.

Also, note that the specified input frequency range is 1 Hz - 10 kHz.

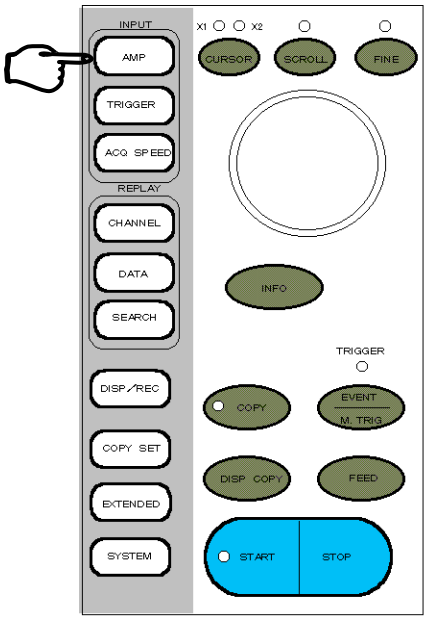
●Detection of the input frequency is done at the instant of the level of the input signal passing through the trigger level. Therefore, the input waveform should always be fluctuating around the voltage level of approximately 0.1 V for you to perform frequency measurement.

●Input impedance

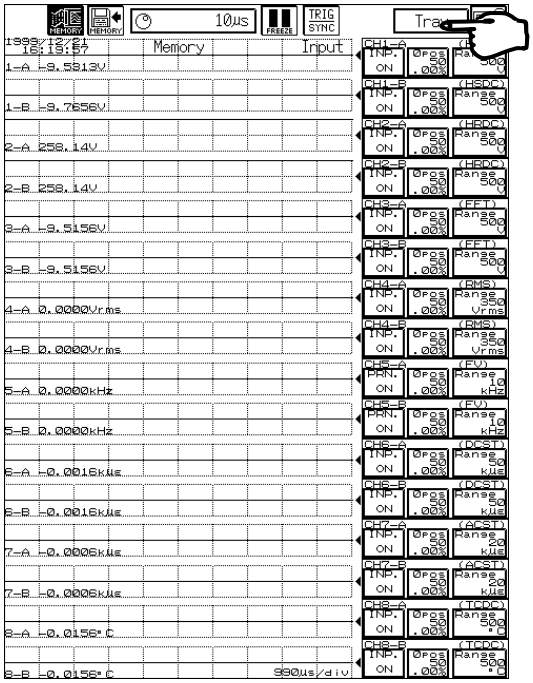
The input impedance is always 100 Ω approximately.

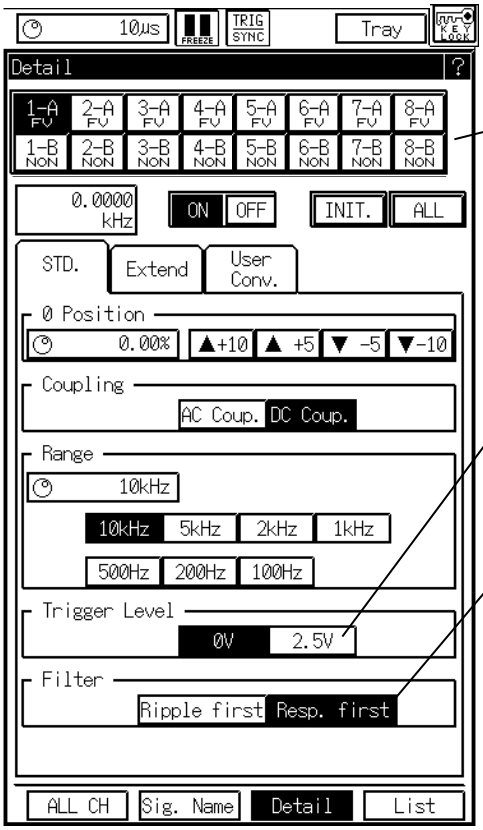
• Maintain the input voltages within the range of -12V - +12V in using the equipment.
Normal and correct measurement cannot be expected if the input voltage exceeds the range above.

1.8.3. Setting for F/V converter units



The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.





Set the equipment by selecting a channel you want.

Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures that are not presented on this page.

Trigger Level:
This unit converts the input frequency into desired data form by detecting the rising edge of the input signal.
You can change the detection voltage level in this box. The initial status (default) of the detection level is “0 V”.

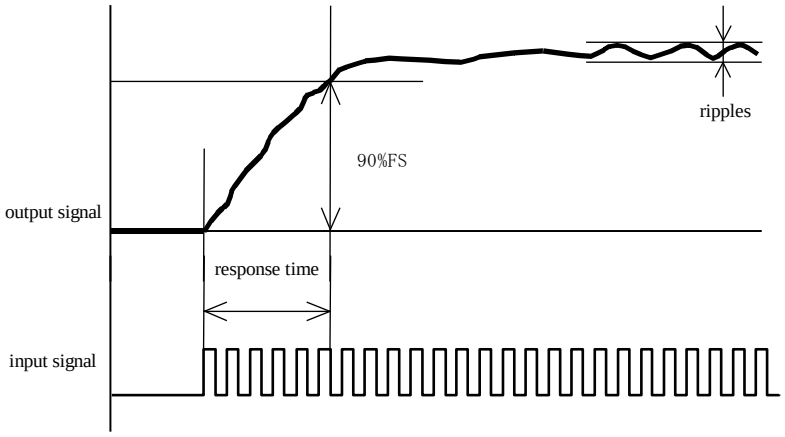
Filter:
Choose one of the following two filter modes for operation of this unit:
“Ripple first”:·····To be used when you want to place the priority on the level of ripples (normally no more than 0.3 %).The initial status (default) is set at this choice.
“Resp. first”:·····To be used when you want to place the priority on the response time.
The relationship between the “Ripple first” and “Resp. first” is shown in the following table:

Range (Hz-FS)	Ripple first		Resp. first	
	ripple	response time (ms)	ripple	response time (ms)
100	0.3%	about 600	about 3%	about 200
200	0.3%	about 300	about 3%	about 100
500	0.3%	about 200	about 2%	about 50
1k	0.3%	about 200	about 2%	about 30
2k	0.3%	about 200	about 1%	about 20
5k	0.3%	about 30	about 1%	about 20
10k	0.3%	about 20	about 1%	about 5

※See the following for more detailed information on the ripple and the response time:

TIPS

※Ripple ratio and response time



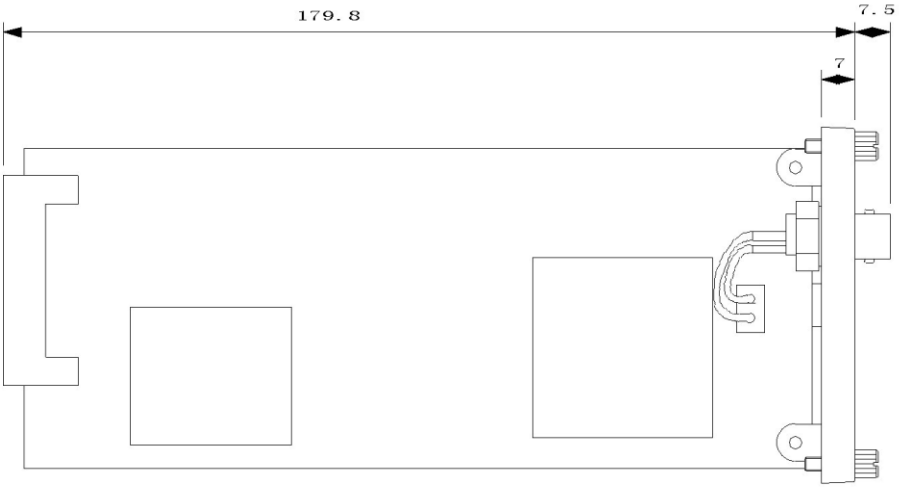
Ripple ratio: Ripples are defined as a type of waveform like wavelets that are contained in the output signal. The ripple ratio is defined as a percentage % with respect to the full scale.
The magnitude of ripples depends on the frequency of the input signal.

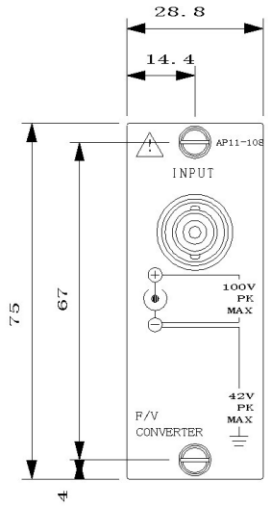
Response time: The response time is defined as the time period that the output signal reaches 90% of the full scale when the input signal is such that it produces the full scale output in the stable condition (e.g., input signal of 10kHz for the range of 10kHz-FS(full scale)).

1.8.4. Specifications of F/V converter units(AP11-108)

<table>
<tr><td>Number of channels</td><td colspan="2">1 channel(CH)/unit</td></tr>
<tr><td>Input mode</td><td colspan="2">unbalanced input (The channel is insulated from cabinet.)</td></tr>
<tr><td>Input coupling modes</td><td colspan="2">AC coupling and DC coupling</td></tr>
<tr><td>Input frequency range</td><td colspan="2">1 Hz - 10 kHz</td></tr>
<tr><td>Triggering level</td><td colspan="2">selectable between about 0V or about 2.5V</td></tr>
<tr><td>Input pulse width</td><td colspan="2">no less than 20 μs</td></tr>
<tr><td rowspan="2">Sensitivity and Accuracy</td><td>Input range</td><td>100, 200, 500, 1k, 2k, 5k and 10kHz-FS (seven ranges in all)</td></tr>
<tr><td>Accuracy</td><td>within ±0.5% ・FS</td></tr>
<tr><td>Offset accuracy</td><td colspan="2">within ±0.5% • FS ※at 25℃ of environment temperature of mainframe operation</td></tr>
<tr><td>Input impedance</td><td colspan="2">no less than 100 kΩ</td></tr>
<tr><td>Permissible input voltage</td><td colspan="2">±100V(in DC or in AC peak value)</td></tr>
<tr><td>Permissible common mode input voltage(CMV)</td><td colspan="2">±42 V (in DC or in AC peak value) for an amplifier unit only.
※300 VAC when an insulated BNC cable(signal cable 0311-5175) is used.</td></tr>
<tr><td>Linearity</td><td colspan="2">within ±0.3% • FS</td></tr>
<tr><td>Response time and ripples</td><td colspan="2">zero point: within ±0.03% • FS/°C
range: within ±0.02% • FS/°C</td></tr>
<tr><td>Response time and ripples</td><td colspan="2">When “Ripple first” is selected, ripples are automatically set/controlled so that the ripple ratio is confined to within 0.3%-FS.
When “Resp. first” is selected, the response time is automatically set/controlled to be the shortest.
<table>
<tr><td rowspan="2">Range
Hz-FS</td><td colspan="2">Ripple first</td><td colspan="2">Resp. first</td></tr>
<tr><td>Response time</td><td>Ripples</td><td>Response time</td><td>Ripples</td></tr>
<tr><td>100</td><td>about 600ms</td><td>about 0.3%·FS</td><td>about 200ms</td><td>about 5.0%·FS</td></tr>
<tr><td>200</td><td>about 300ms</td><td>about 0.3%·FS</td><td>about 100ms</td><td>about 4.0%·FS</td></tr>
<tr><td>500</td><td>about 200ms</td><td>about 0.3%·FS</td><td>about 50ms</td><td>about 3.0%·FS</td></tr>
<tr><td>1k</td><td>about 200ms</td><td>about 0.3%·FS</td><td>about 30ms</td><td>about 3.0%·FS</td></tr>
<tr><td>2k</td><td>about 200ms</td><td>about 0.3%·FS</td><td>about 20ms</td><td>about 3.0%·FS</td></tr>
<tr><td>5k</td><td>about 30ms</td><td>about 0.3%·FS</td><td>about 20ms</td><td>about 2.0%·FS</td></tr>
<tr><td>10k</td><td>about 20ms</td><td>about 0.3%·FS</td><td>about 10ms</td><td>about 2.0%·FS</td></tr>
</table>
Response time: time period required for waveform to reach 90%-FS(full scale)</td></tr>
<tr><td rowspan="3">A/D conversion characteristics</td><td>resolution</td><td>16 bits</td></tr>
<tr><td>conversion time</td><td>10 μs max</td></tr>
<tr><td>conversion method</td><td>serial comparison method</td></tr>
<tr><td>Input connector</td><td colspan="2">insulated connector of the BNC type</td></tr>
<tr><td>Withstand voltage</td><td colspan="2">1.5 kV AC for one minute between input terminal and ground.</td></tr>
<tr><td>Mass</td><td colspan="2">about 125 g</td></tr>
</table>

1.8.5. External drawings of F/V converter units





1.9. 2CH vibration & RMS amplifier units

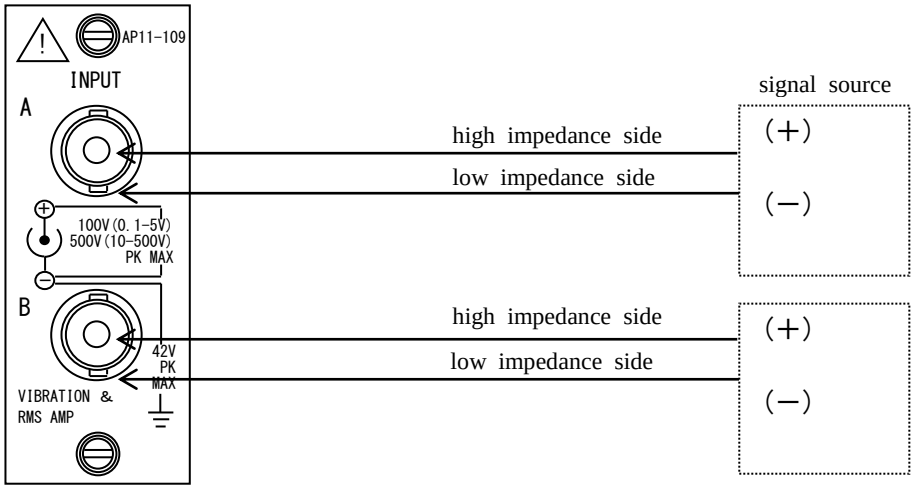
1.9.1. Overview

2CH vibration & RMS amplifier units have dual capabilities of A/D-converting output voltages of piezoelectric acceleration sensors built-in the amplifier and of A/D-converting the root-mean-square value of input voltages.
The units incorporate two(2) channels per unit and the two channels are insulated to each other within the unit.

CAUTION ●Application to this unit of voltages exceeding the permissible input voltages specified below will lead to equipment failure. Maintain the input voltages not exceeding the permissible voltages at all times.

Permissible input voltages (Dc or AC peak value)	Input Ranges	
	RMS mode	DC mode
100 V	0.1 - 1 Vrms-FS	0.1 - 5 V-FS
500 V	2 - 350 Vrms-FS	10 - 500 V-FS

1.9.2. Connection with input signals



WARNING Use by all means insulated BNC cables (optional item: input signal cables 0311-5175, with a BNC connector and test clips, of 2 m in length) for input connection. The outer shell of BNC connectors of the metallic type has the negative (-) polarity potential of the input signal. Therefore, you would be suffered with electric shock by touching the outer shell while the cable is connected to a signal source. Thus, note that it is very dangerous for you to touch it. Confirm that the common mode input voltage is within the range of ±42 VDC(in DC or in AC peak value) through carrying out appropriate examination of the signal source.

NOTE ●Please pay attention to the following points when you want to record low level signals:
- not to use unnecessarily long cables for input connection
- to use shielded cables for input connection to avoid electrostatic noise

●Please keep the signal source impedance as low as possible, i.e., less than 100 ohms.
The lower the signal source impedance, the higher the quality of measurement records.

● Input Signals

CAUTION ・Permissible input voltages
If you apply, by error, any voltages that are more than the permissible voltage defined for each sensitivity range, equipment failures would be induced due to breakdown of internal parts or other reasons. Do not apply input voltages exceeding the permissible voltages for individual sensitivity ranges listed in the following table:

Sensitivity ranges(V in FS)	0.1, 0.2, 0.5, 1, 2, 5	10, 20, 50, 100, 200, 500
Permissible input voltages(V)	100 V	500 V

・Input impedance

The input impedance is approximately one(1) MΩ. However, note that the input impedance will be lowered to approximately 15 kΩ, when the input voltage becomes ±8 V or more for the input sensitivity ranges of 0.1 - 5 V-FS(full-scale) in the DC coupling mode.

・Permissible common mode input voltages(CMV)

Use the insulated BNC cable, an optional item. In this case, confirm that the permissible common mode input voltage is no more than ±300 V in DC or in AC peak value.

CAUTION

・In the vibration mode and the vibration RMS mode, a constant-current of 2 mA is output from the amplifier. (18 V or more can be output.)
Do not connect any other sensors other than the types of sensors that are specified for the use with the amplifier. If a wrong sensor is connected, the connected equipment may be damaged.
・In the vibration mode, do not apply voltages at the input. Application of voltages of ±30 V or more at the input by error would induce amplifier failures.

NOTE

・Use cables having the insulation sheath of no less than 2 kV of withstand voltages.
・Do not apply voltages exceeding the permissible common mode input voltage, since application of such voltages would lead to malfunctions or failures of equipment. Also, note that recordings may involve noise components due to degradation of common mode rejection ratio(CMRR), when noise-like impulsive common mode voltages are applied.

NOTE

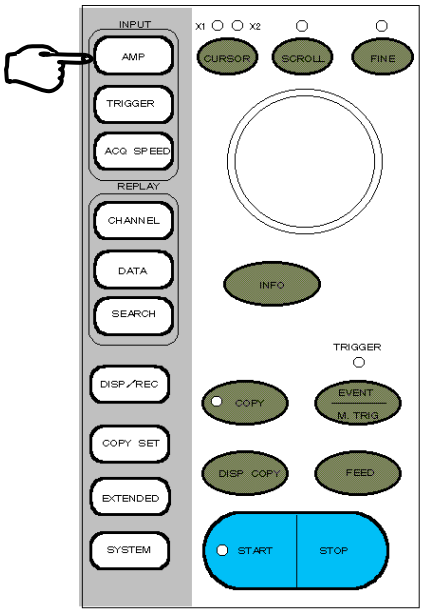
・Use the equipment through keeping the input voltage within the range of -30V - +30V including the DC component, when the sensitivity range is one of 0.1 - 5 V-FS in the AC coupling mode.
Note that correct measurement cannot be expected when the input voltage exceeds the voltage range mentioned above.

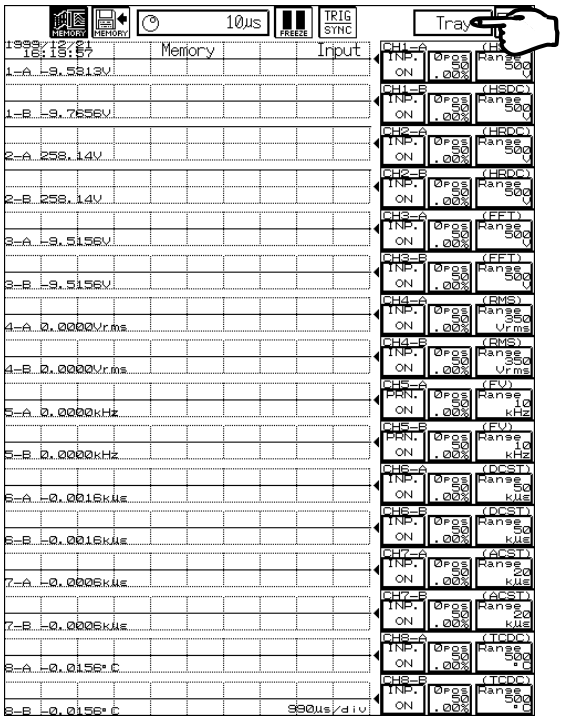
NOTE

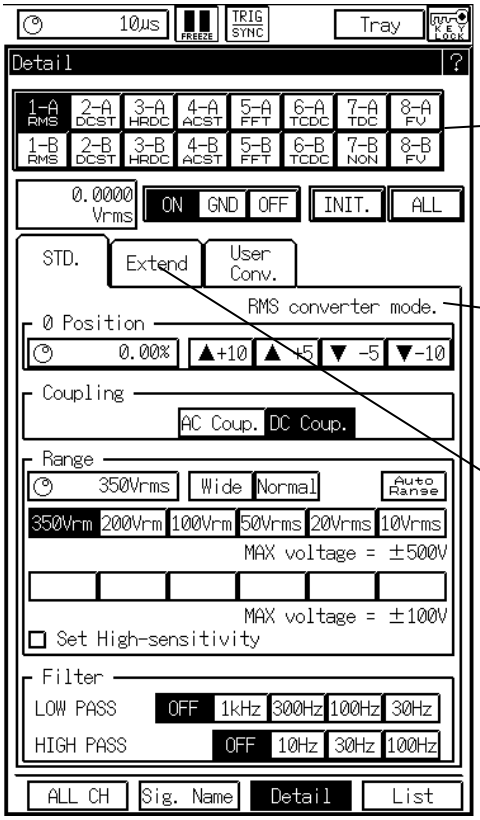
The sample speed must be set at 10 μ s step otherwise the signal waveform can not be obtained correctly.
Example : 5 μ s or 11 μ s, etc. makes the waveform distort.

1.9.3. Setting for 2CH vibration & RMS amplifier units

The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.







Set the equipment by selecting a channel you want.

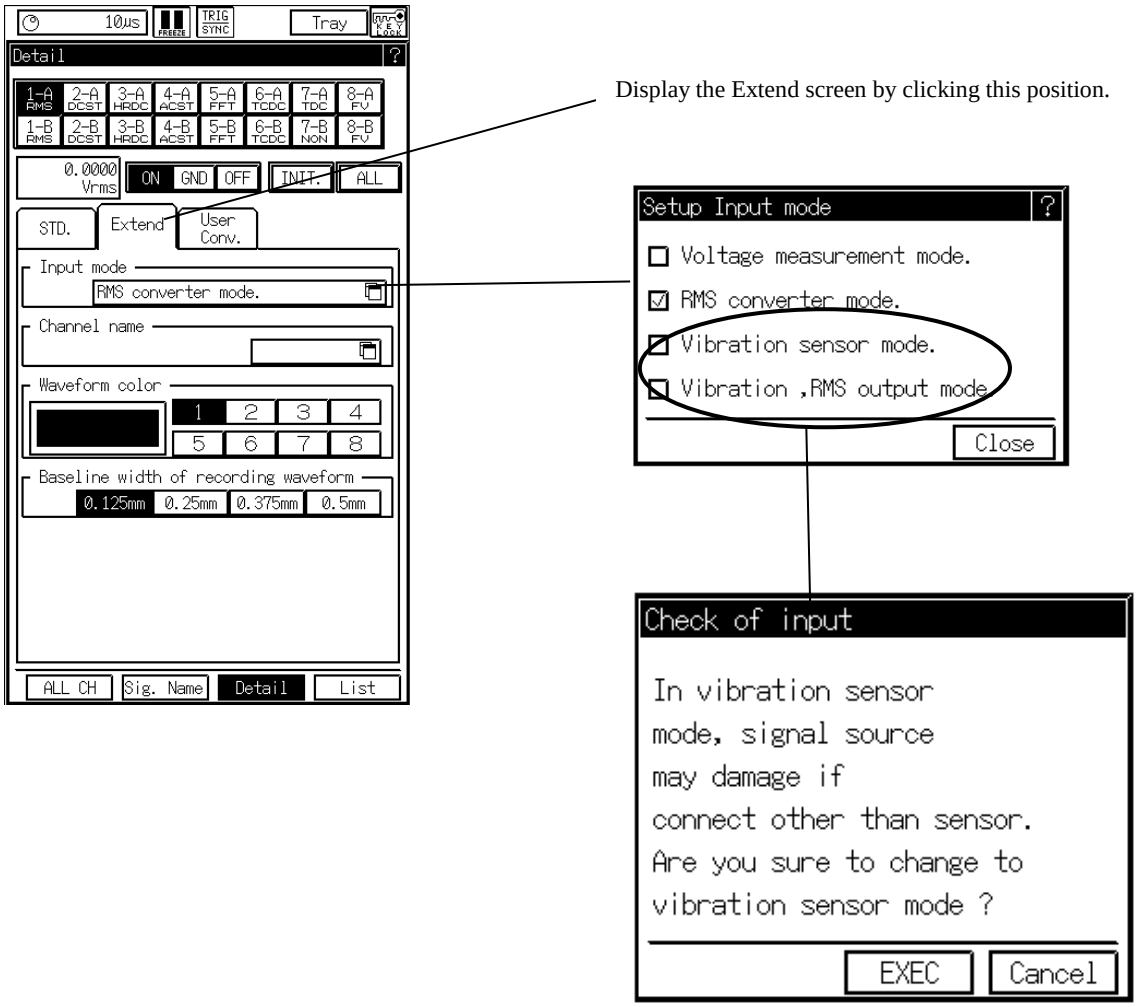
Proceed with the setting operation by following displayed instructions.
Refer to Section 3 for detailed instructions of setting procedures.

The figure in the left-hand side shows the operation of the 2CH vibration type RMS amplifier unit in the RMS converter mode for the input mode (i.e., input mode = RMS converter mode).
You can set the input mode at one of the following modes by switching the input mode to an appropriate one:

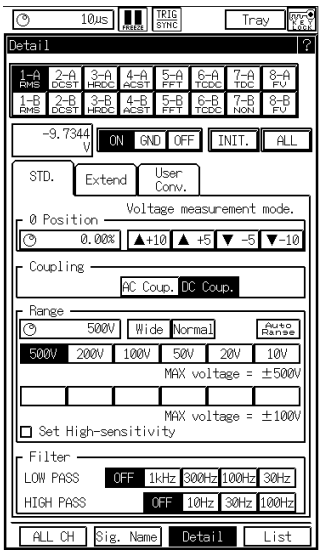
- Voltage measurement mode
- RMS converter mode
- Vibration sensor mode
- Vibration, RMS output mode

Switching of the input mode is made on the Extend screen.

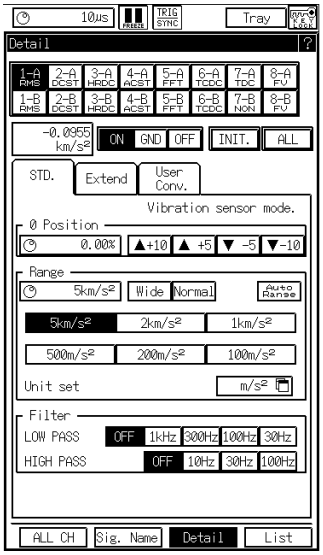
Switching/changing of input mode:



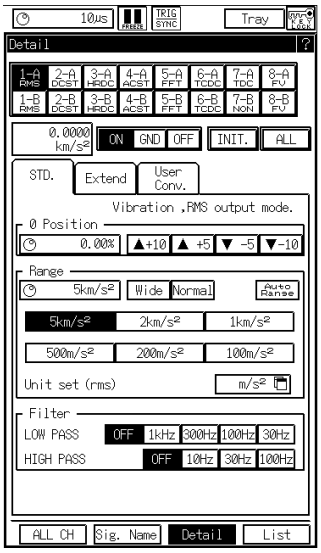
Voltage measurement mode:



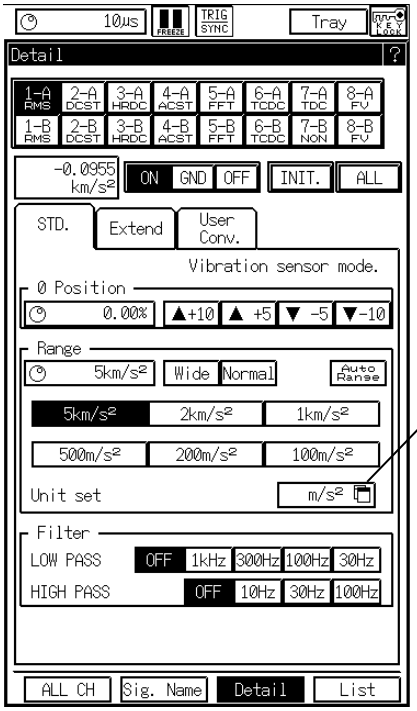
Vibration sensor mode:



Vibration, RMS output mode:

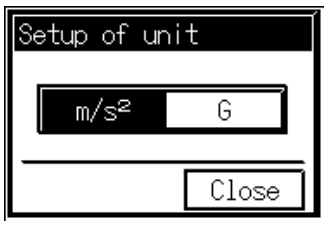


Unit settings in the vibration sensor mode and in the vibration sensor RMS output mode:

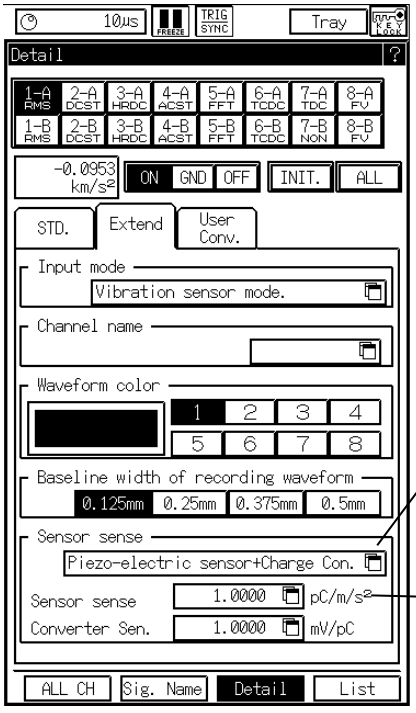


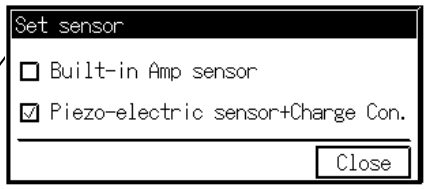
You can set the unit of vibration at one of the following in this box:

- m/s^2
- G



Use of the remote charge converter:





You can set the type of sensors connected at one of the following in this box:

- Built-in Amp sensor
- Piezo-electric sensor + Charge Con.

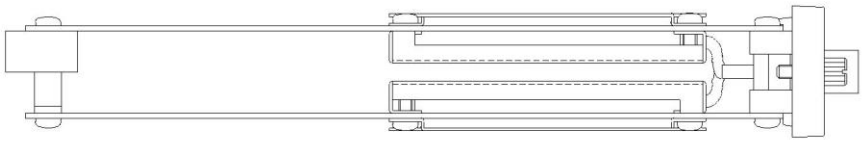
When both the Piezo-electric sensor + Charge Con. are selected for use, the following items shall be set:

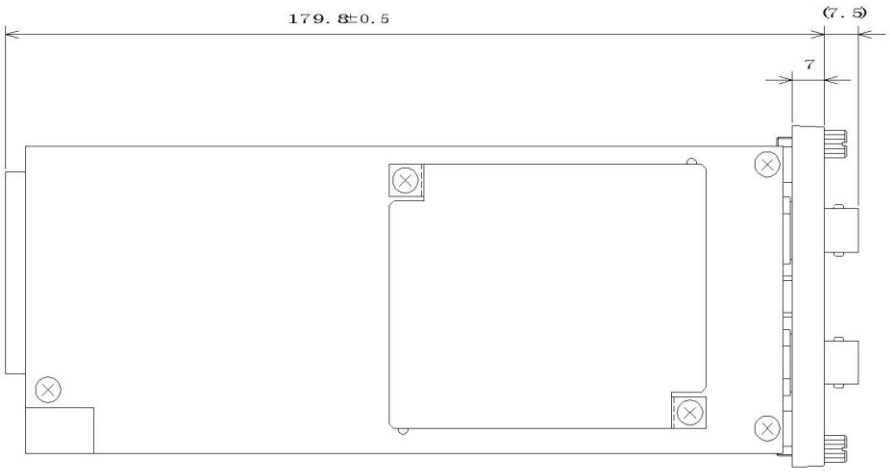
- Sensor sense
- Converter Sen.

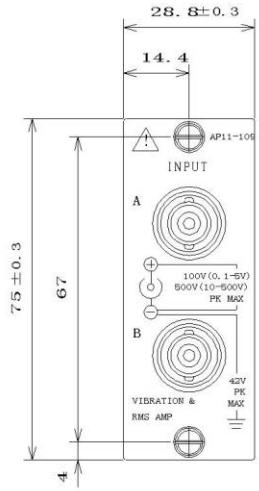
1.9.4. Specifications of 2CH vibration & RMS amplifier units(AP11-109)

Number of channels	2 channels(CHs)/unit	
Input mode	unbalanced input (Each channel is insulated to each other and also from cabinet within the unit.)	
Input coupling modes	AC coupling and DC coupling	
Sensitivity and Accuracy	Input range	For voltage measurement mode and for RMS converter mode: 0.1, 0.2, 0.5, 1, 2 and 5 V-FS (Voltages exceeding ±30V shall not be applied for the ranges 0.1 - 5 V-FS in AC coupling.) 10, 20, 50, 100, 200 and 500 V-FS (The unit should be interpreted as Vrms-FS for RMS converter mode.) For every range(i.e., ±0.1 - ±500 V-FS), fine adjustment capability and wide-scale provisions are provided. For vibration sensor mode and for vibration sensor RMS output mode: 5km/s^2, 2km/s^2, 1km/s^2, 500m/s^2, 200m/s^2 and 100m/s^2-FS The unit can also be set at G. (The unit should be interpreted as m/s^2-FS or m/s^{2}rms-FS) For every range, fine adjustment capability and wide-scale provisions are provided.
	Accuracy	within ±0.3%・FS ***※within ±0.8%-FS for 500 V-FS*** Sensitivity expression change capability is provided (for 1/1 full scale).
Offset accuracy	within ±0.3%・FS for use as DC amplifier ***※at 23℃ of environment temperature of mainframe operation***	
Input impedance	no less than 1 MΩ	
Permissible input voltage	±500V(DC or AC peak value) ***※±100V(DC or AC peak value) for input ranges of 0.1 - 5 V-FS***	
Permissible common mode input voltage(CMV)	±42 V (DC or AC peak value) for an amplifier unit only ***※300 VAC when an insulated BNC cable(signal cable 0311-5175) is used***	
Common mode rejection ratio(CMRR)	No less than 80 dB for frequencies DC - 60 Hz	
Frequency characteristics	For DC coupling: within the range of +1 dB and -3 dB for frequency range of DC - 50 kHz For AC coupling: within the range of +1 dB and -3 dB for frequency range of 1 Hz - 50 kHz	
Linearity	within ±0.1%-FS	
Low pass filter	four-pole Butterworth type: 30Hz, 100Hz, 300Hz, 1kHz and OFF (50kHz) attenuation characteristics: -24 dB/oct. approximately	
High pass filter	four-pole Butterworth type: 10Hz, 30Hz, 100Hz and OFF attenuation characteristics: -24 dB/oct. approximately	
Sensor power supply	no less than 2mA and 18V	
RMS output capability	0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10, 20, 50, 100, 200 and 350 Vrms-FS accuracy: within ±2%-FS crest factor: 5 max. (except for ranges of 200Vrms-FS and 350Vrms-FS)	
Temperature stability characteristics	zero point: within ±0.02%・FS/°C range: within ±0.01%・FS/°C (for RMS converter mode: within ±0.01%・FS/°C)	
A/D conversion characteristics	resolution	16 bits
	conversion time	10 μs max.
	conversion method	serial comparison method
Input connector	insulation type BNC connector	
Withstand voltage	1.5 kV AC for one minute between input terminal and ground, and between channels.	
S/N ratio	-46 dB or greater (when set at Wide Range)	
Mass	about 270 g	

1.9.5. External drawings of 2CH vibration & RMS amplifier units







1.10. 2CH DC strain amplifier units

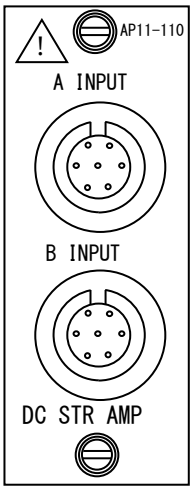
1.10.1. Overview

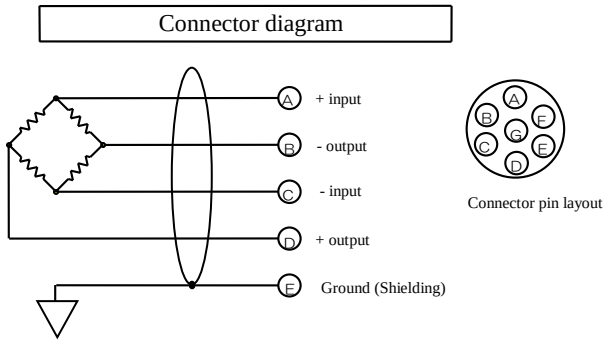
The 2CH DC strain amplifier unit has dual capabilities of A/D-converting voltage variations obtained from strain gauge-type converters or from strain gauges connected to the input and of converting fine voltages into 16 bits of data with high resolution.
The units incorporate two(2) channels per unit and the two channels are insulated to each other within the unit.

1.10.2. Connection with input signals

● Connection instructions

The diagrams/figures below show the input section of the 2CH DC strain amplifier unit.
Strain gauge type converters or bridge boxes are connected to the input connector.
When the unit is used as a DC amplifier, the terminals of B(- input), D(+ input) and E(shield/ground), are used.
Use the cable dedicated to the connection of the unit.





● Notes on the use of the converter

NOTE

Observe the following when you use the converter:

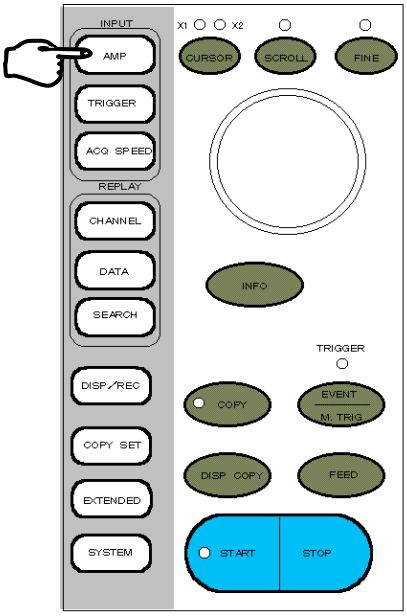
- To tightly fix converters at place by referring to the converter instruction manual, since unstable fixation of the converters will lead to equipment malfunctioning and/or noise generation.
- To prevent converters and connecting cables from rain, water, etc., while they are humidity resistant in general.
- To use converters that do not have connections between the ground (shield) terminal (E) and any of the other terminals (A, B, C and D) of this product.
- Not to place converters and connecting cables in the environment with high electric or magnetic field.
- When the length of cables connecting this product to the bridge box or converters is large, you will have measured values substantially lower than the actual value by the amount of voltage drop of bridge source due to line resistance. The error caused by the voltage drop can be corrected by using the following table listing bridge voltage drop factors:

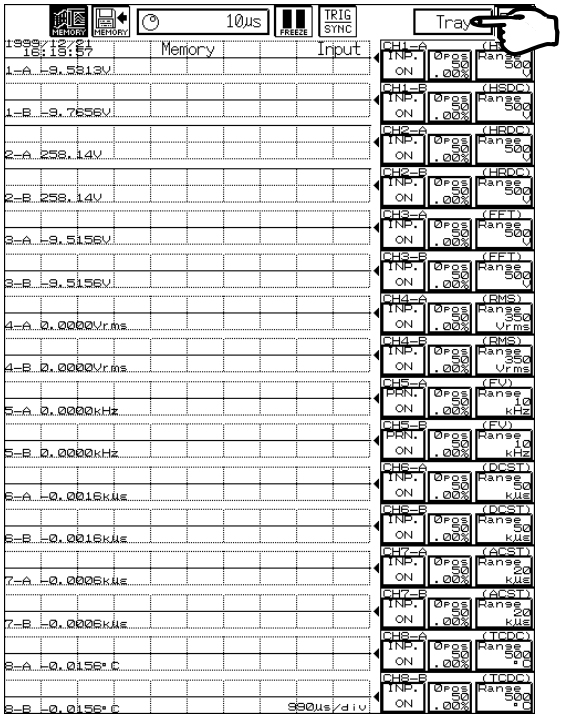
bridge voltage drop factors (approximate in %):

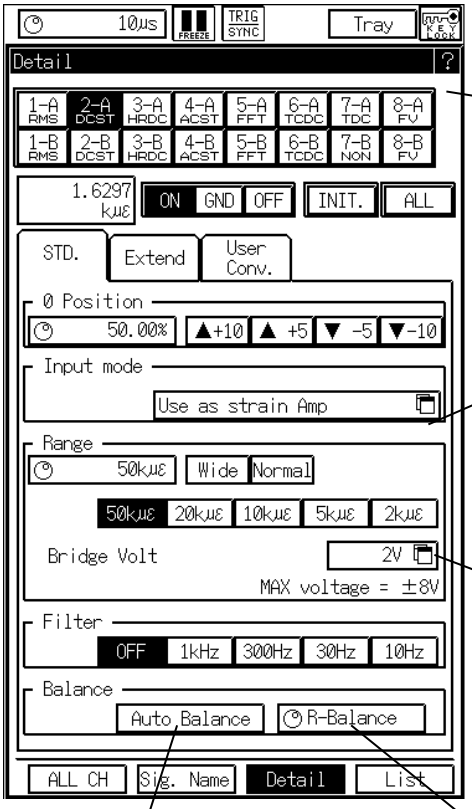
bridge resistance (Ω)	length of cable between this product and bridge box (wire type: AWG20, at +20°C)			
	20 m	50 m	100 m	200 m
120Ω	- 1.2	- 3.0	- 5.8	- 11.0
350Ω	- 0.4	- 1.1	- 2.1	- 4.1
500Ω	- 0.3	- 0.7	- 1.5	- 2.9
1 kΩ	- 0.1	- 0.4	- 0.7	- 1.5

1.10.3. Setting for 2CH DC strain amplifier units

The Detail display/screen is displayed when any one of the following indications, “ALL CH”, ”Sig.Name” or ”List”, is shown.



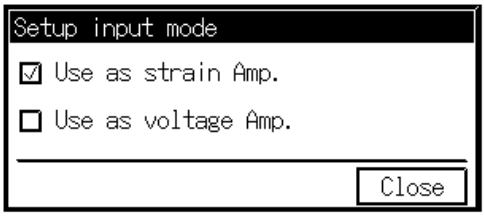




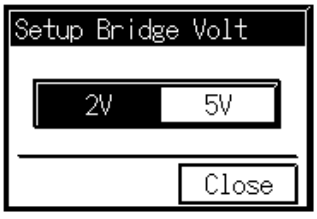
Set the equipment by selecting a channel you want.

Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures.

Window for setting input mode



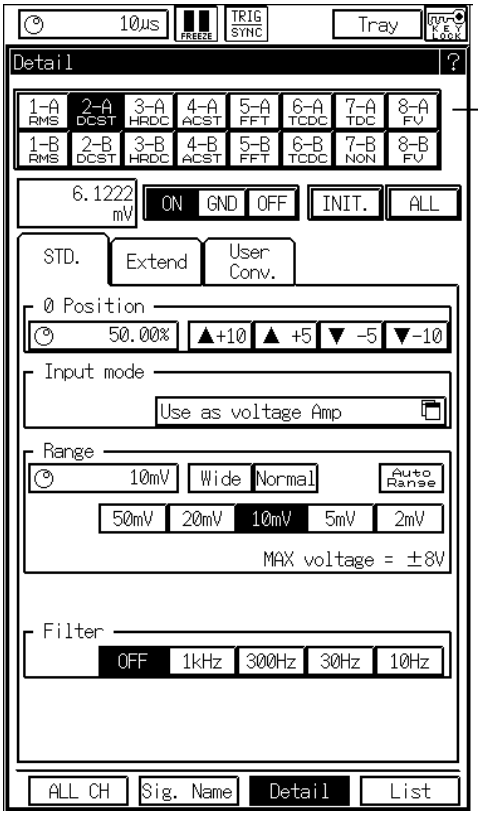
Setting of bridge voltages



Auto Balance:
This provides automatic canceling of initial unbalance components (offset) through automatic balancing operation by changing R values.

R-Balance:
This enables fine adjustment for achieving R-balancing. Normally, this is used for fine adjustment after autobalance.

For the setting of DC amplifier mode:

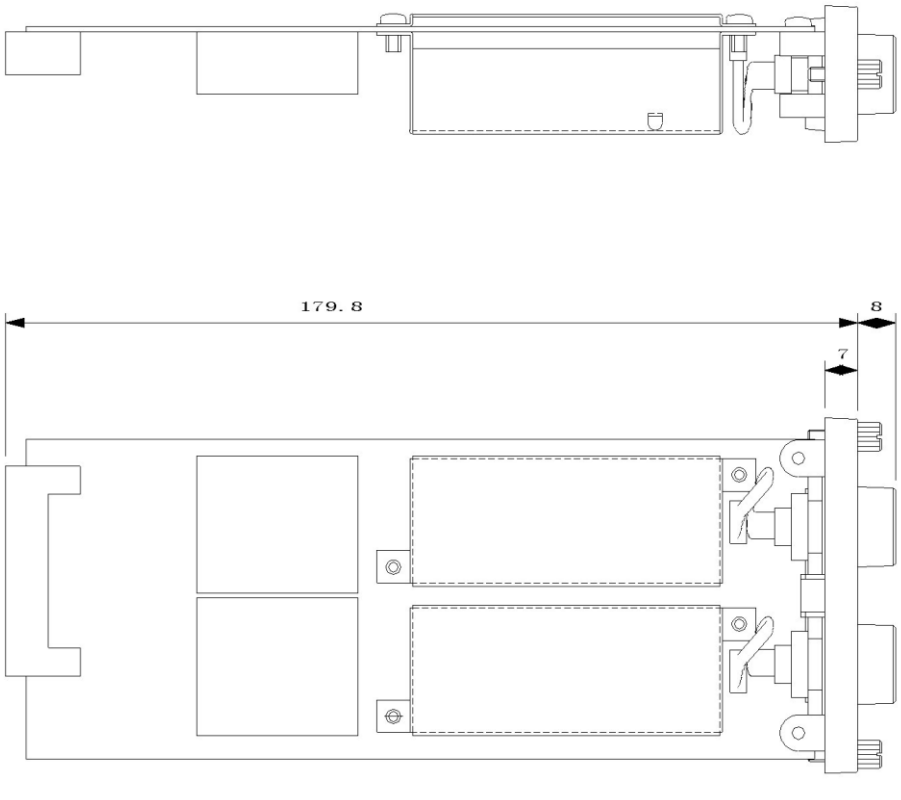


Set the equipment by selecting a channel you want.
Proceed with the setting operation by following displayed instructions.
Refer to Section 2 for detailed instructions of setting procedures that are not shown in this page.

1.10.4. Specifications of 2CH DC strain amplifier units(AP11-110)

Number of channels	2 channels(CHs)/unit	
Input mode	unbalanced input (Each channel is insulated to each other and also from cabinet.)	
Input coupling mode	DC coupling	
Applicable strain gauge resistance	120Ω - 2kΩ (for BV=2V), 350Ω - 2kΩ (for BV=5V)	
Gauge factor(ratio)	2.0	
Bridge voltages(BV)	2V or 5V	
Autobalance	time required	within 0.5 sec./channel
	accuracy in residual voltage	within ±0.3%-FS
Balancing range	thin ±3% (strain of 15000x10^{-6})	
Sensitivity and Accuracy	For use as strain amplifier: BV=2V: 2k, 5k, 10k, 20k and 50k x10^{-6} of strain-FS BV=5V: 800, 2k, 4k, 8k and 20k x10^{-6} of strain-FS Fine adjustment capability is provided for every range. For use as DC amplifier: 2, 5, 10, 20 and 50 mV-FS Fine adjustment capability is provided for every range.	
	Accuracy	±0.3%·FS
	Stability	±0.01%/°C
Offset accuracy	within ±0.3% • FS for use as DC amplifier ***※at 23℃ of environment temperature of mainframe operation***	
Input impedance	more than 10MΩ+10MΩ	
Linearity	within ±0.1%-FS	
Frequency characteristics	DC - 50 kHz (within +0.5,-3 dB)	
Low pass filter	two-pole Bessel type: 10Hz, 30Hz, 300Hz, 1kHz and OFF attenuation characteristics: -12 dB/oct. approximately	
Permissible input voltage	±8V(DC or AC peak value)	
Permissible common mode input voltage(CMV)	300 VAC	
Common mode rejection ratio(CMRR)	No less than 100 dB for frequencies DC - 60 Hz (50, 60Hz)	
Temperature stability characteristics	zero point: within ±0.1% • FS/°C range: within ±0.01% • FS/°C	
A/D conversion characteristics	resolution	16 bits
	conversion time	10 μs max.
	conversion method	serial comparison method
Input connector	NDIS strain input connector	
Withstand voltage	1 kV AC for one minute between input terminal and ground, and between channels.	
S/N ratio	-42 dB or greater (when set at Wide Range)	
Mass	about 240 g	

1.10.5. External drawings of 2CH DC strain amplifier units

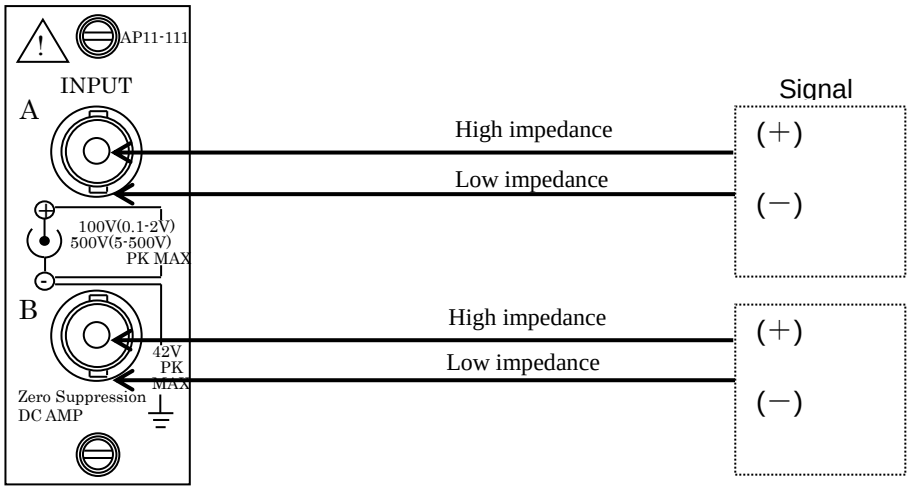


1.11. 2CH Zero Suppression amplifier units

1.11.1. Overview

The 2CH Zero Suppression Amp is an amplifier that can cancel a DC voltage element added to the input signal and amplify only fluctuating portion of the input signal. The maximum cancellation voltage is ±13 V (0.1 to 2 V FS), or ±110 V (5 to 500 V FS). The cancellation voltage is automatically generated. In this manual, this cancellation voltage is designated as the zero-suppression voltage.

1.11.2. Connection with input signals



Caution Always use an isolated BNC cable for signal input (Signal input cable 0311-5175, optional, 2m with BNC - Alligator clip). The polarity of the exterior metal in the metal-type BNC connector is minus. Do not touch while this cable is connected to the signal source. If you use a metal-type BNC cable, use under the condition that the allowable common mode voltage is less than ±42 VDC (DC or AC peaks).

NOTE Pay attention to the following points especially when recording small signals.
Do not use an input cable that is longer than required.
Use a shield wire to avoid static electricity noise.

Keep the signal source resistance as low as possible (e.g. 100 Ω or less). The lower the signal source resistance, the better the data is that can be measured.

Input signals

Caution

• Maximum input voltage
If a voltage higher than the rated voltage is input, this unit may be damaged due to internal damage such as component breakdown. Be sure not to exceed the following allowable input voltage for each input range.

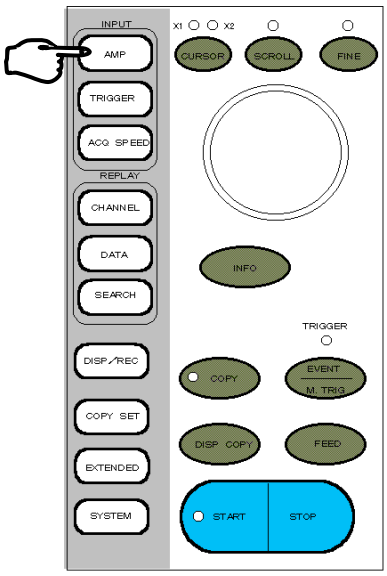
Range (V･FS)	0.1, 0.2, 0.5, 1, 2	5, 10, 20, 50, 100, 200, 500
Allowable Input Voltage (V)	100 V	500 V

• Input impedance
The input impedance is set to approximately 1 MΩ. Note that, however, if ±15 V or higher voltage is input in the range of 0.1 to 1 V FS at DC coupling, the input impedance is decreased to 15 MΩ.
• Common mode voltage (CMV)
Use an optional isolated BNC cable. In this case, use this cable under the condition of which common mode voltage is not exceeding ±300 VDC or AC peak values.

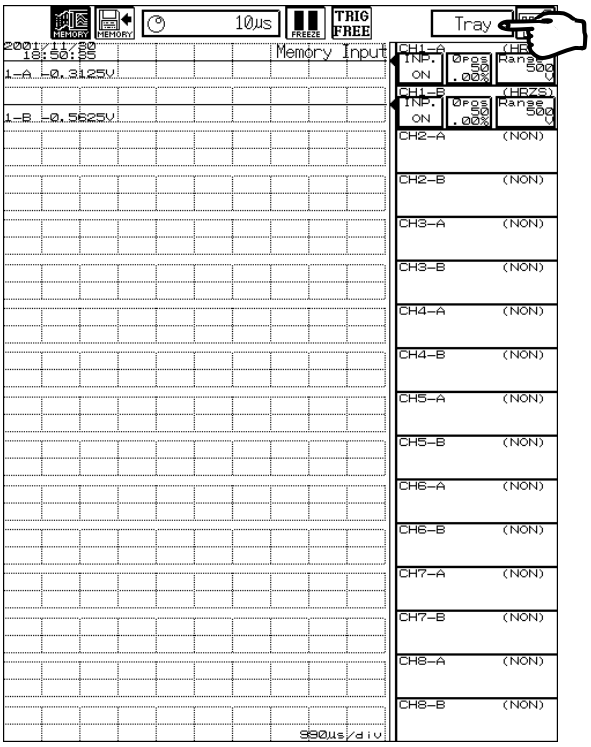
NOTE

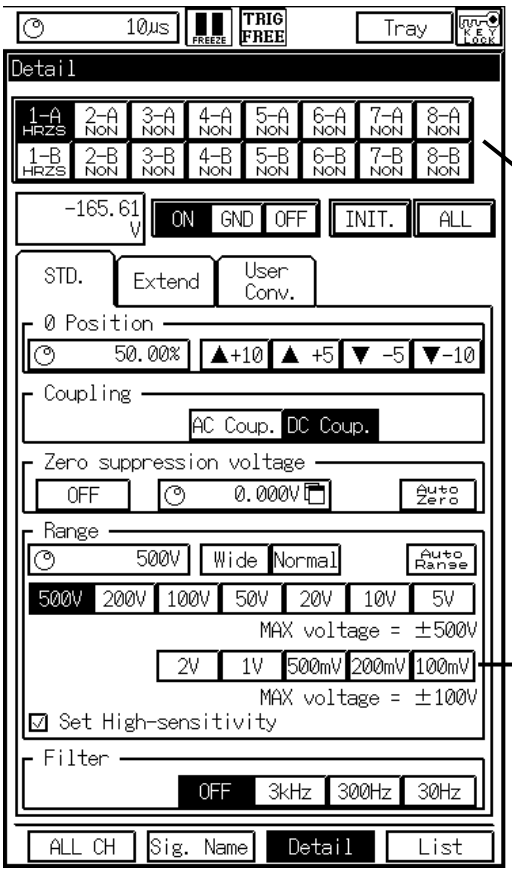
- Use a cable whose withstand voltage is at least 2 kV.
- Avoid inputting voltage over the allowable common voltage since it may cause erroneous operation and malfunction. Additionally, when common mode voltage such as pulse noise is applied to the circuit, the common mode rejection ratio (CMRR) is lowered. Accordingly, the recording may include noises in signals.
- When the range is set to 0.1 to 2.0 V FS in the AC coupling, use this amp under the condition of which the input voltage within ±30 V including the DC portion. If a signal over this voltage is input, measurement cannot be performed correctly.

1.11.3. Setting for 2CH Zero suppression amplifier units



Detailed screen is displayed when "All CH", "Signal Name", or "View" appears.



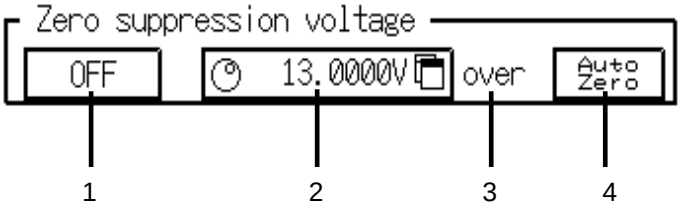


Select the channel to be set and set.

Set parameters that appear. For more details, refer to Chapter 3.

Sensitivity screen appears when "Set high sensitivity" is checked.

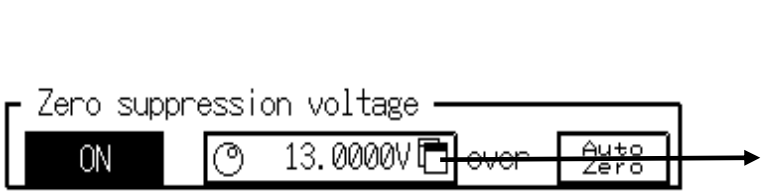
Zero suppression voltage settings

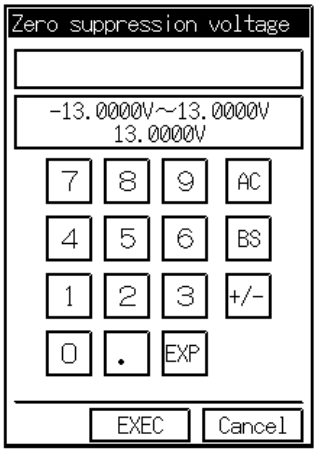


1. Sets whether zero suppression voltage is added or not. When you use the zero suppression voltage, the switch changes as [OFF] – [ON] - [OFF] with each key pressing.

TIPS Zero suppression voltage (2) and auto-zero suppression (4) are disabled, opening a Caution window during [OFF].

2. The zero suppression voltage can be set and displayed.
Use the jog-dial or ten keys. (Set the zero suppression voltage key to [ON] in advance.)





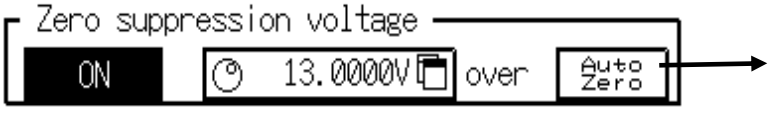
NOTE The zero suppression voltage range is as follows.

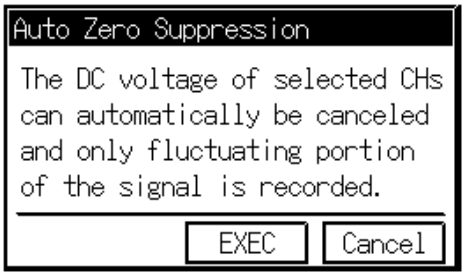
Input range (V FS)	Range can be set (V DC)	Resolution
0.1 to 2	±13 V DC	500 µV
2 to 500	±110 V DC	5 mV

3. When the measurement range is changed (changed to 0.1 to 2 V FS), OVER is displayed if the zero suppression is set to ±13 V or higher in the previous setting (5 to 500 V FS)

4. Auto-zero suppression

Sets the zero suppression voltage automatically.
(Set the zero suppression voltage setup key to [ON] in advance.)



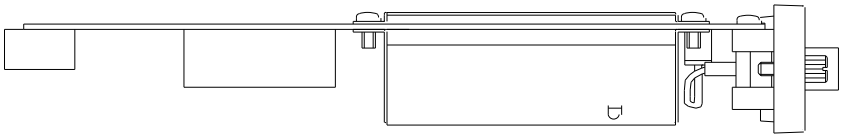


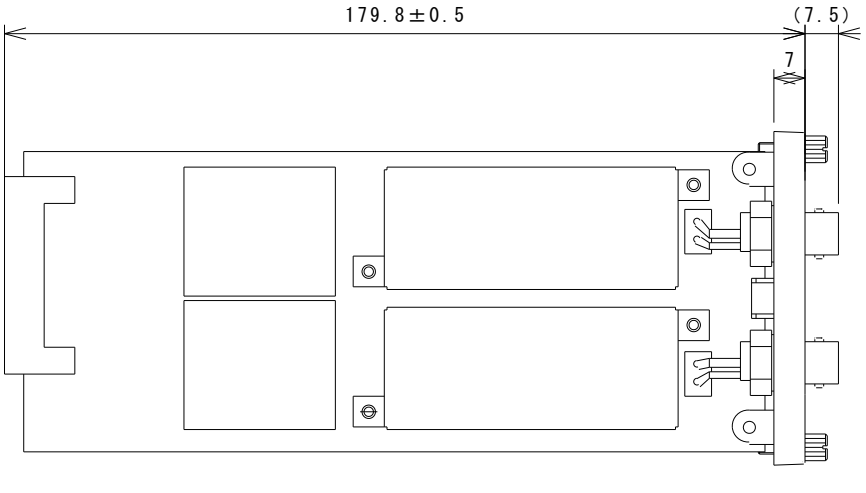
As soon as pressing the [OK] button, the zero suppression is applied to the input voltage and then the window closes.

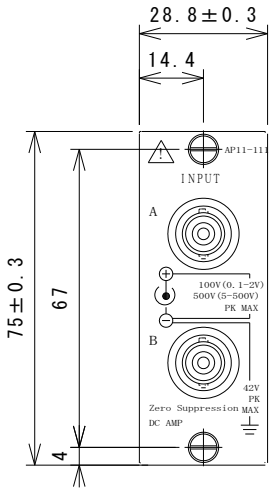
1.11.4. Specifications of 2CH Zero suppression amplifier units (AP11-111)

Number of channel	2CH/unit	
Input type	Unbalanced input (Isolation: Between channels in a unit and between a channel and case)	
Input coupling	AC coupling and DC coupling	
Sensitivity and reliability	Input range	0.1, 0.2, 0.5, 1, 2, 5V FS (at 0.1 to 5V FS and AC coupling, ±30 V or lower) 10, 20, 50, 100, 200, 500 V FS Fine function is provided for each channel Wide scale supported (±0.1 to ±500V FS)
	Reliability	±0.5% FS or lower **** at 500 V･FS, it is ±1% FS or lower***
Offset reliability	±0.5% FS or lower ****23ºC at 23ºC***	
Input impedance	1MΩ or more	
Allowable input voltage	±500 V (DC or AC peak values) **** at 0.1～2 V FS, ±100 V (DC or AC peak values)***	
Allowable common mode voltage (CMV)	±42 V for only unit (DC or AC peak values) **** When using the isolated BNC cable (Signal cable 0311-5175), 300 VAC***	
Common mode rejection ratio (CMRR)	AT DC to 60 Hz, 80 dB or more	
Frequency response	DC coupling DC to 10 kHz (+0.5, -3 dB or less) AC coupling 0.3 Hz to 10 kHz (+0.5, -3 dB or less)	
Zero suppression voltage	Suppression voltage range	0.1, 0.2, 0.5, 1,2 V FS…±13V 5, 10, 20, 50, 100, 200, 500V FS…±110V
	Setup (Display) resolution	At ±13V or ±110V, -0.5% to +0% or less
	Resolution	0.1, 0.2, 0.5, 2V FS…500 μV 5, 10, 20, 100, 200, 500 V FS…5 mV
	Temperature stability	±0.005%/°C or less (at 13-V suppression voltage)
Auto zero suppression	Auto zero suppression time: 1 second or shorter Remained voltage range: ±(Suppression voltage resolution x 10) V or less.	
Linearity	±0.2% FS or less	
Low-pass filter	2-pole Vessel: 30 Hz, 300 Hz, 3 kHz or OFF Attenuation characteristics: Approx. -12 dB/oct	
Temperature stability	Zero point: ±0.02%･FS/°C or less Range: ±0.01%･FS/°C or less	
A/D conversion	Resolution	16 bits
	Conversion time	10 μs max.
	Conversion method	Serial comparison method
Input connector	Isolated BNC connector	
Isolation	Between input terminal and ground or a channel: 1.5 kVAC for 1 min.	
S/N ratio	-46 dB or higher (at wide-range setup)	
Weight	Approx. 250g	

1.11.5. External drawings of 2CH Zero suppression amplifier units



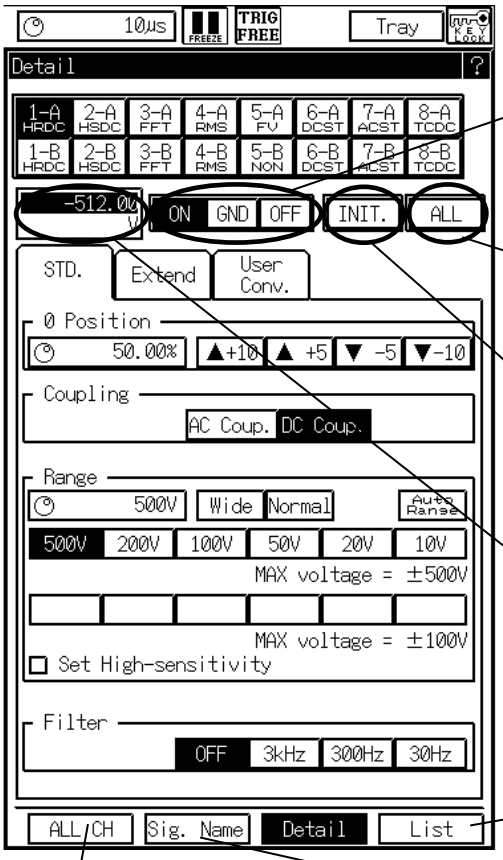




Section 2. Common settings on amplifier Detail screens

2.1. Settings of ON/OFF/GND, All and initialization of amplifier units

Produce the following settings and indications at the amp detailed screen.



ON/OFF/GND :
Select and set the on/off status of display and recording for each channel.
when you set the status at GND, the output data will be the one corresponding to zero input.

ALL :
Pressing this key and selecting multiple channels with the same type of amplifiers will enable you to set the status for all selected channels at one time.

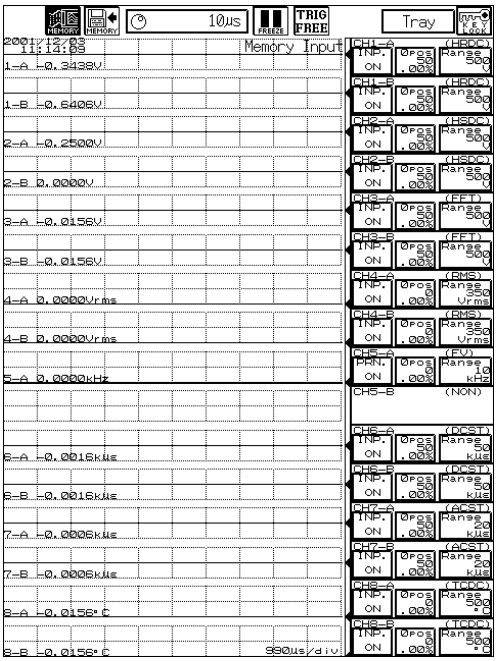
INIT.:
This key is used to set the status of individual channels at the initial condition (initialization).

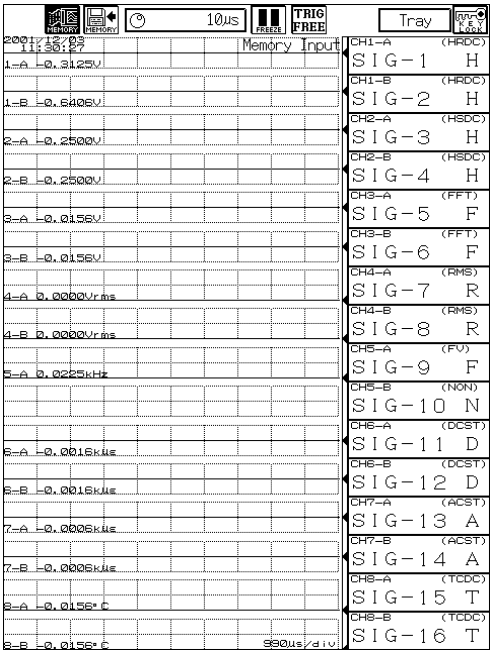
Digital display:
The input signal is displayed in the digital format. When "#" or "*" is displayed, following setting has been performed.
#: change of full scale
*: physical conversin

List:
Press this key to display the status of all individual channels at one time for each tab of【STD.】, 【Extend】and【User Conv.】

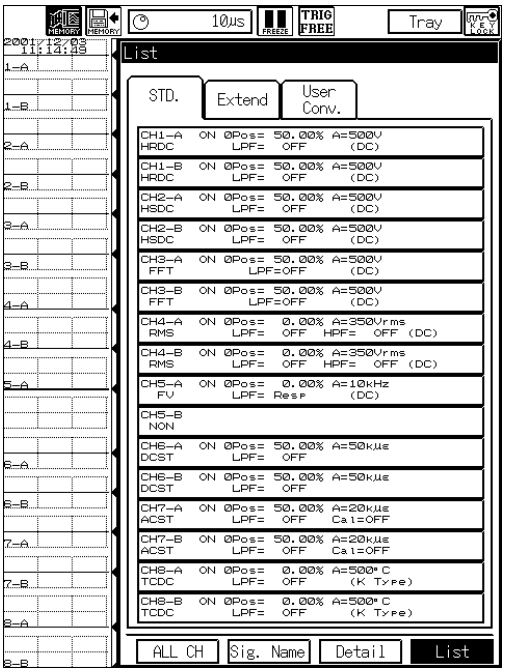
ALL CH:
Press this key to enlarge the waveform monitor display region by storing setting trays.

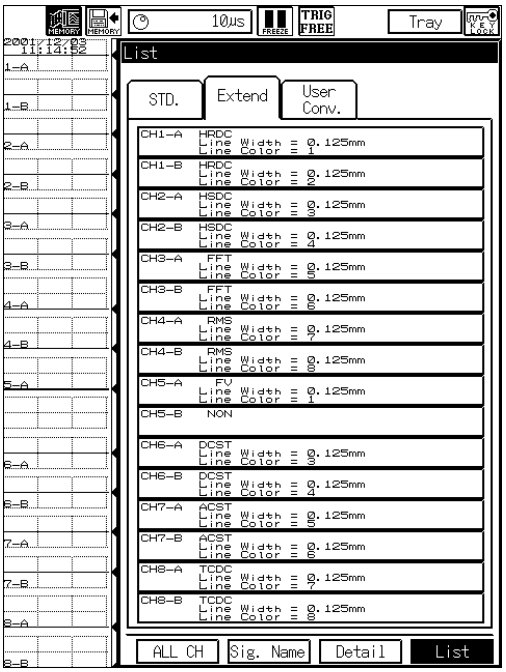
Sig. Name:
Press this key to display the signal name.

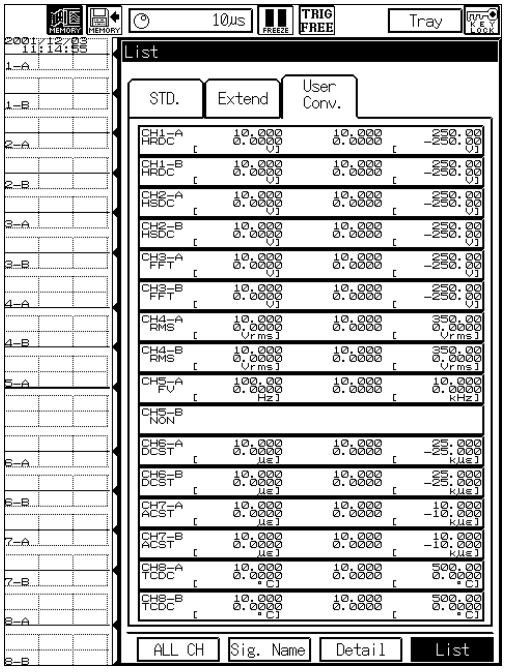




※The following shows display screens when the key [List] is pressed:



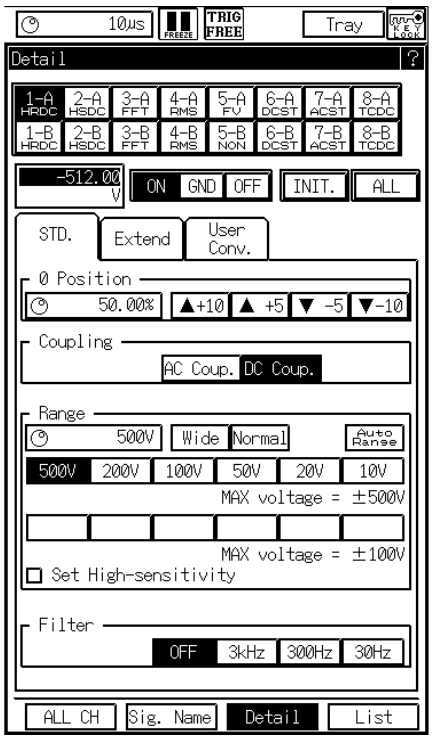




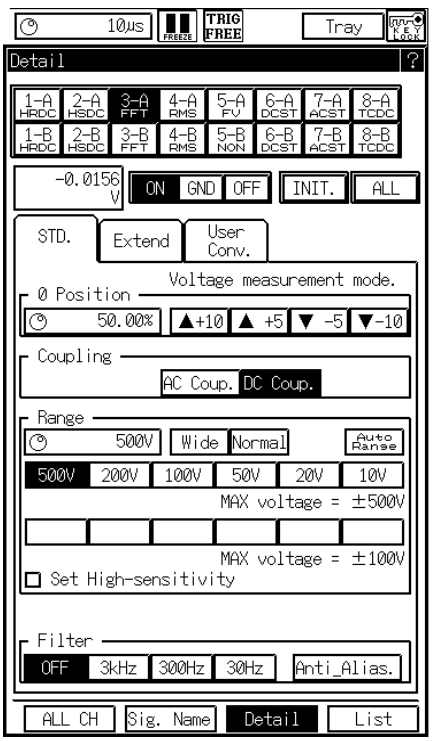
2.2. Initial status of each type of amplifier units

1. Initial status/conditions of STD. screens:

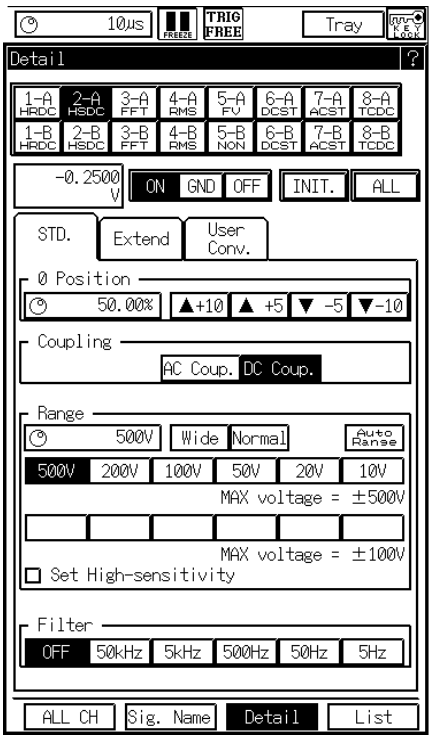
HRDC



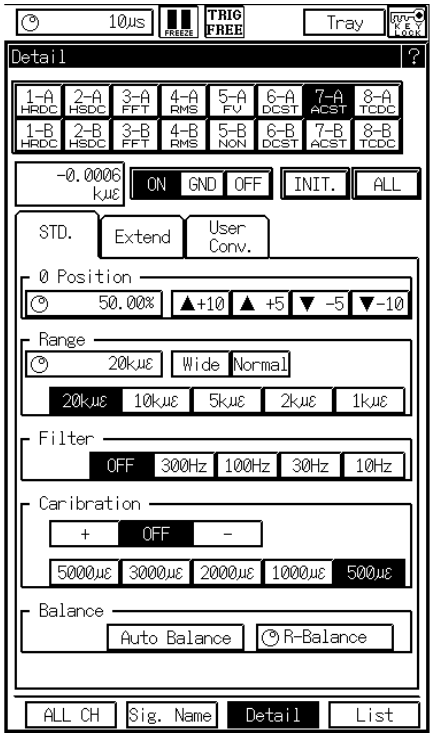
FFT



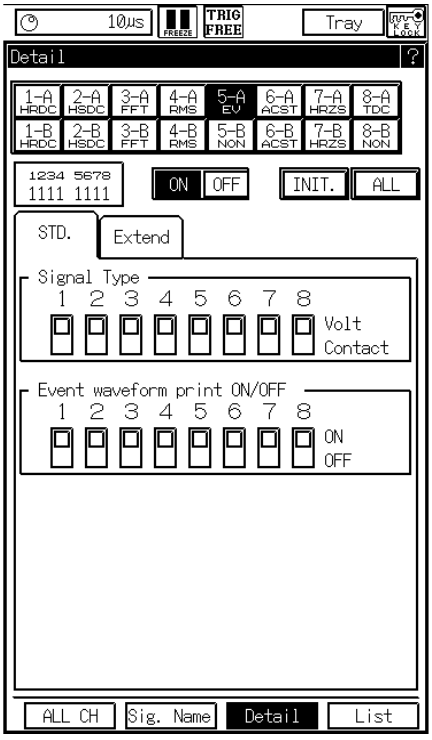
HSDC



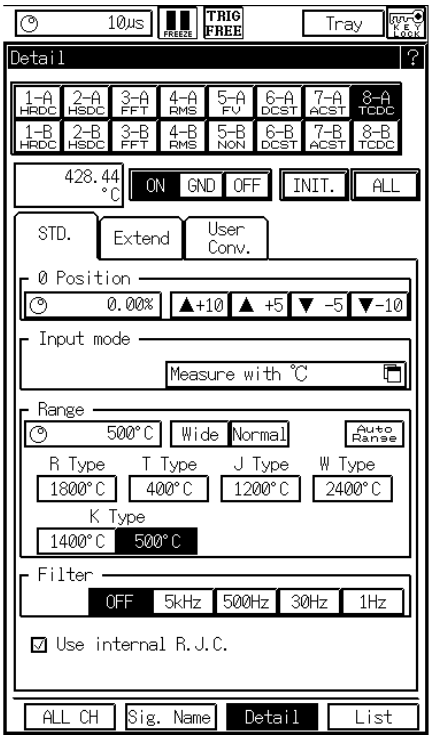
ACST



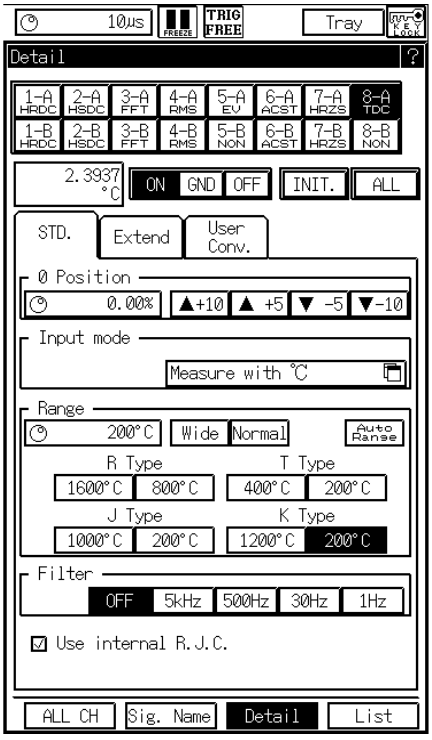
EV



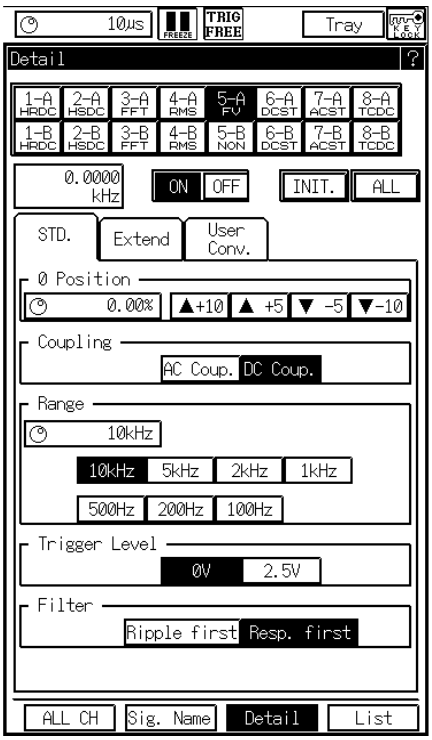
TCDC



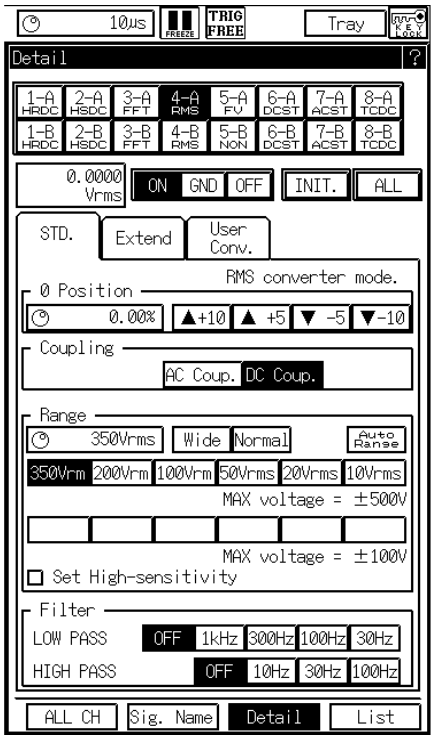
TDC



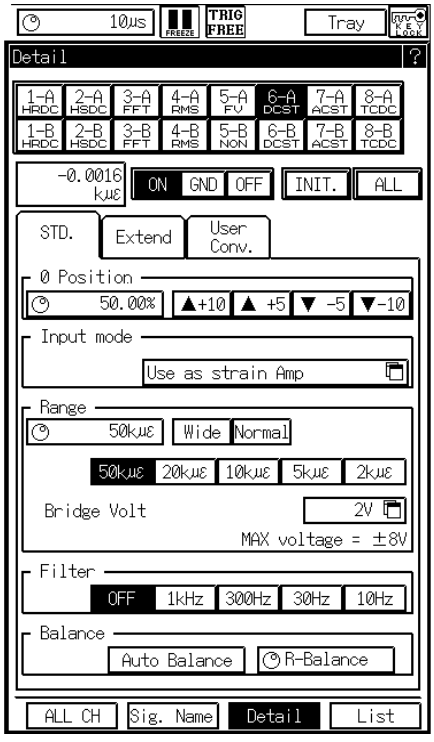
FV



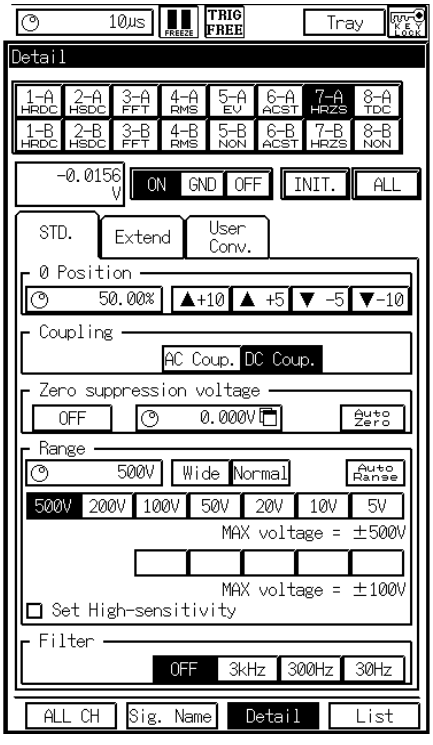
RMS



DCST

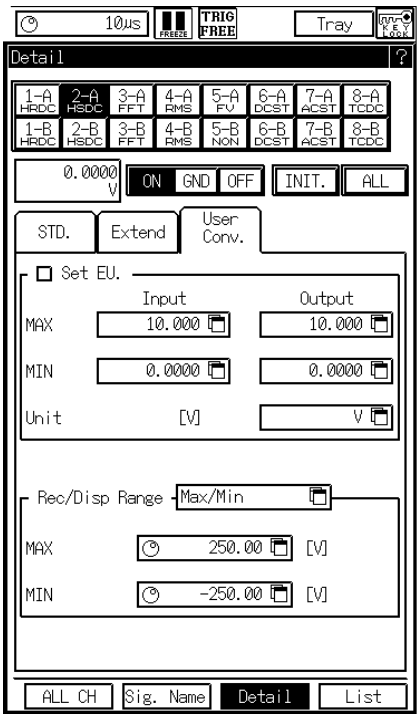


HRZS



2. Amplifier Detail - Initial status/conditions of User Conv. screen

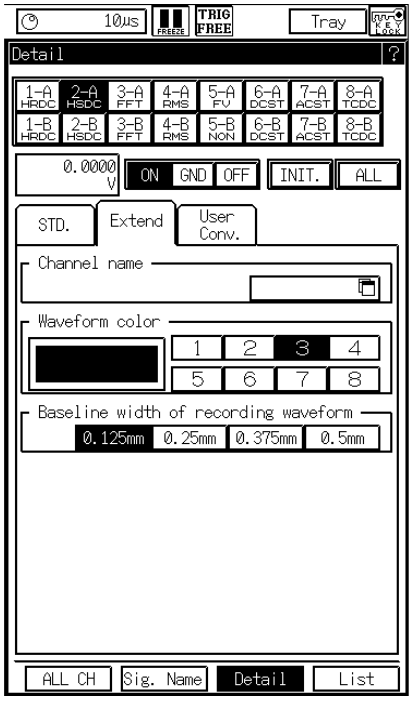
(example) ＨＳＤＣ



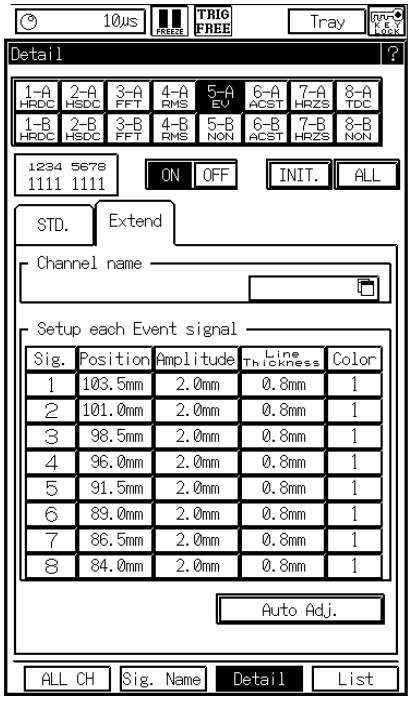
3. Amplifier Detail - Initial status/conditions of Extend screen

(example)

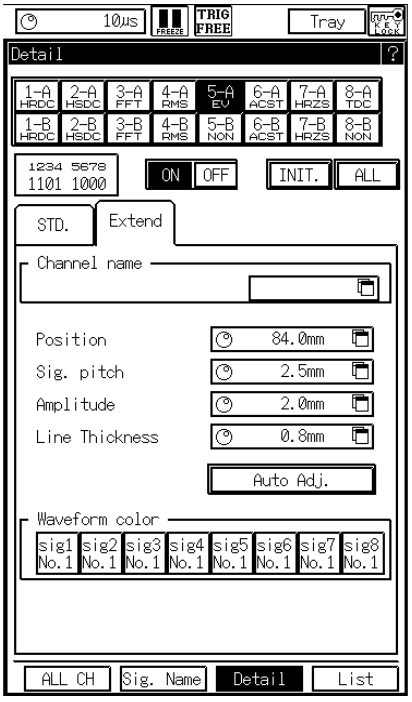
ＨＳＤＣ



ＥＶ (RA1100,RA1200)



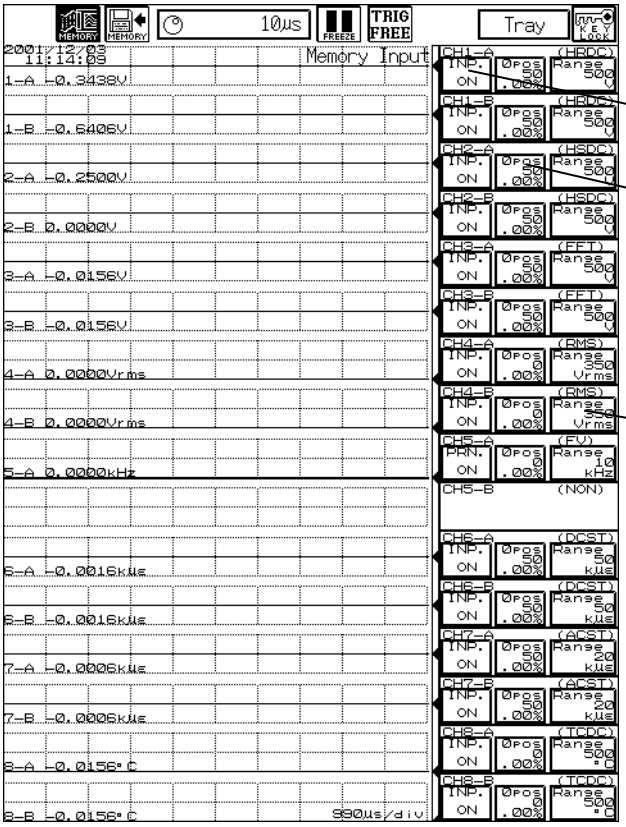
ＥＶ (RA1300)



Section 3. Common settings for individual amplifier units (amplifier STD. screen)

1. Input setting - amplifier screen

Press the key of either [AMP] or [Tray] to display the input setting - amplifier screen.



①Press the key to set the input status of ON/OFF(/GND).

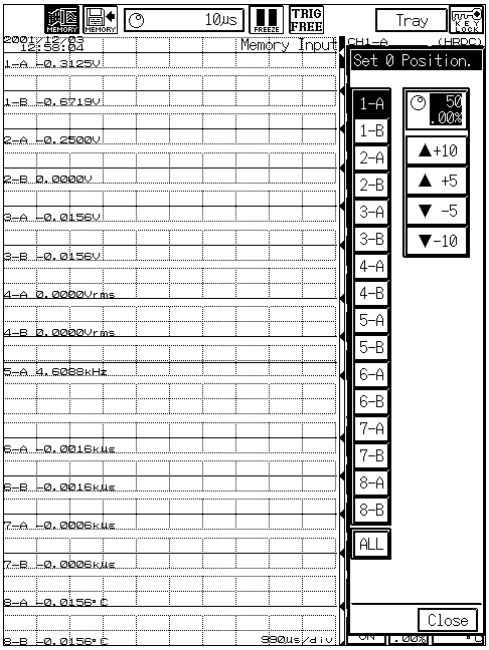
②The key is used to set the position of zero (0).

Once the key is pressed, settings will be done by using the jogdial. Press the key again to display the setting screen② as shown below.

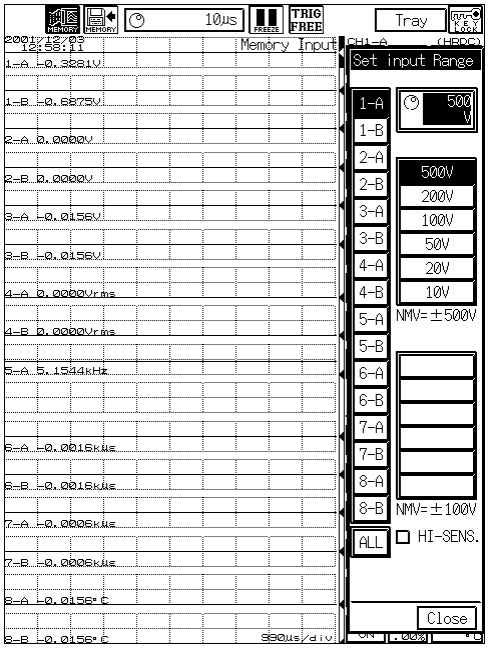
③Range setting

Once the key is pressed, settings will be done by using the jogdial. Press the key again to display the setting screen③ as shown below.

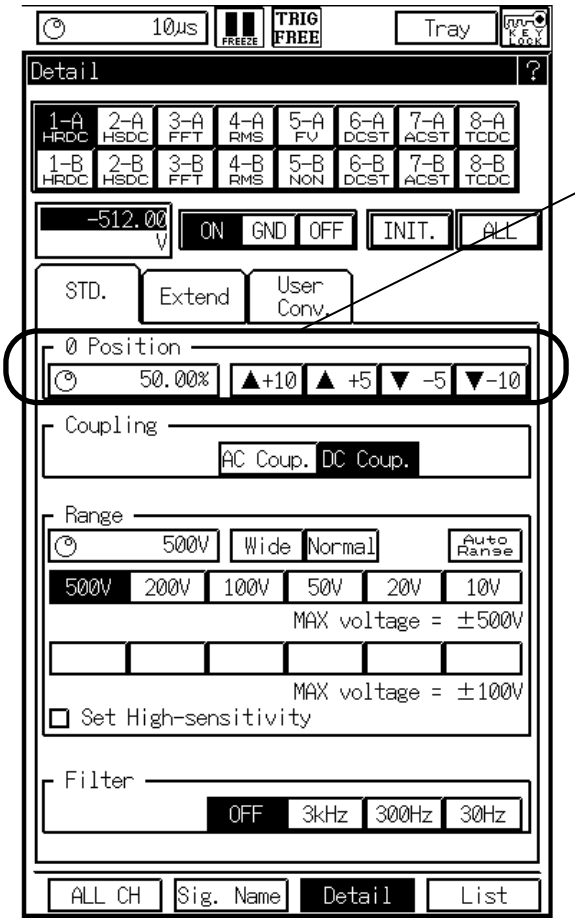
Setting screen② (zero(0) position setting)



Setting screen③ (range setting)

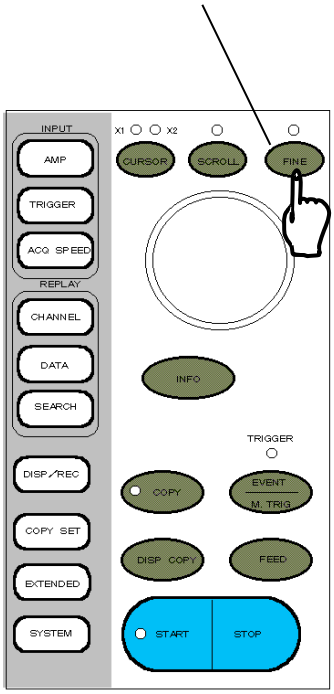


2. Zero (0) position



The zero (0) position is defined as the position of the waveform display and recording when an input equivalent to “GND” is provided at the input terminal.
Press one of the buttons to change the position in steps of 5% or 10% and/or use the jogdial to change it in steps of 1%, where the full scale refers to 100%.

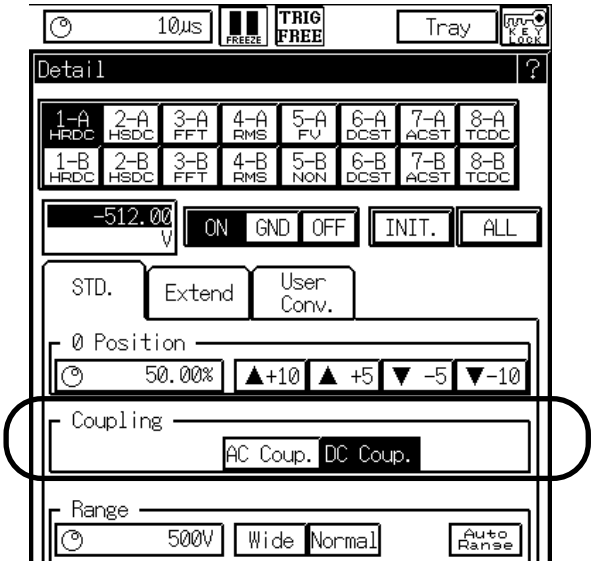
Select the zero position window and press the button of “Fine” to change the setting step (increment/decrement) of the jogdial into 0.05%.



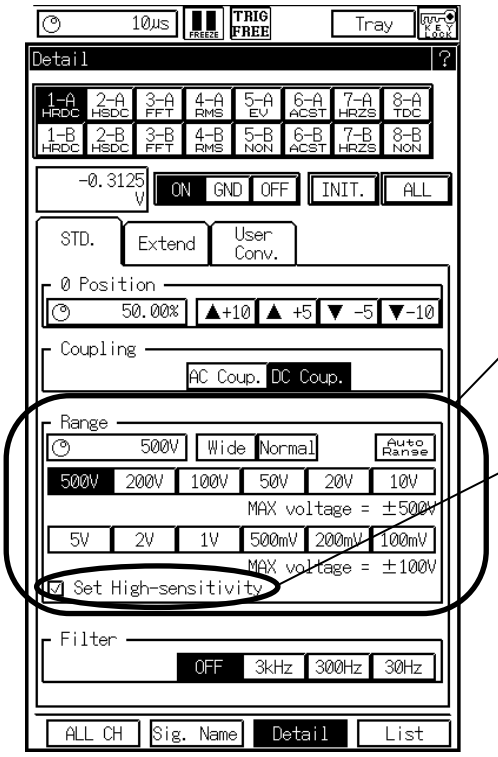
3. Input coupling (AC coupling, DC coupling)

The amplifier units listed below have provisions of changing the type of input coupling.
The setting at the AC coupling provides a capability of data recording with DC components excluded from the input signal.
The DC coupling provides input data recording without signal processing

- 2CH high-resolution DC amplifier units
- 2CH FFT amplifier units
- 2CH high-speed DC amplifier units
- F/V converter units
- 2CH vibration & RMS amplifier units



4. Range setting and high sensitivity setting

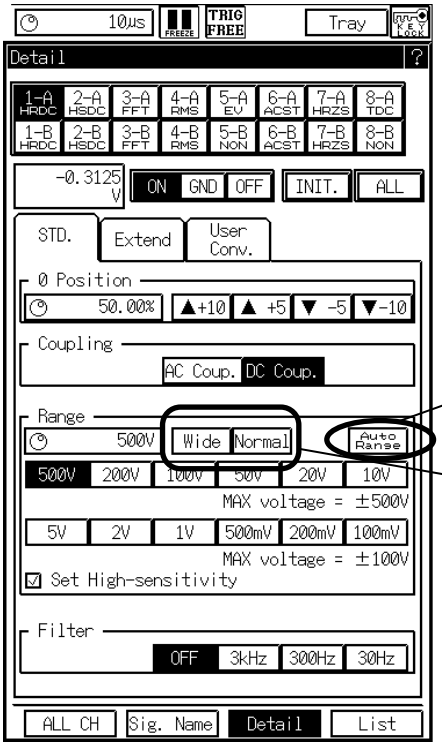


Range:
Range setting can also be done by using the jogdial.

Changing the input range to any one of 5V - 100mV ranges while the input voltage is 100V or more would lead to amplifier failures and/or providing adverse effects on the signal source.
Provision is incorporated in some types of amplifier units to prevent human errors as mentioned above, so that you can set at one of the ranges of 5V - 100mV only after checking "Set High-sensitivity"
The following amplifier units have such provisions:

- 2CH high-resolution DC amplifier units
- 2CH FFT amplifier units
- 2CH high-speed DC amplifier units
- 2CH vibration & RMS amplifier units

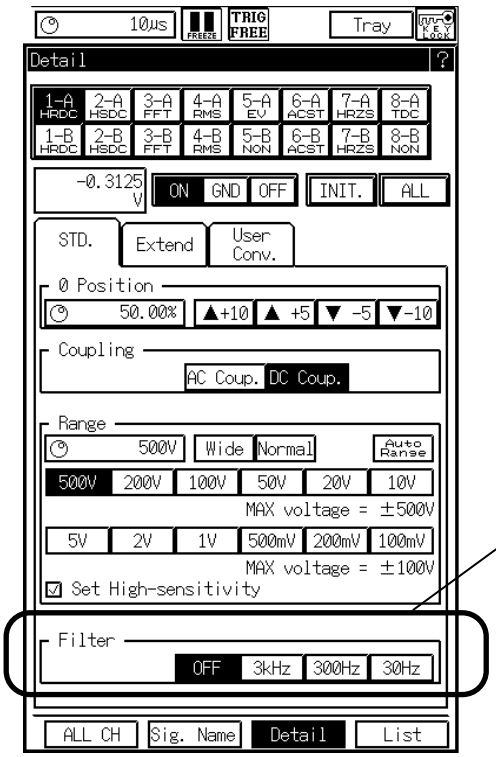
5. Wide/normal settings and autorange



Auto Range:
The key provides automatic range setting according to the input signal.

Wide/Normal:
Press the key and set at "Normal" in the 5V input range to display or record the waveform in the voltage range of -2.5V and +2.5V.
Set at "Wide" in the same input range to display or record the waveform in the voltage range of -5V - +5V.

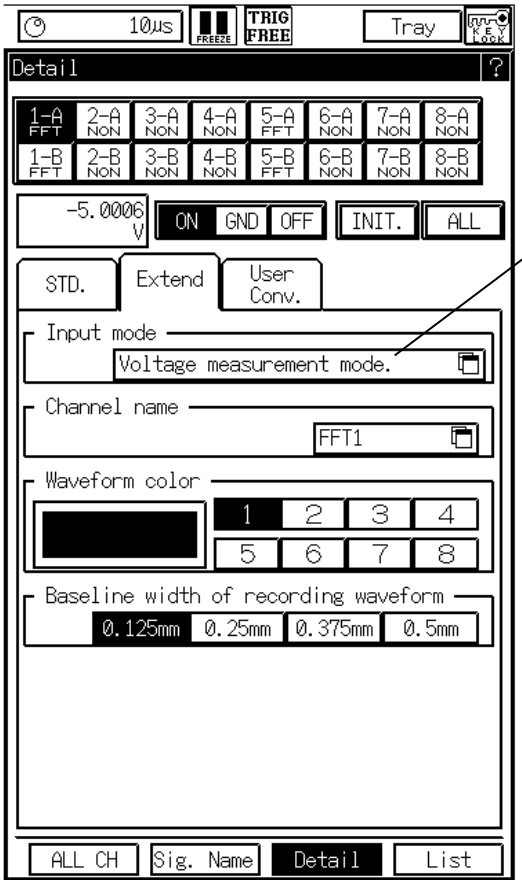
6. Filter setting



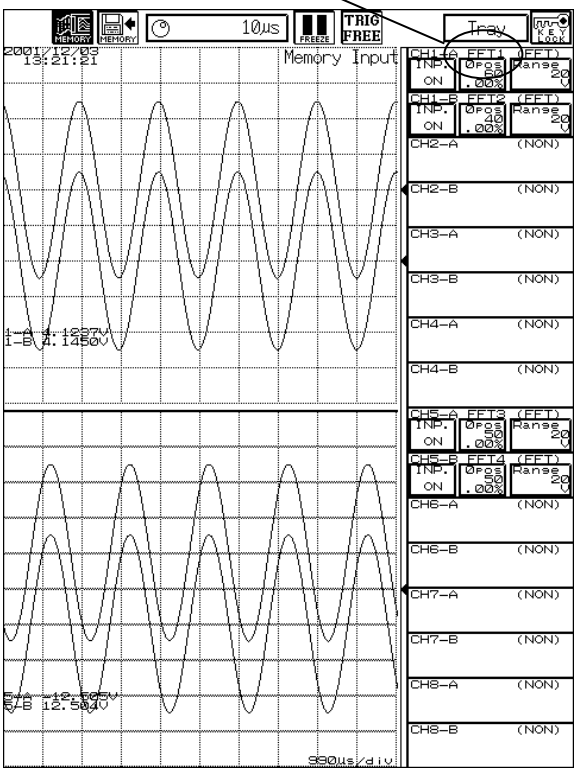
Filter:
You can set the filter for individual amplifiers.
The expression of “Filter” indicates low pass filters.
Note that other types of filters than low pass filters are provided as follows:
High pass filters for 2CH vibration & RMS amplifier
Anti-aliasing filters for 2CH FFT amplifiers

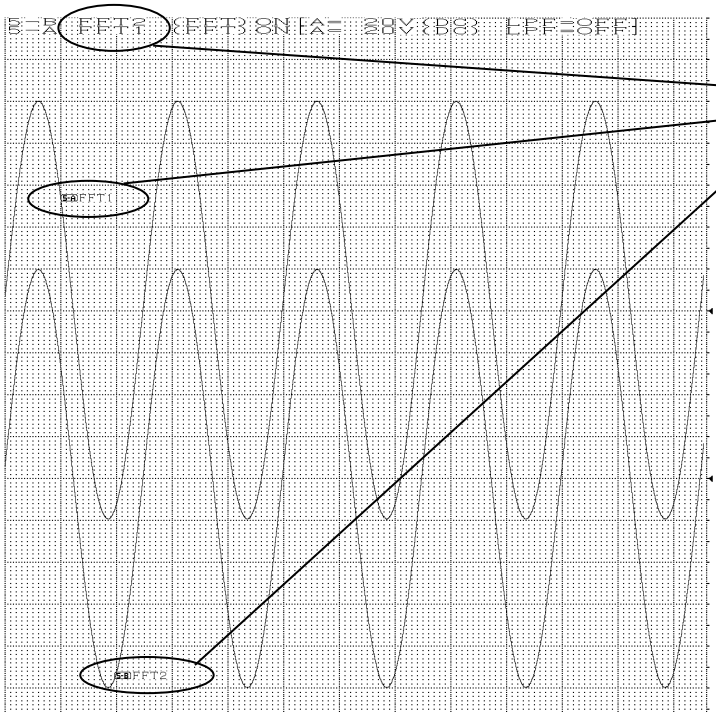
Section 4. Extend setting

1. Entry of channel names (signal names)



Enter up to four(4) arbitrary characters for each channel to set the signal name.
You can see and confirm the signal name in the "ALL CH" screen.

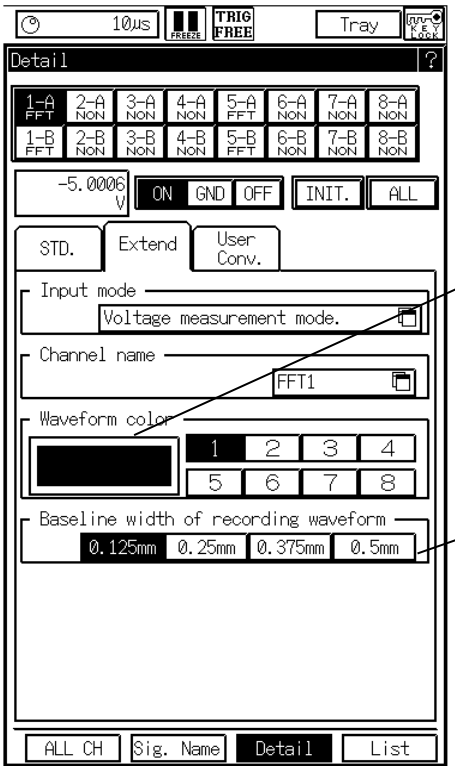




In RA1200 RA1300, signal names are printed in the waveform records as channel annotation during waveform recording.
The signal names are printed together with channel numbers.

2 Setting of waveform display colors

3 Setting of Baseline width of recording waveform

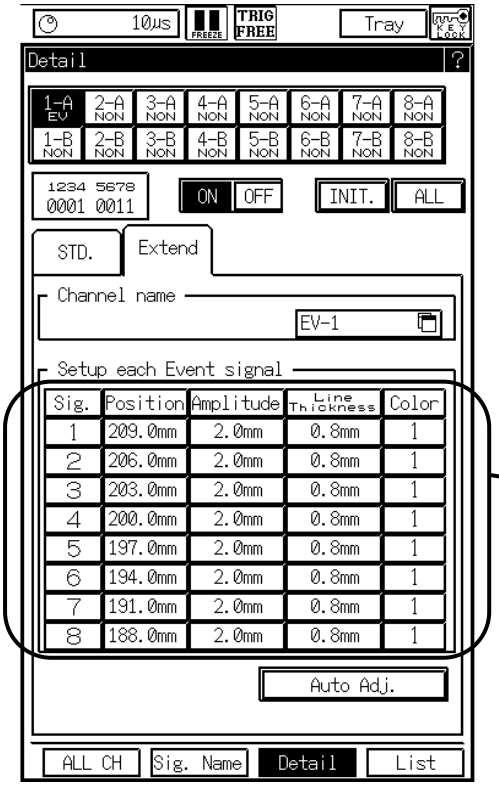


Waveform color:
You can select waveform display colors in the screen for individual channels from eight (8) color selections.

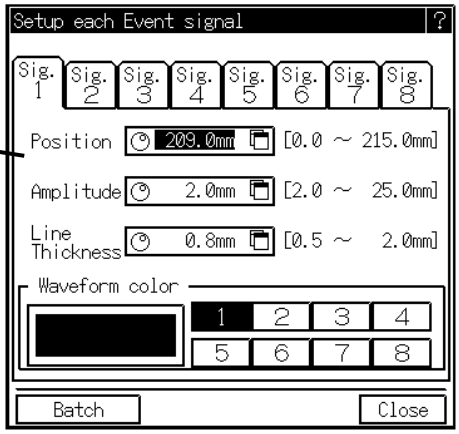
Baseline width of recording waveform:
When recording signal waveforms by RA1200, you can select and set waveform line-widths for individual channels.

4. Change of recording position and amplitude for event amplifier <u>RA1100, RA1200</u>

For event amplifiers, you can set recording/display positions, amplitudes, baseline widths and colors for individual signals. Setting of display/recording positions should be done according to the definition of 0 mm for the top position and 200 mm for the bottom position of the waveform display screen.



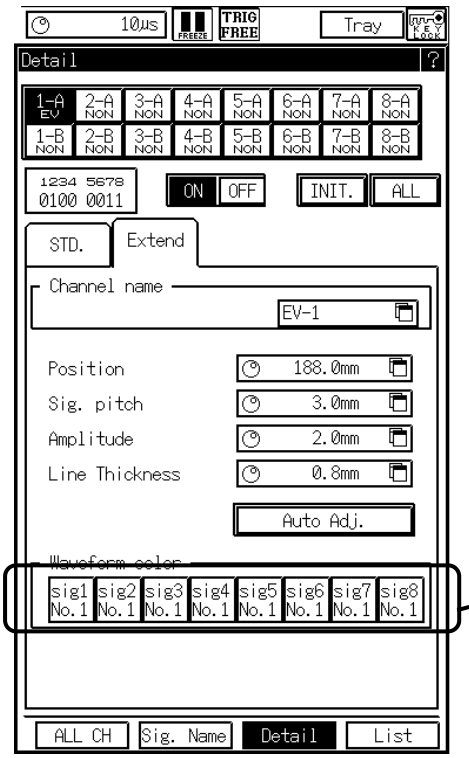
Press channel to change.



RA1300

Recording position, pitch of signals, amplitude, recording line thickness and display color of signals can be set.

Recording position sets distance from lower edge to low waveform of No.8 signal on the screen (waveform recording).

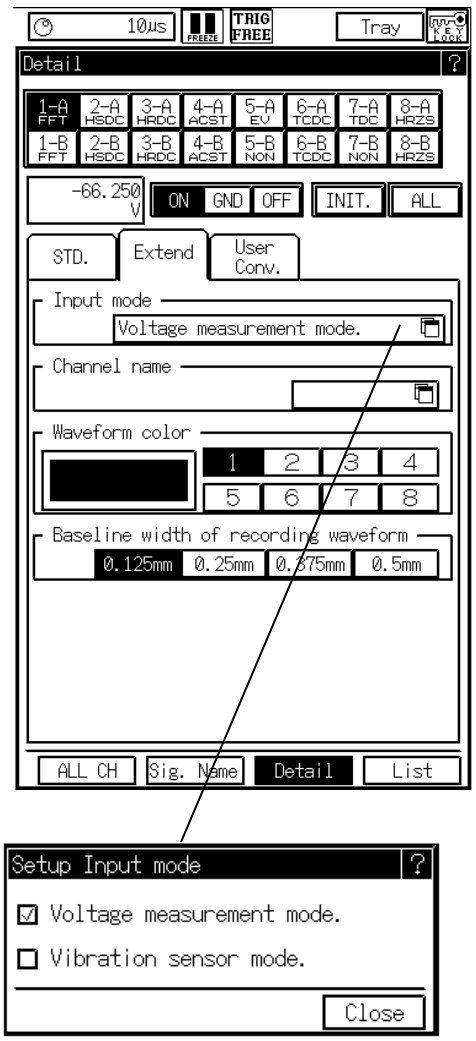


Display color of waveform changes every pressing key of each channel.

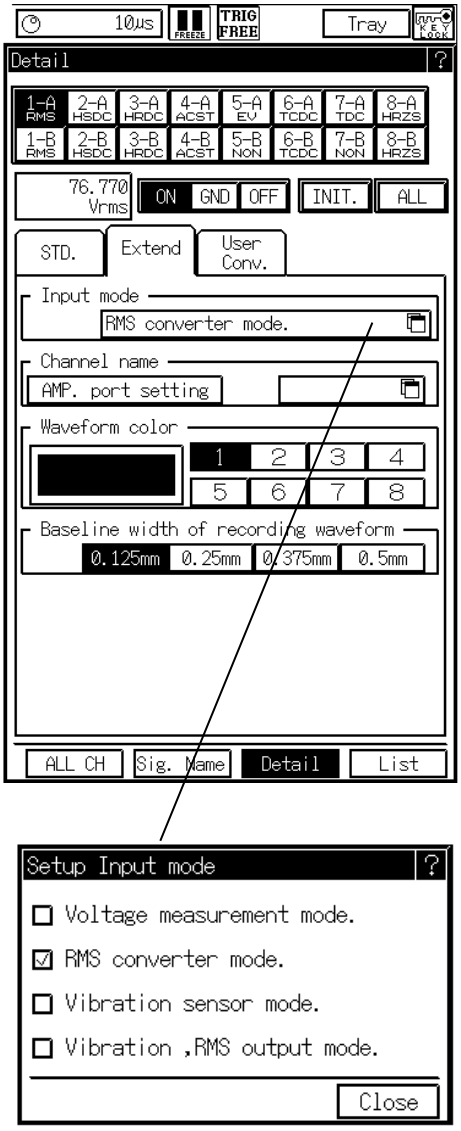
5. Switching/change of input mode

Set the input mode in the Extend screen for 2CH FFT amplifiers and 2CH vibration & RMS amplifiers.

For 2CH FFT amplifiers:



For 2CH vibration & RMS amplifiers:



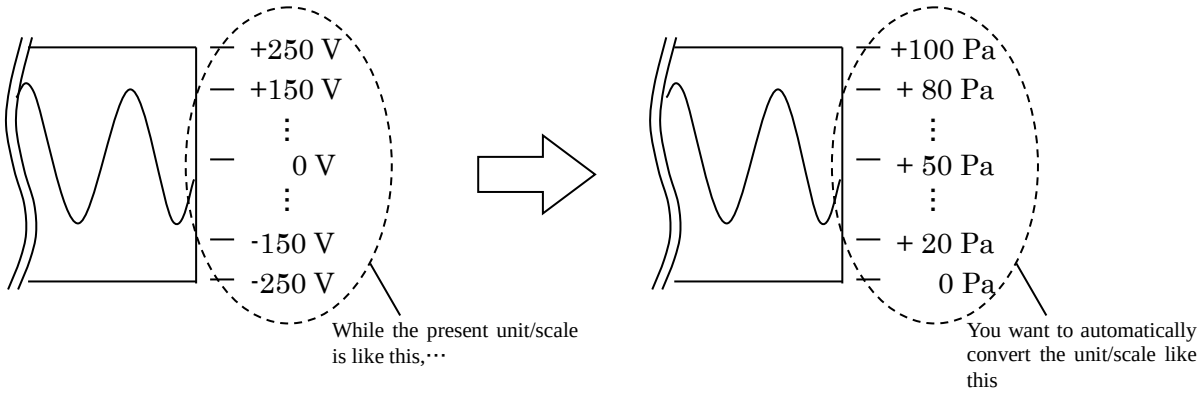
5. User Conv.

～ Conversion of waveform amplitudes and units～

◆ The capabilities of physical value conversion involves those of converting the raw unit of input signals into physical values or into arbitrary characters as well as the full scale, i.e., the amplitude of waveform recordings, into different ones. (Event amplifier units are excluded.)

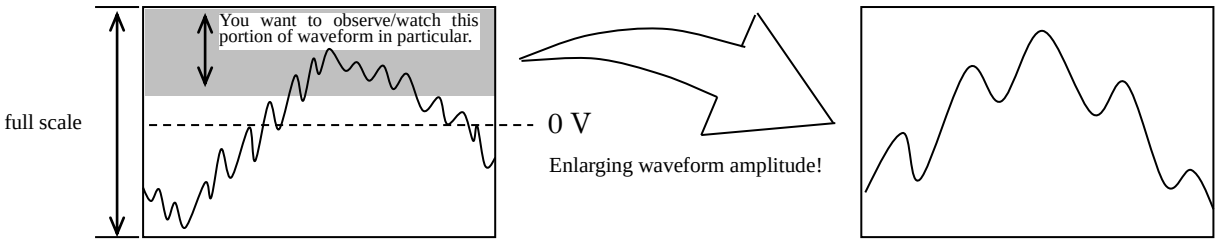
●Performing physical conversions

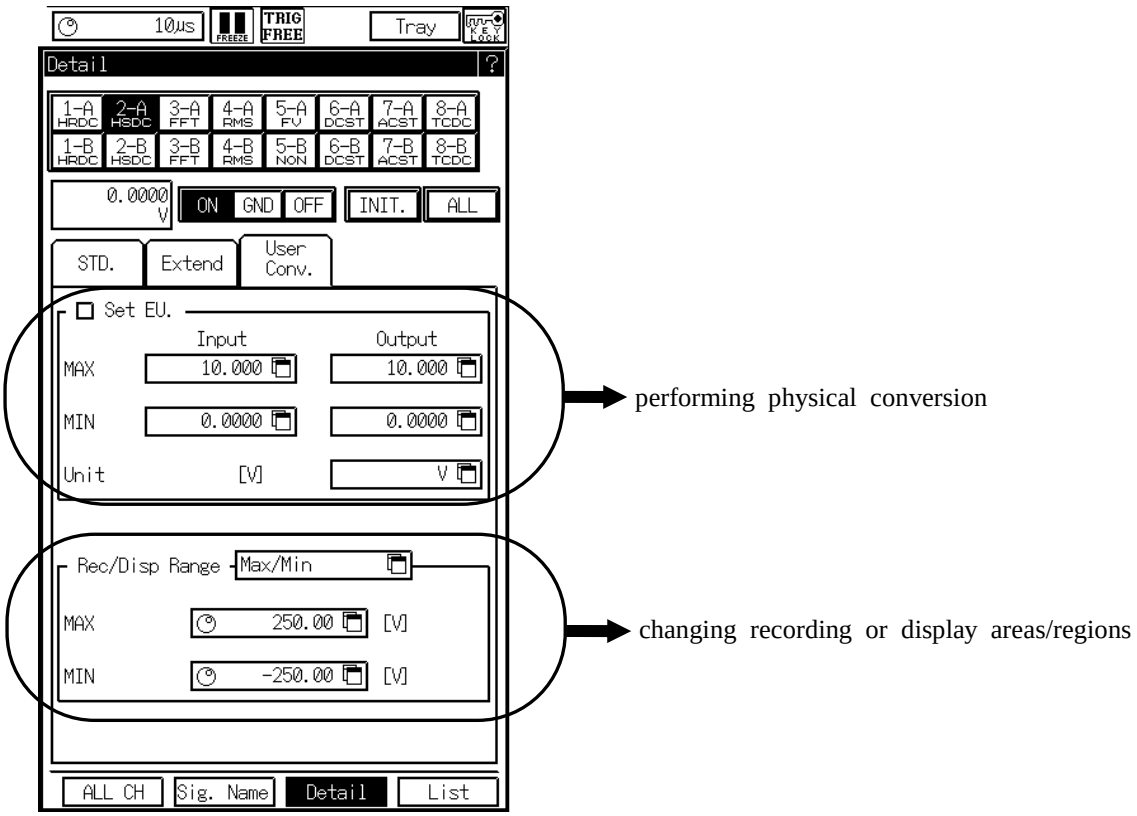
By using the conversion capability, you do not need to manually convert the physical unit, since the unit is automatically converted into the desired one



●Changing recording or display areas/regions

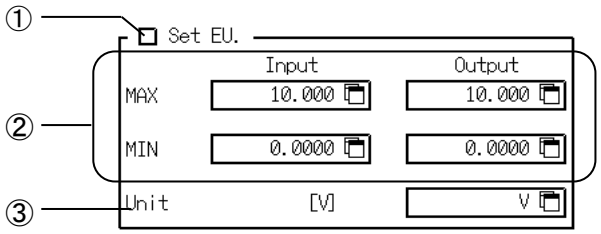
By using the capability of changing the amplitude of waveforms, you can enlarge and observe only a required portion of the waveform.





5.1 How to do User Conv.

Change the magnitude of the unit so that the desired portion of the input signal can be seen exactly within the full scale.

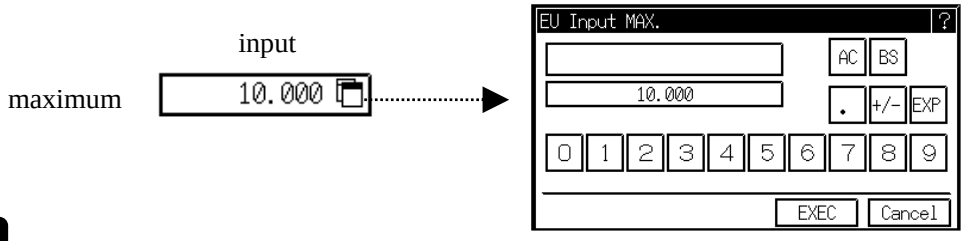


①Using physical conversion

The check box is used for choosing whether or not you want to convert the scale. Check the box when you want to convert the scale. Checking the box leads to activation of setting capabilities of ② and ③ in the illustration above, and the mark of "*" is displayed in the digital value display areas.

②Setting input and output

This area is used to set the maximum/minimum values for the input signal as well as the maximum/minimum values for the converted output values.

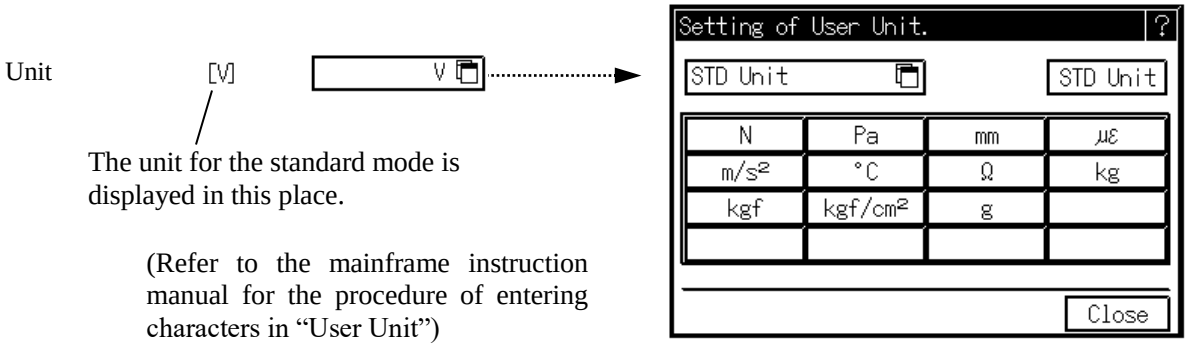


TIPS

- You can invert the maximum/minimum values of the output in polarity.
- Changing the maximum/minimum values of the output leads to automatically setting the recording scale at the same values as the maximum/minimum values of the output.
- You cannot enter, in the minimum value box of the input or the output, any such numerical values that are larger than the maximum value (i.e., to turn to the inverted scale).
- The range covered by the maximum/minimum values of the input cannot exceed the maximum permissible input values of individual input units concerned.
- The resolution of the maximum/minimum values of the input to be set is 1/1000 of respective input sensitivity ranges. If you enter any value with a fraction for the maximum/minimum value for the input, the fraction is omitted for the setting.
- The difference (span) between the maximum/minimum values to be set shall be no less than 1/10 of respective input sensitivity ranges. If you enter any values that provides a span smaller than this limit, the span is automatically set to the lowest limit.

③Unit

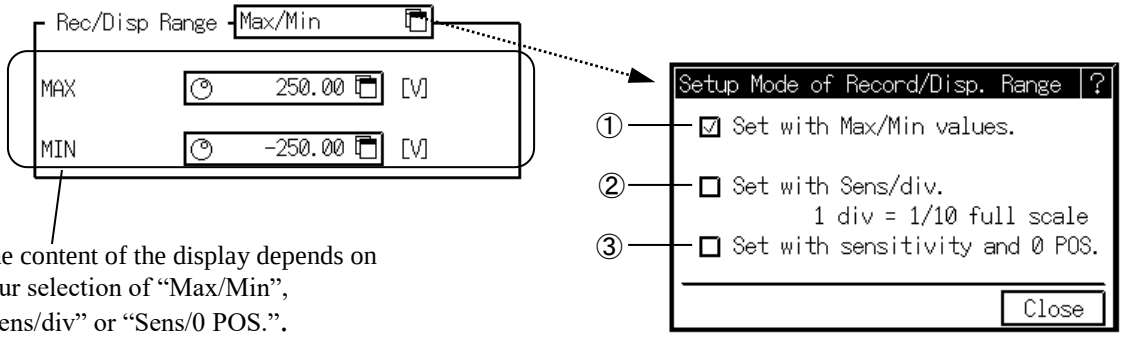
This box is used to set the unit of output conversion values. Press the window mark to open the window "Setting of User Unit" as shown below. Check a check mark at the check box ☐ for the unit you want to use. You can enter up to a maximum of nine(9) characters in "User Unit".



(Refer to the mainframe instruction manual for the procedure of entering characters in "User Unit")

5.2 Recording/Display range

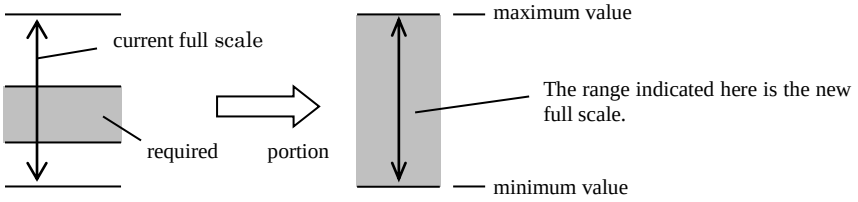
Further, you can scale (enlarge) a desired portion of the output signal range that has been set with the maximum/minimum values.
Three modes are available for setting the record scaling as described below.



The content of the display depends on your selection of "Max/Min", "Sens/div" or "Sens/0 POS.".
When changing the numerical value, "#" is displayed in part of the digital display.

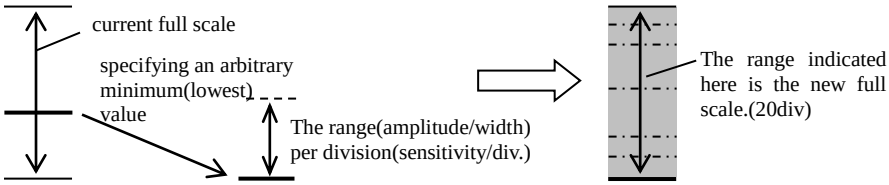
①Setting with maximum/minimum values

A desired (new) full scale is obtained by newly setting the maximum and minimum values to cover the required portion from within the range of the current full scale setting.



②Setting with sensitivity/division (Sens/div)

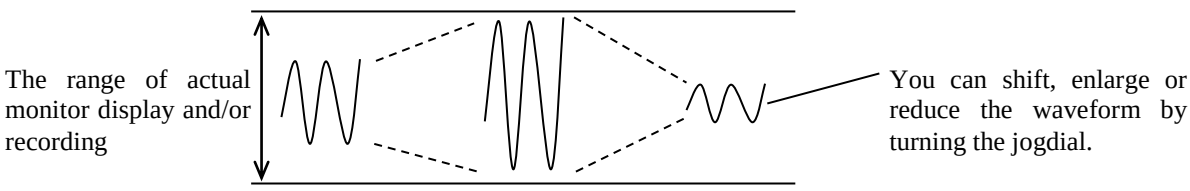
A desired full scale is obtained by newly specifying/setting the minimum(lowest) value for the desired portion from within the range of the current full scale setting and also the amplitude/width per division that you want.



T I P S When display unit form is set to Sensitivity·FS, setting amplitude value per 1div here and displaying amplitude value per 1div are not matched. In order to match them, set display unit form to Sensitivity / div.
(Refer 14.2.10 in Instruction Manual of the Mainframe.)

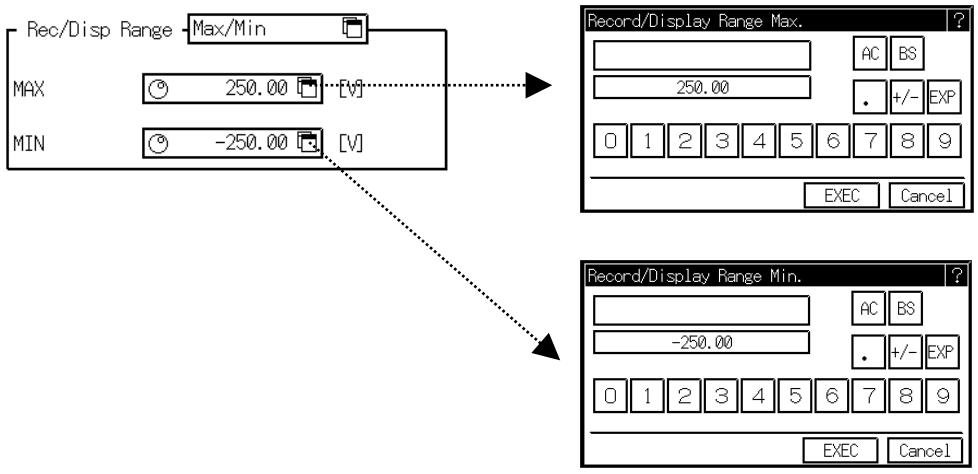
③Setting with sensitivity/zero(0) position

This mode provides you with a simple and easy method of shifting, enlarging or reducing the waveform amplitude.



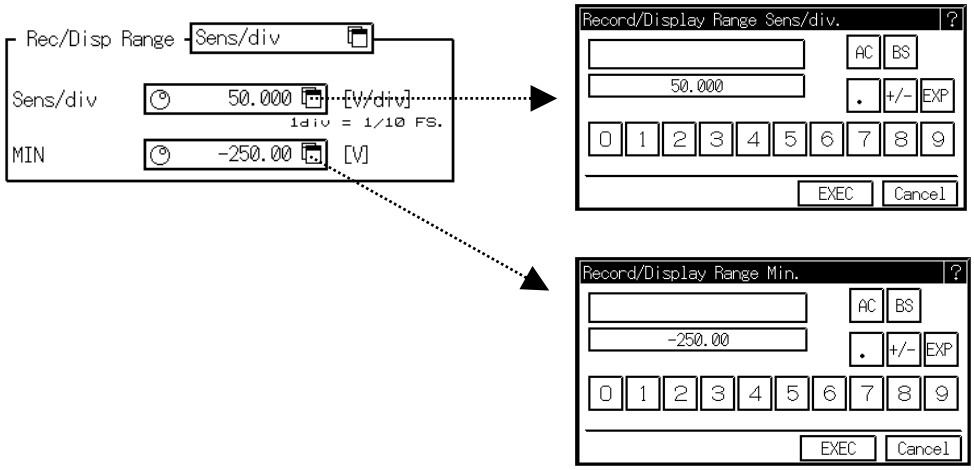
5.2.1 How to set the Recording/Display range with maximum/minimum values

Specify the desired maximum/minimum values for record scaling as shown in the display figures below.



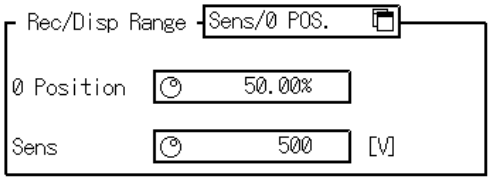
5.2.2 How to set the Recording/Display range with sensitivity/division (Sens/div)

Specify the desired sensitivity per division as well as the desired minimum value as shown in the display figures below.



5.2.3 How set the Recording/Display range with sensitivity/zero(0) position

Set an appropriate parameter by turning the jogdial after pressing “0 Position” or “Sens” as shown in the display figure below.

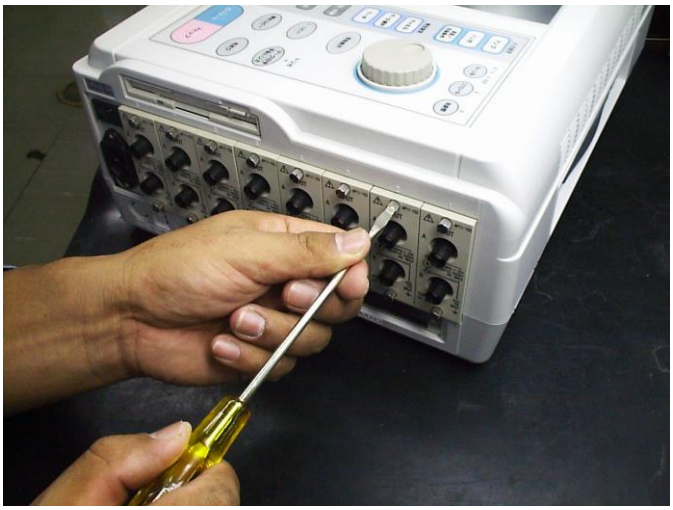


Section 6. Procedures for changing amplifier units

Amplifier units can be changed easily, since they have plug-in mounting structure.
However, mount or dismount amplifier units, only after you have turned off the power supply switch and disconnected the power supply cable from the mainframe.
Mounting or dismounting amplifier units while the mainframe is powered on would lead to damages to the mainframe, Omniace II.
Be sure to change amplifier units after confirming the power supply switched-off by all means.

The following describes the procedure of changing amplifier units by taking a sample of the second amplifier unit at the second right position as seen from the mainframe front.

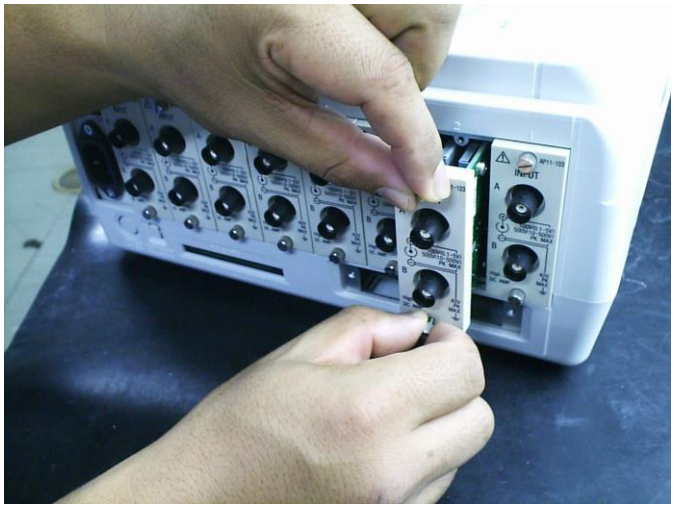
①Turn off the power supply switch.
②Disconnect the power supply cable from the mainframe.
③Disconnect all input cables that are connected to individual amplifier units.
④



Confirm that the power supply of the mainframe is off.
By using a flat tip screw driver, turn the two(2) screws at the top and bottom positions of the amplifier unit which are fixing the unit to the mainframe. (The flat tip screw driver should have the tip thickness of no more than 0.65 mm.)

Turn the screws until they comes off the mainframe. (Be careful that screws might come off the amplifier unit if you turn them too much.)

⑤



Hold between your fingers the two screws at the top and bottom of the amplifier unit, and draw the unit of the mainframe toward yourself.
Thus, you can easily take the amplifier unit off the mainframe.

The mounting procedure for the amplifier unit is just the reverse of the above.
Tighten the screws firmly by all means using a flat tip screw driver.
Operations of mounting amplifier units should also be done after switching off the mainframe power supply.

⚠WARNING Always keep blank panels inserted/mounted at individual vacant slots for input amplifier units to prevent electric shock and also to prevent the mainframe from potential damages due to foreign matter penetration.

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