



BIPOLAR AMPLIFIER

**As-161-30/60**

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INSTRUCTION MANUAL



DA00009311-002

BIPOLAR AMPLIFIER

# **As-161-30/60**

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**Instruction Manual**

**NF Corporation**



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## Forward

We appreciate your purchase of As-161-30/60 BIPOLAR AMPLIFIER. At the outset, please take a few minutes to read the Safety Precautions indicated in this manual in order to use this equipment safely and correctly.

### ———— Safety Precautions ————

Observe the following warnings and cautions in order to use this equipment safely. No responsibility or warranty is assumed for damages arising from use in a manner contrary to these warnings and cautions.

This product is classified as Class I equipment for insulation standard (with a protective conductor terminal) according to IEC.

#### ● Observe the instructions herein

This manual has been compiled in order to enable safe operation and use of this equipment. Be sure to read this manual before using the equipment.

All the warning items in this manual are described for prevention of serious physical hazards. Be sure to observe them carefully.

#### ● Be sure to connect to ground

Since the unit includes a line filter, there is risk of shock if used without grounding.

To prevent electric shock, securely connect the equipment to a ground providing a resistance to ground of 100 ohms or less according to the electrical installation technical standard.

#### ● Confirm power supply voltage

This equipment operates at a supply voltage described in “Grounding and power supply connection” in the instruction manual.

Before connecting this equipment, check that the proper voltage is being supplied to the wall power outlet.

#### ● Smoke, odor, noise

In the event of smoke, off odor or noise, immediately disconnect the power supply and avoid further operation.

Whenever such an abnormality occurs, prevent the equipment from being used until it is completely repaired and immediately contact us or our sales agency.

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● **Flammable gas**

Do not use this equipment in the presence of flammable gas. There is danger of fire and explosion.

● **Do not remove the cover.**

Never remove the cover since this product contains some high-voltage parts. When the internal check is necessary, our qualified service engineer only is allowed to perform the service.

● **Do not modify**

Do not use parts other than specified by the manufacturer and by no means attempt to modify the equipment. There is risk of personnel hazard and damage to the equipment. The manufacturer reserves the option of refusing service in such cases.

● **Safety related symbols and indications**

Followings are general definitions of the symbols and indications used on the product and manual.



**Reference symbol for instruction manual**

Advises of possible hazard to the user, as well as the need to consult this manual.



**Symbol indicating danger of electric shock**

This symbol is posted in places posing danger of electric shock under particular conditions.



**Protective grounding terminal symbol**

This symbol appears on a terminal that needs to be grounded to prevent electric shock.

Before operating the equipment, be sure to connect this terminal to a ground providing a resistance to ground for 100 ohms or less.

(Connecting the 3-conductor power cable to a 3-terminal wall socket with grounding eliminates the need to ground this grounding terminal.)



**Warning mark**

The information helpful to avoid any risk or dangers of serious and possible fatal physical injury of the user during operation, such as electric shock, is contained.





**Caution mark**

The information helpful to avoid risk of damaging the equipment during operation is contained.

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●Other marks

- | Indicates ON position of the power switch.
- Indicates OFF position of the power switch.
-  Indicates that the external conductor of connector is connected to the case.
-  Indicates that the external conductor of connector is connected to the signal ground.

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# 1. General Description

## 1.1 Overview

As-161-30/60 Bipolar Amplifier (hereinafter called "this product") is a constant-voltage power amplifier with the frequency range of DC to 150kHz and the output voltage range of -15VDC to +60VDC.

This product is mainly used for power supply environment testing of the electrical component used in automobiles and others.

The maximum output current is:

As-161-30: maximum DC current 15A, maximum peak current 30A

As-161-60: maximum DC current 30A, maximum peak current 60A

This product operates stably over a wide range of LC load and overshoot and sag of the step response waveform of R load hardly occur. Unstable operation, which is apt to occur when capacity load is applied to an amplifier, hardly takes place. When the large capacitor (100 $\mu$ F) is provided as load, the amplifier characteristic does not show any peaks or instability.

In addition, since this is a DC amplifier, both the asymmetric waveform in positive-and-negative and the waveform where the direct current is superposed can be amplified accurately, which makes the power supply optimal for environment testing of electric components.

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## 1.2 Features

○ Wideband DC to 150kHz

Amplification from DC is available which can amplify the asymmetric waveform and the DC superposed waveform accurately.

○ High power

	Output voltage range	Max. output current
As-161-30	-15Vdc to +60Vdc	$\pm 15\text{A}_{\text{dc}}$ , $\pm 30\text{A}_{\text{peak}}$
As-161-60	-15Vdc to +60Vdc	$\pm 30\text{A}_{\text{dc}}$ , $\pm 60\text{A}_{\text{peak}}$

However, the maximum duration of peak current output is 20ms.

○ Large load capacity

When the capacity up to 100 $\mu\text{F}$  is connected to the output terminal, the amplifier does not oscillate or the peak does not appear in gain.

However, the output amplitude is affected by the following output impedance.

○ Low impedance output (rear output terminal)

As-161-30	[10m $\Omega$ ] or less (DC~500Hz) [100m $\Omega$ +0.4 $\mu\text{H}$ ] or less (500Hz more)
As-161-60	[10m $\Omega$ ] or less (DC~500Hz) [100m $\Omega$ +0.4 $\mu\text{H}$ ] or less (500Hz more)

○ Slew rate limit function

By using a push-button switch, the following slew rates can be limited:

Five positions are selectable: 0.1V/ $\mu\text{s}$ , 0.3V/ $\mu\text{s}$ , 1V/ $\mu\text{s}$ , 3V/ $\mu\text{s}$  and OFF

○ Indication of DC output voltage/current on LED digital display

DC output voltage and DC output current are displayed in numerals at a resolution of 10mV and 10mA respectively.

○ Remote ON/OFF function

Remote ON/OFF function is available via a connector for remote control arranged on the rear panel.

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## 1.3 Functions

The main functions of this product are as follows.

### 1.3.1 Output

- **Output ON/OFF by the illuminated-type push-button switch on the front panel**  
The output is turned on and off at the contacts of the relay contactor. When the output is turned on and off, the output voltage is turned to 0V temporarily to protect the contacts from burning.
  
- **Rear remote control connector**  
One of the four modes can be selected through pin connection:  
Mode 0: The ON/OFF switch on the panel is invalid. When the external ON signal is driven Low, the output is turned ON. When the external ON signal is driven High, the output is turned OFF.  
Mode 1: The ON/OFF switch on the panel, the external ON signal and external OFF signal are valid. When the external ON signal is temporarily driven Low, the output is turned ON. When the external OFF signal is temporarily driven Low, the output is turned OFF.  
Mode 2: The external ON/OFF signal is disregarded. Only the ON/OFF switch on the panel is valid. When power is turned on, the output is turned ON.  
Mode 3: The external ON/OFF signal is disregarded. Only the ON/OFF switch on the panel is valid. When power is turned on, the output is turned OFF.

### 1.3.2 Input

- **Input connector**  
BNC receptacle is equipped on the front and rear panels. Both receptacles are directly connected. Use either of them.  
The ground for the input signal is connected to the output and the ground of the chassis.  
The input impedance is  $100k\Omega \pm 10\%$ .
  
- **Gain switching**  
The following gains can be set using the push-button switch on the front panel:  
x2, x5, x10, x20
  
- **DC addition function**  
The 10-turn potentiometer equipped on the front panel can add the DC from -15Vdc to +60Vdc.

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- **DC offset fine control**

The semi-fixed resistor equipped on the front panel can fine adjust the DC offset.

- **Slew rate limit setting**

By using a push-button switch on the front panel, the following slew rates can be limited.

Five positions are selectable:  $0.1V/\mu s$ ,  $0.3V/\mu s$ ,  $1V/\mu s$ ,  $3V/\mu s$  and OFF

When the slew rate is turned OFF, 10% to 90% of the leading edge of the signal is within  $5\mu s$ .

### 1.3.3 Indication

- **Output ON/OFF**

The output ON/OFF is indicated with an illuminated type ON/OFF switch on the front panel.

- **Output voltage**

The output voltage is measured and displayed on the LED digital display at a resolution of 10mV.

- **Output current**

The output current is measured and displayed on the LED digital display at a resolution of 10mA.

- **Over status lamp**

When the rated voltage or rated current is exceeded, the LED will illuminate.

When the rated current is exceeded for 2 seconds or more, the output will be turned off automatically for protection.

### 1.3.4 Monitor signal output

- **Output voltage monitor**

The output voltage waveform is reduced to 1/10 and output from the BNC receptacle on the front panel as a monitor voltage. The ground for the output signal is connected to the ground of the chassis.

- **Output current monitor**

The output current waveform is converted to voltage with gain of  $0.1V/A$  and output to the BNC receptacle on the front panel as a monitor current. The ground for the output signal is connected to the ground of the chassis.

## 1.4 Operational principle

As-161-30/60 consists of a preamplifier, power amplifier and power supply.

"Fig. 1-1 As-161-30/60 Block Diagram" shows the internal configuration.

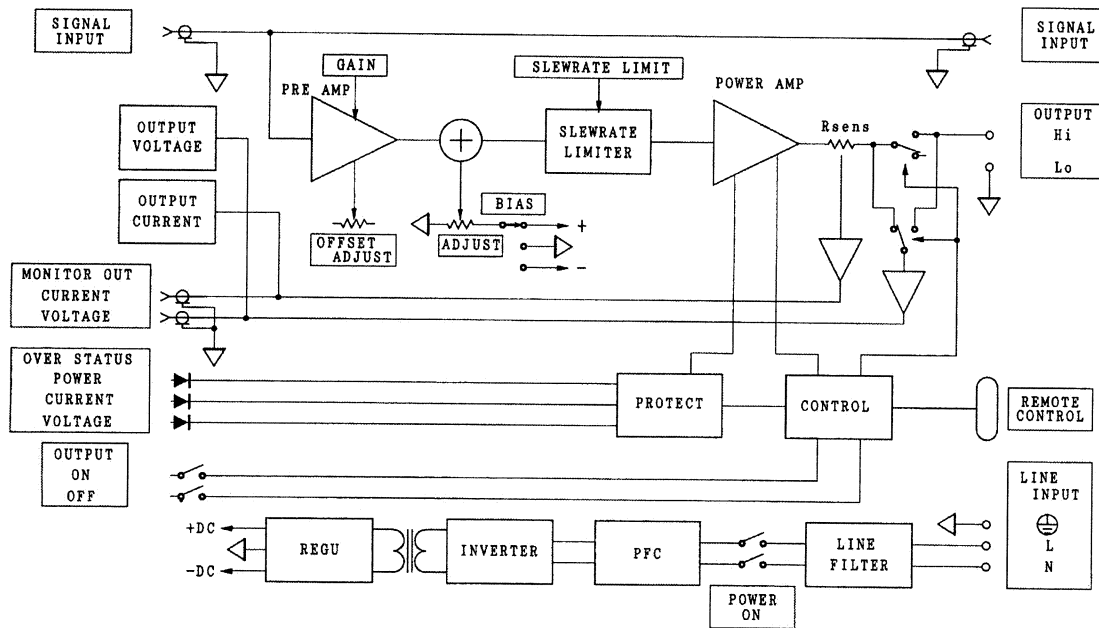


Fig. 1-1 As-161-30/60 block diagram

The signals from "SIGNAL INPUT" are amplified at "PRE AMP." The DC offset voltage of the preamplifier can be fine adjusted with "OFFSET ADJUST" installed on the front panel. The output from the "PRE AMP" and "BIAS ADJUST" voltage are added and connected to the "SLEWRATE LIMIT" circuit. The "SLEWRATE LIMIT" circuit enables the user to select slew rate from  $0.1\text{V}/\mu\text{s}$ ,  $0.3\text{V}/\mu\text{s}$ ,  $1\text{V}/\mu\text{s}$ ,  $3\text{V}/\mu\text{s}$  or leave it undefined.

"POWER AMP" consists of a high-speed DC amplifier. The output from "POWER AMP" is connected to the output terminal via the current detecting resistor and the output ON/OFF relay.

The voltage detected at both ends of the current detecting resistor is converted to the signal based on the chassis ground and connected to the BNC receptacle as output current. The signal is AD-converted and monitored as output current on the digital display.

The output voltage monitor detects the output signal "POWER AMP" when the output is OFF and the output terminal signal when the output is ON. The amplitude of such signal is divided to ten and connected to the BNC receptacle. This signal is AD-converted and is monitored as output voltage on the digital display.

For power supply, necessary DC voltage is gained from DC-DC converter that converts DC converted from AC in the power-factor corrective circuit.

## 2. Preparation before Use

### 2.1 Check of appearance and accessories

- Check that no flaws, damage, or dents are found on the panel surface, dials and connectors.
- Accessories are shown in "Table 2-1 Component List." Check that no accessories are missing.

### 2.2 Contents

As-161-30/60 is composed as shown below. Check the number of the accessories.

Table 2-1 Component list

○ Bipolar amplifier	.....	1
○ Instruction manual	.....	1
○ Accessories		
Power cable (Note 1)	.....	1
Remote ON/OFF control connector	.....	1

**Note 1:** The power cable for the product varies depending on type as follows.

As-161-30

3.5mm<sup>2</sup> 3-core cable , 3m , Cut off at one end 1

As-161-60

5.5mm<sup>2</sup> 3-core cable , 3m , Cut off at one end 1

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## 2.3 Installation

○ Installation location

Install this product securely on a floor or desk while taking care not to place the rear or side of the product facing downward.

Place the product so that four rubber feet on the bottom (As-161-30) or casters (As-161-60) rest on a flat surface such as a floor or desk.

The casters of As-161-60 do not withstand frequent transportation.

○ Cautions in transportation

To transport this product, two or four persons should grab the handles on the front and rear of the product. The weight of this product is as follows:

As-161-30: Approx. 36kg, As-161-60: Approx. 64kg

○ Rack mounting

By using optionally available auxiliary hardware, it is possible to mount this product on a millimeter or inch-based standard rack. Specify millimeter system or inch system when contacting the sales representative.

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 **CAUTION**

- For rack mounting, support this product by using a rail or a shelf.
  - This product takes air for cooling from the front and exhausts it from the rear. Open up the rear of the rack and allow at least 30cm from the wall in order to avoid convection of exhaust in the rack.
- 

○ Installation condition

Forced air-cooling with fan is used on this product. Install this product so that its front, rear and side, where the inlet and outlet are located, are away from the wall more than 30cm to secure the air flow.

The acceptable ranges of temperature and humidity are as follows.

Operation      0 to 40°C      5 to 85%RH

Storage        -20 to 50°C      5 to 95%RH

No dew condensation is allowed.

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Avoid installing the equipment in the following locations.

- Where flammable gas exists.
- Outside or where the equipment is exposed to direct sunlight.
- Near fire or heat sources.
- Where corrosive gas, water or dust exists.
- The place with high humidity.
- Near the source of electromagnetic field, high-voltage equipment, power lines.
- Where vibration frequently occurs.

## 2.4 Grounding and power supply connection

- The power requirements of this product are as shown below.

Power voltage	90 to 132VAC, 180 to 230VAC, automatic selection, single-phase	
Frequency range	48Hz to 62Hz	
Power consumption		
Without load	As-161-30	400VA
	As-161-60	700VA
With rated load	As-161-30	1500VA
	As-161-60	3000VA

- Grounding

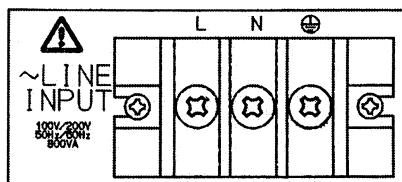
 **WARNING**

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Always ground the earth terminal of this product for safety.

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This product has a line filter at the input of the power supply. To secure the effect of the line filter and to avoid danger, ground the grounding terminal of this product. The maximum leakage current of the line filter used in this product is 2mA. As shown below, the rightmost terminal on the rear power input terminal block is the grounding terminal.





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○ Connection of power cable

Use an attached power cable or a cable with higher capacity.

Since the power consumption of this product is large with the rated output, use a distribution board or a power outlet with sufficient capacity. In case power is supplied from a table tap or a cord reel, the voltage drops and the normal operation will be disabled. Even in the case of rated output, ensure that the supplied voltage is sufficiently above the minimum voltage of 90VAC.

In particular, As-161-60 has large power consumption and an AC plug is not available. So, connect As-161-60 directly to the distribution board. In addition, when the power voltage drops, the power consumption increases and the circuit breaker of this product may trip.

○ Connect the power supply in the following procedure:

- Turn OFF the power switch of this product.
- Connect the attached power cable to the power input terminal of the product.
- Connect the plug of the power cable to an AC outlet with sufficient capacity or connect the power cord to a distribution board.

Connecting a three-pole power plug to three-pole power outlet having a protective ground terminal contact automatically grounds the product.

For As-161-60, power consumption is so large that a three-pole power plug cannot be used. Be sure to ground the power input ground terminal.

## 2.5 Connection of output terminal

The output current capacity of this product is as follows:

As-161-30  $\pm 15\text{A}_{\text{dc}}$ ,  $\pm 30\text{A}_{\text{peak}}$

As-161-60  $\pm 30\text{A}_{\text{dc}}$ ,  $\pm 60\text{A}_{\text{peak}}$

The duration of peak current output is 20ms at maximum. The output current capacity of this product is as below.

The output impedance of the output terminal of this product is as follows:

As-161-30 [10m $\Omega$ ] or less (DC~500Hz)  
[100m $\Omega$ +0.4 $\mu$ H] or less (500Hz more)

As-161-60 [10m $\Omega$ ] or less (DC~500Hz)  
[100m $\Omega$ +0.4 $\mu$ H] or less (500Hz more)

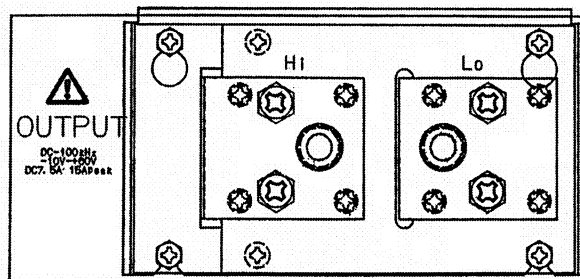
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As shown in the figure below, two fixing screws 6mm in diameter and binding posts for monitor are installed on the output terminal of the product.

When connecting a cable terminated with a crimp connector to a load, be sure to fix it with 6mm diameter screws.

**⚠ CAUTION**

The binding post terminal is used to observe the waveform of an output voltage and not for drawing out a current. Take special care because it is dangerous.



○ Output cable

This product is a bipolar amplifier featuring low voltage, large current and wideband. To make the best use of such features, the construction of the output cable matters greatly.

For example, when two 3.5mm<sup>2</sup> cables with a length of 3m are used for the output cable, the impedance is approx. 30mΩ only, but the inductance is approx. 3μH for direct current.

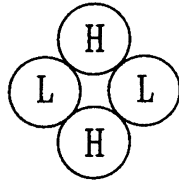
This inductance shows low impedance of approx. 1mΩ at 50Hz but increases to 0.2 Ω at 10kHz and 2Ω at 100kHz.

If the current of 10kHz 10A is applied to this cable, the voltage will drop by 2V, and in the case of the current of 100kHz 10A, the voltage will drop by 20V.

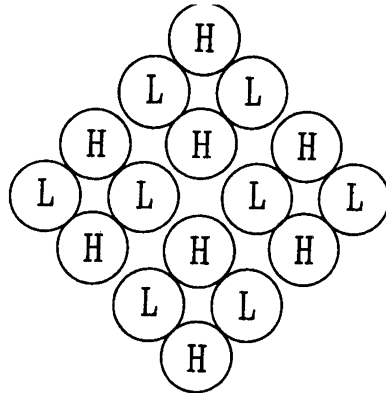
Therefore, the output cable to be used is preferably as short as possible with the shape of less inductance. To lower the inductance, it is effective to use four wires for the output cable and twist them together as shown on the left of the figure below. In addition, using four of such four-wire output cables together as shown on the right of the figure below will make the inductance even lower.

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## Cross Sectional View of Twist Cable



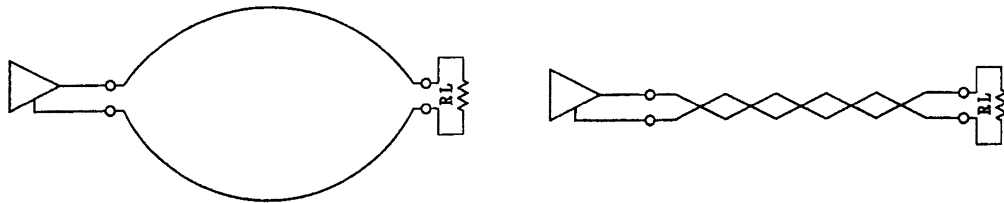
**L:** cable on the Low side  
**H:** cable on the High side



**Twist four sets of the cables shown on the left together**

When two cables are used and they are far from each other forming a loop as shown below left, large inductance will be generated.

When two cables are used, twist two cables together as shown below right to make the inductance smaller.



## 2.6 Simple operation check

This section describes simple operation check to be made when this product is purchased brand new or to be used after a long storage period.

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### **WARNING**

Never remove the cover of this product.  
Internal inspection of the product must be made only by a service technician who is well aware of the danger involved.

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○ Necessary measuring instruments

The operation check requires the following measuring instruments:

Signal generator: Frequency 10kHz, waveform sine wave and square wave, output voltage 2V<sub>rms</sub> or more, for example WF1946 Synthesizer from NF Corporation.

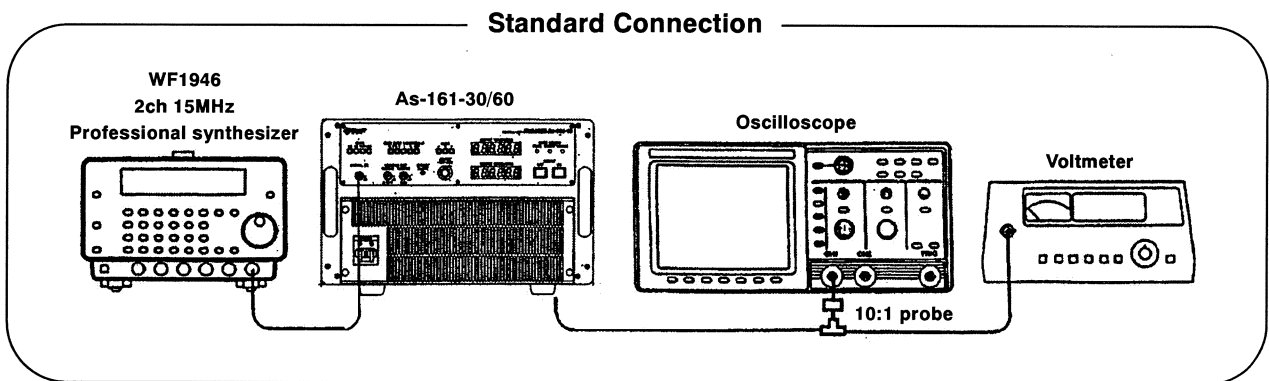
Oscilloscope: Frequency band 20MHz or more. Capable of measuring voltages up to 100V using a 10:1 probe.

Voltmeter: Capable of AC/DC voltage, Capable of measuring voltages up to 100V.

Since no load test is performed, load (terminal) resistance is not required.

○ Connection

As shown in Standard Connection below, connect the signal generator, voltmeter and oscilloscope. Draw out the output of the product from the binding posts at the output terminal on the rear.



○ Panel setting

Set the dials and push-buttons on the panel of this product as follows:

GAIN:  $\times 10$  SLEWRATE LIMIT: OFF BIAS: 0

ADJUST: Fully rotate the 10-turn potentiometer counterclockwise up to the "0" position.

Check that no connector is engaged to "REMOTE CONTROL" on the rear panel.

---

## ○ Operation

- Remove the signal cable from the oscillator.
  
- Turn on the power. The "OVER STATUS" lamp comes on transiently for one second and goes off. The lamp of the "OUTPUT OFF" push-button comes on. The output voltage/current monitor digital display "OUTPUT VOLTAGE" and "OUTPUT CURRENT" indicate values approximately "0" in the range of +0.05 to -0.05.
  
- Set "BIAS" to "+." Rotate the "ADJUST": 10-turn potentiometer slowly in clockwise direction. The voltage indication of output voltage monitor digital display rises. Check that the indication is about 60V when the 10-turn potentiometer is fully rotated.
  
- Use the "ADJUST" 10-turn potentiometer to set the output voltage to 22.5V. Press the "OUTPUT ON" switch. Check that the lamp of the "OUTPUT ON" switch comes on and confirm by the voltmeter that full-scale voltage of  $22.5V \pm 2\%$  is delivered to output.
  
- Set the oscillator waveform so that 1kHz sine wave output voltage will be the minimum value. Connect a signal cable to "SIGNAL IN" on the front panel of the product. Set the oscilloscope to DC coupling, 10V/DIV and 0.5ms/DIV. Check while monitoring on the oscilloscope that the sine wave is observed and its amplitude rises as the output amplitude of oscillator is augmented.
  
- Check that, when the peak of the output waveform of the product becomes higher than +60V or below -15V, the "OVER STATUS VOLTAGE" LED comes on.
  
- Set the oscillator amplitude so that the output voltage of this product will reach 10Vp-p. Switch over "GAIN" and check that the output voltage corresponding to the gain is obtained.
  
- Set "GAIN" to " $\times 10$ " and the output waveform of the oscillator to a square wave of 1kHz. Set the oscillator output amplitude so that the output voltage of this product will reach 50Vp-p. Switch over "SLEWRATE LIMIT" and check that the corresponding slew rate is obtained. At a slew rate of  $0.1V/\mu s$ , an increase of 50V requires  $500\mu s$ .

When operation check is complete, turn "BIAS" fully to "0" and "ADJUST" fully counterclockwise, and then turn OFF the power.

## 3. Name and Function of Each Part

### 3.1 Name and function of each part of the panel

The operation panel is in common with two types: As-161-30 and As-161-60.

Refer to Fig. 3-1 Front Panel View, Fig. 3-2 Front Panel Operation Part, and Fig. 3-3 Rear Connectors.

#### Front panel

- ① "POWER": Power switch.

Also serves as a non-fuse breaker.

The power capacity of this product is as follows. Supply power from a power outlet with sufficient capacity or a distribution board.

With rated load

As-161-30: 1500VA, As-161-60: 3000VA

As the power voltage drops, the current consumption increases. Be fully aware that this product may not function normally below 90VAC.

An abnormal increase power consumption or abnormal internal heating of this product will automatically trip the power switch.

In case the power switch has tripped automatically, check the operating status and make sure that ambient temperature, power supply voltage, and load are within the rated operation range.

- ② "GAIN ×2 ×5 ×10 ×20": Push-button switch for setting a gain.

The voltage signal input to ⑧ "SIGNAL IN" or ⑮ "SIGNAL INPUT" is multiplied as many times as the set multiplication factor to produce the voltage at the output terminal.

The set bias value of "④OFFSET ADJUST," "⑤" BIAS - 0 +" or "⑥ADJUST -10V-+60V" is not influenced by this gain setting.

Do not press the four push-buttons "×2," "×5," "×10," "×20" at the same time. Push only one push-button at a time when using this product.

The maximum input voltage range is -1.5V to +6.0V. Setting of "×2" or "×5" may not produce the maximum output voltage.

Use the setting of "×2" or "×5" in the case, for example, when a minute AC voltage is superimposed on the DC output of the set bias value.

- 
- ③ "SLEWRATE LIMIT (V/μs) 0.1, 0.3, 1, 3, OFF": Push-button switch for slew rate limit. Under capacitive load, the output current increases in proportion to the slew rate. The current flowing at a given slew rate is obtained by the following equation:

$$I_c = \text{Slew rate} \times \text{capacity}$$

For example, the current obtained when the waveform of 0.1V/μs (100000V/s) flows into a capacitor of 100μF is 10A.

Under capacitive load, the output current can be limited to a constant value by limiting the slew rate; use this function as needs dictate.

- ④ "OFFSET ADJUST": Semi-fixed resistor for DC offset voltage adjustment. Adjust it by using a flat-blade screwdriver so that the output voltage will become 0V when the input voltage is 0V and bias voltage is 0V.
- ⑤ "BIAS - 0 +": Switch to change the polarity of the bias voltage and the bias voltage to 0V. The polarity of bias voltage can be set with ⑥"ADJUST -10V-+60V".
- ⑥ "ADJUST -10V-+60V": 10-turn potentiometer for bias voltage setting. The output DC bias voltage is settable from -15V to +60V by rotating the potentiometer with the polarity set with ⑤"BIAS - 0 +".
- ⑦ "OVER STATUS POWER CURRENT VOLTAGE"

This is an LED that shows the output of this product has exceeded the rated value.

- "POWER": Comes on when the power consumption in this product has exceeded the following values or when the average current has exceeded the rated value:

As-161-30: 900VA As-161-60: 1800VA

When this state lasts for two seconds or more, the output is automatically turned OFF. In case the output is automatically turned OFF, the "POWER" LED stays on to show that the output is turned OFF due to overload.

Removing the overload state and pressing the "OUTPUT OFF" or "OUTPUT ON" switch again turns off the "POWER" LED.

- "CURRENT": Comes on when the peak output current of this product has exceeded the following values:

As-161-30: 30Apeak As-161-60: 60Apeak

When this state lasts for two seconds or more, the output is automatically turned OFF. In case the output is automatically turned OFF, the "CURRENT" LED stays on to show that the output is turned OFF due to overload.

Removing the overload state and pressing the "OUTPUT OFF" or "OUTPUT ON" switch again turns off the "CURRENT" LED.

- 
- "VOLTAGE": Comes on when the output voltage of this product has exceeded the range of "-15V to +60V".

The output is not automatically turned OFF even when this LED comes on. Note that the output amplitude has saturated and the output value is not normal.

- ⑧ "SIGNAL IN": BNC receptacle for an input signal.

The input impedance is 100k $\Omega$ . A longer signal cable results in attenuation of a high frequency signal components due to cable capacity. Use a signal source having the output impedance of 50 k $\Omega$ . Use the signal level within the range of -1.5V to +6V. This terminal is directly connected to ⑮ "SIGNAL INPUT". Never connect different signals at the same time.

- ⑨ "MONITOR OUT CURRENT 0.1V/A": BNC receptacle for outputting a current monitor signal. The output sensitivity is 0.1V/A. When a signal of 1V is output from this receptacle, an output current of 10A is flowing.

The common ground for this signal is at the same potential as the signal output ground and chassis ground.

- ⑩ "MONITOR OUT VOLTAGE 1/10": BNC receptacle for outputting a voltage monitor signal. The output sensitivity is 1/10. When a signal of 1V is output from this receptacle, an output voltage of 10A is flowing.

The common ground for this signal is at the same potential as the signal output ground and chassis ground.

- ⑪ "OUTPUT VOLTAGE (V)": Digital display for monitoring a DC output voltage. Displays the output voltage from -15.00V to +60.00V in steps of 10mV.

- ⑫ "OUTPUT CURRENT(A)": Digital display for monitoring a DC output current. Displays the output current for the following range in steps of 10mA:

As-161-30: -15A to +15A , As-161-60: -30A to +30A

- ⑬ "OUTPUT OFF ON": Illuminated-type push-button switch for turning output ON/OFF. Set the output to 0 V and control relay ON/OFF in order to avoid damage to the output relay contacts before turning the output ON/OFF.

When the output current or internal loss exceeds its rated value and 2 seconds have elapsed, the output is automatically turned OFF.



## Rear panel

### ⑭ "REMOTE CONTROL": Remote control connector for turning the output ON/OFF

Pin arrangement is as follows:

1. NC	8. NC
2. +5V	9. REMOTE ON
3. GND	10. REMOTE OFF
4. GND	11. ON STATUS C
5. ON STATUS E	12. OVER STATUS C
6. OVER STATUS E	13. MODE B0
7. GND	14. MODE B1

The ON/OFF control of this product has four modes depending on the level of Mode B0 and Mode B1.

B1	B0		
Low	Low	Mode 0	Remote mode only
Low	High	Mode 1	Remote/Panel mode
High	Low	Mode 2	Panel mode only, Output ON when power is ON
High	High	Mode 3	Panel mode only, Output OFF when power is ON

Level setting of Mode B0 and Mode B1 is High when open and Low when connected to GND.

#### - Mode 0 operation

Mode 0 performs ON/OFF control in accordance with the level of the REMOTE ON signal.

The output is OFF when the level is HIGH and ON when the level is Low.

In case overload is detected for two seconds, the output is forcibly turned OFF even when the signal is Low. To remove the overload and turn the output ON again, drive the REMOTE ON signal High, and then Low to turn the output ON.

#### - Mode 1 operation

In Mode 1, the output is always OFF when the power is ON.

The output is ON/OFF controlled in accordance with the OUTPUT ON/OFF switch on the panel and the REMOTE ON signal and OFF signal.

In case overload is detected for two seconds, the output is forcibly turned OFF.

#### - Mode 2 operation

In Mode 2, the output is always ON when the power is ON.

The REMOTE ON OFF signal is disregarded and the output is turned ON/OFF by way of the operation of OUTPUT ON/OFF switch on the operation panel alone.

---

- Mode 3 operation

In Mode 3, the output is always OFF when the power is ON.

The REMOTE ON OFF signal is disregarded and the output is turned ON/OFF by way of the operation of OUTPUT ON/OFF switch on the operation panel alone.

The system enters Mode 3 when nothing is connected to the remote control connector.

- ON STATUS C/E: A signal indicating that the output is ON. This signal is connected to the collector and the emitter of photo-coupler output. The photo-coupler output is ON when the output is ON.

- OVER STATUS C/E: A signal indicating that this product is overloaded. This signal is connected to the collector and the emitter of photo-coupler output. The photo-coupler output is ON when the product is overloaded.

Apply a voltage of maximum 50 VDC to the photo-coupler.

Draw out a current of maximum 10mA from the photo-coupler.

⑮ "SIGNAL INPUT"

The input impedance is 100k $\Omega$ . A longer signal cable results in attenuation of a high frequency signal components due to cable capacity. Use a signal source having the output impedance of 50 $\Omega$ . Use the signal level within the range of -1.5V to +6V. This terminal is directly connected to ⑧ "SIGNAL IN". Never connect different signals at the same time.

⑯ "OUTPUT Hi Lo" (6mm screw terminals) Screw terminals for output

Connect the input signal to Hi. Connect the signal ground to Lo. Lo is connected to the chassis ground. Since large current flows with low impedance, they must be engaged securely with crimp terminals.

The maximum output current is as follows:

As-161-30       $\pm 15\text{A}_{\text{dc}}, \pm 30\text{A}_{\text{peak}}$

As-161-60       $\pm 30\text{A}_{\text{dc}}, \pm 60\text{A}_{\text{peak}}$

However, the maximum duration of peak current output is 20ms.

The output impedance is as follows:

As-161-30    [10m $\Omega$ ] or less (DC~500Hz)  
                  [100m $\Omega$ +0.4 $\mu\text{H}$ ] or less (500Hz more)

As-161-60    [10m $\Omega$ ] or less (DC~500Hz)  
                  [100m $\Omega$ +0.4 $\mu\text{H}$ ] or less (500Hz more)

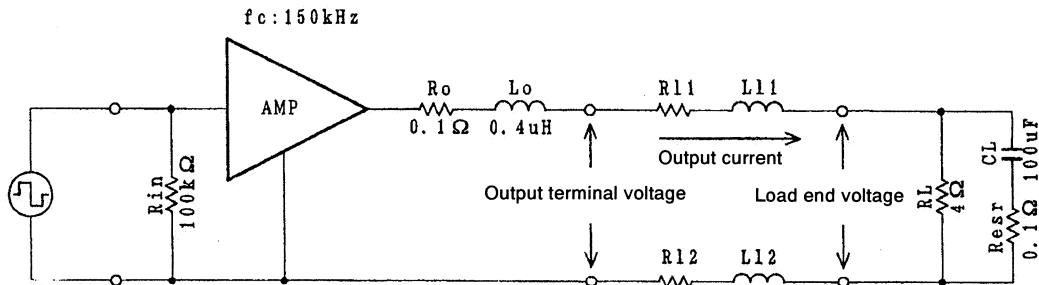
- 
- ⑰ "OUTPUT Hi Lo" (binding post): This binding post is for observation of an output voltage waveform. The current cannot be drawn out. Connect the input signal to the black terminal. Connect the signal ground to the white terminal.  
Take care so that a current exceeding 1A will not flow.
  - ⑱ "LINE INPUT L N": Terminal block for power input. Connect the attached power cable. For safety, ground the ground terminal.

- Power supply conditions for this product are as follows:

Power voltage	90 to 132VAC, 180 to 230VAC, automatic selection, single-phase	
Frequency range	48Hz to 62Hz	
Power consumption		
Without load	As-161-30	400VA
	As-161-60	700VA
With rated load	As-161-30	1500VA
	As-161-60	3000VA

## 3.2 Output cable and output waveform

The equivalent circuit obtained when an output cable and load are connected to this product is shown below.



Symbols represent the following characteristics:

- $R_{in}$ : Input impedance of this product
- AMP: Amplifier having a frequency characteristic of  $150kHz -3dB$ .
- $R_o$ : Resistance component of output impedance
- $L_o$ : Inductor component of output impedance
- $R_{11}, R_{12}$ : Resistance component of output cable
- $L_{11}, L_{12}$ : Inductance component of output cable
- $R_L$ : Load resistance
- $C_L$ : Load capacity
- $R_{esr}$ : Serial resistance component which is parasitic to load capacity

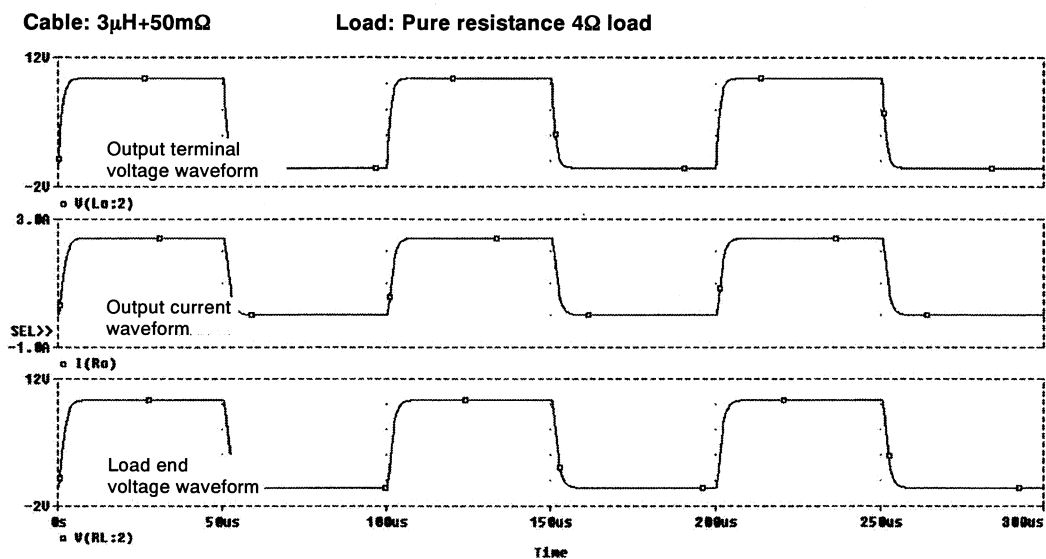
○ Waveform of each part under load of pure resistance

The following shows the waveform of each part obtained by inputting a 10kHz square wave 1V0-p, multiplying the wave by 10 and driving load.

The load connected is only fixed to a load of pure resistance of 4Ω. The total inductance (L11+L12) of the output cable is 3μH and the total resistance component (R11+R12) is 50mΩ.

The total inductance value 3μH is obtained when the length of the output cable is set to some 3 meters.

The output terminal voltage waveform, the output current waveform, and the load end voltage waveform are transmitted in waveforms almost similar to each other. The rise time of the output terminal waveform is substantially influenced by the AMP frequency characteristic of 150kHz -3dB. The leading edge of the load end voltage waveform is a little delayed from the leading edge of the output terminal waveform. This is due to the influence of the inductance component of the output cable.



○ Waveform of each part under load of pure resistance plus capacity load

The following shows the waveform of each part obtained when a load of pure resistance of  $4\Omega$  and a capacity load of  $100\mu\text{F}$  are connected.

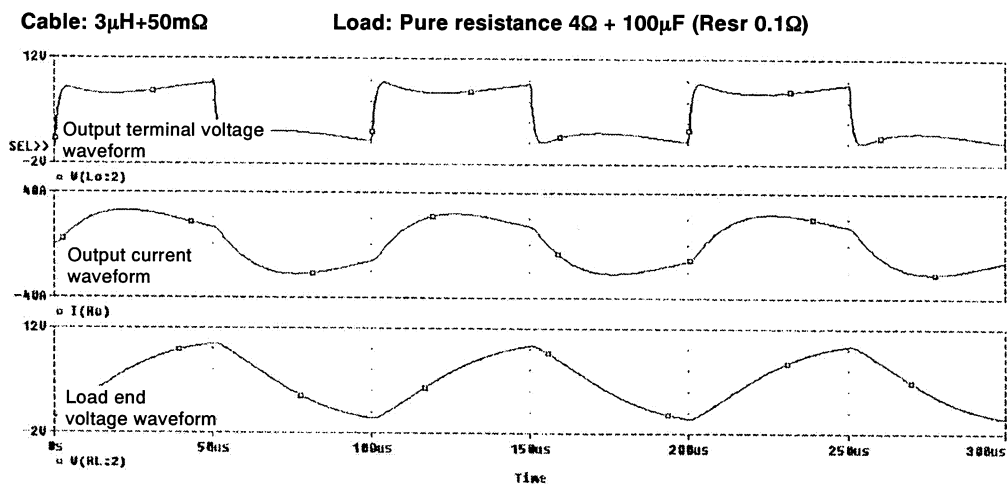
Resr serially connected to the capacity load is a resistance component which is always present in the capacity. The value of  $0.1\Omega$  is a relatively small value assuming the capacity load is an electrolytic capacitor.

Capacity is added to the load. A large charging current flows at the leading edge of the signal showing  $25\text{A}_0\text{-p}$  current in the example below.

Due to this current and the output impedance  $R_o$ ,  $L_o$  of this product, the square wave of the output terminal voltage waveform is distorted. This distortion decreases as  $R_o L_o$  becomes smaller.

The value of  $0.1\Omega$ ,  $0.4\mu\text{H}$  is a relatively small value among the existing power amplifiers.

The leading edge of the load terminal voltage waveform is considerably delayed. This is mainly attributable to the inductance component and capacity load of the output cable.

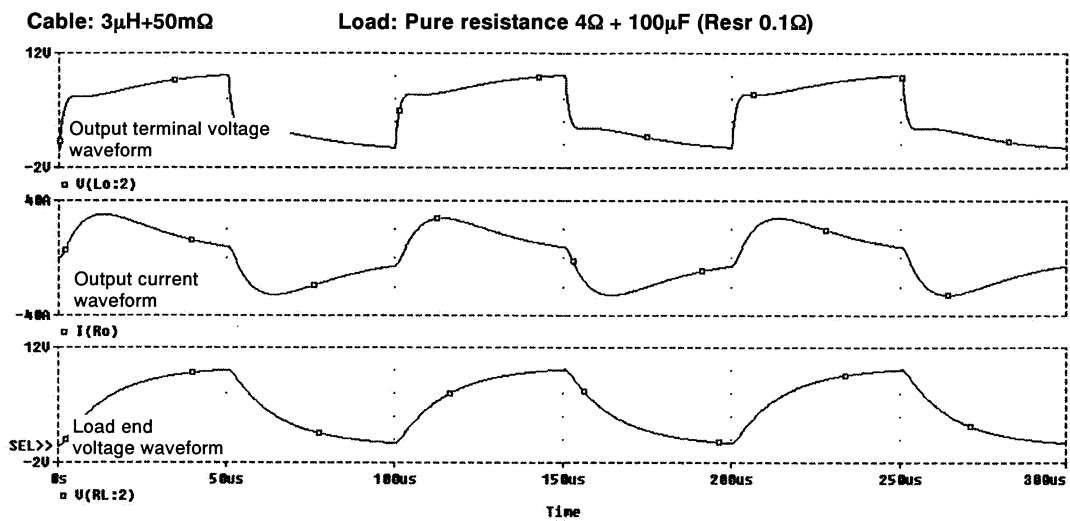


- Waveform of each part under load of pure resistance plus capacity load with a shorter cable length

The following shows the waveform of each part obtained when the length of the cable is 1/3 that of the cable on the preceding page.

Compared with the preceding page, rise time of the load end voltage waveform is earlier.

When a waveform which rises earlier than this waveform is required, further reduce the cable length or connect multiple cables containing four twisted wires in parallel described under “2.5 Connection of Output Terminal” and reduce the inductance component of the output cable before using it.



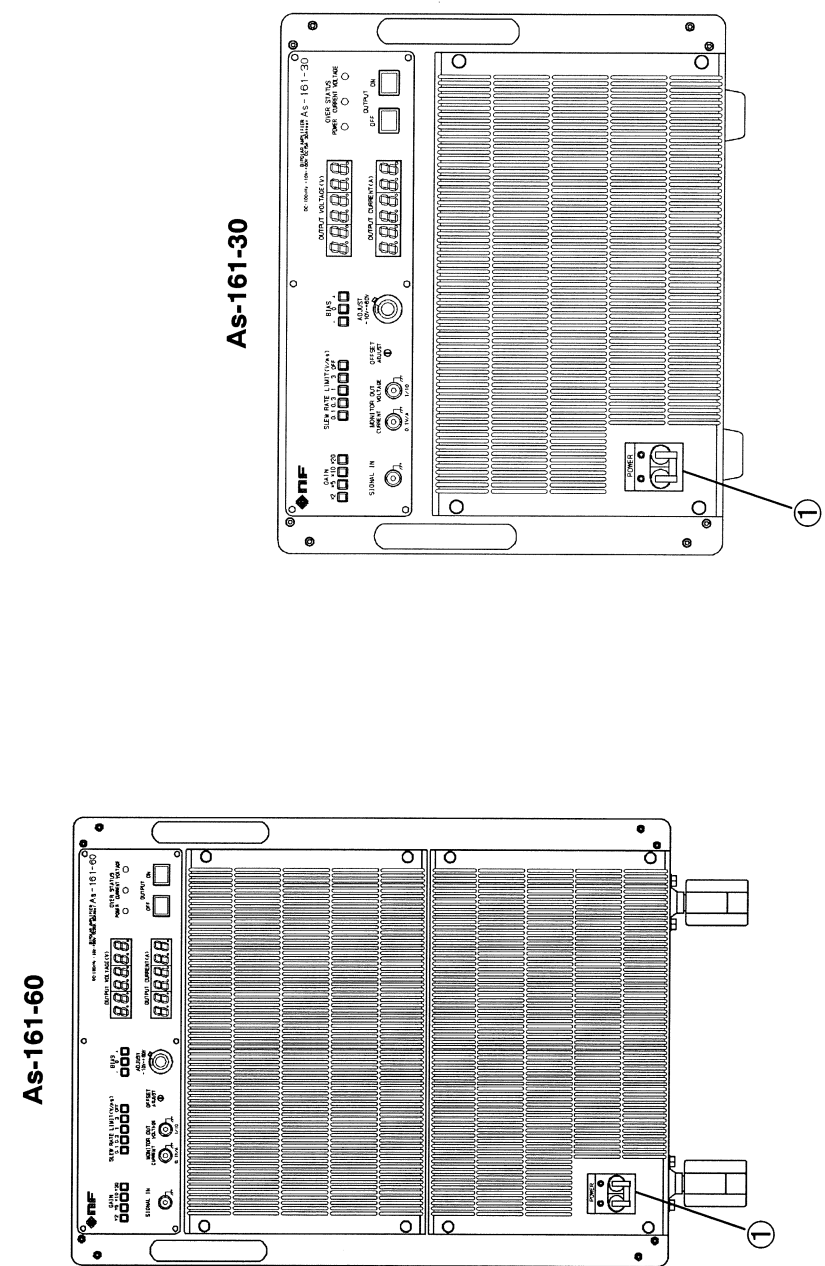
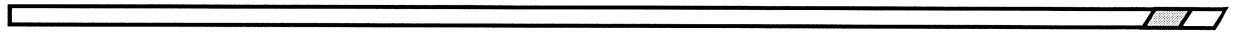


Fig. 3-1 Front panel view





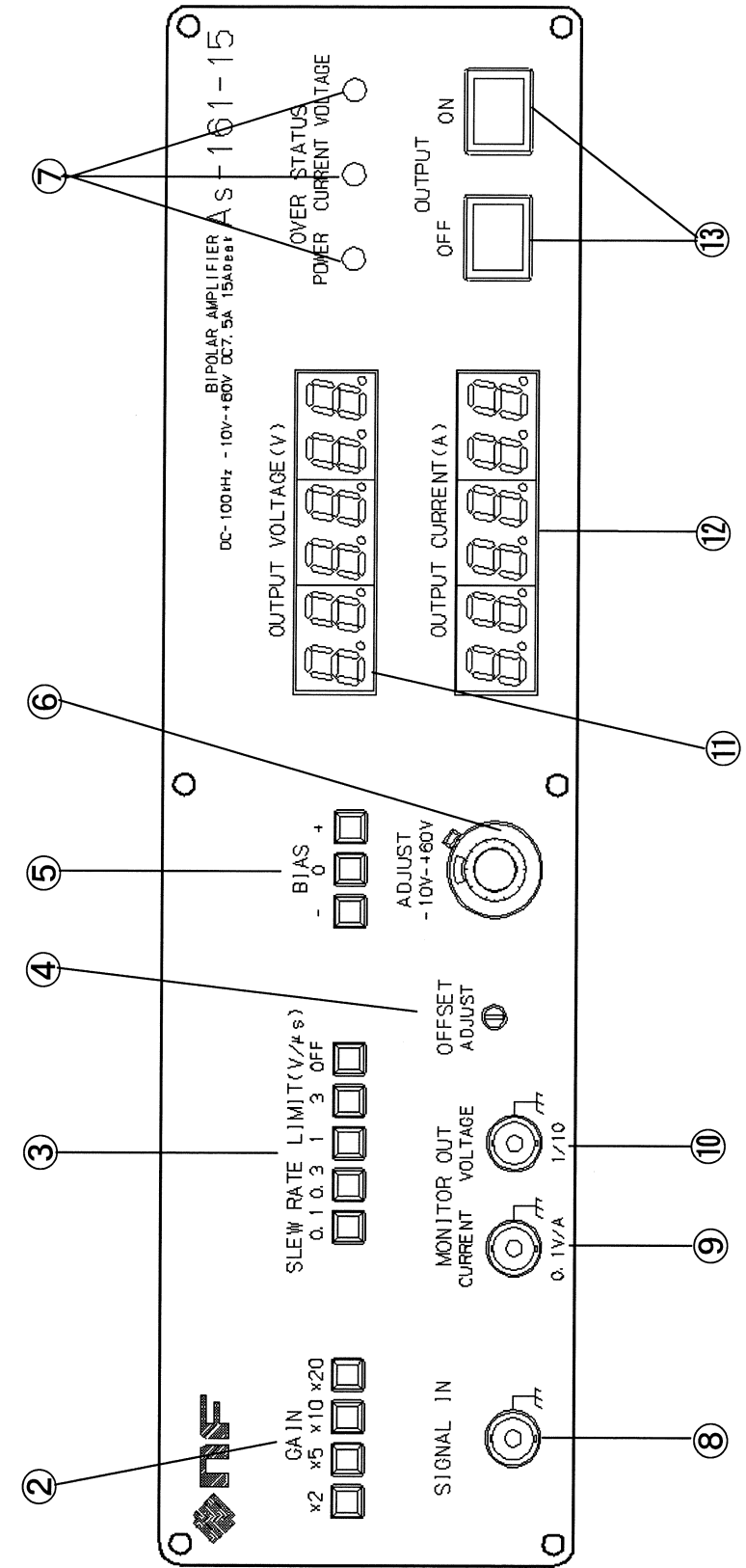


Fig. 3-2 Operation panel view

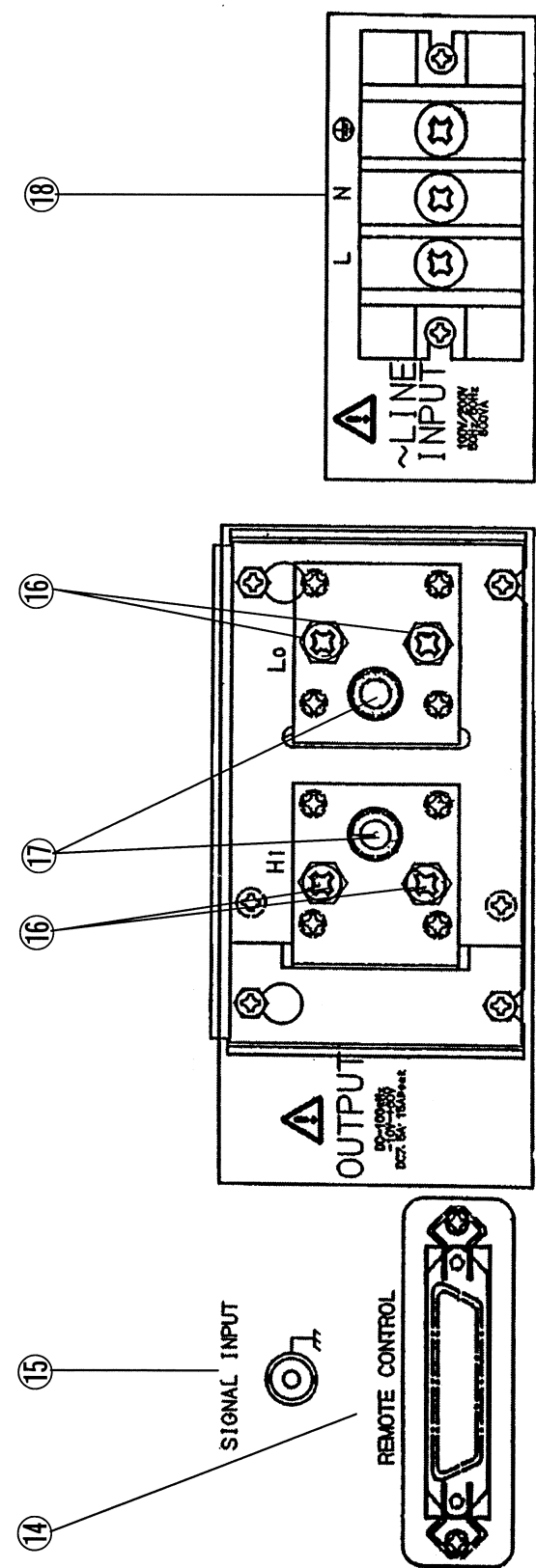


Fig. 3-3 Rear connector view

## 4. Specification

Specification for As-161-30 or As-161-60 is described by model name only when the specification differs among models.

The rated load of each model is as follows:

	Positive voltage output	Negative voltage output
As-161-30	Pure resistance of $4\Omega$	Pure resistance of $1\Omega$
As-161-60	Pure resistance of $2\Omega$	Pure resistance of $0.5\Omega$

### 4.1 Input

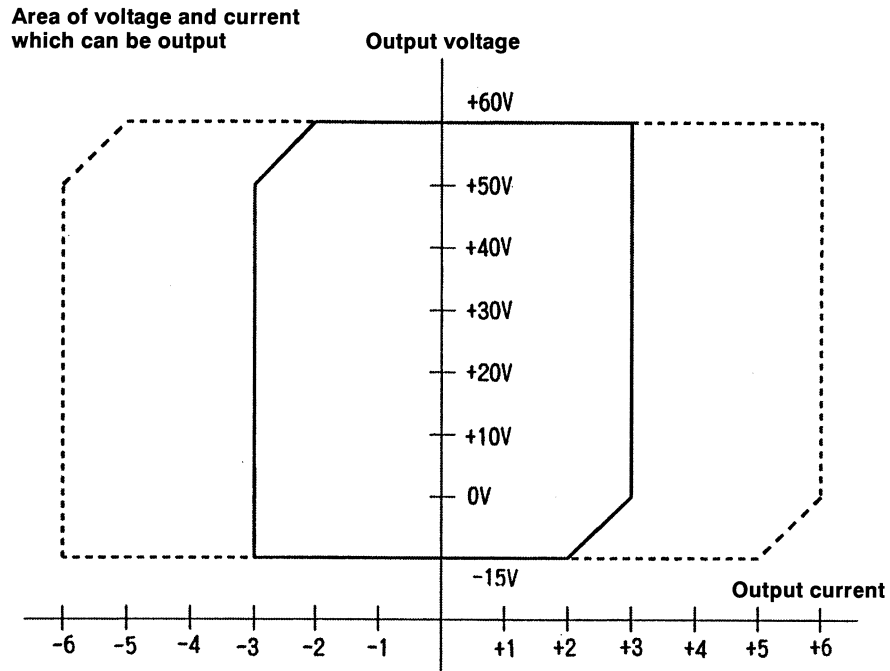
- Input form Unbalanced. One BNC receptacle equipped on the front and rear each. Input to the front and the rear are directly connected. Use either of them. Never connect different signals at the same time.
- Input impedance  $100k\Omega \pm 10\%$
- Input voltage range  $-1.5V$  to  $+6.0V$

### 4.2 Output

- Output form Unbalanced.  
Ground side is at the same potential as the signal input ground and chassis ground.
- Maximum output voltage  $-15V$  to  $+60V$
- Maximum output current
  - As-161-30  $\pm 15A_{dc}$ ,  $\pm 30A_{peak}$
  - As-161-60  $\pm 30A_{dc}$ ,  $\pm 60A_{peak}$However, the maximum duration of peak current output is 20ms.

- Area of voltage and current which can be output

The maximum output current of As-161-30/60 is limited by the output voltage as shown below.



Solid lines indicate the range with a DC current.  
Dotted lines indicate the range with the AC current(25Hz or more).

For As-161-30, the maximum output current is a value obtained by multiplying the value on the current axis by 5A.

For As-161-60, the maximum output current is a value obtained by multiplying the value on the current axis by 10A.

- Output impedance

As-161-30 [10mΩ] or less (DC~500Hz)  
[100mΩ+0.4μH] or less (500Hz more)

As-161-60 [10mΩ] or less (DC~500Hz)  
[100mΩ+0.4μH] or less (500Hz more)

- Load capacity

100μF or less

- Output noise level

Within 50mVrms (in the frequency band of 10Hz to 1MHz).

- Harmonic distortion ratio

1% or less (DC bias voltage +22.5V, output voltage 26.5Vrms, at positive voltage rated load, frequency of 1kHz)

- 
- DC bias voltage                      Measurement possible in the range of  $-15\text{V}$  to  $+60\text{V}$  by using the "+ - OFF" switch and the 10-turn potentiometer.
  - Output offset voltage              Adjustable to zero using the semi-fixed resistor equipped on the front panel.

### 4.3 Amplification characteristic

- Frequency characteristic          Within  $\pm 3\text{dB}$  (from DC to  $150\text{kHz}$ )
- Gain                                      Four positions:  $\times 2$ ,  $\times 5$ ,  $\times 10$ ,  $\times 20$
- Gain accuracy                        Within  $\pm 5\%$
- Slew rate limit                        Five positions:  $0.1\text{V}/\mu\text{s}$ ,  $0.3\text{V}/\mu\text{s}$ ,  $1\text{V}/\mu\text{s}$ ,  $3\text{V}/\mu\text{s}$  and OFF
- Slew rate limit accuracy          Within  $\pm 20\%$
- Output waveform rising/falling time    Within  $5\mu\text{s}$  (Slew rate OFF, over 10% up to 90% of the waveform)

### 4.4 Output monitor , Measurement display

- DC voltage output digital display
  - Display range                           $-15.00\text{V}$  to  $+60.00\text{V}$  in steps of  $10\text{mV}$
  - Display error                          Within 2% of the full scale
- DC current output digital display
  - Display range
    - As-161-30                               $-15.00\text{A}$  to  $+15.00\text{A}$  in steps of  $10\text{mA}$
    - As-161-60                               $-30.00\text{A}$  to  $+30.00\text{A}$  in steps of  $10\text{mA}$
  - Display error                          Within 2% of the full scale

---

- Voltage output monitor output

Output form	Unbalanced BNC receptacle The ground terminal is connected to the chassis ground.
Output impedance	50Ω
Maximum output current	±5mA
Frequency characteristic	Within +1dB -3dB from DC to 150kHz
Output level	1V/10V(monitor output/voltage output)
Output voltage accuracy	Within ±5% of the full scale (full scale ±6V)
Phase	In-phase with the input

- Current output monitor output

Output form	Unbalanced BNC receptacle The ground terminal is connected to the chassis ground.
Output impedance	50Ω
Maximum output current	±5mA
Frequency characteristic	Within +1dB -3dB from DC to 150kHz
Output level	1V/10A(monitor output/current output)
Output voltage accuracy	Within ±5% of the full scale (full scale As-161-30: ± 1.5V, As-161-60: ± 3.0V)
Phase	In-phase with the input

## 4.5 Generals

- Rear remote control connector

One of the four modes can be selected through pin connection:

Mode 0: The ON/OFF switch on the panel is invalid. When the external ON signal is driven Low, the output is turned ON. When the external ON signal is driven High, the output is turned OFF.

Mode 1: The ON/OFF switch on the panel, the external ON signal and external OFF signal are valid. When the external ON signal is temporarily driven Low, the output is turned ON. When the external OFF signal is temporarily driven Low, the output is turned OFF.

Mode 2: The external ON/OFF signal is disregarded. Only the ON/OFF switch on the panel is valid. When power is turned on, the output is turned ON.

Mode 3: The external ON/OFF signal is disregarded. Only the ON/OFF switch on the panel is valid. When power is turned on, the output is turned OFF.

---

- Power supply

Power supply voltage      90 to 132VAC, 180 to 230VAC, automatic selection,  
single-phase

- Frequency range      48Hz to 62Hz

- Power consumption

Without load	As-161-30	400VA
	As-161-60	700VA
With rated load	As-161-30	1500VA
	As-161-60	3000VA

- Insulation/Withstand voltage

Insulation      100M $\Omega$  minimum at 500VDC (between total power input  
and chassis)

Withstand voltage      1 minute or more at 1500VAC (between total power input  
and chassis)

- Temperature/Humidity range

Operating      0 to +40 °C, 5-85%RH

Storage      -20 to +50 °C, 5-95%RH

- External dimensions

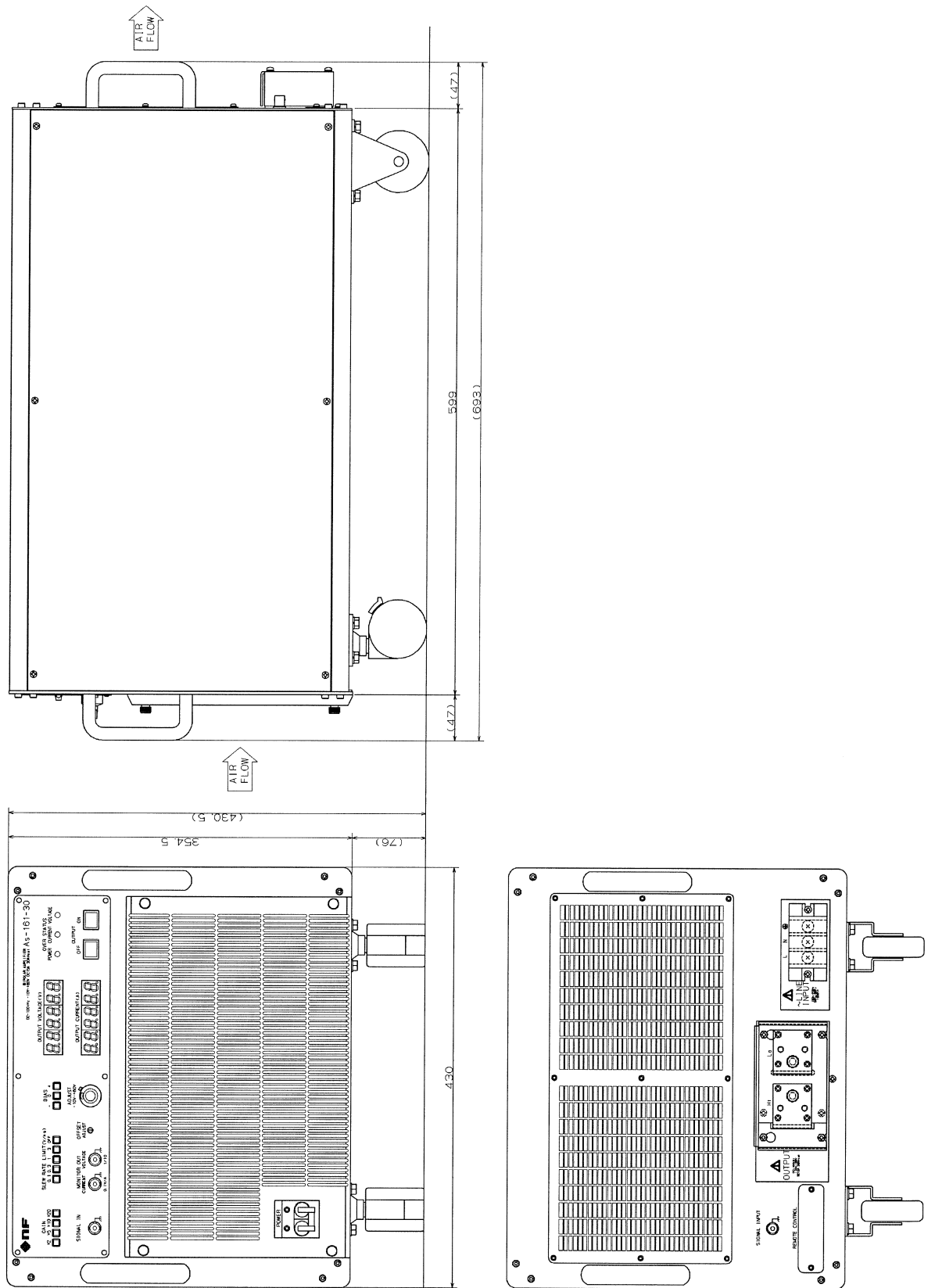
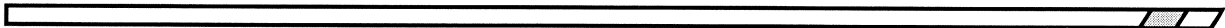
As-161-30	430(W) $\times$ 354.5(H) $\times$ 599(D)	excluding protruding portion
	430(W) $\times$ 354.5(H) $\times$ 599(D)	maximum external dimensions

As-161-60	430(W) $\times$ 577(H) $\times$ 599(D)	excluding protruding portion
	430(W) $\times$ 652.5(H) $\times$ 599(D)	maximum external dimensions

- Mass

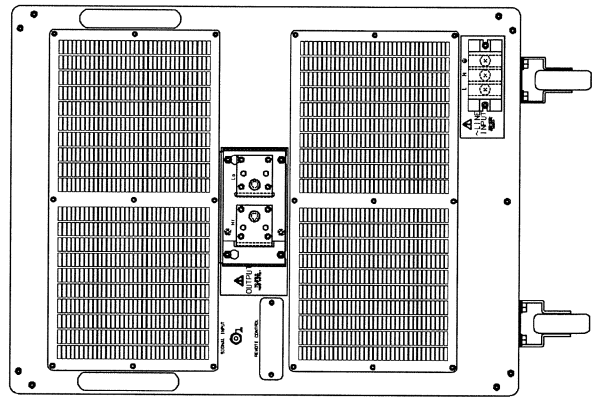
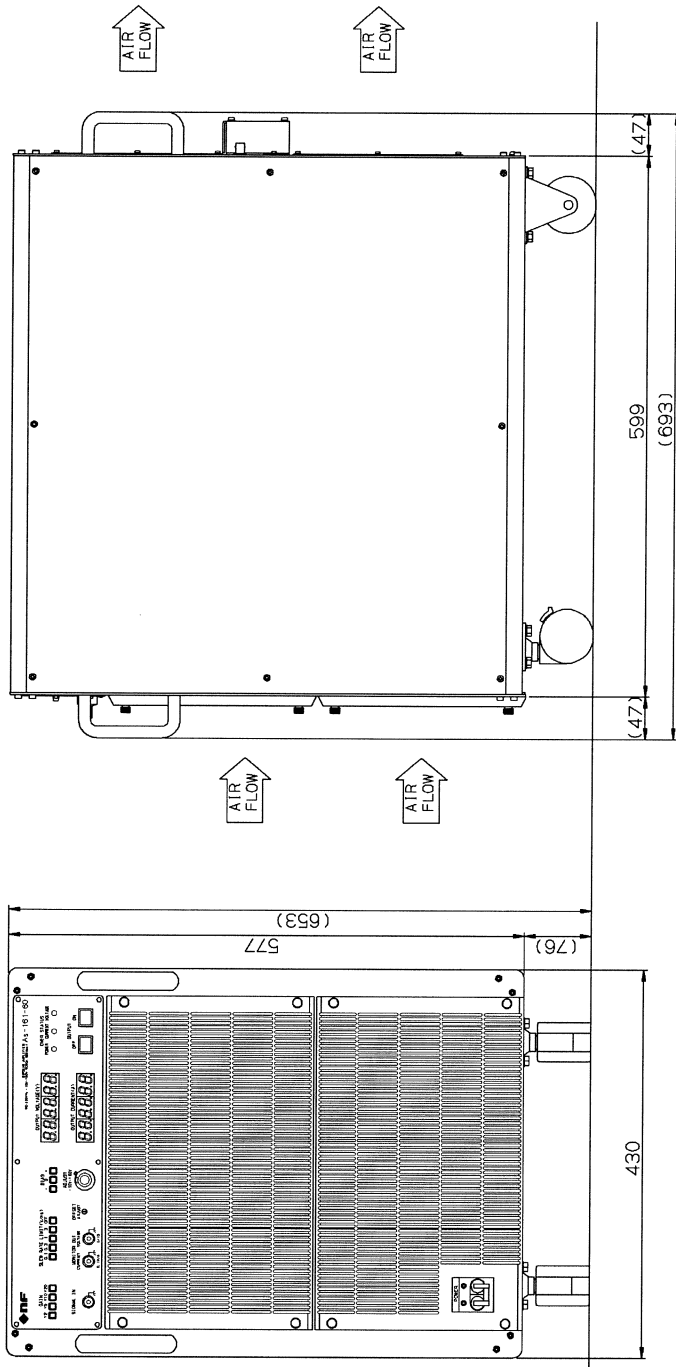
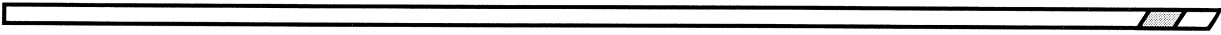
As-161-30      Approx. 36kg

As-161-60      Approx. 64kg



As-161-30 External view





As-161-60 External view



# -----Warranty-----

**NF Corporation** certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from our factory.

All **NF** products are warranted against defects in materials and workmanship for a period of one year from the date of shipment. During the warranty period, **NF** will, at its option, either will repair the defective product without any charge for the parts and labor, or repair/replace products that prove to be defective. For repair service under warranty, the product must be returned to a service center designated by **NF**. Purchaser shall prepay all shipping cost, duties, and taxes for the product to **NF** from another country, and **NF** shall pay shipping charge to return the product to purchaser.

This warranty shall not apply to any defect, failure or damage caused by improper use, improper or inadequate maintenance and care or modified by purchaser or personnel other than **NF** representatives.

**NF Corporation**



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As-161-30/60 BIPOLAR AMPLIFIER Instruction Manual

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