

PAN-A SERIES REGULATED DC POWER SUPPLY

Electronic Test
Instruments &
Power Supplies

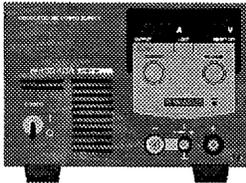


OPERATION MANUAL



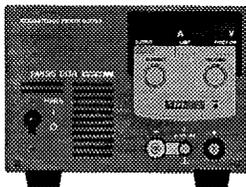
PAN-A SERIES MODEL 175W

PAN16-10A, PAN35-5A,
PAN55-3A, PAN70-2.5A,
PAN110-1.5A, PAN160-1A



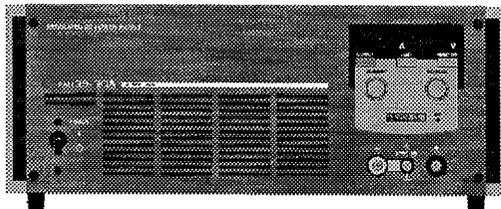
PAN-A SERIES MODEL 350W

PAN16-18A, PAN35-10A,
PAN55-6A, PAN70-5A,
PAN110-3A, PAN160-2A



PAN-A SERIES MODEL 700W

PAN16-30A, PAN35-20A,
PAN55-10A, PAN70-8A,
PAN110-5A, PAN160-3.5A,
PAN250-2.5A



PAN-A SERIES MODEL 1000W

PAN16-50A, PAN35-30A,
PAN55-20A, PAN70-15A,
PAN110-10A, PAN160-7A,
PAN250-4.5A

Use of Operation Manual

- Please read through and understand this Operation Manual before operating the product. After reading, always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.
- If you find any incorrectly arranged or missing pages in this manual, they will be replaced. If the manual it gets lost or soiled, a new Operation Manual can be purchased. In either case, please contact your Kikusui agent, and provide the "Kikusui Part No." given on this page.
- This manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact your Kikusui agent.

Reproduction and reprinting of this product as well as this operation manual, whole or partially, without our permission is prohibited. Both unit specifications and manual contents are subject to change without notice.

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly. (Revision should be applied to items indicated by a check mark)

Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC.

Use the product within this range only.

Input fuse

The rating of this product's input fuse is
_____ A, _____ VAC, and _____ .

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

Power Requirements of this Product (cont'd)

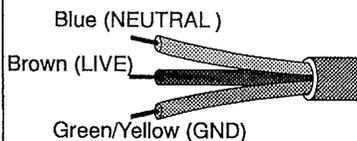
AC power cable

The product is provided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

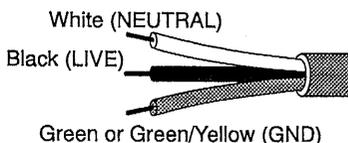
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

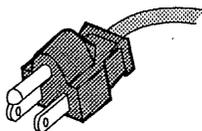
Without a power plug



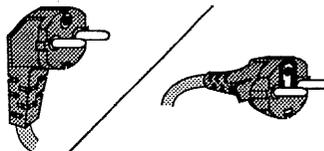
Without a power plug



Plugs for USA



Plugs for Europe



Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable. For further information, contact your Kikusui agent.

Safety Precautions

The following safety precautions must be observed to avoid fire hazard, electrical shock, accidents, and other failures. Keep them in mind and make sure that all of them are observed properly. Kikusui assumes no liability against any damages or problems resulting from negligence of the precautions.



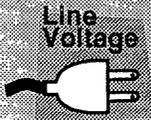
Users

- This product must be used only by qualified personnel who understand the contents of this operation manual.
- If it is handled by disqualified personnel, personal injury may result. Be sure to handle it under supervision of qualified personnel (those who have electrical knowledge.)



Purposes of use

- If the product is to be used for purposes not described in this manual, contact your Kikusui agent in advance.



Input power

- Use the product with the specified input power voltage.
- For applying power, use the AC power cable provided. The shape of the plug differs according to the power voltage and areas. Use the cable which is suitable for the line voltage used.



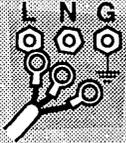
Fuse

- With products with a fuse holder on the exterior surface, the fuse can be replaced with a new one. When replacing a fuse, use the one which has appropriate shape, ratings, and specifications.



Cover

- There are parts inside the product which may cause physical hazards. Do not remove the external cover. If the cover must be removed, contact your Kikusui agent in advance.



Installation

- When installing products be sure to observe "Precautions for Installation" described in this manual.
- To avoid electrical shock, connect the protective ground terminal to electrical ground (safety ground).
- When applying power to the products from a switchboard, be sure work is performed by a qualified and licensed electrician or is conducted under the direction of such a person.
- Be sure to use the AC power cable provided. Consult your Kikusui agent if other cable than included is to be used for some reason.
- When installing products with casters, be sure to lock the casters.



Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Use two or more persons when relocating the product which weights more than 20 kg. The weight of the products can be found on the rear panel of the product and/or in this operation manual.
- Use extra precautions such as using more people when relocating into or out of present locations including inclines or steps. Also handle carefully when relocating tall products as they can fall over easily.
- Be sure the operation manual be included when the product is relocated.



Operations

- Check that the AC input voltage setting and the fuse rating are satisfied and that there is no abnormality on the surface of the AC power cable. Be sure to unplug the AC power cable or stop applying power before checking.
- If any abnormality or failure is detected in the products, stop using it immediately. Unplug the AC power cable or disconnect the AC power cable from the switchboard. Be careful not to allow the product to be used before it is completely repaired.
- For output wiring or load cables, use connection cables with larger current capacity.
- Do not disassemble or modify the product. If it must be modified, contact your Kikusui agent.



Maintenance and checking

- To avoid electrical shock, be absolutely sure to unplug the AC power cable or stop applying power before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking. If the cover must be removed, contact your Kikusui agent in advance.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking, cleaning, and calibration be performed.

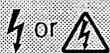


Service

- Internal service is to be done by Kikusui service engineers. If the product must be adjusted or repaired, contact your Kikusui agent.

Safety Symbols

This operation manual and this product use the following safety symbols. Note the meaning of each of the symbols to ensure safe use of the product. (As using symbols depend on the product, all of symbols may not be used.)



Indicates the presence of 1000V or higher. Inadvertently touching such a part may cause electrical shock resulting in death. If it is necessary to touch such a part to conduct work, first make sure no voltage is being supplied.



Indicates the possibility of personal injury or death. Never fail to follow the operating procedure. Do not proceed beyond a WARNING sign until the noted conditions are fully understood and met.



Indicates the existence of damage to the product or connected equipment. Always follow the operating procedure. Do not proceed beyond a CAUTION sign until the indicted conditions are fully understood and met.



Indicates additional information such as operating procedure.



Describes technical terms used in this manual.



Indicates action prohibited.



Indicates general warning, caution, risk of danger. When this mark is indicated on the product, refer the relevant section of the Operation Manual.



Indicates a grounding (earth) terminal.



Indicates a chassis grounding terminal.

Arrangement of Operation Manual

This manual is arranged as follows. An outline of each chapter is given below.

Preface

Describes all the models covered by this manual, as well as outlines the features of each model.

Chapter 1 Setup

Describes the necessary procedure from unpacking to preparation before use. Since details on installation location and power supply are provided, be sure to read this chapter before using the unit for the first time.

Chapter 2 Basic Operation

Describes the unit's start-up function, protection circuit, and the basic operations managed from the front panel of the unit.

Chapter 3 Applied Operation

Explains the remote control of the unit, and use of multiple number of power supply in combination to increase output capacity.

Chapter 4 Names and Functions of Controls

Provides an outline of the switches and terminals on the panels, including their names and functions.

Read this chapter to learn the meanings of the  caution marks indicated on the panels of the unit.

Chapter 5 Maintenance

Describes the daily inspection procedures and the calibration conducted when necessary. To remote-control the unit, such calibration is necessary. Follow the calibration procedures detailed in this chapter. The chapter also describes some symptoms of possible problems encountered during use of the unit, along with appropriate remedies.

Chapter 6 Specifications

Describes the electrical, mechanical and general specifications of the unit.

Contents

Power Requirements of this Product I

△ Safety Precautions III

Safety Symbols VI

Arrangement of Operation Manual VII

Preface _____ P-1

Outline of the manual P-1

Introduction of the products P-2

Option P-3

Chapter 1 Setup _____ 1-1

1.1 Checks during unpacking 1-1

1.2 Precautions for moving 1-5

1.3 Precautions for installation 1-8

1.4 Checking the input fuse 1-9

1.5 Connecting the AC power cable 1-10

1.6 Grounding 1-14

Chapter 2 Basic Operation _____ 2-1

2.1 Precautions and preparation for use 2-1

2.2 Turning on the power 2-6

2.3 Basic operation 2-8

2.3.1 OVP trip point presetting 2-8

2.3.2 Using as a constant voltage power supply 2-10

2.3.3 Using as a constant current power supply 2-11

2.4 Connecting load 2-12

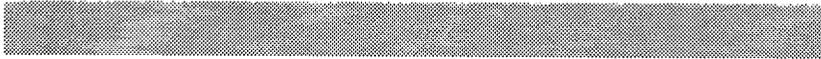
2.5 Mounting the auxiliary output terminal cover 2-16

2.6 Fixing output presetting 2-17

Chapter 3 Applied Operation _____ 3-1

3.1 CONTROL terminal board 3-1

3.2 Remote sensing 3-5



- 3.3 Analog remote control 3-8
 - 3.3.1 Controlling output voltage with external resistor 3-10
 - 3.3.2 Controlling output voltage with external voltage 3-12
 - 3.3.3 Controlling output current with external resistor 3-16
 - 3.3.4 Controlling output current with external voltage 3-18
 - 3.3.5 Output ON/OFF control 3-22
- 3.4 Master-slave-control parallel operation 3-24
- 3.5 Master-slave-control series operation 3-33

Chapter 4 Names and Functions of Controls _____ 4-1

- 4.1 Front panel 4-1
- 4.2 Rear panel 4-6

Chapter 5 Maintenance _____ 5-1

- 5.1 Cleaning 5-1
- 5.2 Inspection 5-1
- 5.3 Calibration 5-2
 - 5.3.1 Test equipment required 5-2
 - 5.3.2 Calibration procedure 5-2
- 5.4 Malfunctions and Causes 5-9

Chapter 6 Specifications _____ 6-1

- Specifications of PAN-A Series Model 175W 6-2
- Specifications of PAN-A Series Model 350W 6-7
- Specifications of PAN-A Series Model 700W 6-12
- Specifications of PAN-A Series Model 1000W 6-17

Index I-1

Preface

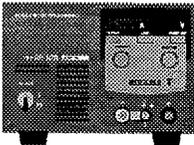
Outline of the manual

The PAN-A series is classified depending on output capacity. This Operation Manual describes the PAN-A series, including the specific types named below.



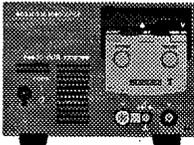
PAN-A SERIES MODEL 175W

PAN16-10A, PAN35-5A,
PAN55-3A, PAN70-2.5A,
PAN110-1.5A, PAN160-1A



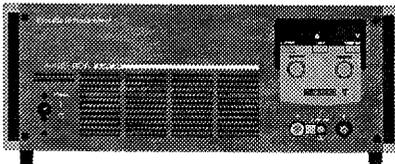
PAN-A SERIES MODEL 350W

PAN16-18A, PAN35-10A,
PAN55-6A, PAN70-5A,
PAN110-3A, PAN160-2A



PAN-A SERIES MODEL 700W

PAN16-30A, PAN35-20A,
PAN55-10A, PAN70-8A,
PAN110-5A, PAN160-3.5A,
PAN250-2.5A



PAN-A SERIES MODEL 1000W

PAN16-50A, PAN35-30A,
PAN55-20A, PAN70-15A,
PAN110-10A, PAN160-7A,
PAN250-4.5A

Fig. P-1 Models and types covered by this manual

The contents of this manual apply to all the models shown in the above-mentioned. However, descriptions of specific types and models are designated as follows.

Example 1 Descriptions of entire models of 175W and 1000W



The input fuses of the models 175W and 1000W are located inside, and users are not able to check or replace them.

Example 2 Descriptions of PAN16-50A



The PAN16-50A has no auxiliary output terminals on the front panel.

Introduction of the products

The PAN-A series is an automatic constant voltage/constant current shifting regulated DC power supply equipped with the phase control pre-regulator. A series regulator system is used to assure low-noise and stable output.

The PAN-A series are featured with the following points.

- The two distinctly visible LED display units on the front panel display output voltage, output current and various preset data.
- The output control potentiometer (for voltage and current presetting) is of a 10-turns wire-wound design, and allows precise setting.
- For both the front and rear panels, the output terminals can be equipped with a cover for safety.
- Using external voltage or external resistor, output voltage and current can be remote-controlled. With the GPIB interface available with our PIA3200, an automatic testing system can be formed.
- The remote control and remote sensing terminals use screwless terminal boards, which facilitates wiring.
- The phase control pre-regulator is furnished with a choke input smoothing circuit, which decreases apparent input power and suppresses harmonic components in the input current. Therefore, potential effects on the power line, such as input voltage distortion, are decreased.
- High-speed transient response of 50 μ s allows it to follow a sudden load change.

- Carefully selected parts, improved circuit, and forced air cooling heat dissipation combine to produce an excellent low temperature drift of 100 ppm/°C (constant voltage characteristic).
- To protect a load from unexpectedly excessive voltage, the unit includes a built-in OVP (over-voltage protection) circuit capable of handling voltages 10-110% of the rated output voltage.

With the above-mentioned features, PAN-A series units offers a wide range of applications to laboratory experimental equipment, test equipment for mass-production lines, power supply for aging, etc.

NOTE

- Since this unit uses a phase control circuit for the pre-regulator, output is superimposed with pulsive noise. Although the noise level is kept sufficiently low, it may still cause some problem with certain types of applications. Please study this issue carefully before choosing which unit to use.

Option

The following optional accessories are available for rack mounting.

- Rack mount frame RMF4M (Metric rack conforming to JIS standards)
 RMF4 (Inch rack conforming to EIA standards)
- Blank panel BP2, BP4
- Bracket B22, B42, BH4M, BH4

CAUTION

- The unit is furnished with air intake ports for forced air cooling. For rack mounts, therefore, we request that you mount a blank panel of at least one panel wide on the rack.

For details on optional accessories, contact your Kikusui agent.

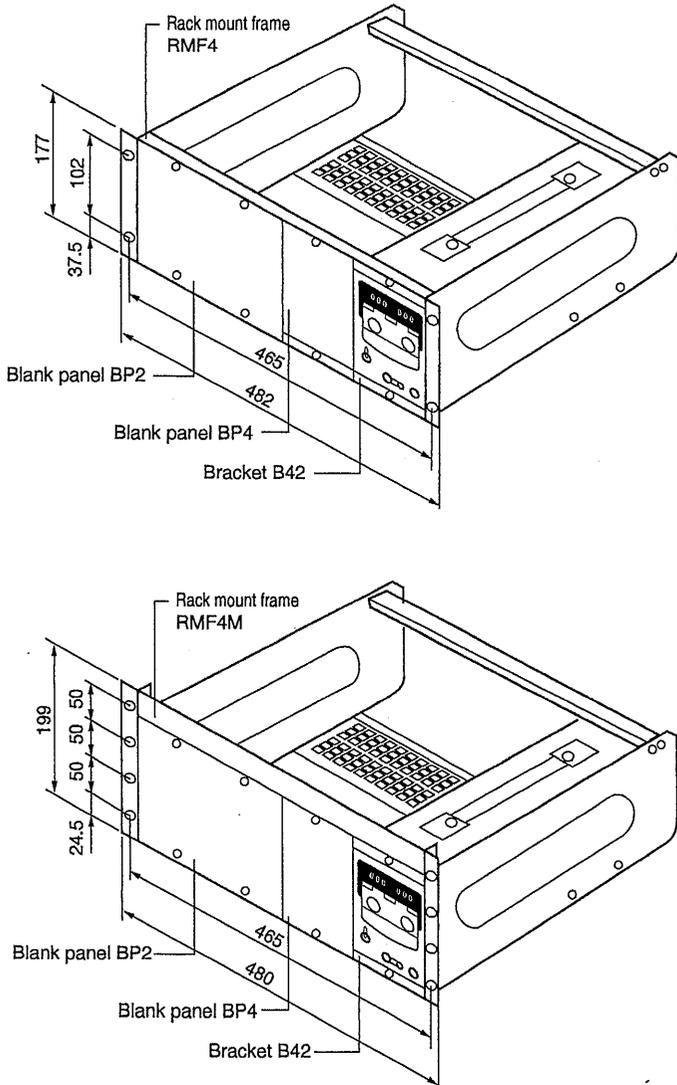


Fig. P-2A Model 175W mounted into RMF4M/RMF4

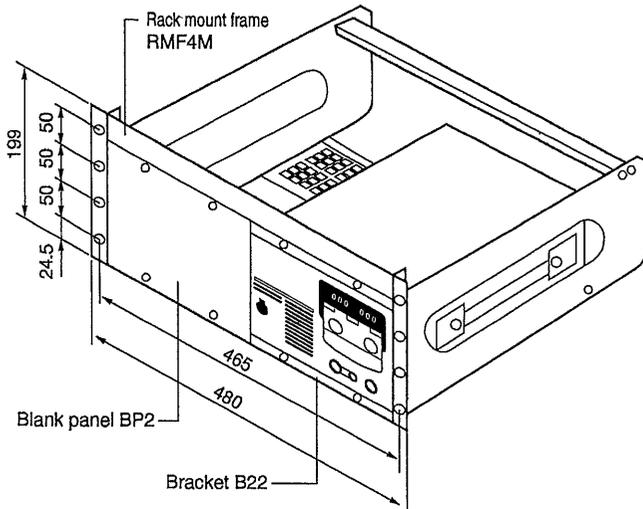
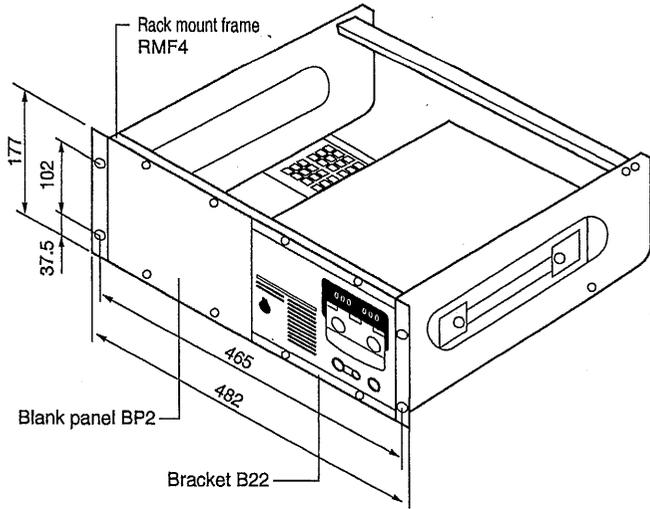
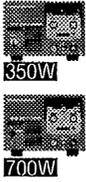


Fig. P-2B Model 350W/700W mounted into RMF4M/RMF4

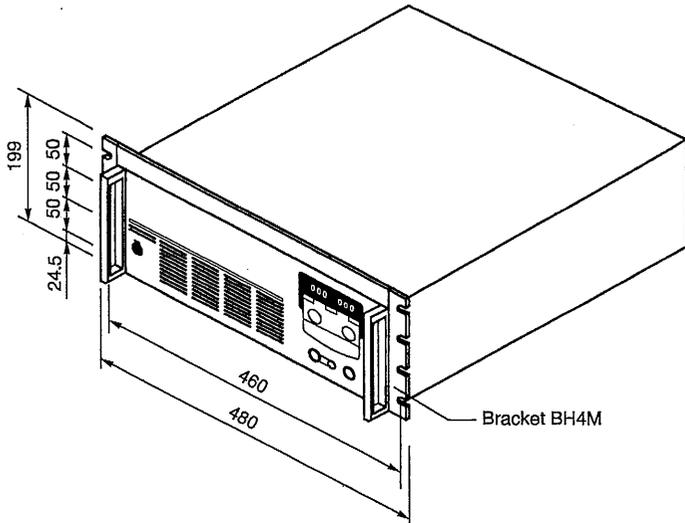
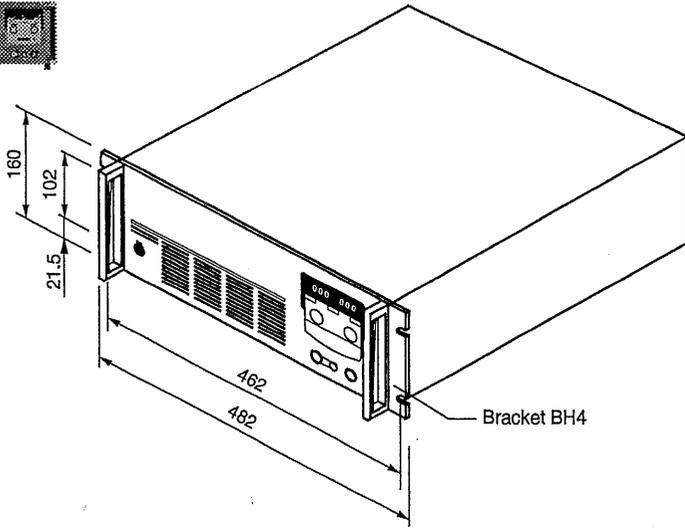


Fig. P-2C Model 1000W with BH4M/ BH4 mounted on it

1.1 Checks during unpacking

When you unpack the product, make sure that you have all the parts and that none have been damaged during transportation. If any parts is damaged or missing, contact your Kikusui agent.

Accessories vary depending on the model. Check with Fig. 1-1.



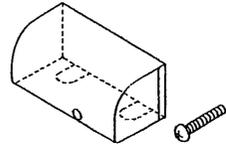
The model 175W includes the following accessories.



Operation manual



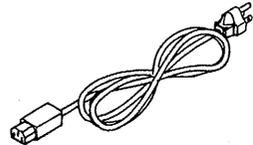
Guard cap



Auxiliary output terminal cover



Rear output terminal cover
(Mount on the unit.)



AC power cable

Fig. 1-1A Accessories (model 175W)

NOTE

- We recommend that all packing materials be saved, in case the product needs to be transported at a later date.
- Models that have had their rated inputs changed according to a factory option, i.e., those other than 100 V AC input models, may come with no plugs.



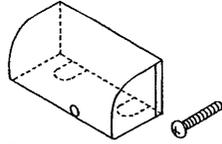
The model 350W includes the following accessories.



Operation manual



Guard cap



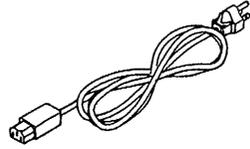
Auxiliary output terminal cover



Rear output terminal cover
(Mount on the unit.)



Fuse



AC power cable

Fig. 1-1B Accessories (model 350W)

NOTE

- We recommend that all packing materials be saved, in case the product needs to be transported at a later date.
- Models that have had their rated inputs changed according to a factory option, i.e., those other than 100 V AC input models, may come with no plugs.



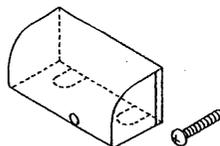
The model 700W includes the following accessories.



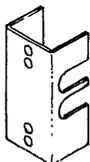
Operation manual



Guard cap



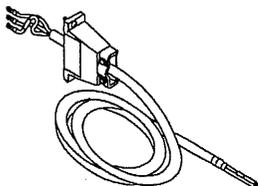
Auxiliary output terminal cover



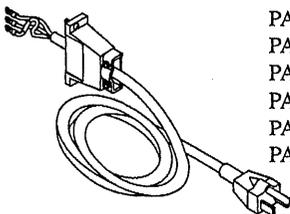
Rear output terminal cover
(Mount on the unit.)



Fuse



PAN35-20A
(with no plug)



PAN16-30A
PAN55-10A
PAN70-8A
PAN110-5A
PAN160-3.5A
PAN250-2.5A

AC power cable
(with cable clamp)

Fig. 1-1C Accessories (model 700W)

NOTE

- We recommend that all packing materials be saved, in case the product needs to be transported at a later date.
- Models that have had their rated inputs changed according to a factory option, i.e., those other than 100 V AC input models, may come with no plugs.



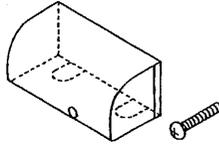
The model 1000W includes the following accessories.



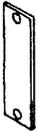
Operation manual



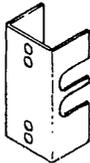
Guard cap



Auxiliary output terminal cover
(Not included for the PAN16-50A.)

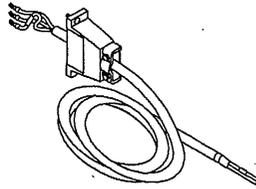


PAN16-50A



PAN35-30A
PAN55-20A
PAN70-15A
PAN110-10A
PAN160-7A
PAN250-4.5A

Rear output terminal cover
(Mount on the unit.)



AC power cable
(with cable clamp)

Fig. 1-1D Accessories (model 1000W)

NOTE

- We recommend that all packing materials be saved, in case the product needs to be transported at a later date.

1.2 Precautions for moving

To carry the unit, hold the handle as shown below. When moving the unit for a short distance, to the next room, for example, carry it on a wagon whenever available.

WARNING

- For safety, check that the power switch is turned off.

CAUTION

- When transporting the product, be sure to use the original packing materials. If they are missing, contact your Kikusui agent.
- When packing the product, remove the power cable and all other connection cables.



In the case of the model 175W, hold the handle located on the top.

Hold the handle.

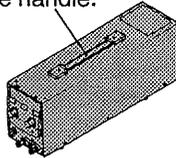


Fig. 1-2A Precaution for moving (model 175W)



In the case of the model 350W, the power transformer is located on the left seen from the front, and the center of gravity of the unit is deviated to the left. For carrying the unit, position the left side to be bottom first as shown in Fig. 1-2B, and carry it with the handle.

Position the left side to the bottom.

Hold the handle.

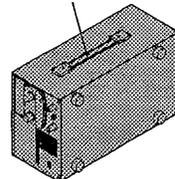
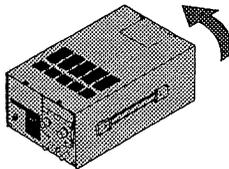


Fig. 1-2B Precaution for moving (model 350W)

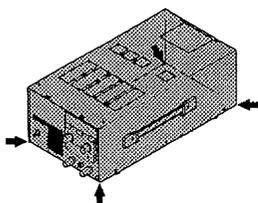


In the case of the model 750W, the power transformer is located on the left seen from the front, and the center of gravity of the unit is deviated to the left. For carrying the unit, take sufficient care.

WARNING

- The weight of the model 700W exceeds 22 kg. To prevent any danger, never carry the unit by one person.

When moving the unit, two persons should hold the two locations at the rear and front of the unit, respectively, as shown in Fig. 1-2C.



Two persons should hold the two locations at the rear and front of the unit.

Fig. 1-2C Precaution for moving (model 700W)



In the case of the model 1000W, the power transformer is located on the left seen from the front, and the center of gravity of the unit is deviated to the left. For carrying the unit, take sufficient care.

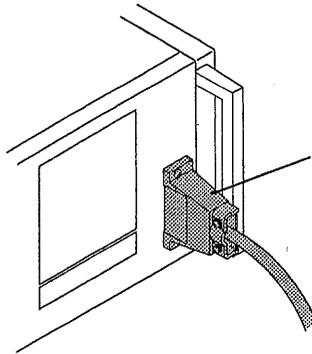
WARNING

- The weight of the model 1000W exceeds 35 kg. To prevent any danger, never carry the unit by one person.
- Holding the handles of the unit with the cable clamp mounted can be difficult. Therefore, when moving the unit, always remove the cable clamp and disconnect the AC power cable.

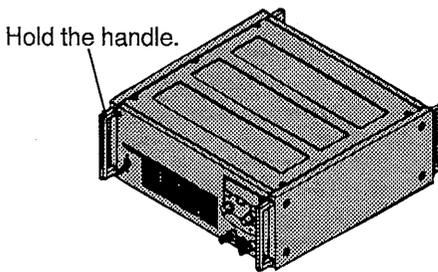
CAUTION

- Before placing the unit upright, always remove the cable clamp and AC power cable; otherwise, the clamp may be damaged.

To carry the unit, hold handles on the front panel and rear panel with two persons or more, or stand the unit as shown in Fig. 1-2D, and hold handles on the front panel with two persons. After moving, quickly place the unit with its bottom underneath.

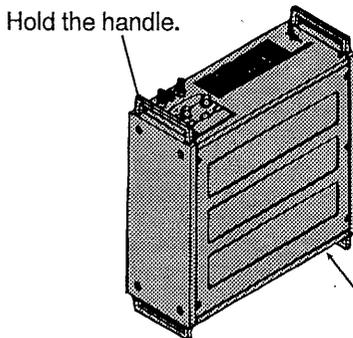


Remove the cable clamp and AC power cable from the rear panel before moving the unit.



Hold the handle.

To carry the unit in a horizontal position, two or more persons should hold the handles in four places.



Hold the handle.

To carry the unit in an upright position, the front panel handles should be held by two persons. Do not leave the unit in the upright position.

Remove the cable clamp and AC power cable from the rear panel.

Fig. 1-2D Precaution for moving (model 1000W)

1.3 Precautions for installation

Be sure to observe the following precautions when installing the unit.

- **Do not use the unit in a flammable atmosphere.**

To prevent explosion or fire, do not use the unit near alcohol or thinner, or in an atmosphere containing such vapors.

- **Avoid locations where the unit is exposed to high temperature or direct sunshine.**

Do not locate the unit near a heater or in areas subject to drastic temperature changes.

Operation temperature range: 0 to 40°C

Storage temperature range: -10 to 60°C

- **Avoid locations of high humidity.**

Do not locate the unit in high-humidity locations, i.e., near a boiler, humidifier, water supply, etc.

Operation humidity range: 10 to 90% RH

Storage humidity range: 0 to 70% RH

Dew condensation may take place even in the operation humidity range. In such a case, do not use the unit until the dew dries up completely.

- **Do not place the unit in a corrosive atmosphere.**

Do not install the unit in a corrosive atmosphere or one containing sulfuric acid mist, etc. This may cause corrosion of various conductors and imperfect contact with connectors, malfunction and failure, or in the worst case, a fire.

Modification may allow the unit to cope with such an atmosphere. If the unit is to be used in such an atmosphere, contact your Kikusui agent.

- **Do not locate the unit in a dusty location.**

- **Do not use the unit where ventilation is poor.**

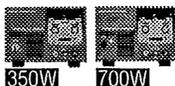
The unit employs a forced air cooling system. Air is taken in from intake ports located on the unit's sides and front, and is exhausted from the rear. Prepare sufficient space around the unit so that the intake ports and exhaust port are always completely unobstructed.

Do not install the unit with its front panel positioned upward or downward.

- **Do not install the unit along a tilted section of floor or in a location subject to vibrations.**

- **Do not use the unit in locations affected by strong magnetic and/or electric fields.**

1.4 Checking the input fuse



Use an input fuse element suitable for the AC power source. A seal is attached to the rear panel indicating suitable fuse ratings. See Fig. 1-3.

WARNING

- To avoid electric shock, always disconnect the AC power cable or turn off the switch on the switchboard.

CAUTION

- Select a fuse element of external design, rating and characteristics suitable for the unit. Use of a fuse of different rating or a short circuit of the fuse holder may damage the unit.

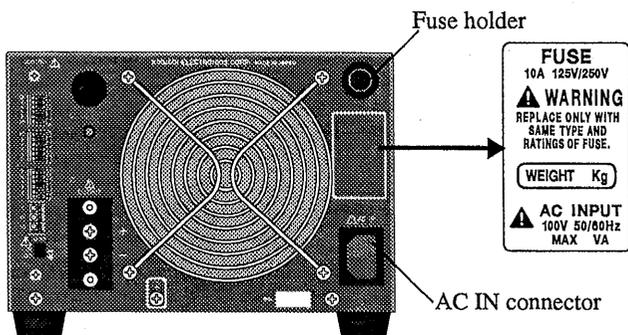
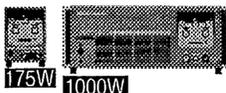


Fig. 1-3 Rear panel (model 350W)



The input fuses of the models 175W and 1000W are located inside, and users are not able to check or replace them.

WARNING

- Users are requested to never remove the cover and check or replace the fuse.

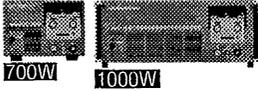
1.5 Connecting the AC power cable

Connect the AC power cable to an AC power source specified for the unit. A seal is attached to the rear panel indicating the rated input. See Fig. 1-3.

Connecting procedure of PAN-A series side



- ① Insert the supplied AC power cable into the AC IN connector on the rear panel.



WARNING

- To avoid electric shock, first connect the cable to the AC IN terminal board before connecting it to the power source.

- ① Connect the supplied AC power cable to the terminal board as shown in Fig. 1-4.

CAUTION

- Inside the unit, protective circuits including input fuses are connected in order to meet the input terminal rating. Confirm that the wires of the specified color are connected to the corresponding terminals (L, N, and ⊕(GND)).

NOTE

- Fig. 1-4 shows the connections on the model 700W. Connections on model 1000W can be performed in the same manner.

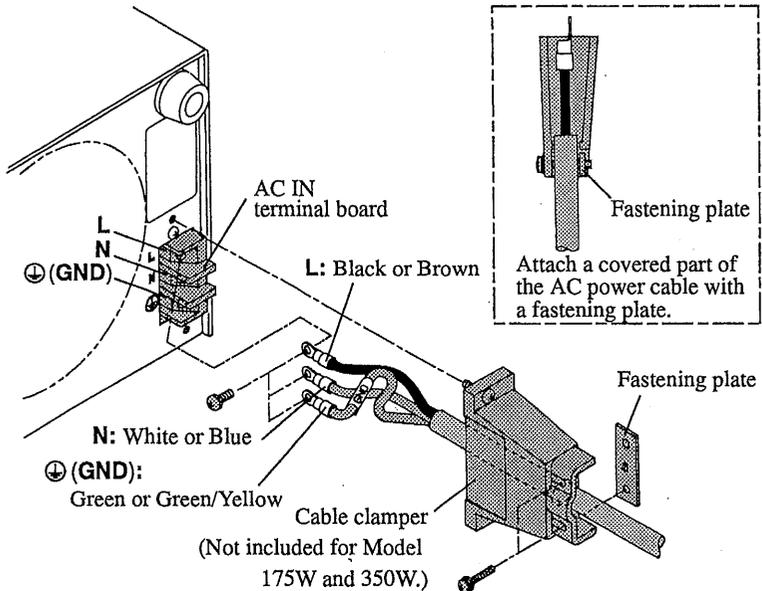
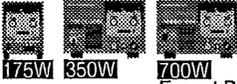


Fig. 1-4 Connection of AC power cable

Connecting procedure of AC power source side



Except PAN35-20A

- ① Insert the plug of the AC power cable into a power socket.

■ Direct connection to a switchboard

To directly connect the unit to a switchboard, remove the plug from the AC power cable and attach a crimp terminal to the end of each wire.

For connection, follow the procedure for the 1000W model, as described on the next page.

■ If the supplied AC power cable has no plug:

Models that have had their rated inputs changed according to a factory option, i.e., those other than 100 V AC input models, may come with no plugs. For such models, use one of the following methods to connect the cable to a power socket.

- a. Attach a suitable plug to the AC power cable, then connect the cable to the socket.

CAUTION

- Inside the unit, protective circuits including input fuses are connected in order to meet the input terminal rating. When attaching a plug to the AC power cable, refer to Fig.1-5 and confirm that the wires of the specified color are connected to the corresponding terminals (L, N, and ⊕(GND)). (This connection must be performed by qualified personnel.)
- b. Attach crimp terminals to the wires of the AC power cable and connect the wires directly to the switchboard. For connection, follow the procedure for the 1000W model, as described on the next page.



700W
PAN35-20A



1000W

- ① Attach crimp terminals to the wires of the AC power cable.

CAUTION

- Check the terminal screw on the switchboard, and crimp a terminal on each wire end suitable for the said terminal screw. (This connection must be performed by qualified personnel.)

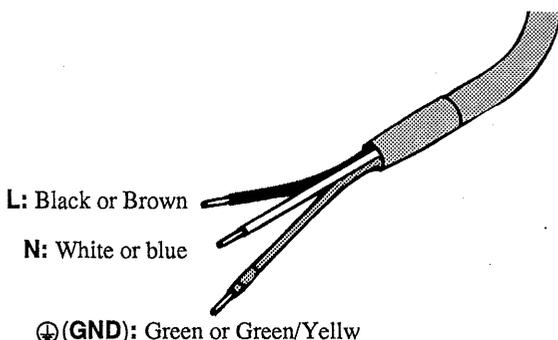


Fig. 1-5 AC power cable (AC power source side)

- ② Turn off the switch on the switchboard.

WARNING

- To avoid electric shock, always turn off the switch on the switchboard before cable connection.

- ③ Connect the AC power cable to the switchboard.

CAUTION

- Inside the unit, protective circuits including input fuses are connected in order to meet the input terminal rating. Confirm that the wires of the specified color are connected to the corresponding terminals (L, N, and ⊕(GND)). (This connection must be performed by qualified personnel.)

1.6 Grounding

WARNING

- Improper or no grounding may cause electrical shock.
- Connect the ground terminal to electrical ground (safety ground).



175W

350W

700W

Except PAN35-20A

To ground the models 175W, 350W and 700W (except PAN35-20A), two methods are available as described below. Select one of them, and securely ground the unit.

- a. Connect the 3-P plug to a grounded 3-P receptacle.
- b. Cut off the plug, put a crimped terminal on the ⊕(GND) wire, and connect it to the grounding terminal on the switchboard.



700W

PAN35-20A

1000W

In the case of the PAN35-20A and the models 1000W, securely connect the ⊕(GND) wire of the power cable to the GND terminal of the switchboard.

2.1 Precautions and preparation for use

Before using the unit, users are requested to thoroughly understand the following matters.

■ Inrush current

A inrush current may flow when the POWER switch is turned on. See Table 2-1. If you are planning to use several sets of the unit in a system, and to turn on the POWER switches at the same time, check that the AC power source or the switchboard is of sufficient capacity. Keep 3 seconds or longer interval between ON and OFF of the POWER switch. Repeated ON/OFF at a shorter interval may cause inrush current and shorten the service lives of the input fuse and power switch.

Table 2-1 Inrush current of each model

	Model 175W	Model 350W	Model 700W	Model 1000W
Peak current range	100A to 150A	140A to 200A	300A to 400A	450A to 550A
Half-amplitude level	5ms	5ms	5ms	5ms

■ Negative voltage

Regardless of the OUTPUT switch's ON or OFF setting, when the VOLTAGE control or the CURRENT control is turned fully counter-clockwise, a negative voltage of 0-0.6 V is generated.

Affected by this voltage, approx. 10 mA reverse current flows to the load. In cases where the load will be affected by such a reverse current, carefully check the suitability of the application.

■ Output terminals on the front panel

The output terminals on the front panel are auxiliary output terminals. These terminals, however, may not satisfy the given specifications of the unit.



1000W
PAN16-50A

The PAN16-50A has no output terminals on the front panel.

■ Load

Note that the output may become unstable when one of the following loads is connected.

1. When load current has peaks or is pulse-shaped

The current meter on the unit indicates only mean values. Even when the indicated value is less than the preset current value, therefore, a peak may exceed the preset current value. In such a case, the unit is instantaneously put into constant-current operation mode, and the output voltage drops accordingly. If you look carefully, you will see the constant current (CC) indicator light up dimly.

For such a load, a larger value should be preset for the constant current, or the current capacity should be increased.

--- Constant current preset value
----- Meter indication value
(mean value)

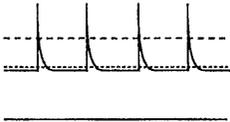


Fig. 2-1 Load current with peak value

--- Constant current preset value
----- Meter indication value
(mean value)

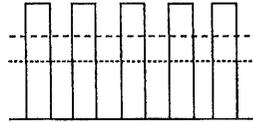


Fig. 2-2 Pulse-shaped load current

2. When a load generates a reverse current to the power supply

The unit cannot absorb a reverse current from a regenerative load such as an inverter, converter or transformer that supplies current to a power supply. Consequently, the output voltage will increase and the output will fluctuate.

As a remedy, connect a resistor R_D as shown in Fig. 2-3 to bypass the reverse current. However, the amount of current to the load decreases by I_{rp} .

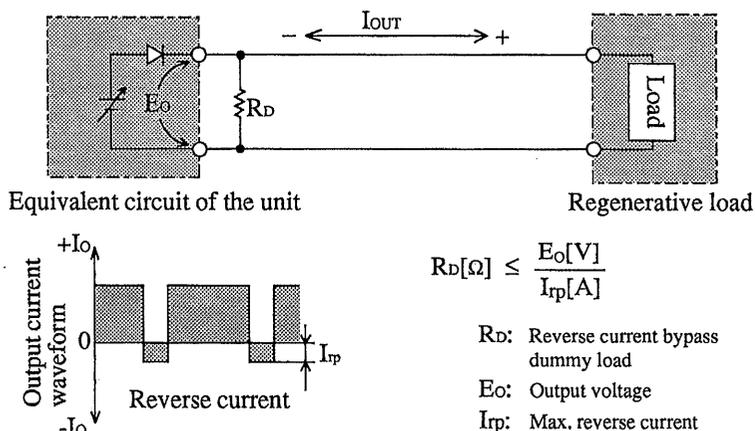


Fig. 2-3 Remedy for regenerative load

CAUTION

- For the resistor R_D , select a resistor of the rated power (allowing sufficient margin). If a resistor of insufficient rated power is used in the circuit, it may burn out.

■ Load (cont'd)

3. In case of load with accumulated energy, such as batteries

Connecting a load with accumulated energy, such as a battery, to the output of the unit may cause a large current to flow from the load through the internal output control circuit protection diode to the internal capacitor. Such currents may damage the internal components of the unit, and reduce the life of the load.

As a remedy, connect a reverse-current-prevention diode D between the unit and the load as shown in Fig. 2-4. In this case, however, the unit cannot be used in combination with remote sensing units.

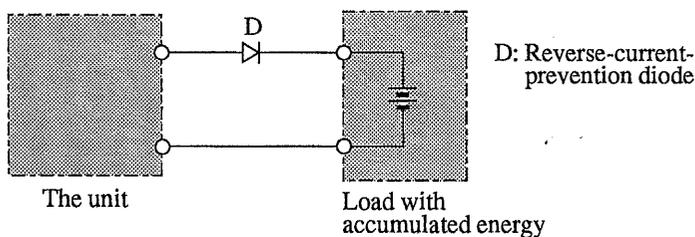


Fig. 2-4 Measures against load with accumulated energy

CAUTION

- To protect the unit and the load, select the reverse-current-prevention diode D according to the following standard.
 1. Reverse voltage withstand capacity: Minimum of twice the rated output voltage of the unit.
 2. Forward current capacity: Three to ten times the rated output current of the unit.
 3. A diode with small loss
- Be sure to take account of heat generation from the diode D. The diode may burn unless adequately dissipated.

■ CV power supply and CC power supply

The unit is capable of both constant voltage and constant current operation.

First, we will describe constant voltage (CV) operation.

As an example, we assume that PAN35-10A is used to apply 20 V to a 10 Ω load under constant voltage (CV) operation. Fig. 2-5 shows operation under this condition.

Assuming that the maximum current under this load is 4A, PAN35-10A output is set to 20 V / 4 A. Because 20 V is applied to the 10 Ω load, a current of 2 A flows in the load. If the resistance of the load changes to 5 Ω , the power supply's output becomes 20 V / 4 A. As is apparent from the figure, the power supply's output is kept at 20 V for a load resistance variation of more than 5 Ω . However, if load resistance falls below 5 Ω , the power supply automatically changes to constant current (CC) operation in order to keep the current at 4 A. Note that the output voltage becomes less than 20 V.

Next, we describe constant current (CC) operation of the unit.

Assuming that the maximum voltage that can be applied to the load is 30 V / 2 A in the above example, PAN35-10A output is set to 30 V / 2 A. Fig. 2-6 shows operation under this condition.

As is clear from the figure, the output current of the power supply is kept at 2 A for a load resistance of 0 to 15 Ω . If load resistance exceeds 15 Ω , the power supply automatically changes to constant voltage (CV) operation in order to maintain output voltage at 30 V. Note that output current becomes less than 2 A.

In this way, the unit automatically selects constant voltage or constant current operation according to the output setting of the unit and the load status, so that output does not exceed the preset value. This protects the load.

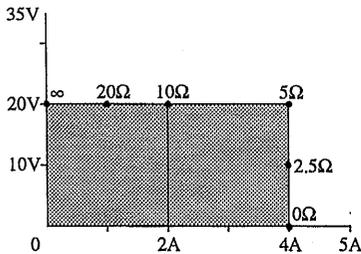


Fig. 2-5 Constant voltage (CV) operation

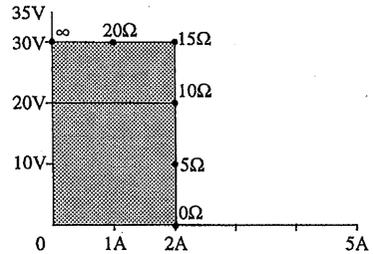


Fig. 2-6 Constant current (CC) operation

2.2 Turning on the power

Before turning on the POWER switch, always check the status of the OUTPUT switch. Push in the OUTPUT switch to turn it on, and release it to turn it off.

CAUTION

- If the POWER switch is turned on while the OUTPUT switch remains on, a preset voltage or current is supplied to the load.

NOTE

- If the POWER switch is turned on while the OUTPUT switch remains on, AC ripple components may be superimposed at startup depending on the operation speed of the phase control circuit and the status of the load.
- When the remote sensing function is not being used, be sure to turn off the SENS switch. Turning on the SENS switch can cause difference between output voltage and display.

Turning on the power procedure

- ① Check that the POWER switch is turned off.
- ② Check that the OUTPUT switch is turned off.
- ③ Open the sub-panel cover of the control panel to confirm that all control switches (S1 to S5) are off.
- ④ Check that the SENS switch on the rear panel is off.
- ⑤ Check that the AC power cable is correctly connected.
- ⑥ Turn on the switch on the switchboard which supplies power to the unit, or connect the AC power cable plug to a receptacle.
- ⑦ Turn on the POWER switch.
- ⑧ The LED on the control panel lights up.
- ⑨ While pressing the LIMIT switch, and turn the VOLTAGE control; check that the output voltage can be preset in a range from zero to the rated output voltage value.
- ⑩ Continue pressing the LIMIT switch, and turn the CURRENT control; check that the output current can be preset in a range from zero to the rated output current value.

Now, the unit is ready for use.

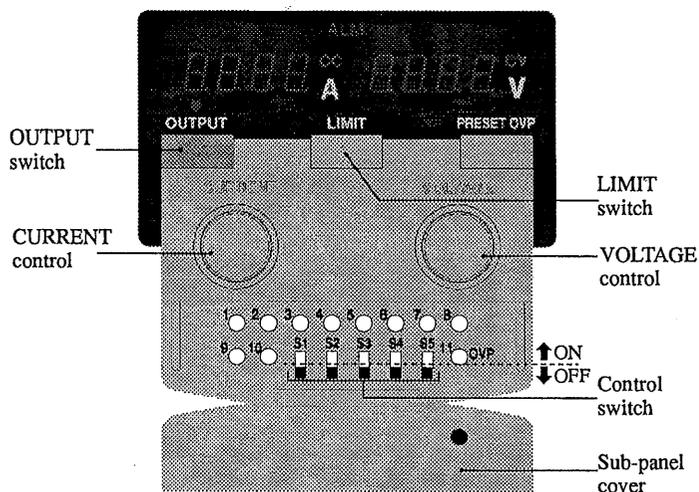


Fig. 2-7 Control panel
Hold the right and left edges of the sub-panel between your fingers and open the sub-panel towards you.

2.3 Basic operation

There are two different modes for the unit: constant voltage (CV) mode, and the constant current (CC) mode. Before starting to use the unit, determine which mode is to be employed, and select the procedure suitable for the selected operation mode.

CAUTION

- To protect the load, preset the OVP trip point for either operation mode.

2.3.1 OVP trip point presetting

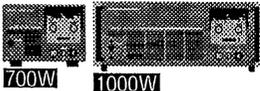
The overvoltage protection (OVP) function protects a load from unexpectedly high voltage. If the OVP function is activated, the "ALM" (alarm) LED on the control panel lights up, and output is shut down. To release the alarm, turn off the OUTPUT switch and turn on the POWER switch again. In this case, lower the output voltage preset value. Otherwise, the OVP function is re-activated when the OUTPUT switch is turned on.

CAUTION

- The OVP trip point is factory-preset to approx. 110% of the rated output voltage of the unit. When using the unit, preset to an OVP trip point suitable for the load.

NOTE

- To turn on the POWER switch again after OVP has been activated, wait for at least 3 seconds after cutting off the output, then turn on the POWER switch. Otherwise, the output cut-off circuit may remain latched, disabling the output.



- If the OVP function is activated, the 700W and 1000W models turn off the POWER switch when output is shut down.

Presetting the OVP trip point

CAUTION

- After presetting the OVP trip point, be sure to check that the OVP function works at the preset voltage (Procedure ④ - ⑥). For checking, it is necessary to output an actual voltage. Therefore, first check that no load is connected, and proceed with the following procedure.

- ① Turn off the OUTPUT switch.
 - ② Turn on the POWER switch.
 - ③ While presetting the PRESET OVP switch, turn the OVP control with a Phillips-head screwdriver, and preset to the over voltage against which the load is to be protected.
 - ④ Turn the VOLTAGE control fully counter-clockwise.
 - ⑤ Turn on the OUTPUT switch.
 - ⑥ Gradually turn the VOLTAGE control clockwise, and check that the "ALM" (alarm) LED lights up and the output is shut down when the output voltage has reached the preset OVP voltage.
 - ⑦ Turn the VOLTAGE control fully counter-clockwise again.
 - ⑧ Turn off the OUTPUT switch.
 - ⑨ Turn off the POWER switch.
- Now, the OVP trip point presetting is completed.

2.3.2 Using as a constant voltage power supply

WARNING

- For safety, turn off the POWER switch when connecting the load.
- ① Check that the OUTPUT switch is turned off.
 - ② Turn on the POWER switch.
 - ③ While pressing the LIMIT switch, preset the requested current by turning the CURRENT control.

NOTE

- The LIMIT switch simply displays the present voltage and current settings. It has no memory feature.
- ④ While pressing the LIMIT switch, preset the requested voltage by turning the VOLTAGE control.
 - ⑤ Turn on the OUTPUT switch.
 - ⑥ The "CV" LED lights up on the control panel to indicate that the unit is in constant voltage mode.

CAUTION

- For the loads listed below in which sudden voltage application is undesirable, follow steps ① to ③ above, then follow steps ④ to ⑦ below.
 - a. Loads of unknown resistance
 - b. Loads whose resistance varies over a wide range
 - c. Loads of large inductance
- ④ Turn the VOLTAGE control fully counter-clockwise.
 - ⑤ Turn on the OUTPUT switch.
 - ⑥ Turn the VOLTAGE control slowly to raise voltage gradually.
 - ⑦ The "CV" LED lights up on the control panel to indicate that the unit is in constant voltage mode.

2.3.3 Using as a constant current power supply

WARNING

- For safety, turn off the POWER switch when connecting the load.
- ① Check that the OUTPUT switch is turned off.
 - ② Turn on the POWER switch.
 - ③ While pressing the LIMIT switch, preset the requested voltage by turning the VOLTAGE control.

NOTE

- The LIMIT switch simply displays the present voltage and current settings. It has no memory feature.
- ④ While pressing the LIMIT switch, preset the requested current by turning the CURRENT control.
 - ⑤ Turn on the OUTPUT switch.
 - ⑥ If a load is connected, the "CC" LED lights up on the control panel showing that the unit is in constant current mode.

CAUTION

- For the loads listed below in which sudden current application is undesirable, follow steps ① to ③ above, then follow steps ④ to ⑦ below.
 - a. Loads of unknown resistance
 - b. Loads whose resistance varies over a wide range
 - c. Loads of large inductance
- ④ Turn the CURRENT control fully counter-clockwise.
 - ⑤ Turn on the OUTPUT switch.
 - ⑥ Turn the CURRENT control slowly to increase current gradually.
 - ⑦ The "CC" LED lights up on the control panel showing that the unit is in constant current mode.

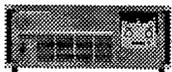
2.4 Connecting load

WARNING

- The connection cable to the load (the load cable) should be of a sufficient capacity for the rated current.

NOTE

- The output terminals of this unit are found in two locations, on the rear panel and the front panel. The terminals on the front panel, however, are for auxiliary purposes and may not satisfy the specified performance.
- Usually, connect the chassis ground terminal (\perp) on the front panel to a - (neg.) output terminal or + (pos.) output terminal using the shorting bar.



1000W
PAN16-50A

- The PAN16-50A has no front panel output terminal. The shorting bar to connect the output terminal to the chassis ground terminal (\perp) is mounted on the rear panel output terminals.

Using the auxiliary output terminals on the front panel

WARNING

- For safety, turn off the POWER switch when connecting the load.

See Fig. 2-8.

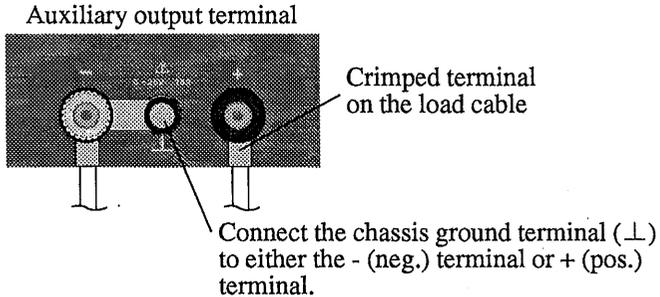
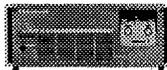


Fig. 2-8 Connection to the auxiliary output terminals on the front panel

CAUTION

- To assure a good connection of the load cable to the output terminals, use crimped terminals.
- After connecting the load cable, mount the auxiliary output terminal cover.

To mount the auxiliary output terminal cover, see section 2.5, "Mounting the auxiliary output terminal cover".



1000W
PAN16-50A

The PAN16-50A has no auxiliary output terminals on the front panel.

Using the OUTPUT terminal board on the rear panel

WARNING

- For safety, turn off the POWER switch when connecting the load.

For the model 175W user, see Fig. 2-9.

For the model 350W, 700W, or 1000W user, see Fig. 2-10.

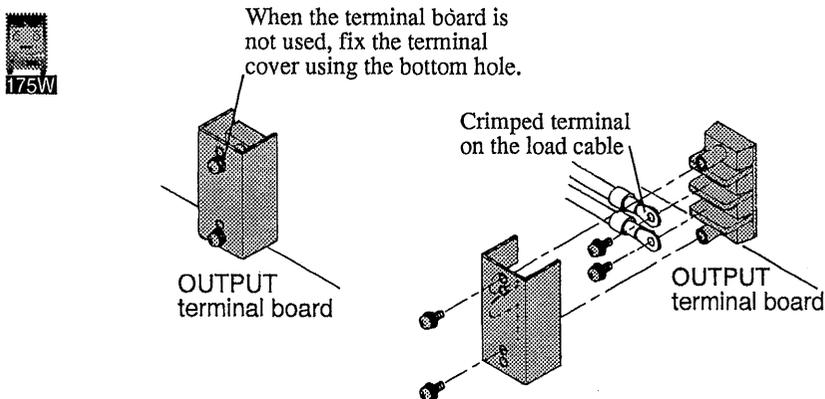


Fig. 2-9 Connection to the OUTPUT terminal board on the rear panel (model 175W)

As shown in Fig. 2-9, lay load cables at the left of the OUTPUT terminal board, as seen from the rear panel.

CAUTION

- To assure a good connection of the load cable to the output terminals, use crimped terminals.
- After connecting the load cable, mount the rear output terminal cover.

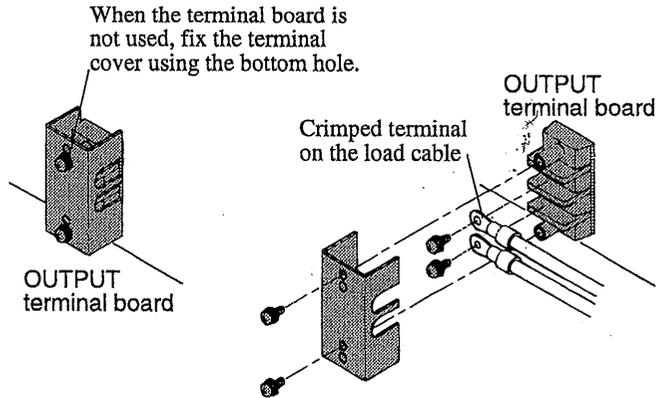
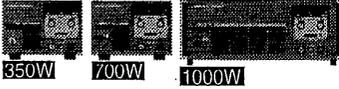


Fig. 2-10 Connection to the OUTPUT terminal board on the rear panel (model 350W/700W/1000W)

As shown in Fig. 2-10, lay load cables at the right of the OUTPUT terminal board, as seen from the rear panel.

CAUTION

- To assure a good connection of the load cable to the output terminals, use crimped terminals.
- After connecting the load cable, mount the rear output terminal cover.

NOTE



- The shape of the rear output terminal cover of the PAN16-50A is different from that shown in Fig. 2-10.

2.5 Mounting the auxiliary output terminal cover

The unit is provided with a front auxiliary output terminal cover. Mount the cover when the unit is to be used.

CAUTION

- To mount the cover, be sure to use the screws supplied. Other screws, if of an incorrect length, may contact some internal part of the unit.

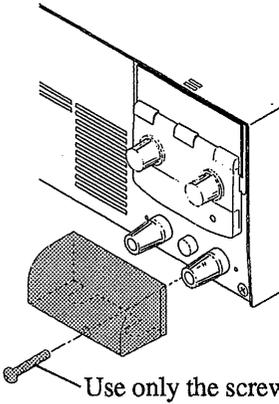


Fig. 2-11 Mounting the auxiliary output terminal cover



The PAN16-50A has no auxiliary output terminals on the front panel.

2.6 Fixing output presetting

The unit includes VOLTAGE and CURRENT controls; in order to make them mechanically fixed or semi-fixed, guard caps are supplied with the unit. Use them if output presetting is seldom necessary.

Using the guard caps

- ① Check that the OUTPUT switch is turned off.
- ② Turn on the POWER switch.
- ③ While pressing the LIMIT switch, preset the output level (voltage and/or current) to a desired value. Here, a rough presetting is acceptable.
- ④ Pull out the VOLTAGE and/or CURRENT control (knob) without turning it.
- ⑤ While pressing the LIMIT switch, use a flat-head screwdriver, and preset the output to a desired value.

■ To fix presetting

- ⑥ Push in the guard cap, instead of the removed knob.
- ⑦ Press the LIMIT switch again to confirm the presetting is not changed.

■ To semi-fix presetting

- ⑥ As shown in Fig. 2-12, pierce the guard cap top with a Phillips-head screwdriver.
- ⑦ Push in the guard cap, instead of the removed knob. Since the guard cap is pierced, the output level may be readjusted using a flat-head screwdriver.

NOTE

- If you intend to re-install the knob, keep it in a safe place. There is a metal fitting inside the knob's bushing that engages with the axis of a potentiometer (see Fig. 2-13). Even when you remove a knob, this metal fitting does not usually come off the knob. However, if it does come off, place it inside the knob's bushing.

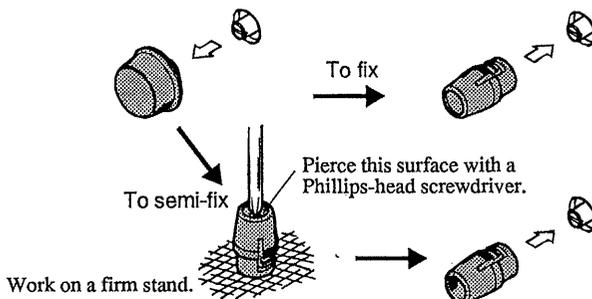


Fig. 2-12 Mounting the guard cap

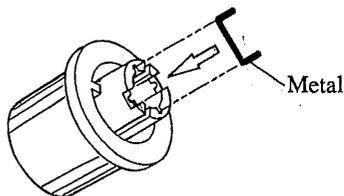


Fig. 2-13 Metal Fitting inside the Bushing

Re-mounting the knob

There is a slot on the end of the shaft of the output preset potentiometer. Mount the knob so that it engages the slot to prevent the knob from turning freely. Follow the procedure described below.

- ① Check that there is a metal fitting inside the knob's bushing.
- ② Remove the guard cap pressing the two locking mechanisms.
- ③ Press in the knob till it softly touches the shaft of the potentiometer.
- ④ Using gentle force, turn the knob fully counter-clockwise.
- ⑤ Pressing the knob, turn it further counter-clockwise until it settles in deeply, and the knob and shaft are engaged.

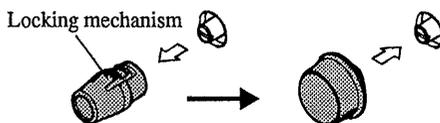


Fig. 2-14 Removing the guard cap

Chapter 3 Applied Operation

Use of the CONTROL terminal board on the rear panel allows the unit to perform remote sensing, external output control, parallel operation, and series operation.

3.1 CONTROL terminal board

This section describes the procedure for connecting wires, and precautions when using the CONTROL terminal board.

■ Wires and tools required for connection

1. Wires

As shown in Fig.3-1, the CONTROL terminal board has two types of terminals, which use different wires.

Group A (No. 2 to 19 terminals)

Single wire: ϕ 0.32 to ϕ 0.65 (AWG28 to 22)

Twisted wire: 0.08 mm² to 0.32 mm² (AWG28 to 22)

Group B (-S, +S, and No. 1 terminal)

Single wire: ϕ 0.4 to ϕ 1.2 (AWG26 to 16)

Twisted wire: 0.3 mm² to 1.25 mm² (AWG22 to 16)

(Bare wire diameter: ϕ 0.18 or more)

2. Screwdriver

Axis diameter: ϕ 3

End width: 2.6 mm

3. Wire stripper

One suitable for the wires described above

Table 3-1 Alignment on CONTROL terminal board

Expression on the panel		Signal name	Description	Expression on the CAUTION label
No.				
19	19	NC	No connection	⑰ NC
18	•	NC	No connection	⑱ NC
17	•	MASTER OUT	Master unit output for master-slave control parallel connection	⑰ MASTER OUT
16	•	MASTER COM	Master unit common line for master-slave control parallel connection	⑱ MASTER COM
15	•	SLAVE IN 1	Slave unit input for master-slave control parallel connection	⑮ SLAVE 1
14	14	SLAVE COM 1	Slave unit common line for master-slave control parallel connection	⑭ COM (SLAVE 1)
13	13	SLAVE IN 2	Slave unit output for master-slave control parallel connection	⑮ SLAVE 2
12	•	SLAVE COM 2	Slave unit common line for master-slave control parallel connection	⑫ COM (SLAVE 2)
11	•	OUTPUT ON/OFF	Output ON/OFF control	⑪ 
10	•	A COM	Common line for internal control circuit	⑩ 
9	•	CC R CONT IN	Input for output current control using external resistor	⑨ 
8	8	CC R CONT OUT	Output for output current control using external resistor	⑧ 
7	7	CC V CONT	Input for output current control using external voltage	⑦ 
6	•	A COM	Common line for internal control circuit	⑥ 
5	•	CV R CONT IN	Input for output voltage control using external resistor	⑤ 
4	•	CV R CONT OUT	Output for output voltage control using external resistor	④ 
3	•	CV V CONT	Input for output voltage control using external voltage	③ 
2	2	A COM	Common line for internal control circuit	② 
1	1	SERIES SIG OUT	Signal output for master-slave control series connection	① SERIES SIG
+S	+S	SENSING +	Positive input for remote sensing	-
-S	-S	SENSING -	Negative input for remote sensing	-

A COM is connected to the + (pos.) terminal inside.

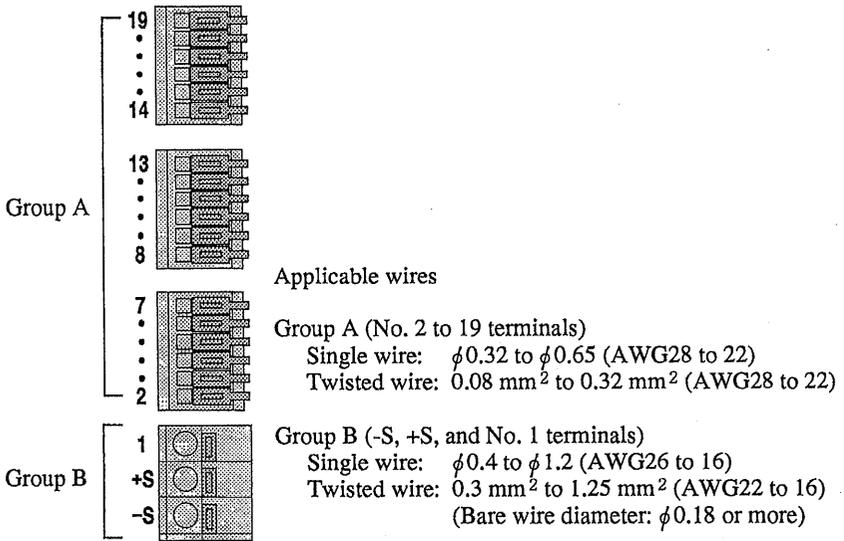


Fig. 3-1 CONTROL terminal board

Connecting procedure

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ Use a wire stripper to remove the covering from wires.

NOTE

- Remove the covering from each wire over a distance of 7 to 10 mm (9 mm is recommended). Use of the strip gauge on the top or rear panel of the unit, or that shown in Fig. 3-2, allows you to remove the required amount of covering from a wire.

CAUTION

- If you use a twisted wire, solder the end so that it remains intact.

Lingering solder flux can cause contact failure, which may lead to a malfunction.

WARNING

- Never attempt to connect wires to the control terminals while the POWER switch turned on. This may result in electric shock or damage to the internal circuitry.

- ④ Insert wires into control terminals as shown in Fig. 3-2.

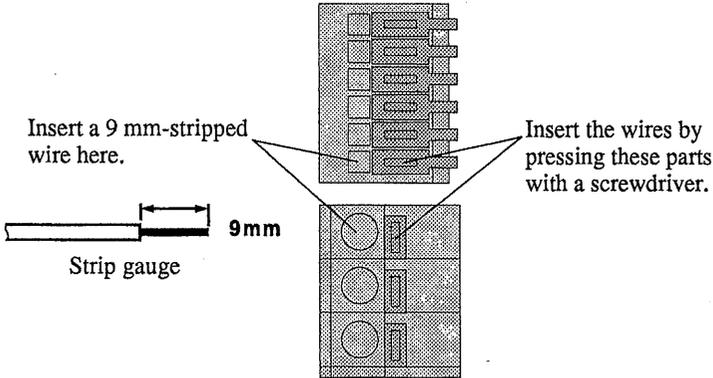


Fig. 3-2 Connection to the control terminals

CAUTION

- The potential of the control terminals is nearly the same as that of the + (pos.) output terminals of the unit. If part of the wire extending off a control terminal makes contact with the chassis, electric shock or internal circuit breakage may be caused. Insert wires into the terminals in such a way that bare parts are not exposed.



Fig. 3-3 Connecting precautions

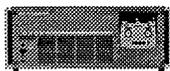
- ⑤ Remove the screwdriver from the terminal, and pull the wire gently to ensure that it is securely inserted.

3.2 Remote sensing

The remote sensing function is intended to reduce the influence of voltage drops affected by the load cable resistance, to keep the output voltage stable at the load terminal. To perform remote sensing, an electrolytic capacitor that has good frequency characteristics is needed at the sensing point (load terminal).

Connecting procedure

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ As shown in Fig. 3-4A, connect the +S terminal and the + (pos.) terminal of the load, and connect the -S terminal and the - (neg.) terminal of the load.



1000W
PAN16-50A

For the PAN16-50A user, see Fig. 3-4B.

NOTE

- To decrease output ripple voltages caused by inductive effect, use a shielded wire for sensing. Connect the shield to the + (pos.) terminal.

WARNING

- Sufficiently insulate the shield from the others. The potential of the shield is the same as that of the + (pos.) terminal. For example, if the - (neg.) output terminal of the unit is connected to the \perp (chassis ground) terminal and the shield is not insulated, there may be a danger of electric shock and/or accidents caused by a short circuit of the output across the chassis (case) of the unit and shield.

CAUTION

- To turn on/off the power supplied to a load using a mechanical switch, provide additional switches between the sensing wires as shown in Fig. 3-4C; turn on/off the power and remote sensing function simultaneously.

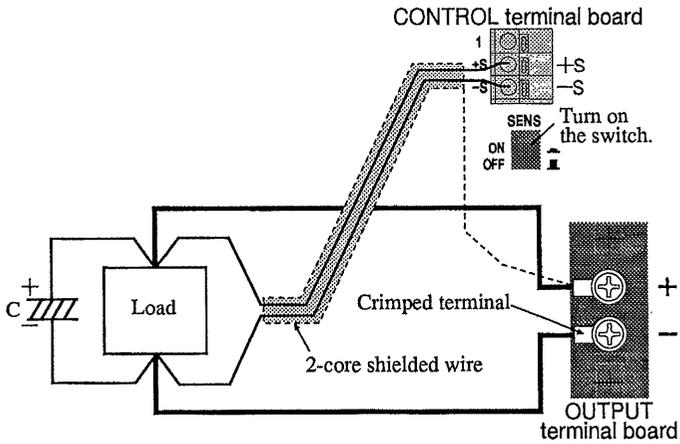


Fig. 3-4A Remote sensing connection

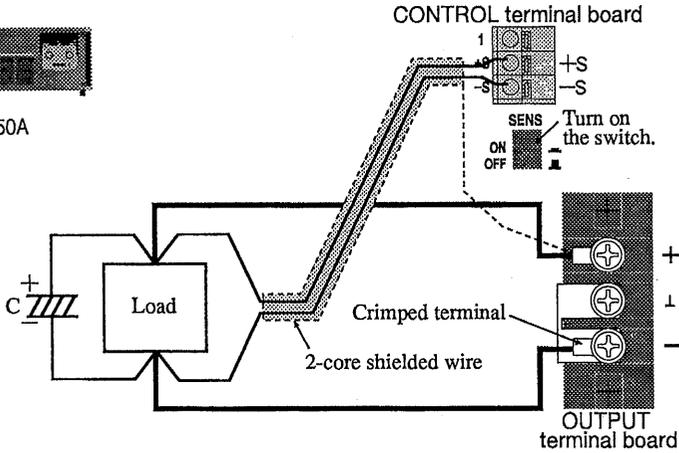


Fig. 3-4B Remote sensing connection (PAN16-50A)

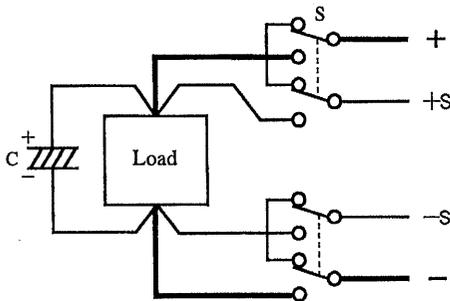


Fig. 3-4C Power ON/OFF using mechanical switches

- ④ Connect an electrolytic capacitor (C) with a capacity of approx. 1,000 to 100,000 μ F across the load terminals.

CAUTION

- Use a capacitor (C) whose withstand voltage is 120% or more of the unit's rated voltage.

NOTE

- If the length of wiring to a load extends to 3 m or more, the phase shift caused by the inductance and capacitance of the wiring becomes non-negligible, thereby causing oscillation. In such cases, the capacitor (C) prevents oscillation.
 - If the load current changes suddenly to pulse form, the output voltage may increase due to effects from the inductance components of the wiring. In such cases, the capacitor (C) also prevents variations in output.
- ⑤ Check again that all the cables and wires are connected correctly.

CAUTION

- If the sensing wire is disconnected, the output voltage at the load terminals cannot be stabilized, and excessive voltage may be applied to the load. Connect the sensing wire correctly.
- ⑥ Turn on the sensing switch.

CAUTION

- After using the remote sensing, remove the sensing wire, and be sure to turn off the SENS switch.
- Do not turn on/off the SENS switch while the POWER switch is on.

3.3 Analog remote control

It is possible to remotely control the unit's output voltage and current using analog signals. Output ON/OFF operation by means of external contact points is also possible.

The above-mentioned remote of controls can be used in combination, but note the following exceptions.

- Combination of output voltage control using external resistor and output voltage control using external voltage.
- Combination of output current control using external resistor and output current control using external voltage.

WARNING

- Incorrect handling of the CONTROL terminal board may cause electric shock or accidents due to short circuit of the output. When using remote control, always follow the procedures for each corresponding control method.
- The common line for the internal control circuit of the unit is connected to the + (pos.) output terminal inside. Therefore, the potential of the common terminal of the CONTROL terminal board, resistors, voltage source and switch to be connected to the CONTROL terminal board are nearly the same as that of the + (pos.) output terminal.

■ Before performing analog remote control

The unit is factory-calibrated for control from the front panel (i.e., local control). Before using remote control (excluding output ON/OFF using external contact points), re-calibration is necessary. Re-calibration is also necessary when changing from remote control back to local control. For details on calibration, see section 5.3, "Calibration".

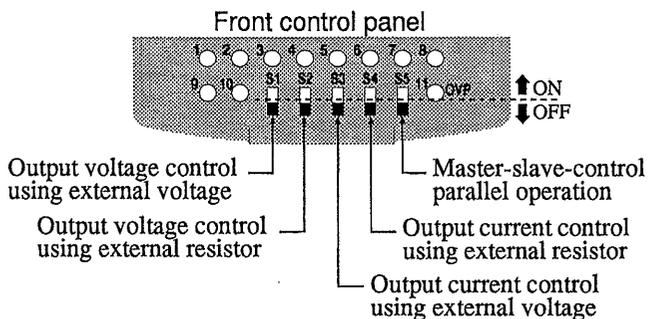


Fig. 3-5 Alignment of control switches

3.3.1 Controlling output voltage with external resistor

This method is used to control output voltage using a 0-approx. 10 k Ω external resistor.

WARNING

- To avoid electric shock, insulate the external resistor (Rext) from the others. The potential of Rext is nearly the same as that of the unit's + (pos.) output terminal. For example, if the - (neg.) output terminal is connected to the chassis ground terminal (\perp) and Rext is left non-insulated, there may be a danger of electric shock and accidents due to a short circuit of the output across the chassis (case) of the unit and Rext.

Connection and setup procedure

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ Set the control switches S1 and S2 as shown in Fig. 3-6.
- ④ Connect an external resistor across the control terminals ④ and ⑤ as shown in Fig. 3-6.

CAUTION

- If Rext is disconnected, excessive voltage may be applied to a load. Connect the Rext to the control terminals firmly.
- To use Rext which consists of a multiple number of fixed resistors and a switch, and select one of them for control, use a short circuit type or continuous type switch.

NOTE

- To minimize the influence of noise on the output, use a 2-core shielded wire or a twisted-pair wire to connect the control terminals and Rext. If using a shielded wire, connect the shield to the + (pos.) output terminal.
- Approx. 1 mA of current always flows in Rext. For Rext, use a 1/2 W or larger metal film or wire-wound type resistor with a good temperature coefficient and small aging effect.

- ⑤ Re-check that the connections on the terminal board and the switch settings are correct.

WARNING

- When using shielded wires, sufficiently insulate the shield from the others. The potential of the shield is the same as that of the + (pos.) terminal. For example, if the - (neg.) output terminal of the unit is connected to the ⊥ (chassis ground) terminal and the shield is not insulated, there may be a danger of electric shock and/or accidents caused by a short circuit of the output across the chassis (case) of the unit and shield.

Before controlling output voltage using the external resistor, recalibrate the voltage system of the unit. For the calibration procedure, see section 5.3, "Calibration".

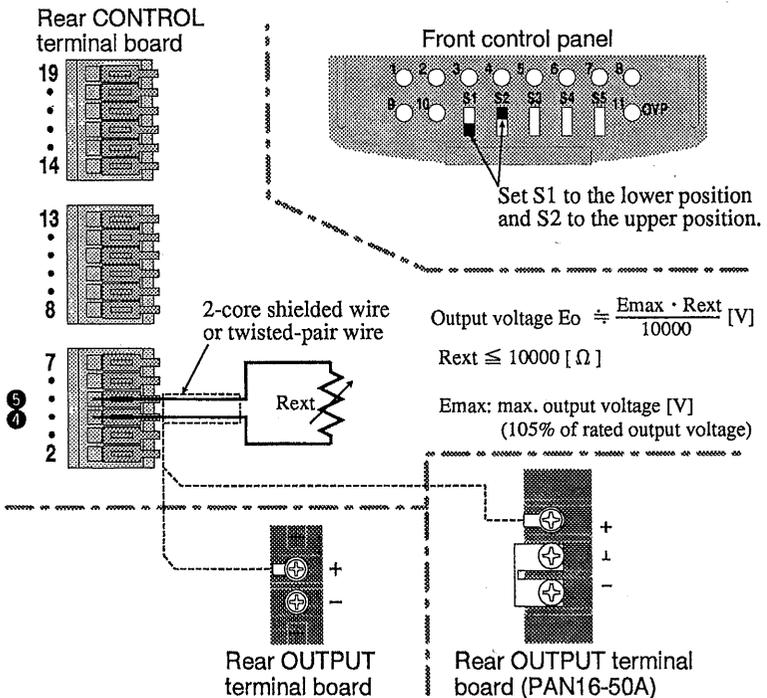


Fig. 3-6 Connection and setup for output voltage control using external resistor

3.3.2 Controlling output voltage with external voltage

This method is used to control output voltage using 0- approx. 10 V.

WARNING

- To avoid electric shock, do not ground the output of the external voltage source (V_{ext}) — float it instead. The potential of V_{ext} is nearly the same as that of the unit's + (pos.) output terminal. For example, if the - (neg.) output terminal is connected to the chassis ground terminal (\perp) and the output of V_{ext} is connected to the V_{ext} case, there may be a danger of electric shock and accidents due to a short circuit of the output across the chassis (case) of the unit and the V_{ext} case.

NOTE

- When controlling the unit using an external voltage source which has a quick rising time relative to the capacitive load, the phase control circuit of the unit cannot respond to the external voltage, which may cause AC components to be superimposed on the rising waveform.

Connection and setup procedure

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ Turn the VOLTAGE control fully clockwise.

NOTE

- In output voltage control using external voltage, it is also possible to change the output using the VOLTAGE control. Therefore, keep the control turned fully clockwise so that output voltage can be remotely controlled, up to the rated output voltage. If output preset on the panel needs to be fixed, use the supplied guard cap.

- ④ Set the control switches S1 and S2 to the position shown in Fig. 3-7A.
- ⑤ Connect the voltage source across the control terminals ② and ③ as shown in Fig. 3-7A.

CAUTION

- Watch the polarity of Vext. Connection at incorrect polarity may damage the unit.
- If Vext is disconnected, an unexpected voltage may be supplied by external noise. Connect the Vext to the control terminals firmly.
- Do not apply a voltage of 10.5 V or more, or reverse the voltage between control terminals ② and ③. Otherwise, the unit may be damaged.

NOTE

- To minimize the influence of noise on the output, use a 2-core shielded wire or a twisted-pair wire to connect the control terminals and Vext. If using a shielded wire, connect the shield to the + (pos.) output terminal.
- The input impedance across the control terminals ② and ③ is approx. 10 k Ω .
- For Vext, use a voltage source of low noise and good stability. Noise in Vext is multiplied by the amplification degree of the unit and appears in the unit's output. Thus, output ripple noise may not meet the unit's specifications.

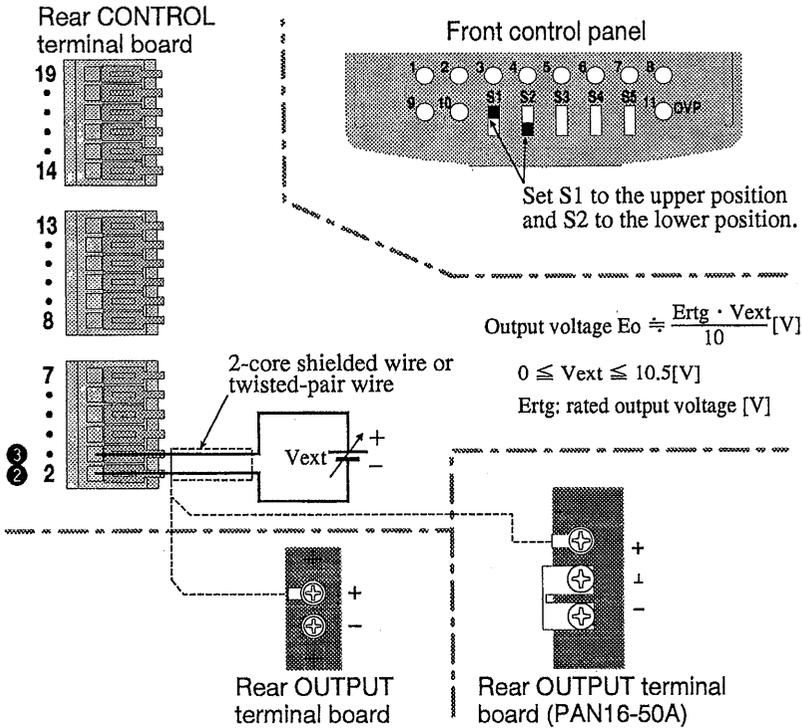


Fig. 3-7A Connection and setup for output voltage control using external voltage

- ⑥ Re-check that the connections on the terminal board and the switch settings are correct.

WARNING

- When using shielded wires, sufficiently insulate the shield from the others. The potential of the shield is the same as that of the + (pos.) terminal. For example, if the - (neg.) output terminal of the unit is connected to the ⊥ (chassis ground) terminal and the shield is not insulated, there may be a danger of electric shock and/or accidents caused by a short circuit of the output across the chassis (case) of the unit and shield.

Before controlling output voltage using the external voltage, recalibrate the voltage system of the unit. For the calibration procedure, see section 5.3, "Calibration".

■ When you wish to connect the shield to Vext

CAUTION

- When connecting the shield to the Vext side, do not connect the shield to the + (pos.) output terminal of the unit.

When using shielded wires, some external voltage sources may require that the shield be connected to the external voltage source. In such cases, the grounding method used for the external voltage source (Vext) and the unit creates a condition where the output is short-circuited, as shown in Fig. 3-7B. Thus, do not connect the shield to the + (pos.) output terminal of the unit.

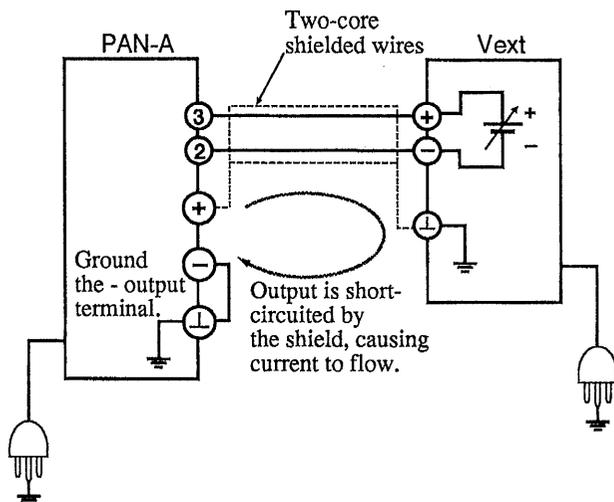


Fig. 3-7B A connection where output is short-circuited by the shield

3.3.3 Controlling output current with external resistor

This method is used to control output current using a 0- approx. 10 k Ω external resistor.

WARNING

- To avoid electric shock, insulate the external resistor (Rext) from the others. The potential of Rext is nearly the same as that of the unit's + (pos.) output terminal. For example, if the - (neg.) output terminal is connected to the chassis ground (\perp) and Rext is left non-insulated, there may be a danger of electric shock and accidents due to a short circuit of the output across the chassis (case) of the unit and Rext.

Connection and setup procedure

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ Set the control switches S3 and S4 to the position as shown in Fig. 3-8.
- ④ Connect an external resistor across the control terminals ⑧ and ⑨ as shown in Fig. 3-8.

CAUTION

- If Rext is disconnected, the internal overcurrent-protection circuit will be activated, causing the "ALM" LED to light up. However, current exceeding the rating will be output until this circuit functions. Thus, connect Rext to the control terminals securely.
- To use Rext which consists of a multiple number of fixed resistors and a switch, and select one of them for control, use a short circuit type or continuous type switch.

NOTE

- To minimize the influence of noise on the output, use a 2-core shielded wire or a twisted-pair wire to connect the control terminals and Rext. If using a shielded wire, connect the shield to the + (pos.) output terminal.
- Approx. 0.4 mA of current always flows in Rext. For Rext, use a 1/2 W or larger metal film or wire-wound type resistor with a good temperature coefficient and small aging effect.

- ⑤ Re-check that the connections on the terminal board and the switch settings are correct.

WARNING

- When using shielded wires, sufficiently insulate the shield from the others. The potential of the shield is the same as that of the + (pos.) terminal. For example, if the - (neg.) output terminal of the unit is connected to the ⊥ (chassis ground) terminal and the shield is not insulated, there may be a danger of electric shock and/or accidents caused by a short circuit of the output across the chassis (case) of the unit and shield.

Before controlling output current using the external resistor, re-calibrate the current system of the unit. For the calibration procedure, see section 5.3, "Calibration".

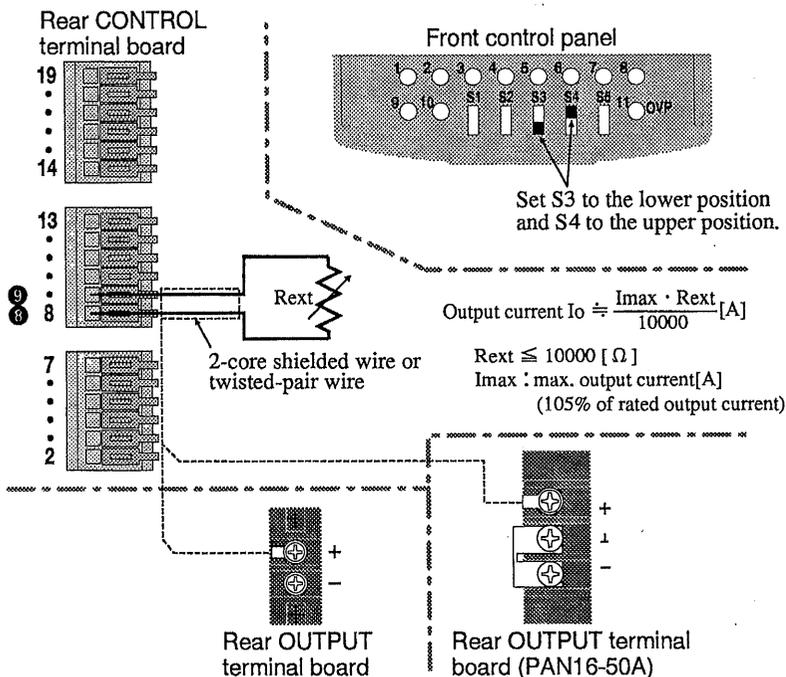


Fig. 3-8 Connection and setup for output current control using external resistor

3.3.4 Controlling output current with external voltage

This method is used to control output current using 0-approx. 10 V.

WARNING

- To avoid electric shock, do not ground the output of the external voltage source (V_{ext}) — float it instead. The potential of V_{ext} is nearly same as that of the unit's + (pos.) output terminal. For example, if the - (neg.) output terminal is connected to the chassis ground terminal (\perp) and the output of V_{ext} is connected to the V_{ext} case, there may be a danger of electric shock and accidents due to a short circuit across the chassis (case) of the unit and the V_{ext} case.

NOTE

- When controlling the unit using an external voltage source which has a quick rising time relative to the capacitive load, the phase control circuit of the unit cannot respond to the external voltage, which may cause AC components to be superimposed on the rising waveform.

Connection and setup procedure

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ Turn the CURRENT control fully clockwise.

NOTE

- In output current control using external voltage, it is also possible to change the output using the output CURRENT control. Therefore, keep the control turned fully clockwise so that output current can be remotely controlled, up to the rated output current. If the output preset on the panel needs to be fixed, use the supplied guard cap.

- ④ Set the control switches S3 and S4 to the position as shown in Fig. 3-9A.
- ⑤ Connect the voltage source across the control terminals ⑥ and ⑦ as shown in Fig. 3-9A.

CAUTION

- Watch the polarity of the external voltage source (Vext). Connection at an incorrect polarity may damage the unit.
- If Vext is disconnected, an unexpected voltage may be supplied by external noise. Connect the Vext to the control terminals firmly.
- Do not apply a voltage of 10.5 V or more, or reverse the voltage between control terminals ⑥ and ⑦. Otherwise, the unit may be damaged.

NOTE

- To minimize the influence of noise on the output, use a 2-core shielded wire or a twisted-pair wire to connect the control terminals and Vext. If using a shielded wire, connect the shield to the + (pos.) output terminal.
- The input impedance across the control terminals ⑥ and ⑦ is approx. 25 k Ω .
- For Vext, use a voltage source of low noise and good stability. Noise in Vext is multiplied by the amplification degree of the unit and appears in the unit's output. Thus, output ripple noise may not meet the unit's specifications.

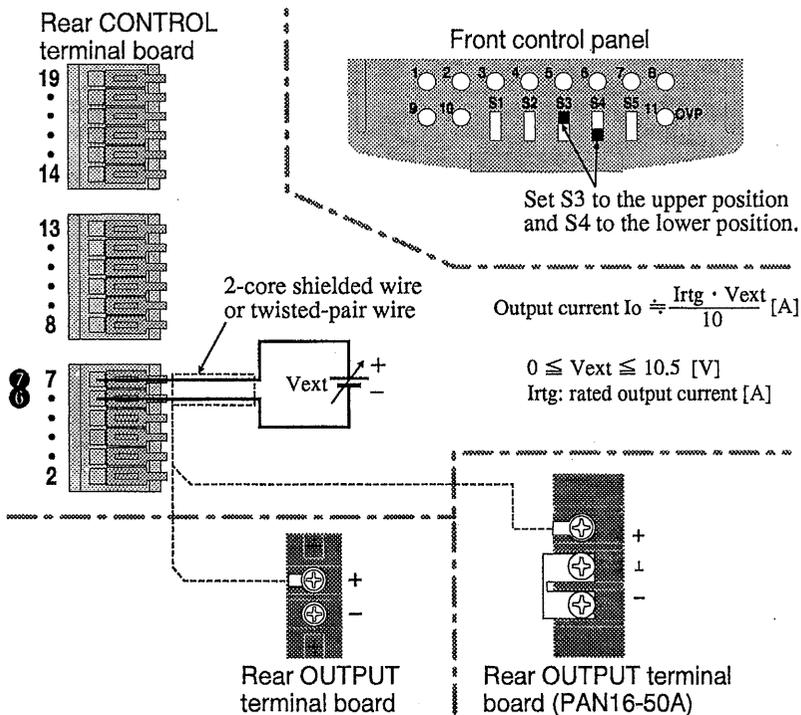


Fig. 3-9A Connection and setup for output current control using external voltage

- ⑥ Re-check that the connections on the terminal board and the switch settings are correct.

WARNING

- When using shielded wires, sufficiently insulate the shield from the others. The potential of the shield is the same as that of the + (pos.) terminal. For example, if the - (neg.) output terminal of the unit is connected to the ⊥ (chassis ground) terminal and the shield is not insulated, there may be a danger of electric shock and/or accidents caused by a short circuit of the output across the chassis (case) of the unit and shield.

Before controlling output current using the external voltage, recalibrate the current system of the unit. For the calibration procedure, see section 5.3, "Calibration".

■ When you wish to connect the shield to Vext

CAUTION

- When connecting the shield to the Vext side, do not connect the shield to the + (pos.) output terminal of the unit.

When using shielded wires, some external voltage sources may require that the shield be connected to the external voltage source. In such cases, the grounding method used for the external voltage source (Vext) and the unit creates a condition where the output is short-circuited, as shown in Fig. 3-9B. Thus, do not connect the shield to the + (pos.) output terminal of the unit.

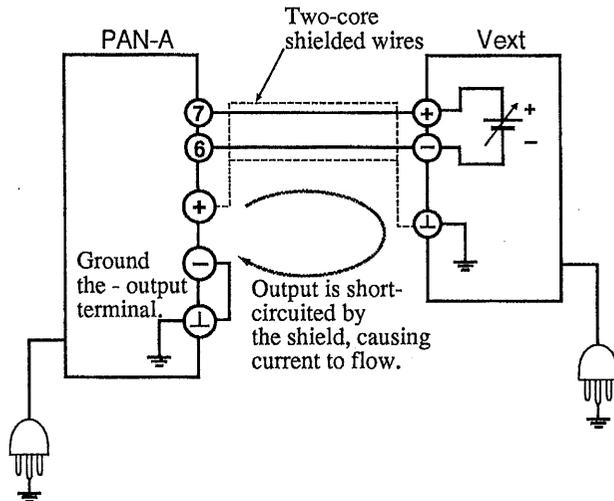


Fig. 3-9B A connection where wutput is short-circuited by the shield

3.3.5 Output ON/OFF control

This method is used to control the output's ON/OFF status using external contact points. Output is turned off when the external contact points are closed.

WARNING

- To avoid electric shock, insulate the external contact points (S) from the others. The potential of the contact points is nearly the same as that of the unit's + (pos.) output terminal. For example, if the - (neg.) output terminal is connected to the chassis ground terminal (\perp) and the external contact points are not insulated, there may be a danger of electric shock and accidents due to a short circuit of the output across the chassis (case) of the unit and the external contact points.

CAUTION

- A negative voltage of approx. 0.6 V is generated when the output is turned off, and a reverse current of approx. 10 mA may flow.

NOTE

- In output of ON/OFF, "OFF" has higher priority. Therefore, always set the OUTPUT switch to ON so that ON/OFF control using external contact points can be performed.

Connection and setup procedure

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ Connect the contact points S (switch) across the control terminals ⑩ and ⑪ as shown in Fig. 3-10.

NOTE

- To minimize the influence of noise on the output, use a 2-core shielded wire or a twisted-pair wire to connect the control terminals and the external contact points. If using a shielded wire, connect the shield to the + (pos.) output terminal.
- The control terminal ⑩ is "common" for the control circuit. It is internally connected to +S on the unit.

- The release voltage across the control terminals ⑩ and ⑪ is approx. 5 V, and the short circuit current is approx. 1.5 mA.
 - Use external contact points of rated 10 VDC min. and 10 mA min.
 - For long-distance wiring, use a small relay and extend the coil side of that relay.
- ④ Re-check that the connections on the terminal board and the switch settings are correct.

WARNING

- When using shielded wires, sufficiently insulate the shield from the others. The potential of the shield is the same as that of the + (pos.) terminal. For example, if the - (neg.) output terminal of the unit is connected to the \perp (chassis ground) terminal and the shield is not insulated, there may be a danger of electric shock and/or accidents caused by a short circuit of the output across the chassis (case) of the unit and shield.

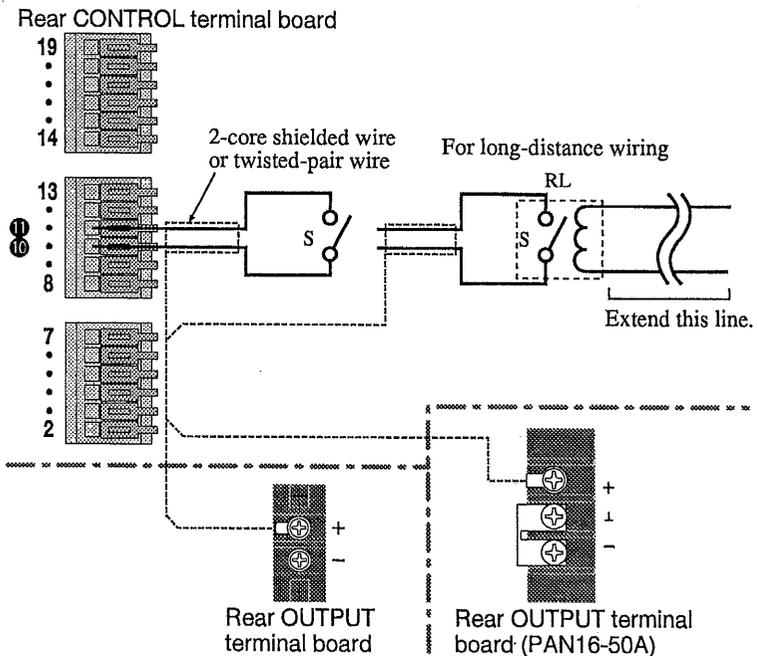


Fig. 3-10 Output ON/OFF control connection

3.4 Master-slave-control parallel operation

It is possible to increase the current capacity by connecting a maximum two slave units in parallel to one master unit. In a master-slave-control parallel operation system, the output preset for all the units connected in parallel can be provided only on the master unit.

To perform such master-slave-control parallel operation, an electrolytic capacitor having good frequency characteristics should be connected to the load terminals.

CAUTION

- Parallel connection is possible only for the PAN-A or PAN series power supplies that have the same rated output voltage and rated output current. Connecting power supplies of different rated outputs in parallel may cause malfunction.
- Perform parallel operation only when using the master-slave-control parallel operation system. Parallel connection of output alone may cause unit failure.

■ Presetting of OVP trip points in parallel operation

When carrying out parallel operation, OVP (overvoltage protection) trip points should be preset for both the master unit and for all slave units. For example, if the master unit becomes unable to control the slave units — because, for example, its POWER switch is inadvertently turned off during parallel operation — the slave units may output their maximum output voltage. If an appropriate OVP trip point has been preset for these units, however, the load can still be protected.

In parallel operation, the OVP trip points for slave units should be set to slightly higher values than that used for the master unit. However, do not preset them to a value exceeding 105% of the rated voltage.

If the OVP trip points for the slave units are preset to a value below that of the master unit, their overvoltage protection will function first, turning off output from the slaves but not from the master unit.

Connection and setup procedure

- ① Turn off the OUTPUT switch of each unit.
- ② Turn off the POWER switch of each unit.
- ③ Determine the master unit.

NOTE

- If the PAN-A and PAN series are used together, assign the PAN-A series power supply as the master unit.

- ④ Preset the OVP (overvoltage protection) trip points for the master and slave units.

NOTE

- Preset the OVP trip points for the slave units to a value slightly higher than that used for the master unit. However, do not preset them to a value exceeding 105% of the rated voltage.

- ⑤ Set the control switch S5 of the master unit and slave units to the positions shown in Fig. 3-11.

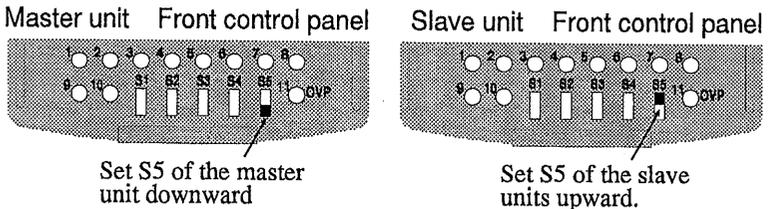
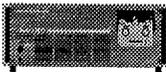


Fig. 3-11 Control switch presetting for master-slave-control parallel operation

- ⑥ Connect the master unit and slave unit as shown in Fig. 3-12A. Fig. 3-12A shows an example of how the rear output terminals are connected in parallel for two slave units



1000W
PAN16-50A

For the PAN16-50A user, see Fig. 3-12B.

To combine the PAN-A and PAN series, see Fig. 3-12C.

WARNING

- Use a load cable of sufficient current capacity to cover the rated value.

CAUTION

- Use wires of the same length and size for connecting the load and each unit. Use of varying lengths and size may cause different output current from each unit.
- To assure good connection of load cables, use crimped terminals.
- After parallel connection, mount the output terminal cover (on the front or rear panel).

To mount the front auxiliary output terminal cover, see section 2.5, "Mounting the auxiliary output terminal cover".

- Position each unit with sufficient space around it. Do not stack units a top one another.

NOTE

- To minimize the influence of noise on the output, use a 2-core shielded wire or a twisted-pair wire to connect across the control terminals.
- When using shielded wires, connect the shield between the master and slave units to the + (pos.) output terminal of the master unit. Connect the shield between the slave units to the shield between the master and slave units.
- When performing remote sensing in master-slave-control parallel operation, prepare the sensing wiring only for the master unit. For information on connection, see section 3.2, "Remote sensing".
- If both parallel operation and remote sensing are required when combining the PAN-A and PAN series, the error in the current display of the PAN series used as slave units may increase. In this case, use the slave units in sensing mode.

- ⑦ Connect an electrolytic capacitor (C) with a capacity of approximately 1,000 to 100,000 μ F to the load terminals as necessary.

CAUTION

- Use a capacitor (C) whose withstand voltage is 120% or more of the unit's rated voltage.

NOTE

- If the length of wiring to a load extends to 3 m or more, the phase shift caused by the inductance and capacitance of the wiring becomes non-negligible, thereby causing oscillation. In such cases, the capacitor (C) prevents oscillation.
- ⑧ Re-check that the connections and the switch settings are correct.

WARNING

- When using shielded wires, sufficiently insulate the shield from the others. The potential of the shield is the same as that of the + (pos.) terminal. For example, if the - (neg.) output terminal of the unit is connected to the \perp (chassis ground) terminal and the shield is not insulated, there may be a danger of electric shock and/or accidents caused by a short circuit of the output across the chassis (case) of the unit and shield.

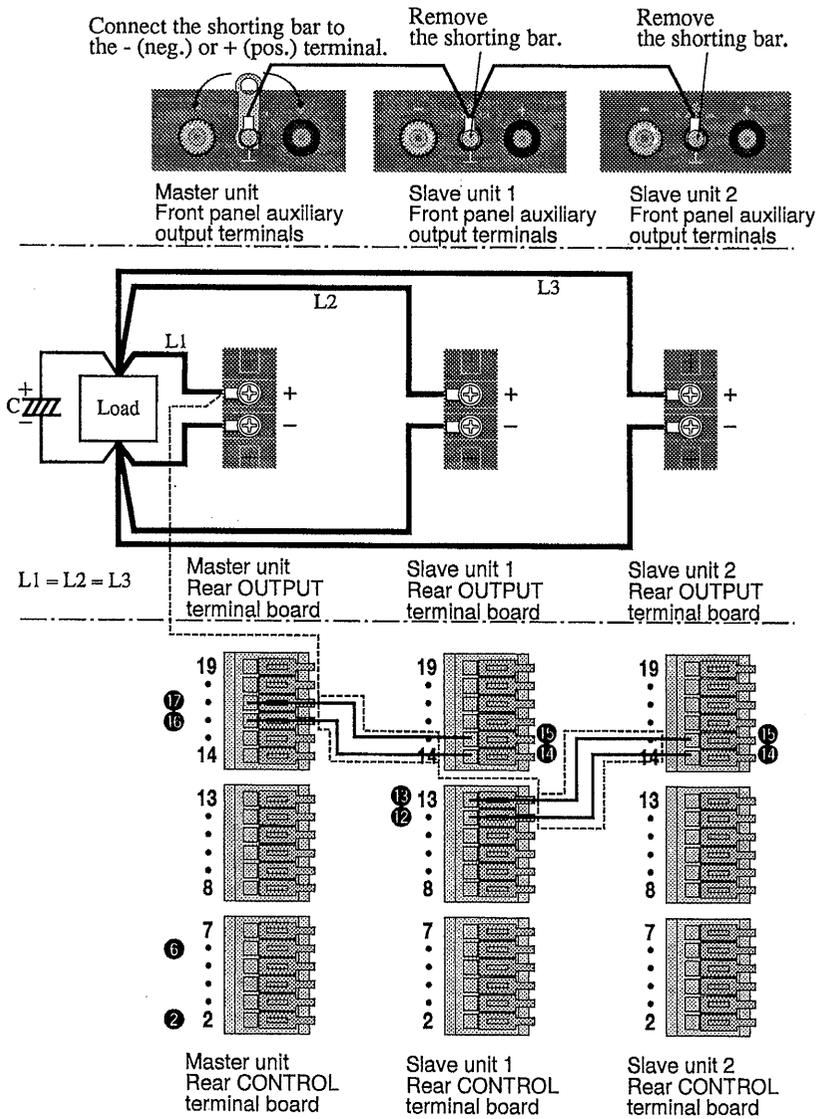


Fig. 3-12A Connection for master-slave-control parallel operation

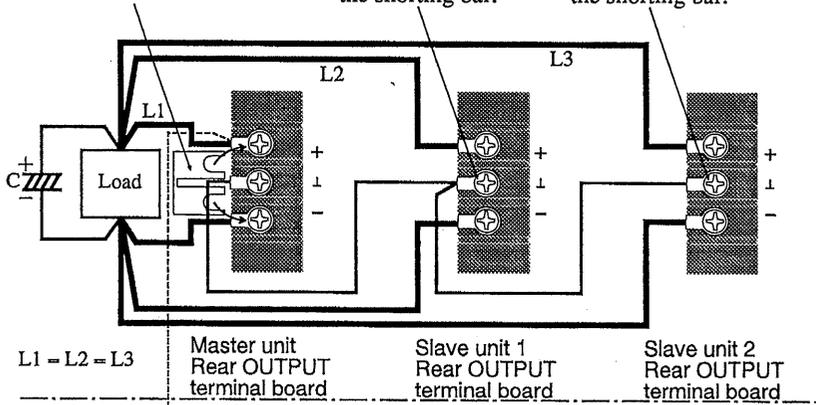


1000W
PAN16-50A

Connect the shorting bar to the - (neg.) or + (pos.) terminal.

Remove the shorting bar.

Remove the shorting bar.

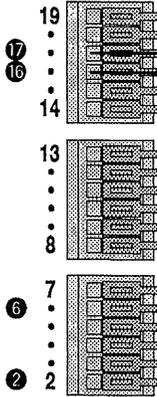


L1 = L2 = L3

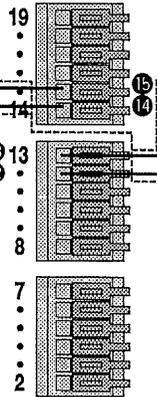
Master unit
Rear OUTPUT
terminal board

Slave unit 1
Rear OUTPUT
terminal board

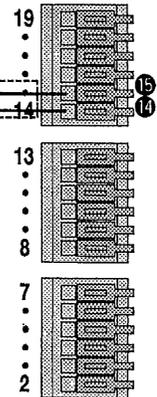
Slave unit 2
Rear OUTPUT
terminal board



Master unit
Rear CONTROL
terminal board



Slave unit 1
Rear CONTROL
terminal board



Slave unit 2
Rear CONTROL
terminal board

Fig. 3-12B Connection for master-slave-control parallel operation (PAN16-50A)

NOTE

- When carrying out master-slave-control parallel operation with the PAN16-50A and PAN16-50 combined, refer to Fig. 3-12C for connection of the CONTROL terminal board.

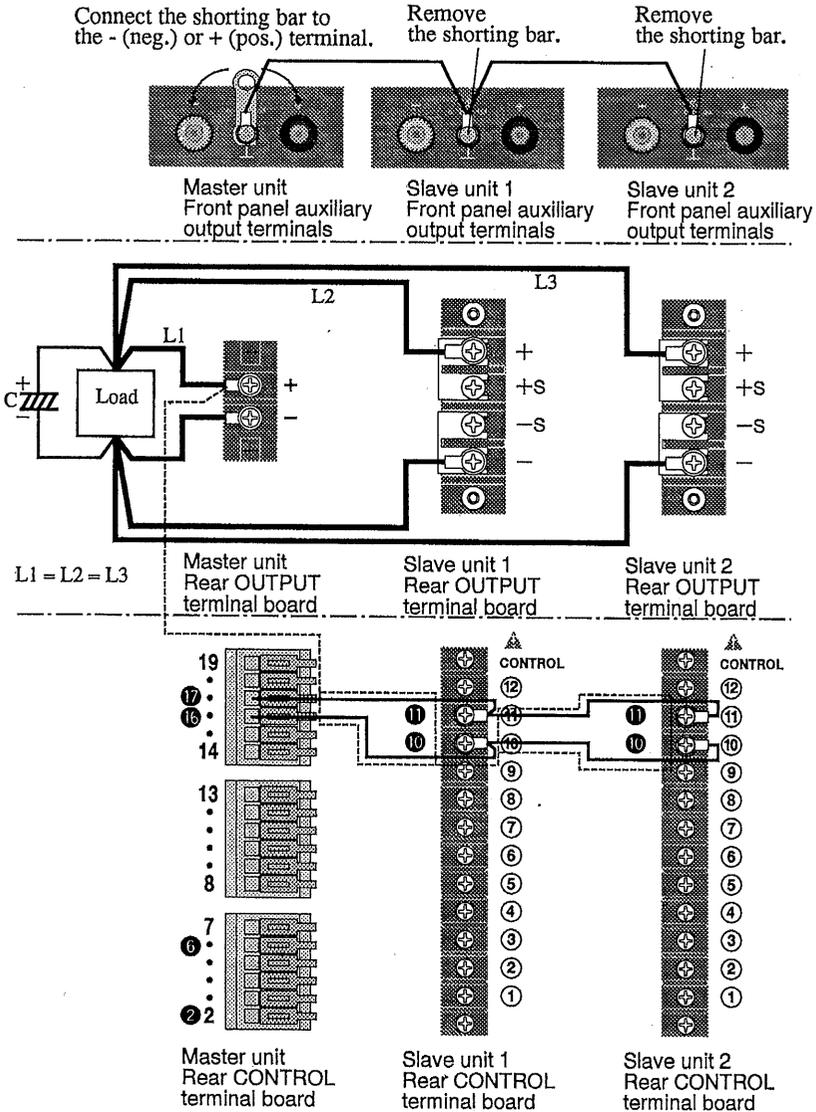


Fig. 3-12C Connection for master-slave-control parallel operation (When the PAN-A and PAN series are used together)

NOTE

- Assign the PAN-A series as the master unit.
- Slave units may be either PAN-A series or PAN series.

Starting master-slave-control parallel operation

CAUTION

- To start master-slave-control parallel operation, always follow the procedure below. Because the slave units are under control of the master unit, if the procedure is incorrectly observed, the slave units may output their maximum output voltage.

- ① Check that the OUTPUT switch of each unit is turned off.
- ② Turn on the POWER switch of the master unit.
- ③ Turn on the POWER switch of each slave unit.
- ④ Turn the VOLTAGE control and the CURRENT control of each slave unit fully clockwise.

NOTE

- Preset the output of each slave unit to the maximum level, so that it can follow the preset output of the master unit.
- ⑤ While presetting the LIMIT switch of the master unit, preset the output voltage and current.

NOTE

- The total output current setup value can be found by multiplying the preset value of the master unit by the number of units used for the parallel operation.
 - If both parallel operation and remote sensing are required when combining the PAN-A and PAN series, the error in the current display of the PAN series used as slave units may increase. In this case, use the slave units in sensing mode.
- ⑥ Turn on the OUTPUT switch of each slave unit.
 - ⑦ "CC" lights up on the control panel of each slave unit, indicating that the unit is in constant current operation mode.
 - ⑧ Turn on the OUTPUT switch of the master unit.
 - ⑨ "CV" lights up on the master unit control panel, indicating that the unit is in constant voltage operation mode.
 - ⑩ The same output voltage and current displayed on the master unit are also displayed on all the slave units. This means that the total current of all the units is applied to the load.

Finishing the master-slave-control parallel operation

CAUTION

- To finish master-slave-control parallel operation, always observe the following procedure. If the POWER switch of the master unit is turned off while parallel operations are still being carried out, the slave units may output their maximum output voltage.

- ① Turn off the OUTPUT switch of the master unit.
- ② Turn off the OUTPUT switch of each slave unit.
- ③ Turn off the POWER switch of each slave unit.
- ④ Turn off the POWER switch of the master unit.

3.5 Master-slave-control series operation

It is possible to increase the output voltage by connecting several slave units in series to one master unit. In a master-slave-control series operation system, a preset output for all the units connected in series can be designated only from the master unit.

Number of units connectable in series:

The number of slave units to be connected in series is determined by the rated output voltage and isolation voltage of each unit.

Taking the PAN35-10A as an example for series connection:

Since the rated output voltage is 35 V, and the isolation voltage is ± 250 V, $250/35 = 7.1$, i.e., up to 7 units including the master unit can be connected in series.

The rated output voltage and the isolation voltage are described in chapter 6, "Specifications"

WARNING

- Be sure to observe the limitation on the maximum number of units that can be connected in series. If the maximum output voltage exceeds the isolation voltage, it may create a danger of electric shock.

CAUTION

- Series connection is possible only for the PAN-A or PAN series power supplies that have the same rated output voltage and rated output current. Connecting power supplies of different rated outputs in parallel may cause malfunction.
- Perform series operation only when using the master-slave-control series operation system. Serial connection of output alone may cause unit failure.
- In case of master-slave-control series operation, the master unit, slave unit 1, and slave unit 2 are started in this order. Thus, the rise in output will be delayed in comparison with single-unit operation. This may cause AC ripple components to be superimposed on the output voltage. If rise waveform becomes a problem, use a single high-output-voltage unit.

■ Presetting of OVP trip points in series operation

When carrying out series operation, OVP (overvoltage protection) trip points should be preset for both the master unit and for all slave units.

In series operation, the OVP trip points for slave units should be set to slightly higher values than that used for the master unit.

If the OVP trip points for the slave units are preset to a value below that of the master unit, their overvoltage protection will function first, turning off output from the slaves but not from the master unit.

Connection and setup procedure

- ① Turn off the OUTPUT switch of each unit.
- ② Turn off the POWER switch of each unit.
- ③ Determine the master unit.

NOTE

- If the PAN-A and PAN series are used together, assign the PAN-A series power supply as the master unit.

- ④ Preset the OVP (overvoltage protection) trip points for the master and slave units.

NOTE

- Preset the OVP trip points for the slave units to a value slightly higher than that used for the master unit.

- ⑤ Set the control switch S1 of the master unit and slave units to the positions shown in Fig. 3-13.

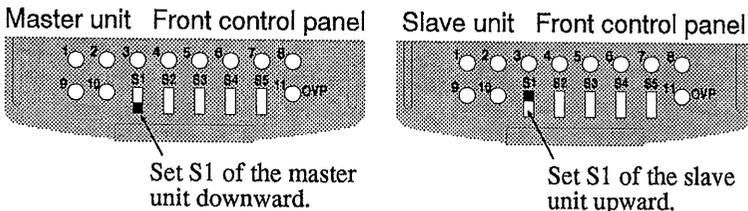


Fig. 3-13 Presetting of control switches for master-slave-control series operation

- ⑥ Connect the master unit and slave units shown in Fig. 3-14A. Fig. 3-14A shows an example of how the rear output terminals are connected in series for two slave units.



1000W
PAN16-50A

For the PAN16-50A user, see Fig. 3-14C.

When performing remote sensing in master-slave-control series operation, see Fig. 3-14B.

To combine the PAN-A and PAN series, see Fig. 3-14D. When remote sensing must be performed, see Fig. 3-14E.

WARNING

- Use a load cable of sufficient current capacity to cover the rated value.

CAUTION

- To assure good connection of load cables and control wires, use crimped terminals.
- After series connection, mount the output terminal cover (on the front or rear panel).

To mount the front auxiliary output terminal cover, see section 2.5, "Mounting the auxiliary output terminal cover".

- Position each unit with sufficient space around it. Do not stack units a top one another.
 - Connect any one of the + (pos.) and - (neg.) output terminals to the \perp (chassis ground) terminal, using a shorting bar.
- ⑦ Re-check that the connections and the switch settings are correct.

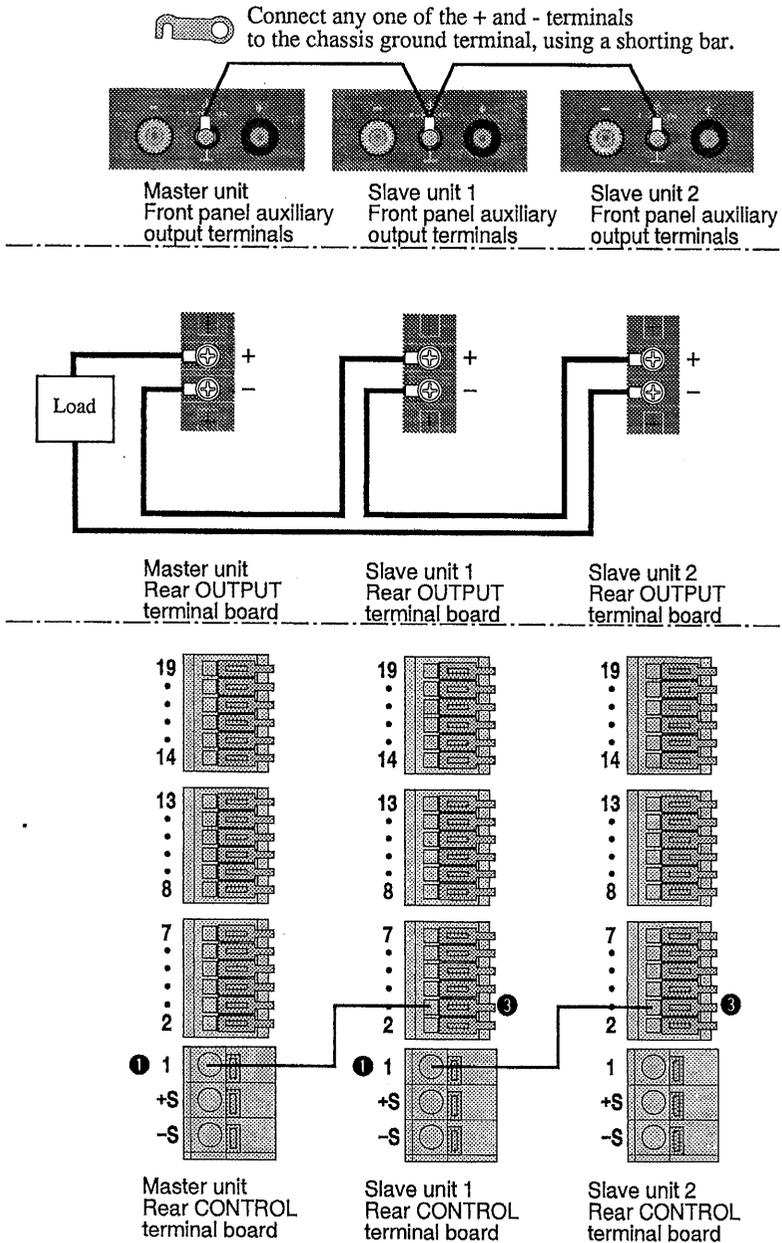


Fig. 3-14A Connection for master-slave-control series operation

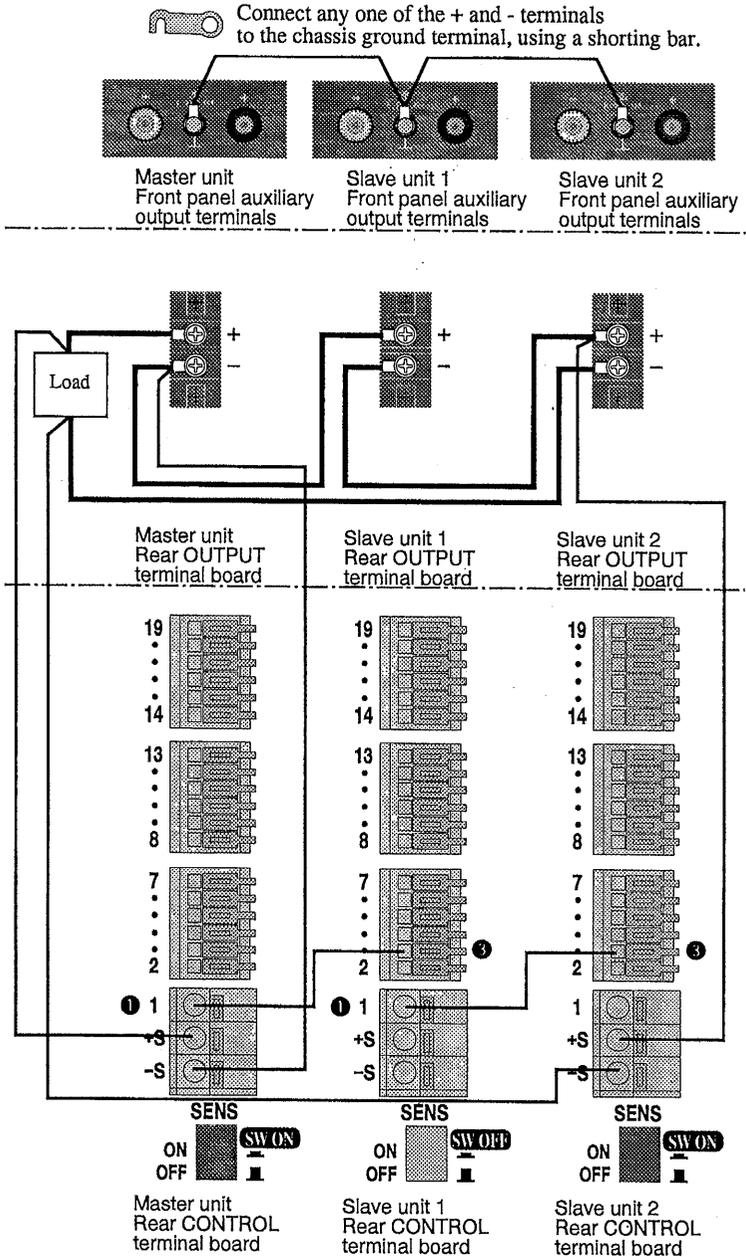


Fig. 3-14B Connection for master-slave-control series operation using sensing

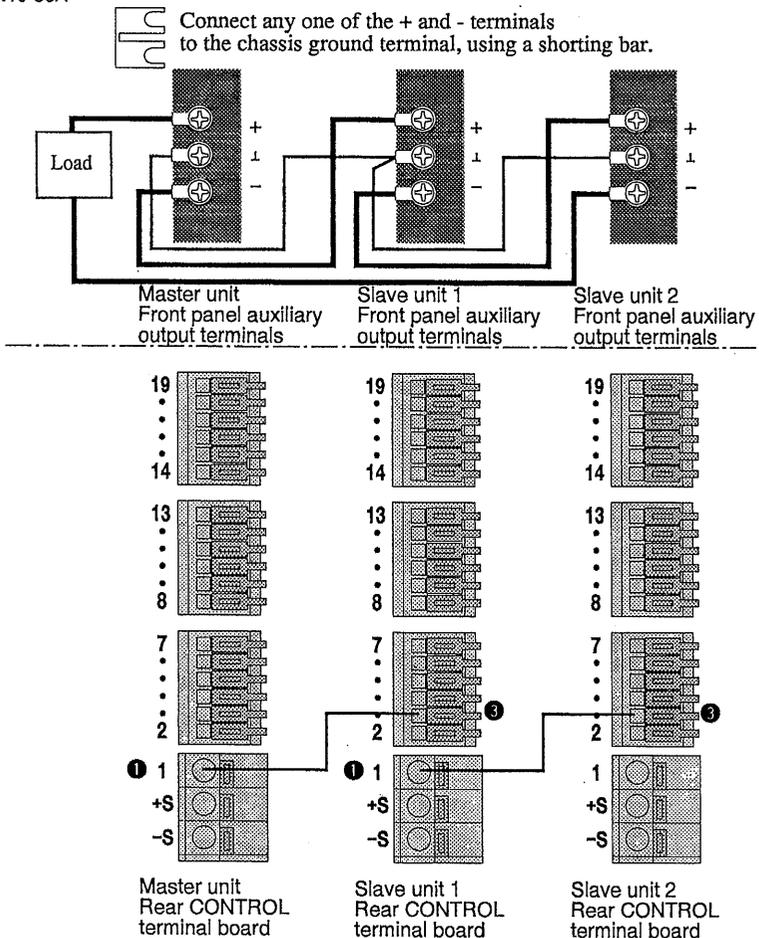


Fig. 3-14C Connection for master-slave-control series operation (PAN16-50A)

NOTE

- When carrying out master-slave-control series operation with the PAN16-50A and PAN16-50 combined, refer to Fig. 3-14D for connection of the CONTROL terminal board.

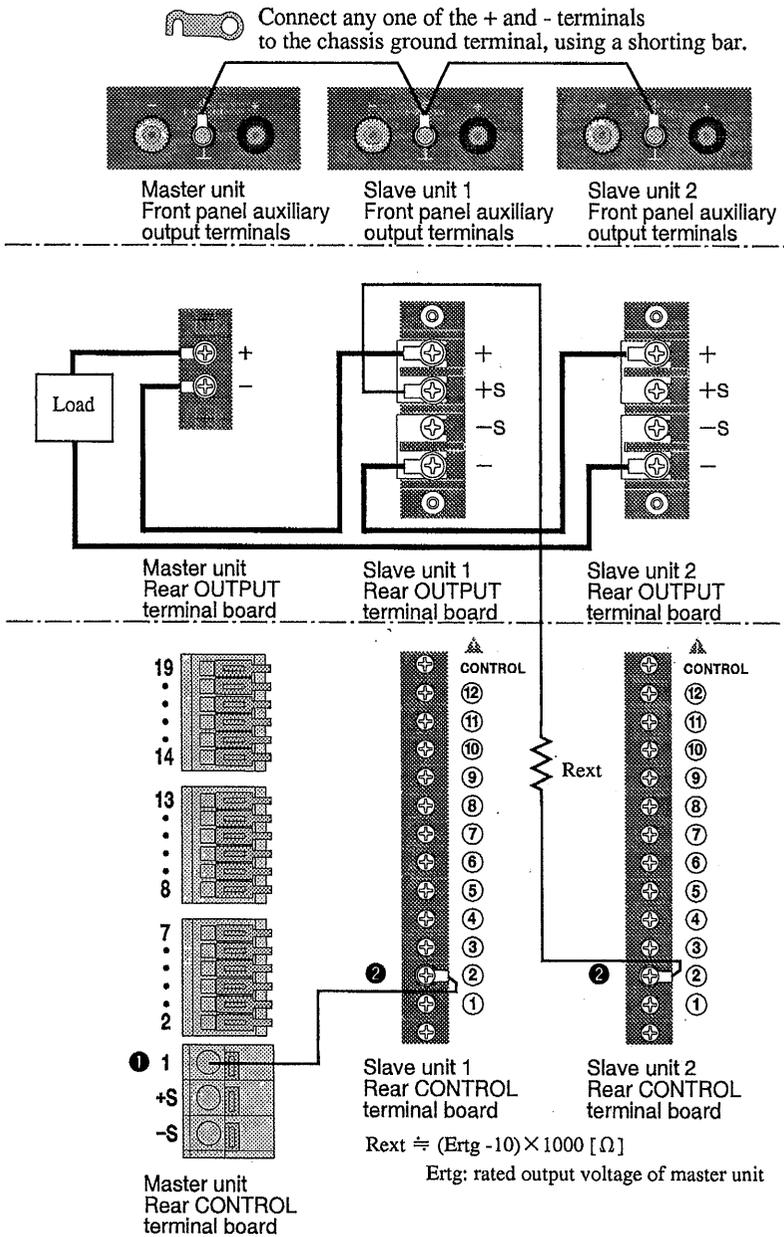


Fig. 3-14D Connection for master-slave-control series operation (When the PAN-A and PAN series are used together)

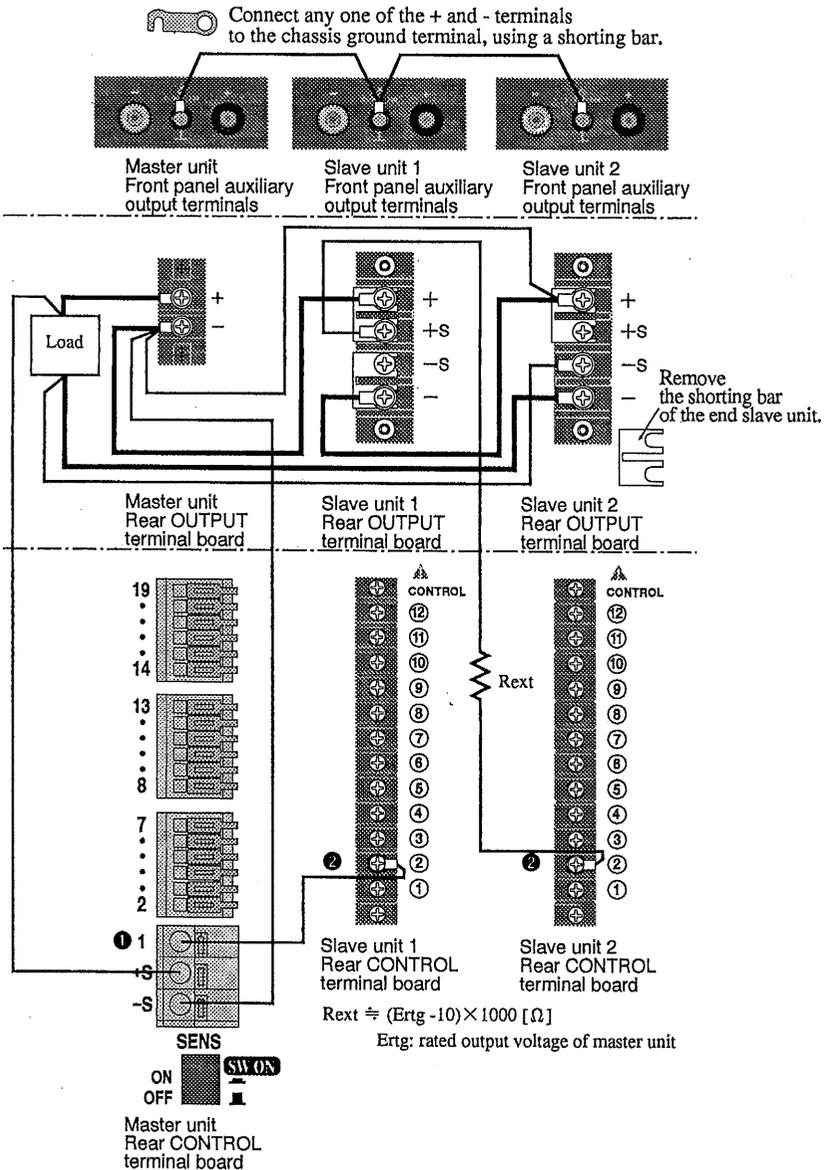


Fig. 3-14E Connection for master-slave-control series operation using sensing (When the PAN-A and PAN series are used together)

NOTE

- Assign the PAN-A series as the master unit.
- Slave units may be either PAN-A series or PAN series.
- For Rext, use a 1 W or larger metal film or wire-wound type resistor with a good temperature coefficient and small aging effect.
- An external resistor (Rext) is required only when connecting the PAN-series power supplies to each other.

Starting master-slave-control series operation

CAUTION

- To start master-slave-control serial operation, always follow the procedure below. The slave units are under control of the master unit, so do not turn ON the POWER switches of the slave units first.
- ① Check that the OUTPUT switch of each unit is turned off.
 - ② Turn on the POWER switch of the master unit.
 - ③ Turn on the POWER switch of each slave unit.
 - ④ Turn the VOLTAGE control and the CURRENT control of each slave unit fully clockwise.

NOTE

- Preset the output of each slave unit to the maximum level, so that it can follow the preset output of the master unit.
- ⑤ While presetting the LIMIT switch of the master unit, preset the output voltage and current.

NOTE

- The total output voltage setup value can be found by multiplying the preset value of the master unit by the number of units used for the series operation.
- ⑥ Turn on the OUTPUT switch of the slave unit.
 - ⑦ "CV" lights up on the slave unit control panel, indicating that the unit is in constant voltage operation mode.
 - ⑧ Turn on the OUTPUT switch of each master unit.
 - ⑨ "CV" lights up on the control panel of each master unit, indicating that the unit is in constant voltage operation mode.
 - ⑩ The same output voltage and current displayed on the master unit are also displayed on each slave unit. This means that the total voltage of all the units is applied to the load.

Finishing the master-slave-control series operation

CAUTION

- To finish master-slave-control serial operation, always follow the procedure below. If the POWER switch of the master unit is turned off while serial operations are still being carried out, the slave units may malfunction.

- ① Turn off the OUTPUT switch of the master unit.
- ② Turn off the OUTPUT switch of each slave unit.
- ③ Turn off the POWER switch of each slave unit.
- ④ Turn off the POWER switch of the master unit.

Chapter 4 Names and Functions of Controls

4.1 Front panel

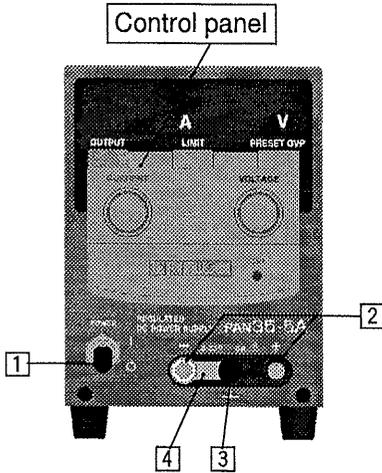


Fig. 4-1A Front panel of PAN-A series model 175W

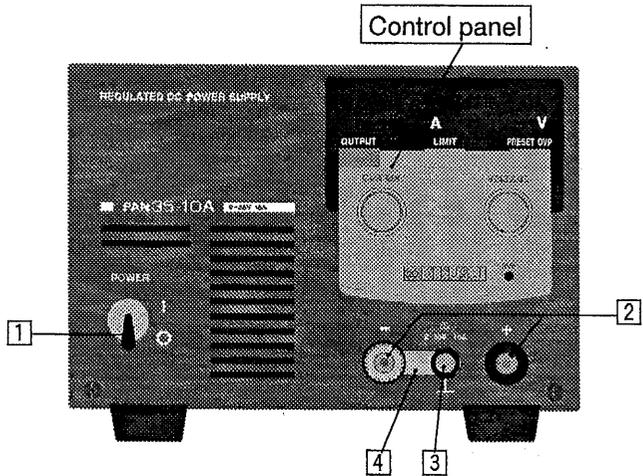


Fig. 4-1B Front panel of PAN-A series model 350W

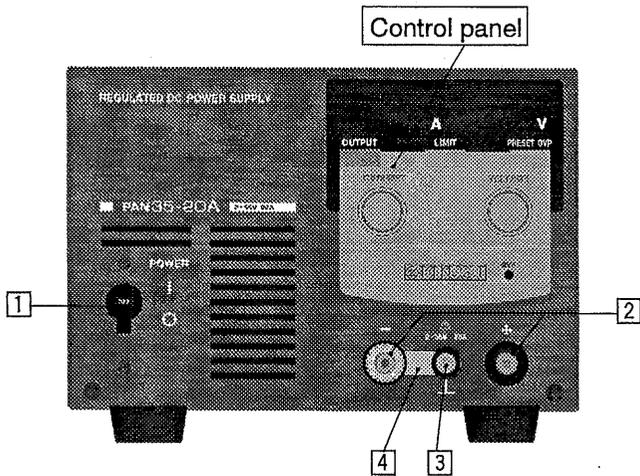


Fig. 4-1C Front panel of PAN-A series model 700W

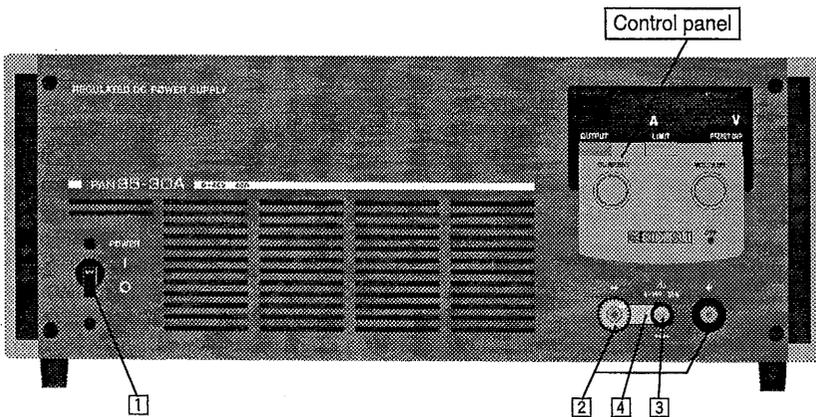


Fig. 4-1D Front panel of PAN-A series model 1000W

NOTE



- On the front panel of the PAN16-50A, there is no [2] + and - (auxiliary output terminals), [3] ⊥ (chassis ground terminal), and [4] shorting bar for grounding chassis.

1 POWER

Turns the power of the unit on and off. Flip up the lever to turn the power ON (I), and flip it down to turn the power OFF (O).

2 +, - (auxiliary output terminals) ⚠

These terminals are designed for handy use in supplying output from the unit. Output from these terminals, however, may not satisfy the specifications of the unit.

WARNING

- To avoid electric shock, always turn off the POWER switch whenever it is necessary to touch the terminals.

NOTE



1000W
PAN16-50A

- The PAN16-50A has no auxiliary output terminals.

3 ⊥ (chassis ground terminal)

This terminal is connected to the chassis of the unit. This terminal and the auxiliary output + (pos.) or - (neg.) terminal should usually be connected using the shorting bar.

4 Shorting bar for grounding chassis

This is used to connect the auxiliary output + (pos.) or - (neg.) terminal to the chassis ground terminal (⊥).

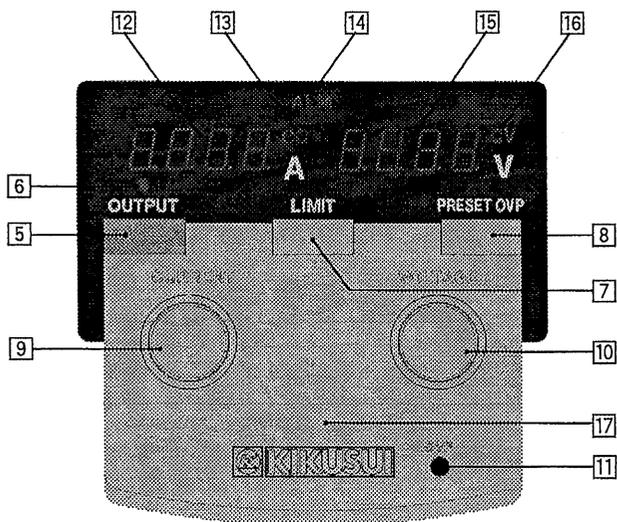


Fig. 4-2 PAN-A series control panel

5 OUTPUT

Turns the output on and off. It is turned on at pushed.

When the output is turned off, the output circuit is set into a state of high impedance (several $k\ \Omega$).

6 OUTPUT ON indication

This LED lights up when the output is turned on.

7 LIMIT

This is used to preset or check the output voltage and/or the output current. While pressing this switch, the currently preset voltage and current are displayed.

8 PRESET OVP

This is used to preset or check the OVP (overvoltage protection) voltage. While this switch is held down, the currently preset OVP voltage is displayed.

9 CURRENT

This is used to set output current for constant current operation mode. (10 turns)

10 VOLTAGE

This is used to set output voltage for constant voltage operation mode. (10 turns)

11 OVP

This is the OVP (overvoltage protection) control, and used to preset the trip point of the OVP circuit.

12 Ammeter

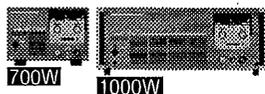
Indicates the output current when the OUTPUT switch is turned on. Indicates the output current limit when the LIMIT switch is pressed.

13 CC

"CC" (Constant Current) LED is displayed when the unit is in its constant current operation mode.

14 ALM

"ALM" (alarm) LED lights up when the OVP circuit trips.



In the case of the models 700W and 1000W, the power switch is shut down as soon as the ALM lamp lights up, and all displays on the panel go off.

ALM lights up if any one of the following protection circuits is activated.

1. Overvoltage protection circuit (OVP)
2. Overheat protection circuit (protects the semiconductor cooler from becoming overheated)
3. Voltage detection circuit (protects smoothing capacitors in the phase control circuit from overvoltage)
4. Overcurrent protection circuit (protects the internal circuit from overcurrent caused by erroneous operation of external controls)

Circuits other than the overvoltage protection circuit are intended to protect the internal circuit of the unit; a trip point cannot be set for them.

15 Voltmeter

Indicates output voltage when the OUTPUT switch is turned on. Indicates the output voltage limit when the LIMIT switch is pressed. Indicates the OVP trip voltage when the PRESET OVP switch is pressed.

16 CV

"CV" (Constant Voltage) LED is displayed when the unit is in its constant voltage operation mode.

17 Front sub-panel cover

This is used to cover the switches and variable resistors that are seldom used. To open it, press both sides of the cover and pull it forward. Beneath the cover are the remote control switches and variable resistors for calibration.

4.2 Rear panel

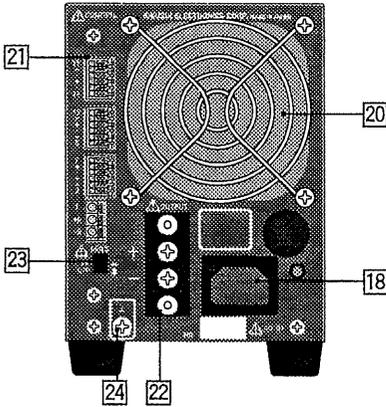


Fig. 4-3A Rear panel of PAN-A series model 175W

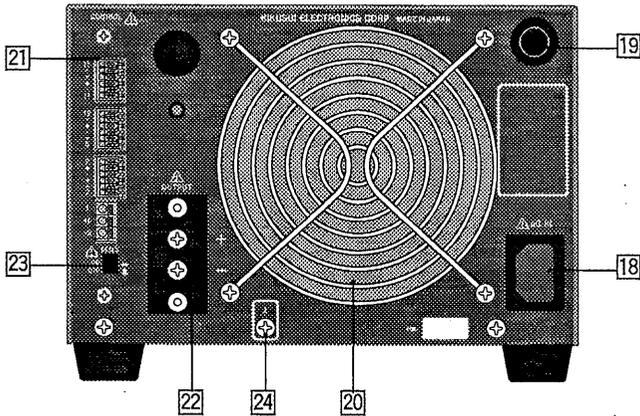


Fig. 4-3B Rear panel of PAN-A series model 350W

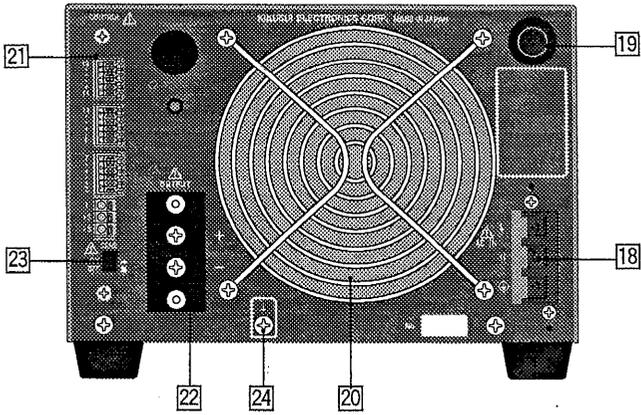


Fig. 4-3C Rear panel of PAN-A series model 700W

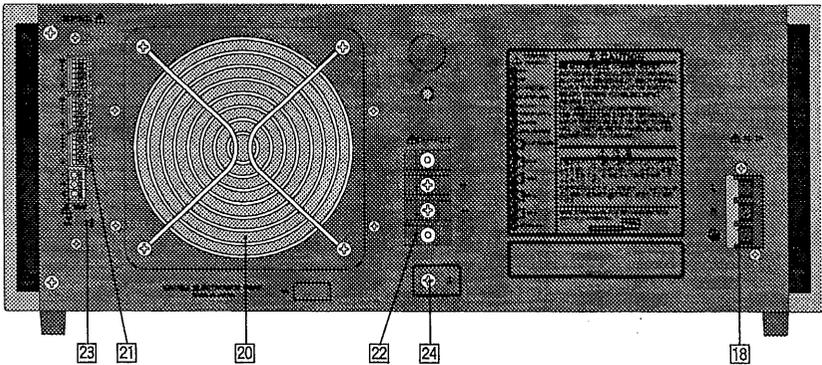


Fig. 4-3D Rear panel of PAN-A series model 1000W (excluding PAN16-50A)

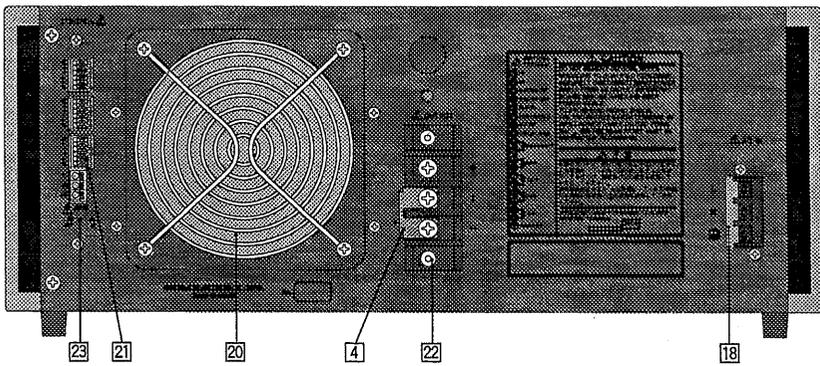


Fig. 4-3E Rear panel of PAN16-50A

18 AC IN ⚠

AC input terminals. Connect the supplied AC power cable.

WARNING

- Incorrect handling may cause electric shock. Always follow the instructions in section 1.5, "Connecting the AC power cable".
- Make sure that the ground terminal Ⓢ is securely grounded. For details, see section 1.6, "Grounding".

19 FUSE ⚠

Fuse holder. A AC input fuse element is put in this.

WARNING

- Incorrect handling may cause electric shock. Always follow the instructions in section 1.4, "Checking the input fuse".

NOTE



- The input fuses of the models 175W and 1000W are located inside, and no fuse holder is found on the rear panel.

20 Exhaust port

This port uses a fan to exhaust heated air from inside. Keep sufficient space around the unit for good ventilation.

21 CONTROL ⚠

This is the terminal board used for applied operations such as remote control.

WARNING

- Incorrect handling may cause electric shock. For details, see Chapter 3, "Applied Operation".

22 OUTPUT ⚠

This is the output terminal board.

WARNING

- To avoid electric shock, always turn off the POWER switch whenever it is necessary to touch the terminals.

NOTE



1000W
PAN16-50A

- The ⊥ terminal is chassis ground terminal.

23 SENS ⚠

Turn this switch on when using the sensing function. It is turned on at pushed.

24 ⊥

Chassis ground terminal

To maintain the unit's original performance as long as possible, conduct periodic checks and maintenance.

5.1 Cleaning

When the panel gets soiled, wet a piece of soft cloth with a water-diluted neutral detergent, and wipe the panel softly.

The air intake port on the front panel is equipped with an air filter inside. Suck out any dust with a vacuum cleaner.

CAUTION

- For maintenance work, always turn off the POWER switch, and either disconnect the AC power cable or turn off the switch on the switchboard.
- Do not use volatile solvents such as thinner and benzene. They may discolor the unit surface coating, erase printed characters, or make face of display opaque.

5.2 Inspection

AC power cable

Check that there is no damage on the insulation coating, and that the plug is firmly attached and free from cracks.

WARNING

- Breaks in the insulation coating may cause electric shock. If a break is found, immediately stop using the unit.

To purchase accessories, contact your Kikusui agent.

5.3 Calibration

The unit is factory-calibrated based on control from the front panel (i.e., local control). To use remote control (excluding output ON/OFF using external contact points), however, re-calibration is necessary. Re-calibration is also necessary when changing from remote control back to local control.

This Operation Manual describes calibration only of the unit's remote-control function. In the course of long use of the unit, however, other items may also need calibration due to the effect of age. For all such calibrations, contact your Kikusui agent.

5.3.1 Test equipment required

For calibration, the following equipment is necessary.

- DC voltmeter (DVM) with measuring accuracy of 0.02% max.
- Shunt resistor with accuracy of 0.1% max.

5.3.2 Calibration procedure

Calibration items can be roughly classified into two areas: the voltage system and the current system. These items may change depending on what is to be controlled by remote control. It is not necessary, however, to calibrate remote control for the output ON/OFF.

If remote control is used for the output current by means of external voltage, calibration of the current system is necessary.

Calibration is conducted by using the adjusting variable resistors "2" and "4" - "8", located under the front panel cover.

NOTE

- Never touch the variable resistors "1", "3", "9" and "10", as they are not involved in the user adjustment process. If you have moved any of them by mistake, re-adjustment is necessary. In such cases, contact your Kikusui agent.

Voltage system calibration procedure

The voltage system includes the following three items. Since all the items are related to one another, calibrate them all in the following sequence.

- Output voltage offset
- Output voltage in full scale
- Output voltage display in full scale

■ Connection of equipment

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ Check that the SENS switch is turned off.
- ④ Connect a DVM as shown in Fig. 5-1A.



1000V
PAN16-50A

For the PAN16-50A user, see Fig. 5-1B.

- ⑤ Connect the - (neg.) terminal and the chassis ground terminal (⊥) with the shorting bar.

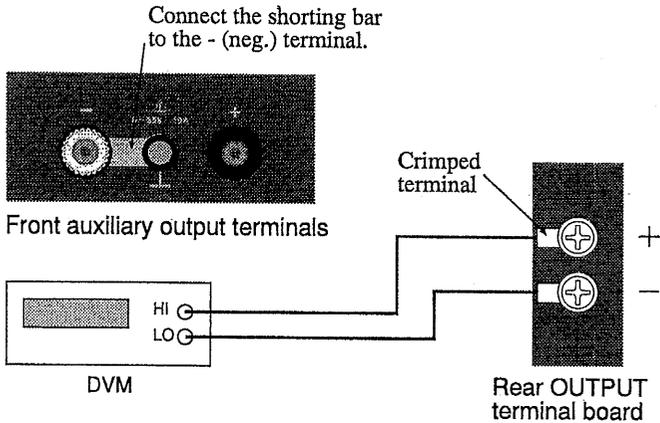


Fig. 5-1A Connection for voltage system calibration

NOTE

- If the SENS switch is turned on, it is impossible to calibrate correctly. Check the SENS switch is turned off.



1000W
PAN16-50A

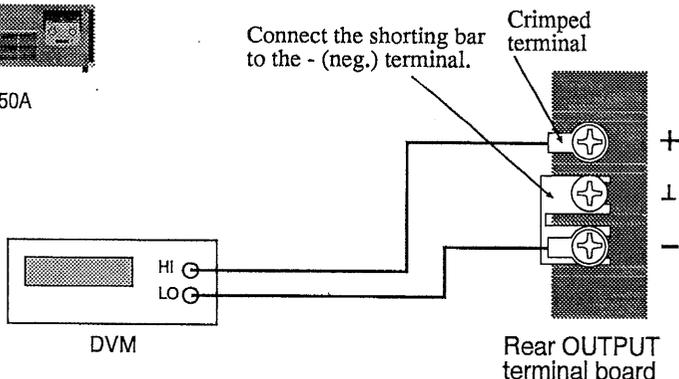


Fig. 5-1B Connection for voltage system calibration (PAN16-50A)

- ⑥ Turn on the POWER switch.

■ Warming-up

NOTE

- To minimize calibration error affected by initial drift, warm up the unit at least 30 minutes before starting calibration.

- ⑦ Set the output voltage to the rated output voltage.
For local control, turn the VOLTAGE control fully clockwise. For remote control, set the control input to 10 V or 9.5 k Ω .
- ⑧ Turn on the OUTPUT switch.
- ⑨ Turn off the OUTPUT switch 30 minutes or more later.

● Output voltage offset

- ⑩ Set the output voltage to 0 V.
For local control, turn the VOLTAGE control fully counter-clockwise. For remote control, set the control input to 0 V or 0 Ω .
- ⑪ Turn the CURRENT control clockwise.
- ⑫ Turn on the OUTPUT switch.
- ⑬ Check that the unit is in the constant voltage operation mode.
- ⑭ Using variable resistor "2", adjust the output voltage to 0 V.

● Output voltage in full scale

- ⑮ Set the output voltage to the maximum.
For local control, turn the VOLTAGE control fully clockwise. For remote control, set the control input to 10.5 V or 10 k Ω .
- ⑯ Using variable resistor "4", adjust the output voltage to 105% of the rated output voltage.

CAUTION

- The maximum output voltage of the unit is specified at 105% of the rated output voltage. It is possible to adjust to a level higher than 105% using variable resistor "4", but this may damage the unit.

NOTE

- For remote control using external voltage, a 10 V control signal may be selected and adjusted to 100% of the rated output voltage of the unit.

● Output voltage display in full scale

- ⑰ Adjust with variable resistor "5" so that the output voltage indication of the unit equals the indication on the external digital voltmeter (DVM) in a rated-voltage output condition.

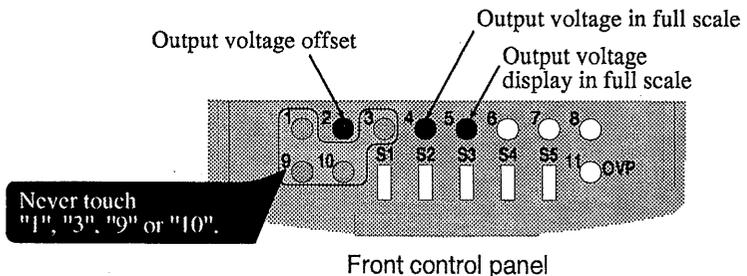


Fig. 5-2 Voltage system adjustment variable resistor

Current system calibration procedure

The current system includes the following three items. Since all the items are related to one another, calibrate them all in the following sequence.

- Output current offset
- Output current in full scale
- Output current display in full scale

■ Connection of equipment

- ① Turn off the OUTPUT switch.
- ② Turn off the POWER switch.
- ③ Connect a shunt resistor and DVM as shown in Fig. 5-3A.



1000W
PAN16-50A

For the PAN16-50A user, see Fig. 5-3B.

- ④ Connect the - (neg.) terminal and the chassis ground terminal (⊥) with the shorting bar.

WARNING

- Use load cables of sufficient current capacity to cover the rated current.

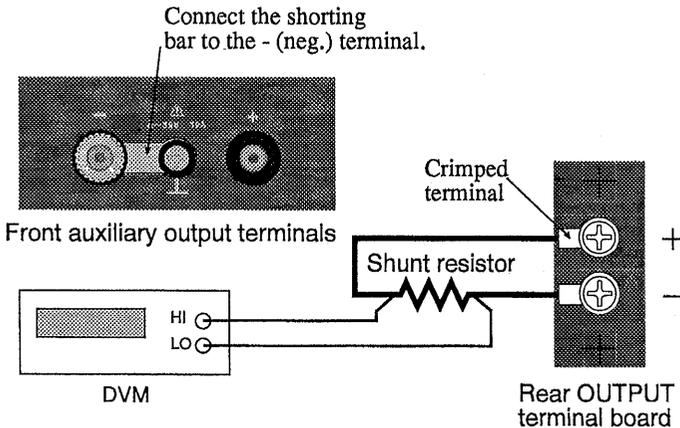


Fig. 5-3A Connection for current system calibration

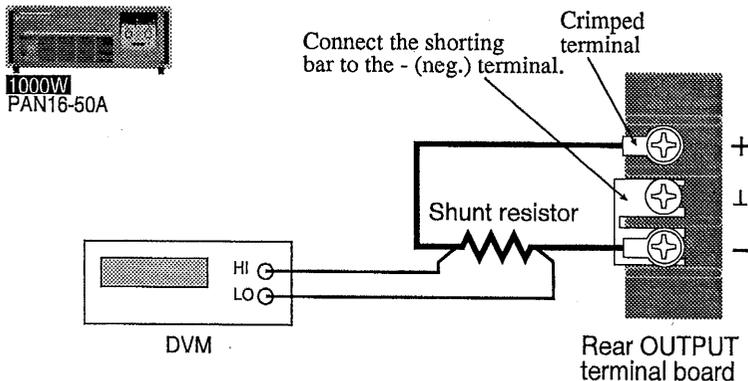


Fig. 5-3B Connection for current system calibration (PAN16-50A)

- ⑤ Turn on the POWER switch.

■ Warming-up

NOTE

- To minimize calibration error affected by initial drift, warm up the unit at least 30 minutes before starting calibration.

- ⑥ Set the output current to the rated output current.
For local control, turn the CURRENT control fully clockwise. For remote control, set the control input to 10 V or 9.5 k Ω .
- ⑦ Turn on the OUTPUT switch.
- ⑧ Turn off the OUTPUT switch 30 minutes or more later.

● Output current offset

- ⑨ Set the output current to 0 A.
For local control, turn the CURRENT control fully counter-clockwise. For analog remote control, set the control input to 0 V or 0 Ω .
- ⑩ Turn the VOLTAGE control clockwise.
- ⑪ Turn on the OUTPUT switch.
- ⑫ Check that the unit is in its constant current operation mode.
- ⑬ Using variable resistor "6", adjust the output current to 0 A.

● Output current in full scale

- ⑭ Set the output current to the rated output current.
For local control, turn the CURRENT control fully clockwise. For analog remote control, set the control input to 10.5 V or 10 k Ω .
- ⑮ Using variable resistor "7", adjust the output current to 105% of the rated output current.

CAUTION

- The maximum output current of the unit is specified as 105% of the rated output current. It is possible to adjust to a level higher than 105% using variable resistor "7", but this may damage the unit.

NOTE

- For remote control using external voltage, a 10 V control signal may be selected and adjusted to 100% of the rated output current of the unit.

● Output current display in full scale

- ⑯ Adjust with variable resistor "8" so that the output current indication of the unit equals the current value obtained from the indication on the external digital voltmeter (DVM) and shunt resistor, in a rated-current output condition.

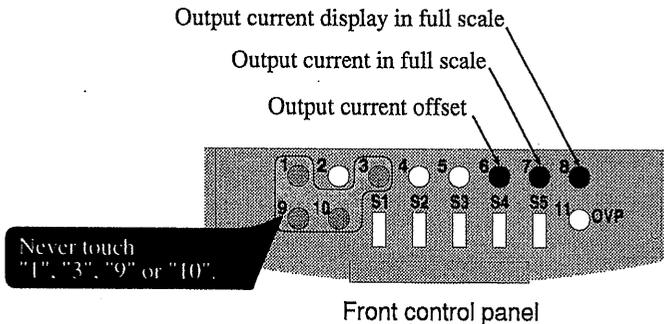


Fig. 5-4 Current system adjustment variable resistor

5.4 Malfunctions and Causes

This section describes some symptoms of possible malfunctions encountered during use of the unit, along with appropriate remedies.

Here, we provide seven typical symptoms and possible check items for each; you simply find the relevant item. Ideally, you will be able to cure these symptoms without difficulty.

When you find a relevant item, follow the corresponding remedy. If this does not solve or improve the problem, or if no relevant item can be located, please contact your Kikusui agent.

■ Symptom 1: The control panel displays nothing.

Check item	Cause and remedy
<input type="checkbox"/> Check that the wires to the AC input terminals are connected correctly.	<ul style="list-style-type: none">• Wiring to the L, N, and GND terminals is wrong. Connect the wires to these terminals correctly by referring to Section "1.5 Connecting the AC power cable."
<input type="checkbox"/> Check that the AC power cable is plugged into a power socket securely.	<ul style="list-style-type: none">• Plug the AC power cable into the socket securely.
<input type="checkbox"/> Check that the AC power cable contains no broken wires.	<ul style="list-style-type: none">• Replace the power cable with a new AC power cable.
<input type="checkbox"/> Check that the input fuse is not blown. (For models 350W or 700W only)	<ul style="list-style-type: none">• Input voltage is high, exceeding the input voltage range. Supply a voltage within the input voltage range. Replace the fuse by referring to Section "1.4 Checking the input fuse."• The fuse appears to have suffered long-term damage from inrush currents. Replace it by referring to "1.4 Checking the input fuse."

■ Symptom 2: When you turn on the POWER switch, it is turned off or the "ALM" LED lights up.

Check item	Cause and remedy
<input type="checkbox"/> Check that switch S4 on the control panel has not been set to on (upper position).	<ul style="list-style-type: none"> The overcurrent protection circuit has been activated. Switch S4 should be off (lower position) when output current control using an external resistor is not carried out.
<input type="checkbox"/> Check that control wires are secure in controlling output with external resistor.	<ul style="list-style-type: none"> The overcurrent protection circuit has been activated. Connect the control wires correctly by referring to Section "3.3.1 Controlling output voltage with external resistor," or "3.3.3 Controlling output current with external resistor."
<input type="checkbox"/> Check that a switch used for switching the resistor is not open during switching in external resistor-based control.	<ul style="list-style-type: none"> The overcurrent protection circuit has been activated. Replace the switch with a shorting-type or continuous-type switch. See the CAUTION note in Sections "3.3.1 Controlling output voltage with external resistor," or "3.3.3 Controlling output current with external resistor."
<input type="checkbox"/> Check that input voltage is not distorted into a square waveform.	<ul style="list-style-type: none"> The voltage detection circuit of the phase control circuit has been activated. If the crest factor of input voltage is 1.2 or less, the phase control circuit may malfunction. In this case, use a regulated AC power supply as an input source. The capacity of the regulated AC power supply requires at least twice the power consumption (VA) of the unit.

■ Symptom 3: When you turn on the OUTPUT switch, the POWER switch is turned off or the "ALM" LED lights up.

Check item	Cause and remedy
<input type="checkbox"/> Check that the OVP trip point is not preset to a level below output voltage.	<ul style="list-style-type: none"> • The overvoltage protection circuit has been activated. Preset the OVP trip point to a level above the output voltage. See "2.3.1 OVP trip point presetting."
<input type="checkbox"/> Check that the actual output voltage is not higher than voltage displayed on the panel.	<ul style="list-style-type: none"> • The overvoltage protection circuit has been activated. The voltage system requires calibration. Re-calibrate the unit by referring to "5.3.2 Calibration procedure."
<input type="checkbox"/> Check that the SENS switch is not on.	<ul style="list-style-type: none"> • The overvoltage protection circuit has been activated. The SENS switch should be off when the remote sensing function is not used.
<input type="checkbox"/> Check that no special load is connected.	<ul style="list-style-type: none"> • The overvoltage protection circuit has been activated. See the item "Load" in "2.1 Precautions and preparation for use."
<input type="checkbox"/> Check that control wires are secure in controlling output with external resistor.	<ul style="list-style-type: none"> • The overvoltage protection circuit or overcurrent protection circuit has been activated. Connect the control wires correctly by referring to Sections "3.3.1 Controlling output voltage with external resistor," or "3.3.3 Controlling output current with external resistor."
<input type="checkbox"/> Check that control wires are secure and that external voltage is not excessive in controlling output with external voltage.	<ul style="list-style-type: none"> • The overvoltage protection circuit or overcurrent protection circuit has been activated. Connect the control wires correctly by referring to Sections "3.3.2 Controlling output voltage with external voltage," or "3.3.4 Controlling output current with external voltage."
<input type="checkbox"/> Check to see if the fan runs normally.	<ul style="list-style-type: none"> • The overheat protection circuit has been activated. Ambient temperature has exceeded the operating ambient temperature or the fan has possibly failed. If the fan does not run when the unit is used in the range of 0° C to 40° C, stop using the unit immediately and contact us for repair service.

■ Symptom 4: No output is generated even when the OUTPUT switch is turned on.

Check item	Cause and remedy
<input type="checkbox"/> Check to see if both the "CV" and "CC" LEDs are off.	<ul style="list-style-type: none"> • The VOLTAGE and CURRENT knobs have been turned fully counterclockwise. Both LEDs may not light up, depending on the offset setting conditions. This is not a form of equipment failure. Set the required output using the VOLTAGE and CURRENT knobs.
<input type="checkbox"/> Check that the VOLTAGE or CURRENT knob has not been turned fully counterclockwise.	<ul style="list-style-type: none"> • Set the required output using the VOLTAGE or CURRENT knob.
<input type="checkbox"/> Check to see if the "OUTPUT ON" LED is off.	<ul style="list-style-type: none"> • The external contact points have been closed in output ON/OFF control using external contact points. See "3.3.5 Output ON/OFF control."
<input type="checkbox"/> Check that the switches S1, S3, and S5 on the control panel have not been set to on (upper position).	<ul style="list-style-type: none"> • For control from the front panel, control switches S1, S3, and S5 should all be set to off (lower position). See "3.3 Analog remote control."

■ Symptom 5: No output is generated or the output is unstable even when the OUTPUT switch is turned on.

Check item	Cause and remedy
<input type="checkbox"/> Check to see if the operation mode changes from CV to CC or CC to CV.	<ul style="list-style-type: none"> • Turn the setting knob (VOLTAGE or CURRENT) that has been clamped, in the clockwise direction. If the knob has already been turned fully clockwise, it is necessary to use a power supply with greater capacity.
<input type="checkbox"/> Check that the SENS switch is not on.	<ul style="list-style-type: none"> • The SENS switch should be off when the remote sensing function is not being used.
<input type="checkbox"/> Check to see if it has been more than 30 minutes since a power-on.	<ul style="list-style-type: none"> • The output is unstable due to initial drift. Carry out a warm-up (power application) for at least 30 minutes.
<input type="checkbox"/> Check to see if both the "CV" and "CC" LEDs are lit.	<ul style="list-style-type: none"> • Input voltage is low, i.e., below the input voltage range. Supply voltage within the input voltage range. • Ambient temperature is less than the operating ambient temperature. Use the unit within a range of 0° C to 40° C. • If remote sensing and master-slave-control parallel operations are carried out, causing oscillation, add a capacitor to the load end. See "3.2 Remote sensing," and "3.4 Master-slave-control parallel operation." • The internal circuit may be faulty. If a load such as battery is connected to the output terminals directly, the internal circuit may break or the output fuse may blow. See the item "Load" in "2.1 Precautions and preparation for use." Stop using the unit immediately and contact us for repair service.
<input type="checkbox"/> Check to see if current flows even though no load is connected.	<ul style="list-style-type: none"> • The internal circuit may be broken. If a capacitor of large capacity or a battery is connected in reverse polarity, a diode for preventing reverse connection will break. Stop using the unit immediately and contact us for repair service.
<input type="checkbox"/> Check to see if output is generated even though the OUTPUT switch is turned off.	<ul style="list-style-type: none"> • The internal circuit may be broken. Application of voltage higher than the rating of the unit to the output terminals will cause the bleeder circuit to break. If a load such as a battery is connected to the output terminals directly, the power transistors will break. Stop using the unit immediately and contact us for repair service.

■ Symptom 6: Large output ripple

Check item	Cause and remedy
<input type="checkbox"/> Check that the input voltage is not below the correct range.	<ul style="list-style-type: none"> Supply a voltage within the input voltage range.
<input type="checkbox"/> Check that the output terminals and chassis ground terminal are not floated.	<ul style="list-style-type: none"> Being subjected to induction of input power frequency (50/60 Hz). If possible, connect the output terminals to the ground using a capacitor of 0.1 μF or more.
<input type="checkbox"/> Check that there is no intense magnetic or electric field generating source nearby.	<ul style="list-style-type: none"> Being subjected to electromagnetic induction. Take measures such as locating the unit away from such generating sources and using twisted cables.
<input type="checkbox"/> Check that external voltage is not noisy in controlling output with external voltage.	<ul style="list-style-type: none"> Take measures against noise by referring to Sections "3.3.2 Controlling output voltage using external voltage," or "3.3.4 Controlling output current using external voltage."
<input type="checkbox"/> Check that the SENS switch is not on.	<ul style="list-style-type: none"> The SENS switch should be off when the remote sensing function is not used.

■ Symptom 7: Display value does not indicate output value

Check item	Cause and remedy
<input type="checkbox"/> Check that the SENS switch is not on.	<ul style="list-style-type: none"> The SENS switch should be off when the remote sensing function is not used.
<input type="checkbox"/> Check that sensing wires or load cables are broken wires or have poor contact when the remote sensing function is used.	<ul style="list-style-type: none"> Check that all cables and wires are connected correctly after turning off the POWER switch
<input type="checkbox"/> Check that the load current has peaks or is pulse-shaped.	<ul style="list-style-type: none"> See 'Load' in Section '2.1 Precautions and preparation for use'.
<input type="checkbox"/> Check that the variable resistor '1' on the control panel was moved.	<ul style="list-style-type: none"> Internal reference voltage has been changed. Because re-adjustment is necessary, contact your Kikusui agent.

Unless otherwise specified, the specifications of the unit are based on the following conditions.

- The load is a pure resistance.
- The - (neg.) output terminal is connected to the chassis ground terminal (\perp) with the supplied shorting bar.
- The unit should be used after 30 minutes warming-up time (with current flowing), at an ambient temperature of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, with 80% RH max.
- TYP value, standard value and theoretical value do not guarantee performance. They should be referred to as target values only.

Specifications of PAN-A Series Model 175W

Model 175W		PAN16-10A	PAN35-5A	PAN55-3A	PAN70-2.5A	PAN110-1.5A	PAN160-1A
Input							
Input voltage and frequency		100VAC±10%, 50/60Hz, 1-phase, Crest factor: 1.2-1.41 (110, 120, 200, 220, 230 and 240VAC input are factory option.*1)					
Power consumption, at 100VAC, rated load		Approx. 400VA	Approx. 400VA	Approx. 350VA	Approx. 350VA	Approx. 400VA	Approx. 330VA
Output							
Voltage	Rated voltage	16V	35V	55V	70V	110V	160V
	Variable range	0-16V	0-35V	0-55V	0-70V	0-110V	0-160V
	Resolution (theoretical value) *2	3mV	7mV	10mV	13mV	20mV	30mV
Number of turns of panel control		10 turns					
Current	Rated current	10A	5A	3A	2.5A	1.5A	1A
	Variable range	0-10A	0-5A	0-3A	0-2.5A	0-1.5A	0-1A
	Resolution (theoretical value) *2	1.8mA	0.9mA	0.6mA	0.5mA	0.3mA	0.2mA
Number of turns of panel control		10 turns					

*1: For 230 and 240VAC input requirement, maximum input voltage is limited to 250VAC.

*2: The value is calculated from the number of turns of the wire-wound potentiometer. In practice, use 3-5 times each value as a target.

Model	175W	PAN16-10A	PAN35-5A	PAN55-3A	PAN70-2.5A	PAN110-1.5A	PAN160-1A
Constant voltage characteristics							
Ripple and noise (5Hz-1MHz) RMS	0.5mV	0.5mV	0.5mV	0.5mV	0.5mV	0.5mV	1mV
Source effect (to $\pm 10\%$ of AC input voltage)	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV
Load effect (to 0-100% of output current) *3	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV
Transient response (standard value) *3, *4	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s
Temperature coefficient	100ppm/ $^{\circ}$ C (TYP value)						
Constant current characteristics							
Ripple and noise (5Hz-1MHz) RMS	2mA	1mA	1mA	1mA	1mA	1mA	1mA
Source effect (to $\pm 10\%$ of AC input voltage)	1mA	1mA	1mA	1mA	1mA	1mA	1mA
Load effect (to approx. 1 V-100% of output voltage)	3mA	2mA	2mA	2mA	1mA	1mA	1mA
Temperature coefficient	300ppm/ $^{\circ}$ C (TYP value)						
Constant voltage operation indication							
C.V. green LED indication							
Constant current operation indication							
C.C. red LED indication							
Range of operation temperature and humidity							
0-40 $^{\circ}$ C/10-90% RH (no dew condensation allowed)							
Range of storage temperature and humidity							
-10-60 $^{\circ}$ C/0-70% RH max. (no dew condensation allowed)							
Cooling system							
Forced air cooling with fan							
Output polarity							
Positive or negative grounding possible							
Isolation							
$\pm 250V$ $\pm 250V$ $\pm 250V$ $\pm 250V$ $\pm 250V$ $\pm 500V$ $\pm 500V$ $\pm 500V$							

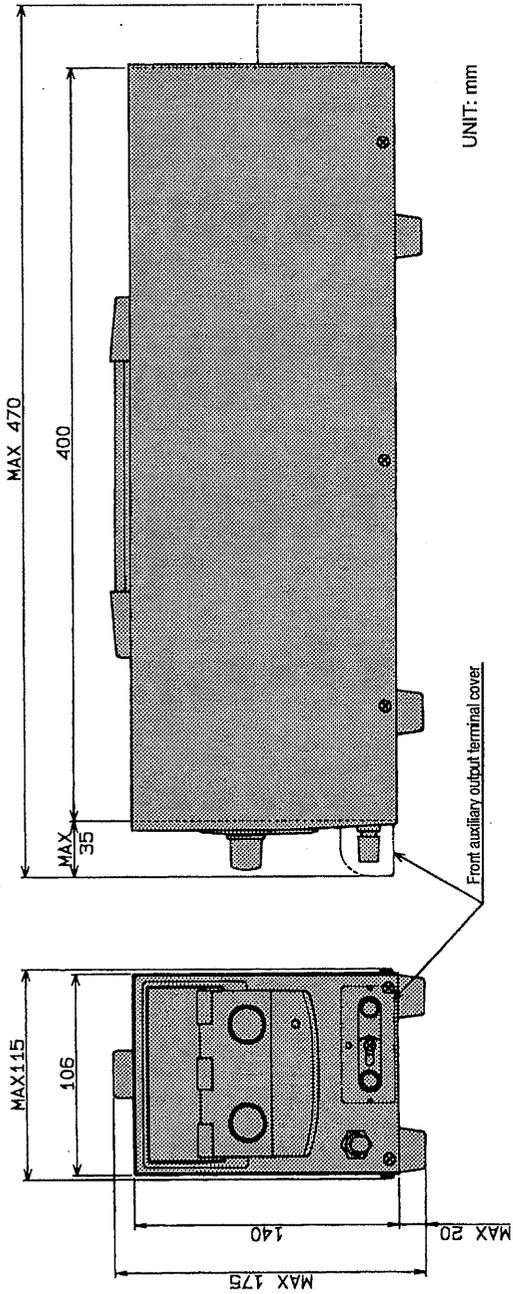
*3: Measured at the OUTPUT terminal board on the rear panel using the remote sensing function.
 *4: Time necessary for output voltage to return to $\pm (0.05\%+10mV)$ max. of rated value at 5%-100% changes of output current.

Model 175W		PAN16-10A	PAN35-5A	PAN55-3A	PAN70-2.5A	PAN110-1.5A	PAN160-1A
Insulation resistance							
Across chassis and input terminals		500VDC, 30M Ω min. (measured at ambient humidity 70% RH max.)					
Across chassis and output terminals		500VDC, 20M Ω min. (measured at ambient humidity 70% RH max.)					
Withstanding voltage							
Across input terminals and output terminals		Should withstand 1500VAC, 1 min. with no abnormalities					
Across input terminals and chassis							
Meter display							
Output voltage	Max. figure displayed (fixed range)	19.99	199.9	199.9	199.9	199.9	199.9
	Display error	$\pm(0.5\%rdg+2digits)$ at 23°C $\pm 5^\circ\text{C}$					
Temperature coefficient		300 ppm/ $^\circ\text{C}$ (TYP value)					
Output current	Max. figure displayed (fixed range)	19.99	19.99	19.99	19.99	1.999	1.999
	Display error	$\pm(1\%rdg+5digits)$ at 23°C $\pm 5^\circ\text{C}$					
Temperature coefficient		400ppm/ $^\circ\text{C}$ (TYP value)					
Remote control							
Output voltage/control voltage ratio		16V/ approx. 10V	35V/ approx. 10V	55V/ approx. 10V	70V/ approx. 10V	110V/ approx. 10V	160V/ approx. 10V
Output voltage/control resistance ratio		16V/ approx. 10k Ω	35V/ approx. 10k Ω	55V/ approx. 10k Ω	70V/ approx. 10k Ω	110V/ approx. 10k Ω	160V/ approx. 10k Ω
Output current/control voltage ratio		10A/ approx. 10V	5A/ approx. 10V	3A/ approx. 10V	2.5A/ approx. 10V	1.5A/ approx. 10V	1A/ approx. 10V
Output current/control resistance ratio		10A/ approx. 10k Ω	5A/ approx. 10k Ω	3A/ approx. 10k Ω	2.5A/ approx. 10k Ω	1.5A/ approx. 10k Ω	1A/ approx. 10k Ω
Remote sensing		Possible (compensation one way approx. 0.6V max.)					
Master-slave-control parallel operation		Possible					
Master-slave-control series operation		Possible					

Model 175W	PAN16-10A	PAN35-5A	PAN55-3A	PAN70-2.5A	PAN110-1.5A	PAN160-1A
Protective circuit	Over-voltage protection (OVP) for output Preset range: Approx. 10-110% of rated output voltage, ALM LED lights up, control transistor cut off, and rectification circuit shut down when OVP tripped.					
Input fuse, 6.4mm dia. X 32mm	7A, 125VAC/250VAC					
Output fuse, standard pre-arcing time-current type	15A	7A	4A	3A	2A	2A
Thermal fuse	Incorporated in transformer					
EMC	Complied with the following standards *5 European Community Requirements (89/336/EEC) EN55011 Radiated Emissions class A Conducted Emissions class A EN50082-1 IEC801-2 Electro-static Discharge IEC801-3 Radiated Susceptibility IEC801-4 Fast Burst Transient					
Safety	Complied with the following standard *5 European Community Requirements (73/23/EEC)					
Weight	Approx.11kg	Approx.11kg	Approx.11kg	Approx.11kg	Approx.11kg	Approx.11kg
Dimensions	See outline drawing.					
Accessory	Operation manual 1 copy					
Power cable	1 pc. (SVT3 X 18AWG, approx. 3m) *6					
Protection cover	Guard cap 2 pcs., Rear output terminal cover 1 pc., Front auxiliary output terminal cover 1 pc., (Mounting screw(M3 X 20) 1 pc.)					

*5: CE marking are put only on the PAN-A series sold in Europe.

*6: 1 pc. (H05VV-F 3 X 1.0mm², approx. 2m) for the PAN-A series put on CE marking



PAN-A Series Model 175W Outline Drawing

Specifications of PAN-A Series Model 350W

Model 350W		PAN16-18A	PAN35-10A	PAN55-6A	PAN70-5A	PAN110-3A	PAN160-2A
Input							
Input voltage and frequency		100VAC ± 10%, 50/60Hz, 1-phase, Crest factor: 1.2-1.41 (110, 120, 200, 220, 230 and 240VAC input are factory option. *1)					
Power consumption, at 100VAC, rated load		Approx. 800VA	Approx. 800VA	Approx. 700VA	Approx. 800VA	Approx. 700VA	Approx. 700VA
Output							
Voltage	Rated voltage	16V	35V	55V	70V	110V	160V
	Variable range	0-16V	0-35V	0-55V	0-70V	0-110V	0-160V
	Resolution (theoretical value) *2	3mV	7mV	10mV	13mV	20mV	30mV
	Number of turns of panel control	10 turns					
Current	Rated current	18A	10A	6A	5A	3A	2A
	Variable range	0-18A	0-10A	0-6A	0-5A	0-3A	0-2A
	Resolution (theoretical value) *2	3.3mA	1.8mA	1.1mA	0.9mA	0.6mA	0.4mA
	Number of turns of panel control	10 turns					

*1: For 230 and 240VAC input requirement, maximum input voltage is limited to 250VAC.

*2: The value is calculated from the number of turns of the wire-wound potentiometer. In practice, use 3-5 times each value as a target.

Model 350W	PAN16-18A	PAN35-10A	PAN55-6A	PAN70-5A	PAN110-3A	PAN160-2A
Constant voltage characteristics						
Ripple and noise (5Hz-1MHz) RMS	0.5mV	0.5mV	0.5mV	0.5mV	0.5mV	1mV
Source effect (to $\pm 10\%$ of AC input voltage)	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV
Load effect (to 0-100% of output current) *3	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV
Transient response (standard value) *3, *4	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s
Temperature coefficient	100ppm/ $^{\circ}$ C (TYP value)					
Constant current characteristics						
Ripple and noise (5Hz-1MHz) RMS	5mA	2mA	2mA	2mA	1mA	1mA
Source effect (to $\pm 10\%$ of AC input voltage)	1mA	1mA	1mA	1mA	1mA	1mA
Load effect (to approx. 1 V-100% of output voltage)	3mA	3mA	3mA	2mA	2mA	2mA
Temperature coefficient	300ppm/ $^{\circ}$ C (TYP value)					
Constant voltage operation indication						
C.V, green LED indication						
Constant current operation indication						
C.C, red LED indication						
Range of operation temperature and humidity						
0-40 $^{\circ}$ C/10-90% RH (no dew condensation allowed)						
Range of storage temperature and humidity						
-10-60 $^{\circ}$ C/0-70% RH max. (no dew condensation allowed)						
Cooling system						
Forced air cooling with fan						
Output polarity						
Positive or negative grounding possible						
Isolation						
$\pm 250V$ $\pm 250V$ $\pm 250V$ $\pm 250V$ $\pm 500V$ $\pm 500V$						

*3: Measured at the OUTPUT terminal board on the rear panel using the remote sensing function.

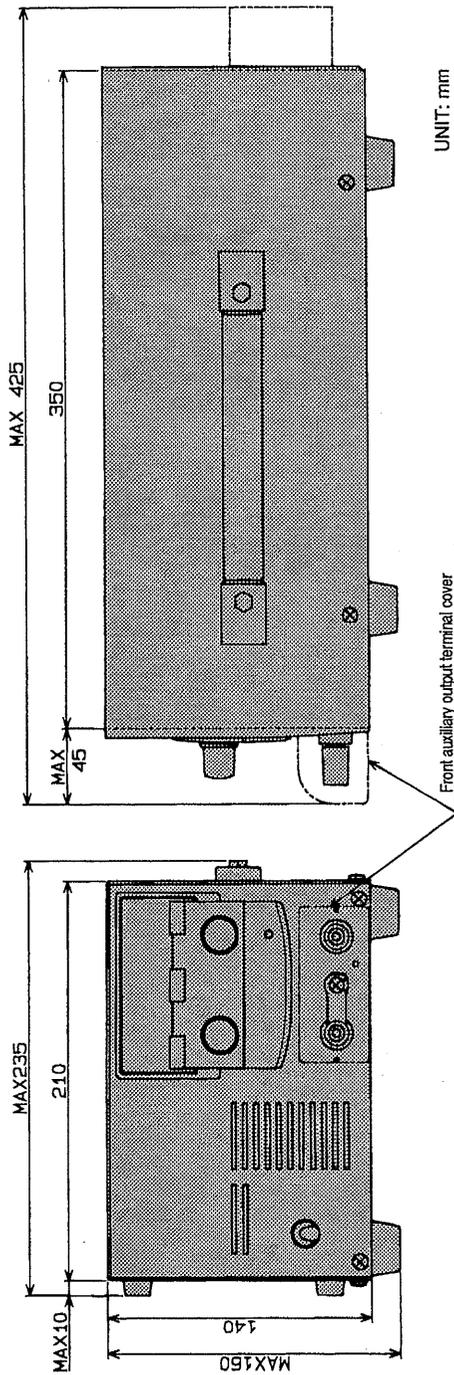
*4: Time necessary for output voltage to return to $\pm (0.05\%+10mV)$ max. of rated value at 5%-100% changes of output current.

Model 350W	PAN16-18A	PAN35-10A	PAN55-6A	PAN70-5A	PAN110-3A	PAN160-2A
Insulation resistance						
Across chassis and input terminals	500VDC, 30M Ω min. (measured at ambient humidity 70% RH max.)					
Across chassis and output terminals	500VDC, 20M Ω min. (measured at ambient humidity 70% RH max.)					
Withstanding voltage						
Across input terminals and output terminals	Should withstand 1500VAC, 1 min. with no abnormalities					
Across input terminals and chassis						
Meter display						
Output voltage	19.99	199.9	199.9	199.9	199.9	199.9
Display error	$\pm(0.5\%rdg+2digits)$ at 23 $^{\circ}$ C \pm 5 $^{\circ}$ C					
Temperature coefficient	300 ppm/ $^{\circ}$ C (TYP value)					
Output current	19.99	19.99	19.99	19.99	19.99	19.99
Display error	$\pm(1\%rdg+5digits)$ at 23 $^{\circ}$ C \pm 5 $^{\circ}$ C					
Temperature coefficient	400ppm/ $^{\circ}$ C (TYP value)					
Remote control						
Output voltage/control voltage ratio	16V/ approx. 10V	35V/ approx.10V	55V/ approx.10V	70V/ approx.10V	110V/ approx.10V	160V/ approx.10V
Output voltage/control resistance ratio	16V/ approx.10k Ω	35V/ approx.10k Ω	55V/ approx.10k Ω	70V/ approx.10k Ω	110V/ approx.10k Ω	160V/ approx.10k Ω
Output current/control voltage ratio	18A/ approx.10V	10A/ approx.10V	6A/ approx.10V	5A/ approx.10V	3A/ approx.10V	2A/ approx.10V
Output current/control resistance ratio	18A/ approx.10k Ω	10A/ approx.10k Ω	6A/ approx.10k Ω	5A/ approx.10k Ω	3A/ approx.10k Ω	2A/ approx.10k Ω
Remote sensing	Possible (compensation one way approx. 0.6V max.)					
Master-slave-control parallel operation	Possible					
Master-slave-control series operation	Possible					

Model 350W		PAN16-18A	PAN35-10A	PAN55-6A	PAN70-5A	PAN110-3A	PAN160-2A
Protective circuit							
Over-voltage protection (OVP) for output		Preset range: Approx. 10-110% of rated output voltage, ALM LED lights up, control transistor cut off, and rectification circuit shut down when OVP tripped.					
Input fuse, 6.4mm dia. X32mm		10A, 125VAC/250VAC					
Output fuse, standard pre-arcing time-current type		30A	15A	10A	6A	4A	3A
Thermal fuse		Incorporated in main transformer					
EMC							
		Complied with the following standards *5 European Community Requirements (89/336/EEC) Radiated Emissions class A EN55011 Conducted Emissions class A EN50082-1 IEC801-2 Electro-static Discharge IEC801-3 Radiated Susceptibility IEC801-4 Fast Burst Transient					
Safety							
		Complied with the following standard *5 European Community Requirements (73/23/EEC)					
Weight		Approx.17kg	Approx.17kg	Approx.17kg	Approx.17kg	Approx.17kg	Approx.17kg
Dimensions		See outline drawing.					
Accessory							
Operation manual		1 copy					
Power cable		1 pc. (SVT3 X 18AWG, approx. 3m) *6					
Input fuse		1 pc.					
Protection cover		Guard cap 2 pcs., Rear output terminal cover 1 pc., Front auxiliary output terminal cover 1 pc., (Mounting screw(M3 X 20) 1 pc.)					

*5: CE marking are put only on the PAN-A series sold in Europe.

*6: 1 pc. (H05VV-F 3 X 1.0mm², approx. 2m) for the PAN-A series put on CE marking



PAN-A Series Model 350W Outline Drawing

Specifications of PAN-A Series Model 700W

Model 700W		PAN16-30A	PAN35-20A	PAN55-10A	PAN70-8A	PAN110-5A	PAN160-3.5A	PAN250-2.5A
Input								
Input voltage and frequency		100VAC ± 10%, 50/60Hz, 1-phase, Crest factor: 1.2-1.41 (110, 120, 200, 220, 230 and 240VAC input are factory option.*1)						
Power consumption, at 100VAC, rated load		Approx. 1100VA	Approx. 1400VA	Approx. 1000VA	Approx. 1100VA	Approx. 1000VA	Approx. 1000VA	Approx. 1100VA
Output								
Voltage	Rated voltage	16V	35V	55V	70V	110V	160V	250V
	Variable range	0-16V	0-35V	0-55V	0-70V	0-110V	0-160V	0-250V
	Resolution (theoretical value) *2	3mV	7mV	10mV	13mV	20mV	30mV	45mV
Number of turns of panel control		10 turns						
Current	Rated current	30A	20A	10A	8A	5A	3.5A	2.5A
	Variable range	0-30A	0-20A	0-10A	0-8A	0-5A	0-3.5A	0-2.5A
	Resolution (theoretical value) *2	5.4mA	3.6mA	1.8mA	1.5mA	0.9mA	0.7mA	0.5mA
Number of turns of panel control		10 turns						

*1: For 230 and 240VAC input requirement, maximum input voltage is limited to 250VAC.

*2: The value is calculated from the number of turns of the wire-wound potentiometer. In practice, use 3-5 times each value as a target.

Model	700W	PAN16-30A	PAN35-20A	PAN55-10A	PAN70-8A	PAN110-5A	PAN160-3.5A	PAN250-2.5A
Constant voltage characteristics								
Ripple and noise (5Hz-1MHz) RMS	0.5mV	0.5mV	0.5mV	0.5mV	1mV	1mV	1mV	5mV
Source effect (to $\pm 10\%$ of AC input voltage)	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+2mV
Load effect (to 0-100% of output current) *3	0.005%+2mV	0.005%+2mV	0.005%+2mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+2mV	0.005%+3mV
Transient response (standard value) *3, *4	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s
Temperature coefficient	100ppm/ $^{\circ}$ C (TYP value)							
Constant current characteristics								
Ripple and noise (5Hz-1MHz) RMS	5mA	3mA	3mA	3mA	2mA	1mA	1mA	2mA
Source effect (to $\pm 10\%$ of AC input voltage)	3mA	3mA	3mA	3mA	1mA	1mA	1mA	1mA
Load effect (to approx. 1 V-100% of output voltage)	3mA	3mA	3mA	3mA	3mA	2mA	2mA	1mA
Temperature coefficient	300ppm/ $^{\circ}$ C (TYP value)							
Constant voltage operation indication	C.V, green LED indication							
Constant current operation indication	C.C, red LED indication							
Range of operation temperature and humidity	0-40 $^{\circ}$ C/10-90% RH (no dew condensation allowed)							
Range of storage temperature and humidity	-10-60 $^{\circ}$ C/0-70% RH max. (no dew condensation allowed)							
Cooling system	Forced air cooling with fan							
Output polarity	Positive or negative grounding possible							
Isolation	$\pm 250V$	$\pm 250V$	$\pm 250V$	$\pm 250V$	$\pm 250V$	$\pm 500V$	$\pm 500V$	$\pm 500V$

*3: Measured at the OUTPUT terminal board on the rear panel using the remote sensing function.

*4: Time necessary for output voltage to return to $\pm(0.05\%+10mV)$ max. of rated value at 5%-100% changes of output current.

Model 700W	PAN16-30A	PAN35-20A	PAN55-10A	PAN70-8A	PAN110-5A	PAN160-3.5A	PAN230-2.5A
Insulation resistance							
Across chassis and input terminals	500VDC, 30M Ω min. (measured at ambient humidity 70% RH max.)						
Across chassis and output terminals	500VDC, 20M Ω min. (measured at ambient humidity 70% RH max.)						
Withstanding voltage							
Across input terminals and output terminals	Should withstand 1500VAC, 1 min. with no abnormalities						
Across input terminals and chassis	Should withstand 1500VAC, 1 min. with no abnormalities						
Meter display							
Output voltage	19.99	199.9	199.9	199.9	199.9	199.9	1999
Display error	$\pm(0.5\%rdg+2digits)$ at 23°C \pm 5°C						
Temperature coefficient	300 ppm/°C (TYP value)						
Output current	199.9	199.9	19.99	19.99	19.99	19.99	19.99
Display error	$\pm(1\%rdg+5digits)$ at 23°C \pm 5°C						
Temperature coefficient	400ppm/°C (TYP value)						
Remote control							
Output voltage/control voltage ratio	16V/ approx. 10V	35V/ approx. 10V	55V/ approx. 10V	70V/ approx. 10V	110V/ approx. 10V	160V/ approx. 10V	250V/ approx. 10V
Output voltage/control resistance ratio	16V/ approx. 10k Ω	35V/ approx. 10k Ω	55V/ approx. 10k Ω	70V/ approx. 10k Ω	110V/ approx. 10k Ω	160V/ approx. 10k Ω	250V/ approx. 10k Ω
Output current/control voltage ratio	30A/ approx. 10V	20A/ approx. 10V	10A/ approx. 10V	8A/ approx. 10V	5A/ approx. 10V	3.5A/ approx. 10V	2.5A/ approx. 10V
Output current/control resistance ratio	30A/ approx. 10k Ω	20A/ approx. 10k Ω	10A/ approx. 10k Ω	8A/ approx. 10k Ω	5A/ approx. 10k Ω	3.5A/ approx. 10k Ω	2.5A/ approx. 10k Ω
Remote sensing	Possible (compensation one way approx. 0.6V max.)						
Master-slave-control parallel operation	Possible						
Master-slave-control series operation	Possible						

Model 780W	PAN16-30A	PAN35-20A	PAN65-10A	PAN70-9A	PAN110-5A	PAN160-3.5A	PAN250-2.5A
Protective circuit	Preset range: Approx. 10-110% of rated output voltage, ALM LED lights up, control transistor cut off, and rectification circuit and circuit breaker shut down when OVP tripped.						
Over-voltage protection (OVP) for output	15A, 125VAC /250VAC						
Input fuse, 6.4mm dia. X 32mm	30A	30A	15A	10A	6A	6A	3A
Output fuse, standard pre-arcing time-current type	Incorporated in main transformer						
Thermal fuse	Incorporated in main transformer						
EMC	Complied with the following standards *5 European Community Requirements (89/336/EEC) EN55011 Radiated Emissions class A Conducted Emissions class A IEC801-2 Electro-static Discharge IEC801-3 Radiated Susceptibility IEC801-4 Fast Burst Transient						
Safety	Complied with the following standard *5 European Community Requirements (73/23/EEC)						
Weight	Approx.23kg	Approx.23kg	Approx.22kg	Approx.22kg	Approx.22kg	Approx.22kg	Approx.23kg
Dimensions	See outline drawing.						
Accessory	Operation manual 1 copy Cable A *6 Cable B *7 Cable A *6 Cable B *7 Input fuse 1 pc. Protection cover Guard cap 2 pcs., Rear output terminal cover 1 pc., Front auxiliary output terminal cover 1 pc., (Mounting screw(M3×20) 1 pc.) Cable clamp 1 pc.						

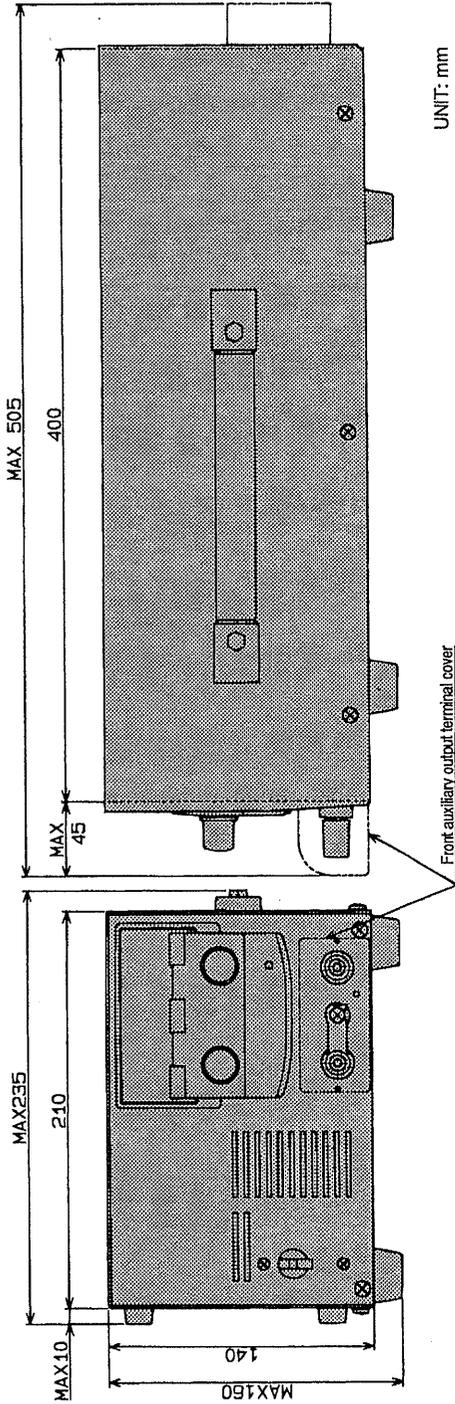
*5: CE marking are put only on the PAN-A series sold in Europe.

*6: Cable A; 1 pc. (Nominal cross section 2mm², cabtyre cable, with 3P plug, approx. 3m)

1 pc. (H05VV-F 3×1.0mm², approx. 2m) for the PAN-A series put on CE marking

*7: Cable B; 1 pc. (Nominal cross section 3.5mm², cabtyre cable, no plug, approx. 3m)

1 pc. (Nominal cross section 2.5mm², cabtyre cable, no plug, approx. 3m) for the PAN-A series put on CE marking



PAN-A Series Model 700W Outline Drawing

Specifications of PAN-A Series Model 1000W

Model 1000W		PAN16-50A	PAN35-30A	PAN55-20A	PAN70-15A	PAN110-10A	PAN160-7A	PAN250-4.5A
Input								
Input voltage and frequency		100VAC±10%, 50/60Hz, 1-phase, Crest factor: 1.2-1.41 (110, 120, 200, 220, 230 and 240VAC input are factory option.*1)						
Power consumption, at 100VAC, rated load		Approx. 1600VA	Approx. 1800VA	Approx. 1900VA	Approx. 1900VA	Approx. 2000VA	Approx. 1900VA	Approx. 1800VA
Output								
Voltage	Rated voltage	16V	35V	55V	70V	110V	160V	250V
	Variable range	0-16V	0-35V	0-55V	0-70V	0-110V	0-160V	0-250V
	Resolution (theoretical value) *2	3mV	7mV	10mV	13mV	20mV	30mV	45mV
	Number of turns of panel control	10 turns						
Current	Rated current	50A	30A	20A	15A	10A	7A	4.5A
	Variable range	0-50A	0-30A	0-20A	0-15A	0-10A	0-7A	0-4.5A
	Resolution (theoretical value) *2	9mA	5.4mA	3.6mA	2.7mA	1.8mA	1.3mA	0.9mA
	Number of turns of panel control	10 turns						

*1: For 230 and 240VAC input requirement, maximum input voltage is limited to 250VAC.

*2: The value is calculated from the number of turns of the wire-wound potentiometer. In practice, use 3-5 times each value as a target.

Model	1000W	PAN16-50A	PAN35-30A	PAN55-20A	PAN70-15A	PAN110-10A	PAN160-7A	PAN250-4.5A
Constant voltage characteristics								
Ripple and noise (5Hz-1MHz) RMS	0.5mV	0.5mV	0.5mV	0.5mV	1mV	1mV	1mV	5mV
Source effect (to $\pm 10\%$ of AC input voltage)	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+2mV
Load effect (to 0-100% of output current) *3	0.005%+2mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+1mV	0.005%+2mV	0.005%+3mV
Transient response (standard value) *3, *4	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s	50 μ s
Temperature coefficient	100ppm/ $^{\circ}$ C (TYP value)							
Constant current characteristics								
Ripple and noise (5Hz-1MHz) RMS	10mA	5mA	2mA	2mA	5mA	2mA	2mA	2mA
Source effect (to $\pm 10\%$ of AC input voltage)	3mA	3mA	1mA	1mA	1mA	1mA	1mA	1mA
Load effect (to approx. 1 V-100% of output voltage)	5mA	5mA	2mA	2mA	3mA	3mA	2mA	2mA
Temperature coefficient	300ppm/ $^{\circ}$ C (TYP value)							
Constant voltage operation indication C, V, green LED indication								
Constant current operation indication C, C, red LED indication								
Range of operation temperature and humidity	0-40 $^{\circ}$ C/10-90% RH (no dew condensation allowed)							
Range of storage temperature and humidity	-10-60 $^{\circ}$ C/0-70% RH max. (no dew condensation allowed)							
Cooling system	Forced air cooling with fan							
Output polarity	Positive or negative grounding possible							
Isolation	± 250 V	± 250 V	± 250 V	± 250 V	± 250 V	± 500 V	± 500 V	± 500 V

*3: Measured at the OUTPUT terminal board on the rear panel using the remote sensing function.

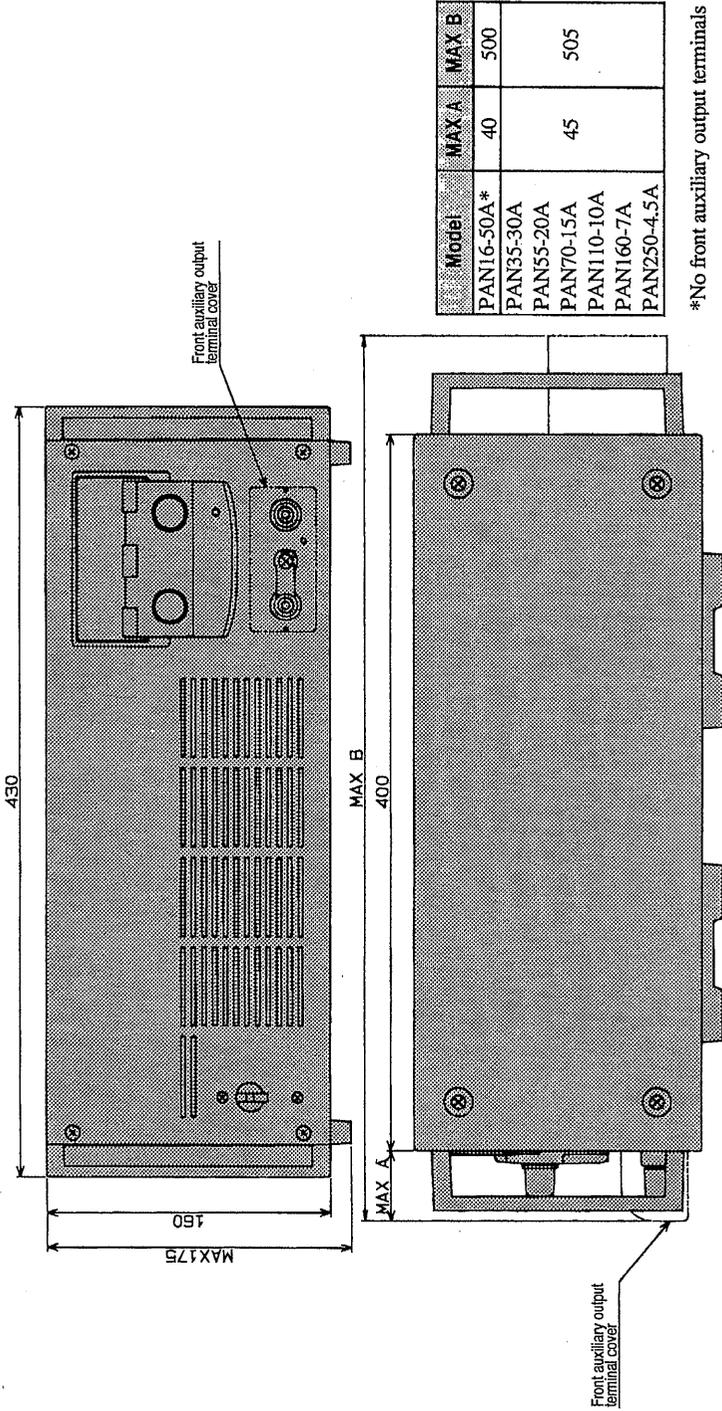
*4: Time necessary for output voltage to return to $\pm(0.05\%+10mV)$ max. of rated value at 5%-100% changes of output current.

	PAN16-50A	PAN35-30A	PAN55-20A	PAN70-15A	PAN110-10A	PAN160-7A	PAN250-4.5A
Model: 1000W							
Insulation resistance							
Across chassis and input terminals	500VDC, 30M Ω min. (measured at ambient humidity 70% RH max.)						
Across chassis and output terminals	500VDC, 20M Ω min. (measured at ambient humidity 70% RH max.)						
Withstanding voltage							
Across input terminals and output terminals	Should withstand 1500VAC, 1 min. with no abnormalities						
Across input terminals and chassis							
Meter display							
Output voltage	Max. figure displayed (fixed range)	19.99	199.9	199.9	199.9	199.9	1999
	Display error	$\pm(0.5\%rdg+2digits)$ at 23 $^{\circ}$ C \pm 5 $^{\circ}$ C					
Output current	Temperature coefficient	300 ppm/ $^{\circ}$ C (TYP value)					
	Max. figure displayed (fixed range)	199.9	199.9	199.9	19.99	19.99	19.99
Display error	$\pm(1\%rdg+5digits)$ at 23 $^{\circ}$ C \pm 5 $^{\circ}$ C						
Temperature coefficient	400ppm/ $^{\circ}$ C (TYP value)						
Remote control							
Output voltage/control voltage ratio	16V/ approx. 10V	35V/ approx. 10V	55V/ approx. 10V	70V/ approx. 10V	110V/ approx. 10V	160V/ approx. 10V	250V/ approx. 10V
	16V/ approx. 10k Ω	35V/ approx. 10k Ω	55V/ approx. 10k Ω	70V/ approx. 10k Ω	110V/ approx. 10k Ω	160V/ approx. 10k Ω	250V/ approx. 10k Ω
Output voltage/control resistance ratio	50A/ approx. 10V	30A/ approx. 10V	20A/ approx. 10V	15A/ approx. 10V	10A/ approx. 10V	7A/ approx. 10V	4.5A/ approx. 10V
	50A/ approx. 10k Ω	30A/ approx. 10k Ω	20A/ approx. 10k Ω	15A/ approx. 10k Ω	10A/ approx. 10k Ω	7A/ approx. 10k Ω	4.5A/ approx. 10k Ω
Possible (compensation one way approx. 0.6V max.)							
Remote sensing							
Master-slave-control parallel operation	Possible						
Master-slave-control series operation	Possible						

Model	1000W	PAN16-50A	PAN35-30A	PAN55-20A	PAN70-15A	PAN110-10A	PAN160-7A	PAN250-4.5A
Protective circuit								
Over-voltage protection (OVP) for output								
Preset range: Approx. 10-110% of rated output voltage, ALM LED lights up, control transistor cut off, and rectification circuit and circuit breaker shut down when OVP tripped.								
Input fuse, 15mm dia. X 40mm								
Output fuse, standard pre-arcing time-current type								
Thermal fuse								
Incorporated in sub-transformer								
EMC								
Complied with the following standards *5								
European Community Requirements (89/336/EEC)								
EN55011 Radiated Emissions class A								
EN50082-1 Conducted Emissions class A								
IEC801-2 Electro-static Discharge								
IEC801-3 Radiated Susceptibility								
IEC801-4 Fast Burst Transient								
Safety								
Complied with the following standard *5								
European Community Requirements (73/23/EEC)								
Approx.36kg Approx.36kg Approx.35kg Approx.35kg Approx.35kg Approx.36kg Approx.35kg Approx.35kg								
Weight								
Dimensions								
See outline drawing.								
Accessory								
Operation manual								
1 copy								
Power cable								
1 pc. (Nominal cross section 3.5 mm ² , cablety cable, no plug, approx. 3m) *6								
Protection cover								
Guard cap 2 pcs., Rear output terminal cover 1 pc.,								
Front auxiliary output terminal cover 1 pc., (Mounting screw(M3×20) 1 pc.)								
Cable clamp								
1 pc.								

*5: CE marking are put only on the PAN-A series sold in Europe.

*6: 1 pc. (Nominal cross section 2.5mm², cablety cable, no plug, approx. 3m) for the PAN-A series put on CE marking



Model	MAX A	MAX B
PAN16-50A*	40	500
PAN35-30A		
PAN55-20A	45	505
PAN70-15A		
PAN110-10A		
PAN160-7A		
PAN250-4.5A		

*No front auxiliary output terminals

UNIT: mm

PAN-A Series Model 1000W Outline Drawing

Index

Symbol

- + 4-3
- 4-3

A

- AC IN 4-8
- AC power cable 1-10
- ALM 4-5
- Ammeter 4-5
- Analog remote control 3-8
- auxiliary output terminal
 - cover 2-16
- auxiliary output
 - terminals 2-1, 2-13, 4-3

C

- Calibration 5-2
- CC 2-5, 2-11, 4-5
- chassis ground terminal 4-3, 4-9
- Cleaning 5-1
- constant current
 - power supply 2-5, 2-11
- constant voltage
 - power supply 2-5, 2-10
- CONTROL 4-8
- control switches 3-9
- CONTROL terminal board 3-1
 - cover 2-16
- CURRENT 4-4
- CV 2-5, 2-10, 4-5

E

- external contact points 3-22
- external resistor 3-10, 3-16
- external voltage 3-12, 3-18

F

- FUSE 4-8
- fuse 1-9

G

- grounding 1-14
- guard caps 2-17

I

- input fuse 1-9
- inrush current 2-1
- Inspection 5-1

L

- LIMIT 4-4
- load 2-2, 2-12

M

- Malfunctions 5-9
- Master-slave-control
 - parallel operation 3-24
- Master-slave-control
 - series operation 3-33

N

- negative voltage 2-1

O

- OUTPUT 4-4, 4-9
- Output ON/OFF 3-22
- OUTPUT terminal board 2-14
- overvoltage protection 2-8
- OVP 4-5
- OVP trip point 2-8

P

- packing the product 1-5
- parallel operation 3-24
- POWER 4-3
- POWER switch 2-6
- PRESET OVP 4-4

R

rack mounting P-3
remote control 3-8
remote sensing 3-5

S

SENS 4-9
sensing 3-5
series operation 3-33
Shorting bar 4-3
sub-panel cover 4-5

T

Turning on the power 2-6

V

VOLTAGE 4-4
Voltmeter 4-5

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