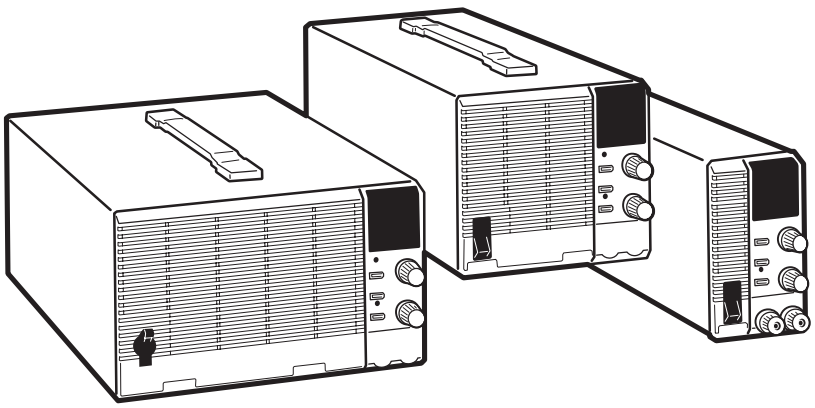
Part No. Z1-001-872, IA001034
May. 2007

INSTRUCTION MANUAL

REGULATED DC POWER SUPLY

PAK-A SERIES
PAK-AM SERIES

PAK6-60A	PAK10-35A	PAK20-18A
PAK35-10A	PAK60-6A	PAK6-120A
PAK10-70A	PAK20-36A	PAK35-20A
PAK60-12A	PAK6-160A	PAK10-100A
PAK20-50A	PAK35-30A	PAK60-18A
PAK6-60AM	PAK10-35AM	PAK20-18AM
PAK35-10AM	PAK60-6AM	PAK6-120AM
PAK10-70AM	PAK20-36AM	PAK35-20AM
PAK60-12AM	PAK6-160AM	PAK10-100AM
PAK20-50AM	PAK35-30AM	PAK60-18AM



KIKUSUI

Use of Instruction Manual

Please read through and understand this Instruction 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 copy can be provided for a fee. In either case, please contact Kikusui distributor/agent, and provide the “Kikusui Part No.” given on cover.

This manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact Kikusui distributor/agent.

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.

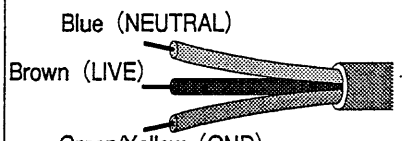
☐ AC power cable

The product is porvided 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.

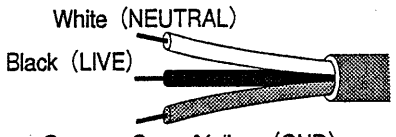
WARNING

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

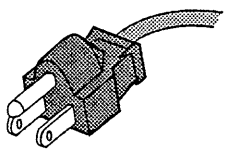
☐ Without a power plug



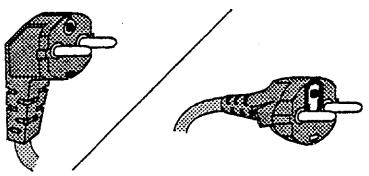
☐ Without a power plug



☐ 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.

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

TABLE OF CONTENTS

1. GENERAL

1.1 Description

The PAK-A/AM is a high reliability and safty regulated DC power supply for industrial use. It is a switching regulator and provides a high total efficiency, and is extremely compact and light. It is incorporated with various provisions for use as an industrial system component, including a local/remote switchover circuit, remote control signal input circuits, monitor signal output circuits, and protectors.

The advantageous features of the PAK-A/AM Power Supply are as follows:

(1) Compact and light

The sizes and weight of the PAK-A/AM is less than a half to one-third of those of the conventional power supply (those of the corresponding model of Kikusui PAD-L Power Supply).
Thus, the PAK-A/AM can be very advantageously used as a system component. It can be easily handled for maintenace and replacement.

(2) High efficiency

The overall efficiency of the PAK-A/AM is as high as approximately 80%, greatly reducing its Joule loss and increasing its rated output power. When the PAK-A/AM is used as a system component, the overall system cooling provision cost as well as the electicity cost itself will be substantially decreased.

(3) High reliability and safety

The PAK-A/AM has been designed to the highest reliability and safety available based on the full technical assets of Kikusui as a leading manufacturer of measuring instruments and power supplies. The PAK-A/AM is incorporated with protectors against output overvoltage, input overvoltage or overcurrent, and equipment overheat. Trip of any of these protectors will cause the switching drive stop and the input power switch (circuit breaker) turned off.

(4) Provisions for system component

In order to be able to serve as a component of an industrial system, the PAK-A/AM is incorporated with the various features.
The PAK-A/AM is available either in a blind type or in an indicating

type (with a digital meter). It is incorporated with monitor, status, and control signal output circuits. It is provided with a remote/local selector switch. It employs a front air intake system, to improve the space factor of system components. It can be installed on a rack from the front of the rack.

(5) Fan speed control for low acounstic noise

The revolutionary speed of the cooling fan motor is automatically controlled in proportion to the heat sink temperature. This fan speed control is usefull for reducing the thermal stress of power device. Thus, automatically fan speed down when the load is light and/or ambient temperature is low, the PAK-A/AM generates less noise and the air filter is required to be replaced less frequently.

(6) Remote control provisions

In order to be operated as an industrial system component, the PAK-A/AM is incoporated with remote control provisions for continuously-variable control of the output voltage or current with an external voltage or resistance, for on/off control of the output switch with an external contact signal, for turning off of the input power switch, etc.

The indicating model has a digital readout, which operates either as an output voltmeter or ammeter of 3-1/2 digits, as selected with a panel switch. The indicating model has a digital output voltmeter and an ammeter. Both are of 3-1/2 digits.

The PAK-A/AM employs the switching rectification circuit and, therefore, it cannot serve the following types of uses:

(a) For use at an EMI measuring site or in a shielded room.

(b) For R & D use which do not tolerate even several millivolts of ripple noise.

(c) For adjustment of receivers and tuners.

Before starting operating your PAK-A/AM power supply, be sure to read this manul to make you familiar with the PAK-A/AM.

2. SPECIFICATIONS

2.1 Specifications

Models	Standard type	PAK	6-60A	10-35A	20-18A	35-10A	60-6A	6-120A	10-70A	20-36A	35-20A	60-12A	6-160A	10-100A	20-50A	35-30A	60-18A
	Module type	PAK	6-60AM	10-35AM	20-18AM	35-10AM	60-6AM	6-120AM	10-70AM	20-36AM	35-20AM	60-12AM	6-160AM	10-100AM	20-50AM	35-30AM	60-18AM
AC input			85 to 132 V AC (170 to 250 V AC *1), 47 to 63 Hz, single phase														
DC output		*10															
Voltage	Range		0～6 V	0～10 V	0～20 V	0～35 V	0～60 V	0～6 V	0～10 V	0～20 V	0～35 V	0～60 V	0～6 V	0～10 V	0～20 V	0～35 V	0～60 V
	Adjustment		Standard type: 10-turn Resolution 0.018% of F.S								Module type: FINE, COARSE 1-turn (semi-fixed)						
Current	Range		0～60 A	0～35 A	0～18 A	0～10 A	0～6 A	0～120 A	0～70 A	0～36 A	0～20 A	0～12 A	0～160 A	0～100 A	0～50 A	0～30 A	0～18 A
	Adjustment		Standard type: 10-turn Resolution 0.025% of F.S								Module type: 1-turn (semi-fixed)						
Efficiency	Typical	*2	73%	75%	78%	80%	78%	73%	75%	78%	80%	78%	73%	75%	78%	80%	78%
Input current (Approx.)			8 A (100 V AC), 5 A (200 V AC) *1					16 A (100 V AC), 10 A (200 V AC) *1					24 A (100 V AC), 15 A (200 V AC) *1				
Inrush current			33 A peak or ress					60 A peak or less					90 A peak or less				
Constant-voltage characteristics			*10														
Stability	Source effect	*11	For ±10% change of line voltage 0.05% + 5 mV														
	Load effect	*11	For 0 to 100% change of outptu current 0.1% + 5 mV														
Ripple and noise (PARD)																	
[p-p] *3	Typical		40 mV	40 mV	40 mV	40 mV	40 mV	100 mV	70 mV	70 mV	100 mV	100 mV	100 mV	70 mV	70 mV	100 mV	100 mV
	Max.		60 mV	60 mV	60 mV	60 mV	60 mV	150 mV	100 mV	100 mV	150 mV	150 mV	150 mV	100 mV	100 mV	150 mV	150 mV
[rms]	(5Hz - 1MHz)		10 mV	10 mV	10 mV	10 mV	10 mV	10 mV	10 mV	10 mV	10 mV	15 mV	15 mV	15 mV	15 mV	15 mV	20 mV
Transient response		*4	Typical 1 msec					Typical 2 msec					Typical 2 msec				
Temperature coefficient			Typical 150 ppm/℃														
Rise time			(No load)/(Full load) Approx. 50/50 msec					(No load)/(Full load) Approx. 150/150 msec					(No load)/(Full load) Approx. 150/150 msec				
Fall time			(No load)/(Full load) Approx. 2000/150 msec														
Remote control			Output voltage control with an external voltage (0 to approx. 10 V) Output voltage control with an external resistance (0 to approx. 10 kΩ)														
Constant-current characteristics																	
Stability	Source effect		For ±10% change of line voltage 0.2% + 5 mA					For ±10% change of line voltage 0.2% + 10mA					For ±10% change of line voltage 0.2% + 15mA				
	Load effect		For 1V to 100% change of output voltage 0.2% + 5 mA					For 1V to 100% change of output voltage 0.2% + 10 mA					For 1V to 100% change of output voltage 0.2% + 15 mA				
Ripple and noise (PARD) [rms] (5Hz - 1MHz)		*7	120 mA	70 mA	40 mA	20 mA	12 mA	260 mA	160 mA	92 mA	60 mA	44 mA	340 mA	220 mA	120 mA	80 mA	56 mA
Temperature coefficient			Typical 300 ppm/℃														
Remote control			Output current control with an external voltage (0 to approx. 10 V) Output current control with an external resistance (0 to approx. 10kΩ)														

Model	Standard type	PAK	6-60A	10-35A	20-18A	35-10A	60-6A	6-120A	10-70A	20-36A	35-20A	60-12A	6-160A	10-100A	20-50A	35-30A	60-18A
	Module type	PAK	6-60AM	10-35AM	20-18AM	35-10AM	60-6AM	6-120AM	10-70AM	20-36AM	35-20AM	60-12AM	6-160AM	10-100AM	20-50AM	35-30AM	60-18AM
Meters (Standard type)																	
Voltmeter																	
	Display, accuracy		3 1/2 digits green LED, ±0.1% rdg ±2 digits (23 ±5℃), Temperature coefficient ±200 ppm/℃ (0 to 50℃)														
	Sensitivity		10 mV	10 mV	100 mV	100mV	100 mV	10 mV	10 mV	100 mV	100 mV	100 mV	10 mV	10 mV	100 mV	100 mV	100 mV
Ammeter																	
	Display, accuracy		3 1/2 digits green LED, ±0.5% rdg ±3 digits (23 ±5℃), Temperature coefficient ±400 ppm/℃ (0 to 50℃)														
	Sensitivity		100 mA	100 mA	10 mA	10 mA	10 mA	100 mA	100 mA	100 mA	100 mA	10 mA	100 mA	100 mA	100 mA	100 mA	10 mA
Constant voltage mode indication			C.V.: With green LED														
Constant current mode indication			C.C.: With red LED														
Output signals																	
	Constant-voltage operation		Open collector, Active LOW (Refer to Section 3.3.9.)														
	Constant-current operation		Open collector, Active LOW (Refer to Section 3.3.9.)														
	Power ON-OFF/Alarm		Open collector, Active LOW (Refer to Section 3.3.9.)														
Protections																	
	Overvoltage protection		Voltage setting range: Approx. 10% to 110% of rated output voltage / Operation: Cuts out power switch *8														
	Overcurrent protection		Limits output at approx. 110% of rated output current														
	Overtemperature protection		Stops oscillation at 85 ±5℃ or 90 ±5℃ (heatsink temperature)														
	Thermal fuse rating		Blows out at 139℃ (resistor temperature)														
	Input fuse rating		10 A					20 A					30 A				
	Overvoltage protection of input (Line voltage)		Cuts out power switch														
Environmental conditions																	
	Operating ambient temperature range		0 to 50℃														
	Operating ambient humidity range		30 to 80% RH														
	Storage temperature range		-20 to 70℃														
	Storage humidity range		20 to 80% RH														
Cooling method			Forced air cooling with variable speed fan, front air intake system														
Output terminals	Front output (Standard type only)				○	○	○				○	○				○	○
	Rear output		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

Model	Standard type	PAK	6-60A	10-35A	20-18A	35-10A	60-6A	6-120A	10-70A	20-36A	35-20A	60-12A	6-160A	10-100A	20-50A	35-30A	60-18A
	Module type	PAK	6-60AM	10-35AM	20-18AM	35-10AM	60-6AM	6-120AM	10-70AM	20-36AM	35-20AM	60-12AM	6-160AM	10-100AM	20-50AM	35-30AM	60-18AM
Function (Standard type)																	
	Output switch		To turn on/off output power (automatically reset to off when input power is turned on)														
	Voltage/current limit switch		To let meter indicate limit voltage/current														
	Preset OVP switch		To let meter indicate OVP trip voltage (OVP: Over Voltage Protector)														
Applications																	
	Remote sensing		Compensates for up to 1 V of voltage drop per one-way *5														
	Remote control		Output voltage or current can be remote controlled.														
	Master/slave parallel operation		Up to three units (including master unit) of same model										Up to tow units (including master unit) of same model				
	On-off control of output		With make-contact signal														
	Turning off of power switch		With make-contact signal														
Isolation from ground			DC ±250 V														
Insulation resistance (at room temperature, 70% RH or less)			Between chassis and inptut: 30 MΩ or more (500 V DC) Between chassis and output: 20 MΩ or more (500 V DC)														
Withstand voltage			Between input and output, input and chassis: 1500 V AC, 1 minute														
External dimensions (Refer to Mechanical outline Drawing)			71 W x 124 H x 350 D mm (2.80 W x 4.88 H x 13.78 D in.)					143 W x 124 H x 350 D mm (5.63 W x 4.88 H x 13.78 D in.)					214 W x 124 H x 350 D mm (8.43 W x 4.88 H x 13.78 D in.)				
Weight (Including accessories)			Approx. 3.5 kg (7.7 lbs)					Approx. 6 kg (13 lbs)					Approx. 8.5 kg (19 lbs)				
Rack mounting	For EIA		Rack adaptor KRA3														
	For JIS *9		Rack adaptor KRA150														
Accessories		*6															
	Operation manual		1														
	Cover for output, Bolts, Nuts		Cover 1 ea, Bolts 2 ea, Nuts 2 ea.														
	20P Connector (for control)		1 set (Terminal, Socket, Hood cover)														
	Input cable		3-core cord, approx. 2.5 to 3 m with 3P plug					3-core cord of cross section area 3.5 mm², approx. 2.5 to 3 m with 2P plug.					3-core cord of cross section area 3.5 mm², approx. 2.5 to 3 m.				
	GND cable		Singe cord, with lug terminal														

*1 For conversion into the nominal 200V system (170 - 250 V AC), consult your Kikusui agent.
Do not attempt to convert the power supply for yourself.

*2 Typical at input 100 V AC, rated load.

*3 As measured with an oscilloscope (bandwith 10Hz to 10MHz)

*4 Rcovary time within 0.1% + 10 mV of Eout for 20% to 100% change of Iout at 50% to 100% output voltage setting.

*5 The maximum output voltage attainable with compensation is the maximum rated output voltage plus 0.6 V.

*6 Refer to Section 2.5.

*7 As measured within a range of 1% to 100% of rated output range.

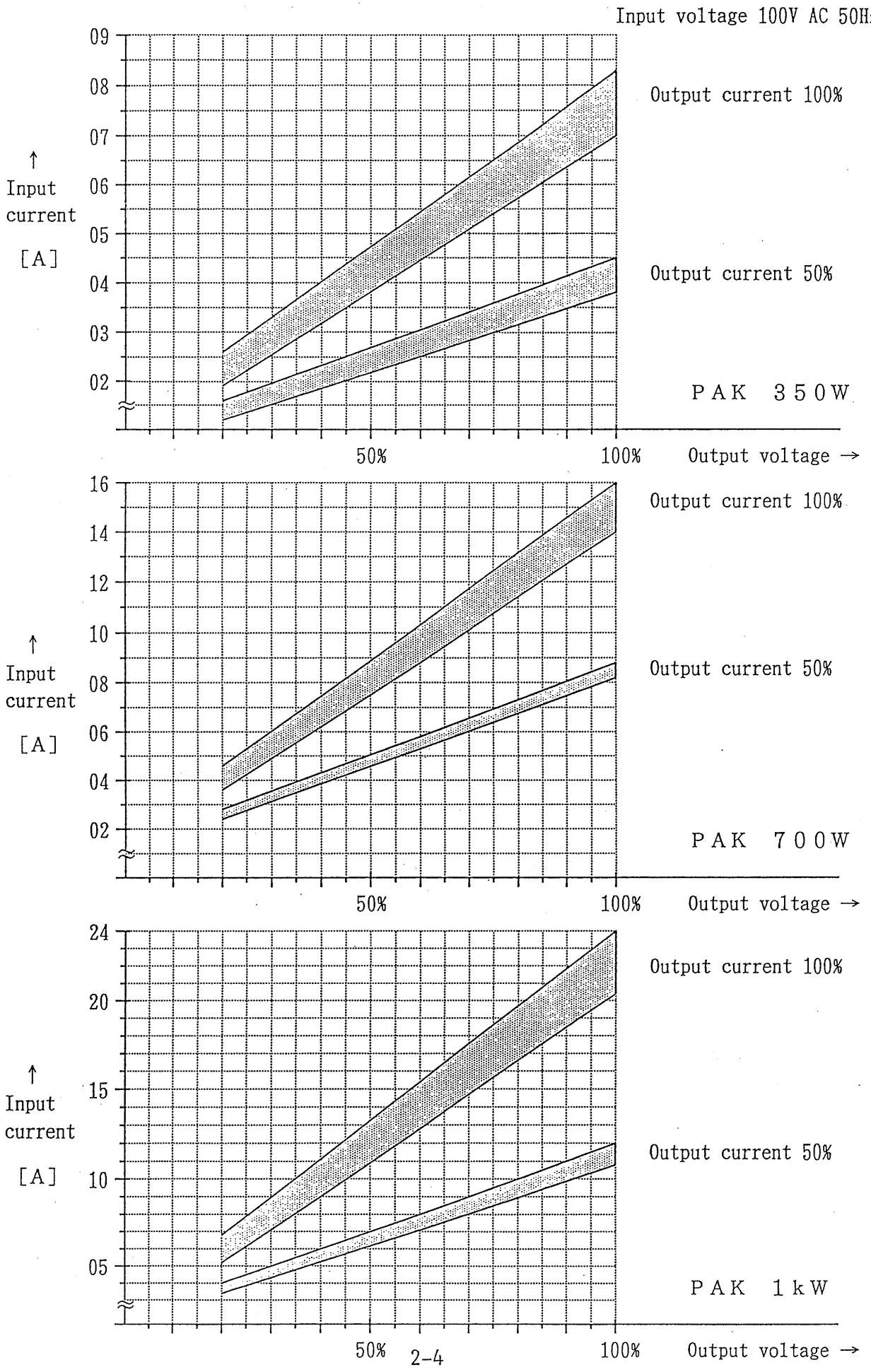
*8 The range of voltage which can be set on O.V.P to let it trip when a pulse voltage which sharply changes from 90% to 110% of the set voltage is applied to the output.

*9 JIS: Japanese Industrial Standards

*10 The output as delivered via the rear output terminals and measured at the rear output terminals. (Note that the output performance when the front output terminals are used may be slightly degraded from that specified here.)

*11 As measured at the sensing point (Refer to Section 3.2.2)

2.2 Input Current vs Output Voltage Characteristics



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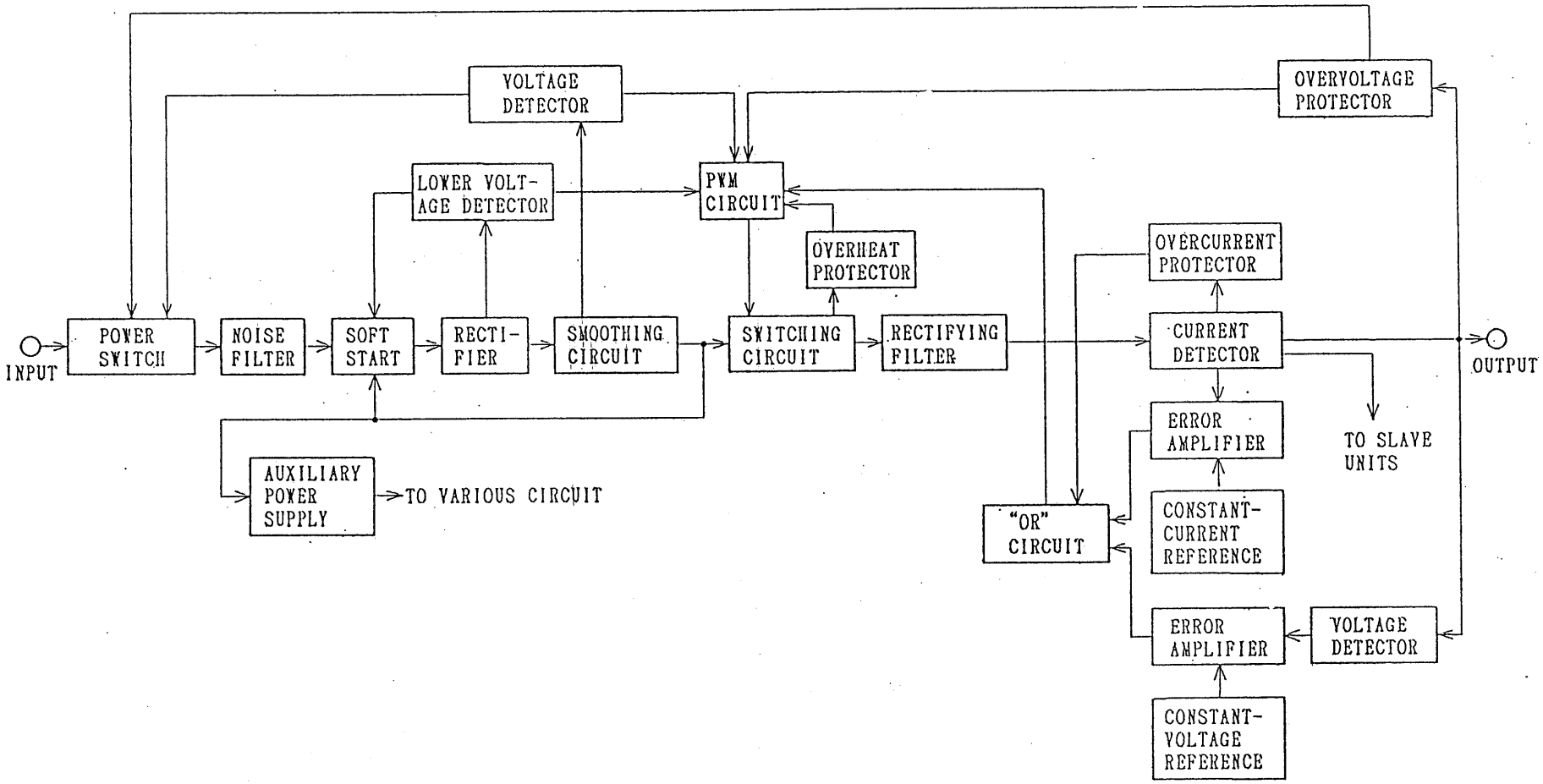
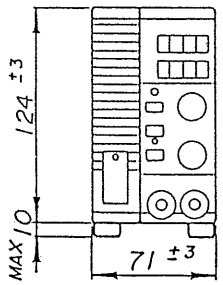


2.3 PAK-A/AM Series Block Diagram

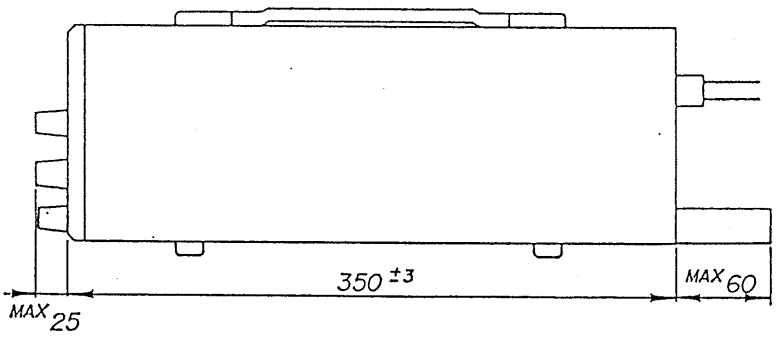
2.4 Mechanical Outline Drawing 1 (Standard type)

(The illustrated ones are those of models with output terminals on the front panel also. The models marked with an asterisk have output terminals on the rear panel only.)

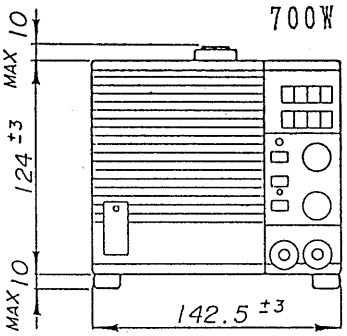
350W



PAK 6-60A *
PAK10-35A *
PAK20-18A
PAK35-10A
PAK60-6A

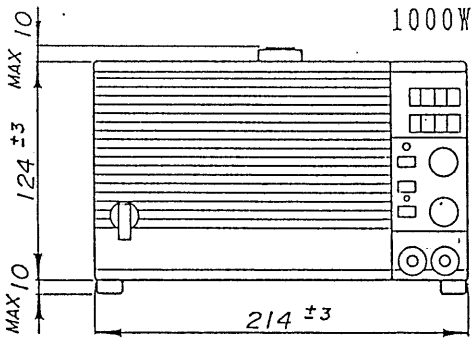


700W



PAK 6-120A *
PAK10-70A *
PAK20-36A *
PAK35-20A
PAK60-12A

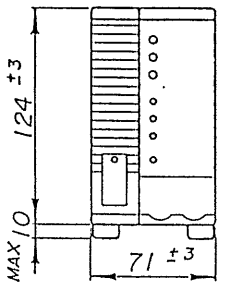
1000W



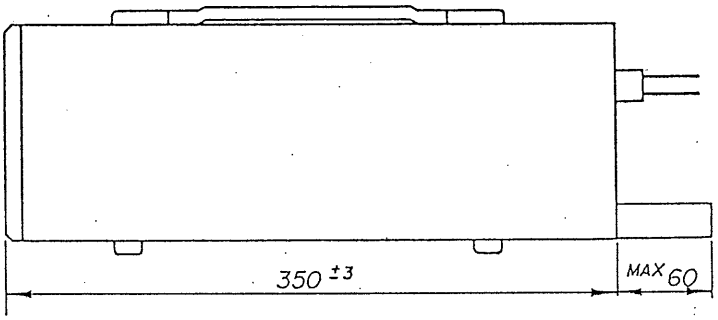
PAK 6-160A *
PAK10-100A *
PAK20-50A *
PAK35-30A
PAK60-18A

Mechanical Outline Drawing 2 (Module type)

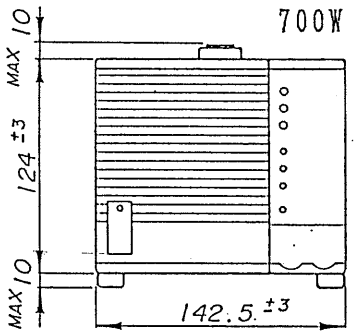
350W



PAK 6-60AM
PAK10-35AM
PAK20-18AM
PAK35-10AM
PAK60-6AM

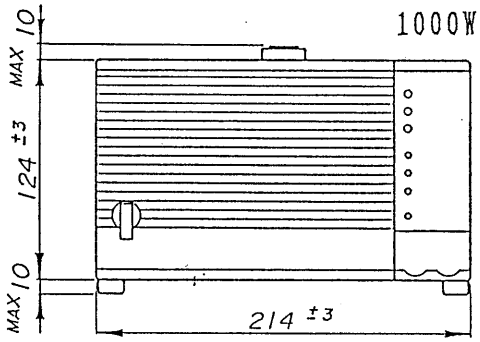


700W



PAK 6-120AM
PAK10-70AM
PAK20-36AM
PAK35-20AM
PAK60-12AM

1000W



PAK 6-160AM
PAK10-100AM
PAK20-50AM
PAK35-30AM
PAK60-18AM

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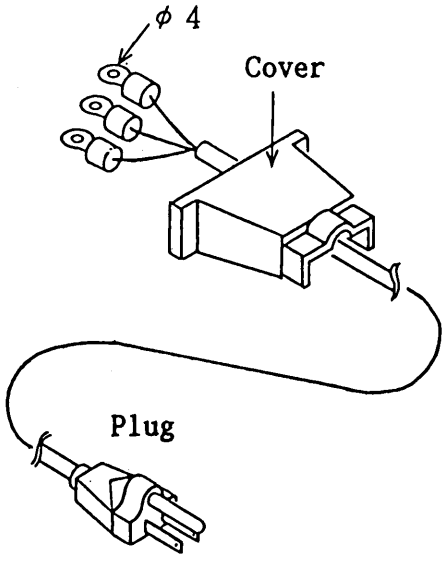
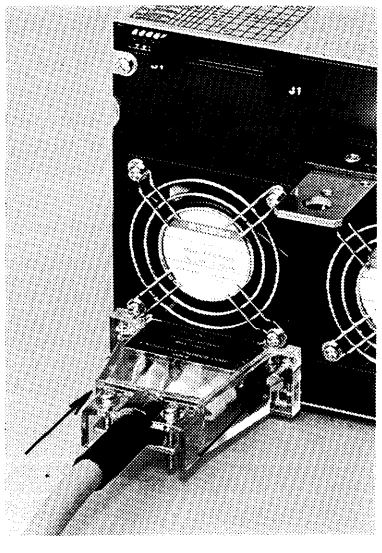
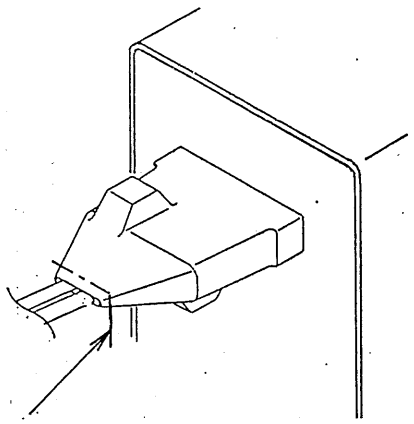
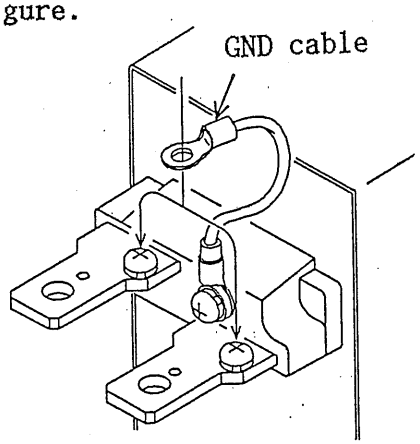
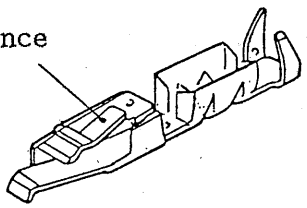
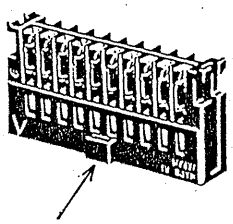
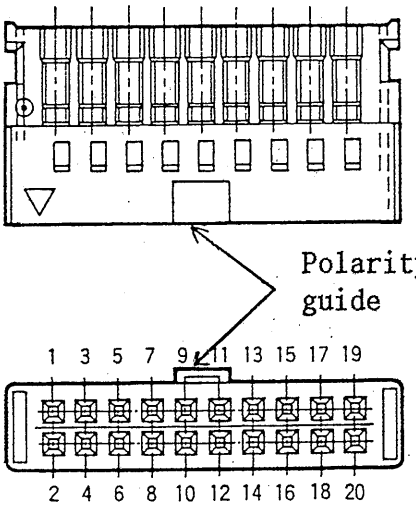
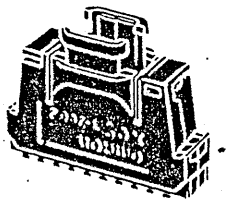
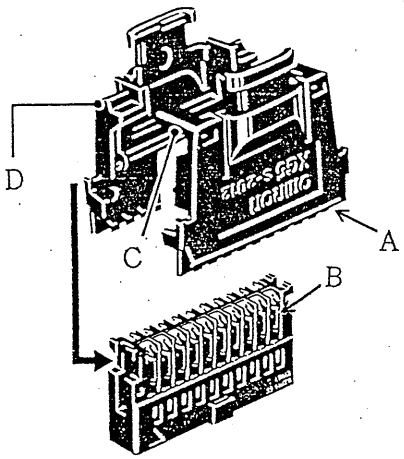
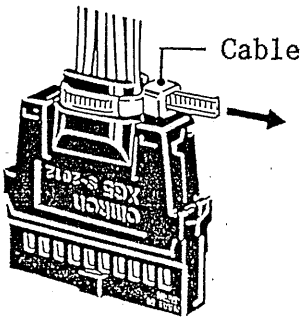
2.5 Accessories

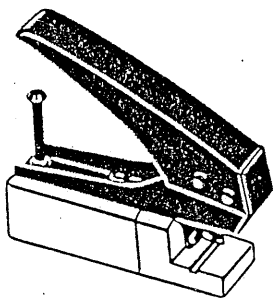
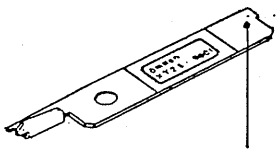
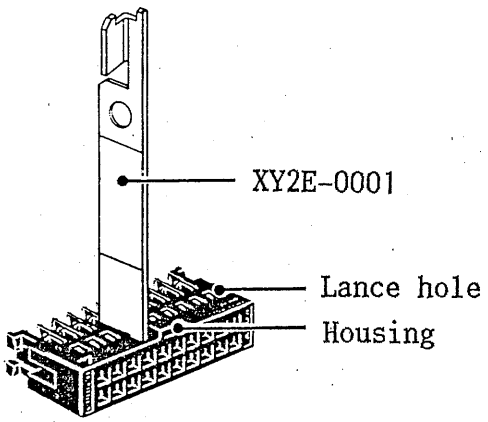
Name & Parts No.	Description & Notes
Input cable	  o Approx. 2.5 - 3 m long o 3-conductor cable Green: GND Black: LIVE White: NEUTRAL o Accessory cable of 350 W STV, 18 AWG o Plug of 350 W 3P plug 125 V, 10 A o Accessory cable of 700 W, 1000 W VCTF, 3.5 SQ o Plug of 700 W 2P plug 125 V, 15 A o 1000 W has no plug The ratings of the plug adapter supplied is 125V AC. When the power supply is converted into nominal 200-V AC system, remove the plug and connect the wires directly and securely (e.g. employing press-connected terminals) to an AC line source. Note: o Be sure to connect the GND terminal to an earth line. o Be sure to fix the terminal cover with the screws.

Name & Parts No.	Description & Notes
OUTPUT terminal cover. GND cable	Fix the cover as shown in the figure.   If the hole dimension of the cover dose not conform with the diameter of the cable to be connected, cut the cover at an appropriate position so that they conform.
XG5W-0031 Terminal	 ○ Applicable wire gaguge AWG 24 (UL-1061) ○ Wires may be connected by soldering when the equipment is used for a temporary purpose (such as for laboratory use). When a high reliability is needed, it is most recommendable to connect the wires using the solderless connecting tool (press type connecting tool). ○ Terminal remover The terminals can be pulled out conveniently by using the terminal remover.
XG5M-2032-N Socket	 Polarity guide  Equivalents: Matsushita AXW 120431A

Name & Parts No.	Description & Notes
XG5S-2012 Food cover	Fixing the hood cover    To fix the hood cover (split type), proceed as follows: (1) Mate the extrusion (A) of one of the halves of hood cover with the indent (B) of the socket. (2) Mate the indent (D) of the above half of hood cover with the extrusion (C) of the other half of hood cover. (3) Bind the cable with the cable band. When the amount of cables is less and there remains spaces between cables and the band, fill the spaces with packing stuff (e.g. wound the cables with insulative tape) and fix the cables securely with the cable band so that no mechanical force is directly applied to the pins of the socket.

For the optional tools, see the next page.

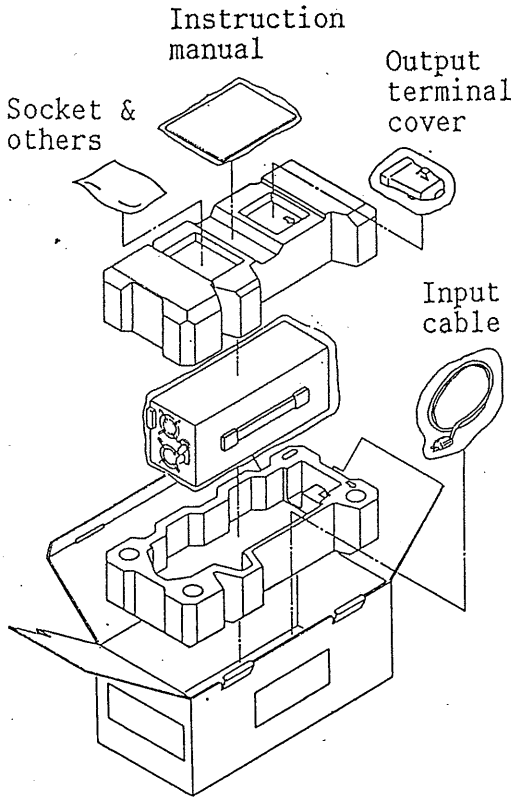
o Press-type Terminal Connector and Contact Remover Introduction

Name & Parts No.	Description & Notes
XY2B-7006 (OMRON type) Simplified press-type connecting tool	 o For the operation method, refer to the instruction sheet for the tool. o Use of the tool is recommendable as it allows secure connections.
XY2E-0001 (OMRON type) Contact Remover	o To use the remover, remove the hood cover.  Lance retainer  XY2E-0001 Lance hole Housing

3. OPERATION INSTRUCTIONS

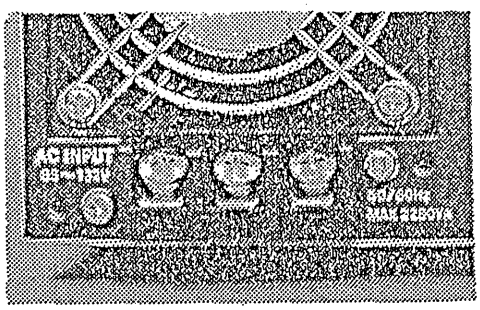
3.1 General Precautions

(1) Unpacking and Repacking



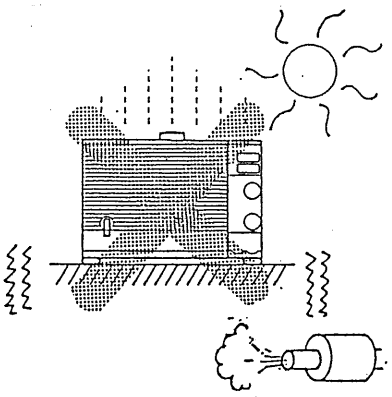
- When the Power Supply is delivered to you, immediately unpack it and check it for any damage which might have been sustained while in transportation.
- Check that no accessories are missing. For the accessories which are delivered accompanying the Power Supply, see Section 2.5.
- For transportation of the Power Supply, be sure to use the dedicated packing materials in which the Power Supply was deliverd to you.
- Before packing the power supply, disconnect the AC cable, load cable, and control signal connector.
- When no dedicated packing materials are available, consult you Kikusui agent.

(2) AC Input Power



- Be sure to operate the Power Supply on the correct line voltage. The AC input line voltage range is indicated at the left hand side of the input terminal block.
- For the AC input power cable, observe the instructions given in Section 2.5.
- Be sure to connect the GND terminal to an earth line. Also be sure to put back and fix the terminal cover with the screws.

(3) Conditions of Use



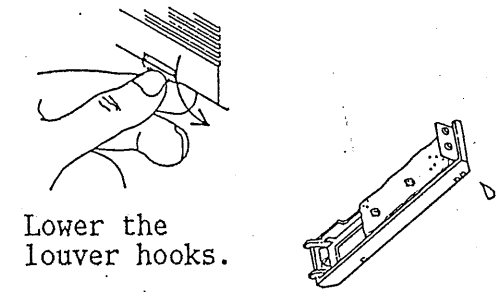
- Pay attention so that the air intake louver is not clogged.
- Pay attention so that the air exit ports are not clogged. Keep a clearance of 30 cm or more at the rear of the Power Supply.
- The place of use of the Power Supply must be reasonably free from heat (direct sunlight), dust, corrosive gas, and mechanical vibration.
- Do not operate high sensitivity devices (e.g. measuring instruments or radio wave receivers) near the power supply.
- Do not put any heavy objects on the power supply.

(4) Ambient Temperature

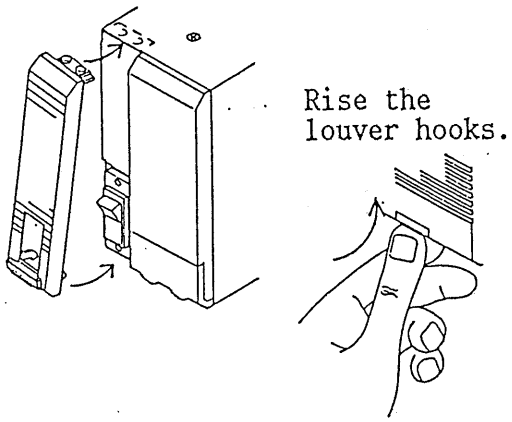
- The ambient temperature range to meet the performance specifications of the power supply is 0 to 50 °C (32 to 122 °F). If the ambient temperature is outside of this range, the power supply may operate unstably and may be damaged in extreme cases. Note that the semiconductors and electrolytic capacitors are not resistant against high temperatures (their operating reliabilities and service life expectancies are degraded in general at a rate of to a half per temperature rise of 10 °C (18 °F). Keep the power supply cool.

(5) Cleaning of Air Filter

o Removing the Louver



o Installing the Louver



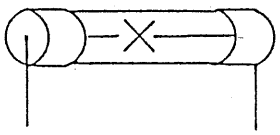
o If the air filter is clogged, the ventilation air flow will be impeded and equipment temperature may rise and troubles may result. Clean the air filter periodically, sufficiently before they become clogged.

Cleaning the Filter

o If the filter is dusty, clean it by blowing it with a compressed air (e.g. the exhaust air of a vacuum cleaner).

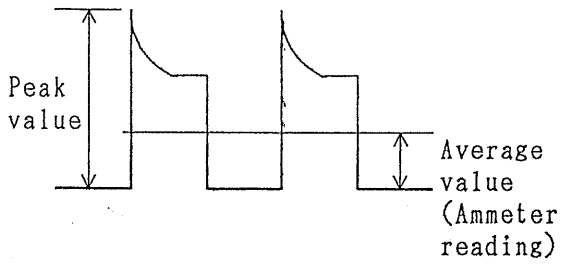
o If the filter is badly stained, wash it (together with the louver) with water and then dry it.

(6) Note for Fuse



o When the fuse is blown out, never attempt to replace it for yourself. The blown out fuse means that the internal circuit of the Power Supply has failed. Never attempt to replace the blown out fuse for yourself. Consult your Kikusui agent for repair.

(7) Note for Load

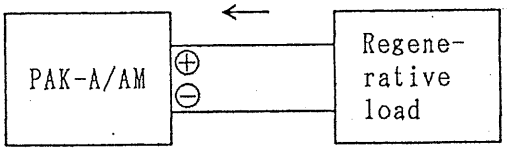


o Even when the ammeter reading is not greater than the preset limit current, if the load current has peaks higher than the preset limit current, operation of the Power Supply will be driven into the constant-current domain and the output voltage may fall.
To avoid this, preset the limit current at a value greater than the peak values. For this purpose, a larger

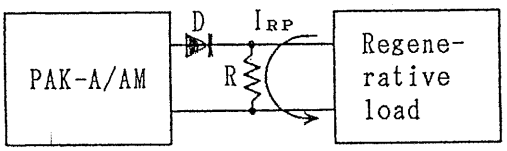
output current rating is needed. When the peaks are narrower pulses, however, this purpose can be met simply by connecting a large-capacitance capacitor in parallel to the load.

(8) Regenerative Load

No current flows in the reverse direction.



Example of Corrective Setup



$$R[\Omega] \leq \frac{Eo}{I_{RP}}$$

Eo: Output voltage of Power Supply

I_{RP}: Peak value of reverse current

o The output circuit of the Power Supply can sink no current which could flow from the load to the Power Supply. When the load is a regenerative type, therefore, pay attention so that the regenerative voltage of the load does not exceed the maximum output voltage of the Power Supply.

o As a corrective measure (to ensure that no voltage higher than the rated output voltage of the power supply is fed to its output circuit), connect a resistor in parallel to the load or connect a diode in series to the output circuit of the power supply.

o When IRp is of a narrower pulse waveform, the state may be corrected simply by connecting a large-capacitance capacitor in parallel to the load.

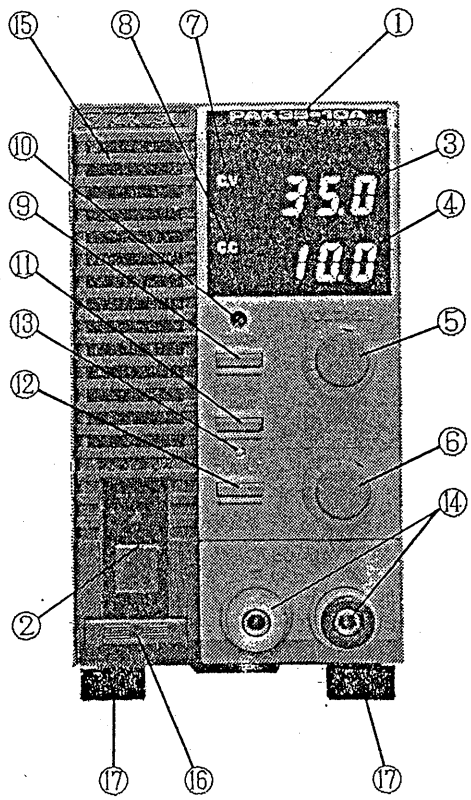
(9) Output Delivery

[Assuming that the rear panel control switch S1 and switches S2 - S8 (Figure 3-3) are set in their home positions (positions as they are set when the instrument is shipped from the factory)]

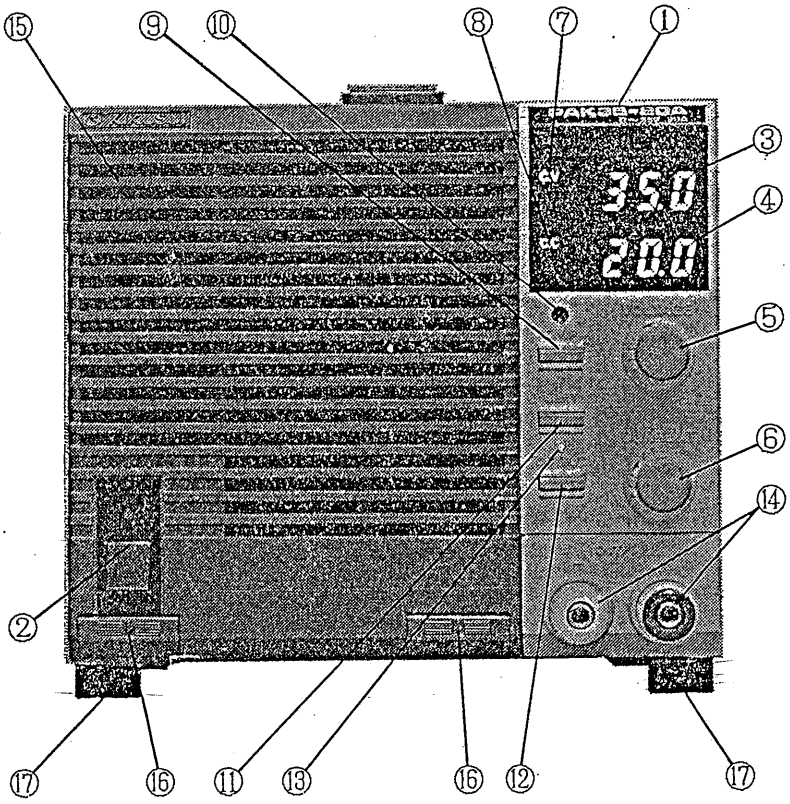
o Model PAK-A
The output is delivered as you turn-on the INPUT switch, check the VOLTAGE/CURRENT LIMIT switch and OVP switch, and press the OUTPUT switch.

o Model PAK-AM
The output is delivered as you turn-on the INPUT switch, but with a time delay of about 1 sec due to the function of the soft-start circuit.

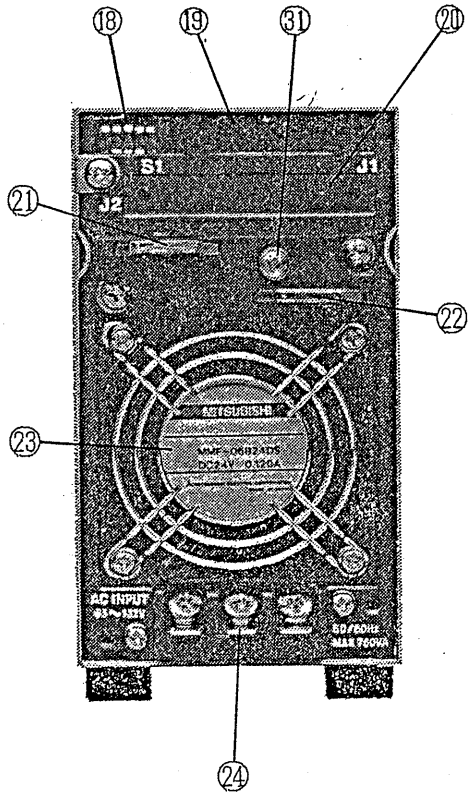
3.2 Layouts and Functions of Panel Items



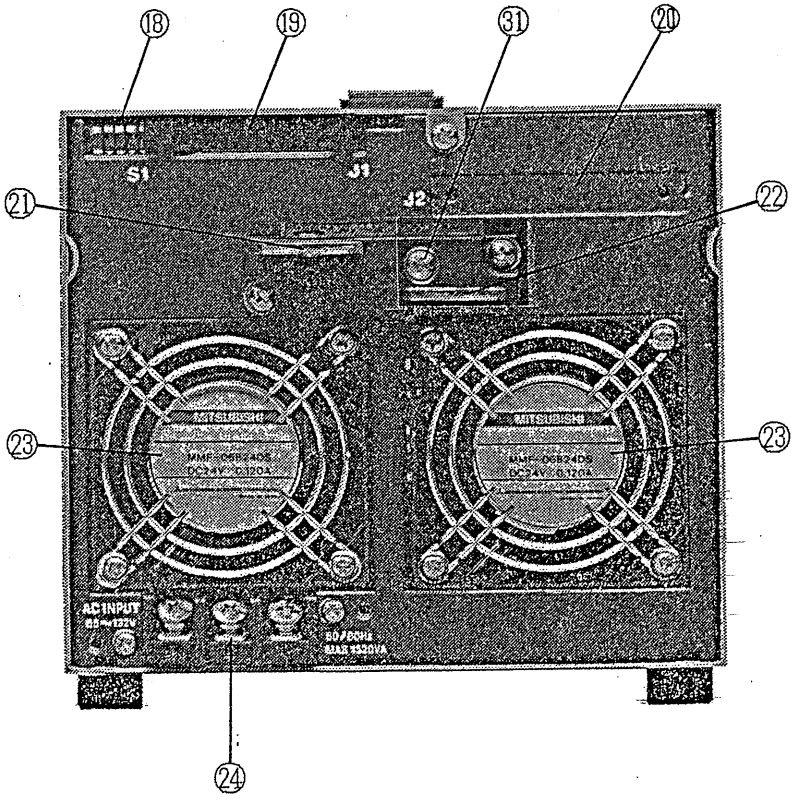
Front view (350 W)



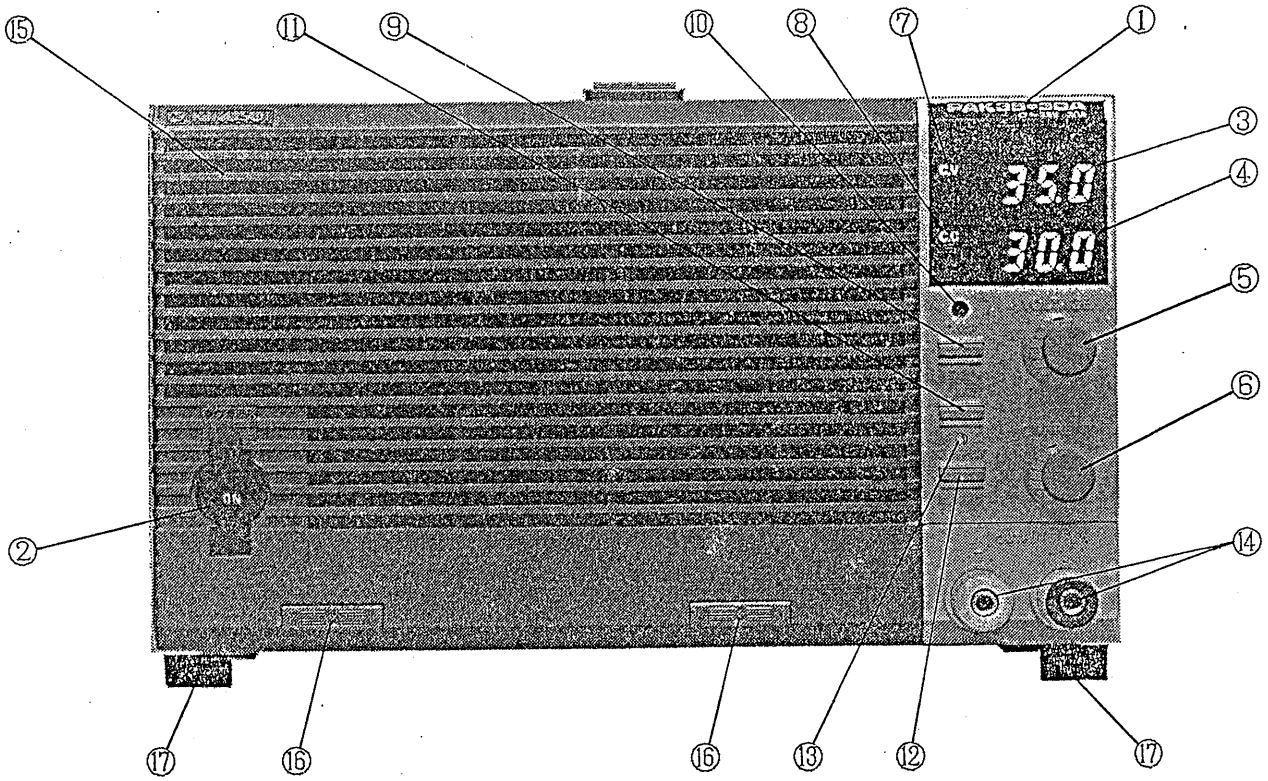
Front view (700 W)



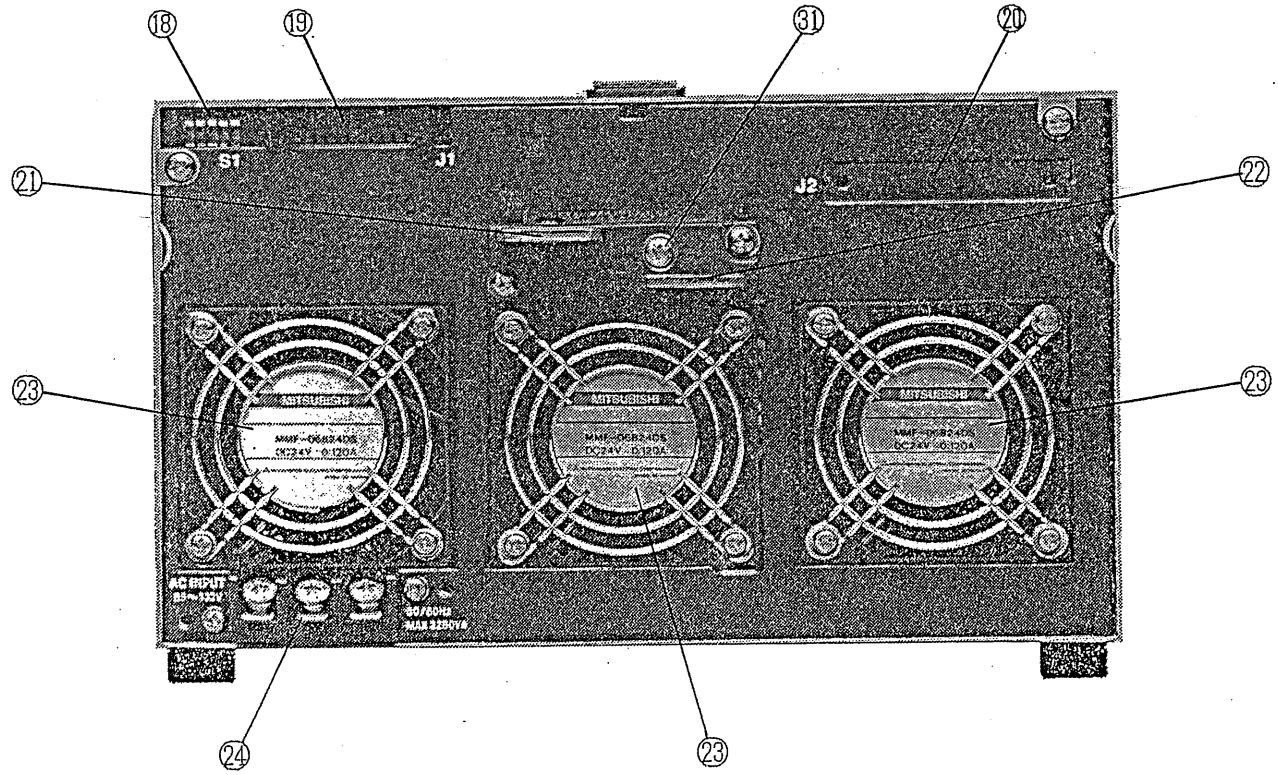
Rear view (350 W)



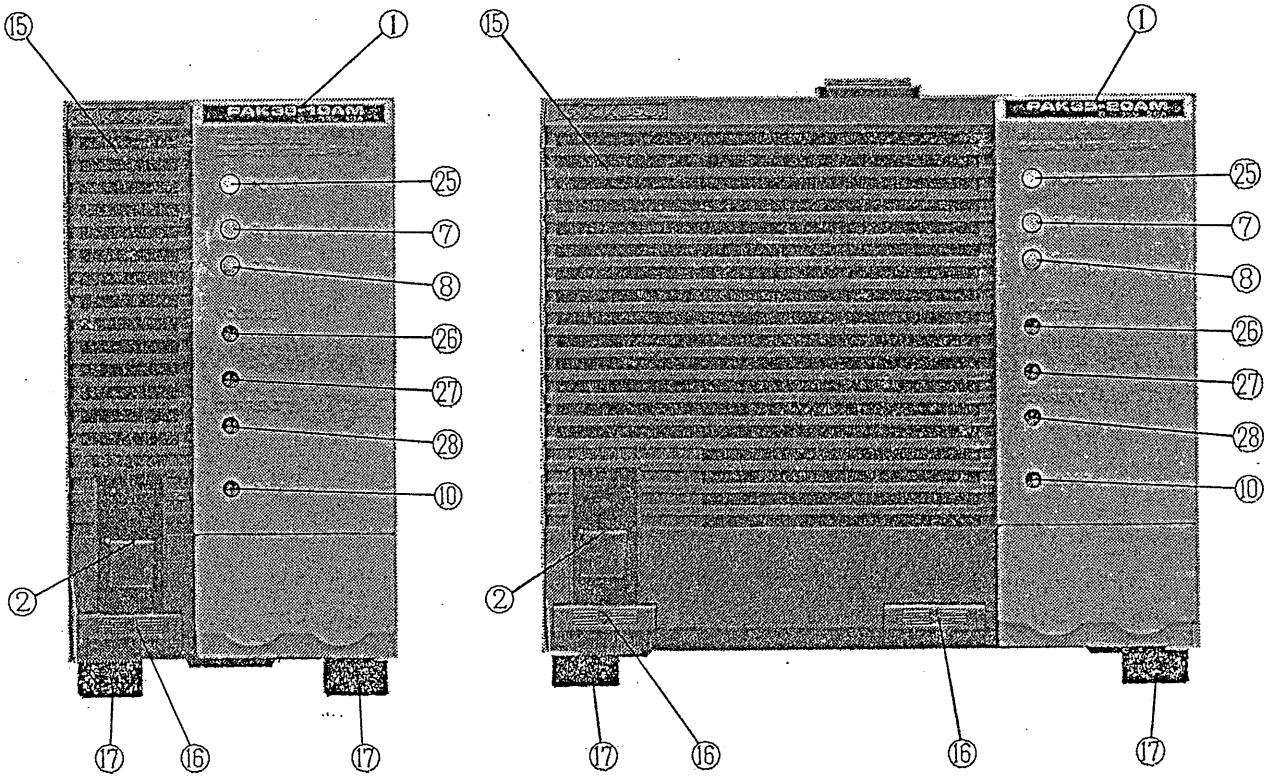
Rear view (700 W)



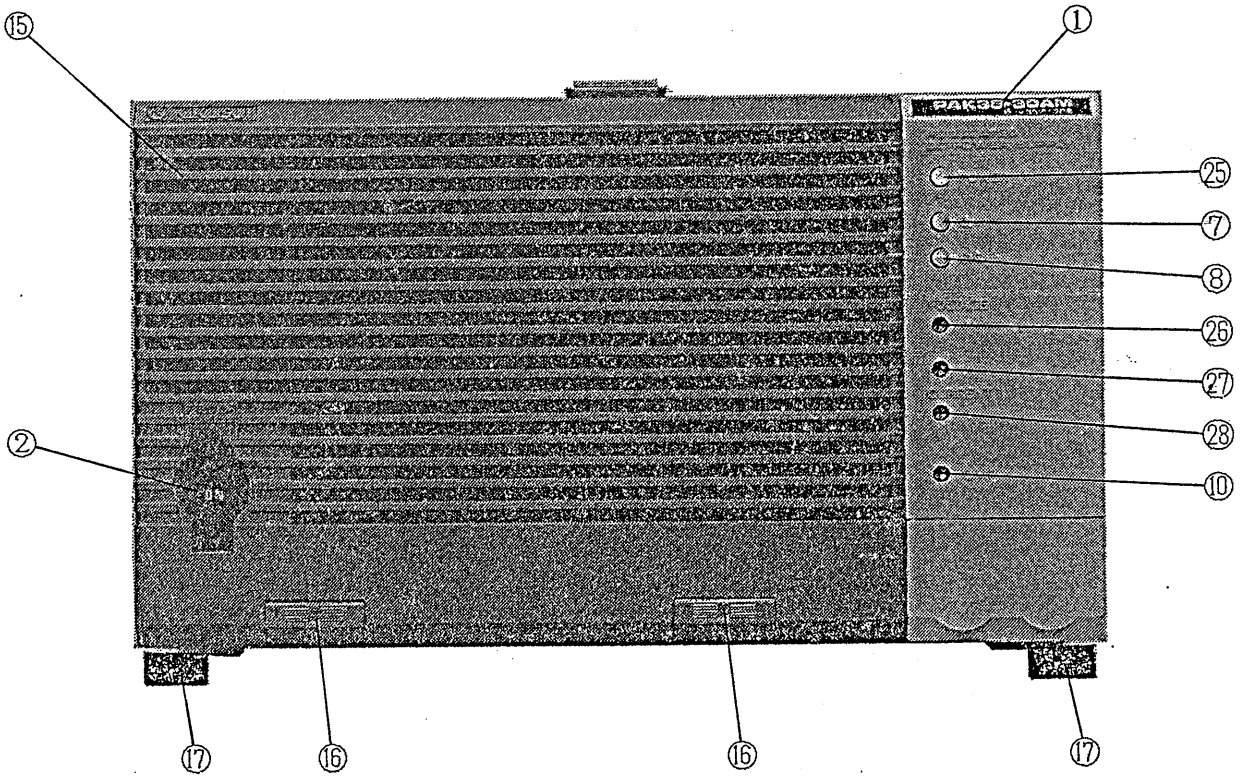
Front view (1000 W)



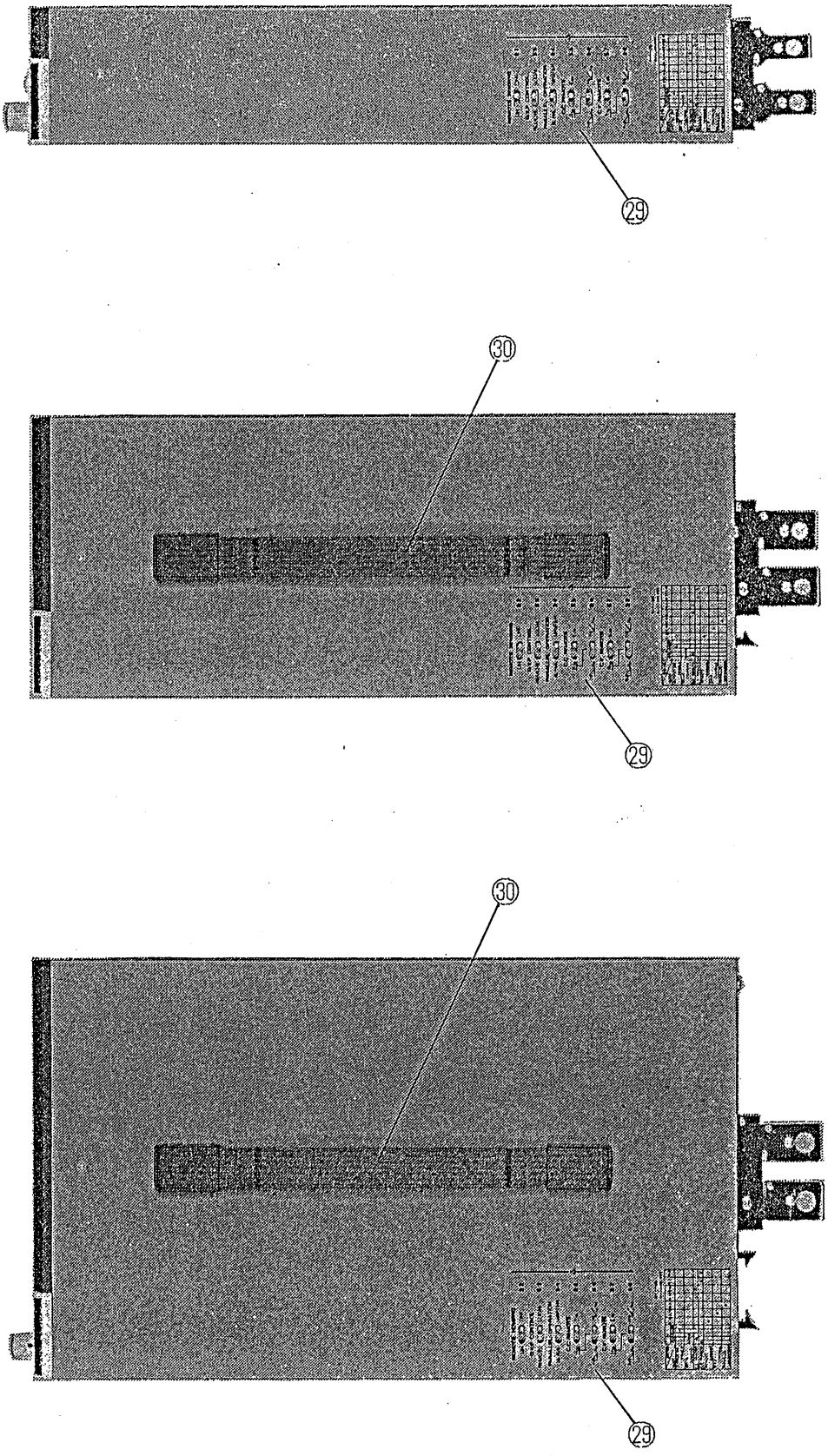
Rear view (1000 W)



(350 W) Front view of Module Type (700 W)



Front view of Module Type (1000 W)



Top view (350 W, 700 W, 1000 W)

No.	Name	Function
①	Nameplate	o Indicates the model number.
②	POWER Switch	o Turns on/off the AC input power. When this switch is thrown to the upper position, the instrument power is turned on. A circuit breaker is used for the switch. The switch is automatically turned off when the input/output overvoltage protector has tripped. o It also is possible to turn off the swtich with a remote conrol signal. o As an inrush current suppression circuit is incorporated, the power supply actually is started up at approximately 1 second after turning on the switch.
③	Voltmeter	o Indicates the output voltage. Green LED digital display. o When the limit switch is pressed, indicates the limit voltage or OVP trip voltage.
④	Ammeter	o Indicates the output current, or limit current when the limit switch is pressed.
⑤	VOLTAGE Setting Knob	o Adjusts the output voltage for constant-voltage operation.
⑥	CURRENT Setting Knob	o Adjusts the output current for constant-current operation.
⑦	C.V	o Illuminates to indicate the constant-voltage mode.
⑧	C.C	o Illuminates to indicate the constant-current mode.
⑨	Preset OVP Switch	o During the period you keep this switch presed, the CV meter indicates the OVP trip voltage.
⑩	OVP Trip Voltage Setting Potentiometer	o Keeping the preset OVP switch depressed, set the OVP trip voltage. o The trip voltage should be set at approximetely 105 - 110% of the operating voltage.
⑪	Voltage/Current LIMIT Switch	o During the period you keep this switch pressed, the Voltmeter indicates the limit output voltage and the Ammeter indicates the limit output current.

No.	Name	Function
⑫	OUTPUT Switch	o Each time as you press the output switch, the output is turned on or off. o When the input switch is turned off, the output switch is reset by the automatic reset function. When the input switch is turned on for the next time, the output switch starts by the off state.
⑬	OUTPUT Indicator Lamp	o Illuminates to indicate that the output is on. (Green LED)
⑭	Sub-output Terminals Red : "+" White: "-"	o Allow to deliver the output via the front panel. [Note that the output voltage stability when the front output terminals (sub-output terminals) are used may be slightly degraded from that when the rear output terminals (regular output terminals) are used. The output voltage stability indicated as equipment performance specification on page 2-1 is that of the latter case.] Models which have sub-output terminals: PAK20-18A PAK35-10A PAK60-6A PAK35-20A PAK60-12A PAK35-30A PAK60-18A
⑮	Air Intake Louver	o Allows to intake the cooling air. o A filter is provided inside. (Clean the filter periodically.)
⑯	Louver Hooks	o Clamp the louver in position. To detach the louver (e.g. to take out the filter for cleaning), press the hooks downward.
⑰	Rubber Studs	
⑱	Control Switch S1	o Selects functions of remote control with external voltage or resistance signal (ON/OFF-control of output, GP-IB control, etc.). (See Section 3.3.) For the PAK-AM model (modular-type model), be sure to set switch S1 - S4 to ON. (The output will not be delivered if it is set to OFF.)
⑲	Control Signal Connector J1	o Connects control signals. (See Section 3.3.)

No.	Name	Function
⑳	For Control Signal Connector J2	o Space for GP-IB Controller connector (optional)
㉑	Output Terminal "+"	o Use the supplied bolt and nut.
㉒	Output Terminal "-"	o Use the supplied bolt and nut.
㉓	Cooling Fan Motor	o Cools the power supply. (A temperature proportional type of forced air cooling system)
㉔	Input Terminals	o Connects the AC line input power.
㉕	Power Indicator Lamp	o Illuminates to indicate that the AC input power switch is on.
㉖	VOLTAGE Control, COARSE	o Controls coarsely the constant-voltage output. (Potentiometer adjustable with screwdriver)
㉗	VOLTAGE Control, FINE	o Conrrols finely the constant-voltage output. (Potentiometer adjustable with screwdriver)
㉘	CURRENT Conrrol	o Controls the constant-current output. (Potentiometer adjustable with screwdriver)
㉙	Control Switches S2 - S8	o For the various control actions. (See Section 3.3.)
㉚	Handle	
㉛	GND	o Frame ground. When the output is required to be grounded, use the supplied GND cable from the viewpoint of output noise suppression.

3.3 Remote Sensing and Remote Control

The PAK-A/AM Power Supply is allows remote sensing and remote control modes of operation. For this prupose, remote control terminals and switches are provided as shown in Figure 3-1 - 3-3.

> Note: Be sure to turn off the POWER switch before making wiring to the remote control terminals or changing the remote control switches (S1 - S9).

3.3.1 Remote Control Terminals and Switches

The remote sensing and control terminals are with a 20-pin MIL-type standard connector as shown in Figures 3-1 and 3-2. The settings of the switches when the power supply is delivered to you are as shown in Figure 3-3.

As viewed from rear of equipment

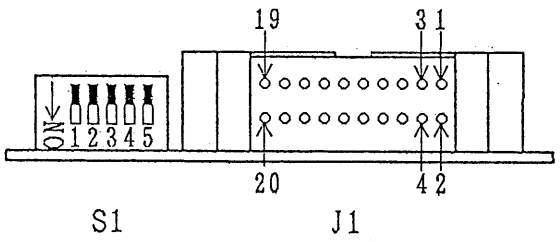


Figure 3-1

Applicable 20P sockets
(OMRON : XG5M-2032
MATSUSHITA: AXW 120431A)

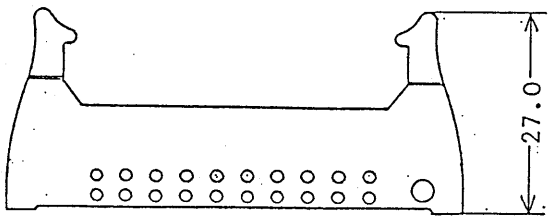


Figure 3-2

Switch setting when equipment is delivered

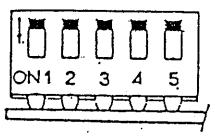
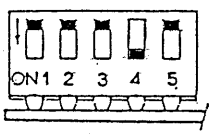
Switches (S2 - S8) on top panel	Switch S1 on rear panel	
	PAK-A series	PAK-AM series
REMOTE SENSING ON ● OFF S2 O.V.P CONTROL REMOTE ● LOCAL S3 PARALLEL OPERATION SLAVE ● MASTER S4 C.C REMOTE RIN ● EIN S5 IO RM ● IO RM S6 C.V REMOTE RIN ● EIN S7 EO RM ● EO RM S8	All switches is set to OFF states  S1	4 of S1 is set to ON state  S1

Figure 3-3

Function of control terminals

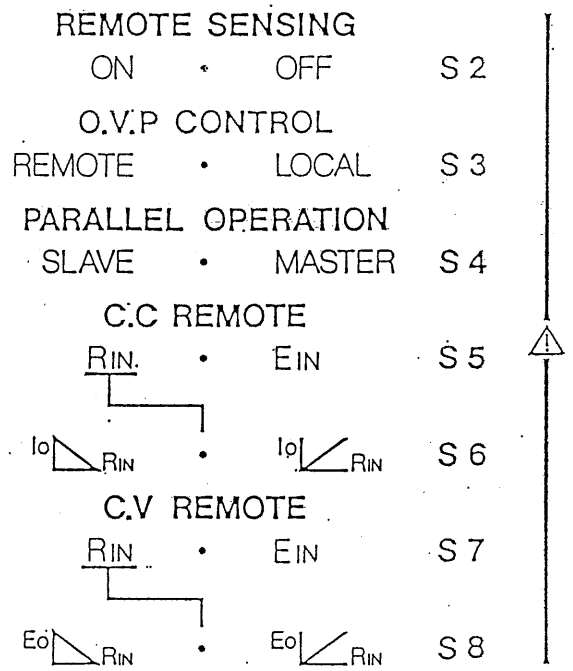
No.	Function
1	Common for analog (Note)
2	Common for digital
3	Voltage monitoring (Note)
4	+S
5	Remote control of output current with external resistance signal
6	-S
7	Remote control of output voltage with external resistance signal
8	Input for parallel operation signal
9	Input for parallel operation signal
10	Remote control of output voltage with external voltage/resistance signal (Note)
11	Remote control of output current with external voltage/resistance signal (Note)
12	Remote ON/OFF-control of output
13	Remote control for turning OFF the Power switch
14	C.C mode signal
15	C.V mode signal
16	Common for signal
17	Output signal for parallel operation
18	Current monitoring (Note)
19	ON/OFF signal of power switch
20	Alarm signal

(Note): The analog common line normally is connected to the "-" output line. When in the remote-sensing mode, it is connected to the ⊖S terminal (terminal 6). Noting to the fact that the common line of the monitor output and that of the control voltage signal are connected to the analog common line, pay full attention to the reference potentials of signals when connecting the ground lines.

Control Switches S1 - S8

Switch	Mode	Description
S1	OUTPUT SW DISABLE	o Disables the output switch. For Model PAK-A only, fix the switch at ON. (For details, Section 3.3.6 (2).) o For Model PAK-AM (modular type), Fix element 4 of switch S1 at ON.
	GP-IB CONTROL	o Not to be used when in the standard mode of operation. o To be turned on when the GP-IB card is put in J2 and the power supply is operated as a member device of a GP-IB programmed control system.
	C.C REMOTE	o To select remote or local control of output current. o As this switch is turned on, operation mode is changed from the local control at front panel to the remote control via terminal J1 on rear panel. This switch should be used in conjunction with switches S5 and S6.
	C.V REMOTE	o To select remote or local control of output voltage. o As this switch is turned on, operation mode is changed from the local control at front panel to the remote control via terminal J1 on rear panel. This switch should be used in conjunction with switches S7 and S8.
S2	REMOTE SENSING	o To select the remote sensing function to compensate for voltage drop in wiring between power supply and load in order to improve voltage regulation at the load end. (See Section 3.3.2.)
S3	O.V.P CONTROL	o When the power supply is operated in the local mode, this switch should be set to the LOCAL. o When the power supply is operated in the GP-IB mode, this switch selects whether O.V.P setting is to be done locally at the front panel or to be done remotely from the GP-IB controller.
S4	PARALLEL OPERATION	o To select whether the power supply is to act as a master unit or a slave unit when operated as a member unit of a master/slave control system. Two or three units can be operated in a master slave system. (See Section 3.3.5.)

Switch	Mode	Description
S5	C.C REMOTE	o To select either a voltage signal or a resistance signal for remote control of the output current.
S6		o When in remote control with a resistance signal, to select a relationship of control signal vs. output current. (See Section 3.3.4.)
S7	C.V REMOTE	o To select either a voltage signal or a resistance signal for remote control of the output voltage.
S8		o When in remote control with a resistance signal, to select a relationship of control signal vs. output voltage. (See Section 3.3.2.)

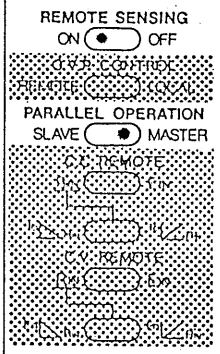
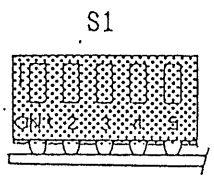
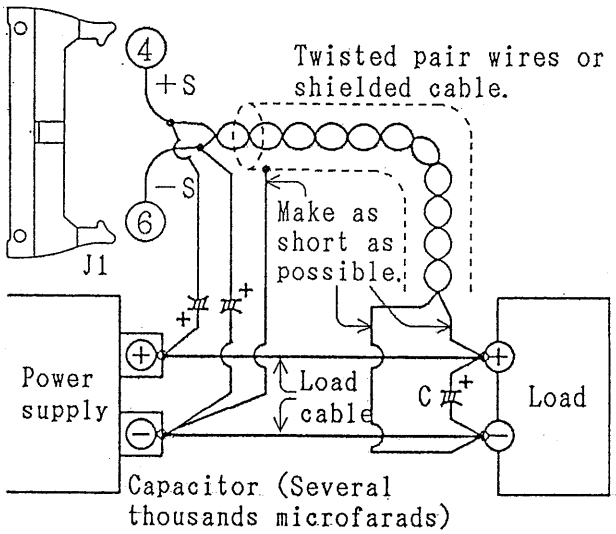


●---ON
o---SELECT

SW NO. / MODE	S1 1	S1 2	S1 3	S1 4	S1 5	S2	S3	S4	S5	S6	S7	S8
OUTPUT SW DISABLE				●								
GP-IB CONTROL	●	●	●	o								
C.C REMOTE		●							o	o		
C.V REMOTE	●										o	o
REMOTE SENSING						●						
O.V.P CONTROL							o					
PARALLEL OPERATION								o				

3.3.2 Remote Sensing

The remote sensing mode of operation is employed when the voltage drop in the wiring from the power supply to the load cannot be tolerated.
This mode compensates for the voltage drops caused by wire resistances and contact resistances, thereby improving the regulation of the supply voltage at the load end.

Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		

Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)

Notes: (a) With the remote sensing function, a voltage drop of up to approximately 1 volt per one way of electrical wiring from the power supply to the load can be compensated for, when the output voltage of the power supply at its output terminal is within its rated range.

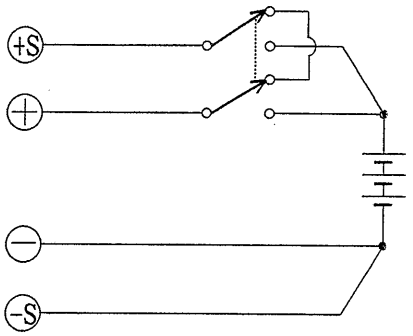
(b) Be sure to connect to the sensing point an electrolytic capacitor of several thousands microfarads and of a sufficiently high working voltage, in the correct polarity and with a minimal wiring distance.

(c) When the sensing distance is long and voltage regulation at the sensing point is poor, the state may be improved by connecting an electrolytic capacitor of several hundreds microfarads and of a sufficiently high working voltage to each of between "+S" and "OUTPUT +" terminals and between "-S" and "OUTPUT -" terminals, in the correct polarity.

(d) When units are used by a Master/Slave control parallel operation, provide remote sensing for all units (master and slave(s)). The unit(s) which remote sensing is not provided, may be not able to output the rating depending on the voltage drop of load lines.

(e) For a regenerative load (e.g. a battery), connect the load cable before connecting the sensing cable.

(f) When controlling the output power by providing an ON/OFF switch in the load cable, provide an ON/OFF switch for the sensing cable also as illustrated below.



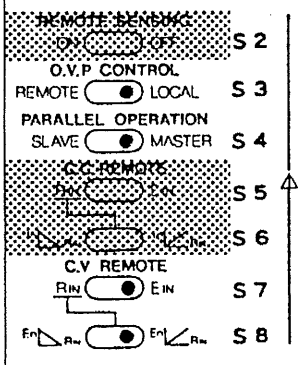
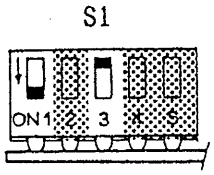
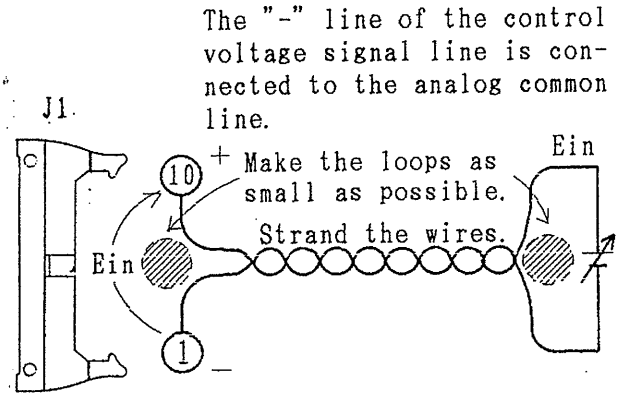
(g) When the load current changes sharply, regulation of the output voltage may be rather better without any remote sensing.

3.3.3 Remote Control of Output Voltage

The output voltage of the power supply can be remote-controlled with an external voltage or resistance signal as explained in the following:

(1) Remote Control of Output Voltage with Voltage Signal

The output voltage of the power supply can be remote-controlled with an external voltage signal (0 to approx. 10 volts) as explained below.

Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		
Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)		

Notes: (a) Impedance between ① and ⑩ of J1 is 10kΩ.
A control voltage signal source which allows up 1 mA is needed.

(b) Ripples or other noise components of Ein are directly reflected onto the outout voltage. For Ein, use a quality voltage signal source of less noise.

(c) For wiring from the remote control voltage signal source Ein to the power supply, use a shielded cable or a stranded pair of wires in order to prevent induction noise.

(d) The "-" line of the "Ein" signal is connected to the analog common line. The analog common line normally is connected to the "-" output line; when in the remote sensing mode, the analog common line is connected to the ⊖S line. Therefore, in order to prevent failures and hazards, use for the "Ein" signal a voltage source which is isolated from the frame ground.

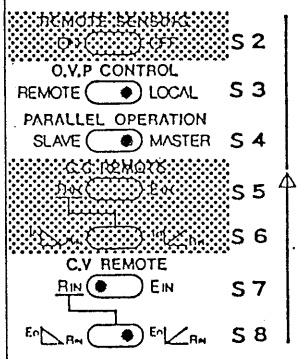
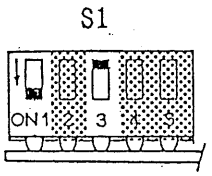
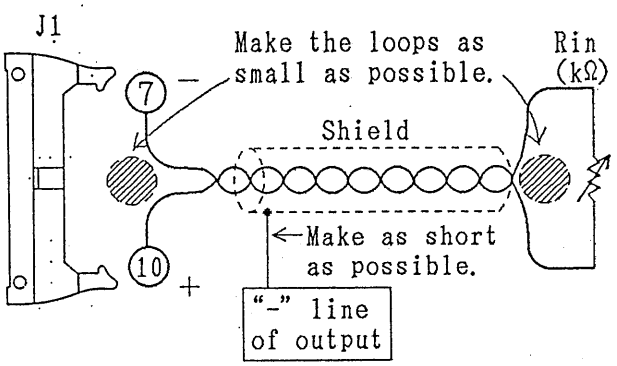
Precaution: Be sure that the signal source is isolated. If not, the control circuit of the power supply may be damaged (burnt).

(e) Linearity of the power supply output voltage with respect the external control signal voltage is approximately 0.1% (typical), with normal line voltage (100V AC) and normal room temperature.

(2) Remote Control of Output Voltage with Resistance Signal Ⅰ

The output voltage of the power supply can be controlled with an external resistance signal as shown below. The output voltage increases as the control signal resistance increases.

If the equipment is to be driven to the safer side when the resistor (Rin) has become open, employ the control method of Item (3) "Method Ⅱ".

Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		 $Eo \fallingdotseq \frac{Em \cdot Rin}{10}$ Eo: Output voltage (V) Em: Rated voltage (V) Rin: Control signal resistance (kΩ) 0≦Rin≦approx. 10kΩ

Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)

Notes: (a) The current which flows in the control resistor (Rin) is constant at approx. 1 mA.

(b) For the resistor (Rin), use a quality resistor of 1/2 watt or more, sith good temperature coefficient, aging and noise characteristics (such as a metallic film or wire-wound resistor.)

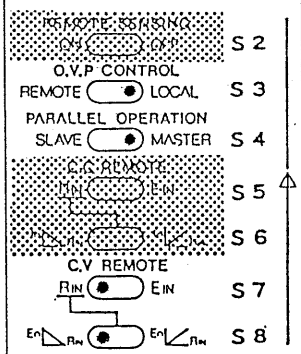
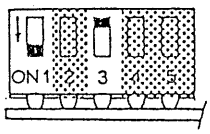
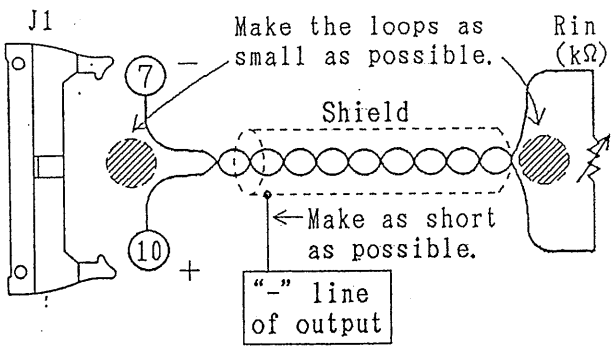
(c) When the control resistance signal circuit is made open, the power supply output voltage will increase. To protect the load, set the OVP at an appropriate voltage (see Section 3.2 (9) and (10)).

(d) Connect the shielding wire of the signal cable to the "-" line of the power supply output, using a wire as short as possible.

(e) Linearity of the power supply output voltage with respect the external control signal resistance is approximately 0.1% (typical), with normal line voltage (100V AC) and normal room temperature.

(3) Remote Control of Output Voltage with Resistance Signal Ⅱ

The output voltage of the power supply can be controlled with an external resistance signal as shown below. The output voltage decreases as the control signal resistance increases.
When the control resistance signal circuit is made open, the power supply output voltage falls to zero, thereby causing no damage to the load.
When the equipment is to be driven to the safer side when the resistor (Rin) is shorted (e.g, by .ater splash), employ the control method of Item (2) "Method Ⅰ".

Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		 $Eo \fallingdotseq Em - \frac{Em \cdot Rin}{10}$ Eo: Output voltage (V) Em: Rated voltage (V) Rin: Control signal resistance (kΩ) $0 \leqq Rin \leqq$ approx. 10kΩ
Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)		

Notes: (a) The current which flows in the control resistor (Rin) is constant at approx. 1 mA.

(b) For the resistor (Rin), use a quality resistor of 1/2 watt or more, with good temperature coefficient, aging and noise characteristics (such as a metallic film or wire-wound resistor.)

(c) When the control resistance signal circuit is shorted, the power supply output voltage will increase to the rated voltage. To protect the load, set the OVP at an appropriate voltage (see Section 3.2 (9) and (10)).

(d) Connect the shielding wire of the signal cable to the "-" line of the power supply output, using a wire as short as possible.

(e) Note that, due to tolerances of resistors used in the power supply, the output may not become zero when a resistor of 10 kΩ is used.
Use a resistor which can cover additional variable ranges of approximately ±15% of the required controlling resistance range.

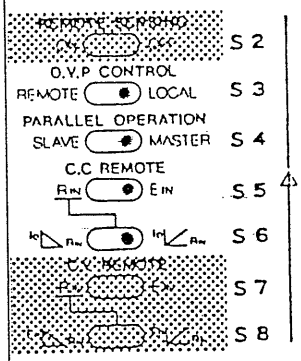
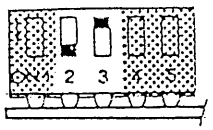
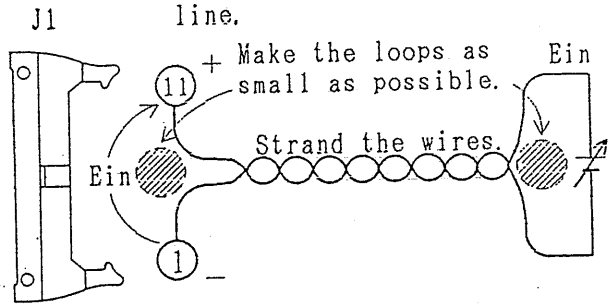
(f) Linearity of the power supply output voltage with respect the external control signal resistance is approximately 0.1% (typical), with normal line voltage (100V AC) and normal room temperature.

3.3.4 Remote Control of Output Current

The output current of the power supply can be remote-controlled with anexternal voltage or resistance signal as explained in the following:

(1) Remote Control of Output Current with Voltage Signal

An example of controlling the output current with a remote control voltage signal of 0 - approximately 10 V is explained below.

Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		The "-" line of the control voltage signal line is connected to the analog common line.  $Io \fallingdotseq \frac{Im \cdot Ein}{10}$ Io: Output current (A) Im: Rated current (A) Ein: Control signal voltage (V) $0 \leqq Ein \leqq$ approx. 10V
Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)		

Note: (a) The J1 input impedance between terminal ① and ⑪ is 10kΩ. A control voltage signal source which allows up 1 mA is needed.

(b) Ripples or other noise components of Ein are directly reflected onto the outout voltage. For Ein, use a quality voltage signal source of less noise.

(c) For control signal wiring, use a shielded cable or a pair of stranded wires. Pay attantion to noise especially when the wiring distance is long.

(d) The "-" line of the "Ein" signal is connected to the analog common line. The analog common line normally is connected to the "-" output line; when in the remote sensing mode, the analog common line is connected to the Ⓢ line. Therefore, in order to prevent failures and hazards, use for the "Ein" signal a voltage source which is isolated from the frame ground.

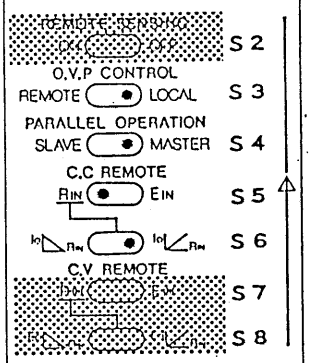
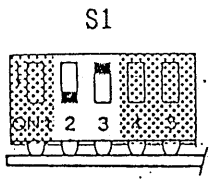
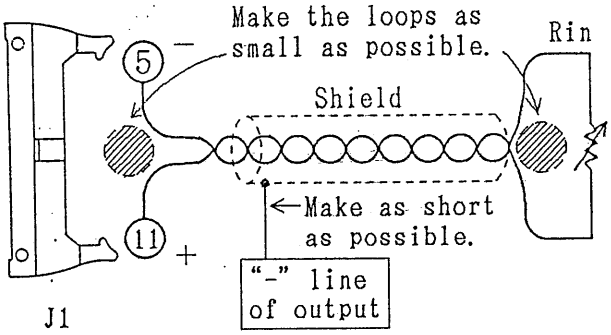
Precaution: Be sure that the signal source is isolated. If not, the control circuit of the power supply may be damaged (burnt).

(e) Linearity of the power supply output current with respect the external control signal voltage is approximately 0.1% (typical), with normal line voltage (100V AC) and normal room temperature.

(2) Remote Control of Output Current with Resistance Signal I

The output current of the power supply can be controlled with an external resistance signal as shown below. The output current increases as the control signal resistance increases.

If the equipment is to be driven to the safer side when the resistor (Rin) has become open, employ the control method of Item (3) "Method Ⅱ".

Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		 Io: Output current (A) Im: Rated current (A) Rin: Control signal resistance (kΩ) $Io \fallingdotseq \frac{Im \cdot Rin}{10}$ 0≦Rin≦approx. 10kΩ

Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)

Notes: (a) The current which flows in the control resistor (Rin) is constant at approximately 1mA.

(b) For the resistor (Rin), use a quality resistor of 1/2 watt or more, with good temperature coefficient, aging and noise characteristics (such as a metallic film or wire-wound resistor.)

(c) Note that, if the Rin circuit is made open, the output current is driven into the increasing side.
(The limit circuit trips at approximately 110% of the rated output current of the power supply.)

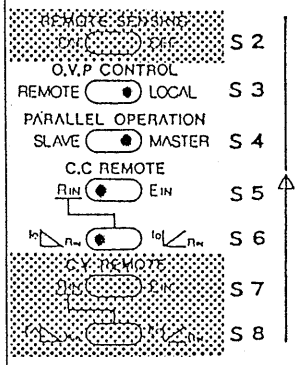
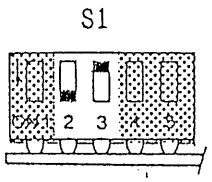
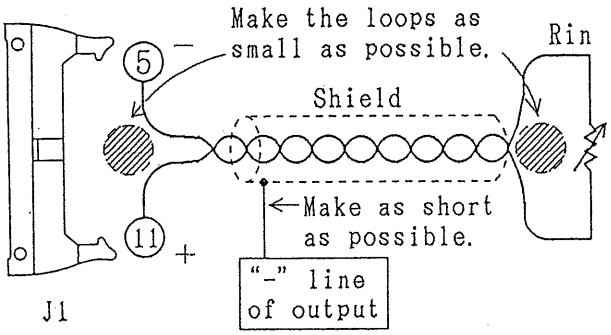
(d) Connect the shielding wire of the signal cable to the "-" line of the power supply output, using a wire as short as possible.

(e) Linearity of the power supply output current with respect the external control signal resistance is approximately 0.1% (typical), with normal line voltage (100V AC) and normal room temperature.

(3) Remote Control of Output Current with Resistance Signal Ⅱ

The otuput current of the power supply can be controlled with an external resistance signal as shown below. The output current decreases as the control signal resistance increases.
When the control resistance signal circuit is made open, the power supply output current falls to zero, thereby causing no damage to the load.

When the equipment is to be driven to the safer side when the resistor (Rin) is shorted (e.g. by water splash), employ the control method of Item (2) "Method Ⅰ".

Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		 $Io \fallingdotseq \frac{Im \cdot Rin}{10}$ Io: Output current (A) Im: Rated current (A) Rin: Control signal resistance (kΩ) 0≦Rin≦approx. 10kΩ
Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)		

Notes: (a) The current which flows in the control resistor (Rin) is constant at approximately 1mA.

(b) For the resistor (Rin), use a quality resistor of 1/2 watt or more, with good temperature coefficient, aging and noise characteristics (such as a metallic film or wire-wound resistor.)

(c) When the control resistance signal circuit is shorted, the power supply output current will increase to the rated current.

(d) Connect the shielding wire of the signal cable to the "-" line of the power supply output, using a wire as short as possible.

(e) Note that, due to tolerances of resistors used in the power supply, the output may not become zero when a resistor of 10 kΩ is used.
Use a resistor which can cover additional variable ranges of approximately ±15% of the required controlling resistance range.

(f) Linearity of the power supply output current with respect the external control signal resistance is approximately 0.1% (typical), with normal line voltage (100V AC) and normal room temperature.

3.3.5 Master/Slave Parallel Operation

Tow or three power supply units can be connected in parallel and operated in a master/slave mode, using one of them as a master unit which dictates the operation of all of them.

	Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
Master unit	REMOTE SENSING ON OFF S2 O.V.P CONTROL REMOTE LOCAL S3 PARALLEL OPERATION SLAVE MASTER S4 C.C REMOTE S5 S6 C.V REMOTE S7 S8	S1 ON 1 2 3 4 5	J1 17 Output terminal + − L1 Load L2 + − L1 = L2
Slave unit	REMOTE SENSING ON OFF S2 O.V.P CONTROL REMOTE LOCAL S3 PARALLEL OPERATION SLAVE MASTER S4 C.C REMOTE S5 S6 C.V REMOTE S7 S8	S1 ON 1 2 3 4 5	J1 8 9 Next slave unit

Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)

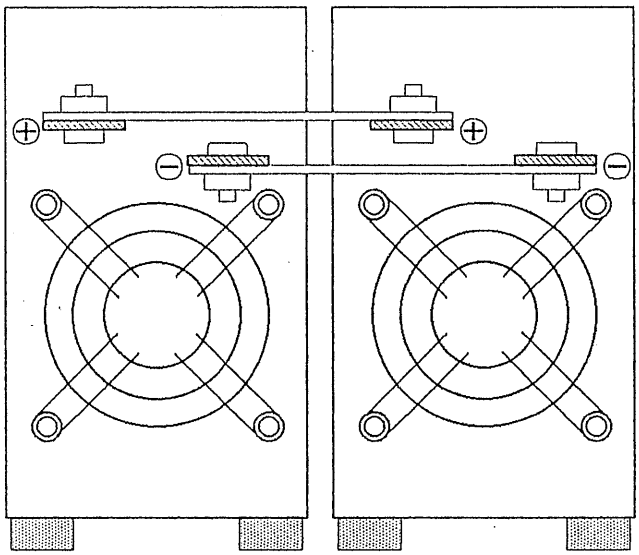
Notes: (a) For connections from the power supply outputs to the load, use wires of the same gauge and same length (as short as possible).

(b) Be sure that the "-" output terminals are securely connected.

(c) The slave units also do not deliver their outputs unless their OUTPUT switches are turned on. For disabling the local operation of the OUTPUT switches of the slave units, see Section 3.3.6.

(d) Set the output voltage of the slave unit(s) at a voltage higher than that of the master unit.
Normally, the slave unit(s) operate in the constant current mode.

(e) The maximum number of units for master slave parallel operation is: Up to three units including the master unit for 350W or 700W Series; or up to two units including the master unit for 1000W Series.



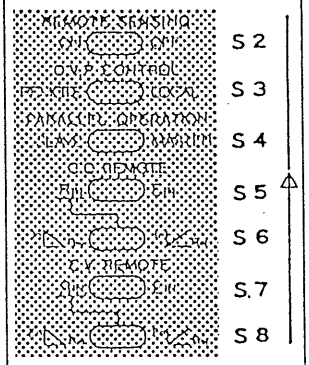
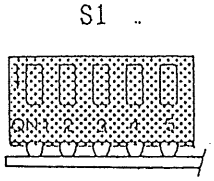
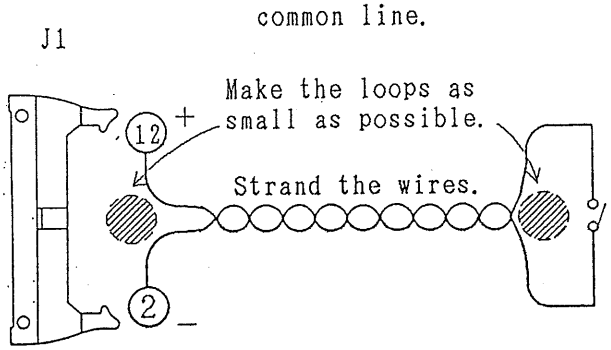
Parallel Connection

'92. 2. 3

9020A

3.3.6 Remote ON/OFF-Control of Output

(1) The output of the power supply can be on/off-controlled with an external contact signal.

Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		○ Terminal ⑫ is pulled up to 15 V with an internal resistor (15 kΩ). ○ Terminal ② is of a common line. 

S	ON	OFF
OUTPUT	OFF	ON

Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)

Notes: (a) The ON/OFF-control of the output is with a higher priority given to the OFF control.
The output is not delivered unless all of the front panel output switch (12), the GP-IB control signal, and the remote control signal applied via the rear terminals are ON.

(b) The current which flows through switch (S) is not greater than 1 mA. The voltage across the switch when it is open is 15 V DC.

(2) Disabling the OUTPUT switch:
(PAK-A standard type only)

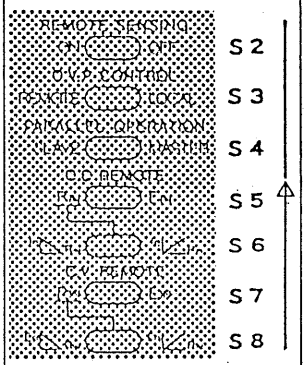
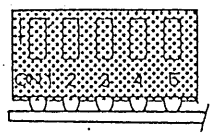
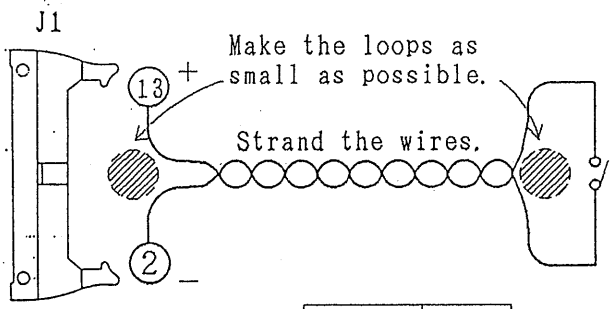
(a) The OUTPUT switch on the front panel of the power supply can be disabled (held in the ON state) by setting the element switch 4 of S1 in the ON state. The power supply actually is started up at approximately 1 second after turning on the input POWER switch.

(b) The output can be ON/OFF-controlled with a remote control signal even when 4 of S1 is set to ON.

Note: For PAK-AM (modular type), fix element 4 of switch S1 at ON.

3.3.7 Remote Control for Turning OFF the POWER Switch

The input POWER switch of the power supply can be turned OFF with an external contact signal.

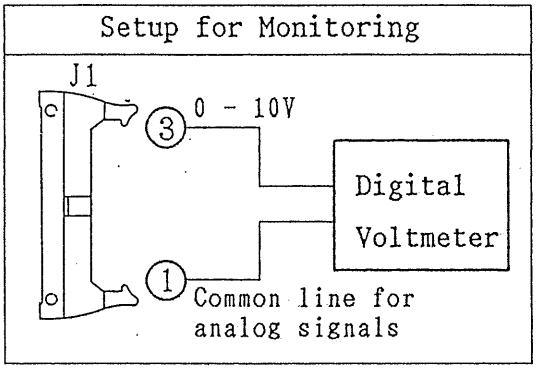
Switches (S2 - S8) on top panel	Switch S1 on rear panel	Wiring
		○ Terminal ⑬ is pulled up to 15 V with an internal resistor (22 kΩ). ○ Terminal ② is of a common line.  S: ON Power Supply Switch: OFF

Note: Unless specified in the above, make switch settings and terminal connections as required by other modes of control operation. Regarding the switches which do not require any particular settings, set them as they were set when the power supply was delivered to you. (Fig. 3-3, P. 3-12)

Note: The current which flows through switch (S) is not greater than 1 mA. The voltage across the switch when it is open is 15 V DC.

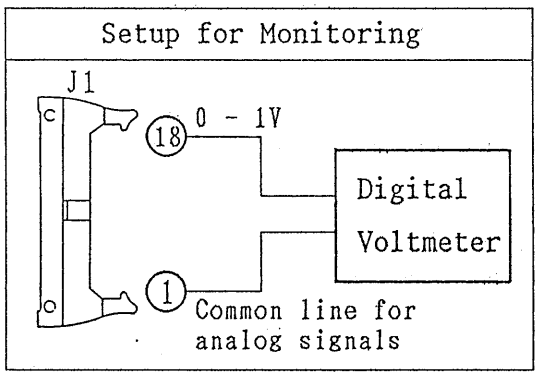
3.3.8 CV Monitor and CC Monitor

(1) Voltage Monitor



The voltage-monitoring voltage is approximately 0 to 10 V for the output voltage of 0 V to the rated voltage.

(2) Current Monitor



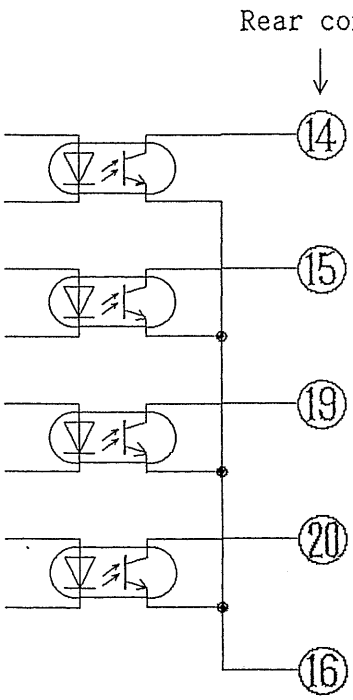
The current-monitoring voltage is approximately 0 to 1 V for the output current of 0 A to the rated current.

Notes: (a) Monitoring is with a voltmeter (not with any waveform display).

(b) The linearity of the monitor signal is approximately 0.1% (typical) when the power supply is operated with 100 V AC at normal room temperature.

(c) The common line of the monitor signal is connected to ①, whose potential normally is identical with that of the "-" line of the power supply output but is identical with that of the Ⓢ terminal when in the remote-sensing mode.

3.3.9 Output Signals



⑭ C.C mode signal ····· ON state for constant-current mode of operation

⑮ C.V mode signal ····· ON state for constant-voltage mode of operation

⑲ Power switch ON signal ····· ON state for power switch turned on

⑳ Alarm signal ····· ON for approx. 1 sec for trip of OVP or OHP

⑯ Common (floating)

Photon coupled transistor rating

Maximum ratings (Ta = 25°C)

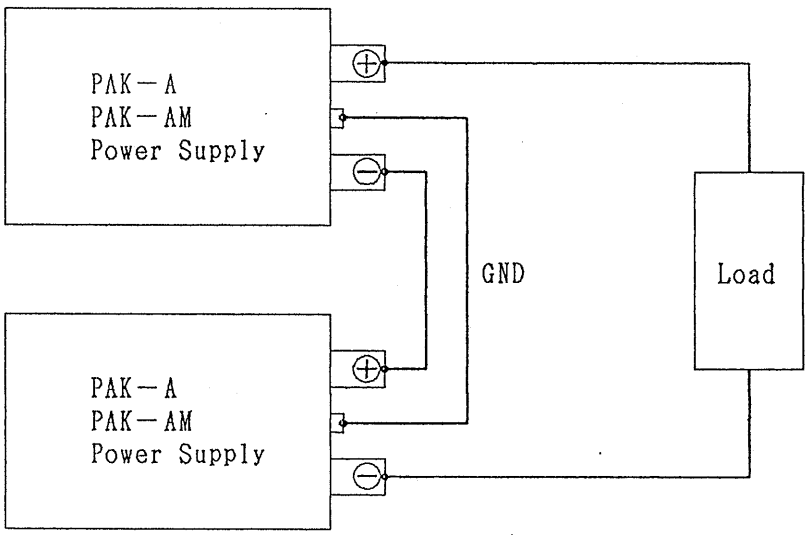
	Parameter	Symbol	TLP521-1	Unit
Photo transistor	Collector-Emitter voltage	V_{CEO}	55	V
	Emitter-Collector voltage	V_{ECO}	7	V
	Collector current	I_C	50	mA
	Collector dissipation (signal circuit)	Pc	150	mW
	Derate collector dissipation derating (Ta = 25°C or over) (signal circuit)	Δ Pc/°C	-1.5	mW/°C
Operating temperature		Topr	-55 to 100	°C
Storage temperature		Tstr	-55 to 125	°C
Permissible dissipation (signal circuit)		Pt	250	mW
Permissible dissipation derating (Ta = 25°C or over) (signal sircuit)		Δ Pt/°C	-2.5	mW/°C
Isolation voltage (Note 1)		BVs	2500	Vrms

(Note 1) AC, 1 minute R.H. = 40 to 60%

3.3.10 Series Operation and Parallel Operation

(1) Series Operation

Two or more units of PAK-A/PAK-AM Power Supplies can be operated being connected in series to obtain a higher output voltage.



Notes:

1. The number of power supplies which can be connected in series is restricted by the rated voltage (250V DC) of the power supplies with respect to ground.

2. To make equal the chassis potentials of all power supplies, connect together the GND terminals of all power supplies and connect the ground line to a line of a potential yor may require.

3. Exercise care so that no current greater than the rated output current of the power supplies is fed. For example, if you connect in series two or more power supplies whose rated output currents are different, a current which is greater than the rated output current of the smaller power supply or supplies may be fed through by the larger power supply or supplies, thereby causing damage or buring of the amaller power supply or supplies. This occurs irrespective of whether the POWER switches or the OUTPUT switches of the smaller power supply or supplies are on or off. It is most recommendable to connect in series the power supplies of the same rated output current only.

4. To deliver the output after connecting the power supplies in

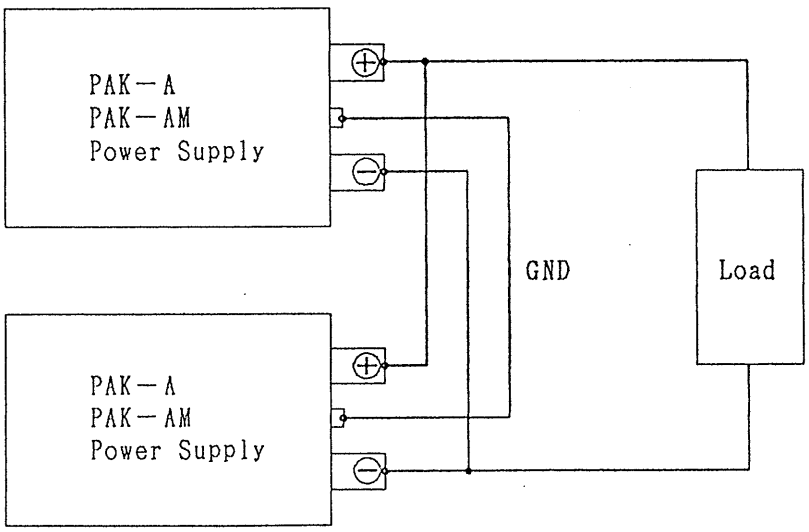
series, turn on the input power switches of all power supplies.

5. The remote sensing mode of operation is unavailable when in the series mode of operation.

6. The master-slave mode of operation is unavailable when in the series mode of operation.

(2) Parallel Operation

Two or more units of PAK-A/PAK-AM Power Supplies can be operated being connected in parallel to obtain a larger output current.



Notes: 1. Exercise care so that no voltage higher than the rated output voltage of the power supplies is applied. For example, if you connect in parallel two or more power supplies whose rated output voltages are different, a voltage which is higher than the rated output voltage of the smaller power supply or supplies may be applied by the larger power supply or supplies, thereby causing damage or burning of the smaller power supply or supplies. This occurs irrespective of whether the POWER switches or the OUTPUT switches of the smaller powersupply or supplies are on or off. It is most recommendable to connect in parallel the power supplies of the same output voltage only.

2. The remote sensing mode of operation is available by employing the master-slave mode of operation described in 3.3.5.

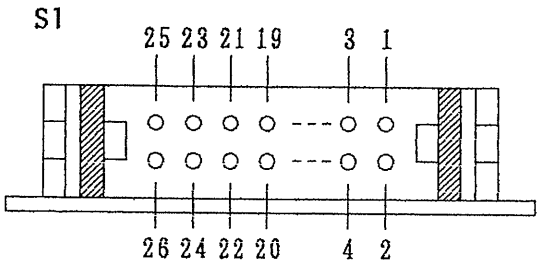
3.3.11 GP-IB Control

(With IF01-PAK-A and PIA3200/PIA4800)

- The PAK-A/AM Power Supply can be operated on an IEEE-488 GP-IB bus if the power supply is incorporated with an IF01-PAK-A Interface Card (optinal; factory-installed at the rear of the power supply) and a PIA3200/PIA4800 System Controller (optional) is available. This mode of operation allows programmed control of output voltage, output current, OVP trip voltage, and reading and sending back of major data items. For further details, see the operation manual of the PIA3200/PIA4800.

- Control Connector J2

Pin Layout



The control connector (J2) is a MIL-spec type of 26-pin connector. Its pin layout is as shown in the left and its pin assignment as shown in the below table. The mating connector is an XG5M-2632 26-pin connector manufactured by OMRON Corp.

Pin Assignment

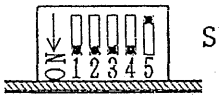
Pin No.	Assingment	Pin No.	Assingment
1	NO CONNECTION	14	$\overline{\text{REMOTE}}$/LOCAL CONTROL
2	ANALOG COMMON (0 LEVEL)	15	NO CONNECTION
3	NO CONNECTION	16	NO CONNECTION
4 *	CV EXT VOLTAGE CONTROL (0~10V)	17	STATUS/$\overline{\text{ID}}$ SELECT
5 *	CC EXT VOLTAGE CONTROL (0~10V)	18	$\overline{\text{CV MODE}}$ ($\overline{ID_0}$)
6	NO CONNECTION	19	$\overline{\text{OUTPUT ON}}$ ($\overline{ID_5}$)
7 *	OVP EXT VOLTAGE CONTROL (0~10V)	20	$\overline{\text{O.V.P ALARM}}$ ($\overline{ID_2}$)
8 *	VOLTAGE MONITOR (0~10V)	21	$\overline{\text{O.H.D ALARM}}$ ($\overline{ID_3}$)
9 *	CURRENT MONITOR (0~1V)	22	POWER ON ($\overline{ID_4}$)
10	DIGITAL COMMON	23	$\overline{\text{CC MODE}}$ ($\overline{ID_1}$)
11	$\overline{\text{OUTPUT SW ON/OFF CONTROL}}$	24	$\overline{\text{REMOTE}}$/LOCAL ($\overline{ID_6}$)
12	POWER SW OFF CONTROL	25	$\overline{\text{CONNECTION}}$ ($\overline{ID_7}$)
13	NO CONNECTION	26	+5V INPUT

*: Pin for analog voltage input

Other signal are to TTL, low-active.

Notes: 1. Be sure to turn off power of both PAK-A/AM and PIA3200 before connecting them with the cable or altering the setting of switch S1 on the rear panel.

2. When the PAK-A/AM is shipped from the factory, all of the element switches of S1 are set for the LOCAL mode of control (all element switches are set to OFF). For the GP-IB mode of control, set the element switches as shown below.
(For details, refer to the instruction manual of the PIA3200.)

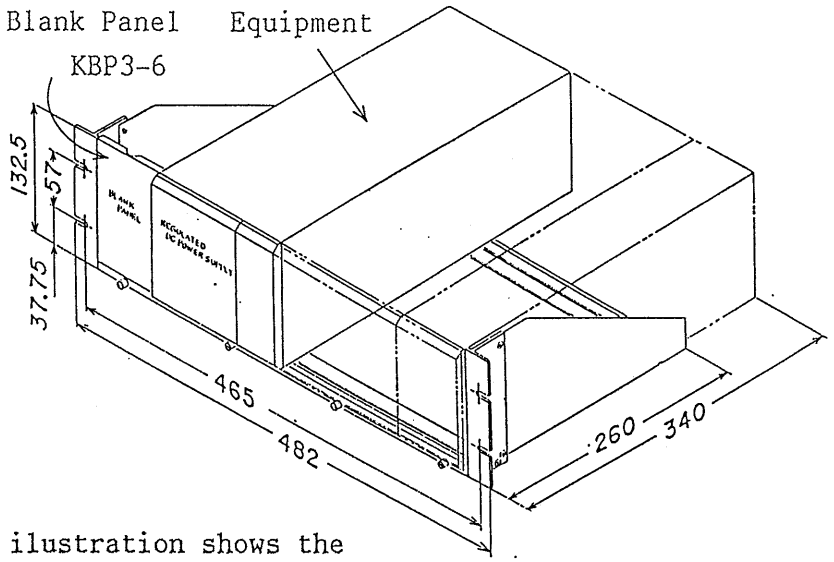
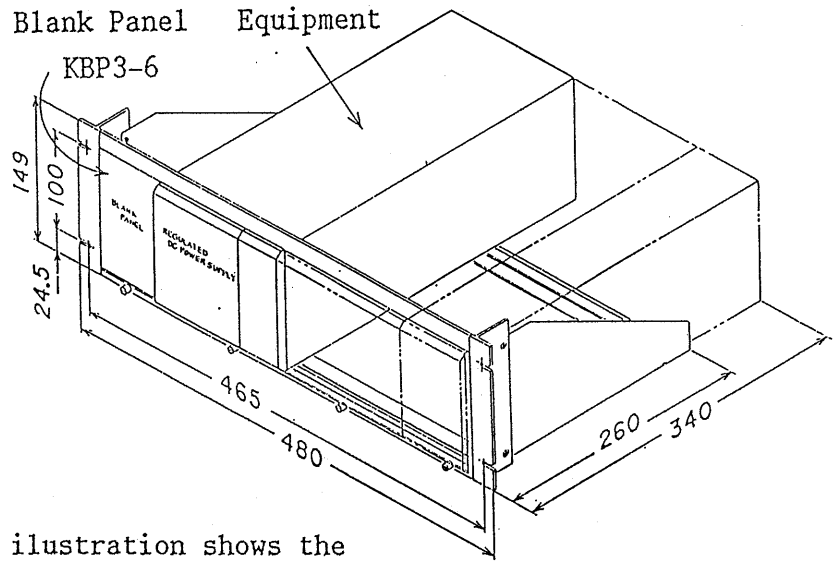
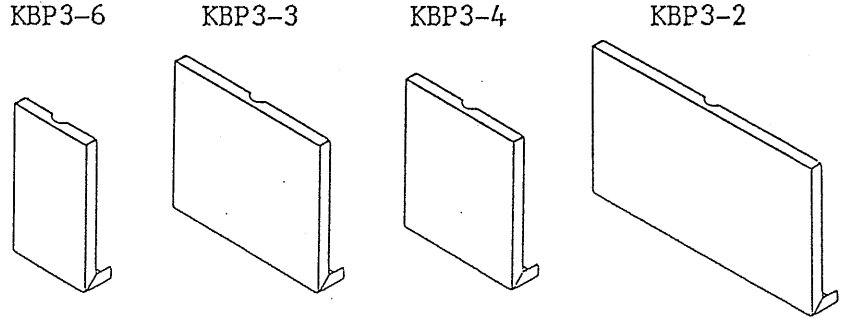
S1	Switches 1, 2, 3	ON		S1	To connect to PIA3200
	Switch 4 (normally)	ON			
	Switch 5	OFF			

For details of the functions of individual element switches, refer to Items "Control Switches" of Chapter "Applications" of this manual.

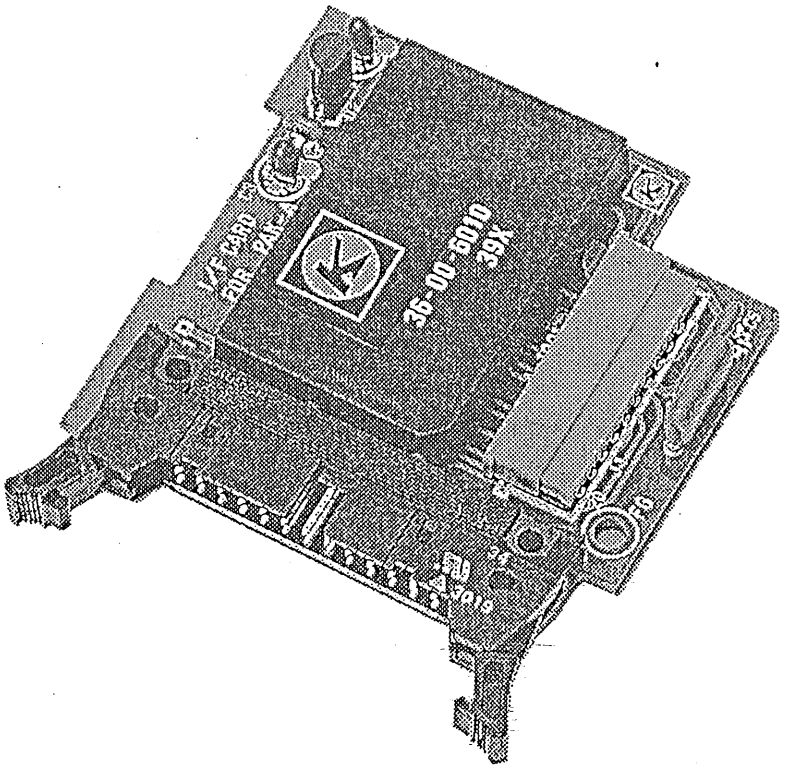
3. The socket (without pins) which accompanies the J2 connector is for connector protection when the PAK-A/AM is operated only in the LOCAL mode.

4. When the PIA3200 is connected to the PAK-AM, remote control of the constant voltage or constant current output with an external voltage or resistance signal via control connector J1 on the rear panel is inhibited. Note that the equipment may be damaged if a voltage is applied neglecting this inhibition.
If remote control with a voltage signal is required, disconnect the connector from between PAK-A/AM and PIA3200 and then apply an external control signal voltage.

4. RACK ADAPTORS, BLANK PANELS AND INTERFACE CARD (OPTIONAL)

Item	Description
KRA3 Rack Adaptor (EIA Standard)	 The ilustration shows the frame with an equipment installed on it.
KRA150 Rack Adaptor (JIS Standard)	 The ilustration shows the frame with an equipment installed on it.
KBP3-6 Blank Panel 1/6 KBP3-3 Blank Panel 1/3 KBP3-4 Blank Panel 1/4 KBP3-2 Blank Panel 1/2	 These panels are only for KRA3 (optional) and KRA150 (optional).

For details, refer to the instruction sheet for the rack mount frame.

Item	Description
IF01-PAK-A Interface Card (optional) (For connection to System Controller PIA3200)	 This option is of a factory-installed type. That is, the card is to be installed in the mainframe of PAK-A/AM. For the modification, please order your KIKUSUI agent.

5. MAINTENANCE

It is most recommendable to render maintenance and calibration service for the instrument at certain intervals. The maintenance items are covered in this section.

5.1 Maintenance

The recommendable maintenance items are as mentioned in the following.

5.1.1 Cleaning the Instrument

- When the panel surfaces have become dirty, wipe them lightly with a cloth moistened with neutral soap or alcohol and then wipe them a dry cloth. Never use benzine, thinner, or other chemical detergent.

- If the air filter is clogged, cooling of the instrument will be degraded and troubles may result. Clean the filter periodically, lest it should be clogged. For the cleaning procedure of the filter, see Section 3.1, Item (5) "Cleaning the Air Filter."

- When dust is collected on the louvers and internal components of the instrument, blow them with compressed air. (The exhaust air of a vacuum cleaner may be used for this purpose.)

5.1.2 Inspecting the AC Power Cord

Inspect the AC power cord of the instrument for damage of the cable sheath, breakage of the plug, and loosening of the plug screw.

5.2 Troubleshooting

Simple troubleshooting procedures to be followed by the user are shown in the below table. If the trouble cannot be remedied by following the procedures shown in the table, the power supply may have failed and, if this is the case, please order your Kikusui agent for repair.

Prohibition: The troubleshooting rendered by the user for himself should be limited to the items given in the below table, as a general rule. Note that Kikusui may not accept repair orders if the power supply is modified.

Symptom	Items to be Checked	Probable Cause
The power supply does not operate at all even when its input POWER switch is turned on.	1. Check that the line power is supplied to the input terminal.	o Open circuiting of input power cable o Wrong connection of input power cable
The power supply displays no indications at all.	2. The above item is in the normal state.	o Equipment failure
The input POWER switch cannot be turned on.	1. Check that the input voltage is normal.	o The input voltage is too high.
	2. Check that no alarm signal is generated. (See Section 3.3.9.)	o Trip of OVP (Note 1)
	3. Check that the input POWER switch is not remote-controlled for OFF. (See Section 3.3.9.)	o The remote control signal is in the ON state.
	4. The above items are in the normal states.	o Equipment failure

Symptom	Items to be Checked	Probable Cause
No output is delivered even when the input POWER switch and OUTPUT switch are turned on. The OUTPUT lamp illuminates.	1. Check that the VOLTAGE and CURRENT controls are correctly set.	o The controls are set at full counterclock-wise positions.
	2. Check that the setup for remote control operation is correct.	o Incorect setting of switch S1 on rear panel or switch S2 on top panel, or wrong wiring to the control terminals
	3. Check that no alarm signal is generated. (See Section 3.3.9.)	o Trip of overheat protector (Note 2)
	4. The above items are in the normal states.	o Equipment failure
The output is unstable.	1. Check that remote-sensing setup is correctly made. (See Section 3.3.2.)	o Open circuiting or wrong connections of remote-sensing setup o Wrong connection of capacitor
	2. Check that remote control operation is correctly done. (See Section 3.3.)	o Remote control signal voltage or resistance is unstable. o Wrong wiring
	3. Check that the input AC line voltage is normal and stable.	o The inpit AC line voltage is lower than the specified limit. o The input sorce includes large noise.
	4. The above items are in the normal states.	o Equipment failure

Note 1 : Correctly set the OVP.

Note 2 : Eliminate the causes of overheating (such as clogging of the intake air filter and blocking of the cooling air outlet), and leave the input POWER switch in the ON state for approximately 15 minutes. In this case, keep the OUTPUT switch in the OFF state.