MODEL PAD500-1.2

REGULATED DC POWER SUPPLY

INSTRUCTION MANUAL

KIKUSUI ELECTRONICS CORP.

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.

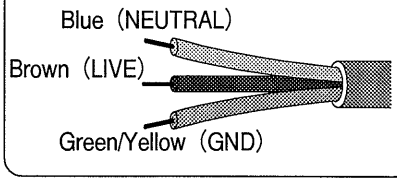
☐ AC power cable

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.

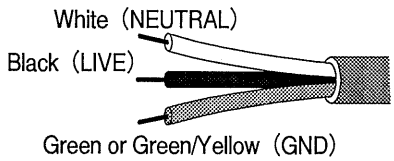
WARNING

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

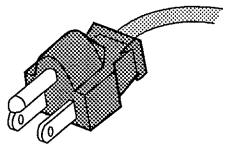
☐ Without a power plug



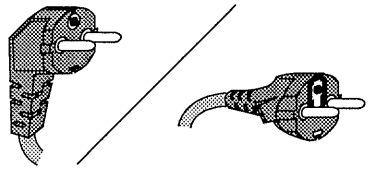
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

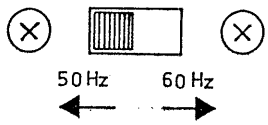
Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

CAUTION BEFORE OPERATION



It is requested for stable operation to turn the 50Hz·60Hz switch on rear in the appropriate line frequency position.

Unless turning it, unstable operation may be made.

Do not turn the switch, if unnecessary.

CONTENTS

1. GENERAL

Kikusui Electronics' Model PAD 500-1.2 is ICs used and all-silicon-transistorized, highly reliable, variable regulated DC power supply which has excellent regulation, a low temperature coefficient. It is a universal type usable for either a digital or analog circuit. Since a preregulated circuit by thyristors is built-in, overheating of the entire instrument is suppressed. Therefore, the instrument is compact and light-weight in comparison with the conventional instruments although it is of natural cooling type.

The output voltage is adjustable precisely and smoothly over a range of zero to 500V with a 10-turn herical potentiometer.

The maximum current is 1.2A. Model PAD 500-1.2 can be used as a constant current power supply over a range of 50mA to 1.2A.

Use of a new circuit technique permits the constant characteristic to be improved largely, as compared with the other type. Especially, load regulation of constant current supply is made 2mA or less (measured value).

Model PAD 500-1.2 is a constant voltage-current automatic crossover type in which the constant output voltage performance and constant current performance are changed over automatically according to load variation.

Two LEDs mounted on the front panel indicate the respective operation modes alternately (constant voltage or constant current).

Model PAD 500-1.2 is not only used in operation but in parallel, one-control parallel operation by which current can be expanded.

Use of an external resistor also permits the output voltage to be remote-controlled.

As Model PAD 500-1.2 is high voltage power supply, withstanding voltage of parts and other condition are fully considered in view of the safety and it is designed.

Model PAD 500-1.2 can be used in series operation. (for withstanding voltage of parts)

2. SPECIFICATIONS

AC Input	100V AC ±10%, 50/60 Hz
Full load	Approximately 1.5kVA
Dimensions	Case 430W x 160H x 400D mm
Maximum	431W x 175H x 490D mm
Weight	Approximately 26kg
Ambient temperature	0 ~ 40°C
Accessories	Short bar 1
	High voltage fuse 1.5A ... 1
	Instruction manual 1
	Power cord 1
Output terminals	Aligned horizontally on front panel.
	- , GND , +
	Obtainable from front and rear panels.
Polarity	Positive or negative
Floating voltage	± 500V maximum
Cooling	Convection
Constant voltage characteristics	
Voltage	0 ~ 500V continuously variable with 10-turn potentiometer.
Current	Maximum 1.2A
Ripple noise (5Hz~1MHz)	5 mVrms
Voltage regulation (At sampling terminals)	
Line regulation	0.005% + 5 mV against ± 10% variation of line voltage.
Load regulation	0.005% + 5 mV against 0 ~ 100% variation of output current.
Transient response (At load change of 10%~100%)	
(Refer to Chapter 3.5)	Typical 100μs
Temperature coefficient	Typical 100ppm/°C

Constant current characteristics		
	Voltage	0 ~ 500V continuously variable with 10 turn potentiometer.
	Current	50 mA ~ 1.2 A continuously variable (1 turn)
	Ripple noise (5Hz~1MHz)	1 mArms
	Current regulation	
	Line regulation	1 mA against ±10% variation of line voltage voltage.
	Load regulation	2 mA against 1.2V ~ 500V variation of output voltage.
Operation		Parallel connection One control parallel operation Output voltage remote control
Operation mode indication		
	LED indication	Constant voltage ..... C.V Constant current ..... C.C
Internal temperature detector circuit		When temperature of heat sink (transistor) (transistors) exceeds 120°C, built-in circuit automatically cut off the output.
Voltmeter		DC 500V class 2.5 (JIS)
Ammeter		DC 1.2A class 2.5 (JIS)

Optional accessories

* PAD 500-1.2 can be mounted on a 19" or 500 mm standard rack with rack mounting angle.

Use of over voltage and over current protection system (option) is possible.

3. OPERATION

3.1 Panel description

Front panel (See Fig. 3-1)

1	Power switch	ON/OFF switch for the input power. Throw it upwards, and the power is on. An electromagnetic switch employs for automatically cut off the AC input, when input current exceeds the specified limit.
2	Pilot lamp	Lights when the power is on.
3	Constant voltage indicating lamp	Lights when the power supply is operated in the constant voltage mode. C.V
4	Constant current indicating lamp	Lights when the power supply is operated in the constant current mode. C.C
5	VOLTAGE	Knob for setting the output voltage. Clockwise rotation increases the output current.
6	CURRENT	Knob for setting the output current. Clockwise rotation increases the output current.
7	Voltmeter	Indicates the output voltage. DC 500V class 2.5 (JIS)
8	Ammeter	Indicates the output current. DC 1.2A class 2.5 (JIS)
9	Output terminals	Aligned in the following order from the left. -(black), GND(black), +(black)

Rear panel (See Fig. 3-2)

10	Rear terminal plate	Output terminals, sampling terminals, GND terminal, remote control terminal and one-control paralleled operation terminals are provided on this terminal board.
11	50Hz, 60Hz switch	Switch for setting power line frequency. Set it to the side of supply line frequency.
12	Terminal board	Terminals are located in order of ' AC, AC, GND ' . Connected power cord (Supplied accessory).

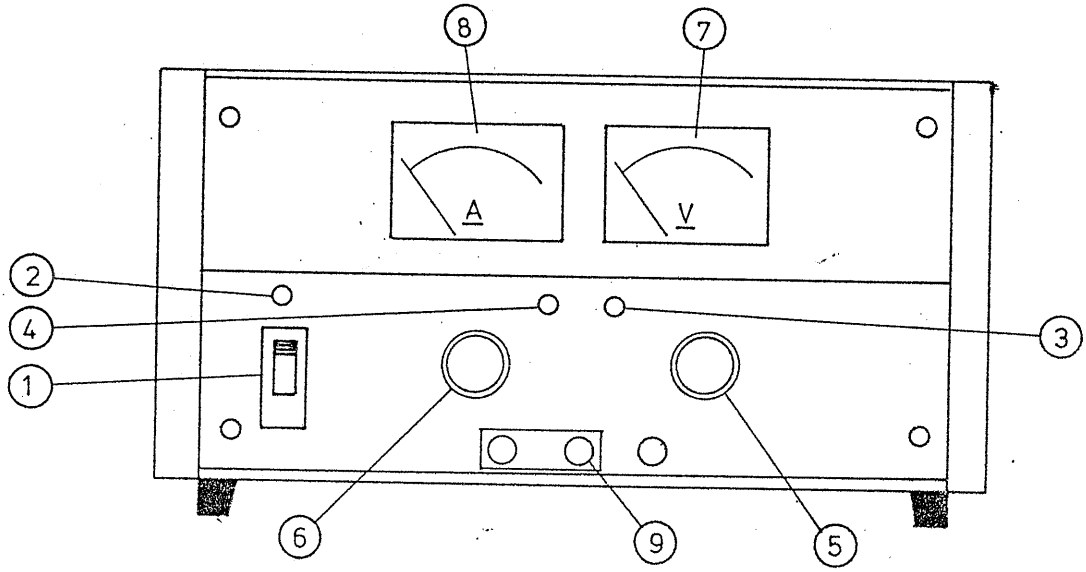


Fig. 3-1

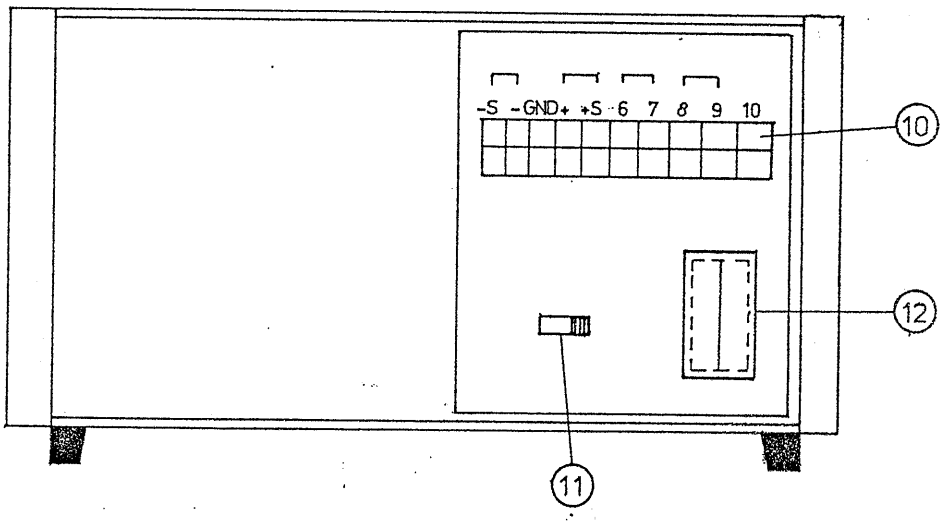


Fig. 3-2

3.2 Precautions

(1) AC input

AC input for PAD 500-1.2 should be within a range of 100V AC ±10%, 48 ~ 62Hz.

(2) Installation

Avoid using PAD 500-1.2 at a place exposed to heat; where the ambient temperature exceeding a range of zero to 40℃, that is humid or dusty, where it is not be level.
During operation, do not lay PAD 500-1.2 on its side nor put anything on it. Otherwise, a fault may be caused by reduction of its radiation effect. When some power supplies are used by mounting it on another, make power supplies 50mm or more distant from other power supplies.

(3) Output voltage variable knob

The 10 turn herical type potentiometer employs for continuous, fine and smooth adjustment of output voltage.
(Calculated efficiency : 33 mV)

(4) Output voltage overshoot

Voltage between terminals never exceeds the preset value when the power is turned on or off.

(5) When two or more power supplies are operated, potential difference between cases may be occurred by unbalance of built-in line filters. In such a case, connect GND terminals one another.

3.3 How to use sampling terminals

When PAD 500-1.2 is far from the load, long leads connecting the output terminals and the load causes load regulation to be deteriorated because of voltage drop due to lead resistance. The sampling terminals serve to solve this trouble. For the connection diagram, see Fig. 3-3.

(1) Remove the jumpers between -S and -, and, + and +S terminals on the rear terminal board.

2. Connect the output terminals on the rear or front panel to the load. Connect the sampling terminals and the nearest load terminals with other leads. Match the polarity off the sampling terminals to that of the output terminals.

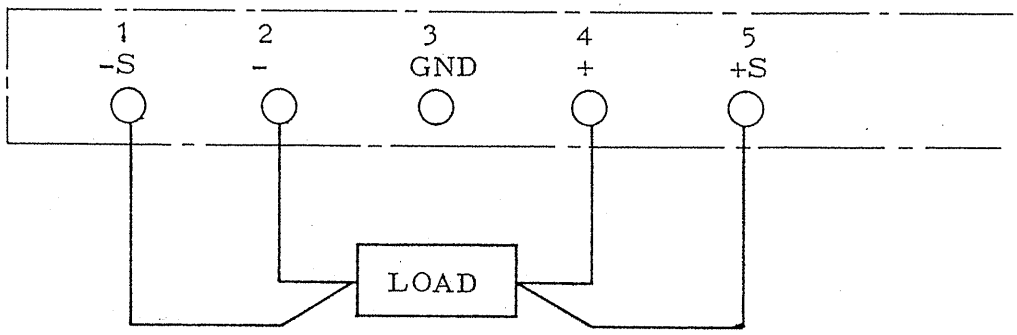


Fig. 3-3

Note 1 Deterioration of load regulation is calculated by the following formula;

Vd= Io x R (mΩ)

where

Io (A)= Load current, R (mΩ) = Load resistance

Vd = Voltage drop

Note 2 Use two-conductor shielded wire for sampling to avoid induction causing ripple from outside. Check the sampling leads for proper polarity.

Note 3 Be careful since the lead connected to the load affects the preset constant current value due to its resistance.

Note 4 As long sampling leads tend to cause oscillation, connect a electrolytic capacitor with a capacitance of a few μF's and a dielectric strength of 550V to sampling terminals in the proper polarity.

Note 5 Sampling is impossible if voltage drop of the connected to the load is 0.3V or more.

Note 6 Do not connect any load, when jumper wires between -S and -, and, + and +S on the terminal board is removed. But use off sampling terminals permits load to be connected.

3.4 Constant-voltage , current characteristics

The working output characteristics of Model PAD 500-1.2, called constant-voltage/ constant-current automatic crossover type, permits continuous transition from constant-current to constant-voltage operation mode in response to the load change.
The intersection of constant-voltage and constant-current operation modes is called crossover point. Fig. 3-4 shows the relationship between this point and the load.

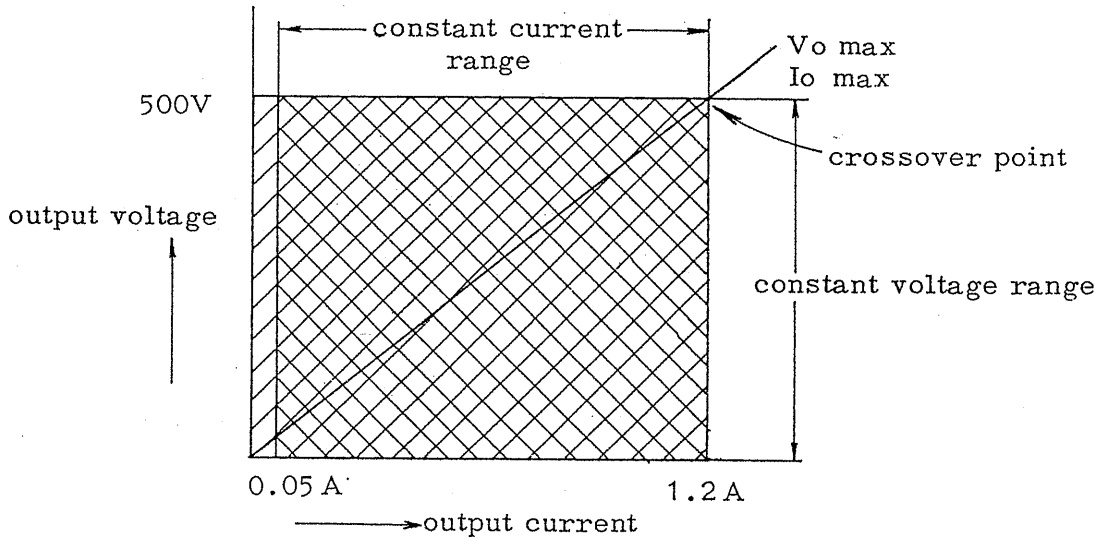


Fig. 3-4

The operation modes of PAD 500-1.2 are indicated by the area with oblique lines. Operation is possible anywhere within this area. s area.

3.5 Transient response

Designed to meet a transient response quickly enough, PAD 500-1.2 can be used for digital or other circuits involving a drastic load variation and in which performance is affected by a transient variation. But this is the characteristic at the output terminals and if a long lead is extended to the load, then influence of the inductance is not negligible.
In such a case, use capacitors to cancel the inductance.

Load current waveform and voltage waveform between output terminals on transient response test are shown in Fig. 3-5

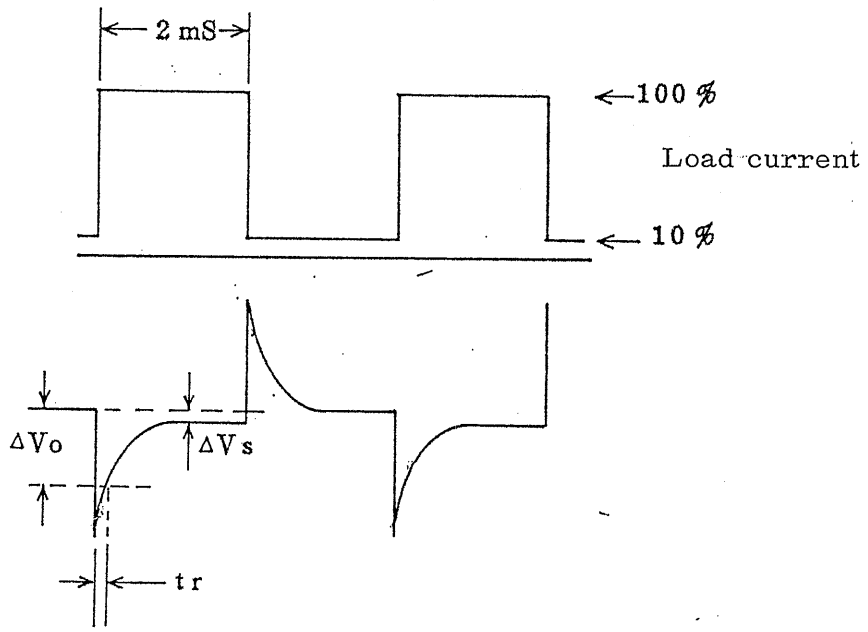


Fig. 3-5

Load current : Duty 50%

ΔVs ; Load regulation value
ΔVo ; 0.1% of output voltage
tr ; Transient response time 100μs typical value

3.6 Single peration

Constant voltage performance

(1) Connect the power cord. Throw the power switch upwards, and Model PAD 500-1.2 is ready to operate immediately, lighting the pilot lamp simultaneously.

(2) Turn the CURRENT knob fully clockwise. Turn the VOLTAGE knob until the desired voltage is obtained.
(Clockwise rotation increases the output voltage.)

(3) Connect the output terminals to the load.
Note: When requiring limiting the load current to a certain value. Before the load connect, short the output terminals.

Constant current performance

(1) The same as Paragraph (1) in " Constant voltage performance " above.

(2) Turn the " VOLTAGE " knob in the maximum clockwise position.
(This implies the maximum output voltage.)

(3) Short the output terminals. Turn the " CURRENT " knob until the desired current value is obtained.
(Clockwise rotation increases the output current.)

(4) The same as Paragraph (3) in " Constant voltage performance " above.

Note 1 Model PAD 500-1.2 is a constant voltage-current automatic crossover type. when the load current is smaller, the constant current mode is changed over to the constant voltage mode at a specific voltage. Thus, when requiring limiting the output voltage to a certain value, preset the output voltage to the desired value.

Note 2 The constant voltage or constant current mode is indicated by the respective lamps on the front panel alternately.
Constant current mode .....C.C
Constant voltage mode .....C.V

Note 3 For use of the sampling terminals, see Note 3 in Chapter 3.3 " How to use sampling terminals ".

3.7 Parallel Connection

When a large current than 1.2A is required, connect the output terminals of two Model PAD 500-1.2 in parallel.

1) Set the output voltage of the two Model PAD 500-1.2 in parallel connection at values as close as possible each other since a setting difference between the two would cause load fluctuation.

2) Turn "CURRENT" knobs fully clockwise.

3) Connect the output terminals of two Model PAD 500-1.2 to the load so that their polarity matches.
The grounding polarity of both should also match.

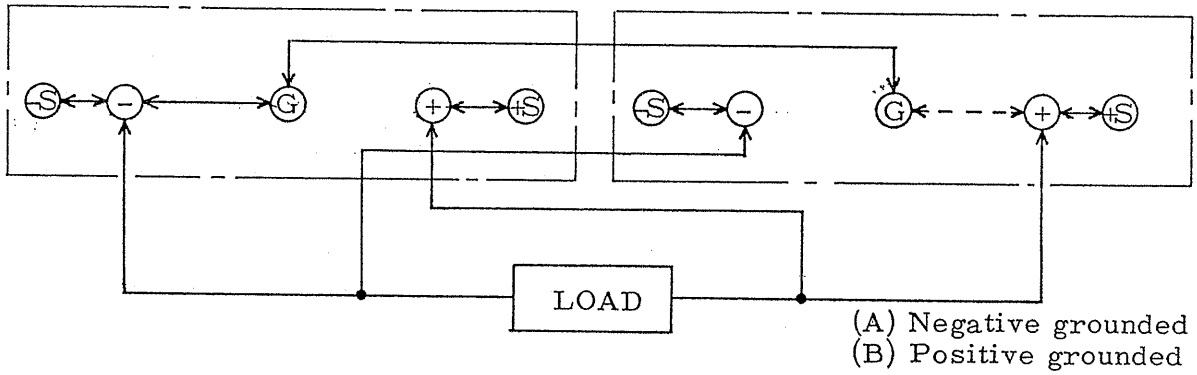


Fig. 3-6 Parallel connection diagram

Voltage-current characteristics in parallel connection

As the voltage-current characteristics in parallel connection in Fig. 3-9 show, the output voltage in parallel operation remains constant until one Model PAD 500-1.2 (A) with a higher output voltage is overloaded. When one Model PAD 500-1.2 is changed over to the constant current mode, the output voltage decreases until it reaches the value preset by the other Model PAD 500-1.2 (B) whose output terminals are changed over from an inverse voltage to a normal one, causing the constant voltage mode. Thus, load fluctuation causes the output voltage to fluctuate by the preset output voltage difference ΔV between the two units, and ripple characteristics are deteriorated.

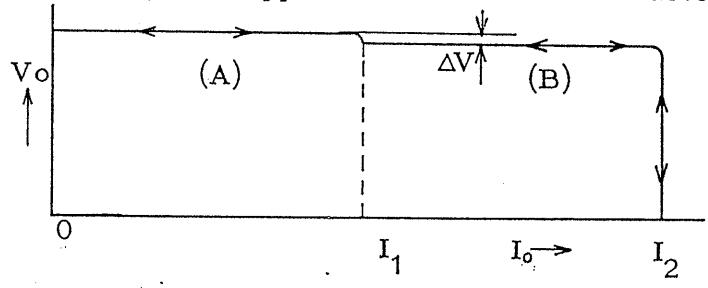


Fig. 3-7 Characteristics diagram

3.8 One-control parallel operation

When a larger current than 1.2 A is required, one-control parallel operation of two or more Model PAD 500-1.2 is preferable since the characteristics are improved largely, as compared with those in parallel connection.

(1) Connect the terminals on the rear panel of the master (Output voltage is directly controlled.) to the slave (Output voltage is controlled by master power supply.) as shown in Fig. 3-8.

(2) Pick up the output at the output terminals on the rear panel of the master.
When turning on the power switches of the master and slave, start with the master.
When turning them off, start with the slave.

Note 1 Picking up the output at the output terminals on the front panel of the master causes load regulation to be deteriorated somewhat, and current unbalance occurs between the master and slave.

Note 2 To prevent load regulation from increase, use the sampling terminals.
(Connection is shown in Fig. 3-9.)

Note 3 Turn the "VOLTAGE, CURRENT" knob of the slave fully clockwise.

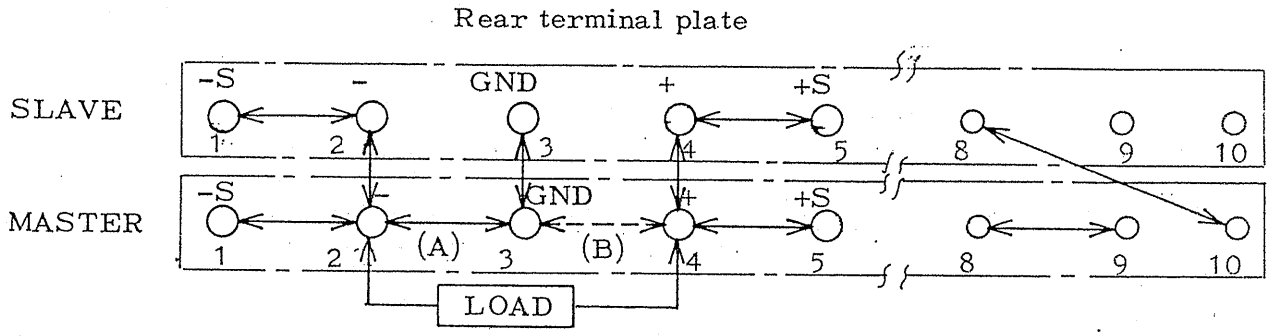


Fig. 3-8 One-control parallel operation master, slave, load

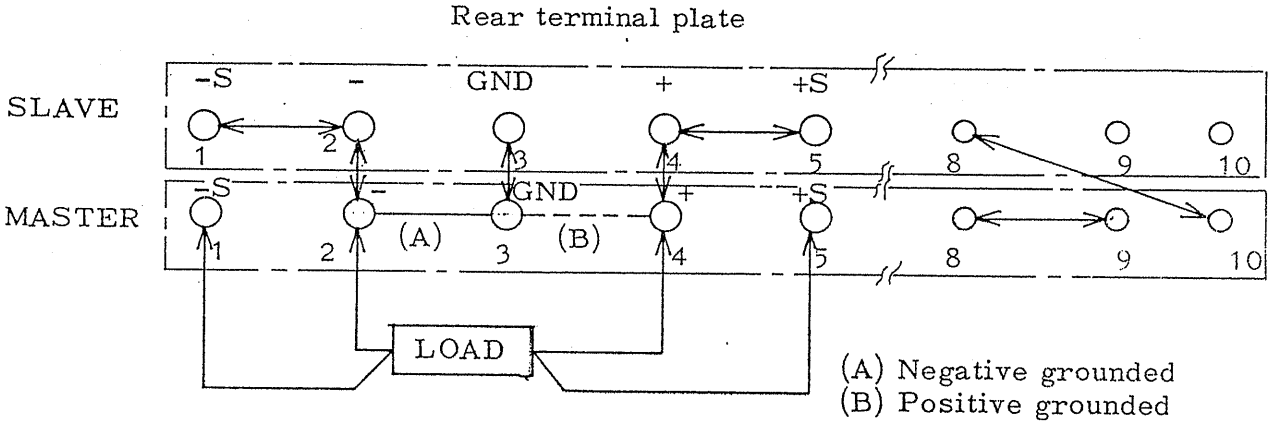


Fig. 3-9 Using sampling terminals in one-control parallel operation

3.9 Remote control

To vary output voltage by remote control, improve efficiency in varying output voltage and obtain the preset output voltage simply by operation of switches or others, use the remote control terminals on the rear panel.

1) Turn off power switch and remove jumpers from terminals 6 and 7 on the rear panel.

2) Provide a suitable variable element between 6 and -S .

Note Variable element will be described in detail later.

3) Turn on power switch and then output voltage will vary according to the characteristics of the variable element connected.

Note If the line connected to variable element is open, output voltage cannot be controlled, and excessive output voltage is detected.

Make the connection with power switched off.

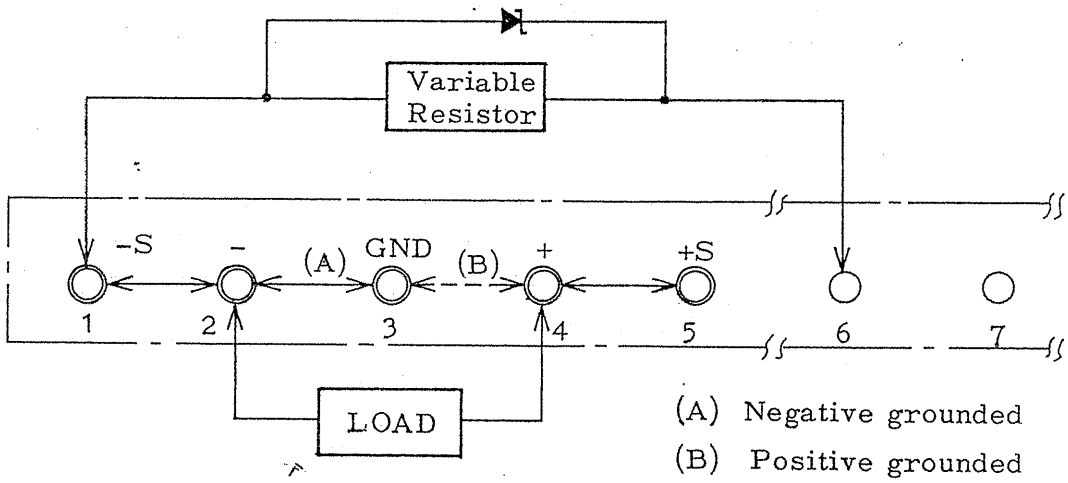


Fig. 3-10

3.9-1 To vary output voltage by remote control.

Output voltage varies at a rate of approximately 2.77V/kΩ with reference to the resistance of the resistor connected. Therefore,

Output voltage Vo(V) = Voltage variation rate 2.77V/kΩ x Rr (kΩ)

where voltage variation rate indicates voltage change for each 1kΩ, and Rr the resistance (kΩ) for remote control.

If no suitable resistor is available and output Vo may exceed the rated output or it is desired to fix voltage at a certain level, output voltage can be limited by connecting zener diode with a small leakage current to the resistor. (See Fig. 3-10)

Note Use a wire wound type variable resistor with a low temperature coefficient or a metal film one , and the power rating of such a resistor must be at least 0.5W more over. Otherwise, the temperature drift of output voltage may deteriorate.

Note PAD 500-1.2 can operate steadily if the external lines connected are limited to approximately 2 meters.
If longer lines are used , output voltage may become unstable.

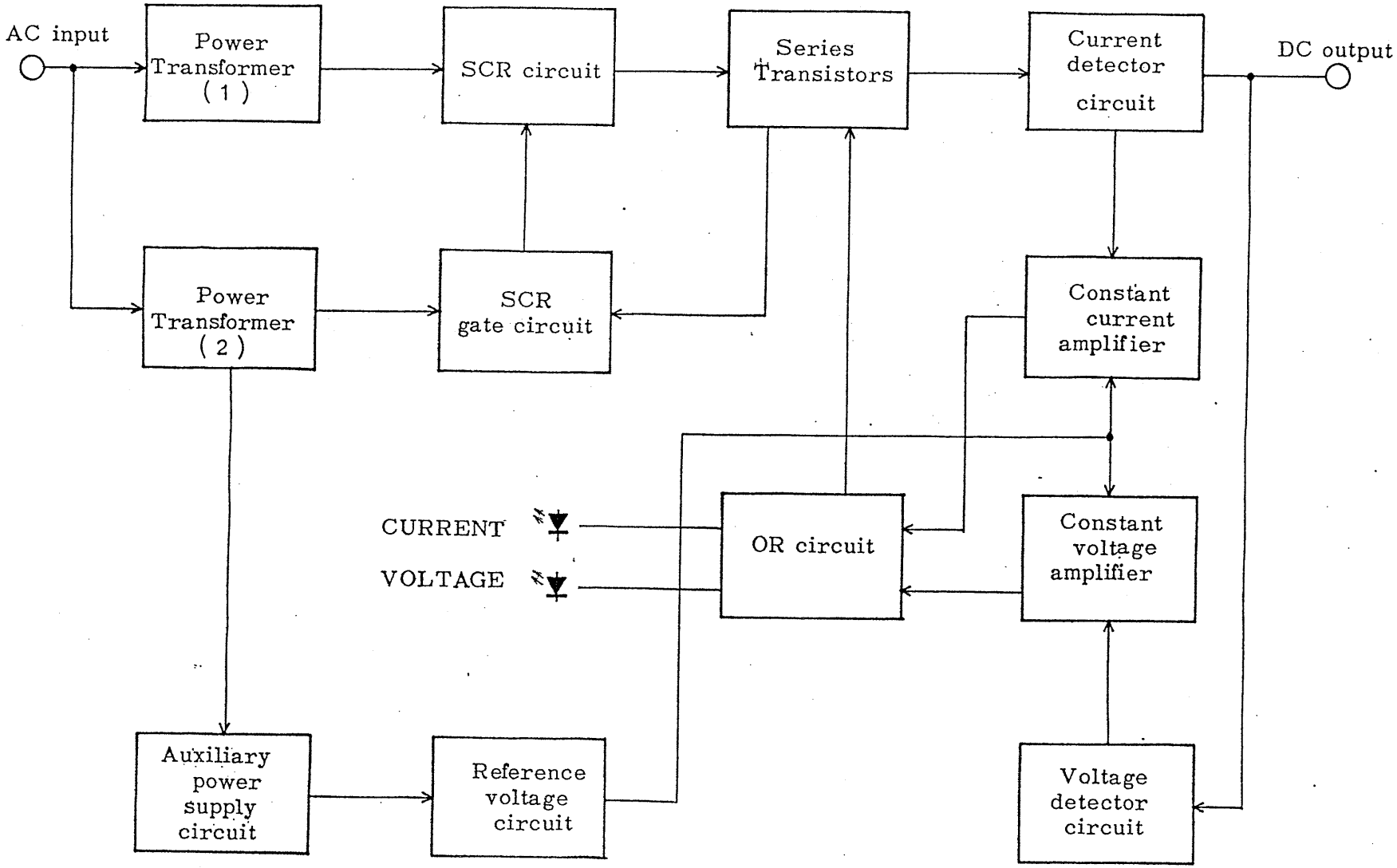
3.9-2 To improve efficiency in varying output voltage
(to finely adjust voltage).
As already mentioned, output voltage is proportional to the external resistance.
Letting Vres stand for the required efficiency, the efficiency of the resistor can be formulated as follows.

$$Rres = \frac{Vres}{\text{Voltage variation rate } 2.77V/k\Omega} \ (k\Omega)$$

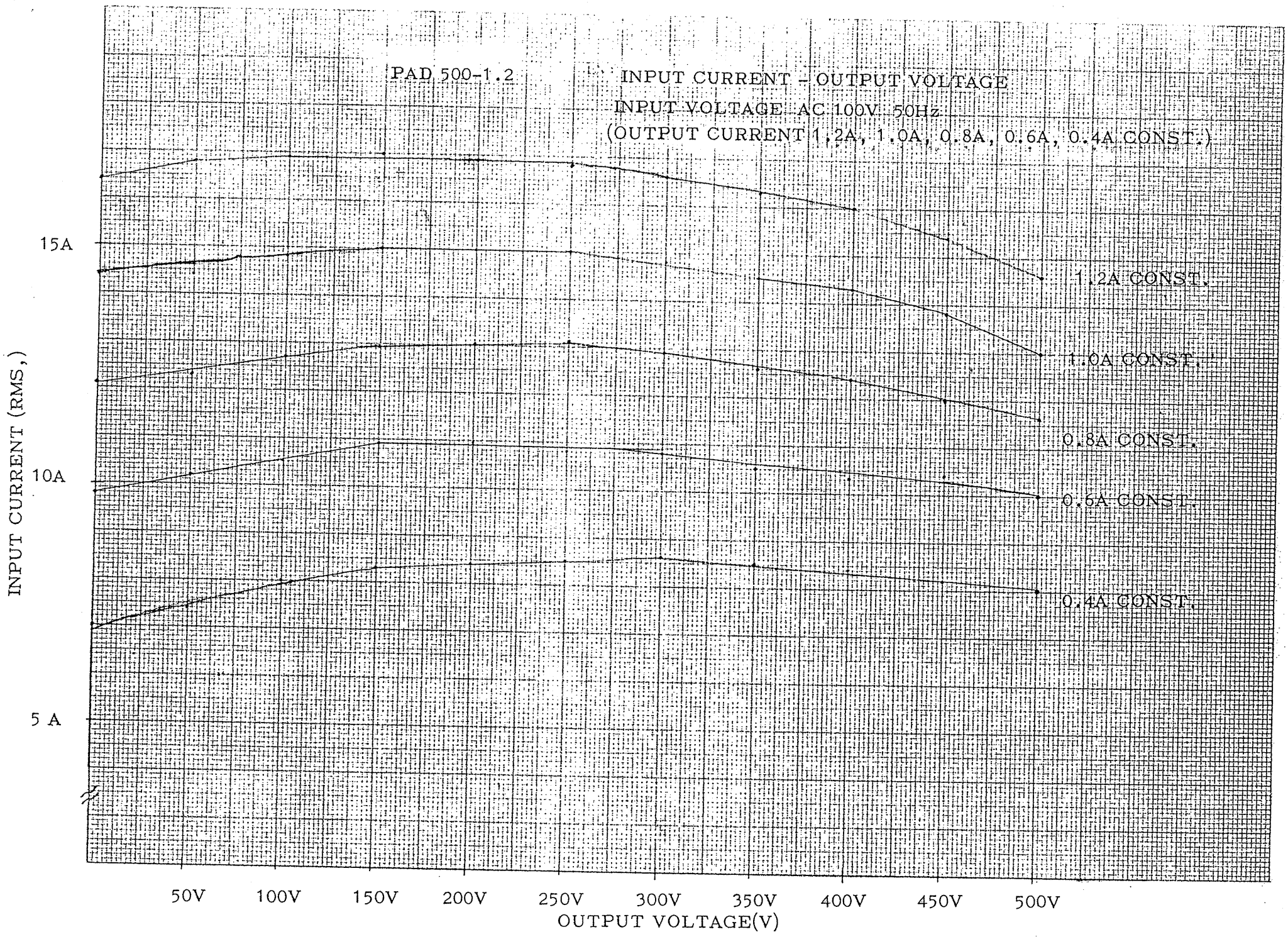
3.10 Internal temperature detector circuit

When the internal temperature exceeds rated the built-in circuit automatically cuts off the output.

Therefore, if this instrument is used in a place where the ambient temperature is over 40°C, or used by mounting it on another instrument, the entire output or current may not be obtained. Since this circuit is restored to its original condition soon after the internal temperature lowers below the specific value, turn off the power switch, and cool the instrument if the output cannot be obtained as specified while the circuits operate normally.



Block diagram


PAD 500-1.2
INPUT CURRENT - OUTPUT VOLTAGE
INPUT VOLTAGE AC 100V 50Hz
(OUTPUT CURRENT 1.2A, 1.0A, 0.8A, 0.6A, 0.4A CONST.)
15A
10A
5 A
INPUT CURRENT (RMS,)
1.2A CONST.
1.0A CONST.
0.8A CONST.
0.6A CONST.
0.4A CONST.
50V
100V
150V
200V
250V
300V
350V
400V
450V
500V
OUTPUT VOLTAGE(V)