

MODEL PAD 500-0.6
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

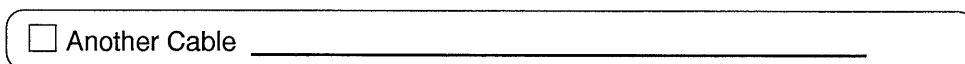
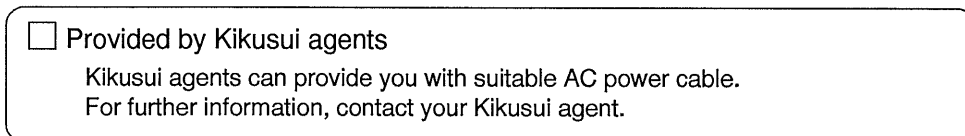
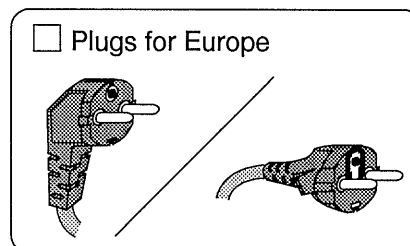
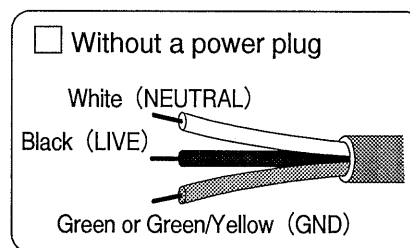
- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that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

AC power cable

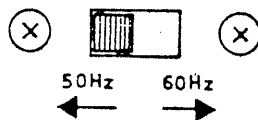
The product is provided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

WARNING

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



PRECAUTIONS



Before operating this instrument, ensure that the 50Hz/60Hz selector switch on the rear panel is set in the position corresponding to the frequency of the AC line on which the instrument is to be operated. Note that the operation may be unstable if the switch is not set correctly. Avoid tampering of the switch.

This instrument is incorporated with a protection circuit against shorted output. This circuit instantaneously reduces the output current in order to protect the control transistors when the output terminals are short-circuited by mistake or when the output voltage has become dangerously high (higher than approximately 290 V).

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* BLOCK DIAGRAM

* INPUT CURRENT - OUTPUT VOLTAGE
CHARACTERISTICS

1. GENERAL

Kikusui Electronics' Model PAD 500-0.6 is an IC used and all-silicon-transistorized, highly reliable, variable regulated DC power supply which has excellent regulation, a low temperature coefficient and transient response. It is a universal type usable for either a digital or analog circuit. Since a preregulated circuit 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 potentiometer.

The maximum output current is 0.6A. Model PAD 500-0.6 can be used as a constant current power supply over a range of 5mA to 0.6A.

Use of a new circuit technique permits the constant characteristic to be improved largely, as compared with the other type.

Model PAD 500-0.6 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 500-0.6 is not only used in operation but in parallel, one-control parallel operation by which current can be expanded.

As Model PAD 500-0.6 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 500-0.6 can not be used in series operation. (for withstanding voltage of parts)

2. SPECIFICATIONS

AC input	100 V AC $\pm 10\%$, 50/60 Hz
Full load	Approximately 700VA
Dimensions	Case 210W x 140H x 410D mm *
Maximum	215 W x 165H x 458D mm
Weight	Approximately 17kg
Ambient temperature	0~40°C
Accessories	Short bar 1 Hexagonal wrench key 1 Fuse 15A 2 Instruction manual 1
Output terminals	On the front panel aligned horizontally spaced 19mm equally (-, GND, +); the terminal board on the rear panel (-sampling, - , GND, + , +sampling). obtainable from the front and rear panels.
Polarity	Positive or negative
Floating voltage	$\pm 500V$ maximum
Cooling	Convection
Constant voltage characteristics;	
Voltage	0~500V continuously variable with 10-turn potentiometer
Current	0.6A
Ripple noise (5Hz~1 MHz)	5mV rms

Voltage regulation (At sampling terminals)

Line regulation 0.005% +5mV against $\pm 10\%$ variation
of line voltage
Load regulation 0.005% +5mV against 0~100% variation
of output current

Transient response (10~100%) Typical 100 μ s

Temperature coefficient Typical 100 ppm/ $^{\circ}$ C

Constant current characteristics:

Voltage 0~500V continuously variable with
5-turn variable resistor

Current 5mA~0.6A continuously variable

Ripple noise (5Hz~ 1 MHz) 1mA rms

Current regulation

Line regulation 1mA against $\pm 10\%$ variation of line voltage

Load regulation 10mA against 0~100% variation of output
voltage

Operation

Parallel connection

One-control parallel operation

Operation mode indication

LED indication

Constant Voltage C.V.

Constant Current C.C.

Internal temperature detector circuit

When the internal temperature exceed
the rated built-in circuit automatically
shunts off the output

Voltmeter

DC 500V, accuracy 2.5% full scale

Ammeter

DC 0.6A, accuracy 2.5% full scale

* Two PAD 500-0.6 can be mounted side by side on a 19" or 500 mm
standard rack with rack mounting angle.

3. OPERATION

3.1 Panel descriptions

Front panel

(See Fig. 3-1)

- | | | |
|---|----------------------------------|----------------------------------------------------------------------------------------|
| 1 | POWER switch | ON/OFF switch for the input power. Throw it upwards. and the power is on. |
| 2 | Pilot lamp | Lights when the power is on. |
| 3 | Constant voltage indicating lamp | Lights when the constant voltage mode. |
| 4 | Constant current indicating lamp | Lights when the constant current mode. |
| 5 | VOLTAGE | Knob for setting the output voltage. Clockwise rotation increases the output voltage. |
| 6 | CURRENT | Knob for setting the output current. Clockwise rotation increases the output current. |
| 7 | Voltmeter | Indicates the output voltage. DC 500V. |
| 8 | Ammeter | Indicates the output current. DC 0.6A. |
| 9 | Output terminals | Spaced 19mm equally and aligned in the following order;
from the left - , GND , + . |

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 | Input fuse | Inserted in the primary of the power transformer to avoid possible subsequent faults trouble. Slow blow 15A. |
| 12 | 50Hz, 60Hz switch | Switch for setting power line frequency. Set it to the side of supply line frequency. |

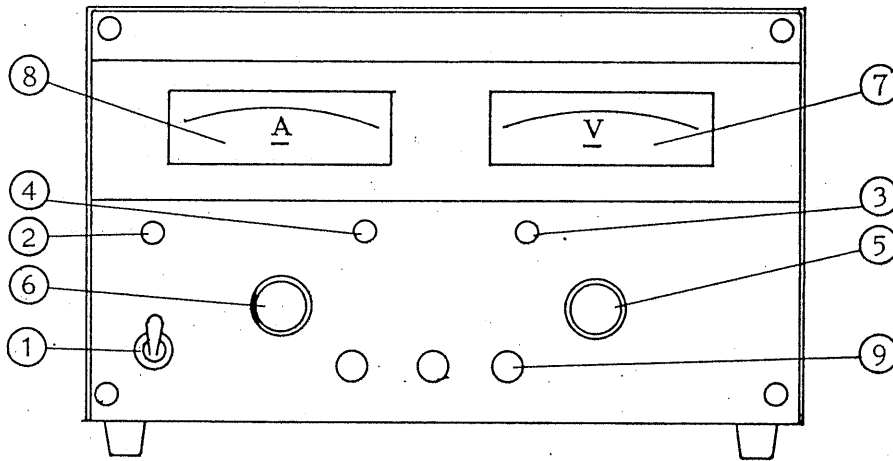


Fig. 3-1 Front Panel

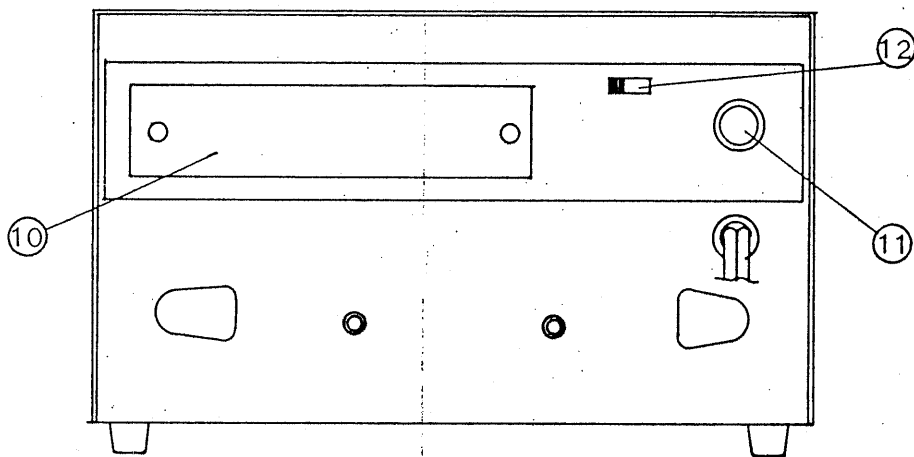


Fig. 3-2 Rear Panel

3.2 Precaution

AC input

AC input for Model PAD 500-0.6 should be within a range of
100V AC $\pm 10\%$, 48~62 Hz.

Installation

Avoid using PAD 500-0.6 at a place exposed to heat; where the ambient temperature exceeds a range of zero to 40°C, that is humid or dusty, where it is not be level.

During operation, don't lay Model PAD 500-0.6 on its side nor put anything on it. Otherwise, a fault may be caused by reduction of its radiation effect.

Variable knob output voltage

The vernier type variable resistor for adjusting the output voltage of Model PAD 500-0.6 is endless. When rotated more than five turns, its motion will become considerably rough. This shows the ultimate position of electrical variation.

Output voltage overshoot

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

3.3 How to use sampling terminals

When Model PAD 500-0.6 is far from the load, a long lead 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 +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 of the sampling terminals to that of the output terminals.

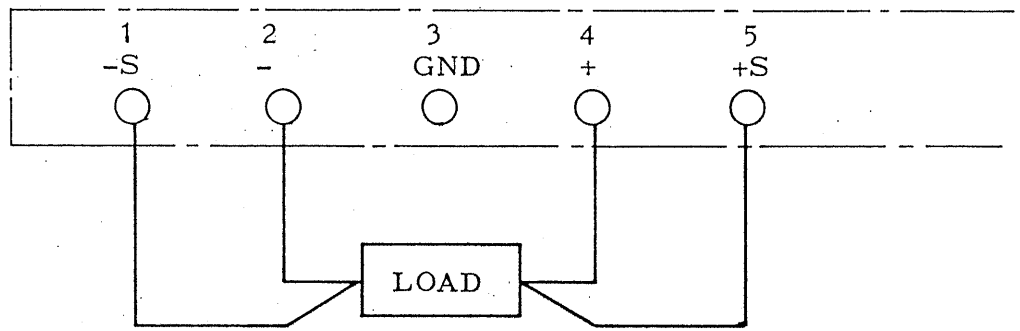


Fig. 3-3

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

$$V_d = I_o \times R \text{ (m}\Omega \text{)}$$

where

$$I_o \text{ (A)} = \text{Load current, } R \text{ (m}\Omega \text{)} = \text{Load resistance}$$

$$V_d = \text{Voltage drop}$$

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.

3.4 Constant-voltage , current characteristics

The working output characteristics of Model PAD 500-0.6 , 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.

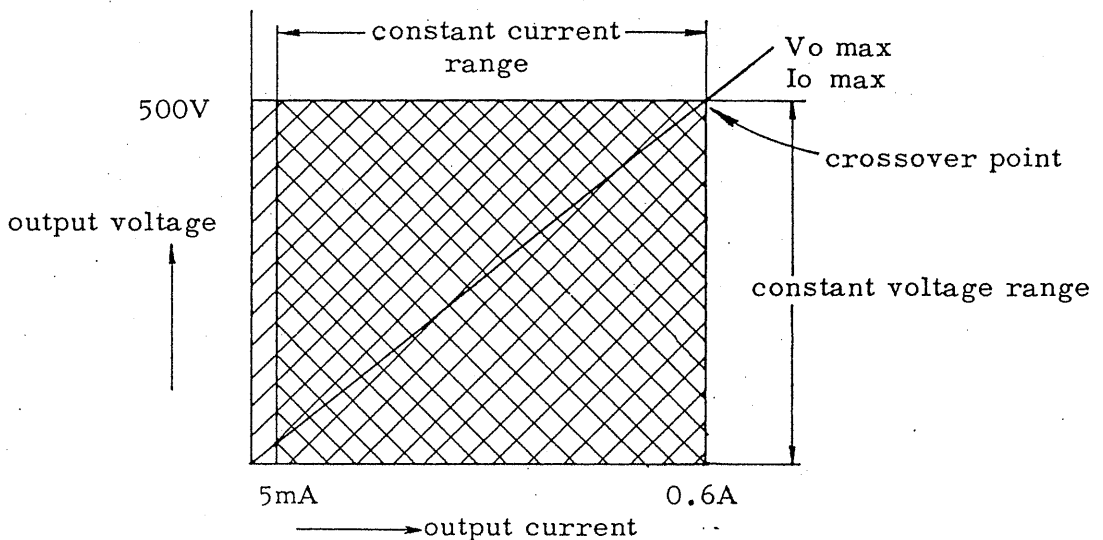


Fig. 3-4

The operation modes of PAD 500-0.6 are indicated by the area with oblique lines. Operation is possible anywhere within this area.

3.5 Transient response

Designed to meet a transient response quickly enough, PAD 500-0.6 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.

3.6 Single operation

Constant voltage performance

- 1) Connect the power cord. Throw the power switch upwards, and Model PAD 500-0.6 is ready to operate immediately, lighting the pilot lamp simultaneously.
- 2) Turn CURRENT knob fully clockwise. Turn 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. Set "CURRENT" knob to the desired current value.

Constant current performance

- 1) The same as Paragraph (1) in "Constant voltage performance" above.
- 2) Turn "VOLTAGE" knob clockwise until its motion becomes slightly rough. (This implies the maximum output voltage.)
- 3) Short the output terminals. Turn "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 500-0.6 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 3.4 " How to use sampling terminals" .

3.7 Parallel Connection

When a large current than 0.6A is required, connect the output terminals of two Model PAD 500-0.6 in parallel.

- 1) Set the output voltage of the two Model PAD 500-0.6 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 500-0.6 to the load so that their polarity matches.

The grounding polarity of both should also match.

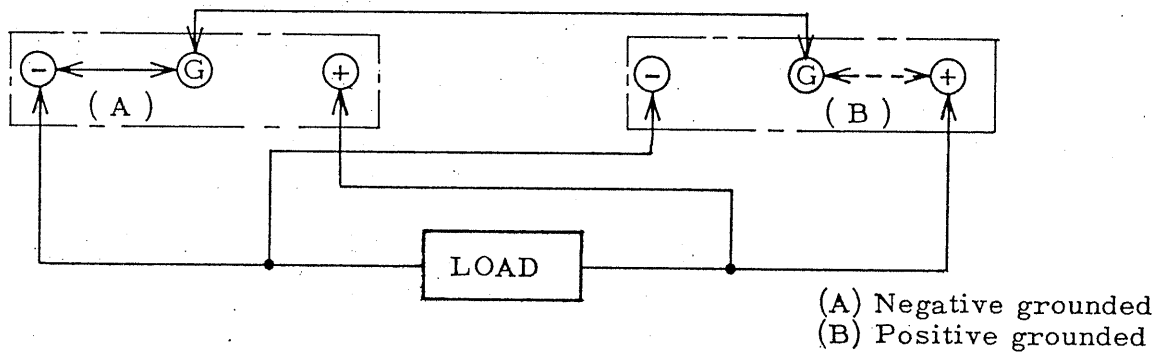


Fig. 3-5 Parallel connection diagram

Voltage-current characteristics in parallel connection

As the voltage-current characteristics in parallel connection in Fig. 3-6 show the output voltage in parallel operation remains constant until one Model PAD 500-0.6 with a higher output voltage is overloaded. When one Model PAD 500-0.6 is changed over to the constant current mode, the output voltage decreases until it reaches the value preset by the other Model PAD 500-0.6 whose output terminals are changed over from an inverse voltage condition 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 reduced.

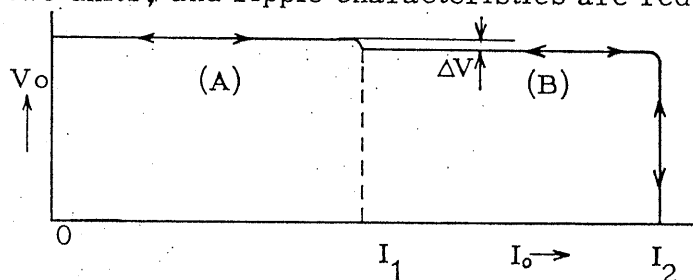


Fig. 3-6 Characteristics diagram

3.8 One-control parallel operation

When a larger current than 0.6A is required, one-control parallel operation of two Model PAD 500-0.6 is preferable since the characteristics are improved largely, as compared with those in parallel connection.

In one-control parallel operation, one of the Model PAD 500-0.6 operates as the master unit, by which the output voltage is adjusted, and the other as the slave whose output voltage is controlled by the master unit.

- 1) Connect the terminals on the rear panel of the master to the slave and the load as shown in Fig. 3-7.
- 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 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 showed Fig. 3-8)

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

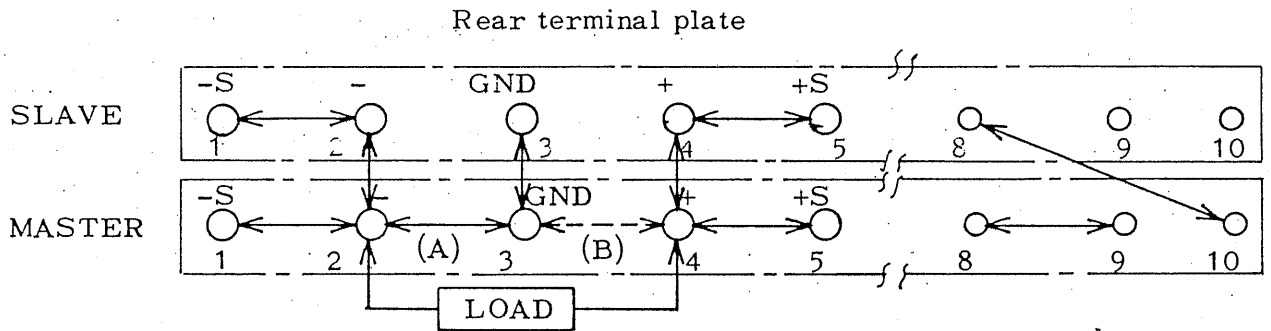


Fig. 3-7 One-control parallel operation master, slave, load

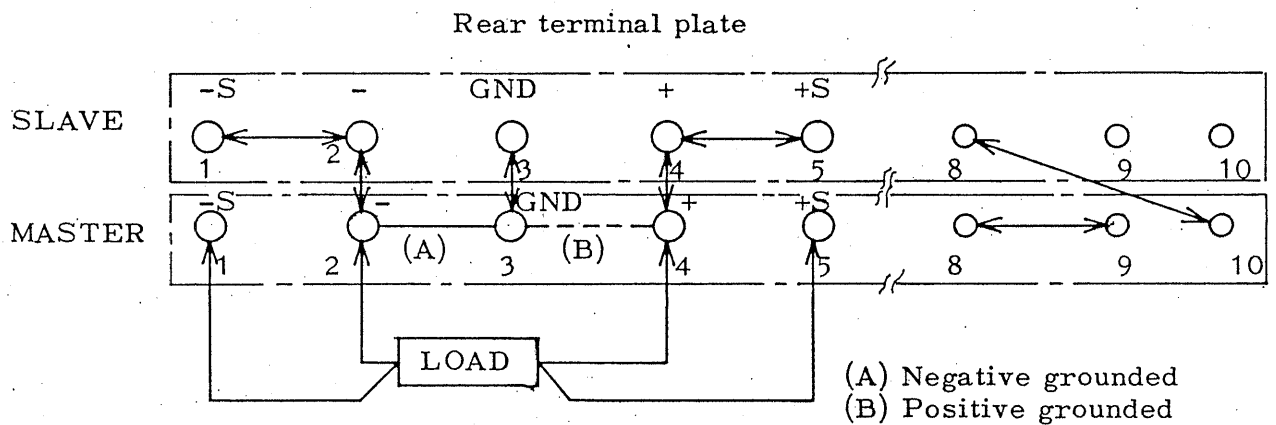


Fig. 3-8 Using sampling terminals in one-control parallel operation

3.9 Internal temperature detector circuit

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

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.

4. ADJUSTMENT

4.1 Adjustment of maximum output voltage

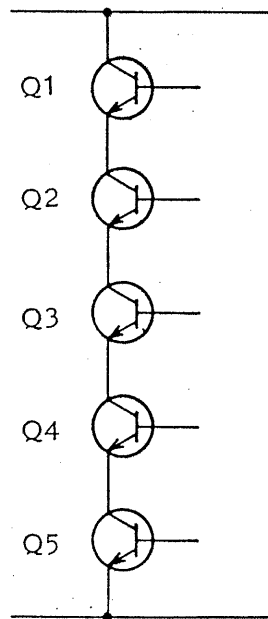
- 1) Turn VOLTAGE knob to clockwise over 10 turns.
- 2) Turn on OUTPUT switch, and connects a voltmeter having an accuracy of over 0.5% to the output terminal.
- 3) Adjust semi-fixed resistor R24 on PCB A-001A until the output voltage becomes 505V.

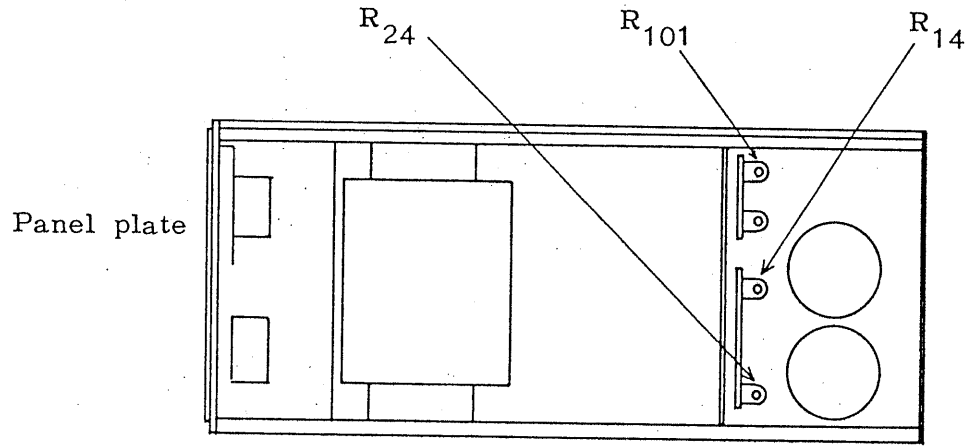
4.2 Adjustment of maximum output current

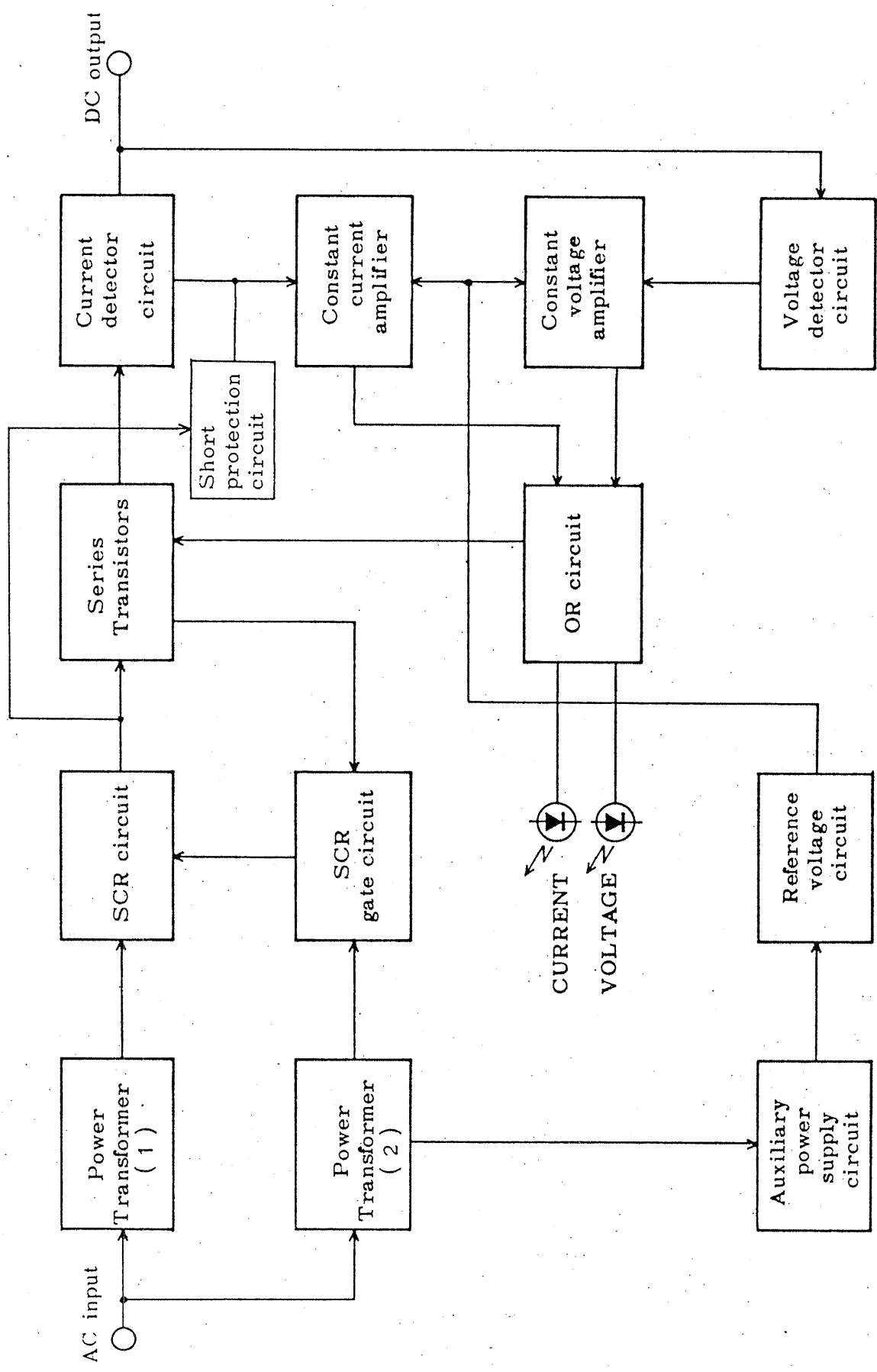
- 1) Turn VOLTAGE knob fully counterclockwise.
- 2) Turn CURRENT knob fully clockwise.
- 3) Connect an ammeter having an accuracy of over 0.5% to the output terminals, and slowly increase the voltage by turning VOLTAGE knob.
- 4) Turn semi-fixed resistor R14 on PCB A-001A until the output current becomes 0.62A.

4.3 Adjustment of voltage across the collector and the emitter of series transistors

- 1) Turn the CURRENT knob until the output current becomes 0.6A under 4.2 condition.
- 2) Adjust the semi-fixed resistor R101 on PCB A-004 until the voltage between the collector of the series transistors Q1 and the emitter of Q5 becomes 60V under this condition.







Block diagram

PAD 500 - 0.6
INPUT CURRENT - OUTPUT VOLTAGE
INPUT VOLTAGE AC 100 V 50 Hz
(OUTPUT CURRENT 0.6A, 0.4A, 0.2A, CONST.)

PAD 500 - 0.6

0.6A CONST.

0.4A CONST.

0.2A CONST.

8A

7A

6A

5A

4A

3A

2A

1A

INPUT CURRENT (ARMS)

100V

200V

300V

400V

500V

OUTPUT VOLTAGE (V)

