MODEL PAD 55-13

REGULATED DC POWER SUPPLY

OPERATION MANUAL

KIKUSUI ELECTRONICS CORP.

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 _____ .
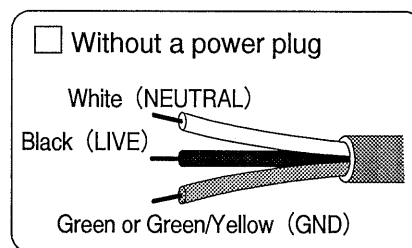
▬▬▬▬▬▬▬▬ WARNING ▬▬▬▬▬▬▬▬

· 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

Blue (NEUTRAL)
Brown (LIVE)
Green/Yellow (GND)

☐ Without a power plug

White (NEUTRAL)
Black (LIVE)
Green or Green/Yellow (GND)

☐ 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

CONTENTS

1. GENERAL DESCRIPTION

Kikusui Electronics' Model PAD 55-13 is an all-silicon-transistorized, highly reliable, variable regulated DC power supply which has excellent regulation, a low temperature coefficient and fast transient response. It is a universal type usable for either a digital or analog circuit. Since a pre-regulated 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 55V with a 5-turn vernier type variable resistor.

The maximum output current is 13A. Model PAD 55-13 can be used as a constant current power supply over a range of 0.3 to 13A.

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

Model PAD 55-13 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 lamps mounted on the front panel indicate the respective operation modes alternately (constant voltage or constant current).

Model PAD 55-13 is not only used in single operation but in series, parallel or one-control paralled operation by which the voltage or current can be expanded. Use of an external resistor also permits the output voltage to be remote-controlled.

2. SPECIFICATIONS

AC input		...100.. V AC ± 10%, 50/60 Hz
Full load		Approximately 1.5 kVA
Dimentions	Case	430W × 160H × 400D mm*
Maximum		431W × 175H × 490D mm
Weight		Approximately 28 kg
Ambient temperature		0 ~ 40°C

Accessories supplied

Short bar (long) 1

(Short) 2

Hexagonal wrench key 1

Fuse 15A 2

Operation manual 1

Output

Terminals   Color coded, aligned horizontally; 5
terminals on the rear panel (-sampling,
-, GND, +, +sampling; Obtainable from
the front and rear panels).

Polarity   Positive or negative

Floating voltage   ±250V maximum

Air-cooling system   By natural convection

CONSTANT VOLTAGE CHARACTERISTICS;

    Voltage   0 ~ 55V continuously variable with 5-turn variable resistor.

    Current   13A

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

    Voltage regulation (At sampling terminals)

        Line regulation 0.005% + 1mV against ±10% variation of line voltage

        Load regulation 0.005% + 2mV against 0 ~ 100% variation of output current

    Transient response (10~100%)   Typical value 100 µS

    Temperature coefficient   Typical value 100PPM/°C

CONSTANT CURRENT CHARACTERISTICS;

    Voltage   0 ~ 55V continuously variable with 5-turn variable resistor.

    Current   0.3 ~ 13A continuously variable

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

    Current regulation

        Line regulation 2mA against ±10% variation of line voltage

        Load regulation 4mA against 0 ~ 100% variation of output voltage

Operation   Series operation

                                   Parallel operation

                                   One-control parallel operation

                                   Output voltage remote control

Operation mode indication

          indication   Constant voltage ..... C.V

     by light emitton diode   Constant current ..... C.C

Internal temperature detector circuit

                                   When the internal temperature exceeds

                                   75°C, this built-in circuit automatically

                                   shuts off the output circuit.

Voltmeter   DC 60V accuracy ... 2.5% of full scale

Ammeter   DC 15A accuracy ... 2.5% of full scale

   * Two PAD 55-13 can be mounted side by side on a 19" or

     500 mm standard rack with rack mounting angle.

   * Overvoltage, overcurrent protector can be mounted.

3. OPERATION

3.1 Front Panel Description (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 (breaker) is used for automatically interrupting the power supply in case of failure.
2	Pilot lamp	Lights when the power is on.
3	Constant voltage indicating lamp	Lights when Model PAD 55-13 in the constant voltage mode.
4	Constant current indicating lamp	Lights when Model PAD 55-13 is in 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 60V. Accuracy is 2.5% of the full scale.

8	Ammeter	Indicates the output current. DC 15A. Accuracy is 2.5% of the full scale.
9	Output terminals	Spaced 19 mm equally and alinged in the following order; from the left, -SAMPLING (white), (white), GND (black), +(red). +SAMPLING (red).
10	Rear terminal plate (1)	Output terminals, sampling terminals, GND terminals are provided on it.
11	Rear terminal plate (2)	Remote control terminal and one-control paralled operation terminals are provided on it.
12	Power supply connector	Attached connector is inserted.
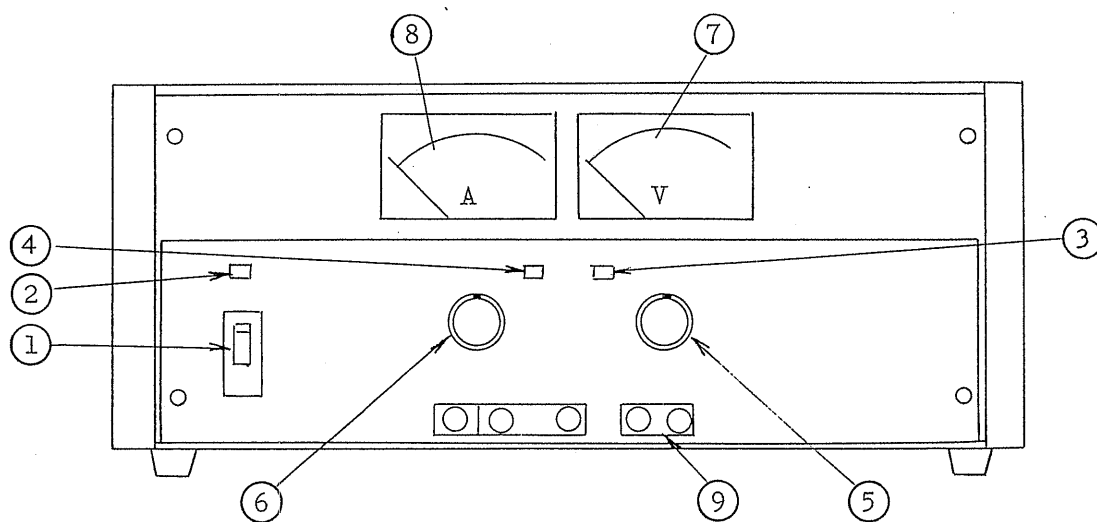
Fig. 3-1   Front Panel
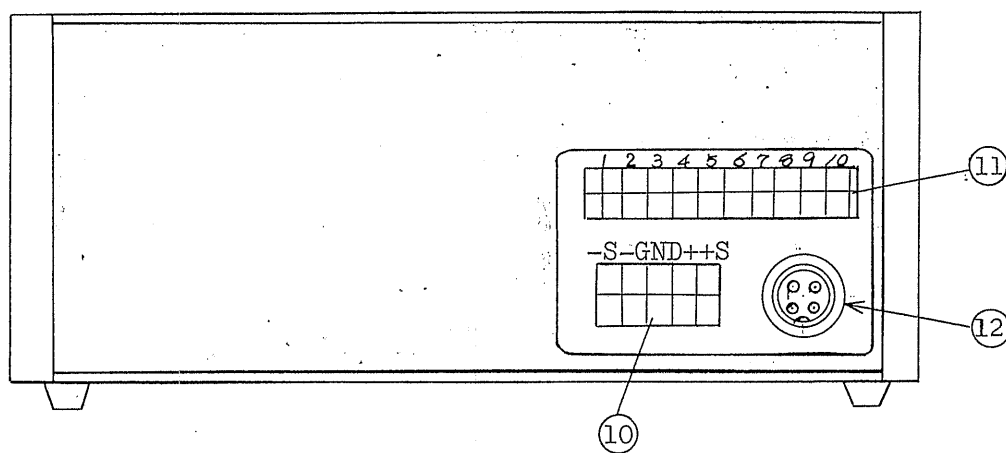
Fig. 3-2   Rear Panel

3.2   Precaution

AC input

AC input for Model PAD 55-13 should be within a range of

.... V AC ± 10%, 48 ~ 62 Hz.

Installation

Avoid using Model PAD 55-13 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 55-13 on its side nor put anything on it. Otherwise, a fault may be caused by reduction of its rediation effect.

Variable knob output voltage

The vernier type variable resistor for adjusting the output voltage of Model PAD 55-13 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 55-13 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. Disconnect the short bars from −SAMPLING, − and +, and

   +SAMPLING terminals on the front panel.

   Remove the jumpers between −S, − and +, and +S terminals

   on the rear terminal board (1).

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.

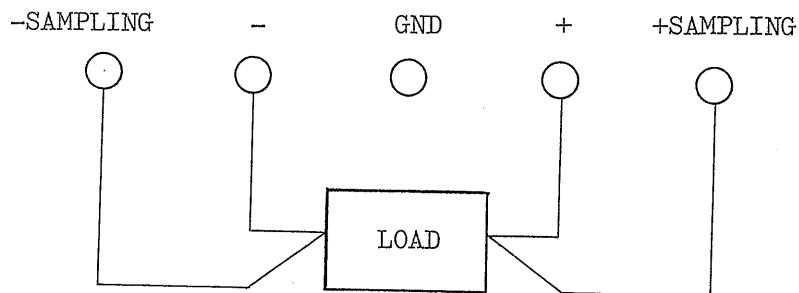   Match the polarity of the sampling terminals to that of the

   output terminals.

−SAMPLING   −   GND   +   +SAMPLING

LOAD

Fig. 3−3

Note 1. Deterioration of load regulation is calculated

by the following formula;

$Vd = Io \times R \ (m\Omega)$

where

$Io \ (A) =$ Load current, $R \ (m\Omega) =$ lead 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,

connecta electrolyc condenser with a capacitance

of a few μF's and a dielectric strength of 63V

to sampling terminals in the proper polarity.

Note 5. Sampling is impossible if voltage drop of the

lead connected to the load is 0.3V or more.

3.4 Constant-voltage, Current Characteristics

The working output characteristic of Model PAD 55-13, 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

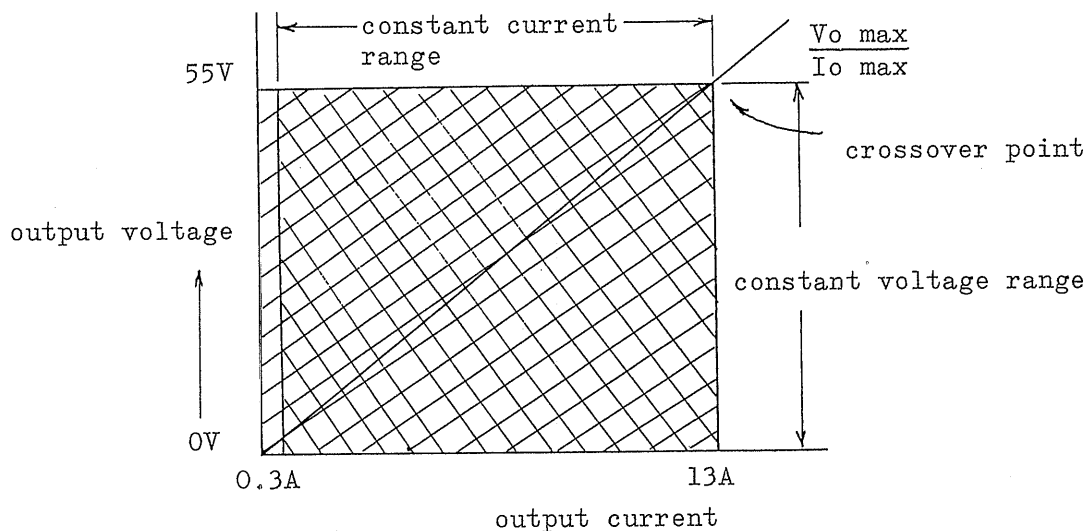the relationship between this point and the load.

Fig. 3-4

The operation modes of PAD 55-13 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 55-13

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 55-13 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 slighly
    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 55-13 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 lamp .... C.C
   Constant voltage mode lamp .... C.V

   Note 3. For use of the sampling terminals, see Note 3 in Chapter 3.4 "How to use sampling terminals".

3.7 Series Connection

A higher output voltage than 55V can be obtained by connecting two Model PAD 55-13 in series.

   Note 1. Be careful not to ground the positive terminal of one Model PAD 55-13 when grounding the negative terminal of the other in Fig. 3-5.

Note 2.   The voltage at each output terminal should not

exceed the floating voltage.

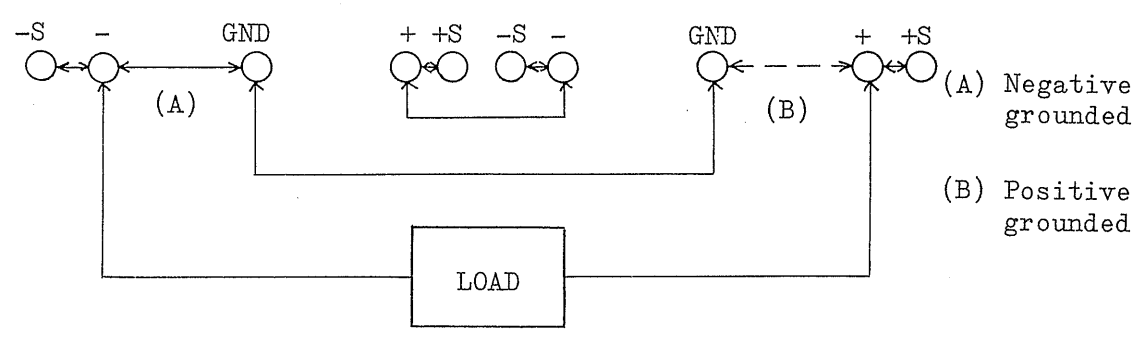Note 3.   Avoid the series connection with other model.
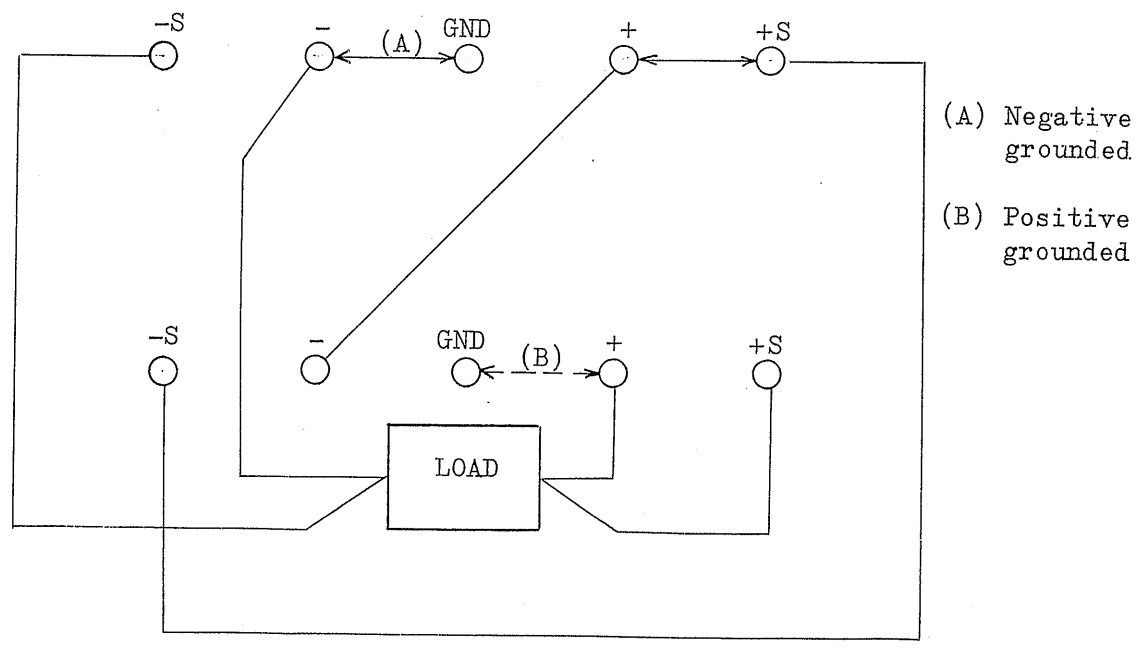

Fig. 3-5   Series connection diagram

Fig. 3-6   Sampling terminal connection diagram
in series connection

When two Model PAD 55-13 connected in series are overloaded,

one Model PAD 55-13, which has been changed over to the constant

current mode first, would be supplied with the output voltage of

the other inversely.

This would damage series transistors of the former.

To avoid this trouble, a diode is connected between the output

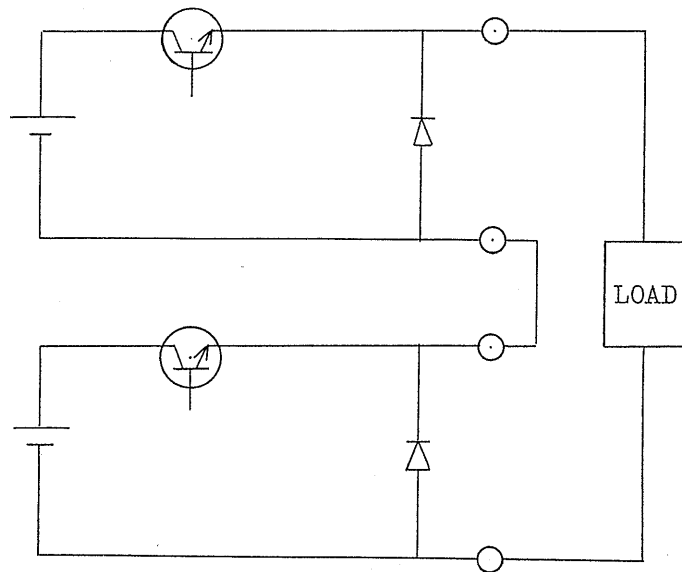terminals of each Model PAD 55-13, as shown in Fig. 3-7.

Fig. 3-7

3.8　Paralled Connection

When a larger current than 13A is required, connect the output

terminals of two Model PAD 55-13 in parallel.

1)　Set the output voltages of the two Model PAD 55-13 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 55-13 to

    the load so that their polarity matches.

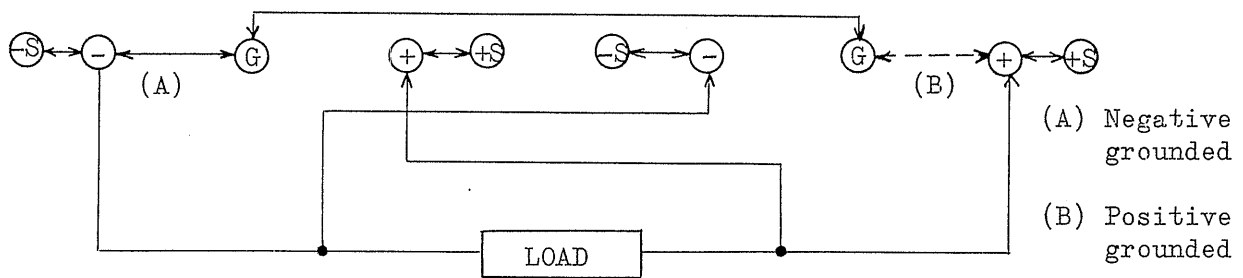   The grounding polarity of both should also match.

Fig. 3-8   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 55-13 with a higher output voltage

is overloaded. When one Model PAD 55-13 is changed over to the

constant current mode, the output voltage decreases until it reaches

the value preset by the other Model PAD 55-13, 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   V between the two units,
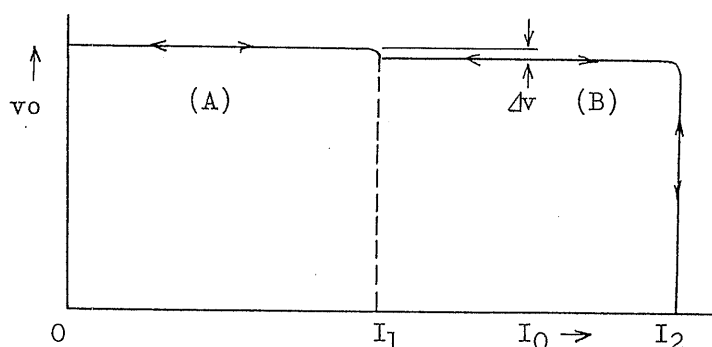
and ripple characteristics are reduced.

Fig. 3-9   Characteristics diagram

3.9   One-control Parallel Operation

When a larger current than 13A is required, one-control parallel
operation of two Model PAD 55-13 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 55-13
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. 3-10.

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

Note 1. Picking up the output on 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. 3-11)

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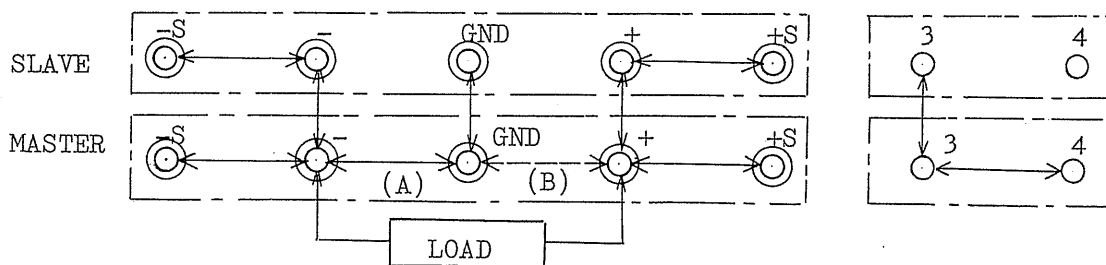   clockwise.

Fig. 3-10   One-control parallel operation master,
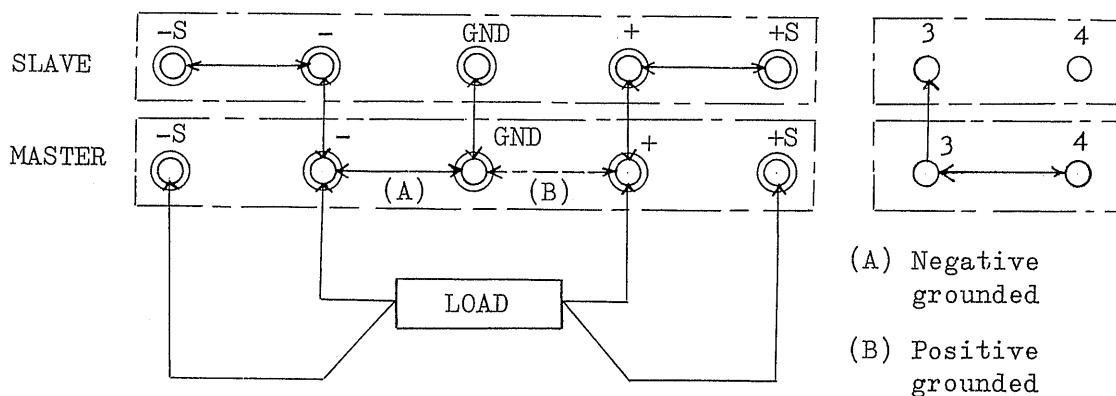   slave, load

(A) Negative
    grounded

(B) Positive
    grounded

Fig. 3-11   Using sampling terminal in
            one-control parallel operation

3.10 Remote Control

To vary output voltage by remote control, improve efficiency
in varying output voltage and obtain the preset output voltages
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 ①
    and ② on the rear panel.

2) Provide a suitable variable element between ① 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 characteristic 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
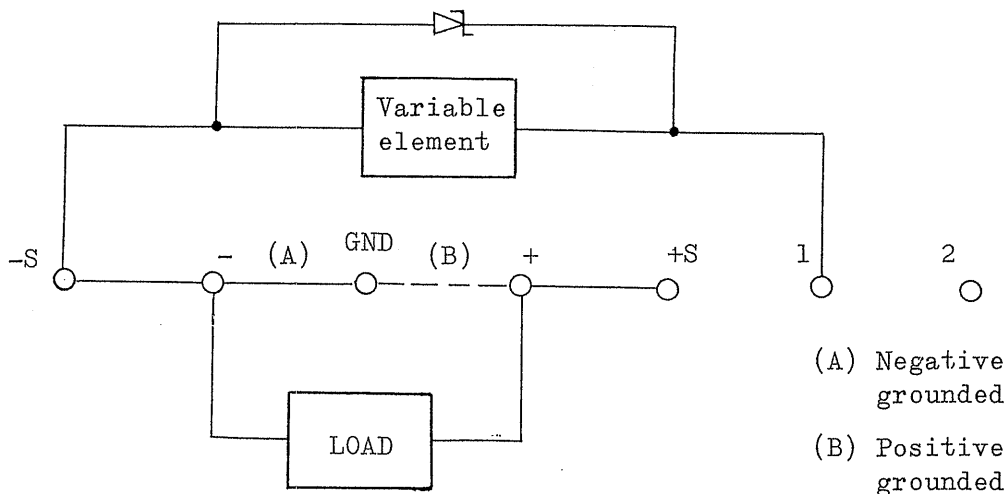   power switched off.

Fig. 3-12

3.10-1 To vary output voltage by remote control.

Output voltage varies at a rate of approximately 0.55V/k ohms

with reference to the resistance of the resistor connected.

Therefore,

output voltage $V_o(V)$ = Voltage variation rate 0.55V/k ohms

$\times R_r$ 「k ohms」

where voltage variation rate indicates voltage change for

each 1 k ohms, and R_r the resistance 「k ohms」 for remote

control.

If no suitable resistor is available and output V_o 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. 3-12)

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 55-13 can operate steadily if the external lines

connected are limited to approximately 2 m.

If longer lines are used, output voltage may become

unstable.

3.10-2 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.

$$Rres = \frac{Vres}{\text{Voltage variation rate 0.55V/k ohms}} \quad \ulcorner k \text{ ohms} \lrcorner$$

3.11 Internal Temperature Detector Circuit

When the internal temperature exceeds 75°C, 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 instru-

ment, 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

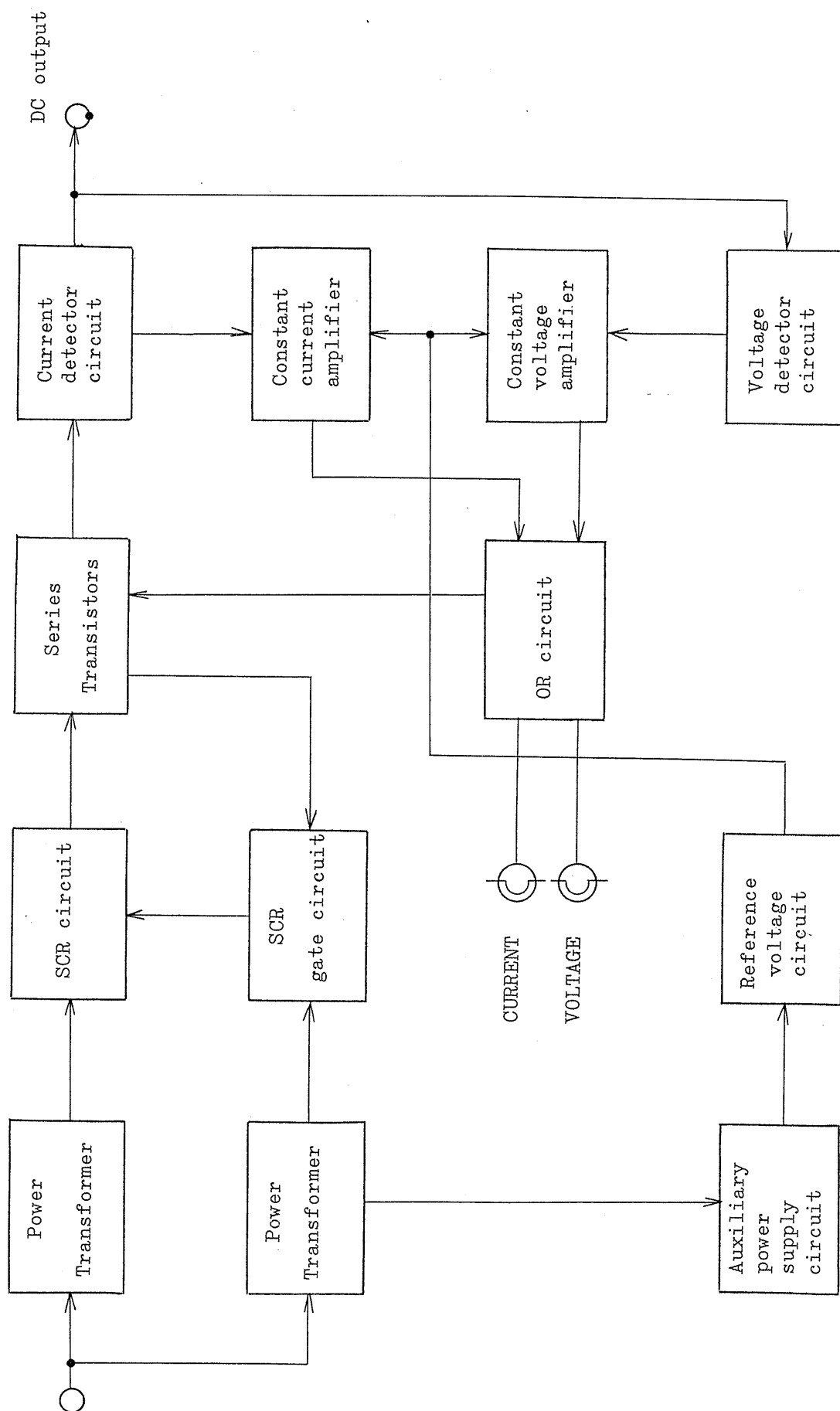be obtained as specified while the circuits operate normally.

Fig. 4-1 Block diagram

PAD 55-13   INPUT CURRENT – OUTPUT VOLTAGE

INPUT VOLTAGE AC 100V 50Hz

OUTPUT CURRENT 13A CONST.

INPUT CURRENT (RMS.) AC 100V

OUTPUT VOLTAGE

20A

15A

5V 10V 15V 20V 25V 30V 35V 40V 45V 50V 55V