

MODEL PAD55-60
REGULATED DC POWER SUPPLY
OPERATION MANUAL

KIKUSUI ELECTRONICS CORPORATION

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.



TABLE OF CONTENTS

	<u>PAGE</u>
1. INTRODUCTION	1
2. SPECIFICATIONS	2
3. OPERATION	4
3.1 EXPLANATION OF FRONT AND REAR PANELS	4
3.2 PRECAUTIONS	7
3.3 USE OF SAMPLING TERMINALS	8
3.4 CONSTANT-VOLTAGE AND CONSTANT-CURRENT CHARACTERISTICS ...	9
3.5 TRANSIENT RESPONSE	10
3.6 OPERATION	10
3.7 SERIES OPERATION	11
3.8 PARALLEL OPERATION	12
3.9 OVERHEAT PROTECTIVE CIRCUIT	13
3.10 SERIES TRANSISTOR	13
3.11 VIBRATION	13
4. MAINTENANCE	14

1. INTRODUCTION

The Kikusui Mode PAD55-60 Regulated DC Power Supply is featured with an excellent regulation, a low temperature coefficient, and a fast response. Silicon transistors are employed through the circuits of the PAD55-60. It is a universal-type power supply which can be used for analog and digital circuits.

The PAD55-60 employs a pre-regulation circuit (with SCR) and a forced air cooling system. As a result, its casing dimensions and weight have been substantially reduced making the PAD55-60 much smaller and lighter as compared with a conventional power supply of equivalent performances.

The output voltage is finely and smoothly variable for a range of 0 ~ 55 V with a 5-turn variable resistor. The maximum rating of the output current is 60 A. A range of 2 A ~ 60 A is used for the constant-current power supply. A new, unique circuit is employed for improvement of current load regulation.

The PAD55-60 incorporates an automatic circuit for transfer between constant-voltage mode and constant-current mode in response to the load. Lamps to indicate the operating modes are mounted on the front panel of the power supply.

The PAD55-60 also includes an automatic output cut off circuit to guard against overheating. When the temperature inside the power supply (especially that of heat generating components) has exceeded a preset limit, the output is automatically disconnected and an alarm lamp lights on the front panel of the power supply. The output is automatically re-connected when the temperature has become lower than the preset limit.

2. SPECIFICATIONS

AC input:	---V AC $\pm 10\%$, 50/60 Hz 1 ϕ Full load approx. 7 kVA
Dimensions:	556 W x 665 H x 490 D (mm)
(Maximum)	560 W x 735 H x 595 D (mm)
Weight:	Approx. 100 kg
Ambient temperature:	0 ~ 40°C
Accessories:	Hexagonal wrench 1 Fuses, 60 A 2 Operation manual 1 1
Output terminals:	Rear output terminals
Polarity:	Positive or negative
Voltage against ground:	± 250 V max.
Constant-voltage Characteristics:	
Voltage:	0 ~ 55 V, continuously variable with 5-turn variable resistor
Current:	60 A max.
Ripple noise:	1 mV rms (5 Hz ~ 1 MHz)
Voltage regulation:	Line voltage variation (1) ... 0.005% +1 mV Load variation (2) 0.005% +2 mV
Temperature coefficient:	100 ppm/°C (typical value)
Constant-current Characteristics:	
Voltage:	0 ~ 55 V, continuously variable
Current:	2 ~ 60 A, continuously variable
Ripple noise:	3 mA rms (5 Hz ~ 1 MHz)
Current regulation:	Line voltage variation (1) ... 3 mA Load variation (2) 5 mA

Operation: Series connection
Parallel connection

Mode indication: indication by light emitton diode
Constant-voltage mode ... Blue
Constant-current mode ... Yellow

Overheat alarm: With red alarm lamp
(Automatic restore type)

Voltmeter: 60 V (accuracy 2.5% of full scale)

Ammeter: 70 A (accuracy 2.5% of full scale)

Cooling system: Forced air

Equipment movement: Housing has casters (with stopper bolts)
for easy movement.

Notes: (1) For $\pm 10\%$ line voltage variation.

(2) For 0 ~ 100% load variation.

3. OPERATION

3.1 EXPLANATION OF FRONT AND REAR PANELS

(See Figs. 3-1 and 3-2.)

- (1) Power Switch: For on-off operation of the AC input. Actually, an electromagnetic switch (breaker) which automatically cuts out the power in case of equipment failure is employed.
- (2) Pilot Lamp: Lamp which lights when the AC input is on.
- (3) Constant-voltage Lamp: Blue lamp which indicates that the equipment is operating in the constant-voltage mode.
- (4) Constant-current Lamp: Yellow lamp which indicates that the equipment is operating in the constant-current mode.
- (5) Voltage Setting Knob: For setting of output voltage. The voltage increases as the knob is turned clockwise.
- (6) Current Setting Knob: For setting of output current. The current increases as the knob is turned clockwise.
- (7) Voltmeter: Indicates output voltage. 60 V DC
- (8) Ammeter: Indicates output current. 70 A DC
- (9) Output Terminals: Feed the output of the equipment. The terminals, from left to right, are minus sampling (white), minus (bolt), ground (bolt), plus (bolt), and plus sampling (white).

- (10) AC Power Cord: AC power input cord. Approx. 4 meters long.
- (11) Casters and Stoppers: To move and fix the equipment. The stoppers are 10-mm dia. bolts.
- (12) Air Exit: Vent of forced cooling air. The vent air flow must not be hampered.
- (13) Air Inlet: Entrance of forced cooling air. A dust screen is provided at the inlet.
- (14) Alarm Lamp: Red alarm lamp which lights when the temperature sensing circuit has detected an overheating and the output has been cut out.

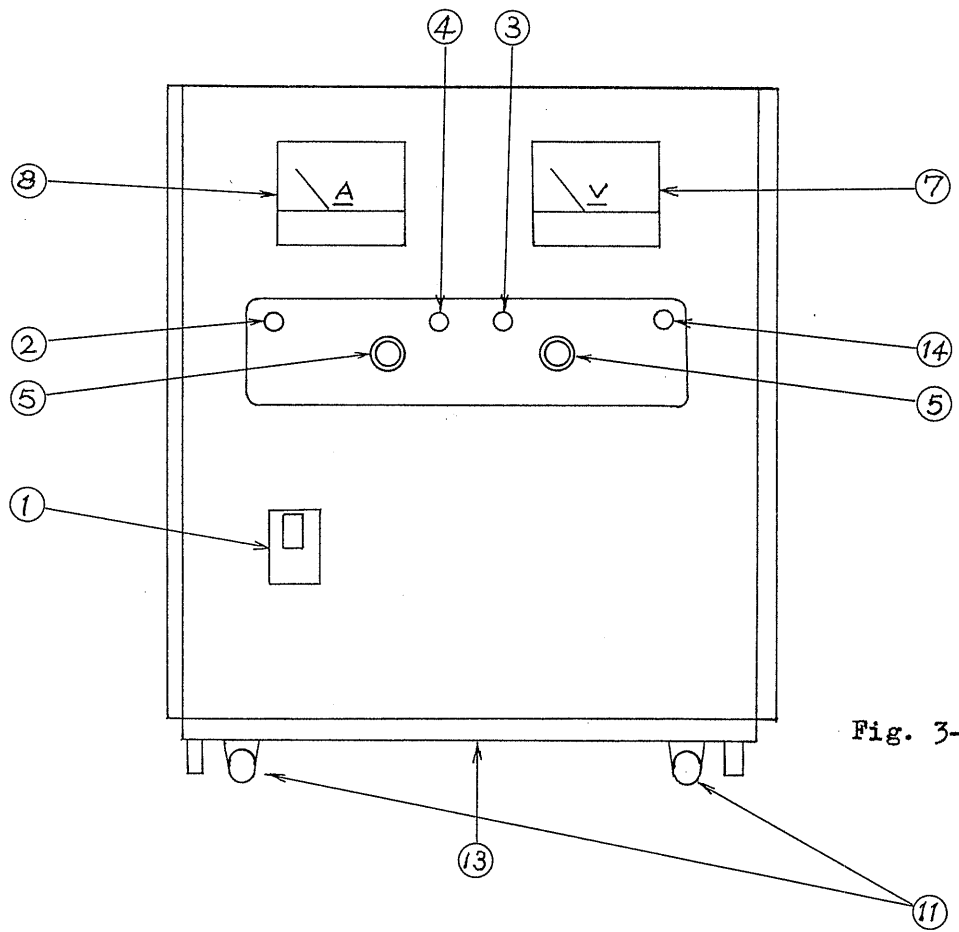


Fig. 3-1

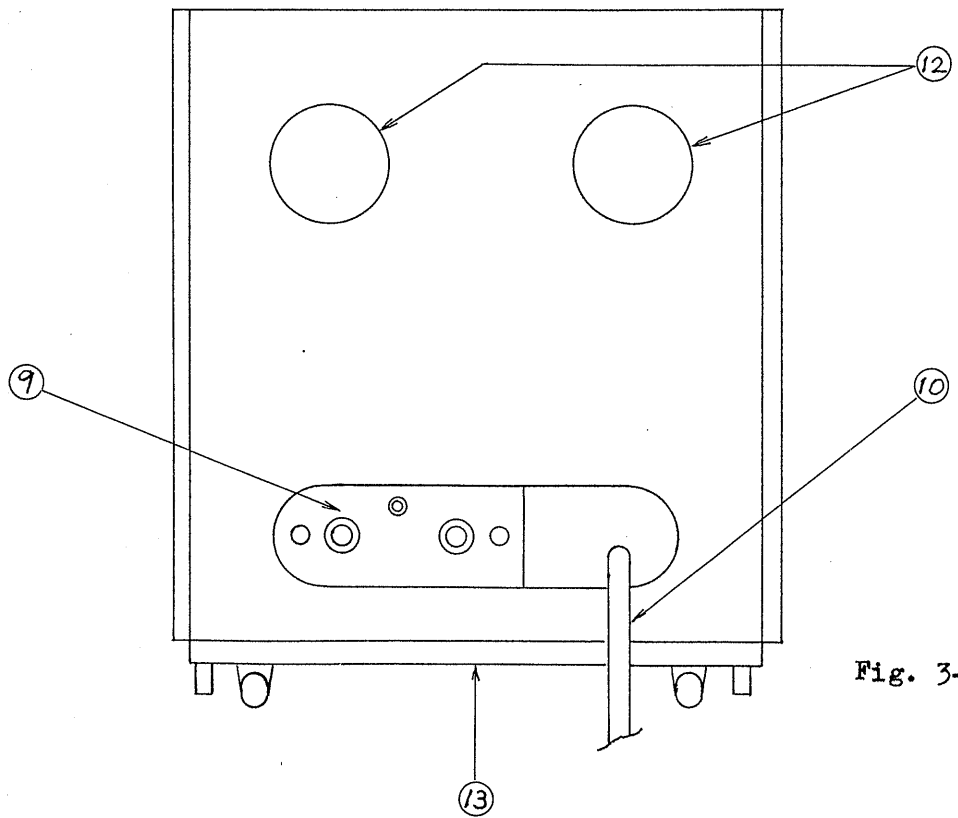


Fig. 3-2

3.2 PRECAUTIONS

In using the PAD55-60, the below-mentioned precautions must be strictly observed.

(1) AC Power Input

The AC source must be of a voltage of $\pm 10\%$ AC, 48 ~ 62 Hz, and must be a sufficiently heavy duty line.

(2) Installation

The equipment must not be used under the following conditions:

- (a) The equipment is subjected to radiant heat from heat generating device.
- (b) Ambient temperature is not within $0 \sim 40^{\circ}\text{C}$.
- (c) Highly humid and dusty atmosphere.
- (d) Un-even (un-level) floor.

(3) Output Voltage Control Resistor

This resistor is a vernier-type endless resistor. When its control knob is turned more than 5 revolutions, the turning will become slightly heavy. This is the end point of the electrical variable range.

(4) Overshoot

The output voltage of this equipment never, including on-off operation of the AC input power, exceeds the preset voltage.

3.3 USE OF SAMPLING TERMINALS

When the load is located apart from this equipment and long lead wires are used, load variation may be caused due to the voltage drop in the lead wires. The sampling terminals are used to compensate for such load variation. For the connections, refer to Fig. 3-3.

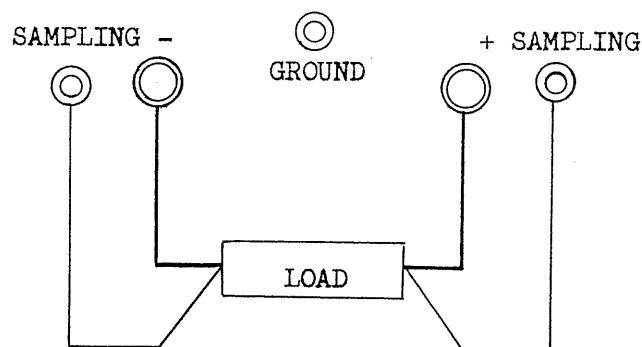


Fig. 3-3

To make use of the sampling terminals, proceed as follows: Turn off the power switch, and remove the short bars between minus terminal and sampling terminal and between plus terminal and sampling terminal. Connect the plus and minus terminals to the load, using wires of a large current capacity; connect the sampling terminals to the load at points near the load terminals (at points where the regulation is to be effected). (For the latter connection, wires of a smaller current capacity may be used.)

Note: The polarities of the sampling terminals must always conform with those of the output terminals.

The use of shield wires as for the sampling wires is advantageous, since they prevent external induction noise and improve the ripple factor. In this case their shielding conductors must be connected to the GROUND terminal.

Note that the set value of the constant-current can be affected by the resistance of the lead wires used to feed the current to the load.

When the sampling wires are long, oscillation is apt to be produced. In such a case, to suppress oscillation, connect a capacitor of several microfarads and of a working voltage of 80V or over, at the sampling point in the same polarity with the load current.

Note that the sampling function becomes ineffective when the voltage drop in the lead wires feeding the load current has become more than 0.3V.

3.4 CONSTANT-VOLTAGE AND CONSTANT-CURRENT CHARACTERISTICS

The output operation characteristics of this equipment is of an automatic constant-voltage/constant-current crossover type which is capable of continuous variation from the constant-current operation range to the constant-voltage operation range even when the load is varied from zero to infinity.

The intersecting point between the constant-voltage operation range and the constant current operation range is called "crossover point." The relationship between the crossover point and the load is shown in Fig. 3-4.

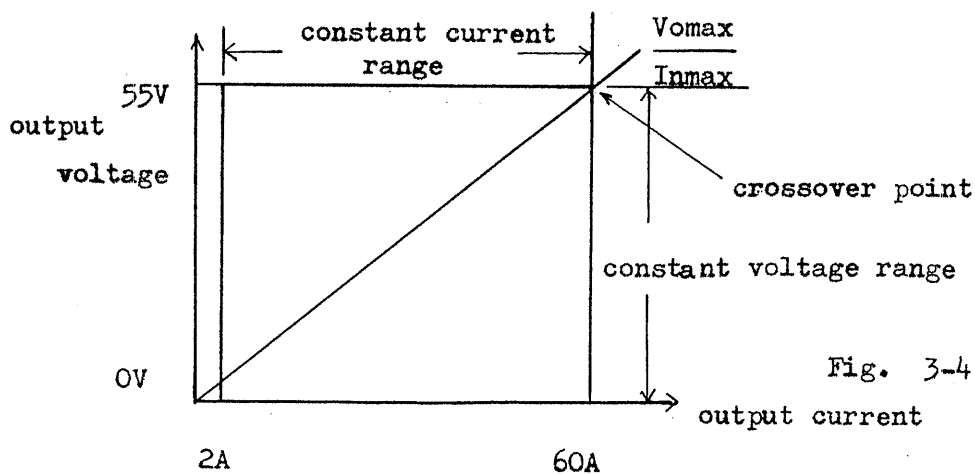


Fig. 3-4

3.5 TRANSIENT RESPONSE

The PAD55-60 has a sufficiently fast response to handle fast-changing transients. It can be used as a power supply for a digital circuit, of which load may rapidly change causing transient variations. This can be said, however, for the characteristics at the output terminals of the power supply. When the load is located at a distance from the power supply and long power feed wires are used, the inductance of the wires will degrade the characteristics. In such a case, connect a capacitor between the wires to cancel out the inductance. When a high response is required, flow a current of 10% load in addition to the switching current.

3.6 OPERATION

CONSTANT-VOLTAGE OPERATION

- (1) Connect the power cord and turn on the power switch. When this is done, the power pilot lamp lights, the cooling fan starts turning, and the blue lamp lights indicating that the equipment is operating in the constant-voltage mode.
- (2) Turn the CURRENT knob to the fully clockwise position. Turn the VOLTAGE knob so that the desired output voltage is obtained. (The output voltage increases as the VOLTAGE knob is turned clockwise.)
- (3) Turn off the power switch. Connect the load. Then, turn on the power switch again.
- (4) When the load current is required to be limited at a certain value, short between output terminals and turn the CURRENT knob to obtain the required value prior to connecting the load.

CONSTANT-CURRENT OPERATION

- (1) The same with Item (1) of CONSTANT-VOLTAGE OPERATION.
- (2) Turn the VOLTAGE knob fully counterclockwise to a position where rotation becomes slightly heavy (where the output voltage is made minimum).
- (3) Short the output terminals and turn the CURRENT knob so that the required current value is obtained. When this is done, the yellow lamp lights to indicate that the operation is in the constant-current mode. (The current increases as the CURRENT knob is turned clockwise.)
- (4) The same with Item (3) of CONSTANT-VOLTAGE OPERATION.
- (5) Since this equipment is an automatic constant-voltage/constant-current crossover type, the operation mode is automatically transferred from the constant-current mode to the constant-voltage mode when the load current is increased. Therefore, when the voltage to be applied to the load in such a case is required to be limited at a certain required value, preset the output voltage at the required value in the procedure of Item (2) above.

3.7 SERIES OPERATION

When a voltage higher than the rated output voltage of a single PAD55-60 unit is required, a plural number of units may be operated in series. In this application, connect together the ground terminals of the units and connect this common ground to one of the output terminals. Note that the voltage between the output terminal of the highest voltage and the housings of the units must not exceed the rated withstand voltage with respect to the ground (housings).

When overloading is caused in the above application, one of the series units will be transferred into the constant-current before the other unit(s) is still remaining in the constant-voltage mode. When this has happened, the output voltage of the latter unit will be applied in the reverse polarity to the output circuit of the former unit, and the series transistor of the former unit could be damaged. In order to prevent this, a diode is connected between the output terminals.

3.8 PARALLEL OPERATION

When a current larger than can be supplied by a single PAD55-60 unit is required, a plural number of units may be operated in parallel. For a parallel operation, proceed as follows:

- (1) Set the output voltages as close to the required voltage as practicable. (Difference of set voltages of units directly affects the load variation.)
- (2) Turn the CURRENT knob to the fully clockwise position.
- (3) Connect the output terminals of the units in parallel, correctly observing their polarities. Feed the connected outputs to the load. The polarities of connections of the GROUND terminals also must be the same.

Voltage/Current Characteristics in Parallel Operation

Of the parallel-connected units, the current primarily is drawn from the unit of the highest output voltage. The other unit(s) is biased in the reverse polarity by the amount of the voltage difference and delivers no current. When the operation of the former unit is driven into the constant-current operation range, the other unit also is brought into operation and starts delivering its output current to the load so that the required constant-current is maintained.

Although the current increases as above, the load variation cannot be reduced below the difference of set voltages of parallel units and other performance characteristics, such as the ripple factor, also are degraded.

3.9 OVERHEAT PROTECTIVE CIRCUIT

The overheat protective circuit detects the internal temperature of the equipment and, when the temperature has exceeded a certain safe level, the protective circuit automatically cut out the output and the overheat alarm lamp (red) lights on the front panel of the equipment. When the equipment is operated in an ambient temperature of higher than 40°C or when the forced cooling air flow is hampered, the equipment may not be cable to supply the maximum rated current. When the equipment temperature (especially of the heat generating components) is lowered, the output is automatically restored. When the overheat protective circuit has been tripped and the output has been cut out, disconnect the load to cool off the equipment and clean the dust filter.

3.10 SERIES TRANSISTOR

A specially-selected 2SD113 is used as the series transistor of this equipment. To replace this transistor, not a common-grade transistor but a specially-selected transistor must be used.

3.11 VIBRATION

When the equipment output is shorted, the equipment will produce a larger vibration and noise than in its normal operation. This, however, does not adversely affect the performance or construction of the equipment.

4. MAINTENANCE

The equipment has a dust filter located at the bottom of its casing, to clean the intake air for forced cooling. When the filter is clogged, the cooling effect will be impaired and the maximum rated will not be able to be obtained. Clean the filter periodically.

Fig. 3-4

1. Output voltage
2. Constant-current operation range
3. V_o max.
4. I_o max.
5. Crossover point
6. Constant-voltage operation range
7. Output current

5. BLOCK DIAGRAM

1. AC input
2. Power transformer (1)
3. Power transformer (2)
4. SCR circuit
5. SCR gate
6. Series transistor
7. Current detecting circuit
8. DC output
9. Constant-current amplifier
10. OR circuit
11. Constant-voltage amplifier
12. Voltage detecting circuit
13. Reference voltage circuit
14. Auxiliary power supply

