INSTRUCTION MANUAL

ELECTRONIC LOAD

MODEL PLZ50-50A

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.

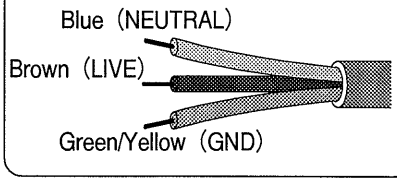
☐ AC power cable

The product is 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.

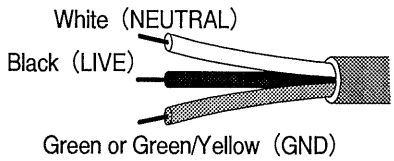
WARNING

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

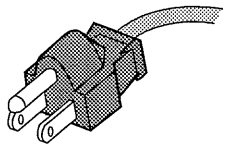
☐ Without a power plug



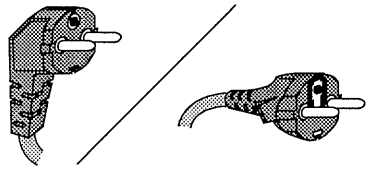
☐ Without a power plug



☐ 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

Kikusui's Model PLZ50-50A Electronic Load is a completely electronic device which can be used as a load for an electronic power circuit, electric generator, storage battery, or other power source equipment. As well as a resistive load, the Electronic Load can be used as a constant-current load. It can also be used to draw a constant current from a non-regulated power source.

When used as a constant-current load, the Electronic Load can be used being remote-controlled with an external signal source. This feature is useful especially when the Electronic Load is used as a load device for system measurement.

The Electronic Load is incorporated with various protective circuits to protect both Load itself and the power source. It employs a forced-air cooling system with a fan, for safer operation with minimum overheating.

2. SPECIFICATIONS

AC line power requirements:	120 V ±10%, 50/60-Hz single-phase AC, approx. 380 VA
Dimensions:	430 W × 160 H × 400 D mm (16.93 W × 6.30 H × 15.75 D in.)
(Maximum dimensions):	435 W × 170 H × 485 D mm (17.13 W × 6.69 H × 19.09 D in.)
Weight:	Approx. 28 kg (62 lbs)
Ambient temperature:	0 to 40°C (32 to 104°F)
Accessory:	Instruction manual (1 copy)
Load terminals:	On front panel and rear panel. M6 bolts
Grounding:	Positive or negative grounded. (on rear panel)
Cooling:	Forced air cooling with fan
Loading voltage:	0 - 50 V
Load current:	0 - 50 A
Loading power:	300 watts
Operation modes:	(1) Constant-current mode 2 ranges, continuously variable (a) 0 - 50 A (b) 0 - 5.0 A (2) Constant-resistance mode 3 ranges, continuously variable. (See Figure 9.) (a) 0.1 Ω minimum (b) 1 Ω minimum (c) 8 Ω minimum

(3) External control mode (constant-current mode)

Input: 0 - 5.5 V
(See Figures 12 and 14.)

Of all (1) - (3), coarse adjustment and fine adjustment are possible.

Stability:

Source effect

50 mA (constant current mode) for ±10% change of AC line voltage.

Load effect

50 mA (constant current mode) for 0 - 100% change of loading voltage.

Ripple noise (5 Hz - 1 MHz):

10 mA (rms) when in constant current mode

5 mA (rms) typical when in constant resistance mode.

Protection circuits:

(1) Overvoltage protection, approx. 60 V

(2) Overcurrent protection, approx. 55 A

(3) Overpower protection, approx. 350 W (See Figure 18.)

(4) Reverse connection protection, approx. 0.6 V

(5) Internal overheat protection

For protection of (1) - (5), internal circuit breaker trips.

Operation modes:

(1) Single-unit operation

(2) One-control parallel operation

(3) Remote control (constant current mode)

Voltmeter: 60V/6V DC, 2 ranges, Class 2.5 (±2.5% of F.S)

Ammeter: 60A/6A DC, 2 ranges, Class 2.5 (±2.5% of F.S)

3. DESCRIPTION OF PANEL ITEMS

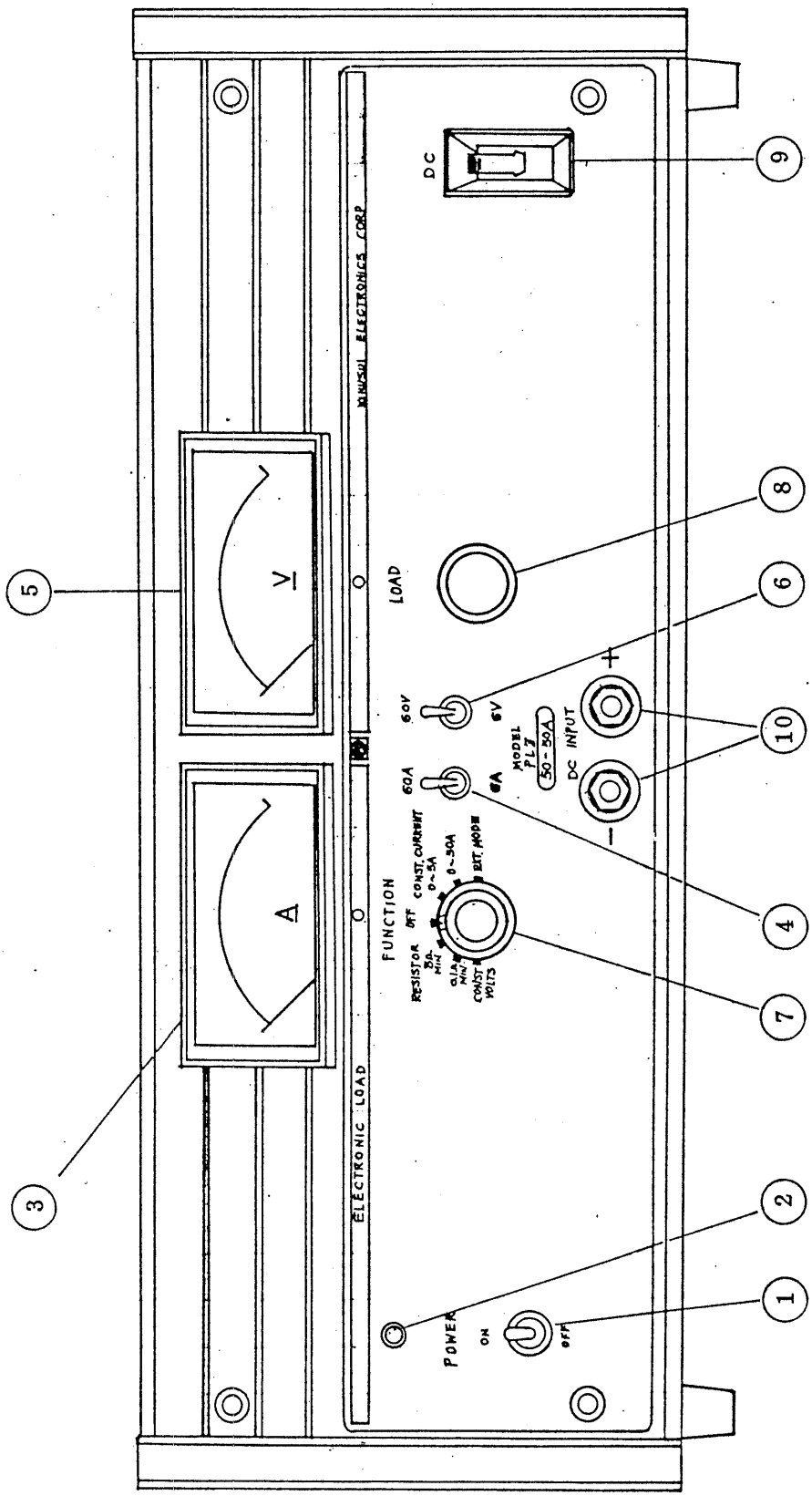


Figure 1. Front panel

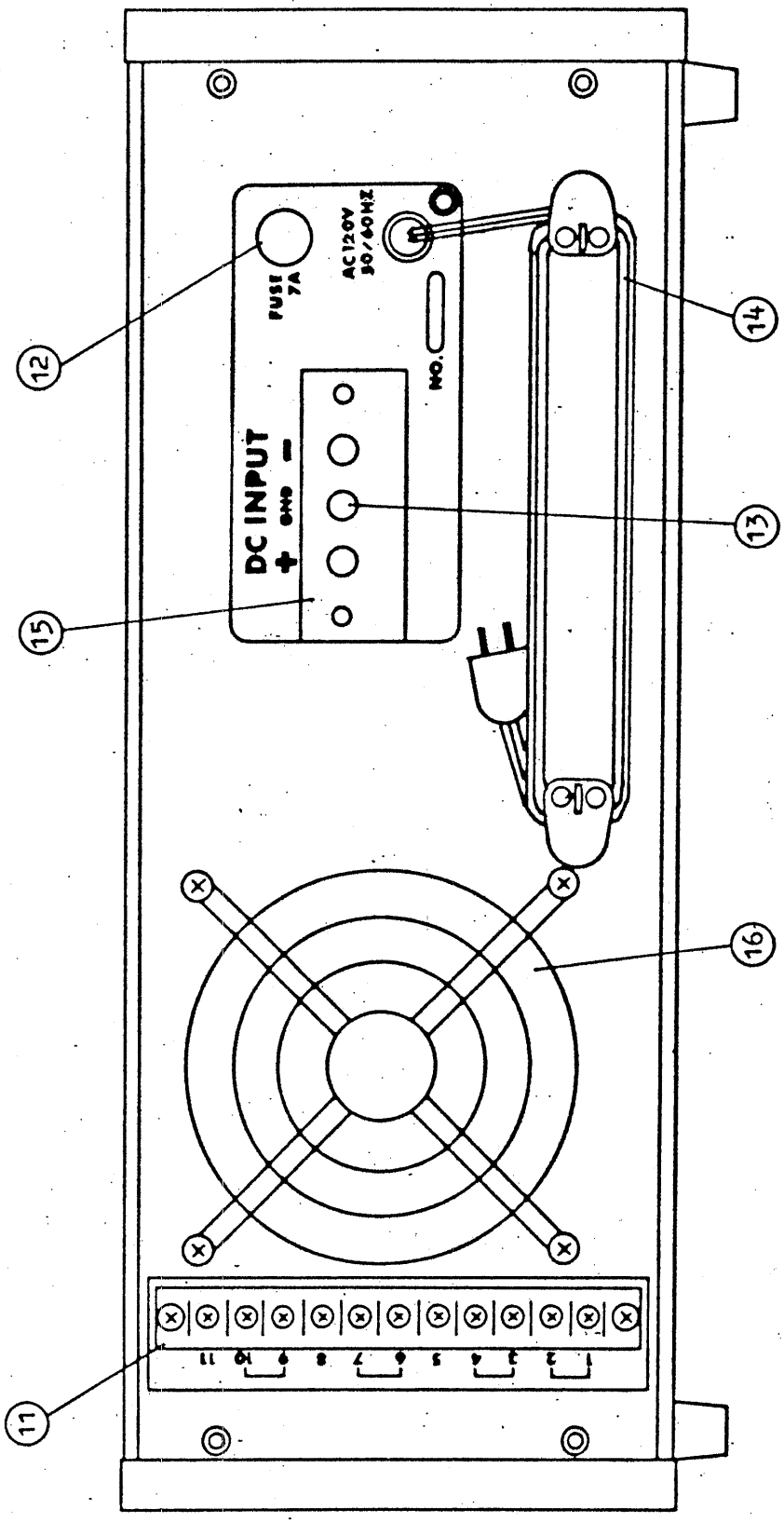


Figure 2. Rear panel

① Power switch:

For ON/OFF-control of AC input power. Upper position is for ON.

② Pilot lamp:

AC power pilot lamp (red LED). Turns on when power is ON.

③ Ammeter:

Indicates the DC load current. 60 A full scale.

④ Ammeter range selector switch:

Selects ammeter range between 60 A and 6 A. The upper position is for 60 A full scale and the lower position for 6 A full scale.

Precautions: Note that if the switch is thrown inadvertently to the 6 A position while it is set in the 60 A position for measurement of a current near the full scale, the meter pointer will deflect over the full scale and the meter accuracy may be adversely affected.

⑤ Voltmeter:

Indicates the DC loading voltage. 60 V full scale.

⑥ Voltmeter range selector switch:

Selects the voltmeter range between 60 V full scale (upper position) and 6 V full scale (lower position). Voltage setting of the overvoltage protection circuit automatically changes in conformity with setting of this switch.

⑦ Function selector switch:

Selects the operation mode of the Electronic Load.

⑧ Load adjustment knobs:

To adjust the current, resistance, and voltage for each operation mode. The outer knob is for coarse adjustment and the inner knob for fine adjustment. As the knobs are turned counterclockwise, the current increases and the resistance decreases.

⑨ Load switch:

A circuit breaker for ON/OFF-control of the DC input. The breaker automatically trips when the overvoltage, overpower, reverse-polarity or overheat protection circuit has operated.

⑩ Load terminals:

Bolt-type (M6) terminals for DC input. The left-hand one (white) is for negative line and the right-hand one (red) for positive line.

⑪ Terminal board:

Terminals for input, parallel operation, remote control and external control are mounted on the rear panel. (See Figure 3.)

⑫ Fuse:

Fuse (3 A) in the primary line of the AC input power line.

⑬ GND terminal:

Ground terminal connected to the chassis. Use this terminal as required.

⑭ Input power cord:

AC power input cord with plug. Connect this cord to an AC line outlet of the specified voltage. Cord hooks are provided to take up the cord when carrying the device.

⑮ Load terminals:

Terminals identical with those of the front panel are provided on the rear panel also, for DC input.

⑯ Cooling fan:

Fan to cool the device by carrying away the heat dissipated in it. Do not impede air ventilation by placing any object near the fan.

Description of Items on Rear Panel

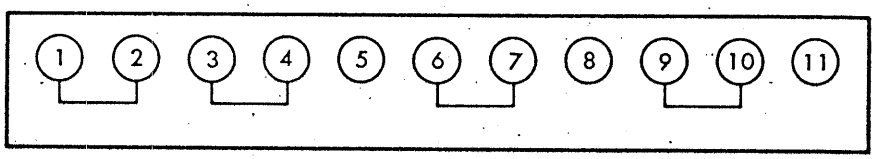


Figure 3. Terminal board on rear panel

①

② Input, voltmeter, "+" line

③ Input, voltmeter, "-" line

④

⑤ External control signal input terminal

⑥, ⑦ Terminals for remote control, one-control parallel operation

⑧ One-control parallel operation

⑨, ⑩, ⑪ Terminals for remote control

Note: Terminals between ① - ②, ③ - ④, ⑥ - ⑦. ⑨ - ⑩ are electrically shorted with shorting chips. When operating the device, make it sure that these shorting chips are securely tightened.

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4. OPERATION METHOD

4.1 General Precautions

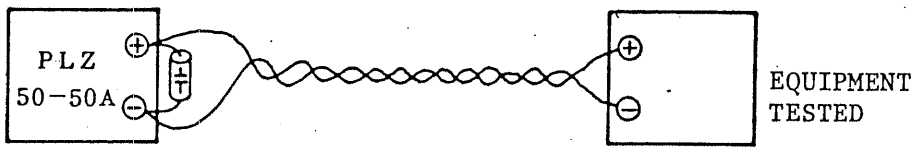
The PLZ50-50A Electronic Load is a particular type of electronic load device which is incorporated with an internal drive power source so that the device can be operated with an loading voltage of higher than zero volts. (Keep the loading voltage higher than zero volts.) The load switch may trip in any of the following case:

(a) No signal (power) is connected to the load terminals.

(b) No load current flows although a power source or other signal is connected to the input terminals. (For example, when no current flows as the current control knob of the power source is set in the minimum position.)

(c) The voltage at the load terminals is lower than approximately -6.0 V due to low source voltage and large voltage drop in lead wires.

For the lead wires, use wires as large as possible (cross section area 14 mm^2 or over) and as short as possible (not longer than 2 meters). Strand the two lead wires securely. Do not connect a capacitor directly across the load terminals of the device, lest the capacitor should cause oscillation. (See Figure 4.)



(Make distance short and strand lead wires.)

(Do not connect capacitor.)

Figure 4

(1) Input powers:

The AC input power for the device is 120 V ±10%, 48 - 62 Hz. Warm up time is 5 - 10 minutes.

The DC input power to the device must not exceed 300 watts.

(2) Conditions of use:

Never use the device in any of the following conditions:

- o Place where the device is subjected to direct radiation from a source of heat.
- o Place where ambient temperature is not within 0 to 40°C.
- o Place where atmosphere is dusty or damp.
- o Place where the floor is not level.

Do not operate the device being laid on its side or with other object put on the device, lest air ventilation should be impeded and troubles should be caused by overheating.

When two or more devices are used being stacked up or mounted on a rack, pay attention to ventilation and provide 50 mm or more of spacing between the top and the bottom of two mutually adjoining units.

When connecting a DC source to the device, be sure to turn on the power switch after securely connecting the power source.

4.2 Function Switch

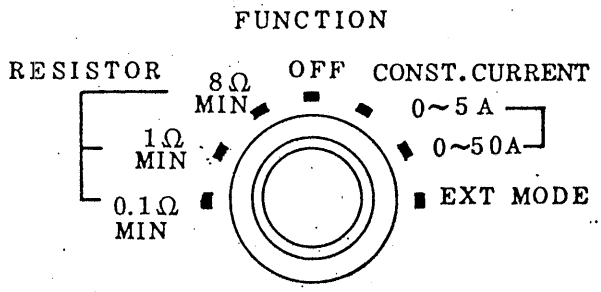


Figure 5. FUNCTION switch

The function switch is for selecting the required operation mode of the device, as shown in Figure 5. Details of the operation modes are explained at a later part of this instruction manual.

Note: Be sure to set the load switch (9) to the OFF state before turning the FUNCTION switch.

4.3 Constant-current Operation

4.3.1 To Use the Device as a Constant-current Load

To use the device for constant-current discharge test of a storage battery equipment or for load test of a power supply equipment, proceed as follows:

(1) Set the FUNCTION switch to the CONSTANT CURRENT 0 - 5 A or 0 - 50 A position.

(2) Set the LOAD switch in the OFF state. Connect the tested equipment. (When connecting the equipment, make sure that the lead wires are connected in the correct polarity.) As the voltmeter will deflect when this is done, set the range at an appropriate value if the voltage is predictable or at a higher range if the voltage is not predictable.

(3) Set the LOAD switch to the ON state and turn clockwise the LOAD knob so that a constant current flows in the device and the ammeter indicates the current. (See Figure 6.)

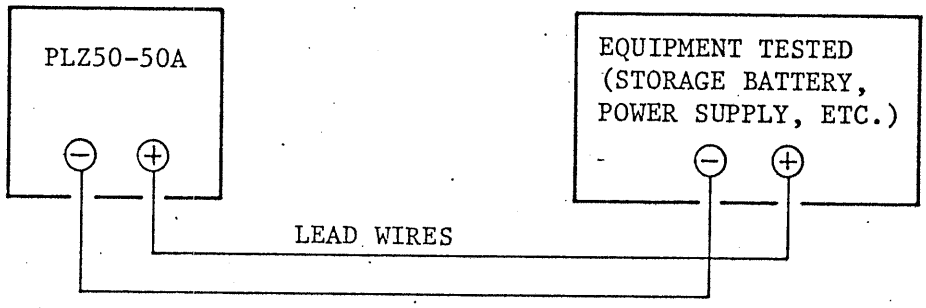


Figure 6

* When the device is operated with a large current, the voltage indicated by the voltmeter may become meaningfully lower than the actual voltage at the tested equipment due to the voltage drop in the lead wires. In such a case, to measure more accurately the voltage which exists at the tested equipment, the voltmeter may be directly and separately wires to the tested euqipment. For this measurement, proceed as follows: Disconnect the shorting bars from between terminals ① - ② and between ③ - ④. Connect terminals ② and ③ to the tested equipment, with terminal ② for "+" and terminal ③ for "-". With this setup, the voltmeter indicates the voltage of the tested equipment eliminating the error caused by the voltage drop in the lead wires.

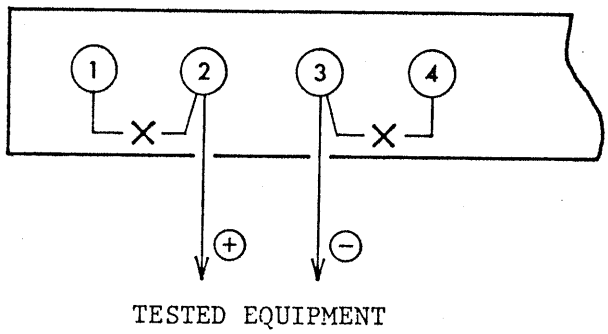


Figure 7

° The set current of the device is not affected by the voltage drop developed in the lead wires so far as the loading voltage is not lower than 0 V.

* If the LOAD switch trips when in operation, check the cause (operation of the overvoltage, overpower, or other protection circuit) and, then, turn on the switch again.

4.3.2 To Use the Device as a Constant-current Source

A constant current source can be readily obtained by using a power source and this device. (See Figure 8).

(1) Connect the positive (+) terminal of the power source to that of this device. Connect the negative (-) terminal of the device to the positive terminal (+) of the load and connect the negative terminal (-) of the power source to the negative terminal (-) of the load.

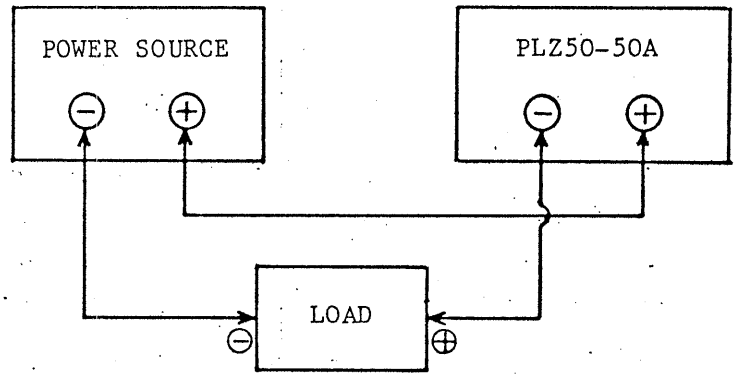


Figure 8

4.4 Constant-resistance Operation

By setting the FUNCTION switch in the RESISTOR position, the device can be used as a constant-resistance load (in three minimum resistance ranges of approximately 0.1 Ω, 1 Ω, and 8 Ω). As you turn the LOAD knob counterclockwise, the resistance increases up to several kilo-ohms.

The relationship of loading voltage versus resistance is shown in Figure 9.

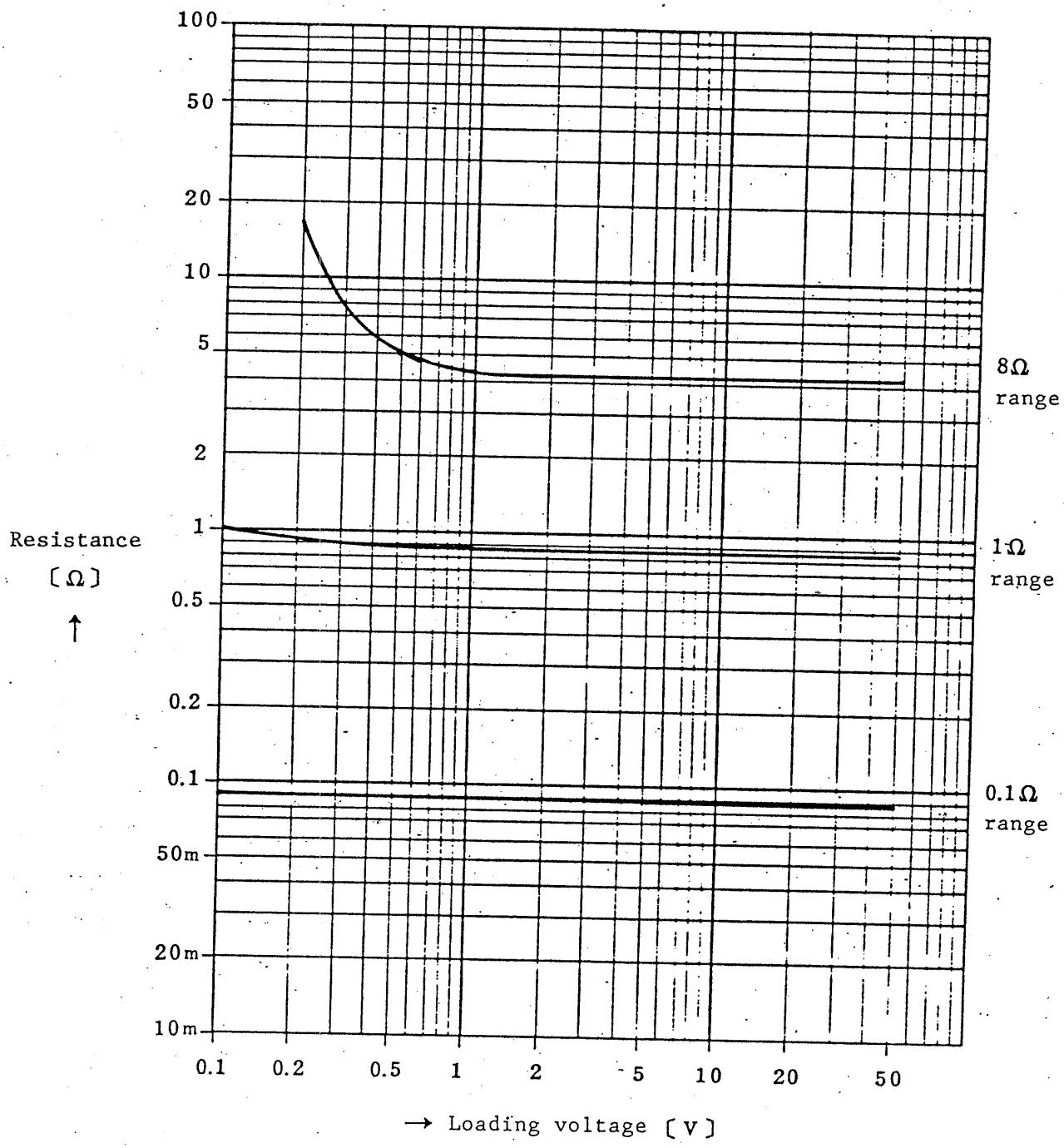


Figure 9. Loading voltage versus resistance

4.5 External Control Mode (EXT Mode)

This mode is used when an external power is supplied and the output is required to be controlled irrspective of the LOAD knob setting on the front panel or when the load current is required to be controlled with various waveforms.

For this mode of operation, apply a signal between terminals ④ (-) and terminal ⑤ (+) as shown in Figure 10. With this setup, the device operates in the constant-current mode. The input resistance in this case is approximately 15 kΩ.

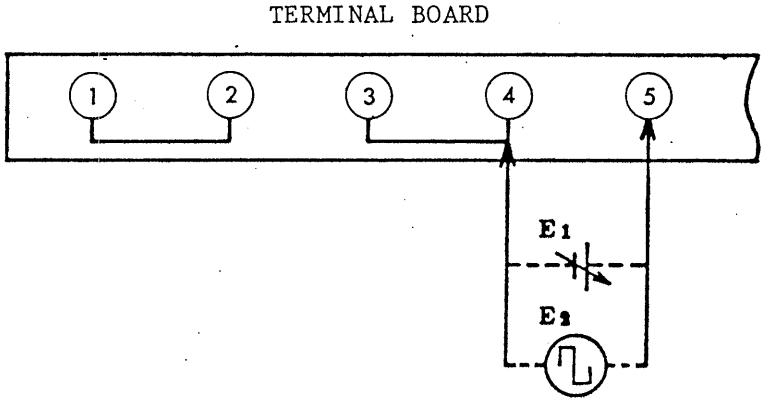


Figure 10

4.5.1 Control with DC Voltage

Connect a variable DC voltage source (E_1) as shown in Figure 10. With this setup, when the LOAD knob on the front panel is set in the clockwise extreme position and an input voltage of 5.5 V is applied, the current becomes approximately 50 A. The current can be controlled with the input voltage (E_1) as shown in Figure 11.

By adjusting the LOAD knob, the current for the 5.5 V input can be set to a value lower than 50 A. When setting is made as represented with line ② in Figure 11, the current for 5 5 V is 40 A and that for 2.75 V is 20 A.

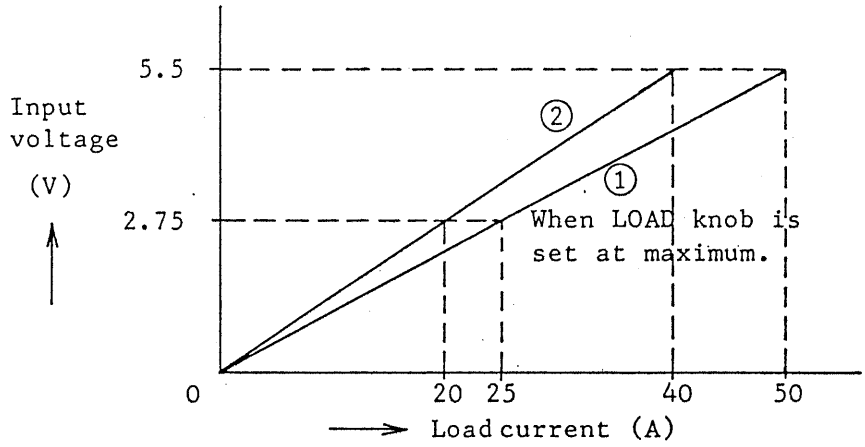


Figure 11

When controlled with an external DC voltage, the relationships between the external input voltage and the load current is as shown in Figure 12. At the low input level range, however, the linearity is slightly degraded.

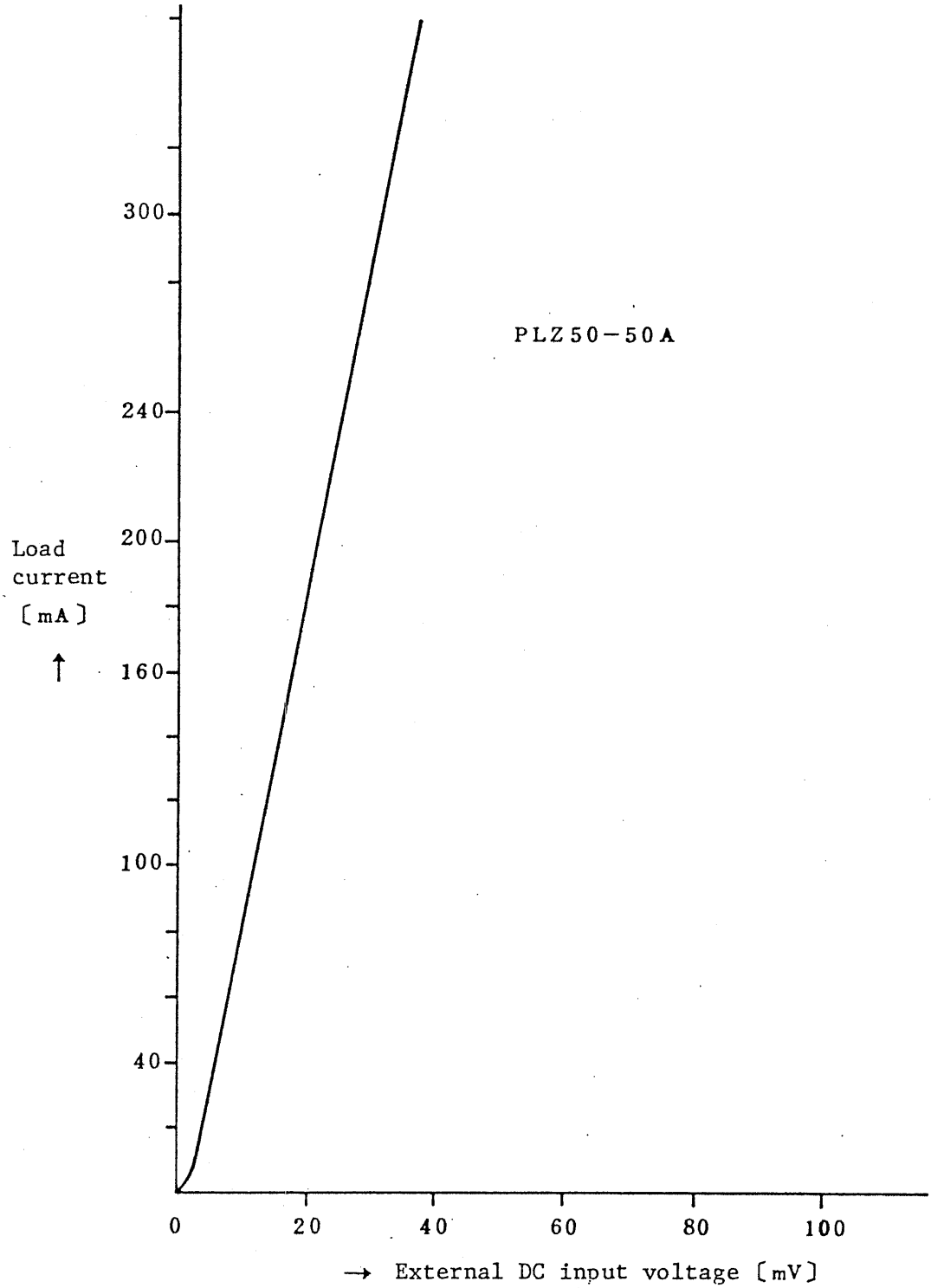


Figure 12. External DC input voltage versus load current at low level range

4.5.2 Control with External Signals of Various Waveforms

The current of the device can be controlled with an external signal of one of various different waveforms as well as with a DC signal as explained in 4.5.1. For this operation, connect E_2 instead of E_1 in Figure 10. A signal of any waveform can be used -- sinusoidal, square. triangular, etc. Note, however, that the current is controllable only within the positive range of the oscillator output. (See Figure 13).

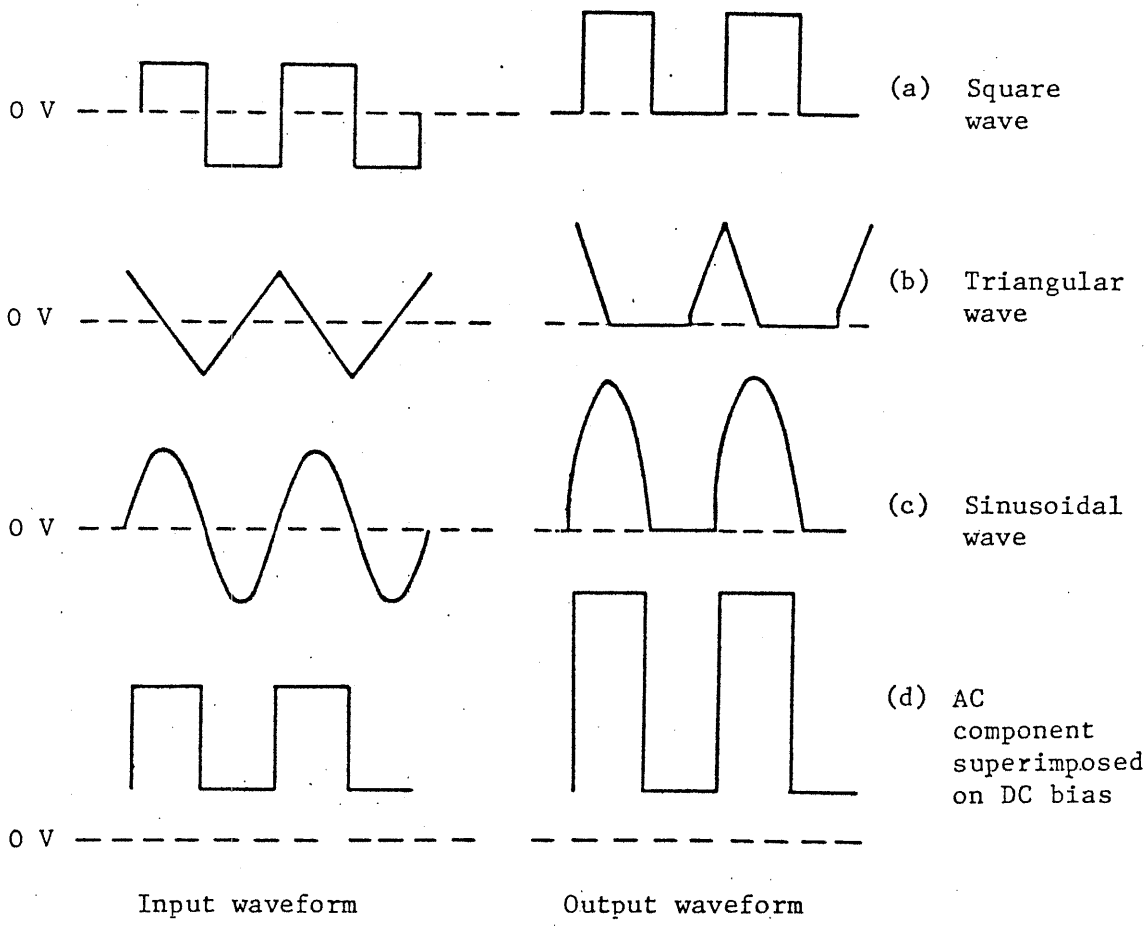


Figure 13

Connect a resistor in series with the PLZ and apply an external signal. Note that, if the signal is modulated with a square wave, the resistance of the series resistor should be as small as possible.

If the resistance is large, the rise-up and fall-down characteristics of the load current may be degraded. Both rise-up and fall-down characteristic of the load may be degraded. Both rise-up and fall-down periods are approximately 30 μsec when the series resistance is small with respect to an input voltage of approximately 5 - 50 V.

If the loading voltage is lower than 5 V, overshoots may be caused or the rise time characteristics may be degraded or other unfavorable effects may be caused depending on the load current. To vary the load current, vary the oscillator output while keeping the LOAD knob constant in the maximum position.

* Note that the power of the device must not exceed 300 Wpeak. Also note that, when the device is operated with a signal frequency of 100 Hz or higher, the breaker may fail to trip in response to a peak-to-peak overpower state.

* Note that the sum of the peak value of the input waveform plus the value of the DC bias must not exceed 5.5 V.

* To connect the PLZ50-50A to a detecting resistor to observe the load current waveform employing an oscilloscope, use sufficiently large lead wires and make the connection distance as short as possible. If the lead wires are long, their inductance (L) may cause overshoots. To prevent such adverse effects, strand the lead wires and connect a capacitor of small capacitance across the load terminals.

The frequency response characteristics of the device when used in the EXT mode are shown in Figure 14.

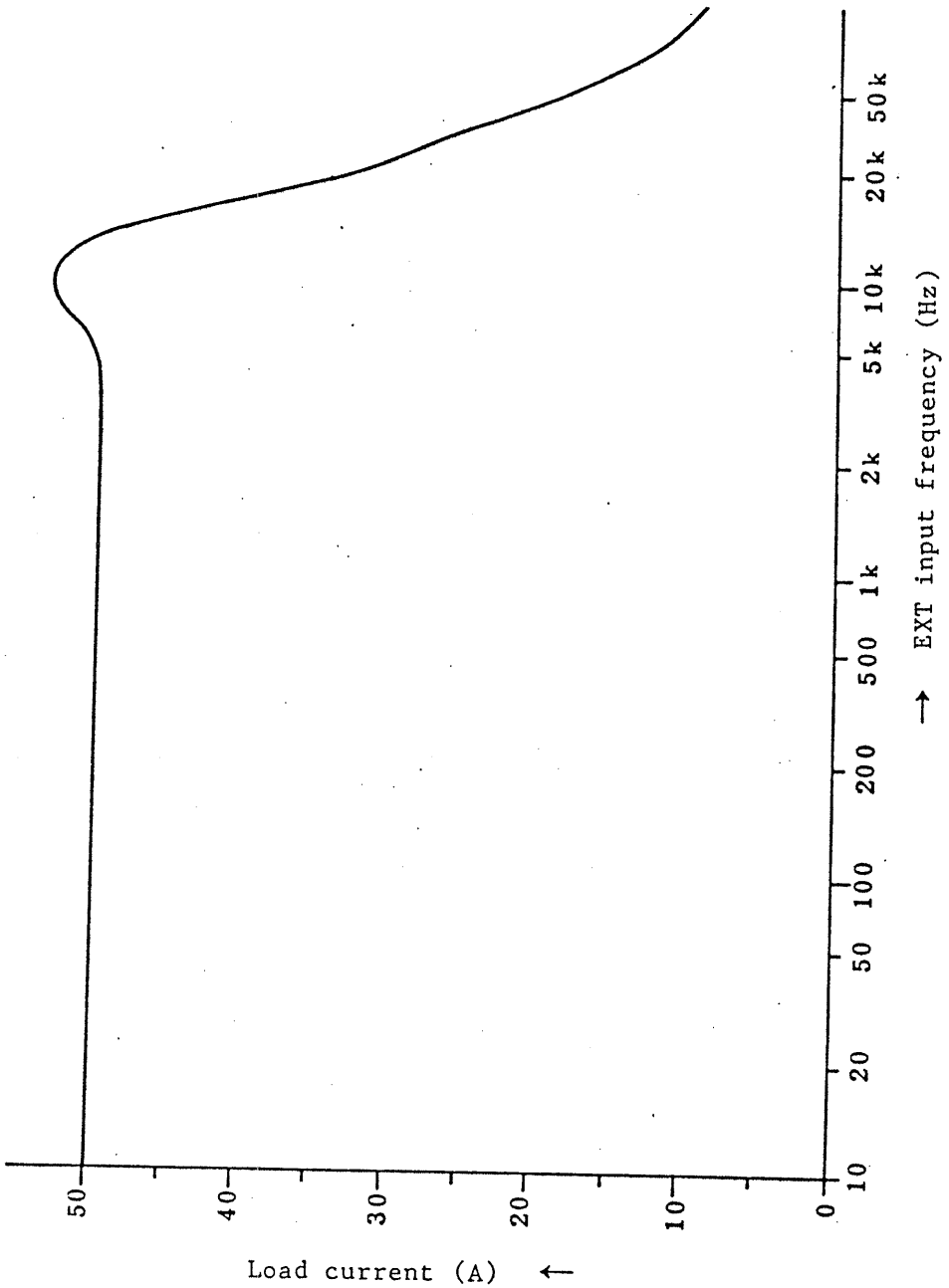


Figure 14

4.6 One-control Parallel Operation

Two or more units can be connected in parallel to increase the current rating or power rating. For parallel operation, it also is possible to use one of the two or more units as a master unit and to use the remaining units as slave units, as well as it is possible to connect all units simply in parallel.

To operate three units of PLZ50-50A in parallel for example, connect them directly to the power source as shown in Figure 15.

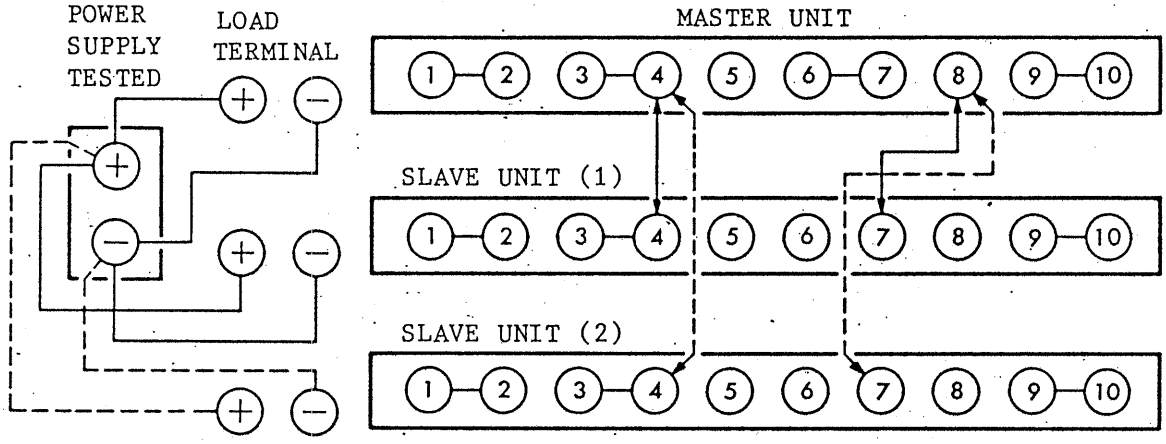


Figure 15. Connections of terminals on rear panels

(1) Turn on the power source switch and the load switches of the slave units.

(2) Turn on the load switch of the master unit, and the current will flow.

(3) All opertions are controlled with the master unit.

(4) To finish the operation, turn-off at first the switch of the master unit and next the switches of the slave units. The currents of the units are cut off when the switch of the naster unit is turned off.

Notes: (1) Connect the terminals of the rear panel with lead wires of the minimum length.

(2) The protection circuits of individual units operate mutually independently.

(3) The current of each slave unit is adjustable with its LOAD control knob (red FINE control knob). Keep this knob in the minimum current position in order to keep the balance between the master and slave units.

4.7 Remote Control Operation

The device can be remote-controlled with an external DC voltage signal as explained in the above. The device also can be controlled with a resistance signal as follows:

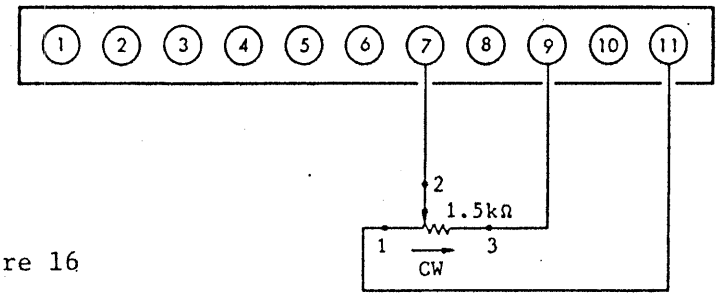
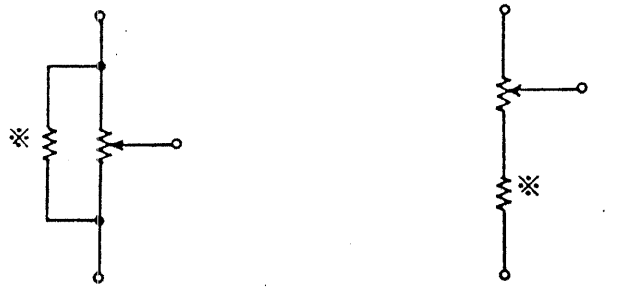


Figure 16

(1) Connect a variable resistor (1.5 kΩ) as shown in Figure 16.

(2) When the variable resistor is used at a distance from the device, use a shielded calbe in order to guard against ripple and other external inducation noise.

Note: The device has been calibrated for a variable resistor of 1.5 kΩ. If no variable resistor of this resistance is available, connect a compensating resistor in parallel or series as shown in Figure 17 so that the total resistance becomes 1.5 kΩ. When using a parallel compensating resistor, note that the device characteristics may be degraded if the resistance of the variable resistor becomes 5 kΩ or higher.



(a) Parallel compensation (b) Series compensation

4.8 Protection Circuits

The device is incorporated with full protective features as mentioned in the following.

4.8.1 Overvoltage Protection Circuit

This circuit protects the device against overvoltage, by turning off the load switch. The protection limit voltage is approximately 60 V or 6 V, as switched in gang with the voltmeter range selector switch.

4.8.2 Overpower Protection Circuit

The device is designed for 300-watt heat dissipation. If the power exceed this limit, the power transitors may be damaged.

This circuit protects the device by tripping the load switch when the power has exceeded the shaded area shown in Figure 18. Since the device is designed for 300 watts, operate it with a power less than 300 watts.

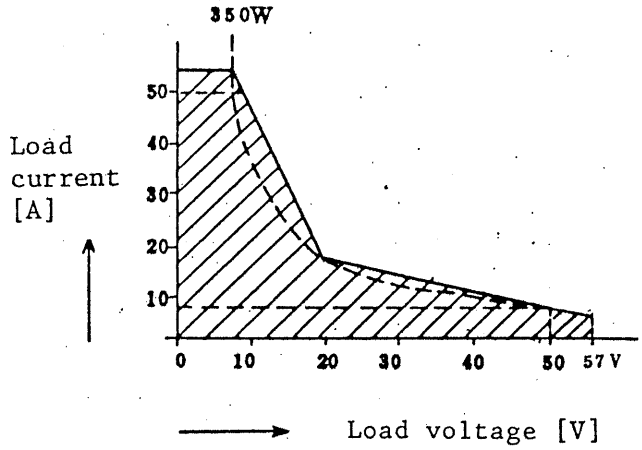


Figure 18

4.8.3 Overcurrent Protection Circuit

When an overcurrent (larger than 55 A) has flowed in the input circuit of the device, the protection circuit turns off the load switch.

4.8.4 Reverse-polarity Protection Circuit

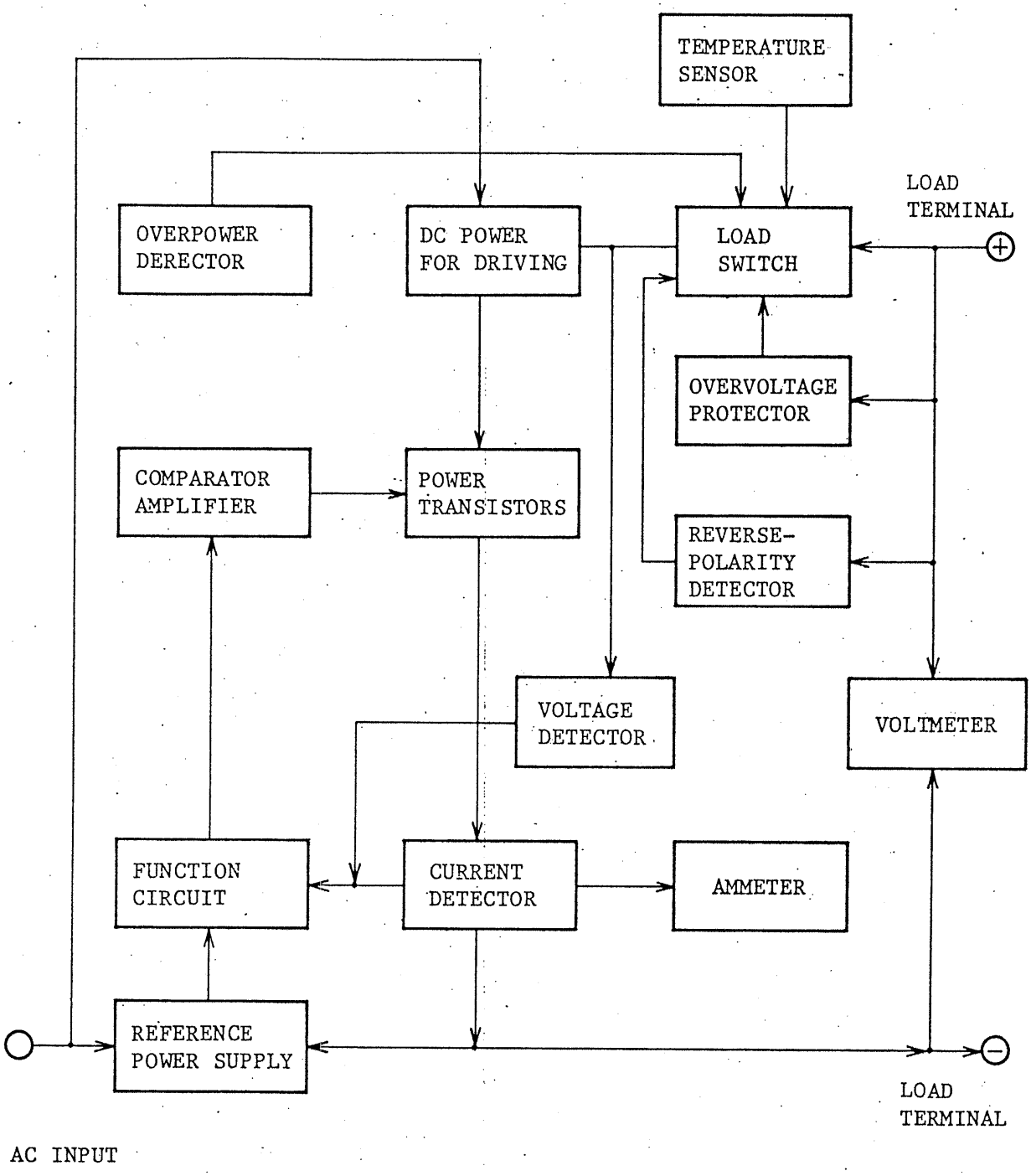
This circuit turns off the load switch when the loading power (with a voltage of approximately 0.6 V or over) is applied in the reverse polarity.

4.8.5 Overheat Protection Circuit

Even when the device is operated within the specified rating, the internal temperature of the device may become untolerably high due to imperfect ventilation. This circuit trips the load switch when the internal temperature of the device has risen above the tolerable limit. The device can be re-started by turning on the load switch when the device is cooled off.

When any of the above-mentioned protection circuits has tripped, check and eliminate the cause of the trouble and, then, turn on the power. When the load switch has tripped as mentioned in Para. 4.8.5, cool off the device and then turn on the switch. Unless the unit has been cooled off, the switch may trip again at the instant it is turned on again.

5. BLOCK DIAGRAM



Block Diagram of PLZ-50-50A Electronic Load