

KENWOOD

REGURATED DC POWER SUPPLY

PA18-1.2 PA36-3

PA18-3 PA70-1

PA36-1.2

INSTRUCTION MANUAL

KENWOOD CORPORATION

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This manual covers PA18 - 1.2, PA18 - 3, PA36 - 1.2, PA36 - 3, and PA70 - 1.
Read the description corresponding to the model you purchased.

1. Outline

The PA series are compact and high-performance DC constant voltage/constant current power supplies, each having the 3.5-digit voltage/3-digit current LED indicator.

The output can be changed in a range of 0 to the rated voltage/current by the serial control method. The constant voltage can be set finely by using the coarse/fine adjustment dial even though the output is off. The output voltage and current values can be digitally displayed at the same time. The PA series have the output on/off and output sensing terminal functions allows a variety of external remote controls, so they are high cost-performance universal and compact power supplies that can accommodate a wide range of users' requests for research and development or as the aging power supply or various fixed power supplies for systems.

2. Features

- Low ripple and low noise power supply
By using the series regulator method, the ripple and noise are minimized. Also, a lower temperature coefficient and excellent electrical characteristics are provide.

- Voltage/current concurrent digital LED display

The voltage is displayed in 3.5 digits with the auto range (20.0 V or more). The current is displayed in 3 digits. By using LEDs, the voltage and current can be set or checked at the same time. The constant voltage operation is indicated by a green LED, while the constant current operation is indicated by a red LED.

- Increase in output by serial/parallel operation

The output voltage can be increased by the serial connection, while the output current can be increased by the parallel connection. Through the one-control serial/parallel operation, a master power supply can control

multiple slave power supplies.

- Floating output and output sensor terminal

Since the output terminal employs the floating output, either positive or negative polarity can be applied.

The panel has the output sensor terminal to be used when fine setting of the load terminal voltage is needed.

- Systematization by using various remote controls

Since the remote control terminal is provided, the output can be turned on/off by an external contact signal. The output voltage or output current can be remotely controlled by external voltage 0 to 10 V or input resistance 0 to 10 kilohms.

- By using the GP - IB adapter, the output can be turned on/off and the output voltage/current can be controlled by GP - IB.

Note :

To use GP - IB, modification of the equipment is needed.

3. SPECIFICATIONS

Item	Model					
	PA18-1.2	PA18-3		PA36-1.2	PA36-3	PA70-1
Output						
Output voltage	0~18V			0~36V		0~70V
Resolution (logical value)	4.2mV			8.4mV		16.6mV
Voltage setting dial	With coarse/fine adjustment			One rotation		
Output current	0~1.2A	0~3A		0~1.2A	0~3A	0~1A
Resolution (logical value)	2mA	4.8mA		2mA	4.8mA	1.6mA
Constant voltage characteristics (CV)						
Input fluctuation	For AC +/- 10% fluctuation *1			2mV		5mV
Load fluctuation	For 0 to 100% fluctuation *1			2mV	4mV	5mV
Ripple and noise	rms(10Hz~1MHz)*2			0.5mVrms		1mVrms
Transient response	Standard value (current 5% to 100%)			50μs Typical		
Temperature coefficient	Standard value			100ppm/°C Typical		
Remote control	External voltage/output voltage ratio			Approx10V/36V		Approx10V/70V
Remote control	External resistance/output voltage ratio			Approx10kΩ/36V		Approx10kΩ/70V
Constant current characteristics (CC)						
Input fluctuation	For AC +/- 10% fluctuation			2mA		
Load fluctuation	For 0 to 100% fluctuation			10mA	15mA	10mA
Ripple and noise	rms(10Hz~1MHz)*2			1mA _{rms}		1mA _{rms}
Temperature coefficient	Standard value			250ppm/°C Typical		
Remote control	External voltage/output current ratio			Approx10V/1.2A	Approx10V/3A	Approx10V/1A
Remote control	External resistance/output current ratio			Approx10kΩ/1.2A	Approx10kΩ/3A	Approx10kΩ/1A
Constant voltage operation indication	Green CV LED on					
Constant current operation indication	Red CC LED on					

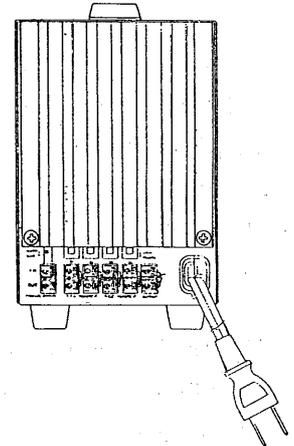
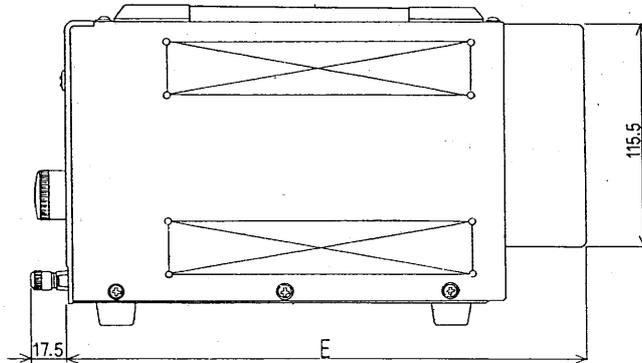
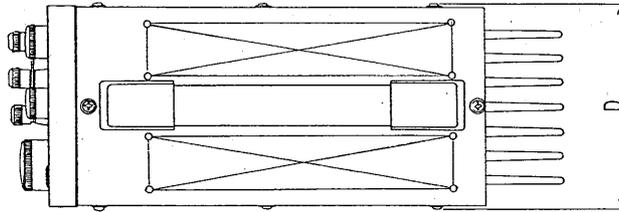
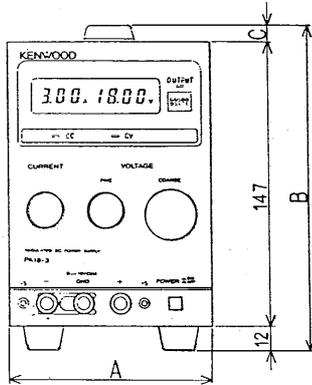
Item	Model					
	PA18-1.2	PA18-3		PA36-1.2	PA36-3	PA70-1
Digital meter indication						
Voltmeter indication	Red 3.5-digit LED	Maximum 19.99 V, fixed range		Maximum 19.99 V/99.9 V, auto range		
Accuracy	Output on	$\pm(0.2\%rdg+1digit)$		23°C±5°C	80%RH or less	
Ammeter indication	Red 3-digit LED	Maximum 9.99 A, fixed range				
Accuracy	Output on	*3	$\pm(1.0\%rdg+2digit)$		23°C±5°C	80%RH or less
Sampling rate		Approximately 2.5 times/second				
Functions						
Output on/off	Remote-controllable	The red LED lights when the output is on.				
Remote sensing		Possible by using the (+S) and (-S) terminals on the panel. Compensation is possible for up to 0.5V in one way.				
Serial operation	Master/slave mode	One-control serial operation possible (within the grounding-resistant voltage)				
Parallel operation	Master/slave mode	One-control parallel operation possible (for same models only)				
Operating conditions						
Operating temperature/ humidity range		0~40°C 10~80%RH				
Storage temperature/ humidity range		-20~60°C 10~85%RH				
Cooling method		Natural convection				
Output polarity		+(Red)-(white)GND(Black), positive or negative grounding possible				
Grounding-resistant voltage		±250VDC				
Insulation resistance	Between the chassis and input power supply	DC 500V 30MΩ or more				
	Between the chassis and output terminal	DC 500V 20MΩ or more				
INPUT						
Input power		AC100V±10% 50/60Hz 120V/220V/240V±10%(Maximum 250 VAC) Internal switching possible				
Power consumption		Approx62VA/45W	Approx140VA/105W		Approx105VA/80W	Approx250VA/185W
					Approx150VA/113W	
Accessories		1) One copy of instruction manual 2) Two sensor plugs 13) Two fuses				

Item		Model						
		PA18-1.2	PA18-3		PA36-1.2	PA36-3	PA70-1	
Dimentions and weight								
	Dimentions	(Width x Height x Depth)mm	104×147×180	104×147×215		104×147×180	138×147×230	104×147×215
	Maximum Dimentions	(Width x Height x Depth)mm	108×161×200	108×167×265		108×161×200	142×167×290	108×167×265
	Weight		Approximately 4kg	Approximately 5.9kg		Approximately 4.6kg	Approximately 8.6kg	Approximately 6.0kg

- * 1 The sensing terminal is measured in non – open mode.
- * 2 Measurement is done by grounding either positive or negative output.
- * 3 After warm up for approximately 30 minutes when the current is fed

■ Circuit and ratings subject to change without notice due to developments in technology

External view



Size of each model

	A	B	C	D	E	Size
PA18-1.2	104	161	\	108	200	S
PA18-3	104	167	8	108	265	M
PA36-1.2	104	161	\	108	200	S
PA36-3	138	167	8	142	290	L
PA70-1	104	167	8	108	265	M

4. Precautions for Use

Before using this equipment, be sure to read the following :

1. Power voltage check

* Use the power voltage within the rated range. The rated voltage of this equipment is single-phase 100/120/220/240 VAC + / - 10% (maximum 250 VAC), 50/60 Hz.

* The rated voltage is shown on the rating nameplate beside the power input connector on the rear of this equipment.

* For power voltage rating change, see the description of maintenance.

2. Power code connection

* Insert the power code plug into the outlet at the rated voltage accurately.

3. Notes on connecting the output terminal

* This equipment is a floating type power supply. In normal use, connect either (+)

or (-) output terminal on the panel to the GND terminal (case GND) by using a short bar.

* Sensor terminals (+S) and (-S) on the panel are remote sensing terminals. In normal use, do not insert the plug.

If the plug is inserted, the internal sensor contact is opened and an error occurs in output voltage indication.

For the remote sensing connecting method, see 6.2 in operation procedures.

4. Output current value setting

* To set the constant current value, short-circuit output terminals (+) and (-) and deliver the output current.

5. Switches and terminal on the rear

* Check that the MASTER / SLAVE switch on the rear has been set to MASTER (up).

* Check the remote switches (S1 to S4) on the rear have been set to

LOCAL (up).

* Do not connect the remote terminal on the rear unless the master/slave or remote control operation.

6. Digital display

* One digit flickers in digital display on this equipment. This is caused by the performance of the A/D converter but not by the ripple/noise factor in the output.

* If the commercial - use power contains much common - mode noise or a strong noise source exists near this equipment, display may be unstable. Therefore, care must be taken.

7. Installing environment

* When this equipment is used, the ambient temperature should be in a range of 0 to 40°C

* This equipment employs natural convection. Do not stack things on this equipment, put this equipment on a heat

generating material, or stack up some sets of this equipment. Use this equipment in a well - ventilated environment.

* The heat sink on the rear of this equipment may become hot during operation. Check ventilation and do not put materials that will be affected by heat near this equipment.

5. panel Explanation

5-1 Front panel

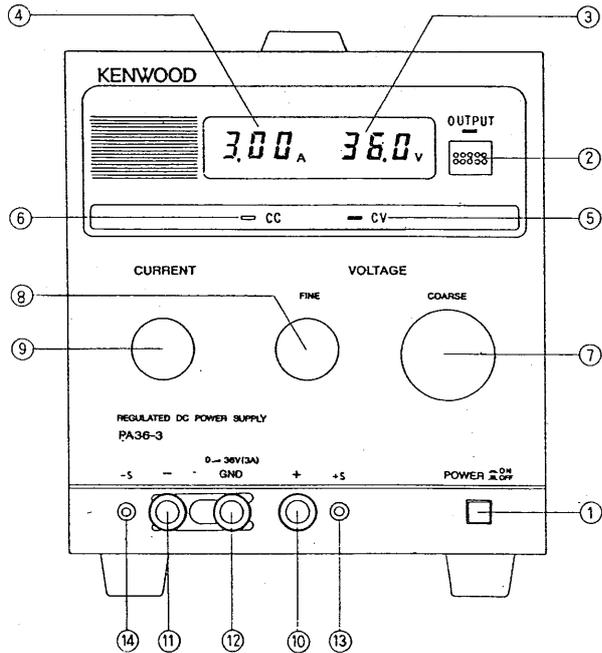


Figure 1
PA36-3

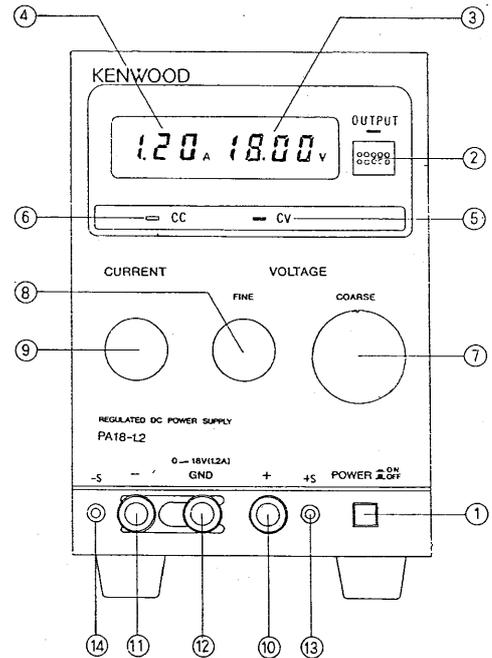


Figure 2
PA18-1.2 PA36-1.2
PA18-3 PA70-1

(1) POWER ON  / OFF 

Power switch. When this switch is pressed, power is turned on and this equipment starts.

(2) OUTPUT key / OUTPUT LED (red)

Output on/off switch. If the OUTPUT key is pressed, the output LED lights and output is done. The voltmeter/ammeter indicates the current output value. If the OUTPUT key is pressed while the output LED is lighting, the output LED goes out and the output is stopped. In this case, the voltmeter indicates the voltage value that has been set. (Upon power on, the output LED always goes out and the output off mode is set.)

(3) Digital voltmeter (3.5 – digit LED indication)

The output voltage and the voltage value that has been set are indicated.

(4) Digital ammeter (3 – digit LED indication)

The output current value is indicated.

(5) CV LED (green)

Constant voltage operation indicating LED. If this LED is lighting, the constant voltage operation mode is indicated.

(6) CC LED (red)

Constant current operation indicating LED. If this LED is lighting, the constant current operation mode is indicated.

(7) VOLTAGE COARSE

Coarse adjustment dial to set the voltage value for the constant voltage operation

(8) VOLTAGE FINE

Fine adjustment dial to set the voltage value for the constant voltage operation

(9) CURRENT

Dial to set the current value for the constant current operation.

The limited current value for the output current can be changed or set.

(10) Output terminal (+)

Terminal to fetch the (+) output

(11) Output terminal (-)

Terminal to fetch the (-) output

(12) GND terminal

Connected to the cabinet by the grounding terminal. Normally, it is connected to the (+) or (-) terminal by using a short bar.

(13) Sensor terminal (+ S)

(+) output remote sensing terminal, Normally, do not insert the plug.

(14) Sensor terminal (- S)

(-) output remote sensing terminal. Normally, do not insert the plug.

Note :

Do not insert the plug into sensor terminal (+S) and (-S) unless the remote sensing operation is done. If the plug is inserted, the internal sensor contact is opened and an error occurs in output voltage indication.

5 - 2 Rear panel

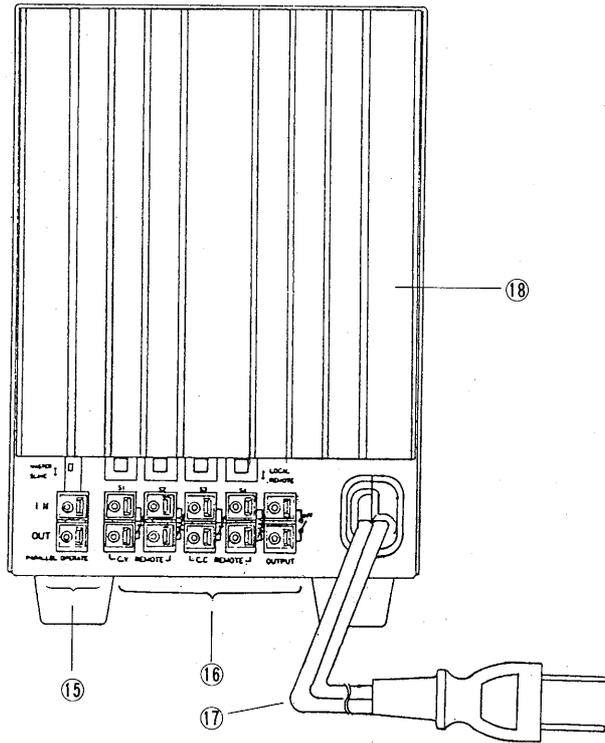


Figure 3

(15) MASTER/SLAVE switch and terminal

This switch is used for one-control parallel operation in master/slave. Normally, set it to MASTER.

(For details, see the description of one-control parallel operation.)

(16) LOCAL/REMOTE switch and terminal

Constant voltage, constant current, or output on/off remote control changeover switch. Normally, set it to LOCAL. Panel operation is allowed if this switch is set to LOCAL. If this switch is set to REMOTE, remote control is allowed. (For details, see the description of remote control.)

(17) Power cord

Approximately 2 m code with plug to connect the input power

(18) Heat sink

Heat radiator. It may be hot during operation, so care must be taken.

6. Operation Procedures

6-1 Single operation

* If this equipment is used alone, perform the panel operation.

* However, check that the switches on the rear have been set as shown below.

MASTER/SLAVE switch : MASTER
LOCAL/REMOTE(S1 to S4) switch : LOCAL

6-2 Remote sensing

* When the load is connected to this equipment, the load terminal voltage fluctuates as load variation by voltage reduction caused by the output terminal contact resistance and connecting wire conductor resistance.

* For fine setting of the load terminal voltage, insert the attached sensor plugs into the output sensor terminals (+S) and (-S) on the panel. Perform connection as shown in Figure 4 and carry out remote sensing.

* For this equipment, the output line

voltage reduction can be compensated by 0.5 V for one way. If the sensor plug is inserted, the internal sensor contact is opened.

* In normal use, do not insert the plug.

Note :

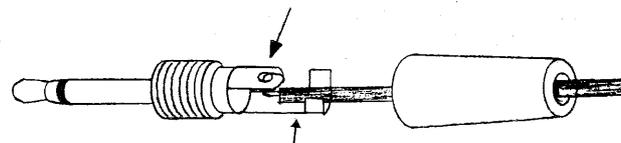
If remote sensing connection by inserting the sensor plug is not done, the output value may be high and the load may be destroyed.

Note :

For connection to the sensor terminal, be sure to use the attached sensor plug.

Sensor plug (2.5mm diameter)

Connect to the hot side.



Note :

Do not wire to the shield (outer) terminal of the sensing plug.

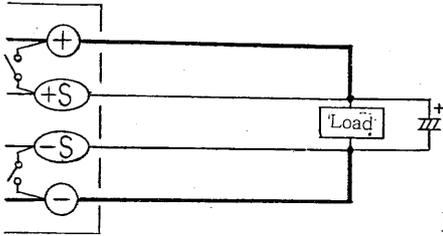


Fig 4

Note :

If the load is too far apart, oscillation may be caused by the output line inductance and capacitance. In this case, connect an approximately 100 μ F electrolytic capacitor in parallel with the load terminal.

6-3 Various remote control functions

* Remote control application function on the rear

(Upon shipping, the MASTER/SLAVE and LOCAL/REMOTE switches are set as shown in Figure 5.)

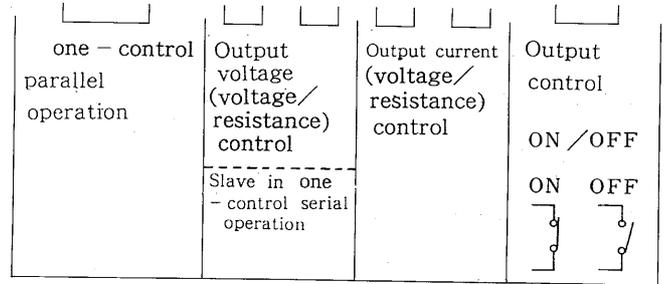
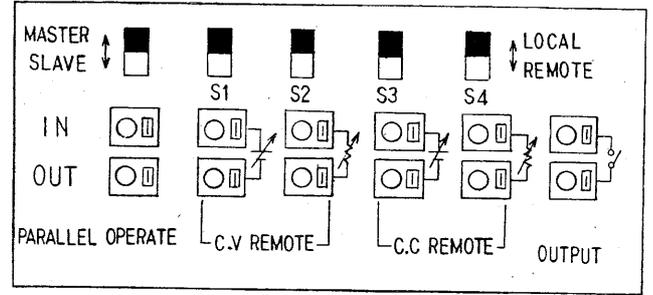


Figure 5

※ Remote control application

Remote function Operating method		MASTER	CV remote voltage/ resistance	CC remote voltage/ resistance	OUTPUT ON/OFF
		SLAVE			
Single operation of this equipment		Set to M	○ or ○	○ or ○	○
One - control parallel operation	MASTER	Set to M	○ or ○	○ or ○	○
	SLAVE	Set to S	× ×	× ×	×
One - control serial operation	MASTER	Set to M	○ or ○	○ or ○	○
	SLAVE	Set to M	× ×	× ×	×

○ : Remote - controllable

× : Not remote - controllable

* Handling of the connecting terminal on the rear

Install the connecting cord to the connecting terminal at the bottom on the rear as explained below.

1) Fit a thin screwdriver into the slit (concavity) to the right of the cord mounting round hole of the terminal. While pressing with the screwdriver, insert the

cord end into the round hole.

2) Upon removal, pull out the cord while pressing the slit with the screwdriver.

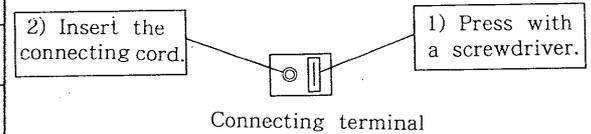


Figure 6

Note :

Applicable connecting wire;

Single wire 0.4 to 1.0 mm dia.(AWG26 to 18)

Stranded wire 0.3mm² to 0.75 mm² (AWG22 to 20), strand diameter 0.18 mm or more
Standard bare wire length: 10 mm (Solder the bare wire for stranded wire.)

6-4 OUTPUT on/off remote control
Output on/off can be controlled by an external contact signal.

- 1) Turn off the power switch
- 2) Connect the external contact signal to the OUTPUT terminal on the rear as shown in Figure 7.

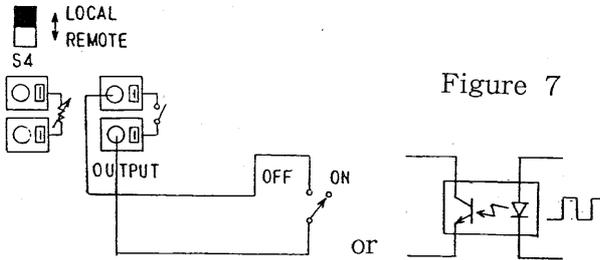


Figure 7

OUTPUT terminal closed: Output off
OUTPUT terminal opened: Output on
Set the OUTPUT switch on the panel to ON for operation.

Notes:

- Use the potential of the external signal by floating from the (+) and (-) outputs and GND (case GND). On/off can be controlled by using a photo coupler.

- 5 mA and maximum 5 V are applied to the external contact.

6-5 Constant voltage remote control

1. Output voltage control by an external voltage

* The output voltage can be controlled by a 0 to 10 V external voltage.

- 1) Turn off the power switch.
- 2) Set the CV REMOTE S1 and S2 switches on the rear to REMOTE.

As shown is Figure 8, connect the external voltage and external fixed resistance.

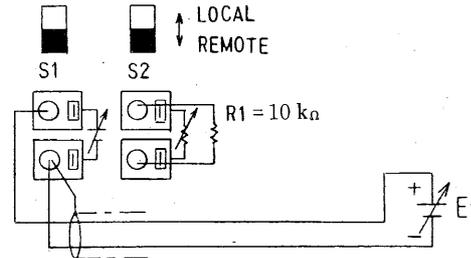


Figure 8

Relationship between the output voltage (E_o) and external voltage (E_1)

$$E_o \doteq \frac{E_{max}}{10} \times E_1 \text{ [V]}$$

E_o : Output voltage
 E_{max} : Maximum rated voltage
 E_1 : External voltage

$$(0 \leq E_1 \leq 10V)$$

Note 1 :

- The (-) side potential of the external voltage (E1) is that of the output (+) terminal.
- Since the ripple/noise factor in the external voltage is amplified and appears in the output, use the external voltage with less ripple/noise.
- The E1 input impedance (Zin) is as follows :

Rated voltage	18V	36V	70V
Zin	Approx. 6.1k Ω	Approx. 3.1k Ω	Approx. 1.6k Ω

- For E1 connection, use a two-conductor shield. Connect the outer shield as shown in Figure 8.

Note 2 :

- Use a metal film resistor 1/2W at an approximately 100 ppm/°C temperature coefficient for R1 = 10 kilohms. The maximum rated voltage is applied to R1.

Note 3 :

- If the S2 switch is set to LOCAL, the output voltage can be controlled manually (by using the voltage setting dial on the panel.)

2. Output voltage control by an external resistance

* The output voltage can be controlled by a 0 to 10 kilohm external resistance.

- 1) Turn off the power switch.
- 2) Set the CV REMOTE S2 switch on the rear to REMOTE. As shown in Figure 9, connect an external resistor (VR1 = 10 kilohms).

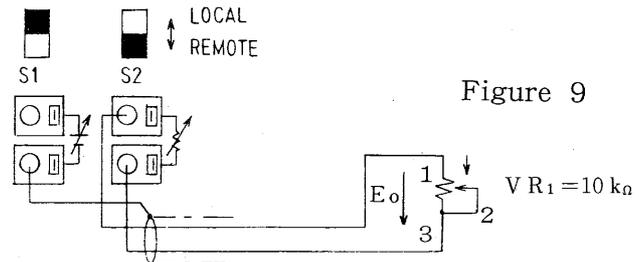


Figure 9

Relationship between the output voltage (E_o) and external resistance (VR_1)

$$E_o = \frac{E_{max}}{10} \times VR_1 \text{ [V]}$$

$$VR_1 \leq 10 \text{ k}\Omega$$

E_o : Output voltage

E_{max} : Maximum rated voltage

VR_1 : External resistance

Note 1 :

- The terminal (1) side of the external resistance (VR1) has the potential of the output (-) terminal.

- For VR1, use 1/2W at an approximately 100 ppm/°C temperature coefficient with less aging and noise.

- The maximum rated voltage is applied to VR1.

- For connection of VR1, use a two-conductor shield. Connect the outer shield to the (+) output. (See Figure 9.)

Note 2 :

- If VR1 is opened, overvoltage occurs on the output.

- When switching the resistance with a switch, use the short-circuit type so that the circuit will not be opened.

Note 3 :

- If S2 is set to LOCAL, the output voltage can be controlled manually (by using the voltage setting dial on the panel).

Note 4 :

- Do not set the S2 switch to REMOTE

while the output is on . A voltage higher than the maximum rated voltage may be applied as output and the load may be destroyed.

6-6 Constant current remote control

1. Output current control by an external voltage

* The output current can be controlled by a 0 to 10 V external voltage.

1) Turn off the power switch.

2) Set the CC REMOTE S3 and S4 switches on the rear to REMOTE.

As shown in Figure 10, connect the external voltage and external fixed resistance.

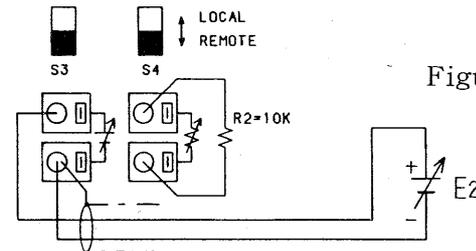


Figure 10

Relationship between the output current (I_o) and external voltage (E_2)

$$I_o = \frac{I_{max}}{10} \times E_2 \text{ [A]}$$

I_o : Output current
 I_{max} : Maximum rated current
 E_2 : External voltage
($0 \leq E_2 \leq 10V$)

Note 1 :

- The (-) side potential of the external voltage (E2) is the floating potential that is close to the output (+).

- Since the ripple/noise factor in the external voltage is amplified and appears in the output, use the external voltage with less ripple/noise.

- The input impedance (Zin) of E2 is approximately 180 kilohms.

- For connection of E2, use a two-conductor shield. Connect the outer shield as shown in Figure 10.

Note 2 :

- For R2 = 10 kilohms, use a metal film resistor, 1/4W or above, at an approximately 100 ppm/°C temperature coefficient.

Note 3 :

- If the S4 switch is set to LOCAL, the output current can be controlled manually (by using the current setting dial on the panel).

2. Output current control by an external resistance

* The output current can be controlled by a 0 to 10 kilohm external resistance.

1) Turn off the power switch.

2) Set the CC REMOTE S4 switch on the rear to REMOTE. As shown in Figure 11, connect the external resistor (VR2 = 10 kilohms).

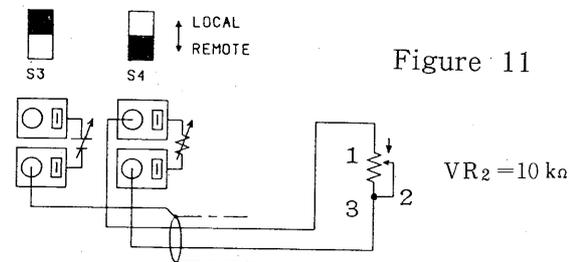


Figure 11

Relationship between the output current (Io) and external resistance (VR2)

$$I_o = \frac{I_{max}}{10} \times VR_2 \quad [A]$$

Io : Output current
Imax : Maximum rated current
VR2 : External resistance

(VR2 ≤ 10 kΩ)

Note 1 :

- The terminal (1) of the external resistance (VR2) has the floating potential that is close to the output (+).
- For VR2, use 1/4W or above at an approximately 100 ppm/°C temperature coefficient with less aging and noise.
- The maximum voltage is applied to VR2.
- For connection of VR2, use a two-conductor shield. Connect the outer shield as shown in Figure 11.

Note 2 :

- If VR2 is opened, overcurrent flows. This equipment may be damaged.
- When switching the resistance with a switch, use a short-circuit time that does not open the circuit.

Note 3 :

- If the S4 switch is set to LOCAL, the output current can be controlled manually (by using the current setting dial on the panel).

Note 4 :

- Do not switch the S4 switch to REMOTE while the output is on. Current larger than the rated current will flow as the output and the load may be destroyed.

6 - 7 Serial/parallel connection

1. Serial connection

* The output voltage can be increased by connecting two or more sets of this equipment serially.

- In onnection in Figure 12, the output voltage is the sum of the output voltage of each power supply.

- In connection in Figure 13, the output voltage is positive or negative.

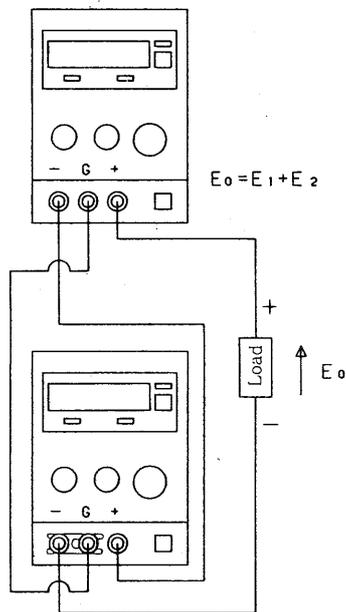


Figure 12

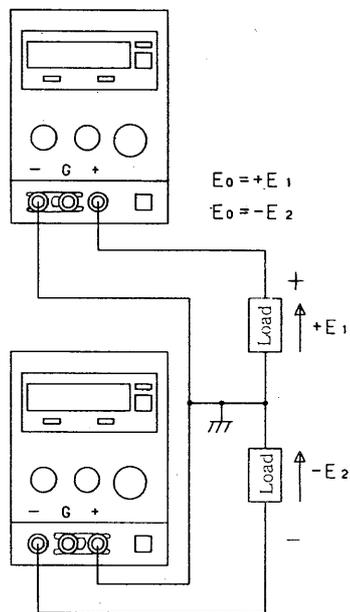


Figure 13

Note 1 :

In serial connection, the output terminal must not exceed the grounding resistant voltage, 250 VDC, (between the output terminal and case GND).

Note 2 :

To eliminate the potential to case GND for each power supply, set the GND terminal of each power supply common and connect it to the desired potential. (Figure 12 shows (-) grounding.)

2. Parallel connection

* The output current can be increased by connecting two or more sets of this equipment in parallel.

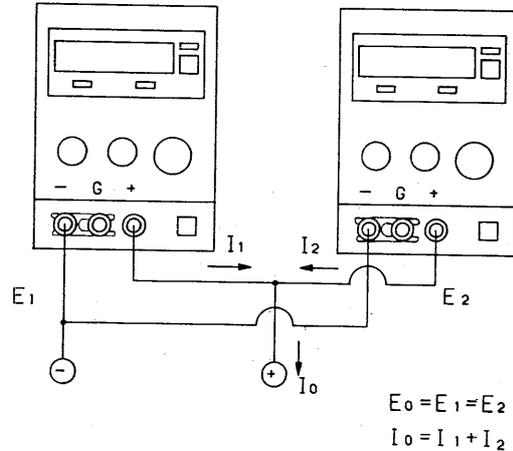
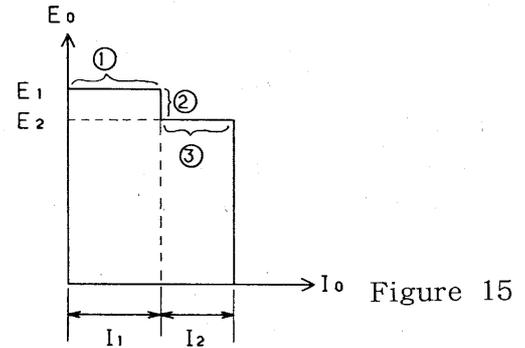


Figure 14



* When a constant voltage (CV) is applied:

Match the output voltage of each power supply.

If $E_1 > E_2$, the output voltage difference causes fluctuation to the load.

- (1) E1 supplies current.
- (2) The output voltage reduces after transition to the constant current (CC) area.
- (3) E2 supplies current.

* When constant current (CC) is applied Check that the CC LED of each model is lighting. The output current is the sum of the output current of each power supply.

Note 1 :

Do not apply a voltage higher than the rated voltage to the output of each power supply.

Note 2 :

A current at some milliampere reverses to the power supply with a lower output voltage.

6 - 8 One - control parallel operation.

* Slave machines in parallel can be controlled by operating a master machine and the output voltage can be increased.

Note :

This connection is valid for same models only.

* The output current is the sum of the output current of each power supply.

1) Turn off the power of the master

machine and all slave machines.

2) Set the MASTER/SLAVE switch on the rear of all slave machines to SLAVE.

3) Connect the parallel operation terminal (IN/OUT) on the rear of the master machine and slave machines as shown in Figure 16.

4) Use the same - length cord for connection between the output terminal of each power supply and the load.

5) Set the voltage setting dial of slave machines to the maximum (fully clockwise).

6) Turn on the power switch and output switch on slave machines.

7) Turn on the power switch and output switch on the master machine.

With the voltage/current dial on the master machine, the output voltage/current can be set arbitrarily.

Note 1 :

- The output operation is indicated by CV /CC LED on the master machine.
- The CC LED is always lighting on slave machines.

Note 2 :

- For grounding of the GND terminal, connect both master machine and slave machines to the (+) or (-) terminal. (The output connection diagram shows (-) grounding.)

Note 3 :

- In parallel operation, if the output becomes 0 ampere, the master machine may not be able to change the output voltage.

Perform operation so that some per cent or more of the rated current will flow.

* In remote control, control the master machine only.

Read 6 - 3 " Various remote control functions".

Parallel operation rear terminal connection diagram

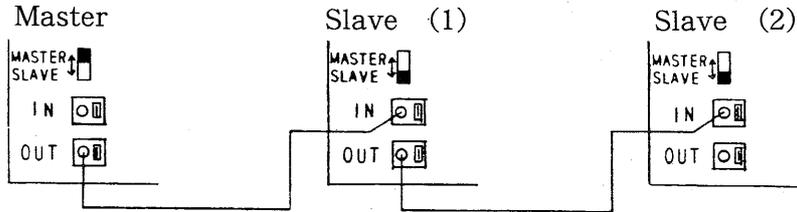
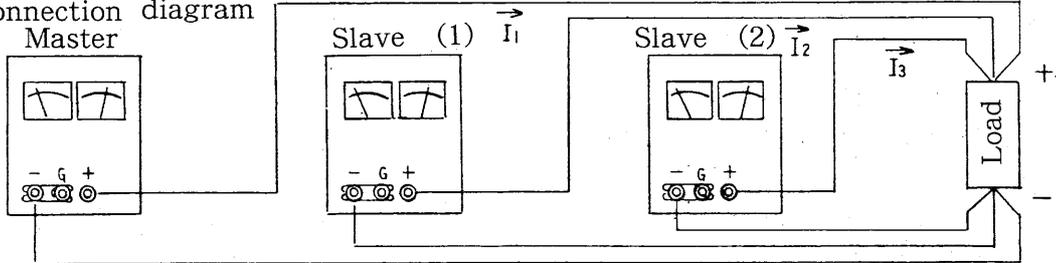


Figure 16

Parallel operation output connection diagram



Note $I_3 = I_1 + I_2 + I_1$. Set the voltage setting dial on all slave machines to the maximum. The master operates in the constant voltage mode, while slave operate in the constant current mode.

Figure 17

For parallel operation with different models, call our dealer.

6-9 One-control serial operation

* Serially connected slave machines can be controlled by operating a master machine and the output voltage can be increased.

* The output voltage is the sum of the output voltage of each power supply.

* Read 6-3 "Various remote control functions".

1) Turn off the power of the master machine and slave machines.

2) Set the MASTER/SLAVE switch on the rear of the master machine and slave machines to MASTER.

3) Set the CV REMOTE S1 switch on slave machines to REMOTE. As shown in Figure 19, connect the external fixed resistance.

4) Set the voltage/current setting dial on slave machines to the maximum (fully clockwise).

5) Set the GND terminal of each power supply common and connect it to the desired potential.

6) Turn on the power switch and output

switch of slave machines.

7) Turn on the power switch and output switch of the master machine. With the voltage/current dial on the master machine, the output voltage/current can be set arbitrarily.

* External resistance R3/R4 decision method

$$R_3 \div \left(\frac{E_1}{E_2} \times 10 \text{ k}\Omega \right) - R_s \quad [\text{k}\Omega]$$

where ($R_3 \geq 0$, $E_2 \leq \frac{10 \text{ k}\Omega}{R_s}$)

E_1 [V] : Output voltage of the master machine

E_2 [V] : Output voltage of slave machine (1)

R_s [kΩ] : Constant by model of slave machine (1)

Rated voltage	18V	36V	70V
Rs constant	6.1 kΩ	3.1 kΩ	1.6 kΩ

Determine R4 by replacing E1, E2, and R3 with E2, E3, and R4, respectively.

- Adjust the output voltage by using the voltage setting dial on the panel of the slave machine.

- For external resistance R3 and R4, use

a resistor of $1/2W$ or above with less temperature coefficient, aging, and noise. The output voltage is applied to the resistor, so care must be taken.

In serial connection, the output terminal must not exceed the grounding resistant voltage, 250 VDC, (between the output terminal and case GND).

To eliminate the potential to case GND, set the GND terminal of each power supply common and connect it to the desired potential.

(Figure 20 shows (-) grounding.)

* For remote control, control the master machine only.

Read 6 - 3 "Various remote control functions".

* The equipment can be used as a positive /negative tracking power supply.

If single control is applied to output connection in serial connection diagram 13, the equipment can be used as the positive /negative dual tracking power supply.

Theory of single-control serial operation

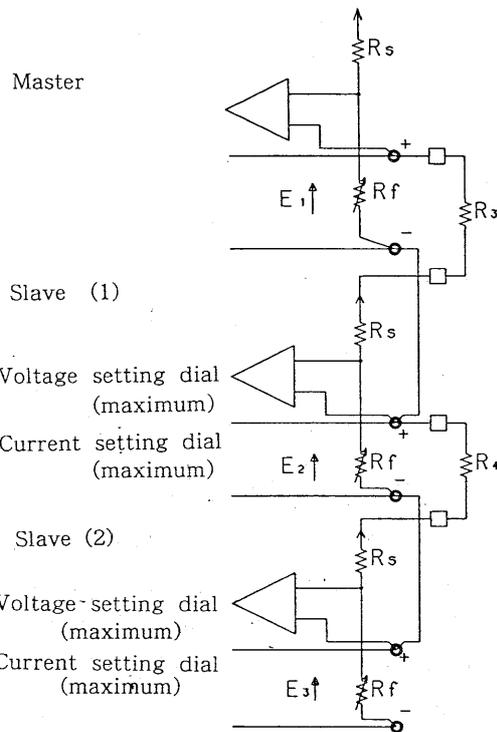


Figure 18

$$\begin{aligned}
 \frac{E_2}{R_f} &= \frac{E_1}{(R_s + R_3)} \\
 E_2 &= \frac{R_f}{(R_s + R_3)} \times E_1
 \end{aligned}
 \left. \vphantom{\begin{aligned} \frac{E_2}{R_f} \\ E_2 \end{aligned}} \right\} R_3 = \left(\frac{E_1}{E_2} \times R_f \right) - R_s$$

One - control serial operation rear terminal connection diagram

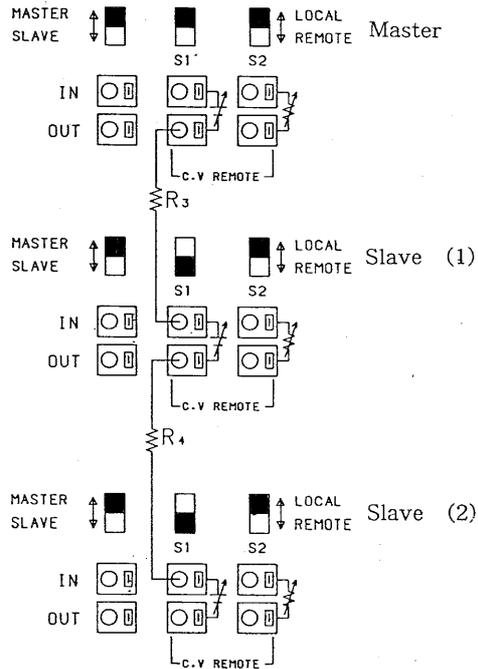


Figure 19

One - control serial operation output connection diagram

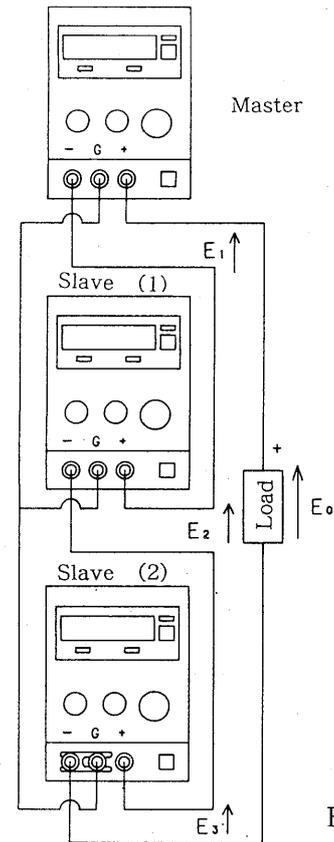


Figure 20

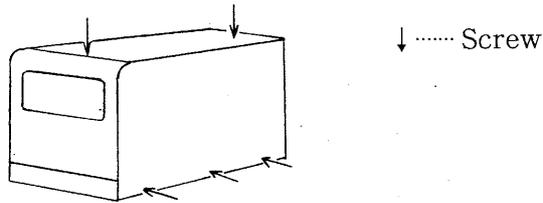
$$E_0 = E_1 + E_2 + E_3$$

Set the voltage/current setting dial on the slave to the maximum.

7. Maintenance

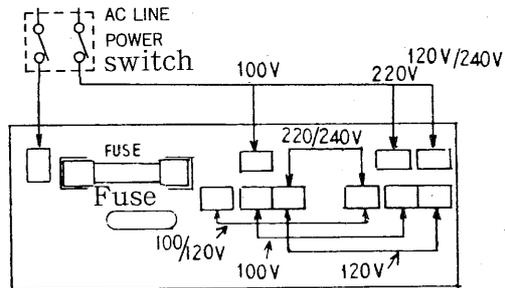
7-1 Removing the case

Remove screws from the top and side on the case and pull up the case.



7-2 Power voltage change

For switching of the rated input voltage, change the ratings of the power transformer and fuse inside the equipment as shown below.



Voltage switching and fuse P.C board

7-3 Fuse replacement

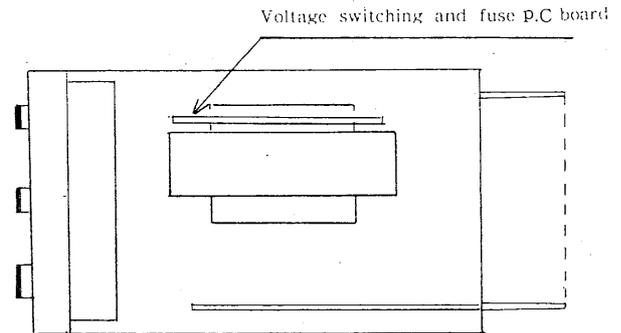
If the fuse blows, check the cause and replace the fuse.

Use the fuse matching the following rating according to the changed power voltage.

Note :

Before power voltage switching and fuse replacement, remove the power cord from the AC outlet.

Model	PA18-1.2	PA18-3	PA36-1.2	PA36-3	PA70-1
100/120V	1.5 A	3 A	2.5 A	5 A	3 A
220/240V	0.8 A	2 A	1.5 A	3 A	2 A



8. Troubleshooting

Trouble	Check point	Cause
Power cannot be turned on.	The LEDs on the voltmeter and ammeter do not light.	<ul style="list-style-type: none"> * Power cord connection error or disconnection * Power switch error * Fuse blown
The output voltage does not appear.	The indicator of the voltmeter does not move.	* Circuit error
The output current does not appear.	The indicator of the ammeter does not move.	* Circuit error
The output is too large.	The output voltage/current is not reduced.	<ul style="list-style-type: none"> * Power transistor error or control error * Circuit error
The output is unstable.	Input voltage difference Oscillation A strong magnetic/electric field is close.	<ul style="list-style-type: none"> * Out of the rated input voltage * Oscillation by a special load * Separation from the oscillation source

If a failure occurs, call our dealer.

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