

INSTRUCTION MANUAL

CONTROL BOARD

FOR PAR SERIES

TYPE APO-R1

KIKUSUI ELECTRONICS CORPORATION

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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.



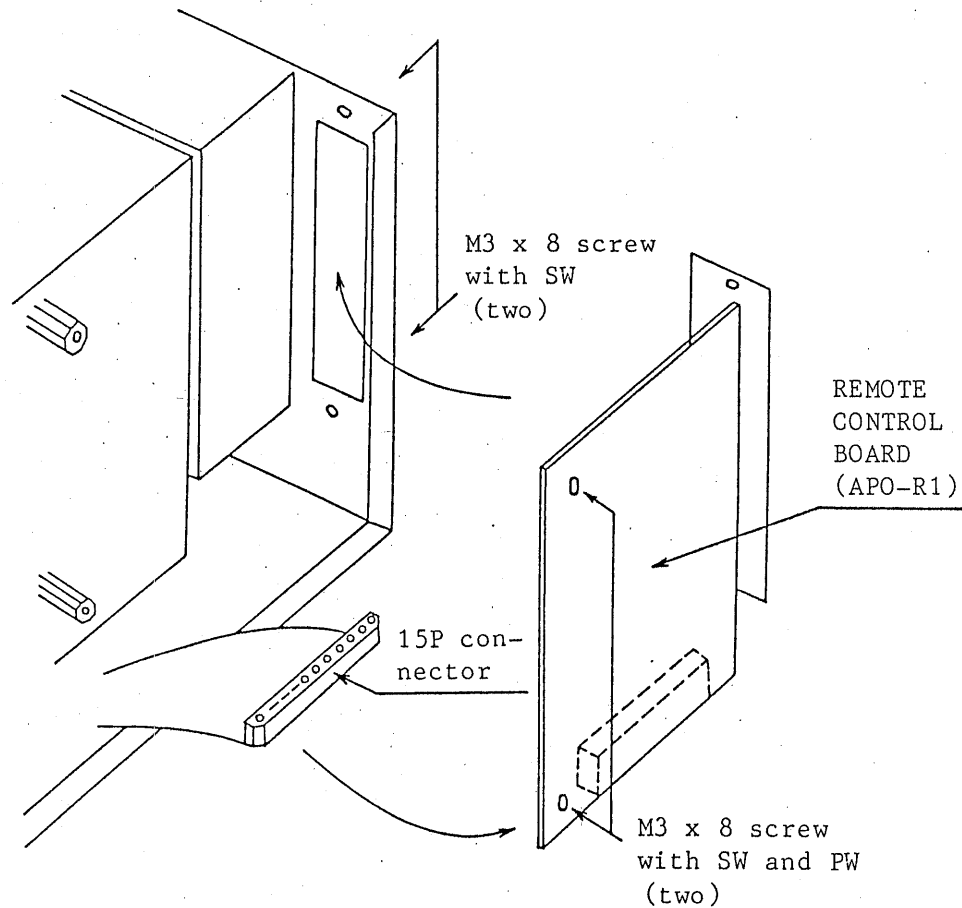
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1. CONTROL BOARD (APO-R1) INSTALLATION



- (1) Disconnect the power supply cord and remove the cover and rear panel.
- (2) Connect the control board to the PAR main frame by the 15P connector.
- (3) Fix the control board to the main frame by the four M3 x 8 screws.
- (4) Put on the cover.

If no particular specification is given by the user, the initial setting for the control board (APO-R1) is done at the factory as below.

The following control and operation modes may be selected by the initial setting:

1. Control of output voltage by external voltage (Common (+S))

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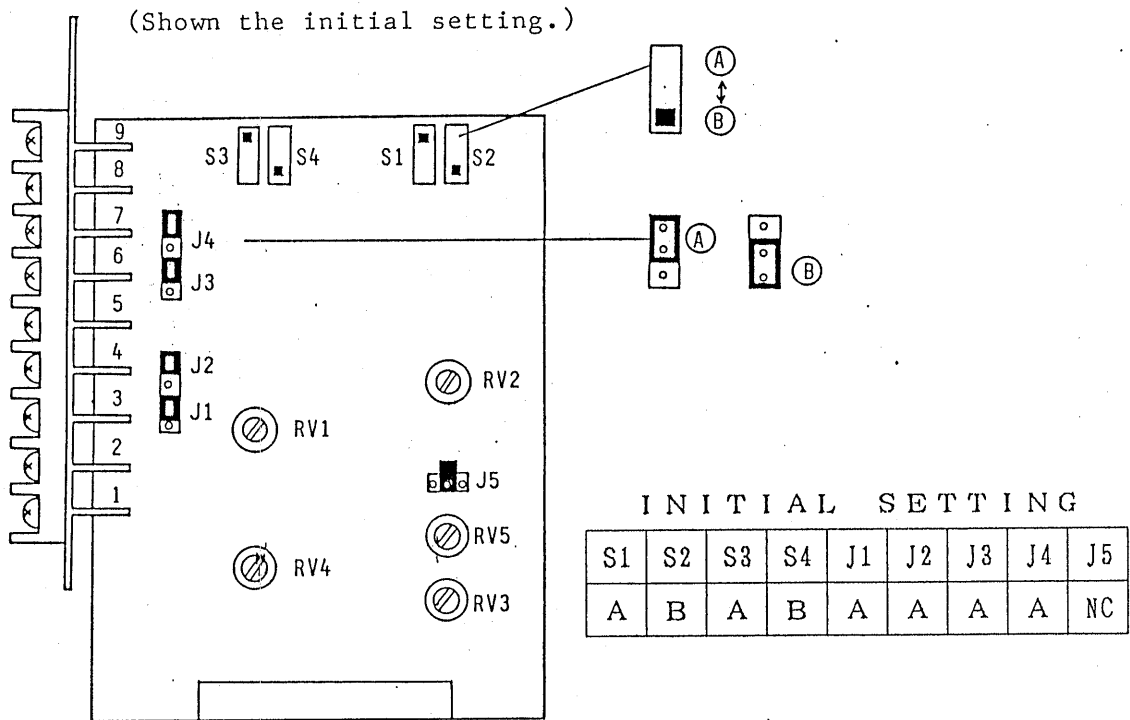
2. Control of output current by external voltage (Common (+S))
3. One-control parallel operation (the setting need not be changed)
4. One-control serial operation (the setting need not be changed)

Note: To control the output voltage/current by external resistance, remove the cover from the main frame and manipulate the relevant switches.

To execute the common convert operation, disconnect the APO-R1 from the main frame and switch jumpers.

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2. PARTS LOCATION



S1: Input voltage switch for regulated voltage (Internal reference voltage ↔ External voltage)

S2: Feedback resistance switch for regulated voltage (Internal resistance ↔ External resistance)

S3: Input voltage switch for regulated current (Internal reference voltage ↔ External voltage)

S4: Feedback resistance switch for regulated current (Internal resistance ↔ External resistance)

J1: Common converter switching jumper for regulated voltage

J2: Common converter switching jumper for regulated voltage

J3: Common converter switching jumper for regulated current

J4: Common converter switching jumper for regulated current

J5: Common converter selection jumper (voltage, current, invalid)

RV1: Resistor for fine adjustment of output regulated current

RV2: Resistor for fine adjustment of output regulated voltage

RV3: Common converter circuit adjustment resistor

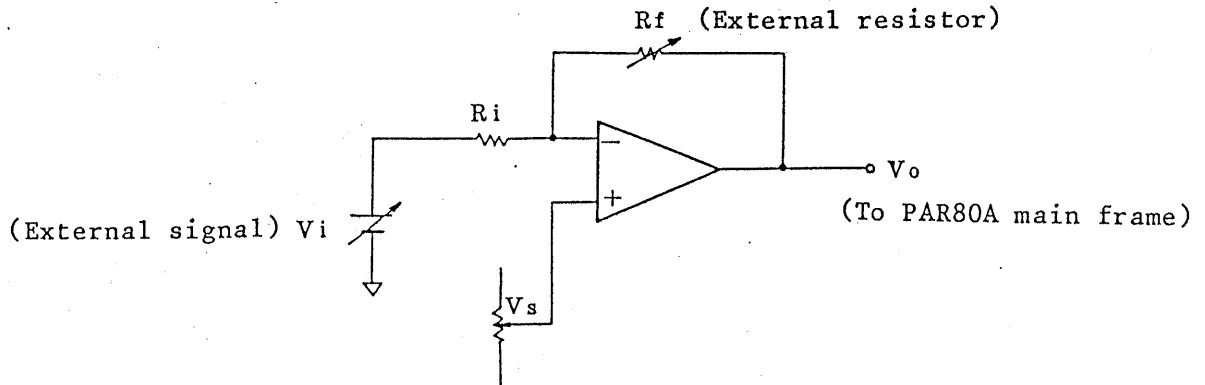
RV4: Common converter circuit adjustment resistor

RV5: Common converter circuit adjustment resistor

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3. OFFSET ADJUSTMENT

If the input signal has a plus offset or if a variable resistor having residual resistance is used as external resistor, the output voltage and current will also have residuals. If this is a problem, adjust the offset by the offset control dials on the front panel. The input/output relational formula for adjusting offset is as follows:



$$V_o = \frac{R_f}{R_i} V_i + \left(1 + \frac{R_f}{R_i}\right) V_s$$

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4. CONTROL OF REGULATED VOLTAGE BY EXTERNAL VOLTAGE

Set the switches and jumpers on the control board as follows:

S1	S2	S3	S4	J1	J2	J3	J4	J5
A	B	A	B	A	A	A	A	NC

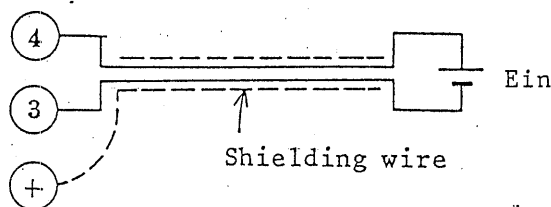
Input a signal voltage between (3) and (4) paying attention to the polarity.

- * The input resistance between (3) and (4) is approximately $10k\Omega$.
- * The relationship between the input signal voltage and output regulated voltage is as follows:

$$E_{out} = 8E_{in}$$

where E_{out} = Output voltage (V)

E_{in} = Input signal voltage (V)



- * Use a shielding wire for wiring, and connect its housing net to the (+) terminal.
- * The maximum input signal voltage is 10.5V. Be sure to observe this regulation.

Set the CONTROL switch (C.V) on the front panel to the REM position, and the output voltage can be controlled by the control board described above; set it to the LOC position, and the output voltage is to be controlled by the voltage control dial on the front panel.

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5. CONTROL OF REGULATED VOLTAGE BY EXTERNAL RESISTANCE

Set the switches and jumpers on the control board as follows:

S1	S2	S3	S4	J1	J2	J3	J4	J5
B	A	A	B	A	A	A	A	NC

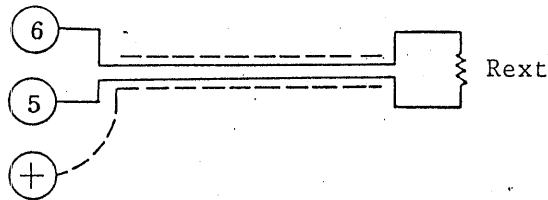
Connect an external resistor between (5) and (6).

* The relationship between the resistance and output voltage is as follows:

$$E_{out} \approx 8R_{ext}$$

where E_{out} = Output voltage (V)

R_{ext} = External resistance ($k\Omega$)



- * Use a shielding wire for wiring, and connect its housing net to the (+) terminal.
- * The maximum external resistance is 10k Ω . Be sure to observe this regulation.
- * When the external resistance is to be changed by a switch, use a closed-circuit-type switch to prevent open circuit between (5) and (6).

Set the CONTROL switch (C.V) on the front panel to the REM position, and the output voltage can be controlled by the control board described above; set it to the LOC position, and the output voltage is to be controlled by the voltage control dial on the front panel.

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6. CONTROL OF REGULATED CURRENT BY EXTERNAL VOLTAGE

Set the switches and jumpers on the control board as follows:

S1	S2	S3	S4	J1	J2	J3	J4	J5
A	B	A	B	A	A	A	A	NC

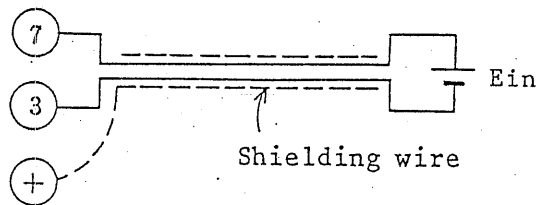
Input a signal voltage between ③ and ⑦ paying attention to the polarity.

- * The input resistance between ③ and ⑦ is approximately 10kΩ.
- * The relationship between the input signal voltage and output current is as follows:

$$I_{out} \approx E_{in}$$

where I_{out} = Output current (A)

E_{in} = Input signal voltage (V)



- * Use a shielding wire for wiring, and connect its housing net to the (+) terminal.
- * The maximum input signal voltage is 10.5V. Be sure to observe this regulation.

Set the CONTROL switch (C.C) on the front panel to the REM position, and the output current can be controlled by the control board described above; set it to the LOC position, and the output current is to be controlled by the current control dial on the front panel.

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7. CONTROL OF REGULATED CURRENT BY EXTERNAL RESISTANCE

Set the switches and jumpers on the control board as follows:

S1	S2	S3	S4	J1	J2	J3	J4	J5
A	B	B	A	A	A	A	A	NC

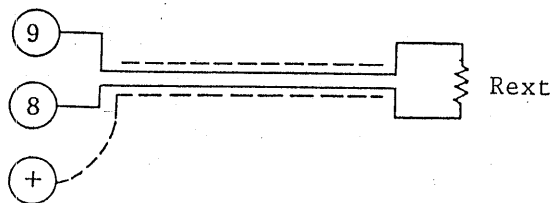
Connect an external resistor between ⑧ and ⑨.

* The relationship between the resistance and output current is as follows:

$$I_{out} \approx R_{ext}$$

where I_{out} = Output current (A)

R_{ext} = External resistance (k Ω)



- * Use a shielding wire for wiring, and connect its housing net to the (+) terminal.
- * The maximum external resistance is 10k Ω . Be sure to observe this regulation.
- * If the external resistance is to be changed by a switch, use a closed-circuit-type switch to prevent open circuit between ⑧ and ⑨.

Set the CONTROL switch (C.C) on the front panel to the REM position, and the output current can be controlled by the control board described above; set it to the LOC position, and the output current is to be controlled by the current control dial on the front panel.

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8. COMMON CONVERT FUNCTION

Normally, the common terminal of the external voltage to control output voltage/current is +S, but that to control only the output voltage or the output current may be converted to any desired point.

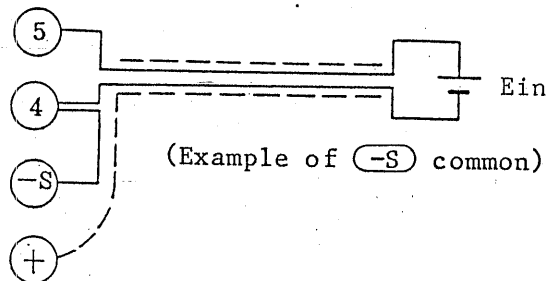
- (1) To convert common terminal for controlling output voltage.

Set the switches and jumpers on the control board as follows:

S1	S2	S3	S4	J1	J2	J3	J4	J5
A	B	A	B	B	B	A	A	A

Connect (4) to the desired point to be used as common terminal (e.g. (-S)).

Apply external voltage between (4) and (5) paying attention to the polarity.



The relationship between the external voltage and output voltage is as follows:

$$E_{out} \approx 8E_{in}$$

where E_{out} = Output voltage (V)

E_{in} = External input voltage (V)

- (2) To convert common terminal for controlling output current

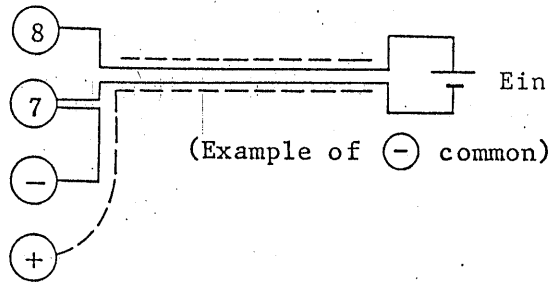
Set the switches and jumpers on the control board as follows:

S1	S2	S3	S4	J1	J2	J3	J4	J5
A	B	A	B	A	A	B	B	B

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Connect ⑦ to the desired point to be used as common terminal (e.g. ⊖), and apply external voltage between ⑦ and ⑧ paying attention to the polarity.



The relationship between the external voltage and output current is as follows:

$$I_{out} \approx E_{in}$$

where I_{out} = Output current (A)

E_{in} = External input voltage (V)

Note: Use a shielding wire for wiring, and connect its housing net to the ⊕ terminal.

The maximum input signal voltage is 10V. Be sure to observe this regulation.

The input resistance is approximately 100kΩ. As the input signal source, use a circuit, such as an operational amplifier, that has the capacity of absorbing the current of 1mA or more.

Be careful not to open the input terminal. If it is opened, excessive voltage/current will be output.

Set the CONTROL switch (C.V) on the front panel to the REM position, and the output voltage/current can be controlled by the control board described above; set it to the LOC position, and the output voltage/current is to be controlled by the voltage/current control dial on the front panel.

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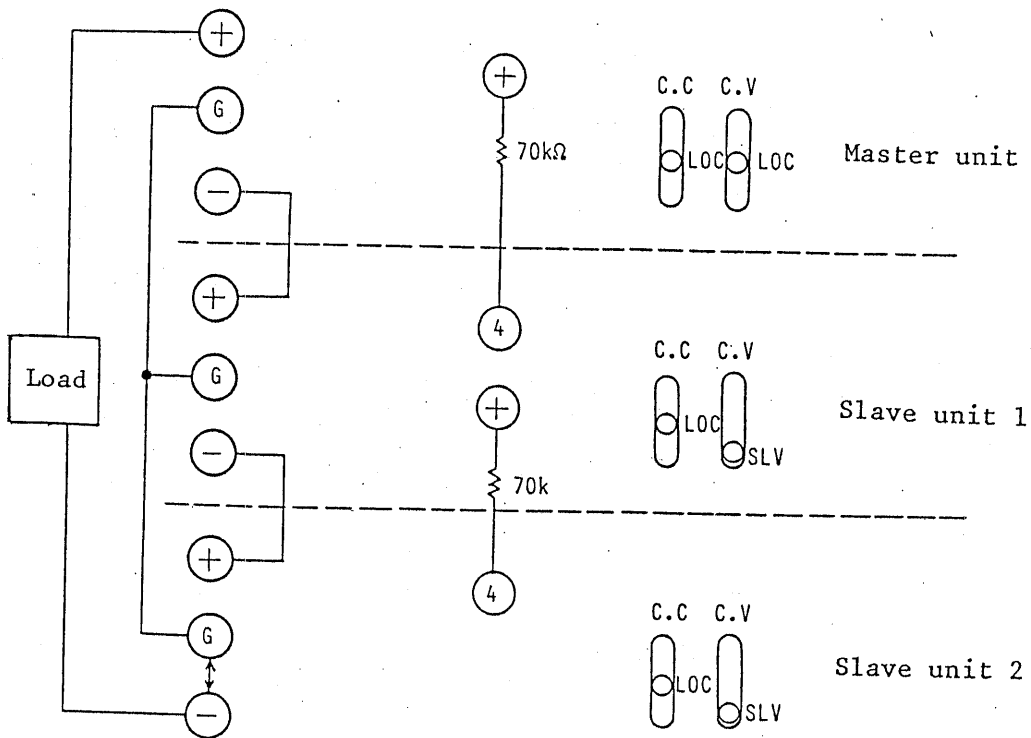
9. ONE-CONTROL SERIAL OPERATION

To obtain high voltage, up to three power supply units may be connected serially. The voltage can be controlled only by the operation on the master unit.

- Set the switches and jumpers on the control board of each slave unit as follows:

S1	S2	S3	S4	J1	J2	J3	J4	J5
A	B	AorB	AorB	A	A	A	A	NC

- Set the CONTROL switch (C.V) on the front panel of each slave unit to the SLV position.
- Connect (+) on the rear panel of master unit to (4) of each slave unit via a resistor of $70k\Omega$ ($1/2W$, $50ppm/^\circ C$).
- Remove the short-circuit bars on the front panels, connect the GND terminals to each other, and further connect them to a desired potential terminal.



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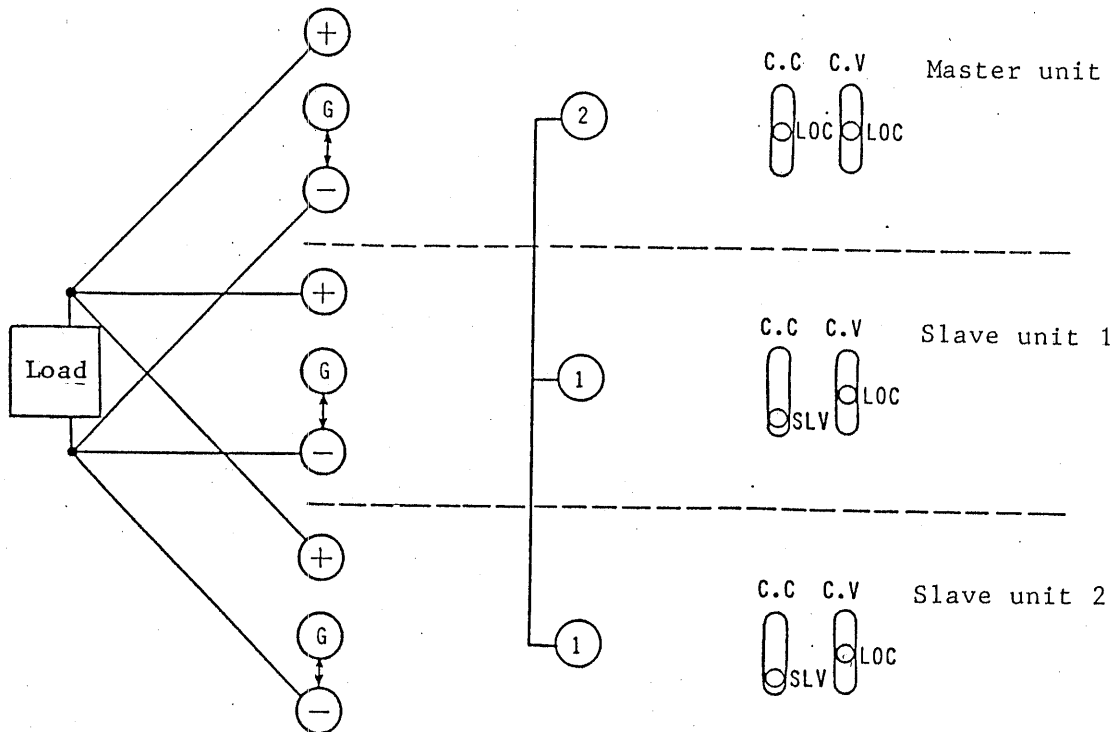
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- Turn on the power switches of the slave units and master unit in this order. Then, turn on the output switches also.

10. ONE-CONTROL PARALLEL OPERATION

To obtain great current, up to three power supply units may be connected in parallel. The current can be controlled only by the operation on the master unit.

- Set the CONTROL switch (C.C) on the front panel of each slave unit to the SLV position.
- Connect terminal ② of master unit to terminal ① of each slave unit.
- Connect the output terminals of each unit to the load, using the wires of the same length and thickness.



- Turn the power on for the slave units and master unit in this order, and turn it off in the reverse order. If the power is turned on only for the master unit, the current approximately 5% greater than that indicated by the ammeter of the master unit flows.

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11. OUTPUT CURRENT READ OUT

Since terminal ② is the current detection circuit output terminal, the user can know the output current by the voltage at this terminal.

The power supply unit is adjusted so that the voltage at terminal ② based on terminal ③ will be -10V when the output current is 10A.

Note 1: A warm-up drift occurs because of the self-heating of the current detection resistor. Therefore, the above value of -10V is obtained after the warm-up period of 20 or more minutes with the current of 10A.

Note 2: To read the voltage at terminal ②, use a unit having the input impedance of $50k\Omega$ or higher. If a unit having extremely low resistance is connected to terminal ②, an excessive current will flow.

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