PBA / ACE series Application Circuit 2006/2007

COSEL CO., LTD

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COSEL

PBA / ACE series Application Circuit

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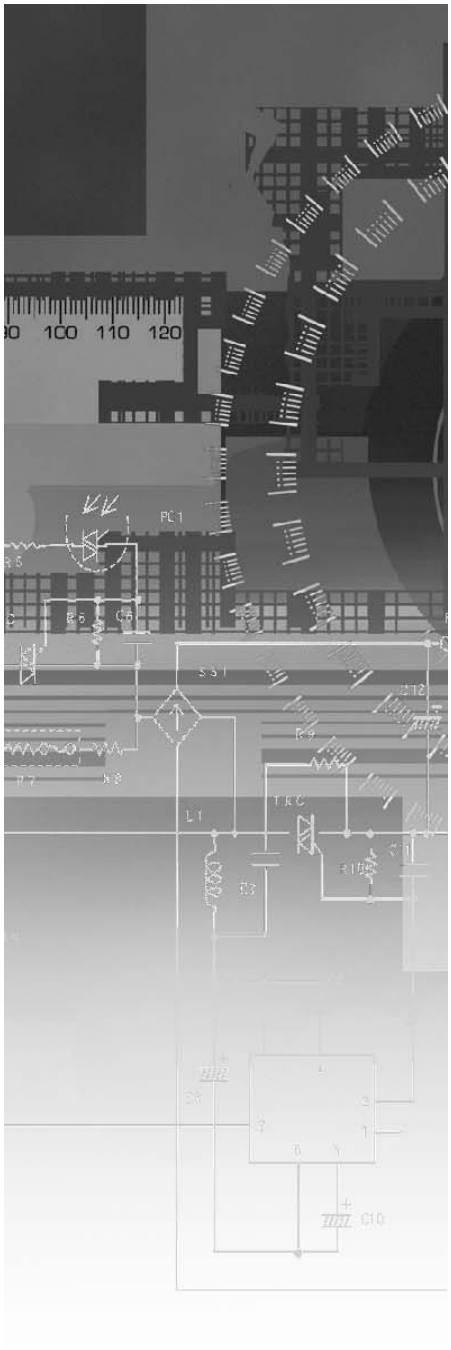


- Redundancy operation for PBA series -

As for the PBA series (PBA300F ~ 1500F and 1500T), parallel redundancy operation is available to improve a system reliability (Back-up operation). Also N+1 redundancy operation is available to build a reliable system with minimum required units.

Feature of each method

In PBA300F ~ 1500F and 1500T series, three different kinds of way are available as following.

Method ① : Redundancy operation with external diode
Method ② : Redundancy operation with current sharing
(N+1 redundancy)
Method ③ : Redundancy operation with optional harness (H-PA-3)
(N+1 redundancy)

Table1. Redundancy availability

A way of redundancy	Failure happened at;		
	Primary side	Secondary power block	Secondary Control part
Method ①	available	available	available
Method ② (N+1)	available	available	N/A
Method ③ (N+1)	available	N/A	N/A

* N+1 redundancy
If you add one extra power supply in parallel operation, even if one of the power supplies in your system fails, the remaining non-failed power supplies continue to sustain the system.

* Hot-swap or Hot-plug is not available.

①Redundancy operation with external diode

■ Circuit

PBA300F ~ 1500F and 1500T, example circuit for redundancy operation is shown below.

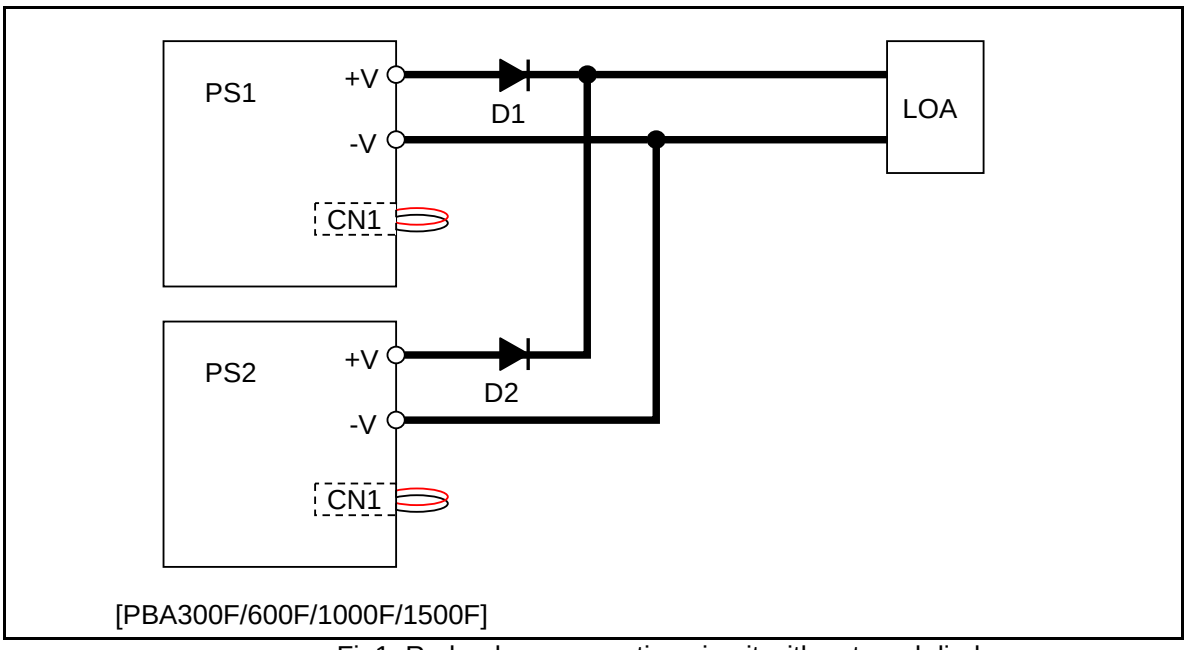


Fig1. Redundancy operation circuit with external diode

■ Explanation of Operation

In this method, output power is provided by one back-up unit if the failure happened at one of power supply. And this method is effective to be recovered from all failure modes, such as failure at primary / secondary circuit.

The external diode is required to prevent influence from failure unit.

This method is the most reliable connection in redundancy connection.

Since there is no current sharing, output current is not balanced between PS1 and PS2. Therefore, this method can not be used for increasing power.

A Reference value for D1 and D2.
*D1 and D2 are same value.
Rated current :
Double of power supply's rated current
Rated voltage :
Double of power supply's rated voltage

D1 and D2 dissipate heat by output current. Therefore, heat-sink would be required for cooling.

Output voltage will be dropped by D1, D2. Adjust each output voltage higher by internal potentiometer if required, and also adjust them to be the same value.

■ Note

The power that load requires must be rated power or less of one unit.
Load < Rated power of one unit

②Redundancy operation with current sharing

■ Circuit

PBA300F ~ 1500F and 1500T, example circuit for redundancy (N+1) operation is shown below.

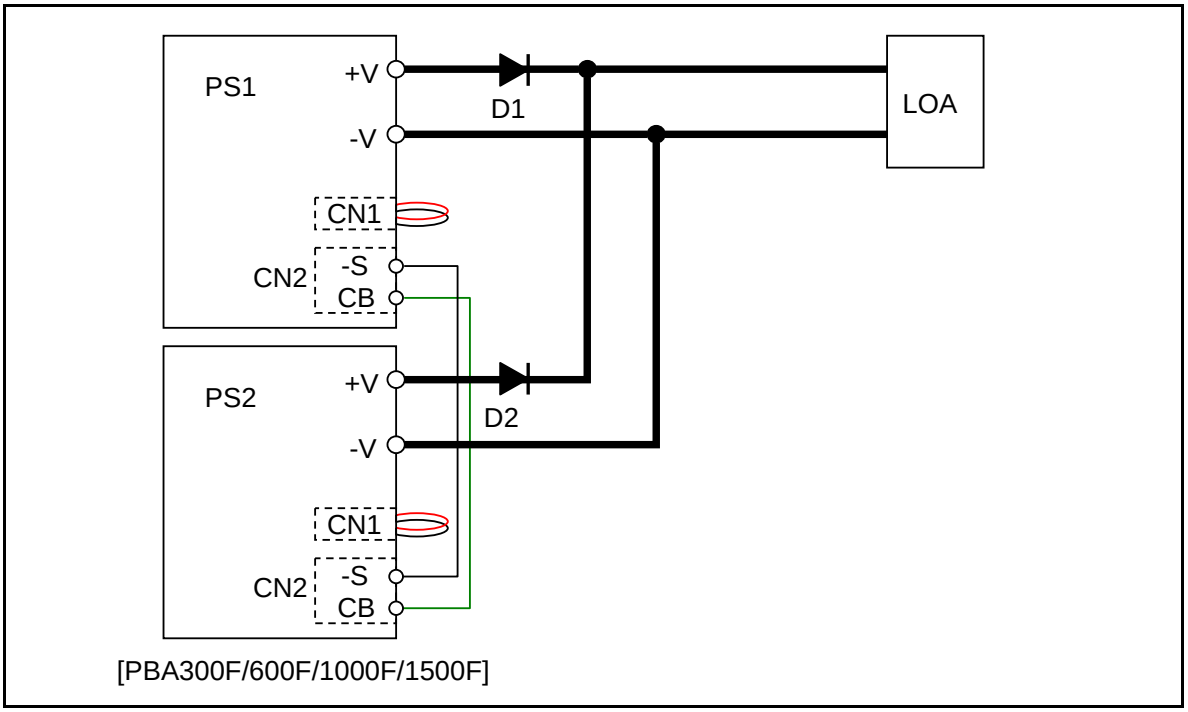


Fig2. Redundancy operation with current sharing

■ Explanation of Operation

In this method, output power is provided by one back-up unit if the failure happened at one of power supply. And this method will recover from all failure modes except CB circuit failure. CB terminal is used for current sharing.

The external diode is required to prevent influence from failure unit.

The advantage of this method is that output current of each power supplies can be balanced in this method.

(Output current in parallel operation) =
(Rated current per unit)x(Number of units)x0.9

A Reference value for D1 and D2.
*D1 and D2 are same value.
Rated current :
Double of power supply's rated current
Rated voltage :
Double of power supply's rated voltage

D1 and D2 dissipate heat by output current. Therefore, heat-sink would be required for cooling.

■ Note

Differences in the output current values among the power supplies in parallel connection are 10% at most. Please make sure that the sum of the output current values does not exceed a value obtained from the right side of the following equation.

Output voltage will be dropped by D1, D2. Adjust each output voltage higher by internal potentiometer if required, and also adjust them to be the same value.

If one of the power supplies stops operating, the output voltage may change about 5% appx.

③Redundancy operation with optional harness (H-PA-3)

■ Circuit

PBA300F ~ 1500F and 1500T, example circuit for redundancy (N+1) operation with H-PA-3 is shown below.

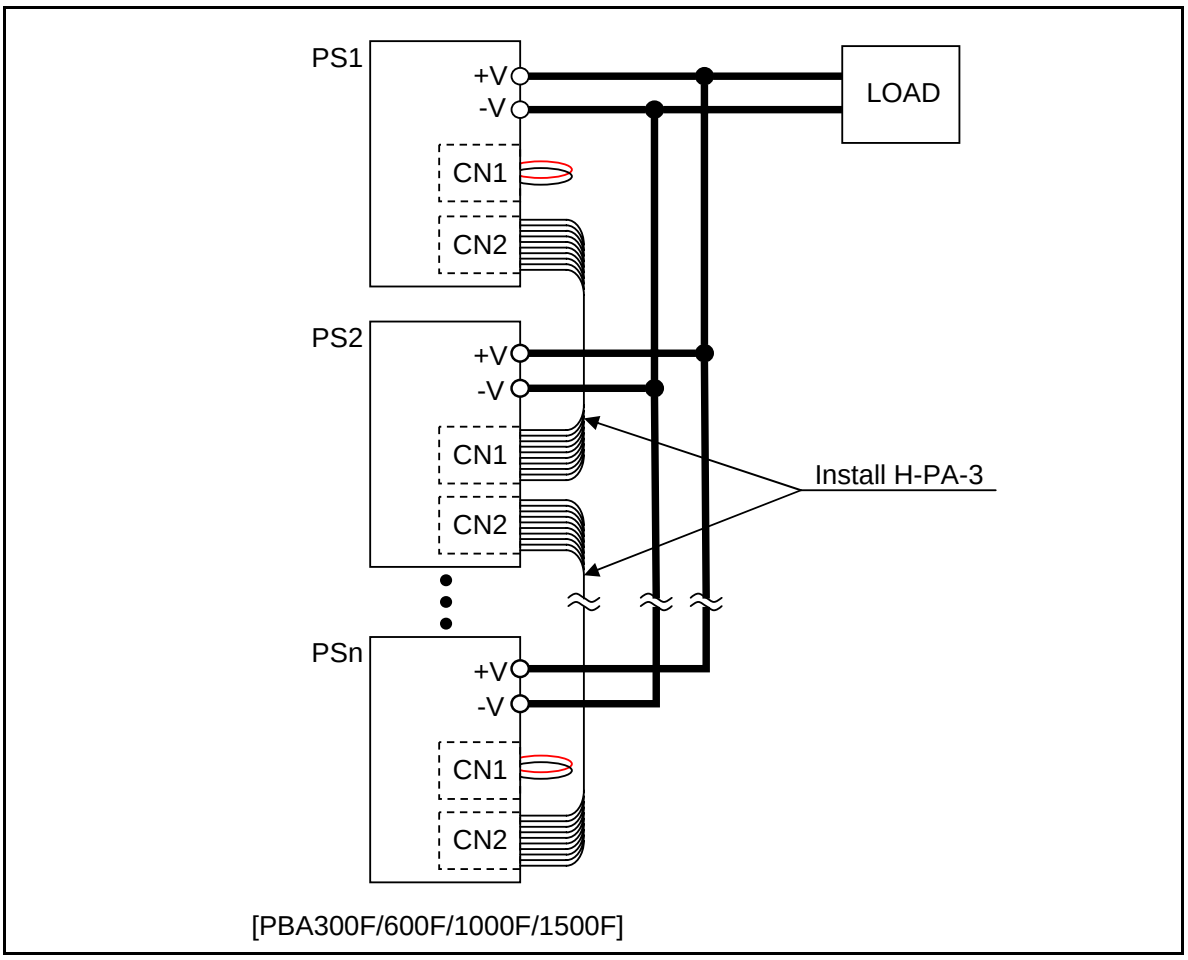


Fig3. Parallel redundancy operation with H-PA-3

■ Explanation of Operation

Option harness H-PA-3 is available for redundancy operation. In this method, the external diode should not be used for stable operation. Therefore, this method will recover from primary circuit failure only. If the failure happened at one of power supply, output power is provided by the rest of unit with current sharing.

■ Note

If one of the power supplies stops operation, the output voltage may change about 5% appx.

When unit replacement is required due to unit failure, input voltage for all units must be cut off. After replaceement, input-line, output-line and H-PA-3 must be connected correctly, before re-applying input voltage.

- Output voltage adjustment -

Table of contents

1. Introduction

The output voltage in PBA / ACE series can be adjusted from 0Vdc approximately by adding external circuit. The main feature of each series is shown below.

*PBA series is suitable for general application which requires voltage swing.
*ACE series is suitable for the application which requires voltage swing and multi output.
*ACE series -H option is for medical application.

Next, the basic method changing the output voltage in each series is shown below.

■PBA300F ~ 1500F, 1500T series

PBA300F ~ 1500F and 1500T series have TRM terminal to control the output voltage.

When the voltage of the terminal TRM is 2.5Vdc, the output voltage becomes the rated output. voltage. By applying voltage to this TRM terminal, the output voltage can be adjusted from 0Vdc approximately.

The output voltage can be calculated in this case from equation below.

$$\text{Output voltage} = \frac{\text{The voltage between TRM and -S [V]}}{2.5\ [\text{V}]} \times \text{rated output voltage}$$

Please note that power supply might stop its operation or PG alarm will output, if the output voltage reaches less than 10% of rated voltage.

Output voltage adjustment range:
Minimum: 10% of rated output voltage
Maximum: See Table1-1

Table1-1 Output voltage adjustment range

No.	Rated output voltage [V]	Adjustment range [V]		
		Min.		Max.
1	3.3	0.33	-	3.96
2	5	0.50	-	6.00
3	7.5	0.75	-	8.25
4	12	1.20	-	13.20
5	15	1.50	-	16.50
6	24	2.40	-	26.40
7	36	3.60	-	39.60
8	48	4.80	-	56.00

■ACE series

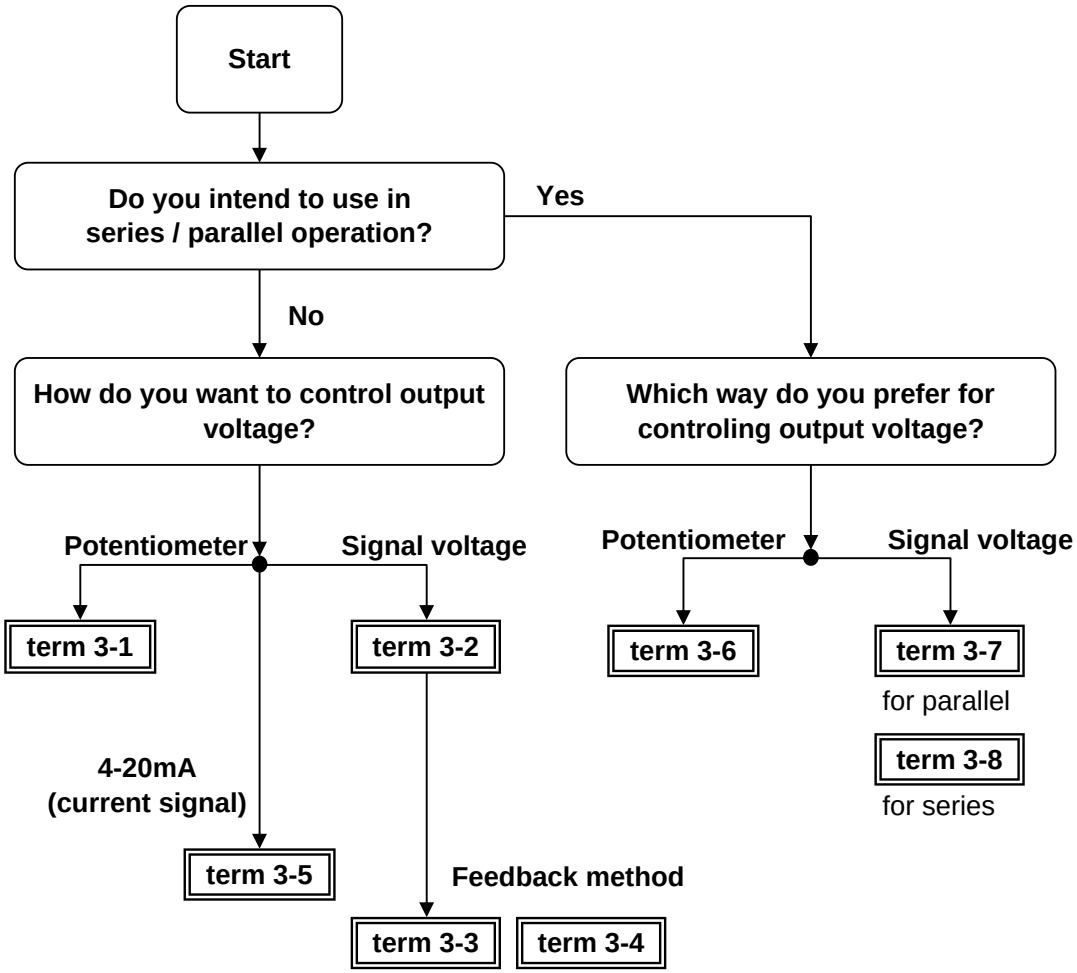
[available for module code:A-K,2A-2K]

ACE series don't have the terminal to control output voltage like TRM terminal. Therefore, in ACE series, the monitoring and the remote sensing terminals (-M and -S) is used to change the output voltage.

When the voltage between the terminal -S and -M(-V) is 0V, the output voltage becomes the rated voltage. And, in case that the rated voltage is applied to this terminals, the output voltage can be adjusted to 0Vdc approximately.

2. External Circuit Selection Flow Chart

■PBA seriess [available for PBA300F ~ 1500F and 1500T series]



■ACE series [available for module code:A-K,2A-2K]

Refer to term 4.

3. PBA300F ~ 1500F and 1500T series

3-1.Output Voltage Adjustment by External Potentiometer

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for output voltage adjustment by external potentiometer is shown below.

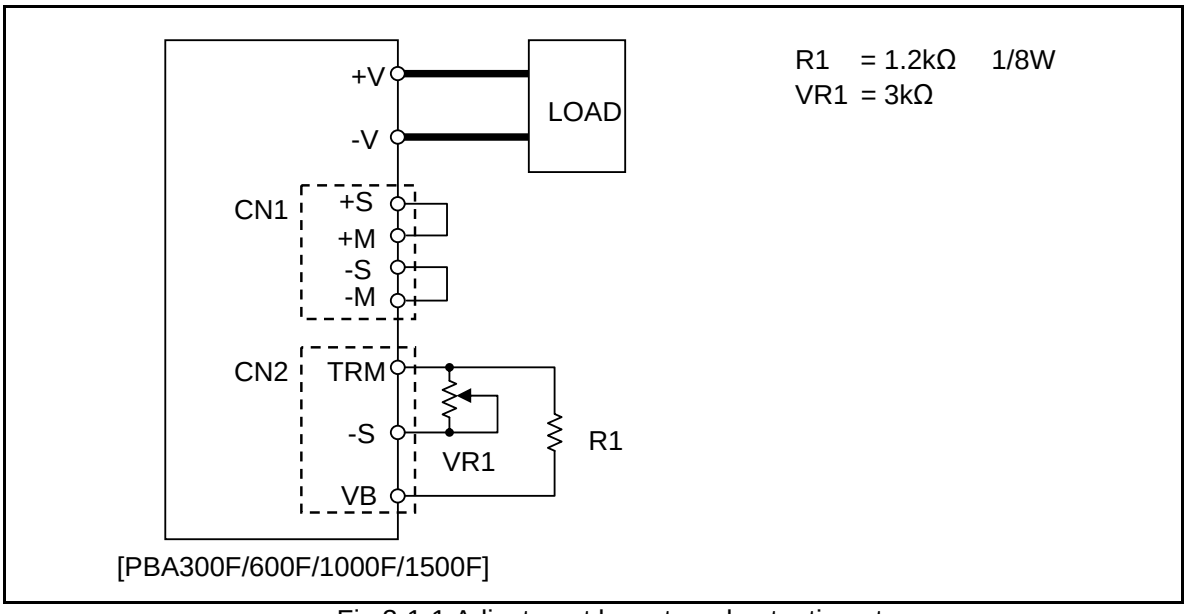


Fig.3-1-1 Adjustment by external potentiometer

■ Explanation of Operation

VB provides stable 5Vdc. If it is divided by resistor (R1) and potentiometer (VR1), and applied to TRM, the output voltage can be adjusted.

Please note that if the external circuit is removed, the voltage higher than rated voltage might be generated, and it would cause the unit shut-down by overvoltage protection circuit.

■ Note

Output voltage adjustment range:
Minimum: 10% of rated output voltage
Maximum: See Table1-1

Potentiometer (VR1) : 3kΩ
Cermet type, coefficient less than ±300ppm/°C
Resistor (R1) : 1.2kΩ, 1/8W or more
Metal film type, coefficient less than ±100ppm/°C

Please note that internal potentiometer should not be adjusted because there is possibility the intented voltage could not be set up correctly.

CN1, CN2 are connected each other internally. Therefore, it is also possible to connect external circuit on CN1.

■ Characteristic

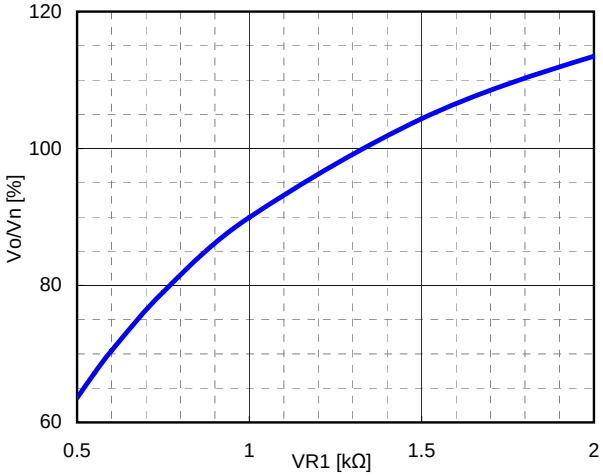


Fig.3-1-2 VR1 - Vo/Vn

*Vn : Rated output voltage
*Vo : Adjusted output voltage

3-2.Output Voltage Adjustment by Signal Voltage

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for output voltage adjustment by signal voltage is shown below.

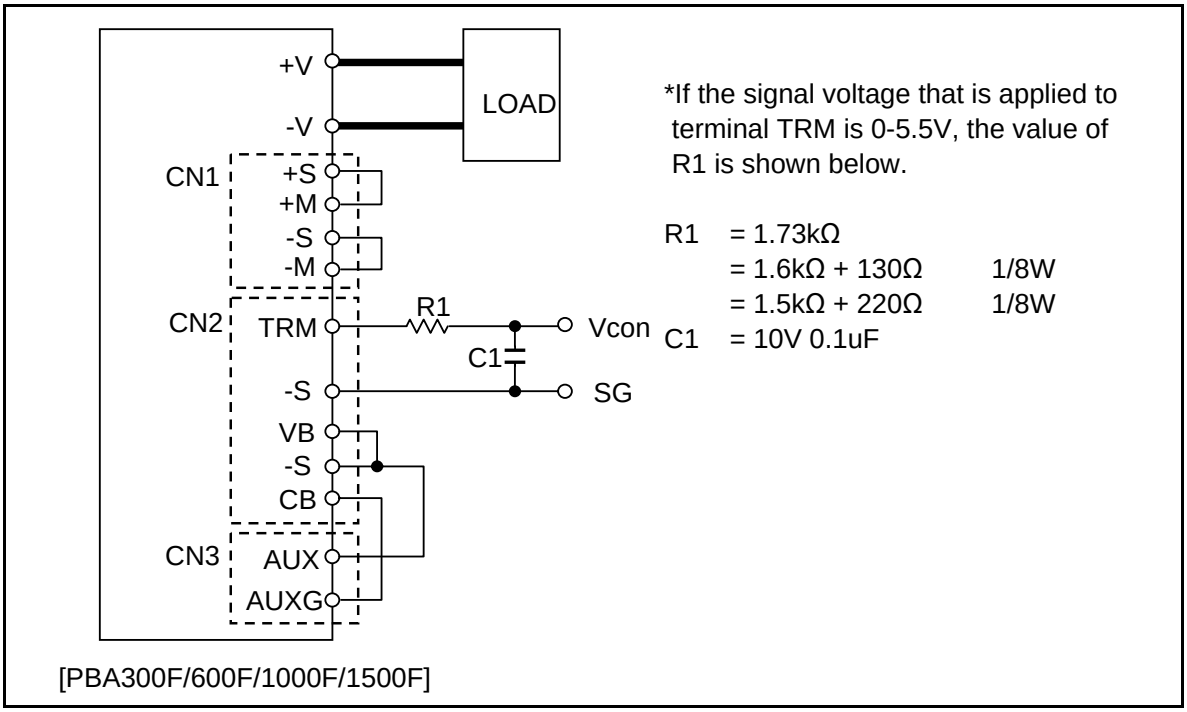


Fig.3-2-1 Adjustment by Signal Voltage

■ Explanation of Operation

The output voltage in PBA series can be adjusted from 0Vdc approximately by adding external resistor. By changing value of this external resistor, the output voltage could be adjusted by any signal voltage. And, the relationship between the external resistor and the signal voltage is shown in Fig.3-2-2.

For example, when the signal voltage is 5V, 1.73kΩ is required as external resistor. In this case, characteristic of "Vcon-Vout" is shown in Fig.3-2-3.

■ Note

Output voltage adjustment range:
*Minimum:10% of rated output voltage
*Maximum: *See Table1

CN1, CN2 are connected each other internally. Therefore, it is also possible to connect external circuit on CN1.

If signal voltage is less than 2.5V, the output voltage becomes less than the rated output voltage even if external resistor uses 0Ω.

■ Characteristic

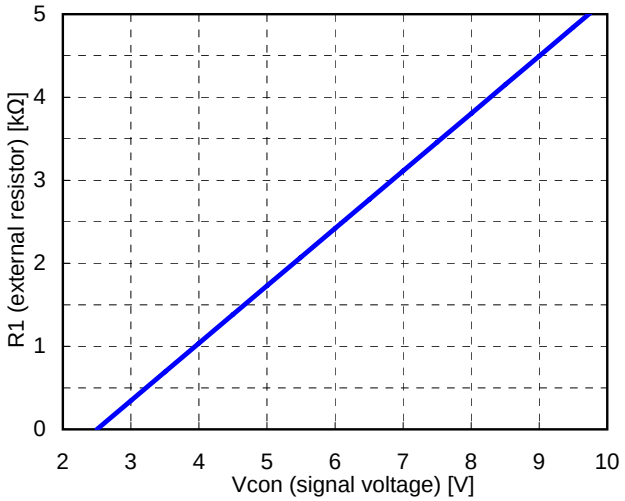


Fig.3-2-2 Vcon - R1

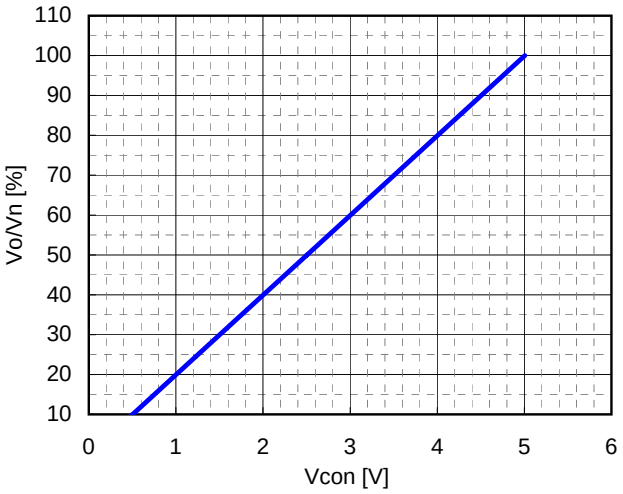


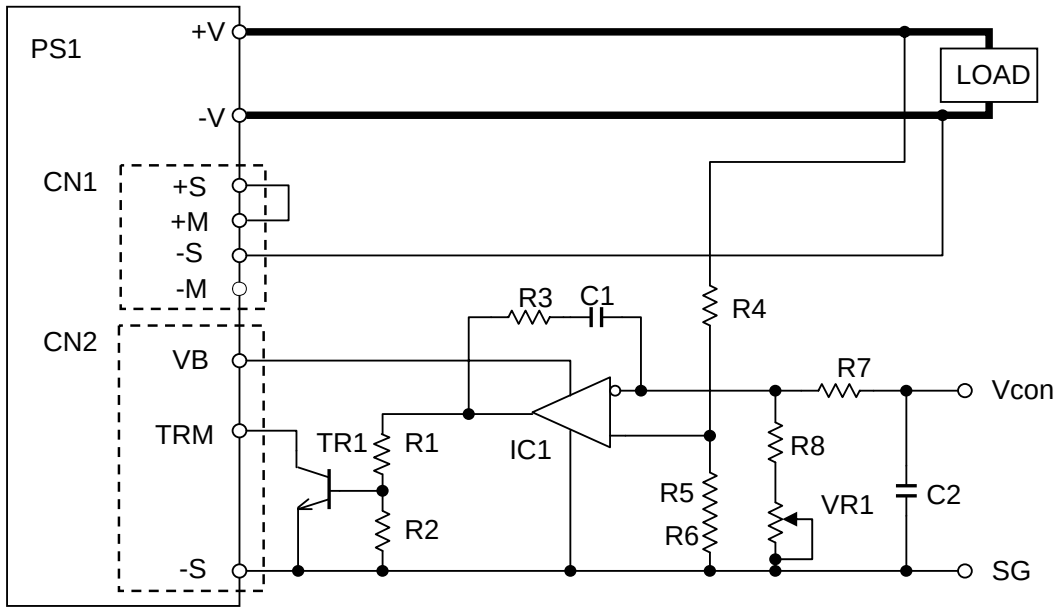
Fig.3-2-3 Vcon - Vo/Vn

*Vn : Rated output voltage
*Vo : Adjusted output voltage

3-3.Output Voltage Adjustment by Signal Voltage with Feedback

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for output voltage adjustment by signal voltage with feedback is shown below.



In case that signal voltage (Vcon) is changed in range of "0-5V", output voltage adjustment range becomes "0-12Vdc".

R1	=10kΩ, 1/8W or more	R6	=390Ω, 1/8W or more	C1	=10V, 0.47μF
R2	=4.7kΩ, 1/8W or more	R7	=10kΩ, 1/8W or more	C2	=10V, 0.1μF
R3	=10kΩ, 1/8W or more	R8	=9.1kΩ, 1/8W or more	VR1	=3kΩ, 1/8W or more
R4	=10kΩ, 1/8W or more	TR1	=20V, 0.1A or more	PS1	=PBA300F-12
R5	=2.2kΩ, 1/8W or more	IC1	=LM358 or equivalent		

Fig.3-3-1 Adjustment by signal voltage with feedback

■ Explanation of Operation

The output voltage can be adjusted by the voltage of Vcon.

In this circuit, the feedback control is used to keep the output voltage constant. Therefore, the output voltage could be high accuracy by the feedback control.

CN1, CN2 are connected each other internally. Therefore, it is also possible to connect external circuit on CN1.

Please note that if CN1 or CN2 is removed, the voltage higher than rated voltage might be generated, and it would cause the unit shut -down by over voltage protection circuit.

■ Note

Please note that internal potentiometer should not be adjusted because there is possibility the intended voltage could not be set up correctly.

If the output voltage becomes unstable when the power supply is set in your system, please try to change value of R3 or C1 bigger.

■ Characteristic

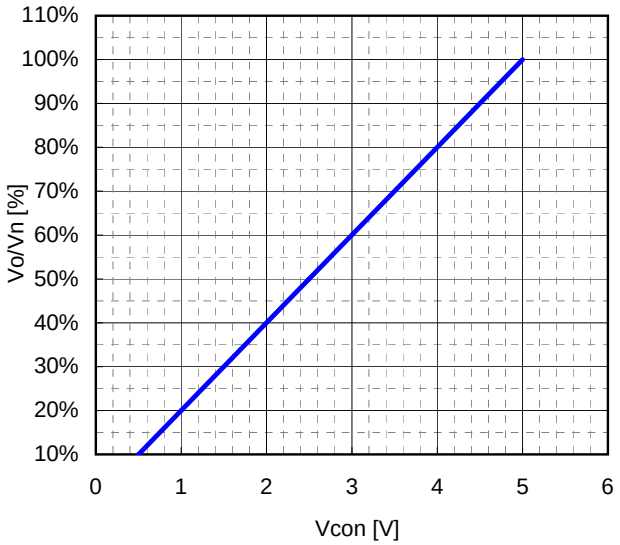


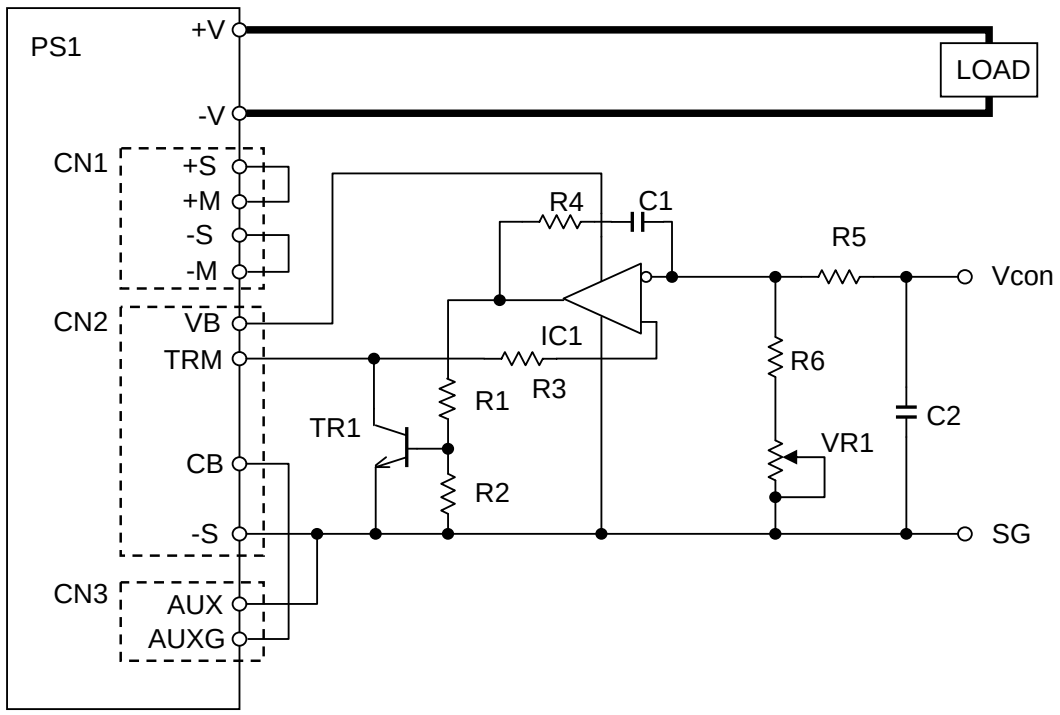
Fig.3-3-2 Vcon - Vo/Vn

*Vn : Rated output voltage
*Vo : Adjusted output voltage

3-4.Output Voltage Adjustment by Signal Voltage with Indirect Feedback

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for output voltage adjustment by signal voltage with feedback is shown below.



In case that signal voltage (Vcon) is changed in range of "0-5V", output voltage adjustment range becomes "0-12Vdc".

R1	=10kΩ, 1/8W or more	R5	=10kΩ, 1/8W or more	TR1	=20V, 0.1A or more
R2	=4.7kΩ, 1/8W or more	R6	=9.1kΩ, 1/8W or more	VR1	=3kΩ, 1/8W or more
R3	=10kΩ, 1/8W or more	C1	=10V, 0.47μF	IC1	=LM358 or equivalent
R4	=10kΩ, 1/8W or more	C2	=10V, 0.1μF	PS1	=PBA300F-12

Fig.3-4-1 Adjustment by signal voltage with feedback

■ Explanation of Operation

The output voltage can be adjusted by the voltage of Vcon.

In this circuit, IC1 compare TRM and Vcon voltage to keep the output voltage constant. TRM voltage is proportional to output voltage. Therefore, the output voltage can be controled and more stable than the circuit shown in Fig.3-3-1.

■ Note

If internal potentiometer is adjusted, the adjusted output voltage should be considered as Vn (rated output voltage).

CN1, CN2 are connected each other internally. Therefore, it is also possible to connect external circuit on CN1.

Please note that if CN1 or CN2 is removed, the voltage higher than rated voltage might be generated, and it would cause the unit shut -down by over voltage protection circuit.

If the output voltage becomes unstable when the power supply is set in your system, please try to change value of R4 or C1 bigger.

■ Characteristic

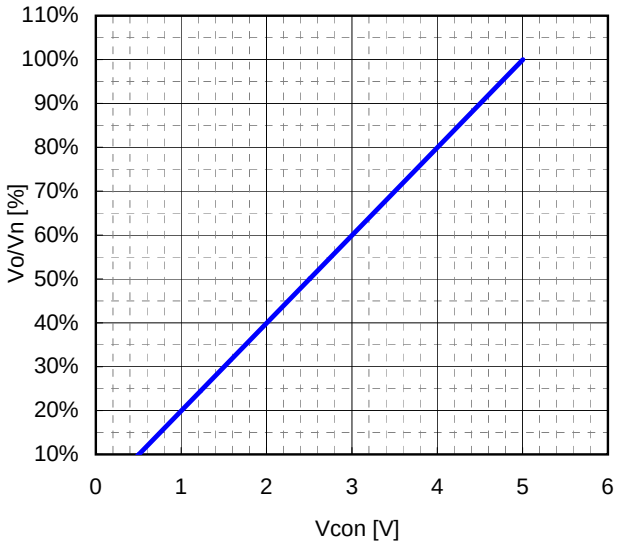


Fig.3-4-2 Vcon - Vo/Vn

*Vn : Rated output voltage
*Vo : Adjusted output voltage

3-5.Output Voltage Adjustment by 4 - 20 mA Current Signal

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for output voltage adjustment by 4 - 20 mA current signal is shown below.

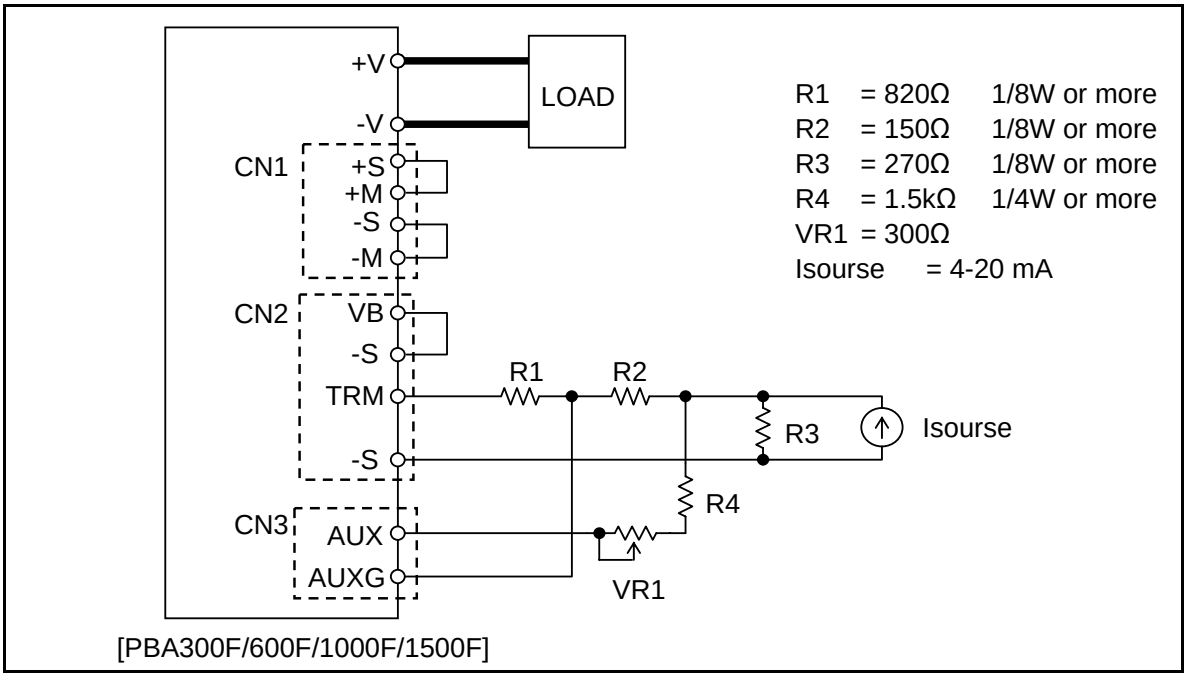


Fig.3-5-1 Adjustment by 4 -20 mA current signal

■ Explanation of Operation

The output voltage can be adjusted by 4 - 20mA current signal. When the current signal of the Isourse is 4mA, the output voltage becomes the 0V approximately. Also, the current is 20mA, the output voltage becomes the rated output voltage.

The terminal AUX always applies the constant voltage of about 12Vdc. This 12Vdc is needed to use output voltage adjustment in 4-20mA.

■ Note

Output voltage adjustment range:
*Minimum:10% of rated output voltage
*Maximum: *See Table1

Please adjust the external potentiometer so the output voltage is set to the rated voltage when signal current is about 20mA.

Please note that internal potentiometer should not be adjusted because there is possibility the intented voltage could not be set up correctly.

CN1, CN2 are connected each other internally. Therefore, it is also possible to connect external circuit on CN1.

Please note that if the external circuit is removed, the voltage higher than rated voltage might be generated, and it would cause the unit shut-down by overvoltage protection circuit.

■ Characteristic

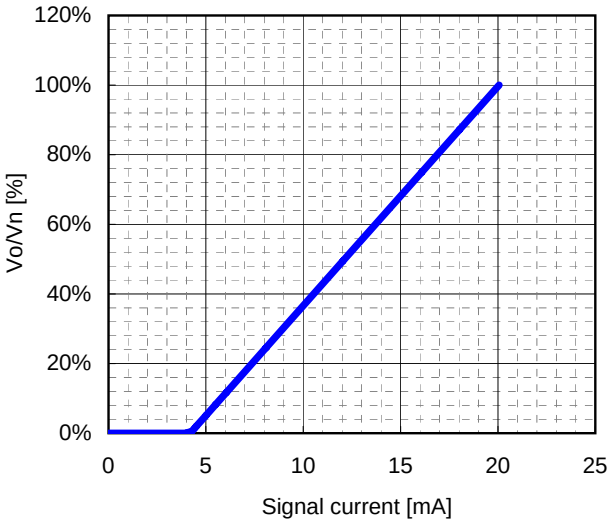


Fig.3-5-2 Signal current - Vo/Vn

*Vn : Rated output voltage

*Vo : Adjusted output voltage

3-6.Output Voltage Adjustment by External Potentiometer in Parallel Operation

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for for output voltage adjustment by external potentiometer is shown below.

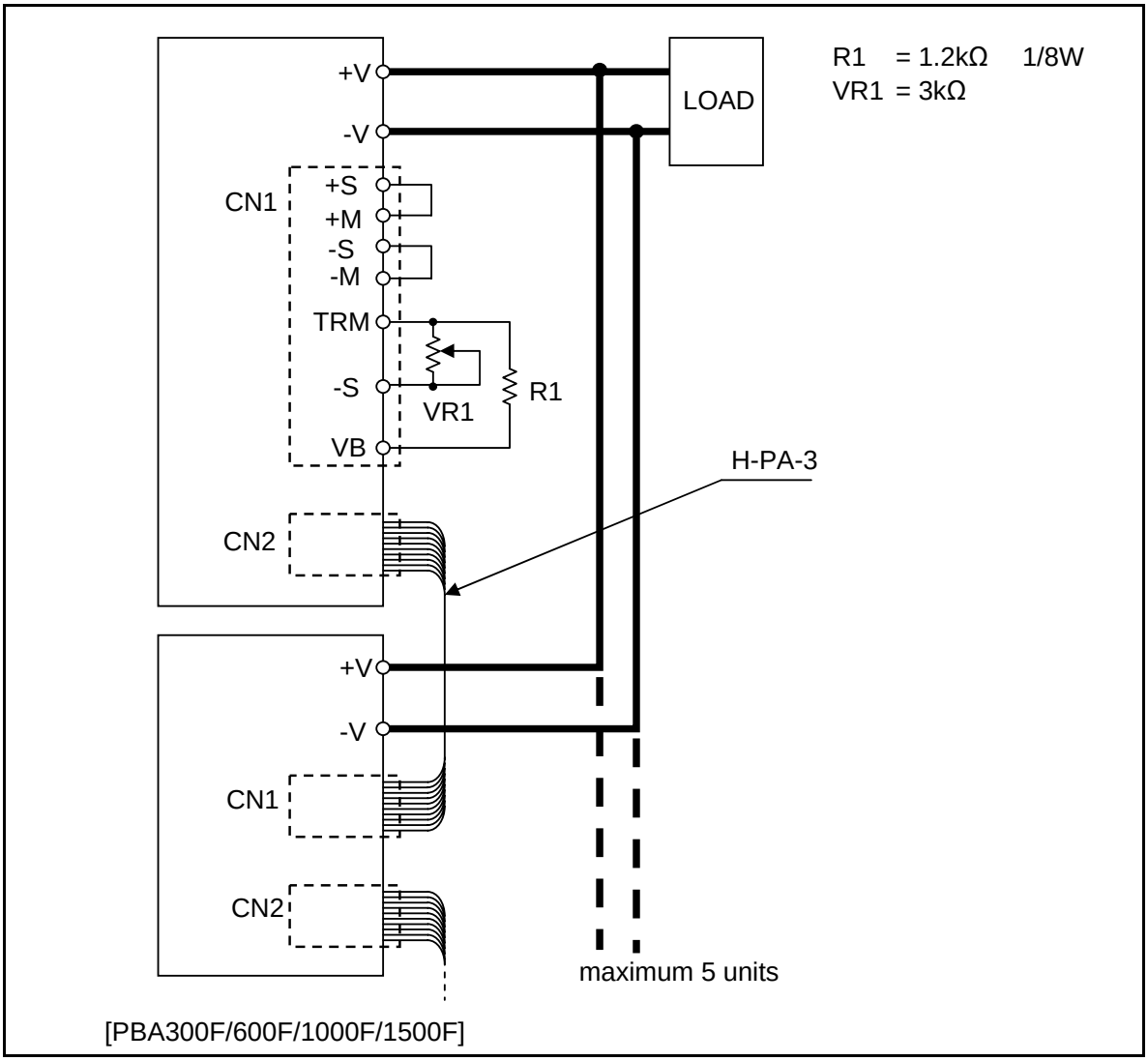


Fig.3-6-1 Adjustment by external potentiometer

■ Explanation of Operation

VB provides stable 5Vdc. If it is divided by resistor (R1) and potentiometer (VR1), and applied to TRM, the output voltage can be adjusted.

■ Note

Please parallelly connect ±S, VB and CB of each power supplies in parallel operation.
In this case, an optional harness (H-PA-3) can be used to connect each terminals.

Output voltage adjustment range:
*Minimum:10% of rated output voltage
*Maximum: *See Table1

Potentiometer (VR1) : 3kΩ
Cermet type, coefficient less than ±300ppm/°C
Resistor (R1) : 1.2kΩ, 1/8W or more
Metal film type, coefficient less than ±100ppm/°C

Please note that internal potentiometer should not be adjusted because there is possibility the intented voltage could not be set up correctly.

Please note that if the external circuit is removed, the voltage higher than rated voltage might be generated, and it would cause the unit shut-down by overvoltage protection circuit.

■ Characteristic

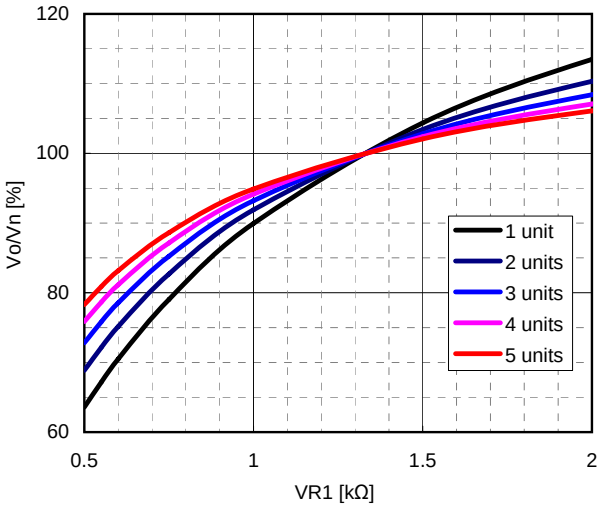
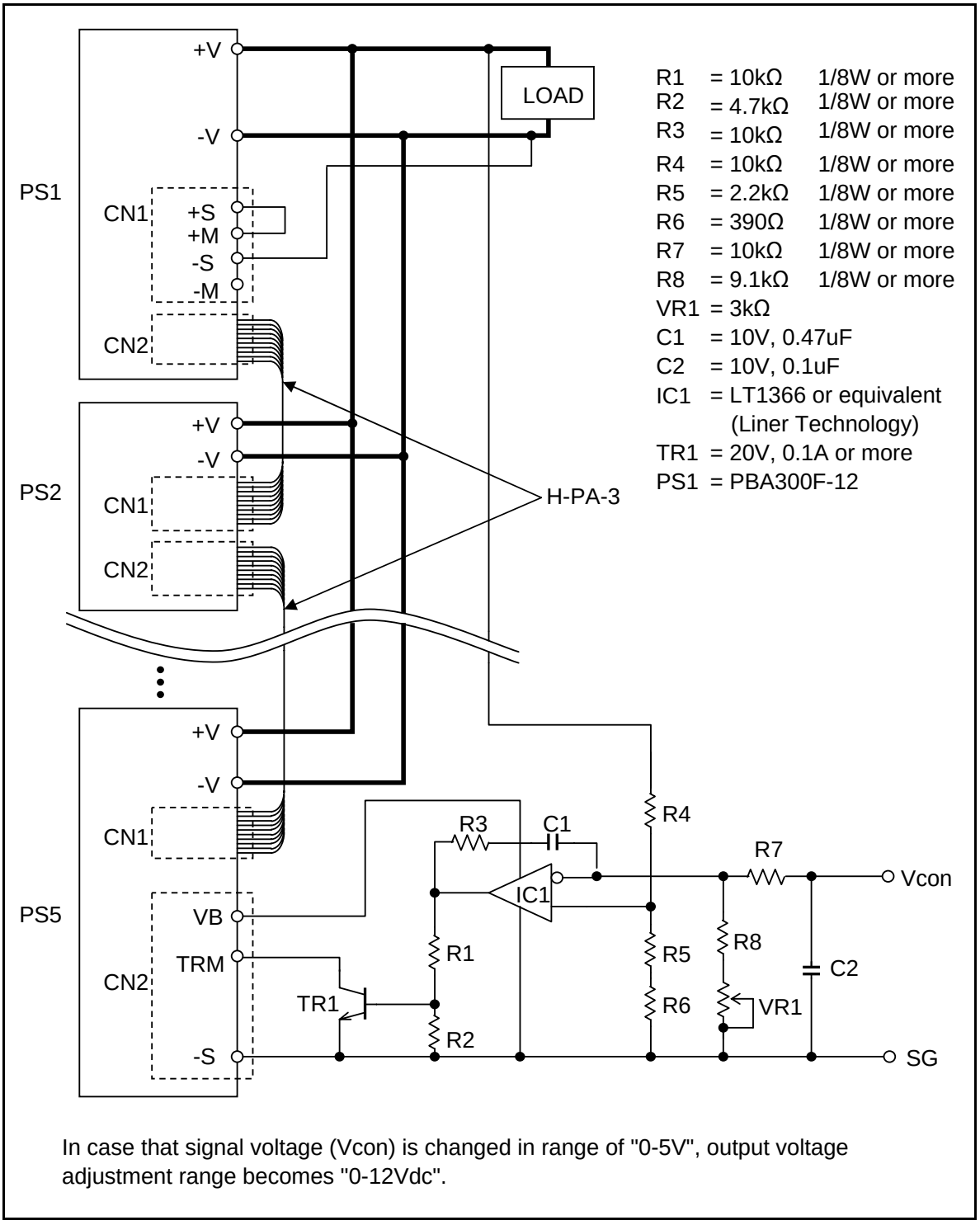


Fig.3-6-2 Vo/Vn - VR1
*Vn : Rated output voltage
*Vo : Adjusted output voltage

3-7.Output Voltage Adjustment by Signal Voltage with Feedback in Parallel Operation

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for output voltage adjustment by signal voltage with feedback is shown below.



In case that signal voltage (Vcon) is changed in range of "0-5V", output voltage adjustment range becomes "0-12Vdc".

Fig.3-7-1 Adjustment by Signal Voltage with Feedback

■ Explanation of Operation

The output voltage can be adjusted by the voltage of Vcon. In this circuit, the feedback control is used to keep the output voltage constant. Therefore, the output voltage could be high accuracy by the feedback control.

■ Note

Output voltage adjustment range:
*Minimum:10% of rated output voltage
*Maximum: *See Table1

Please note that internal potentiometer should not be adjusted because there is possibility the intented voltage could not be set up correctly.

Please note that if the external circuit is removed, the voltage higher than rated voltage might be generated, and it would cause the unit shut-down by overvoltage protection circuit.

If the output voltage becomes unstable when the power supply is set in your system, please try to change value of R3 or C1 bigger.

■ Characteristic

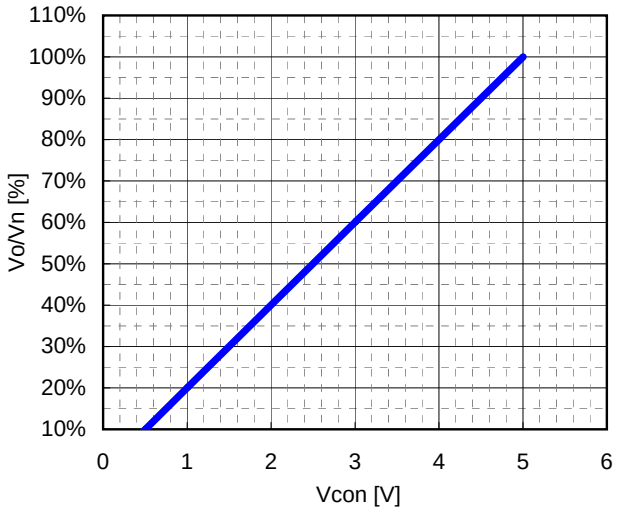
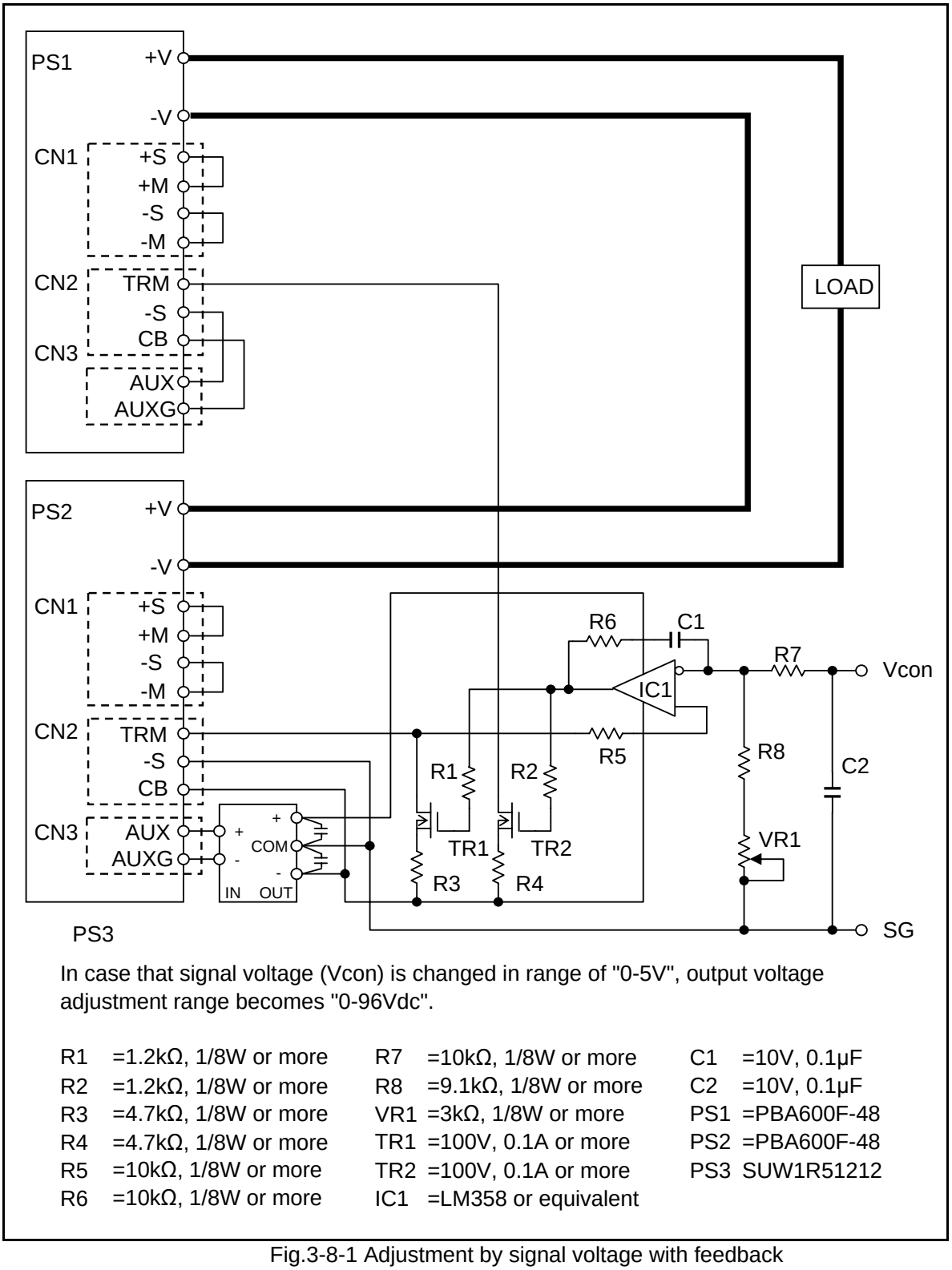


Fig.3-7-2 Vcon - Vo/Vn
*Vn : Rated output voltage
*Vo : Adjusted output voltage

3-8.Output Voltage Adjustment by Signal Voltage with Indirect Feedback in Series Operation

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for output voltage adjustment in series operation is shown below.



In case that signal voltage (Vcon) is changed in range of "0-5V", output voltage adjustment range becomes "0-96Vdc".

R1	=1.2kΩ, 1/8W or more	R7	=10kΩ, 1/8W or more	C1	=10V, 0.1μF
R2	=1.2kΩ, 1/8W or more	R8	=9.1kΩ, 1/8W or more	C2	=10V, 0.1μF
R3	=4.7kΩ, 1/8W or more	VR1	=3kΩ, 1/8W or more	PS1	=PBA600F-48
R4	=4.7kΩ, 1/8W or more	TR1	=100V, 0.1A or more	PS2	=PBA600F-48
R5	=10kΩ, 1/8W or more	TR2	=100V, 0.1A or more	PS3	SUW1R51212
R6	=10kΩ, 1/8W or more	IC1	=LM358 or equivalent		

Fig.3-8-1 Adjustment by signal voltage with feedback

■ Explanation of Operation

The output voltage can be adjusted by the voltage of Vcon.

In this circuit, IC1 compare PS1's TRM and Vcon voltage to keep the output voltage constant. TRM voltage is proportional to output voltage. Therefore, the output voltage can be controled by adjusting TRM voltage in each units concurrently.

■ Note

If internal potentiometer is adjusted, the adjusted output voltage should be considered as Vn (rated output voltage).

CN1, CN2 are connected each other internally. Therefore, it is also possible to connect external circuit on CN1.

Please note that if CN1 or CN2 is removed, the voltage higher than rated voltage might be generated, and it would cause the unit shut -down by over voltage protection circuit.

If the output voltage becomes unstable when the power supply is set in your system, please try to change value of R6 or C1 bigger.

■ Characteristic

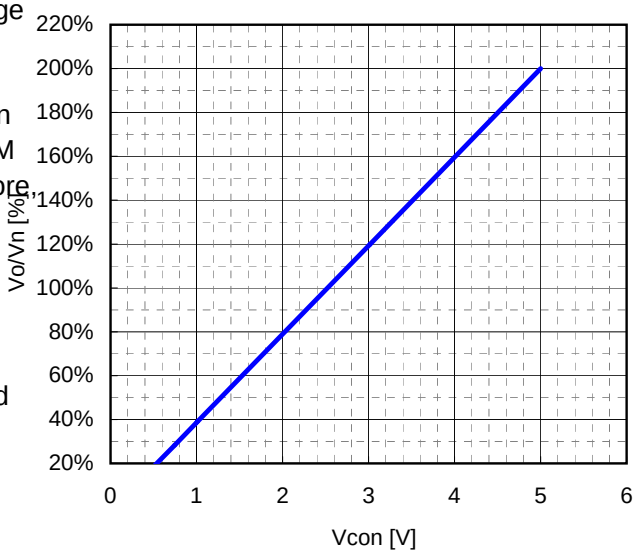


Fig.3-8-2 Vcon - Vo/Vn

*Vn : Rated output voltage
*Vo : Adjusted output voltage

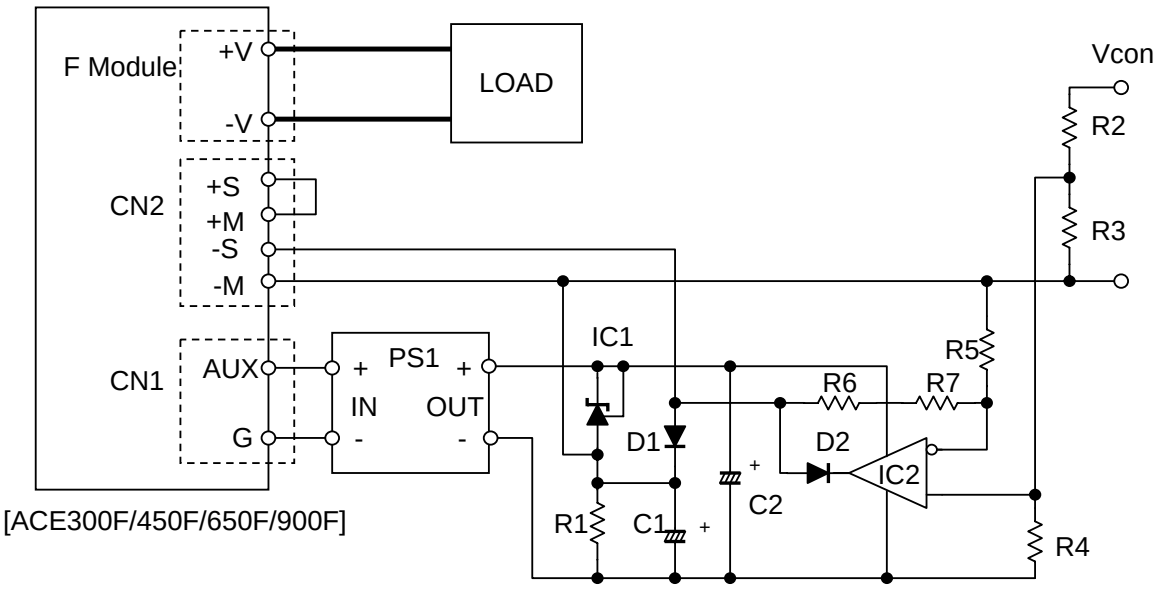
4. ACE series Output Voltage Adjustment by External Potentiometer

4-1.Output Voltage Adjustment by Signal Voltage

■ Circuit

In ACE300F/450F/650F/900F, example circuit for output voltage adjustment by external voltage is shown below.

As a reference, in case of F Module, value of output voltage adjustment circuit is shown below.



R1	=1.5kΩ, 1/8W or more	R7	=2.2kΩ, 1/8W or more	D1	=50V0.1A
R2	=4.7kΩ, 1/8W or more	C1	=10μF, 50V	D2	=50V0.1A
R3	=1.2kΩ, 1/8W or more	C2	=10μF, 50V	PS1	=SUW1R51212
R4	=27kΩ, 1/8W or more	IC1	=TL431 or equivalent		
R5	=1kΩ, 1/8W or more	IC2	=LM358 or equivalent		
R6	=12kΩ, 1/8W or more				

Fig.4-1 Adjustment by signal voltage

■ Explanation of Operation

In ACE series, the monitoring and the remote sensing terminals (-M and -S) is used to change the output voltage. When the voltage between the terminal -S and -M(-V) is 0V, the output voltage becomes the rated output voltage.
And, in case that the rated voltage is applied to this terminals, the output voltage can be adjusted to 0Vdc approximately.

An operational amplifier could be used to transfer any signal voltage to the needed voltage.

■ Note

The output voltage accuracy will be ±5% approximately. It depends on components used for external circuit.

Please do not remove CN1, CN2 or any other wiring during operation due to safety reason.

■ Characteristic

Characteristic of example circuit in Fig.4-1 is shown below.

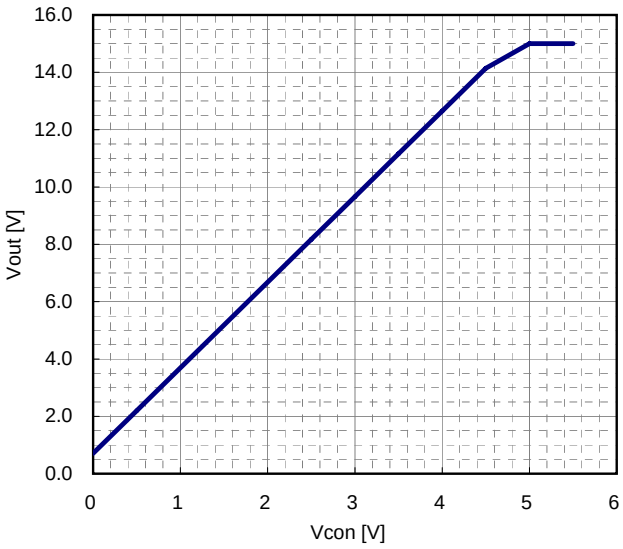


Fig.4-2 Vcon - Vout

4-2.Output Voltage Adjustment with X-version module

■ Circuit

In ACE series, the output voltage can be adjusted simply by using X-version 300W module (2A - 2K), example circuit for output voltage adjustment by signal voltage is shown below.

As a reference, in case of F Module, value of output voltage adjustment circuit is shown below.

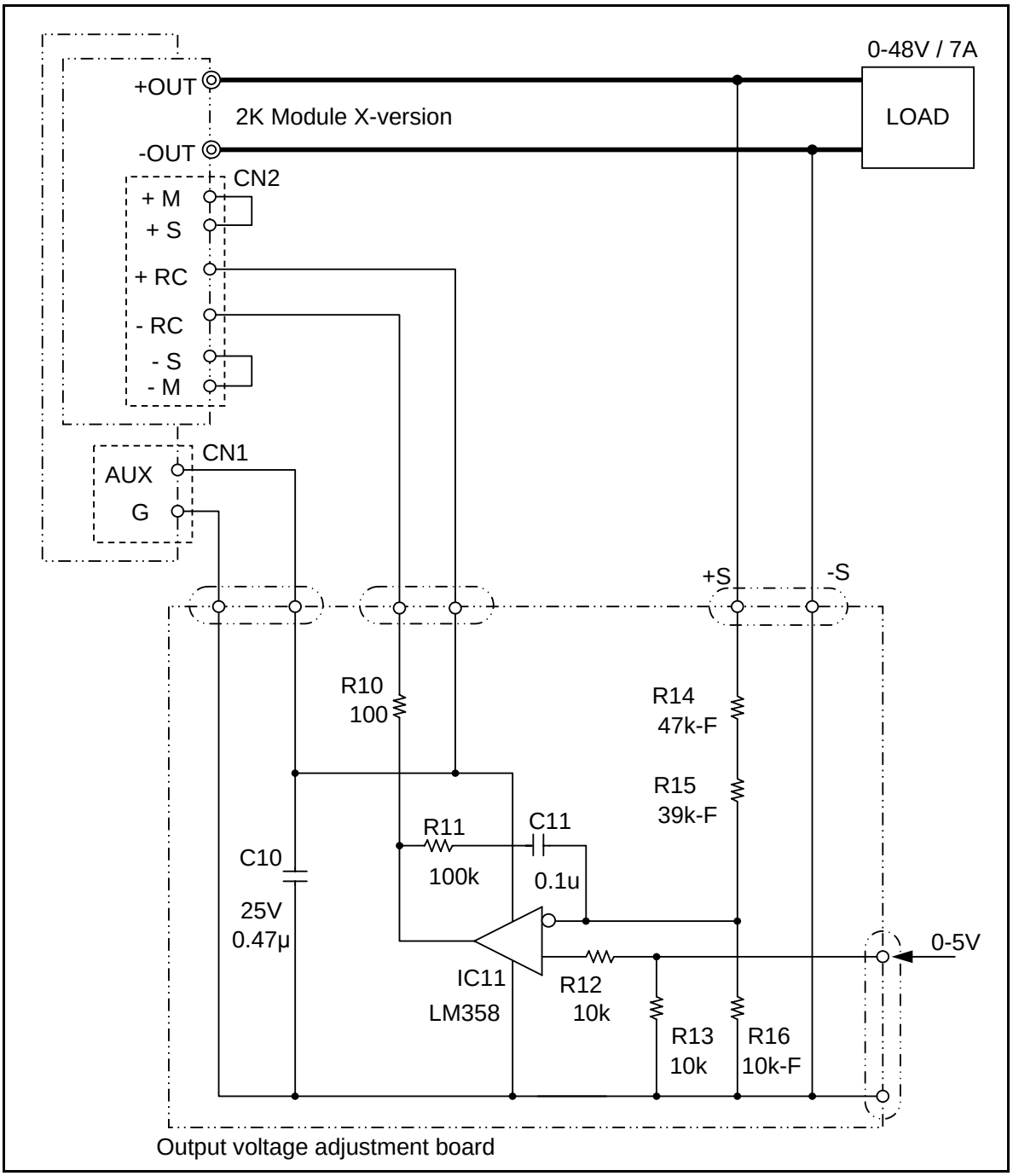


Fig.4-3 Adjustment by signal voltage

- Constant current circuit -

PBA and ACE series are available as a current source power supply by adding external circuit.
The main feature of each series is shown below.

PBA series [PBA300F ~ 1500F and 1500T]

*PBA series is suitable for general application which requires a current source power supply.

1.Constant current circuit by using a shunt resistor
2.Constant current circuit by using a current sensor
3.Constant current circuit by using a shunt resistor in parallel operation

ACE series [module code:A-K,2A-2K]

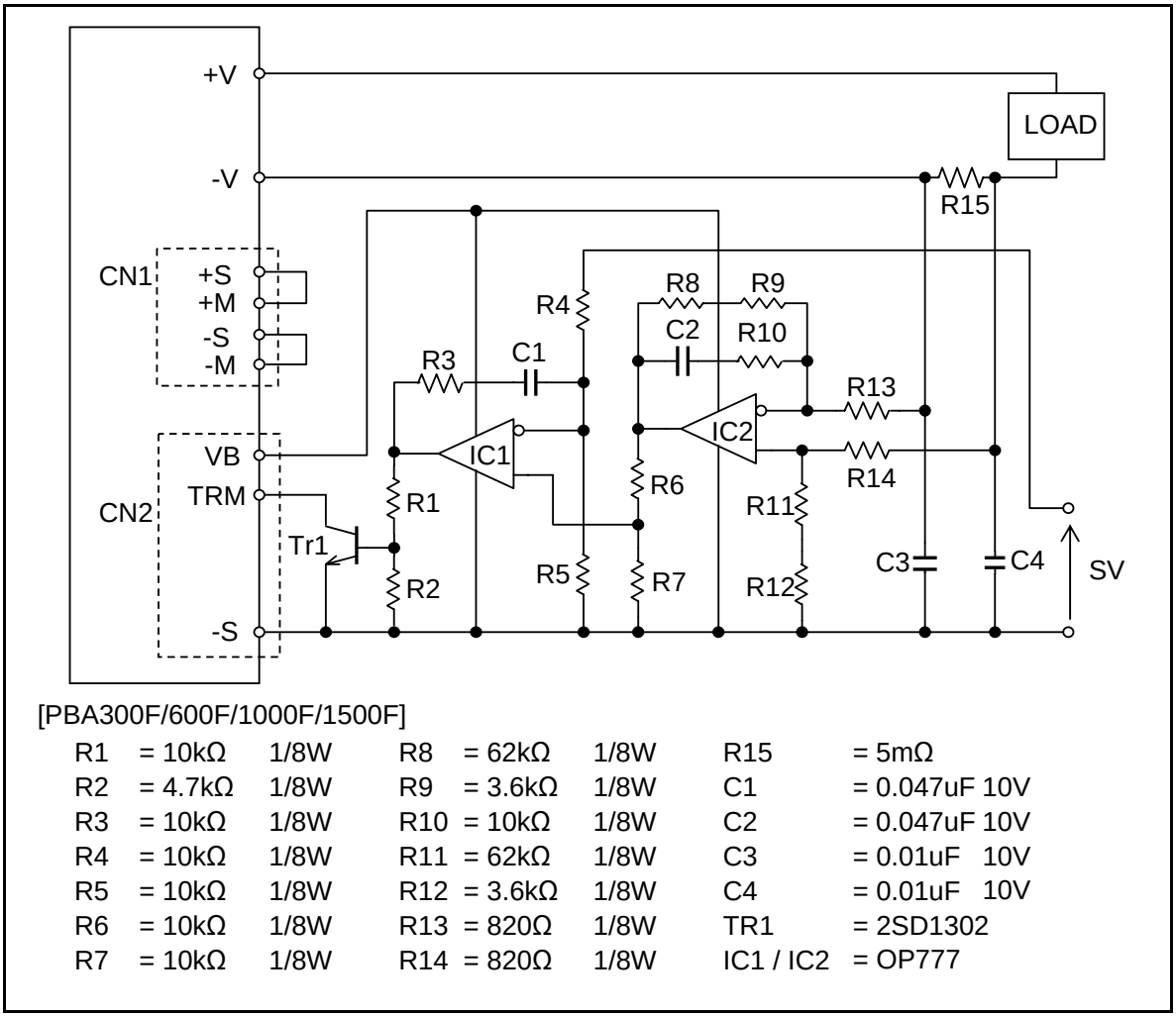
*ACE series is suitable for the application which requires a current source power supply and multi output.
*ACE series -H option is for medical application.

4.Constant current circuit by using a shunt resistor

1.Constant current circuit by using a shunt resistor

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for constant current by signal voltage is shown below.



[PBA300F/600F/1000F/1500F]

R1	= 10kΩ	1/8W	R8	= 62kΩ	1/8W	R15	= 5mΩ
R2	= 4.7kΩ	1/8W	R9	= 3.6kΩ	1/8W	C1	= 0.047uF 10V
R3	= 10kΩ	1/8W	R10	= 10kΩ	1/8W	C2	= 0.047uF 10V
R4	= 10kΩ	1/8W	R11	= 62kΩ	1/8W	C3	= 0.01uF 10V
R5	= 10kΩ	1/8W	R12	= 3.6kΩ	1/8W	C4	= 0.01uF 10V
R6	= 10kΩ	1/8W	R13	= 820Ω	1/8W	TR1	= 2SD1302
R7	= 10kΩ	1/8W	R14	= 820Ω	1/8W	IC1 / IC2	= OP777

Fig.1-1 constant current circuit by using a shunt resistor

■ Explanation of Operation

In the circuit shown in Fig.1-1, the output current can be adjusted by the signal voltage (SV). For example, in case signal voltage is 4V, the output current should be 10A. And if the voltage (SV) doesn't change, the output current could be kept constantly.

Next, the operation of constant current control is shown as follows.
In this power supply, the output voltage can be adjusted by the voltage of TRM terminal. For example, in case the output current increases, the voltage generated in R15 gets high. At this time, the noise on this voltage would reduce by IC2 (differential amplifier) and also this voltage could be amplified. Next, the output voltage of IC1 gets high by rising of the input voltage (the output voltage of IC2) and Tr1 turns ON. Because the voltage of TRM terminal gets low, the output voltage also gets low and the output current decreases.
In this way the output current could be kept constantly even if impedance in the load is changed.

■ Note

Please note the rating wattage of shunt resistor (R15).

Please confirm CN1 and CN2 are connected correctly. And if CN2 is unconnected, the output voltage gets the rated voltage and the power supply can not work as current source.

CN1 and CN2 are connected each other internally. Therefore, it is also possible to connect external circuit on CN1.

Please note that PG alarm will output, if the output voltage reaches less than 10% of rated voltage.

■ Characteristic

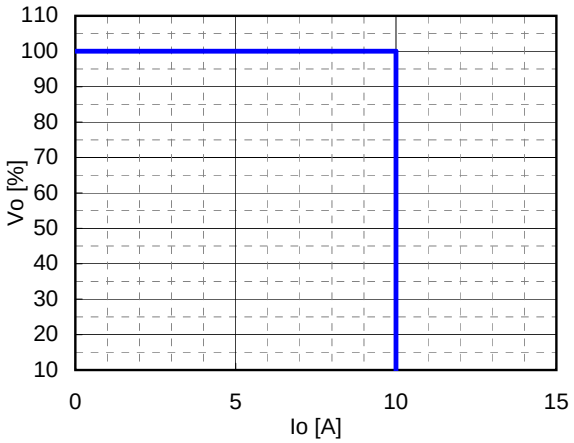


Fig.1-2 Vo - Io

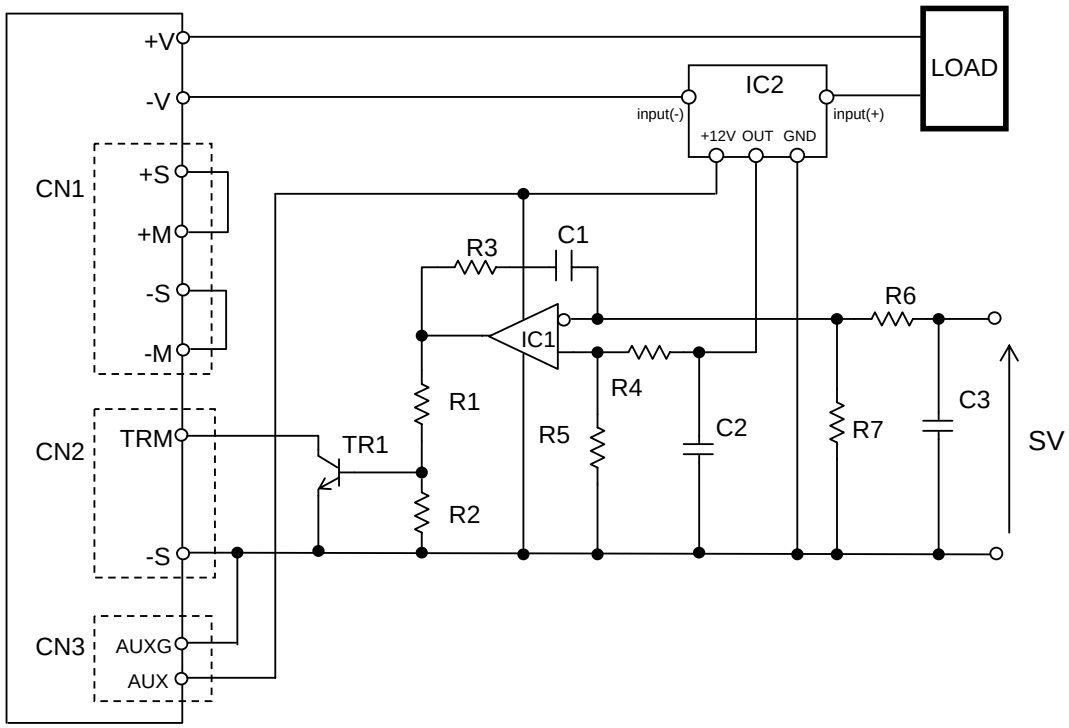
*Vo : Rated output voltage

*Io : output current

2.Constant current circuit by using a current sensor

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for constant current by signal voltage is shown below.



R1	=10kΩ	1/8W	R7	=4.7kΩ	1/8W	PS	=PBA300F-12
R2	=4.7kΩ	1/8W	C1	=0.47μF	50V	TR1	=2SD1302 or equivalent
R3	=10kΩ	1/8W	C2	=0.1μF	50V		
R4	=4.7kΩ	1/8W	C3	=0.1μF	50V		
R5	=4.7kΩ	1/8W	IC1	=LM358 or equivalent			
R6	=4.7kΩ	1/8W	IC2	=HPS20A-AS(U_RD) or equivalent			

Fig.2-1 constant current circuit by using a current sensor

■ Explanation of Operation

In the circuit shown in Fig.2-1, the output current can be adjusted by the signal voltage (SV). For example, in case signal voltage is 5V, the output current should be 20A. And if the voltage (SV) doesn't change, the output current could be kept constantly.

In case that the output current is too big and the suitable shunt resistor can't be selected, the current sensor (IC2) is available to the circuit as shown in Fig.2-1.

The current sensor converts the output current to the signal of voltage like the shunt resistor.

■ Note

Please confirm CN1 and CN2,3 are connected correctly. And if CN2 or CN3 is unconnected, the output voltage gets the rated voltage and the power supply can not work as current source.

CN1 and CN2 are connected each other internally. Therefore, it is also possible to connect external circuit on CN1.

Please note that PG alarm will output, if the output voltage reaches less than 10% of rated voltage.

There is a possibility that the output voltage becomes unstable when the power supply is set in your system. If this is the case, please try to change value of R3 or C1 bigger.

■ Characteristic

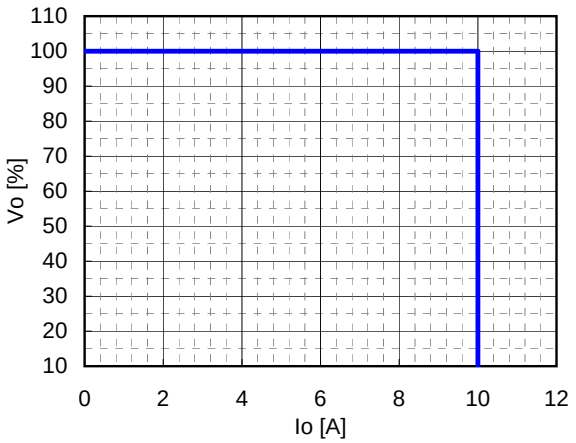
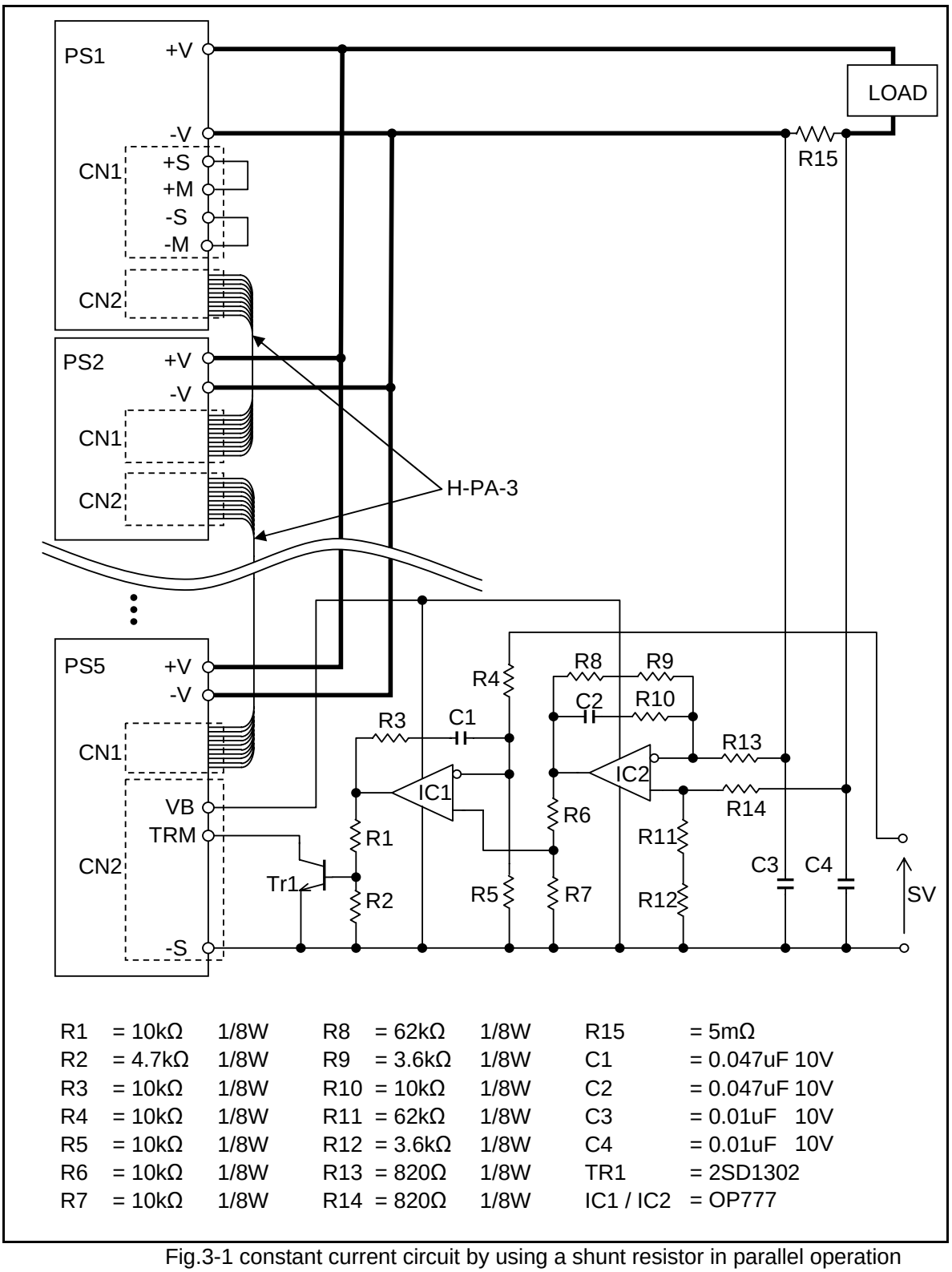


Fig.2-2 Vo - Io
*Vo : Rated output voltage
*Io : output current

3.Constant current circuit by using a shunt resistor in parallel operation

■ Circuit

In PBA300F ~ 1500F and 1500T, example circuit for constant current in parallel operation is shown bel



R1	= 10kΩ	1/8W	R8	= 62kΩ	1/8W	R15	= 5mΩ	
R2	= 4.7kΩ	1/8W	R9	= 3.6kΩ	1/8W	C1	= 0.047uF	10V
R3	= 10kΩ	1/8W	R10	= 10kΩ	1/8W	C2	= 0.047uF	10V
R4	= 10kΩ	1/8W	R11	= 62kΩ	1/8W	C3	= 0.01uF	10V
R5	= 10kΩ	1/8W	R12	= 3.6kΩ	1/8W	C4	= 0.01uF	10V
R6	= 10kΩ	1/8W	R13	= 820Ω	1/8W	TR1	= 2SD1302	
R7	= 10kΩ	1/8W	R14	= 820Ω	1/8W	IC1 / IC2	= OP777	

Fig.3-1 constant current circuit by using a shunt resistor in parallel operation

■ Explanation of Operation

In the circuit shown in Fig.3-1, the output current can be adjusted by the signal voltage (SV). For example, in case signal voltage is 4V, the output current should be 10A. And if the voltage (SV) doesn't change, the output current could be kept constantly.

Please connect each power supplies by harness (H-PA-3).

■ Note

Please note the rating wattage of shunt resistor (R15).

Please confirm CN1 and CN2 are connected correctly. And if CN2 is unconnected, the output voltage gets the rated voltage and the power supply can not work as current source.

Please note that PG alarm will output, if the output voltage reaches less than 10% of rated voltage.

■ Characteristic

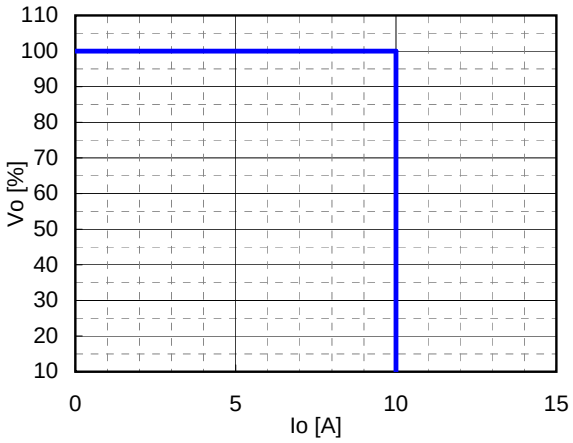
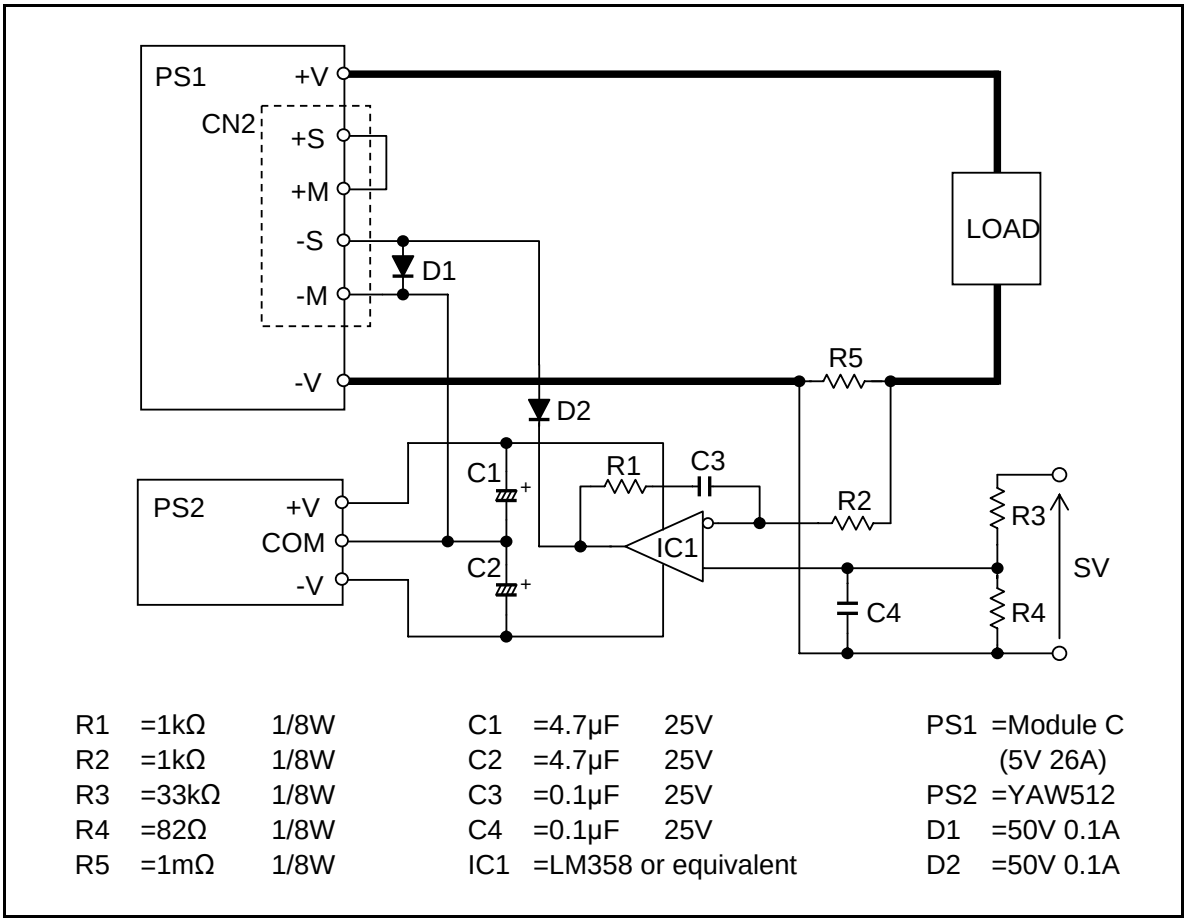


Fig.3-2 Vo - Io
*Vo : Rated output voltage
*Io : output current

4.Constant current circuit by using a shunt resistor

■ Circuit

ACE series [module code:A-K,2A-2K], example circuit for constant current is shown below.



R1	=1kΩ	1/8W	C1	=4.7μF	25V	PS1	=Module C
R2	=1kΩ	1/8W	C2	=4.7μF	25V		(5V 26A)
R3	=33kΩ	1/8W	C3	=0.1μF	25V	PS2	=YAW512
R4	=82Ω	1/8W	C4	=0.1μF	25V	D1	=50V 0.1A
R5	=1mΩ	1/8W	IC1	=LM358 or equivalent		D2	=50V 0.1A

Fig.4-1 constant current circuit by using a shunt resistor

■ Explanation of Operation

In the circuit shown in Fig.4-1, the output current can be adjusted by the signal voltage (SV). For example, in case signal voltage is 10V, the output current should be 25A. And if the voltage (SV) doesn't change, the output current could be kept constantly.

Next, the operation of constant current control is shown as follows.
In this power supply, the output voltage can be adjusted by the voltage between -S and -M terminal, and if the voltage gets big, the output voltage should get small.

For example, in case the output current increases, the voltage generated in R5 gets big. Next, the output voltage of IC1 gets small by rising the input negative voltage. Therefore, because the voltage between -S and -M terminal gets big, the output voltage gets small and the output current decreases.
In this way the output current could be kept constantly even if impedance in the load is changed.

■ Note

In case that the output voltage is smaller than 8V approximately, AUX terminal could substitute for the external power supply.

The setting value of constant current must be the rated current or less.

■ Characteristic

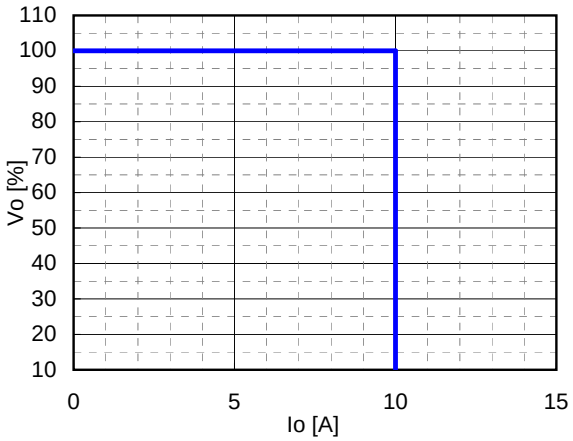


Fig.4-2 Vo - Io

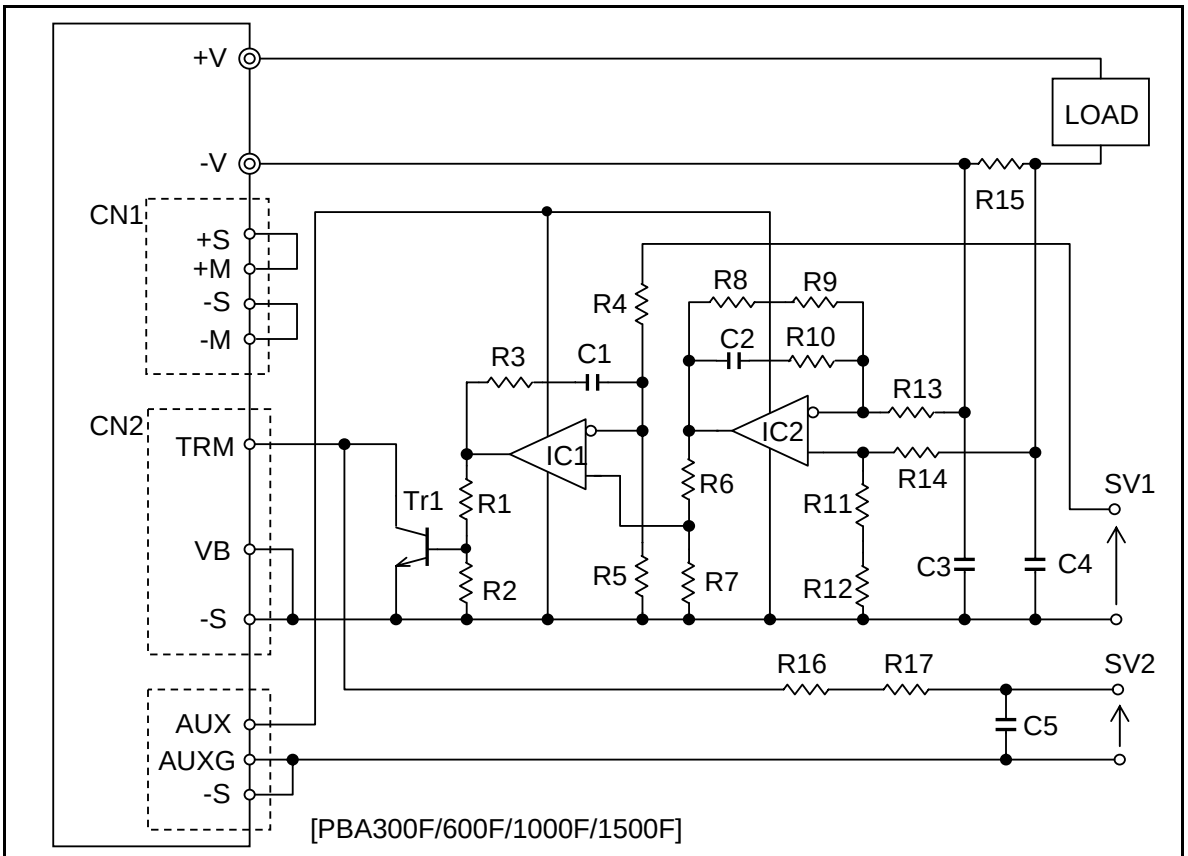
*Vo : Rated output voltage

*Io : output current

- Constant voltage, constant current circuit for PBA series -

■ Circuit

PBA300F ~ 1500F and 1500T, example circuit for Constant voltage constant current circuit is shown below.



R1	= 10kΩ	1/10W	R9	= 3.6kΩ	1/10W	R17	= 220Ω	1/10W
R2	= 4.7kΩ	1/10W	R10	= 10kΩ	1/10W	C1	= 0.047uF	10V
R3	= 10kΩ	1/10W	R11	= 62kΩ	1/10W	C2	= 0.047uF	10V
R4	= 10kΩ	1/10W	R12	= 3.6kΩ	1/10W	C3	= 0.01uF	10V
R5	= 10kΩ	1/10W	R13	= 820Ω	1/10W	C4	= 0.01uF	10V
R6	= 10kΩ	1/10W	R14	= 820Ω	1/10W	C5	= 0.01uF	10V
R7	= 10kΩ	1/10W	R15	= 5mΩ		TR1	= 2SD1302	
R8	= 62kΩ	1/10W	R16	= 1.5kΩ	1/10W	IC1 / IC2	= OP777	

Fig1. Constant voltage constant current circuit

■ Explanation of Operation

SV1 and SV2 are terminals to control output current and output voltage. In the circuit shown in Fig1, output current and output voltage can be adjusted simply by signal voltage (SV1 and SV2). If signal voltage/SV1 is 4V, output current would be 10A. And, if signal voltage/SV2 is 5V, output voltage would be rated output voltage.

To use as constant current source, TRM terminal is utilized for output voltage adjustment. If the output current increases, the voltage of the TRM terminal shall be decreased. Once output voltage decreases, the output current also decreases. Therefore, the output current will be kept constant.

R15 is shunt resistor, and the output current is converted into the voltage. After this voltage is amplified with differential amplifier circuit with IC2, and is controlled as the negative feedback.

■ Note

1. Use shunt resistor for R1, and power raring should be considered.
2. Make sure CN1 and CN2 are connected correctly.
3. If CN2 is unconnected, output voltage will generate rated voltage.
4. Do not remove any wiring during operation.
5. PG alarm will output, if output voltage reaches around 10% of rated voltage or less.
6. Evaluate under end-use condition sufficiently before using.

■ Characteristic

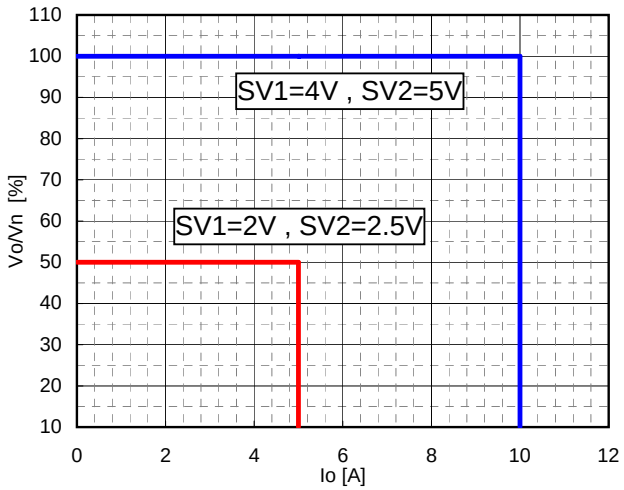


Fig2.1 Vo - Io

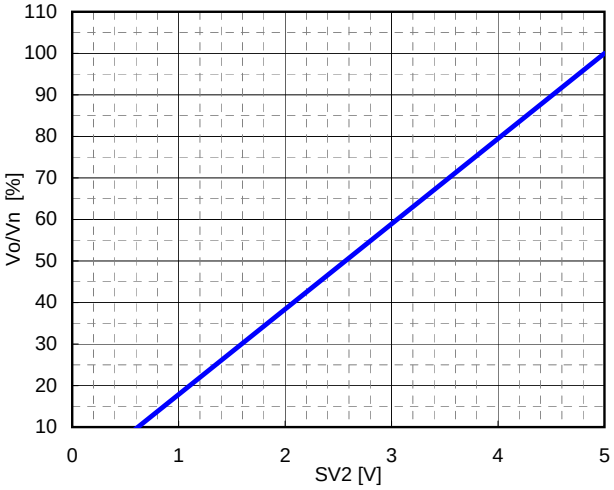


Fig2.2 Vo - SV2

*Vn : Rated output voltage
*Vo : Adjusted output voltage
*Io : output current

- Remote ON/OFF circuit for multiple PBA units -

■ Circuit

PBA300F ~ 1500F and 1500T, how to remote ON/OFF for multiple PBA units is shown below.

[PBA300F ~ 1500F and 1500T]

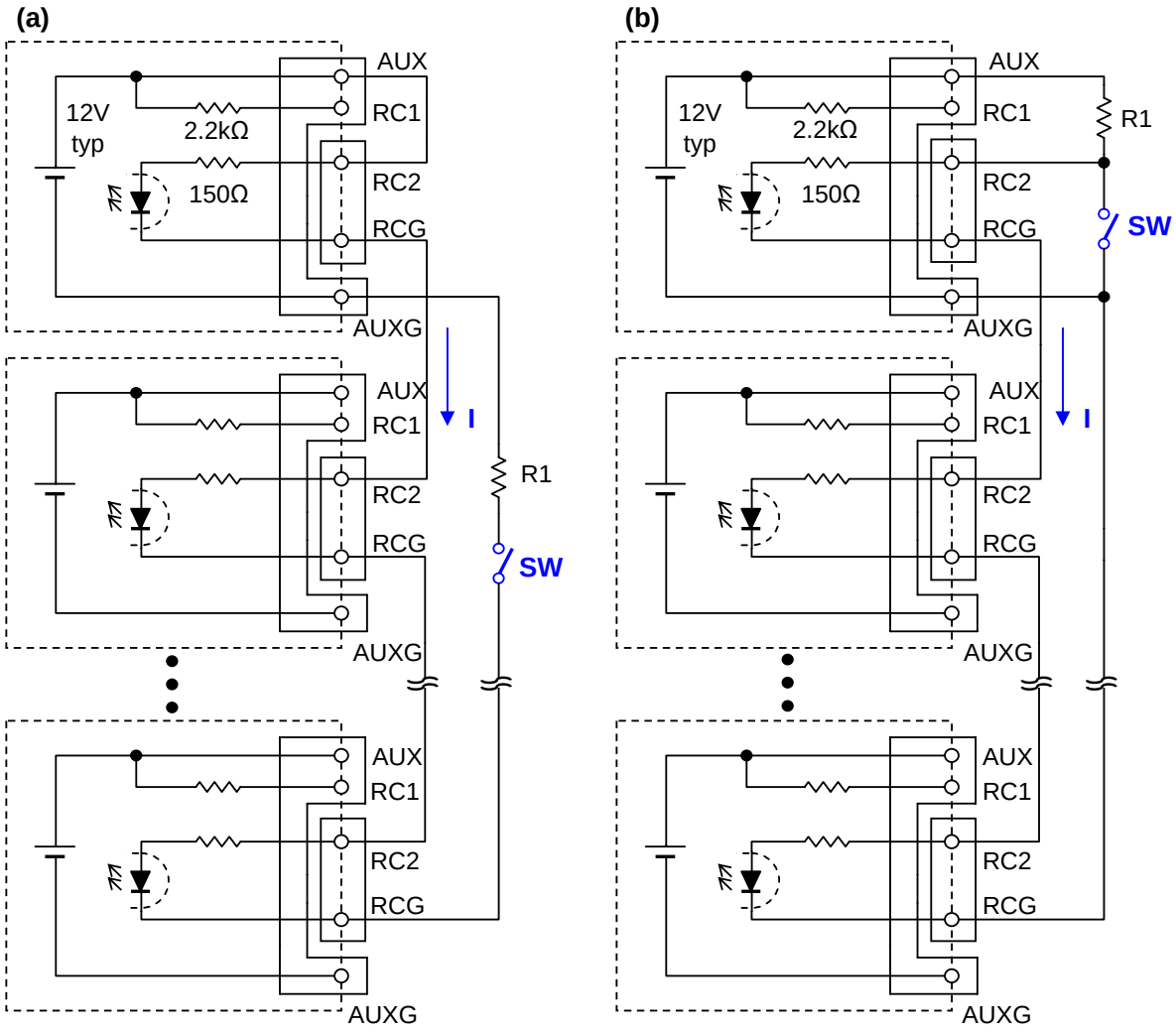


Fig1. Remote ON/OFF circuit for multiple PBA units

Table1. Specifications of remote ON/OFF

Method	(a)	(b)	Output
State of SW	SW open (I=0.1mA max)	SW close (I=0.1mA max)	ON
	SW close (I=3mA min)	SW open (I=3mA min)	OFF

*I : current from RC2 to RCG

■ Explanation of Operation

The output state is controlled by the current that flows through internal photocoupler. If the current flows, the output is turned OFF, or if the current is zero, the output is turned ON. Therefore, positive/negative logic is available depending on external wiring. Please see Table1 for specs and Fig1 for wiring. Remote ON/OFF circuit (RC2 and RCG) are isolated from input, output, FG and AUX.

■ Note

Please set the current that flows into RC2 as 5mA typ (12mAmax).

If the output voltage is turned off by the remote ON/OFF circuit, the built-in fan stops. However, in PBA300F, the fan speed slows down and keeps rotation.

If the output voltage is turned off by the remote ON/OFF circuit, PG signals turn to "High".

If the voltage/current that is not listed in Table1 is applied between RC2 and RCG, the remote ON/OFF function may not work correctly.

■ Characteristic

The example how to calculate R1, in case of three power supplies is shown below.

1. Case of **(a)**
   (1)SW open
   I = 0mA

   (2)SW close
   I = (12V-1.4V x 3) / (150Ω x 3 + R1) = 5mA
   →R1 = 1.2 kΩ

2.Case of **(b)**
   (1)SW open
   I = (12V-1.4V x 3) / (150Ω x 3 + R1) = 5mA
   →R1 = 1.2 kΩ

   (2)SW close
   I = 0mA

- Alarm Circuit Example for PBA series -

■ Circuit

The example of connecting the alarm circuit of the PBA series is shown below.

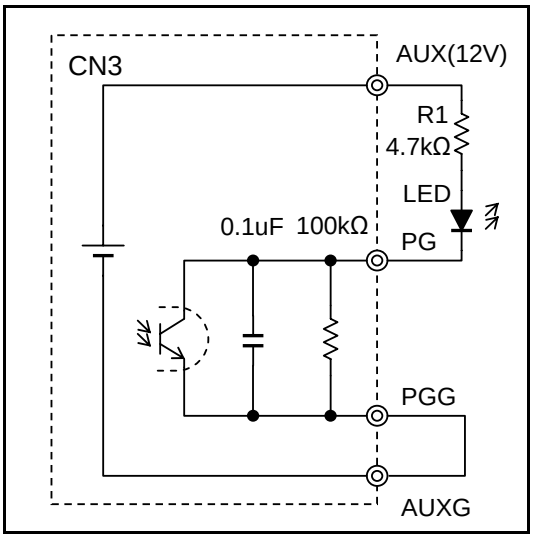


Fig 1 Alarm Circuit Example

■ Explanation of Operation

Table 1 PG alarm

	Alarm
PG	The PG gives "Low" signal during normal operation. If internal fan has stopped or output voltage has dropped below certain level or stopped due to activated protection circuit, PG gives "High" signal. ●Protection circuit; Thermal protection Overvoltage protection Overcurrent protection
	Output of Alarm LED
	Good:LED ON (PG:Low) Bad :LED OFF (PG High)

■ Note

The purpose of PG alarm in PBA series is to see if unit is working correctly or not. Therefore, there is time delay to change to high level, and it depends on model and condition.

PBA300F / PBA600F
◆◆◆◆ less than 1 second

PBA1000F / PBA1500F/1500T
◆◆◆◆ less than 10 second

If the output voltage is turned off through a remote ON/OFF circuit, the PG gives "High" signal.

The PG signal may turn "High", if the output current becomes 10% or below of the rated current in parallel operation (in this case, the fan also stops).

If the output voltage is decreased to almost 0V or dropped rapidly through an external voltage adjustment when load is light, the PG signal may give "High".

The PG signal (Alarm) circuit is isolated from input, output, FG, RC and AUX.

- Alarm Circuit Example for ACE series -

■ Circuit

The example of connecting the alarm circuit of the ACEseries is shown below.

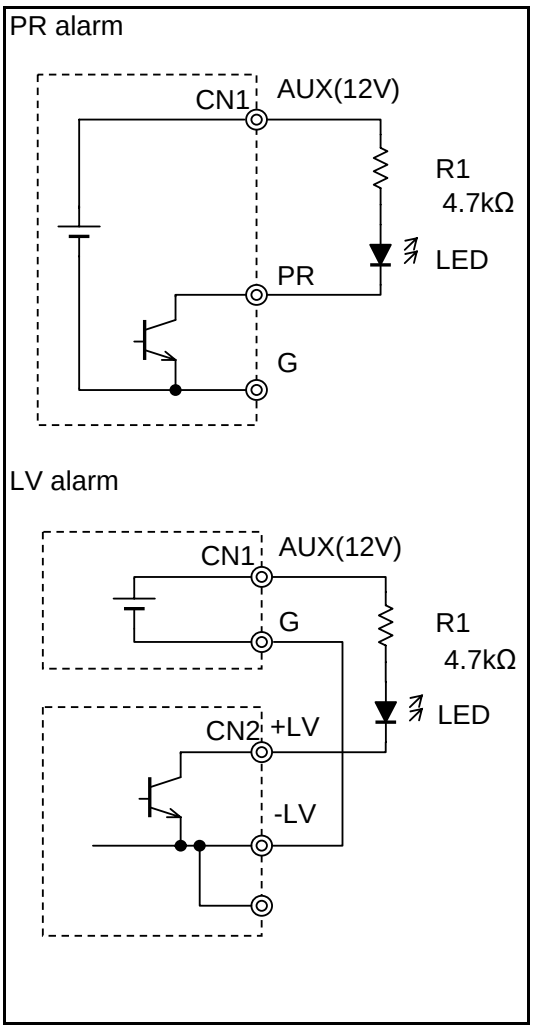


Fig 1 Alarm Circuit Example

■ Explanation of Operation

Table 1 PR alarm

	Alarm
PR	When input voltage has failed (low input) or internal fan has stopped, the PR gives a TTL signal from CN1.
	Output of Alarm LED
	Good:LED ON (PR Low) Bad :LED OFF (PR High)

Table 2 LV alarm

	Alarm
LV	When output voltage has dropped than certain level, LV gives a TTL signal from CN2.
	Output of Alarm LED
	Good:LED ON (LV Low) Bad :LED OFF (LV High)

Terminals in CN1(PR, AUX, G) are isolated from input, output, FG.
LV alarm circuit (+LV, -LV) are not isolated from output.

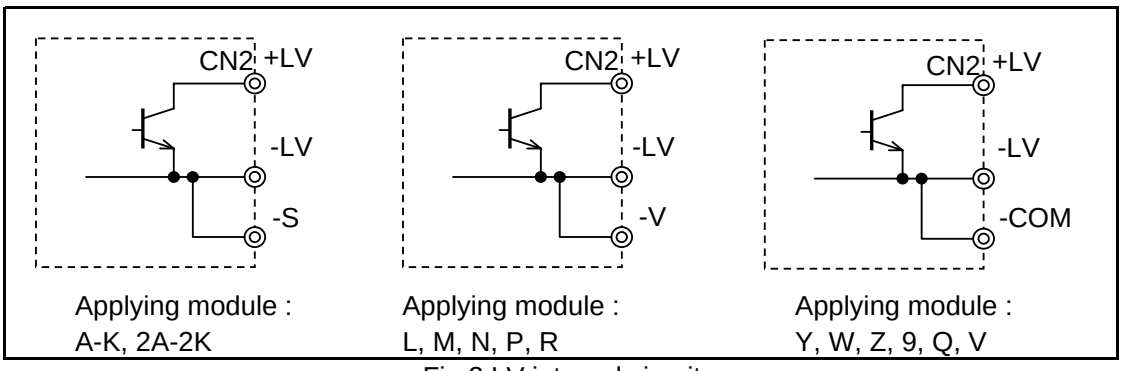


Fig 2 LV internal circuit

■ Note

AUX is available as voltage source for PR and LV alarm.
As far as each -V potential is the same, -LV can also be connected directly as Fig 3.
Please set the current of AUX to 0.1A or less.

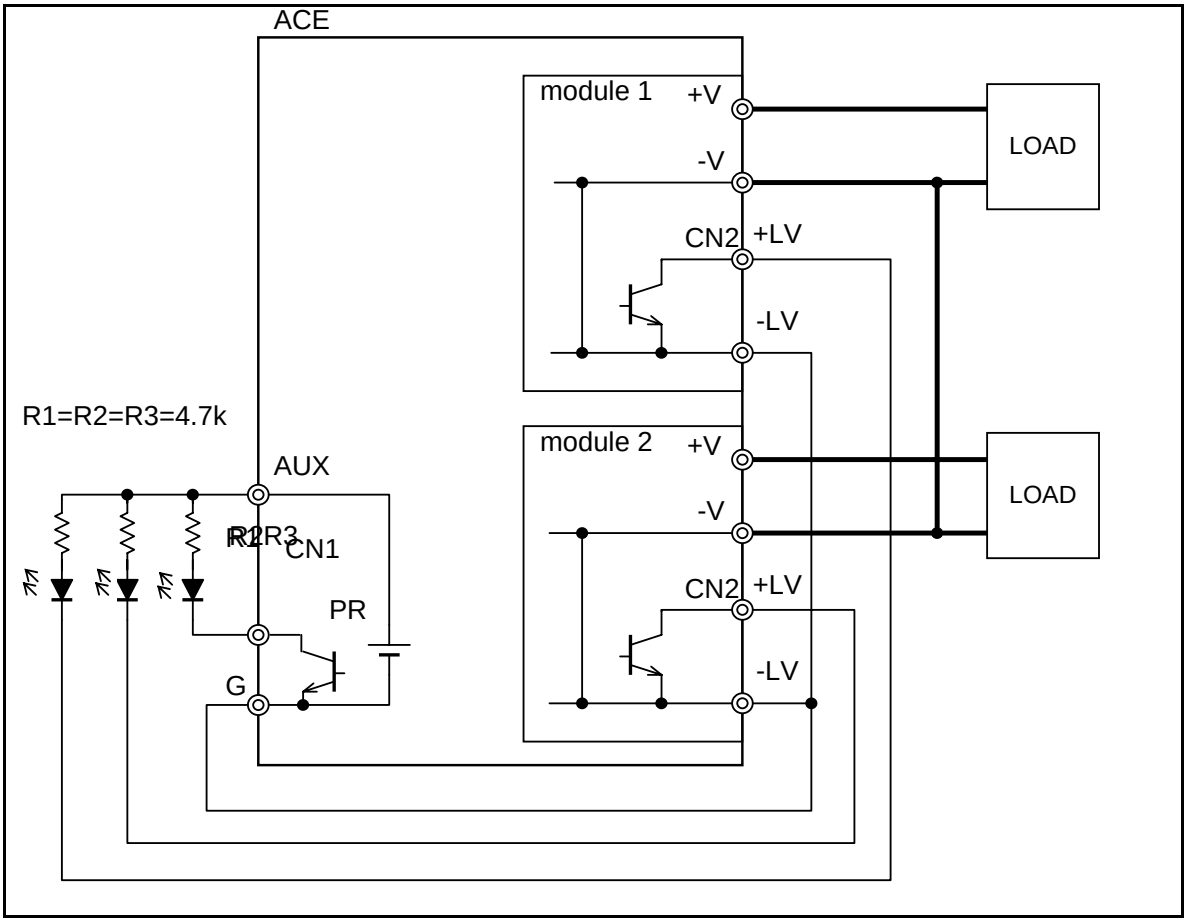


Fig 3 Alarm Circuit Example

Since LV circuit is not isolated from output, -LV can not be connected each other when each -V potential is not same, such as in series operation. In such a case, other voltage source that is isolated independently is required.

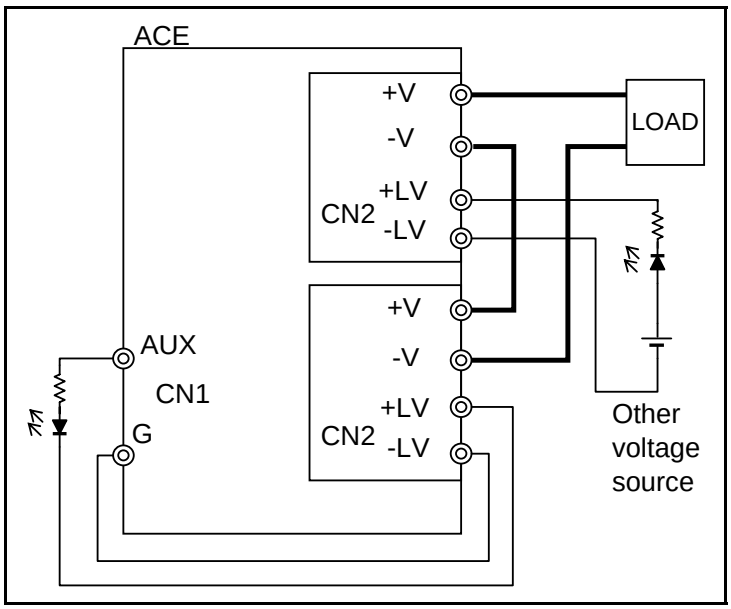


Fig 4 Alarm Circuit Example

- Reverse Polarity Circuit Example -

■ Circuit

Reverse polarity circuit example for output voltage is shown below.

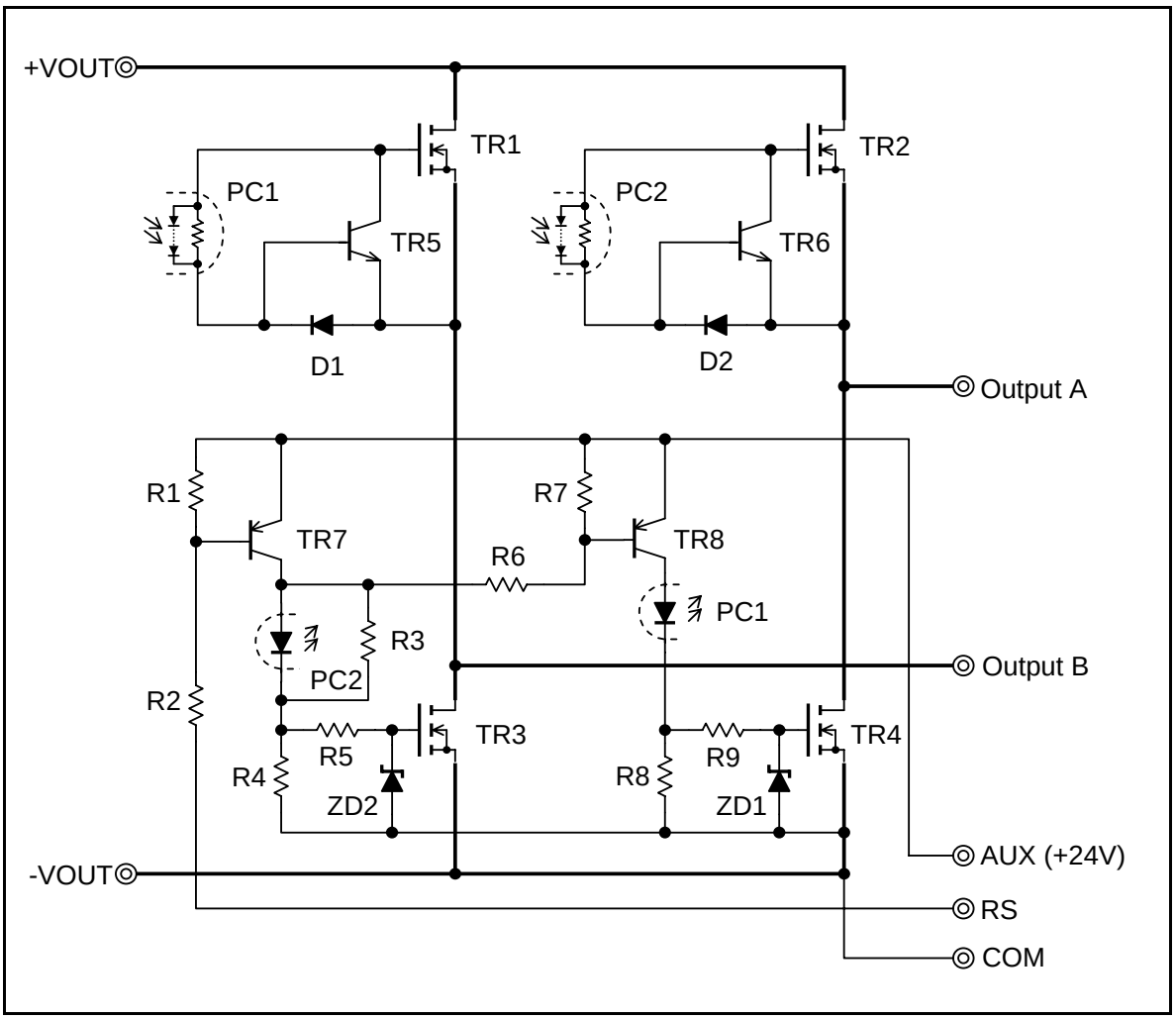


Fig 1 Reverse Polarity Circuit Example

■ Explanation of Operation

The polarity can be reversed by applying signal voltage.
When the RS terminal is connected to AUX terminal, the output polarity is positive.
Conversely, if RS terminal is connected to COM terminal, the output polarity is negative.

Table 1 Timing chart

Reverse signal	TR1	TR2	TR3	TR4	Output A - Output B
Low	OFF	ON	ON	OFF	Positive Out
High	ON	OFF	OFF	ON	Negative Out

Reverse polarity signal is designed as 24V (High).

■ Note

Table 2 Component list

Symbol	Component name	Mfg.
TR1	2SK3135	Renesas
TR2	2SK3135	Renesas
TR3	2SK3135	Renesas
TR4	2SK3135	Renesas
TR5	2SC1815	Toshiba
TR6	2SC1815	Toshiba
TR7	2SA1015	Toshiba
TR8	2SA1015	Toshiba
ZD1	HZS24NB2	Renesas
ZD2	HZS24NB2	Renesas
D1	1SS120	Renesas
D2	1SS120	Renesas
PC1	TLP591B	Toshiba
PC2	TLP591B	Toshiba

Table 3 Component value

Symbol	Value
R1	1.5kΩ 1/4W
R2	47kΩ 1/4W
R3	1.5kΩ 1/4W
R4	1.5kΩ 1/4W
R5	47Ω 1/4W
R6	45kΩ 1/4W
R7	1.5kΩ 1/4W
R8	1.5kΩ 1/4W
R9	47Ω 1/4W

TR1 to TR4 should be selected depending on power that system required.