

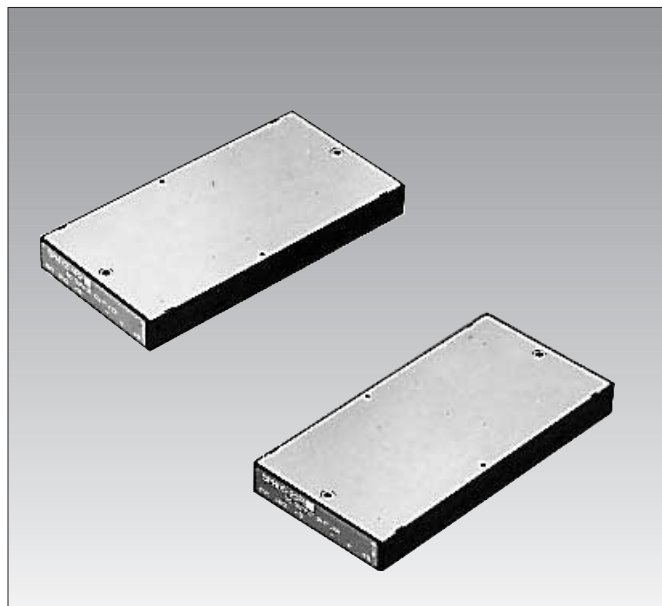
S SERIES SPH

[FEATURES]

- DC.48V input ultra-thin type single output power supply.
- Plastic package, onboard type.
- Remote ON-OFF function.
- Remote sensing function.
- Ultra-light.

[SUMMARY]

The S series SPL/SPM/SPH products have an ultra-thin onboard type feature. A full product lineup is available such as input voltages DC.12V (SPL), 24V (SPM), and 48V (SPH). It is possible to take out large current with the output capacity 50W or 100W. With enhanced remote ON-OFF and remote sensing functions, you can apply the products to a further variety of uses.



PART NUMBERS AND RATINGS

Output voltage(V)	50W Type		100W Type		Input voltage range (V)
	Current(A)	Part No.	Current(A)	Part No.	
5	10	SPH05-10R	20	SPH05-20R	DC.40 to 56
12	4.2	SPH12-4R2	8.3	SPH12-8R3	DC.40 to 56
24	2.1	SPH24-2R1	4.2	SPH24-4R2	DC.40 to 56

- To take out rated output power, take into consideration introducing a radiator, a forcible air-cooling, or the like.
- The above products are only produced upon receipt of order. Please check a delivery date.

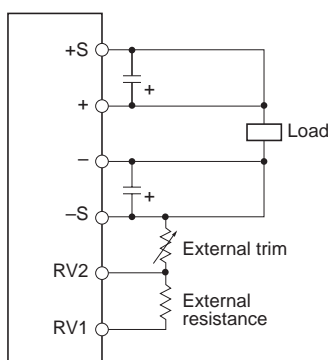
S SERIES SPH50W TYPE

SPECIFICATIONS AND STANDARDS

PART NO.		SPH05-10R	SPH12-4R2	SPH24-2R1
Rated output voltage and current		5V • 10A	12V • 4.2A	24V • 2.1A
Maximum output power*1	W	50	50.4	50.4
INPUT CONDITIONS				
Input voltage E _{dc}	V	40 to 56[Rating: 48]		
Input current	A	1.5typ./1.8max.[DC.48/40V]		
Efficiency	%	80typ.	81typ.	85typ.
OUTPUT CHARACTERISTICS				
Output voltage E _{dc}	V	5	12	24
Voltage variable range*2 E _{dc}	V	4.5 to 5.5	10.8 to 13.2	21.6 to 26.4
Maximum output current	A	10	4.2	2.1
Output voltage setting deviation	%	±5max.[Without external resistance and external trim]		
Overvoltage threshold E _{dc}	V	5.5 to 6.9	13.7 to 15.7	27 to 30.5
Overcurrent threshold	A	10.3 to 13.5	4.3 to 5.7	2.2 to 2.9
Voltage stability	Input variation	%	2max.(1typ.)[Within the input voltage range]	
	Load variation	%	2max.(1typ.)[10 to 100% load]	
	Temperature variation	%	2max.(1typ.)[Ambient temperature: 0 to +60°C]	
	Drift	%	2max.(0.1typ.)[25°C, input and output ratings, after input voltage ON for 30min to 8h]	
	Dynamic load	%/ms	±4max./1ms[50 to 100% sudden load change]	
Ripple E _{p-p}	mV	150max.	200max.	200max.
Ripple noise E _{p-p}	mV	250max.	300max.	400max.
AUXILIARY FUNCTIONS				
Overvoltage protection		Voltage shut-down type, recovers upon reset.		
Overcurrent protection		Fixed current and voltage threshold type, automatic recovery.		
Remote ON-OFF		Yes		
Remote sensing		Yes		
STANDARDS				
Safety standards		—		
CONSTRUCTIONS				
External dimensions	mm	12.7×58×115[H×W×L]		
Weight	g	150max.		
Mounting method		Can be attached to terminal side (soldered and screwed).		
Case material		Nonflammable resin[UL94-V0]		
Heat sink		Sold separately(Part No.: 3JR0AB179)		

^{*1} Radiant heating and forced air cooling should be considered. Sufficient space should be provided so that the base plate(aluminum surface) temperature is below 85°C when the surrounding environment is less than 60°C.

^{*2} Terminals should be wired as indicated below.



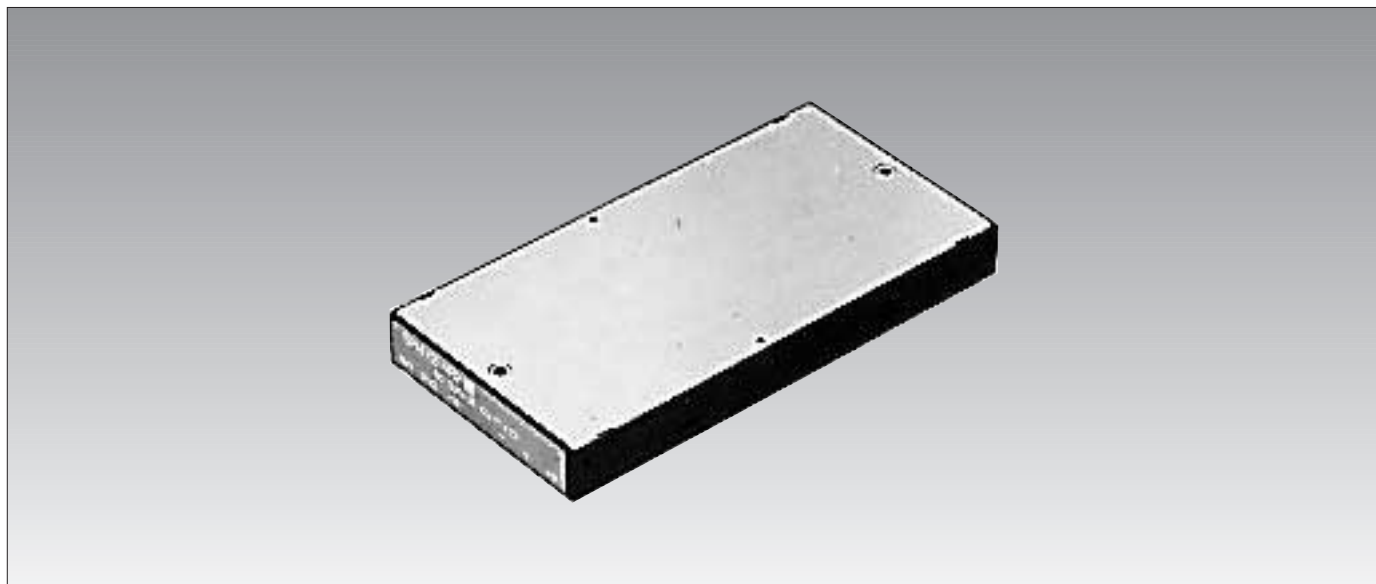
- When +S is not connected to the +terminal, and when -S is not connected to the -terminal, output voltage rises due to the sense amp open circuit. Output can then halt due to the overvoltage protection function. Also RV1 and RV2 should be left open if output voltage is not adjusted.

Recommended external resistance values

Output voltage rating(V)	5	12	24
External trim(Ω)	10k	10k	10k
External resistance(Ω)	1k	5.6k	27k

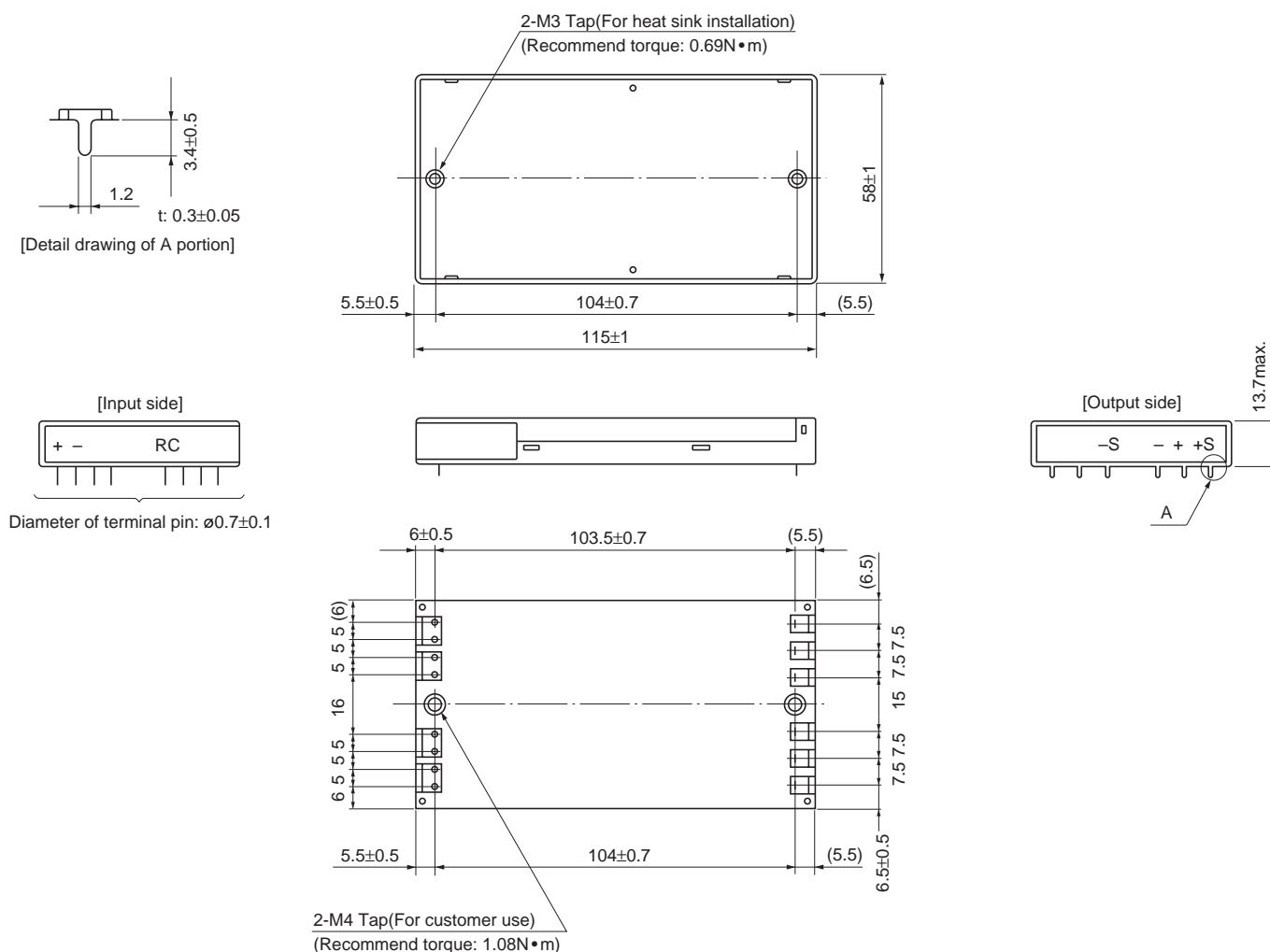
For details of the connections or the like, refer to the descriptions in Characteristics, Functions, and Applications on the later pages.

S SERIES SPH50W TYPE



SHAPES AND DIMENSIONS SPH50W TYPE

Dimensions in mm
±0.3mm : without specified dimensions



Note)

- Do not insert M3 and M4 installation screws more than 6mm from surface of power supply.

S SERIES SPH100W TYPE

SPECIFICATIONS AND STANDARDS

PART NO.		SPH05-20R	SPH12-8R3	SPH24-4R2	
Rated output voltage and current		5V • 20A	12V • 8.3A	24V • 4.2A	
Maximum output power* ¹	W	100	99.6	100.8	
INPUT CONDITIONS					
Input voltage E _{dc}	V	40 to 56[Rating: 48]			
Input current	A	2.7typ./3.5max.[DC.48/40V]			
Efficiency	%	80typ.	84typ.	87typ.	
OUTPUT CHARACTERISTICS					
Output voltage E _{dc}	V	5	12	24	
Voltage variable range* ² E _{dc}	V	4.5 to 5.5	10.8 to 13.2	21.6 to 26.4	
Maximum output current	A	20	8.3	4.2	
Output voltage setting deviation	%	±5max.[Without external resistance and external trim]			
Overvoltage threshold E _{dc}	V	5.5 to 6.9	13.7 to 15.7	27 to 30.5	
Overcurrent threshold	A	20.6 to 27	8.5 to 11.2	4.3 to 5.7	
Voltage stability	Input variation	%	2max.(1typ.)[Within the input voltage range]		} Total variation 6max.(3typ.)
	Load variation	%	2max.(1typ.)[10 to 100% load]		
	Temperature variation	%	2max.(1typ.)[Ambient temperature: 0 to +60°C]		
	Drift	%	2max.(0.1typ.)[25°C, input and output ratings, after input voltage ON for 30min to 8h]		
	Dynamic load	%/ms	±4max./1ms[50 to 100% sudden load change, however, 5V output is assumed when the 680μF electrolytic capacitor is connected to the loaded terminal.]		
Ripple Ep-p		mV	150max.	200max.	200max.
Ripple noise Ep-p		mV	250max.	300max.	400max.

AUXILIARY FUNCTIONS

Overvoltage protection	Voltage shut-down type, recovers upon reset.
Overcurrent protection	Fixed current and voltage threshold type, automatic recovery.
Remote ON-OFF	Yes
Remote sensing	Yes

STANDARDS

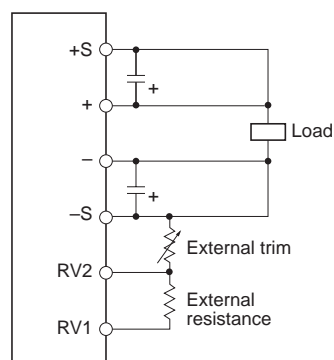
Safety standards	—
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CONSTRUCTIONS

External dimensions	mm	12.7×58×115[H×W×L]
Weight	g	150max.
Mounting method	Can be attached to terminal side (soldered and screwed).	
Case material	Nonflammable resin[UL94-V0]	
Heat sink	Sold separately(Part No.: 3JR0AB179)	

^{*1} Radiant heating and forced air cooling should be considered. Sufficient space should be provided so that the base plate(aluminum surface) temperature is below 85°C when the surrounding environment is less than 60°C.

^{*2} Terminals should be wired as indicated below.

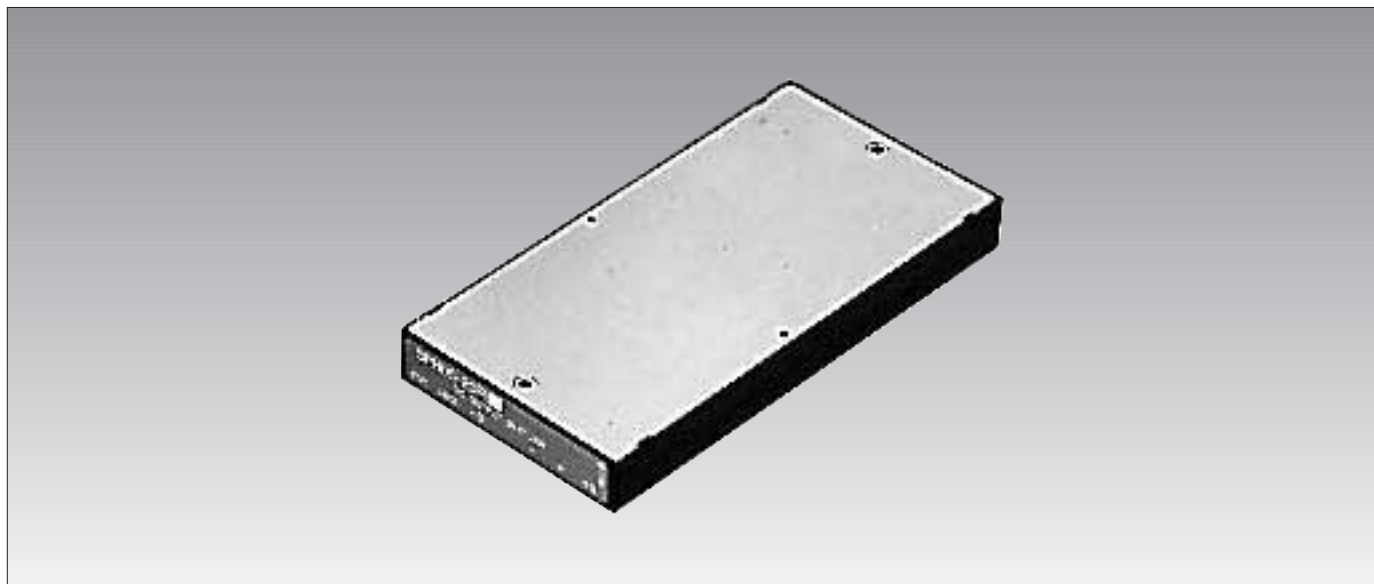


- When +S is not connected to the +terminal, and when -S is not connected to the -terminal, output voltage rises due to the sense amp open circuit. Output can then halt due to the overvoltage protection function. Also RV1 and RV2 should be left open if output voltage is not adjusted.

Recommended external resistance values

Output voltage rating(V)	5	12	24
External trim(Ω)	10k	10k	10k
External resistance(Ω)	1k	5.6k	27k

For details of the connections or the like, refer to the descriptions in Characteristics, Functions, and Applications on the later pages.



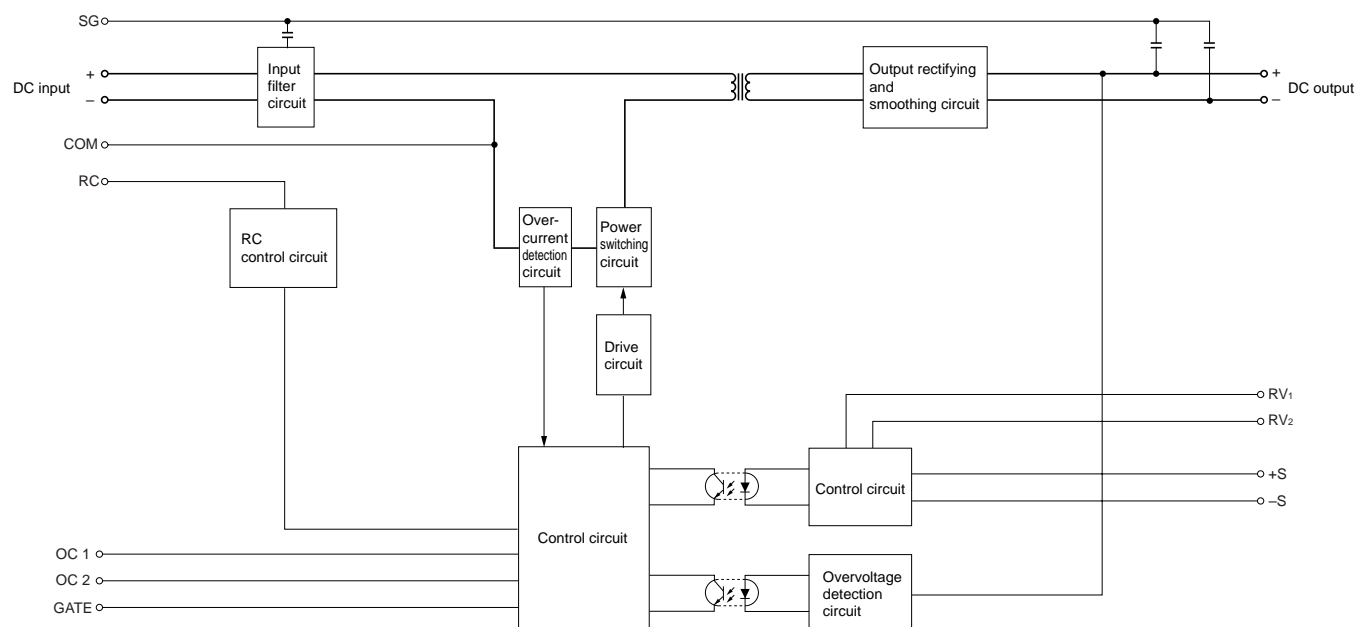
Dimensions in mm
±0.3mm : without specified dimensions



- Do not insert M3 and M4 installation screws more than 6mm from surface of power supply.

Characteristics, Functions, and Applications

BLOCK DIAGRAM



COMMON SPECIFICATIONS

Temperature and humidity

Temperature range	Operating(°C)	0 to +60 Derating is necessary when operating environment temperature exceed 40°C. (Case temperature: +85°C max.)
	Storage(°C)	-25 to +105
Humidity range	Operating(%)RH	20 to 95[Maximum wet-bulb temperature: 35°C, without dewing]
	Storage(%)RH	

Amplitude and vibration

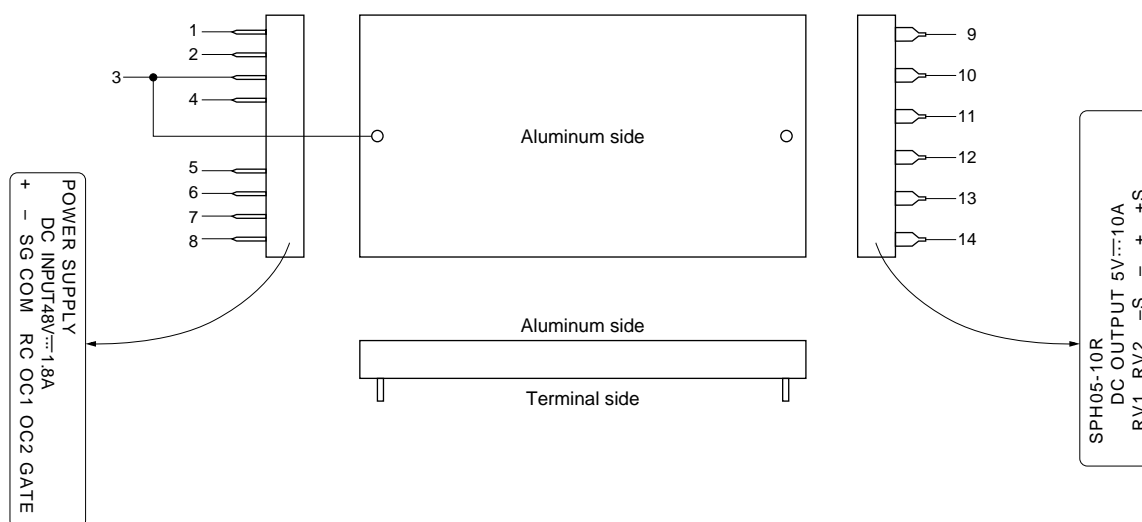
Amplitude	5 to 10Hz	All amplitude 10mm[3 directions, each 1h]
	10 to 55Hz	Acceleration 19.6m/s ² [2G, 3 directions, each 1h]
Vibration	Acceleration	196m/s ² [20G, 3 directions, each 3 times]
	Vibration time	11±5ms

Withstand voltage and insulation resistance

Withstand voltage	Input terminal to output terminal	Edc(V)500, 1min(25°C, 45 to 75(%)RH)
	Input terminal to signal ground terminal	
Insulation resistance	Input terminal to output terminal	Edc(V)500, 100MΩ min.(25°C, 45 to 75(%)RH)
	Output terminal to signal ground terminal	

Characteristics, Functions, and Applications

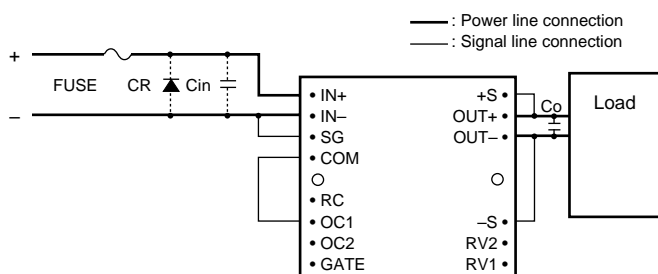
TERMINAL DESIGNATIONS AND FUNCTIONS



- | | | |
|---|-------|---|
| 1 DC input terminal(+) | ..... | Connect these terminals to DC input power supply. |
| 2 DC input terminal(-) | ..... |  |
| 3 Signal ground terminal(SG) | ..... | Connected to a case (aluminum side). Connect this terminal to the DC input terminal (-) or (+). Can be connected to FG in the unit side. |
| 4 Common terminal(COM) | ..... | Connected to the DC input terminal (-) via an input filter. Use it for the common mode of the signal system (OC1,RC) in the input side. |
| 5 Remote ON-OFF terminal(RC) | ..... | The output voltage can be turned on or off by applying a voltage of the TTL level to a portion between this RC terminal and the COM terminal. Turned on at a high level for the RC and COM terminals or when they are on and turned off at a low level for them or when they are off. |
| 6 Overcurrent detection terminal 1(OC1) | ..... | For use in power supply overcurrent setting. Connect the OC1 to the COM in a single unit operation. The distance between them should be as short as possible. |
| 7 Overcurrent detection terminal 2(OC2) | ..... | Adjustment terminal inside the power supply. Release it without use. A use of this terminal for a junction terminal or the like will cause a damage or malfunction. |
| 8 Gate terminal(GATE) | ..... | Adjustment terminal inside the power supply. Release it without use. A use of this terminal for a junction terminal or the like will cause a damage or malfunction. |
| 9 Remote sensing terminal(+S) | ..... | Connect these terminals at load ends in remote sensing. Unless the remote sensing is used, connect them to respective DC output terminals. |
| 12 Remote sensing terminal(-S) | ..... |  |
| 10 DC output terminal(+) | ..... | Power supply output terminals. Connect them to a load line. |
| 11 DC output terminal(-) | ..... |  |
| 13 Output voltage external variable terminal(RV2) | ..... | Output voltage can be externally adjusted by approx. $\pm 10\%$ of the rated output voltage by connecting resistances between the RV1 and RV2 terminals and between the RV2 and -S terminals. Release these terminals unless they are in use. |
| 14 Output voltage external variable terminal(RV1) | ..... |  |

Characteristics, Functions, and Applications

INPUT-OUTPUT TERMINAL BASIC CONNECTION



RECOMMENDED FUSE CAPACITY (A)

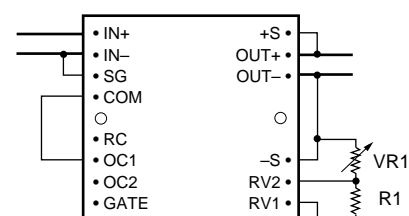
	50W	100W
SPH	2.5-4	5-6.3

NOTES

- No input fuse is incorporated. It is recommended to externally mount a protection fuse (normal melting type fuse) and reverse connection preventing diodes (CR). As for a selection of diodes, select ones having current characteristics twice or three times the fuse rated current for taking into consideration fuse melting characteristics.
- If an impedance of the input line is high, install an electrolytic capacitor (Cin) between power supply input terminals of a high ripple type.
 - High impedance conditions
 - Long input wire
 - Thin input wire
 - Filter on input line
- If the wire in the load side is long, an oscillation may be caused by an effect of inductance or noise. If the oscillation easily occurs, connect an aluminum electrolytic capacitor having 100 μ F (Co) or higher between OUT+ and OUT- of the power supply.

CONNECTION METHOD

1) Single operation with output voltage adjustment function

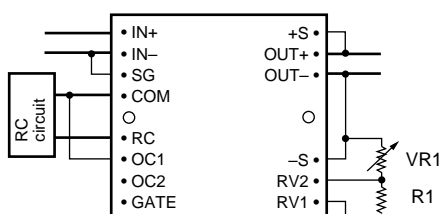


Recommended external resistance value (When using output voltage adjustment function)

Output voltage(V)	5	12	24
VR1(Ω)	10k	10k	10k
R1(Ω)	1k	5.6k	27k

- Output voltage can be adjusted by approx. $\pm 10\%$ with the recommended external resistance value. It should be noted that, however, the resistance must be used within the output power range.

2) Single operation with RC



Output can be turned on or off by adding a signal of the TTL level between the RC terminal and the COM terminal or by releasing the connection between the terminals.

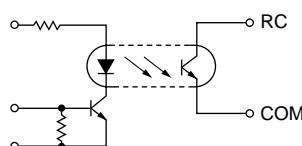
Between RC and COM:

At high level (2.4 to 5V) or when open: ON

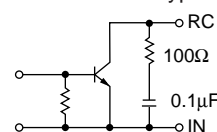
At low level (0 to 0.4V) or when short: OFF

The remote ON-OFF circuit is connected to a primary circuit inside the power supply. Therefore, it is recommended to use an element having an insulating function such as a relay (chattering preventive measures on contacts are required), a photo coupler, or the like as an external control circuit. In case of being compelled to use a non-insulation circuit, do not use a COM terminal, but use an input (-) terminal. It should be noted that, however, noise to the input terminal must be suppressed to the minimum in the above case. In addition, be careful with a release of the input terminal; if the input terminal is released, large current flows into the COM pattern, by which the pattern may be burned and damaged. The RC terminal is pulled up to 5V inside the power supply. Release it when it is not in use.

Insulation type recommended circuit



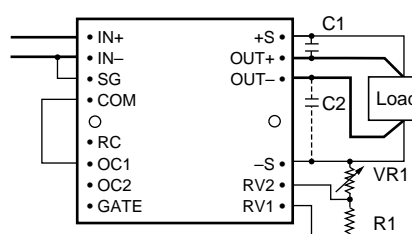
Non-insulation type



1 For the SPL type, the rise time or the fall time of a signal to the RC terminal should be 2ms or shorter.

2 An input signal to the RC terminal should be accompanied by little chattering. Chattering for 0.1ms or more may cause a malfunction in an output of the power supply.

3) Single operation with remote sensing

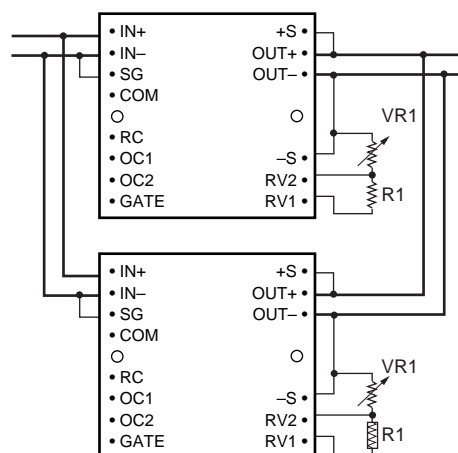


Characteristics, Functions, and Applications

NOTES

- Remote sensing is possible for a line drop between the +S and OUT+ (–S and OUT–) terminals up to the following levels:
5V output: 0.25V or lower
12 to 24V output: 0.4V or lower
- By using a shielded wire or a stranded wire is used as a remote sensing wire, effects of noise can be reduced. If the overvoltage protection is easily activated or oscillation easily occurs, attach C1 and C2 capacitors of 0.1μF or higher between the +S and OUT+ terminals and between the –S and OUT– terminals to check the output voltage (Refer to the above diagram).
- If an electrolytic capacitor is used, be careful with polarities.
- The rise time is extended due to the capacity of the electrolytic capacitor.

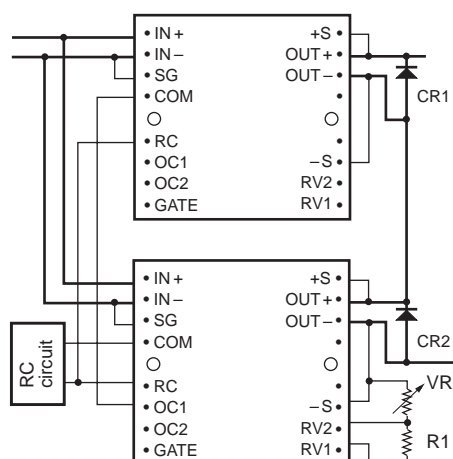
4) Parallel operation



NOTES

- In parallel operation, use the power supplies within 80% of the rated power of each power supply.
- Wiring impedance should be equalized as completely as possible from each power supply to a load.
- To increase a precision of an output current balance, set a dispersion of respective output voltages to 1% or lower at VR1.
- In parallel operation, release the OC1 terminal. The release of the OC1 terminal causes the overcurrent setting value to be automatically set to 80% of the rated current.
- In parallel operation, up to 8 units can be connected. It should be noted that, however, the units must be of the same type. Check that there is no malfunction in the output caused by a mutual interference before use.

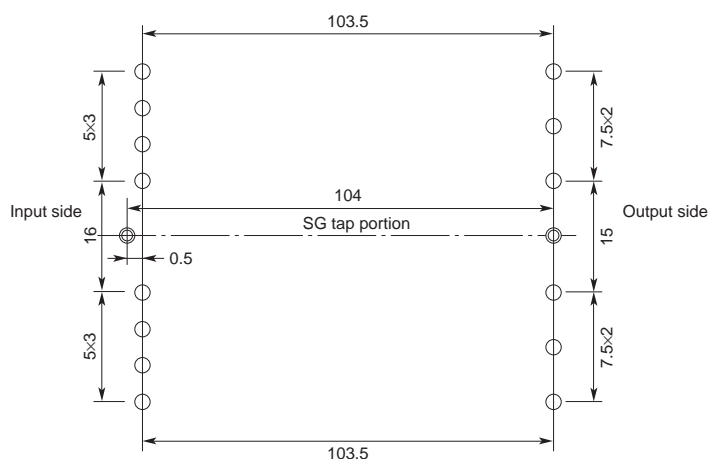
5) Serial operation



NOTES

- In serial operation, attach the diodes CR1 and CR2 for preventing reverse voltage application without fail.
- CR setting conditions
Reverse withstand voltage: Twice or more each output voltage
Forward current: Twice or more each output current
Forward voltage loss: As small as possible
- The maximum current is equal to a value of the output current of a power supply having the smallest output current of the power supplies in the serial connection.

RECOMMENDED PIN PATTERN (TOP VIEW)



(Unit: mm)

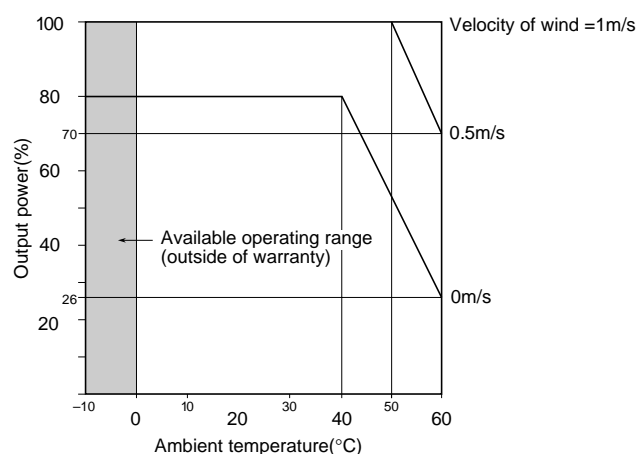
Input terminal hole dia.: ø1	Output terminal hole dia.: ø1.5	SG connection tap portion (◎)
Round dia.: ø3	Round dia.: ø4 to 6	Hole dia.: ø4.5
		Round dia.: ø8.5 to 9.5

Characteristics, Functions, and Applications

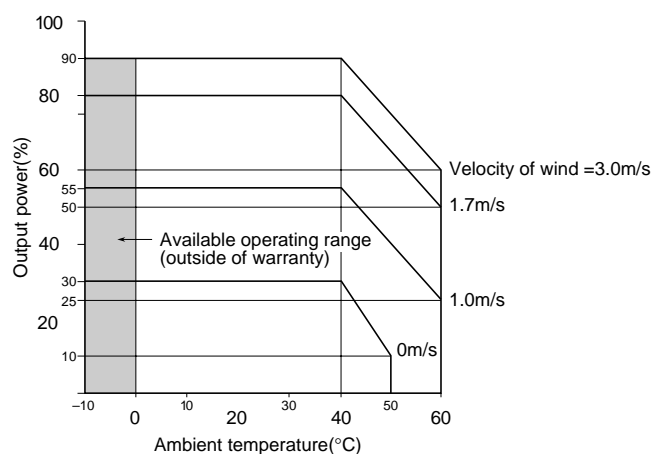
OUTPUT POWER-AMBIENT TEMPERATURE(DERATINGS)

[SPH50W TYPE]

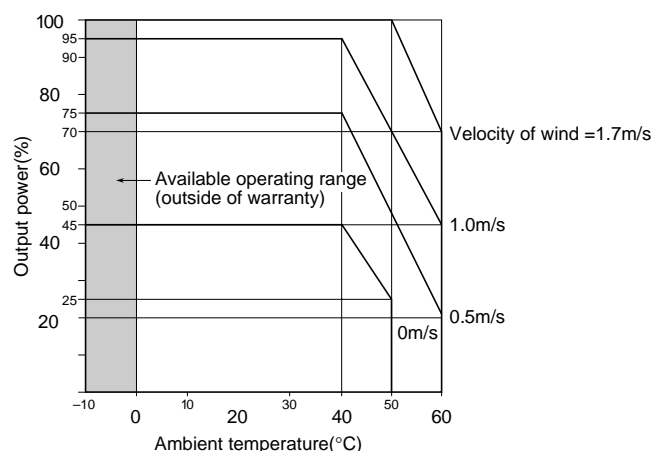
With heat sink(3JR0AB179)



Without heat sink

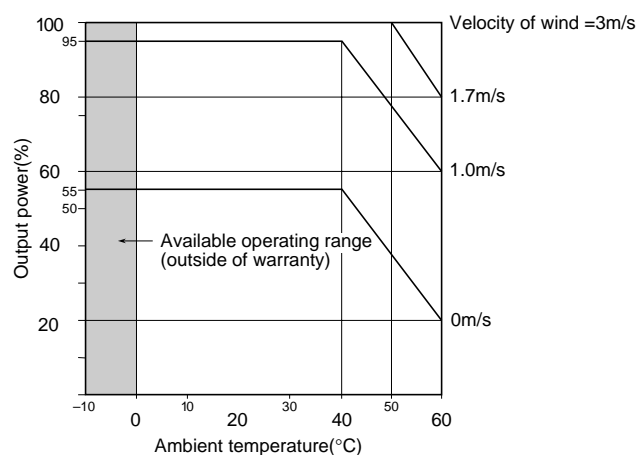


Without heat sink



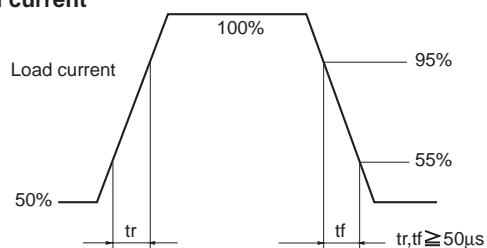
[SPH100W TYPE]

With heat sink(3JR0AB179)

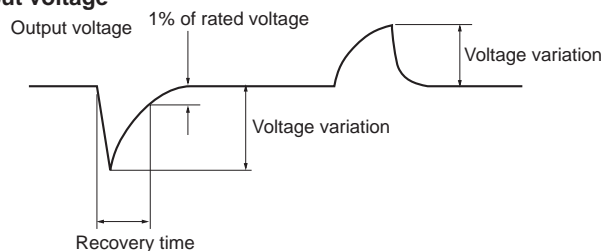


DYNAMIC LOAD VARIATION CHARACTERISTICS

Load current



Output voltage



The voltage variations depend upon conditions of the input voltage and the load current.

DYNAMIC LOAD VARIATION IMPROVING METHOD

To suppress voltage variations, connect an external capacitor in the load side of the output.

It should be noted that, however, a connection of too many capacitors may cause an oscillation. Therefore, pay particular attention to the number of the units. Particularly when using laminated ceramic capacitors or tantalum capacitors, it is recommended to connect the least number of capacitors or to use capacitors together with electrolytic capacitors.

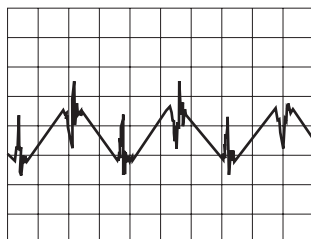
Characteristics, Functions, and Applications

OUTPUT NOISE REDUCTION

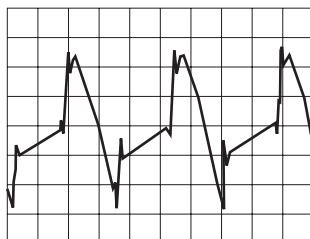
Ripple/noise waveform before taking countermeasures

Ripple/noise waveform (SPH05-20R, at rated input/output)

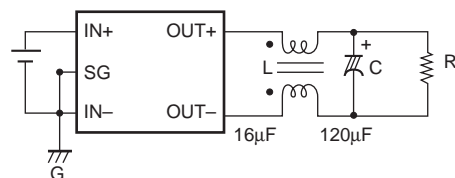
Between outputs: 20mV/div,
0.5μs/div



Between SG and output: 0.1V/div,
0.5μs/div

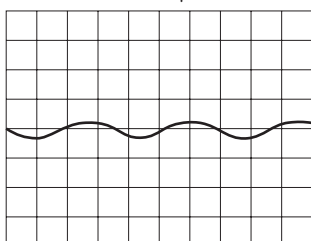


(1) Example of basic countermeasures



16μH common-mode choke+12μF electrolytic capacitor

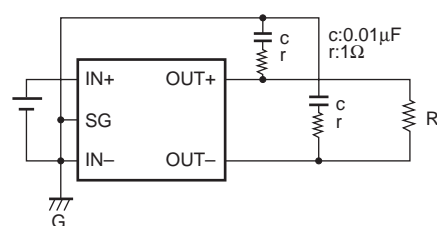
Between outputs: 20mV/div,
0.5μs/div



Between SG and output: 0.1V/div,
0.5μs/div

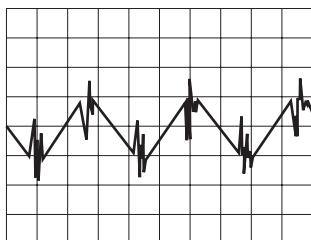


(2) Example of using Y capacitor for output

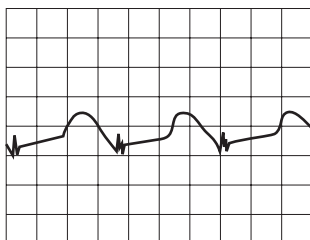


Output Y capacitor: 0.01μF+1Ω (Typical example)

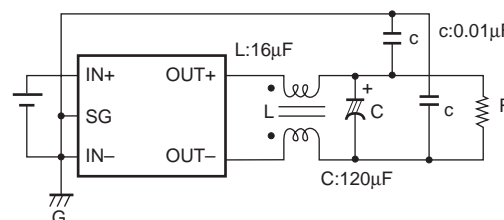
Between outputs: 20mV/div,
0.5μs/div



Between SG and output: 0.1V/div,
0.5μs/div

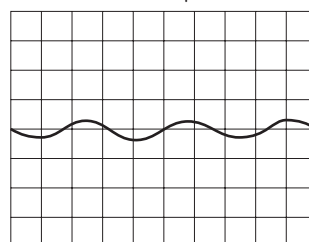


(3) Example of using two examples in the above

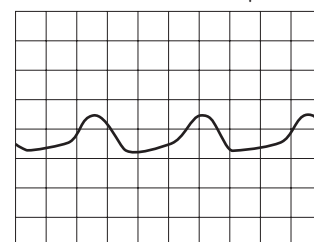


16μH common-mode choke+120μF electrolytic capacitor+Y capacitor 0.01μF

Between outputs: 20mV/div,
0.5μs/div



Between SG and output: 0.1V/div,
0.5μs/div



MOUNTING METHOD

• Fixing method

In fixing to the PC board, use mounting taps at two places in the side of the lower surface (terminal side). Use M4 screws for fixing and pay attention not to insert the screws 6mm or deeper from the surface of the body (Recommended clamping torque: 1.08N • m).

In fixing a radiator, use mounting taps at two places in the upper surface of the case (aluminum plate side). Use M3 screws for fixing and pay attention not to insert the screws 6mm or deeper from the surface of the body (Recommended clamping torque: 0.69N • m).

In addition, it is recommended to use thermal conducting grease to enhance a radiating effect between the radiator and the power supply body (aluminum surface) when mounting.

• Pattern width

Large current flows into the input-output pattern. It may cause a voltage drop or heat developed. Be very careful with designing the pattern. The pattern width should be determined on the basis of a reference value of 1mm/A.

• Recommended soldering conditions

Dip: 230±5°C, 5s

• Recommended cleaning conditions

Partially clean the PC board pattern surface. The recommended conditions are as follows:

Cleaning fluid: IPA

Cleaning method: Brush cleaning

* See that the cleaning fluid does not permeate into the inside of the power supply. It may cause a trouble.

Separately-sold Option List

Product name	Part No.	Applicable device	Shapes and dimensions (mm)
Heat sink	3JR0AB179	SPH50W SPH100W	<div><p>The technical drawing shows two views of the heat sink. The top view is a rectangle with a width of 115±0.35 mm and a height of 56.5 mm. It features a central fin array with a width of 104±0.3 mm and a height of 12±0.2 mm. The fin array has 23 fins with a pitch of 4.3 mm, totaling 94.6 mm. The fin height is 1.2 mm. The base of the fin array has a radius of 23-R0.5. The mounting holes are 2-ø3.5 mm, spaced 5.5 mm from the left and right edges. The side view shows a total width of 104±0.3 mm and a height of 56.5 mm. The mounting holes are 5.5 mm from the left and right edges. The material is Aluminum and cooling grease should be used at mounting.</p></div>

Please specify the part No. for ordering.