

# PSS · PSD SERIES

## Instruction Manual

### ■ Before Using This Power Supply

Be sure to take note of precautions and warnings indicated in this manual when using this product. Improper usage may lead to electric shock or fire. Be sure to read this instruction manual thoroughly before using this product.

### ■ Caution

- There are high voltage and high temperature components within this product. Refrain from disassembling this product or touching its internal components as this may lead to electric shock or burned.
- When the unit is operating, keep your hands and face away from the unit. You may get injured by accident.
- Confirm connections to input/output terminals and signal terminals are correct as indicated in the instruction manual.
- This power supply is designed for professional installation within the end user equipment.
- Use isolated voltage by reinforced or double insulation as input power source.
- Do not inject abnormal voltage to output terminal and signal terminal from the outside.
- The injection of reverse voltage or over voltage exceeding nominal output voltage to output terminals might cause damage to internal output capacitor
- The application circuits and their parameter are for reference only. Be sure to verify effectiveness of application circuits and their parameters before finalizing circuit design.
- The information in this document is subject to change without prior notice. For actual design-in, please refer to the latest publications of data sheet, etc., for the most up-to date specifications of the unit.
- For input voltages greater than 57.5Vdc, it must be ensured the positive input and positive output are not earthed or connected together since under certain fault conditions, non-SELV voltages can appear at the output terminals under these conditions.
- No part of this document may be copied or reproduced in any form, or by any mean without prior written consent of Densai-Lambda.

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<i>17. May '06</i>	<i>17. May '06</i>	<i>17. May '06</i>

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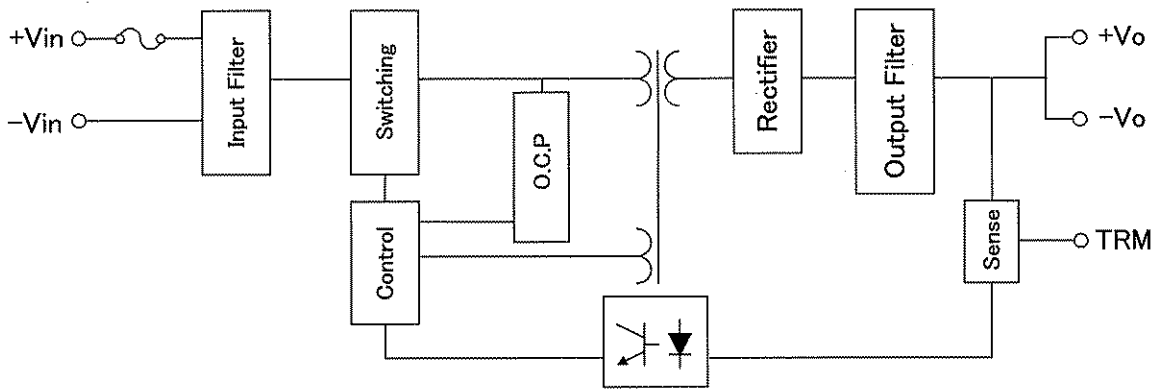
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# PSS·PSD SERIES

## Block Diagram

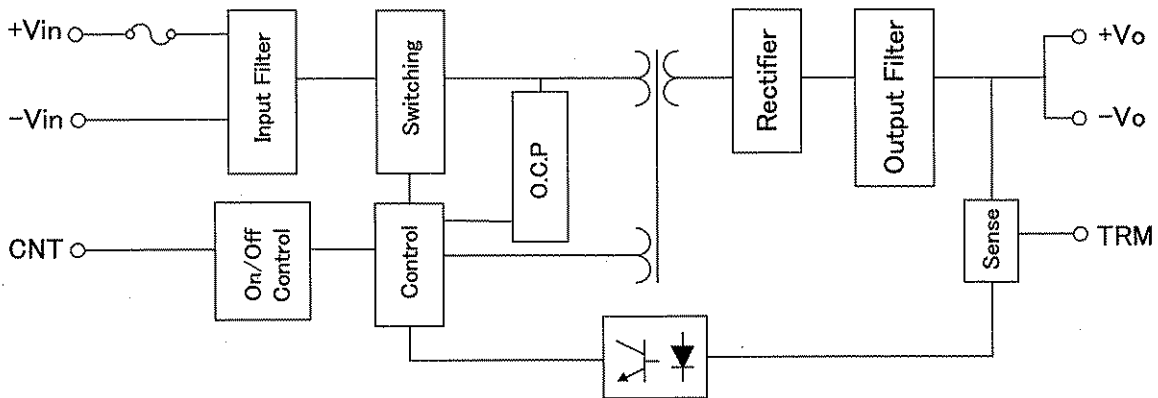
PSS1R5



Circuit Topology : RCC (Self-commutated Flyback)

Switching frequency: 150 ~ 800 kHz  
(Frequency is changed by input and output condition)

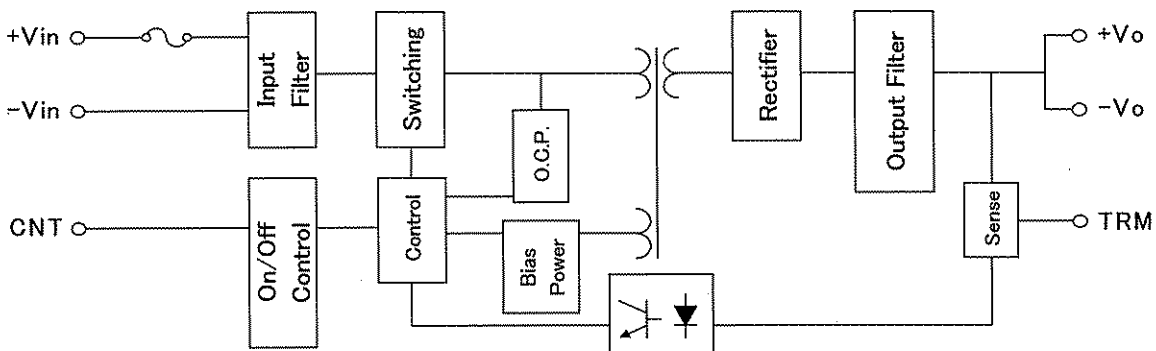
PSS3,PSS6



Circuit Topology : RCC (Self-commutated Flyback)

Switching frequency: 150 ~ 800 kHz  
(Frequency is changed by input and output condition)

PSS10

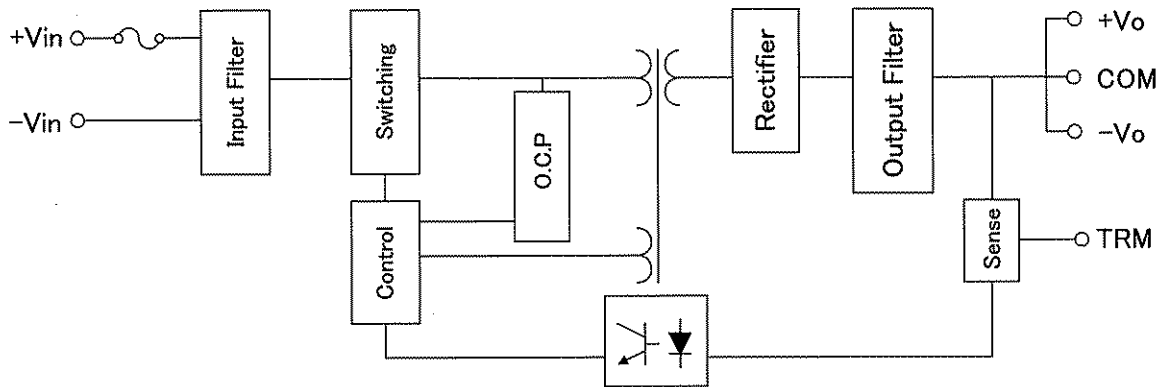


Circuit Topology : Flyback

Switching frequency: 5V input model 340 kHz  
24V input model 380 kHz  
12,48V input model 420 kHz

# PSS-PSD SERIES

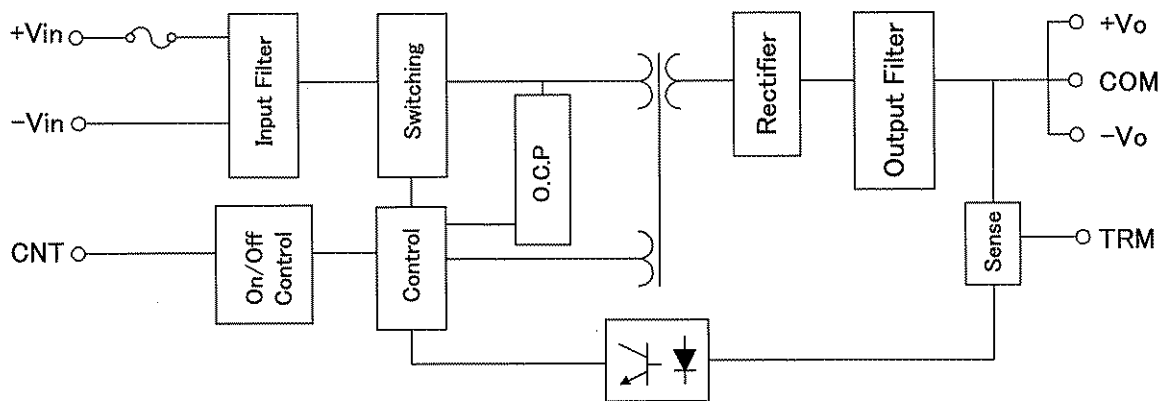
## PSD1R5



Circuit Topology : RCC (Self-commutated Flyback)

Switching frequency: 150 ~ 800 kHz  
(Frequency is changed by input and output condition)

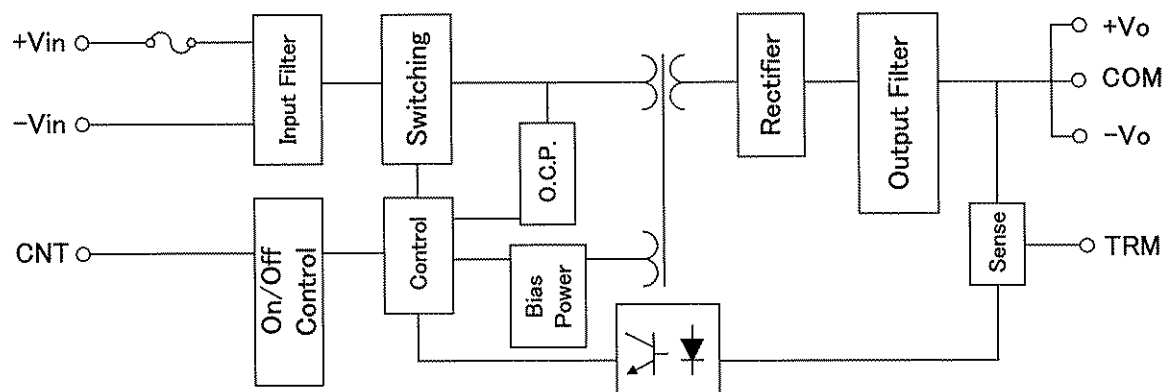
## PSD3,PSD6



Circuit Topology : RCC (Self-commutated Flyback)

Switching frequency: 150 ~ 800 kHz  
(Frequency is changed by input and output condition)

## PSD10



Circuit Topology : Flyback

Switching frequency: 5V input model 340 kHz  
12,24V input model 380 kHz  
48V input model 420 kHz

# PSS·PSD SERIES

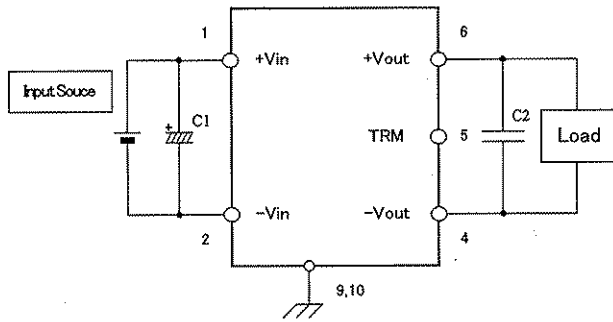
## Terminal Explanation

### 1. Before Using This Power Supply

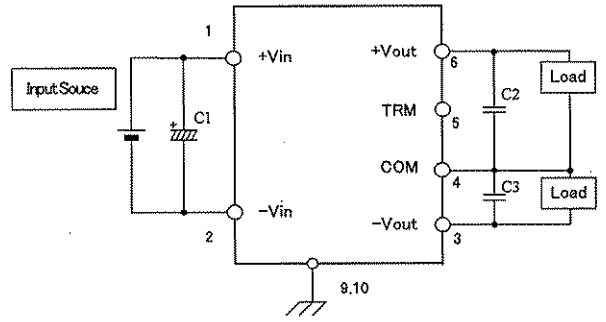
- Confirm connections to input/output terminals and signal terminals are correct as indicated in the instruction manual.

### 2. Terminal connection method

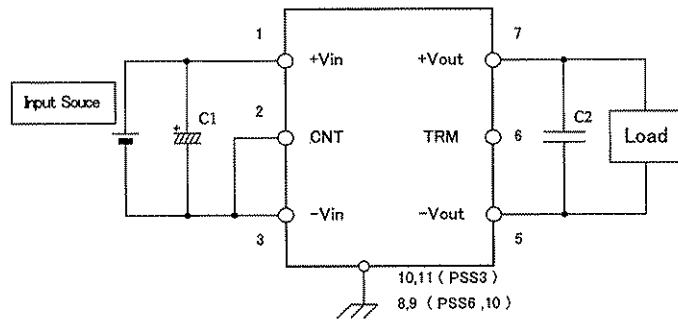
PSS1R5



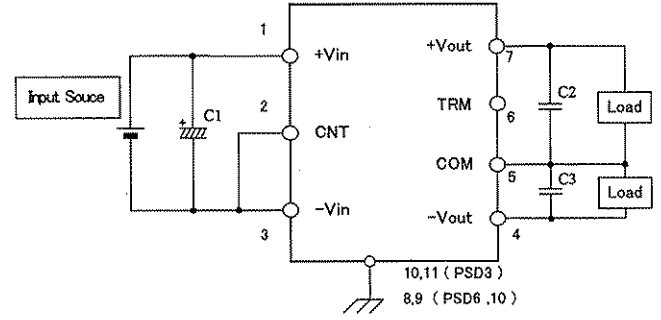
PSD1R5



PSS3,PSS6,PSS10



PSD3,PSD6,PSD10



< Connected capacitor when evaluation data is measured >

C1 : Electrolytic capacitor

Input voltage	PSS/PSD 1R5	PSS/PSD 3	PSS/PSD 6	PSS/PSD 10
5V	150 $\mu$ F	220 $\mu$ F	470 $\mu$ F	680 $\mu$ F
12V	47 $\mu$ F	68 $\mu$ F	100 $\mu$ F	220 $\mu$ F
24V	10 $\mu$ F	22 $\mu$ F	33 $\mu$ F	47 $\mu$ F
48V	2.2 $\mu$ F	4.7 $\mu$ F	10 $\mu$ F	22 $\mu$ F

C2, C3 : Ceramic capacitor 1  $\mu$ F

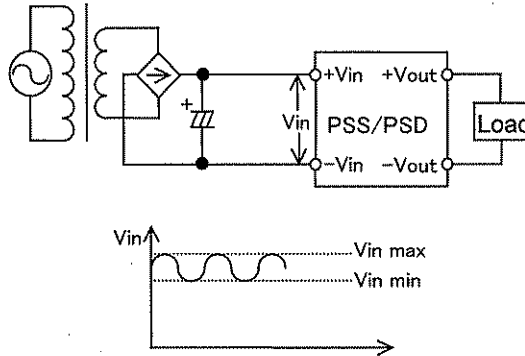
# PSS·PSD SERIES

## ■ Explanation of Functions and Precautions

### 1 Basic Connection

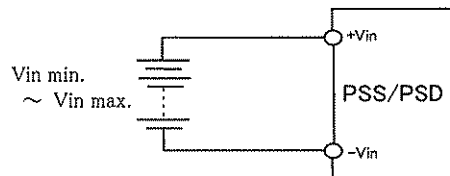
#### 1) Unstable Input Voltage

For input voltage with ripple voltage, the range of ripple voltage shall be within the input voltage range shown in the specification as the following figure.



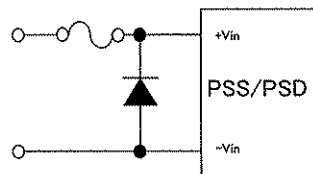
#### 2) Battery

When using battery as input power source, the minimum and maximum input voltage shall not sway out of the specification.



#### 3) Reverse Input Polarity

Wrong polarity of input may lead to damage of the power supply unit. Attach a diode and a fuse to avoid damage due to inverse connection of input.



#### 4) Input Fuse

An internal fuse is provided in a unit. If output current of input power source is limited, the fuse may not blow out. Internal fuse ratings are as follows:

Input voltage	PSS/PSD 1R5	PSS/PSD 3	PSS/PSD 6	PSS/PSD 10
5V	2.3A	4.0A	5.0A	10.0A
12V	1.2A	2.5A/2.3A	2.5A	5.0A
24V	0.7A	1.2A	2.0A	2.5A
48V	0.7A	0.7A	1.5A	2.0A

# PSS·PSD SERIES

## 2. Input Surge Current

Input surge current flows for a short period of time during line throw-in. When using plural number of the units together following input currents are added. Please choose input switch and external fuse with proper current rating.

## 3. Over Current Protection (OCP)

When OCP activates, output voltage drops. When over current condition is released, the output voltage is automatically recovered. Being in short or overload condition for more than 30 seconds may cause damage on the unit.

Due to fold back characteristics of OCP, the output may not rise up steady with constant current load or inductive load.

## 4. Over Voltage Protection

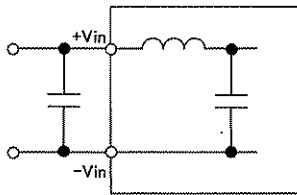
Over Voltage Protection is not provided in this PSS and PSD series.

## 5 Input / Output Filter

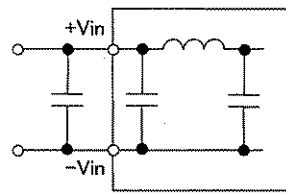
### 1) Input Ripple and Noise

An internal filter is provided in a unit. Unit can operation even without external input capacitor but attaching capacitor at input have effect in further reducing the noise. The external capacitor shall be attached as close as possible to input terminal of PSS and PSD series.

PSS/PSD1R5,3,6



PSS/PSD10



When wire from input power source to PSS/PSD series is long, the impedance of input line is large and spike noise or inductance of input wire may exert a bad influence on the unit due to high impedance of input wire. In this case, attachment of external capacitor is recommended.

Recommended capacitance of the external capacitor is 10~680  $\mu$  F. Choose a suitable external capacitor in accordance with operating condition.

### 2) Output Ripple and Noise

(1) To reduce output ripple, attachments of aluminum electrolytic capacitors are recommended at output.

The capacitors shall be 1~200  $\mu$  F. Please adjust the maximum capacity of the capacitor to 1000  $\mu$  F or less.

In addition, when using 200  $\mu$  F~1000  $\mu$  F capacitors characteristics are especially affected.

Therefore please perform sufficient evaluation before using this product.

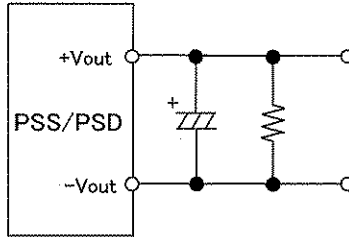
When load is equal or less than 20% output ripple might increase.

For this case, please add external circuit below.

# PSS-PSD SERIES

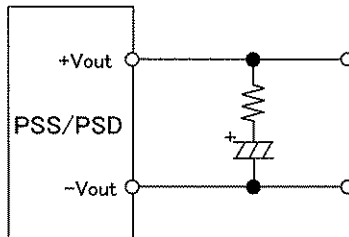
① Attach a dummy resistor (dummy resistor value shown in table below) in parallel with the output capacitor

Output voltage \ Capacitors value	82 $\mu$ F	100 $\mu$ F	220 $\mu$ F	470 $\mu$ F	680 $\mu$ F	1000 $\mu$ F
3.3V	—	—	—	—	5%	5%
5V	—	—	—	5%	5%	5%
12V	—	5%	5%	10%	10%	10%

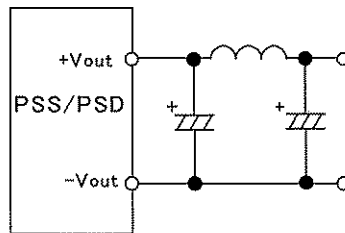


② Connector a resistor in series with the output capacitor.

Series resistor range=0.1  $\Omega$  to 0.47  $\Omega$



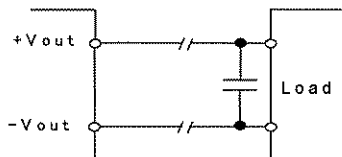
Also, attach  $\pi$  shape filter as following to further reduce output ripple. For this case, use 1~100 $\mu$ H coil.



(2) To reduce high frequency output noise, connect 1  $\mu$ F or less ceramic capacitor at output.

3) Using Long Load Wires

If noise is generated due to long wiring to load terminal from output terminal, attach a capacitor as close as possible to load terminal as shown below.





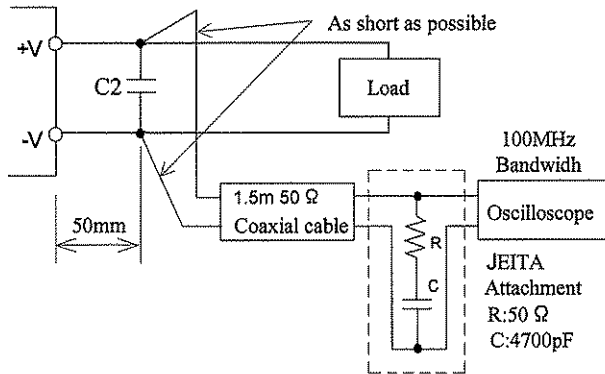
# PSS·PSD SERIES

## 6. Maximum Ripple and Noise

Measure according to the specified methods based on JEITA RC-9141(Clause 7.12 and 7.13) which is described in the following. Connect ceramic capacitor C2:1  $\mu$ F at 50mm distance from the output terminals.

Measure at ceramic capacitor (C2) leads using coaxial cable with JEITA attachment.

Use oscilloscope with 100MHz frequency bandwidth or equivalent.



Take note that output ripple voltage and output spike noise may vary depending on PCB wiring design. Generally, output ripple voltage and output spike noise can be reduced by increasing value of external capacitor.

## 7. Output Voltage Adjustment (TRM)

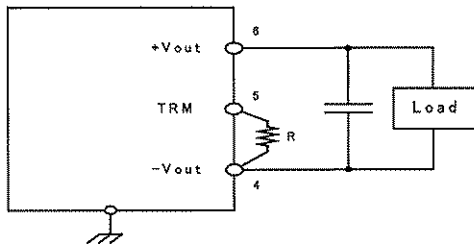
By connecting TRM terminal to +Vout or -Vout, output voltage can be adjusted as the following table.

Model	Open	-Vout and Short	+Vout and Short
PSS*-*-3R3	3.3V	3.67V	2.84V
PSS*-*-5	5V	6V	4.3V
PSS*-*-12	12V	15.3V	-
PSD*-*-1212	$\pm 12$ V	$\pm 15.3$ V	-

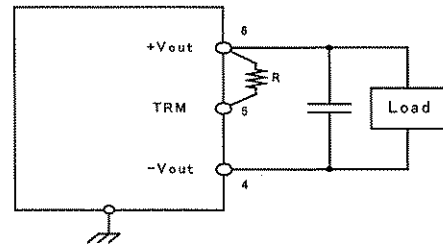
(Typ.)

Also, voltage can be adjusted by connecting TRM terminal to +Vout or -Vout terminal with resistor.

When increasing output voltage



When decreasing output voltage



Model	Open	-Vout and Resistor	+Vout and Resistor
PSS*-*-3R3	3.3V	3.3~3.67V (*1)	2.84~3.3V (*2)
PSS*-*-5	5V	5~6V (*3)	4.3~5V (*4)
PSS*-*-12	12V	12~15.3V (*5)	-
PSD*-*-1212	$\pm 12$ V	$\pm 12 \sim \pm 15.3$ V (*6)	-

(Typ.)

# PSS-PSD SERIES

*1: $V_o = (3.252 \times R + 36.136) / (R + 10)$	or	$R = (36.136 - 10 \times V_o) / (V_o - 3.252)$
*2: $V_o = (3.252 \times R + 36.136) / (R + 12.92)$	or	$R = (36.136 - 12.92 \times V_o) / (V_o - 3.252)$
*3: $V_o = (5.01 \times R + 40.862) / (R + 6.8)$	or	$R = (40.862 - 6.8 \times V_o) / (V_o - 5.01)$
*4: $V_o = (5.01 \times R + 40.862) / (R + 9.522)$	or	$R = (40.862 - 9.522 \times V_o) / (V_o - 5.01)$
*5: $V_o = (12.17 \times R + 125.92) / (R + 8.2)$	or	$R = (125.92 - 8.2 \times V_o) / (V_o - 12.17)$
*6: $V_o = (24.488 \times R + 304.26) / (R + 10)$	or	$R = (304.26 - 10 \times V_o) / (V_o - 24.488)$

Connection Resistor: R(kΩ)

- Note) 1. For 12V and ±12V model, output voltage cannot be adjusted down.  
 2.  $V_o$  on above formula is the voltage between +Vout and -Vout.  
 3. If the output voltage is adjusted higher than nominal, use the unit at derated maximum output power.  
 4. When the output ripple become larger due to adjusting of output voltage lower, put dummy load of about 5% of full load.

## 8. ON/OFF Control (CNT Terminal)

This function is provided only in PSS3/PSD3, PSS6/PSD6, PSS10/PSD10.

By On/Off Control, the power supply can be controlled without applying or shutting down the input.

This control circuit is located at input (primary) side and uses CNT terminal. When controlling it at secondary side, use relay or photo-coupler for isolation. CNT terminal operates with respect to -Vout of input terminal.

If this function is not needed, short between CNT terminal and -Vin terminal of input.

CNT Level for -Vin	Status of Output
Open	OFF
Short	ON

		PSS/PSD3	PSS/PSD6	PSS/PSD10
Open Voltage (V)	PSS/PSD-5-*	9	7	4
	PSS/PSD-12-*	15	11	4
	PSS/PSD-24-*	20	13	4
	PSS/PSD-48-*	20	15	4
Source Current (mA)	PSS/PSD-5-*	5	1	0.5
	PSS/PSD-12-*	2	1	0.5
	PSS/PSD-24-*	1	0.5	0.5
	PSS/PSD-48-*	1	0.5	0.5

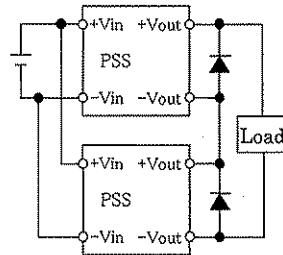
(Max.)

# PSS-PSD SERIES

## 9. Series · Parallel Operation

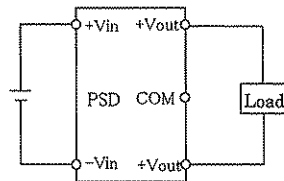
### 1) Series Operation

As shown in the following figure, it is possible to connect the units in series. If the output voltage does not start up in series connection, connect a diode with low forward voltage i.e., schottky barrier diode. Use diode that reverses voltage is more than twice the voltage between +Vout and -Vout. Also, the maximum forward current of the diode shall be sufficiently larger than the output current. Whichever smaller nominal current of a unit in series operation shall be maintained as the maximum output current.



### 2) An application of PSD series

PSD series can be used as shown below figure. In this case, PSD series operate as if single output (24V output) units.



### 3) Parallel Operation

It is not allowed to connect in parallel to increase the output current, however, it is possible if the load current is less than the maximum output current of the unit.

## 10. Operating Ambient Temperature

The operating ambient temperature is from  $-40^{\circ}\text{C}$ ~ $85^{\circ}\text{C}$ . However, the output load should be derated accordingly to the ambient temperature and airflow speed (refer to derating curve of specification sheet).

There is no restriction on mounting direction but there should be enough consideration for airflow so that heat does not accumulate around the power supply vicinity.

Determine external components configuration and mounting direction on PCB such that airflow through the power supply from force air or convection cooling is not blocked.

## 11 Operating Ambient Humidity

Take note that moisture could lead to power supply abnormal operation or damage.

## 12 Cooling Method

The operating ambient temperature is from  $-40^{\circ}\text{C}$ ~ $85^{\circ}\text{C}$ . However, the output load should be derated accordingly to the ambient temperature and airflow speed (refer to derating curve of specification sheet).

## 13 Isolation and Withstand Voltage Test

Avoid performing the isolation resistance test with voltage that is over specification. At the withstand voltage test, the voltage shall be gradually increased to apply and decreased to shut down the input. Especially using timer, the impulse voltage several times as the applied voltage may break out at shutting down and cause of damage on the units.

## 14 Vibration

Vibration of power supply is defined in case of mounting on PCB.

## 15 Shock

Value for the conditions of out shipping and packaging

## 16 Soldering Condition

Soldering temperature

- ① Soldering Dip : 260 °C less than 10sec  
Pre-heat: 110 °C 30 - 40 sec
- ② Manual soldering : 350°C less than 3sec

## 17 Cleaning Method

Recommended cleaning method after soldering is as follows:

- ① Solvent: IPA
- ② Procedure

PSS/PSD series used non-cleaning flux. So it is recommended not to wash the unit. For unavoidable cases, use IPA only terminals when cleaning with brush.

Note) contact us if you are going to clean up the power supply not follow by the recommended method.

## 18 Storage condition and duration

- ① Storage condition  
Temperature: 5 - 30°C  
Humidity: 40 - 60 %RH

- ② Storage duration

Please store the products less than one year after the delivery is made. For the product which storage duration are longer than one year, please check the solderability and if the leads are rusty before they are used.

## 19 Safety Consideration

1.Consideration shall be given to measuring the ambient temperature around of power supply vicinity when the converter is installed in the end use equipment.

It must be ensured the temperature does not exceed 85 degrees Celsius. This temperature limit governs the working ambient temperature.

2.The input to the units must be isolated from the mains by reinforced insulation in accordance with IEC/EN60950. Due to the potential non-SELV voltages at the input, the input to those units must be considered a hazardous secondary voltage, outputs were considered SELV, see note 1 above.

# PSS·PSD SERIES

## ■ Mounting Method

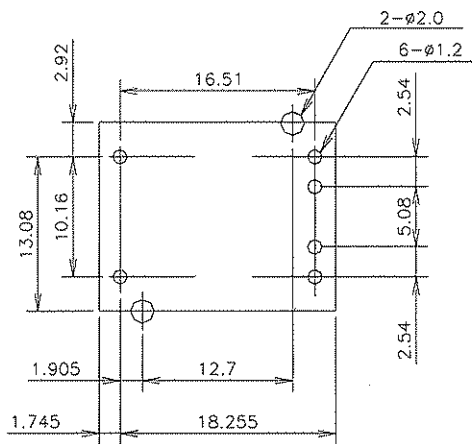
### 1) Mounting hole on PCB

Below is the recommended diameter of hole and land of PCB.

Type	In/Output Terminal Pin	Case Terminal Pin
Pin	□0.64mm	□1.0X0.3mm
Hole Diameter	φ 1.2mm	φ 2.0mm
Land Diameter	φ 2.0mm	φ 3.0mm

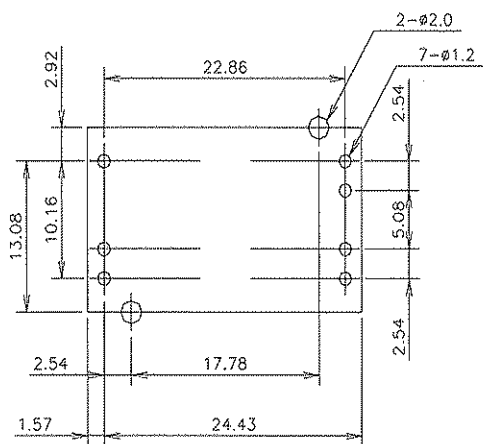
For position of the holes, see outline drawing of the power supply.

PSS/PSD1R5



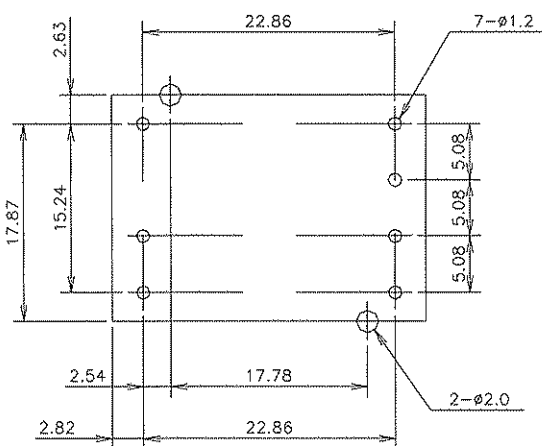
(TOP VIEW)

PSS/PSD3



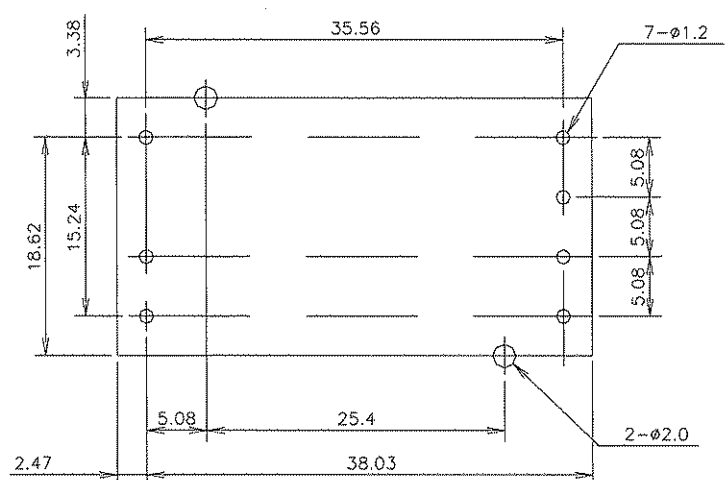
(TOP VIEW)

PSS/PSD6



(TOP VIEW)

PSS/PSD10



(TOP VIEW)

## 2) Recommended Material of PCB

Recommended materials of the printed circuit board is double sided glass epoxy with through holes.  
(Thickness :  $t=1.6\text{mm}$ )

## 3) Output Pattern Width

When several to tens amperes of current flows to output pattern, voltage would drop and heat generation would be higher for narrow pattern. Relationship between current and pattern width changes depending on material of printed circuit board, thickness of conductor and temperature rise allowance. Fig. 2-1 shows an example of a  $35\mu\text{m}$  copper glass epoxy printed circuit board. For example, when 5A of current flows and temperature rise below  $10^\circ\text{C}$  are expected, pattern width shall be more than 4.2mm with  $35\mu\text{m}$  copper plate (generally  $1\text{mm}/\text{A}$  is standard).

Confirmation is definitely necessary for designing because characteristics shown in Fig. 2-1 depends on manufactures of printed circuit board.

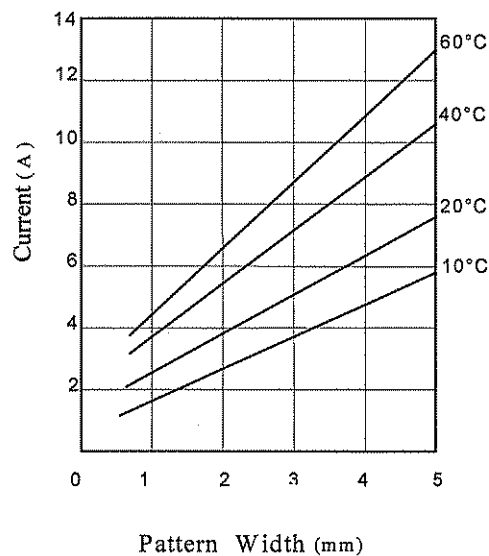


Fig.2-1 Characteristic of current allowance

## ■ Before concluding module damage

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Verify following items before concluding power supply damage.

### 1) No output voltage

- Is specified input voltage applied?
- Are the ON/OFF control terminal (CNT terminal), output voltage-trimming terminal (TRM) correctly connected?
- For cases where output voltage adjustment is used, is the resistor or variable resistor setting, connections correctly done?
- Are there no abnormalities in the output load used?

### 2) Output voltage is high

- For cases where output voltage adjustment is used, is the resistor or volume setting, connections correctly done?

### 3) Output voltage is low

- Is specified input voltage applied?
- For cases where output voltage adjustment is used, is the resistor or variable resistor setting, connections correctly done?
- Are there no abnormalities in the output load used?

### 4) Load regulation and line regulation is large

- Is specified input voltage applied?
- Are the input terminals and the output terminals firmly connected?
- Is the input or output wire too thin?

### 5) Output ripple voltage is large

- Is the measuring method used the same or equivalent with the specified method in the Application Notes?
- Is the input ripple voltage value within the specified value?