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Safety Precautions for Power Supply Operation

⚠ WARNINGS

- Do not remove the cover. Do not disassemble.
  Portions of the power supply are at high voltage. These can cause electrical shock.
- Power supply models without covers also have high voltage components. Do not touch.
  Contact with power supply components can cause electrical shock.

⚠ PRECAUTIONS

- Prior to using this product, be sure to read the catalog / handling instructions.
  In particular, it should be confirmed that the product conforms to specification documents for the application.
- This product has been designed and constructed for use with electronic equipment. A warning label should be attached to the final product for the end user to read. Furthermore, these safety precautions should be included in the final product handling instructions.
- Output power and output current should be within the specified ranges. Exceeding these ratings can result in shortened operational life due to heating, or can result in electrical shock.
- Do not exceed the operational temperature range. This can result in electrical shock.
  Actual internal temperature of the final product should be measured.
- The power supply should be used in a manner so that condensation does not result from moisture or humidity. Such condensation can cause electrical shock.
- Never use in high temperature, high humidity, dusty, gaseous or corrosive environments(such as salt, acid or alkaline). Such conditions can cause electrical shock.
- Do not rebuild or modify the power supply. TDK is not responsible for rebuilt or modified products. Rebuilding of modification can result in electrical shock.
- Input voltage should be within specifications. Damage, etc. can occur if the specified input voltage is exceeded.
- If a fuse blows, do not use the product after simply replacing the fuse.
  It is possible that some abnormality has occurred within the product. Be certain to contact TDK.
- Do not use external fuses other than those specified or recommended by TDK.
- Some form of protection should be used to prevent voltage surges from lightening, etc.
  Abnormal voltages can cause damage, etc.

REPAIRS

- A TDK office or a TDK representative should be contacted for repair and overhaul of TDK products.
- After expiration of the warranty period, product repair is carried out for a fee.
- A replacement product is sometimes shipped when repair is impossible.

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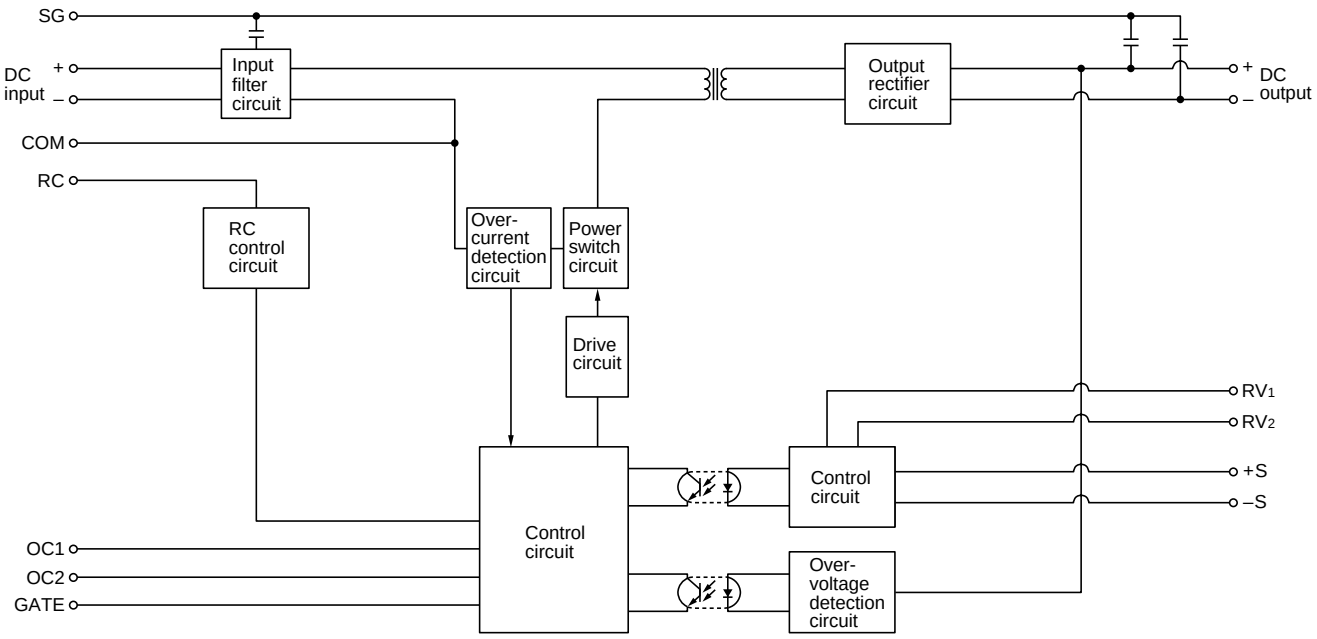
BLOCK DIAGRAM



GENERAL SPECIFICATIONS

Temperature range	Operating	0 to +60 °C [However, derating is required at 40°C min. Maximum base plate temperature : +85°C.]
	Storage	–25 to +105°C
Humidity range	Operating	20 to 95(%)RH [Maximum wet-bulb temperature : 35°C, without dewing]
	Storage	
Vibration	5 to 10Hz	10 mm total amplitude [3 directions, each 1h]
	10 to 55Hz	2G acceleration [3 directions, each 1h]
Impact	Acceleration	20G [3 directions, each 3 times]
	Time period of impact	11±5ms
Withstand voltage	Between input terminal and output terminal	Edc: 500V, 1min[25°C, 45 to 75(%)RH]
	Between input terminal and signal ground	
Insulation resistance	Between input terminal and output terminal	100MΩmin., Edc: 500V[25°C, 45 to 75(%)RH]
	Between input terminal and signal ground	
	Between output terminal and signal ground	

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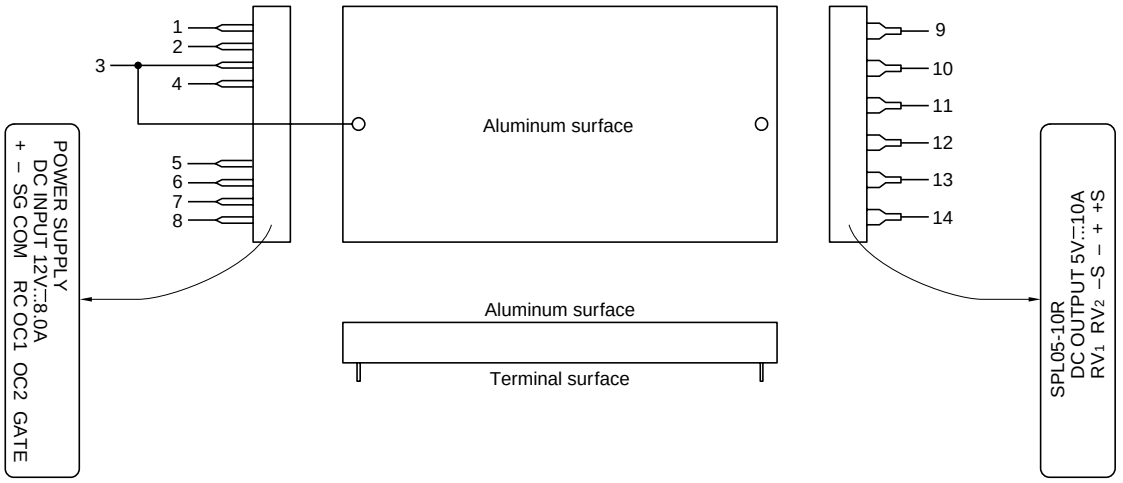
TERMINAL DESIGNATIONS AND FUNCTIONS



Terminal No.	Designation	Function
1 2	DC input terminal (+) DC input terminal (–)	Connect to DC input power lines.
3	Signal ground terminal (SG)	This is connected to the base plate (aluminum surface). This should be connected to the DC input (–) or the DC input (+). This can also be connected to the equipment FG.
4	Common terminal (COM)	This is connected to the DC input (–) through an input filter. Use this as common for the input signal system (OC1.RC).
5	Remote ON-OFF terminal (RC)	The output voltage is turned ON-OFF by TTL level control voltage applied between this RC terminal and the COM terminal. Output is ON when this control voltage is at H level, or if control is open. Output is OFF when this control voltage is at L level, or control is shorted.
6	Overcurrent detection terminal1 (OC1)	This determines the power supply overcurrent setting. OC1 and COM should be connected for single unit operation. This connection should be as short as possible.
7	Overcurrent detection terminal2 (OC2)	This terminal is used for internal adjustment of the power supply. Leave this open. Do not use this terminal. Damage or abnormal operation can occur if this is used as an intermediate terminal, etc
8	Gate terminal (GATE)	This terminal is used for internal adjustment of the power supply. Leave this open. Do not use this terminal. Damage or abnormal operation can occur if this is used as an intermediate terminal, etc.
9 12	Remote sensing terminal (+S) Remote sensing terminal (–S)	These are connected to the load terminals if remote sensing is used. Each of these should be connected to the respective DC output terminal if remote sensing is not used.
10 11	DC output terminal (+) DC output terminal (–)	Power supply output terminals. Connect to load lines.
13 14	Output voltage external trim terminal (RV_2) Output voltage external trim terminal (RV_1)	Roughly ±10% external adjustment is possible of the fixed output voltage by connecting a resistance between the RV_1 to RV_2 terminals or between the RV_2 to –S terminals. These should be left open if unused.

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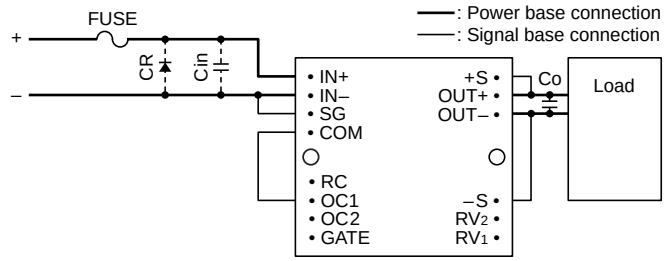
BASIC INPUT TERMINAL CONNECTIONS



Recommended fuse ratings

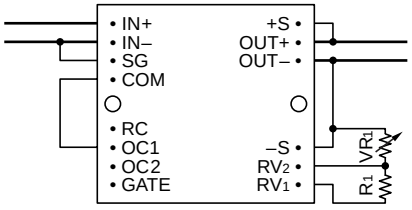
Output power	50W	100W
SPL	15 to 20A	—
SPM	6.3 to 10A	15 to 20A
SPH	2.5 to 4A	5 to 6.3A

PRECAUTIONS

- This product contains no built-in input fuse.
  Installation of an external protective fuse (normal type) and an external reverse voltage prevention diode (CR) is recommended. Fuse blowing characteristics should be considered when selecting the diode. A diode should be selected that has a forward current rating at least twice that of the power supply current rating.
- When the input line impedance is high, an electrolytic capacitor (Cin) should be placed between the power supply input terminals. This electrolytic capacitor should be capable of handling high ripple current.
  [Example: Causes of high impedance]
  (1) Long input power lines
  (2) Thin input power lines
  (3) Filter installed in input lines
- Inductance and noise can result in oscillations when the lines to the load are long. If such oscillations readily occur, connect a 100µF min. (Co) aluminum electrolytic capacitor between the power supply OUT+ and OUT- terminals

WIRING METHODS

(1) SINGLE UNIT OPERATION UTILIZING THE OUTPUT VOLTAGE ADJUSTMENT FUNCTION

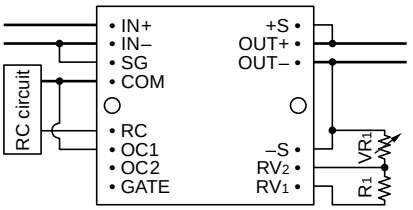


Recommended external resistance values (for use when utilizing the output voltage adjustment function)

Output voltage	5V	12V	15V	24V
VR_1	10kΩ	10kΩ	10kΩ	10kΩ
R_1	1kΩ	5.6kΩ	10kΩ	27kΩ

It is possible to adjust the output voltage ±10% by connecting an external resistance. However, output power range should not be exceeded.

(2) SINGLE UNIT OPERATION USING THE REMOTE ON-OFF FUNCTION



The output is turned ON-OFF by TTL level signal voltage applied between the RC and COM terminals, or by opening-closing the connection between the RC and COM terminals.

RC-COM control voltage:

H (high) level (2.4V to 5V), or control is open → ON

L (low) level (0V to 0.4V), or control is shorted → OFF

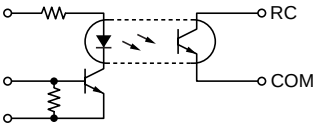
Since the remote ON-OFF circuit is connected internally to the power supply primary circuitry, it is recommended that this should only be connected to external control circuitry though an element possessing an isolating function, such as a relay (contact chattering should be avoided), photocoupler, etc.

If use of a non-isolated control circuit is unavoidable, the input (–) terminal should be used instead of the COM terminal.

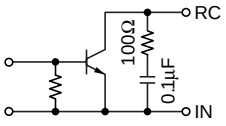
If a non-isolated control circuit is used in this manner, noise to the input terminal should be suppressed as much as possible.

Furthermore, caution is necessary since the COM pattern can burn due to high current flow to the COM pattern if the input terminal is open. Within the power supply, the RC terminal is pulled up to 5V, so the RC terminal should be left open if not in use.

Recommended circuit for isolated type control



Recommended circuit for non-isolated type control



1. For SPL type power supplies, signal rise time and signal fall time to the RC terminal should be less than 2ms.
2. The input signal to the RC terminal should have low chatter. Power source output errors can occur is chatter exceeds 0.1ms.

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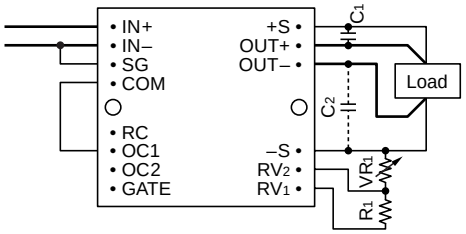
WIRING METHODS

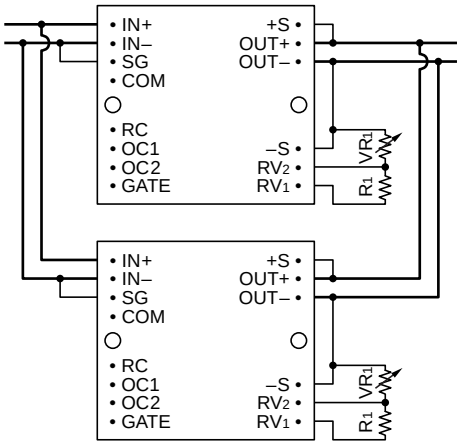
(3) SINGLE UNIT OPERATION USING THE REMOTE SENSING FUNCTION



PRECAUTIONS

- At up to the maximum voltage listed below, remote sensing is possible using the +S to OUT+ (–S to OUT–) line drop.
  5V output :0.25V max.
  12 to 24V output : 0.4V max.
- Jacketed or twisted lines, etc. should be used for remote sensing wiring to decrease the influence of noise. If the overvoltage protection circuit readily trips or oscillates, 0.1µF min. electrolytic capacitors (C_1, C_2) should be placed between the +S to OUT+ terminals and between the –S to OUT– terminals, and the output voltage should be checked (see above diagram).
- Polarity should be considered when electrolytic capacitors are used.
- Startup time is delayed by capacitance of the electrolytic capacitors.

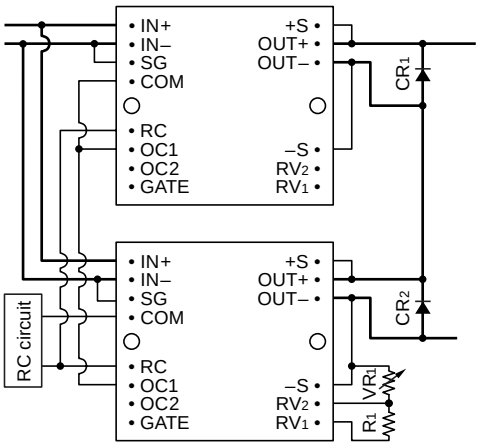
(4) PARALLEL OPERATION



PRECAUTIONS

- During parallel operation, total power should be less than 80% of the rated power of each power supply.
  Example : Two 50W units are used to supply 80W.
  (50W×2)×0.8 =80W
- Line impedances between each power source and the load should be as equal as possible.
- If improved precision of the output current balance is desired, use the VR_1 potentiometers to set the output voltage variance for each power supply to within 1%.
- When operating power supplies in parallel, the OC_1 terminal should be left open. Leaving the OC_1 terminal open automatically sets the overcurrent threshold value to 80% of the current rating.
- Parallel operation is possible for up to 8 power supply units. However, each of these units should be the identical type. It should also be confirmed by testing that erroneous operation does not occur due to mutual interference between outputs.

(5) SERIES OPERATION



PRECAUTIONS

- For series operation, reverse polarity prevention diodes CR_1 and CR_2 must be installed.
- CR diode selection requirements
  Maximum reverse voltage: at least two times the respective output voltages
  Forward current rating: at least two times the respective output currents
  Forward voltage drop: as small as possible
- The maximum current is the lowest output current from among the power supplies connected in series.

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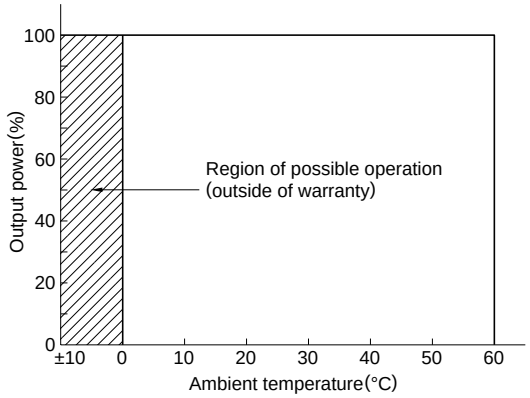
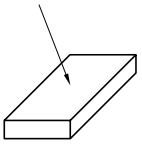
DERATING

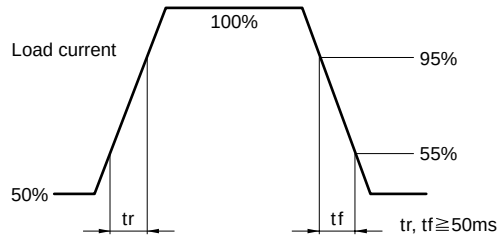


The power supply should not be used under conditions where the base plate (aluminum surface) is hotter than 85°C. When using a heat sink, it is recommended that thermal resistance and forced air cooling (fan, etc.) should be considered. If a heat sink is used, base plate temperature should be measured by drilling a small hole in the heat sink near the base plate center (see figure below). Base plate temperature is measured by thermocouple, etc.

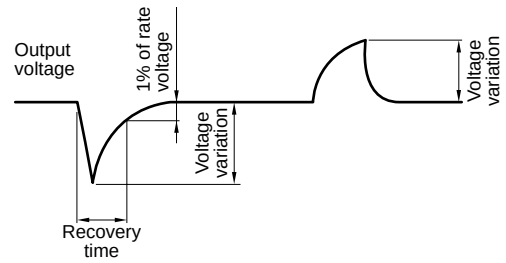


DYNAMIC LOAD VARIATION

LOAD CURRENT



OUTPUT VOLTAGE



Voltage variation will change depending upon input voltage and load current.

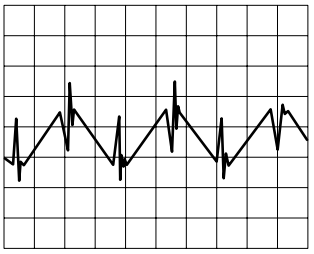
COUNTERMEASURES FOR EXCESSIVE RESPONSE

- If voltage variation is judged to be excessive, an external capacitor should be connected to the output to load.
- Caution is required when multiple power supplies are connected together since oscillations can occur.
- If multilayer ceramic or tantalum capacitors are used, it is recommended that there should be as few such capacitors are possible, or alternatively, electrolytic capacitors should also be used.

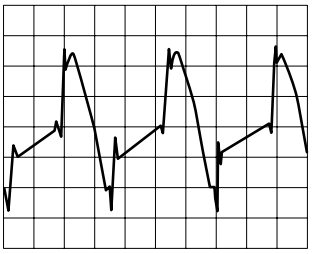
OUTPUT NOISE REDUCTIONS

Ripple / Noise Waveform prior to Countermeasure (SPH05-20R at Rated Input / Output

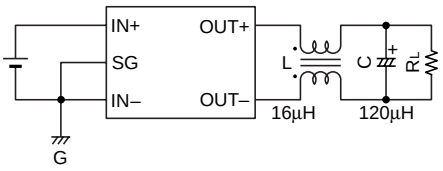
Voltage between output terminals
20mV/div, 0.5μs/div



Voltage between SG to output terminals
0.1V/div, 0.5μs/div

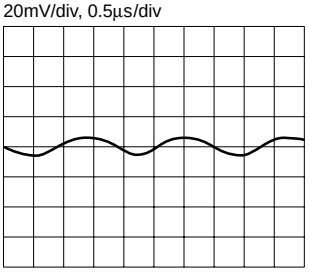


(1) BASIC EXAMPLE OF COUNTERMEASURE

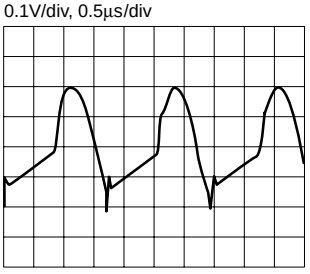


16 μH common-mode choke + 120 μF electrolytic capacitor

Voltage between output terminals
20mV/div, 0.5μs/div



Voltage between SG to output terminals
0.1V/div, 0.5μs/div



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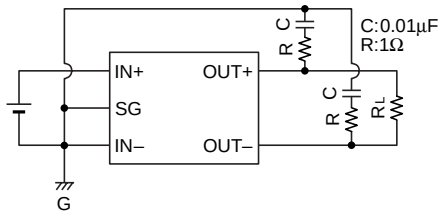
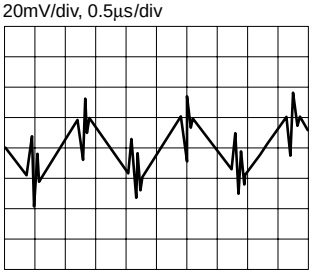
OUTPUT NOISE REDUCTIONS

(2) EXAMPLE OF CONNECTION OF A Y-CAPACITOR TO OUTPUT

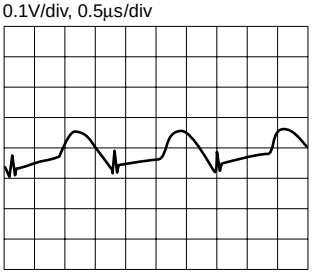


Output Y capacitor: 0.01 + 1Ω (representative example)

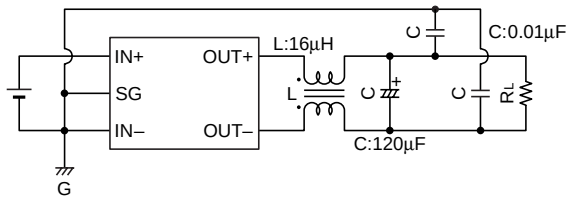
Voltage between output terminals
20mV/div, 0.5µs/div



Voltage between SG to output terminals
0.1V/div, 0.5µs/div

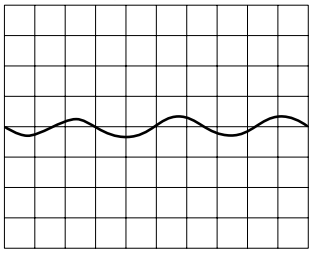


(3) COMBINATION OF THE TWO PREVIOUS EXAMPLES

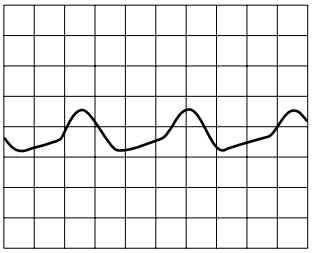


16 µH common-mode choke + 120 µF electrolytic capacitor
+ 0.01 µF Y capacitor

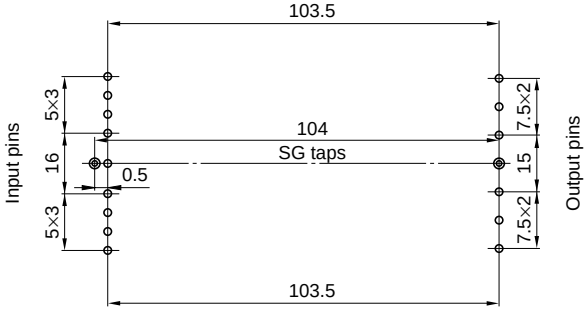
Voltage between output terminals
20mV/div, 0.5µs/div



Voltage between SG to output terminals
0.1V/div, 0.5µs/div



RECOMMENDED PIN PATTERN (TOP VIEW)



Input terminal
Hole dia.: 1
Round dia.: 3
Round dia.: 8.5 to 9.5

Output terminal
Hole dia.: 1.5
Round dia.: 4 to 6

Tap for SG signal
ground connection (◎)
Hole dia.: 4.5

Dimensions in mm

MOUNTING PRECAUTIONS

- Attachment method

  Taps at two locations (next to the terminals) on the case bottom should be used to attach the power supply to the board. Use M4 screws to attach the power supply, making certain not to penetrate into the base surface to a depth greater than 6mm (recommended torque:1.08N • m).

  Tapped holes at two locations upon the case top surface (aluminum) should be used for attachment of the heat sink. Use M3 screws to attach the heat sink, making certain not to penetrate into the power supply to a depth greater than 6 mm (recommended torque:0.67N • m).

  To improve the effectiveness of the heat sink, application of thermally conductive grease between the heat sink and the power supply case (aluminum surface) during power supply installation is recommended.

- Pattern width

  High current flows through the input pattern. During circuit design, sufficient attention should be paid to voltage drops since such voltage drops cause heat generation. 1 mm/A pattern width should be used as a rule-of-thumb reference design factor

- Recommended soldering conditions

  Dip temperature:230 ± 5°C, 5s.

- Cleaning recommended conditions

  The board pattern surface should be partially cleaned. Recommended conditions are listed below.

  Solvents:Alcohol, xylene

  Method:Brush cleaning

  Care should be taken during cleaning so as to avoid seeping of cleaning solution into the power supply interior. Cleaning solution wetting of the power supply interior can cause damage.

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