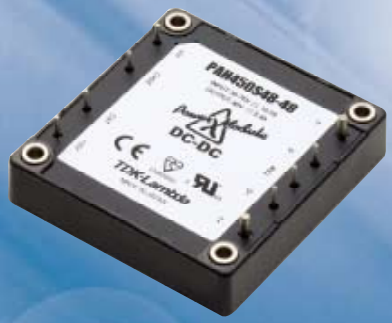


PAH450S Series

Compact and high-power DC/DC Power-module

TDK·Lambda

The new era for base station transmission amplifiers: Compact and high-power output

actual size

PAH450S Series

Compact and high-power DC/DC Power-module

PAH450S Series

High efficiency: 92% - top level in the industry

PAH450S48 achieves a 3% improvement on efficiency against our previous half-brick sized product (PAH350S48)! It even achieves a 2% improvement compared with our previous product (PAF500F48) with 48Vin and similar output capacity.

Support for gallium nitride (GaN) devices

The long-awaited compound semiconductor, GaN (gallium nitride) is now coming introduced. This new semiconductor has captured the attention of the telecommunications industry as a semiconductor that enables to operate at high voltages and high current densities, which was impossible with previous semiconductors. PAH450S48 supports the GaN device.

Compact & high density: 1/2 in size and 164.8W/in^3 max

Previously, 350W was the maximum output capacity with our half brick sized power modules with 48Vin and 28Vout, but PAH450S48 takes a dramatic leap forward to 450W. Also, we used to have no other choice for 350W+ than full-brick size before, but from now on the half-brick is all you need.

Wide operating temperature range: -40 to +100°C (baseplate)

For a base station transmission amplifier, which is installed outside, a wide operating temperature range is essential. Users have the peace of mind of being able to use this product within a wide operating temperature range of -40 to +100°C.

Power supplies with high power (450W) and high efficiency (92%) support transmission amplifiers for next-generation cell phones.

Keeping up with telecom trends

PAH450S48 is the power module developed for telecom power amplifiers. Supporting the latest industry developments, our telecom customers can rest assured that we'll keep up with the trends.

For third and later generation cell phones, high-speed communication is critical. Base station transmission amplifiers must achieve as high output power as possible to cater for high-speed communication and traffic increases. The next-generation transmission amplifiers must meet many other conditions, such as small size, low cost and high energy efficiency.

Our product doesn't meet only the de facto industry standards in terms of shape and input voltage etc. which comprise the basic specifications, but also has high output power. Also, it is compact and highly efficient, and making it an ideal power supply for the next generation of transmission amplifiers.

- Size: half-brick size(industry standard)
- Input Voltage: VDC48, common in the telecom industry
- Output Power: 450W

Model name

PAH450S48-28/□

- Options
  None: Standard
  T: ϕ3.4 Through Hole Type
- Nominal Output Voltage: 28V, 48V
- Nominal Input Voltage: 48V
- S: Single Output
- Output Power
- Series Name

Product line-up

48VDC input

Output Voltage	450W	
	Output Current	Model
28V	16A	PAH450S48-28
48V	9.4A	PAH450S48-48

PAH450S48 SPECIFICATIONS

ITEMS/UNITS \ MODEL				PAH450S48-28	PAH450S48-48
Input	Voltage Range		V	DC36 - 76	
	Efficiency (typ)	(*1)	%	92	
	Current (typ)	(*2)	A	10.3	10.4
Output	Nominal Voltage		VDC	28	48
	Maximum Current		A	16	9.4
	Maximum Power		W	448	451.2
	Voltage Setting Accuracy	(*2)	%	±1	
	Maximum Line Regulation	(*3)	mV	56	96
	Maximum Load Regulation	(*4)	mV	56	96
	Temperature Coefficient (%)			0.02%/°C	
	Maximum Ripple & Noise	(*10)	mVp-p	280	480
	Voltage Adjustable Range	(*10)		-40%, +18%	-40%, +20%
Function	Over Current Protection	(*5)		105% - 140%	
	Over Voltage Protection	(*6)(*9)		125% - 145%	
	Remote Sensing	(*9)		Possible	
	Remote ON/OFF Control	(*9)		Possible (SHORT : ON OPEN : OFF)	
	Parallel Operation	(*9)		———	
	Series Operation	(*9)		Possible	
Environment	Operating Temperature	(*7)	°C	-40 - +100 (Baseplate) Ambient Temperature min= -40	
	Storage Temperature		°C	-40 - +100	
	Operating Humidity		%RH	5 - 95 (No Dewdrop)	
	Storage Humidity		%RH	5 - 95 (No Dewdrop)	
	Vibration			At No Operating, 10 - 55Hz (Sweep for 1min.) Amplitude 0.825mm Constant (Maximum 49.0m/s^2) X, Y, Z 1 hour each	
	Shock			196.1m/s^2	
	Cooling	(*8)		Conduction Cooled	
Isolation	Withstand Voltage			Input-Baseplate : 1.5kVDC, Input-Output : 1.5kVDC for 1min. Output-Baseplate : 500VDC for 1min.	
	Isolation Resistance			More than 100MΩ at 25°C and 70%RH Output-Baseplate...500VDC	
Mechanical	Weight (typ)		g	100	
	Size (W × H × D)		mm	61 × 12.7 × 57.9 (Refer to Outline Drawing)	

=NOTES=

(*1) At 48VDC, 80% of Maximum Output Current and Baseplate Temperature = +25°C.

(*2) At 48VDC and Maximum Output Current. Baseplate Temperature = +25°C.

(*3) 36 - 76VDC, Constant Load.

(*4) No load - Full load, constant input voltage.

(*5) Constant current limiting with automatic recovery.

(*6) Inverter shutdown method, manual reset.

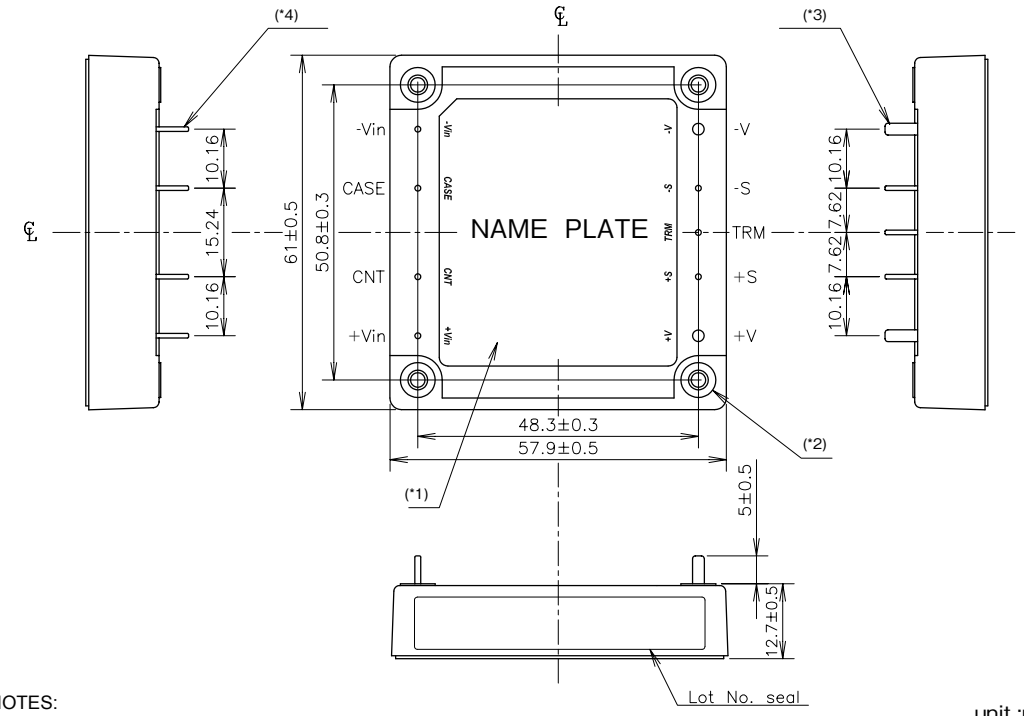
(*7) Ratings - Refer to Derating Curve.
- Load(%) is percent of Maximum Output Current.
- Refer to Instruction Manual.

(*8) Heatsink has to be chosen according to Instruction Manual.

(*9) Refer to Instruction Manual.

(*10) External components are needed for operation.(Refer to Basic Connection and Instruction Manual)

Outline Drawing



NOTES:

(*1) Model name, input voltage range, nominal output voltage, maximum output current, country of manufacture and safety marking (C-UL-US, BSI & CE marking) are shown here in accordance with the specifications.

(*2) M3 threaded holes 4 for customer chassis mounting (FG).

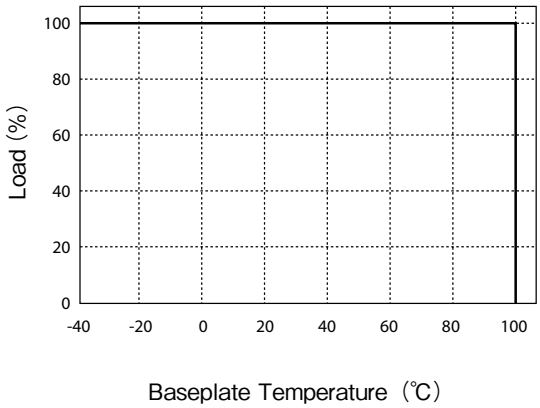
(*3) Output terminals : 2－ϕ2.0

(*4) Input and signal terminals : 7－ϕ1

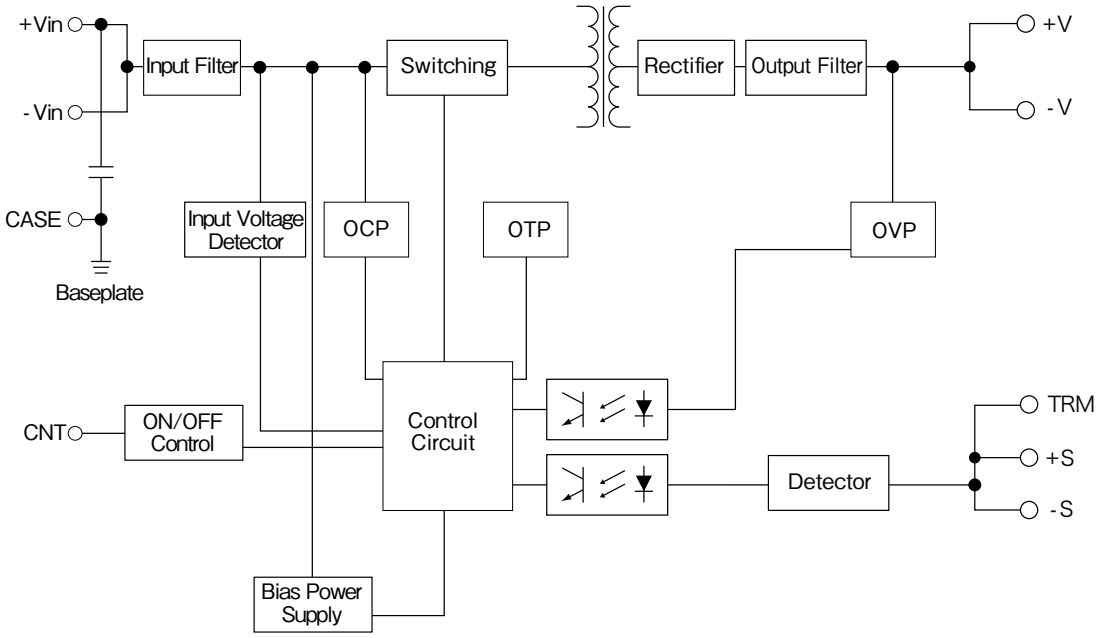
(*5) Unless otherwise specified dimensional tolerance : ±0.25

unit :mm

Derating Curve

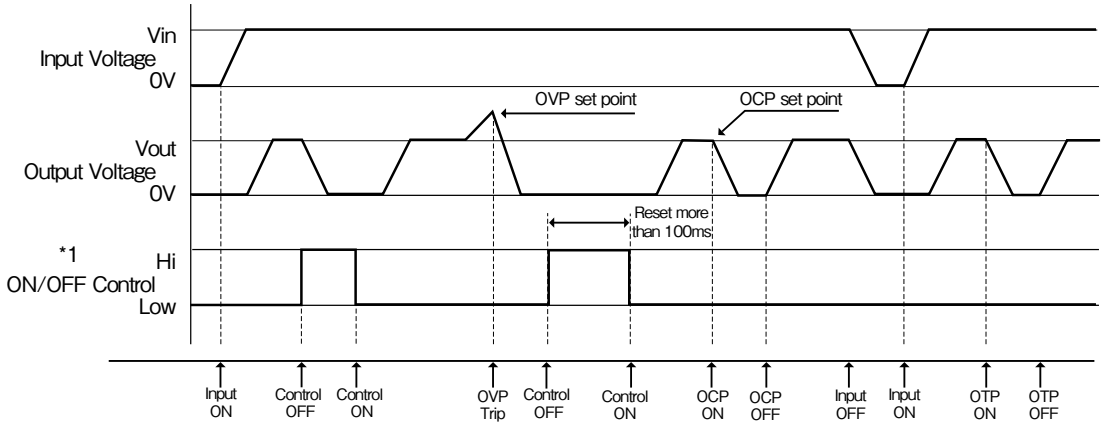


Block Diagram



Switching Frequency (fixed) : 400kHz (typ.) for 28V Model, 460kHz (typ.) for 48V Model

Sequence Time Chart



*1 level : 4≦H≦35 (V) or Open
0≦L≦0.8 (V) or Short

PAH450S48 Instruction Manual

BEFORE USING THE POWER SUPPLY UNIT

Be sure to read this instruction manual thoroughly before using this product. Pay attention to all cautions and warnings before using this product. Incorrect usage could lead to an electrical shock, damage to the unit or a fire hazard.

⚠ WARNING

- Do not make unauthorized changes to power supply unit, otherwise you may have electric shock and void your warranty.
- Do not touch this unit and the internal components in operation or shortly after shut down. They may have high voltage or high temperature and as the unit dissipates its heat so the surface of the unit is hot. You may receive electric shock or burn.
- When the unit is operating, keep your hands and face away from it; you may be injured by an accident.
- Do not use unit under unusual condition such as emission of smoke or abnormal smell and sound etc. It might cause fire and electric shock. In such case, please contact us; do not repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into unit. It might cause failure and fire.
- Do not operate these units under condensation condition. It may cause fire and electric shock.

⚠ CAUTION

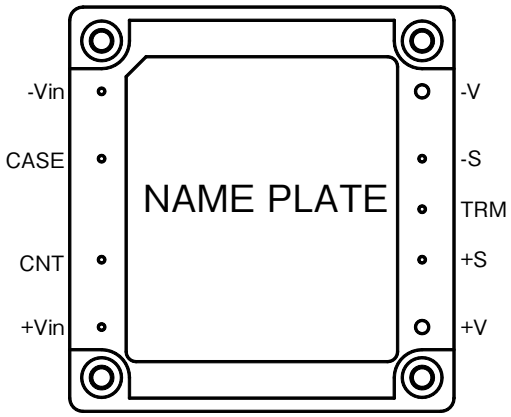
- As a component part, compliance with the standard will be based upon installation in the final application. This product must be installed in a restricted access location, accessible to authorized competent personnel only. These DC to DC converters have basic insulation between the input and the output. All models with an output 48V and above are considered to be non-SELV and must not be accessible to the operator. The installer must also provide protection against inadvertent contact by a service engineer.
- The input to this power supply must be isolated from the mains input by reinforced insulation.
- The equipment has been evaluated for use in a Pollution Degree 2 environment.
- This power supply is primarily designed and manufactured to be used and enclosed in other equipment.
- Confirm connections to input/output terminals and signal terminals are correct as indicated in the instruction manual.
- Attach a HBC external fuse to each module to ensure safety operation and compliance to each safety standard approval. The recommended input fuse rating within the instructions is as follows: 30A, 250V fast acting fuse. The breaking capacity and voltage rating of this fuse may be subject to the end use application.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be used within specifications, otherwise the unit will be damaged.
- For application equipment, which requires very high reliability (Nuclear related equipment, traffic control equipment, medical equipment, etc.), please provide fail safety function in the equipment.
- Do not use the product in environment with strong electromagnetic field, corrosive gas and conductive substance.
- Do not operate and store this unit at an environment where condensation occurs. In such case, waterproof treatment is necessary.
- Never operate the unit under over current or shorted conditions for 30 seconds or more and out of Input Voltage Range as specification. Insulation failure, smoking, burning or other damage may occur to the unit.
- The output voltage of this power supply unit is considered to be a hazardous energy level (The voltage is 2V or more and the electric power is 240VA or more). Prevention from direct contact with output terminal is highly necessary. While installing or servicing this power supply unit, avoid dropping tools by mistake or direct contact with output terminal. This might cause an electrical shock. While repairing this power supply unit, the DC input power must be switched off and the input and output voltage should be safe level.
- To maintain the SELV output for outputs 28V and below, under fault conditions, the output must be connected to earth in the final application. However, during installation please ensure both the input positive and output positive are not grounded.
- 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.
- 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 components.
- This 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.
- No part of this document may be copied or reproduced in any form without prior written consent of Densei-Lambda.

Note : CE MARKING

CE Marking when applied to a product covered by this handbook indicates compliance with the low voltage directive (2006/95/EC) in that it complies with EN60950.

1. Terminal Explanation

1 Terminal Arrangement



[Input Side Terminals]
-Vin : -Input Terminal
CASE : Baseplate Terminal
CNT : ON/OFF Control Terminal
+Vin : +Input Terminal

[Output Side Terminals]
-V : -Output Terminal
-S : -Remote Sensing Terminal
TRM : Output Voltage Trimming Terminal
+S : +Remote Sensing Terminal
+V : +Output Terminal

Baseplate can be connected to FG (frame ground) M3 threaded holes. (standard model)
Connect +Vin, -Vin, +V, -V with consideration of contacting resistance.

2. Explanations on Specifications

1 Input Voltage Range

Input voltage range for PAH450S48 Series is indicated below.

Input Voltage Range : 36 - 76VDC

Basically, ripple voltage (Vrpl) which results from rectification and filtering of commercial AC line is included within the input voltage as shown in Fig. 1-1. Ripple voltage must be limited within the voltage described below.

Allowable input ripple voltage : 4Vp-p

When this value is exceeded, the output ripple voltage becomes large.

Note that sudden input voltage change may cause variation of output voltage transitionally.

Also, input voltage waveform peak value must not exceed above input voltage range.

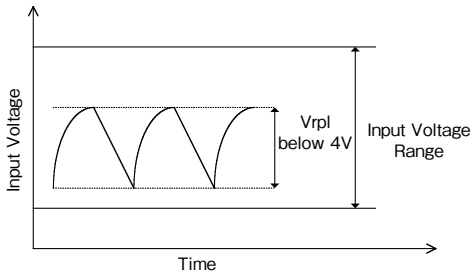


Fig.1-1 Input Ripple Voltage

● **Basic Connection**

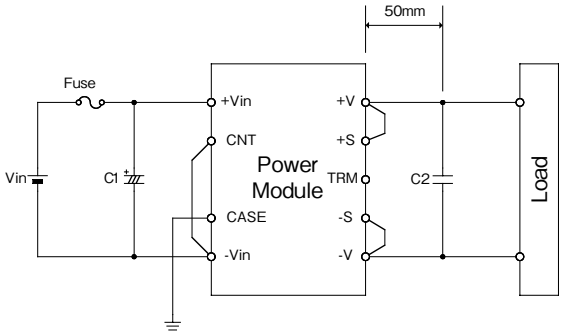


Fig.1-2 Basic Connection

Input Fuse

This power module has no built-in fuse. Use external fuse to acquire various Safety Standards and to improve safety. Also, use fast-blow type for every module.

Furthermore, fuse must be connected to the +Vin side if -Vin side is used as ground, or fuse must be connected to -Vin side if +Vin side is used as a ground.

Input Fuse recommended current rating:
PAH450S48 : 30A

C1 : 100μF

To prevent the effect of input line inductance to the power module, connect electrolytic capacitor or ceramic capacitor between +Vin and -Vin terminals.

Furthermore, use electrolytic capacitor with small ESR value. Especially take note that during line turn off at low ambient temperature, power module output will not normally shut down due to unstable C1 voltage.

Also, ripple current flows across this capacitor. Therefore, verify maximum allowable ripple current this capacitor when selecting component. Verify actual ripple current value by actual measurement.

Recommended capacitor value : 100μF and above
(Voltage Rating 100V and above)

Notes 1. Use low impedance electrolytic capacitor with excellent temperature characteristics.
(Nippon Chemi-con LXV Series or equivalent)
2. When input line inductance becomes excessively high due to insertion of choke coil, operation of the power module could become unstable. For this case, increase C1 value more than the value indicated above.

C2 :

For stable operation, connect a ceramic capacitor between +V and -V within 50mm distance from the output terminals.

Take note that output ripple and output shutdown could be affected by ceramic capacitor, equivalent impedance and inductance characteristics of wiring.

Take note that output ripple voltage could vary according to PCB wiring design.

For cases of abrupt changes in load current or input voltage, increasing capacitance value of the external capacitors could reduce the voltage fluctuation.

Vout	C2
28V	50V 22μF×4parallel
48V	100V 4.7μF×6parallel

Table1-1 C4 Recommended Values of External Output Capacitor

Maximum capacitance (electrolytic capacitor) that can be connected between +V and -V, is shown below.

Maximum capacitance of output capacitor
28V : 10,000μF
48V : 2,000μF

Notes Take note of the allowable ripple current of the capacitor to be used. Especially, when load adding capacitors for abrupt current changes, be sure to verify that ripple current does not exceed allowable ripple current before use.

C3 :

When switches or connectors are used between input source and PAH450S48 Series input terminals, impulse surge voltage is generated due to input throw-in by switch on/off or due to inserting/ removing of power module from the active line. For this case, connect an additional electrolytic capacitor C3 as shown in fig.1-3 and fig. 1-4.

Recommended Capacitance Value : 100μF and above
(Voltage Rating 100V and above)

Also, in-rush current flows at line throw-in. Therefore, be sure to verify capability of switch or fuse to withstand I^2t at line throw-in.

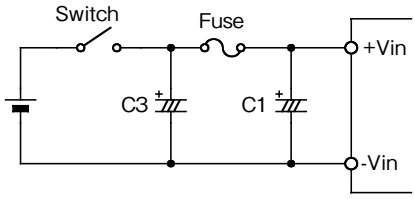


Fig.1-3 Input Filter with Input Switch

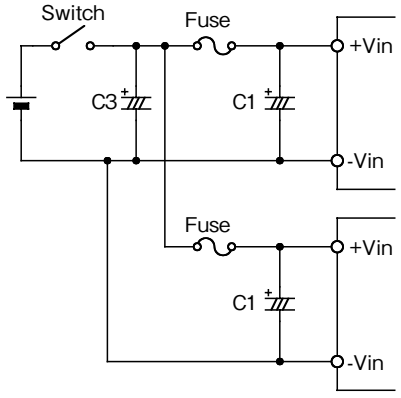


Fig.1-4 Input Filter when Plural Power Modules

Reverse input connection

Reverse input polarity would cause module damage. For cases where reverse connections are possible, connect a protective diode and fuse. Use protective diode with higher voltage rating than the input voltage, and with higher surge current rating than the fuse.

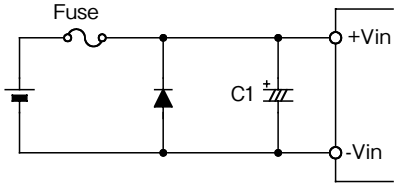


Fig.1-5 Protection for Reversed Connection of Input

● Recommended application as EMI countermeasure (compliant to VCCI Class 1, FCC class A)

(1) Recommended application as EMI countermeasure

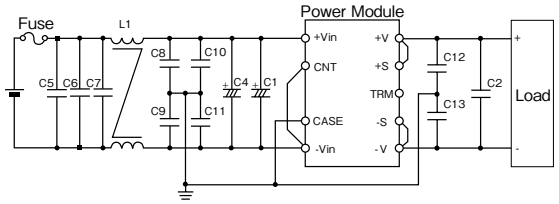


Fig.1-6 Recommended input filter as EMI countermeasure

Recommended Values:

C1: 220μF (Electrolytic Capacitor)
C2: Apply C2 capacitance in Basic Connection.
C4: 220μF (Electrolytic Capacitor)
C5-C7: 2.2μF (Ceramic Capacitor)
C8,C9: 0.22μF (Film Capacitor)
C10, C11: 4700pF (Film Capacitor)
C12, C13: 0.47μF (Film Capacitor)
L1 : 80μH (Common-mode choke coil)

Notes 1. C4 (Electrolytic Capacitor) can be deleted if impedance of input line is lower and operation of power module is stable.
2. C12 and C13 (Film Capacitor) can be deleted when output is connected to earth.
3. VCCI Class 1, FCC Class A limits can be satisfied with the above recommended filter at Densei-Lambda measuring conditions. However, there are cases where above limits might not be satisfied due to input and output wiring method, as well as, peripheral circuits. When selecting input filter, be sure to verify actual EMI characteristics (CE and RE) before finalizing the filter. Refer to PAH450S48-* Evaluation Data for details.

2 Output Voltage Adjustment Range

Output voltage could be adjusted within the range described below by external resister or variable resistor.

However, take note that OVP might trigger when output voltage adjustment exceeds the ranges indicated below.

Output Voltage Adjustment Range
28V: -40% - +18% of Nominal Output Voltage
48V: -40% - +20% of Nominal Output Voltage

When increasing the output voltage, reduce the output current accordingly so as not to exceed the maximum output power.

Take note that input voltage range is limited as shown in fig.2-1 when output voltage is increased.

Remote sensing is possible even when output voltage is varied. For details on remote sensing function, please refer to "9.Remote Sensing"

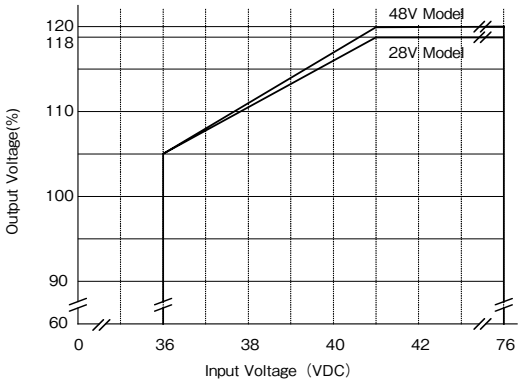


Fig.2-1 Limit of Input Voltage

●Output Voltage Adjustment by external resistor or by variable resistor

(1) In case of adjusting output voltage lower

(1-1) Available maximum output current = rated output current

(1-2) Connect an external resistor Radj(down) between the TRM terminal and -S terminal.

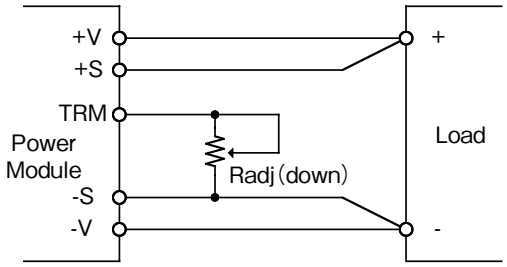


Fig.2-2 Connection for output voltage trim down

(1-3) Equation of external resistor and output voltage

$$Radj(down) = \left(\frac{100\%}{\Delta\%} - 2\right)[k\Omega]$$

Radj(down) : Value of external resistor
Δ(%) : Output voltage change rate against nominal output voltage

Below graph is relation Δ(%) and value of external resistor.

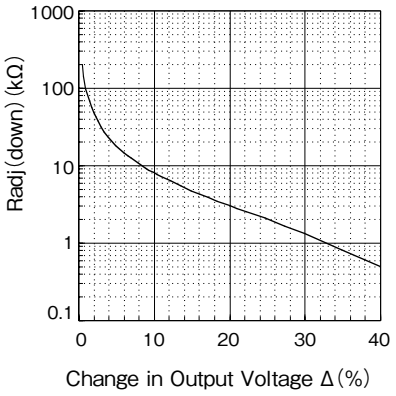


Fig.2-3 Δ(%) vs. Radj(down) (1)

(2) In case of adjusting output voltage higher

(2-1) Allowable maximum output current = maximum output power ÷ output voltage (reduce maximum output current in specification.)

(2-2) Connect an external resistor Radj(up) between TRM terminal and +S terminal.

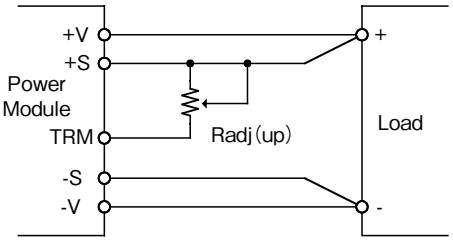


Fig.2-4 Connection for output voltage trim up

(2-3) Equation of external resistor and output voltage

$$Radj(up) = \left(\frac{Vo(100\%+\Delta\%)}{1.225\times\Delta\%} - \frac{100\%+2\times\Delta\%}{\Delta\%} \right) [k\Omega]$$

Vo : nominal output value of module
Radj(up) : external adjustment resistor
Δ (%) : Output voltage change rate against nominal output voltage

Below graph is relation Δ(%) and value of external resistor.

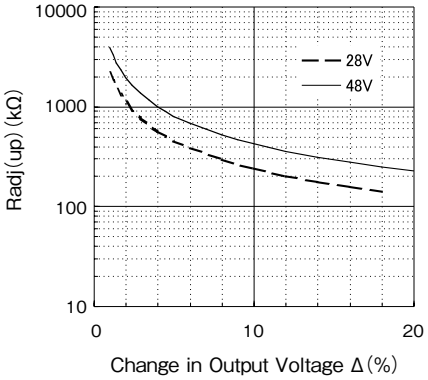


Fig.2-5 Δ(%) vs. Radj(up) (2)

3 Maximum Ripple and Noise

Measured value according to the specified methods based on JEITA-9141 (Clause 7.12 and clause 7.13) which is described in the following.

Connect according to fig.3-1 and measure. Connect capacitors (C2: refer to table 1-1 for ceramic capacitor values) at 50mm distance from the output terminals. Measure at ceramic capacitor (C2) terminals as shown in fig. 3-1 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, increasing capacitance value of external capacitor can reduce output ripple voltage and output spike noise.

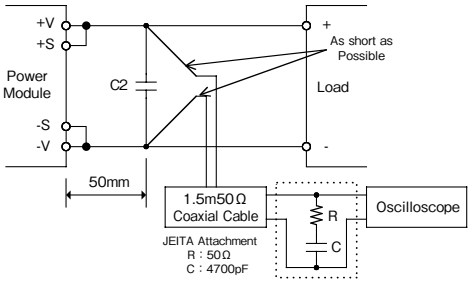


Fig.3-1 Measurement of Maximum Output Ripple & Noise

4 Maximum Line Regulation

Maximum value of output voltage change when input voltage is gradually varied (steady state) within specified input voltage range.

5 Maximum Load Regulation

Maximum value of output voltage change when output current is gradually varied (steady state) within specified output current range.

When using at dynamic load mode, audible noise could be heard from the power module and output voltage fluctuation might increase. A thorough pre-evaluation must be performed before using this power module.

6 Over Current Protection (OCP)

This power module has built-in OCP function.

Output will recover when short circuit or overload conditions are released. OCP setting value is fixed and therefore, cannot be externally adjusted.

Also, take note that power module might be damaged continuing output short circuit or over load conditions depending on thermal conditions.

7 Over Voltage Protection (OVP)

This power module has built-in OVP function.

OVP set point is relative to the rated output voltage value. OVP setting value is fixed and therefore, cannot be externally adjusted.

When OVP is triggered, output can be recovered by turning input line off and then turning it on again after lowering the input voltage below the voltage value indicated below, or by manual reset of the ON/OFF control terminal. Reset time for ON/OFF control terminal is 100ms or longer.

OVP release input voltage value : 10VDC and below

When verifying OVP function by applying external voltage at the output terminals, applied voltage value should not exceed specified OVP maximum value. Refer to specification table for OVP maximum value. Avoid applying external voltage that exceeds OVP maximum value because this will cause power module damage.

8 Over Temperature Protection (OTP)

This power module has built-in OTP function.

This function operates and shuts down the output when ambient temperature or internal temperature of power module abnormally rises. OTP operates at 105℃ to 130℃ baseplate temperature. OTP can be released when baseplate temperature drops down approximately to within 80℃ to 95℃. However, take note that OTP will operate again unless the cause of abnormal heat of the power module is eliminated.

9 Remote Sensing (+S, -S terminal)

Remote sensing terminal is provided to compensate for voltage drop across the wirings from the power module output terminal to the load input terminal.

When remote sensing function is not used (local sensing), short +S terminal to +V terminal and, -S terminal to -V terminal.

Take note that voltage compensation range for line drop (voltage drop due to wiring) is determined such that output voltage at the output terminals is within output voltage range and that

voltage between -V and -S terminals is within 2V or less. Even for remote sensing case, use power module such that output power is within specified maximum output power.
Furthermore, reduce noise effect by using shield wire, twist pair, or parallel pattern.

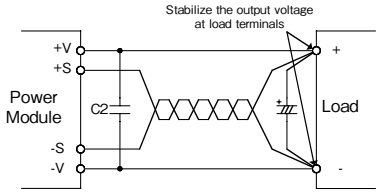


Fig.9-1 Remote Sensing is in Use

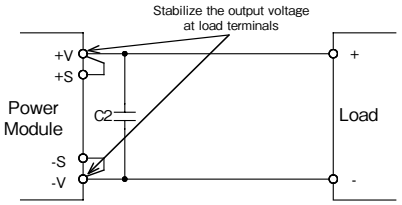


Fig.9-2 Remote Sensing is Not in Use

10 ON/OFF Control (CNT terminal)

Without turning the input supply on and off, the output can be enabled and disabled using this function. This function also can be used for output sequence of plural power modules.
ON/OFF control circuit is on the primary side (the input side). For secondary control, isolation can be achieved through the use of an opto-coupler or relay.

Notes 1. When ON/OFF control function is not used for the Standard and /T option, CNT terminal should be shorted to -Vin terminal.

2. When using long wiring, for prevention of noise, attach a 0.1μF capacitor between CNT terminal and -Vin terminal.
3. At L level, maximum source current from CNT terminal to -Vin terminal is 0.5mA.
4. The maximum CNT terminal voltage is 35V.

(1) Output ON/OFF control

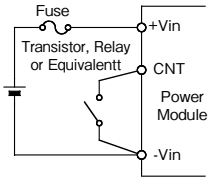


Fig.10-1 CNT Connection (1)

(2) Secondary (output side) control

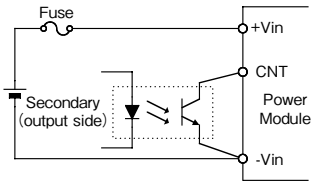


Fig.10-2 CNT Connection (2)

11 Parallel Operation

Parallel Operation can not be used.

12 Series Operation

Series operation is possible for PAH450S48 series. Connections shown fig. 12-1 and fig. 12-2 are possible.

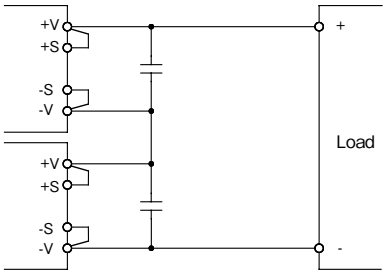


Fig.12-1 Series Operation due to High Output Voltage

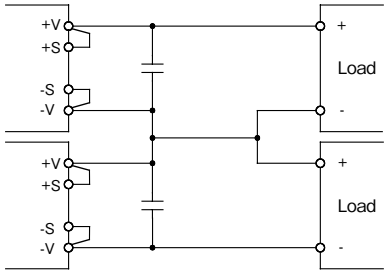


Fig.12-2 Series Operation due to ±Output

13 Operating ambient temperature

There is no restriction on mounting direction but there should be enough consideration for airflow so that heat does not accumulate around the power module vicinity. Determine external components configuration and mounting direction on PCB such that air could flow through the heatsink at forced cooling and conventional cooling.
By maintaining actual baseplate temperature below 100℃, operation is possible.
For details on thermal design, refer to Application Notes "Thermal Design".

Note : Maximum baseplate temperature is 100℃. For worst case operating condition, verify baseplate temperature at measurement point indicated in fig. 13-1.

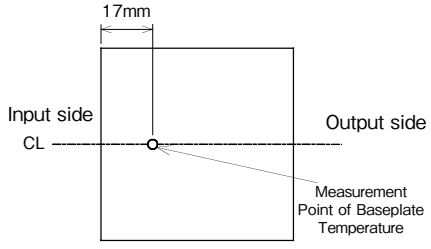


Fig.13-1 Measurement Point of Baseplate Temperature

For better improvement of power module reliability, derating of baseplate temperature when using is recommended.

14 Operating Ambient Humidity

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

15 Storage Ambient Temperature

Abrupt temperature change would cause moisture formation that leads to poor solderability of each terminal of the power module.

16 Storage Ambient Humidity

Take enough care when storing the power module because rust which causes poor solderability would form in each terminal when stored in high temperature, high humidity environment.

17 Cooling Method

Operating temperature range is specified by the baseplate temperature. Therefore, several methods of heat dissipation are possible.

For details on thermal design, refer to Application Notes "Thermal Design".

18 Baseplate Temperature vs. Output Voltage Drift

Output voltage drift is defined as the rate of voltage change when baseplate temperature only is changed during operation.

19 Withstand Voltage

This power module is designed to have a withstand voltage of 1.5kVDC between input and baseplate, 1.5kVDC between input and output and 500VDC between output and baseplate for 1 minute. When conducting withstand voltage test during incoming inspection, be sure to apply DC voltage. Also, set the current limit value of the withstand voltage testing equipment to 10mA.

Be sure to avoid conducting test with AC voltage because this would cause power module damage.

Furthermore, avoid throw in or shut off of the testing equipment when applying or when shutting down the test voltage. Instead, gradually increase or decrease the applied voltage. Take note especially not to use the timer of the test equipment because when the timer switches the applied voltage off, impulse voltage which has several times the magnitude of the applied voltage is generated causing damage to the power module.

Connect the terminals as shown in the diagram below.

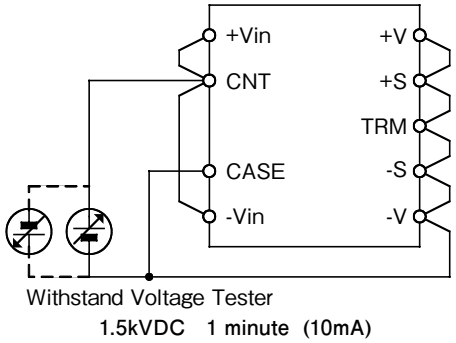


Fig.19-1 Withstand Voltage Test
for Input-Output and Input - Baseplate

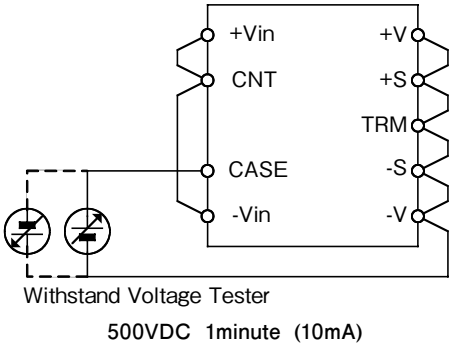


Fig.19-2 Withstand Voltage Test for Output-Baseplate

20 Isolation Resistance

Use DC isolation tester (MAX 500V) between output and baseplate. Isolation resistance value is 100MΩ and above at 500VDC applied voltage. Also take note that depending on the isolation tester used, some testers generate high voltage pulse. Discharge the power module after test using a resistor, etc.

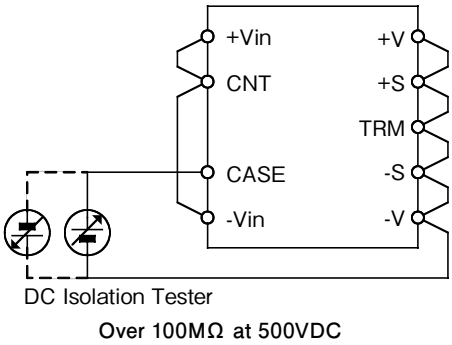


Fig.20-1 Isolation Test

21 Vibration

Vibration of power module is defined in case of mounting on printed circuit board.

22 Shock

Withstand shock value is defined to be the value at Densei -Lambda shipment and packaging conditions.

3. Installation

1 Mounting Method

By the following instruction shown in Fig.1-1 and Fig.1-2, mount power module onto printed circuit board.

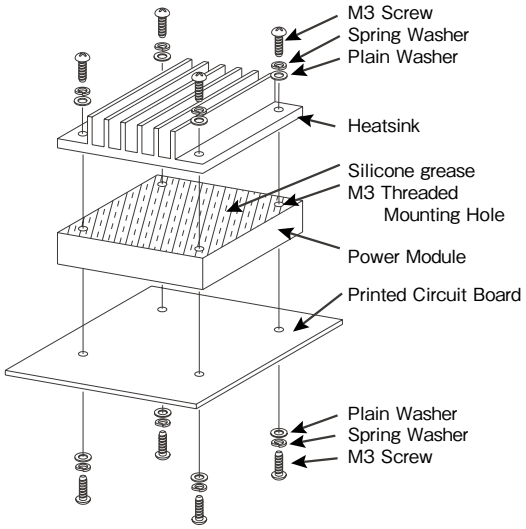


Fig.1-1 Mounting method for standard model

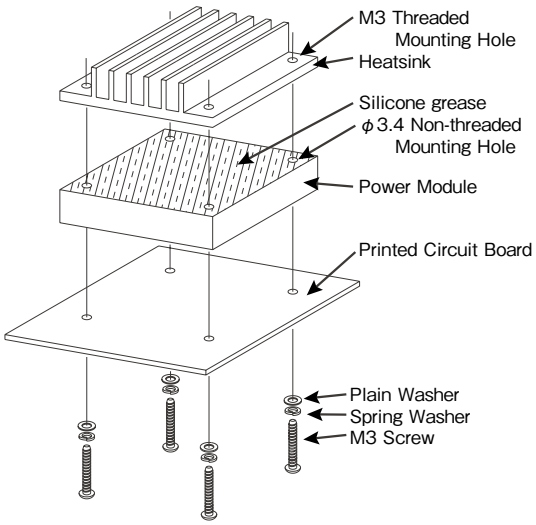


Fig.1-2 Mounting method for /T option model

(1) Method to Fix

(1-1) Standard model

To fix a power module onto printed circuit board, use M3 screws and mount it to the M3 threaded holes (4 places) of the power module. Recommended torque is 0.54N・m.

(1-2) /T option model

To fix a power module onto printed circuit board, use M3 screws and mount it to the M3 threaded holes of the heatsink (4 places) through the φ3.4 non-threaded holes (4 places) of the power module. Recommended torque is 0.54N・m.

(2) Mounting Holes

Mounting holes of the power module are connected to baseplate. Connect baseplate to FG (Frame Ground) by using this mounting holes

(3) Mounting Holes on Printed Circuit Board

Refer to the following sizes when determining diameter of hole and land diameter of printed circuit board.

Input / Signal terminals (φ1.0 mm)
- Hole diameter : φ1.5 mm
- Land diameter : φ3.0 mm

Output terminals (φ2.0 mm)
- Hole diameter : φ2.5 mm
- Land diameter : φ4.5 mm

Mounting Holes (FG)
- Hole diameter : φ3.5 mm
- Land diameter : φ5.5 mm

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

(4) Recommended Material of PCB

Recommended materials of the printed circuit board is double sided glass epoxy with through holes.
(thickness t: 1.6mm , copper 35μm).

(5) Input / Output terminal pin

Connect +Vin, -Vin, +V, -V terminals such that contact resistance is minimal. Note that if contact resistance is high, efficiency will drop and power module will be damaged by abnormal heat.

(6) Input / Output Pattern Width

Large current flows through input and output pattern. If pattern width is too narrow, heat on pattern will increase because of voltage drop of pattern. Relationship between allowable current and pattern width varies depending on materials of printed circuit board, thickness of conductor. It is definitely necessary to confirm on manufacturers of printed circuit board for designing pattern.

2 Heatsink Installation Method

(1) Method to Fix

(1-1) Standard model

To fix the heatsink onto power module, use M3 screws and mount it to the M3 threaded holes (4 places) at the baseplate side. Recommended torque is 0.54 N·m.

(1-2) /T option model

To fix the heatsink onto power module, use M3 screws those are the same screws for mounting power module onto printed circuit board.

Use silicone grease or thermal conductive sheet in between heatsink and baseplate to minimize the contact

thermal resistance and to enhance the heat conductivity. Also use the no-warped heatsink and make sure good contact between baseplate and heatsink.

(2) Mounting Hole of Heatsink
Recommended mounting hole is as follows.
(2-1) Standard model
φ3.5 Non-threaded hole
(2-2) /T option model
M3 Threaded hole

3 Regarding Vibration

The vibration specification of the module is determined assuming that only the power module is mounted on printed circuit board. To prevent excessive force to the module and the printed circuit board, fix the heatsink to the chassis as well as to the module when a large size of heastsink is used.

4 Recommended Soldering Method

Recommended soldering conditions are as follows.

(1) Soldering dip
Dip condition : 260°C within 10 seconds
Pre-heat condition : 100 to 130°C for 30 to 60 seconds

(2) Soldering iron
φ1.0 mm : 350°C (60W) within 3 seconds
φ2.0 mm : 350°C (150W) within 20 seconds

※Soldering time changes according to heat capacity of soldering iron, pattern on printed circuit board, etc. Please confirm actual performance.

5 Recommended Cleaning Condition

Recommended cleaning condition after soldering is as follows.
(1) Cleaning solvent
IPA (isopropyl alcohol)
(2) Cleaning Procedure
Use brush and dry the solvent completely.

4. Before concluding power module damage

Verify following items before concluding power module damage.

1) No output voltage
- Is specified input voltage applied?
- Are the ON/OFF control terminal (CNT), remote sensing terminal (+S, -S), 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?
- Is the baseplate temperature within the specified temperature range?

2) Output voltage is high
- Are the remote sensing terminals (+S, -S) correctly connected?
- Is the measurement done at the sensing points?
- 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?
- Are the remote sensing terminals (+S, -S) correctly connected?
- Is the measurement done at the sensing points?
- 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 measurement done at the sensing points?
- 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?

TDK Corporation

HEAD OFFICE 1-13-1Nihonbashi, Chuo-ku, Tokyo 103-8270, JAPAN
Tel: 81-3-5201-7206 Fax: 81-3-5201-7207
http://www.tdk.co.jp/

TDK Sales Network

ASIA

KOREA

KOREA TDK CO.,LTD
Tel: 82-2-3019-4300
Fax: 82-2-3019-4341

CHINA

TDK (TIANJIN) CO., LTD.
Tel: 86-22-23111751
Fax: 86-22-23111750
DALIAN Sales Office
Tel: 86-411-8731-4455
Fax: 86-411-8731-4955
QINGDAO Branch Office
Tel: 86-532-8579-6522
Fax: 86-532-8579-6364
BEIJING Sales Office
Tel: 860-10-85866277
Fax: 860-10-858662202
TDK (SHANGHAI) INTERNATIONAL TRADING CO., LTD.
Tel: 86-21-62701100
Fax: 86-21-62709900
SUZHOU Sales Office
Tel: 86-512-6807-3163
Fax: 86-512-6807-3175
TDK (Guangzhou) Co.,LTD.
Tel: 86-20-8222-4535
Fax: 86-20-8221-6733
SHENZHEN Branch Office
Tel. 86-755-8348-0190
Fax. 86-755-8359-9218
MIANYANG Sales Office
Tel. 86-816-222-4915
Fax. 86-816-222-4619
XIAMEN Sales Office
Tel. 86-592-615-0333
Fax. 86-592-615-0320

HONGKONG

TDK HONGKONG CO., LTD.
Tel: 852-27362238
Fax: 852-27362108

TAIWAN

TDK TAIWAN CORPORATION
Tel: 886-2-2712-5090
Fax: 886-2-2712-3090
KAO HSIUNG Sales Office
Tel: 886-7-211-3158
Fax: 886-7-251-7518
HSINCHU Sales Office
Tel: 886-3-573-9550
Fax: 886-3-573-9560

PHILIPPINES

TDK Electronics PHILIPPINES CORPORATION
Tel: 63-2-729-5827
Fax: 63-49-541-3140

SINGAPORE

TDK SINGAPORE (PTE) LTD.
Tel: 65-6273-5022
Fax: 65-6272-9543

INDONESIA

JAKARTA Representative Office
Tel: 62-21-5201213
Fax: 62-21-5200898

INDIA

INDIA Liaison Office.
Tel: 91-44-302-70709
Fax: 91-44-302-70712

MALAYSIA

TDK (MALAYSIA) SDN. BHD.
Tel: 60-6-799-1130
Fax: 60-6-799-1844
PENANG Sales Office
Tel: 60-4-644-0653
Fax: 60-4-644-0581

THAILAND

TDK (THAILAND) CO., LTD.
Tel: 66-2-266-3158
Fax: 66-2-266-3161

THE AMERICAS

U.S.A

TDK CORPORATION OF AMERICA
Tel: 1-847-803-6100
Fax: 1-847-803-6296
NEW JERSEY District Office
Tel: 1-732-494-0100
Fax: 1-732-494-5306
NEW ENGLAND District Office
Tel: 1-603-622-0003
Fax: 1-603-622-1196
ATLANTA Sales Office
Tel: 1-678-584-2275
FAX: 1-678-584-2276
GREENSBORO District Office
Tel: 1-336-292-0012
Fax: 1-336-292-3831
FLORIDA District Office
Tel: 1-954-425-0095
Fax: 1-954-425-8287
DETROIT District Office
Tel: 1-734-462-1210
Fax: 1-734-462-1193
INDIANAPOLIS District Office
Tel: 1-317-872-0370
Fax: 1-317-872-2978
HUNTSVILLE District Office
Tel: 1-256-464-0222
Fax: 1-256-464-9963
DALLAS District Office
Tel: 1-972-506-9800
Fax: 1-972-869-3353
AUSTIN Sales Office
Tel: 1-512-514-6308
FAX: 1-413-541-8329
SAN JOSE District Office
Tel: 1-408-437-9585
Fax: 1-408-437-9591
SAN DIEGO District Office
Tel: 1-858-554-0999
Fax: 1-858-554-1861
LOS ANGELES Sales Office
Tel: 1-562-596-1212
Fax: 1-562-596-4841
DENVER Sales Office
Tel: 1-303-926-4996
Fax: 1-303-926-4997

BRASIL

TDK DO BRASIL IND. E COM. LTDA.
Tel: 55-11-289-9599
Fax: 55-11-289-9940
TDK DA AMAZONIA IMP. E COM. LTDA.
Tel: 55-92-3622-1967
Fax: 55-92-3622-3270

EUROPE

GERMANY

TDK ELECTRONICS EUROPE GmbH.
Tel: 49-211-90770
Fax: 49-211-414984
STUTTGART Regional Office
Tel: 49-7152-928290
Fax: 49-7152-928295

ITALY

MILAN Branch Office
Tel: 39-02-9822271
Fax: 39-02-98240765

FRANCE

PARIS Branch Office
Tel: 33-1-40943400
Fax: 33-1-40943444

SWEDEN

STOCKHOLM Branch Office
Tel: 46-8-59099100
Fax: 46-8-59030026

U.K.

UK Branch Office
Tel: 44-1737-773-773
Fax: 44-1737-781-360

HUNGARY

HUNGARY Sales Office
Tel: 36-35-551-777
Fax: 36-35-551-899

DENSEI-LAMBDA K.K.

HEAD OFFICE Denpa Bldg. 1-11-15 Higashi-Gotanda,
Shinagawa-ku, Tokyo 141-0022, JAPAN
Tel: 81-03-3447-4411 Fax: 81-03-3447-7784
http://www.densei-lambda.com/

DENSEI-LAMBDA Sales Network

ASIA

CHINA

SHANGHAI OFFICE OF WUXI NEMIC-LAMBDA ELECTRONICS CO. LTD.
Tel: 86-21-6485-0777
Fax: 86-21-6485-0666
SHENZHEN OFFICE OF WUXI NEMIC-LAMBDA ELECTRONICS CO., LTD.
Tel: 86-755-83588261
Fax: 86-755-83588260
DENSEI-LAMBDA K.K. BEIJING OFFICE
Tel: 86-10-63104872/75
Fax: 86-10-63104874
DENSEI-LAMBDA K.K. HONG KONG BRANCH
Tel: 852-2420-6693/852-9460-5801
Fax: 852-2420-3362

INDIA

NEMIC-LAMBDA INDIA
Tel: 91-80-64503815
Fax: 91-80-41467450

KOREA

DENSEI-LAMBDA K.K. KOREA BRANCH
Tel: 82-2-556-1171~2/82-31-717-7051~3
Fax: 82-2-555-2706/82-31-726-9137

MALAYSIA

NEMIC-LAMBDA (M) SDN. BHD. PJ OFFICE
Tel: 60-3-79578800
Fax: 60-3-79582400

SINGAPORE

NEMIC-LAMBDA (S) PTE LTD
Tel: 65-6251-7211
Fax: 65-6250-9171

ISRAEL

ISRAEL

NEMIC-LAMBDA LTD. (SALES OFFICE)
Tel: 972-3-9024333
Fax: 972-3-9024777

NORTH AMERICA

U.S.A.

LAMBDA AMERICAS INC. (Headquarter)
Tel: 1-619-575-4400
Fax: 1-619-575-7185
LAMBDA AMERICAS INC. (Neptune Office)
Tel: 1-732-922-9300
Fax: 1-732-922-8160
LAMBDA AMERICAS INC. (New York Office)
Tel: 1-631-967-3000
Fax: 1-516-967-3022

EUROPE

GERMANY

LAMBDA GmbH Acherm office
Tel: 49-7841-6660
Fax: 49-7841-5000

U.K.

COUTANT LAMBDA LTD.
Tel: 44-1271-856666
Fax: 44-1271-864894

SWEDEN

LAMBDA SCANDINAVIA
Tel: 46-8-598-94090
Fax: 46-8-540-66096

FRANCE

LAMBDA SAS
Tel: 33-1-60-12-71-65
Fax: 33-1-60-12-71-66

ITALY

LAMBDA S.R.L.
Tel: 39-02-61-29-38-63
Fax: 39-02-61-29-09-00

PAH450S48-0706E