PAH75D48 SERIES

APPLICATION NOTES

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POWER MODULE

DRAWING NO. . PA550-04-01D		
NLS R&D		
PREPARED	CHECKED	APPROVED
2/8/01	15/8/01	15/8/01
DATE ISSUE : 15 Aug 01		

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PAH75D48 SERIES

Before Using This Power Module

Pay attention to all warnings and cautions before using this unit. Incorrect usage could lead to an electrical shock, damage to the unit, or a fire hazard. Be sure to read below ***warning*** and ***caution*** before using the power module.

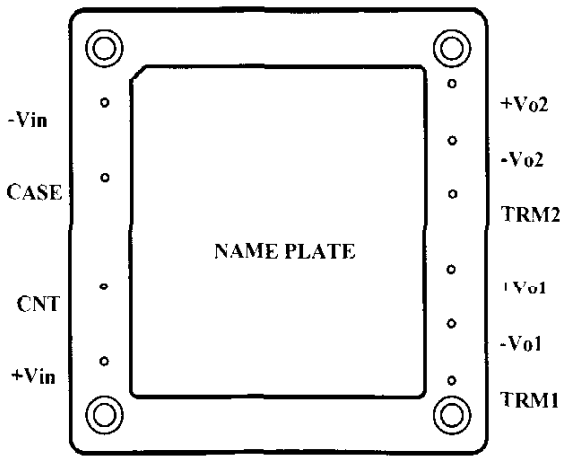
Warning

- Do not touch heatsink and case which may be hot.
- Do not open the case and touch the internal components. They may have high temperature or high voltage which may get you in electrical shock or burned.
- When the unit is operating, keep your hands and face away from the unit. You may get injured by an accidents.

Caution

- Confirm connections to input/output terminals and signal terminals are correct as indicated in the instruction manual.
- Attach a fast blow type external fuse to each module to ensure safety operation and to acquire each safety standard approval.
- This power module is designed for professional installation within an end user equipment.
- The input supply, 36–76Vdc must be isolated from the mains primary power supply by reinforced insulation in accordance with EN60950/UL1950.
- 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 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 or by any mean without prior written consent of Densei-Lambda.
- Do not inject abnormal voltage to output or signal pins. Especially, when inject negative voltage or voltage exceeding rated output voltage to output pins might cause damage to internal output capacitor (Functional Polymerized Capacitor).

Terminal Pin Configurations



-Vin	: Negative Input Terminal
CASE	: Baseplate Terminal
CNT	: ON/OFF Control Terminal
+Vin	: Positive Input Terminal
+Vo2	: CH2 Positive Output Terminal
-Vo2	: CH2 Negative Output Terminal
TRM2	: CH2 Output Voltage Adjustment Terminal
+Vo1	: CH1 Positive Output Terminal
-Vo1	: CH1 Negative Output Terminal
TRM1	: CH1 Output Voltage Adjustment Terminal

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APPLICATION NOTES

FEATURES :

- High power density : 27.41W/inch^3
- High efficiency : 82% (Vo1 = 5V @ 15A & Vo2 = 3.3V @ 0A)
- Operating baseplate temperature : -40°C ~ +100°C
- Safety : UL1950, EN60950, CSA950, CE Marked
- Input Voltage : 36V ~ 76VDC
- Over temperature protection : auto-recovery
- Small size : 2.40in X 2.28in X 0.5in

OPTION :

- Remote On / Off control logic (Negative logic[standard], Positive logic[option /P])
- Over voltage protection (Shut-down[standard], Auto-recovery[option /V])

Description

PAH75D48 SERIES power modules are high efficiency and high power density dc-dc converters. It is suitable for wide range of application such as EDP equipment, workstations and telecommunications equipments.

The mechanical design of these modules make it easy for heat dissipation as well as easy mounting on any equipment. An additional advantage to these power modules is that the OVP for shut-down [standard] can be reset by using the control pin, CNT instead of recycled the input power as in the conventional method; which is also possible.

All options of power modules come with output adjustable range, over current protection and remote ON/OFF. With all these features, the power modules are flexible to be use in any power supply applications.

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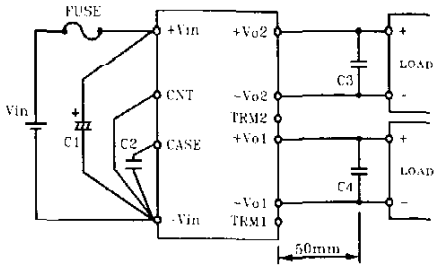
PAH75D48 SERIES
APPLICATION NOTES

CONTENTS :-

BASIC CONNECTION



Note : This diagram is for Negative Logic "ON/OFF" Option.

1. External Components

The table below shows the recommended values for the above external components.

Item	Vo1	Vo2
F1	250V 5A (UL approved and fast acting)	
C1	Tbp = -20°C ~ 100°C : 100V 33uF E-cap. (Use low ESR type E-cap such as KME series of Nippon Chemi-con) Tbp = -40°C ~ 100°C : 100V 33uF Ceramic cap.	
C2	Ceramic capacitor : 2kVAC 4700pF	
C3,C4	Ceramic capacitor : 33uF	

PAH75D48 SERIES module is not internally fused. To ensure safe operation and to receive each safety standard approval, please connect an external fuse, F1 as shown in the diagram above.

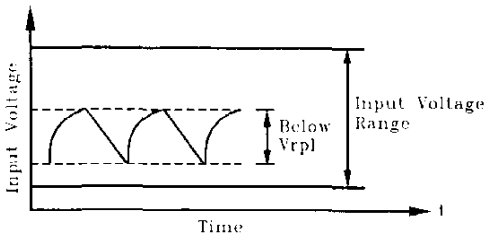
Input capacitor C1 is recommended to stabilize the module when the module is powered from an high impedance source. Capacitor C2 is used to absorb noise coming from the module itself. This capacitor will also help the EMI performance of the module.

The function of capacitor C3 is to reduce the output ripple of the power module and high frequency noise that is produced by the module.

If in any application that an input reversal connection is possible, a protective diode which is connected across +Vin and -Vin is recommended.

2. Input Voltage Range

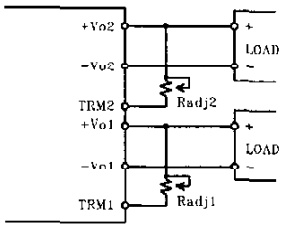
The operating input voltage range of PAH75D48 SERIES is 36 ~ 76VDC. The maximum allowable input ripple voltage (Vrpl) is 4V. Any ripple that *exceeds this value might cause the module to* become unstable.



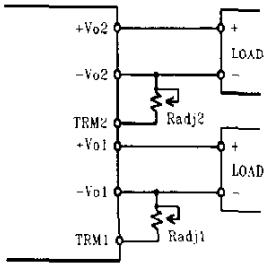
3. Output Voltage Adjust Range

The output voltage of power module can be adjusted by connecting an external resistor (R_{adj}) between the TRIM pin and either the +Vo or –Vo pins. There are two options available for the trim function for model 5033 & 3325, which are standard & /Z option.

With an external resistor (R_{adj}) between TRIM pin and +Vo pin, output voltage will decrease as shown in diagram below.



If the external resistor (R_{adj}) is connected between the TRIM pin and –Vo pin, the output voltage will *increase. Diagram shown below is the output* voltage trim up connection.



The equations and graphs for the required external resistor (R_{adj}) value to obtain a percentage output voltage change of ΔVo% is as shown in the next page.

For output adjust down , the allowable output current have to same as nominal output current.
For output adjust up , the allowable output current have to derate to maximun power.
Refer to the below table

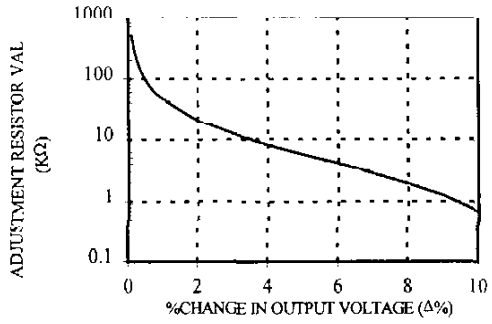
	Vo1 (V)	Io1 (A)	Vo2 (V)	Io2 (A)	Po (W)
Output adjust up	5.5	4.64	3.3	15	75
	5	4.11	3.63	15	75
nominal output	5	5.1	3.3	15	75
Output adjust down	4.5	5.1	3.3	15	72.45
	5	5.1	2.97	15	70.05

3.1 PAH75D24-5033 – Output Adjustment

Followings show the equations and graphs for the required external resistor to tune down and up output voltage for PAH75D24-5033model

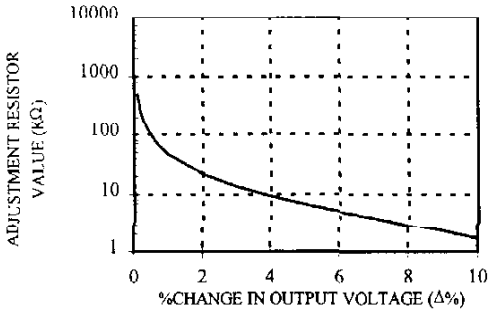
i) Vo1 (5V) : output adjust down

$$R_{adj1}(down) = (\frac{2.5 - \Delta Vo(4.32)}{\Delta Vo})k\Omega$$



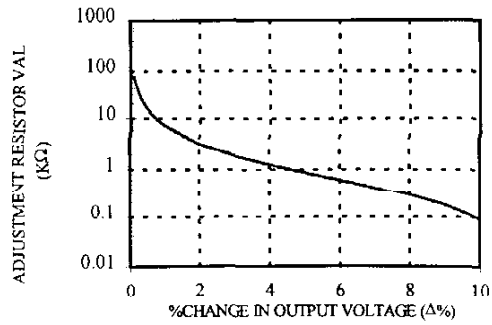
iii) Vo1 (5V) : output adjust up

$$R_{adj1}(up) = (\frac{2.5 - \Delta Vo(3.32)}{\Delta Vo})k\Omega$$



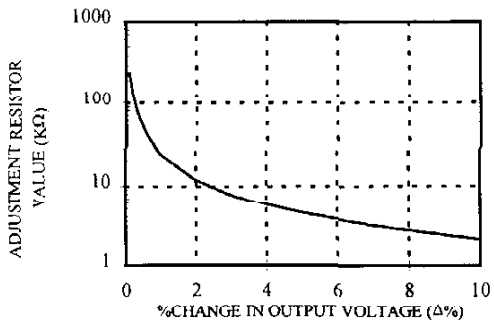
ii) Vo2 (3.3V) : output adjust down

$$R_{adj2}(down) = (\frac{0.256 - \Delta Vo(0.685)}{\Delta Vo})k\Omega$$



iv) Vo2 (3.3V) : output adjust up

$$R_{adj2}(up) = (\frac{0.8 - \Delta Vo(0.365)}{\Delta Vo})k\Omega$$

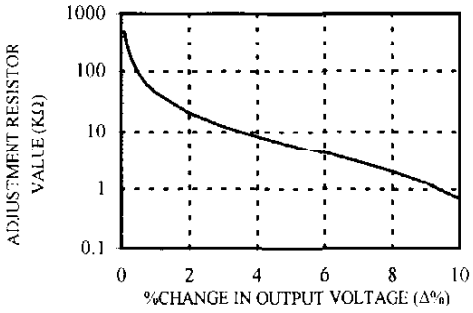


3.1.2 PAH75D48-5033/Z – Output Adjustment (/Z Option)

Followings show the equations and graphs for the required external resistor to tune down and up output voltage for PAH75D48-5033/Z optional model.

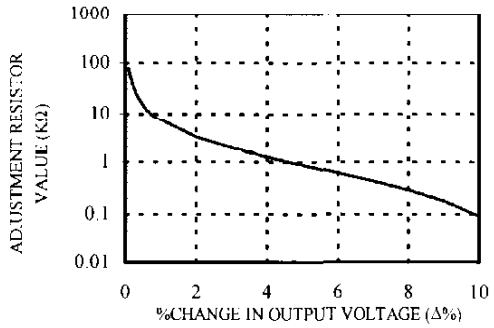
i) Vo1 (5V) : output adjust down

$$R_{adj1}(down) = (\frac{2.5 - \Delta Vo(4.32)}{\Delta Vo})k\Omega$$



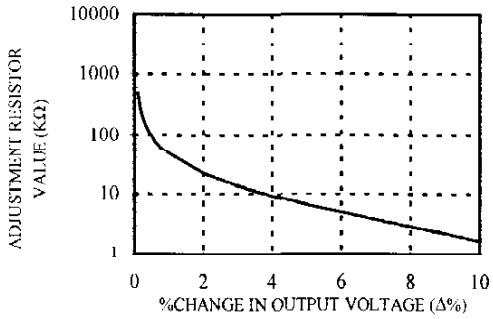
ii) Vo2 (3.3V) : output adjust down

$$R_{adj2}(down) = (\frac{0.256 - \Delta Vo(0.685)}{\Delta Vo})k\Omega$$



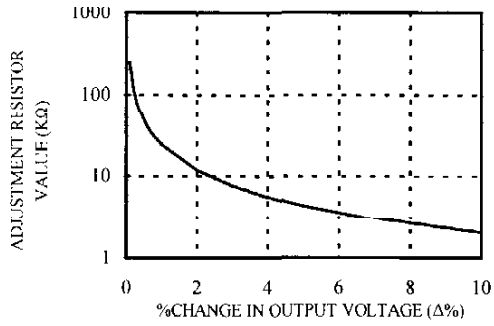
iii) Vo1 (5V) : output adjust up

$$R_{adj1}(up) = (\frac{2.5 - \Delta Vo(3.32)}{\Delta Vo})k\Omega$$



iv) Vo2 (3.3V) : output adjust up

$$R_{adj2}(up) = (\frac{0.8 \quad \Delta Vo(0.365)}{\Delta Vo})k\Omega$$

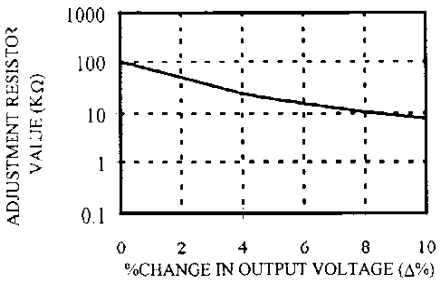


3.2.1 PAH75D48-3325 – output adjustment (Standard)

Followings show the equations and graphs for the required external resistor to tune down and up output voltage for PAH75D48-3325 standard model.

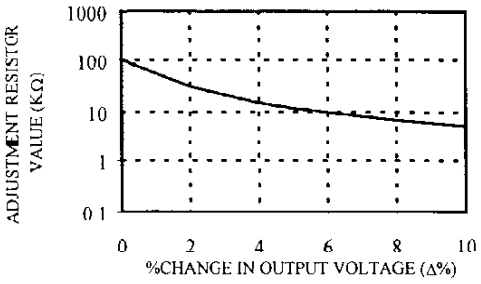
i) Vo1 (3.3V) : output adjust down

$$R_{adj1}(down) = (\frac{3.4814 - \Delta Vo(2.69)}{\Delta Vo})k\Omega$$



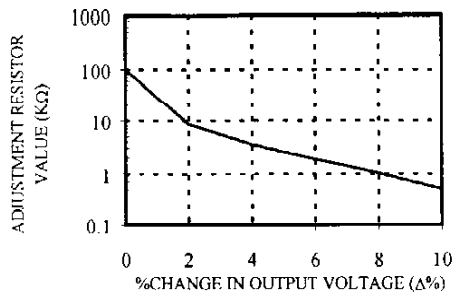
iii) Vo1 (3.3V) : output adjust up

$$R_{adj1}(up) = (\frac{2.0956 - \Delta Vo}{\Delta Vo})k\Omega$$



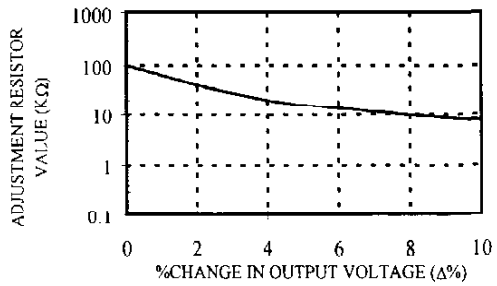
ii) Vo2 (2.5V) :output adjust down

$$R_{adj2}(down) = (\frac{0.51 - \Delta Vo(1.53)}{\Delta Vo})k\Omega$$



iv) Vo2 (2.5V) : output adjust up

$$R_{adj2}(up) = (\frac{2.04 - 0.510\Delta Vo}{\Delta Vo})k\Omega$$

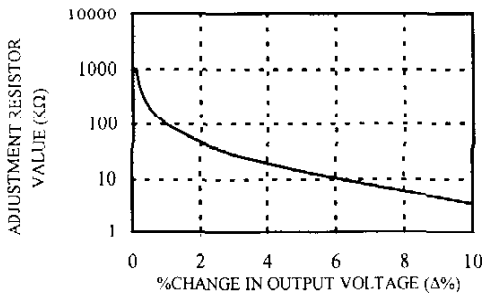


3.2.2 PAH75D48-3325/Z – Output Adjustment (/Z Option)

Followings show the equations and graphs for the required external resistor to tune down and up output voltage for PAH75D48-3325/Z optional model.

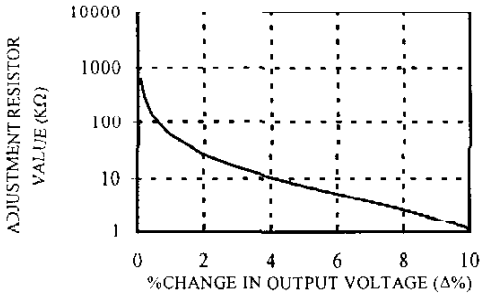
i) Vo1 (3.3V) : output adjust down

$$R_{adj1}(down) = (\frac{3.4222 - \Delta Vo(6.7712)}{\Delta Vo})k\Omega$$



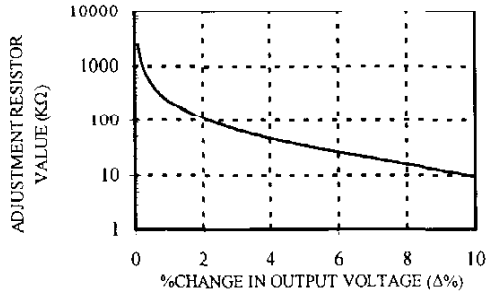
iii) Vo1 (3.3V) : output adjust up

$$R_{adj1}(up) = (\frac{2.0599 - \Delta Vo(5.11)}{\Delta Vo})k\Omega$$



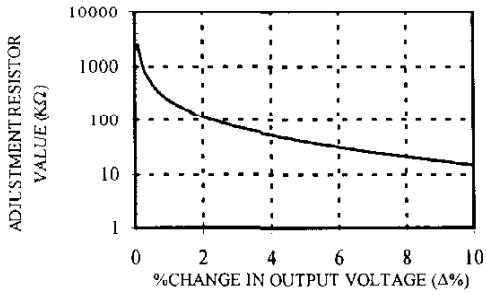
ii) Vo2 (2.5V) :output adjust down

$$R_{adj2}(down) = (\frac{6.1511 - \Delta Vo(14.9307)}{\Delta Vo})k\Omega$$



iv) Vo2 (2.5V) : output adjust up

$$R_{adj2}(up) = (\frac{6.1757 - \Delta Vo(10)}{\Delta Vo})k\Omega$$

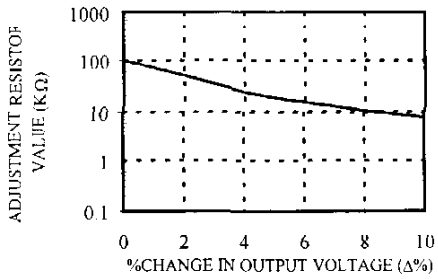


3.3 PAH75D48-3318 – output adjustment

Followings show the equations and graphs for the required external resistor to tune down and up output voltage for PAH75D48-3318 model. There is no trim option for this model.

i) Vo1 (3.3V) : output adjust down

$$R_{adj1}(down) = (\frac{3.4814 - \Delta Vo(2.69)}{\Delta Vo})k\Omega$$

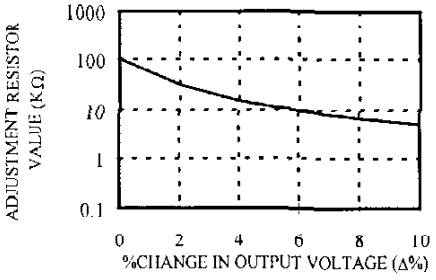


ii) Vo2 (1.8V) : output adjust down

Tune-down of Vo2 is not applicable.

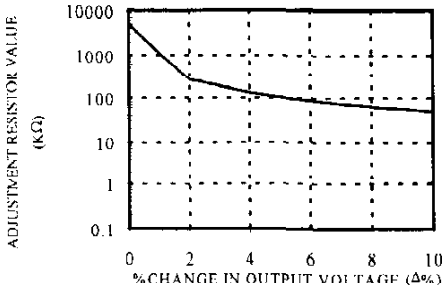
iii) Vo1 (3.3V) : output adjust up

$$R_{adj1}(up) = (\frac{2.0956 - \Delta Vo}{\Delta Vo})k\Omega$$



iv) Vo2 (1.8V) : output adjust up

$$R_{adj2}(up) = (\frac{9.28 - \Delta Vo}{\Delta Vo})k\Omega$$



3.4 PAH75D48-2518 – Output Adjustment

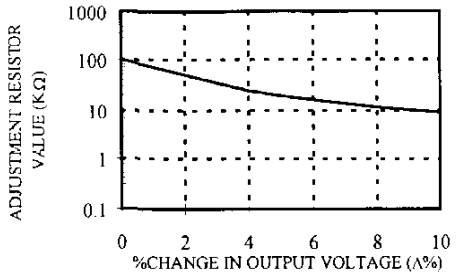
Followings show the equations and graphs for the required external resistor to tune down and up output voltage for PAH75D48 2518 model. There is also no trim option for this model.

i) Vo1 (2.5V) &Vo2 (1.8V) : output adjust down

Tune down of Vo1 and Vo2 is not applicable

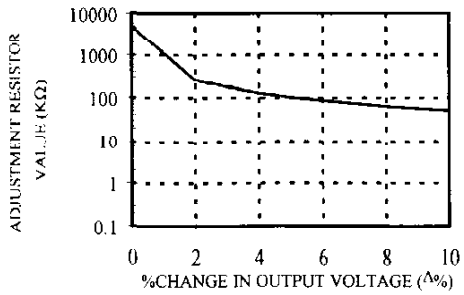
ii) Vo1 (2.5V) : output adjust up

$$R_{adj1}(up) = (\frac{2.542 - \Delta Vo}{\Delta Vo})k\Omega$$



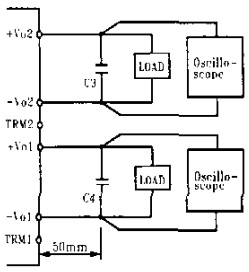
iii) Vo2 (1.8V) : output adjust up

$$R_{adj2}(up) = (\frac{9.28 - \Delta Vo}{\Delta Vo})k\Omega$$



4. Output Ripple & Noise Measurement Method

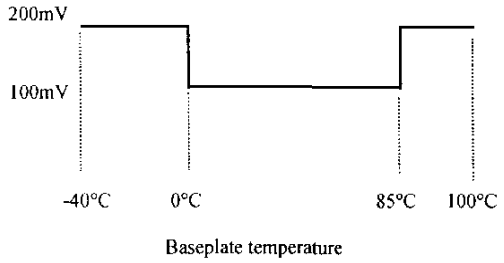
The standard measurement for output ripple and noise are based on normal probe with 20MHz bandwidth scope. Upon measurement of the ripple voltage, make sure that the oscilloscope probe leads are not too long.



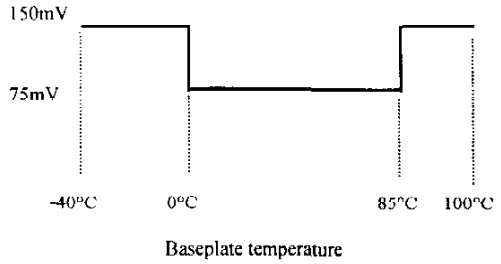
4.1 Specification

The ripple & noise specification for operating range between –40°C to 100°C is shown below.

i) 5V & 3.3V



ii) 2.5V & 1.8V



iii) EIAJ measurement method

Below results are for reference only which is based on EIAJ standard (EIAJ probe with 100MHz bandwidth scope). The measurement condition is Vin = 48V and Tbp = 25°C.

PAH75D48-5033

Load Condition	Vo1(5V)	Vo2(3.3V)
Io1 = 15A ; Io2 = 0A	50mV	43mV
Io1 = 0A ; Io2 = 15A	40mV	36mV
Io1 = 5A ; Io2 = 15A	51mV	60mV

PAH75D48-3325

Load Condition	Vo1(3.3V)	Vo2(2.5V)
Io1 = 15A ; Io2 = 0A	46mV	33mV
Io1 = 0A ; Io2 = 15A	48mV	46mV
Io1 = 5A ; Io2 = 15A	42mV	33 mV

PAH75D48-3318

Load Condition	Vo1(3.3V)	Vo2(1.8V)
Io1 = 15A ; Io2 = 0A	49mV	33mV
Io1 = 0A ; Io2 = 15A	46mV	48mV
Io1 = 5A ; Io2 = 15A	42.5mV	40mV

PAH75D48-2518

Load Condition	Vo1(2.5V)	Vo2(1.8V)
Io1 = 15A ; Io2 = 0A	32mV	36mV
Io1 = 0A ; Io2 = 15A	35mV	34mV
Io1 = 5A ; Io2 = 15A	40.5mV	35mV

5. *Maximum Line Regulation*

Maximum line regulation is the maximum output voltage change when the input voltage is slowly varied within the input voltage range. The measurement point for the input and output voltages are ±Vin , ±Vo1 and ±Vo2 respectively.

6. *Maximum load regulation*

Maximum load regulation is the maximum output voltage value change when varying the load current slowly within the standard output current range. The measurement point for the input and output voltages are ±Vin , ±Vo1 and ±Vo2 respectively.

7. *Brownout*

There will be output voltage overshoot during brown-out (momentary input line off) condition.

8. *Over Current Protection*

The PAH75D48 SERIES is equipped with an over current protection circuit. When the short or overload condition is removed, the output will automatically recover. This setting is fixed and cannot be varied externally. If the short or overload condition continues, the power module could be damaged due to the heat condition.

9. *Over Voltage Protection*

There are 2 types of over protection method available for PAH75D48 SERIES. In the standard model, a latching shutdown method is adopted. For this method there are two ways to reset the power module after OVP protection triggers. They are by (i) giving a pulse to the control pin or (ii) recycling the input voltage. In the /V optional model, the power module will shutdown after OVP protection triggers but will recover automatically when over voltage is removed.

10. *Thermal Protection*

The PAH75D48 SERIES have a thermal protection circuit that senses the baseplate temperature between the range of 105°C to 130°C for an over temperature condition. Under a condition where the ambient temperature or the power module internal temperature rises excessively, the thermal protection circuit will shut down the power module. The power module will recover automatically when the baseplate temperature cools down.

11. *ON /OFF Control (CNT)*

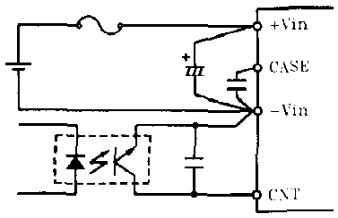
Without turning the input on and off, the output can be enabled and disabled using this function. This control circuit is on the input side of the power module; CNT terminal pin. There are two options available in this function, which are Negative Logic and Positive Logic. In the standard model where Negative Logic is used, power module will turn on when the CNT terminal pin is shorted to –Vin or a low logic voltage is provided. The Power module will turn off when CNT terminal pin is open or Logic high is provided. In the /P optional model where Positive Logic is used, the control method is vice versa to Negative logic.

The maximum CNT pin voltage when it is opened is 7V. The maximum low logic sourcing current is 0.6mA. When using this function, attach a 0.1uF capacitor between the CNT and –Vin terminals as close as possible.

Remote ON/OFF control can also be exercised by opening or closing the contacts of a switch or relay, or by operating a transistor as a switch in series with the CNT terminal.

Standard remote ON/OFF control circuit is provided in the primary circuit. For secondary control, isolation can be achieved through use of an optocoupler or relay.

CNT Connection Method



Below tables summarizes the CNT levels and output states with different logic types.

a) Negative Logic: (Standard model)

CNT Level for INPUT –V	OUTPUT
H (more than 2.0V) or Open	OFF
L (less than 1.0V) or Short	ON

b)Positive Logic: (/P option)

CNT Level for INPUT –V	OUTPUT
H (more than 2.0V) or Open	ON
L (less than 1.0V) or Short	OFF

12. Operation Temperature

The baseplate temperature range for PAH75D48 SERIES is from -40°C to 100°C.

13. Operation Humidity

Avoid the buildup of condensation on or in the power module.

14. Storage Temperature

Please note that sudden temperature changes can cause condensation buildup, and other harmful affects to each terminal solder.

15. Storage Humidity

High temperature and humidity can cause the terminals on the module to oxidize. The quality of the solder will become worse.

16. Cooling Method

The operating temperature is specified by the baseplate temperature. Various cooling methods are possible such as using heatsink or chassis of the equipment. If the temperature is very high, fan is recommended.

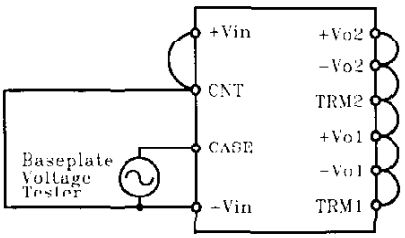
17. Baseplate Temperature vs. Output Regulation

This is the output voltage change ratio when varying the baseplate operation temperature.

18. Withstand Voltage

The power module is designed to withstand 1.5kVDC between the input to the baseplate and input to output for 1 minute. In the case that the withstand voltage is tested in the incoming goods test, etc., please set the limit of the test equipment to 20 mA. The applied voltage must be increased gradually from zero to the testing value, and then decreased gradually at shutdown. Do not use a timer where a pulse of several times the applied voltage can be generated. This could cause damage to the module. Be sure to short all the input and output pins as shown below.

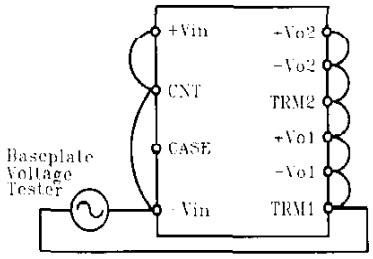
Input ~ Baseplate



1.5kVDC 1 min. (20mA)

Note :- Please be sure to short all the input & output pins as shown above.

Input ~ Output

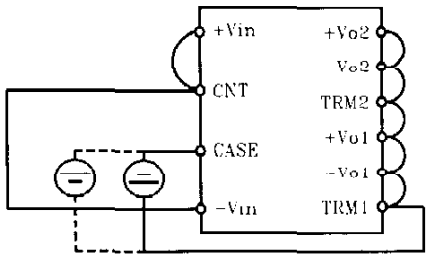


1.5kVDC 1 min.(20mA)

Note :- Please be sure CASE is not shorted to any pins

19. Isolation Resistance

The isolation resistance is more than 100MΩ at 500VDC when tested with a DC isolation tester between the output and the baseplate. Make sure that during testing, the isolation testers does not produce a high pulse when the applied voltage is varied. Ensure that the tester is fully discharged after the test.



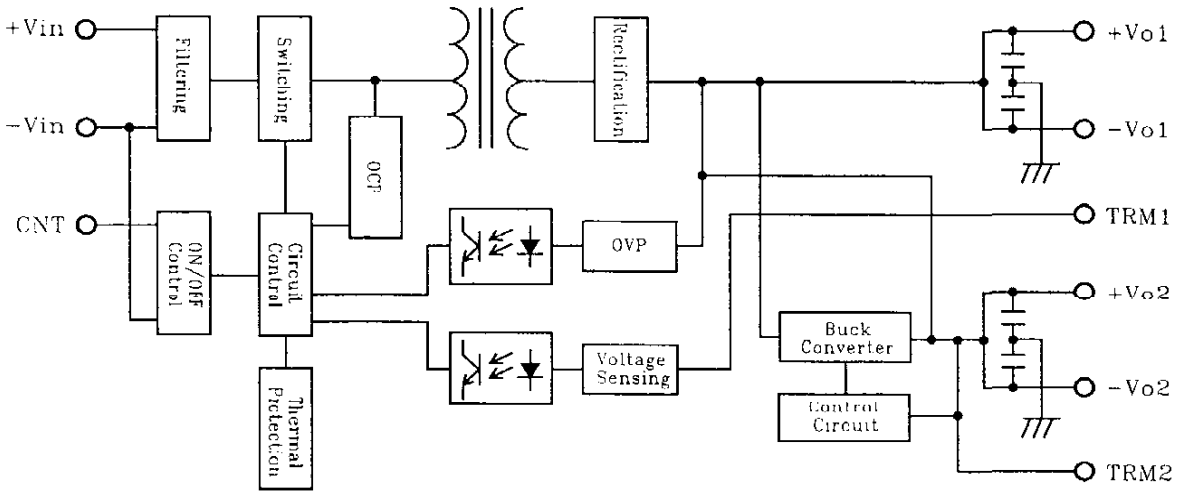
20. Vibration

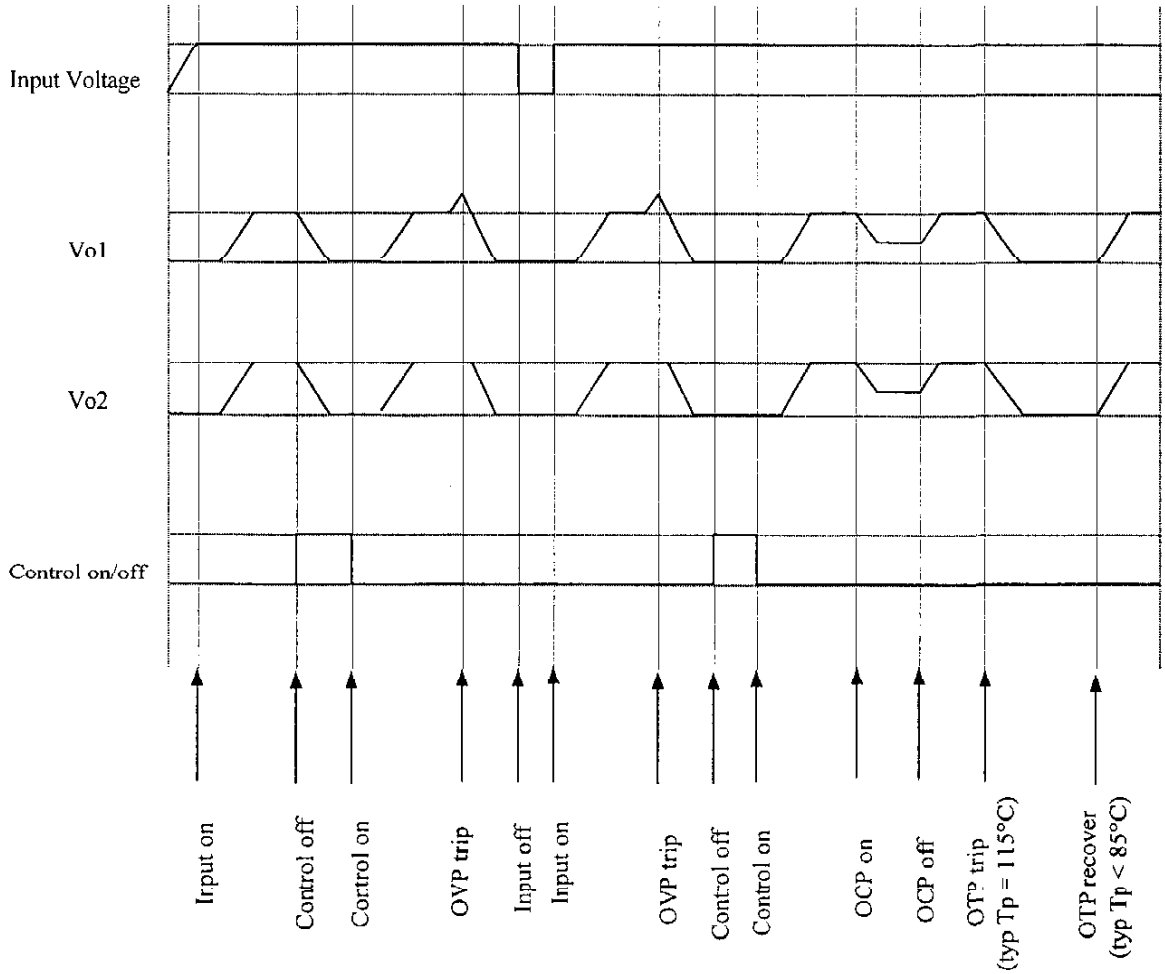
Please refer to the power module mounting in the PAH75D48 SERIES Handbook in order to achieve vibration level stated in the specification.

21. Shock

Value for the conditions of our shipping and packaging.

22. Block Diagram . Sequence Chart





Note : This timing diagram is for Negative Logic "ON/OFF Option.