AVE240B-48S12

240 Watts

Half-brick Converter

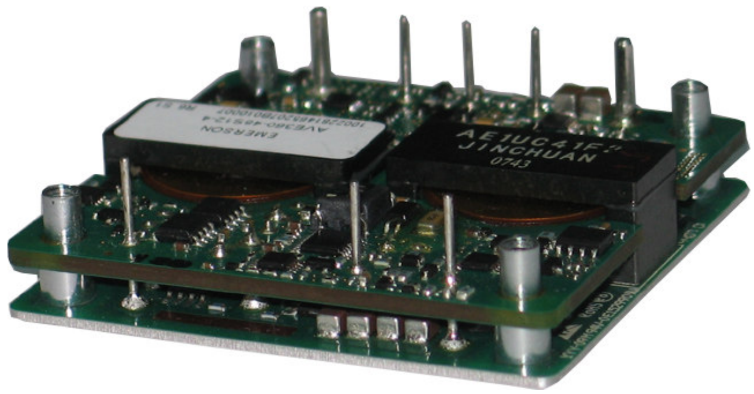
Total Power: 240 Watts
Input Voltage: 36 to 75 Vdc
# of Outputs: Single

Special Features

- Delivering up to 20A output current
- Basic isolation
- Ultra-high efficiency 94% typ. at full load
- Improved thermal performance
- High power density
- Low output noise
- 2:1 wide input voltage of 36-75V
- CNT function
- Remote sense
- Trim function: -10% ~ +10%
- Input under-voltage lockout
- Output over-current protection
- Output over-voltage protection
- Over-temperature protection
- CNT Function logic optional
- Pins Length optional

Safety

UL/EN60950
CSA C22.2



Product Descriptions

The AVE240B-48S12 is a single output DC/DC converter with standard half-brick form factor and output is isolated from input. It delivers up to 20A output current with 12V output, provides CNT and trim functions. Ultra-high 94% efficiency and excellent power density makes it an ideal choice for use in use in computing and telecommunication applications and can operate over an ambient temperature range of -40 ^{O}C ~ +85 ^{O}C.

Applications

Telecom/ Datacom

ARTESYN™
EMBEDDED TECHNOLOGIES

Model Numbers

Standard	Output Voltage	Structure	Remote ON/OFF logic	RoHS Status
AVE240B-48S12-4	12Vdc	Baseplated	Negative	R5

Ordering information

AVE240	B	-	48	S	12	P	-	4
①	②		③	④	⑤	⑥		⑦

①	Series name	AVE: series name, 240: rated output power 240W
②	Version	B: Version B
③	Input voltage	48: 36V ~ 75V input range, rated input voltage 48V
④	Output number	S: single output
⑤	Rated output voltage	12: 12V output
⑥	Remote ON/OFF logic	P: positive logic; Default: negative logic
⑦	Pin length	4: 4.80 mm ± 0.5mm 6: 3.80 mm ± 0.5mm 8: 2.80 mm +0.5mm/-0.3mm Default is 5.8 mm±0.5mm

Options

None

Electrical Specifications

Absolute Maximum Ratings

Stress in excess of those listed in the "Absolute Maximum Ratings" may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply's reliability.

Table 1. Absolute Maximum Ratings:

Parameter	Model	Symbol	Min	Typ	Max	Unit
Input Voltage Operating -Continuous Non-operating -100mS	 All All	$V_{IN,DC}$	 0 0	 - -	 80 100	 Vdc Vdc
Maximum Output Power	All	$P_{O,max}$	-	-	240	W
Isolation Voltage[1] Input to outputs	 All		 -	 -	 1500	 Vdc
Ambient Operating Temperature (See thermal consideration)	All	T_A	-40	+25	+85	^{O}C
Operating Ambient Temperature (Near temperature sensor Rt)	All	T_C	-	-	+135	^{O}C
Storage Temperature	All	T_{STG}	-55	+25	+125	^{O}C
Humidity (non-condensing) Operating Non-operating	 All All		 - -	 - -	 95 95	 % %

Note1:1mA for 5s,slew rate = 1500V/10s

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions[1]	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC	All	$V_{IN,DC}$	36	48	75	Vdc
Turn-on Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,ON}$	31	34	36	Vdc
Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	30	33	35	Vdc
Inrush current transient rating	Power ON		-	-	2	A^2s
Recommended Input Fuse[1]	Fast blow external fuse recommended		-	-	20	A
Input Reflected Ripple Current	5Hz to 20MHz: 12µH source impedance, $T_A = 25^OC$	I_I	-	50	80	mA_{PK-PK}
Operating Efficiency	T_A=25 ^OC Air velocity: 300LFM $I_O = I_{O,max}$ $I_O = 70\%I_{O,max}$	η	 93 93	 94 94	 - -	 % %

Note 1 - Ta = 25 ^OC, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.
Note 2 - This power module is not internally fused. An input line fuse must always be used.

Output Specifications

Table 3. Output Specifications

Parameter		Condition[1]	Symbol	Min	Typ	Max	Unit
Factory Set Voltage		$V_{IN,DC}$ = 48V_{DC} I_O=$I_{O,max}$	V_O	11.8	12	12.2	Vdc
Output Voltage Line Regulation (Vi,min to Vi,max)		All	%V_O	-	-	0.3	%
Output Voltage Load Regulation (Io = Io,min to Io,max)		All	%V_O	-	-	0.5	%
Output Voltage Temperature Regulation		All	%V_O	-	-	0.02	%V_O/^{O}C
Output Voltage Adjustment Range		All	%V_O	90	-	110	%
Output Ripple, pk-pk		Whole range	V_O	-	-	300	mV_{PK-PK}
Output Current		All	I_O	0	-	20	A
Output DC current-limit inception[2]		All	I_O	21	-	30	A
V_O Load Capacitance[3]		All	C_O	680	2200	10000	uF
V_O Dynamic Response[4]	Peak Deviation Settling Time	25% $I_{O,max}$ step from 50%$I_{O,max}$, slew rate = 0.1A/us	±V_O T_s	- -	- -	600 400	mV uSec
Turn-on transient	Turn-on delay time	I_O = $I_{O,max}$ Vo from 10% to 90%	$T_{turn-on}$	-	-	100	mS
	Output voltage overshoot	T_A = 25^{O}C I_O = $I_{O,max}$	%V_O	-	-	5	%
Isolation Capacitance		-	-	-	-	-	PF
Isolation Resistance		-	-	10	-	-	MΩ
Switching frequency		All	f_{SW}	-	280	-	KHz
Enable pin voltage	Logic Low	All	-	-0.7	-	1.2	Vdc
	Logic High	All	-	3.5	-	5	Vdc
Enable pin current	Logic Low	All	-	-	-	1.0	mA
	Logic High	All	-	-	-	-	uA
Output over-voltage protection[5]	Static	All	V_O	14	-	16.5	Vdc

Note 1 - Ta = 25 ^{O}C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.
Note 2 - Hiccup: auto-restart when over-current condition is removed.
Note 3 - Ta: 25ºC, Vin: 48V, 30000µF can start-up.
Note 4 - The external capacitor should be 10µ tantalum(ESR≤100 mΩ) // 1µ ceramic capacitor.
Note 5 - Hiccup: auto-restart when over-voltage condition is removed.

Output Specifications

Table 3. Output Specifications, con't:

Parameter	Condition[1]	Symbol	Min	Typ	Max	Unit
Output over-temperature protection[6]	All	T	85	-	112	^{O}C
MTBF	Vin: 48V, 100%Load, Board T_C=25^{O}C		-	2	-	10^6 h
Vibration(Sine wave)	Vibration level: 3.5mm (2 ~ 9Hz), 10m/s^2 (9 ~ 200HZ),15m/s^2 (200 ~ 500Hz) Directions and time: 3 axis (X, Y, Z), 30 minutes each Sweep velocity: 1oct / min					
Shock (Half-sine wave)	Peak acceleration: 300m/s^2 Duration time: 6ms Continuous shock 3 times at each of 6 directions (±X, ±Y, ±Z)					
Note 6 - Auto recovery.						

AVE240B-48S12 Performance Curves

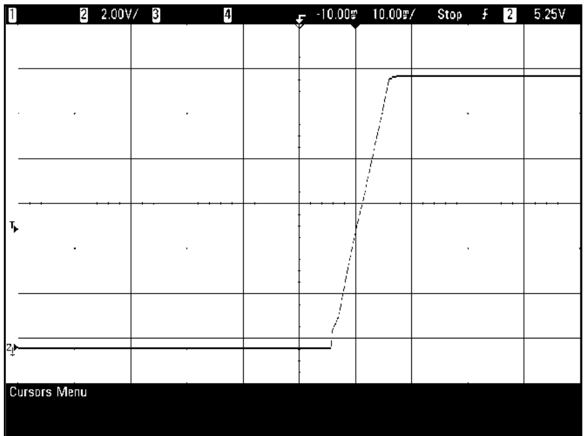


Figure 1: AVE240B-48S12-4 Output Voltage Startup Characteristic

Ch 1: Vo (2V/div)

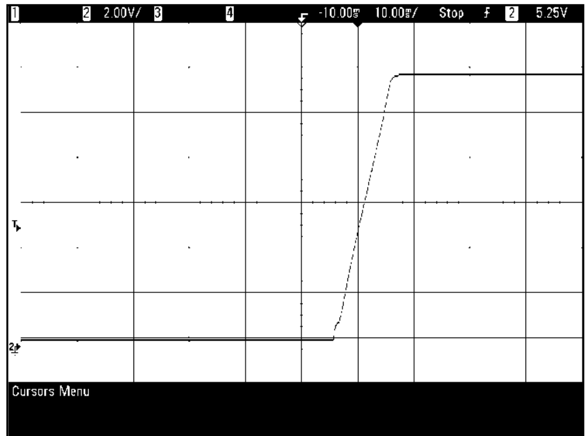


Figure 2: AVE240B-48S12-4 Remote ON Waveform (10mS/div)

Ch 1: Vo (2V/div)

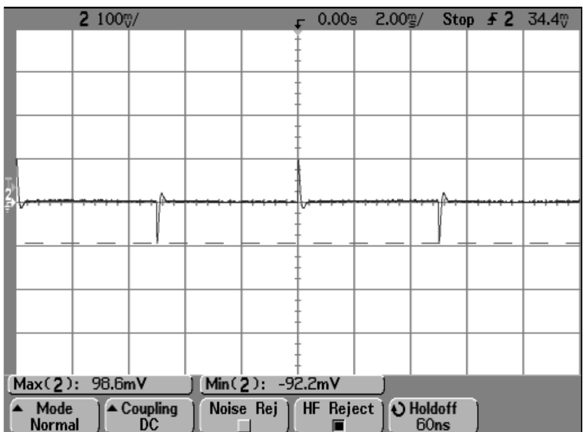


Figure 3: AVE240B-48S12-4 Transient Response (2mS/div)
25% $I_{O,max}$ step from 50% $I_{O,max}$, 0.1A/uS slew rate
Ch 1: Vo (100mV/div)

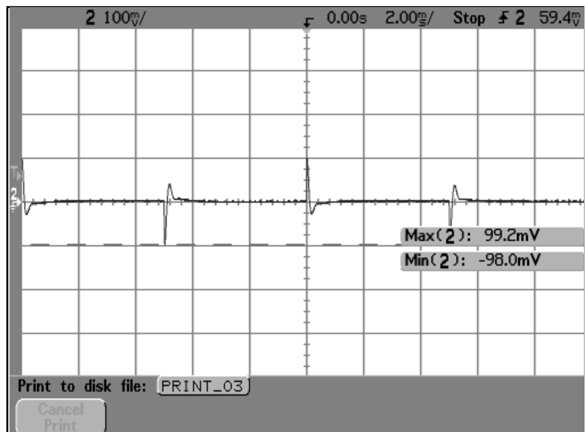


Figure 4: AVE240B-48S12-4 Transient Response (2mS/div)
50% $I_{O,max}$ step from 75% $I_{O,max}$, 0.1A/uS slew rate
Ch 1: Vo (100mV/div)

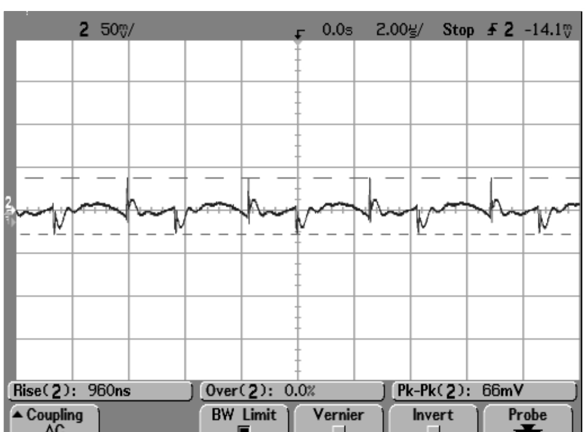


Figure 5: AVE240B-48S12-4 Ripple and Noise measurement
Vin = 48Vdc, Vout = 12V, Iout = 20A ,Air Velocity=300LFM
Ch 1: Vo (50mv/div)

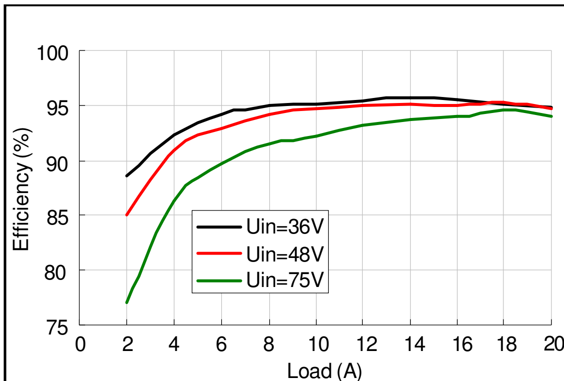


Figure 6: AVE240B-48S12 Efficiency Curves @ 25 °C

Loading: Io = 10% increment to 20A, forced air direction: from Vin+ to Vin-

Protection Function Specification

Over Voltage Protection (OVP)

The output over-voltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold, then the module will work on hiccup mode. When the over-voltage condition is removed, the converter will automatically restart.

The protection mechanism is such that the unit can continue in this condition until the fault is cleared.

Parameter	Min	Nom	Max	Unit
V_O Output Overvoltage	14	/	16.5	V

Over Current Protection (OCP)

AVE240B-48S12 DC/DC converter feature foldback current limiting as part of their Over-current Protection (OCP) circuits. When output current exceeds 105 to 140% of the rated current, such as during a short circuit condition, the module will work on intermittent mode, also can tolerate short circuit conditions indefinitely. When the over-current condition is removed, the converter will automatically restart.

Parameter	Min	Nom	Max	Unit
V_O Output Overcurrent	105	/	140	%A

Over-Temperature Protection (OTP)

These modules feature an over-temperature protection circuit to safeguard against thermal damage. The module will work in intermittent mode when the maximum device reference temperature is exceeded. When the over-temperature condition is removed, the converter will automatically restart.

Input Reverse Voltage Protection

Under installation and cabling conditions where reverse polarity across the input may occur, reverse polarity protection is recommended. Protection can easily be provided as shown in Figure 7. In both cases the diode used is rated for 15A/100V. Placing the diode across the inputs rather than in-line with the input offers an advantage in that the diode only conducts in a reverse polarity condition, which increases circuit efficiency and thermal performance.

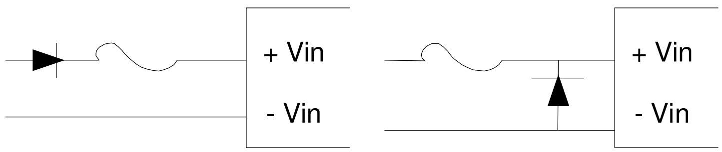
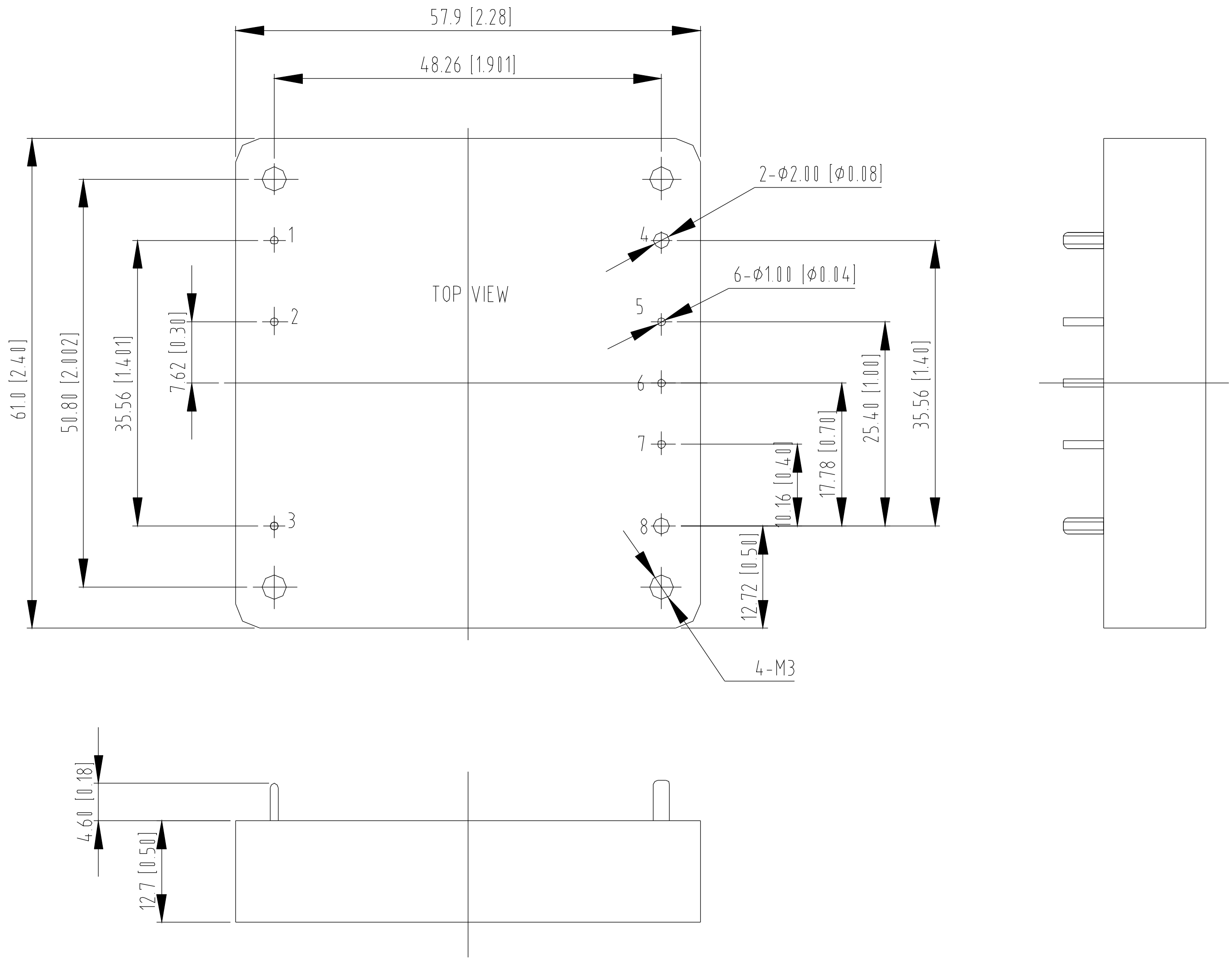


Figure 7 Reverse polarity protection circuit

Mechanical Specifications

Mechanical Outlines



TOLERANCES: X.Xmm= +/-0.5mm
X.XXmm=+/-0.25mm

Pin Length options

Device code suffix	L
-4	4.8mm+/-0.5 mm
-6	3.8mm+/-0.5 mm
-8	2.8mm+0.5/-0.3 mm
None	5.8mm+/-0.5 mm

Pin Designations

Pin No	Name	Function
1	+Vin	Positive input voltage
2	CNT	Remote ON/OFF control
3	-Vin	Negative input voltage
4	+Vo	Positive output voltage
5	+SENSE	Positive remote sense
6	TRIM	Output voltage trim
7	-SENSE	Negative remote sense
8	-Vo	Negative output voltage

Safety Certifications

For safety-agency approval of the system in which the power module is used, the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standard, i.e., UL60950, CSA C22.2, and EN60950. AVE240B-48S12 input-to-output isolation is a basic insulation. The DC/DC power module should be installed in end-use equipment, in compliance with the requirements of the ultimate application, and is intended to be supplied by an isolated secondary circuit. When the supply to the DC/DC power module meets all the requirements for SELV (<60Vdc), the output is considered to remain within SELV limits (level 3). If connected to a 60Vdc power system, double or reinforced insulation must be provided in the power supply that isolates the input from any hazardous voltages, including the AC mains. One input pin and one output pin are to be grounded or both the input and output pins are to be kept floating. Single fault testing in the power supply must be performed in combination with the DC/DC power module to demonstrate that the output meets the requirement for SELV. The input pins of the module are not operator accessible.

Note: Do not ground either of the input pins of the module, without grounding one of the output pins. This may allow a non-SELV voltage to appear between the output pin and ground. The circuit cannot withstand transient over-voltage.

Table 4. Safety Certifications for the AVE240B-48S12 series power supply system

Document	File #	Description
UL60950/CSA C22.2		US and Canada Requirements
EN60950		European Requirements

Operating Temperature

The AVE240 series power supplies will start and operate within stated specifications at an ambient temperature from -40 ^{O}C to 85 ^{O}C under all load conditions. The storage temperature is -55 ^{O}C to 125 ^{O}C.

Thermal Considerations

AVE240B-48S12 modules have ultra high efficiency at full load. With less heat dissipation and temperature-resistant components such as ceramic capacitors, these modules exhibit good behavior during pro-longed exposure to high temperatures. Maintaining the operating board temperature within the specified range helps keep internal component temperatures within their specifications which in turn helps keep MTBF from falling below the specified rating. Proper cooling of the power modules is also necessary for reliable and consistent operation.

Measuring the board temperature of the module is shown in Figure 8

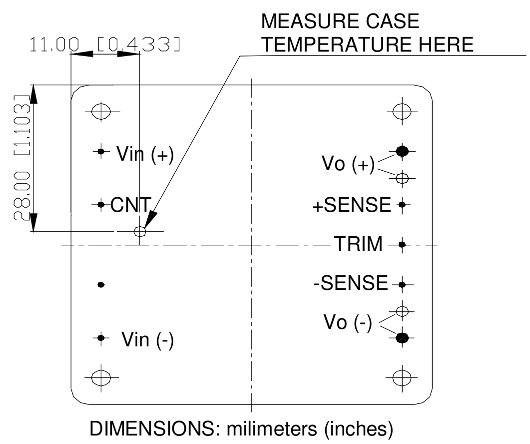


Figure 8 Temperature measurement location

The module should work under 85 ^{O}C ambient for the reliability of operation and the board temperature must not exceed 112 ^{O}C while operating in the final system configuration. The measurement can be made with a surface probe after the module has reached thermal equilibrium. No heatsink is mounted, make the measurement as close as possible to the indicated position. It makes the assumption that the final system configuration exists and can be used for a test environment. Note that the board temperature of module must always be checked in the final system configuration to verify proper operational due to the variation in test conditions. Thermal management acts to transfer the heat dissipated by the module to the surrounding environment. The amount of power dissipated by the module as heat (PD) is got by the equation: PD = PI-PO.

Where PI is input power; PO is output power; PD is dissipated power.

Also, module efficiency (η) is defined as the following equation: η = PO / PI.

If eliminating the input power term, from two above equations can yield the equation below:

PD = PO (1-η) / η.

The module power dissipation then can be calculated through the equation.

Because each power module output voltage has a different power dissipation curve, a plot of power dissipation versus output current over three different line voltages are given in the following figures.

Module Derating

From the experiment setup shown in Figure 9, the derating curves shown in Figure 10 can be drawn. Note that the Printed Wiring Board (PWB) and the module must be mounted vertically. The Passage has a rectangular cross-section. The clearance between the facing PWB and the top of the module is kept 13 mm (0.5 in.) constantly.

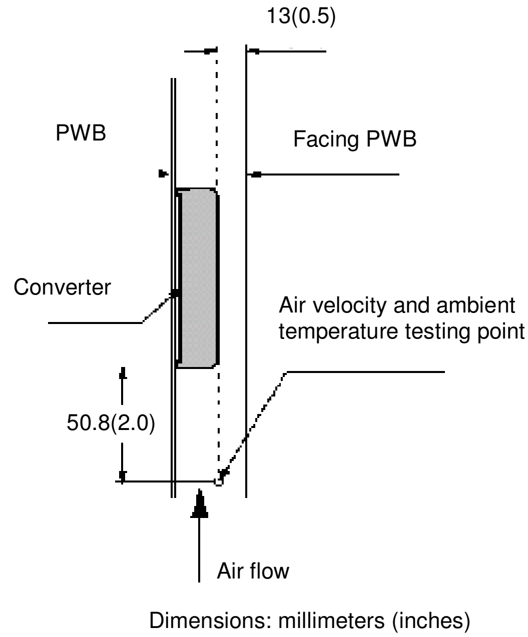


Figure 9 Experiment setup

Forced Convection

Figure 10 shows the change of the module output current with the change of ambient temperature. In the test, the airflow was created with externally adjustable fans. A heatsink should be fitted in the case the input voltage is 36V or 75V.

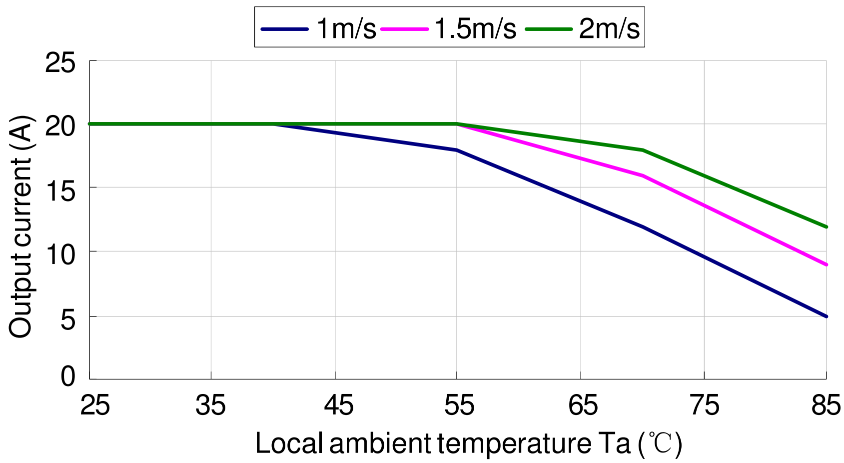


Figure 10 Forced convection power derating, airflow direction from Vin(+) to Vin(-): Vin=36,48,75V;

Heatsink Configuration

Several standard heatsinks available for the AVE240B-48S12 are shown in Figure 11 to 13.

The heatsinks mounted to the top surface of the module with screws torqued to 0.56 N-m (5 in.-Ib). A thermally conductive dry pad or thermal grease is placed between the case and the heatsink to minimize contact resistance (typically 0.1 ^{O}C/W to 0.3 ^{O}C /W) and temperature differential.

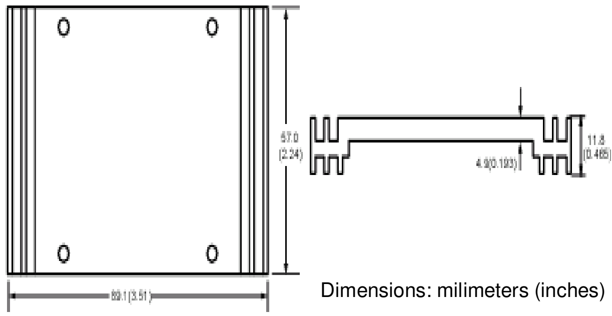
Nomenclature for heatsink configurations is as follows:

WDxyyy40

x = fin orientation: longitudinal (L) or transverse (T)

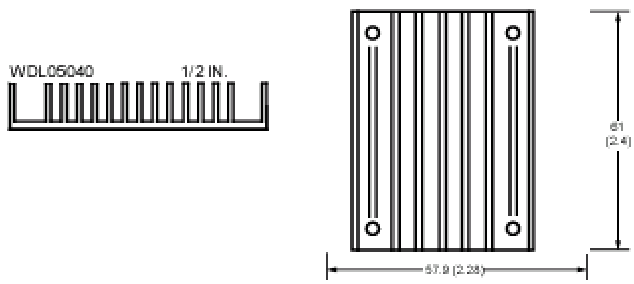
yyy = heatsink height (in 100ths of inch)

For example, WDT5040 is a heatsink that is transverse mounted for a 61mm × 57.9mm (2.4in × 2.28in) module with a heatsink height of 0.5 in.



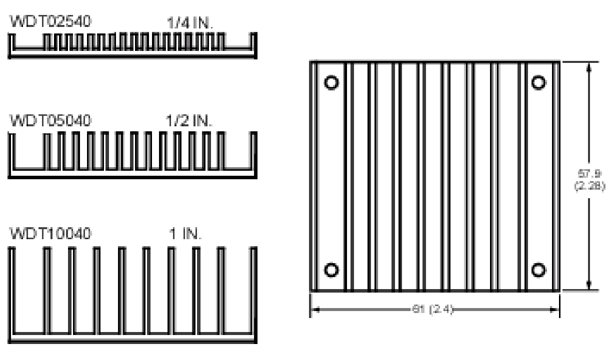
Dimensions: milimeters (inches)

Figure 11 Non-standard heatsink



Dimensions: milimeters (inches)

Figure 12 Longitudinal fins heatsink



Dimensions: milimeters (inches)

Figure 13 Transverse fins heatsink

Heatsink Mounting

A crucial part of the thermal design strategy is the thermal interface between the baseplate of the module and the heatsink. Inadequate measures taken will quickly negate any other attempts to control the baseplate temperature. For example, using a conventional dry insulator can result in a case-heatsink thermal impedance of >0.5^{O}C/W, while use one of the recommended interface methods (using silicon grease or thermal pads) can result in a case-heatsink thermal impedance around 0.1^{O}C/W.

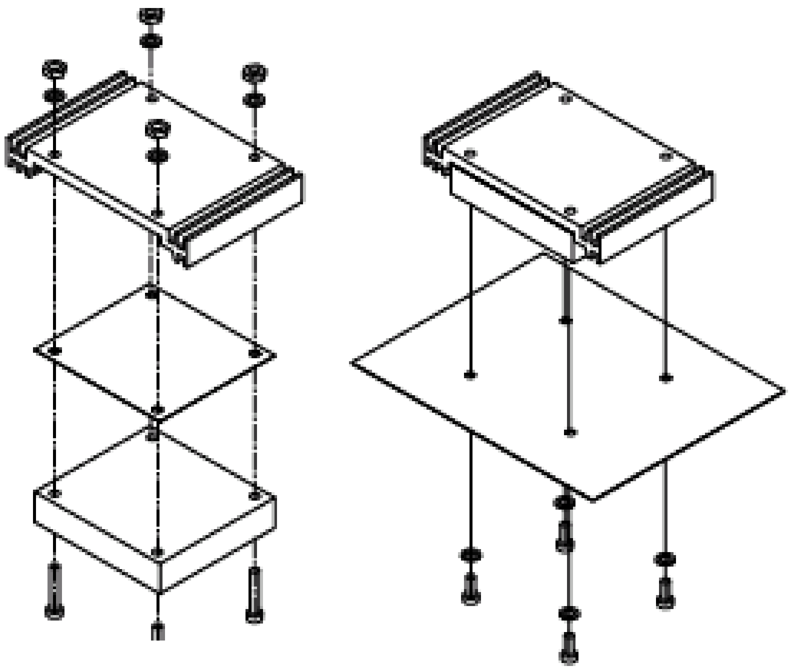


Figure 14 Heatsink mounting

Application Notes

Typical Application

Below is the typical application of the AVE240B-48S12 series power supply.

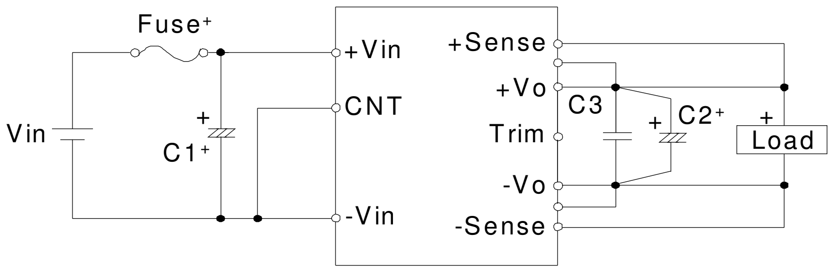


Figure 15 Typical application

F1: Fuse*: Use external fuse (fast blow type) for each unit. For 12V output: 20A (Pout=240W).

C1: Recommended input capacitor C1 ≥ 100μF/100V electrolytic or ceramic type capacitor.

C2: Recommended -40^{O}C ~ 100^{O}C uses: 2,200μF/25V (electrolytic capacitor).

C3: Recommended 10μF/25V.

Fusing: The AVE240B-48S12 power module has no internal fuse. An external fuse must always be employed! To meet international safety requirements, a 250 Volt rated fuse should be used. If one of the input lines is connected to chassis ground, then the fuse must be placed in the other input line.

Standard safety agency regulations require input fusing. Recommended fuse ratings for the AVE240B-48S12 are shown as following list. For 12V output : 20A (Pout=240W).

Note: the fuse is fast blow type.

CNT Function

Two CNT logic options are available. The CNT logic, CNT voltage and the module working state are as the following table.

	L	H	OPEN
N	ON	OFF	OFF
P	OFF	ON	ON

N: negative logic

P: positive logic

L: low voltage, -0.7V≤L≤1.2V

H: high voltage, 3.5V≤H≤5V

ON: Module is on,

OFF: Module is off

Open: CNT pin is left open

Note: When CNT is left open, V_{CNT} may reach 6V.

Figure 16 shows a few simple CNT circuits.

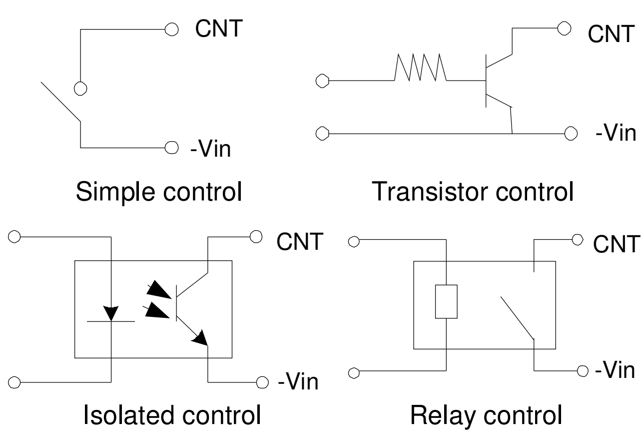


Figure 16 CNT circuit

Trim Characteristics

The +Vo output voltage of AVE240B-48S12 can be trimmed using the trim pin provided. Applying a resistor to the trim pin through a voltage divider from the output will cause the +Vo output to increase by up to 10% or decrease by up to 10%. Trimming up by more than 10% of the nominal output may activate the OVP circuit or damage the converter. Trimming down more than 10% can cause the converter to regulate improperly. If the trim pin is not needed, it should be left open.

Trim up

With an external resistor connected between the TRIM and +Sense pins, the output voltage set point increases (see Figure 17).

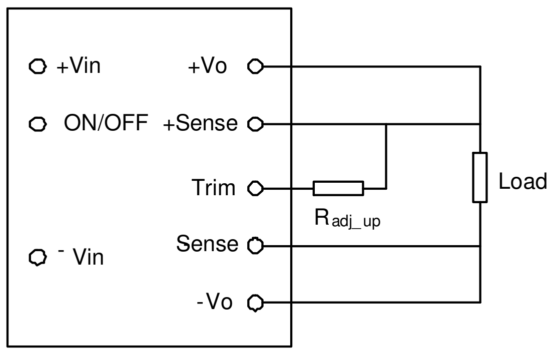


Figure 17 Trim up circuit

The following equation determines the required external-resistor value to obtain a percentage output voltage change of %.

$$R_{adj-up} = \left(\frac{V_{o,nom} * (100 + \Delta\%)}{1.225 * \Delta\%} - \frac{(100 + 2 * \Delta\%)}{\Delta\%} \right) K\Omega$$

Where,

$$\Delta\% = \left| \frac{V_{o,nom} - V_{desired}}{V_{o,nom}} \right| \times 100$$

$V_{desired}$ = Desired output voltage set point (V).

V_{trim} tolerance less than ±2%

R_{adj} tolerance is ±1%

Note that the trim-up function is valid only when the input is above 38V.

Trim down

With an external resistor between the TRIM and -Sense pins, the output voltage set point decreases (see Figure 18).

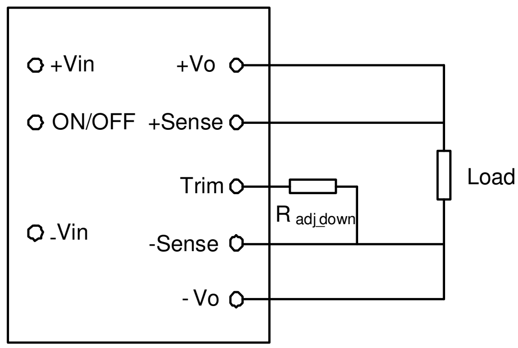


Figure 18 Trim down circuit

The following equation determines the required external-resistor value to obtain a percentage output voltage change of %.

$$R_{adj-down} = \left(\frac{100}{\Delta\%} - 2\right) K\Omega$$

Where,

$$\Delta\% = \left|\frac{V_{o,nom} - V_{desired}}{V_{o,nom}}\right| \times 100$$

$V_{desired}$ = Desired output voltage set point (V).

V_{trim} tolerance less than ±2%

R_{adj} tolerance is ±1%

Although the output voltage can be increased by both the remote sense and the trim, the maximum increase for the output voltage is not the sum of both. The maximum increase is the larger of either the remote sense or the trim.

Note that at elevated output voltages the maximum power rating of the module remains the same, and the output current capability will decrease correspondingly.

Remote Sense

AVE240B-48S12 converter can remotely sense both lines of its output which moves the effective output voltage regulation point from the output terminals of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of AVE240B-48S12 to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load.

When the converter is supporting loads far away, or is used with undersized cabling, significant voltage drop can occur at the load. The best defense against such drops is to locate the load close to the converter and to ensure adequately sized cabling is used. When this is not possible, the converter can compensate for a drop of up to 10%Vo, through use of the sense leads.

When used, the + Sense and - Sense leads should be connected from the converter to the point of load as shown in Figure 19, using twisted pair wire, or parallel pattern to reduce noise effect. The converter will then regulate its output voltage at the point where the leads are connected. Care should be taken not to reverse the sense leads. If reversed, the converter will trigger over-voltage protection (OVP) and turn off. When not used, the +Sense lead must be connected with +Vo, and -Sense with -Vo. Although the output voltage can be increased by both the remote sense and trim, the maximum increase for the output voltage is not the sum of both.

The maximum increase is the larger of either the remote sense or the trim.

Note that at elevated output voltages the maximum power rating of the module remains the same, and the output current capability will decrease correspondingly.

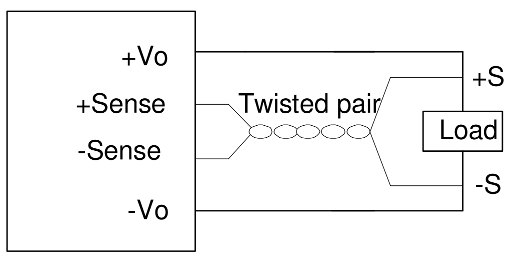


Figure 19 Sense connection

Output Capacitance

High output current transient rate of change (high di/dt) loads may require high values of output capacitance to supply the instantaneous energy requirement to the load. To minimize the output voltage transient drop during this transient, low Equivalent Series Resistance (ESR) capacitors may be required, since a high ESR will produce a correspondingly higher voltage drop during the current transient.

When the load is sensitive to ripple and noise, an output filter can be added to minimize the effects. A simple output filter to reduce output ripple and noise can be made by connecting a capacitor C1 across the output as shown in Figure 20. C1 ranges from 680µF to 10000µF , the recommended value for C1 is 2200µF.

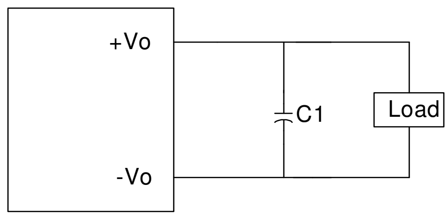


Figure 20 Output ripple filter

Extra care should be taken when long leads or traces are used to provide power to the load. Long lead lengths increase the chance for noise to appear on the lines. Under these conditions C2 can be added across the load, with a 1µF ceramic capacitor C2 in parallel generally as shown in Figure 21.

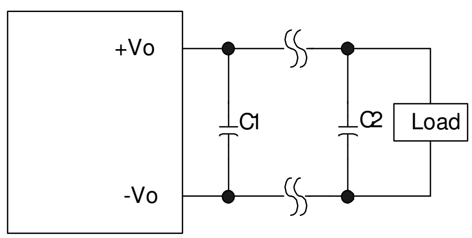


Figure 21 Output ripple filter for a distant load

Decoupling

The converter does not always create noise on the power distribution system. High-speed analog or digital loads with dynamic power demands can cause noise to cross the power inductor back onto the input lines. Noise can be reduced by decoupling the load. In most cases, connecting a 10μF ceramic capacitor in parallel with a 0.1μF ceramic capacitor across the load will decouple it. The capacitors should be connected as close to the load as possible.

Ground Loops

Ground loops occur when different circuits are given multiple paths to common or earth ground, as shown in Figure 22 . Multiple ground points can slightly different potential and cause current flow through the circuit from one point to another. This can result in additional noise in all the circuits. To eliminate the problem, circuits should be designed with a single ground connection as shown in Figure 23.

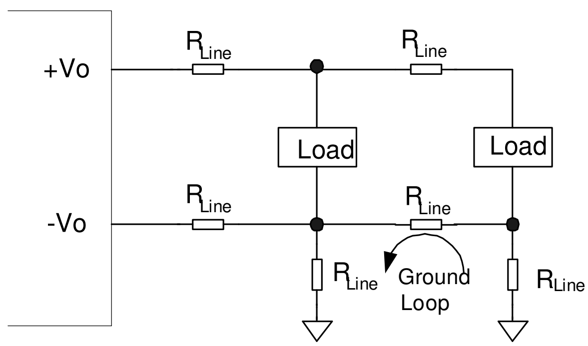


Figure 22 Ground loops

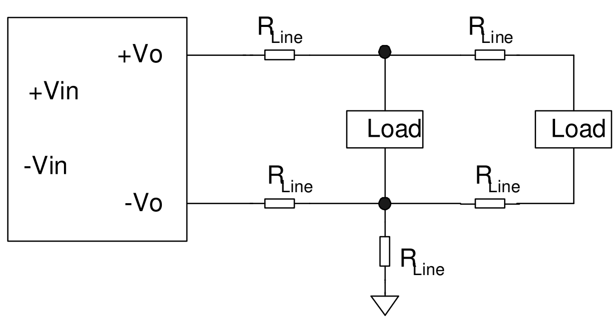


Figure 23 Single point ground

Weight

The AVE240B-48S12 series weight is 72g maximum.

Installation

Although AVE240B-48S12 converters can be mounted in any orientation, free air-flowing must be taken. Normally power components are always put at the end of the airflow path or have separate airflow paths. This can keep other system equipment cooler and increase component life spans.

Soldering

AVE240B-48S12 converter is compatible with standard wave soldering techniques. When wave soldering, the converter pins should be preheated for 20-30 seconds at 110^{O}C, and wave soldered at 260^{O}C for less than 10 seconds.

When hand soldering, the iron temperature should be maintained at 425^{O}C and applied to the converter pins for less than 5 seconds. Longer exposure can cause internal damage to the converter. Cleaning can be performed with cleaning solvent IPA or with water.

Hazardous Substances Announcement (RoHS of China R5)

Parts	Hazardous Substances					
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
AVE240B-48S12	√	x	x	x	x	x

x: Means the content of the hazardous substances in all the average quality materials of the part is within the limits specified in SJ/T-11363-2006

√: Means the content of the hazardous substances in at least one of the average quality materials of the part is outside the limits specified in SJ/T11363-2006

Artesyn Embedded Technologies has been committed to the design and manufacturing of environment-friendly products. It will reduce and eventually eliminate the hazardous substances in the products through unremitting efforts in research. However, limited by the current technical level, the following parts still contain hazardous substances due to the lack of reliable substitute or mature solution:

1. Solders (including high-temperature solder in parts) contain plumbum.
2. Glass of electric parts contains plumbum.
3. Copper alloy of pins contains plumbum

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