

## AVE240C-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
- Ultra-high efficiency 94.6% typ. at full load;95% typ. at half load
- Wide input range: 36V ~ 75V
- Excellent thermal performance
- No minimum load requirement
- RoHS compliant
- Remote ON/OFF control function
- Remote output sense
- Trim function: -10% ~ +10%
- Input under voltage lockout
- Output over current protection
- Output over voltage protection
- Over temperature protection
- Industry standard half-brick pin-out outline
- Pin length optional

### Safety

IEC/EN/UL/CSA 60950  
CE Mark  
TUV  
FCC Class A  
EN55022 Class A



## Product Descriptions

The AVE240C-48S12 is a single output DC-DC converter with standard half-brick form factor and pin configuration. It delivers up to 20A output current with 12V output voltage. Ultra-high 94.6% efficiency and excellent thermal performance makes it an ideal choice to use in telecom and datacom applications and can operate under an ambient temperature range of -40 °C ~ +85 °C.

## Applications

Telecom/ Datacom

## Model Numbers

Standard	Output Voltage	Structure	Remote ON/OFF logic	RoHS Status
AVE240C-48S12-4L	12Vdc	Baseplated	Negative	R6
AVE240C-48S12P-4L	12Vdc	Baseplated	Positive	R6

## Ordering information

AVE240	C	-	48	S	12	P	-	4	L
①	②		③	④	⑤	⑥		⑦	⑧

①	Series name	AVE: series name, 240: rated output power 240W
②	Version	C: Version C
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
⑧	RoHS status	L: RoHS, R6

## 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	$V_{IN,DC}$	-	-	80	Vdc
	Non-operating -100mS		-	-	100	Vdc
Maximum Output Powerff	All	$P_{O,max}$	-	-	240	W
Isolation Voltage <sup>1</sup>	All		-	-	1500	Vdc
			-	-	1500	Vdc
			-	-	500	Vdc
Ambient Operating Temperature	All	$T_A$	-40	-	+85	°C
Storage Temperature	All	$T_{STG}$	-55	-	+125	°C
Humidity (non-condensing)	Operating	All	-	-	95	%
	Non-operating	All	-	-	95	%
Voltage at remote ON/OFF pin	All		-0.7	-	+12	V

Note1:1mA for 60s,slew rate = 1500V/10s

## Input Specifications

Table 2. Input Specifications:

Parameter	Conditions <sup>1</sup>	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	35.1	36	Vdc
Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	30	33.6	35	Vdc
Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	1.5	3	V
Maximum Input Current ( $I_O = I_{O,max}$ )	$V_{IN,DC} = 36V_{DC}$	$I_{IN,max}$	-	-	8	A
No-load input current	$I_O = 0A$	$I_{IN}$	-	-	0.09	A
Standby Input current	Remote OFF	$I_{IN}$	-	-	0.05	A
Inrush current transient rating	Power ON		-	-	2	A <sup>2</sup> s
Recommended Input Fuse	Fast blow external fuse recommended		-	-	20	A
Input filter component values (C\L)	Internal values			11\1		$\mu F \backslash \mu H$
Recommended External Input Capacitance	Low ESR capacitor recommended	$C_{IN}$	-	100	-	$\mu F$
Input Reflected Ripple Current	Through 12 $\mu H$ inductor		-	-	80	mA
Operating Efficiency	$T_A = 25^\circ C$ $I_O = I_{O,max}$ $I_O = 50\% I_{O,max}$	$\eta$	-	94.6 95	-	% %

Note 1 -  $T_A = 25^\circ C$ , airflow rate = 400 LFM,  $V_{in} = 48V_{dc}$ , nominal  $V_{out}$  unless otherwise noted.

## Output Specifications

Table 3. Output Specifications:

Parameter	Condition <sup>1</sup>	Symbol	Min	Typ	Max	Unit	
Factory Set Voltage	$V_{IN,DC} = 48V_{DC}$ $I_O = I_{O,max}$	$V_O$	11.8	12.0	12.2	Vdc	
Total Regulation	Inclusive of line, load temperature change, warm-up drift	$V_O$	11.9	12.0	12.1	Vdc	
Output Voltage Line Regulation	All	$\%V_O$	-	0.05	-	%	
Output Voltage Load Regulation	All	$\%V_O$	-	0.1	-	%	
Output Voltage Temperature Regulation	All	$\%V_O$	-	0.02	-	$\%/^{\circ}C$	
Output Voltage Trim Range	All	$V_O$	10.8	-	13.2	V	
Output Ripple, pk-pk	Measure with a 1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth	$V_O$	-	150	180	$mV_{PK-PK}$	
Output Current	All	$I_O$	0	-	20	A	
Output DC current-limit inception <sup>2</sup>		$I_O$	22	24	28	A	
$V_O$ Load Capacitance <sup>3</sup>	All	$C_O$	470	-	10000	$\mu F$	
$V_O$ Dynamic Response  Peak Deviation Settling Time (Recovery to within 1% $V_{O,max}$ )	50%~75%~50% load change slew rate = 0.1A/us	$\pm V_O$ $T_s$	- -	230 40	- -	mV uSec	
	50%~75%~50% load change slew rate = 1A/us	$\pm V_O$ $T_s$	- -	281 70	- -	mV uSec	
Turn-on transient	Rise time	$I_O = I_{max}$	$T_{rise}$	-	25	-	mS
	Turn-on delay time	$I_O = I_{max}$	$T_{turn-on}$	-	60	-	mS
	Output voltage overshoot	$I_O = I_{max}$ $T_A = 25^{\circ}C$	$\%V_O$	-	0	-	%

Note 1 -  $T_a = 25^{\circ}C$ , airflow rate = 400 LFM,  $V_{in} = 48V_{dc}$ , nominal  $V_{out}$  unless otherwise noted.

Note 2 - Hiccup: auto-restart when over-current condition is removed.

Note 3 - High frequency and low ESR is recommended.

## Output Specifications

Table 3. Output Specifications, con't:

Parameter	Conditions <sup>1</sup>	Symbol	Min	Typ	Max	Unit
Switching frequency	All	$f_{sw}$	265	270	275	KHz
Remote ON/OFF control (positive logic)	Off-state voltage		-0.7	-	1.2	V
	On-state voltage		3.5	-	12	V
Remote ON/OFF control (Negative logic)	Off-state voltage		3.5	-	12	V
	On-state voltage		-0.7	-	1.2	V
Output over-voltage protection <sup>4</sup>	All	$V_O$	14.6	-	16	V
Output over-temperature protection <sup>5</sup>	All	T	-	118	-	°C
Over-temperature hysteresis	All	T	-	10	-	°C
Output voltage remote sense range	All	$\pm V_O$	-	-	0.5	V
MTBF	Telcordia SR-332-2006; 80% load, 300LFM, 40 °C T <sub>A</sub>		-	1.5	-	10 <sup>6</sup> h

Note 4 – Hiccup: auto-restart when over-voltage condition is removed.

Note 5 – Auto recovery.

## AVE240C-48S12 Performance Curves

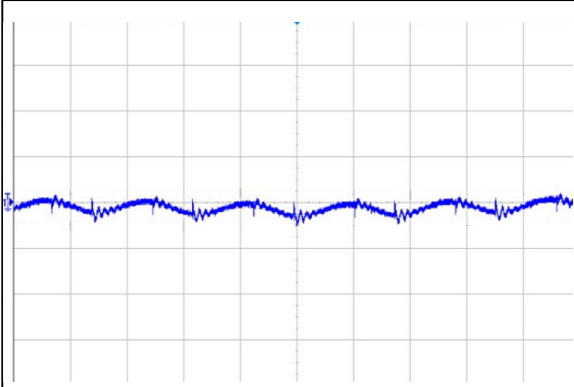


Figure 1: AVE240C-48S12 Input Reflected Ripple Current Waveform (20µs/div, 20mA/div)

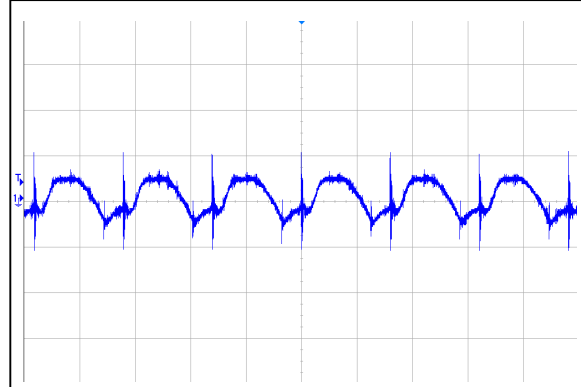


Figure 2: AVE240C-48S12 Ripple and Noise Measurement (20µs/div, 20mV/div)

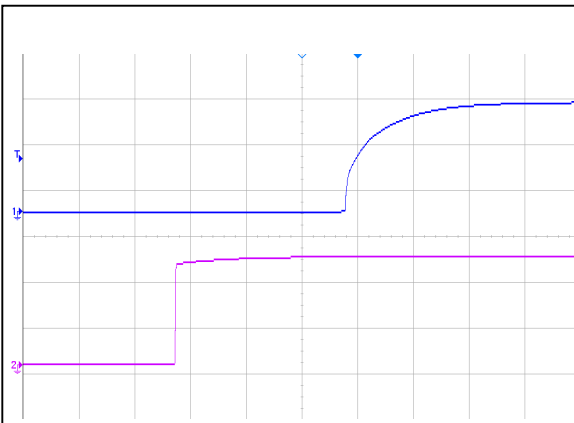


Figure 3: AVE240C-48S12 Output Voltage Startup Characteristic (5ms/div)

Ch 1: Vo (5V/div) Ch 2: Vin (20V/div)

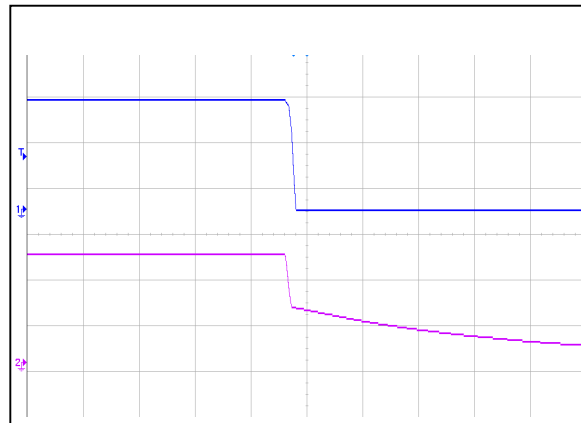


Figure 4: AVE240C-48S12 Turn Off Characteristic (2ms/div)

Ch 1: Vo (5V/div) Ch 2: Vin (20V/div)

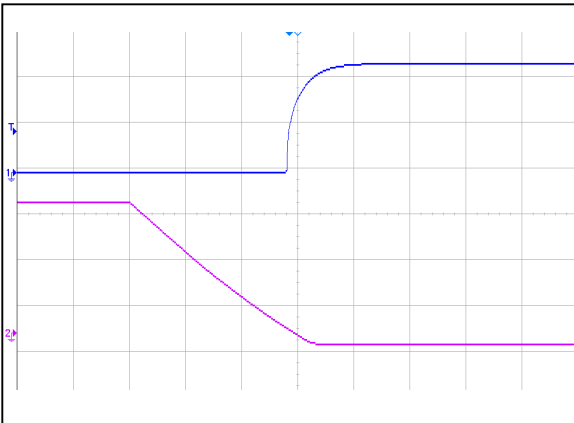


Figure 5: AVE240C-48S12 Remote ON Waveform (5ms/div)

Ch 1: Vo (5V/div) Ch 2: Remote ON (2V/div)

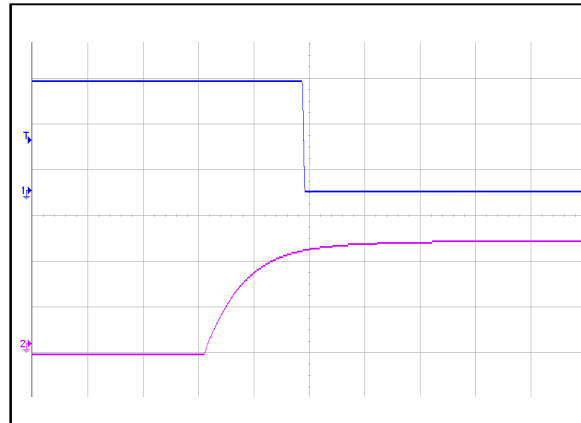


Figure 6: AVE240C-48S12 Remote OFF Waveform (5ms/div)

Ch 1: Vo (5V/div) CH 2: Remote OFF (2V/div)

## AVE240C-48S12 Performance Curves

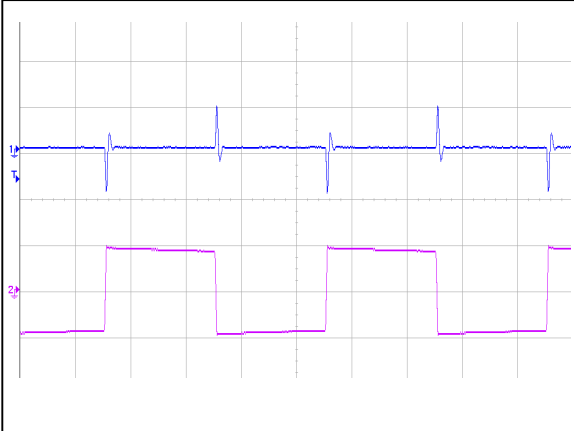


Figure 7: AVE240C-48S12 Transient Response (2mS/div)  
 50%-75%-50% load change, 0.1A/uS slew rate  
 Ch 1: Vo (200mV/div) Ch 2: Io (0.1A/div)

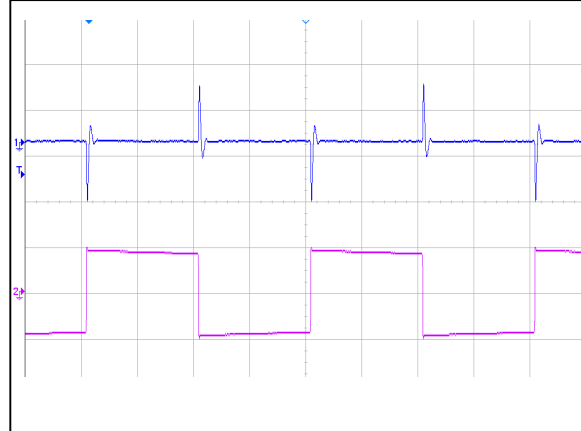


Figure 8: AVE240C-48S12 Transient Response (2mS/div)  
 50%-75%-50% load change, 1A/uS slew rate  
 Ch 1: Vo (200mV/div) Ch 2: Io (1A/div)

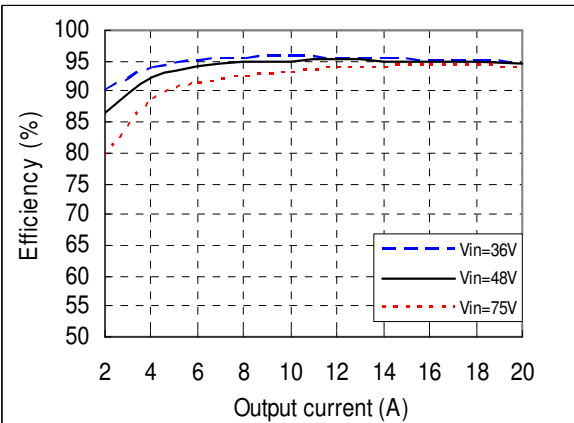
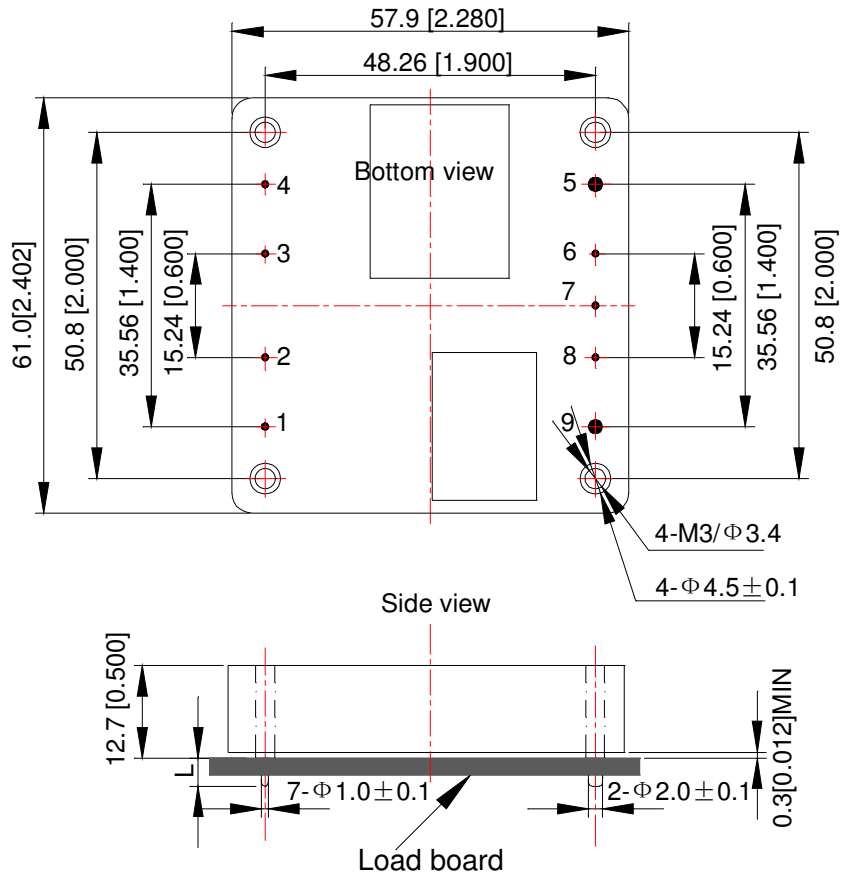


Figure 9: AVE240C-48S12 Efficiency Curves @ 25 °C, Vo=12V



## Mechanical Specifications

### Mechanical Outlines



Unit: mm[inch]

Bottom view: pin on upside

Tolerance: X.Xmm ± 0.5mm[X.X in. ± 0.02in.]

X.XXmm ± 0.25mm[X.XX in. ± 0.01in.]

## Pin Length Options

Device code suffix	L
-4	4.8mm ± 0.5 mm
-6	3.8mm ± 0.5 mm
-8	2.8mm ± 0.5 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	Case	
4	Vin-	Negative input voltage
5	Vo-	Negative output voltage
6	S-	Negative remote sense
7	Trim	Output voltage trim
8	S+	Positive remote sense
9	Vo+	Positive output voltage

## Environmental Specifications

### EMC Immunity

AVE240C-48S12 Series power supply is designed to meet the following EMC immunity specifications:

Document	Description	Criteria
EN55022, Class A Limits	Conducted and Radiated EMI Limits	/
IEC/EN 61000-4-2, Level 3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques - Electrostatic discharge immunity test. Enclosure Port	B
IEC/EN 61000-4-4, Level 3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient. DC input port.	B
IEC/EN 61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Immunity to surges - 600V common mode and 600V differential mode for DC ports	B
IEC/EN 61000-4-6, Level 2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Continuous Conducted Interference. DC input port	A
EN61000-4-29	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Voltage Dips and short interruptions and voltage variations. DC input port	B

Criterion A: Normal performance during and after test.

Criterion B: For EFT and surges, low-voltage protection or reset is not allowed. Temporary output voltage fluctuation ceases after disturbances ceases, and from which the EUT recovers its normal performance automatically.

For Dips and ESD, output voltage fluctuation or reset is allowed during the test, but recovers to its normal performance automatically after the disturbance ceases.

Criterion C: Temporary loss of output, the correction of which requires operator intervention.

Criterion D: Loss of output which is not recoverable, owing to damage to hardware.

## EMC Filter Configuration

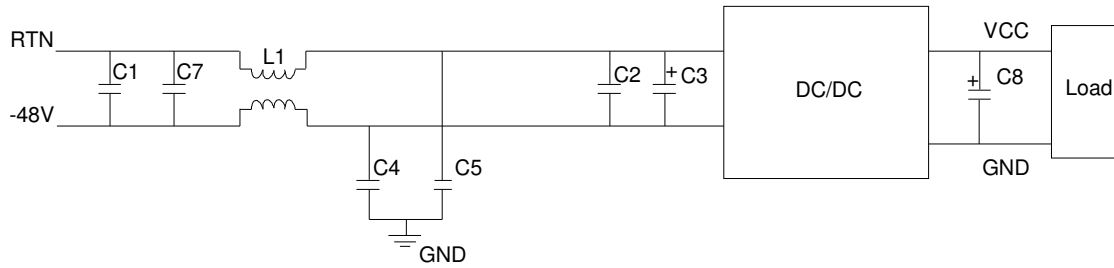


Figure 10 EMC test configuration

- C1/C7: 1000nF/100V X7R ceramic capacitor
- C2: 100nF/100V X7R ceramic capacitor
- C3: 100 $\mu$ F/100V electrolytic capacitor
- C6: 470 $\mu$ F/50V electrolytic capacitor
- C4/C5: 0.1U/1000V X7R ceramic capacitor
- L1: 809 $\mu$ H- $\pm$ 25%-9.7A-R5K common-mode inductor

## Safety Certifications

The AVE240C-48S12 power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand alone product.

Table 4. Safety Certifications for AVE240C-48S12 series power supply system

Document	File #	Description
UL/CSA 60950		US and Canada Requirements
EN60950		European Requirements
IEC60950		International Requirements
TUV		German Requirements
CE		CE Marking

## Operating Temperature

The AVE240C series power supplies will start and operate within stated specifications at an ambient temperature from -40 °C to 85 °C under all load conditions. The storage temperature is -55 °C to 125 °C.

## Thermal Considerations

The converter is designed to operate in different thermal environments and sufficient cooling must be provided.

Proper cooling of the DC-DC converter can be verified by measuring the temperature at the test point(s). The temperature at this/these point(s) should not exceed the max values in the Table 5.

The converter can operate in an enclosed environment without forced air convection. Cooling of the converter is achieved mainly by conduction from the baseplate to a heatsink. The converter can deliver full output power at 85 °C ambient temperature provided the baseplate temperature is kept below the max values in the following table.

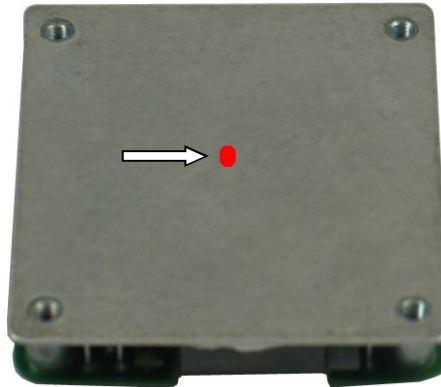


Figure 11 Test point on baseplate

Table 5 Temperature limit of the test points

Test point	Temperature limit
Test point	113 °C

**Thermal Considerations, con't**

The converter can also operate with a smaller heatsink and sufficient airflow. Figure 14 shows the derating output current vs. ambient air temperature at different air velocity with a specified heatsink.

The typical test condition is shown in Figure 12.

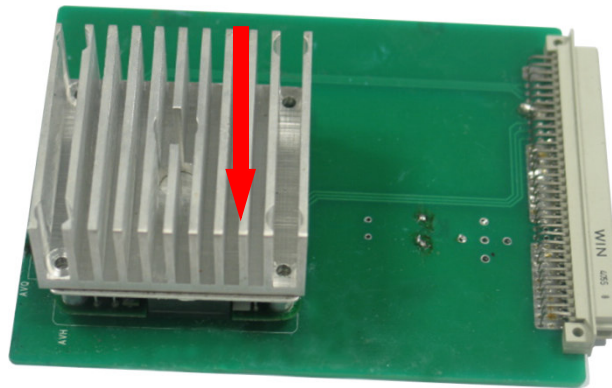


Figure 12 Typical test condition, forced airflow direction is from  $V_{in-}$  to  $V_{in+}$

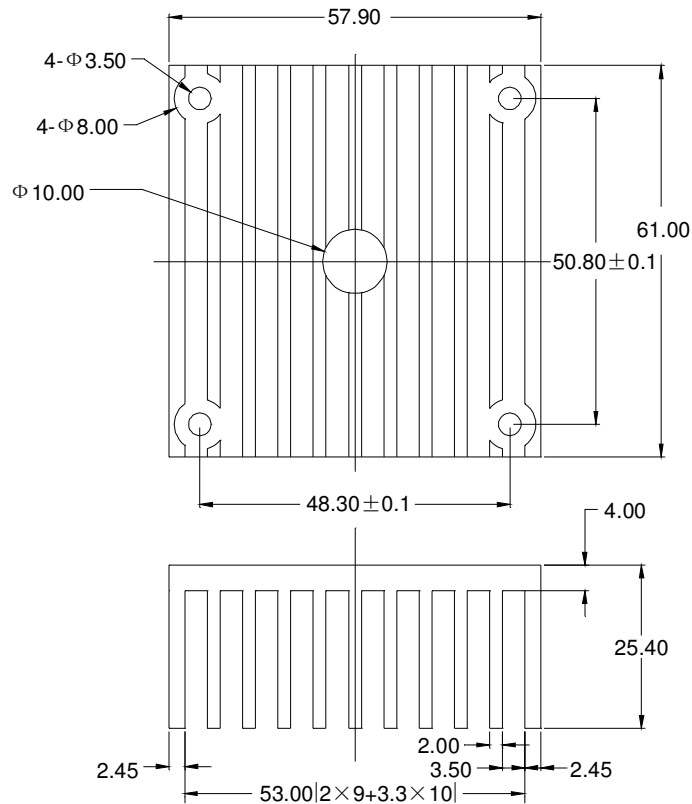


Figure 13 Outline drawing of the heatsink

**Thermal Considerations, con't**

The converter can operate with a smaller heatsink and sufficient airflow. Figure 14 shows the derating output current vs. ambient air temperature at different air velocities with a specified heatsink.

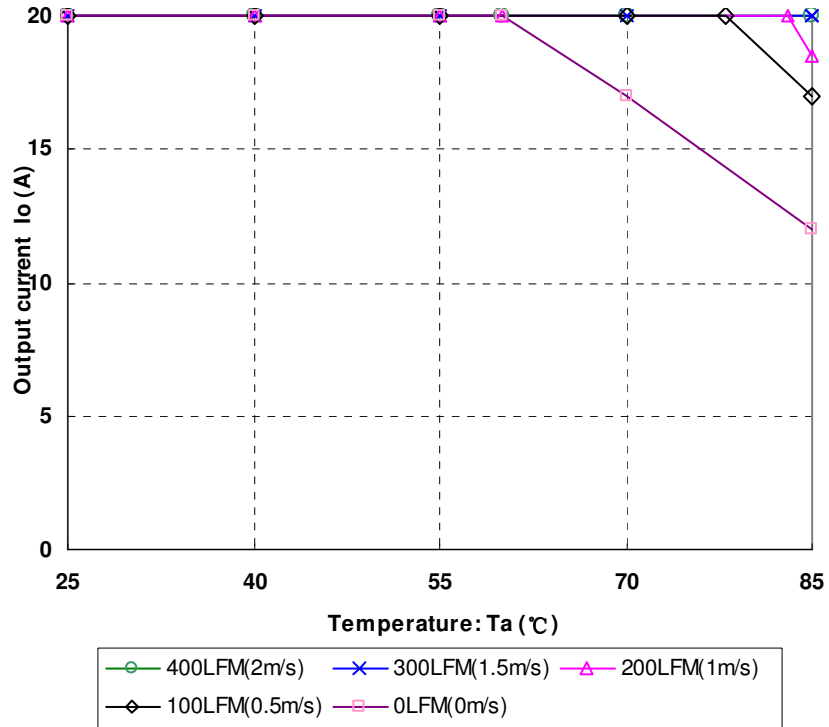


Figure 14 Output power derating,  $48V_{in}$ , air flowing across the converter from  $V_{in-}$  to  $V_{in+}$



## Qualification Testing

Parameter	Unit (pcs)	Test condition
Halt test	4-5	$T_{a,min} - 10\text{ }^{\circ}\text{C}$ to $T_{a,max} + 10\text{ }^{\circ}\text{C}$ , $5\text{ }^{\circ}\text{C}$ step, $V_{in} = \text{min to max}$ , $0 \sim 105\%$ load
Vibration	3	Frequency range: $5\text{Hz} \sim 20\text{Hz}$ , $20\text{Hz} \sim 200\text{Hz}$ , A.S.D: $1.0\text{m}^2/\text{s}^3$ , $-3\text{db/oct}$ , axes of vibration: X/Y/Z. Time: 30min/axes
Mechanical Shock	3	30g, 6mS, 3axes, 6directions, 3time/direction
Thermal Shock	3	$-40\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$ , unit temperature 20cycles
Thermal Cycling	3	$-40\text{ }^{\circ}\text{C}$ to $55\text{ }^{\circ}\text{C}$ , temperature change rate: $1\text{ }^{\circ}\text{C}/\text{min}$ , cycles: 2cycles
Humidity	3	$40\text{ }^{\circ}\text{C}$ , 95%RH, 48h
Solder Ability	15	IPC J-STD-002C-2007

## Application Notes

### Typical Application

Below is the typical application of the AVE240C-48S12 series power supply.

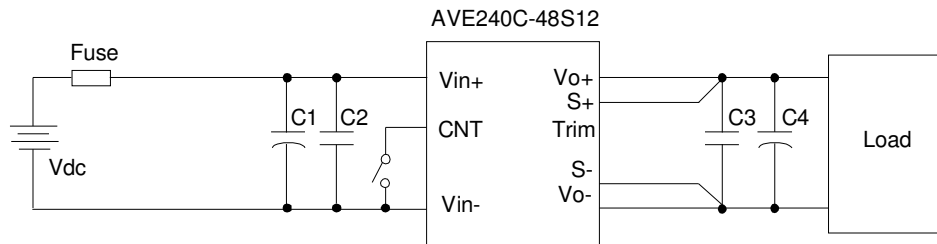


Figure 15 Typical application

C1: 100µF/100V electrolytic capacitor, P/N: UPW2A101MHD (Nichicon) or equivalent caps

C2: 1µF/100V X7R ceramic capacitor, P/N: C3225X7R2A105KT0L0U (TDK) or equivalent caps

C3: 1µF/25V X7R ceramic capacitor, P/N: C3225X7R1E105KT000N (TDK) or equivalent caps

C4: 470µF electrolytic capacitor, P/N: UUD1H471MNL1GS (Nichicon) or equivalent caps

Fuse: External fast blow fuse with a rating of 20A. The recommended fuse model is 314020P MXP from LITTLEFUSE.

### Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AVE240C-48S12. The logic is CMOS and TTL compatible. The following figure is the detailed internal circuit and reference in AVE240C-48S12.

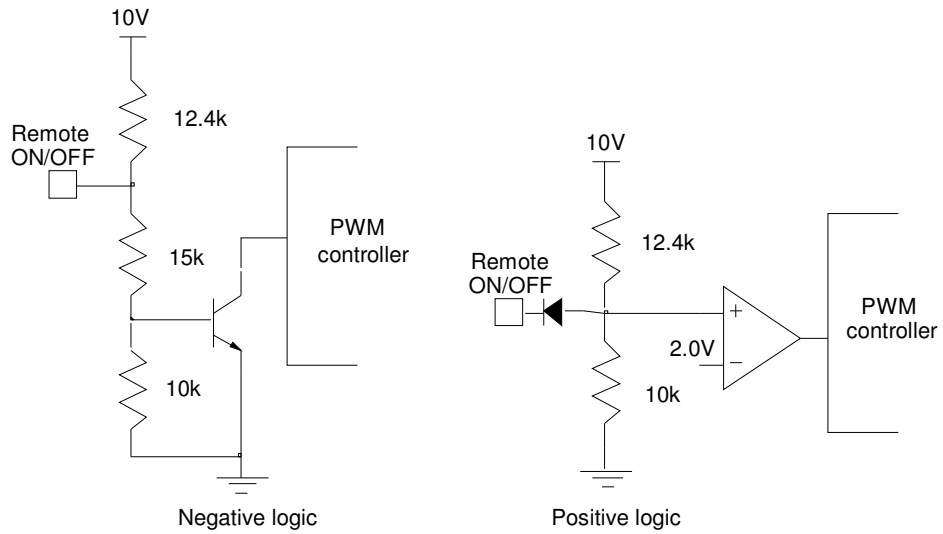


Figure 16 Remote ON/OFF internal diagram

## Trim Characteristics

Connecting an external resistor between Trim pin and  $V_o-$  pin will decrease the output voltage. While connecting it between Trim and  $V_o+$  will increase the output voltage. The following equations determine the external resistance to obtain the trimmed output voltage.

$$R_{adj-down} = \frac{1}{\Delta} - 2(k\Omega)$$

$$R_{adj-up} = \frac{V_{nom} \times (1 + \Delta)}{1.225 \times \Delta} - \frac{1 + 2\Delta}{\Delta} (k\Omega)$$

$$\Delta = \frac{|V_{nom} - V_{desired}|}{V_{nom}}$$

$V_{nom}$  : Nominal output voltage.

For example, to get 13.2V output, the trimming resistor is

$$R_{adj-up} = \frac{12 \times (1 + 0.1)}{1.225 \times 0.1} - \frac{1 + 2 \times 0.1}{0.1} (k\Omega) = 95.75k\Omega$$

The output voltage can also be trimmed by potential applied at the Trim pin.

$$V_o = (V_{trim} + 1.225) \times 9.8$$

Where  $V_{trim}$  is the potential applied at the Trim pin, and  $V_o$  is the desired output voltage.

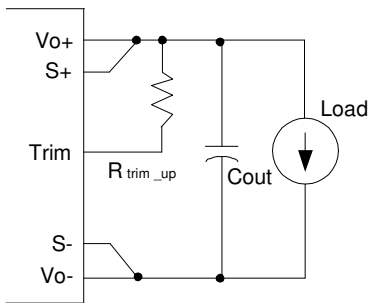


Figure 17 Trim up

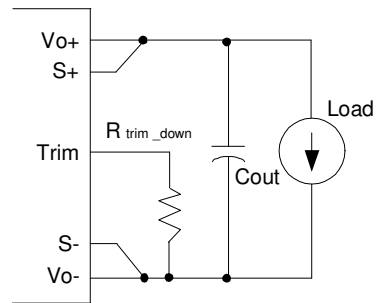


Figure 18 Trim down

When trimming up, the output current should be decreased accordingly so as not to exceed the maximum output power and the minimum input voltage should be increased as shown in Figure 19.

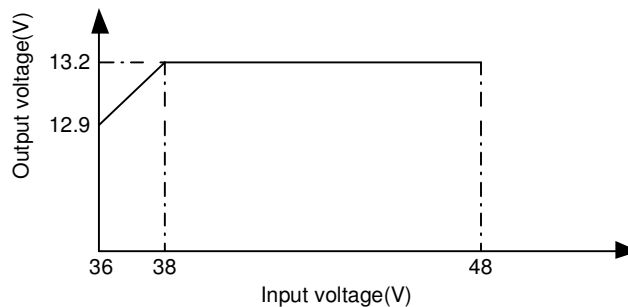


Figure 19 Output trim voltage vs. input voltage

## Input Ripple & Output Ripple & Noise Test Configuration

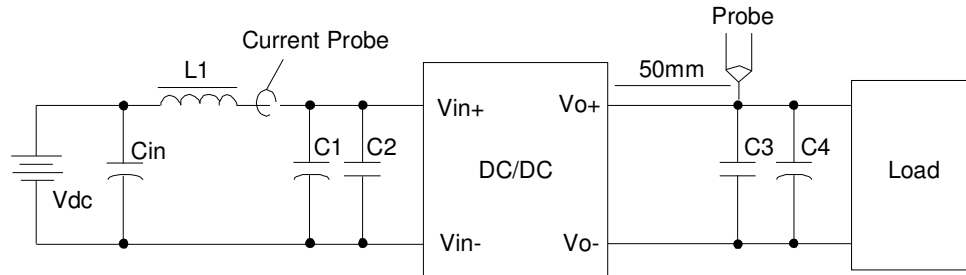


Figure 20 Input ripple & inrush current, output ripple & noise test configuration

Vdc: DC power supply

L1: 12 $\mu$ H

Cin: 220 $\mu$ F/100V typical

C1 ~ C4: See Figure 15

Note: It is recommended to use a coaxial cable with series 50 $\Omega$  resistor and 0.68 $\mu$ F ceramic capacitor or a ground ring of probe to test output ripple & noise.

### **Sense Characteristics**

If the load is far from the unit, connect S+ and S- to the terminal of the load respectively to compensate the voltage drop on the transmission line. See Figure 18.

If the sense compensate function is not necessary, connect S+ to  $V_{o+}$  and S- to  $V_{o-}$  directly.

### **Soldering**

The product is intended for standard manual or wave soldering.

When wave soldering is used, the temperature on pins is specified to maximum 260°C for maximum 7s.

When soldering by hand, the iron temperature should be maintained at 300°C ~ 380°C and applied to the converter pins for less than 10s. Longer exposure can cause internal damage to the converter.

## Hazardous Substances Announcement (RoHS of China)

Parts	Hazardous Substances					
	Pb	Hg	Cd	Cr <sup>6+</sup>	PBB	PBDE
AVE240C-48S12-14L	x	x	x	x	x	x
AVE240C-48S12P-14L	x	x	x	x	x	x
AVE240C-48S12-14Y	√	x	x	x	x	x
AVE240C-48S12P-14Y	√	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

### WORLDWIDE OFFICES

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