EMERSON
Network Power

48Vdc Input, 12Vdc@20A Output Half-brick Converter AVE240C-48S12

Description

The AVE240C-48S12 is a single output DC-DC converter with standard half-brick outline and pin configuration. It delivers up to 20A output current with 12V output voltage. above 94.6% efficiency and excellent thermal performance makes it an ideal choice to supply power in telecom and datacom. It can work under -40°C ~ +85°C. 36V ~ 75V wide input range makes it for 48V power system application.

Operational Features

- Delivers up to 20A output current
- High efficiency: 94.6% (typ., full load, 48V); 95% (typ., half load, 48V)
- Wide input range: 36V ~ 75V
- Excellent thermal performance
- No minimum load requirement
- RoHS 5/6,RoHS 5/6 compliant

Control Features

- Remote control function (negative or positive logic optional)
- Remote output sense
- Trim function: 80% ~ 110%

Protection Features

- Input under voltage lockout
- Output over current protection
- Output over voltage protection
- Over temperature protection

Mechanical Features

- Industry standard half-brick pin-out outline
- Pin length option: 3.8mm, 4.8mm, 5.8mm

Safety & EMC

- Meet basic insulation requirements of IEC/EN/UL/CSA 60950
- UL/CSA 60950 recognized and certified to IEC/EN 60950
- Meet the Low Voltage directives 2006/95/EC with the Amendment Directive 93/68/EEC which facilitates CE marking in user's end product
- Approved by UL and TUV
- Materials meet UL94, V-0 flammability rating
- Meet conducted emission's requirements of FCC Class A and EN55022 Class A with external filter

Electrical Characteristics

Full operating ambient temperature range is -40°C to +85°C.
Specifications are subject to change without notice.

Parameter		Min.	Typ.	Max.	Unit	Notes & Conditions
Absolute max. ratings						
Input voltage	Non-operating			100	V	100ms
	Operating			80	V	Continuous
Operating temperature		-40		85	°C	
Storage temperature		-55		125	°C	
Voltage at remote ON/OFF pin		-0.7		12	V	
Input characteristics						
Operating input voltage range		36	48	75	V	
Input under-voltage lockout	Turn-on voltage threshold	31	35.1	36	V	
	Turn-off voltage threshold	30	33.6	35	V	
	Lockout voltage hysteresis	1	1.5	3	V	
Max. input current				8	A	36V_{in}, full load
No-load input current				0.09	A	
Standby Input current				0.05	A	Remote OFF
Inrush current transient rating				2	A^2s	Figure 15
Input reflected ripple current				80	mA	Through 12μH inductor; Figure 5
Recommended input fuse				20	A	Fast blow external fuse recommended; Figure 10
Input filter component values (C\L)			11\1		μF\μH	Internal values
Recommended external input capacitance			100		μF	Low ESR capacitor recommended; Figure 10
Output characteristics						
Output voltage set point (standard option)		11.8	12	12.2	V	48V_{in}, full load
Output voltage line regulation			0.05		%	
Output voltage load regulation			0.1		%	

Parameter		Min.	Typ.	Max.	Unit	Notes & Conditions
Output voltage temperature regulation			0.02		%/°C	
Total output voltage range		11.9	12	12.1	V	Over sample, line, load, temperature & life
Output voltage ripple and noise			150	180	mVpp	Figure 2 20MHz bandwidth; Figure 5
Operating output current range		0		20	A	
Output DC current-limit inception		22	24	28	A	Hiccup: auto-restart when over-current condition is removed
Output capacitance		470		10000	μF	High frequency and low ESR is recommended
Dynamic characteristics						
Dynamic response	50% ~ 75% ~ 50% $I_{o,max}$, 0.1A/μs		230		mV	Figure 4 Test condition: 25°C, nominal input voltage, see Figure 10
	Setting time		40		μs	Recovery to within 1% $V_{o,nom}$
	50% ~ 75% ~ 50% $I_{o,max}$, 1A/μs		281		mV	Figure 5 Test condition: 25°C, nominal input voltage, see Figure 10
	Setting time		70		μs	Recovery to within 1% $V_{o,nom}$
Turn-on transient	Rise time		25		ms	Full load, Figure 6
	Turn-on delay time		60		ms	Full load, Figure 6
	Output voltage overshoot		0		$\%V_o$	Full load, Figure 6
Efficiency						
100% load ($48V_{in}$)			94.6		%	Figure 1
50% load ($48V_{in}$)			95		%	Figure 1

Electrical Characteristics (Continued)

Parameter		Min.	Typ.	Max.	Unit	Notes & Conditions
Isolation characteristics						
Isolation voltage (conditions: 1mA for 60s, slew rate of 1500V/10s)		1500			V	Basic insulation, pollution degree 2, input to output
		1500			V	Basic insulation, pollution degree 2, input to baseplate
		500			V	Basic insulation, pollution degree 2, output to baseplate
Feature characteristics						
Switching frequency		265	270	275	kHz	
Remote ON/OFF control (positive logic)	Off-state voltage	-0.7		1.2	V	See Figure 11
	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 voltage trim range		10.8		13.2	V	See *Trim Characteristics* of *Application Note*
Output voltage remote sense range				0.5	V	
Output over-voltage protection		14.6		16	V	Hiccup: auto-restart when over-voltage condition is removed
Over-temperature shutdown			118		°C	Auto recovery;over-temperature protect (OTP) test point: see Figure 16
Over-temperature hysteresis			10		°C	
Reliability characteristics						
Calculated MTBF (telcordia)			1.5		10^6h	Telcordia SR-332-2006; 80% load, 300LFM, 40°C T_a

Electromagnetic compatibility requirements

Test Item	Regulations	Criteria	Notes & Conditions
Conducted Emission	EN 55022 DC input port, Class A Limits		See *EMC Test Conditions*
Immunity to Electrostatic Discharge	IEC/EN61000-4-2 Enclosure Port, Level 3	B	
Immunity to Electrical Fast Transient	IEC/EN61000-4-4 DC input port, Level 3	B	
Immunity to Surges	IEC/EN61000-4-5 DC input port Line to Ground(earth): 600V Line to Line: 600V	B	
Immunity to Continuous Conducted Interference	IEC/EN61000-4-6 DC input port, Level 2	A	
Immunity To Voltage Dips and short interruptions and voltage variations	EN 61000-4-29 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.

Qualification Testing

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

Characteristic Curves

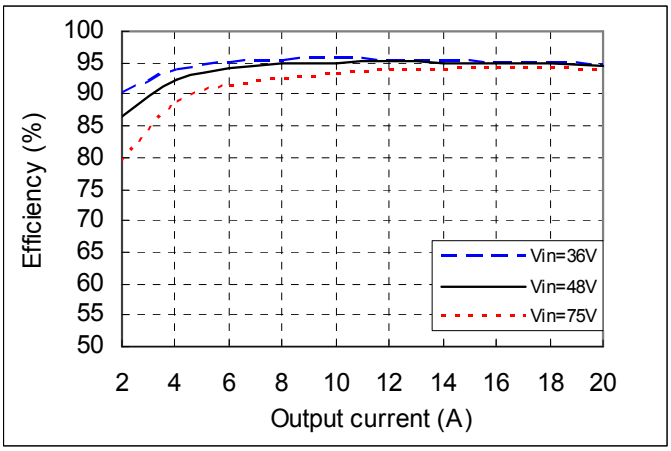


Figure 1 Efficiency vs. output current, T_a=25°C, V_o=12V

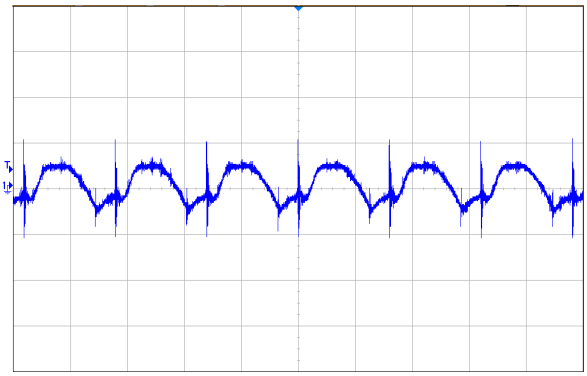


Figure 2 Output ripple & noise (2μs/div, 20mV/div), see Figure 15 for test configuration

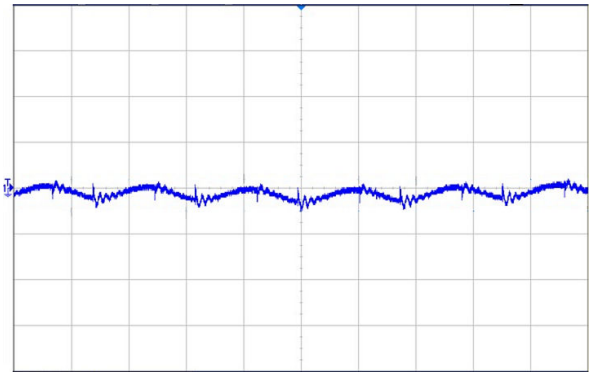


Figure 3 Input reflected ripple current (2μs/div , 20mA/div), see Figure 15 for test configuration

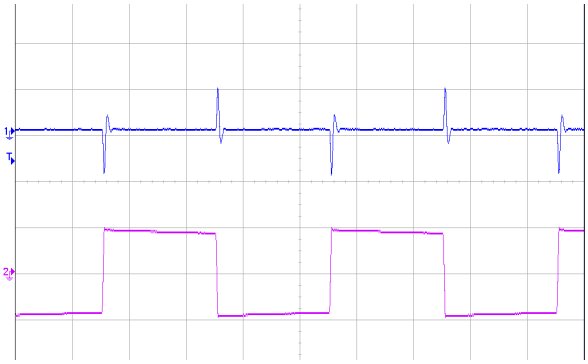


Figure 4 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 0.1A/μs slew rate, (2ms/div), see Figure 10 for test configuration; CH1-output voltage (200mV/div); CH2-output current (0.1A/div)

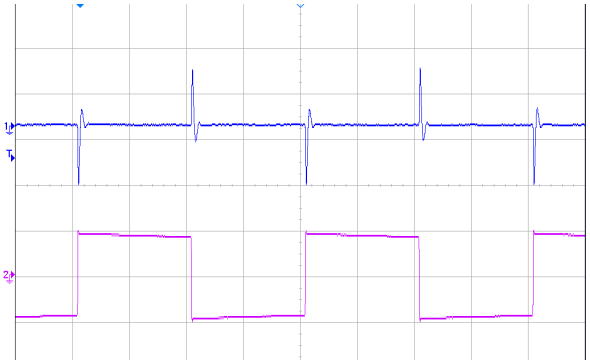


Figure 5 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 1A/μs slew rate, (2ms/div), see Figure 10 for test configuration; CH1-output voltage (200mV/div); CH2-output current (1A/div)

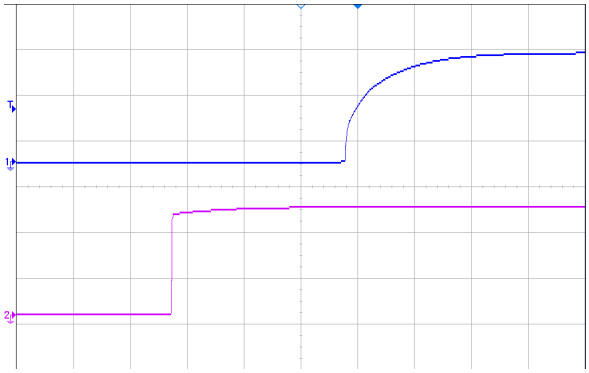


Figure 6 Output voltage startup by power on, (5ms/div), see Figure 10 for test configuration; CH1-output voltage (5V/div); CH2-intput voltage (20V/div)

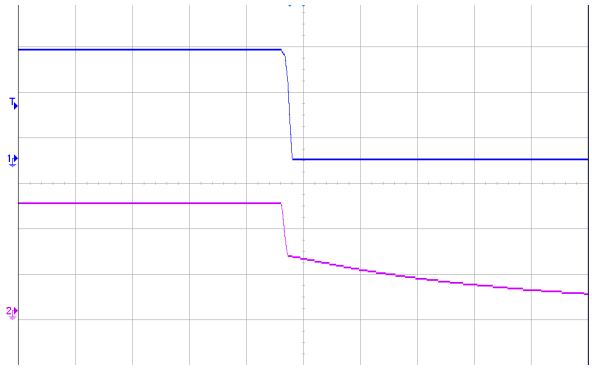


Figure 7 Output voltage shut down by power off, (2ms/div), see Figure 10 for test configuration; CH1-output voltage (5V/div); CH2-input voltage (20V/div)

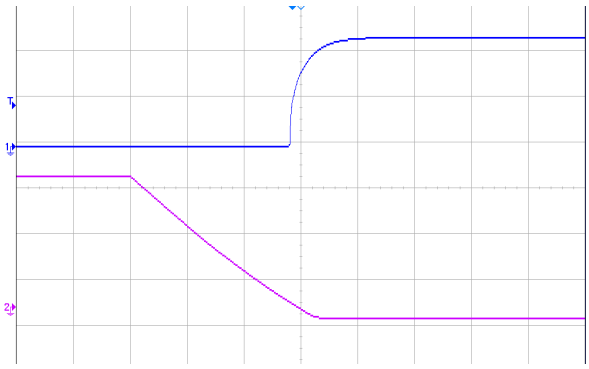


Figure 8 Output voltage startup by remote ON, (5ms/div), see Figure 10 for test configuration; CH1-output voltage (5V/div); CH2-remote ON (2V/div)

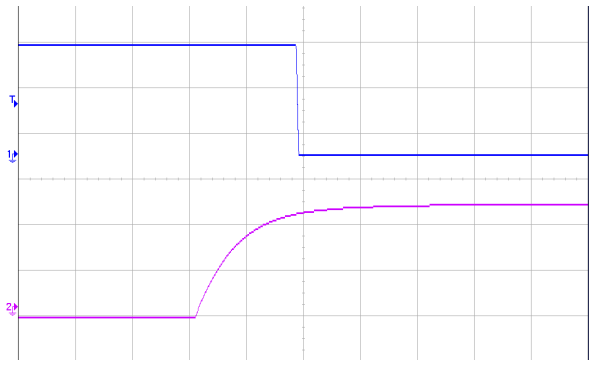


Figure 9 Output voltage shutdown by remote OFF, (5ms/div), see Figure 10 for test configuration; CH1-output voltage (5V/div); CH2-remote OFF voltage (2V/div)

Application Note

Typical Application

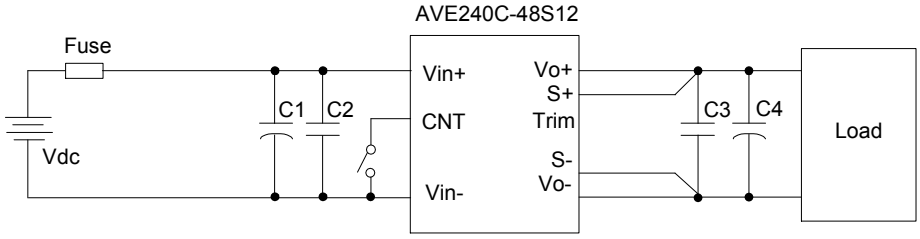


Figure 10 Typical application

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.

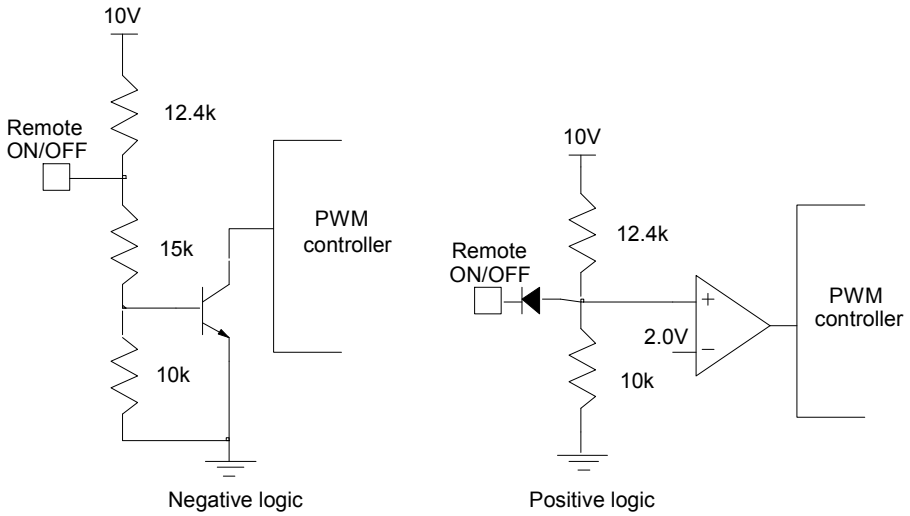


Figure 11 Remote ON/OFF internal diagram

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.

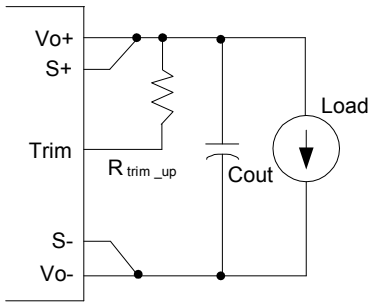


Figure 12 Trim up

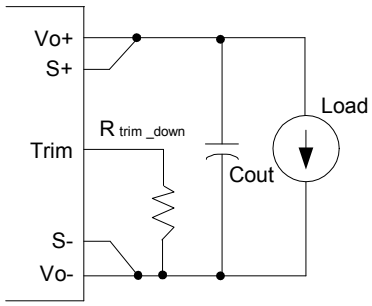


Figure 13 Trim down

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 14.

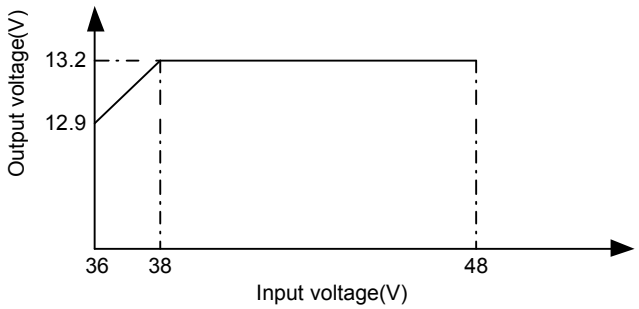


Figure 14 Output trim voltage vs. input voltage

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 13.
If the sense compensate function is not necessary, connect S+ to V_o+ and S- to V_o- directly.

Input Ripple & Inrush Current And Output Ripple & Noise Test Configuration

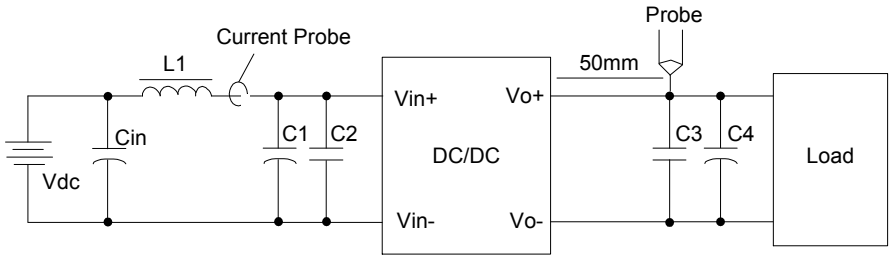


Figure 15 Input ripple & inrush current, output ripple & noise test configuration

Vdc: DC power supply
L1: 12μH
Cin: 220μF/100V typical
C1 ~ C4: See Figure 10
Note: It is recommended to use a coaxial cable with series 50Ω resistor and 0.68μF ceramic capacitor or a ground ring of probe to test output ripple & noise.

EMC Test Conditions

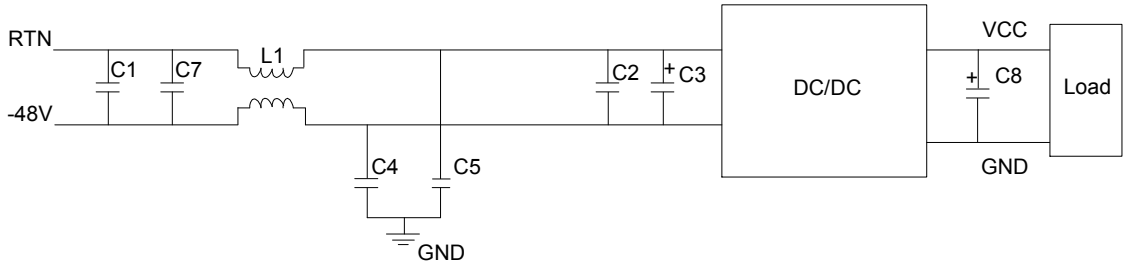


Figure 16 EMC test configuration

C1/C7: 1000nF/100V X7R ceramic capacitor
C2: 100nF/100V X7R ceramic capacitor
C3: 100μF/100V electrolytic capacitor
C6: 470μF/50V electrolytic capacitor
C4/C5: 0.1U/1000V X7R ceramic capacitor
L1: 809μH-±25%-9.7A-R5K common-mode inductor

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.

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.

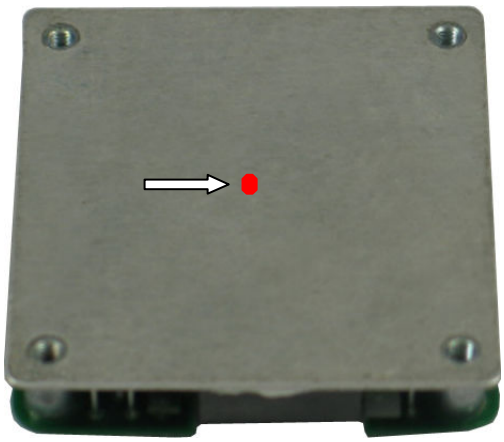


Figure 17 Test point on baseplate

Test point	Temperature limit
Test point	113°C

The converter can also operate with a smaller heatsink and sufficient airflow. Figure 20 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 18.

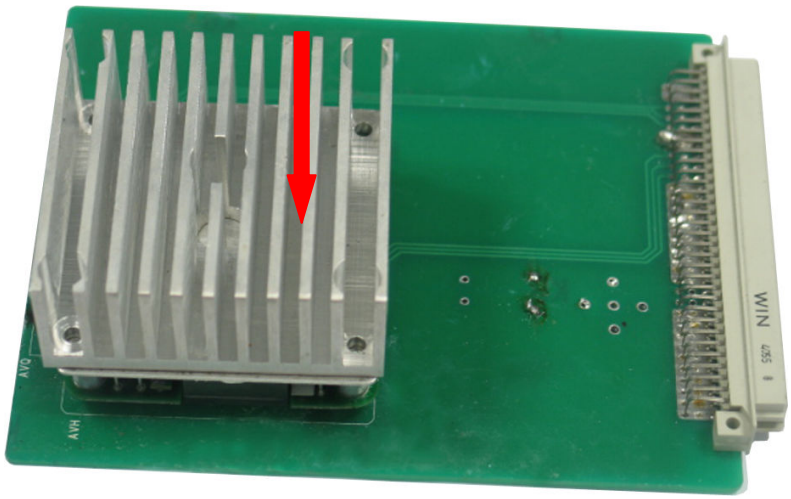


Figure 18 Typical test condition, forced airflow direction is from V_{in}- to V_{in}+

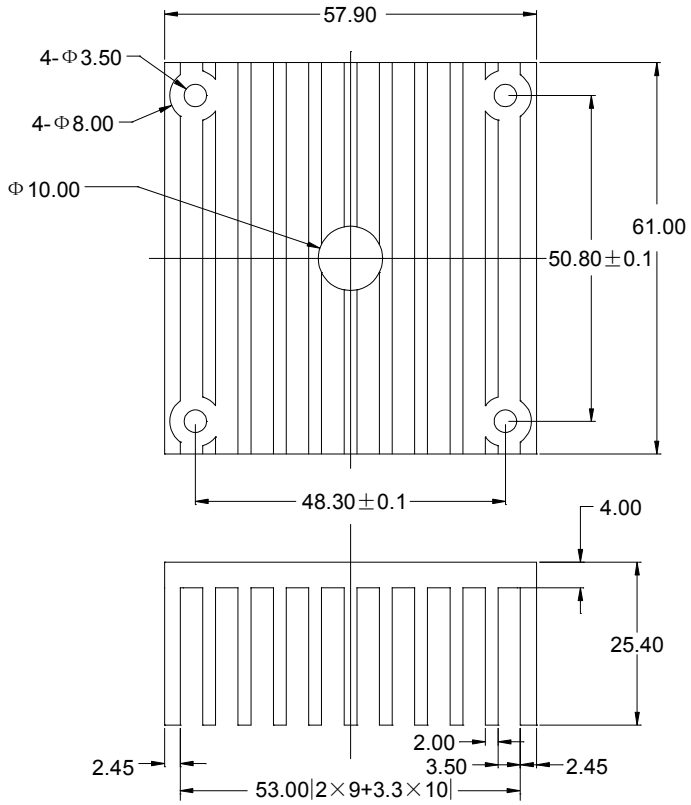


Figure 19 Outline drawing of the heatsink

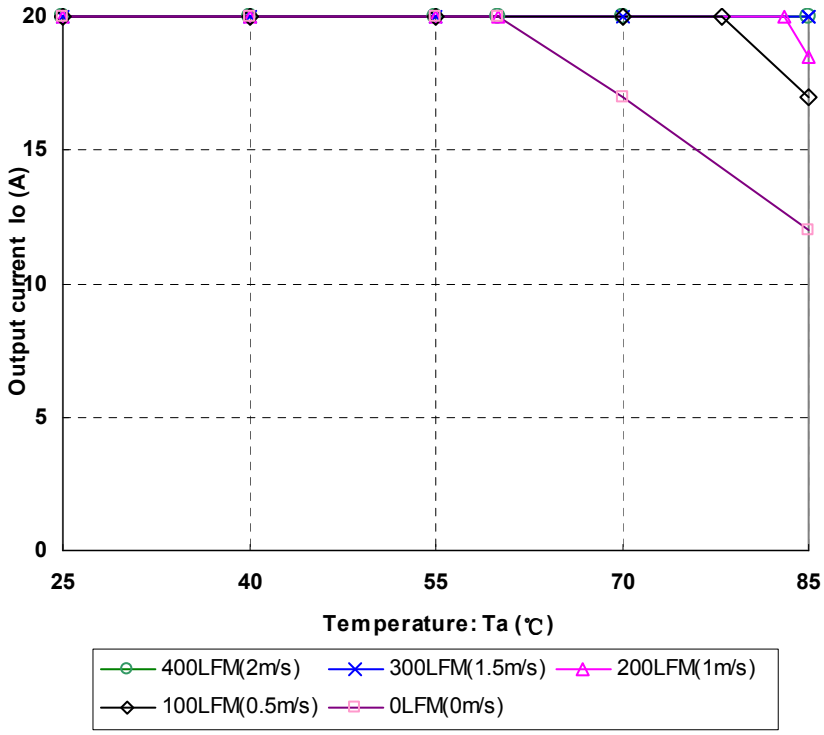
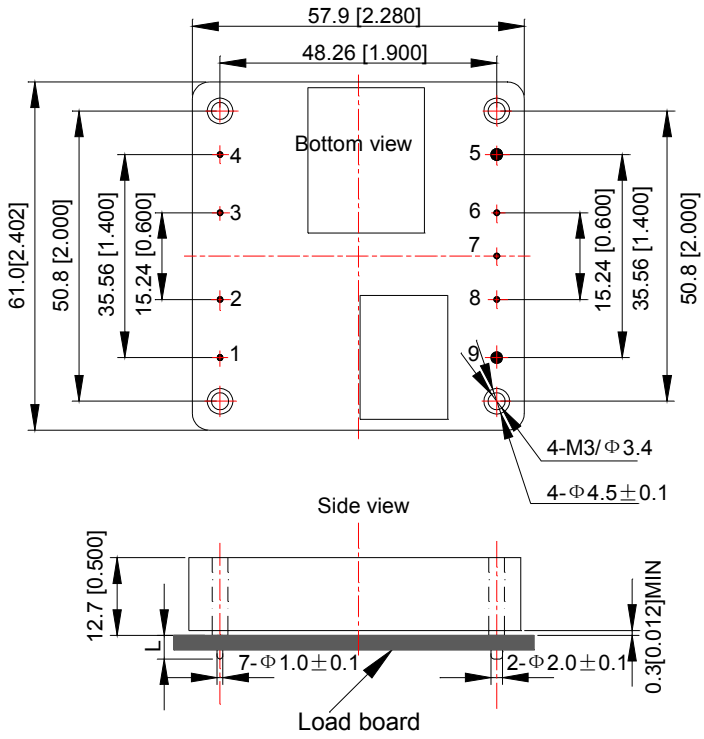


Figure 20 Output power derating, 48V_{in}, air flowing across the converter from V_{in}- to V_{in}+

Mechanical Diagram



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.]

Figure 21 Mechanical diagram

Pin length option

Device code suffix	L
-4	4.8mm±0.5mm
-6	3.8mm±0.5mm
-8	2.8mm±0.5mm
None	5.8mm±0.5mm

Pin Designations

Pin NO.	Name	Function
1	V_{in}+	Positive input voltage
2	Remote ON/OFF	Remote control
3	Case	
4	V_{in}-	Negative input voltage
5	V_o-	Negative output voltage
6	S-	Negative remote sense
7	Trim	Output voltage trim
8	S+	Positive remote sense
9	V_o+	Positive output voltage

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.

Ordering Information

AVE240C	-	48	S	12	P	-	4	L
①		②	③	④	⑤		⑥	⑦

①	Model series	AVQ: high efficiency quarter brick series, 100: output power 82.5W
②	Input voltage	36: 36V ~ 75V input range, rated input voltage 48V
③	Output number	S: single output
④	Rated output voltage	12: 12V output
⑤	Remote ON/OFF logic	Default: negative; P: positive logic
⑥	Pin length	-4: 4.8mm
⑦	RoHS status	L: RoHS, R6; Y: RoHS, R5

Model number	Description
AVE240C-48S12-4L	3.8mm pin length; negative on/off logic; without thread inside mounting hole; R6 compliant
AVE240C-48S12P-4L	3.8mm pin length; positive on/off logic; without thread inside mounting hole; R6 compliant
AVE240C-48S12-4Y	3.8mm pin length; negative on/off logic; with thread inside mounting hole; R5 compliant
AVE240C-48S12P-4Y	3.8mm pin length; positive on/off logic; with thread inside mounting hole; R5 compliant

Hazardous Substances Announcement (RoHS Of China)

Parts	Hazardous substances					
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
AVE240C-48S12-4L	○	○	○	○	○	○
AVE240C-48S12P-4L	○	○	○	○	○	○
AVE240C-48S12-4Y	×	○	○	○	○	○
AVE240C-48S12P-4Y	×	○	○	○	○	○

○: 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

Emerson Network Power Co., Ltd. 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