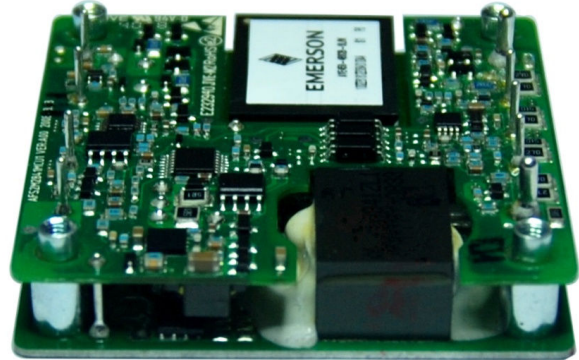


## Description

AVE450-48S32LD is a single output DC-DC converter with standard half-brick outline and pin configuration. It delivers up to 14A output current with 32V output voltage. Above 94.5% ultra-high efficiency and excellent thermal performance make it an ideal choice to supply power to a power amplifier in telecom and datacom. The aluminium baseplate structure makes it possible for the module to work under -40°C ~ +85°C without air cooling.



## Operational Features

- Delivering up to 14A output current
- Ultra-high efficiency 94.5% typ. at full load
- Wide input range: 38V ~ 75V
- Excellent thermal performance
- No minimum load requirement
- Fixed frequency operation
- RoHS 6 compliant

## Control Features

- Remote control function (negative or positive logic optional)
- Remote output sense
- Trim function: -50% ~ +3%

## 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
- With a baseplate
- Pin length option: 5.8mm

## Safety & EMC

- Meets basic insulation requirements of EN60950
- UL60950 recognized and certified to IEC/EN60950
- Meets 72/23/EEC and 93/68/EEC Directives which facilitates CE marking in user's end product
- All materials meet UL94, V-0 flammability rating
- Meets conducted emissions 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
<b>Absolute max. ratings</b>						
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		-0.3		15	V	
<b>Input characteristics</b>						
Operating input voltage range		38	48	75	V	When the input voltage is less than 38V, the output voltage may be less than 32V. Figure 13
Input under-voltage lockout	Turn-on voltage threshold	32	34	36	V	
	Turn-off voltage threshold	30	32	35	V	
	Lockout voltage hysteresis	1	1.5	2	V	
Max. input current				14	A	38V <sub>in</sub> , full load
No-load input current				0.2	A	
Standby input current			0.01	0.1	A	Remote OFF
Inrush current transient rating					A2s	
Input reflected ripple current			50	600	mA	Through 12μH inductor, see <i>Application Note</i>
Recommended input fuse				20	A	External fast blow fuse is recommended; Figure 11
Input filter component values (C/L)			10\0.7		μF\μH	Internal values
Recommended external input capacitance			470		μF	Low ESR capacitor is recommended; Figure 11
<b>Output characteristics</b>						
Output voltage set point (standard option)		31.68	32	32.32	V	48V <sub>in</sub> , full load, 25°C
Output voltage line regulation			0.05	0.2	%	
			16	64	mV	

Parameter		Min.	Typ.	Max.	Unit	Notes & conditions
Output voltage load regulation			0.1	0.5	%	
			32	160	mV	
Output voltage temperature regulation			6.4		mV/°C	
Total output voltage range		31.04	32.00	32.92	V	Over sample, line, load, temperature & life
Output voltage ripple and noise			100	200	mVpp	20MHz bandwidth; Figure 16
Operating output current rang		0		14	A	
Output DC current-limit inception		16.8		22	A	First foldback then hiccup; Figure 10
Output capacitance		680	1000	4400	μF	High frequency and low ESR capacitor are recommended
<b>Dynamic characteristics</b>						
Dynamic response	50% ~ 75% ~ 50% I <sub>o,max</sub> , 0.1A/μs		200	500	mV	25°C, nominal input voltage; Figure 11
	Settling time		60	500	μs	Recovery to within 1% V <sub>o,nom</sub>
Turn-on transient	Rise time		50	100	ms	Figure 6
	Turn-on delay time		50	100	ms	
	Output voltage overshoot		0	5	%Vo	
<b>Efficiency</b>						
100% load			94.5		%	Figure 1
50% load			94.5		%	Figure 1

## Electrical Characteristics (Continued)

Parameter	Min.	Typ.	Max.	Unit	Notes & conditions
<b>Isolation characteristics</b>					
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
<b>Feature characteristics</b>					
Switching frequency	260	290	320	kHz	
Remote ON/OFF control (positive logic)	Off-state voltage	-0.3	0.8	V	Figure 8 and Figure 9
	On-state voltage	2.0	15	V	
Remote ON/OFF control (negative logic)	Off-state voltage	2.0	15	V	
	On-state voltage	-0.3	0.8	V	
Output voltage trim range	14		33	V	See <i>Trim Characteristics of Application Note</i>
Output voltage remote sense range			0.5	V	
Output over-voltage protection	110	114	131	%V <sub>o,nom</sub>	Auto recovery
Over-temperature shutdown	100	110	120	°C	Auto recovery; Test point: Figure 19
Over-temperature hysteresis		10		°C	
<b>Reliability characteristics</b>					
Calculated MTBF (telcordia )		2.8		10 <sup>6</sup> h	Telcordia SR-332-2006; 80% load, 300LFM, 40°C Ta

Caution: External output capacitor must be present for normal operation

## Qualification Testing

Parameter	Unit (pcs)	Test condition
Halt test	4 ~ 5	Ta,min-10°C to Ta, max+10°C, 5°C step, Vin = min to max, 0 ~ 105% load
Vibration	3	Frequency range: 5Hz ~ 20Hz, 20Hz ~ 200Hz, A.S.D: 1.0m2/s3, -3db/oct, axes of vibration: X/Y/Z Time: 30 min/axis
Mechanical shock	3	30g, 6ms, 3 axes, 6 directions, 3 time/direction
Thermal shock	3	-40°C to +100°C, unit temperature 20 cycles
Thermal cycling	3	-40°C to +55°C, temperature change rate: 1°C/min, cycles: 2 cycles
Humidity	3	40°C, 95%RH, 48h
Solder ability	15	IPC J-STD-002C-2007

## Characteristic Curves

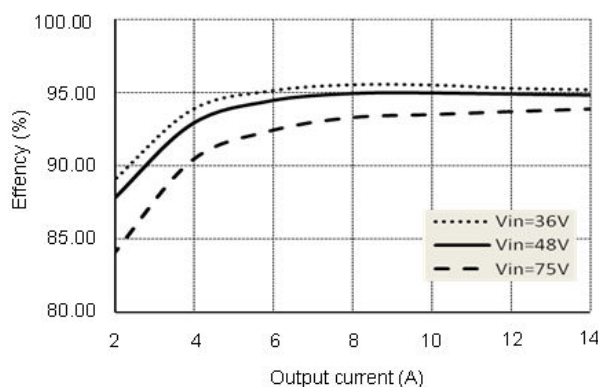


Figure 1 Efficiency vs. output current, Ta = 25°C, Vo = 32V

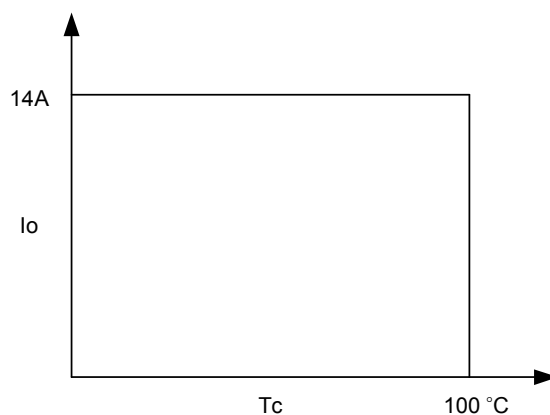


Figure 2 Output power derating

Tc: temperature test point on baseplate, see Figure 19 for test configuration

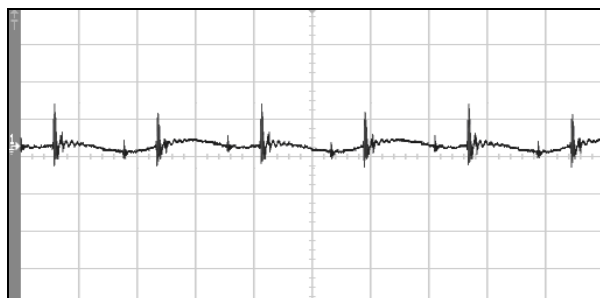


Figure 3 Output ripple & noise (2 $\mu$ s/div, 50mV/div), see Figure 16 for test configuration

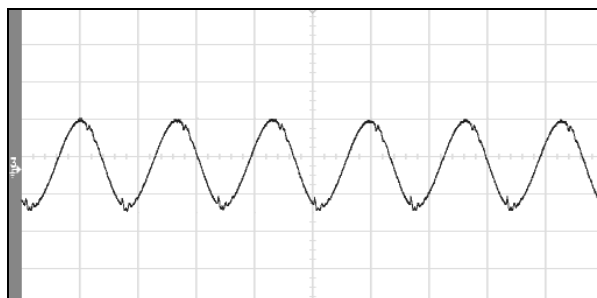


Figure 4 Input reflected ripple current (2 $\mu$ s/div, 25mA/div), see Figure 16 for test configuration

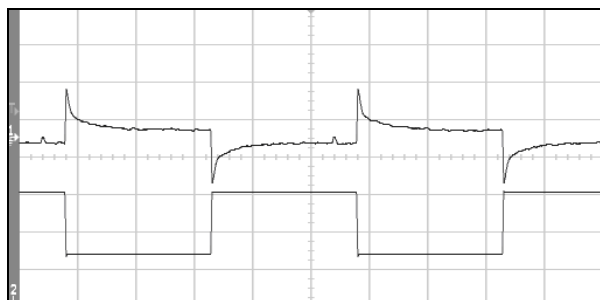


Figure 5 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 0.1A/ $\mu$ s slew rate, (2ms/div), see Figure 11 for test configuration; CH1-output voltage (200mV/div); CH2-output current (5A/div)

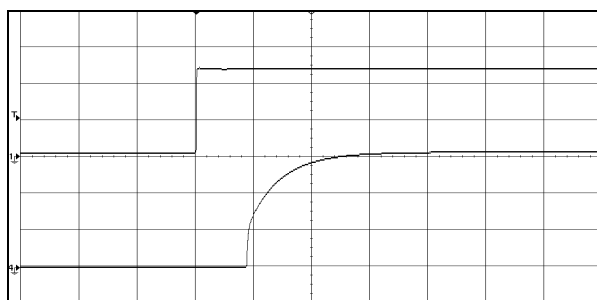


Figure 6 Output voltage startup by power-on, (50ms/div), see Figure 11 for test configuration; CH1-input voltage (20V/div); CH4-output voltage (10V/div)

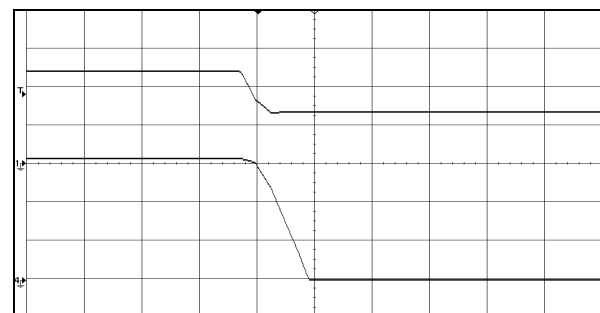


Figure 7 Output voltage shut down by power-off, (5ms/div), see Figure 11 for test configuration; CH1-input voltage (20V/div); CH4-output voltage (10V/div)

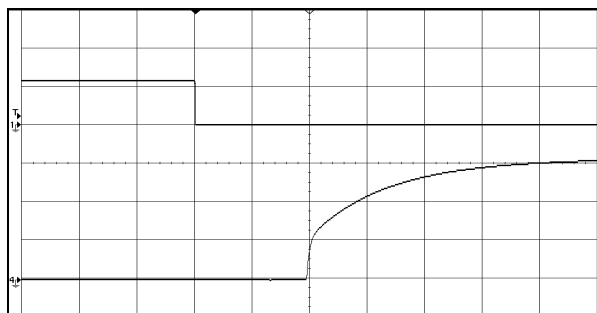


Figure 8 Output voltage startup by remote ON, (20ms/div), see Figure 11 for test configuration; CH1-remote ON (5V/div); CH4-output voltage (10V/div)

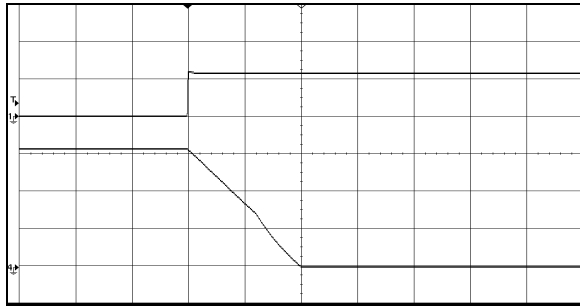


Figure 9 Output voltage shutdown by remote OFF, (2ms/div), see Figure 11 for test configuration; CH1-remote OFF voltage (5V/div); CH4-output voltage (10V/div)

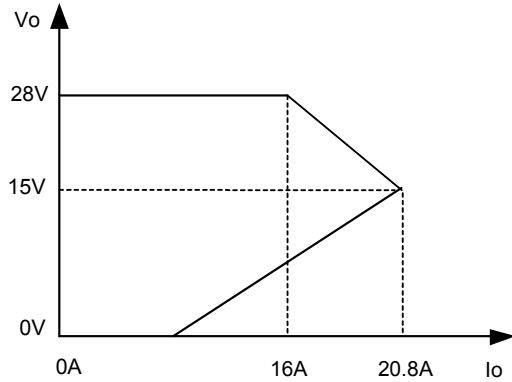


Figure 10 Over-current protection characteristics (for reference only)

## Application Note

### Typical Application

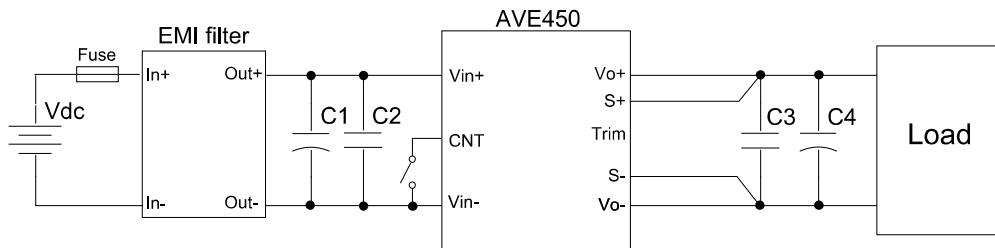


Figure 11 Typical application

C1: 470μF/100V electrolytic capacitor, P/N: UPW2A471MHD (Nichicon) or equivalent

C2, C3: 1μF/100VX7R ceramic capacitor, P/N: C3225X7R2A105KT0L0U (TDK) or equivalent

C4: 680μF electrolytic capacitor, P/N: UUD1H681MNL1GS (Nichicon) or equivalent

Fuse: 20A fast blow fuse. P/N: 0324020 MXP (LITTLEFUSE)

Double minimum input/output capacitance is necessary for normal operation and performance in case of  $T_a < 0^\circ\text{C}$ .

## Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AVE450-48S32LD. The logic is CMOS and TTL compatible.

Below is the detailed internal circuit and reference in AVE450-48S32LD.

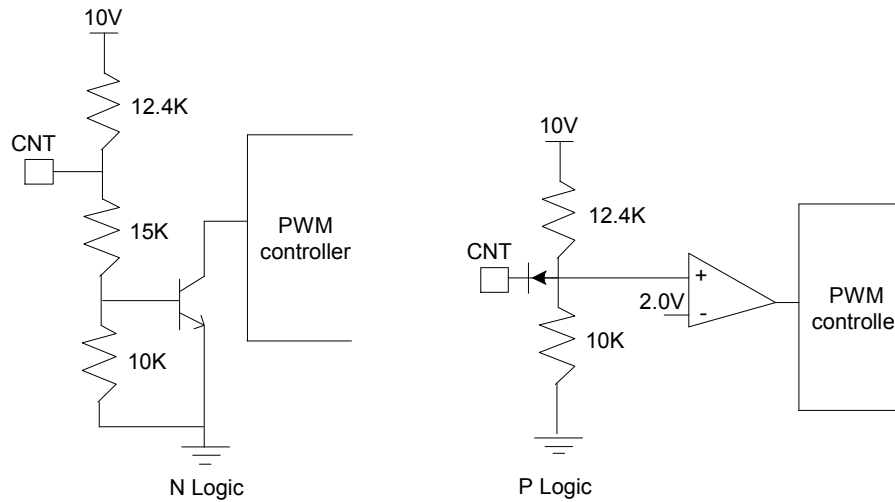


Figure 12 Remote ON/OFF internal diagram

## 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.

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

$$R_{adj\_up} = \left( \frac{V_o(100\% + \Delta\%)}{1.225 \times \Delta\%} - \frac{100\% + 2 \times \Delta\%}{\Delta\%} \right) k\Omega$$

$\Delta\%$  : Output voltage rate against nominal output voltage.

$V_{norm}$  : Nominal output voltage.

For example, to get 33V output, the trimming resistor is:

$$R_{adj\_up} = \left( \frac{33}{1.225 \times (33 - 32) / 32} - \frac{100\% + 2 \times (33 - 32) / 32}{(33 - 32) / 32} \right) = 827.8k\Omega$$

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

$$V_o = (V_{trim} + 1.225) \times 13.07$$

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

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 the following figure.



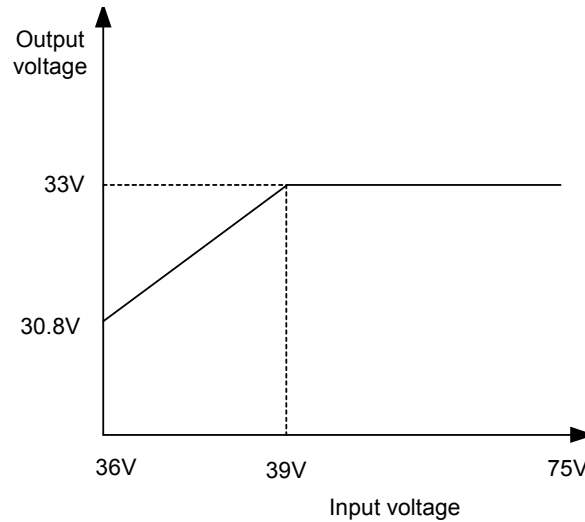


Figure 13 Maximum adjustable output voltage vs. input voltage

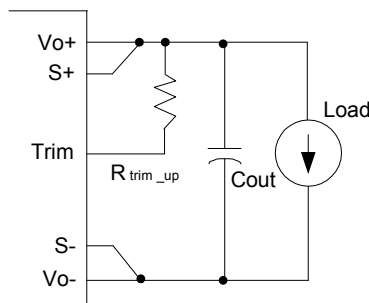


Figure 14 Trim up

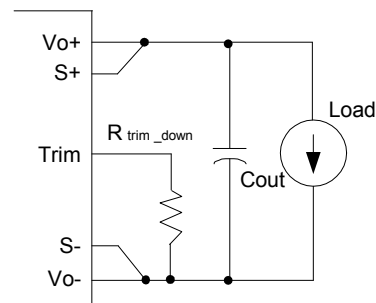


Figure 15 Trim down

### Sense Characteristics

If the load is far from the unit, connect S+ and S- to the terminals of the load respectively to compensate the voltage drop on the transmission line. See Figure 11.

If the sense compensation function is not necessary, short S+ to Vo+ and S- to Vo- respectively.

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

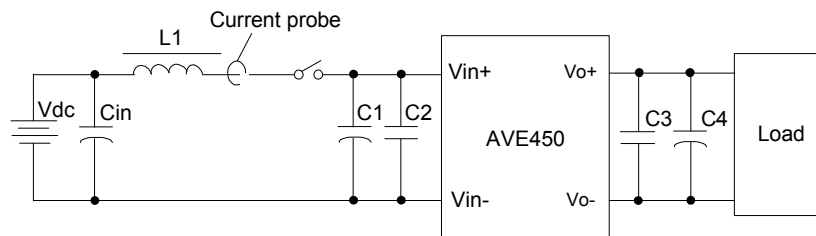


Figure 16 Inrush current, input and output ripple & noise test configuration

Vdc: DC power supply.

L1: 12μH inductor.

Cin: 220μF/100V electrolytic capacitor.

C1 ~ C4: See Figure 11.

Note: It is recommended to use a coaxial cable with 50Ω resistor and 0.68μF ceramic capacitor or a ground ring of probe to test output ripple & noise.

### EMC Filter Configuration

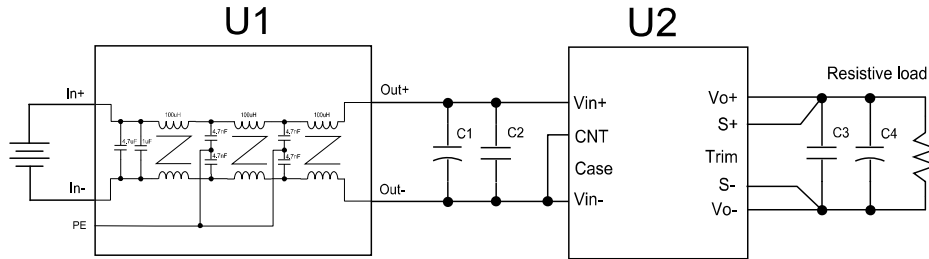


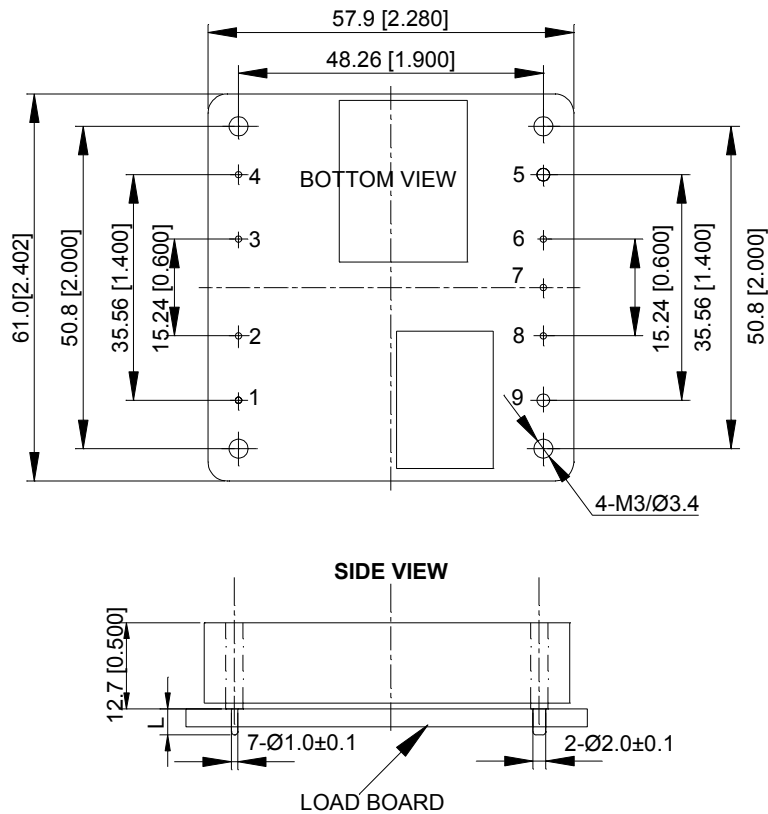
Figure 17 EMC test configuration

U1: 20A input EMC filter module (P/N: FM100-20)

U2: Module to test, AVE450-48S32LD

C1 ~ C4: See Figure 11

### 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 18 Mechanical diagram

## Pin Length Option

Device code suffix	L
-4	4.8mm ± 0.2mm
-6	3.8mm ± 0.2mm
-8	2.8mm ± 0.2mm
None	5.8mm ± 0.2mm

## Pin Designations

Pin No.	Name	Function
1	Vin+	Positive input voltage
2	CNT	Remote ON/OFF control
3	Case	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

## 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 manual soldering is used, 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.

Cleaning of solder joint can be performed with cleaning solvent IPA or similitive.

### Thermal Considerations

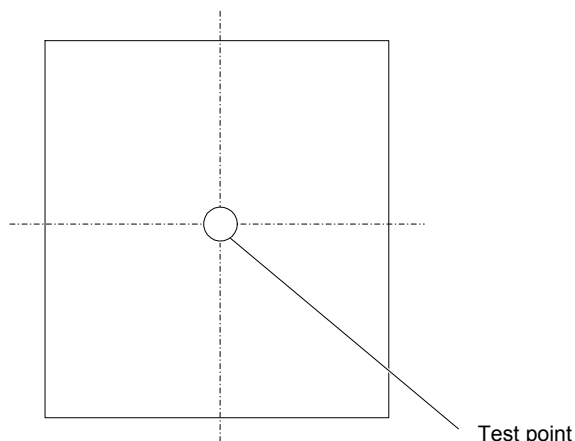


Figure 19 Temperature test point on baseplate

### Ordering Information

<b>AVE450</b>	<b>-</b>	<b>48</b>	<b>S</b>	<b>32</b>	<b>P</b>	<b>-</b>	<b>6</b>	<b>L</b>	<b>/</b>	<b>M</b>
①		②	③	④	⑤		⑥	⑦		⑧

①	Model series	AVE: high efficiency half-brick series; 450: output power 450W
②	Input voltage	48: 38V ~ 75V input range, rated input voltage 48V
③	Number of outputs	S: single output
④	Rated output voltage	32: 32V output
⑤	Remote ON/OFF logic	Default: negative; P: positive logic
⑥	Pin length	-6: 3.8mm
⑦	RoHS status	L: RoHS, R6
⑧	Structure	Default: non-threaded mounting hole; M: threaded mounting hole

Model number	Description
AVE450-48S32LD	5.8mm pin length; negative on/off logic; threaded mounting hole; R6 compliant

## Hazardous Substances Announcement (RoHS of China)

Parts	Hardarzous substances					
	Pb	Hg	Cd	Cr <sup>6+</sup>	PBB	PBDE
AVE450-48S32LD	○	○	○	○	○	○
<p>○: 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</p> <p>√: 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</p> <p>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:</p> <ol style="list-style-type: none"> <li>1. Solders (including high-temperature solder in parts) contain plumbum.</li> <li>2. Glass of electric parts contains plumbum.</li> <li>3. Copper alloy of pins contains plumbum</li> </ol>						