48Vdc Input, 28Vdc,5.5Vdc Dual Output Half-brick DC-DC Converter AVE450-48D2805

Description

AVE450-48D2805 is a dual output DC-DC converter with half-brick outline. It delivers up to 12A output current with 28V output voltage and 20A with 5.5V output voltage. Above 92% ultra-high efficiency and excellent thermal performance makes 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 16A output current for 28V or 12A for 28V and 20A for 5.5V
- Ultra-high efficiency 92% typ. with both full load
- Wide input range: 36V ~ 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: 14V ~ 33V for 28V output and 4.5V~12V for 5.5V output

Protection Features

- Input under voltage lockout
- Output over current protection
- Output over voltage protection
- Over temperature protection
- Power good for 28V output

Mechanical Features

- With baseplate
- Pin length option: 3.8mm, 4.8mm, 5.8mm

Safety & EMC

- Meets latest safety standards UL 60950-1, CSA-C22.2 NO.60950-1, IEC/EN 60950-1 and GB4943.
- Approved by UL and TUV.
- Meets 2006/95/EEC and 93/68/EEC directives which facilitates CE marking in user's end product
- Material meets UL 94 V-0.
- Meets conducted emissions requirements of FCC Class B and EN55022 Class B 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		-0.3		12	V	
Input characteristics						
Operating input voltage range		36	48	75	V	
Input under-voltage lockout	Turn-on voltage threshold	33	35	36	V	
	Turn-off voltage threshold	31	33	35	V	
	Lockout voltage hysteresis	1	2		V	
Max. input current				14	A	36Vin, 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			100	300	mA	Through 12μH inductor; See application note
Recommended input fuse				20	A	Fast blow external fuse recommended; Figure 13
Input filter component values (C\L)			10\0.7		μF\μH	Internal values
Recommended external input capacitance			470		μF	Low ESR capacitor recommended; Figure 13
Output characteristics						
Output voltage set point (standard option)		27.72	28	28.28	V	48Vin, full load, 25°C
		5.44	5.5	5.56	V	48Vin, full load, 25°C
Output voltage line regulation			0.1	0.5	%	Either 28V or 5.5V

Parameter		Min.	Typ.	Max.	Unit	Notes & Conditions
Output voltage load regulation			0.3	0.5	%	For 28V output
			0.5	1	%	For 5.5V output
Output voltage temperature regulation				5.6	mV/°C	Either 28V or 5.5V
Total output voltage range		27.16	28	28.84	V	Over sample, line, load, temperature & life
		5.33	5.5	5.67		
Output voltage ripple and noise			150	300	mVpp	For 28V output. 20MHz bandwidth; see Figure 20
			50	100	mVpp	For 5.5V output.20MHz bandwidth; see Figure 20
Operating output current range		0		16*	A	For 28V. See*Trim Characteristics* of *Application Note*
		0		20	A	For 5.5V.See*Trim Characteristics* of *Application Note*
Output DC current-limit inception		16.5		22.5	A	For 28V output without load at 5.5V,First foldback then hiccup. see Figure 11.
		105			%	For 5.5V output,Hiccup mode. No load at 28V.
Output capacitance		680	1000	4400	μF	For 28V output; High frequency and low ESR capacitor is recommended.
		330	680	4400	μF	For 5.5V output; High frequency and low ESR capacitor is recommended.
Dynamic characteristics						
Dynamic response	50% ~ 75% ~ 50% $I_{o,max}$, 0.1A/μs		200	840	mV	for 28V output. 25°C, nominal input voltage, see Figure 5
			100	250	mV	for 5.5V output. 25°C, nominal input voltage, see Figure 6
	Settling time		60	500	μs	Recovery to within 1% $V_{o,nom}$
Turn-on transient	Rise time		50	100	ms	for 28V output. Figure 7
			10	30	ms	for 5.5V output .Figure 7
	Turn-on delay time		50	150	ms	both 28V and 5.5V
	Output voltage overshoot		0	5	$\%V_o$	

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Efficiency					
16A for 28V; 0A for 5.5V		94		%	Figure 1
8A for 28V; 0A for 5.5V		94.5		%	Figure 1
12A for 28V; 20A for 5.5V		92		%	Figure 2
6A for 28V; 10A for 5.5V		93		%	Figure 2

Note: The 28V output can deliver 16A only with no load at 5.5V output. If 5.5V output is with full load (20A), the load at the 28V output should be reduced to 12A to make sure the total output power is below 450W.

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	Fucntion insulation, pollution degree 2, output to baseplate
Feature characteristics						
Switching frequency		220	250	280	kHz	
Remote ON/OFF control (positive logic)	Off-state voltage	-0.3		0.8	V	See Figure 14
	On-state voltage	2.4		12	V	
Remote ON/OFF control (negative logic)	Off-state voltage	2.4		12	V	
	On-State Voltage	-0.3		0.8	V	
Output voltage trim range		14		33	V	28V output. See*Trim Characteristics* of *Application Note*
		4.5		12	V	5.5V output. See*Trim Characteristics* of *Application Note*
Output voltage remote sense range				0.5	V	For both outputs
Output over-voltage protection		35	37	40	V	28V only. Latch off. Reset by power on or remote on
Over-temperature shutdown		105	115	130	°C	Auto recovery; Test point: see Figure 22
Over-temperature hysteresis			5		°C	
Reliability characteristics						
Calculated MTBF (telcordia)			2.8		10^6h	Telcordia SR-332-2006; 80% load, 300LFM, 40°C T_a

Caution: External output capacitor must be present for normal operation

Electromagnetic compatibility requirements

Test Item	Regulations	Criteria	Notes & Conditions
Conducted Emission	EN 55022 DC input port, Class B Limits	N/A	See *EMC test conditions*
Immunity to Electrostatic Discharge	IEC/EN61000-4-2 Enclosure Port, Level 3 ±6kV Contact	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 to 100°C, unit temperature 20cycles
Thermal cycling	3	-40°C to 55°C, temperature change rate: 1°C/min, cycles: 2cycles
Humidity	3	40°C, 95%RH, 48h
Solder ability	15	IPC J-STD-002C-2007

Characteristic Curves

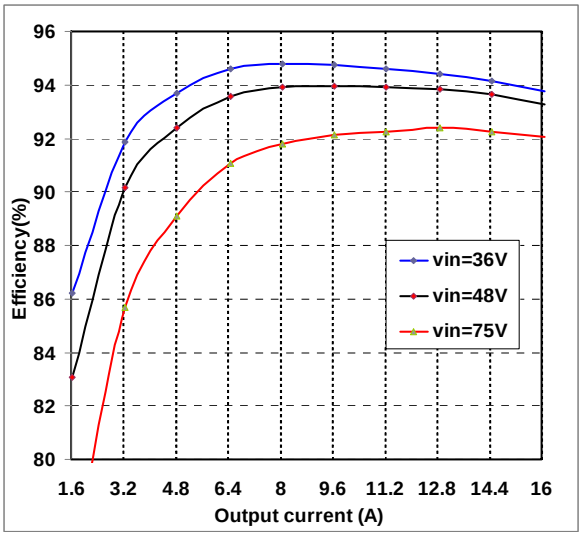


Figure 1 Efficiency vs. output current, no load at 5.5V

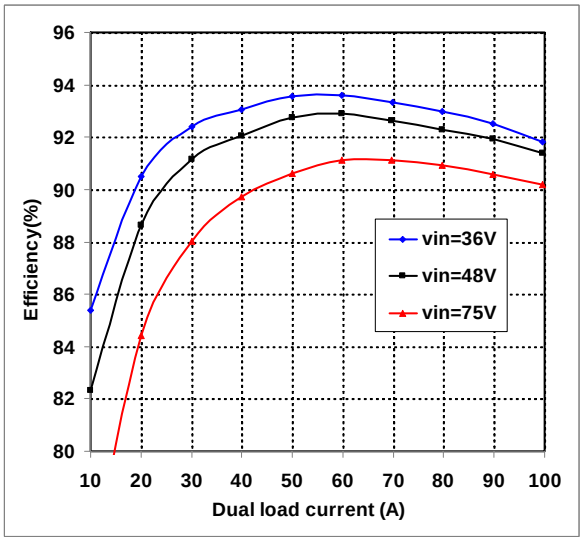


Figure 2 Efficiency vs. output current, both load

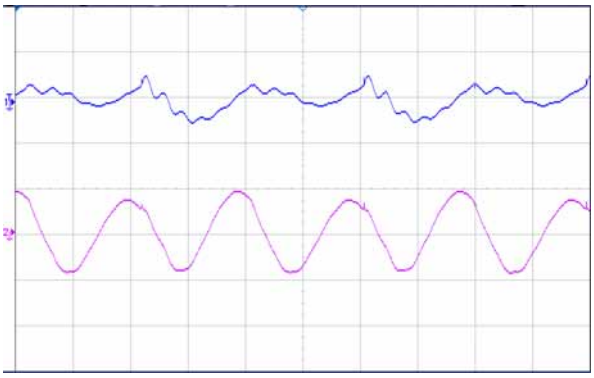


Figure 3 Output ripple & noise (2μs/div), see Figure 20 for test configuration; CH1- 28V output (500mV/div); CH2-5.5V output (20mV/div)

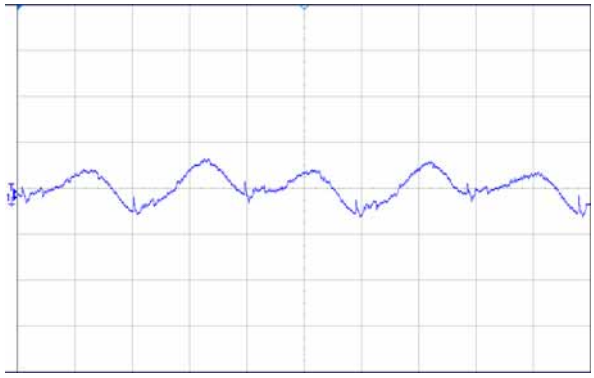


Figure 4 Input reflected ripple current (2μs/div , 20mA/div), see Figure 20 for test configuration

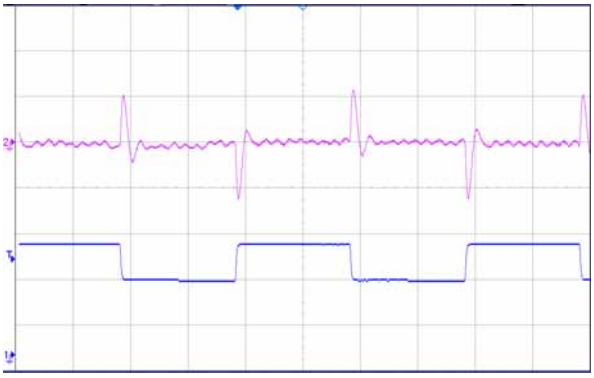


Figure 5 28V Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 0.1A/μs slew rate, (1ms/div), see Figure 13 for test configuration; CH1-output current (5A/div); CH2-output Voltage (100mV/div)

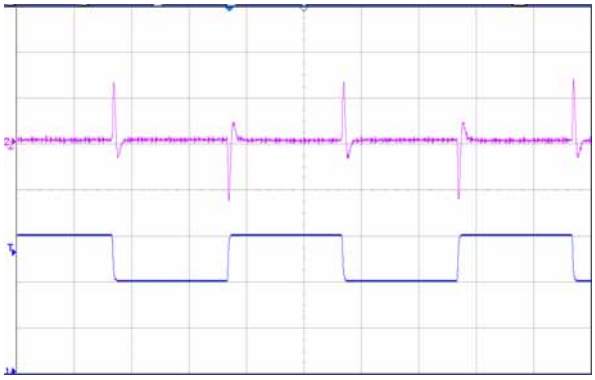


Figure 6 5.5V Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 0.1A/μs slew rate, (1ms/div), see Figure 13 for test configuration; CH1-output current (5A/div); CH2-output Voltage (50mV/div)

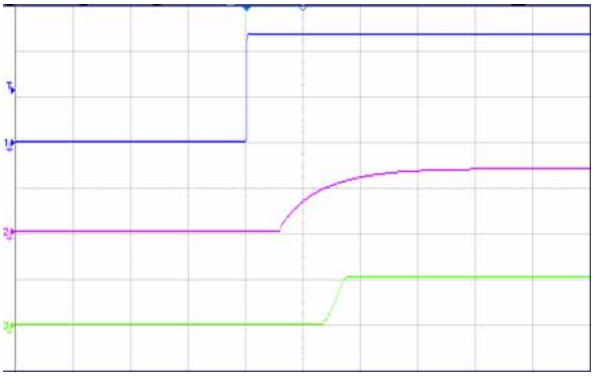


Figure 7 Output voltage startup by power on, (50ms/div), see Figure 13 for test configuration; CH1-input voltage (20V/div); CH2-28V output voltage (20V/div); CH3-5.5V output voltage (5V/div)

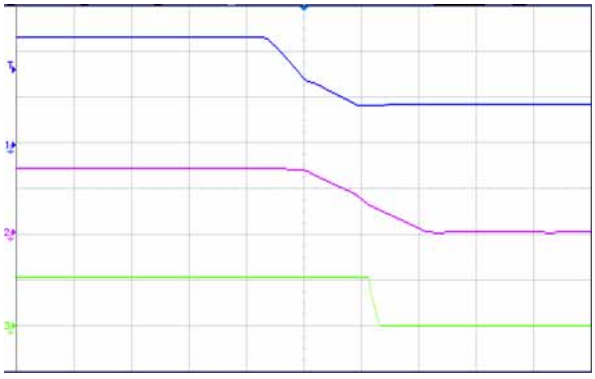


Figure 8 Output voltage shut down by power off, (1ms/div), see Figure 13 for test configuration; CH1-input voltage (20V/div); CH2-output voltage (20V/div); CH3-5.5V output voltage (5V/div)

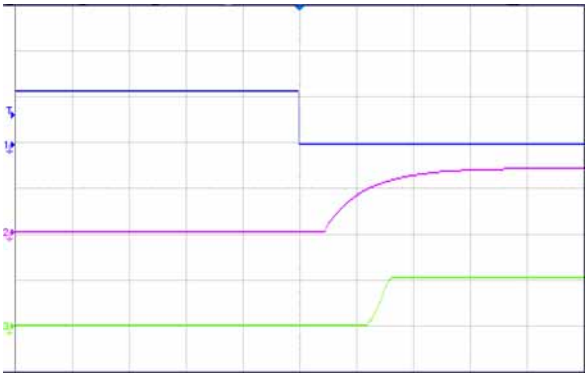


Figure 9 Output voltage startup by remote ON, (50ms/div), see Figure 13 for test configuration; CH1-remote ON (5V/div); CH2- output voltage (20V/div); CH3-5.5V output voltage (5V/div)

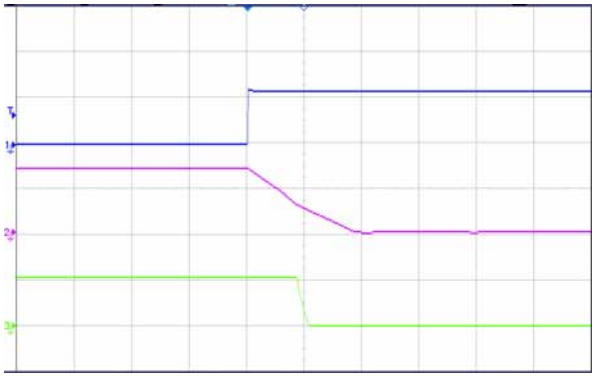


Figure 10 Output voltage shutdown by remote OFF, (1ms/div), see Figure 13 for test configuration; CH1-remote OFF voltage (5V/div); CH2-output voltage (20V/div); CH3-5.5V output voltage(5V/div)

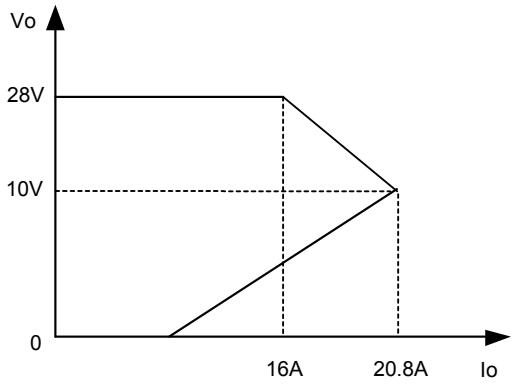


Figure 11 28V Over-current protection characteristics. For reference only

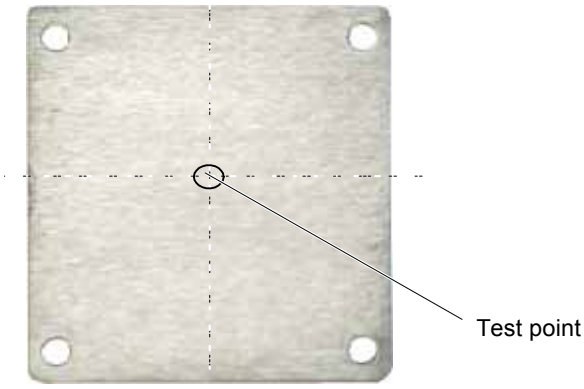


Figure 12 Temperature test points

Application Note

Typical Application

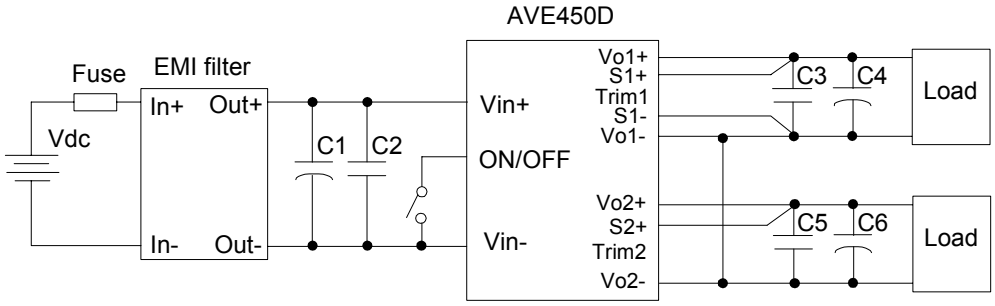


Figure 13 Typical application

C1: 470μF/100V electrolytic capacitor, P/N: UVZ2A471MPD (Nichicon) or equivalent
C2, C3,C5: 1μF/100V X7R ceramic capacitor, P/N: C3225X7R2A105KT0L0U (TDK) or equivalent
C4:1000uF electrolytic capacitor, P/N: UPM1H102MHD(Nichicon) or equivalent
C6: 680μF electrolytic capacitor, P/N: UPM1E681MHD (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 Ta<0°C.

Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AVE450-48D2805. The logic is CMOS and TTL compatible.
Below is the detailed internal circuit and reference in AVE450-48D2805.

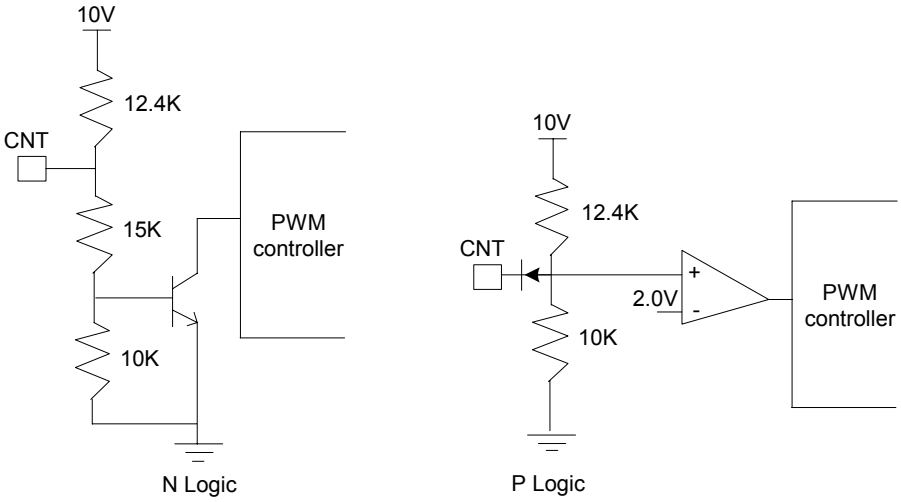


Figure 14 Remote ON/OFF internal diagram

Trim Characteristics

28V:

Connecting an external resistor between Trim1 pin and V_o1- pin will decrease the output voltage. While connecting it between Trim and V_o1+ will increase the 28V output voltage. The following equations determine the external resistance to obtain the trimmed output voltage.

$$R_{adj\_down} = \left(\frac{5.11}{\Delta\%} - 10.22 \right) k\Omega$$

$$R_{adj\_up} = \left(\frac{4.12V_o - 5.11}{\Delta\%} - 10.22 \right) k\Omega$$

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

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

$$R_{adj\_up} = \left(\frac{33 \times 4.12 - 5.11}{(33-28)/28} - 10.22 \right) = 722k\Omega$$

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

$$V_o = (V_{trim} + 1.24) \times 11.29$$

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 rated output power 450W, when trimming down, the rated output power of this module is

$$V_{o1} \times I_{o1} + V_{o2} \times I_{o2} \le V_{o1} \times 16\,\mathrm{W}$$

Vo1: the desired output voltage.

For example, if trimming down to 20V, the rated power is 320W.

The minimum input voltage should be increased as shown in the following figure.

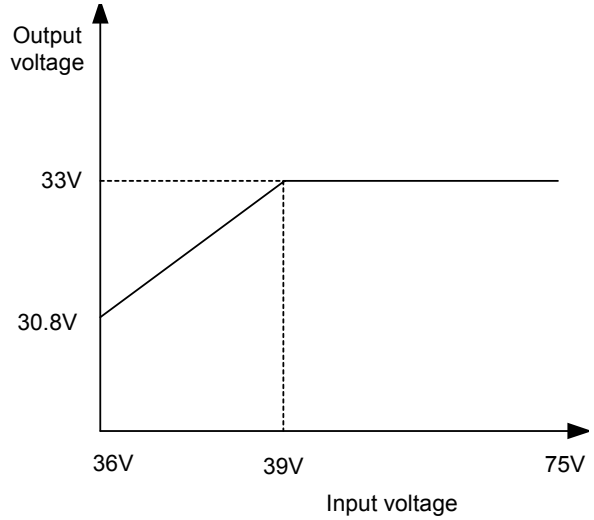


Figure 15 Max. adjustable output voltage vs. input voltage

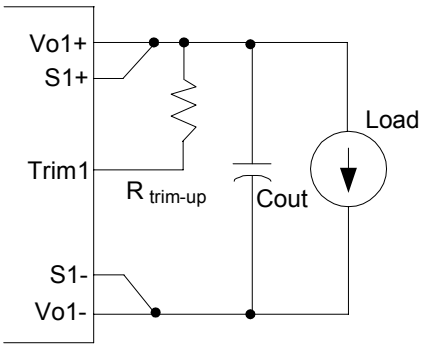


Figure 16 Trim up (28V)

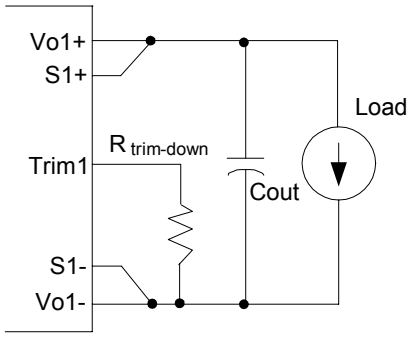


Figure 17 Trim down(28V)

5. 5V:

Connecting an external resistor between Trim2 pin and V_o2- pin will increase the output voltage. While connecting it between Trim and V_o2+ will decrease the output voltage. The following equations determine the external resistance to obtain the trimmed output voltage.

$$R_{adj\_down} = \left(\frac{69.3}{\Delta V_o} - 15.44 \right) k\Omega$$

$$R_{adj\_up} = \left(\frac{10.1}{\Delta V_o} - 1 \right) k\Omega$$

ΔV_o : Deference between output voltage and nominal output voltage.

For example, to get 12V output voltage, the trimming resistor is

$$R_{adj\_up} = \left(\frac{10.1}{12 - 5.5} - 1 \right) k\Omega = 0.55 k\Omega$$

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

$$\Delta V_o = (V_{trim} - 0.7) \times 14.44$$

Where V_{trim} is the potential that applied at the Trim pin, and ΔV_o is the desired output voltage which minus the nominal output voltage.

When trimming up, the output current should be decreased accordingly so as not to exceed the rated output power 110W.

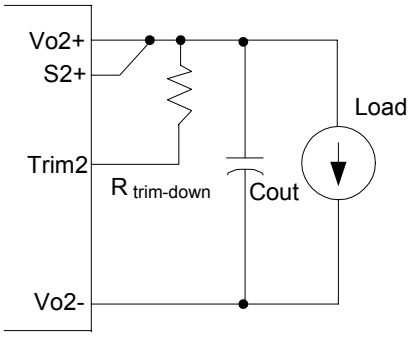


Figure 18 Trim down (5.5V)

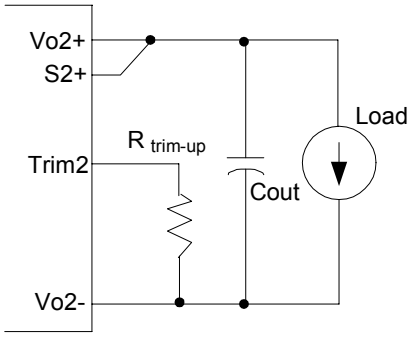


Figure 19 Trim up(5.5V)

When 28v rail trims down and 5.5V rail trims up, we must keep 7V voltage difference between 28V rail and 5.5V rail.

For example, if 28V rail trims down to 15V, the 5.5V rail's trim-up-able limitation value is 8V.

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, short S+ to V_o+ and S- to V_o- respectively.

Inrush Current, Input and Output Ripple&Noise Test Configuration

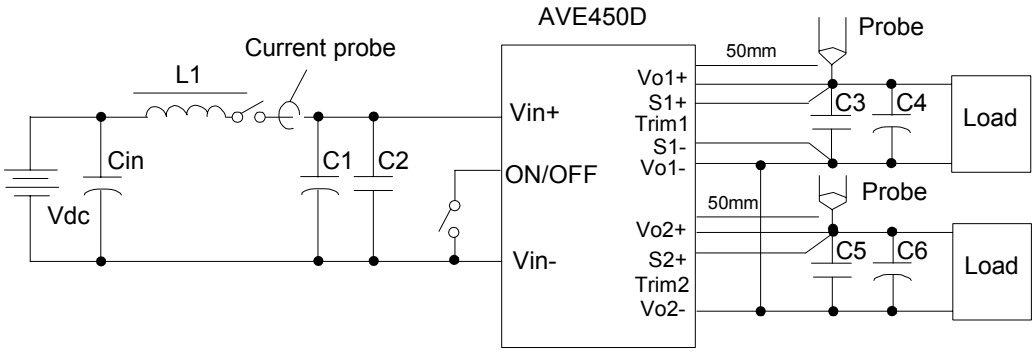


Figure 20 Inrush current, input and output ripple&noise test configuration

Vdc: DC power supply.

L1: 12μH inductor.

Cin: 220μF/100V electrolytic capacitor.

C1 ~ C4: See Figure 13.

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

EMC Filter Configuration

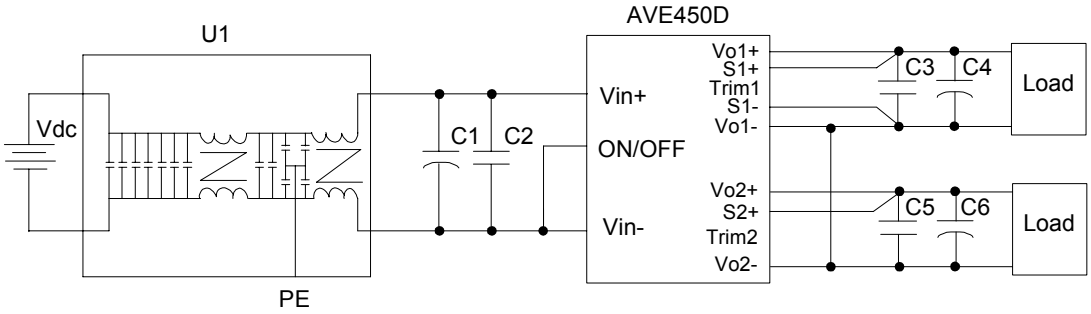


Figure 21 EMC test configuration

U1: 20A input EMC filter

C1 ~ C4: See Figure 13

Thermal Considerations

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 Table 1. The baseplate temperature test points' location is shown in Figure 22. Figure 23 shows the derating output current vs. baseplate temperature.

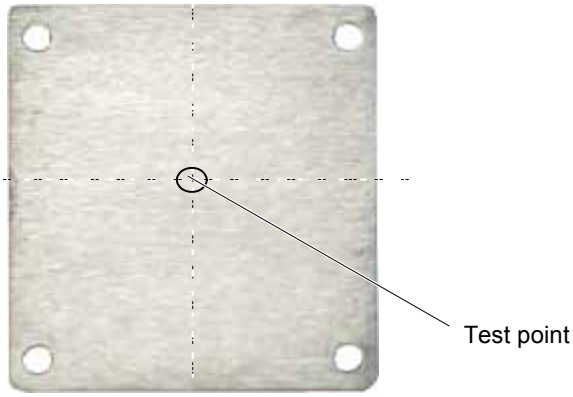


Figure 22 Temperature test point on baseplate

Table 1 Temperature limit of the test points

Test Point	Temperature limit
Test point on baseplate	105°C

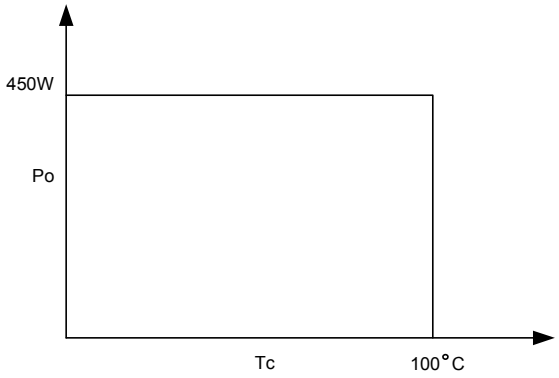
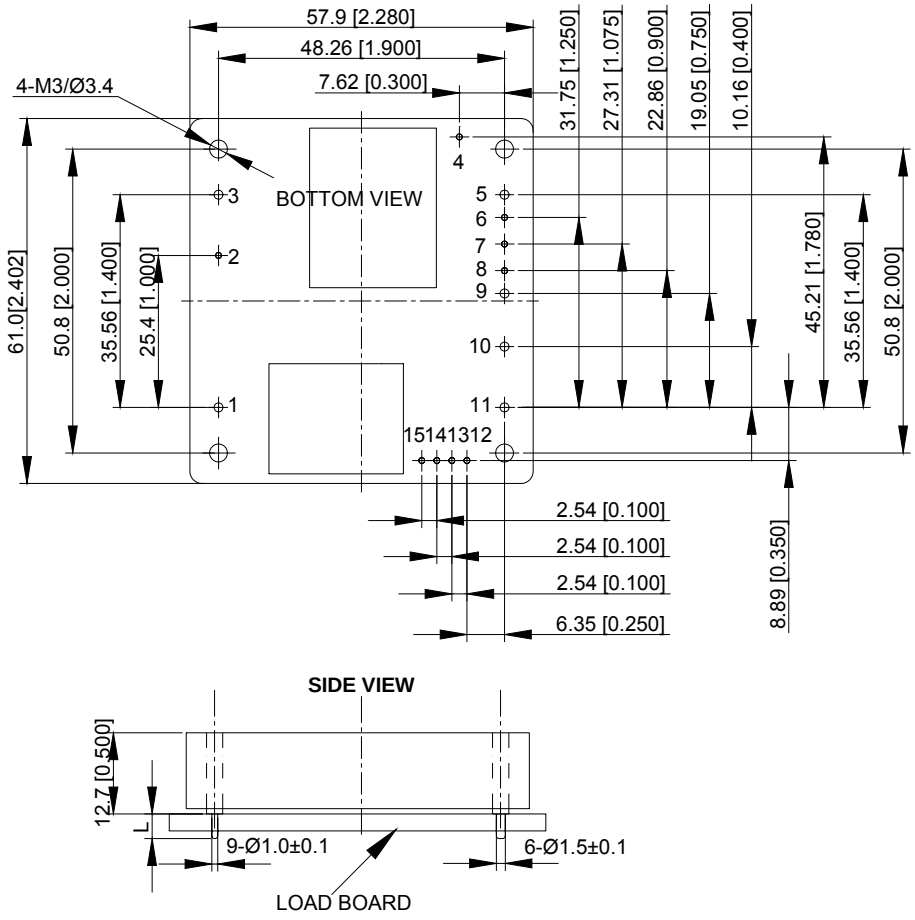


Figure 23 Output power derating,

Tc: temperature test point on baseplate, see Figure 22 for test configuration

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 24 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.	Pin Name	Pin Description
1	Vin+	Positive input voltage
2	ON/OFF	Remote control
3	Vin-	Negative input voltage
4	Case	Pin connected to baseplate
5	Vo1-	Negative output voltage(28V)
6	S1-	Negative sense(28V)
7	Trim1	Output voltage trim (28V)
8	S1+	Positive sense(28V)
9	Vo1+	Positive output voltage(28V)
10	Vo2-	Negative output voltage(5.5V)
11	Vo2+	Positive output voltage(5.5V)
12	S2+	Positive sense(5.5V)
13	NC	Not connected
14	Trim2	Output voltage trim (5.5V)
15	PG	Power good(28V)

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.

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

Ordering Information

AVE450	-	48	D	2805	P	-	6	L	/	M
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: 36V ~ 75V input range, rated input voltage 48V
③	Number of outputs	D: dual outputs
④	Rated output voltage	2805: 28V output and 5.5V 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
AVE450-48D2805-6L	3.8mm pin length; negative on/off logic; non-threaded mounting hole; R6 compliant
AVE450-48D2805P-6L	3.8mm pin length; positive on/off logic; non-threaded mounting hole; R6 compliant
AVE450-48D2805-6L/M	3.8mm pin length; negative on/off logic; threaded mounting hole; R6 compliant
AVE450-48D2805P-6L/M	3.8mm pin length; positive on/off logic; threaded mounting hole; R6 compliant

Hazardous Substances Announcement (RoHS of China)

Parts	Hardarzous Substances					
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
AVE450-48D2805	○	○	○	○	○	○

○: 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