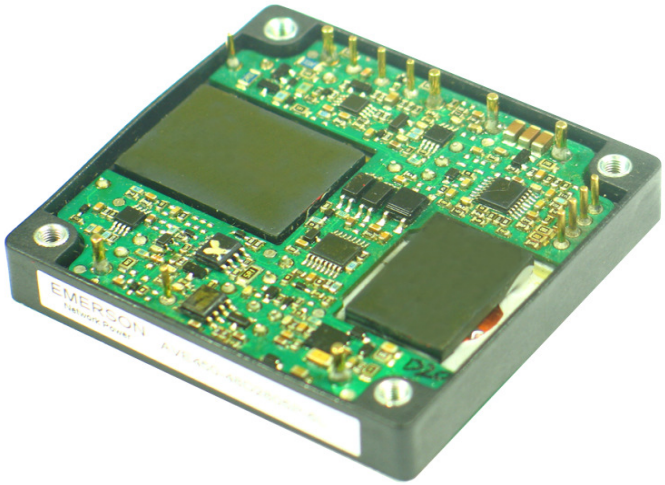
AVE450-48D2805

450 Watts

Half-brick Converter

Total Power: 450 Watts
Input Voltage: 36 to 75 Vdc
# of Outputs: Dual



Special 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
- Remote output sense
- Trim function: 14V ~ 33V for 28V output and 4.5V~12V for 5.5V output
- Input under voltage lockout
- Output over current protection
- Output over voltage protection
- Over temperature protection
- Power good for 28V output
- With baseplate
- Remote control logic optional
- Pin length optional

Safety

UL/CSA/IEC/EN 60950
GB4943
CE Mark
UL/TUV

Product Descriptions

The AVE450-48D2805 is a dual output DC/DC converter with half-brick form factor and pin configuration. It delivers up to 12A output current with 28V output and 20A with 5.5V output. Ultra-high 92% efficiency and excellent thermal performance makes it an ideal choice to supply power to a power amplifier in telecom and datacom, and can operate over an ambient temperature range of -40 ^{O}C ~ 85 ^{O}C.

Applications

Telecom/ Datacom

ARTESYN™
EMBEDDED TECHNOLOGIES

Model Number

Standard	Output Voltage		Structure	Remote ON/OFF logic	RoHS Status
	V1	V2			
AVE450-48D2805-6L	28Vdc	5.5Vdc	Baseplate	Negative	R6
AVE450-48D2805P-6L	28Vdc	5.5Vdc	Baseplate	Positive	R6
AVE450-48D2805-6L/M	28Vdc	5.5Vdc	Baseplate	Negative	R6
AVE450-48D2805P-6L/M	28Vdc	5.5Vdc	Baseplate	Positive	R6

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	Output number	D: dual outputs
④	Rated output voltage	2805: 28V output and 5.5V output
⑤	Remote ON/OFF logic	Default: negative logic; P: positive logic
⑥	Pin length	6: 3.8mm
⑦	RoHS status	L: RoHS, R6
⑧	Mounting hole	Default: non-threaded mounting hole; M: threaded mounting hole

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	All	$V_{IN,DC}$	-	-	80	Vdc
Non-operating -100mS	All		-	-	100	Vdc
Maximum Output Power	All	$P_{O,max}$	-	-	450	W
Isolation Voltage[1]						
Input to outputs			-	-	1500	Vdc
Input to baseplate	All		-	-	1500	Vdc
Outputs to baseplate			-	-	500	Vdc
Ambient Operating Temperature	All	T_A	-40	-	+85	^{O}C
Storage Temperature	All	T_{STG}	-55	-	+125	^{O}C
Voltage at remote ON/OFF pin	All		-0.3	-	12	Vdc

Note 1 - 1mA for 60s, slew rate of 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	$I_O = I_{O,max}$	$V_{IN,ON}$	33	35	36	Vdc
Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	31	33	35	Vdc
Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	2	-	V
Maximum Input Current ($I_O = I_{O,max}$)	$V_{IN,DC} = 36V_{DC}$	$I_{IN,max}$	-	-	14	A
No-load input current	All	$I_{IN,no-load}$	-	-	0.2	A
Standby input current	Remote off	$I_{IN,standby}$	-	0.01	0.1	A
Inrush current transient rating	All		-	-	-	A^2s
Recommended Input Fuse	Fast blow external fuse recommended		-	-	20	A
Input filter component values (C\L)	Internal values		-	10\0.7	-	µF\µH
Recommended External Input Capacitance	Low ESR capacitor recommended	C_{IN}	-	470	-	uF
Input Reflected Ripple Current	Through 12uH inductor		-	100	300	mA
Operating Efficiency	16A for 28V; 0A for 5.5V	η	-	94	-	%
	8A for 28V; 0A for 5.5V	η	-	94.5	-	%
	12A for 28V; 20A for 5.5V	η	-	92	-	%
	6A for 28V; 10A for 5.5V	η	-	93	-	%

Note 1 - Ta = 25 ^{O}C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.

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	27.72	28	28.28	Vdc
			5.44	5.5	5.56	Vdc
Output Voltage Line Regulation	Either 28V or 5.5V	%V_O	-	0.1	0.5	%
Output Voltage Load Regulation	28V output	%V_O	-	0.3	0.5	%
	5.5V output	%V_O		0.5	1	%
Output Voltage Temperature Regulation	Either 28V or 5.5V	V_O	-	-	5.6	mV/^{O}C
Total output voltage range (Over sample, line, load, temperature & life)	28V output	V_O	27.16	28	28.84	V
	5.5V output	V_O	5.33	5.5	5.67	V
Output Voltage Trim Range	28V output	V_O	14	-	33	V
	5.5V output	V_O	4.5	-	12	V
Output Ripple, pk-pk	28V output, 20MHz bandwidth	V_O	-	150	300	mV_{PK-PK}
	5.5V output, 20MHz bandwidth	V_O	-	50	100	mV_{PK-PK}
Output Current	28V output[2]	I_O	0	-	16	A
	5.5V output	I_O	0	-	20	A
Output DC current-limit inception[3]	28V output	I_O	16.5	-	22.5	A
	5.5V output	I_O	105	-	-	%
V_O Load Capacitance[4]	28V output	C_O	680	1000	4400	uF
	5.5V output	C_O	330	680	4400	uF
V_O Dynamic Response Peak Deviation Settling Time[5]	28V output, 50% ~ 75% ~ 50% Io,max, slew rate = 0.1A/us	$\pm V_O$ T_s	- -	200 60	840 500	mV uS
	5.5V output, 50% ~ 75% ~ 50% Io,max, slew rate = 0.1A/us	$\pm V_O$ T_s	- -	100 60	250 500	mV uS

Note 1 - Ta = 25 ^{O}C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.

Note 2 - 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.

Note 3 - For 28V output without load at 5.5V, first foldback then hiccup. For 5.5V output, Hiccup mode.

Note 4 - High frequency and low ESR is recommended. **Caution**: External output capacitor must be present for normal operation.

Note 5 - Recovery to within 1% $V_{o,\ nom}$

Output Specifications

Table 3. Output Specifications, con't:

Parameter		Condition[1]	Symbol	Min	Typ	Max	Unit
Turn-on transient	Rise time	28V output	T_{rise}	-	50	100	mS
		5.5V output	T_{rise}	-	10	30	mS
	Turn-on delay time	Both outputs	$T_{turn-on}$	-	50	150	mS
	Output voltage overshoot	Both outputs	$\%V_O$	-	0	5	%
Switching frequency		All	f_{SW}	220	250	280	KHz
Remote ON/OFF control (positive logic)	Off-state voltage	All		-0.3	-	0.8	V
	On-state voltage	All		2.4	-	12	V
Remote ON/OFF control (Negative logic)	Off-state voltage	All		2.4	-	12	V
	On-state voltage	All		-0.3	-	0.8	V
Output over-voltage protection[6]		28V output only	V_O	35	37	40	V
Output over-temperature protection[7]		All	T	105	115	130	^{O}C
Over-temperature hysteresis		All	T	-	5	-	^{O}C
Output voltage remote sense range		Both outputs		-	-	0.5	V
Power Good	High Level (Source current)	All		7.5	9.5	10	V
		All		-	0.1	0.5	mA
	Low Level	All		0	-	0.3	V
MTBF		Telcordia SR-332-2006; 80% load, 300LFM, 40 ^{O}C T_A		-	2.8	-	10^6 h

Note 6 - Latch off. Reset by power on or remote on.
Note 7 - Auto recovery.

AVE450-48D2805 Performance Curves

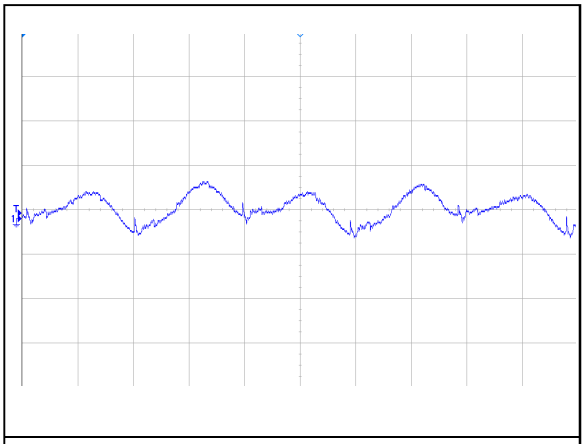


Figure 1: AVE450-48D2805 Input Reflected Ripple Current Waveform

Ch 1: Iin (2uS/div, 20mA/div)

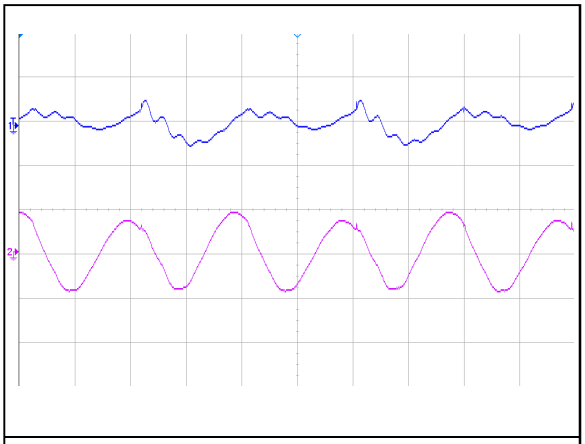


Figure 2: AVE450-48D2805 Ripple and Noise Measurement(2uS/div)

Ch 1: Vo1 = 28V (500mV/div) Ch 2: Vo2 = 5.5V (20mV/div)

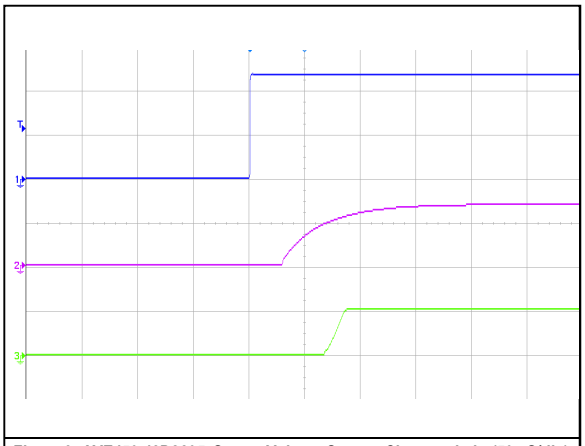


Figure 3: AVE450-48D2805 Output Voltage Startup Characteristic (50mS/div)

Ch 1: Vi (20V/div) Ch 2: Vo1 = 28V (20V/div) Ch 3: Vo2 = 5.5V (5V/div)

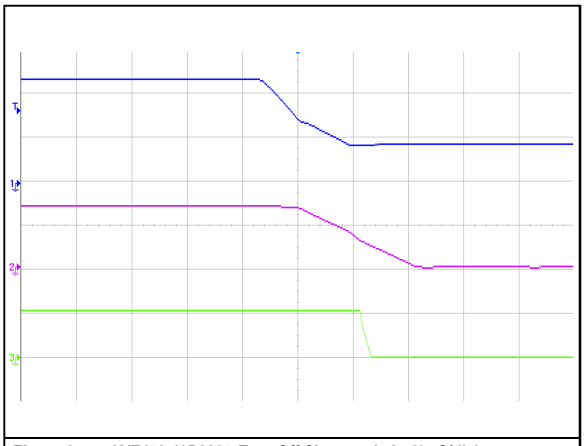


Figure 4: AVE450-48D2805 Turn Off Characteristic (1mS/div)

Ch 1: Vi (20V/div) Ch 2: Vo1 (20V/div) Ch 3: Vo2 (5V/div)

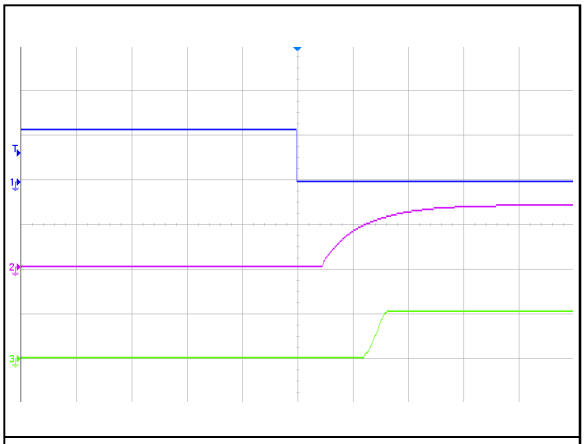


Figure 5: AVE450-48D2805 Remote ON Waveform (50mS/div)

Ch 1: Remote ON (5V/div) Ch 2: Vo1 (20V/div) Ch 3: Vo2 (5V/div)

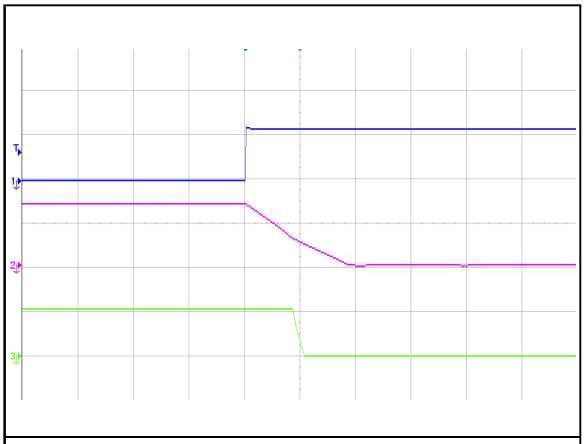


Figure 6: AVE450-48D2805 Remote OFF Waveform (1mS/div)

Ch 1: Remote OFF (5V/div) Ch 2: Vo1 (20V/div) CH3: Vo2 (5V/div)

AVE450-48D2805 Performance Curves

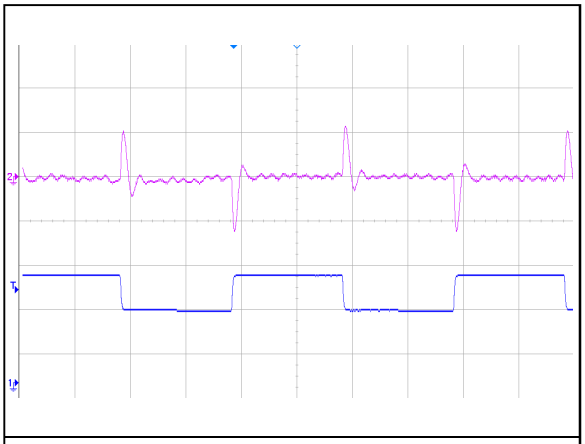


Figure 7: AVE450-48D2805 28V Transient Response (1mS/div)
50%~75%~50% load change, 0.1A/uS slew rate
Ch 1: Io (5A/div) Ch 2: Vo1 (100mV/div)

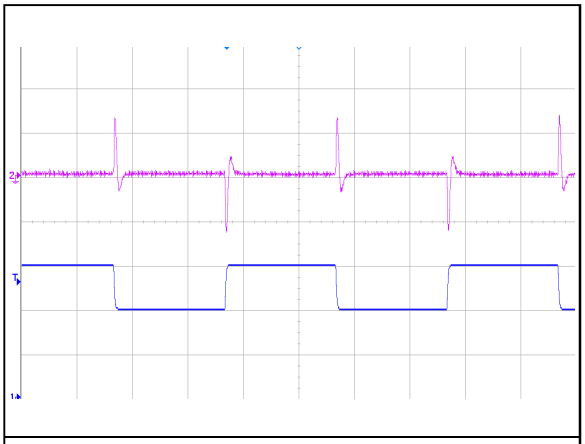


Figure 8: AVE450-48D2805 5.5V Transient Response (1mS/div)
50%~75%~50% load change, 0.1A/uS slew rate
Ch 1: Io (5A/div) Ch 2: Vo2 (50mV/div)

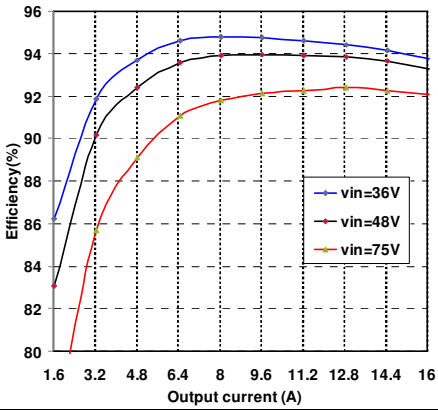


Figure 9: AVE450-48D2805 Efficiency Curves @ 25 °C
Loading: No load at 5.5V

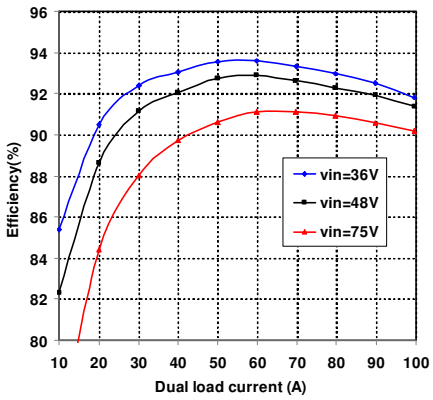


Figure 10: AVE450-48D2805 Efficiency Curves @ 25 °C
Loading: Both load

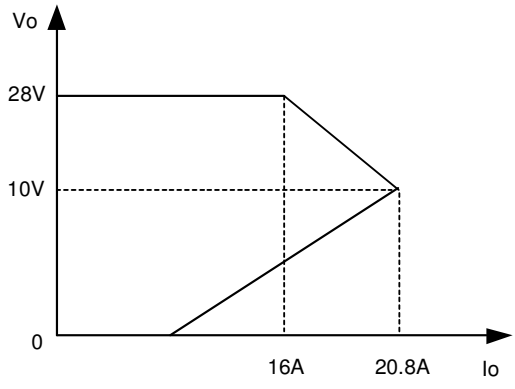
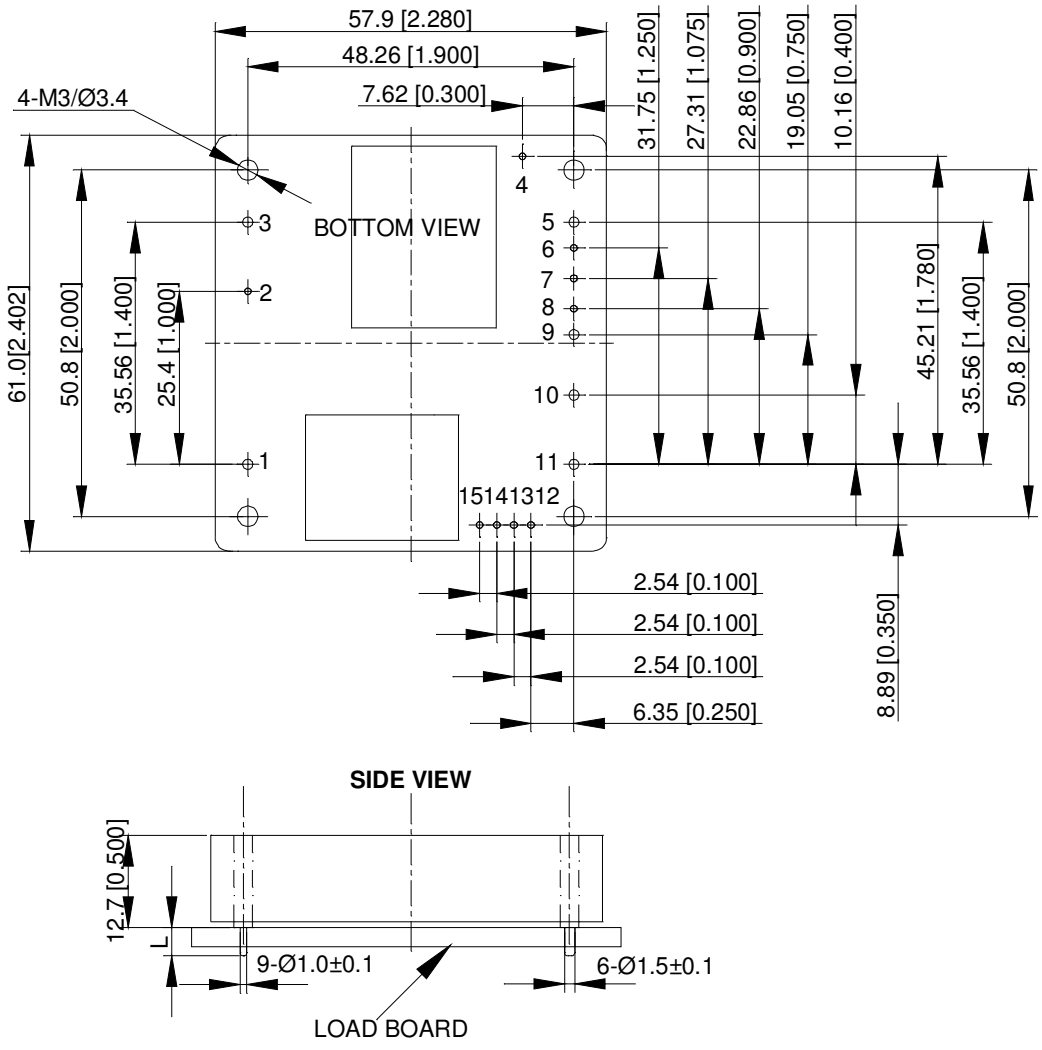


Figure 11: AVE450-48D2805 28V Over-current Protection Characteristics
For reference only

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.]

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Pin Length Option

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	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)

Environmental Specifications

EMC Immunity

AVE450-48D2805 series power supply is designed to meet conducted emission's requirements of EN55022 Class B with external filter.

EMC Filter Configuration

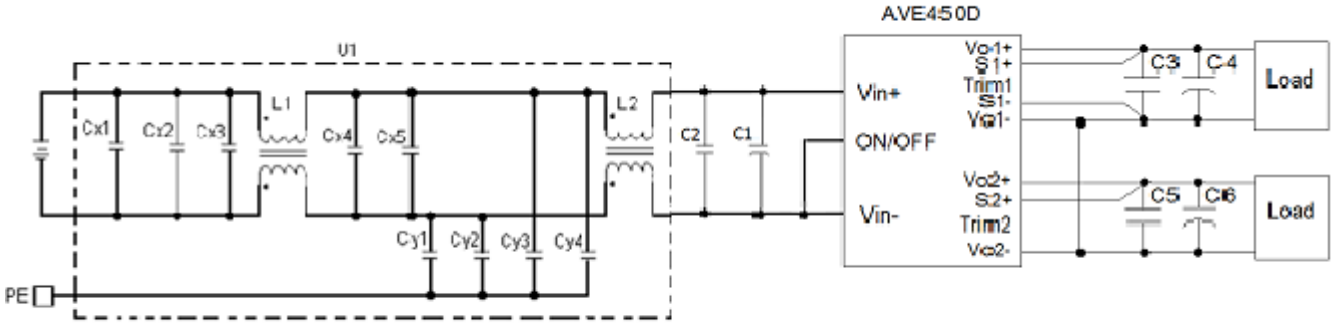

Figure 12 EMC filter configuration

CX1, CX2, CX3, CX4, CX5: 1000nF/100V/X7R capacitor
Cy1, Cy2, Cy3, Cy4: 0.1μF/1000V/X7R, Y capacitor
L1, L2: 473μH, common mode inductor
C1~C6: See Figure 15
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

Safety Certifications

The AVE450-48D2805 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 AVE450-48D2805 series power supply system

Document	File #	Description
UL/CSA 60950		US and Canada Requirements
EN60950		European Requirements
IEC60950		International Requirements
CE		CE Marking
GB4943		Chinese Requirements
TUV		German Requirements
UL94		US Requirements

Operating Temperature

The AVE450-48D2805 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

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 ^{O}C ambient temperature provided the baseplate temperature is kept below the max values in Table 5. The baseplate temperature test points' location is shown in Figure 13. Figure 14 shows the derating output current vs. baseplate temperature.

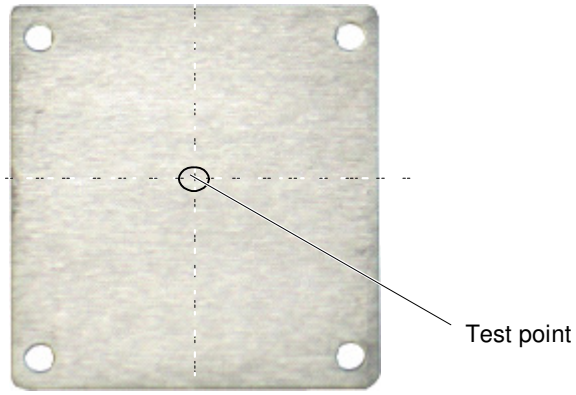

Figure 13 Temperature test point

Table 5. Temperature limit of the test point

Test Point	Temperature Limit
Test point on baseplate	105 ^{O}C

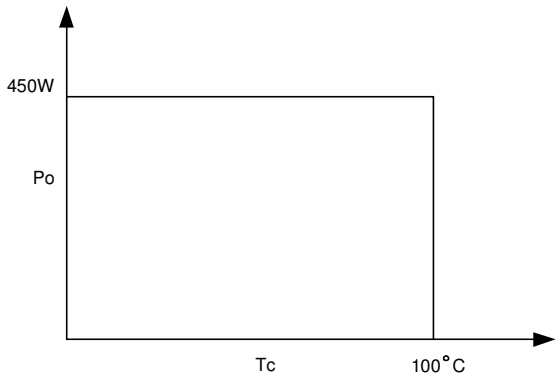

Figure 14 Output power derating,

Tc: temperature test point on baseplate, see Figure 13 for test configuration

Qualification Testing

Parameter	Unit (pcs)	Test condition
Halt test	4-5	$T_{a,min}$-10 ^{O}C to $T_{a,max}$+10 ^{O}C, 5 ^{O}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/axes
Mechanical Shock	3	30g, 6ms, 3axes, 6directions, 3time/direction
Thermal Shock	3	-40 ^{O}C to 100 ^{O}C, unit temperature 20cycles
Thermal Cycling	3	-40 ^{O}C to 55 ^{O}C, temperature change rate: 1 ^{O}C/min, cycles: 2cycles
Humidity	3	40 ^{O}C, 95%RH, 48h
Solder Ability	15	IPC J-STD-002C-2007

Application Notes

Typical Application

Below is the typical application of the AVE450-48D2805 series power supply.

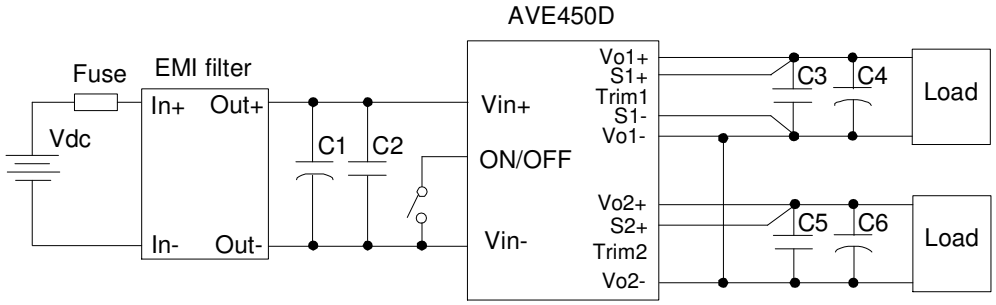

Figure 15 Typical application

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 ^{O}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.

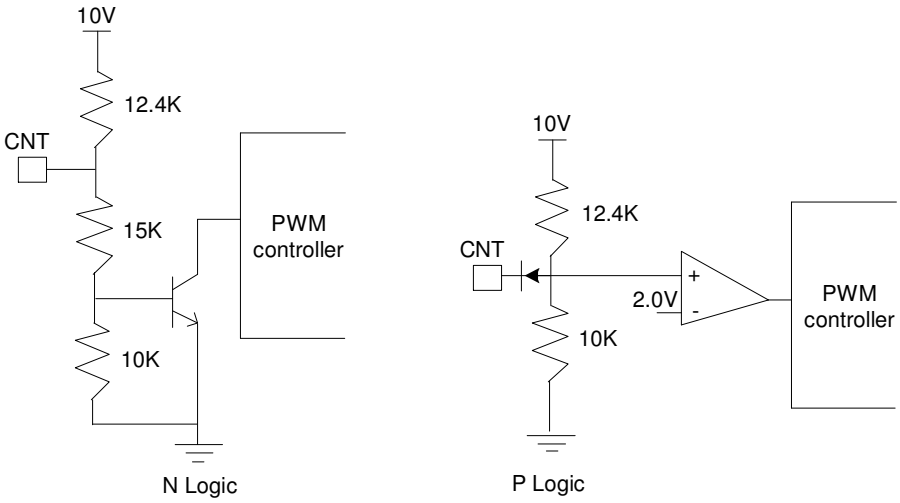

Figure 16 Remote ON/OFF internal diagram

Trim Characteristics

28V:

Connecting an external resistor between Trim1 pin and Vo1- pin will decrease the output voltage. While connecting it between Trim and Vo1+ 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 *Vtrim* 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

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

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.

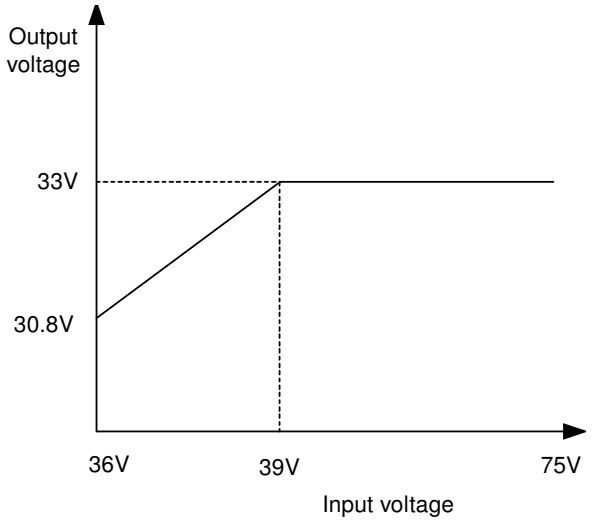

Figure 17 Max. adjustable output voltage vs. input voltage

Trim Characteristics, con't

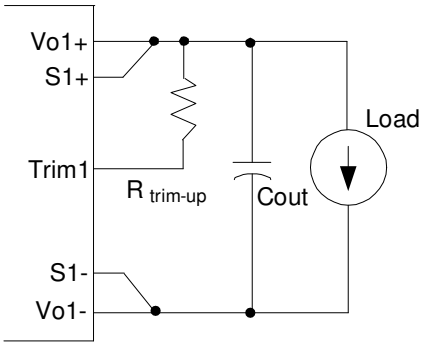

Figure 18 Trim up (28V)

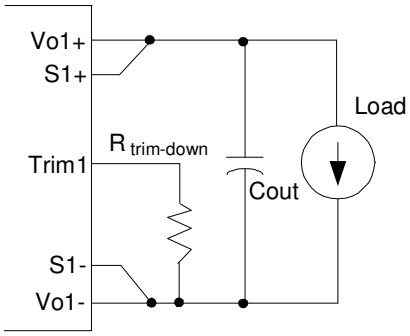

Figure 19 Trim down (28V)

5.5V:

Connecting an external resistor between Trim2 pin and Vo2- pin will increase the output voltage. While connecting it between Trim and Vo2+ 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 *Vtrim* is the potential that applied at the Trim pin, and ΔV_o is the desired output voltage which minus the nominal 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.

Trim Characteristics, con't

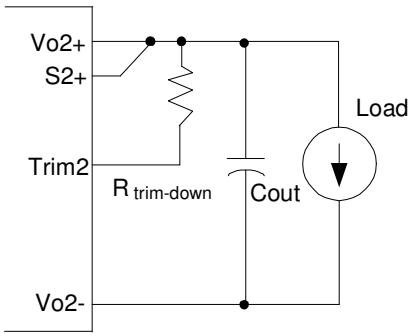

Figure 20 Trim down (5.5V)

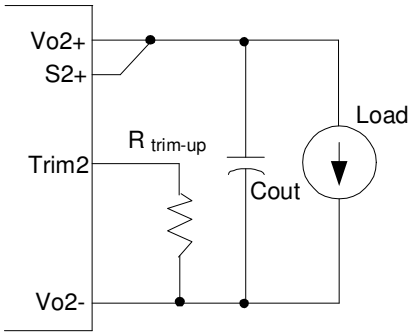

Figure 21 Trim up (5.5V)

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 15.

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

Power Good Characteristics

The PG pin is an open collector output. Its purpose is to indicate whether the converter is operating normally. The pin's signal is generated by the internal auxiliary rail of the module and is independent of input or output conditions. A typical voltage of 9.5V will be present at the pin if the converter is running correctly; however when the converter is in a Fault-condition, the pin is pull down to GND internally. When the signal is high level, the voltage will be in the range of 7.5V min to 10V max with a source current rating of 0.5mA maximum.

Inrush Current, Input and Output Ripple & Noise Test Configuration

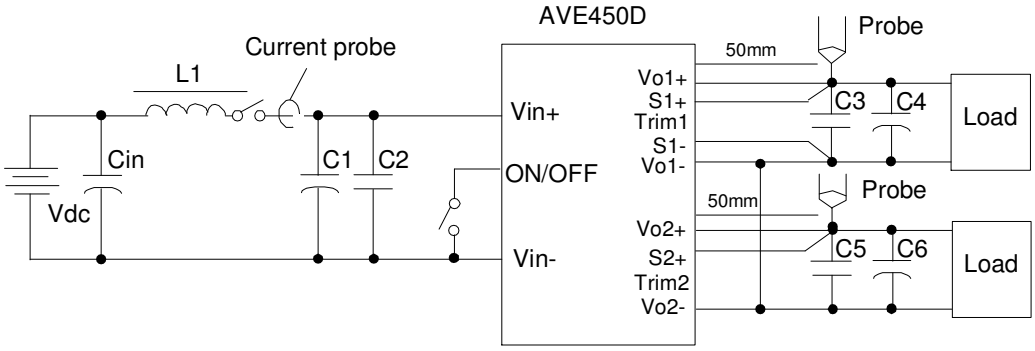

Figure 22 Inrush current, input and output ripple & noise test configuration

Vdc: DC power supply

L1: 12uH inductor

Cin: 220uF/100V electrolytic capacitor

C1 ~ C4: See Figure 15

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

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 ^{O}C for maximum 7s.

When soldering by hand, the iron temperature should be maintained at 300 ^{O}C ~ 380 ^{O}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.

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Hazardous Substances Announcement (RoHS of China R6)

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

Record of Revision and Changes

Issue	Date	Description	Originators
1.0	06.23.2014	First Issue	V.Wei
1.1	10.13.2014	Add some Notes	V.Wei
1.2	01.28.2016	Update the EMC setup	V.Wei

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