

ARTESYN AVE700-48S28B SERIES

700 Watts Half-brick Converter



PRODUCT DESCRIPTION

The Advanced Energy's Artesyn AVE700-48S28PB-6L is a single output DC/DC converter with standard half-brick outline and pin configuration. It delivers up to 25A output current with 28V output. Ultra-high 95.5% efficiency and excellent thermal performance makes it an ideal choice for use in computing and telecommunication applications and can operate over an ambient temperature range of -40 °C to +85 °C. without air cooling, and baseplate operating temperature up to 100 °C.

AT A GLANCE

Total Power:

700 Watts

Input Voltage:

36 to 75 Vdc

of Outputs:

Single



SPECIAL FEATURES

- Delivering up to 25A output
- Ultra-high efficiency 95.5% typ. at full load
- Wide input range: 36V to 75Vdc
- Excellent thermal performance
- No minimum load requirement
- Basic isolation
- High power density
- Low output noise
- RoHS 3.0
- Remote control function
- Remote output sense
- Trim function: 50% to 118%
- Input under-voltage lockout
- Output over current protection
- Output short circuit protection
- Output over voltage protection

- Over temperature protection
- Industry standard half-brick

SAFETY

- IEC/EN/UL/CSA 62368-1
- CE Mark
- UKCA Mark

TYPICAL APPLICATIONS

- Telecom/ Datacom

MODEL NUMBERS

Standard	Output Voltage	Structure	Remote ON/OFF logic
AVE700-48S28B-6L	28Vdc	Baseplate	Negative
AVE700-48S28PB-6L	28Vdc	Baseplate	Positive

Ordering Information

AVE700	-	48	S	28	P	B	-	6	L
①		②	③	④	⑤	⑥		⑦	⑧

①	Model series	AVE: series name , 700:output power 700W
②	Input voltage	48: 36V ~ 75V input range, rated input voltage 48V
③	Output number	S: single output
④	Rated output voltage	28: 28V output
⑤	Remote on/off logic	Default: negative logic; P: positive logic
⑥	Baseplate	B: Baseplate
⑦	Pin length	-6: 3.8mm
⑧	RoHS status	L: RoHS3.0

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 Non-operating -100mS	All	$V_{IN,DC}$	85 -	- -	80 100	Vdc Vdc	
Maximum Output Power	All	$P_{O,max}$	-	-	700	W	
Isolation Voltage ¹ Input to output Input to baseplate Output to baseplate	All		- - -	- - -	1500 750 750	Vdc Vdc Vdc	
Insulation Resistance Input to output Input to baseplate Output to baseplate	All		- - -	- - -	10 10 10	Mohm Mohm Mohm	
Ambient Operating Temperature	All	T_A	-40	-	+85	°C	
Operating Baseplate Temperature	All	$T_{Baseplate}$	-40		+100	°C	
Storage Temperature	All	T_{STG}	-55	-	+125	°C	
Voltage at remote ON/OFF pin	All		-0.3	-	8	Vdc	

Note 1 - 1mA for 60s, slew rate of 1500V/10s

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC	All	$V_{IN,AC}$	36	48	75	Vdc
Turn-on Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,ON}$	31	-	35	Vdc
Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	29	-	33	Vdc
Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	-	4	Vdc
Maximum Input Current $I_O = I_{O,max}$	$V_{IN,DC} = 36Vdc$	$I_{IN,max}$	-	-	23	A
Recommended Input Fuse	Fast blow external fuse recommended		-	-	30	A
Recommended External Input Capacitance ²	Low ESR capacitor recommended	C_{IN}	470	-	-	uF
Input Reflected Ripple Current	Through 12uH inductor		-	100	600	mA
Operating Efficiency	$T_A = 25\text{ }^\circ\text{C}$ $I_O = I_{O,max}$ $I_O = 50\% I_{O,max}$ $I_O = 20\% I_{O,max}$	η	94.0 94.5 92.0	95.5 96.0 93.5	- - -	% % %

Note 1 - $T_a = 25\text{ }^\circ\text{C}$, airflow rate = 400 LFM, $V_{in} = 48Vdc$, nominal V_{out} unless otherwise noted. All electrical specification is guaranteed above 36V input voltage after module turn on.

Note 2 - Recommended ESR < 0.14mΩ at -40 °C.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Voltage	$T_A=25\text{ }^\circ\text{C}$ $V_{IN,DC} = 48\text{Vdc}$ $I_O = I_{O,max}$	V_O	27.44	28.00	28.56	Vdc
Output Voltage Line Regulation	All	$\%V_O$	-	-	0.5	%
Output Voltage Load Regulation	All	$\%V_O$	-	-	0.5	%
Output Voltage Temperature Regulation	All	V_O	-	-	0.02	$\%^\circ\text{C}$
Total Output Voltage Range (Over sample, line, load, temperature & life)	All	V_O	27.2	28.0	28.8	V
Output Voltage Trim Range	All	V_O	14	-	33	V
Output Ripple, pk-pk	20MHz bandwidth	V_O	-	200	250	mV_{PK-PK}
Output Current	All	I_O	0	-	25	A
Output DC Current-limit Inception ²	All	I_O	28	-	52	A
Vo Load Capacitance ³	All	C_O	470	820*3	4000	μF
Vo Dynamic Response	25% - 50% - 25% $I_O = I_{O,max}$ 1A/10 μs	$\pm V_O$ T_s	- -	200 0	500 500	mV μSec
	75% - 50% - 75% $I_O = I_{O,max}$ 1A/10 μs	V_O T_s	- -	200 0	500 500	mV μSec
	10% - 90% - 10% $I_O = I_{O,max}$ 1A/ μs , 500Hz	$\pm V_O$	-	400	1400	mV
	10% - 100% - 10% $I_O = I_{O,max}$ 1A/ μs , 500Hz	$\pm V_O$	-	500	1400	mV
	10% - 100% (80% duty) - 10% (20% duty) $I_O = I_{O,max}$ 1A/ μs , 500Hz	$\pm V_O$	-	500	1400	mV
Switch frequency	All	f_{SW}	-	150	-	KHz
Turn-on transient	Rise time	T_{rise}	-	60	200	mS
	Turn-on delay time	$T_{turn-on}$	-	60	100	mS
	Output voltage overshoot	$\%V_O$	-	0	5	%

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications Con't							
Parameter		Condition ¹	Symbol	Min	Typ	Max	Unit
Remote ON/OFF control (positive logic)	Off-state voltage	All		-0.3	-	1.2	V
	On-state voltage	All		3.5	-	8	V
Remote ON/OFF control (Negative logic)	Off-state voltage	All		3.5	-	8	V
	On-state voltage	All		-0.3	-	1.2	V
Output voltage remote sense range		All		-	-	0.5	V
Output Over-voltage Protection		All	V _O	35	-	43	V
Output over-temperature protection ⁴		All	T	105	115	125	°C
Over-temperature hysteresis		All	T	5	-	-	°C
MTBF		300 LFM 40 °C T _A Normal Input and Rated Output@80% load Telcordia,SR332 Method 1 Case3		-	1.5	-	10 ⁶ h

Note 1 - T_a = 25 °C, airflow rate = 400 LFM, V_{in} = 48Vdc, nominal V_{out} unless otherwise noted. All electrical specification is guaranteed above 36V input voltage after module turn on.

Note 2 - Hiccup.

Note 3 - Electrolytic capacitor or equivalent cap

Note 4 - Auto recovery.

PERFORMANCE CURVES

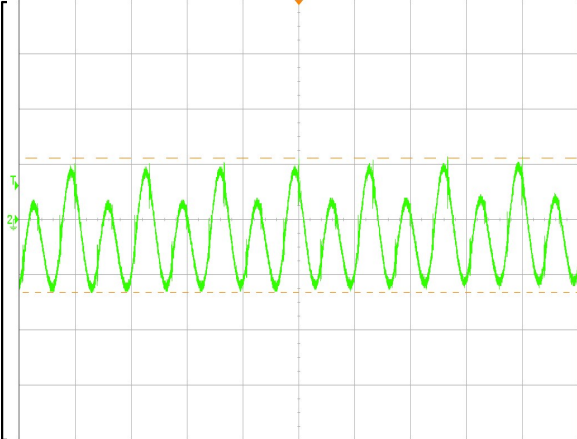


Figure 2: AVE700-48S28PB-6L Input Reflected Ripple Current Waveform
Ch 2: lin (5uS/div, 20mA/div)

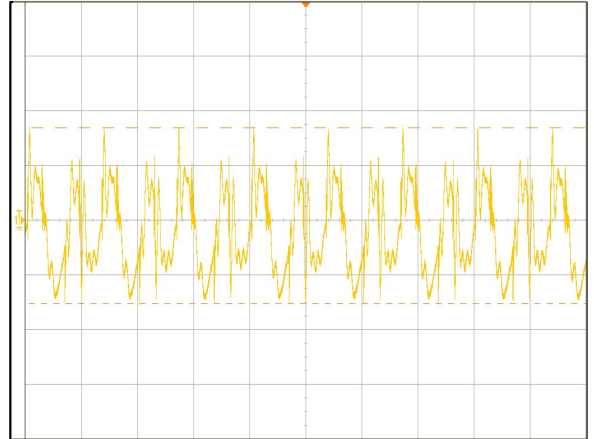


Figure 2: AVE700-48S28PB-6L Ripple and Noise Measurement
Ch 1: Vo (5uS/div, 50mV/div)

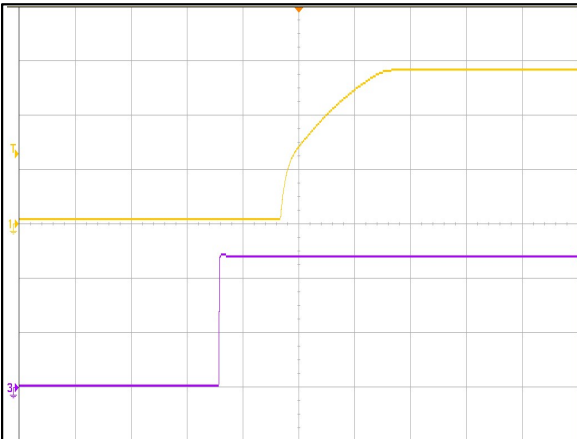


Figure 3: AVE700-48S28PB-6L Output Voltage Startup (50mS/div)
Ch 1: Vo (10V/div) Ch 3: Vin (20V/div)

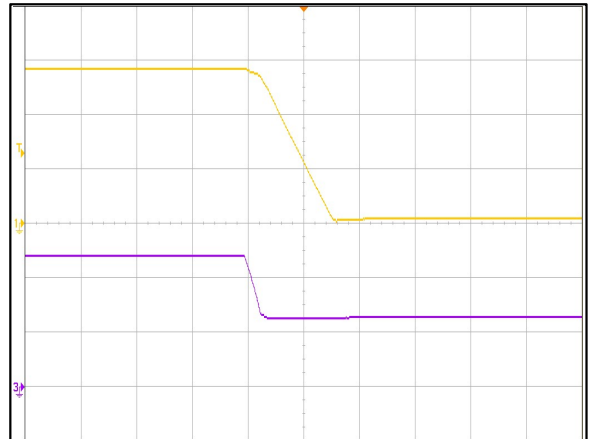


Figure 4: AVE700-48S28PB-6L Turn Off (2mS/div)
Ch 1: Vo (10V/div) Ch 3: Vin (20V/div)

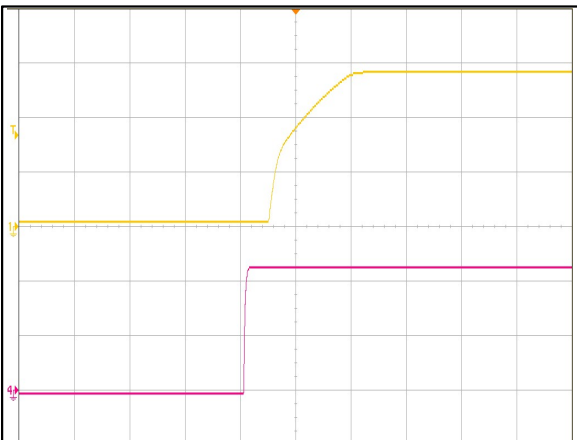


Figure 5: AVE700-48S28PB-6L Remote ON Waveform (50mS/div)
Ch 1: Vo (10V/div) Ch 4: Remote ON (2V/div)

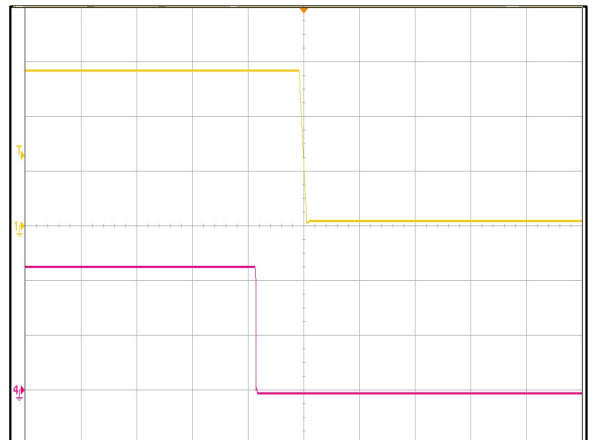


Figure 6: AVE700-48S28PB-6L Remote OFF Waveform (20mS/div)
Ch 1: Vo (10V/div) Ch 4: Remote ON (2V/div)

PERFORMANCE CURVES

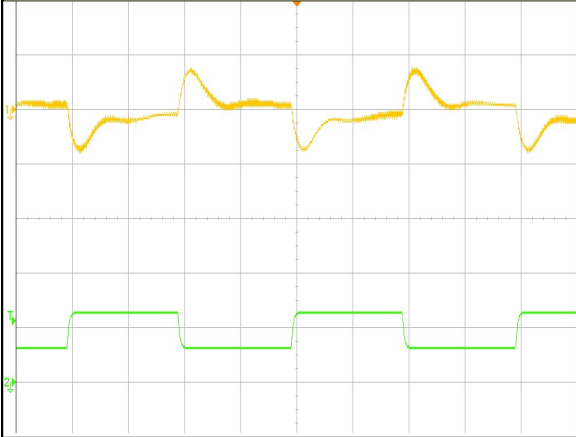


Figure 7: AVE700-48S28PB-6L Transient Response (500uS/div)
25%-50%-25% load change, 0.1A/uS slew rate,
Ch 1: Vo (200mV/div) Ch 2: Io (10A/div)

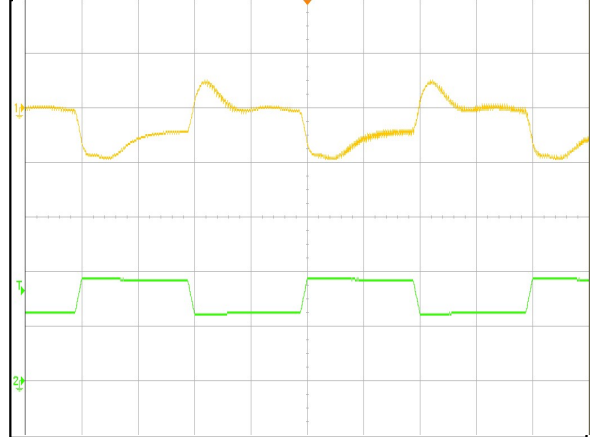


Figure 8: AVE700-48S28PB-6L Transient Response (500uS/div)
50%-75%-50% load change, 0.1A/uS slew rate,
Ch 1: Vo (200mV/div) Ch 2: Io (10A/div)

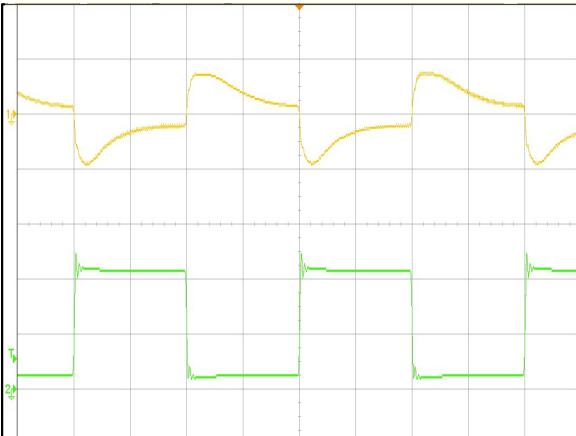


Figure 9: AVE700-48S28PB-6L Transient Response (500uS/div)
10%-90%-10% load change, 1A/uS slew rate,
Ch 1: Vo (500mV/div) Ch 2: Io (10A/div)

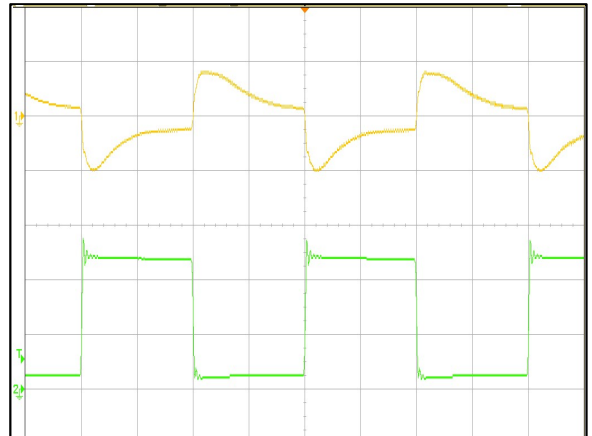


Figure 10: AVE700-48S28PB-6L Transient Response (500uS/div)
10%-100%-10% load change, 1A/uS slew rate,
Ch 1: Vo (500mV/div) Ch 2: Io (10A/div)

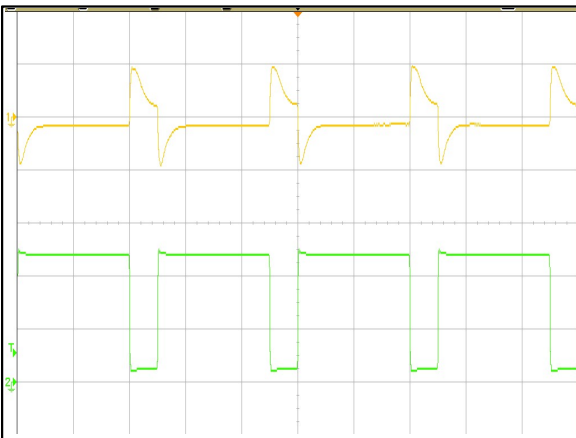


Figure 11: AVE700-48S28PB-6L Transient Response (2mS/div)
10%-100%-10% load change, 1A/uS slew rate,
Ch 1: Vo (500mV/div) Ch 2: Io (10A/div)

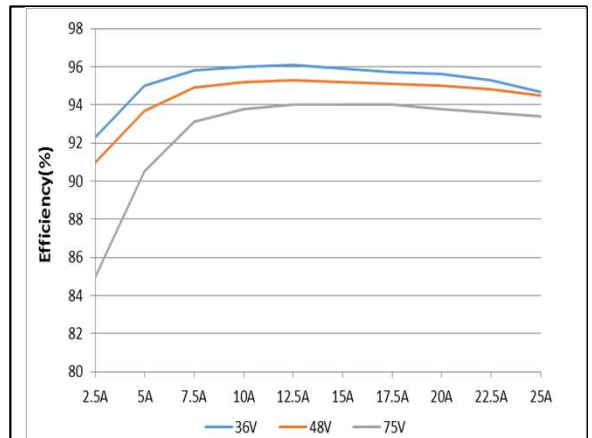


Figure 12: AVE700-48S28PB-6L Efficiency Curves @ 25 °C
Loading: Io = 10% increment to 25A 400LFM Vo=28V

PERFORMANCE CURVES

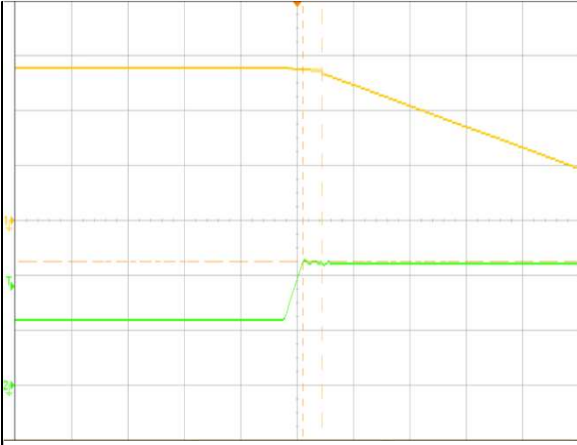


Figure 13: AVE700-48S28PB-6L Over Current Protection Mode (200uSec/div)
Ch 1: Vo (10V/div) Ch 2: Io (20A/div)

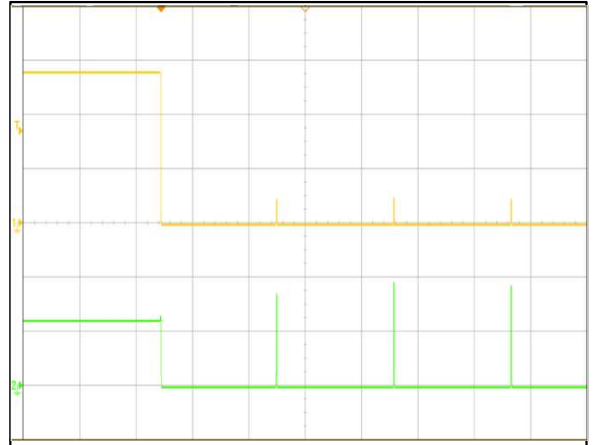


Figure 14: AVE700-48S28PB-6L Over Current Protection Timing (1Sec/div)
Ch 1: Vo (10V/div) Ch 2: Io (20A/div)

MECHANICAL SPECIFICATIONS

Mechanical Outlines

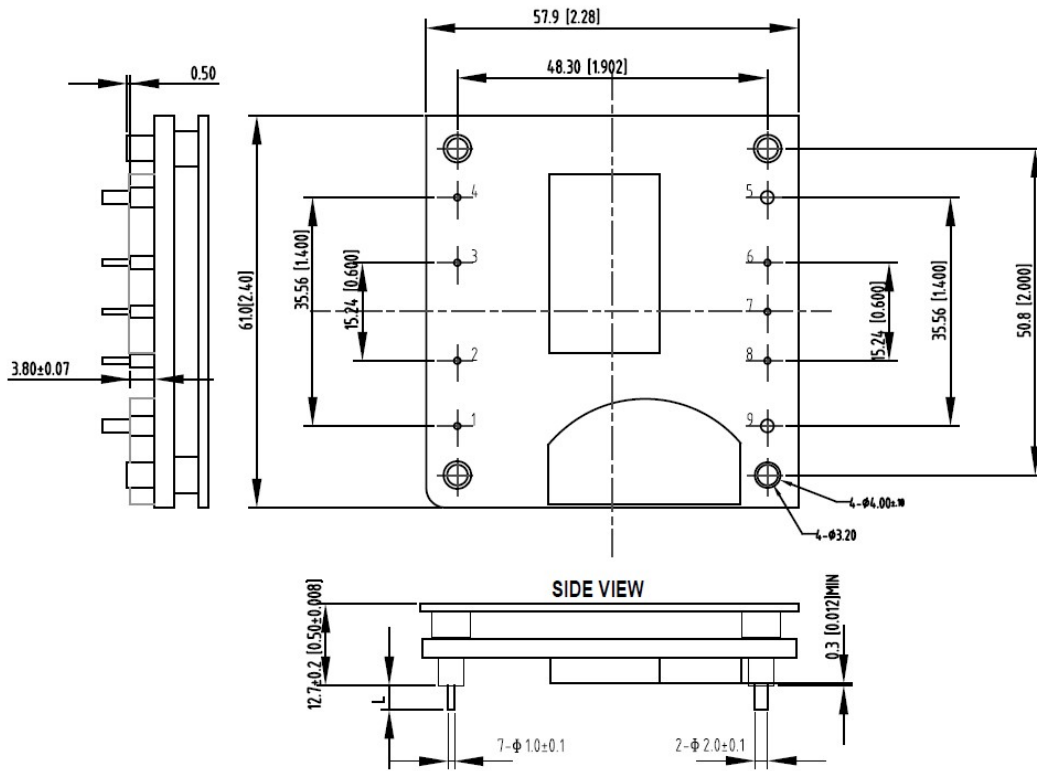


Figure 15 Mechanical Outlines

UNIT: mm[inch]

TOLERANCE: X.X mm±0.5 mm[X.XX in. ±0.02 in.]

X.XX mm±0.25 mm[X.XXX in. ±0.01 in.]

Note: The coplanarity of the top of 4 nuts is less than 0.1mm.

MECHANICAL SPECIFICATIONS

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	CNT	Remote ON/OFF control
3	NC	Not Connected
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

Noted: Baseplate flatness : <0.3mm

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

AVE700-48S28PB-6L power supply is designed to meet the following EMC immunity specifications:

Table 4. Environmental Specifications:		
Document	Description	Criteria
EN55032, DC input port, Class B	Conducted Limits	B
IEC/EN 61000-4-2, Enclosure port, Level 3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques: Electrostatic discharge immunity test	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, 0.6KV	Electromagnetic Compatibility (EMC) - Testing and measurement techniques: Immunity to surges - 600V common mode and 600V differential mode for DC input port	B
IEC/EN 61000-4-6, DC input port, Level 2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques: Continuous Conducted Interference. DC input port	A
Conducted Limits EN61000-4-29, DC input port	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.

SAFETY CERTIFICATIONS

The AVE700-48S28PB-6L 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 5. Safety Certifications for AVE700-48S28B series power supply system		
Standard	Certification	Description
UL/CSA 62368-1	UL	Certified under US and Canada safety standard
EN62368-1	TUV	Certified under European safety standard
EN62368-1 and EN50581	CE	Self-DOC is mandatory for EU
UKCA Mark		UK requirements

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature

The AVE700-48S28B 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 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 Table 6. The location of the baseplate temperature test point is shown in Figure 16.

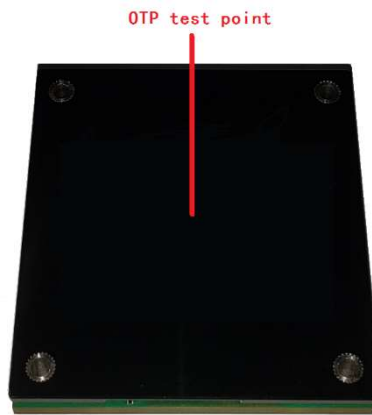


Figure 16 Temperature test point on baseplate

Table 6. Temperature limit of the test points	
Test Point	Description
Test point	100°C

For a typical application, Figure 17 shows the derating of output current vs. different baseplate temperature at 48V.

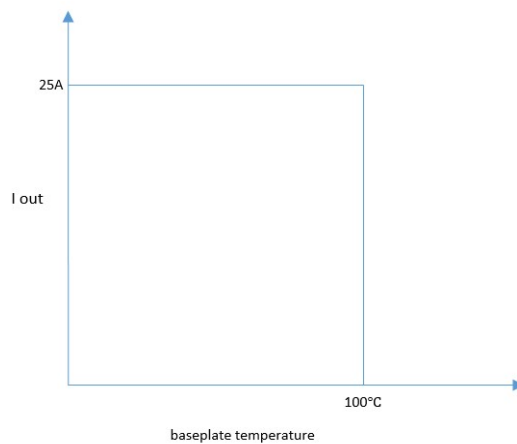


Figure 17 Output power derating at 48Vin

QUALIFICATION TESTING

Parameter	Unit (pcs)	Test condition
Halt test	4-5	Ta,min -20°C to Ta,max+35°C, 5°C step, Vin = min to max, 0 to 100% load
Vibration	3	Frequency range: 5Hz to 20Hz, 20Hz ~ 200Hz, A.S.D: 1.0m2/s3, -3db/oct, axes of vibration: X/Y/Z. Time: 30min/axes. Non operational
Mechanical Shock	3	Half sine, Acceleration:30g, 6ms, 3axes, 6directions, 3time/direction. Non operational
Thermal Shock	3	-55°C to 125°C, Temp Dwell Time: 30min, Temp change rate: 20 °C/min, unit temperature 20 cycles. Non operational
Thermal Cycling	3	-40°C~85°C, Temp change rate: 1°C/min,Cycles:2cycles
Humidity	3	40°C, 95%RH, 48h
Solder Ability	15	IPC J-STD-002C-2007

APPLICATION NOTES

Typical Application

Below is the typical application of the AVE700-48S28B series power supply.

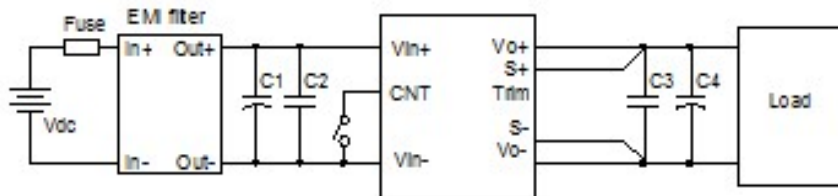


Figure 18 Typical application

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

C2: 0.1 μ F/100V X7R ceramic capacitor, P/N: 12101C104JAT2A (AVX) or equivalent caps

C3: 1 μ F/100V X7R ceramic capacitor, P/N: C3225X7R2A105KT0LOU (TDK) or equivalent parallel with 4.7 μ F/50V X7R ceramic capacitor, P/N: C3216X7R1H475K160AC(TDK) or equivalent

C4: 820 μ F/50V *3 electrolytic capacitor, P/N: EGPA500ELL821MK30S(NIPPON) or equivalent caps

Fuse: 30A fast blow fuse. P/N: 314030P (LITTLEFUSE).

Double minimum input/output capacitance is necessary for normal operation and performance in case of Ta<0 °C.

Note: EMI filter please refer to Figure 26.

APPLICATION NOTES

Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AVE700-48S28B. The logic is CMOS and TTL compatible.

Figure 19 is the detailed internal circuit and reference in AVE700-48S28PB-6L.

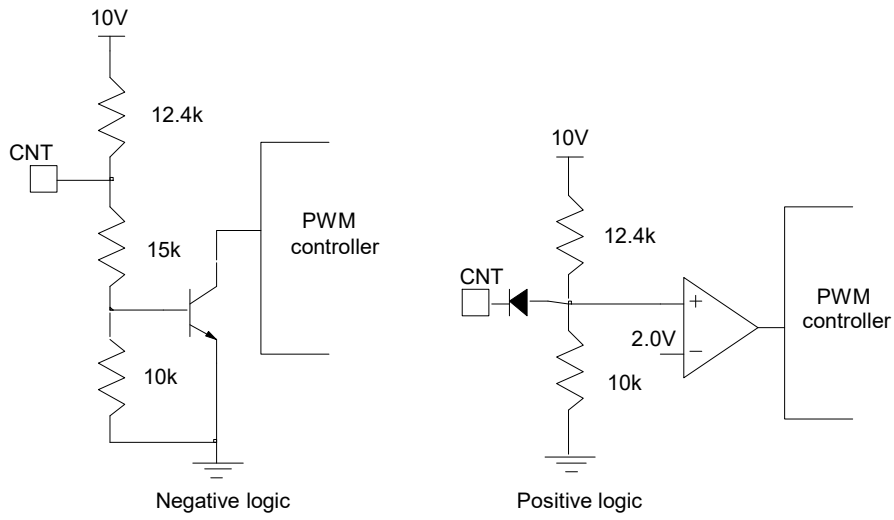


Figure 19 Remote ON/OFF internal diagram

APPLICATION NOTES

Trim Characteristics

1. Resistance adjustment mode

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

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

$$R_{adj_up} = \left(\frac{V_{norm}(100\% + \Delta\%)}{1.24 \times \Delta\%} - \frac{100\% + 2 \times \Delta\%}{\Delta\%} \right) k\Omega$$

Δ : Output rate against nominal output voltage.

$$\Delta = \left| \frac{100 \times (V_o - V_{norm})}{V_{norm}} \right|$$

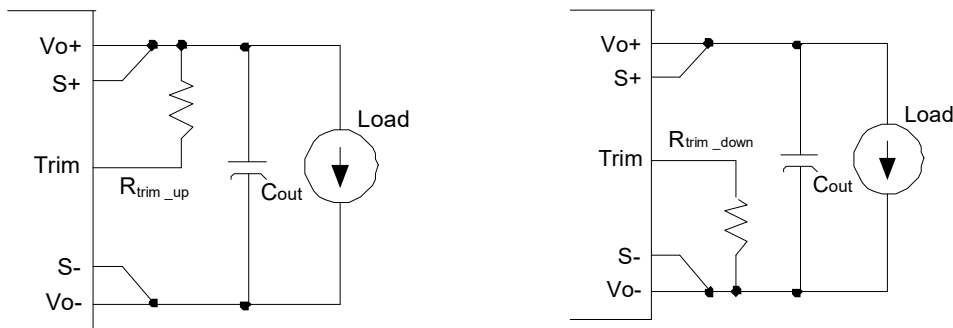
V_{norm} : Nominal output voltage.

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

$$\Delta = \frac{100 \times (V_o - V_{norm})}{V_{norm}} = \frac{100 \times (33 - 28)}{28} = 17.86$$

$$R_{adj-up} = \frac{28 \times (100\% + 17.86\%)}{1.24 \times 17.86\%} - \frac{100\% + 2 \times 17.86\%}{17.86\%} = 141.41(K\Omega)$$

For 1% adjustment resistor, the trimmed output voltage is guaranteed within $\pm 2\%$.



APPLICATION NOTES

2. Voltage adjustment mode

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

An external trim resistor (Rtrim) is connected between trim pin and Vtrim. See Figure 22,23.

V_{trim} : the potential voltage applied at the Trim pin

V_o : the desired output voltage

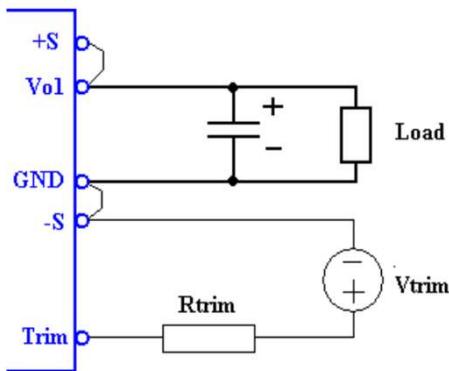


Figure 22. Trim circuit by voltage mode

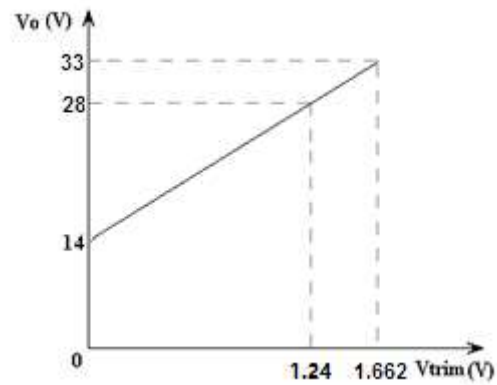


Figure 23 Vo vs. Vtrim

For AVE700-48S28PB-6L, if the sense compensate function is not necessary, connect S+ to Vo+ and S- to Vo- directly. When trimming up, the output current should be decreased accordingly so as not to exceed the maximum output power. When trimming up the output voltage, the minimum input voltage should be increased as shown in below Figure 24.

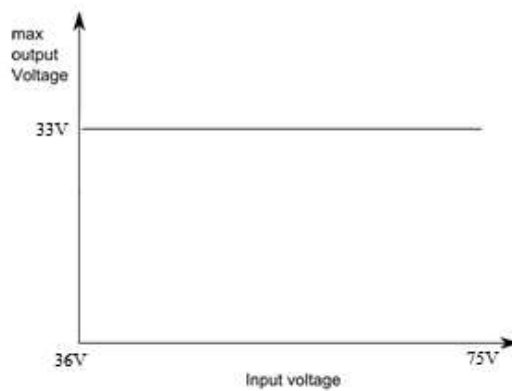


Figure 24 trimming up the output voltage

APPLICATION NOTES

Inrush Current, Input and Output Ripple & Noise Test Configuration

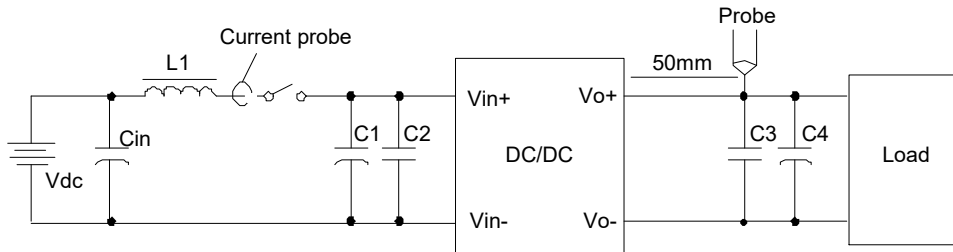


Figure 25 Input ripple & inrush current, output ripple & noise test configuration

Vdc: DC power supply

L1: 12 μ H

Cin: 220 μ F/100V typical

C1: 470 μ F/100V electrolytic capacitor, High frequency and low ESR

C2: 0.1 μ F/100V X7R ceramic capacitor, P/N: 12101C104JAT2A (AVX) or equivalent caps

C3, C4: refer to Figure 18

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

APPLICATION NOTES

EMC Test Conditions

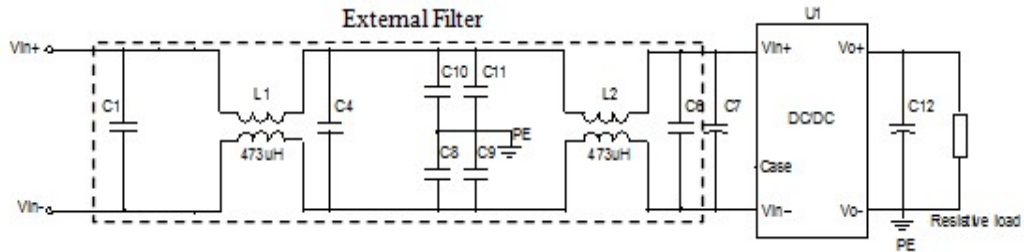


Figure 26 EMC test conditions

U1: Module to test, AVE700-48S28PB-6L

L1, L2: 470uH.

C1: 1uF/100V X7R ceramic capacitor *5, P/N: C3225X7R2A105K(TDK) or equivalent caps parallel 2.2uF/100V X7R ceramic capacitor *1, P/N: C3225X7R2A225K(TDK) or equivalent caps

C4: 1uF/100V X7R ceramic capacitor *4, P/N: C3225X7R2A105K(TDK) or equivalent caps parallel 2.2uF/100V X7R ceramic capacitor *2, P/N: C3225X7R2A225K(TDK) or equivalent caps

C6: 0.1uF/100V X7R ceramic capacitor, P/N: 12101C104JAT2A (AVX) or equivalent caps parallel 1uF/100V X7R ceramic capacitor, P/N: C3225X7R2A105K(TDK) or equivalent caps

C8-C11: 0.22uF/630V ceramic capacitor *8, P/N: C5750X7T2J224K250KC (TDK) or equivalent caps

C7: 470uF/100V electrolytic capacitor, P/N: UPM2A471MHD (Nichicon) or equivalent caps

C12: 820uF/50V *3 electrolytic capacitor, P/N: EGPA500ELL821MK30S(NIPPON) or equivalent caps or equivalent

PE: Connect to Vo-, Case: Not connected

ENVIRONMENTAL SPECIFICATIONS

Weight

The AVE700-48S28B-6L(Baseplate) weight is 123g.maximum.(101g.minmum)

The AVE700-48S28PB-6L(Baseplate) weight is 123g.maximum.(101g.minmum)

SOLDERING INFORMATION

Soldering

AVE700-48S28PB-6L

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 similarity.

RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	06.09.2020	First Issue	C.Yan
1.1	06.30.2020	Update new picture on first page	K. Wang
1.2	10.15.2020	Add OCP waveform	K. Wang
1.3	04.13.2021	Update Mechanical Drawing	K. Wang
1.4	04.28.2021	Update Mechanical Drawing and add OCP spec	K. Wang
1.5	10.14.2021	Update OCP from 42A to 52A	K. Wang
1.6	04.19.2022	Add UKCA Mark	K. Wang



For international contact information,
visit advancedenergy.com.

powersales@aei.com (Sales Support)
productsupport.ep@aei.com (Technical Support)
+1 888 412 7832

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