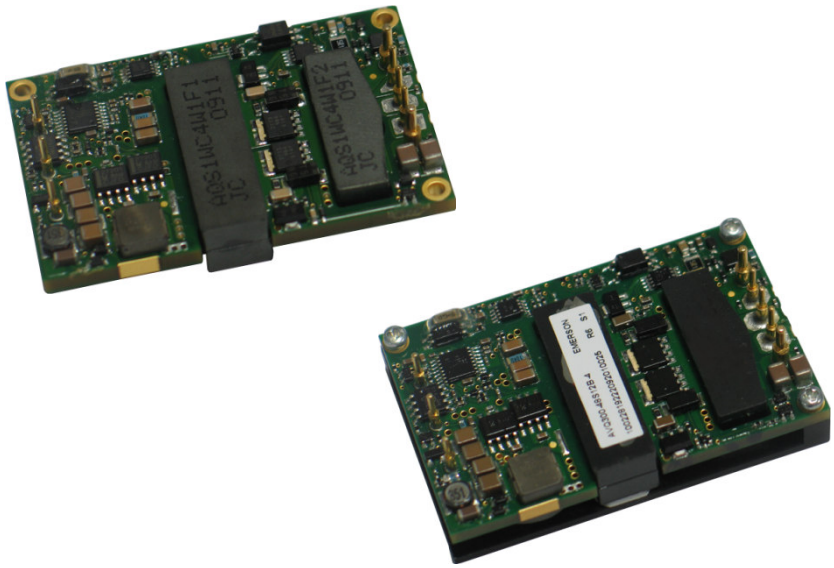
AVQ300-48S12

300 Watts

Quarter-brick Converter

Total Power: 300 Watts
Input Voltage: 48 Vdc
# of Outputs: Single



Special Features

- Delivering up to 25A output
- Industry standard quarter brick pin-outline
- Basic isolation
- Ultra-high efficiency 94.5% typ. at full load
- wide input voltage of 36V~75V
- Improved thermal performance
- High power density
- Low output noise
- No minimum load requirement
- Remote ON/OFF control function
- Remote output sense
- Trim function
- Input under voltage lockout
- Over temperature protection
- Output over current protection
- Output over voltage protection
- RoHS compliant
- Pin length optional

Safety

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

Product Descriptions

The AVQ300-48S12 is a single output DC/DC converter with standard quarter brick form factor and output is isolated from input. It delivers up to 25A output current with 12V output. Above 94.5% efficiency and excellent thermal performance makes it an ideal choice to use in telecom and datacom applications and can operate under an ambient temperature range of -40 ^{O}C ~ +85 ^{O}C.

Applications

Telecom/ Datacom

ARTESYN™
EMBEDDED TECHNOLOGIES

Model Numbers

Standard	Output Voltage	Structure	Remote ON/OFF logic	RoHS Status
AVQ300-48S12-6L	12Vdc	No baseplate	Negative	R6
AVQ300-48S12P-6L	12Vdc	No baseplate	Positive	R6
AVQ300-48S12B-6L	12Vdc	Baseplate	Negative	R6
AVQ300-48S12PB-6L	12Vdc	Baseplate	Positive	R6

Ordering information

AVQ300	-	48	S	12	P	B	-	4	L
①		②	③	④	⑤	⑥		⑦	⑧

①	Model series	AVQ: high efficiency quarter-brick series, 300: output power 300W.
②	Input voltage	48: 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 logic; P: positive logic
⑥	Baseplate	B: baseplate; default: no baseplate
⑦	Pin length	4: 4.8±0.25mm
⑧	RoHS status	L: RoHS, R6

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	$P_{O,max}$	-	-	300	W
Isolation Voltage[1]						
Input to output	Open frame module		1500	-	-	Vdc
Input to baseplate	Baseplate module		1500	-	-	Vdc
Output to baseplate	Baseplate module		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		-0.7	-	12	Vdc
Humidity (non-condensing)						
Operating	All		-	-	95	%
Non-operating			-	-	95	

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	$I_O = I_{O,max}$	$V_{IN,ON}$	-	35	36	Vdc
Turn-off Voltage Threshold	I_O = Lomax	$V_{IN,OFF}$	32	34	-	Vdc
Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	-	3	V
Maximum Input Current ($I_O = I_{O,max}$)	$V_{IN,DC} = 36V_{DC}$	$I_{IN,max}$	-	-	12	A
No-load input current		I_{IN}	-	-	0.2	A
Standby Input current	Remote OFF	I_{IN}	-	0.01	0.1	A
Recommended Input Fuse	Fast blow external fuse recommended		-	-	15	A
Input filter component values (C\L)	Internal values			8.8\1		µF\µH
Recommended External Input Capacitance	Low ESR capacitor recommended	C_{IN}	100	-	-	uF
Input Reflected Ripple Current	Through 12uH inductor		-	-	150	mA
Operating Efficiency	T_A=25 °C $I_O = I_{O,max}$ $I_O = 50\% I_{O,max}$	η	- -	94.5 95	- -	% %

Note 1 - Ta = 25 °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	11.80	12	12.20	Vdc
Output Voltage Line Regulation		All	%V_O	-	-	0.2	%
Output Voltage Load Regulation		All	%V_O	-	-	0.2	%
Output Voltage Temperature Regulation		All	%V_O	-	-	0.02	%/^{O}C
Total output voltage range (Over sample, line, load, temperature & life)		All	V_O	11.70	12.00	12.30	V
Output Voltage Trim Range		All	V_O	10.80	-	13.20	V
Output Ripple, pk-pk		20MHz bandwidth	V_O	-	-	150	mV_{PK-PK}
Output Current		All	I_O	0	-	25	A
Output DC current-limit inception[1]			I_O	26.25	-	32.5	A
V_O Load Capacitance		All	C_O	470	1000	10000	uF
V_O Dynamic Response	Peak Deviation	50% ~75%~50% slew rate = 0.1A/us	±V_O T_s	- -	600 700	- -	mV uSec
	Settling Time	50% ~75%~50% slew rate = 1A/us	±V_O T_s	- -	1200 700	- -	mV uSec
Turn-on transient	Rise time	I_O = I_{max}	T_{rise}	-	-	100	mS
	Turn-on delay time	I_O = I_{max}	$T_{turn-on}$	-	-	150	mS
	Output voltage overshoot	I_O = 0	%V_O	-	-	5	%

Note 1 - Ta = 25 ^{O}C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.
Note 2 - Hiccup: auto-restart when over-current condition is removed.

Output Specifications

Table 3. Output Specifications, con't:

Parameter		Conditions[1]	Symbol	Min	Typ	Max	Unit
Switching frequency		All	f_{SW}	135	145	155	KHz
Remote ON/OFF control (positive logic)	Off-state voltage	All		-0.7	-	1.2	V
	On-state voltage	All		3.5	-	12	V
Remote ON/OFF control (negative logic)	Off-state voltage	All		3.5	-	12	V
	On-state voltage	All		-0.7	-	1.2	V
Output over-voltage protection[2]		All	$\%V_O$	125	-	150	%
Output over-temperature protection[3]		No baseplate	T	-	120	-	^{O}C
		Baseplate		-	100	-	
Over-temperature hysteresis		All	T	-	10	-	^{O}C
Output voltage remote sense range		All	Vo	-	-	0.6	V
MTBF		Telcordia SR-332-2006; 80% load, 300LFM, 40^{O}C Ta		-	1.5	-	10^6 h

Note 3 – Hiccup: auto-restart when over-voltage condition is removed.
Note 4 – Auto recovery.

AVQ300-48S12 Performance Curves

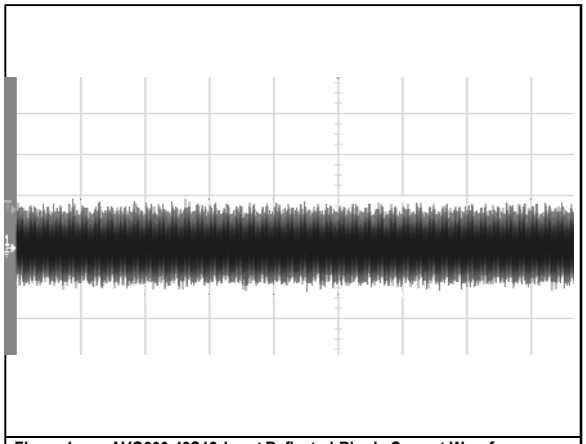


Figure 1: AVQ300-48S12 Input Reflected Ripple Current Waveform (100mS/div, 10mA/div)

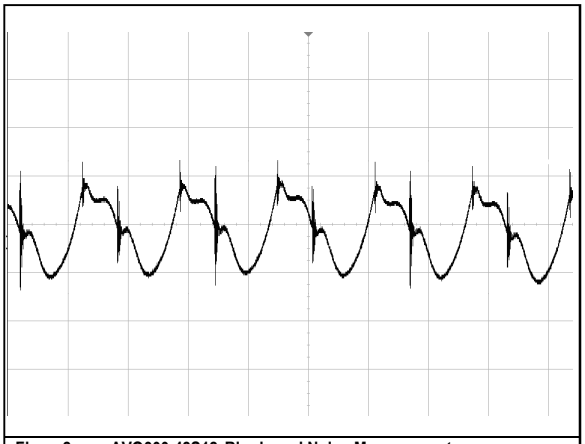


Figure2: AVQ300-48S12 Ripple and Noise Measurement (2uS/div, 20mV/div)

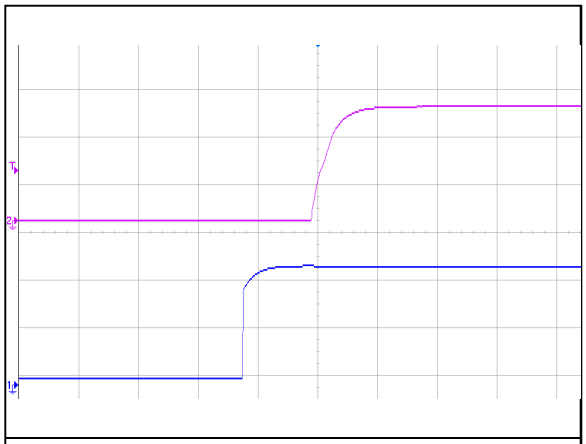


Figure 3: AVQ300-48S12 Output Voltage Startup Characteristic (100mS/div)

Ch 2: Vo (5V/div) Ch 1: Vin (20V/div)

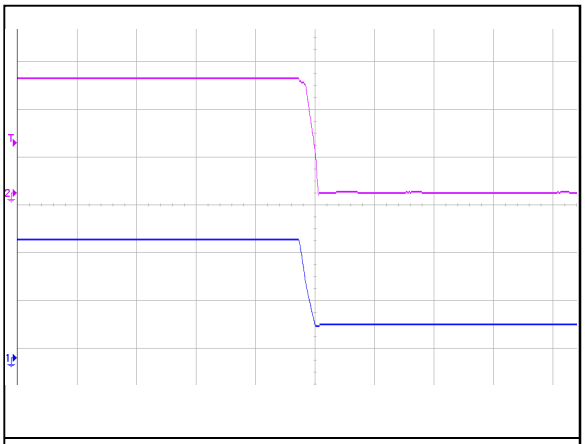


Figure 4: AVQ300-48S12 Turn Off Characteristic (50mS/div)

Ch 2: Vo (5V/div) Ch 1: Vin (20V/div)

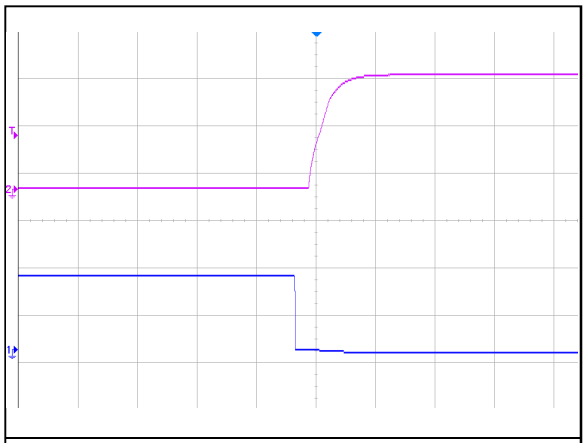


Figure 5: AVQ300-48S12 Remote ON Waveform (100mS/div)

Ch 2: Vo (5V/div) Ch 1: Remote ON (2V/div)

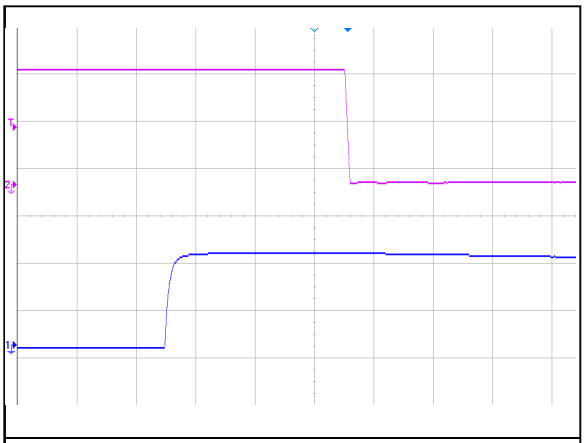


Figure 6: AVQ300-48S12 Remote OFF Waveform (5mS/div)

Ch 2: Vo (5V/div) CH 1: Remote OFF (2V/div)

AVQ300-48S12 Performance Curves

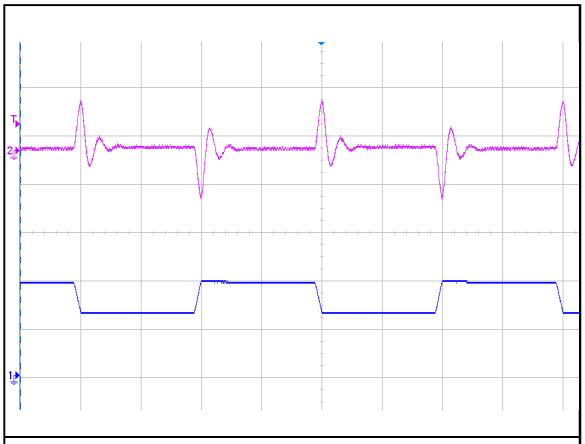


Figure 7: AVQ300-48S12 Transient Response (2mS/div)
50%~75%~50% load change, 0.1A/uS slew rate
Ch 2: Vo (200mV/div) Ch 1: Io (10A/div)

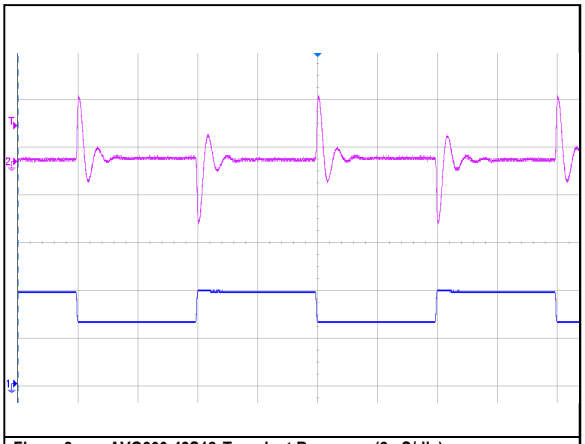


Figure 8: AVQ300-48S12 Transient Response (2mS/div)
50%~75%~50% load change, 1A/uS slew rate
Ch 2: Vo (200mV/div) Ch 1: Io (10A/div)

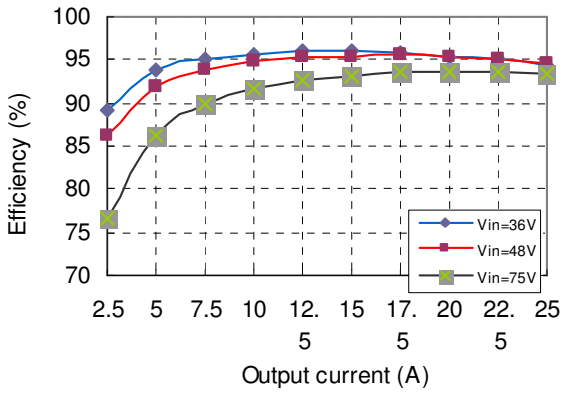
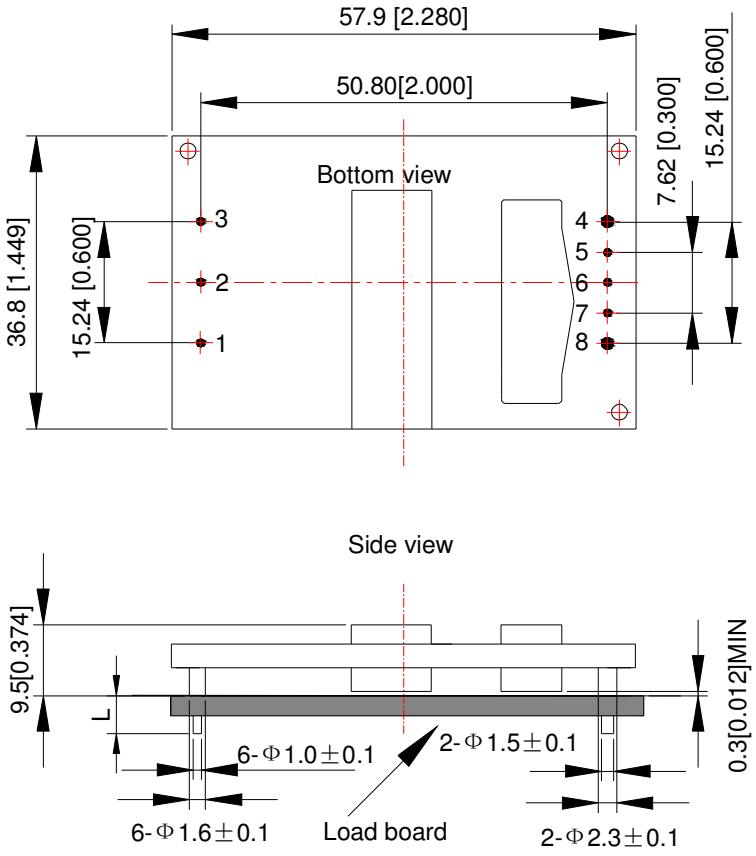


Figure 9: AVQ300-48S12 Efficiency Curves @ 25 °C, Vo=12V

Mechanical Specifications

Mechanical Outlines – No baseplate Module



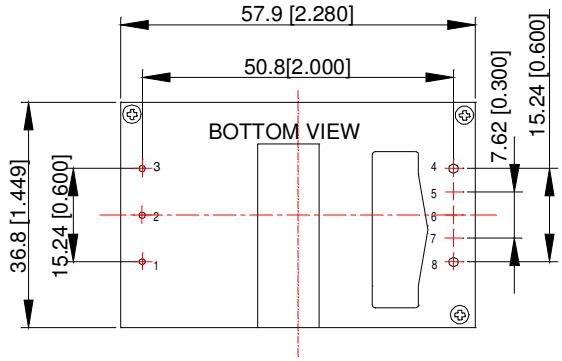
Unit: mm[inch]

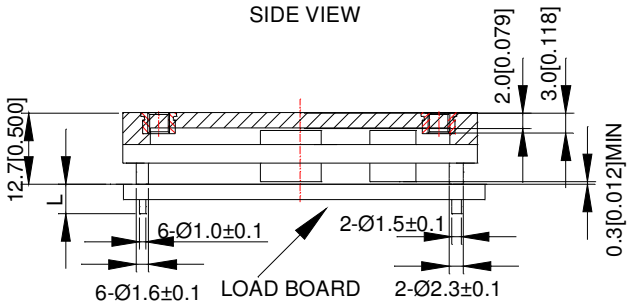
Bottom view: pin on upside

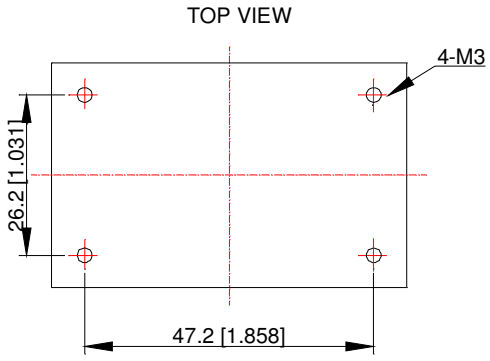
Tolerance: X.Xmm±0.5mm[X.X in.±0.02in.]

X.XXmm±0.25mm[X.XX in.±0.01in.]

Mechanical Outlines – Baseplate Module







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.]

Mechanical Specifications

Pin Length Options

Device code suffix	L
-4	4.8mm±0.25 mm
-6	3.8mm±0.25 mm
-8	2.8mm±0.25 mm
None	5.8mm±0.25 mm

Pin Designations

Pin No	Name	Function
1	Vin+	Positive input voltage
2	CNT	Remote ON/OFF control
3	Vin-	Negative input terminal
4	Vo-	Negative output terminal
5	Sense-	Negative remote sense
6	Trim	Output voltage trim
7	Sense+	Positive remote sense
8	Vo+	Positive output terminal

EMC Immunity

AVQ300-48S12 Series power supply is designed to meet the following EMC immunity specifications:

Document	Description	Criteria
IEC/EN61000-4-2 Level 3	ESD	B
IEC/EN61000-4-4 Level 3	EFT[1]	B
IEC/EN61000-4-5[2]	Surges[1]	B
IEC/EN61000-4-6 Level 2	Conducted disturbances immunity	A
EN61000-4-29	DC voltage dips, short interruption, variation	B
EN55022[3]	Conducted Emission	/

Note 1 - System reset is no allowed
Note 2 - Line to Ground(earth): 600V, Line to Line: 600V, System reset is no allowed
Note 3 - DC Input, Class B

Criterion A: Normal performance during and after test.

Criterion B: Normal performance after test, automatic restart is allowed after test .

Criterion C: Normal performance after test, the module can be restarted manually after test.

Normal performance means that output noise (Vpp) meet the requirement of the specifications.

Environmental Specifications

EMC Test Configuration

:

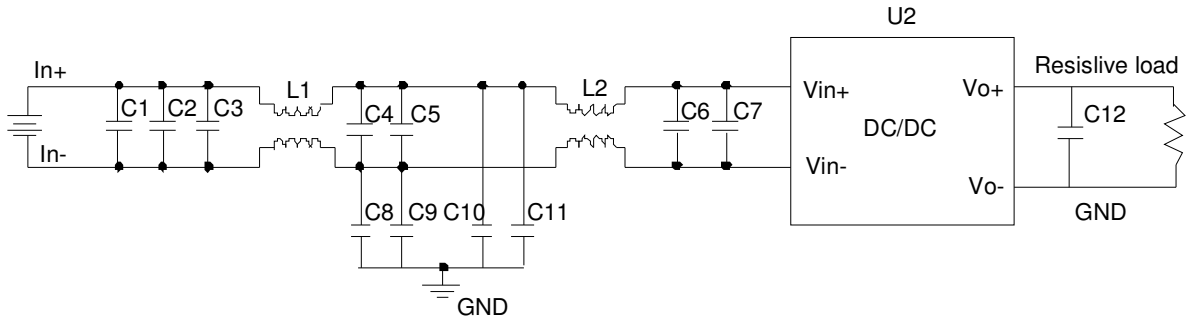


Figure 10 EMC test configuration

U2: Module to test, AVQ300-48S12

C1 ~ C5: SMD ceramic capacitor -100V-1000nF-X7R-1210

C6: SMD ceramic capacitor -100V-100nF-±10%-X7R-1206

L1 , L2 : Common mode inductor - single phase -473uH-±25%-14A magnetic ring 1*25.4*12.7mm - working temperature range includes module temperature rise. Temperature rise at rated current: 55 ^{O}C max

C8 ~ C11: High-voltage CHIP ceramic capacitor. Capacitance: 0.1U/630V/X7R. Size: 2220. Capable of withstanding 1kV voltage

C7: Input electrolytic capacitor, according to the same type as C1 in Figure 16

C12: Output electrolytic capacitor, according to the same type as C3 in Figure 16

PE: Connected to output

Safety Certifications

The AVQ300-48S12 Series 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 AVQ300-48S12 series power supply system

Document	File #	Description
UL60950,CSA-C22.2		US and Canada Requirements
EN60950-1		European Requirements
IEC60950		International Requirements
GB4943		Chinese Requirements
CE		CE Marking

Operating Temperature

The AVQ300-48S12 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 —No baseplate Model

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 as shown in the Figure 11. The temperature at this point should not exceed the max values of 120 ^{O}C.

The converter can operate in an enclosed environment without forced air convection. The converter can deliver output power at 85 ^{O}C ambient temperature provided the test point temperature is kept below the max values of 120 ^{O}C in the Table 5.

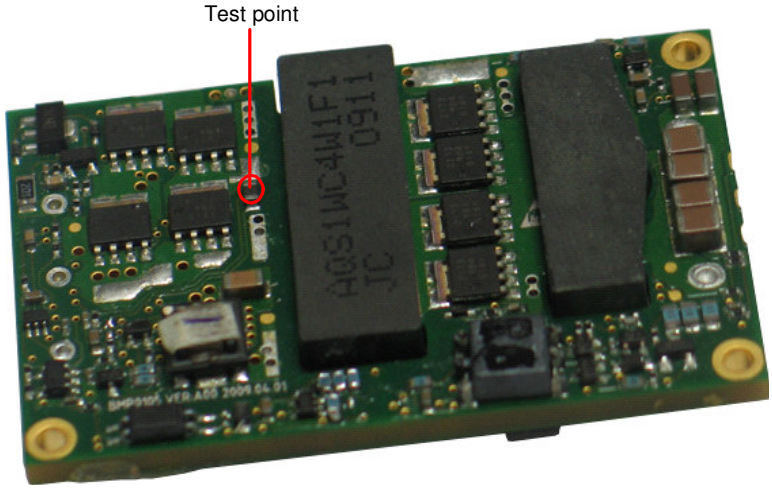


Figure 11 No baseplate model temperature test point , air flowing across the converter from pin 1 to pin 3

Table 5 Temperature limit of the test points

Test Point	Temperature limit
Test point	120^{O}C

Thermal Considerations — No baseplate Model, con't

Figure 12 shows the derating output current vs. ambient air temperature at different air velocity .The typical test condition is shown in Figure 12.

.

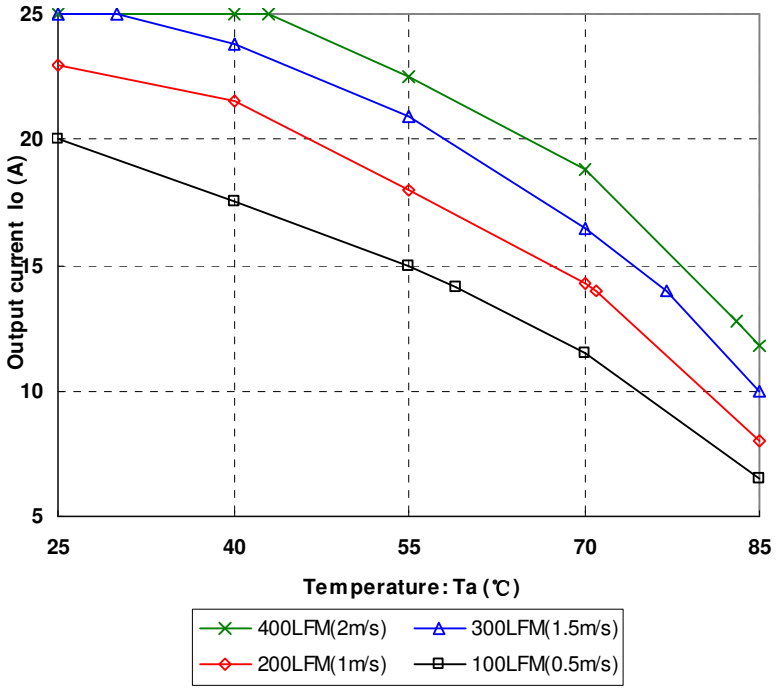


Figure 12 Output power derating, 48V_{in}, air flowing across the converter from pin 1 to pin 3

Thermal Considerations — Baseplate Model

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 as shown in the Figure 13. The temperature at this point should not exceed the max values of 100 ^{O}C.

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 output power at 85 ^{O}C ambient temperature provided the baseplate temperature is kept below the max values of 100 ^{O}C in Table 6.

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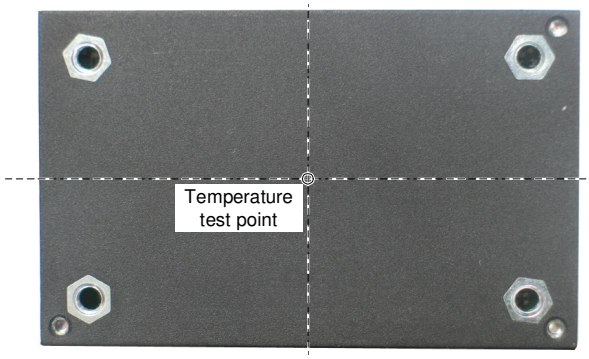

Figure 13 Baseplate model temperature test point on converter, air flowing across the converter from pin 1 to pin 3

Table 6 Temperature limit of the test points

Test Point	Temperature limit
Test point	100^{O}C

The converter can also operate with a smaller heatsink and sufficient airflow. The heatsink is shown in Figure 14.

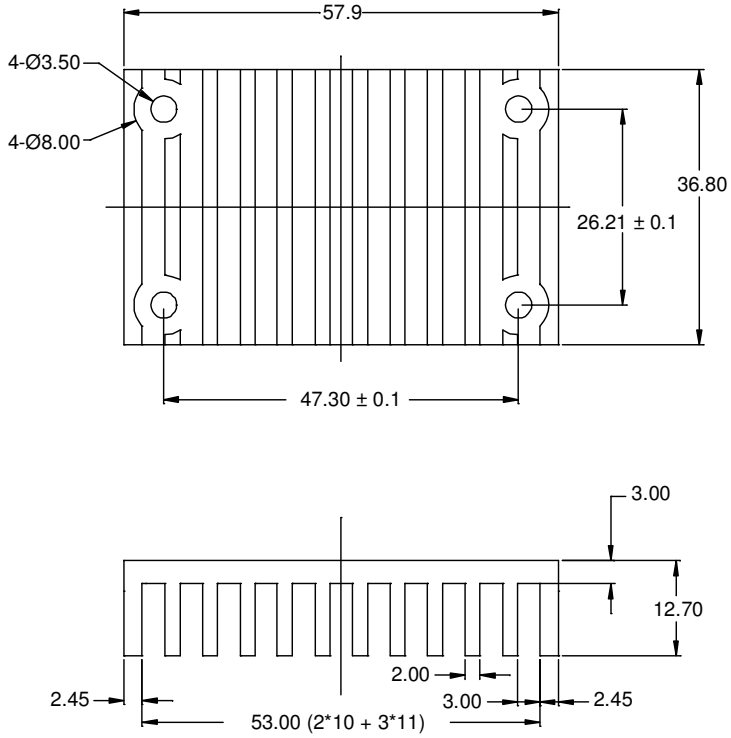

Figure 14 Heatsink

Thermal Considerations — Baseplate Model, con't

Assembly

The maximum length of the screw driven into heat-sink is 3.3mm.

Figure 15 shows the derating output current vs. ambient air temperature at different air velocity with a heatsink, the heatsink spec is shown in Figure14. The typical test condition is shown in Figure 15.

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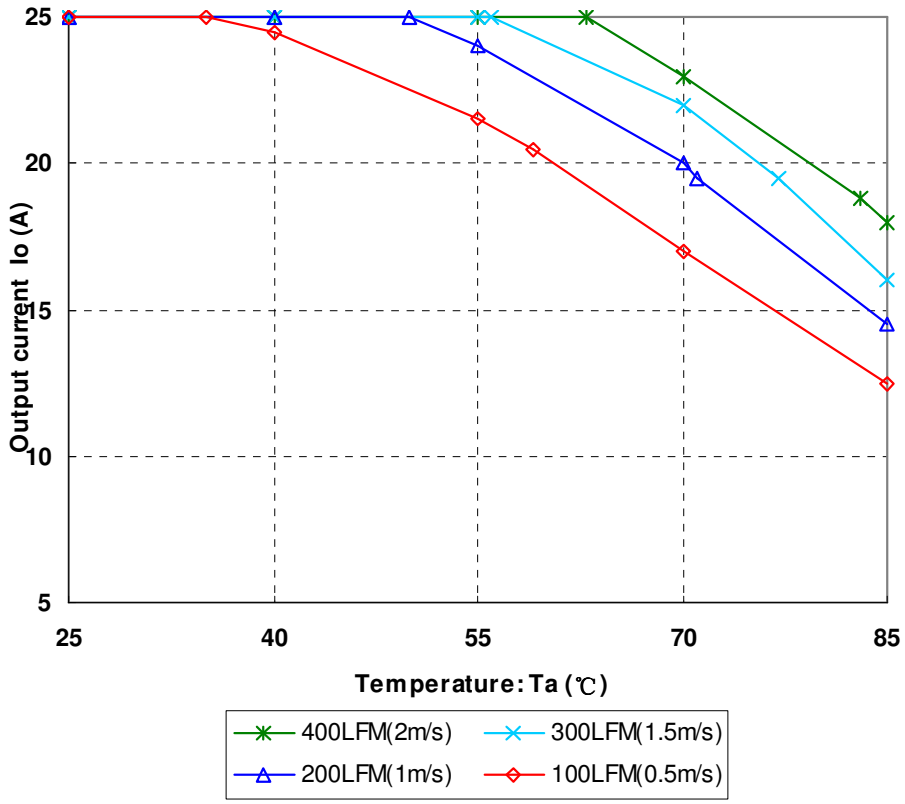

Figure 15 Output power derating, 48V_{in}, air flowing across the converter from pin 1 to pin 3

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 AVQ300-48S12 series power supply.

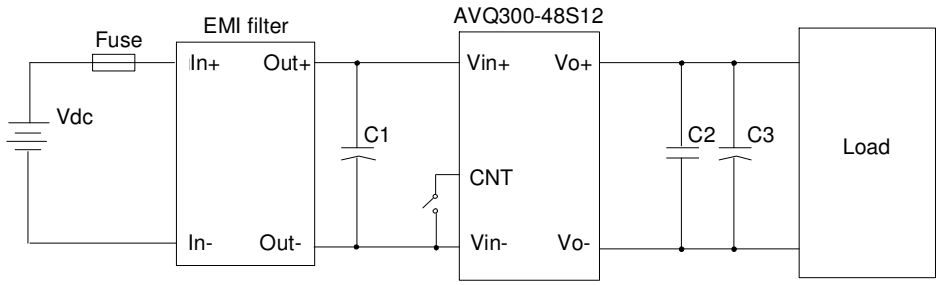

Figure 16 Typical application

C1: 100μF/100V electrolytic capacitor, P/N: UPM2A101MHD (Nichicon) or equivalent caps

C2: 1μF/100V X7R ceramic capacitor, P/N: C3225X7R2A105KT0L0U (TDK) or equivalent caps

C3: 1000μF electrolytic capacitor, P/N: UPM1E102MHP (Nichicon) or equivalent caps

Fuse: External fast blow fuse with a rating of 15A. The recommended fuse model is 0324020 MXP from LITTLEFUSE.

Note: The converter cannot be used in parallel mode directly!

Remote ON/OFF

The converter is equipped with a primary ON/OFF pin used to remotely turn the converter on or off via a system signal. Two CNT logic options are available. For the positive logic model a system logic low signal will turn the converter off. For the negative logic model a system logic high signal will turn the converter off. For negative logic models where no control signal will be used the ON/OFF pin should be connected directly to $-V_{in}$ to ensure proper operation. For positive logic models where no control signal will be used the ON/OFF pin should be left unconnected.

The following figure shows a few simple CNT circuits.

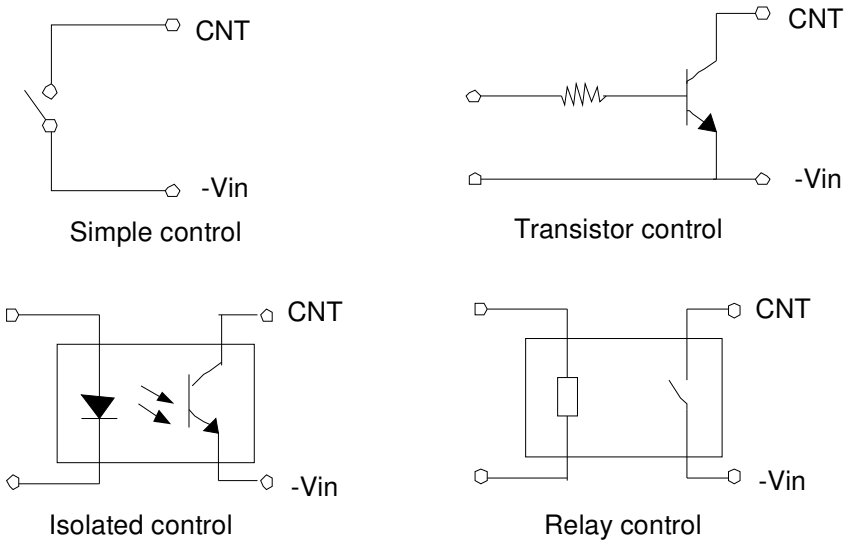

Figure 17 External Remote ON/OFF diagram

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.

$$R_{Trim-down} = (\frac{511}{\Delta\%} - 10.22)k\Omega$$

$$R_{trim-up} = (\frac{5.11V_{nominal}(100+\Delta\%)}{1.225\Delta\%} - \frac{511}{\Delta\%} - 10.22)k\Omega$$

$$\Delta\% = \left|\frac{V_{nominal} - V_{desired}}{V_{nominal}}\right| \times 100$$

V_{nom}: Nominal 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.

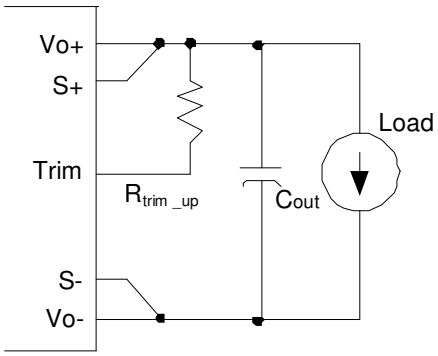

Figure 18 Trim up

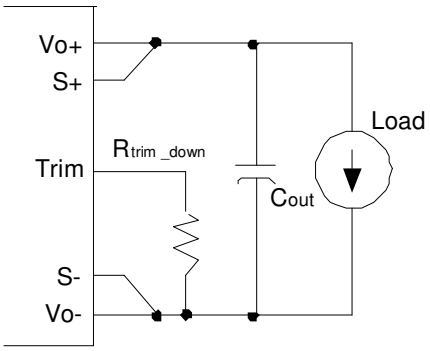

Figure 19 Trim down

Input Ripple & Output Ripple & Noise Test Configuration

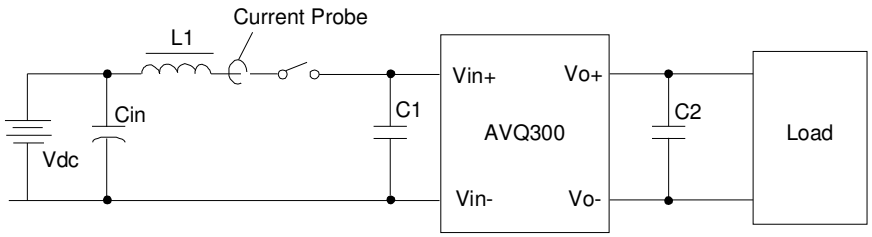

Figure 20 Input ripple & output ripple & noise test configuration

Vdc: DC power supply

L1: 12uH

Cin: 220uF/100V typical

C1: Input electrolytic capacitor, according to the same type as C1 in Figure 16

C2: Output electrolytic capacitor, according to the same type as C3 in Figure 16

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

Sense Characteristics

If the load is far from the unit, connect Sense + and Sense - to the terminals of the load respectively to compensate the voltage drop on the transmission line. See Figure 16.

If the sense compensation function is not necessary, connect Sense + to V_o+ and Sense - to V_o- directly.

Soldering

The product is intended for standard manual, 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
AVQ300-48S12	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