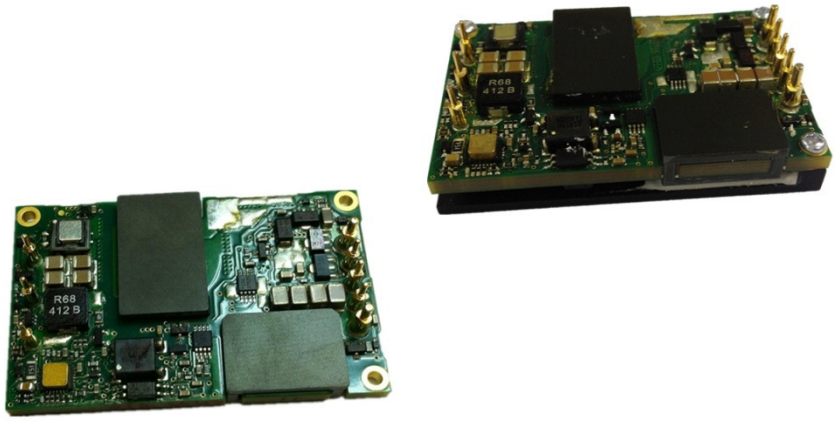
AVQ200-36S12

200 Watts
Quarter-brick Converter



Total Power: 200 Watts
Input Voltage: 18 to 75 Vdc
# of Outputs: Single

Special Features
- Delivers up to 19A output current
- Industry standard quarter brick foot print 57.9mm x 36.8mm x 12.7mm (2.28" x 1.45" x 0.5")
- No minimum load requirement
- Ultra high efficiency: 93% typ. at full load
- Excellent thermal performance
- Wide input voltage of 18V-75V
- Remote control function (negative or positive logic optional)
- Remote sense
- Trim function: 90%~110%
- Input under-voltage lockout
- Output over-current protection
- Output over-voltage protection
- Over-temperature protection
- RoHS 6 compliant
- Pin length option: 3.8mm

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

Product Descriptions
The AVQ200-36S12 series is a single output DC/DC converter with standard quarter-brick form factor and pin configuration. It delivers up to 19A output current with 12V output. Ultra-high 93% efficiency and excellent thermal performance makes it an ideal choice to supply power in telecom and datacom. It can operate over an ambient temperature range of -40 ^{O}C ~ +85 ^{O}C with air cooling.

Applications
Telecom/ Datacom

ARTESYN™
EMBEDDED TECHNOLOGIES

Model Numbers

Standard	Output Voltage	Structure	Remote ON/OFF logic	RoHS Status
AVQ200-36S12-6L	12Vdc	Open-frame	Negative	R6
AVQ200-36S12B-6L	12Vdc	Baseplate	Negative	R6

Ordering information

AVQ200	-	36	S	12	P	B	-	6	L
①		②	③	④	⑤	⑥		⑦	⑧

①	Model series	AVQ: high efficiency quarter brick series, 200: output power 200W
②	Input voltage	36: 18V ~ 75V input range, rated input voltage 24V/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: with baseplate; default: open frame
⑦	Pin length	Omit for 5.8mm 4: 4.8mm 6: 3.8mm 8: 2.8mm
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	$V_{IN,DC}$	0	-	80	Vdc
Non-operating -100mS	All		0	-	100	Vdc
Maximum Output Power	All	$P_{O,max}$	0	-	228	W
Isolation Voltage[1]						
Input to outputs	All		1500	-	-	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	All		-	-	95	%

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

Input Specifications

Table 2. Input Specifications:

Parameter		Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC		All	$V_{IN,DC}$	18	24/48	75	Vdc
Turn-on Voltage Threshold		$I_O = I_{O,max}$	$V_{IN,ON}$	16	17.1	18	Vdc
Turn-off Voltage Threshold		$I_O = I_{O,max}$	$V_{IN,OFF}$	15	15.6	17	Vdc
Lockout voltage hysteresis		$I_O = I_{O,max}$		1	-	3	Vdc
Maximum Input Current ($I_O = I_{O,max}$)		$V_{IN,DC}$ = 18V	$I_{IN,max}$	-	-	15	A
No Load input current				-	0.2	-	A
Standby input current		Remote OFF		-	0.01	0.1	A
Recommended Input Fuse		Fast blow external fuse recommended		-	-	30	A
Input filter component values (C\L)		Internal values		-	4\0.68	-	µF\µH
Recommended External Input Capacitance		Low ESR capacitor recommended	C_{IN}	-	220	-	uF
Input Reflected Ripple Current		Through 12µH inductor		-	70	-	mA
Operating Efficiency	AVQ200-36S12	V_{IN}=24V, $I_O = I_{O,max}$ V_{IN}=48V, $I_O = I_{O,max}$ V_{IN}=24V, I_O = 50%$I_{O,max}$ V_{IN}=48V, I_O = 50%$I_{O,max}$	η	- - - -	92.5 91 93 90	- - - -	%
	AVQ200-36S12B	V_{IN}=24V, $I_O = I_{O,max}$ V_{IN}=48V, $I_O = I_{O,max}$ V_{IN}=24V, I_O = 50%$I_{O,max}$ V_{IN}=48V, I_O = 50%$I_{O,max}$	η	- - - -	93 92 93 90	- - - -	%

Output Specifications

Table 3. Output Specifications:

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Factory Set Voltage		$V_{IN,DC}$ = 24V/48V_{DC} I_O=$I_{O,max}$	V_O	11.76	12.00	12.24	Vdc
Total Regulation		Inclusive of line, load, temperature and life	V_O	11.46	12.00	12.54	Vdc
Output Voltage Line Regulation		$V_{IN,min}$ to $V_{IN,max}$	%V_O	-	0.05	0.2	%
Output Voltage Load Regulation		$I_{O,min}$ to $I_{O,max}$	%V_O	-	0.05	0.2	%
Output Voltage Temperature Regulation		All	%V_O	-	0.002	0.02	%/^{O}C
Output Voltage Trim Range		All	V_O	10.8	-	13.2	V
Output Ripple, pk-pk		Measure with a 1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	80	-	mV_{PK-PK}
Output Current		All	I_O	0	-	19	A
Output DC current-limit inception[1]			I_O	21	-	29	A
Output Capacitance[2]		All	C_O	470	-	3000	uF
V_O Dynamic Response	Peak Deviation Settling Time	50%~75%~50% 25% load change slew rate = 0.1A/us	$\pm V_O$ T_s	- -	150 100	- -	mV uSec
		50%~75%~50% 25% load change slew rate = 1A/us	$\pm V_O$ T_s	- -	200 200	- -	mV uSec
Turn-on transient	Rise time	I_O = $I_{O,max}$	T_{rise}	-	18.8	50	mS
	Turn-on delay time	I_O = $I_{O,max}$	$T_{turn-on}$	-	15	100	mS
	Output voltage overshoot	I_O = $I_{O,max}$	%V_O	-	0	-	%
Switching frequency		All	f_{SW}	-	300	-	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

Note 1 - Hiccup: auto-restart when over-current condition is removed.
Note 2 - High frequency and low ESR is recommended.

Output Specifications

Table 3. Output Specifications, con't:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Output over-voltage protection[3]	All	V_O	13.8	-	15.5	V
Output over-temperature protection[4] With baseplate Without baseplate	 All All	 T T	 - -	 110 130	 120 135	 ^{O}C ^{O}C
Over-temperature hysteresis	All	T	5	-	-	^{O}C
Output voltage remote sense range	All	Vo	-	-	0.6	V
Calculated MTBF	Telcordia SR-332 Method 1 Case3; 80% load; 300LFM, 40 ^{O}C T_A		-	1.5	-	10^6 h

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

AVQ200-36S12 Performance Curves

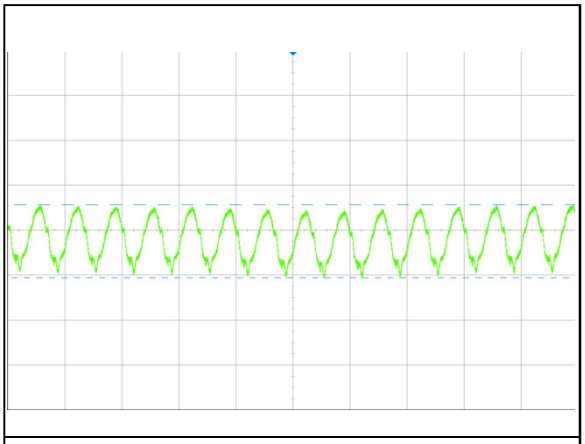


Figure 1: AVQ200-36S12 Input Reflected Ripple Current Waveform

Ch 1: Iin (5uS/div, 40mA/div)

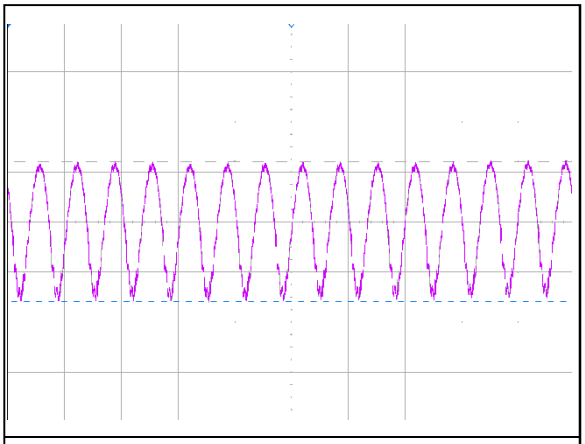


Figure 2: AVQ200-36S12 Ripple and Noise Measurement

Ch 1: Vo (5us/div, 30mV/div)

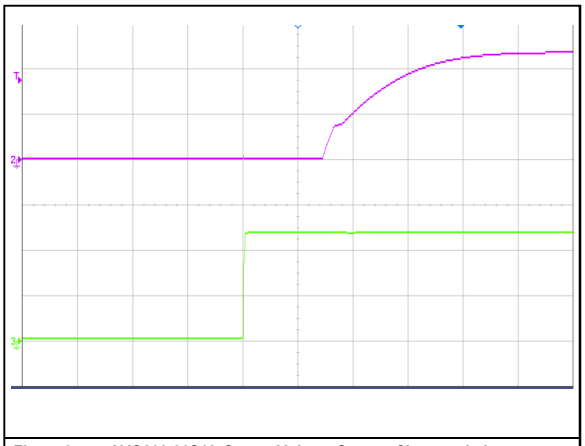


Figure 3: AVQ200-36S12 Output Voltage Startup Characteristic
20ms/div
Ch 2: Vo (5V/div) Ch 3: Vin (20V/div)

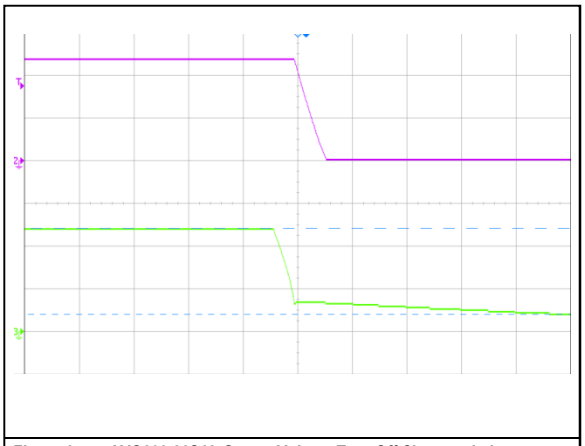


Figure 4: AVQ200-36S12 Output Voltage Turn Off Characteristic
5ms/div
Ch 2: Vo (5V/div) Ch 3: Vin (20V/div)

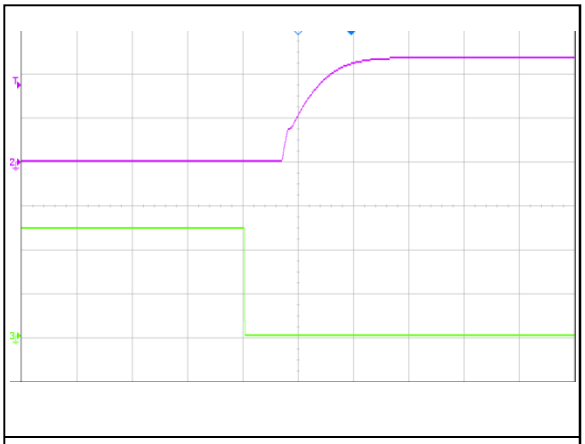


Figure 5: AVQ200-36S12 Remote ON Waveform (10mS/div)
Negative logic
Ch 2: Vo (5V/div) Ch 3: Remote ON (2V/div)

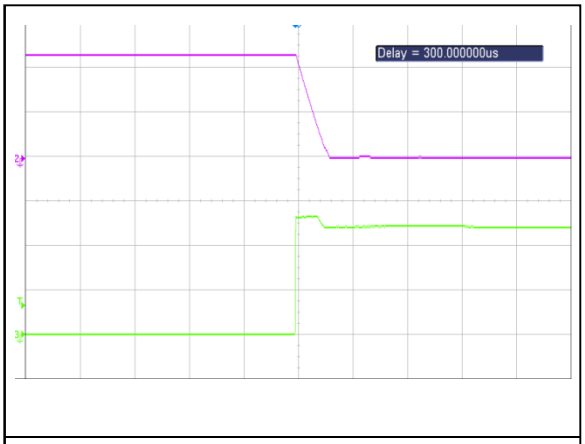


Figure 6: AVQ200-36S12 Remote OFF Waveform (20mS/div)
Negative logic
Ch 2: Vo (5V/div) Ch 3: Remote OFF (2V/div)

AVQ200-36S12 Performance Curves

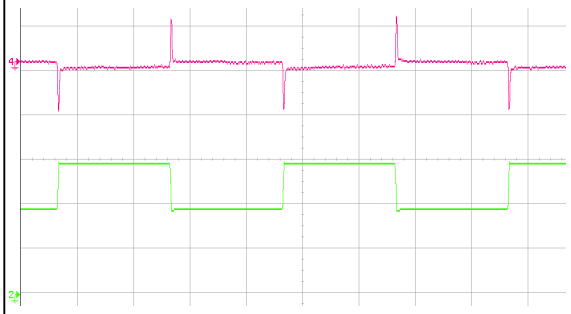


Figure 7: AVQ200-36S12 Transient Response (2mS/div)
50%~75%~50% load change, 0.1A/uS slew rate
Ch 4: Vo (100mV/div) Ch 2: Io (5A/div)

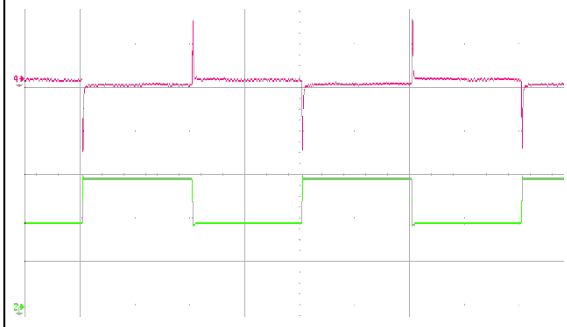


Figure 8: AVQ200-36S12 Transient Response (2mS/div)
50%~75%~50% load change, 1A/uS slew rate
Ch 4: Vo (100mV/div) Ch 2: Io (5A/div)

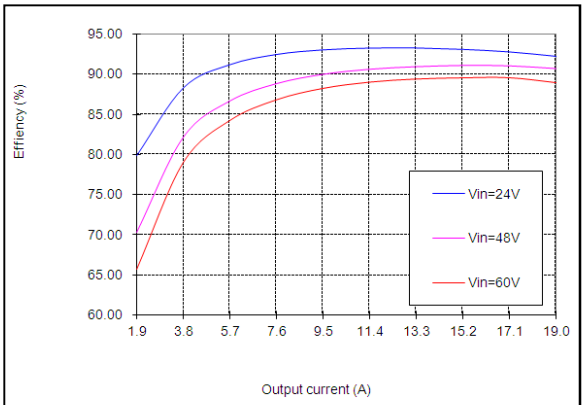


Figure 9: AVQ200-36S12 Efficiency Curves @ 25 degC, Vo=12V
Loading: Io = 10% increment to 19A

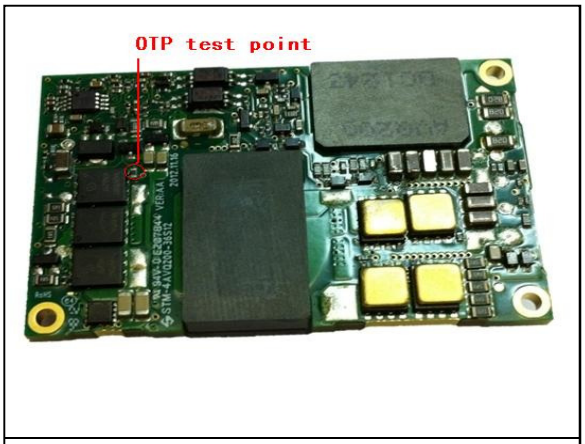


Figure 10: AVQ200-36S12 OTP test point

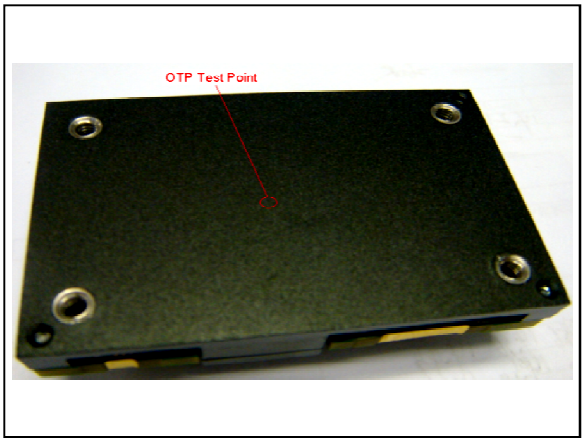
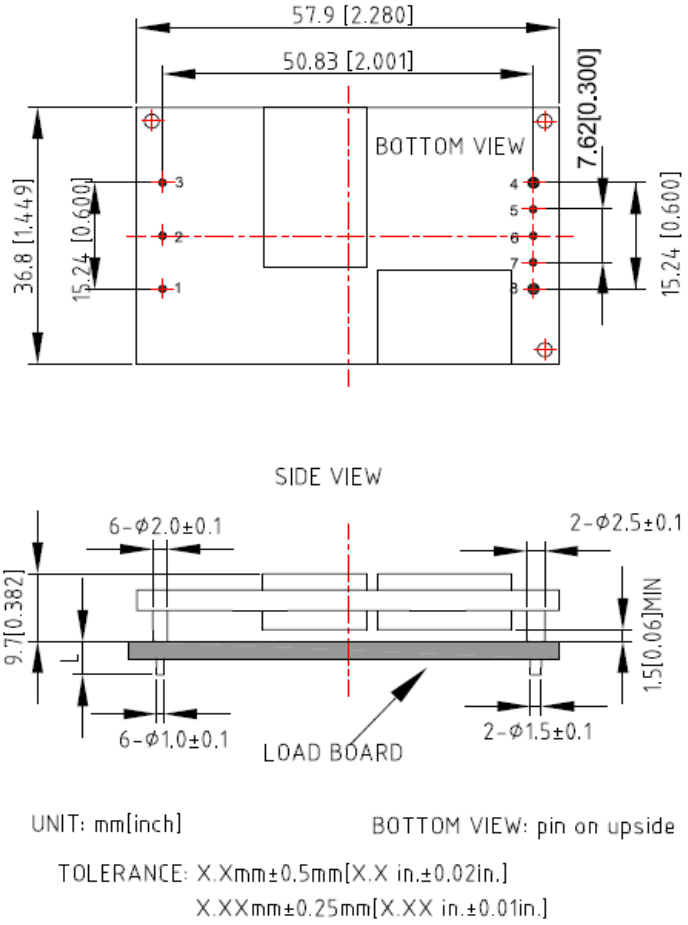


Figure 11: AVQ200-36S12B OTP test point

Mechanical Specifications

Mechanical Outlines – Open Frame Module

AVQ200-36S12



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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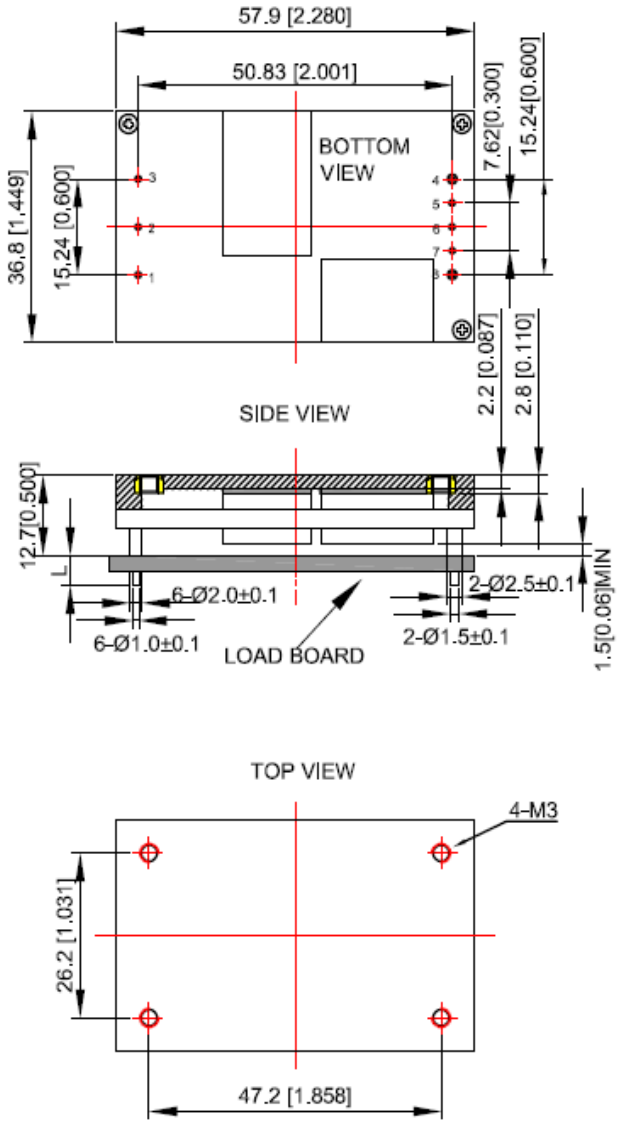
Mechanical Outlines – Baseplate Module

AVQ200-36S12B



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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.]

Pin Length Option

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

Pin Designations

Pin No	Name	Function
1	Vin+	Positive input voltage
2	Remote On/Off	Remote control
3	Vin-	Negative input voltage
4	Vo-	Negative output voltage
5	S-	Negative remote sense
6	Trim	Output voltage trim
7	S+	Positive remote sense
8	Vo+	Positive output voltage

Environmental Specifications

EMC Immunity

AVQ200-36S12 power supply is designed to meet the following EMC immunity specifications:

Table 4. Environmental Specifications:

Document	Description	Criteria
EN55022, Class A Limits	Conducted Emission	/
IEC/EN 61000-4-2, Level 3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques - Electrostatic discharge immunity test. Enclosure Port	B
IEC/EN 61000-4-6, Level 2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Continuous Conducted Interference. DC input port	A
IEC/EN 61000-4-4, Level3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient. DC input port.	B
IEC/EN 61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Immunity to surges - 600V Line to Ground (earth) and 600V Line to Line for DC ports	B
EN61000-4-29	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.

Recommend EMC test Conditions

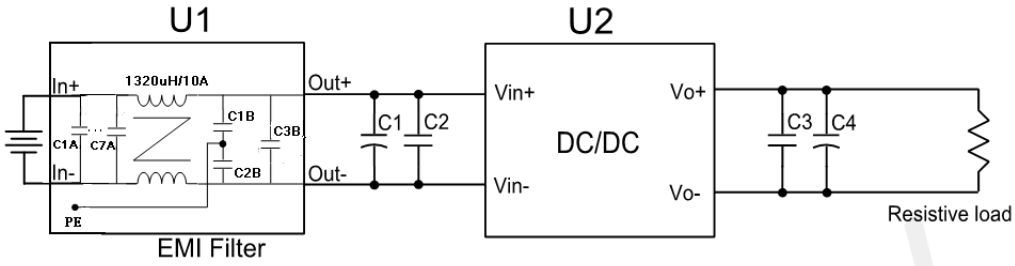

Figure 17 EMC test configuration

Figure 12 EMC test configuration

U1: Input EMC filter

U2: Module to test, AVQ200-36S12

C1 ~ C4: See Figure 23

C1A ~ C7A: Chip SMD ceramic-100V-1000nF-±10%-X7R-1210

C1B, C2B: SMD ceramic- 100nF/1000V/X7R-2220

C3B: SMD ceramic-100V-100nF-±10%-X7R-1206

Safety Certifications

The AVQ200-36S12 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 AVQ200-36S12 series power supply system

Document	File #	Description
UL/CSA 60950		US and Canada Requirements
EN60950		European Requirements
IEC60950		International Requirements
CSA60950		International Requirements
TUV		International Requirements
UL94		Materials meet V-0 flammability rating
EN55022 Class A		Meets conducted emission's requirements with external filter
CE		CE Marking Meets the Low Voltage directives 2006/95/EEC with the Amendment Directive 93/68/EEC which facilitates CE marking in user's end product

Operating Temperature

The AVQ200-36S12 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 – Open-frame module

The converter is designed to operate in different thermal environments and sufficient cooling must be provided. Proper cooling can be verified by measuring the temperature at the test points. The temperature at these test points should not exceed the maximum values in Table 6.

Figure 13 Temperature test point

Table 6. Temperature limit of the test point

Test Point	Temperature Limit
P1	125 ^{O}C
P2	122 ^{O}C

For a typical application, Figure 14 shows the derating of output current vs. ambient air temperature at different air velocity @24V input. Figure 15 shows the derating of output current vs. ambient air temperature at different air velocity @48V input. Figure 16 shows the derating of output current vs. ambient air temperature at different air velocity @60V input. Figure 17 shows the thermal image taken by a RF camera at a rated I/O condition.

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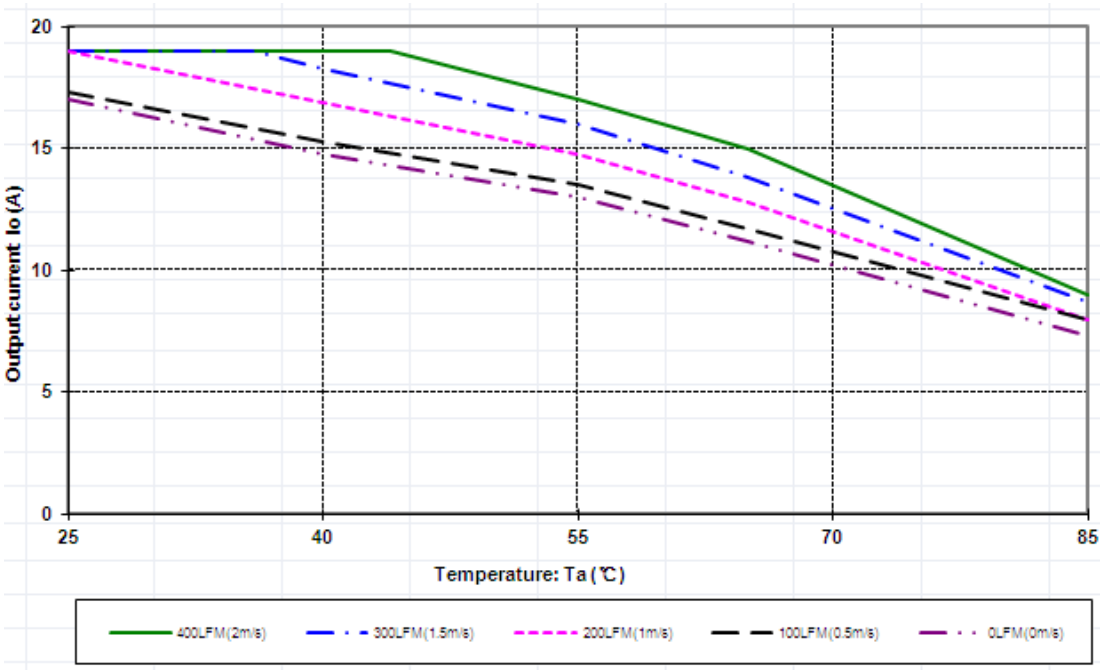

Figure 14 Output power derating, 24V_{in}, air flowing across the converter from Vin to Vout

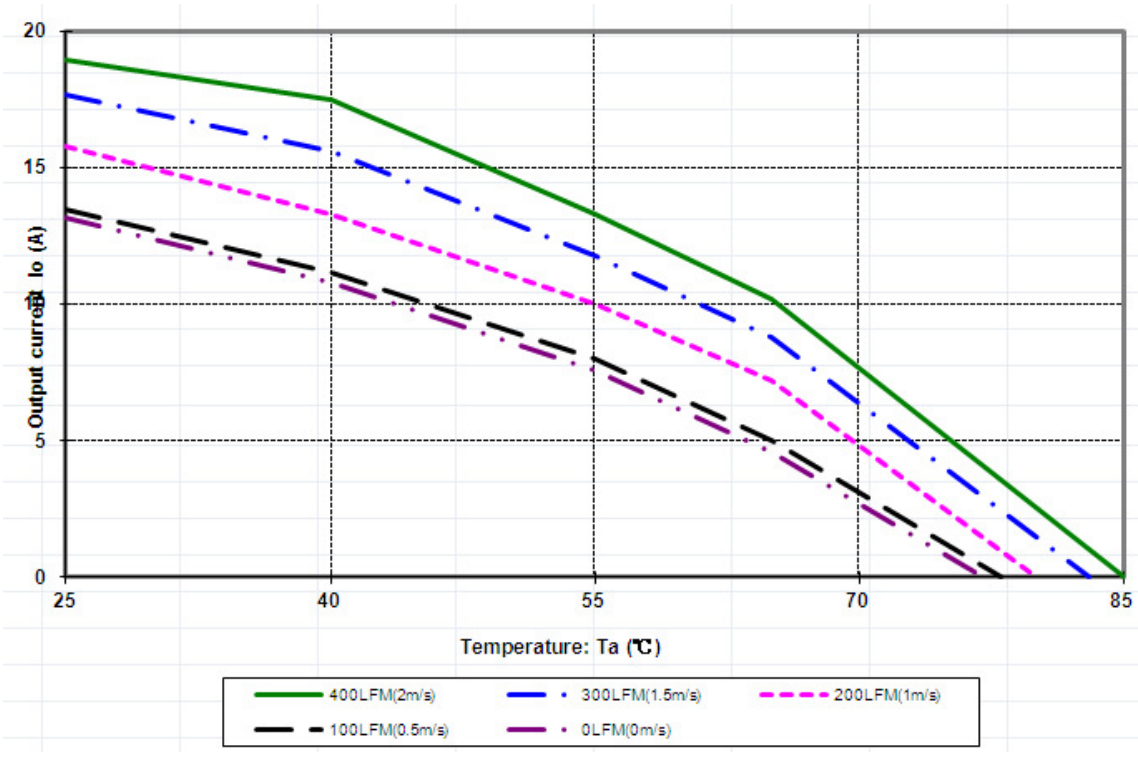

Figure 15 Output power derating, 48V_{in}, air flowing across the converter from Vin to Vout

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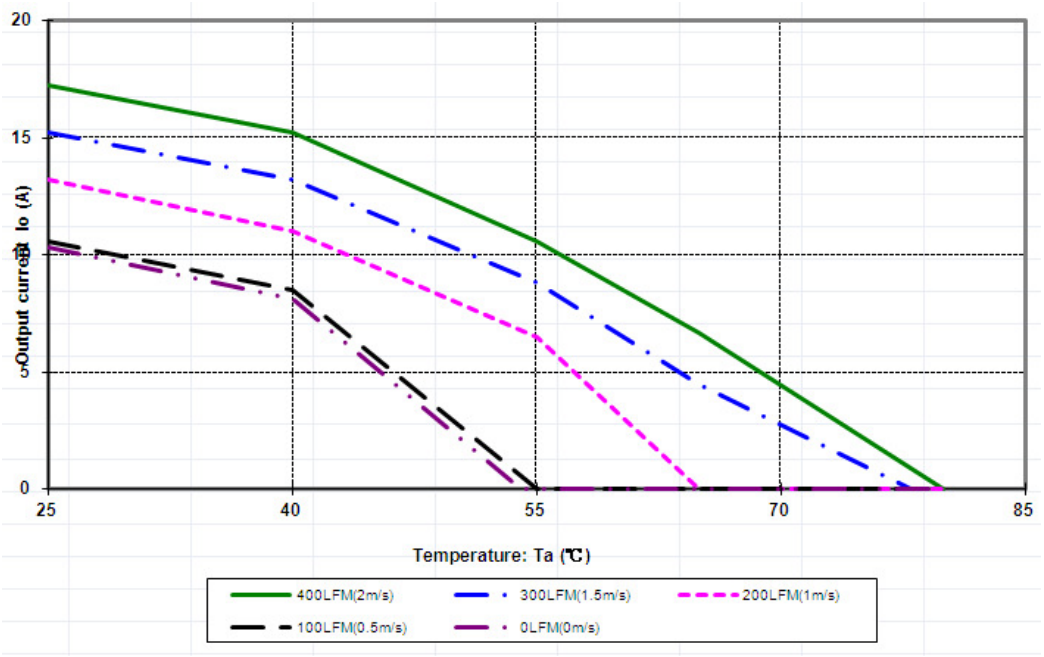
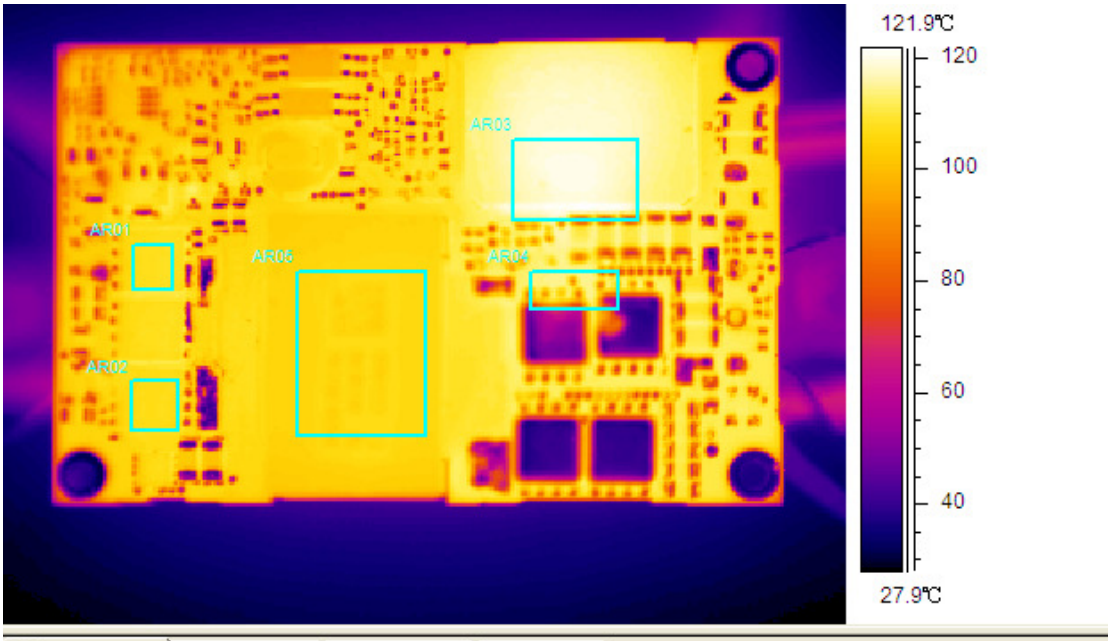


Figure 16 Output power derating, 60V_{in}, air flowing across the converter from Vin to Vout



Analysis | Position | Obj. Par | Image

Label	Value [℃]	Min	Max	Max - Min	Avg	Stdev	Result	Expression
Image		27.6	122.4	94.7				
AR01		106.5	109.1	2.6	108.2	0.5		
AR02		106.0	109.5	3.5	107.5	0.5		
AR03		72.6	122.4	49.7	117.9	6.3		
AR04		47.8	115.3	67.6	100.6	16.4		
AR05		104.0	107.8	3.7	106.4	0.7		

Figure 17 Thermal image, 48V_{in}, 12V_o, full load, room temperature

Thermal Considerations –Base plate module

The converter is designed to operate in different thermal environments and sufficient cooling must be provided. Proper cooling can be verified by measuring the temperature at the test points as shown in Figure 18. The temperatures at these points should not exceed the maximum values in Table 7.

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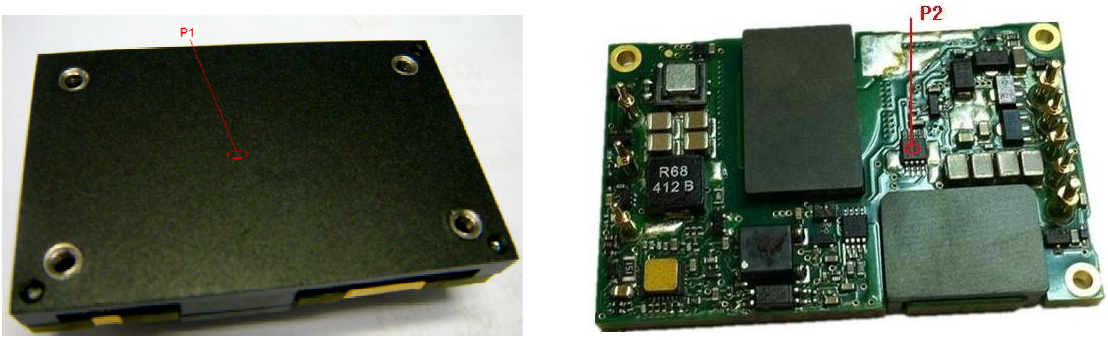

Figure 18 Temperature test point

Table 7. Temperature limit of the test point

Test Point	Temperature Limit
P1	110 ^{O}C
P2	122.5 ^{O}C

For a typical application, figure 20 shows the derating of output current vs. ambient air temperature at different air velocity @24V input with a specified heatsink. Figure 21 shows the derating of output current vs. ambient air temperature at different air velocity @48V input with a specified heatsink. Figure 22 shows the derating of output current vs. ambient air temperature at different air velocity @60V input with a specified heatsink. The typical test condition is shown in Figure 19.

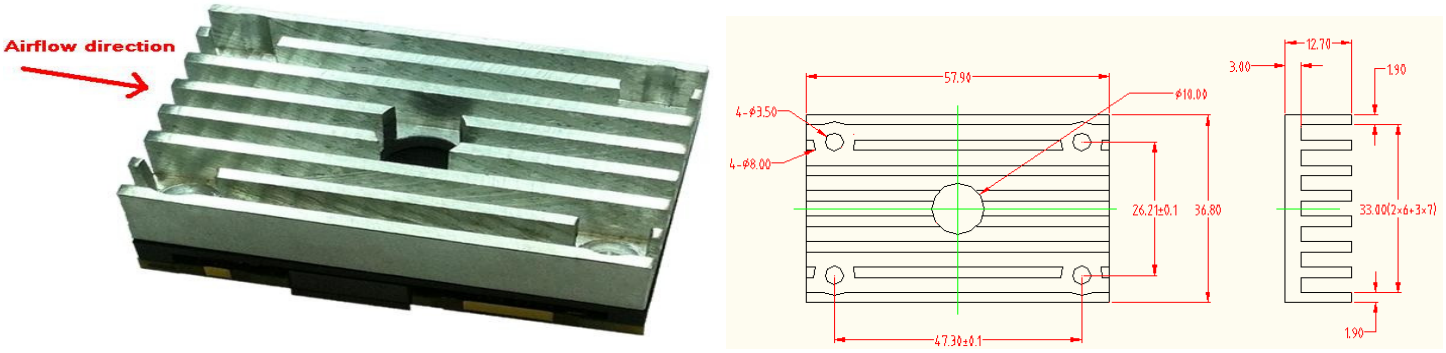

Figure 19 Typical test condition, heatsink

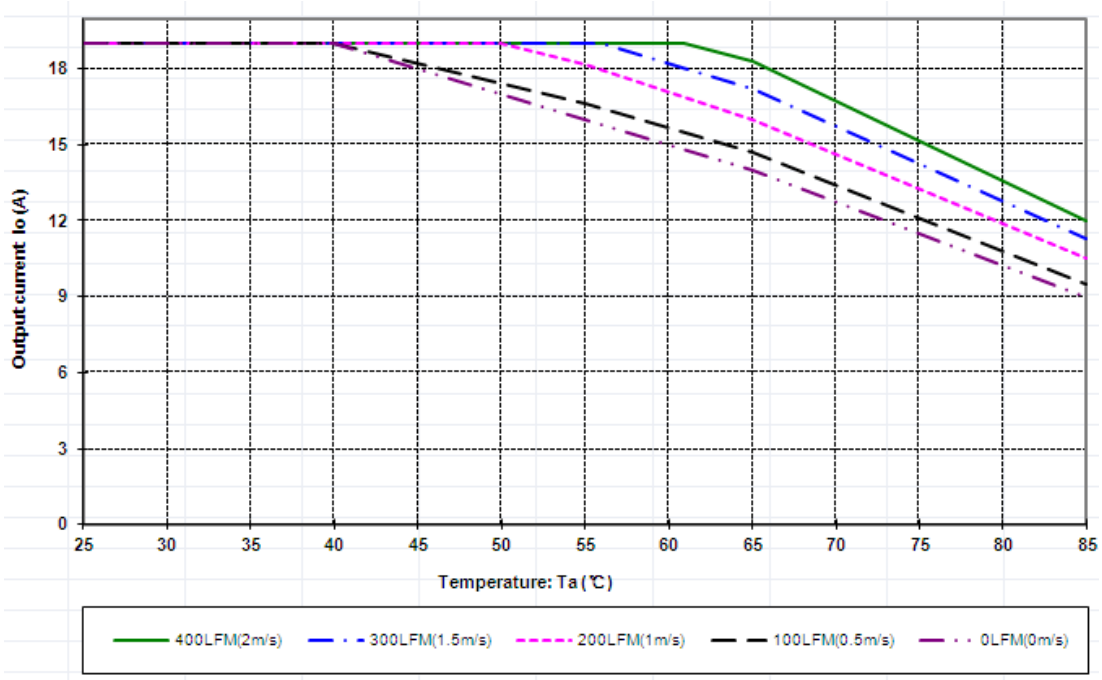

Figure 20 Output power derating, 24V_{in}, air flowing across the converter from Vin to Vout

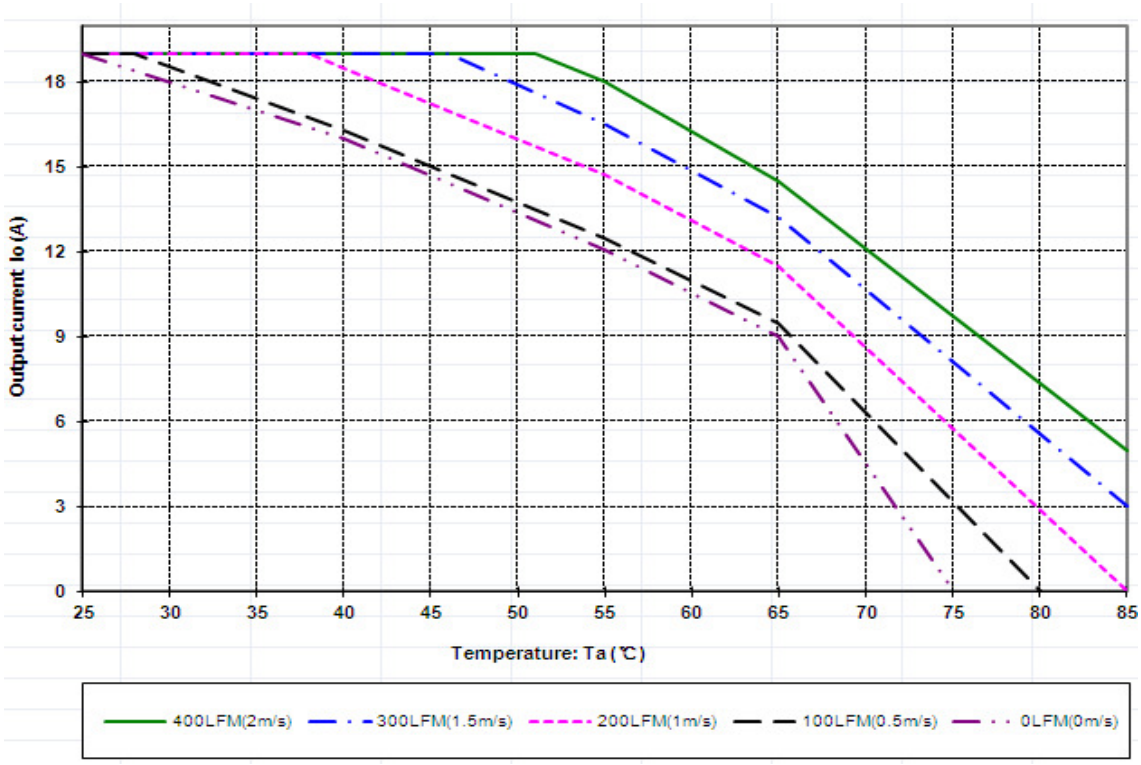

Figure 21 Output power derating, 48V_{in}, air flowing across the converter from Vin to Vout

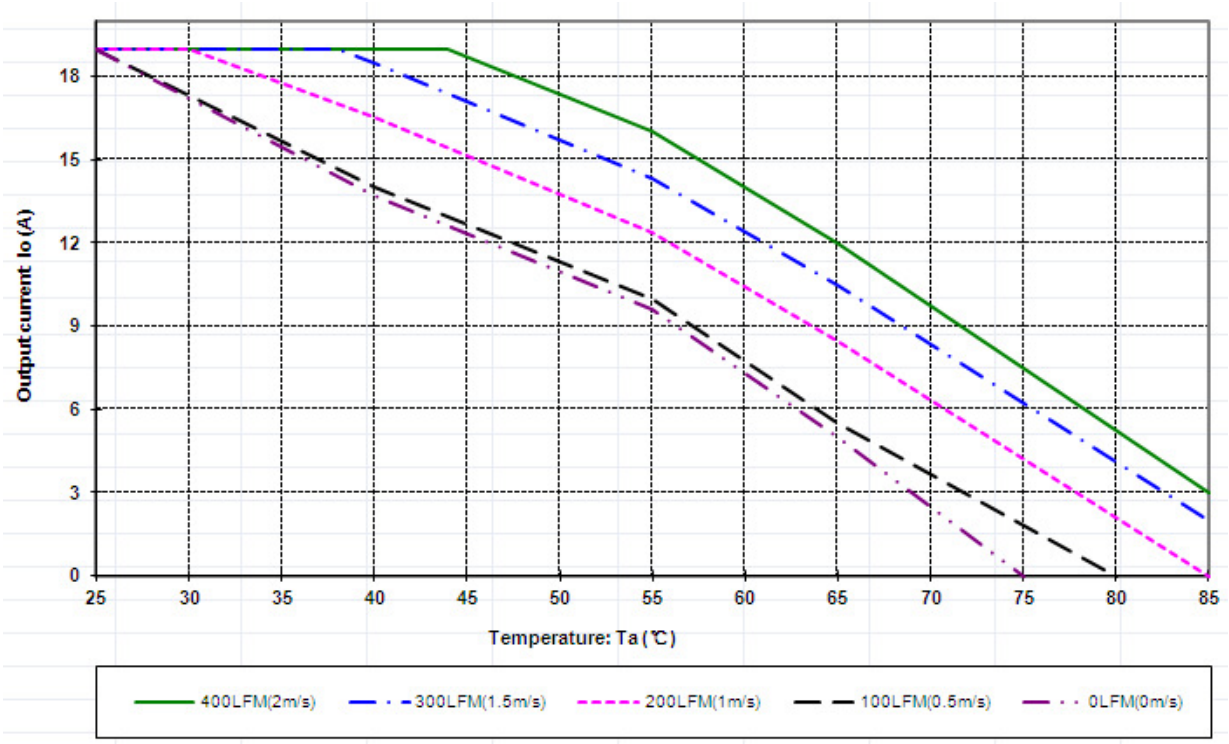

Figure 22 Output power derating, 60V_{in}, air flowing across the converter from Vin to Vout

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/axis
Mechanical Shock	3	30g, 6ms, 3axes, 6directions, 3times/direction
Thermal Shock	3	-55 ^{O}C to 125 ^{O}C, unit temperature 20cycles
Thermal Cycling	3	-40 ^{O}C to 85 ^{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 AVQ200-36S12 series power supply.

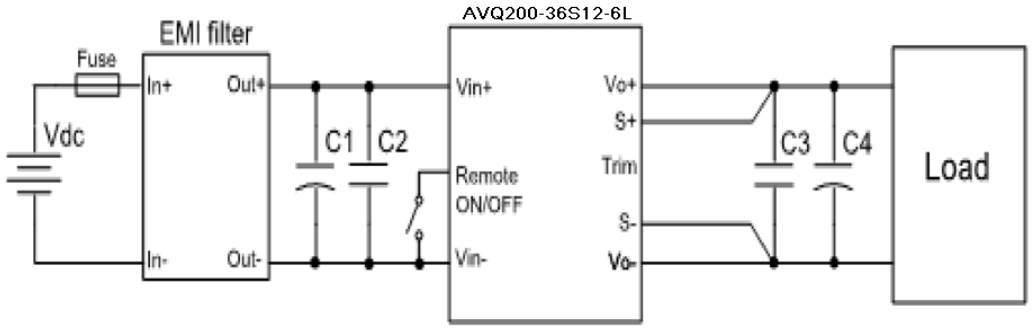

Figure 23 Typical application

C1: 220μF/100V electrolytic capacitor, P/N: UPM2A221MPD (Nichicon) or equivalent caps

C2, C3: 1μF/100V X7R ceramic capacitor, P/N: C3225X7R2A105KT0L0U (TDK) or equivalent caps

C4: 470μF/25V electrolytic capacitor, P/N: UPM1E471MED (Nichicon) or equivalent caps

Note: If ambient temperature is below -5 ^{O}C, double output capacitor (Low ESR, ESR≤100m ohm) is needed for output.

Fuse: External fast blow fuse with a rating of 30A/250Vac. The recommended fuse model is 0314030 MRP from Karwin Tech limited.

Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AVQ200-36S12 series. The logic is CMOS and TTL compatible.

Below is the detailed internal circuit and reference in AVQ200-36S12 series.

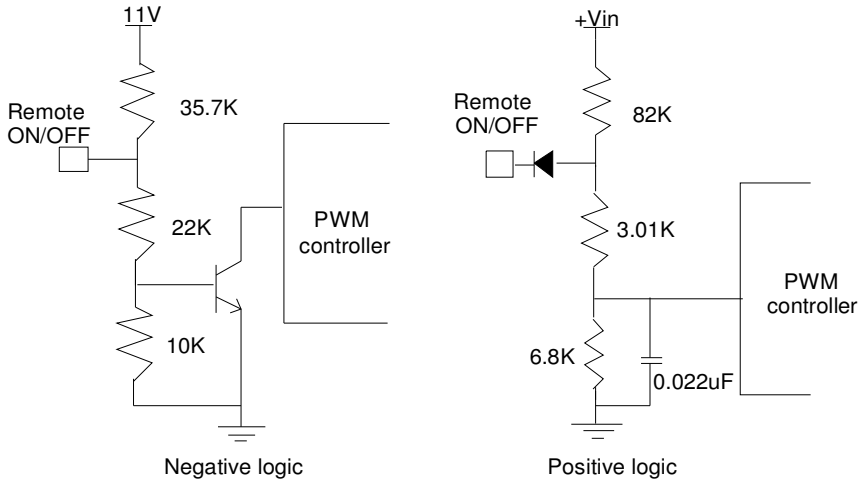

Figure 24 Remote ON/OFF internal diagram

The voltage between pin Remote ON/OFF and pin Vin- must not exceed the range listed in table “Output Specifications” to ensure proper operation. The external remote ON/OFF circuit is highly recommended as shown in Figure 25.

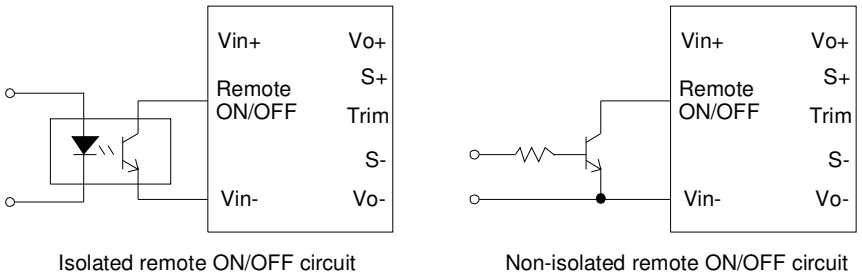

Figure 25 External Remote ON/OFF circuit

Trim Characteristics

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.

$$R_{adj-down} = \frac{511}{\Delta} - 10.22(K\Omega)$$

$$R_{adj-up} = \frac{5.11 \times V_{nom} \times (100+\Delta)}{1.225 \times \Delta} - \frac{511}{\Delta} - 10.22(K\Omega)$$

△: Output e rate against nominal output voltage.

$$\Delta = \frac{100 \times (V_{nom} - V_0)}{V_{nom}}$$

V_{nom}: Nominal output voltage

For example, to get 13.2V output, the trimming resistor is

$$\Delta = \frac{100 \times (V_{nom} - V_0)}{V_{nom}} = \frac{100 \times (13.2 - 12)}{12} = 10$$

$$R_{adj-up} = \frac{5.11 \times 12 \times (100+10)}{1.225 \times 10} - \frac{511}{10} - 10.22 = 489.3(K\Omega)$$

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

$$V_O = (V_{trim} + 1.225) \times 1.347$$

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

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

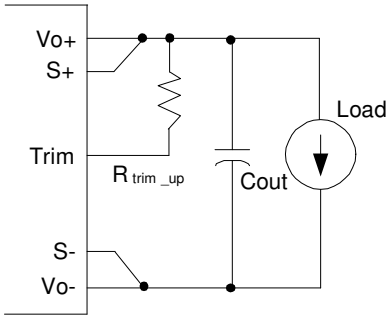

Figure 26 Trim up

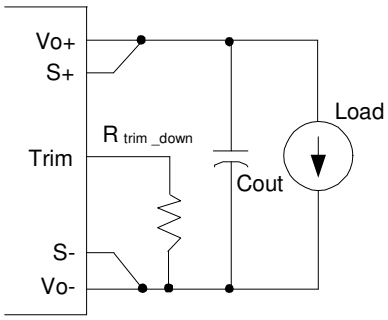

Figure 27 Trim down

Input Ripple & Inrush Current and Output Ripple & Noise Test Configuration

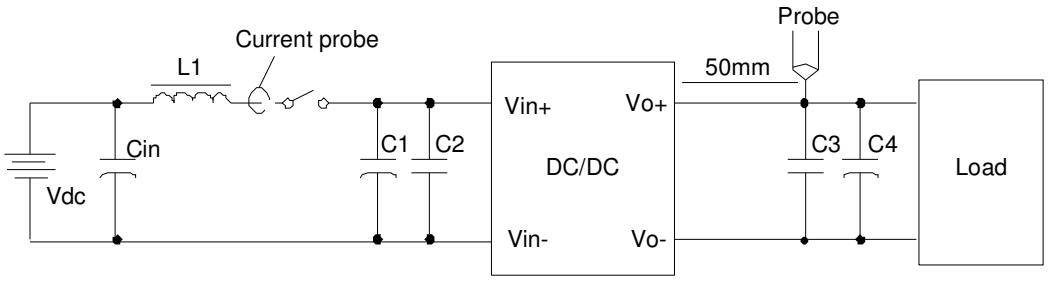

Figure 28 Input ripple & inrush current output ripple & noise test configuration

Vdc: DC power supply

L1: 12uH

Cin: 220uF/100V typical

C1 ~ C4: See Figure 23

Note - Using a coaxial cable with series 50ohm resistor and 0.68uF 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 S+ and S- to the terminal of the load respectively to compensate the voltage drop on the transmission line. See Figure 23.

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

Soldering

The product is intended for standard manual or wave soldering.

When wave soldering is used, the temperature on pins is specified to maximum 255 ^{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 simulative.

	Product requirement	Remark	Product Name
R6	Wave soldering	12V	AVQ200-36S12-6L
R6	Wave soldering	12V	AVQ200-36S12B-6L

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Hazardous Substances Announcement (RoHS of China)

Parts	Hazardous Substances					
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
AVQ200-36S12 series	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	05.11.2015	First Issue	A. Zhang
1.1	09.18.2015	Updated the mechanical outlines for AVQ200-36S12	K. Wang

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