48Vdc/24Vdc Input, 3.3Vdc@25A Output
Quarter-brick Converter AVQ100-36S3V3

• Description

The AVQ100-36S3V3 is a single output DC-DC converter with standard quarter-brick outline and pin configuration. It delivers up to 25A output current with 3.3V output voltage. above 90% efficiency and excellent thermal performance makes it an ideal choice to supply power in telecom and datacom. It can work under -40°C ~ +85°C. 18V ~ 60V wide input range makes it possible for both 24V and 48V power system application.

Operational Features

- Delivers up to 25A output current
- High efficiency: 90% (typ., full load, 48V). 92% (typ., half load, 24V)
- Wide input range: 18V ~ 60V
- Excellent thermal performance
- No minimum load requirement
- Start-up and shut-down monotonically into any normal and pre-biased loads, internal pre-bias function circuit prevents back negative current drawn from external load
- RoHS 5/6,RoHS 6/6 compliant

Control Features

- Remote control function (negative or positive logic optional)
- Remote output sense
- Trim function: 80% ~ 110%

Protection Features

- Input under voltage lockout
- Output over current protection
- Output over voltage protection
- Over temperature protection



Mechanical Features

- Industry standard quarter-brick pin-out outline
- open frame structure and with baseplate option
- Pin length option: 3.8mm, 4.8mm, 5.8mm

Safety & EMC

- Meets safety standards UL 60950-1, CSA-C22.2 NO.60950-1, IEC/EN 60950-1 and GB4943.
- Approved by UL and TUV.
- Meets 2006/95/EEC and 93/68/EEC directives which facilitates CE marking in user's end product
- Meets conducted emission's requirements of FCC Class (and EN55022 Class A with external filter.

Electrical Characteristics

Full operating ambient temperature range is -40°C to +85°C.
Specifications are subject to change without notice.

Parameter		Min.	Typ.	Max.	Unit	Notes & Conditions
Absolute max. ratings						
Input voltage	Non-operating			80	V	100ms
	Operating			60	V	Continuous
Operating temperature		-40		85	°C	
Storage temperature		-55		125	°C	
Voltage at remote ON/OFF pin		-0.7		12	V	
Input characteristics						
Operating input voltage range		18	48	60	V	
Input under-voltage lockout	Turn-on voltage threshold	16.2	16.7	17.2	V	
	Turn-off voltage threshold	14.6	15.1	15.6	V	
	Lockout voltage hysteresis	1.1	1.6	2.1	V	
Max. input current				6	A	$18V_{in}$, full load
No-load input current				0.1	A	
Standby Input current			0.005	0.01	A	Remote OFF
Inrush current transient rating				0.5	A^2s	Figure 14
Input reflected ripple current			10	20	mA	Through 12μH inductor; Figure 14
Recommended input fuse				15	A	Fast blow external fuse recommended; Figure 10
Input filter component values (C\L)			7.6\2.2		μF\μH	Internal values
Recommended external input capacitance			100		μF	Low ESR capacitor recommended; Figure 10
Output characteristics						
Output voltage set point (standard option)		3.267	3.300	3.333	V	$48V_{in}$, full load
Output voltage line regulation			0.05	0.15	%	
			2	5	mV	
Output voltage load regulation			0.05	0.15	%	
			2	5	mV	

Parameter		Min.	Typ.	Max.	Unit	Notes & Conditions
Output voltage temperature regulation			0.02		%/°C	
Total output voltage range		3.25	3.30	3.35	V	Over sample, line, load, temperature & life
Output voltage ripple and noise			40	70	mVpp	Figure 2 20MHz bandwidth; Figure 14
Operating output current range		0		25	A	
Output DC current-limit inception		27.5		35	A	Hiccup: auto-restart when over-current condition is removed
Reverse current-limit while enabled		0.5	1.0	2.0	A	Negative current drawn from output
Reverse current-limit while disabled		0	10	50	mA	Negative current drawn from output
Vout pre-bias level				90	$\%V_o$	
Output capacitance		470	470	10000	μF	High frequency and low ESR is recommended
Dynamic characteristics						
Dynamic response	50% ~ 75% ~ 50% $I_{o,max}$, 0.1A/μs		150		mV	Figure 4 Test condition: 25°C, nominal input voltage, see Figure 10
	Settling time		100		μs	Recovery to within 1% $V_{o,nom}$
	50% ~ 75% ~ 50% $I_{o,max}$, 1A/μs		180		mV	Figure 5 Test condition: 25°C, nominal input voltage, see Figure 10
	Settling time		200		μs	Recovery to within 1% $V_{o,nom}$
Turn-on transient	Rise time		10	30	ms	Full load, Figure 6
	Turn-on delay time		5	10	ms	
	Output voltage overshoot		0		$\%V_o$	
Efficiency						
100% load ($24V_{in}$)			90		%	Figure 1
50% load ($24V_{in}$)			92		%	Figure 1
100% load ($48V_{in}$)			90.5			Figure 1
50% load ($48V_{in}$)			90			Figure 1

Electrical Characteristics (Continued)

Parameter		Min.	Typ.	Max.	Unit	Notes & Conditions
Isolation characteristics						
Isolation voltage (conditions: 1mA for 60s, slew rate of 1500V/10s)		1500			V	Basic insulation, pollution degree 2, input to output
		1500			V	Basic insulation, pollution degree 2, input to baseplate
		1500			V	Basic insulation, pollution degree 2, output to baseplate
Feature characteristics						
Switching frequency		295	300	305	kHz	
Remote ON/OFF control (positive logic)	Off-state voltage	-0.7		1.2	V	See Figure 11
	On-state voltage	3.5		12	V	
Remote ON/OFF control (negative logic)	Off-state voltage	3.5		12	V	
	On-state voltage	-0.7		1.2	V	
Output voltage trim range		2.64		3.63	V	See *Trim Characteristics* of *Application Note*
Output voltage remote sense range				0.3	V	
Output over-voltage protection		3.8	4.2	5	V	Hiccup: auto-restart when over-voltage condition is removed
Over-temperature shutdown			125		°C	Auto recovery;over-temperature protect(OTP) test point: see Figure 16
Over-temperature hysteresis			5		°C	
Reliability characteristics						
Calculated MTBF (telcordia)			2.5		10^6h	Telcordia SR-332-2006; 80% load, 300LFM, 40°C T_a

Electromagnetic compatibility requirements

Test Item	Regulations	Criteria	Notes & Conditions
Conducted Emission	EN 55022 DC input port, Class A Limits	/	See EMC test conditions
Immunity to Electrostatic Discharge	IEC/EN61000-4-2 Enclosure Port, Level 3	B	
Immunity to Electrical Fast Transient	IEC/EN61000-4-4 DC input port, Level 3	B	
Immunity to Surges	IEC/EN61000-4-5 DC input port Line to Ground(earth): 600V Line to Line: 600V	B	
Immunity to Continuous Conducted Interference	IEC/EN61000-4-6 DC input port, Level 2	A	
Immunity To Voltage Dips and short interruptions and voltage variations	EN 61000-4-29 DC input port	B	

Criterion A: Normal performance during and after test.
Criterion B: For EFT and surges, low-voltage protection or reset is not allowed. Temporary output voltage fluctuation ceases after disturbances ceases, and from which the EUT recovers its normal performance automatically.
For Dips and ESD, output voltage fluctuation or reset is allowed during the test, but recovers to its normal performance automatically after the disturbance ceases.
Criterion C: Temporary loss of output, the correction of which requires operator intervention.
Criterion D: Loss of output which is not recoverable, owing to damage to hardware.

Qualification Testing

Parameter	Unit (pcs)	Test condition
Halt test	4 ~ 5	$T_{a,min}$-10°C to $T_{a,max}$+10°C, 5°C step, V_{in} = min to max, 0 ~ 105% load
Vibration	3	Frequency range: 5Hz ~ 20Hz, 20Hz ~ 200Hz, A.S.D: 1.0m^2/s^3, -3db/oct, axes of vibration: X/Y/Z Time: 30min/axis
Mechanical shock	3	30g, 6ms, 3axes, 6directions, 3time/direction
Thermal shock	3	-40°C to 100°C, unit temperature 20cycles
Thermal cycling	3	-40°C to 55°C, temperature change rate: 1°C/min, cycles: 2cycles
Humidity	3	40°C, 95%RH, 48h
Solder ability	15	IPC J-STD-002C-2007

Characteristic Curves

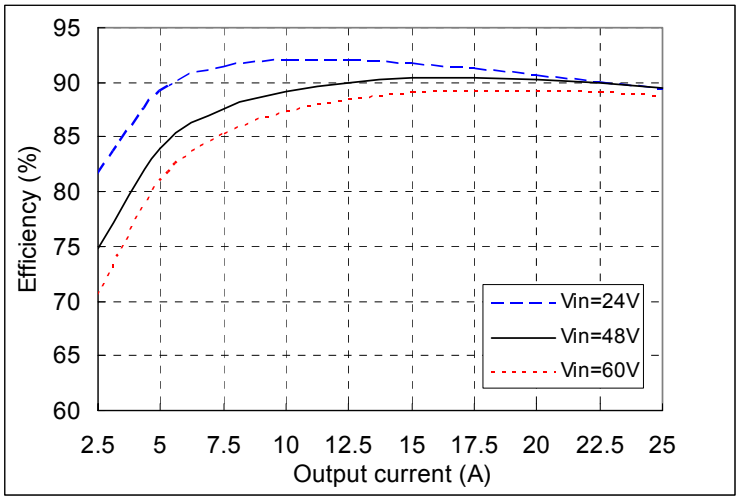


Figure 1 Efficiency vs. Output current, T_a=25°C, V_o=3.3V

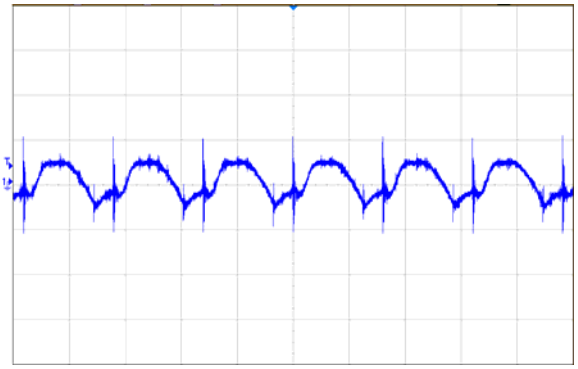


Figure 2 Output ripple & noise (2μs/div, 20mV/div), see Figure 14 for test configuration

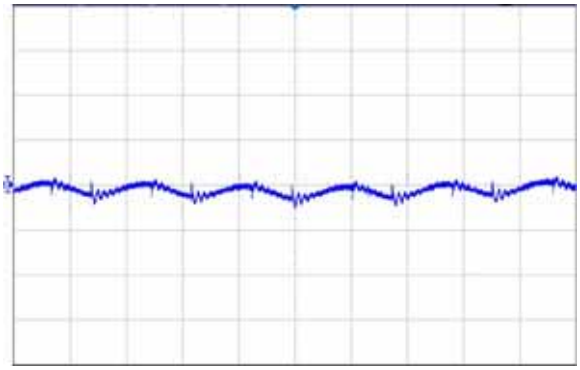


Figure 3 Input reflected ripple current (2μs/div, 5mA/div), see Figure 14 for test configuration

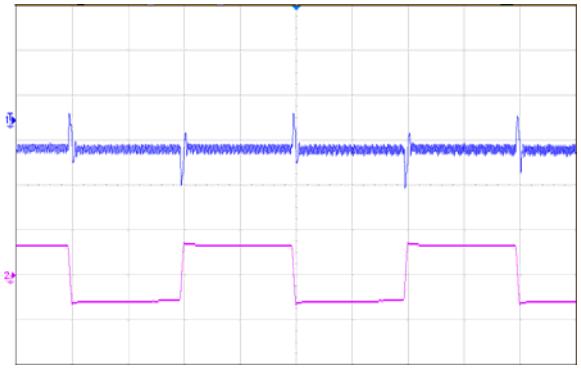


Figure 4 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 0.1A/μs slew rate, (1ms/div), see Figure 10 for test configuration; CH1-output voltage (50mV/div); CH2-output current (2A/div)

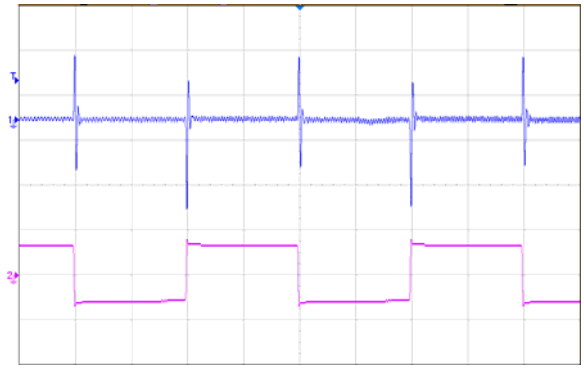


Figure 5 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 1A/μs slew rate, (1ms/div), see Figure 10 for test configuration; CH1-output voltage (100mV/div); CH2-output current (2A/div)

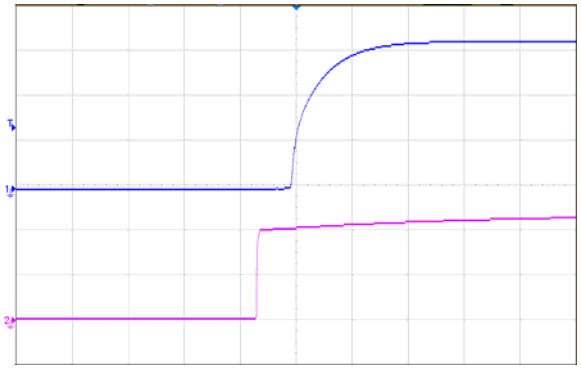


Figure 6 Output voltage startup by power on, (5ms/div), see Figure 10 for test configuration; CH1-output voltage (1V/div); CH2-intput voltage (20V/div)

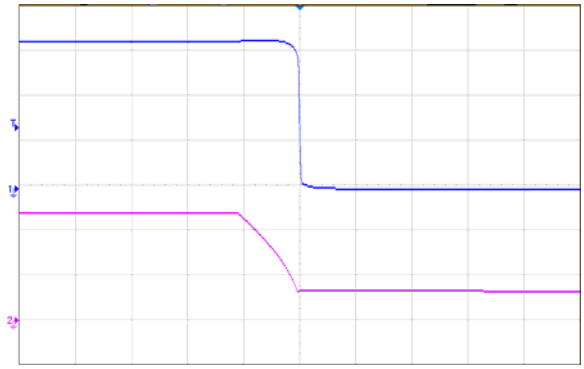


Figure 7 Output voltage shut down by power off, (2ms/div), see Figure 10 for test configuration; CH1-output voltage (1V/div); CH2-input voltage (20V/div)

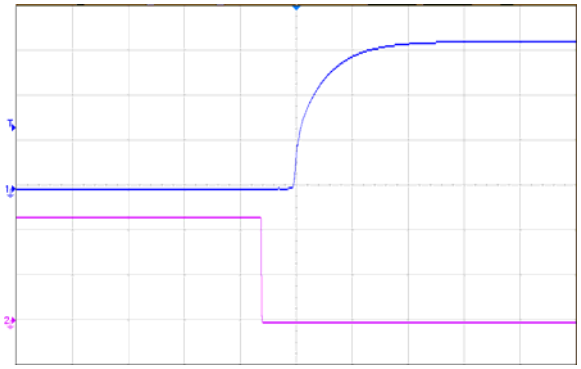


Figure 8 Output voltage startup by remote ON, (5ms/div), see Figure 10 for test configuration; CH1-output voltage (1V/div); CH2-remote ON (2V/div)

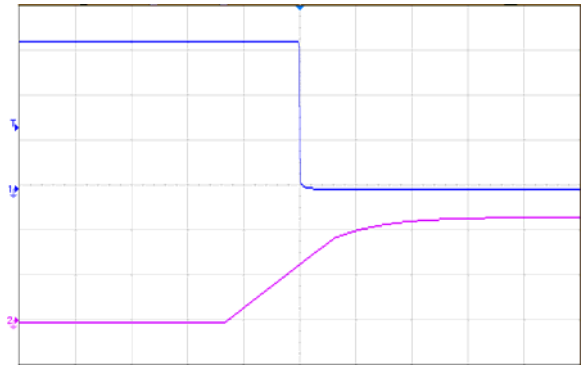


Figure 9 Output voltage shutdown by remote OFF, (5ms/div), see Figure 10 for test configuration; CH1-output voltage (1V/div); CH2-remote OFF voltage (2V/div)

Application Note

Typical Application

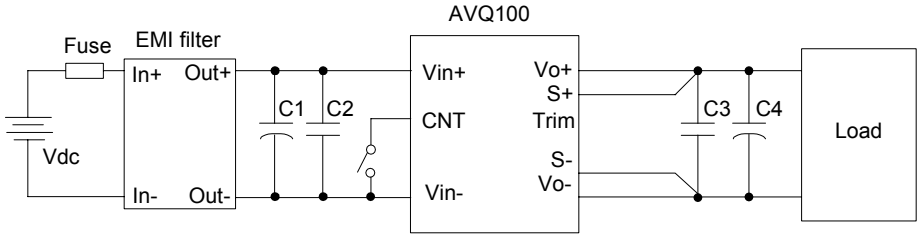


Figure 10 Typical application

C1: 100μF/100V electrolytic capacitor, P/N: UPW2A101MHD (Nichicon) or equivalent caps
C2: 1μF/100V X7R ceramic capacitor, P/N: C3225X7R2A105KT0L0U (TDK) or equivalent caps
C3: 1μF/25V X7R ceramic capacitor, P/N: C3225X7R1E105KT000N (TDK) or equivalent caps
C4: 470μF electrolytic capacitor, P/N: UUD1H471MNL1GS (Nichicon) or equivalent caps
Fuse: External fast blow fuse with a rating of 15A. The recommended fuse model is 0324020 MXP from LITTLEFUSE.

Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AVQ100-36S3V3. The logic is CMOS and TTL compatible.
Below is the detailed internal circuit and reference in AVQ100-36S3V3.

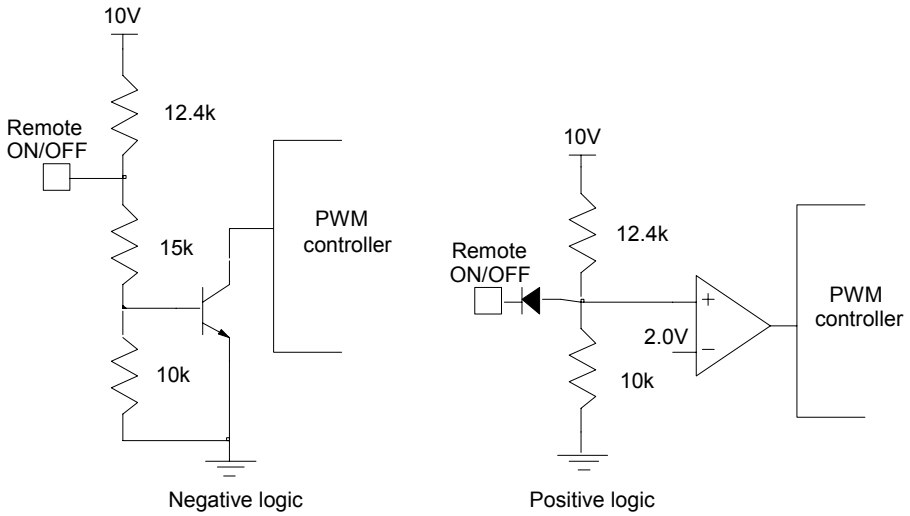


Figure 11 Remote ON/OFF internal diagram

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.

$$R_{adj-down} = \frac{510}{\Delta} - 10.2(K\Omega)$$

$$R_{adj-up} = \frac{5.1 \times V_{nom} \times (100 + \Delta)}{1.225 \times \Delta} - \frac{510}{\Delta} - 10.2(K\Omega)$$

$$\Delta = \frac{|V_{nom} - V_{desired}|}{V_{nom}} \times 100$$

V_{norm} : Nominal output voltage.

For example, to get 3.63V output, the trimming resistor is

$$R_{adj-up} = \frac{5.1 \times 3.3 \times (100 + 10)}{1.225 \times 10} - \frac{510}{10} - 10.2(K\Omega) = 89.9K\Omega$$

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

$$V_O = (V_{trim} + 1.225) \times 2.69$$

Where V_{trim} is the potential 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 and the minimum input voltage should be increased as shown in the following figures.

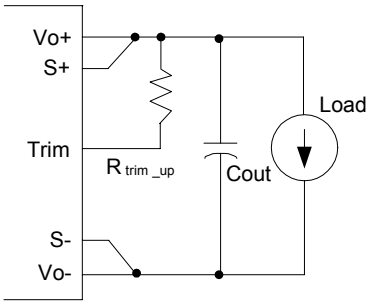


Figure 12 Trim up

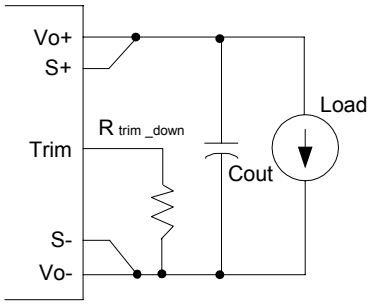


Figure 13 Trim down

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 10.

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

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

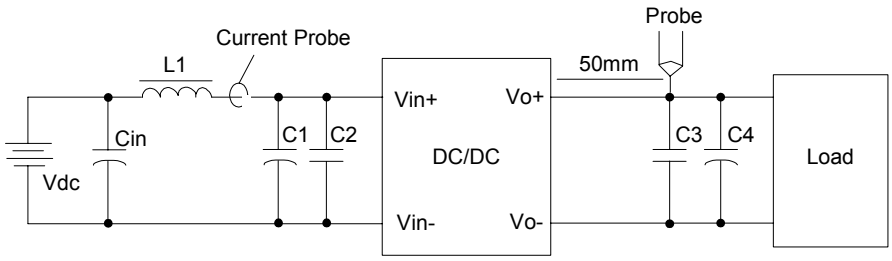


Figure 14 Input ripple & inrush current, ripple & noise test configuration

Vdc: DC power supply
L1: 12μH
Cin: 220μF/100V typical
C1 ~ C4: See Figure 11
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.

EMC test conditions

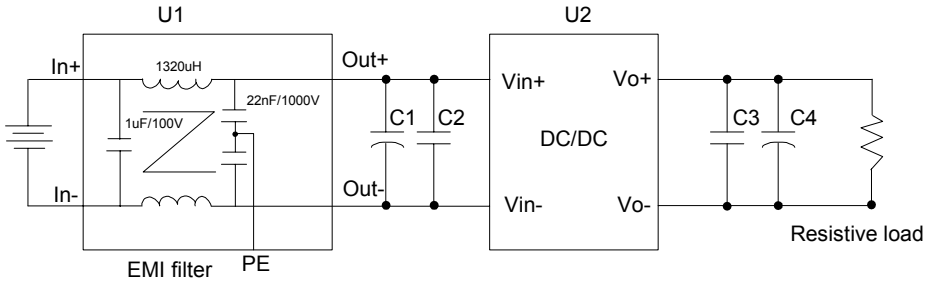


Figure 15 EMC test configuration

U1: 5A input EMC filter module
U2: Module to test, AVQ100-36S3V3
C1 ~ C4: See Figure 11

Thermal Considerations

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 OTP Test Point. The temperature at this point should not exceed the max values in the table.

For a typical application, Figure 18 and Figure 19 show the derating of output current vs. ambient air temperature at different air velocity.

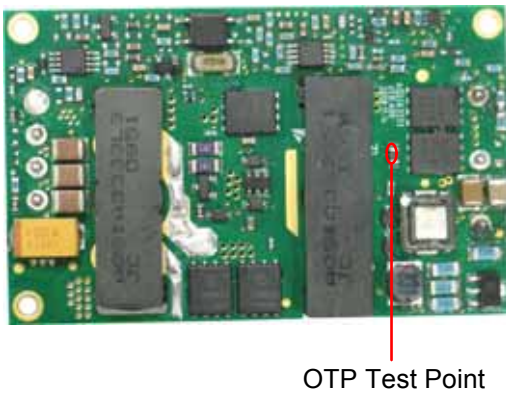


Figure 16 Thermal test point

Test point	Temperature limit
OTP Test Point	113°C

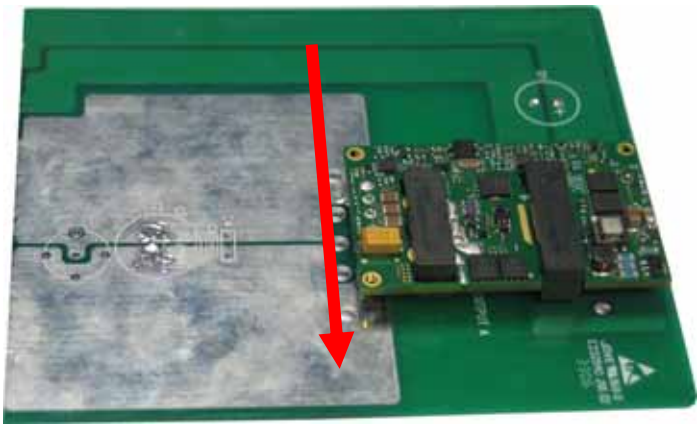


Figure 17 Typical test condition Forced airflow direction is from V_{in}- to V_{in}+

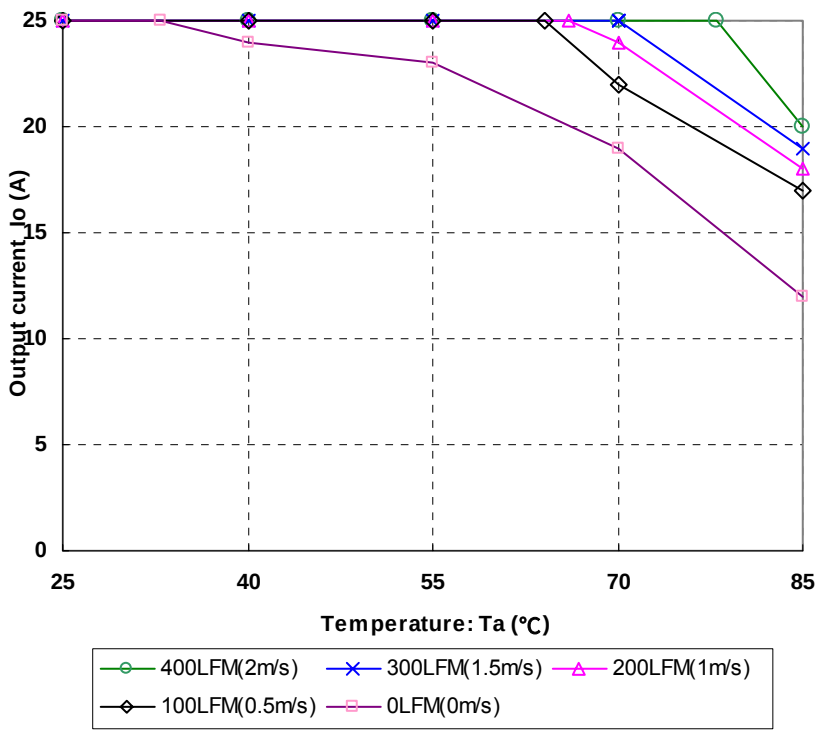


Figure 18 Output power derating, 48V_{in}, air flowing across the converter from V_{in}- to V_{in}+

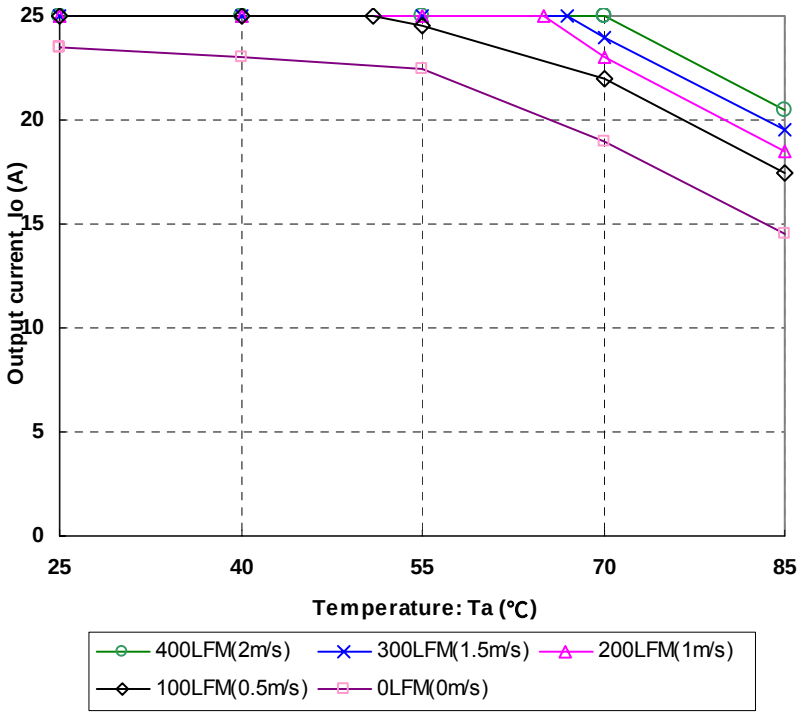
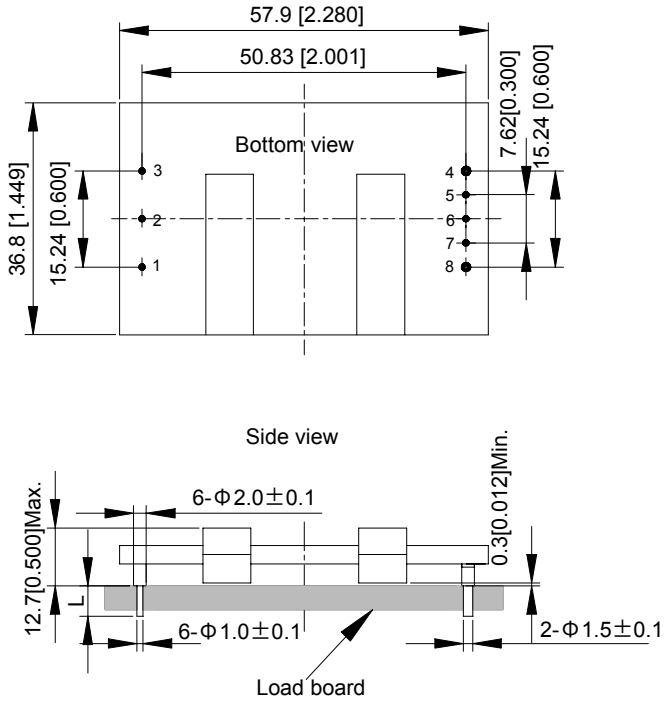


Figure 19 Output power derating, 24V_{in}, air flowing across the converter from V_{in}- to V_{in}+

Mechanical Diagram



Unit: mm[inch] Bottom view: pin on upside

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

X.XXmm±0.25mm[X.XX in.±0.01in.]

Figure 20 Mechanical diagram

Pin length option

Device code suffix	L
-4	4.8mm±0.2mm
-6	3.8mm±0.2mm
-8	2.8mm±0.2mm
None	5.8mm±0.2mm

Pin Designations

Pin NO.	Name	Function
1	V_{in}+	Positive input voltage
2	Remote ON/OFF	Remote control
3	V_{in}-	Negative input voltage
4	V_o-	Negative output voltage
5	S-	Negative remote sense
6	Trim	Output voltage trim
7	S+	Positive remote sense
8	V_o+	Positive output voltage

Soldering

The product is intended for standard manual or wave soldering.

When wave soldering is used, the temperature on pins is specified to maximum 260°C for maximum 7s.

When soldering by hand, the iron temperature should be maintained at 300°C ~ 380°C and applied to the converter pins for less than 10s. Longer exposure can cause internal damage to the converter.

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

Ordering Information

AVQ100	-	36	S	3V3	P	-	6	L		
①		②	③	④	⑤		⑥	⑦		

①	Model series	AVQ: high efficiency quarter brick series, 100: output power 82.5W
②	Input voltage	36: 18V ~ 60V input range, rated input voltage 48V
③	Output number	S: single output
④	Rated output voltage	3V3: 3V3 output
⑤	Remote ON/OFF logic	Default: negative; P: positive logic
⑥	Pin length	-6: 3.8mm
⑦	RoHS status	L: RoHS, R6; Y: RoHS, R5

Model number	Description
AVQ100-36S3V3-6L	3.8mm pin length; negative on/off logic; without thread inside mounting hole; R6 compliant

AVQ100-36S3V3P-6L	3.8mm pin length; positive on/off logic; without thread inside mounting hole; R6 compliant
AVQ100-36S3V3-6Y	3.8mm pin length; negative on/off logic; with thread inside mounting hole; R5compliant
AVQ100-36S3V3P-6Y	3.8mm pin length; positive on/off logic; with thread inside mounting hole; R5 compliant

Hazardous Substances Announcement (RoHS Of China)

Parts	Hazardous substances					
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
AVQ100-36S3V3	○	○	○	○	○	○

○: Means the content of the hazardous substances in all the average quality materials of the part is within the limits specified in SJ/T-11363-2006

√: Means the content of the hazardous substances in at least one of the average quality materials of the part is outside the limits specified in SJ/T11363-2006

Emerson Network Power Co., Ltd. has been committed to the design and manufacturing of environment-friendly products. It will reduce and eventually eliminate the hazardous substances in the products through unremitting efforts in research. However, limited by the current technical level, the following parts still contain hazardous substances due to the lack of reliable substitute or mature solution:

1. Solders (including high-temperature solder in parts) contain plumbum.
2. Glass of electric parts contains plumbum.
3. Copper alloy of pins contains plumbum