Technical Reference Note

AVO75B-36S3V3

66 Watts

Eighth-brick Converter

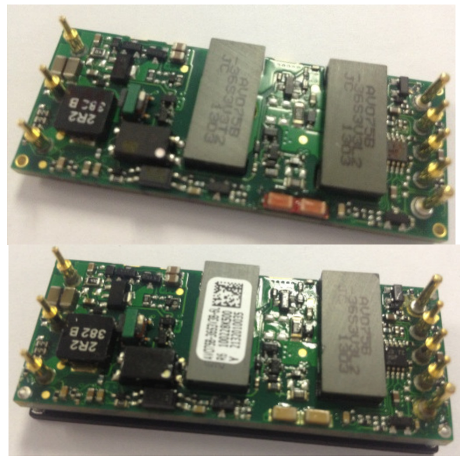
Total Power: 66 Watts
Input Voltage: 18 to 75 Vdc
# of Outputs: Single

Special Features

- Delivering up to 20A output
- Ultra-high efficiency 93% typ. at half load
- Wide input range: 18V ~ 75V
- 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 6 compliant

Safety

IEC/EN/UL/ 60950-1
CSA-C22.2 NO. 60950-1
CE Mark
UL/TUV



Product Descriptions

The AVO75B-36S3V3 is a single output DC/DC converter with standard eighth-brick form factor and pin configuration. It delivers up to 20A output current with 3.3V output. Above 93% ultra-high efficiency and excellent thermal performance makes it an ideal choice for use in datacom and telecommunication applications and can operate over 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
AVO75B-36S3V3-6L	3.3Vdc	Open-frame	Negative	R6
AVO75B-36S3V3B-6L	3.3Vdc	Baseplate	Negative	R6

Ordering information

AVO75B	-	36	S	3V3	P	B	-	6	L
①		②	③	④	⑤	⑥		⑦	⑧

①	Model series	AVO75B: Standard eighth-brick series
②	Input voltage	48: 36V ~ 75V input range, rated input voltage 48V
③	Output number	S: single output
④	Rated output voltage	3V3: 3.3V output
⑤	Remote ON/OFF logic	Default: negative logic; P: positive logic
⑥	Baseplate	B: with baseplate; default: open-frame
⑦	Pin length	6: 3.8mm pin length
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	$P_{O,max}$	-	-	66	W
Isolation Voltage[1]						
Input to outputs	Open frame modules		-	-	2000	Vdc
Input to baseplate	Baseplate modules		-	-	1500	Vdc
Outputs to baseplate	Baseplate modules		-	-	1500	Vdc
Ambient Operating Temperature	All	T_A	-40	-	+85	^{O}C
Storage Temperature	All	T_{STG}	-55	-	+125	^{O}C
Humidity						
Operating	All		-	-	95	%
Voltage at remote ON/OFF pin	All		-0.7	-	12	Vdc

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

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions[1]	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC	All	$V_{IN,DC}$	18	36	75	Vdc
Turn-on Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,ON}$	16.6	17.2	18	Vdc
Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	15.2	15.8	16.6	Vdc
Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	-	3	V
Maximum Input Current ($I_O = I_{O,max}$)	$V_{IN,DC} = 18V_{DC}$	$I_{IN,max}$	-	-	4.5	A
No Load Input Current (V_O On, I_O = 0A, I_{VSB} = 0A)		I_{IN,no_load}	-	-	0.1	A
Standby Input Current		$I_{IN,standby}$	-	-	0.015	A
Inrush Current Transient Rating			-	-	1.5	A^2S
Recommended Input Fuse	Fast blow external fuse recommended		-	-	10	A
Recommended External Input Capacitance	Low ESR capacitor recommended	C_{IN}	-	100	-	uF
Input Reflected Ripple Current	Through 12uH inductor		-	10	40	mA
Input filter component values (C\L)	Internal values		-	2\2.2	-	μF\μH
Operating Efficiency	T_A=25 °C $I_O = I_{O,max}$ $I_O = 50\%I_{O,max}$	η	- -	92 93	- -	% %

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		$V_{IN,DC}$ = 36V_{DC} I_O=$I_{O,max}$	V_O	3.25	3.3	3.35	Vdc
Output Voltage Line Regulation		All	±%V_O	-	0.15	0.3	%
Output Voltage Load Regulation		All	±%V_O	-	0.3	0.6	%
Output Voltage Temperature Regulation		All	±%V_O	-	-	0.02	%/^{O}C
Total output voltage range		Over sample, line, load, temperature & life		3.2	3.3	3.4	V
Output Voltage Trim Range		All	V_O	2.64	-	3.63	V
Output Ripple, pk-pk		Measure with a 1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 20MHz bandwidth	V_O	-	40	-	mV_{PK-PK}
Output Current		All	I_O	0	-	20	A
Output DC current-limit inception[2]		All	I_O	22	25	31	A
Vout pre-bias level				-	-	75	%Vo
V_O Load Capacitance[3]		All	C_O	220	-	10000	uF
V_O Dynamic Response	Peak Deviation Settling Time	50%~75%~50% 25% load change slew rate = 0.1A/us	±V_O T_s	- -	50 70	160 400	mV uSec
		50%~75%~50% 25% load change slew rate = 1A/us	±V_O T_s	- -	80 80	400 400	mV uSec
Turn-on transient	Rise time	I_O = I_{max}	T_{rise}	-	-	50	mS
	Turn-on delay time	I_O = I_{max}	$T_{turn-on}$	-	-	30	mS
	Output voltage overshoot	I_O = 0	%V_O	-	-	5	%
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 - 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.
Note 3 - High frequency and low ESR is recommended.

Output Specifications

Table 3. Output Specifications, con't:

Parameter	Condition[1]	Symbol	Min	Typ	Max	Unit
Output voltage remote sense range	All	V_O	-	-	0.165	V
Output over-voltage protection[4]	All	V_O	3.8	-	4.6	V
Output over-temperature protection[5] With baseplate Without baseplate	 All All	 T T	 - -	 115 110	 130 125	 ^{O}C ^{O}C
Over-temperature hysteresis	All	T	-	5	-	^{O}C
Switching frequency		f_{SW}	300	310	320	KHz
MTBF	Telcordia SR-332 Method 1 Case3; 80% load, 300LFM, 40 ^{O}C T_A		-	1.5	-	10^6 h

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

Note 5 - Auto recovery. see Figure 10,11 test point.

AVO75B-36S3V3 Performance Curves

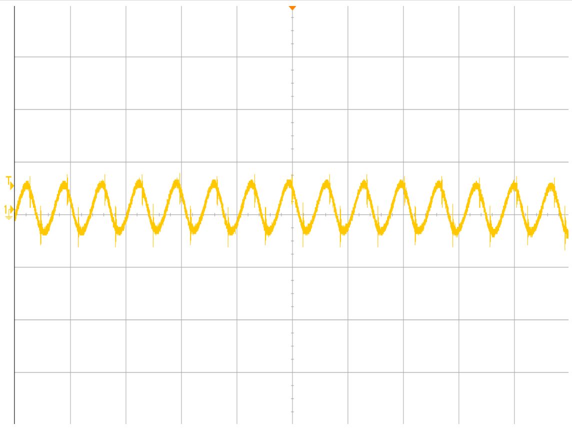


Figure 1: AVO75B-36S3V3 Input Reflected Ripple Current Waveform

Ch 1: Iin (5uS/div, 10mA/div)

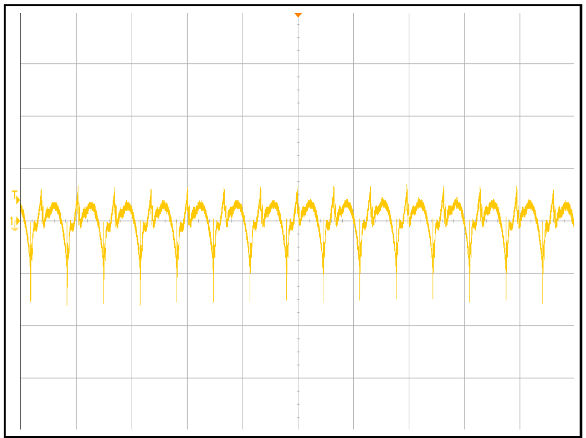


Figure 2: AVO75B-36S3V3 Ripple and Noise Measurement

Ch 1: Vo (5uS/div, 20mV/div)

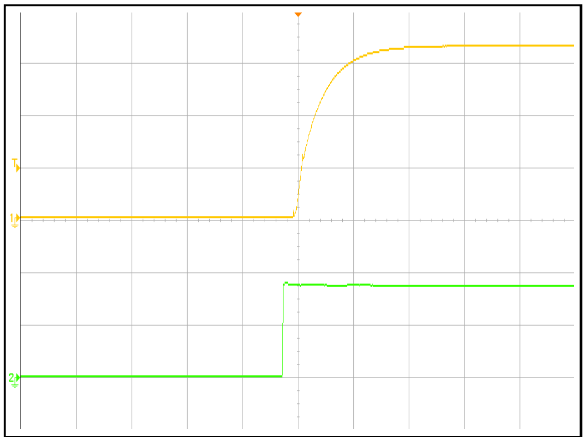


Figure 3:AVO75B-36S3V3 Output Voltage Startup Characteristic (50mS/div)

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

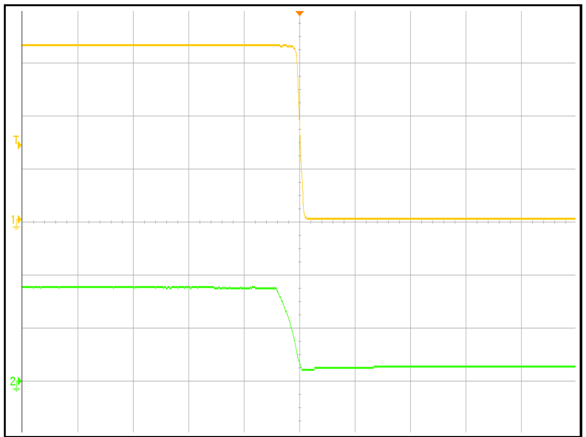


Figure 4: AVO75B-36S3V3 Turn Off Characteristic (2mS/div)

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

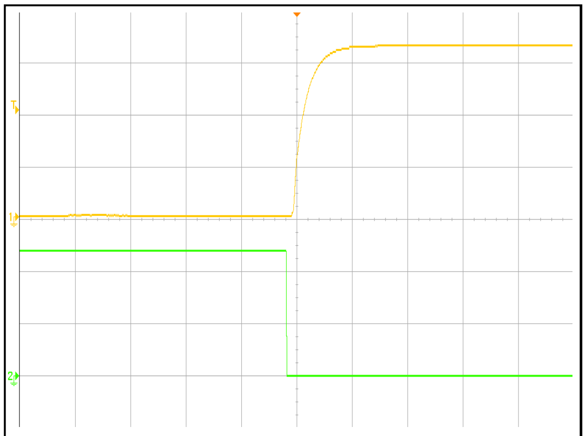


Figure 5: AVO75B-36S3V3 Remote ON Waveform (100mS/div)

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

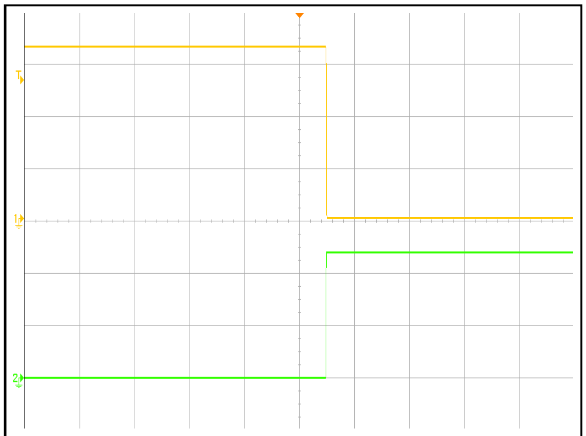


Figure 6: AVO75B-36S3V3 Remote OFF Waveform (50mS/div)

Ch 1: Vo (1V/div) Ch2: Remote OFF (2V/div)

AVO75B-36S3V3 Performance Curves

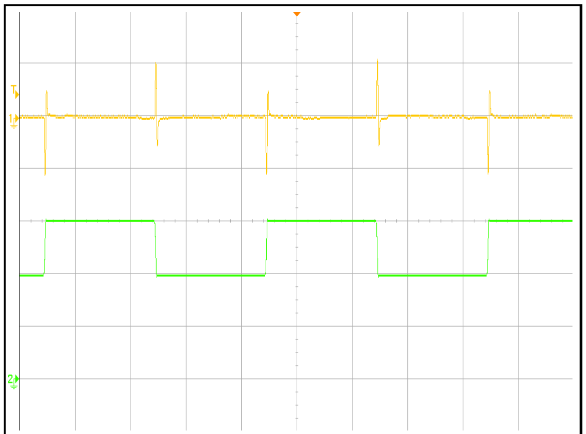


Figure 7: AVO75B-36S3V3 Transient Response (2mS/div)
50%~75%~50% load change, 0.1A/uS slew rate,
Ch 1: Vo (50mV/div) Ch 2: Io (5A/div)

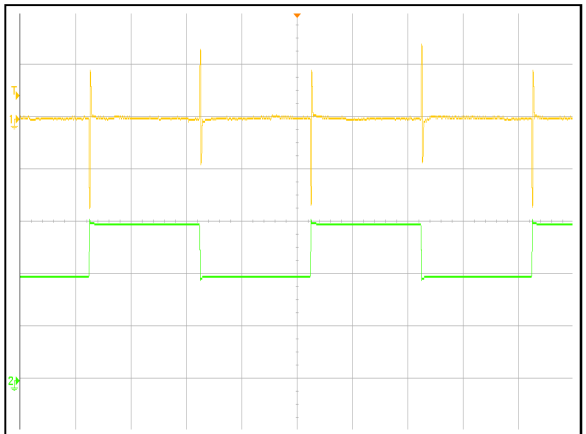


Figure 8: AVO75B-36S3V3 Transient Response (2mS/div)
50%~75%~50% load change, 1A/uS slew rate
Ch 1: Vo (50mV/div) Ch 2: Io (5A/div)

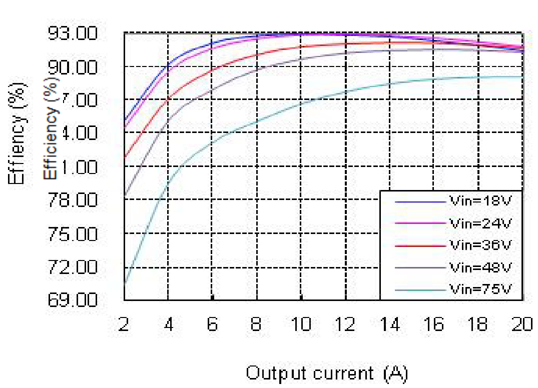


Figure 9: AVO75B-36S3V3 Efficiency Curves @ 25 ^{o}C

Loading: Io = 10% increment to 20A

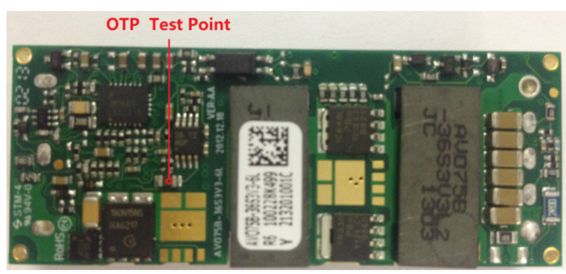


Figure 10: AVO75B-36S3V3 OTP Test Point

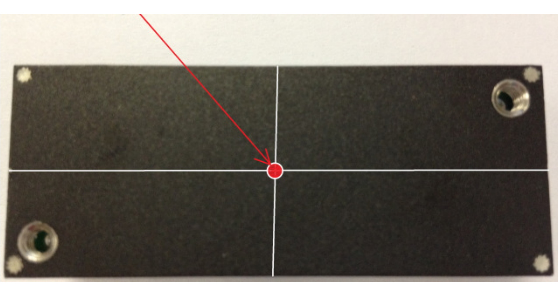
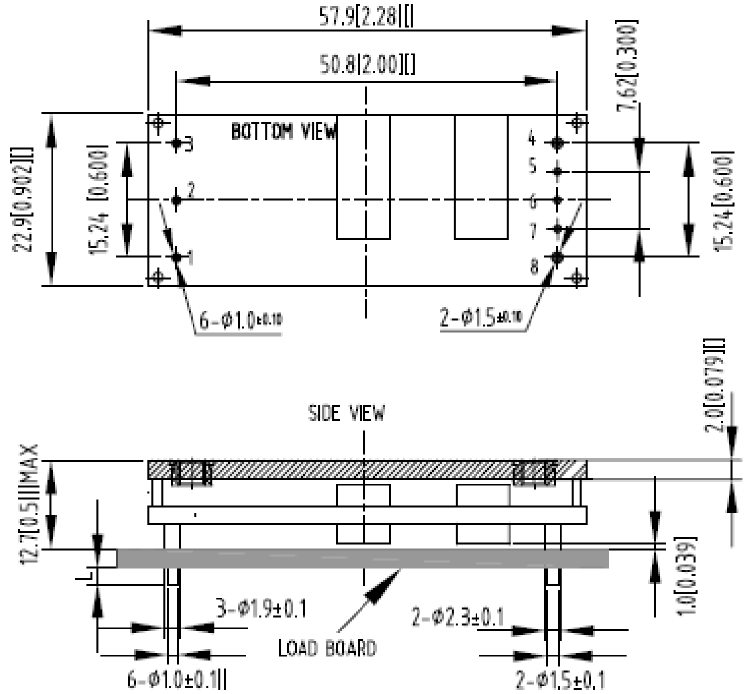


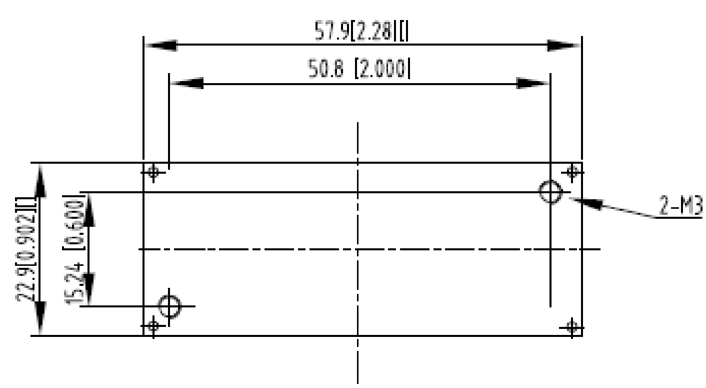
Figure 11: AVO75B-36S3V3B OTP Test Point

Mechanical Specifications

Mechanical Outlines – Base plate Module

AVO75B-36S3V3B





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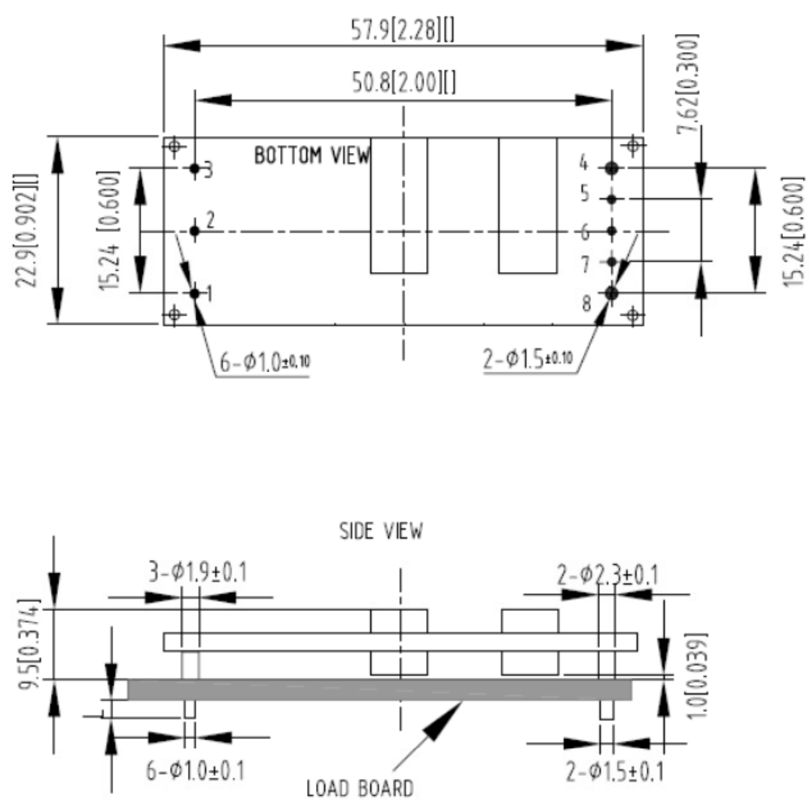
UNIT: mm[inch]

BOTTOM VIEW: pin on upside

TOLERANCE: X.Xmm±0.5mm[X.X in.±0.02in.]
X.XXmm±0.25mm[X.XX in.±0.01in.]

Mechanical Outlines – Open-Frame Module

AVO75B-36S3V3



UNIT: mm[inch]

BOTTOM VIEW: pin on upside

TOLERANCE: X.Xmm±0.5mm[X.X in.±0.02in.]
X.XXmm±0.25mm[X.XX in.±0.01in.]

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Pin Length Option

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

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

AVO75B-36S3V3 power supply is designed to meet the following EMC immunity specifications:

Table 4. Environmental Specifications:

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

See Figure 27

Safety Certifications

The AVO75B-36S3V3 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 AVO75B-36S3V3 power supply system

Document	File #	Description
UL/CSA 60950		US and Canada Requirements
EN60950		European Requirements
IEC60950		International Requirements
GB4943		China Requirements
CE		CE Marking

Operating Temperature

The AVO75B-36S3V3 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 -40 ^{O}C to 85 ^{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 as shown in the Figure 12. The temperature at these test points should not exceed the maximum values in Table 6.

For a typical application, forced airflow direction is from pin 3 to pin1. Figure 13, 14 shows the derating of output current vs. ambient air temperature at different air velocity. Figure 15 shows the thermal image taken by a RF camera at a rated I/O condition.

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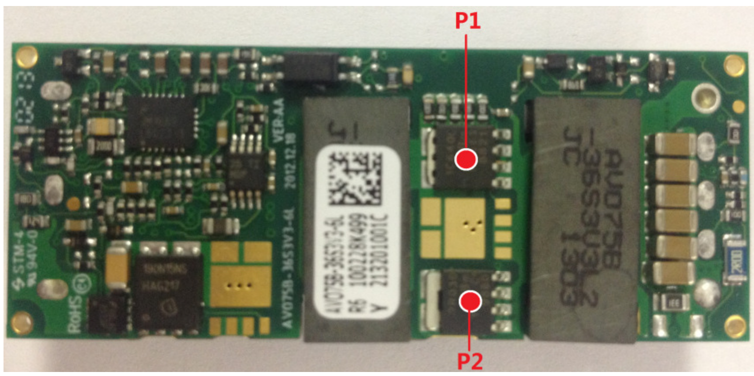

Figure 12 Temperature test point

Table 6. Temperature limit of the test point

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

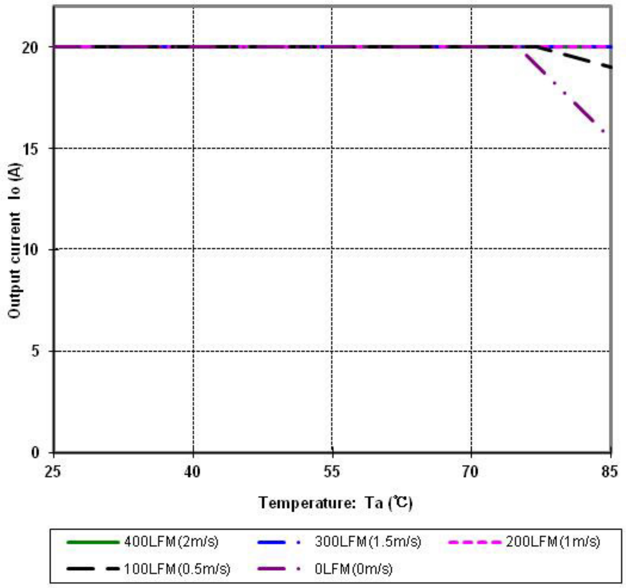

Figure 13 Output power derating, $24V_{in}$,

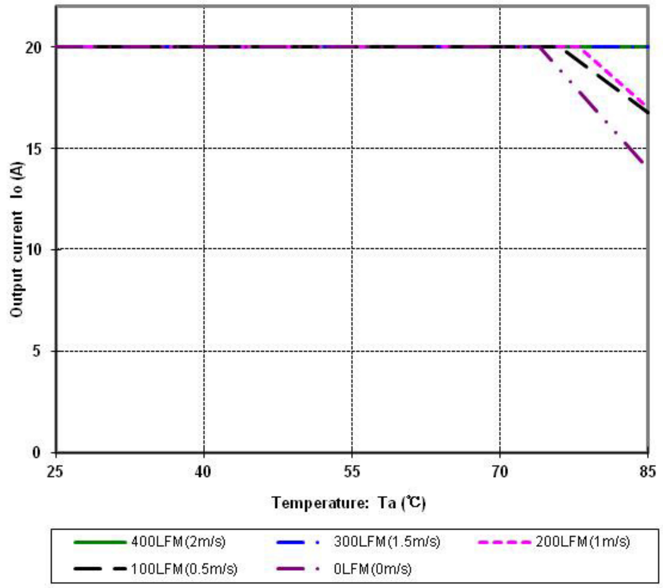

Figure 14 Output power derating, $48V_{in}$

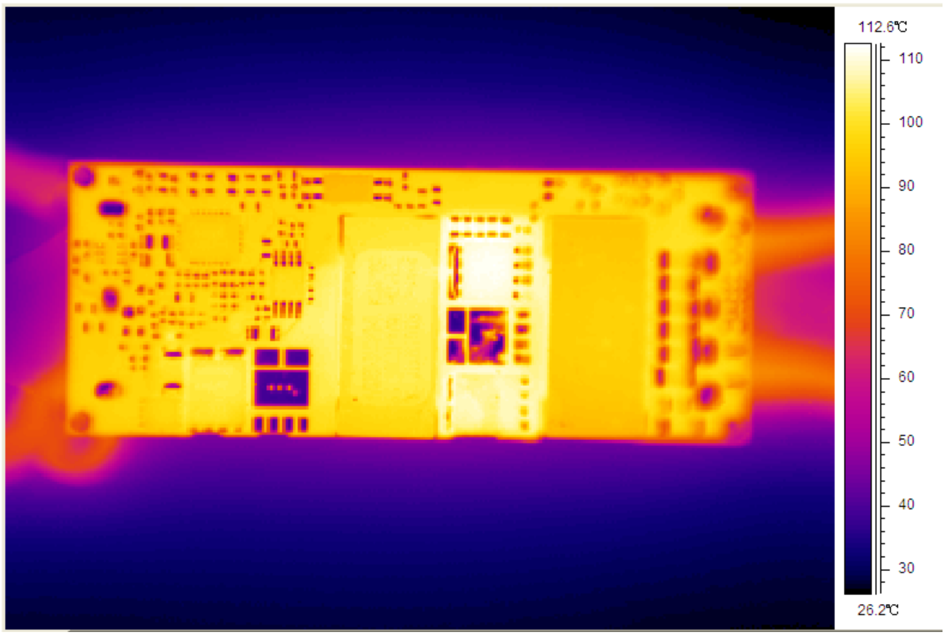

Figure 15 Thermal image, $36V_{in}$, $3.3V_o$, full load, room temperature, 100LFM (air flowing from pin 3 to pin 1)

Thermal Considerations –Baseplate 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 16. The temperature at these points should not exceed the maximum values in Table 7.

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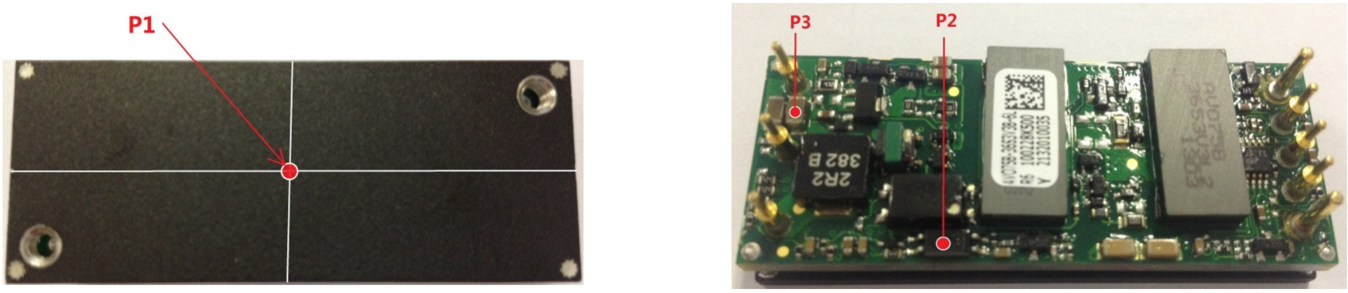

Figure 16 Temperature test point

Table 7. Temperature limit of the test point

Test Point	Temperature Limit
P1	113 ^{O}C
P2	112 ^{O}C
P3	110 ^{O}C

The converter can also operate with a smaller heatsink and sufficient airflow. Figure 18, 19 show the derating output current vs. ambient air temperature at different air velocity with a specified heatsink. The typical test condition is shown in Figure 17. For a typical application, forced airflow direction is from Vin- to Vin+. Figure 20 shows the thermal image taken by a RF camera at a rated I/O condition.

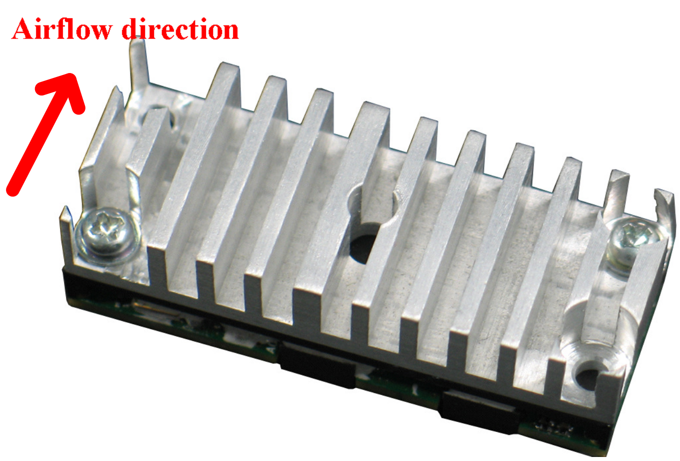

Figure 17 Typical test condition, heatsink size (L*W*H): 57.9mm * 22.86mm * 6.3mm

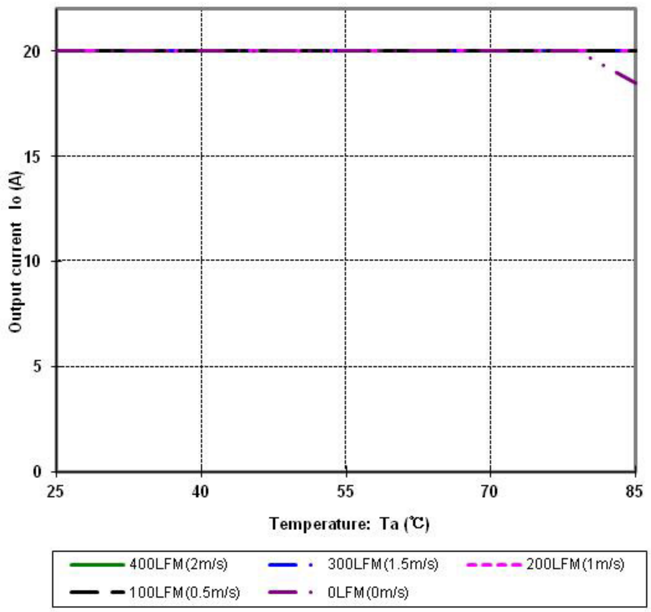

Figure 18 Output power derating, $24V_{in}$,

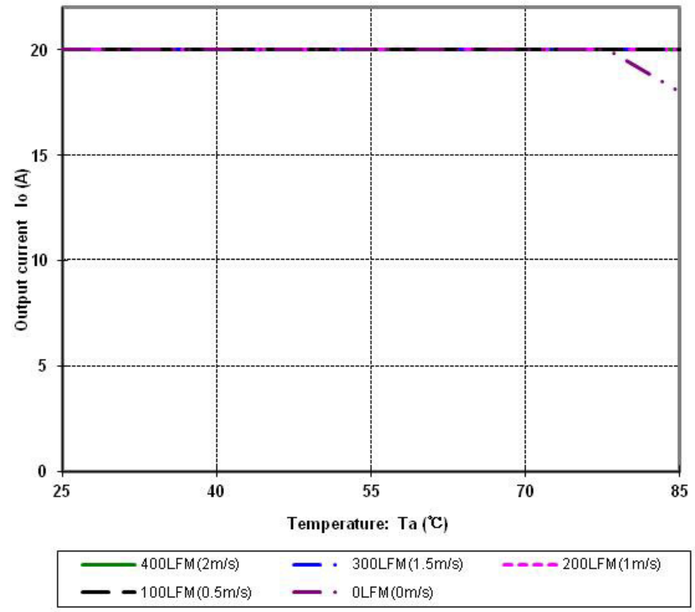

Figure 19 Output power derating, $48V_{in}$

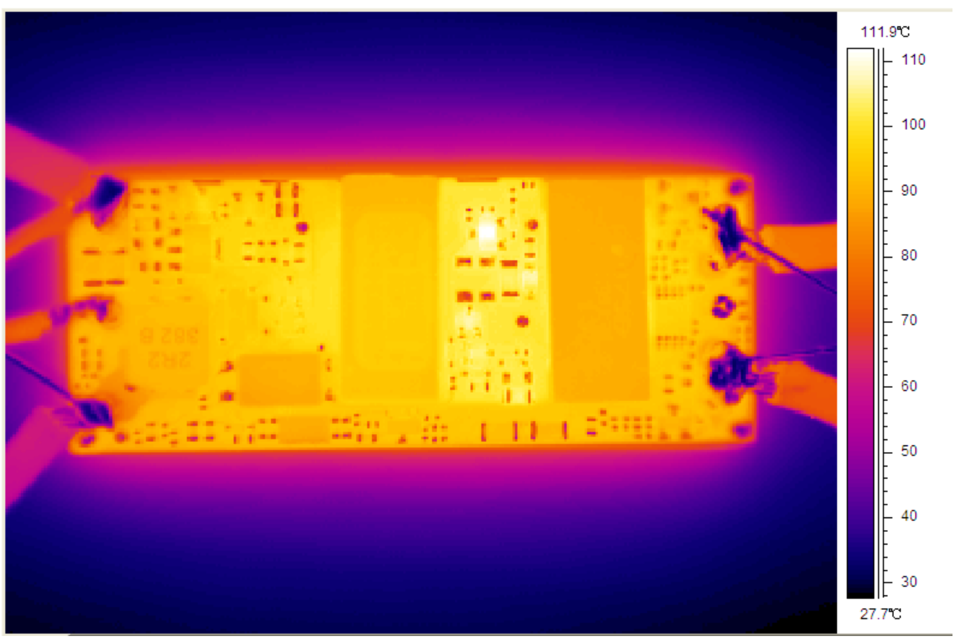

Figure 20 Thermal image, $36V_{in}$, $3.3V_{o}$, full load, room temperature, 100LFM (air flowing from pin 3 to pin 1)

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, 3time/direction
Thermal Shock	3	-40 ^{O}C to 100 ^{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 AVO75B-36S3V3 series power supply.

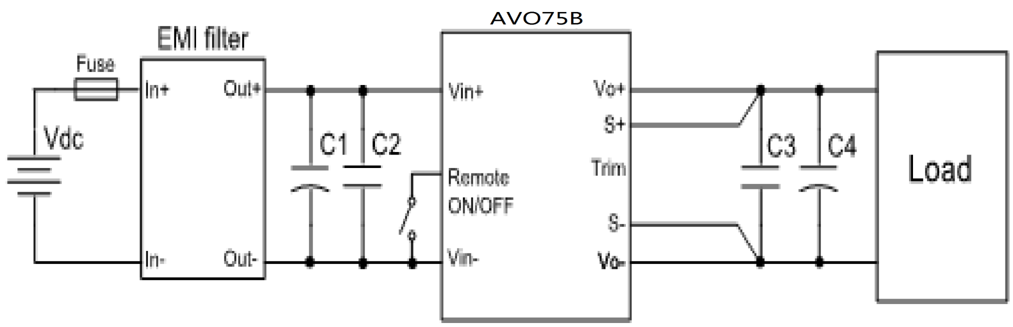

Figure 21 Typical application

Recommended input fuse: 0314010.MXP from LITTELFUSE FAR EAST PTE LTD.

C1: 100μF/100V electrolytic capacitor, P/N: UPM2A101MPD (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,additional 220μF tantalum capacitor (Low ESR, ESR≤100mΩ) is needed for output..

Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AVO75B-36S3V3. The logic is CMOS and TTL compatible. Below is the detailed internal circuit and reference in AVO75B-36S3V3.

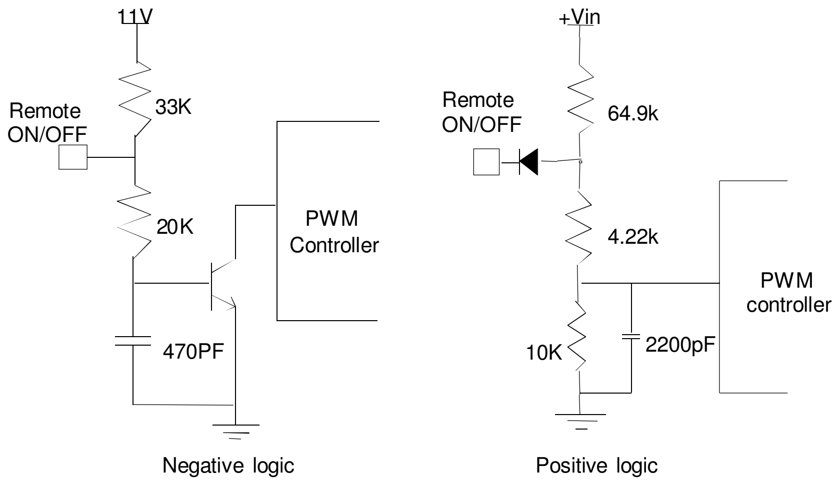

Figure 22 Remote ON/OFF internal diagram

The voltage between pin Remote ON/OFF and pin Vin- must not exceed the range listed in table "Feature characteristics" to ensure proper operation. The external Remote ON/OFF circuit is highly recommended as shown in Figure 23..

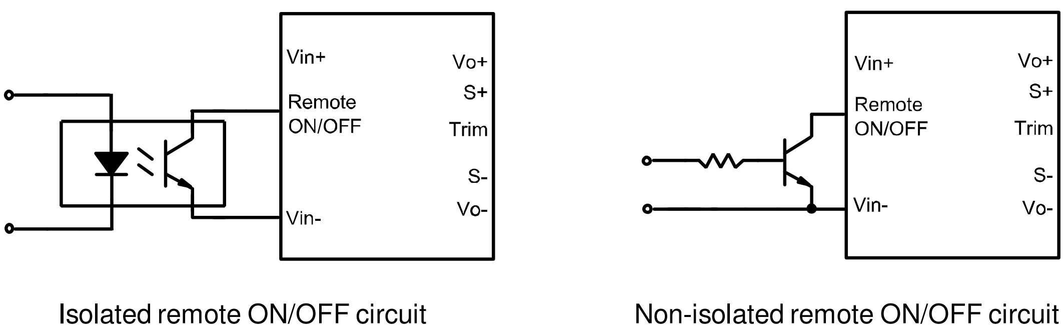

Figure 23 External Remote ON/OFF circuit

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.

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

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

△: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 3.65V output, the trimming resistor is

$$\Delta = \frac{100 \times (V_{nom} - V_0)}{V_{nom}} = \frac{100 \times (3.63 - 3.3)}{3.3} = 10$$

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

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 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.

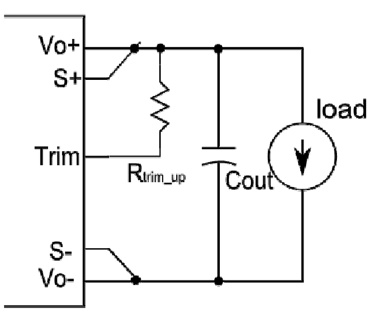

Figure 24 Trim up

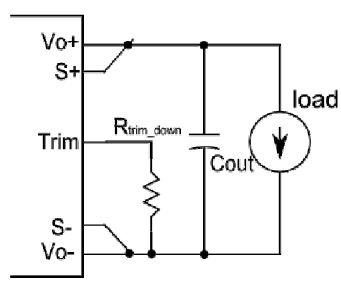

Figure 25 Trim down

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

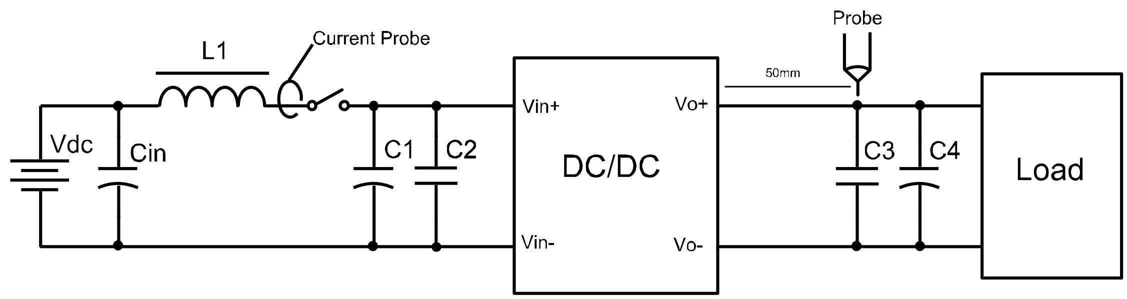

Figure 26 Input ripple & inrush current output ripple & noise test configuration

Vdc: DC power supply

L1: 12uH

Cin: 220uF/100V typical

C1 ~ C4: see Figure 21

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

EMC test conditions

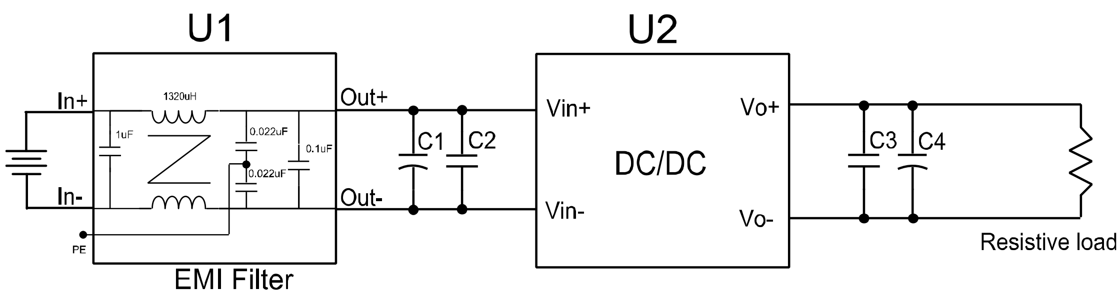

Figure 27 EMC test configuration

U1: Input EMC filter

U2: Module to test, AVO75B-36S3V3

C1 ~ C4: see Figure 21

Sense Characteristics

If the load is far from the unit, connect S+ and S- to the terminals of the load respectively to compensate the voltage drop on the transmission line. see Figure 21.

If the sense compensation 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 similative.

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Hazardous Substances Announcement (RoHS of China R6)

Parts	Hazardous Substances					
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
AVO75B-36S3V3	x	x	x	x	x	x
AVO75B-36S3V3B	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