TECHNICAL REFERENCE NOTE

ARTESYN AVD85B-48S12 Series

85 Watts Sixteenth-brick Converter

PRODUCT DESCRIPTION

Advanced Energy's Artesyn AVD85B-48S12 is a single output DC/DC converter with standard sixteenth-brick outline and pin configuration. It delivers up to 7.1A output current with 12V output voltage. Above 93% ultra-high efficiency and excellent thermal performance make it an ideal choice to supply power in telecom and datacom.

AT A GLANCE

Total Power

85 Watts

Input Voltage

36 to 75 Vdc

# of Outputs

Single

RoHS

SPECIAL FEATURES

- Delivering up to 7.1A output current
- Ultra high efficiency 93% typ. at full load
- 2:1 wide input voltage: 36V to 75V
- Excellent thermal performance
- No minimum load requirement
- Basic isolation
- High power density
- Low output noise
- RoHS 3.0
- Remote control function
- Remote output sense
- Trim function: 80% to 110%
- Input under voltage lockout
- Output over current protection
- Output short circuit protection
- Output over voltage protection
- Over-temperature protection
- Industry standard sixteenth-brick pin-out outline
- SMT or PTH version available

SAFETY

- UL UL/CSA 60950-1
- TUV EN 62368-1
- CE EN 62368-1

TYPICAL APPLICATIONS

- Telecom
- Datacom

MODEL NUMBERS

Standard	Output Voltage	Structure	Remote ON/OFF logic	ROHS
AVD85B-48S12B-6L	12Vdc	Baseplate	Negative	RoHS 3.0
AVD85B-48S12-6L	12Vdc	Open-frame	Negative	RoHS 3.0
AVD85B-48S12B-6L-1	12Vdc	Baseplate	Negative	RoHS 3.0
AVD85B-48S12-6L-1	12Vdc	Open-frame	Negative	RoHS 3.0
AVD85B-48S12TL	12Vdc	Open-frame	Negative	RoHS 3.0

Order Information

AVD85B	-	48	S	12	P	B	-	6	L	-	1
①		②	③	④	⑤	⑥	⑦	⑧	⑨		⑩

①	Model series	AVD: high efficiency sixteenth brick series, 85: output power 85W
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: with baseplate; default: open frame
⑦	-	Need "-" for through-hole unit, to separate the data of voltage and pin length, omit for SMT unit
⑧	Pin length	T: SMT; 6: 3.8mm ± 0.25mm pin length
⑨	RoHS status	L: RoHS 3.0
⑩	PCB type	Default : ENIG ; 1 : Immersion Tin

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	$P_{O,max}$	-	-	85	W
Ambient Operating Temperature	All	T_A	-40	-	+85	°C
Isolation Voltage[1]						
Input to output	All		-	-	2250	Vdc
Storage Temperature	All	T_{STG}	-55	-	+125	°C
Voltage at remote ON/OFF pin	All		-0.3	-	12	Vdc
Humidity (non-condensing)						
Operating	All		-	-	95	%
Non-operating	All		-	-	95	%

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

ELECTRICAL SPECIFICATIONS

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	$I_O = I_{O,max}$	$V_{IN,ON}$	31	-	36	Vdc
Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	30	-	35	Vdc
Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	-	3	V
Maximum Input Current	$I_O = I_{O,max}$ $V_{IN,DC}$ = 36Vdc	$I_{IN,max}$	-	-	3.5	A
Recommended Input Fuse	Fast blow external fuse recommended		-	-	5	A
Recommended External Input Capacitance	Low ESR capacitor recommended	C_{IN}	100	-	-	uF
Input Reflected Ripple Current	Through 12uH inductor	$I_{IN,typ}$	-	25	-	mA
Operating Efficiency	$I_O = I_{O,max}$ I_O = 50%*$I_{O,max}$	η	- -	93.3 90.5	- -	%

Note 1 - Ta = 25 ^{O}C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications

Parameter	Conditions[1]	Symbol	Min	Typ	Max	Unit
Factory Set Voltage	$V_{IN,DC}$ = 48V_{DC} I_O = 50%*$I_{O,max}$	V_O	11.88	12	12.12	Vdc
Output Voltage Line Regulation	All	±%V_O	-	0.063	-	%
		±V_O	-	7.5	-	mV
Output Voltage Load Regulation	All	±%V_O	-	0.063	-	%
		±V_O	-	7.5	-	mV
Output Voltage Temperature Regulation	All	%V_O	-	-	0.02	%/^{O}C
Output Voltage Trim Range	All	V_O	9.6	-	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	-	64	-	mV_{PK-PK}
Output Current	All	I_O	0	-	7.1	A
Output DC current-limit inception[2]	All	I_O	7.3	-	15	A
V_O Load Capacitance[3]	All	C_O	220	-	3300	uF
V_O Dynamic Response Peak Deviation Settling Time	25%~50%~25% or 50%~75%~50% 25% load change slew rate = 0.1A/us	±V_O T_s	- -	60 50	- -	mV uSec
	25%~50%~25% or 50%~75%~50% 25% load change slew rate = 1A/us	±V_O T_s	- -	70 100	- -	mV uSec

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.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications Con't

Parameter		Conditions	Symbol	Min	Typ	Max	Unit
Turn-on Transient	Rise time	$I_O = I_{O,max}$	T_{rise}	-	20	-	mS
	Turn-on delay time	$I_O = I_{O,max}$	$T_{turn-on}$	-	10	-	mS
	Output voltage overshoot	$I_O = 0$	$\%V_O$	-	-	5	%
Switching Frequency		All	f_{SW}	-	350	-	kHz
Remote ON/OFF Control (positive logic)	Off-state voltage	All		-0.3	-	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		-0.3	-	1.2	V
Output Over-voltage Protection[4]		Static	V_O	14	-	16.8	V
		Dynamic	V_O	14	-	17.0	V
Output Over-temperature Protection[5]		All	T	-	120	-	^OC
Output Over-temperature Hysteresis		All	T	-	10	-	^OC
+ Sense		All	%Vo	-	-	5	%
- Sense		All	%Vo	-	-	5	%
MTBF[6]		Telcordia SR-332-2006; 80% load, 300LFM, 40 ^OC T_A		-	2.0	-	10^6 h

Note 4 - Hiccup: auto-restart when over-voltage condition is removed.
Note 5 - Auto recovery. over-temperature protect(OTP) test point: see Figure 10 and Figure 11.
Note 6 - 300LFM, 40^{O}C, 48Vdc input voltage, 80%*$I_{O,max}$

ELECTRICAL SPECIFICATIONS

AVD85B-48S12 Performance Curves

Figure 1: AVD85B-48S12 Input Reflected Ripple Current Waveform
1uS/div
Ch 4: Iin (20mA/div)

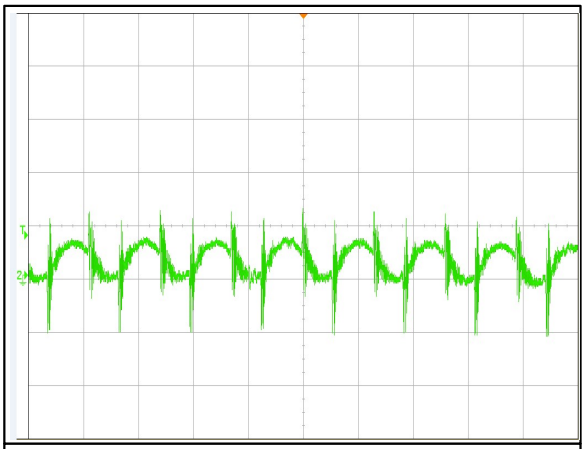


Figure 2: AVD85B-48S12 Ripple and Noise Measurement
2uS/div
Ch 2: Vo (10mV/div)

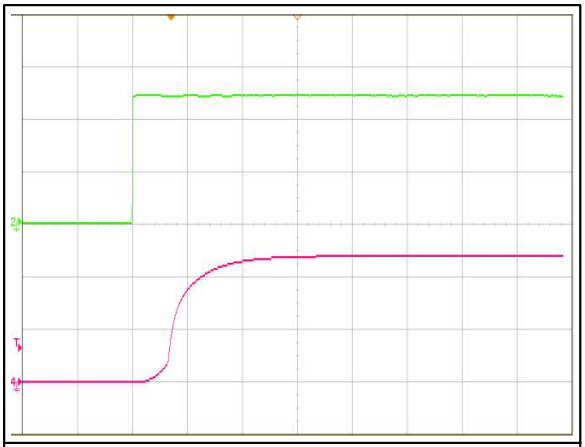


Figure 3: AVD85B-48S12 Output Voltage Start Up By Power On
Vin = 48Vdc, Io = Io,max, 20mS/div
Ch 2: Vin (20V/div) Ch 4: Vo (5V/div)

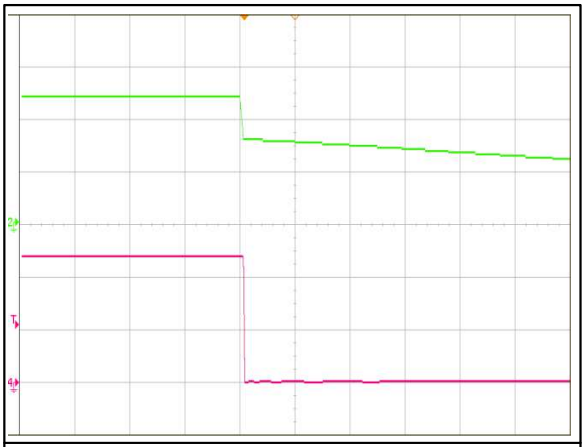


Figure 4: AVD85B-48S12 Output Voltage Shut Down By Power Off
Vin = 48Vdc, Io = Io,max, 20mS/div
Ch 2: Vin (20V/div) Ch 4: Vo (5V/div)

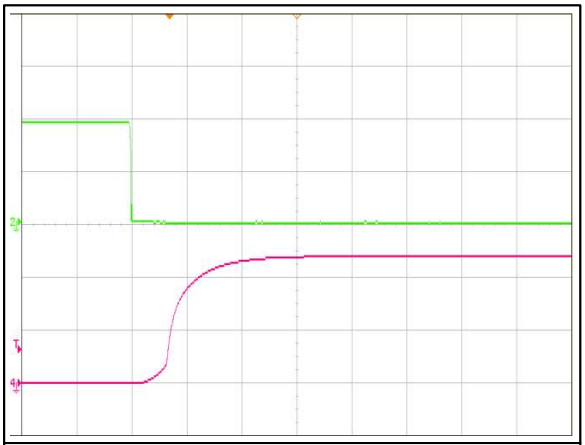


Figure 5: AVD85B-48S12 Output Voltage Start Up By Remote On
Vin = 48Vdc, Io = Io,max ,20mS/div
Ch 2: Remote On (2V/div) Ch 4: Vo (5V/div)

Figure 6: AVD85B-48S12 Output Voltage Shut Down By Remote Off
Vin = 48Vdc, Io = Io,max ,10mS/div
Ch 2: Remote Off (2V/div) Ch 4: Vo (5V/div)

ELECTRICAL SPECIFICATIONS

AVD85B-48S12 Performance Curves

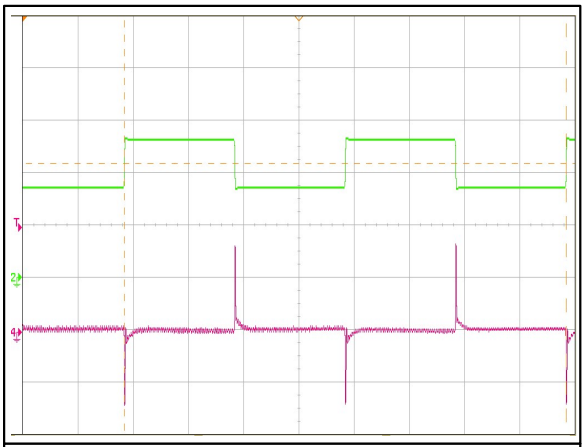


Figure 7: AVD85B-48S12 Output Voltage Dynamic Response
50% ~ 75% ~50% , 0.1A/uS slew rate, 2mS/div
Ch 2: Io (2A/div) Ch 4: Vo (20mV/div)

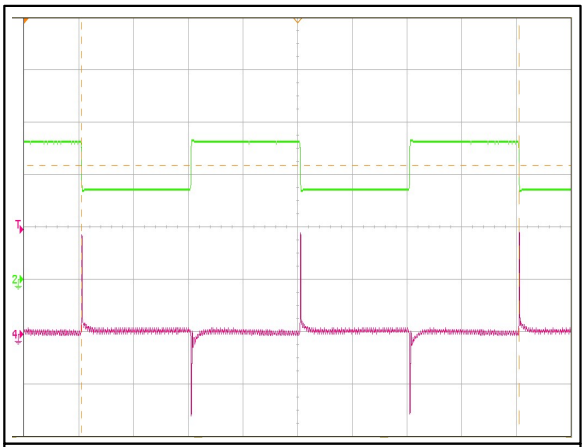


Figure 8: AVD85B-48S12 Output Voltage Dynamic Response
50% ~ 75% ~50% , 1A/uS slew rate, 2mS/div
Ch 2: Io (2A/div) Ch 4: Vo (20mV/div)

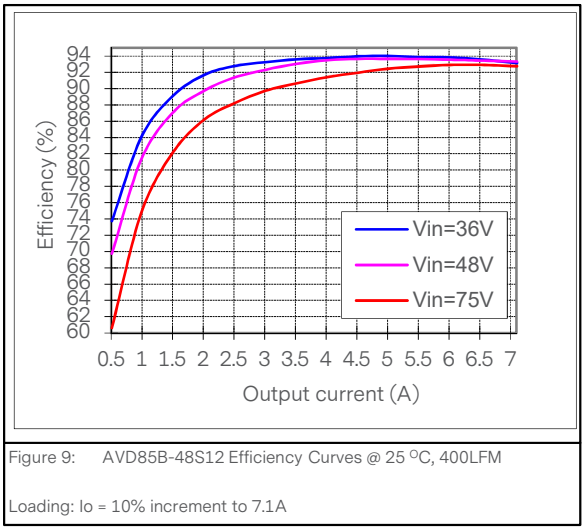


Figure 9: AVD85B-48S12 Efficiency Curves @ 25 °C, 400LFM

Loading: Io = 10% increment to 7.1A

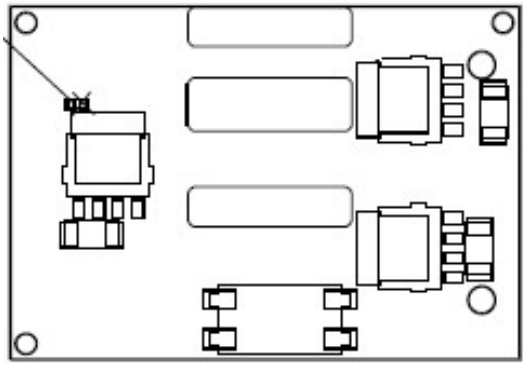


Figure 10: AVD85B-48S12 OTP test point (Open-frame module)

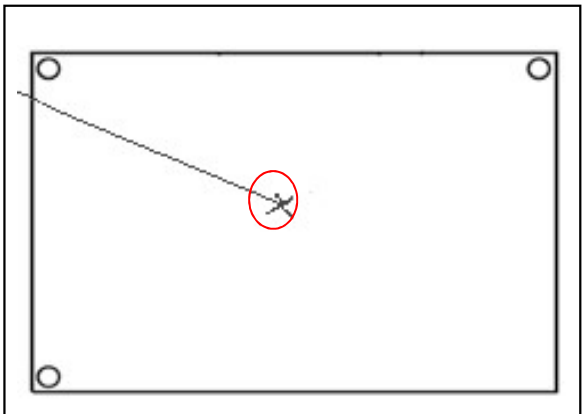


Figure 11: AVD85B-48S12B OTP test point (Module with baseplate)

MECHANICAL SPECIFICATIONS

Mechanical Outlines – Surface Mounted Module

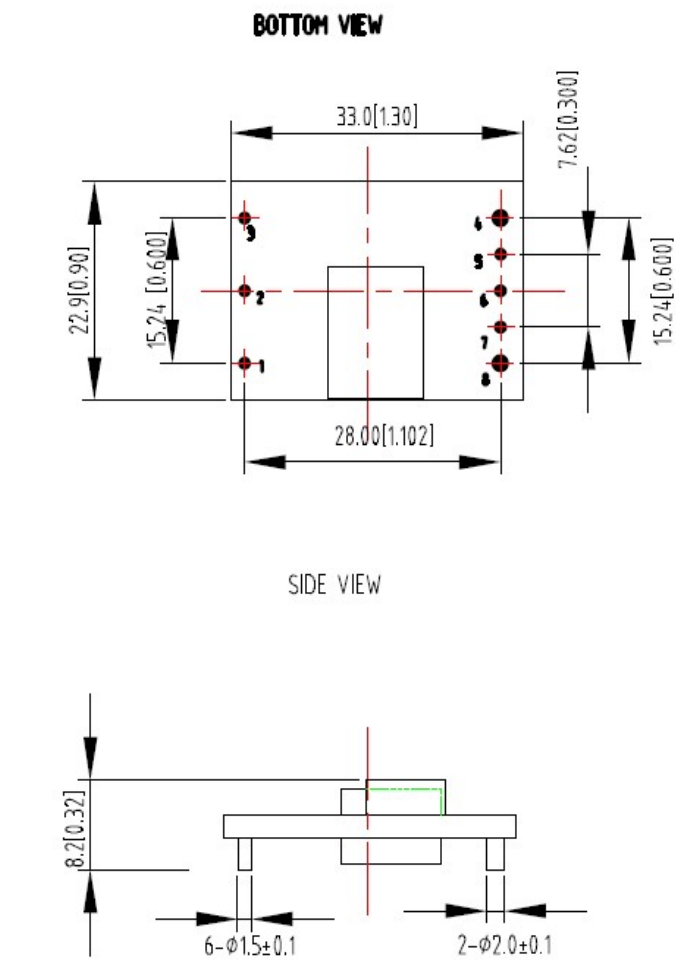


Figure 12 Mechanical Outlines for Surface Mounted Module

MECHANICAL SPECIFICATIONS

Mechanical Outlines – Open Frame Module

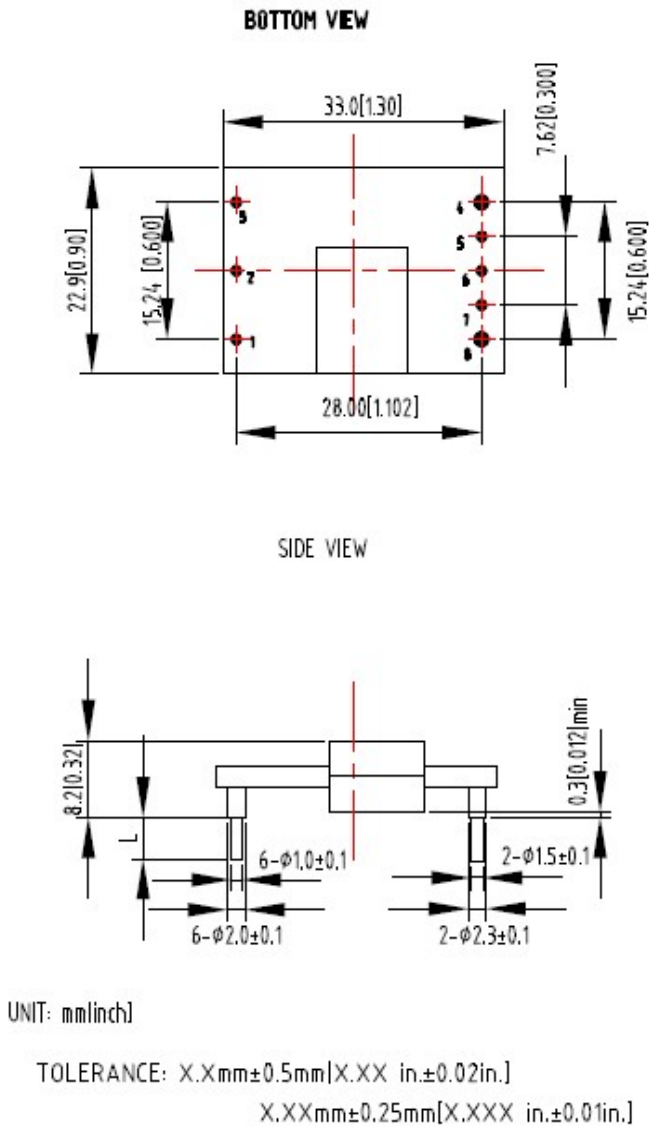


Figure 13 Mechanical Outlines for Open Frame Module

MECHANICAL SPECIFICATIONS

Mechanical Outlines – Base plate Module

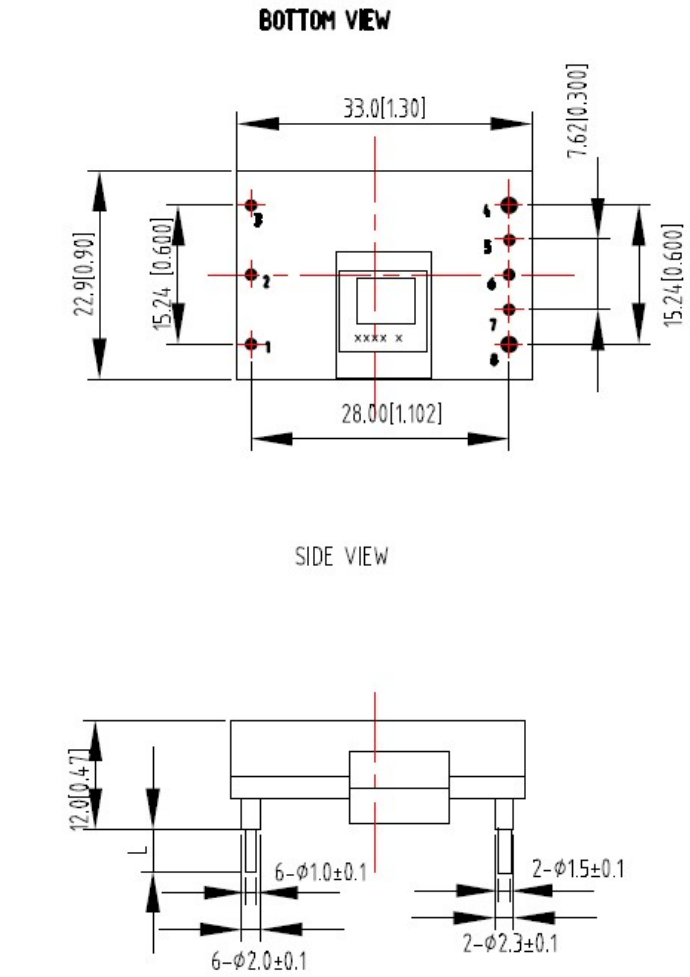


Figure 14 Mechanical Outlines for Baseplate Module

Note: Depth penetration into base plate, of M3 screws used at baseplate mounting holes, not to exceed maximum of 3.0mm

MECHANICAL SPECIFICATIONS

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	Vin+	Positive input voltage
2	Remote On/Off	Remote control
3	Vin-	Negative input voltage
4	Vo-	Negative output voltage
5	Sense-	Negative remote sense
6	Trim	Output voltage trim
7	Sense+	Positive remote sense
8	Vo+	Positive output voltage

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

AVD85B-48S12 power supply is designed to meet the following EMC immunity specifications:

Table 4. Environmental Specifications

Document	Description	Criteria
EN55032, Class A Limits	Conducted and Radiated EMI Limits	/
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 common mode and 600V differential mode 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: 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.

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The AVD85B-48S12 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 AVD85B-48S12 power supply system

Standard	Agency	Description
UL 60950-1, 2nd Edition, 2014-10-14; CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10	UL+CUL	US and Canada Requirements
EN 62368-1:2014/A11:2017	TUV-SUD	European Requirements
EN 62368-1:2014/A11:2017	CE	CE Marking

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature

The AVD120 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

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 15. The temperature at this point should not exceed the max values in the table 6.

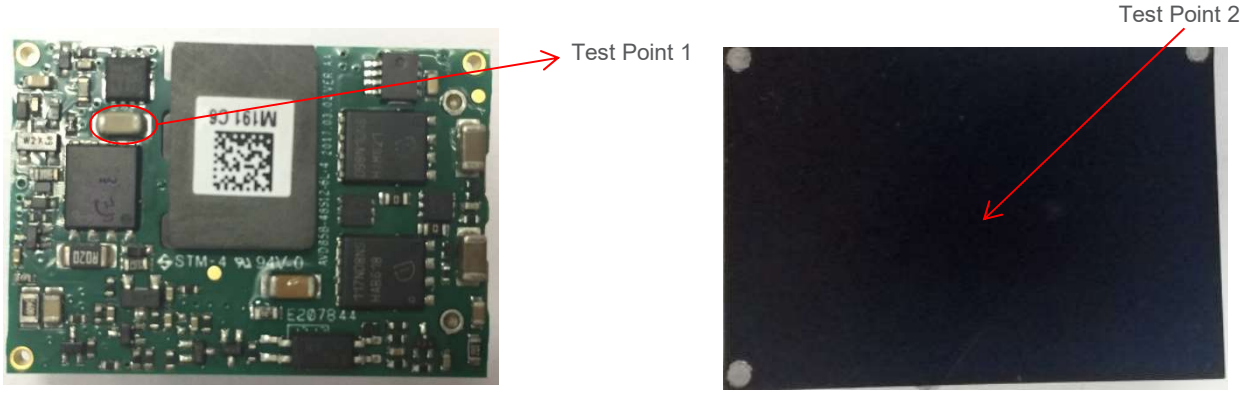


Figure 15 Temperature Test Point

Table 6. Temperature limit of the test point	
Test Point	Temperature limit
Test Point1 (C3)	135 ^{O}C
Test Point2 (Baseplate)	120 ^{O}C

ENVIRONMENTAL SPECIFICATIONS

Thermal Considerations – Con't

For a typical application, below are the derating curves show the derating of output current vs. ambient air temperature at different air velocity. The airflow direction is from Vin- to Vin+.

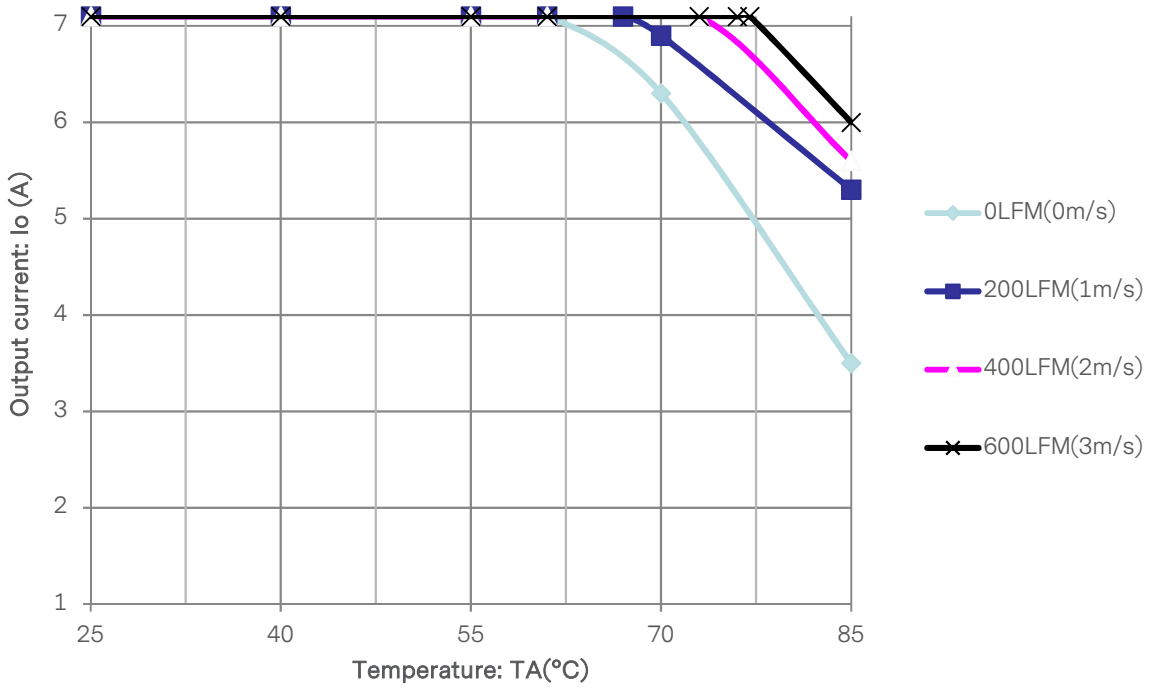


Figure 16 AVD85B-48S12-6L and AVD85B-48S12TL

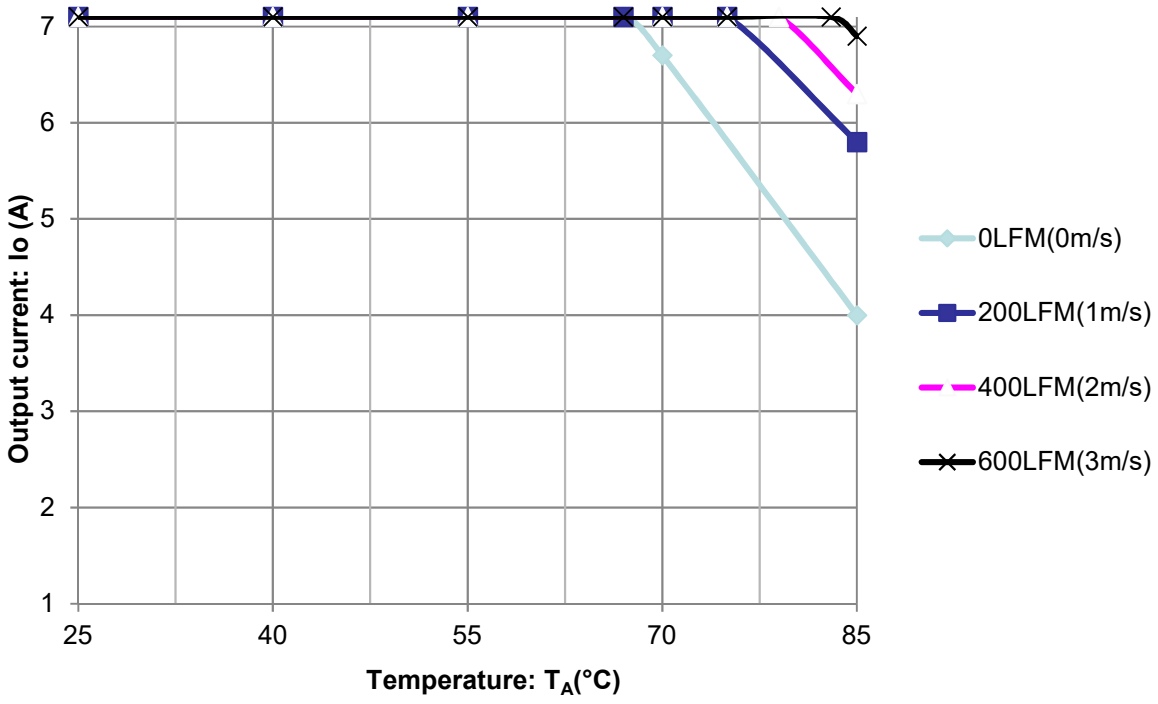


Figure 17 AVD85B-48S12B-6L

ENVIRONMENTAL SPECIFICATIONS

Qualification Testing

Parameter	Unit (pcs)	Test condition
Halt test	4-5	$T_{a,min}$-20 ^{O}C to $T_{a,max}$+25 ^{O}C, 10 ^{O}C step, V_{in} = min to max, 0 ~ 100% 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	-55 ^{O}C to 125 ^{O}C, unit temperature 20 cycles
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 AVD85B-48S12 series power supply.

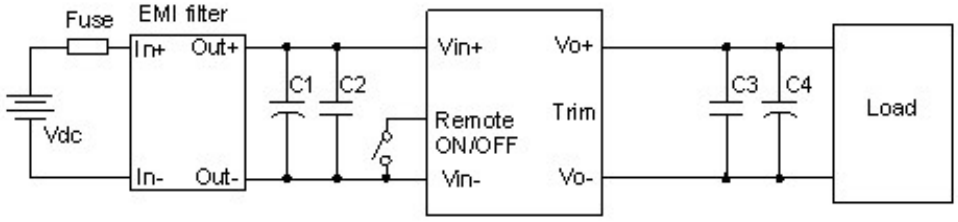


Figure 18 Typical application

C1: 220uF/100V electrolytic capacitor, P/N: UPM2A101MPD (Nichicon) or equivalent caps.

C2: 0.1uF/100V X7R ceramic capacitor, P/N: C3216X7R2A104KT0L0S (TDK) or equivalent caps.

C3: 1uF/100V X7R ceramic capacitor, P/N: C3216X7R2A105KT0L0U (TDK) or equivalent caps.

C4: 220uF oscon capacitor, P/N: CUXAE1C221M2BA (Sanyo).

Fuse: External fast blow fuse with a rating of 5A. The recommended fuse model is 0453005.MR from LITTLEFUSE.

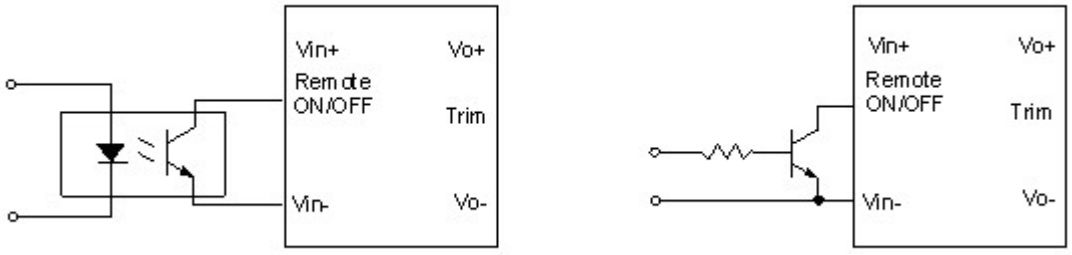
EMI filter: see Figure 23.

48V input and full load output are default.

APPLICATION NOTES

Remote ON/OFF

Negative remote ON/OFF logic is available in AVD85B-48S12. The logic is CMOS and TTL compatible. The voltage between pin Remote ON/OFF and pin Vin- must not exceed the range listed in Table 3 to ensure proper operation. The external remote ON/OFF circuit is highly recommended as shown in Figure 19.



Isolated remote ON/OFF circuit

Non-isolated remote ON/OFF circuit

Figure 19 External Remote ON/OFF circuit

APPLICATION NOTES

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 rate against nominal output voltage.

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

V_{nom}: Nominal output voltage.

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

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

$$R_{adj-up} = \frac{5.1 \times 12 \times (100 + 10)}{1.225 \times 10} - \frac{510}{10} - 10.2 = 488.35(K\Omega)$$

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

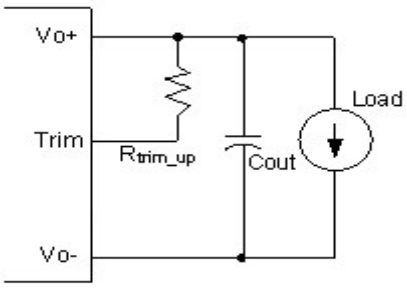


Figure 20 Trim up

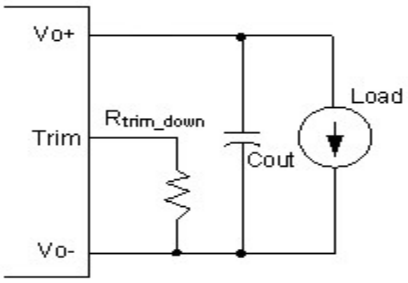


Figure 21 Trim down

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

APPLICATION NOTES

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

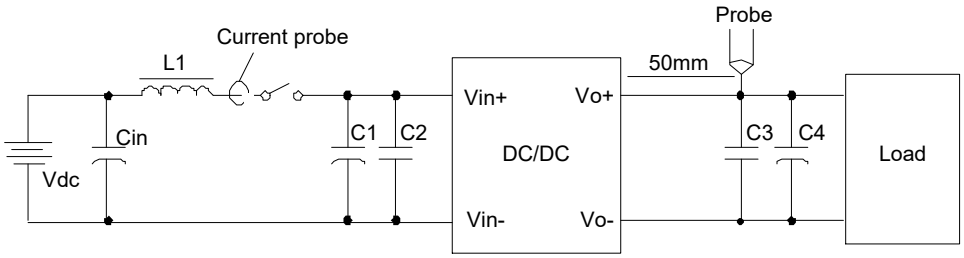


Figure 22 Input ripple & output ripple & noise test configuration

Vdc: DC power supply

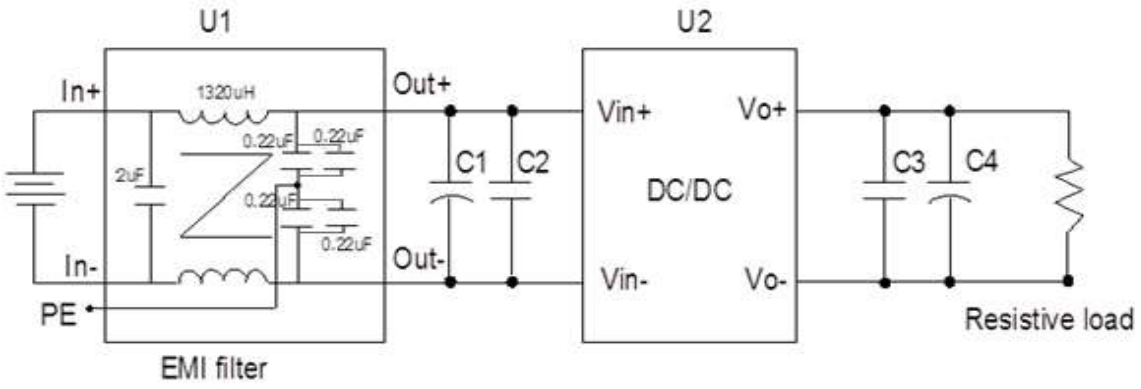
L1: 12uH

Cin: 220uF/100V typical

C1 ~ C4: See Figure 18

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 configuration



U1: Input EMC filter
U2: Module to test, AVD85B-48S12
C1 ~ C4: See Figure 18

Figure 23 EMC Test configuration

APPLICATION NOTES

Package Information

Package type

Moisture sensitivity level 3, Moisture Barrier Bags

Minimal Package QTY

192 PCS

Package disassembly

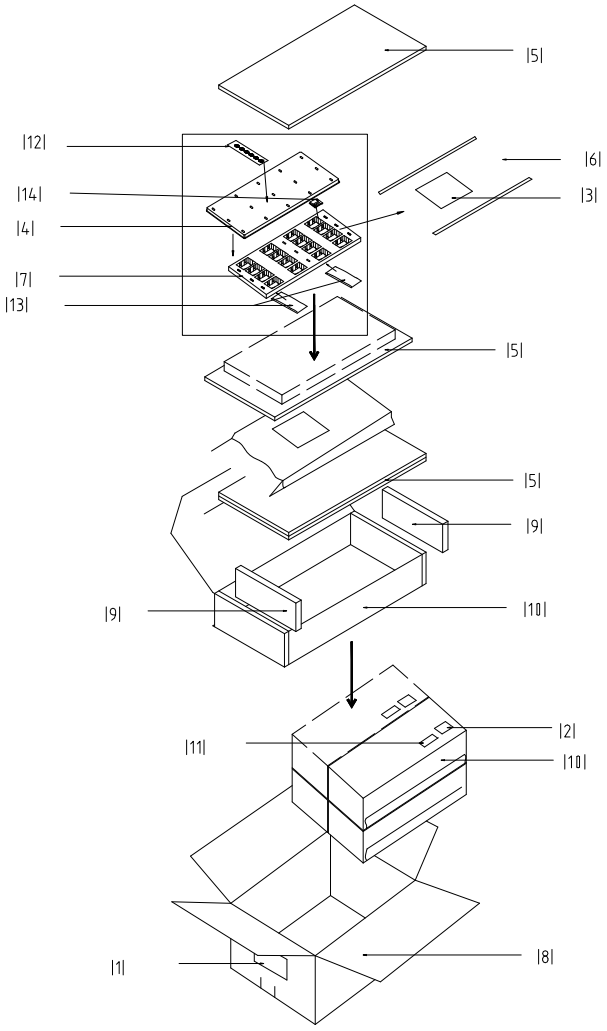


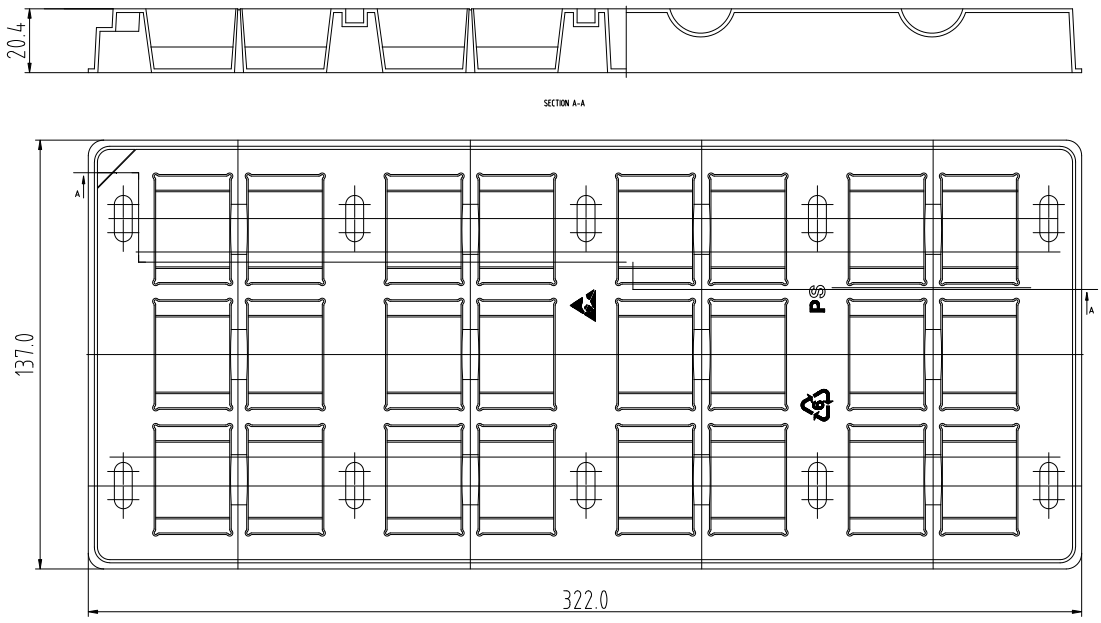
Figure 24 Package Disassembly

APPLICATION NOTES

Package Information

Table 7. Assemblies description	
No.	Description
1	Shipping label
2	Moisture proof identification label
3	Moisture proof caution label
4	Tray cover
5	Anti-static PE foam 1
6	Moisture barrier bag
7	Tray
8	Shipping carton
9	Anti-static PE foam 2
10	Inner box
11	Model barcode label
12	Humidity indicating card
13	Desiccant
14	Model

Package tray information



SOLDERING INFORMATION

Soldering

The product is intended for standard manual or wave soldering.

	Product Requirement	Product Name
R6	Wave soldering	AVD85B-48S12B-6L AVD85B-48S12-6L

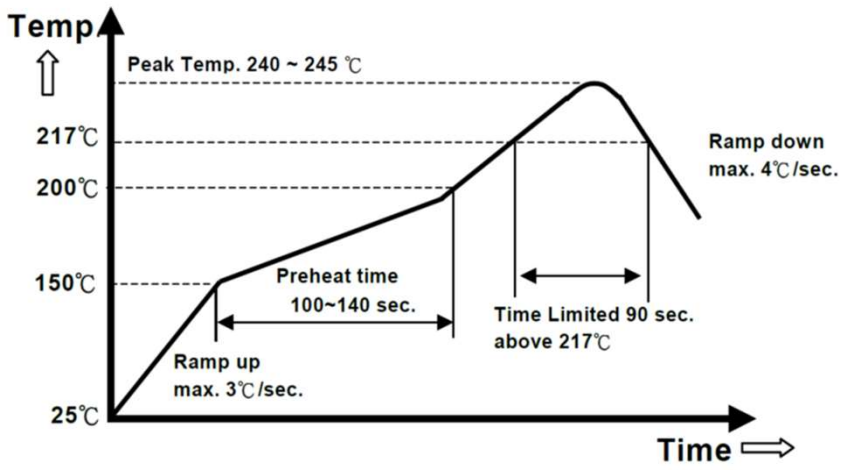
When wave soldering is used, the temperature on pins is specified to maximum 260 ^{O}C for maximum 7s.

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 simulative.

The below products are intended for standard reflow soldering.

	Product Requirement	Product Name
R6	Reflow soldering	AVD85B-48S12-6L AVD85B-48S12-6LT

When reflow soldering is used, Please refer to following fig for recommended temperature profile parameters.



Record of Revision and Changes

Issue	Date	Description	Originators
1.0	08.08.2017	First Issue	L. Leo
1.1	11.21.2017	Update the isolation voltage	L. Leo
1.2	07.10.2018	Update the trim error	K. Wang
1.3	12.09.2019	Update the soldering information	L. Leo
1.4	06.04.2019	Add Part Number “-1” Update Rohs	J. Ma
1.5	06.04.2020	Update the 62368 cert	L.Leo
1.6	12.01.2020	EMC Test configuration	K. Wang
1.7	07.22.2021	Update AE template	J. Zhang
1.8	03.14.2023	Update OCP point to 7.3 to 15 A	K. Wang

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

PRECISION | POWER | PERFORMANCE | TRUST

For international contact information,
visit advancedenergy.com.

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

AVD85B-48S12 - Rev.03.14.23_#1.8