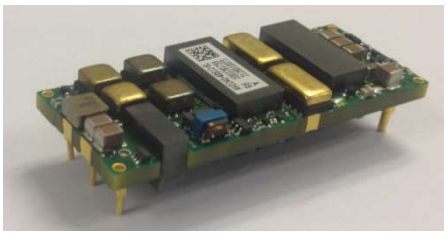
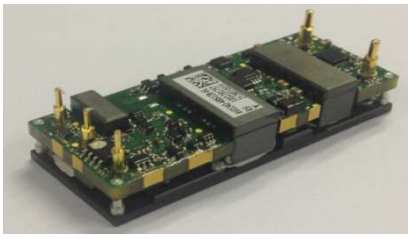
# AVO240-48S12

## 240 Watts
### Eighth-brick Converter





**Total Power:** 240 Watts
**Input Voltage:** 41 to 75 Vdc
**# of Outputs:** Single

## Special Features

- Delivering up to 20A output
- Ultra-high efficiency 94% typ. at full load
- Wide input range: 41V ~ 75V
- Excellent thermal performance
- No minimum load requirement
- Fixed frequency operation
- RoHS 6 compliant
- Remote control function
- Input under voltage lockout
- Output over current protection
- Output over voltage protection
- Over temperature protection
- Industry standard eighth-brick
- Open frame or baseplate optional
- Pin length option: 3.8mm

## Safety

IEC/EN 60950-1
UL/TUV
CE Marking
GB4943
EN55022 Class A

## Product Descriptions

The AVO240-48S12 series is a single output DC/DC converter with standard eighth-brick form factor and pin configuration. It delivers up to 20A output current with 12V output. Ultra-high 94% efficiency and excellent thermal performance makes it an ideal choice for use in computing and telecommunication applications and can operate over an ambient temperature range of -40 $^{O}$C ~ +85 $^{O}$C.

## Applications

Telecom/ Datacom

ARTESYN™
An Advanced Energy Company

# Model Numbers

| Standard | Output Voltage | Structure | Remote ON/OFF logic | RoHS Status |
|---|---|---|---|---|
| AVO240-48S12-6L | 12Vdc | Open-frame | Negative | R6 |
| AVO240-48S12P-6L | 12Vdc | Open-frame | Positive | R6 |
| AVO240-48S12B-6L | 12Vdc | Baseplate | Negative | R6 |
| AVO240-48S12PB-6L | 12Vdc | Baseplate | Positive | R6 |

## Ordering information

| AVO240 | - | 48 | S | 12 | P | B | - | 6 | L |
|---|---|---|---|---|---|---|---|---|---|
| ① | | ② | ③ | ④ | ⑤ | ⑥ | | ⑦ | ⑧ |

| | | |
|---|---|---|
| ① | Model series | AVO: series name, 240: rated output power 240W |
| ② | Input voltage | 48: 41V ~ 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 | Default: without baseplate; B:with baseplate |
| ⑦ | Pin length | 6: 3.8mm |
| ⑧ | RoHS status | L: RoHS, R6; Y: RoHS, R5 |

## 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 | $P_{O,max}$ | - | - | 240 | W |
| Isolation Voltage[1] | | | | | | |
| Input to outputs | Open frame modules | | - | - | 1500 | Vdc |
| | Baseplate modules | | - | - | 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 input pin | All | | -0.7 | - | 5 | 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[1] | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Operating Input Voltage, DC | All | $V_{IN,DC}$ | 41 | 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 | Vdc |
| Maximum Input Current ($I_O = I_{O,max}$) | $V_{IN,DC} = 41V_{DC}$ | $I_{IN,max}$ | - | - | 6.7 | A |
| Recommended Input Fuse | Fast blow external fuse recommended | | - | - | 15 | A |
| Input filter component values (C\L) | Internal values | | - | 5.4\2.2 | - | µF\µH |
| Recommended External Input Capacitance | Low ESR capacitor recommended | $C_{IN}$ | 220 | - | - | uF |
| Input Reflected Ripple Current | Through 12uH inductor | | - | 45 | - | mA |
| Operating Efficiency | $T_A$=25 °C<br>$I_O = I_{O,max}$<br>$I_O = 50\%I_{O,max}$<br>$I_O = 20\%I_{O,max}$ | η | -<br>-<br>- | 94<br>94.3<br>91 | -<br>-<br>- | % |

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 | | $V_{IN,DC}$ = 48$V_{DC}$ $I_O$=$I_{O,max}$ | $V_O$ | 11.6 | 11.9 | 12.2 | Vdc |
| Total output voltage range[2] | | All | $V_O$ | 11.2 | 11.9 | 12.5 | Vdc |
| Output Voltage Line Regulation | | All | %$V_O$ | - | 0.1 | 0.3 | % |
| Output Voltage Load Regulation | | All | %$V_O$ | - | 0.1 | 0.5 | % |
| Output Voltage Temperature Regulation | | All | %$V_O$ | - | - | 0.02 | %/$^O$C |
| Output Ripple, pk-pk | | Measure with a 1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth | $V_O$ | - | 70 | - | $mV_{PK-PK}$ |
| Operating Output Current Range | | All | $I_O$ | 0 | - | 20 | A |
| Output DC current-limit inception[3] | | All | $I_O$ | 21.5 | - | 43 | A |
| Output Capacitance[4] | | All | $C_O$ | 100 | 1000 | 5000 | uF |
| $V_O$ Dynamic Response | Peak Deviation<br>Settling Time | 25% ~ 50% ~ 25% Io,max load change slew rate = 0.1A/us | $\pm V_O$<br>$T_s$ | -<br>- | 200<br>200 | -<br>- | mV<br>uSec |
| Turn-on transient | Rise time | $I_O$ = $I_{max}$ | $T_{rise}$ | - | - | 50 | mS |
| | Turn-on delay time | $I_O$ = $I_{max}$ | $T_{turn-on}$ | - | - | 100 | mS |
| | Output voltage overshoot | $I_O$ = 0 | %$V_O$ | - | 0 | - | % |
| Switching frequency | | All | $f_{SW}$ | - | 150 | - | KHz |
| Remote ON/OFF control (positive logic) | Off-state voltage | All | | -0.7 | | 1.2 | V |
| | On-state voltage | All | | 3.5 | - | 5 | V |
| Remote ON/OFF control (Negative logic) | Off-state voltage | All | | 3.5 | - | 5 | 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 - At Vin = 36 V to 41 Vo is the lower limit 10.5 V
Note 3 - Hiccup: auto-restart when over-current condition is removed.
Note 4 - 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[5] | All | $V_O$ | 13.5 | - | 18 | Vdc |
| Output over-temperature protection[6] | All | T | 110 | 124 | 135 | $^{O}$C |
| Over-temperature hysteresis<br>Without baseplate | All | T | 5 | - | - | $^{O}$C |
| MTBF | Telcordia SR-332-2006; 80% load, 300LFM, 40 $^{O}$C $T_A$ | | - | 1.5 | - | $10^6$ h |

Note 5 - Hiccup: auto-restart when over-voltage condition is removed.
Note 6 - Auto recovery.

## AVO240-48S12-6L Performance Curves

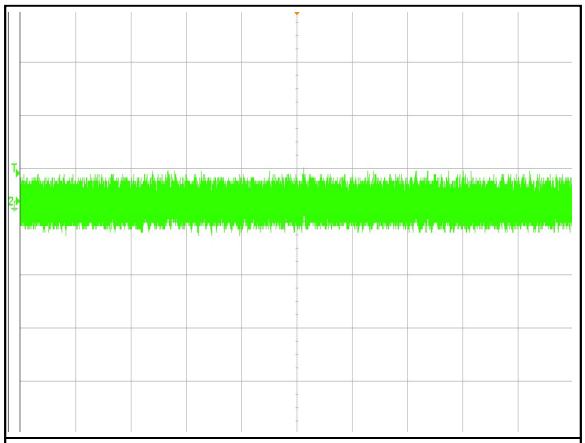


Figure 1: AVO240-48S12-6L Input Reflected Ripple Current Waveform

Ch 1: Iin (2mS/div, 20mA/div)

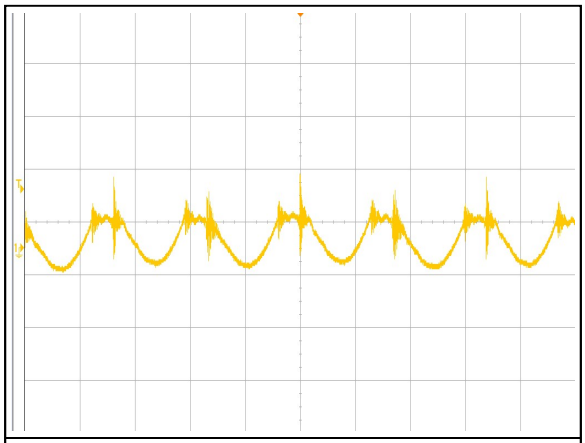


Figure 2: AVO240-48S12-6L Ripple and Noise Measurement

Ch 1: Vo (2us/div, 20mV/div)

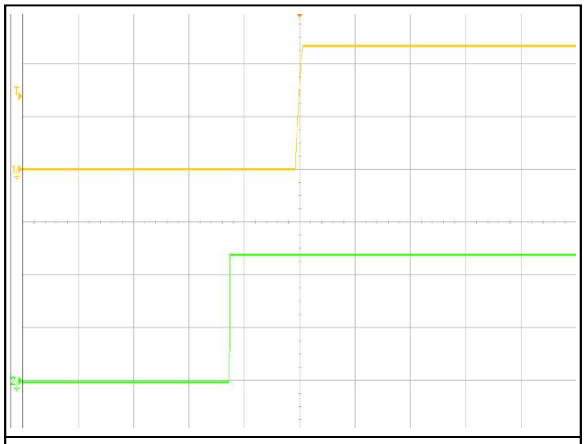


Figure 3: AVO240-48S12-6L Turn on Characteristic (50mS/div)

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

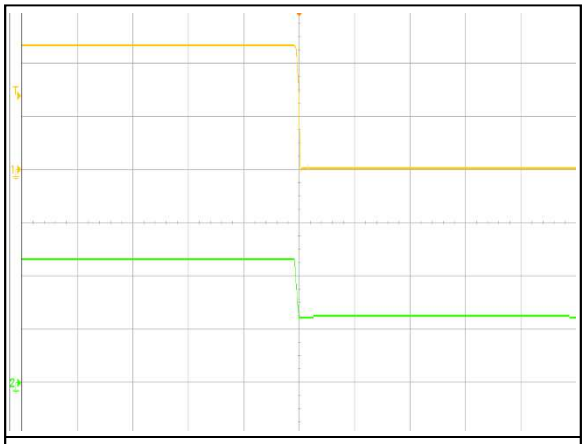


Figure 4: AVO240-48S12-6L Turn Off Characteristic (10mS/div)

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

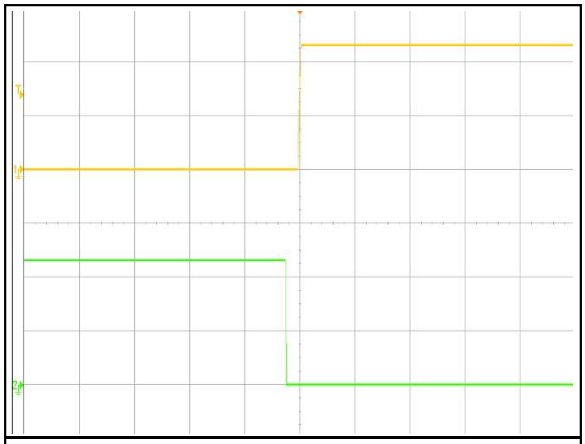


Figure 5: AVO240-48S12-6L Remote ON Waveform (100mS/div)

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

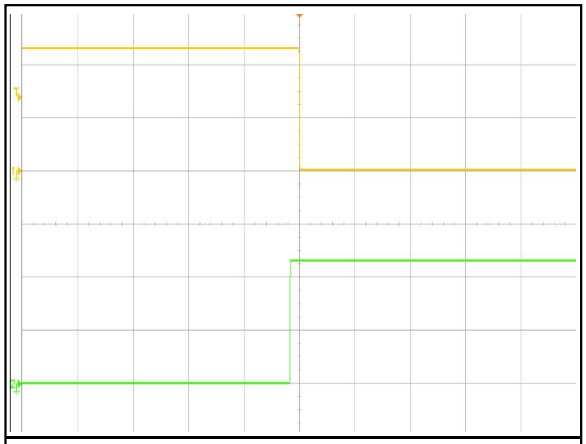


Figure 6: AVO240-48S12-6L Remote OFF Waveform (100mS/div)

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

## AVO240-48S12-6L Performance Curves

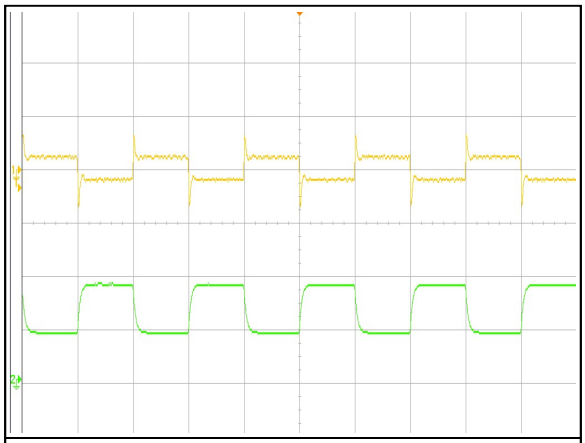


Figure 7: AVO240-48S12-6L Transient Response (2mS/div)
25%~50%~25% load change, 0.1A/uS slew rate,
Ch 1: Vo (50mV/div) Ch 2: Io (5A/div)

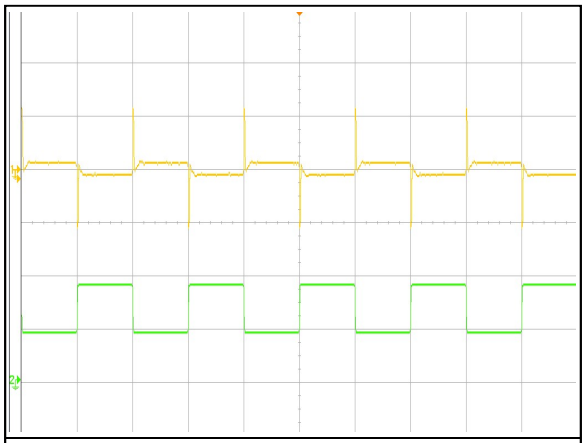


Figure 8: AVO240-48S12-6L Transient Response (2mS/div)
25%~50%~25% load change, 1A/uS slew rate,
Ch 1: Vo (100mV/div) Ch 2: Io (5A/div)

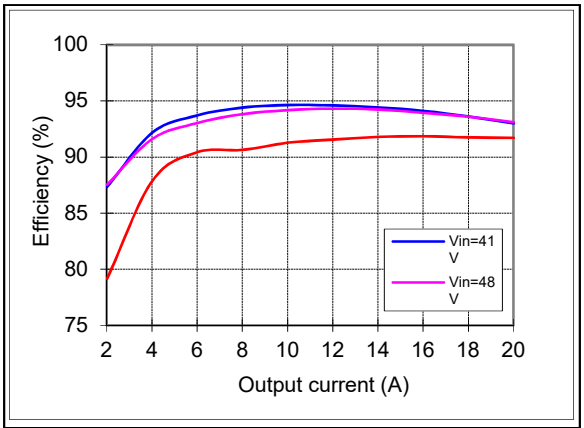



Figure 9: AVO240-48S12-6L Efficiency Curves
@ 25 degC, Vo = 12V
Loading: Io = 10% increment to 20A

## AVO240-48S12B-6L Performance Curves

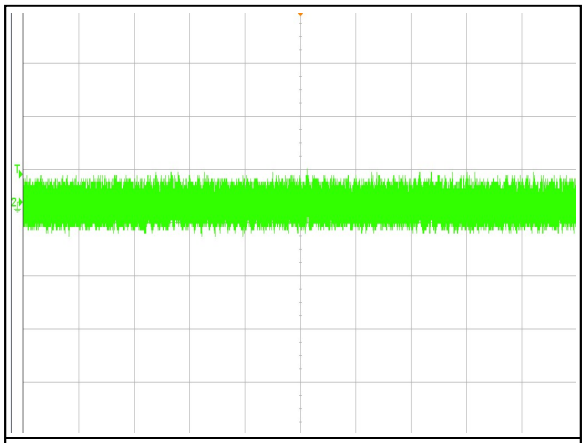


Figure 10: AVO240-48S12B-6L Input Reflected Ripple Current Waveform

Ch 1: Iin (2mS/div, 20mA/div)

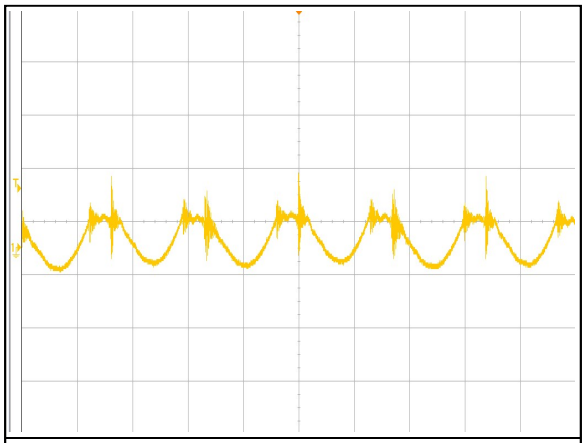


Figure 11: AVO240-48S12B-6L Ripple and Noise Measurement

Ch 1: Vo (2us/div, 20mV/div)

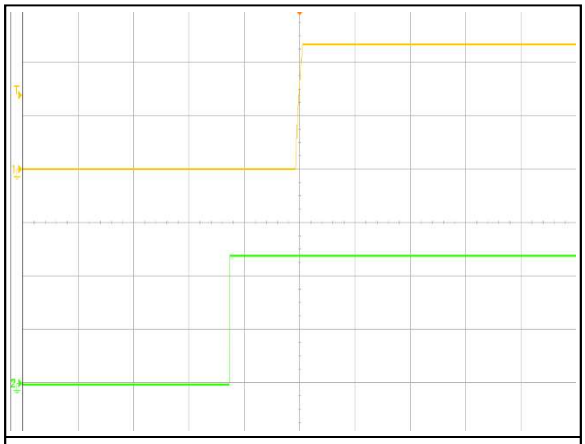


Figure 12: AVO240-48S12B-6L Turn on Characteristic (50mS/div)

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

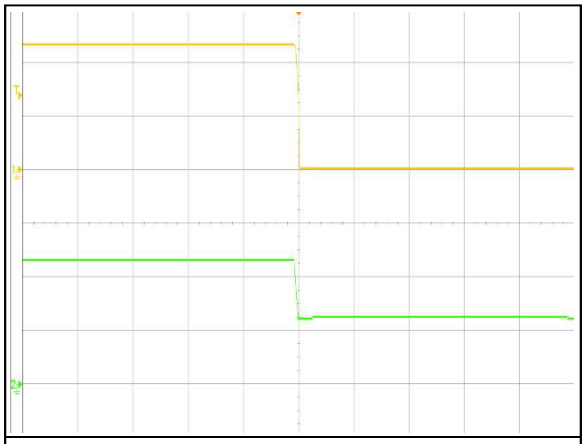


Figure 13: AVO240-48S12B-6L Turn Off Characteristic (10mS/div)

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

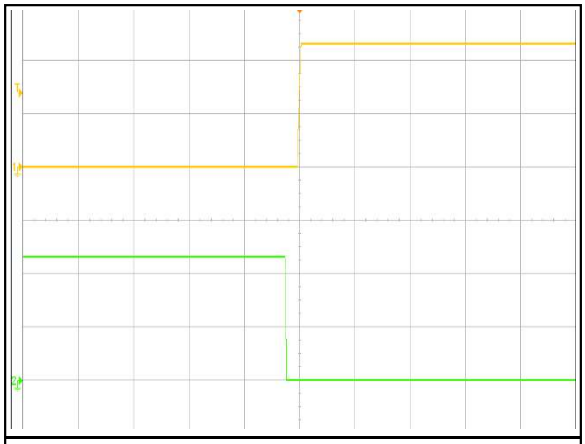


Figure 14: AVO240-48S12B-6L Remote ON Waveform (100mS/div)

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

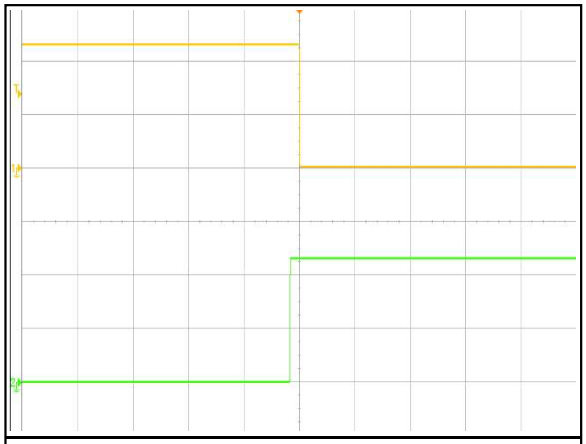


Figure 15: AVO240-48S12B-6L Remote OFF Waveform (20mS/div)

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

## AVO240-48S12B-6L Performance Curves

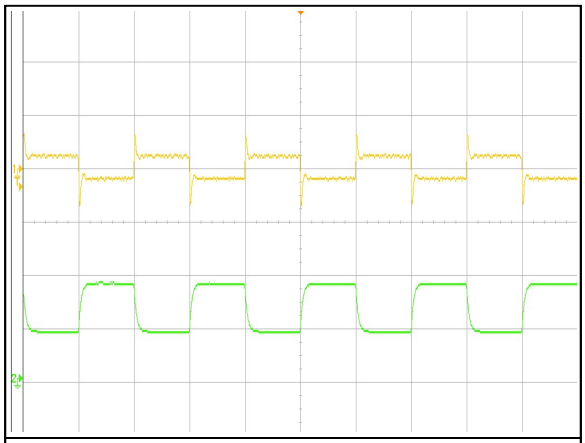


Figure 16: AVO240-48S12B-6L Transient Response (2mS/div)
25%~50%~25% load change, 0.1A/uS slew rate,
Ch 1: Vo (50mV/div) Ch 2: Io (5A/div)

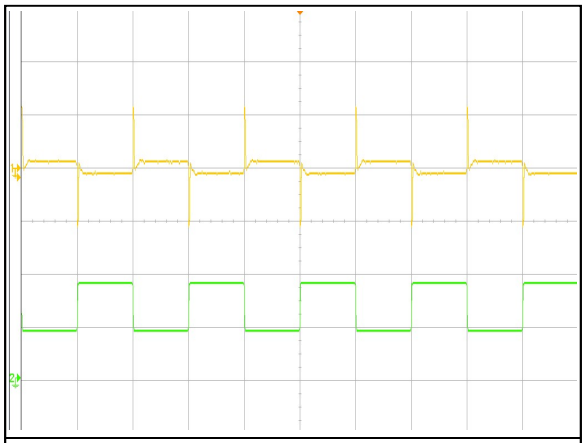


Figure 17: AVO240-48S12B-6L Transient Response (2mS/div)
25%~50%~25% load change, 1A/uS slew rate,
Ch 1: Vo (100mV/div) Ch 2: Io (5A/div)

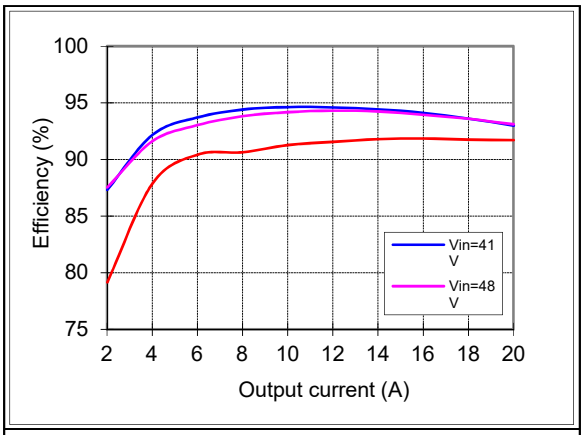



Figure 18: AVO240-48S12B-6L Efficiency Curves
@ 25 degC, Vo = 12V
Loading: Io = 10% increment to 20A

# Mechanical Specifications

## Mechanical Outlines – Base plate Module

AVO240-48S12

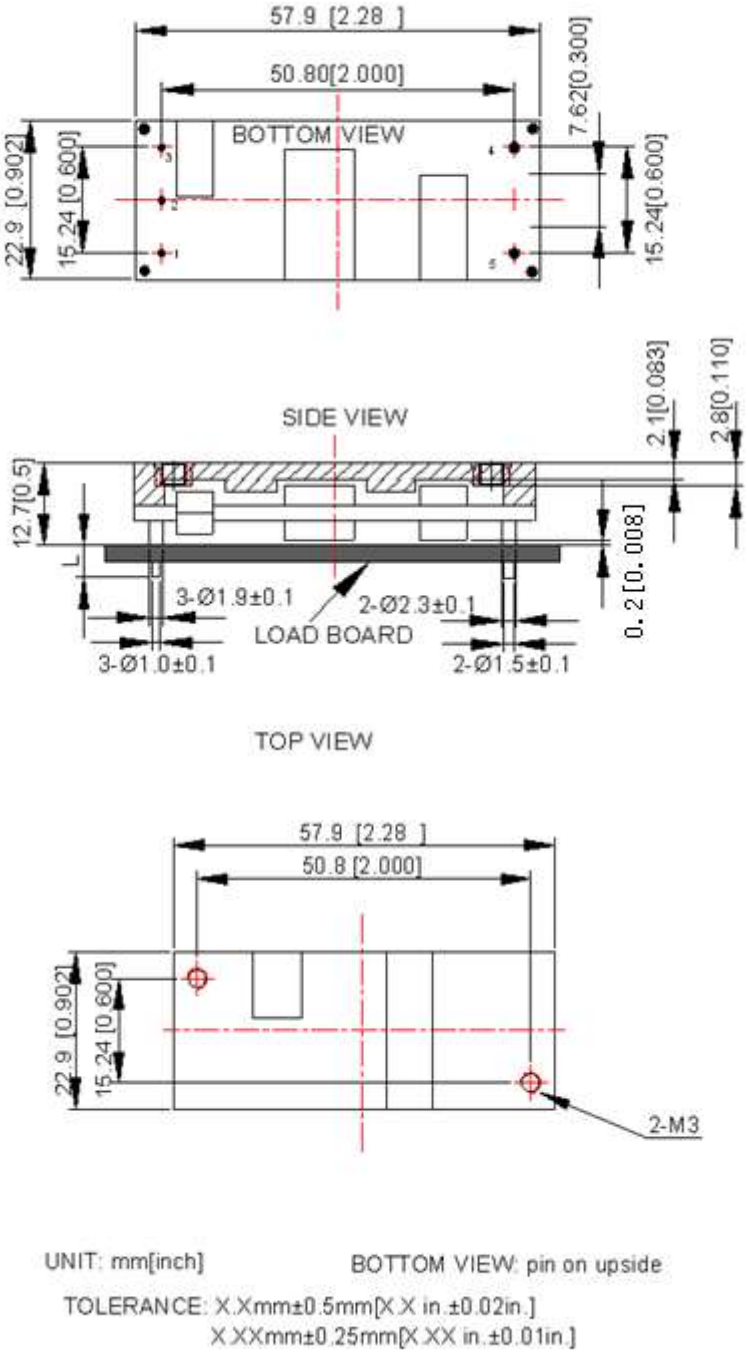
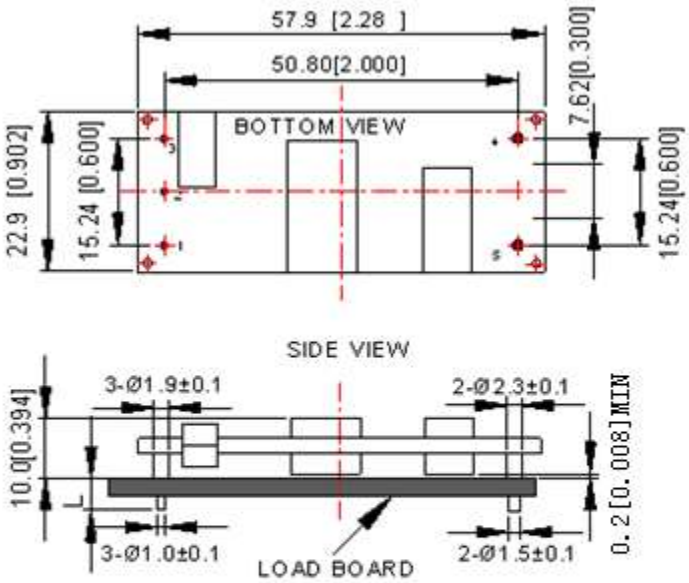



Figure 19 Mechanical diagram

## Mechanical Outlines – Open-Frame Module

AVO240-48S12




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±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 | Vo+ | Positive output voltage |

# Environmental Specifications

## EMC Immunity

AVO240-48S12 power supply is designed to meet the following EMC immunity specifications:

Table 4. Environmental Specifications:

| Document | Description | Criteria |
|---|---|---|
| EN55022, 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 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 Filter Configuration

See figure 28

## Safety Certifications

The AVO240-48S12 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 AVO240-48S12 series power supply system

| Document | File # | Description |
|---|---|---|
| UL 60950 | | US Requirements |
| TUV 60950 | | Germany Requirements |
| EN60950 | | European Requirements |
| IEC60950 | | International Requirements |
| GB4943 | | China |
| CE | | CE Marking |

## Thermal Considerations – Open-frame module

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 points as shown in the Figure 21 and Figure 22. The temperature at this point should not exceed the max values in the table 1.

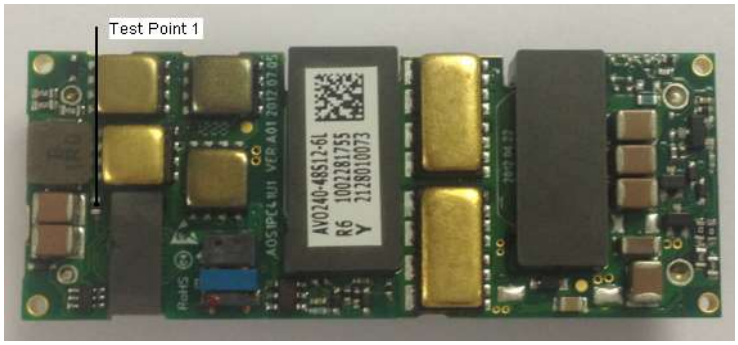



Figure 21 Thermal test points(TOP)

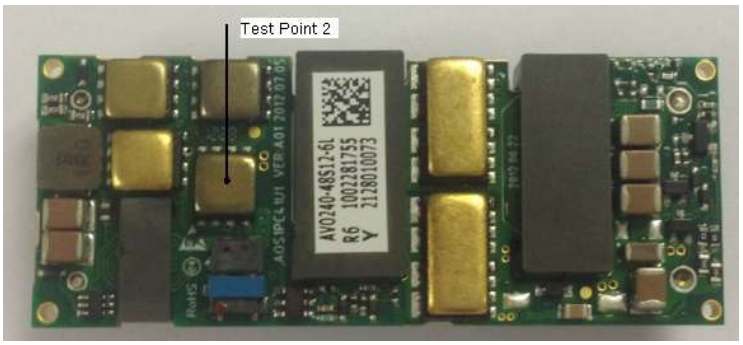



Figure 22 Thermal test points(TOP)

Table 6. Temperature limit of the test point

| Test Point | Temperature Limit |
|---|---|
| Test point 1 | 120 $^{O}$C |
| Test point 2 | 130 $^{O}$C |

## Thermal Considerations – Open-frame module

For a typical application, forced airflow direction is from Vin- to Vin+, Figure 23 shows the derating output current vs ambient air temperature at different air velocity .

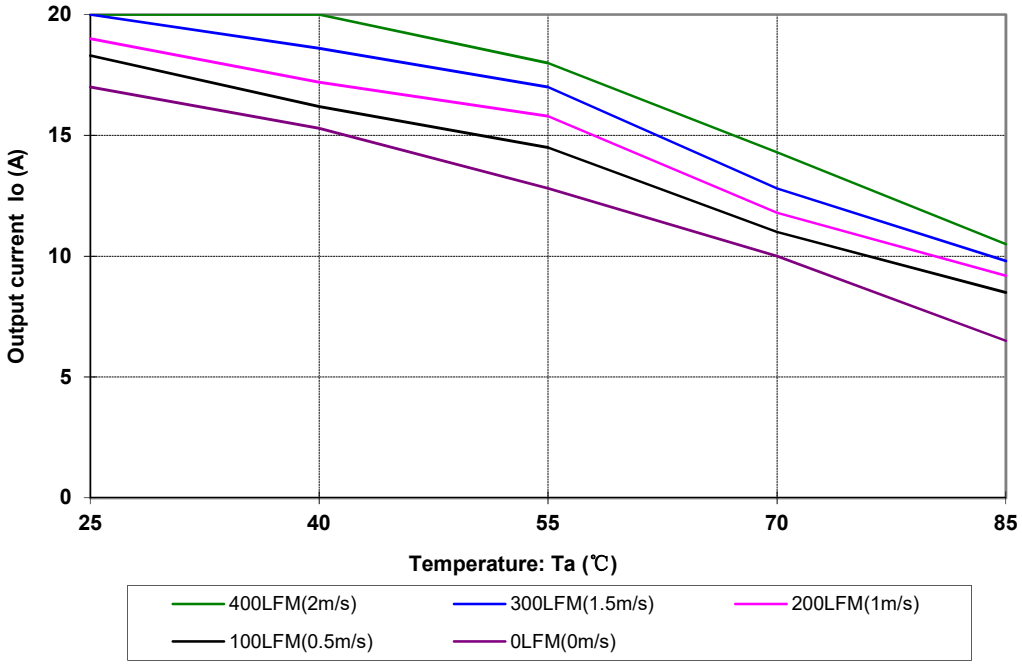



Figure 23 Output power derating, $48V_{in,}$ air flowing across the converter from Vin- and Vin+

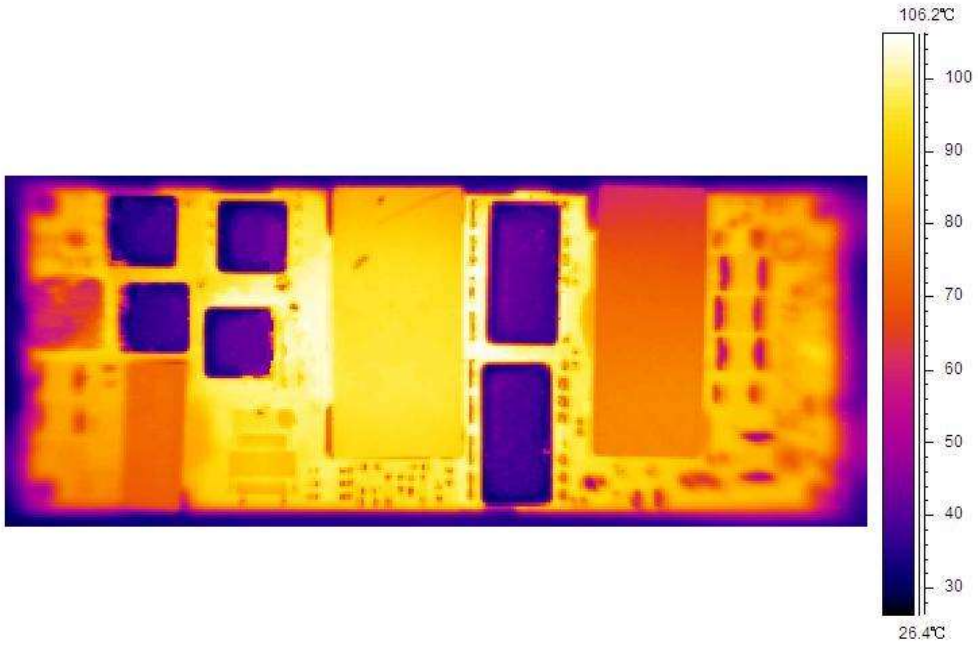



Figure 24 Infrared thermal image, $48V_{in}$@70%load, 200LFM, 25℃

## Thermal Considerations – Base plate module

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 25. The temperature at this point should not exceed the max values in the table 1.

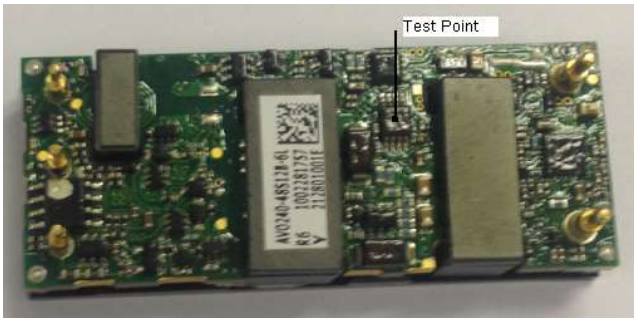



Figure 25 Thermal test point

Table 7. Temperature limit of the test point

| Test Point | Temperature Limit |
|---|---|
| Test point | 125 $^{O}$C |

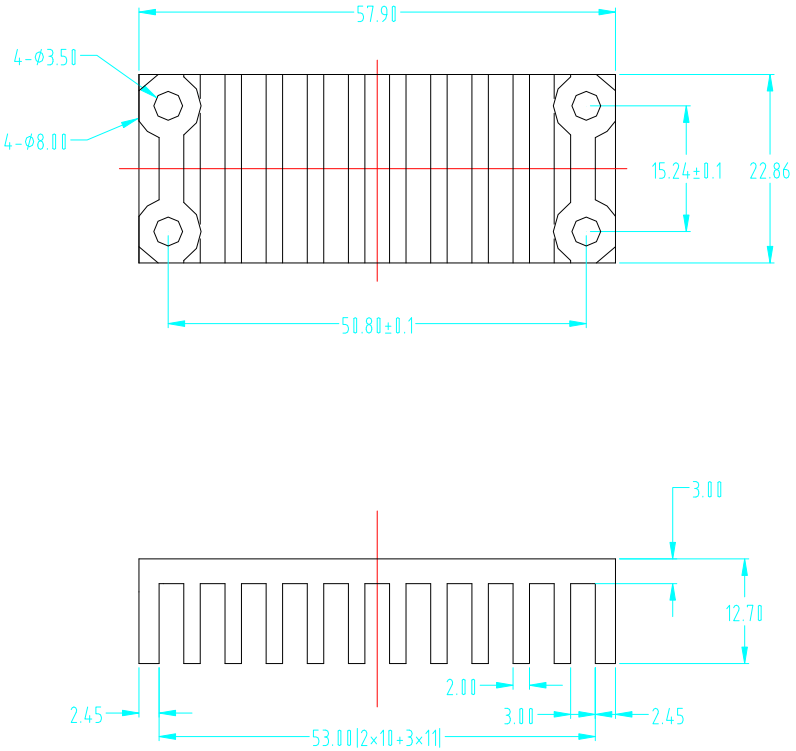



Figure 26 Heatsink

## Thermal Considerations – Base plate module

For a typical application, forced airflow direction is from Vin- to Vin+, Figure 27 shows the derating output current vs ambient air temperature at different air velocity .

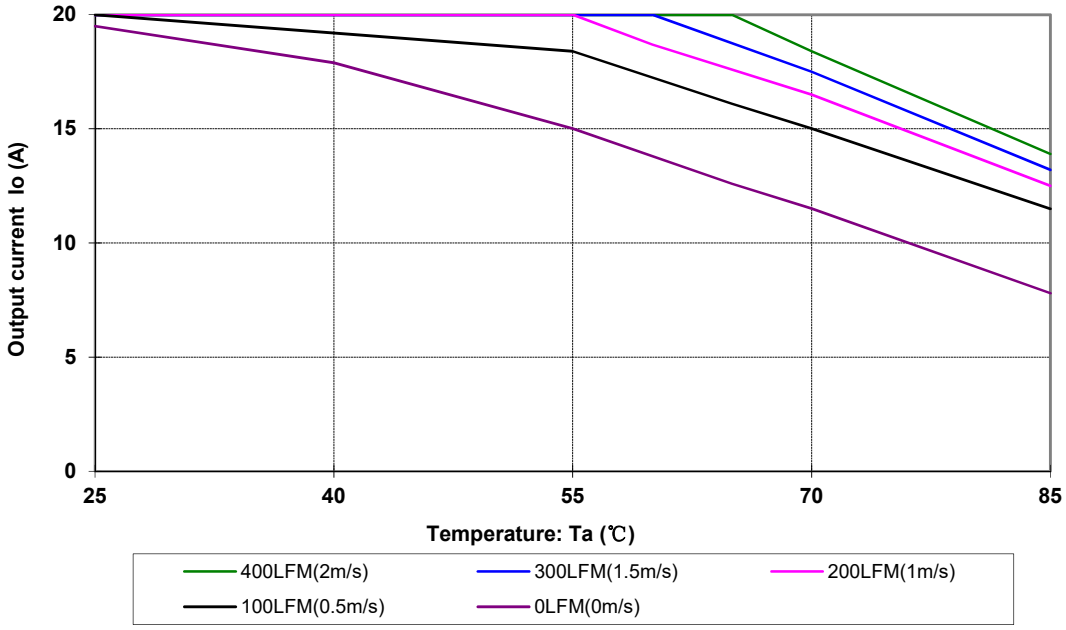



Figure 27 Output power derating, $48V_{in,}$ air flowing across the converter from Vin- and Vin+

## 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: /$s^3$, -3db/oct,<br>axes of vibration: X/Y/Z<br>Time: 30 min/axis |
| Mechanical shock | 3 | 30g, 6ms, 3 axes, 6 directions, 3 time/direction |
| Thermal shock | 3 | -40 $^{O}$C to +100 $^{O}$C, unit temperature 20 cycles |
| Thermal cycling | 3 | -40 $^{O}$C to +55 $^{O}$C, temperature change rate: 1 $^{O}$C/min, cycles: 2 cycles |
| 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 AVO240-48S12 series power supply.

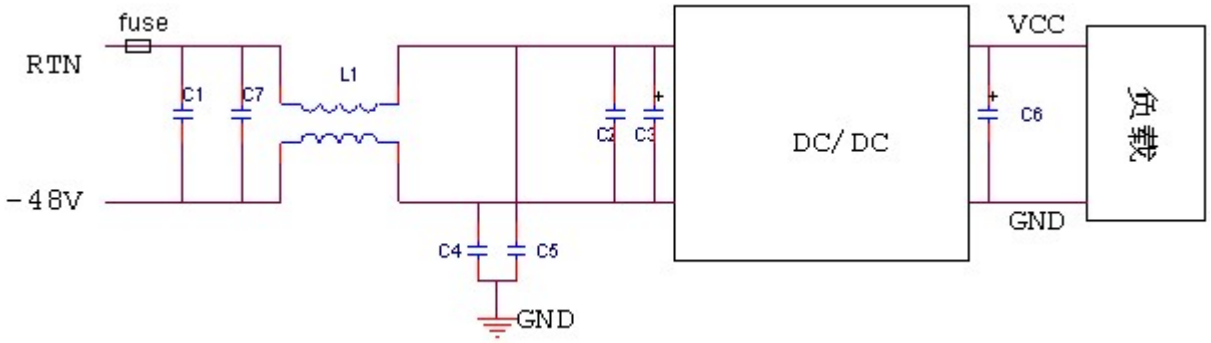



Figure 28 Typical application

Recommended input fuse:Littel fuse 0314015.P 15A
C1 C7:SMDceramic-100V-2.2uF-X7R-1210
C2 : SMDceramic-100V-100nF-±10%-X7R-1206
C3: 100μF/100V electrolytic capacitor, High frequency and low ESR
C6:1000μF/25V electrolytic capacitor, High frequency and low ESR
C4 C5: SMD ceramic-0.1U/1000V/X7R- 2220
L1: 809uH-±25%-9.7A-R5K-28*26*12.7mm

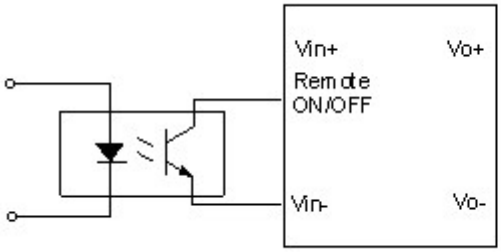
.

.

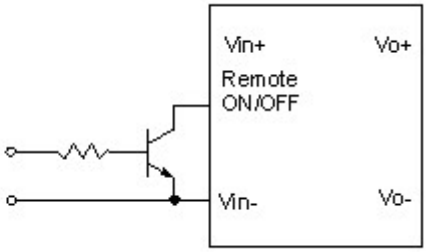
## Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AVO240-48S12 series. 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 29.




Isolated remote ON/OFF circuit




Non-isolated remote ON/OFF circuit

Figure 29 External Remote ON/OFF circuit

## Input Ripple & Output Ripple & Noise Test Configuration

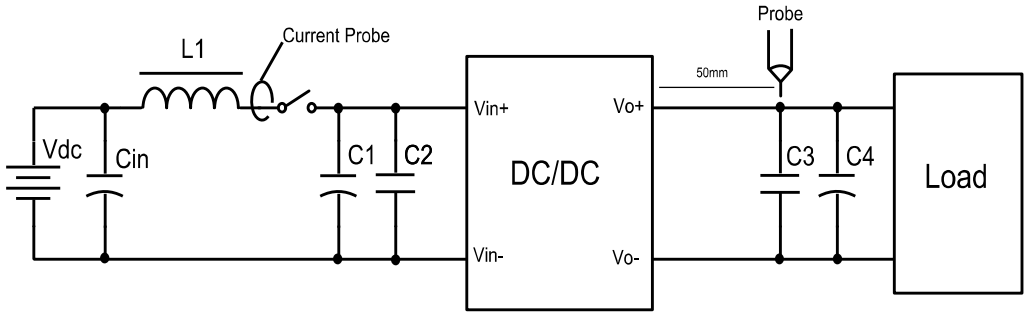



Figure 30 Input ripple & inrush current, output ripple & noise test configuration

Vdc: DC power supply
L1: 12μH
Cin: 220μF/100V typical
C1: 220μF/100V electrolytic capacitor, High frequency and low ESR
C2 C3: SMDceramic-100V-1000nF-X7R-1210
C4:1000μF/25V electrolytic capacitor, High frequency and low ESR

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.

## Soldering

The product is intended for standard manual, reflow or wave soldering.

| | Product requirement | Product Name |
|---|---|---|
| R6 | Wave Soldering | AVO240-48S12-6L<br>AVO240-48S12B-6L |

When wave soldering is used, the temperature on pins is specified to maximum 260 $^{O}$C for maximum 10s.

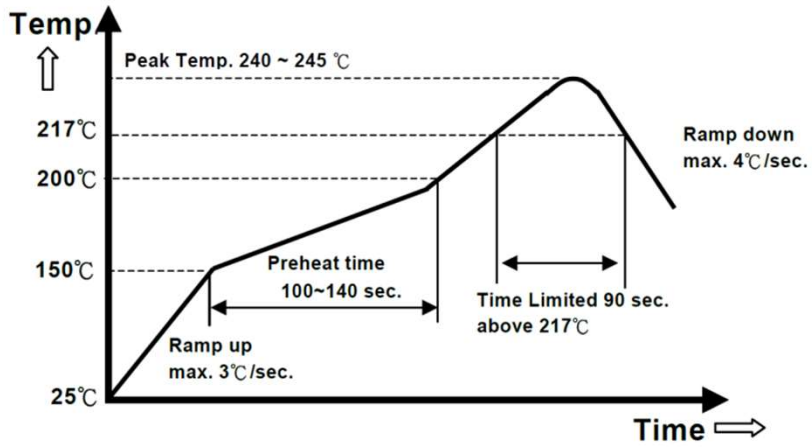
When soldering by hand, the iron temperature should be maintained at 300 $^{O}$C ~ 380 $^{O}$C and applied to the converter pins for less than 10s. Longer exposure can cause internal damage to the converter.

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

The below products are intended for standard reflow soldering.

| | Product requirement | Product Name |
|---|---|---|
| R6 | Reflow | AVO240-48S12-6L |

Please refer to following fig for recommended temperature profile parameters.



## Hazardous Substances Announcement (RoHS of China)

| Parts | Hazardous Substances | | | | | |
|---|---|---|---|---|---|---|
| | Pb | Hg | Cd | $Cr^{6+}$ | PBB | PBDE |
| AVO240-48S12-6L | x | x | x | x | x | x |
| AVO240-48S12B-6L | 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 |
|---|---|---|---|
| 1.1 | 10.16.2014 | First Issue | S. Dong |
| 1.2 | 10.25.2016 | Update the soldering part | K. Wang |
| 1.3 | 11.26.2019 | Update the soldering part | K. Wang |

**WORLDWIDE OFFICES**

**Americas**
2900 South Diablo Way
Suite B100
Tempe, AZ 85282
USA
+1 888 412 7832

**Europe (UK)**
Ground Floor Offices
Barberry House, 4 Harbour Buildings
Waterfront West, Brierley Hill
West Midlands, DY5 1LN, UK
+44 (0) 1384 842 211

**Asia (HK)**
14/F, Lu Plaza
2 Wing Yip Street
Kwun Tong, Kowloon
Hong Kong
+852 2176 3333



ARTESYN™
An Advanced Energy Company
www.artesyn.com

For more information: www.artesyn.com
For support: productsupport.ep@artesyn.com