

## Description

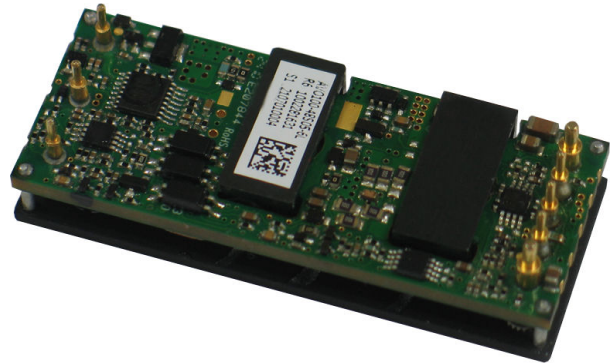
The AVO100-48S05B is a single output DC-DC converter with standard eighth-brick outline and pin configuration. It delivers up to 20A output current with 5V output voltage. It provides CNT, remote control, trim and sense functions, with OVP, OCP, OTP full protection method. Pre-bias start-up capability is realized. Efficiency above 92.8% and excellent thermal performance make it an ideal choice for telecom and datacom application. It can work under -40°C ~ +85°C.

## Operational Features

- Up to 20A output current
- Ultra-high efficiency 92.8% typ. at full load
- Wide input range: 36V ~ 75V
- Pre-bias function
- Excellent thermal performance
- No minimum load requirement
- Fixed frequency operation
- RoHS 6 compliant

## Control Features

- Remote control function
- Remote output sense
- Trim function: -20% ~ +10%



## Protection Features

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

## Mechanical Features

- Industry standard eighth-brick pin-out outline
- With a baseplate
- Pin length: 3.8mm

## Safety & EMC

- Meets safety standards UL 60950-1, IEC/EN 60950-1 and GB4943
- Approved by UL and TUV
- Meets 2006/95/EEC and 93/68/EEC directives which facilitate CE marking in user's end product
- Meets conducted emission's requirements of FCC Class A 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                                |
|--|----------------------------|------|---------|------|-------|---|
| <b>Absolute max. ratings</b>               |                            |      |         |      |       |   |
| Input voltage                              | Non-operating              | -    | -       | 100  | V     | 100ms   |
|  | Operating                  | -    | -       | 80   | V     | Continuous  |
| Operating temperature                      |                            | -40  | -       | +85  | °C    | -   |
| Storage temperature                        |                            | -55  | -       | +125 | °C    | -   |
| Voltage at remote ON/OFF pin               |                            | -0.7 | -       | 12   | V     | -   |
| <b>Input characteristics</b>               |                            |      |         |      |       |   |
| Operating input voltage range              |                            | 36   | 48      | 75   | V     | -   |
| Input under-voltage lockout                | Turn-on voltage threshold  | 31   | 34      | 36   | V     | -   |
|  | Turn-off voltage threshold | 30   | 32      | 35   | V     | -   |
|  | Lockout voltage hysteresis | 1    | 2       | 3    | V     | -   |
| Max. input current                         |                            | -    | -       | 3.5  | A     | 36V <sub>in</sub> , full load                     |
| No-load input current                      |                            | -    | 0.05    | 0.1  | A     | -   |
| Standby input current                      |                            | -    | 0.01    | 0.03 | A     | Remote OFF  |
| Inrush current transient rating            |                            | -    | 0.5     | 1    | A2s   | Figure 15   |
| Input reflected ripple current             |                            | -    | 15      | -    | mA    | Through 12μH inductor; Figure 15                  |
| Recommended input fuse                     |                            | -    | -       | 10   | A     | External fast blow fuse is recommended; Figure 11 |
| Input filter component values (C/L)        |                            | -    | 4.4\3.0 | -    | μF\μH | Internal values                                   |
| Recommended external input capacitance     |                            | -    | 100     | -    | μF    | Low ESR capacitor is recommended; Figure 11       |
| <b>Output characteristics</b>              |                            |      |         |      |       |   |
| Output voltage set point (standard option) |                            | 4.93 | 5       | 5.07 | V     | 48V <sub>in</sub> , full load                     |
| Output voltage line regulation             | -                          | 0.1  | 0.2     | %    | -     |   |
|  | -                          | 5    | 10      | mV   | -     |   |
| Output voltage load regulation             | -                          | 0.2  | 0.5     | %    | -     |   |
|  | -                          | 10   | 25      | mV   | -     |   |

| Parameter  |  | Min. | Typ. | Max.  | Unit | Notes & conditions   |
|--|--|------|------|-------|------|--|
| Output voltage temperature regulation                        |  | -    | -    | 0.02  | %/°C | -  |
| Total output voltage range                                   |  | 4.85 | 5    | 5.15  | V    | Over sample, line, load, temperature & life                        |
| Output voltage ripple and noise                              |  | -    | 40   | 90    | mVpp | Figure 2<br>20MHz bandwidth; Figure 15                             |
| Operating output current range                               |  | 0    | -    | 20    | A    | -  |
| Output DC current-limit inception                            |  | 22   | -    | 32    | A    | Hiccup: auto-restart when over-current condition is removed        |
| Output capacitance   |  | 220  | 1000 | 10000 | μF   | -  |
| <b>Dynamic characteristics</b>                               |  |      |      |       |      |  |
| Dynamic response<br>(output capacitance 220μ)                | 50% ~ 75% ~ 50%<br>$I_{o,max}$ , 0.1A/μs | -    | 80   | -     | mV   | Figure 4<br>Test condition: 25°C, nominal input voltage, Figure 11 |
|  | 50% ~ 75% ~ 50%<br>$I_{o,max}$ , 1A/μs   | -    | 230  | -     | mV   | Figure 5<br>Test condition: 25°C, nominal input voltage, Figure 11 |
|  | Settling time                            | -    | 100  | -     | μs   | Recovery to within 1% $V_{o,nom}$                                  |
| Turn-on transient  | Rise time                                | -    | 5    | 30    | ms   | Full load, Figure 6  |
|  | Turn-on delay time                       | -    | 3    | 30    | ms   | -  |
|  | Output voltage overshoot                 | -    | 0    | -     | %Vo  | -  |
| <b>Efficiency</b>  |  |      |      |       |      |  |
| 100% load. Test condition: Ta: 25°C.<br>Air velocity: 300LFM |  | -    | 92.8 | -     | %    | Figure 1   |
| 60% load   |  | -    | 92.4 | -     | %    | Figure 1   |

## Electrical Characteristics (Continued)

| Parameter   |                   | Min. | Typ. | Max. | Unit                | Notes & conditions  |
|---|-------------------|------|------|------|---------------------|---|
| <b>Isolation characteristics</b>                                    |                   |      |      |      |                     |   |
| Isolation voltage (conditions: 1mA for 60s, slew rate of 2000V/10s) |                   | 2250 | -    | -    | V                   | Basic insulation, pollution degree 2, input to output       |
| <b>Feature characteristics</b>                                      |                   |      |      |      |                     |   |
| Switching frequency   |                   | 280  | 310  | 360  | kHz                 | -   |
| Remote ON/OFF control (negative logic)                              | Off-state voltage | 3.5  | -    | 12   | V                   | Figure 12   |
|   | On-state voltage  | -0.7 | -    | 1.2  | V                   |   |
| Output voltage trim range   |                   | 4    | -    | 5.5  | V                   | See <i>Trim Characteristics of Application Note</i>         |
| Output voltage remote sense range                                   |                   | -    | -    | 0.5  | V                   | -   |
| Output over-voltage protection (static)                             |                   | 115  | -    | 140  | %V <sub>o,nom</sub> | Hiccup: auto-restart when over-voltage condition is removed |
| Over-temperature shutdown   |                   | -    | 123  | -    | °C                  | Auto recovery;<br>OTP test point: Figure 10                 |
| Over-temperature hysteresis   |                   | 5    | -    | -    | °C                  | -   |
| <b>Reliability characteristics</b>                                  |                   |      |      |      |                     |   |
| Calculated MTBF (telcordia)   |                   | -    | 1.5  | -    | 10 <sup>6</sup> h   | 300LFM, 40C Ta. Normal input/rated output@80%load           |

## Electromagnetic Compatibility Characteristics

| Test item   | Regulations  | Criteria | Notes & conditions      |
|---|--|----------|-------------------------|
| Conducted emission  | EN 55022<br>DC input port, class A limits  | /        | See EMC Test Conditions |
| Immunity to electrostatic discharge                                     | IEC/EN61000-4-2<br>Enclosure port, level 3   | B        |                         |
| Immunity to electrical fast transient                                   | IEC/EN61000-4-4<br>DC input port, level 3  | B        |                         |
| Immunity to surges  | IEC/EN61000-4-5<br>DC input port<br>Line to ground (earth): 600V<br>Line to line: 600V | B        |                         |
| Immunity to continuous conducted interference                           | IEC/EN61000-4-6<br>DC input port, level 2  | A        |                         |
| Immunity to voltage dips and short interruptions and voltage variations | EN 61000-4-29<br>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.

## Qualification Testing

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

# Characteristic Curves

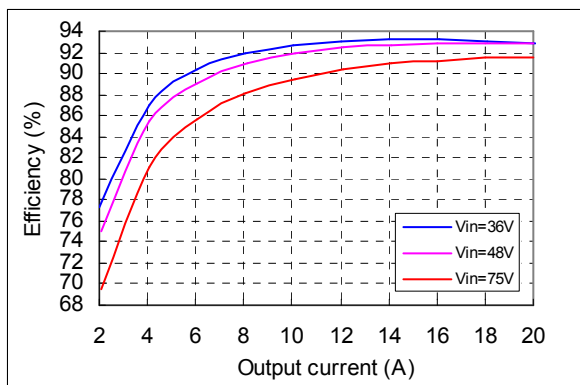


Figure 1 Efficiency vs. output current,  $T_a = 25^\circ\text{C}$ ,  $V_o = 5\text{V}$ , Air velocity = 300LFM

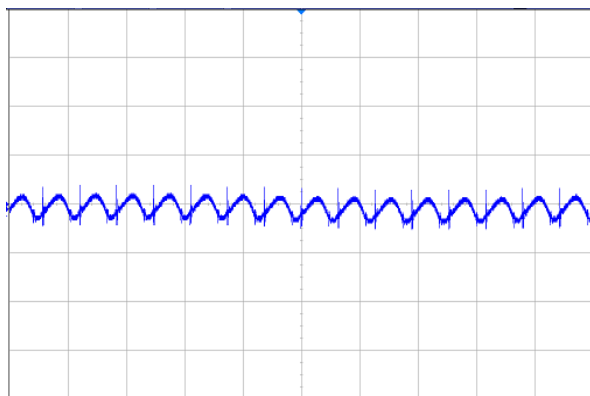


Figure 2 Output ripple & noise (5 $\mu\text{s}/\text{div}$ , 50mV/div), see Figure 15

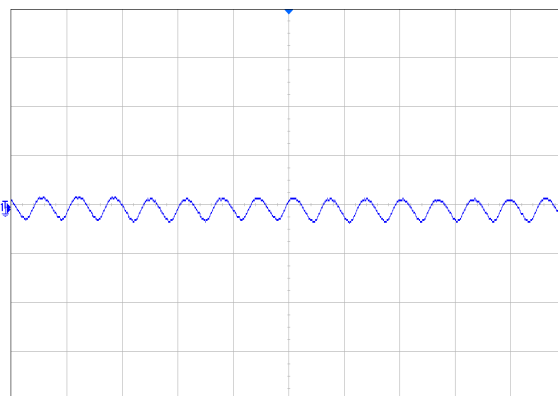


Figure 3 Input reflected ripple current (5 $\mu\text{s}/\text{div}$ , 10mA/div), see Figure 15

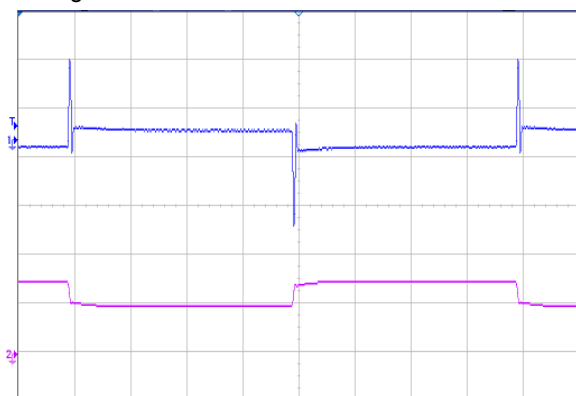


Figure 4 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 0.1A/ $\mu\text{s}$  slew rate, (1ms/div), see Figure 11; CH1-output voltage (50mV/div) CH2-output current (10A/div)

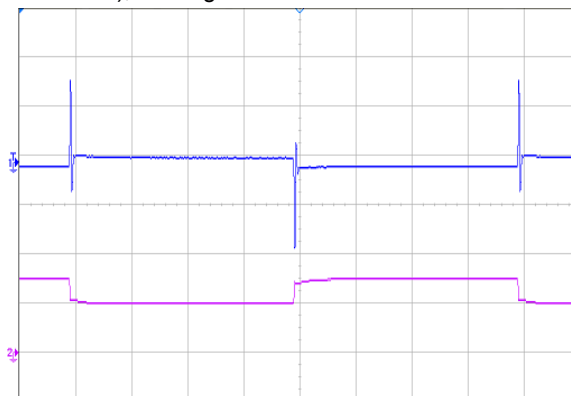


Figure 5 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 1A/ $\mu\text{s}$  slew rate, (1ms/div), see Figure 11; CH1-output voltage (100mV/div) CH2-output current (10A/div)

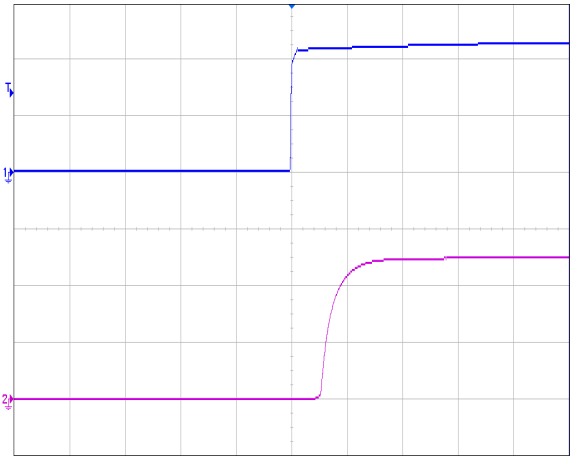


Figure 6 Output voltage startup by power-on, (5ms/div), see Figure 11; CH1-input voltage (20V/div) CH2-output voltage (2V/div)

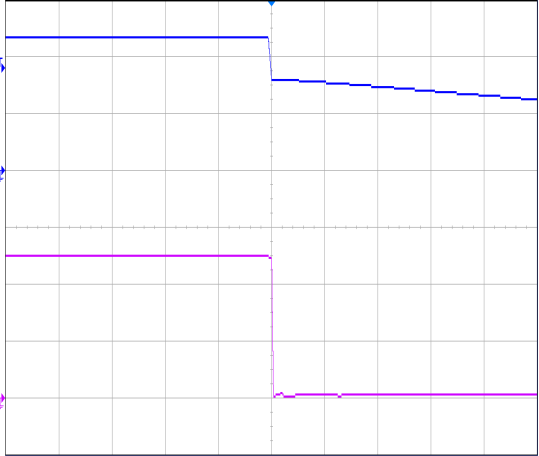


Figure 7 Output voltage shut down by power-off, (10ms/div), see Figure 11; CH1-input voltage (20V/div) CH2-output voltage (2V/div)

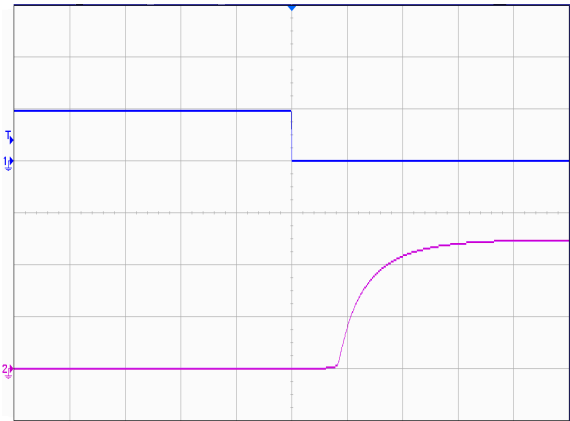


Figure 8 Output voltage startup by remote ON, (2ms/div); see Figure 12; CH1-remote ON (5V/div) CH2-output voltage (2V/div)

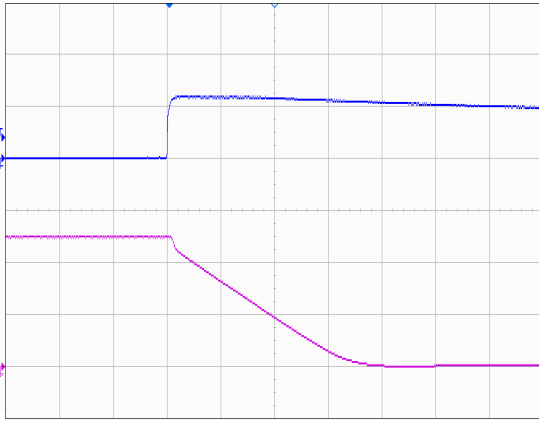


Figure 9 Output voltage shutdown by remote OFF, (100µs/div), see Figure 12; CH1-remote OFF voltage (5V/div); CH2-output voltage (2V/div)

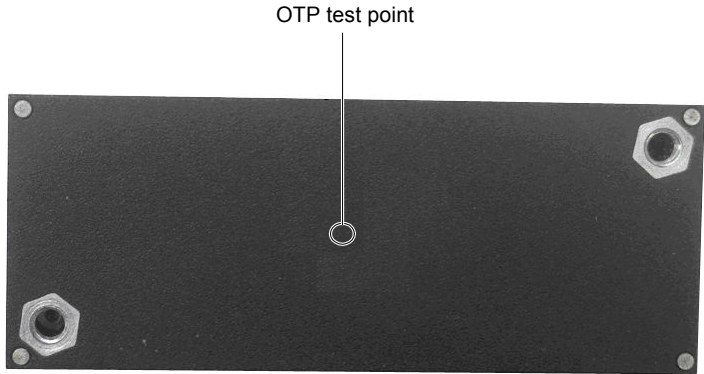


Figure 10 OTP test point (center of the baseplate)

# Application Note

## Typical Application

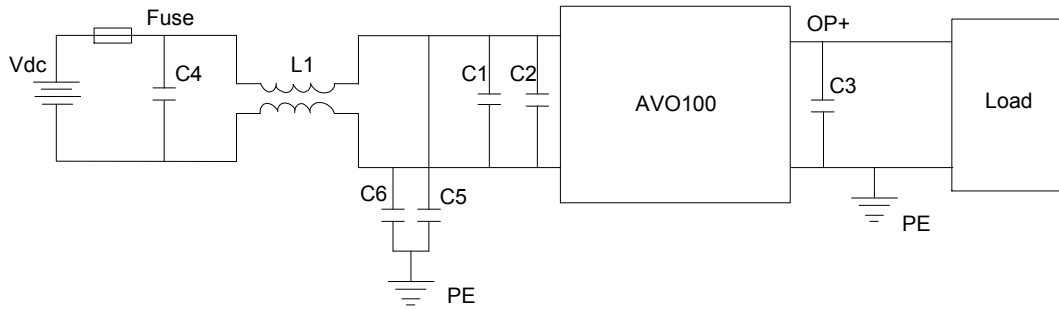


Figure 11 Typical application

Recommended input fuse: LITTLEFUSE 216010.P 10A

C1: SMD ceramic-100V-100nF- ± 10%-X7R-1206

C2: 100µF/100V electrolytic capacitor, high frequency and low ESR

C3: 1000µF/10V electrolytic capacitor, high frequency and low ESR

C4: SMD ceramic-100V-1000nF-X7R-1210

C5, C6: SMD ceramic- 22nF/1000V/X7R-1210

L1: 1320uH- ± 25%-4A-R5K-21 × 21 × 12.5mm

## Remote ON/OFF

Negative remote ON/OFF logic is available in AVO100-48S05B. Below is the detailed internal circuit in AVO100-48S05B.

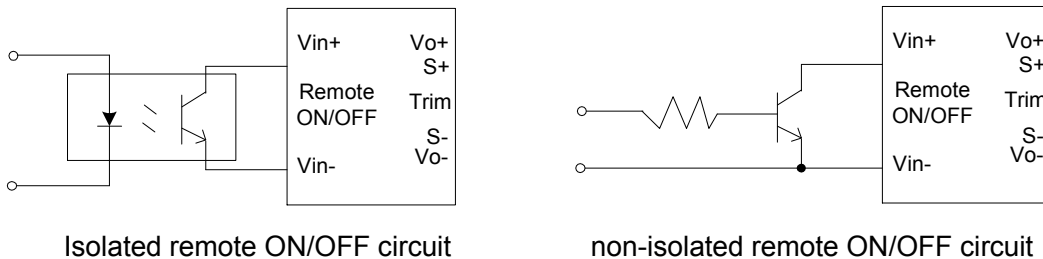


Figure 12 External remote ON/OFF circuit



### Trim Characteristics

Connecting an external resistor between Trim pin and V<sub>o-</sub> pin will decrease the output voltage, while connecting it between Trim and V<sub>o+</sub> will increase the output voltage. The following equations determine the external resistance to obtain the trimmed output voltage.

$$R_{adj-down} = \frac{511}{\Delta} - 10.2(k\Omega)$$

Where  $\Delta = (V_{nom} - V_o) \times 100 / V_{nom}$

$$R_{trim-up} = \frac{5.11 \times V_{nom} \times (100 + \Delta)}{1.225 \times \Delta} - \frac{511}{\Delta} - 10.2(k\Omega)$$

Where  $\Delta = (V_o - V_{nom}) \times 100 / V_{nom}$

V<sub>nom</sub> : Nominal output voltage.

For example, to get 5.5V output, the trimming resistor is

$$R_{trim-up} = \frac{5.11 \times 5 \times (100 + (5.5 - 5) \times 100 / 5)}{1.225 \times (5.5 - 5) \times 100 / 5} - \frac{511}{(5.5 - 5) \times 100 / 5} - 10.2 = 167.78(k\Omega)$$

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

$$V_o = \frac{(V_{trim} + 1.225) \times V_{norm}}{2.45}$$

Where V<sub>trim</sub> is the potential applied at the Trim pin, and V<sub>o</sub> is the desired output voltage. When trimming up, the output current should be decreased accordingly so as not to exceed the maximum output power.

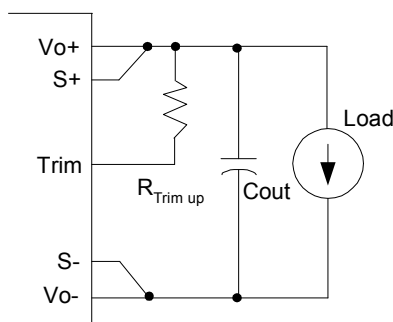


Figure 13 Trim up

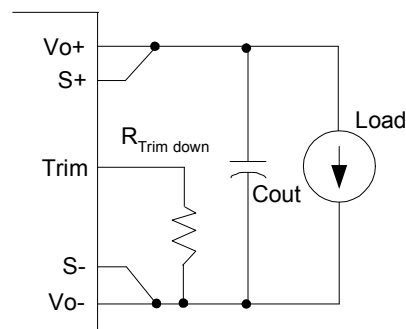


Figure 14 Trim down

### 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.

If the sense compensation function is not necessary, connect S+ to V<sub>o+</sub> and S- to V<sub>o-</sub> respectively.

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

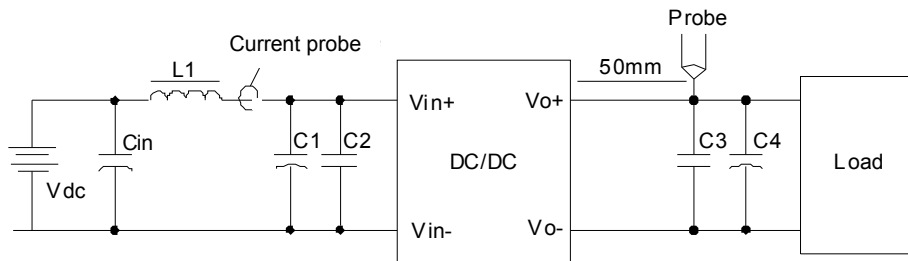


Figure 15 Input ripple & inrush current, output ripple & noise test configuration

Vdc: DC power supply

L1: 12μH

Cin: 220μF/100V typical

C1: SMDceramic-100V-100nF-±10%-X7R-1206

C2: 100μF/100V electrolytic capacitor, High frequency and low ESR

C3: SMDceramic-10V-1μF-±10%-X7R-1206

C4: 1000μF/10V electrolytic capacitor, High frequency and low ESR

Note: It is recommended to use a coaxial cable with series 50Ω resistor and 0.68μF ceramic capacitor or a ground ring of probe to test output ripple & noise.

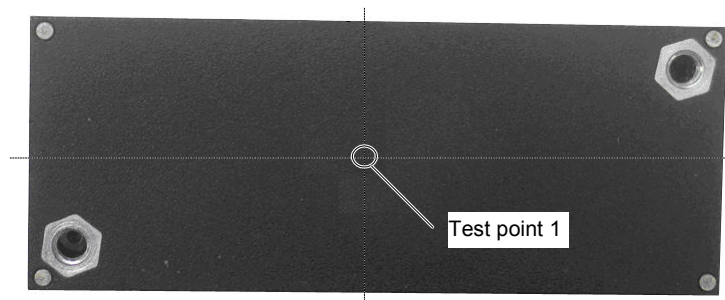
## Recommend EMC Filter Configuration

See Figure11.

## 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 test points. The temperature at these points should not exceed the maximum values in Table 1.

For a typical application, forced airflow direction is from Vin- to Vin+, Figure 16 shows the derating of output current vs. ambient air temperature at different air velocity.



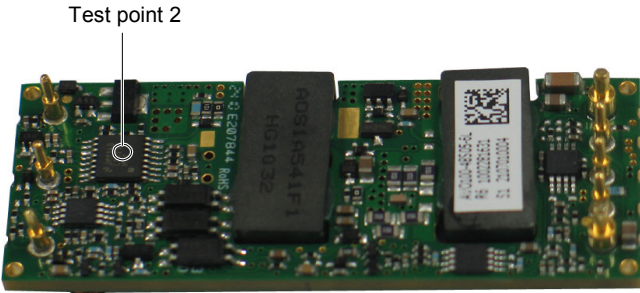


Figure 16 Temperature test points on converter

Table 1 Temperature limit

| Test point   | Temperature limit |
|--------------|-------------------|
| Test point 1 | 116°C             |
| Test point 2 | 118°C             |

The converter can also operate with a smaller heatsink and sufficient airflow. The heatsink is shown in Figure 17.

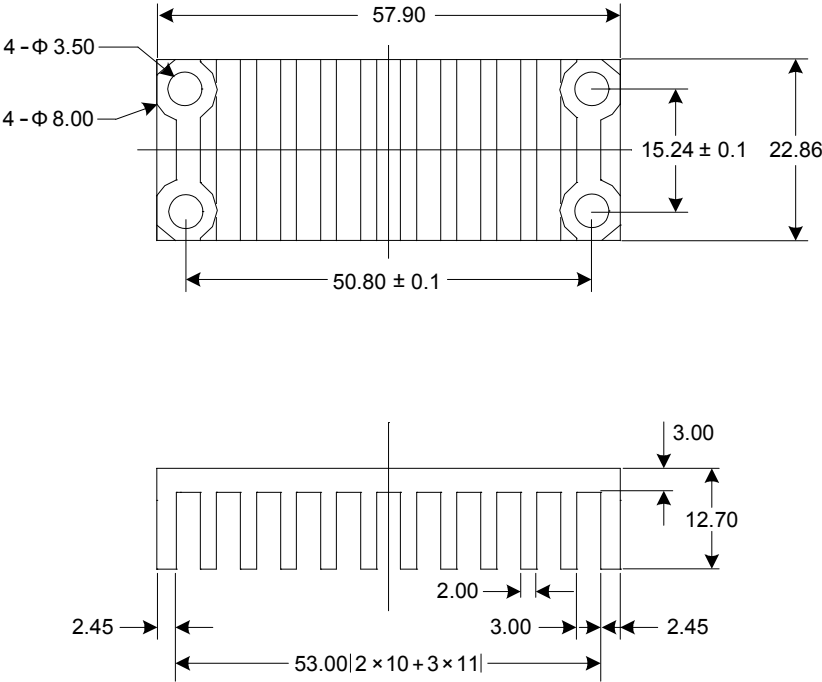


Figure 17 Heatsink (unit: mm)

Figure 18 shows the derating output current vs. ambient air temperature at different air velocity with a heatsink, the heatsink specification is shown in Figure17. The typical test condition is shown in Figure 18.

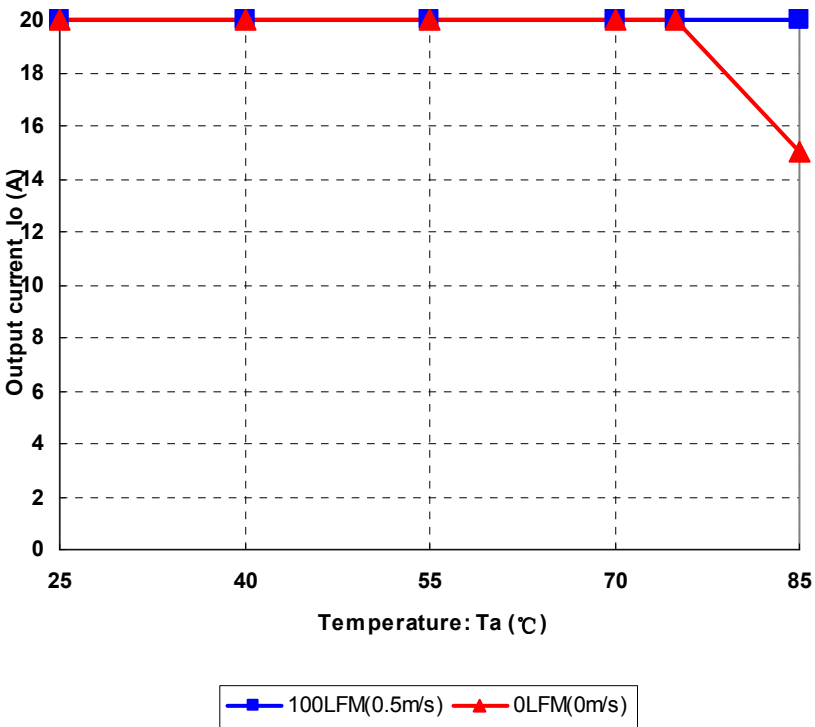


Figure 18 Derating curve

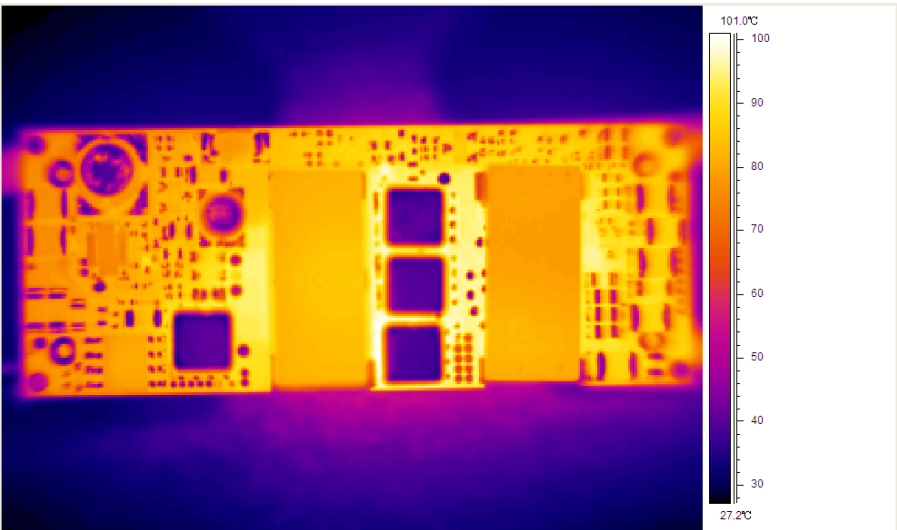
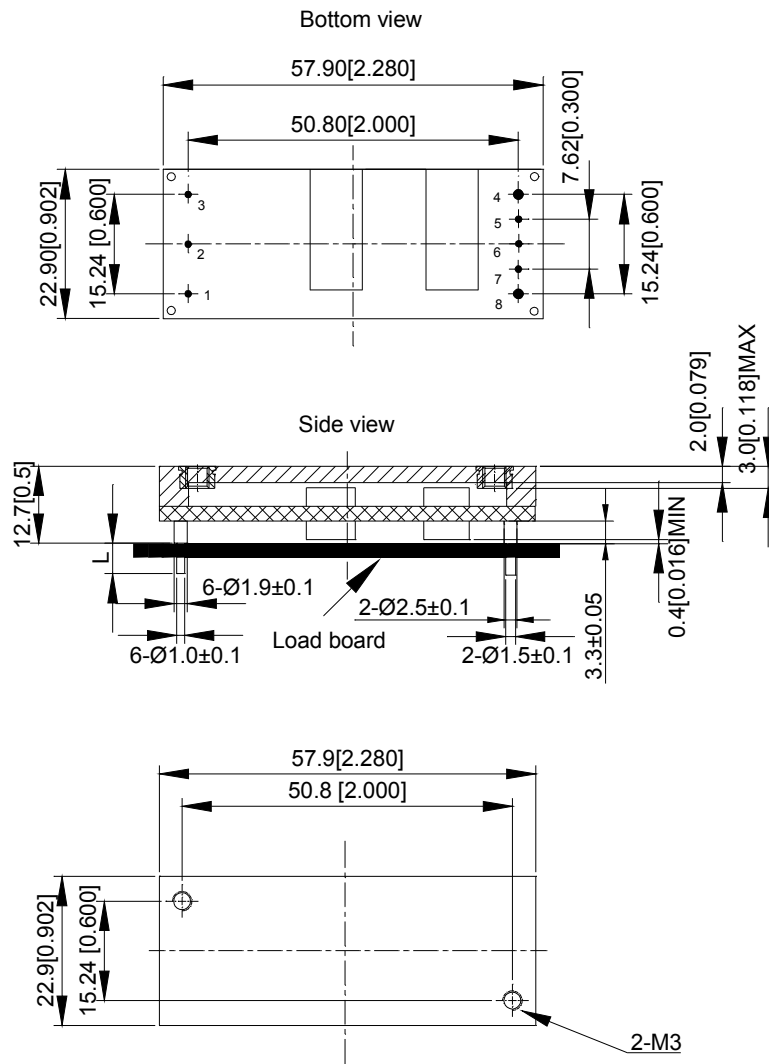


Figure 19 Thermal image, 48V<sub>in</sub>, 5V<sub>o</sub>, full load, room temperature, 100LFM (air flowing from pin 1 to pin 3)

Mechanical Diagram



Unit: mm [inch]                      Bottom view: pin on upside  
 Tolerance: X.Xmm ± 0.5mm [X.X in. ± 0.02in.]  
                   X.XX mm± 0.25mm [X.XX in. ± 0.01in.]

Figure 20 Mechanical diagram

Recommended Hole Pattern

Through hole with diameter 1.37mm (0.054 inch) is recommended for pin1, pin2, pin3, pin5, pin6 and pin7 soldering. Through hole with diameter 1.88mm (0.074 inch) is for pin4 and pin8. See Figure 21.

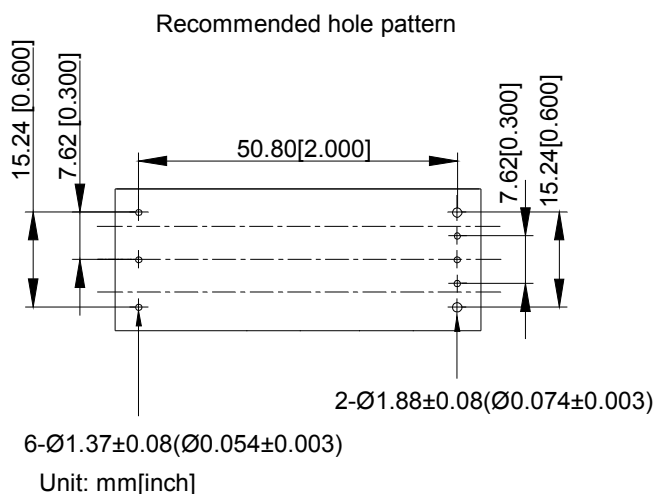


Figure 21 Recommended hole pattern

### 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 <sub>in+</sub> | Positive input voltage  |
| 2       | Remote ON/OFF    | Remote control          |
| 3       | V <sub>in-</sub> | Negative input voltage  |
| 4       | V <sub>o-</sub>  | Negative output voltage |
| 5       | S-               | Negative remote sense   |
| 6       | Trim             | Output voltage trim     |
| 7       | S+               | Positive remote sense   |
| 8       | V <sub>o+</sub>  | Positive output voltage |

## Soldering

The product is intended for standard manual wave soldering.

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

When manual soldering is used, 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 simulative.

## Ordering Information

|               |          |           |          |           |          |   |          |          |          |
|---------------|----------|-----------|----------|-----------|----------|---|----------|----------|----------|
| <b>AVO100</b> | <b>-</b> | <b>48</b> | <b>S</b> | <b>05</b> | <b>B</b> |   | <b>-</b> | <b>6</b> | <b>L</b> |
| ①             |          | ②         | ③        | ④         | ⑤        | ⑥ |          | ⑦        | ⑧        |

|   |                      |   |
|---|----------------------|---|
| ① | Model series         | AVO: standard eighth-brick series, 100: output power 100W |
| ② | Input voltage        | 48: 36V ~ 75V input range, rated input voltage 48V        |
| ③ | Output number        | S: single output  |
| ④ | Rated output voltage | 05: 5V output   |
| ⑤ | Baseplate            | B: with baseplate   |
| ⑥ | Remote ON/OFF logic  | Default: negative   |
| ⑦ | Pin length           | -6: 3.8mm   |
| ⑧ | RoHS status          | L: RoHS, R6   |

| Model number      | Description   |
|-------------------|---|
| AVO100-48S05-6Y   | 3.8mm pin length; negative on/off logic; without thread inside mounting hole; open frame; R5 compliant, see <i>AVO100-48S05 TRN</i> |
| AVO100-48S05P-6Y  | 3.8mm pin length; positive on/off logic; without thread inside mounting hole; open frame; R5 compliant, see <i>AVO100-48S05 TRN</i> |
| AVO100-48S05B-6Y  | 3.8mm pin length; negative on/off logic; without thread inside mounting hole; with base plate; R5 compliant                         |
| AVO100-48S05PB-6Y | 3.8mm pin length; positive on/off logic; without thread inside mounting hole; with base plate; R5 compliant                         |
| AVO100-48S05-6L   | 3.8mm pin length; negative on/off logic; without thread inside mounting hole; open frame; R6 compliant; see <i>AVO100-48S05 TRN</i> |
| AVO100-48S05P-6L  | 3.8mm pin length; positive on/off logic; without thread inside mounting hole; open frame; R6 compliant; see <i>AVO100-48S05 TRN</i> |
| AVO100-48S05B-6L  | 3.8mm pin length; negative on/off logic; without thread inside mounting hole; with base plate; R6 compliant                         |
| AVO100-48S05PB-6L | 3.8mm pin length; positive on/off logic; without thread inside mounting hole; with base plate; R6 compliant                         |
| AVO100-48S05SL-6L | SMT model; negative on/off logic; open frame; R6 compliant; see <i>AVO100-48S05 TRN</i>   |

## Hazardous Substances Announcement (RoHS Of China)

| Parts  | Hazardous substances |    |    |                  |     |      |
|--|----------------------|----|----|------------------|-----|------|
|  | Pb                   | Hg | Cd | Cr <sup>6+</sup> | PBB | PBDE |
| AVO100-48S05B-6L   | ○                    | ○  | ○  | ○                | ○   | ○    |
| ○: 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<br>√: 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: <ol style="list-style-type: none"> <li>1. Solders (including high-temperature solder in parts) contain plumbum.</li> <li>2. Glass of electric parts contains plumbum.</li> <li>3. Copper alloy of pins contains plumbum</li> </ol> |                      |    |    |                  |     |      |