

20W isolated DC-DC converter  
Wide input and regulated dual / single output



CE Patent Protection RoHS

### FEATURES

- Wide 2:1 input voltage range
- High efficiency up to 90%
- No-load power consumption as low as 0.15W
- I/O isolation test voltage 1.5k VDC
- Output short-circuit, over-voltage, over-current protection
- Operating ambient temperature range: -40℃ to +85℃
- Meets CISPR32/EN55032 CLASS A, without extra components
- Six-sided metal shielded package
- EN60950 approved

VRA\_LD-20WR3 & VRB\_LD-20WR3 series of isolated 20W DC-DC converter products with a 2:1 input voltage range. They feature efficiencies of up to 90%, 1500VDC input to output isolation, operating ambient temperature range of -40℃ to +85℃, output short-circuit, over-voltage, over-current protection. They meet CLASS A of CISPR32/EN55032 EMI standards without external components and they are widely used in applications such as data transmission device, battery power supplies, tele-communication device, distributed power supply system, hybrid module system, remote control system, industrial robot system fields.

### Selection Guide

| Certification | Part No.        | Input Voltage (VDC) |        | Output        |                          | Full Load Efficiency® (%)<br>Min./Typ. | Capacitive Load® (μF)<br>Max. |
|---------------|-----------------|---------------------|--------|---------------|--------------------------|----------------------------------------|-------------------------------|
|               |                 | Nominal (Range)     | Max. ① | Voltage (VDC) | Current(mA)<br>Max./Min. |                                        |                               |
| --            | VRA1215LD-20WR3 | 12<br>(9-18)        | 20     | ±15           | ±667/0                   | 85/87                                  | 625                           |
|               | VRA1224LD-20WR3 |                     |        | ±24           | ±417/0                   | 86/88                                  | 220                           |
|               | VRB121DLD-20WR3 |                     |        | 110           | 182/9                    | 86/88                                  | 66                            |
| CE            | VRA2405LD-20WR3 | 24<br>(18-36)       | 40     | ±5            | ±2000/0                  | 82/84                                  | 4800                          |
|               | VRA2409LD-20WR3 |                     |        | ±9            | ±1111/0                  | 84/86                                  | 1000                          |
|               | VRA2412LD-20WR3 |                     |        | ±12           | ±834/0                   | 84/86                                  | 800                           |
|               | VRA2415LD-20WR3 |                     |        | ±15           | ±667/0                   | 84/86                                  | 625                           |
| --            | VRA2424LD-20WR3 |                     |        | ±24           | ±417/0                   | 84/86                                  | 500                           |
| CE            | VRB2403LD-20WR3 |                     |        | 3.3           | 5000/0                   | 84/86                                  | 10000                         |
|               | VRB2405LD-20WR3 |                     |        | 5             | 4000/0                   | 88/90                                  | 10000                         |
|               | VRB2409LD-20WR3 |                     |        | 9             | 2222/0                   | 85/87                                  | 4700                          |
|               | VRB2412LD-20WR3 |                     |        | 12            | 1667/0                   | 85/87                                  | 1600                          |
|               | VRB2415LD-20WR3 |                     |        | 15            | 1333/0                   | 86/88                                  | 1000                          |
|               | VRB2424LD-20WR3 |                     |        | 24            | 834/0                    | 86/88                                  | 500                           |
|               | VRA4805LD-20WR3 | 48<br>(36-75)       | 80     | ±5            | ±2000/0                  | 84/86                                  | 4800                          |
|               | VRA4812LD-20WR3 |                     |        | ±12           | ±834/0                   | 86/88                                  | 800                           |
|               | VRA4815LD-20WR3 |                     |        | ±15           | ±667/0                   | 87/89                                  | 625                           |
|               | VRB4803LD-20WR3 |                     |        | 3.3           | 5000/0                   | 84/86                                  | 10000                         |
|               | VRB4805LD-20WR3 |                     |        | 5             | 4000/0                   | 88/90                                  | 10000                         |
|               | VRB4809LD-20WR3 |                     |        | 9             | 2222/0                   | 87/89                                  | 4700                          |
|               | VRB4812LD-20WR3 |                     |        | 12            | 1667/0                   | 87/89                                  | 1600                          |
|               | VRB4815LD-20WR3 |                     |        | 15            | 1333/0                   | 88/90                                  | 1000                          |
|               | VRB4824LD-20WR3 |                     |        | 24            | 834/0                    | 88/90                                  | 500                           |

Notes: ①Exceeding the maximum input voltage may cause permanent damage;  
②Efficiency is measured in nominal input voltage and rated output load;  
③The specified maximum capacitive load value for positive and negative output is identical.

## Input Specifications

| Item                                                    | Operating Conditions                             |                 | Min.                                     | Typ.    | Max.    | Unit |
|---------------------------------------------------------|--------------------------------------------------|-----------------|------------------------------------------|---------|---------|------|
| Input Current (full load / no-load)                     | 12VDC input                                      | ±15V output     | --                                       | 1916/12 | 1960/20 | mA   |
|                                                         |                                                  | ±24V output     | --                                       | 1894/15 | 1938/25 |      |
|                                                         |                                                  | Others          | --                                       | 1894/35 | 1938/-- |      |
|                                                         | 24VDC input                                      | 3.3V output     | --                                       | 799/40  | 818/45  |      |
|                                                         |                                                  | 5V output       | --                                       | 969/40  | 993/45  |      |
|                                                         |                                                  | Others          | --                                       | 947/6   | 969/10  |      |
|                                                         | 48VDC input                                      | 3.3V output     | --                                       | 400/20  | 409/25  |      |
|                                                         |                                                  | 5V output       | --                                       | 485/20  | 497/25  |      |
|                                                         |                                                  | Others          | --                                       | 474/5   | 485/9   |      |
| Reflected Ripple Current                                | 12VDC input                                      | 110V output     | --                                       | 20      | --      |      |
|                                                         |                                                  | others          | --                                       | 30      | --      |      |
|                                                         | 24VDC / 48VDC input                              |                 | --                                       | 30      | --      |      |
| Surge Voltage (1sec. max.)                              | 12VDC input                                      |                 | -0.7                                     | --      | 25      | VDC  |
|                                                         | 24VDC input                                      |                 | -0.7                                     | --      | 50      |      |
|                                                         | 48VDC input                                      |                 | -0.7                                     | --      | 100     |      |
| Start-up Voltage                                        | 12VDC input                                      |                 | --                                       | --      | 9       |      |
|                                                         | 24VDC input                                      |                 | --                                       | --      | 18      |      |
|                                                         | 48VDC input                                      |                 | --                                       | --      | 36      |      |
| Start-up Time                                           | Nominal input voltage & constant resistance load |                 | --                                       | 10      | --      | ms   |
| Input Filter                                            |                                                  |                 | PI filter                                |         |         |      |
| Ctrl <sup>①</sup>                                       | Module on                                        |                 | Ctrl pin open or pulled high (3.5-12VDC) |         |         |      |
|                                                         | Module off                                       |                 | Ctrl pin pulled low to GND (0-1.2VDC)    |         |         |      |
|                                                         | Input current when off                           | VRB121DLD-20WR3 | --                                       | 5       | --      | mA   |
|                                                         |                                                  | Others          | --                                       | 4       | 7       |      |
| Hot Plug                                                |                                                  |                 | Unavailable                              |         |         |      |
| Note: ①The Ctrl pin voltage is referenced to input GND. |                                                  |                 |                                          |         |         |      |

Note: ①The Ctrl pin voltage is referenced to input GND.

## Output Specifications

| Item                          | Operating Conditions                                                                |                                 |                 | Min. | Typ. | Max.  | Unit  |
|-------------------------------|-------------------------------------------------------------------------------------|---------------------------------|-----------------|------|------|-------|-------|
| Voltage Accuracy <sup>①</sup> | 5%-100% load                                                                        | VRA1215LD-20WR3                 |                 | --   | ±1   | ±3    | %     |
|                               | 0%-100% load                                                                        | VRA1224LD-20WR3                 | Positive output | --   | ±1   | ±3    |       |
|                               |                                                                                     |                                 | Negative output | --   | ±2   | ±4    |       |
|                               |                                                                                     | Others                          |                 | --   | ±1   | ±3    |       |
| Linear Regulation             | Input voltage variation from low to high at full load                               | Positive output                 |                 | --   | ±0.2 | ±0.5  |       |
|                               |                                                                                     | Negative output                 |                 | --   | ±0.5 | ±1    |       |
| Load Regulation <sup>②</sup>  | 5%-100% load                                                                        | VRA1215LD-20WR3/VRA1224LD-20WR3 | Positive output | --   | ±0.5 | ±1    |       |
|                               |                                                                                     |                                 | Negative output | --   | ±1   | ±1.5  |       |
|                               |                                                                                     | Others                          | Positive output | --   | ±0.5 | ±1    |       |
|                               |                                                                                     |                                 | Negative output | --   | ±0.5 | ±1.5  |       |
| Cross Regulation              | Dual output with Positive output at 50% load and Negative output from 10%-100% load |                                 |                 | --   | --   | ±5    |       |
| Transient Recovery Time       | 25% load step change, Nominal input voltage                                         |                                 |                 | --   | 300  | 500   | μs    |
| 3.3V/5V/±5VDC output          |                                                                                     |                                 | --              | ±5   | ±8   | %     |       |
| Others                        |                                                                                     |                                 | --              | ±3   | ±5   |       |       |
| Temperature Coefficient       | Full load                                                                           |                                 |                 | --   | --   | ±0.03 | %/℃   |
| Ripple & Noise <sup>③</sup>   | 20MHz bandwidth, 5%-100% load                                                       |                                 | VRB121DLD-20WR3 | --   | --   | 250   | mVp-p |
|                               |                                                                                     |                                 | Others          | --   | 50   | 100   |       |
| Trim                          | Input voltage range(24V/48V input series)                                           |                                 |                 | --   | ±10  | --    | %Vo   |

|                                                                                                                                                                                       |                                                                               |                 |                                   |     |     |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------|-----------------------------------|-----|-----|-----|
| Over-voltage Protection                                                                                                                                                               | Input voltage range(24V/48V input series and VRA1215LD-20WR3/VRA1224LD-20WR3) |                 | 110                               | --  | 160 |     |
| Over-current Protection                                                                                                                                                               | Input voltage range                                                           | VRB121DLD-20WR3 | --                                | 130 | --  | %Io |
|                                                                                                                                                                                       |                                                                               | Others          | 110                               | --  | 190 |     |
| Short-circuit Protection                                                                                                                                                              |                                                                               |                 | Hiccup, continuous, self-recovery |     |     |     |
| Note:                                                                                                                                                                                 |                                                                               |                 |                                   |     |     |     |
| ①Output voltage accuracy of ±5VDC/±9VDC output converter for 0%-5% load is ±5% max;                                                                                                   |                                                                               |                 |                                   |     |     |     |
| ②Load regulation for 0%-100% load is ±5%;                                                                                                                                             |                                                                               |                 |                                   |     |     |     |
| ③The “parallel cable” method is used for Ripple and Noise test, please refer to DC-DC Converter Application Notes for specific information. Ripple & Noise at < 5% load is 5%Vo. Max. |                                                                               |                 |                                   |     |     |     |

## General Specifications

| Item                                                                                                                                               | Operating Conditions                                                                |                 | Min.                                   | Typ. | Max. | Unit    |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------|----------------------------------------|------|------|---------|
| Isolation                                                                                                                                          | Input-output Electric Strength Test for 1 minute with a leakage current of 1mA max. |                 | 1500                                   | --   | --   | VDC     |
| Insulation Resistance                                                                                                                              | Input-output resistance at 500VDC                                                   |                 | 1000                                   | --   | --   | M Ω     |
| Isolation Capacitance                                                                                                                              | Input-output capacitance at 100KHz/0.1V                                             | VRB2424LD-20WR3 | --                                     | 2050 | --   | pF      |
|                                                                                                                                                    |                                                                                     | VRB121DLD-20WR3 | --                                     | 2000 | --   |         |
|                                                                                                                                                    |                                                                                     | Others          | --                                     | 1050 | --   |         |
| Operating Temperature                                                                                                                              | See Fig. 1                                                                          |                 | -40                                    | --   | +85  | ℃       |
| Storage Temperature                                                                                                                                |                                                                                     |                 | -55                                    | --   | +125 |         |
| Storage Humidity                                                                                                                                   | Non-condensing                                                                      |                 | 5                                      | --   | 95   | %RH     |
| Pin Soldering Resistance Temperature                                                                                                               | Soldering spot is 1.5mm away from case for 10 seconds                               |                 | --                                     | --   | 300  | ℃       |
| Max. Case Temperature                                                                                                                              | Refer to temperature derating curve (VRB121DLD-20WR3)                               |                 | --                                     | --   | 105  |         |
| Vibration                                                                                                                                          |                                                                                     |                 | 10-150Hz, 5G, 90 Min. along X, Y and Z |      |      |         |
| Switching Frequency ①                                                                                                                              | PWM mode                                                                            | VRB121DLD-20WR3 | --                                     | 300  | --   | KHz     |
|                                                                                                                                                    |                                                                                     | Others          | --                                     | 270  | --   |         |
| MTBF                                                                                                                                               | MIL-HDBK-217F@25℃                                                                   |                 | 1000                                   | --   | --   | K hours |
| Note: ①Switching frequency is measured at full load. The module reduces the switching frequency for light load (below 50%) efficiency improvement. |                                                                                     |                 |                                        |      |      |         |

## Mechanical Specifications

|                |                          |
|----------------|--------------------------|
| Case Material  | Aluminum alloy           |
| Dimensions     | 50.80 x 25.40 x 11.80 mm |
| Weight         | 26.0g(Typ.)              |
| Cooling Method | Free air convection      |

## Electromagnetic Compatibility (EMC)

|           |                                                                   |                  |                                                                                      |
|-----------|-------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------|
| Emissions | CE                                                                | CISPR32/EN55032  | CLASS A (without extra components)/ CLASS B (see Fig.3-① for recommended circuit)    |
|           | RE                                                                | CISPR32/EN55032  | CLASS A (without extra components)/ CLASS B (see Fig.3-① for recommended circuit)    |
| Immunity  | ESD                                                               | IEC/EN61000-4-2  | Contact $\pm 4\text{KV}$ perf. Criteria B                                            |
|           | RS                                                                | IEC/EN61000-4-3  | 10V/m perf. Criteria A                                                               |
|           | EFT                                                               | IEC/EN61000-4-4  | $\pm 2\text{KV}$ (see Fig.3-② for recommended circuit) perf. Criteria B              |
|           | Surge                                                             | IEC/EN61000-4-5  | line to line $\pm 2\text{KV}$ (see Fig.3-② for recommended circuit) perf. Criteria B |
|           | CS                                                                | IEC/EN61000-4-6  | 3 Vr.m.s perf. Criteria A                                                            |
|           | Voltage dips, short interruptions and voltage variations immunity | IEC/EN61000-4-29 | 0%, 70% perf. Criteria B                                                             |

Typical Characteristic Curves

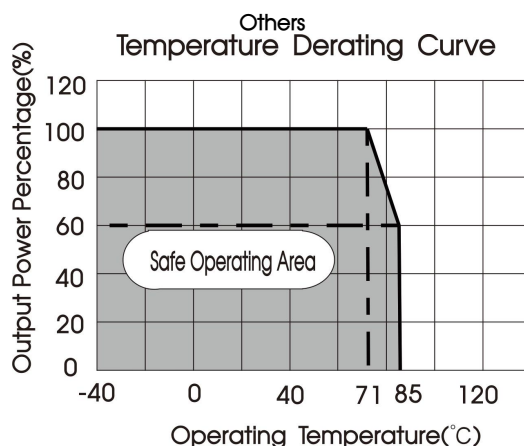
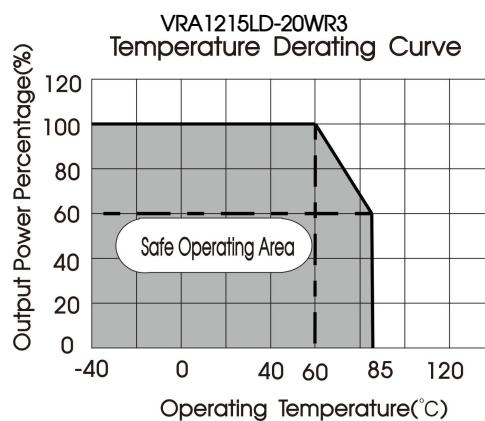
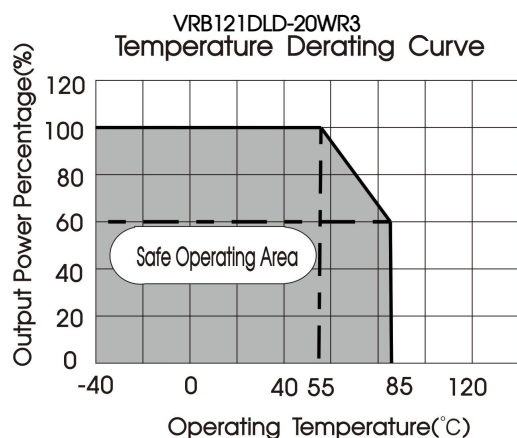
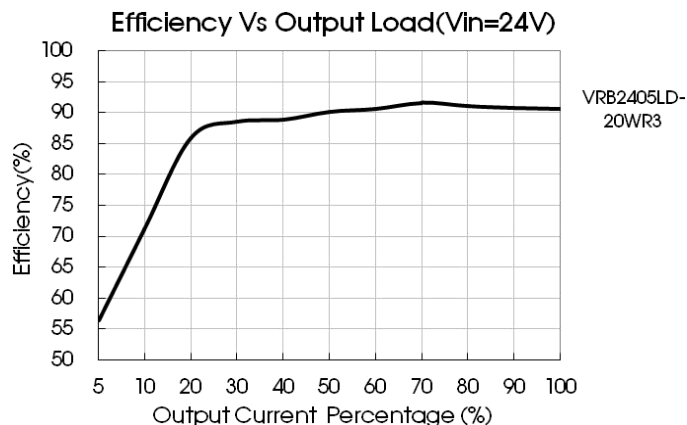
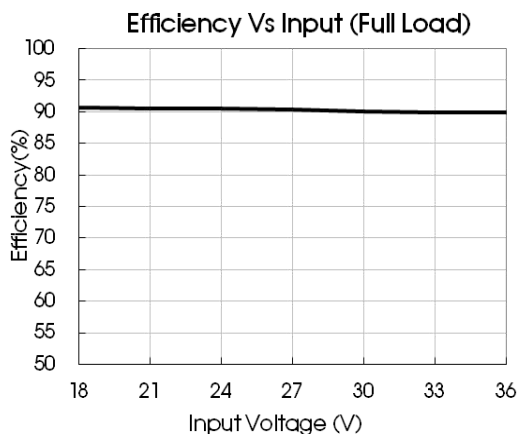
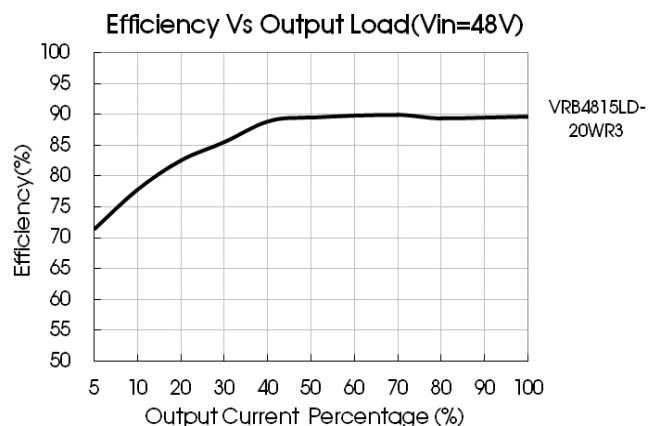
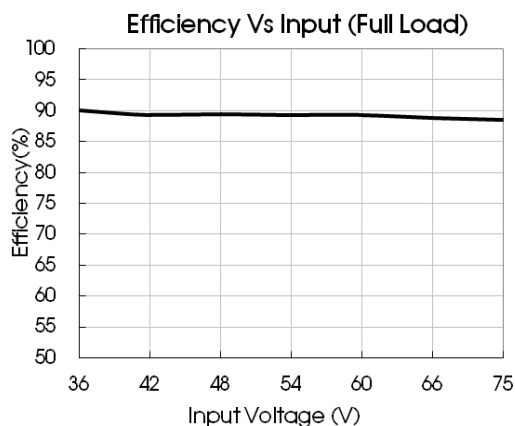
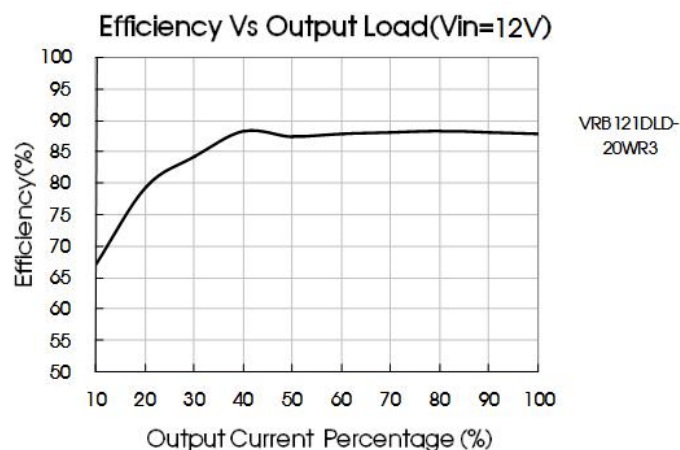
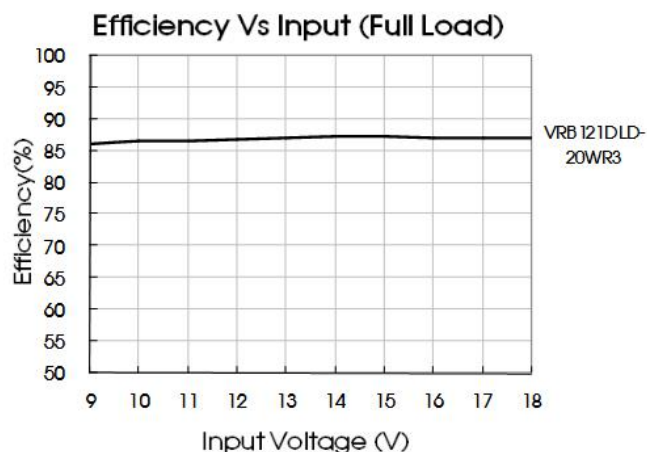


Fig. 1





## Design Reference

### 1. Typical application

All the DC/DC converters of this series are tested before delivery using the recommended circuit shown in Fig. 2.

Input and/or output ripple can be further reduced by appropriately increasing the input & output capacitor values  $C_{in}$  and  $C_{out}$  and/or by selecting capacitors with a low ESR (equivalent series resistance). Also make sure that the capacitance is not exceeding the specified max. capacitive load value of the product.

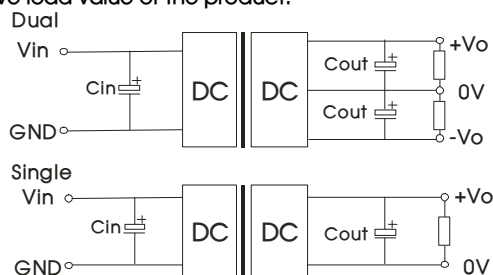
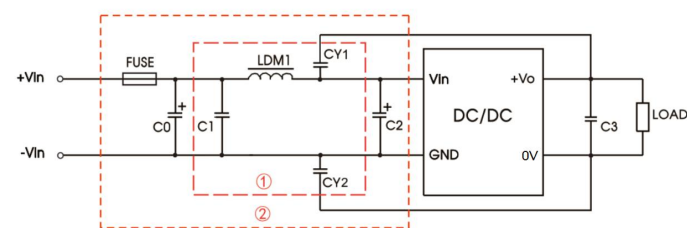


Fig. 2

| Single Vout (VDC) | Cout (μF) | Cin (μF) | Dual Vout (VDC) | Cout (μF) | Cin (μF) |
|-------------------|-----------|----------|-----------------|-----------|----------|
| 3.3/5             | 470       | 100      | ±5              | 220       | 100      |
| 9/12/15           | 220       |          | ±9/±12/±15      | 100       |          |
| 24                | 100       |          | ±24             | 100       |          |
| 110               | —         |          |                 |           |          |

### 2. EMC compliance circuit

Single:



Dual:

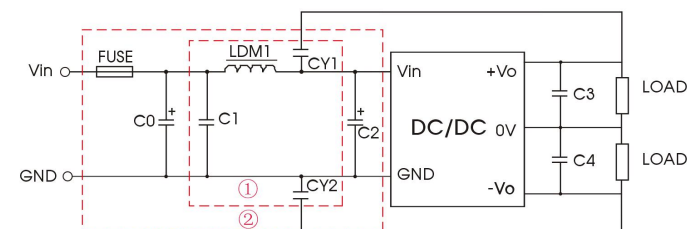


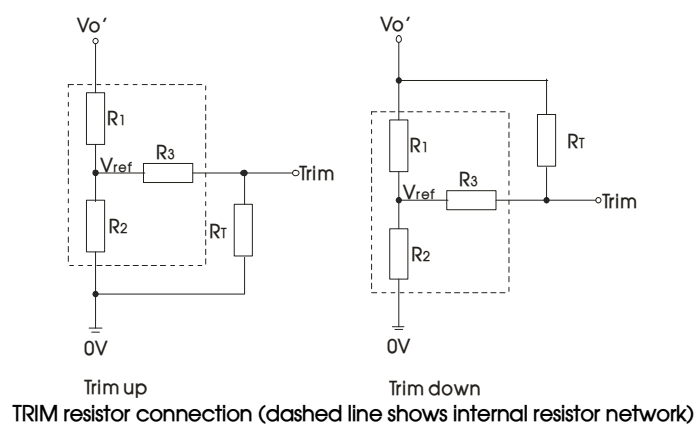
Fig. 3

Notes: For EMC tests we use Part ① in Fig. 3 for emissions and part ② for immunity test.

Parameter description

| Model    | Vin:12V/24V                              | Vin:48V    |
|----------|------------------------------------------|------------|
| FUSE     | Choose according to actual input current |            |
| C0       | 680μF/100V                               | 680μF/100V |
| C1       | 1μF/50V                                  | 1μF/100V   |
| C2       | 330μF/50V                                | 330μF/100V |
| C3 / C4  | Refer to the Cout in Fig.2               |            |
| LDM1     | 4.7μH                                    |            |
| CY1/ CY2 | 1nF/2KV                                  |            |

3. Trim Function for Output Voltage Adjustment (open if unused)



Calculating Trim resistor values:

$$\begin{aligned} \text{up: } R_T &= \frac{\alpha R_2}{R_2 - \alpha} - R_3 & \alpha &= \frac{V_{ref}}{V_{o'} - V_{ref}} \cdot R_1 \\ \text{down: } R_T &= \frac{\alpha R_1}{R_1 - \alpha} - R_3 & \alpha &= \frac{V_{o'} - V_{ref}}{V_{ref}} \cdot R_2 \end{aligned}$$

$R_T$  = Trim Resistor value;  
 $\alpha$  = self-defined parameter.

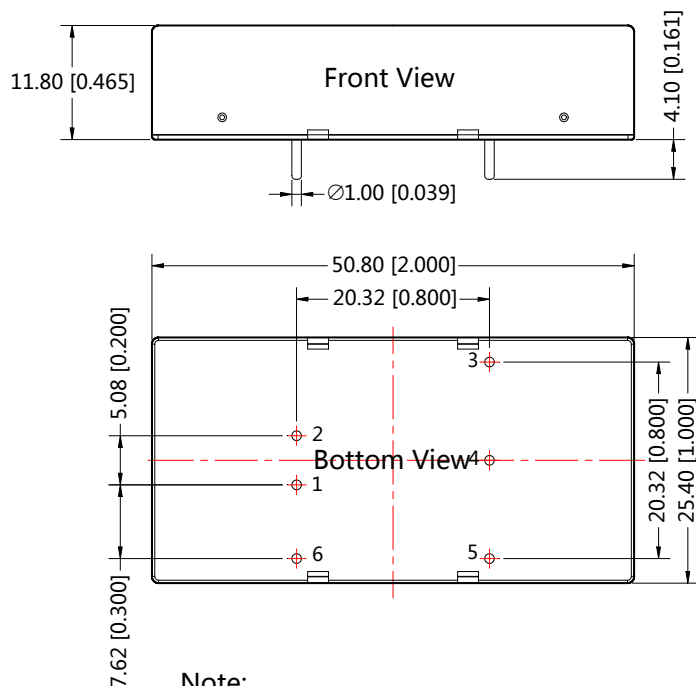
| Vout(V) | R1(K $\Omega$ ) | R2(K $\Omega$ ) | R3(K $\Omega$ ) | Vref(V) |
|---------|-----------------|-----------------|-----------------|---------|
| 3.3     | 4.801           | 2.87            | 12.4            | 1.24    |
| 5       | 2.883           | 2.87            | 10              | 2.5     |
| 9       | 7.500           | 2.87            | 15              | 2.5     |
| 12      | 11.000          | 2.87            | 15              | 2.5     |
| 15      | 14.494          | 2.87            | 15              | 2.5     |
| 24      | 24.872          | 2.87            | 17.8            | 2.5     |
| 110     | 130.43          | 3.00            | 22              | 2.5     |

4. The products do not support parallel connection of their output
5. For additional information please refer to DC-DC converter application notes on [www.mornsun-power.com](http://www.mornsun-power.com)

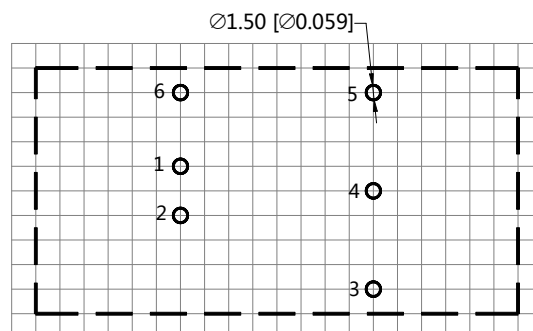


## Horizontal Package Dimensions and Recommended Layout

THIRD ANGLE PROJECTION 



Note:  
 Unit :mm[inch]  
 Pin diameter tolerances : $\pm 0.10$  [ $\pm 0.004$ ]  
 General tolerances: $\pm 0.50$  [ $\pm 0.020$ ]



Note : Grid 2.54\*2.54mm

| Pin-Out |        |      |
|---------|--------|------|
| Pin     | Single | Dual |
| 1       | GND    | GND  |
| 2       | Vin    | Vin  |
| 3       | +Vo    | +Vo  |
| 4       | Trim   | 0V   |
| 5       | 0V     | -Vo  |
| 6       | Ctrl   | Ctrl |

### Notes:

- For additional information on Product Packaging please refer to [www.mornsun-power.com](http://www.mornsun-power.com). The Packaging bag number of Horizontal package: 58200035;
- We suggest to use module at load of over 5%, if not, the ripple of the product may exceeds the specification, but does not affect the reliability of the product;
- The maximum capacitive load offered were tested at input voltage range and full load;
- Unless otherwise specified, parameters in this datasheet were measured under the conditions of Ta=25°C, humidity<75%RH with nominal input voltage and rated output load;
- All index testing methods in this datasheet are based on company corporate standards;
- We can provide product customization service, please contact our technicians directly for specific information;
- Products are related to laws and regulations: see "Features" and "EMC";
- Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units.

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