# LED Driver
## KC24H-R Series

MORNSUN®

Constant current great power buck LED driver




RoHS

## FEATURES

- Efficiency up to 95%
- Ultra wide range voltage input (5.5-46 VDC)
- Drive current:300/350/500/600/700mA
- Output power：10/12/18/21/25W
- Low ripple & noise(<100mV)
- With large capacitive loads(1000μF)
- PWM dimming & analogue dimming
- Continuous short circuit protection

*KC24H-R series is a high-power LED driver design for the step-down constant current source. With high efficiency, wide input voltage range, high-temperature environment, functional and so on. Contains a PWM dimming, analog dimming and remote shutdown capabilities. They can be widely used in Backlight and 12V, 24V, 36V automotive lighting, landscape lighting, special lighting controls, commercial lighting, street lighting, home lighting and other lighting systems.*

## Selection Guide

| Model | Input | | Output | | Efficiency (%, Typ), Full Load | Max. Capacitive Load(uF) |
|---|---|---|---|---|---|---|
| | Input Voltage (VDC) | Input Current (mA) (Typ.)(5LEDs) | Output Voltage (VDC) | Output Current (mA) | | |
| KC24H-300R(X1/X2/X3) | 24(5.5-48) Nominal (range) | 237 | 3.3-36 | 0-300 | 95 | 1000 |
| KC24H-350R(X1/X2/X3) | | 276 | | 0-350 | | |
| KC24H-500R(X1/X2/X3) | | 395 | | 0-500 | | |
| KC24H-600R(X1/X2/X3) | | 474 | | 0-600 | | |
| KC24H-700R(X1/X2/X3) | | 553 | | 0-700 | | |

Notes:
1. For the product model without a suffix such as KC24H-300R, this product is a 4-pin product without the functions of analogue dimming and PWM dimming.
2. For the product model with a suffix X1 such as KC24H-300RX1, this product is a 5-pin product only with the function of analogue dimming.
3. For the product model with a suffix X2 such as KC24H-300R X2, this product is a 5-pin product only with the function of PWM dimming.
4. For the product model with a suffix X3 such as KC24H-300R X3, this product is a 6-pin product with the functions of analogue dimming and PWM dimming.

## Input Specifications

| Item | Operating Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Input Voltage Limit | ≤10 seconds | 5 | -- | 55 | VDC |
| Recommended Input Voltage | | 5.5 | 24 | 46 | |
| Min. Input-output Voltage Drop | Input voltage range | 2 | -- | 4 | |
| Internal Power Dissipation | Vin=24V, 5LEDs | -- | -- | 0.7 | W |
| Reverse Polarity Input | | Forbid | | | |
| Input Filter | | Capacitor Filter | | | |

## Output Specifications

| Item | Operating Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Output Power | Io:300mA | -- | -- | 10.8 | W |
| | Io:350mA | -- | -- | 12.6 | |
| | Io:500mA | -- | -- | 18 | |
| | Io:600mA | -- | -- | 21.6 | |
| | Io:700mA | -- | -- | 25.2 | |
| Output Current Accuracy | Io:300-600mA | -- | ± 3 | ±5 | % |
| | Io:700mA | -- | ± 5 | ±7 | |
| Output Current Stability | Vin=46V，Vo=3.3V~36V | -- | ±3 | ±5 | |
| Temperature Drift Coefficient | -40 °C ~+71 °C | -- | -- | ± 0.015 | %/°C |
| Ripple & Noise* | 20MHz bandwidth(Vin=46V, 1~ 10 LEDs) | -- | -- | 100 | mVp-p |
| Over-temperature Protection | | Self-recovery after cooling | | | |
| Output Short Circuit Protection | | Continuous, self-recovery | | | |


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Note: *Parallel line test method is adopted to test the ripple and noise. Test with X1 probe, please see *DC-DC Converter Application Notes* for specific operation methods.

## General Specifications

| Item | Operating Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operating Temperature | 300mA / 350mA | -40 | -- | 85 | ℃ |
| | 500mA/ 600mA/ 700mA | -40 | -- | 71 | |
| Storage Temperature | | -55 | -- | 125 | |
| Operating Humidity | | -- | -- | 95 | % |
| Storage Humidity | | -- | -- | 95 | |
| Case Temperature Rise | Ta=25°C | -- | -- | 65 | ℃ |
| Lead Temperature | Welding spot is 1.5mm away from the casing, 10 seconds | -- | -- | 300 | |
| Operating Frequency* | | 550 | 645 | 750 | KHz |
| MTBF | MIL-HDBK-217F@25℃ | 1000 | -- | -- | K hours |
| Thermal Impedance | | -- | 60 | -- | °C/W |

Note:* When the mode works in the high-voltage input-area and 1LED load, its operating frequency will range from 100KHz to 400KHz.

## PWM Dimming and Remote on/off Control

| Item | | Operating Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Analogue Dimming | Input Voltage Range | Vin=5.5-46V | 0-15V | | | |
| | Output Current Range | Vin=5.5-46V | 0%-100% | | | |
| | Control Voltage Range | Full on | 0.2V±50mV | | | |
| | | Full off | 4.5V±200mV | | | |
| | Driving Current | Vc=5V | -- | -- | 0.2 | mA |
| PWM Dimming& Remote Turn-off | ON | | Open or 2.8V<Vc<6V | | | |
| | OFF | | Vc<0.6V | | | |
| | Turn-off-mode Static Input Current | Vin=24V, Vc <0.6V | -- | 400 | -- | μA |
| | Isink | Vc=5V, Vin=24V, 5LEDs | -- | -- | 1 | mA |
| | Isourse | Vc<0.6V, Vin=24V, 5LEDs | -- | 1 | -- | μA |
| | PWM Dimming Frequency* | | -- | -- | 200 | Hz |

Note: *Refer to "PWM Dimming Control" on page five.

## Physical Specifications

| | |
|---|---|
| Casing Material | Black flame-retardant and heat-resistant plastic (UL94-V0) |
| Package Dimensions | 22.80*10.20*9.50 mm |
| Weight | 4.3g(Typ) |
| Cooling method | Free air convection |

## EMC Specifications

| | | | | |
|---|---|---|---|---|
| EMI | Conducted Disturbance | | EN55015 power port/CISPR22 CLASS B (see Fig. 5 for recommended circuit) | |
| | Radiated Emission | | EN55015 /CISPR22 CLASS B (see Fig. 5 for recommended circuit) | |
| EMS | Electrostatic Discharge | KC24H-xxxR(X1) | IEC/EN 61000-4-2 Contact ±6KV | perf. Criteria B |
| | | KC24H-xxxRX2/X3 | IEC/EN 61000-4-2 Contact ±2KV(see Fig. 5 for recommended circuit) | perf. Criteria B |
| | Radiation Immunity | | IEC/EN 61000-4-3 10V/m | perf. Criteria A |
| | EFT | | IEC/EN 61000-4-4 ±1KV (see Fig. 5 for recommended circuit) | perf. Criteria B |
| | Surge Immunity | | IEC/EN 61000-4-5 ±1KV (see Fig. 5 for recommended circuit) | perf. Criteria B |
| | Conducted Disturbance Immunity | | IEC/EN 61000-4-6 3Vr.ms | perf. Criteria A |


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## Product Characteristic Curve

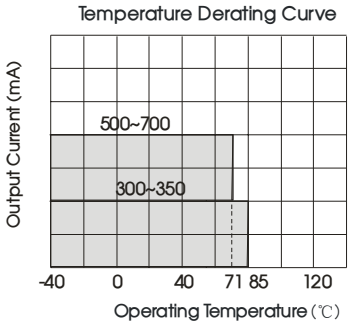
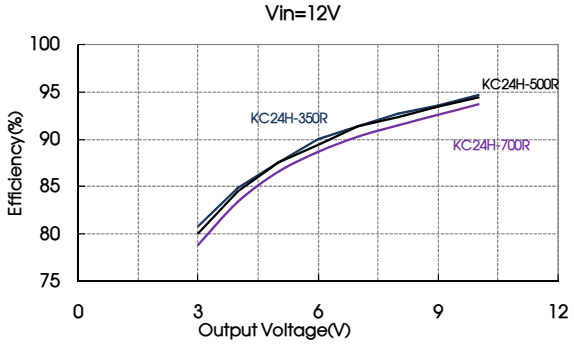
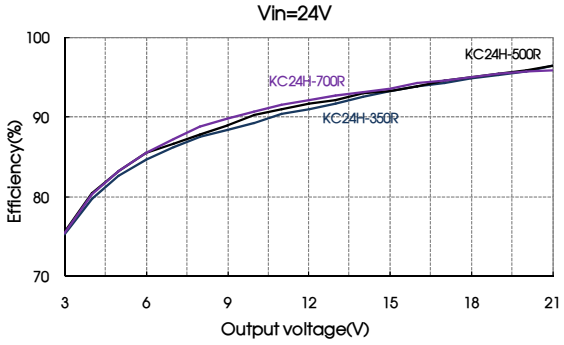
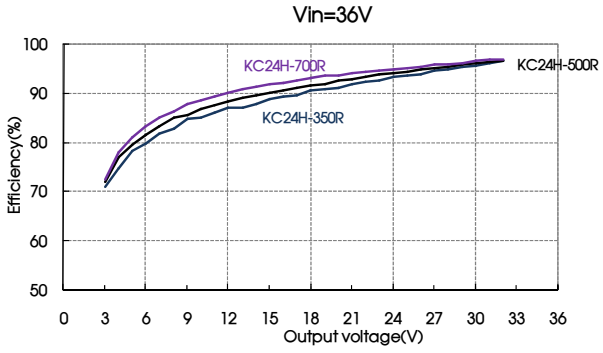
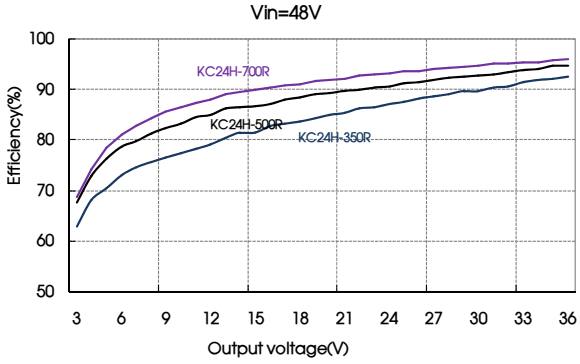



Fig. 1




## Design Reference

### 1. Input/output relationship

| Input voltage(VDC) | Output voltage range(VDC) | Constant output current (mA) | Output power (W Max) | Input voltage(VDC) | Output voltage range(VDC) | Constant output current (mA) | Output power (W Max) |
|---|---|---|---|---|---|---|---|
| 46 | 3.3-36.0 | 300 | 10.80 | 46 | 3.3-36.0 | 350 | 12.60 |
| 36 | 3.3-32.0 | 300 | 9.60 | 36 | 3.3-32.0 | 350 | 11.20 |
| 24 | 3.3-21.0 | 300 | 6.30 | 24 | 3.3-21.0 | 350 | 7.35 |
| 20 | 3.3-17.0 | 300 | 5.10 | 20 | 3.3-17.0 | 350 | 5.95 |
| 15 | 3.3-13.2 | 300 | 3.96 | 15 | 3.3-13.2 | 350 | 4.62 |
| 12 | 3.3-10.0 | 300 | 3.00 | 12 | 3.3-10.0 | 350 | 3.50 |
| 5.5 | 3.3-4.0 | 300 | 1.20 | 5.5 | 3.3-4.0 | 350 | 1.40 |
| | | | | | | | |
| 46 | 3.3-36.0 | 500 | 18.00 | 46 | 3.3-36.0 | 600 | 21.60 |
| 36 | 3.3-32.0 | 500 | 16.00 | 36 | 3.3-32.0 | 600 | 19.20 |
| 24 | 3.3-21.0 | 500 | 10.50 | 24 | 3.3-21.0 | 600 | 12.60 |
| 20 | 3.3-17.0 | 500 | 8.50 | 20 | 3.3-17.0 | 600 | 10.20 |
| 15 | 3.3-13.2 | 500 | 6.60 | 15 | 3.3-13.2 | 600 | 7.92 |
| 12 | 3.3-10.0 | 500 | 5.00 | 12 | 3.3-10.0 | 600 | 6.00 |
| 5.5 | 3.3-4.0 | 500 | 2.00 | 5.5 | 3.3-4.0 | 600 | 2.40 |


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| Input voltage(VDC) | Output voltage range(VDC) | Constant output current (mA) | Output power (W Max) | | Input voltage(VDC) | Output voltage range(VDC) | Constant output current (mA) | Output power (W Max) |
|---|---|---|---|---|---|---|---|---|
| 46 | 3.3-36.0 | 700 | 25.20 | | -- | -- | -- | -- |
| 36 | 3.3-32.0 | 700 | 22.40 | | -- | -- | -- | -- |
| 24 | 3.3-21.0 | 700 | 14.70 | | -- | -- | -- | -- |
| 20 | 3.3-17.0 | 700 | 11.90 | | -- | -- | -- | -- |
| 15 | 3.3-13.2 | 700 | 9.24 | | -- | -- | -- | -- |
| 12 | 3.3-10.0 | 700 | 7.00 | | -- | -- | -- | -- |
| 5.5 | 3.3-4.0 | 700 | 2.80 | | -- | -- | -- | -- |

## 2. Typical application circuit

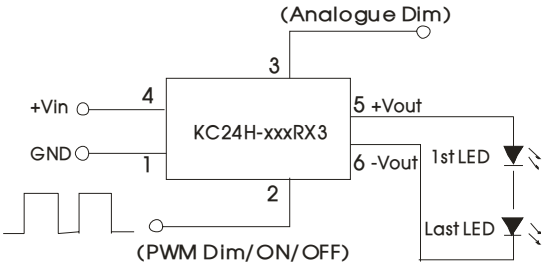



Fig. 2 Application circuits in series

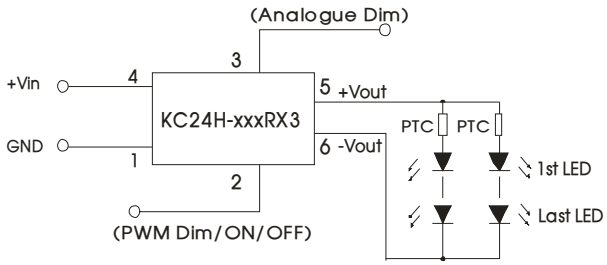



Fig. 3 Application circuits in series and parallel

If it is necessary to protect LED in actual application, you could connect a PTC to the input of every channel or all channels, as shown in Figure 4.

Note: The negative output terminal can't connect GND, or the module may be damaged.

## 3. Recommended AC input circuit

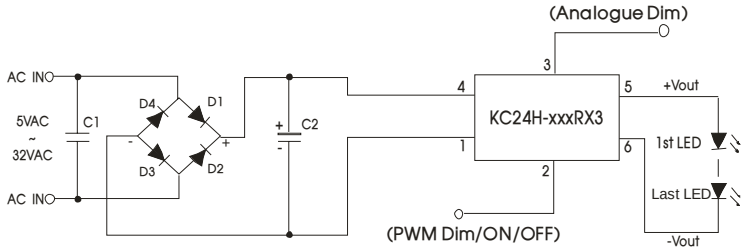



Fig. 4

| Components | Specification |
|---|---|
| C1 | X1 Safety capacitor, 0.1μF /300VAC (QIYA) |
| C2 | 100μF /63V Electrolytic capacitor, Φ10x16(Flat surface)NCC |
| D1, D2, D3, D4 | Rectifier diode 1N4007 1A/1000V D0-41(PANJIT) |

## 4. EMC solution-recommended circuit

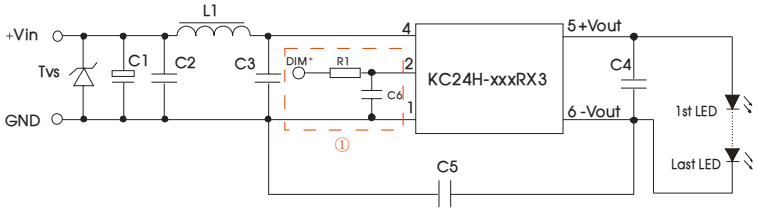


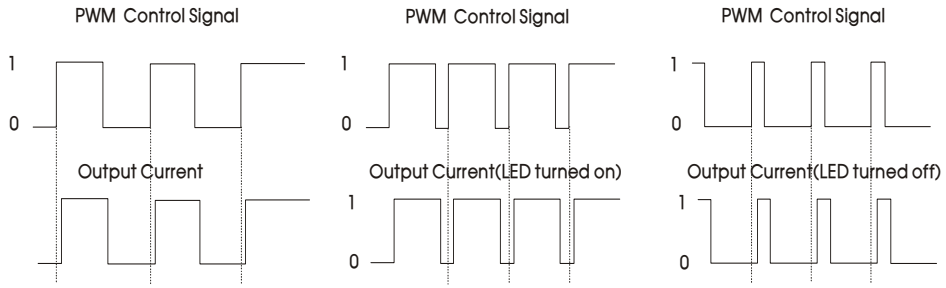

Fig.5 Recommended EMC circuit

Note: Add circuit ① may let the ESD level of PWM-control pin reach to ±6KV.

| Components | Specification |
|---|---|
| Tvs | SMC51A,1500W（ON） |
| L1 | CD53-82μH（CEAIYA） |
| C1 | 470μF/100V（NCC） |
| C2 | 225K/50V 1210 X7R (TORCH) |
| C3 | 104K/50V 0805 X7R (TORCH) |
| C4 | 105K/50V 1210 X7R (TORCH) |
| C5 | 102K/2000V 1210 (TDK) choose or no） |
| C6 | 470pF/100V 0805 (TORCH) |
| R1 | 680Ω 0805(can replaced by inductance or magnetic bead) |


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## 5. PWM dimming control




For PWM dimming signals with a certain frequency, the output current of the driver is related to the duty ratio of PWM signal. Refer to the formula for the calculation method:

$$I_{o_set} = \frac{(DT-0.8)}{T} I_{o_norm}$$

Where, Io_set represents required output current (mA); D represents the duty ratio (%) of PWM signal; T represents the period (ms) of PWM signal; and Io_norm represents the rated output value (mA) of the driver.

Note: The above formula is for reference only; and deviation of output current may exist due to various loads. The min. conducted time of PWM signal shall not be less than 0.8ms, or the product will be in abnormal operation; in case of low voice from the driver during PWM dimming, it is normal since the PWM dimming frequency is within the auditory frequency range of human ears (20Hz-20KHz in general). To prevent seeing flash of the LED by human eyes, it is suggested to set the PWM dimming frequency between 100-200Hz.

PWM curve(Vin=24V,5LEDs):

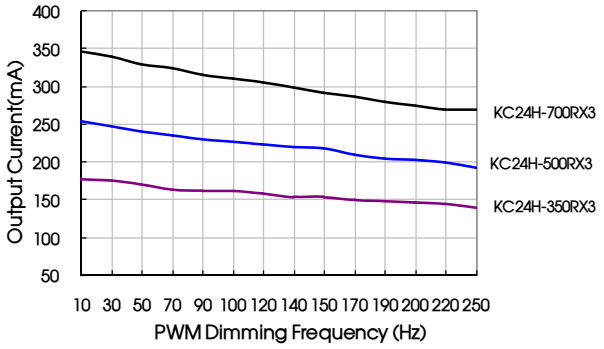



Fig. 6 Output current VS PWM dimming frequency (D=50%)

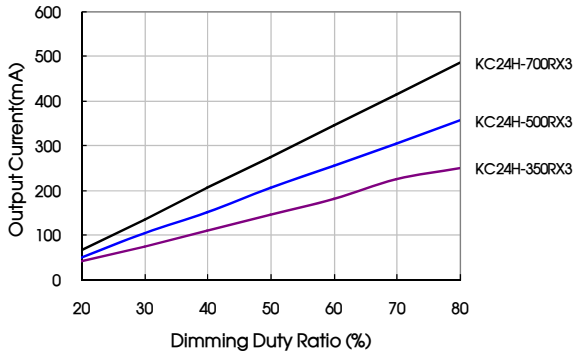



Fig. 7 Output current VS Dimming duty ratio(f=200Hz)

## 6. Analogue dimming and typical application

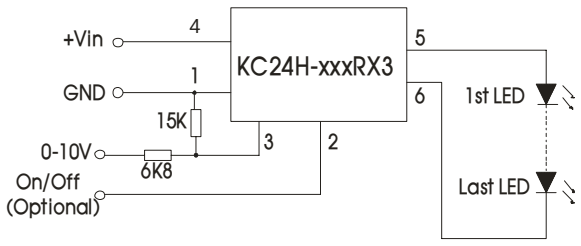



Fig. 8 Analogue dimming circuit

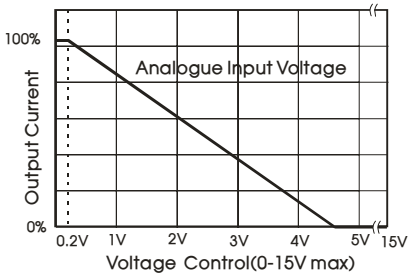
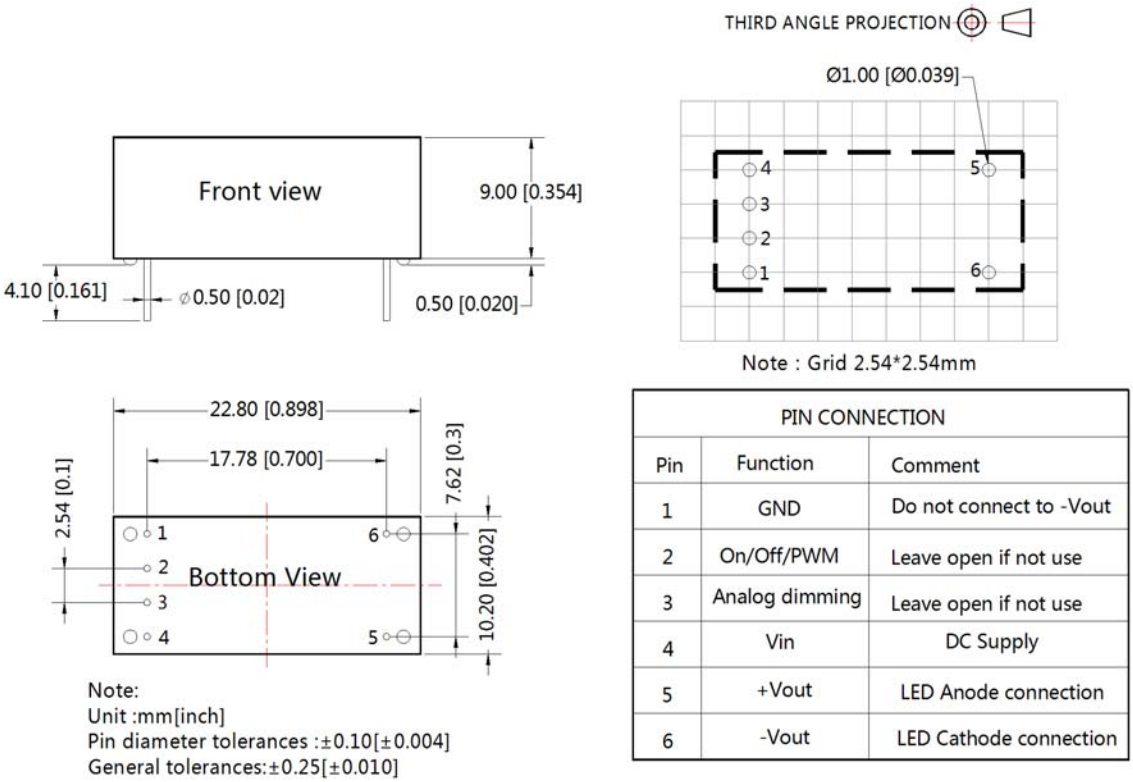



Fig. 9 Analogue input voltage and output current

7. The voltage drop of all LEDs in the datasheet is 3.3-3.8V，during actual application, the number of LEDs can be confirmed based on the actual voltage drop and output voltage of LEDs.
8. This product does not support hot-Plug use.
9. For more information Please find the application notes on www.mornsun-power.com


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## Dimensions and Recommended Layout




| PIN CONNECTION | | |
|---|---|---|
| Pin | Function | Comment |
| 1 | GND | Do not connect to -Vout |
| 2 | On/Off/PWM | Leave open if not use |
| 3 | Analog dimming | Leave open if not use |
| 4 | Vin | DC Supply |
| 5 | +Vout | LED Anode connection |
| 6 | -Vout | LED Cathode connection |

Notes:

1. Packing Information please refer to 'Product Packing Information'. Packing bag number: 58210025;
2. If the product is not operated within the required load range, the product performance can not be guaranteed to comply with all performance indexes in the datasheet;
3. Unless otherwise specified, data in this datasheet should be tested under the conditions of Ta=25°C, humidity<75% when inputting nominal voltage and outputting 5 LEDs;
4. All index testing methods in this datasheet are based on our Company's corporate standards;
5. The performance indexes of the product models listed in this datasheet are as above, but some indexes of non-standard model products will exceed the above-mentioned requirements, and please directly contact with our technician for specific information;
6. We can provide product customization service;
7. The product specification may be changed at any time without prior notice.

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