MORNSUN

LD10 SERIES

10W, AC-DC CONVERTER

LD---- are high efficiency green power modules with least packaging provided by Mornsun. The features of this series are: wide input voltage, DC and AC all in one, high efficiency, high reliability, low loss, safety isolation etc. They are widely used in industrial, office, civil and medical equipments. EMC and safety standards meet international standards IEC61000, UL60950, EN60601 and IEC60950, and Multi-certificate is in processing.

PRODUCT FEATURES

1. Universal Input :85 ~ 264VAC,50/60Hz
2. AC and DC all in one (input from the same terminal)
3. Low Ripple and Noise
4. Over output voltage protection , short circuit protection and Over temperature
5. High efficiency, High power density
6. Low loss, green power
7. Multiple models available
8. Industrial, medical level specifications

MODEL SELECTION

LD10-20B24

- Output Voltage
- Output Style
- Input Voltage
- Isolation Voltage
- Rated Power
- Package Style
- Product Series

PRODUCT PROGRAM

Approval	Model	Package	Power	Output (Vo1/Io1)	Ripple and Noise (TYP)	Efficiency (%)(TYP)
UL/CE	LD10-20B03	53.5X28.5X19.0mm	6.6W	3.3V/2000mA	50mV	70
	LD10-20B05		10W	5V/2000mA		74
	LD10-20B09			9V/1100mA		76
	LD10-20B12			12V/900mA		76
	LD10-20B15			15V/700mA		78
	LD10-20B24			24V/450mA		80

Remarks :
1. Ripple and Noise were measured by the method of parallel lines;
2. Unless otherwise specified, all specifications above are measured at rated input voltage and rated output load, TA=25°C, humidity < 75%.

INTPUT SPECIFICATIONS

Input Voltage Range	85~264VAC, 120~370VDC	
Input Frequency	47~440Hz	
Input Current	110VAC 230mA, typ	230VAC 150mA, typ
Inrush Current	110VAC 10A, typ	230VAC 20A, typ
External input fuse(Recommended)	2A/250V	Slow blow

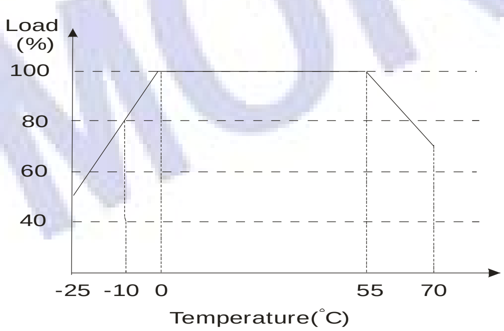
OUTPUT SPECIFICATIONS

Voltage set accuracy	±2% (3.3V: ±3%)(typ)
Input variation	±0.5% (typ)
Load variation (10% to 100%)	±1% (typ)
Ripple& noise(p-p) (20MHz Bandwidth)	50mV(typ)
Short circuit protection	Continuous, and auto resume
Over current protection	≥110% I_O

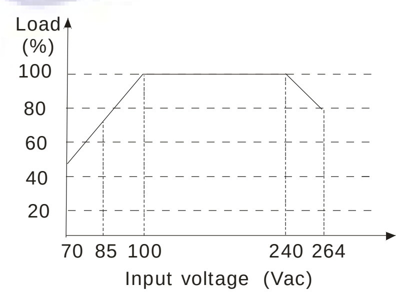
COMMON SPECIFICATIONS

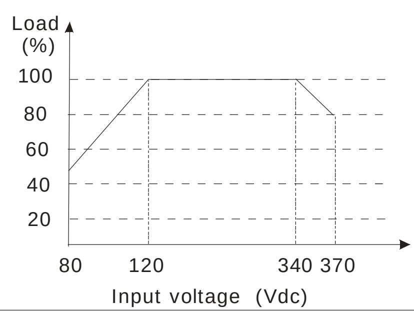
Temperature ranges	Operating Power derating (above 55°C): (below 0°C): Storage: Case temperature:	-25°C ~ +70°C 2%/°C 2%/°C -40°C ~ +105°C +95°C max
Hold-up time	(Vin=230VAC)	50ms(typ)
Humidity		95%(max)
Temperature coefficient		0.02%/°C
Switching frequency		60kHz(typ)
Efficiency		78%(typ)
I/O-isolation voltage		4000VAC/1Min
Leakage current		0.1mA (typ)
EMI/RFI conducted		EN55011, levelB
EMC compliance	Electrostatic discharge ESD RF field susceptibility *Electrical fast transients/bursts on mainsline *Surge	IEC/EN 61000-4-2 level 4 8kV/15kV IEC/EN 61000-4-3 IEC/EN 61000-4-4 level 4 4kV IEC/EN 61000-4-5 level 4 2kV/4kV
Safety standards		IEC60601,EN60601,UL60950
Safety approvals		EN60601,UL60950
Safety Class		CLASS II
Case material		UL94V-0
Install		PCB
MTBF		>200,000h @25°C
Note: * EMC application circuit is required.		

TEMPERATURE VS LOAD

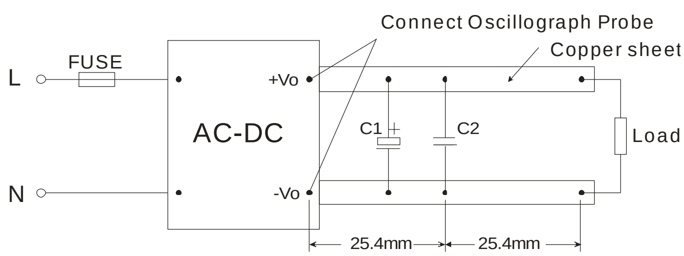


INPUT VOLTAGE VS LOAD





ANEAR MEASURE



TYPICAL APPLICATIONS

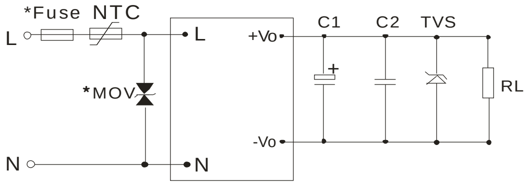


Figure 1 EMC Application Figure 1

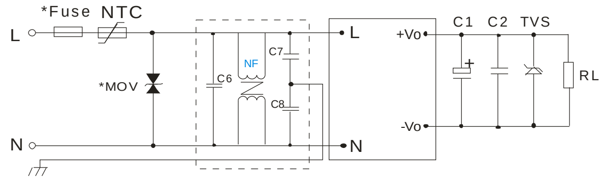


Figure 2 LD10 EMC Application Figure 2

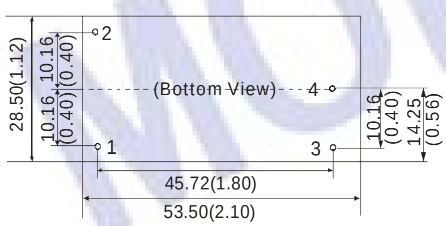
EXTERNAL CAPACITORS TYPICAL VALUE(Unit: mF)			
model	C1	C2	TVS
LD10-20B03	220μF/10V	0.1μF/50V	P6KE6.8A
LD10-20B05	220μF/10V	0.1μF/50V	P6KE6.8A
LD10-20B09	120μF/25V	0.1μF/50V	P6KE12A
LD10-20B12	120μF/25V	0.1μF/50V	P6KE20A
LD10-20B15	120μF/25V	0.1μF/50V	P6KE20A
LD10-20B24	68μF/35V	0.1μF/50V	P6KE30A

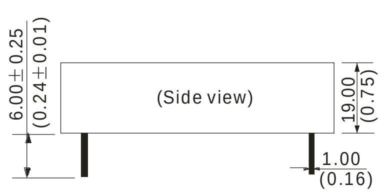
Note:

1. Output filtering capacitors C1 is electrolytic capacitors, It is recommended to use high frequency and low impedance electrolytic capacitors. For capacitance and current of capacitor please refer to manufacture's datasheet. Voltage derating of capacitor should be 80% or above. C2 is ceramic capacitor, it is used to filter high frequency noise. TVS is a recommended component to protect post-circuits (if converter fails).
2. MOV is required to LD10 models, model: 471KD05, it is used to protect the device under surge.
3. It is recommended to connect FUSE, the parameter is 2A/250V slow blow. External input NTC model is recommended to use 5D-9.
4. If common requirement to EMC performance, refer to figure 1, if higher requirement to EMC performance, refer to figure 2.
   C6:X capacitor, recommended parameter 0.1uF/275V;
   C7,C8:Y capacitor, recommended parameter 2200pF/400V;
   NF: common model choke, recommended inductance is about 10mH-30mH.

OUTLINE DIMENSIONS & PIN CONNECTIONS

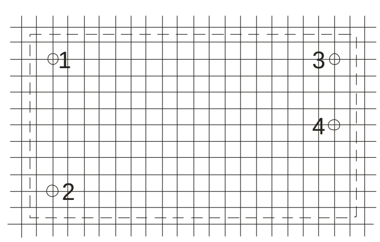
First Angle Projection





Note:
Unit:mm(inch)
Pin diameter:1.00 ±0.10mm
General tolerances: ±0.50mm
Weight: 50 ±3g

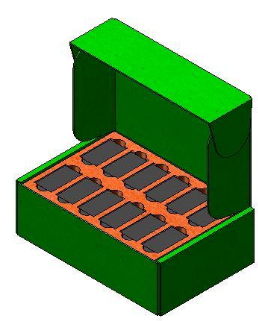
RECOMMENDED FOOTPRINT
Top view,grid:2.54mm(0.1inch),
diameter:1.60mm(0.063inch)



FOOTPRINT DETAILS

PIN	FUNCTION
1	N
2	L
3	+Vo
4	- Vo

PACKAGE DIAGRAM



Package box:
L*W*H=255*170*80mm
Package quantity: 24pcs

AC-DC Converter Application Guidelines

1. Foreword

The following guidelines should be carefully read prior to converter use. Improper use may result in the risk of electric shock, damaging the converter, or fire.

1. 1 Risk of Injury

A. To avoid the risk of burns, do not touch the heat sink or the converter’s case.

B. Do not touch the input terminals or open the case and touch internal components, which cold result in electric shock or burns.

C. When the converter is in operation, keep hands and face at a distance to avoid potential injury during improper operation.

1. 2 Installation Advice

A. Please make sure the input terminals and signal terminals are properly connected in accordance with the stated datasheet requirements.

B. To ensure safe operation and meet safety standard requirements, install a ***slow blow*** fuse at input of the converter.

C. Installation and use of AC/DC converters should be handled by a qualified professional.

D. AC/DC converters are used in the primary transmission stage of a design and thus, should be installed in compliance with certain safety standards.

E. Please ensure that the input and output of the converter are incorporated into the design out of the reach of the end user. The end product manufacturer should also ensure that the converter is protected from being shorted by any service engineer or any metal filings.

F. The application circuits and parameters shown are for reference only. All parameters and circuits are to be verified before completing the circuit design.

G. These guidelines are subject to change without notice; please check our website for updates.

2. General AC-DC Converter Applications

2.1 Basic Application Circuit

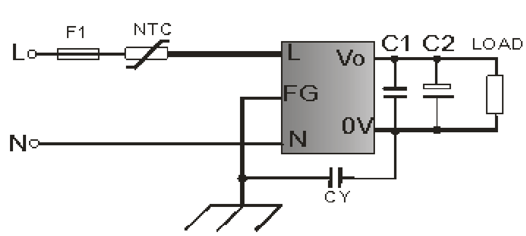


Figure 1.General AC-DC converter applications circuit

In Figure 1, F1 refers to the input fuse. Proper fuse selection should be a safety agency approved, slow blow fuse. Selection of the proper fuse rating is necessary to ensure power converter and system protection (potential failure if the rating is too high) and prevent false fuse blowing (which could happen if the rating is too low). Below is the formula to calculate the proper rating:

$$I = 3 \times V_o1 \times I_o1 / \eta / Vin(min.)$$

V_o1 = output voltage

I_o1 = output current;

η = the converter's efficiency;

Vin(min) = the minimum input voltage

Futher circuit notations:

- **NTC** is a thermistor.
- **CY** and CX are safety capacitors.
- **C1** is a high frequency ceramic capacitor or polyester capacitor, 0.1μF/50V.
- **C2** is output filtering high frequency aluminum electrolytic capacitor. Select a 220μF rating if the output current is greater than 5A, or a 100μF rating if the output current is less than 5A. The insulation voltage should be derated to less than 80% of rated value.

For dual or triple output converters, the circuit of input side remains the same and the outputs should be considered independently in component selection (see Figure 3).

The application circuit shown in Figure 1 is typical application circuit, whereby all MORNSUN products will meet EMI Class B, and Class 3 lightening strike and surge testing (see component datasheets for more details). To comply with more stringent EMC testing, additional filtering should be incorporated. See Figure 2 for a suggested filtering circuit.

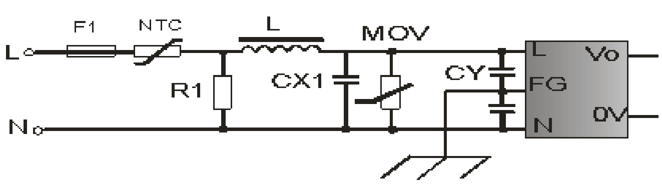


Figure 2. Input filter circuit

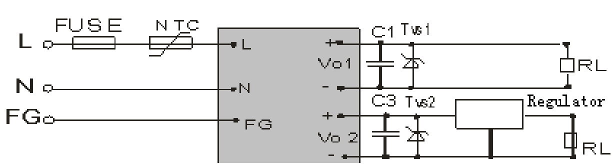


Figure 3. Typical application circuit

For multi-output converters, the main output is typically a fully regulated output. If the end application requires critical regulation on the auxiliary output(s), a linear regulator or other regular should be added after the converter. (Note: Some MORNSUN converters have built in linear regulators; please contact our Technical Department for details).

3. AC-DC Converter Safety Related Design Notes

3.1 Marking Requirements

Wherever, there are fuses, protective grounds, or switches, clear symbols should be indicated according safety standards. Touchable dangerous high voltage and energy sources should be marked with "**Caution!**" indications.

3.2 Input Cable Requirements:

Input cables of L, N and E should be brown, blue and yellow/green cables, respectively. Ensure that the ground cable (yellow & green cable) of Type I devices (those that rely on basic insulation and protection ground to avoid electric shock) are securely connected to the ground, and the earth resistance is lower than 0.1Ω

3.3 Clearance and Creepage

For Type I devices, ensure:

- L and N are in front of the fuse.
- The clearance distance between the input and the metal case is above 2mm and creepage is above 2.5mm.

For Type II devices (those that rely on strengthened insulation or double insulation to avoid electric shock) ensure:

- L and N are in front of the fuse
- The clearance distance between the input and the metal case is above 2mm and creepage is above 2.5mm.
- The clearance between the input and the metal case or SELV is above 4mm, and creepage of that is above 5mm.

3.4 Input energy

If the input capacitor is large, a discharge resistor may be added to ensure that, after disconnect, the voltage held between Input L, N, and the protective ground will be discharged to 37% of its maximum value or below. In Figure 2, R1 is the discharge resistor.

4. Heat Dissipation in AC/DC Converter Module Applications

Trends toward higher density in AC/DC module designs make heat dissipation an important concern. The effect of heat on the electrolytic capacitor is of particular concern, as the life of such capacitors can be drastically reduced when operated in a constant high temperature environment, leading to a higher potential for failure. Proper handling of heat will increase the life of the converter and surrounding components, thus lowering risk of failures. Some suggestions for handling dissipated heat are summarized, below:

(1) Ambient Air Cooling

For miniature and high power density converters, free air cooling is recommended, mainly due to cost and space concerns.

- Heat dissipates to the ambient air through the converter case or exposed surfaces. Heat may also dissipate to ambient air if there is a gap between the converter and the PCB.
- Heat dissipates from the converter case and exposed surfaces to PCB by radiation.
- Heat conducts through terminals (pins) to PCB.

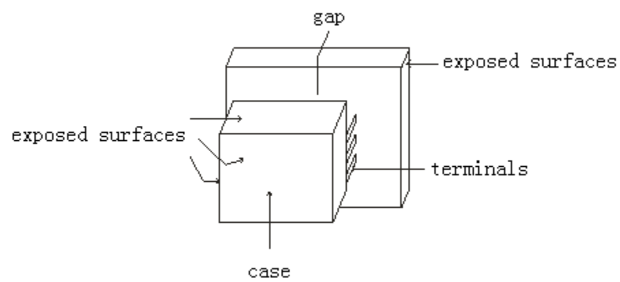


Figure 4. converter assembled on PCB

In such applications, please pay particular attention to:

A. Air Flow - Because the heat dissipation is mainly through convection and radiation, the converter needs an environment with good air flow. It may be helpful to design heat dissipation venting holes throughout the end product, near the converter's location. For best convection cooling, ensure that air flow is not blocked by large components

B. Layout of Heat Generating Components - In most applications, the AC/DC converter is usually not the only heat generating component. It is recommended to keep a good distance between each heat generating component to minimize heat dissipating clusters.

C. PCB Design - The PCB, which the power converter is assembled on, is not only a base to mount the converter, but also acts as a heat sink for it, therefore heat dissipation should be considered in PCB layout. We recommend extended the area of the main copper loop and decrease the component density on the PCB to improve the ambient environment.

(2) Heat Sinks

When free air convection is not sufficient enough, we recommend the use of a heat sink for further cooling. As the converters are filled with heat conductive silicon or epoxy, the heat distribution in converter is even and it radiates from the converter to the air. The efficiency of this convection is dependent on the size of the surface area of the converter. The use of heat sinks is a practical method to add surface area and improve the convection. There are many kinds of heat sinks available in the market. MORNSUN recommends considering the following factors in selecting a heat sink:

- The heat sink should be made of a good heat conducting material, such as aluminum and copper.
- The larger the surface area, the better the radiation. Therefore, heat sinks usually have a ridged surface or special coatings to make a larger surface area.
- Use the longest and thickest possible heat sink for best convection.

Heat sinks are best attached to the converter's surface, where the difference in temperature between the surface and the ambient is largest. The use of heat conductive material between the heat sink and the converter's surface to make a better contact and to improve heat conductance is suggested. To avoid case distortion, please do not affix the heat sink too firmly to the converter case.

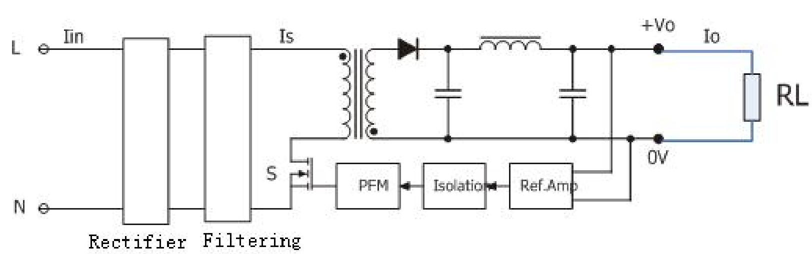
(3) Forced Air Cooling

In some systems, where a heat sink does not effectively reduce the ambient temperature, a fan is used to improve the heat radiation. Fans can lower the surface temperature of the converter, but large fans also occupy extra space in the system. It is important to select a suitable fan size, where the speed of the fan will determines how effective it is. The faster the speed, the better the effect on reducing radiated heat. As high speed will also cause increased noise, there is a need to balance the choice between the how effective the fan is against how much audible noise it generates.

A long, rectangular shaped AC/DC converter should use a horizontal fan, and channeled heat sinks should use vertical fans, in order to encourage air flow through the channels.

5. Input Under Voltage Impact

5.1 Block Diagram of AC/DC Converter

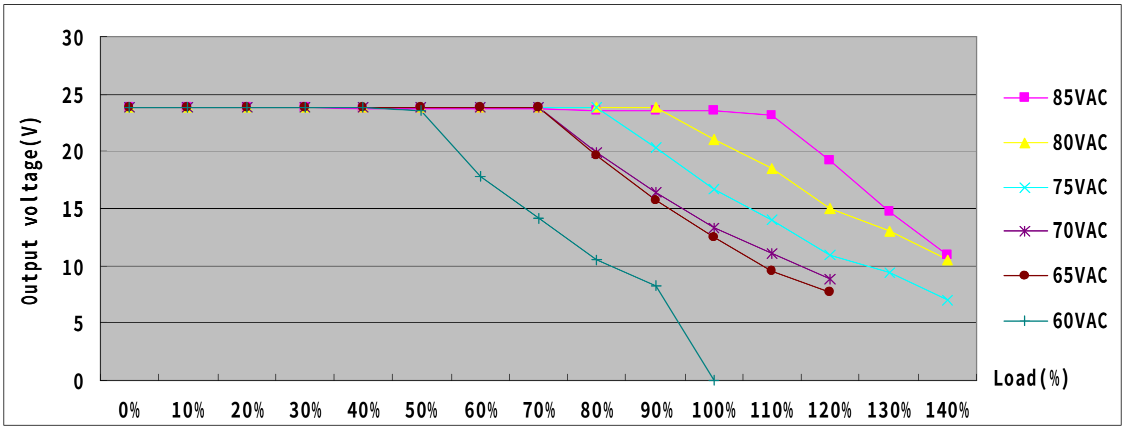


5.2 Impact to Converter Reliability

The input voltage range of MORNSUN's AC/DC converters is 85~264VAC or 120~370VDC. When the converter is operated within the rated input voltage range, the output current can be used up to the maximum rated specification. The total output power is $I_o \times V_o$.

If the converter is operated with an input voltage that is under the rated voltage, offering the same output power of $I_o \times V_o$, causes the current (Is) at the transistor (S) to be increased. Long term operation under this condition will damage the transistor (S).

5.3 Input Voltage vs Load Capability (LD03-00B24)



Load	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%
85VAC	23.85	23.82	23.79	23.77	23.74	23.71	23.68	23.65	23.61	23.58	23.57	23.19	19.2	14.7	11
80VAC	23.83	23.82	23.82	23.83	23.82	23.82	23.81	23.81	23.81	23.8	21	18.5	15	13	10.5
75VAC	23.83	23.83	23.83	23.83	23.82	23.82	23.82	23.81	23.77	20.29	16.65	14.02	10.98	9.39	7.04
70VAC	23.83	23.83	23.83	23.83	23.82	23.82	23.81	23.79	19.96	16.44	13.32	11.14	8.79		
65VAC	23.83	23.83	23.83	23.83	23.82	23.82	23.82	23.8	19.6	15.67	12.46	9.57	7.65		
60VAC	23.83	23.83	23.83	23.83	23.82	23.51	17.86	14.13	10.52	8.28	0				