

## LDXX SERIES

### 3-5W,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 EN60950/UL60601 and IEC60950, and Multi-certificate is in processing.

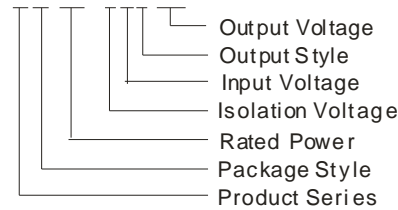


### PRODUCT FEATURES

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
9. 3 years warranty

### MODEL SELECTION

#### LD05-20B24



### PRODUCT PROGRAM

Approval	Model	Package	Power	Output (Vo1/Io1)	Output (Iomax/T)	Ripple and Noise (TYP)	Efficiency (%) (TYP)
UL/CE60950	LD03-10B03	37.0X23.0X15.0mm	2.3W	3.3V/700mA	900mA/60S	30mV	63
	LD03-10B05		3W	5v/600mA	750mA/60S		72
	LD03-10B09			9V/330mA	450mA/60S		74
	LD03-10B12			12V/250mA	330mA/60S		76
	LD03-10B15			15V/200mA	250mA/60S		76
	LD03-10B24			24V/125mA	160mA/60S		78
UL/CE60601	LD05-20B03	50.8X25.4X15.16mm	4.2W	3.3V/1250mA	1400mA/60S	30mV	66
	LD05-20B05		5W	5v/1000mA	1300mA/60S		72
	LD05-20B09			9V/550mA	700mA/60S		74
	LD05-20B12			12V/420mA	550mA/60S		76
	LD05-20B15			15V/333mA	450mA/60S		76
	LD05-20B24			5.5W	24V/230mA		300mA/60S

Note:

1. Ripple and Noise were measured by the method of anear measure(The details see the anear measure);
2. Unless otherwise specified, all specifications above are measured at rated input voltage and rated output load, TA=25°C, humidity < 75%;
3. All specifications stated in this datasheet are subject to the above listed models only. For specifications of non-standard models, please contact our technical Support team.
4. Product can not be continuously over current, or it will cause permanent damage to the device.

### INTPUT SPECIFICATIONS

Input Voltage Range	85~264VAC, 110~370VDC	
Input Frequency	47~440Hz	
Input Current	LD03 models LD05 models	110VAC 65mA, typ 110mA,typ 230VAC 30mA, typ 70mA, typ
Inrush Current	LD03 models LD05 models	110VAC 10A, typ 10A,typ 230VAC 20A, typ 20A, typ
External input fuse(recommended)	LD03 models LD05 models	0.5A/250V Slow blow 1A/250V Slow blow

## OUTPUT SPECIFICATIONS

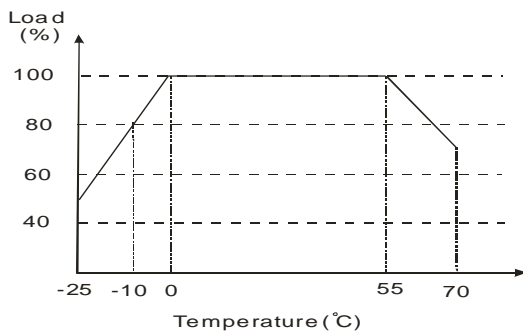
Voltage set accuracy		±2% (±3% when 3.3V output), (typ)
Input variation		±0.5% (typ)
Load variation (10% to 100%)		±1% (typ)
Ripple & noise (p-p)	20MHz Bandwidth	30mV (typ)
Short circuit protection		Continuous, and auto resume
Over temperature protection		150°C (max)
Over output voltage protection	LD03 models LD05 models	chip lock up diode clamp and chip lock up

## COMMON SPECIFICATIONS

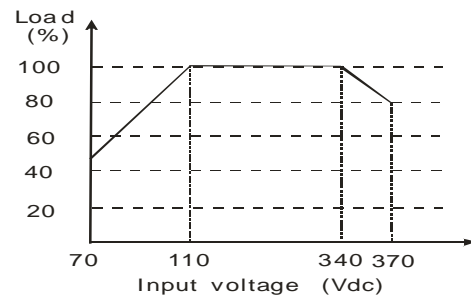
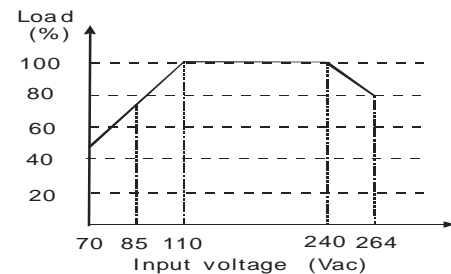
Temperature ranges	Operating Power derating (above 55°C): Storage: Case temperature:	-25°C ~ +70°C 2% / °C -40°C ~ +105°C +95°C max
Hold-up time	(Vin=230VAC)	50ms (typ)
Humidity		95% (max)
Temperature coefficient		0.02%/°C
Switching frequency		100kHz (typ)
Efficiency		76% typ
I/O-isolation voltage	LD03 models LD05 models	3000VAC/1Min 4000VAC/1Min
Leakage current		None
EMI/RFI conducted	LD03 models LD05 models	EN55022, level A EN55011, level A
EMC compliance	Electrostatic discharge ESD RF field susceptibility Electrical fast transients/bursts on mainsline LD03 models LD05 models Surge* LD03 models LD05 models	IEC/EN 61000-4-2 level 4 8kV/15kV IEC/EN 61000-4-3  IEC/EN 61000-4-4 level 3 2kV IEC/EN 61000-4-4 level 4 4kV IEC/EN 61000-4-5 level 3 1kV/2kV IEC/EN 61000-4-5 level 4 2kV/4kV
Safety standards	LD03 models LD05 models	IEC60950, EN60950, UL60950 IEC60601, EN60601
Safety approvals	LD03 models LD05 models	EN60950, UL60950 EN60601-1
Safety Class		CLASS 2
Case material		UL94V-0
Install		PCB
MTBF		>200,000h @25°C

Note: External input pressure sensitive resistor is required to LD03 models at inrush experiment, refer to typical application figure.

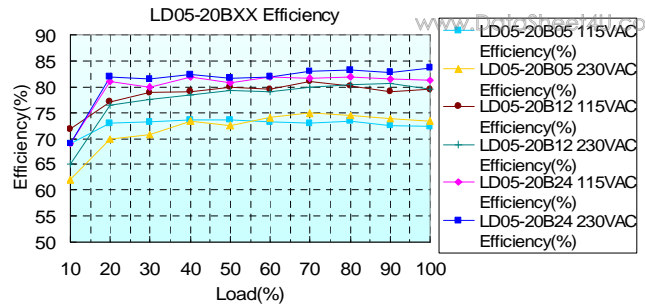
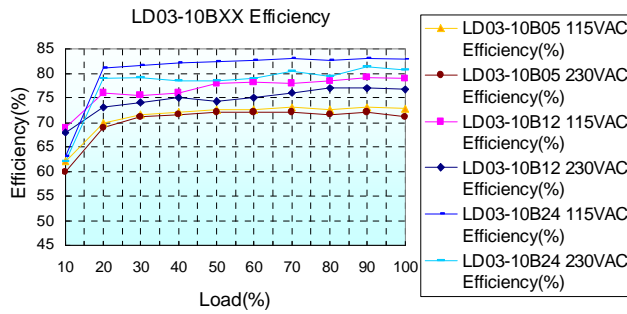
## TEMPERATURE VS LOAD



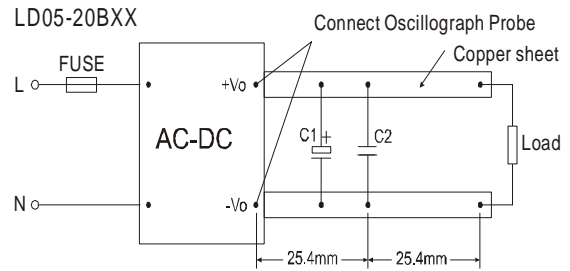
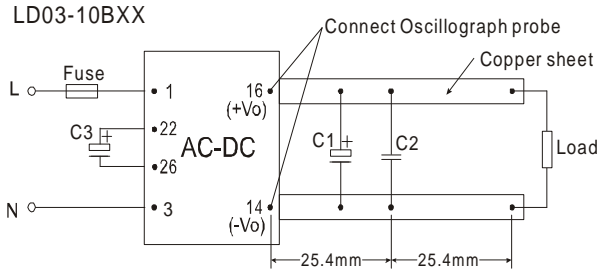
## INPUT VOLTAGE VS LOAD



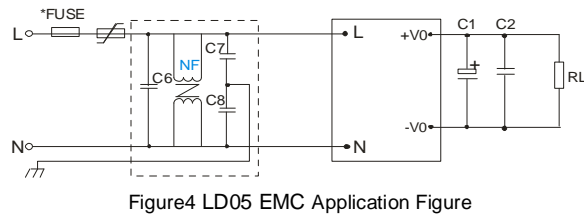
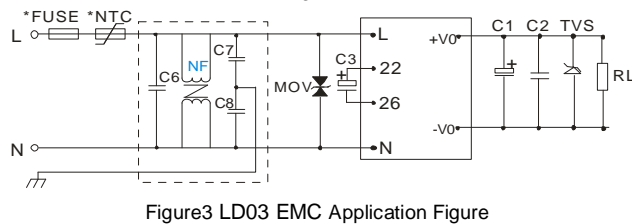
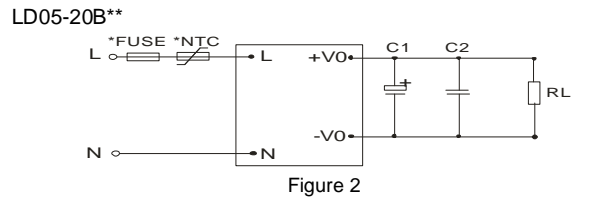
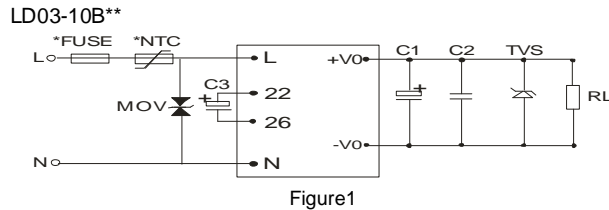
## TYPICAL EFFICIENCY CURVE



## ANEAR MEASURE



## TYPICAL APPLICATIONS



### EXTERNAL CAPACITORS TYPICAL VALUE(Unit: $\mu\text{F}$ )

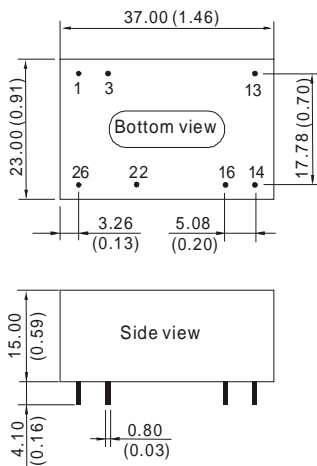
model	C1	C2	C3	TVS	model	C1	C2
LD03-10B03	150	0.1	4.7/400V	P4KE6.8A	LD05-20B03	47	0.1
LD03-10B05	150	0.1	4.7/400V	P4KE6.8A	LD05-20B05	47	0.1
LD03-10B09	120	0.1	4.7/400V	P4KE12A	LD05-20B09	33	0.1
LD03-10B12	120	0.1	4.7/400V	P4KE20A	LD05-20B12	33	0.1
LD03-10B15	120	0.1	4.7/400V	P4KE20A	LD05-20B15	33	0.1
LD03-10B24	68	0.1	4.7/400V	P4KE30A	LD05-20B24	10	0.1

#### Note:

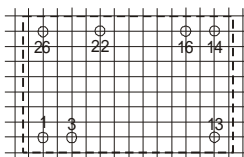
- Output filtering capacitors C1, C3 is electrolytic capacitors, It is recommended to use high frequency and low impedance electrolytic capacitors. For capacitance and current of capacitor please refer to manufacture's datasheet. Voltage derating of capacitor should be 80% or above. C2 is ceramic capacitor, it is used to filter high frequency noise. TVS is a recommended component to protect post-circuits (when converter fails).
- MOV is required to LD03 models, model: 471KD05, it is used to protect the device under surge.
- It is recommended to connect FUSE, the parameter for LD03 models is 0.5A/250V slow blow, for LD05 models is 1A/250V slow blow. External input NTC is recommended to use 5D-14 or 10Q/2W wire-round resistor.
- If EMC performance is required, recommended to add "EMC filter" at the input end(see figure 3,4)  
C6:X capacitor, recommended parameter 0.1 $\mu\text{F}$ /275V;  
C7,C8:Y capacitor, recommended parameter 220pF/2000V;  
NF: common model choke, recommended inductance is about 10mH-30mH.
- LD03 models: Terminals 22 and 26 are internal rectification and filtering terminals. To protect the models further, it is recommended to connect an electrolytic capacitor C3 (it is recommended to be 4.7 $\mu\text{F}$ /400V). If operation voltage of the module is between 160~264VAC, C3 can be removed.

### LD03-10BXX

First Angle Projection



RECOMMENDED FOOTPRINT  
 Top view, grid: 2.54mm (0.1 inch),  
 diameter: 1.20mm (0.047 inch)



FOOTPRINT DETAILS

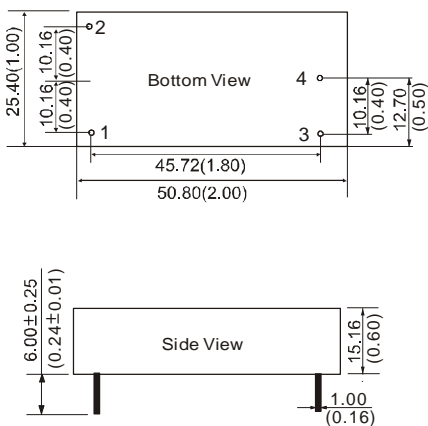
PIN	FUNCTION
1	L
3	N
13	NC
14	-Vo
16	+Vo
22	+Vin(DC)
26	-Vin(DC)

NC: No connection

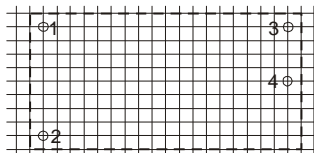
Note:  
 Unit: mm (inch)  
 Pin diameter: 0.80 ± 0.05 mm  
 Pin tolerances: ± 0.25 mm  
 General tolerances: ± 0.50 mm  
 Weight: 25 g

### LD05-20BXX

First Angle Projection



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



FOOTPRINT DETAILS

Pin	Function
1	N
2	L
3	+Vo
4	-Vo

Note:  
 Unit: mm (inch)  
 Pin diameter: 1.00 ± 0.10 mm  
 General tolerances: ± 0.50 mm  
 Weight: 35 g

## 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 could 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

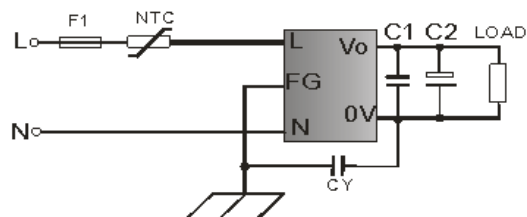


Figure 1. General AC-DC converter applications circuit

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:

$$I = 3 \times V_{o1} \times I_{o1} / \eta / V_{in(\min.)}$$

$V_{o1}$  = output voltage

$I_{o1}$  = output current;

$\eta$  = the converter's efficiency;

$V_{in(\min)}$  = the minimum input voltage

Further circuit notations:

- ◆ **NTC** is a thermistor.
- ◆ **CY** and **CX** are safety capacitors.
- ◆ **C1** is a high frequency ceramic capacitor or polyester capacitor, 0.1 $\mu$ F/50V.
- ◆ **C2** is output filtering high frequency aluminum electrolytic capacitor. Select a 220 $\mu$ F rating if the output current is greater than 5A, or a 100 $\mu$ F 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 lightning 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.

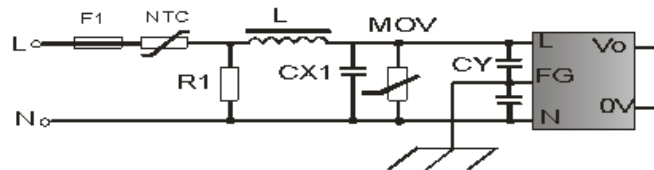


Figure 2. Input filter circuit

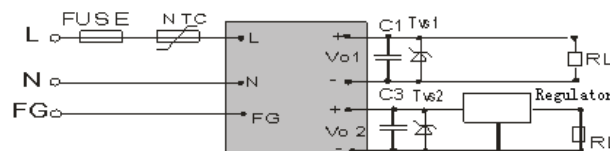


Figure 3. Typical application circuit

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.

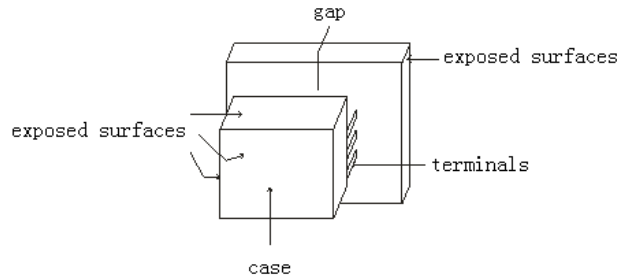


Figure 4. converter assembled on PCB

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.

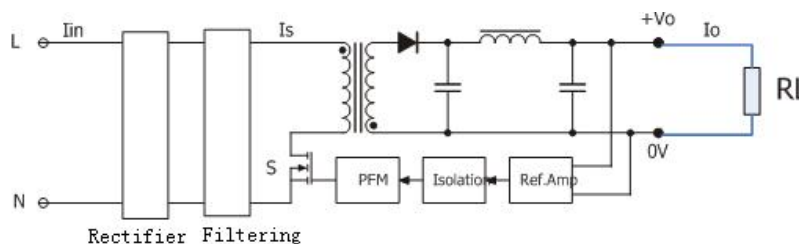
### (3) Forced Air Cooling

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

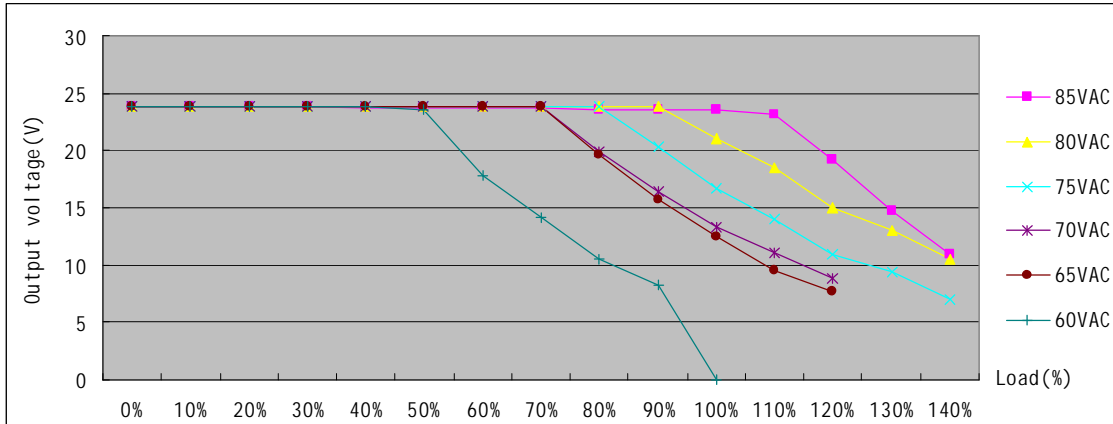


### 5.2 Impact to Converter Reliability

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 ( $I_s$ ) 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				