XND18 PV bypass switched circuit instructions (V3.0)

Introduction

XND18 PV bypass switched circuit is a novel rectifying circuit, consists of low-loss power switch chip, control circuit chip and energy storage element, is a solution to SiP (System in Package) used in PV Panel. Like traditional Schottky diode, and realizes bypass rectifier function. The XND18 has even lower forward voltage drop and reverse leakage current than traditional Schottky diode, can take directly the place of the bypass diode used to prevent the hot spot effect currently, and is packaged in plastic package TO-263.

Features

- •Low power dissipation, low loss, high efficiency
- •Very low average forward voltage
- •High anti-surge capacity
- •High ESD protection capability
- •Special device for solar junction box bypass
- •Lead-free product

Device characteristic

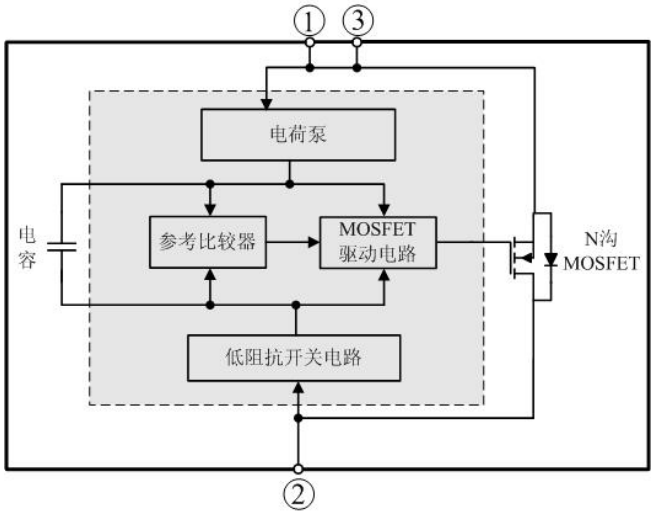
Device name	package	Operational junction temperature
XND18	TO-263	-55□～+175□

Application

- PV panel bypass switched circuit

Functional block diagram

Functional block diagram is shown in Fig.1.



电荷泵-charge pump

电容-capacitor

参考比较器- reference comparator

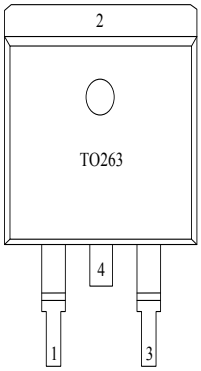
MOSFET 驱动电路-MOSFET drive circuit

N沟 MOSFET-N-channel MOSFET

低阻抗开关电路-low-impedance switching circuit

Fig. 1 Functional block diagram of XND18 PV bypass switched circuit

Pin configuration



Note: Baseplate is connected with pin 2

Pin number	Symbol	Description
1	A_1	Anode 1
2	K_1	Cathode 1
3	A_2	Anode 2
4	K_2	Cathode 2

Fig.2 XND18 Pin configuration

Maximum absolute rating

(All voltages are referred to GND)

Parameters	Min	Max	Unit
Operating junction temperature range	-55	175	□
ESD(HBM)		30	KV
Reverse voltage		40	V
Forward current		30	A
Storage temperature	-55	175	□

Electrical characteristics

Parameters	Symbol	Typical value	Unit
Maximum reverse voltage	V_R	40	V
Maximum forward current	I_F	30	A
Surge forward current (50Hz half-sinusoid/8.3ms)	I_{FSM}	250	A
ESD（HBM）		30	KV
Max average forward on-voltage（IF=16.5A）	$V_{F(AVG)}$	80	mV
Max average forward on-voltage（IF=30A）		160	mV
Maximum reverse leakage current（VR=40V）	I_R	100	uA
Thermal resistance	R_{RthJC}	2	□/W
Operating junction temperature range	T_J	-55～+175	□
Storage temperature	T_{STG}	-55～+175	□

Parameter curve

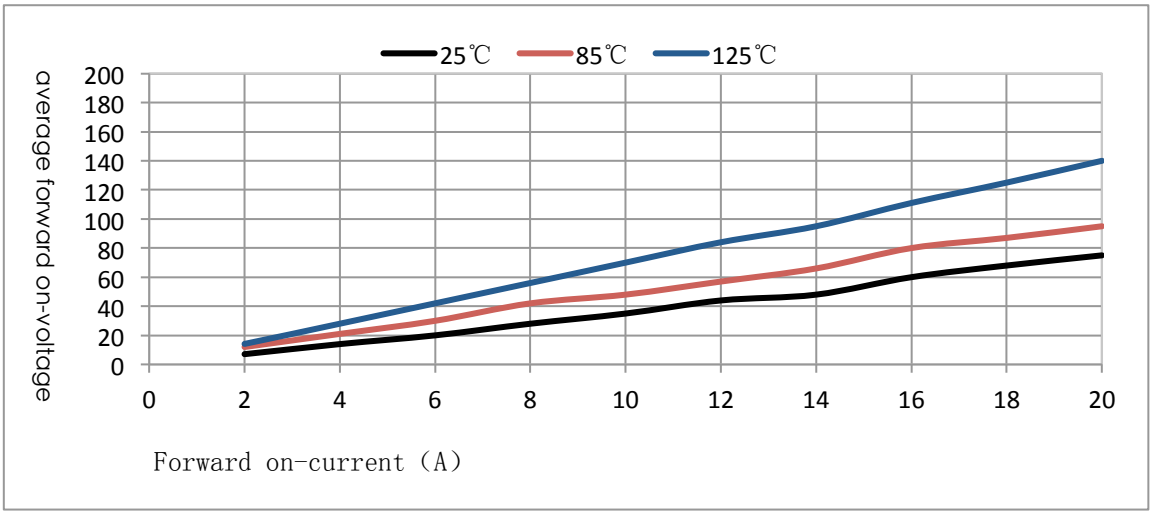


Fig.3 XND18 average forward on-voltage curve

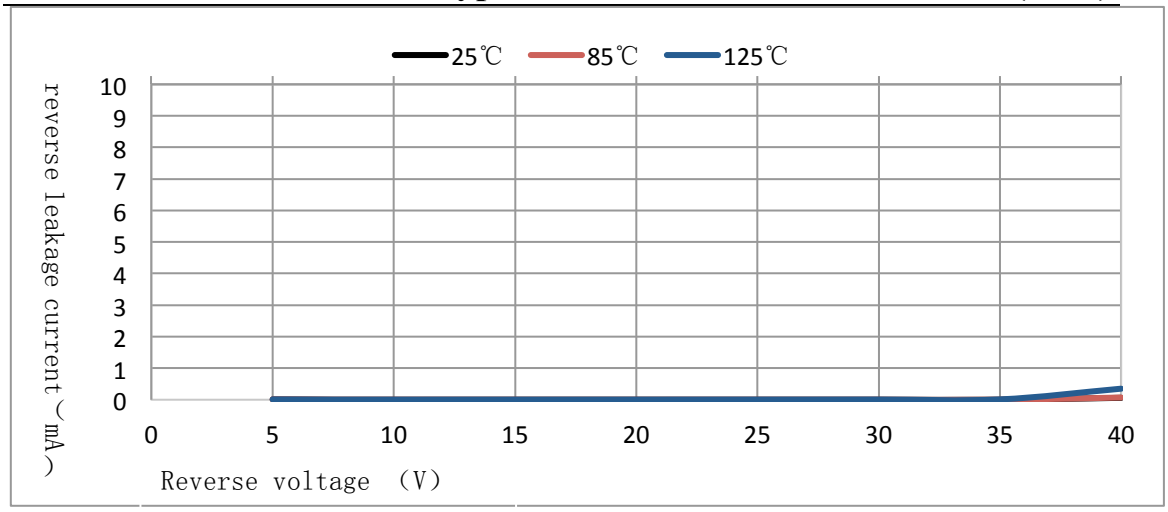


Fig.4 XND18 reverse leakage current curve

Functional description

The XND18 resolves the current PV bypass Schottky diode issues such as high forward voltage drop, severe heat generation, high reverse leakage current by using the features of the very low on-resistance and very low reverse leakage current of power MOSFET.

Pins 1 & 3 are the anodes of XND18 PV bypass switched circuit, and pins 2 & 4 are the cathodes of XND18 PV bypass switched circuit. At forward-bias, the XND18 is divided into two working states: on-state and off-state. At first, the circuit is in off state, and high voltage V_H across bypass switched circuit drives internal circuits to operate. After the time period V_L, built-in MOSFET is on. If the circuit is in on state, the voltage across the bypass switched circuit will be reduced to low level V_L. After time period T_L, MOSFET switch is switched off again, the circuit is in off state, thus one operational period is completed. By control circuit regulating T_H and T_L, the average on-voltage of the circuit is reduced, achieving the goal of low power dissipation and saving energy.

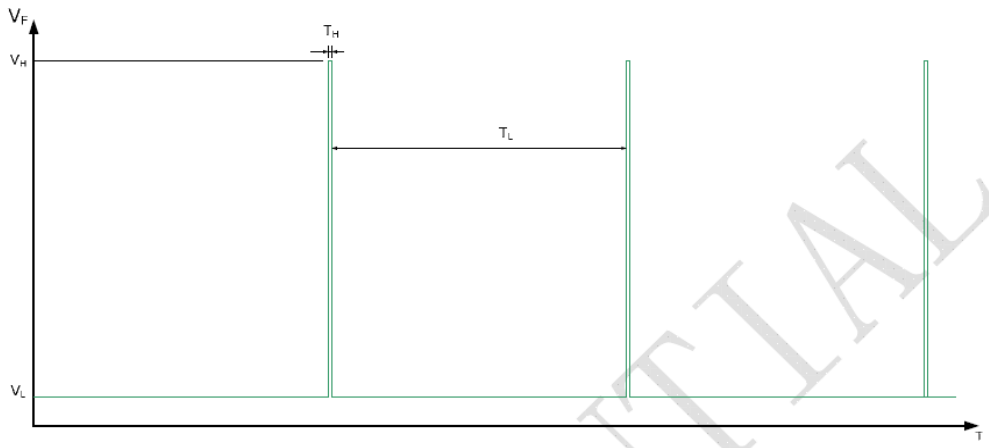


Fig.5 XND18 forward operational voltage waveform

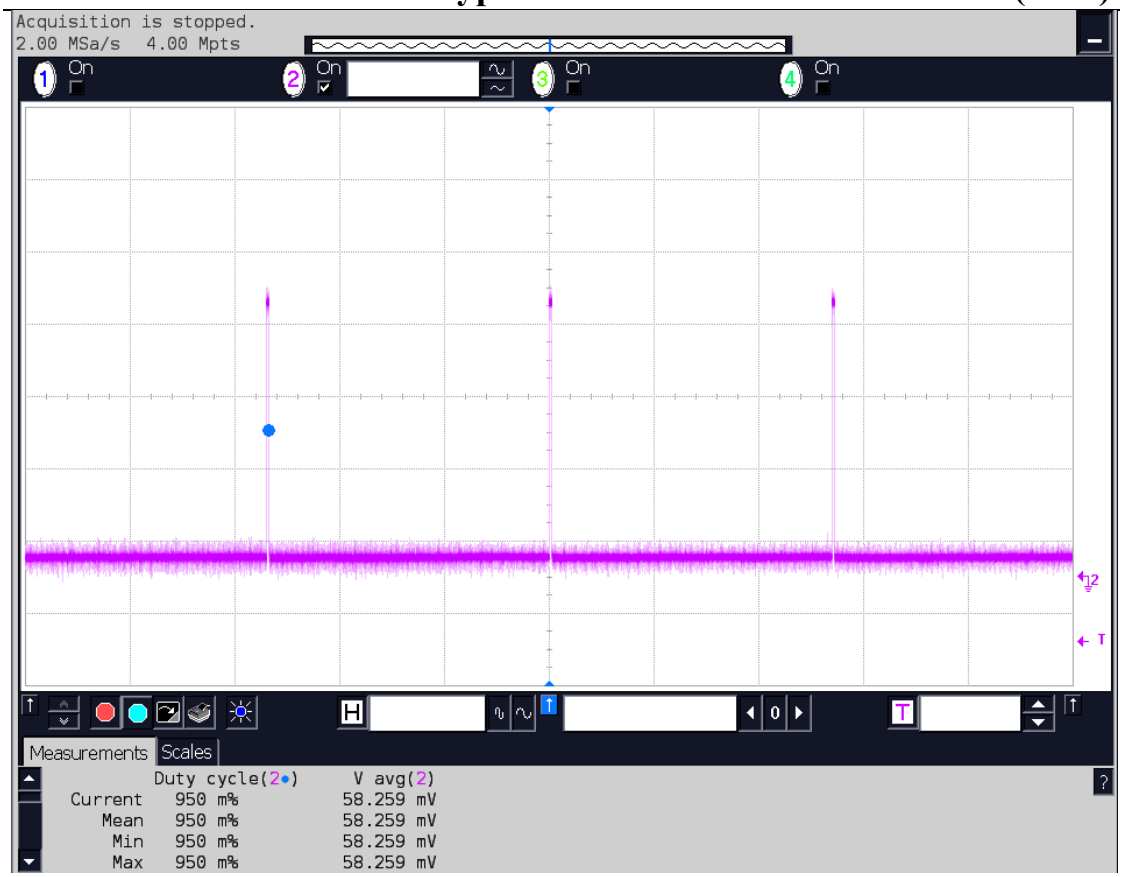
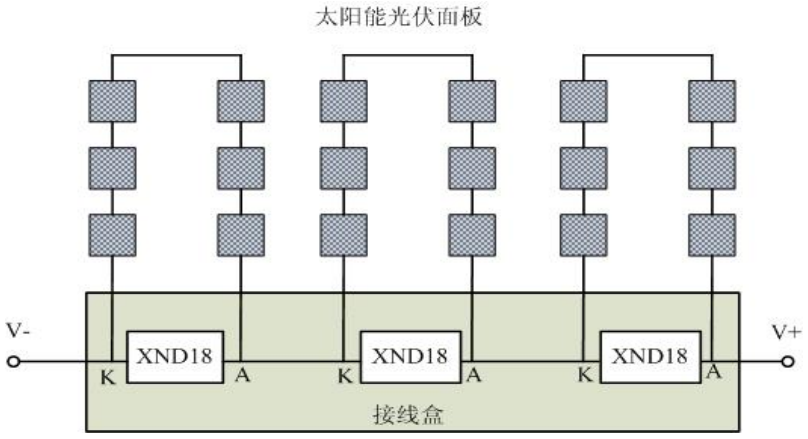


Fig.6 XND18 anode-to-cathode voltage waveform in junction box （T_A=25□ I_F=16.5A）

Typical applied circuit



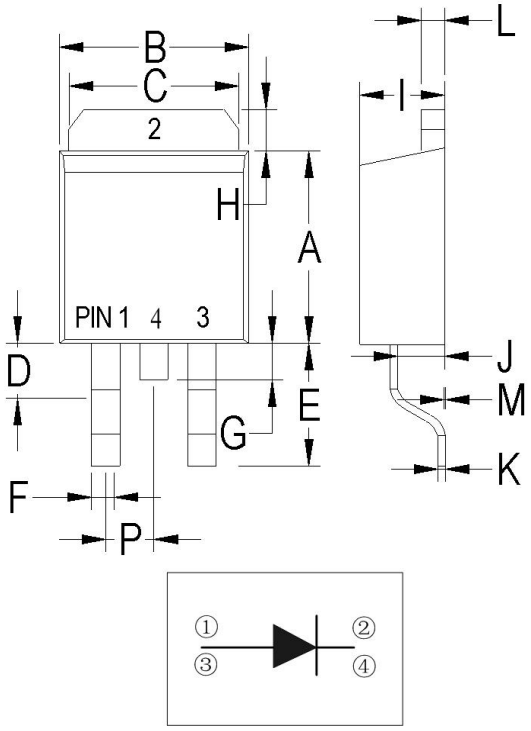
Note: Pins 4 & 2 are collected in package. In use, pin 4 should be used as cathode collecting terminal.

太阳能光伏面板-solar PV panel

接线盒-junction box

Fig.7 XND18 typical applied circuit

Package outline



TO-263-3L		
Dim	Min	Max
A	.323(8.20)	.348(8.85)
B	.394(10.0)	.413(10.5)
C	.394(10.0)	.402(10.2)
D	.077(1.95)	.100(2.55)
E	.204(5.17)	.227(5.77)
F	.027(0.68)	.037(0.94)
G	--	.067(1.70)
H	.046(1.17)	.053(1.34)
I	.175(4.44)	.191(4.86)
J	.100(2.54)	.110(2.79)
K	.014(0.35)	.025(0.64)
L	.047(1.20)	.055(1.40)
M	.000(0.00)	.010(0.25)
P	.095(2.41)	.105(2.67)

Fig. 8 TO-263 package outline

Measuring methods

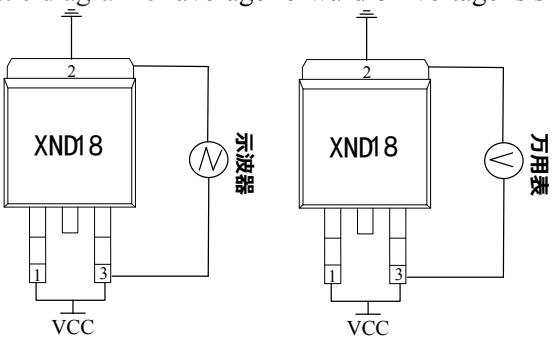
1 **Average forward on-voltage $V_{F(AVG)}$**

1.1 **Goal**

To test average forward on-voltage of circuit

1.2 **Measuring schematic diagram**

Measuring schematic diagram of average forward on-voltage is shown in Fig.9.



示波器- oscilloscope

万用表- multimeter

Fig.9 VF(AVG)measuring schematic diagram

1.3 **Test conditions**

a) Set up forward current IF based on user requirement;

1.4 **Test procedures**

a）Set up power supply as current limiting output that is consistent with the forward current IF used by users;

b）Collect equipment and instrument according to the schematic diagram in Fig.9. Positive terminal of power supply is collected with pins 1 & 3, negative terminal of power supply is collected with pin 2, oscilloscope probe probe-terminal is collected with pins 1 & 3, and oscilloscope probe ground-terminal is collected with pin 2.

c) Set up oscilloscope time axis as 200ms/decade, oscilloscope voltage axis as 200mv/decade, and open the “average voltage measuring” option in oscilloscope;

d）Start power supply, and read XND18 average forward on-voltage directly in oscilloscope.

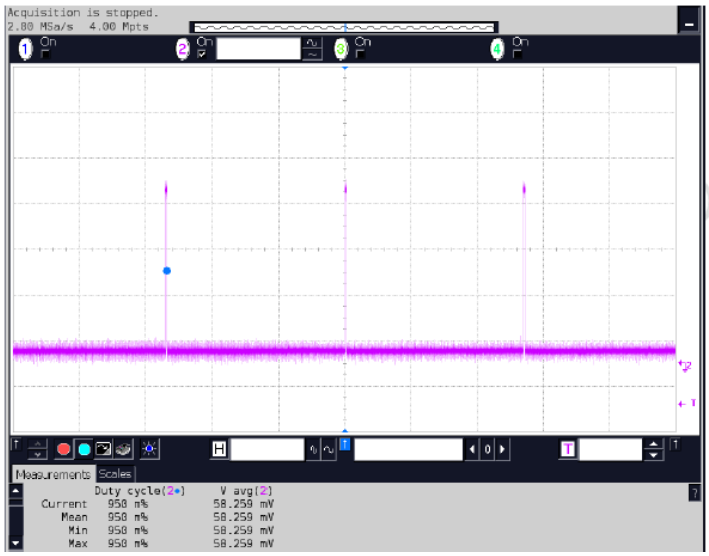


Fig.10 Oscilloscope-tested VF(AVG) waveform

Note: If oscilloscope is not available, then multimeter can be used to test XND18 average forward on-voltage, as follows:

a）Set up power supply as current limiting output that is consistent with the forward current IF used by users;

b）Collect equipment and instrument according to the schematic diagram in Fig.9. Positive terminal of power supply is collected with pins 1 & 3, negative terminal of power supply is collected with pin 2, multimeter positive-terminal is collected with pins 1 & 3, and multimeter negative-terminal is collected with pin 2.

c）Set up multimeter as voltage-testing mode, start power supply, and read XND18 average forward on-voltage directly in oscilloscope.

2 Reverse leakage current IR

2.1 Goal

To test the reverse leakage current of circuit

2.2 Measuring schematic diagram

Measuring schematic diagram of reverse leakage current is shown in Fig.11.

Note: To guarantee current-measuring accuracy, it is recommended that ammeter at a resolution of 6½ bit should be used for test.
电流表-ammeter

Fig.11 IR measuring schematic diagram

2.3 Test conditions

a) VR =40V；

2.4 Test procedures

a）Collect circuit and instrument according to the schematic diagram in Fig.11. Negative terminal of power supply is collected with pins 1 & 3 of the XND18, negative terminal of ammeter is collected with pin 2, and ammeter positive-terminal collects with positive-terminal of power supply.

b) Set up supply voltage as 40V, and switch on power supply.

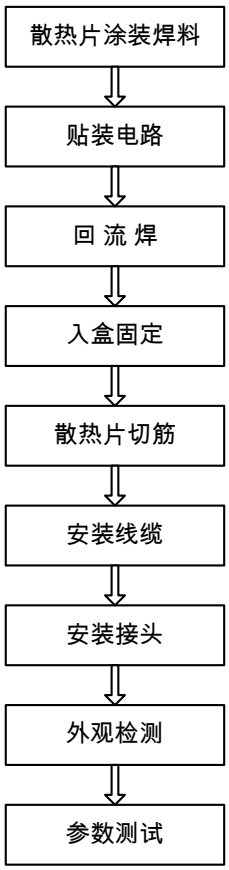
c）Set up multimeter as DC current-testing mode, and read reverse leakage current IR directly in multimeter.

Note: XND18 PV bypass switched circuit test differs to a certain extent from traditional Schottky diode test. Aimed at XND18 junction box mass-production and mass-test, SWID has developed high-efficiency, cost-effective testing system. If need be, SWID can provide customers with solution package for it.

Recommendation of process technology

1 **Recommended processing flow**

Aimed at XND18 junction box production, it is recommended to use the processing steps in the figure below, ensuring product quality in the course of production

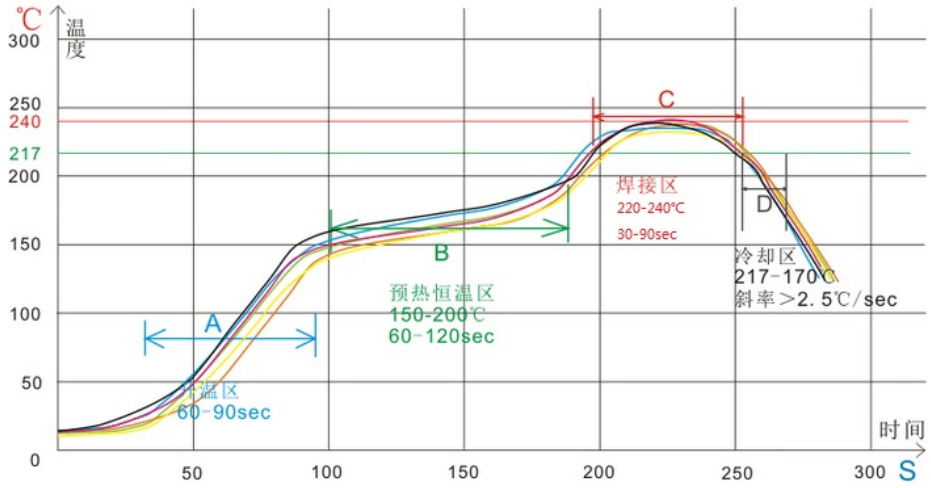


散热片涂装焊料- heatsink solder coating
贴装电路-circuit mount
回流焊- reflow soldering
入盒固定- in-box fixing
散热片切筋-heatsink trim
安装线缆- cable installation
安装接头-joint installation
外观检测- visual inspection
参数测试- parameter testing

Fig.12 Recommended XND18 junction box processing flow

1、**Reflow soldering**

If lead solder paste reflow soldering is used, then recommended reflow soldering furnace temperature peak will not exceed 220□; if lead-free solder paste reflow soldering is used, then recommended reflow soldering furnace temperature peak will not exceed 240□. In setting up reflow soldering curve, specific temperature rise needs to be controlled in the range between 2.5□ and 3.0□/sec, recommended cooling rate in the cooling area needs controlling in the range between 2.5□ and 3□/sec.



温度-temperature
时间-time
升温区-heating-up area
预热恒温区-preheating & thermostatic area
焊接区-soldering area
冷却区-cooling area
斜率-slope

Fig.13 Recommended reflow soldering curve

2、 Heatsink trim

If heatsink is not placed in box and fixed (e.g. prior to the processing step “in-box fixing”), then direct heatsink trim will generate stress on the circuit that may cause the circuit to be damaged. If heatsink trim is after the processing step “in-box fixing”, then most stress will be undertaken by box body, thus reducing the circuit damage due to stress. Therefore, It is recommended that the “heatsink trim” processing step be after the processing step “in-box fixing”.

3 、Ultrasonic soldering

During junction box production, each manufacturer with cable fixed will use ultrasonic soldering technology. HF vibration occurs in ultrasonic soldering. If ultrasonic power is too high, the circuit damage in junction box would be caused. Therefore, output power of ultrasonic soldering machine is not the bigger the better, but needs to be adjusted in a rational range in order to ensure that circuit is not damaged with good ultrasonic soldering being guaranteed. Recommended ultrasonic soldering conditions are as follows. The frequency is controlled between 20K and 30K, the ultrasonic power is controlled under 1KW, and the ultrasonic welding time is controlled at 0.5S or so.

4 、Storage requirements

1) Product is stored in vacuum packaging: for up to 12 months at temperature less than 30□ and at humidity less than 90%.

2) After a vacuum packaging bag is opened, components in reflow soldering must meet the following requirements:

a) Complete reflow soldering within 72 hours of opening a vacuum packaging bag at fab environmental temperature of ≤30□ at RH≤60%.

b) If the storage time with vacuum packaging bag open is longer than one month, then reflow soldering can only be conducted after high-temperature baking for 4 hours at 125□

Notes

1. This instructions will be modified without notice in the future.