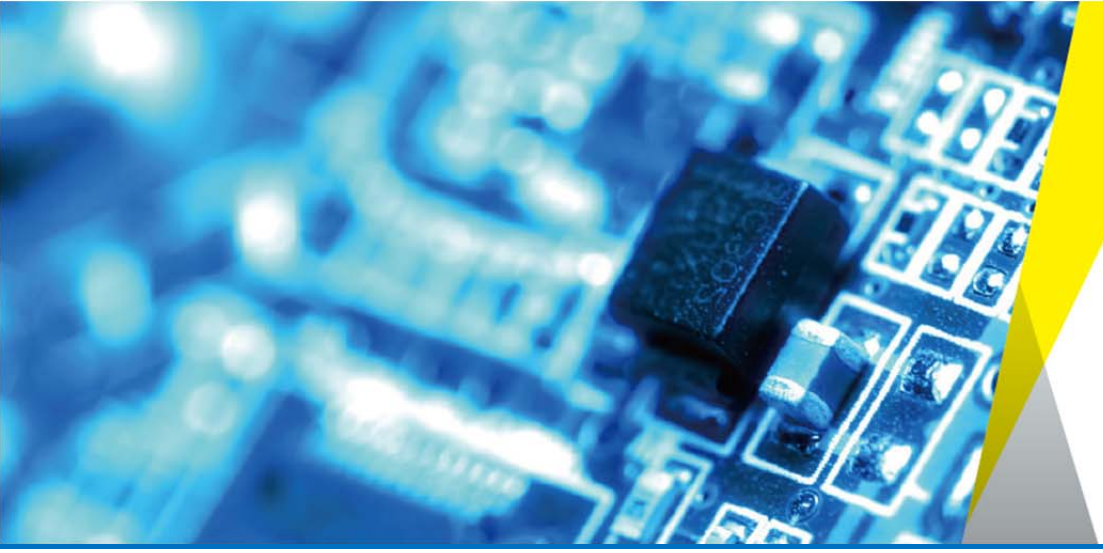

DATA SHEET

Product Name **Anti- Electro Static Discharge Thick Film Chip Resistors**

Part Name **ES Series**

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Manufacture Plant Uniroyal Electronics Industry Co., Ltd.

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1. Scope

1.1 This datasheet is the characteristics of Anti- Electro Static Discharge Thick Film Chip Resistors manufactured by UNI-ROYAL.
1.2 High voltage
1.3 Suitable for reflow & wave soldering
1.4 Application Medical Devices, Industrial Controls, AV adapter, Flash lamp of camera Automotive Industry, Outdoor Equipments.

2. Part No. System

Part No. includes 14 codes shown as below:
2.1 1st~4th codes: Part name. E.g.: ES01、ES02、ES03、ES05、ES06、ES07
2.2 5th~6th codes: Power rating.

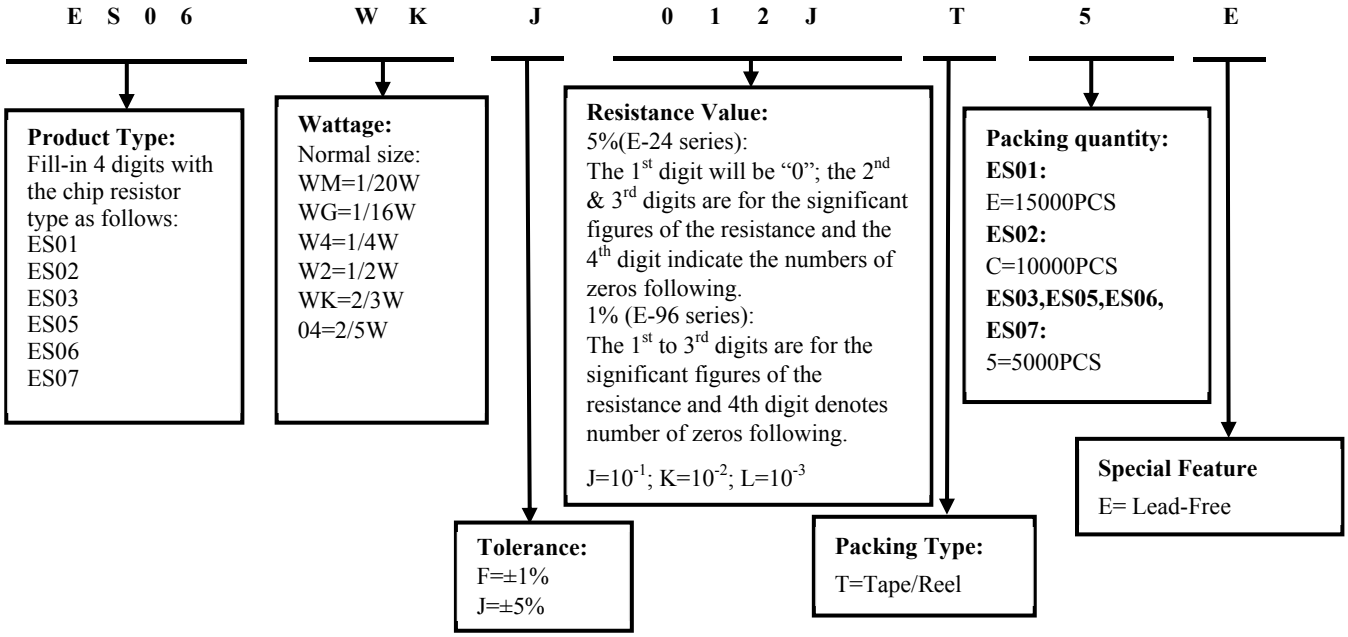
E.g.: W=Normal Size "1~G" = "1~16"

Wattage	1/2	1/4	1/16	1/20	2/3	2/5
Normal Size	W2	W4	WG	WM	WK	04

If power rating is equal or lower than 1 watt, 5th code would be "W" and 6th code would be a number or letter.
E.g.: WM=1/20W W4=1/4W
2.3 7th code: Tolerance. E.g.: D=±0.5% F=±1% G=±2% J=±5% K= ±10%
2.4 8th~11th codes: Resistance Value.
2.4.1 If value belongs to standard value of E-24 series, the 8th code is zero, 9th~10th codes are the significant figures of resistance value, and the 11th code is the power of ten.
2.4.2 If value belongs to standard value of E-96 series, the 8th~10th codes are the significant figures of resistance value, and the 11th code is the power of ten.
2.4.311th codes listed as following:
0=10^0 1=10^1 2=10^2 3=10^3 4=10^4 5=10^5 6=10^6 J=10^{-1} K=10^{-2} L=10^{-3} M=10^{-4}
2.5 12th~14th codes.
2.5.1 12th code: Packaging Type. E.g.: C=Bulk T=Tape/Reel
2.5.2 13th code: Standard Packing Quantity.
4=4,000pcs 5=5,000pcs C=10,000pcs D=20,000pcs E=15,000pcs
Chip Product: BD=B/B-20000pcs TC=T/R-10000pcs
2.5.3 14th code: Special features.
E = Environmental Protection, Lead Free, or Standard type.

3. Ordering Procedure

(Example: ES06 2/3W ±5% 1.2Ω T/R-5000)



4. Marking

4.1 For ES01 and ES02 size. Due to the very ES01、ES02 small size of the resistor's body, there is no marking on the body.

4.2 ±5% tolerance products (E-24 series):
3 codes.
1st~2nd codes are the significant figures of resistance value, and the rest code is the power of ten.

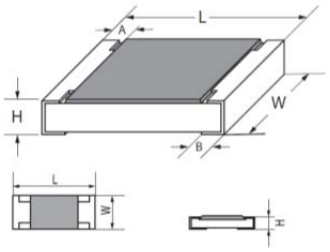
333 → 33KΩ

4.3 ±1% tolerance products (E-96 series):
4 codes.
1st~3rd codes are the significant figures of resistance value, and the rest code is the power of ten.
Letter "R" in mark means decimal point.

2701 → 2.7KΩ

5. Dimension

Type	Dimension(mm)				
	L	W	H	A	B
ES01(0201)	0.60±0.03	0.30±0.03	0.23±0.03	0.10±0.05	0.15±0.05
ES02(0402)	1.00±0.10	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10
ES03(0603)	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20
ES05(0805)	2.00±0.15	1.25+0.15/-0.10	0.55±0.10	0.40±0.20	0.40±0.20
ES06(1206)	3.10±0.15	1.55+0.15/-0.10	0.55±0.10	0.45±0.20	0.45±0.20
ES07(1210)	3.10±0.10	2.60±0.20	0.55±0.10	0.50±0.25	0.50±0.20

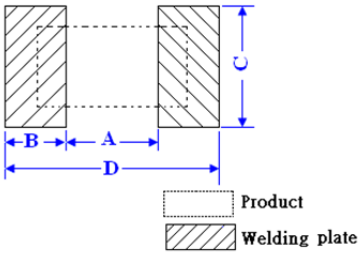


6. Resistance Range

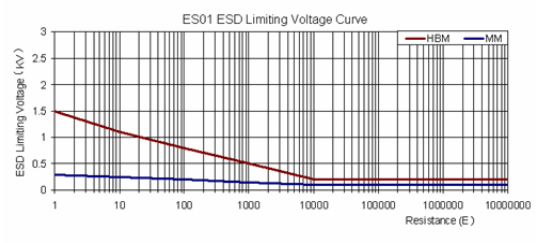
Type	Power Rating at 70℃	Max. Working Voltage	Max. Overload Voltage	Dielectric withstanding Voltage	Resistance Range 1%&5%	Operating Temperature
ES01	1/20W	25V	50V	--	1Ω~10MΩ	-55 ~ +155℃
ES02	1/16W	50V	100V	100V		
ES03	1/4W	150V	200V	300V		
ES05	2/5W	200V	400V	500V		
ES06	2/3W	500V	1000V	500V		
ES07	1/2W	800V	1500V	500V		

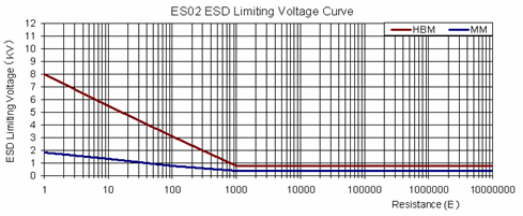
7. Soldering pad size recommended

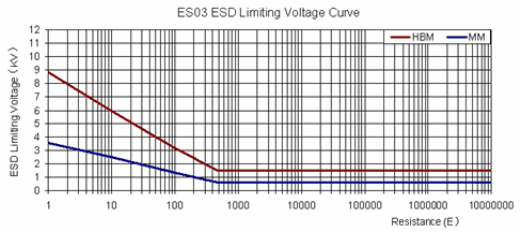
Type	Dimension(mm)			
	A	B	C	D
ES01	0.3±0.05	0.35±0.05	0.4±0.05	1.0±0.05
ES02	0.5±0.05	0.5±0.05	0.6±0.05	1.5±0.05
ES03	0.8±0.05	0.8±0.05	0.9±0.05	2.4±0.05
ES05	1.0±0.1	1±0.1	1.4±0.1	3±0.1
ES06	2.0±0.1	1.1±0.1	1.8±0.1	4.2±0.1
ES07	2.0±0.1	1.1±0.1	2.9±0.1	4.2±0.1

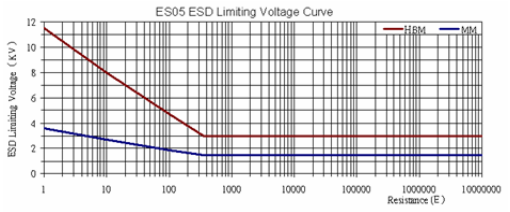


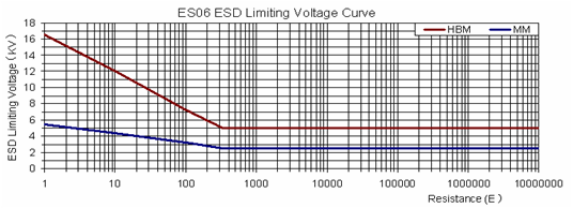
8. ESD Limiting Voltage Curve

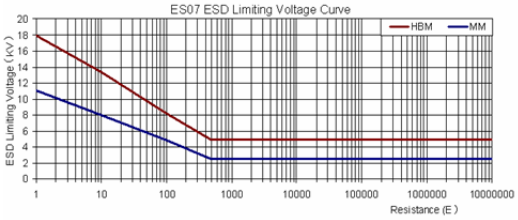






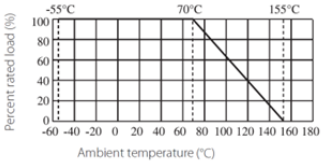






9. Derating Curve

Power rating will change based on continuous load at ambient temperature from -55 to 155℃.
It is constant between -55 to 70℃, and derate to zero when temperature rise from 70 to 155℃.

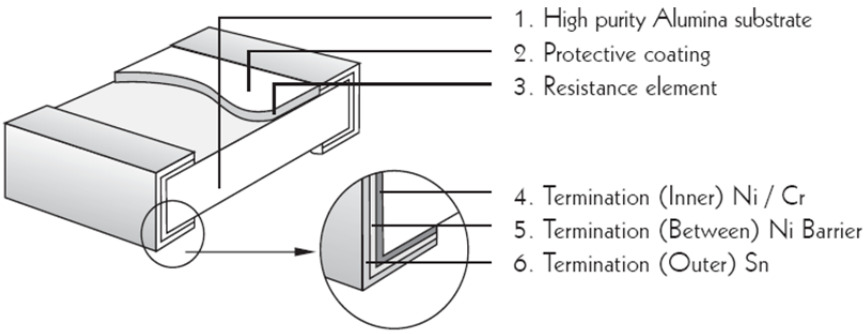


Voltage rating:
Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula:

$$RCWV = \sqrt{P \times R}$$

Remark: RCWV: Rating Continuous Working Voltage (Volt.) P: power rating (Watt) R: nominal resistance (Ω)
In no case, the rated DC or RMS AC continuous working voltage must be greater than the applicable maximum value.
The overload voltage is 2.5 times RCWV or Max. Overload voltage whichever is lower.

10. Structure



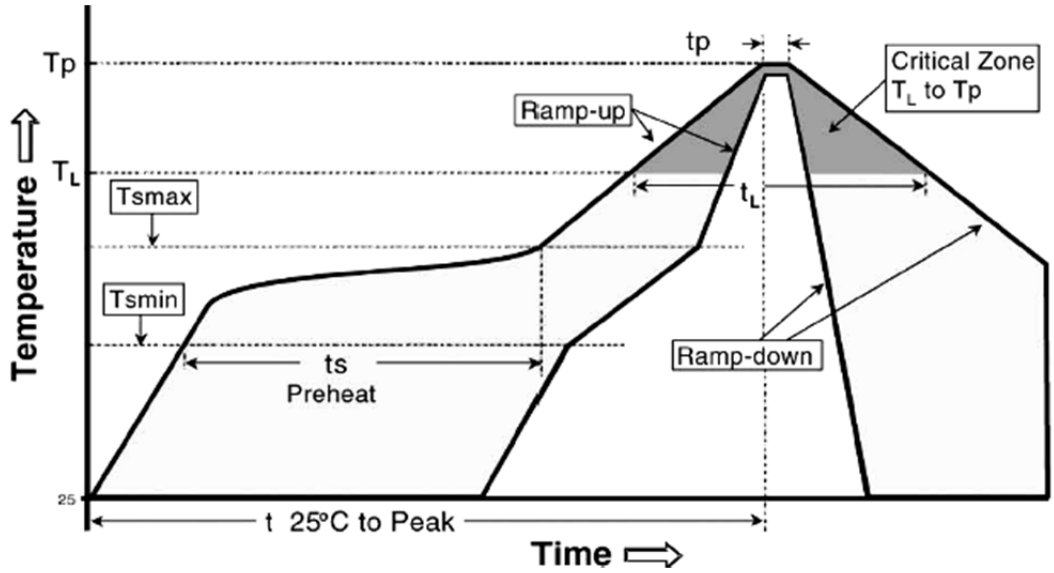
11. Performance Specification

Characteristic	Limits		Test Methods (GB/T5729&JIS-C-5201&IEC60115-1)
Temperature Coefficient	ES01： 1Ω≤R≤10Ω：±400PPM/℃ 10Ω＜R≤10MΩ：±200PPM/℃		4.8 Natural resistance changes per temp. Degree centigrade $\frac{R_2-R_1}{R_1(t_2-t_1)} \times 10^6$ (PPM/℃) R_1: Resistance Value at room temperature （t_1）; R_2: Resistance at test temperature (Upper limit temperature or Lower limit temperature) t_1: +25℃ or specified room temperature t_2: Upper limit temperature or Lower limit temperature test temperature
	ES02、ES03、ES05、ES06、ES07： 1Ω≤R≤10Ω：±200PPM/℃ 10Ω＜R≤10MΩ：±100PPM/℃		
Short-time overload	±5%	±(2.0%+0.1Ω)	4.13 Permanent resistance change after the application of 2.5 times RCWV for 5 seconds.
	±1%	±(1.0%+0.1Ω)	
Terminal bending	±(1.0%+0.05Ω)		4.33 Twist of test board: Y/X = 3/90 mm for 60 Seconds
Dielectric withstanding voltage	No evidence of flashover mechanical damage, arcing or insulation breaks done.		4.7 Clamped in the trough of a 90℃ metallic v-block and shall be tested at ac potential respectively specified in the type for 60-70 seconds
Soldering heat	±(1.0%+0.05Ω)		4.18 Dipping the resistor into a solder bath having a temperature of 260℃±5℃ and hold it for 10±1 seconds
Solderability	Coverage must be over 95%.		4.17 The area covered with a new, smooth, clean, shiny and continuous surface free from concentrated pinholes. Temperature of solder:245±3°C; Dwell time in solder: 2~3 seconds.
Rapid change of temperature	±5%	±(1.0%+0.05Ω)	4.19 30 min at lower limit temperature and 30 min at upper limit temperature，100 cycles.
	±1%	±(0.5%+0.05Ω)	
Humidity (Steady State)	±5%	±(3.0%+0.1Ω)	4.24Temporary resistance change after240 hours exposure in a humidity test chamber controlled at 40±2℃ and 90-95% relative humidity,
	±1%	±(0.5%+0.1Ω)	
Load life	±5%	±(3.0%+0.1Ω)	4.25.1 Permanent resistance change after 1,000 hours operating at RCWV with duty cycle 1.5 hours “ON”, 0.5 hour “OFF” at 70℃±2℃ ambient.
	±1%	±(1.0%+0.1Ω)	
ESD	±(1.0%+0.05Ω)		HBM:100PF 1K5 1Cycle MM: 200PF 0E 1Cycle Note: ESD Voltag Refer to 4.0
Low Temperature Storage	±5%	±(3.0%+0.1Ω)	4.23.4 - 55 ℃ for 2hrs
	±1%	±(1.0%+0.1Ω)	
High Temperature Exposure	±5%	±(3.0%+0.1Ω)	4.23.2 155℃ for 1000hrs
	±1%	±(1.0%+0.1Ω)	
Leaching	No visible damage		J-STD-002 test D Lead free solder ,260°C, 30 seconds immersion time

12. Soldering Condition

(This is for recommendation, please customer perform adjustment according to actual application)

12.1 Recommend Reflow Soldering Profile：(solder : Sn96.5 / Ag3 / Cu0.5)

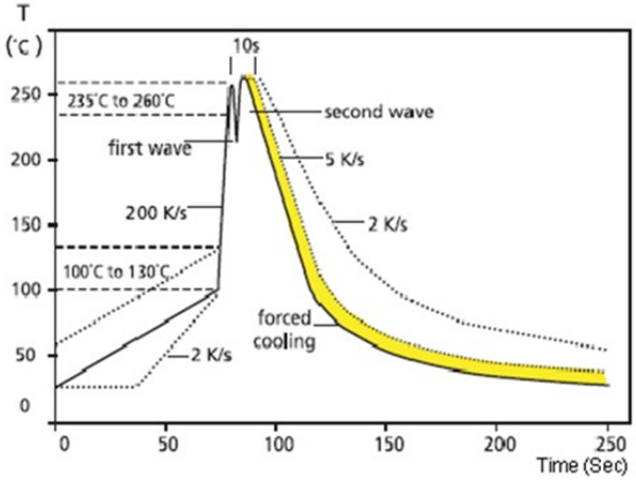


Profile Feature	Lead (Pb)-Free solder
Preheat： Temperature Min (Ts_{min}) Temperature Max (Ts_{max}) Time (Ts_{min} to Ts_{max}) (ts)	 150℃ 200℃ 60 -120seconds
Average ramp-up rate： (Ts max to Tp)	 3℃ / second max.
Time maintained above : Temperature (T_L) Time (t_L)	 217℃ 60-150 seconds
Peak Temperature (Tp)	260℃
Time within $^{+0}_{-5}$℃ of actual peak Temperature (tp)[2]	10 seconds
Ramp-own Rate	6℃/second max.
Time 25℃ to Peak Temperature	8mimutes max.

Allowed Re-flow times : 2 times

Remark : To avoid discoloration phenomena of chip on terminal electrodes, please use N2 Re-flow furnace .

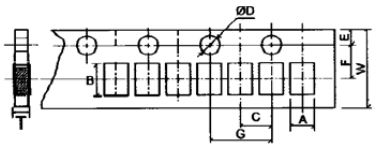
12.2 Recommend Wave Soldering Profile：(Apply to 0603 and above size)



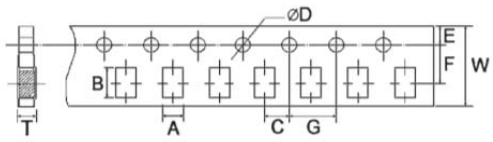
13. Packing

13.1 Dimension of Paper Taping :(Unit: mm)

Type	A	B	C ±0.05	$\Phi D^{+0.1}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T
ES01	0.40±0.05	0.70±0.05	2.00	1.50	1.75	3.50	4.00	8.00	0.42±0.1
ES02	0.65±0.10	1.20±0.10	2.00	1.50	1.75	3.50	4.00	8.00	0.42±0.05

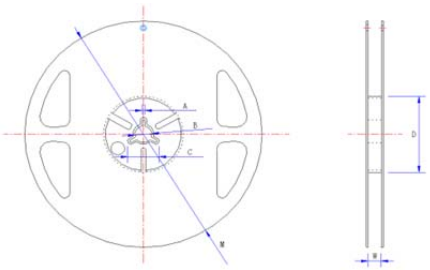


Type	A ±0.2	B ±0.2	C ±0.05	$\Phi D^{+0.1}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.1
ES03	1.10	1.90	2.00	1.50	1.75	3.50	4.00	8.00	0.67
ES05	1.65	2.40	2.00	1.50	1.75	3.50	4.00	8.00	0.81
ES06	2.00	3.60	2.00	1.50	1.75	3.50	4.00	8.00	0.81
ES07	2.80	3.50	2.00	1.50	1.75	3.50	4.00	8.00	0.75



13.2 Dimension of Reel：（Unit: mm）

Type	Taping	Qty/Reel	A ±0.5	B ±0.5	C ±0.5	D ±1	M ±2	W ±1
ES01	Paper	15,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
ES02	Paper	10,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
ES03	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
ES05	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
ES06	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
ES07	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0



14. Note

14.1. UNI-ROYAL recommend products store in warehouse with temperature between 15 to 35℃ under humidity between 25 to 75%RH. Even under storage conditions recommended above, solder ability of products will be degraded stored over 1 year old.

14.2. Cartons must be placed in correct direction which indicated on carton, otherwise the reel or wire will be deformed.

14.3. Storage conditions as below are inappropriate:

a. Stored in high electrostatic environment

b. Stored in direct sunshine, rain, snow or condensation.

c. Exposed to sea wind or corrosive gases, such as Cl_2, H_2S, NH_3, SO_2, NO_2, etc.

15. Record

Version	Description	Page	Date	Amended by	Checked by
1	First version	1~7	Mar.20, 2018	Haiyan Chen	Nana Chen
2	Modify ES01 packing quantity	7	Jun.06, 2018	Haiyan Chen	Nana Chen
3	Modify characteristic	5	Feb.13, 2019	Haiyan Chen	Yuhua Xu
4	Modify the High Temperature Exposure conditions	7	July.29, 2019	Haiyan Chen	Yuhua Xu
5	Modify the reflow curve and add the wave soldering curve	6	Apr.29, 2020	Haiyan Chen	Yuhua Xu