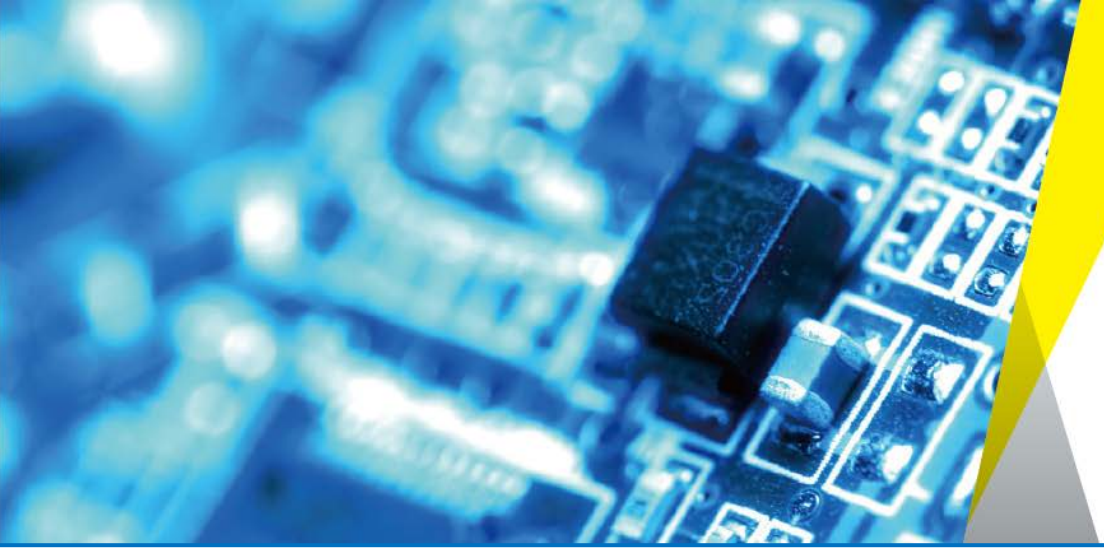

DATA SHEET

Product Name	**Anti-Sulfurized Thick Film Chip Resistors Array-Convex Terminal**
Part Name	**2S02/4S02/4S03 Series**
File No.	**SMD-SP-023**

Uniroyal Electronics Global Co., Ltd.

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Manufacture Plant	Uniroyal Electronics Industry Co., Ltd.
	Aeon Technology Corporation
	Royal Electronic Factory (Thailand) Co., Ltd.
	Royal Technology (Thailand) Co., Ltd.

1. Scope

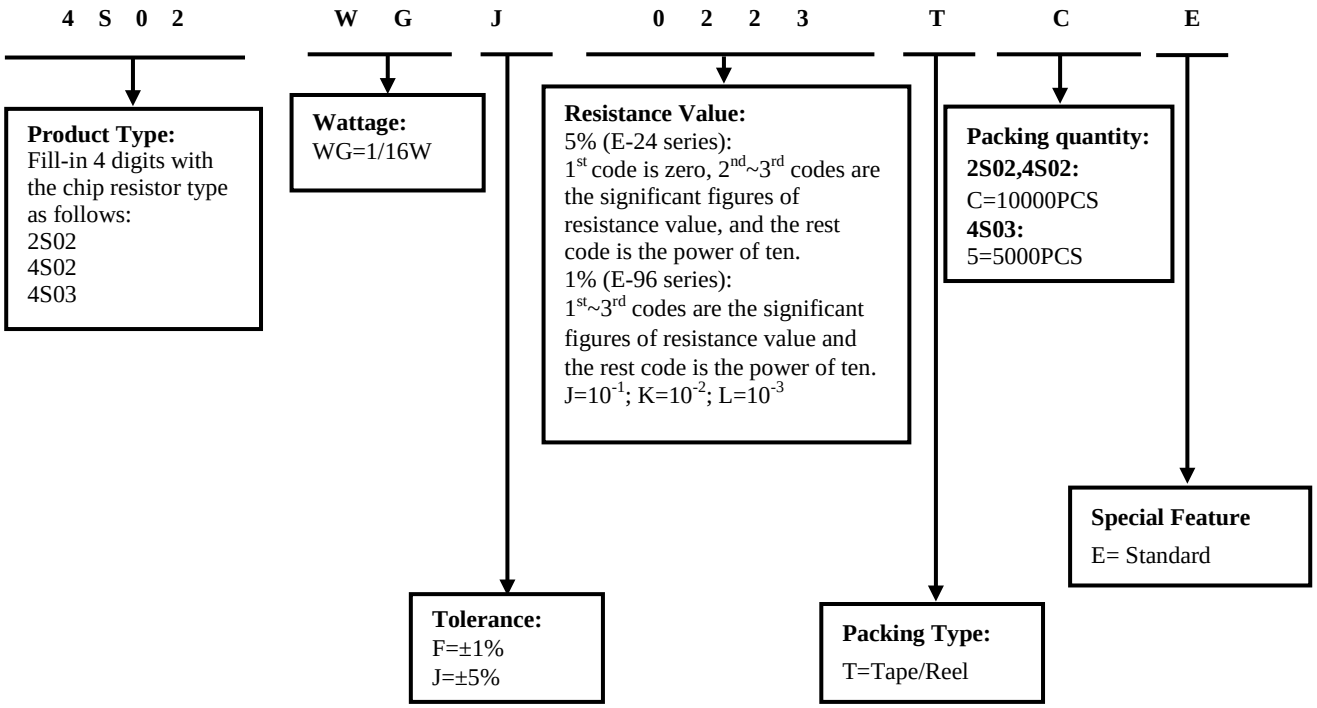
1.1 This datasheet is the characteristics of Anti-Sulfurized Thick Film Chip Resistors Array-Convex Terminal manufactured by UNI-ROYAL.
1.2 Anti-Sulfidation
1.3 Suitable for reflow & wave soldering
1.4 Application car，power
1.5 AEC-Q200 qualified
1.6 Compliant with RoHS directive.
1.7 Halogen free requirement.

2. Part No. System

Part No. includes 14 codes shown as below:
2.1 1^{st}~4^{th} codes: Part name. E.g.: 2S02, 4S02, 4S03.
2.2 5^{th}~6^{th} codes: Power rating.
E.g.: W=Normal Size, WG=1/16W
2.3 7^{th} code: Tolerance. E.g.: F=±1% J=±5%
2.4 8^{th}~11^{th} codes: Resistance Value.
2.4.1 If value belongs to standard value of E-24 series, the 8^{th} code is zero, 9^{th}~10^{th} codes are the significant figures of resistance value, and the 11^{th} code is the power of ten.
2.4.2 If value belongs to standard value of E-96 series, the 8^{th}~10^{th} codes are the significant figures of resistance value, and the 11^{th} code is the power of ten.
2.4.3 11^{th} 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 12^{th}~14^{th} codes.
2.5.1 12^{th} code: Packaging Type. E.g.: T=Tape/Reel
2.5.2 13^{th} code: Standard Packing Quantity.
5=5,000pcs C=10,000pcs
2.5.3 14^{th} code: Special features.
E= Standard

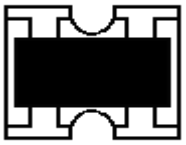
3. Ordering Procedure

(Example: 4S02 1/16W ±5% 22KΩ T/R-10000)

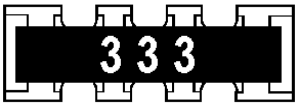


4. Marking

4.1 Normal for 2S02 sizes, no marking on the body.0Ω resistors is no marking too



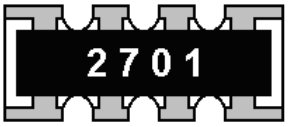
4.2 ±5% Tolerance of 4S02、4S03 size: the first two digits are significant figures of resistance and the third denotes number of zeros following .



333→ 33KΩ

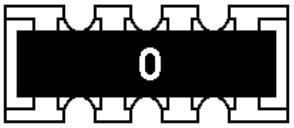
4.3 ±1%Tolerance of 4S02、4S03 size: first three digits are significant figures of resistance and the fourth denotes number of zeros following

Example: 4S02、4S03

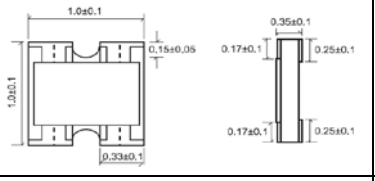
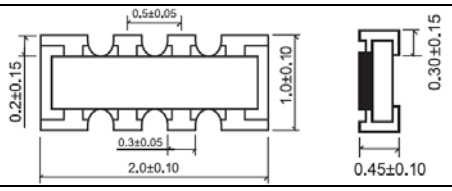
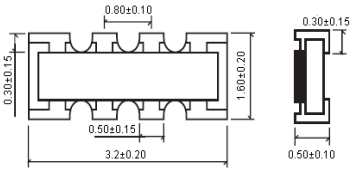
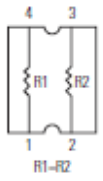
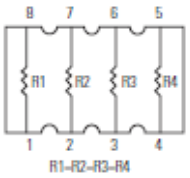
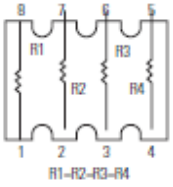


2701 → 2.7KΩ

4.4. 0Ω：Normal of 4S02 、4S03size, the marking as following:
Example: 4S02 、4S03



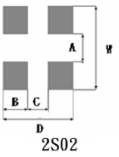
5. Ratings & Dimension

Type	2S02	4S02	4S03
Size	0402×2	0402×4	0603×4
Dimension（mm）			
Equivalent Circuit Diagram			

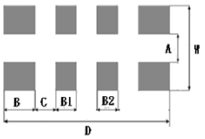
Type	2S02	4S02	4S03
Power Rating at 70℃	1/16W	1/16W	1/16W
Resistance Value of jumper	＜50mΩ	＜50mΩ	＜50mΩ
Jumper Rated Current	1A	1A	1A
Max Working Voltage	50V	50V	50V
Max Overload Voltage	100V	100V	100V
Dielectric Withstanding Voltage	100V	100V	300V
±1%	10Ω-1MΩ	10Ω-1MΩ	1Ω-1MΩ
±5%	10Ω-1MΩ	10Ω-1MΩ	1Ω-1MΩ
Operating Temperature	-55 ~ +155℃		

6. Soldering pad size recommended

Type	Dimension(mm)						
	A	B	B1	B2	W	C	D
2S02	0.5±0.1	0.33±0.1	/	/	2.0±0.1	0.34±0.1	1.0±0.1
4S02	0.5±0.1	0.3±0.1	0.28±0.1	0.28±0.1	2.0±0.1	0.22±0.1	1.82±0.1
4S03	1.0±0.1	0.4±0.1	0.4±0.1	0.4±0.1	2.6±0.1	0.4±0.1	2.8±0.1



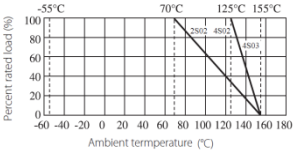
2S02



4S02/4S03

7. Derating Curve

Power rating will change based on continuous load at ambient temperature from -55 to 155℃.
It is constant between -55 to 125℃(2S02,4S02 is from -55℃ to 70℃), and derate to zero when Temperature rise from 125 to 155℃(2S02,4S02 is from 70℃ to 155℃).

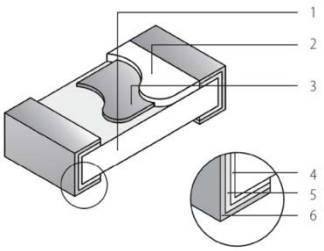


Voltage rating:
Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following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

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

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

8. Structure



1: High purity alumina substrate
(96%AL_2o_3、0.3±0.1%CaO、1.0±0.3%MgO、2.1±0.05%SiO_2)
2: Protective covering
3:Resistive covering (Ag for 0Ω)
4: Termination（inner）Ag/Pd
5: Termination（between）Ni plating
6: Termination（outer）Sn plating

9. Performance Specification

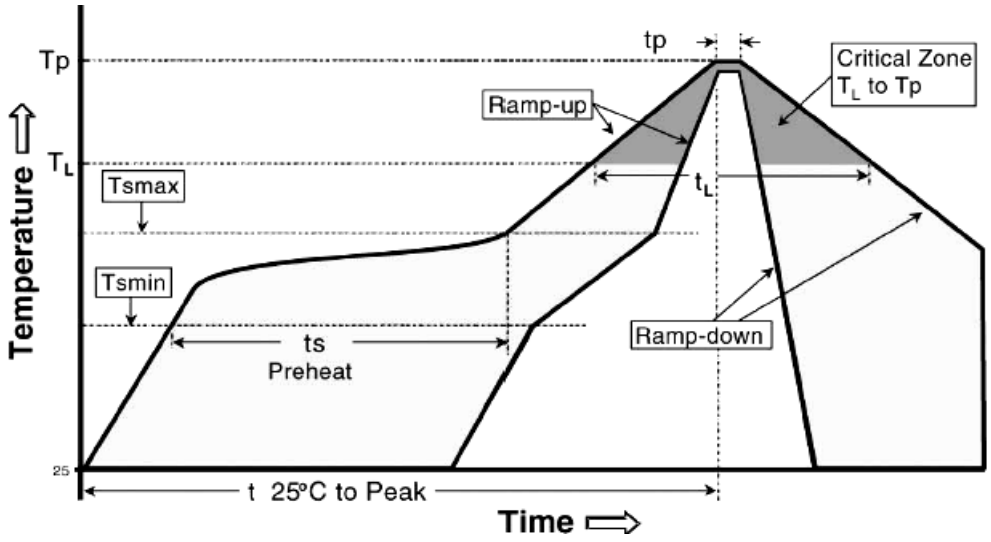
Characteristic	Limits		Ref. Standards	Test Method
	Resistor	0Ω		
Operational life	±(3.0%+0.1Ω)	<100mΩ	MIL-STD-202 Method 108	125℃, at 36% of operating power, 1000H (1.5 hours “ON”, 0.5 hour “OFF”). Measurement at 24±4hours after test conclusion. Apply to rate current for 0 Ω
Electrical Characterization (T.C.R)	2S02,4S02: ±200 PPM/℃ 4S03: ＜10Ω： ±400 PPM/℃ ≥10Ω： ±200 PPM/℃	NA	GB/T 5729 4.8 JIS-C-5201 4.8 IEC 60115-1 6.2	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 （t_2） t_1: +25°C or specified room temperature t_2: Test temperature（-55℃or 125℃）
Short-time overload	±(2.0%+0.05Ω)	<50mΩ	GB/T 5729 4.13 JIS-C-5201 4.13 IEC 60115-1 8.1.4.2	Permanent resistance change after the application of a potential of 2.5 times RCWV or Max. Overload Voltage whichever less for 5 seconds.. Apply max Overload current for 0Ω

External Visual	Marking Complete , no mechanical damage		MIL-STD-883 Method 2009	Electrical test not required. Inspect device construction, marking and workmanship
Physical Dimension	Reference 5. Dimension Standards		JESD22 MH Method JB-100	Verify physical dimensions to the applicable device detail specification. Note: User(s) and Suppliers spec. Electrical test not required.
Resistance to Solvent	Marking Complete , no mechanical damage		MIL-STD-202 Method 215	Note: Add Aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents.
Terminal Strength	Not broken		JIS-C-6429	Force of 1.8kg for 60 seconds.
High Temperature Exposure (Storage)	±(1%+0.1Ω)	<100mΩ	MIL-STD-202 Method 108	1000hrs. @T=155℃.Unpowered. Measurement at 24±4 hours after test conclusion.
Temperature Cycling	±(1%+0.05Ω)	<100mΩ	JESD22 Method JA-104	1000 Cycles (-55℃ to +155℃). Measurement at 24±4 hours after test conclusion.
Biased Humidity	±(3.0%+0.05Ω)	<100mΩ	MIL-STD-202 Method 103	1000 hours 85℃,85%RH. Note: Specified conditions: 10% of operating power. Measurement at 24±4 hours after test conclusion. Apply to rate current for 0 Ω
Vibration	±(1%±0.1Ω)	<50mΩ	MIL-STD-202 Method 204	5g's for 20 min., 12cycle each of 3 orientations. Note: Use 8"*5"PCB. 031" thick 7 secure points onone long side and 2 secure points at corners of opposite sides. Parts mounted within 2' from any secure point. Test from 10-2000Hz.
Mechanical Shock	±(1%+0.1Ω)	<50mΩ	MIL-STD-202 Method 213	Half sine wave, acceleration 100g's, each three times in X, Y and Z directions, pulse width 6ms.
ESD	±(3.0%+0.1Ω)	<50mΩ	AEC-Q200-002	With the electrometer in direct contact with the discharge tip, verify the voltage setting at levels of ±500V,±1KV, ±2KV, ±4KV, ±8KV, The electrometer reading shall be within ±10% for voltages from 500V to ≦800V.
Solderability	Coverage must be over 95%.		J-STD-020E	For both leaded & SMD. Electrical test not required. Magnification 50X. Conditions: a) Method B 4hrs at 155℃ dry heat, the dip in bath with 245℃,5s. b) b) Method D: at 260℃, 30±0.5s.
Flammability	No ignition of the tissue paper or scorching or the pinewood board		UL-94	V-0 or V-1 are acceptable. Electrical test not required.
Board Flex	±(1%+0.05Ω)	<50mΩ	AEC-Q200-005	Bending 2mm(min) for 60+5sec
Flame Retardance	No flame		AEC-Q200-001	Only requested, when voltage/power will increase the surface temp to 350℃.Apply voltage from 9V to 32V. No flame; No explosion.
Resistance to Soldering Heat	±(1%+0.05Ω)	<50mΩ	MIL-STD-202 Method 210	Condition B No per-heat of samples. Dipping the resistor into a solder bath having a temperature of 260℃±5℃ and hold it for 10±1 seconds
Sulfuration test	±(5.0%+0.05Ω)		/	Soaked in industrial oil with sulfur substance 3.5% contained 105℃±3℃, 500H
	±(1.0%+0.05Ω)		ASTMB-809-95	Sulfur (Saturated vapor) : Test temp.: 50℃ Relative humidity: 86~90%RH Test time: 1000h

10. Soldering Condition

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

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

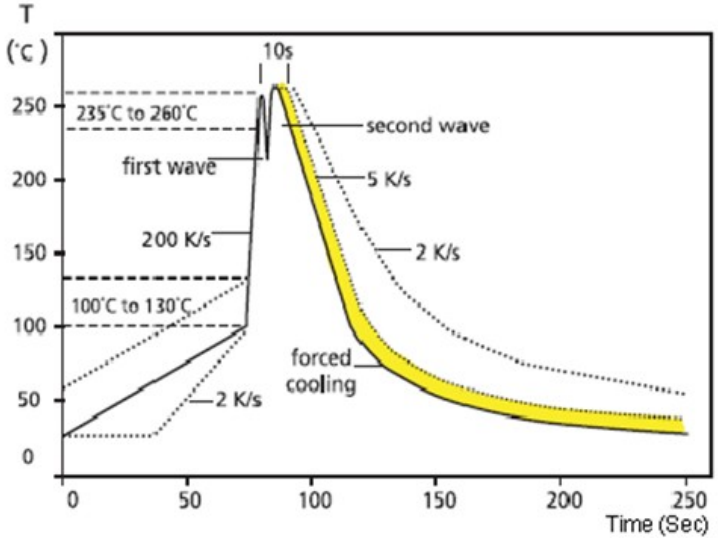


Profile Feature	Lead (Pb)-Free solder
Preheat: Temperature Min (Ts_{min}) Temperature Max (Ts_{max}) Time (Ts_{min} to Ts_{max}) (ts)	 150℃ 200℃ 60 -120 seconds
Average ramp-up rate： (Ts max to Tp)	 3℃ / second max.
Time maintained above : Temperature (T_L) Time (t_L)	 217℃ 60-150 seconds
Peak Temperature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

Allowed Re-flow times : 2 times

Remark : To avoid discoloration phenomena of chip on terminal electrodes, we suggest use N_2 Re-flow furnace .

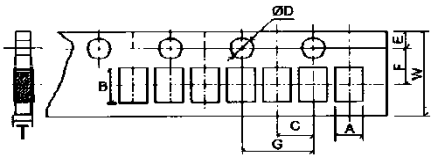
10.2 Recommend Wave Soldering Profile：(Apply to 0603 and above size)



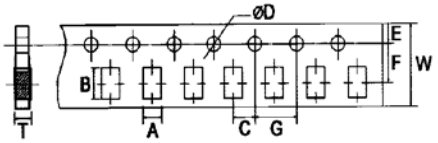
11. Packing of Surface Mount Resistors

11.1 Dimension of Paper Taping :(Unit: mm)

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
2S02	1.2	1.2	2.0	1.5	1.75	3.5	4.0	8.0	0.45
4S02	1.2	2.2	2.0	1.5	1.75	3.5	4.0	8.0	0.70

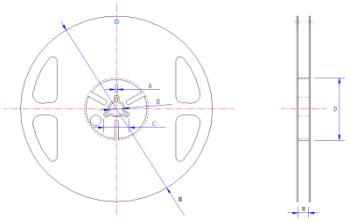


Type	A ±0.2	B ±0.2	C ±0.05	$\Phi D^{+0.1}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.1
4S03	2.0	3.60	2.0	1.5	1.75	3.5	4.0	8.0	0.83



11.2 Dimension of Reel：(Unit: mm)

Type	Qty/Reel	A±0.5	B±0.5	C±0.5	D±1.0	M±2.0	W±1.0
2S02	10,000PCS	2.0	13.0	21.0	60.0	178.0	10.0
4S02	10,000PCS	2.0	13.0	21.0	60.0	178.0	10.0
4S03	5,000PCS	2.0	13.0	21.0	60.0	178.0	10.0



12. Note

12.1. 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.

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

12.3. Storage conditions as below are inappropriate:

a. Stored in high electrostatic environment

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

12.4 This product is used for automotive electronics. UNI-ROYAL will not be responsible for any damage, expense or loss caused by the use of this specification in any special environment. This series of products are suitable for automotive electronics applications, as shown below, If there are other applications, you need to confirm with UNI-ROYAL whether they are applicable:

a. Control unit for information, entertainment, navigation, audio;

b. Control unit for comfortable doors, windows, seat;

c. Control unit for internal lighting.

13. Record

Version	Description	Page	Date	Amended by	Checked by
1	First version	1~7	Mar.20, 2018	Haiyan Chen	Nana Chen
2	Modify characteristic	4~5	Feb.18, 2019	Haiyan Chen	Yuhua Xu
3	1.Modify the reflow curve and add the wave soldering curve 2. Notes for improvement	6	Apr.30, 2020	Haiyan Chen	Yuhua Xu
4	Modify characteristic	4~5	Jun.26, 2023	Haiyan Chen	Yuhua Xu
5	Modify characteristic of ESD	5	Feb.19,2024	Song Nie	Haiyan Chen
6	1.Add AST-809-95 Sulfuration test 2.Modify the temperature coefficient	5 4	Feb.11,2025	Junying Ye	Haiyan Chen