

# DATA SHEET

**Product Name** Metal Foil Chip Resistors

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**Part Name** MS01 MS02 MS03 MS05 MS06 MS10 MS12 Series

**File No.** SMD-SP-015

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Royal Technology (Thailand) Co., Ltd.

## 1. Scope

- 1.1 This specification for approve relates to the Metal Foil Chip Resistors manufactured by UNI-ROYAL.
- 1.2 Low Resistance / TCR / EMF(Only for MnCu)/ Inductance
- 1.3 Excellent long term stability
- 1.4 down size to 0201.
- 1.5 High precision current sensing and voltage division
- 1.6 High current jumper
- 1.7 Compliant with RoHS directive.
- 1.8 Halogen free requirement.

## 2. Part No. System

Part No. includes 14 codes shown as below:

2.1 1<sup>st</sup>~4<sup>th</sup> codes: Part name. E.g.: MS01,MS02,MS03,MS05,MS06,MS10,MS12

2.2 5<sup>th</sup>~6<sup>th</sup> codes: Power rating.

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

Wattage	1/5	1/4	1/3	1/2	3/4	1	1.5	2	3W
Normal Size	W5	W4	W3	W2	07	1W	1A	2W	3W

If power rating is lower or equal than 1 watt, 5<sup>th</sup> code would be "W" and 6<sup>th</sup> code would be a number or letter.

E.g.: WA=1/10W                      W4=1/4W

2.3 7<sup>th</sup> code: Tolerance. E.g.: D=±0.5%      F=±1%                      G=±2%                      J=±5%                      K= ±10%

2.4 8<sup>th</sup>~11<sup>th</sup> codes: Resistance Value.

2.4.1 If value belongs to standard value of ≥5% series, 8<sup>th</sup> code would be zero, 9<sup>th</sup>~10<sup>th</sup> codes are significant figures of the resistance and 11<sup>th</sup> code is the power of ten.

2.4.2 If value belongs to standard value of ≤2% series, 8<sup>th</sup>~10<sup>th</sup> codes are significant figures of the resistance, and 11<sup>th</sup> code is the power of ten.

2.4.3 11<sup>th</sup> codes listed as following:

0=10<sup>0</sup>    1=10<sup>1</sup>    2=10<sup>2</sup>    3=10<sup>3</sup>    4=10<sup>4</sup>    5=10<sup>5</sup>    6=10<sup>6</sup>    J=10<sup>-1</sup>    K=10<sup>-2</sup>    L=10<sup>-3</sup>    M=10<sup>-4</sup>    N=10<sup>-5</sup>    P=10<sup>-6</sup>

2.5 12<sup>th</sup>~14<sup>th</sup> codes.

2.5.1 12<sup>th</sup> code: Packaging Type. E.g.: C=Bulk                      T=Tape/Reel

2.5.2 13<sup>th</sup> code: Standard Packing Quantity.

4=4000pcs    5=5000pcs    C=10000pcs    D=20000pcs    E=15000pcs

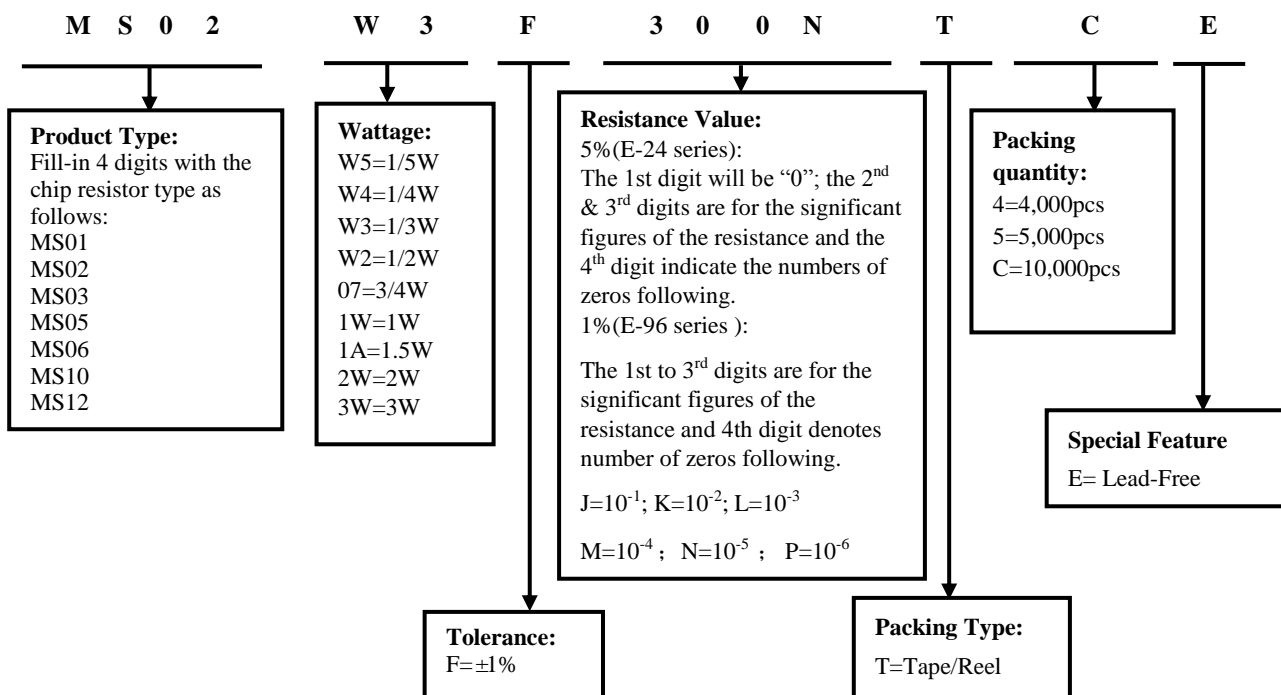
Chip Product: BD=B/B-20000pcs    TC=T/R-10000pcs

2.5.3 14<sup>th</sup> code: Special features.

E = Environmental Protection, Lead Free, or Standard type.

## 3. Ordering Procedure

(Example: MS02 1/3W ±1% 3mΩ T/R-10000)



## 4. Marking

4.1 MS01&MS02 type no marking

4.2 MS03 type products marking are 2 or 3 digits

e.g. 2 digits

10mΩ the product marking is 10.

e.g. 3 digits

“M” designates the decimal location in milli-ohms

2.5mΩ the product marking is 2M5

4.3 MS05,MS06,MS10,MS12 type products marking are 4 digits.

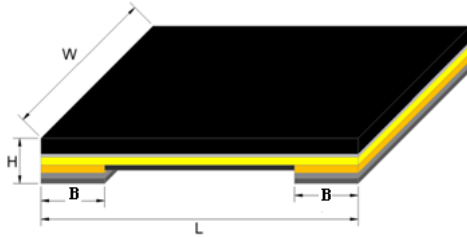
“R” designates the decimal location in ohms

e.g. 10mΩ the product marking is R010

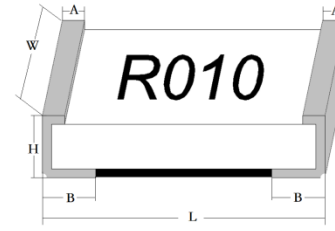
## 5. Electrical Specifications

Type	Rating Power at 70°C	Temperature coefficient (ppm/°C)	Max. Rating Current (A)	Max. Overload Current (A)	Resistance Range (mΩ)	Operating Temperature Range (°C)
					1.0% (F)	
MS01 (0201)	1/5W	±200	4.47	7.07	10 mΩ, 20mΩ	-55°C~+125°C
MS02 (0402)	1/3W	±150	11.48	18.16	2.5 mΩ, 3mΩ	
		±100	8.12	12.84	5 mΩ~25mΩ	
	1/4W	±100	3.10	4.90	26 mΩ~50mΩ	
MS03 (0603)	1/2W	±75	10	15.81	5 mΩ~9mΩ	
		±50	7.07	11.18	10mΩ~30mΩ	
MS05 (0805)	1/2W	±100	10	22.36	5mΩ~9mΩ	
		±50	6.45	14.43	12mΩ~13mΩ	
		±50	7.07	15.81	10mΩ、15mΩ~25mΩ	
	3/4W	±50	8.66	19.36	10mΩ	
MS06 (1206)	1W	±100	11.95	26.72	7mΩ	
		±100	14.14	31.62	5mΩ~6mΩ, 8mΩ~9mΩ	
		±50	10	22.36	10mΩ~25mΩ	
MS10 (2010)	1.5W	±50	12.25	27.39	10mΩ, 25mΩ, 50mΩ, 80mΩ, 100mΩ, 150mΩ	-55°C~+155°C
MS12 (2512)	2W 3W	≥10mΩ: ±50 <10mΩ: ±100	24.49	54.77	5mΩ~100mΩ	
	2W	±50	4.45	9.95	101mΩ~200mΩ	

6. Dimension (Unit: mm)



MS01,MS02



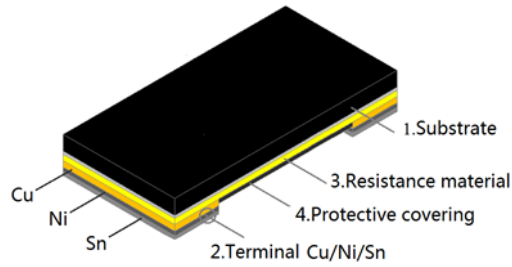
MS03,MS05,MS06,MS10,MS12

Type	Power Rating	Resistance Range	L(mm)	W(mm)	H(mm)	A(mm)	B(mm)
MS01 (0201)	1/5W	10mΩ,20mΩ	0.60±0.15	0.30±0.15	0.25±0.10	/	0.15±0.10
MS02 (0402)	1/3W	2.5mΩ,3mΩ	1.00±0.15	0.55±0.15	0.30±0.10		0.30±0.10
		5mΩ~25mΩ					0.23±0.10
	1/4W	26mΩ~50mΩ					
MS03 (0603)	1/2W	5mΩ	1.60±0.25	0.80±0.25	0.65±0.20	/	0.50±0.20
		6mΩ~30mΩ					0.40±0.20
MS05 (0805)	1/2W	5mΩ~9mΩ	2.00±0.30	1.20±0.30	0.60±0.20	≤1.0	0.65±0.15
		12mΩ~13mΩ					0.57±0.15
		10mΩ、15mΩ~25mΩ					0.42±0.15
	3/4W	10mΩ					0.42±0.15
MS06 (1206)	1W	7mΩ	3.10±0.20	1.60±0.30	0.70±0.20	≤1.0	0.86±0.25
		5mΩ~6mΩ,8mΩ~9mΩ					0.76±0.25
		10mΩ~25mΩ					0.46±0.25
MS10 (2010)	1.5W	10mΩ、25mΩ	5.00±0.20	2.50±0.25	0.70±0.20	≤1.0	1.00±0.30
		50mΩ、80mΩ、100mΩ、150mΩ					0.65±0.30
MS12 (2512)	2W 3W	5mΩ	6.35±0.20	3.20±0.25	0.70±0.20	≤1.0	1.35±0.30
		6mΩ					1.15±0.30
		7mΩ 8mΩ					1.75±0.30
		9mΩ~15mΩ					1.15±0.30
		16mΩ~100mΩ	0.90±0.30				
	2W	101mΩ~200mΩ	6.35±0.20	3.20±0.25	0.70±0.20	≤1.0	0.90±0.30

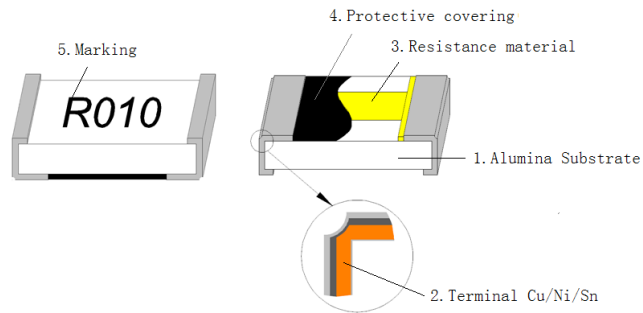
\*Please contact factory for other sizes

7. Structure

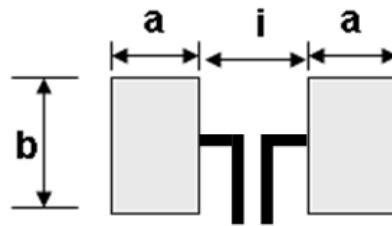
7.1MS01,MS02



7.2MS03,MS05,MS06,MS10,MS12



8. Recommend land pattern

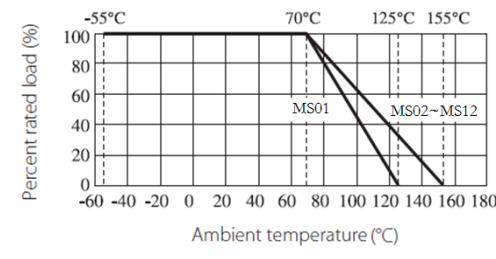


Type	Power	Resistance Range	a (mm)	b (mm)	i (mm)
MS01 (0201)	1/5W	10mΩ, 20mΩ	0.20±0.05	0.33±0.05	0.25±0.05
MS02 (0402)	1/3W	2.5mΩ, 3mΩ	0.60±0.05	0.60±0.05	0.35±0.05
		5mΩ~25mΩ	0.60±0.05	0.60±0.05	0.40±0.05
	1/4W	26mΩ~50mΩ	0.60±0.05	0.60±0.05	0.40±0.05
MS03 (0603)	1/2W	5mΩ	1.35±0.05	0.92±0.05	0.50±0.05
		6m~30mΩ	1.30±0.05	0.92±0.05	0.60±0.05
MS05 (0805)	1/2W	5mΩ~25mΩ	1.20±0.05	1.20±0.05	1.2±0.05
	3/4W	10mΩ	1.20±0.05	1.20±0.05	1.2±0.05
MS06 (1206)	1W	5mΩ~25mΩ	1.90±0.10	1.80±0.10	1.40±0.10
MS10 (2010)	1.5W	10mΩ, 25mΩ, 50mΩ, 80mΩ, 100mΩ, 150mΩ	1.40±0.10	3.00±0.10	3.60±0.10
MS12 (2512)	2W 3W	5mΩ~100mΩ	2.20±0.10	4.00±0.10	3.40±0.10
	2W	101mΩ~200mΩ	2.20±0.10	4.00±0.10	3.40±0.10

## 9. Derating Curve

The Operating Temperature Range: -55°C ~+155°C(MS02~MS12) , -55°C ~+125°C(MS01)

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below



### 9.1 Rating Current:

The following equation may be used to determine the DC (Direct Current) or AC (Alternating Current) (RMS, root mean square value) of normal rated power. However, if the result value exceeds the highest current of regulated standards, the highest normal rated power is to be used

$$I = \sqrt{P/R}$$

I = Rating current (A)

P= Rating Power (W)

R= Resistance( $\Omega$ )

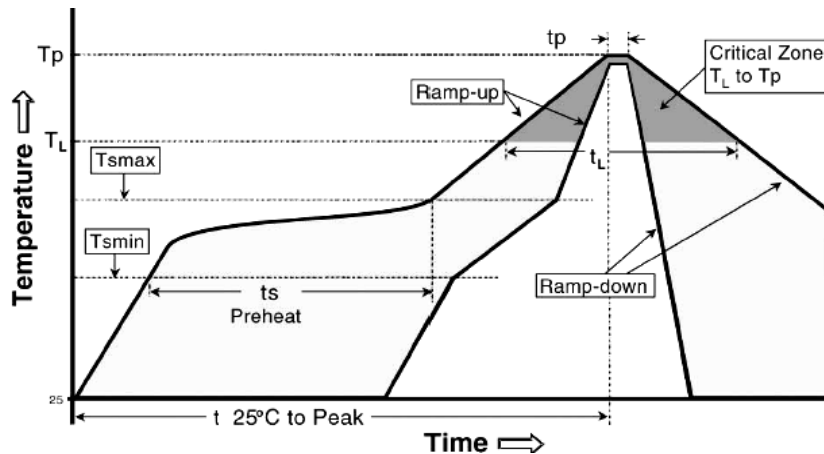
## 10. Performance Specification

Characteristic	Limits	Test Methods (GB/T5729&JIS-C-5201&IEC60115-1)
Temperature Coefficient	Refer to item 5.0	4.8 Natural resistance changes per temp. Degree centigrade $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (PPM/°C)}$ R <sub>1</sub> : Resistance Value at room temperature ( t <sub>1</sub> ) ; R <sub>2</sub> : Resistance at test temperature ( t <sub>2</sub> ) t <sub>1</sub> : +25 °C or specified room temperature t <sub>2</sub> : Test temperature ( +125°C )
Short-time overload	±(1.0%+0.001 $\Omega$ )	4.13 The number of rated power are as follows : MS01,MS02,MS03: 2.5 times of rated power MS05、MS06、MS10、MS12: 5 times of rated power For 5 Seconds
Low Temperature Storage	±(1.0%+0.001 $\Omega$ )	IEC 60068-2-1 (Aa) Lower limit temperature , for 1000H
High Temperature Exposure	±(1.0%+0.001 $\Omega$ )	MIL-STD-202 108A Upper limit temperature , for 1000H
Solderability	More than 95% coverage rate	4.17 The surface of solder must be new, smooth, clean, shiny and continuous, and without concentrated pinholes. The solder's temperature must be within 245±3 °C.Hold in hot solder 2~3seconds.
soldering heat	± (1.0%+0.005 $\Omega$ )	4.18 Dipped into solder at 260°C for 10 seconds.
Load life	± (2.0%+0.001 $\Omega$ )	4.25.1 Permanent Resistance change after 1000 hours operating at RCWV or Max.Working Voltage whichever less with duty cycle of 1.5 hours "ON" , 0.5 hour "OFF" at 70±2°C ambient.
Load life in humidity	± (2.0%+0.001 $\Omega$ )	7.9 Resistance change after 1000 hours (1.5hours "ON" , 0.5hours "OFF" ) at RCWV or Max.Working Voltage whichever less in a humidity test chamber controlled at 40±2 °C and 93% ±3% RH.

**11. Soldering Condition**

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

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

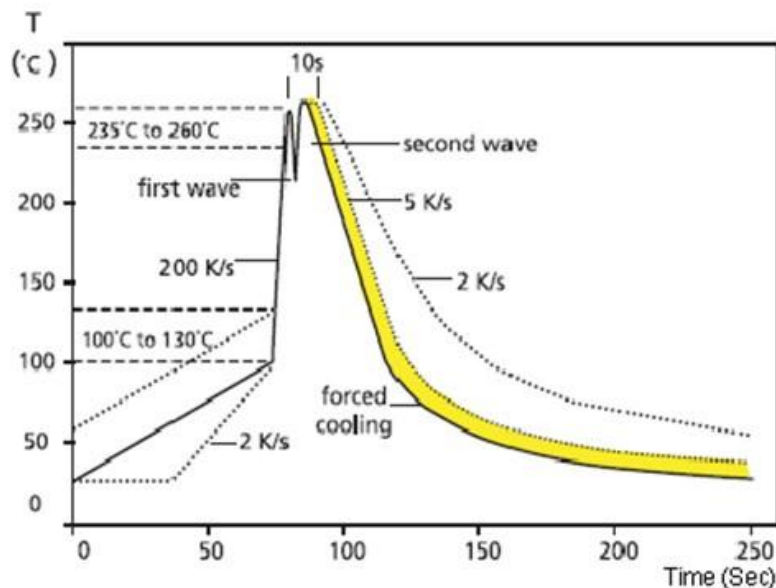


Profile Feature	Lead (Pb)-Free solder
Preheat: Temperature Min ( $T_{s_{min}}$ ) Temperature Max ( $T_{s_{max}}$ ) Time ( $T_{s_{min}}$ to $T_{s_{max}}$ ) ( $t_s$ )	150°C 200°C 60 -120seconds
Average ramp-up rate: ( $T_{s_{max}}$ to $T_p$ )	3°C / second max.
Time maintained above : Temperature ( $T_L$ ) Time ( $t_L$ )	217°C 60-150 seconds
Peak Temperature ( $T_p$ )	260°C
Time within $+0$ $-5$ °C of actual peak Temperature ( $t_p$ ) <sup>2</sup>	10 seconds
Ramp-down Rate	6°C/second max.
Time 25°C to Peak Temperature	8minutes max.

Allowed Re-flow times : 2 times

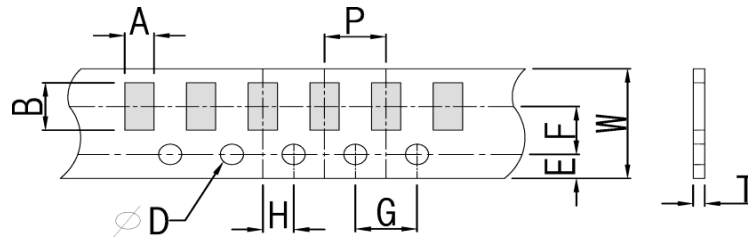
Remark : To avoid discoloration phenomena of chip on terminal electrodes, we suggest use N2 Re-flow furnace .

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



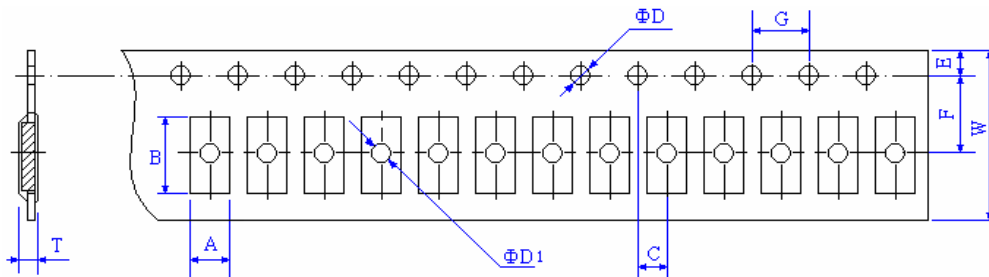
12. Packing of Surface Mount Resistors

12.1 Carrier Dimensions:(Unit: mm)



Unit: mm

Type	W	P	E	F	$\phi D$	G	H	A	B	T
MS01	8.0±0.30	2.0±0.10	1.75±0.10	3.5±0.10	1.50+0.1/-0	4.0±0.10	2.0±0.10	0.40±0.20	0.70±0.20	0.45±0.05
MS02								0.65±0.20	1.10±0.20	0.42±0.05
MS03		4.0±0.10						1.18±0.20	1.98±0.20	0.75±0.20
MS05								1.65±0.20	2.40±0.20	0.81±0.10
MS06								2.00±0.20	3.60±0.20	

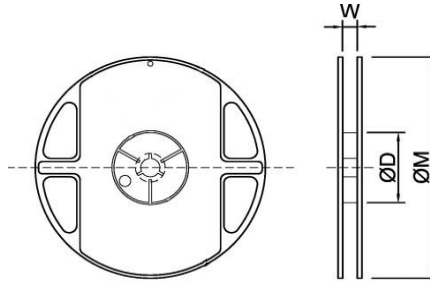


Unit: mm

Type	A ± 0.2	B ± 0.2	C ± 0.05	$\phi D_{-0}^{+0.1}$	$\phi D1_{-0}^{+0.25}$	E ± 0.1	F ± 0.05	W ± 0.2	T ± 0.10	G ± 0.1
MS10	2.90	5.60	2.00	1.50	1.50	1.75	5.50	12.00	1.00	4.00
MS12	3.50	6.70	2.00	1.50	1.50	1.75	5.50	12.00	1.00	4.00



## 12.2 Dimension of Reel : (Unit: mm)



Type	PCS /Reel	φD	W	φM
MS01(0201)	10,000	60±2	9.0±2	178±5
MS02(0402)	10,000			
MS03(0603)	5,000			
MS05(0805)	5,000			
MS06(1206)	5,000			
MS10(2010)	4,000		13.8	
MS12(2512)	4,000			

## 13. Note

13.1 UNI-ROYAL recommend the storage condition temperature:  $25 \pm 5^{\circ}\text{C}$ , humidity :  $60 \pm 20\%$ .  
(Put condition for individual product).

Even under UNI-ROYAL recommended storage condition, solderability of products over 1 year old. (Put condition for each product) may be degraded.

13.2 Store / transport cartons in the correct direction, which is indicated on a carton as a symbol.

Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

13.3 Product performance and soldered connections may deteriorate if the products are stored in the following places:

- Storage in high Electrostatic.
- Storage in direct sunshine、rain and snow or condensation.
- Where the products are exposed to sea winds or corrosive gases, including  $\text{Cl}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ ,  $\text{SO}_2$ ,  $\text{NO}_2$ , Br etc.

## 14. Record

Version	Description	Page	Date	Amended by	Checked by
1	First version	1~7	Mar.20, 2018	Haiyan Chen	Nana Chen
2	1. Add MS03 specifications 2. Modify dimension resistance detail	1~7 3~4	July.12, 2018	Haiyan Chen	Nana Chen
3	1. Delete unrecommended specifications and blocks	1~7	Dec.4, 2018	Dongmei Liao	Shuai Wu
	2. Add 1.6 items and modify 2.51, 2.52, 2.53, 3	2			
	3. Add 5.0 item white code diagram	3			
	4. Add 10.3 items of 1000-grain weight data	3			
	5. Delete the 9.0 performance item Rapid change of temperature、Biased Humidity、Leaching	6 5			
4	Change the resistance range	3	Jan.24,2019	Shuai Wu	Qingfeng Song
5	Modify the product name	1~7	Feb.16, 2019	Haiyan Chen	Yuhua Xu
6	Change the resistance range and temperature coefficient	3	Apr.24, 2019	Haiyan Chen	Yuhua Xu
7	Add the MS12 2W power	3	Sep.11, 2019	Haiyan Chen	Yuhua Xu
8	Modify the reflow curve and add the wave soldering curve	5	Apr.29, 2020	Haiyan Chen	Yuhua Xu
9	Add the MS01,MS02,MS03	1~9	Jul.01, 2020	Haiyan Chen	Yuhua Xu
10	Modify the MS05 Power	3~5,8	Nov.11, 2020	Haiyan Chen	Yuhua Xu
11	1.Modify the MS05, MS06 temperature coefficient	3	Aug.25, 2021	Haiyan Chen	John Zhao
	2.Modify the MS05 resistance range	3~4			
12	1. Delete MS03 1/3W power 2.Add MS06 9mR resistance, cancel MS06 27mR resistance	3~4	Sep.06, 2021	Haiyan Chen	Yuhua Xu
13	Modify the temperature coefficient test conditions	6	Oct.26, 2022	Haiyan Chen	Yuhua Xu
14	Add the MS10,MS12	1~9	Mar.28, 2024	Haiyan Chen	Yuhua Xu

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