

ROYALOHM

C O N F I D E N T I A L D O C U M E N T

SPECIFICATION FOR APPROVAL

SPARK

Description : Thick Film Chip Resistors (Terminal Lead Free)

Royalohm Part no.:

0402WGxxxxxTEE	(RMC 1/16W (0402) +/- 1% & 5%)
0603WAxxxxxT5E	(RMC 1/10W (0603) +/- 1% & 5%)
0805W8xxxxxT5E	(RMC 1/8W (0805) +/- 1% & 5%)
1206W4xxxxxT5E	(RMC 1/4W (1206) +/- 1% & 5%)
1206W8xxxxxT5G	(RMC 1/8W (1206) +/- 1% & 5%)
1210W3xxxxxT5E	(RMC 1/3W (1210) +/- 1% & 5%)
2010W2xxxxxT4E	(RMC 1/2W (2010) +/- 1% & 5%)
25121WxxxxxT4E	(RMC 1W (2512) +/- 1% & 5%)

Approved by

Parts corresponding to RoHS Compliant: 2005-Apr.-1

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Approved	Checked	Prepared
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Issued Date: 2013/08/15

Customer: SPARK

1. Scope:

This specification for approval relates to Thick Film Chip Resistors (Terminal Lead Free) manufactured by ROYALOHM 's specifications.

2. Type designation:

The type designation shall be in the following form:

Ex.

Type	Power Rating	Resistance tolerance	Nominal Resistance
RMC 0402	1/16W	F, J	1K Ω
RMC 0603	1/10W		
RMC 0805	1/8W		
RMC 1206	1/4W		
RMC 2010	3/4W-S		
RMC 2512	1 W		

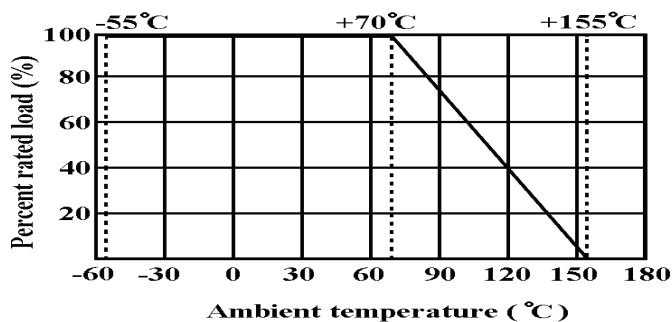
3. Ratings:

Type	RMC 0402	RMC 0603	RMC 0805	RMC 1206	RMC 2010	RMC 2512
Power Rating	0.0625W (1/16W)	0.10W (1/10W)	0.125W (1/8W)	0.25W (1/4W)	0.75W (3/4W-S)	1W
Max. Working Voltage	50 V	50 V	150 V	200 V	200 V	200 V
Max. Overload Voltage	100 V	100 V	300 V	400 V	400 V	400 V
Temperature Range	-55°C ~ +155°C					
Ambient Temperature	70 °C					

3.1 Power rating:

Resistors shall have a power rating based on continuous load operation at an ambient temperature of 70 °C . For temperature in excess of 70 °C , The load shall be derate as shown in figure 1.

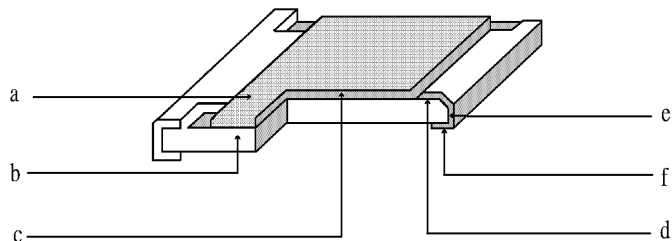
Figure 1



3.2 Nominal Resistance

Effective figures of nominal resistance shall be in accordance with E-24 and E-96 series for 1 % and E-24 series for 2 % and 5 %

4. Construction :



a. Protective coating : Epoxy

b. Al₂ O₃ high purity alumina substrate : Al 96 %

c. Resistive element : RuO₂, Ag, Glass

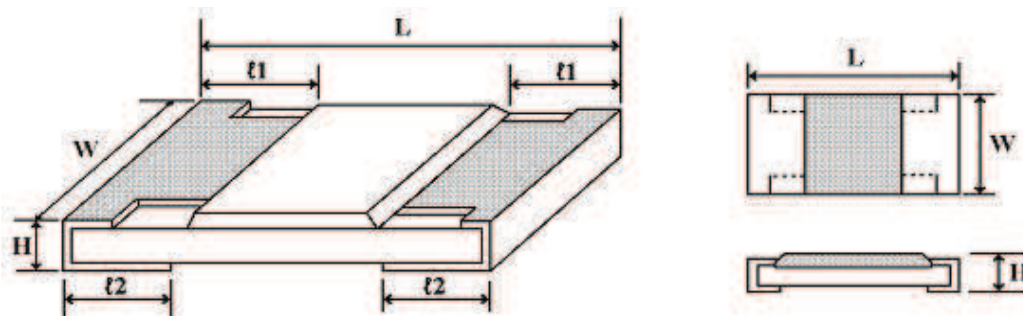
d. Termination (Inner) : Ag/Pd

e. Termination (Between) : Ni plating film

f. Termination (Outer) : Sn plating film

Thick Film Chip Resistors (Terminal Lead Free)

5. Power rating and dimensions



Dimension :

Type	Dimension (mm)				
	L	W	H	ℓ_1	ℓ_2
RMC 0402	1.00 ± 1.0	0.50 ± 0.05	0.35 ± 0.05	0.20 ± 0.10	0.25 ± 0.10
RMC 0603	1.60 ± 0.10	$0.80 + 0.15$ $- 0.10$	0.45 ± 0.10	0.30 ± 0.20	0.30 ± 0.20
RMC 0805	2.00 ± 0.15	$1.25 + 0.15$ $- 0.10$	0.55 ± 0.10	0.40 ± 0.20	0.40 ± 0.20
RMC 1206	3.10 ± 0.15	$1.55 + 0.15$ $- 0.10$	0.55 ± 0.10	0.45 ± 0.20	0.45 ± 0.20
RMC 1210	3.10 ± 0.10	2.60 ± 0.15	0.55 ± 0.10	0.50 ± 0.25	0.50 ± 0.20
RMC 2010	5.00 ± 0.10	2.50 ± 0.15	0.55 ± 0.10	0.60 ± 0.25	0.50 ± 0.20
RMC 2512	6.35 ± 0.10	3.20 ± 0.15	0.55 ± 0.10	0.60 ± 0.25	0.50 ± 0.20

Power Rating :

Type	Power Rating at 70 °C	Tolerance %	Resistance Range	Standard Series
RMC 0402	0.0625W (1/16W)	Jumper	< 50mΩ	E-96 E-24
		± 1	1Ω ~ 1MΩ	
		± 5	1Ω ~ 10MΩ	
RMC 0603	0.10W (1/10W)	Jumper	< 50mΩ	E-96 E-24
		± 1	1Ω ~ 1MΩ	
		± 5	1Ω ~ 10MΩ	
RMC 0805	0.125W (1/8W)	Jumper	< 50mΩ	E-96 E-24
		± 1	1Ω ~ 1MΩ	
		± 5	1Ω ~ 10MΩ	
RMC 1206	0.125W (1/8W)	Jumper	< 50mΩ	E-96 E-24
		± 1	1Ω ~ 1MΩ	
		± 5	1Ω ~ 10MΩ	
RMC 1206	0.25W (1/4W)	Jumper	< 50mΩ	E-96 E-24
		± 1	1Ω ~ 1MΩ	
		± 5	1Ω ~ 10MΩ	
RMC 1210	0.33W (1/3W)	Jumper	< 50mΩ	E-96 E-24
		± 1	1Ω ~ 1MΩ	
		± 5	1Ω ~ 10MΩ	
RMC 2010	0.75W (3/4W-S)	Jumper	< 50mΩ	E-96 E-24
		± 1	1Ω ~ 1MΩ	
		± 5	1Ω ~ 10MΩ	
RMC 2512	1W	Jumper	< 50mΩ	E-96 E-24
		± 1	1Ω ~ 1MΩ	
		± 5	1Ω ~ 10MΩ	

Thick Film Chip Resistors (Terminal Lead Free)

6. Marking :

6.1 Resistors

A. $\pm 5\%$ Tolerance 0603, 0805, 1206, 2010, 2512: the first two digits are significant figures of resistance and the third one denoted number of zeros.

Ex.

	333	
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 33K Ω

B. For ohmic values below 10 Ω

Ex.

	2R2	
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 2.2 Ω

C. For E-96 series [$\pm 1\%$ (F) tolerance] in 0603 size 3 digit system (due to space restrictions) please refer to page 8 for coding formula

Ex.

	02C	
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 10.2K Ω

D. $\pm 1\%$ Tolerance 0805, 1206, 2010, 2512 : 4 Digits, the first three digits are significant figures of resistance and the fourth digit denoted number of zeros. Letter "R" is for decimal point.

Ex.

	2701	
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 2.7K Ω

E. Chip Resistors type 0402 No marking

6.2 Labels

Label shall be marked with the following item :

- A. Nominal Resistance and Resistance Tolerance
- B. Power Rating and Size
- C. Quantity
- D. Part No.
- E. P.O.No.
- F. Lot No.

Ex.

ROYALOHM			
CHIP RESISTOR			
RESISTANCE:	332K	Ω	$\pm 1\%$
WATTAGE:	1/10W	SIZE:	0603
QUANTITY:	5,000	PCS	Pb-Free
PART NO.:			
P.O.NO.:			
LOT NO. :	825723	0603WSAF3323T5E	
			

Remark : **For 0603** $\pm 1\%$: Label is 332K, value is 332K Ω , marking is 51D

$\pm 5\%$: Label is 330K, value is 330K Ω , marking is 334

$\pm 1\%$: Label is 330K, value is 330K Ω , marking is 3303

Thick Film Chip Resistors (Terminal Lead Free)

Mutiplier Code :

Code	A	B	C	D	E	F	G	H	X	Y	Z
Multiplier	⁰ 10	¹ 10	² 10	³ 10	⁴ 10	⁵ 10	⁶ 10	⁷ 10	⁻¹ 10	⁻² 10	⁻³ 10

Coding

Formula

Example :

$$10.2K\Omega = \begin{matrix} 102 \\ \downarrow \\ 02 \end{matrix} \times \begin{matrix} 10 \\ \downarrow \\ C \end{matrix} \Omega = 02C$$

$$33.2\Omega = \begin{matrix} 332 \\ \downarrow \\ 51 \end{matrix} \times \begin{matrix} 10 \\ \downarrow \\ X \end{matrix} \Omega = 51X$$

Value	Code	Value	Code	Value	Code	Value	Code	Value	Code
100	01	162	21	261	41	422	61	681	81
102	02	165	22	267	42	432	62	698	82
105	03	169	23	274	43	442	63	715	83
107	04	174	24	280	44	453	64	732	84
110	05	178	25	287	45	464	65	750	85
113	06	182	26	294	46	475	66	768	86
115	07	187	27	301	47	487	67	787	87
118	08	191	28	309	48	499	68	806	88
121	09	196	29	316	49	511	69	825	89
124	10	200	30	324	50	523	70	845	90
127	11	205	31	332	51	536	71	866	91
130	12	210	32	340	52	549	72	887	92
133	13	215	33	348	53	562	73	909	93
137	14	221	34	357	54	576	74	931	94
140	15	226	35	365	55	590	75	953	95
143	16	232	36	374	56	604	76	976	96
147	17	237	37	383	57	619	77		
150	18	243	38	392	58	634	78		
154	19	249	39	402	59	649	79		
158	20	255	40	412	60	665	80		

*Marking for 0603 E-96 series, the resistance value that no have multiplier code indicate marking follow this:

The first two digits are significant figures of resistance and the third one denoted number of zeros and under line the marking letters.

Ex.

	<u>122</u>	
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1.2KΩ

Thick Film Chip Resistors (Terminal Lead Free)				
7. Performance specification :				
Characteristics	Limits	Test Methods (JIS C 5201-1)		
Insulation resistance	1,000 MΩ or more	Apply 500V DC between protective coating and termination for 1 min, then measure (Sub-clause 4.6)		
Dielectric withstanding voltage	No evidence of flashover mechanical damage, arcing or insulation break down	Apply 500V AC between protective coating and termination for 1 minute (Sub-clause 4.7)		
Temperature coefficient	1Ω-10Ω : ± 400 PPM/°C 11Ω-100Ω : ± 200 PPM/°C >100Ω : ± 100 PPM/°C	Natural resistance change per temp. degree centigrade. $\frac{R_2-R_1}{R_1(t_2-t_1)} \times 10^6 \quad (\text{PPM}/^\circ\text{C})$ R1: Resistance value at room temperature (t1) R2: Resistance value at room temp. plus 100 °C (t2) (Sub-clause 4.8)		
Short time overload	Resistance change rate is ± 5% (2.0% + 0.1 Ω) Max. ± 1% (1.0% + 0.1 Ω) Max.	Permanent resistance change after the application of a potential of 2.5 times RCWV for 5 seconds (Sub-clause 4.13)		
Solderability	95 % coverage Min.	Test temperature of solder : 245 ± 3°C Dipping them solder : 2-3 seconds (Sub-clause 4.17)		
Soldering Heat	Eleltrical characteristics shall be satisf Without distinct deformation in appearance.	<u>Solder bath method</u> Pre-heat : 100 to 105 °C , 30 ± 5 sec. Temperature : 265 ± 3°C , 5 +1/-0 sec. <u>Reflow soldering method</u> Peak : 250 +5/-0°C 230°C or higher 30 ± 10 Sec. <u>Soldering iron method</u> Bit temperature : 350 ± 10°C Application time of soldering iron : 3 +1/-0sec. (Sub-clause 4.18)		
Temperature cycling	± 5% (1.0% + 0.05 Ω) Max. ± 1% (0.5% + 0.05 Ω) Max.	Resistance change after continuous 5 cycles for duty cycle specified below :		
		Step	Temperature	Time
		1	-55°C ± 3°C	30 mins
		2	Room temp.	10~15 mins
		3	+155°C ± 2°C	30 mins
		4	Room temp.	10~15 mins
(Sub-clause 4.19)				

Thick Film Chip Resistors (Terminal Lead Free)

7. Performance specification :

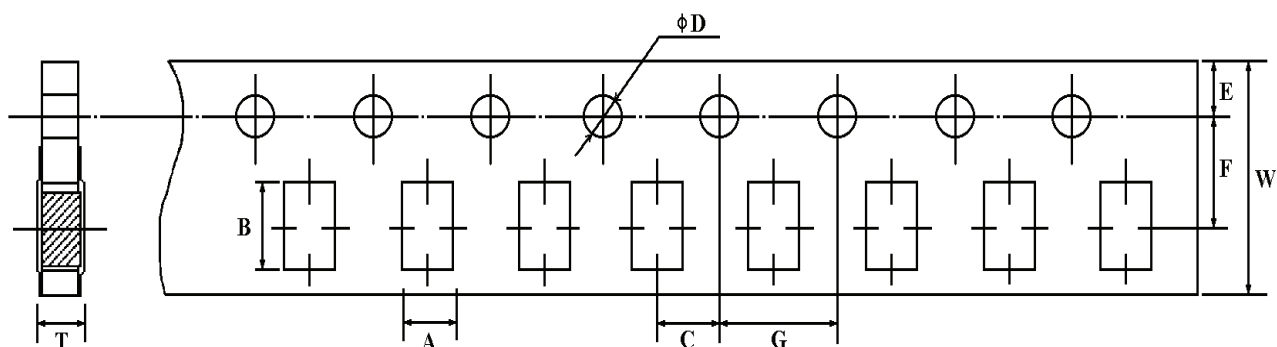
Characteristics	Limits	Test Methods (JIS C 5201-1)
Load life in humidity	Resistance change rate is $\pm 5\%$ (3.0% + 0.1 Ω) Max. $\pm 1\%$ (1.0% + 0.1 Ω) Max.	Resistance change after 1,000 hours (1.5 hours "on", 0.5 hour "off") at RCWV in a humidity chamber controlled at $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and 90 to 95 % relative humidity (Sub-clause 4.24.2.1)
Load Life	Resistance change rate is $\pm 5\%$ (3.0% + 0.1 Ω) Max. $\pm 1\%$ (1.0% + 0.1 Ω) Max.	Permanent resistance change after 1,000 hours operating at RCWV, with duty cycle of (1.5 hours"on", 0.5 hour"off") at $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ambient (Sub-clause 4.25.1)
Terminal bending	$\pm (1.0\% + 0.05 \Omega)$ Max.	Twist of Test Board : $Y/X = 5/90$ mm for 10 seconds (Sub-clause 4.33)

Thick Film Chip Resistors (Terminal Lead Free)

8. Packing specification :

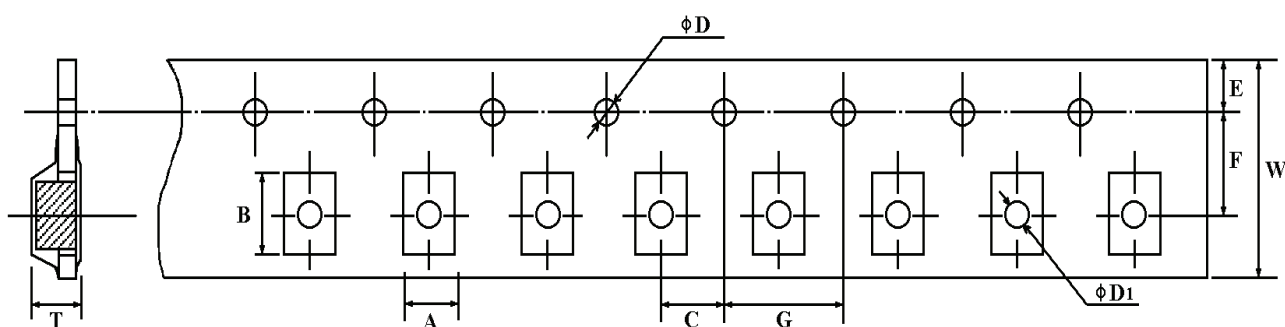
* Taping Dimension (mm)

A. Paper taping



Type	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.05$	$\phi D +0.1$ - 0	$E \pm 0.1$	$F \pm 0.05$	$G \pm 0.1$	$W \pm 0.2$	$T \pm 0.1$
RMC 0402	0.65	1.15	2.0	1.5	1.75	3.5	4.0	8.0	0.45
RMC 0603	1.10	1.90	2.0	1.5	1.75	3.5	4.0	8.0	0.67
RMC 0805	1.65	2.40	2.0	1.5	1.75	3.5	4.0	8.0	0.81
RMC 1206	2.00	3.60	2.0	1.5	1.75	3.5	4.0	8.0	0.81
RMC 1210	2.80	3.50	2.0	1.5	1.75	3.5	4.0	8.0	0.75

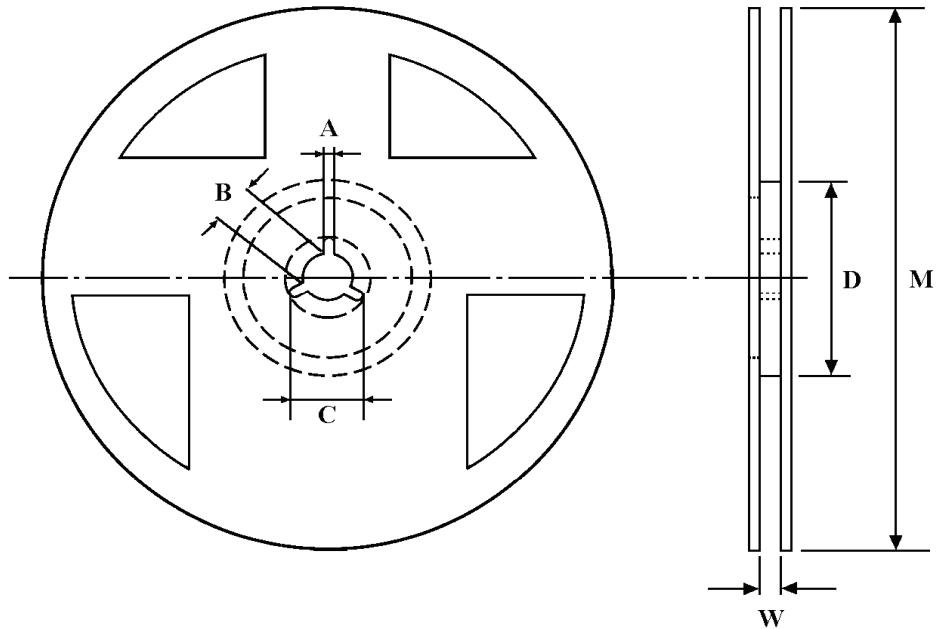
B. Embossed taping



Type	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.05$	$\phi D +0.1$ - 0	$E \pm 0.1$	$F \pm 0.05$	$G \pm 0.1$	$W \pm 0.2$	$\phi D1 +0.1$ - 0	$T \pm 0.1$
RMC 2010	2.90	5.60	2.0	1.5	1.75	5.5	4.0	12.0	1.5	1.0
RMC 2512	3.5	6.7	2.0	1.5	1.75	5.5	4.0	12.0	1.5	1.0

Thick Film Chip Resistors (Terminal Lead Free)

* Reel Dimension (mm)



Type	Packaging	Quantity Per Reel	A ± 0.5	B ± 0.5	C ± 0.5	D ± 1	M ± 2	W ± 1
RMC 0402	Paper	15,000 pcs.	2	13	21	60	178	10
RMC 0603	Paper	5,000 pcs.	2	13	21	60	178	10
RMC 0805	Paper	5,000 pcs.	2	13	21	60	178	10
RMC 1206	Paper	5,000 pcs.	2	13	21	60	178	10
RMC 1210	Paper	5,000 pcs.	2	13	21	60	178	10
RMC 2010	Embossed	4,000 pcs.	2	13	21	60	178	13.8
RMC 2512	Embossed	4,000 pcs.	2	13	21	60	178	13.8

Remark : ϕ M (1) 10,000Pcs/Reel = 255 or 20,000Pcs/Reel = 330

(2) RMC 0402: 20,000Pcs/Reel = 255 or 40,000pcs/Reel = 330

(3) For paper taping, can pack T/R-1,000pcs

Part Number System

Explanation of Part Number System Thick Film Chip Resistors (Terminal Lead Free)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	8	0	5	W	8	J	0	1	2	J	T	E	E

Product Type:

Fill-in these 4 digits with the Chip resistor types as follows:

0402
0603
0805
1206
1210
2010
2512

Wattage:

Fill-in these 2 digits with the codes as follows:

Normal size:

WG = 1/16W
WA = 1/10W
W8 = 1/8W
W4 = 1/4W
W2 = 1/2W
1W = 1W

Small size:

SA = 1/10W-S
S8 = 1/8W-S
S4 = 1/4W-S
S3 = 1/3W-S
07 = 3/4W-S

Special:

WH = 1/32W

Tolerance:

F ~ ± 1%
G ~ ± 2%
J ~ ± 5%
0 ~ Jumper

Resistance Value:

1. E-24 series: the 1st digit is "0", the 2nd & 3rd digits are for the significant figures of the resistance and the 4th indicate the number of zeros following;
2. E-96 series: the 1st to 3rd digits are for the significant figures of the resistance and the 4th digit indicate the number of zeros following.

Decimal point is expressed :

"J"~ 0.1,"K"~0.01,"L"~0.001

Ex: 2Ω26 ~226K, 226Ω ~2260

Packing Quantity:

1 = 1,000pcs
2 = 2,000pcs
3 = 3,000pcs
4 = 4,000pcs
5 = 5,000pcs
A = 500pcs
B = 2,500pcs
C = 10,000pcs
D = 20,000pcs
E = 15,000pcs
G = 25,000pcs
H = 50,000pcs

Packing Type:

T = T/R Packing
B = Bulk in Poly-bag
C = Bulk in cassette

Special Feature:

0 = NIL
E = Lead Free

Sample :	RMC	1/16W	(0402)	+/- 5%	1.2Ω	T/R--15000	→	0402WGJ012JT5E
	RMC	1/10W	(0603)	+/- 5%	1.2Ω	T/R--5000	→	0603WAJ012JT5E
	RMC	1/8W	(0805)	+/- 5%	1.2Ω	T/R--5000	→	0805W8J012JT5E
	RMC	1/8W	(1206)	+/- 5%	1.2Ω	T/R--5000	→	1206W8J012JT5E
	RMC	1/4W	(1206)	+/- 5%	1.2Ω	T/R--5000	→	1206W4J012JT5E
	RMC	1/3W	(1210)	+/- 5%	1.2Ω	T/R--5000	→	1210W3J012JT5E
	RMC	1/2W	(2010)	+/- 5%	1.2Ω	T/R--4000	→	2010W2J012JT4E
	RMC	1W	(2512)	+/- 5%	1.2Ω	T/R--4000	→	25121WJ012JT4E

Thick Film Chip Resistors (Terminal Lead Free)

Environment Related Substance

This product comply to EU RoHS directive, EU PAHs directive, EU PFOS directive and Halogen free.

Ozone layer depleting substances.

Ozone depleting substance are not used in our manufacturing process of these products.

This product is not manufacture using Chloro fluorocabons (CFCs), Hydrochlorofluorocarbons (HCFCs), Hydrobromofluorocarbons (HBFCs) or other ozone depleting substance in any phase of the manufacturing process.