FrelTec GmbH

Mathildenstr. 10A
82319 Starnberg
Germany

Thick Film Chip Resistor
SMD

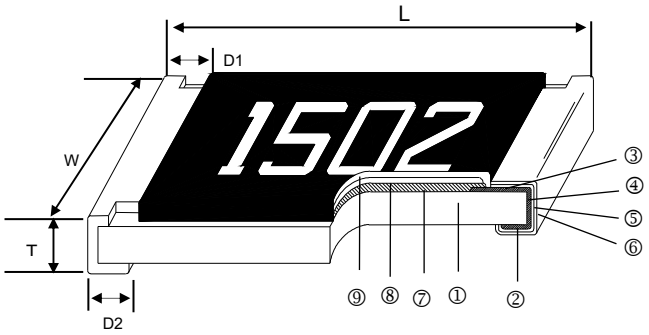
Part Number

014	05*	1001*	J*	T05**	C
Type	Size	Value	Tolerance	Packing	Power Rating
014 : SMD Thick Film Chip Resistor	0A : 01005	The last digit is the multiplier	J : ±5%	T05: Tape and reel for 5k pc (7”reel) 0603 to 1210 and 0612 size	T: 50ppm
	01 : 0201	which denotes the number of zero following	F : ±1%	T10: Tape and reel for 10k pc (7”reel) 1005, 0402 size	A: 1/32W
	02 : 0402	0000=0Ohm	D : ±0,5%	T15: Tape and reel for 15k pc (7”reel) special packing 0201 size	U: 1/20W
	03 : 0603		C : ±0,25%	H10: Paper tape and reel for 20k pc (10”reel) special packing for 0603 up to 1210 size	B: 1/16W
	05 : 0805	Example:	B : ±0,1%	H20: Paper tape and reel for 20k pc (10”reel) special packing for 0201 and 0402 size	C: 1/10W
	06 : 1206	97R6= 97,6Ohm		I20: Paper tape and reel for 20k pc (13”reel) for 0603 up to 1210 size	D: 1/8W
	10 : 1210	9760 = 976Ohm		I40: Paper tape and reel for 40k pc (13”reel) for 0201 and 0402 size	E: 1/4W
	20 : 2010	1001 = 1kOhm		E02: Tape and reel for 2k pc (7”reel) 1225 size	G: 1/3W
	25 : 2512	E24-Series is first digit “0”		E04: Tape and reel for 4k pc (7”reel) 2010 and 2512 size	H: 1/2W
	62 : 0612			K08: Embossed tape and reel for 8k pc (10”reel) special packing 2010 and 2512 size	I: 3/4W
	15 : 1225				J: 1W
			* not all combination is possible		L: 2W

This specification is applicable to lead free series thick film chip resistors.
All products according to RoHS (2015/863/EU)

SMD Thick Film Chip Resistors

THICK FILM CHIP RESISTORS



①	Alumina Substrate	④	Edge Electrode	⑦	Resistor Layer
②	Bottom Electrode	⑤	Barrier Layer	⑧	Primary Overcoat
③	Top Electrode	⑥	External Electrode	⑨	Secondary Overcoat

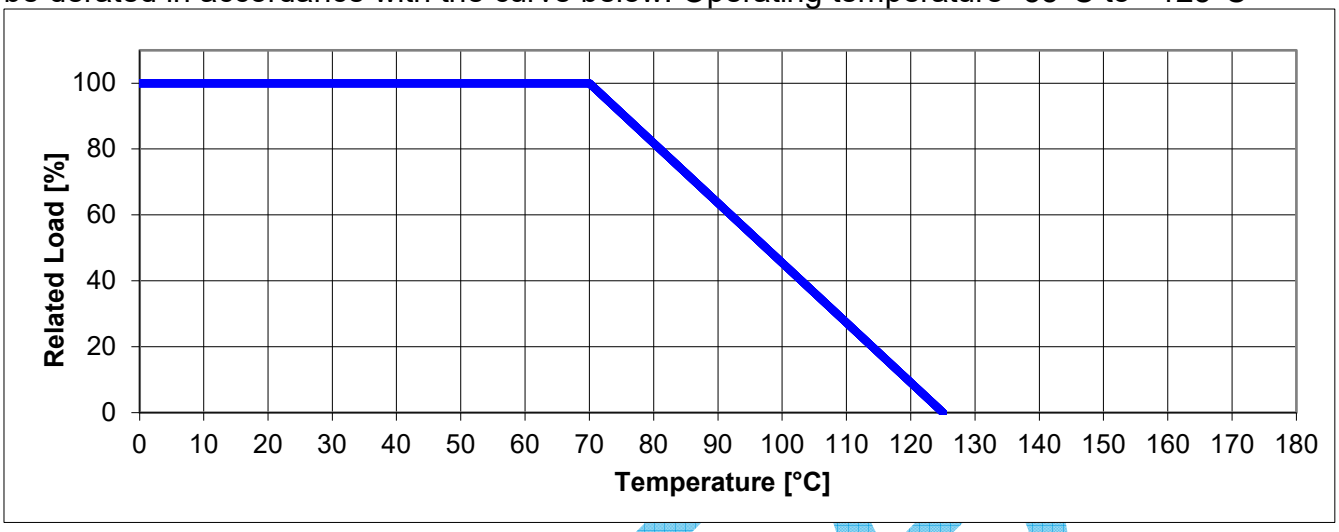
Dimensions

SIZE	L	W	T	D1	D1
01005	0,40±0,02	0,20±0,02	0,13±0,02	0,10±0,03	0,10±0,03
0201	0,60±0,03	0,30±0,03	0,23±0,03	0,15±0,05	0,15±0,05
0402	1,00±0,05	0,50±0,05	0,35±0,05	0,20±0,10	0,20±0,10
0603	1,60±0,10	0,80±0,10	0,45±0,10	0,30±0,20	0,30±0,20
0805	2,00±0,10	1,25±0,10	0,50±0,10	0,35±0,20	0,40±0,20
1206	3,10±0,10	1,55±0,10	0,55±0,10	0,50±0,25	0,50±0,20
1210	3,10±0,10	2,60±0,15	0,55±0,10	0,50±0,25	0,50±0,20
2010	5,00±0,10	2,50±0,15	0,55±0,10	0,60±0,25	0,50±0,20
2512	6,35±0,10	3,10±0,15	0,55±0,10	0,60±0,25	0,50±0,20
1225	3,20±0,15	6,45±0,15	0,90±0,15	0,60±0,30	0,80±0,25
0612	1,55±0,10	3,10±0,15	0,55±0,10	0,25±0,15	0,35±0,15

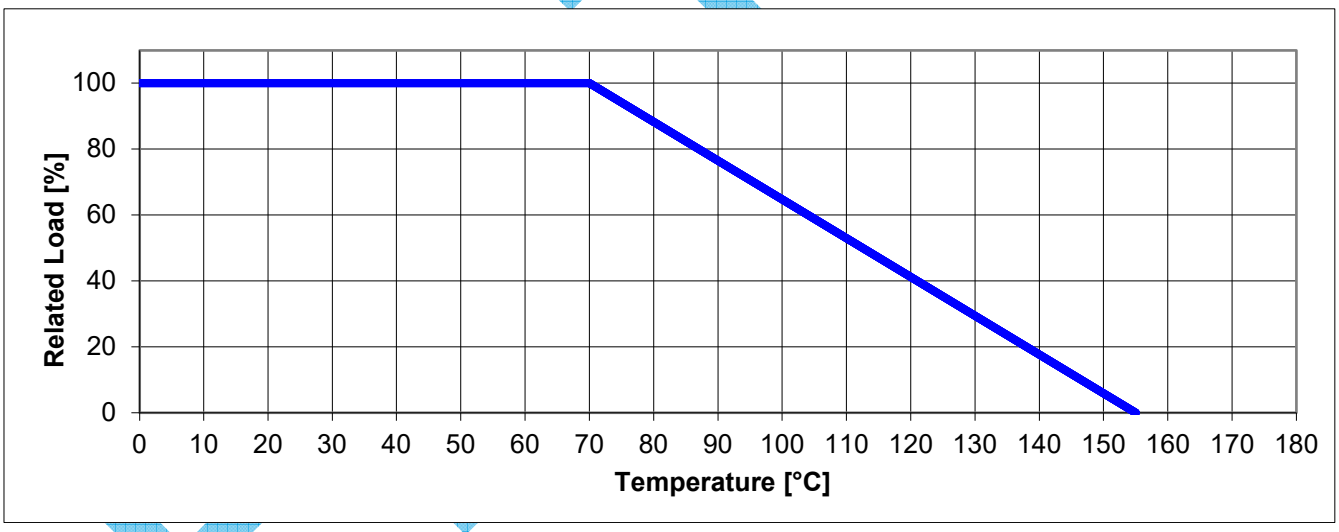
(unit: mm)

Power Derating Curve

For 01005 and 0201 size operated in ambient temperatures above 70℃, power rating must be derated in accordance with the curve below. Operating temperature -55°C to +125°C



For all other resistors operated in ambient temperatures above 70℃, power rating must be derated in accordance with the curve below. Operating temperature -55°C to +155°C



THICK FILM CHIP RESISTORS

Rating

014 *Series*

GENERAL PURPOSE CHIP RESISTORS

Standard Type

Type	Size	Power Rating at 70°C	Max. Operating Voltage	Max. Overload Voltage	Operating temperature	Temperature Coefficient [TCR; ppm/°C]	Resistance Range [Ω] F(±1%) E-96	Resistance Range [Ω] J(±5%) E-24	Jumper 50mΩ Rated Current	Jumper Resistance Value J
014 0A	01005	1/32W	15V	30V	-55 ~ +125°C	±300	10Ω≤R≤1MΩ		0,5A	50mΩ Max
014 01	0201	1/20W	25V	50V		±200	1Ω≤R≤10MΩ		1A	50mΩ Max
014 02	0402	1/16W	50V	100V	-55 ~ +155°C	±200	1Ω≤R≤9,76Ω		1A	50mΩ Max
						±100	10Ω≤R≤1MΩ			
						±200	1,02MΩ≤R≤20MΩ			
						±400	20,5MΩ≤R≤100MΩ			
014 03	0603	1/10W	75V	150V		±200	1Ω≤R≤9,76Ω		1A	50mΩ Max
						±100	10Ω≤R≤1MΩ			
						±200	1,02MΩ≤R≤20MΩ			
						±400	20,5MΩ≤R≤100MΩ			
014 05	0805	1/8W	150V	300V		±200	1Ω≤R≤9,76Ω		2A	50mΩ Max
						±100	10Ω≤R≤1MΩ			
						±200	1,02MΩ≤R≤20MΩ			
						±400	20,5MΩ≤R≤100MΩ			
014 06	1206	1/4W	200V	400V		±200	1Ω≤R≤9,76Ω		2A	50mΩ Max
						±100	10Ω≤R≤1MΩ			
						±200	1,02MΩ≤R≤20MΩ			
						±400	20,5MΩ≤R≤100MΩ			
014 10	1210	1/3W	200V	400V		±200	1Ω≤R≤9,76Ω		2,5A	50mΩ Max
						±100	10Ω≤R≤1MΩ			
						±200	1,02MΩ≤R≤20MΩ			
						±400	20,5MΩ≤R≤39MΩ			
014 20	2010	3/4W	200V	400V		±200	1Ω≤R≤9,76Ω		3,5A	50mΩ Max
						±100	10Ω≤R≤1MΩ			
						±200	1,02MΩ≤R≤20MΩ			
						±400	20,5MΩ≤R≤100MΩ			
014 25	2512	1W	250V	500V		±200	1Ω≤R≤9,76Ω		4A	50mΩ Max
						±100	10Ω≤R≤1MΩ			
						±200	1,02MΩ≤R≤20MΩ			
						±400	20,5MΩ≤R≤100MΩ			
014 62	0612	3/4W	200V	400V		±100	1Ω≤R≤1MΩ		-	
014 15	1225	2W	200V	400V		±100	10Ω≤R≤20kΩ		10A 20mΩ	20mΩ Max

High Precision -Type

Type	Size	Power Rating at 70°C	Max. Operating Voltage	Max. Overload Voltage	Operating temperature	Temperature Coefficient [TCR; ppm/°C]	Resistance Range [Ω]		
							B(±0,1%) E-96 and E-24	C(±0,25%) E-96 and E-24	D(±0,5%) E-96 and E-24
014 02	0402	1/16W	50V	100V	-55 ~ +155°C	±100	-		10Ω≤R≤1MΩ
						±200	-		1,02MΩ≤R≤10MΩ
014 03	0603	1/10W	75V	150V		±100	10Ω≤R≤1MΩ		
						±200	-	1,02MΩ≤R≤10MΩ	
014 05	0805	1/8W	150V	300V		±100	10Ω≤R≤1MΩ		
						±200	-	1,02MΩ≤R≤10MΩ	
014 06	1206	1/4W	200V	400V		±100	10Ω≤R≤1MΩ		
						±200	-	1,02MΩ≤R≤10MΩ	
014 10	1210	1/3W	200V	400V		±100	10Ω≤R≤1MΩ		
						±200	-	1,02MΩ≤R≤10MΩ	
014 20	2010	3/4W	200V	400V		±100	10Ω≤R≤1MΩ		
						±200	-	1,02MΩ≤R≤10MΩ	
014 25	2512	1W	250V	500V		±100	10Ω≤R≤1MΩ		
						±200	-	1,02MΩ≤R≤10MΩ	

50ppm -Type

Type	Size	Power Rating at 70°C	Max. Operating Voltage	Max. Overload Voltage	Operating tempera-ture	Temperature Coefficient [TCR; ppm/°C]	Resistance Range [Ω]			
							B(±0,1%) E-96 and E-24	C(±0,25%) E-96 and E-24	D(±0,5%) E-96 and E-24	F(±1%) E-96 and E-24
014 02	0402	1/16W	50V	100V	-55 ~ +155°C	±50	-		100Ω≤R≤1MΩ	
014 03	0603	1/10W	75V	150V			10Ω≤R≤1MΩ	10Ω≤R≤10MΩ		
014 05	0805	1/8W	150V	300V						
014 06	1206	1/4W	200V	400V						
014 10	1210	1/3W	200V	400V						
014 20	2010	3/4W	200V	400V						
014 25	2512	1W	250V	500V						

High Power and Ultra High Power -Type

Type	Size	Power Rating at 70°C	Max. Operating Voltage	Max. Overload Voltage	Operating tempera-ture	Temperature Coefficient [TCR; ppm/°C]	Resistance Range [Ω]			Jumper 20mΩ Rated Current
							D(±0,5%) E-96 E-24	**F(±1%)** E-96 E-24	**J(±5%)** E-24	
014 02	0402	1/8W	50V	100V	-55 ~ +155°C	±200	-	1Ω≤R≤9,76Ω		1,5A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		
014 03	0603	1/4W	75V	150V		±200	-	1Ω≤R≤9,76Ω		2A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		
014 05	0805	1/3W	150V	300V		±200	-	1Ω≤R≤9,76Ω		2,5A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		
014 06	1206	1/3W	200V	400V		±200	-	1Ω≤R≤9,76Ω		3,5A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		
		1/2W				±200	-	1Ω≤R≤9,76Ω		3,5A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		
014 10	1210	1/2W	200V	400V		±200	-	1Ω≤R≤9,76Ω		5A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		
		3/4W				±200	-	1Ω≤R≤9,76Ω		5A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		
014 20	2010	1W	200V	400V		±200	-	1Ω≤R≤9,76Ω		6A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		
014 25	2512	2W	250V	500V		±200	-	1Ω≤R≤9,76Ω		7A
						±100	10Ω≤R≤1MΩ	10Ω≤R≤1MΩ		

Operating Voltage=√(P*R) or Max. operating voltage listed above, whichever is lower.
Overload Voltage=2,5*√(P*R) or Max. overload voltage listed above, whichever is lower.

10005 to 0402 no marking
Jumper "0" marking

E96+E24 (1%) 0805 to 2512 and 1225

4 digit marking, first three digits marking are significant figures; forth digit is multiplier (10^X).

Examples: 1542 = 154x10²=15.400 Ohm=15,4kOhm

E24 (5%) 0603 to 2512 and 1225

3 digit marking, first two digits marking are significant figures; third digit is multiplier (10^X).

Examples: 512 = 51×10² = 5,1kOhm

1% E24 is different to E96 then 3 digit marking like above for 5%

E96 (1%) 0603 3 digit marking,

examples: 12C (Table below) = 130×10² = 13kOhm

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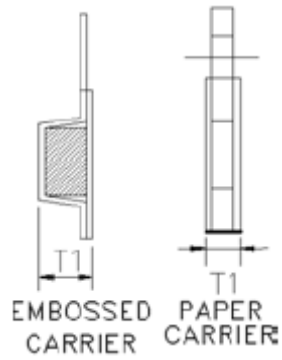
3 digit Marking Table

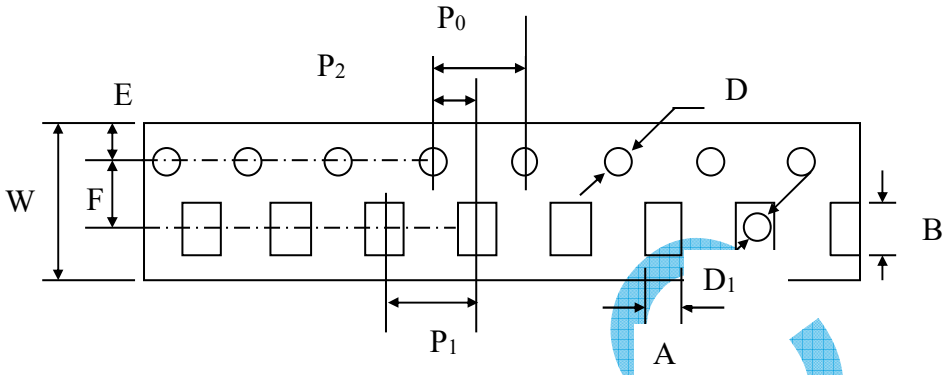
Code	E96	Code	E96	Code	E96	Code	E96
01	100	25	178	49	316	73	562
02	102	26	182	50	324	74	576
03	105	27	187	51	332	75	590
04	107	28	191	52	340	76	604
05	110	29	196	53	348	77	619
06	113	30	200	54	357	78	634
07	115	31	205	55	365	79	649
08	118	32	210	56	374	80	665
09	121	33	215	57	383	81	681
10	124	34	221	58	392	82	698
11	127	35	226	59	402	83	715
12	130	36	232	60	412	84	732
13	133	37	237	61	422	85	750
14	137	38	243	62	432	86	768
15	140	39	249	63	442	87	787
16	143	40	255	64	453	88	806
17	147	41	261	65	464	89	825
18	150	42	267	66	475	90	845
19	154	43	274	67	487	91	866
20	158	44	280	68	499	92	887
21	162	45	287	69	511	93	909
22	165	46	294	70	523	94	931
23	169	47	301	71	536	95	953
24	174	48	309	72	549	96	976

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

SPECIFICATION

Tape And Reel Package



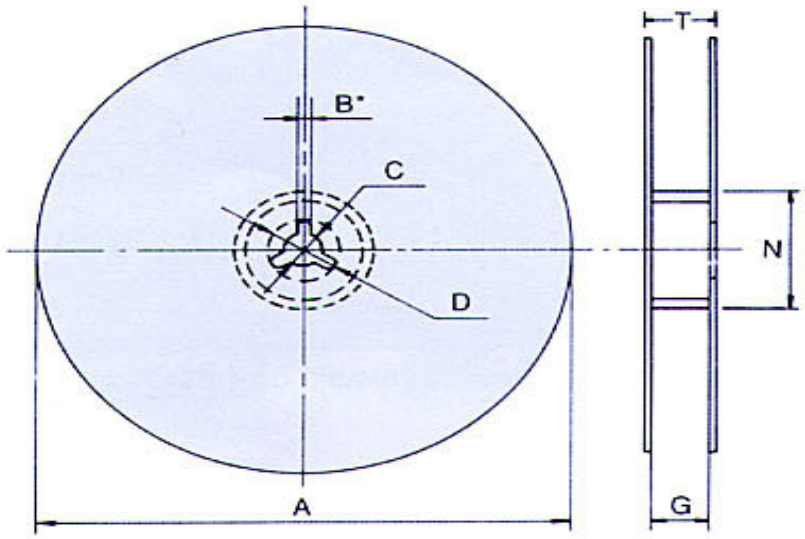


P_0: Accumulated dimensional tolerance 40±0,2mm

In Accordance with EIA RS-481

Packing	Size	A	B	W	E	F	P_0	P_1	P_2	D	D_1	T_1
Paper Tape	01005	0,24±0,05	0,45±0,05	8,0±0,2	1,75±0,10	3,50±0,05	4,00±0,10	2,00±0,05	2,00±0,05	1,50+0,1 -0	-	0,40±0,10
	0201	0,38±0,05	0,68±0,05									0,42±0,20
	0402	0,65±0,10	1,15±0,10									0,45±0,10
	0603	1,10±0,10	1,90±0,10					4,00±0,05				0,70±0,10
	0805	1,60±0,10	2,40±0,20									0,85±0,1
	1206	1,90±0,10	3,50±0,20									
	1210	2,90±0,10	3,50±0,20									
	0602	1,9±0,10	3,50±0,20									
Embossed Tape	2010	2,8±0,20	5,4±0,20	12,0±0,3		5,5±0,05	4,00±0,10	4,00±0,10		1,55+0,05	1,5+0,25 -0	1,2+0
	2512	3,5±0,20	6,7±0,20									
	1225	3,38±0,10	6,68±0,10			5,5±0,1						1,45±0,20

Reel size



Symbol		Reel Type / Tape	A	N	C	G	T
Dimension	Paper Tape	7” reel for 8 mm Tape	178,5±1,5	60,0+1 -0	13,0±0,2	9,0±0,5	12,5±0,5
		10” reel for 8 mm Tape	254±1,0	100,0±0,5	13,0±0,2	9,5±0,5	13,5±0,5
		13” reel for 8 mm Tape	330±1,0	100,0±0,5	13,0±0,2	9,5±0,5	13,5±0,5
	Embossed Tape	7” reel for 12 mm Tape	178,5±1,5	60,0+1 -0	13,0±0,5	13,0±0,5	15,5±0,5
		10” reel for 12 mm Tape	250±1	62±0,5	13,0±0,5	12,5±0,5	16,5±0,5

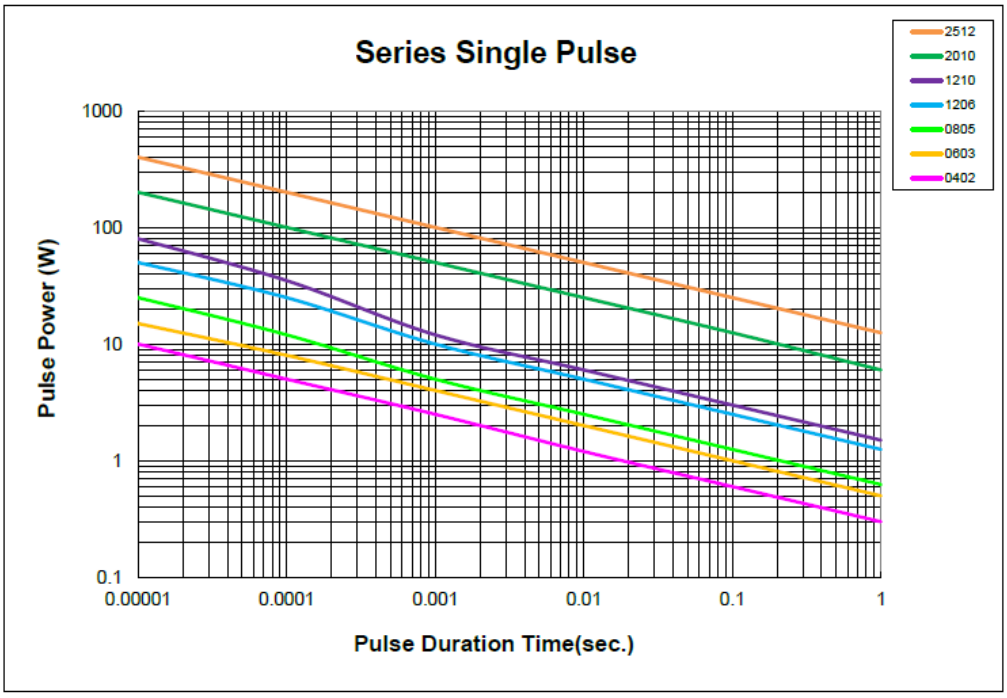
in mm

Stock period

The Temperature condition must be controlled at 22± 6 °C, the R.H. must be controlled at less than 80%. The stock can maintain quality level in 12 month.

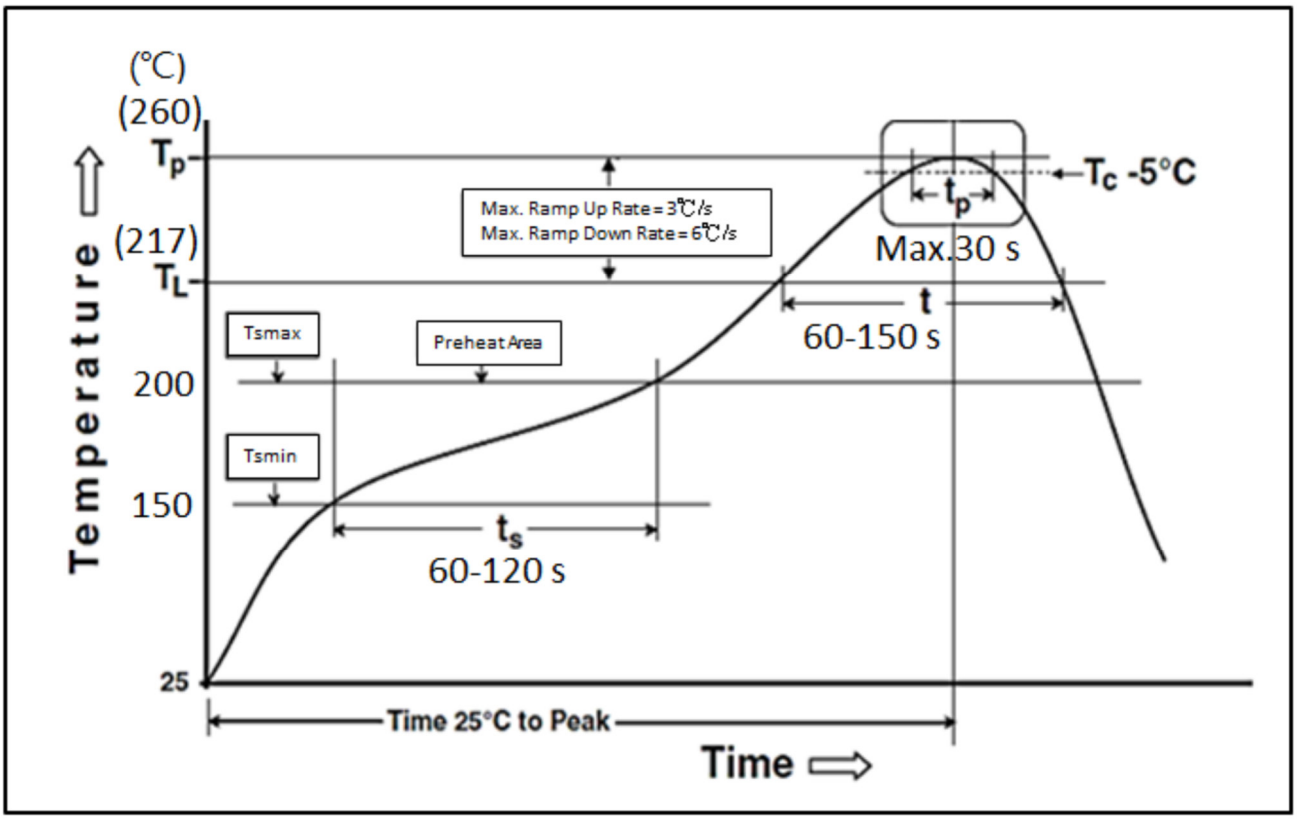
Pulse withstanding capacity

The limit of acceptance was a shift in resistance of less than 1% fromthe initial value. The power applied was subject to the restrictions of the maximum permissible impulse voltage.

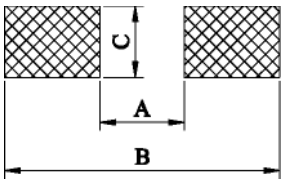


The limit of the applicable voltage is the max. overload voltage. Please consult us about the resistance characteristic when pulse isapplied continuously. This data is a reference value, please be sure to test the products on the actual circuit before you use them.

Soldering Profile IPC/JEDEC J-STD-020



Recommended Land Pattern Design:



Size	A	B	C
0602	0,70	3,10	3,20
1225	1,20	5,20	7,00
2512	4,90	8,10	3,50
2010	3,80	5,60	2,80
1210	2,00	3,80	2,80
1206	2,00	3,80	1,60
0805	1,20	2,60	1,30
0603	0,90	2,10	0,90
0402	0,50	1,40	0,60
0201	0,30	0,80	0,30
01005	0,14	0,50	0,25

Environmental Characteristics

Item	Requirement			Test Method
	±1% and Below	±5%	Jumper	
Temperature Coefficient of Resistance (T.C.R.)	As Spec.			JIS-C-5201-1 4.8 IEC-60115-1 4.8 -55°C~+125°C, 25°C is the reference temperature
Short Time Overload	±(1,0%+0,05Ω)	±(2,0%+0,05Ω)	<50mΩ	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2,5 or Max. overload voltage whichever is lower for 5 seconds, 2 seconds for high power series
Insulation Resistance	≥10G			JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. overload voltage for 1 minute
Endurance	±(1,0%+0,10Ω)	±(2,0%+0,10Ω)	<100mΩ	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70±2°C, Max. working voltage for 1000 hrs with 1,5 hrs “ON” and 0,5 hrs “OFF”
Damp Heat with Load	±(1,0%+0,10Ω)	±(2,0%+0,10Ω)	<100mΩ	JIS-C-5201-1 4.24 IEC-60115-1 4.24 40±2°C, 90~95% R.H. RCWV for 1000 hrs with 1,5 hrs “ON” and 0,5 hrs “OFF”
Dry Heat	±(1,0%+0,05Ω)	±(1,5%+0,10Ω)	<50mΩ	JIS-C-5201-1 4.23 IEC-60115-1 2.23.2 at +125/+155°C for 1000 hrs
Bending Strength	±(1,0%+0,05Ω)	±(1,0%+0,05Ω)	<50mΩ	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 5 seconds 2010, 2512 sizes: 2mm Other sizes: 3mm
Solderability	95% min. coverage			JIS-C-5201-1 4.17 IEC-60115-1 4.17 245±5°C for 3 seconds
Resistance to Soldering Heat	±(0,5%+0,05Ω)	±(1,0%+0,05Ω)	<50mΩ	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C for 10 seconds
Voltage Proof	No breakdown or flashover			JIS-C-5201-1 4.7 IEC-60115-1 4.7 1,42 times RCWV (RMS) for 1 minute
Leaching	Individual leaching area ≦5% Total leaching area ≦ 10%			JIS-C-5201-1 4,18 IEC-60068-2-58 8,2,1 260±5°C for 30 seconds
Rapid Change of Temperature	±(0,5%+0,05Ω)	±(1,0%+0,05Ω)	<50mΩ	JIS-C-5201-1 4.18 IEC-60115-1 4.18 -55°C to +125/+155°C, 5 cycles

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