

# FrelTec GmbH

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82319 Starnberg  
Germany

## Pulse Withstanding Chip Resistor

### SMD

# FrelTec

## Pulse Withstanding Chip Resistor

### SMD

#### SPECIFICATION

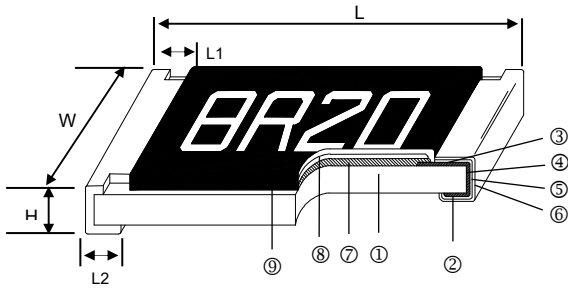
### Part Number

020	05*	1001*	J*	T05**	D	E
Type	Size	Value	Tolerance	Packing	TCR	Power Rating
020: SMD Pulse Withstanding Chip Resistor	02 : 0402	The last digit is the multiplier which denotes the number of zero following	J : ±5%	T05: Paper Tape and Reel for 5k pc (7"reel)	F : ±100ppm/°C	C: 1/10W
	03 : 0603		F : ±1%	T10: Paper Tape and Reel for 10kpc (7"reel)	G : ±200ppm/°C	D: 1/8W
	05 : 0805		D : ±0,5%	E04: Embossed Tape and reel for 4k pc (7"reel)	H : ±300ppm/°C	E: 1/4W
	06 : 1206			H10: Paper Tape and Reel for 10kpc (10"reel)	L: ±350ppm/°C	G: 1/3W F: 2/5W
	10 : 1210		Example:	K20: Paper Tape and Reel for 20kpc (10"reel)		H: 1/2W
	20 : 2010		97R6=	K08: Embossed Tape and reel for 8k pc (10"reel)		I: 3/4W
	25 : 2512		9760 = 9760hm	I20: Paper Tape and Reel for 20kpc (13"reel)		J: 1W
			1001 = 1kOhm	I40: Paper Tape and Reel for 40kpc (13"reel)		K: 1,5W
						L: 2W
						* not all combination is possible

### SMD

### THIN FILM CHIP RESISTORS

### Construction



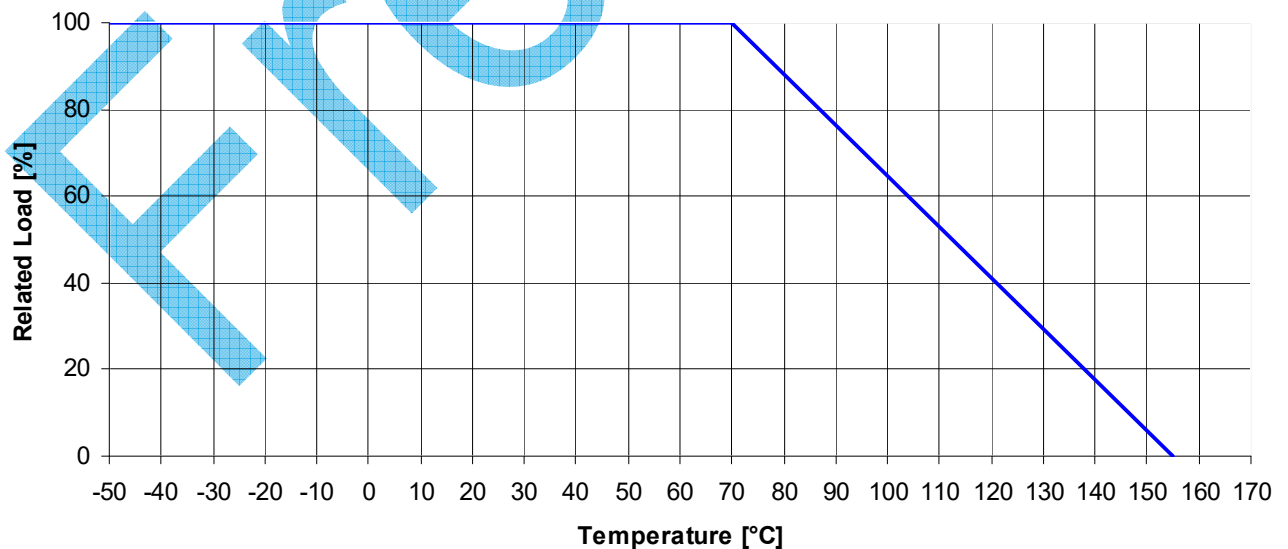
① Alumina Substrate	④ Edge Electrode	⑦ Resistor Layer
② Bottom Electrode	⑤ Barrier Layer	⑧ Primary Overcoat
③ Top Electrode	⑥ External Electrode	⑨ Secondary Overcoat

### Dimensions

Size	L	W	H	L1	L2
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±0,20	2,60±0,15	0,55±0,10	0,50±0,25	0,50±0,20
2010	5,00±0,20	2,50±0,15	0,55±0,10	0,60±0,25	0,50±0,20
2512	6,35±0,20	3,10±0,15 3,15±0,15 (2W)	0,55±0,10 0,60±0,10 (2W)	0,60±0,25	0,50±0,20 0,60±0,20 (2W)

### Power Derating Curve

For resistors operated in ambient temperatures above 70 °C , power rating shall be derated in accordance with figure below, Operating Temperature Range : -55°C 155°C



# FrelTec Pulse Withstanding Chip Resistor

## SMD

### Rating 020 Series

#### GENERAL PURPOSE CHIP RESISTORS

Type	Size	Power Rating at 70°C	Max. Operating Voltage	Max. Overload Voltage	Temperature Coefficient [TCR; ppm/°C]	Resistance Range [Ω]		
						D(±0,5%) E24, E96	F(±1%) E24, E96	F(±5%) E24
020 02	0402	1/5W	50V	100V	±300		1Ω~20Ω	
					±100	100Ω~1MΩ	20,5Ω~1MΩ	
020 03	0603	1/10W	50V	100V	±200	10Ω~294Ω	1Ω~294Ω	
					±100	300Ω~1MΩ		
020 05	0805	1/8W	150V	300V	±200	10Ω~294Ω	1Ω~294Ω	
					±100	300Ω~20MΩ		
020 06	1206	1/3W	200V	400V	±200	10Ω~20Ω	1Ω~20Ω	
					±100	20,5Ω~20MΩ		
020 10	1210	1/2W	200V	400V	±200	10Ω~20Ω	1Ω~20Ω	
					±100	20,5Ω~20MΩ		
020 20	2010	3/4W	400V	800V	±200	10Ω~20Ω	1Ω~20Ω	
					±100	20,5Ω~20MΩ		
020 25	2512	1,5W	500V	1000V	±200	10Ω~20Ω	1Ω~20Ω	
					±100	20,5Ω~20MΩ		

#### Special High Power

Type	Size	Power Rating at 70°C	Max. Operating Voltage	Max. Overload Voltage	Temperature Coefficient [TCR; ppm/°C]	Resistance Range [Ω]		
						D(±0,5%) E24, E96	F(±1%) E24, E96	F(±5%) E24
020 03	0603	1/4W Jumper: 5A <sup>1</sup>	75V	150V	±200	10Ω~294Ω	1Ω~294Ω	
					±100	300Ω~1MΩ		
020 05	0805	2/5W	150V	300V	±200	10Ω~294Ω	1Ω~294Ω	
					±100	300Ω~1MΩ		
		1/2W <sup>1</sup> Jumper: 6A <sup>1</sup>	400V	600V	±200	10Ω~294Ω	1Ω~294Ω	
					±100	20,5Ω~1MΩ		
020 06	1206	1/2W	200V	400V	±200	10Ω~20Ω	1Ω~20Ω	
					±100	20,5Ω~1MΩ		
		3/4W <sup>1</sup> Jumper: 10A <sup>1</sup>	500V	1000V	±200	10Ω~20Ω	1Ω~20Ω	
					±100	20,5Ω~1MΩ		
020 10	1210	3/4W	200V	400V	±200	10Ω~20Ω	1Ω~20Ω	
					±100	20,5Ω~1MΩ		
020 20	2010	1W	400V	800V	±200	10Ω~20Ω	1Ω~20Ω	
					±100	20,5Ω~1MΩ		
020 25	2512	2W	500V	1000V	±350	10Ω~20Ω	1Ω~20Ω	
					±100	10,5Ω~200kΩ		

<sup>1</sup>: Ultra High Power: Double side printed resistor element

Operating Voltage= $\sqrt{P \cdot R}$  or Max. Operating Voltage listed above, whichever is lower.

Overload Voltage= $2,5 \cdot \sqrt{P \cdot R}$  or Max. Overload Voltage listed above, whichever is lower.

The power rating depends on the maximum temperature of the resistive element. Due to the power dissipation of the resistor, the temperature of the resistive element will rise depending on the condition of heat dissipation from PCB. The maximum power rating in application only applies if the temperature of the resistive element is not exceed 155°C

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## Pulse Withstanding Chip Resistor

### SMD

#### SPECIFICATION



**0402 no marking**

**0805 to 2512:**

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

examples: 1542 =  $154 \times 10^2 = 15,400 \text{ Ohm} = 15,4\text{kOhm}$

**0603 E-96-series:**

examples: 12C (Table below) =  $130 \times 10^2 = 13\text{kOhm}$

000 = 0 Ohm

**0603 E-24 series:**

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

examples: 222 =  $22 \times 10^2 = 2,2\text{kOhm}$

3 digit Marking Table E96

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

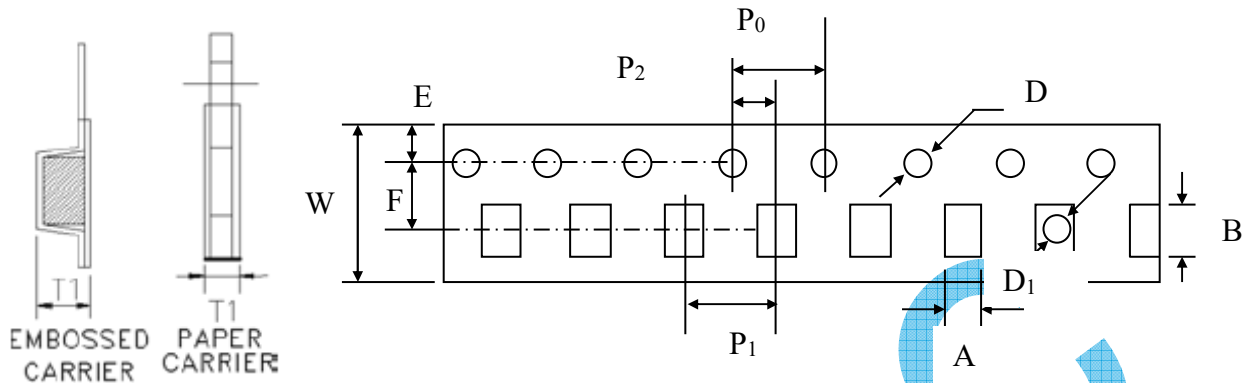
3 digit Marking Table E24

E24	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
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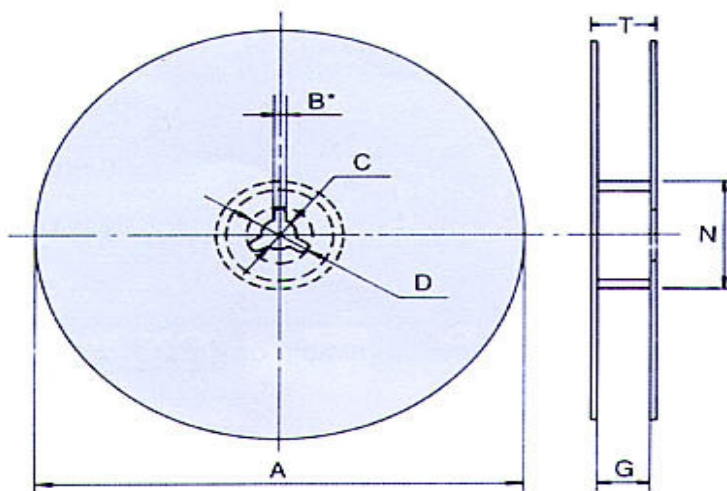
# FrelTec Pulse Withstanding Chip Resistor

## SMD SPECIFICATION

### Tape And Reel Package



Type	A	B	W	E	F	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	ΦD	ΦD <sub>1</sub>	T1
0402	0,65±0,10	1,15±0,10	8,00±0,20	1,75±0,10	3,50±0,05	4,00±0,10	2,00±0,50	2,00±0,05	1,50+0,1,-0	-	0,45±0,10
0603	1,10±0,10	1,90±0,10	8,00±0,20	1,75±0,10	3,50±0,05	4,00±0,10	4,00±0,50	2,00±0,05	1,50+0,1,-0	-	0,70±0,10
0805	1,60±0,10	2,40±0,20	8,00±0,20	1,75±0,10	3,50±0,05	4,00±0,10	4,00±0,05	2,00±0,05	1,50+0,1,-	-	0,85±0,10
1206	1,90±0,10	3,50±0,20	8,00±0,20	1,75±0,10	3,50±0,05	4,00±0,10	4,00±0,05	2,00±0,05	1,50+0,1,-	-	0,85±0,10
1210	2,90±0,10	3,50±0,20	8,00±0,20	1,75±0,10	3,50±0,05	4,00±0,05	4,00±0,05	2,00±0,05	1,50+0,1,-	-	0,85±0,10
2010	2,80±0,20	5,40±0,20	12,0±0,30	1,75±0,10	5,50±0,05	4,00±0,05	4,00±0,10	2,00±0,05	1,50+0,1,-	1,5+0,1,-0	1,20±0,10
2512	3,50±0,20	6,70±0,20	12,0±0,30	1,75±0,10	5,50±0,05	4,00±0,05	4,00±0,10	2,00±0,05	1,50+0,1,-	1,5+0,1,-0	1,20±0,10



Type	Packaging	Quantity	Reel Diameter	A	C	G	T	N	Tape width
020 02	T10	10k	7"	178,5±1,5	13,0±0,2	9,0±0,5	12,5±0,5	60,0+1/-0	8mm
	T20	20k	10"	254,0±1,0	13,0±0,2	9,5±0,5	13,5±0,5	100,0±0,5	
	T40	40k	13"	330,0±1,0	13,0±0,2	9,5±0,5	13,5±0,5	100,0±0,5	
020 03	T05	5k	7"	178,5±1,5	13,0±0,2	9,0±0,5	12,5±0,5	60,0+1/-0	8mm
020 05	T10	10k	10"	254,0±1,0	13,0±0,2	9,5±0,5	13,5±0,5	100,0±0,5	
020 06		20k	13"	330,0±1,0	13,0±0,2	9,5±0,5	13,5±0,5	100,0±0,5	
020 10	T20	20k	13"	330,0±1,0	13,0±0,2	9,5±0,5	13,5±0,5	100,0±0,5	12mm
020 20	E04	4k	7"	178,5±1,5	13,0±0,5	13,0±0,5	15,5±0,5	60,0+1/-0	
	E08	8k	10"	250,0±1,0	13,0±0,5	12,5±0,5	16,5±0,5	62,0±0,5	
020 25									

in mm

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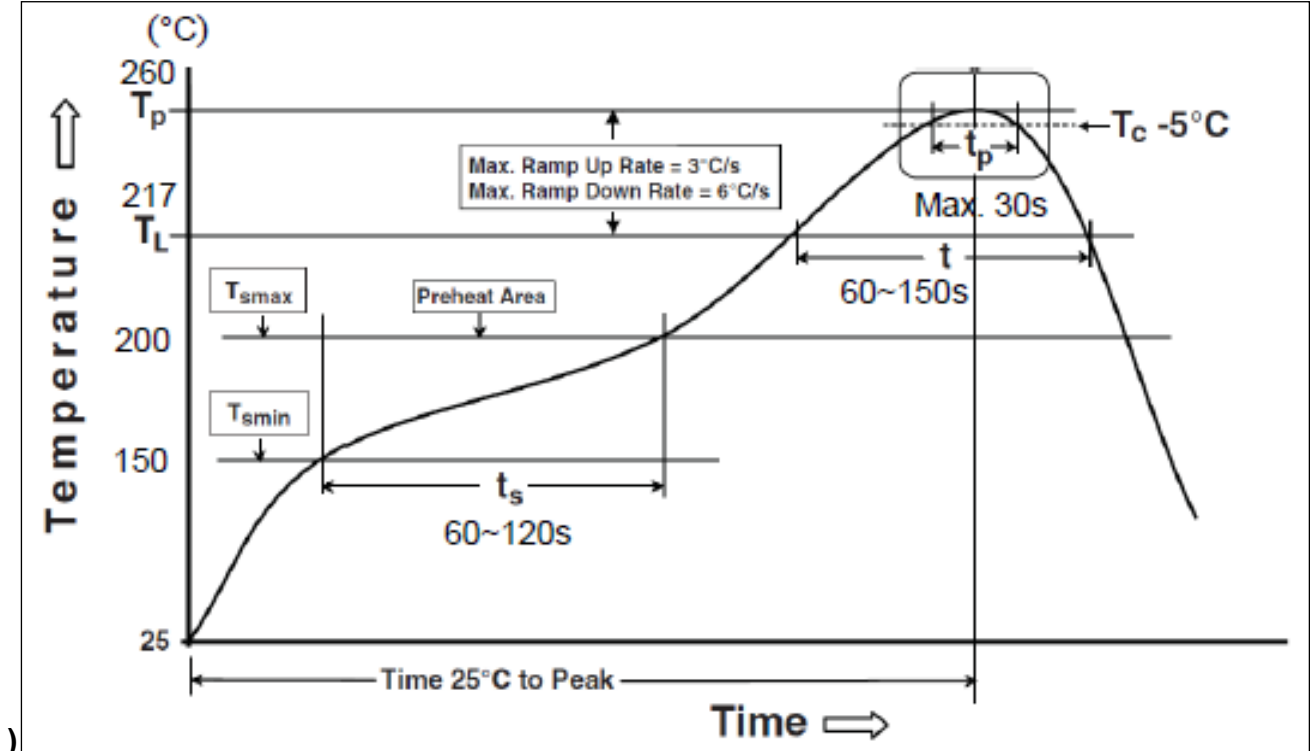
## Pulse Withstanding Chip Resistor

### SMD

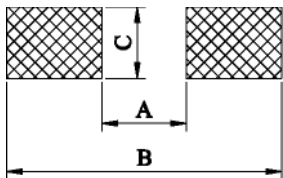
#### Stock period

The performance of these products, including the solderability, is guaranteed for 12 month, provided that they remain packed as they were when delivered and stored at a temperature of  $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$  and a relative humidity less than 80%RH

#### Soldering Condition (Ref. IPC/JEDEC J-STD-020 & J-STD-002)



#### Recommended Land Pattern Design (mm):



Size	A	B	C
0402	0,50	1,4	0,60
0603	0,90	2,1	0,90
0805	1,20	2,6	1,30
1206	2,00	3,8	1,60
1210	2,00	3,8	2,80
2010	3,80	5,6	2,80
2512	3,80	6,9	3,40

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## SMD Pulse Withstanding Chip Resistor

Item	Requirement	Jumper	Test Method
Temperature Coefficient of Resistance	As Spec.		<b>JIS-C-5201-1 4.8</b> <b>IEC-60115-1 4.8</b> At 25°C/-55°C and 25°C/+125°C, 25°C is the reference temperature
Short Time Overload	$\pm(1,0\%+0,05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	<b>JIS-C-5201-1 4.13</b> <b>IEC-60115-1 4.13</b> RCWV*2.5 or Max. Overload Voltage whichever is lower for 5 seconds Jumper: $2 \cdot I_{max}$ for 5 seconds
Insulation Resistance	>10G $\Omega$		<b>JIS-C-5201-1 4.6</b> <b>IEC-60115-1 4.6</b> Max. Overload Voltage for 1 minute
Endurance	$\pm(1,0\%+0,05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	<b>JIS-C-5201-1 4.25</b> <b>IEC-60115-1 4.25.1</b> 70 $\pm 2^\circ\text{C}$ , RCWV for 1000 hrs with 1,5 hrs "ON" and 0,5 hr "OFF"
Damp Heat with Load	$\pm(0,5\%+0,05\Omega)$ Ultra High Power: $\pm(1,0\%+0,05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	<b>JIS-C-5201-1 4.24</b> <b>IEC-60115-1 4.24</b> 40 $\pm 2^\circ\text{C}$ , 90~95% R.H., RCWV for 1000 hrs with 1,5 hrs "ON" and 0,5 hr "OFF"
Dry Heat	$\pm(0,5\%+0,05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	<b>JIS-C-5201-1 4.23</b> <b>IEC-60115-1 4.23.2</b> at +155°C for 1000 hrs
Bending Strength	$\pm(1,0\%+0,05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	<b>JIS-C-5201-1 4.33</b> <b>IEC-60115-1 4.33</b> Bending once for 60 seconds 2010, 2512 sizes: 2mm Other sizes: 3mm
Solderability	95%min coverage		<b>JIS-C-5201-1 4.17</b> <b>IEC-60115-1 4.17</b> 245 $\pm 5^\circ\text{C}$ for 3 seconds
Resistance to Soldering Heat	$\pm(0,5\%+0,05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	<b>JIS-C-5201-1 4.18</b> <b>IEC-60115-1 4.18</b> 260 $\pm 5^\circ\text{C}$ for 10 seconds
Voltage Proof	No breakdown or flashover		<b>JIS-C-5201-1 4.7</b> <b>IEC-60115-1 4.7</b> 1,42 times Max. Operating Voltage for 1 minute
Leaching	Individual leaching area $\leq 5\%$ Total leaching area $\leq 10\%$		<b>JIS-C-5201-1 4.18</b> <b>IEC-60068-2-58 8.2.1</b> 260 $\pm 5^\circ\text{C}$ for 30 seconds
Rapid Change of Temperature	$\pm(0,5\%+0,05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	<b>JIS-C-5201-1 4.19</b> <b>IEC-60115-1 4.19</b> -55°C to +155°C, 5 cycles

RCWV (Rated Continuous Working Voltage)= $\sqrt{(P \cdot R)}$  or Max. Operating Voltage whichever is lower.



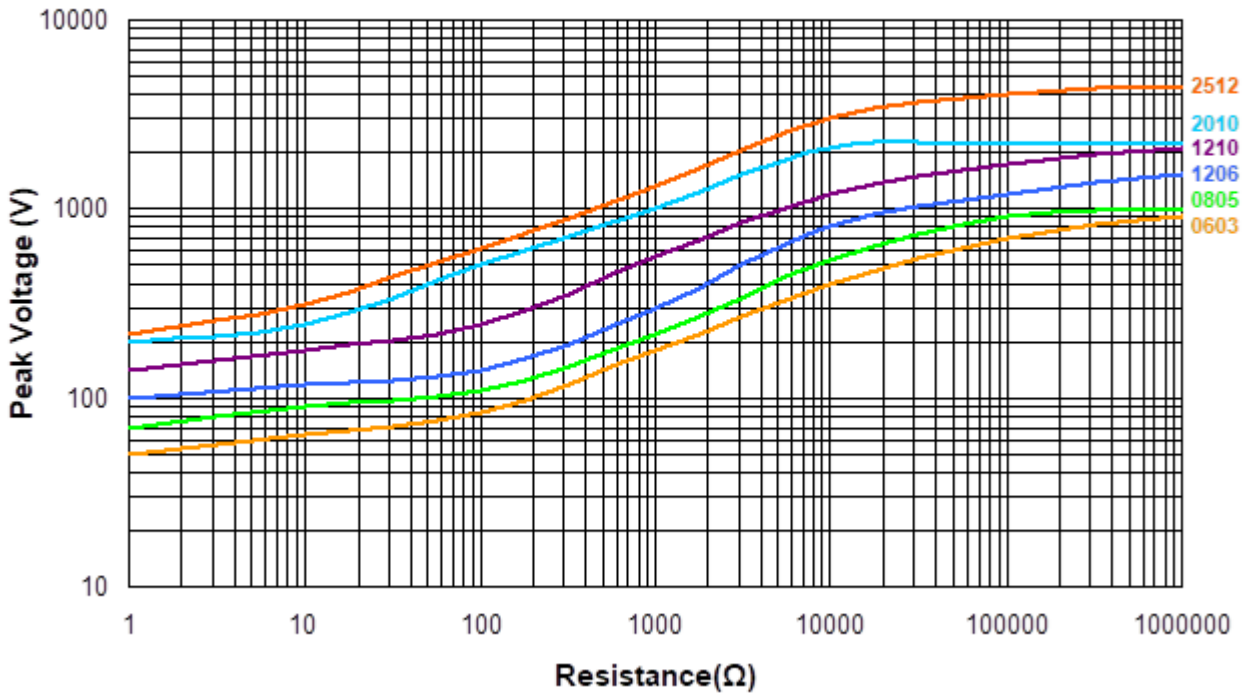
# FrelTec Pulse Withstanding Chip Resistor

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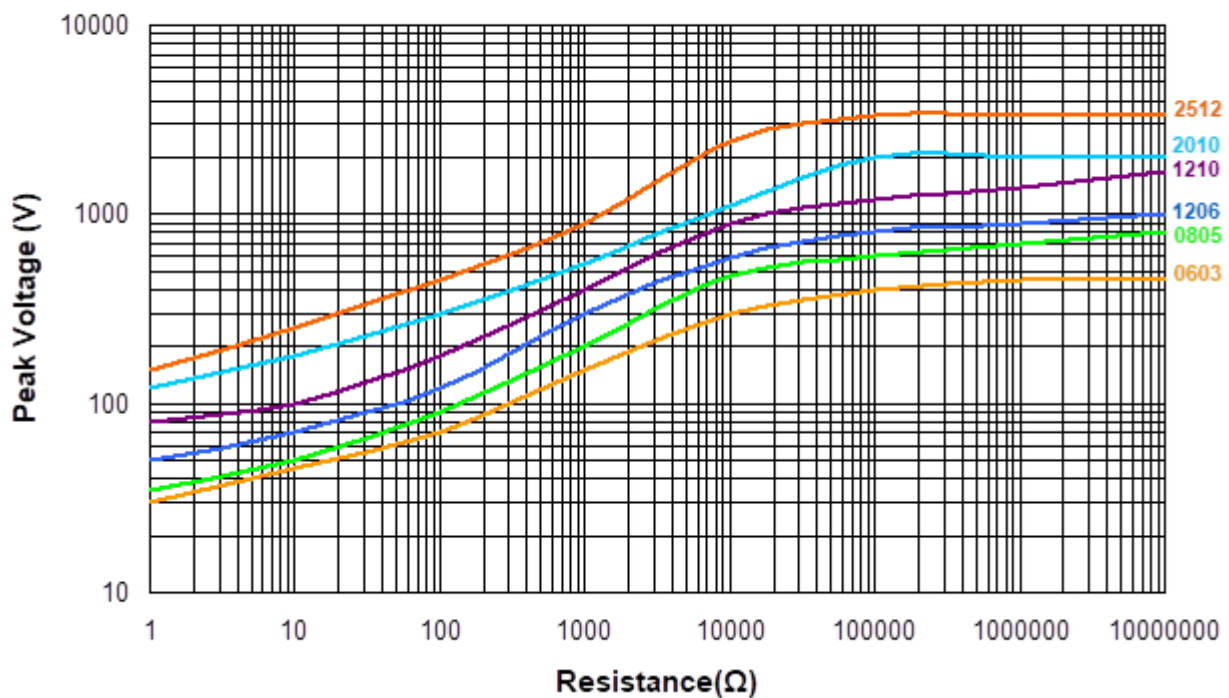
### Lightning Surge

Resistors are tested in accordance with IEC 60 115-1 using both 1,2/50us and 10/700 pulse shapes. The limit of acceptance is a shift in resistance of less than 1% from the initial value.

### Series 1.2/50us Lightning Surge



### Series 10/700us Lightning Surge



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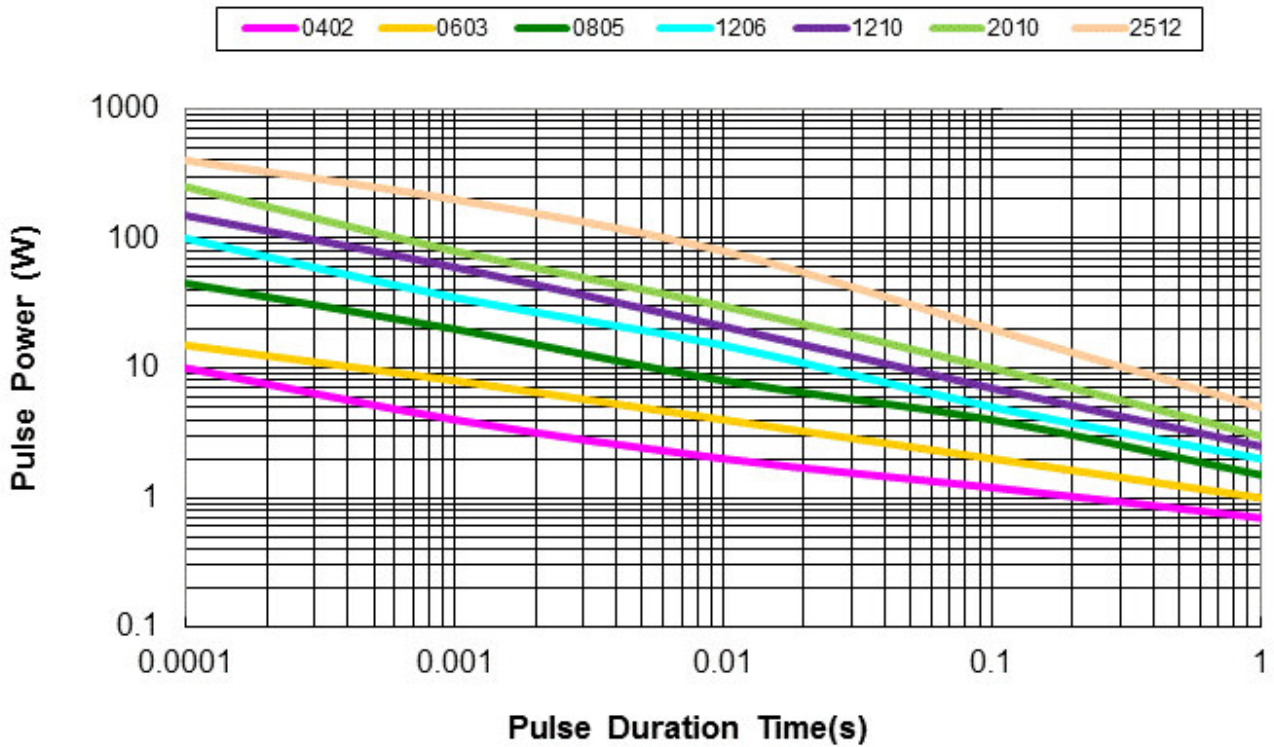
## Pulse Withstanding Chip Resistor

### SMD

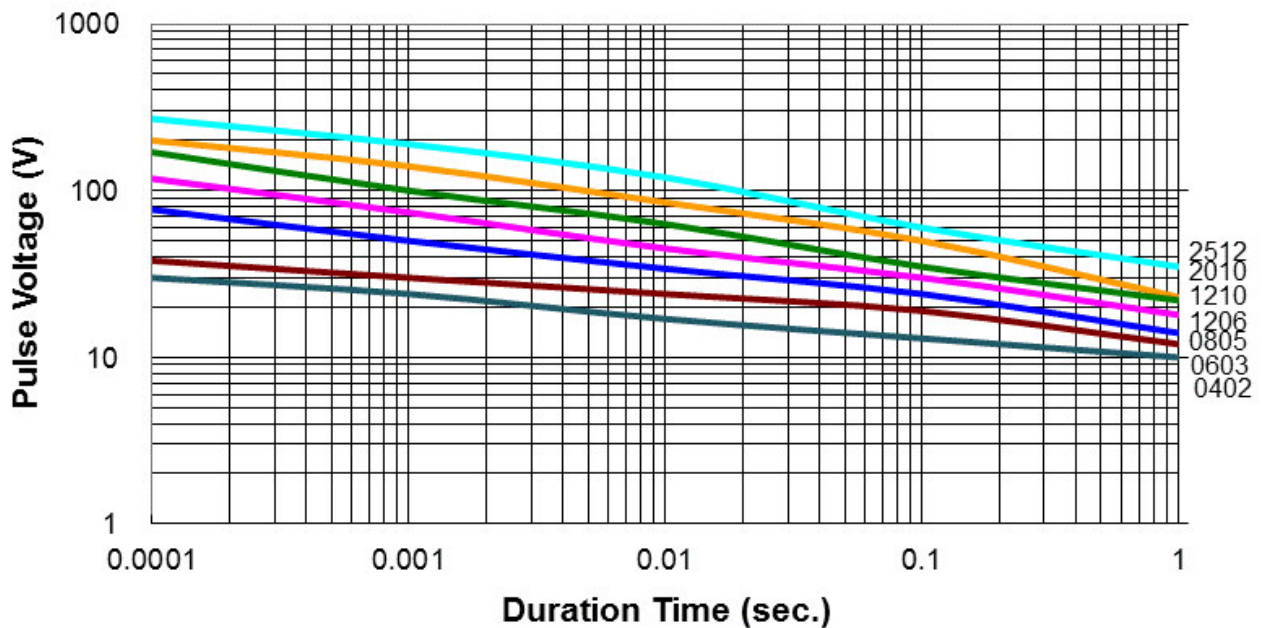
#### Continuous Pulse

The continuous load graph was obtained by applying repetitive rectangular pulses where the pulse period was adjusted so that the average power dissipated in the resistor was equal to its rated power at 70°C. Again the limit of acceptance was a shift in resistance of less than 1% from the initial value.

**Series Continuous Pulse(100 Ohm)**



**Series Pulse Voltage(100 Ohm)**



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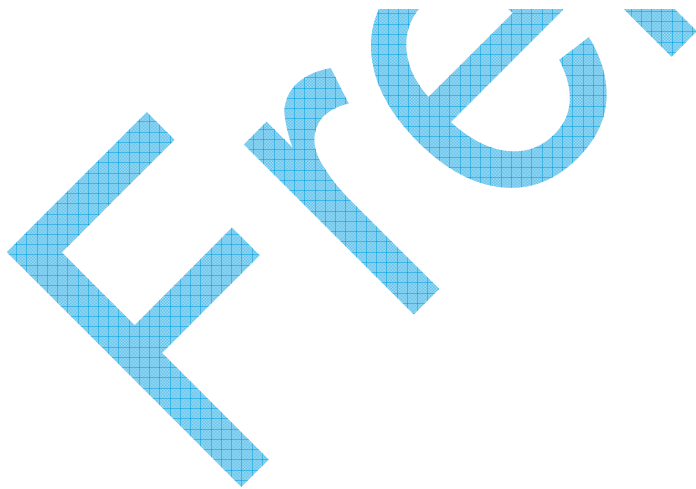
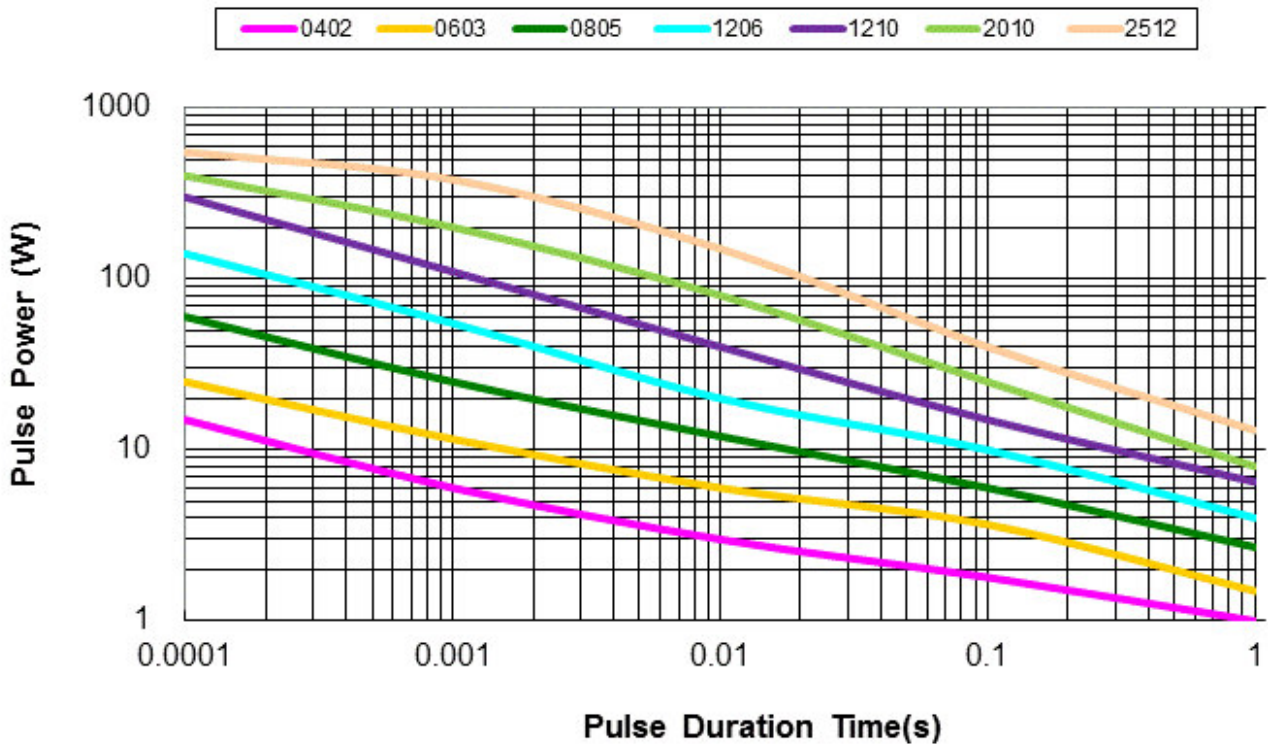
## Pulse Withstanding Chip Resistor

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#### Pulse withstand capacity

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

**Series Single Pulse(100 Ohm)**



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# Pulse Withstanding Chip Resistor

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