

### FEATURES:

- Excellent pulse withstanding performance
- Higher power ratings than General Purpose Thick Film Resistors
- Improved working voltage ratings
- Offered in 0402 to 2512 package sizes



### PART NUMBER STRUCTURE

PWCR Series	1206 Size	- U Power Rating	K TCR	- 1001 Resistance	D Resistance Tolerance	T Packaging
0402	0603	Q = 1/10W	K = ±100ppm/°C	3 DIGIT (J TOL.)	D = ±0.50%	T = Tape & Reel
0805	1206	R = 1/8W	L = ±200ppm/°C	4 DIGIT (D & F TOL.)	F = ±1%	
1210	2010	A = 1/5W	M = ±300ppm/°C	Jumper	J = ±5%	
1206	2512	T = 1/4W	N = ±350ppm/°C			
1210		U = 1/3W				
2010		B = 2/5W				
2512		V = 1/2W				
		W = 3/4W				
		X = 1W				
		Y = 1.25W				
		Z = 1.50W				
		J = 2W				

Example P/N: PWCR1206-UK-1001DT

Standard termination finish is 100% matte Tin (Sn) over Nickel.

### DIMENSIONS

SIZE	L	W	T	C <sub>1</sub>	C <sub>2</sub>	Weight (g/1000pcs)
0402	0.039±0.002 (1.00±0.05)	0.020±0.002 (0.50±0.05)	0.013±0.002 (0.35±0.05)	0.008±0.004 (0.20±0.10)	0.008±0.004 (0.20±0.10)	0.6
0603	0.062±0.004 (1.60±0.10)	0.031±0.004 (0.80±0.10)	0.018±0.004 (0.45±0.10)	0.012±0.008 (0.30±0.20)	0.012±0.008 (0.30±0.20)	2.0
0805	0.079±0.004 (2.0±0.10)	0.049±0.004 (1.25±0.10)	0.019±0.004 (0.50±0.10)	0.013±0.008 (0.35±0.20)	0.016±0.008 (0.40±0.20)	4.4
0805 (1/2W)	0.079±0.004 (2.0±0.10)	0.049±0.004 (1.25±0.10)	0.019±0.004 (0.50±0.10)	0.013±0.008 (0.35±0.20)	0.016±0.008 (0.40±0.20)	5.0
1206	0.122±0.004 (3.10±0.10)	0.061±0.004 (1.55±0.10)	0.022±0.004 (0.55±0.10)	0.019±0.009 (0.50±0.25)	0.019±0.008 (0.50±0.20)	8.9
1206 (3/4W)	0.122±0.004 (3.10±0.10)	0.061±0.004 (1.55±0.10)	0.022±0.004 (0.55±0.10)	0.019±0.009 (0.50±0.25)	0.019±0.008 (0.50±0.20)	9.5
1210	0.122±0.004 (3.10±0.10)	0.102±0.006 (2.60±0.15)	0.022±0.004 (0.55±0.10)	0.019±0.009 (0.50±0.25)	0.019±0.008 (0.50±0.20)	16.0
2010	0.196±0.004 (5.0±0.10)	0.098±0.006 (2.50±0.15)	0.022±0.004 (0.55±0.10)	0.024±0.009 (0.60±0.25)	0.020±0.008 (0.50±0.20)	24.0
2512	0.25±0.004 (6.35±0.10)	0.122±0.006 (3.10±0.15)	0.022±0.004 (0.55±0.10)	0.024±0.009 (0.60±0.25)	0.020±0.008 (0.50±0.20)	39.0
2512 (2W)	0.25±0.008 (6.35±0.20)	0.124±0.006 (3.15±0.15)	0.024±0.004 (0.60±0.10)	0.024±0.009 (0.60±0.25)	0.024±0.008 (0.60±0.20)	42.0

Unit: inches (mm)

### STRUCTURE

1	Alumina Substrate	5	Nickel Plating
2	Backside Electrode	6	Tin Plating
3	Top Electrode	7	Resistive layer
4	Edge Electrode	8	Overcoat

### ELECTRICAL SPECIFICATION & RANGE

SIZE	0402	0603			0805			
Power Rating @ 70°C	0.20W (1/5W)	0.10W (1/10W)	0.25W (1/4W)	0.33W (1/3W)	0.125W (1/8W)	0.25W (1/4W)	0.40W (2/5W)	0.50W (1/2W)*
Max. Working Voltage	50V	50V	75V	75V	150V	150V	150V	400V
*Max. Overload Voltage	100V	100V	150V	150V	300V	300V	300V	600V
Operating Temp. Range	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C
ZERO OHM (JUMPER)	Current Rating	-	-	5A*	5A*	-	-	6A*
ZERO OHM (JUMPER)	Resistance	-	-	<8mΩ	<8mΩ	-	-	<5mΩ
TOLERANCE	TCR	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE
±0.5%(D)	±100ppm	100Ω - 1MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ
	±200ppm	-	10Ω - 294Ω	10Ω - 294Ω	10Ω - 294Ω	10Ω - 294Ω	10Ω - 294Ω	10Ω - 294Ω
±1% (F)	±100ppm	20.5Ω - 1MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ
	±200ppm	(300PPM) 1Ω - 20Ω	1Ω - 294Ω	1Ω - 294Ω	1Ω - 294Ω	1Ω - 294Ω	1Ω - 294Ω	1Ω - 294Ω
±5% (J)	±100ppm	20.5Ω - 1MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ
	±200ppm	(300PPM) 1Ω - 20Ω	1Ω - 294Ω	1Ω - 294Ω	1Ω - 294Ω	1Ω - 294Ω	1Ω - 294Ω	1Ω - 294Ω

SIZE	1206			1210		
Power Rating @ 70°C	0.33W (1/3W)	0.50W (1/2W)	0.75W (3/4W)*	0.50W (1/2W)	0.75W (3/4W)	1W
Max. Working Voltage	200V	200V	500V	200V	200V	200V
*Max. Overload Voltage	400V	400V	1000V	400V	400V	400V
Operating Temp. Range	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C
ZERO OHM (JUMPER)	Current Rating	-	-	10A*	-	-
ZERO OHM (JUMPER)	Resistance	-	-	<5mΩ	-	-
TOLERANCE	TCR	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE
±0.5%(D)	±100ppm	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 20MΩ	10Ω - 1MΩ
	±200ppm	10Ω - 20Ω	10Ω - 20Ω	10Ω - 20Ω	10Ω - 20Ω	10Ω - 20Ω
±1% (F)	±100ppm	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 20MΩ	10Ω - 1MΩ
	±200ppm	1Ω - 20Ω	1Ω - 20Ω	1Ω - 20Ω	1Ω - 20Ω	1Ω - 20Ω
±5% (J)	±100ppm	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 20MΩ	10Ω - 1MΩ
	±200ppm	1Ω - 20Ω	1Ω - 20Ω	1Ω - 20Ω	1Ω - 20Ω	1Ω - 20Ω

### ELECTRICAL SPECIFICATION & RANGE

SIZE	2010			2512	
	Power Rating @ 70°C	1W	1.25W	1.5W	2W*
Power Rating @ 70°C	0.75W (3/4W)	1W	1.25W	1.5W	2W*
Max. Working Voltage	400V	400V	400V	500V	500V
*Max. Overload Voltage	800V	800V	800V	1000V	1000V
Operating Temp. Range	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C	-55°C to+155°C
ZERO OHM (JUMPER)	Current Rating	-	-	-	-
ZERO OHM (JUMPER)	Resistance	-	-	-	-
TOLERANCE	TCR	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE	RESISTANCE RANGE
±0.5%(D)	±100ppm	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 200KΩ
	±200ppm	10Ω - 20Ω	10Ω - 20Ω	10Ω - 20Ω	-
	±350ppm	-	-	-	10Ω
±1% (F)	±100ppm	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 200KΩ
	±200ppm	1Ω - 20Ω	1Ω - 20Ω	1Ω - 20Ω	-
	±350ppm	-	-	-	1Ω - 10Ω
±5% (J)	±100ppm	10Ω - 20MΩ	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 200KΩ
	±200ppm	1Ω - 20Ω	1Ω - 20Ω	1Ω - 20Ω	-
	±350ppm	-	-	-	1Ω - 10Ω

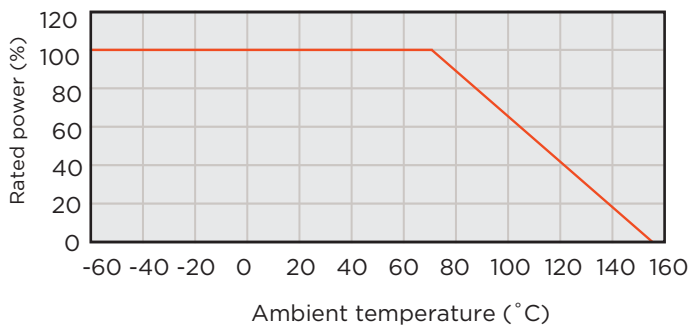
\* Ultra High Power: double sided printed resistor element.

Operating Voltage=  $2.5 \cdot (P \cdot R)^{1/2}$  or Max. Operating Voltage listed above, whichever is lower.

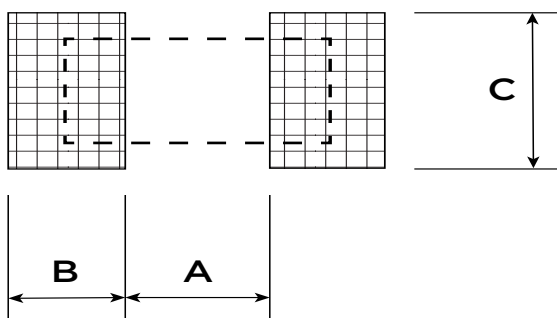
Overload Voltage=  $2.5 \cdot (P \cdot R)^{1/2}$  or Max. Overload Voltage listed above, whichever is lower.

Ther 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 does not exceed 155°C.

### DERATING CURVE

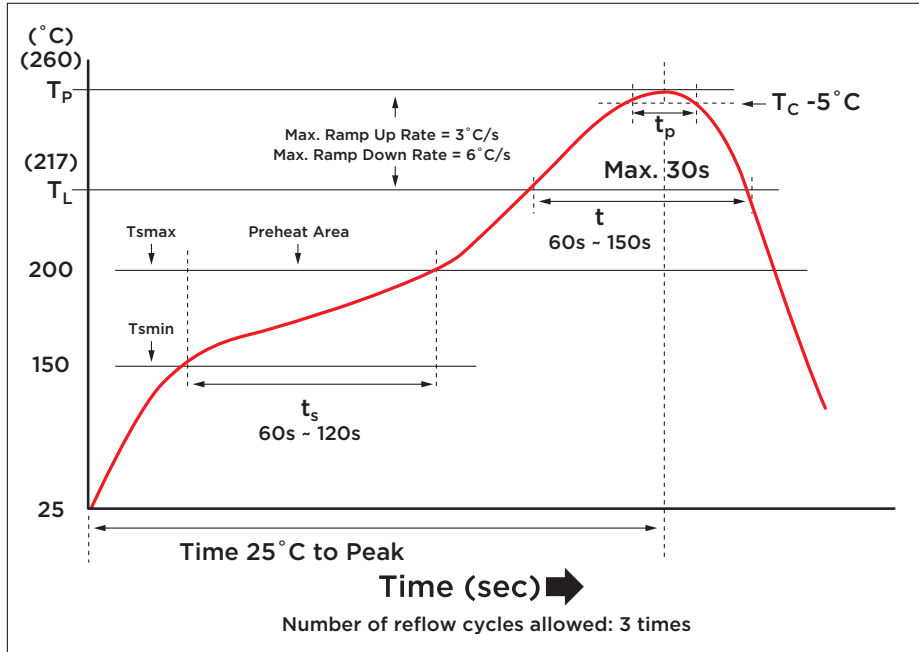


### RECOMMENDED LAND PATTERN



Size	A (mm)	B (mm)	C (mm)
0402	0.50	0.45	0.60
0603	0.90	0.60	0.90
0805	1.20	0.70	1.30
1206	2.00	0.90	1.60
1210	2.00	0.90	2.80
2010	3.80	0.90	2.80
2512	4.90	1.00	3.40

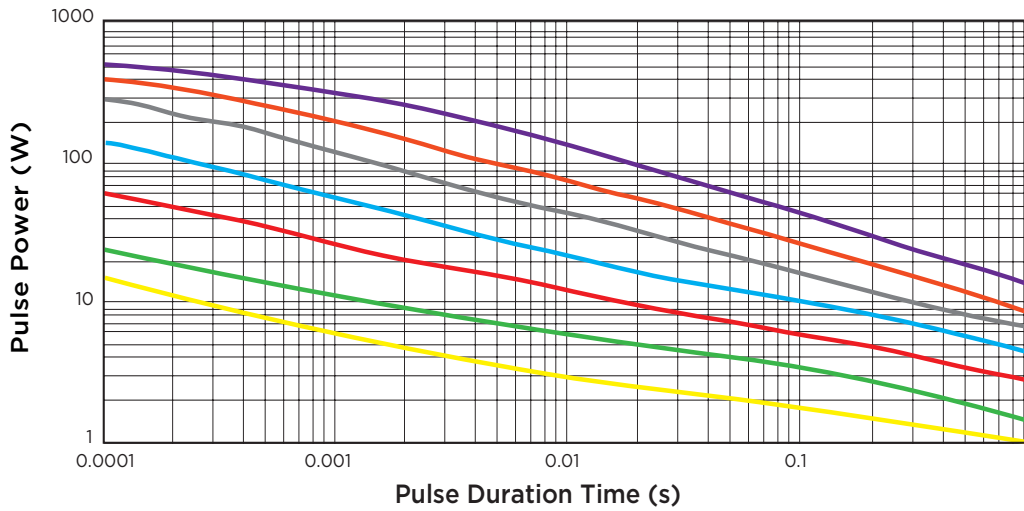
### SOLDERING CONDITION



### REFLOW PROFILES

PROFILE FEATURE	Pb-FREE ASSEMBLY
<b>PREHEAT</b> Min. Temperature (T <sub>sm</sub> ) Max Temperature (T <sub>smx</sub> ) Preheating time (t <sub>s</sub> from (T <sub>sm</sub> to T <sub>smx</sub> )"	150 °C 200 °C 60-120 seconds
Ramp-up rate (T <sub>L</sub> to T <sub>p</sub> )	3 °C/second max.
Liquidous temperature (T <sub>L</sub> ) Time (t <sub>L</sub> ) maintained above T <sub>L</sub>	217 °C 60-150 seconds
Min. Peak temperature (T <sub>p min</sub> )	235°C
Max. Peak temperature (T <sub>p max</sub> )	260°C
Time (t <sub>p</sub> ) within 5 °C of the specified classification temperature (T <sub>C</sub> )	30 seconds max.
Ramp-down rate (T <sub>p</sub> to T <sub>L</sub> )	6 °C/second max.
Time 25 °C to peak temperature	8 minutes max.

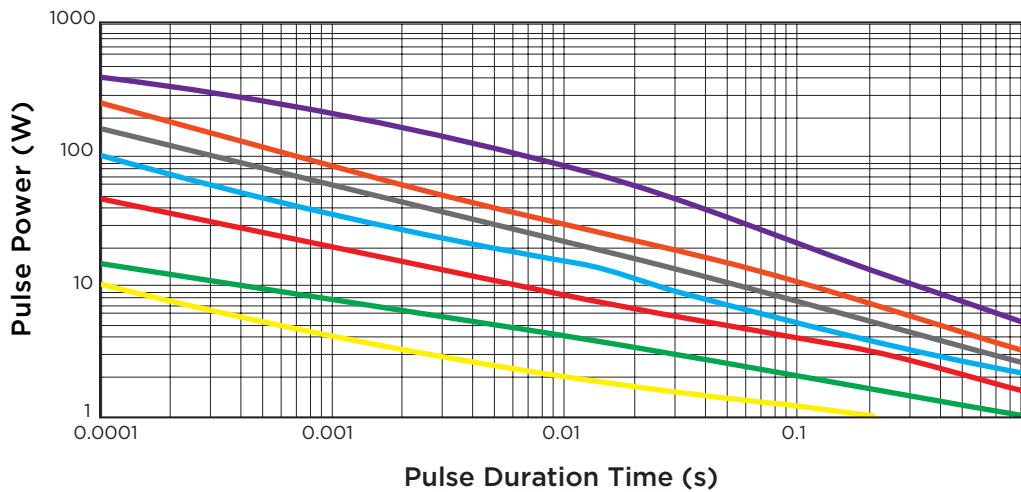
### SINGLE PULSE GRAPH (100 OHM)



- 2512 ———
- 2010 ———
- 1210 ———
- 1206 ———
- 0805 ———
- 0603 ———
- 0402 ———

Note: 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 above.

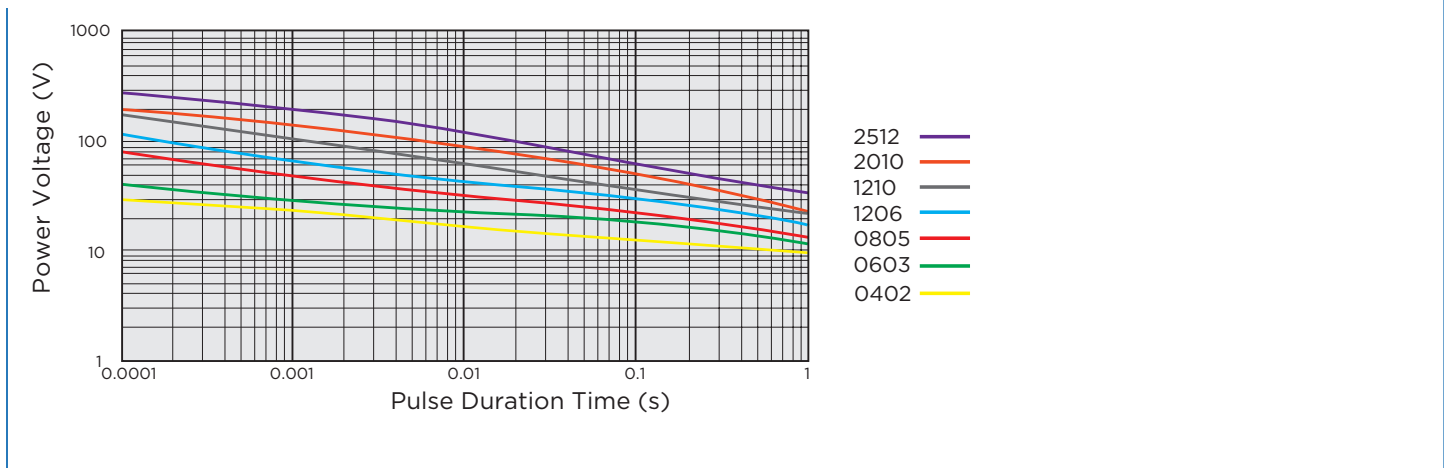
### MULTI PULSE GRAPH (100 OHM)



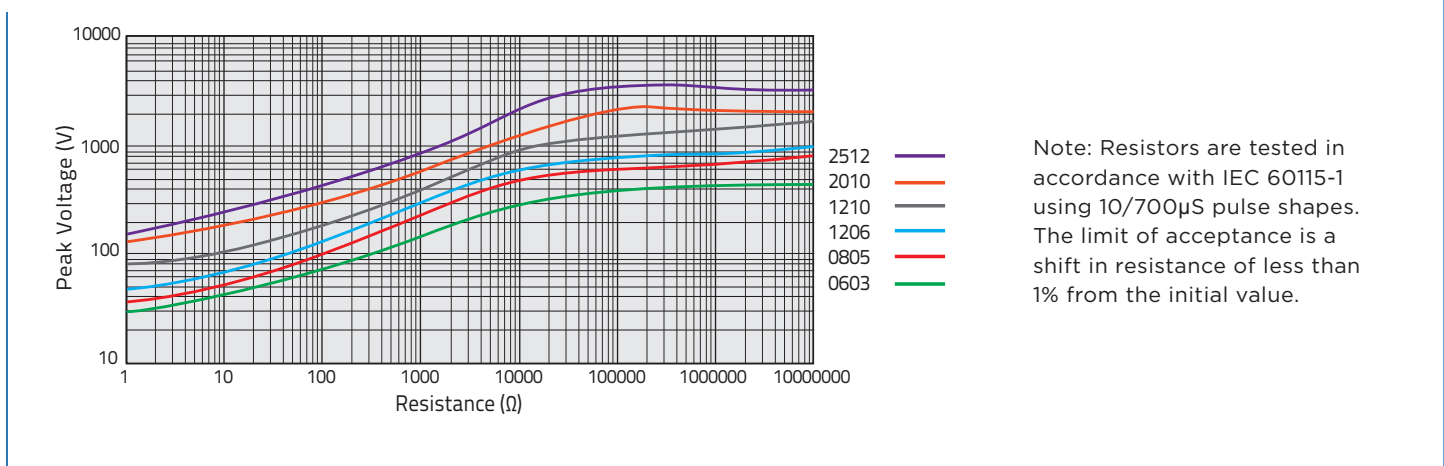
- 2512 ———
- 2010 ———
- 1210 ———
- 1206 ———
- 0805 ———
- 0603 ———
- 0402 ———

Note: 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.

### PULSE VOLTAGE (100 OHM)

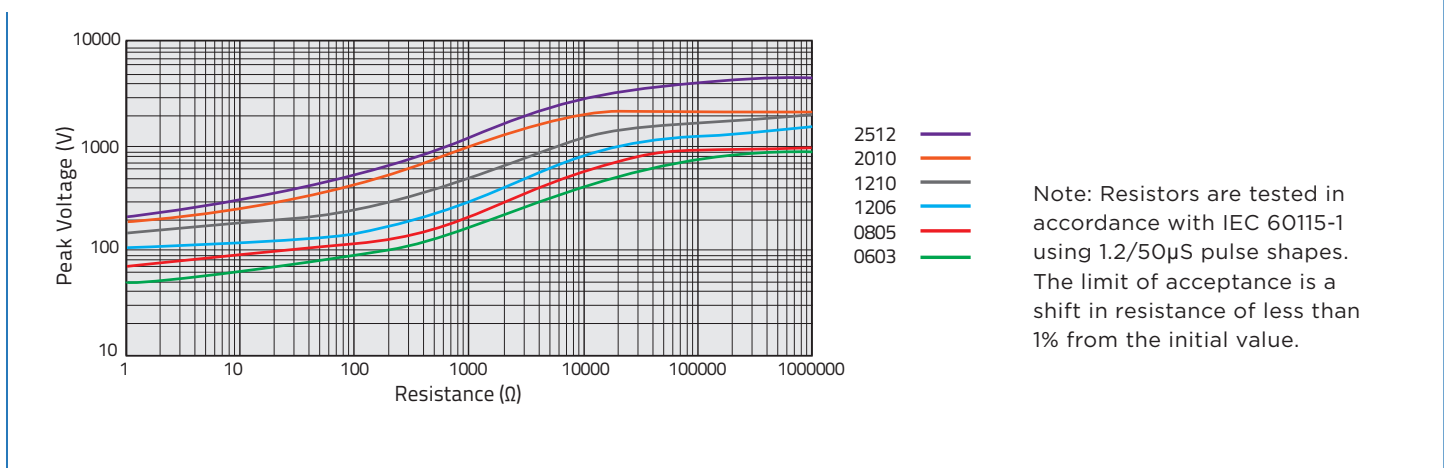


### 10/700 $\mu$ S LIGHTNING SURGE



Note: Resistors are tested in accordance with IEC 60115-1 using 10/700 $\mu$ S pulse shapes. The limit of acceptance is a shift in resistance of less than 1% from the initial value.

### 1.2/50 $\mu$ S LIGHTNING SURGE



Note: Resistors are tested in accordance with IEC 60115-1 using 1.2/50 $\mu$ S pulse shapes. The limit of acceptance is a shift in resistance of less than 1% from the initial value.

### MARKING

No Marking for 0402

Example:

1% for 0805/1206/1210/  
2010/2512: 4 digits marking

RESISTANCE	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ
MARKING	1000	2201	1002	4992	1003

5% for 0603/0805/0612/1206/1210/2010/2512: 3 digits marking in E24

Example: 101 =100Ω 102 =1KΩ (1st and 2nd are E24 code and 3rd code is multiplier)

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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1% for 0603(E24): 3 digits marking in E24, When the E24 and E96 are the same resistance, this marking in E96

Example: 01A= 100Ω 05C=11KΩ 123=12KΩ 273=27KΩ



1% for 0603(E96): 3 digits marking in E96

Example: 14C=13K7Ω 13C=13K3Ω 68B=4K99Ω 68X=49.9Ω

### 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	X	Y
Multiplier	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>6</sup>	10 <sup>-1</sup>	10 <sup>-1</sup>

### REEL SPECIFICATIONS

Unit: mm (inch)

SIZE	C	E	F	G	H	M
0402 0603 0805 1206 1210	13.0±0.2 (0.51±0.008)	60.0±1.0 (2.36±0.03)	12.5±0.5 (0.49±0.02)	9.0±0.5 (0.35±0.02)	1.75±0.3 (0.069±0.012)	178.5±1.5 (7.03±0.059)
2010 2512	13.0±0.5 (0.51±0.02)	60.0±1.0 (2.36±0.03)	15.5±0.5 (0.61±0.02)	13.0±0.5 (0.51±0.02)	1.25±0.3 (0.49±0.012)	178.5±1.5 (7.03±0.059)

Minimum of 30 empty pockets at the beginning of reel, 65 minimum empty pockets at the end.

### TAPE SPECIFICATIONS

Unit: mm (inch)

TAPE	SIZE	A	B	W	E	F	T	G	H	J	DØ
Paper	0402	1.15±0.10 (0.045±0.004)	0.65±0.10 (0.026±0.004)	8.0±0.20 (0.315±0.008)	1.75±0.10 (0.069±0.004)	3.50±0.05 (0.138±0.002)	0.45±0.10 (0.018±0.004)	2.00±0.05 (0.079±0.002)	4.00±0.10 (0.158±0.004)	2.00±0.05 (0.079±0.002)	1.50±0.05 (0.059±0.002)
	0603	1.90±0.10 (0.075±0.004)	1.10±0.10 (0.043±0.004)	8.0±0.20 (0.315±0.008)	1.75±0.10 (0.069±0.004)	3.50±0.05 (0.138±0.002)	0.70±0.10 (0.028±0.004)	4.00±0.05 (0.157±0.002)	4.00±0.10 (0.158±0.004)	2.00±0.05 (0.079±0.002)	1.50±0.05 (0.059±0.002)
	0805	2.40±0.20 (0.094±0.008)	1.60±0.10 (0.063±0.004)	8.0±0.20 (0.315±0.008)	1.75±0.10 (0.069±0.004)	3.50±0.05 (0.138±0.002)	0.85±0.10 (0.033±0.004)	4.00±0.05 (0.157±0.002)	4.00±0.10 (0.158±0.004)	2.00±0.05 (0.079±0.002)	1.50±0.05 (0.059±0.002)
	1206	3.50±0.2 (0.138±0.008)	1.90±0.10 (0.075±0.004)	8.0±0.20 (0.315±0.008)	1.75±0.10 (0.069±0.004)	3.50±0.05 (0.138±0.002)	0.85±0.10 (0.033±0.004)	4.00±0.05 (0.157±0.002)	4.00±0.10 (0.158±0.004)	2.00±0.05 (0.079±0.002)	1.50±0.05 (0.059±0.002)
	1210	3.50±0.2 (0.138±0.008)	2.90±0.10 (0.114±0.004)	8.0±0.20 (0.315±0.008)	1.75±0.10 (0.069±0.004)	3.50±0.05 (0.138±0.002)	0.85±0.10 (0.033±0.004)	4.00±0.05 (0.157±0.002)	4.00±0.10 (0.158±0.004)	2.00±0.05 (0.079±0.002)	1.50±0.05 (0.059±0.002)
Embossed	2010	5.40±0.20 (0.213±0.008)	2.80±0.10 (0.110±0.004)	12.00±0.30 (0.472±0.012)	1.75±0.10 (0.069±0.004)	5.50±0.05 (0.217±0.002)	1.20 (0.047)	4.00±0.10 (0.157±0.004)	4.00±0.10 (0.158±0.004)	2.00±0.05 (0.079±0.002)	1.50±0.05 (0.059±0.002)
	2512	6.70±0.10 (0.264±0.004)	3.50±0.10 (0.138±0.004)	12.00±0.30 (0.472±0.012)	1.75±0.10 (0.069±0.004)	5.50±0.05 (0.217±0.002)	1.20 (0.047)	4.00±0.10 (0.157±0.004)	4.00±0.10 (0.158±0.004)	2.00±0.05 (0.079±0.002)	1.50±0.05 (0.059±0.002)

### PEEL BACK FORCE AND DIRECTION DIAGRAM

Peel back force and direction of peel back angle should follow EIA481-1-A. Peel back force should be between 0.1N - 1.3N and peel back angle of 165° - 180°.



## ENVIRONMENTAL CHARACTERISTICS

TYPE OF TEST	REQUIREMENT		TEST METHOD
	±5% and below	Jumper	
Temperature Coefficient of Resistance (T.C.R)	As per Spec.		JIS-C-5201-1 4.8 IEC-60115-1 4.8 -55°C to +125°C, 25°C is the reference temperature
Short Time Overload	±(1.0%+0.05Ω)	0603: ≤8mΩ 0805: ≤5mΩ 1206: ≤5mΩ	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max. Overload voltage whichever is lower for 5 seconds
Insulation Resistance	≥10G		JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload voltage for 1 minute
Endurance	±(1.0%+0.05Ω)	0603: ≤8mΩ 0805: ≤5mΩ 1206: ≤5mΩ	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70±2°C, RCWV for 1000 hrs with with 1.5 hrs "ON" and 0.5 hrs "OFF"
Damp Heat with Load	±(0.5%+0.05Ω)	0603: ≤8mΩ 0805: ≤5mΩ 1206: ≤5mΩ	JIS-C-5201-1 4.24 IEC-60115-1 4.24 40±2°C, 90-95% R.H., RCWV for 1000 hrs with with 1.5 hrs "ON" and 0.5 hrs "OFF"
	Ultra High Power ±(1.0%+0.05Ω)		
Dry Heat	±(0.5%+0.05Ω)	0603: ≤8mΩ 0805: ≤5mΩ 1206: ≤5mΩ	JIS-C-5201-1 4.23 IEC-60115-1 4.23.2 at +155°C for 1000 hrs
Bending Strength	±(1.0%+0.05Ω)	0603: ≤8mΩ 0805: ≤5mΩ 1206: ≤5mΩ	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 60 seconds. 2010,2515 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)	0603: ≤8mΩ 0805: ≤5mΩ 1206: ≤5mΩ	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 Max. Operating voltage for 1 minute
Leaching	Individual leaching area ≤5% Total leaching area ≤10%		JIS-C-5201-1 4.18 IEC-600068-2-1 8.2.1 260±5°C for 30 seconds
Rapid Change of Temperature	±(0.5%+0.05Ω)	0603: ≤8mΩ 0805: ≤5mΩ 1206: ≤5mΩ	JIS-C-5201-1 4.19 IEC-60115-1 4.19 -55°C to +155°C, 5 cycles

RCWV= 2.5\*(P\*R)<sup>1/2</sup> or Max. Operating Voltage or whichever is lower.  
Storage Temperature: 15-28°C; Humidity < 80%RH  
Shelf Life: 2 years from production date.