

Data Sheet

Customer: _____

Product: Automotive Grade Pulse Withstanding Chip Resistor –
PWR..A Series

Size: 0402/0603/0805/1206/1210/2010/2512

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Automotive Grade Pulse Withstanding Chip Resistor – PWR..A Series



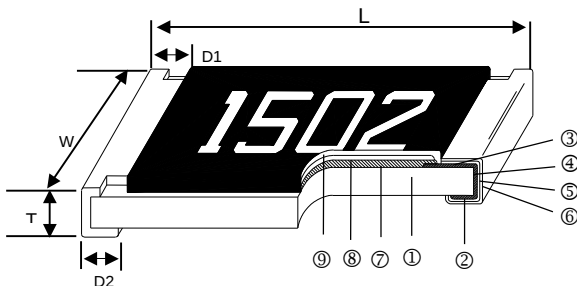
■Features

- Tolerance from $\pm 0.5\%$ ~5%
- High power rating
- Excellent pulse withstanding performance
- Improved working voltage ratings
- Standard package sizes of 0402~2512
- Special construction to prevent sulfuration in a sulfur containing environment
- AEC-Q200 Compliance
- 100% CCD inspection

■Applications

- Metering (Testing/Measurement)
- Diagnostic Equipment
- Medical Devices
- Industrial Controls
- Plasma
- LCD Video Monitors

■Construction

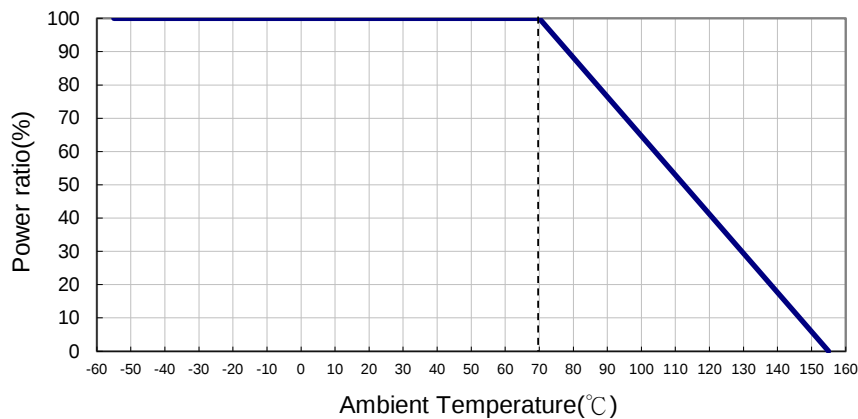


①	Alumina Substrate	⑥	External Electrode
②	Bottom Electrode	⑦	Resistor Layer
③	Top Electrode	⑧	Primary Overcoat
④	Edge Electrode	⑨	Secondary Overcoat
⑤	Barrier Layer		

■Dimensions

Type	Size (Inch)	L (mm)	W (mm)	T (mm)	D1 (mm)	D2 (mm)	Weight (g) (1000pcs)
PWR02	0402	1.00 $\pm$ 0.05	0.50 $\pm$ 0.05	0.35 $\pm$ 0.05	0.20 $\pm$ 0.10	0.20 $\pm$ 0.10	0.6
PWR03	0603	1.60 $\pm$ 0.10	0.80 $\pm$ 0.10	0.45 $\pm$ 0.10	0.30 $\pm$ 0.20	0.30 $\pm$ 0.20	2.0
PWR05	0805	2.00 $\pm$ 0.10	1.25 $\pm$ 0.10	0.50 $\pm$ 0.10	0.35 $\pm$ 0.20	0.40 $\pm$ 0.20	4.4
PWR05 (1/2W)	0805	2.00 $\pm$ 0.10	1.25 $\pm$ 0.10	0.55 $\pm$ 0.10	0.35 $\pm$ 0.20	0.40 $\pm$ 0.20	5.0
PWR06	1206	3.10 $\pm$ 0.10	1.55 $\pm$ 0.10	0.55 $\pm$ 0.10	0.50 $\pm$ 0.25	0.50 $\pm$ 0.20	8.9
PWR06 (3/4W)	1206	3.10 $\pm$ 0.10	1.55 $\pm$ 0.10	0.55 $\pm$ 0.10	0.60 $\pm$ 0.25	0.55 $\pm$ 0.25	9.5
PWR13	1210	3.10 $\pm$ 0.10	2.60 $\pm$ 0.15	0.55 $\pm$ 0.10	0.50 $\pm$ 0.25	0.50 $\pm$ 0.20	16.0
PWR10	2010	5.00 $\pm$ 0.10	2.50 $\pm$ 0.15	0.55 $\pm$ 0.10	0.60 $\pm$ 0.25	0.50 $\pm$ 0.20	24.2
PWR12	2512	6.35 $\pm$ 0.10	3.10 $\pm$ 0.15	0.55 $\pm$ 0.10	0.60 $\pm$ 0.25	0.50 $\pm$ 0.20	39.4
PWR12 (2W)	2512	6.35 $\pm$ 0.20	3.15 $\pm$ 0.15	0.60 $\pm$ 0.10	0.80 $\pm$ 0.25	0.60 $\pm$ 0.30	42.0

Derating Curve



Part Numbering

PWR	12	J	T	E	S	1001	A	059
Product Type	Dimensions	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance	Marking	Internal
	02: 0402 03: 0603 05: 0805 06: 1206 13: 1210 10: 2010 12: 2512	D: ±0.5% F: ±1% J: ±5% -: No specified	T: 7" Taping Reel V: 10" Taping Reel W: 13" Taping Reel	E: ±100 F: ±200 G: ±300 4: ±350 -: No specified	A: 1.5W T: 1W Q: 3/4W U: 1/2W G: 2/5W O: 1/3W V: 1/4W W: 1/8W X: 1/10W P: 1/5W S: 2W K: 1.25W	1001: 1KΩ 1004: 1MΩ R0R0: 0Ω	A: Automotive Grade NA: Automotive Grade & No Marking	

Standard Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range			TCR (PPM/°C)
					±0.5% (E24,E96)	±1% (E24,E96)	±5% (E24)	
PWR02 (0402)	1/5W	-55 ~ +155°C	50V	100V	-	1Ω-20Ω		±300
					100Ω-1MΩ	20Ω-1MΩ		±100
PWR03 (0603)	1/10W	-55 ~ +155°C	50V	100V	10Ω - 294Ω	1Ω - 294Ω		±200
					10Ω - 1MΩ			±100
PWR05 (0805)	1/8W	-55 ~ +155°C	150V	300V	10Ω - 294Ω	1Ω - 294Ω		±200
					10Ω - 20MΩ			±100
PWR06 (1206)	1/3W	-55 ~ +155°C	200V	400V	10Ω - 20Ω	1Ω - 20Ω		±200
					10Ω - 20MΩ			±100
PWR13 (1210)	1/2W	-55 ~ +155°C	200V	400V	10Ω - 20Ω	1Ω - 20Ω		±200
					10Ω - 20MΩ			±100
PWR10 (2010)	3/4W	-55 ~ +155°C	400V	800V	10Ω - 20Ω	1Ω - 20Ω		±200
					10Ω - 20MΩ			±100
PWR12 (2512)	1.5W	-55 ~ +155°C	500V	1000V	10Ω - 20Ω	1Ω - 20Ω		±200
					10Ω - 20MΩ			±100

High Power & Ultra High Power Rating Electrical Specifications

Type	Item	Power Rating at 70°C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range			TCR (PPM/°C)
		Jumper Rated Current				±0.5% (E24,E96)	±1% (E24,E96)	±5% (E24)	
PWR03 (0603)	1/4W 1/3W	-55 ~ +155°C	75V	150V	10Ω - 294Ω	1Ω - 294Ω		±200	
	10Ω - 1MΩ				±100				
	Jumper: 5A*				-		0Ω(≤8mΩ)	-	
PWR05 (0805)	2/5W	-55 ~ +155°C	150V	300V	10Ω - 294Ω	1Ω - 294Ω		±200	
	10Ω - 1MΩ				±100				
PWR05 (0805)	1/2W *	-55 ~ +155°C	400V	600V	10Ω - 294Ω	1Ω - 294Ω		±200	
	10Ω - 1MΩ				±100				
	Jumper: 6A*				-		0Ω(≤5mΩ)	-	
PWR06 (1206)	1/2W	-55 ~ +155°C	200V	400V	10Ω - 20Ω	1Ω - 20Ω		±200	
	10Ω - 1MΩ				±100				
PWR06 (1206)	3/4W *	-55 ~ +155°C	500V	1000V	10Ω - 20Ω	1Ω - 20Ω		±200	
	10Ω - 1MΩ				±100				
	Jumper: 10A*				-		0Ω(≤5mΩ)	-	
PWR13 (1210)	3/4W 1W	-55 ~ +155°C	200V	400V	10Ω - 20Ω	1Ω - 20Ω		±200	
	10Ω - 1MΩ				±100				
PWR10 (2010)	1W 1.25W	-55 ~ +155°C	400V	800V	10Ω - 20Ω	1Ω - 20Ω		±200	
	10Ω - 1MΩ				±100				
PWR12 (2512)	2W *	-55 ~ +155°C	500V	1000V	10Ω	1Ω - 10Ω		±350	
	10Ω -200K				±100				

*: Ultra High Power: double side printed resistor element

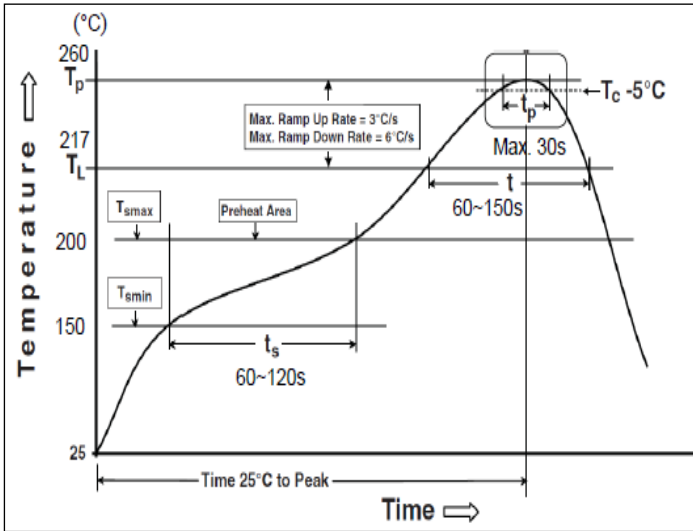
Operating Voltage= $\sqrt{P \cdot R}$ or Max. Operating Voltage listed above, whichever is lower.

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.

■ Viking is capable of manufacturing the optional spec based on customer's requirement.

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



Reflow Profiles	
Profile Feature	Pb-Free Assembly
Preheat	
Min. Temperature (T_{smin})	150 °C
Max Temperature (T_{smax})	200 °C
Preheating time (t_s) from (T_{smin} to T_{smax})	60-120 seconds
Ramp-up rate (T_L to T_p)	3 °C/second max.
Liquidous temperature (T_L)	217 °C
Time (t_L) maintained above T_L	60-150 seconds
Min. Peak temperature (T_p min)	235°C
Max. Peak temperature (T_p max)	260°C
Time (t_p) within 5 °C of the specified classification temperature (T_c)	30 seconds max.
Ramp-down rate (T_p to T_L)	6 °C/second max.
Time 25 °C to peak temperature	8 minutes max.

■ Environmental Characteristics

Item	Requirement		Test Method
	±5% and Below	Jumper	
Temperature Coefficient of Resistance (T.C.R.)	As Spec.		JIS-C-5201-1 4.8 IEC-60115-1 4.8 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: $\leq 5m\Omega$	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max. Overload Voltage whichever is lower for 5 seconds Jumper: $2 \times I_{max}$ for 5 seconds
Insulation Resistance	$\geq 10G$		JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload Voltage for 1 minute
Operational Life	$\pm(1.0\%+0.05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	MIL-STD-202 Method 108 Condition D Steady State $T_A=125^\circ C$ at derated power. Measurement at 24 ± 4 hours after test conclusion.
Biased Humidity	$\pm(1.0\%+0.05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	MIL-STD-202 Method 103 1000 hrs $85^\circ C/85\%RH$ 10% of operating power
High Temperature Exposure	$\pm(1.0\%+0.05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	MIL-STD-202 Method 108 at $+155^\circ C$ for 1000 hrs
Board Flex	$\pm(1.0\%+0.05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	AEC-Q200-005 Bending once for 60 seconds 2010, 2512 sizes: 2mm Other sizes: 3mm
Solderability	95% min. coverage		JIS-C-5201-1 4.17 IEC-60115-1 4.17 $245 \pm 5^\circ C$ for 3 seconds
Resistance to Soldering Heat	$\pm(0.5\%+0.05\Omega)$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	JIS-C-5201-1 4.18 IEC-60115-1 4.18 $260 \pm 5^\circ C$ 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

Item	Requirement		Test Method
	±5% and Below	Jumper	
Leaching	Individual leaching area $\leq 5\%$ Total leaching area $\leq 10\%$		JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds
Temperature Cycling	±(0.5%+0.05Ω)	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	JESD22 Method JA-104 -55°C to +125°C, 1000 cycles
Mechanical Shock	±(0.25%+0.05Ω)	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	MIL-STD-202 Method 213 Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6.
Vibration	±(0.5%+0.05Ω)	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	MIL-STD-202 Method 204 5 g's for 20 min., 12 cycles each of 3 orientations, 10-2000 Hz
ESD	±(3%+0.05Ω)		AEC-Q200-002 Human body model 0402/0603: 1KV 0805 and above: 2KV
Resistance to Solvents	No visible damage on appearance and marking.		MIL-STD-202 Method 215 Add Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.
Terminal Strength	No broken		AEC-Q200-006 Force of 1.8kg for 60 seconds.
Flammability	No ignition of the tissue paper or scorching of the pinewood board		UL-94 V-0 or V-1 are acceptable. Electrical test not required.
Sulfur Test	$\Delta R \pm 1\%$	0603: $\leq 8m\Omega$ 0805: $\leq 5m\Omega$ 1206: $\leq 5m\Omega$	EIA-977 (Condition A) 60±2°C, no power rating for 500 hrs.

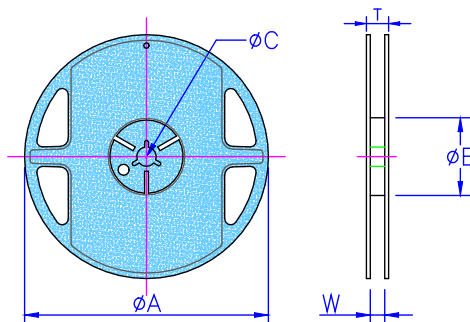
RCWV(Rated Continuous Working Voltage)= $\sqrt{P \cdot R}$ or Max. Operating Voltage whichever is lower.

■Storage Temperature: 15~28°C; Humidity < 80%RH

■Shelf Life: 2 years from production date.

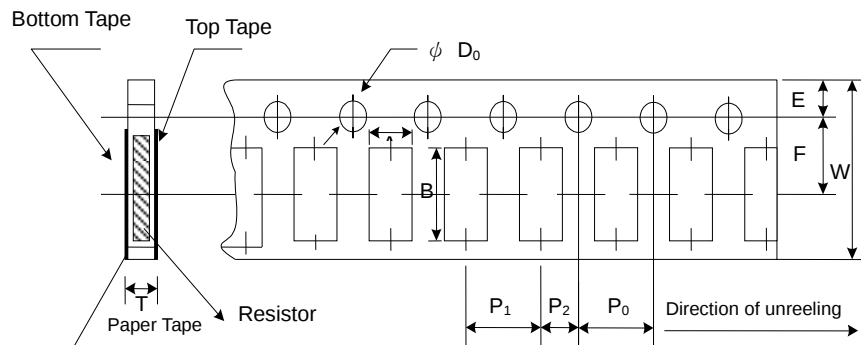
■Packaging

Reel Specifications & Packaging Quantity



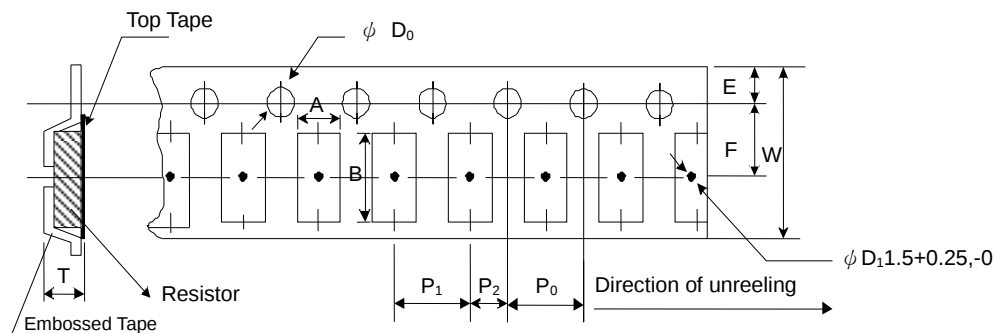
Type	Packaging Quantity		Tape Width	Reel Diameter	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)
PWR02	Paper	10K	8mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.2	9.0±0.5	12.5±0.5
		20K	8mm	10 inch	254±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		40K	8mm	13 inch	330±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
PWR03 PWR05 PWR06 PWR13	Paper	5K	8mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.2	9.0±0.5	12.5±0.5
		10K	8mm	10 inch	254±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		20K	8mm	13 inch	330±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
PWR10 PWR12	Embossed	4K	12mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.5	13.0±0.5	15.5±0.5
		8K	12mm	10 inch	250±1.0	62±0.5	13.0±0.5	12.5±0.5	16.5±0.5

Paper Tape Specifications



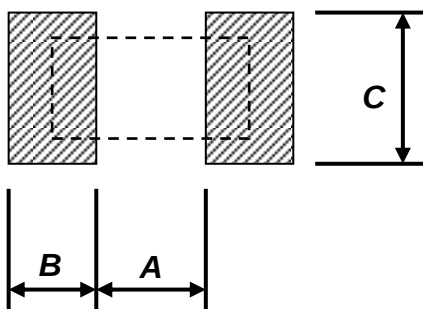
Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T (mm)
PWR02	0.65±0.10	1.15±0.10	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50+0.1,-0	0.45±0.1
PWR03	1.10±0.10	1.90±0.1	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.70±0.1
PWR05	1.60±0.10	2.40±0.2	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.1
PWR06	1.90±0.10	3.50±0.2	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.1
PWR13	2.90±0.10	3.50±0.2	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.1

Embossed Plastic Tape Specifications



Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T (mm)
PWR10	2.8±0.10	5.40±0.20	12.0±0.3	1.75±0.1	5.5±0.05	4.00±0.10	4.00±0.1	2.00±0.05	1.50+0.1, -0	1.2 ⁺⁰
PWR12	3.5±0.10	6.70±0.10	12.0±0.3	1.75±0.1	5.5±0.05	4.00±0.10	4.00±0.1	2.00±0.05	1.50+0.1, -0	1.2 ⁺⁰

Recommend Land Pattern



Type	A (mm)	B (mm)	C (mm)
PWR02	0.50	0.45	0.60
PWR03	0.90	0.60	0.90
PWR05	1.20	0.70	1.30
PWR06	2.00	0.90	1.60
PWR13	2.00	0.90	2.80
PWR10	3.80	0.90	2.80
PWR12	4.90	1.00	3.40

■ Marking

No Marking for 0402

0805~2512 4 digits marking for Example

Resistance	5.6Ω	97.6Ω	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ	1MΩ
marking	5R60	97R6	1000	2201	1002	4992	1003	1004

0603: 3 digits marking in E24

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

E24 code	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: 3 digits marking in E96 (E96 series except E24 series)



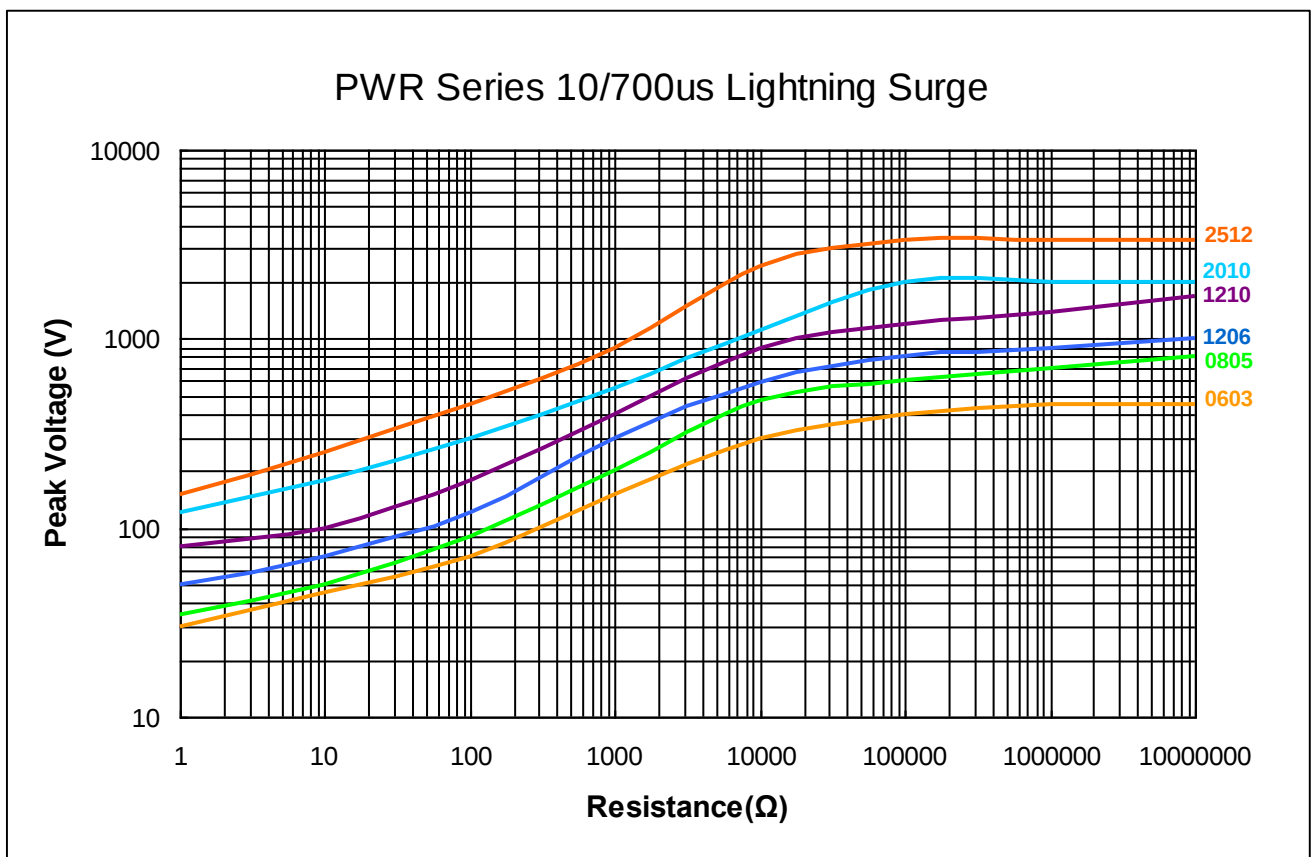
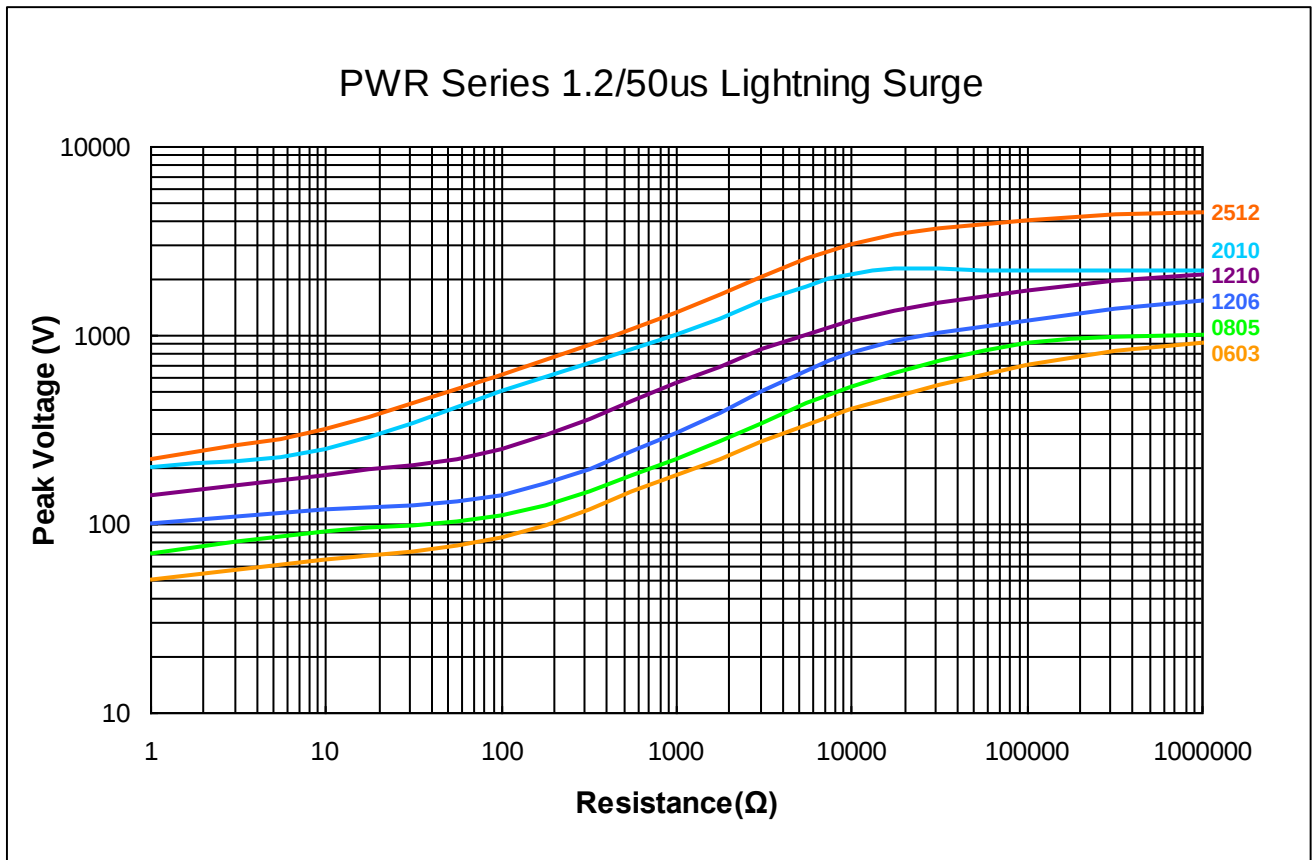
digits marking for Example: 13C=13K3Ω 68B=4K99Ω 68X=49.9Ω

Marking Table

Code	E96		Code	E96		Code	E96		Code	E96	
02	102		28	191		52	340		75	590	
03	105		29	196		53	348		76	604	
04	107		31	205		54	357		77	619	
06	113		32	210		55	365		78	634	
07	115		33	215		56	374		79	649	
08	118		34	221		57	383		80	665	
09	121		35	226		58	392		81	681	
10	124		36	232		59	402		82	698	
11	127		37	237		60	412		83	715	
13	133		38	243		61	422		84	732	
14	137		39	249		62	432		86	768	
15	140		40	255		63	442		87	787	
16	143		41	261		64	453		88	806	
17	147		42	267		65	464		89	825	
19	154		43	274		66	475		90	845	
20	158		44	280		67	487		91	866	
21	162		45	287		68	499		92	887	
22	165		46	294		69	511		93	909	
23	169		47	301		70	523		94	931	
24	174		48	309		71	536		95	953	
25	178		49	316		72	549		96	976	
26	182		50	324		73	562				
27	187		51	332		74	576				
Code	A	B	C	D	E	F	G	X	Y		
Multiplier	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁻¹	10 ⁻²		

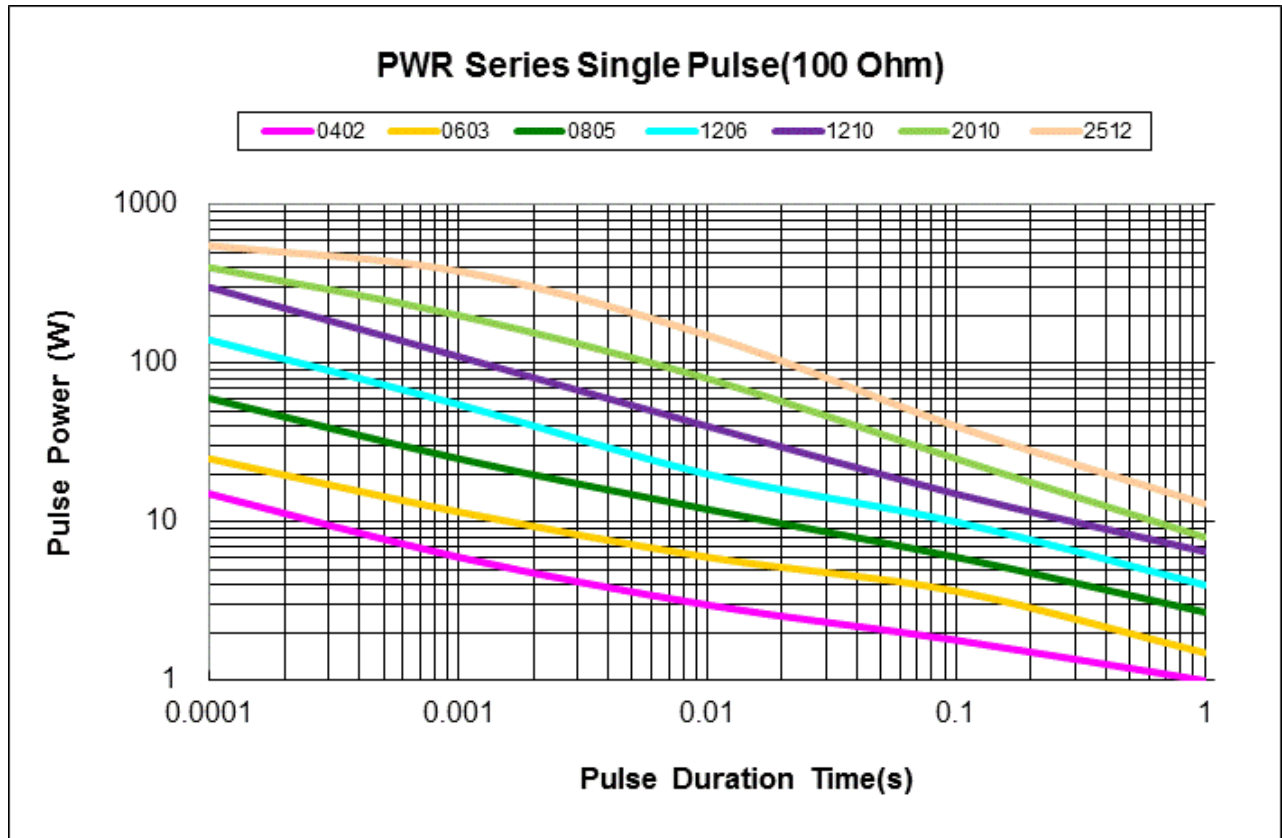
■ Lightning Surge

Resistors are tested in accordance with IEC 60115-1 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.



■ Pulse withstanding 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.



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.

