APPROVAL SHEET

MF12F/W, MF08F/W, MF06F/W, MF04F/W

±1%,±0.5%, ±0.25%, ±0.1%, ±0.05%

TC15 , TC10

Precision Thin Film Chip Resistors

Size 1206, 0805, 0603, 0402

AEC-Q200 Qualified

RoHS COMPLIANT

Pb Pb-Free

*Contents in this sheet are subject to change without prior notice.

FEATURE

1. SMD TaN Thin Film Resistor
2. Special passivation layer on resistive film
3. AEC-Q200 qualified
4. Products with lead free terminations meet RoHS requirements
5. Sulfur resistant (per ASTM B809-95 humid vapor test)
6. AEC-Q200 ESD rated class 1C (2 kV)
7. +/-0.02% is upon the customer request.
8. Laser trimmed to any value

APPLICATION

- Automotive Electronics
- Medical equipment
- Measuring instrument
- Industrial Equipment

DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum oxide). Internal metal electrodes are added at each end and connected by a resistive layer that is applied to the top surface of the substrate. The composition of the resistive layer is adjusted to give the approximate resistance required and the value is trimmed to nominated value within tolerance which controlled by laser trimming of this resistive layer.

The resistive layer is covered with a protective coat. Finally, the two external end terminations are added. For environmental soldering issue, the outer layer of these end terminations is a Lead-free solder .

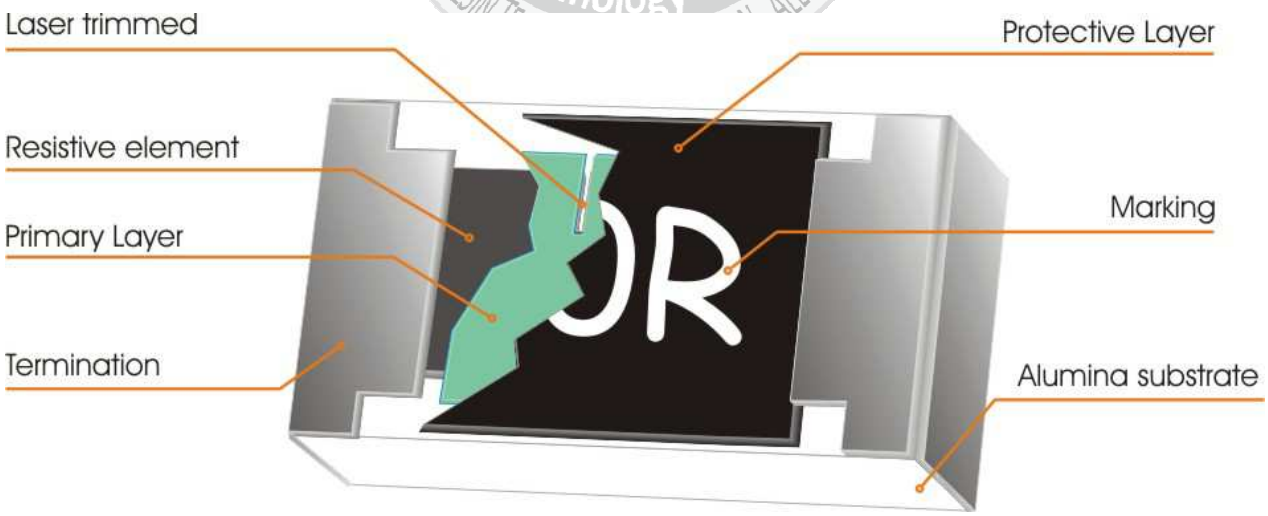


Fig 1. Construction of Chip-R MFxxF

QUICK REFERENCE DATA

Item	General Specification			
Series No.	MF12F&W	MF08F&W	MF06F&W	MF04F&W
Size code	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)
Resistance Tolerance	±1%, ±0.5%, ±0.25%, ±0.1%, ±0.05%			
Resistance Range	10Ω ~ 1MΩ	10Ω ~ 350KΩ	40Ω ~ 130KΩ	40Ω ~ 35KΩ
TCR (ppm/°C)	+15 /+10 ppm/°C			
Max. dissipation at T_{amb}=85°C	0.4W	0.2W	0.15W	0.0625W
Max. Operation Voltage (DC or RMS)	200V	100V	75V	50V
Max. Overload Voltage (DC or RMS)	400V	200V	150V	100V
Operating Temperature Range	- 55~ +155'C			

Note :

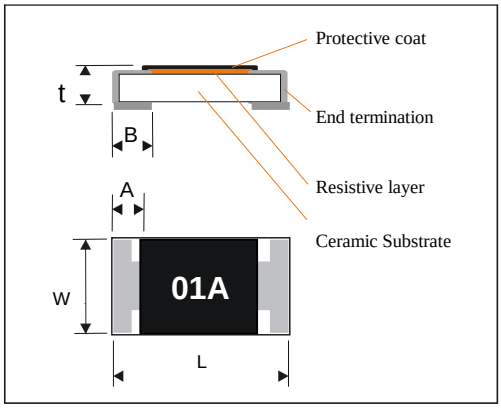
1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"

2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

$$RCWV = \sqrt{Rated\,Power \times Resistance\,Value}$$ or Max. RCWV listed above, whichever is lower.

DIMENSIONS:(unit:mm)

Type	MF12	MF08	MF06	MF04
L	3.10 ± 0.10	2.00 ± 0.10	1.55 ± 0.10	1.00 ± 0.10
W	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
A	0.40 ± 0.20	0.35 ± 0.20	0.3 ± 0.20	0.25 ± 0.15
B	0.40 ± 0.20	0.40 ± 0.20	0.30 ± 0.15	0.30 ± 0.10
t	0.60 ± 0.15	0.50 ± 0.15	0.45 ± 0.15	0.30 ± 0.10



MARKING

- ***3-digits marking for 0603 size***

3-digits marking（±1% : 0603）

Nominal resistance	Description
1.E-24 series	As *0603 WF06U* ±1%.
2.E-96 series	The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value : $Y=10^{-2}$，$X=10^{-1}$，$A=10^{0}$，$B=10^{1}$，$C=10^{2}$，$D=10^{3}$，$E=10^{4}$，$F=10^{5}$ EX : 17.8Ω=25X，178Ω=25A，1K78 =25B 17K8=25C， 178K=25D， 1M78=25E
3. Remark	There is no marking for the items are not under E-24 and E-96 series

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

- ***4-digits marking for 1206, 0805 size***

For E24/E96 series, each resistor is marked with a four digits code on the protective coating to designate the nominal resistance value. For non E24/E96 series, no marking is applied!

Example

RESISTANCE	10Ω	12Ω	100Ω	6800Ω	47000Ω
4-digits marking	10R0	12R0	1000	6801	4702

- ***No marking code for 0402 size***

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E192 & E24 series for resistors with a tolerance of ±1%, ±0.5%, ±0.25%, ±0.1%, ±0.05%. The values of the E24/E192 series are in accordance with “IEC publication 60063”.

Derating

The power that the resistor can dissipate depends on the operating temperature; see Fig.2

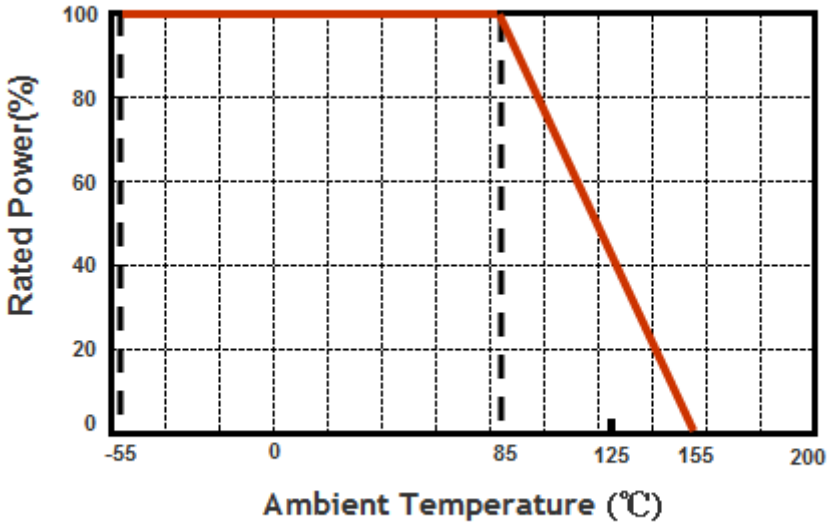


Fig.2 Maximum dissipation in percentage of rated power as a function of ambient temperature

MOUNTING

Due to their rectangular shapes and small tolerances, Surface Mountable Resistors are suitable for handling by automatic placement systems.

Chip placement can be on ceramic substrates and printed-circuit boards (PCBs).

Electrical connection to the circuit is by individual soldering condition.

The end terminations guarantee a reliable contact.

Storage and Handling Condition:

1. Products are recommended to be used up within two years. Check solderability in case shelf life extension is needed.
2. To store products with following condition:
   Temperature : 5 to 40℃
   Humidity : 20 to 70% relative humidity
3. Caution:
   a. Don’t store products in a corrosive environment such as sulfide, chloride gas, or acid. It may cause oxidation of electrode, which easily be resulted in poor soldering.
   b. To store products on the shelf and avoid exposure to moisture.
   c. Don’t expose products to excessive shock, vibration, direct sunlight and so on.

SOLDERING CONDITION

The robust construction of chip resistors allows them to be completely immersed in a solder bath of 260°C for 10 seconds. Therefore, it is possible to mount Surface Mount Resistors on one side of a PCB and other discrete components on the reverse (mixed PCBs).

Surface Mount Resistors are tested for solderability at 235°C during 2 seconds within lead-free solder bath. The test condition for no leaching is 260°C for 30 seconds. Typical examples of soldering profile and condition that provide reliable joints without any damage are given in Fig 3. and Table 1.

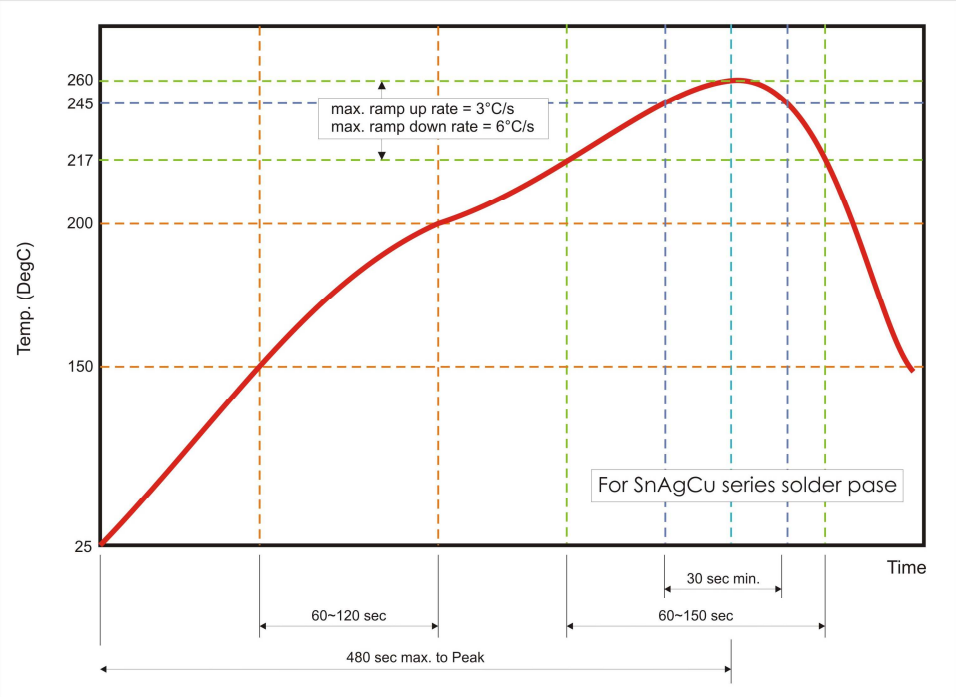


Fig. 3 Infrared soldering profile for Chip Resistors

Table 1. Infrared soldering condition for Chip Resistors

Temperature Condition	Exposure Time
Average ramp-up rate (217°C to 260°C)	Less than 3°C/second
Between 150 and 200°C	Between 60-120 seconds
> 217°C	Between 60-150 seconds
Peak Temperature	260ºC +0/-5°C
Time within 245°C	Min. 30 seconds
Ramp-down rate (Peak to 217°C)	Less than 6°C/second
Time from 25°C to Peak	No greater than 480 seconds

CATALOGUE NUMBERS

The resistors have a catalogue number starting with.

MF06	F	XXXX	B	T	L
Size code MF12: 1206 MF08: 0805 MF06: 0603 MF04: 0402	**Type code** F: TCR 15 ppm W: TCR 10 ppm	**Resistance code** 3 significant digits followed by no. of zeros 102Ω =1020 37.4KΩ =3742 220Ω =2200	**Tolerance** F : ±1% D : ±0.5% C: ±0.25% B : ±0.1% A : ±0.05%	**Packaging code** T: 7" Taped & Reeled M: 7" Taped & Reeled. Size: 0402 ,5Kpcs /RL Z : 7"Taped & Reeled 3kpcs/RL V : 7" Reel & Taped 1Kpcs	**Termination code** L = Sn base (lead free)

1. Reeled tape packaging: 8mm width paper taping.

   5,000pcs/Reel for MF06F&W; MF08F&W, MF12F&W

   5,000pcs and 10,000pcs /Reel for MF04F&W

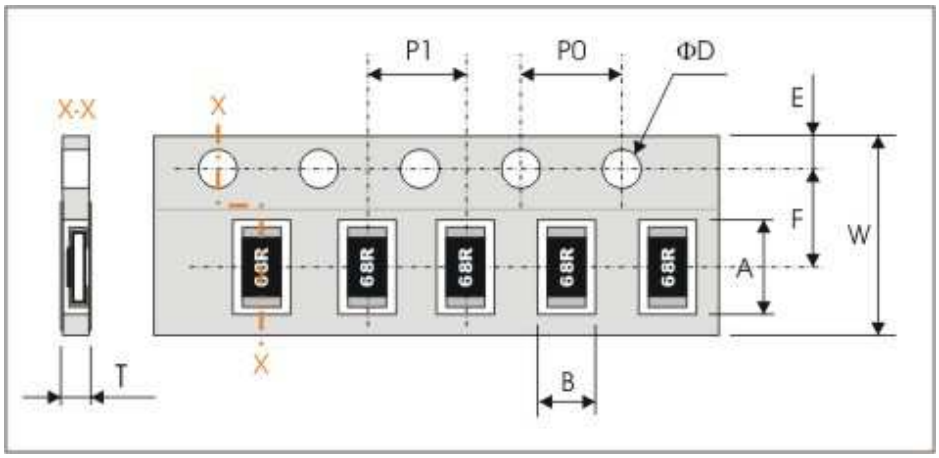
TEST AND REQUIREMENTS

TEST	PROCEDURE	REQUIREMENT
		Resistor
Electrical Characteristics **IEC 60115-1 4.8**	- DC resistance values measurement - Temperature Coefficient of Resistance (T.C.R) Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ (ppm/°C) t_1 : 20℃+5℃-1℃ R_1 : Resistance at reference temperature (20℃+5℃/-1℃) R_2 : Resistance at test temperature (-55℃ or +125℃)	Within the specified tolerance
Short time overload (S.T.O.L) **IEC 60115-1 4.13**	Permanent resistance change after a 5second application of a voltage 2.5 times RCWV or the maximum overload voltage specified in the above list, whichever is less.	ΔR/R max. ±(0.1%+0.02Ω)
Resistance to soldering heat(R.S.H) **AEC-Q200-15**	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 260℃±5ºC	no visible damage Δ R/R max. ±(0.1%+0.02Ω)
Solderability **IEC 60068-2-58**	Un-mounted chips completely immersed for 2±0.5 second in a SAC solder bath at 235℃±5℃	good tinning (>95% covered) no visible damage
Temperature cycling **JESD22 method JA-104**	1,000 cycles, -55℃ ~ +125℃, dwell time 5~10min	ΔR/R max. ±(0.1%+0.02Ω)
	1,000 cycles, -55℃ ~ +155℃, dwell time 5~10min	ΔR/R max. ±(0.2%+0.02Ω)
Bias Humidity **AEC-Q200-7**	1,000 +48/-0 hours, loaded with 10% rated power in humidity chamber controller at +85℃/ 85%RH	ΔR/R max. ±(0.1%+0.02Ω)
Load Life **IEC 60115-1 4.25**	1,000 +48/-0 hours, loaded with RCWV or Vmax in chamber controller 85 ±2ºC, 1.5 hours on and 0.5 hours off	ΔR/R max. ±(0.1%+0.02Ω)
Operational Life **AEC-Q200-8** **MIL-STD-202 -108**	1,000 hours at 125±2℃, loaded with rated power continuously	ΔR/R max. ±(0.1%+0.02Ω)
High Temperature Exposure **AEC-Q200-3**	1,000 hours 125℃, un-powered	ΔR/R max. ±(0.1%+0.02Ω)
	1,000 hours 155℃, un-powered	ΔR/R max. ±(0.15%+0.02Ω)
Moisture Resistance **AEC-Q200-6** **MIL-STD-202 Method 106**	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(0.1%+0.02Ω)
Mechanical Shock **MIL-STD-202 Method 213**	1/2 Sine Pulse / 1500g Peak / Velocity 15.4ft/sec	ΔR/R max. ±(0.1%+0.02Ω)

TEST	PROCEDURE	REQUIREMENT
		Resistor
Vibration **MIL-STD-202 Method 204**	5 g's for 20 min , 12 cycles each of 3 orientations	ΔR/R max. ±(0.1%+0.02Ω)
Terminal strength **AEC-Q200-6**	1 kg for 60 s	No broken
Board flex **AEC-Q200-005**	Bending 2mm for 60 sec	ΔR/R max. ±(0.1%+0.02Ω)
Flower of sulfur **ASTM-B809-95**	105±2℃, duration 1,000hours.	0402 ΔR/R max. ±(0.2%+0.02Ω) others ΔR/R max. ±(0.1%+0.02Ω)

PACKAGING

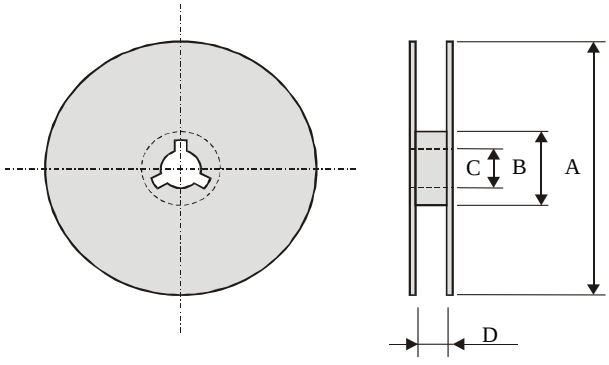
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
MF12	3.60±0.20	2.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
MF08	2.40±0.20	1.65±0.20	8.00±0.30	3.50±0.20	1.75±0.10
MF06	1.90±0.20	1.10±0.20	8.00±0.30	3.50±0.20	1.75±0.10
MF04	1.20±0.10	0.7±0.10	8.00±0.30	3.50±0.05	1.75±0.10

Series No.	P1	P0	ΦD	T
MF12	4.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.0
MF08	4.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.0
MF06	4.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	0.65±0.05
MF04	2.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	0.40±0.05

Reel dimensions



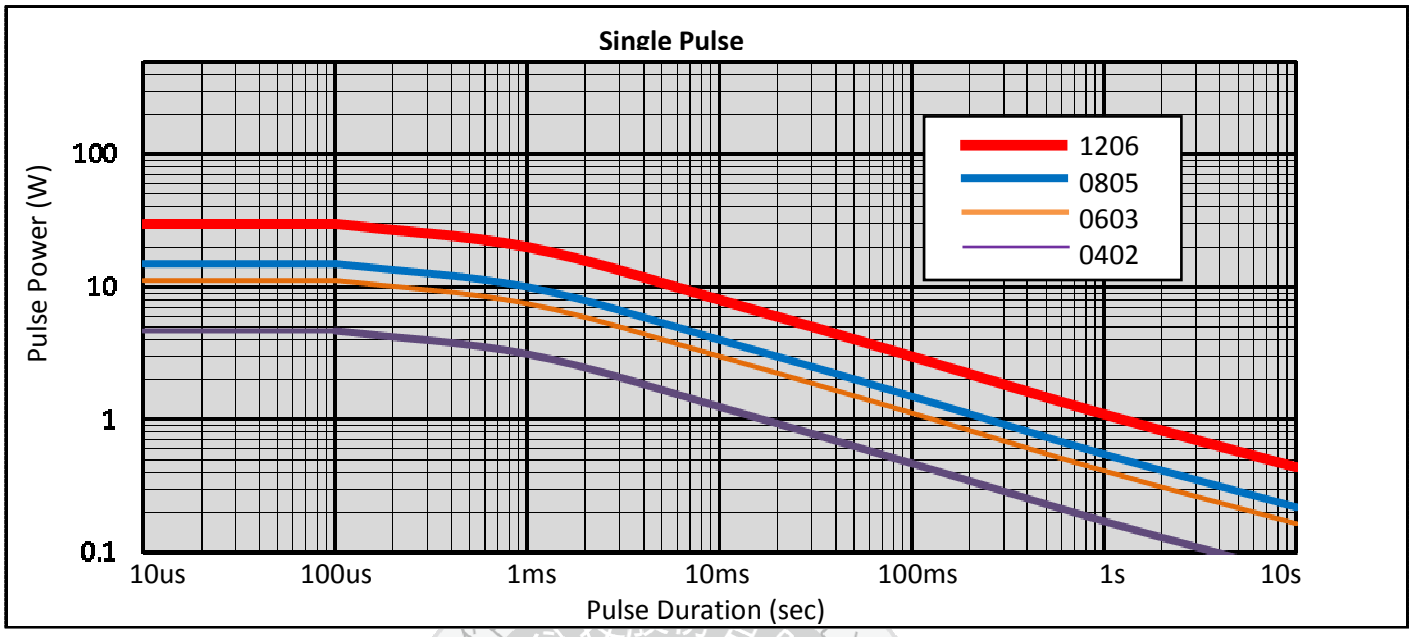
Symbol	A	B	C	D
(unit : mm)	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0±0.5

Taping quantity

- Chip resistors 5,000 pcs per reel (MF06F&W, MF08F&W, MF12F&W)
- Chip resistors 5,000pcs and 10,000 pcs per reel (MF04F&W)

PULSE LOAD PERFORMANCE:

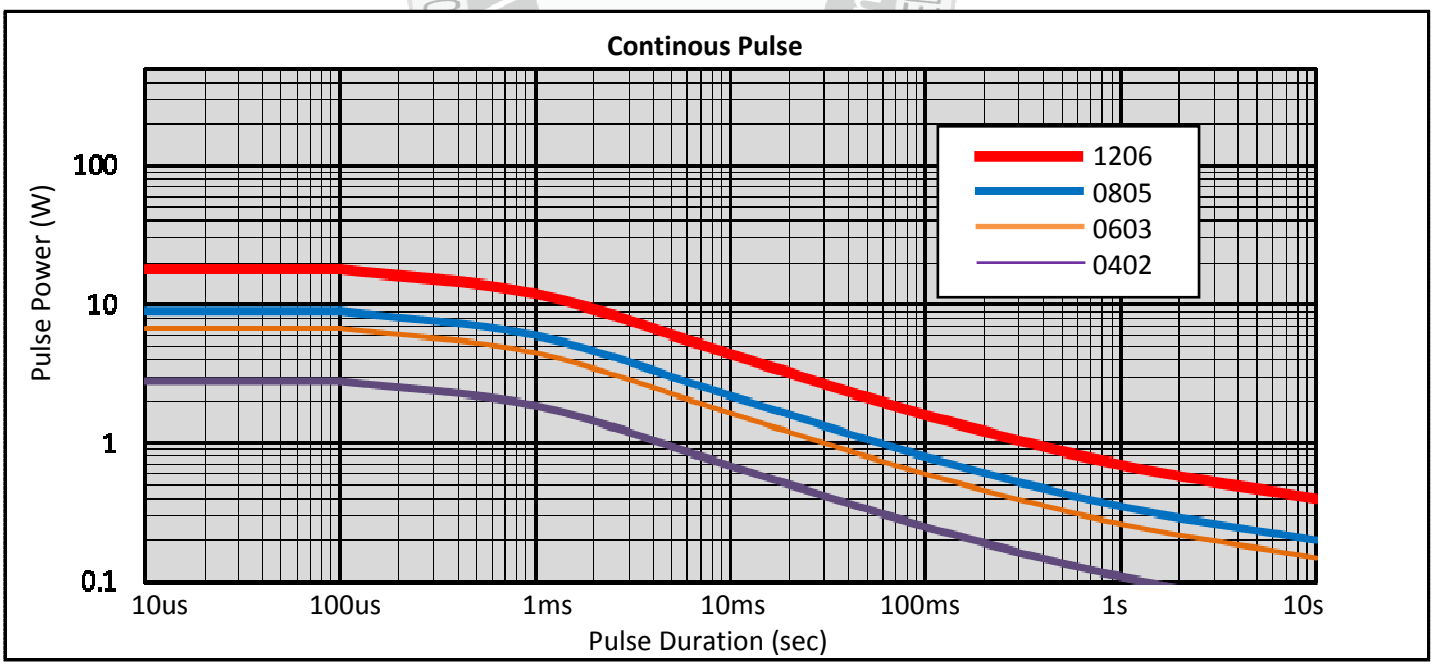
Single Pulse：



Single Pulse for $R \geq$ 10 Ω

50 rectangular pulse amplitudes are applied to the component at intervals of 60seconds, permissible the resistance to be varied by ± (0.5% R + 0.01Ω).

Continuous Pulse：

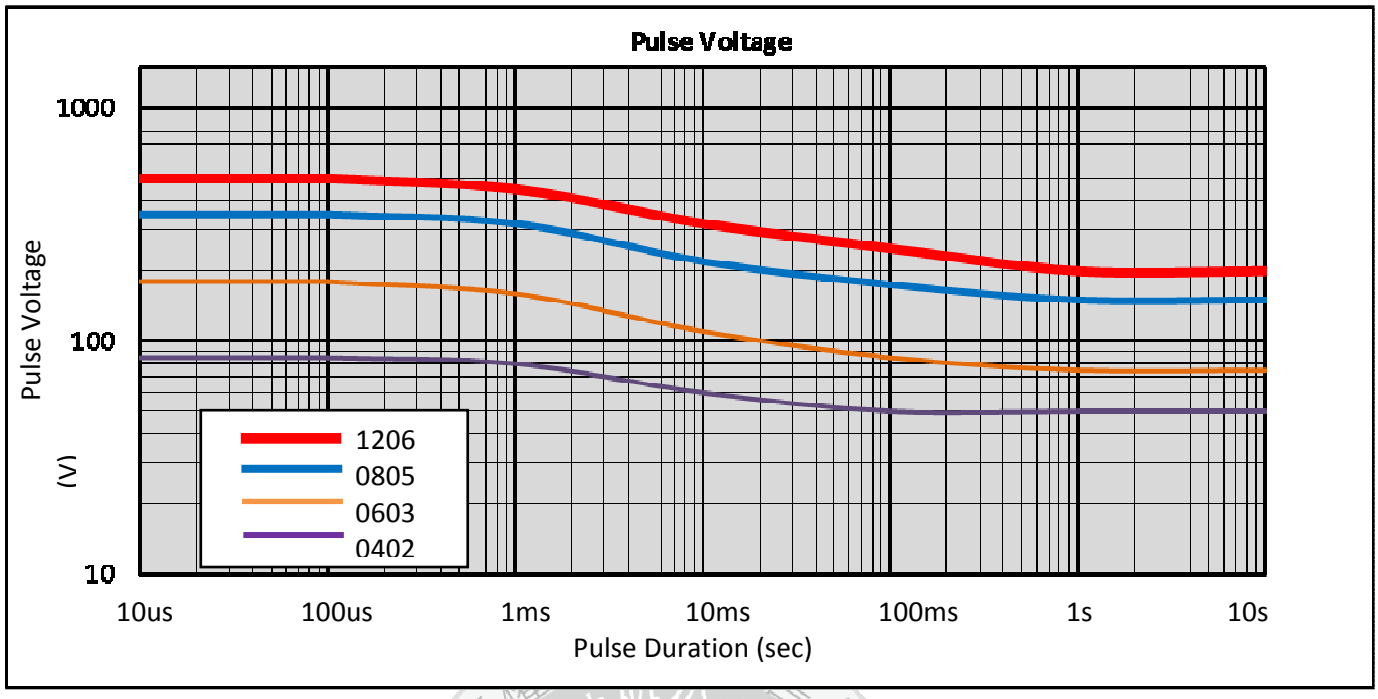


Continuous Pulse for $R \geq$ 10 Ω

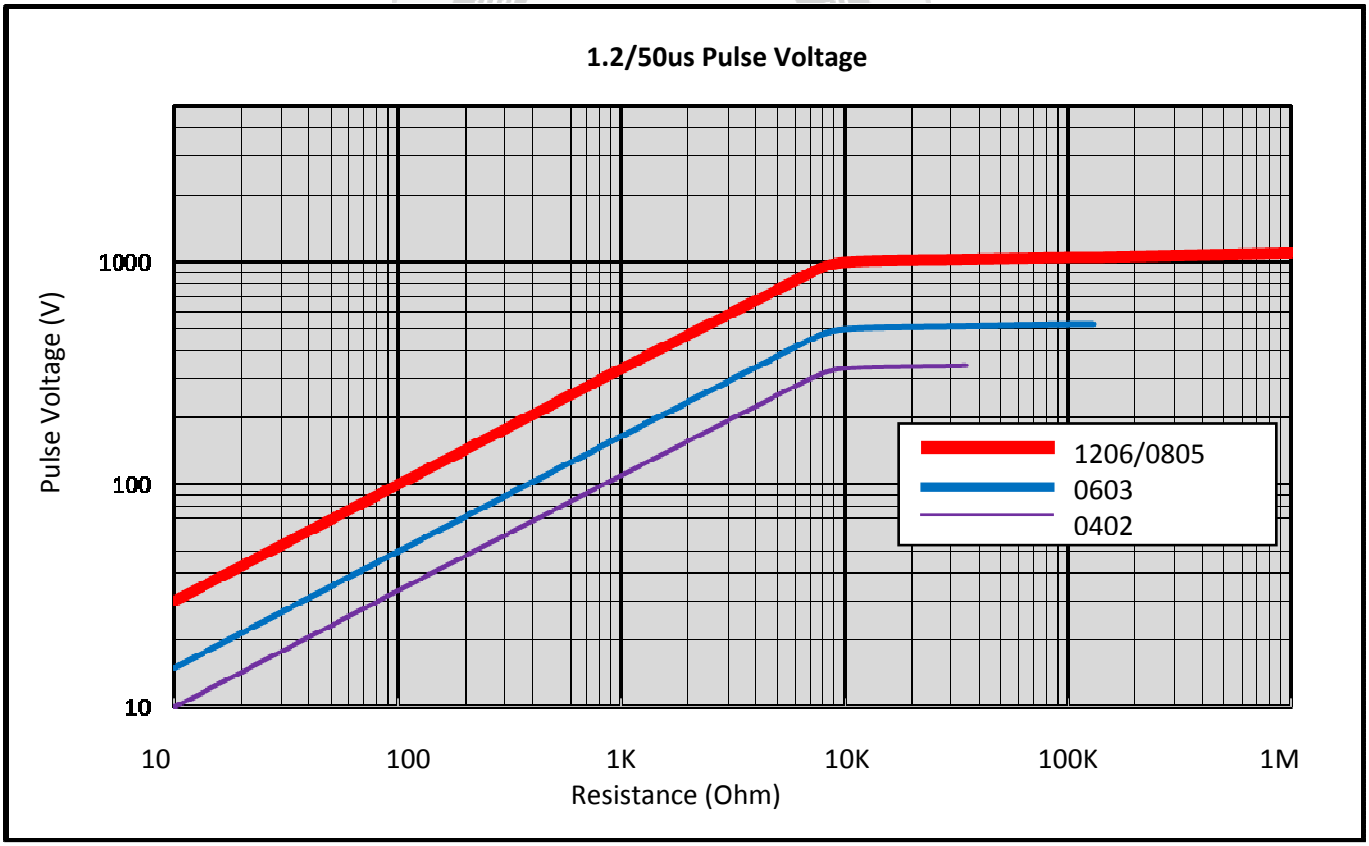
Continuous load is a pulse period generated by the repetitive rectangular pulse amplitude, the applied power dissipation is at a rated power of 70 °C.

Permissible the resistance to be varied by ± (0.5% R + 0.01Ω).

Pulse Voltage：

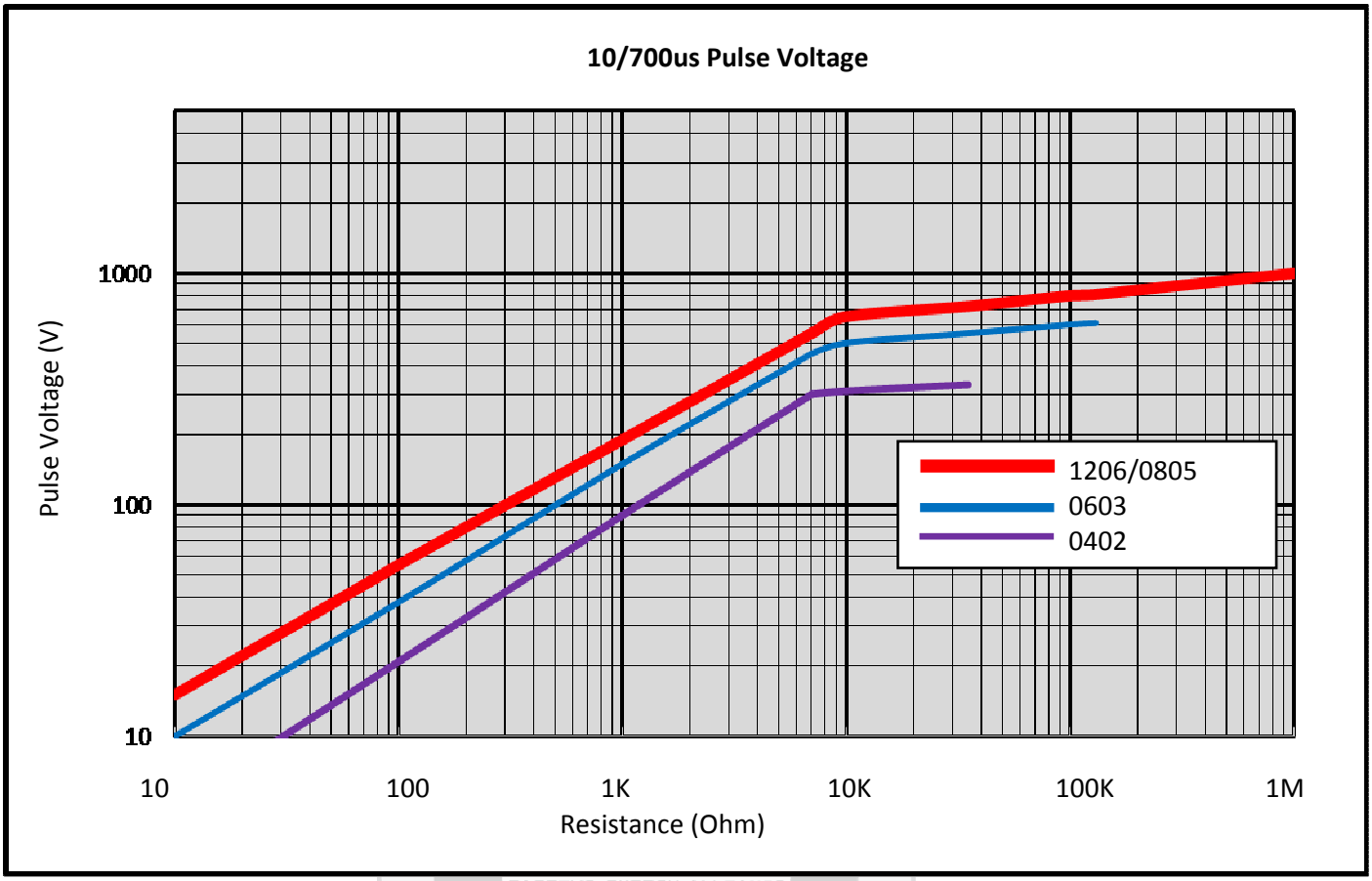


Pulse Surge Overload：
1.2 / 50us Pulse



According to IEC 60115-1 4.27 1.2 / 50us use 5 pulses at 12sec intervals pulse shapes test resistor,permissible the resistance to be varied by ± (0.5% R + 0.01Ω).

10 / 700us Pulse



According to IEC 60115-1 4.27 10 / 700us use 10 pulses at 60sec intervals pulse shapes test resistor, permissible the resistance to be varied by ± (0.5% R + 0.01Ω).