

# APPROVAL SHEET

## **MF12E, MF08E, MF06E, MF04E**

**$\pm 5\%$ ,  $\pm 1\%$ ,  $\pm 0.5\%$**

Thick Film Triple Power Surge Chip Resistors

Size 1206 , 0805, 0603, 0402

Automotive AEC Q200 Qualified

Anti-Sulfuration ASTM B-809 50'C 1000hrs

RoHS 2 Compliant with exemption 7C-1  
Halogen free

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

## FEATURE

1. High reliability and stability
2. Reduced size of final equipment
3. Ultra high power
4. Automotive AEC Q200 compliant
5. RoHS compliant with exemption 7C-1 and Halogen free products
6. Anti-Sulfuration against ASTM B-809 50C 90% RH, 1000hrs
7. Flammability against UL94-V0

## APPLICATION

- Consumer electrical equipment
- Automotive application
- EDP, Computer application
- Telecom application

## 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 paste that is applied to the top surface of the substrate. The composition of the paste 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 ease of soldering the outer layer of these end terminations is a Tin (lead free) alloy.

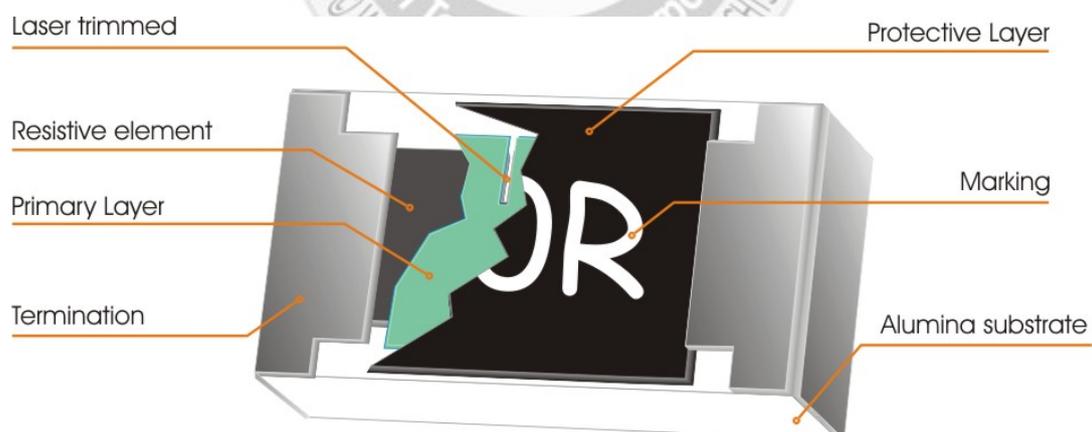


Fig 1. Construction of Chip-R

## QUICK REFERENCE DATA

Type	Size	Power Rating at 70°C	Max. RCWV	Max. Overload Voltage	Resistance Tolerance	Temperature Coefficient (ppm/°C)	Resistance Range		Standard Resistance Values
							Min.	Max.	
MF04E	0402	1/5W	50V	100V	±1%(F) ±0.5%(D)	±100ppm	10Ω	1MΩ	E96/E24
					±1%(F)	±200ppm	1Ω	9.76Ω	E96/E24
					±5%(J)	±200ppm	1Ω	1MΩ	E24
MF06E	0603	1/3W	75V	125V	±1%(F) ±0.5%(D)	±100ppm	10Ω	1MΩ	E96/E24
					±1%(F)	±200ppm	1Ω	9.76Ω	E96/E24
					±5%(J)	±200ppm	1Ω	1MΩ	E24
MF08E	0805	1/2W	200V	300V	±1%(F) ±0.5%(D)	±100ppm	10Ω	1MΩ	E96/E24
					±1%(F)	±150ppm	1Ω	9.76Ω	E96/E24
					±5%(J)	±200ppm	1Ω	1MΩ	E24
MF12E	1206	3/4W	250V	500V	±1%(F) ±0.5%(D)	±100ppm	10Ω	1MΩ	E96/E24
					±1%(F)	±200ppm	1Ω	9.76Ω	E96/E24
					±5%(J)	±200ppm	1Ω	1MΩ	E24

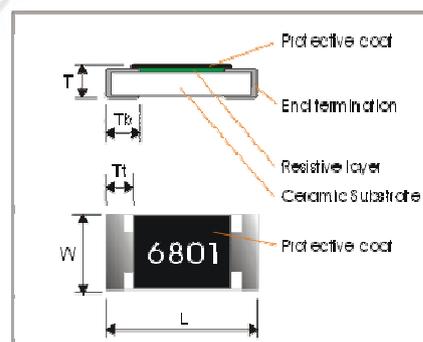
Note :

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

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

## DIMENSIONS (unit : mm)

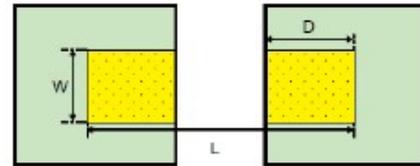
Part No	MF12E	MF08E	MF06E	MF04E
<b>L</b>	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
<b>W</b>	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
<b>Tt</b>	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20	0.20 ± 0.10
<b>Tb</b>	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20	0.25 ± 0.10
<b>t</b>	0.55 ± 0.10	0.50 ± 0.10	0.45 ± 0.10	0.35 ± 0.05



**Recommend Solder Pad Dimensions :**

Type	W	D	L
MF06E	0.90	1.00	3.00
MF08E	1.30	1.15	3.50
MF12E	1.80	1.30	4.70
MF04E	0.60	0.50	1.50

Unit:mm



**MARKING**

**0402 has no marking.**

**E24 ±5% : 3 Digits marking to identify the resistance value**

0603/0805/1206



$$301 \rightarrow 30 \times 10^1 = 300 \Omega$$

**E24/E96 ±1% : 4 Digits marking to identify the resistance value**

0805/1206



$$1542 \rightarrow 154 \times 10^2 = 15.4 \text{ K}\Omega$$

E24 ±1% : 3 Digits marking to identify the resistance value

0603



$$222 \rightarrow 22 \times 10^2 = 2.2 \text{ K}\Omega$$

E96 ±1% : 3 Digits marking to identify the resistance value

0603



01B → Refer 0603 marking table = 1 KΩ

■ 0603 1% Marking Table (Table 1)

Code	E48	E96									
01	100	100	25	178	178	49	316	316	73	562	562
02		102	26		182	50		324	74		576
03	105	105	27	187	187	51	332	332	75	590	590
04		107	28		191	52		340	76		604
05	110	110	29	196	196	53	348	348	77	619	619
06		113	30		200	54		357	78		634
07	115	115	31	205	205	55	365	365	79	649	649
08		118	32		210	56		374	80		665
09	121	121	33	215	215	57	383	383	81	681	681
10		124	34		221	58		392	82		698
11	127	127	35	226	226	59	402	402	83	715	715
12		130	36		232	60		412	84		732
13	133	133	37	237	237	61	422	422	85	750	750
14		137	38		243	62		432	86		768
15	140	140	39	249	249	63	442	442	87	787	787
16		143	40		255	64		453	88		806
17	147	147	41	261	261	65	464	464	89	825	825
18		150	42		267	66		475	90		845
19	154	154	43	274	274	67	487	487	91	866	866
20		158	44		280	68		499	92		887
21	162	162	45	287	287	69	511	511	93	909	909
22		165	46		294	70		523	94		931
23	169	169	47	301	301	71	536	536	95	953	953
24		174	48		309	72		549	96		976

Code	A	B	C	D	E	F	G	H	X	Y	Z
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>7</sup>	10 <sup>-1</sup>	10 <sup>-2</sup>	10 <sup>-3</sup>

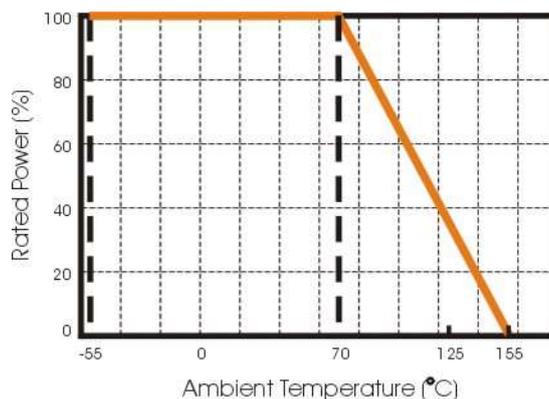
## FUNCTIONAL DESCRIPTION

### Product characterization

Standard values of nominal resistance are taken from the E96 & E24 series for resistors with a tolerance of  $\pm 0.5\%$ ,  $\pm 1\%$ ,  $\pm 5\%$ . The values of the E24/E96 series are in accordance with "IEC publication 60063".

### Derating

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



## 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. The test condition for no leaching is 260°C for 30 seconds. Typical examples of soldering processes that provide reliable joints without any damage are given in Fig 3.

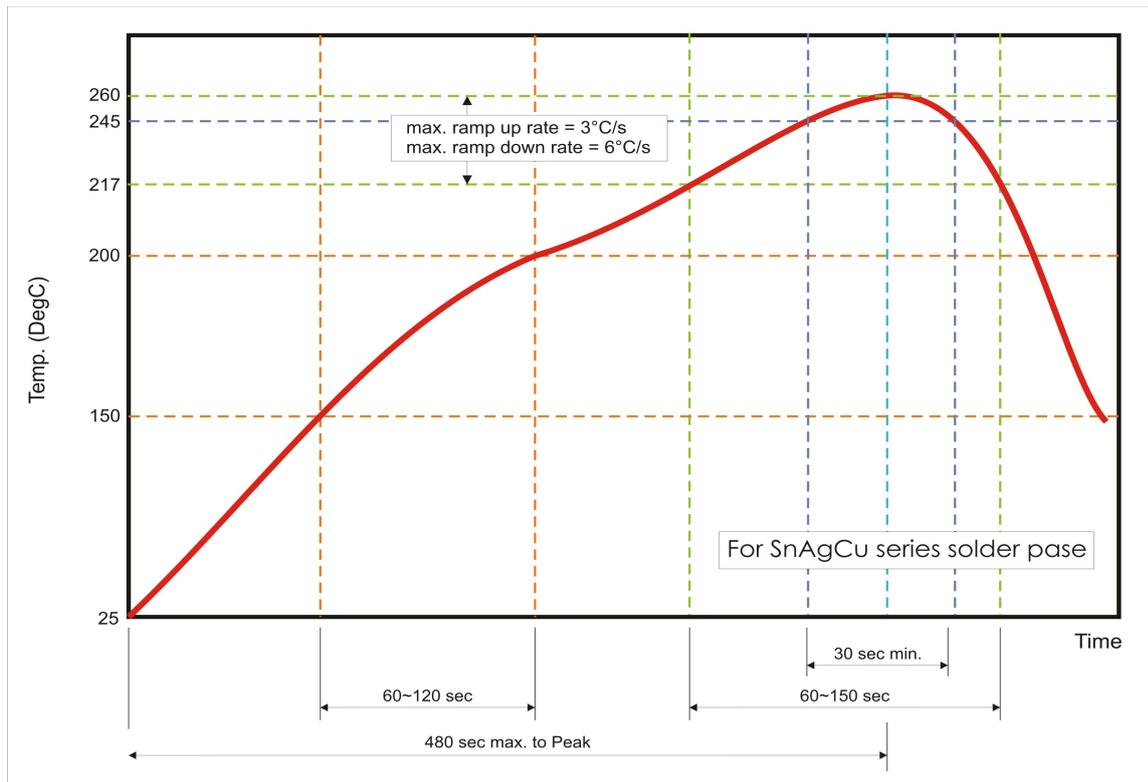


Fig 3. Infrared soldering profile for Chip Resistors

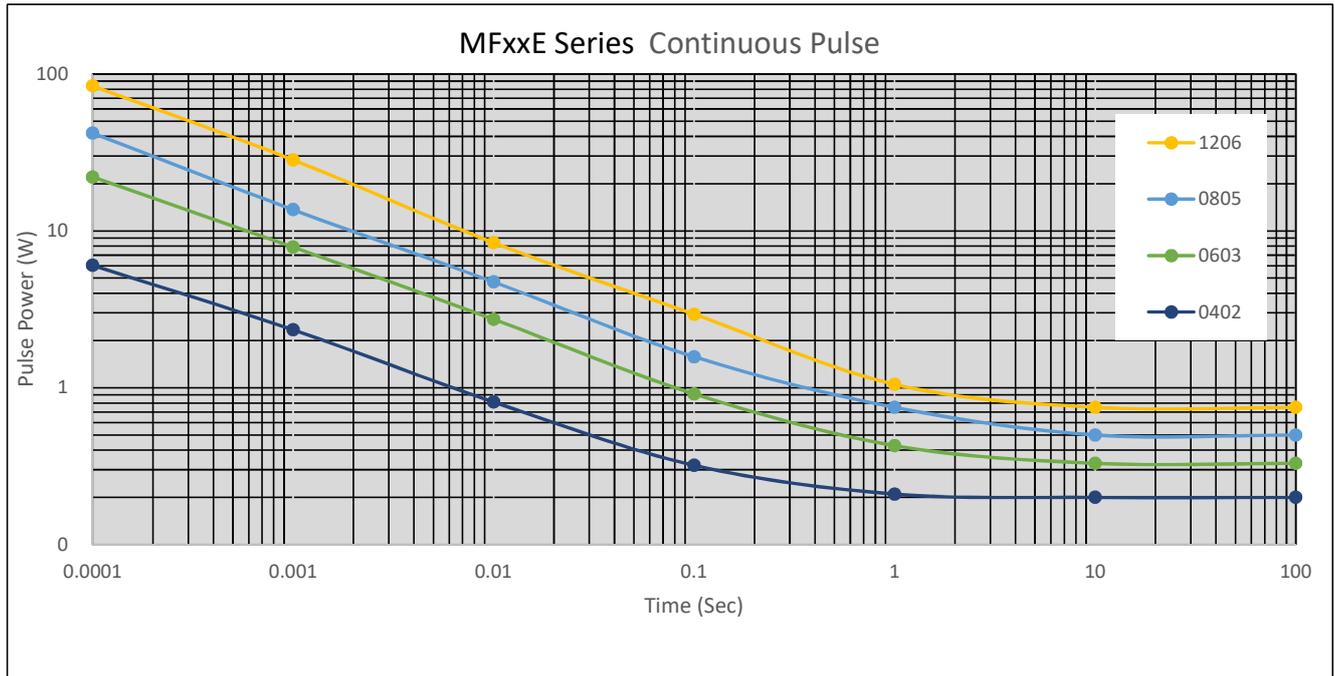
### CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

MF12	E	1202	F	T	L
<b>Size code</b>	<b>Type code</b>	<b>Resistance code</b>	<b>Tolerance</b>	<b>Packaging code</b>	<b>Termination code</b>
MF12: 1206 MF08: 0805 MF06: 0603 MF04: 0402	E : Triple Power + Surge	5%, E24: 2 significant digits followed by no. of zeros 100Ω = 101_ 10KΩ = 103_ 1%, E24+E96: 3 significant digits followed by no. of zeros 100Ω = 1000 37.4KΩ = 3742	J: ± 5% F: ± 1% D: ± 0.5%	T: 7" Reeled taping	L = Sn base (lead free)

- Reeled tape packaging : 0603/0805/1206 8mm width paper taping 5,000pcs per 7" reel.  
0402 8mm width paper taping 10,000pcs per 7" reel.

**SURGE POWER CHART**



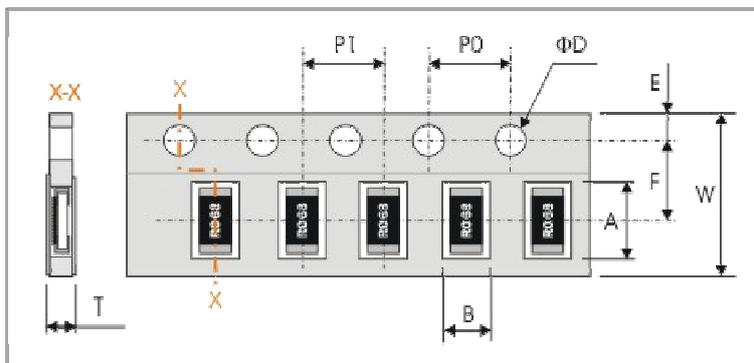
**TEST AND REQUIREMENTS ( AEC Q200 )**

Test Item	Specification	Test Method (AEC-Q200. IEC 60115)
<b>DC Resistance</b>	J : ±5% F : ±1% D : ±0.5%	<b>AEC-Q200 TABLE 7.1</b> <b>IEC 60115-1 / JIS C 5201-1 , Clause 4.5</b> Measure the resistance Value.
<b>Short Time Overload</b>	J : $\Delta R \leq \pm(2\%+0.1\Omega)$ F, D : $\Delta R \leq \pm(1\%+0.05\Omega)$	<b>IEC 60115-1, Clause 4.13</b> 5 x rated power for 5 seconds
<b>High Temperature Exposure (Storage)</b>	J : $\Delta R \leq \pm(3\%+0.1\Omega)$ F, D : $\Delta R \leq \pm(1\%+0.05\Omega)$	<b>AEC-Q200 TABLE 7.3</b> 1000 hrs. @ T=125°C. Unpowered. Measurement at 24 ±2 hours after test conclusion.
<b>Temperature Cycling</b>	J : $\Delta R \leq \pm(1\%+0.1\Omega)$ F, D : $\Delta R \leq \pm(0.5\%+0.05\Omega)$ No mechanical damage.	<b>AEC-Q200 TABLE 7.4</b> 1000 Cycles (-55°C to +125°C). Measurement at 24±2 hours after test conclusion.
<b>Moisture Resistance</b>	$\Delta R \leq \pm(0.5\%+0.05\Omega)$	<b>AEC-Q200 TABLE 7.6</b> Test 65°C/80~100%RH/10Cycles. Measurement at 24±2 hours after test conclusion. (t=24hrs/cycle).
<b>Biased Humidity</b>	$\Delta R \leq \pm(1\%+0.05\Omega)$	<b>AEC-Q200 TABLE 7.7</b> 1000 hours 85°C/85%RH. 10% of operating power. Measurement at 24 ±2 hours after test conclusion.

Test Item	Specification	Test Method (AEC-Q200. IEC 60115)
<b>Operational Life</b>	$\Delta R \leq \pm(1\%+0.05\Omega)$	<b>AEC-Q200 TABLE 7.8</b> Test 1000hr @ TA=125°C at specified rated power. Measurement at 24±2 hours after test conclusion.
<b>External Visual</b>	No visual damage and refer the marking code specification.	<b>AEC-Q200 TABLE 7.9</b> Inspect device construction, marking and workmanship.
<b>Physical Dimension</b>	Within the specification..	<b>AEC-Q200 TABLE 7.10</b> Verify physical dimensions to the applicable device detail specification.
<b>Mechanical Shock</b>	Within product specification tolerance and no visible damage.	<b>AEC-Q200 TABLE 7.13</b> Test Peak value:100g's,Wave:Hail-sine, Duration:6ms,Velocity:12.3ft/sec.
<b>Vibration</b>	$\Delta R \leq \pm(1\%+0.05\Omega)$ no mechanical damage.	<b>AEC-Q200 TABLE 7.14</b> 5 g's for 20 min., 12 cycles each of 3 orientations. Test from 10-2000 Hz.
<b>Resistance To Solder Heat</b>	$\Delta R \leq \pm(0.5\%+0.05\Omega)$ No mechanical damage.	<b>AEC-Q200 TABLE 7.15</b> Solder dipping @ 270°C±5°C for 10sec.±1sec.
<b>Thermal Shock</b>	$\Delta R \leq \pm(0.5\%+0.05\Omega)$ No mechanical damage.	<b>AEC-Q200 TABLE 7.16</b> -55 to 155°C / dwell time 15min/ Max transfer time 20sec/ 300cycles.
<b>ESD</b>	$\Delta R \leq \pm(1\%+0.1\Omega)$ No mechanical damage.	<b>AEC-Q200-002</b> Test contact min. 1KV (0.5KV for 0402 only).
<b>Solder Ability</b>	Over 95% of termination must be covered with solder.	<b>AEC-Q200 TABLE 7.18</b> a)Baking 155°C 4H, dipping 235°C 5s b)Steam 8H, dipping 215°C 5s c)Steam 8H, dipping 260°C 7s
<b>Flammability</b>	Refer UL-94.	<b>AEC-Q200 TABLE 7.20</b> UL-94 V-0 or V-1 are acceptable
<b>Board Flex</b>	$\Delta R \leq \pm(0.5\%+0.05\Omega)$ No mechanical damage.	<b>AEC-Q200 TABLE 7.21</b> Bending 2mm for 2512,2010,1210,1206,0402 3mm for 0805,0603
<b>Terminal Strength</b>	No mechanical damage	<b>AEC-Q200 TABLE 7.22</b> Force: 1.8kg (0402 for 1.0kg) / 60 sec
<b>Temperature Coefficient of Resistance (TCR)</b>	Within the spec.	<b>IEC 60115-1, Clause 4.8</b> T1 T2 Test temperature : 25°C~ -55°C 25°C~ +155°C $TCR(ppm/^{\circ}C) = (R2-R1)/R1 \times 1 / (T2-T1) \times 10^6$

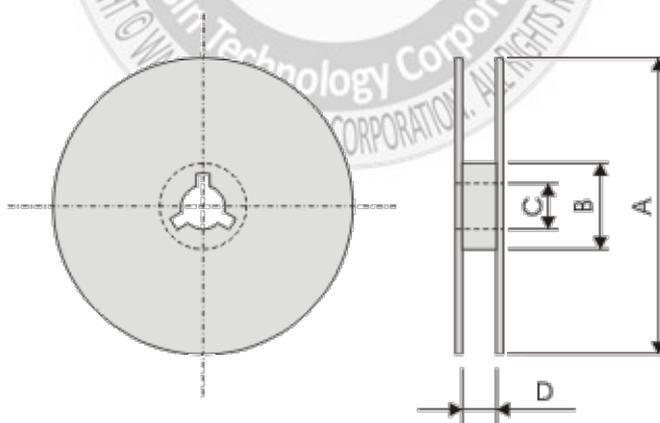
## PACKAGING

### Paper Tape specifications (unit :mm)



Component Size / Series	W	F	E	P0	ΦD
MF12E	8.00±0.30	3.50±0.20	1.75±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>
MF08E	8.00±0.30	3.50±0.20	1.75±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>
MF06E	8.00±0.30	3.50±0.20	1.75±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>
MF04E	8.00±0.30	3.50±0.20	1.75±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>
Component Size / Series	A	B	P1	T	
MF12E	3.60±0.20	2.00±0.20	4.00±0.10	Max. 1.0	
MF08E	2.40±0.20	1.65±0.20	4.00±0.10	Max. 1.0	
MF06E	1.90±0.20	1.10±0.20	4.00±0.10	Max. 0.8	
MF04E	1.20±0.10	0.70±0.10	4.00±0.10	Max. 0.6	

### 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

- 0603/0805/1206 Chip resistors 5,000 pcs/reel. 0402 10,000pcs/reel.