APPROVAL SHEET

MF12E, MF08E, MF06E

±1%, ±5%

Thick Film Triple Power Surge Chip Resistors
Size 1206 3/4W, 0805 1/2W, 0603 1/3W
Automotive AEC Q200 Compliant

*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 and Lead free products

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.

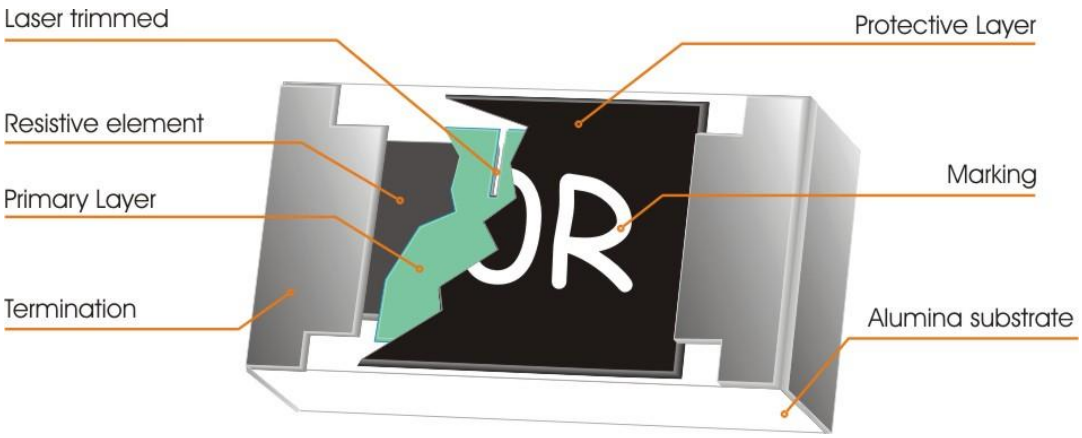


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

Type	Size	Power Rating at 70℃	Max. RCWV	Max. Overload Voltage	Resistance Tolerance	Temperature Coefficient (ppm/℃)	Resistance Range		Standard Resistance Values
							Min.	Max.	
MF06E	0603	1/3W	75V	125V	±1%(F)	±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)	±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)	±100ppm	1Ω	1MΩ	E96/E24
					±5%(J)	±200ppm	1Ω	1MΩ	E24

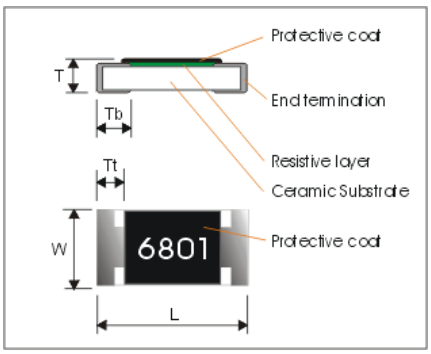
Note :

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)

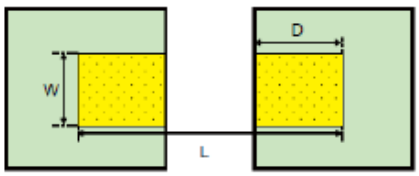
Part No	MF12E	MF08E	MF06E
L	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10
W	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10
Tt	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20
Tb	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20
t	0.55 ± 0.10	0.50 ± 0.10	0.45 ± 0.10



Recommend Solder Pad Dimensions :

Unit:mm

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



MARKING

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

0603/0805/1206

301 → $30 \times 10^{1} = 300\Omega$

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

0805/1206

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

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

0603

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

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	Code	E48	E96	Code	E48	E96	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	10^0	10^1	10^2	10^3	10^4	10^5	10^6	10^7	10^{-1}	10^{-2}	10^{-3}

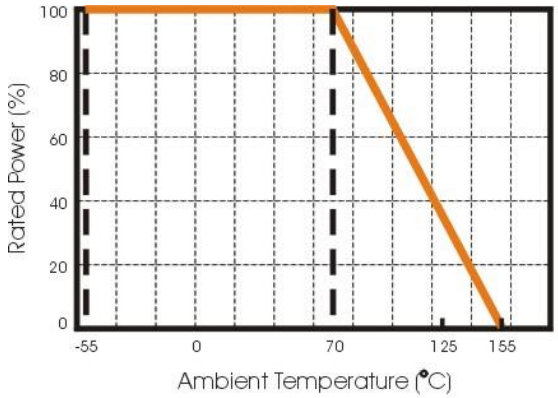
FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E96 & E24 series for resistors with a tolerance of ±1%, ±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.

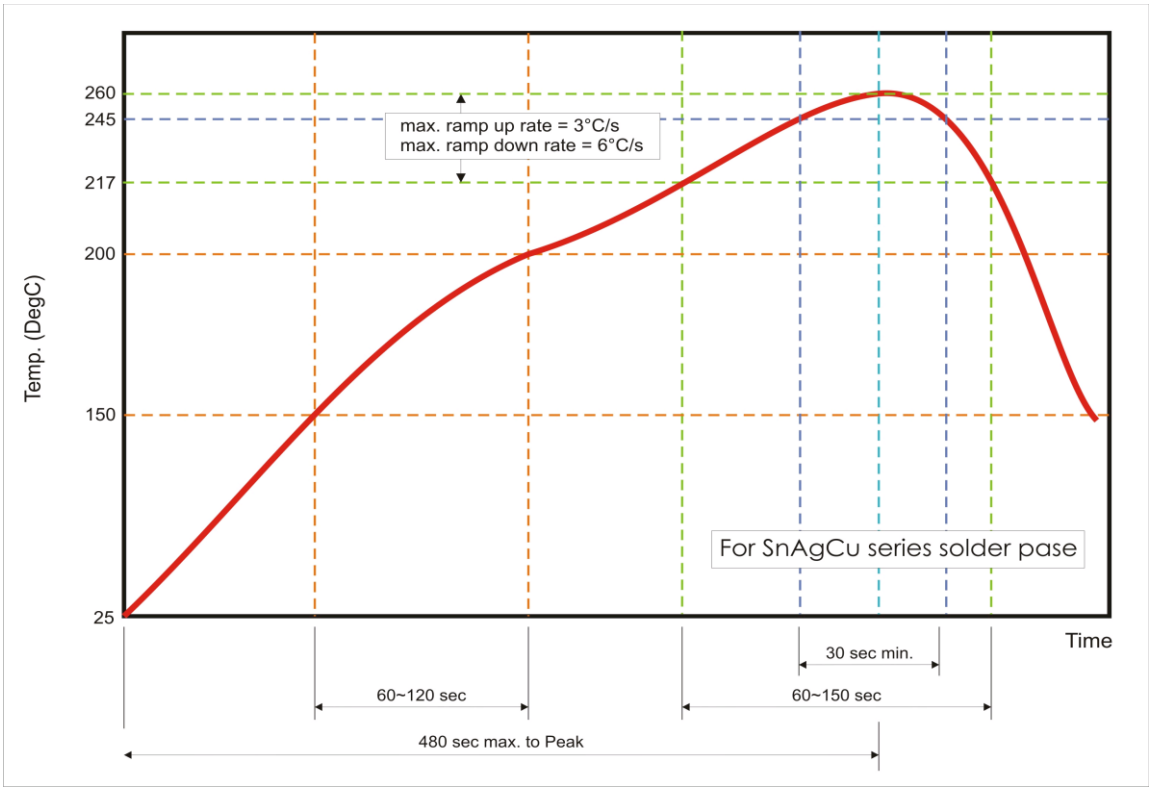


Fig 3. Infrared soldering profile for Chip Resistors

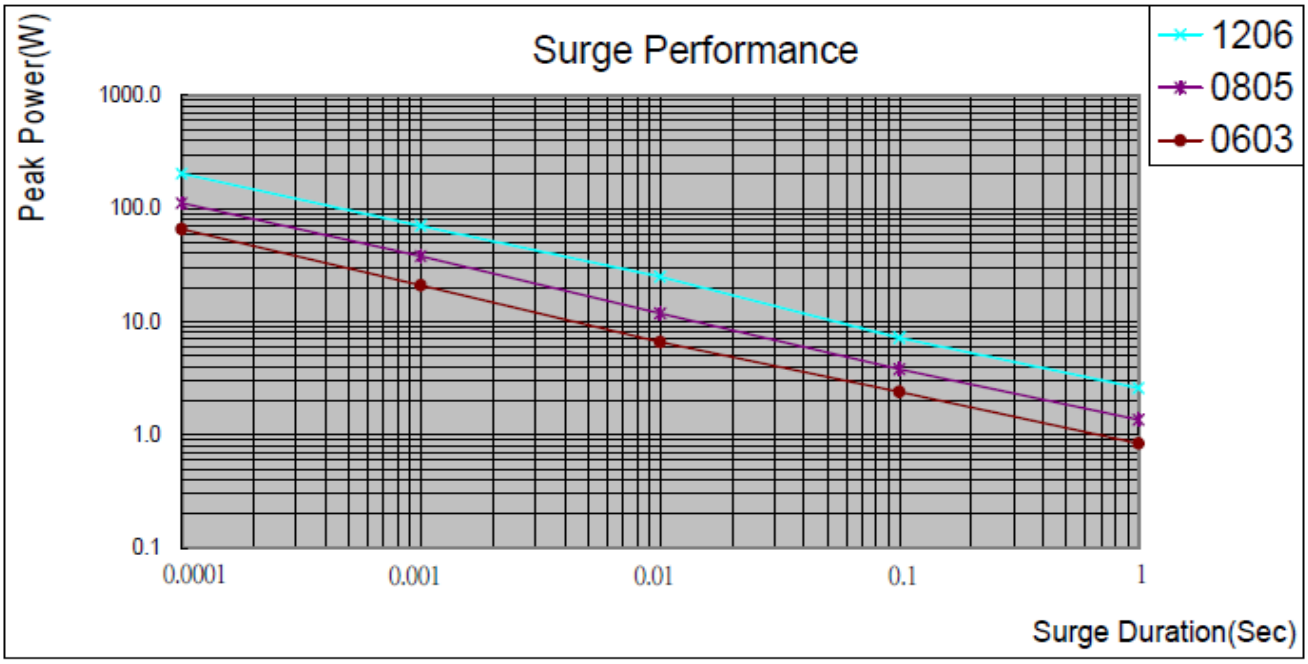
CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

MF12	E	1202	F	T	L
Size code **MF12: 1206** **MF08: 0805** **MF06: 0603**	**Type code** **E** : Triple Power + Surge	**Resistance code** 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	**Tolerance** **F: ± 1%** **J: ± 5%**	**Packaging code** **T: 7" Reeled taping**	**Termination code** **L** = Sn base (lead free)

■ **Reeled tape packaging : 8mm width paper taping 5,000pcs per 7" reel.**

SURGE POWER CHART



TEST AND REQUIREMENTS (AEC Q200)

8. Reliability Performance (AEC-Q200)

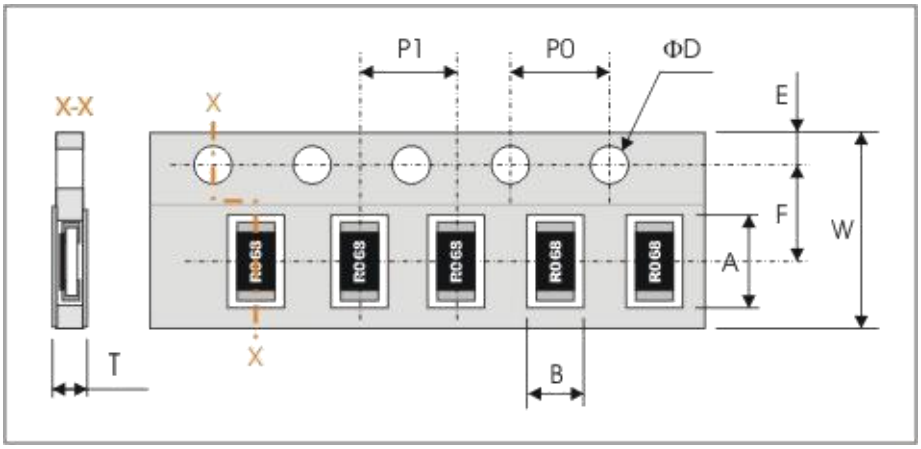
Test Item	Specification	Test Method (AEC-Q200. IEC 60115)
***DC Resistance**	F：±1%；J：±5%	**AEC-Q200 TABLE 7.1** **IEC 60115-1 / JIS C 5201-1 , Clause 4.5** Measure the resistance Value.
Short Time Overload	J：ΔR≦ ±(2%+0.1Ω) F：ΔR≦ ±(1%+0.05Ω)	**IEC 60115-1, Clause 4.13** 5 x rated power for 5 seconds
High Temperature Exposure (Storage)	J：ΔR≦ ±(3%+0.1Ω) F：ΔR≦ ±(1%+0.05Ω)	**AEC-Q200 TABLE 7.3** 1000 hrs. @ T=125℃. Unpowered. Measurement at 24 ±2 hours after test conclusion.
***Temperature Cycling**	J：ΔR≦ ±(1%＋0.1Ω) F：ΔR≦ ±(0.5%＋0.05Ω) No mechanical damage.	**AEC-Q200 TABLE 7.4** 1000 Cycles (-55°C to +125°C). Measurement at 24±2 hours after test conclusion.

Moisture Resistance	△R≦ ±(0.5%+0.05Ω)	**AEC-Q200 TABLE 7.6** Test 65℃/80~100%RH/10Cycles. Measurement at 24±2 hours after test conclusion. (t=24hrs/cycle).
Biased Humidity	△R≦ ±(1%+0.05Ω)	**AEC-Q200 TABLE 7.7** 1000 hours 85℃/85%RH. 10% of operating power. Measurement at 24 ±2 hours after test conclusion.
Operational Life	△R≦ ±(1%+0.05Ω)	**AEC-Q200 TABLE 7.8** Test 1000hr @ TA=125℃ at specified rated power. Measurement at 24±2 hours after test conclusion.
External Visual	No visual damage and refer PDC marking code.	**AEC-Q200 TABLE 7.9** Inspect device construction, marking and workmanship.
Physical Dimension	Within the spec.	**AEC-Q200 TABLE 7.10** Verify physical dimensions to the applicable device detail specification.
Mechanical Shock	Within product specification tolerance and no visible damage.	**AEC-Q200 TABLE 7.13** Test Peak value:100g's,Wave:Hail-sine, Duration:6ms,Velocity:12.3ft/sec.
Vibration	△R≦ ±(1%+0.05Ω) No mechanical damage.	**AEC-Q200 TABLE 7.14** 5 g's for 20 min., 12 cycles each of 3 orientations. Test from 10-2000 Hz.
Resistance to Solder Heat	ΔR≦ ±(0.5%+0.05Ω) No mechanical damage.	**AEC-Q200 TABLE 7.15** Solder dipping @ 270℃±5℃ for 10sec.±1sec.
Thermal Shock	ΔR≦ ±(0.5%+0.05Ω) No mechanical damage.	**AEC-Q200 TABLE 7.16** -55 to 155℃/ dwell time 15min/ Max transfer time 20sec/ 300cycles.
ESD	ΔR≦ ±(1%+0.1Ω) No mechanical damage.	**AEC-Q200-002** Test contact min. 1KV.
Solder Ability	Over 95% of termination must be covered with solder.	**AEC-Q200 TABLE 7.18** a)Baking 155℃ 4H, dipping 235℃ 5s b)Steam 8H, dipping 215℃ 5s c)Steam 8H, dipping 260℃ 7s

Flammability	Refer UL-94.	**AEC-Q200 TABLE 7.20** UL-94 V-0 or V-1 are acceptable
Board Flex	ΔR≦ ±(0.5%+0.05Ω) No mechanical damage.	**AEC-Q200 TABLE 7.21** Bending 2mm 2512.2010.1210.1206, 3mm 0805.0603.
Terminal Strength	No mechanical damage	**AEC-Q200 TABLE 7.22** Force 1.8 Kg for 60 seconds.
Temperature Coefficient of Resistance (TCR)	Within the spec.	**IEC 60115-1, Clause 4.8** T_1 T_2 Test temperature： 25℃~ -55℃ 25℃~ +155℃ TCR(ppm/℃) = $(R_2-R_1)/R_1 \times 1 / (T_2-T_1) \times 10^6$

PACKAGING

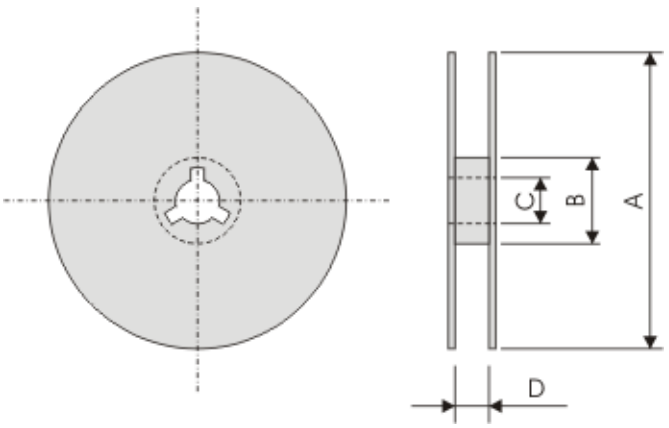
Paper Tape specifications (unit :mm)



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	$\Phi 1.50^{+0.1}_{-0.0}$
MF08E	8.00±0.30	3.50±0.20	1.75±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$
MF06E	8.00±0.30	3.50±0.20	1.75±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$

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

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/reel

APPROVAL SHEET

MF10E, MF20E, MF25E

±1%, ±5% 1Ω~1MΩ, Jumper

Thick film High Power Surge Chip Resistors

Size 1210, 2010, 2512

Automotive Grade & Anti-Sulfuration

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FEATURE

1. Automotive grade AEC Q-200 compliant
2. High reliability 1% stability
3. 100% CCD inspection
4. RoHS compliant and Halogen free and Lead free products
5. High power rating up to 2W
6. Anti-sulfur against ASTM B-809 50'C, 90% RH, 1000hrs

APPLICATION

1. High accuracy dc-power supply
2. Digital multi-meter
3. Telecommunication
4. Computer
5. Automotive industry
6. Medical and military 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 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.

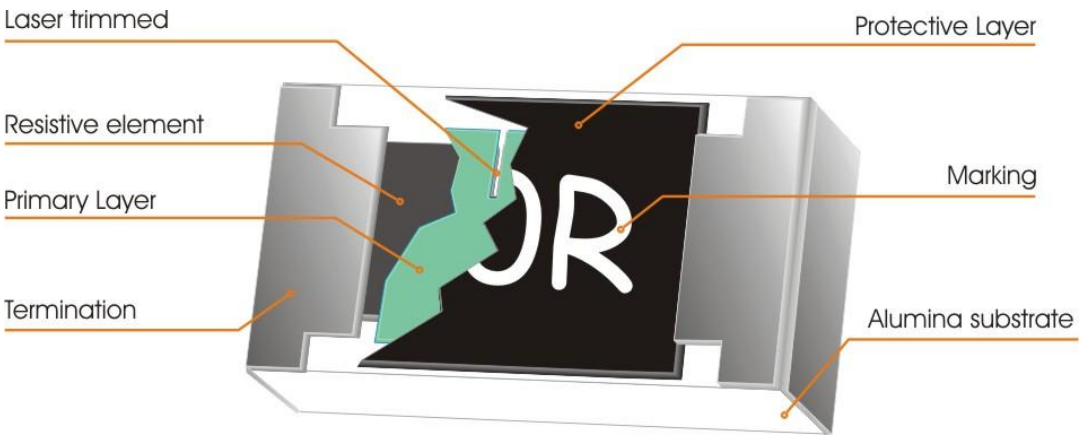


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

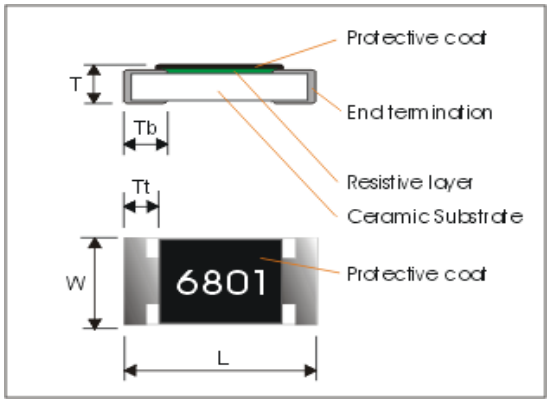
Type	Size	Power Rating at 70℃	Max. RCWV	Max. Overload Voltage	Resistance Tolerance	Temperature Coefficient (ppm/℃)	Resistance Range		Standard Resistance Values
							Min.	Max.	
MF10E	1210	3/4W	250V	500V	±1%(F)	±100ppm	1Ω	1MΩ	E96/E24
					±5%(J)	±200ppm	1Ω	1MΩ	E24
MF20E	2010	1W	200V	400V	±1%(F)	±100ppm	1Ω	1MΩ	E96/E24
					±5%(J)	±200ppm	1Ω	1MΩ	E24
MF25E	2512	2W	300V	600V	±1%(F)	±100ppm	1Ω	1MΩ	E96/E24
					±5%(J)	±200ppm	1Ω	1MΩ	E24

Type	Size	Description	Max. Rated Current	Resistance
MF10E	1210	Zero Ohm，Jumper	≦ 4A	＜20mΩ
MF20E	2010	Zero Ohm，Jumper	≦ 6A	＜20mΩ
MF25E	2512	Zero Ohm，Jumper	≦ 6A	＜20mΩ

Note：RCWV＝$(P\times R)^{1/2}$ or Max. RCWV listed above, whichever is lower.
RCWV：Working Voltage (V)，P：Rated Power (W)，R：Resistance Value (Ω)
2512 2W loading with total solder-pad and trace size of 300 mm^2

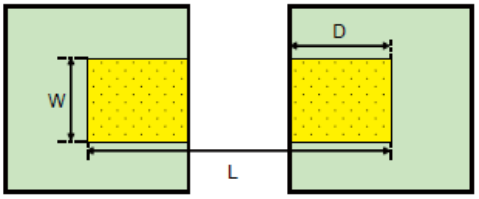
DIMENSIONS (unit: mm)

Part No	MF10E	MF20E	MF25E
L	3.10 ± 0.10	5.00 ± 0.20	6.40 ± 0.20
W	2.60 ± 0.10	2.50 ± 0.20	3.10 ± 0.20
T	0.55 ± 0.10	0.60 ± 0.10	0.60 ± 0.15
Tt	0.50 ± 0.25	0.65 ± 0.25	0.60 ± 0.25
Tb	0.50 ± 0.25	0.60 ± 0.25	1.80 ± 0.25

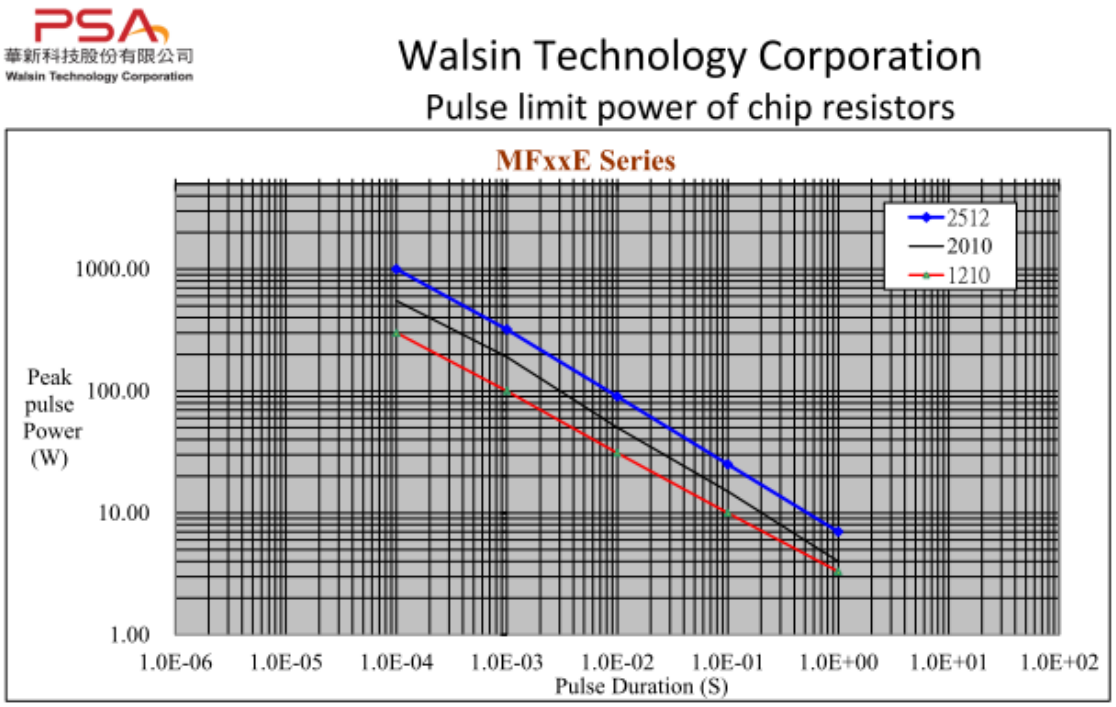


Recommend Solder Pad Dimensions：

Type	W	D	L
MF10E	3.00	1.30	4.70
MF20E	3.00	1.50	6.80
MF25E	3.70	2.45	7.60



PULSE POWER CHART



MARKING

Size \ Nr. Of digit of code\ tolerance	±5%	±1%
2512 (6432)	3-digits marking	4-digits marking
2010 (5025)	3-digits marking	4-digits marking
1210 (3225)	3-digits marking	4-digits marking

4-digits marking（±1% : 2512/ 2010/ 1210）

Each resistor is marked with a four digits code on the protective coating to designate the nominal resistance value.

Example

RESISTANCE	10Ω	12Ω	100Ω	6800Ω	47000Ω
3-digits marking（1206 & 0805 & 0603 ±5% ）	100	120	101	682	473
4-digits marking	10R0	12R0	1000	6801	4702

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E96&E24 series for resistors with a tolerance of ±1%,±5%. The values of the E96/E24 series are in accordance with “IEC publication 60063”.

Derating

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

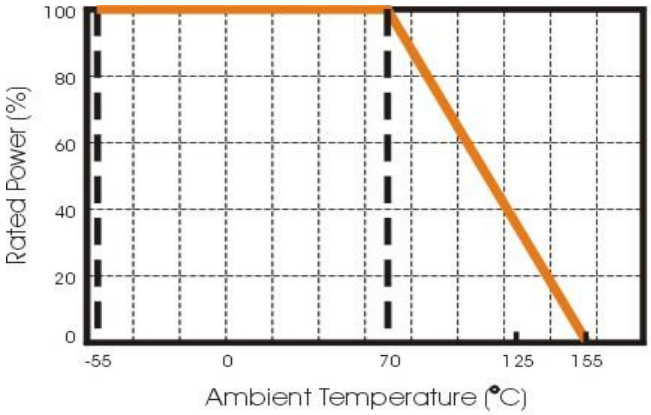


Fig.2 Maximum dissipation in percentage of rated power
As a function of the ambient temperature

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.

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.

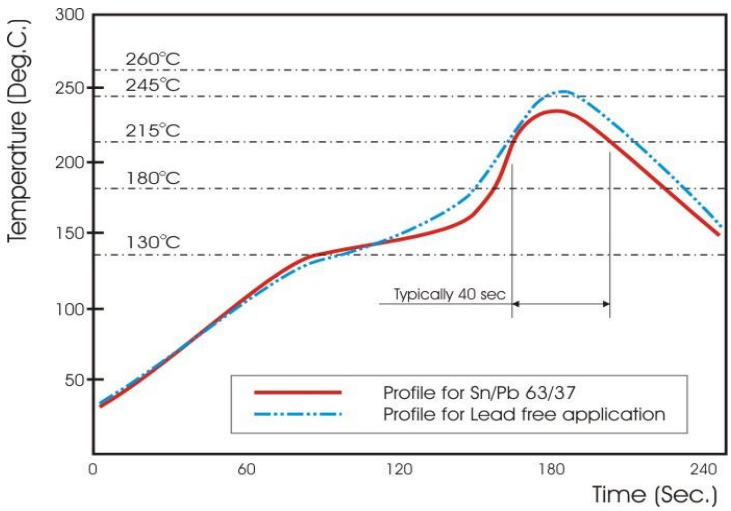


Fig 3. Infrared soldering profile for Chip Resistors

CATALOGUE NUMBERS

The resistors have a catalogue number starting with:

MF25	E	1002	F	T	L
Size code MF10: 1210 MF20: 2010 MF25: 2512	**Type code** **E** :Power Surge 1210 size = 3/4W 2010 size = 1W 2512 size = 2W	Resistance code 5%, E24: 2 significant digits followed by No. of zeros e.g.: 3ohm =3R0 10ohm =100 56Kohm =563 1%, E24+E96: 3 significant digits followed by No. of zeros 100Ω =1000 37.4KΩ =3742	**Tolerance** J : ±5% F : ±1% P : Jumper	**Packaging code** T: 7" Reeled taping .	**Termination code** L = Sn base (lead free)

- Reeled tape packaging : 8mm width paper taping 5000pcs per 7" reel for 1210 size.
- Reeled tape packaging : 12mm width plastic taping 4000pcs per 7" reel for 2010, 2512 sizes.

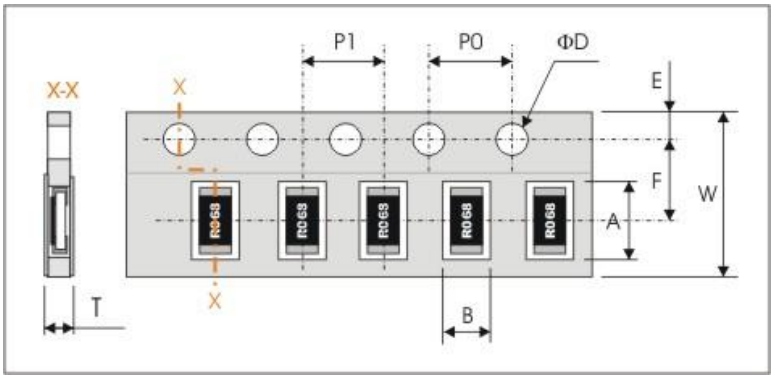
TEST AND REQUIREMENTS (refer to AEC Q200)

TEST	PROCEDURE / TEST METHOD	REQUIREMENT Resistor
Electrical Characteristics **JISC5201-1: 1998** Clause 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°C+5°C-1°C R_1 : Resistance at reference temperature R_2 : Resistance at test temperature	Within the specified tolerance Refer to "QUICK REFERENCE DATA"
Short time overload **IEC 60115-1,** Clause 4.13	5 × Rated power for 5 seconds	J: ΔR/R max. ±(2.0%+0.1Ω) F: ΔR/R max. ±(1.0%+0.05Ω) no visible damage
Resistance to soldering heat (R.S.H) **MIL-STD-202 Method 210**	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 270℃±5°C	J: ΔR/R max. ±(1.0%+0.1Ω) F: ΔR/R max. ±(0.5%+0.05Ω) no visible damage
Solderability **J-STD-002**	a) Bake the sample for 155℃ dwell time 4hrs/ solder dipping 235℃/ 5sec. b) Steam the sample dwell time 8 hour/ solder dipping 215℃/ 5sec. c) Steam the sample dwell time 8 hour/ solder dipping 260℃/ 7sec.	95% coverage min., good tinning and no visible damage
Temperature cycling **JESD22 Method JA-104**	1000 cycles, -55℃ ~ +125℃, dwell time 30min maximum. Measurement at 24±2 hours after test conclusion.	J: ΔR/R max. ±(1.0%+0.1Ω) F: ΔR/R max. ±(0.5%+0.05Ω) no visible damage
Moisture Resistance **MIL-STD-202 Method 106**	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	J: ΔR/R max. ±(1.0%+0.1Ω) F: ΔR/R max. ±(0.5%+0.05Ω) no visible damage
Bias Humidity **MIL-STD-202 Method 103**	1000+48/-0 hours; 85°C, 85% RH, 10% of operation power. Measurement at 24±2 hours after test conclusion.	J: ΔR/R max. ±(3.0%+0.1Ω) F: ΔR/R max. ±(1.0%+0.05Ω) no visible damage
Operational Life **MIL-STD-202 Method 108**	1000+48/-0 hours; 35% of operation power, 125±2°C Measurement at 24±2 hours after test conclusion.	J: ΔR/R max. ±(3.0%+0.1Ω) F: ΔR/R max. ±(1.0%+0.05Ω) no visible damage
High Temperature Exposure **MIL-STD-202 Method 108**	1000+48/-0 hours; without load in a temperature chamber controlled 125±3°C	J: ΔR/R max. ±(3.0%+0.1Ω) F: ΔR/R max. ±(1.0%+0.05Ω) no visible damage
Board Flex **AEC-Q200-005**	Resistors mounted on a 90mm PCB (FR4), bending once 2mm for 2512,2010,1210,1206, 3mm for 0805, 0603.	J: ΔR/R max. ±(1.0%+0.1Ω) F: ΔR/R max. ±(0.5%+0.05Ω) no visible damage
Terminal strength **AEC-Q200-006**	Force: 1.8Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations
Thermal shock **MIL-STD-202 Method 107**	Test –55 to 155℃/ dwell time 15min/ Max transfer time 20sec , 300cycles	J: ΔR/R max. ±(1.0%+0.1Ω) F: ΔR/R max. ±(0.5%+0.05Ω) no visible damage

ESD **AEC-Q200-002**	Test contact min.1.0KV	ΔR/R max. ±(1.0%+0.1Ω) No visible damage
Mechanical Shock **IL-STD-202 Method 213**	Test ½ Sine Pulse, Peak value: 100g, normal duration: 6ms, Velocity change:12.3ft/sec. Three shocks in each direction, total 18 shocks.	Within product specification tolerance and no visible damage.
Vibration **MIL-STD-202 Method 204**	Test 5g's for 20 min., 12 cycles each of 3 orientations.	No visible damage
External Visual **MIL-STD-883** **Method 2009**	Electrical test not required. Inspect device construction, marking and workmanship	No visual damage and refer WTC marking code.
Physical Dimension **JESD22 Method JB-100**	Verify physical dimensions(L, W, T, Tb, Tt)	Within the specified tolerance for WTC.

PACKAGING

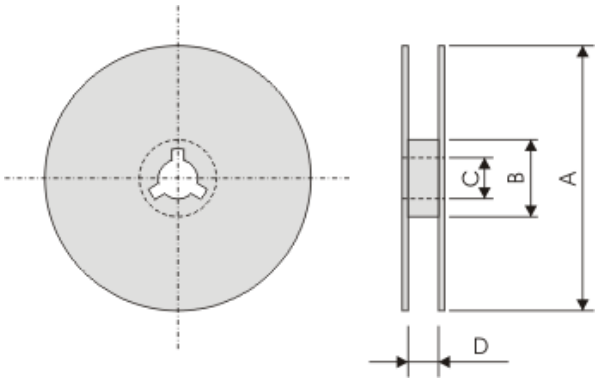
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
MF25E	6.70±0.20	3.50±0.20	12.00±0.30	5.50±0.10	1.75±0.10
MF20E	5.50±0.20	2.80±0.20	12.00±0.30	5.50±0.10	1.75±0.10
MF10E	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10

Series No.	P1	P0	ΦD	T
MF25E	4.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.2
MF20E				Max. 1.2
MF10E				Max. 1.0

Reel dimensions



Symbol	A	B	C	D
12 mm tape	Φ178.0±2.0	Φ60.0±1.0	13.0±0.5	13.8±1.5
8 mm tape	Φ178.0±2.0	Φ60.0±1.0	13.0±0.5	10.0±1.5

STORAGE & HANDLING

… Products are recommended to be used up within one year as ensured shelf life.
Check solderability in case shelf life extension is needed.
… To store products with following condition:
Temperature:5 to 40℃ ； Humidity: 20 to 70% relative humidity.

Precaution for use

The AEC-Q200 series resistor is mainly used on general automotive equipment without safety considerations.
Please contact our company in advanced if you intend to use resistor for designing the equipment which may
damage itself and the safety of third party. If necessary, please consider to add the protect circuit in devising
process and obtaining fully safety evaluation. The contents of the acknowledgment is only used for our parent
company, marketing subsidiaries and official marketing agents who purchase our products. Not applicable for the
other non-official channels.