APPROVAL SHEET

MF25E, MF20E, MF10E, MF12E, MF08E, MF06E, MF04E

±1%, ±5%, Jumper

Thick Film Triple Power Surge Chip Resistors

Size 2512,2010,1210,1206,0805,0603,0402

Automotive AEC Q200 Qualified
Anti-Sulfuration ASTM B-809 50°C 1000hrs

RoHS 2 Compliant with exemption 7C-I
Halogen free

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

FEATURES

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-I and Halogen free products
6. Anti-Sulfuration against ASTM B-809 50°C 90% RH, 1000hrs
7. Fiammability against UL94-V0

APPLICATIONS

- 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.

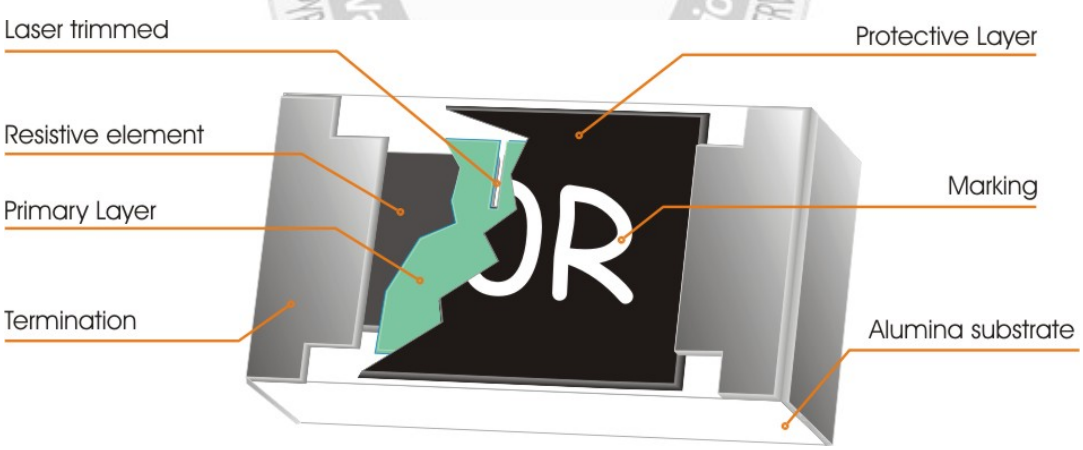


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

Item	General Specification						
Series No.	MF25E	MF20E	MF10E	MF12E	MF08E	MF06E	MF04E
Size code	2512 (6432)	2010 (5025)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)
Resistance Tolerance	±1% (E24+E96) ±5% (E24)						
Resistance Range	1Ω ~ 1MΩ						
TCR (ppm/°C) 1% 10Ω~1MΩ 1% 1~9.76Ω	 ±100 ±100	 ±100 ±100	 ±100 ±100	 ±100 ±200	 ±100 ±150	 ±100 ±200	 ±100 ±200
TCR (ppm/°C) 5% 1~1MΩ	 ±200	 ±200	 ±200	 ±200	 ±200	 ±200	 ±200
Max. dissipation at T_{amb}=70°C	2 W	1 W	3/4 W	3/4 W	1/2 W	1/3 W	1/5 W
Max. Operation Voltage	300V	200V	250V	250V	200V	75V	50V
Max. Overload Voltage	600V	400V	500V	500V	300V	125V	100V
Operation Temperature	- 55~+155°C						

Notes:

1. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by
   $RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}}$ or Max. RCWV listed above, whichever is lower.
2. Solder-pad and trace size should be evaluated and board surface temperature should not exceed 105°C when applied full rated power.

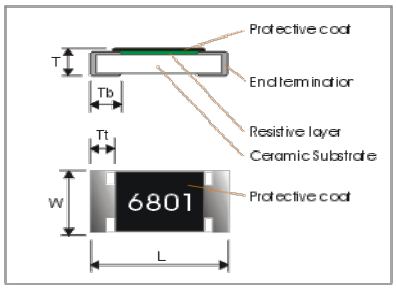
High Current Power Jumpers (0Ω)

Item	General Specification						
Series No.	MF25E	MF20E	MF10E	MF12E	MF08E	MF06E	MF04E
Size code	2512 (6432)	2010 (5025)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)
Resistance Range	<20mΩ	<20mΩ	<20mΩ	≤10mΩ	≤10mΩ	≤10mΩ	<30mΩ
TCR (ppm/°C)	TCR is not applicable for Jumper product						
Max. dissipation @ T_{amb}=70°C	2 W	1 W	3/4 W	3/4 W	1/2 W	1/3 W	1/5 W
Max Rated Current	≦ 6A	≦ 6A	≦ 4A	≦ 9A	≦ 7A	≦ 6A	≦ 3A
Max Overload Current	≦12A	≦12A	≦ 8A	≦18A	≦14A	≦12A	≦ 6A
Operation temperature	- 55~+155°C						

Notes:

1. TCR is not applicable for Jumper product
2. Solder-pad and trace size should be evaluated and board surface temperature should not exceed 105°C when applied full rated power

DIMENSIONS (unit : mm)



Part No	MF25E	MF20E	MF10E	MF12E	MF08E	MF06E	MF04E
L	6.40 ± 0.20	5.00 ± 0.20	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	3.10 ± 0.20	2.50 ± 0.20	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
T	0.60 ± 0.15	0.60 ± 0.10	0.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.10	0.45 ± 0.10	0.35 ± 0.05
Tt	0.60 ± 0.25	0.65 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20	0.20 ± 0.10
Tb	1.80 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20	0.25 ± 0.10

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

MF12	E	1202	F	T	L
Size code MF25: 2512 MF20: 2010 MF10: 1210 MF12: 1206 MF08: 0805 MF06: 0603 MF04: 0402	**Type code** **E:**: Triple Power Surge 2512 size = 2W 2010 size = 1W 1210 size = 3/4W 1206 size = 3/4W 0805 size = 1/2W 0603 size = 1/3W 0402 size = 1/5W	**Resistance code** 5%, E24: 2 significant digits followed by no. of zeros and a blank 100Ω = 101_ 10KΩ = 103_ Jumper = 000_ ("_" means a blank) 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)

- Sulfur-resistant, ΔR≤(1%+0.05Ω),ASTM-B809, 50±2°C, 1000hrs
  Note: Jumper product is not applicable.
- Reeled tape packaging

  12mm width plastic taping 4000pcs per 7" reel for 2010, 2512 sizes

  8mm width paper taping 5000pcs per 7" reel for 1210 , 1206, 0805, 0603 size

  8mm width paper taping 10000pcs per 7" reel for 0402 size

MARKING

Size \ Nr. Of digit of code\tolerance	± 1%, ±5%
2512/2010/1210/1206/0805	± 1%: 4 digits marking; ± 5%: 3 digits marking
0603	3 digits marking
0402	N0 MARKING

Size \ Nr. Of digit of code\tolerance	Jumper (0Ω)
2512/2010	4 digits marking
1210/1206/0805/0603	3 digits marking
0402	N0 MARKING

3 digits marking （±5% 2512,2010,1210,1206,0805,0603）

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

3 digits marking（±1% 0603）

Nominal resistance	Description
1.E24 series	2 significant digits followed by No. of zeros .As *0603 WR06X* ±5% Example

RESISTANCE	4.7Ω	47Ω	470Ω	4K70	47K0	470K	4M70
3 digits marking	4R7	470	471	472	473	474	475

2.E96 series

The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value.
Repeat values between E24 and E96 series, whose marking are based on the E96 CODE table.

Code	Z	Y	X	A	B	C	D	E	F	G
Multiplier	10^{-3}	10^{-2}	10^{-1}	10^{0}	10^{1}	10^{2}	10^{3}	10^{4}	10^{5}	10^{6}

Example

RESISTANCE	1.78Ω	17.8Ω	178Ω	1K78	17K8	178K	1M78
3 digits marking	25Y	25X	25A	25B	25C	25D	25E

3. Remark	There is no marking for the items not under E24 and E96 series.

E96 CODE table:

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（±1% 2512,2010,1210,1206,0805）

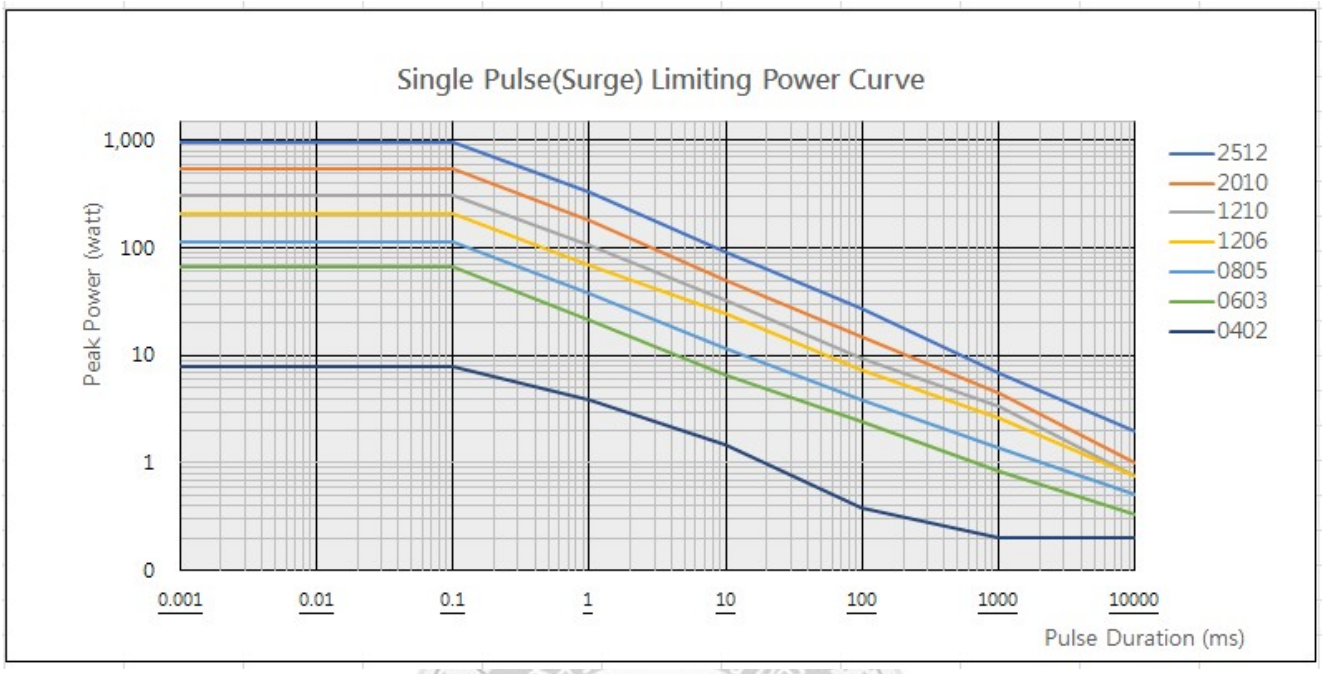
Each resistor is marked with a four digits code on the protective coating to designate the nominal resistance value. For values below 97Ω6 the R is used as a digit. For values of 100Ω or greater, the first 3 digits are significant, and the fourth digit indicates the number of multiple to follow.

Example

RESISTANCE	Jumper (0Ω)	4.7Ω	10Ω	12Ω	100Ω	6800Ω	47000Ω	470000Ω
3 digits marking ±5% 2512,2010,1210,1206, 0805, 0603 Jumper 1210,1206, 0805, 0603	000	4R7	100	120	101	682	473	474
4 digits marking ±1% 2512,1210,1206, 0805 Jumper 2512,2010	0000	4R70	10R0	12R0	1000	6801	4702	4703

SURGE PERFORMANCE

Single pulse



Note.

1. Due to application is varied, the pulse endurance are not assured values. Please evaluate the products on actual circuits when use them.
2. 10 rectangular pulses are amplitudes are applied to the compoment at intervals of 60 seconds, permissible the resistance to be varied by ±(1% R+0.01Ω).
3. Pulse duration over 10 seconds, need use the resistor's rated power for evaluate.

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

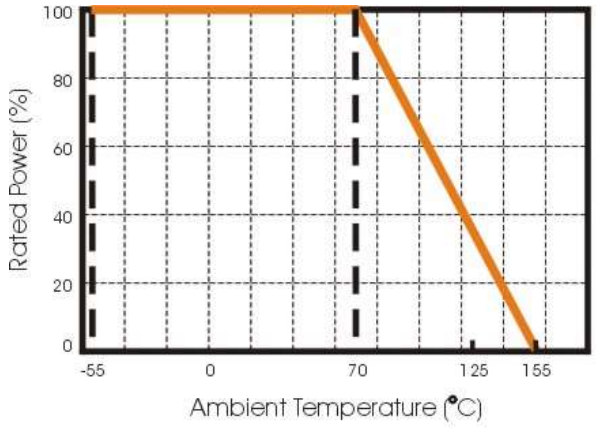


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

Storage and Handling Conditions:

1. Products are recommended to be used up within two years since operation date as ensured shelf life. Check solderability in case shelf life extension is needed.
2. To store products with following condition:

   Temperature :5 to 40°C

   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 oxdization 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. 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.

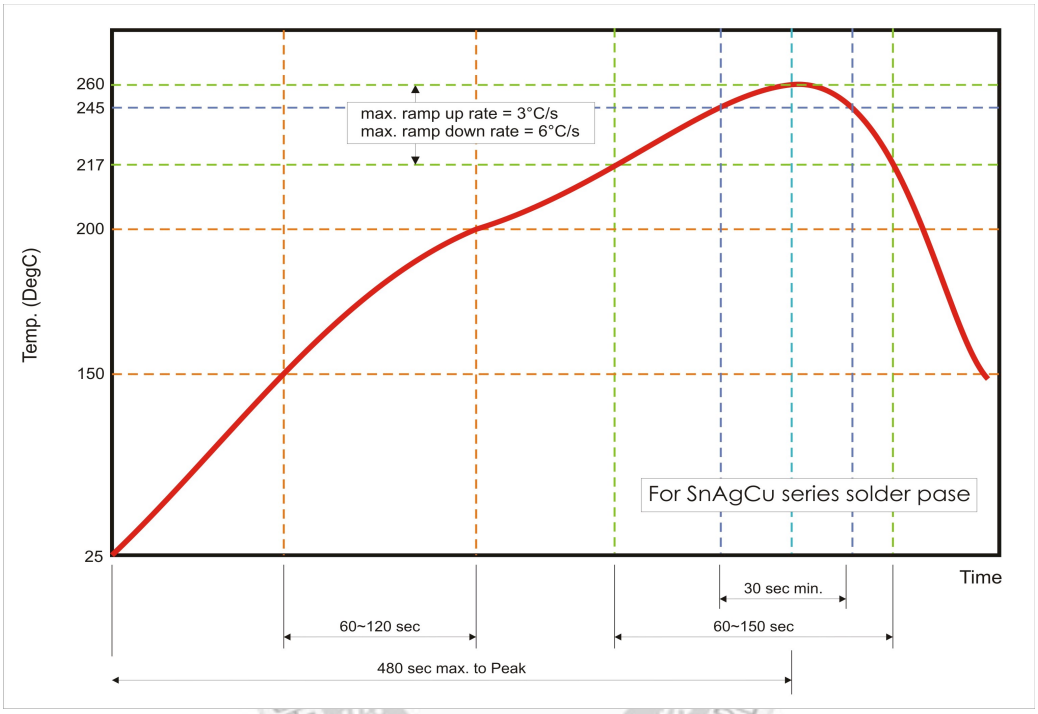
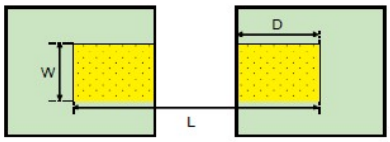


Fig 3. Infrared soldering profile for Chip Resistors

Recommend Solder Pad Dimensions:

Type	W	D	L
MF25E	3.70	2.45	7.60
MF20E	3.00	1.50	6.80
MF10E	3.00	1.30	4.70
MF12E	1.80	1.30	4.70
MF08E	1.30	1.15	3.50
MF06E	0.90	1.00	3.00
MF04E	0.60	0.50	1.50

Unit: mm



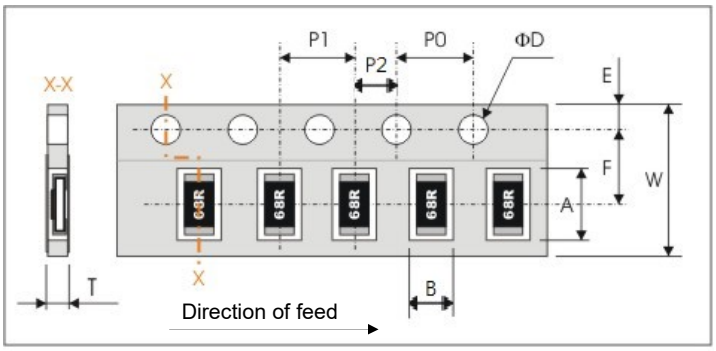
TEST AND REQUIREMENTS (AEC-Q200)

Test Item	Specification	Test Method (AEC-Q200. IEC 60115)
DC Resistance	J：±5% F：±1% Jumper: refer “QUICK REFERENCE DATA” Jumper resistance specification	**AEC-Q200 TABLE 7.1** **IEC 60115-1 / JIS C 5201-1 , Clause 4.5** Measure the resistance Value.
Short Time Overload	J：△R≦ ±(2%+0.1Ω) F：△R≦ ±(1%+0.05Ω)	**IEC 60115-1, Clause 4.13**
High Temperature Exposure (Storage)	△R≦ ±(1%+0.05Ω) Jumper: refer “QUICK REFERENCE DATA” Jumper resistance specification	**AEC-Q200 TABLE 7.3** 1000 hrs. @ T=155°C. Unpowered. Measurement at 24 ±2 hours after test conclusion.
Temperature Cycling	ΔR≦ ±(0.5%+0.05Ω) Jumper: refer “QUICK REFERENCE DATA” Jumper resistance specification No mechanical damage	**AEC-Q200 TABLE 7.4** 1000 Cycles (-55°C to +155°C). Measurement at 24±2 hours after test conclusion.
Moisture Resistance	△R≦ ±(0.5%+0.05Ω) Jumper: refer “QUICK REFERENCE DATA” Jumper resistance specification	**AEC-Q200 TABLE 7.6** Test 65°C /80~100%RH/10Cycles. Measurement at 24±2 hours after test conclusion. (t=24hrs/cycle).
Biased Humidity	△R≦ ±(1%+0.05Ω) Jumper: refer “QUICK REFERENCE DATA” Jumper resistance specification	**AEC-Q200 TABLE 7.7** 1000 hours 85°C /85%RH. 10% of operating power. Measurement at 24 ±2 hours after test conclusion.
Operational Life	△R≦ ±(1%+0.05Ω) Jumper: refer “QUICK REFERENCE DATA” Jumper resistance specification	**AEC-Q200 TABLE 7.8** Test 1000hr @ TA=125°C at specified rated power. Measurement at 24±2 hours after test conclusion.
External Visual	No visual damage and refer the marking code specification.	**AEC-Q200 TABLE 7.9** Inspect device construction, marking and workmanship
Physical Dimension	Within the specification..	**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. Jumper : refer “QUICK REFERENCE DATA” Jumper resistance specification	**AEC-Q200 TABLE 7.14** 5 g's for 20 min., 12 cycles each of 3 orientations. Test from 10-2000 Hz.

Test Item	Specification	Test Method (AEC-Q200. IEC 60115)
Resistance To Solder Heat	ΔR≦±(0.5%+0.05Ω) Jumper : refer "QUICK REFERENCE DATA" Jumper resistance specification No mechanical damage	**AEC-Q200 TABLE 7.15** Solder dipping @ 270˚C±5˚C for 10sec.±1sec.
Thermal Shock	ΔR≦±(0.5%+0.05Ω) Jumper : refer "QUICK REFERENCE DATA" Jumper resistance specification No mechanical damage.	**AEC-Q200 TABLE 7.16** -55 to 155˚C / dwell time 15min/ Max transfer time 20sec/ 300cycles.
ESD	ΔR≦ ±(1%+0.1Ω) Jumper: refer "QUICK REFERENCE DATA" Jumper resistance specification No mechanical damage.	**AEC-Q200-002** Test contact min. 1KV (0.5KV for 0402 only).
Solder Ability	Over 95% of termination must be covered with solder.	**AEC-Q200 TABLE 7.18** a)Baking 155˚C 4H, dipping 235˚C 5s b)Steam 8H, dipping 215˚C 5s c)Steam 8H, dipping 260˚C 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) Jumper : refer "QUICK REFERENCE DATA" Jumper resistance specification No mechanical damage.	**AEC-Q200 TABLE 7.21** Bending 2mm for 2512,2010,1210,1206 3mm for 0805,0603,0402
Terminal Strength	No mechanical damage	**AEC-Q200 TABLE 7.22** Force: 1.8kg (0402 for 1.0kg) / 60 sec
Temperature Coefficient of Resistance (TCR)	Within the spec.	**IEC 60115-1, Clause 4.8** T_1 T_2 Test temperature : 25˚C ~ -55˚C 25˚C ~ +155˚C TCR(ppm/˚C) = $(R_2-R_1)/R_1 \times 1 / (T_2-T_1) \times 10^6$

PACKAGING

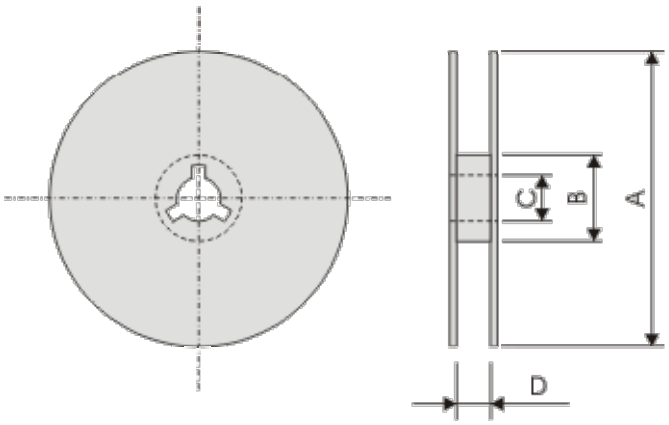
Tape specifications (unit :mm)



Series No.	A	B	W	F	E
MF25E	6.70±0.20	3.50±0.20	12.00±0.30	5.50±0.05	1.75±0.10
MF20E	5.50±0.20	2.80±0.20	12.00±0.30	5.50±0.05	1.75±0.10
MF10E	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.05	1.75±0.10
MF12E	3.60±0.20	2.00±0.20	8.00±0.30	3.50±0.05	1.75±0.10
MF08E	2.40±0.20	1.65±0.20	8.00±0.30	3.50±0.05	1.75±0.10
MF06E	1.90±0.20	1.10±0.20	8.00±0.30	3.50±0.05	1.75±0.10
MF04E	1.20±0.10	0.70±0.10	8.00±0.30	3.50±0.20	1.75±0.10

Series No.	P1	P0	P2	ΦD	T
MF25E	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.50
MF20E	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.00
MF10E	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.00
MF12E	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.00
MF08E	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.00
MF06E	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 0.80
MF04E	2.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 0.60

Reel dimensions



Symbol	A	B	C	D
7” 8mm tape	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0+1/-0
7” 12mm tape	Φ178.0±2.0	Φ60.0±1.0	13.0±0.5	13.8±1.5

Taping Quantity

- 12mm width plastic taping 4000pcs per 7” reel for 2010, 2512 sizes
- 8mm width paper taping 5000pcs per 7” reel for 1210 , 1206, 0805, 0603 size
- 8mm width paper taping 10000pcs per 7” reel for 0402 size