

# APPROVAL SHEET

## **MK06S, MK08S**

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

**Thick Film Power Surge Chip Resistors**

**High Grade AEC Q200 Qualified**

**Anti-Sulfuration**

**Size 0603, 0805**

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

## FEATURE

1. Power rating and compact size
2. High reliability and stability
3. Reduced size of final equipment
4. High anti-surge protection
5. Halogen free
6. Automotive high grade AEC Q-200 qualified
7. Anti-sulfuration against ASTM B-809 60°C, 95% RH, 1000hrs

## APPLICATION

- Power supply
- Measurement instrument
- Automotive industry
- Medical or Military equipment

## DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum oxide). Internal 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 request resistance to nominal value within tolerance which controlled by printing process in 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 (Pb free) alloy.

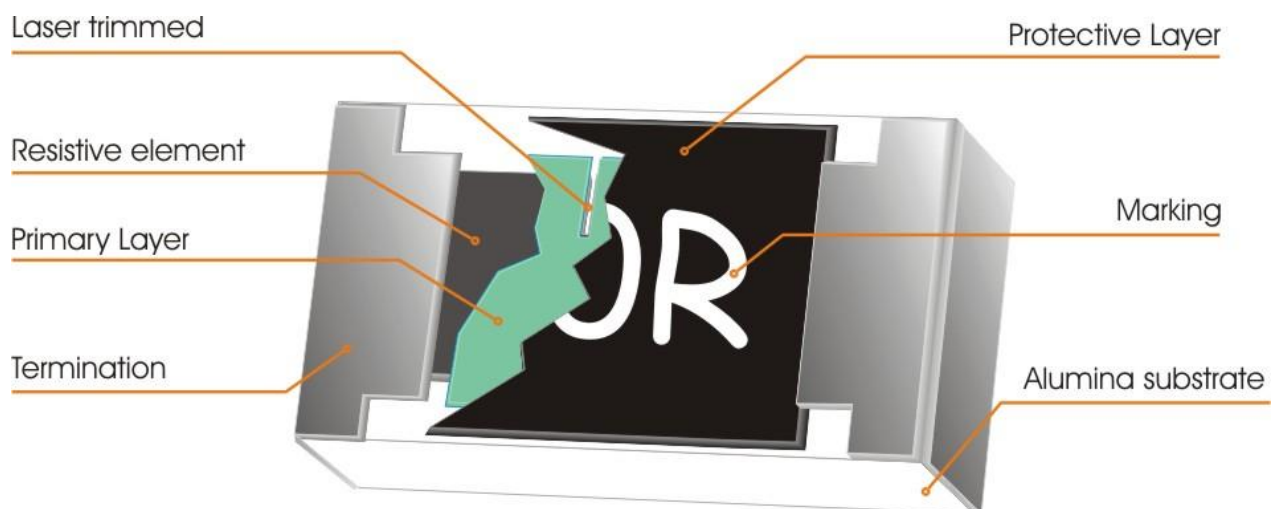


Fig 1. Construction of Chip-R MKxxS

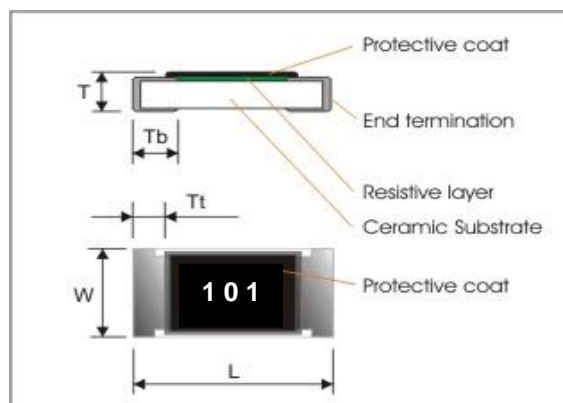
**QUICK REFERENCE DATA**

Item	General Specification	General Specification
Series No.	MK06S	MK08S
Size code	0603 (1608)	0805 (2012)
Resistance Tolerance	$\pm 0.5\% \pm 1\%$ , (E24+E96) $\pm 5\%$ , (E24)	$\pm 0.5\% \pm 1\%$ , (E24+E96) $\pm 5\%$ , (E24)
Resistance Range	$1\Omega \sim 1M\Omega$	$1\Omega \sim 1M\Omega$
TCR (ppm/°C)		
10 $\Omega \sim 1M\Omega$	$\pm 100 \text{ ppm } / ^\circ\text{C}$	$\pm 100 \text{ ppm } / ^\circ\text{C}$
1 $\Omega \sim 9.76\Omega$	$\pm 200 \text{ ppm } / ^\circ\text{C}$	$\pm 200 \text{ ppm } / ^\circ\text{C}$
Max. dissipation at T <sub>amb</sub> =70°C	1/4W	1/3W
Max. Operation Voltage	150V	200V
Max. Overload Voltage	300V	400V
Operation temperature	- 55 ~ +155°C	- 55 ~ +155°C

Note :

- This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
- Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by  

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

**MECHANICAL DATA(unit : mm)**

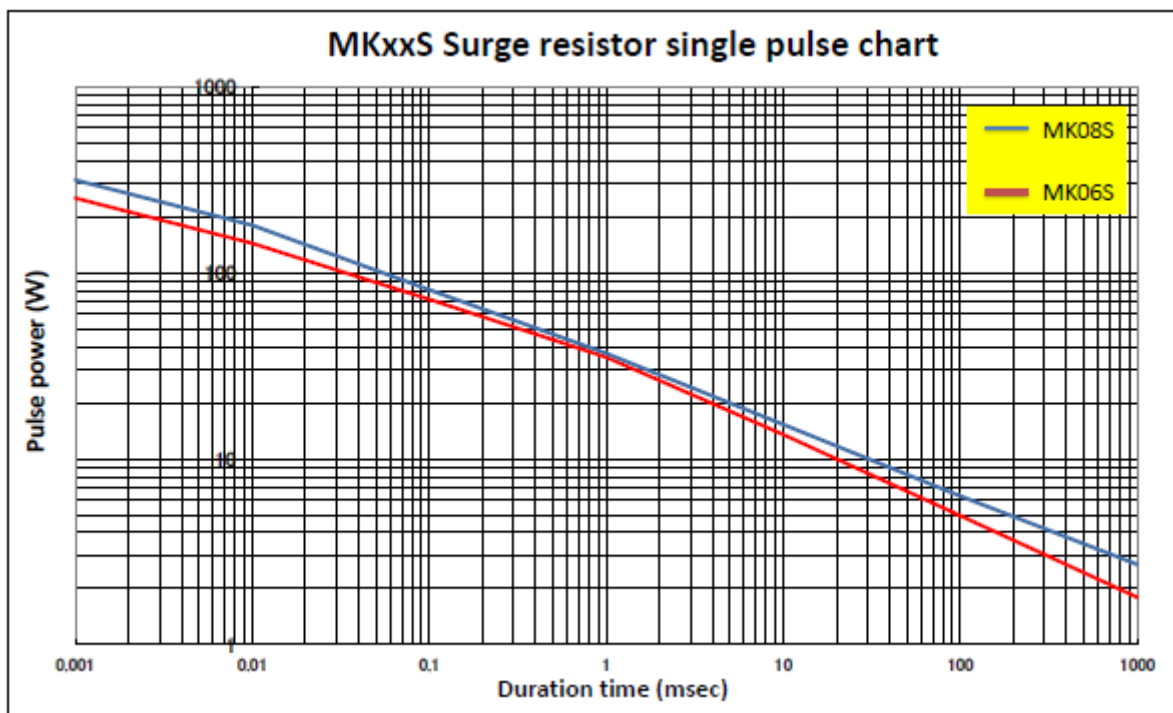
Symbol	MK06S	MK08S
L	$1.60 \pm 0.10$	$2.00 \pm 0.10$
W	$0.80 +0.15/-0.05$	$1.25 \pm 0.10$
T	$0.45 \pm 0.10$	$0.55 \pm 0.10$
Tt	$0.25 \pm 0.10$	$0.30 \pm 0.20$
Tb	$0.30 \pm 0.10$	$0.40 \pm 0.20$

## MARKING

- For 0805, each resistor is marked with 3 digits or 4 digits on the protective coating to designate the nominal resistance value. E24 series: 3 digits; E96 series: 4 digits. In case E96 overlaps with E24, 3 digits should be marked.
- For 0603 E24, each resistor is marked with 3 digits. No marking for E96!
- Example as below

Marking example	Contents
123	$12 \times 10^{-3} [\Omega] \rightarrow 12 [\text{k}\Omega]$
2R2	2.2 $[\Omega]$
5623	$562 \times 10^{-3} [\Omega] \rightarrow 562 [\text{k}\Omega]$
12R7	12.7 $[\Omega]$

## Single pulse limiting power chart



## De-rating curve

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

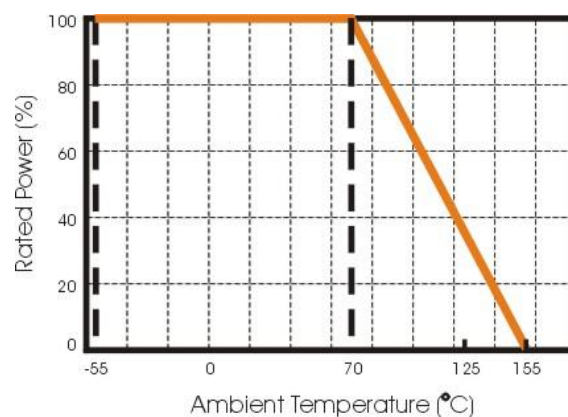


Fig.2 Maximum dissipation in percentage of rated power  
As a function of the ambient temperature

## 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.

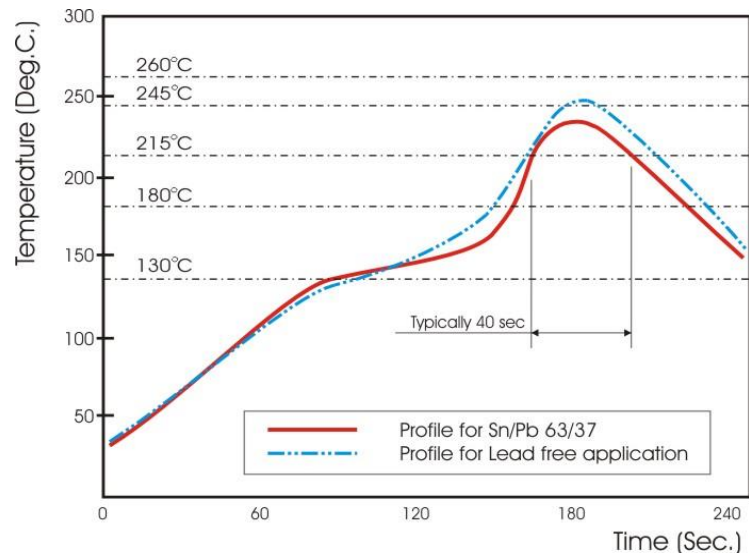


Fig 3. Infrared soldering profile for Chip Resistors

## CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

MK06	S	472_	J	T	L
Size code	Type code	Resistance code	Tolerance	Packaging code	Termination code
MK06 : 0603 MK08 : 0805	S : surge	E24 : 3 significant digits followed by no. of zeros and a blank 472 = 4K7	J: ±5% F: ±1% D: ±0.5%	T : 7" Reeled taping	L = Sn base (lead free)

### Taping quantity

- 0603/0805 Chip resistors 5,000 pcs paper tape per 7" reel.

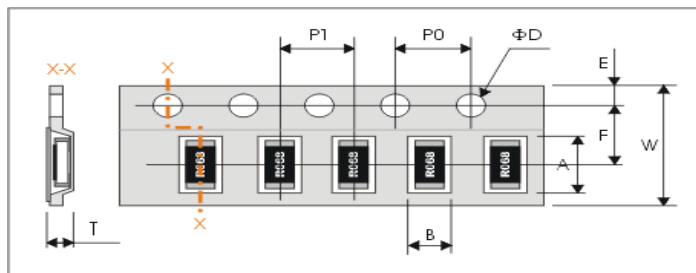
**TEST AND REQUIREMENTS(JIS C 5201-1 : 1998)**

TEST	PROCEDURE	REQUIREMENT
High temperature exposure <b>MIL-STD-202 method 108</b>	155°C, no load, 1000hours	$\Delta R/R$ max. $\pm(1\%+0.05\Omega)$ no visible damage
Temperature cycling <b>AEC Q200-4</b>	30 minutes at -55°C $\pm$ 3°C, 2~3 minutes at 20°C+5°C-1°C, 30 minutes at +155°C $\pm$ 3°C, 2~3 minutes at 20°C+5°C-1°C, total 1000 cycles	no visible damage $\Delta R/R$ max. $\pm(0.5\%+0.05\Omega)$
Bias Humidity <b>MIL-STD-202 method 103</b>	1000 hours, at 10% rated continuous power in humidity chamber controller at 85°C $\pm$ 2°C and 85% relative humidity,	$\Delta R/R$ max. $\pm(1\%+0.05\Omega)$ no visible damage
Operational Life <b>MIL-STD-202 method 108</b>	1000+48/-0 hours; 35% of operation power, 125 $\pm$ 2°C	$\Delta R/R$ max. $\pm(1\%+0.05\Omega)$ no visible damage
Resistance to Solvent <b>MIL-STD-202 method 215</b>	Solvent: 2-propanol at 25°C Immersion time: 3 min Brush: 10 times brushing Immersion and brush cycle: 3cycle	$\Delta R/R$ max. $\pm(0.5\%+0.05\Omega)$ no visible damage
Mechanical Shock <b>MIL-STD-202 method 213</b>	Waveform: half sine, Peak value 100G, Normal duration 6ms Condition: XX'YY'ZZ', 10times each	$\Delta R/R$ max. $\pm(0.5\%+0.05\Omega)$ no visible damage
Vibration <b>MIL-STD-202 method 204</b>	Peak acceleration and Sweep time: 5 g's for 20 min , Frequency 10Hz to 2000Hz, Condition: 12 cycles each of 3 orientations	$\Delta R/R$ max. $\pm(0.5\%+0.05\Omega)$ no visible damage
Resistance to soldering heat (R.S.H) <b>MIL-STD-202 method 210</b>	Un-mounted chips completely immersed for 10 $\pm$ 1second in a solder bath at 260°C $\pm$ 5°C	$\Delta R/R$ max. $\pm(0.5\%+0.05\Omega)$ no visible damage
ESD test <b>JIS-STD-002</b>	Human body model, 2 Kohm, 150 pF, Test voltage: 2KV	$\Delta R/R$ max. $\pm(1\%+0.05\Omega)$ no visible damage
Solderability <b>JIS-STD-002</b>	a) Bake the sample for 155 °C dwell time 4hrs / solder dipping 235°C/ 5s. Solder: Sn96.5-Ag3-Cu0.5 b) Solder dipping 215°C/ 5s. Solder: Sn63Pb37 c) Solder dipping 260°C/ 7s.	good tinning (>95% covered) no visible damage
Temperature Coefficient of Resistance(T.C.R) <b>Clause 4.8</b>	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$ $t_1 : 20^\circ\text{C}+5^\circ\text{C}-1^\circ\text{C}$ $R_1$ : Resistance at reference temperature $R_2$ : Resistance at test temperature +155°C	Refer to "QUICK REFERENCE DATA"
Bending strength <b>AEC Q200-005</b>	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 2 mm, once for 60 seconds	$\Delta R/R$ max. $\pm(0.5\%+0.05\Omega)$ no visible damage
Adhesion <b>AEC Q200-006</b>	Pressurizing force: 10N for 0603; 17.7N for 0805, Test time: 60 $\pm$ 1sec.	$\Delta R/R$ max. $\pm(0.5\%+0.05\Omega)$ No remarkable damage or removal of the terminations

Sulfuration test ASTM B-809-95	ASTM B-809-95 Sulfur vapor Test temp.: 60°C Relative humidity: 95% Test period: 1000h	$\Delta R/R$ max. $\pm(1\%+0.05\Omega)$ no visible damage
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## PACKAGING

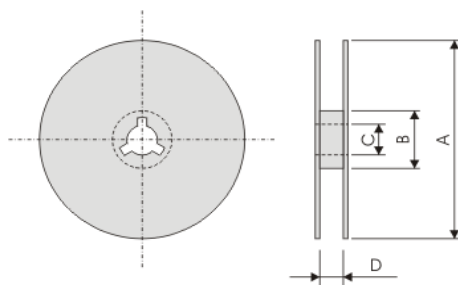
Tape specifications (unit :mm)



Series No.	A	B	W	F	E
MK06S	1.90±0.20	1.15±0.15	8.00±0.30	3.50±0.05	1.75±0.10
MK08S	2.50±0.20	1.65±0.15	8.00±0.30	3.50±0.05	1.75±0.10

Series No.	P1	P0	ΦD	T
MK06S	4.00±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 0.8
MK08S	4.00±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.0

### Reel dimensions



Reel / Tape	A	B	C	D
7" reel for 8mm tape	Φ180.0+0/-1.5	Φ60.0+1/0	13.0±0.2	9+1.0/0

### Taping quantity

- 0603/0805 Chip resistors 5,000 pcs paper tape per 7" reel.