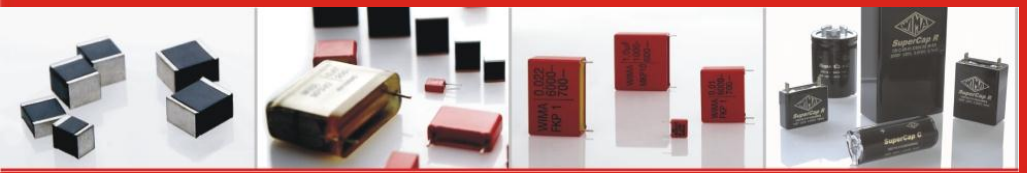

BEST CAPACITORS
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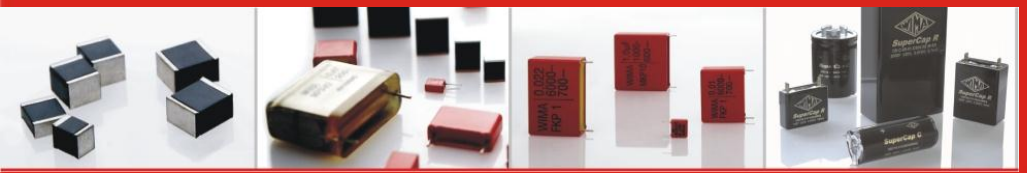
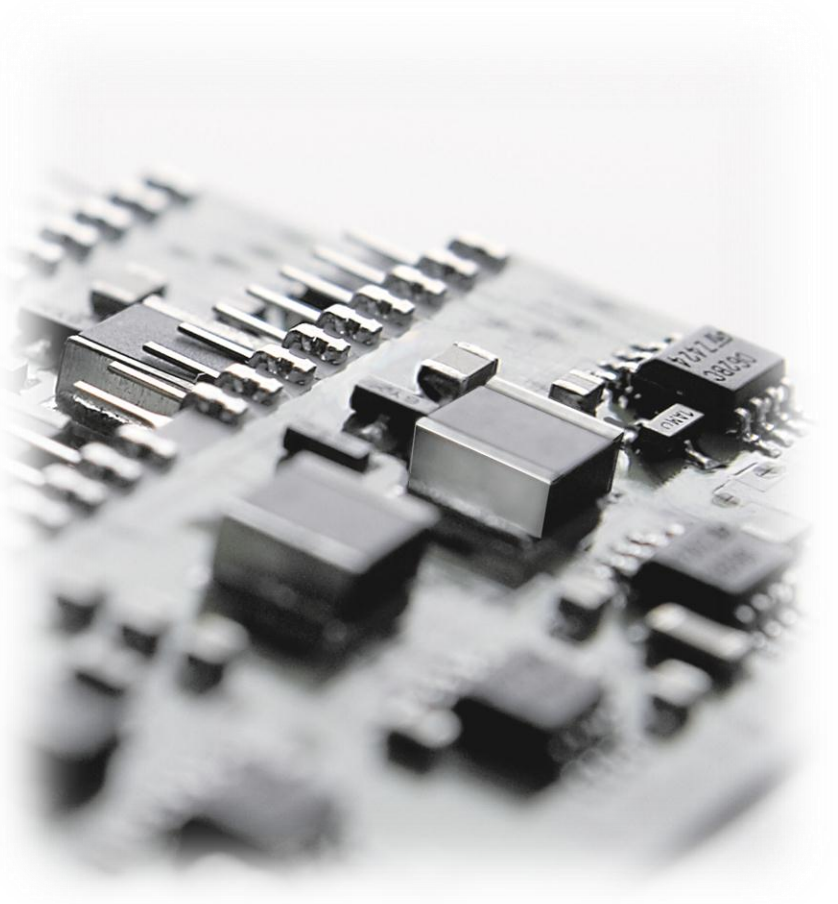
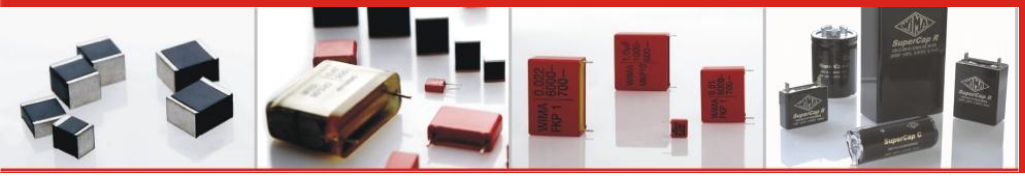
WIMA SMD Film Capacitors

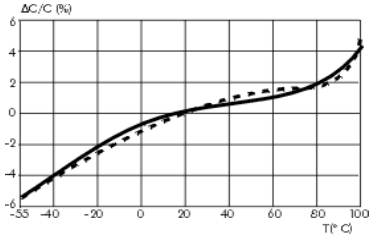
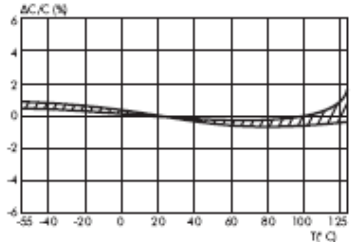
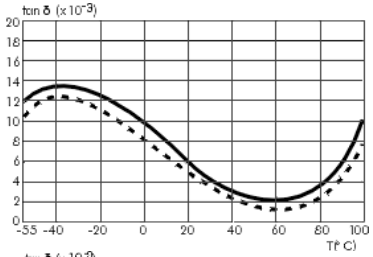
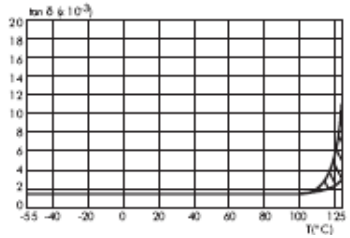
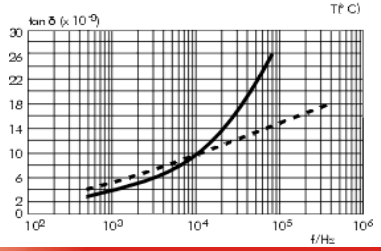
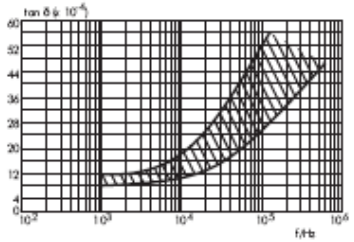


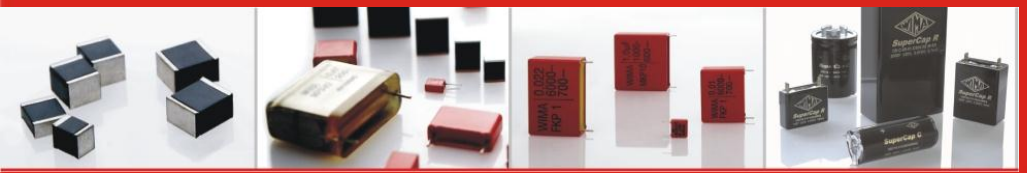
Outline

- Comparison of Plastic film with other Dielectrics
- Construction Principle of SMD Film Capacitors
- Characteristics and Graphs of WIMA SMD Capacitors
- Processing of WIMA SMD Capacitors
- Ceramic SMD (MLCC) Problems





	PET Film	PPS Film
Typical applications	Decoupling/Bypassing Coupling/Blocking Smoothing	Filtering Oscillating Resonating
Film properties	Operating temperature: +100°C Film thickness: > 0.5 µm Advantageous price/performance and capacitance/volume ratio	Operating temperature: +140°C Low dissipation factor Quite constant TKc
Capacitance change versus temperature (f = 1 kHz) (general guide)		
Dissipation factor change versus temperature (f = 1 kHz) (general guide)		
Dissipation factor change versus frequency (general guide)		



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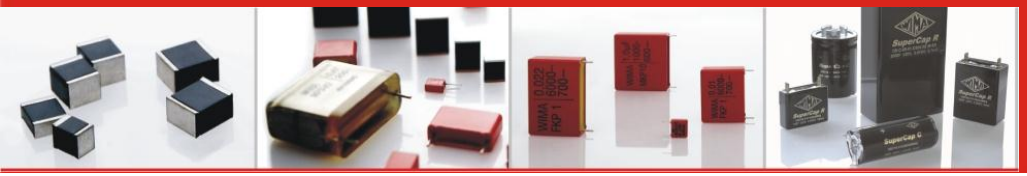
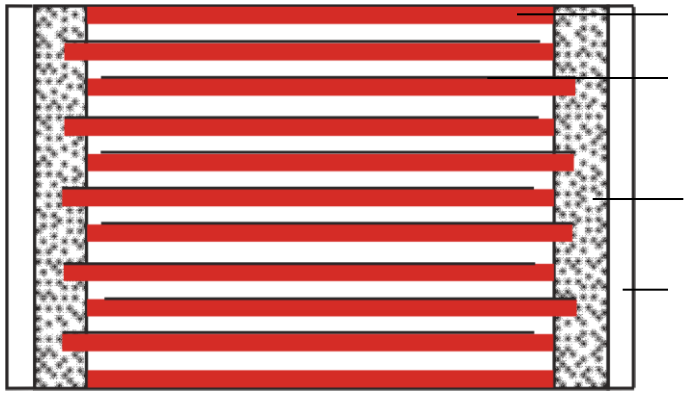
Comparison of Dielectrics

	PET	PPS	NPO	X7R	Tantalum
Dielectric constant 1kHz/23°C	3.3 (positive as temperature rise)	3.0 (very constant versus temperature)	12...40	700-2000	26
ΔC/C versus temperature (%)	+/-5	+/-1.5	+/-1	+/-15	+/-10
DC Voltage coefficient (%)	negligible	negligible	negligible	-20	negligible
ΔC Aging rate (%/h decreasing)	negligible	negligible	negligible	2	n.a.
Dissipation factor (%) 1 kHz 10 kHz 100 kHz	 0.8 1.5 3.0	 0.2 0.25 0.5	 0.10 0.10 0.10	2.5	8
ESR	low	quite low	low	mod./high	high
Dielectric absorption (%)	0.5	0.05	0.6	2.5	n.a.
Self-healing	yes	yes	no	no	no
Typical failure mode at end of life	open	open	short	short	short
Reliability	high	high	high	moderate	low
Resistance to thermal and mechanical shock	high	high	mod./low	mod./low	high
Polarity	no	no	no	no	yes

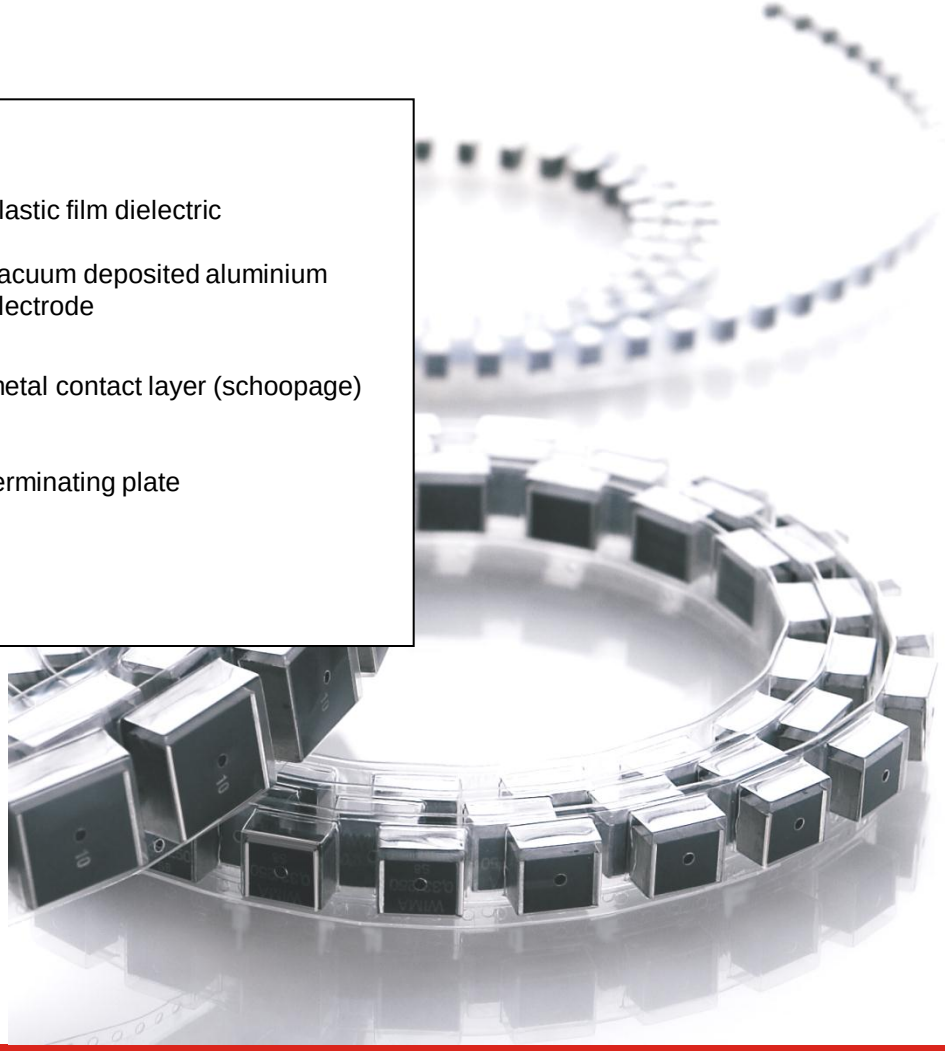


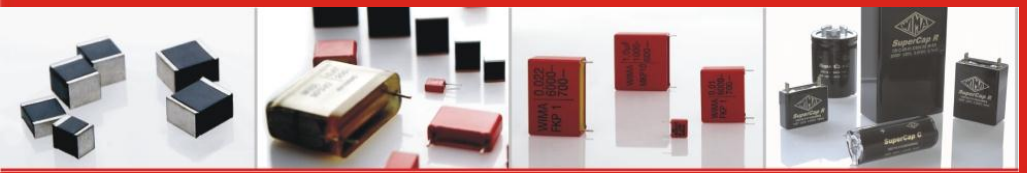
Metallized Construction



With metallized capacitors ultra-thin film (> 0.5 µm) is metallized with aluminium serving as an electrode resulting in a **favourable capacitance/ volume** ratio.
(WIMA SMD-PET / 6.8 µF / 63 VDC / Size Code 6054)

Another specific characteristic is the **excellent self-healing ability** ensuring an almost **unlimited life expectancy** of the capacitors.



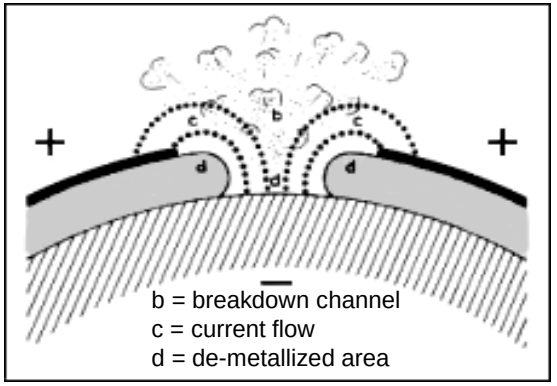


Self-healing Process

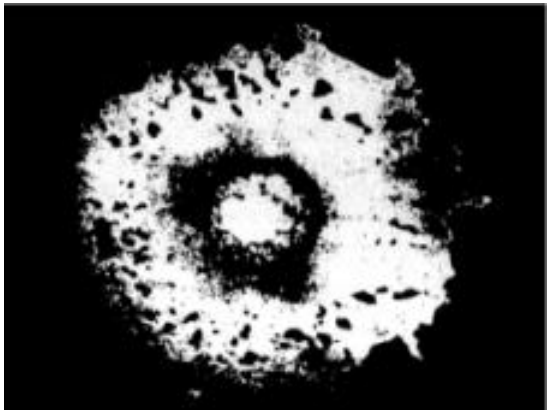
The physical process which leads to self-healing of a metallized film capacitor is basically as follows:

- during operation e.g. voltage spikes and/or high temperature may impact the capacitor
- as a result there is an electrical breakdown at the weakest point of the dielectric causing temperatures occurring in its surrounding of several thousand °C
- as a consequence the metallization evaporates in the area of the break-through channel
- a metal-free zone is created around the affected spot isolating the area electrically. The capacitor has regenerated (self-healed) completely.

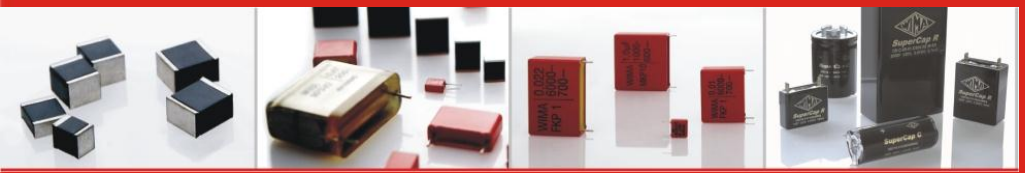
Only metallized film and paper capacitors exhibit the self-healing property. Ceramic, tantalum or electrolytic capacitors regularly fail after a breakdown.



Schematic depiction of the self-healing process



Isolated area after the self-healing process



SMD Plastic Film Capacitors

Capacitances:

0.01 µF – 6.8 µF

Voltages:

63 VDC – 1000 VDC

Size Codes:

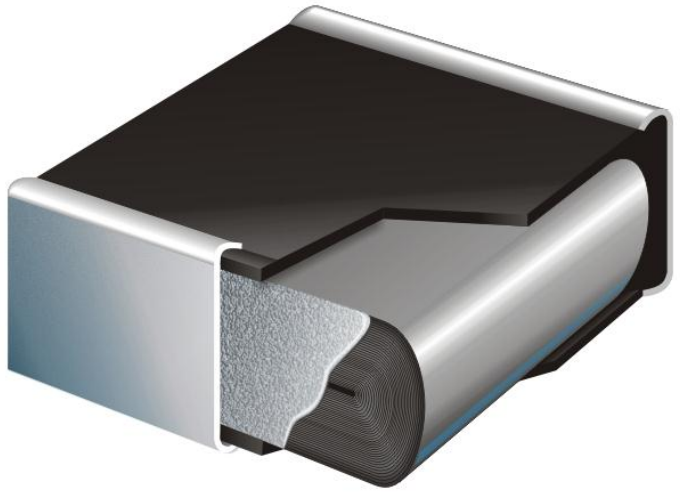
1812 – 6054

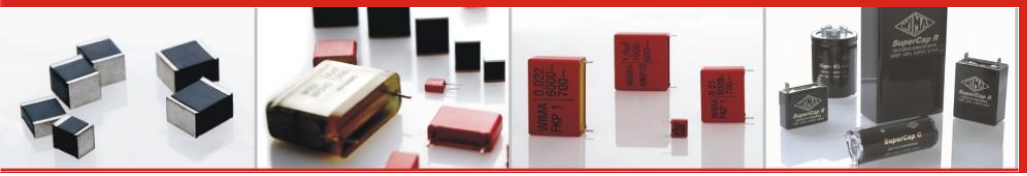
Dielectrics:

PET, PPS

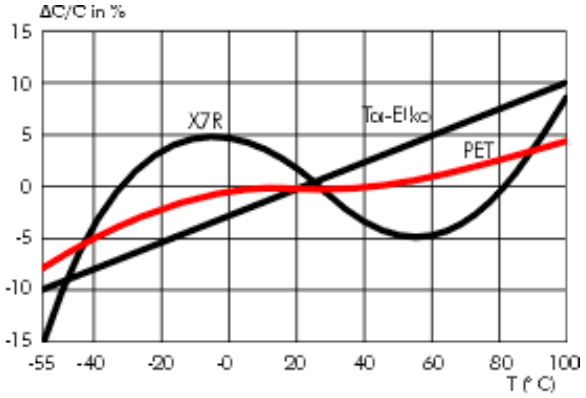
WIMA SMD capacitors are produced with the proven box technology offering many advantages in comparison with non-encapsulated or moulded capacitor versions:

- Safe protection of the capacitor element against mechanical and thermal stress during processing and operation.
- No risk of internal cracks or impact on the contacts due to construction-inherent elasticity.
- No risk of delamination due to solder plates covering the capacitor‘s entire end surfaces
- Solvent-resistant, flame-retardent plastic case in accordance with UL 94 V-0.

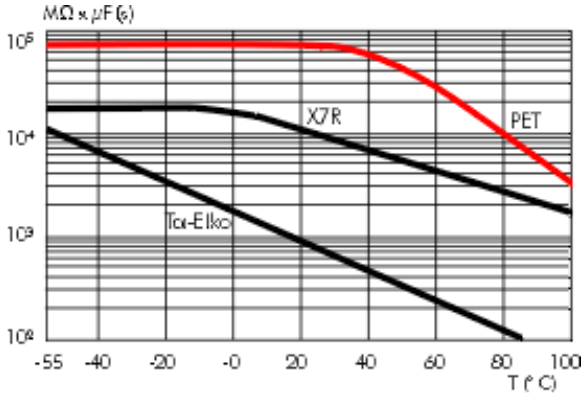




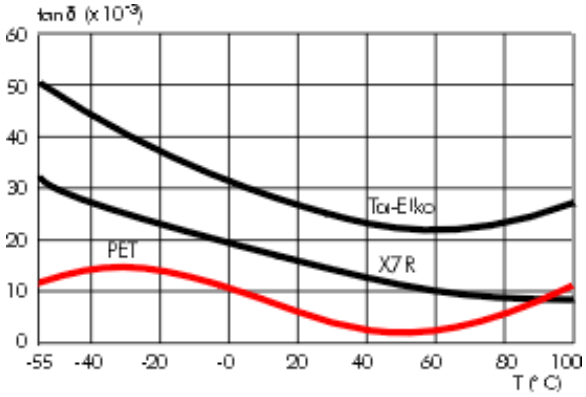
SMD Polyester Capacitors in Comparison with Ceramic and Tantalum Capacitors



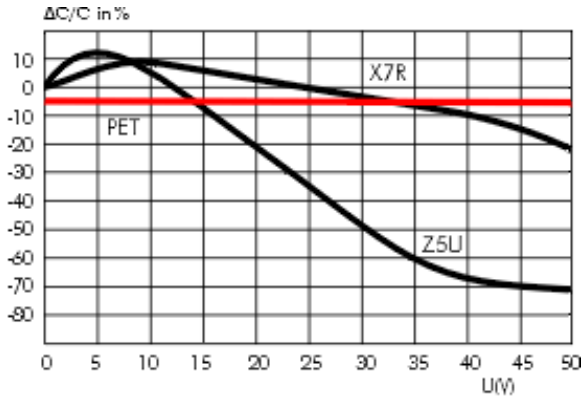
Capacitance change versus temperature (f = 1 kHz) (general guide)



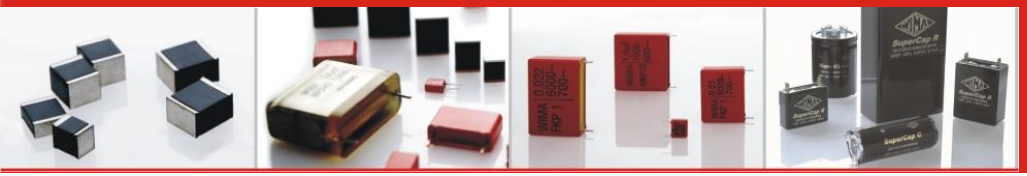
Insulation resistance change versus temperature (general guide)



Dissipation factor change versus temperature (f = 1 kHz) (general guide)



Capacitance change versus voltage (general guide)



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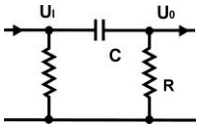
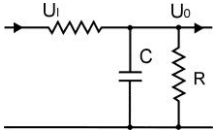
Industrial Electronics · Power Supplies/UPS/SMPS · AC/DC Converters · Measuring and Control Equipment

Coupling/ Blocking



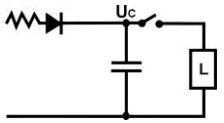
SMD	MKS 2
MKS 02	MKS 4

Decoupling/ Bypassing



SMD	MKS 2
MKS 02	FKS 3
FKS 2	MKS 4

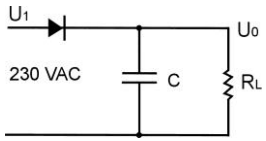
Energy Storing



MKP 2 *	FKP 1
MKP 10	Snubber
FKP 4	GTO

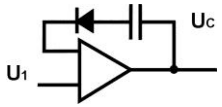
* ≥ 250VDC

Smoothing



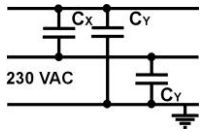
SMD	MKS 4
MKS 02	MKP 4
MKS 2	MKP 10

A/D Conversion



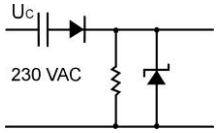
FKP 02	FKP 3
FKP 2	MKP 4
MKP 2	

RFI - Suppression



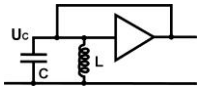
MKP-X2	MP3-X1
MKP-Y2	MP3-Y2
MP3-X2	MP3R-Y2

Voltage Dropper



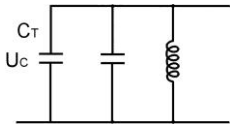
MP3-X2	MKS 4 *
MP 3-X2	* ≥ 630VDC ≥ PCM 10

Oscillating



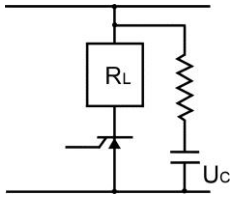
SMD-PPS	MKP 4
FKP 02	MKP 10
FKP 2	FKP 4
MKP 2*	FKP 1
FKP 3	* ≥ 250VDC

Temperature Compensating



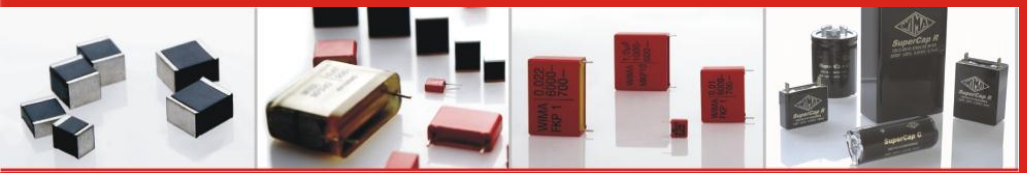
FKP 02/2	FKP 3
MKP 2	MKP4

Snubbing



FKP 02/2	FKP 4
MKP 2 *	FKP 1
FKP 3	Snubber
MKP 10	GTO

* ≥ 250VDC



SMD Processing

Processing of SMD components

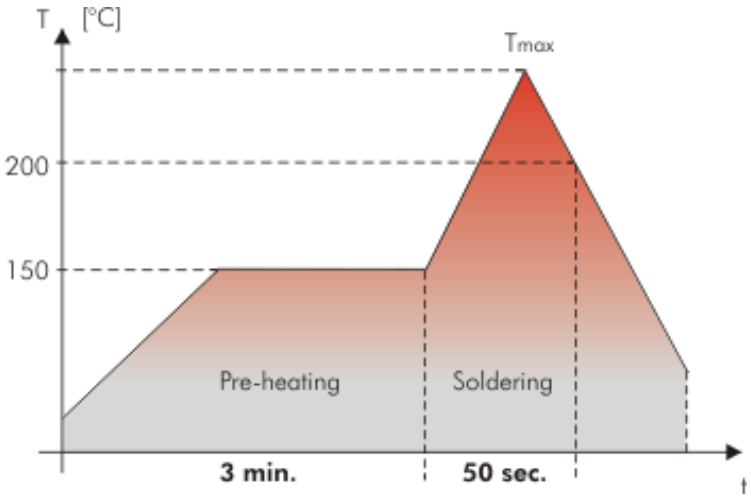
- Assembling
- Soldering
- Washing
- Electrical final inspection / calibration

must be regarded as a complete process which can constitute considerable stress on electronic components. Manufacturer's instructions are mandatory!

Due to different soldering equipment and temperature requirements of the components respectively, exact temperature and/or time data for soldering processes cannot be specified. Hence graphs are to be regarded as a recommendation only.

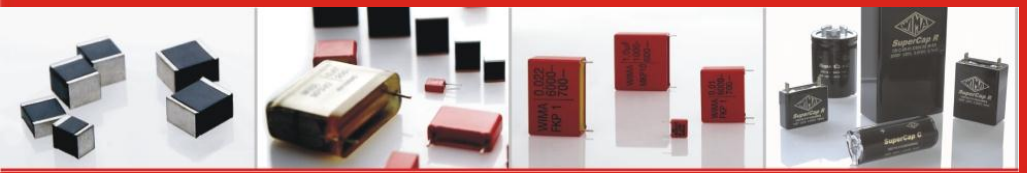
SMD: Reflow Soldering

Temperature/time graph showing the permissible processing temperatures for typical convection soldering processes



SMD-PET	
Size Code	Tmax.
1812	220° C
2220	230° C
2824	230° C
4030	230° C
5040	240° C
6054	250° C

SMD-PPS	
Size Code	Tmax.
1812	250° C
2220	250° C
2824	250° C
4030	250° C
5040	250° C
6054	250° C

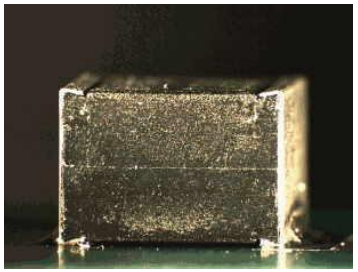


Ceramic SMD (MLCC) Problems

Substrate Bending Test

In the substrate bending test, SMD components are mounted on a 100mm x 30mm printed circuit test board standardized, e.g. in accordance with IEC 60068-2-21. The printed circuit test board is subjected to bending of 1mm to 5 mm by means of a special tool.

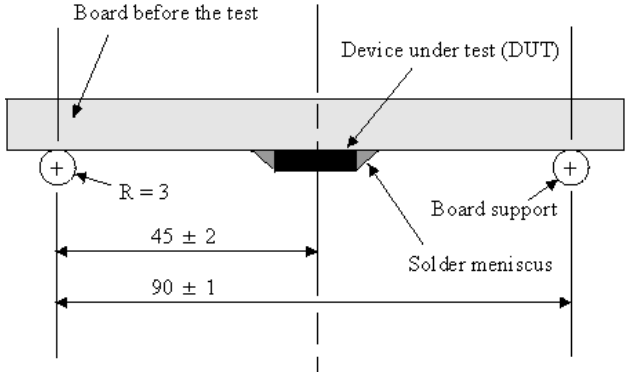
Ceramic capacitors, especially larger size codes, demonstrate extremely low stress strength.



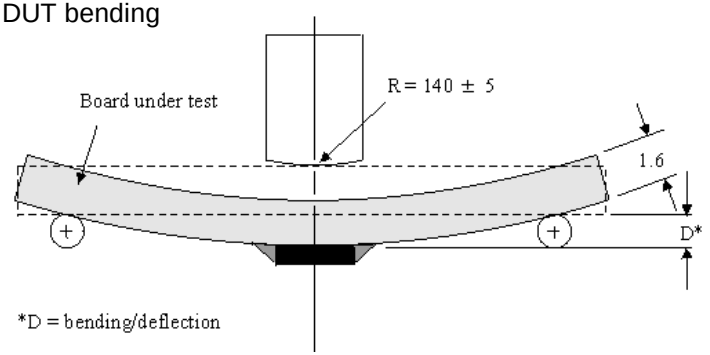
WIMA SMD film capacitors with metal plate configuration subjected to the test are not affected.

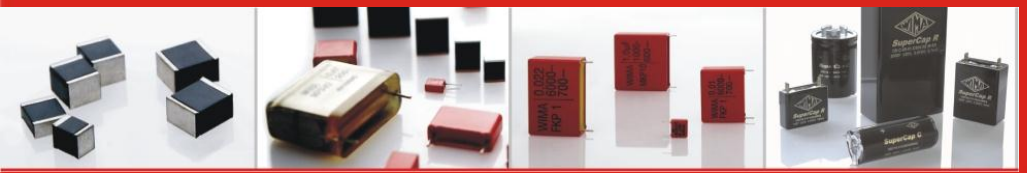
Test configuration in accordance with IEC 60068-2-21

DUT on test board



DUT bending





Ceramic SMD (MLCC) Problems

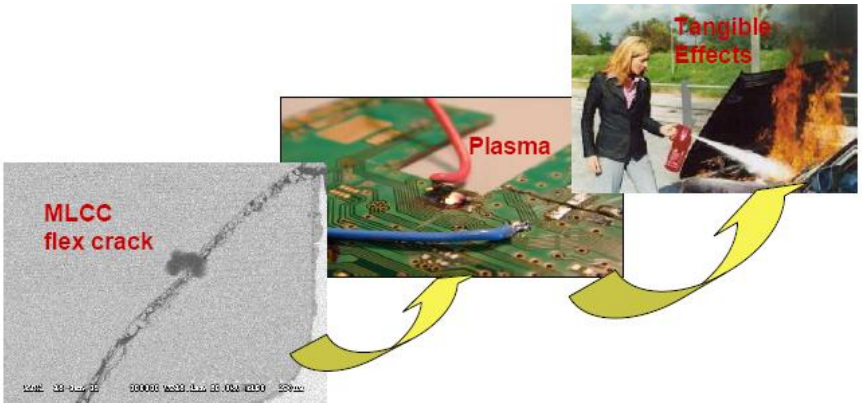
Disadvantages of MLCC

- Component aging
- Low mechanical / thermal withstanding ability (brittleness)
- Intermetallic stress in end termination layers (Cu, Ni, Sn)
- „Tombstoning“ effect (lack of contact)
- No self-healing properties

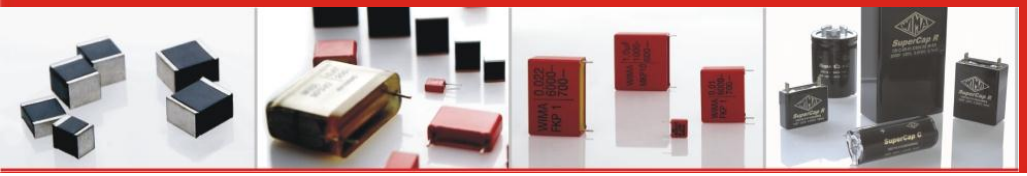
Most common failures of MLCC

- Mode: low insulation resistance / short circuit
- Mechanism: airgap, microcrack, moisture, conduction
- Root causes: board flex, thermal shock, voltage stress, contamination (moisture, solvents, radiation)

Low insulation resistance or short circuit due to board flexing tensile forces create air gaps resulting in voltage stress. High temperature reduces $BaTiO_2$ and creates plasma which can lead to fire.



Source: KEMET



Thank you!

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