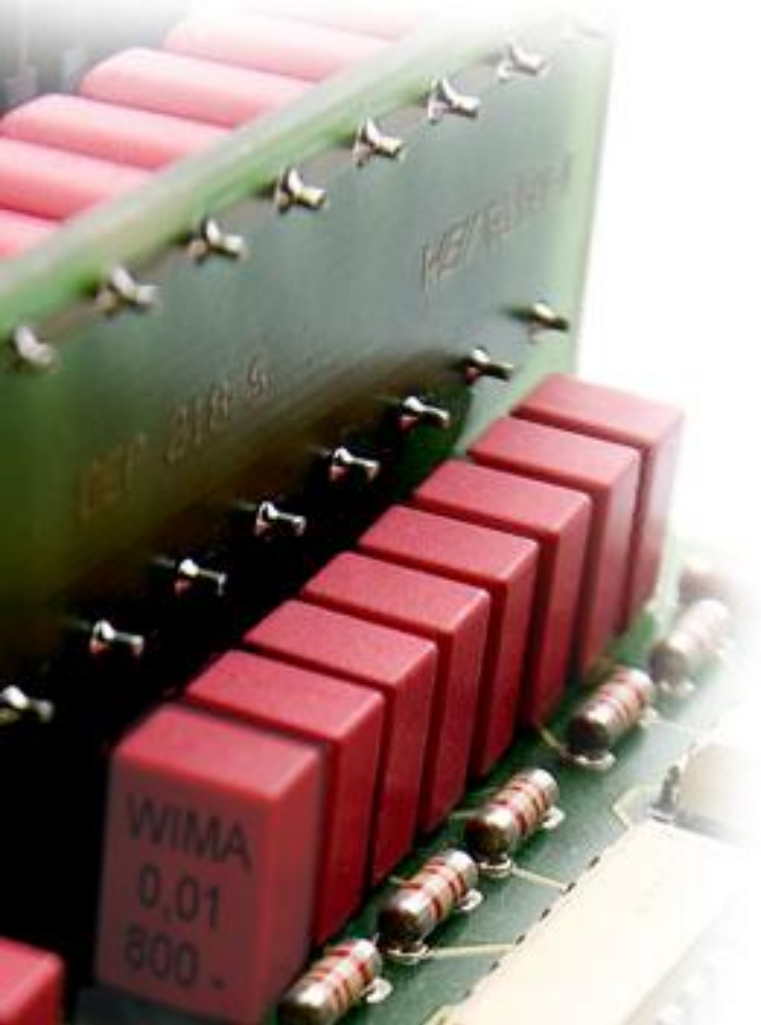
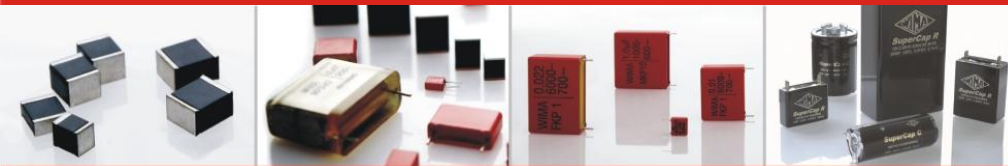


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WIMA Film Capacitors



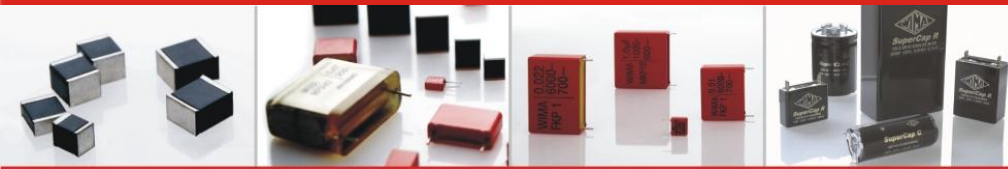
**BEST CAPACITORS
MADE IN GERMANY**



Outline

- Plastic Film Technology
- Characteristics of Plastic Film Dielectrics
- Comparison of Plastic Film with other Dielectrics
- Construction Principles of WIMA Film Capacitors
- Ranges and Applications of WIMA Film Capacitors
- WIMA Quality and Reliability



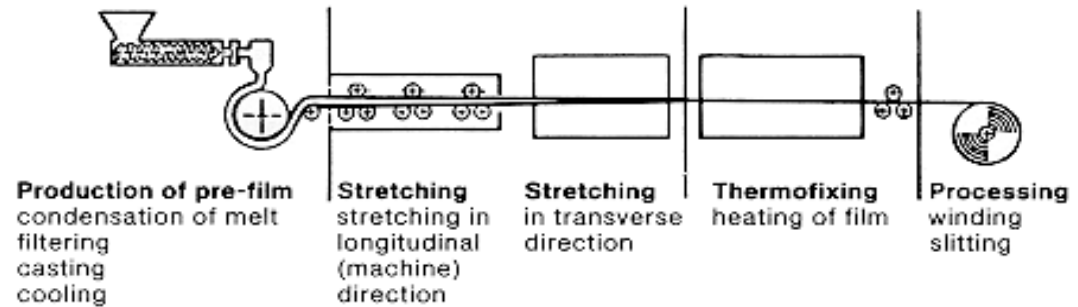


**BEST CAPACITORS
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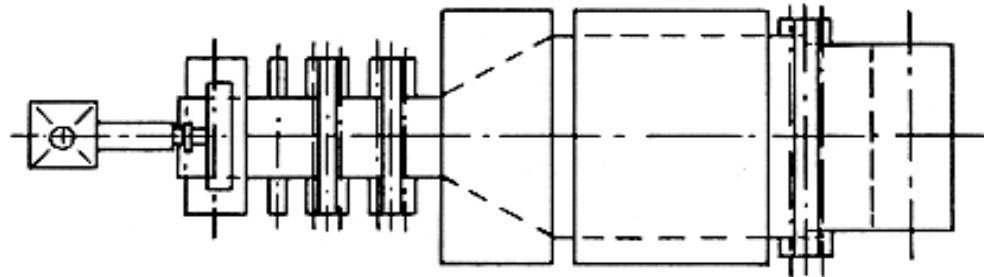


Manufacturing Process of Polyester Film

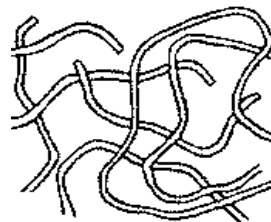
Extrusion



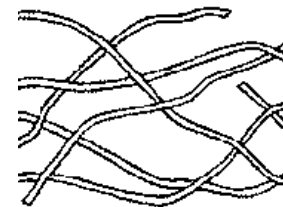
Bi-axial stretching



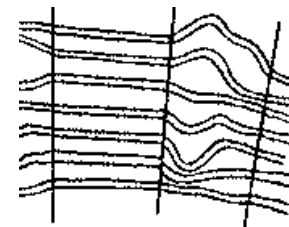
Crystallisation



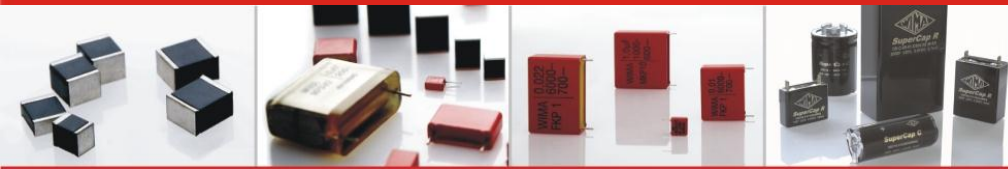
tangled felted



stretched



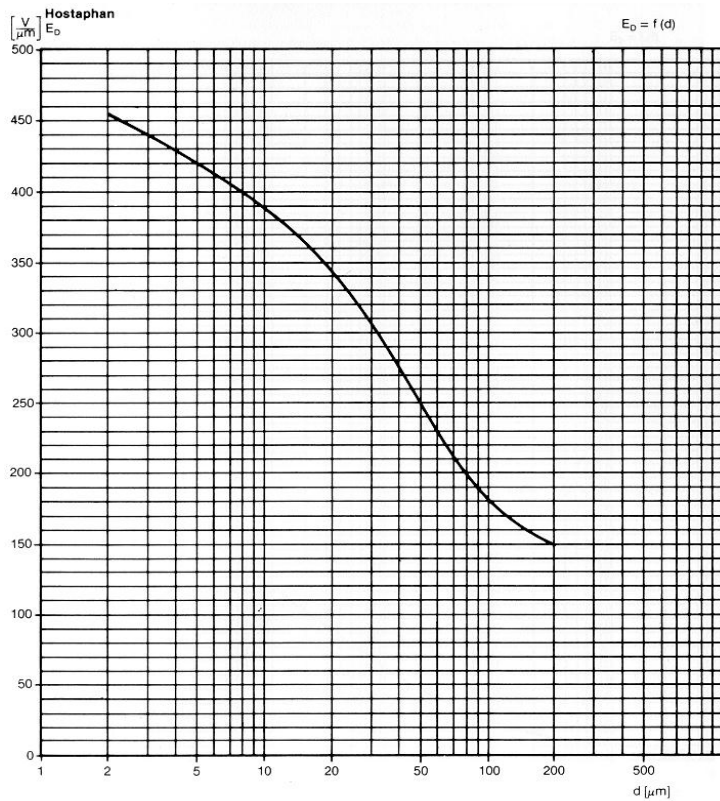
crystallised (cross-linked, knotted)



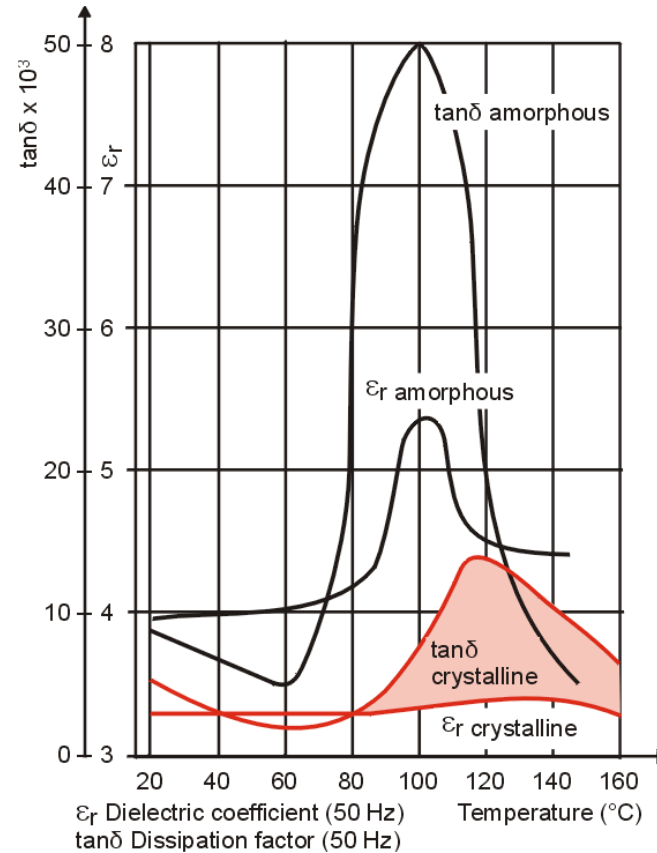
**BEST CAPACITORS
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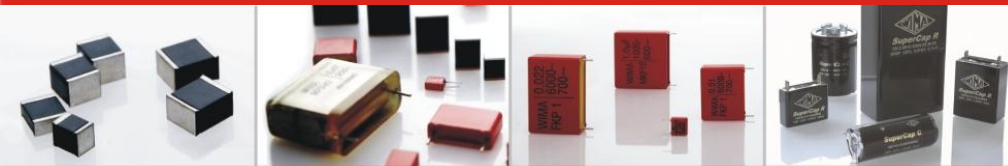
Film Technology



Dielectric strength in relation to film gauge



The electrical properties of PET film are generated during manufacturing process



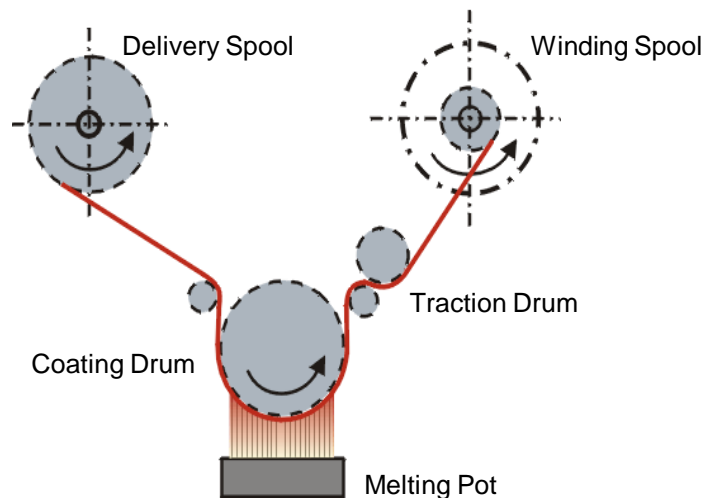
**BEST CAPACITORS
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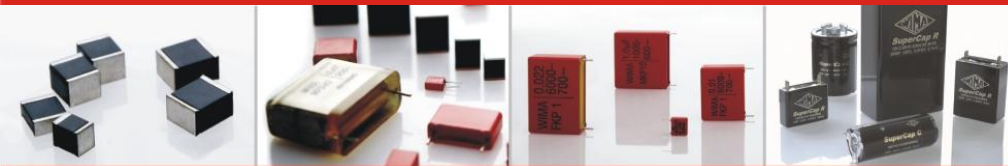
Film Technology

Metallization of Plastic Film

- Aluminium is heated up to approx. 1400° C.
- The evaporated aluminium precipitates on the plastic film.
- In order not to damage the ultra-thin plastic film the coating drum has to be cooled down to approx. - 50°C.



Metallization of films used for production of WIMA capacitors are made by WIMA using special equipment.



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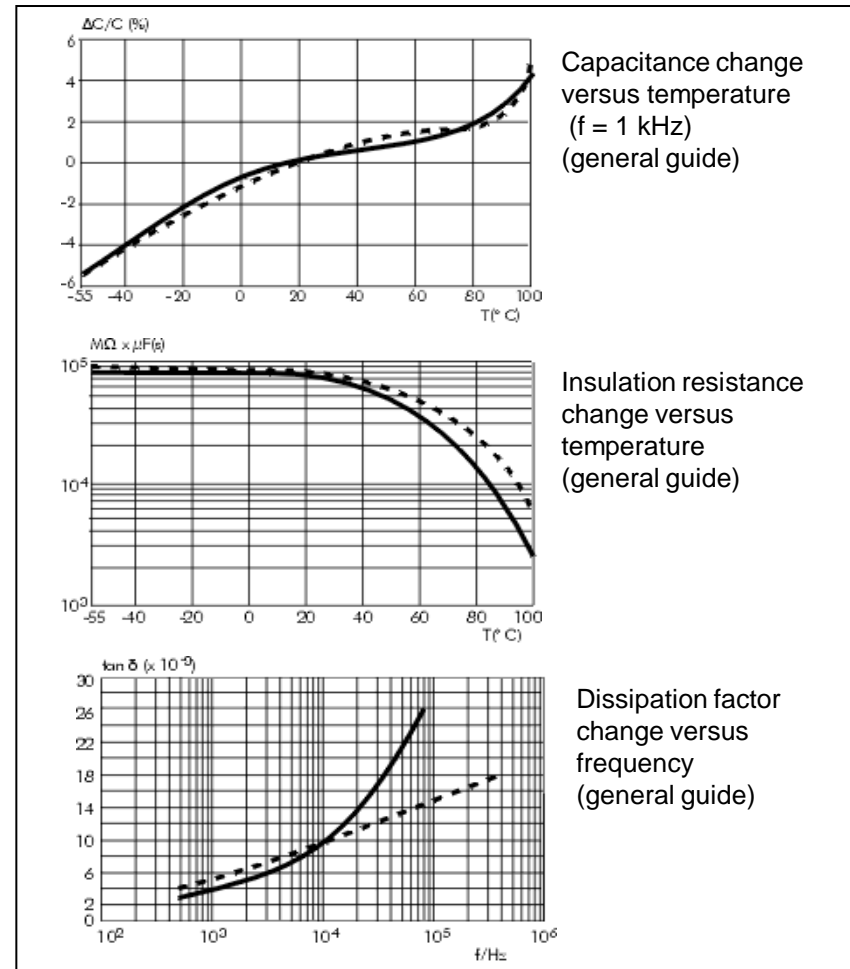
Polyester (PET) Film

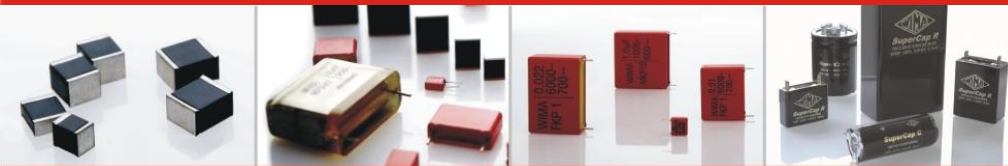
Typical Applications

- Decoupling/Bypassing
- Coupling/Blocking
- Smoothing etc.

Film Properties

- Max. operating temperature: +100°C
- Film thickness: > 0.5 μm
- Advantageous price/performance ratio
- Advantageous capacitance/volume ratio
- Substitution of ceramic, electrolytic and tantalum capacitors





**BEST CAPACITORS
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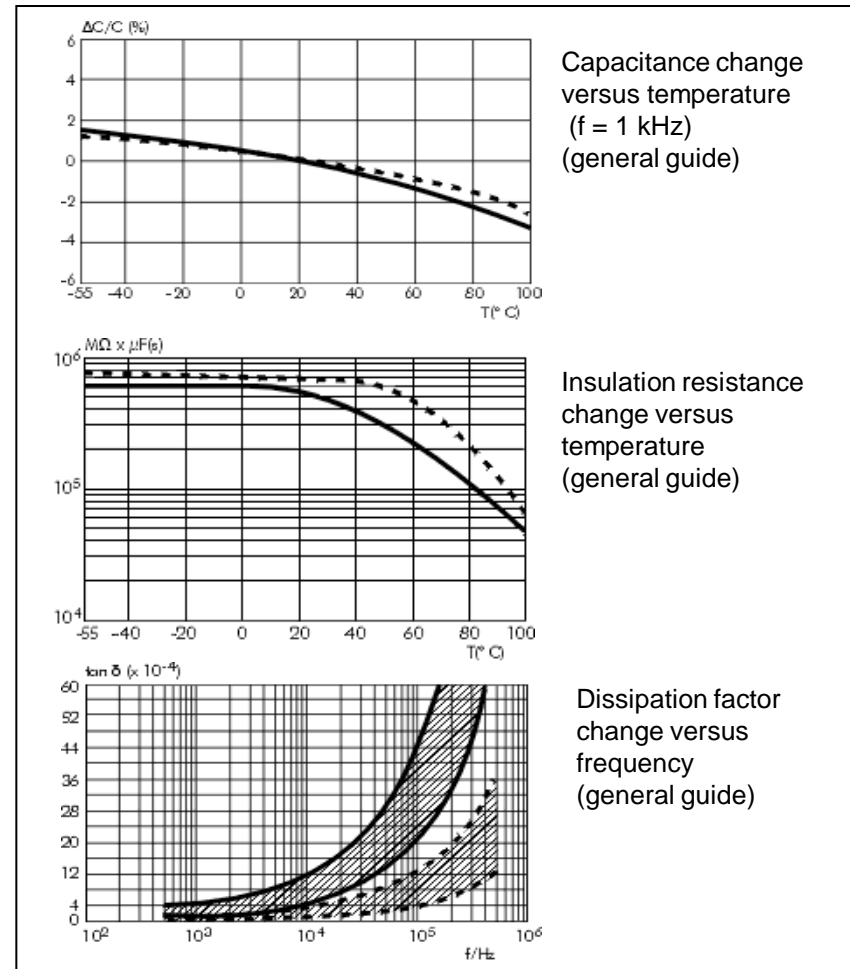
Polypropylene (PP) Film

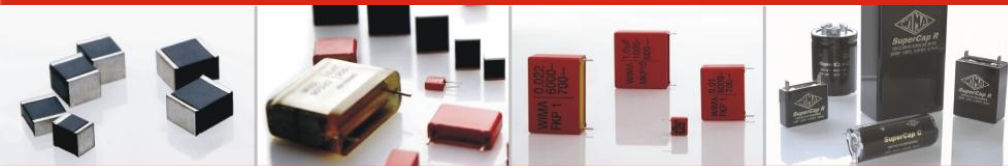
Typical Applications

- Energy storing
- Oscillating
- Resonating
- Smoothing
- A/D conversion
- Snubbing
- Temperature compensation
- RFI suppression
- Sample and hold circuits etc.

Film Properties

- Max. operating temperature: +100°C
- Film thickness: > 4 μm
- Lowest dissipation factor
- Constantly negative TKc
- Tight tolerances





**BEST CAPACITORS
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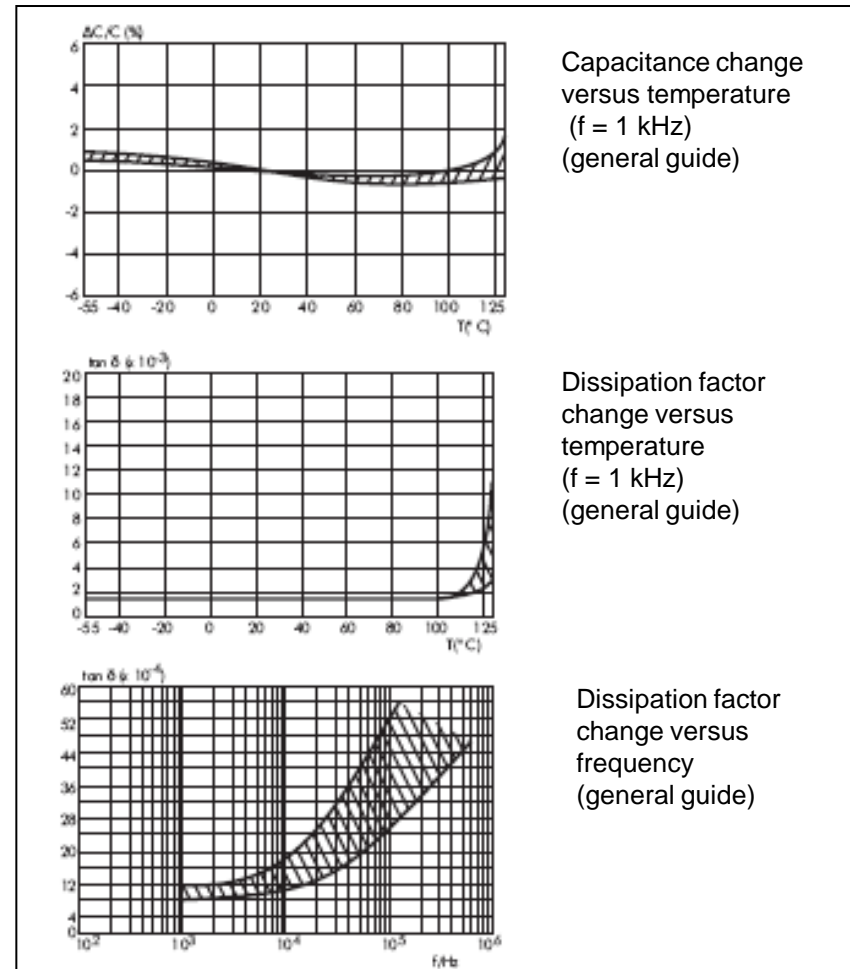
Polyphenylene-sulphide (PPS) Film

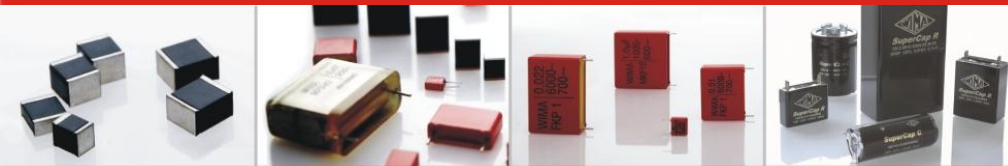
Typical Applications

- Filtering
- Oscillating
- Resonating

Film Properties

- Max. operating temperature: +140°C
- Advantageous capacitance/volume ratio
- Low dissipation factor
- Quite constant TKc





**BEST CAPACITORS
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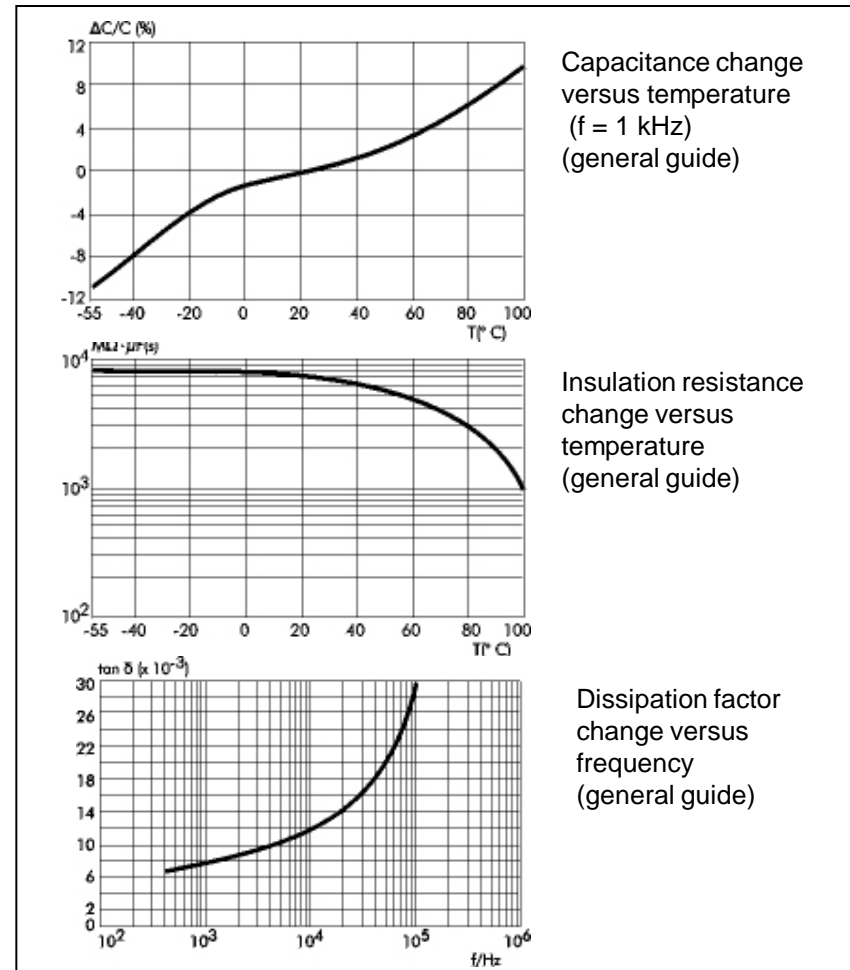
Paper (MP) Dielectric

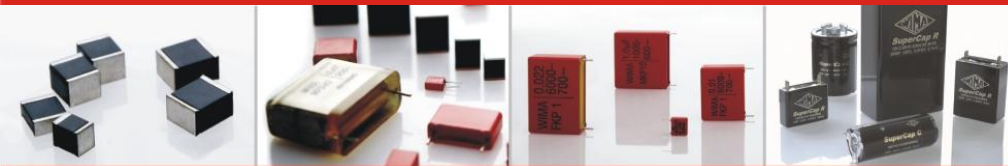
Typical Applications

- RFI circuits (class X and Y)
- Across the line applications
- Phase to earth applications

Film Properties

- Temperature range up to +110° C
- Excellent self-healing property (oxidation ratio)
- High reliability against active and passive flammability
- Recommended for across the line applications also during stand-by mode



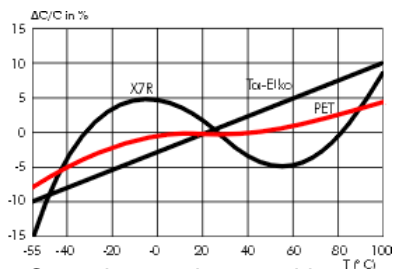


**BEST CAPACITORS
MADE IN GERMANY**

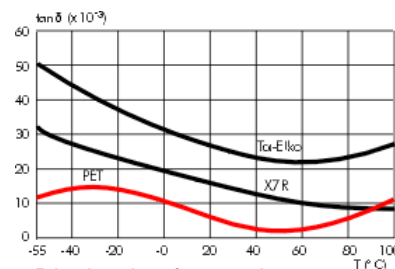


Comparison of Dielectrics

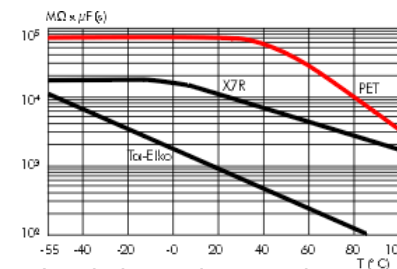
| | PET | PP | PPS | NPO | X7R | Tantalum |
|--|--------------------------------------|------------------------------------|--|----------------------|----------|------------|
| Dielectric constant 1kHz/23°C | 3.3 (positive with temperature rise) | 2.2 (negative as temperature rise) | 3.0 (very constant versus temperature) | 12...40 | 700-2000 | 26 |
| $\Delta C/C$ with temperature(%) | +/-5 | +/-2.5 | +/-1.5 | +/-1 | +/-15 | +/-10 |
| DC Voltage coefficient (%) | negligible | negligible | negligible | negligible | -20 | negligible |
| ΔC Aging rate (%/h dec.) | negligible | negligible | negligible | negligible | 2 | n.a. |
| Dissipation factor (%) 1 kHz 10 kHz 100 kHz | 0.8 1.5 3.0 | 0.05 0.08 0.25 | 0.2 0.25 0.5 | 0.10 0.10 0.10 | 2.5 | 8 |
| Self-healing | yes | yes | yes | no | no | no |
| Dielectric absorption (%) | 0.5 | 0.05...0.10 | 0.05 | 0.6 | 2.5 | n.a. |



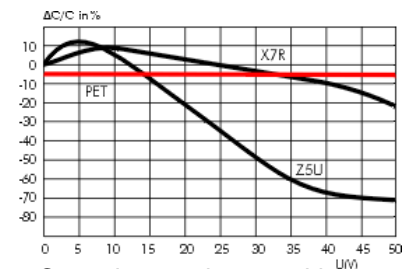
Capacitance change with temperature (f = 1 kHz)



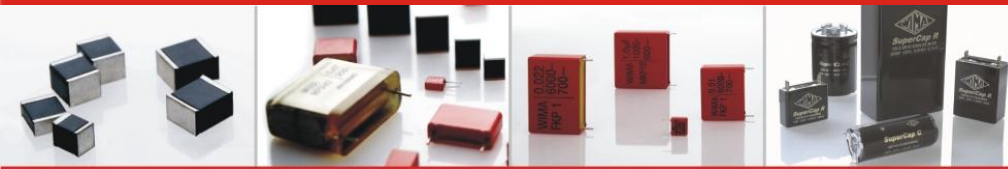
Dissipation factor change with temperature (f = 1 kHz)



Insulation resistance change with temperature



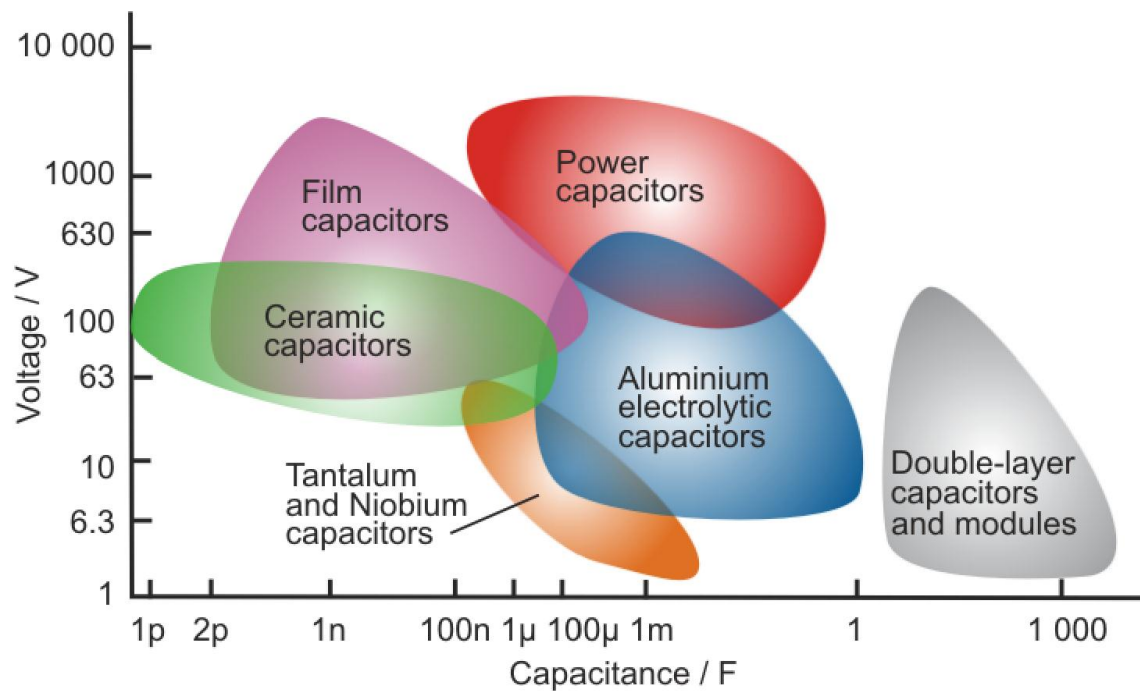
Capacitance change with voltage (f = 1 kHz)

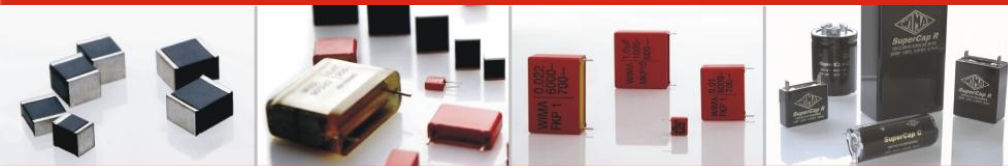


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Range of Capacitors by Capacitance and Voltage

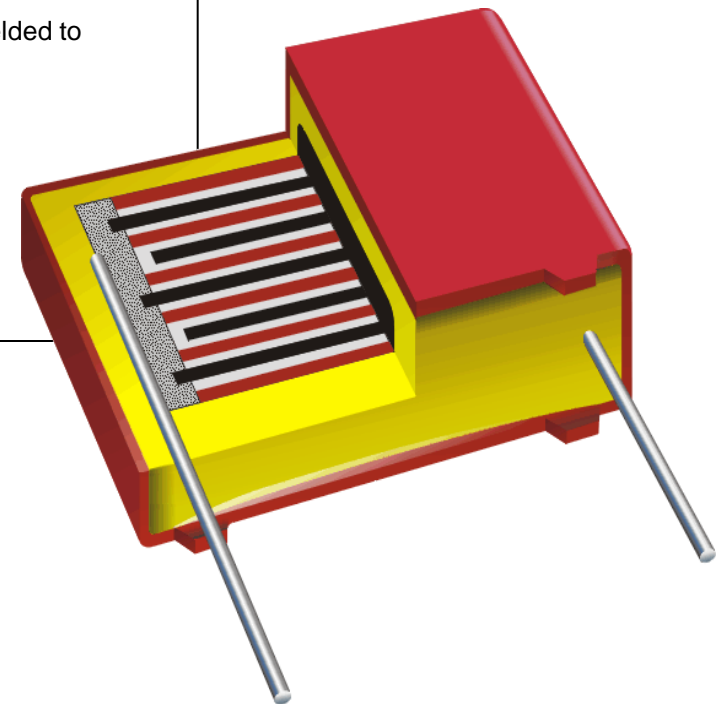
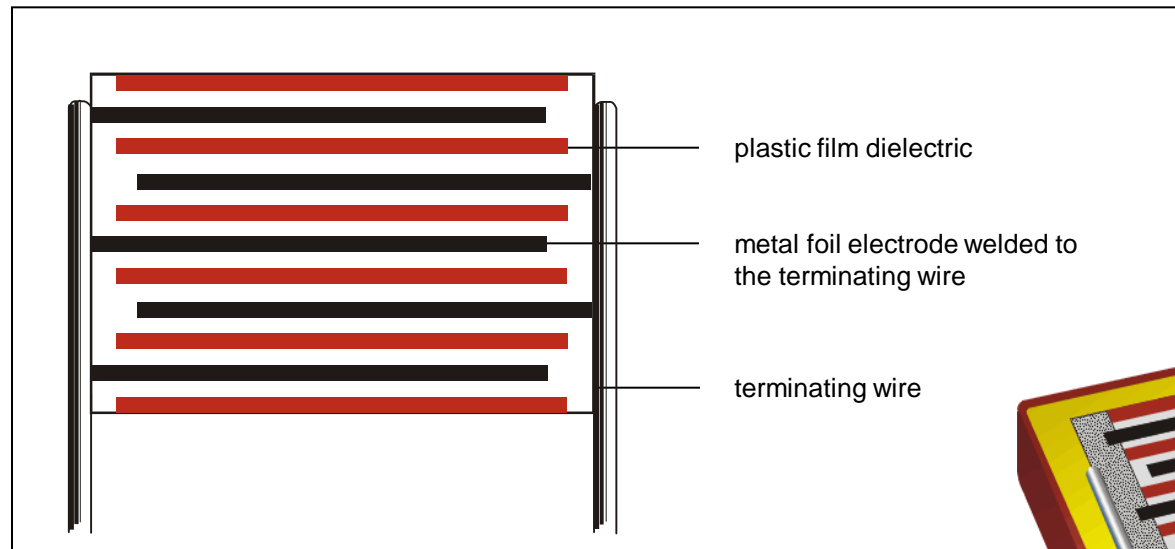




**BEST CAPACITORS
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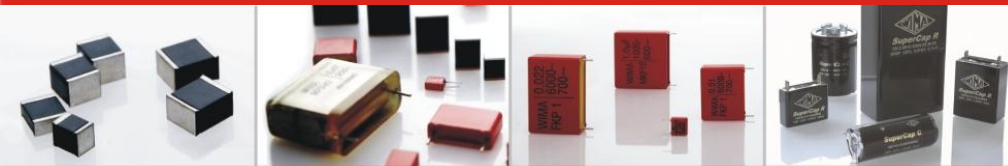


Film/Foil Construction



With film/foil capacitors the electrode being a metal foil is wound together with the dielectric film.

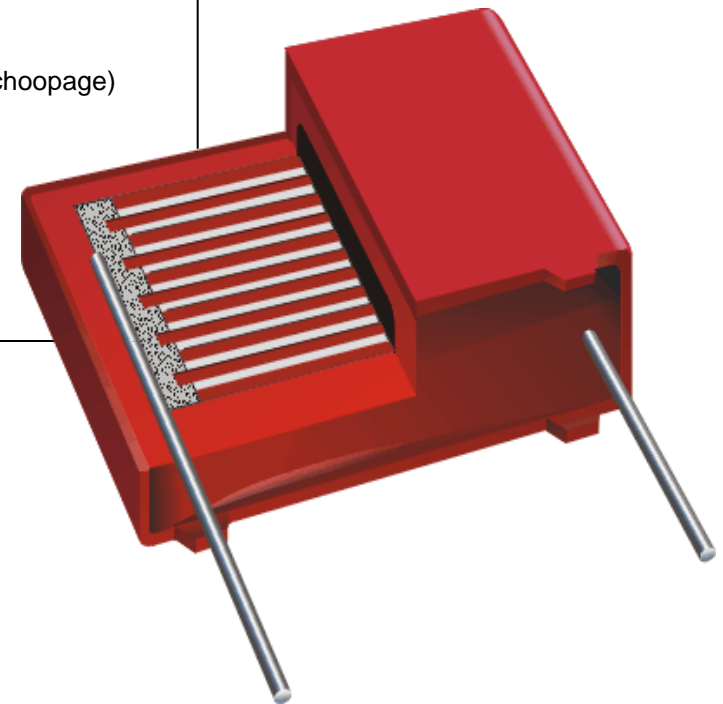
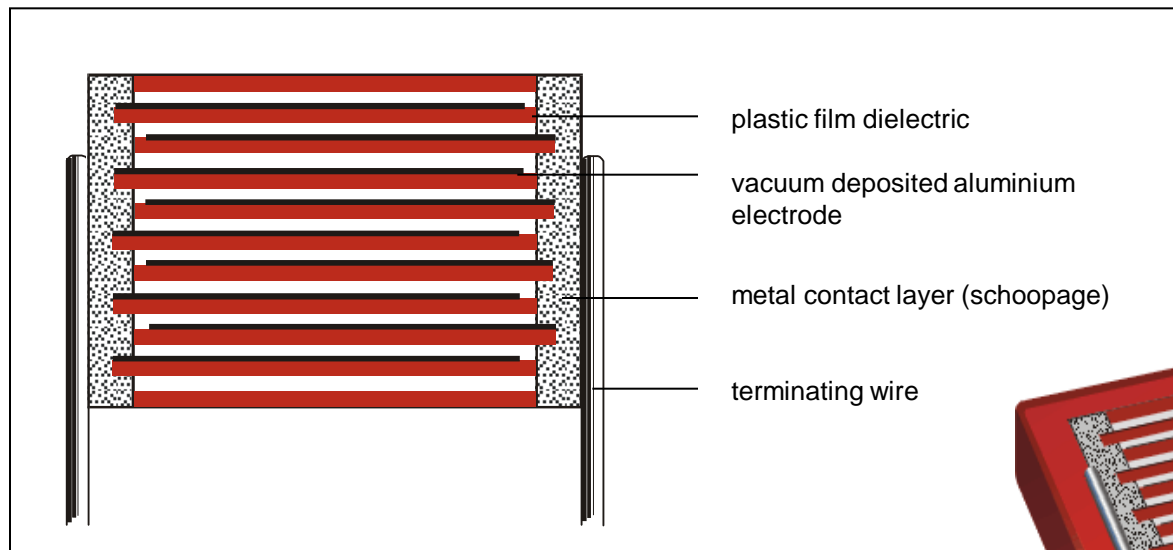
Due to their low series resistance, components of this construction type exhibit **excellent pulse and current carrying capabilities** as well as a **very high insulation resistance**.



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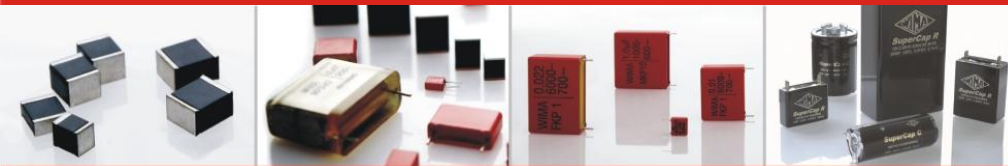


Metallized Construction



With metallized capacitors the dielectric film is metallized with aluminium serving as an electrode resulting in a **favourable capacitance / volume ratio**.

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



**BEST CAPACITORS
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Construction Principles

Film/Foil Construction

Advantages

- Excellent pulse and current carrying capability
- High insulation resistance
- Close tolerances up to $\pm 1\%$
- Voltage ranges up to 1000 VDC in PCM 5 mm.

Disadvantages

- Irreversible short circuit in case of breakdown

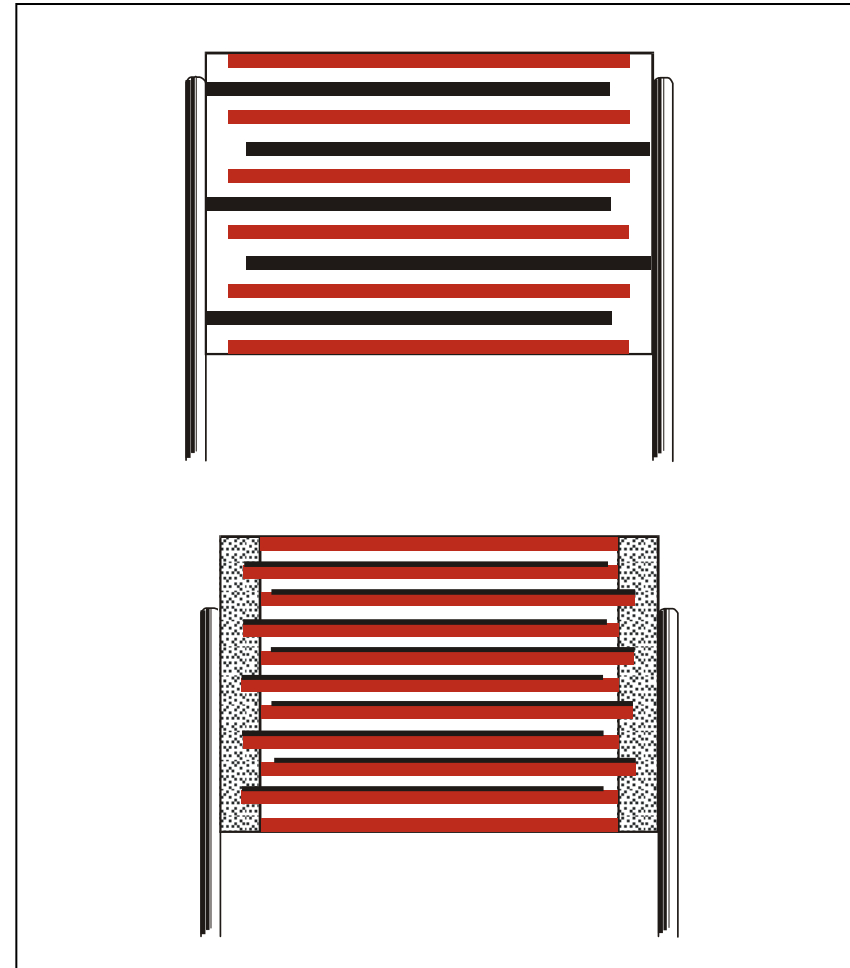
Metallized Construction

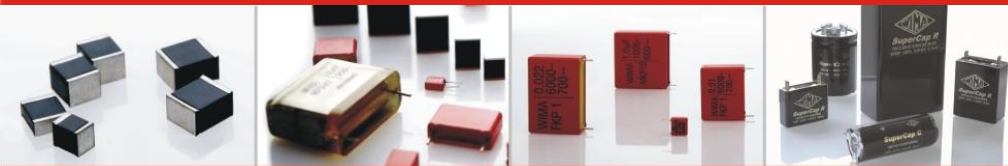
Advantages

- Small size
- Excellent self-healing properties
- Cost effectiveness

Disadvantages

- Low pulse resistance





**BEST CAPACITORS
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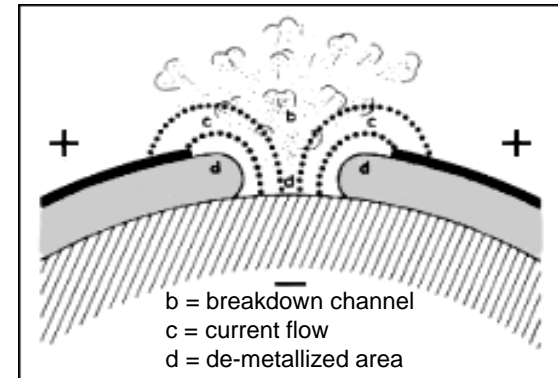


Self-healing Process

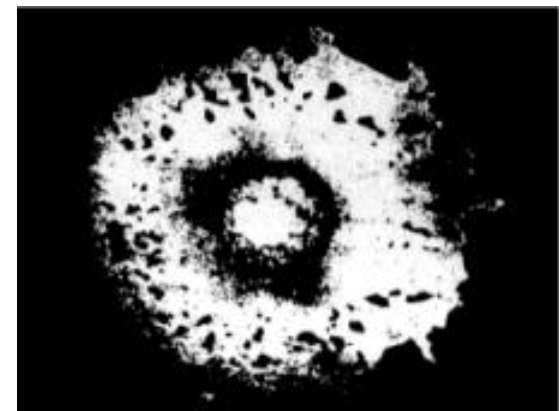
The physical process which leads to self-healing of a metallized film capacitor is basically as follows:

- 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.

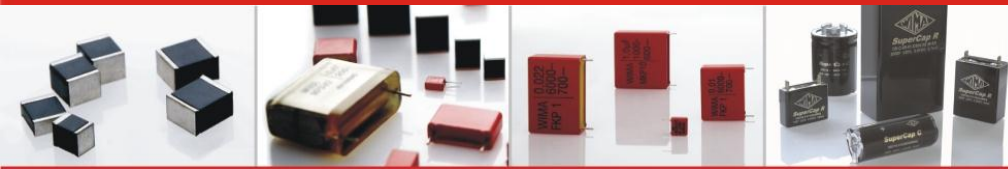
Only metallized film and paper capacitors exhibit the self-healing property. Ceramic, tantalum or electrolytic capacitors regularly fail after a breakdown.



Schematic depiction of the self-healing process



Isolated area after the self-healing process

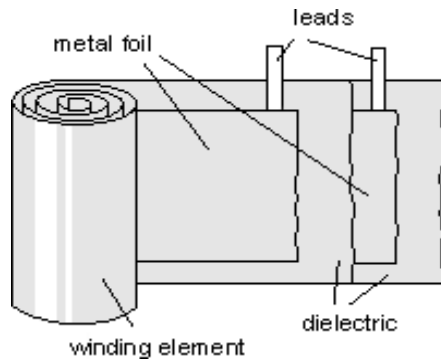


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Self-Inductance Depends on Construction Principle

Antiquated construction with high self-inductance



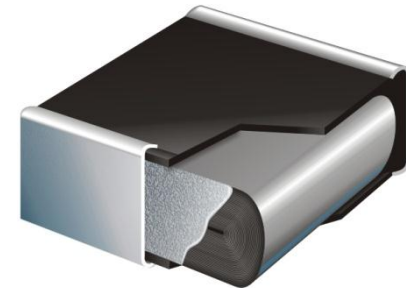
The tape length of the winding element determines the amount of the self-inductance

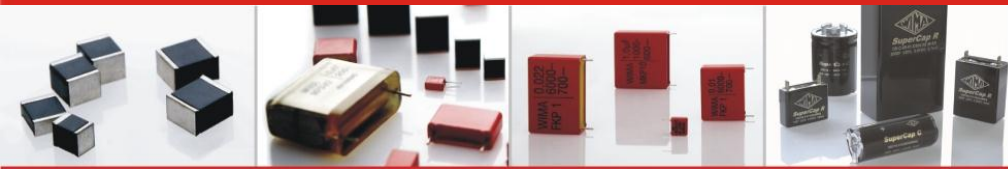
WIMA MKS 02
PCM 2.5 mm
Self-inductance $L < 8\text{nH}$



The self-inductance is determined only by the PCM and the remaining length of the terminating wires (for SMD capacitors the distance between the soldering tabs is relevant).

WIMA SMD 1812
Self-inductance $L < 4\text{nH}$



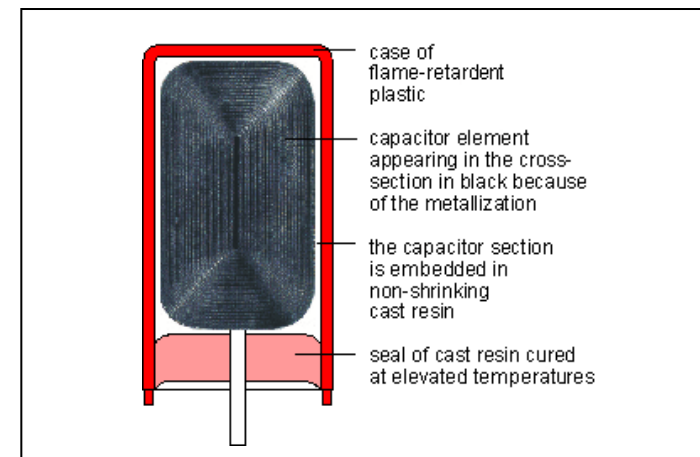
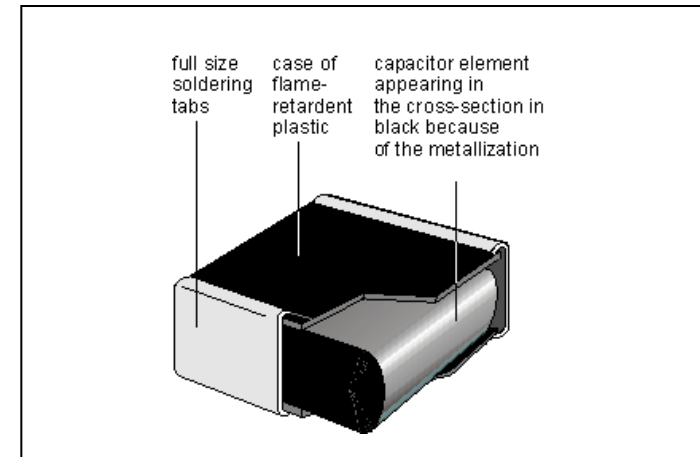


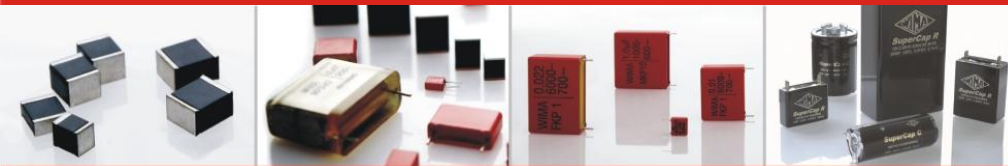
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Encapsulation of WIMA Capacitors

- Safe protection of the capacitor element against mechanical and environmental stress during processing and operation.
- No delamination, internal cracks or impact on the contacts.
- Excellent self-healing properties due to pressure-free layers in the winding element.
- Flame retardent plastic case in accordance with UL 94 V-0.
- Clearly defined dimensions allow close placement and exact assembly on PC-boards.
- Unproblematic second-sourcing due to standardized box sizes.

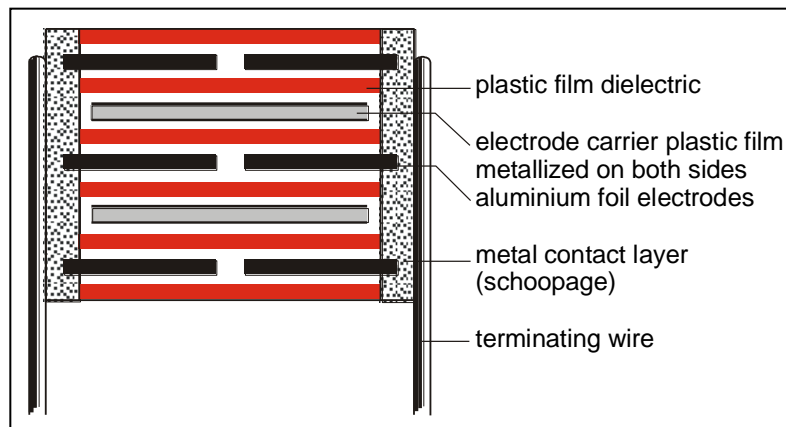
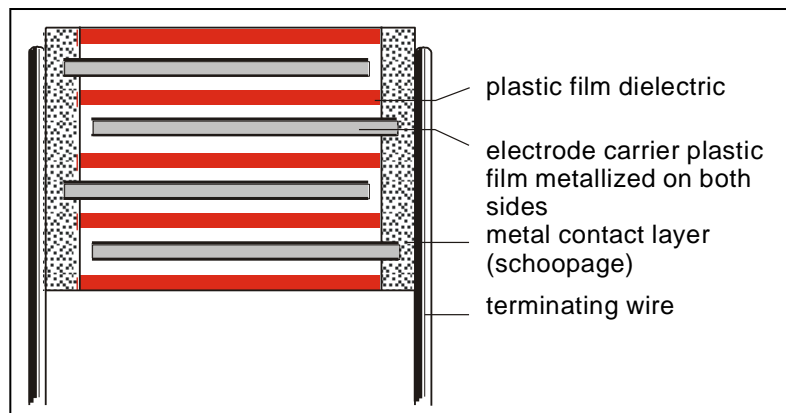




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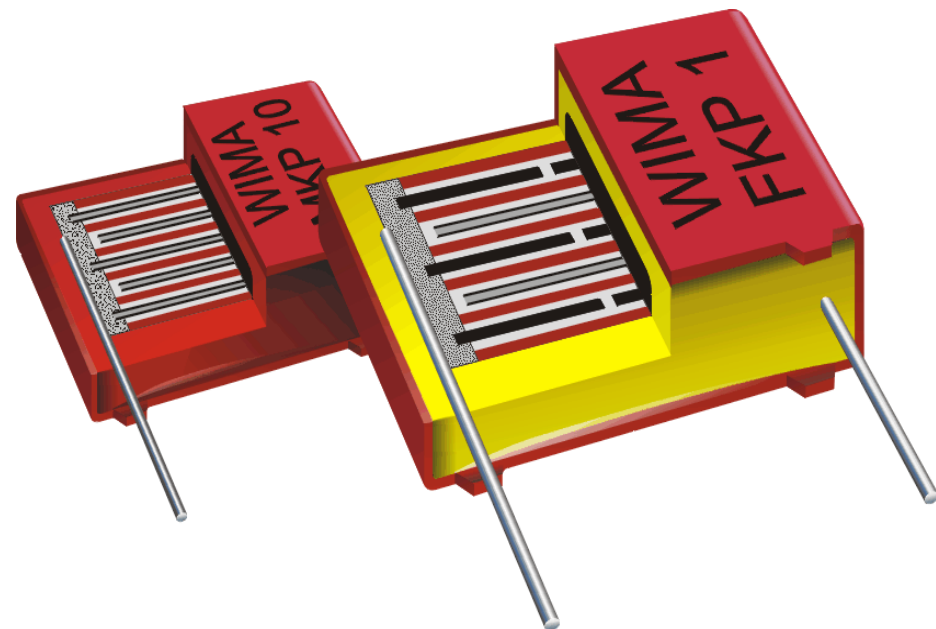


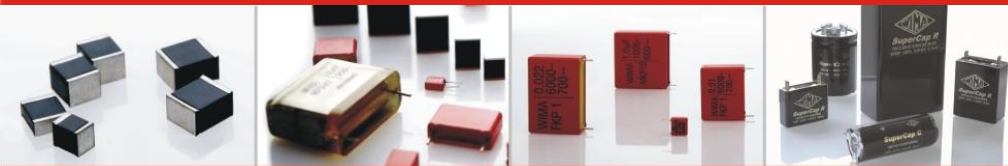
WIMA Constructions for Pulse Applications



WIMA MKP 10 exhibit a non-metallized dielectric and a carrier film electrode metallized on both sides.

WIMA FKP 1 / FKP 4 have an internal series connection, the metal foil electrodes being combined with a floating metallized electrode. Due to their special construction they combine the properties of metallized and film/foil capacitors as there are **excellent pulse and current carrying capability** as well as **very good self-healing properties**.





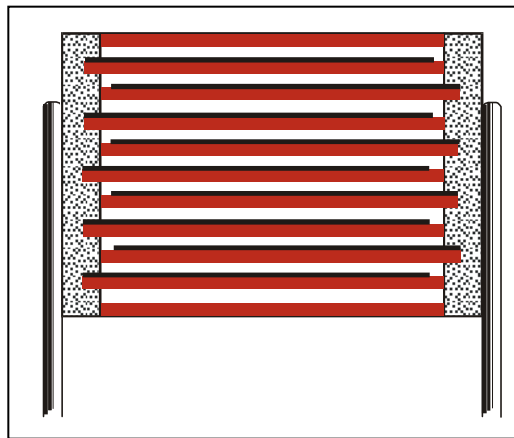
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Pulse Capability

WIMA MKP 4

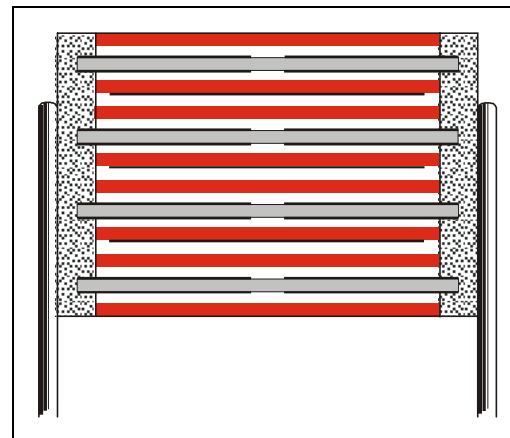
single metallized plastic film



| Capacitance μF | max. pulse rise time $\text{V}/\mu\text{s}$ at $T_A < 40^\circ\text{C}$ | | |
|------------------------------|--|------------|-------------|
| | 400 VDC | 630 VDC | 1000 VDC |
| 0.01 ...0.022 | 450 | 500 | 550 |
| 0.033...0.068 | 300 | 350 | 400 |
| 0.1 ...0.22 | 200 | 250 | 300 |

WIMA MKP 10

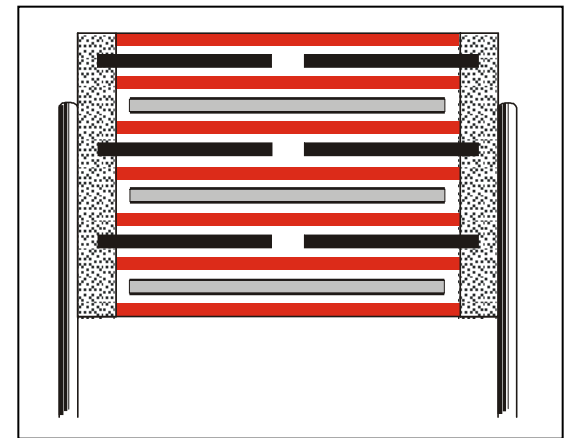
double sided metallized plastic film



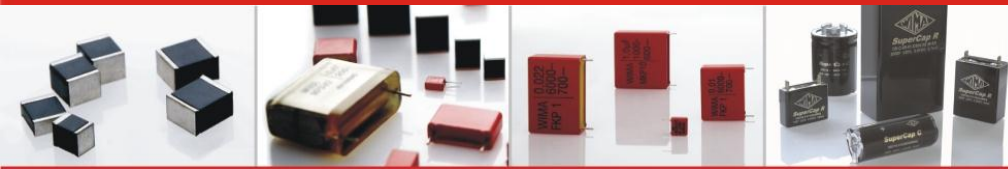
| Capacitance μF | max. pulse rise time $\text{V}/\mu\text{s}$ at $T_A < 40^\circ\text{C}$ | | |
|------------------------------|--|------------|-------------|
| | 400 VDC | 630 VDC | 1000 VDC |
| 0.01 ...0.022 | 1200 | 1800 | 2100 |
| 0.033...0.068 | 900 | 1800 | 2100 |
| 0.1 ...0.22 | 500 | 900 | 1400 |

WIMA FKP 1

aluminium foil and double sided metallized plastic film



| Capacitance μF | max. pulse rise time $\text{V}/\mu\text{s}$ at $T_A < 40^\circ\text{C}$ | | |
|------------------------------|--|------------|-------------|
| | 400 VDC | 630 VDC | 1000 VDC |
| 0.01 ...0.022 | 9000 | 11000 | 11000 |
| 0.033...0.068 | 9000 | 11000 | 11000 |
| 0.1 ...0.22 | 7000 | 11000 | 11000 |

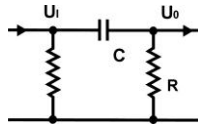


**BEST CAPACITORS
MADE IN GERMANY**



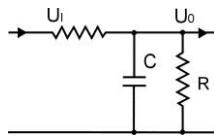
Industrial Electronics · Power Supplies/UPS/SMPS · AC/DC Converters · Measuring and Control Equipment

Coupling/
Blocking



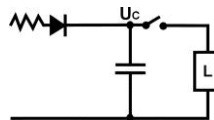
| | |
|---------------|--------------|
| SMD | MKS 2 |
| MKS 02 | MKS 4 |

Decoupling/
Bypassing



| | |
|---------------|--------------|
| SMD | MKS 2 |
| MKS 02 | FKS 3 |
| FKS 2 | MKS 4 |

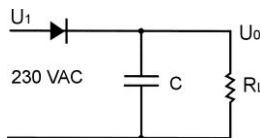
Energy
Storing



| | |
|----------------|----------------|
| MKP 2 * | FKP 1 |
| MKP 10 | Snubber |
| FKP 4 | GTO |

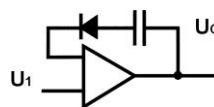
* ≥ 250VDC

Smoothing



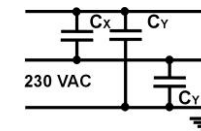
| | |
|---------------|---------------|
| SMD | MKS 4 |
| MKS 02 | MKP 4 |
| MKS 2 | MKP 10 |

A/D
Conversion

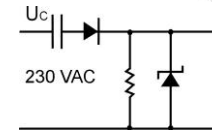


| | |
|---------------|--------------|
| FKP 02 | FKP 3 |
| FKP 2 | MKP 4 |
| MKP 2 | |

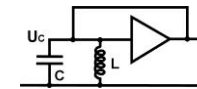
RFI -
Suppression



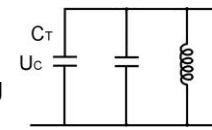
Voltage
Dropper



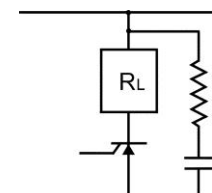
Oscillating



Temperature
Compensating



Snubbing



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

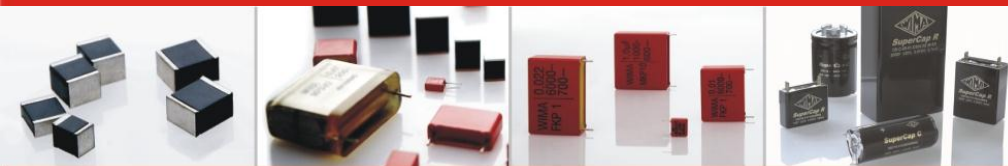
| | |
|----------------|------------------------|
| MP3-X2 | MKS 4 * |
| MP 3-X2 | * ≥ 630VDC ≥ PCM 10 |

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

| | |
|-----------------|--------------|
| FKP 02/2 | FKP 3 |
| MKP 2 | MKP 4 |

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

* ≥ 250VDC

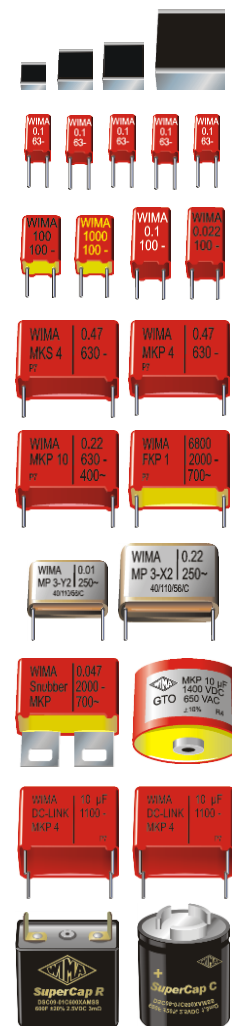


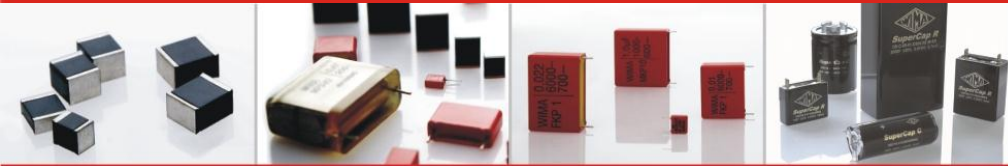
**BEST CAPACITORS
MADE IN GERMANY**



WIMA Product Range

- **SMD Plastic Film Capacitors** Capacitances.....0.01 μ F - 6.8 μ F
 Voltages.....63 VDC - 1000 VDC
- **Capacitors in PCM 2.5 mm** Capacitances.....100 pF - 1 μ F
 Voltages.....50 VDC - 400 VDC
- **Capacitors in PCM 5 mm** Capacitances.....27 pF - 10 μ F
 Voltages.....50 VDC - 1000 VDC
- **Capacitors for Stringent Requirements** Capacitances.....100 pF - 220 μ F
 Voltages.....50 VDC - 2000 VDC
- **Capacitors for High Current Ratings** Capacitances.....100 pF - 15 μ F
 Voltages.....100 VDC - 6000 VDC
- **RFI Capacitors Class X1, X2, Y2** Capacitances.....1000 pF - 10 μ F
 Voltages.....250 VAC - 500 VAC
- **Snubber Capacitors** Capacitances.....0.01 μ F - 25 μ F
 Voltages.....250 VDC - 4000 VDC
- **GTO Capacitors** Capacitances.....1.0 μ F - 100 μ F
 Voltages.....400 VDC - 1500 VDC
- **DC-LINK Capacitors** Capacitances..... 2 μ F - 4500 μ F
 Voltages..... 400 VDC - 1600 VDC
- **SuperCapacitors (Single Cells)** Capacitances.....100 F - 6500 F
 Voltage.....2.5 VDC - 2.7 VDC





Application Guide

■ Lighting:

- Ballasts
- Energy saving lamps

■ Industry:

- RFI (Radio Interference Suppression)
- Control electronics
- Security systems
- EMC (Electromagnetic Compatibility)
- Potential transformer
- Sensor technology
- Liquid control / flow measuring

■ Automotive:

- Ignition capacitors for airbag
- Control units for communication, motor and gear
- EMC (Electromagnetic Compatibility)
- Belt pretensioner
- Lighting: Xenon-ballasts
- Bus interface systems

■ Power Supply:

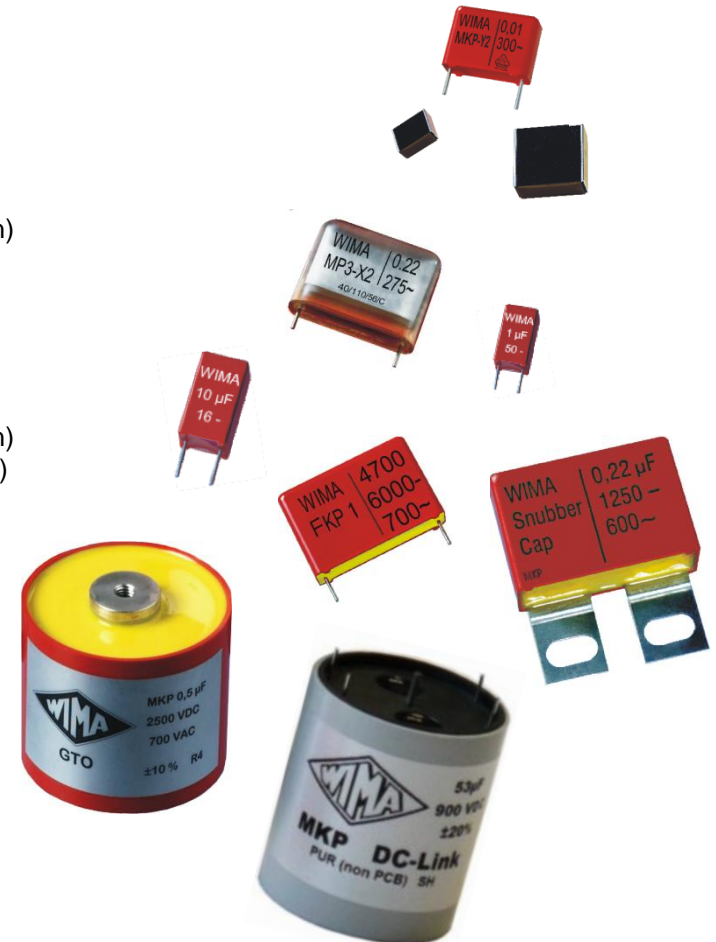
- RFI (Radio Interference Suppression)
- Transformers
- AC/DC converters

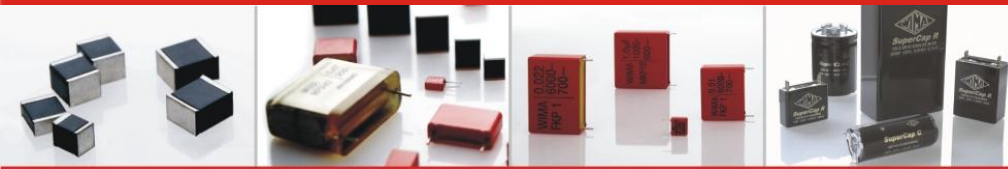
■ Medical Technology:

- RFI (Radio Interference Suppression)
- EMC (Electromagnetic Compatibility)
- X-Ray / dialysis

■ Others:

- Alternative energies
- Wind power / solar panels
- Data transmission
- Amplifiers for overseas wires
- Communications engineering
- Air / Space technology
- Train / Railway vehicles
- Modems
- DSL/ADSL splitters



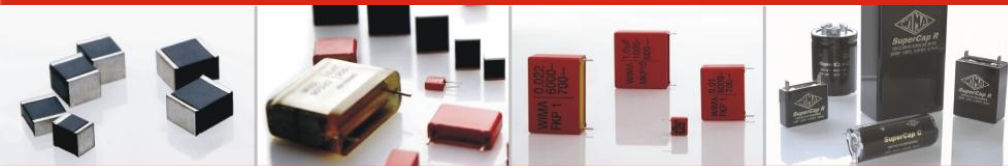


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WIMA Specials

| | | | |
|---|--|---|--|
| <p> $6 - 2$ d 10 (± 0.6) PCM =P.C.Module at the lead exit points (± 0.6) </p> <p> $6 - 2$ d $d = 0.8 \text{ } \varnothing$ PCM =P.C.Module at the lead exit points (± 0.6) </p> <p>Larger box sizes are available as 4-lead versions on customer request.</p> | <p>Snubber capacitors are available in various tag configurations.</p> <p>Customized solutions can be provided upon request.</p> | <p>GTO capacitors are available with capacitances up to 100 µF and voltages up to 1500 VDC.</p> <p>Customized solutions can be provided upon request.</p> | <p>DC-Link capacitors are especially designed for applications in high power converter technology. Non-polarized 4-lead versions or screwable plate connections provides a reliable contact configuration.</p> |
|---|--|---|--|



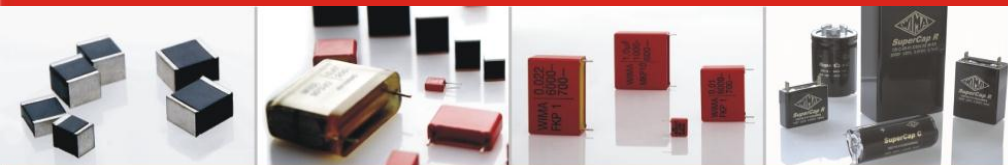
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WIMA Quality

All WIMA factories are approved to **ISO 9001:2008** as well as to **ISO 14001:2009** certifying that organisation, equipment and monitoring of quality assurance correspond to internationally recognized standards.





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WIMA Reliability

Failure Rate in fit ($10^{-9}/h$)

$$\lambda = \lambda_0 \times \pi_T \times \pi_U$$

λ_0 = Expected value
 π_T = Temperature factor
 π_U = Voltage factor

Temperature Factor π_T

| | | | | | |
|----------------|----|----|----|----|-----|
| T(°C) | 40 | 50 | 70 | 80 | 100 |
| π_T (Film) | 1 | 2 | 5 | 10 | 15 |

WIMA MKS 2 0.1 / 63 VDC

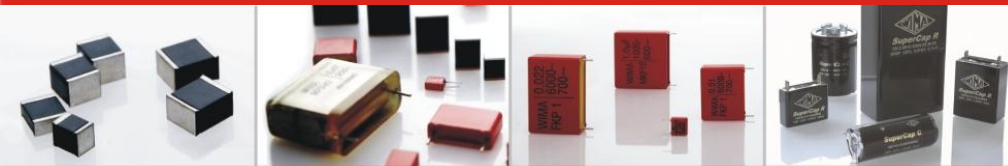
$\lambda_0 = 2$ fit
 $\pi_T = 1$
 $\pi_U = 5$
 $\lambda = 2 \times 5 \times 1 = 10$ fit

Voltage Factor π_U

| | | | | | |
|------------------|-----|------|-----|------|-----|
| U/U _R | 0.1 | 0.25 | 0.5 | 0.75 | 1.0 |
| π_U (Film) | 0.2 | 0.3 | 1 | 2 | 5 |

Ceramic

$\lambda_0 > 20$ fit
 $\pi_T = 1$
 $\pi_U = 5$
 $\lambda = 20 \times 5 \times 1 = 100$ fit



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WIMA Website

WIMA - Competence in Capacitors - Microsoft Internet Explorer

http://www.wima.com/en_index.php

english

Select Product ... OK

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COMPETENCE IN CAPACITORS

As specialist in film capacitors our goal is to achieve customer satisfaction in terms of quality, innovation, delivery reliability and cost effectiveness

Parametric Search:

Construction -- Please choose --
 Capacitance in pF/nF -- Please choose --
 DC Voltage -- Please choose --
 AC Voltage -- Please choose --
 Tolerance -- Please choose --
 Lead Space/Size Code -- Please choose --
 Dielectric -- Please choose --

< Top News >

Double-Layer Capacitors developed by WIMA are storage capacitors with highest capacitance values in the Farad range. They are among others suited to serve as batteries, can deliver considerably higher currents for a short time, however, and are maintenance-free.

< Technical Spotlight >

WIMA MKS 2-XL capacitors are made of plastic film which is 60 times thinner than human hair. This results in components with extremely high capacitance values in comparatively small cases. Values up to 22 µF so far requiring a PCM of 27.5 mm are now available in PCM 5 mm. With the new values the highest available capacitance in PCM 5 mm could be more than doubled.

Fertig

Internet Explorer

http://www.wima.com/EN/technicalinformation.htm

Select Product ... OK

Products Technical Info Samples Distribution News Contact Parametric Search Imprint

You are here: [Home](#) > [Technical Info](#)

Technical Information

Basic Technical Data for Capacitors:

- Basic Concept The Plate Capacitor
- Dielectric
- Capacitance
- Capacitance Tolerance
- Rated Voltage / Voltage Derating
- Insulation Resistance
- Dissipation Factor (tan δ) and ESR
- Inductance and Self-Resonance
- Temperature Coefficient (TKC)
- Pulse Stressing
- Long Term Stability/Temporal Inconstancy
- Dielectric Absorption
- Reliability
- Warning Notice

Construction of Plastic Film Capacitors:

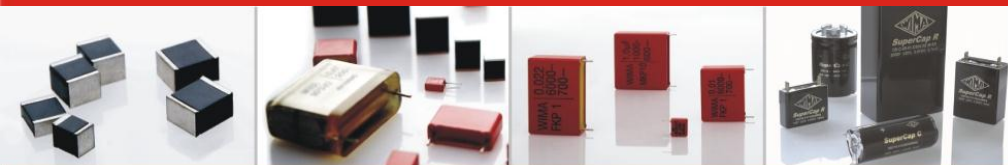
- Film/Foil Construction
- Metallized Construction
- Metallized Construction for Pulse Applications
- Film/Foil Construction with Metallized Electrode Carrier Film
- Self-Healing Process in Metallized Capacitors

Dielectric:

- Characteristics of the Plastic Film Dielectrics
- Polypropylene

Special Technical Subjects

WIMA capacitors conform to RoHS 2002/95/EC



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Thank you!

PT ELECTRONICS

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