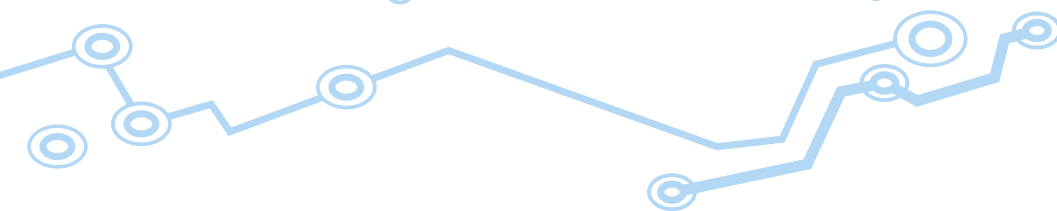


Insulation & Protection Materials for Capacitors



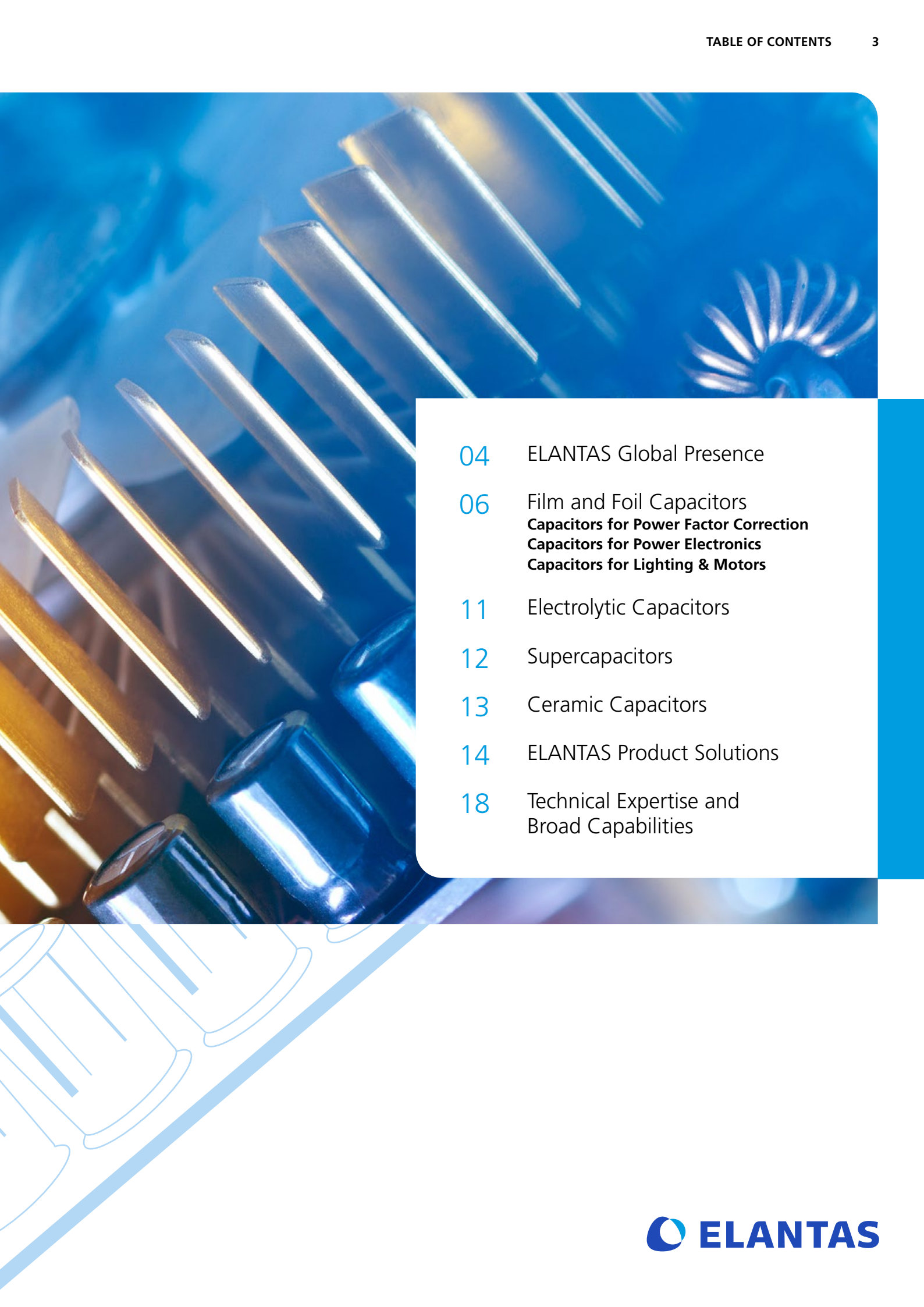
From the smallest capacitor beads to large power factor correction ones, they all have one thing in common: the capability to store energy in the form of an electrical charge producing a potential difference.

The capacitor market is complex, with many product geometries, designs, properties and applications. New technologies and the demand for improved productivity levels have a high impact on the materials used for the construction of capacitors. These materials must meet the rigorous demands of the industry. In addition, trends like e-mobility are driving the development of new materials that can withstand severe conditions and stresses.

ELANTAS Europe offers a full portfolio of materials for protecting capacitors in different applications and environments, including one and two component epoxy resins, two component polyurethane resins, soft gels and polyimide varnishes. We are known for our product quality and performance, technical expertise and comprehensive support, and customer challenges spur us to continually innovate.

The demands that capacitors face depend on the application. To offer focused solutions, our portfolio is organized into Film and Foil Capacitors, Electrolytic Capacitors, Supercapacitors and Ceramic Capacitors.



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Broad Capabilities



Our Global Presence for a Global Industry

ELANTAS is as global as the capacitor industry. With a worldwide network of production facilities, we can supply customers locally wherever they are. Our local expertise is backed by a worldwide network of R&D, applications and testing laboratories.

Our customer support is no less global. Our worldwide Technical Sales Team ensures that you get full service across all locations. Wherever you need us, we're close by.

This extensive international presence gives us the flexibility and resilience needed to serve global capacitor manufacturers.

At the same time, as a manufacturer with facilities across the globe, we place great emphasis on consistent and standardized production.

We are certified according to DIN EN ISO 9001 and DIN EN ISO 14001.



Worldwide Locations

ELANTAS GmbH
Wesel – Germany

ELANTAS Europe GmbH
Hamburg – Germany

ELANTAS Europe S.r.L.
Ascoli Piceno, Collecchio, Quattordio – Italy

ELANTAS PDG, Inc.
St. Louis, Olean – U.S.A.

ELANTAS Isolantes
Elétricos do Brasil Ltda.
Cerquilha – Brazil

ELANTAS Beck India Ltd.
Ankleshwar, Pune – India

ELANTAS Zhuhai Co. Ltd.
Zhuhai – P.R. China

ELANTAS Tongling Co. Ltd.
Tongling – P.R. China

ELANTAS Malaysia Sdn. Bhd.
Kapar – Malaysia

Our products hold a list of homologations that cover different characteristics:

- + Flame Retardancy (V-0, 5VA)
- + HAI (High-Current Arc Ignition Test)
- + HWI (Hot Wire Ignition Test)
- + CTI (Comparative Tracking Index)
- + GWIT, GWFI
(Glow Wire Ignition Temperature, Glow Wire Flammability Index)
- + RTI (Relative Temperature Index, Electrical and Mechanical)

Film and Foil Capacitors

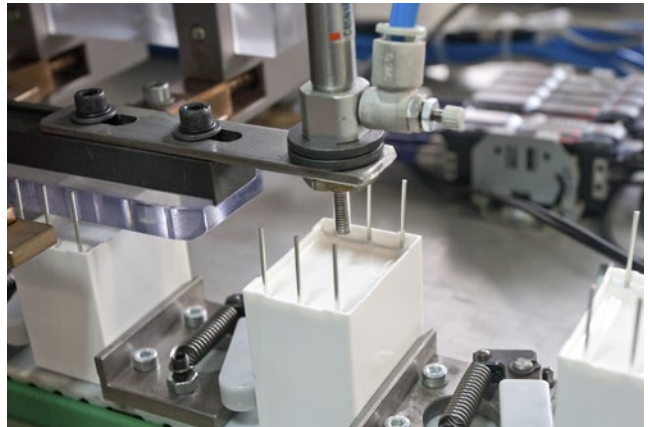


Film and foil capacitors are the most commonly used capacitors in the industry. Their essential differentiator is the dielectric used and its properties.

Film capacitors come in capacitance ranges from as small as 5pF to as large as 100uF. A special subcategory are plastic film capacitors, which use polystyrene, polycarbonate or Teflon as their dielectrics. These work well under high temperature, have smaller tolerances, very long service life and a high reliability.

On metallized foil capacitors the conductive film is sprayed onto each side of the dielectric. This has self-healing properties, so that much thinner dielectric films can be used. These devices feature high capacitance values with smaller case sizes.

The materials used to protect capacitors have a major influence on their service life. They must provide sealing and mechanical, thermal and chemical resistance.



For capacitors exposed to harsh conditions, materials must withstand temperatures and temperature cycles, particulates, electrostatic discharges (ESD), electromagnetic interference (EMI), vibration, impacts, high voltage, humidity and other chemical aggression.

Capacitors can be damaged in many ways, including internal faults or external overloads that can cause an explosion, especially in devices like AC film capacitors with relatively high energy content. There are several design options to prevent this, such as an internal pressure interrupter. Film and foil capacitors are typically potted for internal protection with a very soft, gel type material.

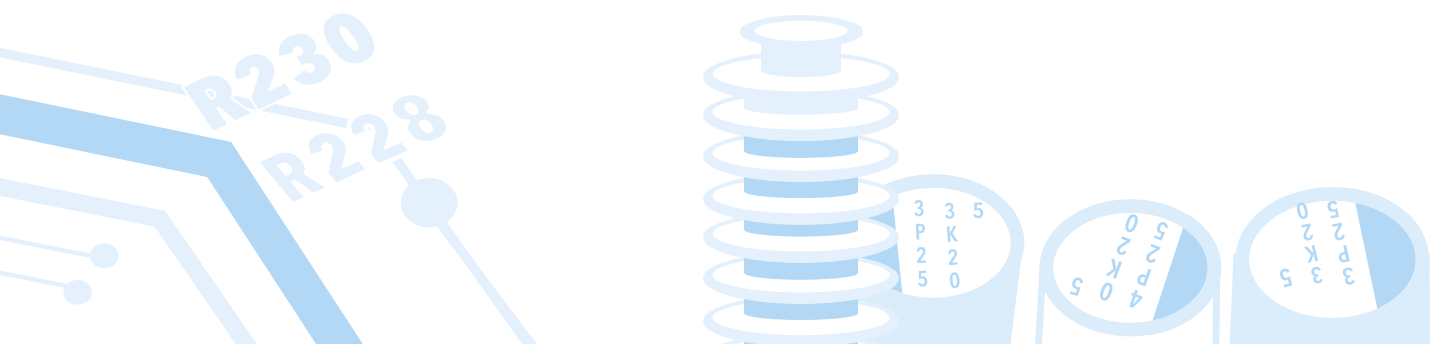
ELANTAS Europe offers a broad portfolio of epoxy and polyurethane compounds to ensure the safety and reliability of these capacitors, ranging from very soft to rigid and stiff materials.

Our products meet the challenging requirements of these applications:

- Capacitors for Power Factor Correction
- Capacitors for Power Electronics
- Capacitors for Lighting & Motors

⊕ CHARACTERISTICS

- + Very good Processability
- + Low Water Uptake
- + Excellent Electrical Insulation
- + Resistance to Chemicals
- + Toughness
- + Dimensional Stability
- + Self-extinguishing Behaviour
- + Thermal Resistance





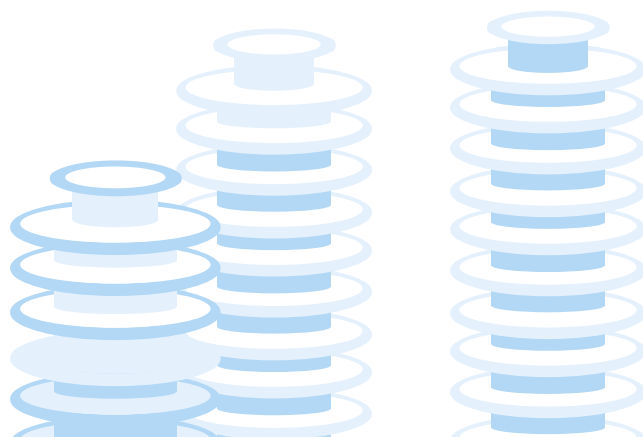
Capacitors for Power Factor Correction

The power factor is the ratio of the useful (true) power (kW) to the total (apparent) power (kVA) consumed by an item of AC electrical equipment or an electrical installation. Power factor correction is the term for restoring the power factor to as close to unity as is economically viable. This is normally achieved by adding capacitors to the electrical network. Based on the nominal voltage, applications are classified as low voltage below 1 kV, and medium, high or very high voltage from 1 to 35 kV and higher.

ELANTAS Europe offers a comprehensive assortment of materials to protect these capacitive elements in all voltage classes.

Our materials are characterized by:

- Very good processability
- Very good flowability
- Low water uptake
- Tunable reactivities for higher productivity



Capacitors for Power Electronics

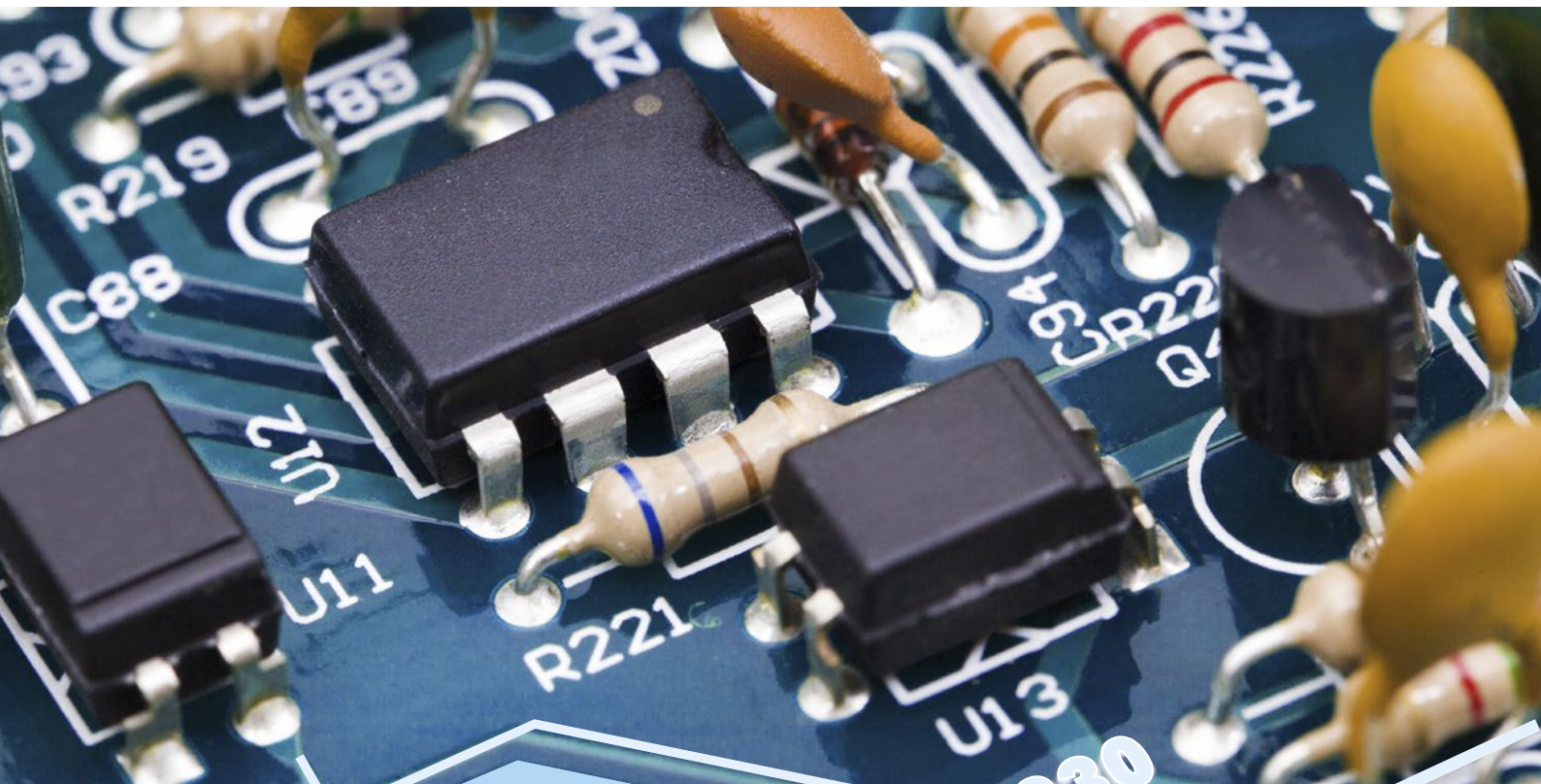
Power electronics is the technology used for the efficient conversion, control and conditioning of electric power, from its input into the system to the desired electrical power output form.

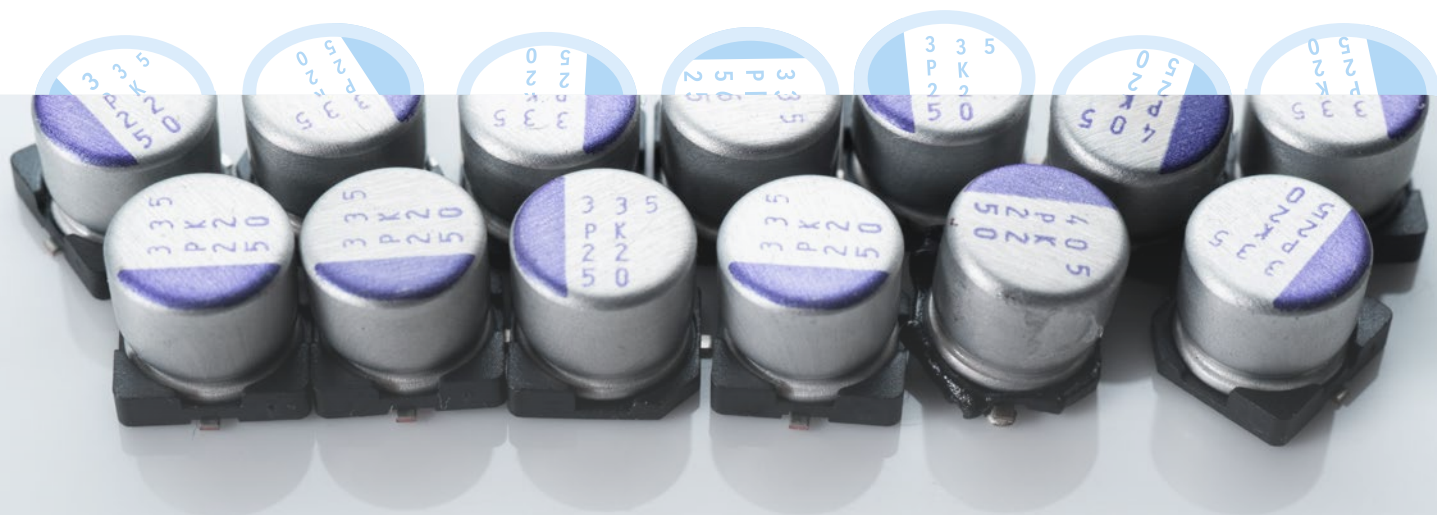
The power levels encountered in this field vary from less than one watt in supplies for battery-operated portable equipment, to thousands of watts in office equipment power units, to the megawatt range for variable speed motor drives, and for rectifiers and inverters connected to local transmission lines in power systems.

Capacitors in these systems must meet many different technical requirements, and exhibit various capacitance, ESR and other characteristics to suit the application.

Our materials for protecting power electronic capacitors feature:

- Very good electrical insulation
- Stable permittivity over a wide range of frequency and temperature
- Excellent chemical and thermal aging resistance





Capacitors for Lighting & Motors

Capacitors are used in industrial motors, especially in variable frequency drives, to provide maximum efficiency. The AC plastic film capacitors used in industrial motors can handle thousands of volts per cell, but at extremely low capacitance, generally in the 1 microfarad range.

Capacitors are used in lighting to smooth signals, suppress interference and in some instances provide burst power. They can be either plastic film, ceramic, or aluminum, and often use a combination of all three dielectrics in a single ballast.

The materials used to protect these capacitors must ensure safety and reliability, and must be in compliance with mandatory requirements such as UL.

Our materials are characterized by:

- Very good processability
- Low viscosity for good penetration
- Low moisture uptake
- High adhesion to the plastic or aluminum housing for perfect sealing

Electrolytic Capacitors

Electrolytic capacitors have higher capacitance than other capacitor types, and store large amounts of energy in a small size. The large capacitance makes them particularly suitable for DC power supply circuits, where they attenuate ripple voltage, as well as for coupling and decoupling applications. Electrolytic capacitors are generally used in DC power supplies, batteries and power filters.

The materials used to protect electrolytic capacitors must be capable of withstanding stresses from voltage, temperature and humidity, while at the same time exhibiting excellent mechanical properties. A potting compound is often added for additional protection. By this way, a better stability and endurance is guaranteed. Materials for the potting can be chosen from very soft to rigid to meet the different demands.

Depending on the individual application, ELANTAS Europe offers specific and customized product solutions, on demand.

Typical application areas for electrolytic capacitors include:

- Power Supplies
- Switched-mode Power Supplies
- DC-DC Converters
- Industrial Power Supplies
- Frequency Converters, e.g. in Wind Turbines
- Storage, e.g. in Photoflash or Strobe Applications
- Signal Coupling in Audio Applications





Supercapacitors

Supercapacitors are a special category of their own. Like the name implies, these devices have an exceedingly high level of capacitance, but with lower voltage limits, and bridge the gap between electrolytic capacitors and rechargeable batteries.

Supercapacitors are also called supercaps, double-layer capacitors or ultracapacitors, and can have capacitance levels up to several thousand farads. They are typically used in applications involving many rapid charge/discharge cycles, rather than long-term compact energy storage.

Like electrolytic capacitors, supercapacitors can be additionally protected with a potting compound, in order to improve thermal dissipation and protection against ambient influences. Protective materials can be selected in a range of different hardness and mechanical stiffness, according to the specific needs of the application.

Depending on the individual application, ELANTAS Europe offers specific and customized product solutions, on demand.

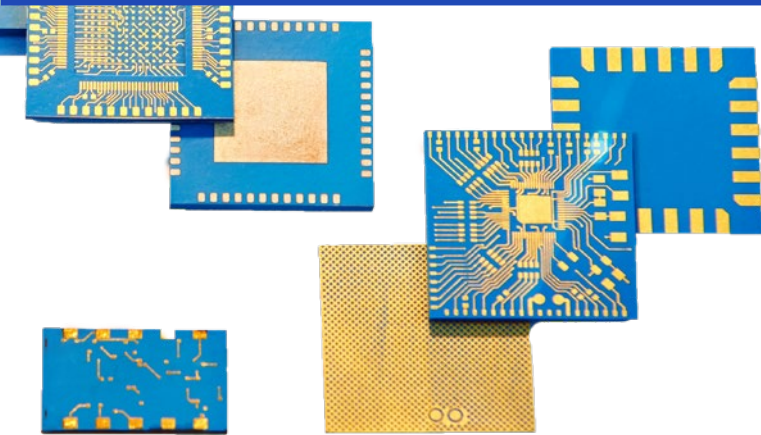
Common applications for supercapacitors are:

- Automobiles, Buses, Trains, Cranes, Elevators
- Power Backup for Static Random-access Memory (SRAM)

CHARACTERISTICS

- + Very Good Processability
- + Excellent Electrical Insulation
- + Thermal Resistance
- + Dimensional Stability
- + Self-extinguishing Behavior

Ceramic Capacitors



Ceramic capacitors use ceramics as a dielectric, stacked with metal layers. These devices are ideal for applications with high voltage, high frequency, high power demands, and high temperatures, like the petroleum, automotive, avionics and other industries, and as multi-layer ceramic capacitors (MLCCs). Ceramic capacitors have a high dielectric constant (high-K) and allow relatively high capacitance in a small physical size.

Some types of ceramic capacitors can be used in temperatures far above 200°C, beyond the limitations of other capacitor types.

Lacquers are often used to keep moisture and ambient influences from affecting ceramic capacitors. We offer a full suite of materials for protecting ceramic capacitors against humidity, dust and mechanical stress.

⊕ CHARACTERISTICS

- + High Performance Protective Lacquer
- + Excellent Electrical Insulation, even at High Temperature
- + Very High Tg > 260°C
- + Very good Mechanical Performance over a Wide Temperature Range

Our materials are characterized by:

- Low water uptake
- High toughness and dimensional stability
- High mechanical and electrical strength

Applications for ceramic capacitors include:

- High Voltage Capacitors
- High Frequency Capacitors
- High Power Capacitors
- Printed Circuit Boards and Other High-density Applications

ELANTAS Product Solutions for Capacitors

Product	Mix Viscosity (mPas 25 °C)	Gel Time (min) (25 °C; 100 ml)	Tg (°C)	Self-extinguishing behaviour
General Purpose Applications				
Alifar® PU U2896E/HU01	1,000 – 2,000	10 – 25	-15 ÷ -5	n.a.
Alifar® PU U2902/HU01	2,500 – 3,500	25 – 45 (40 °C)	0 ÷ 10	V-0 6,4 mm
Alifar® PU U2912V/HU01	800 – 1,200	35 – 50 (40 °C)	-10 ÷ 5	V-0 6 mm
Elan-tron® MC640/WH72	1,700 – 2,300	25 – 35 (100 °C)	110 – 120 115 – 125 (max)	V-0 6 mm
Elan-tron® MC62/W342	1,800 – 2,600	62 – 74	100 – 105	V-0 5 mm
Elan-tron® MC62/W364NF	1,000 – 2,500	39 – 48	52 – 60	V-0 4,6 mm
Elan-tron® MC638/WH72	1,600 – 2,600	25 – 35 (80 °C)	120 – 130 140 – 150 (max)	V-0 6 mm
Elan-tron® MC639/WH24	800 – 1,300	28 – 42 (100 °C)	105 – 115	HB 6 mm
Elan-tron® MC642/WH22	2,000 – 3,000	18 – 32 (100 °C)	100 – 110	V-0 6 mm
Elan-tron® PU4140FR/PH4920	2,000 – 3,200	100 – 150 sec (20g)	20 ÷ 30	V-0 5 mm
Micares® X1269Rxy/P978	3,200 – 3,700	5 – 7 (R2) 25 – 30 (R3)	55 – 65	V-0 6 mm
Micares® X1269Rxy/P983	1,400 – 1,900	6 – 9 (R5) 25 – 35 (R6)	20 – 30	HB 1,6 mm

Materials for Electrolytic and Supercapacitors are available on demand.

Dissipation factor	Description	CAPACITORS FOR POWER FACTOR CORRECTION	CAPACITORS FOR POWER ELECTRONICS	CAPACITORS FOR LIGHTING & MOTORS	CERAMIC CAPACITORS
0,080 – 0,090	Two component polyurethane, low hardness, flowable	✓	✓	✓	–
0,120 – 0,150	Two component polyurethane, fast, UL94 V-0 listed	✓	✓	✓	–
0,085 – 0,115	Two component polyurethane, self-extinguish, low hardness	✓	✓	✓	–
0,005 – 0,015	Two component epoxy-anhydride, flowable, high Tg	✓	✓	✓	–
0,020 – 0,030	Two component epoxy-amine, flowable, UL94 V-0 listed, high Tg	–	–	✓	–
0,020 – 0,030	Two component epoxy-amine, flowable, UL94 V-0 listed	–	–	✓	–
0,005 – 0,015	Two component epoxy-anhydride, flowable, high Tg	✓	✓	✓	–
0,005 – 0,015	Two component epoxy-anhydride, easy processing	✓	✓	✓	–
0,010 – 0,020	Two component epoxy-anhydride, dimensionally stable, UL94 V-0 listed	✓	–	✓	–
0,110 – 0,150	Two component polyurethane, fast, UL94 V-0 and RTI listed	–	✓	✓	–
0,040 – 0,050	Two component polyurethane, various reactivity, UL94 V-0 and RTI 170° C listed	✓	✓	✓	–
0,040 – 0,070	Two component polyurethane, various reactivity, tough	✓	✓	✓	–

ELANTAS Product Solutions for Capacitors

Product	Mix Viscosity (mPas 25°C)	Gel Time (min) (25°C; 100 ml)	Tg (°C)	Self-extinguishing behaviour
Explosion Proof Applications				
Alifar® EPOXYGEL 3	250 – 450	30 – 45 (120 °C)	-55 ÷ -50	n.a.
Alifar® PU2801/HU01	1,000 – 1,400	15 – 35	-45 ÷ -35	n.a.
Elan-tron® EC208/WH028	1,000 – 2,000		< -50	n.a.
Elan-tron® SG 65L2-30/SG 69L5-30	10,000 – 12,000		-60 to -45	
Elan-tron® SG 65V1-60/SG 69V1-60	150 – 350		-60 to -40	
Micares® X1311 R1/P983	1,000 – 1,500	80 – 100 (50 °C)		n.a.
High Temperature Applications				
Bectron® PI 9141 series	200 to 2,350 (dep. on solid content)	n.a. requires high T cure	293	n.a. typical layer thickness 5 m
Harsh Environment Applications				
Elan-tron® MC640/WH72	1,700 – 2,300	25 – 35 (100 °C)	110 – 120 115 – 125 (max)	V-0 6 mm
Elan-tron® MC638/WH72	1,600 – 2,600	25 – 35 (80 °C)	120 – 130 140 – 150 (max)	V-0 6 mm
Elan-tron® MC639/WH24	800 – 1,300	28 – 42 (100 °C)	105 – 115	HB 6 mm
Elan-tron® MC642/WH22	2,000 – 3,000	18 – 32 (100 °C)	100 – 110	V-0 6 mm
Micares® X1269Rxy/P983	1,400 – 1,900	6 – 9 (R5) 25 – 35 (R6)	20 – 30	HB 1,6 mm

Materials for Electrolytic and Supercapacitors are available on demand.

Dissipation factor	Description	CAPACITORS FOR POWER FACTOR CORRECTION	CAPACITORS FOR POWER FOR ELECTRONICS	CAPACITORS FOR LIGHTING & MOTORS	CERAMIC CAPACITORS
0,450 – 0,650	One component epoxy, high temperature curing, very low hardness, good thermal resistance	✓	✓	✓	✓
0,020 – 0,040	Two component polyurethane, easy processing, hardness tunable with mix ratio	✓	✓	✓	–
0,095 – 0,100	Two component epoxy-anhydride, high temperature curing, excellent electrical properties	✓	✓	✓	–
	Two component silicone, soft gel even at high temperatures, good thermal conductivity, good thermal resistance	–	–	✓	✓
	Two component silicone, soft gel even at high temperatures, low viscosity, good thermal resistance	–	✓	✓	✓
0,005 – 0,007	Two component polyurethane, low hardness, good electrical properties	✓	✓	✓	–
< 0,008 (190°C)	Polyimide varnish with superior thermal, electrical and mechanical performance	–	✓	–	✓
0,005 – 0,015	Two component epoxy-anhydride, flowable, high Tg	✓	✓	✓	–
0,005 – 0,015	Two component epoxy-anhydride, flowable, high Tg	✓	✓	✓	–
0,005 – 0,015	Two component epoxy-anhydride, easy processing	✓	✓	✓	–
0,010 – 0,020	Two component epoxy-anhydride, dimensionally stable, UL94 V-0 listed	✓	✓	✓	–
0,040 – 0,070	Two component polyurethane, various reactivity, tough	✓	✓	✓	–

Technical Expertise and Broad Capabilities



Application Laboratories

Our materials are really ideal for their applications: Testing is how we make sure. The result is in-depth technical expertise on the behavior of our products, and enables us to offer expert product selection and application guidance. We test devices under climatic conditions (including 85/85 and thermal shock), and also test for capacitance deviation, insulation resistance, and dissipation factor as a function of frequency.

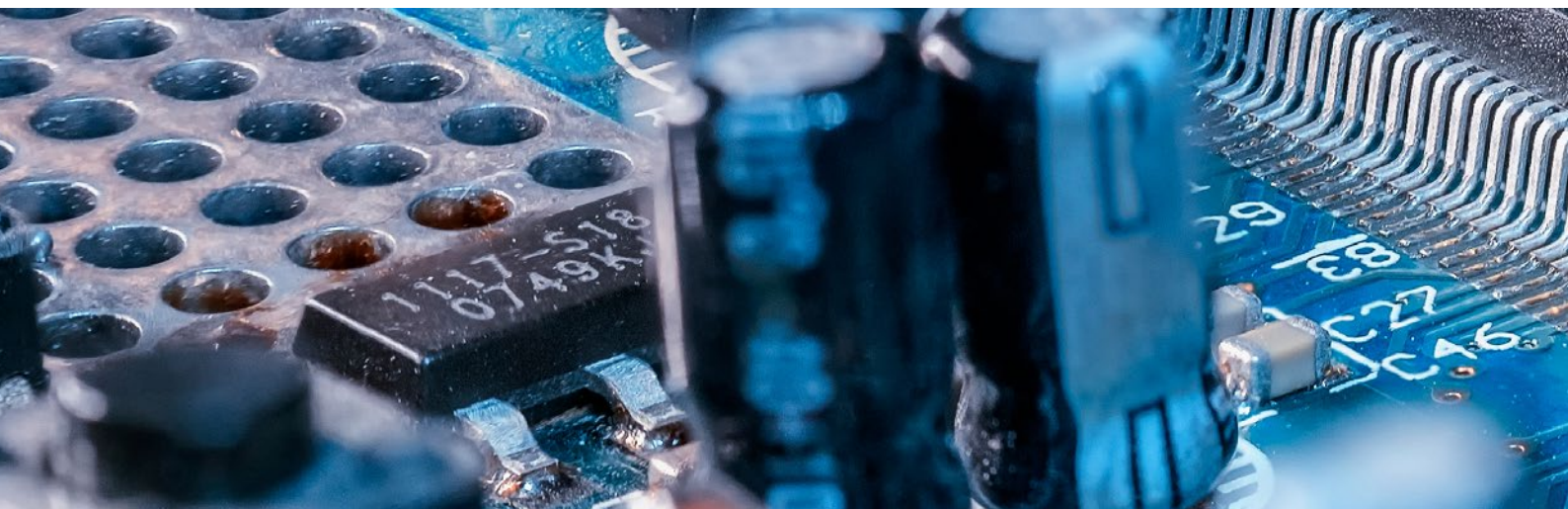
State-of-the-art Research Laboratories

With expertise in a very broad range of chemistries, we cover the entire development process, from initial research in state-of-the-art laboratory facilities to final added value. Our R&D specialists combine a deep understanding of many different classes of materials, including polyurethane, silicone, and polyimide varnishes, with expertise in chemical engineering, design, and processing. Thus, we are able to develop solutions that combine different materials and product properties.

A major focus of our research effort is the development of next-generation hybrid materials that combine the desirable qualities of different chemistries. This will allow us to offer products with superior electrical insulation, high thermal resistance, and excellent mechanical and chemical properties.



We perform many additional tests on processed components, including mechanical, electrical, chemical, environmental testing, as well as finished product testing and complete evaluation.





Quality Testing Laboratories

Our quality testing laboratories perform the full range of standard chemical, physical and electrical tests on all ELANTAS materials. We monitor product quality across the process chain, starting with incoming goods inspection and continuing through in-process checks to final product release approvals. We also do UL Approval and System Testing, and provide Certificates of Analysis.

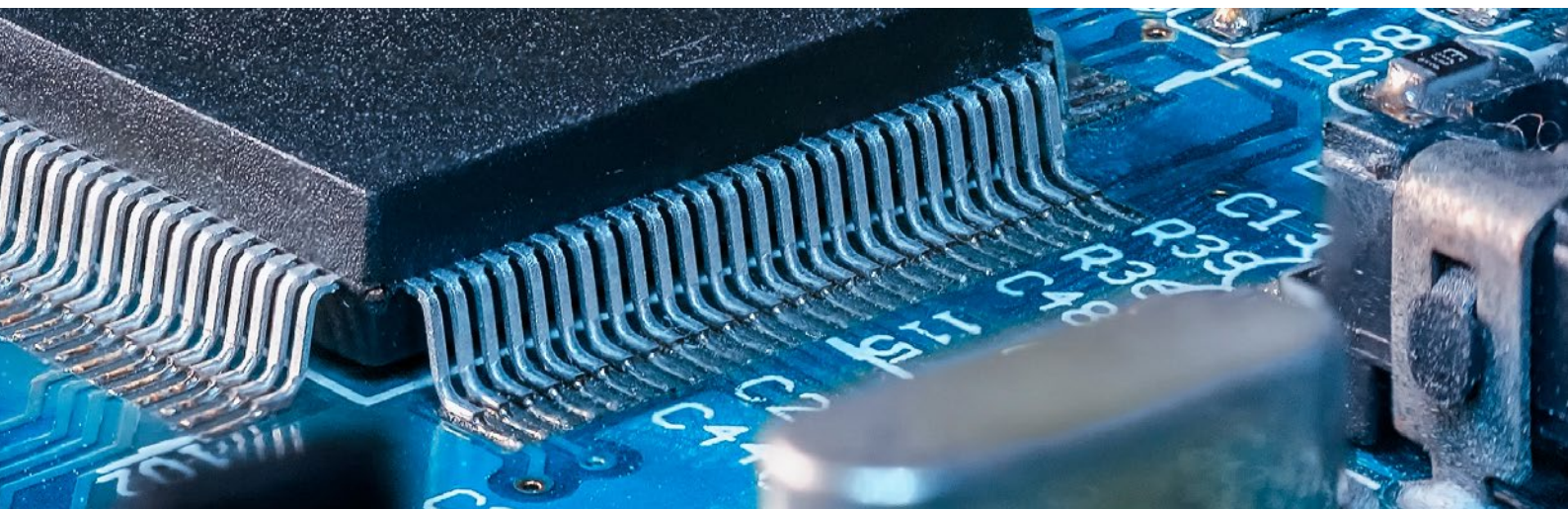
Automated systems ensure swift and efficient documentation for customers, as well as full materials traceability.

Sustainability

We are acutely aware of our environmental responsibility, as are our customers. As market requirements change, we respond to customer needs, and have developed a range of halogen, antimony and red phosphorous-free materials. All of our future product development is focused on delivering tomorrow's environmental solutions, with the use of non-hazardous raw materials, reduction of VOCs, and lower energy requirements for processing as top priorities.



Currently all of our plants work to the highest industrial environmental standards, and we plan to be a carbon neutral company by 2025.





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Insulation & Protection Materials for Capacitors

