Printed electronics
Smart surface solutions
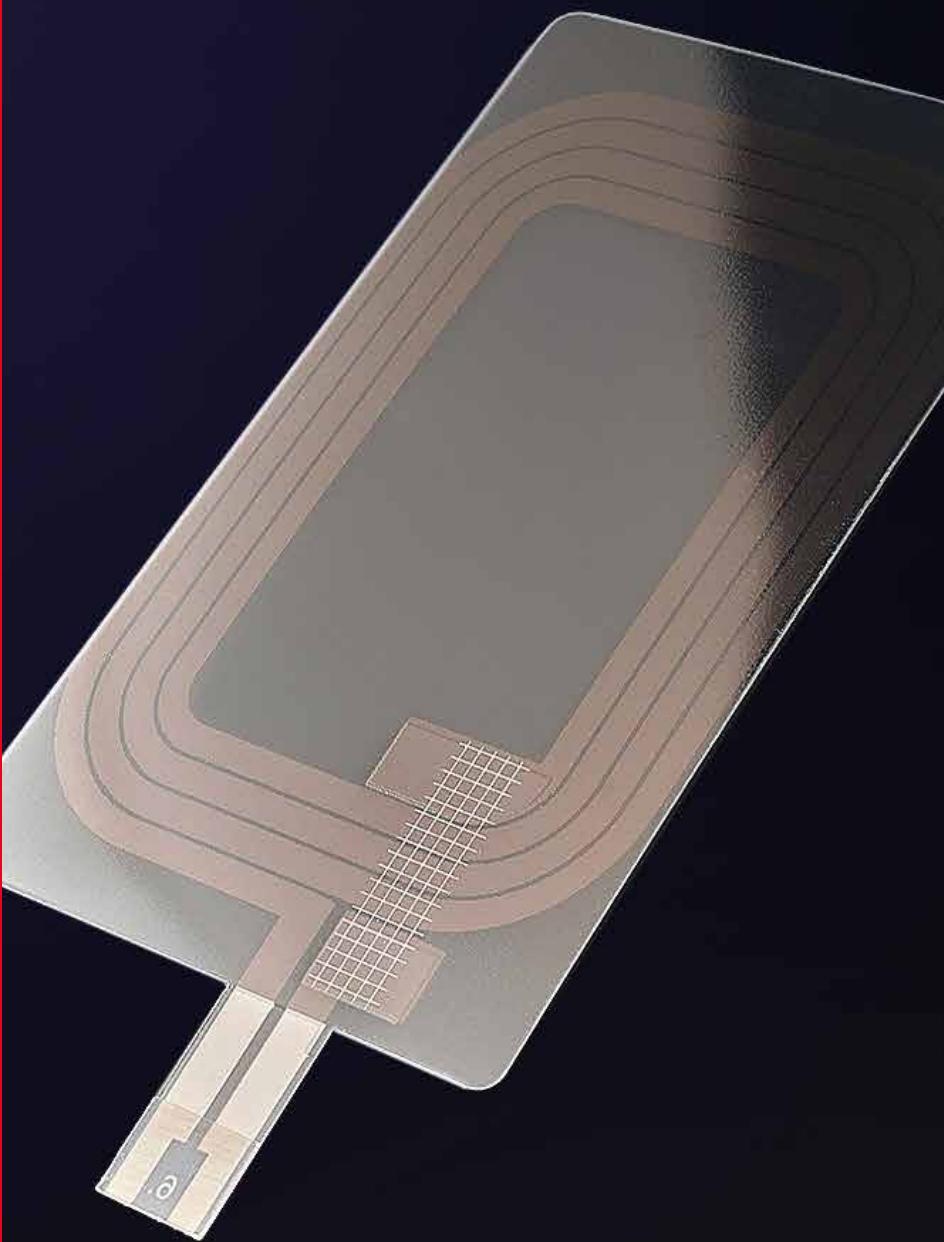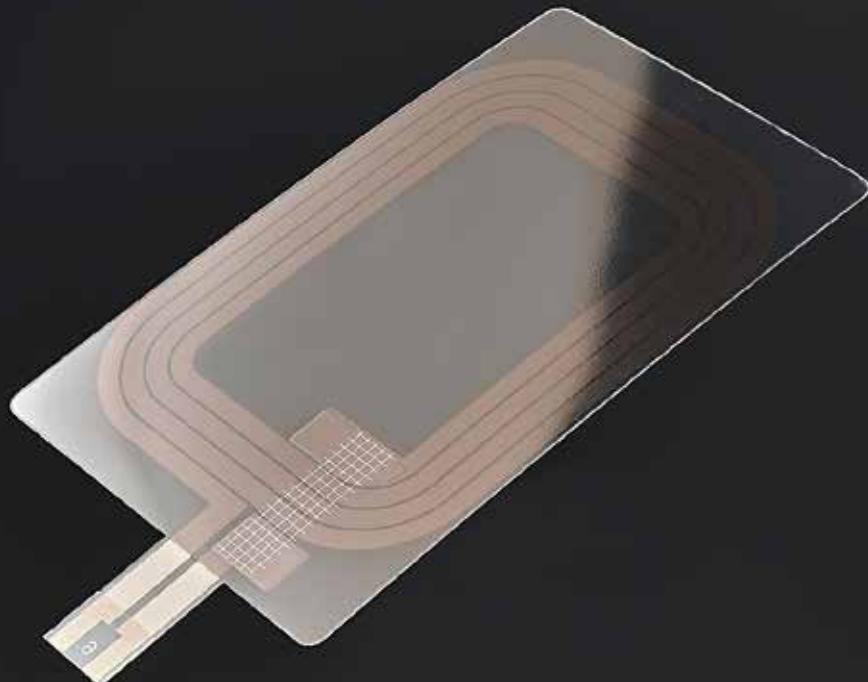
Transparent antennas

The future of flexible communication.

Transparent antennas combine outstanding conductivity, flexibility and design freedom – enabling almost invisible integration into state-of-the-art products. They are the smart answer to the communication requirements of today and tomorrow.

Advantages:
- Invisibly integrated and space-saving
- Highly flexible with excellent conductivity
- Seamless integration thanks to precise metal mesh structure

With individually adaptable designs, transparent antennas are cost-efficient, versatile and qualified for automotive applications. They are also UV-stabilised and robust, ensuring long-lasting performance – even under extreme conditions. Protected manufacturing processes guarantee maximum quality, reliability and precision in every application. The technology can also be used for shielding of up to 60 dB at approximately 80% transmission.

Example applications:
- NFC, transparent WiFi and RFID antennas
- 5G/6G applications
- Passive antennas and reflectors

> **"** Our partnership with BOPLA has been collaborative, solution-driven and efficient from the very start. Together we succeeded in developing a unique 5G window antenna that is setting new standards worldwide. **"**

Frank Hennig
Managing Director, FTS-Hennig

ⓘ METAL MESH TECHNOLOGY

- **More than 90% transparency**
- **Wavelength range 400–900 nm**
- **Exceptional electrical resistance as low as 0.2 Ω/square**
- **Power density up to 3000 W/m²**
- **Peak temperatures up to 85 °C**

Learn more
www.bopla.de/en/transparentantennas

Transparent foil heaters

Invisible efficiency – for applications that require a clear view.
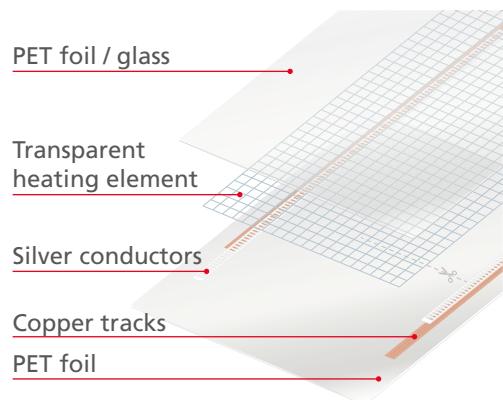
Transparent heating films provide clear visibility and targeted warmth, making them ideal for cameras, sensors, displays or glass surfaces. With smart heating and metal mesh technology, they heat up quickly, save energy and defrost up to 50% faster than conventional solutions – while using only 30% of the energy.

Advantages:
- Rapid heat-up and smart heating
- Longer operating time with lower energy consumption
- Flexible, easy to integrate and freely configurable

Maintenance-free, suitable for outdoor use and optionally enhanced by screen printing, they offer maximum flexibility. Available in a size of 250 x 430 mm, with special sizes on request. With heating capacities up to 3000 W/m², temperatures up to 85 °C, transparency up to 93 % and operating voltages from 3 V to 48 V, they are an efficient solution for a wide range of applications.

Example applications:
- Camera, lidar and radar systems
- Smart traffic monitoring and control
- Surfaces requiring a defined temperature level

PET foil / glass

Transparent heating element

Silver conductors

Copper tracks

PET foil

ℹ️

SMART HEATING
- **Maximum efficiency with minimal consumption**
- **Even, targeted heat distribution only where needed**
- **Energy-saving**

Learn more
www.bopla.de/en/transparentfoilheaters

Transparent touch keys

A new approach to operation – for modern HMIs.

Modern user interfaces demand clear design and intuitive operation. Our transparent touch keys blend seamlessly into displays, glass or plastic surfaces and enable precise, reliable inputs without compromising appearance.

Advantages:
- Highly conductive sensors made from metal mesh or transparent conductive paste
- Button, slider and matrix sensors available
- Transparency > 85%
- Optional integrated evaluation unit
- Serial interfaces: I²C, SPI, UART, USB

Transparent shielding

Invisible protection for sensitive electronics.

Electromagnetic interference can significantly impair the function of delicate devices. Transparent shielding foils provide effective EMC protection – even for applications that require a clear view.

Advantages:
- Protects sensitive electronics – including across windows, touchscreens and covers
- Highly conductive, transparent structures for reliable EMC shielding with attenuation of up to 60 dB
- Higher performance than printed polymers or ITO
- Seamless product and display integration using optically transparent adhesives

Serial interfaces

Compact integration – full functionality.

Our printed membrane keypads integrate all electronic components directly on the base foil – the controller, passive components and interface logic are fully incorporated into the structure. The result is extremely flat, cost-efficient and flexible input solutions.

Advantages:
- Supports USB (HID), I²C and CAN – additional bus systems available on request
- Integrated keypad controller – plug & play via USB
- No separate PCB required – minimal installation depth, flexible flat cable
- Smart LED control, including addressable LEDs with a full colour spectrum

With optimised conductor track design, even complex lighting concepts can be realised within flat foil structures.

Capacitive membrane keypads

For high mechanical loads.
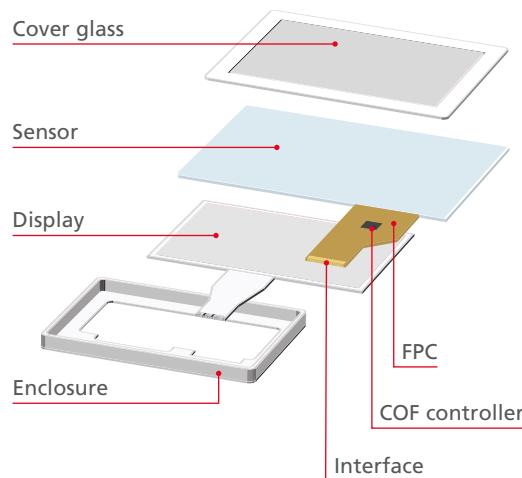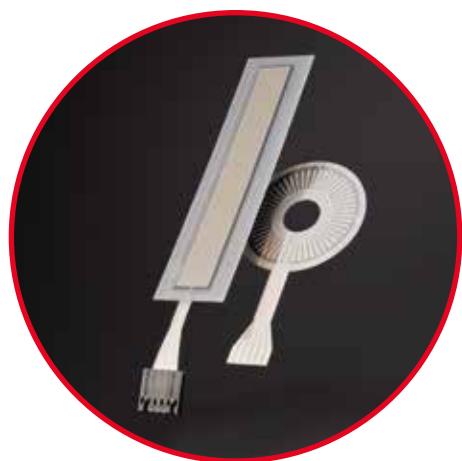
Capacitive operating elements – whether individual keys, keypad fields or complex touch surfaces – offer a smooth, closed surface with no mechanically moving parts. This makes them resistant to dirt, water and chemicals.

Advantages:
- Robust, durable and resistant to chemicals
- Hygienic and easy to clean
- Flexible, customisable key layouts
- Reliable functionality, even if the surface is damaged

The intuitive operation enabled by light touch makes capacitive solutions particularly hygienic and comfortable to use. Flexible key shapes, customised layouts and complex geometries can be implemented with ease, while optional visual or acoustic feedback enhances the user experience.
PCAP and PCT touch sensors open up a wide range of technical possibilities – from industrial control systems to sophisticated design solutions.

Our complete solution:
We supply capacitive operating units as a fully integrated system.
Sensor, evaluation chip and surface deliver maximum functionality – even on curved or complex surfaces. Our in-house software and firmware development enables tailored adaptations: from the cover glass through to a fully functional unit with display and enclosure.

Cover glass

Sensor

Display

Enclosure

Interface

COF controller

FPC

Learn more
www.bopla.de/en/capacitivekeypads

System integration

Custom enclosure solutions for modern electronics.

More than just an enclosure. A system built around your solution.
With long-standing experience, deep vertical manufacturing capability and an integrated systems approach, we support your project reliably – from the first concept through to the finished product.

This is how solutions are created.

Enclosure
Standard enclosure or custom-designed manufacture – our enclosure is the basis for your product.

Services
From milling to laser engraving. We process and refine your enclosure according to your wishes.

System integration
We integrate your individual HMI input system – from foil mounting to touch screen integration.

Learn more
www.bopla.de/systemintegration