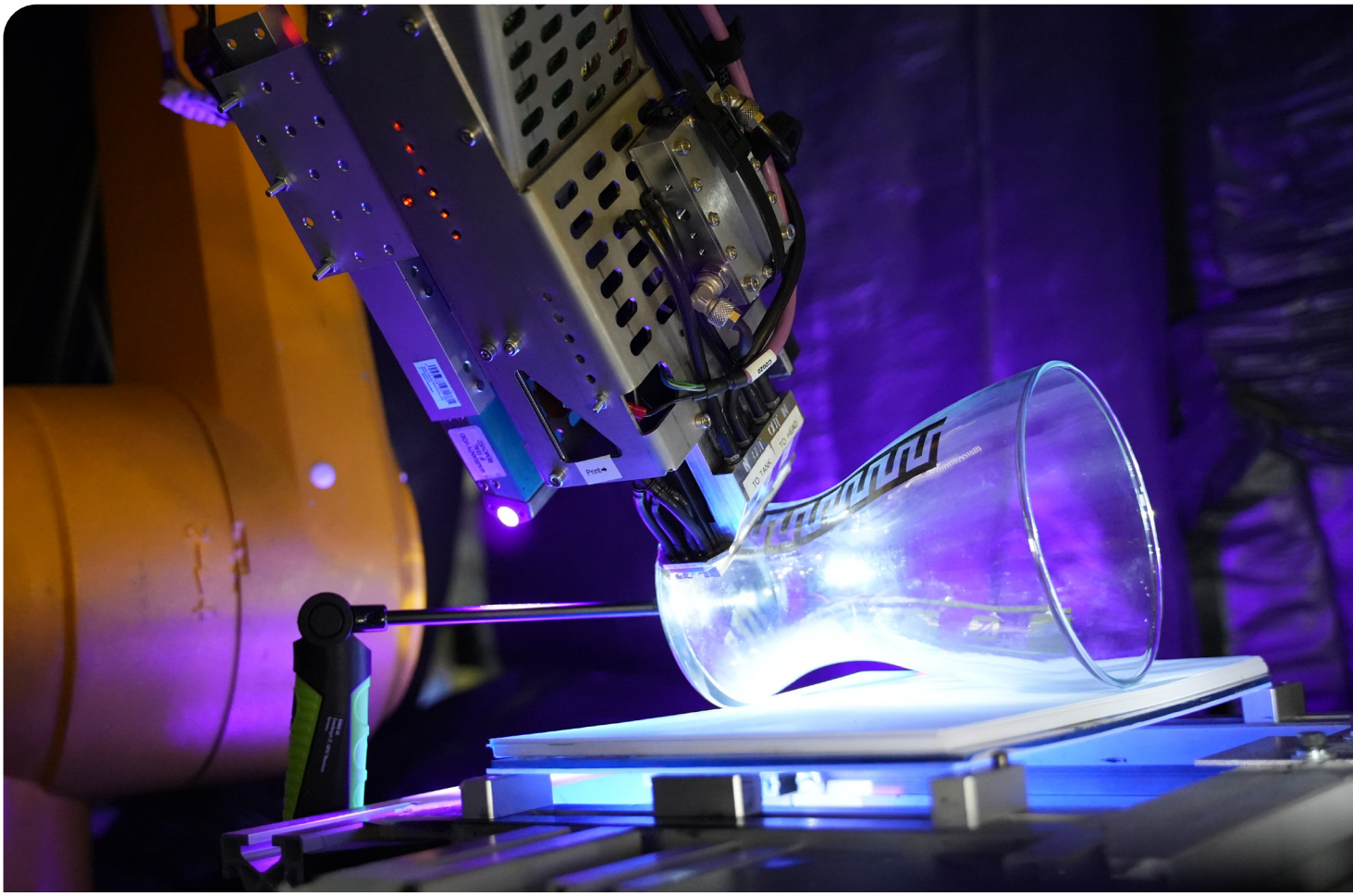
PROFACTOR®
FROM RESEARCH TO PRODUCTION

Industrial Inkjet Printing

Advanced Technologies for Printing Electronics and Printing on Free-Form Objects



Industrial Inkjet Printing

Directly print smart functions and appealing designs onto your components

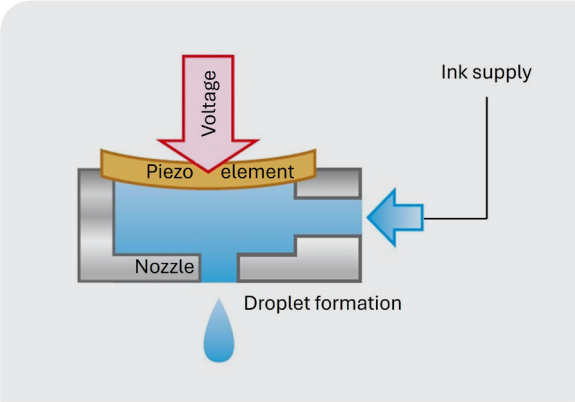
Conventional industrial printing processes require a great deal of effort in setting them up and are usually designed for printing on flat substrates. The **decoration of curved components** poses a major challenge and can usually only be achieved by applying film.

Inkjet printing – digital, contactless, additive

In the inkjet print head, tiny drops of ink are generated and are jetted onto the substrate by applying an impulse from a piezo element.

By precisely controlling the size and placement of the droplets, **complex images and patterns can be created from digital print data** – which can be used for graphic prints as well as for the production of electronic structures.

The parallel arrangement of thousands of nozzles enables efficient printing of large areas with one or more colors. By adapting the print data, print images can be exactly **aligned with the components.**



Drop-on-demand principle: piezoelectric elements generate individual ink drops

Advantages of industrial inkjet printing

- **High flexibility**: In contrast to analog printing processes, design changes can be implemented quickly and cost-effectively.
- **Printing on curved surfaces** through contactless application of inks
- **Precise positioning of the print image** by adapting the print data to each individual component (compensation of manufacturing tolerances)
- **High-resolution printing** through precise control of the size and positioning of the ink droplets
- **Simple multilayer printing** thanks to additive manufacturing principle
- **Individualization of products** due to digital print image generation

Industrial applications

In addition to graphic printing on components, inkjet technology also plays a key role in the production of functional structures:

Graphic printing directly onto components (direct to shape): Decoration or masking, of surfaces and components of different materials such as metal, glass, plastic, textile, leather, etc.

Printing of functional structures (on different materials): electrically conductive or insulating elements, optical functional layers, protective layers against corrosion or mechanical stress, bio-active surfaces, etc.

Inks, Processes and Industrial Printing Systems

PROFACTOR offers technologies and solutions from the ink to the complete printing system

Ink development

Inkjet printing requires special inks that enable the precise production of individual droplets. Here, the ink properties not only depend on the print head used, but also on the required print quality and the substrate material.

PROFACTOR supports you in the **selection of suitable commercial ink systems** and develops special inks in-house.

The characterisation of inks and surfaces is key for good print quality.

Process development

By process development, we mean all development steps from the printing strategy through to **stable inkjet printing** on your substrate or component.

After selecting suitable industrial print heads, we start by pretreating the surface to be printed and optimizing the printing parameters.
The production of various demonstrators and a detailed characterization of the inks and print results **guarantee a high print quality** (coverage, edge sharpness, etc.) and functionality (conductivity, adhesion, biocompatibility, etc.) of the components.

Multi-material printer for the development of inkjet-printed electronics and small series.

Building custom printing systems

Building on our many years of experience in inkjet technology, robotics and plant engineering, we develop and build customized printing systems for **industrial free-form inkjet printing** as well as special **printing systems for research and development.**

Our solutions

Process development and small series for printed electronics

» SEE PAGES 4-5

We develop customized, fully inkjet-printed solutions for electronic systems and sensors tailored to customer requirements.

Inkjet printing systems for free-form components

» SEE PAGES 6-7

We supply complete systems and develop processes for digital printing on components with curved surfaces, including part handling and integration into your production.

Inkjet Printing of Electronic Elements

Flexible and efficient functionalization of products and surfaces

Printed electronics refers to electronic components that are manufactured entirely or partially using printing processes. Here, inkjet technology can be used to apply tiny amounts of ink in the form of conductive and insulating layers **(multi-material structure)** and thus produce three-dimensional electrical structures.

The inks are often organic solvents that are filled with **electrically conductive, inorganic particles.** The subsequent sintering process makes it possible to achieve a sufficient level of **electrical conductivity** of the printed structure.

Inkjet systems also enable printing on large and flexible substrates. This opens up **new functionalities** and fields of application (e.g. biosensors in textiles, seamlessly connected electronic surfaces in mobility applications, smart labels on packaging). Pick & place technology can be used to place conventional components (integrated circuits, passive components) on or next to printed structures and thus realize complex circuits **(hybrid integration).**

We are happy to support your projects: From the development of specific printing processes to the production of small series for electronic systems and sensors including optical and electrical characterization.

Inks & materials for printed electronics

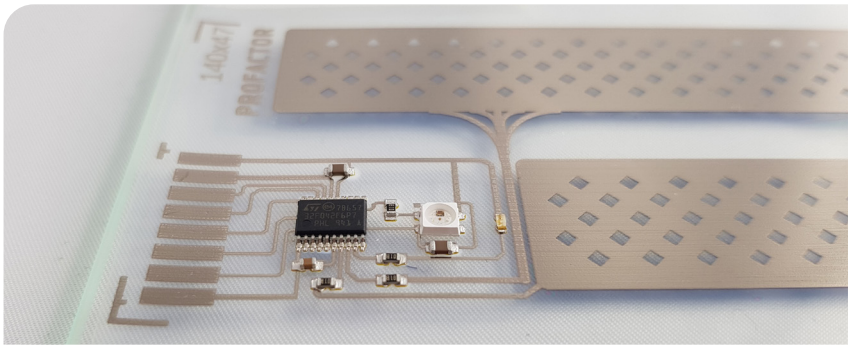
In the field of printed electronics, inkjet allows a choice from a variety of functional materials. In particular, we are offering printing services with the following ink classifications:

- Solvent- and water-based inks
- Conductive nanoparticle inks (silver or copper)
- Resistive nanoparticle inks (carbon)
- UV curable inks (dielectric materials)

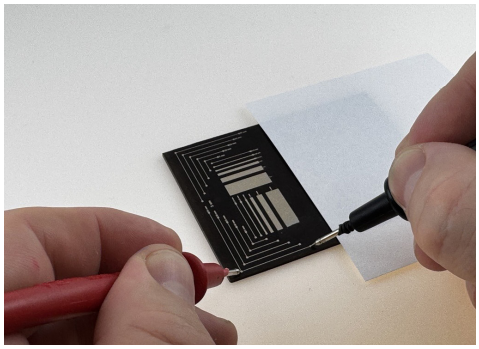
Post processing – a vital step in establishing conductivity

After printing, the ink must be post-treated in order to achieve the required electrical and mechanical properties.

- Pinning with UV light to increase the viscosity after the printing process
- Drying and sintering using infrared light
- Photonic sintering with a pulsed xenon light source



Pick & place process: Integration of conventional electronic components and printed structures



Testing the electrical conductivity after the sintering process

Printed Electronics Applications

Small form factor – Cost-efficient – Sustainable

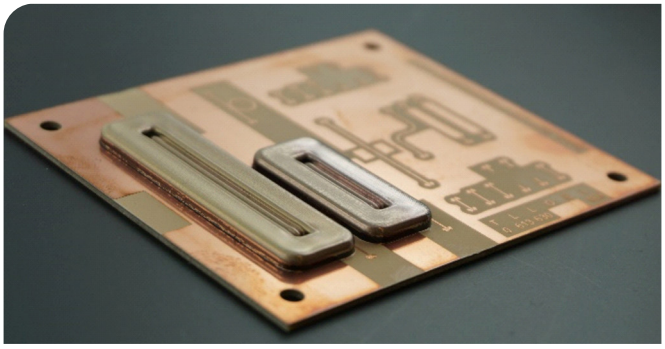
Advantages of digitally printed electronics

- **Flexible and thin circuits** with a high degree of customization
- **Cost-effective production** even of small batch sizes
- **Great freedom in design** thanks to multilayer and multi-material printing

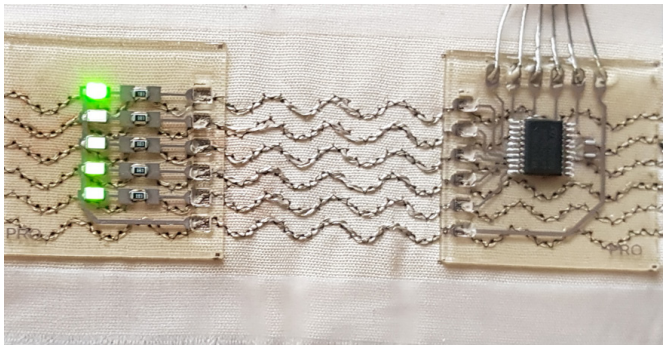
Applications

Together with partners from various industries, PROFACTOR has developed and successfully demonstrated a wide range of digitally printed electronic components.

- **Printed antennas:** RADAR antennas for low-loss transmission and miniaturization for mobility applications
- **Smart Textiles:** printed sensors and their seamless integration into textiles for monitoring of patient vital functions in medical and elderly care environments
- **Smart Windows:** printed conductor paths for intelligent windows for the functional integration of energy generation, monitoring of air quality or data transmission
- **Sustainable Electronics:** printed circuits on wood-based substrates to reduce electronic waste and cut CO_2 emissions



Printed antennas for radar applications



Functionalizing textiles with printed electronic structures

Printed semi-transparent conductors for smart window applications

Conductive interconnections printed on sustainable lignin-based substrate

Inkjet Printing on Free-Form Components

Flexible and efficient digital printing on curved component surfaces

Analog printing processes quickly reach their limits with curved surfaces, as the use of stamps, transfer foils or stencils is especially time-consuming and often imprecise.

With PROFACTOR inkjet technology, **single and multi-colored motifs** can also be **applied directly to curved components.**

This contactless printing process enables the adaptation of motifs to individual component shapes and flexible implementation of design changes.

Decoration of free-form components with a robot inkjet printing system

Digital printing on curved surfaces

We combine industrial inkjet print heads with state-of-the-art robot and axis systems to print motifs on almost any shaped surface. The print head is guided precisely over the surface, ensuring high-quality printing. Alternatively, the component is moved under the print head.

Component geometries and manufacturing tolerances are automatically recognized, and the print data is adapted to them in real time. This allows **three-dimensional components to be printed precisely.**

Inkjet decoration on 3D printed part

Digital decoration

The multi-colored design or individualization of components is becoming increasingly important. Here, digital free-form printing has clear advantages, as it can **decorate complex surfaces** in different colors without distortion.

Depending on the application, the motif is printed directly onto the base material or as a sandwich between the base layer and a topcoat.

Digital masking

Masking is the partial, single-color coating of a component.

This enables, for example, beautifully shaped product surfaces without joints and gaps with **partially transparent as well as completely opaque areas.** The latter are used to cover or mask underlying elements or structures.

Free-Form Inkjet Printing Applications

Flexible – Digital – On almost any shape

Solutions

PROFACTOR supports you in all stages of development, from the idea and process development to the industrial inkjet printing system and integration into your production.

Talk to us. **We are happy to help you with your shaped printing needs.**

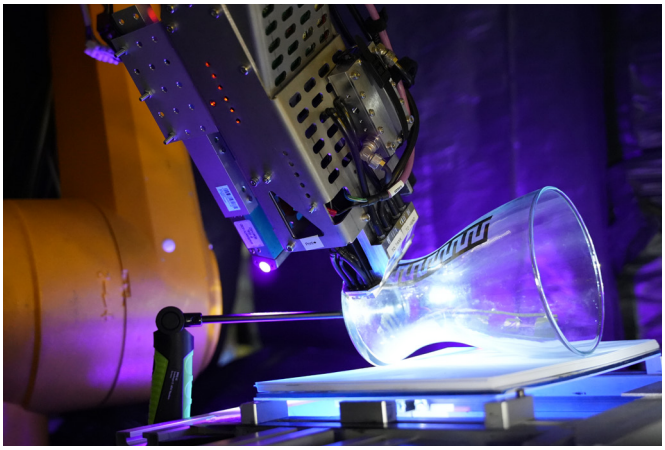
Advantages

- **Flexibility in production** thanks to a fully digital printing process without time-consuming conversion of production systems to new motifs and decors.
- **Direct to shape printing on curved or irregular component geometries.**
- **Perfect placement of print images** even on components with manufacturing tolerances thanks to automated adaptation of the print data.
- **High quality prints** on a wide range of materials (metal, glass, plastics, textile, leather, etc.) using commercial inks.
- **Cost and resource savings** by avoiding ink overspray, materials for transfer foils, printing forms, etc.

Industrial applications

- Decoration and functionalization of **interior or exterior parts,** e.g. in the automotive industry
- Printing on free-form parts, e.g. in **aerospace,** the **white goods industry,** etc.
- Direct to shape decoration of **consumer goods,** e.g. fashion, sports, shoes, etc.
- **Transforming existing printing processes** from analog to digital

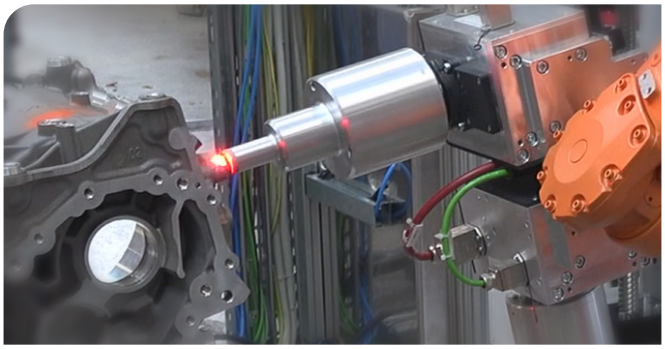
Inkjet decoration on multi-material surfaces



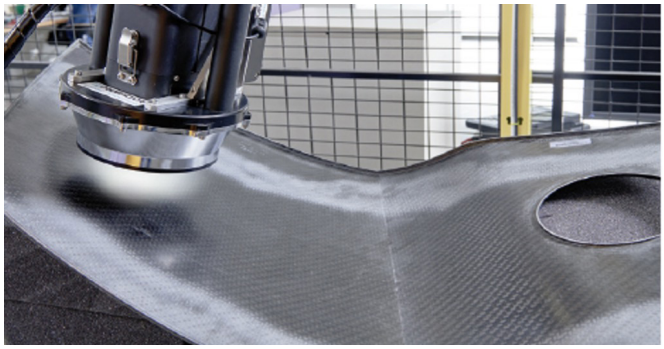
Robotic inkjet printing on free-form parts

PROFACTOR – Your Advanced Technology Partner

Industrial Inspection – Collaborative Robotics – Digital Assistance – Micro and Nano Manufacturing



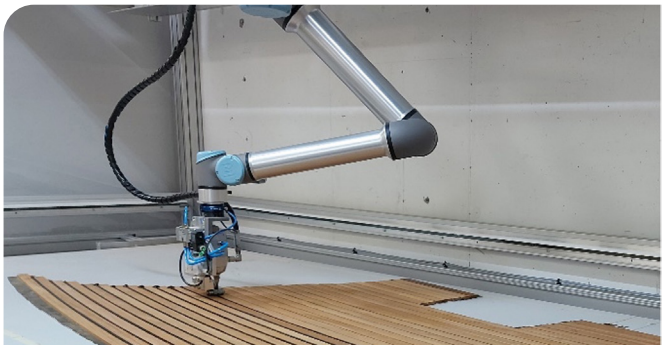
Surface inspection of metal parts



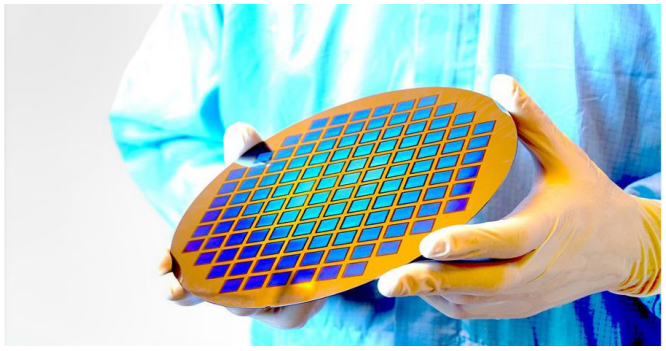
Surface inspection of carbon composite components and materials

Industrial thermography: automated non-destructive crack detection

Q-Station: Quality control and digital assistance for dynamic assembly line scenarios



Collaborative machining, handling and (dis)assembling



Nanoimprint Lithography (NIL) prototyping and small series manufacturing

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Funded by the ERDF (European Regional Development Fund) as well as the federal government and the province of Upper Austria