

1 Track & Trace Fingerprint test stand, comprising a Fingerprint reader, a control unit and testing accessories.

2 The constraints for inline component tracing can be simulated and examined with the aid of just a few dozen components.



TRACK & TRACE FINGERPRINT TEST STAND

Traceability is the cornerstone of Industry 4.0, ensuring sustainable manufacturing and perfect documentation. Only if individual components and semi-finished products are definitively identified can data collected in the production process be traced back to individual components. Fraunhofer IPM's Track & Trace Fingerprint technology is the first of its kind to use existing surface microstructures as distinguishing features for tracing mass-produced components. Each component is assigned a unique bit sequence – or fingerprint (FP) – based on its own individual microstructure, eliminating the need for any additional marking.

The Track & Trace Fingerprint test stand enables users to easily review how the technology can best be used for specific components and process steps. The test stand makes it possible to use real components to determine the extent to which production steps affect tracing stability and to gain experience with the

Track & Trace Fingerprint technology quickly and effectively.

Successful integration into production lines

Track & Trace Fingerprint is already being used in industry for inline component tracing. Camera systems provide the images necessary to identify components in production. These systems are placed where important production parameters are set to be assigned to the individual components. A number of factors must be considered, including the mounting space, the handling systems, the rate of production, the environmental conditions, the amount of components in circulation and, of course, the component surface itself. All of these conditions can be tested using the Track & Trace Fingerprint test stand, making it an indispensable tool for the integration of component-tracing technology into the production line.



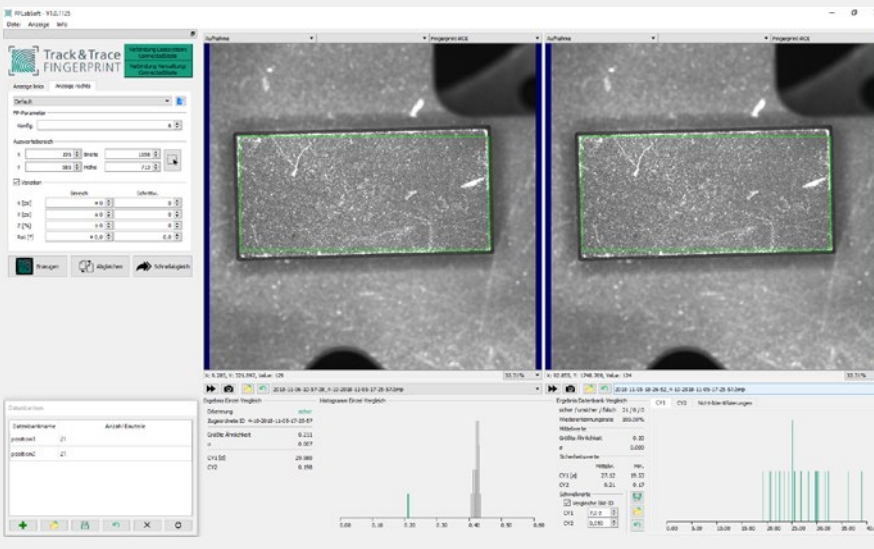
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3 Graphical user interface of the FP laboratory software. This software can generate and display component images as well as compare the fingerprints created from them. The resulting statistical values are displayed in the lower third of the user interface, allowing suitable parameters to be established for the Track & Trace Fingerprint process.

Planning marker-free tracing under production conditions

Nearly all technical surfaces have unique features that can be used for tracing purposes – similarly to a human fingerprint. These microstructures and the changes they undergo in production can be analyzed using the Track & Trace Fingerprint test stand. The camera system (FP reader) and software (FP laboratory software) parameters can be adjusted for optimal recognition results. For example, the type of lighting used by the FP reader as well as its aperture, depth of field, field of view and evaluation position can be adjusted according to each individual component. The resulting findings enable precise planning for later use in the production line.

Minimal effort, maximal informative value

The FP laboratory software generates fingerprints based on camera images, saves and compares these fingerprints and calculates the statistics for the component recognition's reliability. The fingerprints can be read directly by the FP reader or generated from recorded images of the components saved on a hard drive. All statistical values can be exported and saved for further analysis, documentation and archiving.

A component's fingerprint must be generated on a specifically defined area on the component surface for recognition to work. Plus, in addition to suitable component or handling fixtures, image pre-processing is often necessary to compensate tolerances with respect to the positioning and orientation of the component area designated for identification. The FP laboratory software includes a simple imaging pre-processing program that allows high-contrast component edges to be used for the software-based positioning of the area to be evaluated. Images pre-processed by other image processing tools can also be read and analyzed.

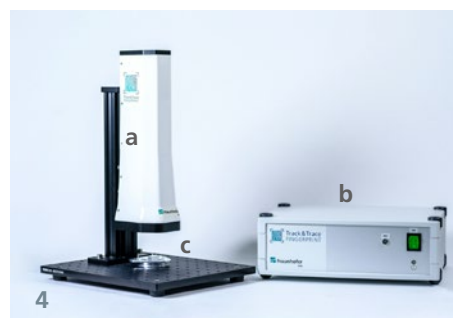
Service: Instruction and support in the commissioning process

The Track & Trace Fingerprint test stand makes it possible to set the constraints

for using the Track & Trace Fingerprint technology for specific components and process steps as well as to determine the necessary handling accuracy. Only a few dozen components are needed to ensure a reliable result.

Fraunhofer IPM supports companies who want to use this technology in the commissioning process and provides detailed instruction to the employees. The Track & Trace Fingerprint test stand is available for loan or sale.

Based on the foundation of substantiated test results, Fraunhofer IPM works together with users to develop and integrate a complete system for enabling the marker-free tracing of components in the production process.



4 Track & Trace Fingerprint test stand, comprising: (a) FP reader incl. camera, optics and lighting fixture; (b) control unit; (c) testing accessories comprising a breadboard and mountings for the camera system and the components to be analyzed. (A PC is also needed.)