Track & Trace Fingerprint Inline

Marker-free component traceability at the rate of production

Track & Trace Fingerprint Inline uses the component's individual surface micro-structure as a marker for their identification.

Measurement data obtained in the production process provide valuable information for process optimization. For components or semi-finished parts to be unambiguously referenced to this data, they need to be unambiguously identified at each stage of production. Track & Trace Fingerprint by Fraunhofer IPM enables component identification and tracing with no need for additional markers. This makes it suitable even for mass-produced parts.

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Tracking components down to the last screw

The quality of complex industrial products may depend on the quality of each and every component. Failure of a component within an assembly often results in the entire batch being sorted out as potentially defective. This may result in costly product recalls. Traceability of even small, inexpensive components is the key to process optimization and hence to quality and sustainability. Linking each component or semi-finished part to an individual ID signature enables tracing them along the entire value chain and referencing them to measurement data from production. This is the only way of eliminating recurring production errors – at the production site and even well beyond the boundaries of a company's own production:

Seamless traceability helps to identify sources of error along the entire supply chain and is therefore a fundamental prerequisite for adaptive production.

No costs per unit

Established tracing methods use component markers, which involves additional production steps such as applying RFID labels or data matrix codes. These methods often fail due to the costs incurred. Track & Trace Fingerprint Inline makes use of the existing individual microstructure of component surfaces for identification, so there are no additional costs per unit. Component functionality is not affected as is the case with many marking techniques. It is not wise for manufacturers to engrave serial numbers on sealing surfaces or place barcodes

Advantages at a glance

- Traceability without the need for markers
- No costs per unit
- Identification within a second
- Highly reliable, robust identification
- Suitable for a broad variety of component geometries and materials

Each punched part is characterized by individual microstructures on its surface. Track & Trace Fingerprint Inline reduces these structures to a simple bit sequence.

on decorative items. Furthermore, while some components are simply too small to be marked, those that can be are at risk of having their markers counterfeited.

symmetrical components and even their curved lateral surfaces. A wide range of materials, from plastics to precision machined aluminum, cast iron and varnished surfaces can be identified.

Suitable for a variety of materials, component sizes and shapes

On closer inspection, almost all technical surfaces reveal individual, incidental characteristics such as microstructures or interwoven colors. The Track & Trace Fingerprint Inline camera system takes high-resolution images of defined areas on the component's surface. The specific structural patterns captured by the image and the way in which they are positioned relative to each other is used to generate a characteristic bit sequence, i.e. the fingerprint code. This fingerprint code is then stored in a database, combined with an individual ID. This process can be repeated to identify the component at a later date by taking an image of the very same component area and matching the newly generated fingerprint code to the codes stored in the database. If this there is a match, the component is clearly identified by the respective ID, which also allows attributing additional information such as measurement or production data to any individual component.

Track & Trace Fingerprint Inline has been designed to enable traceability of different component sizes and geometries, from circuit boards with very small detection areas to cross-sectional areas of steel profiles. The method also works for rotationally

Reliable identification at the rate of production

The Track & Trace Fingerprint camera system relies on a fast CMOS image sensor to record high resolution images of the component's surface microstructure. Based on these images, the fingerprint code of the component is generated by means of a special algorithm developed by Fraunhofer IPM. Image recording, including the generation of the fingerprint code, is performed in a matter of seconds without delaying the production process. The fingerprint code is a simple bit sequence with low memory capacity need, which enables database matching in line with the rate of production and makes Track & Trace Fingerprint suitable for inline use. Tolerances when positioning the components are compensated by software based on suitable geometric reference points. Possible interferences such as impurities or scratches on a component's surface do not impair the identification. Identification rates of over 99.9 percent have already been demonstrated in batch production processes.

Fraunhofer IPM implements the Track & Trace Fingerprint process for industrial customers as a pilot installation and supports the roll-out. The installation includes the Track & Trace Fingerprint Inline reading systems, the fingerprint software and project-specific adaptations.

Track & Trace Fingerprint systems

Track & Trace FINGERPRINT **INLINE**	**Identification in the production line** Permanently installed reading system
Track & Trace FINGERPRINT **FLEX**	**Identification on the production site** Cordless reading system for robust component detection
Track & Trace FINGERPRINT **APP**	**Identification via smartphone app** Quick and easy to use
Track & Trace FINGERPRINT **TEST**	**Optimum preparation for the use of Track & Trace Fingerprint** Test stand for purchase or rental

Contact

Dr. Tobias Schmid-Schirling
Group Manager Inline Vision Systems
Phone +49 761 8857-281
tobias.schmid-schirling@ipm.fraunhofer.de

Fraunhofer Institute for Physical Measurement Techniques IPM
Georges-Köhler-Allee 301
D-79110 Freiburg
www.ipm.fraunhofer.de/en