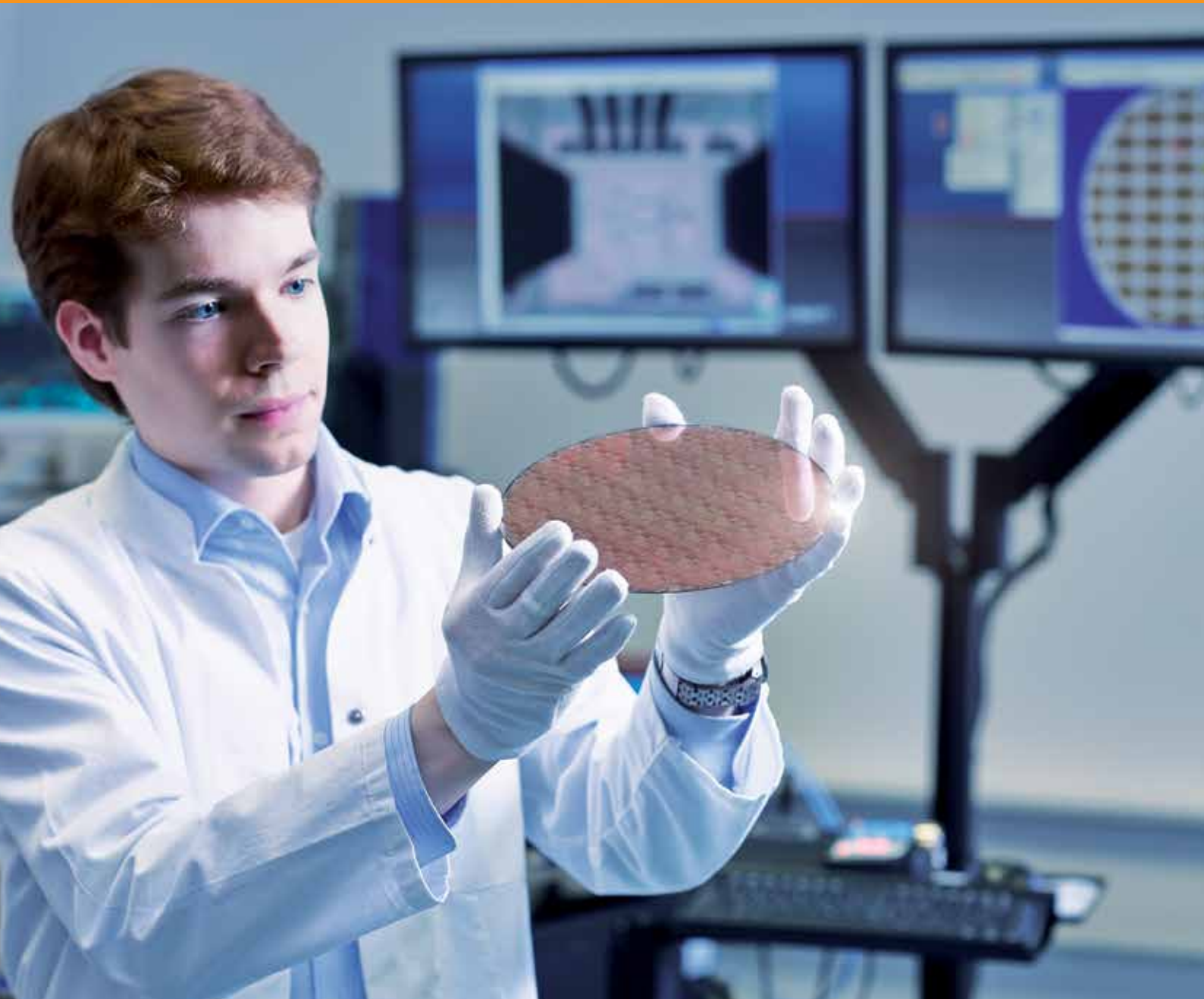
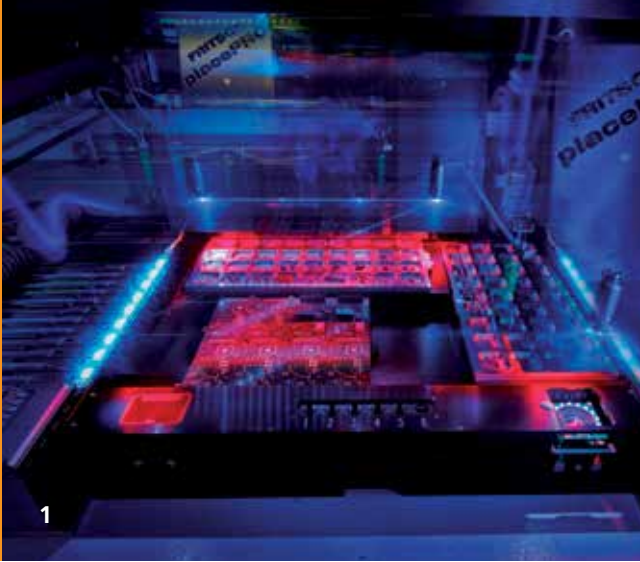


# PRODUCTION





# ALWAYS A WAVELENGTH IN FRONT

Quality control is one of the key ingredients for entrepreneurial success. Zero-defect concepts conserve resources and reduce production costs through the integration of sensors that can detect deviations in the production process and correct these in real time.

## Quality assurance with radar

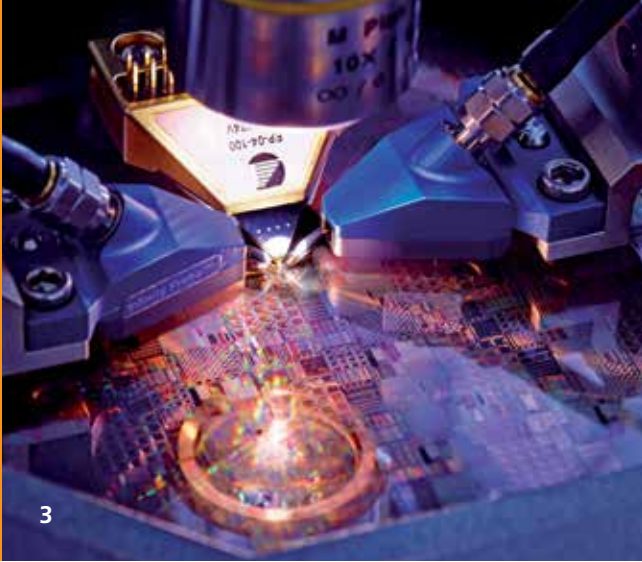
Guaranteeing consistent quality and ensuring that products are not faulty or contaminated are key challenges in modern quality assurance. Modern high frequency systems can not only detect and visualize errors in a product, they are also capable of monitoring the entire production process. Conventional sensors quickly reach their limits in the presence of high production speeds. For this reason, preference is frequently given to camera systems. High-frequency sensors supplement existing high-speed systems in an ideal manner as they also offer an insight into the interior of the product. In addition to the detection of inclusions and defects, they provide a broad spectrum of additional information on, for example, the moisture content and permeability of the product or the structure and layer thickness of multilayer materials.

The application spectrum of high-frequency systems ranges from simple geometric measurements and the determination of material parameters to the monitoring of the ripening process in fruit. Deviations in the mixing ratios of bulk materials or intermediates can be shown both space and time resolved through the observation of the absorption lines of the individual ingredients.

## Zero-defect production with high frequency systems

A further advantage of radar systems is their insensitivity to air turbidity caused by smoke, dust or water vapor. The capability to precisely measure distances in the micrometer range is the key to consistently high quality, even under critical ambient conditions.

The best technical solution, however, is not always the best solution for the customer. For this reason, Fraunhofer FHR aims to deliver integrated, individual solutions that also optimize costs, the development period and the techniques that are used. The integration of sensors in the production process is a central focus. Thanks to the alliance with partners within and outside the Fraunhofer-Gesellschaft, a wide spectrum of different sensors and measurement techniques is now available. The multispectral sensor concepts even allow solutions for tasks that previously could not be accomplished with conventional quality control systems.



## Classification of materials using radar technology

Non-destructive and non-contact inspection is already an important element of quality control in modern industry. Penetrating techniques such as X-ray or radar can determine properties deep inside the material. Radar systems not only use the attenuation coefficient in the medium, but, by way of phase measurement, also the propagation time of the signal at the time of transmission through the test specimen. For this reason, a distinction can be made between materials with very similar attenuation values. In addition, inspection systems based on radar techniques can also be used at belt speeds in excess of 10 meters per second.

High frequency systems are also characterized by their ability to measure the geometry of an object. The systems can cover a wide frequency spectrum and can therefore deliver spectral information. The combination of different types of information paves the way for the exact determination of the material properties. The characterization of the material parameters takes place contact-free and in real time. Due to their high dynamics, they can also detect the slightest deviations and react very sensitively to temporal changes in the material properties, e.g. as a result of drying out or heating. The application areas for the classification of materials in industry are broad and growing steadily.

- 1 *Pick-and-place machine*
- 2 *Fraunhofer conducts research on the sorting of black plastics in the project blackValue®.*
- 3 *On-wafer prober for the high frequency measurement of integrated circuits.*
- 4 *The terahertz scanner SAMMI can visualize the contents of mail items.*



Speaker Business Unit:

**Dipl.-Ing**

**DIRK NÜBLER**

Phone +49 228 9435-550

[dirk.nuessler@fhr.fraunhofer.de](mailto:dirk.nuessler@fhr.fraunhofer.de)

# CONTACT

**Fraunhofer Institute for  
High Frequency Physics and  
Radar Techniques FHR**

Fraunhoferstr. 20  
53343 Wachtberg

Phone +49 (0)228 9435-227  
Fax: +49 (0)228 9435-627  
info@fhr.fraunhofer.de  
www.fhr.fraunhofer.de

**Head of the Institute**

Prof. Dr.-Ing. Joachim Ender  
Phone +49 (0)228 9435 - 227  
joachim.ender@fhr.fraunhofer.de

**Speaker Business Unit Production**

Dipl.-Ing. Dirk Nüßler  
Phone +49 (0)228 9435 - 550  
dirk.nuessler@fhr.fraunhofer.de



Reference Projects:  
<http://www.fhr.fraunhofer.de/production>

**TITLE** *Highly integrated  
radar chips on SiGe basis al-  
low high frequency circuits  
of 100 GHz and more for  
complex tasks.*

*Illustrations*

© Fraunhofer FHR

© Uwe Bellhäuser