

**W-BAND RADAR MODULES**  
FOR SENSORS, AUTOMATION, AND SECURITY



# RADAR – MAKE THE INVISIBLE VISIBLE

## FEATURES & BENEFITS PERFORMANCE

Our millimeter-wave radar measures distances and movements with a precision of  $0.5\ \mu\text{m}$  – in real time, in any weather and even in the most difficult visibility conditions. Our radar opens up many new applications in materials testing, industrial sensor technology, logistics and safe human-robot collaboration (more information on the right).

Fraunhofer IAF researches innovative, compact and cost-efficient radar sensors that offer higher resolution, measurement accuracy and robustness than existing radar systems with silicon circuits. We would be pleased to advise you on your customized sensor solution.

### Advantages of our radar sensors at a glance:

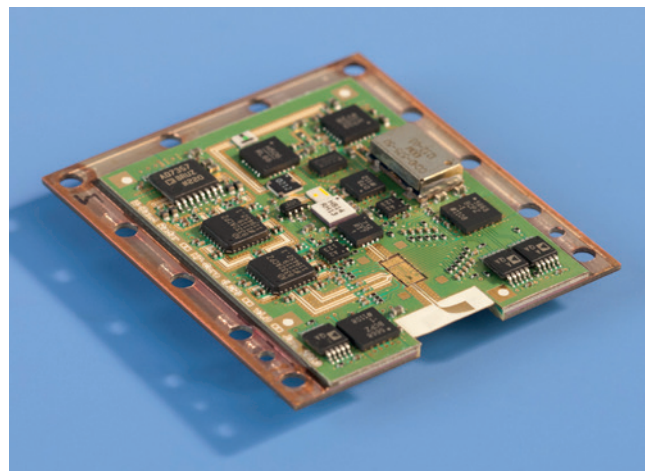
- high bandwidth, corresponding to very high resolution in the range of a few micrometers
- cost-efficient technology: commercial printed circuit board
- small and compact size: only  $42 \times 28 \times 79\ \text{mm}^3$
- ready for use: integrated transmitter and receiver antenna, integrated signal processing and object analysis, integrated microcontroller unit, Ethernet and serial interface
- single-channel module for precise distance measurements or multi-channel module for additional azimuthal direction determination

## 85–100 GHz

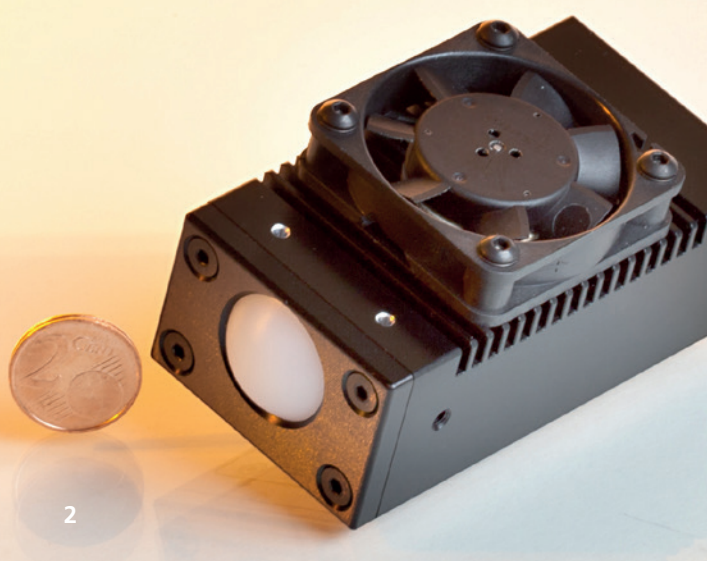
The high frequencies at which our radar sensors operate offer high resolution and very high measuring accuracy.

The heart of the radar sensor is a monolithically integrated microwave circuit (MMIC) developed using IAF's proprietary 50 nm mHEMT technology based on gallium arsenide. A frequency multiplier, power amplifier, low-noise input amplifier and I/Q mixer are integrated on the chip. The radar sensor offers a maximum bandwidth of 15 GHz (85–100 GHz), a noise figure of only 4 dB (LNA) and operates with only one Vivaldi antenna for transmitting and receiving.

Additionally included is a digital signal processor running a LINUX kernel. Robust signal processing algorithms suppress interference data and noise for optimum measurement results. The internal parameters of the module (e. g. frequency range, sweep duration, output power, etc.) can be defined by software. The output power can be adjusted over a dynamic range of 30 dB with a maximum of 10 dBm.



1 The high-frequency module, is integrated on a commercial printed circuit board. This makes the assembly and connection technology much more cost-effective.



2



3

## APPLICATIONS

Due to its high resolution and measurement accuracy our radar sensor is suitable for numerous applications:

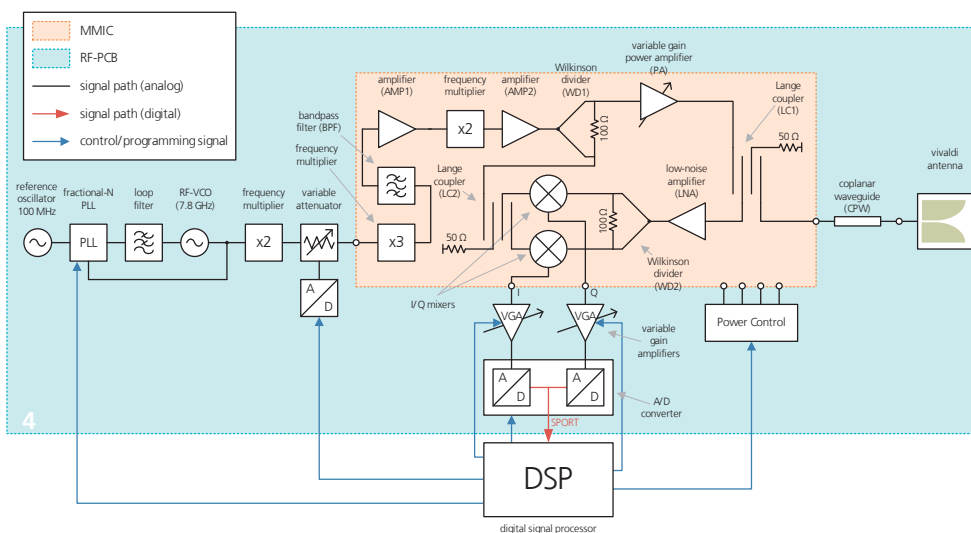
- **Air safety:** safely and precisely display the distance information even in dusty or snowy environments
- **Industrial sensors:** give precise distance measurements even when optical systems fail, when there is no clear line of sight, or in harsh environments e. g. steelworks
- **Logistics:** check packaged goods for faults or missing pieces
- **Material inspection:** many materials, e. g. wind turbine blades, can be inspected non-destructively
- **Human-robot collaboration:** measure the distance, position and movement of people working with robots even when they are concealed by objects which are non-transparent to optical systems

In our measuring laboratory we can also test a wide variety of application scenarios for you using our latest sensor developments.

## INDUSTRY 4.0

The ability of machines, sensors and people to connect and communicate with each other via the Internet of Things (IoT) is one of the main goals and challenges in Industry 4.0. In an autonomous production chain, people, machines, industrial plants, logistics and products communicate and cooperate directly with each other.

Due to its ability to penetrate most non-metallic materials, our radar sensor can support industry 4.0 in a variety of ways. For example it can surveil the collaborative space of people working directly with robots by calculating dynamic safety zones and situationally adjusting the speed and movement of the robots. This works even when optical systems such as laser scanners fail due to glare caused by sunlight or when materials, dust or smoke obstruct visibility. Our radar also takes industrial automation a step further. It checks packaged goods for content and completeness. Based on the results, faulty goods deliveries can be sorted out before dispatch. This saves resources and increases production efficiency.



2 The 94 GHz FMCW radar is only 42 x 28 x 79 mm<sup>3</sup> small.

3 Radar sensors can be used alongside optical sensors to make human-robot collaboration safer, even in conditions of reduced visibility.

© Juice Images - Fotolia.com

4 Functional block diagram of the 94 GHz FMCW radar module.

# PLEASE CONTACT US!

**Fraunhofer Institute for  
Applied Solid State Physics IAF**  
Tullastrasse 72  
79108 Freiburg, Germany

[www.iaf.fraunhofer.de](http://www.iaf.fraunhofer.de)



**Dr. Markus Rösch**  
(Group Manager Sensor Systems)

Phone +49 761 5159-648  
[markus.roesch@iaf.fraunhofer.de](mailto:markus.roesch@iaf.fraunhofer.de)



**Dr. Sébastien Chartier**  
(Head of Business Unit High Frequency Electronics)

Phone +49 761 5159-446  
[sebastien.chartier@iaf.fraunhofer.de](mailto:sebastien.chartier@iaf.fraunhofer.de)

Part of  
 **Forschungsfabrik  
Mikroelektronik**  
Deutschland



[www.micro-radar.de](http://www.micro-radar.de)