

Contributions to the APECS Pilot Line: Fraunhofer FHR

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Fraunhofer FHR is one of 14 German research institutes involved in the implementation of the APECS pilot line. As one of the 12 Fraunhofer institutes, Fraunhofer FHR develops cutting-edge radar and high-frequency solutions that enable precise sensing, high-resolution imaging, and robust detection under demanding conditions, including high temperatures, strong vibrations, and zero-visibility environments. Its application-oriented research supports innovation in industrial monitoring, security and defense, autonomous mobility, space situational awareness, as well as environmental observation.

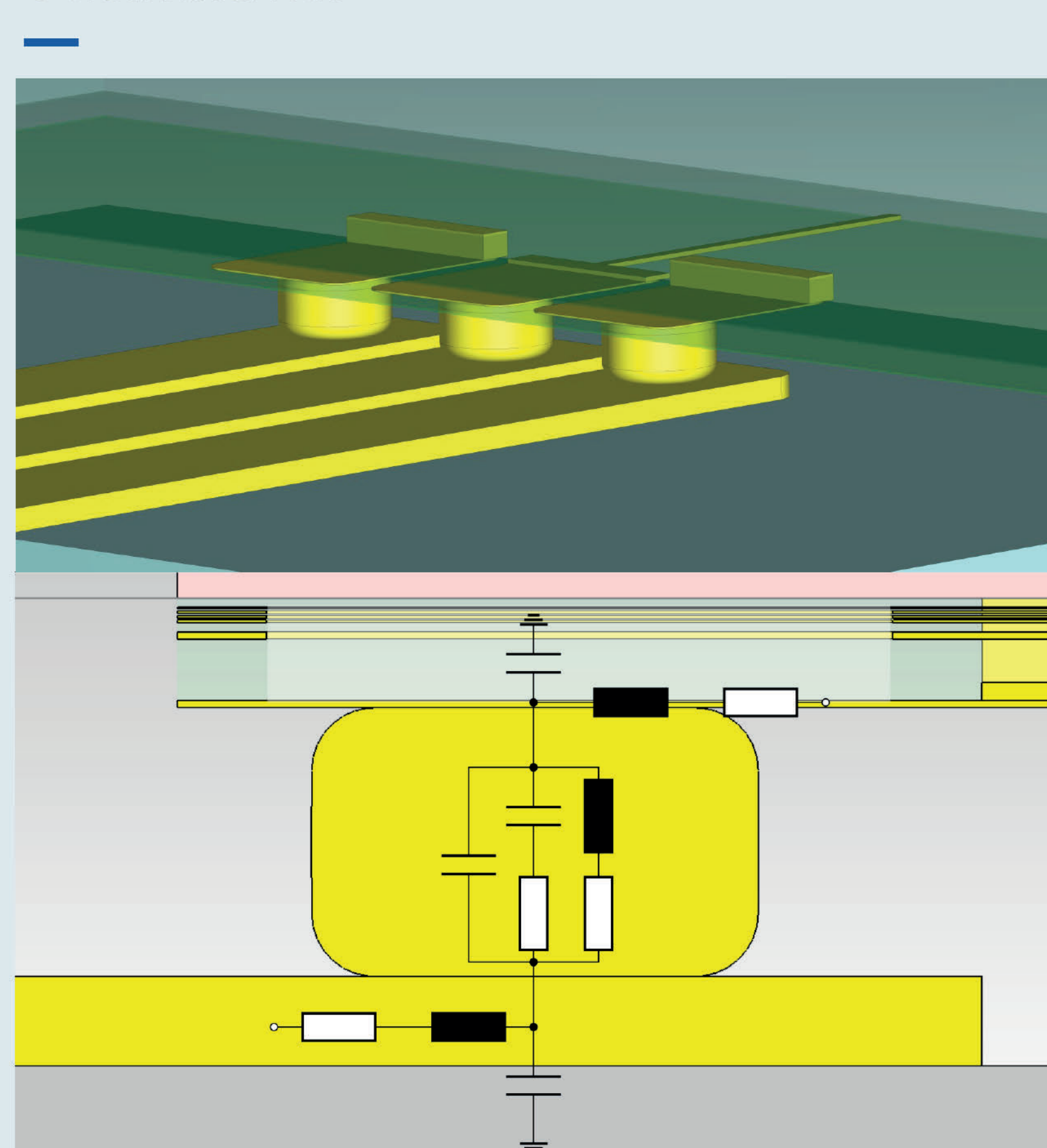
The role of Fraunhofer FHR in the APECS pilot line

Researchers at Fraunhofer FHR combine system design, high-frequency electronics, electromagnetic modelling, advanced algorithms, and AI-driven signal processing to push the boundaries of modern radar and sensor technologies. Their expertise helps industry and public-sector partners improve system performance, strengthen situational awareness, and deploy reliable, scalable high-frequency sensing solutions.

Within the APECS pilot line, Fraunhofer FHR plays a key role in advancing heterogeneous integration by linking millimeter wave and terahertz technologies with system-level design. Its capabilities include:

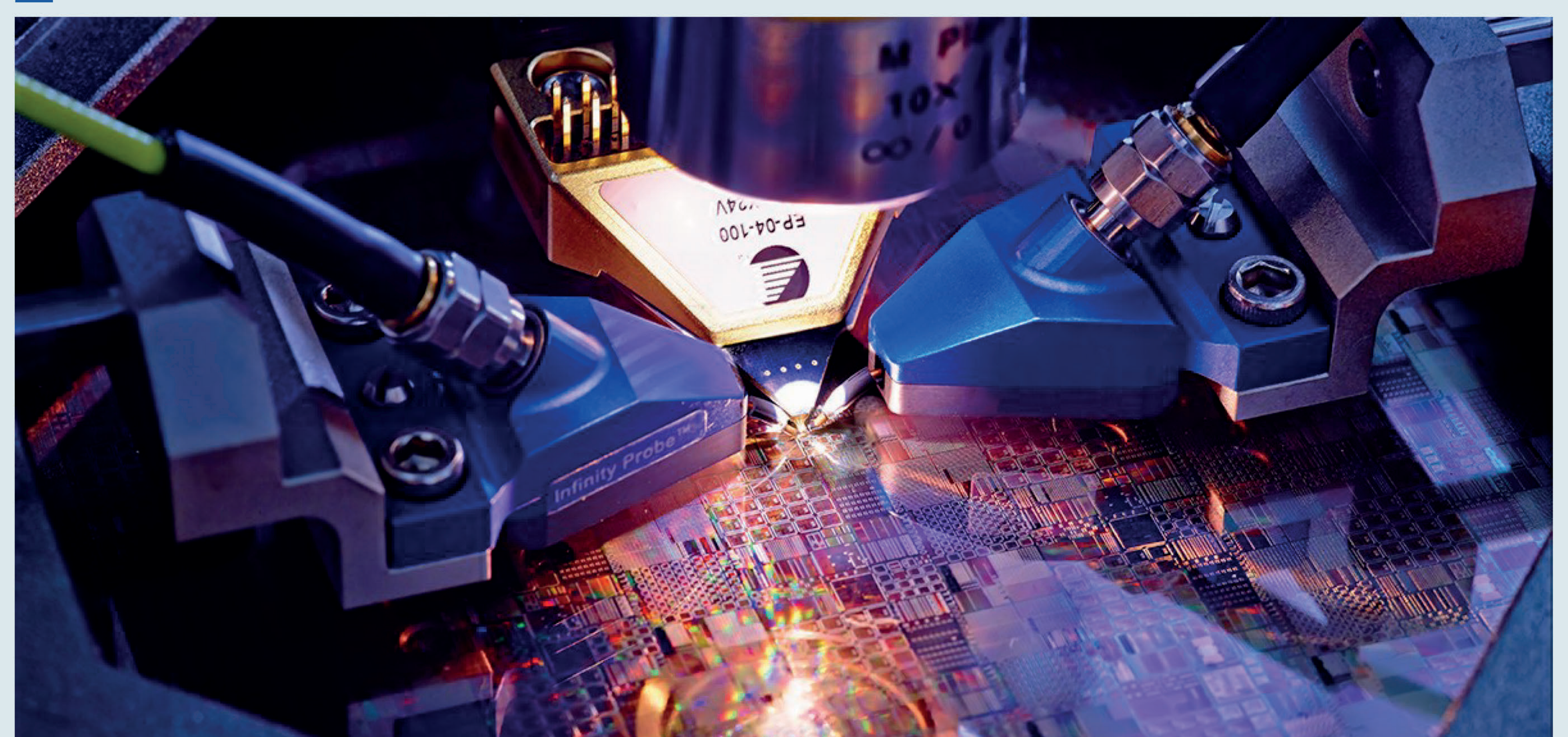
- Chip design in the millimeter wave to terahertz frequency range, intended for 2.5D and 3D heterogeneous integration
- Support for system-on-chip development through scalable simulation models of RF interfaces across components within the APECS pilot line
- Modeling and characterization of on- and off-chip components at frequencies up to 1.1 THz
- Development of millimeter-wave on-chip radar transceivers for heterogeneously integrated systems and smart sensor applications

CAD Model of a Flip-Chip Transition and Corresponding Circuit-Model



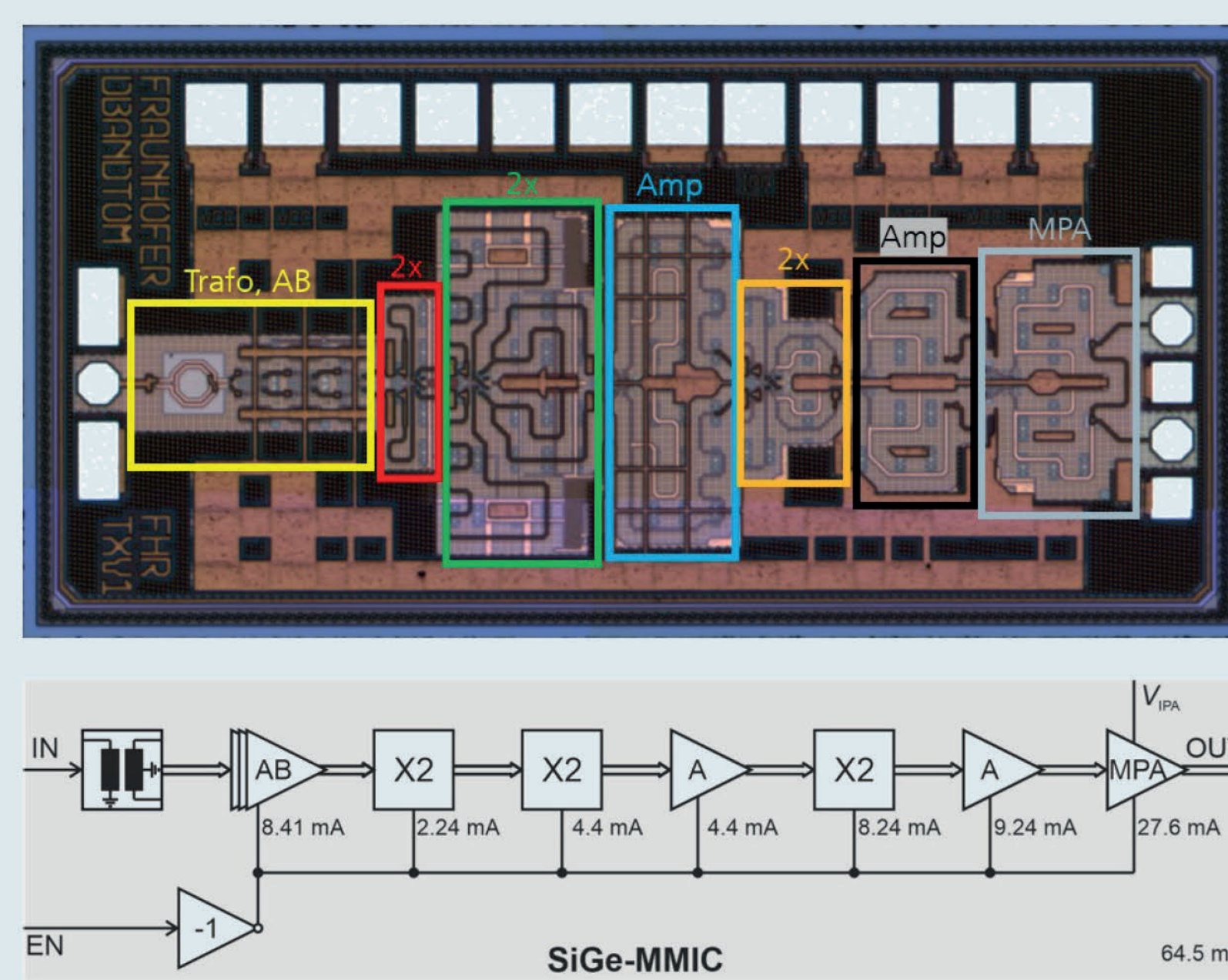
On-wafer probe station for MMIC characterization from millimeter waves to terahertz frequencies

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Micrograph of a Millimeterwave Radar Transmitter MMIC for MIMO Tomography (WP 6.4 – Subdemo 3)

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What is APECS?

APECS (Advanced Packaging and Heterogeneous Integration for Electronic Components and Systems) is one of 5 European pilot lines established under the EU Chips Act. APECS is the foundation for Europe's competitive position in heterogeneous system integration and advanced packaging. It plays a vital role in enhancing Europe's strategic autonomy by reducing dependence on foreign suppliers and strengthening Europe's capabilities in critical technology areas.

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Contributions to the APECS pilot line

Fraunhofer FHR contributes by characterizing high-performance millimeter-wave transitions as well as on- and off-chip components, which enables heterogeneous RF integration. The approach combines full-wave 3D electromagnetic simulation, development of suitable circuit-models, and validation based on RF-measurements. Furthermore, Fraunhofer FHR provides designs for the D-band radar demonstrator in WP6.4 – sub demo 3. The key contributions include:

- 3D electromagnetic modeling, circuit-model fitting, and measurement of millimeter-wave transitions
- Corresponding parametrized cells (PCells) for systematic development of on-chip/on-interposer matching networks
- On-chip calibration structures (single-ended & differential)
- Integration of the D-band radar transmitter MMIC into the multi-channel D-band radar demonstrator

Additional information

The work presented was carried out in the framework of the APECS Pilot Line of the Chips Joint Undertaking, funded by Horizon Europe and Digital Europe Programmes and national funding authorities of Austria, Belgium, Finland, France, Germany, Greece, Portugal, Spain.

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