



High-Frequency and Digital Measurement Technology

Service

- Dielectric material characterization of PCB laminates, thin films, enclosures as bulk samples or metallized structures
- Simulation and characterization of high-speed digital interconnects
- Simulation and characterization of antenna radiation pattern
- Design and simulation of embedded ICs and passives components
- RF frontend design and testing

Expertise

- Bulk material characterization up to 2THz
- On wafer measurements up to 500GHz
- Anechoic chamber up to 320GHz
- S-Parameter measurements of coaxial connectorized modules up to 110GHz or waveguide connectorized modules up to 500GHz
- Generating digital pattern up to 64Gbps (PAM4)
- Measurement of digital pattern up to 112Gbps / 224Gbps (PAM4)

Contact

Fraunhofer Institute for Reliability and Microintegration IZM
Gustav-Meyer-Allee 25
13355 Berlin

Jens Schneider
jens.schneider@izm.fraunhofer.de
Tel.: +49 30 46403-614

Tekfouy Lim
tekfouy.lim@izm.fraunhofer.de
Tel.: +49 30 46403-8110

www.izm.fraunhofer.de



 **Fraunhofer**
IZM

Fraunhofer Institute for Reliability
and Microintegration IZM

Communication Module Development

From Material to
Embedded IC



Embedded IC and Interconnects

Mobile communication electronics for 6G, 3GPP, tend to compact module design with embedded active and passive components. Fraunhofer IZM provides the integration of CMOS Si-based and III-V components in embedding PCB-based technology, using PCB laminates and thin film materials (build-up-films). In current projects we demonstrate embedded RF frontends for future 6G at frequencies of 140GHz and higher.

RF Materials Analysis

At Fraunhofer IZM, we are specialized in analyzing dielectric materials, including PCB laminates, thin films, and enclosures. Our comprehensive services cover:

- Dielectric Constant and Loss Extraction: Accurate measurement of dielectric properties for both metalized and non-metalized substrates
- Extensive Material Coverage: Analysis of various materials, including adhesives, coatings, underfill, mold, wafers, and PCB laminates
- Broad Frequency Range:
 - Non-metalized substrates: 1 MHz to 170 GHz
 - Metalized substrates: 1 GHz to 500 GHz
- Advanced Measurement Techniques: Utilization of quasi-optical free-space setups for precise analysis

Our measurements and extractions are performed across a frequency range of 1 MHz to 500 GHz, within a temperature range of -20°C to 250°C, and include assessments of humidity and aging effects.

Antennas and Reflectors

The development of next generation 6G IC packages makes use of an integrated Antenna-In-Package approach, using PCB laminates, thin films or mold for planar antennas. Fraunhofer IZM has shown well matched patch antenna arrays for 140GHz with 24GHz (-10dB) bandwidth and 18dBi gain. Actual research projects have shown passive reflectors at 140GHz and investigate the effects of meta-materials.

Expertise

- 3D Maxwell-Solver (Ansys-HFSS): Optimization of matching, loss, crosstalk, and radiation
- Patch Antennas: Simulation and characterization of well-matched designs
- Planar Reflectors: Simulation and characterization with meta-materials

Capabilities

- Design and fabrication of antennas in embedded IC packages
- Measurement of radiation patterns of antennas (passive planar, waveguide, etc.) up to 320 GHz

Expertise

- 3D simulation with Ansys-HFSS for optimizing matching, loss, crosstalk, and radiation
- Design and simulation of embedded IC structures (interposers, chiplets, Antenna-In-Package)
- System behavior simulation with Keysight ADS (bandwidth and ISI)

Capabilities

- On-wafer analog measurements up to 500 GHz
- Characterizations of embedded antennas, power amplifiers, LNAs, and beamformers in RF frontends

