Why Fraunhofer IAF?

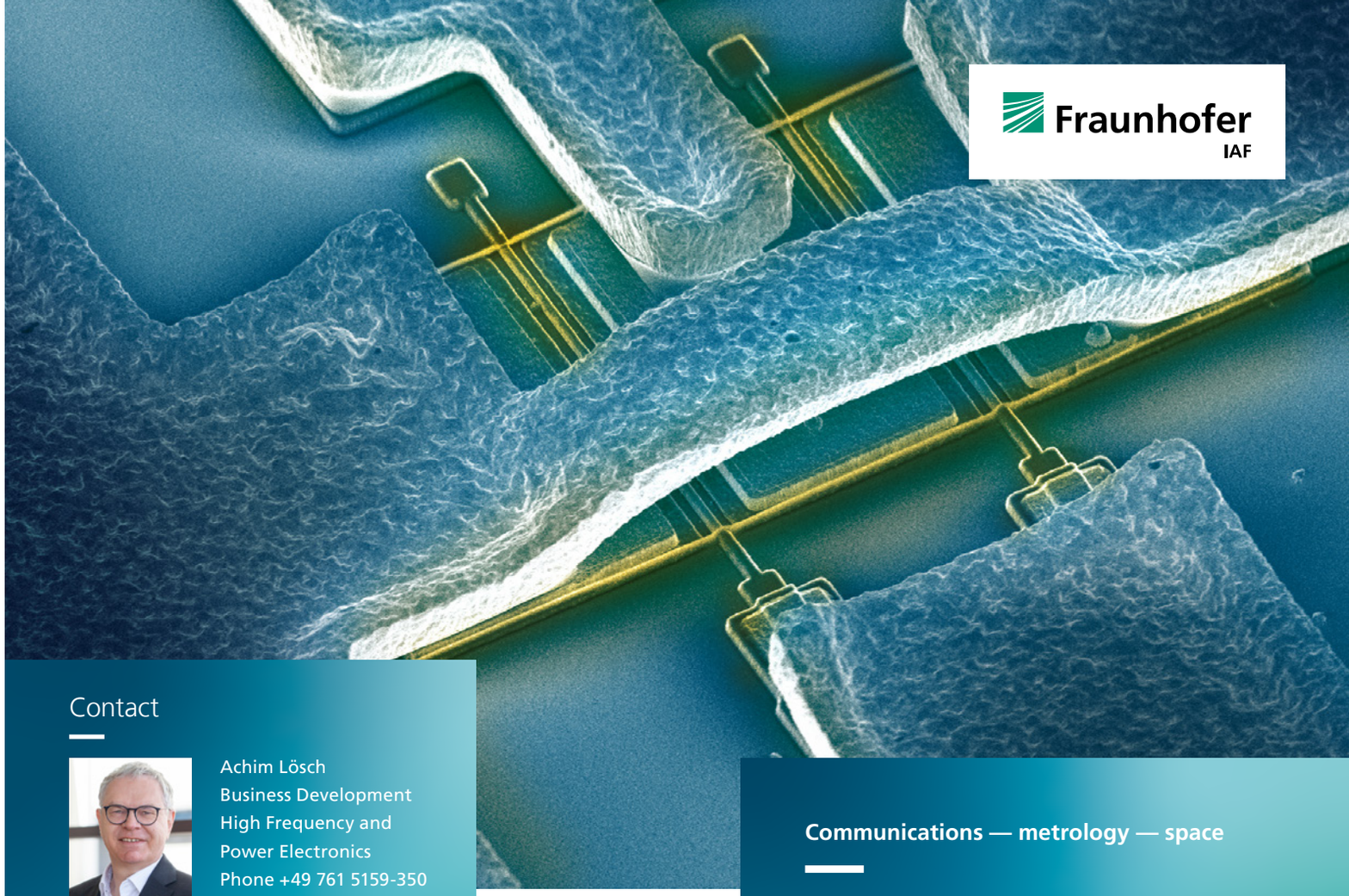
Together with national and international partners from academia, research and industry, Fraunhofer IAF plays a leading role in the development of customized high-frequency MMICs, modules, and subsystems for various applications. Thanks to the expertise of its researchers, its large network, and its unique research infrastructure, the institute covers the entire value chain from epitaxy, technology, modeling, MMIC and module design, characterization, assembly up to the implementation in subsystems.

In addition, Fraunhofer IAF has decades of experience in running complex international research projects and collaborations with customers from industry. This enables an equally efficient and flexible cooperation in the application-oriented research and development of innovative electronics technologies as well as in the customized implementation of orders.

What we offer:

- Epitaxy of III-V compound semiconductors according to customer specifications
- Process development and processing of wafers to transistors and integrated circuits
- Simulation-based design and realization of semiconductor devices
- High-frequency measurements, characterization of circuits, material analysis
- Application-specific development of modules and demonstrators

We will be happy to present our research activities and services in the field of high-frequency electronics to you in person.



Fraunhofer IAF

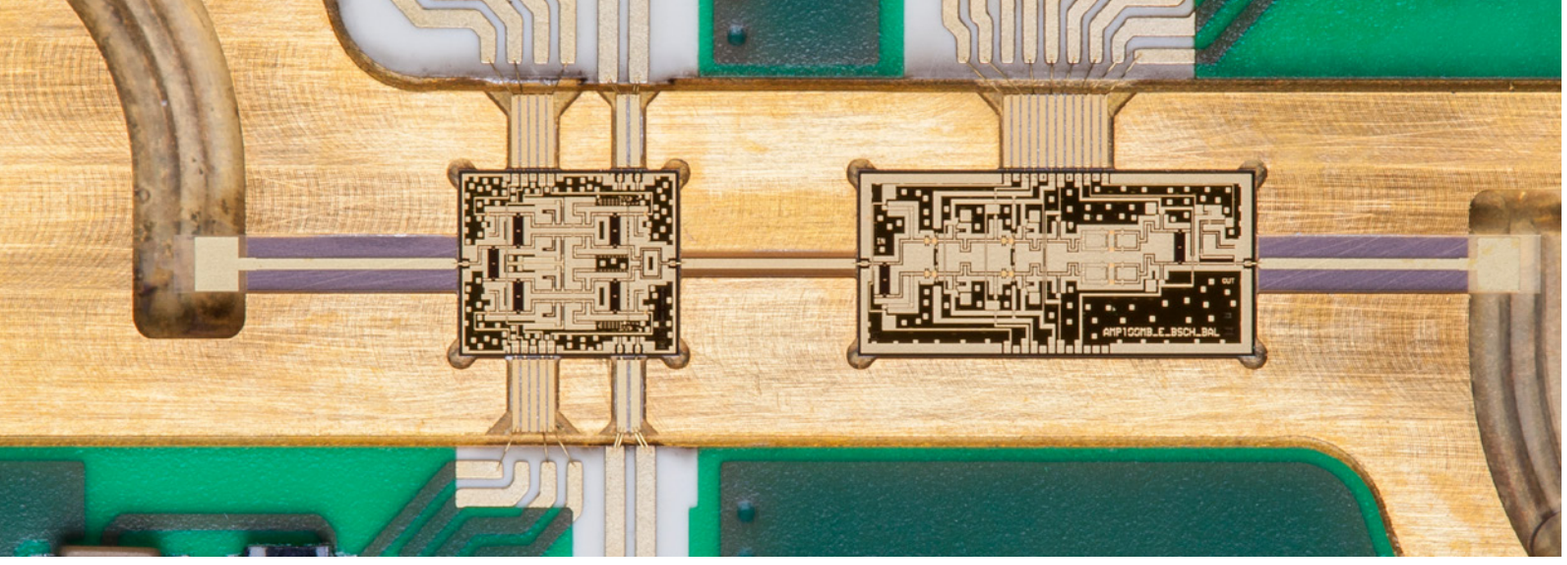
Contact

Achim Lösch
Business Development
High Frequency and
Power Electronics
Phone +49 761 5159-350
electronics@
iaf.fraunhofer.de

Fraunhofer Institute for Applied
Solid State Physics IAF
Tullastrasse 72
79108 Freiburg, Germany
www.iaf.fraunhofer.de/en

Communications — metrology — space

Powerful high-frequency components



High-frequency components up to 1 THz

Fraunhofer IAF provides novel high-frequency components and supports industry in the development of innovative products for satellite communications, metrology, or detection and ranging.

High power — broad bandwidth — low noise

Fast point-to-point data transmission from radio mast to radio mast or from ground station to orbit, radar systems for material thickness measurement or drone detection, energy efficient 6G networks, or cryogenic devices for use in quantum computers — each application demands electronic components that combine high power, broad bandwidth and low noise.

Due to its scientists' extensive know-how, its state-of-the-art equipment, and a 1000 m² clean room, Fraunhofer IAF offers world-class research and development services in high-frequency electronics and the measurement of semiconductor materials and components.

Technologies for MMIC designs

Technology	Sub-strate	Gate length	Achievements
InGaAs metamorphic HEMT	GaAs/Si	20 nm	f_{max} >1 THz, silicon substrate, superior gain and bandwidth (in dev.)
		35 nm	f_{max} ~1 THz, low-noise up to 664 GHz, P_{out} ~ 14 dBm @ 300 GHz
		50 nm	f_{max} > 500 GHz, low-noise, optimized for cryogenic operation
AlGaN/GaN HEMT	SiC	70 nm	> 110 GHz, MMIC (in dev.)
		100 nm	> 70 GHz, MMIC, > 2 W, N_F 2 dB @ 80 GHz
		150 nm	10–70 GHz, MMIC, > 5 W, N_F 2 dB @ 15 GHz
		500 nm	1–10 GHz power transistor, 100 V_{DS}, PAE > 50 %

Design examples

High-power solid state amplifier in the Ka-band (GaN)
- Power > 100 W, efficiency > 20 %, bandwidth: 10 GHz
- Applications: radar, transmission amplifier, satellite communication

7 GHz power transistor (GaN)
- 100 V, 140 W qcw, package customized to 50 Ω
- Applications: radar, deep-space communication

D-band module (GaN)
- 130–160 GHz, P_{sat} 18 dBm
- WR 06 split block
- Application: 6G communications

664 GHz low-noise amplifier (InGaAs mHEMT)
- 20 nm InGaAs mHEMT on insulator
- > 20 dB gain
- N_F ~ 11 dB (sim.)
- Application: radiometer

Wideband amplifier (InGaAs mHEMT)
- 35 nm InGaAs mHEMT
- > 300 GHz bandwidth
- > 10 dB gain
- Application: high-resolution sensing

67–116 GHz cryogenic LNA (InGaAs mHEMT)
- 50 nm InGaAs mHEMT
- $Gain_{avg}$ ~ 25.2 dB (@ 15 K)
- Te_{avg} ~ 21.4 K (@ 15 K)
- Application: radiometer

In-house THz test and measurement capabilities

- S-parameter up to 1.1 THz
- Noise parameter up to 50 GHz
- Noise figure up to 750 GHz
- Power up to 300 GHz, intermodulation up to 50 GHz
- DC and HF measurements at cryogenic temperatures