Why Fraunhofer IAF?

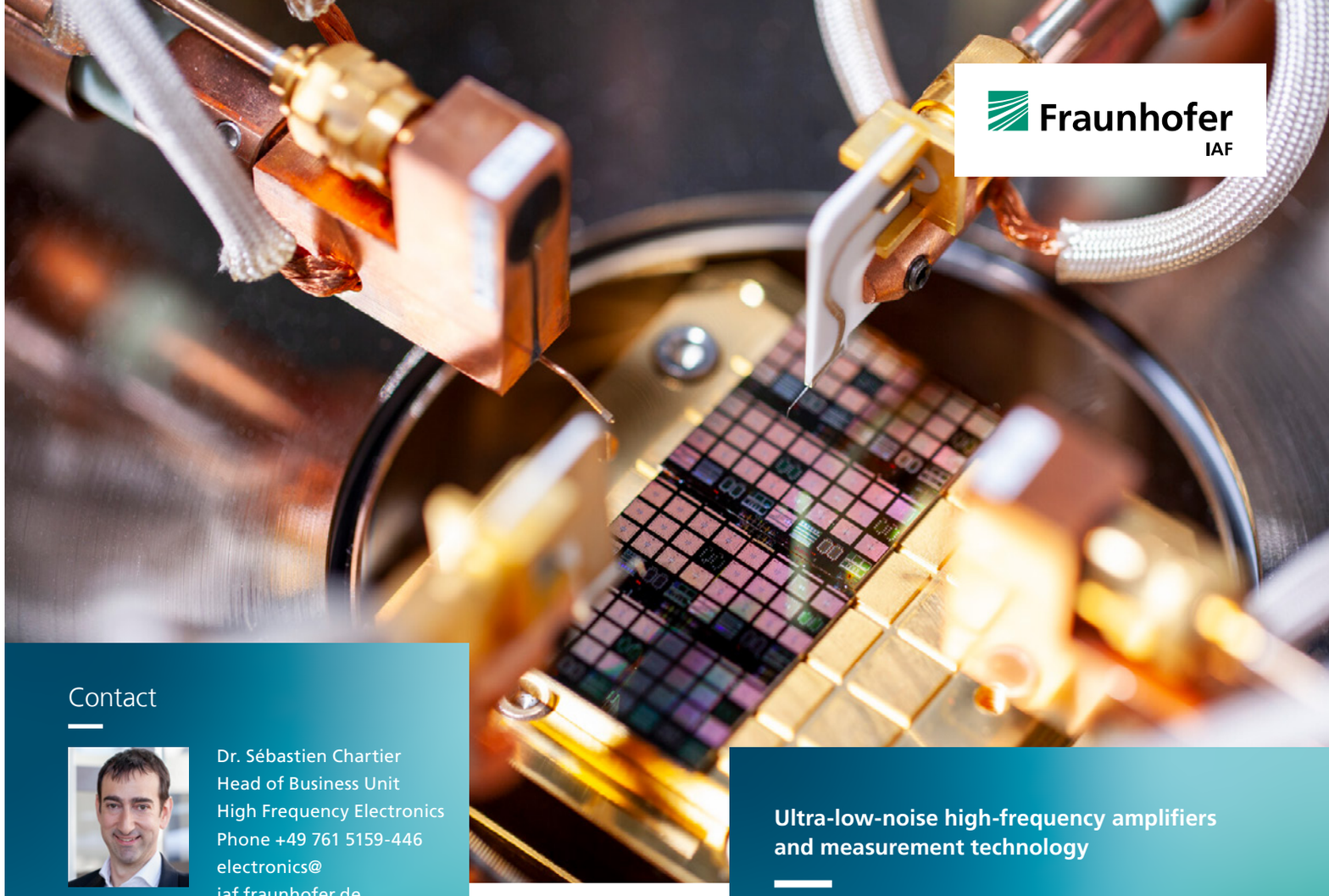
Together with national and international partners from academia, research and industry, Fraunhofer IAF plays a leading role in the development of customized high-frequency MMICs, modules, and subsystems for various applications. Thanks to the expertise of its researchers, its large network, and its unique 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:

- Ultra low-noise amplifiers (LNA) based on monolithic microwave integrated circuits (MMICs)
- 50 nm metamorphic high-electron-mobility transistor (mHEMT) technology
- Module design
- Test station for devices and circuits down to temperatures of 2 K
- Fully automatic on-wafer prober for characterization of 8'' and 12'' wafers at temperatures below 2 K
- Single measurements below 50 mK

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



Fraunhofer IAF

Contact

Dr. Sébastien Chartier
Head of Business Unit
High Frequency Electronics
Phone +49 761 5159-446
electronics@
iaf.fraunhofer.de

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

Ultra-low-noise high-frequency amplifiers and measurement technology

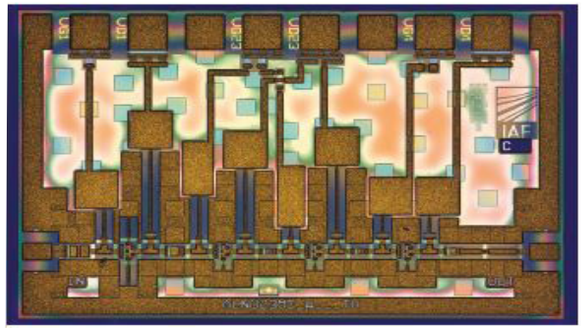
Cryogenic electronics

Electronics and measurement technology for extremely low temperatures

Fraunhofer IAF develops ultra-low noise and compact high-frequency electronics for applications such as satellite communication, climate and Earth observation from space, or quantum computing. In applications like these, electronic components must not only work at extremely low temperatures, but also produce extremely low noise.

Ultra-low-noise amplifiers

Low-noise amplifiers (LNAs) in the frequency range around 5 GHz are central components in quantum computers' readout circuits and operate in current systems at temperatures of about 4 K. Research projects target noise temperatures of less than 2 K at a power consumption of few mW. The mHEMT technology of Fraunhofer IAF is optimized for developing ultra-low-noise amplifiers with noise performance close to physical limits. InGaAs mHEMTs are the lowest noise transistors worldwide, making them ideal for these applications.



LNA at 70–116 GHz with an average noise temperature of 30 K, realized with 35 nm mHEMT technology of Fraunhofer IAF

Ultra-LNA features

- Record noise characteristics
- Low power consumption
- Metamorphic high-electron-mobility transistors (mHEMTs)
- Monolithic microwave integrated circuits (MMICs)
- Material system (InAlAs/InGaAs) on 4" GaAs substrates

Cryogenic measurement technology for ultra-low-noise electronics

In order to determine and further improve the performance of cryogenic electronic components, Fraunhofer IAF has a state-of-the-art cryogenic measurement capability at its disposal. The cryogenic test stations allow DC measurements as well as scattering parameter and noise temperature measurements of cryogenically cooled single devices and integrated circuits inside a cryochamber down to temperatures of 2 K. The data collected allows the performance of electronic and optoelectronic devices to be determined and further improved.

Novel on-wafer prober for quantum computing components

Since 2023, a cryogenic on-wafer prober has been in operation at Fraunhofer IAF. The system measures the quality of qubit devices at below 2 K. It is capable of characterizing 8'' and 12'' wafers in high volumes (up to 25 wafers in a row) fully automatically at cryogenic temperatures below 2 K as well as single measurements below 50 mK. The data on the variance of qubits generated with different semiconductor technologies are essential for the establishment of a European value chain of industrially ready solid-state quantum computers.

Part of a novel cryogenic on-wafer prober at Fraunhofer IAF which determines the quality of electronic qubit devices at below 2 K

Fields of application

- Quantum computing
- Radio astronomy
- Satellite communications
- Climate and Earth observation from space
- High-performance computing systems