

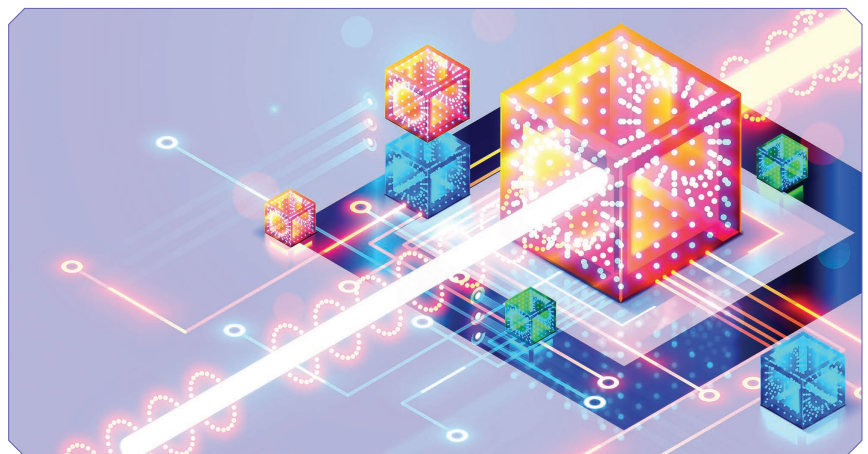


# MTT-S Society News

## TC-11 Microwave Low-Noise Techniques Committee Report

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Technical Committee (TC)-11 promotes activities related to microwave low-noise techniques and covers low-noise technologies spanning dc to terahertz. At the time of this report, which spans from January 2021 through June 2023, the committee was composed of 13 regular members, one affiliate member, and one emeritus member. These members include experts in discrete and integrated low-noise electronics for radio astronomy, terrestrial and satellite communications, and quantum computing, as well as the fundamental theory behind ultralow-noise devices and amplification. A photograph from the committee's last meeting—held at the International Microwave Symposium (IMS) 2023 in San Diego, CA USA—appears in Figure 1 and includes two newly elected members, Leo Belostotski



of the University of Calgary and José Aumentado of the National Institute of Standards and Technology; another new member, Patrick Longhi of the University of Rome “Tor Vergata,” was elected by TC-11 after the IMS. The term of these three new members will begin 1 January 2024. In the remainder of this article, we present committee highlights during this reporting period.

### Awards

Committee members were recognized with prestigious awards during the reporting period. Marian Pospieszalski was awarded the 2022 European Microwave Association Pioneer Award for his contributions to cryogenic low-noise

amplifier research and development over the past 30+ years. Specifically, Dr. Pospieszalski developed a new empirical field-effect transistor noise model capable of describing the noise parameters of field-effect transistors over a wide range of physical temperatures. This modeling approach has been widely adopted and has been essential, for instance, in realizing the cryogenic low-noise amplifiers that have enabled the most sensitive of radio telescopes and quantum computing readout systems. Additionally, Madhu S. Gupta—the 2013 IEEE Microwave Theory and Technology Society (MTT-S) president—received the MTT-S Distinguished Service Award in recognition of his exemplary

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service and long record of contributions to the Society and field.

Additionally, members of the TC have been the recipient of prestigious MTT-S best paper awards. First, Prof. Joe Bardin was the corecipient of the 2022 IEEE Microwave Magazine Best Paper Award for his 2020 paper, “Quantum Computing: An Introduction for Microwave Engineers” [1]. This paper, part of a focus issue on microwaves in quantum computing organized by TC-11, provides an introduction to the field of quantum computing, using superconducting qubit technology as an example. Second, Dr. Mehmet Ogut was a corecipient of the 2023 IEEE Transactions on Terahertz Science and Technology Best Paper Award, given for the paper “A 670 GHz Integrated InP HEMT Direct-Detection Receiver for the Tropospheric Water and Cloud Ice Instrument” [2].

### Distinguished Microwave Lecturers and Speakers Bureau

MTT TC-11 has been very active in the Distinguished Microwave Lecturers (DML) program. The committee nominated class of 2020–2022 DML speaker

Prof. Ruonan Han of the Massachusetts Institute of Technology, whose talk, “Chip-Scale Wave-Matter Interactions at RF-to-Light Frequencies: Circuits, Systems, and Applications” focuses on improved chip-scale sensing and metrology systems enabled by the interaction of integrated subsystems at RF to terahertz frequencies with microscopic particles interfaced locally to the chip. Exciting topics relevant to the low-noise community covered in this talk include an on-chip frequency reference with performance approaching that of atomic clocks as well as quantum magnetometers.

More recently, of the four researchers elected to the 2023–2025 MTT-S DML class, two are TC-11 members. The first of these speakers, Prof. Joe Bardin of Google and the University of Massa-

chusetts Amherst, presents a talk entitled “Quantum Computing: What Is It, How Does It Work, and What Are the Opportunities for Microwave Engineers?” In this talk, the speaker provides a hardware-centric introduction to quantum computing at a level appropriate for microwave engineers, gives a peek into a state-of-the-art quantum computing system, and describes areas of opportunity for microwave engineers interested in the field of quantum computing.

Beyond this, Prof. Vadim Issakov of Braunschweig University of Technology, speaks as a DML on the topic “mm-Wave System and Circuit Design for Highly-Integrated Radar Transceivers.” In this talk, he focuses on system and circuit design considerations for highly integrated radar transceivers in CMOS

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**Figure 1.** In-person attendees of TC-11’s 2023 IMS meeting. Virtual attendees are not shown.

and silicon germanium (SiGe) heterojunction bipolar transistor technologies. He talks about frequency band allocations and presents step-by-step system design considerations for an integrated frequency modulated continuous wave radar transceiver. Finally, several design examples of millimeter-wave integrated radar transceivers are analyzed in detail.

## Research Activity

The committee has been extremely active in terms of research. Over the two year period spanning 2021–2022, the committee published a total of 126 research articles. In aggregate, these articles received more than 1,800 citations. Of the articles, about half were published at MTT-sponsored conferences or in MTT journals. While there is no room in this report to highlight all of the great work carried out by this set of researchers, we note that the research spans a wide range of topics ranging from basic device modeling to system implementation and application (e.g., remote sensing and quantum computing).

Committee member Matthias Rudolph also published two books during this period. The first book, published in 2021, is titled *Microwave Circuit Design Using Linear and Nonlinear Techniques* [3]. The second book, *A Guide to Noise in Microwave Circuits* [4] was also published in 2021.

## Events

A number of events were organized by TC-11 over the reporting period. Focusing just on events at the International Microwave Week, committee members organized a total of seven workshops. Additionally, TC-11 members were instrumental in organizing the well-attended IMS 2022 quantum week event, which consisted of a keynote, quantum bootcamp, multiple workshops, multiple focus and technical sessions, and an evening reception. The bootcamp was held again at IMS 2023 (organized in part by TC-11 committee members).

## Publications Organized

TC-11 has also been active in the organization of focus issues, having organized two in the past approximately three years. First, the August 2020 issue of the *Microwave Magazine*, organized by TC-11, focused on microwaves and quantum computing. This issue featured four articles [1], [5], [6], [7], summarizing different aspects of quantum computing. A fifth article appeared in a later issue [8]. More recently, the TC organized a focus issue titled “Low Noise Techniques,” published in July 2021. This issue contained three articles written by TC-11 members focusing on noise in oscillators [9], advanced noise characterization techniques [10], and nonlinear noise analysis [11].

Additionally, we note that TC-11 members are also active in terms of editorial and organizational responsibilities with MTT-S journals. Prof. Bardin is a steering committee member and associate editor for the *IEEE Transactions on Quantum Engineering* (a relatively new journal cosponsored by MTT-S) and a track editor for the *IEEE Journal of Microwaves*. Vadim Issakov has just recently finished a three-year term as associate editor of the *IEEE Transactions on Microwave Theory and Techniques* and continues serving for a second consecutive three-year term as associate editor of the *IEEE Microwave and Wireless Technology Letters*.

## Plans for the Next Two Years

TC-11 remains committed to fostering low-noise techniques and systems within MTT-S in the coming years. During the upcoming two years, our efforts will focus on attracting young professionals to our technical committee, supporting students in the field through enhanced student activities, and organizing high-quality workshops, tutorials, and technical lectures at upcoming IEEE MTT-S conferences. Two of our TC young professional members, Shirin Montazeri and Mehmet Ogut, are organizing an upcoming workshop on “Low Noise Techniques” at IMS 2024, and hope to engage with young pro-

professionals at that event. Additionally, we are actively recruiting experts from the field of physics to broaden the technical diversity of our committee and expand our research on low-noise circuits, such as quantum-limited parametric amplifiers. Finally, we will continue supporting MTT-S with high-quality DMLs and Speakers Bureau talks.

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