

# The Elektra Award for Design Team of the Year

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## Winner: Nanusens

RF digitally tunable capacitors which are energy-efficient for higher 5G bands were designed by the team at Nanusens.

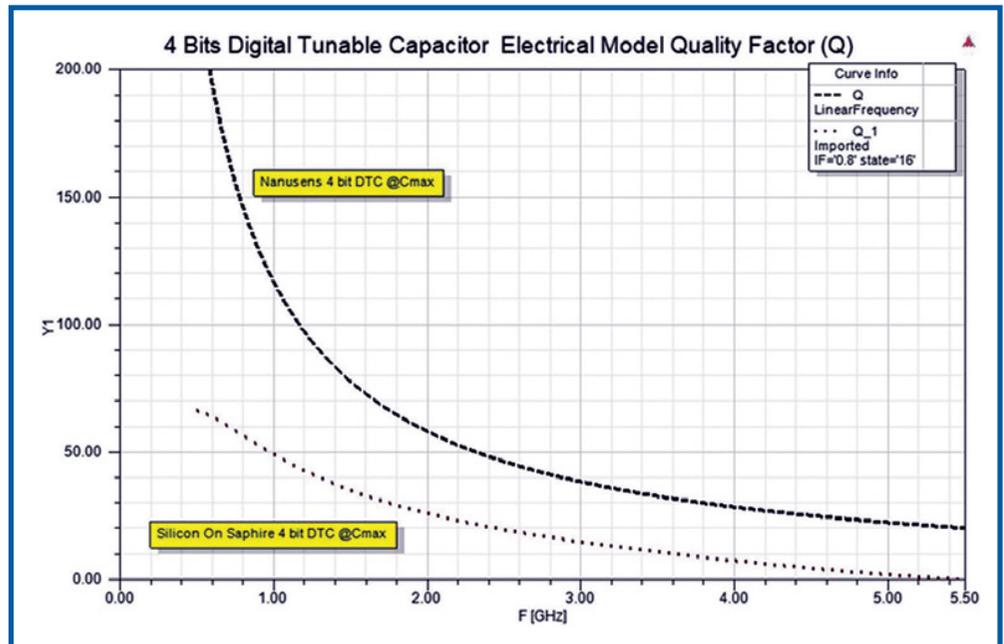
The increasing number of 5G-enabled mobile phones means that the higher 5G bands will start to be needed to accommodate the extra traffic. This will require additional antennas to be integrated into the phone, but as they will need to be smaller to fit more of them inside the phone, their efficiency decreases.

To get the best possible performance from every antenna, each has to be tuned to prevent a mismatch between the RF front-end and the antenna. This is done with an antenna tuner, but solid-state switches have a low Q factor and therefore higher losses during operation, due to on state resistance. This becomes worse as the frequency goes up to the higher 5G bands.

The alternative is to use RF MEMS tunable capacitors, but they suffer from poor reliability and can experience dielectric charging which is the main cause of failure in RF MEMS devices. This also limits the peak-to-peak voltages that they can withstand before dielectric breakdown.

The Nanusens design team created a solution that uses an array of RF MEMS digital tunable capacitors and opens up the implementation of antenna tuning for the higher 5G bands due to their improved Q factors for these bands. The RF digitally tunable capacitors (DTCs) are built using the company's technology of building MEMS structures within CMOS using only standard techniques in a CMOS fab, which also results in lower manufacturing costs.

The result is no on state resistance, a very high Q factor of above 100 at 1GHz and, importantly, the Q factor continues to be high up through to the higher 5G bands.



No dielectric is used in the design so the capacitors are reliable; the DTCs have passed over one billion test cycles in the lab.

## The shortlist

**AMS** – Advanced Optical Sensors division focuses on tech for covid-19 pandemic

**Kabel.Consult.ing** – Networked electronic continuously variable transmission (Patent EP15713831.4)

**Nanusens** – Design of RF digitally tunable capacitors; power efficient use of higher 5G bands

**PRFI** – Advances in the design of mmWave ICs and packaging techniques for 5G, including a 28GHz Doherty power amplifier.