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Executive Interview: Seyed Tabatabaei, Founder, President and CEO of mmTron

Q. You founded mmTron in 2020. What market or technical problem did you see that prompted you to start the company — and during a pandemic?

A. The insatiable appetite for bandwidth has been a driver for the growth in mmWave-band communications technology. However, power is at a premium at mmWave frequencies, and there is a strong need for simultaneously achieving higher output power, linearity and efficiencies in semiconductor solutions. mmTron was founded to do exactly that: provide MMIC solutions that enable users to extend the reach of their mmWave signals and transmit data at much higher rates without distortion.

Q. Before mmTron, you were CEO of Teramics, a MMIC design company focused on mmWave products. What led you to shift the focus from design services to products and do so by starting a new company?

A. We did amazing work at Teramics LLC, designing more than 46 products for top-tier customers. Our original goal was to bootstrap and evolve into a MMIC product company so that our differentiating technology would have an even broader reach in the marketplace. When we were approached by a few angel investors in 2020, we decided to form mmTron Inc. to ramp up our product development efforts. With these investment funds, we have been able to design and fabricate a set of cutting-edge products in just three years.

Q. During the past five years, we've seen significant investment in mmWave technology and products, including fabless semiconductor start-ups developing GaAs, GaN, SiGe and RF CMOS RFICs. What process technologies does mmTron use and how are your products differentiated?

A. We mostly use GaN, GaAs, InP and SiGe. Our years of experience designing in a variety of foundries and process technologies have enabled us to pick the right technology node for each of our MMICs to maximize performance and the value to our customers. Our power amplifier (PA) and front-end module products offer the highest linear power at mmWave frequencies in the world. Our broadband amplifiers offer the highest gain-bandwidth product.

Q. Please give a few examples of your products and the performance achieved.

A. The TMC211 provides 20 W of linear power at high temperature, achieving 19 dB noise power ratio (NPR) in Ka-Band.

The TMC212 has less than 3 percent EVM at 27 dBm output power and was designed for the 5G n260 FR2 band.

The TMC160 is a differential-to-single-ended interface chip for digital-to-analog converters. It has an integrated anti-alias filter and baluns for high common-mode rejection with >10 GHz clock bandwidth and 31 dBm OIP3 and 4 dB noise figure.

The TMC200 is a DC to 26.5 GaAs broadband amplifier MMIC with 2 W saturated output power, which is the highest power available for a low phase noise GaAs MMIC with excellent linearity and power.

Q. Without revealing trade secrets, how do you achieve differentiated performance using commercial foundries?

A. Our differentiation stems from multiple factors: from epi and process customization to our proprietary linearity-based device models and unique circuit architectures, not to mention our many years of experience designing mmWave chips. There are very few engineers in the world who specialize in mmWave and MMIC designs and we happen to have some of the very best of them working at mmTron.

Q. What's the scope of your product portfolio, i.e., types of circuit functions, frequency coverage, target markets?

A. Our objective has been to be the vendor of choice for high linearity products at mmWave frequencies. We initially launched a family of PAs, since they have the most impact on overall linearity. We then moved our focus to linear front-end modules combining the

PA, low noise amplifier and switch functions. We also added two ultra-low phase noise VCO MMICs to our portfolio, followed by a family of broadband amplifiers. We will expand our product portfolio with drivers, 15 to 65 GHz broadband mixers and high-speed DAC and ADC interface chips.

Our target markets are mmWave SATCOM, 5G, instrumentation and aerospace/defense. Our frequency coverage is primarily 15 to 60 GHz; however, we have introduced the TMC774 MMIC that covers DC to 160 GHz for instrumentation and 6G and have multiple broadband amplifiers covering DC to 85 GHz for optical instrumentation.

Q. While the MMIC design sets the performance of the product, many applications require the device to be packaged. What's your approach to packaging and minimizing performance degradation, especially at mmWave frequencies?

A. We use air-cavity packages for mmWave. Our solution extends to 67 GHz. Depending on the requirements, these packages are fabricated in laminate or ceramic. For narrowband applications beyond 67 GHz, our packages have waveguide transitions.

The MMICs are co-designed with the packages to minimize performance degradation. We also support our customers with suggested PCB layout footprints and have customized our solutions to better fit the customer's application.

Q. You started mmTron to focus on mmWave opportunities. Three years in, what's your outlook for these applications, and how have they evolved?

A. We see continued growth in the four market segments we are engaged in. The market traction has been fantastic. We have been able to define the specifications of our chips and their release in alignment with our customers' and overall market evolution. We don't see the demand for increasing data communications bandwidth declining. With new applications like AI and VR continuing to grow, the demands on the wired and wireless networks will continue to increase commensurately.

Q. We understand mmTron will exhibit at the upcoming International Microwave Symposium in San Diego, the first time the company will be at IMS. What are your goals and who should stop by your booth?

A. We are very excited to exhibit at IMS 2023. We will have our products, datasheets, evaluation boards and our team available to engage visitors. Our goal is to show our product portfolio to an audience looking for differentiated high linearity products with high power and efficiency at mmWave frequencies.

While our focus so far has been on U.S. customers, IMS 2023 will enable companies outside the U.S. to learn about our product offerings.

Q. mmTron is not your first company, and you're not new to mmWave technology. Tell us about your background in the RF/microwave industry and what motivated you to combine your technical expertise with an entrepreneurial spirit.

A. I have been working in the mmWave industry since 1986. I was fortunate to work with cutting-edge technologies while doing my Ph.D. and post-doctoral research at the University of Maryland and the Laboratory for Physical Sciences in College Park.

My first job was in the mmWave R&D division of M/A-COM before joining Hewlett Packard (now Keysight Technologies) in 1998. I had the opportunity to work on the manufacturing and operation side of the business and lead a cross-functional team. I then joined Endwave Corporation in 2006 with the goal of building a semiconductor MMIC division. In 2011, Endwave was acquired by Renesas, and I left to start my own design services company, Teramics LLC. In 2020, I started mmTron as a product company.

I have always had the motivation to do a startup. Our technical expertise provides the foundation for developing differentiated products and establishing credibility with potential customers. With technical startups, customers want more than the performance shown on the datasheet. They look to the commitment and capability of the founder and the team. mmTron reflects our expertise in mmWave semiconductor technology and commitment to enable the next generation of mmWave systems.