High Efficiency Power Amplifier Student Design Competition (HEPA-SDC)

Sponsoring MTT-S Technical Committee

MTT-12 (Microwave High-Power Techniques)

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Competition Summary

The seventeen High Efficiency Power Amplifier (HEPA) Student Design Competition (SDC) will take place at the 2021 IEEE MTT-S International Microwave Symposium (IMS) in Atlanta, GA, on Tuesday, June 8, 2021. This competition is open to all students, both undergraduate and graduate, registered at a recognized educational establishment.

This year's contest will focus on PAs having both high efficiency and linearity over a relatively broad frequency band. The competitors are required to design, construct, and measure a highly efficient, linear PA at a frequency of their choice between 1 GHz and 10 GHz. To qualify for the linearity test, the PA must produce an output power of at least 4 watts, but no more than 40 watts, when excited by a single carrier at the frequency of test. All linearity testing will be conducted using two equal amplitude carriers spaced 20 MHz apart. To qualify for the linearity measurement, with 0 dBm per tone input, carrier-to-intermodulation ratio (C/I) must be greater than 30 dB*.

The winner will be the PA that demonstrates the highest power added efficiency (PAE) when producing a two-tone carrier-to-intermodulation ratio (C/I) of 30 dB*.

A representative of the design group must be present at the testing to assist with the evaluation. Each team is limited to a maximum of two entries.

* C/I is based on the ratio expressed in dB between the amplitude of either carrier and the highest intermodulation product. PAE will be measured at the first output power with increasing Pin from 0 dBm where this ratio falls below 30 dB.

Detailed Competition Specification and Rules

1. The power amplifier (PA) design may use any type of technology, but must be the result of new effort, both in the amplifier design and fabrication.
2. The PA mechanical design should allow for internal inspection of all relevant components and circuit elements. The RF ports should be SMA female connectors. Bias connections should be banana plugs.
3. The PA should require a maximum of two dc supply voltages for operation.
4. The PA must operate at a frequency in the range of 1 GHz to 10 GHz and have an output power level when excited by a single carrier of at least 4 watts, but no more than 40 watts at the frequency of test.
5. All PAs should require less than 24 dBm of input power to reach the minimum 4 watt output power when excited with a single carrier.
6. Measurements will be made by the judges only. A team representative must be present at testing to provide information on connections, design frequency, and expected output power level.
7. All linearity measurements will be performed under CW two-tone operation with two equal amplitude carriers spaced 20 MHz apart at room ambient conditions into a 50 ohm load. Only the power at the two fundamental carrier frequencies will be included in the measurement of output.
8. Linearity measurements will be conducted with a maximum of 21 dBm input power per tone. The tone power will be swept from 0 dBm to 21 dBm and the C/I ratio measured.
9. The winner will be based on the amplifier's PAE measured during official testing at the lowest power level for which the C/I ratio* equals 30 dB. If the C/I ratio is better than 30 dB over the entire testing range, the measurement at 21 dBm input power per tone will be used. The figure of merit for scoring will be the PAE multiplied by a frequency weighting factor having the form (GHz)^0.25.
10. A student group may enter a maximum of 2 PAs, but can receive an award for only one PA.
11. Team size will be up to 4 students.
12. The team will be allowed a maximum of 10 minutes to set up their PA and familiarize with the test equipment before testing.
13. The official measurements will be performed by the committee with the chosen device biasing point from the students.
14. The decision of the judges will be final. Awards from IMS and industry will be presented at the Student Awards Luncheon.
15. Student contestants must notify the MTT-S committee by e-mailing to Dr. Kiki Ikossi <ikossi@ieee.org> of their intention to compete in the contest before Thursday, April 1, 2021. This notification must include information on the University or educational affiliation of the entry, the name and contact information of the group's adviser, and the PA's approximate output power level, dc voltage requirements and frequency of operation.

Prizes

- The team with the winning PA design, as measured at IMS and determined by the judges, will receive a prize of $2,000, and will be invited to submit a paper describing the design for the MTT-S Microwave Magazine.
- Modelithics will award their high precision PA model software awards to the top three (3) PA teams.
- Cadence will award 1-year complimentary licenses of its AWR Design Environment software to the top three (3) PA teams.
- Modelithics and Cadence offer design software assistance to all competitors.
- The measurements are performed at IMS by Keysight engineers using Keysight equipment with the oversight of MTT Judges. Keysight offers measurement guidance to all student participants.