**High-Efficiency Power Amplifier for 13.56 MHz**

**Sponsoring MTT-S Technical Committees & Organizations**

MTT-9 & MTT-19

**Coordinators and Contacts**

Frederick H. Raab, [f.raab@ieee.org](mailto:f.raab@ieee.org)

**Competition Summary**

The student(s) will design a power amplifier and driver to produce 10 W CW at 13.56 MHz from a 12-V supply. The winning design will have the highest overall efficiency, subject to meeting the specifications below. The resultant design should be useable on the 20-meter amateur band as well as the 13.54-MHz ISM band, and will produce about 50 W when operated from a higher supply voltage. (Not part of contest). The low operating frequency necessitates the use of discrete components, making this design quite different from the usual 1+ GHz of the MTT-5 PA-design contest. Waveforms can be observed with an oscilloscope, and measurements can be made with relatively simple equipment. Inclusion of the driver presents teams with a number of interesting design trade-offs.

**Detailed Competition Description and Rules**

1. Output power: 10-11 W CW into a 50-ohm load. Only the fundamental-frequency component of

the output will be counted toward the measured power.

1. Frequency: 13.56 MHz
2. Power Supply: 12 V (measured at the supply connectors). Final amp, driver, bias, etc. must all work from the single 12-V supply.
3. Final amplifier, Driver and Intermediate Stages: At discretion of student but must use discrete components as noted below.
4. Input from External Signal Source: +10 dBm (10 mW). CW, constant-amplitude sine wave, no modulation.
5. Input SWR: < 2:1 relative to 50 ohms.
6. Harmonics: < 40 dBc (up to 100 MHz)
7. Non-harmonic spurs: < -70 dBc (10 kHz to 100 MHz).
8. Oscillations: No oscillation if signal input is removed.
9. Subassemblies: No commercial subassemblies are allowed. For example, if a dc to dc converter is used, it must be designed and built with discrete parts and/or ICs, and included in the circuit schematic.
10. Batteries: Not permitted.
11. Connectors: SMA input and output for RF. Female banana jacks for the 12-V supply.

**Evaluation Criteria**

1. Must meet all specs above.
2. Will have the highest overall efficiency defined as (RF output power) / (Total dc-input power)
3. Provides the information specified by the due dates.
4. Presents working amplifier for judging at IMS.
5. The judges reserve the right to make multiple awards, or no awards in case of poor performance.

We will provide a signal generator, power supply, and measurement equipment. During the judging, you will set-up and check your hardware. You may re-adjust before we take the official measurements. You may bring spare parts and tools to use in case there is a problem.

**How to Participate**

Participants must register to the IMS Student Design Competition according to the rules posted on the IMS-2020 homepage. At the same time as the registration to IMS-2020 is made, the competitors must also register with the organizers of the competition. This is done by sending an e-mail containing the name of the team members and their contact details (e-mail preferred) to Frederick H. Raab, [f.raab@ieee.org](mailto:f.raab@ieee.org), with the subject line “IMS-2020 SDC3: Power Amplifier” no later than the official deadline announced on the IMS-2020 SDC homepage and following the below format.

**Needed by April 1, 2020**

Potentially interested participants must submit registration information on the participants as

soon as possible. This information includes the designated contact person and the following for

each participant:

Name

Address

Phone

E-mail

Institution

Degree program and advisor

**Needed by May 1, 2020**

By May 1, the team must provide:

Updates if any on the team members

Description of the amplifier

Photo of the amplifier

Circuit

Parts list

Measured performance data

Submit your information as a single PDF to f.raab@ieee.org.

At least one member from each team must be present at the competition held during the IMS-2020. After the registration period ends, a time-table for the competition day will be made available, with the schedule of the 15 minutes slots of the participating teams. If no team member is present at the competition site within its slot, then the team may be considered as absent. Please also see the general IMS student design competition rules on the IMS-2020 SDC homepage.

**Student Eligibility Criteria**

1. Teams of one to four full-time students.
2. The work must be entirely by the named students without assistance from others.