

MTT-20 STUDENT DESIGN COMPETITION AT IMS'21
Prepared by F. H. Raab
Revision A, 12/11/20

1. GENERAL INFORMATION

Title:

High-Efficiency Power Amplifier for 13.56 MHz.

Abstract

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.

Notes

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 the student with a number of interesting design trade-offs.

Contact

Frederick H. Raab, fraab@gmrr.biz.

2. DETAILED SPECIFICATIONS

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.

Frequency: 13.56 MHz

Power Supply: 12 V (measured at the supply connectors). Final amp, driver, bias, etc. must all work from the single 12-V supply.

Final amplifier, Driver and Intermediate Stages: At discretion of student but must use discrete components as noted below.

Input from External Signal Source: +10 dBm (10 mW). CW, constant-amplitude sine wave, no modulation.

Input SWR: < 2:1 relative to 50 ohms.

Harmonics: < 40 dBc (up to 100 MHz)

Non-harmonic spurs: < -70 dBc (10 kHz to 100 MHz).

Oscillations: No oscillation if signal input is removed.

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.

Batteries: Not permitted.

Connectors: SMA input and output for RF. Female banana jacks for the 12-V supply.

Winning Design:

(a) Must meet all specs above.

(b) Will have the highest overall efficiency defined as

$$(\text{RF output power}) / (\text{Total dc-input power})$$

(c) Provides the information specified by the due dates.

(d) Presents working amplifier for judging at IMS.

The judges reserve the right to make multiple awards, or no awards in case of poor performance.

3. ELIGIBILITY

Teams of one to four full-time students.

The work must be entirely by the named students without assistance from others.

4. INFORMATION NEEDED AND DUE DATES

Needed by April 1, 2021

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, 2021

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
Certification by advisor that work was done by students.

Submit your information as a single PDF to fraab@gmrr.biz.

You may make improvements on your amplifier between this date and the judging.

5. ATTENDANCE AND JUDGING

At least one team member must register for and attend IMS 2021 and be present at the judging.

Judging will be done on Tuesday of IMS 2021 in the exhibit area. Please check the IMS web site for the specific time and place. We will give you a time slot.

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.