Student Design Competition

IEEE IMS 2024 Washington, DC

High-Efficiency Power Amplifier for 50 MHz using GaN FET

TC20 – HF/VHF/UHF Technology

Introduction:

The student(s) will design a power amplifier and driver to produce 10 W CW at 50 MHz from a 12-V supply. The winning design will have the highest overall efficiency, subject to meeting the specifications below.

General Notes:

The resultant design should be useable on the 6-meter amateur band and should produce about 50 W when operated from a higher supply voltage. (Not part of contest).

The VHF operating frequency necessitates the use of discrete components, making this design quite different from the usual 1+ GHz of the MTT-12 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 several interesting design trade-offs.

Design Specification and Rules:

- 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: 50.0 MHz
- Power Supply: 12 V (measured at the supply connectors). Final amp, driver, bias, etc. must all work from the single 12-V supply.
- RF power transistor for final amplifier: Must be GaN FET, not LDMOS.
- 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 500 MHz)
- Non-harmonic spurs: < -70 dBc (10 kHz to 500 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.

Evaluation Process:

During the judging, you will set-up and check your hardware. You may re-adjust before we take official measurements.

You may bring spare parts and tools to use in case there is a problem.

The following criteria will be used to determine a winner:

(a) Provided the information specified by the due dates.
(b) Presents working amplifier for judging at IMS.
(c) Must meet all specs above.
(d) Will have the highest overall efficiency defined as
    i. (RF output power) / (Total dc-input power)

How to Participate:

Competing teams will be required to register to the IMS Student Design Competition according to the rules posted on the IMS-2024 homepage.

After registration, competing teams also need to submit requested information below by the noted deadline to the designated contact person (information below):

Submitted by April 1st, 2024

The following information needs to be submitted for the participating members of each team:

- Name
- Address
- Phone
- E-mail
- Institution
- Degree program and advisor

Submitted by May 1st, 2024

The following information needs to be submitted from the participating team:

- Updated contact information on team members
- Description of the amplifier
- Photo of the amplifier
- Circuit

- Parts list
- Measured performance data
- Certification by advisor that the work was done by the students

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

In addition, participants must meet the following eligibility requirements:

- Teams must be between one to four full-time students
- The work must be done entirely by the named students without assistance from others
- At least one team member must register for and attend IMS and be present at the judging.

Prizes:

Awards will be made per the rules of the Student Design Competition. The judges reserve the right to make no awards in case of poor performance.

Contact Information:

- Frederick H. Raab, Email: fraab@gmrr.biz.