

MTT-20 STUDENT DESIGN COMPETITION AT IMS'25
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Revision -, August 26

1. GENERAL INFORMATION

Title:

High-Efficiency Power Amplifier for 144 MHz.

Abstract

The student(s) will design a power amplifier and driver to produce 10 W CW at 144 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 2-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. Measurements can be made with relatively simple equipment. Inclusion of the driver presents the student with a number of interesting design trade-offs.

2. DETAILED SPECIFICATIONS 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: 144.0 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: Up to the student but must be transistor, not IC.

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 1000 MHz)

Non-harmonic spurs: < -70 dBc (100 kHz to 1000 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 and Scoring

The winning design:

- (a) Provides 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

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

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.

Eligibility

Teams of one to four full-time students.

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

3. SPONSORING TECHNICAL COMMITTEE

MTT-20, HF/VHF/UHF Technology
Contact: Frederick H. Raab, fraab@gmrr.biz.

4. PAST PARTICIPATION

Typically three teams have actually completed the design and shown up at IMS.

Professors whose students may be interested:

"Taylor Barton" <taylor.w.barton@colorado.edu>
"Dr. Peter Asbeck" <asbeck@ece.ucsd.edu>
"Apolinar Reynoso-Hernandez" <apolinar@cicese.mx>
Prof. Rainer Kronberger Rainer.Kronberger @th-koeln.de
Prof. Juan Riva-Davila jmrivas@stanford.edu
Youngoo Yang youngooyang@gmail.com
David Peroulis dperouli@purdue.edu
"Robert Caverly" <caverly@ece.villanova.edu> Member MTT-20

5. EQUIPMENT NEEDED

Equipment must have stand-alone operation, not computer-controlled. We prefer simple equipment that is simple to operate and requires no set-up.

One Power Supply
Adjustable 12+ V 2+ A
Keysight has provided in past.
E36103B, 6621A, or 6622A power supply

Two (2) Digital Multimeters
One measures dc voltage 0 - 15 V.
Other measures dc current 0 - 2 A.
Keysight has provided in past.
Keysight 34470A DMM
If the power supply has a precision current meter, then only one multimeter is needed.

Spectrum Analyzer
Keysight Fieldfox N9917A

Signal Generator
144 MHz +10 dBm CW

RF Power Meter
Boonton 4542 with 51011A-EMC average power sensor
Stand-alone meter – Must NOT require use of computer to read.
Boonton provided in the past.

Cables, attenuators, etc. will be provided by GMRR.

6. OTHER INFORMATION NEEDED AND DUE DATES

Needed by April 1, 2025

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, 2024

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.

Attendance and Judging

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

Judging will be done on Tuesday of IMS 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. Only students on the team may participate.

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