

AC Voltmeter Design

ECE 3200 Electronics II

12 February 2021

References

1. A. S. Sedra and K. C. Smith, *Microelectronic Circuits*, 9th ed., Oxford University Press, 2019.
2. W. H. Middendorf and R. H. Engelmann, *Design of Devices and Systems*, Marcel Dekker, 3rd ed., 1998. That text explores design methods to turn *specifications* (what the device is supposed to do) to *parameters* (information to build the device that meets the specs, e.g. schematics and component values).

Objectives

1. Generate and validate a design based on a set of specifications as a member of an engineering team.
2. Apply your knowledge of circuit analysis and electronics to design an electronic AC voltmeter.

This is an open-ended design problem that will challenge your electrical engineering skills.

Specifications

Design an electronic circuit to meet these specifications:

1. Measure the RMS voltage of a 60Hz 0-10V peak-to-peak AC voltage with $\pm 5\%$ accuracy.
2. Minimum voltmeter input resistance is $1\text{M}\Omega$.
3. The RMS voltage must be displayed on a $100\mu\text{A}$ full-scale meter movement.
When designing your circuit use a $2.4\text{k}\Omega$ resistor to model the meter movement.
4. Maximum available supply voltages are $\pm 15\text{V}$.
Extra credit: only use a 9V battery power source.
5. The only components allowed in your design are: the meter movement, standard resistor and capacitor values, op-amps, diodes, and transistors.
6. Assume that your design will be mass-produced.
Thus you must minimize the number of components.

Your final report must provide a detailed description of how you validated the performance of your design. Arrange your report as follows:

1. Summary
2. Specifications
3. Design
4. Design Validation (via simulation): You must conclusively demonstrate that all specifications have been met.
5. Cost Estimate (use a spreadsheet that list all required components with part numbers).
6. Conclusions
7. References

Since this is an open-ended design, each team is expected to have a unique design!

The most effective design will earn extra credit and a recognition certificate.