EE252 Electronics 2   Remarks About Labs #2 and #3   Fall, 2019

Dear class,

The formal lab reports for section L1 had a raw average of 63 (7 reports). Not much difference between #2 and #3, with similar problems for both. This was your first formal lab report. It is supposed to be a learning experience. But you have to do your part. You had a copy of the Engineering Lab reports manual available to you, and it's apparent that most students did not pay attention to it, or did so sparingly. Very few graphs were properly annotated. Many reports lacked the necessities of a formal report, things like text, callouts, etc. I suppose I should not be surprised that nobody read the Lab reports Manual; apparently nobody read the Syllabus either. But, that's no my fault. I don't feel that I have to compensate you for your inability to refer to information provided about how to write a formal report. But, I don't want to kill anybody in the learning experience either. So, what I have done is "compensate" these first lab reports by adding +10 to the raw grades. So, the class average is 72, not 62. Those in the low 60's or below have "Rejected" lab reports. (Wonder what that means? Where do you suppose there'd be information about that?)

Some specifics that need comment:

1. Figures that you do not draw yourself, but are copied from somewhere, must be acknowledged. Failure to do can be considered Plagiarism. Have you heard that term? That means taking somebody's intellectual property and saying it is your own. Anything in your report that is not attributed to some other source is assumed to be your own. There are proper ways to do attributions. But, even if you don't do it properly, it's still an attribution, so that the error isn't plagiarism, it's just format or an expression error. Now, you might claim that had you drawn the figure yourself, it would look exactly like the one you copied; there is no significant intellectual property that you have stolen. Maybe that would hold up in court. Maybe not. But if someone reading your report even thinks, or worse establishes, that it is copied, a very negative impression is left. Remove all doubt. Do proper attributions of anything copied. Exception: You may use figures out of the syllabus/lab directions – that's my permission to do so.

2. Don't use imperatives directed at the reader. You are not in a position to demand the reader do certain things, like build your circuit and make measurements. This happens most often in "Procedure." The purpose of a procedure section is to report what YOU did. NOT to tell the reader what someone told you to do. If you want to tell the reader that the only reason you did it was that someone told you to (poor you!), put it in an appendix and label it as a copy of the directions, so the reader doesn't have to look at it, and won't get the impression that you misunderstand who is giving instructions to who. Generally, especially in important work, you are the one developing the procedure that you follow to show the effect or the design that is the subject of the report. Giving you such specific directions in a school lab exercise is for the sake of consistency among lab groups, and you are still learning how to, procedurally, do this kind of stuff.

3. Put information where the reader needs it. If you scatter needed information across the report, and the reader has to hunt it down every time, it gets annoying. For example, in "Design" you refer to R4. What is R4? You don't say. The reader has to try to find a schematic (where you probably labeled it "RE" instead of R4). Then you report that the designed current in R4 was to make VE = 1/3 of Vcc. But don't say what Vcc is. Then you say that the simulation results for VC was "a bit different" from the designed value, but don't say what the designed (or simulated) value was. Let the reader have to look for it! Serves him right! It helps if the flow of the whole report and it's organization helps the reader by introducing information where you want to find it. Ultimately, at the end, you want to know how things went in the lab compared to the original design and simulation. So, compare the most important parameters. Usually that would be Q point (particularly VC and IC or comparable data), midband gain, and fH and fL. Don't just throw down a poorly rendered Bode plot from PSpice and don't comment on it. Your text needs to lead the reader through your information, and explain what it means.

4. Always think about how your report will look to an interested reader. The reader is trying to learn what you did and what happened. There should be enough information that the reader can do it himself. Maybe he doesn't have exactly the same instruments, but he can find something similar.

5. References: Did you get data on your transistor from a data sheet? Where's the reference to it? Be specific – give page numbers. You should have learned by now how to do web references. You always need the date! Give page number, too. Some data sheets can be quite lengthy. If you refer to something in the textbook, give a page number. If you can be more specific, like an equation number, do so! A lot of people gave a .128A/V^2 Kn for the MOSFET without ever explaining where that came from! A list of books and documents at the end is not sufficient. Put references in the text or elsewhere as appropriate, and refer to the sources fully listed in your references section.

6. So, for some component, say a resistor, you have a "nominal" (standard) value, a calculated value (from design) and a measured value (from the lab). Which do you use where? Let me walk you through it. You need to make sense of this.

a. You are doing design. You calculate a value for RC. It's 1.689K Ohms. That's "calculated". You are not going to specify a 1.689K .01% precision resistor (custom manufactured for you) at $10 each (quantity 10,000? A guess).

b. You choose the "nearest standard value". That would be 1.6K if you are using 5% standard values (and can find one). Or 1.5K if you are using 10% standard values. Possibly 1.8K if you have reason to go bigger but not smaller. Choosing standard values is part of the DESIGN process. Your ultimate design thus should show "1.5L Ohms" for this part. (Then you do analysis to see if the Q point etc. is acceptably close to your specifications.)

c. What you simulate would use 1.5K, the standard value you chose, since that's what you'd be building. You want to know how well it will work. We design using approximations (assuming C's are shorted are open, ignore VA, etc.) Simulation is sort of "role playing" the electrons in the circuit – what will they actually do? The simulation uses more accurate models.

But doesn't represent everything in reality, and is of limited resolution. To be more specific, you are exploring what the design will do with typical circuit values. (A more exhaustive simulation test would vary components within their tolerances to get a range of possible outcomes.)

d. Then, you build it in the lab. This represents ONE possible instance of the designed circuit. The reason for measuring the resistors, etc. is to see whether you are getting variations from predicted performance because of components varying from their expected value, or something else pertaining to the design, perhaps something (like bypass capacitors) that you did not think of. AFTER seeing lab results, you could possibly plug those actual values back into simulation and see what happened. In these exercises, for example, you found out that VTN was a LOT lower than expected! That meant more Drain current than expected, and possibly the transistor going out of the saturated region. So, don't just guess! Figure out about what VTN actually is, and plug that into your MBreakN model. Then run it. Is ID still off? Maybe Kn needs work too. Are these variation within the range of expectation for a 2N7000 (likely yes). Then maybe RD (and RS) needs to be small enough that enormous changes in ID still will operate in the linear region. (You couldn't do that here since I said to follow 1/3 2/3 rule of thumb. Except as an exploratory exercise.)

7. Use subscripts. Instead of RE, use R_E. Yes, Word can be a pain because you need to adjust the size sometimes to be readable. More important, be consistent. If you call a component R_E in one place, it needs to be R_E everyplace you refer to it, not R_{E1} or R_4 or Re. That means on schematics and documentation, too.

8. In frequency analysis, we ought to have F_L and F_H. Even if you don't need the whole Bode plot, you want to know those numbers.

9. Properly annotate your graphs! A screen shot from the oscilloscope is NOT an appropriately annotated graph. You need to turn it into one. Use Black, not grey. Grey stuff disappears when you run it through a copier, even if it is readable in an original. The reader should NOT have to use a magnifying glass. Learn to use computer graphics tools to annotate images such as graphs and other illustrations. Look at the Lab reports Manual concerning graphs.