

Application Note - Preventative Measures and Advice for When Things Go Wrong By John Villahermosa

"Hope for the best, expect the worst" – Anonymous

This note discusses possible avenues that your group may have to consider if your Quarter 2 system does not work as intended, as well as preventative measures to ensure that everything in your system runs smoothly.

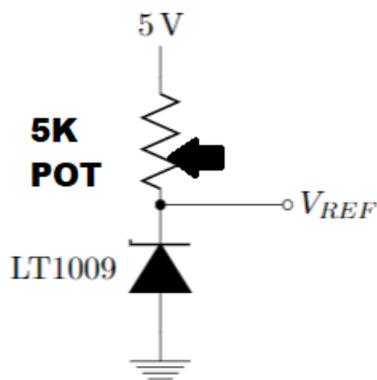
The Importance of Reading Datasheets

Before choosing any component to place onto your PCB, be sure to read through the entirety of its datasheet – there's a reason why we do that for some Prelabs in Quarter 1. Some of the components your group uses may have "recommended Circuit layouts", which are very important for certain applications.

For instance, this Power Amplifier that my group used (<https://www.nxp.com/docs/en/datasheet/MMG20241H.pdf>) had different layouts/parts depending upon the frequency used in operation. Be sure to know exactly what you're getting yourself into!

Making your PCBs Troubleshooter-Friendly and Versatile

First of all, build your PCBs with as many labeled, easy-to-understand test points as possible. This would include all points of interest on the baseband components such as the 5V Regulator Output, the 2.5V VRef, DAC and Teensy Triangle Wave, and the output of the Gain and Low-Pass Filter stages. In regards to the VRef Circuit, a personal recommendation of mine when creating onto your PCB: Use a 5K Potentiometer instead of the 3.6k Resistor to ensure that you will get 2.5V exactly – anything less than that may cause the output of your Gain + LPF stage to be clipped.

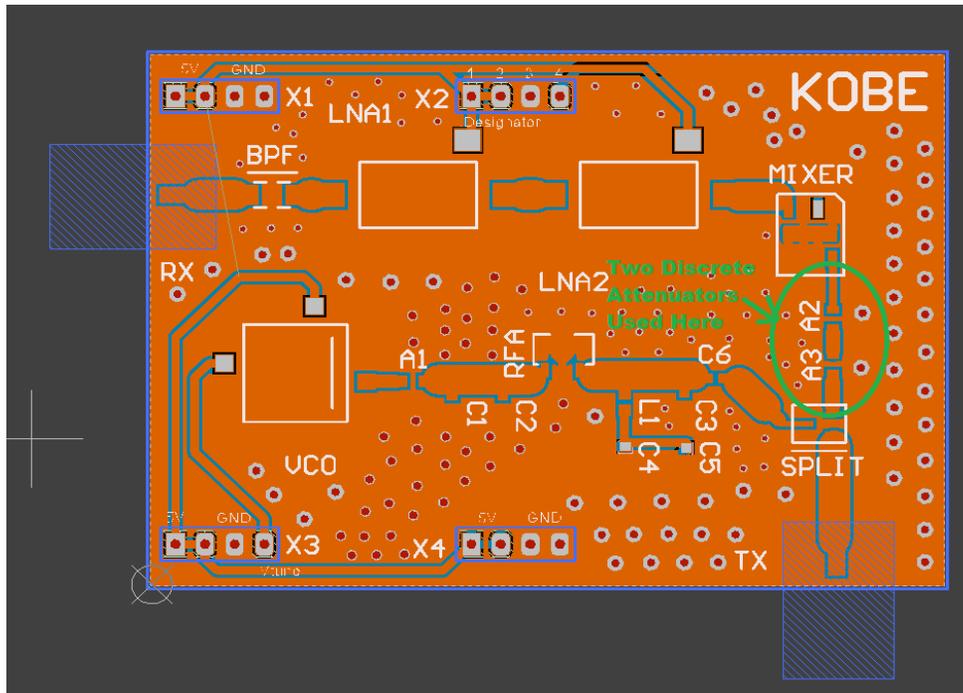


Modified VRef Circuit (original picture taken from EEC134 Lab 1 Manual)

Due to complications that arise when dealing with higher frequencies, you can't necessarily make test points onto the RF-side of your PCBs. However, you can "probe" the input/output pads of each surface-mount RF Component when they're placed onto the PCB. By "probing" the test point with an SMA-Wire, you can use the Spectrum Analyzer provided to your group to see if any outputs are generated. Points of interest would include the output of the VCO, and any Transmitting or Receiving

amplifiers that your group uses.

Another PCB configuration tip: opt to make an “attenuation” path (the one that goes from the output of the splitter into the LO port of the mixer) use more than one attenuator. This is to ensure that your mixer receives its intended LO Power. If not enough attenuation, use higher values, otherwise one can be replaced using an 0Ω resistor of similar size.



“Attenuation Path” for RF PCB

Finally, your group should really consider dividing your system into two PCBs: one for the baseband components, the other for the RF. This is very advantageous for many reasons. One is that we received 3 copies of each PCB, totaling 6, rather than 3 of a PCB that had all components on one. Another is that way, if one of them did not end up working, we would still be able to use the other one with parts from Quarter 1.

Missing Pads on Your PCB

If mistakes were made on your PCB that caused it to have missing pads for components, note that you can “shave” the solder mask off the top layer using a razor blade to make required pads. This is only recommended after going through your PCB schematic on Eagle/CircuitMaker, as you only have so many PCBs to attempt this. Another possibility would be to use fly-wires to make any necessary missing connections – your PCB may not end up looking pretty, but you aren’t being graded on style.

Ordering New PCBs

If shaving solder mask or using fly wires are not a possibility, and if your time and your team’s budget permits, consider revising your PCBs (ensuring that everything is as it needs to be!) and making a rush order. Vendors other than Bay Area Circuits, such as oshpark or some PCB Manufacturers in China can do expedited delivery of your PCBs (for an increased price, of course).

Last Resort: Opting to Use the Quarter 1 System (or parts of it)

If all the previously mentioned solutions to your problems do not apply to your group, and if you all decide that your Quarter 2 system is beyond repair, your only option to compete in the competition would be to use your Quarter 1 system assembled from Lab 6. Hopefully, you didn't end up disassembling your system – it is very useful to keep intact for any testing that your group may want to do. Either way, **ensure that everything in your Quarter 1 system operates as intended (e.g. 5V Regulator Output, Gain + LPF Stage, Mini-Circuit Components, etc.).**

Additional improvements to this system can be made as well in order to remain competitive in the competition. One choice would be to reduce the system weight as much as possible, and there are plenty of things that can be done to accomplish this. First off, replacing the wooden board on which your system was built upon with something more lightweight, such as cardboard or Styrofoam, will reduce weight dramatically. Second would be to replace the coffee cans with a set of purchased PCB Antennas (namely these <http://wa5vjb.com/pcb-pdfs/Yagi2400.pdf>) as they weigh much less and perform just as well as the coffee cans. Finally, and this is only recommended if somebody in your group is very skilled at soldering, would be to implement the baseband system from Lab 1 onto protoboards.