

sdmay20-39: High Speed Magnetic Field Generator

Week 10 Report

February 28 - March 12

Team Members

Jason Cheng — *Technology Lead*

Ben Colson — *Test Lead*

Zach Higgs — *Project Lead*

Harel Cohen — *Hardware Lead*

Craig Philipp — *Communications Lead*

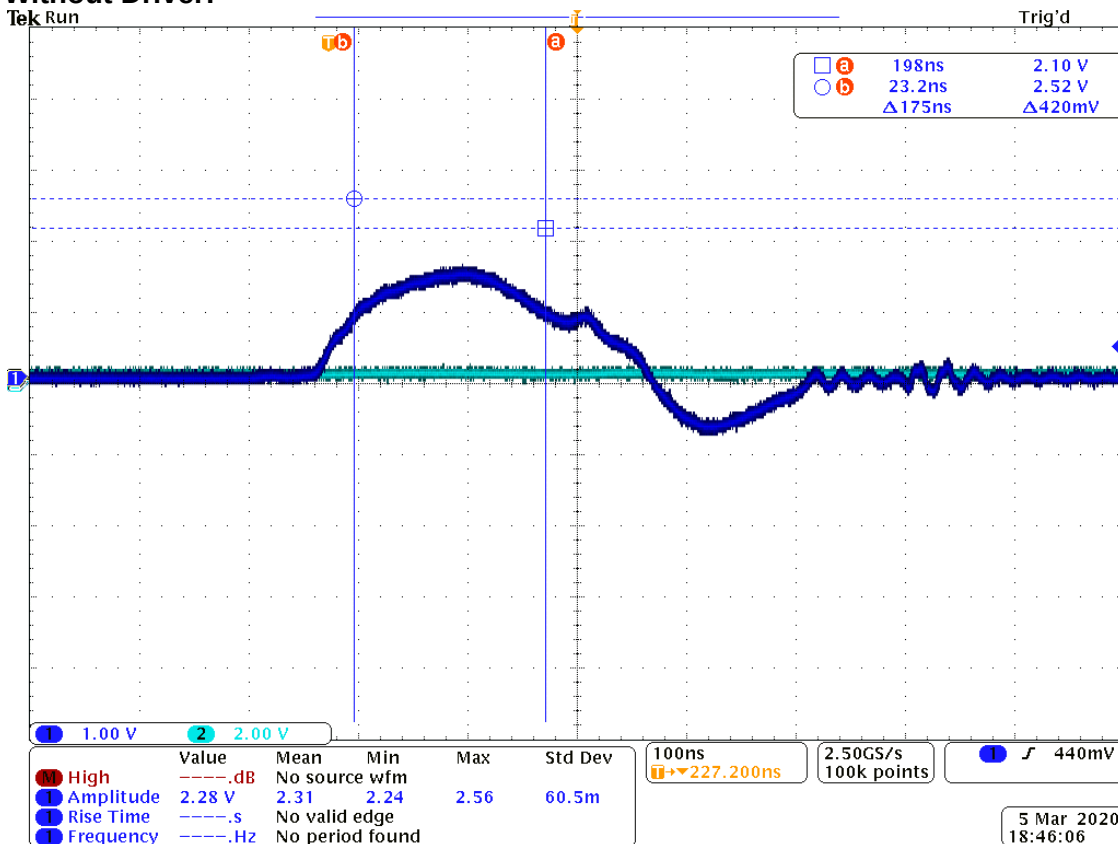
Weekly Summary

This week was mainly focused on testing, testing, and more testing. We hooked up our drivers that we ordered last period to both our breadboard and perfboard setups to try and better approach the rise time requirements and increase our signal. We also used this to try out MOSFETs of different chemistries.

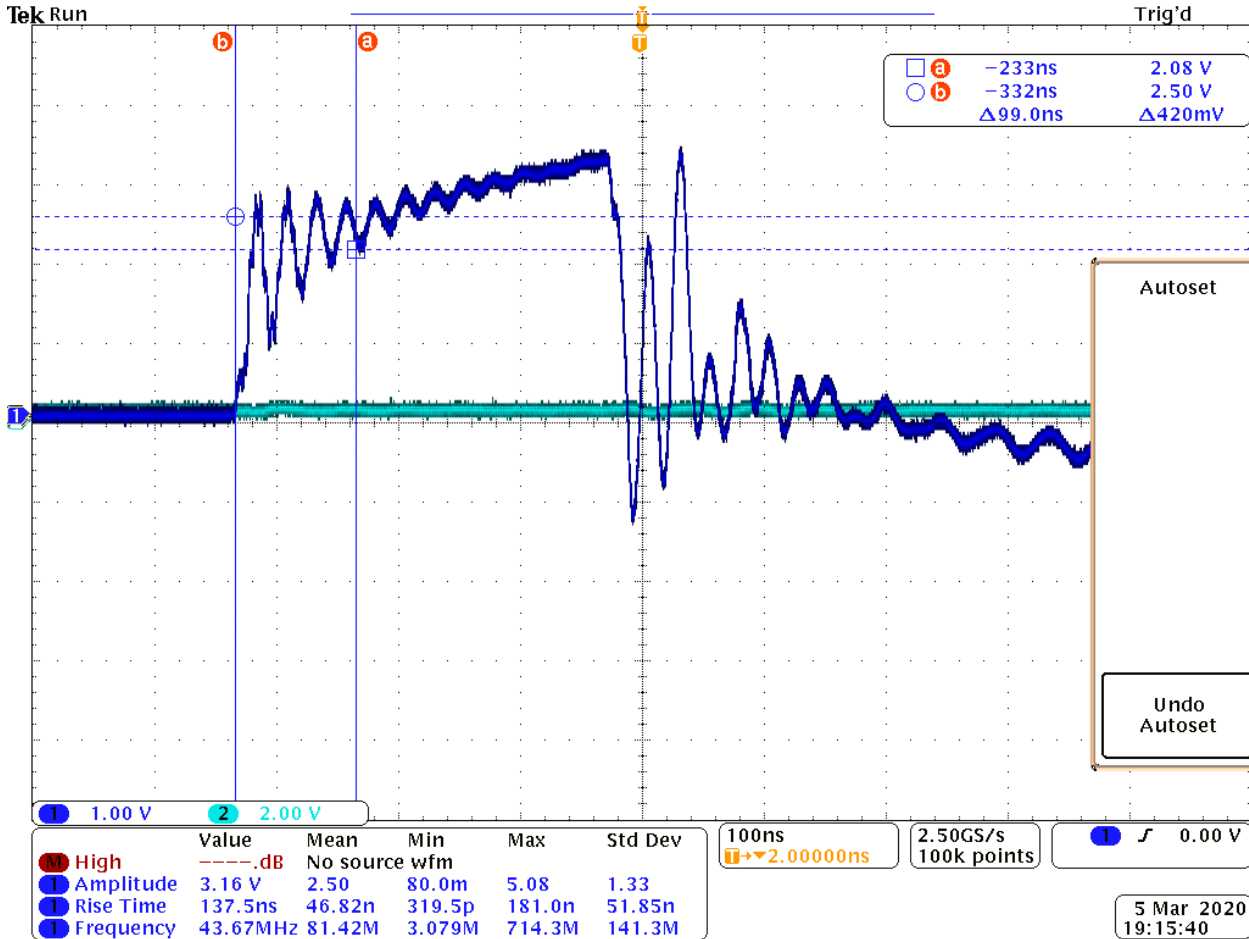
Past Week Accomplishments

A few big tasks we had on our to do list were accomplished. For one, we finally were able to do the testings of different MOSFETs and added a driver to our circuit. This leads us to the ability to use higher voltages and MOSFETs that need more power than we can directly supply. As a result, we used a different chemistry in our MOSFET to better try and achieve the minimum requirements our circuit needs to have to be accepted as a solution to the problem. This means we are now using GaN MOSFETs instead of the Si MOSFETs in our last revision. Along with this, we created a formal documentation behind the testing so we can better compare iteration to iteration without having to dig up image files or other sorts of sparse documentation. After testing, we saw the following signals:

Without Driver:



With Driver:



This means that we have achieved the rise time that we needed to with this circuit, but need to manage the signal better since we can see that there's a loss in signal quality. Beyond this, we also dedicated a chunk of time to making the presentation for the peer review process. This also served as a reflection point for us, as we are now considering that we no longer have the 1 week turnaround on PCBs that we expect while ordering from PCB due to COVID-19. As a result, we are planning on working through spring break to get the revision ordered with plenty of lead time, otherwise our currently on time schedule is going to quickly devolve into running behind and not having enough time to get a final out the door. In regards to last period's outstanding tasks, we were able to finalize our organization strategy and order parts so we can fully test using all our actual parts. We've also finished testing without load, and have determined that our problem is in the MOSFET, not the circuit.

Pending Issues

- Need to evaluate our timeline to see if there's slack in the schedule for COVID-19 related delays
- Ringing is still present in the signal we need to find a way to smooth our signal more. Additional capacitance is being considered near the output to help.
- PCB needs to be designed by the next period for final review

Senior Design Weekly Status Report

page 3 of 4

Individual Contributions

Team Member	Contribution	Bi-Weekly Hours	Total Hours
Jason Cheng	Focused this week mainly on finishing the presentation and making sure everyone was on the same page. Also spent many, many hours on the phone with various suppliers in China to figure out if our turnarounds would be delayed due to the outbreak. Using this, I revised the schedule and pushed up our second revision ordering date to allow for one last revision before we have to finalize and order for the IRB.	15	139
Ben Colson	I have been working with zack and harel to continue testing our current gate driver and implementing it into our pcb. In addition to this I have populated some daughter boards with MOSFETS we want to test. Some of these MOSFETS are variations of the SIR FET we concluded was the best option last semester with hopes to find the best version.	10	128
Zach Higgs	The past two weeks we have been working on getting our gate driver to work with the Gallium Nitride MOSFET. We successfully drive the GaNi MOSFET, but we found that there were large oscillations and more work needs to be done to reduce this extreme ringing. We then tested the gate driver with the normal Si MOSFETs we used last time. We were successful in achieving a rise time of less than 100 ns with still large oscillators. The next step is to try and reduce this ringing.	11	142
Harel Cohen	This week has yielded good results. I helped connect the MOSFET driver to the MOSFET and I tested it with Zack. But we got a very interesting response from this new contraption. There seems to be a lot of	10	136

	<p>oscillations coming from something between the driver and MOSFET. We managed to talk with professor Mina about this problem and he brought to our attention that even with this oscillation, the circuit is in working conditions. We still plan on finding a fix.</p>		
<p>Craig Philipp</p>	<p>Worked to implement the gate driver with the rest of the circuit. Used multiple MOSFETs to see if the driver improved the rise time. We were able to get a fast rise time but there is still a good amount of ringing that we are looking to eliminate. I also created a document (which I shared with everyone) that is going to help us keep track of testing we do from now on. The procedure is to save a screenshot from the oscilloscope output and enter it into the sheet with notes on the input values and type of MOSFET used. Also helped develop the video and recorded audio for it.</p>	<p>15</p>	<p>139</p>

Plans for Upcoming Reporting Period

- Finish testing GaN MOSFETs and add driver to PCB circuit
- Add all parts to Altium libraries and update schematic
- Finish remaining audio recordings and start planning for peer edit
- Update timeline and plans to better reflect slack time waiting for boards