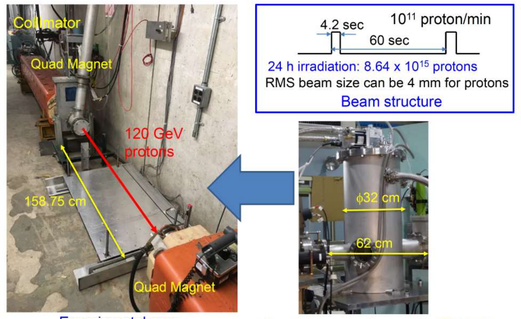
R&D of Remote Motion Table

Antonio Huanay, CCI – Mentor: Katsuya Yonehara

Background and Project Mission

- Remote motion table is needed for DPA experiment at FTBF
- Motion table requires to move target of 100 kg moving in horizontal direction twice a day. Speed not required
- Project's mission is to write a movement program in Python to move controller through Raspberry Pi



Experimental area

Irradiation chamber used at RCNP

Figure 2: Picture of the M03 experimental hall and the dimension of possible target for the DPA experiment at Fermilab.

Figure to the left is the area of experiment. Figure to the right is the target that actuator will move

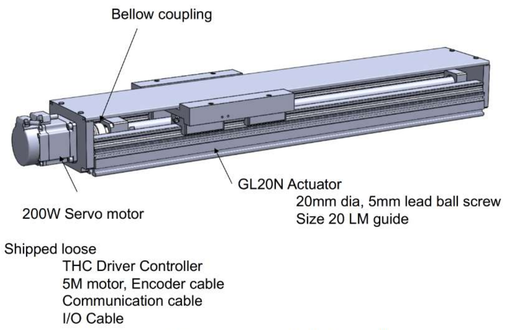


Figure 3: Purchased motion table from THK.

Figure of motion table purchased from THK

- By connecting CN1 of controller to Raspberry Pi, it is possible to send signals to certain pins in the controller to move the actuator. This way it can be controlled remotely
- Each pin has a specific function. When certain combinations of pins are on, the actuator will move. In python, this requires a simple on or off statement

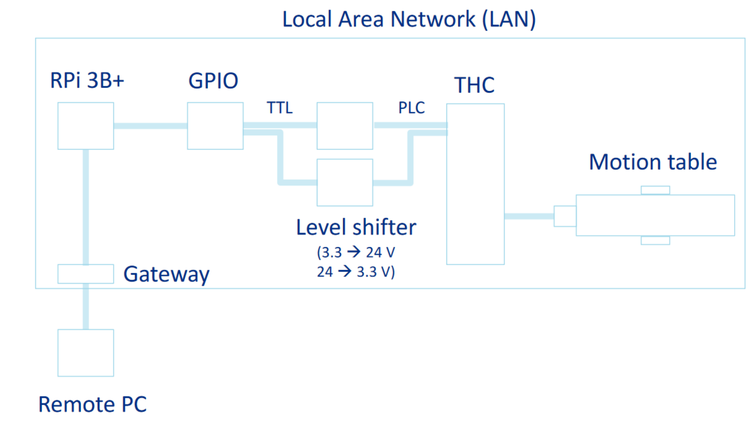
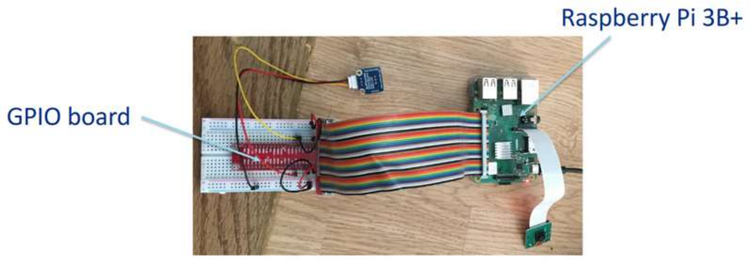


Diagram that shows setup of hardware

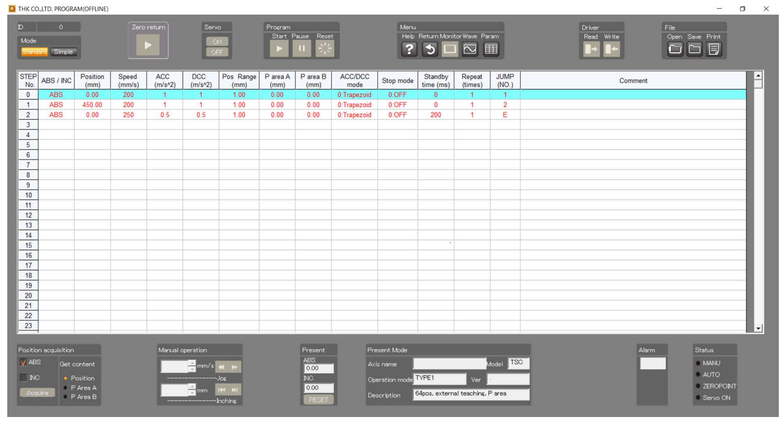


Raspberry Pi connected to controller

Testing

At time of testing, manual switches were used to replace channels of level shifter due to hardware complications. We were able to move actuator remotely through D-STEP program, designed by THK, and control switches of start and pause manually. Signals were also verified with an oscilloscope

Figure to the left is manual switch. Figure to the right is relay that can be controlled remotely



D-STEP program to control remotely

Conclusion

Even though we were not able yet to move actuator through python, we verified through an oscilloscope that signals were sent by the program in Raspberry Pi to the controller. For the future, electronics improvement in actuator can be useful to make the controller read these signals. In addition, testing at laboratory is also needed to see performance of actuator

Making a power supply that produces 1000 A with ripple of 50 parts per million.

Antonio Huanay, CCI – Mentor: Chris Jensen

Background and Project Mission

- Project's mission is to show what type of power supply is best used to produce 1000 A with ripple of 50 ppm
- Current ripple is the amount of change in the current over time when it should be stable
- This is necessary to create a stable magnetic field so that target particle in beam stays in the correct position
- Six simulations of power supplies were done at LTSpice: Two and three phase bridge power supplies with various filters

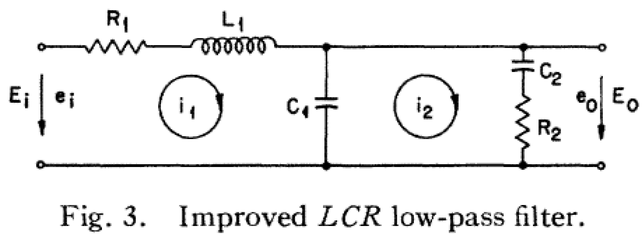
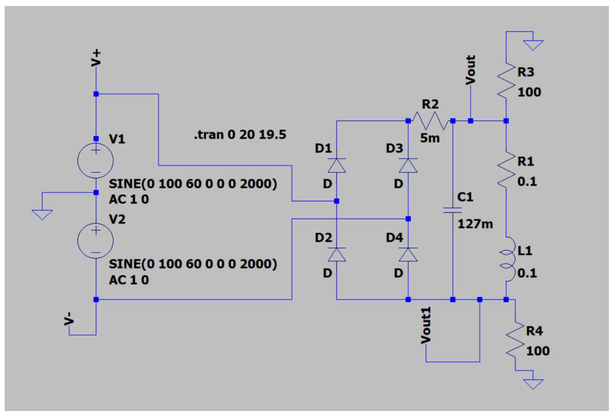


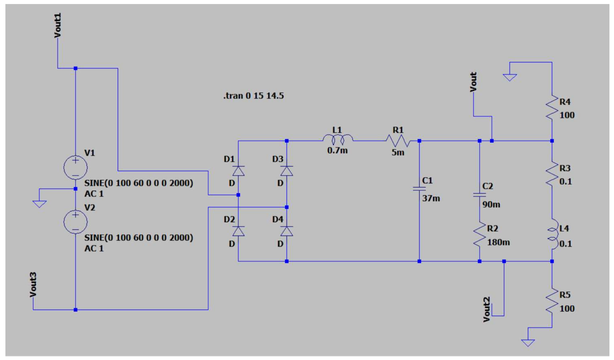
Fig. 3. Improved LCR low-pass filter.

From paper: A High-Current Low-Pass Filter for Magnet Power Supplies by Walter F. Praeg, 1970

Two Phase Bridge Power Supply Simulations

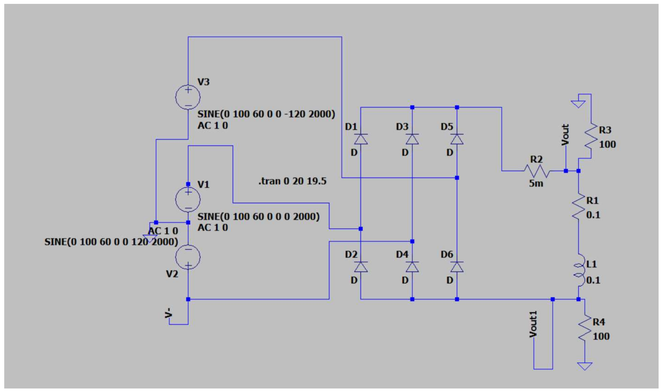


Magnet Load with capacitor

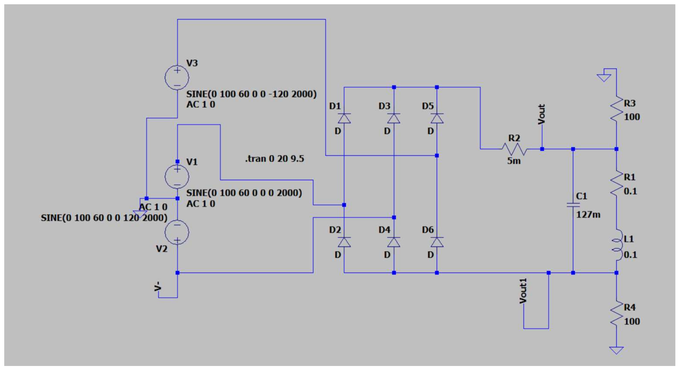


Magnet Load with Praeg Filter

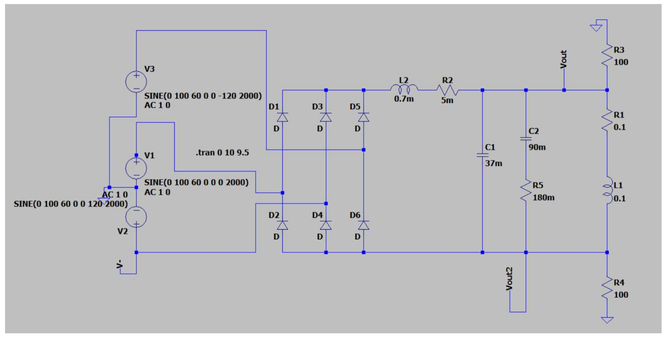
Three Phase Bridge Power Supply Simulations



Magnet Load only



Magnet Load with capacitor



Magnet Load with Praeg Filter

Measurements

	2 phase bridge with load only (R & L)	2 phase Bridge with R, C and L C = 127mF	2 phase bridge with R,L and C = 685mF	2 phase Bridge with Praeg filter C = 127mF
Current Percentage Ripple	0.16 %	0.041 %	0.007%	0.011 %
Peak to Peak current	1.94 A	641.47 mA	123.751 mA	123.24 mA
Average Current	1.170 kA	1.55 kA	1.638 kA	1.1602 kA
Voltage Ripple [V(out) – V(vout1)]	197.5 V	56 V	11 V	11 V
Avg Volt [V(out) – V(vout1)]	116.33 V	156.67 V	165.35 V	117.19

	3 phase bridge with R & L	3 phase bridge with R,L & C C = 127mF	3 phase bridge with praeg filter
Current Percentage Ripple	0.0044%	0.0021%	0.000037%
Peak to Peak current	67.60 mA	32.48 mA	566 uA
Average Current	1.5361 kA	1.542 kA	1.5217 kA
Voltage Ripple [V(out) – V(vout1)]	19.3 V	8.8 V	95 mV
Avg Volt [V(out) – V(vout1)]	154.16	155.16	153.7

Conclusion

- As shown, 3 phase bridge power supplies achieve the goal of reducing the current ripple below 50 parts per million.
- For this reason, these types of power supplies are used at Fermilab