

Project 29

**Testbed for Measurement and Control of
Generator Power Oscillations**



Team name: Shockwave

Team member: Zuhao Zhou
Quan Yan
Changyao Xu
Yutong Chen

Sponsor: The logo for Schweitzer Engineering Laboratories (SEL) is displayed. It consists of a dark blue rectangular background. On the left side, the letters 'SEL' are written in a white, bold, sans-serif font, enclosed within a white rounded rectangular border. To the right of this border, the words 'SCHWEITZER ENGINEERING LABORATORIES' are stacked vertically in a smaller, white, all-caps, sans-serif font.

Client: Matchyaraju Alla



Objective

Building on the data acquisition system designed by a 2018-2019 senior design team design a test bed and test plan for testing generator performance during power swings, especially those near boundary of pole slipping

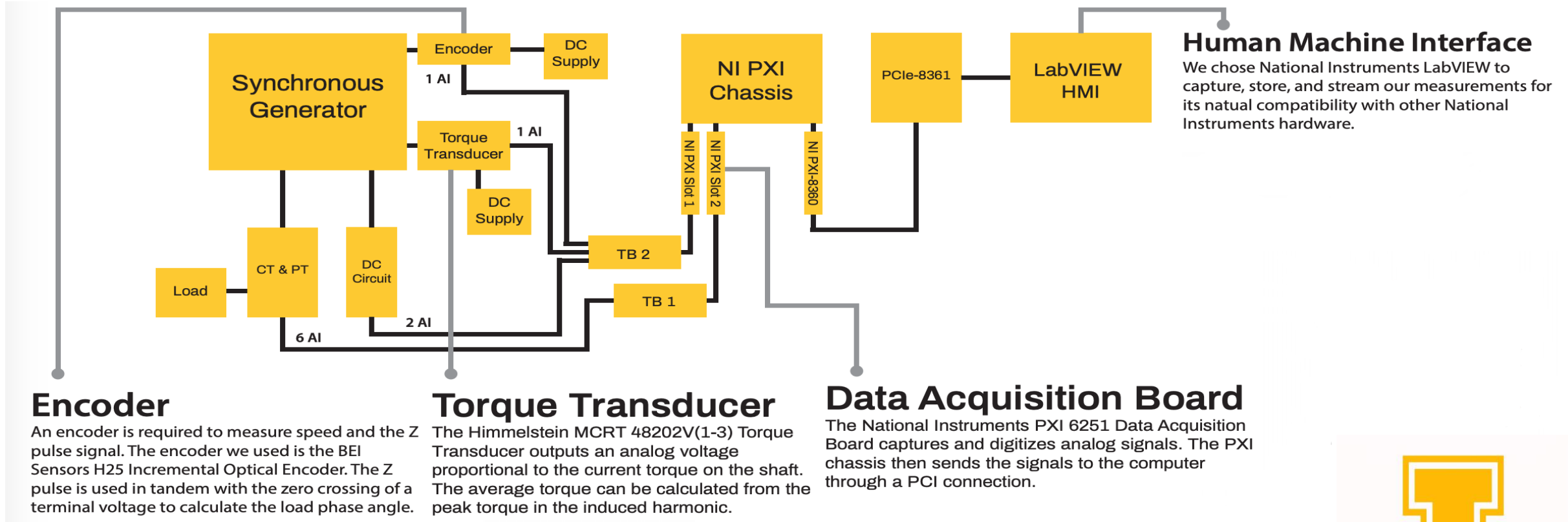


Requirements

1. Make connections in the system look more professional
2. Due to changes in connections, the system can be easy to disconnect and connect
3. Variable testbed should have an ability to characterize different machines



Data Acquisition System



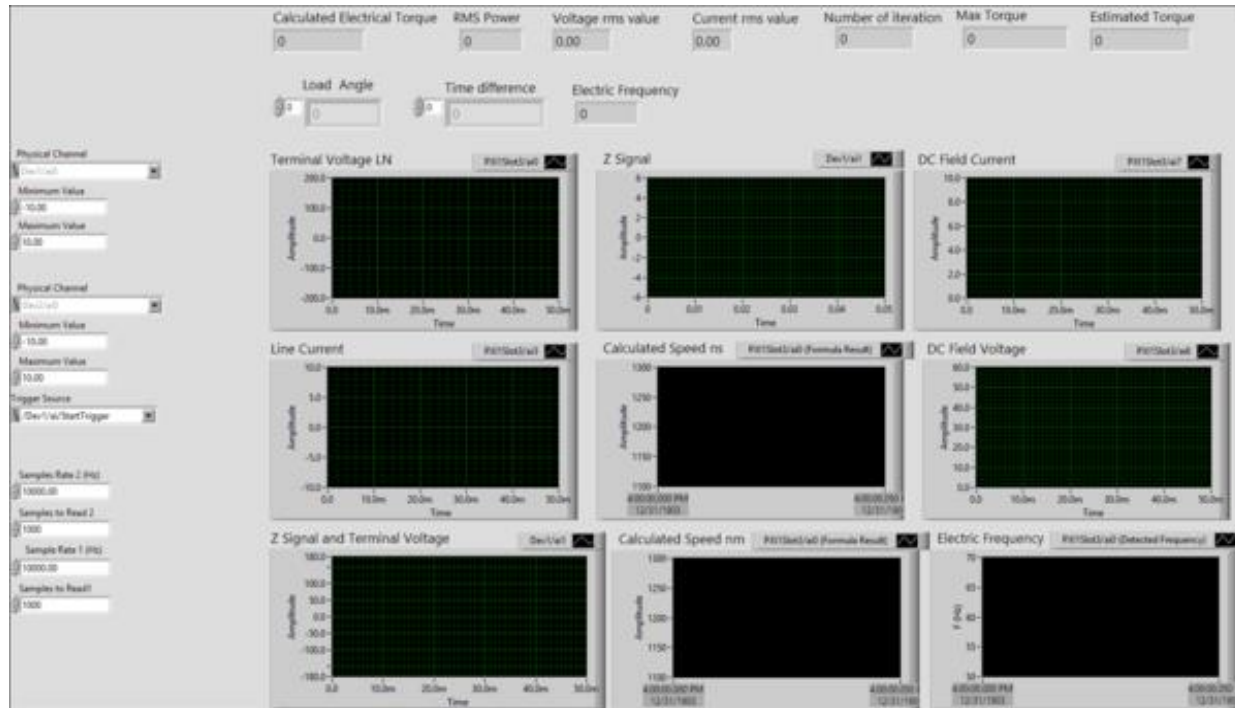
National Instruments PXI 6289 & 6251



PXI 6289	
Channel #	Signal
0	V_A
1	V_B
2	V_C
3	I_A
4	I_B
5	I_C
6	V_{DC}
7	I_{DC}
PXI 6251	
Channel #	Signal
2	$Z_{Encoder}$
3	V_A
4	Torque



LABView panel



The final human machine interface in LabVIEW displays all captured measurements simultaneously.

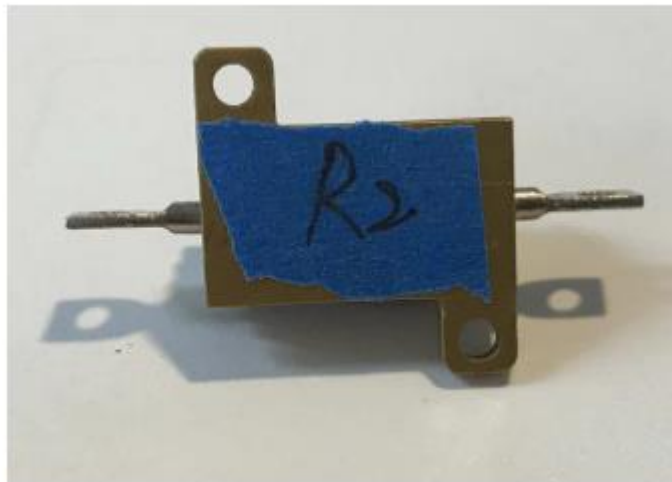
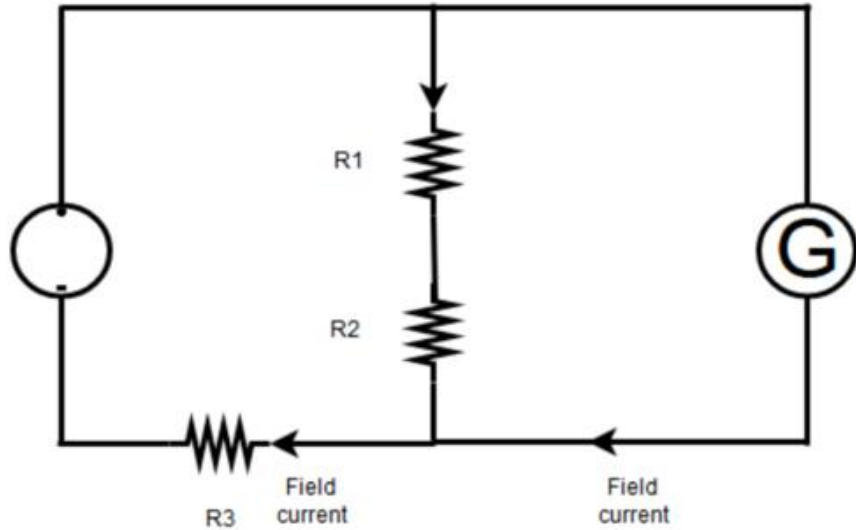


DC Circuit

Connect the circuit between the DC source and generator excitation side

R2 is for field voltage measurement

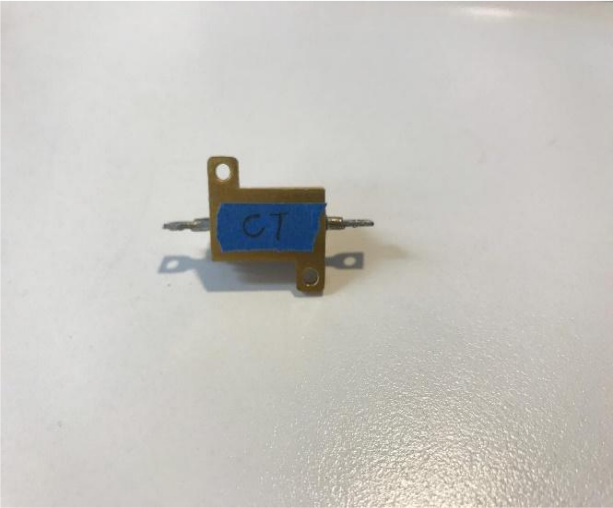
R3 is for field current measurement



PXI 6289	
Channel#	Signal
0	V_A
1	V_B
2	V_C
3	I_A
4	I_B
5	I_C
6	V_{DC}
7	I_{DC}
PXI 6251	
2	$Z_{Encoder}$
3	V_A

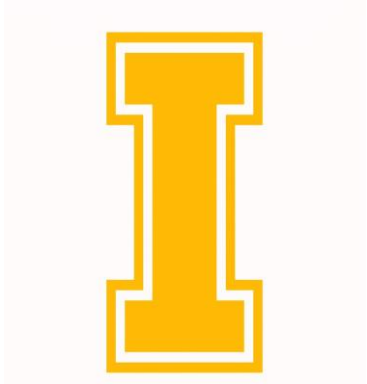


CT-Current Transformer

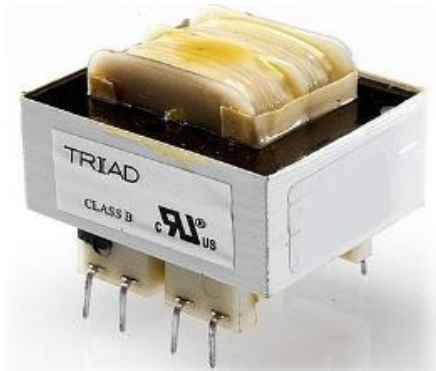


Model	Rating	Ratio
114-151	150A : 5A	30 : 1

PXI 6289	
Channel#	Signal
0	V_A
1	V_B
2	V_C
3	I_A
4	I_B
5	I_C
6	V_{DC}
7	I_{DC}
PXI 6251	
2	$Z_{Encoder}$
3	V_A
4	Torque



Potential transformer



Model	Rating	Specified Ratio
FS24-500	230V:12V	19.2:1

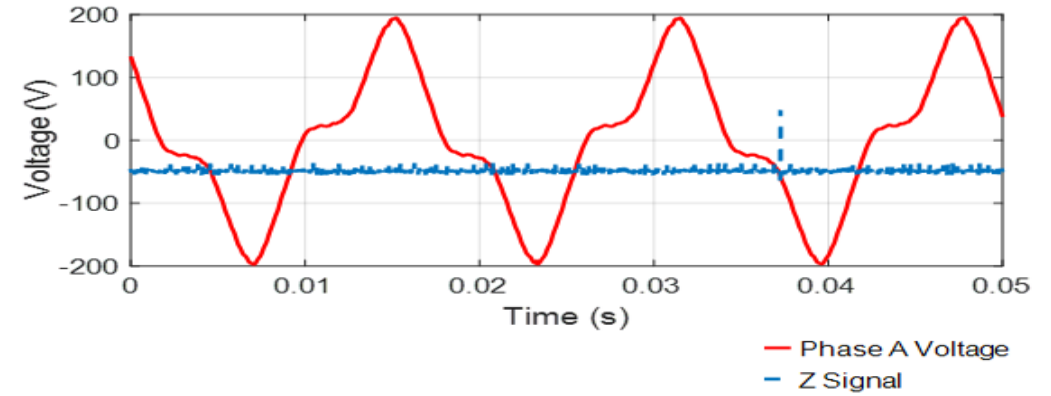
PXI 6289	
Channel#	Signal
0	V_A
1	V_B
2	V_C
3	I_A
4	I_B
5	I_C
6	V_{DC}
7	I_{DC}
PXI 6251	
2	$Z_{Encoder}$
3	V_A
4	Torque



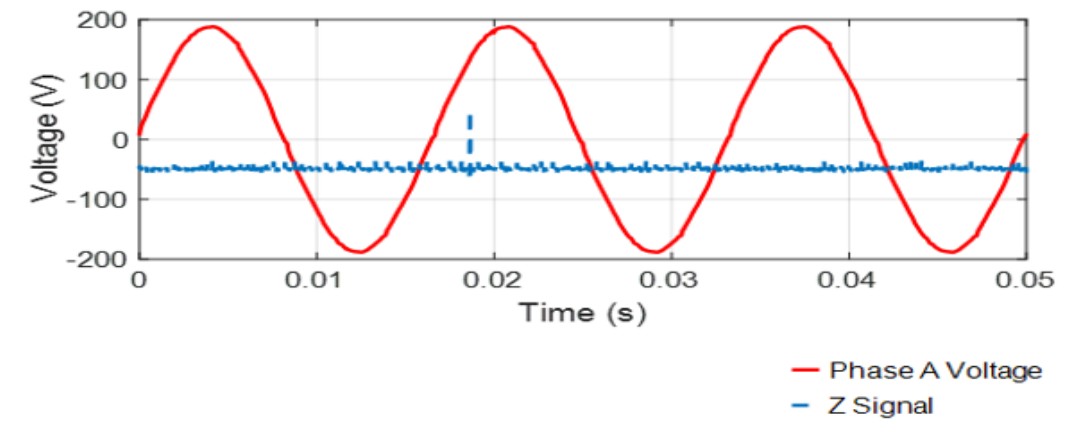
Encoder



Terminal Voltage Waveform and Encoder Pulse Signal (Unloaded)



Terminal Voltage Waveform and Encoder Pulse Signal (Loaded)

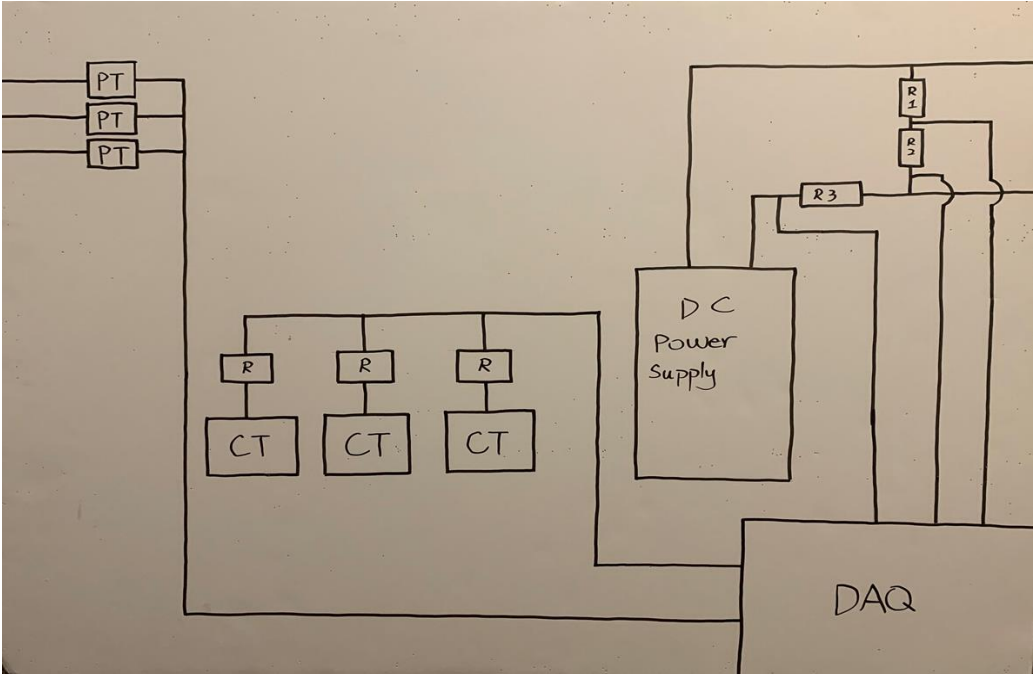
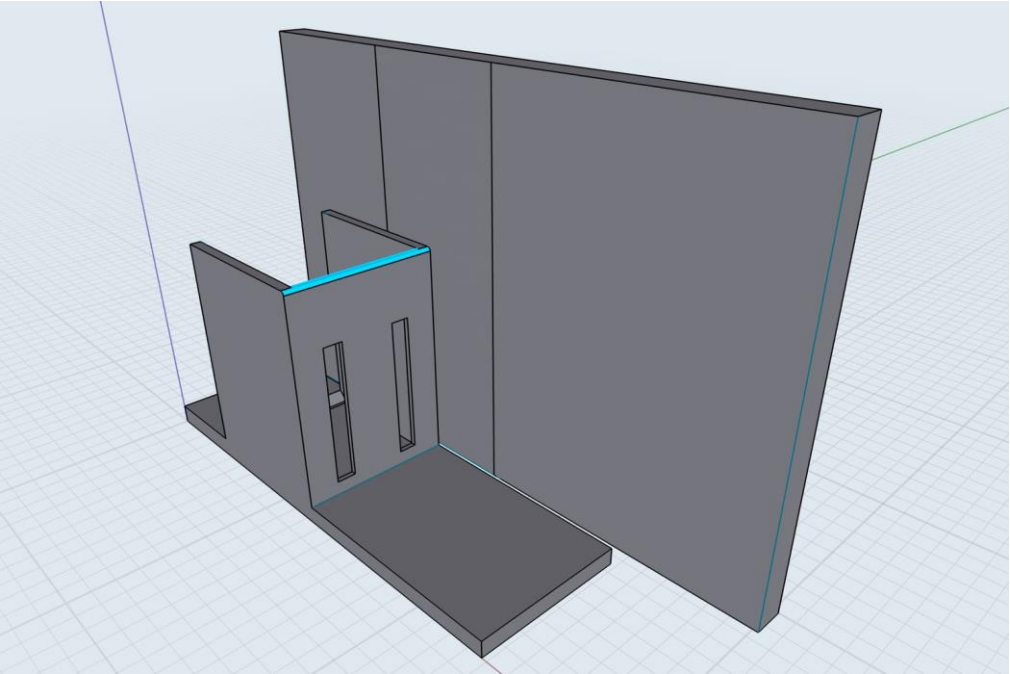


$$\theta_{NL} = \left(\frac{T_{NL}}{T} \times 360^\circ \right)$$

$$\delta = \theta_{UL} - \theta_{NL}$$



Connection Box Solid Model & Testbed Panel Draft



Considerations

Material of Testbed board

Polyvinyl chloride(PVC)

Pros:

- 1) Cheap
- 2) Lighter Material
- 3) Non-conductive
- 4) Environmentally friendly
- 5) Easy to cut

Cons:

- 1) Low heat resistance

Polypropylene(PP)

Pros:

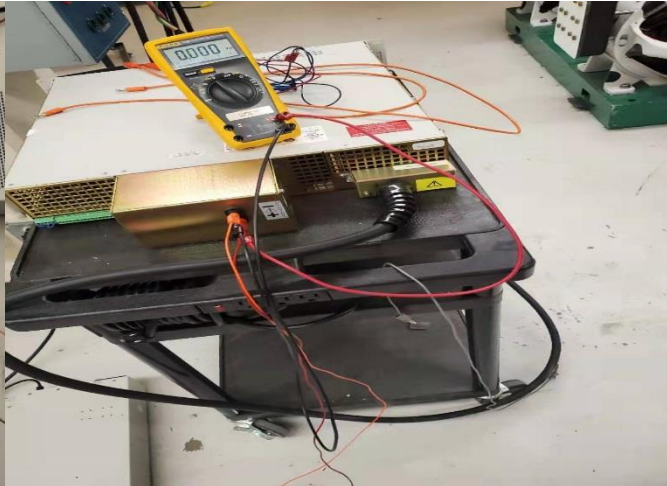
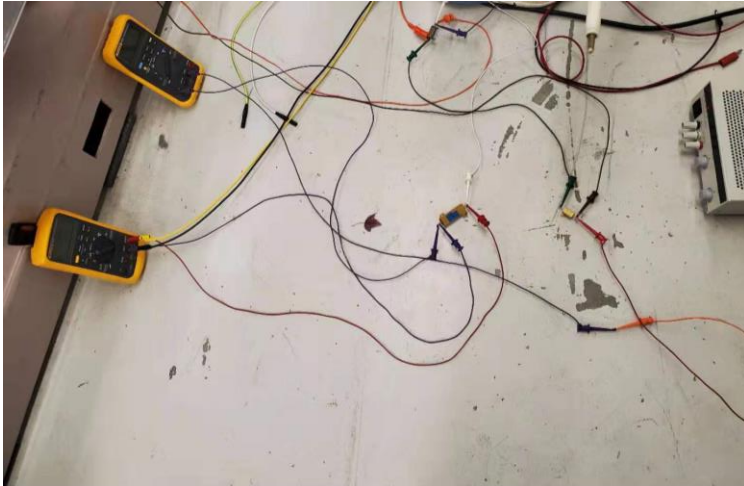
- 1) High heat resistance
- 2) Lighter Material
- 3) Non-conductive

Cons:

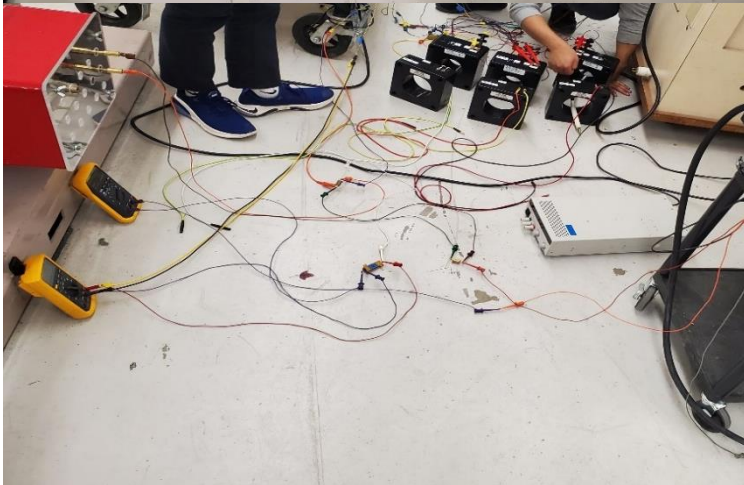
- 1) Aging due to the action of light, heat and oxygen
- 2) High static electricity



Considerations



1) Soldering



2) Change cable connector



Project Schedules

Before the end of fall semester 12/20/2019:

Complete all designs of testbed

Before the start of spring semester 01/15/2019:

Give the draft of the measurement plan

Spring semester:

Jan-Feb: Manufacture the Testbed

Feb-Apr/10/2020: Collect the data of generator performance during power swings
(near boundary of pole slipping)

Apr/10/2020: Documentation

