

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



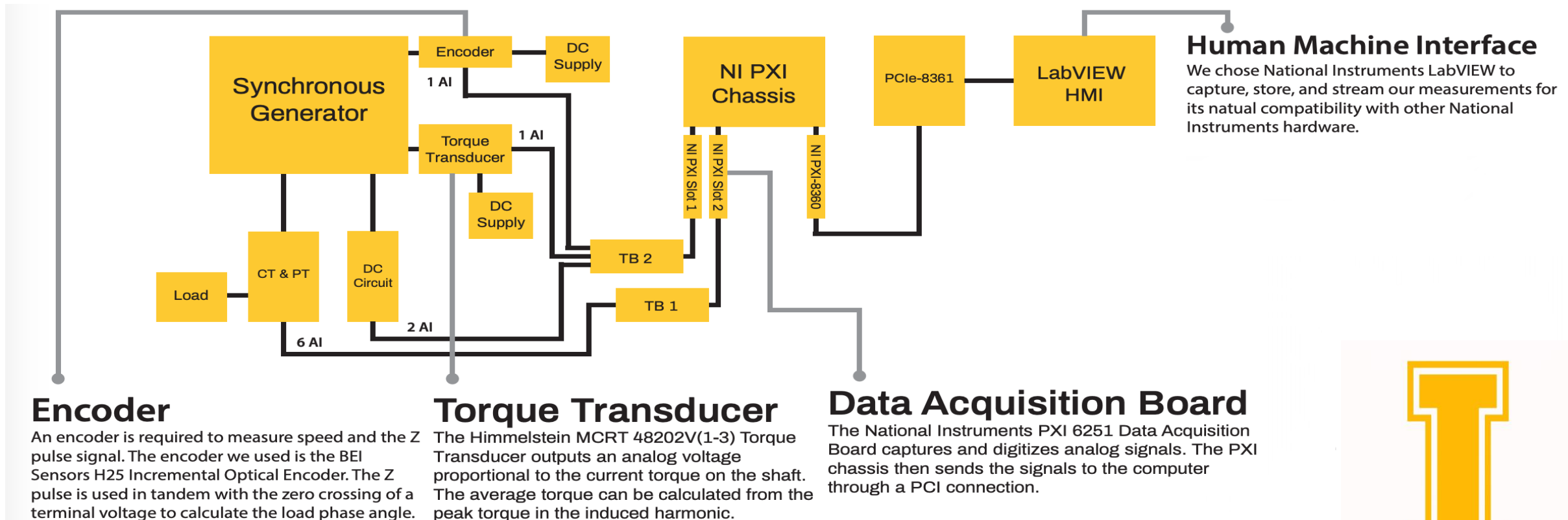
Requirement

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

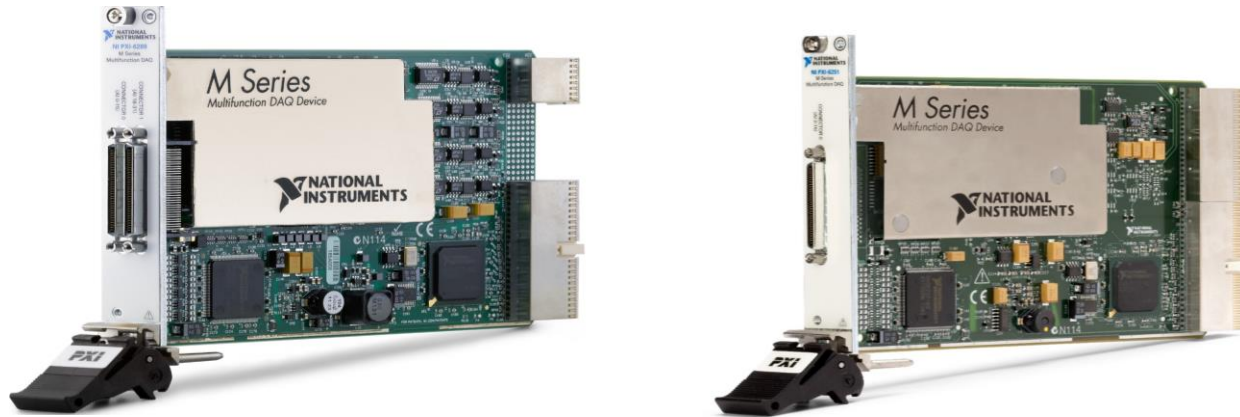


Project Learning

Data Acquisition System



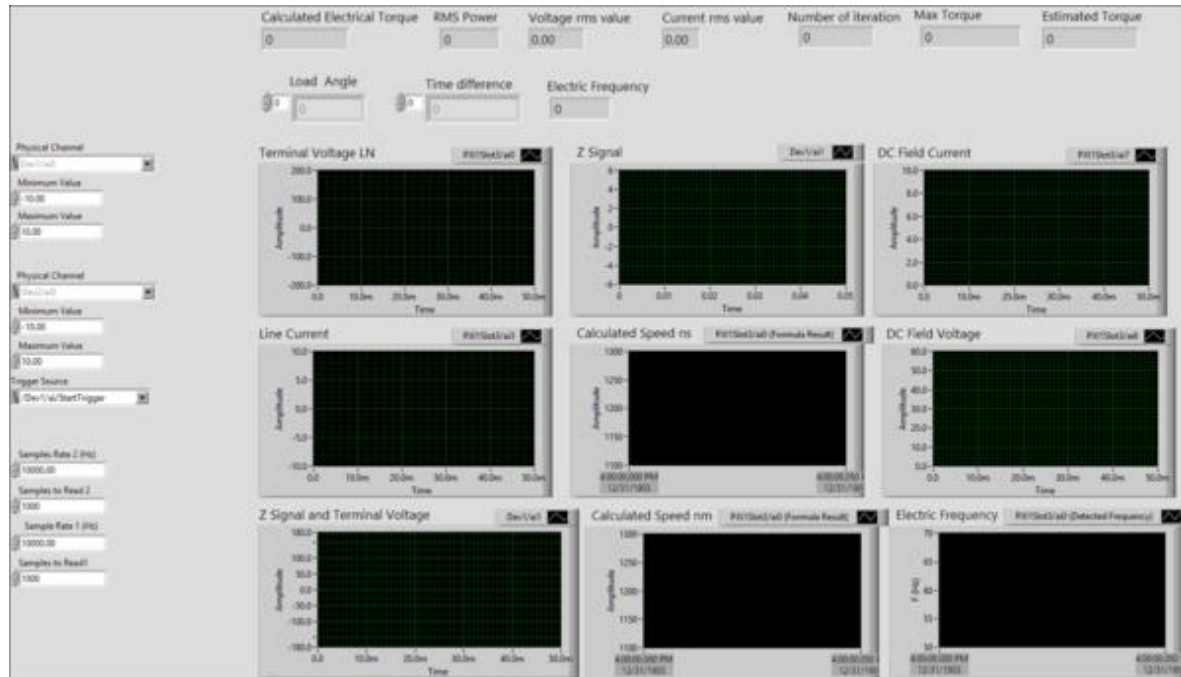
National Instruments PXI 6289 & 6251



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



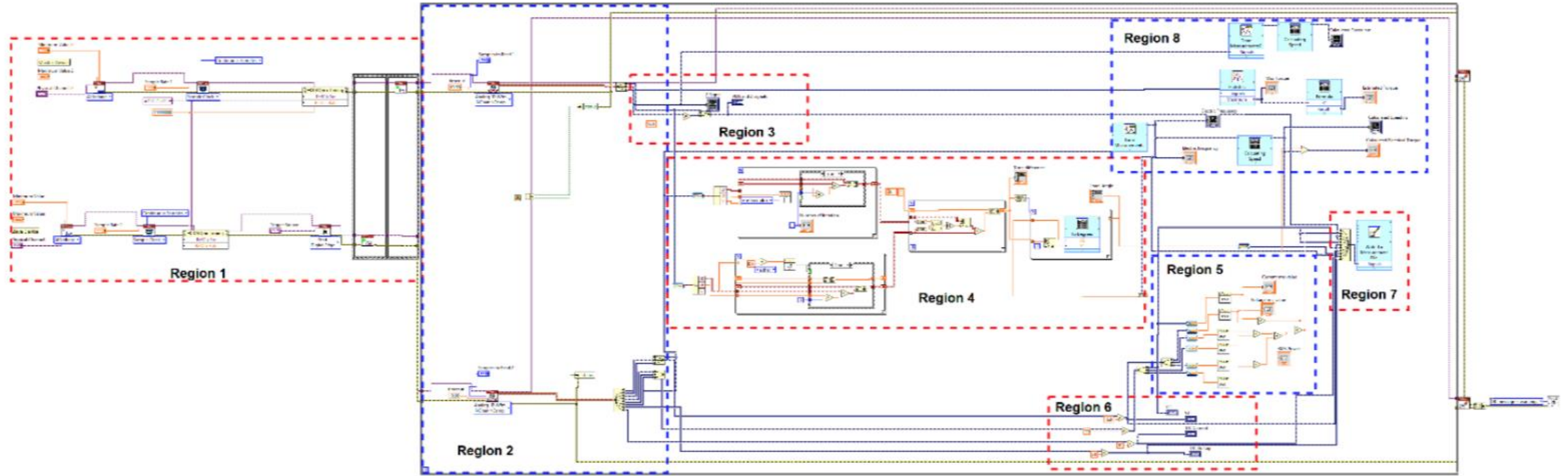
LABView panel



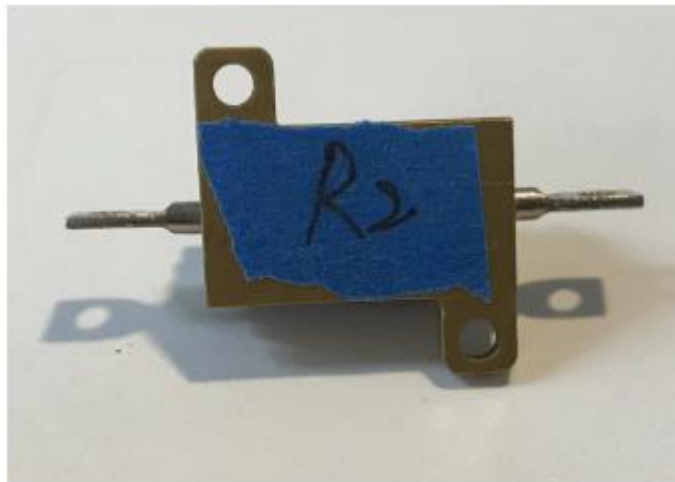
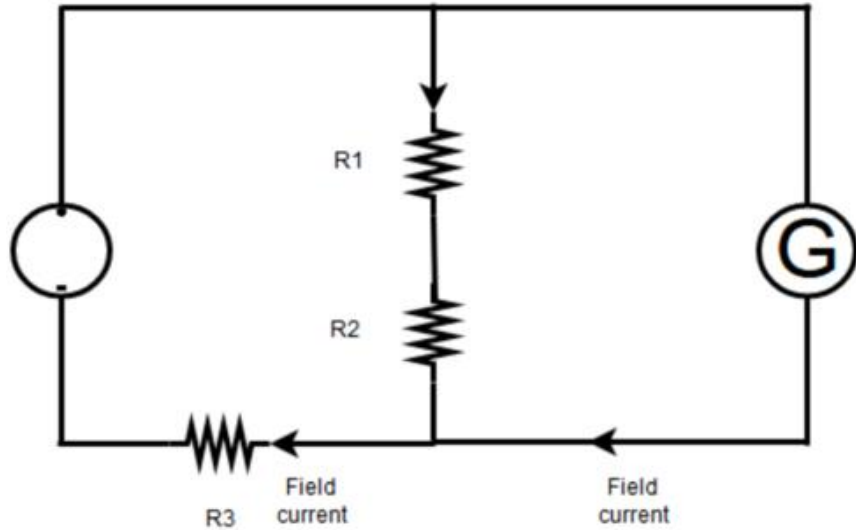
The final human machine interface in LabVIEW displays all captured measurements simultaneously.



LABView Block Diagram



DC Circuit



Connect the circuit between the DC source and generator excitation side

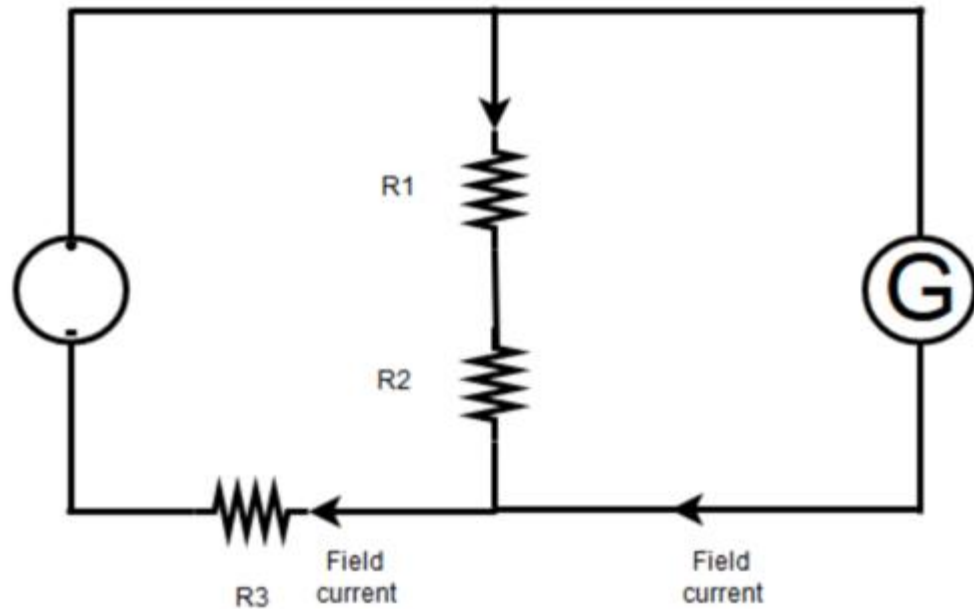
R2 is for field voltage measurement

R3 is for field current measurement

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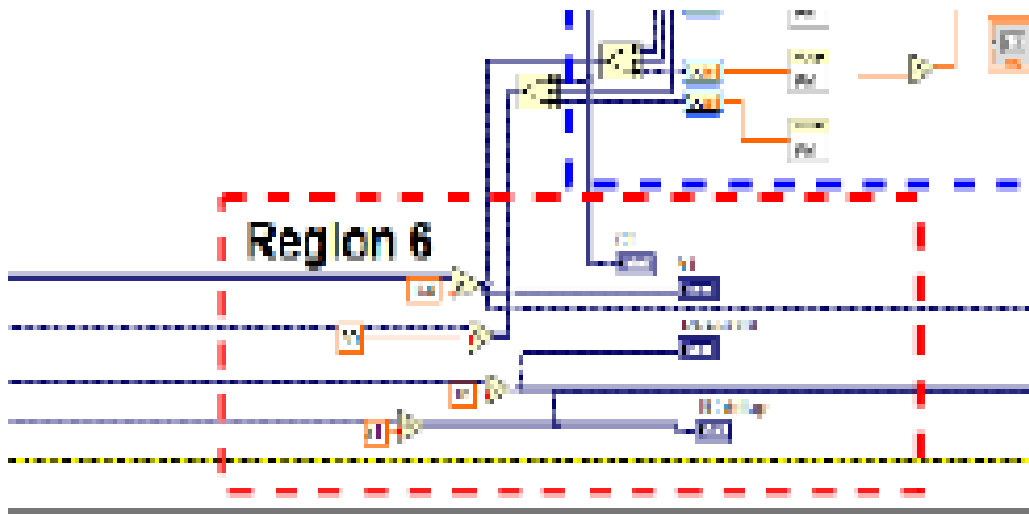
DC Circuit



1 st Time	Measured	Actual
R3	0.4 Ω	0.1 Ω
R2	1.001k Ω	1k Ω
R1	19.91k Ω	20k Ω
2nd Time		
R3	0.2 Ω	0.1 Ω
R2	1.001k Ω	1k Ω
R1	19.91k Ω	20k Ω



Field V&I Measurement

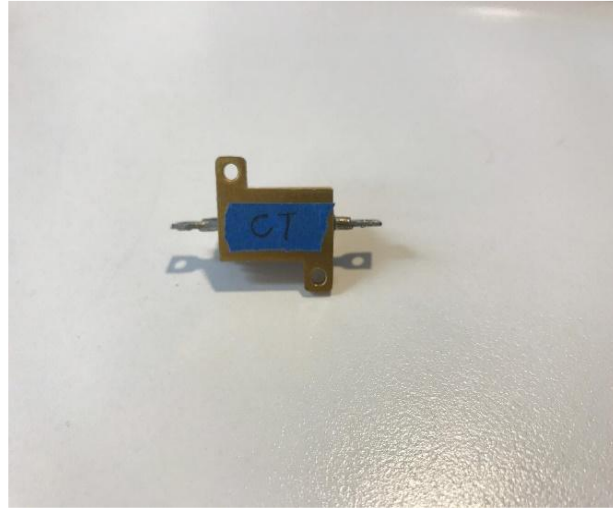


	Applied Voltage	Measured V_{R2}	Ratio V_{ap}/V_{R2}
1 st Test	90V	4.309v	20.887
2 nd Test	100V	4.788V	20.886
3 rd Test	110V	5.266V	20.889
Ratio Average			20.888

DC supply 15V	Labview	WM
V_f	13.7V	0.37V
I_f	3.6A	3.73A
25V		
V_f	23V	0.628V
I_f	6.28A	6.26A

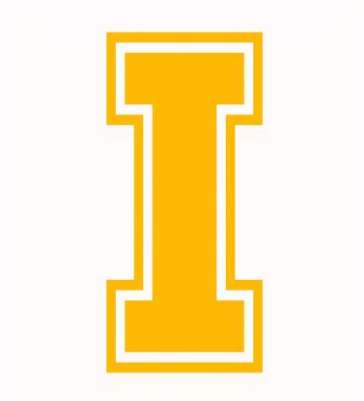


CT-Current Transformer



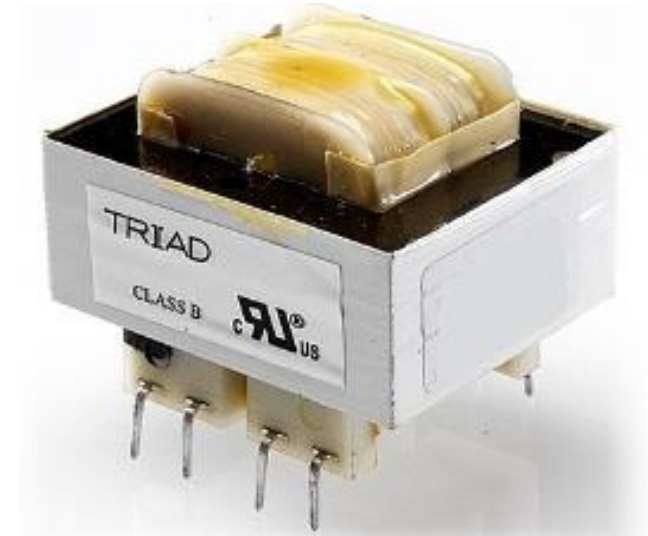
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PXI 6251	
2	$Z_{Encoder}$
3	V_A
4	Torque

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

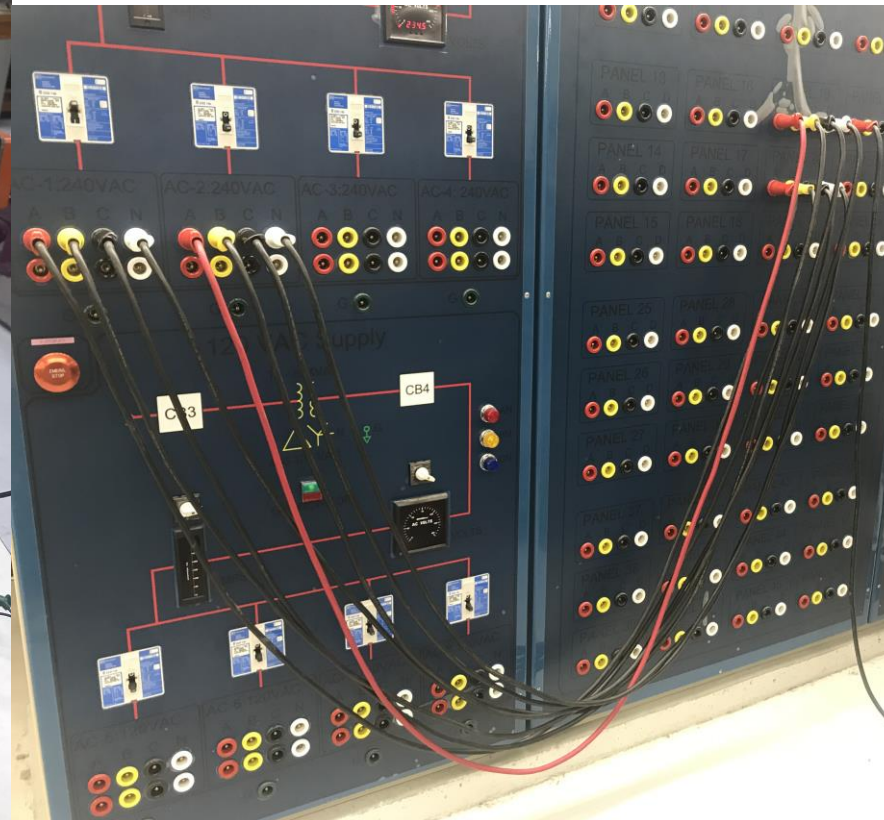
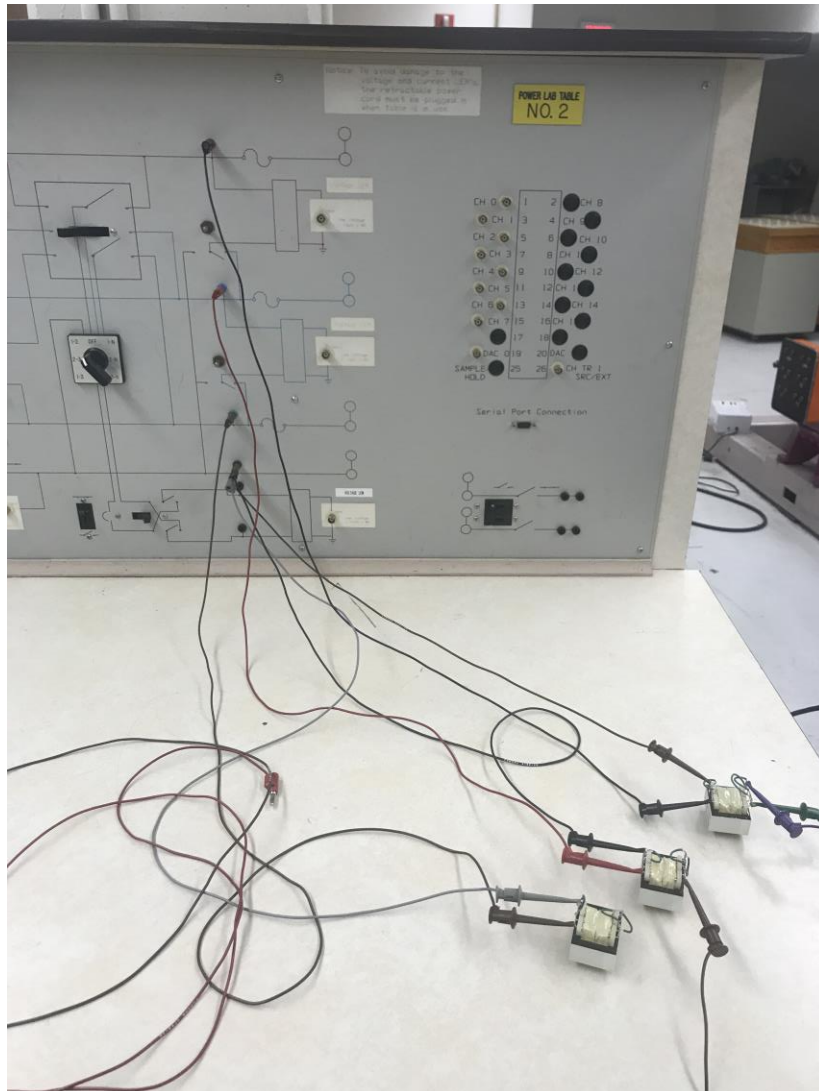


Potential Transformer

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



Pt connection method



PXI 6289	
Channel#	Signal
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3	I_A
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7	I_{DC}
PXI 6251	
2	$Z_{Encoder}$
3	V_A
4	Torque



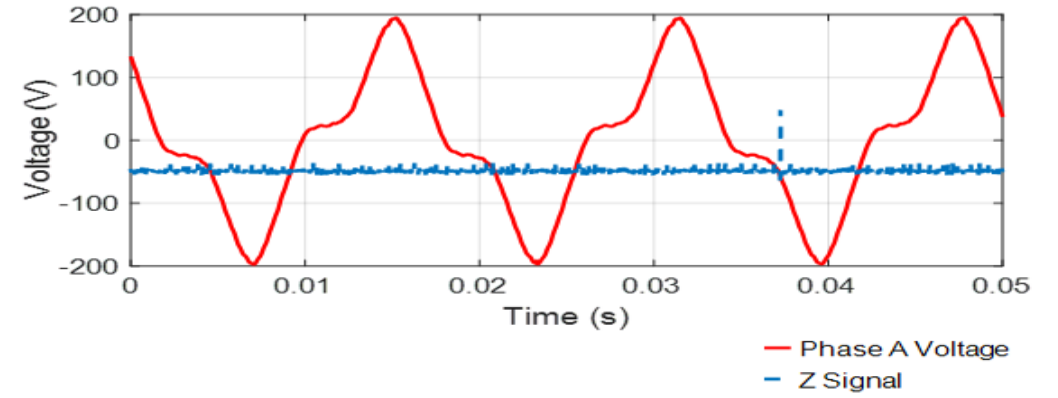
Encoder



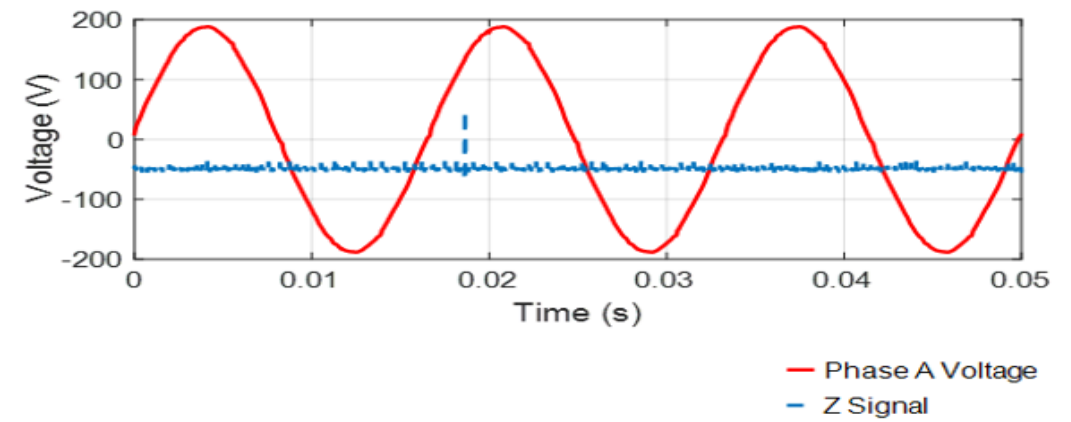
$$\theta_{NL} = \left(\frac{T_{NL}}{T} \times 360^\circ \right)$$

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

Terminal Voltage Waveform and Encoder Pulse Signal (Unloaded)



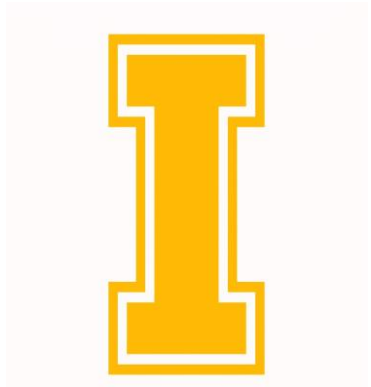
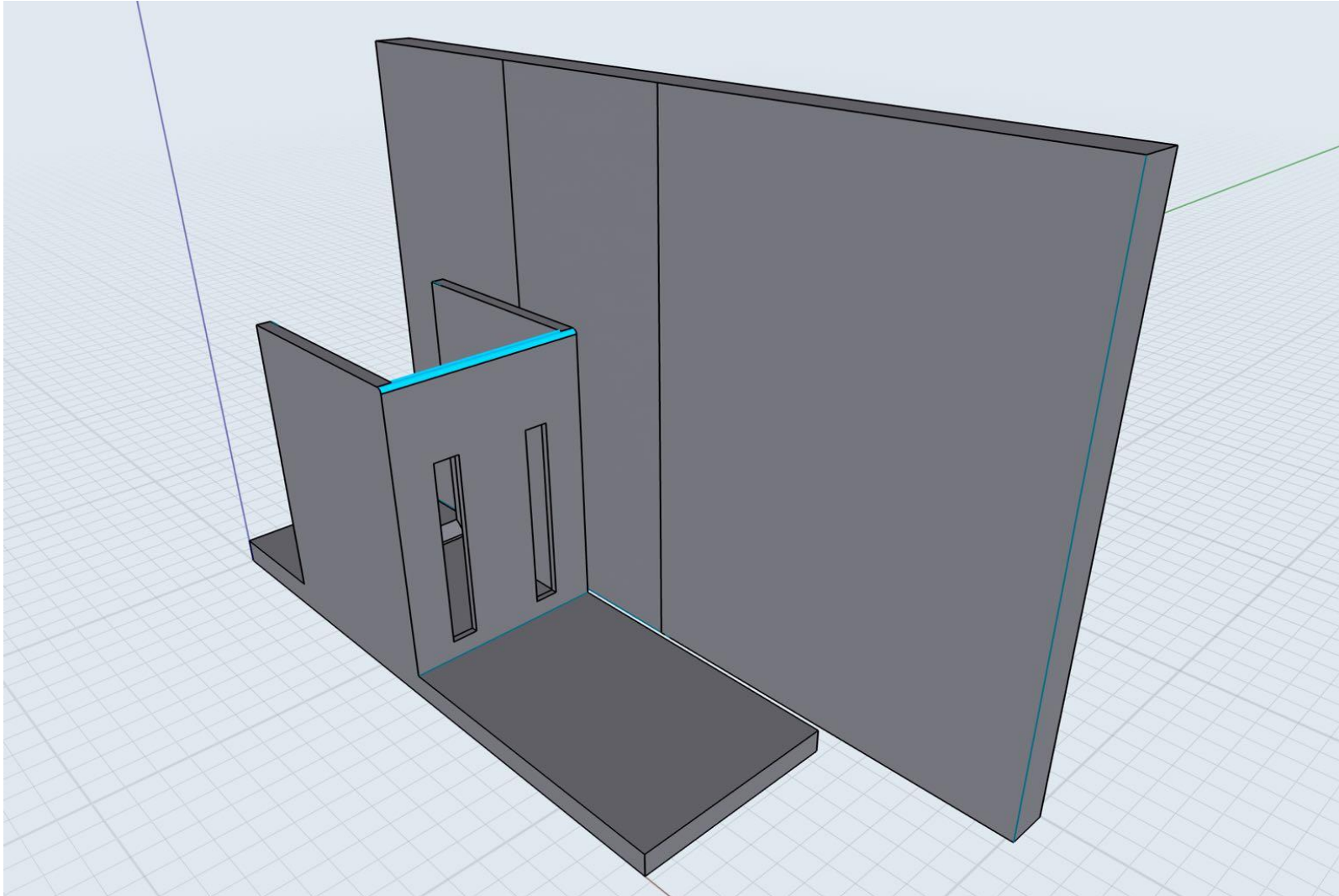
Terminal Voltage Waveform and Encoder Pulse Signal (Loaded)



Torque Transducer



Connection Box Solid Model



Design 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:

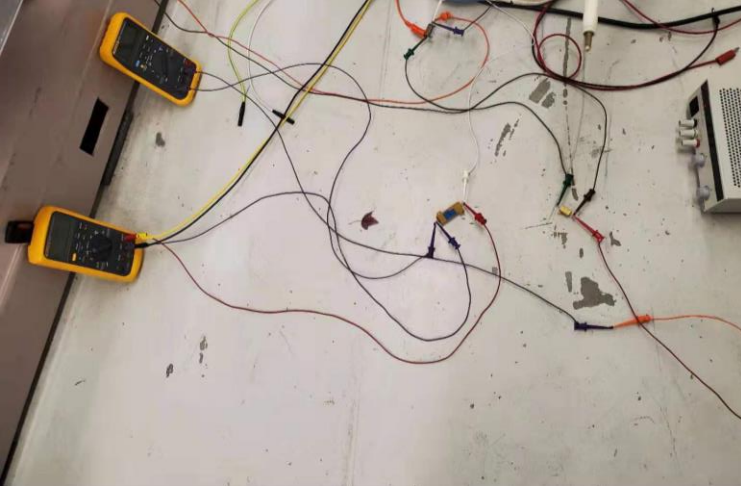
- 1) High heat resistance
- 2) Lighter Material
- 3) Non-conductive

Cons:

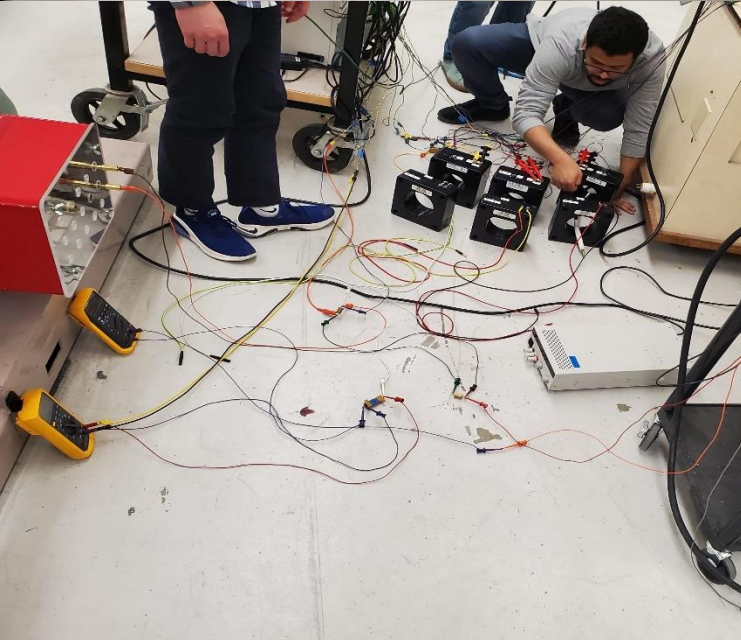
- 1) Aging due to the action of light, heat and oxygen
- 2) High static electricity



Design 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



Question

