EE463

STATIC POWER CONVERSION – I

HARDWARE PROJECT PRESENTATION

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OUTLINE

- Project Requirements
- Proper Topologies
- Simulation Results
- Analytical Calculations
- Component Selections
- Conclusion

Project Requirements

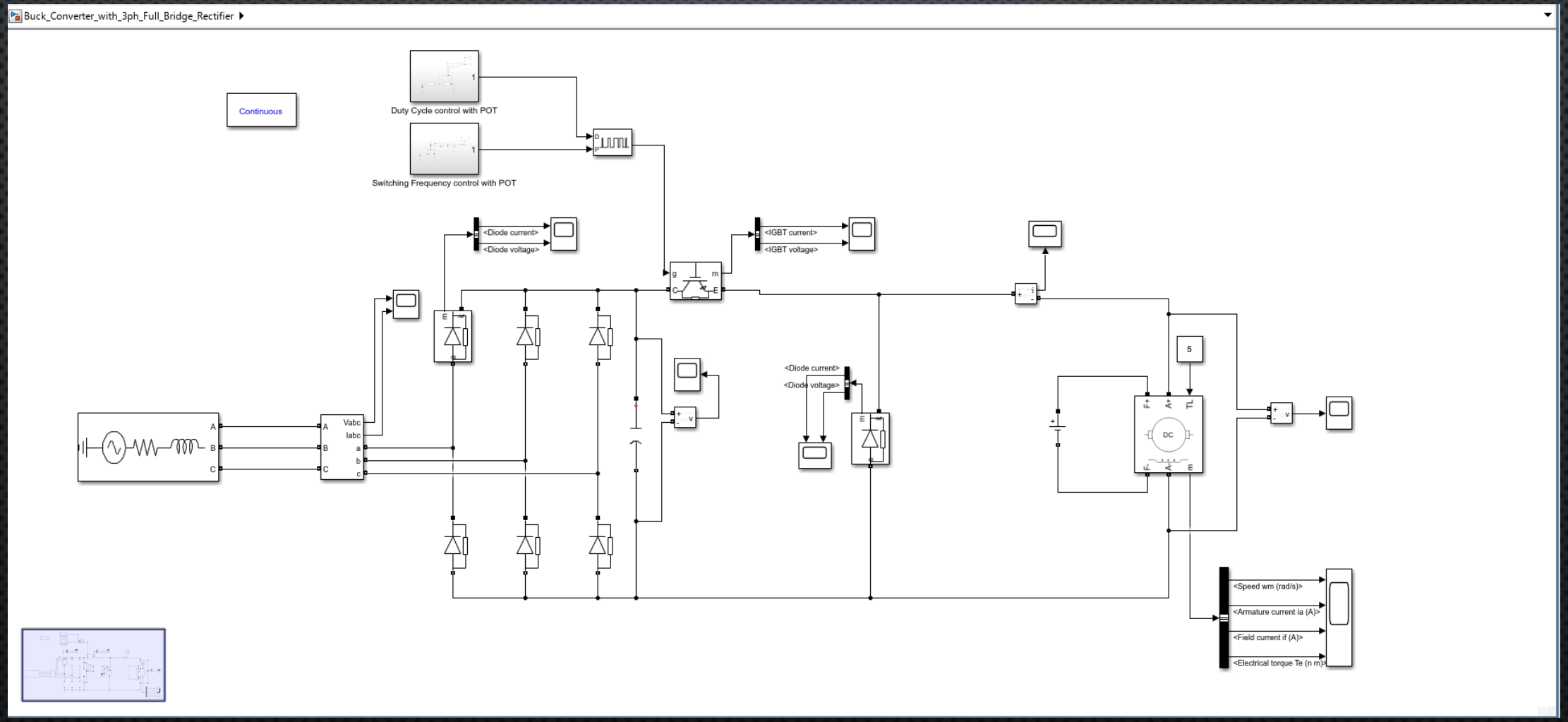
- Power input with 3-phase or 1-phase AC grid (Adjustable with variac)
- Output: Adjustable DC output (Vout,max = 180V)

Proper Topologies

- Thyristor rectifier
  - Better for high power applications
  - Phase control is possible
  - Control circuitry is complex and costly
- Dimmer circuit
  - Easier to control output voltage level
  - Easier to utilize four-quadrant operation
  - Control circuitry is complex and costly
  - Requires high filtering components
- Diode rectifier and buck converter
  - Easier to construct
  - Easier to control output voltage level
  - Basic control circuitry
  - Lacks phase control

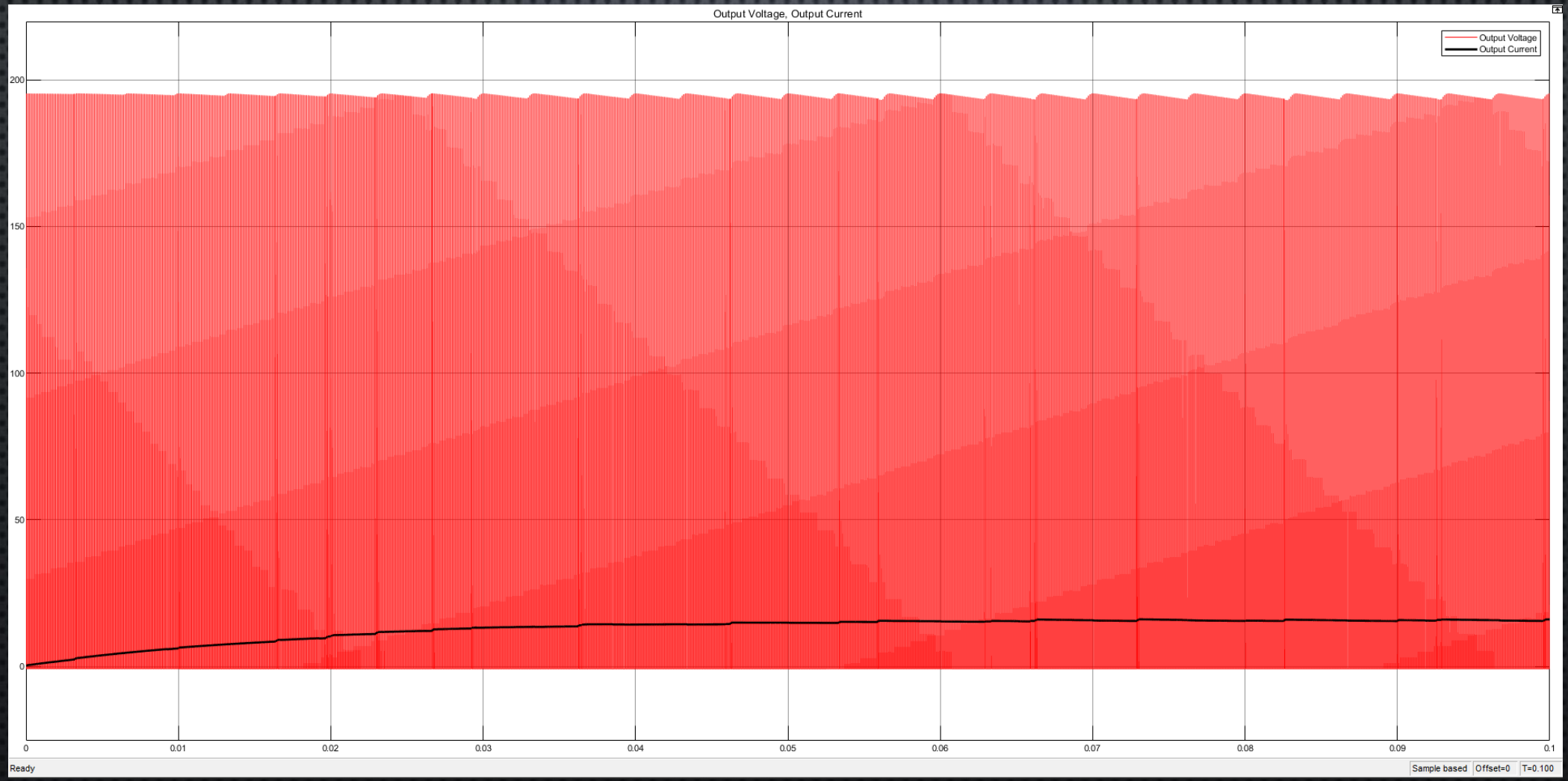
Selected Topology

Diode Rectifier and Buck Converter with manual Duty Cycle and Switching Frequency Control



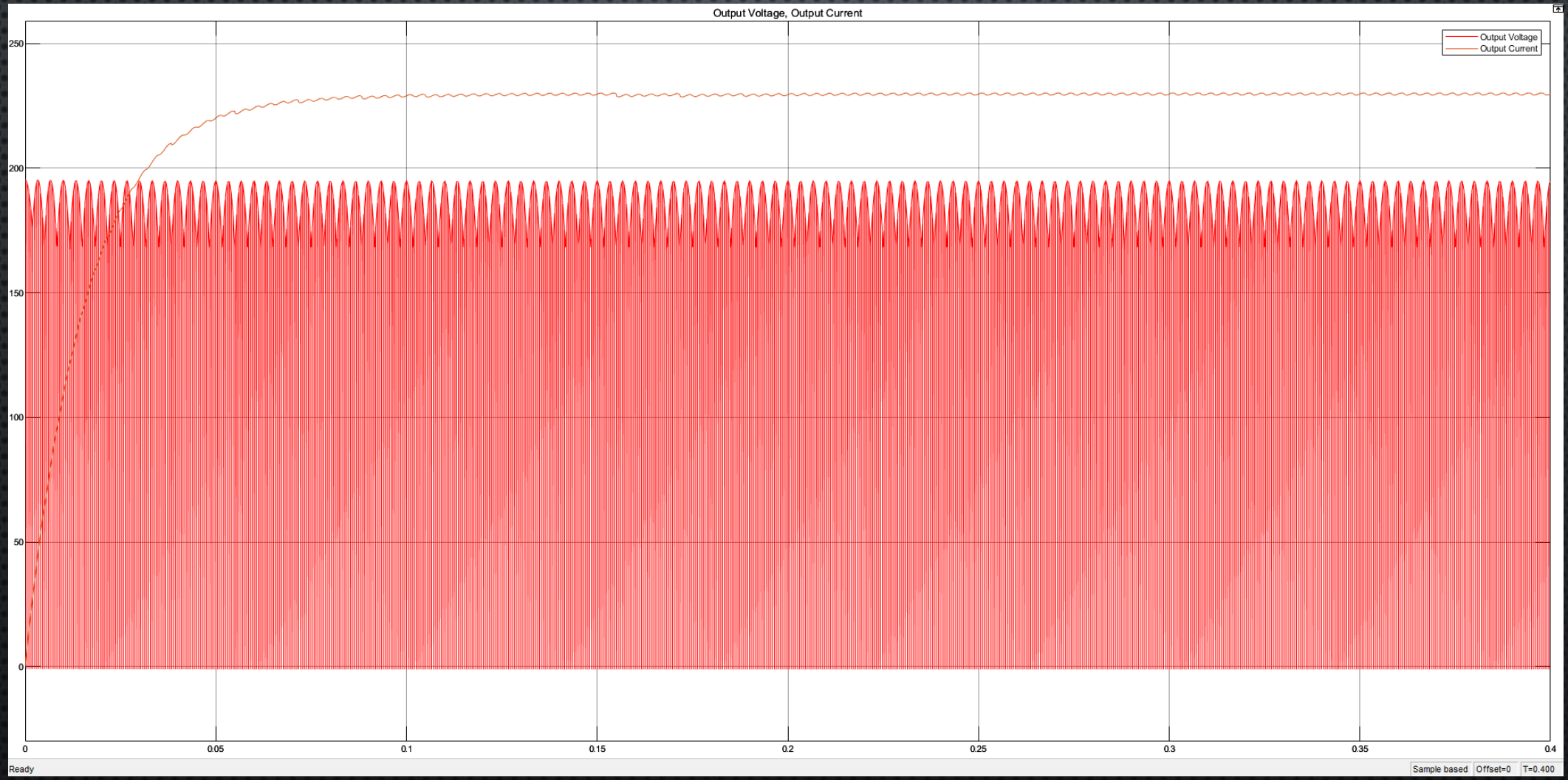
Simulation Results(with RL load)

0.2 Duty Cycle – 10 kHz switching frequency



Simulation Results(with RL load)

0.9 Duty Cycle – 2 kHz switching frequency



Analytical Calculations

$$V_{d,max} = 1.35 * V_{l-l,rms} * \sqrt{2},$$

$$for\ V_{l-l,rms} = 140\ V, V_{d,max} = 198V$$

$$P_{out} = V_{out} * I_{out}$$

$$for\ efficiency\ of\ 70\%$$

$$I_{out} = \frac{2kW}{180V * 0.7} = 16A$$

$$\Delta i_L = \frac{V_o * (1 - D)}{L * f_s}$$

$$for\ V_o = 180\ V, D = 0.2,$$

$$L = 12.5mH, f_s = 2kHz$$

$$\Delta i_L = 1.44\ A$$

$$for\ V_o = 180\ V, D = 0.9,$$

$$L = 12.5mH, f_s = 10kHz$$

$$\Delta i_L = 1.30\ A$$

Component Selection

IGBT	>400V	>25A
RECTIFIER	>400V	>25A
CAPACITOR	400V	3 x 470µF
POTENTIOMETER		1-100kΩ
Schottky Diode	>400V	>25A
Microcontroller Raspberry Pi Pico		

Conclusion

- Testing
- Integration
- PCB Design