

Senior Project – Electrical Engineering – 2020

Three-phase Pulse Width Modulated AC/DC Rectifier and DC/AC Inverter

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INTRODUCTION:

- Alternating current (AC) is an electric current that periodically reverses direction. Direct current (DC) only flows in one direction.
- AC can be converted to DC using a rectifier. DC can be converted to AC using an inverter.
- Three-phase power is the most common method to transfer power. In the system, there are three conductors carrying AC of the same frequency and voltage amplitude but with a phase difference of $1/3$.
- Pulse width modulation (PWM) helps to reduce the harmonics that may distort the output voltage.

DESIGN:

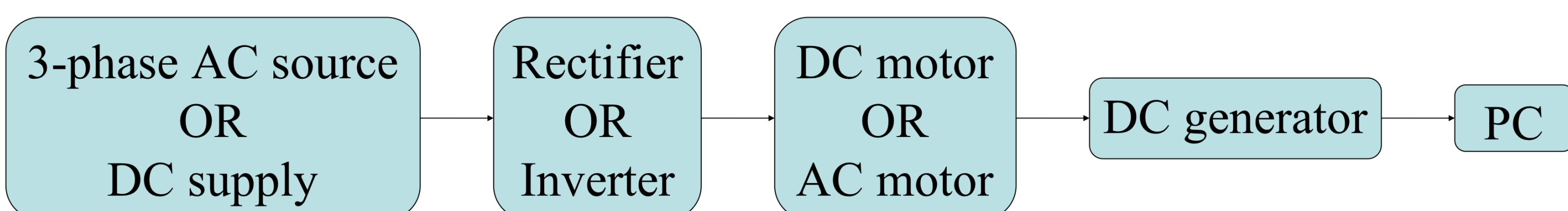


Figure 1: Block diagram of rectifier/inverter system

- Goal: To replicate what happens in an electric vehicle using motors and generators
- Input signal is either three-phase AC or DC
- Circuit converts or inverts signal into DC or three-phase AC
- PWM from Arduino simultaneously creates the new output signal
- The new output signal is fed into the motors to power them or DC will be fed into the microgrid to power the system

DESIGN REQUIREMENTS:

- Convert AC to DC and vice versa to power motors and/or microgrid
- Use PWM to control output, specifically space-vector modulation for the inverter and converter
- Use an Arduino Mega
- Outputs of circuits must be a maximum of 36 V and 7 A for the rectifier and 15 V and 2 A for the inverter

SIMULATION and TESTING:

- Three-phase Rectifier provided by Syed Abdul Rahman Kashif

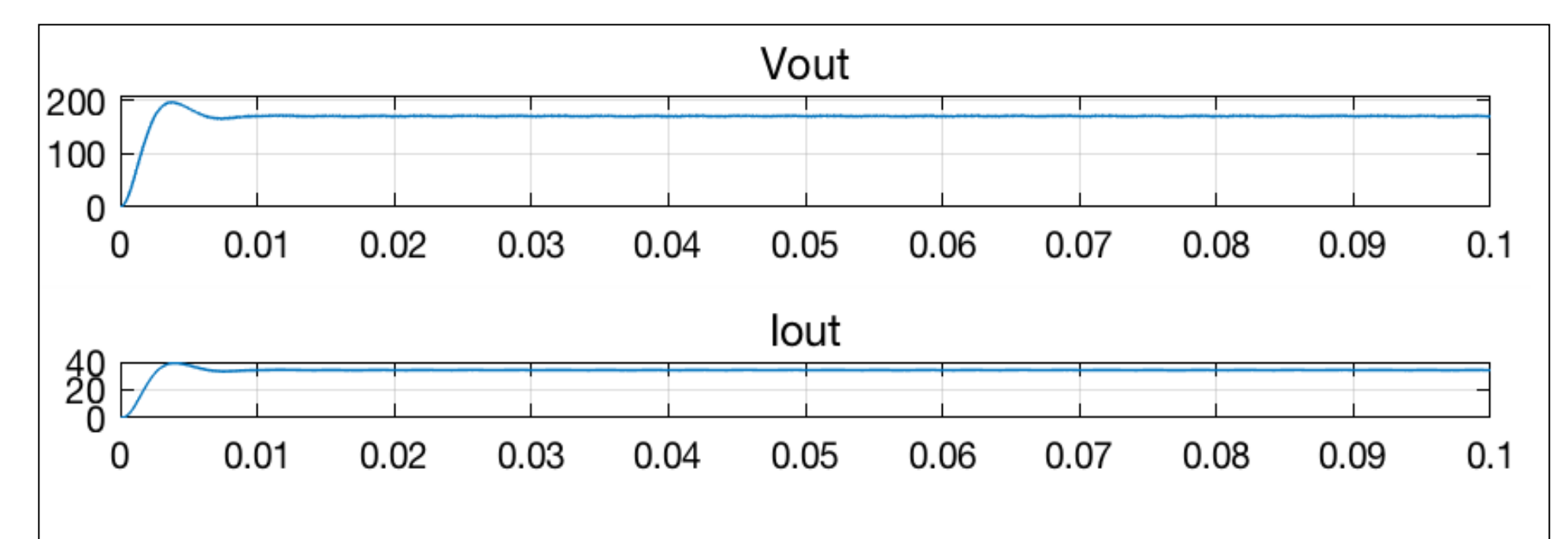
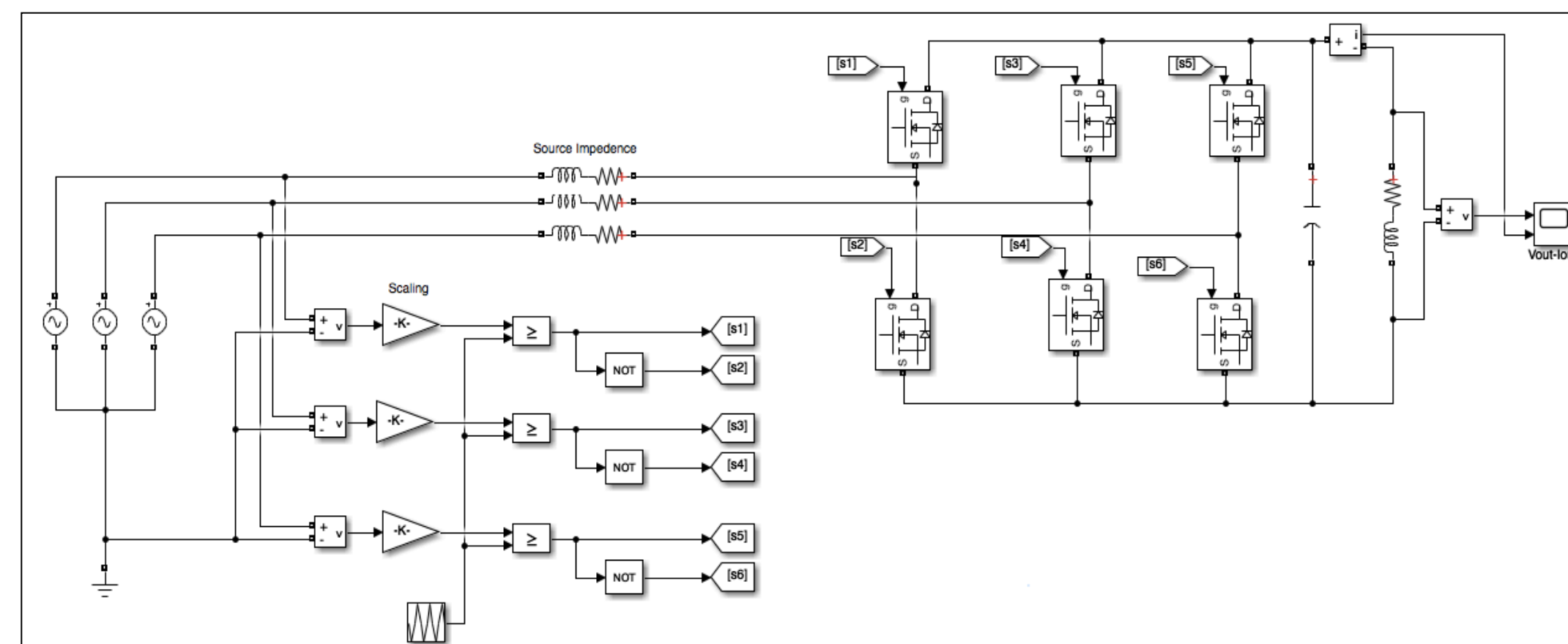


Figure 2 and 3: Rectifier circuit and voltage and current output

- Input: 3-phase AC sinusoidal signals
- Gain controls and logic go into gates of the transistors and drain outputs the signal to be fed to a filter capacitor
- Three-phase Inverter provided by Rashmil Dahanayake

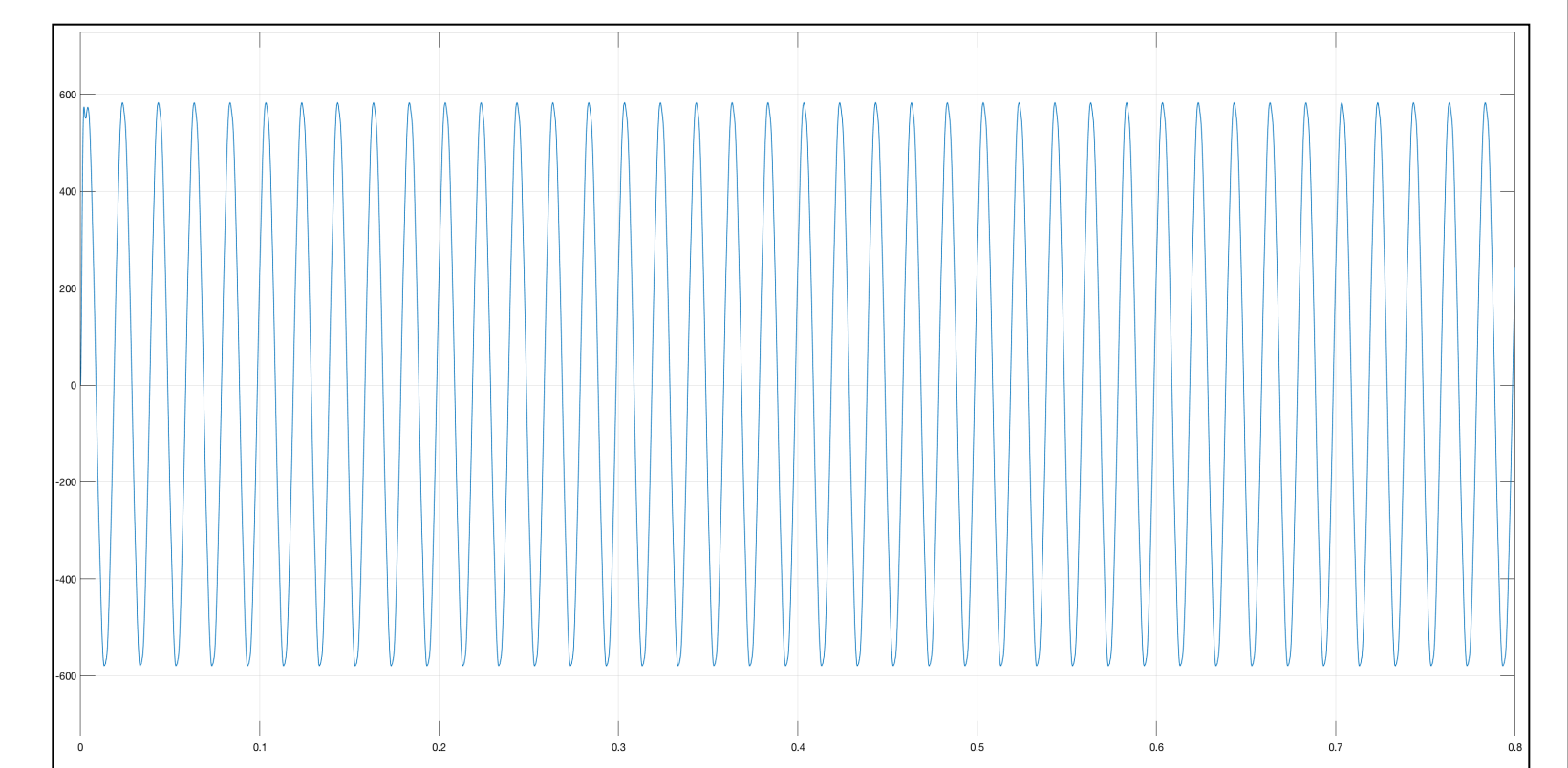
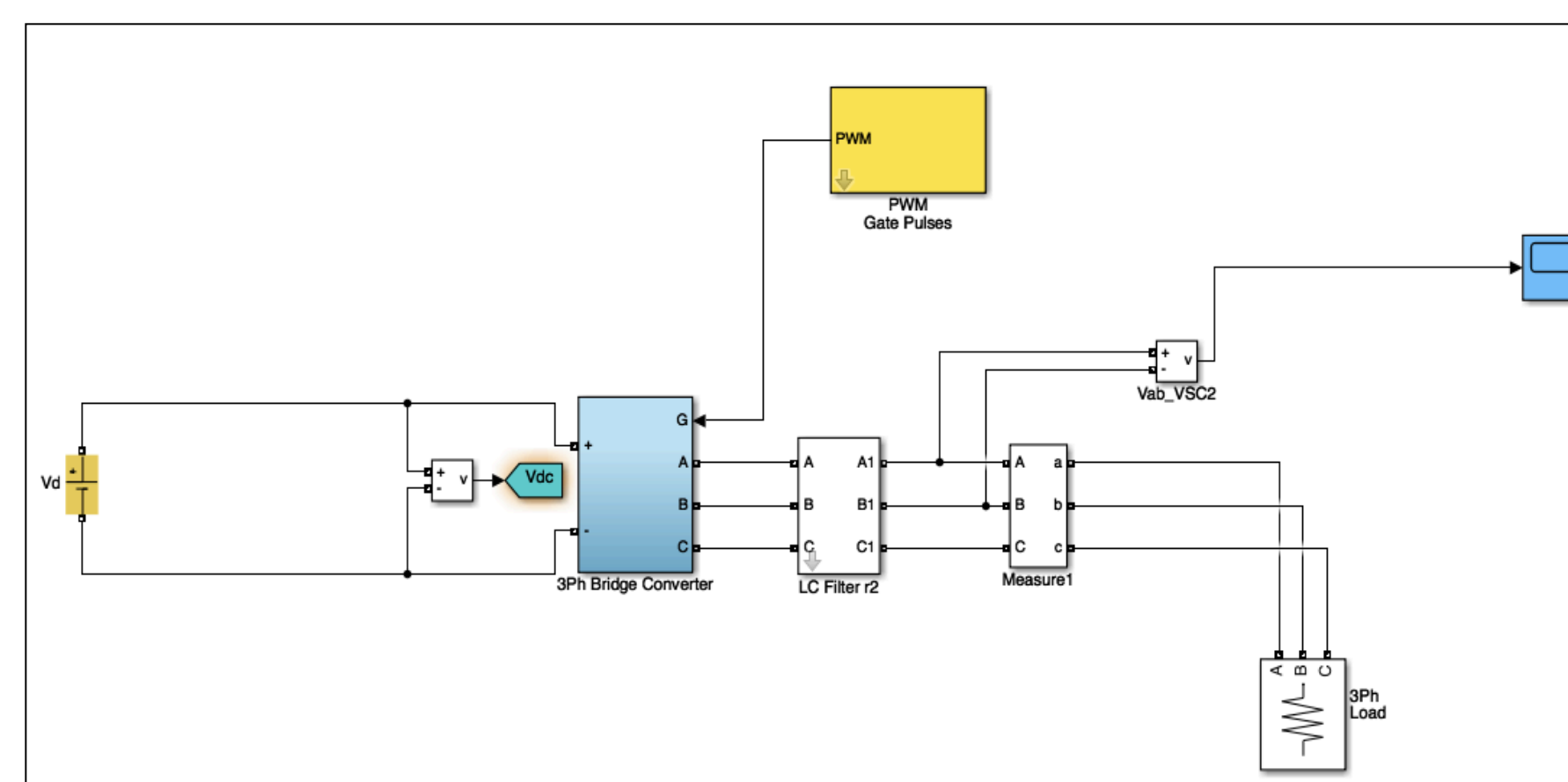


Figure 4 and 5: Inverter circuit and voltage output

- Input: DC signal
- Converter is used to provide comparison values to be fed to the output

FUTURE WORK:

- Build and test first prototype with independent inputs
- Create Simulink + Multisim models from scratch
- Begin Arduino code for PWM
- Integrate final prototype with motors and PWM

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