# Analytical Calculations

It is decided to use three phase diode rectifier to convert AC voltage to DC. Average output voltage of the three phase diode rectifier can be found as:

Then the average output voltage of the rectifier is equal to the input voltage of the buck converter, . And the output coltage of the buck converter is:

Where D is the duty cycle. To satify the project conditions, is equal to 180V. And to work safe and efficient, maximum value of the duty cycle is 80%. Because are ignored nonidealities such as commutation effect.

To give 225V to buck converter, 166.608 should be supplied to rectifier. Considering rectifier is powered through the variac, the variac’s working percentage should be calculated. Using the explained equations, several calculations done in order to decide on the values. The results can be observed in figure X., the analytical choices are done considering that All calculations done under the knowledge of standard RMS voltage in Turkey is 230V, so the variac’s maximum output is V.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Buck Converter Output = Motor Input (V)** | **Duty Cycle** | **Rectifier Output = Buck Converter Input (V)** | **Variac Output = Rectifier Input (V)** | **Variac Percentage** | | 180 | 0,8 | 225 | 166,608 | 0,418 | | 170 | 0,8 | 212,5 | 157,352 | 0,395 | | 170 | 0,2 | 850 | 629,408 | 1,580 | | 170 | 0,35 | 485,714 | 359,662 | 0,903 | | 105 | 0,2 | 525 | 388,752 | 0,976 | | 105 | 0,5 | 210 | 155,501 | 0,390 | | 170 | 0,5 | 340 | 251,763 | 0,632 | | 170 | 0,6 | 283,33 | 209,803 | 0,527 | | 170 | 0,79 | 215,196 | 159,349 | 0,4 | | 105 | 0,49 | 215,196 | 159,349 | 0,4 | | 170 | 0,63 | 268,995 | 199,186 | 0,5 | | 105 | 0,39 | 268,995 | 199,186 | 0,5 | | 129,118 | 0,6 | 215,196 | 159,349 | 0,4 | | 43,039 | 0,2 | 215,196 | 159,349 | 0,4 | | 215,196 | 0,8 | 268,995 | 199,186 | 0,5 | | 134,498 | 0,5 | 268,995 | 199,186 | 0,5 | |

Figure X. Tabulated results and comparision of voltages and percentages