EE4643: Power Electronics

Laboratory 3: AC-AC Controllers

Objectives

The main objectives of this experiment are to investigate the performances of 3ϕ AC-AC power electronic converters (AC Controllers) when supplying a 3ϕ induction motor. The target performances include harmonic contents on the input and output sides of the converter, input power factor, and output power factor.

Review

AC-to-AC power electronic converters (AC Controllers) were developed for providing output ac voltages and currents with different magnitudes and/or frequencies when fed from ac supplies that have fixed voltage and frequency. The power electronic converters (PECs) became popular in different industrial sectors, including light dimmers, AC motor drives, heat controllers, uninterruptable power supplies, etc. There are many different types of AC controllers that were designed to produce an output voltage at the same frequency as the supply with variable amplitudes. Other AC controllers were developed to produce out voltages and currents with adjustable magnitudes and/or frequencies.

CAUTION:

Do not connect or disconnect any component, supply, device while the power switch is on.

Description of the Circuit

Instruments and Components

- AC variable voltage supply: In the lab bench with $ON - OFF$ switch, output pins 4, 5, 6 for 3ϕ supply;
- 3ϕ Induction motor;

- 3ϕ thyristor AC controller;
- The thyristor AC controller firing angle controller;
- Connection Leads (different lengths);
- The LabVolt Data Acquisition Module (DAM)

Experimental Work

The 3ϕ AC controller for this laboratory work is to be constructed using the thyristor module. The firing angles are generated by the firing angle module.

The 3ϕ AC Controller

STEP 1: Construct the circuit shown in Figure 1.

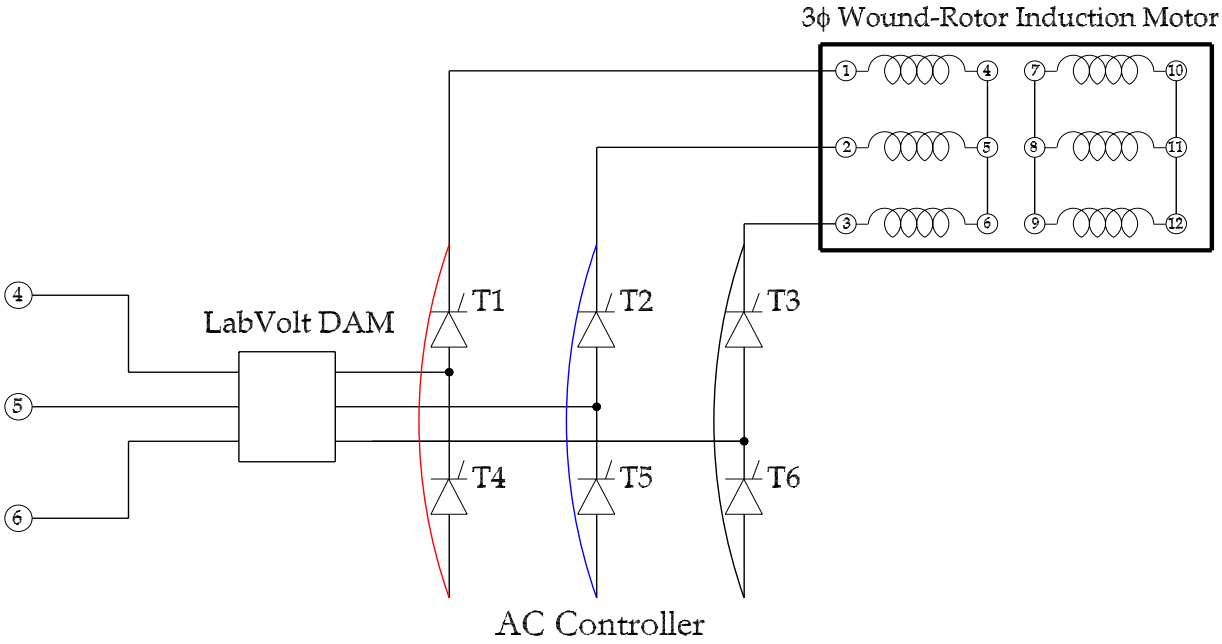

Figure 1: The 3ϕ thyristor AC controller.

STEP 2: Connect and prepare the data acquisition module (DAM) unit. Also, connect the thyristor module with the firing angle unit (remember to select 3ϕ).

STEP 3: Connect the input voltage and current through the DAM. Also, connect the output voltage and current through the DAM unit.

STEP 4: Switch ON the power Supply, and increase the supply voltage to 120 V.

STEP 5: Using the metering feature of DAM, measure the input current, active power and reactive powers, and output voltage, current and active and reactive powers. Complete the data in Table 1. Note that input PF, HF, η need to be calculated.

Table 1: *DATA FOR THE* 3ϕ *THYRISTOR AC CONTROLLER.*

α	$(I_a)_{in}$	P_{in}	Q_{in}	V_o	$(I_a)_{out}$	P_o	Q_o	PF_o	η
0									
20									
40									
60									
80									
100									

STEP 6: for $\alpha = 60$, observe and record the waveforms of the input voltage and current, as well as the the output voltage and current. Save an image for each spectrum, and attach it to your report

STEP 7: Decrease the supply voltage to 0 V, and switch OFF the power Supply.

Calculations and Questions

Q1– From the data in Table 1, create graphs for α vs V_o, α vs PF_o, α vs Q_o, and α vs η.

Q2– Comment on the graphs created in Q1.

Conclusions

The last part of the report has to be the conclusions. In this part, has to be a summary of the observations made during the experimental work. Also, it should reflect on the agreement or disagreement between the theoretical (calculated) and measured values.