ECE 370
POWER & ENERGY SYSTEMS

EXPERIMENT 1
VOLTAGE REGULATION AND EFFICIENCY CALCULATION OF A THREE-PHASE LOAD FED FROM A FEEDER

Objective

The objectives of this laboratory experiment are summarized below:

1. Understand the impact of a Feeder impedance on a balanced three-phase load voltage.
2. Perform Voltage Regulation measurements & calculations for a balanced three-phase load.
3. Perform Efficiency measurements & calculations for a balanced three-phase load.
4. Perform pf correction measurements & calculations for a balanced three-phase load.

Pre - Lab

The Transmission Line Simulator is modeled by a pi-equivalent as shown in Figure 1 and its impedance values are provided in Table 1. Select switch position 3 for this experiment.

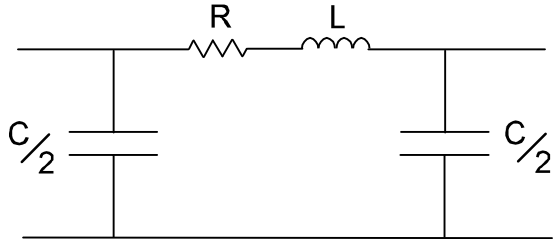

Figure 1. *Pi-equivalent circuit for one phase of the transmission line*

Table 1. Transmission Line Simulator (TLS-100)

Switch Position	kV	Mile	R(Ω)	L(mH)	C(μF)
3	220	200	5.7	97	0.33

The three-phase, wye-connected, balanced load for this experiment consists of a 300 Ω resistor and a 0.8 H inductor in parallel per phase. The load voltage should be kept fixed at 208 V line-to-line (120 V line-to-neutral) for the entire experiment. Be sure that each load component is constructed to these specifications to avoid an unbalanced load.

Perform the calculations of feeder voltage regulation and efficiency for Figure 2 in your lab notebook prior to attending the laboratory. These calculations will form the predicted results.

Also, develop a methodology for correcting the load power factor to unity with a load voltage 208 V line-to-line, and repeat the voltage regulation and efficiency calculations after power factor correction is performed.

Procedure

Set-up the circuit of Figure 2 in the laboratory. Use one phase of the Three-Phase Variable Power Supply as your reference for source voltage. Gradually increase the source voltage until your load voltage is 120 V line-to-neutral and keep it at this value throught the lab.

Use the Tektronix Oscilloscope power measurement feature to measure the source voltage and the average (real) power of "phase a", repeating the measurements for each phase to obtain a total average (real) power. Use the Yokogawa to measure the load voltage, load current, and the load power. Based on these measured values, calculate the feeder voltage regulation and efficiency for the following two cases:

1. The specified load of 300 Ω and 0.8 H.
2. The specified load of 300 Ω and 0.8 H after the power factor correction.

Create a table and document the analytical and measured values of voltage regulation and efficiency for the above two cases. Also, create another table and calculate the percent error of voltage regulation and efficiency for the above two cases.

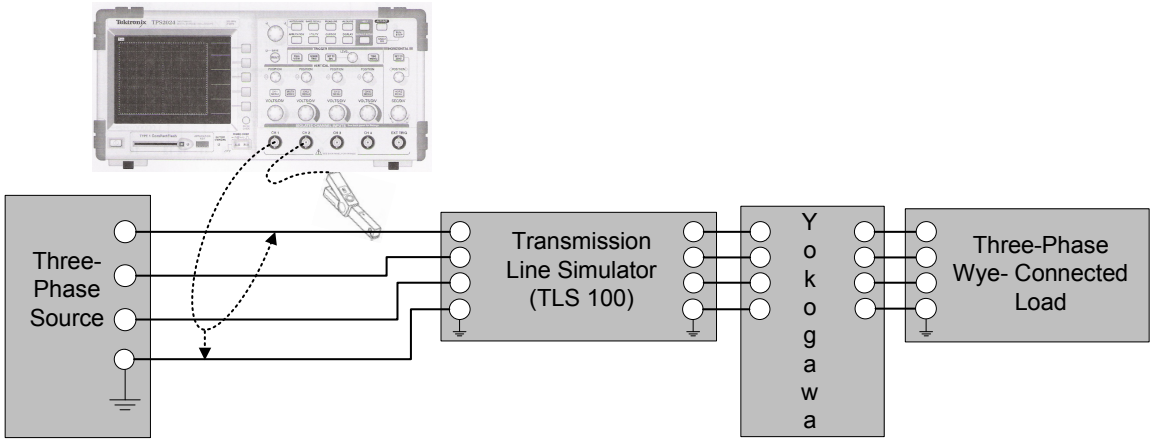

Figure 2. *Circuit Construction for Load fed through Transmission Line Model*

The Yokogawa connections are as shown in Figure 3.

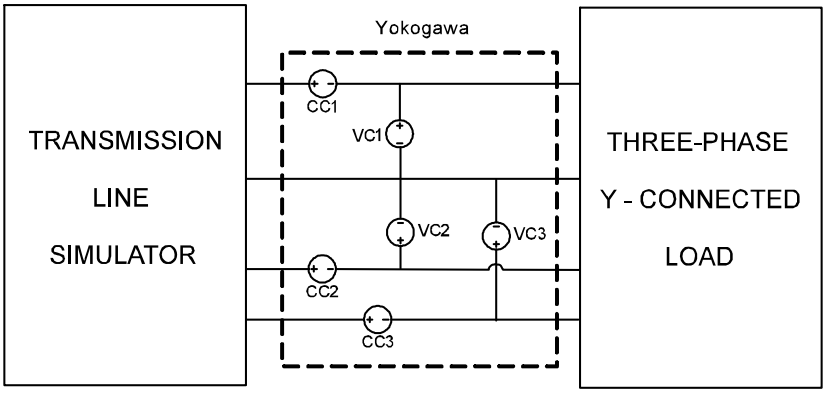

Figure 3. *Yokogawa fed from Transmission Line Model*

Documentation

The experiment should be documented in your lab notebook in a lab log format. Your documentation should be complete and clear, so you would be able to write a formal report based on the logged information. Print-outs should be neatly pasted in your lab notebook.