ELEC 302-81
Lab 2
Transformer Fundamentals

January 28, 2013

Date Performed:	January 28, 2013
Partners:	Rawley Dent
	Charles Pittman
Instructor:	Dr. Weatherford

1 Purpose of Experiment

In this experiment, an RLC circuit was modeled on an EMS workstation. The capacitance was varied for two different inductance values. The circuit was then analyzed to obtain measured values for the circuit power factor, real power, and apparent power. These measured results were then compared to the theoretical values calculated beforehand. Familiarization with the EMS workstation was also obtained.

2 Circuits Tested

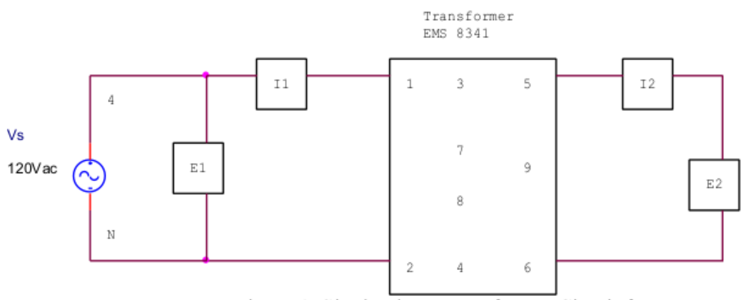

Figure 1: Single Phase Transformer Circuit for part

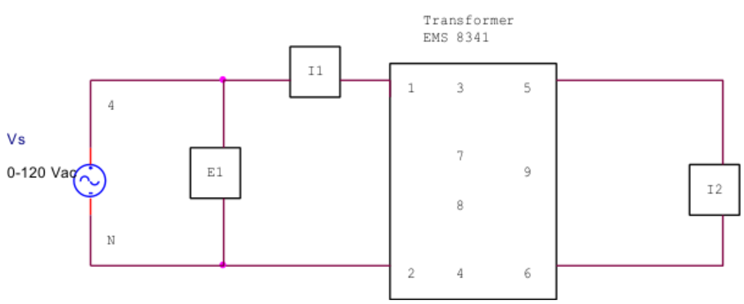

Figure 2:

Figure 3: Single Phase Transformer Circuit for part two

3 Procedure

At the EMS workstation, the main power switch of the Power Supply was verified to be OFF, and the voltage control knob was verified to be completely

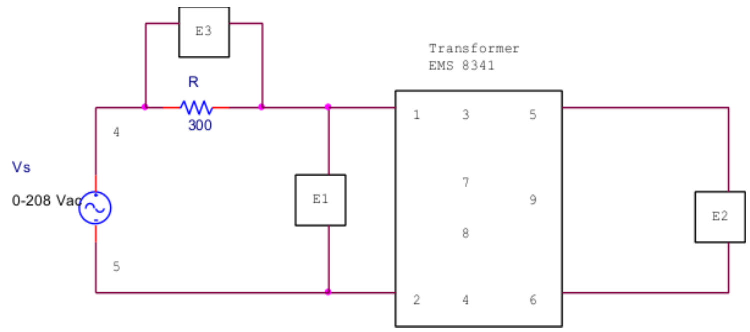

Figure 4: Single Phase Transformer Circuit for part three

R	L	C
Ω	H	μF
1200	0.8	—
1200	0.8	2.2
1200	0.8	4.4
1200	0.8	8.8
1200	1.6	—
1200	1.6	2.2
1200	1.6	4.4
1200	1.6	8.8

Table 1: RLC Values for circuit in Figure **??**

counterclockwise. The voltmeter selector switch was set to position 4-N. The RLC circuit shown in Figure **??** was modeled with the capacitor left out at first. The elements labeled E_1 and I_1 on Figure **??** referred to the ammeter and voltmeter Data Acquisition Interface (DAI) connections. The DAI 24-V supply was connected to the main Power Supply, and the DAI USB cable was connected to the PC workstation. The main power switch of the Power Supply was switched to ON.

On the PC, the Lab-Volt Data Acquisition Management application was started, and the file pertaining to the experiment being worked was opened. Three windows (metering, oscilloscope, and phasor analyzer) were verified to open up along with the experiment file. The three windows were set to continuously refresh.

The supply voltage was adjusted to read 24-V. Verification was obtained by monitoring the EMS analog voltmeter and the digital metering window on the PC. The load voltage E_1, load current I_1, the real power consumed by the circuit, and the phase angle were recorded. In the Phasor Analyzer window, E_1 was selected as the reference phasor. The voltage control knob was then turn completely counterclockwise and the main power switch was set to OFF.

The EMS workstation was then reconfigured to include the capacitance. The subsequent values included in Table **??** were then measured.

4 Calc

R	L	C	I_1	E_1	P	θ	S	Q	p.f.
Ω	H	μF	A	V	W	$\circ$	VA	VAR	
1200	0.8	—	0.210	60	4.56	68.77	12.58	11.73	0.36
1200	0.8	2.2	0.164	60	4.56	62.48	9.86	8.75	0.46
1200	0.8	4.4	0.122	60	4.56	51.65	7.34	5.76	0.62
1200	0.8	8.8	0.076	60	4.56	-2.67	4.56	-0.21	1.00
1200	1.6	—	0.114	60	3.39	60.27	6.84	5.94	0.50
1200	1.6	2.2	0.075	60	3.39	41.06	4.50	2.96	0.75
1200	1.6	4.4	0.057	60	3.39	-0.50	3.39	-0.03	1.00
1200	1.6	8.8	0.115	60	3.39	-60.51	6.89	-6.00	0.49

Table 2: Calculated Data

$$\mathbf{P} = \mathbf{VI}\cos\theta$$

$$\mathbf{Q} = \mathbf{VI}\sin\theta$$

$$\mathbf{S} = \mathbf{VI}^*$$

$$\mathbf{V} = \mathbf{IZ}$$

$$\text{p.f.} = \cos\theta$$

5 Results

6 Comparison with Theoretical: Percent Deviation

$$\%\text{deviation} = \frac{measured - theoretical}{theoretical} \times 100\%$$

7 Conclusions

The effects of different levels of capacitance were observed by conducting this experiment. The theoretical values for real power, apparent power, and the phase angle were calculated. Then, the experiment was conducted to verify the effects of a parallel RLC circuit. These measured results were differed from the theoretical results because of one underlying reason. The switch modeling

R	L	C	I_1	E_1	P	θ	S	Q	p.f.
Ω	H	μF	A	V	W	$\circ$	VA	VAR	
1200	0.8	—	0.206	60.9	4.53	68.0	12.55	11.21	0.37
1200	0.8	2.2	0.158	60.9	4.56	60.9	9.62	8.19	0.49
1200	0.8	4.4	0.117	60.9	4.59	49.0	7.13	5.28	0.66
1200	0.8	8.8	0.081	61.0	4.65	-4.4	4.94	-0.36	1.00
1200	1.6	—	0.116	61.0	3.94	55.4	7.08	0.37	1.00
1200	1.6	2.2	0.079	61.0	3.96	32.8	4.82	2.55	0.84
1200	1.6	4.4	0.067	61.0	3.99	-6.6	4.09	-0.46	1.00
1200	1.6	8.8	0.124	61.2	4.05	-57.4	7.60	-6.33	0.54

Table 3: Experimental Data

R	L	C	I_1	E_1	P	θ	S	Q	p.f.
0.0	0.0	—	1.9	1.5	0.7	1.1	0.2	4.4	2.8
0.0	0.0	0.0	3.7	1.5	0.0	2.5	2.4	6.4	6.5
0.0	0.0	0.0	4.1	1.5	0.7	5.1	2.9	8.3	6.5
0.0	0.0	0.0	6.6	1.7	2.0	65	8.3	71	0.0
0.0	0.0	—	1.8	1.7	16	8.1	3.5	94	100
0.0	0.0	0.0	5.3	1.7	17	20	7.1	14	12
0.0	0.0	0.0	18	1.7	18	1220	21	1433	0.0
0.0	0.0	0.0	7.8	2.0	19	5.1	10	5.5	10

the inductance at the EMS workstation contained an internal impedance. This added impedance caused the calculated results to differ from the measured. Also, one can see that the voltage measured at E_1 fluctuating throughout the experiment. This fluctuation caused added variations between measured and theoretical.

It was noted that row 8 of Tables 2 and 3 contained a negative angle for the phase impedance. This signified a highly capacitative load where the phase current lead the phase voltage. All other loads were inductive, except in rows 4 and 7, where the load was slightly capacitative. In these rows, 4 and 7, the power factor recorded as 1.0 signifying an inductive load efficiently corrected by a capacitance.