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Computer Simulation

15. Build the circuit of Figure 8.1 in a simulator. Using Transient Analysis, determine the voltage across the inductor and compare the magnitude and phase to the theoretical and measured values recorded in Table 8.2.

Data Tables

Circuit 1

Ω	Theory	Experimental	% Deviation
X_C	-1665.7		
X_L	628.00		
$R \| \| X_L$	285.06+j445Ω	302.93+j404Ω	8.48
Z_T Magnitude	1252.9	1282.67	2.38
Z_T θ	-76.85	-75.528	1.72

Table 8.1

$\boxed{\dfrac{128.7^\circ}{-24.472^\circ}}$

	Theory Mag	Theory θ°	Exp Mag	Exp Delay	Exp θ	% Dev Mag	% Dev θ
V_{LR}	2.111 V	134.2	1.970 V	-35.75 μs	~~130.1°~~	6.69	4.13
V_C	6.647 V	-13.15	6.493 V	-95.98 μs	~~13.56°~~	2.32	10.04
i_{in}	3.991 mA	76.85°	3.898 mA	N/A	75.528	2.32	1.72

Table 8.2

Nominal: Measured:

10 nF → 9.555 nF

10 mH 9.995 mH

1 kΩ 0.98183 kΩ

~~R~~ G 10 Ω 10.074 Ω

K 10 Ω 10.072 Ω

V_{LR} Simulator

mag. 2.1418 V

delay. 63.2 μs

phase θ 137.49°

Phasor plots sep. page

Circuit 2

Ω	Theory	Experimental	% Deviation
X_C	-1665.67		
X_L	628.00		
$R + X_L$	991.83+j628	1207+j660.5	22.12 dev
Z_T Magnitude	2090.93	1454.5	30.44
Z_T θ	75.167	77.472	3.07

Table 8.3

mA	Theory Mag	Theory θ	Exp Mag	Exp Delay	Exp θ	% Dev Mag	% Dev θ
G i_{LR}	4.290 mA	-32.604°	3.878 mA	-92.44 ms	~~30.97~~ -30.816	9.60	5.48
K i_C	3.001 mA	90°	2.8097 mA	-24.46 ms	~~-89.82°~~ 88.056	6.40	2.26
i_{in}	2.391 mA	-75.17°	3.4376 mA	-3.481 ms	~~-13.38°~~ -77.472	43.76	3.07

Table 8.4

Questions

1. Is the phase relationship between circuit voltages or currents in a series-parallel AC circuit necessarily a right-angle relationship?

No, due to mixed positions of the 3 components.

2. Based on measurements, do KVL and KCL apply to the tested circuits (show work)?

see separate page 56

2. $1.970 \angle 128.7 + 6.493 \angle -14.472 = 5 \angle 0^\circ$ V

$-1.232 + j1.537 + 6.287 - j1.623 \approx 5$ V circuit 2

Circuit 2:

$0.003878 \angle -30.816^\circ + 0.0028097 \angle 88.056^0 = 0.0034376 \angle -77.472$ A

$0.00333 - j0.00199 + 9 \times 10^{-5} + j0.002808 \approx 0.000746 - j0.00336$ A

3. In general, how would the phasor diagram of Figure 8.1 change if the frequency was raised?

The phasors ~~diagram~~ would rotate with frequency increase until the input current vector is parallel to the imaginary axis.

4. In general, how would the phasor diagram of Figure 8.2 change if the frequency was lowered?

The phasors would rotate with decreasing frequency until the input current vector matches the real axis in parallel.

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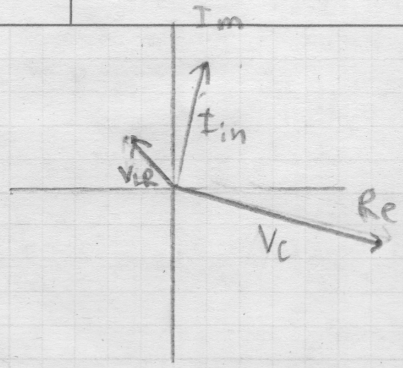
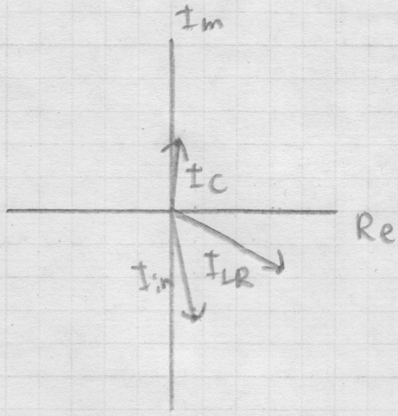
Phasor Plots

1 div = 1 V
= 1 mA



C + R||L



C || R+L

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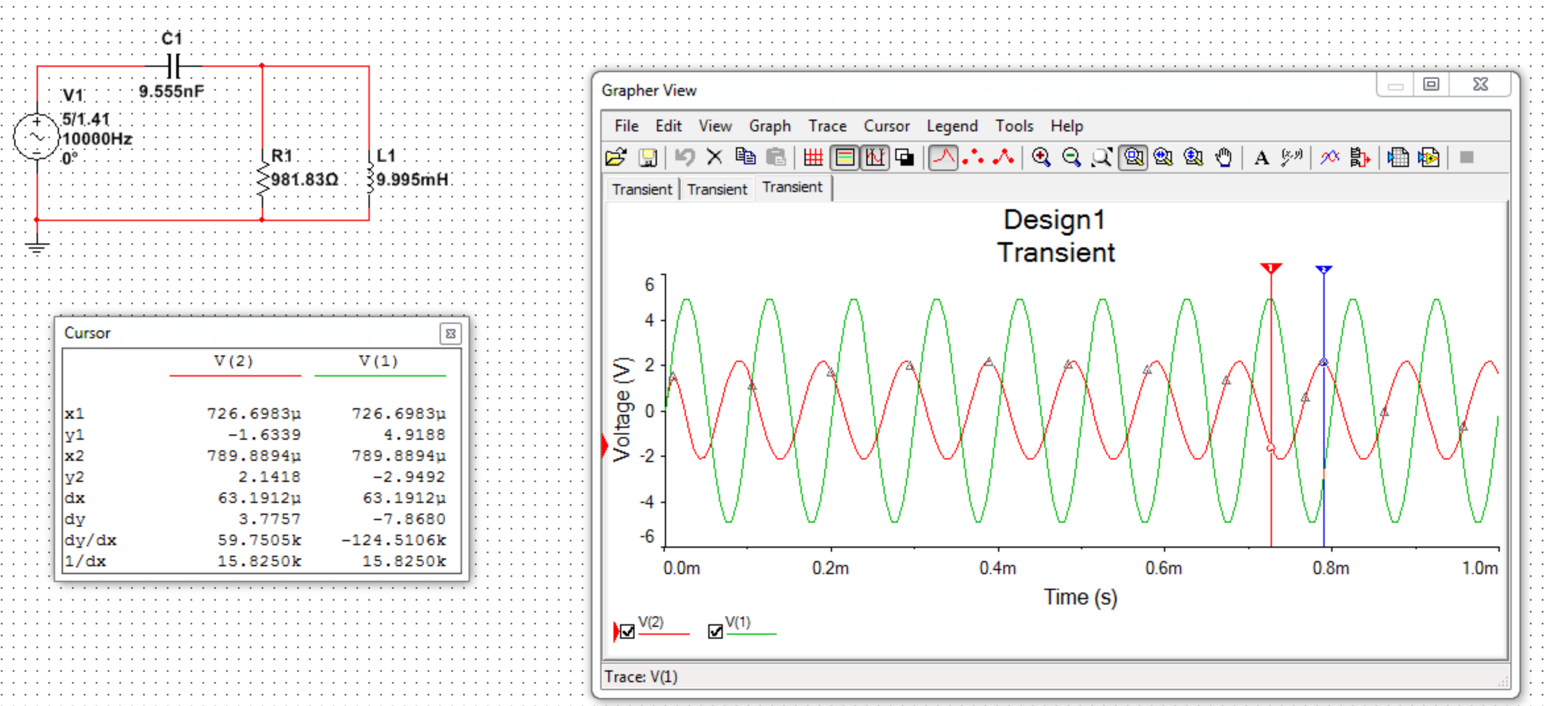

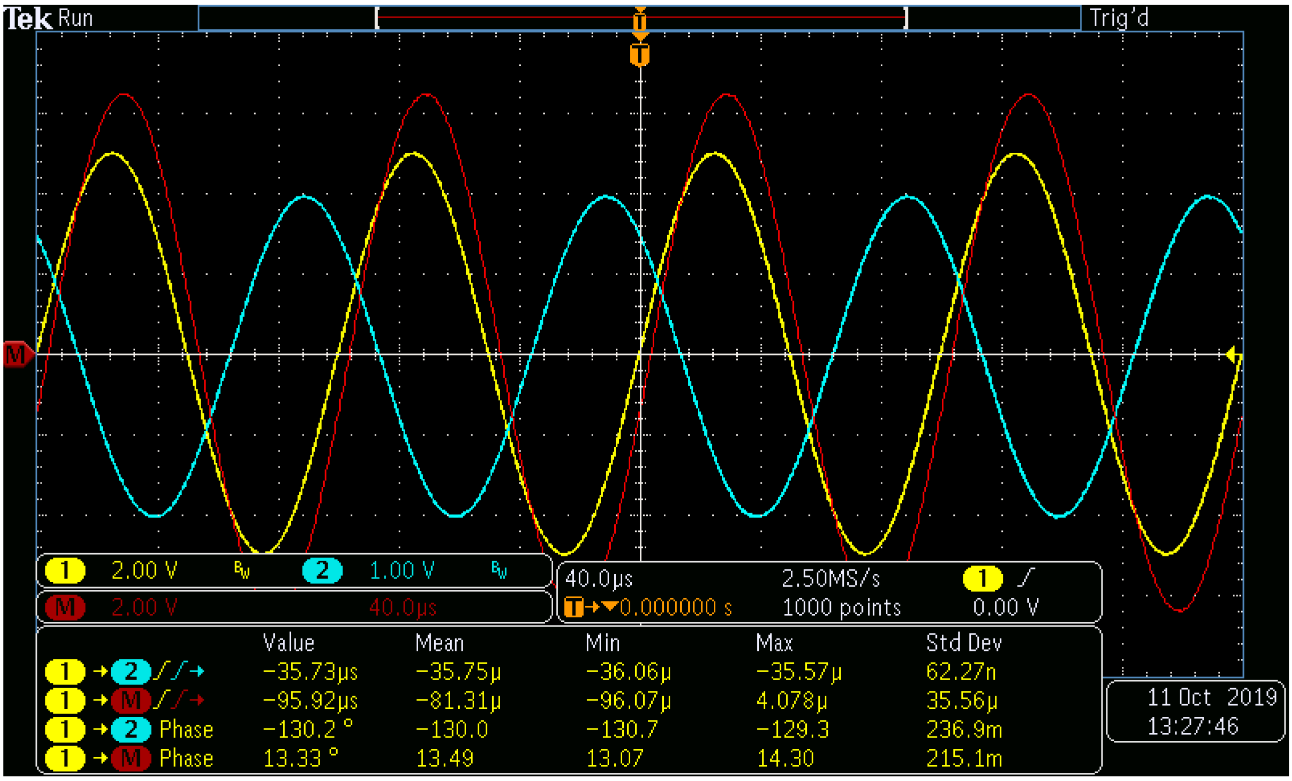

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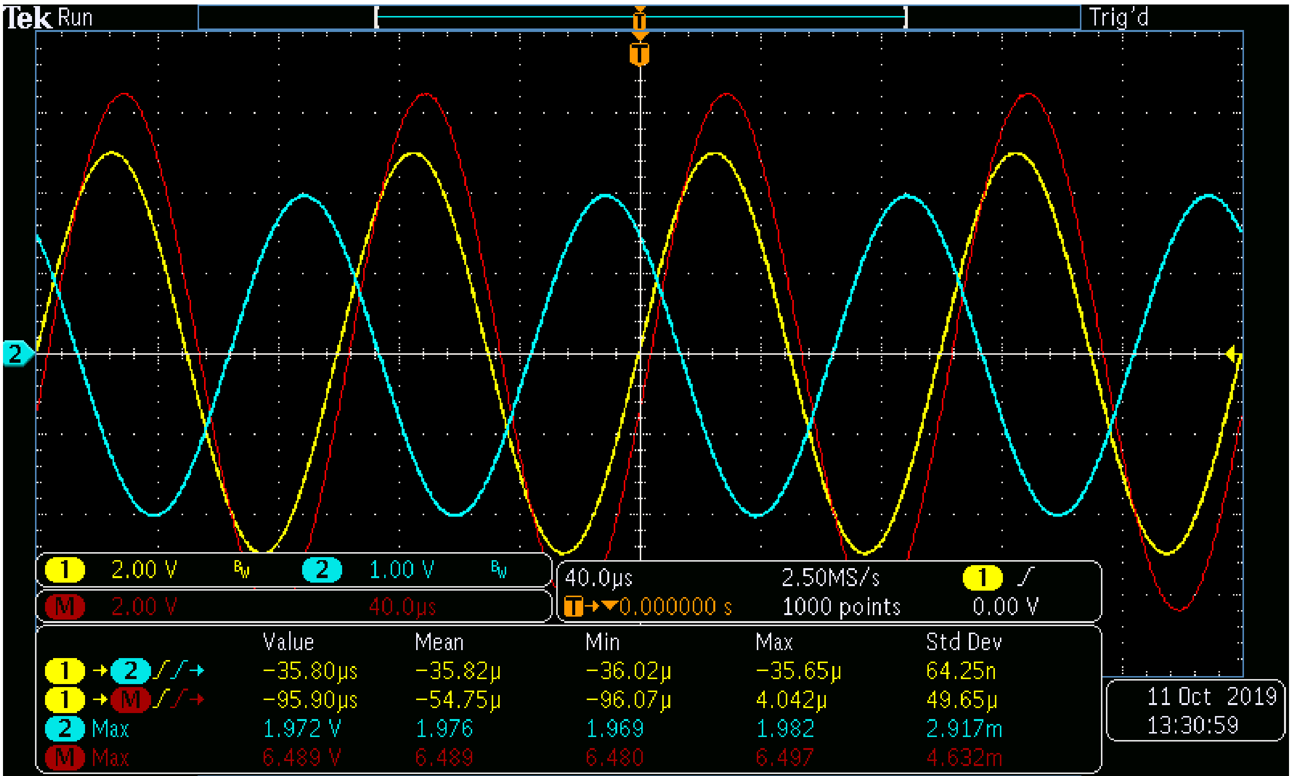

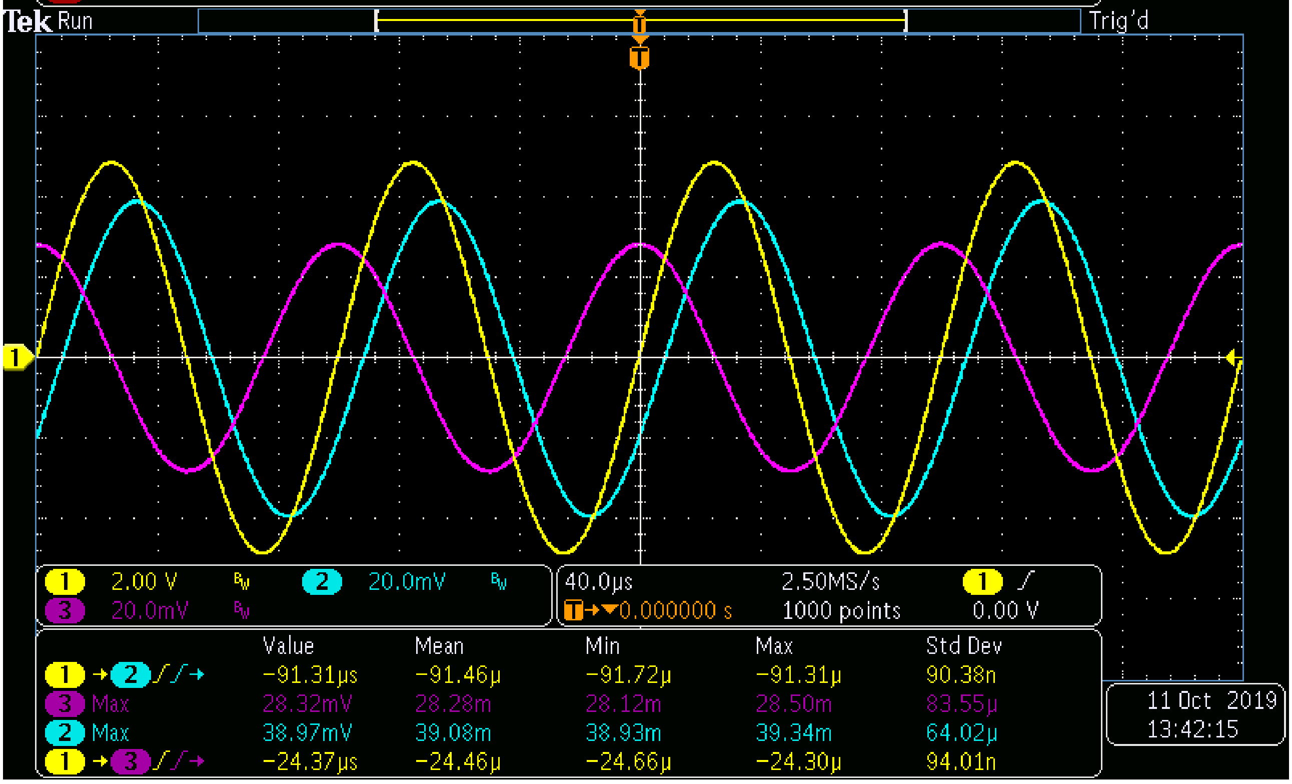

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