EEE Digital Assignment (Software)

RLC Series Resonance Circuit

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Batch: 10(B-Tech Computer Science (Core))

RLC SERIES RESONANCE CIRCUIT

AIM:

Design a circuit for resonance frequency at maximum current condition using first and second order systems.

APPARATUS/TOOL REQUIRED:

ORCAD / PSpice simulator -> **Analog Library – R, L & C**

Source Library – Vac, Vdc & Ground (GND) – 0 (zero)

Simulation Settings: **Analysis Type - Time Domain / AC Sweep**

Run to time - 40m

CIRCUIT DIAGRAM:

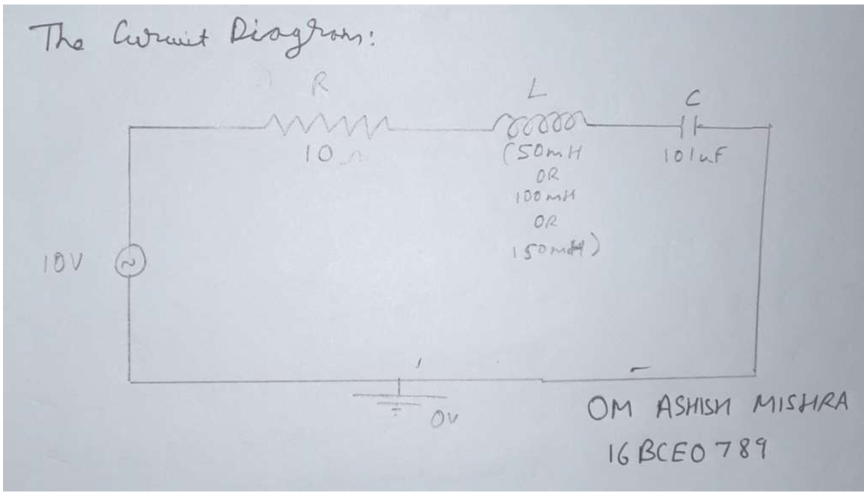

Fig: RLC circuit

THOERY:

Resonance:

An important property of this circuit is its ability to resonate at a specific frequency, the resonance frequency, f_0. Frequencies are measured in units of hertz. In this article, however, angular frequency, ω_0, is used which is more mathematically convenient. This is measured in radians per second. They are related to each other by a simple proportion,

Resonance occurs because energy is stored in two different ways: in an electric field as the capacitor is charged and in a magnetic field as current flows through the inductor. Energy can be transferred from one to the other within the circuit and this can be oscillatory. A mechanical analogy is a weight suspended on a spring which will oscillate up and down when released. This is no passing metaphor; a weight on a spring is described by exactly the same second order differential equation as an RLC circuit and for all the properties of the one system there will be found an analogous property of the other. The mechanical property answering to the resistor in the circuit is friction in the spring–weight system. Friction will slowly bring any oscillation to a halt if there is no external force driving it. Likewise, the resistance in an RLC circuit will "damp" the oscillation, diminishing it with time if there is no driving AC power source in the circuit.

The resonance frequency is defined as the frequency at which the impedance of the circuit is at a minimum. Equivalently, it can be defined as the frequency at which the impedance is purely real (that is, purely resistive). This occurs because the impedances of the inductor and capacitor at resonance are equal but of opposite sign and cancel out. Circuits where L and C are in parallel rather than series actually have a maximum impedance rather than a minimum impedance. For this reason they are often described as antiresonators, it is still usual, however, to name the frequency at which this occurs as the resonance frequency.

PROCEDURE:

Step 1: Open Capture CIS

Step 2: Click on the File button

Step 3: Click on New Project

Step 4: Select Blank Project

Step 5: Go to Library and click on Sources

Step 6: Select Analog Library – R, L & C

Step 7: Select Source Library – Vac, Vdc & Ground (GND) – 0 (zero)

Step 8: Select Analog Library – R, L & C

Step 9: Click on New Simulation

Step 10: Analysis Type - Time Domain / AC Sweep

Step 11: Run to time - 40m

Step 12: Apply it

Step 13: Then we run the simulated program

Step 14: Then we get the graph as the output.

FORMULA:

At Resonance Condition

$X_L = 2\pi f L$

$X_C = \frac{1}{2\pi f C}$

$V_R = IR$

$V_L = I X_L$

$V_C = I X_C$

$V = \sqrt{V_R^2 + (V_L - V_C)^2}$

At resonance, $V_L = V_C$

$\therefore V = V_R$

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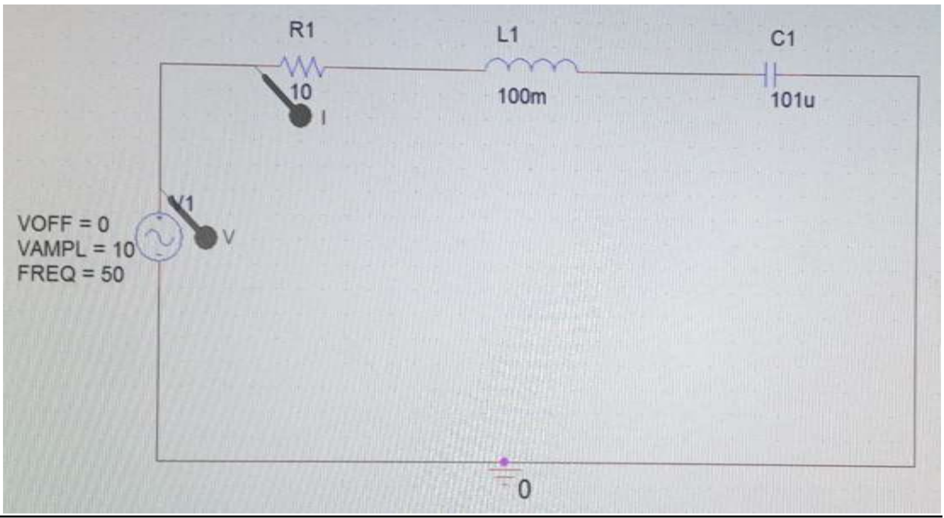
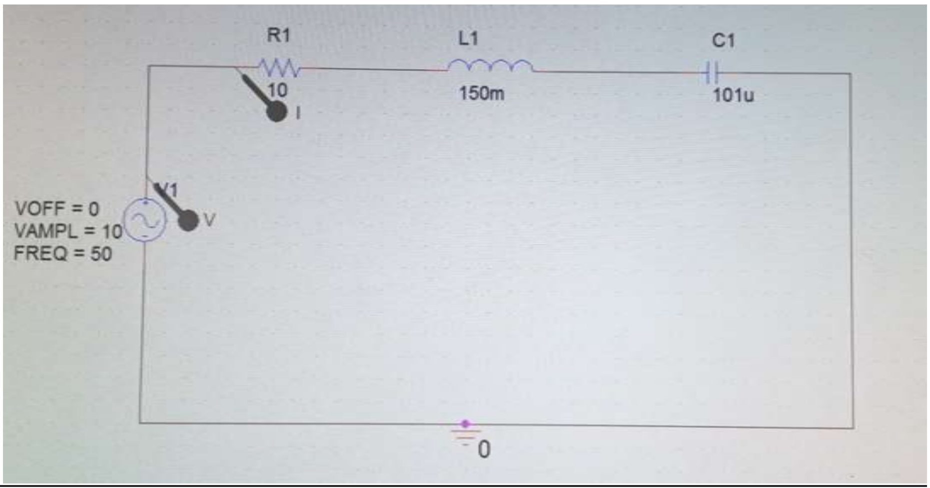
SIMULATION CIRCUIT DIAGRAM:





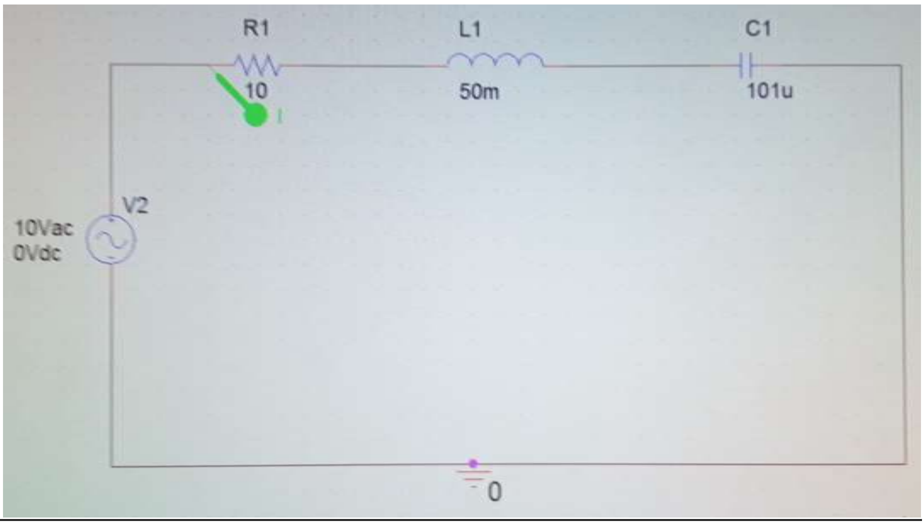
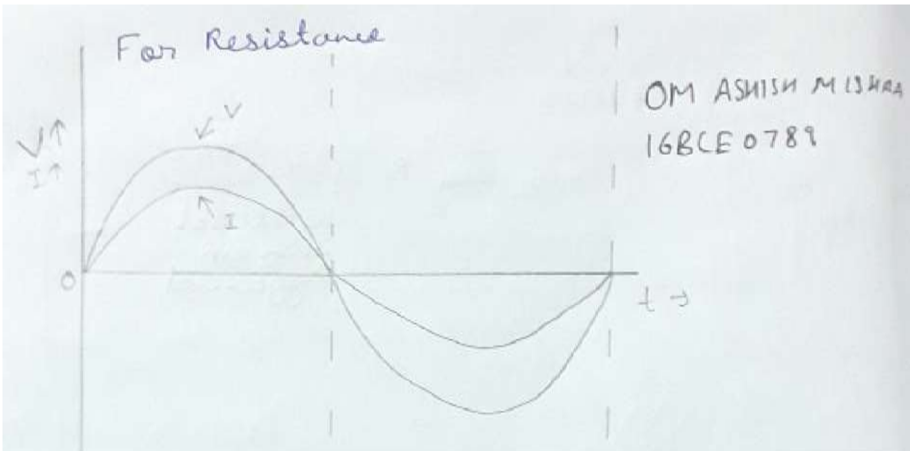
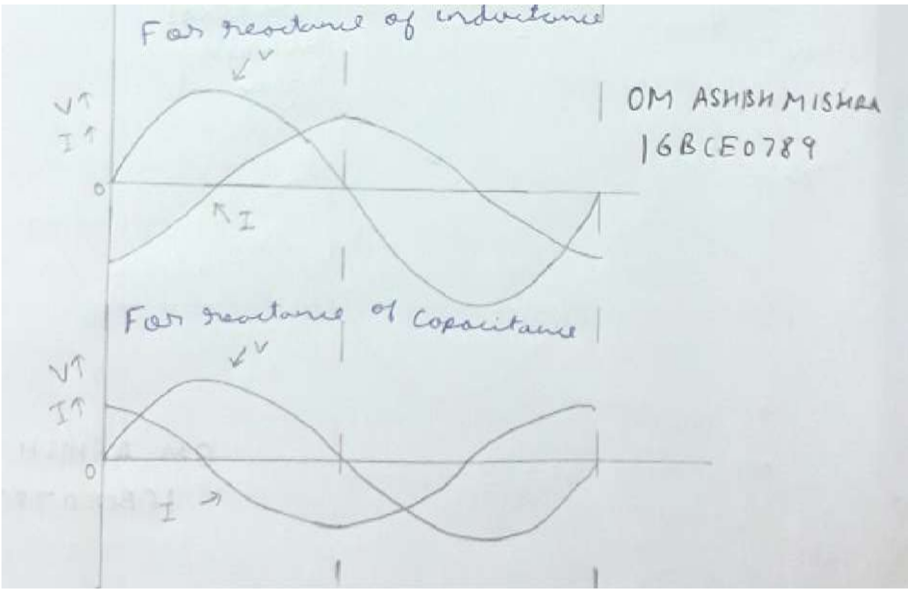


Fig: 50mH, 100mH, 150mH in RLC circuit

MODEL GRAPH:




For reactance of inductance
V
V
I
0
I
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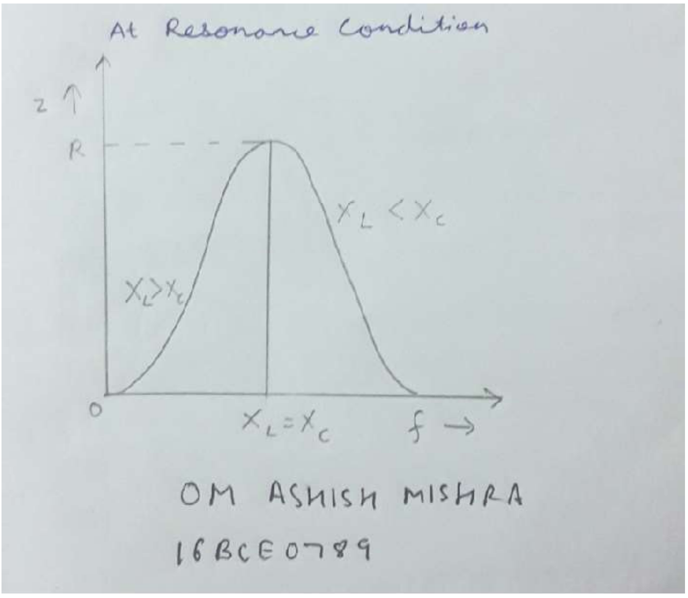
For reactance of Capacitance
V
V
I
0
I


At Resonance Condition
Z
R
$X_L < X_C$
$X_L > X_C$
0
$X_L = X_C$
f
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SIMULATION GRAPH:

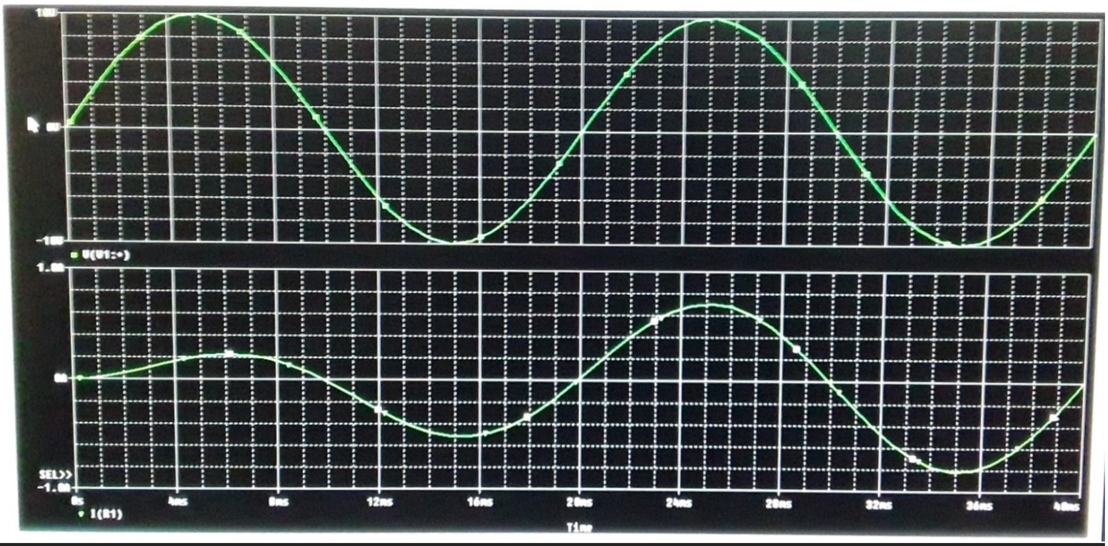

Fig: The graph represents the voltage and second graph represents the current. (100mH)

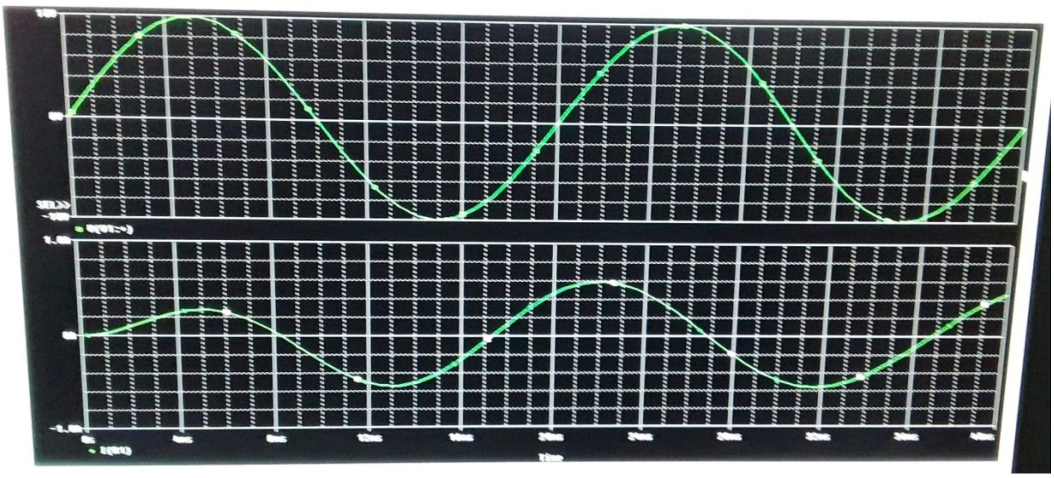

Fig: The graph represents the voltage and second graph represents the current. (150mH)

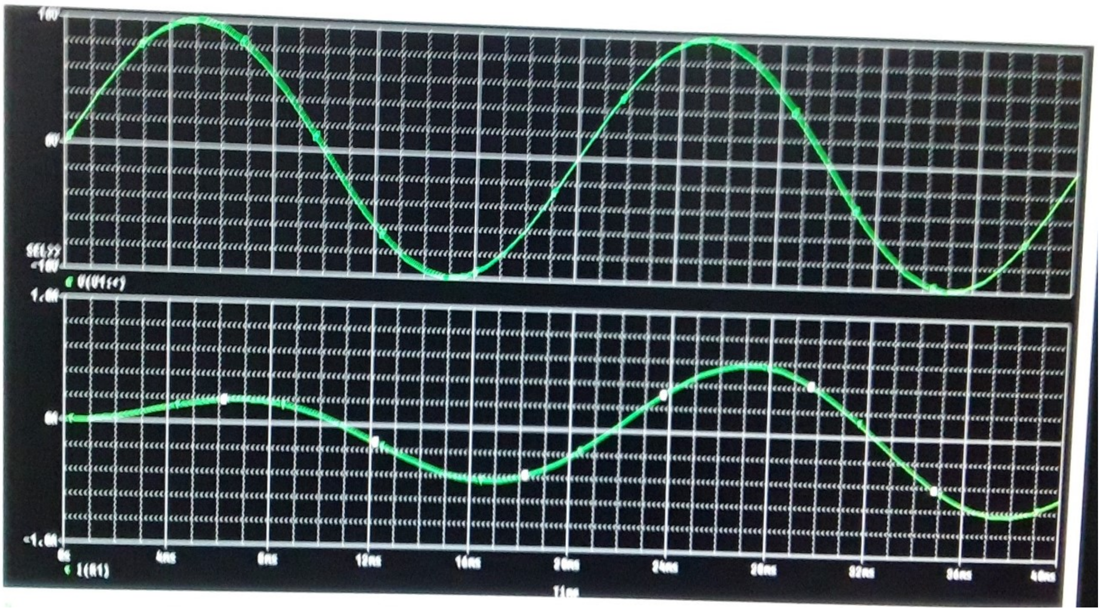

Fig: The graph represents the voltage and second graph represents the current. (50mH)

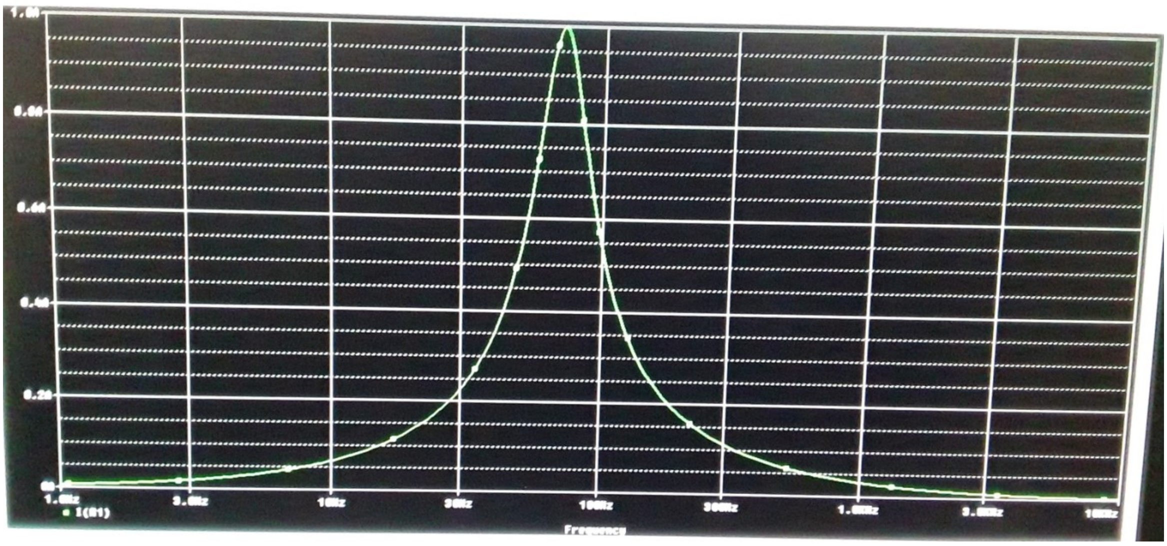

Fig: The graph represents the resonance condition.

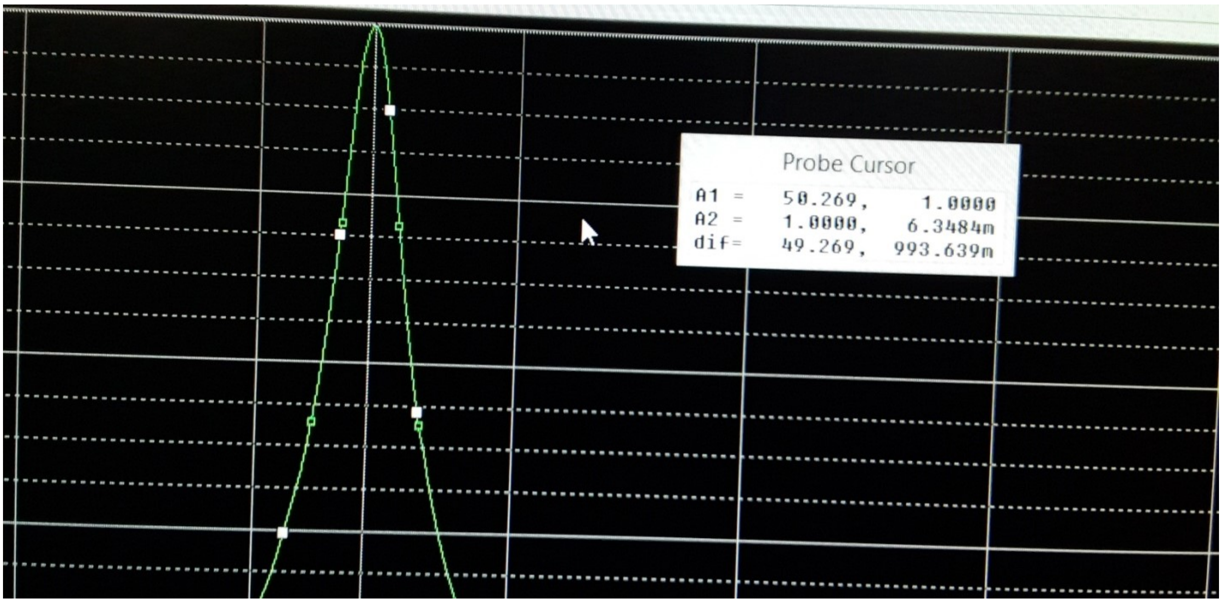

Fig: The Probe Cursor represents the results at the peak.

RESULT:

The peak of curve gives the value of the impedance at the resonance condition.

INTERFERENCE:

- This experiment cleared our picture of the resonance condition in RCL circuit.
- This also gave us the proper understanding of using Orcad.