4. Design and Troubleshooting of Bridge Rectifiers with RC filters

Course: ECE1008 – Electronic Hardware Troubleshooting LAB

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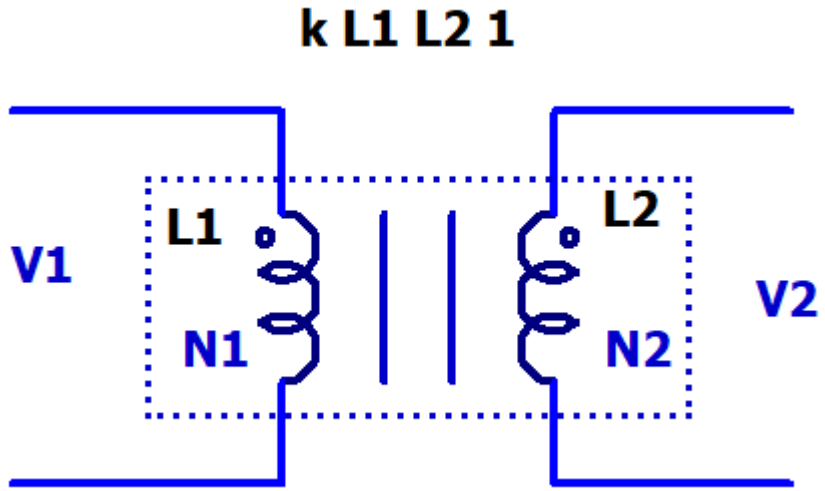
CHENNAI

1. Introduction

- Most circuits around us work with Direct current
- DC: Current direction is unidirectional, though value of current can change continuously.
- Alternating current: AC –
  Current direction changes with respect to time

2. Transformer Basics

	Primary coil	Secondary Coil
Voltage	V1	V2
Turns	N1	N2
Inductance	L1	L2



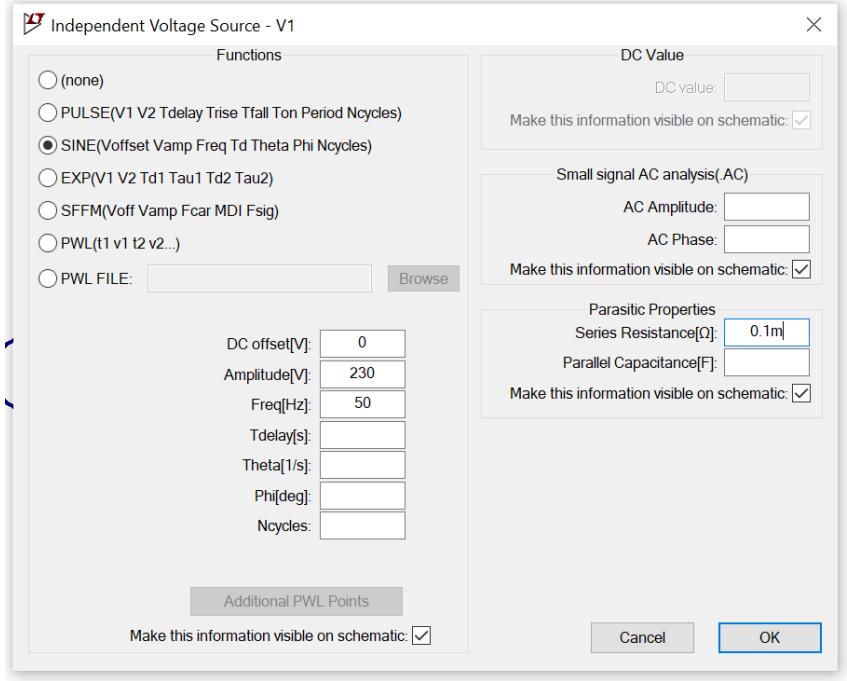
Relation between Voltage and Turns: $V_1 : V_2 = N_1 : N_2$

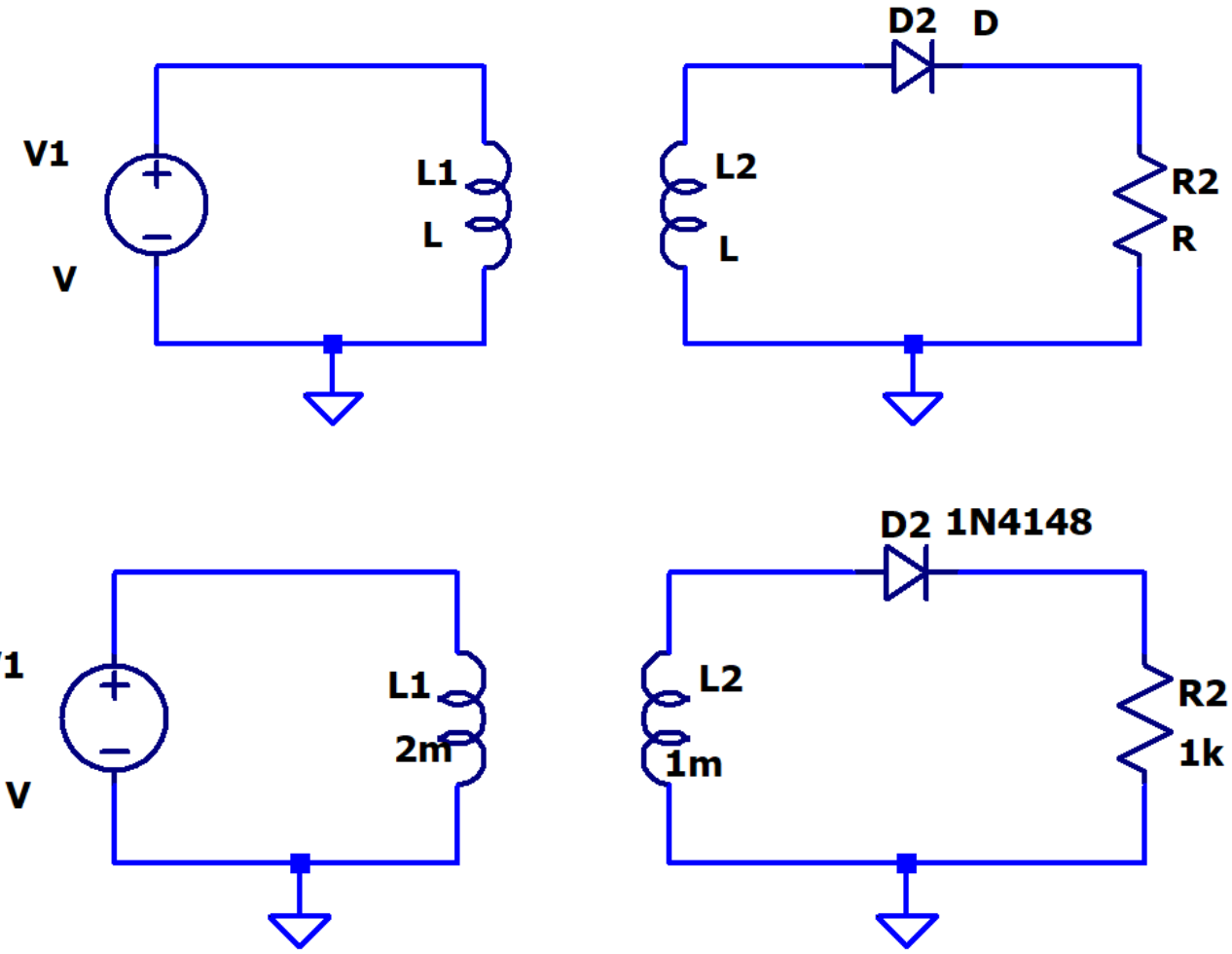
Relation between Inductance, V and N: $L_1 : L_2 = V_1^2 : V_2^2 = N_1^2 : N_2^2$

- In LT Spice, only L1 and L2 are specified

3. Steps to create Half wave rectifier

- Place components

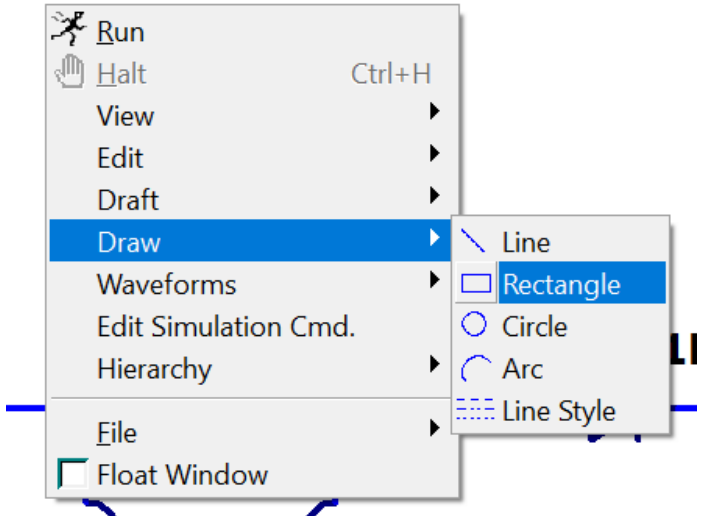


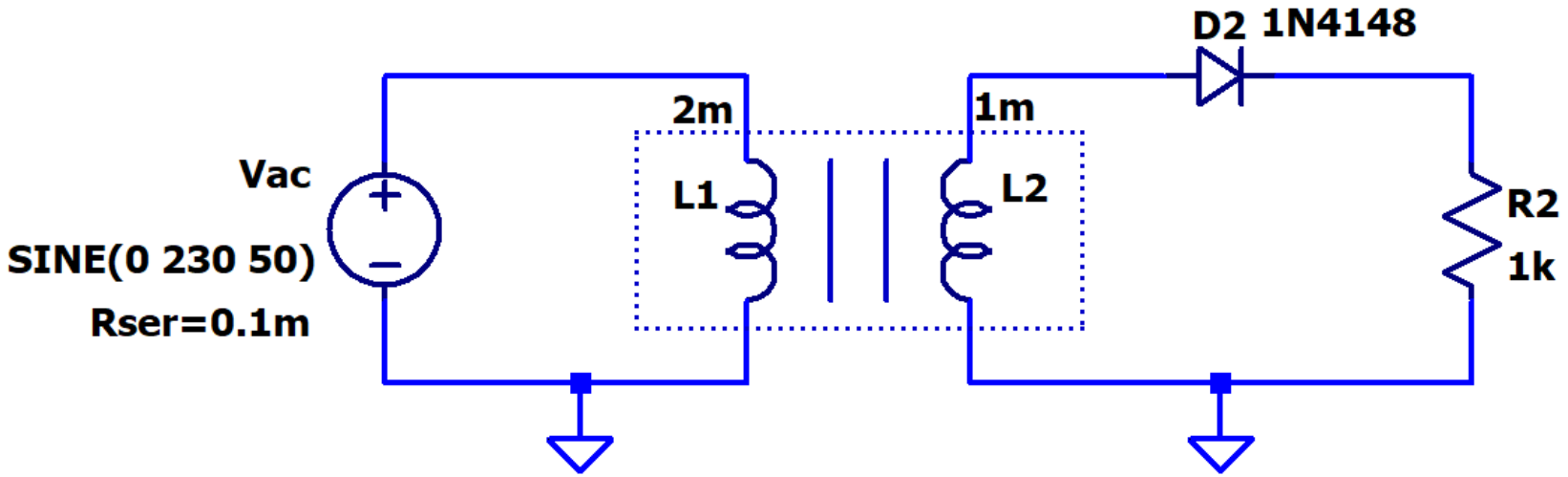


- Set the values of V Source, Inductors, Resistors
- Select the diode

3. Steps to create Half wave rectifier

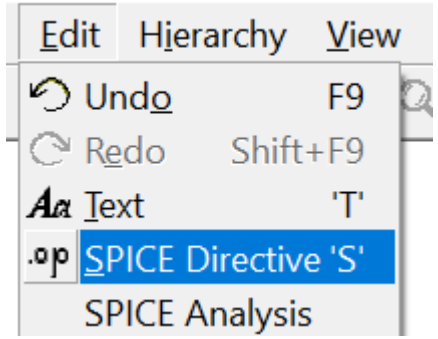
- Right click on screen
  Draw Rectangle
  Draw Lines

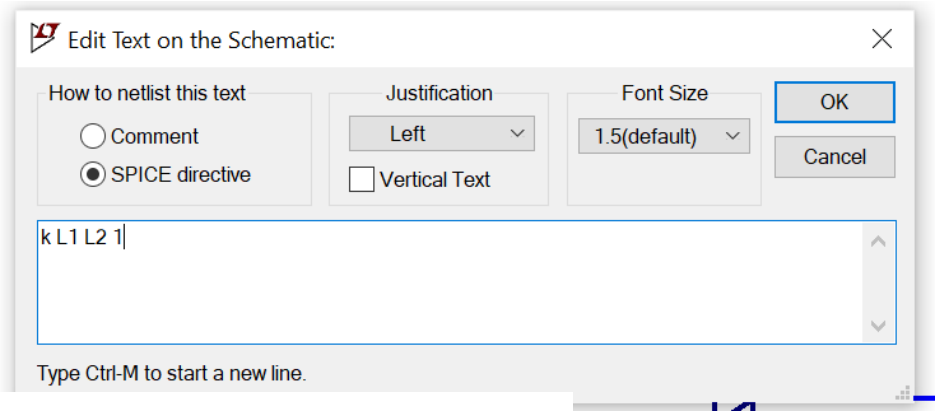


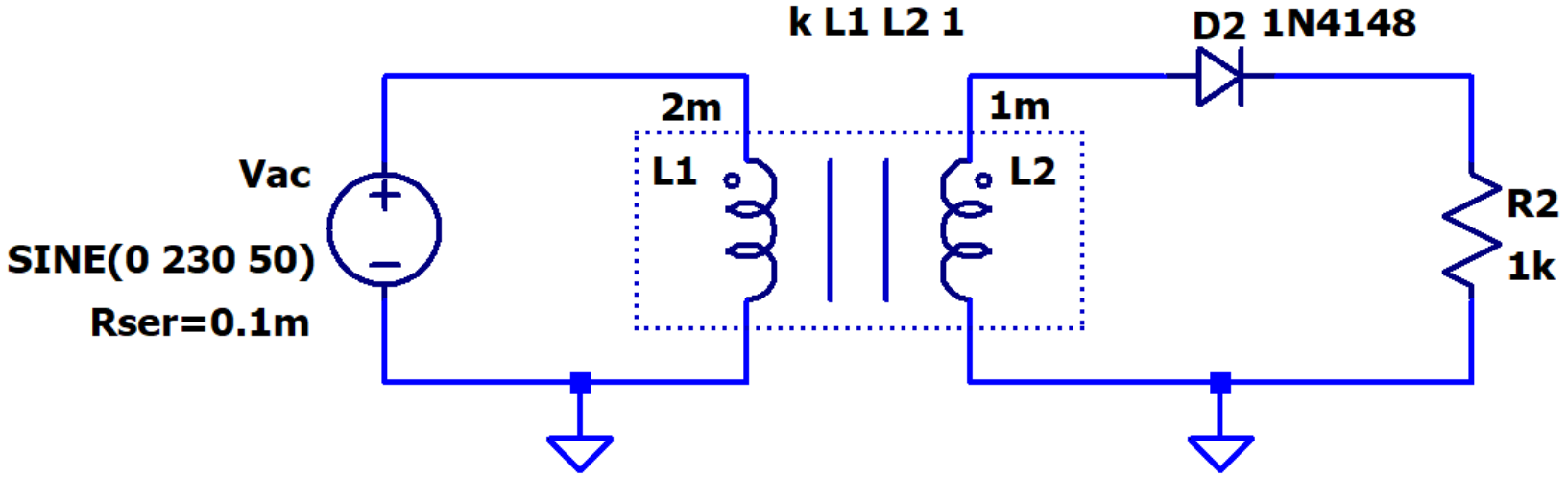


3. Steps to create Half wave rectifier

- In transformers, the two coils are magnetically coupled.
- Edit -> Spice directive

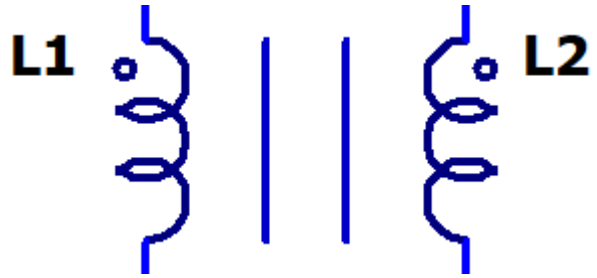






3. Steps to create Half wave rectifier

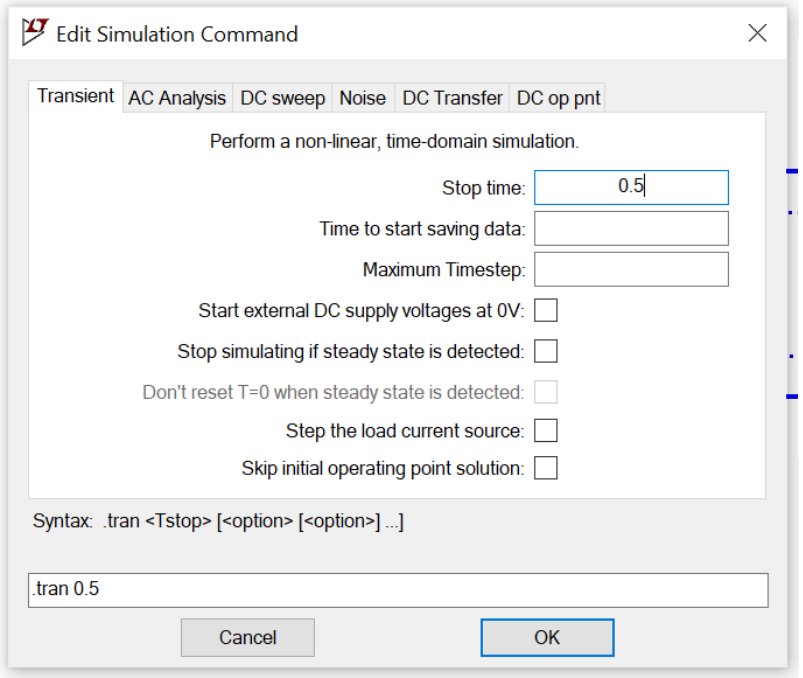
- Notice the dots next to the coils of transformer.
  For necessary configuration, Select the respective coil and Rotate or mirror (Ctrl+R or Ctrl+E keys)
- In phase windings:

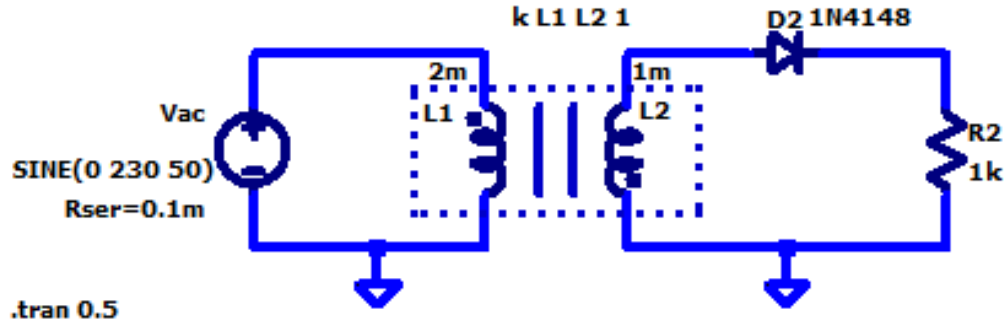


- 180° out of phase windings:

3. Steps to create Half wave rectifier

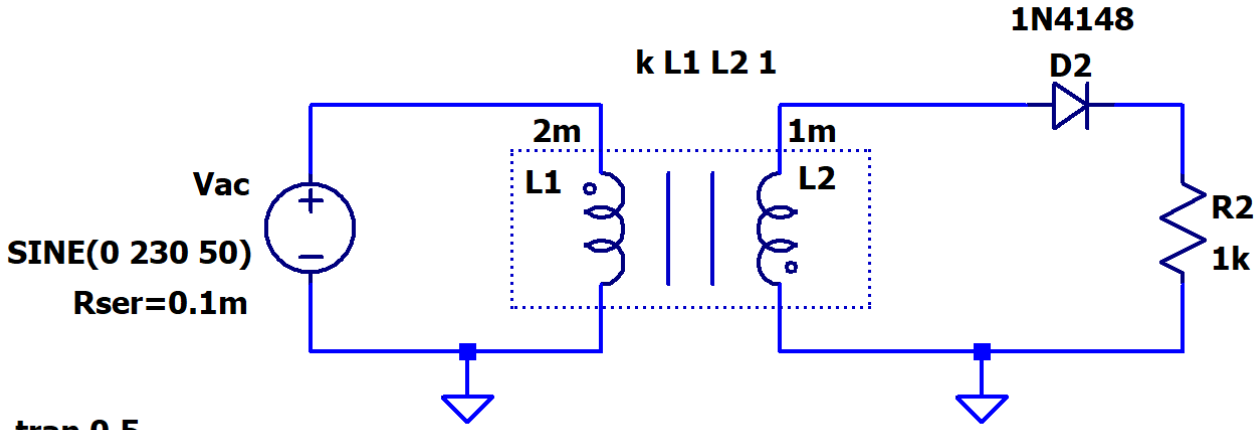
- Run transient analysis





3. Steps to create Half wave rectifier

- For Out of phase winding, with 2m and 1m in primary and secondary coils respectively
- Plot voltage at Primary coil, Voltage at secondary coil (before diode) Voltage across resistive load R.



4. Task #01: Half wave rectifier

Design Half wave rectifier and plot input voltage and output voltages :

(across secondary of coil and across the load – resistor) with

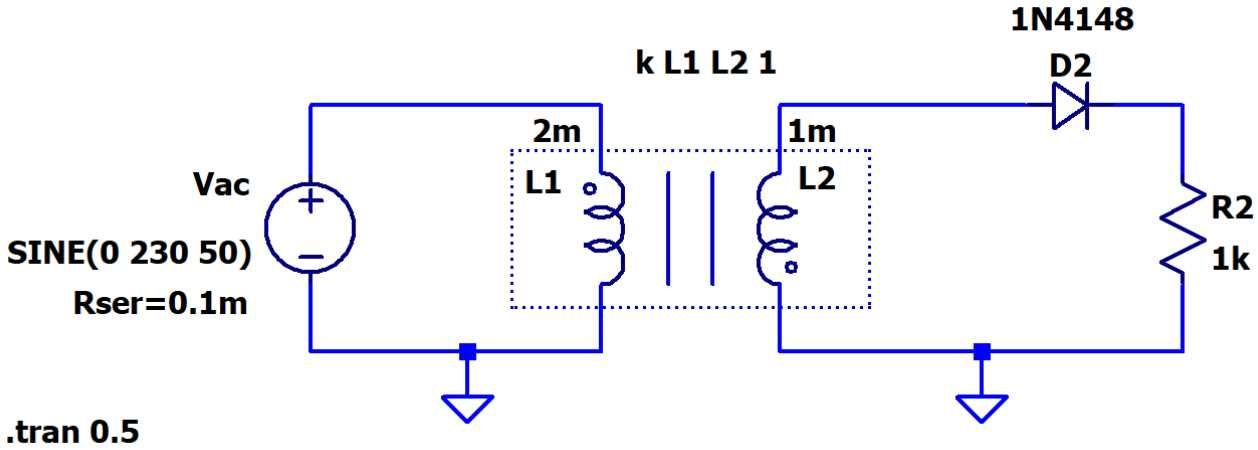
1.1 In phase windings (2m:1m)

1.2 In phase windings (1m:1m)

1.3 In phase windings (1m:2m)

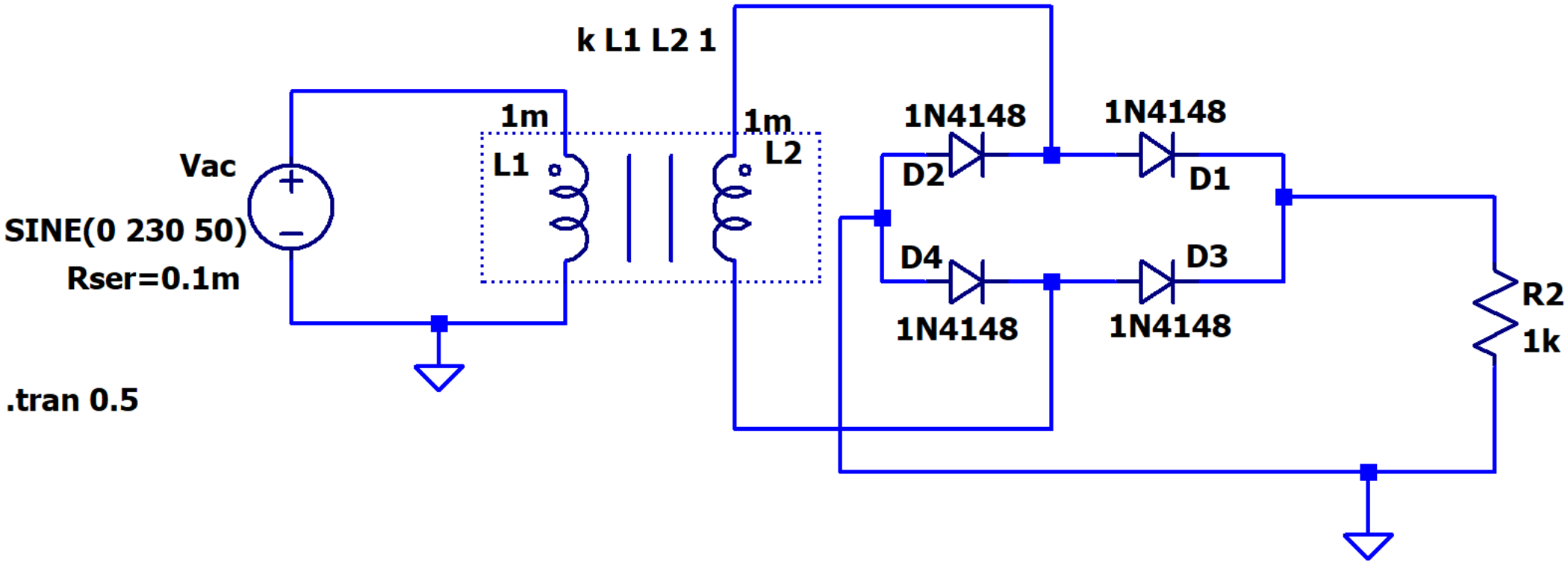
1.4 180° out of phase windings (2m:1m)

1.5 180° out of phase windings (1m:1m)



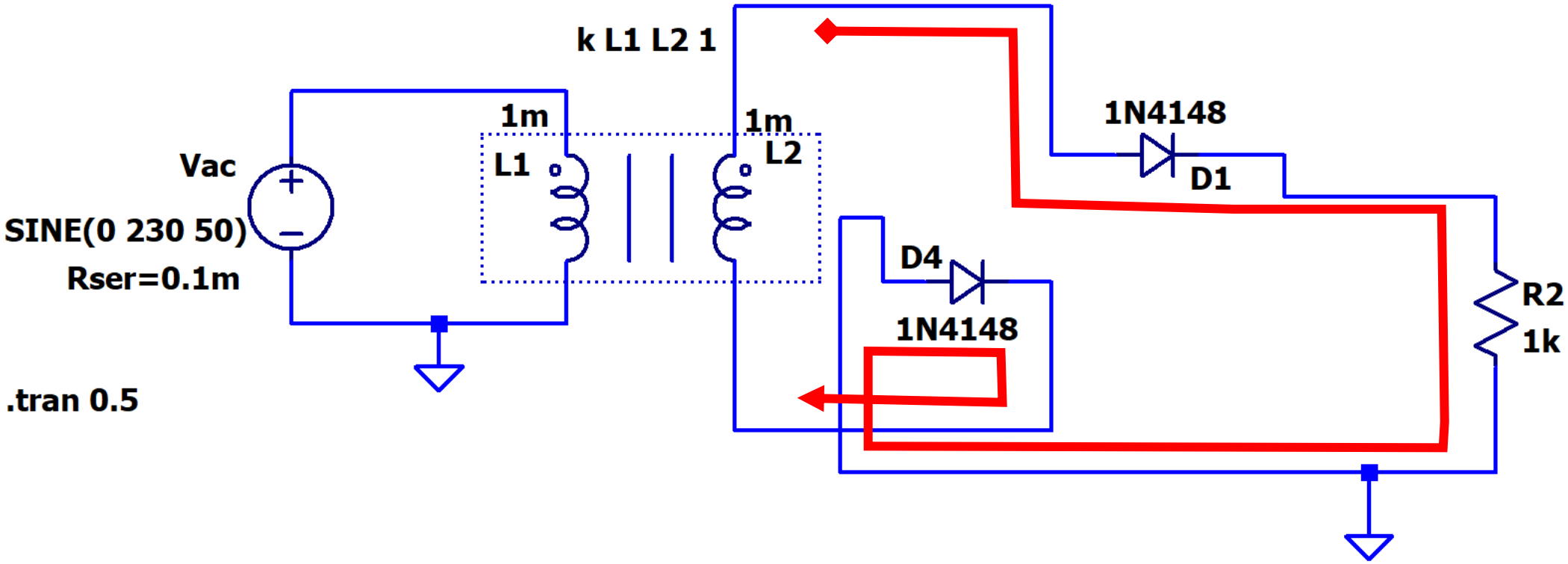
5. Full wave rectifier

- FWR: Complete circuit



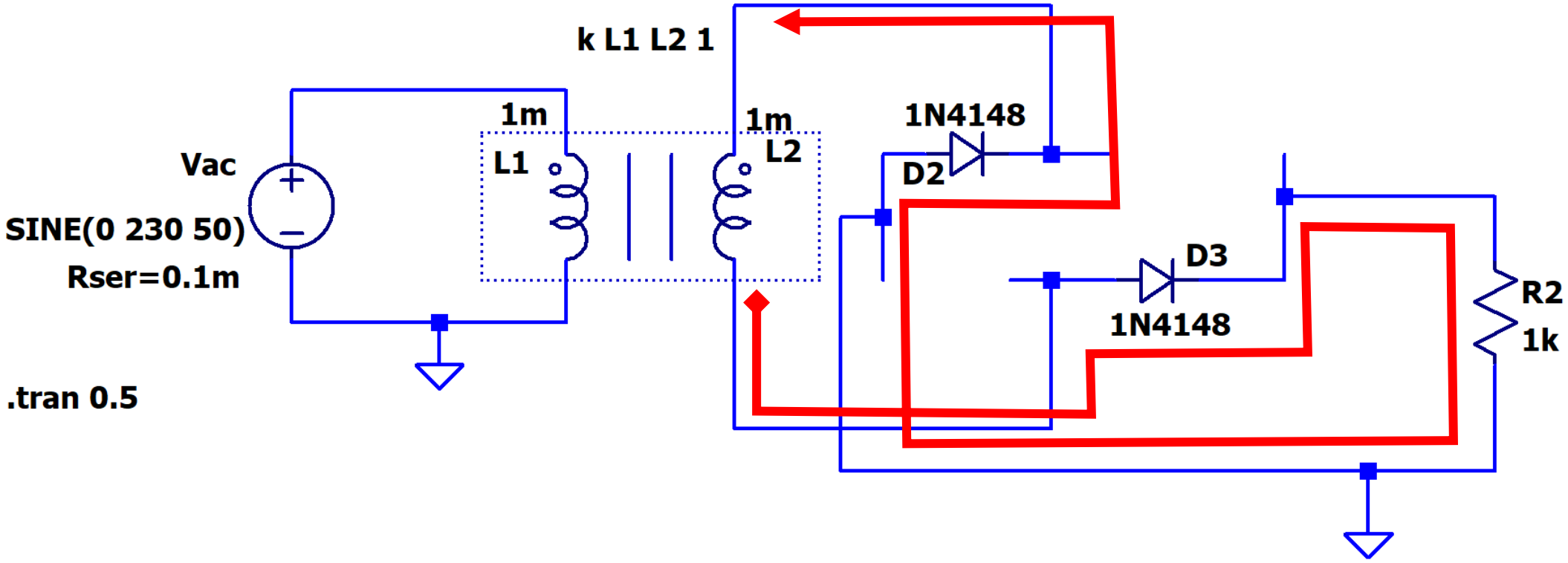
5. Full wave rectifier

- Circuit behavior during positive half cycle:
  Diodes D1 and D4 are forward biased.
  Diodes D2 and D3 are reverse biased.



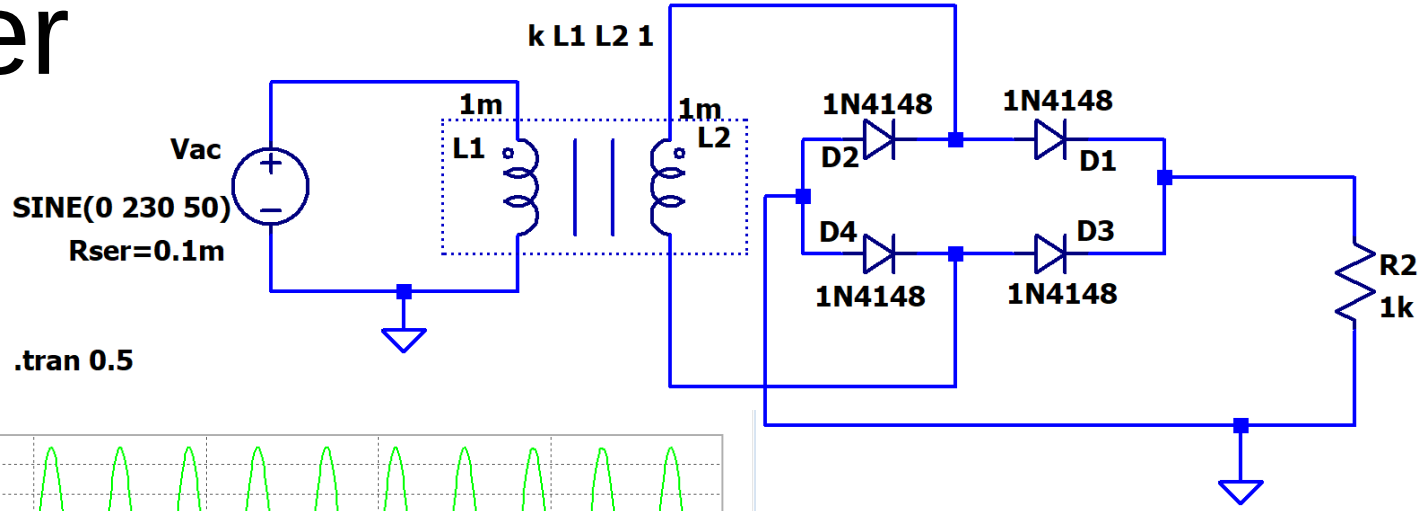
5. Full wave rectifier

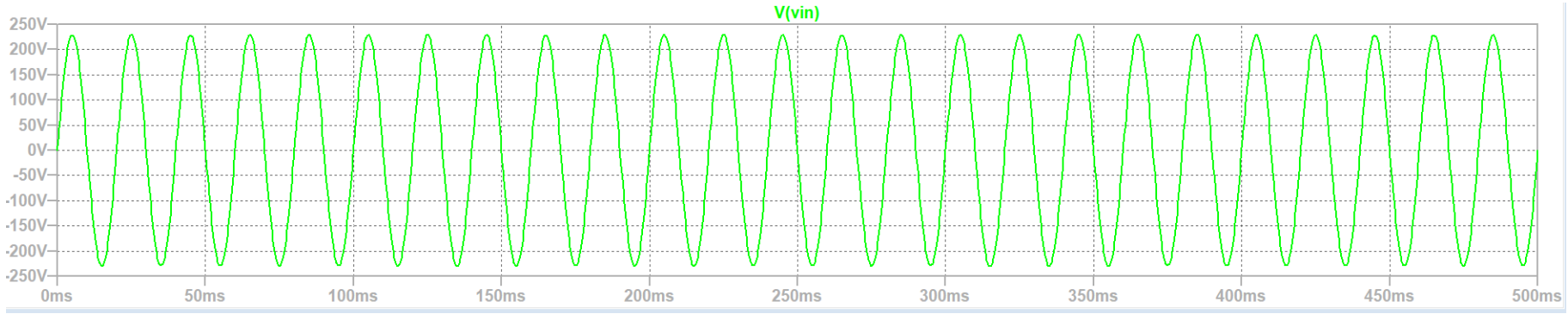
- Circuit behavior during negative half cycle:
  Diodes D2 and D3 are forward biased.
  Diodes D1 and D4 are reverse biased.

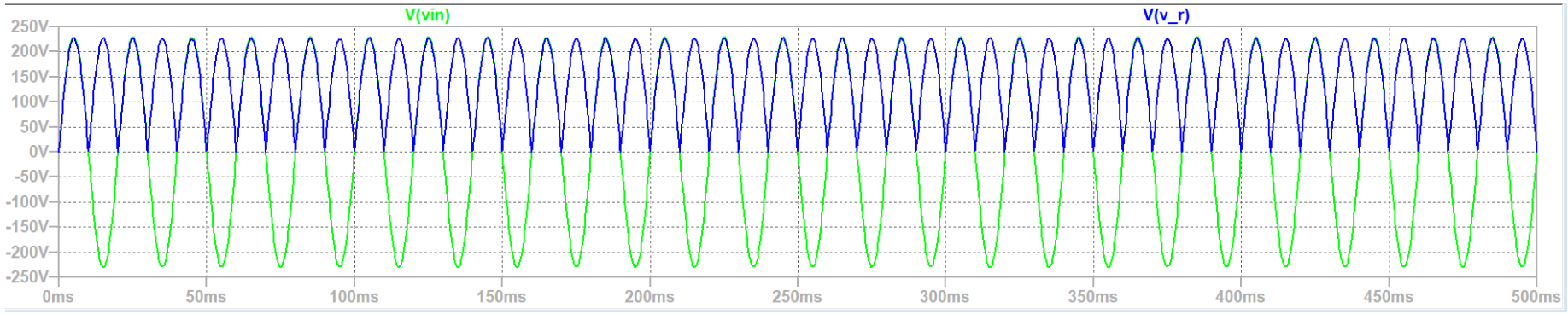


5. Full wave rectifier

- Waveform







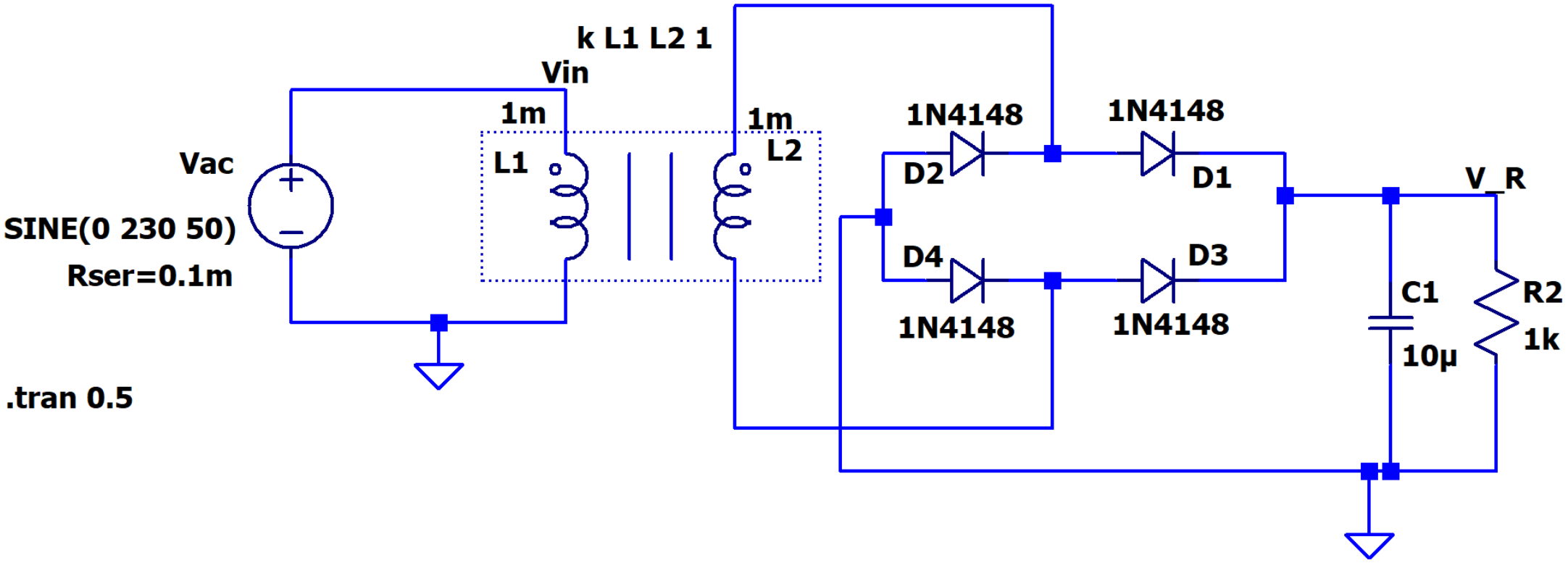
6. Task#02: Full wave rectifier

Design Full wave rectifier and
plot input voltage and
output voltages : (across the load – resistor)
with

2.1 In phase windings (1m:1m)

2.2 180° out of phase windings (1m:1m)

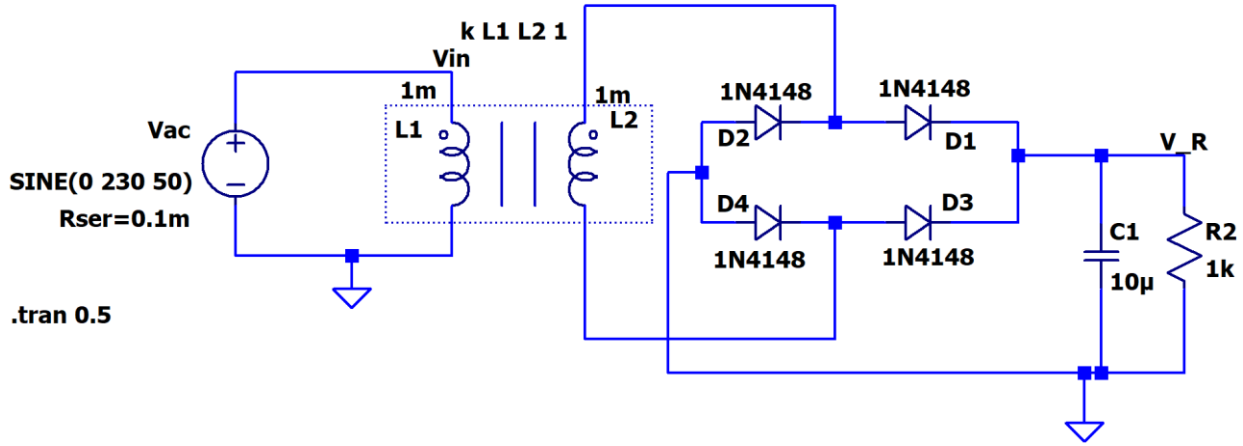
7. DC Power supply using Full wave rectifier

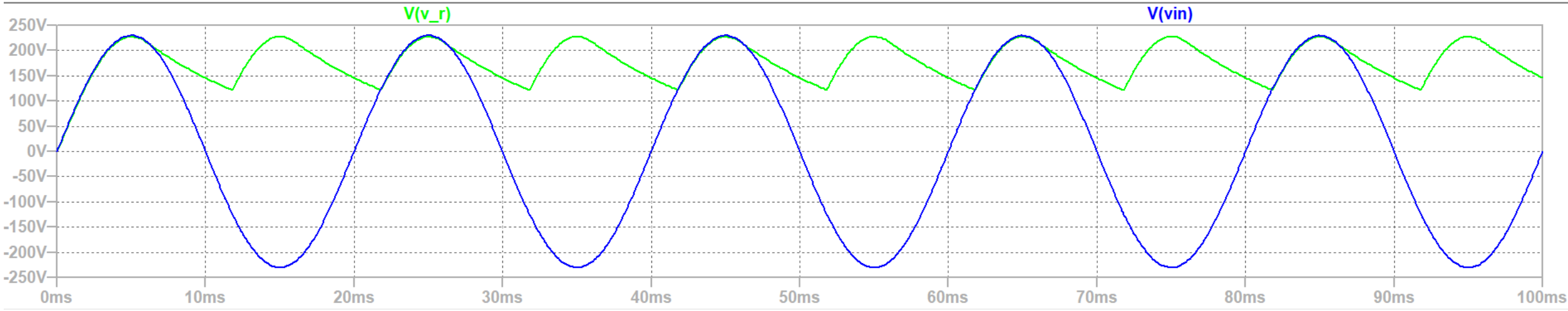


7. DC Power supply using Full wave rectifier

- If voltage above capacitor voltage: Charging of capacitor from supply

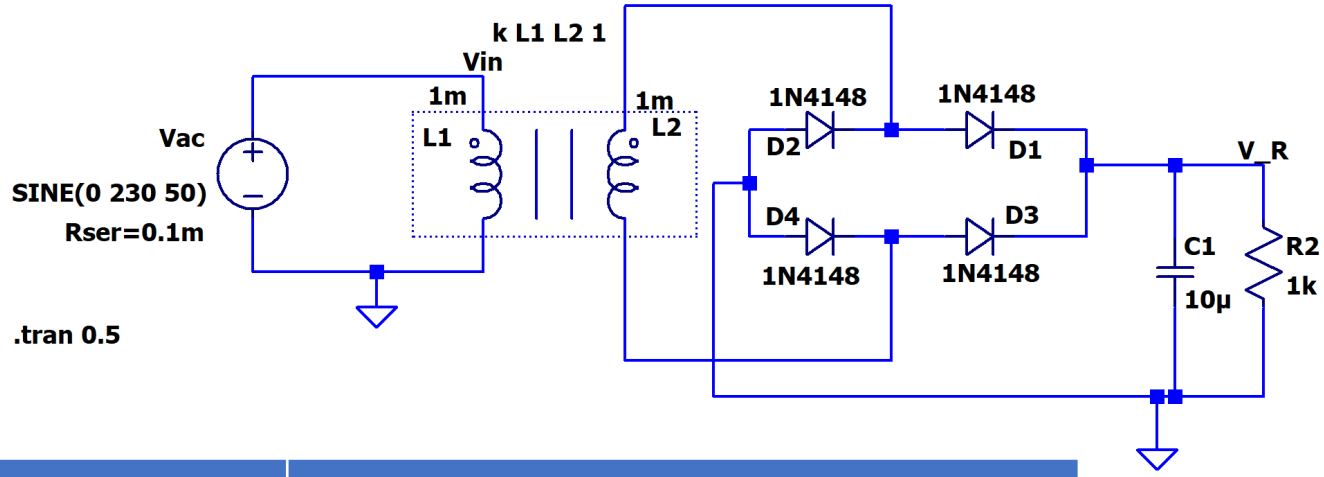
- If voltage is below capacitor voltage: Discharging of capacitor





8. Task#03: DC Power supply

- Obtain output voltage plot for the tasks 3.1 to 3.4 given in table below and enter observation.



Task	Capacitor	Comment on Charging	Comment on discharging	Comment on attainment of 100% of peak of input and saturation (constant) of output.
3.1	10uF			
3.2	100uF			
3.3	1mF			
3.4	10mF			

9. Task#04: Design a DC Power supply of 5V

- For an input 230V 50Hz input,
  Design a DC power supply of 5V DC output (Mobile charging)
  (Allowed output range: $4.85 < V_{Load} < 5.15$)
- Note:
  There will be voltage drop of 2 diodes in both positive and negative half cycles of input, before output voltage is obtained.
  Hence, calculate the necessary secondary coil voltage first,
  and then
  Select the inductance of coil with the ratio formula given in the "Transformer Basics" slide of this file.
  You may then select the capacitor value in the end.

Important NOTE

- Enter your **registration number** and **Full Name** next to

  all your circuits and
  the output plots.
- Keep the background of circuit and plot as white.

LAB record instructions:

For the lab experiment,

- Write the **Aim**.
- Complete the **Software/Hardware components used**.
- **Obtain the expression for the outputs.**
- Place the respective **circuits in LT Spice**.
- Connect the inputs and outputs. Name them and **write the same in the lab copy(inputs and outputs section)**.
- Use probe in LT spice to plot all possible combinations.
- Write a **concluding statement for each circuit**.
- **Submit** the document's soft copy **on time** in lms.vit.ac.in when available.