NISARG UPADHYAYA
19CS30031

EXPERIMENT 1 (B)

RECIPROCITY THEOREM

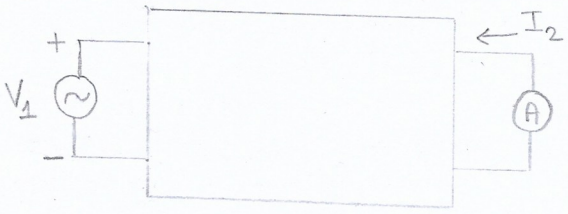
⇒ AIM

Verification of reciprocity theorem.

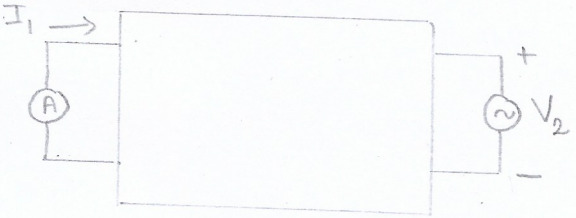
⇒ THEORY

Consider a passive linear bilateral two-port network and two different types of connections.

① Voltage V_1 is applied across port 1 and current I_2 is measured at port 2



② Voltage V_2 is applied across port 2 and current I_1 is measured at port 1



According to reciprocity theorem $\frac{I_1}{V_2} = \frac{I_2}{V_1}$

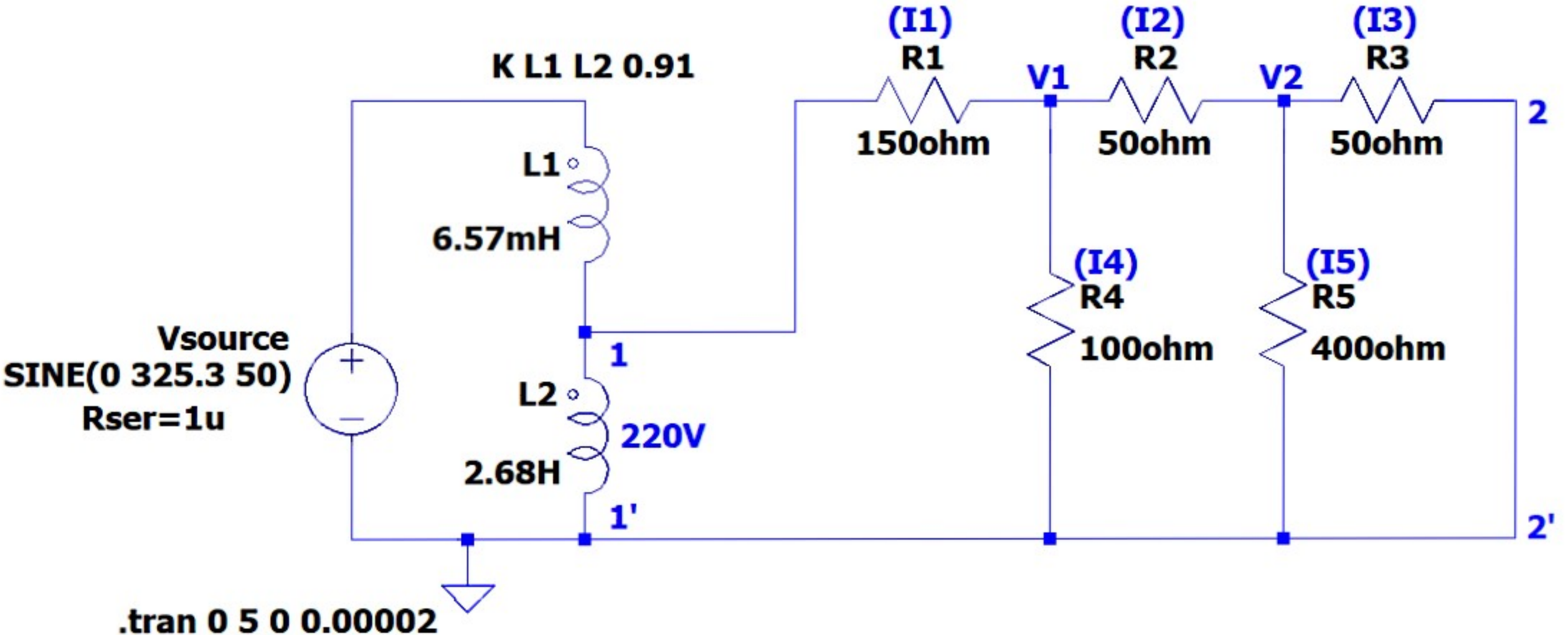
⇒ OBSERVATION TABLE

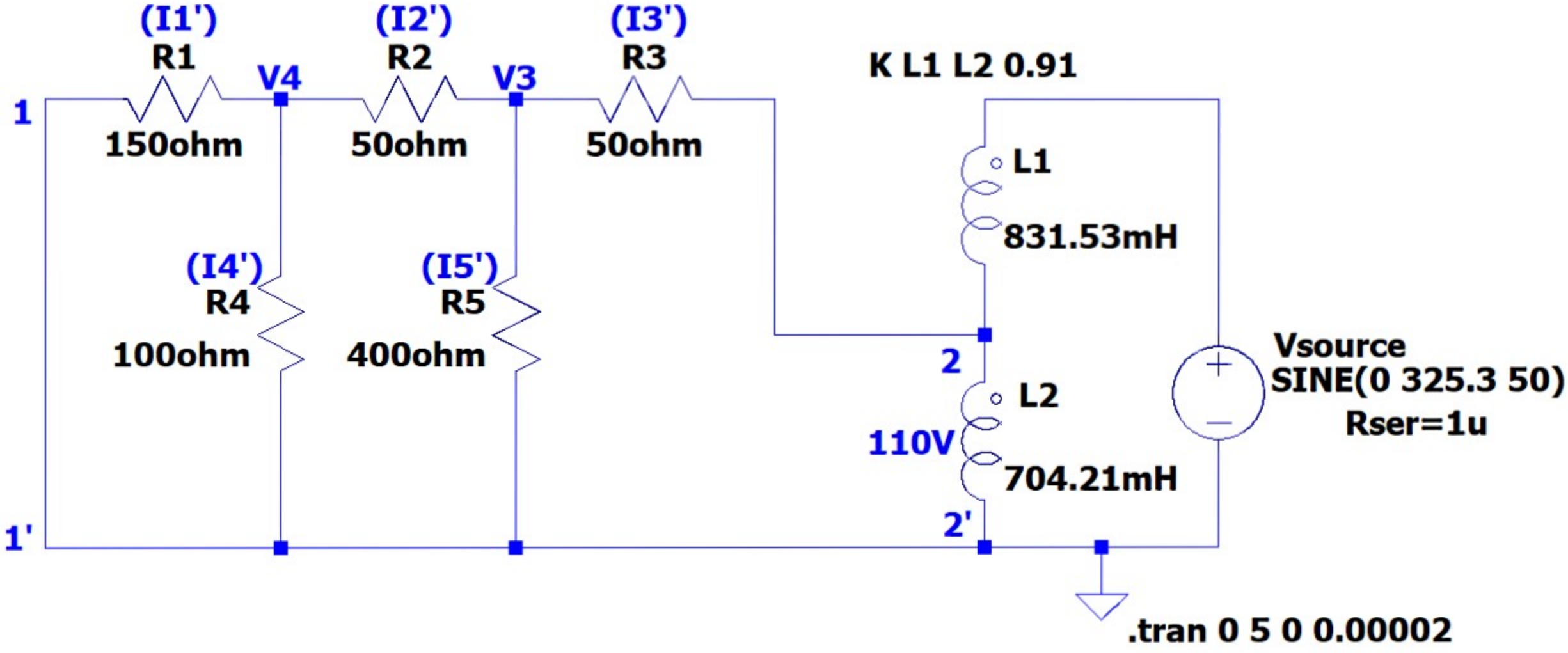
V_s (V)	I_3 (A)	$\frac{V_s}{I_3}$ (V/A)	V_s' (V)	I_1' (A)	$\frac{V_s'}{I_1'}$ (V/A)
220	0.506	434.78	110	0.252	436.51

$I_1 = 1.108\,A$
$I_2 = 0.570\,A$
$I_3 = 0.506\,A$
$I_4 = 0.538\,A$
$I_5 = 0.063\,A$

$I_1' = 0.252\,A$
$I_2' = 0.631\,A$
$I_3' = 0.805\,A$
$I_4' = 0.379\,A$
$I_5' = 0.174\,A$

$V_1 = 53.82\,V$
$V_2 = 25.32\,V$
$V_3 = 69.43\,V$
$V_4 = 37.87\,V$


K L1 L2 0.91
(I1)
R1
150ohm
V1
(I2)
R2
50ohm
V2
(I3)
R3
50ohm
2
L1
6.57mH
(I4)
R4
100ohm
(I5)
R5
400ohm
Vsource
SINE(0 325.3 50)
Rser=1u
1
L2
220V
2.68H
1'
2'
.tran 0 5 0 0.00002


(I1')
R1
150ohm
(I2')
R2
50ohm
(I3')
R3
50ohm
V4
V3
1
1'
(I4')
R4
100ohm
(I5')
R5
400ohm
K L1 L2 0.91
L1
831.53mH
2
L2
110V
704.21mH
2'
Vsource
SINE(0 325.3 50)
Rser=1u
.tran 0 5 0 0.00002

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⇒ CALCULATIONS AND INFERENCE

$$\frac{V_s}{I_3} = \frac{220}{0.506} = 434.78 \text{ V/A} \quad , \quad \frac{V_s'}{I_1'} = \frac{110}{0.252} = 436.50 \text{ V/A}$$

It can be seen that $\frac{V_s}{I_3} \approx \frac{V_s'}{I_1'}$ which is in agreement with the reciprocity theorem.

⇒ DISCUSSION AND COMMENTS

Reciprocity theorem was succesfully verified.

A direct consequence of the reciprocity theorem $\left(\frac{I_1}{V_2} = \frac{I_2}{V_1}\right)$ is that if we take $V_1 = V_2$ then $I_1 = I_2$. In simple words if we have a voltage source V in branch 1 and a current I in branch 2 then we can say that placing the voltage source V in branch 2 will cause a current I to flow in branch 1, i.e., voltage and current are swapped.

One must always remember that reciprocity theorem can only be applied to passive linear bilateral networks only.