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Lab II

To study high Input Resistance Amplifiers, namely common-collector amplifier, Darlington mode transistors, bootstrapped emitter follower

Components Required

- DC Voltage source 10 V
- Resistances of values $39\text{k}\Omega$, $3.9\text{k}\Omega$, $5.6\text{k}\Omega$, $47\text{k}\Omega$ and $10\text{k}\Omega$
- One variable Resistance
- 2 or more Capacitors of values $10\text{ }\mu\text{F}$.
- AC voltage source (100mV , 1kHz)

Results and Conclusions

1. Common Collector Configuration

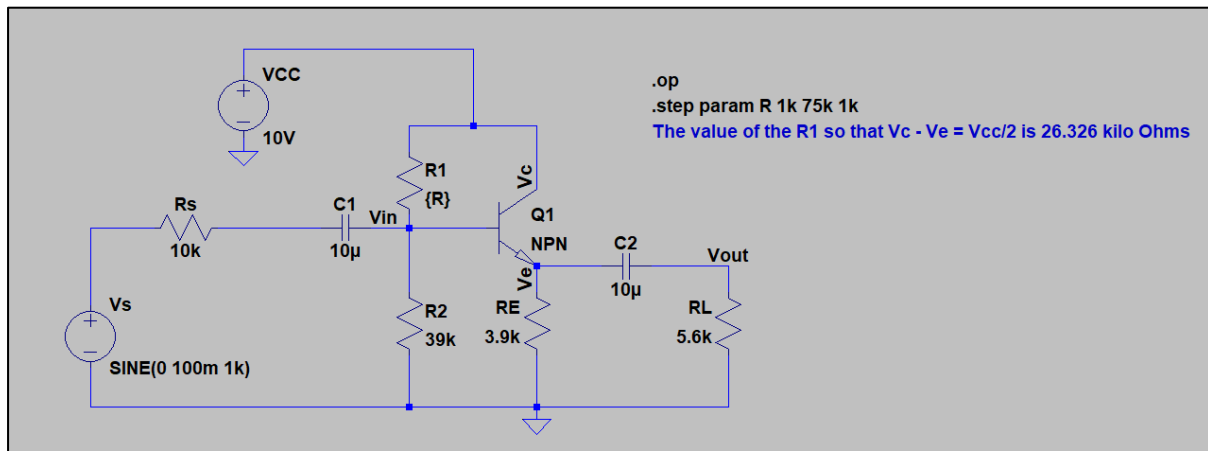


Figure 1.1 – Common Collector Amplifier: Determination of R_1

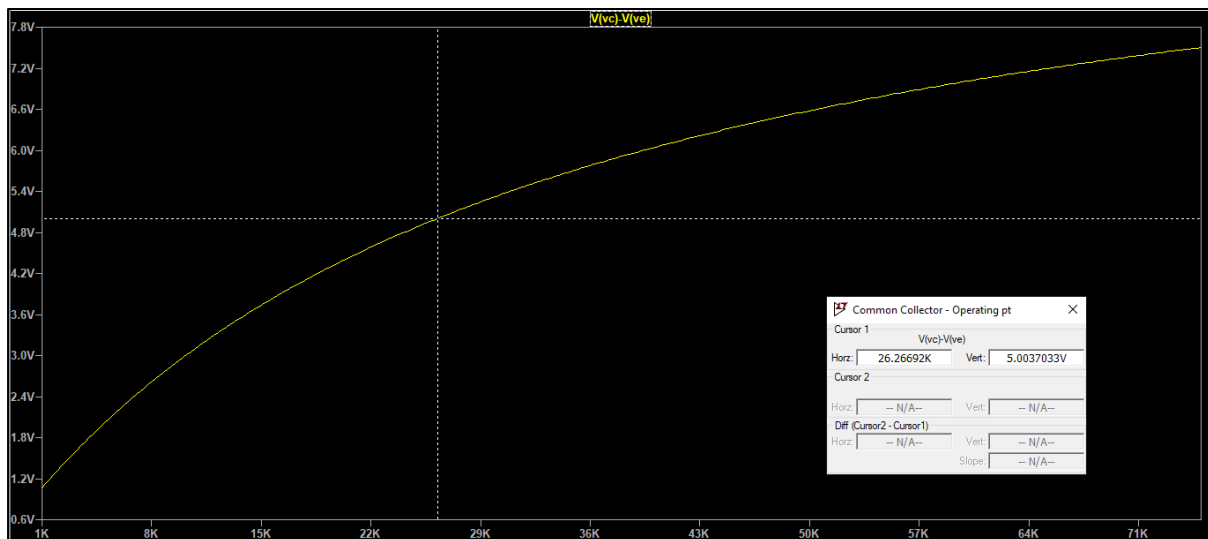


Figure 1.2 – Common Collector Amplifier: R_1 such that $V_C - V_E = V_{cc}/2$

For the desired operating point ($V_C - V_E = V_{cc}/2$), R_1 came out to be 26.326 k Ω .

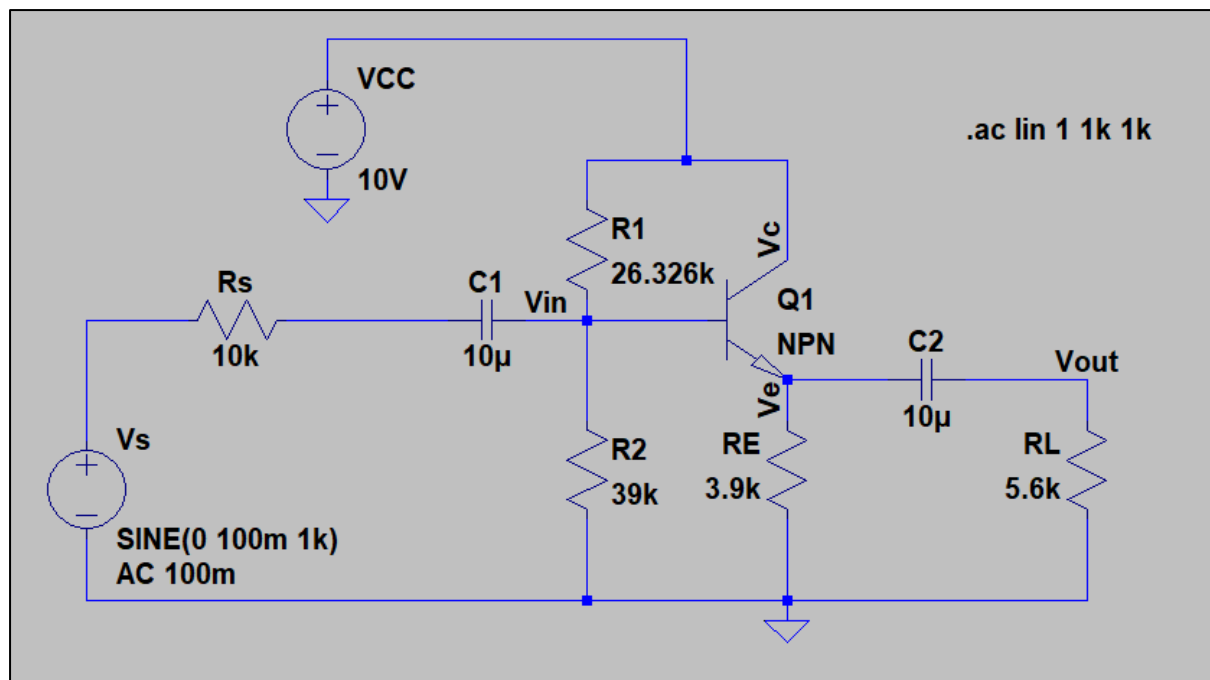


Figure 1.3 – Common Collector Amplifier: Circuit for the determination of V_{in} , V_{out} , I_{in} , I_{out} and R_{in}

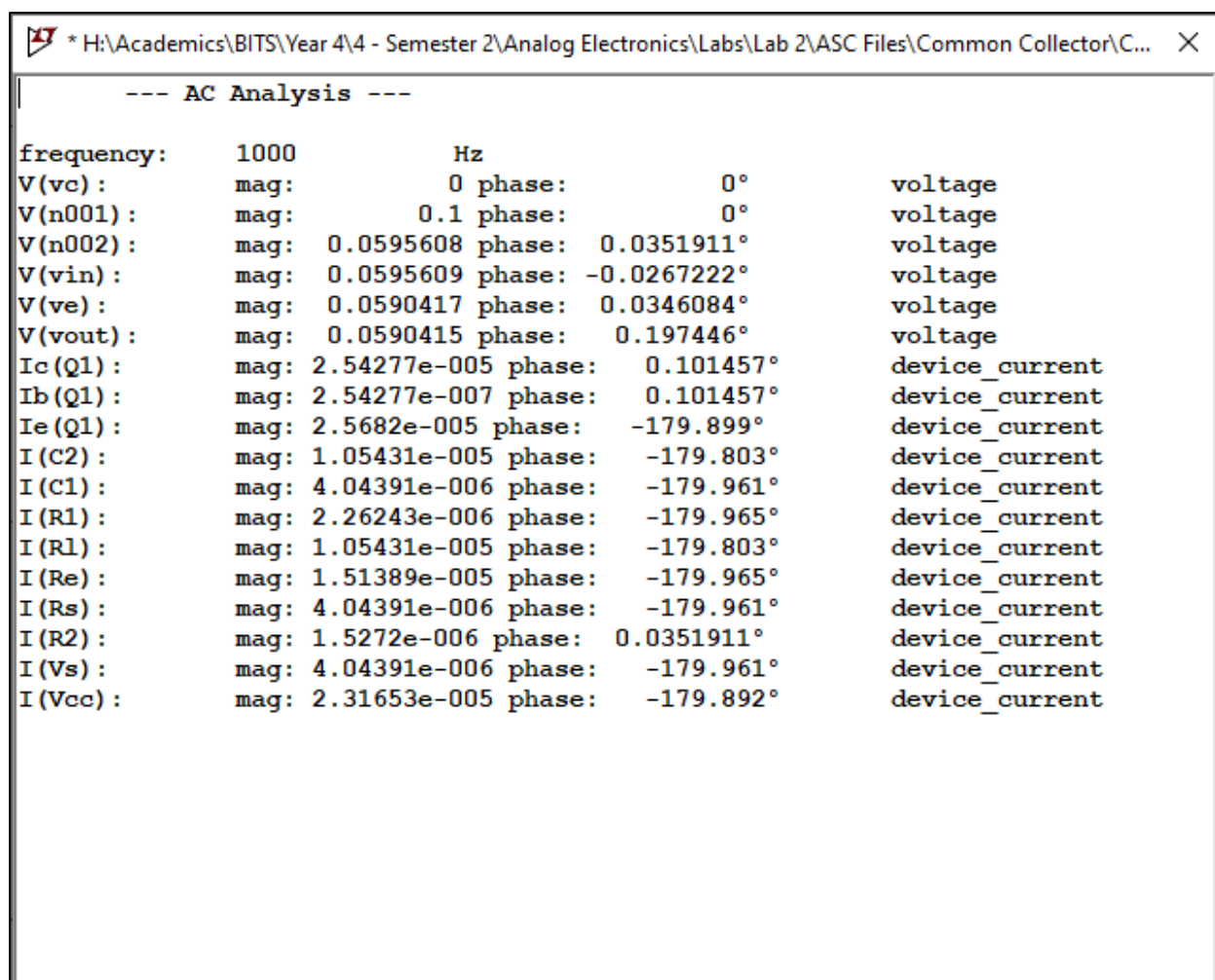


Figure 1.4 – Common Collector Amplifier: .ac results from Figure 3

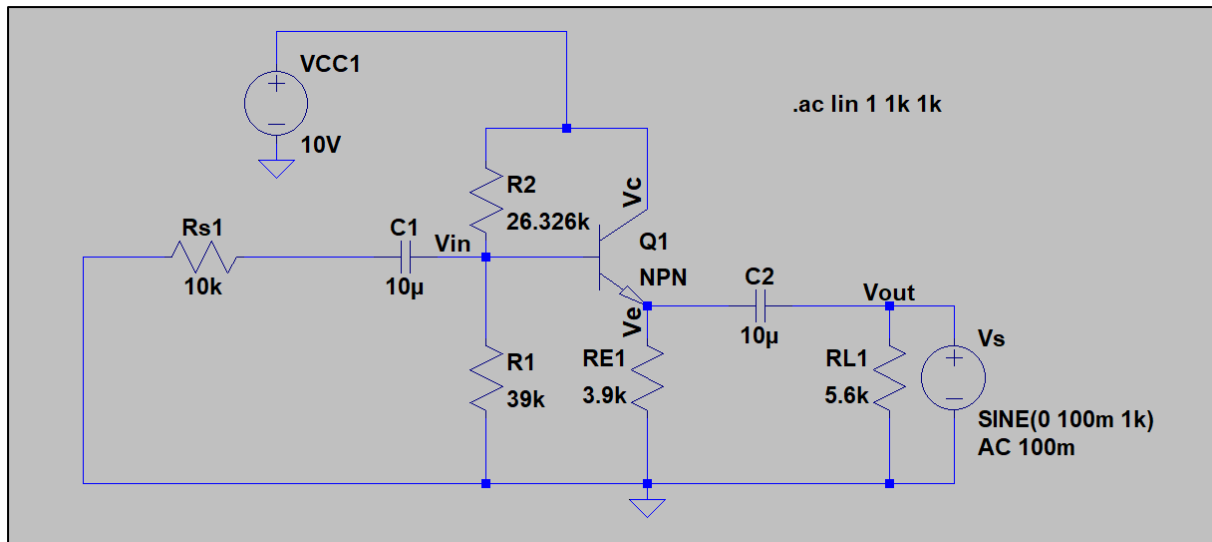


Figure 1.5 – Common Collector Amplifier: R_{out} calculation

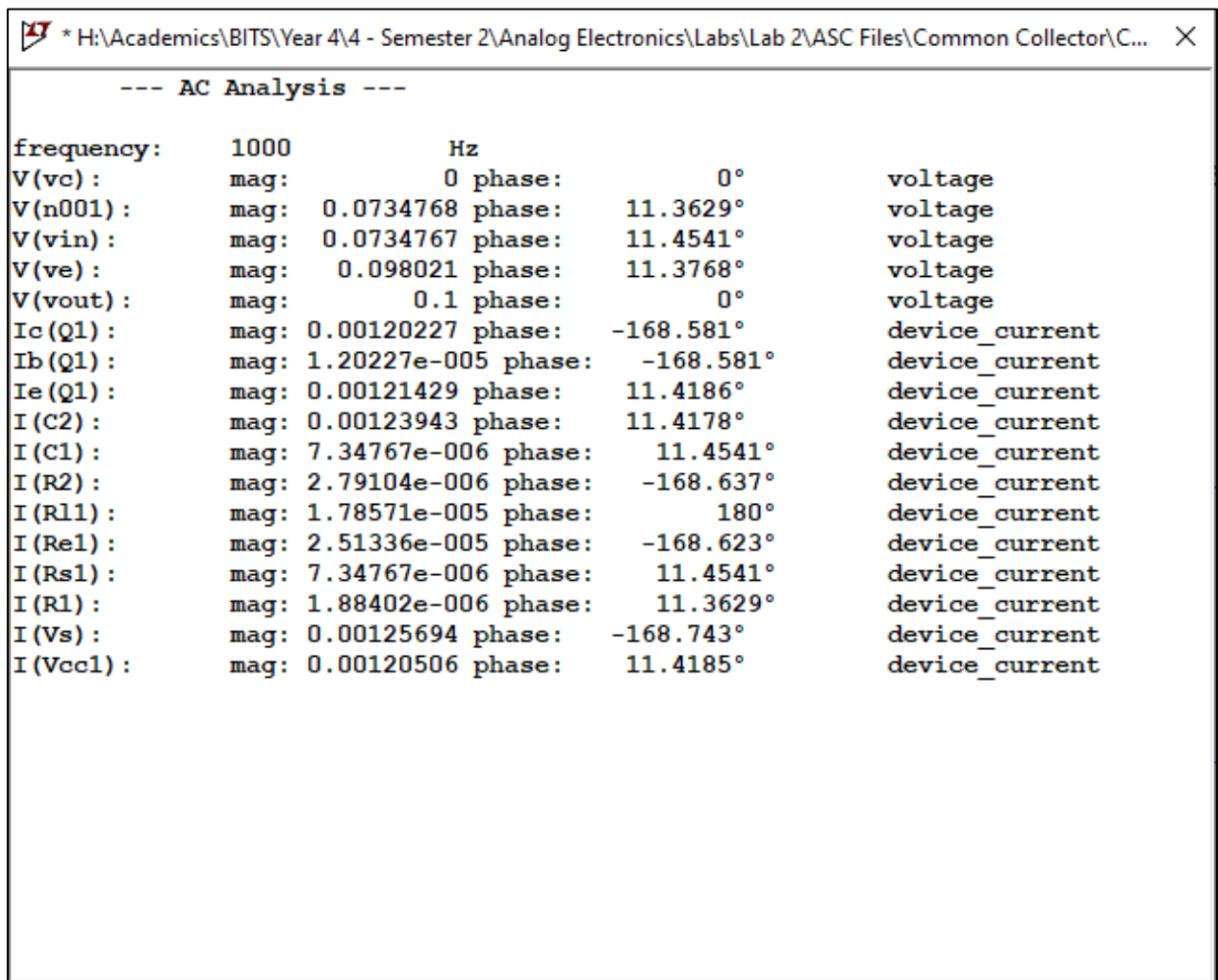


Figure 1.6 – Common Collector Amplifier: R_{out} calculation as obtained from .ac analysis

Table 1.1 - Results Summarized for Common Collector Amplifier

Quantities to be determined	Values obtained
V_{in}	0.0595609 V
V_{out}	0.0590415 V
I_{in}	4.04391 μ A
I_{out}	10.5431 μ A
A_v	0.99127
R_{in}	14.728 k Ω
R_{out}	79.55 Ω

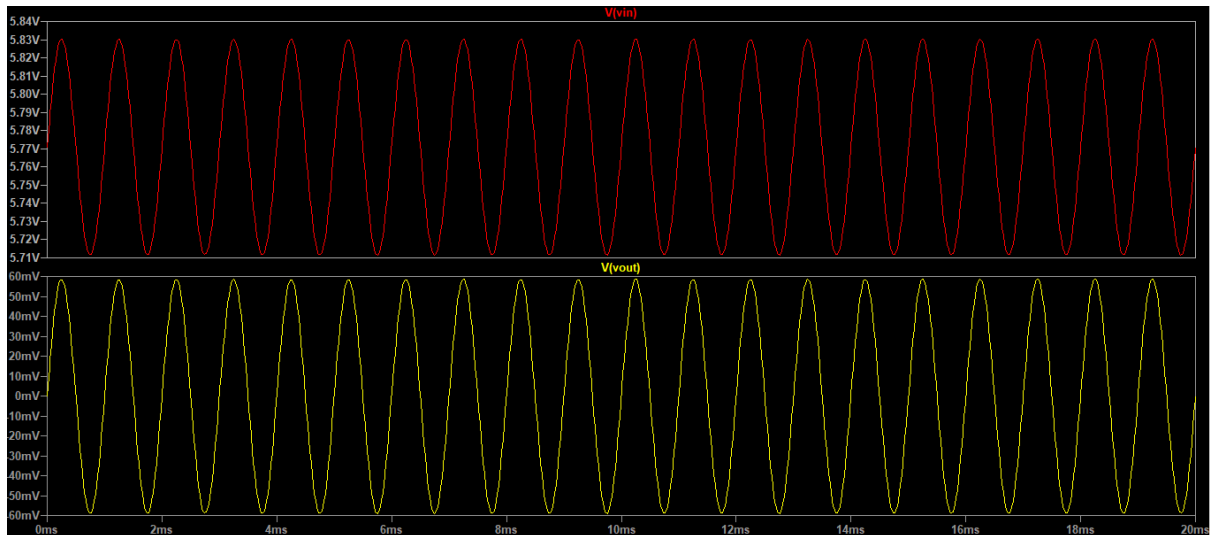


Figure 7 – Output Waveform

2. Darlington Configuration

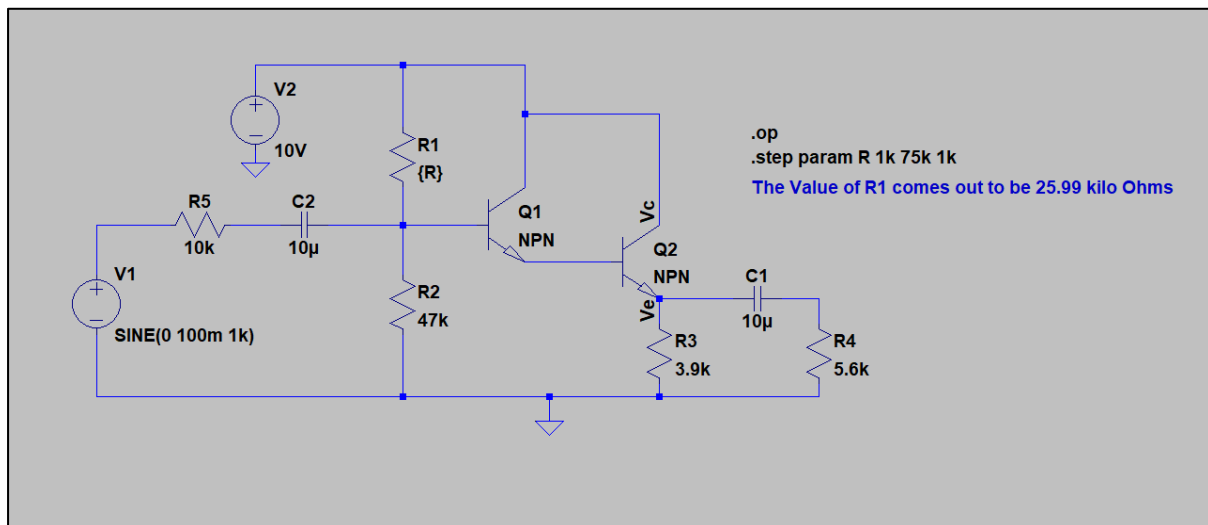


Figure 2.1 – Darlington Configuration: Determination of R_1

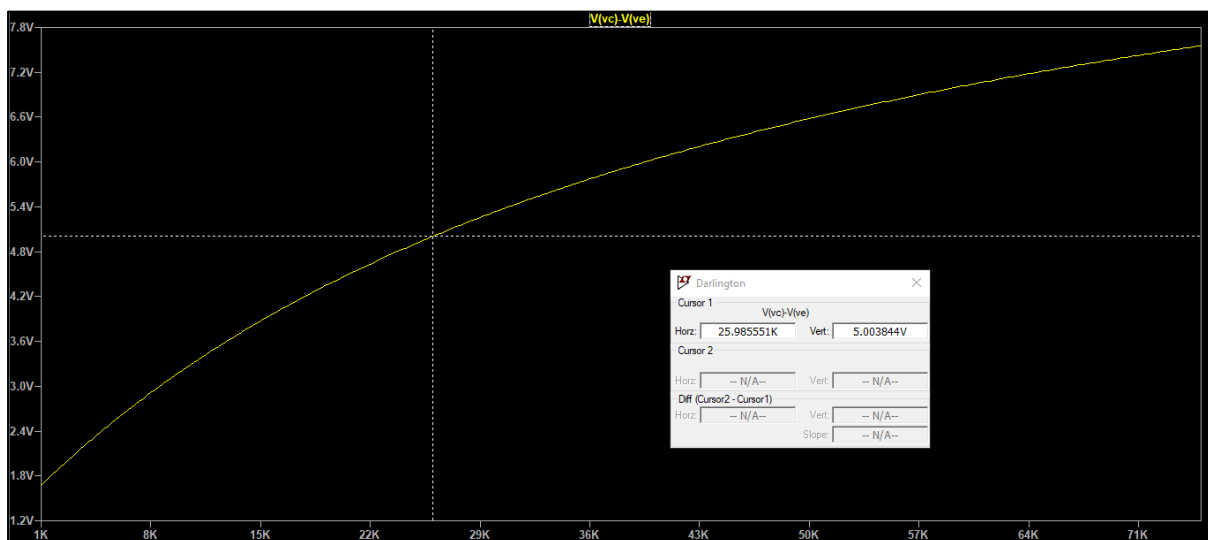
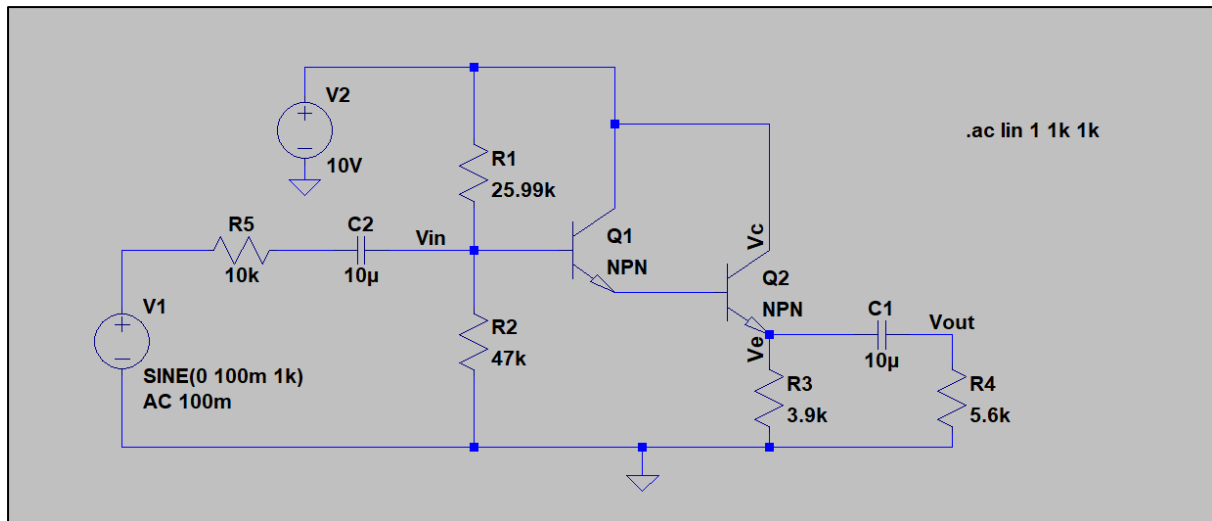


Figure 2.2 – Darlington Configuration: R_1 such that $V_C - V_E = V_{cc}/2$

For the desired operating point ($V_C - V_E = V_{cc}/2$), R_1 came out to be 25.99 kΩ.



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--- AC Analysis ---

frequency:      1000           Hz
V(n001):      mag:      0.1 phase:      0°           voltage
V(vc):        mag:      0 phase:      0°           voltage
V(vin):       mag:      0.0625802 phase: 0.0341055°   voltage
V(ve):        mag:      0.0614999 phase: 0.0329515°   voltage
V(vout):      mag:      0.0614997 phase: 0.195789°   voltage
V(n002):      mag:      0.0625803 phase: -0.0204208°   voltage
V(n003):      mag:      0.0620401 phase: 0.0335335°   voltage
Ic(Q2):       mag:      2.64864e-005 phase: 0.0998003°   device_current
Ib(Q2):       mag:      2.64864e-007 phase: 0.0998003°   device_current
Ie(Q2):       mag:      2.67513e-005 phase: -179.9°     device_current
Ic(Q1):       mag:      2.62242e-007 phase: 0.0998003°   device_current
Ib(Q1):       mag:      2.62248e-009 phase: 0.0997987°   device_current
Ie(Q1):       mag:      2.64864e-007 phase: -179.9°     device_current
I(C2):        mag:      3.74197e-006 phase: -179.966°   device_current
I(C1):        mag:      1.09821e-005 phase: -179.804°   device_current
I(R5):        mag:      3.74197e-006 phase: -179.966°   device_current
I(R4):        mag:      1.09821e-005 phase: 0.195789°   device_current
I(R3):        mag:      1.57692e-005 phase: 0.0329515°   device_current
I(R2):        mag:      1.33149e-006 phase: 0.0341055°   device_current
I(R1):        mag:      2.40786e-006 phase: -179.966°   device_current
I(V2):        mag:      2.43408e-005 phase: -179.894°   device_current
I(V1):        mag:      3.74197e-006 phase: -179.966°   device_current

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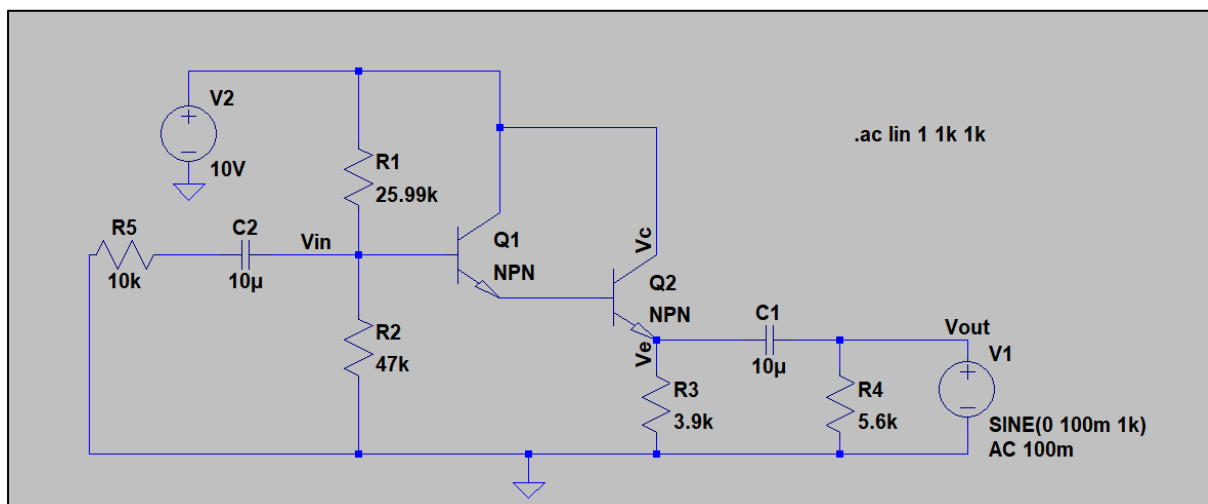


Figure 2.5 – Darlington Configuration: R_{out} calculation

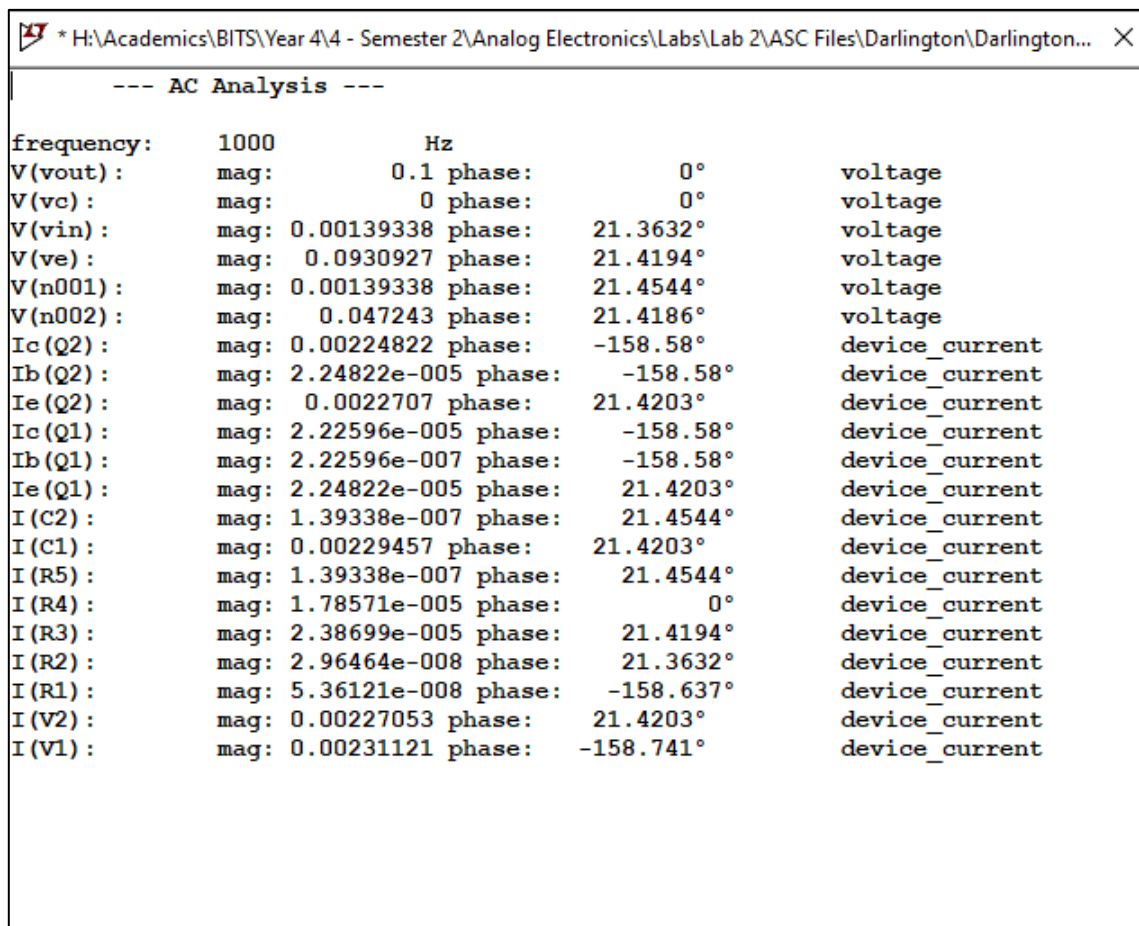


Figure 2.6 – Darlington Configuration: R_{out} calculation as obtained from .ac analysis

Table 2.1 - Results Summarized for Darlington Configuration

Quantities to be determined	Values obtained
V_{in}	0.0625802 V
V_{out}	0.0614997 V
I_{in}	3.74197 μ A
I_{out}	10.9821 μ A
A_v	0.9827
R_{in}	16.724 k Ω
R_{out}	43.26737 Ω

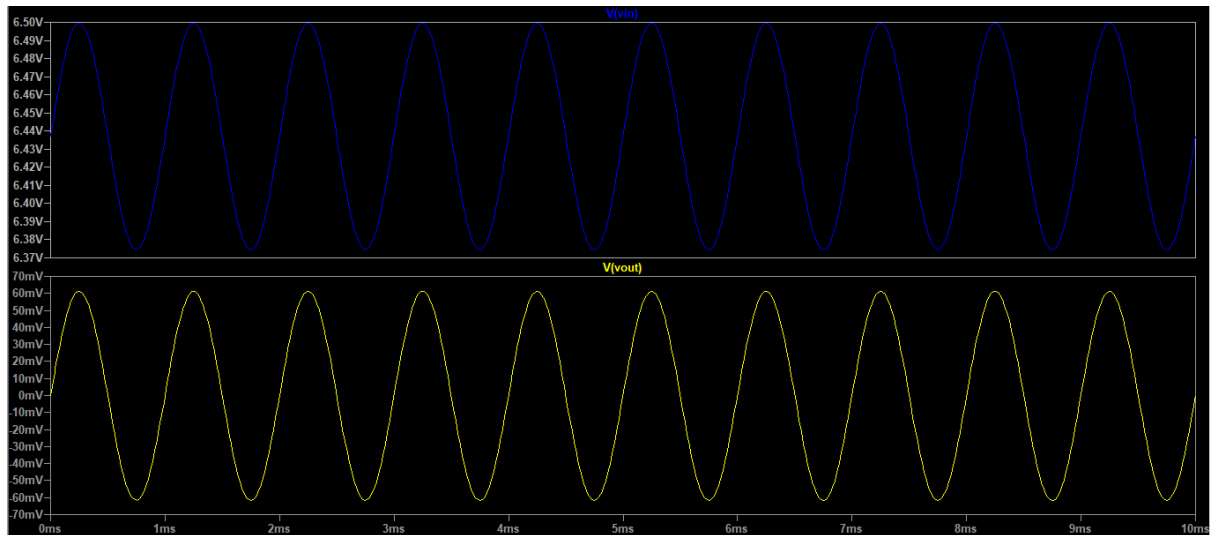


Figure 2.7 – Output Waveform

3. Bootstrap Configuration

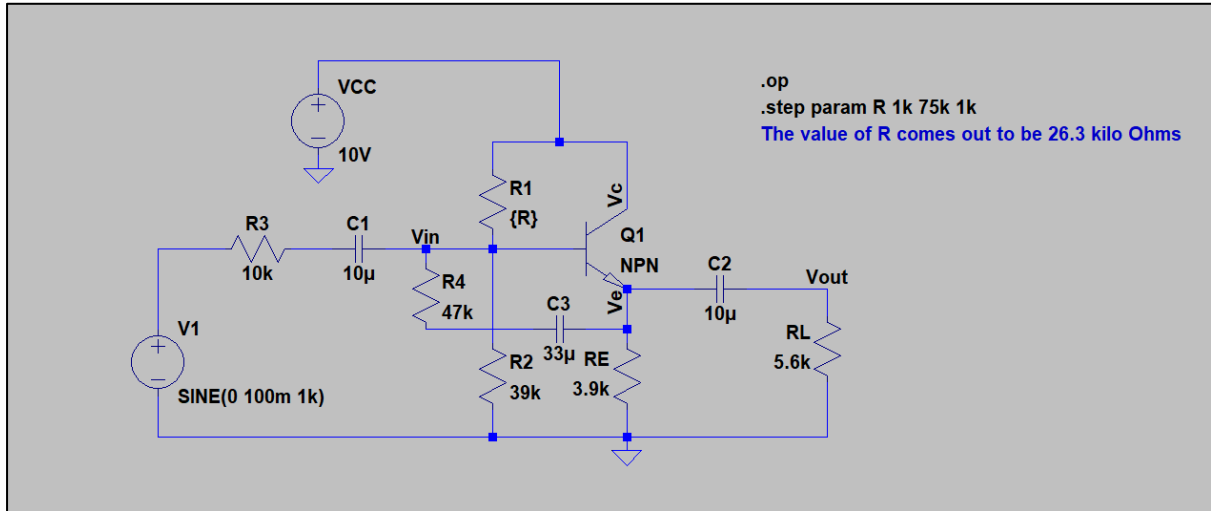


Figure 3.1 – Bootstrap Configuration: Determination of R_1

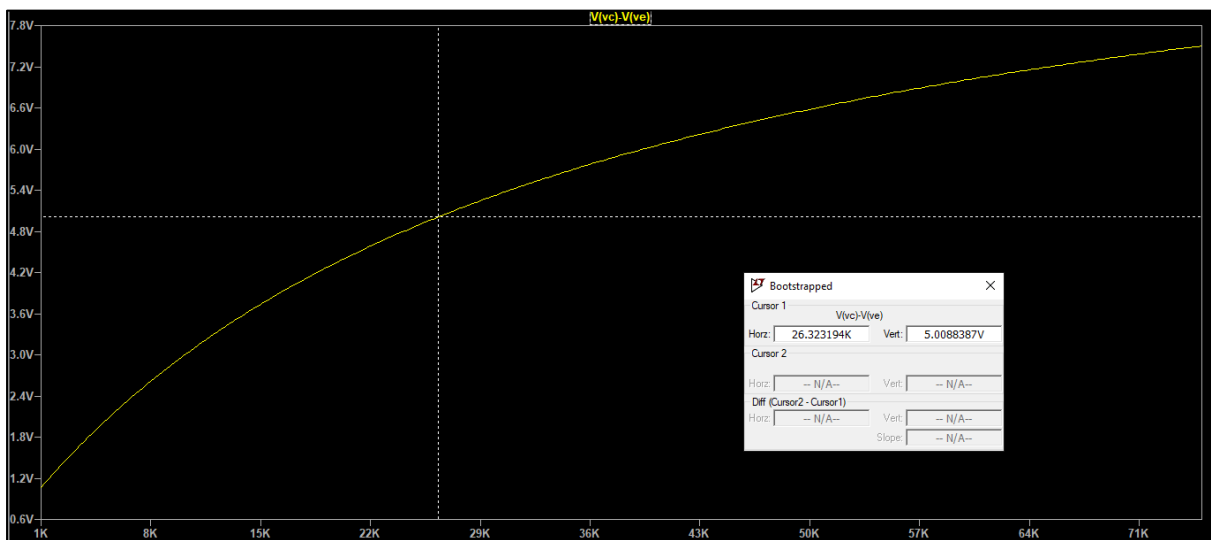


Figure 3.2 – Bootstrap Configuration: R_1 such that $V_C - V_E = V_{cc}/2$

For the desired operating point ($V_C - V_E = V_{cc}/2$), R_1 came out to be 26.323 kΩ.

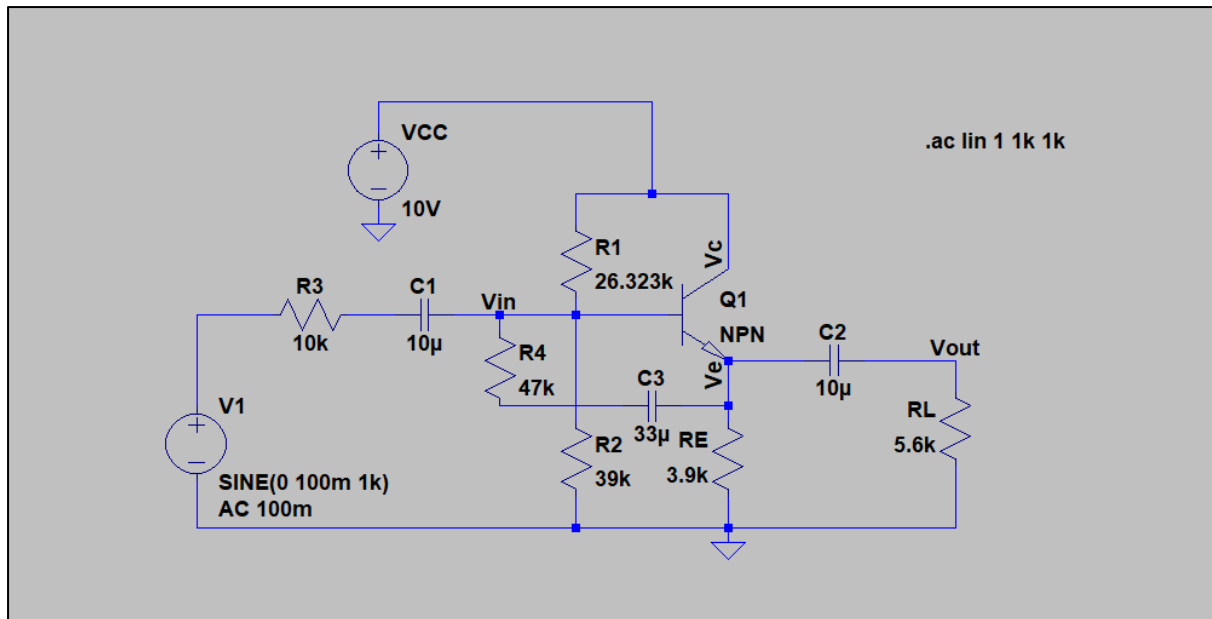


Figure 3.3 – Bootstrap Configuration: Circuit for the determination of V_{in} , V_{out} , I_{in} , I_{out} and R_{in}

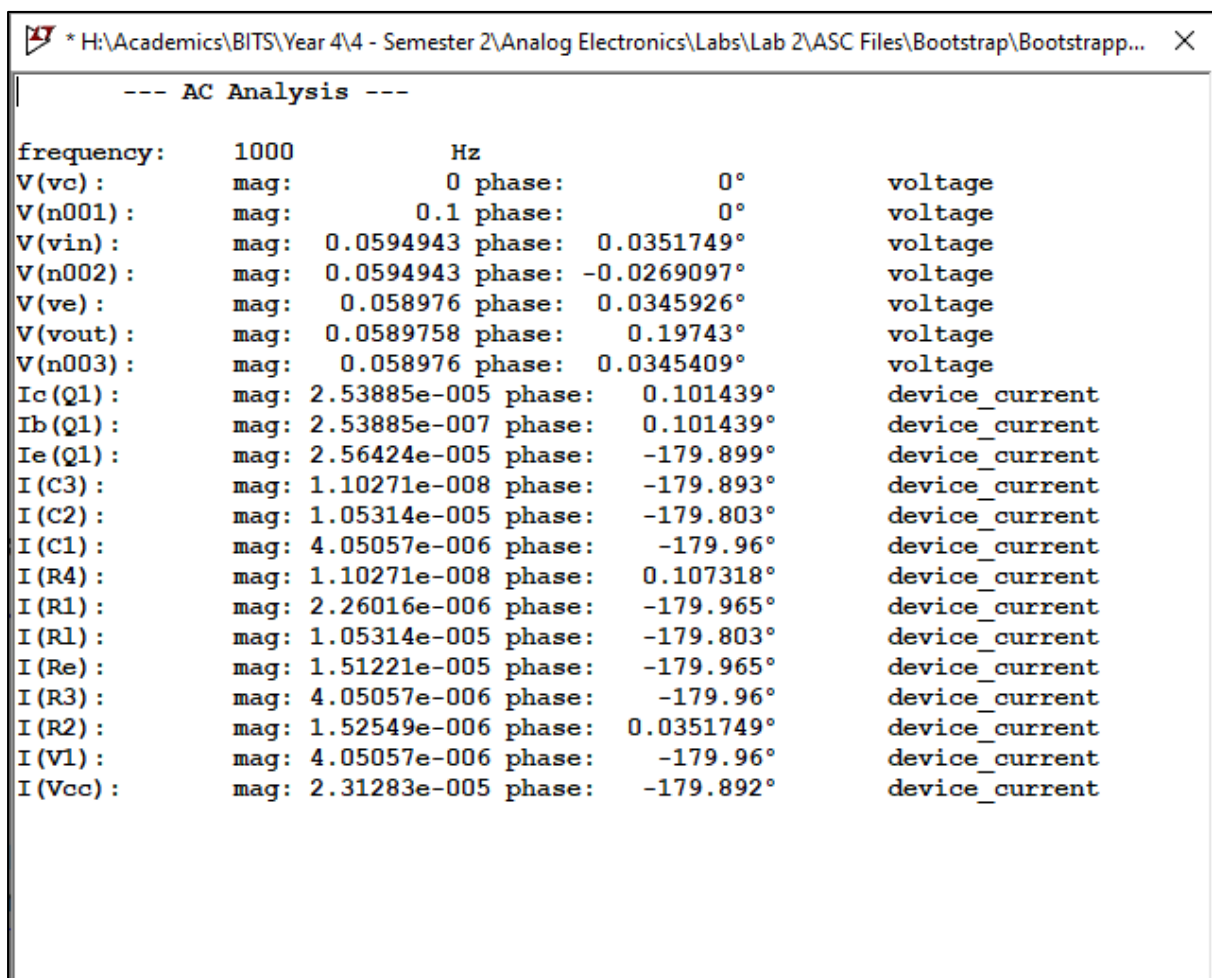


Figure 3.4 – Bootstrap Configuration: .ac results from Figure 3

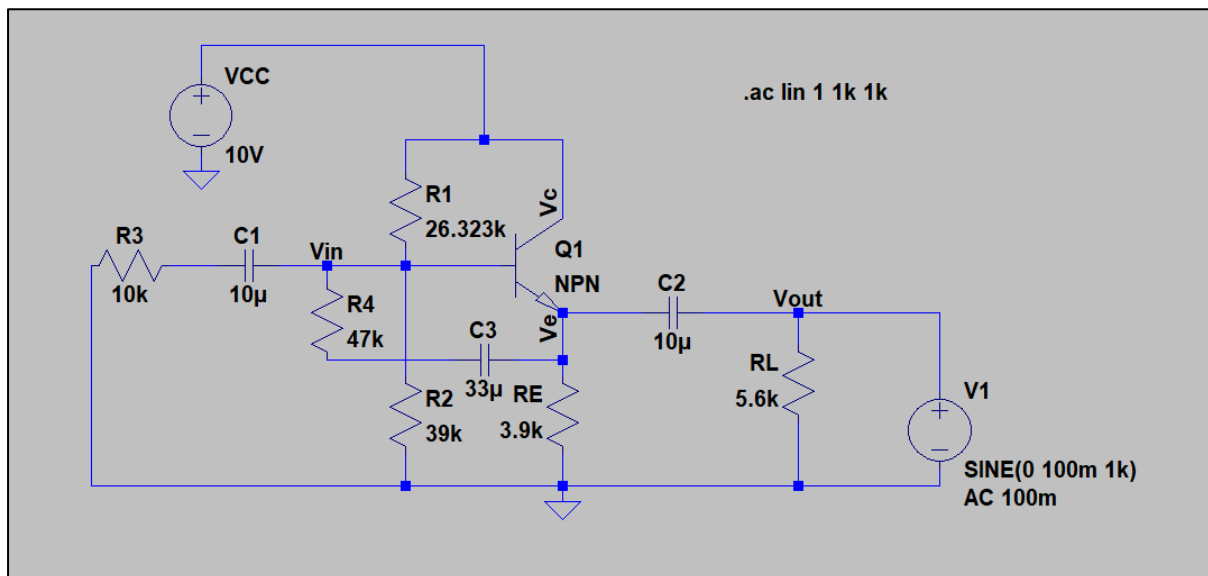


Figure 3.5 – Bootstrap Configuration: R_{out} calculation

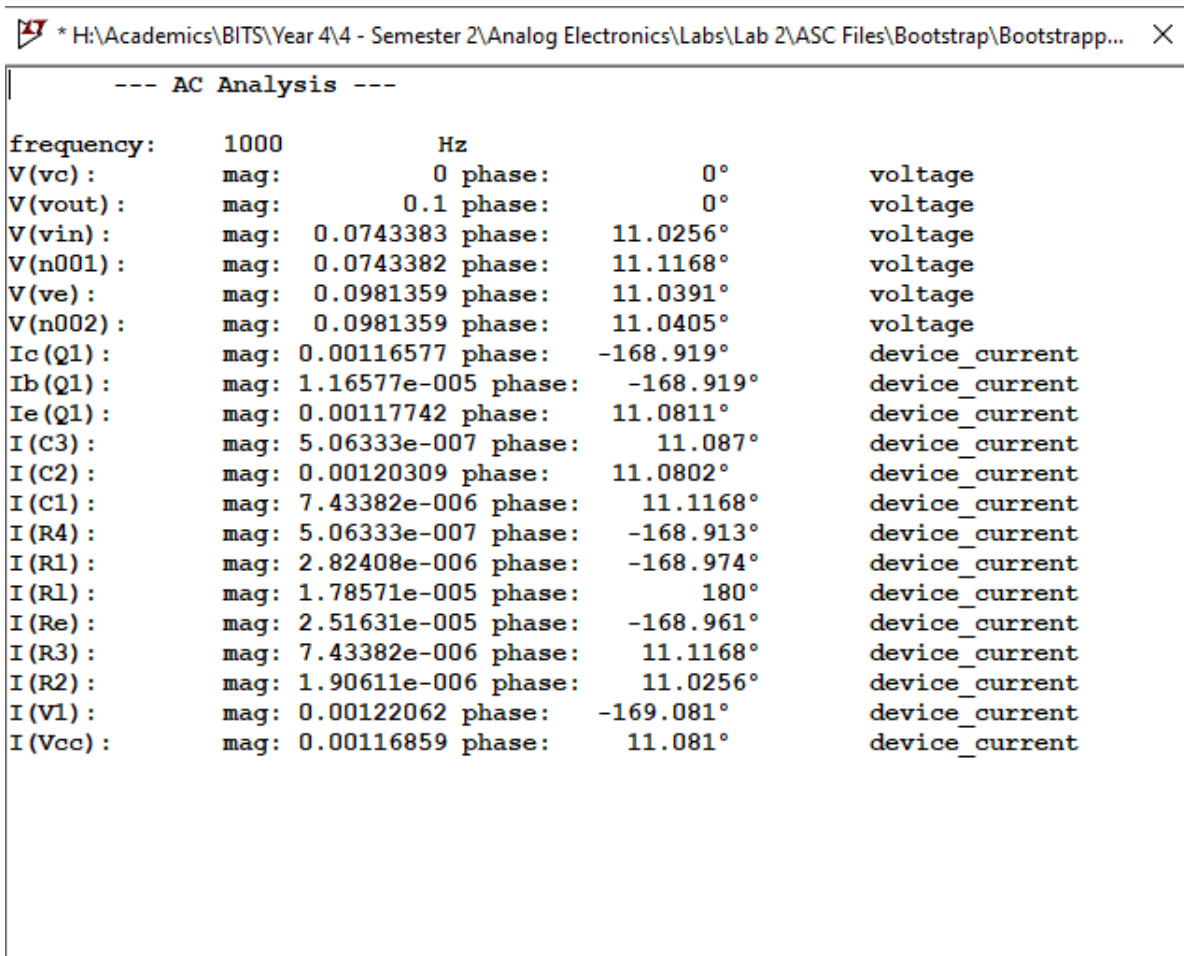


Figure 3.6 – Bootstrap Configuration: R_{out} calculation as obtained from .ac analysis

Table 3.1 - Results Summarized for Bootstrap Configuration

Quantities to be determined	Values obtained
V_{in}	0.0594943 V
V_{out}	0.0589758 V
I_{in}	4.057 μ A
I_{out}	10.5314 μ A
A_v	0.9913
R_{in}	14.688 k Ω
R_{out}	81.9255 Ω

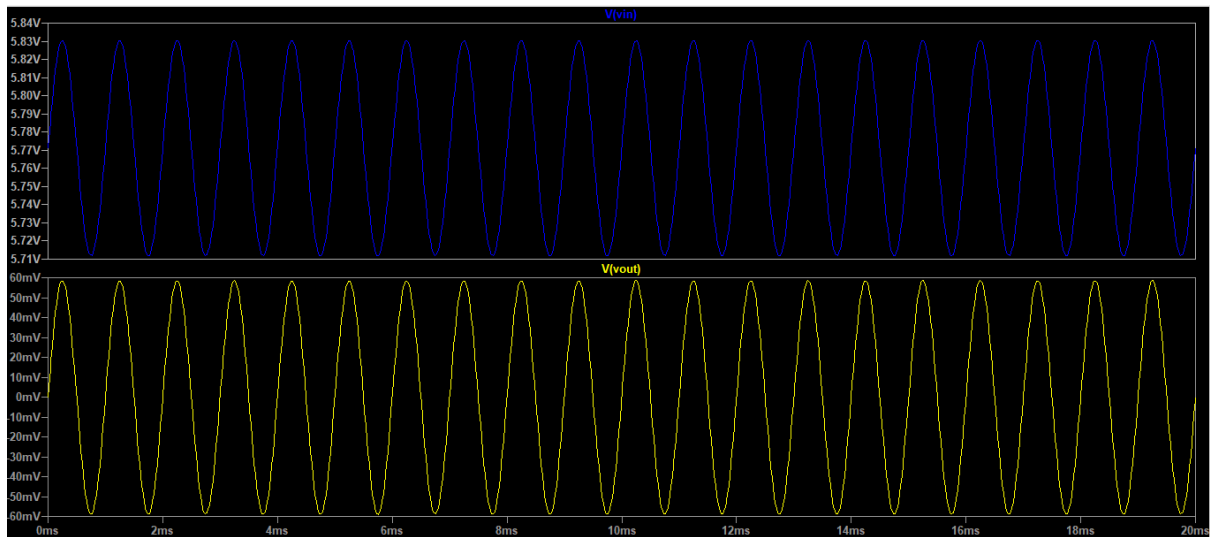


Figure 3.7 – Output Waveform