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Lab IV

Design of VCVS, VCCS, CCVS and CCCS using LM741

Objectives

A To design the following four topologies using LM741 OPAMP

1. Voltage Controlled Voltage Source (VCVS)
2. Current Controlled Voltage Source (CCVS)
3. Voltage Controlled Current Source (VCCS)
4. Current Controlled Current Source (CCCS) and find

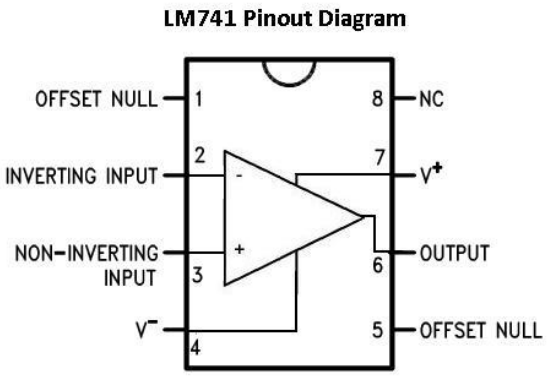
Simulated values of voltage gain (Av) by

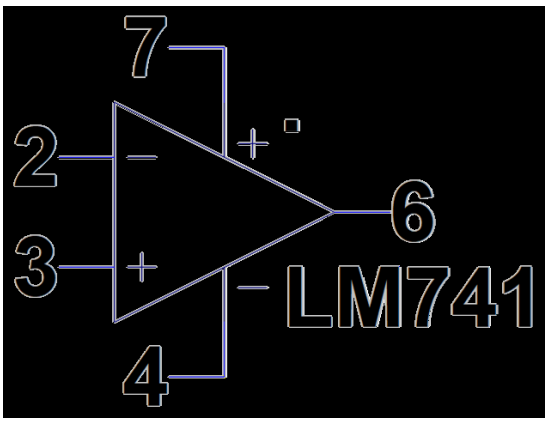
a) Varying RL with constant source
b) Varying source with constant RL

Compare the results from simulation with the theoretical values of Av.

IC LM741

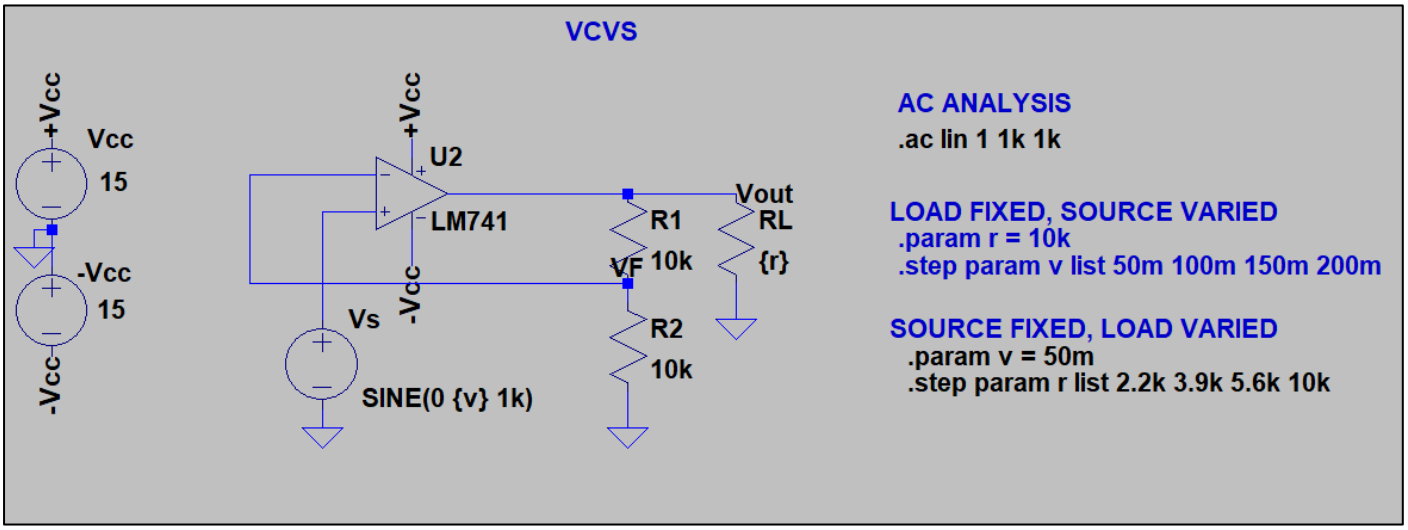
- LM741 operational amplifier is a DC-coupled high gain electronic voltage amplifier.
- It has only one op-amp inside.
- An operational amplifier IC is used as a comparator, which compares the two signals, the inverting and non-inverting signal.
- The main function of this IC is to do mathematical operation in various circuits.
- Op-amps have large gain and usually used as Voltage Amplifier.
- The LM741 can operate with a single or dual power supply voltage.



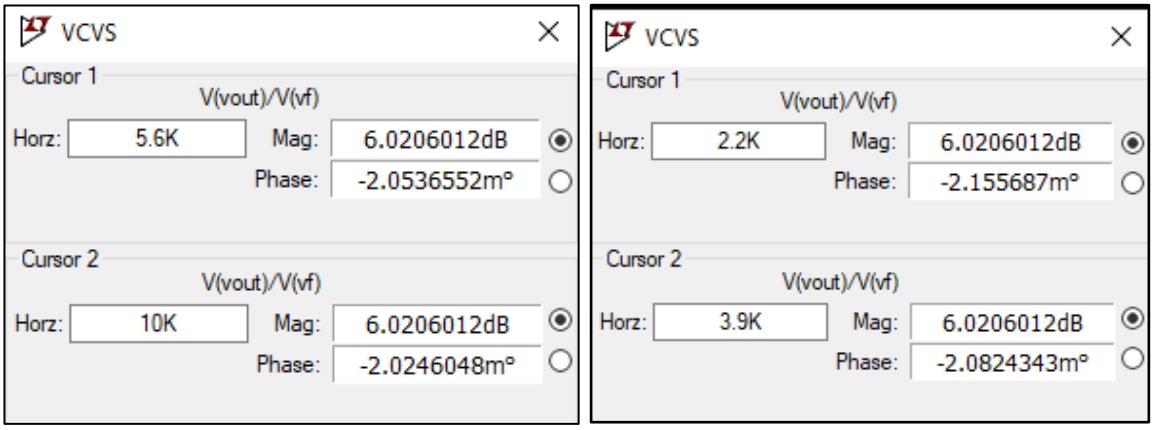


1. VCVS

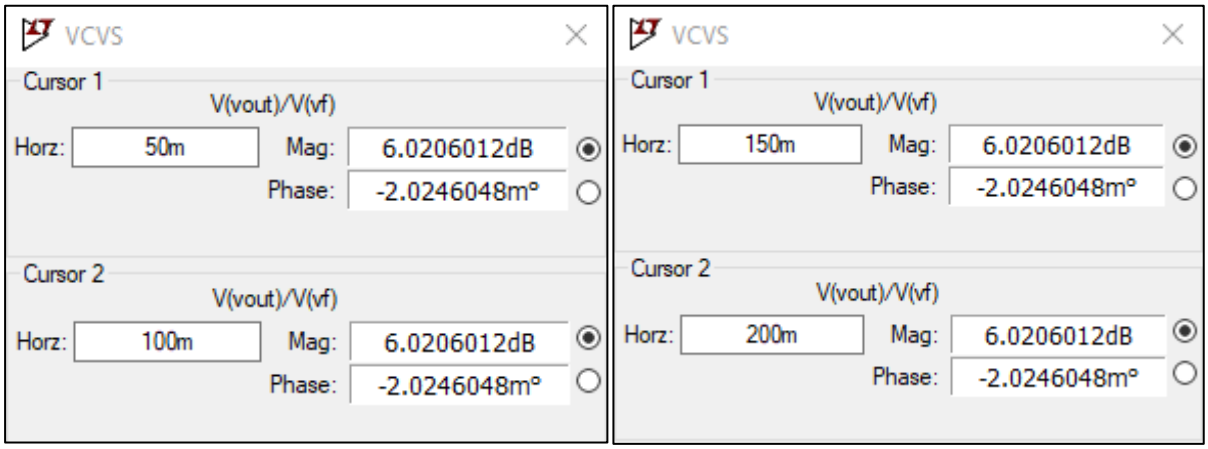
Schematic



Source V_S = 50mV and load varied



Load R_L = 10kΩ and source varied

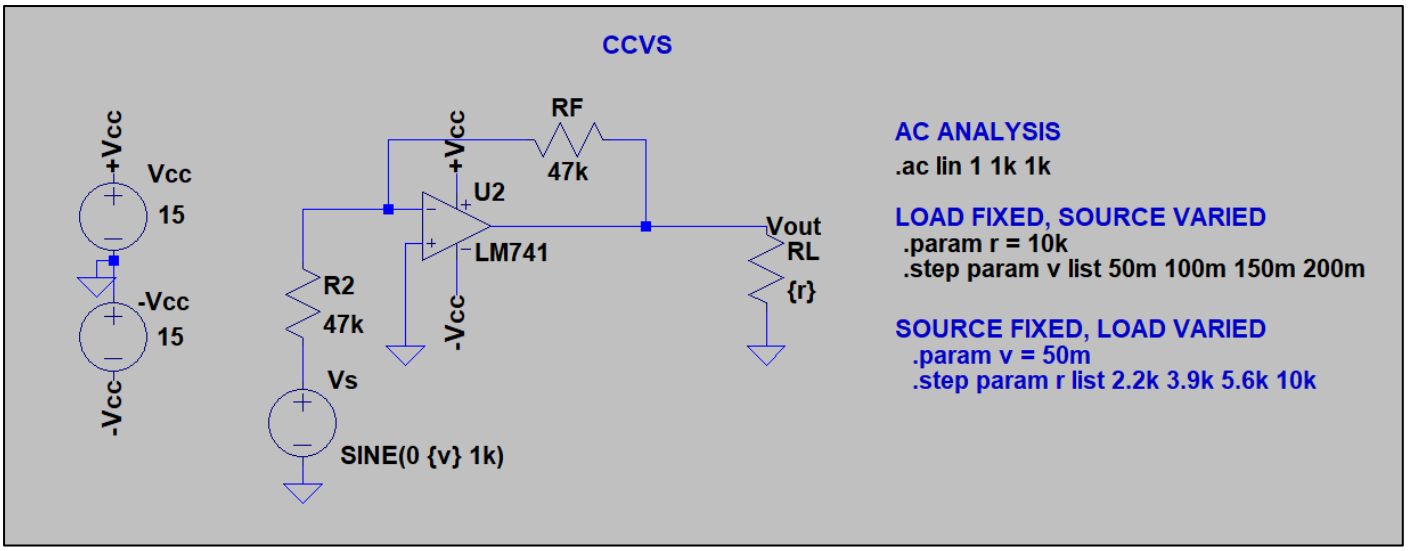


Comparison of simulated and theoretical values

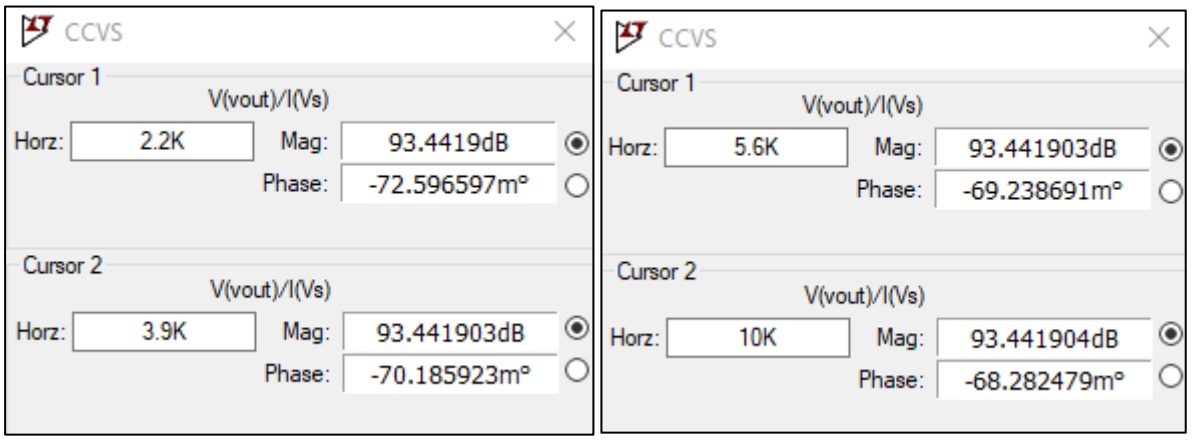
V_s (mV)	R_L (kΩ)	Simulated A_v	Theoretical $A_v = 1 + (R_1/R_2)$
50	2.2	6.0206012 dB = 2 V/V	1 + (10kΩ/10kΩ) = 2 V/V
50	3.9	6.0206012 dB = 2 V/V	1 + (10kΩ/10kΩ) = 2 V/V
50	5.6	6.0206012 dB = 2 V/V	1 + (10kΩ/10kΩ) = 2 V/V
50	10	6.0206012 dB = 2 V/V	1 + (10kΩ/10kΩ) = 2 V/V
50	10	6.0206012 dB = 2 V/V	1 + (10kΩ/10kΩ) = 2 V/V
100	10	6.0206012 dB = 2 V/V	1 + (10kΩ/10kΩ) = 2 V/V
150	10	6.0206012 dB = 2 V/V	1 + (10kΩ/10kΩ) = 2 V/V
200	10	6.0206012 dB = 2 V/V	1 + (10kΩ/10kΩ) = 2 V/V

2. CCVS

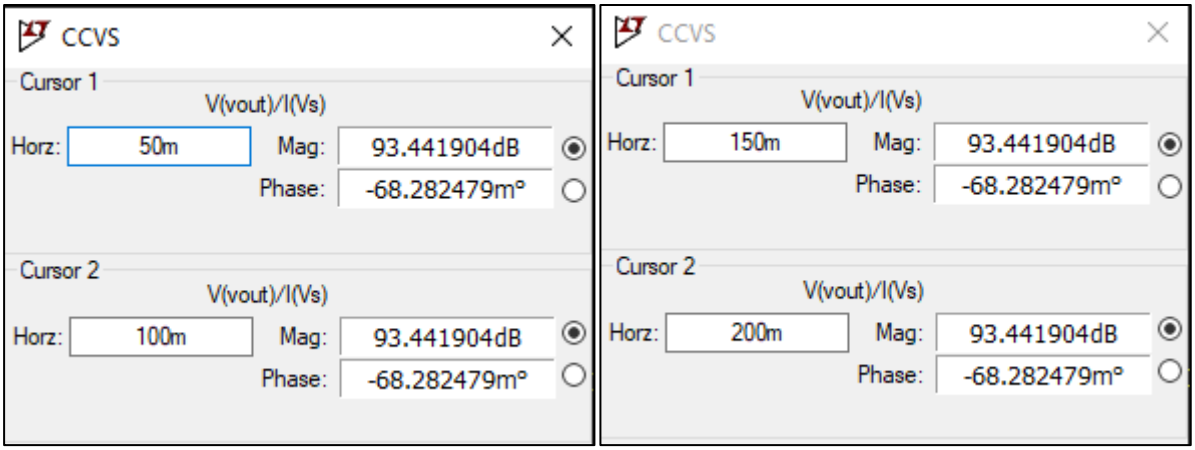
Schematic



Source V_s = 50mV and load varied



Load R_L = 10kΩ and source varied

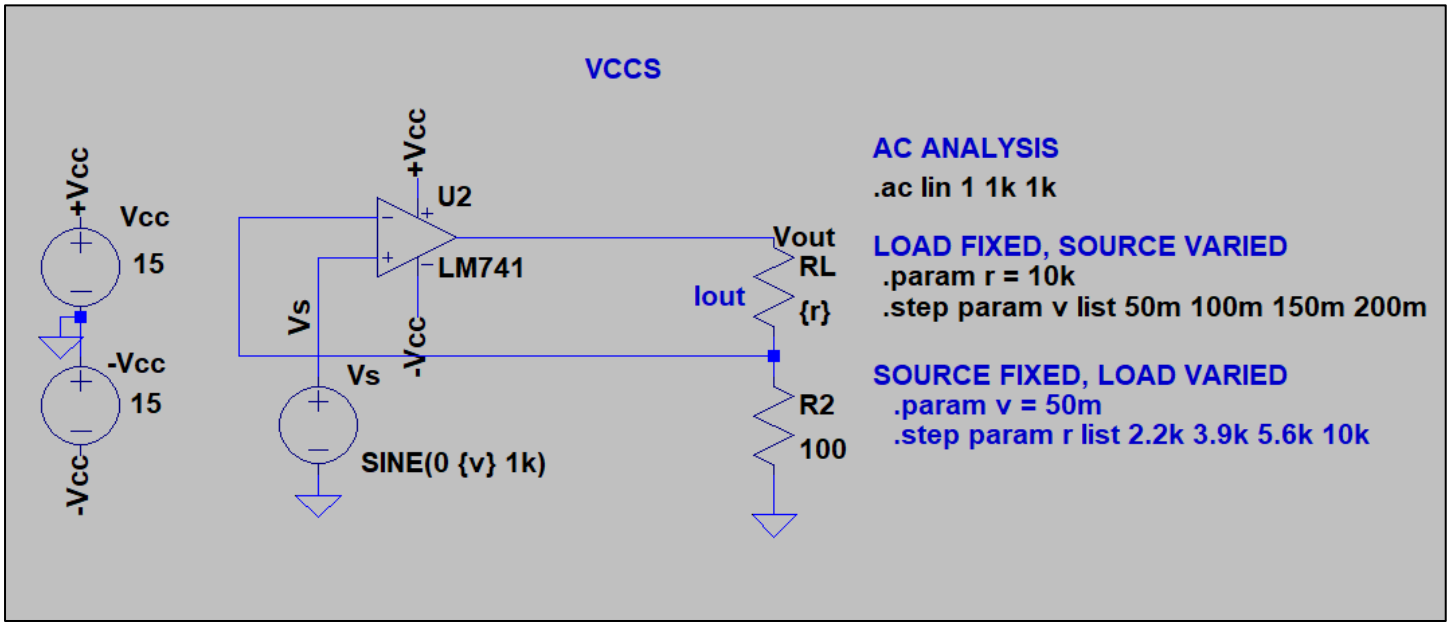


Comparison of simulated and theoretical values

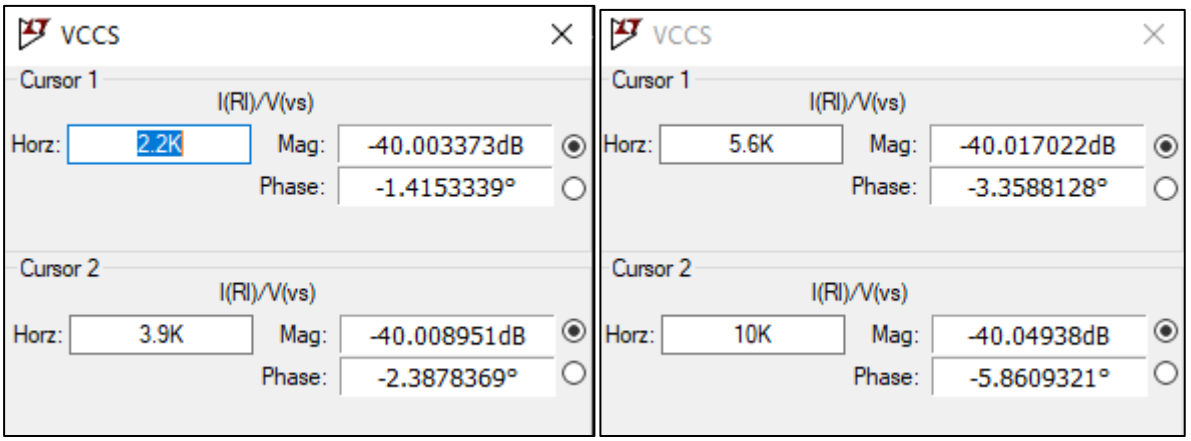
V_s (mV)	R_1 (kΩ)	Simulated A_R	Theoretical $A_R = R_f$
50	2.2	93.4419 dB = 46.99969 kΩ	47 kΩ
50	3.9	93.441903 dB = 46.99971 kΩ	47 kΩ
50	5.6	93.441903 dB = 46.999707 kΩ	47 kΩ
50	10	93.441904 dB = 46.999712 kΩ	47 kΩ
50	10	93.441904 dB = 46.999712 kΩ	47 kΩ
100	10	93.441904 dB = 46.999712 kΩ	47 kΩ
150	10	93.441904 dB = 46.999712 kΩ	47 kΩ
200	10	93.441904 dB = 46.999712 kΩ	47 kΩ

3. VCCS

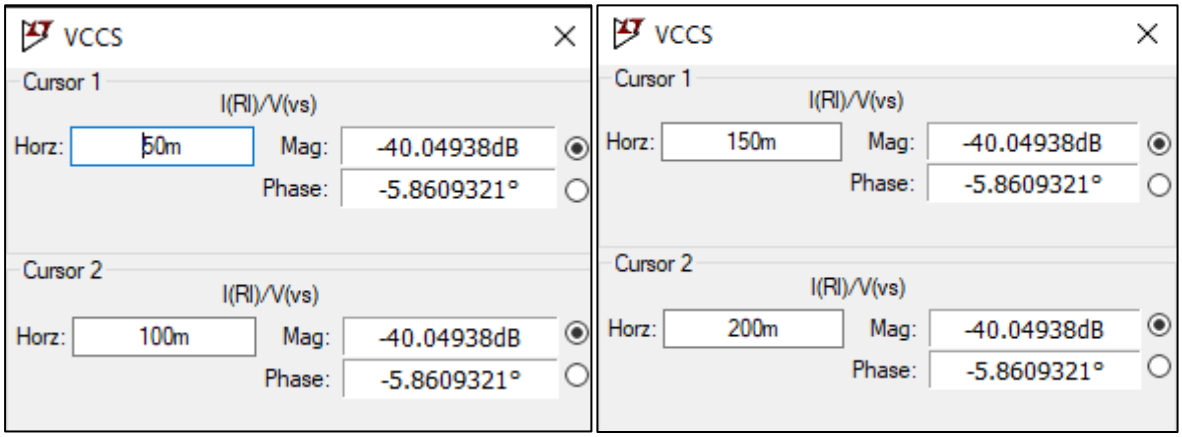
Schematic



Source V_s = 50mV and load varied



Load R_L = 10kΩ and source varied

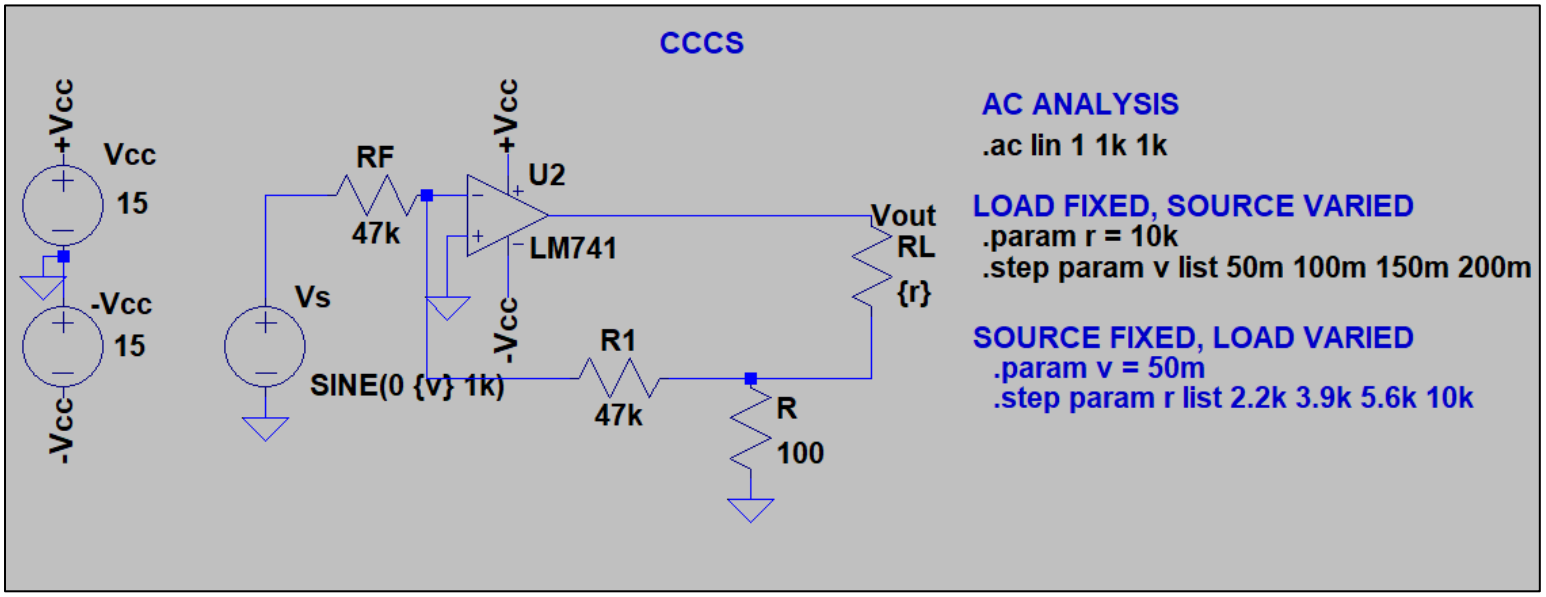


Comparison of simulated and theoretical values

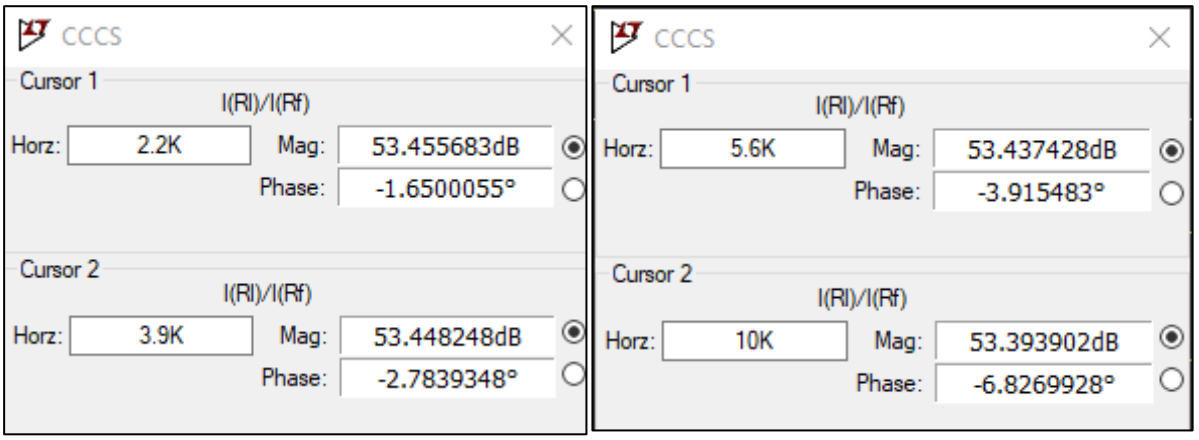
V_S (mV)	R_L (kΩ)	Simulated A_T	Theoretical $A_T = 1/R_2$
50	2.2	-40.003373 dB = 0.009996 Ω-1	1/100Ω = 0.01 Ω-1
50	3.9	-40.008951 dB = 0.009989 Ω-1	1/100Ω = 0.01 Ω-1
50	5.6	-40.017022 dB = 0.009980 Ω-1	1/100Ω = 0.01 Ω-1
50	10	-40.04938 dB = 0.009943 Ω-1	1/100Ω = 0.01 Ω-1
50	10	-40.04938 dB = 0.009943 Ω-1	1/100Ω = 0.01 Ω-1
100	10	-40.04938 dB = 0.009943 Ω-1	1/100Ω = 0.01 Ω-1
150	10	-40.04938 dB = 0.009943 Ω-1	1/100Ω = 0.01 Ω-1
200	10	-40.04938 dB = 0.009943 Ω-1	1/100Ω = 0.01 Ω-1

4. CCCS

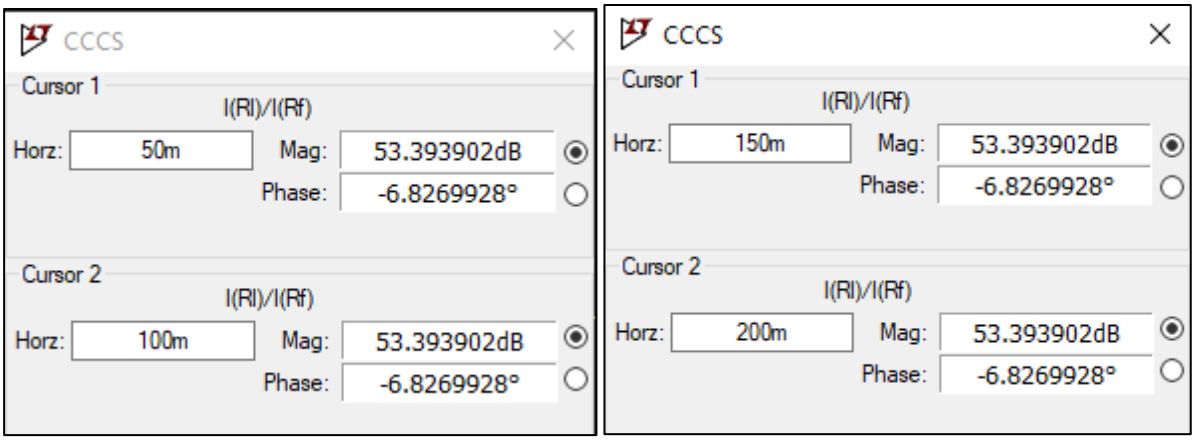
Schematic



Source V_s = 50mV and load varied



Load R_L = 10kΩ and source varied



Comparison of simulated and theoretical values

V_s(mV)	R_1 (kΩ)	Simulated A_i	Theoretical $A_i = 1 + (R_1/R)$
50	2.2	53.455683 dB = 470.7433 A/A	1 + (47kΩ/100Ω) = 471 A/A
50	3.9	53.448248 dB = 470.3405 A/A	1 + (47kΩ/100Ω) = 471 A/A
50	5.6	54.437428 dB = 469.755 A/A	1 + (47kΩ/100Ω) = 471 A/A
50	10	54.393902 dB = 467.4069 A/A	1 + (47kΩ/100Ω) = 471 A/A
50	10	54.393902 dB = 467.4069 A/A	1 + (47kΩ/100Ω) = 471 A/A
100	10	54.393902 dB = 467.4069 A/A	1 + (47kΩ/100Ω) = 471 A/A
150	10	54.393902 dB = 467.4069 A/A	1 + (47kΩ/100Ω) = 471 A/A
200	10	54.393902 dB = 467.4069 A/A	1 + (47kΩ/100Ω) = 471 A/A