Lab 1 Results –Intro to DC Circuits

ECE202: Fundamentals of Electrical Engineering

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2.1 Equipment Familiarization

2.1.5.1

Measure Resistance						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**
	10Ω	100Ω	470Ω	1.0kΩ	4.7kΩ	10MΩ
Color 1	Brown	Brown	Yellow	Brown	Yellow	Brown
Color 2	Black	Black	Purple	Black	Purple	Black
Color 3	Black	Brown	Brown	Red	Red	Blue
Color 4	Golden	Golden	Golden	Golden	Golden	White
Color 5	Brown	NA	NA	NA	NA	NA
Tolerance(%)	1	5	5	5	5	5
R (Ω)	10.1	97.8	463	977	4564	10170

Measure Series Resistors		
RS1	**RS2**	**RS3**
100Ω + 470Ω	1.0kΩ + 4.7kΩ	10MΩ + 10MΩ
556.5 Ω	5.616 kΩ	20.62 MΩ

Measure Parallel Resistors		
RP1	**RP2**	**RP3**
100Ω // 470Ω	1.0kΩ // 4.7kΩ	10MΩ // 10MΩ
80.7	0.810 kΩ	5.15 MΩ

2.2 Ohm's Law and Power

470 Ω - Resistor							
Voltage	(V)	**5.0**	**3.5**	**1.0**	**0**	**-2.5**	**-5.0**
Voltage	(V)	4.9669	4.3821	1.0105	0.02	-2.456	-4.9325
Current	(mA)	10.7	7.48	2.13	0.00	-5.33	-10.69
Resistance	(Ω)	464.2	585.84	474.41	inf	460.8	461.4
Power	(mW)	0.0531	0.0328	0.00215	0.00	0.0131	0.0527
1.0 kΩ – Resistor							
Voltage	(V)	**5.0**	**3.5**	**1.0**	**0**	**-2.5**	**-5.0**
Voltage	(V)	4.9898	3.5001	1.015	0.023	-2.4686	-4.9577
Current	(mA)	5.05	3.54	1.010	0.00	-2.52	-5.06
Resistance	(Ω)	988.08	988.73	1004.95	Inf	979.6	979.78
Power	(mW)	0.0252	0.0124	0.00103	0.00	0.00622	0.0251
4.7 kΩ – Resistor							
Voltage	(V)	**5.0**	**3.5**	**1.0**	**0**	**-2.5**	**-5.0**
Voltage	(V)	5.0076	3.5143	1.0187	0.0234	-2.4732	-4.9766
Current	(mA)	1.08	0.76	0.21	0.00	-0.55	-1.09
Resistance	(Ω)	4636.0	4624.1	4851.0	inf	4496.7	4565.7
Power	(mW)	0.00541	0.00267	0.000214	0.00	0.00136	0.00542

2.3 Voltage Divider

R1	(Ω)	**470**			
R2	(Ω)	**100**	**470**	**1.0 k**	**4.7 k**
VS	(V)	5	5	5	5
IS	(mA)	8.80	5.38	3.44	0.99
V1	(V)	4.0925	2.51	1.6146	0.480
V2	(V)	0.855	2.4583	3.3657	4.5131
P_{R1}	(mW)	36.0	13.5	5.55	0.475
P_{R2}	(mW)	7.52	13.2	11.6	4.47
P_{Total}	(mW)	43.5	26.7	17.2	4.95

1. **In the voltage divider circuit show your work for finding P_{R1} and P_{R2} for the case R1= 470 Ω and R2= 1.0 kΩ.**

P_{R1} = V1 * IS = 1.6146 V * 3.44 mA = 5.55 mW

P_{R2} = V2 * IS = 3.3657 V * 3.44 mA = 11.6 mW

2.4 Current Divider

R1	(Ω)	470			
R2	(Ω)	100	470	1.0 k	4.7 k
VS	(V)	5.0048	5.0021	5.0064	5.0028
IS	(mA)	5.13	5.13	5.13	5.13
I1	(mA)	0.88	2.53	3.46	4.63
I2	(mA)	4.20	2.55	1.62	0.46
P_{R1}	(mW)	4.40	12.7	17.3	23.2
P_{R2}	(mW)	21.0	12.8	8.1	2.30
P_{Total}	(mW)	25.4	25.4	25.4	25.4

2.5 Potentiometer Divider

V1 Set-Point	(V)	0	1.0	2.5	4.0	5.0
V1	(V)	0.0146	1.0731	2.4678	3.9903	4.9920
V2	(V)	4.9623	3.9063	2.5133	0.9935	0.0067
IS	(mA)	4.66	4.66	4.66	4.66	4.66
V_{Total}	(V)	4.9769	4.9794	4.9811	4.9838	4.9987

2.6 Voltmeter Loading

V2	(V)	1.659

V1	(V)	1.678
VS	(V)	5.011
V2 + V1	(V)	3.337

2.6 Ammeter Loading

VS	(V)	**0.5**	**1.5**	**2.5**
IS	(mA)	34.72	103.7	172.7
$V_{(AMMETER)}$	(V)	0.132	0.367	0.607
R_{DMM}	(Ω)	3.80	3.54	3.51

2. **Resistors typically have two important ratings: its resistance and its wattage. Explain how this wattage rating affects the amount of the voltage that can be applied to the resistor. Consider a 100Ω resistor with 0.25watt power rating.**

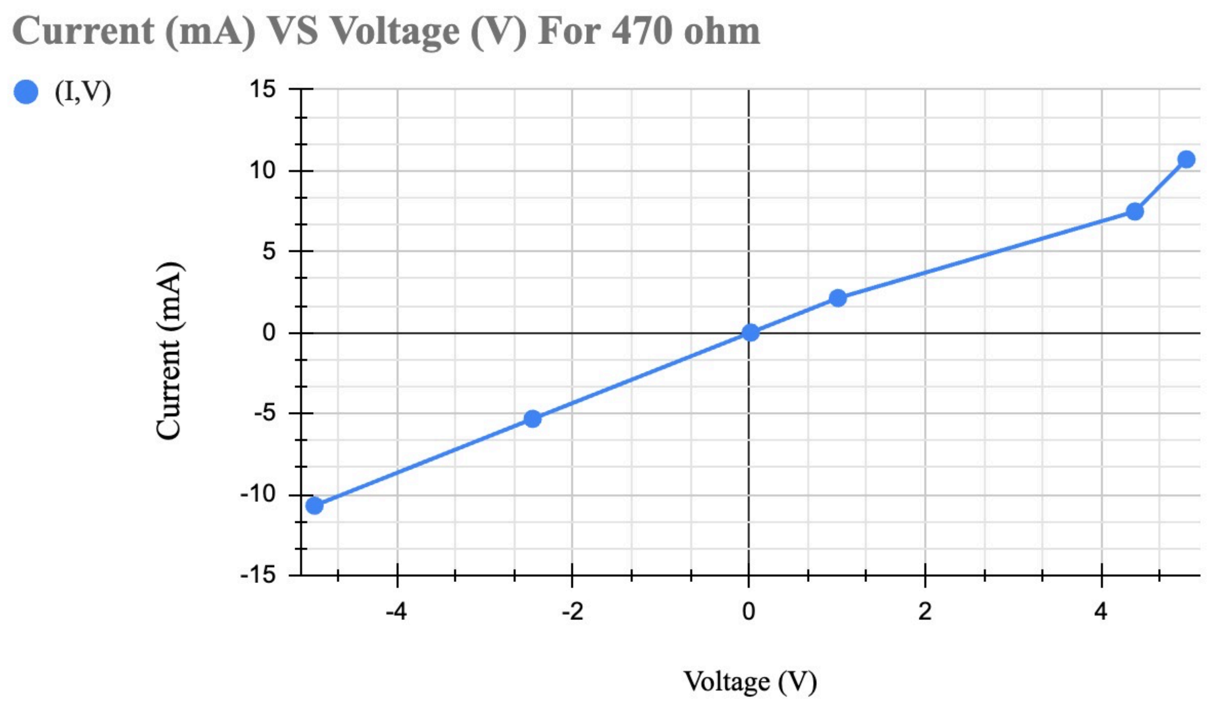
   Wattage can be used to determine the maximum value of current or voltage a resistor can handle. In this scenario we can use $P = V^2/R$ to find the maximum voltage V that the resistor can handle. $V = \sqrt{0.25 * 100} = 5$ V.

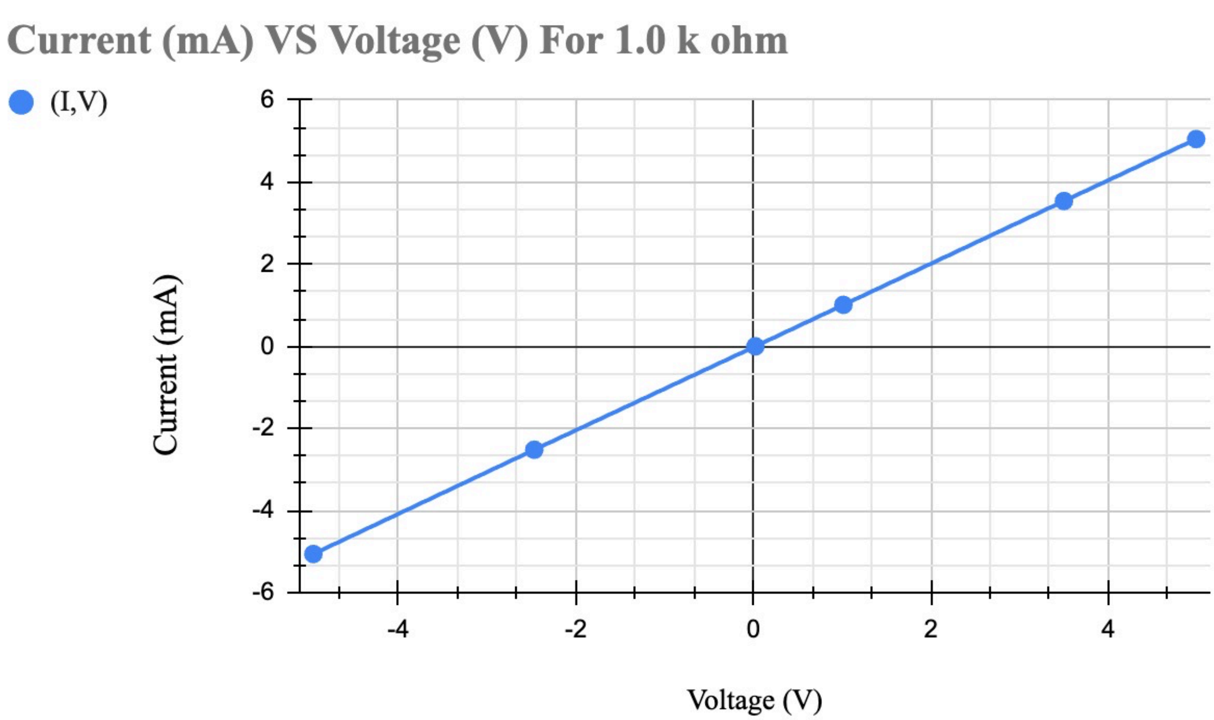
3. **Looking at the Resistor P-V Curves graph the power is always positive. Explain in your own words what this means? What happens to the power dissipated in the resistor when you double the voltage? Explain.**

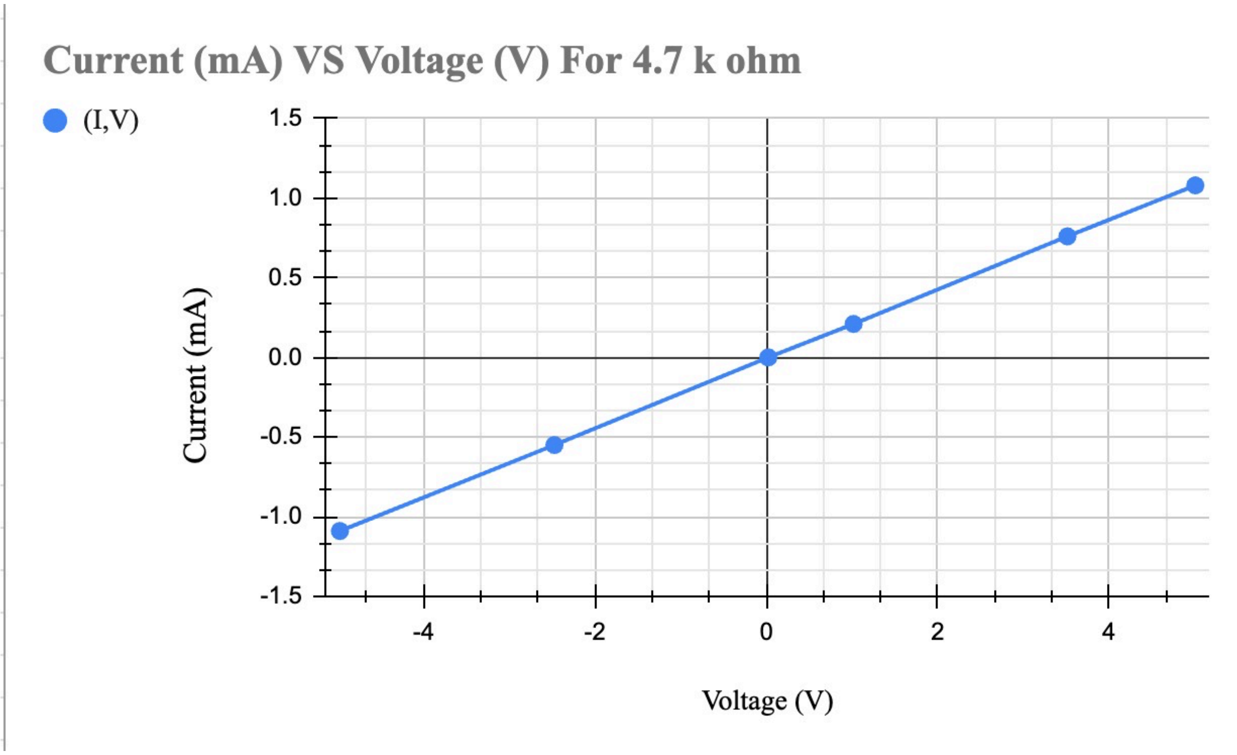
   Power is always positive in a resistor because it converts electrical energy into heat, regardless of current direction. Resistors can only dissipate energy, not generate it.

   Doubling the voltage across a resistor increases the power dissipation by a factor of four, as power (P=V2/RP=V2/R) is proportional to the square of the voltage.

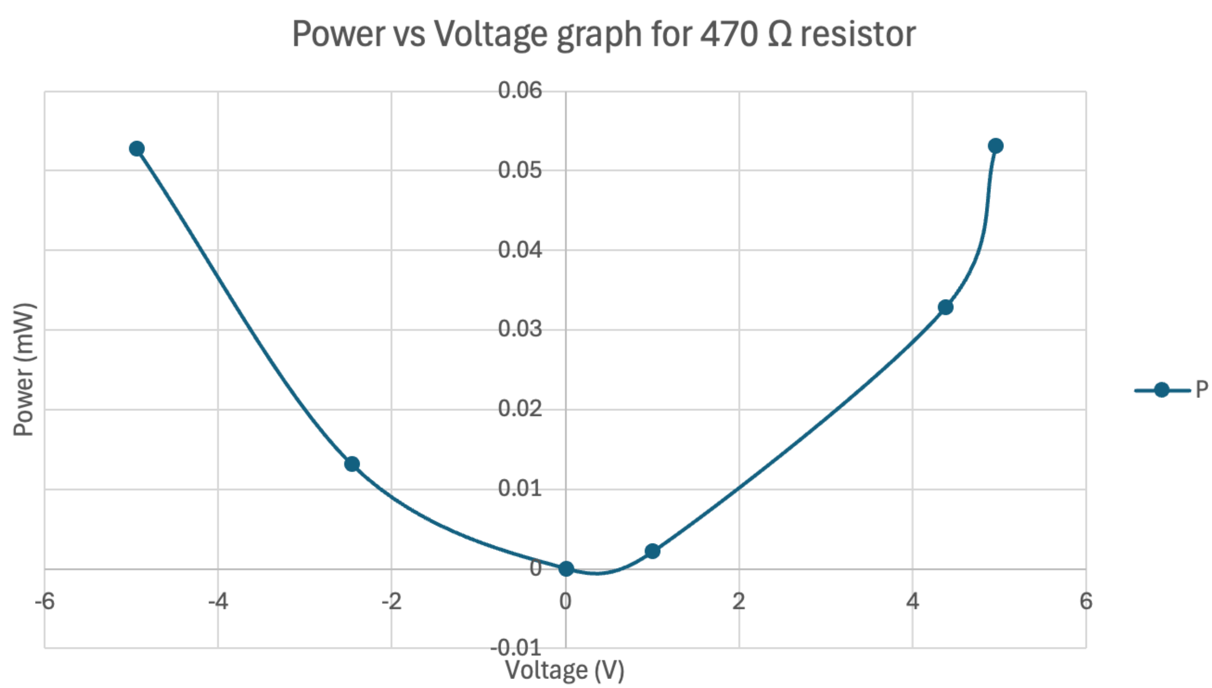
Resistor I-V Characteristic Plot

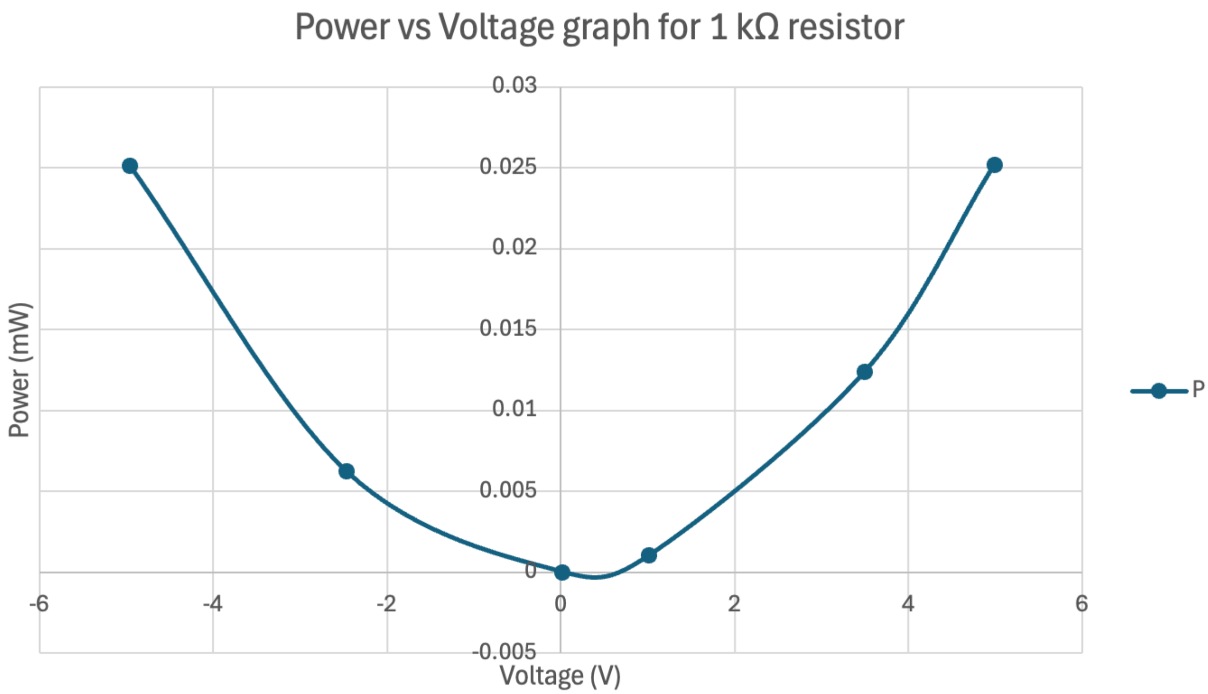


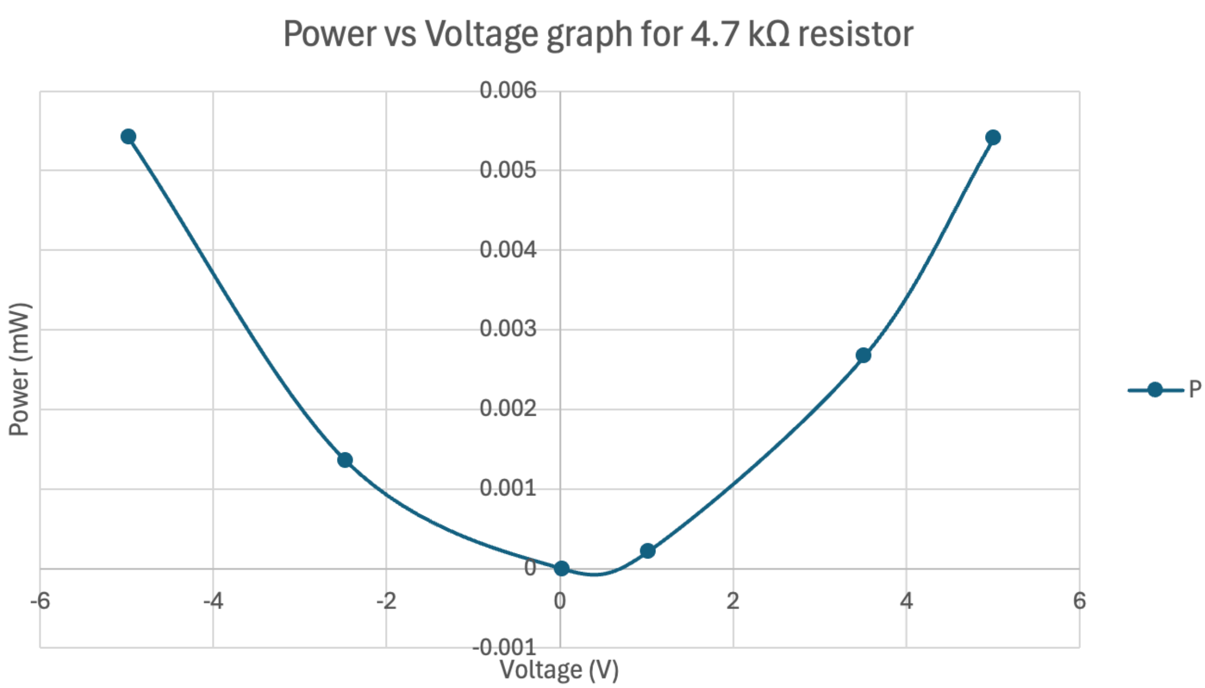




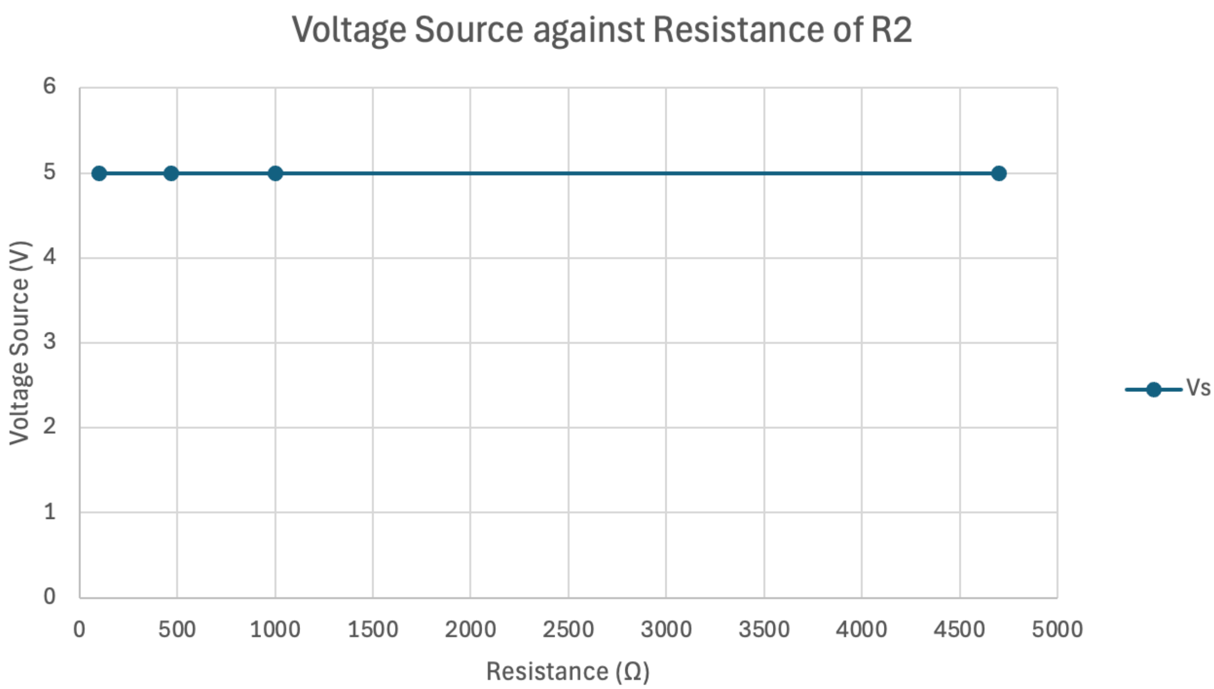
Resistor P-V Characteristic Plot

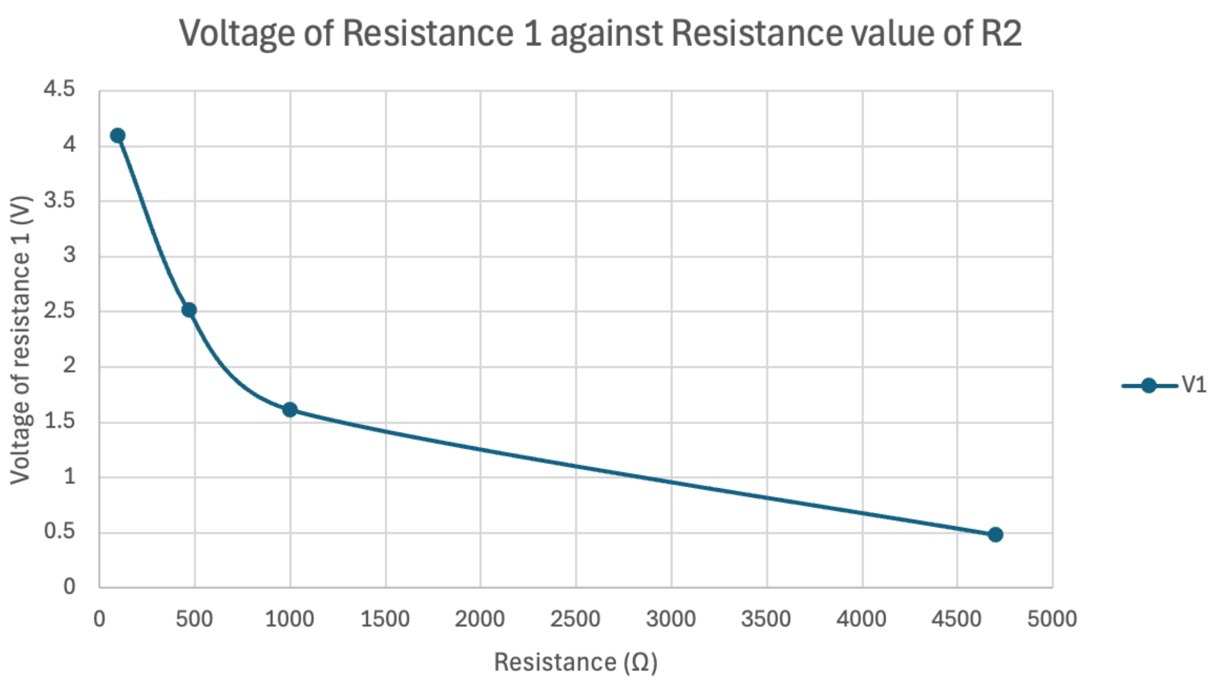


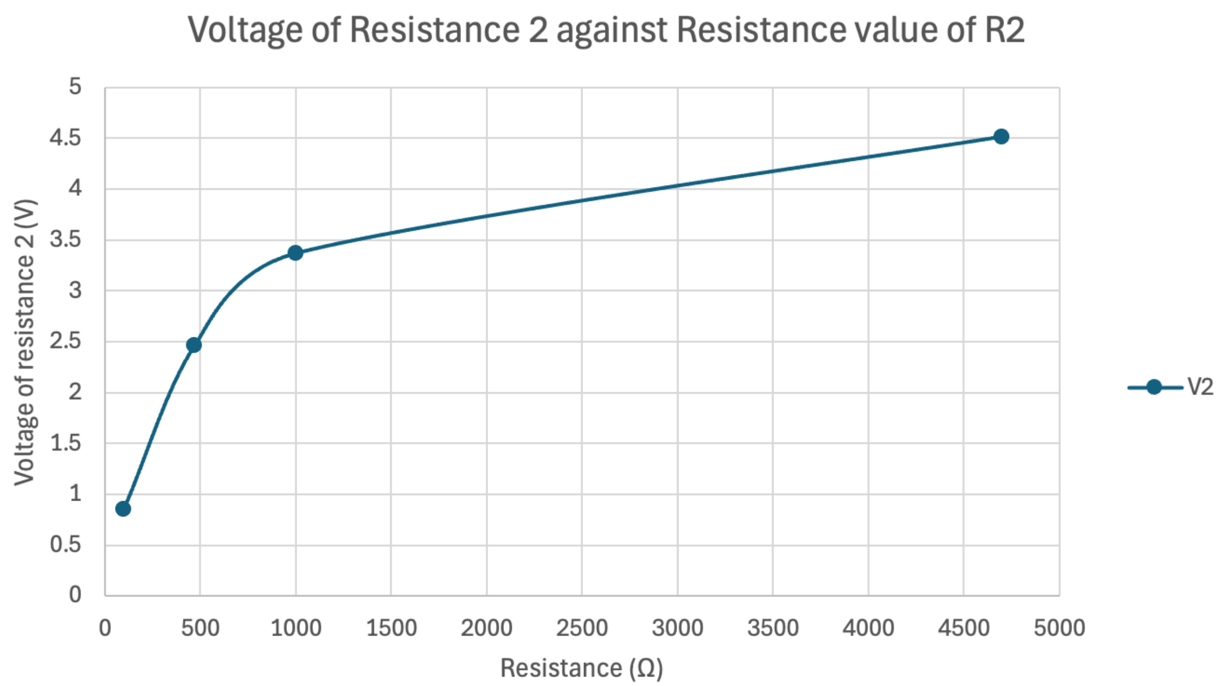

Power vs Voltage graph for 1 kΩ resistor
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
-6
-4
-2
0
2
4
6
Power (mW)
Voltage (V)
P


Power vs Voltage graph for 4.7 kΩ resistor
0.006
0.005
0.004
0.003
0.002
0.001
0
-0.001
-6
-4
-2
0
2
4
6
Power (mW)
Voltage (V)
P

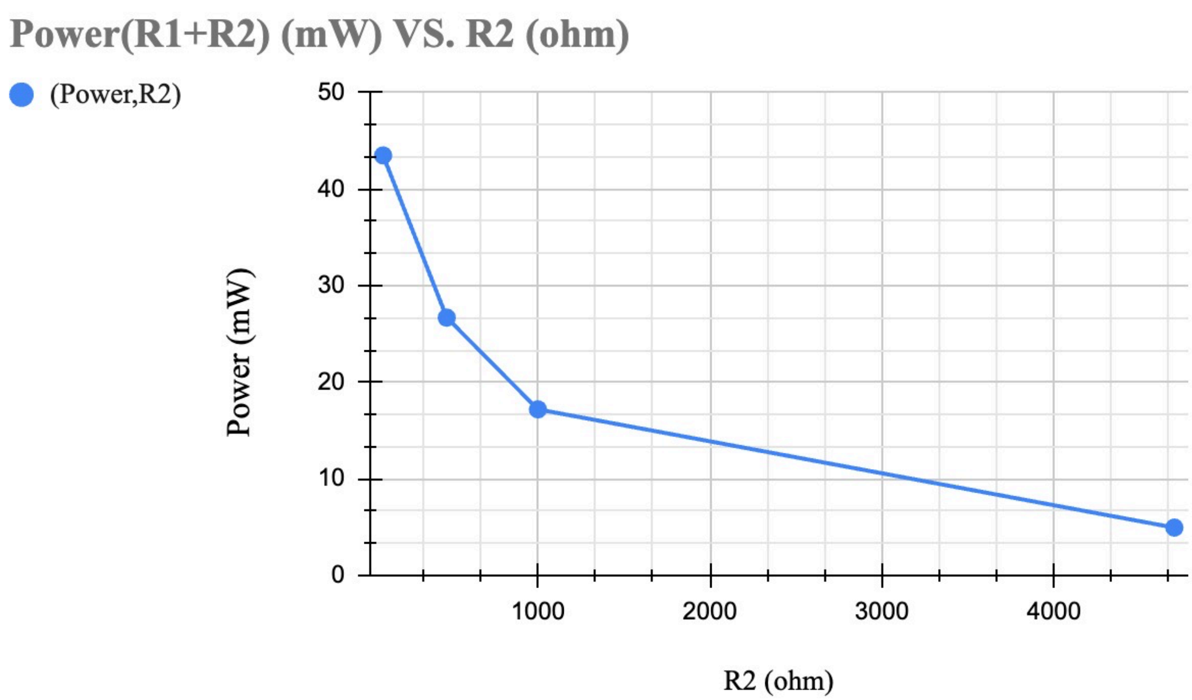
Voltage Divider (R1 = 470Ω) – Voltage Plot

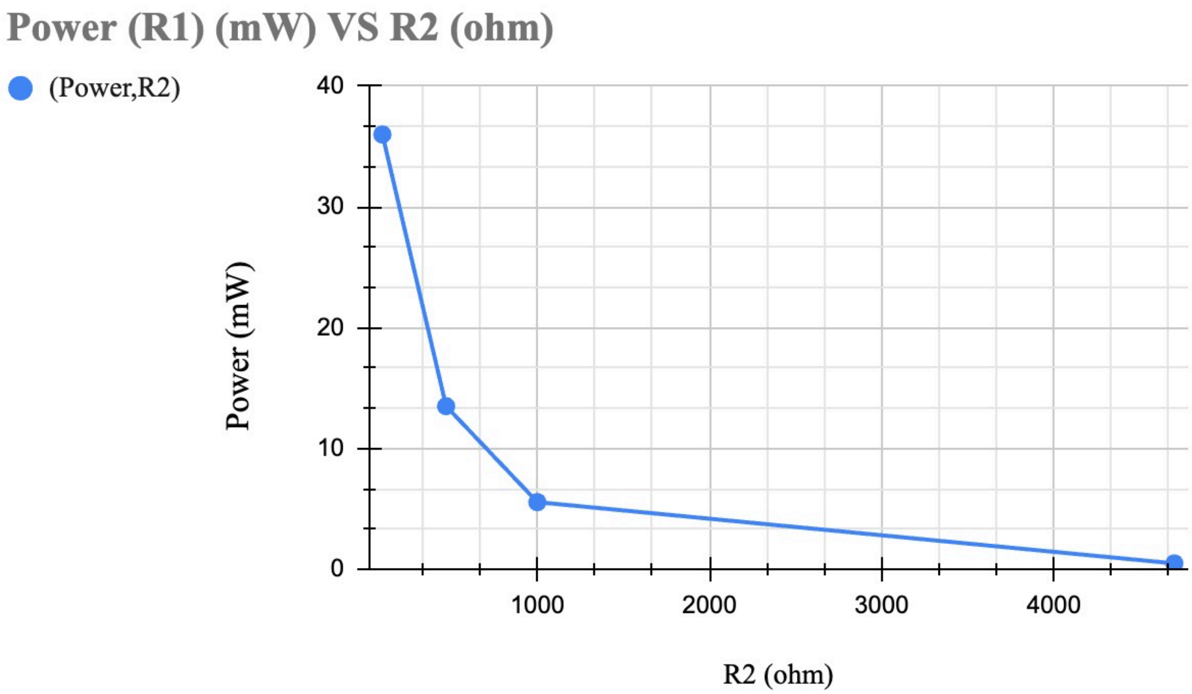


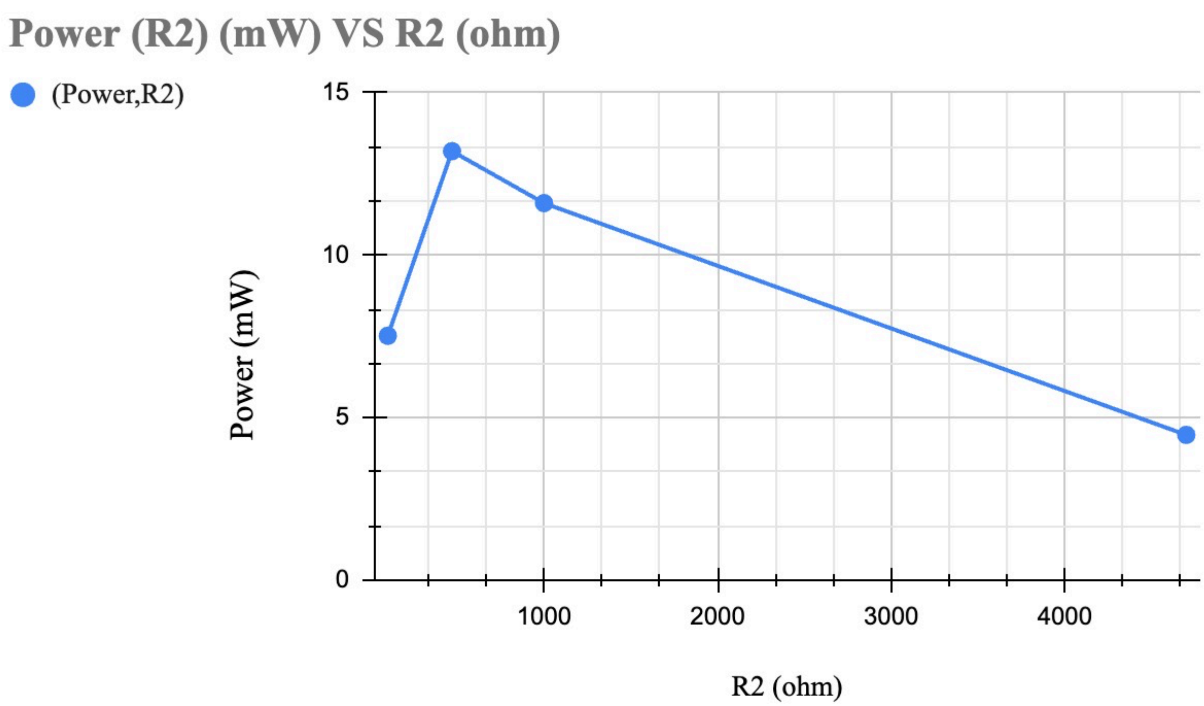




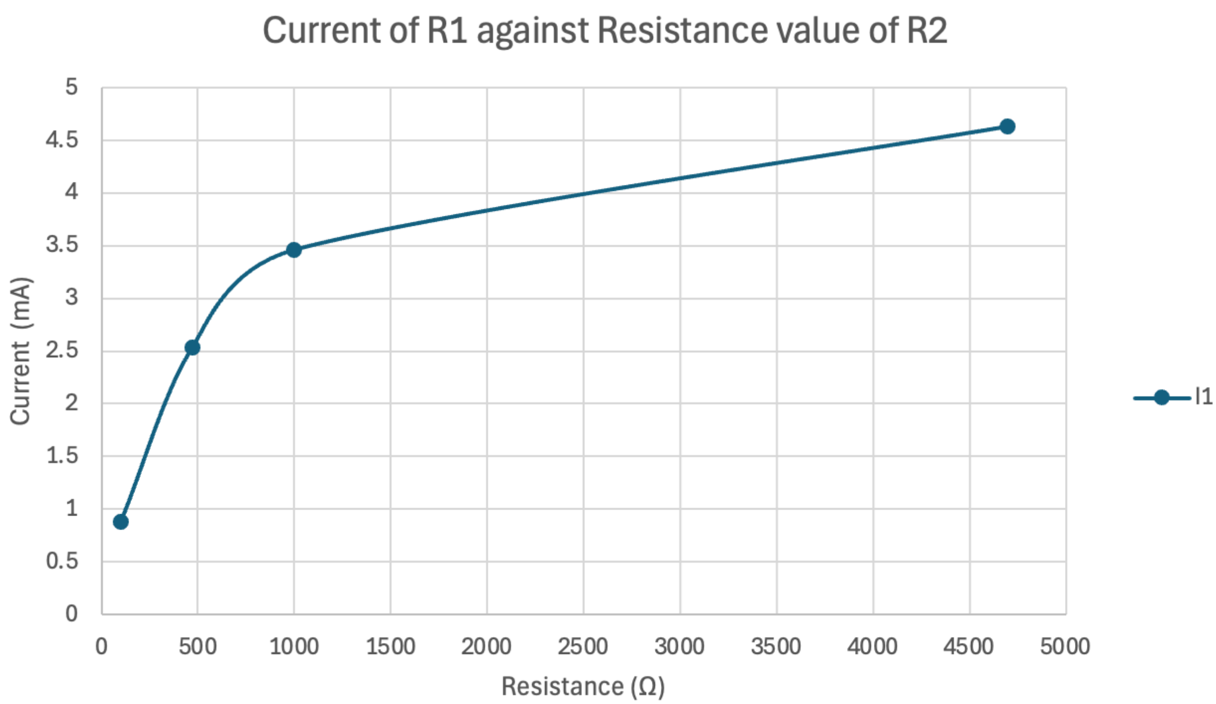
Voltage Divider (R1 = 470Ω) – Power Plot

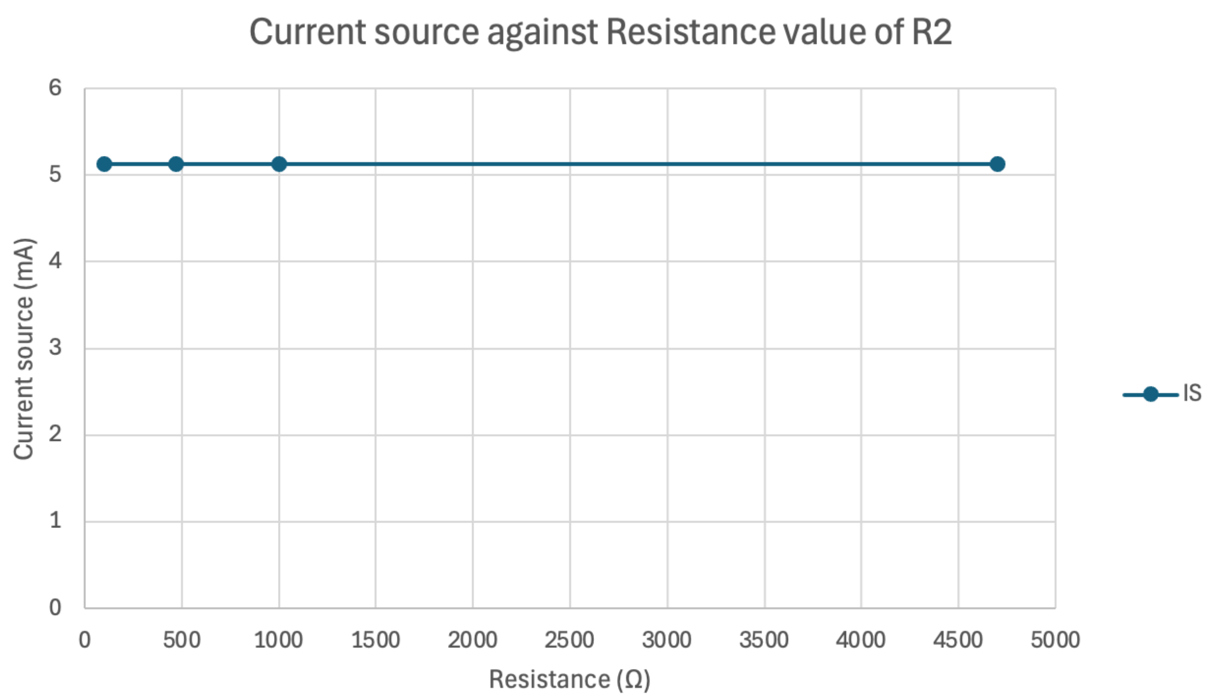


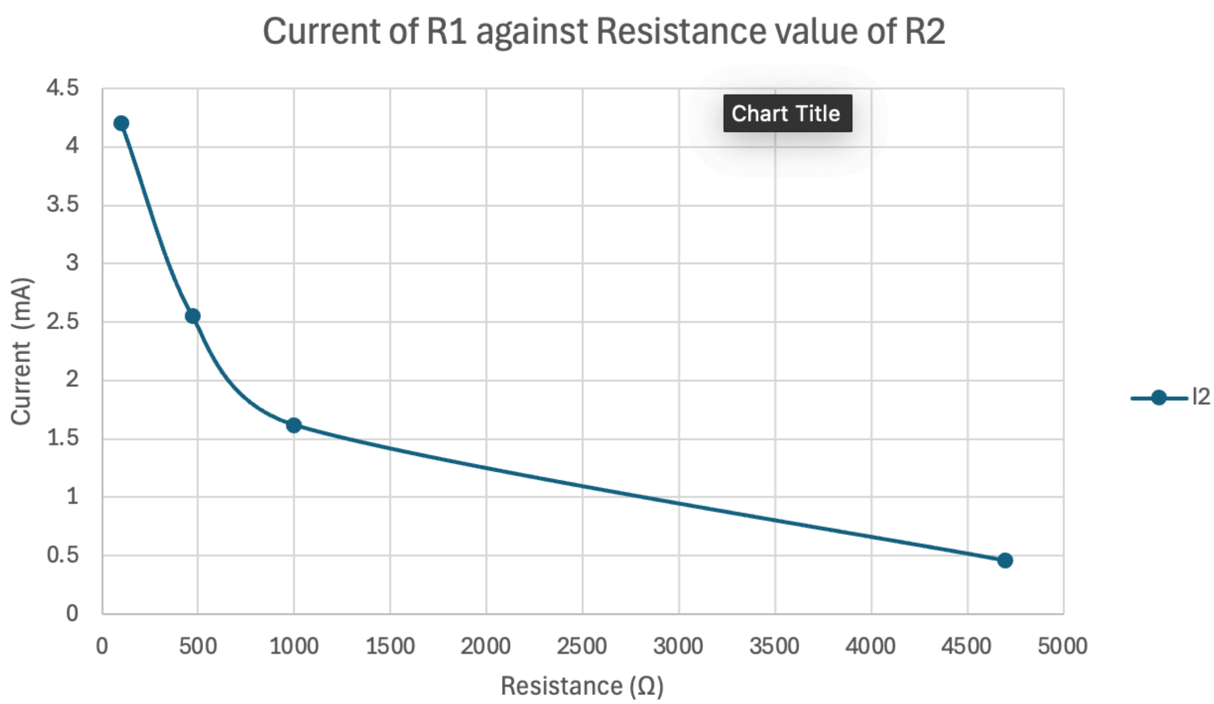




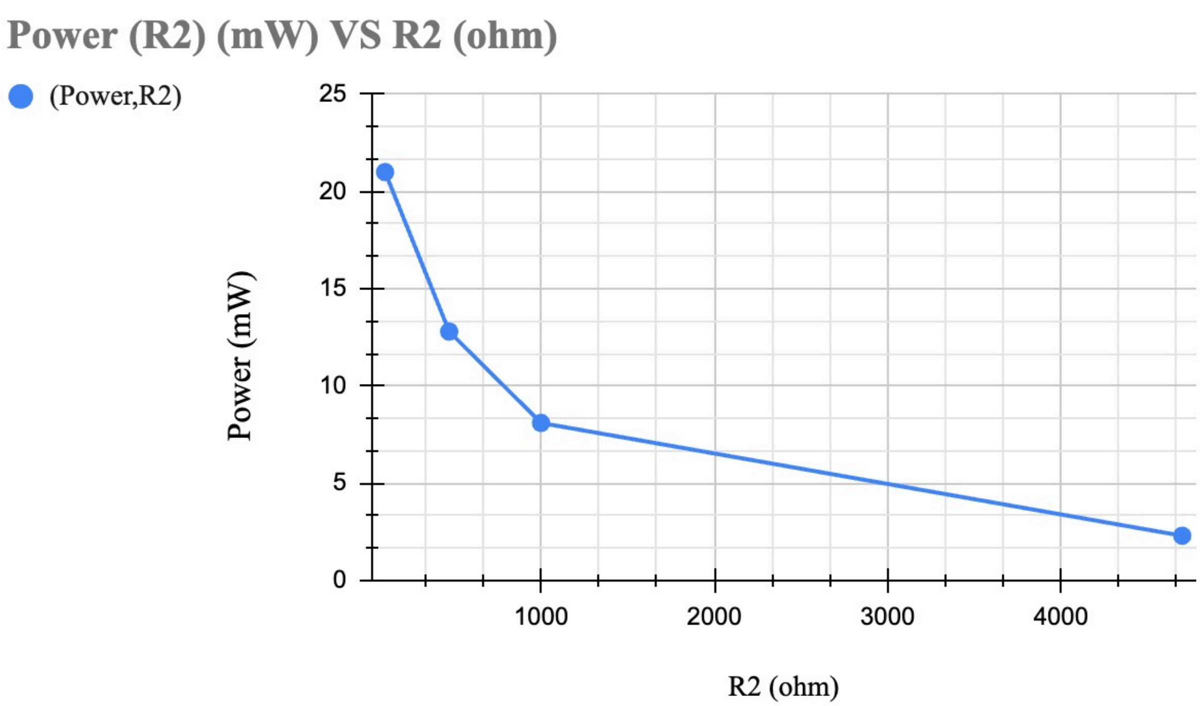
Current Divider (R1 = 470Ω) – Current Plot

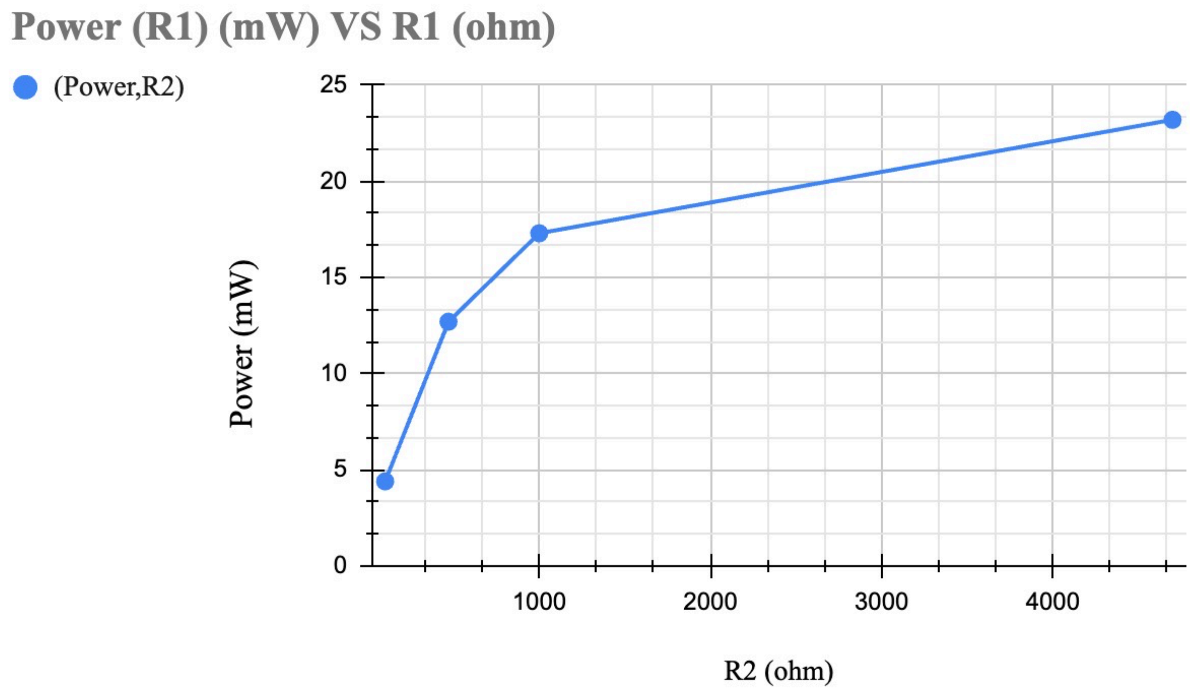

Current of R1 against Resistance value of R2
Current (mA)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Resistance (Ω)
I1

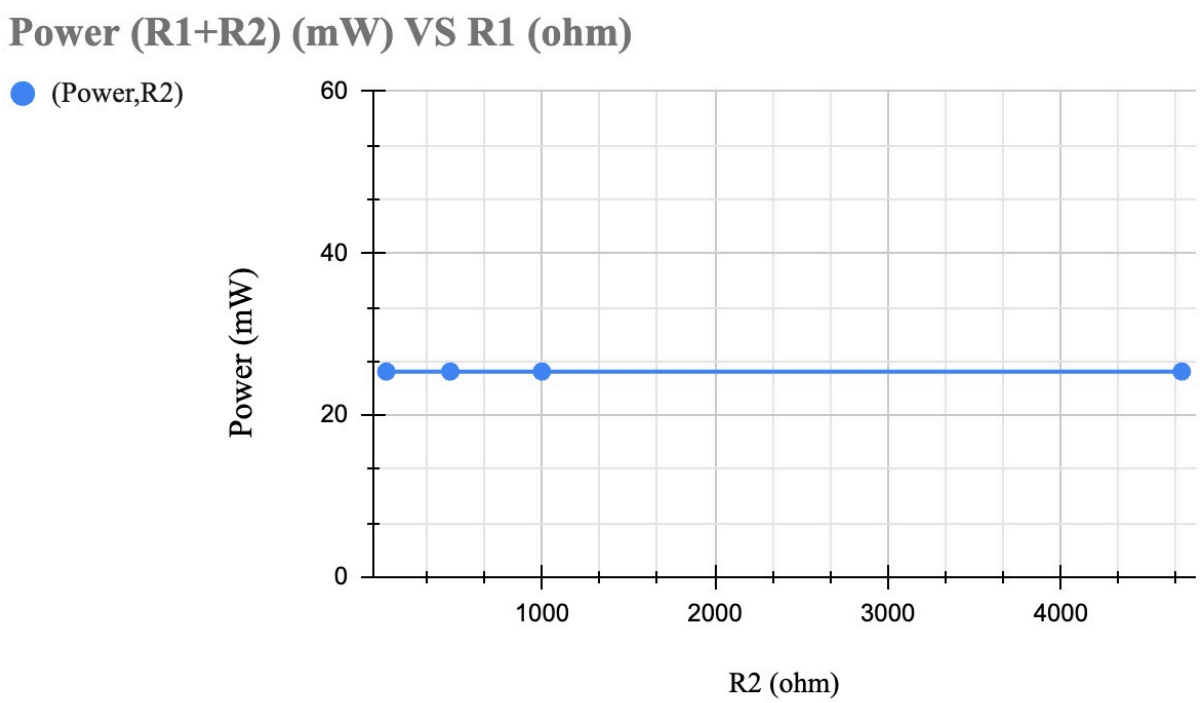

Current source against Resistance value of R2
Current source (mA)
6
5
4
3
2
1
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Resistance (Ω)
IS



Current Divider (R1 = 470Ω) – Power Plot




Power (R1) (mW) VS R1 (ohm)
(Power,R2)
Power (mW)
R2 (ohm)
0
5
10
15
20
25
1000
2000
3000
4000


Power (R1+R2) (mW) VS R1 (ohm)
(Power,R2)
Power (mW)
R2 (ohm)
0
20
40
60
1000
2000
3000
4000