Practice 3 / Control test 2
Operational Amplifiers
Wien bridge oscillator

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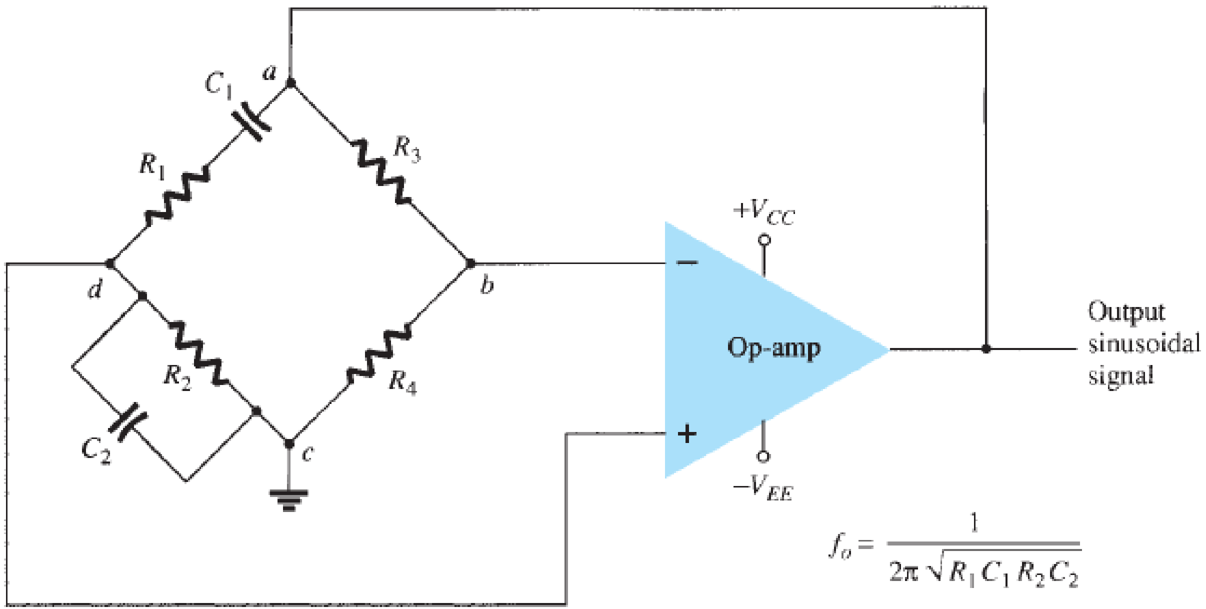
Summary

1. Wien Bridge Oscillator
2. Practice work 2: simulation
3. Control test (after the break)

Wien Bridge Oscillator



$$\frac{R_3}{R_4} = \frac{R_1}{R_2} + \frac{C_2}{C_1}$$

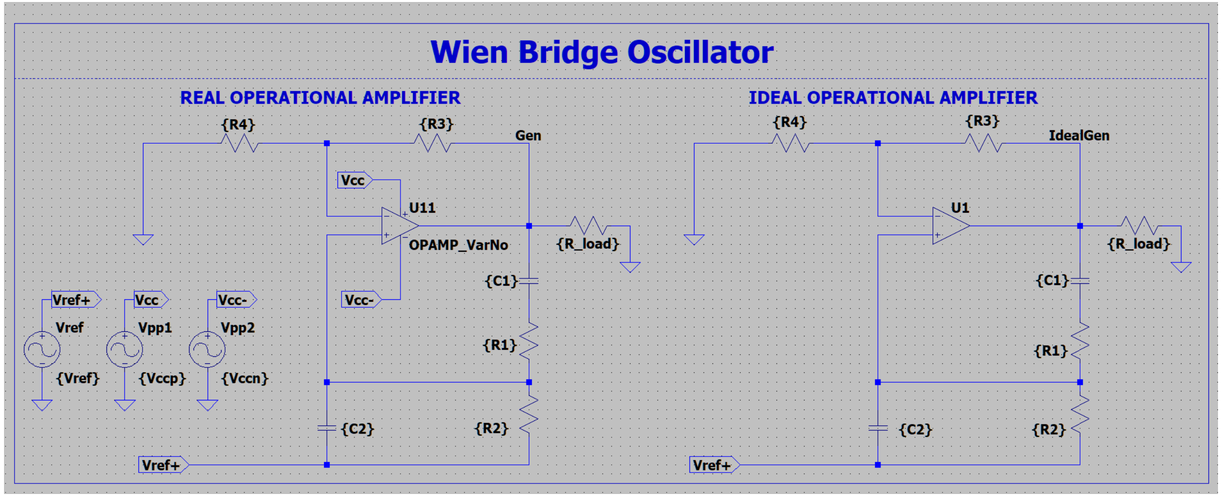
$$f_0 = \frac{1}{2\pi\sqrt{R_1R_2C_1C_2}}$$

If, in particular, the values are $R_1 = R_2 = R$ and $C_1 = C_2 = C$, the resulting oscillator frequency is

$$f_0 = \frac{1}{2\pi RC}$$

$$\frac{R_3}{R_4} = 2$$

Wien Bridge Oscillator



$$\frac{R_3}{R_4} = \frac{R_1}{R_2} + \frac{C_2}{C_1}$$

$$f_0 = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

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$$\frac{R_3}{R_4} = 2$$

Wien Bridge Oscillator

E24	Nominal values of resistances							
1.0	0.01 Ω	0.1 Ω	1 Ω	10 Ω	100 Ω	1 kΩ	10 kΩ	100 kΩ
1.1	0.011 Ω	0.11 Ω	1.1 Ω	11 Ω	110 Ω	1.1 kΩ	11 kΩ	
1.2	0.012 Ω	0.12 Ω	1.2 Ω	12 Ω	120 Ω	1.2 kΩ	12 kΩ	
1.3	0.013 Ω	0.13 Ω	1.3 Ω	13 Ω	130 Ω	1.3 kΩ	13 kΩ	
1.5	0.015 Ω	0.15 Ω	1.5 Ω	15 Ω	150 Ω	1.5 kΩ	15 kΩ	
1.6	0.016 Ω	0.16 Ω	1.6 Ω	16 Ω	160 Ω	1.6 kΩ	16 kΩ	
1.8	0.018 Ω	0.18 Ω	1.8 Ω	18 Ω	180 Ω	1.8 kΩ	18 kΩ	
2.0	0.02 Ω	0.2 Ω	2.0 Ω	20 Ω	200 Ω	2.0 kΩ	20 kΩ	
2.2	0.022 Ω	0.22 Ω	2.2 Ω	22 Ω	220 Ω	2.2 kΩ	22 kΩ	
2.4	0.024 Ω	0.24 Ω	2.4 Ω	24 Ω	240 Ω	2.4 kΩ	24 kΩ	
2.7	0.027 Ω	0.27 Ω	2.7 Ω	27 Ω	270 Ω	2.7 kΩ	27 kΩ	
3.0	0.03 Ω	0.3 Ω	3.0 Ω	30 Ω	300 Ω	3.0 kΩ	30 kΩ	
3.3	0.033 Ω	0.33 Ω	3.3 Ω	33 Ω	330 Ω	3.3 kΩ	33 kΩ	
3.6	0.036 Ω	0.36 Ω	3.6 Ω	36 Ω	360 Ω	3.6 kΩ	36 kΩ	
3.9	0.039 Ω	0.39 Ω	3.9 Ω	39 Ω	390 Ω	3.9 kΩ	39 kΩ	
4.3	0.043 Ω	0.43 Ω	4.3 Ω	43 Ω	430 Ω	4.3 kΩ	43 kΩ	
4.7	0.047 Ω	0.47 Ω	4.7 Ω	47 Ω	470 Ω	4.7 kΩ	47 kΩ	
5.1	0.051 Ω	0.51 Ω	5.1 Ω	51 Ω	510 Ω	5.1 kΩ	51 kΩ	
5.6	0.056 Ω	0.56 Ω	5.6 Ω	56 Ω	560 Ω	5.6 kΩ	56 kΩ	
6.2	0.062 Ω	0.62 Ω	6.2 Ω	62 Ω	620 Ω	6.2 kΩ	62 kΩ	
6.8	0.068 Ω	0.68 Ω	6.8 Ω	68 Ω	680 Ω	6.8 kΩ	68 kΩ	
7.5	0.075 Ω	0.75 Ω	7.5 Ω	75 Ω	750 Ω	7.5 kΩ	75 kΩ	
8.2	0.082 Ω	0.82 Ω	8.2 Ω	82 Ω	820 Ω	8.2 kΩ	82 kΩ	
9.1	0.091 Ω	0.91 Ω	9.1 Ω	91 Ω	910 Ω	9.1 kΩ	91 kΩ	

$$\frac{R_3}{R_4} = \frac{R_1}{R_2} + \frac{C_2}{C_1}$$

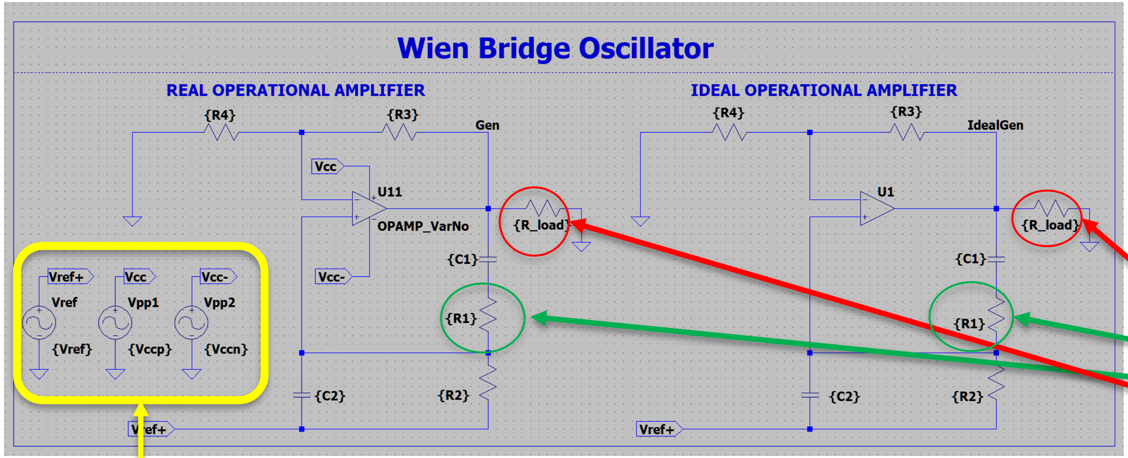
$$f_0 = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

If in particular the values are $R_1 = R_2 = R$ and $C_1 = C_2 = C$, the resulting oscillator frequency is

$$f_0 = \frac{1}{2\pi RC}$$

$$\boxed{\frac{R_3}{R_4} = 2}$$

Wien Bridge Oscillator



$$f_0 = \frac{1}{2\pi\sqrt{R_1R_2C_1C_2}} = \frac{1}{2\pi RC} = \frac{1}{2\pi R_1 C};$$

Source voltage frequency, [Hz]	Load resistance, [Ω]	Resistance, [Ω]	Voltage source power supply [V]	
f_{test}	R_{Load}	R_1	$Vcc\pm$	$Vref$
1000	1000000	10000	±5	0,2

$$C_1 = C_2$$
$$R_1 = R_2$$
$$R_3 = 2R_4$$

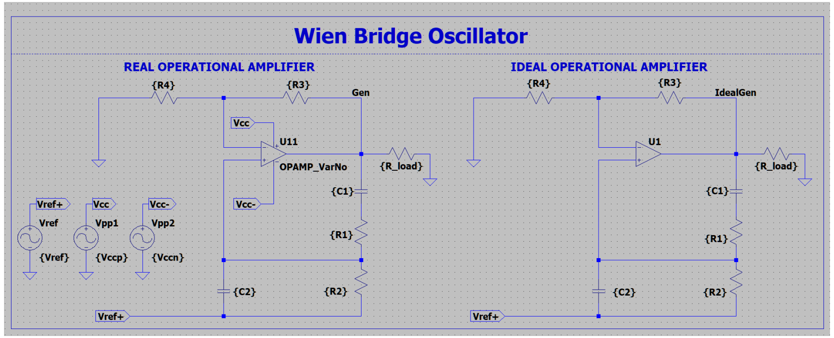
$$C_1 = C_2 = \frac{1}{2\pi R_1 f_{test}}$$

Choose real capacitor E24

$$f_{0\_calculated} = \frac{1}{2\pi R_1 C_{1\_real}}$$

Wien Bridge Oscillator

iTMO



1 pF	10 pF	100 pF	1 nF	10 nF	0.1 µF	1 µF	10 µF	100 µF	1000 µF
1.1 pF	11 pF	110 pF	1.1 nF	11 nF	0.11 µF	1.1 µF	11 µF	110 µF	1100 µF
1.2 pF	12 pF	120 pF	1.2 nF	12 nF	0.12 µF	1.2 µF	12 µF	120 µF	1200 µF
1.3 pF	13 pF	130 pF	1.3 nF	13 nF	0.13 µF	1.3 µF	13 µF	130 µF	1300 µF
1.5 pF	15 pF	150 pF	1.5 nF	15 nF	0.15 µF	1.5 µF	15 µF	150 µF	1500 µF
1.6 pF	16 pF	160 pF	1.6 nF	16 nF	0.16 µF	1.6 µF	16 µF	160 µF	1600 µF
1.8 pF	18 pF	180 pF	1.8 nF	18 nF	0.18 µF	1.8 µF	18 µF	180 µF	1800 µF
2 pF	20 pF	200 pF	2 nF	20 nF	0.2 µF	2 µF	20 µF	200 µF	2000 µF
2.2 pF	22 pF	220 pF	2.2 nF	22 nF	0.22 µF	2.2 µF	22 µF	220 µF	2200 µF
2.4 pF	24 pF	240 pF	2.4 nF	24 nF	0.24 µF	2.4 µF	24 µF	240 µF	2400 µF
2.7 pF	27 pF	270 pF	2.7 nF	27 nF	0.27 µF	2.7 µF	27 µF	270 µF	2700 µF
3 pF	30 pF	300 pF	3 nF	30 nF	0.3 µF	3 µF	30 µF	300 µF	3000 µF
3.3 pF	33 pF	330 pF	3.3 nF	33 nF	0.33 µF	3.3 µF	33 µF	330 µF	3300 µF
3.6 pF	36 pF	360 pF	3.6 nF	36 nF	0.36 µF	3.6 µF	36 µF	360 µF	3600 µF
3.9 pF	39 pF	390 pF	3.9 nF	39 nF	0.39 µF	3.9 µF	39 µF	390 µF	3900 µF
4.3 pF	43 pF	430 pF	4.3 nF	43 nF	0.43 µF	4.3 µF	43 µF	430 µF	4300 µF
4.7 pF	47 pF	470 pF	4.7 nF	47 nF	0.47 µF	4.7 µF	47 µF	470 µF	4700 µF
5.1 pF	51 pF	510 pF	5.1 nF	51 nF	0.51 µF	5.1 µF	51 µF	510 µF	5100 µF
5.6 pF	56 pF	560 pF	5.6 nF	56 nF	0.56 µF	5.6 µF	56 µF	560 µF	5600 µF
6.2 pF	62 pF	620 pF	6.2 nF	62 nF	0.62 µF	6.2 µF	62 µF	620 µF	6200 µF
6.8 pF	68 pF	680 pF	6.8 nF	68 nF	0.68 µF	6.8 µF	68 µF	680 µF	6800 µF
7.5 pF	75 pF	750 pF	7.5 nF	75 nF	0.75 µF	7.5 µF	75 µF	750 µF	7500 µF
8.2 pF	82 pF	820 pF	8.2 nF	82 nF	0.82 µF	8.2 µF	82 µF	820 µF	8200 µF
9.1 pF	91 pF	910 pF	9.1 nF	91 nF	0.91 µF	9.1 µF	91 µF	910 µF	9100 µF

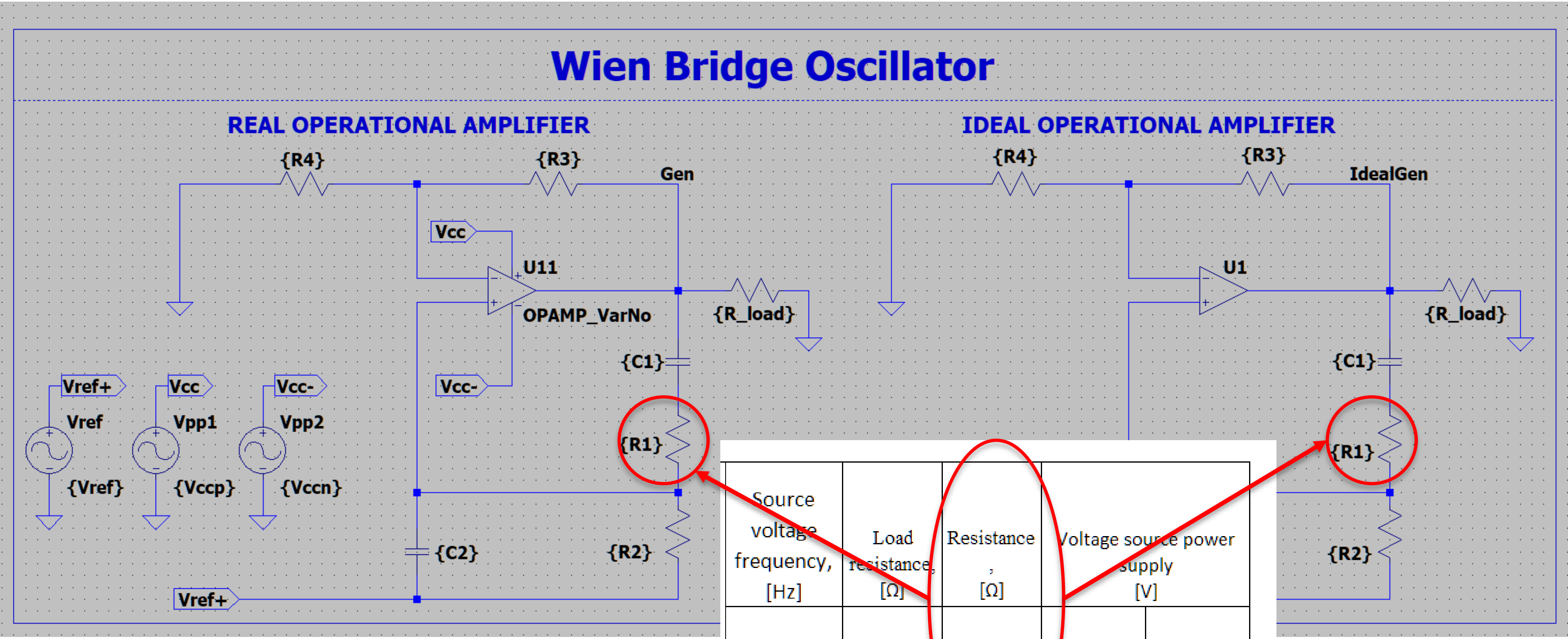
$$\boxed{\begin{gathered} C_1 = C_2 \\ R_1 = R_2 \\ R_3 = 2R_4 \end{gathered}}$$

$$C_1 = C_2 = \frac{1}{2\pi R_1 f_{test}}$$

Choose real capacitor E24

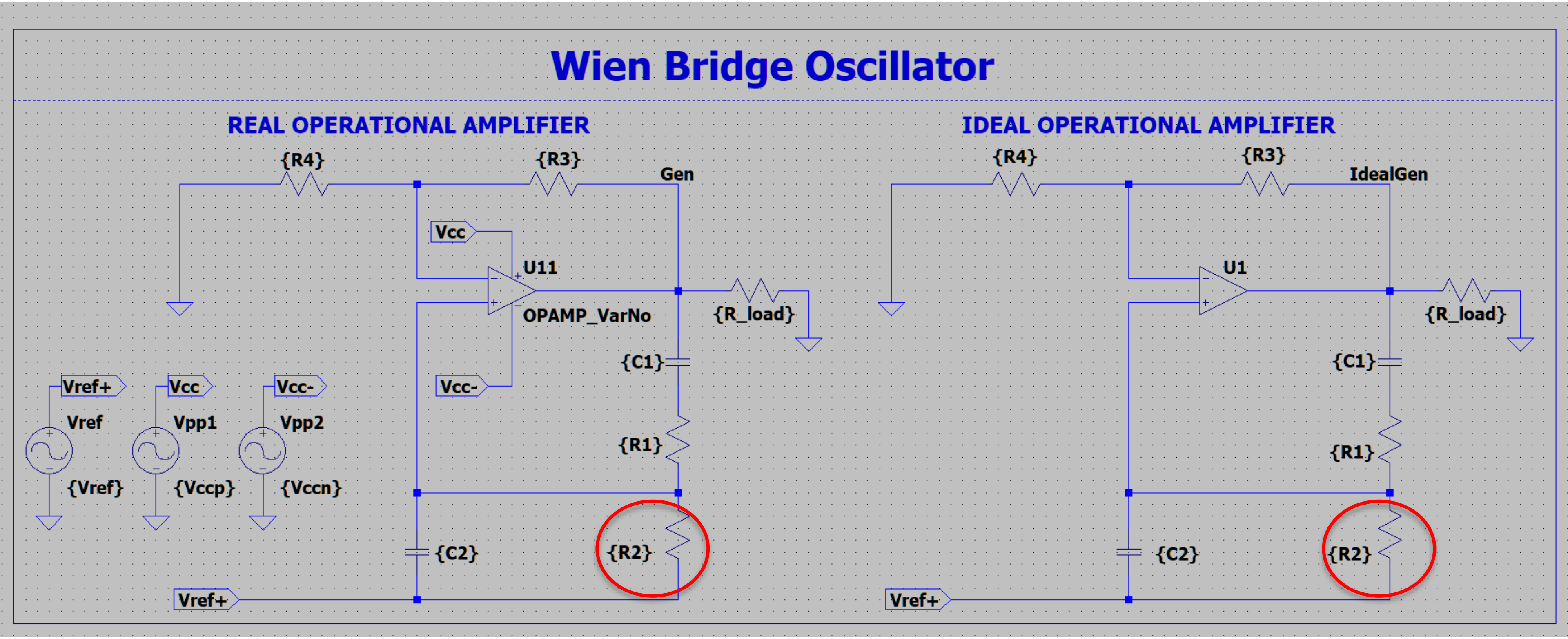
$$f_{0\_calculated} = \frac{1}{2\pi R_1 C_{1\_real}}$$

Wien Bridge Oscillator

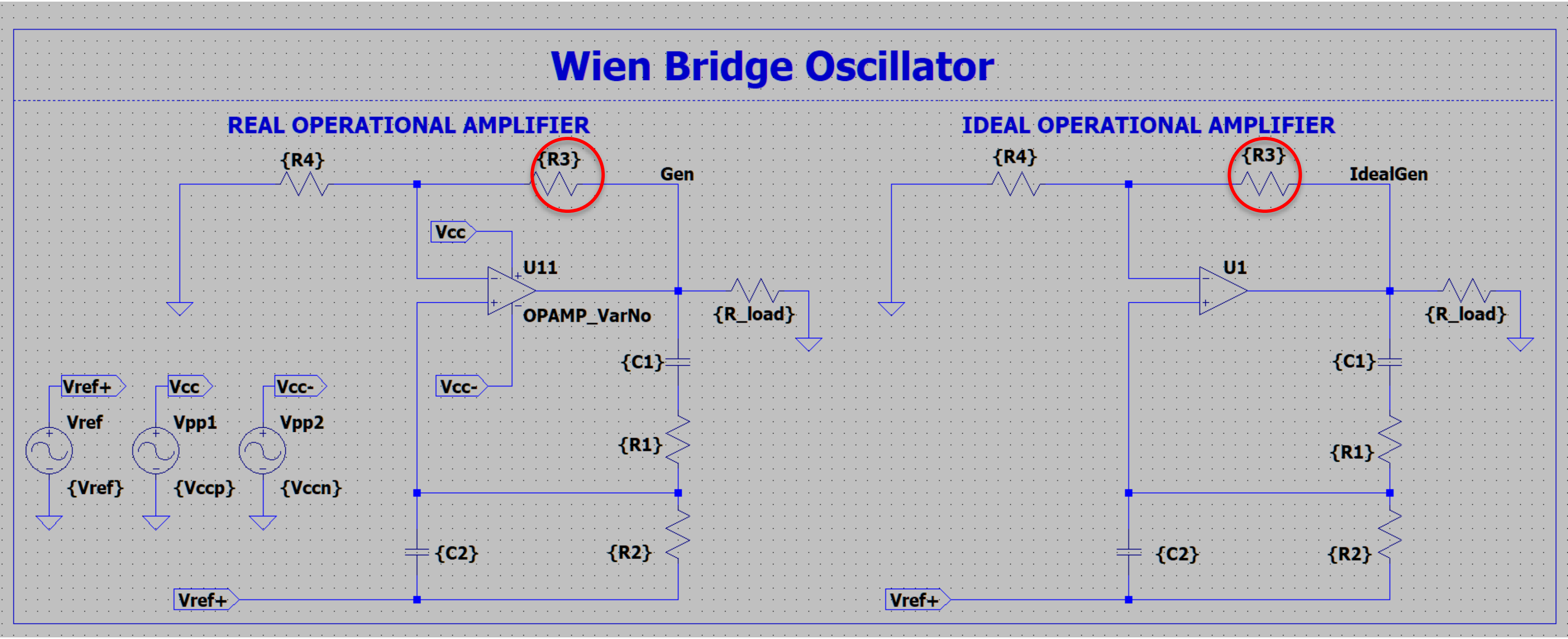


Source voltage frequency, [Hz]	Load resistance, [Ω]	Resistance, [Ω]	Voltage source power supply [V]	
f_{test}	R_{Load}	R_1	$Vcc\pm$	$Vref$
1000	1000000	10000	±5	0,2

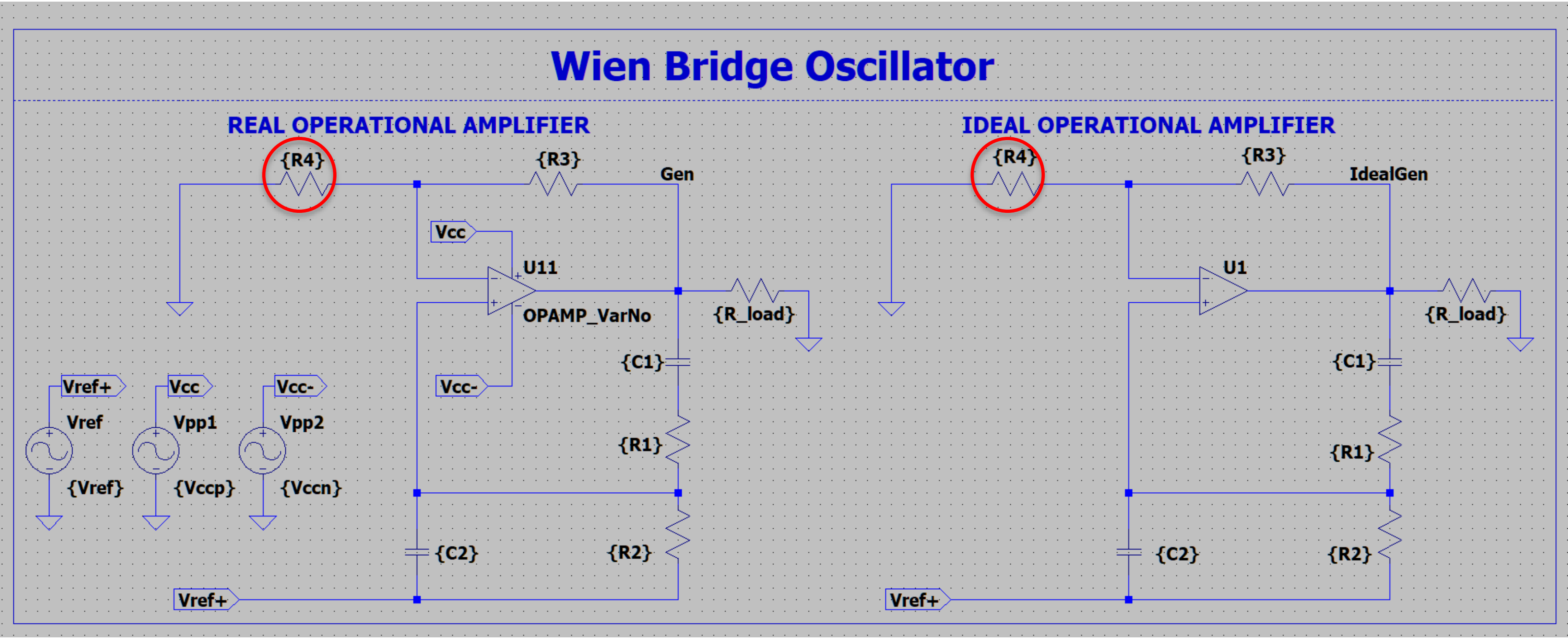
Wien Bridge Oscillator



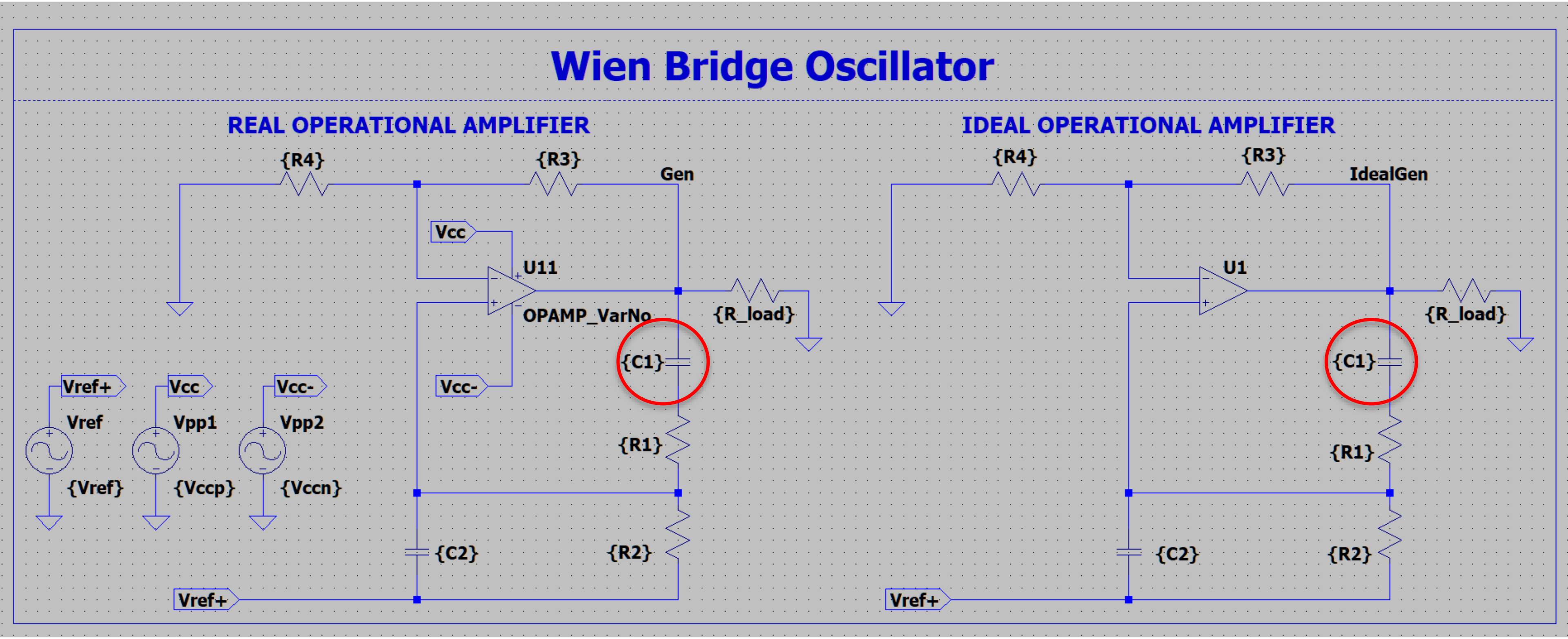
Wien Bridge Oscillator



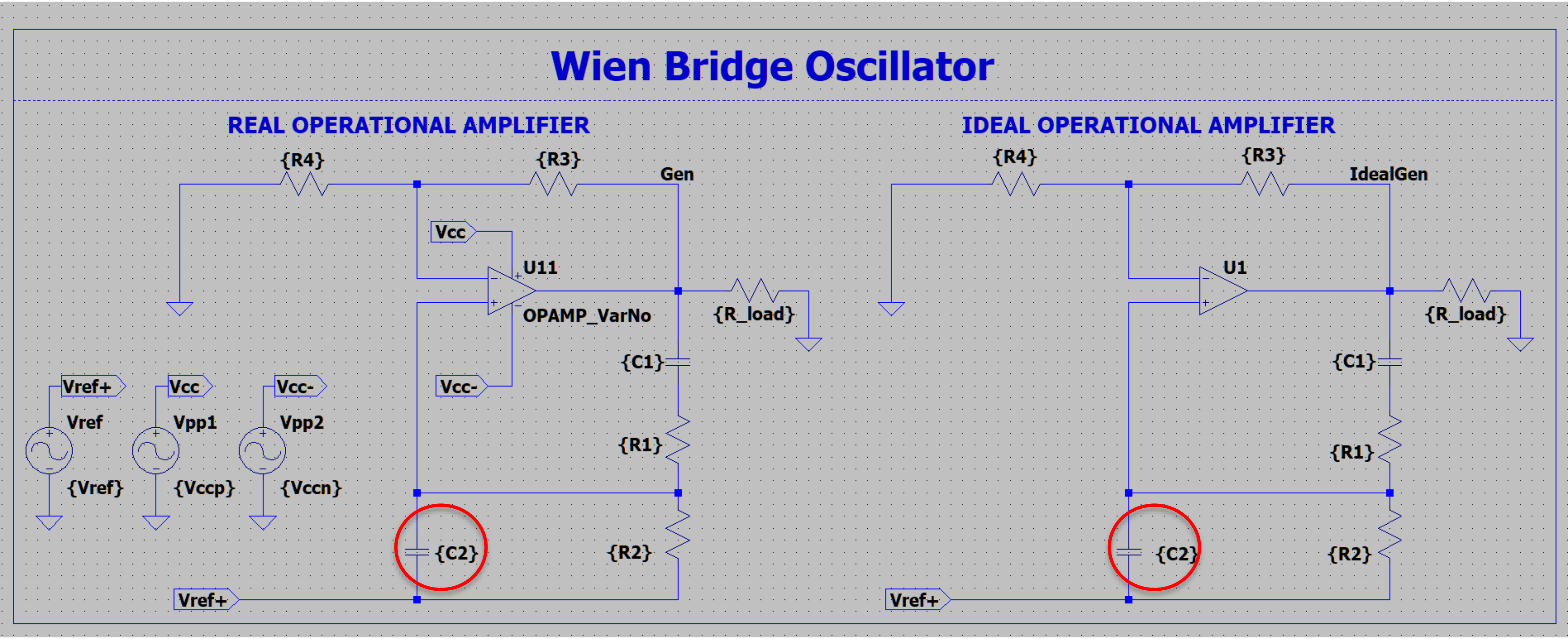
Wien Bridge Oscillator



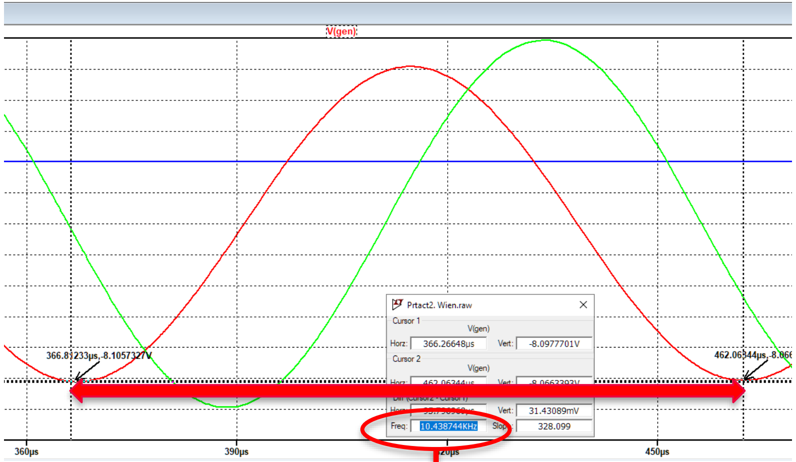
Wien Bridge Oscillator

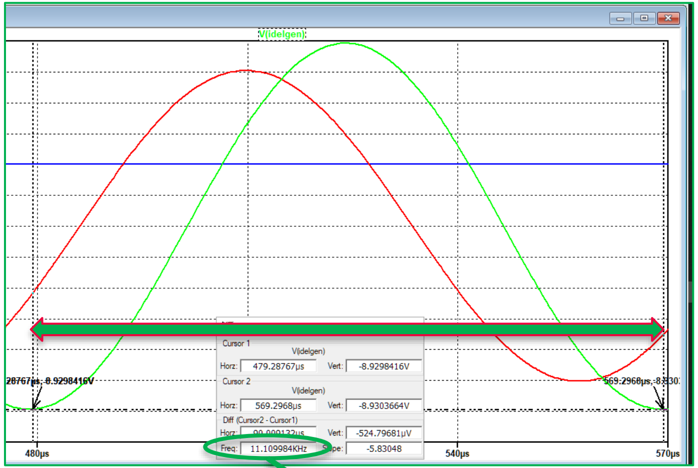


Wien Bridge Oscillator



Wien Bridge Oscillator





f_{0_real} =10.44kHz

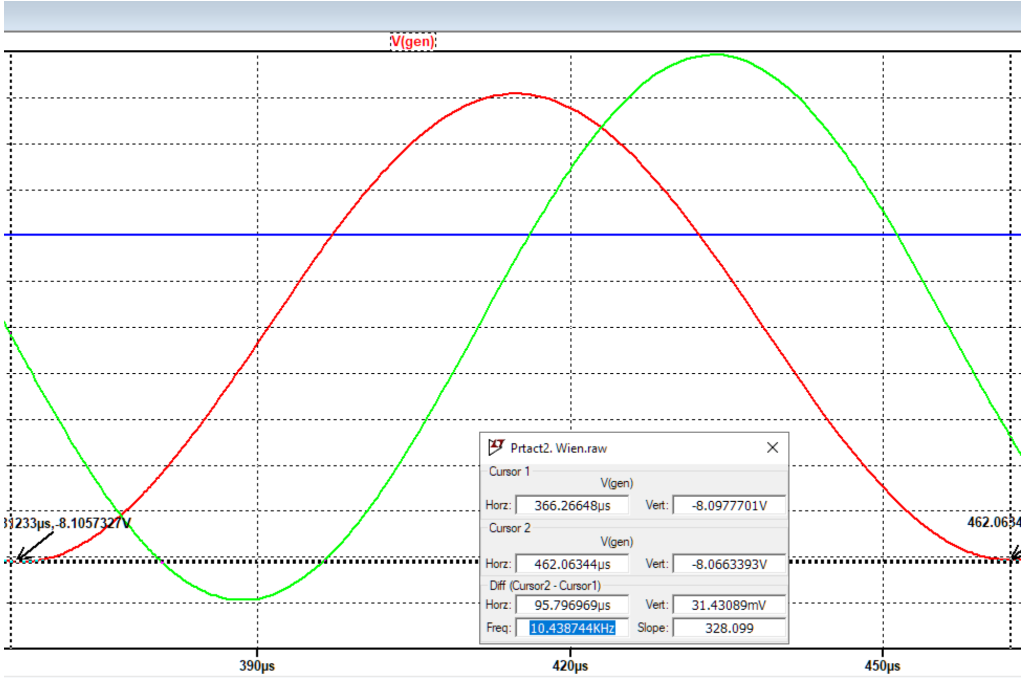
Real operational amplifier

f_{0_ideal} =11.11kHz

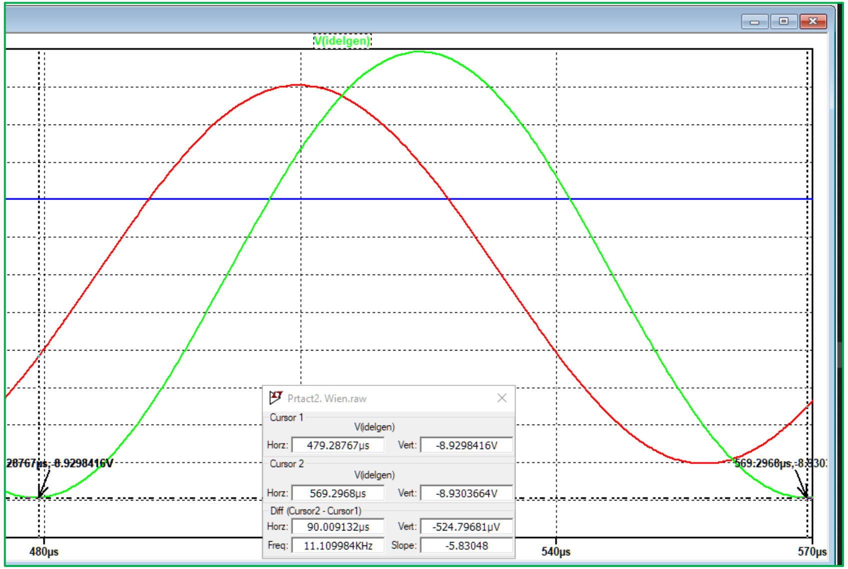
Ideal operational amplifier

$$f_{0\_calculated} = \frac{1}{2\pi\sqrt{R_1R_2C_1C_2}} = \frac{1}{2\pi*110*10^{-12}*130*10^3} = 11{,}129\text{kHz}$$

Wien Bridge Oscillator



Real operational amplifier



Ideal operational amplifier

Practice 3

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https://forms.yandex.com/cloud/637312472530c27b0ef20287/

https://clck.ru/32hC3U

1st deadline: 04.11.2024 10:00 (GMT +8)

ITMO UNIVERSITY

Saint Petersburg, Russia

Thanks for your attention!