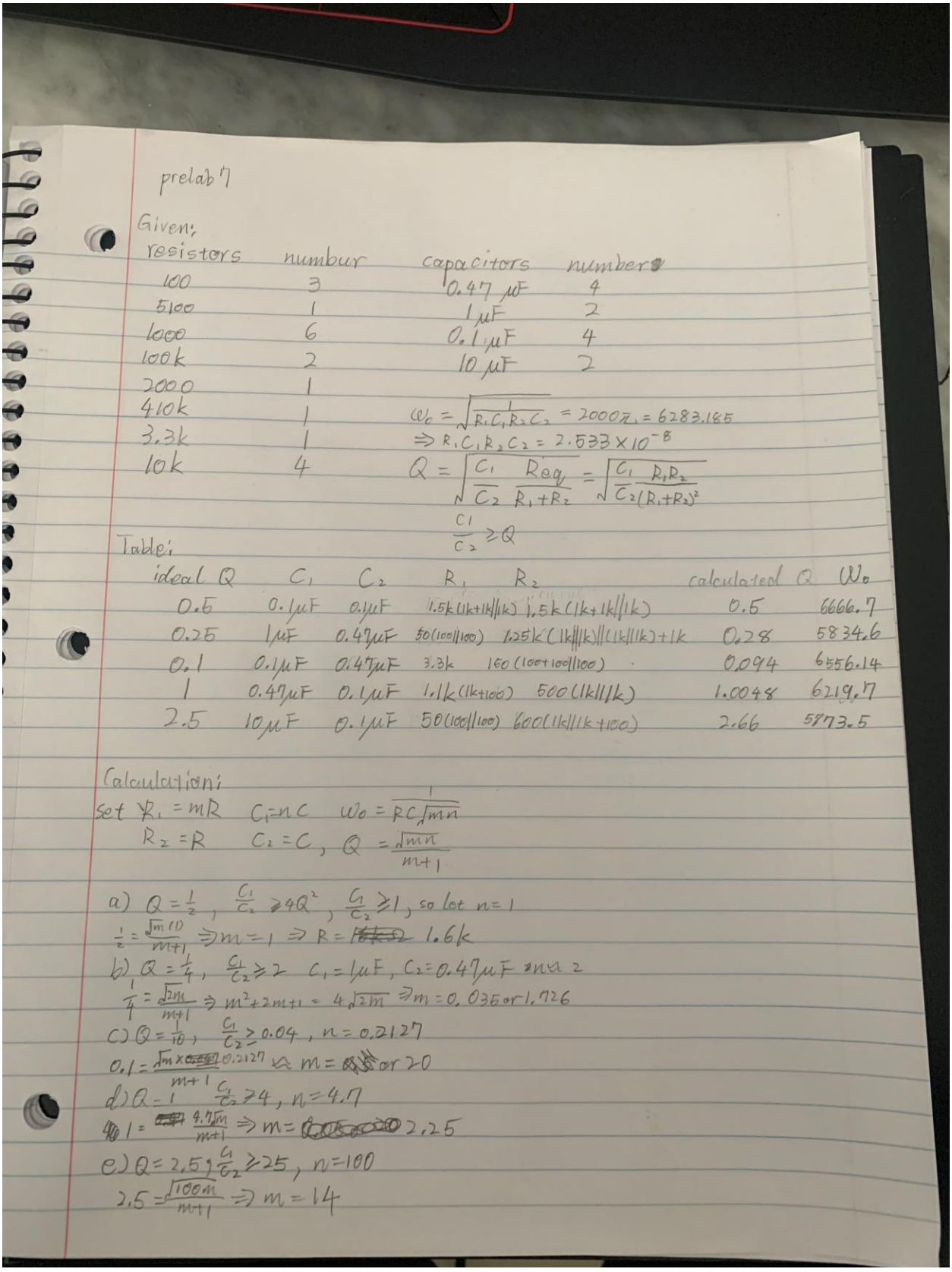
Table:



prelab 7

Given:

resistors	numbur	capacitors	number
100	3	0.47 μF	4
5100	1	1 μF	2
1000	6	0.1 μF	4
100k	2	10 μF	2
2000	1		
410k	1		
3.3k	1		
10k	4		

$\omega_0 = \sqrt{\frac{1}{R_1 C_1 R_2 C_2}} = 2000\pi = 6283.185$

$\Rightarrow R_1 C_1 R_2 C_2 = 2.533 \times 10^{-8}$

$Q = \sqrt{\frac{C_1}{C_2}\frac{R_{eq}}{R_1+R_2}} = \sqrt{\frac{C_1}{C_2}\frac{R_1 R_2}{(R_1+R_2)^2}}$

$\frac{C_1}{C_2} \geq Q$

Table:

ideal Q	C_1	C_2	R_1	R_2	calculated Q	ω_0
0.5	0.1μF	0.1μF	1.5k(1k+1k‖1k)	1.5k(1k+1k‖1k)	0.5	6666.7
0.25	1μF	0.47μF	50(100‖100)	1.25k(1k‖1k)‖(1k‖1k)+1k	0.28	5834.6
0.1	0.1μF	0.47μF	3.3k	150(100+100‖100)	0.094	6556.14
1	0.47μF	0.1μF	1.1k(1k+100)	500(1k‖1k)	1.0048	6219.7
2.5	10μF	0.1μF	50(100‖100)	600(1k‖1k+100)	2.66	5873.5

Calculation:

set $R_1 = mR$ $C_1 = nC$ $\omega_0 = \frac{1}{RC\sqrt{mn}}$

$R_2 = R$ $C_2 = C$, $Q = \frac{\sqrt{mn}}{m+1}$

a) $Q = \frac{1}{2}$, $\frac{C_1}{C_2} \geq 4Q^2$, $\frac{C_1}{C_2} \geq 1$, so let $n=1$

$\frac{1}{2} = \frac{\sqrt{m}(1)}{m+1} \Rightarrow m=1 \Rightarrow R = 1.6k$

b) $Q = \frac{1}{4}$, $\frac{C_1}{C_2} \geq 2$ $C_1 = 1\mu F$, $C_2 = 0.47\mu F$ $n \neq 2$

$\frac{1}{4} = \frac{\sqrt{2m}}{m+1} \Rightarrow m^2+2m+1 = 4\sqrt{2m} \Rightarrow m = 0.035 \text{ or } 1.726$

c) $Q = \frac{1}{10}$, $\frac{C_1}{C_2} \geq 0.04$, $n = 0.2127$

$0.1 = \frac{\sqrt{m \times 0.2127}}{m+1}$ $\Rightarrow m = 20$

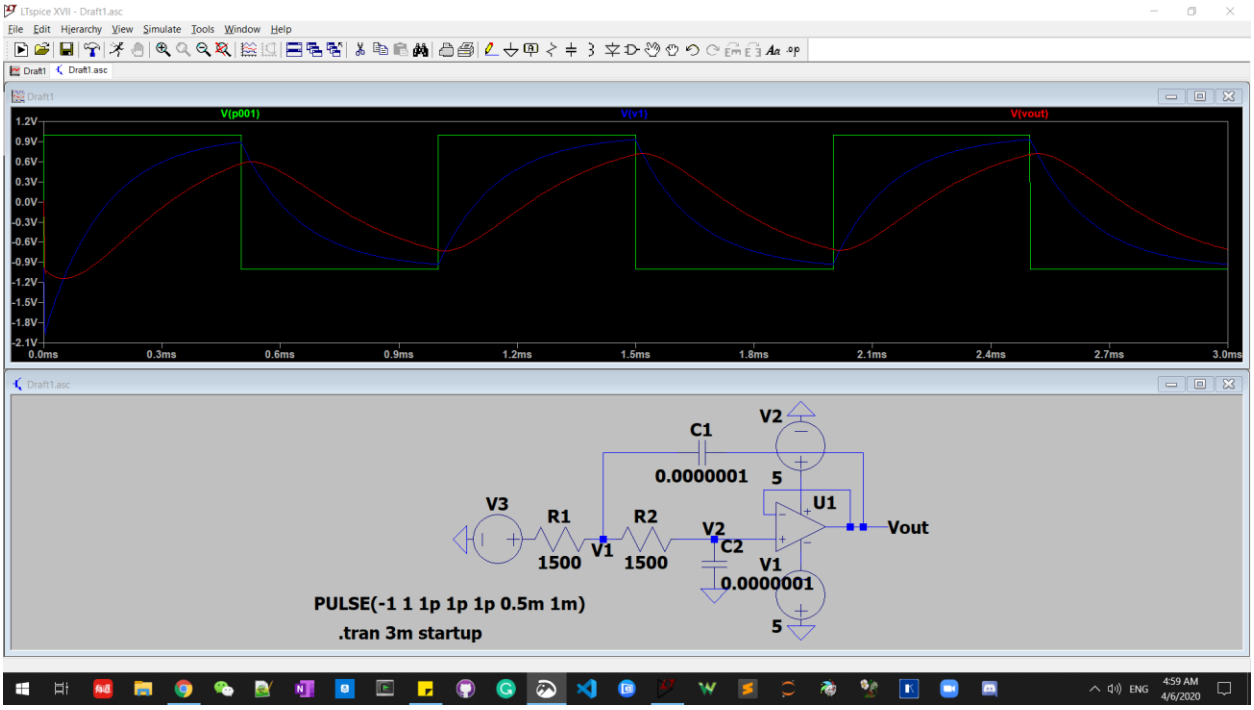
d) $Q = 1$ $\frac{C_1}{C_2} \geq 4$, $n = 4.7$

$1 = \frac{4.7\sqrt{m}}{m+1} \Rightarrow m = 2.25$

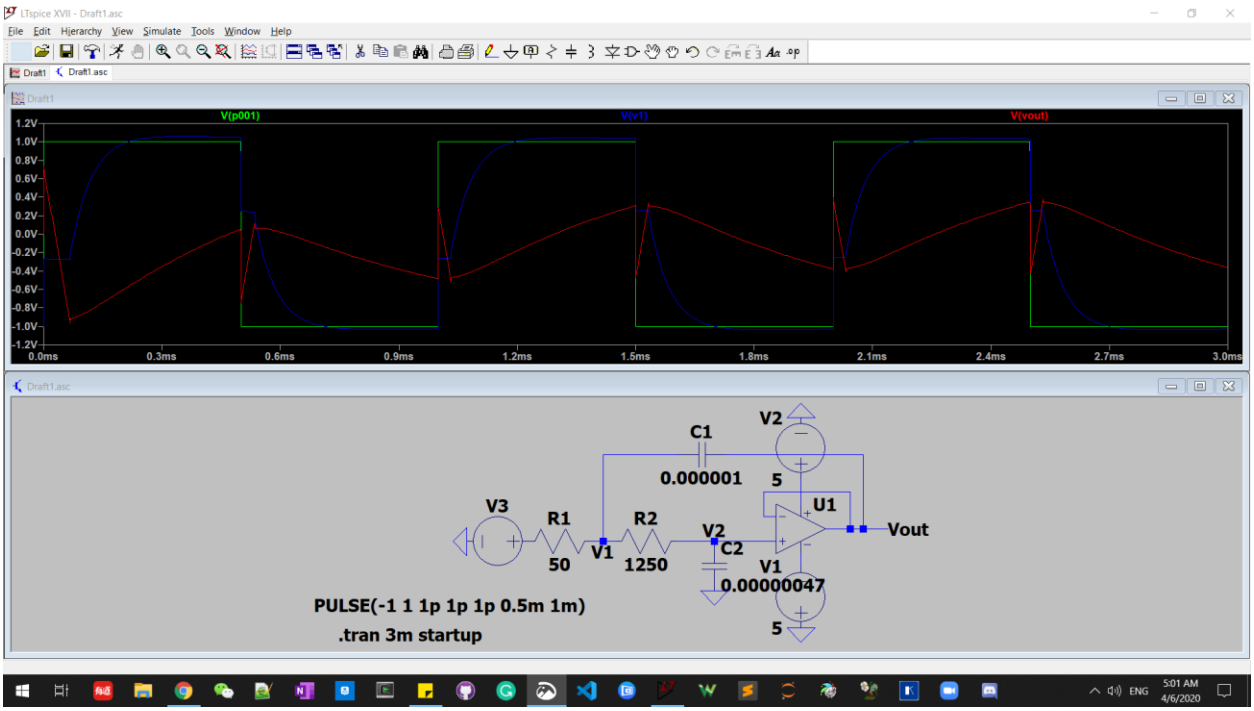
e) $Q = 2.5$, $\frac{C_1}{C_2} \geq 25$, $n = 100$

$2.5 = \frac{\sqrt{100m}}{m+1} \Rightarrow m = 14$

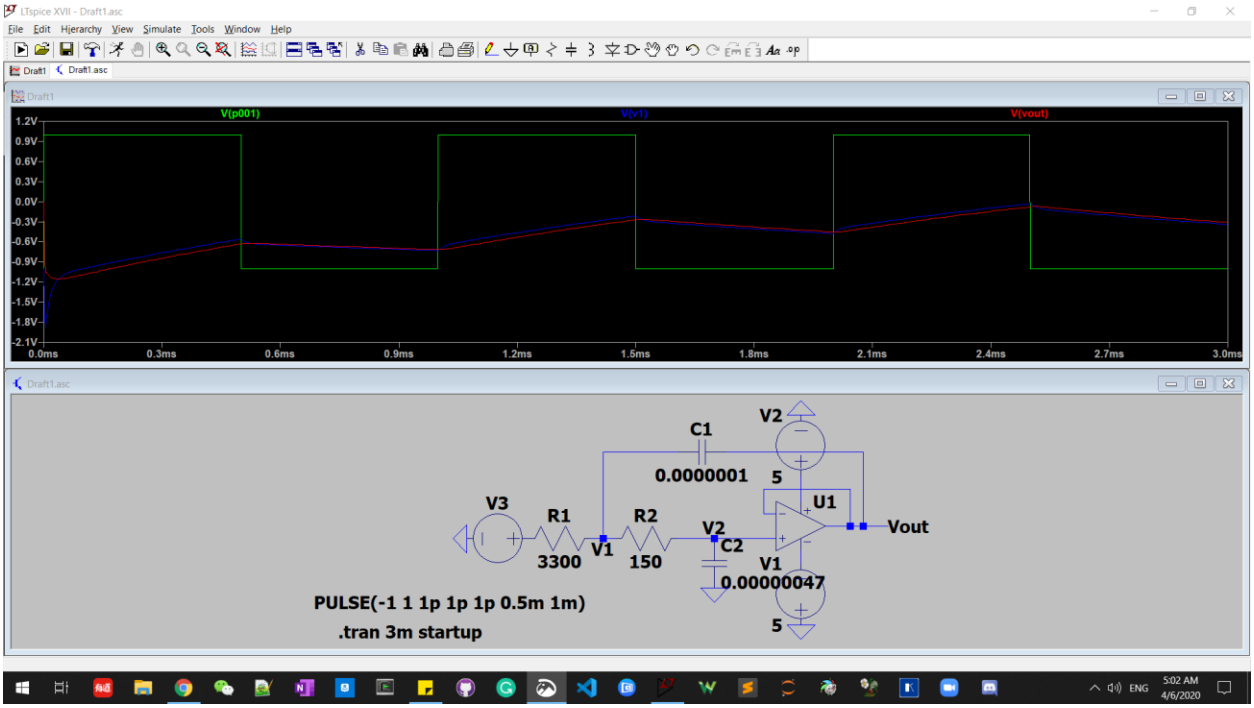
Q=1/2:


LTspice XVII - Draft1.asc
File Edit Hierarchy View Simulate Tools Window Help
V(p001)
V(v1)
V(vout)
1.2V
0.9V
0.6V
0.3V
0.0V
-0.3V
-0.6V
-0.9V
-1.2V
-1.5V
-1.8V
-2.1V
0.0ms 0.3ms 0.6ms 0.9ms 1.2ms 1.5ms 1.8ms 2.1ms 2.4ms 2.7ms 3.0ms
C1
0.0000001
V2
5
V3
R1
1500
R2
1500
V1
V2
C2
V1
0.0000001
U1
Vout
5
PULSE(-1 1 1p 1p 1p 0.5m 1m)
.tran 3m startup
ENG
4:59 AM
4/6/2020

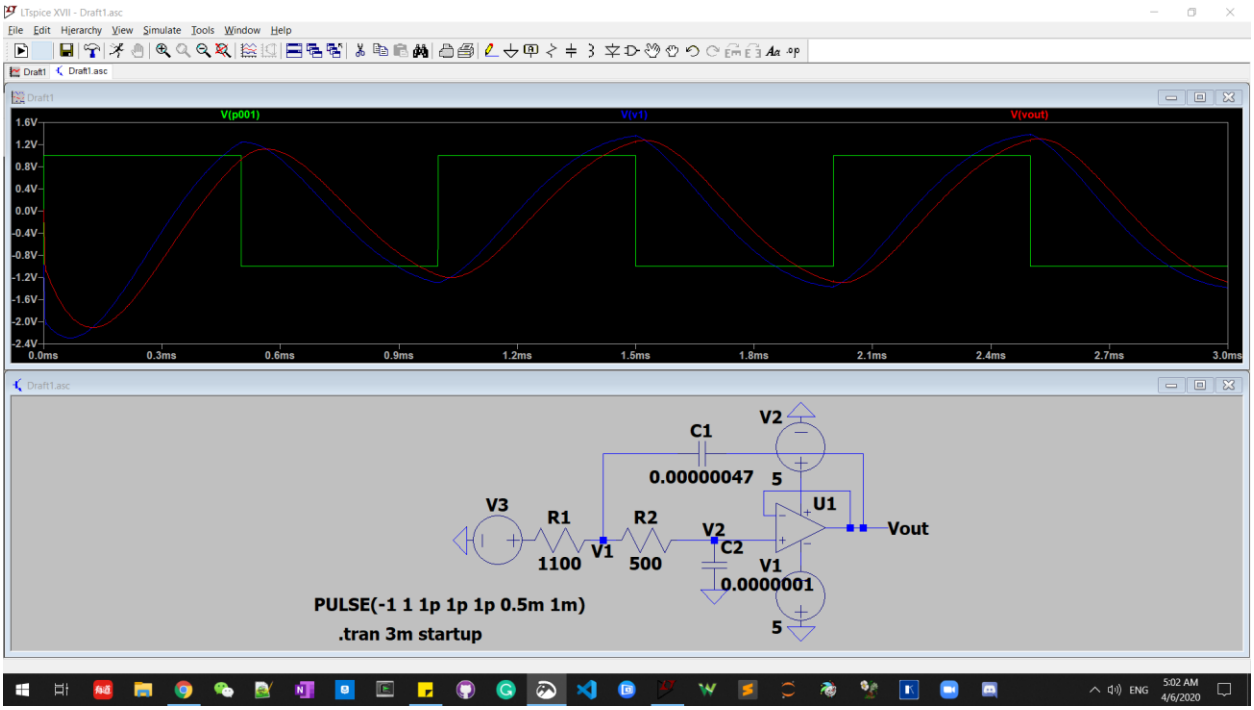
Q=1/4:


LTspice XVII - Draft1.asc
File Edit Hierarchy View Simulate Tools Window Help
V(p001)
V(v1)
V(vout)
1.2V
1.0V
0.8V
0.6V
0.4V
0.2V
0.0V
-0.2V
-0.4V
-0.6V
-0.8V
-1.0V
-1.2V
0.0ms 0.3ms 0.6ms 0.9ms 1.2ms 1.5ms 1.8ms 2.1ms 2.4ms 2.7ms 3.0ms
C1
0.000001
V2
5
V3
R1
50
R2
1250
V1
V2
C2
V1
0.00000047
U1
Vout
5
PULSE(-1 1 1p 1p 1p 0.5m 1m)
.tran 3m startup
ENG
5:01 AM
4/6/2020

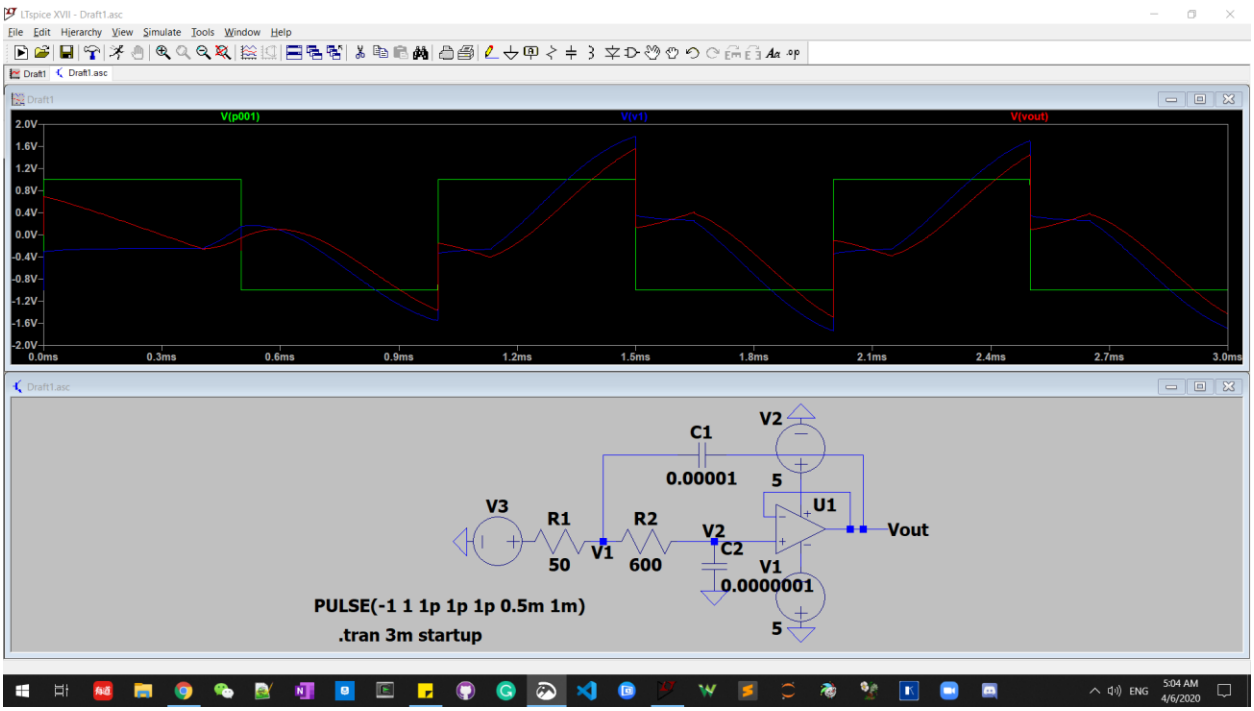
Q=1/10:


LTspice XVII - Draft1.asc
File Edit Hierarchy View Simulate Tools Window Help
Draft1 Draft1.asc
V(p001)
V(v1)
V(vout)
1.2V
0.9V
0.6V
0.3V
0.0V
-0.3V
-0.6V
-0.9V
-1.2V
-1.5V
-1.8V
-2.1V
0.0ms 0.3ms 0.6ms 0.9ms 1.2ms 1.5ms 1.8ms 2.1ms 2.4ms 2.7ms 3.0ms
C1
0.0000001
V2
5
U1
V3
R1
3300
R2
150
V1
V2
C2
V1
0.00000047
Vout
5
PULSE(-1 1 1p 1p 1p 0.5m 1m)
.tran 3m startup
ENG
5:02 AM
4/6/2020

Q=1/1:


LTspice XVII - Draft1.asc
File Edit Hierarchy View Simulate Tools Window Help
Draft1 Draft1.asc
V(p001)
V(v1)
V(vout)
1.6V
1.2V
0.8V
0.4V
0.0V
-0.4V
-0.8V
-1.2V
-1.6V
-2.0V
-2.4V
0.0ms 0.3ms 0.6ms 0.9ms 1.2ms 1.5ms 1.8ms 2.1ms 2.4ms 2.7ms 3.0ms
C1
0.00000047
V2
5
U1
V3
R1
1100
R2
500
V1
V2
C2
V1
0.0000001
Vout
5
PULSE(-1 1 1p 1p 1p 0.5m 1m)
.tran 3m startup
ENG
5:02 AM
4/6/2020

Q=10/4:


LTspice XVII - Draft1.asc
File Edit Hierarchy View Simulate Tools Window Help
Draft1
Draft1.asc
V(p001)
V(v1)
V(vout)
2.0V
1.6V
1.2V
0.8V
0.4V
0.0V
-0.4V
-0.8V
-1.2V
-1.6V
-2.0V
0.0ms
0.3ms
0.6ms
0.9ms
1.2ms
1.5ms
1.8ms
2.1ms
2.4ms
2.7ms
3.0ms
C1
0.00001
V2
5
U1
V3
R1
50
R2
600
V1
V2
C2
0.0000001
V1
5
Vout
PULSE(-1 1 1p 1p 1p 0.5m 1m)
.tran 3m startup
ENG
5:04 AM
4/6/2020