RLC, Filter, Buck, Boost circuits

SIDHARTH SEELA | MOTOMANIPAL E-POWERTRAIN TASKPHASE | August 21, 2020

RLC:

There are two types: parallel, and series.

In series, the current is same throughout the circuit but the voltage drop across each component is different at an instant. Acts as frequency pass at wo. The impedance is usually higher.

In parallel, the voltage drop remains same but the current in any branch depends on the impedance of that branch. Acts as a frequency stop at wo. The impedance is usually lower.

Filters:

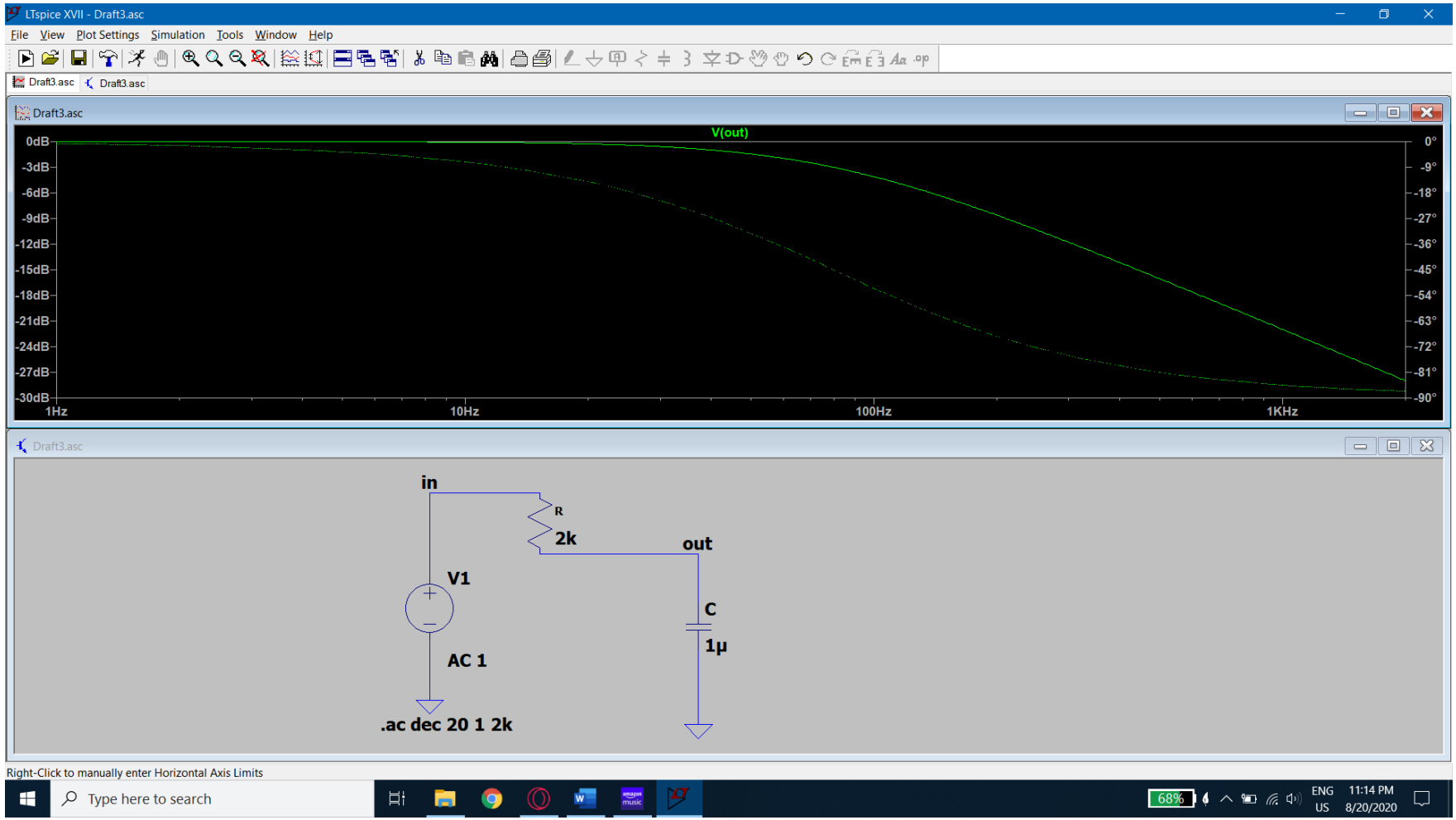
For a capacitor, its frequency constant needs to be higher than input frequency only then it guaranteed that minimum 70.7 percent(-3 dB) of amplitude goes through. TIME CONST = RC

For an inductor it vice-versa. TIME CONST = L/R

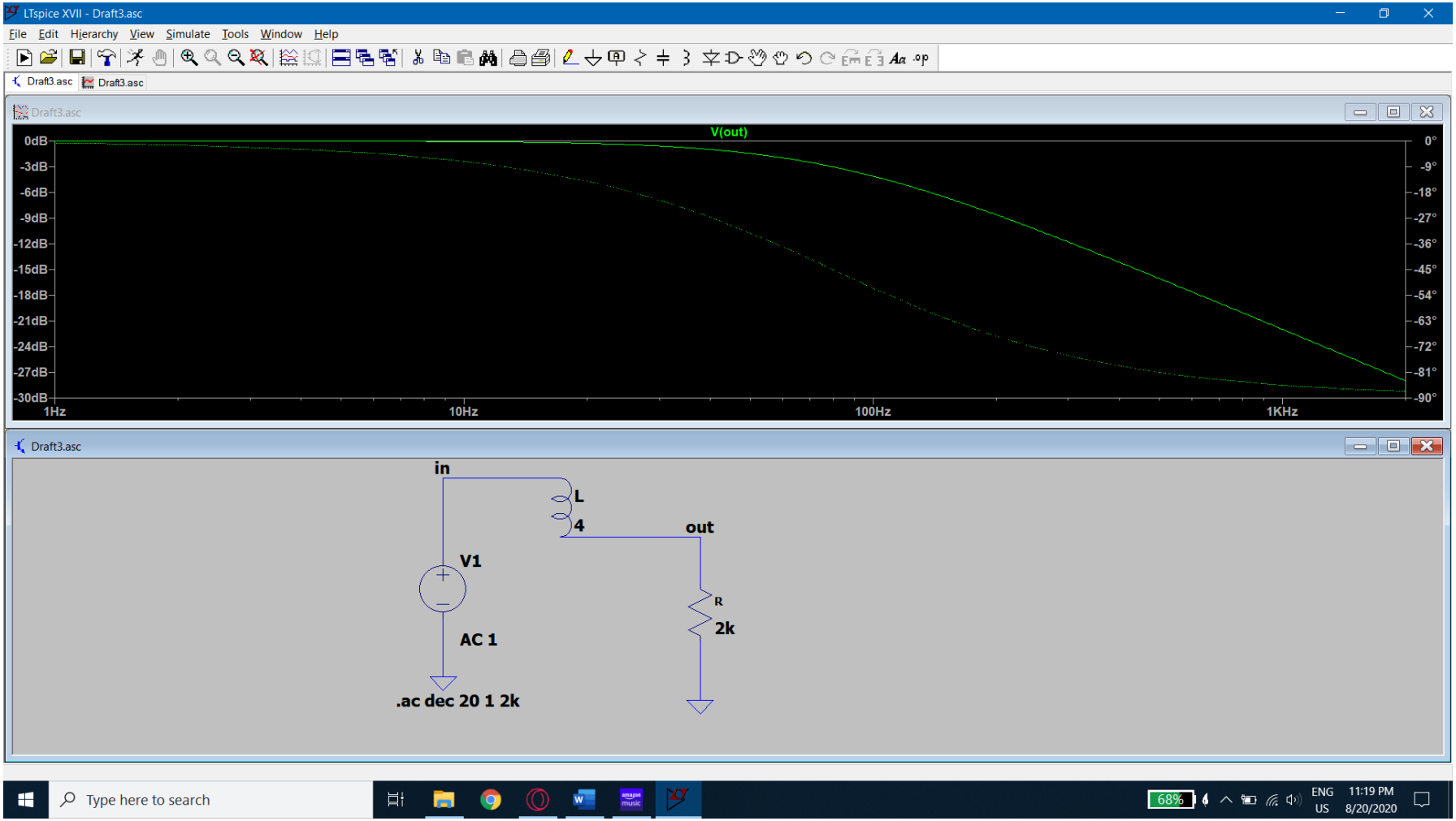
All circuits below have cut off frequencies off 79hz.

LOW PASS FILTER:

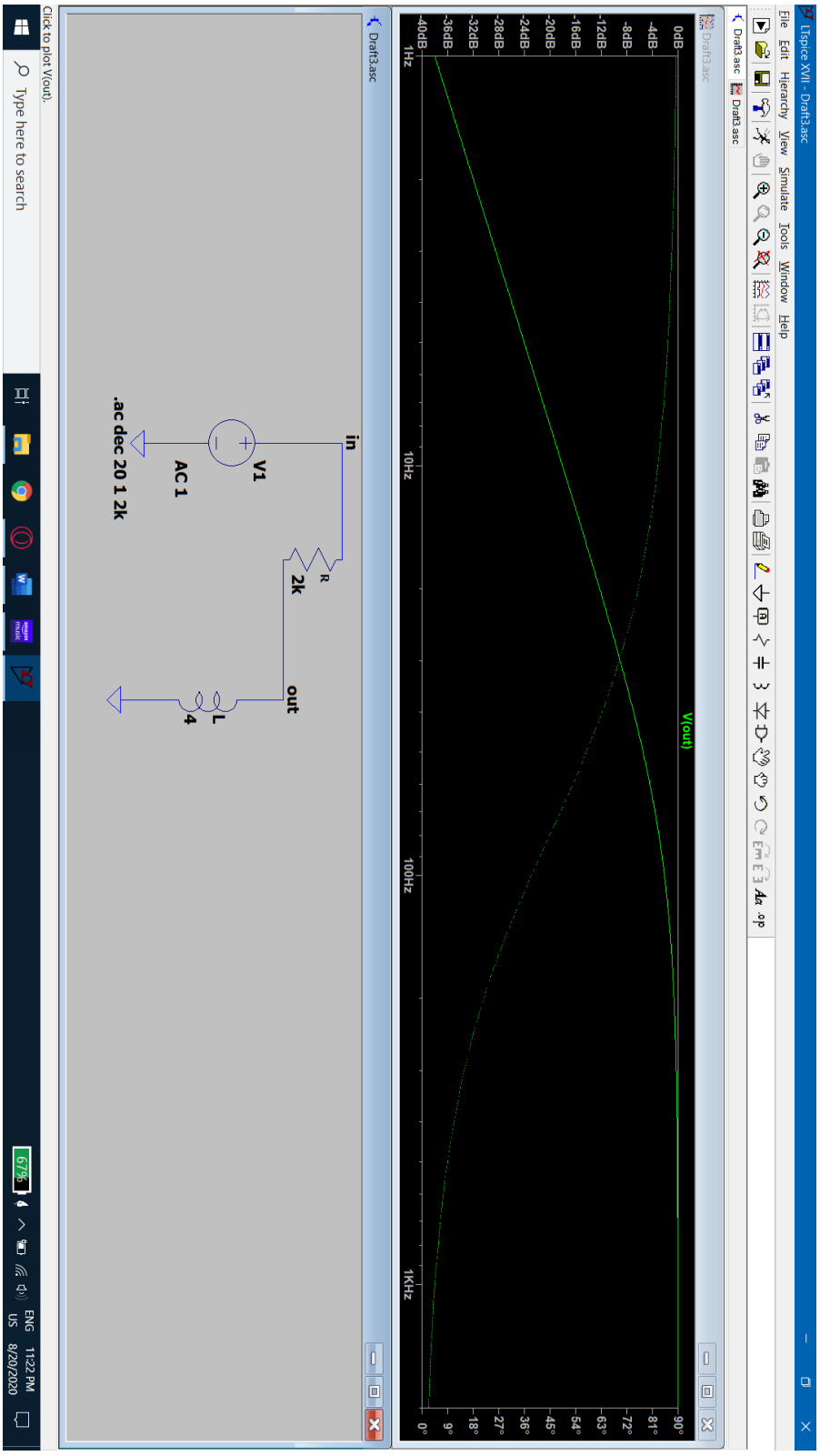
Continue to next page.....


LTspice XVII - Draft3.asc
File View Plot Settings Simulation Tools Window Help
Draft3.asc
Draft3.asc
Draft3.asc
V(out)
0dB
-3dB
-6dB
-9dB
-12dB
-15dB
-18dB
-21dB
-24dB
-27dB
-30dB
0°
-9°
-18°
-27°
-36°
-45°
-54°
-63°
-72°
-81°
-90°
1Hz
10Hz
100Hz
1KHz
Draft3.asc
in
R
2k
out
V1
C
1µ
AC 1
.ac dec 20 1 2k
Right-Click to manually enter Horizontal Axis Limits
Type here to search
68%
ENG
US
11:14 PM
8/20/2020

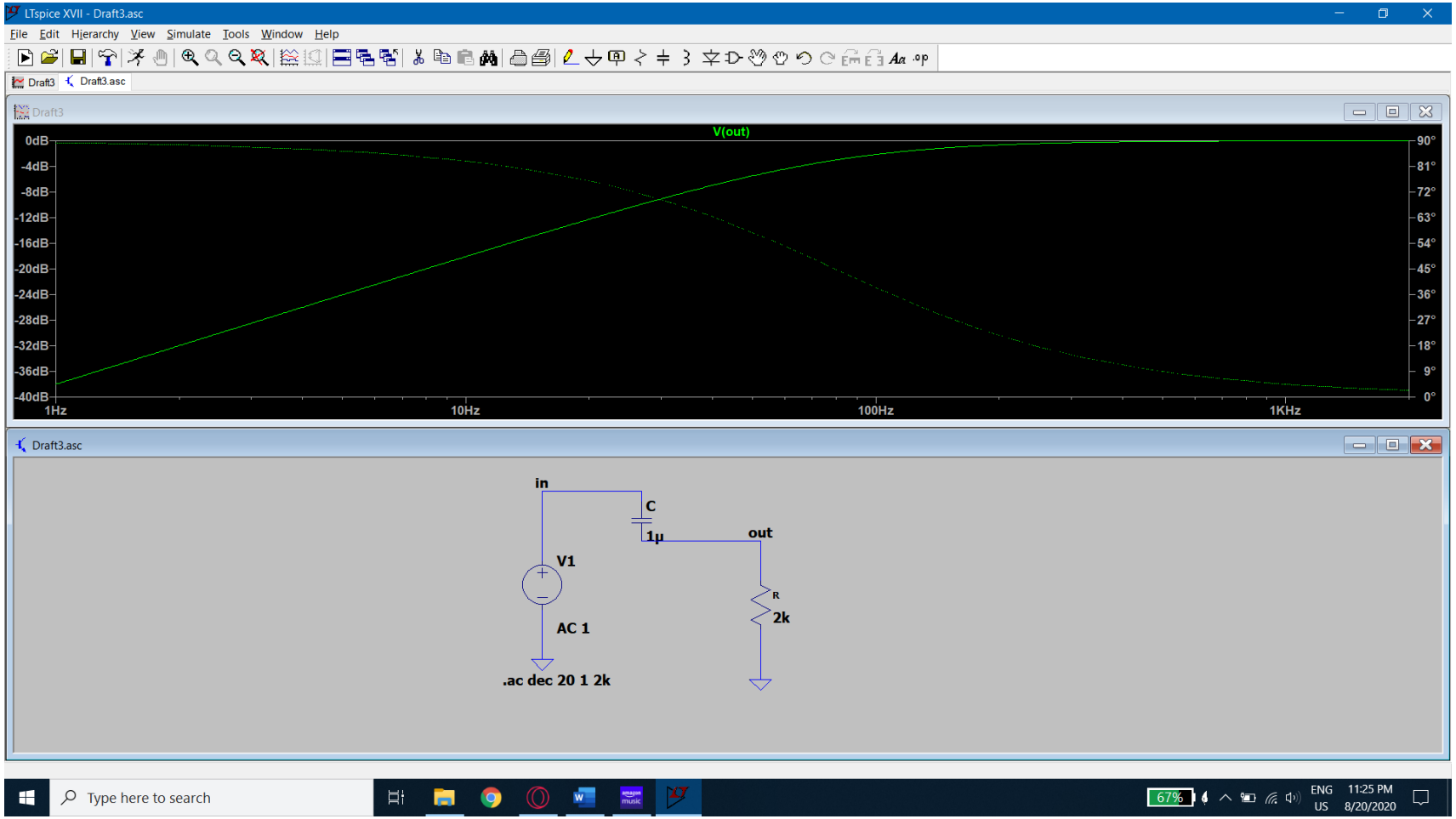
USING LTSPICE



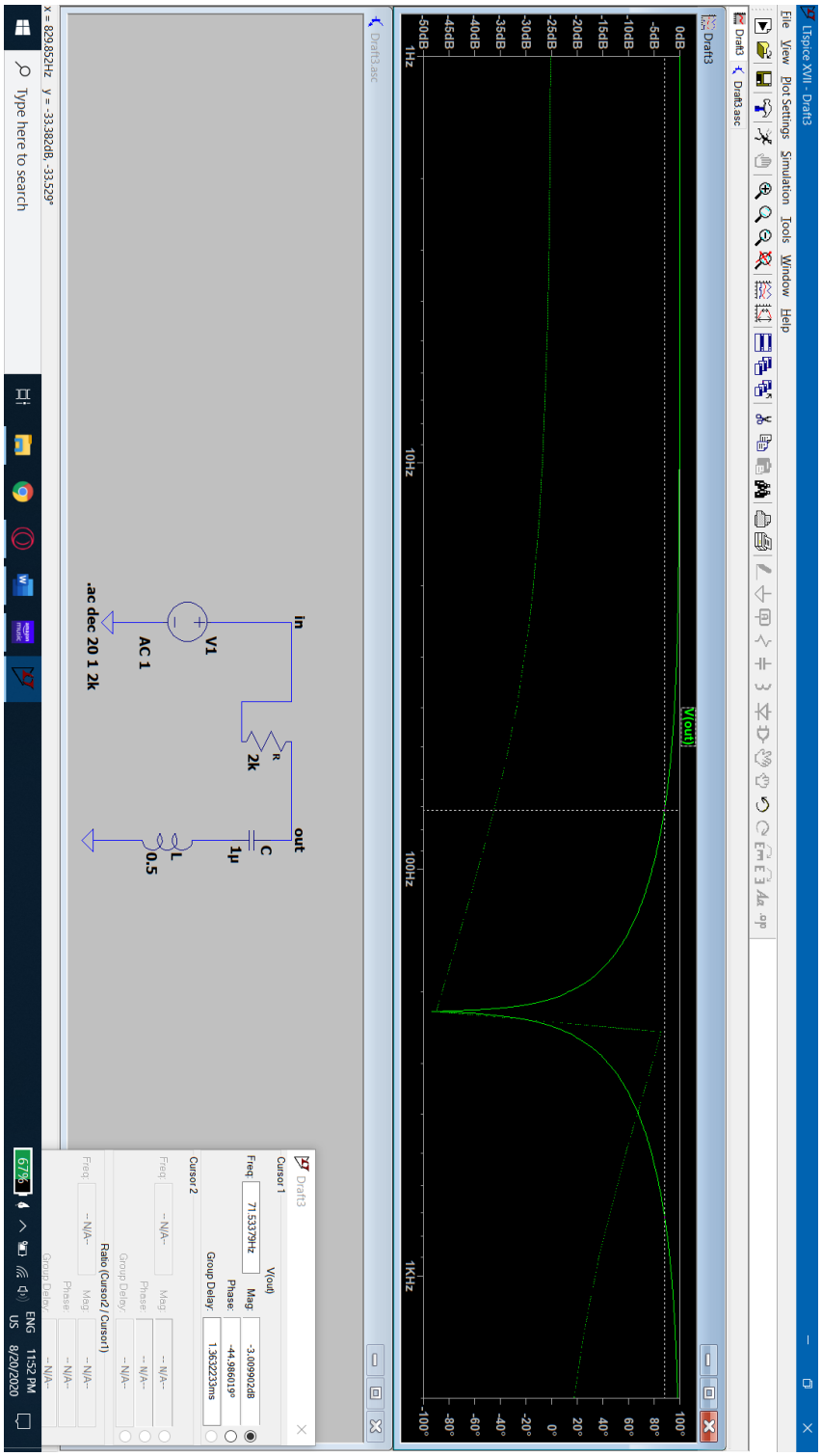
HIGH PASS FILTER:



USING RL


LTspice XVII - Draft3.asc
File Edit Hierarchy View Simulate Tools Window Help
Draft3 Draft3.asc
Draft3
V(out)
0dB -4dB -8dB -12dB -16dB -20dB -24dB -28dB -32dB -36dB -40dB
90° 81° 72° 63° 54° 45° 36° 27° 18° 9° 0°
1Hz 10Hz 100Hz 1KHz
Draft3.asc
in
C
1µ
out
V1
AC 1
R
2k
.ac dec 20 1 2k
Type here to search
67%
ENG US
11:25 PM
8/20/2020

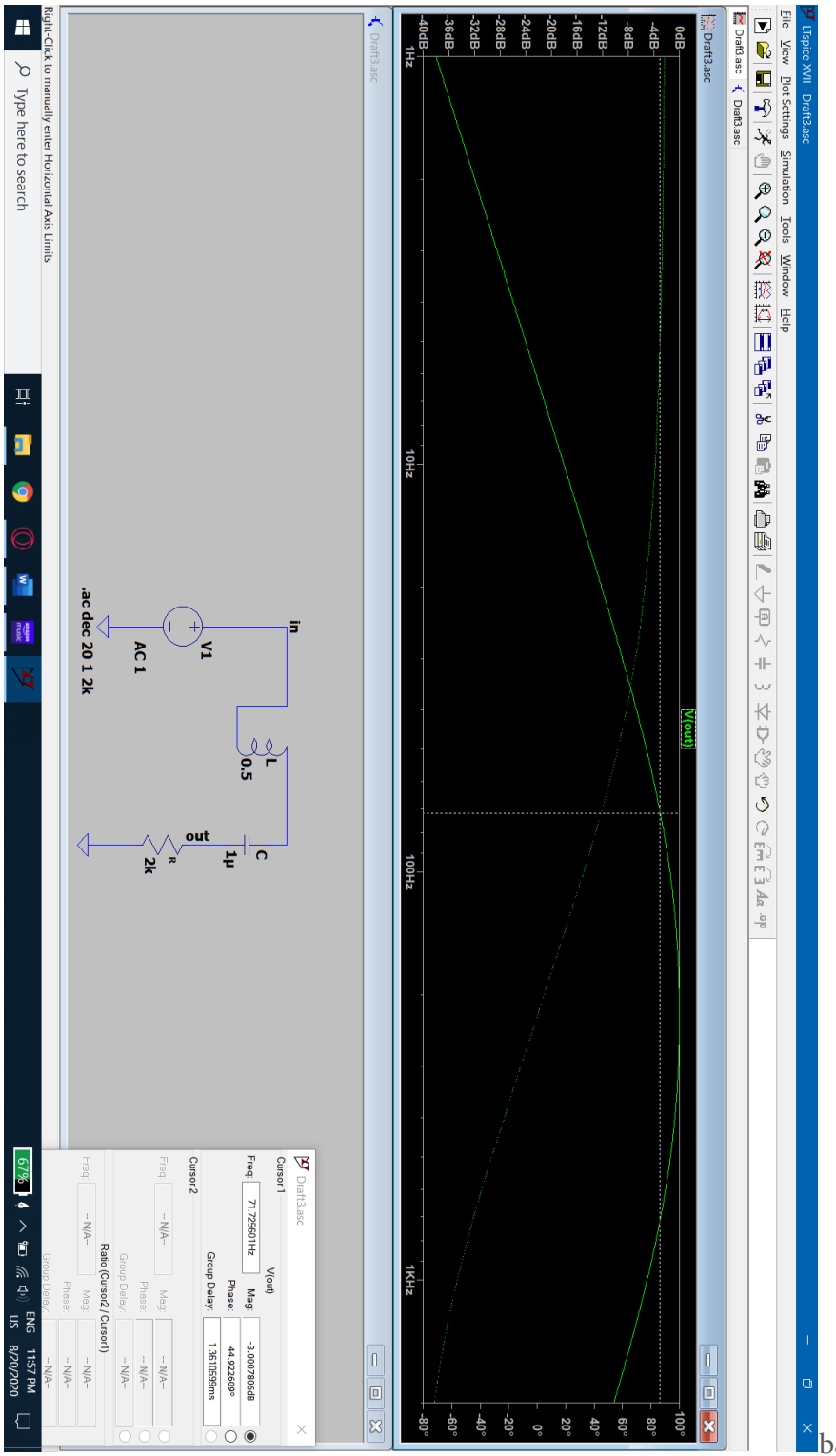
BAND STOP FILTER :



FROM 79 TO 636 HZ

RLC BANDSTOP.

BAND PASS FILTER:

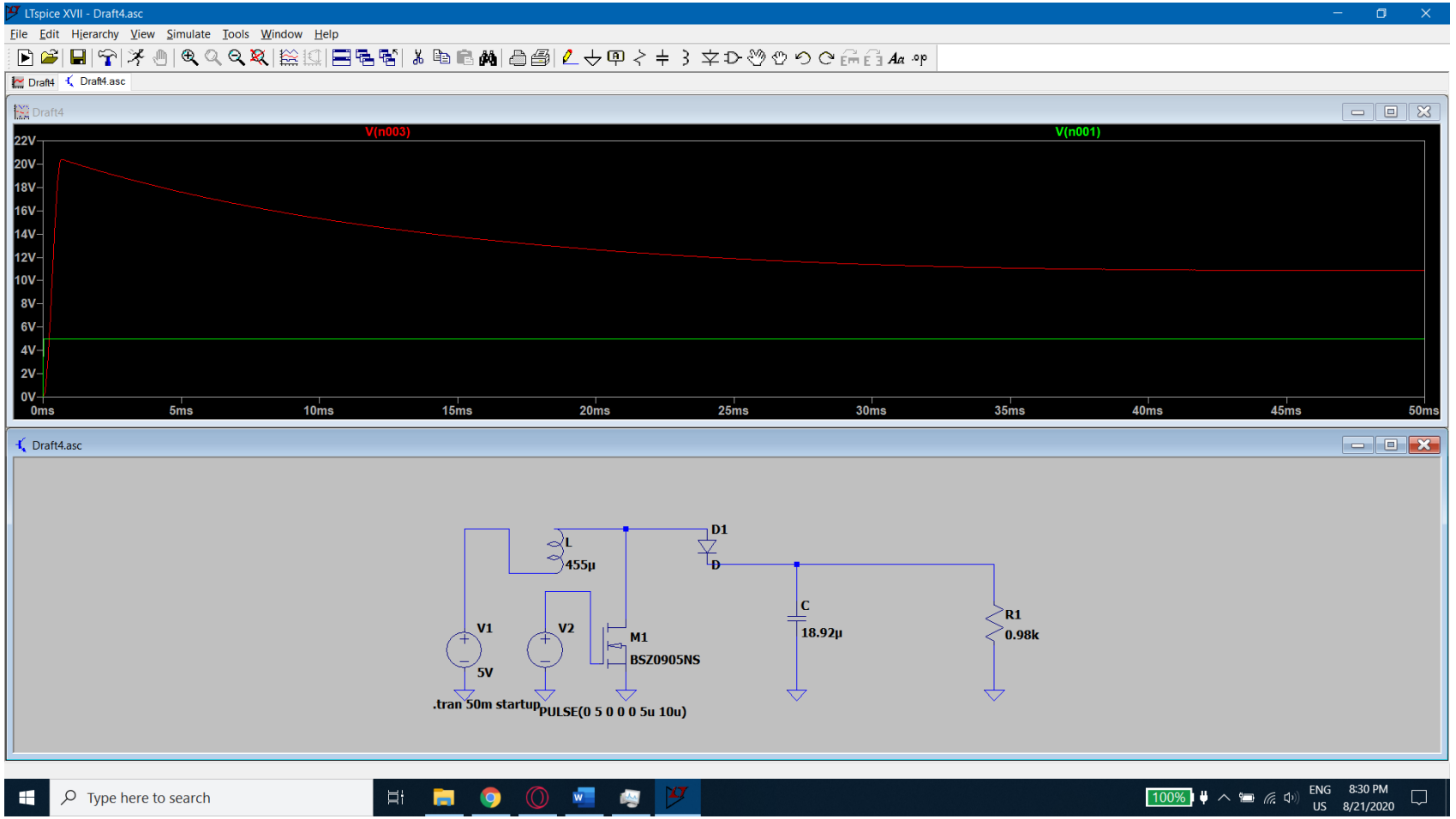


bandpass RLC (79 to 636hz)

we can form any of these circuits using just rl or rc or rlc.

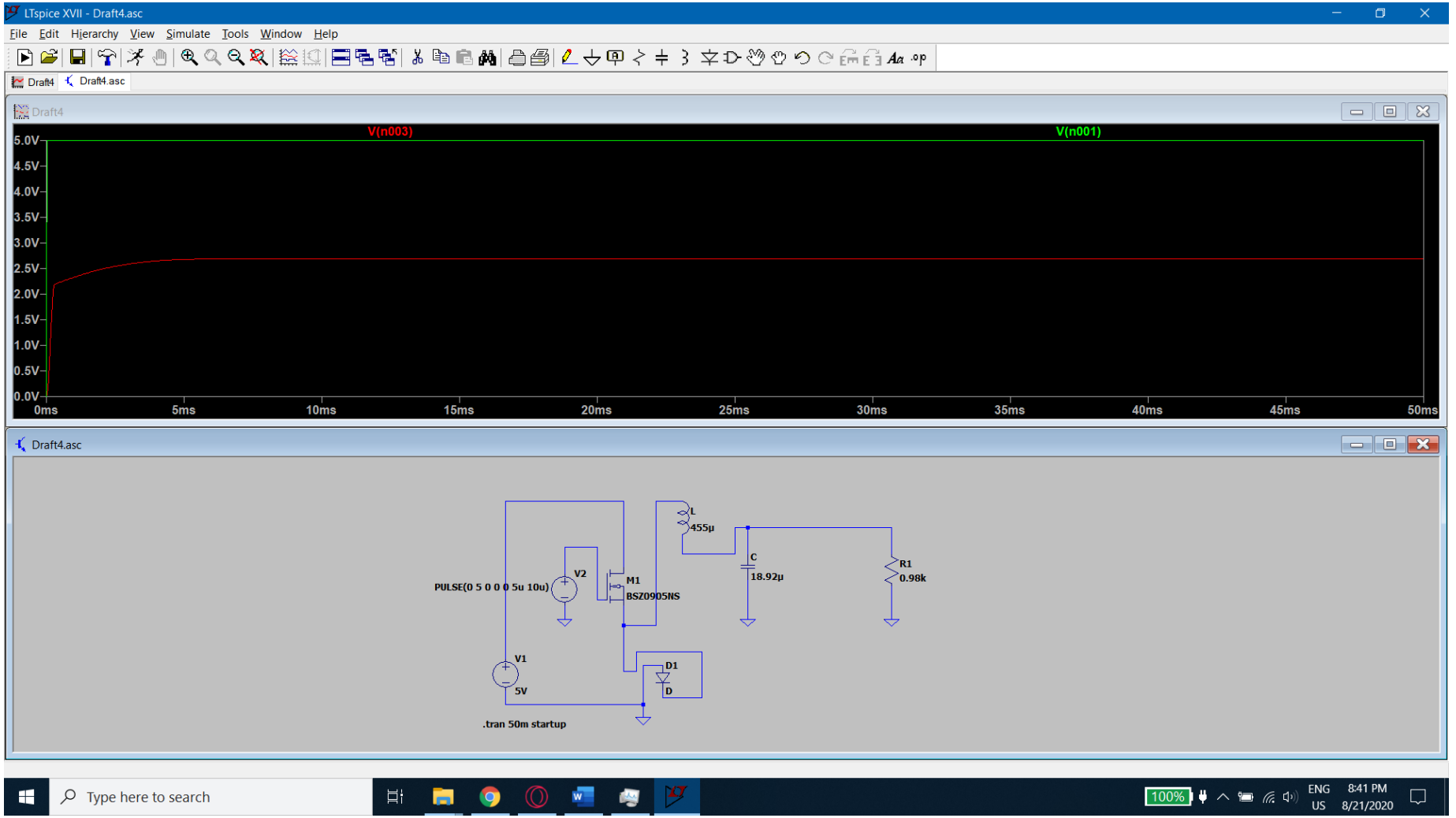
Booster circuit:

This circuit uses a small ac signal to switch a mosfet on and off very fast so that an inductor charges up and discharges the self-induced voltage to the capacitor. The capacitor voltage gains until the charging current and discharging current reach equilibrium. The voltage increase comes with current loss so as to conserve energy. The equation for v out is Vo = Vin/(1-duty ratio). Continued.....


LTspice XVII - Draft4.asc
File Edit Hierarchy View Simulate Tools Window Help
Draft4
Draft4.asc
V(n003)
V(n001)
22V
20V
18V
16V
14V
12V
10V
8V
6V
4V
2V
0V
0ms
5ms
10ms
15ms
20ms
25ms
30ms
35ms
40ms
45ms
50ms
L
455µ
D1
D
C
18.92µ
R1
0.98k
V1
5V
V2
M1
BSZ0905NS
.tran 50m startup
PULSE(0 5 0 0 0 5u 10u)
Type here to search
100%
ENG
US
8:30 PM
8/21/2020

Buck circuit:

When the switch is on the current flows through the inductor and capacitor charging both but when it is off the inductor reverses the polarity and discharges the current into capacitor causing the output to be the difference in voltages of capacitor and inductor. The reduction in voltage is accompanied by increase of current due to the current stored by the impedance of the inductor. Vo = Vin * duty ratio. Continued....


LTspice XVII - Draft4.asc
File Edit Hierarchy View Simulate Tools Window Help
Draft4
Draft4.asc
V(n003)
V(n001)
5.0V
4.5V
4.0V
3.5V
3.0V
2.5V
2.0V
1.5V
1.0V
0.5V
0.0V
0ms
5ms
10ms
15ms
20ms
25ms
30ms
35ms
40ms
45ms
50ms
Draft4.asc
L
455µ
C
18.92µ
R1
0.98k
V2
PULSE(0 5 0 0 0 5u 10u)
M1
BSZ095NS
V1
5V
D1
D
.tran 50m startup
Type here to search
100%
ENG
US
8:41 PM
8/21/2020