f_{3dB} (1)

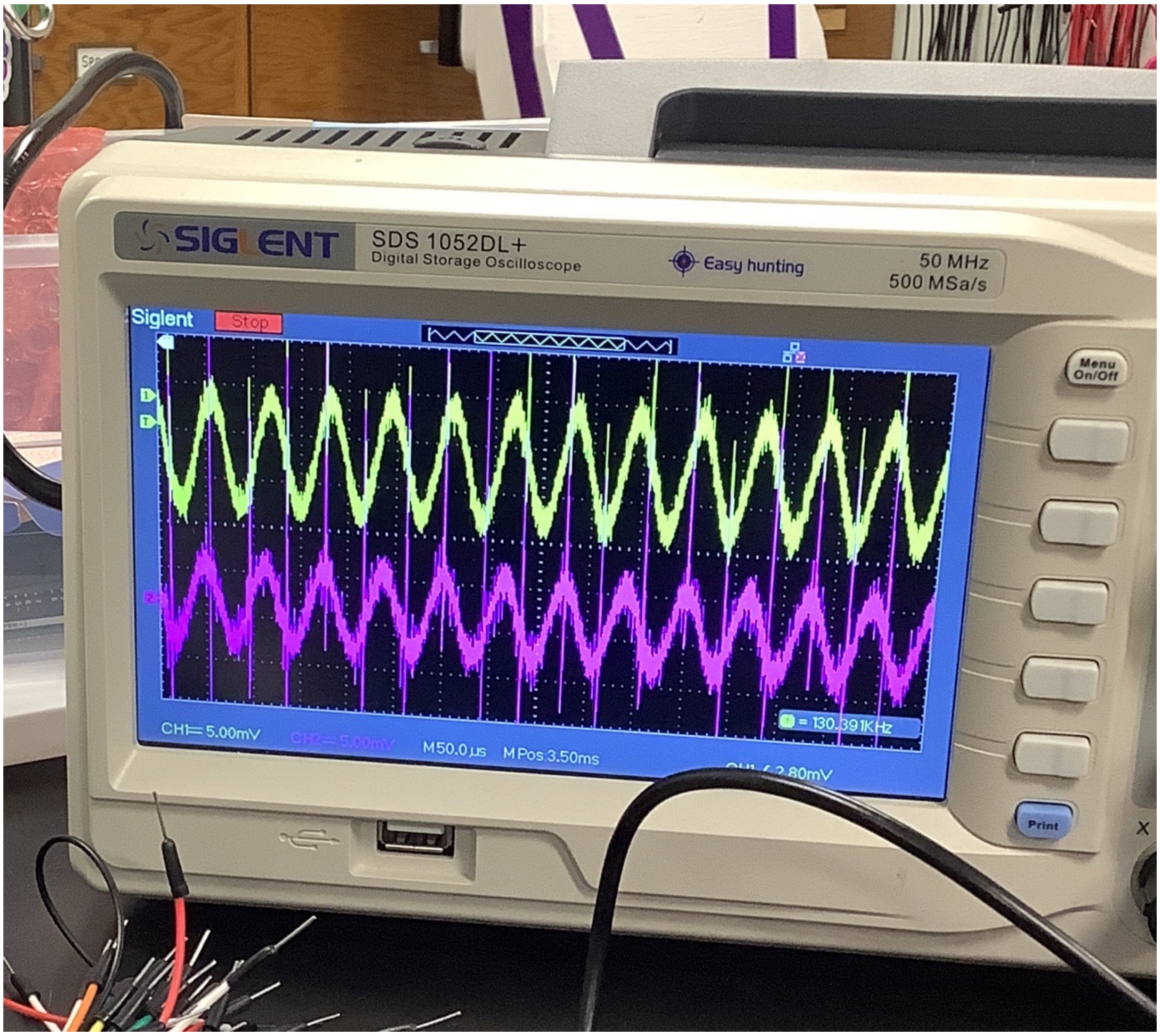
V_{out} = 2.5 squares (5 mV) = 12.5 mV

V_{in} = 3 squares (5 mV) = 15 mV

$$\frac{V_{out}}{V_{in}} = \frac{5}{6}$$

~ 0.707=1/sqrt(2)=-3dB

Phase shift of V_out ~ -1/8 of a period = -45 degrees



$f_{3dB}\left(\frac{1}{10}\right)$

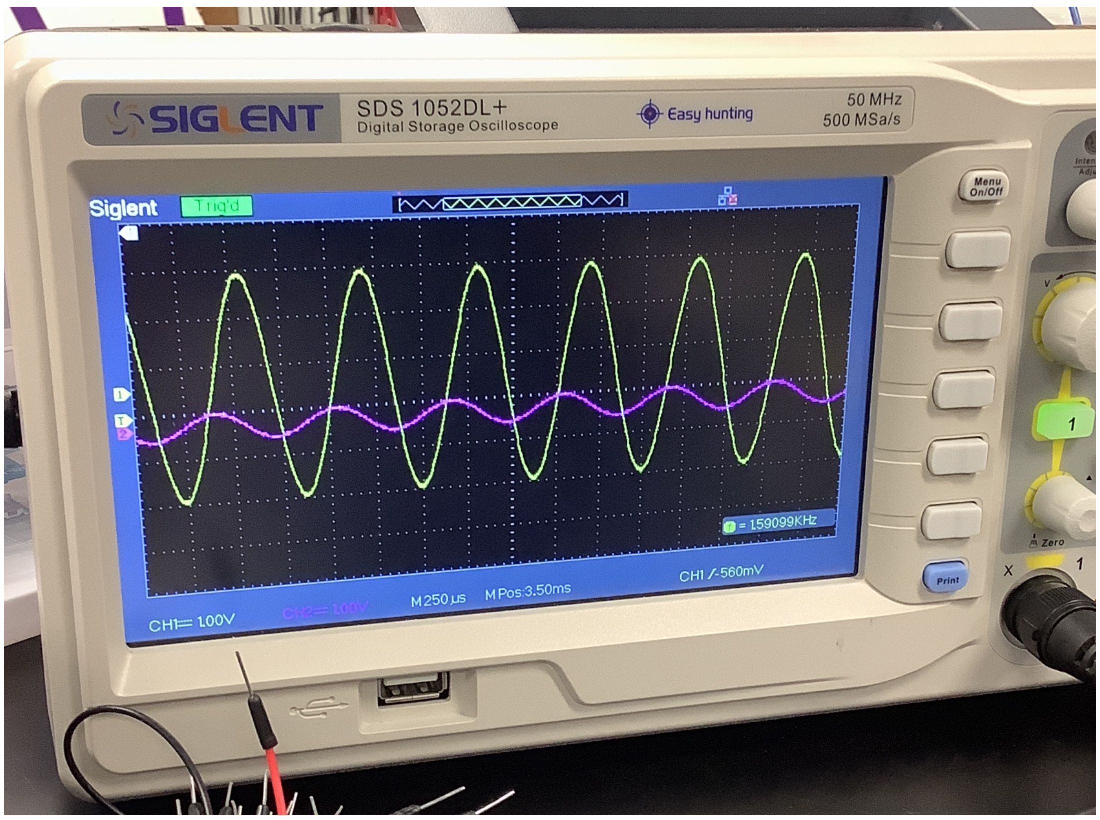
$V_{out} = 5.4(100\ mV) = 540\ mV$

$0.55(1V) = 0.55\ V$

$V_{in} = 5(1\ V) = 5V$

$$\frac{V_{out}}{V_{in}} = \frac{0.55}{5} = \underline{0.11}$$

phase shift ~ -90 degrees



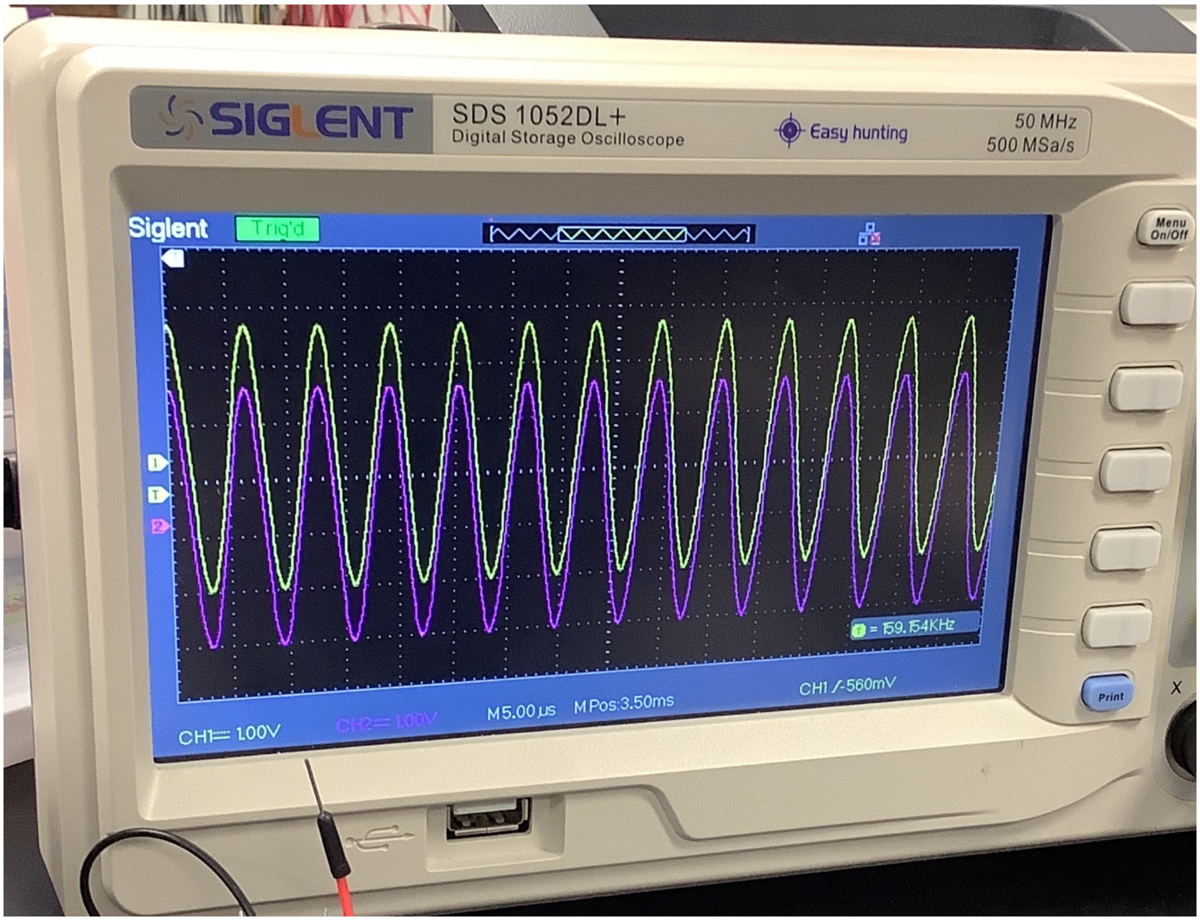
f_{3dB} (10)

$V_{out} = 4.4\,V$

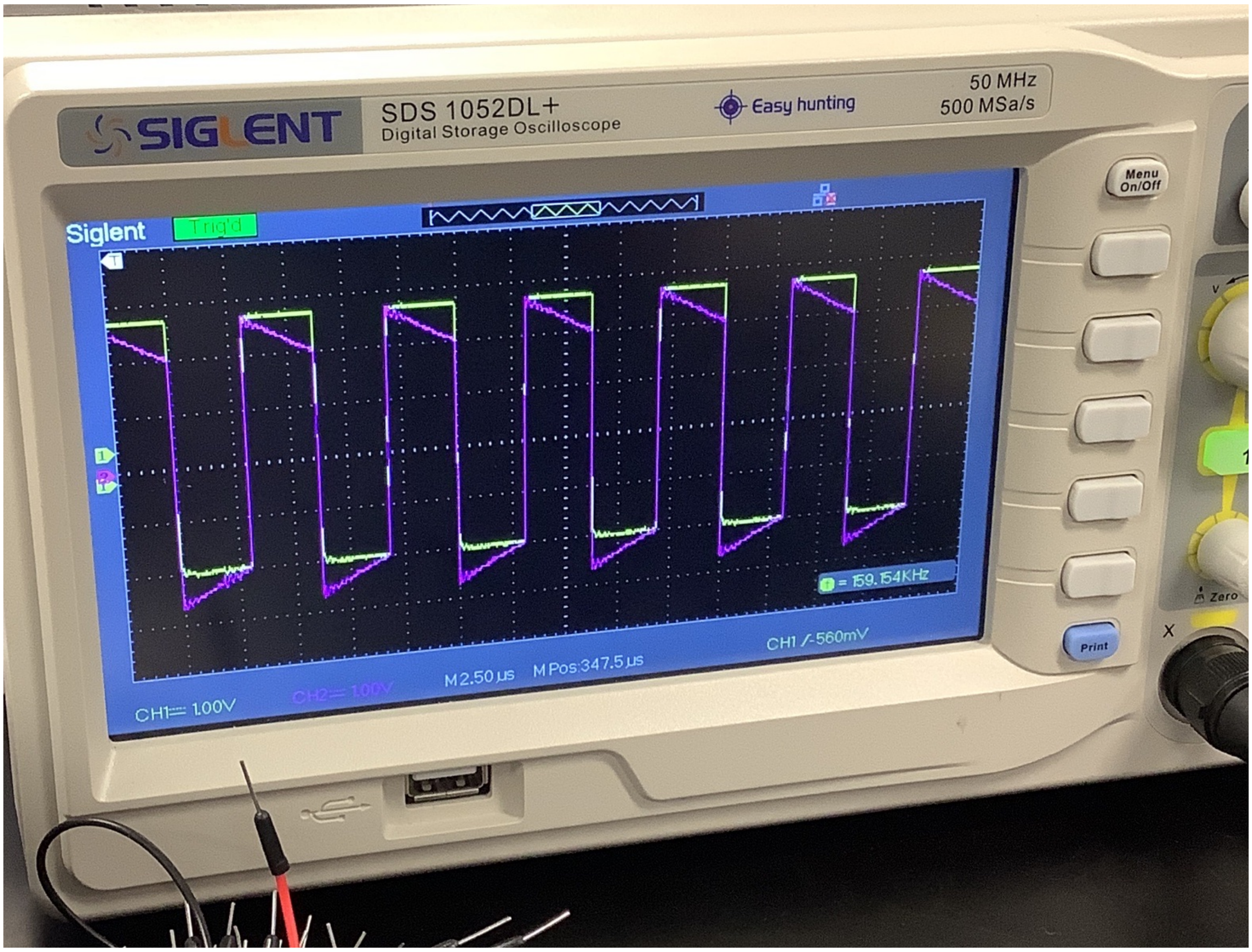
$V_{in} = 4.8\,V$

$$\frac{V_{out}}{V_{in}} = \frac{4.4}{4.8} = \frac{11}{12}$$

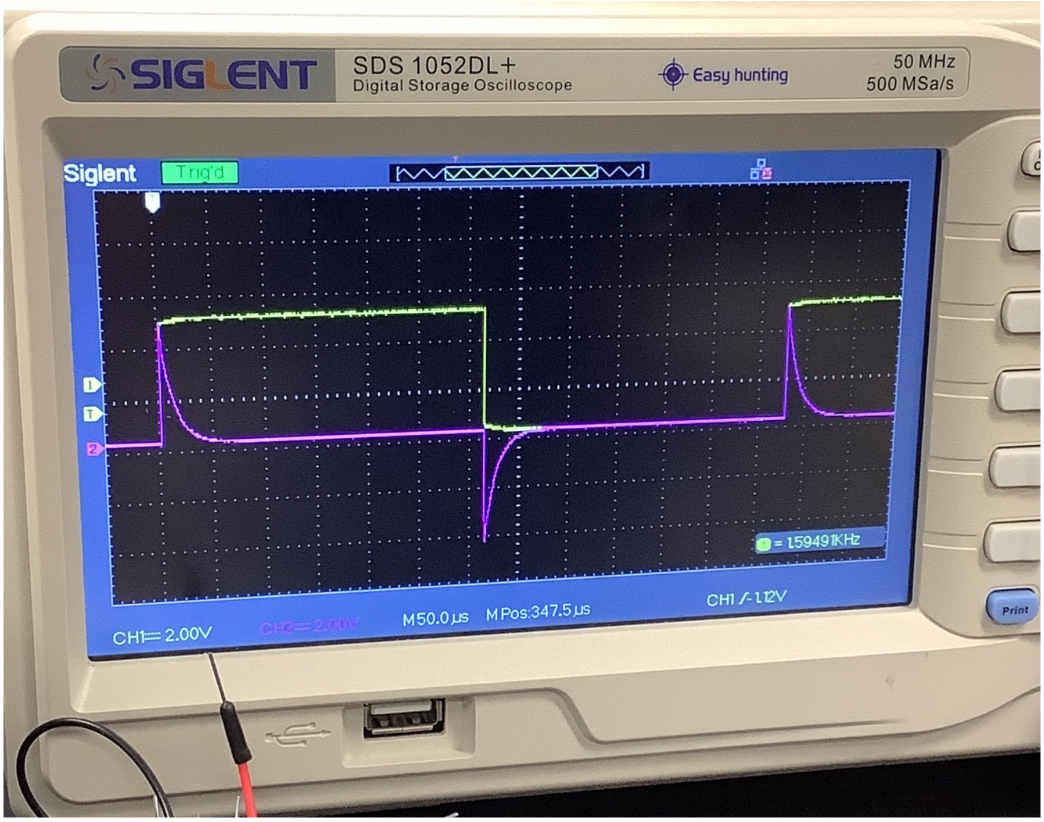
Phase shift is close to 0 (slightly negative)



Square Wave: at $10 \times f_{3dB}$



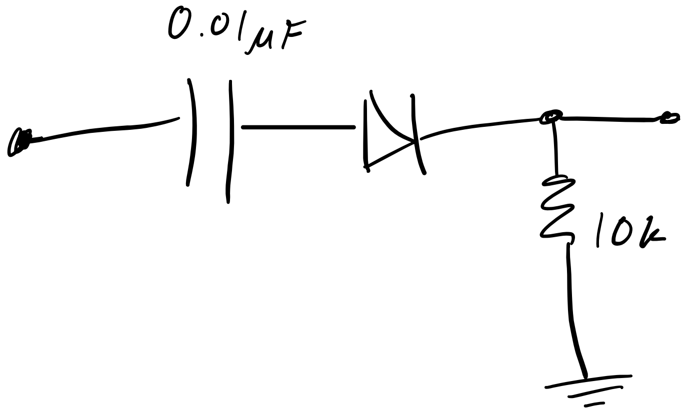
at f_{3dB}



at $\frac{1}{10} f_{3dB}$

The DC component shifts the V_{in}, but does not affect V_{out}.

With the resistor connected to 5V on the lower end, V_{in} and V_{out} read the same, there is no filtering.



can't go backwards through the diode.

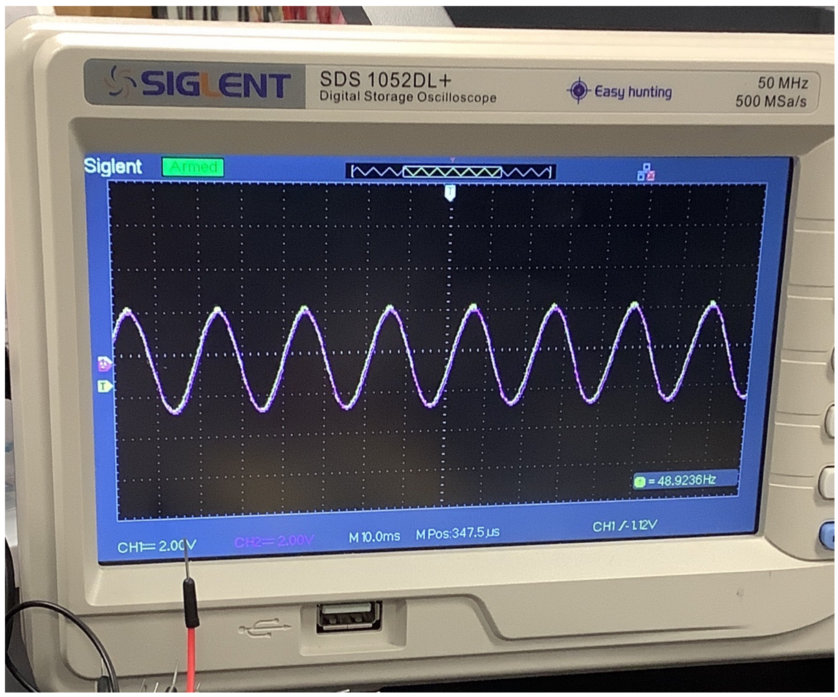
② Low-Pass Fleter

$\frac{1}{10} f_{3dB}$

$V_{out} = 2.4(2V)$
$= 4.8\ V$

$V_{in} = 2.4(2V)$
$= 4.8V$

$\frac{V_{out}}{V_{in}} = 1$

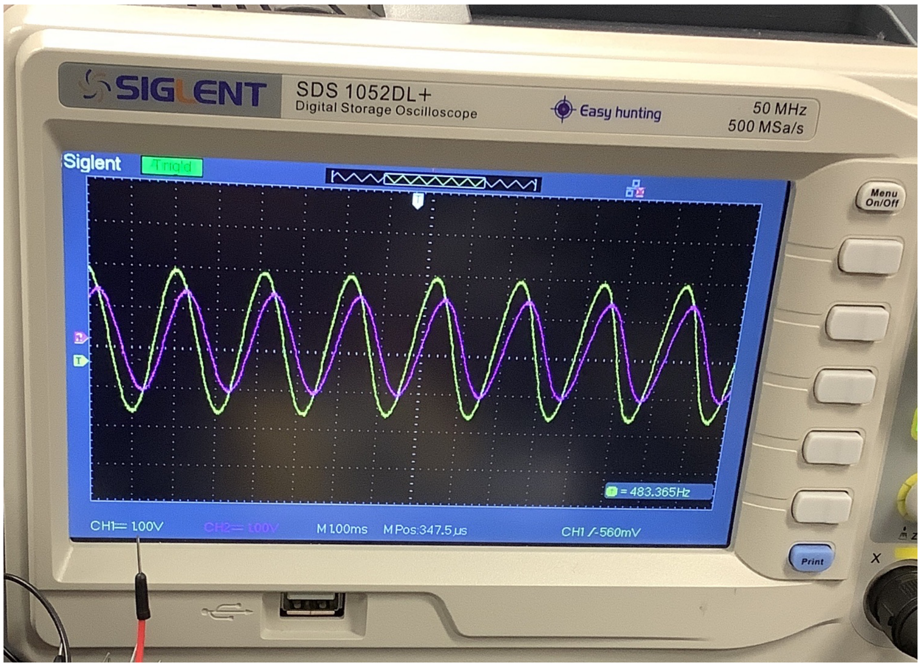


phase shift close to 0 (maybe slightly positive?)

F_{3dB}

$V_{out} = 2.4(1V) = 2.4V$

$V_{in} = 3.5(1V) = 3.5V$

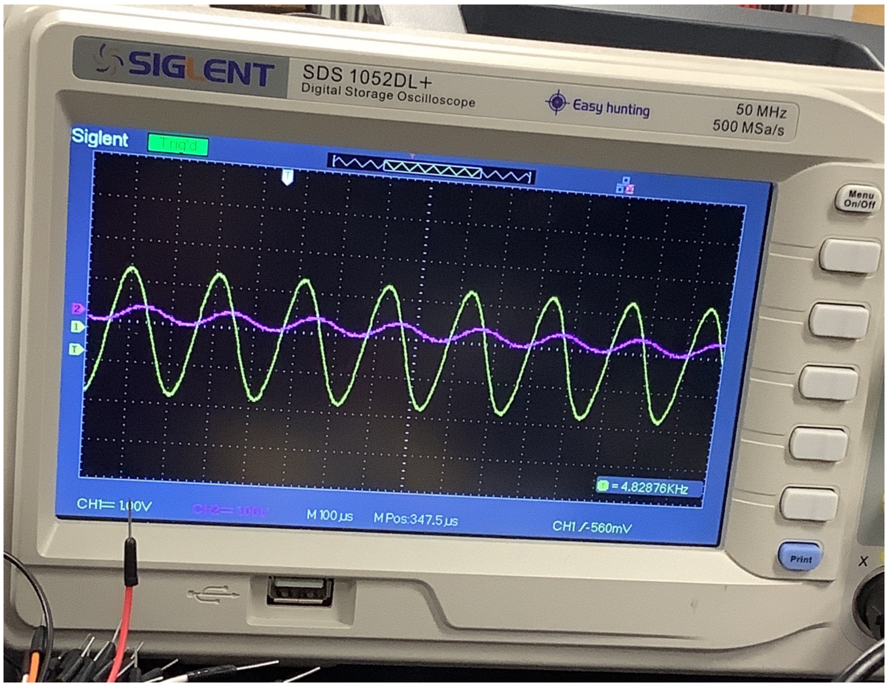


$\frac{V_{out}}{V_{in}} = \frac{2.4}{3.5}$

$10 f_{3dB}$

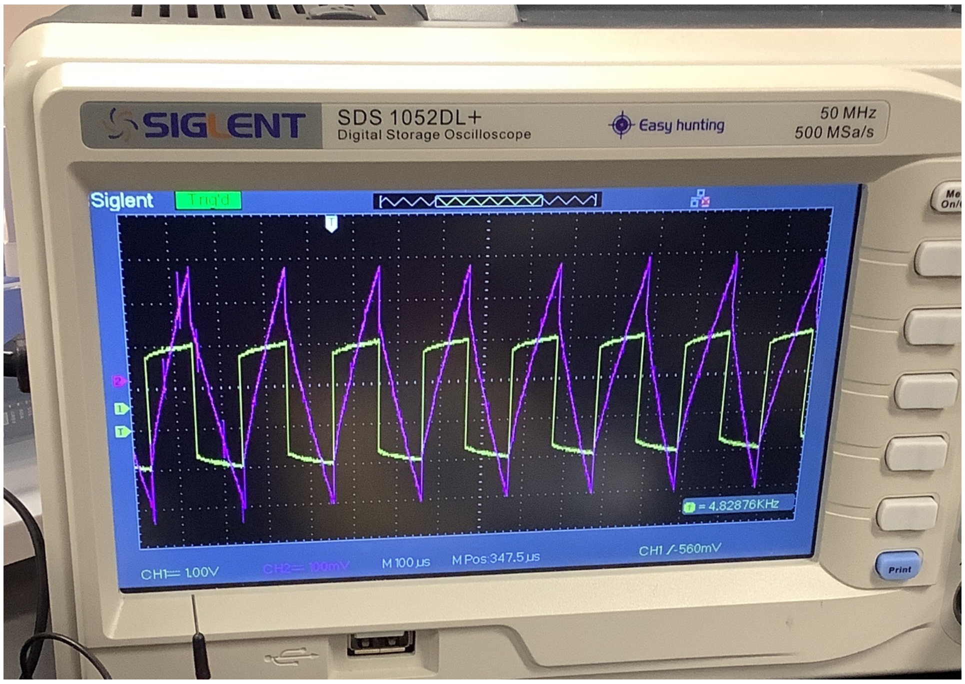
$V_{out} = 3.6(100mV)$
$= 0.36V$

$V_{in} = 3.1V$



$\frac{V_{out}}{V_{in}} = \frac{0.36}{3.1}$

This is a lo-pass filter, so the lower frequencies go through with almost no change, and higher frequencies are reduced or filtered out.



$10 f_{3dB}$

$\frac{1}{10} f_{3dB}$