Laboratory Three — AC Circuits

Rishabh Shah
4655 4192

Partner: Matthew Remillard

October 13, 2017

Pre-Lab

I

$$RiseTime = \frac{arcsin(0.8)}{pi \cdot Freq} = \frac{T \cdot arcsin(0.8)}{pi}$$

$$RiseTime(50kHz) = \frac{arcsin(0.8)}{pi \cdot 50000} = 5.9033 \times 10^{-6} \mu s$$

II

$$MeasuredRatioof \frac{R_1}{/} R_2 = \frac{R_1}{R_2} = \frac{V_1}{V_2} = \frac{1.5}{2} = 0.75$$

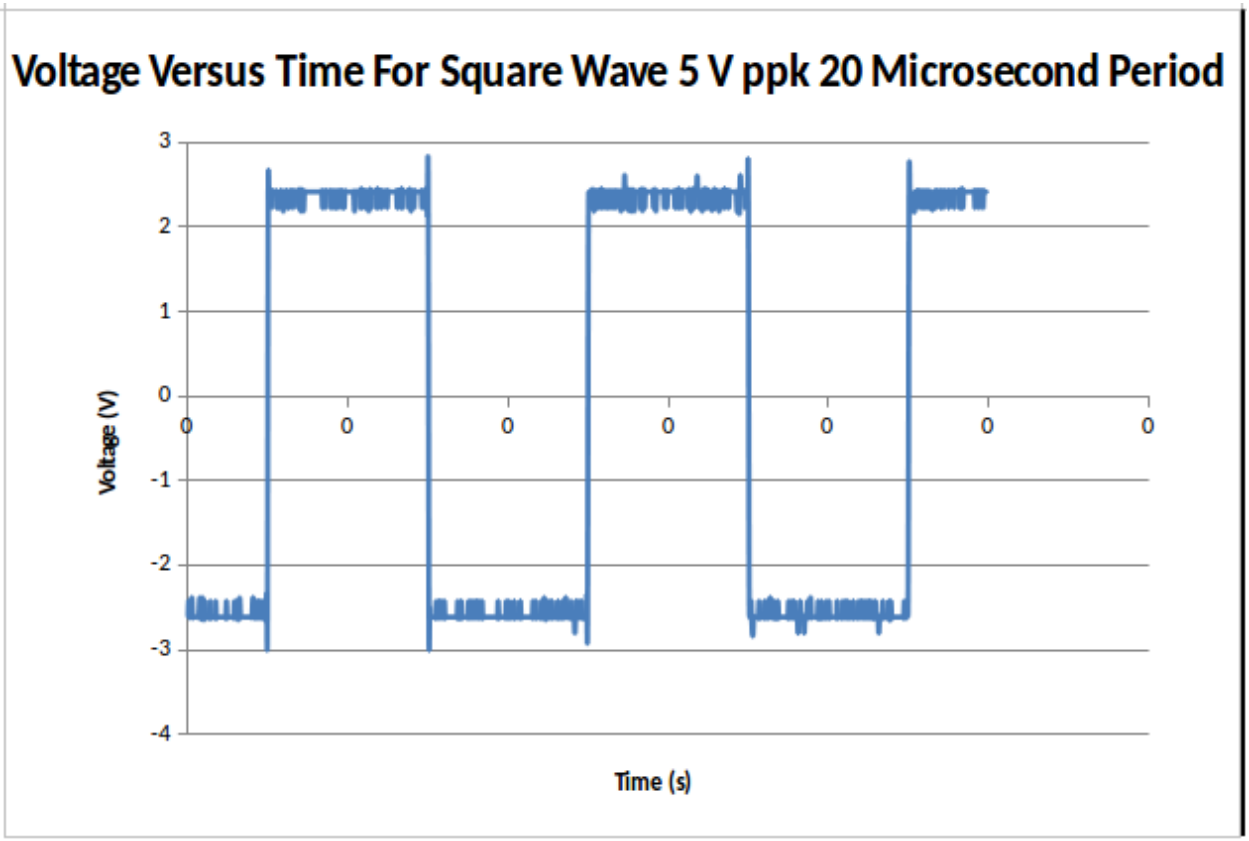
$$CalculatedRatioof \frac{R_1}{/} R_2 = \frac{R_1}{R_2} = \frac{100}{200} = 0.5$$

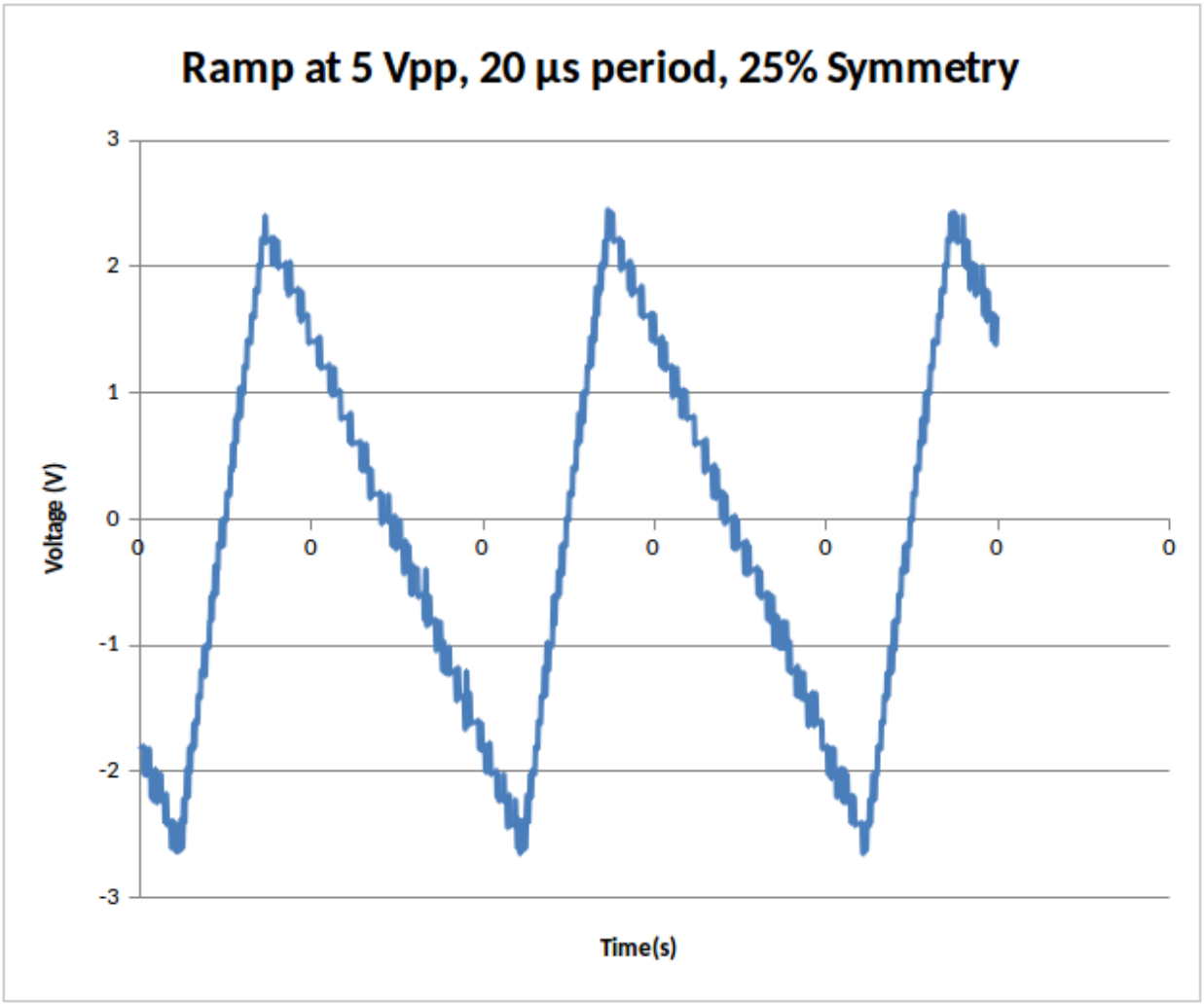
$$PercentageError = \frac{|measured - calculated|}{calculated} = \frac{|0.75 - 0.5|}{0.5} = 50\%$$

III

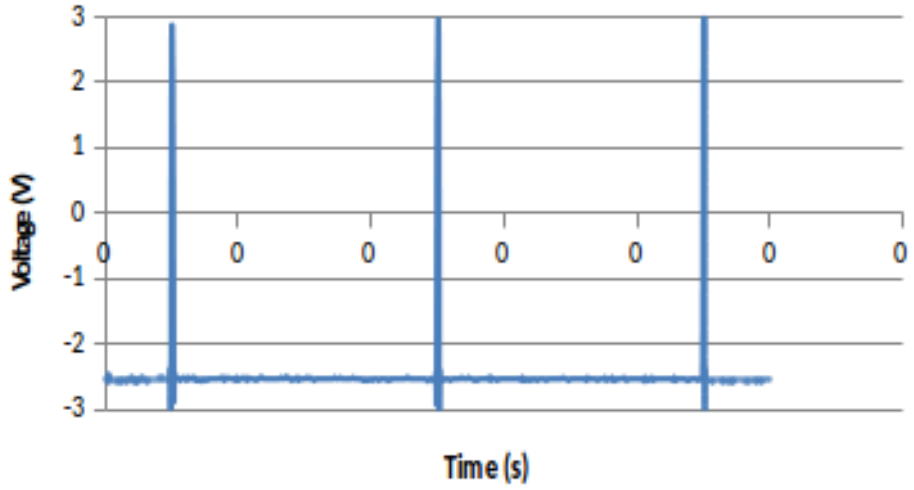
$$V_{D0} = V_S - V_{out} = 4.850 - 608.74 \times 10^{-3} = 4.24V$$

Lab Data

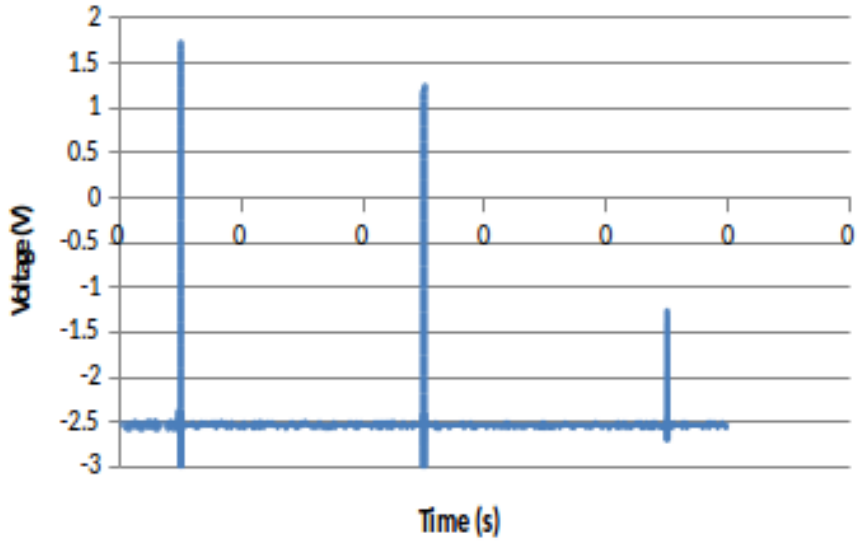


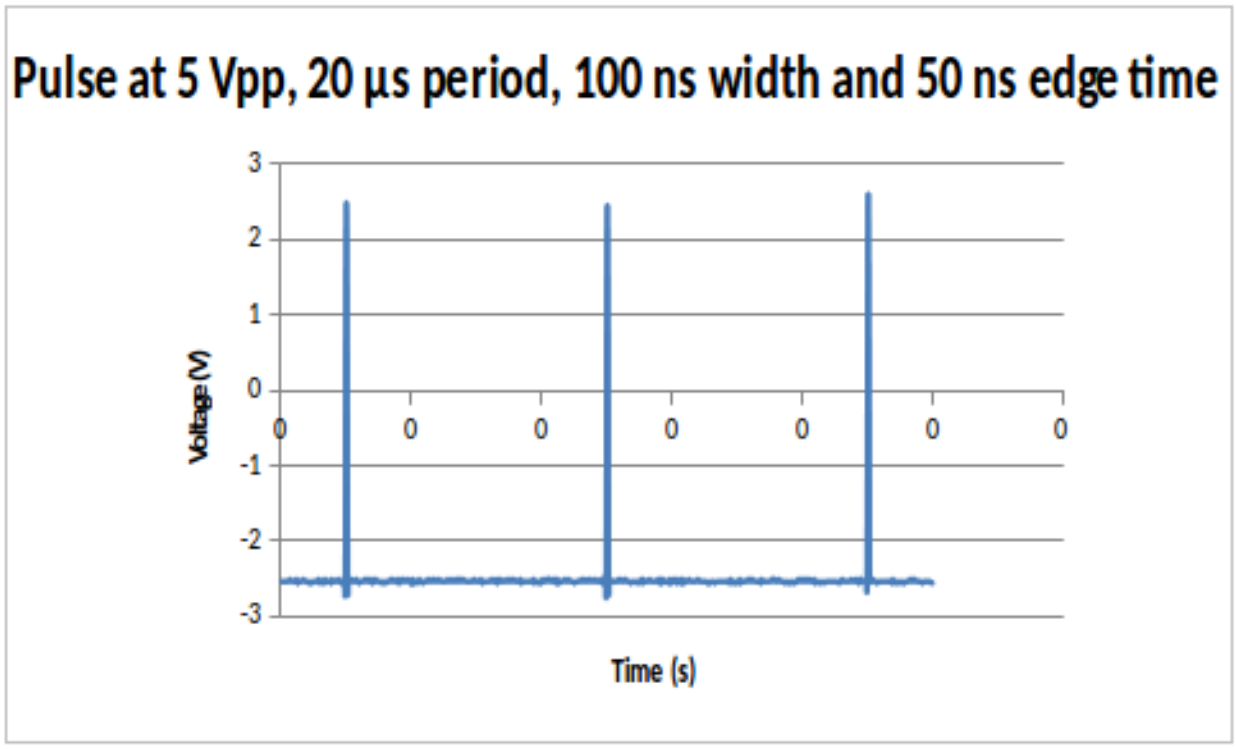

Ramp at 5 Vpp, 20 µs period, 25% Symmetry
Voltage (V)
3
2
1
0
-1
-2
-3
0
0
0
0
0
0
0
Time(s)

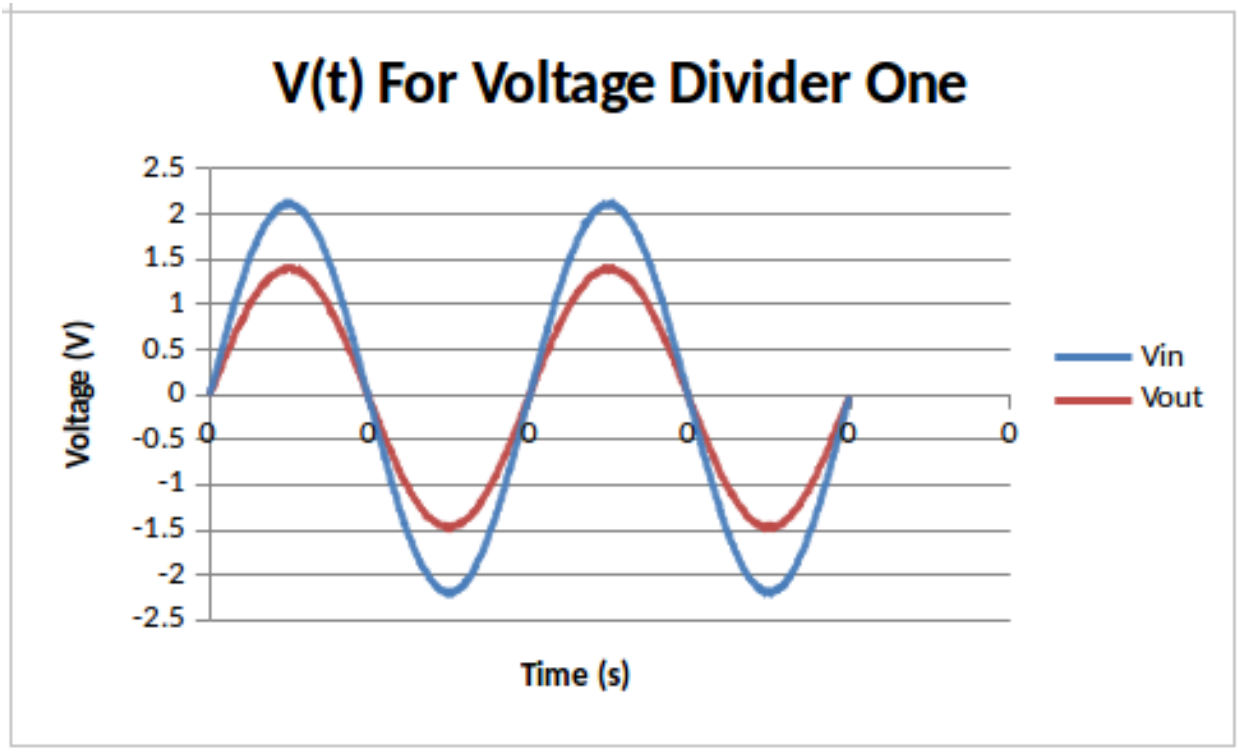
Pulse at 5 Vpp, 20 microsecond period 100 nanosecond width 10 nanosecond edge time

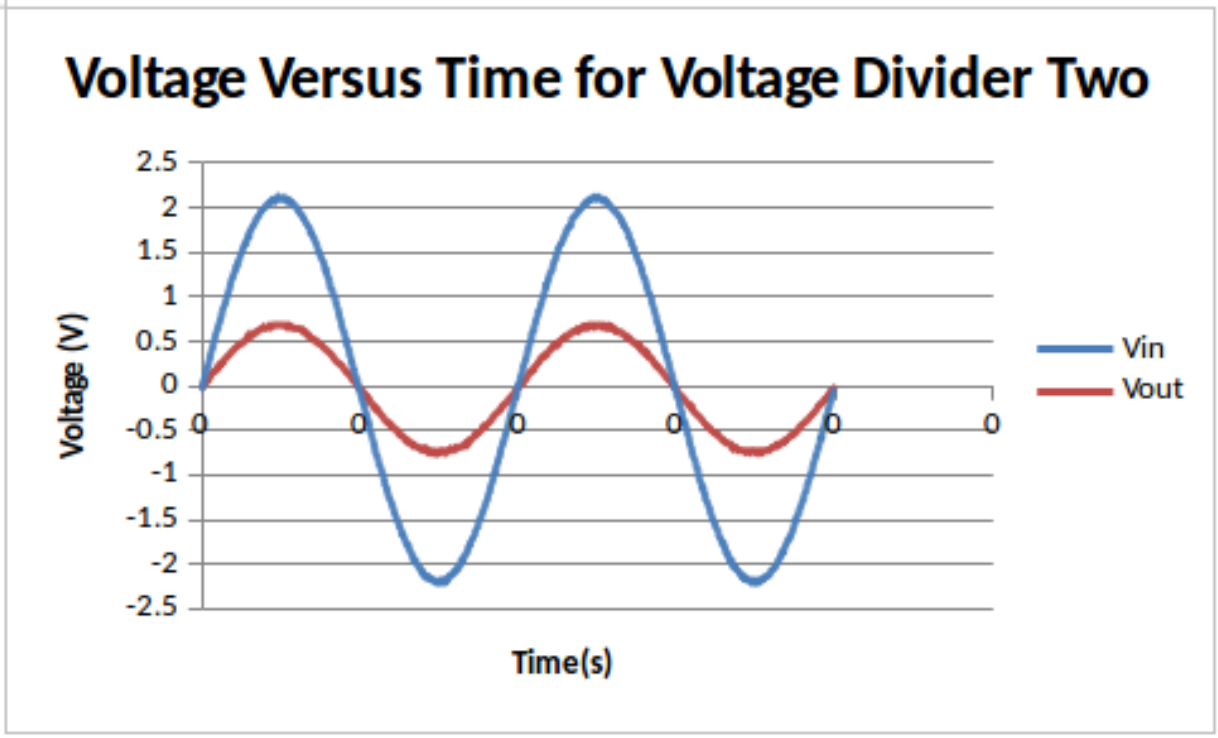


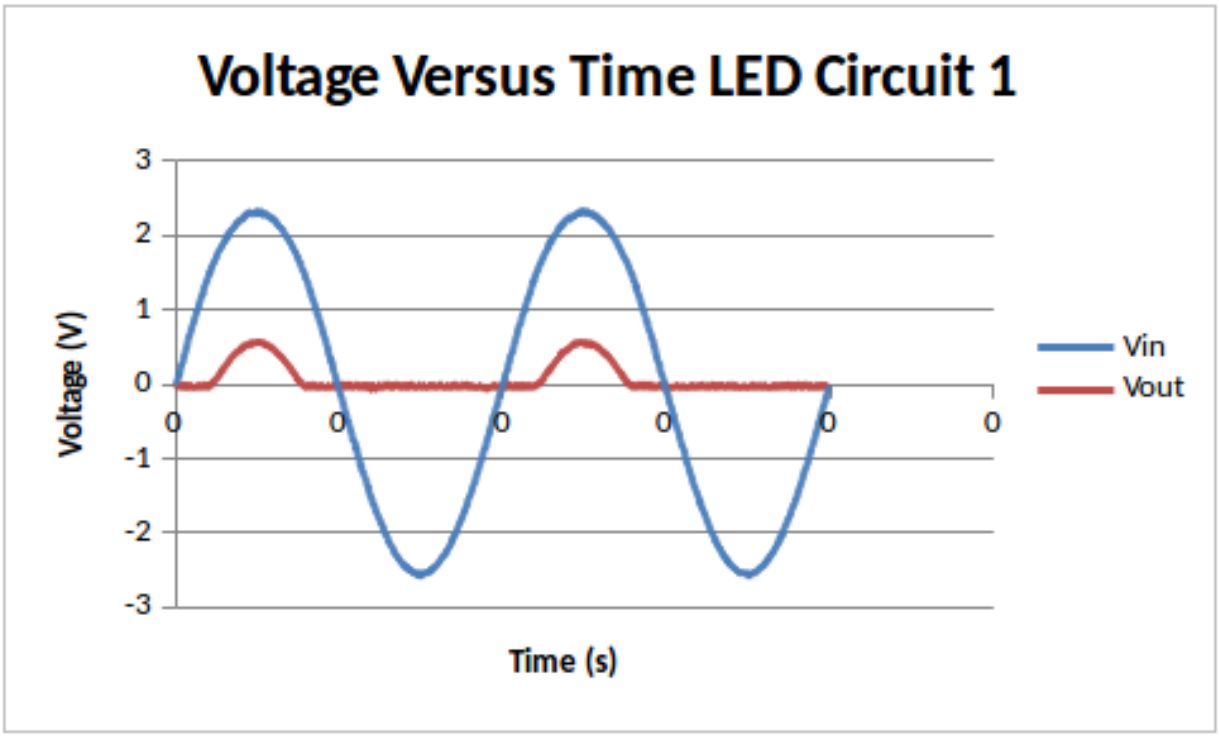
Pulse at 5 Vpp, 20 µs period 20 ns width, 50 ns 12.5 ns edge time

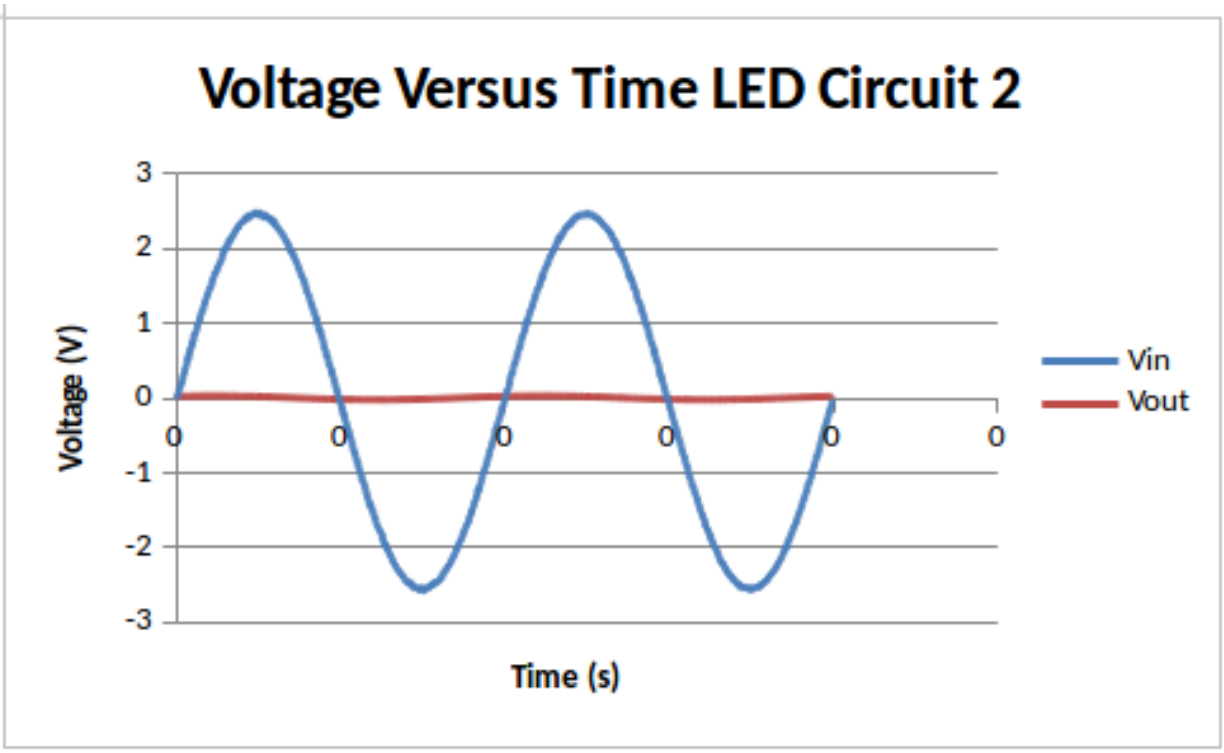


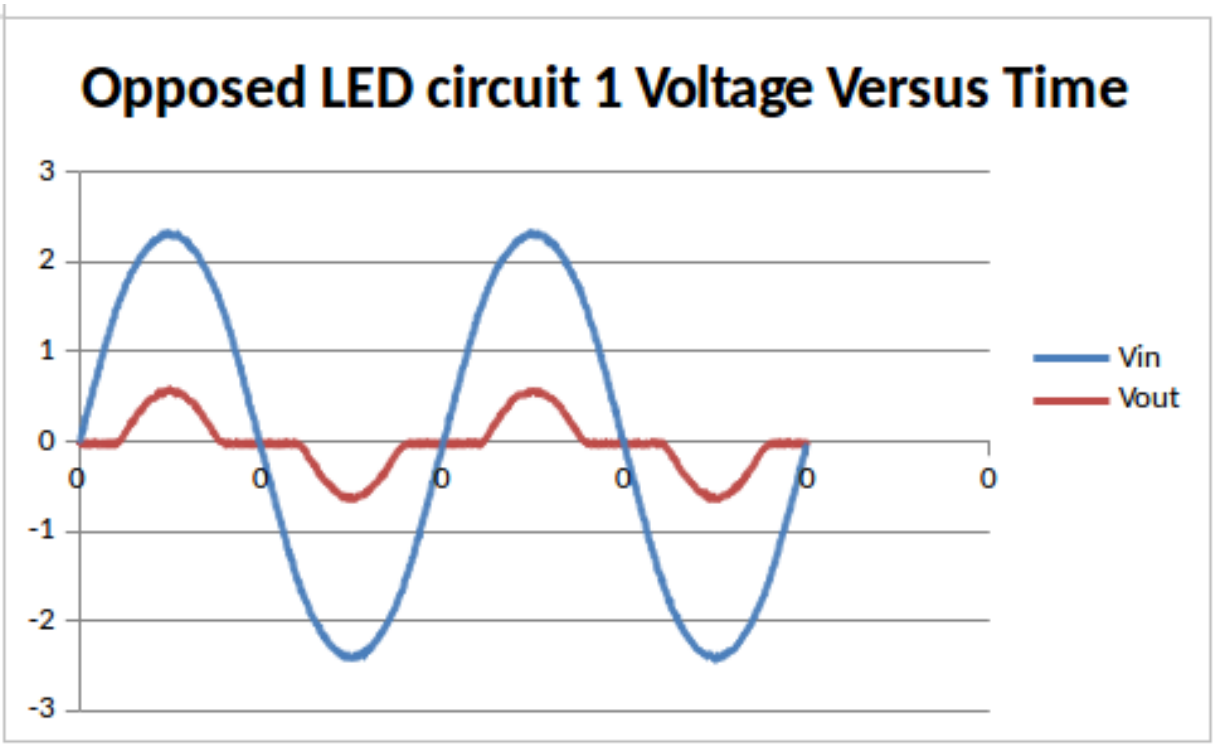

Pulse at 5 Vpp, 20 µs period, 100 ns width and 50 ns edge time
Voltage (V)
Time (s)

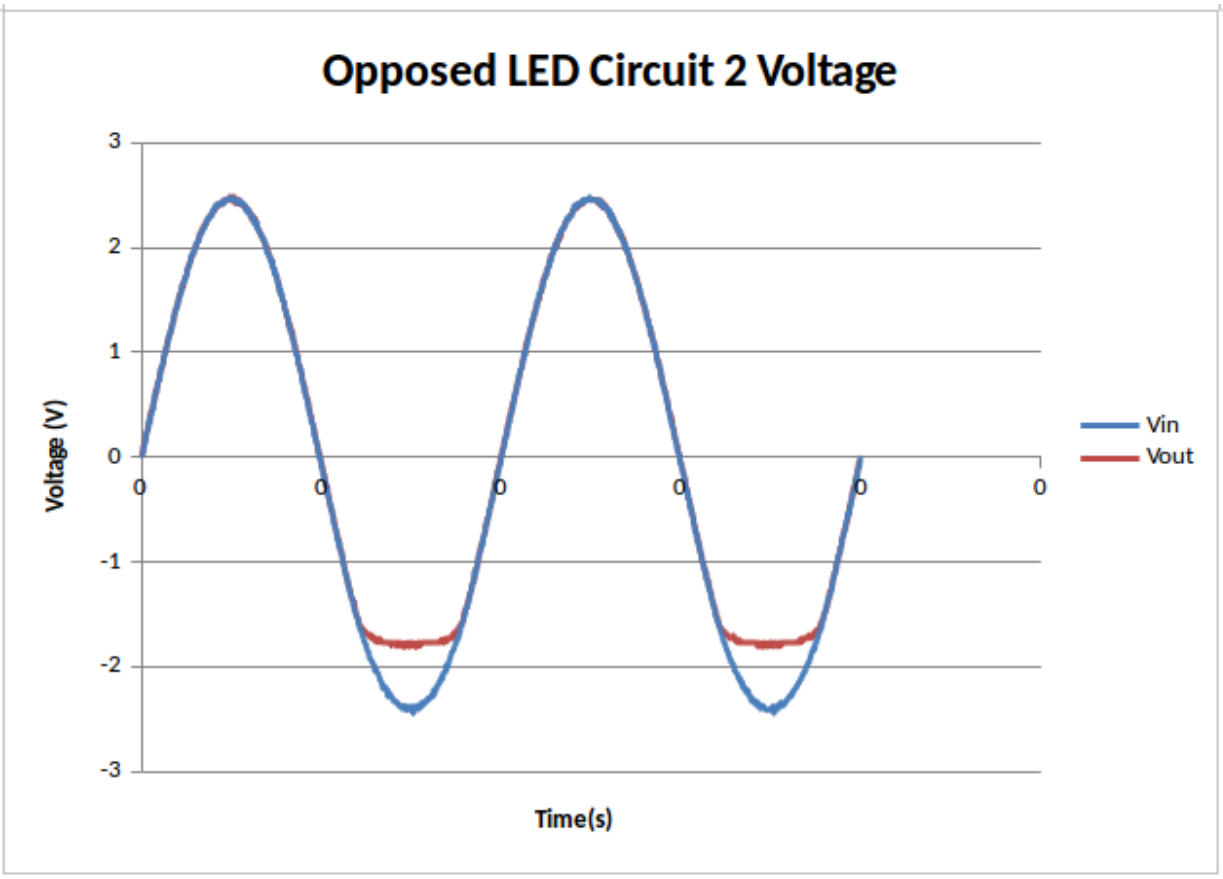

V(t) For Voltage Divider One
Voltage (V)
Time (s)
Vin
Vout

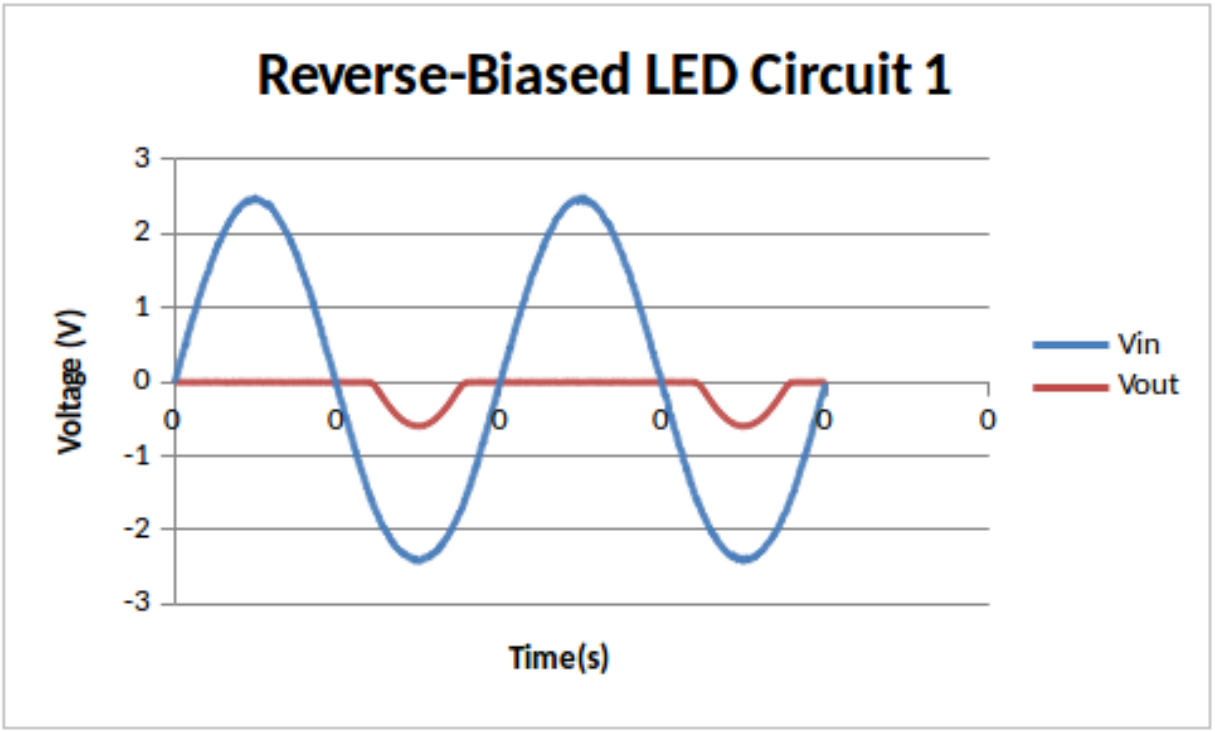

Voltage Versus Time for Voltage Divider Two
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
Voltage (V)
0
0
0
0
0
0
Time(s)
Vin
Vout


Voltage Versus Time LED Circuit 1
3
2
1
0
-1
-2
-3
Voltage (V)
0
0
0
0
0
0
Time (s)
Vin
Vout


Voltage Versus Time LED Circuit 2
Voltage (V)
3
2
1
0
-1
-2
-3
0
0
0
0
0
0
Time (s)
Vin
Vout


Opposed LED circuit 1 Voltage Versus Time
3
2
1
0
-1
-2
-3
0
0
0
0
0
0
Vin
Vout


Opposed LED Circuit 2 Voltage
Voltage (V)
3
2
1
0
-1
-2
-3
0
0
0
0
0
0
Time(s)
Vin
Vout


Reverse-Biased LED Circuit 1
Voltage (V)
3
2
1
0
-1
-2
-3
0
0
0
0
0
0
Time(s)
Vin
Vout

Post-Lab

I

	Fall Time (s)	**Rise Time (s)**
Calculated	5.9033×10^{-6}	5.9033×10^{-6}
Measured	5.8020×10^{-6}	5.8020×10^{-6}

$$PercentageError = \frac{|measured - calculated|}{calculated} = \frac{|5.8020 \times 10^{-6} - 5.9033 \times 10^{-6}|}{5.9033 \times 10^{-6}} = 1.7160\%$$

II

	$V_S(V)$	$V_{out}(V)$	**Voltage Ratio** V_S/V_{out}	**Theoretical Ratio**	**Percentage Error**
Circuit 1	4.50	2.93	0.67	0.6511	2.33%
Circuit 2	4.50	1.47	0.33	0.3267	2.00%

III

$V_S(V)$	$V_{out}(V)$	$V_{Offset}(V)$
0	0.12	n/a
1	0.12	n/a
2	0.12	n/a
3	0.12	n/a
4	0.32	1.840
5	0.68	2.160
6	1.05	2.475

The measured values seem quite far from our calculated offset voltage.

$$PercentageError = \frac{|measured - calculated|}{calculated} = \frac{|2.475 - 4.24|}{4.24} = 41.6274\%$$

Since the diode will only allow current to flow through it if the current has a voltage larger than the forward voltage of the diode, and because it only allows current to flow one way, the current passing through will be DC.

IV

	$V_S(V)$	$V_{out}(V)$
Circuit 1	5.100	0.620
Circuit 2	5.100	4.400

Because the LED only allows current to flow through it if the current has a voltage larger than the forward voltage of the diode, and because it only allows current to flow one way, the LED does not allow current through in the first circuit, but does in the second circuit.

V

	$V_S(V)$	$V_{out}(V)$
Circuit 1	4.82	1.25
Circuit 2	4.90	1.78

VI

	$V_S(V)$	$V_{out}(V)$	$MeasuredV_{offset}(V)$	$TheoreticalV_{offset}(V)$	**Percentage Error**
Circuit 1	4.82	1.25	1.785	1.7	5.00%
Circuit 2	4.90	1.78	1.560	1.7	8.24%

This does match our expectations because it is within 10% of our theoretical values.