Assignment 2

EECS Lab 1 (ECS 327)

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Theory: RMS (Root Mean Square) value of an AC wave is the mean of the root of the square of the voltages at different instants. For an ac wave it will be 1/√2 times the peak value.

RESISTANCE (R1 IN Ω)	LOAD RESISTANCE (R2 IN Ω)	INDUCTANCE (L1)	TIME CONSTANT	OUTPUT @1TC (V_{RMS})	OUTPUT @5TC (V_{RMS})	V(n002) in V	V(n001)or V_{max} in V
100	100	1mH	5×10^{-6} s	77.463 mV	289.4 mV	2.498	5
100	200	1mH	3.3×10^{-6} s	54.074 mV	227.29 mV	3.326	5
100	300	1mH	2.5×10^{-6} s	42.032 mV	185.69 mV	3.742	5

We define V_{RMS} as , Root Mean Square Velocity to be :

$$V_{RMS} = \sqrt{(V_L)^2 + (V_R)^2}$$

Where V_L is the Voltage across the inductor L1 and V_R is the voltage across the net Resistance R. In this assignment we have two resistors, R1 and R2 in series, so the net resistance, R = R1 + R2 in each case.

To calculate the RMS value for each circuit, we use the relation between maximum voltage or peak voltage , i.e V_{max} or V(n001) obtained from LTSpice :

$$V_{max} = \sqrt{2} * V_{RMS}$$

CASE 1:
R1=100Ω ; R2 = 100Ω ; L1= 1mH

V_{RMS} = V(n002)/√2
=2.498/1.414
=**1.766V**

CASE 2:
R1=100Ω ; R2 = 200Ω ; L1= 1mH

V_{RMS} = V(n002)/√2
=3.326/1.414
=**2.351V**

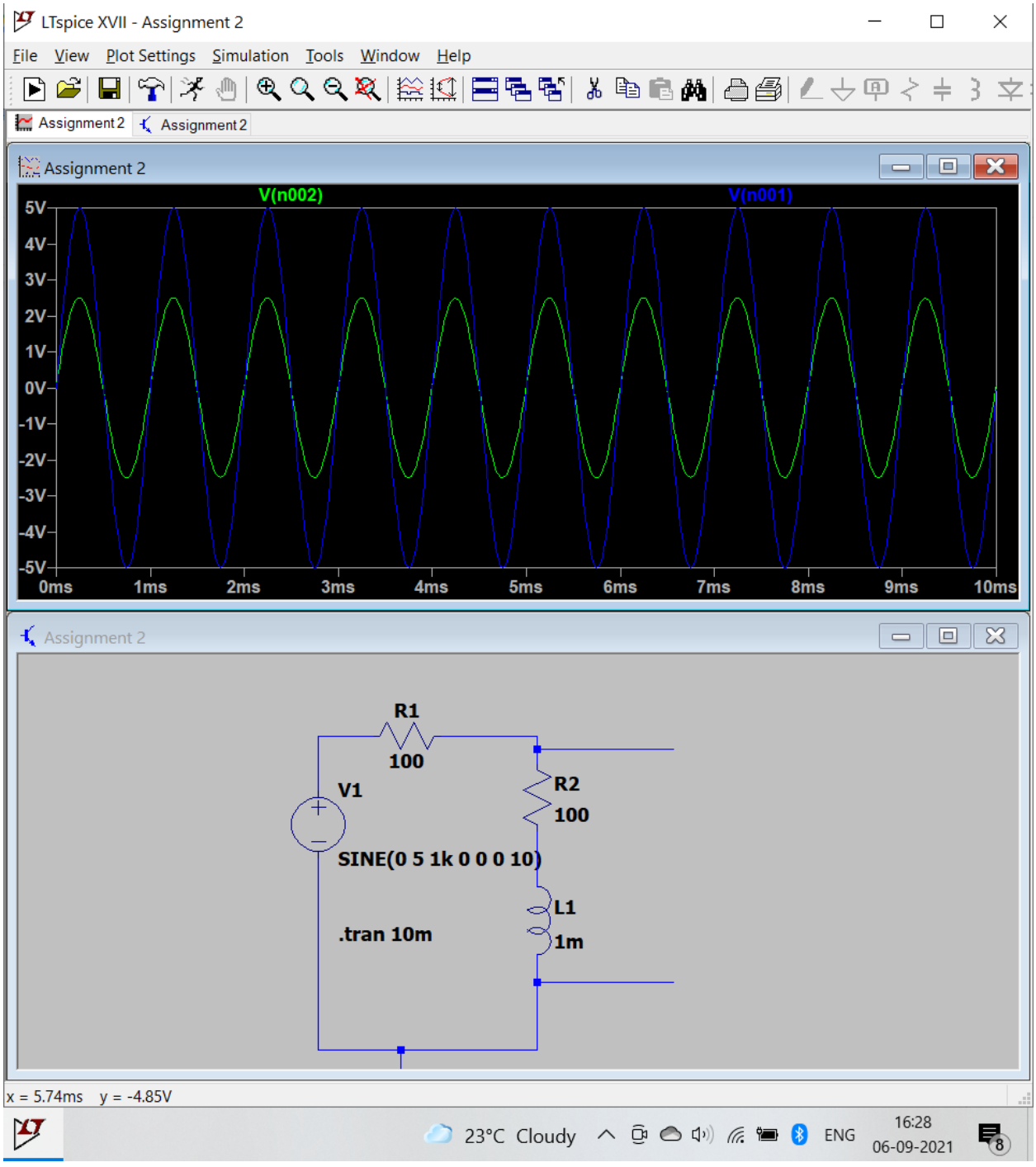
CASE 3:
R1=100Ω ; R2 = 300Ω ; L1= 1mH

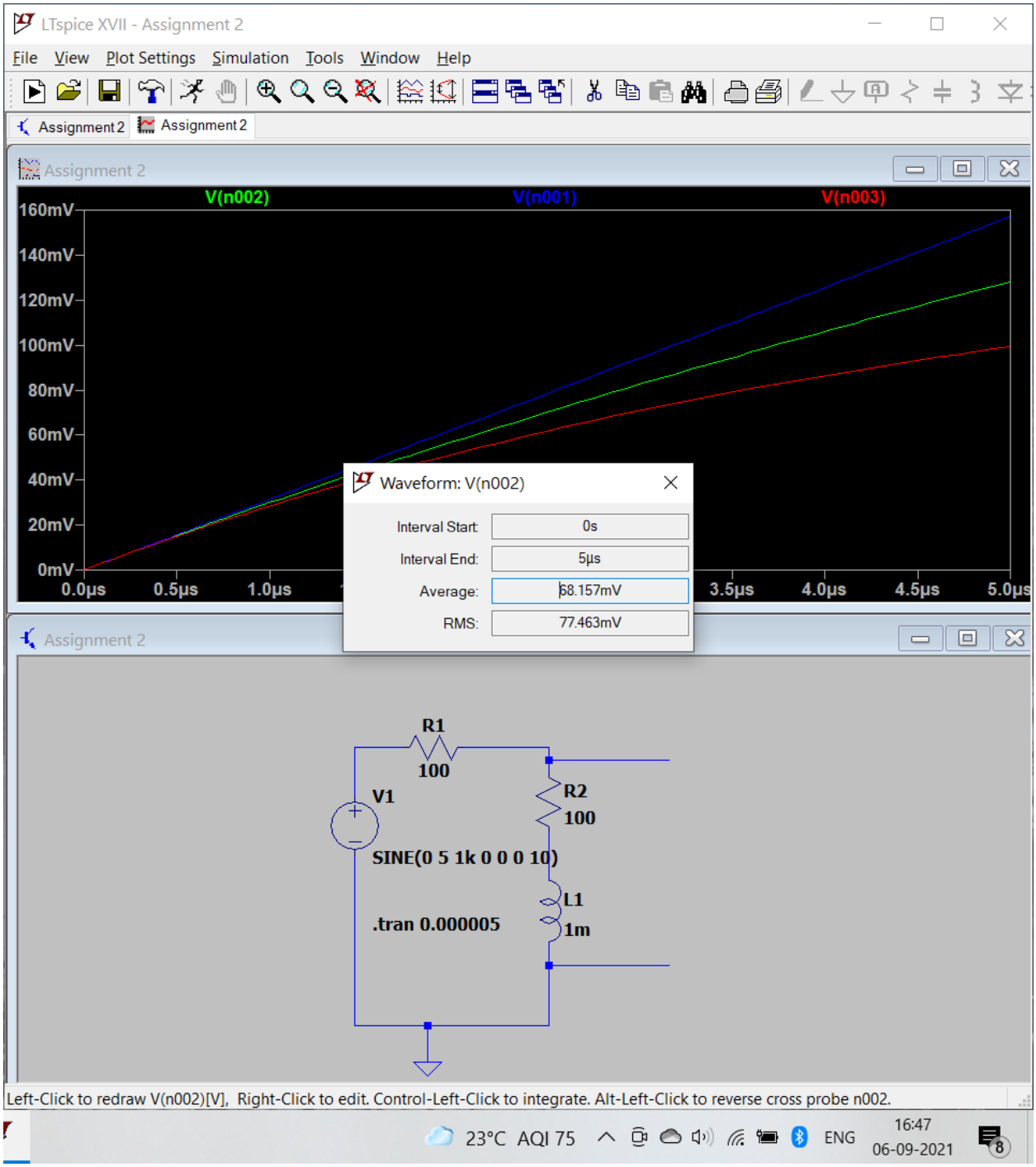
V_{RMS} = V(n002)/√2
=3.742/1.414
=**2.645V**

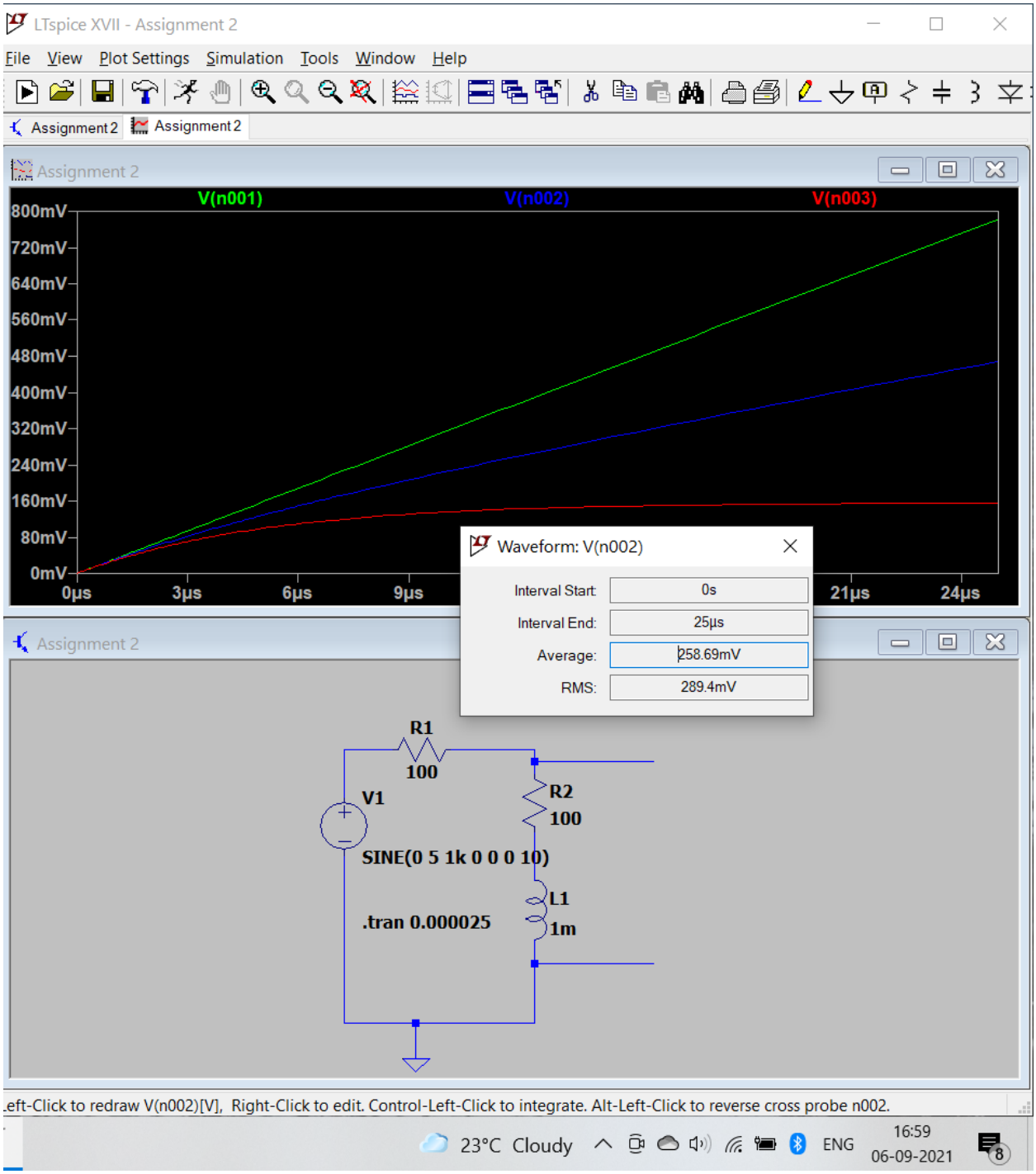
The other outputs for V_{RMS} at 1TC and 5TC were obtained from the LTspice labels, the screenshots of the output waveforms and the associated values have been pasted below here:

Hence the calculated values of RMS tally with the RMS values obtained from LTSpice with a very small error margin.

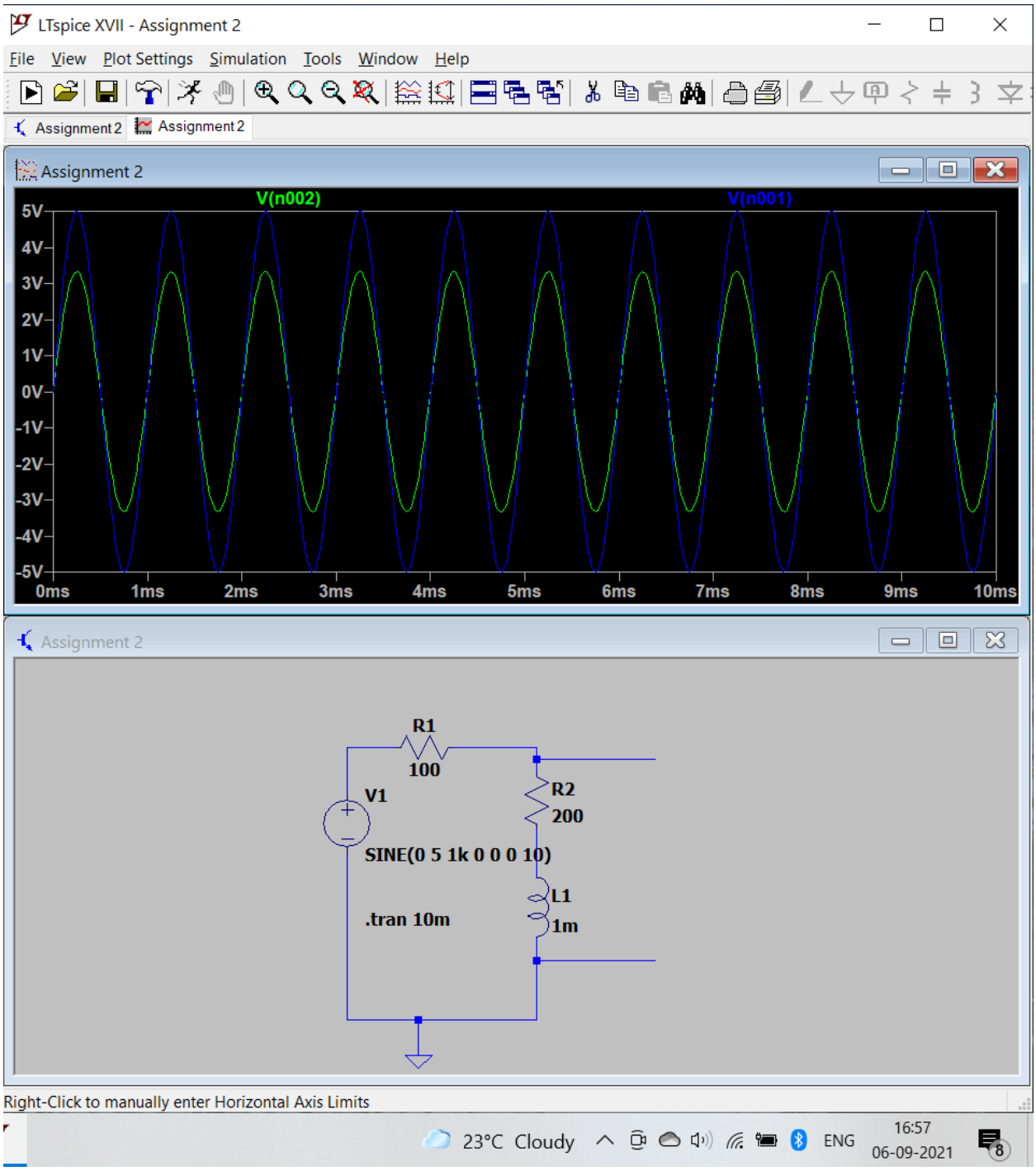
CASE 1:

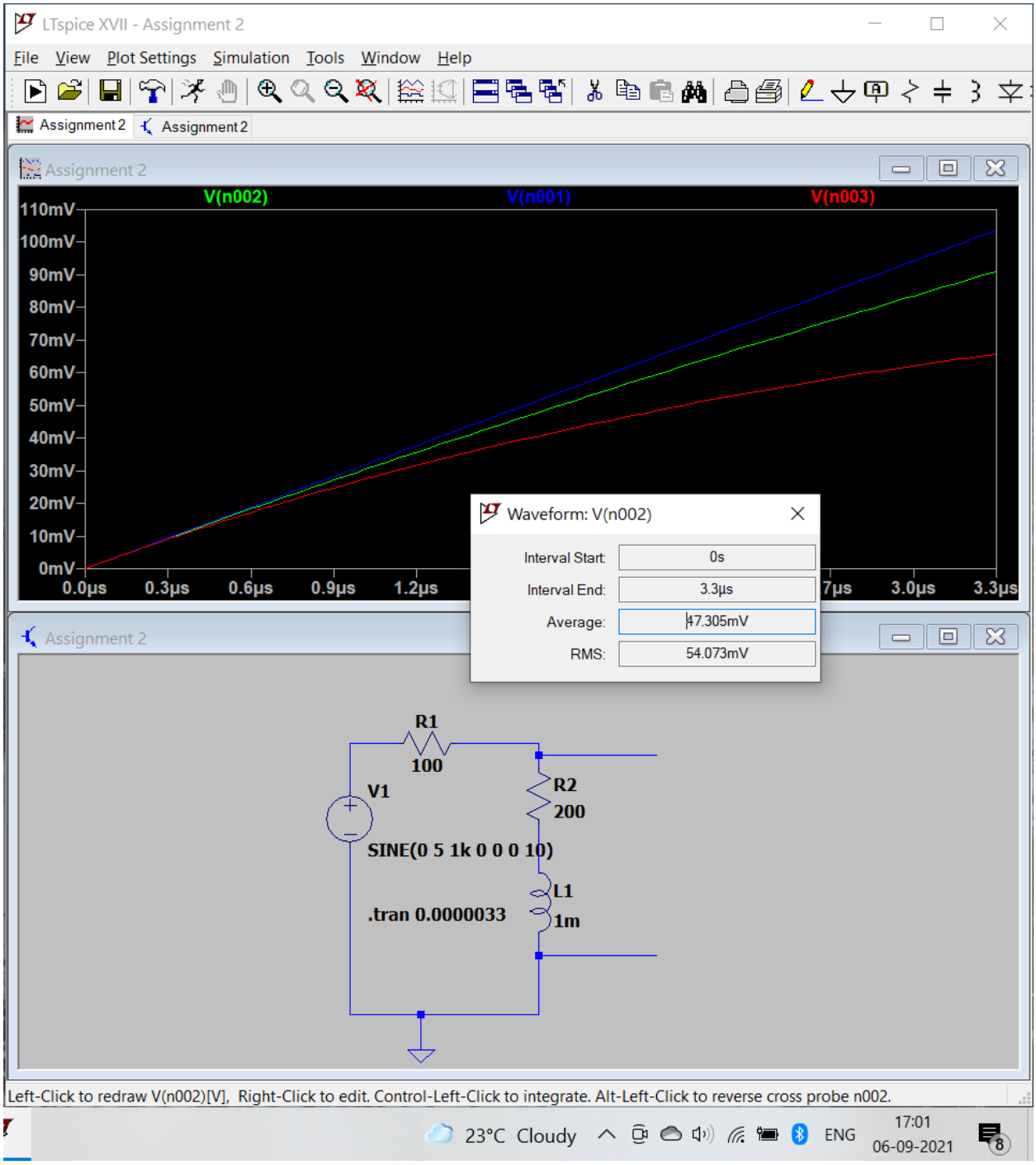

LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
Assignment 2
V(n002)
V(n001)
5V
4V
3V
2V
1V
0V
-1V
-2V
-3V
-4V
-5V
0ms 1ms 2ms 3ms 4ms 5ms 6ms 7ms 8ms 9ms 10ms
Assignment 2
R1
100
V1
R2
100
SINE(0 5 1k 0 0 0 10)
L1
1m
.tran 10m
x = 5.74ms y = -4.85V
23°C Cloudy
ENG
16:28
06-09-2021

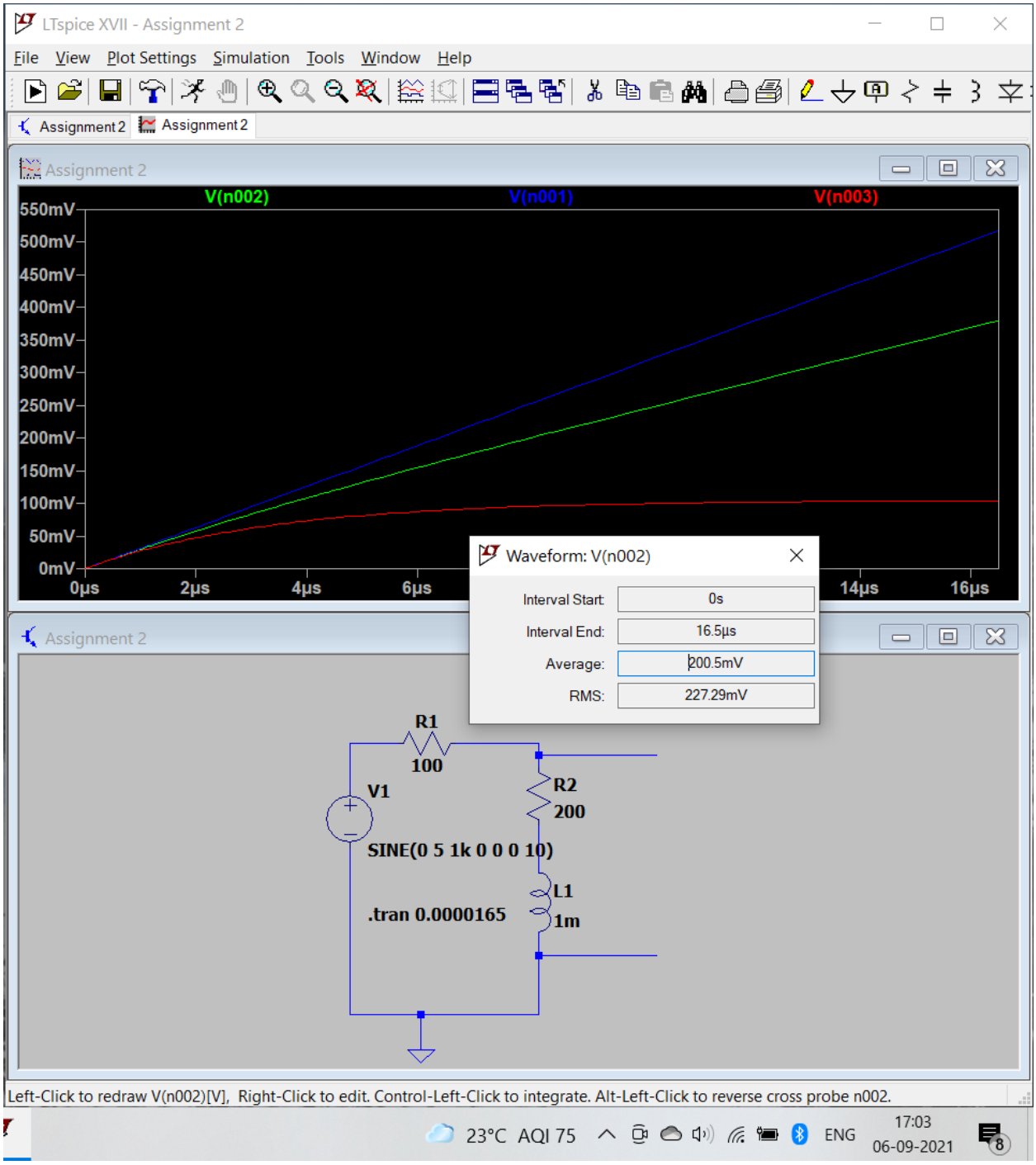

LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
V(n002)
V(n001)
V(n003)
160mV
140mV
120mV
100mV
80mV
60mV
40mV
20mV
0mV
0.0µs
0.5µs
1.0µs
3.5µs
4.0µs
4.5µs
5.0µs
Waveform: V(n002)
Interval Start: 0s
Interval End: 5µs
Average: 68.157mV
RMS: 77.463mV
R1
100
V1
R2
100
SINE(0 5 1k 0 0 0 10)
L1
1m
.tran 0.000005
Left-Click to redraw V(n002)[V], Right-Click to edit. Control-Left-Click to integrate. Alt-Left-Click to reverse cross probe n002.
23°C AQI 75
ENG
16:47
06-09-2021


LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
Assignment 2
V(n001)
V(n002)
V(n003)
800mV
720mV
640mV
560mV
480mV
400mV
320mV
240mV
160mV
80mV
0mV
0µs
3µs
6µs
9µs
21µs
24µs
Waveform: V(n002)
Interval Start: 0s
Interval End: 25µs
Average: 258.69mV
RMS: 289.4mV
Assignment 2
R1
100
V1
SINE(0 5 1k 0 0 0 10)
.tran 0.000025
R2
100
L1
1m
eft-Click to redraw V(n002)[V], Right-Click to edit. Control-Left-Click to integrate. Alt-Left-Click to reverse cross probe n002.
23°C Cloudy
ENG
16:59
06-09-2021

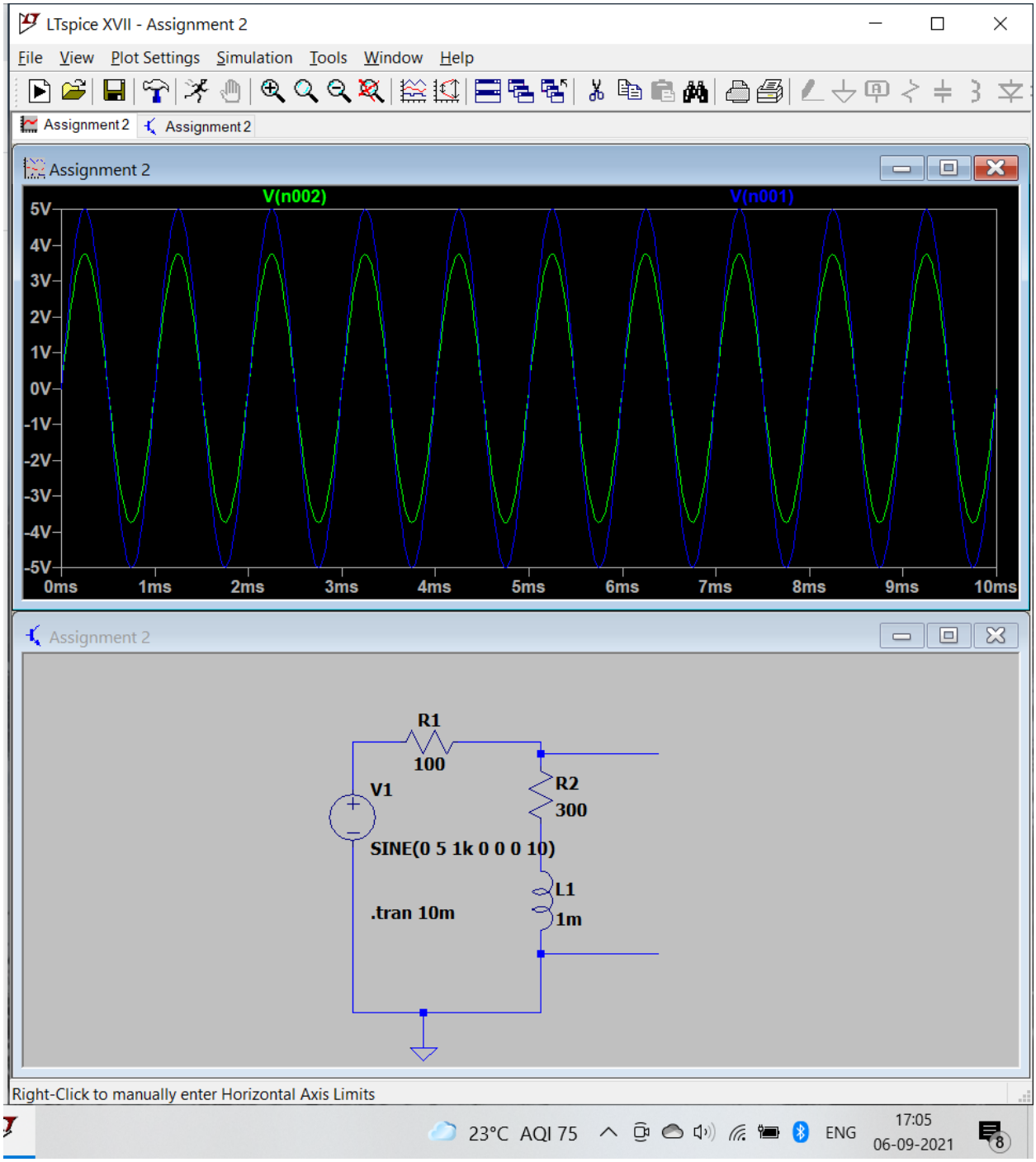
CASE 2:

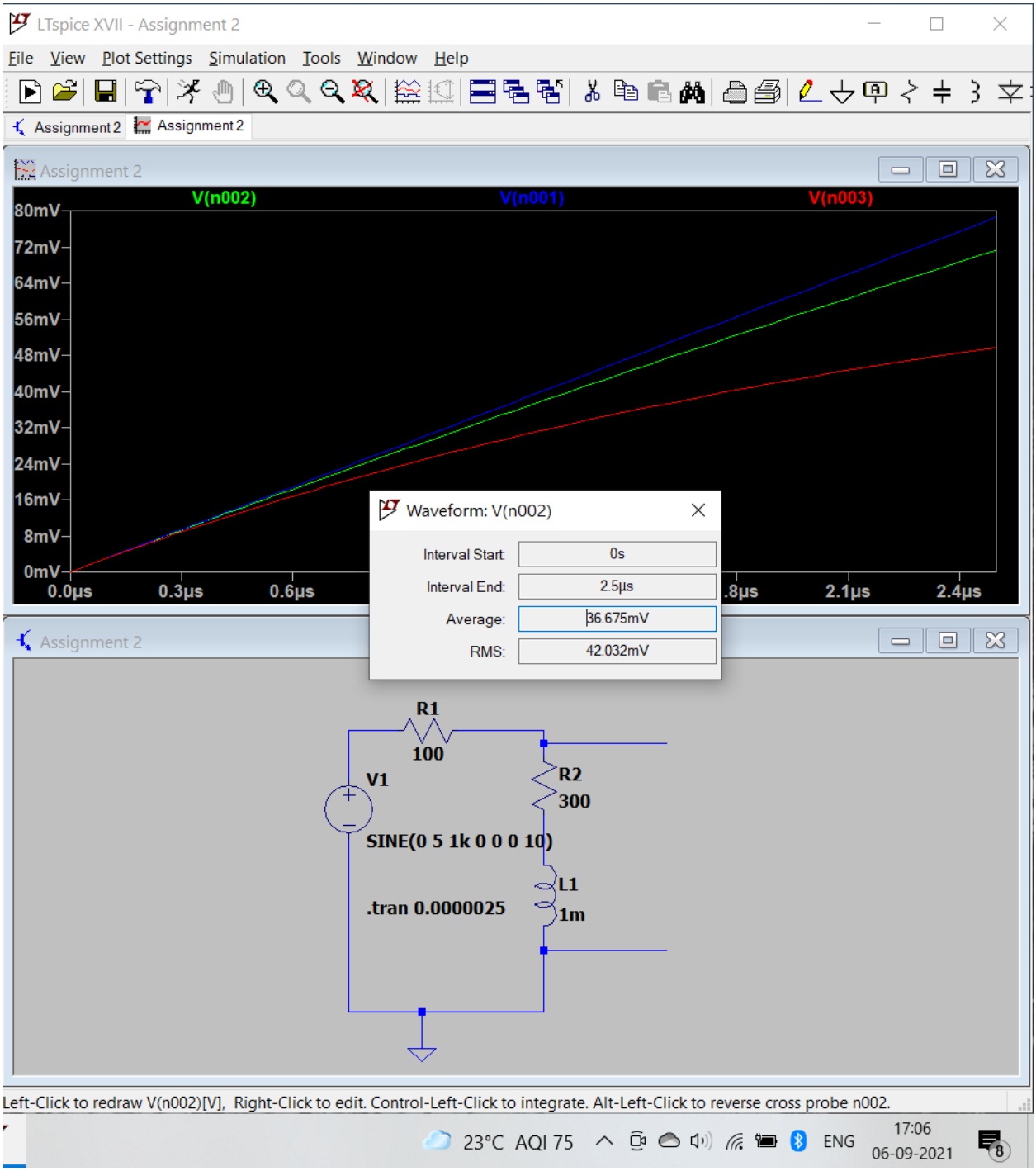

LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
Assignment 2
V(n002)
V(n001)
5V
4V
3V
2V
1V
0V
-1V
-2V
-3V
-4V
-5V
0ms 1ms 2ms 3ms 4ms 5ms 6ms 7ms 8ms 9ms 10ms
Assignment 2
R1
100
V1
R2
200
SINE(0 5 1k 0 0 0 10)
L1
1m
.tran 10m
Right-Click to manually enter Horizontal Axis Limits
23°C Cloudy
ENG
16:57
06-09-2021

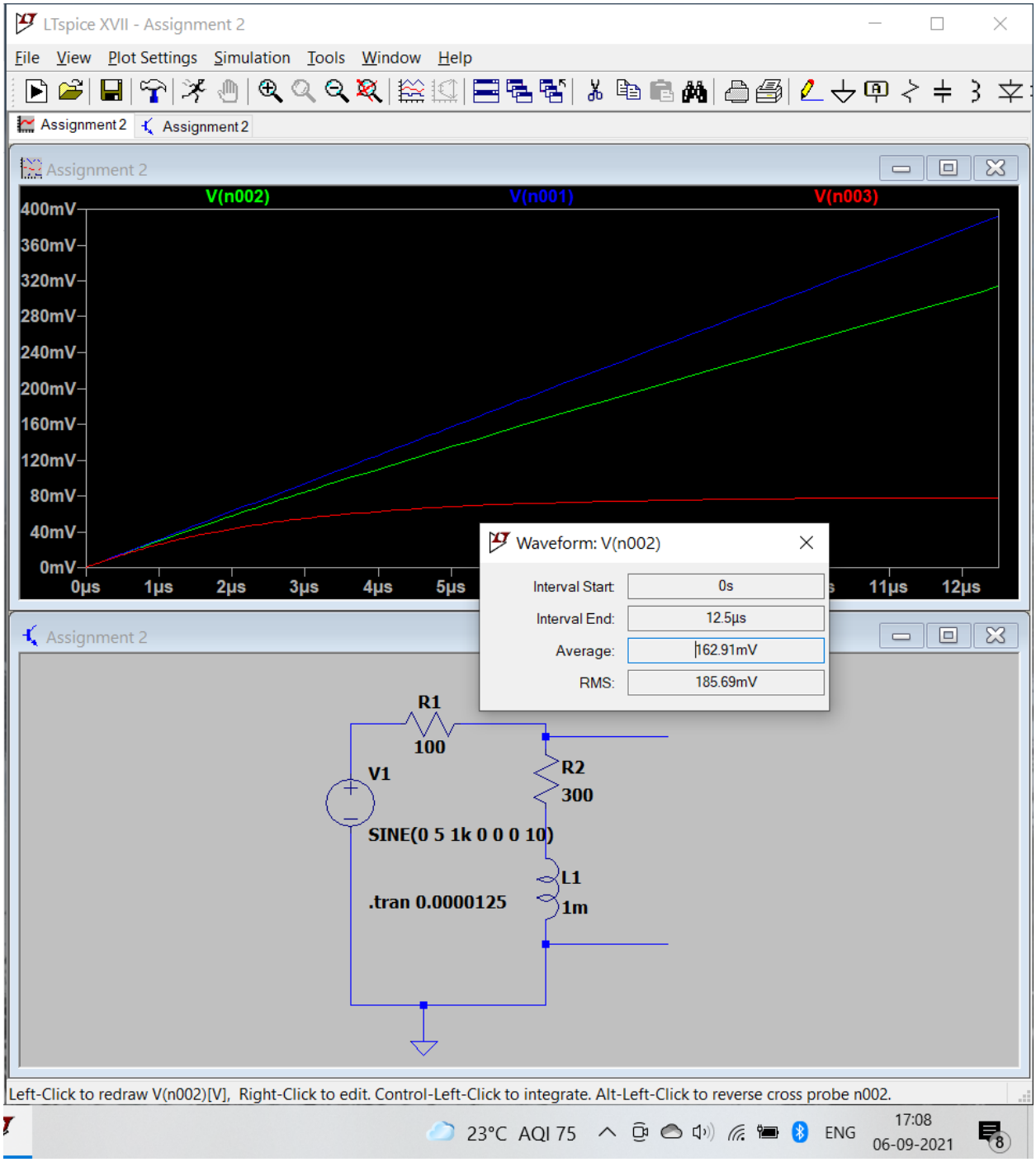

LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
Assignment 2
V(n002)
V(n001)
V(n003)
110mV
100mV
90mV
80mV
70mV
60mV
50mV
40mV
30mV
20mV
10mV
0mV
0.0µs
0.3µs
0.6µs
0.9µs
1.2µs
3.0µs
3.3µs
Waveform: V(n002)
Interval Start: 0s
Interval End: 3.3µs
Average: 47.305mV
RMS: 54.073mV
Assignment 2
R1
100
V1
R2
200
SINE(0 5 1k 0 0 0 10)
L1
1m
.tran 0.0000033
Left-Click to redraw V(n002)[V], Right-Click to edit. Control-Left-Click to integrate. Alt-Left-Click to reverse cross probe n002.
23°C Cloudy
ENG
17:01
06-09-2021


LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
Assignment 2
V(n002)
V(n001)
V(n003)
550mV
500mV
450mV
400mV
350mV
300mV
250mV
200mV
150mV
100mV
50mV
0mV
0µs
2µs
4µs
6µs
14µs
16µs
Waveform: V(n002)
Interval Start: 0s
Interval End: 16.5µs
Average: 200.5mV
RMS: 227.29mV
Assignment 2
R1
100
V1
R2
200
SINE(0 5 1k 0 0 0 10)
L1
1m
.tran 0.0000165
Left-Click to redraw V(n002)[V], Right-Click to edit. Control-Left-Click to integrate. Alt-Left-Click to reverse cross probe n002.
23°C AQI 75
ENG
17:03
06-09-2021

Case 3:


LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
Assignment 2
V(n002)
V(n001)
5V
4V
3V
2V
1V
0V
-1V
-2V
-3V
-4V
-5V
0ms 1ms 2ms 3ms 4ms 5ms 6ms 7ms 8ms 9ms 10ms
Assignment 2
R1
100
V1
R2
300
SINE(0 5 1k 0 0 0 10)
L1
1m
.tran 10m
Right-Click to manually enter Horizontal Axis Limits
23°C AQI 75
ENG
17:05
06-09-2021


LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
Assignment 2
V(n002)
V(n001)
V(n003)
80mV
72mV
64mV
56mV
48mV
40mV
32mV
24mV
16mV
8mV
0mV
0.0µs
0.3µs
0.6µs
2.1µs
2.4µs
Waveform: V(n002)
Interval Start: 0s
Interval End: 2.5µs
Average: 36.675mV
RMS: 42.032mV
Assignment 2
R1
100
V1
R2
300
SINE(0 5 1k 0 0 0 10)
L1
1m
.tran 0.0000025
Left-Click to redraw V(n002)[V], Right-Click to edit. Control-Left-Click to integrate. Alt-Left-Click to reverse cross probe n002.
23°C AQI 75
ENG
17:06
06-09-2021


LTspice XVII - Assignment 2
File View Plot Settings Simulation Tools Window Help
Assignment 2
Assignment 2
Assignment 2
V(n002)
V(n001)
V(n003)
400mV
360mV
320mV
280mV
240mV
200mV
160mV
120mV
80mV
40mV
0mV
0µs
1µs
2µs
3µs
4µs
5µs
11µs
12µs
Waveform: V(n002)
Interval Start: 0s
Interval End: 12.5µs
Average: 162.91mV
RMS: 185.69mV
Assignment 2
R1
100
V1
R2
300
SINE(0 5 1k 0 0 0 10)
L1
1m
.tran 0.0000125
Left-Click to redraw V(n002)[V], Right-Click to edit. Control-Left-Click to integrate. Alt-Left-Click to reverse cross probe n002.
23°C AQI 75
ENG
17:08
06-09-2021