Circuits and Electronic Laboratory

Experiment #6

Purpose of Experiment

In this experiment we will see how diodes work. Learn more about AC/DC and rectifiers.

General Information

Alternating current (AC) is an electric current which periodically reverses direction, in contrast to direct current (DC) which flows only in one direc- tion. Alternating current is the form in which electric power is delivered to businesses and residences, and it is the form of electrical energy that consumers typically use when they plug kitchen appliances, televisions, fans and electric lamps into a wall socket. A common source of DC power is a battery cell in a flashlight. The abbreviations AC and DC are often used to mean simply alternating and direct, as when they modify current or voltage.

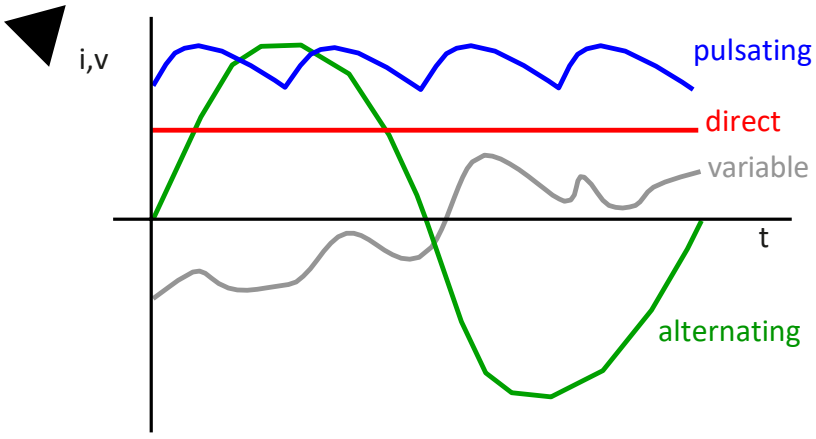


Figure 1: Types of Current Sources

A diode is an electronic component that allows one directional current flow only. Using this property a lot of useful applications such as rectifiers, clippers/clappers, voltage multipliers, etc. can be realized.

Rectifiers are AC-DC converters. They provide time varying but unidirec- tional current at their output. Capacitors are generally used with rectifiers to filter the time varying output of them and obtain a smooth signal instead.

Part List

- $R_1 = 12K$
- $D_1 = 4.7V$ Zener Diode for circut 1
- D_1 1N4001 Diode for circuit 2

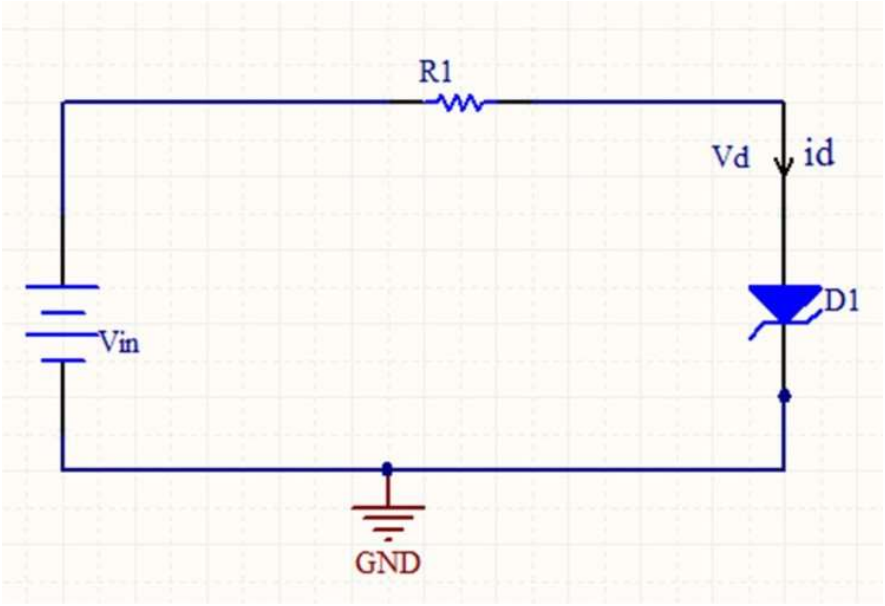
Preparations Before Experiment

- Make research about AC and DC current sources.
- What is a diode? What does it do on a circuit?
- Make research about rectifiers.
- Construct the circuit given in Figure 1 on a simulation program.
- Vary V_{in} on the simulation tool according to the values in the first row of Table 1 and record the voltage across the diode and the current passing through the diode on Table 1 to $Calculated$ rows.

Section 1

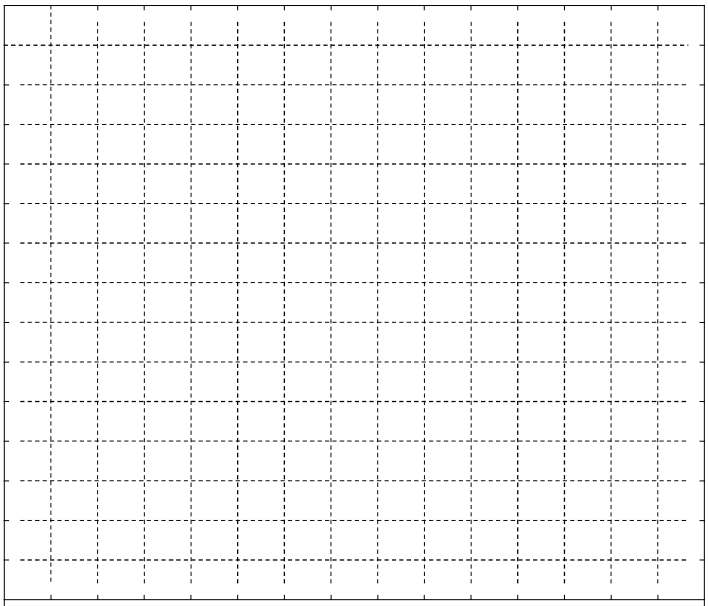
- Construct the circuit depicted in Figure 1 on the board. Be aware that the diode in the circuit is a zener diode.
- Vary V_{in} according to the values in the first row of Table 1 and record the voltage across the diode and the current passing through the diode on Table 1 on measured row.
- Using the data in the 2nd and the 3rd rows of table 1, plot the characteristic curve of the zener diode.

Figure 2: Circuit 1



$V_{in}(V)$	-12	-11	-10	-9	-8	-7	0	0.6	0.65	0.7	0.75	0.8	0.85	0.9
$V_d(V)$ Calculated	-9.782	-9.711	-9.57	-8.995V	-8V	-7V	3.144e^-33	0.277	0.281	0.284	0.286	0.289	0.291	0.293
$I_d(A)$ Calculated	-184.853uA	-107.377uA	-35.865uA	-422.215nA	-880.181pA	-676.792pA	-2.62e^-37A	26.912uA	30.788uA	34.697uA	38.632uA	42.589uA	46.563uA	50.552uA
$V_d(V)$ Measured	-9.782	-9.711	-9.57	-8.995V	-8V	-7V	3.144e^-33	0.277	0.281	0.284	0.286	0.289	0.291	0.293
$I_d(A)$ Measured	-184.853uA	-107.377uA	-35.865uA	-422.215nA	-880.181pA	-676.792pA	-2.62e^-37A	26.912uA	30.788uA	34.697uA	38.632uA	42.589uA	46.563uA	50.552uA

Table 1

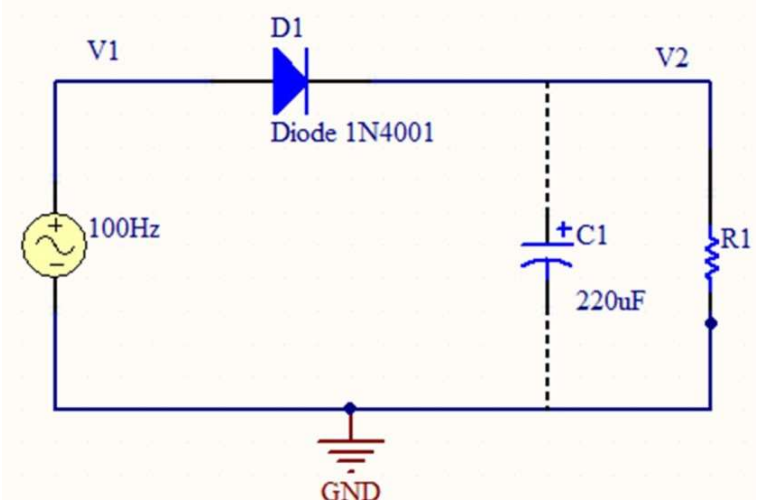


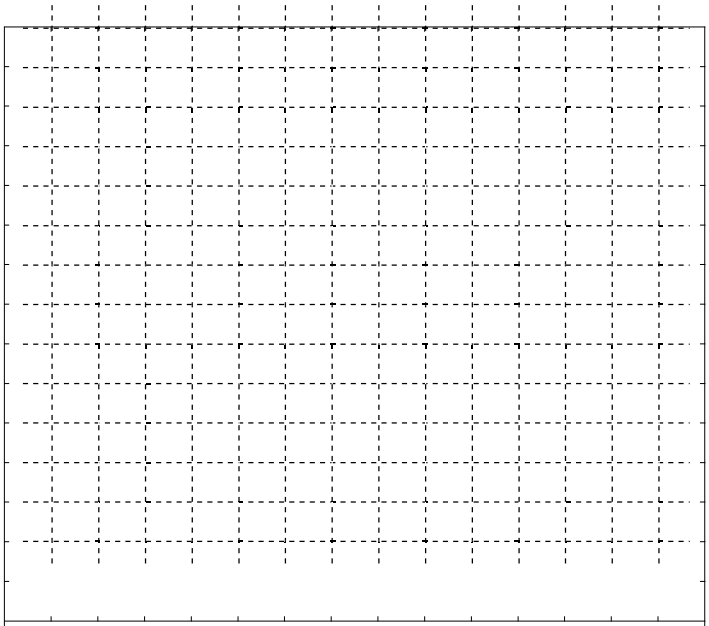
Characteristic Curve using Experimental Data

Section 2

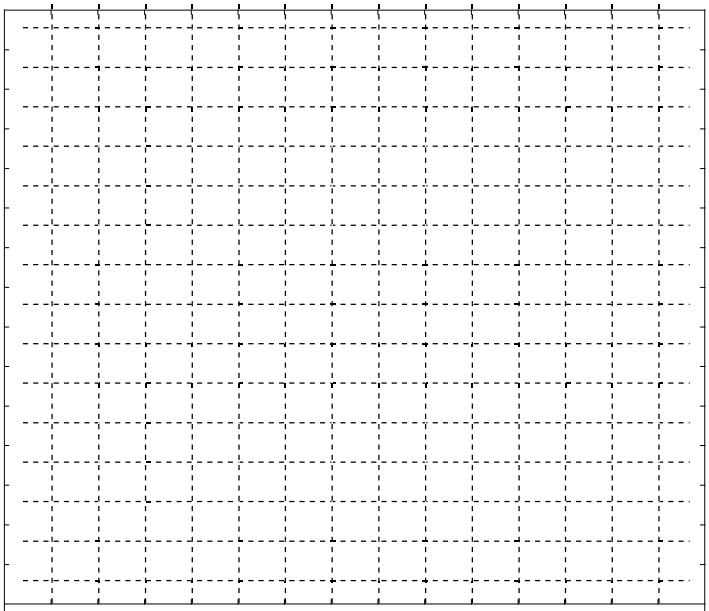
- Construct the circuit given in Figure 2 without connecting the capaci- tor. Use a function generator to supply source voltage.
- Use a scope to observe the voltage signal on V_1 (with respect to the ground) and V_2 (with respect to the ground); connect V_1 to the 1st channel and V2 to the 2nd channel of the scope. Choose the same volts/div value for both channels. Record volts/div and time/div val- ues. Plot the observed graph.
- Connect C_1 to the circuit and repeat step 2.
- Calculate the effective value of V_1. $V\,eff$ = .1.41

Figure 3: Half-Wave Rectifier

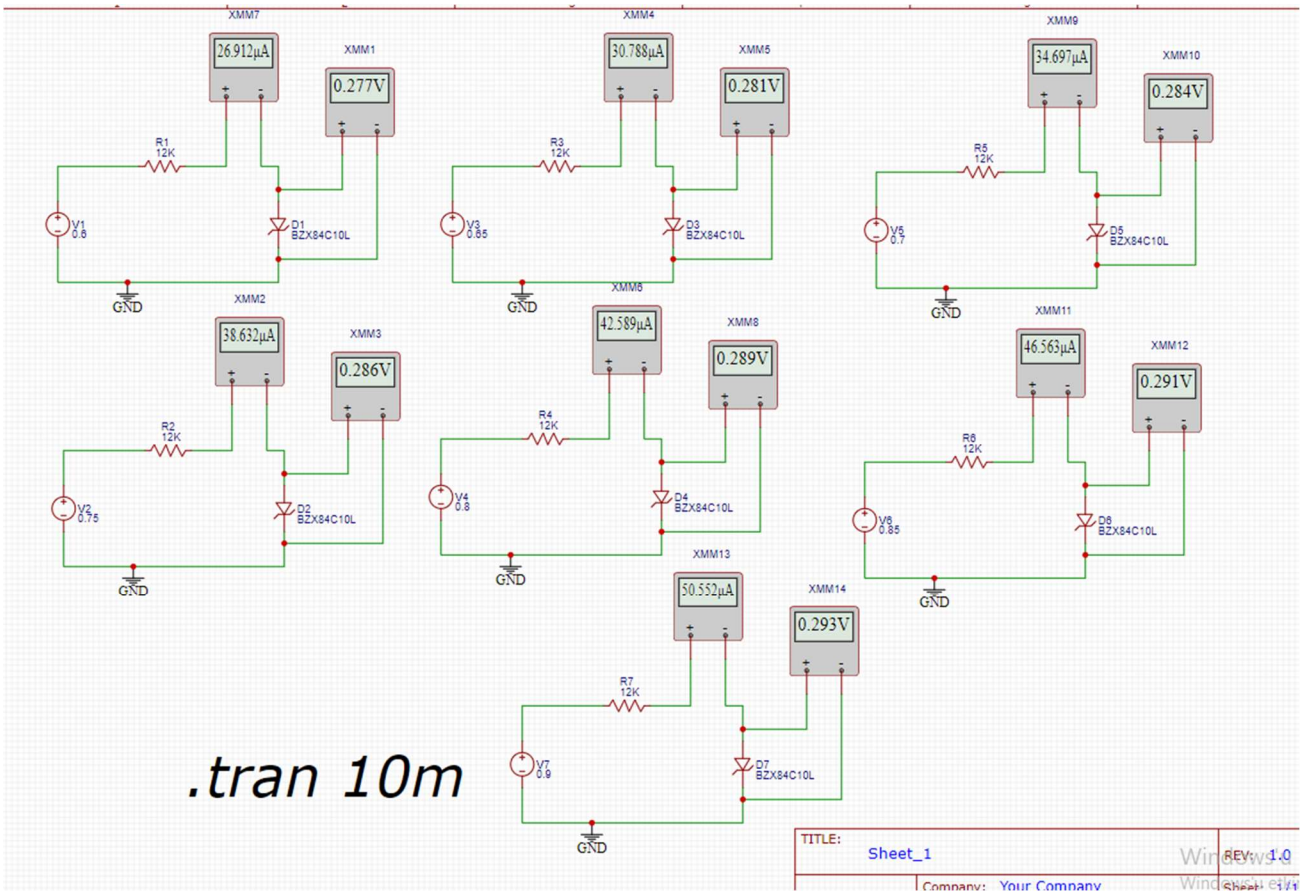




V_2 Plot without C_1 using Experimental Data



V_2 Plot with C_1 using Experimental Data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26.912µA
XMM1
0.277V
R1
12K
V1
0.6
D1
BZX84C10L
GND
XMM4
30.788µA
XMM5
0.281V
R3
12K
V3
0.85
D3
BZX84C10L
GND
XMM9
34.697µA
XMM10
0.284V
R5
12K
V5
0.7
D5
BZX84C10L
GND
XMM2
38.632µA
XMM3
0.286V
R2
12K
V2
0.75
D2
BZX84C10L
GND
XMM6
42.589µA
XMM8
0.289V
R4
12K
V4
0.8
D4
BZX84C10L
GND
XMM11
46.563µA
XMM12
0.291V
R6
12K
V6
0.85
D6
BZX84C10L
GND
XMM13
50.552µA
XMM14
0.293V
R7
12K
V7
0.9
D7
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GND
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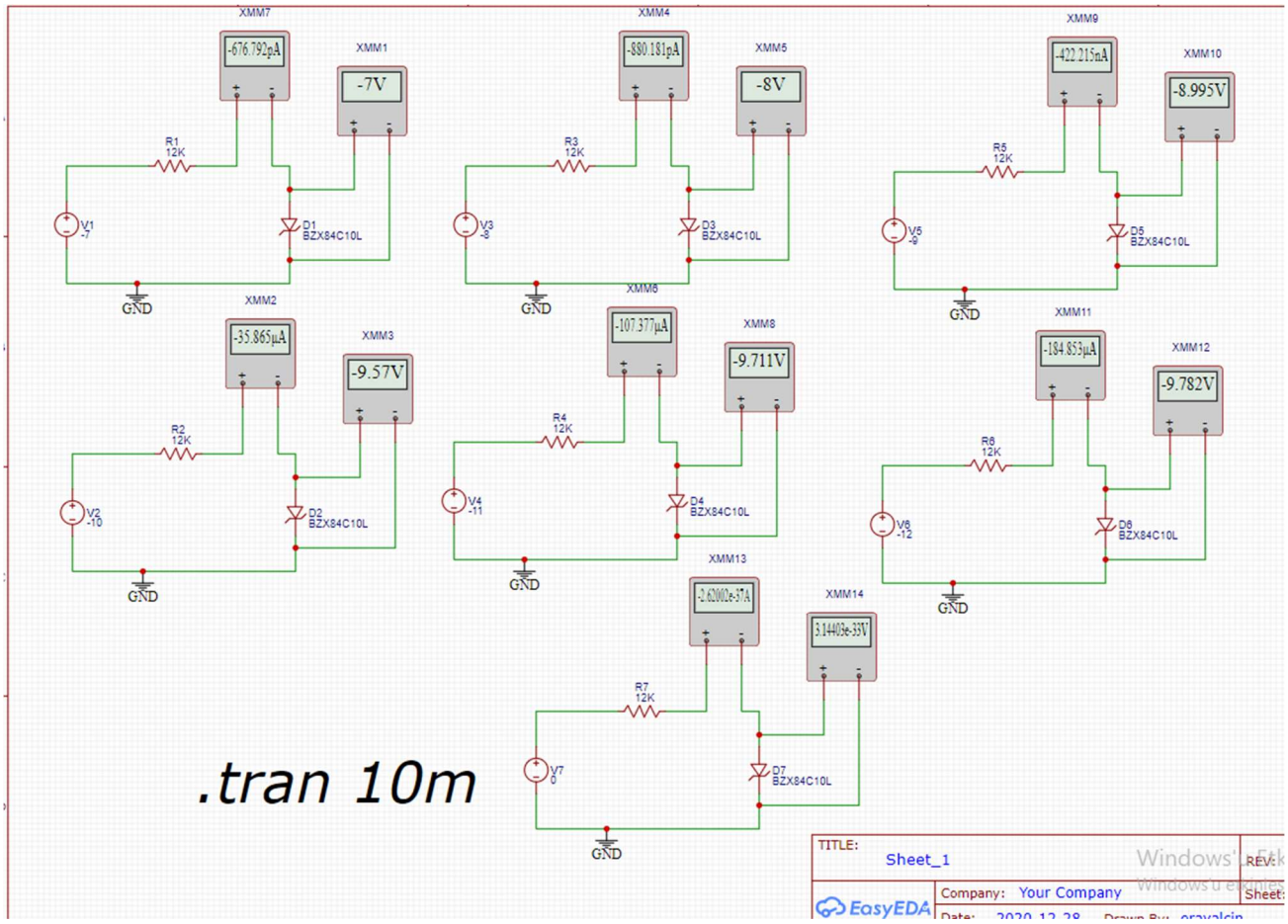
REV: 1.0
Company: Your Company


XMM7
-676.792pA
XMM1
-7V
R1
12K
V1
-7
D1
BZX84C10L
GND
XMM4
-880.181pA
XMM5
-8V
R3
12K
V3
-8
D3
BZX84C10L
GND
XMM9
-422.215nA
XMM10
-8.995V
R5
12K
V5
-9
D5
BZX84C10L
GND
XMM2
-35.865µA
XMM3
-9.57V
R2
12K
V2
-10
D2
BZX84C10L
GND
XMM6
-107.377µA
XMM8
-9.711V
R4
12K
V4
-11
D4
BZX84C10L
GND
XMM11
-184.853µA
XMM12
-9.782V
R6
12K
V6
-12
D6
BZX84C10L
GND
XMM13
-2.62002e-37A
XMM14
3.14403e-35V
R7
12K
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EasyEDA
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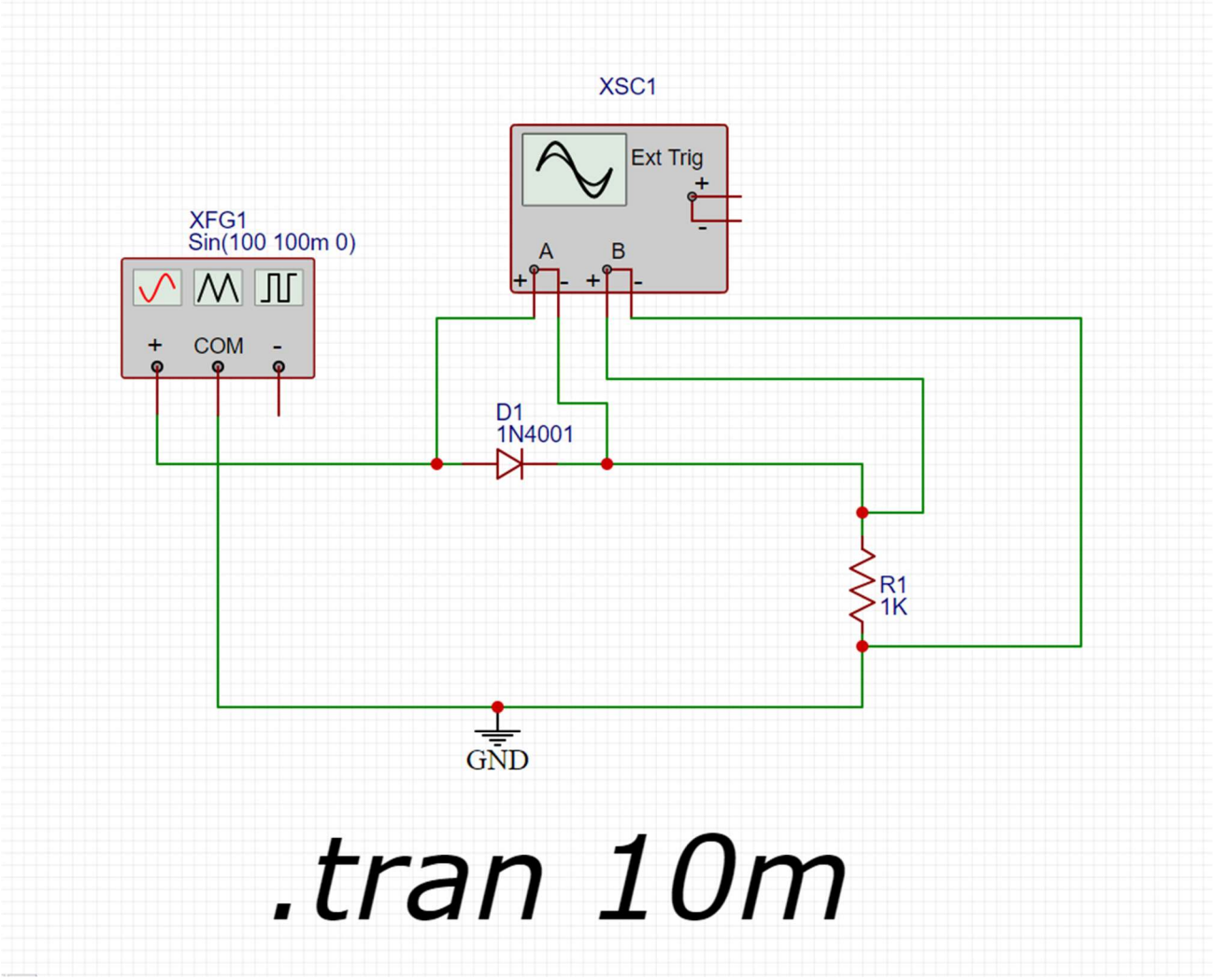
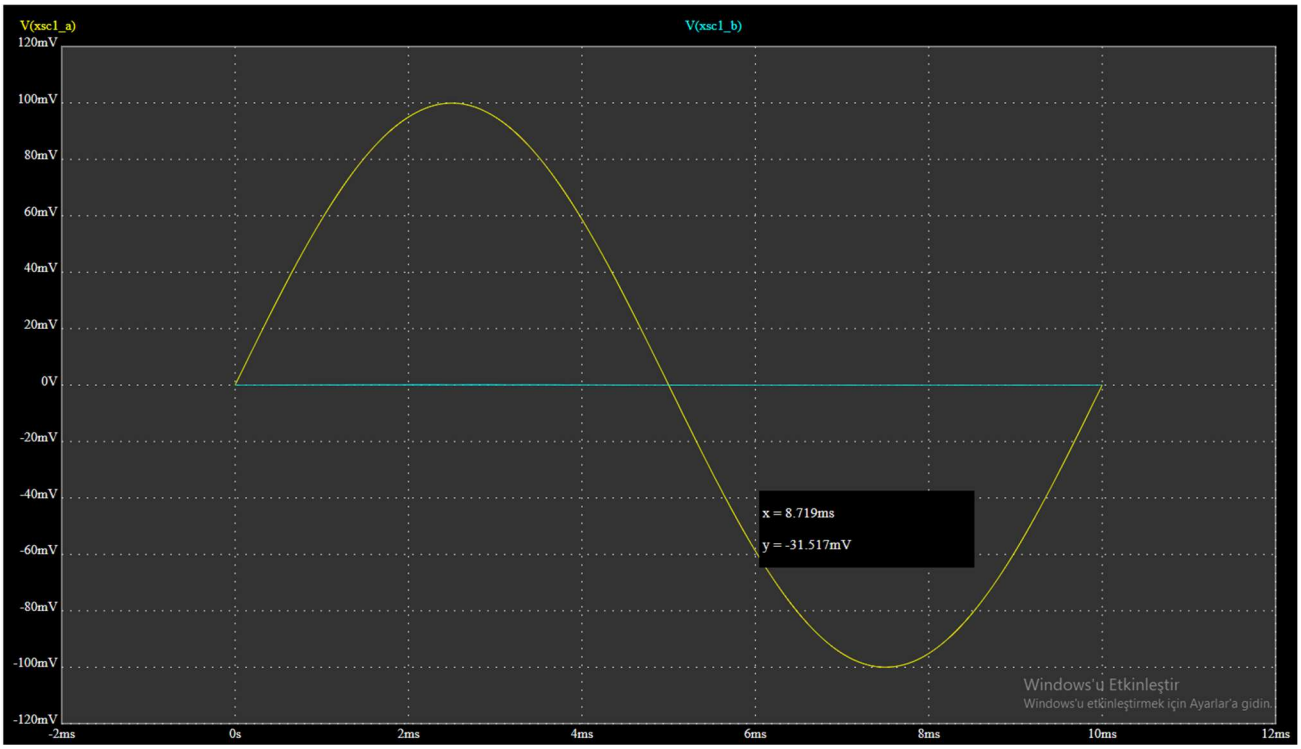

XSC1
Ext Trig
+
-
A
B
+
-
+
-
XFG1
Sin(100 100m 0)
+
COM
-
D1
1N4001
R1
1K
GND
.tran 10m


V(xsc1_a)
V(xsc1_b)
120mV
100mV
80mV
60mV
40mV
20mV
0V
-20mV
-40mV
-60mV
-80mV
-100mV
-120mV
-2ms
0s
2ms
4ms
6ms
8ms
10ms
12ms
x = 8.719ms
y = -31.517mV
Windows'u Etkinleştir
Windows'u etkinleştirmek için Ayarlar'a gidin.

1.

- $V_d = 10V$

$V_R = -12 - 10 = -22V$

$I_d = \frac{-22V}{12 \cdot 10^3} = -183.3 \times 10^{-3} A$

2.

$V_d = 10V$

$V_r = -11 - 10 = -21V$

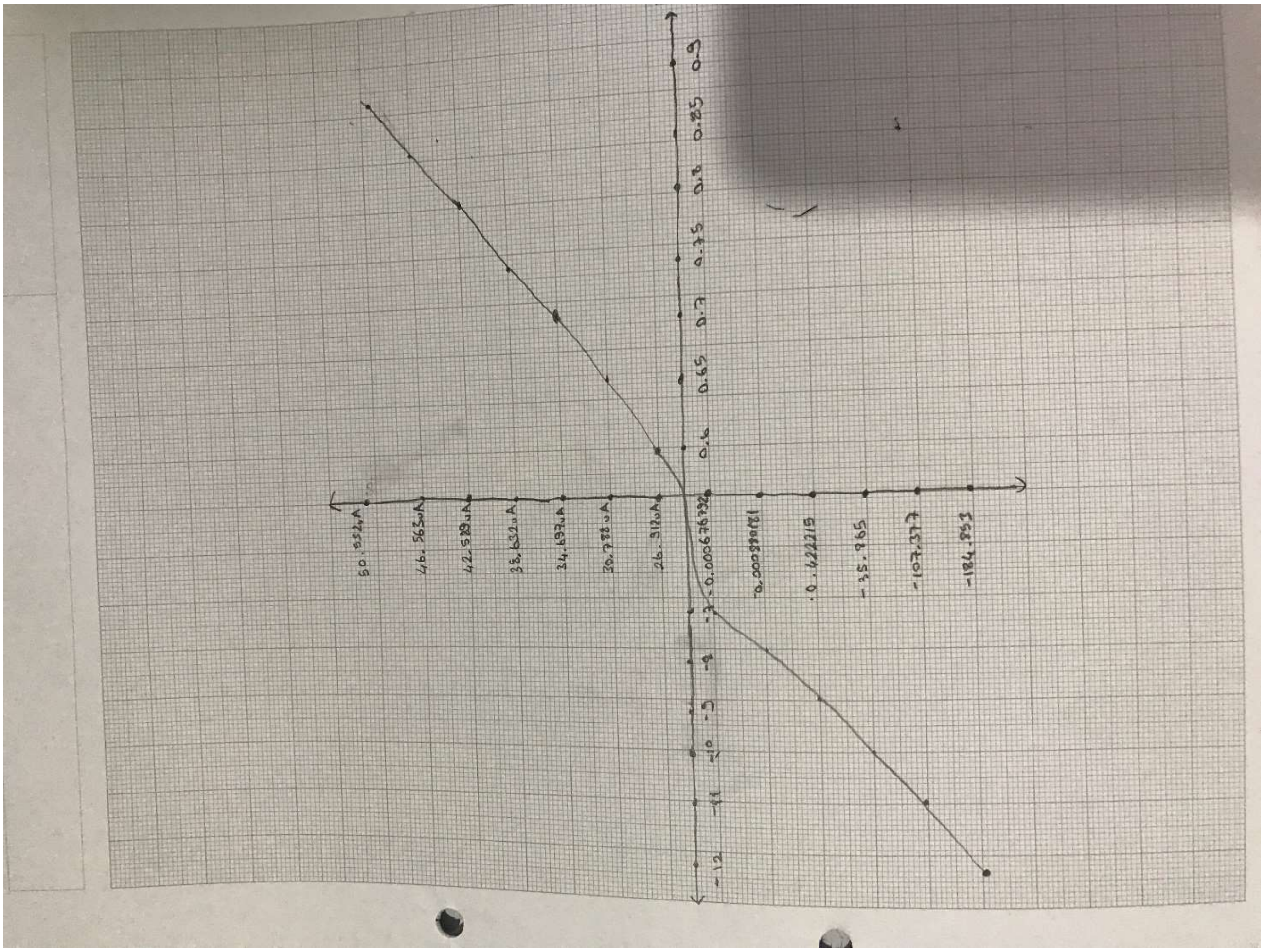
$I_d = \frac{-21}{12 \cdot 10^{-3}} = -175 \times 10^{-3}$

0.75

$V_d = 0.7$

$V_R = 0.75 - 0.7 = 0.05$

$I_d = \frac{0.05}{12 \times 10^3} = 0.004 \times 10^3$


0.6
0.65
0.7
0.75
0.8
0.85
0.9
-7
-8
-9
-10
-11
-12