King Saud University
Science College
Physics and Astronomy Department

Electronics Physics Laboratory Experiments

- 325 Phys -

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Diode Characteristics

1- *Objectives:*

- Diode as valve in a circuit
- Static recording of the current-voltage characteristic
- Dynamic representation of the current-voltage Characteristic.

2- *Circuit elements:*

1 Incandescent lamp 12V/3W 1 Lamp holder E10,
1 Resistor 10 Ω
1 Resistor 100Ω
1 Ge diode AA 118 1 Si Diode 1N4007
Meters:
1 Ammeter
1 Voltmeter
1 Two-channel oscilloscope
DC. Power supply unit
AC. Power supply (0-25V)

3- ***Procedure:***

☒ Diode as valve in a circuit

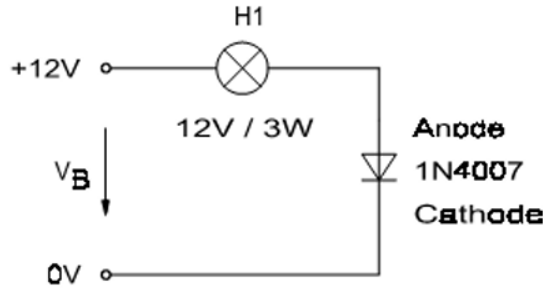


Fig.1

1- Connect the circuit as shown in figure 1, and apply an operating voltage of V_B = 12 V to the input .
2- Comment on the result you obtained.
3- Interchange the connection to diode i.e., reverse bias.
4- Comment on the result you obtained.

☒ Static recording of the current-voltage characteristics

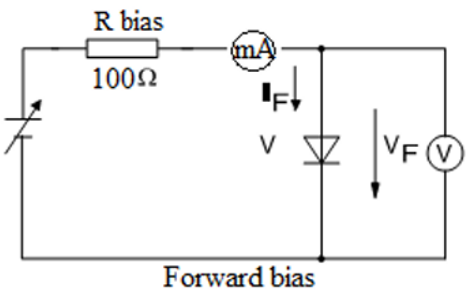


Fig. 2(a)

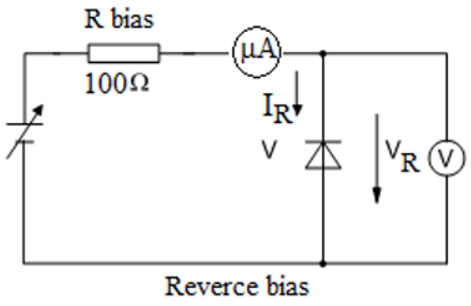


Fig. 2(b)

1- Connect the circuit as shown in figure 2(a).

2- Change the voltage from 0 V to 0.8 V in steps of 0.05, and record the corresponding current value for Si and Ge.

3- Connect the circuit as shown in figure 2(b).

4- Change the voltage from 0 V to 10 V in steps of 1V, and record the corresponding current value for Si and Ge.

V_F/V	Forward bias I_F/mA		V_r/V	Reverse bias I_r/μA	
	1N4007	AA 118		1N4007	AA 118
0.00			0.00		
0.20			0.50		
0.25			1.0		
0.30			2.0		
0.35			3.0		
0.40			4.0		
0.50			5.0		
0.55			6.0		
0.60			7.0		
0.65			8.0		
0.70			9.0		
0.75			10.0		
0.8			-		

Table 1

5- Plot a graph between v and I.

6- Determine the threshold voltage V_{th} of the Si and Ge diodes. (compare the V_{th} of Si and Ge diodes)

☒ Dynamic representation of the current-voltage characteristic

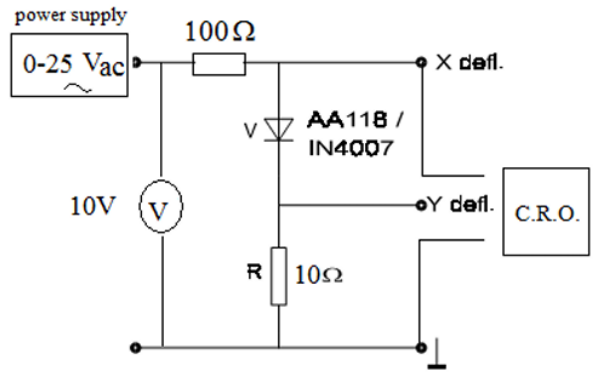


Fig. 3

1. connect the circuit as shown in Fig.3 and apply an ac sinusoidal voltage V = 10 V, f = 50 Hz.
2. Record the settings of the oscilloscope:

   X-deflection: ----- V/div & Y-deflection: ---V/div
3. Use the oscilloscope (C.R.O.) to record the silicon and germanium diode characteristics and compare these with the statically recorded characteristics.
4. Draw the relation between the current I(y- axis) and the voltage V(x-axis)in case for in both: forward and reverse bias.

5. Calculate the diode resistance:

germanium diode	V (V)	I(A)	R_D Ω
	0.3		
	0.5		
	0.65		
silicon diode	0.5		
	0.65		

4- Precautions:

1- Read the ammeter and voltmeter at eye level.

2- Change the scale of ammeter scale from DC. To AC. When performing AC measurement.

3- Check the circuit before starting.

Zener Diodes Characteristics

Objectives:

- Static recording of the current-voltage characteristic $l_z = f(V_z)$ of a Z diode
- Dynamic representation of the current-voltage characteristic I = f(V) of a Z diode
- Differential resistance of Z diodes

Circuit elements:

1 Resistor 330 Ω/2W

1 Resistor 220 Ω/2W

1 Resistor 10 Ω/2W

1 Resistor 1K Ω/2W

1 Resistor 100 Ω/2W

1 Z diode ZPD 6.2

Measuring devices:

1 Multimeter M2032
1 Multimeter M3E
1 Oscilloscope
1 DC Power supply units:
1 AC Power supply unit

Accessories:

1 Plug-in board 297x 300
1 Measuring cable
1 Set of bridging plugs 19
1 Set of connecting leads

Procedure:

Static recording of the current-voltage characteristic l_z .= f(V_z) of a Z diode

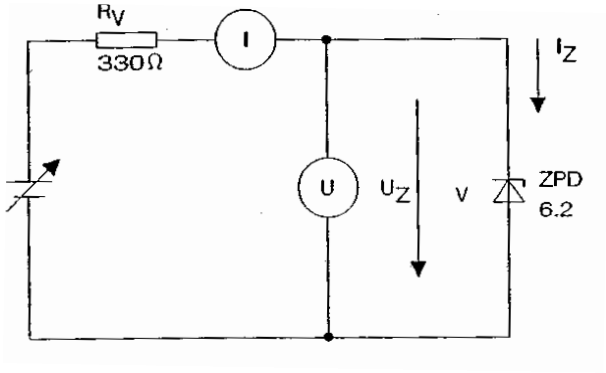


fig.1

Assemble the circuit as shown in fig.1 and carry out the measurements for the voltages given in the table 1.

ZPD 6.2 V	
V z / V	Iz mA
0	
1	
2	
3	
4	
5	
5.5	
6.0	
6.1	
6.2	

Draw the corresponding current-voltage characteristic $l_z = f(V_z)$.

1. What function does the series resistor R_v have?
2. Determine the Z voltage V_{zo} of the diode by drawing a tangent to the approximately linear part of the curve (fig. 2) and reading the voltage from the voltage axis where the tangent intersects it.
3. Set the DC supply (E) to the values appearing in Table 2 and measure both V_Z and V_R. Calculate the Zener current, I_Z using the Ohm's law given in the table and complete the table.
4. Plot I_Z versus V_Z using the data in Table 2 on a graph paper.

Results and Calculations:

E (V)	0	1	3	5	7	9	11	13
VZ (V)								
VR (V)								
$I_Z = V_R / R$ (mA)								

Table 2

part 2:

Dynamic representation of the current-voltage characteristic $l_z = f(V_z)$ of a Z diode.

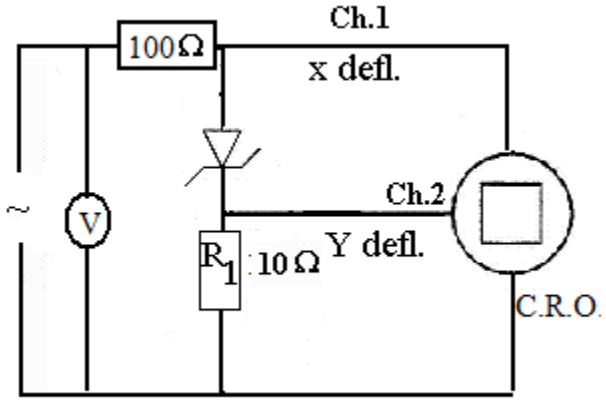


Fig. 3

1. Assemble the circuit as shown in fig.3 and apply a sinusoidal voltage Vp-p12 V, f = 50 Hz.
2. Display the current-voltage characteristic of the Z diodes ZPD 6.2 V and ZPD 9.1 V on the oscilloscope and enter the graphs into the diagram in fig. 4.
3. Record the oscilloscope settings of :

X-deflection: volts/div (DC) & Y-deflection: volts/div (DC, Inverted)

4. Compare the two characteristics and list three differences between them.

Light Emitting Diodes

1-*Objectives:*

The purpose of this experiment is to determine and plot the characteristics of the light emitting diode in the forward-bias region, and to compare between different colored diodes.

2-*Circuit elements:*

1. DC Power Supply.
2. Digital Multimeters.
3. Electronic Test Board.
4. Light Emitting Diodes (LEDs) with different colors (Red, Yellow, and Green).
5. Resistor (330Ω,).
6. Leads and Wires.

3-*Circuit Diagram:*

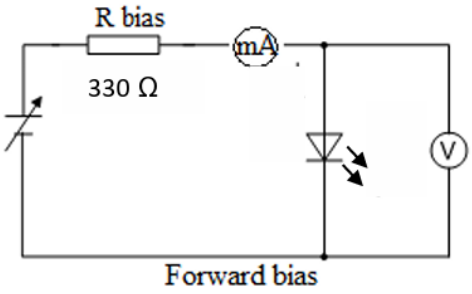


Fig. 1

1- Connect the circuit as shown in figure 1.

2- Change the voltage from 0 V to 2 V in steps of 0.25, and record the corresponding current value.

3- Plot a graph between v and I.

4- Determine the voltage drop V_D of the light emitting diodes (Red and Yellow).

V(volt)	0	0.25	0.5	0.75	1	1.25	1.5	1.6	1.7	1.8	1.9	2
I (mA)												

Table 1: Data of red LED

V(volt)	0	0.25	0.5	0.75	1	1.25	1.5	1.6	1.7	1.8	1.9	2
I (mA)												

Table 2: Data of yellow LED

Half Wave Rectifier

1- *Objectives:*

- To calculate and draw the DC output voltages of half-wave rectifiers.
- Without smoothing capacitor and with smoothing capacitor.

2- *Circuit elements:*

Instruments

AC power supply or Function Generator
2 Voltmeters
Function Generator
Oscilloscope

Components

Diode: Silicon D1N4007
Resistors: 10 kΩ,
Capacitor :(0.47 µF)
Capacitor :(4.7 µF)
Electrolytic Capacitor 100 µF

3- *Circuit Diagram:*

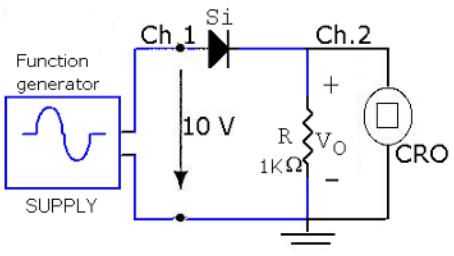


Fig.1

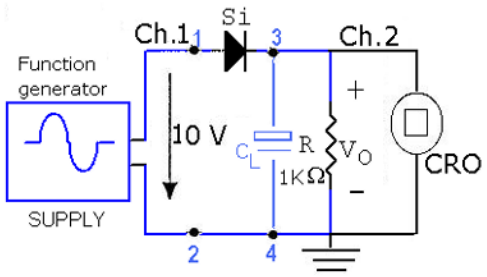


Fig.2

4- ***Procedure:***

1. Connect the circuit as shown in Fig.1, adjust the power supply at 10 V.
2. Measure the input voltage V_1 and the output voltage V_2 using both the voltmeter and the oscilloscope.

	V (input) (Volt)	V (output) (Volt)
With voltmeter	10 Va.c	Vd.c
With oscilloscope	Vp-p	V_{P-P}

3. Draw the input waveform, V_i , and the output waveform, V_o
4. Calculate: 1) Maximum voltage of the input signal

$$V_m = \frac{V_{p-p}}{2}$$

2) the effective value of the input voltage

$$V = \frac{V_m}{\sqrt{2}}$$

3) the average value of the output voltage

$$V_{av} = V_{dc} = 0.318 V_m$$

5. Comment on the results you obtained.

Smoothing and filtering

6. Connect the circuit as shown in Fig.2.
7. Measure V_{out} with voltmeter as a function of the capacitance value of the smoothing capacitor C_L=0.47µF, 4.7 µF, 100 µF and at the same time measure the ripple voltage V_{P-P} using C.R.O.

C_L (μF)	Vo (voltmeter) (Volts)	Vp-p (CRO) (Volts)	T (m sec)	F = l/T (Hz)
0.47				
4.7				
100				

8. Draw the output signal voltage each time of C_L values with true scale.
9. Calculate the ripple factor r using the following equation

$$r = \frac{1}{2\sqrt{3}} \left(\frac{1}{F R_L C_L}\right)$$

Comment on the results you obtained.

Full Wave Rectifier

1- *Objectives:*

- To calculate and draw the DC output voltages of Full-wave rectifiers.
- Without smoothing capacitor and with smoothing capacitor.

2- *Circuit elements:*

Instruments

- AC power supply or Function Generator
- 2 Voltmeters
- Oscilloscope

Components

- Diode: Silicon 4×(D1N4007) or Silicon Bridge rectifier
- Resistors: 10 kΩ,
- Capacitor :(0.47 μF)
- Capacitor :(4.7 μF)
- Electrolytic Capacitor :(100 μF)

3- *Circuit Diagram:*

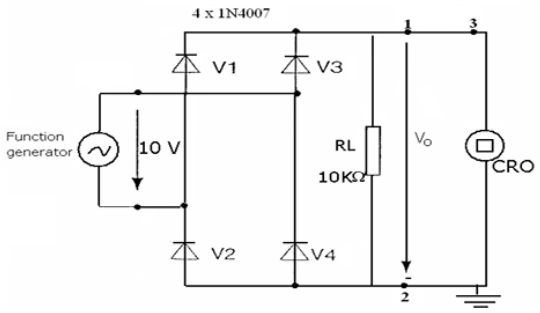


Fig.1

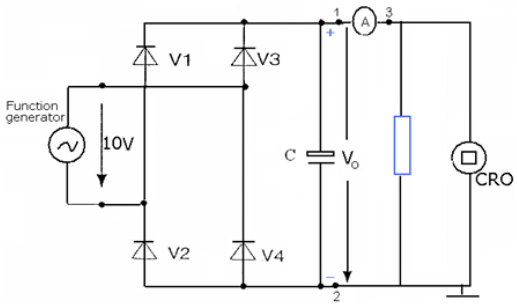


Fig.2

4- ***Procedure:***

1. Connect the circuit as shown in Fig.1, adjust the power supply at 10 V.
2. Measure the input voltage V_1 and the output voltage V_2 using both the voltmeter and the oscilloscope.

	V (input) (Volt)	V (output) (Volt)
With voltmeter	10 Va.c	Vd.c
With oscilloscope	Vp-p	VP-P

3. Draw the input waveform, V_i , and the output waveform, V_o
4. Calculate: 1) Maximum voltage of the input signal

$$V_m = \frac{V_{p-p}}{2}$$

2) the effective value of the input voltage

$$V = \frac{V_m}{\sqrt{2}}$$

3) the average value of the output voltage

$$V_{av} = V_{dc} = 0.636 V_m$$

5. Comment on the results you obtained.

Smoothing and filtering

6. Connect the circuit as shown in Fig.2.
7. Measure V_{out} with voltmeter as a function of the capacitance value of the smoothing capacitor C_L=0.47µF, 4.7 µF, 100 µF and at the same time measure the ripple voltage V_{P-P} using C.R.O.

Transistor input characteristic

1-*Objectives:*

- To measure the base current (I_B) as function of base-to-emitter voltage (V_{BE}), keeping emitter-to-collector voltage (V_{CE}) be constant.

2-*Circuit elements:*

- Power supply unit
- Fixed Resistor 1 kΩ
- Potentiometer 1 kΩ
- Transistor BD130, NPN,
- Ammeter
- Set of connecting leads

3-*Circuit Diagram :*

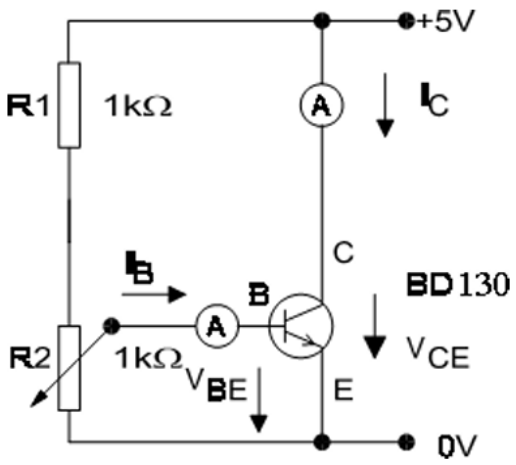


Fig. 1

4-***Procedure:***

- Connect the circuit as shown in the figure 1.
- Change the voltage V_{BE} by means of potentiometer and record the base current I_B values.
- Plot a graph between V_{BE} and I_B.
- Calculate R (ratio of input voltage to input current) from Tab. 1.

V_{BE}(volt)	0	0.1	0.3	0.5	0.6	0.65	0.7	0.75	0.8
I_B(mA)									

Table 1

Part 2: Control characteristic with current amplification

1-*Objectives:*

- To measure how the collector current (I_C) changes with base current (I_B) when the collector-to- emitter voltage (V_{CE}) is kept constant.
- To determine the current gain factor (β) of a common emitter configuration circuit.

2-*Circuit elements:*

- Power supply unit
- Fixed Resistor 1 kΩ
- Potentiometer 1 kΩ
- Transistor BD130, NPN,
- Ammeter
- Set of connecting leads

3-*Circuit Diagram*

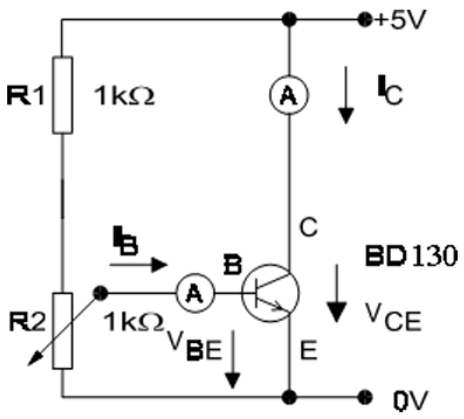


Fig. 2

4-*Procedure:*

- Connect the circuit as shown in the figure 2.
- Change the base current I_B by means of the potentiometer and record the collector current I_C .
- Determine the value (β) for common emitter configuration.
- Plot a graph between I_B and I_C.

$\frac{I_B}{mA}$	$\frac{I_C}{mA}$	B
0.01		
0.02		
0.05		
0.08		
0.10		
0.20		
0.30		
0.50		

Transistor output characteristic

1- *Objectives:*

-Measurement methods for determining the relation between V_{CE} and I_C

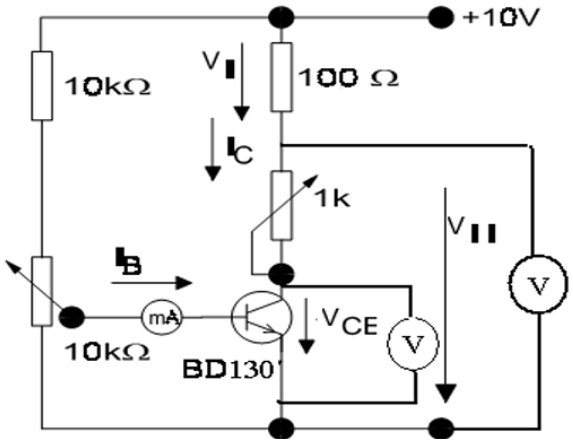
-Recording parameters in tables

-Representing the parameters in the output characteristic field

2- *Circuit elements:*

- Power supply unit
- Resistor 100 Ω
- Resistor 10 kΩ
- Potentiometer 1 kΩ
- Potentiometer 10 kΩ
- Transistor BD130
- 2 Multimeter
- Set of connecting leads

3- *Circuit Diagram*



4- ***Procedure:***

1) Connect the circuit as shown in the circuit diagram.
2) Set the voltages V_{CE} given in Tab. 1 using the collector potentiometer (1 kΩ),
3) Measure the corresponding value VII
4) Calculate VI in each case (VI = 10V - VII)
5) Calculate the corresponding collector currents I_C (I_C = VI / R ; R= 100Ω)
6) Repeat the procedure for the base currents 200 µA, 300 µA, 400 µA, and 500 µA.

V_{CE} [V]	I_B = 100 µA		I_B = 200 µA		IB = 300 µA		IB = 400 µA		IB = 500	
	VI [V]	IC [mA]	VI [V]	IC [mA]	VI [V]	IC [mA]	VI [V]	IC [mA]	VI [V]	IC [mA]
0.2										
0.5										
1.0										
2.0										
4.0										
6.0										
8.0										

Tab. 2

7) Draw the characteristics from the values recorded in Tables 2.

Characteristics of Field Effect Transistor

1- *Objectives:*

- Output characteristics field with V_{GS} as parameter.
- Input characteristic with V_{DS} as parameter.

2- *Circuit elements:*

- Resistor 1 kΩ
- Potentiometer 1 kΩ
- FET transistor BF244
- Multimeter
- Power supply unit
- Set of connecting leads

3- *Circuit Diagram:*

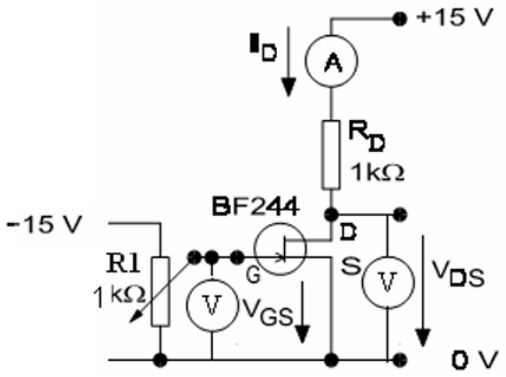


Fig.1

4- ***Procedure:***

1. Connect the circuit as shown in Fig.1.
2. Using R, apply a gate voltage of V_{GS} = - 1.3 and measure the drain currents I_D corresponding to the drain voltages V_{DS} in Table 1. Enter the values in the first column of the table.

V_{GS} / V_{DS} V	-1.3 V I_D mA	-1.0 V I_D mA	-0.6 V I_D mA	-0.3 V I_D mA	0.0 V I_D mA
0.2					
0.5					
1.0					
2.0					
3.0					
5.0					
7.0					
10.0					
12.0					

Table :1

3- Sketch the graphs of this relationship in the coordinate system. Table 1 contains several columns for various gate voltages.

4- Measure the drain current values for the corresponding drain voltages and plot the graphs in the same coordinate system.

5- The relationship between I_D and V_{GS} can be taken from the individual rows, i.e. for each pair of values (V_{GS}/I_D) there is a specific drain voltage V_{DS}.

6- Draw an input characteristic for the values in the row V_{DS} = 3 V in Table 1.

Report Template

Experiment Title

Student Name Group #

dd/mm/yyyy

Objective(s):

Give a brief summary of the purpose of the experiment.

Principle(s):

Write briefly the principle of the experiment.

Apparatus:

List all the tools and apparatus you used to perform the experiment

Data:

In this section you need to show your experimental results (data tables).

x (m)	V (V)
0.0031	0.015
0.0024	0.020
0.0056	0.045
0.0080	0.066

Table 1: Caption is important

Graphs:

Here you should include all the graphs you plotted from your data and write a caption for each one.

Data Analysis:

In this section, you need to explain the results you obtained in the data section, comment on the behavior of the data, and if there is any anomalies results, try to explain them. Also explain any calculations you performed in the tables.

Calculations:

In this section, you should illustrate your calculations and explain them briefly, Also youmay need to include the calculation of the error percentage if required.

Conclusion:

Summarize your results and comment on them.