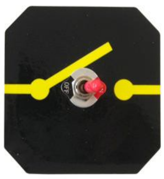
A03-800S-Y01

Electronics Demonstration Kit

Laboratory Instruments List

1. A female Universal bread plate X2
2. Circuit switch connector X1
3. DC power supply input connector X2
4. DC current output terminal connector X2
5. DC voltage output terminal connector X1
6. The adjustable resistor 1KΩ connector X2
7. Resistance 10KΩ connector X1
8. Resistance 47Ω connector X1
9. PNP transistor connector X1
10. NPN transistor connector X1
11. Diode connector X1
12. DC power supply (1.5V, 9V each) X2
13. Digital Multimeter X2
14. Line type connector X5
15. L-shaped connector X12
16. T-shaped connector X5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				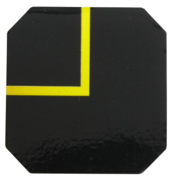
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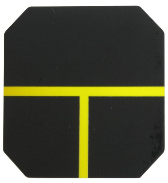				
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Experiment I: Jack Universal Breadboard Understanding

Experimental Purposes

The purpose is to understand the basic fundamentals of the structure as well as learn how to use wildcard circuit breadboard.

Instruments Needed

Item	Name	QTY	Item	Name	QTY
1	Universal Jack with the Breadboard	1			

Experimental Principle

Circuit components have to be crossover between the block box is because we must take every nine-block box set of features (Round 9 holes were extended for the same point) to the circuit component linked with each other; if the circuit components do not use the bypass, then the circuit will not be able to form a complete path.

Experimental Methods

Observe the universal circuit bread plate front 24 Group made up of metal round holes and squares organigram in Figure 1.

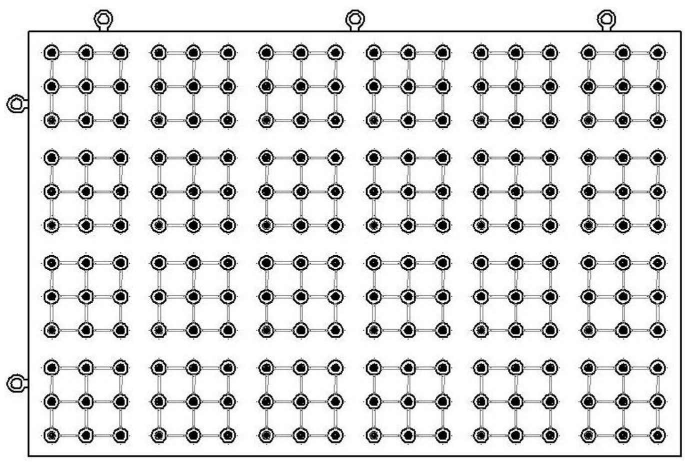


Figure 1

Observe the universal circuit opposite of bread plates, can be easily found in each group of nine-block box round 9 holes are

By a piece of metal linked together, construct diagrams such as Figure 2; therefore we know one thing: each extension of the block box is the same point.

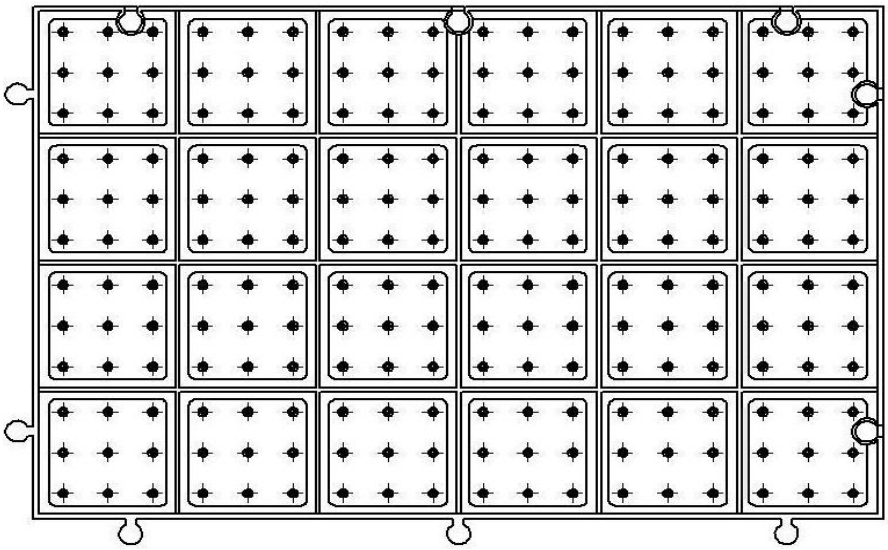


Figure 2

When connecting to the circuit, note that the PIN with the universal circuit Breadboard circuit component metal round holes on the relative position of circuit components the PIN must be bridged between the 2 groups and do the Block box bridged mode as shown in Figure 3.

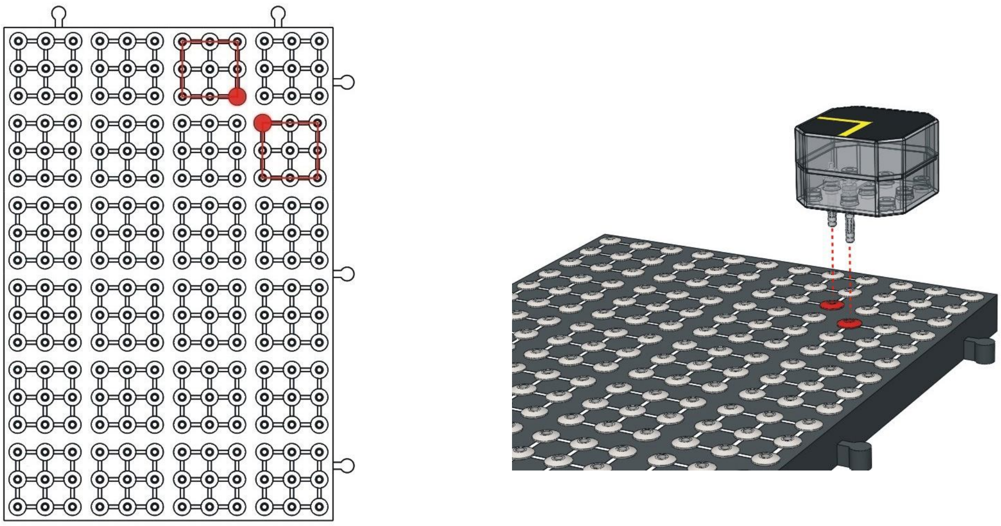


Figure 3

Use a multimeter to measure the Universal circuit breadboard:

Many different stalls in three-use meter indicates, namely, DC voltage, AC voltage, DC current, Resistance, and diode conduction ... , And so on. Here we will use the diode conduction, marking its stalls as shown in Figure 4.

Figure 4

The measurements of the table three electricity wires into the three meters below the Jack: insert the black wire marked "COM"

Insert jacks and the Red wire is marked " VΩmA " Jack, the wire connections as shown in Figure 5. Attaching a multimeter to measure the multimeter wires into below the jack: black wire into the label of "COM" and red wire is inserted into the jack marked " VΩmA "

Figure 5

In Universal circuit breadboard to optionally group squared, and then selected an optional squared within two holes and two wire points. You will hear the three multimeter beep sound, this means the selected two holes are conducting.

shown in Figure 6.

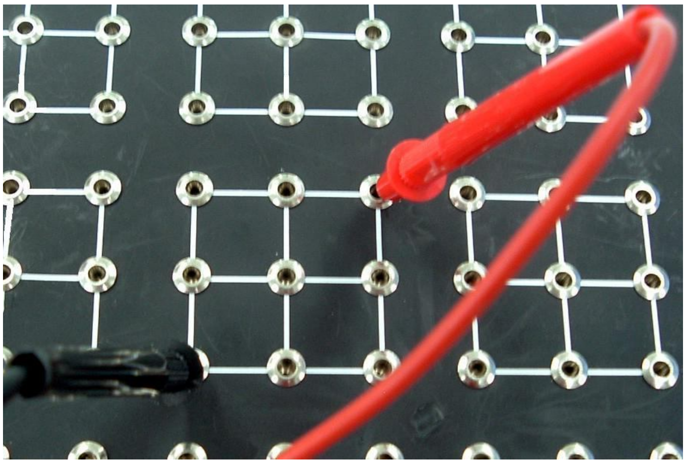


Figure 6

Two points in squared optional test in accordance with the previous steps.

Experimental Results and Discussion

From the experimental verification 9 the each group Style Box within metal round hole conduction are interconnected; In other words, we can actually within the nine Style Box metal round hole as an extension of a metal circular hole Therefore, we must link circuit elements to complete the circuit. Use Style Box characteristics Jumper to procure two components turned also to take advantage of Style Box.

Experiment II

I-V Characteristics of the Diode Curve Measurement

Experimental Purposes

Understand the characteristics of diode by experiment and operating voltage range

Instruments Needed

Item	Name	QTY	Item	Name	QTY
1	Universal Jack bread plate	2	2	Circuit switch	1
3	DC power supply	1	4	Galvanometer jack	1
5	Voltage meter jack	1	6	Variable resistor 1KΩ	1
11	Diodes	1	12	DC power supply (1.5V)	1
13	Digital meter	2	14	A font cable	2
15	L-shaped cable	5	16	T-shaped cable	3

Experimental Principle

The most common diode is joined together by a P-type semiconductor and an N-type semiconductor, known as the P-N junction diode (p-n junction diode) is shown in Figure 1.

The circuit represented by the symbols shown in Figure 2 to the diode. Arrow direction indicates the direction of current flow to the n-sided edge by p. At both ends of the diode connected to the voltage source pick the positive side when p n side then negative, as shown in Figure 3, Claimed by the forward bias diode, when the current flows through the diode, the path state; Conversely, illustrated in Figure 4. Diode is said to be the reverse bias current flows through the diode, then close to zero, and the off state. The aim of this experiment is measurements diode is biased to voltage characteristics curves.

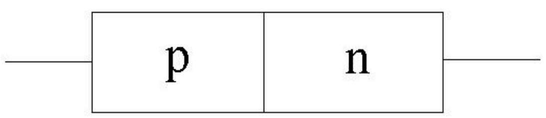


Figure 1

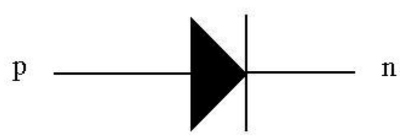


Figure 2

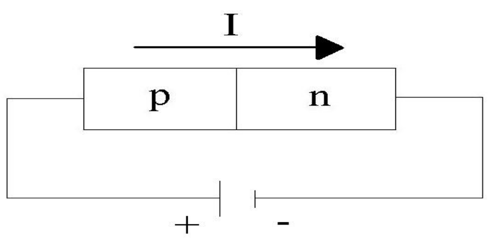


Figure 3

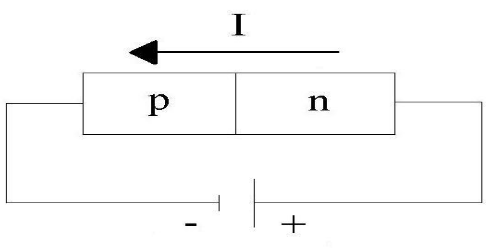


Figure 4

Experimental Method

Combination according to Fig 5, circuit diagram the device shown in Figure 6, this connection allows the diode by the forward bias voltage.

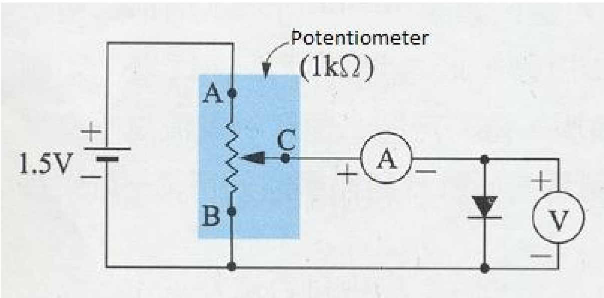


Figure 5

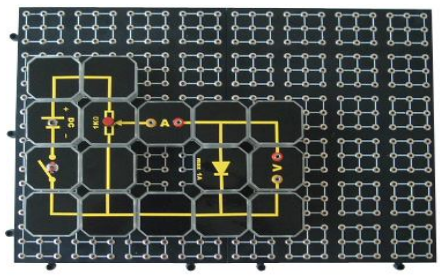


Figure 6

2. Adjust the variable resistor to point B That diode shunt resistor, the switch to ON, this time on the voltmeter voltage value should be zero the variable resistor slowly return to point A to adjust, To add to both ends of the diode voltage V_D increases starting from 0, increase the 0.1V, recording ammeter numerical I_D (meter resolution size to make their own adjustments). When V_D increases to more than 0.5V, Diode current rapidly increases, Subject to the reduced voltage increases, For example, every increase in 0.05V, the voltage increased by nearly 0.8V, the diode may be burned if the voltage is too high for the diode.

3. Polarity of DC power block swaps, the diode is reverse-biased. When the reverse bias voltage the size changes, observe the current I_D
   Is it always zero?

4. To convert data obtained from I_D curve to V_D.

Experimental Results and Discussion

V_D														
I_D														

1. Diode I－V curve, whether in accordance with Ohm's law? What are the characteristics?
2. Please elaborate on why the diode when forward bias voltage of more than 0.5V why it has a current significant increase?

Experiment III

I_C-V_{EB} PNP Transistor Characteristic Curve Measurement

Experimental Purposes

Take this experiment to know PNP transistor characteristics.

Laboratory Instruments

Item	Name	QTY	Item	Name	QTY
1	Jack universal with the bread plate	2	2	Circuit switch	1
3	DC power supply	2	4	Galvanometer jack	1
5	Voltage meter jacks	1	6	Variable resistance 1KΩ	1
9	PNP transistor	1	12	DC power supply (1.5V, 9V 1)	2
13	Digital electric meter	2	14	E-connector	3
15	L-shaped connector	5	16	T-shaped connector	4

Experimental Principle

Bipolar transistors is in between the two pieces of the same type of semiconductor, clip on a layer of thin shaped semiconductor compositions, can be divided into both NPN and PNP. Because the transfer transistors are the free electron and hole current carrier, so called bipolar PNP transistor, are the majority carrier hole, free electron minority carrier; opposite the NPN transistor. Experimental discussion on using PNP transistors as components, measurement of its characteristic curve. Structure and symbol of a PNP transistor as in Figure 1. There are three electrodes: emitter, base, and collector. Circuit symbol the arrow direction in Figure 2 represents conventional current direction. The operation of the transistor in the forward bias is applied between the emitter and the base electrode, while in reverse bias is applied between the collector and base. Figure 3 shows the hole transistor internal flow situation. Starting hole by the emitter area, the vast majority through the thin layer of the base area to reach the collector region. The emitter current I_E, the base current I_B and the collector current I_C is the following relation between the formula.

$$I_E = I_B + I_C \qquad (1)$$

$$I_C = \alpha I_E \qquad (2)$$

$$I_C = \beta I_B \qquad (3)$$

$$\beta = \alpha / (1 - \alpha) \qquad (4)$$

Where α and β are the values of the transistor characteristics. Usually transistor α value of about 99%, while the β-value of approximately between 80 to 200. The emitter current I_E is determined by the emission voltage between the electrode and the base electrode V_{EB} While V_{EB} is greater than

0.5V, the small amount of V_{EB} variation will cause very large changes in I_E. Because of α very close to 1, so the collector current I_C approximately equal to I_E. Base current is very small, and is proportional to the I_C. Both I_E and I_C size General Ma (mA), and I_B is about dozens of micro-ampere (μA)

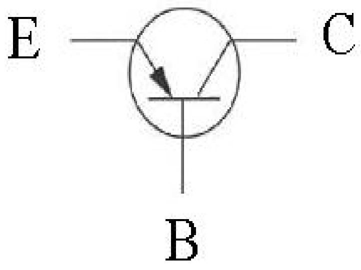


Figure 1

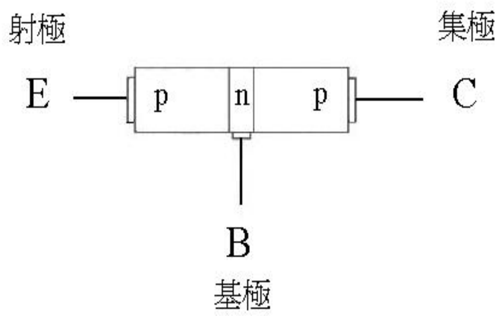


Figure 2

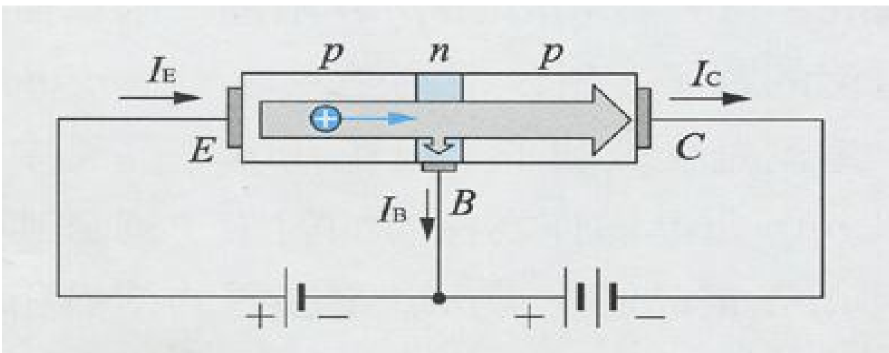


Figure 3

Experimental Methods

1. In accordance with Figure 4 device circuit diagram be combined as shown in Figure 5 Make the shot among the electrode and the base electrode by the forward bias voltage between collector and base by the reverse bias. Voltmeter for measuring the voltage between the emitter and the base of the V_{EB} of the ammeter is used to measure the outflow of the collector current I_C.

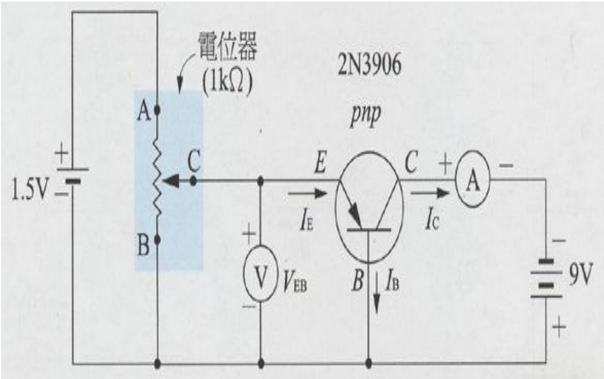


Figure 4

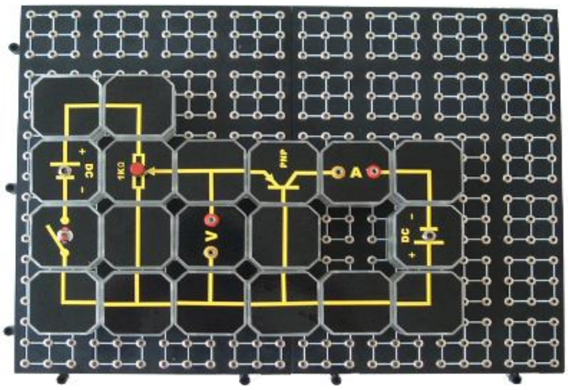


Figure 5

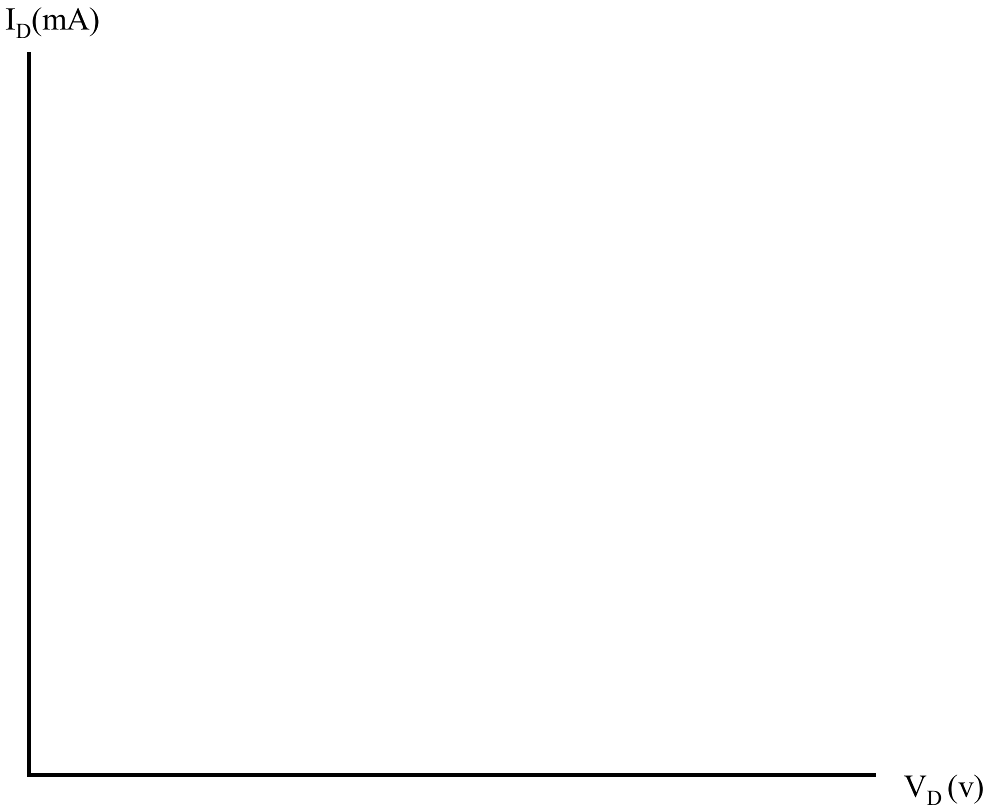
2. Rotating the rotary shaft of the adjustable resistor, the first adjustable resistor on the movable connector C to move to the position B of the fixed joint, the indication on the volt meter should be zero. And then go down to the direction of the fixed connector A moving connector C V_{EB} started to increase from zero. In increments of 0.1V, and corresponding record on ammeter the current readings I_C to zero. When the voltage is increased to 0.5V or more, the I_C current rapidly increased as the case, then need to reduce the voltage increase, for example, increments of 0.05V, continue weighed voltage and current data, until the I_C close to 15mA. After completion of the record, go back to zero.

3. Swap the polarity of the power supply direction, between the emitter and base reverse bias; see whether the emitter current is zero?

4. Converts the data from the I_C to the V_{EB} curve.

Experimental Results and Discussion

V_D														
I_D														



1. Does $I_C - V_{EB}$ curve and ordinary diode transistor characteristic curves differ?
2. According to the $I_C - V_{EB}$ curve, when the currents change when 10 times (for example, I_C has increased from 0.1A to 1.0A), V_{EB} How big is it?

Experiment IV

PNP Transistor's Current Gain β-value Measurement

Experimental Purposes

To know PNP transistor characteristics.

Laboratory Instruments

Item	Name	QTY	Item	Name	QTY
1	Universal Jack with a bread Board	2	2	Circuit switch	1
3	DC power supply	2	4	Galvanometer jack	1
5	Voltage meter jacks	1	6	Variable resistance 1KΩ	1
8	47Ω resistor	1	9	PNP transistor	1
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$$I_C = \beta I_B \quad (3)$$

$$\beta = \alpha / (1 - \alpha) \quad (4)$$

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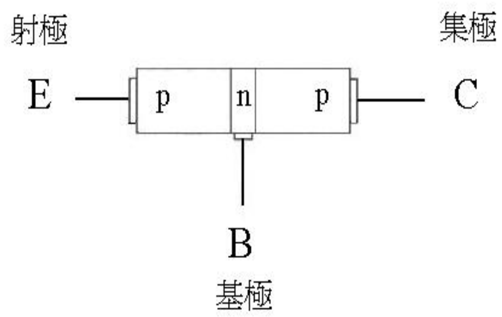


Figure1

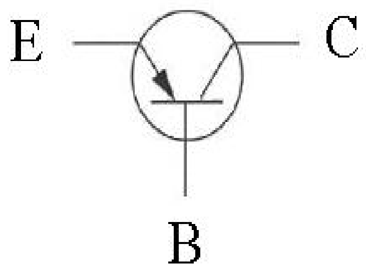


Figure 2

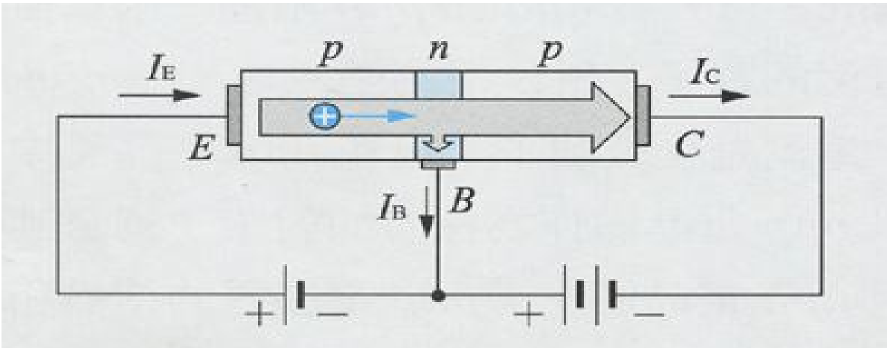


Figure 3

Experimental Methods

1. In accordance with Figure 4 a circuit diagram of the device assembly illustrated in Figure 5, the figure has a 47Ω standard resistor, its use is too large in size, so as not to limit the I_E flows through the transistor current and cause electric crystal volumes overheating. Two amps, respectively, for the measurement of the collector electrode and the base electrode of the current I_C and I_B. (V_{EB} forward bias, V_{CB} reverse bias)

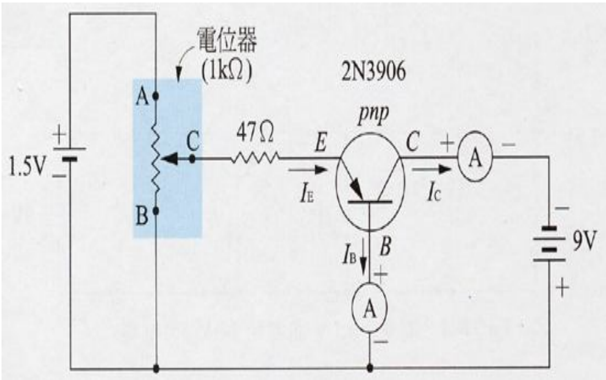


Figure 1

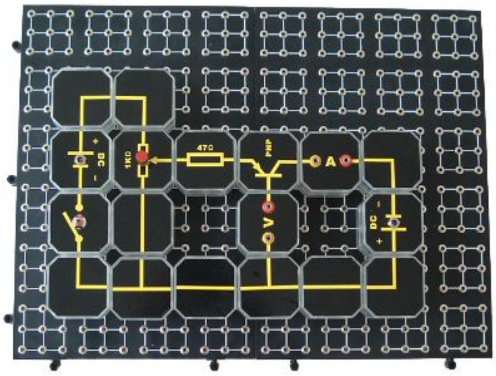


Figure 2

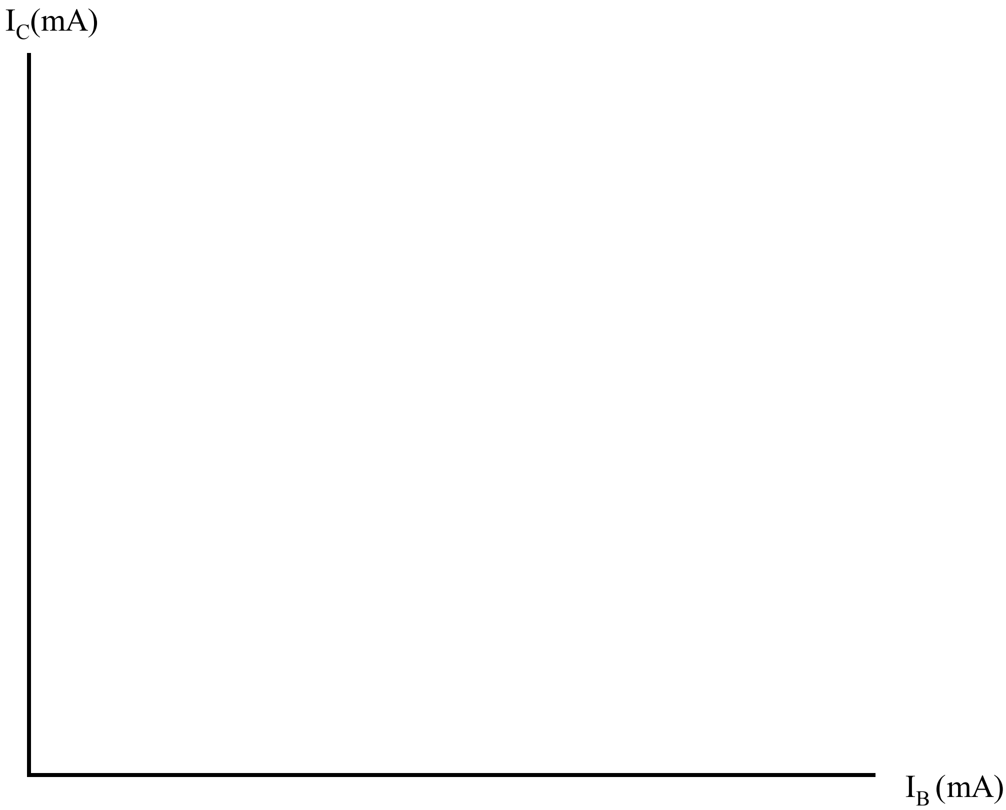
2. Rotating the rotary shaft of the adjustable resistor, the first adjustable resistor on the movable connector C to move to the position of the fixed connector B, and I_B should be zero at this time. And then go down fixed joint A direction by, the mobile connector C I_B increases from zero in increments 10μA, respectively recorded I_B and the corresponding I_C weighed at least 10 data points (I_B, I_C) are numbered sequentially 1 , 2, ..., 10.

3. To convert the data from the I_C on the plot of I_B.

4. Take the first and sixth data points, calculate the current gain $\beta = \Delta I_C / \Delta I_B$ of its corresponding, respectively calculate the current gain value of the corresponding.

Experimental Results and Discussion

I_C														
I_B														



1. Is the Diagram proportional to the relationship between the experimental I_C and I_B?
2. How more desirable to the average value of β is obtained?

Experiment V

I_C-V_{CE} NPN Transistor Characteristic Curve Measurement

Experimental Purposes

Understand the characteristics of the NPN transistor.

Laboratory Instruments

Item	Name	QTY	Item	Name	QTY
1	Universal Jack with a bread Board	2	2	Circuit switch	1
3	DC power supply	2	4	Galvanometer jack	2
5	Voltmeter jack	1	6	Variable resistor 1KΩ	2
7	10KΩ resistor	1	10	NPN transistor	1
12	DC power supply (1.5V, 9V each)	2	13	Digital electric meter	2
14	E-connector	4	15	L-shaped connector	12
16	T-shaped connector	4			

Experimental Principle

This experiment in the npn transistor, and most contained are free electrons, holes are minority carrier. The experimental measurement of its characteristic curve. In the npn transistor structure and symbol as shown in Figure 1, there are three electrodes Emitter, base, and sets. Circuit symbol the arrow direction in Figure 2 represents conventional current direction (that is, the direction of flow of positive charge) The operation of the transistor is in forward bias is applied between the emitter and the base electrode, and the reverse bias is applied between the collector and base Figure 3 displays the movement of free electrons in transistors. By the free electron emitter precinct, the vast majority through a thin layer of the base area, reach the collector region This experiment will measure in case of I_B remained constant, $I_{C.}$ V_{CE} characteristics curves (V_{CE} as a set and the potential difference between the emitter) This characteristic is useful when designing transistor amplifier circuit. As can be seen from Figure 3 V_{CE}= V_{CB} +V_{BE}, where V_{CB} worse for the sets of the potential between the electrode and the base electrode, and the V_{BE} is a potential difference between the base and emitter Because when the transistor is in on-State, V_{BE} roughly unchanged at 0.7V, while V_{CE} >0.7,, V_{CB} >0, electrons flow from the emitter majority arrived at the set, so $I_C \fallingdotseq I_E$. But when the VCE down to 0.7V when the V_{CB} becomes negative, the set voltage is lower than the base of the pole, that is, between the set and the base forward bias. Set most of the polar region contains child (free electrons) will flow from a set base, offset in part by the electron flow from the emitter, so I_C V_{CE} lower decreases to zero. Typical I_C V_{CE} curve as shown in Figure 4, the base current in Figure I3>I2>I1, Saturated zone on the left side of the dash (the emitter and base, as well as between the set and the base face forward-bias) Active area on the right (that is, between the emitter and the base consequent to the interface of bias, set interface between the pole and base reverse bias)

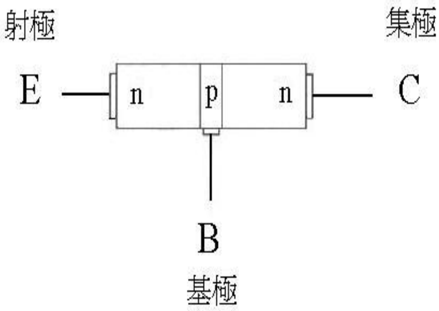


Figure 1

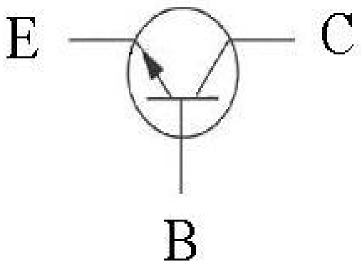


Figure 2

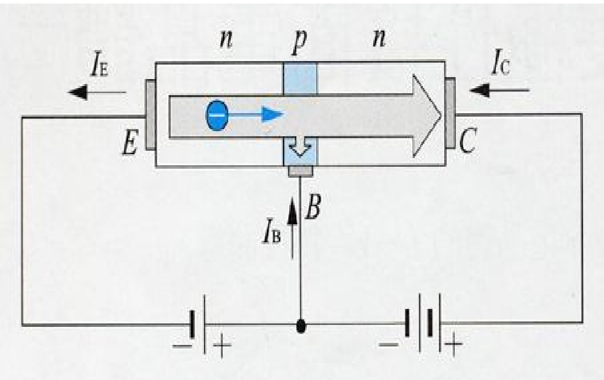


Figure 3

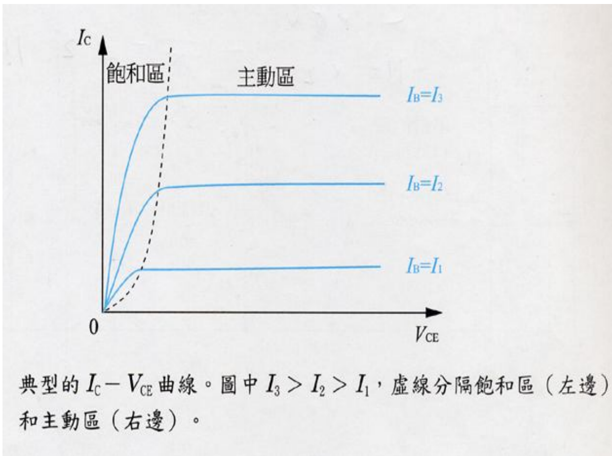


Figure 4

Experimental Methods

1. Accordance with Figure 5, a circuit diagram of the apparatus combination shown in Figure 6, the figure 10kΩ is used to limit the size of the I_B, to avoid excessive current flows into the transistor and cause transistor overheating.

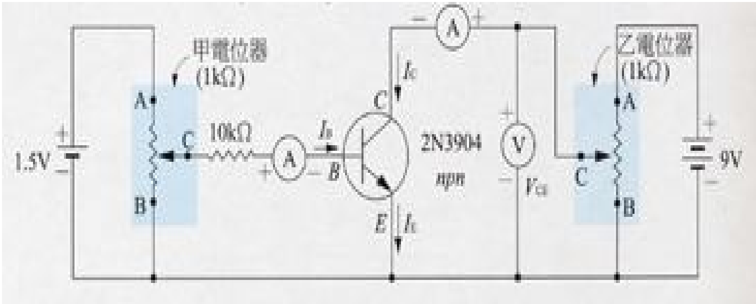


Figure 5

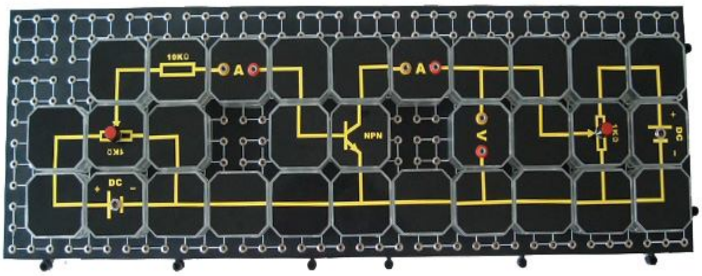


Figure 6

2. Adjust the potentiometer for base current fixed I_B=10μA, then adjust the potentiometer, set between the emitter and the voltage V_{CE} from scratch, first each time you increase the 0.2V, after the current growing value, you can reduce the rate of up to 1.0V, increasing gradually to 8.0V or 9.0V, record each V_{CE} the collector current I_C.
3. The resulting data is converted into the relation curve between the I_C to V_{CE}.
4. Change the I_B=30μA and 50μA, repeat steps 2-3.

Experimental Results and Discussion

Experiment I, measurement characteristic curve of I_C-V_{CE}.

I_B= μ A

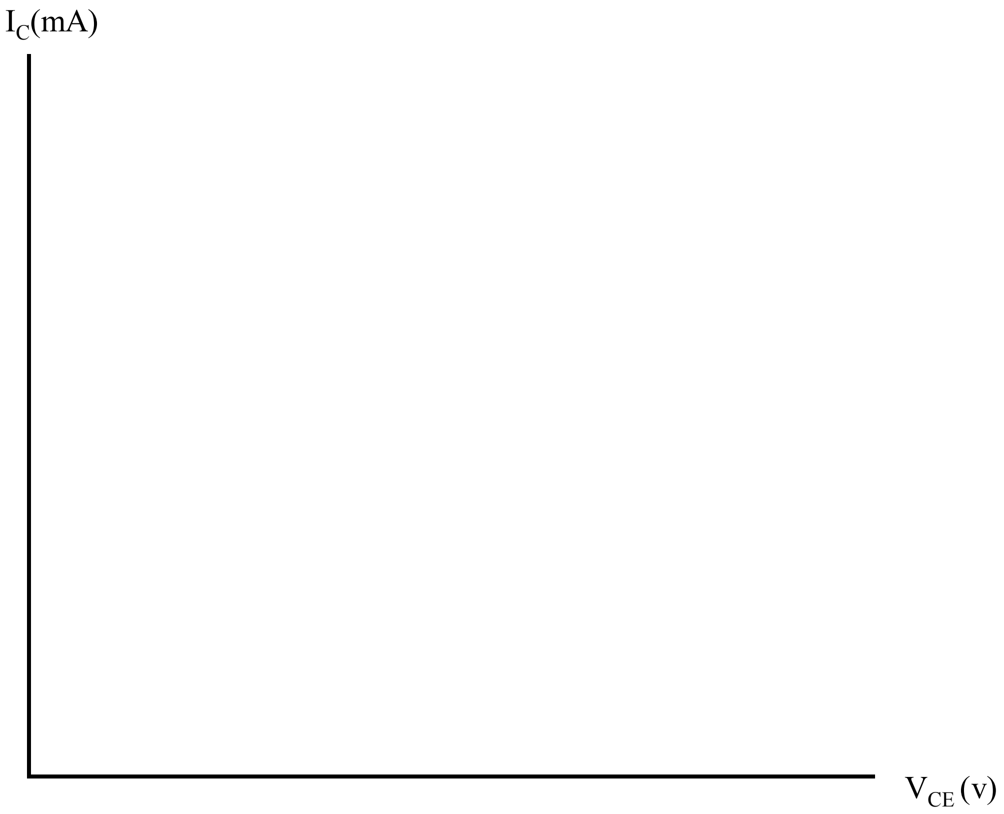
V_{CE}														
I_C														

I_B= μ A

V_{CE}														
I_C														

I_B= μ A

V_{CE}														
I_C														



1. Based on the $I_C - V_{CE}$ relationship derived from experimental curve, when the V_{CE} increases, I_C is a certain value?
2. From the active zone in the $I_C - V_{CE}$ curve, find the current gain β values?
3. From the $I_C - V_{CE}$ curves in the active region, the collector currents change when the base current I_B from 10μA to 50μA. The amount of ΔI_C why? Calculate ratio of ΔI_C and ΔI_B.