

EXPERIMENT REPORT

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| **Experiment Name** | EXTRACTION OF DC CHARACTESISTICS OF  BJT AND MOSFET |
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**EXPERIMENT 2**

**EXTRACTION OF DC CHARACTESISTICS OF**

**BJT AND MOSFET**

**The Purpose of the Experiment**

Theoretical and practical understanding of current-voltage relationship of the Bipolar Junction Transistor (BJT) and MOS transistor in DC operation region.

**Experiment 2.1**

In this experiment we have observed the working principles of forward biased BJT transistor. The purpose of the experiment is observing characteristics of current and voltage and comparing the results with theoretical knowledge. With the help of these results, we tried to drawIC – VBEve IC – IB graphics.

We have build the experiment in Graph 2.2(except R3). We supposed Vc and Vb constant and equal to 5V. By adjusting R1, we have measured VBE, IC ve VR2 with voltmeter and ampermeter. Results are at the table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| R1 (kΩ) | VBE (V) | IC  (mA) | VR2  (mV) | IB (uA) | β |
| 1000 | 0,635 | 1 | 40 | 4 | 250 |
| 680 | 0,643 | 1,42 | 57 | 5,7 | 249,12 |
| 470 | 0,656 | 2,3 | 92,4 | 9,24 | 248,92 |
| 330 | 0,659 | 2,69 | 108,02 | 10,8 | 249,07 |
| 220 | 0,674 | 4,65 | 185,96 | 18,5 | 251,35 |
| 150 | 0,683 | 7,14 | 284,14 | 28,4 | 251,41 |
| 100 | 0,692 | 9,18 | 363,9 | 36,4 | 252,20 |
| 68 | 0,704 | 13,92 | 553,52 | 55,4 | 251,26 |
| 47 | 0,707 | 18,56 | 722 | 72,2 | 257,06 |
| 33 | 0,713 | 24,41 | 932,97 | 93,3 | 261,62 |
| 22 | 0,725 | 33,6 | 1267,7 | 126,8 | 265,19 |
| 15 | 0,733 | 42,2 | 1609,6 | 161 | 262,11 |

IC – VBE relationship acts similar to IC = IS eVBE/VT. IC – IB relationship acts similar to IC = ßIB. Incline gives the β. For R1 = 100k -> IS=10e-15mA, VBE =0,692V, VT = 25mV therefore IC = IS eVBE/VT =10e-15. e0,692/25m =9,15mA. It is so close to our mesasuremernts.

**Experiment 2.2**

In this experiment we examined working principles of BJT transıstor at reverse active and saturation mode. The purpose of the experiment is observing characteristics of current and voltage while BJT transistor is workin reverse active; and comparing the results with theoretical knowledge. We have attached the transistor we build in exp. 2.1 backwards

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | VBE (V) | VCE  (V) | IB (uA) | IC (mA) | β |
| Forward biased | 0,713 | 5 | 93,3 | 24,41 | 261,62 |
| Saturation | -4.45 | -5 | - 0,2 | -2 | 10 |
| Reverse biased | 0,71 | 38,73 | 0,43 | 5,12 | 11,91 |

Therefore we made the transistor to reversely polarized. Furthermore, if we interrupt R1 and use R3 as a variable resistance, we can see saturation datas of the transistor Results are at the table.

IB has got different values cause of its asymmetry.. The electrons which sprayed to emitter while its running forward active, are the same excessive electrons which sprayed to collector while its running reverse action. The number of spaces occuring in the collector is reduced at reverse action mode. Therefore, electron flow velocity will be lower than first experiment.

**Experiment 2.3:**

We have examined the MOS transistor’s working principles at saturation mode. We have built the circuit shown at picture 2.4. Vgs and Id values based on R2’s different values are at the table.

|  |  |
| --- | --- |
| **VGS[V]** | **ID[mA]** |
| 9,2 | 19,25 |
| 8,8 | 17,93 |
| 7,38 | 16,69 |
| 7,87 | 15,06 |
| 7,05 | 12,38 |
| 6,2 | 9,7 |

They act similar to ID = (kn/2)\*(VGS – Vth)2.

**Experiment 2.4**

We have build the circuit shown at picture 2.4. VDS and ID values which related to VD 0-10V are at the table.

|  |  |
| --- | --- |
| VDS[V] | ID[mA] |
| 1,05 | 3,36 |
| 2 | 4,81 |
| 3,05 | 5,1 |
| 4,04 | 5,15 |
| 5,07 | 5,17 |
| 6,03 | 5,19 |
| 7,04 | 5,20 |
| 8,12 | 5,21 |
| 9,08 | 5,213 |
| 10,12 | 5,22 |

Saturation current of the transistor and the source ID that can not be controlled by the voltage difference between the time is increased. Obtained graphic shows transistor starts to run saturation after ID starts to be constant.

**Experiment 2.5**

The circuit shown in Figure 2.5 R1 changing 0Ω, 1k Ω and 2.2K Ω. ID=1mA current is constant. VSB and VGS  values are at the table:

|  |  |  |  |
| --- | --- | --- | --- |
| **R1[k Ω]** | **VSB (V)** | **VGS  (V)** | **VDS  (V)** |
| 0 | 0 | 2,7 | 2,7 |
| 1 | 1,1 | 2,7 | 3,8 |
| 2.2 | 2,4 | 2,66 | 5,1 |