**Министерство образования и науки Российской Федерации**

**Федеральное агентство по образованию**

**ФГБОУВПО**

**Московский государственный университет печати имени Ивана Федорова**

«Биполярный транзистор»

Лабораторная работа по дисциплине “Общая электротехника и электроника”

Выполнил:

Студент 3-го курса

Группы ДЦ 3-1

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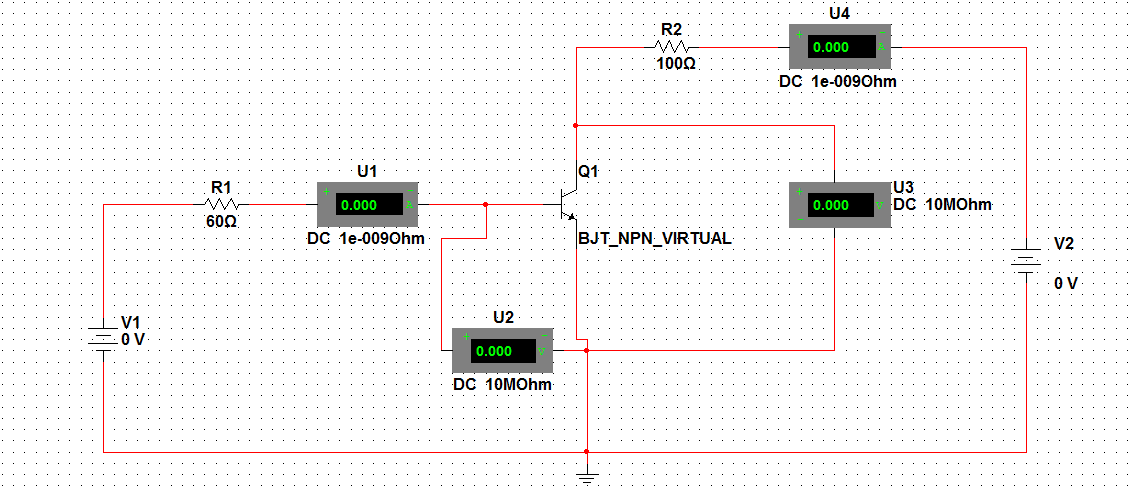
Проверила:

доц. Михайлова О.М.

**МОСКВА 2012**

**Цель работы:** Исследовать зависимость тока коллектора от тока базы и напряжения база-эмиттер, проанализировать зависимость коэффициента усиления по постоянному току от тока коллектора, исследовать работу биполярного транзистора в режиме отсечки, получить входные и выходные характеристики транзистора, определить коэффициент передачи по переменному току, исследовать динамическое входное сопротивление транзистора.

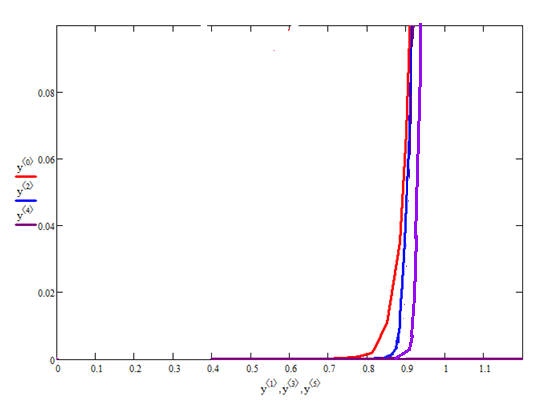
1. **Получение характеристик транзистора на входе:**

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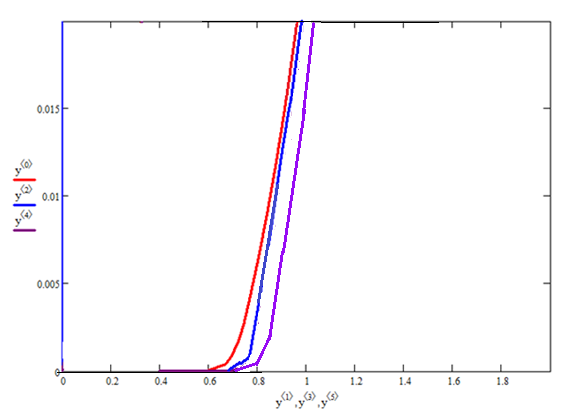
Идеальный транзистор Реальный транзистор

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ek=0 B | | | Ek=5 B | | | Ek=10 B | | | Ek=0 B | | | Ek=5 B | | | Ek=10 B | | |
| E; | I; | U; | E; | I; | U; | E; | I; | U | E; | I; | U; | E; | I; | U | E | I; | U; |
| 0.4 | 0.05\*10 | 0.4 | 0.4 | 0.111\*10 | 0.4 | 0.4 | 0.111\*10 | 0.4 | 0.4 | 0.143 \*10 | 0.4 | 0.4 | 1.167\*10 | 0.4 | 0.4 | 0.167\*10 | 0.4 |
| 0.5 | 0.11\*10 | 0.5 | 0.5 | 0.111\*10 | 0.5 | 0.7 | 0.777\*10 | 0.7 | 0.5 | 0.889 \*10 | 0.5 | 0.5 | 0.333\*10 | 0.5 | 0.5 | 0.22 \*10 | 0.5 |
| 0.6 | 1.332\*10 | 0.6 | 0.7 | 0.777\*10 | 0.6 | 0.8 | 0.026\*10 | 0.798 | 0.6 | 0.39 \*10 | 0.598 | 0.6 | 2.103\*10 | 0.6 | 0.7 | 0.0446\*10 | 0.697 |
| 0.7 | 0.045\*10 | 0.697 | 0.75 | 3.997\*10 | 0.7 | 0.9 | 0.453\*10 | 0.873 | **0.7** | **0.452**\*10 | **0.7** | 0.7 | 0.045\*10 | 0.697 | 0.8 | 0.426\*10 | 0.768 |
| **0.8** | **0.502**\*10 | **0.770** | 0.8 | 0.026\*10 | 0.750 | 0.95 | 0.962\*10 | 0.892 | 0.75 | 0.87 \*10 | 0.694 | 0.75 | 0.192\*10 | 0.701 | 0.82 | 0.702\*10 | 0.778 |
| 0.85 | 1\*10 | 0.790 | 0.85 | 0.137\*10 | 0.798 | 0.97 | 1.282\*10 | 0.893 | 0.77 | 1.071 \*10 | 0.711 | 0.8 | 0.554 \*10 | 0.766 | 0.85 | 0.9\*10 | 0.790 |
| 0.9 | 1.641\*10 | 0.799 | 0.92 | 0.751\*10 | 0.873 | 2 | 0.018 | 0.901 | **0.9** | **2.699** \*10 | **0.744** | 0.84 | 1.105\*10 | 0.774 | 0.9 | 1.618\*10 | 0.803 |
| **0.95** | **1.772**\*10 | **0.811** | 0.94 | 1.07 \*10 | 0.875 | 4 | 0.051 | 0.911 | **1.5** | **0.011** | **0.862** | 0.88 | 1.656\*10 | 0.781 | 1 | 3.022\*10 | 0.813 |
| 1 | 3.01 10 | 0.819 | 1 | 2.059 10 | 0.875 | 6 | 0.085 | 0.918 | 2 | 0.018 | 0.946 | 0.96 | 2.762\*10 | 0.794 | 1.5 | 0.01 | 0.896 |
| **1.5** | **0.01** | **0.853** | 2 | 0.019 | 0.876 | 8 | 0.118 | 0.924 | 4 | 0.046 | 1.255 | 1 | 3.317\*10 | 0.801 | 4 | 0.045 | 1.271 |
| 3 | 0.033 | 0.884 | 4 | 0.052 | 0.889 | 10 | 0.151 | 0.929 | 6 | 0.074 | 1.533 | 2 | 0.017 | 0.961 | 6 | 0.074 | 1.565 |
| 5 | 0.078 | 0.901 | 6 | 0.085 | 0.904 | 11 | 0.176 | 0.932 | 8 | 0.103 | 1.847 | 4 | 0.046 | 1.263 | 8 | 0.102 | 1.867 |
| 8 | 0.112 | 0.915 | 10 | 0.151 | 0.925 | 12 | 0.184 | 0933 | 10 | 0.131 | 2.139 | 10 | 0.131 | 2.144 | 10 | 0.131 | 2.148 |

Идеальный на входе:

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Реальный на входе:

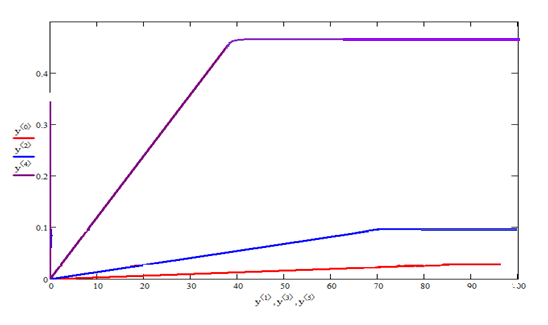


1. **Получение характеристик транзистора на выходе:**

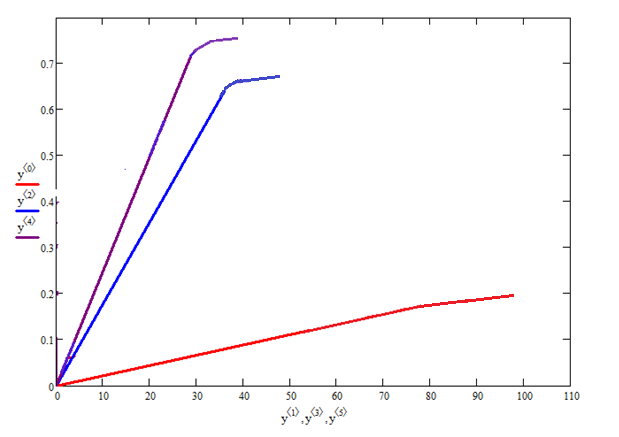
идеальный реальный

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ek=0.8B; **0.502 \*10 A** | | | Ek=0.95 B; **1.74 \*10 A** | | | Ek=1.5 B; **0.01 A** | | | Ek=0.7 B; **0.452\*10 A** | | | Ek=0.9 B; **2.699\*10 A** | | | Ek=1.5 B; **0.011 A** | | |
| E; B | I; A | U; B | E; B | I; A | U; B | E; B | I; A | U; B | E; B | I; A | U; B | E; B | I; A | U; B | E; B | I; A | U; B |
| 1 | 2.549\*10 | 0.745 | 1 | 9.476 10(-3) | 0.052 | 1 | 9.721\*10(-3) | 0.028 | 1 | 5.88\*10(-3) | 0.431 | 1 | 8.668 10(-3) | 0.033 | 1 | 9.769\*10(-3) | 0.023 |
| 5 | 2.555\*10 | 4.745 | 5 | 0.079 | 0.109 | 5 | 0.049 | 0.051 | 5 | 6.32\*10(-3) | 4.371 | 5 | 0.049 | 0.117 | 5 | 0.049 | 0.082 |
| 10 | 2.556\*10 | 9.744 | 10 | 0.096 | 0.385 | 10 | 0.099 | 0.067 | 10 | 7.05\*10(-30 | 9.295 | 10 | 0.098 | 0.224 | 10 | 0.098 | 0.151 |
| 20 | 2.558\*10 | 39.744 | 30 | 0.096 | 20.384 | 20 | 0.199 | 0.086 | 20 | 8.362\*10(-3) | 19.144 | 20 | 0.132 | 6.773 | 20 | 0.197 | 0.282 |
| 40 | 2.558\*10 | 39.744 | 50 | 0.096 | 40.384 | 40 | 0.399 | 0.112 | 30 | 0.010 | 28.993 | 30 | 0.156 | 14.435 | 30 | 0.296 | 0.423 |
| 80 | 2.558\*10 | 79.744 | 80 | 0.096 | 70.384 | 50 | 0.499 | 0.123 | 50 | 0.013 | 48.691 | 50 | 0.202 | 29.759 | 50 | 0.414 | 8.557 |
| 90 | 2.558\*10 | 82.3 | 90 | 0.096 | 90.384 | 60 | 0.599 | 0.135 | 60 | 0.015 | 58.539 | 60 | 0.226 | 37.422 | 60 | 0.462 | 13.767 |
| 100 | 2.558\*10 | 98.1 | 100 | 0.096 | 110.384 | 80 | 0.798 | 0.168 | 70 | 0.016 | 68.388 | 70 | 0.249 | 45.084 | 70 | 0.51 | 18.978 |
| 110 | 2.558\*10 | 110 | 110 | 0.096 | 130.384 | 100 | 0.916 | 8.433 | 80 | 0.018 | 78.237 | 80 | 0.273 | 52.746 | 80 | 0.558 | 24.188 |
| 120 | 2.558\*10 | 118.34 | 120 | 0.096 | 150.384 | 120 | 0.916 | 28.433 | 90 | 0.019 | 88.086 | 90 | 0.296 | 60.408 | 90 | 0.647 | 28.399 |
| 130 | 2.558\*10 | 125.66 | 130 | 0.096 | 170.384 | 130 | 0.916 | 38.433 | 100 | 0.02 | 91.1 | 100 | 0.31 | 69.33 | 100 | 0.718 | 30.122 |

Идеальный на выходе:



Реальный на выходе:



**Н - параметры:**

**Идеальный транзистор:**

H11= ΔUбэ **/** ΔIб = (Uб2 - Uб1) / (Iб2 - Iб1) = (0.811 – 0.799) / (1.772 – 1.641)\* = 0.012 / 0.1\* =**120 Ом**

H12= ΔUбэ **/** ΔUkэ = (Uб2 - Uб1) / (Uk2 - Uk1) = (0.811 – 0.799) / (5 – 0) = 0.012 / 5 = **0.0024**

H21= ΔIk **/** ΔIб = (Ik2 - Ik1) / (Iб2 - Iб1) = (0.079 – 2.549) / (1.74 – 0.502)\* = 0.0832 / 0.071\* = 0.0611\*= **61**

H22 = ΔIk **/** ΔUkэ = (Ik2 - Ik1) / (Uk2 - Uk1) = (0.099 – 0.096) / (1.5 – 0.95) = 0.003 / 0.55 = 0.005 = **5\* См**

**Реальный транзистор ():**

H11= ΔUбэ **/** ΔIб = (Uб2 - Uб1) / (Iб2 - Iб1) = (0.674 – 0.598) / (0.452 – 0.39) = 0.086 / 0.216\*= **344 Ом**

H12= ΔUбэ **/** ΔUkэ = (Uб2 - Uб1) / (Uk2 - Uk1) = (0.701 – 0.694) / (5 – 0) = 0.007 / 5 = **0.0013**

H21= ΔIk **/** ΔIб = (Ik2 - Ik1) / (Iб2 - Iб1) = (0.098 – 7.05 10 ) / (2.599 – 0.426)\* = 0.09095 / 2.173\* = 0.0418\* = **41.8**

H22 = ΔIk **/** ΔUkэ = (Ik2 - Ik1) / (Uk2 - Uk1) = (9.769 – 9.668) / (1.5 – 0.9) = 0.1\* / 0.6 = **1.2\***