

ELECTRICAL&ELECTRONICS ENGINEERING DEPARTMENT

EEM 214 ELECTRONICS

EXPERIMENT- 4

JFET Bias Circuits

RAPOR

Hazırlayan:

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Objective

To analyze the fixed and voltage-divider bias JFET networks.

Part-1 Fixed-Bias Network

For the fixed-bias configuration, V_{GS} will be set by an independent dc supply.

a- Construct the network of Figure-1. Insert the measured value of R_D .

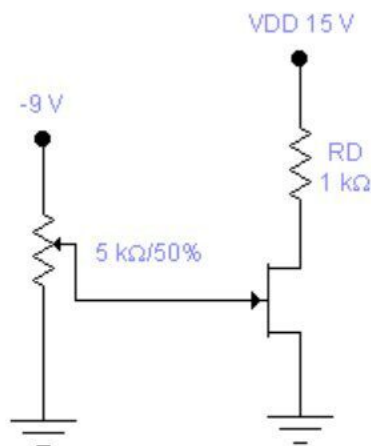


Figure-1

- b- Set V_{GS} to zero volts and measure the voltage V_{RD} . Calculate I_D from $I_D = V_{RD} / R_D$ using the measured value of R_D . Since $V_{GS} = 0$ V the resulting drain current is the saturation value I_{DSS} . Record the value.

$$V_{RD} = 14.48 \text{ V}$$

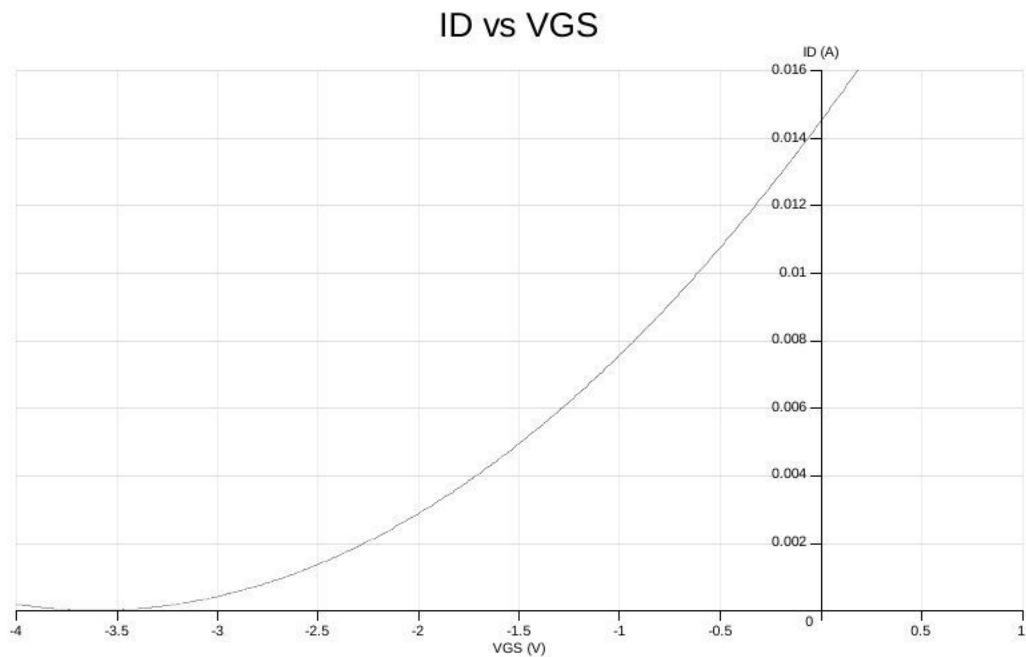
$$I_D = V_{RD} / R_D = I_{DSS} = 14.48 \text{ mA}$$

- c- Make V_{GS} more and more negative until $V_{RD} = 1$ mV (and $I_D = 1 \mu\text{A}$). Since I_D is very small ($I_D = 0$ A), the resulting value of V_{GS} is the pinch of voltage V_P . Record the value.

$$V_P = -3.6 \text{ V}$$

- d- Using the values above for I_{DSS} and V_P , sketch the transfer curve (I_D vs V_{GS}).

$$V_P = -3.6 \text{ V}, I_{DSS} = 14.48 \text{ mA}$$



- e- If $V_{GS} = -1$ V, determine I_{DQ} from the curve that you sketched. Show all work in your sketch.

$$\text{(calculated)} I_{DQ} = 10.40 \text{ mA}$$

- f- Set $V_{GS} = -1$ V in the network and measure V_{RD} . Calculate I_{DQ} using the measured value of R_D and insert below. This is the measured value of I_D .

$$\text{(measured)} V_{RD} = 13.40 \text{ V}$$

$$\text{(from measured)} I_{DQ} = 13.40 \text{ mA}$$

g- Compare the measured and calculated values of I_{DQ} .

(from measured) $I_{DQ} = 13.40\text{mA}$ - (calculated) $I_{DQ} = 10.40\text{ mA}$

Part-2 Voltage-Divider Bias Network

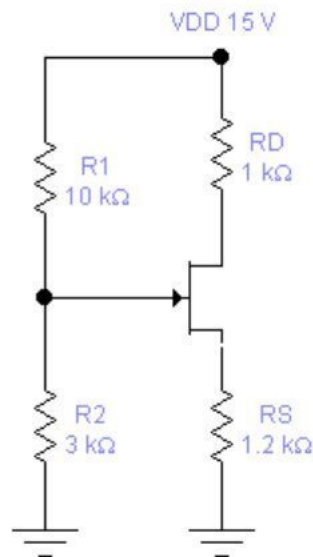
In the voltage-divider-bias configuration V_{GS} is determined by a voltage-divider-bias voltage and voltage drop across the source resistance. That is, for the network of Figure-2,

$$V_G = R_2 \cdot V_{DD} / (R_1 + R_2)$$

and

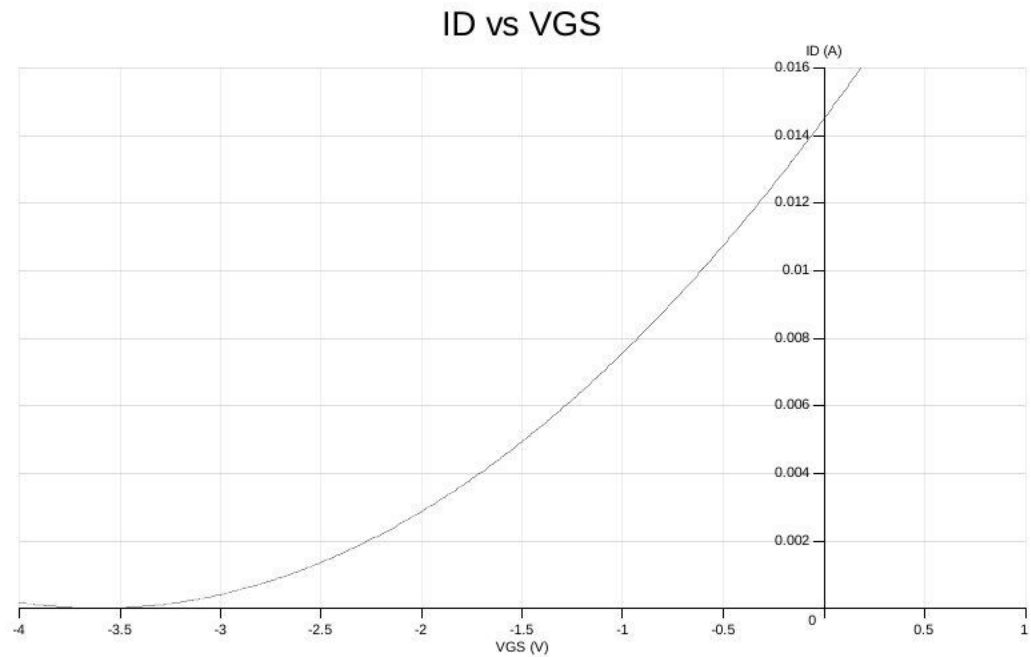
$$V_{GS} = V_G - I_D \cdot R_S$$

a- Construct the network of Figure-2. Insert the measured resistor values.



b- Using the I_{DSS} and V_P determined in Part-1, draw the voltage-divider-bias line in your sketch and find the network Q point. Label the resulting straight line as the voltage-divider line.

To draw the bias line determine two points and then connect the two points with a straight line.



c- Calculate the Q- points of the network (I_{DQ} , V_{GSQ})

$$V_G = R_2 \cdot \frac{V_{DD}}{R_1 + R_2} = 3.46V$$

$$V_G = \mathbf{3.46V \text{ (calc)}}$$

$$V_{GS} = V_G - I_D \cdot R_S$$

$$= 3.46 - 1200 \cdot I_D$$

$$= 3.46 - 1200 \cdot I_{DSS} \cdot \left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$= 3.46 - 1200 \cdot 0.01448 \cdot \left(1 - \frac{V_{GS}}{-3.6}\right)^2$$

$$V_{GS} = \mathbf{-1.648 \text{ V (calc)}}$$

$$I_{DQ} = I_{DSS} \cdot \left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$I_{DQ} = \mathbf{4.25 \text{ mA (calc)}}$$

d- Calculate the theoretical values of V_D , V_S and V_{DS} and record the values.

$$V_D = 15 - I_{DQ} \cdot 1000 = \mathbf{10.75 \text{ V (calc)}}$$

$$V_S = I_{DQ} \cdot 1200 = \mathbf{5.1 \text{ V (calc)}}$$

$$V_{DS} = V_D - V_S = \mathbf{5.65 \text{ V (calc)}}$$

e- Measure the voltages V_{GSQ} , V_D , V_S and V_{DS} and record the values.

$$V_{GSQ} = -1.736 \text{ (meas)}$$

$$V_D = 10.685 \text{ (meas)}$$

$$V_S = 5.321 \text{ (meas)}$$

$$V_{DS} = 5.364 \text{ (meas)}$$

f- Calculate the percent difference between the calculated and the measured values using the equation below.

$$\% \text{ difference} = \left(\frac{|V_{meas} - V_{calc}|}{|V_{calc}|} \right) \times 100\%$$

	calculated	measured	%difference
V_{GSQ}	-1.648	-1.736	%5.34
V_D	10.75	10.685	%0.60
V_S	5.1	5.321	%4.33
V_{DS}	5.65	5.364	%5.06

g- Calculate I_{DQ} from the measured voltages of step e and compare to the value determined in step c.

I_{DQ} can be found using

$$I_{DQ} = (V_{DD} - V_D) / R_D$$

$$I_{DQ} = (15 - 10.685) / 1000 = 4.315 \text{ mA}$$

and the measured values of V_D and R_D . Record the value and calculate the % difference.

$$\% \text{ difference} = \left(\frac{|4.25 - 4.315|}{|4.25|} \right) \times 100\% = \%1.52$$