JFET CHARACTERISTICS

Aim To plot static drain characteristics of an JFET and to calculate its parameters.

Components and equipments required JFET, rheostat, voltmeters, ammeter, dc source and bread board.

Theory Junction Field effect Transistor is a unipolar device since its function depends only upon one type of carrier. JFET has high input impedance unlike BJT.

JFETs are two types, N-channel and P-channel. An N-channel JFET is an N-type silicon bar with a P-type semiconductor is embedded on both sides of the bar. P-type semiconductor forms the gate and the ends of the N-type bar are source and drain. The P-type regions are externally shorted. The gate of an N-channel JFET is connected to a negative potential with respect to source. The drain is connected to a positive potential with respect to the source.

Drain dynamic resistance r_d It is defined as the ratio of change in drain to source voltage to the change in drain current at an operating point, when gate to source voltage remains constant.

$$r_d = \frac{\Delta V_{DS}}{\Delta I_D} \quad \text{with } V_{GS} = \text{constant.}$$

Mutual conductance g_m It is defined as the ratio of change in drain current to the change in gate to source voltage at an operating point, when drain to source voltage remains constant.

$$g_m = \frac{\Delta I_D}{\Delta V_{GS}} \quad \text{with } V_{DS} \text{ constant.}$$

Amplification factor μ It is defined as the ratio of change in drain to source voltage to the change in gate to source voltage, when drain current remains constant.

$$\mu = \frac{\Delta V_{DS}}{\Delta V_{GS}} \quad \text{with } I_D \text{ constant.}$$

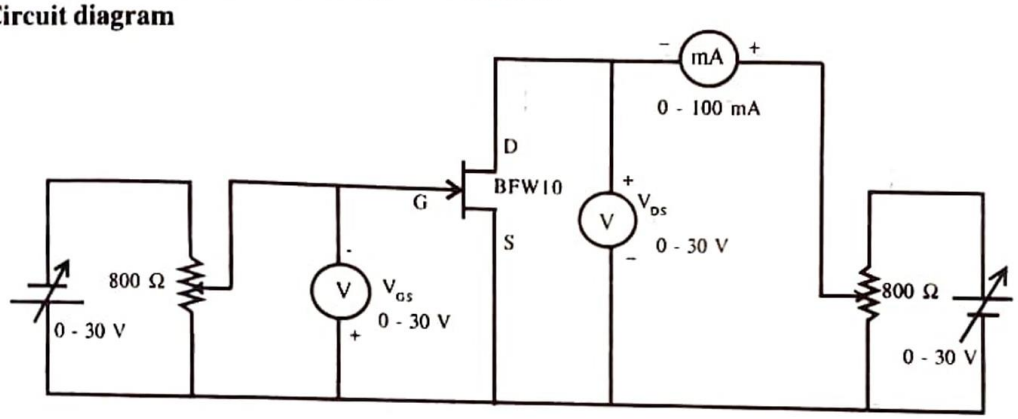
These three parameters are related each other by the equation, $\mu = g_m r_d$.

r_d can be obtained from drain characteristics and gm and μ can obtained from mutual characteristics.

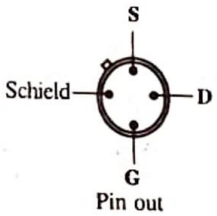
Procedure

1. Identify the terminals of the FET, wire up the circuit on bread board and verify the connections made in the circuit using a multimeter.
2. Switch ON V_{GS} and V_{DD} supplies keeping rheostats in minimum position. Fix V_{GS} at 0 V. Increase V_{DS} in steps and note down the drain current I_D for each value of V_{DS}. Repeat it for various values of V_{GS}.
3. Plot drain characteristics with I_D along y-axis and V_{DS} along x-axis.
4. Keep V_{DS} = 10 V. Vary V_{GS} and note down the values of I_D for various values of V_{GS}. Plot the mutual characteristics (also called transfer or transconductance characteristics) in the second quadrant of a graph sheet with V_{GS} along x-axis and I_D along y-axis. Repeat this step for V_{DS} = 20 V.
5. Calculate FET parameters using their formulae.

Circuit diagram



Details of BFW 10/11 Type N-channel JFET,
I_d = 2mA, g_m = 2.5 mA/V, R_O = 40 k



Observations

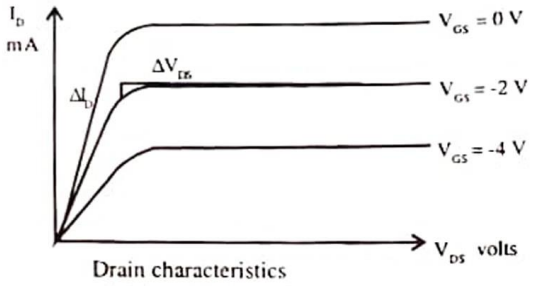
V_{GS} = 0 V		V_{GS} = −2 V		V_{GS} = −4 V	
V_{DS} V	I_D mA	V_{DS} V	I_D mA	V_{DS} V	I_D mA

Drain characteristics

$$r_d = \frac{\Delta V_{DS}}{\Delta I_D} \text{ with } V_{GS} \text{ constant.} \qquad \mu = \frac{\Delta V_{DS}}{\Delta V_{GS}} \text{ with } I_D \text{ constant}$$

52

Graph



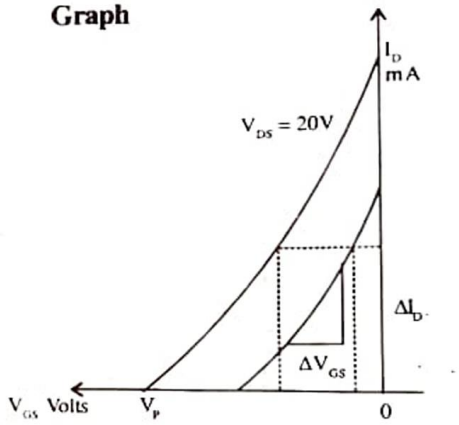
Drain characteristics

Observations

V_{DS} = 0 V		V_{DS} = 20 V	
V_{GS} V	I_D mA	V_{GS} V	I_D mA

Transfer characteristics

Graph



$$g_m = \frac{\Delta I_D}{\Delta V_{GS}} \quad \text{with } V_{DS} \text{ constant}$$

Result Drain dynamic resistance of BFW10 r_d = ...Ω
Mutual conductance g_m = ...
Amplification factor μ = ...

Reference

Electronics Lab Manual Volume I, K.A. Navas, **Rajath Publishers**