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MESFET Characteristics Formulas

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List of 13 MESFET Characteristics Formulas

MESFET Characteristics

1) Cut-off Frequency

$$\text{fx } f_{\text{co}} = \frac{V_s}{4 \cdot \pi \cdot L_{\text{gate}}}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$\text{ex } 30.05192\text{Hz} = \frac{5\text{mm/s}}{4 \cdot \pi \cdot 13.24\mu\text{m}}$$

2) Cut-off Frequency given Transconductance and Capacitance

$$\text{fx } f_{\text{co}} = \frac{g_m}{2 \cdot \pi \cdot C_{\text{gs}}}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$\text{ex } 30.02923\text{Hz} = \frac{0.05\text{S}}{2 \cdot \pi \cdot 265\mu\text{F}}$$

3) Cut-off Frequency using Maximum Frequency

$$\text{fx } f_{\text{co}} = \frac{2 \cdot f_m}{\sqrt{\frac{R_d}{R_s + R_g + R_i}}}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$\text{ex } 30.05347\text{Hz} = \frac{2 \cdot 65\text{Hz}}{\sqrt{\frac{450\Omega}{5.75\Omega + 2.8\Omega + 15.5\Omega}}}$$



4) Drain Resistance of MESFET

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)

$$\text{fx } R_d = \left(\frac{4 \cdot f_m^2}{f_{co}^2} \right) \cdot (R_s + R_g + R_i)$$

$$\text{ex } 450.104\Omega = \left(\frac{4 \cdot (65\text{Hz})^2}{(30.05\text{Hz})^2} \right) \cdot (5.75\Omega + 2.8\Omega + 15.5\Omega)$$

5) Gate Length of MESFET

[Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1_img.jpg\)](#)

$$\text{fx } L_{\text{gate}} = \frac{V_s}{4 \cdot \pi \cdot f_{co}}$$

$$\text{ex } 13.24084\mu\text{m} = \frac{5\text{mm/s}}{4 \cdot \pi \cdot 30.05\text{Hz}}$$

6) Gate Metallization Resistance

[Open Calculator !\[\]\(4fe57c3593bf1b21d272ae7ac8dfaf77_img.jpg\)](#)

$$\text{fx } R_g = \left(\frac{R_d \cdot f_{co}^2}{4 \cdot f_m^2} \right) - (R_s + R_i)$$

$$\text{ex } 2.794445\Omega = \left(\frac{450\Omega \cdot (30.05\text{Hz})^2}{4 \cdot (65\text{Hz})^2} \right) - (5.75\Omega + 15.5\Omega)$$



7) Gate Source Capacitance

$$fx \quad C_{gs} = \frac{g_m}{2 \cdot \pi \cdot f_{co}}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 264.8169\mu F = \frac{0.05S}{2 \cdot \pi \cdot 30.05Hz}$$

8) Input Resistance

$$fx \quad R_i = \left(\frac{R_d \cdot f_{co}^2}{4 \cdot f_m^2} \right) - (R_g + R_s)$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 15.49445\Omega = \left(\frac{450\Omega \cdot (30.05Hz)^2}{4 \cdot (65Hz)^2} \right) - (2.8\Omega + 5.75\Omega)$$

9) Maximum Frequency of Oscillation given Transconductance

$$fx \quad f_m = \frac{g_m}{\pi \cdot C_{gs}}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 60.05847Hz = \frac{0.05S}{\pi \cdot 265\mu F}$$



10) Maximum Frequency of Oscillations in MESFET

$$\text{fx } f_m = \left(\frac{f_t}{2} \right) \cdot \sqrt{\frac{R_d}{R_g}}$$

Open Calculator 

$$\text{ex } 65.28817\text{Hz} = \left(\frac{10.3\text{Hz}}{2} \right) \cdot \sqrt{\frac{450\Omega}{2.8\Omega}}$$

11) Source Resistance

$$\text{fx } R_s = \left(\frac{R_d \cdot f_{co}^2}{4 \cdot f_m^2} \right) - (R_g + R_i)$$

Open Calculator 

$$\text{ex } 5.744445\Omega = \left(\frac{450\Omega \cdot (30.05\text{Hz})^2}{4 \cdot (65\text{Hz})^2} \right) - (2.8\Omega + 15.5\Omega)$$

12) Transconductance in MESFET

$$\text{fx } g_m = 2 \cdot C_{gs} \cdot \pi \cdot f_{co}$$

Open Calculator 

$$\text{ex } 0.050035\text{S} = 2 \cdot 265\mu\text{F} \cdot \pi \cdot 30.05\text{Hz}$$



13) Transconductance in Saturation Region

[Open Calculator !\[\]\(eafc244b53721dd1ec133f0772f70fc7_img.jpg\)](#)

$$\text{fx } g_m = G_o \cdot \left(1 - \sqrt{\frac{V_i - V_g}{V_p}} \right)$$

$$\text{ex } 0.050963\text{S} = 0.174\text{S} \cdot \left(1 - \sqrt{\frac{15.9\text{V} - 9.62\text{V}}{12.56\text{V}}} \right)$$



Variables Used

- C_{gs} Gate Source Capacitance (Microfarad)
- f_{co} Cut-off Frequency (Hertz)
- f_m Maximum Frequency of Oscillations (Hertz)
- f_t Unity Gain Frequency (Hertz)
- g_m Transconductance (Siemens)
- G_o Output Conductance (Siemens)
- L_{gate} Gate Length (Micrometer)
- R_d Drain Resistance (Ohm)
- R_g Gate Metallization Resistance (Ohm)
- R_i Input Resistance (Ohm)
- R_s Source Resistance (Ohm)
- V_g Gate Voltage (Volt)
- V_i Schottky Diode Potential Barrier (Volt)
- V_p Pinch Off Voltage (Volt)
- V_s Saturated Drift Velocity (Millimeter per Second)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Measurement:** **Length** in Micrometer (μm)
Length Unit Conversion 
- **Measurement:** **Speed** in Millimeter per Second (mm/s)
Speed Unit Conversion 
- **Measurement:** **Frequency** in Hertz (Hz)
Frequency Unit Conversion 
- **Measurement:** **Capacitance** in Microfarad (μF)
Capacitance Unit Conversion 
- **Measurement:** **Electric Resistance** in Ohm (Ω)
Electric Resistance Unit Conversion 
- **Measurement:** **Electric Conductance** in Siemens (S)
Electric Conductance Unit Conversion 
- **Measurement:** **Electric Potential** in Volt (V)
Electric Potential Unit Conversion 
- **Measurement:** **Transconductance** in Siemens (S)
Transconductance Unit Conversion 



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