A Field Effect Transistor which can be biased to achieve a uniform depletion region

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Figure 1a. Collector current Vs Collector voltage for BJT

Figure 1b. Drain current Vs Drain voltage for MOSFET
Class F Waveform
Figure 2a

Class E Waveform and current Waveforms
Figure 2b
Drain Current Vs Drain voltage for MOSFET when “knee voltage” is zero.
The drain current when a JFET is saturated:

\[ I_{dsat} = G_0 \left( V_g - V_p - \frac{2}{3}(V_{bi} - V_p)\right) \left(1 - \frac{(V_{bi} - V_g)}{(V_{bi} - V_p)}\right)^{3/2}) \]  \hspace{1cm} (4.1)

The drain current when a MOSFET is saturated using square law analysis:

\[ I_{dsat} = \left( Z\mu'_n C_0/2L \right) (V_g - V_T)^2 \]  \hspace{1cm} (4.2)
The diagrams show the channel of a JFET under different conditions:

Figure 5a, the drain voltage equals the pinchoff voltage

Figure 5b, the drain voltage exceeds the pinchoff voltage.
Figure 6a. The voltage drop along the channel for the JFET when a SEVEN-volt battery is connected to the drain terminal and the source terminal is grounded.

Figure 6b. A “GRAYZEL JFET” where each section of the gate is biased by means of a separate battery.
**Figure 7a.** An n-type “GRAYZEL MOSFET”.

**Figure 7b.** An n-type “GRAYZEL MOSFET” where each section of the gate is biased by means of a battery and a resistor network.
The “GRAYZEL FET” with a square-wave gate voltage.

The susceptance of the channel as a function of time.

\[ G(t) = 0.5G_0 + g(t) \]

where,

\[ g(t) = \frac{2G_0}{\pi} \left( \cos \theta - \cos(3\theta)/3 + \cos(5\theta)/5 - \cos(7\theta)/7 + \cdots \right) \]

\[ = \frac{2G_0}{\pi} \sum_{k=1}^{\infty} (-1)^{k-1} \frac{\cos((2k-1)\theta)}{(2k-1)} \quad (8.1) \]

The drain voltage as a function of time.

\[ V_d(t) = V_0 + v(t) \]

Where,

\[ v(t) = V_1 \cos(\theta) + \sum_{k=1}^{\infty} (V_{2k}) \cos(2k\theta) \quad (8.2) \]
Figure 9a. A schematic of an FET amplifier

Figure 9b. The equivalent circuit of the FET amplifier shown in Figure 9a
The “GRAYZEL FET” with a square-wave gate voltage

The solution for \( I_d(t) \) is derived in the appendix to [12]

\[
I_d(t) = V_d(t)G(t) = [V_0 + v(t)][0.5G_0 + g(t)] = 0.5V_0G_0 + V_0g(t) + 0.5G_0v(t)+v(t)g(t) \tag{10.1}
\]

The solution for the output power and efficiency; derived in the appendix [12]

\[
P_1 = .5(GL)(V_1)^2 = (2(V_0)^2(GL)/\pi^2)/(X+(2/\pi)^2)^2 \tag{10.2}
\]

where \( G_0 \) is the susceptance of the channel when there is no depletion and \( X = GL/G_0=1./(G_0 \times RL) \)

\[
EFF=P_1/P_0 = (2/\pi)^2/(X+(2/\pi)^2 \) \tag{10.3}
\]
Efficiency Vs GL/G0

X = GL/G0

Efficiency Vs GL/G0