NMOS

OFF

$v_{GS} < V_{tn}$

Triode

$v_{GD} > V_{tn} \rightarrow v_{DS} < v_{OV}$

$i_D = k_n' \left(\frac{W}{L} \right) (v_{OV} - 0.5 v_{DS}) v_{DS}$

$v_{OV} = v_{GS} - V_{tn}$

Saturation

$v_{GD} \leq V_{tn} \rightarrow v_{DS} \geq v_{OV}$

$i_D = \frac{1}{2} k_n' \left(\frac{W}{L} \right) v_{OV}^2$

PMOS

OFF

$v_{SG} < |V_{tn}|$

Triode

$v_{DG} > |V_{tp}| \rightarrow v_{SD} < |v_{OV}|$

$i_D = k_p' \left(\frac{W}{L} \right) (|v_{OV}| - 0.5 v_{SD}) v_{SD}$

$v_{OV} = v_{SG} - |V_{tp}|$

Saturation

$v_{GD} \leq V_{tn} \rightarrow v_{DS} \geq v_{OV}$

$i_D = \frac{1}{2} k_n' \left(\frac{W}{L} \right) v_{OV}^2$

BJT

$i_C = \beta_F i_B$

$\alpha = \frac{\beta}{\beta + 1}$

$I_C = \alpha I_E$

$g_m = \frac{I_C}{V_T}$

$r_e = \frac{V_T}{I_E} = \frac{\alpha}{g_m}$

$r_\pi = \frac{\beta}{g_m}$

For MOSFET

$g_m = \mu C_{ox} \left(\frac{W}{L} \right) V_{OV}$

$r_o = V_A / I_D = \frac{1}{\lambda I_D}$