

# STAR: Sziklai Transconductance Analytical Redux

## J-FET static

$$\frac{I_d}{I_{dss}} = \left(1 - \frac{V_{gs}}{V_{po}}\right)^2$$

## J-FET dynamic

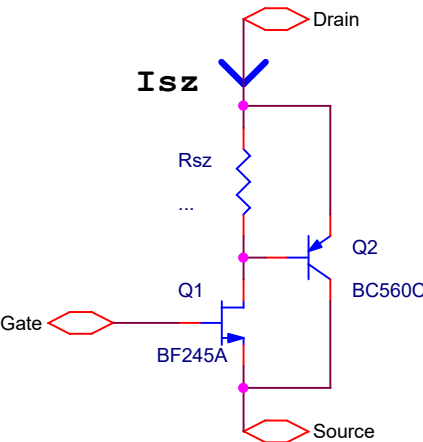
$$S = \frac{d(I_d)}{d(V_{gs})} = \frac{2 * I_{dss}}{-V_{po}} * \left(1 - \frac{V_{gs}}{V_{po}}\right)$$
$$S^{\wedge} = \frac{2 * I_{dss}}{-V_{po}}$$

## BJT static

$$\frac{I_c}{I_{cob}} = \left(e^{\frac{V_{be}}{V_t}} - 1\right)$$

## BJT dynamic

$$S = \frac{d(I_c)}{d(V_{be})} = \frac{1}{V_t} * \left(e^{\frac{V_{be}}{V_t}} - 1\right) = \frac{I_c}{V_t}$$



$$I_d = I_{dss} * \left(1 - \frac{V_{gs}}{V_{po}}\right)^2$$

$$V_{be} = R_{sz} * I_d$$

$$I_c = I_{cob} * \left(e^{\frac{V_{be}}{V_t}} - 1\right)$$

$$I_c = I_{cob} * \left(e^{\frac{(R_{sz} * I_{dss} * (1 - \frac{V_{gs}}{V_{po}})^2 / V_t)}{V_t}} - 1\right)$$

$$I_{sz} = I_d + I_e = I_d + \frac{(B + 1)}{B} * I_c$$

$$S = \frac{d(I_{sz})}{d(V_{gs})}$$

$$S = \frac{2 * I_{dss}}{-V_{po}} * \left(1 - \frac{V_{gs}}{V_{po}}\right) + \frac{2 * I_{dss}}{-V_{po}} * \frac{R_{sz} * \frac{(B + 1)}{B} * I_{cob}}{V_t} * \left(e^{\frac{(R_{sz} * I_{dss} * (1 - \frac{V_{gs}}{V_{po}})^2 / V_t)}{V_t}} - 1\right)$$

$$S = \frac{2 * I_{dss}}{-V_{po}} * \left\{ \left(1 - \frac{V_{gs}}{V_{po}}\right) + \frac{(B + 1)}{B} * \frac{R_{sz} * I_c}{V_t} \right\}$$

## J-FET - BJT combo:

$$S^{\wedge} = \frac{2 * I_{dss}}{-V_{po}} * \frac{R_{sz} * I_c^{\wedge}}{V_t}$$

## BJT - BJT combo:

$$S^{\wedge} = \frac{I_c^{\wedge}}{V_t} * \frac{R_{sz} * I_c^{\wedge}}{V_t}$$

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