Solutions to *The Art of Electronics 3rd Edition*

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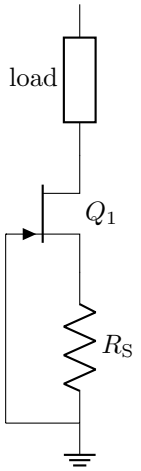
Solutions for Chapter 3

Exercise 3.1

Figure 1.1: JFET current source



From Figure 3.21 of the book, one can see that a drain current equal to 1 mA corresponds to a gate-source voltage of $-0.6\,\mathrm{V}$. Therefore:

$$\boxed{R_S = \frac{0.6\,\mathrm{V}}{1\,\mathrm{mA}} = 600\,\Omega}$$

Exercise 3.2

At $V_{GS} = V_{G0}$:

$$r_{GS} = r_{G0} = \frac{1}{2k\,(V_{G0} - V_{th})}$$

The ratio between r_{DS} and R_{G0} returns:

$$\boxed{\frac{r_{DS}}{r_{G0}} = \frac{2k\,(V_{G0} - V_{th})}{2k\,(V_{GS} - V_{th})}}$$

Exercise 3.3

Being g_m the differential conductance of the FET operated in aturation region, it can be expressed as:

$$g_\mathrm{m} = \frac{\partial I_\mathrm{D}}{\partial V_\mathrm{GS}} = \frac{\partial}{\partial V_\mathrm{GS}} k \left(V_\mathrm{GS} - V_\mathrm{th}\right)^2 = 2k \left(V_\mathrm{GS} - V_\mathrm{th}\right)$$

Therefore:

$$\boxed{g_\mathrm{m} = \frac{1}{r_\mathrm{DS}}}$$

Exercise 3.4

(a) The voltage across the drain-gate capacitance when the JFET is switched on ($V_\mathrm{DS} = 0\,\mathrm{V}$) is equal to $50\,\mathrm{V}$-$10\,\mathrm{V}$=$40\,\mathrm{V}$. Considering a maximum current across this capacitance equal to $1\,\mathrm{mA}$:

$$\boxed{t_\mathrm{ON} = \frac{40\,\mathrm{V}\,200\,\mathrm{pF}}{1\,\mathrm{mA}} = 8\,\mu\mathrm{s}}$$

(b) Since the current is equal to the charge over time, we have:

$$\boxed{t_\mathrm{ON} = \frac{40\,\mathrm{nC}}{1\,\mathrm{mA}} = 40\,\mu\mathrm{s}}$$

Exercise 3.5 TODO: write solution

Exercise 3.6 TODO: write solution

Exercise 3.7 TODO: write solution

Exercise 3.8 TODO: write solution

Exercise 3.9 TODO: write solution

Exercise 3.10 TODO: write solution

Exercise 3.11 TODO: write solution

Exercise 3.12 TODO: write solution

Exercise 3.13 TODO: write solution

Exercise 3.14 TODO: write solution

Exercise 3.15 TODO: write solution

Exercise 3.16 TODO: write solution

Exercise 3.17 TODO: write solution

Exercise 3.18 TODO: write solution