

# EXHIBIT B

WINNER OF THE

1976  
*Frederick Emmons Terman Award in Electrical & Computer Engineering*

THIRD EDITION

# CMOS



**Circuit Design, Layout, and Simulation**

R. JACOB BAKER

IEEE Series on Microelectronic Systems

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## Multipliers

| Name  | Symbol                | Value      |
|-------|-----------------------|------------|
| terra | T                     | $10^{12}$  |
| giga  | G                     | $10^9$     |
| mega  | M (MEG in SPICE)      | $10^6$     |
| kilo  | k                     | $10^3$     |
| milli | m                     | $10^{-3}$  |
| micro | $\mu$ (or u)          | $10^{-6}$  |
| nano  | n                     | $10^{-9}$  |
| pico  | p                     | $10^{-12}$ |
| femto | f                     | $10^{-15}$ |
| atto  | a (not used in SPICE) | $10^{-18}$ |

## Physical Constants

| Name                                 | Symbol                 | Value/Units                           |
|--------------------------------------|------------------------|---------------------------------------|
| Vacuum dielectric constant           | $\epsilon_0$           | $8.85 \text{ aF}/\mu\text{m}$         |
| Silicon dielectric constant          | $\epsilon_{\text{si}}$ | $11.7\epsilon_0$                      |
| SiO <sub>2</sub> dielectric constant | $\epsilon_{\text{ox}}$ | $3.97\epsilon_0$                      |
| SiN <sub>3</sub> dielectric constant | $\epsilon_{\text{ni}}$ | $16\epsilon_0$                        |
| Boltzmann's constant                 | k                      | $1.38 \times 10^{-23} \text{ J/K}$    |
| Electronic charge                    | q                      | $1.6 \times 10^{-19} \text{ C}$       |
| Temperature                          | T                      | Kelvin                                |
| Thermal voltage                      | $V_T$                  | $kT/q = 26 \text{ mV @ } 300\text{K}$ |

**CMOS**

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