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CMOS Circuit Characteristics Formulas

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List of 15 CMOS Circuit Characteristics Formulas

CMOS Circuit Characteristics

1) Area of Source Diffusion

Open Calculator

fx $A_s = D_s \cdot W$

ex $5479.02\text{mm}^2 = 61\text{mm} \cdot 89.82\text{mm}$

2) CMOS Critical Voltage

Open Calculator

fx $V_c = E_c \cdot L$

ex $2.79028\text{V} = 0.004\text{V/mm} \cdot 697.57\text{mm}$

3) CMOS Mean Free Path

Open Calculator

fx $L = \frac{V_c}{E_c}$

ex $697.5\text{mm} = \frac{2.79\text{V}}{0.004\text{V/mm}}$

4) Critical Electric Field

Open Calculator

fx $$E_c = \frac{2 \cdot V_{sat}}{\mu_e}$$

ex $$0.004064\text{V/mm} = \frac{2 \cdot 10.12\text{mm/s}}{49.8\text{cm}^2/\text{V*s}}$$

5) Depletion Region Width

Open Calculator

fx $$L_d = L_{pn} - L_{eff}$$

ex $$11\text{mm} = 19\text{mm} - 8\text{mm}$$

6) Effective Capacitance in CMOS

Open Calculator

fx $$C_{eff} = D \cdot \frac{i_{off} \cdot \left(10^{V_{bc}}\right)}{N_g \cdot [BoltZ] \cdot V_{bc}}$$

ex $$5.137895\mu\text{F} = 1.3\text{E}\hat{}\text{-}25 \cdot \frac{0.01\text{mA} \cdot \left(10^{2.02\text{V}}\right)}{0.95 \cdot [BoltZ] \cdot 2.02\text{V}}$$

7) Effective Channel Length

Open Calculator

fx $$L_{eff} = L_{pn} - L_d$$

ex $$7.99\text{mm} = 19\text{mm} - 11.01\text{mm}$$

8) Oxide Layer Thickness

Open Calculator

fx $$t_{ox} = \varepsilon_{ox} \cdot W_g \cdot \frac{L_g}{C_{in}}$$

ex $$4.979688\text{mm} = 149.79\mu\text{F/mm} \cdot 0.285\text{mm} \cdot \frac{7\text{mm}}{60.01\mu\text{F}}$$

9) Permittivity of Oxide Layer

Open Calculator

fx $$\varepsilon_{ox} = t_{ox} \cdot \frac{C_{in}}{W_g \cdot L_g}$$

ex $$149.7994\mu\text{F/mm} = 4.98\text{mm} \cdot \frac{60.01\mu\text{F}}{0.285\text{mm} \cdot 7\text{mm}}$$

10) PN Junction Length

Open Calculator

fx $$L_{pn} = L_d + L_{eff}$$

ex $$19.01\text{mm} = 11.01\text{mm} + 8\text{mm}$$

11) Sidewall Perimeter of Source Diffusion

Open Calculator

fx $$P_s = (2 \cdot W) + (2 \cdot D_s)$$

ex $$301.64\text{mm} = (2 \cdot 89.82\text{mm}) + (2 \cdot 61\text{mm})$$

12) Transition Width of CMOS

Open Calculator

fx $$W = \frac{C_{mos}}{C_{gs}}$$

ex $$89.82036\text{mm} = \frac{1.8\mu\text{F}}{20.04\mu\text{F}}$$

13) Voltage at Minimum EDP

Open Calculator

fx $$V_{edp} = \frac{3 \cdot V_t}{3 - \alpha}$$

ex $$0.666667\text{V} = \frac{3 \cdot 0.3\text{V}}{3 - 1.65}$$

14) Width of Gate

Open Calculator

fx $$W_g = \frac{C_{in}}{C_{ox} \cdot L_g}$$

ex $$0.285667\text{mm} = \frac{60.01\mu\text{F}}{30.01\mu\text{F/mm}^2 \cdot 7\text{mm}}$$

15) Width of Source Diffusion

Open Calculator

fx $$W = \frac{A_s}{D_s}$$

ex $$89.81967\text{mm} = \frac{5479\text{mm}^2}{61\text{mm}}$$

Variables Used

- μ_e Mobility of Electron *(Square Centimeter per Volt Second)*
- A_s Area of Source Diffusion *(Square Millimeter)*
- C_{eff} Effective Capacitance in CMOS *(Microfarad)*
- C_{gs} MOS Gate Capacitance *(Microfarad)*
- C_{in} Input Gate Capacitance *(Microfarad)*
- C_{mos} MOS Gate Overlap Capacitance *(Microfarad)*
- C_{ox} Capacitance of Gate Oxide Layer *(Microfarad per Square Millimeter)*
- D Duty Cycle
- D_s Length of Source *(Millimeter)*
- E_c Critical Electric Field *(Volt per Millimeter)*
- i_{off} Off Current *(Milliampere)*
- L Mean Free Path *(Millimeter)*
- L_d Depletion Region Width *(Millimeter)*
- L_{eff} Effective Channel Length *(Millimeter)*
- L_g Length of Gate *(Millimeter)*
- L_{pn} PN Junction Length *(Millimeter)*
- N_g Gates on Critical Path
- P_s Sidewall Perimeter of Source Diffusion *(Millimeter)*
- t_{ox} Oxide Layer Thickness *(Millimeter)*
- V_{bc} Base Collector Voltage *(Volt)*
- V_c Critical Voltage in CMOS *(Volt)*

- V_{edp} Voltage at Minimum EDP *(Volt)*
- V_{sat} Velocity Saturation *(Millimeter per Second)*
- V_t Threshold Voltage *(Volt)*
- W Transition Width *(Millimeter)*
- W_g Gate Width *(Millimeter)*
- α Activity Factor
- ε_{ox} Permittivity of Oxide Layer *(Microfarad per Millimeter)*

Constants, Functions, Measurements used

- Constant: **[BoltZ]**, 1.38064852E-23 Joule/Kelvin
  Boltzmann constant
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Area** in Square Millimeter (mm²)
  Area Unit Conversion
- Measurement: **Speed** in Millimeter per Second (mm/s)
  Speed Unit Conversion
- Measurement: **Capacitance** in Microfarad (µF)
  Capacitance Unit Conversion
- Measurement: **Electric Field Strength** in Volt per Millimeter (V/mm)
  Electric Field Strength Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Mobility** in Square Centimeter per Volt Second (cm²/V*s)
  Mobility Unit Conversion
- Measurement: **Oxide Capacitance Per Unit Area** in Microfarad per Square Millimeter (µF/mm²)
  Oxide Capacitance Per Unit Area Unit Conversion
- Measurement: **Permittivity** in Microfarad per Millimeter (µF/mm)
  Permittivity Unit Conversion

Check other formula lists

- Array Datapath Subsystem Formulas
- CMOS Circuit Characteristics Formulas
- CMOS Delay Characteristics Formulas
- CMOS Design Characteristics Formulas
- CMOS Power Metrics Formulas
- CMOS Special Purpose Subsystem Formulas
- CMOS Time Characteristics Formulas

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