



Confidential
Security C

BSIM4.5 WPE&LOD

PDKD/TSMC

PDKD



Empowering Innovation

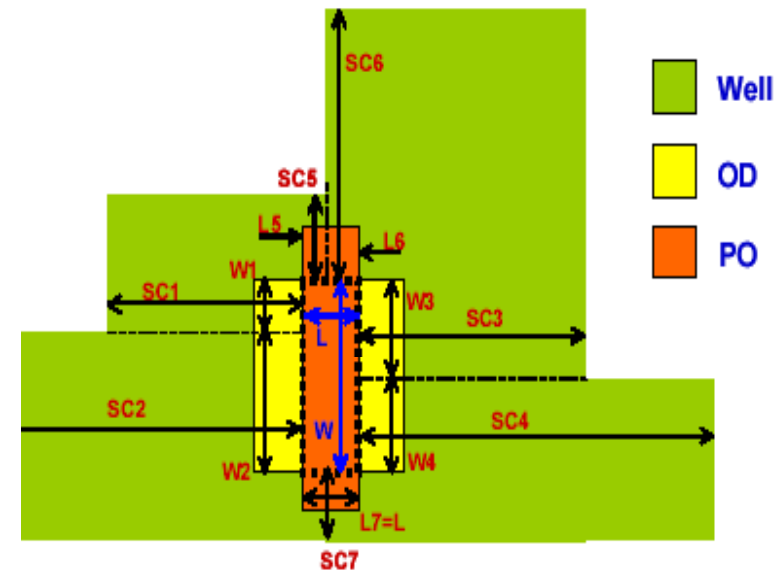
Well Proximity Effect/WPE, BSIM4.5

- Input: GATE, WELL
- Output Property: **SCA, SCB, SCC**

$$SCA = \frac{1}{W_{drawn} L_{drawn}} \left[SC_{ref}^2 \sum_{i=1}^n \left(W_i \left(\frac{1}{SC_i} - \frac{1}{SC_i + L_{drawn}} \right) \right) + SC_{ref}^2 \sum_{i=n+1}^{n+m} \left(L_i \left(\frac{1}{SC_i} - \frac{1}{SC_i + W_{drawn}} \right) \right) + corners_A \right]$$

$$SCB = \frac{1}{W_{drawn} L_{drawn}} \left[\sum_{i=1}^n W_i \left(\frac{SC_{ref} \left(\frac{SC_i}{10} + \frac{SC_{ref}}{100} \right) \exp(-10 \frac{SC_i}{SC_{ref}}) - SC_{ref} \left(\frac{SC_i + L_{drawn}}{10} + \frac{SC_{ref}}{100} \right) \exp(-10 \frac{SC_i + L_{drawn}}{SC_{ref}})}{SC_{ref}} \right) + \sum_{i=n+1}^{n+m} L_i \left(\frac{SC_{ref} \left(\frac{SC_i}{10} + \frac{SC_{ref}}{100} \right) \exp(-10 \frac{SC_i}{SC_{ref}}) - SC_{ref} \left(\frac{SC_i + W_{drawn}}{10} + \frac{SC_{ref}}{100} \right) \exp(-10 \frac{SC_i + W_{drawn}}{SC_{ref}})}{SC_{ref}} \right) + corners_B \right]$$

$$SCC = \frac{1}{W_{drawn} L_{drawn}} \left[\sum_{i=1}^n W_i \left(\frac{SC_{ref} \left(\frac{SC_i}{20} + \frac{SC_{ref}}{400} \right) \exp(-20 \frac{SC_i}{SC_{ref}}) - SC_{ref} \left(\frac{SC_i + L_{drawn}}{20} + \frac{SC_{ref}}{400} \right) \exp(-20 \frac{SC_i + L_{drawn}}{SC_{ref}})}{SC_{ref}} \right) + \sum_{i=n+1}^{n+m} L_i \left(\frac{SC_{ref} \left(\frac{SC_i}{20} + \frac{SC_{ref}}{400} \right) \exp(-20 \frac{SC_i}{SC_{ref}}) - SC_{ref} \left(\frac{SC_i + W_{drawn}}{20} + \frac{SC_{ref}}{400} \right) \exp(-20 \frac{SC_i + W_{drawn}}{SC_{ref}})}{SC_{ref}} \right) + corners_C \right]$$



LOD Effect, SA/SB

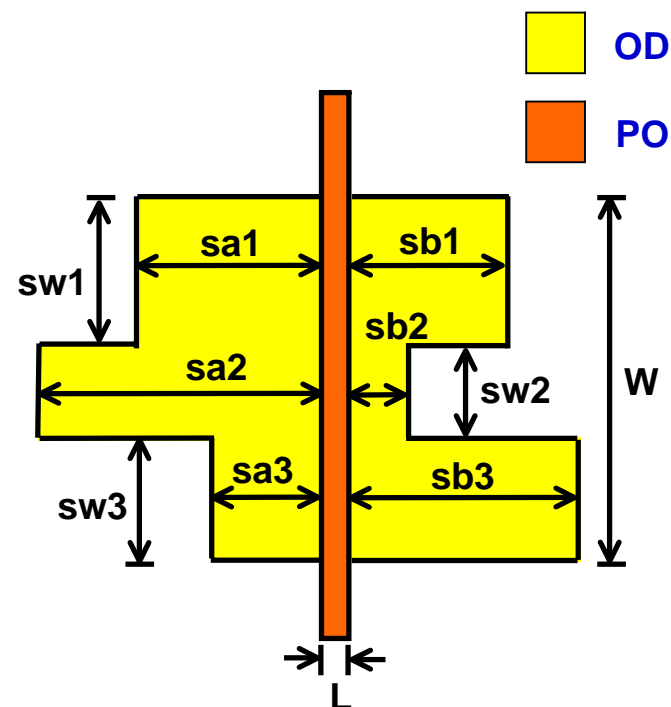
- Input: OD, GATE
- Output Property: **SA, SB**

SA:

$$\frac{1}{SA_{eff} + 0.5 \cdot L_{drawn}} = \sum_{i=1}^n \frac{sw_i}{W_{drawn}} \cdot \frac{1}{sa_i + 0.5 \cdot L_{drawn}}$$

SB:

$$\frac{1}{SB_{eff} + 0.5 \cdot L_{drawn}} = \sum_{i=1}^n \frac{sw_i}{W_{drawn}} \cdot \frac{1}{sb_i + 0.5 \cdot L_{drawn}}$$



Notices

- SRAM cells are fixed layouts and do not extract WPE and LOD properties. These two effects have been covered in the SPICE model.
- Native devices do not extract WPE.
- When $SC_i > 5\text{ }\mu\text{m}$, the extracted WPE parameters will keep the values at $SC_i = 5\text{ }\mu\text{m}$.