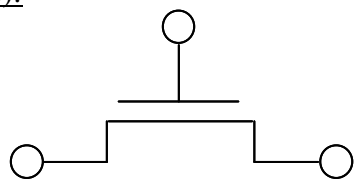
Chapter 7: BSIMSOI RF Model

BSIMSOI4.0 provides the gate resistance model and body resistance model for devices used in RF application.

7.1 Gate Electrode and Intrinsic-Input Resistance (IIR) Model

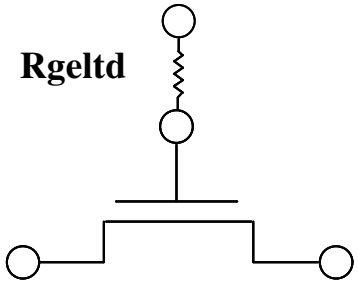
Users have four options for modeling gate electrode resistance (bias independent) and intrinsic-input resistance (Rii, bias-dependent) by choosing model choice parameter rgateMod.

RgateMod = 0 (zero-resistance):



In this case, no gate resistance is generated.

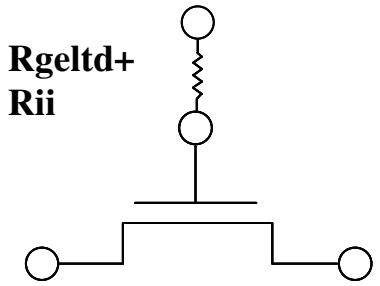
RgateMod = 1 (constant-resistance):



In this case, only the electrode gate resistance (bias-independent) is generated by adding an internal gate node. The electrode gate resistance Rgeltd is given by

$$Rgeltd = \frac{RSHG \cdot \left(XGW + \frac{W_{eff}}{3 \cdot NGCON \cdot NSEG} \right)}{NGCON \cdot \left(L_{drawn} - XGL \right)} \tag{7.1}$$

RgateMod = 2 (RII model with variable resistance):



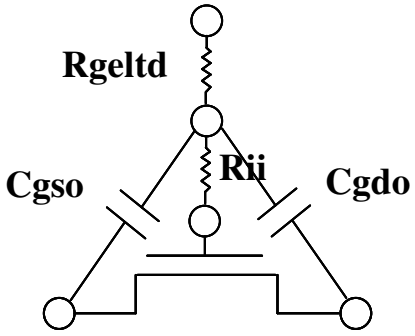
In this case, the gate resistance is the sum of the electrode gate resistance and the intrinsic-input resistance Rii as given by

$$\frac{1}{Rii} = XRCRG1 \cdot \left(\frac{I_{ds}}{V_{dseff}} + XRCRG2 \cdot \frac{W_{eff}\mu_{eff}C_{oxeff}k_BT}{qL_{eff}} \right) \tag{7.2}$$

An internal gate node will be generated.

RgateMod = 3 (RII model with two nodes):

In this case, the gate electrode resistance is in series with the intrinsic-input resistance Rii through two internal gate nodes, so that the overlap capacitance current will not pass through the intrinsic-input resistance.



7.2 Body Resistance Network

RbodyMod = 0

In this case, body resistance network turns off. RF data still could be fit for fully depleted SOI device [28].

RbodyMod =1

A two-resistance body resistance network turns on as shown in the following figure.

Two extra nodes sbNode and dbNode are introduced in this case. The body resistor RBSB/RBDB are located between sbNode/dbNode and bNode. As BSIM4, A minimum conductance, *GBMIN*, is introduced in parallel with each resistance and therefore to prevent infinite resistance values, which would otherwise cause poor convergence.

Note that the intrinsic model body reference point in this case is the internal body node **bNode**, into which the impact ionization current I_{ii} and the GIDL current I_{GIDL} flow through.