Let $V_{ds}=V_{dsat}$ in Eq. (3.3.4) and set this equal to Eq. (3.4.2), we get the following expression for V_{dsat}

$$V_{dsat} = \frac{E_{sat}L(V_{gsteff} + 2v_t)}{A_{bulk}E_{sat}L + V_{gsteff} + 2v_t} \tag{3.4.3}$$

3.4.2 Extrinsic Case (R_{ds}>0)

The V_{dsat} expression for the extrinsic case is formulated from Eq. (3.4.3) and Eq. (2.5.10) to be the following

$$V_{dsat} = \frac{-b - \sqrt{b^2 - 4ac}}{2a} \tag{3.4.4a}$$

where

$$a = A_{bulk}{}^2 W_{eff} v_{sat} C_{ox} R_{DS} + (\frac{1}{\lambda} - 1) A_{bulk} \tag{3.4.4b}$$

$$b = -\left((V_{gsteff} + 2v_t)(\frac{2}{\lambda} - 1) + A_{bulk}E_{sat}L_{eff} + 3A_{bulk}(V_{gsteff} + 2v_t)W_{eff}v_{sat}C_{ox}R_{DS} \right) \tag{3.4.4c}$$

$$c = (V_{gsteff} + 2v_t)E_{sat}L_{eff} + 2(V_{gsteff} + 2v_t)^2 W_{eff}v_{sat}C_{ox}R_{DS} \tag{3.4.4d}$$

$$\lambda = A_1 V_{gsteff} + A_2 \tag{3.4.4e}$$