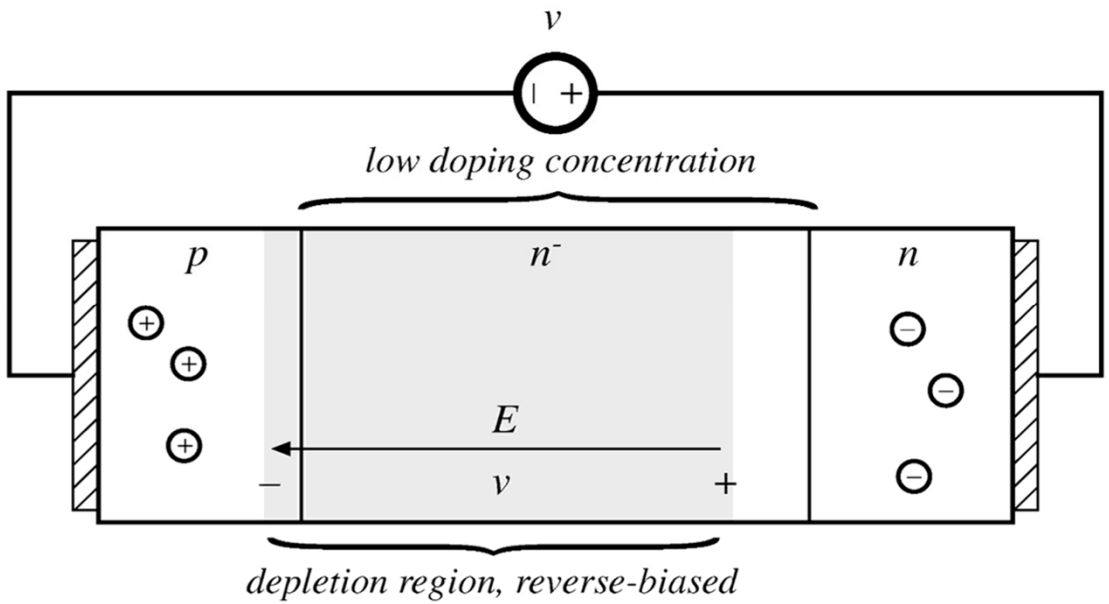
Reverse Biased Diode



Diode Stored Charge

The diode equation:

$$q(t) = Q_0\left(e^{\lambda v(t)} - 1\right)$$

Charge control equation:

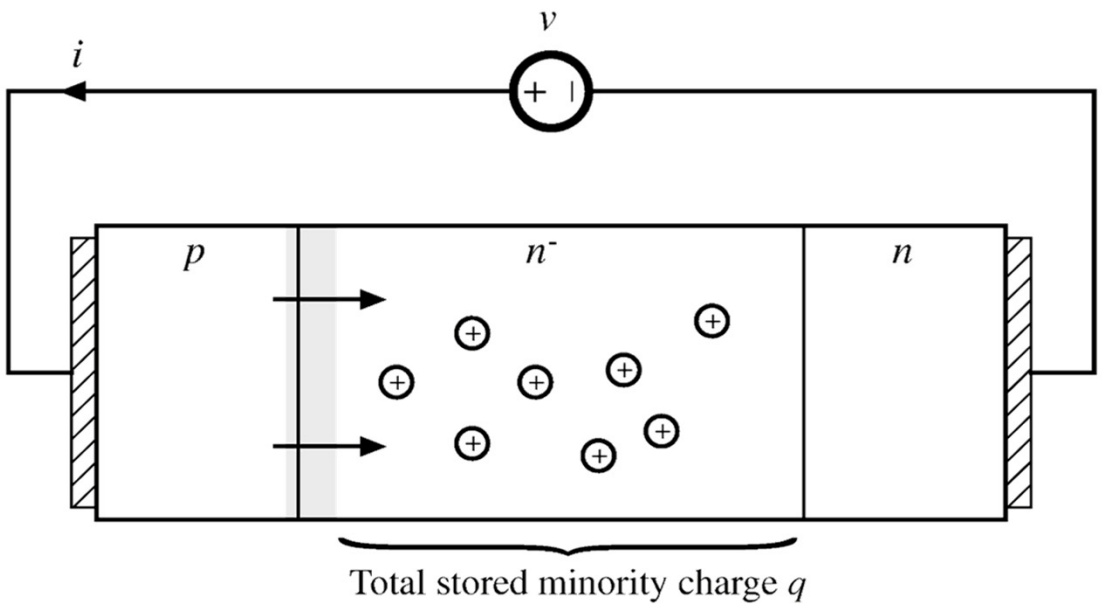
$$\frac{dq(t)}{dt} = i(t) - \frac{q(t)}{\tau_L}$$

With:

λ= 1/(26 mV) at 300 K

τ_L = minority carrier lifetime

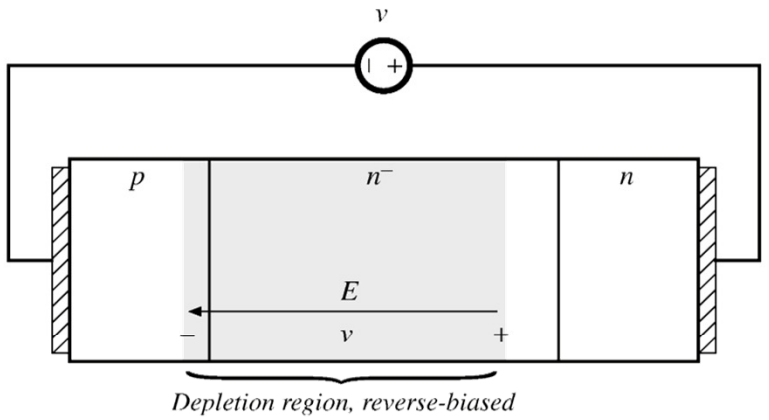
(above equations don't include current that charges depletion region capacitance)

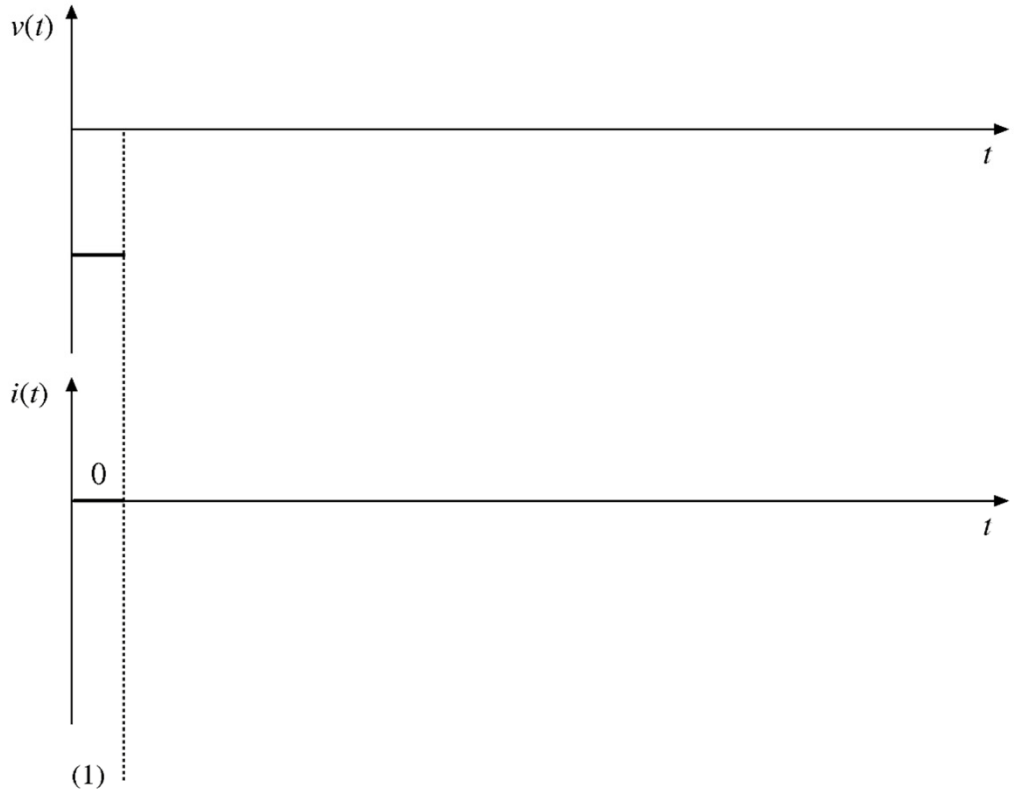


In equilibrium: $dq/dt = 0$, and hence

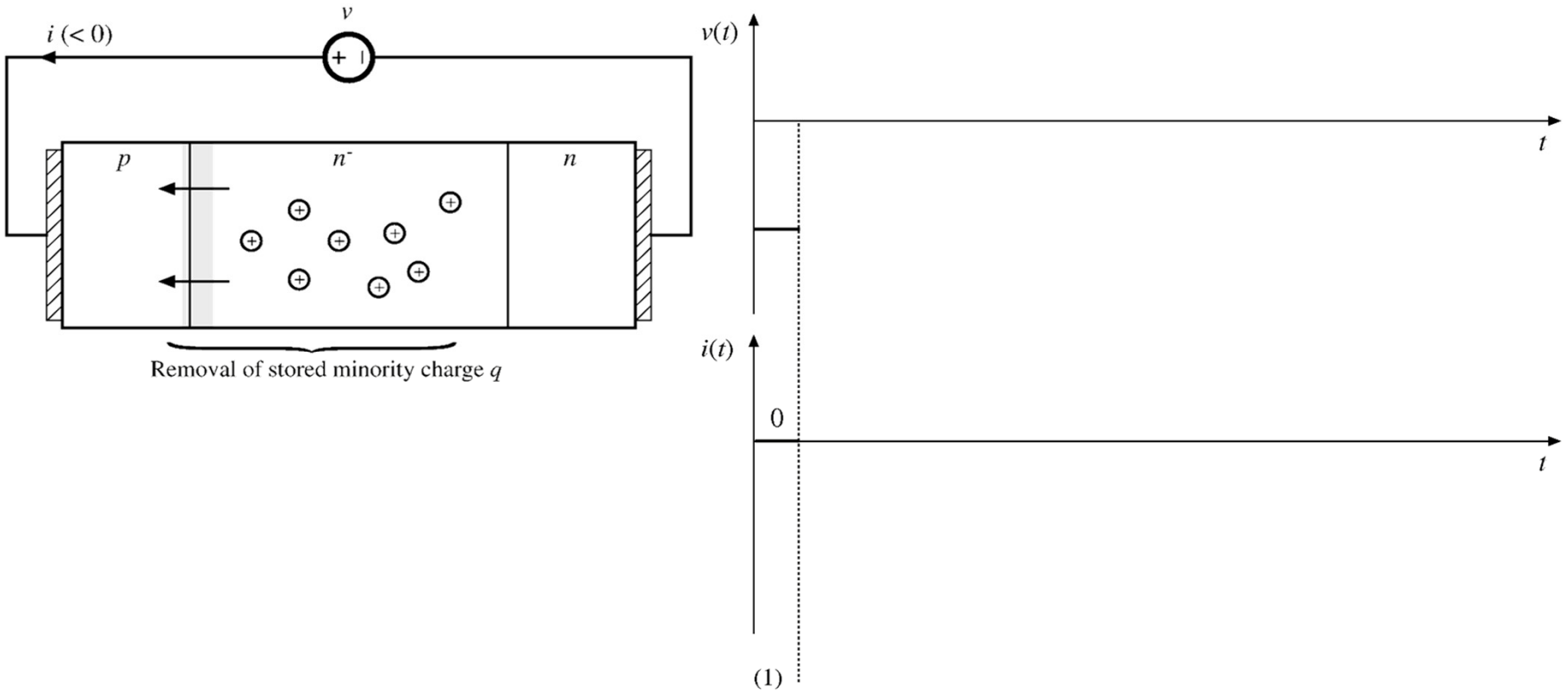
$$i(t) = \frac{q(t)}{\tau_L} = \frac{Q_0}{\tau_L}\left(e^{\lambda v(t)} - 1\right) = I_0\left(e^{\lambda v(t)} - 1\right)$$

Diode Turn-On

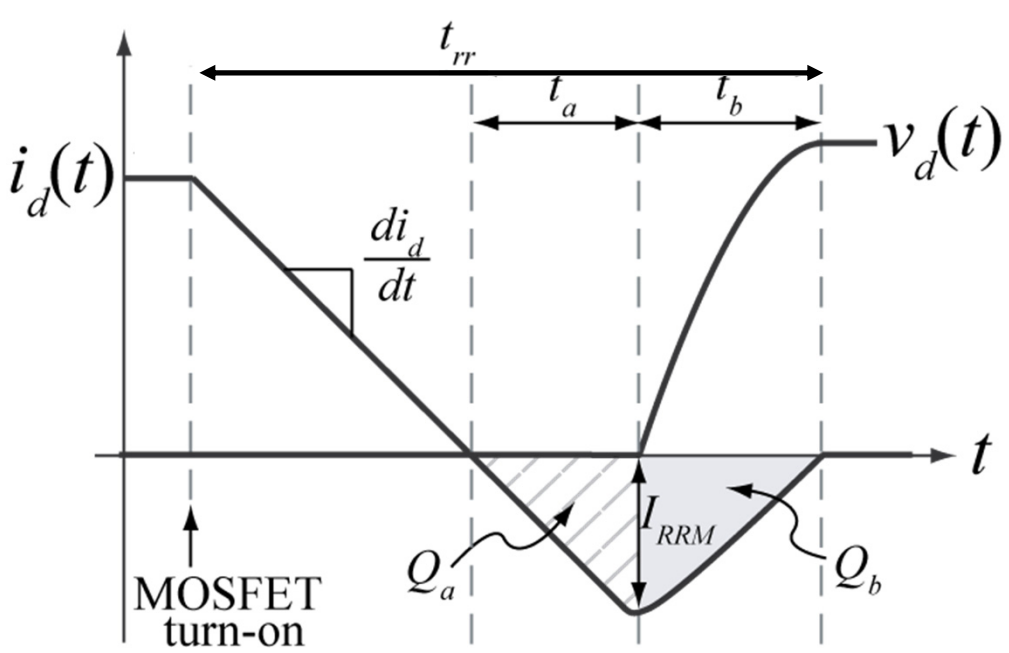


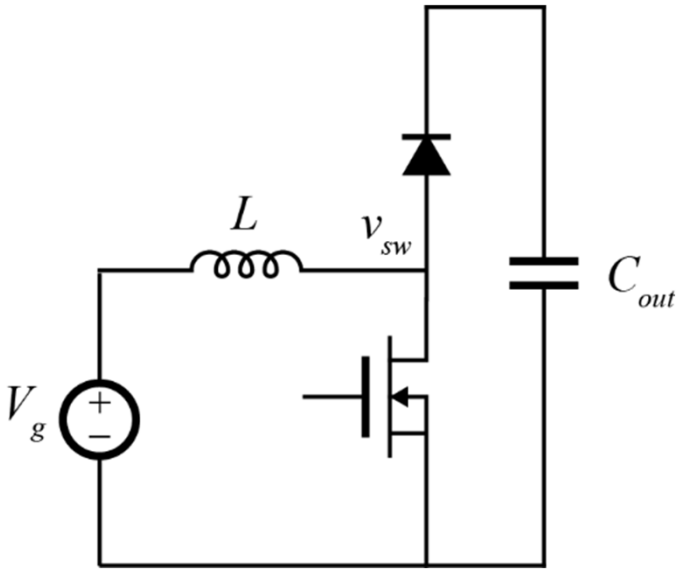


Diode Turn-Off



Diode Reverse Recovery





Datasheet RR Characteristics

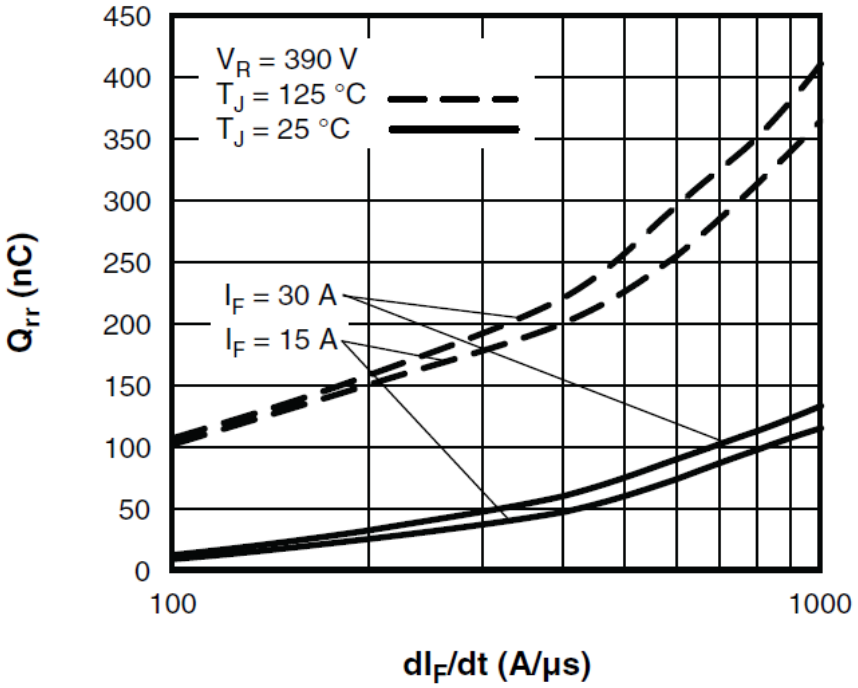


Fig. 10 - Typical Stored Charge vs. dI_F/dt

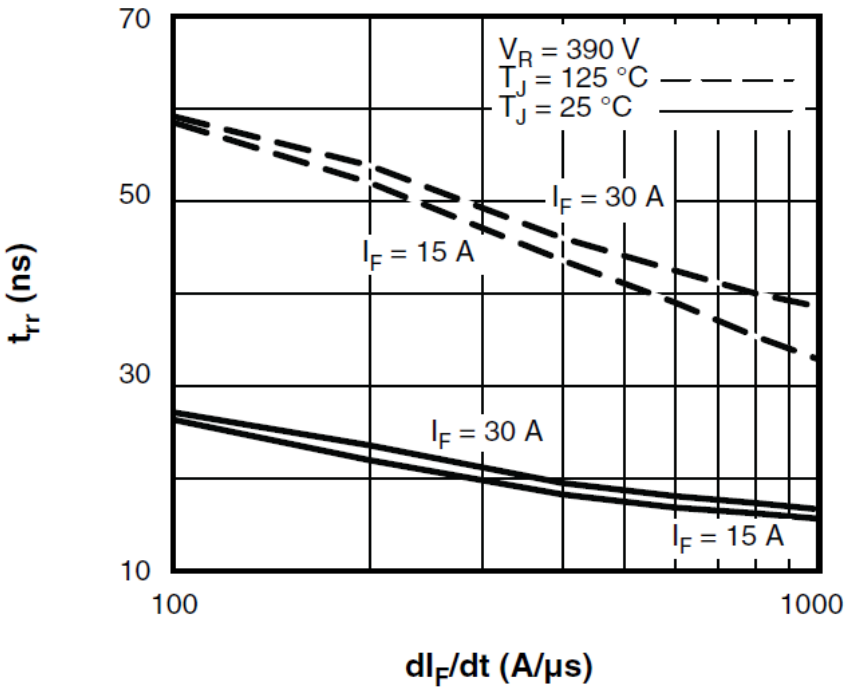
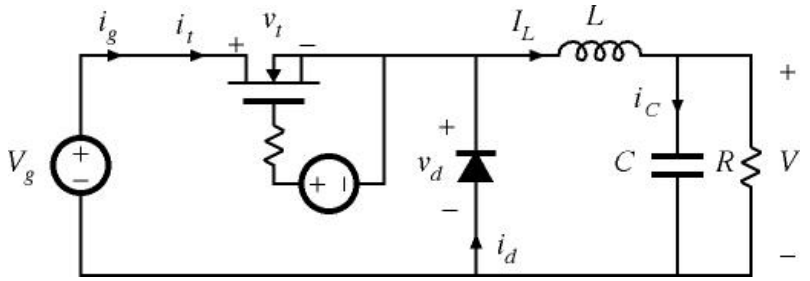


Fig. 9 - Typical Reverse Recovery Time vs. dI_F/dt

Buck Converter Example

- All elements ideal except for reverse recovery (Q_r and t_r) of diode



Buck Average Model with RR