When a semiconductor containing \(N_t\) traps per unit volume is illuminated by a suitable light source, which maintains \(n_f\) mobile carriers inside the semiconductor, the steady state density \(n_t\) of trapped electrons is given by

\[
\frac{n_t N_c}{n_c (N_t-n_t)} = \exp\frac{(E_c-E_t)}{kT}
\]  \hspace{1cm} \text{... (A3.1)}

This may be written as

\[
N_t - n_t = \frac{N_t}{1 + \frac{n_c}{N_c} \exp\frac{(E_c-E_t)}{kT}}
\]  \hspace{1cm} \text{... (A3.2)}

Multiplying both sides of Eqn. (A3.2) by the term \(A_t\), utilising Eqn. (3.15) and writing \(N_t A_t = 1/T_{10}\), we obtain,

\[
\tau_1 = \tau_1 \left[ 1 + \frac{n_c}{N_c} \exp\frac{(E_c-E_t)}{kT} \right]
\]  \hspace{1cm} \text{... (A3.3)}

Substituting Eqn. (A3.3) in Eqn. (3.12) of the text, we obtain,

\[
\tau_p' = \tau_p \left[ 1 + \frac{b}{b+1} \tau_{10} \left[ 1 + \frac{n_c}{N_c} \exp\frac{(E_c-E_t)}{kT} \right] \right]
\]  \hspace{1cm} \text{... (A3.4)}

Now, if it is assumed that Eqn. (A3.4) is also valid for the decay of carriers injected electrically in a semiconductor, then the parameter \(n_t\) can be replaced by,

\[
n_e = n_p (\exp\lambda N_e - 1) \approx n_p \exp\lambda N_e
\]  \hspace{1cm} \text{... (A3.5)}
where \( n_e \) is the density of injected minority carriers in the base region of a transistor. One thus obtains,

\[
\tau_p' = \tau_p \left[ 1 + \frac{b}{b+1} \cdot \frac{\tau_2}{\tau_{10} \left( 1 + \frac{n_e \exp(\Delta E_c) \exp(E_c-E_t)/kT}{N_c} \right)} \right]
\]

\[
= \tau_p \left[ 1 + \frac{b}{b+1} \cdot \frac{\tau_2}{\tau_{10} \left( 1 + m \exp(N_c) \right)} \right]
\]

where

\[
m = \frac{n_p}{N_c} \exp(E_c-E_t)/kT
\]

\[
(A3.6)
\]

\[
(A3.7)
\]