APPENDIX II

EQUATIONS FOR SOLAR PHOTOVOLTAIC CELL AND BOOST CONVERTER
1. The characteristic equation of a solar cell

\[ I = I_L - I_0 \left[ \exp \left( \frac{qV + IR_s}{nkT} \right) - 1 \right] - \frac{V + IR_s}{R_{SH}} \]

where,
\[ I_L = \text{light generated current}, \]
\[ I_0 = \text{reverse saturation current}, \]
\[ q = \text{charge of electron}, \]
\[ V = \text{voltage across output terminals}, \]
\[ R_s = \text{series resistance}, \]
\[ R_{SH} = \text{shunt resistance} \]
\[ n = \text{ideality factor of diode}, \]
\[ k = \text{Boltzmann’s constant}, \]
\[ T = \text{room temperature}, \]

2. Relationship between input voltage \((V_{in})\) and output voltage \((V_{out})\) with duty cycle \((D)\) of the boost converter

\[ V_{out} = \frac{V_{in}}{1 - D} \]

where,
\[ V_{in} = \text{input voltage to the boost converter}, \]
\[ V_{out} = \text{output voltage from the boost converter} \]
\[ D = \text{duty cycle of the switch of boost converter}. \]

where, \(V_{in}\) is the input voltage to the boost converter.

3. Duty cycle of the switch of boost converter

\[ D = \frac{T_{ON}}{(T_{ON} + T_{OFF})} \]

where,
\[ T_{ON} = \text{On period of switch of boost converter} \]
$T_{OFF} = \text{Off period of switch of boost converter}$

4. **Shockley diode equation**

\[ I_D = I_0 \left[ \exp \left( \frac{qV_j}{nkT} \right) - 1 \right] \]

where

$I_0 = \text{reverse saturation current (amperes)}$

$n = \text{diode ideality factor (1 for an ideal diode)}$

$q = \text{electronic charge}$

$k = \text{Boltzmann’s constant}$

$T = \text{absolute temperature}$

At 25°C, $kT/q \approx 0.259 \text{ volts.}$