EE2031
Circuits and System Design Lab

Dr. HENG, Chun Huat

Office: E2 03-27

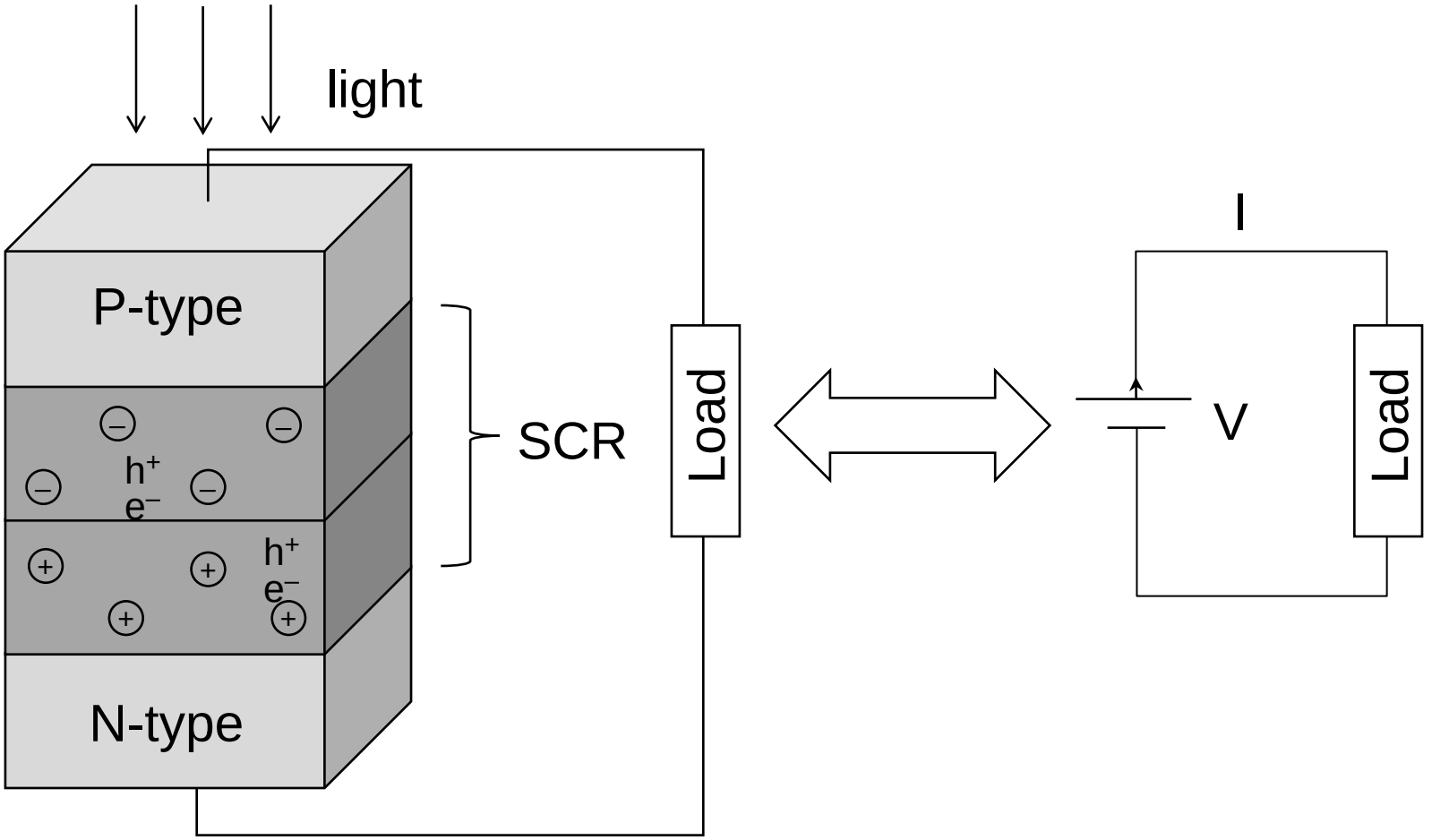
Tel: 6516 1628

Email: elehch@nus.edu.sg

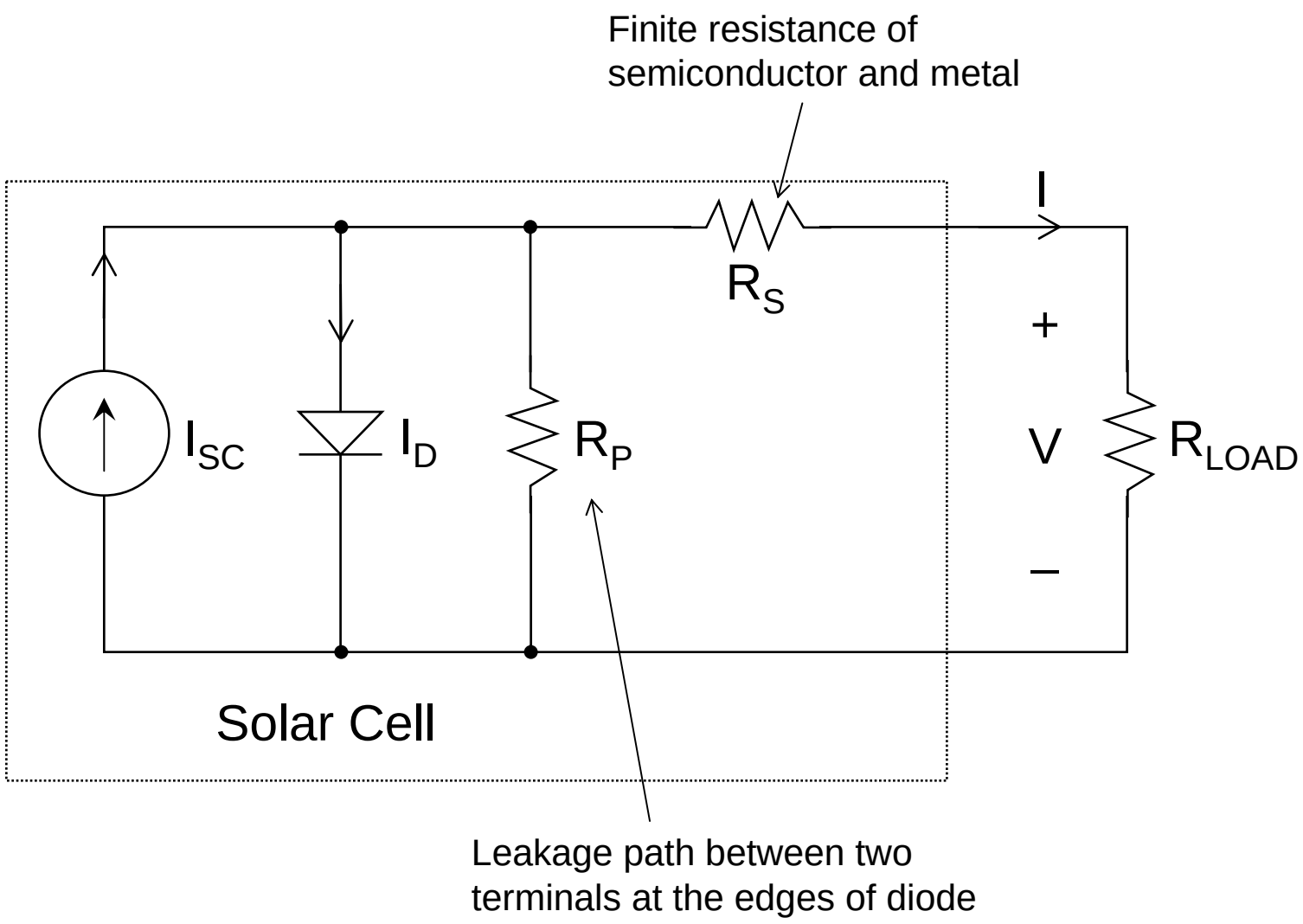
Lecture Outline

- **Overview of Solar Panel**
- **Equivalent Circuit Model**
- **Array of Solar Panel**
- **Equivalent Circuit Model**
- **I-V Characteristic**
- **Maximum Power Point Tracking**

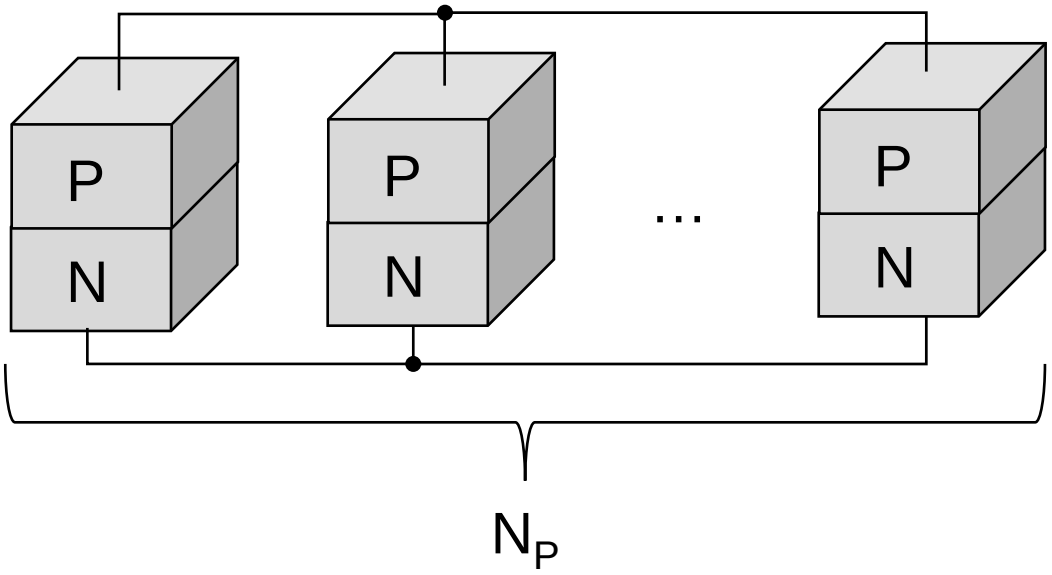
Solar Panel Overview



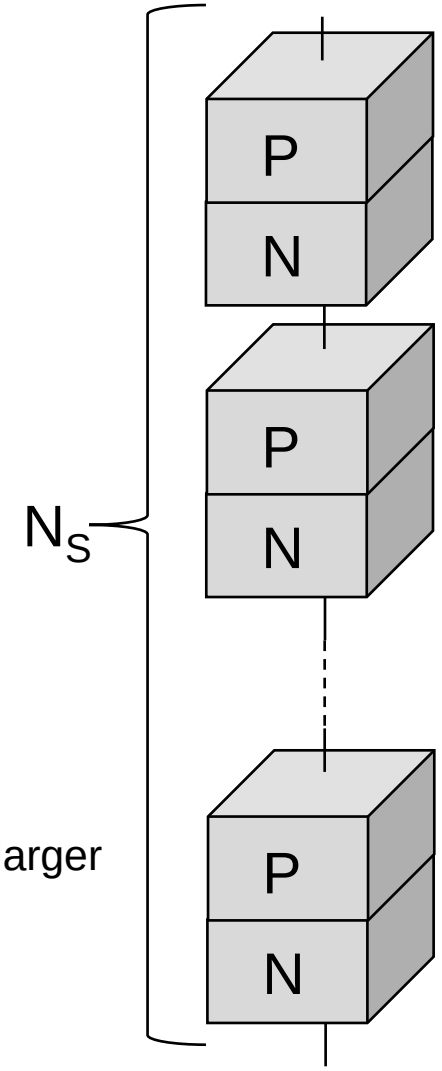
Equivalent Circuit Model



Array of Solar Panel

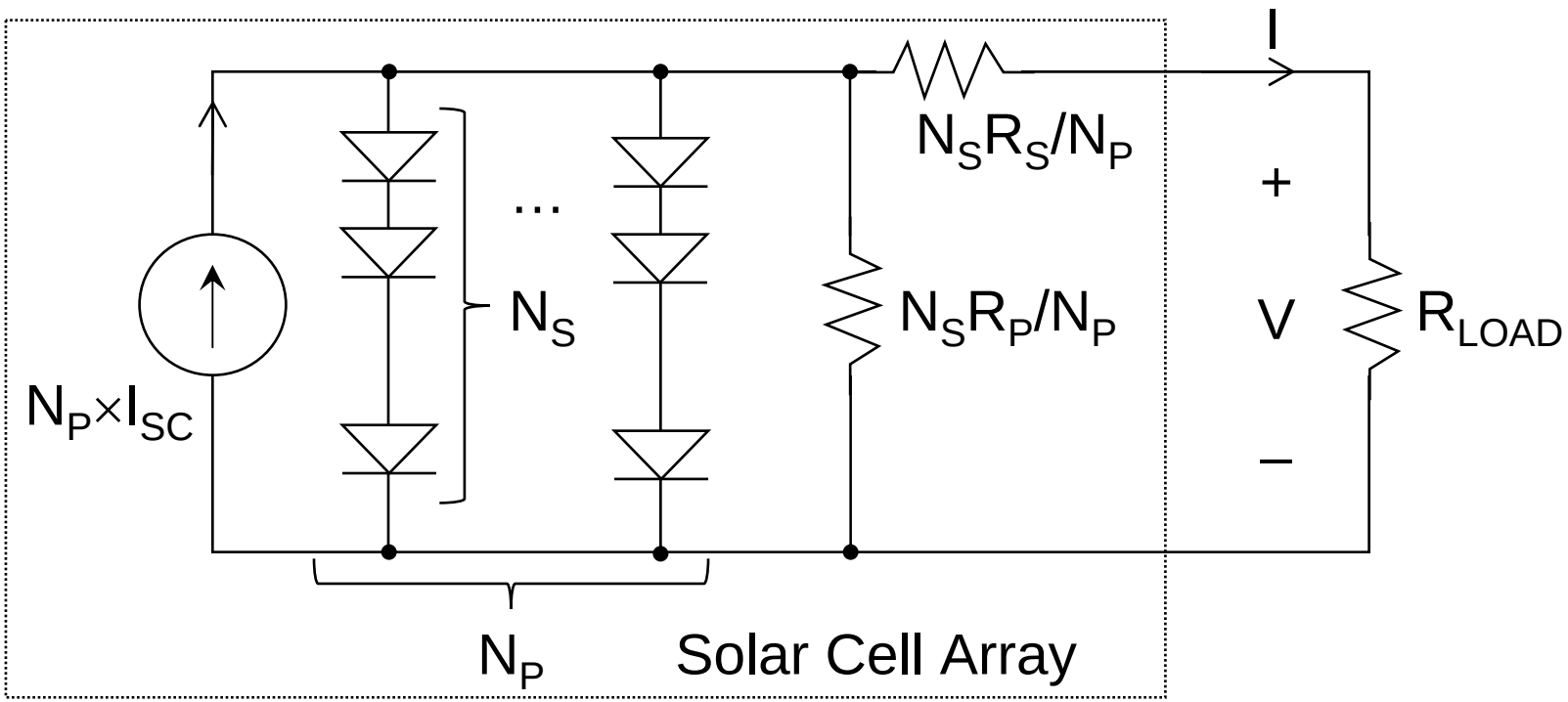


Generated current is N_P times larger
N_P diodes in parallel
N_P R_S in parallel
N_P R_P in parallel

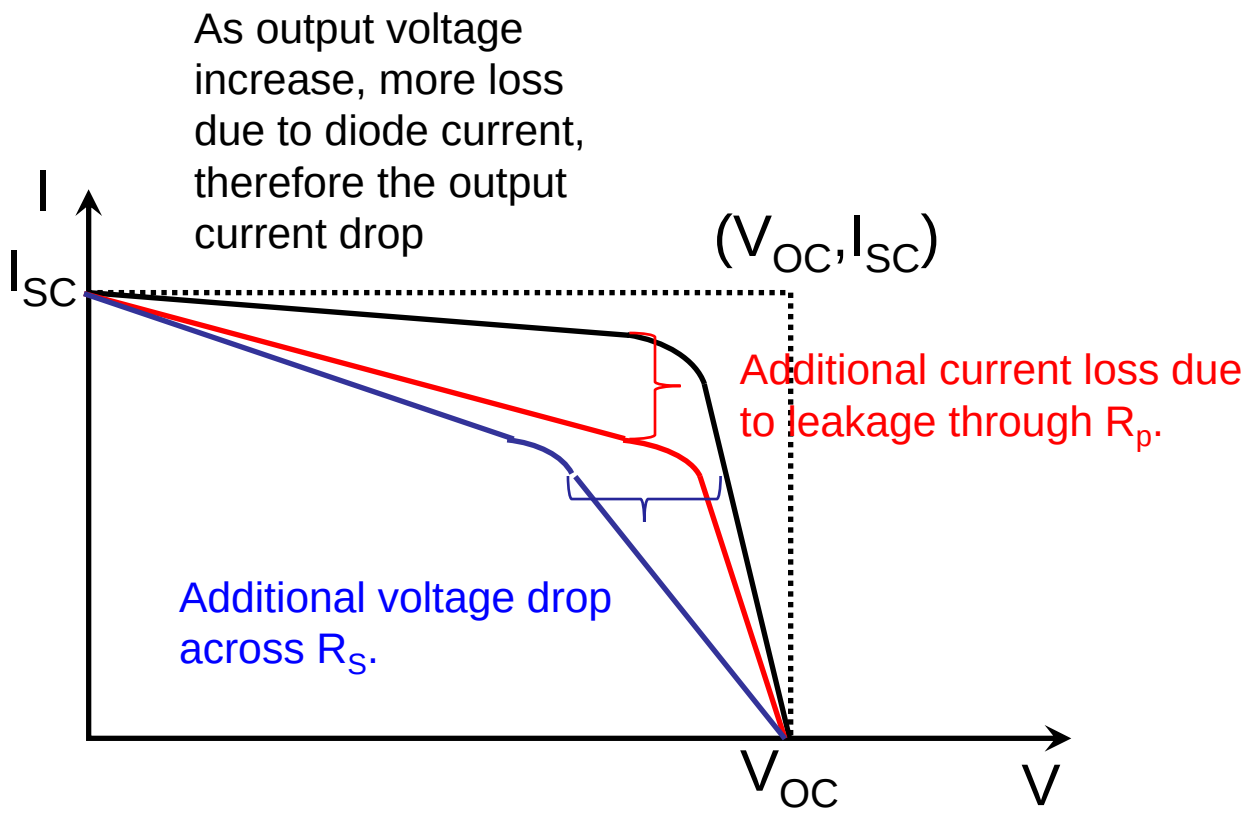


Generated voltage is N_S times larger
N_S diodes in series
N_S R_S in series
N_S R_P in series

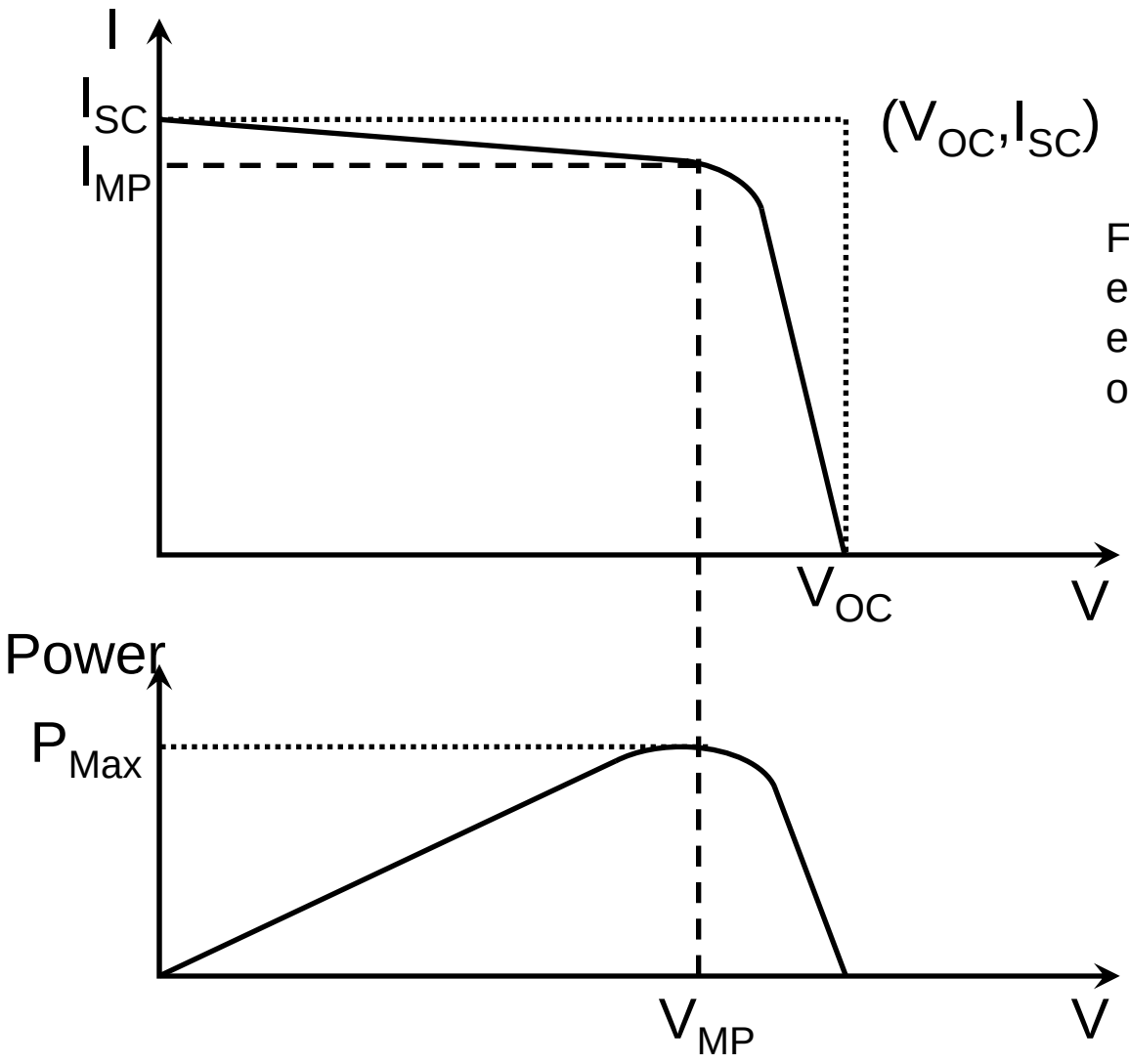
Equivalent Circuit Model



I-V Characteristic

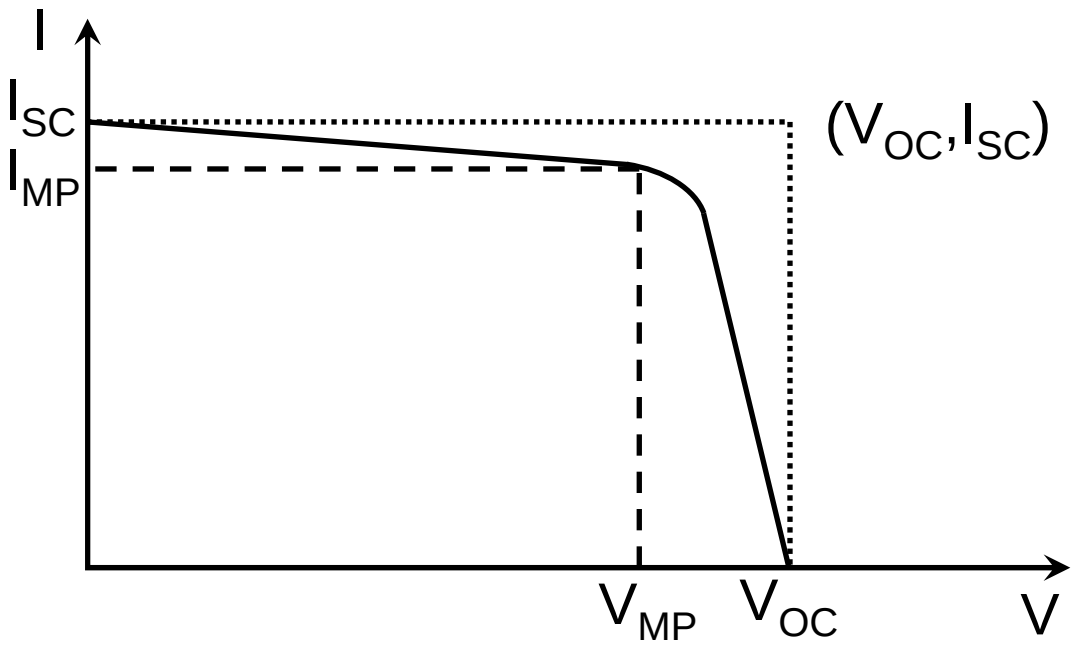


I-V Characteristic



For maximum power extraction, we need to ensure the solar cell operates at (V_{MP}, I_{MP})

Fill Factor (FF)

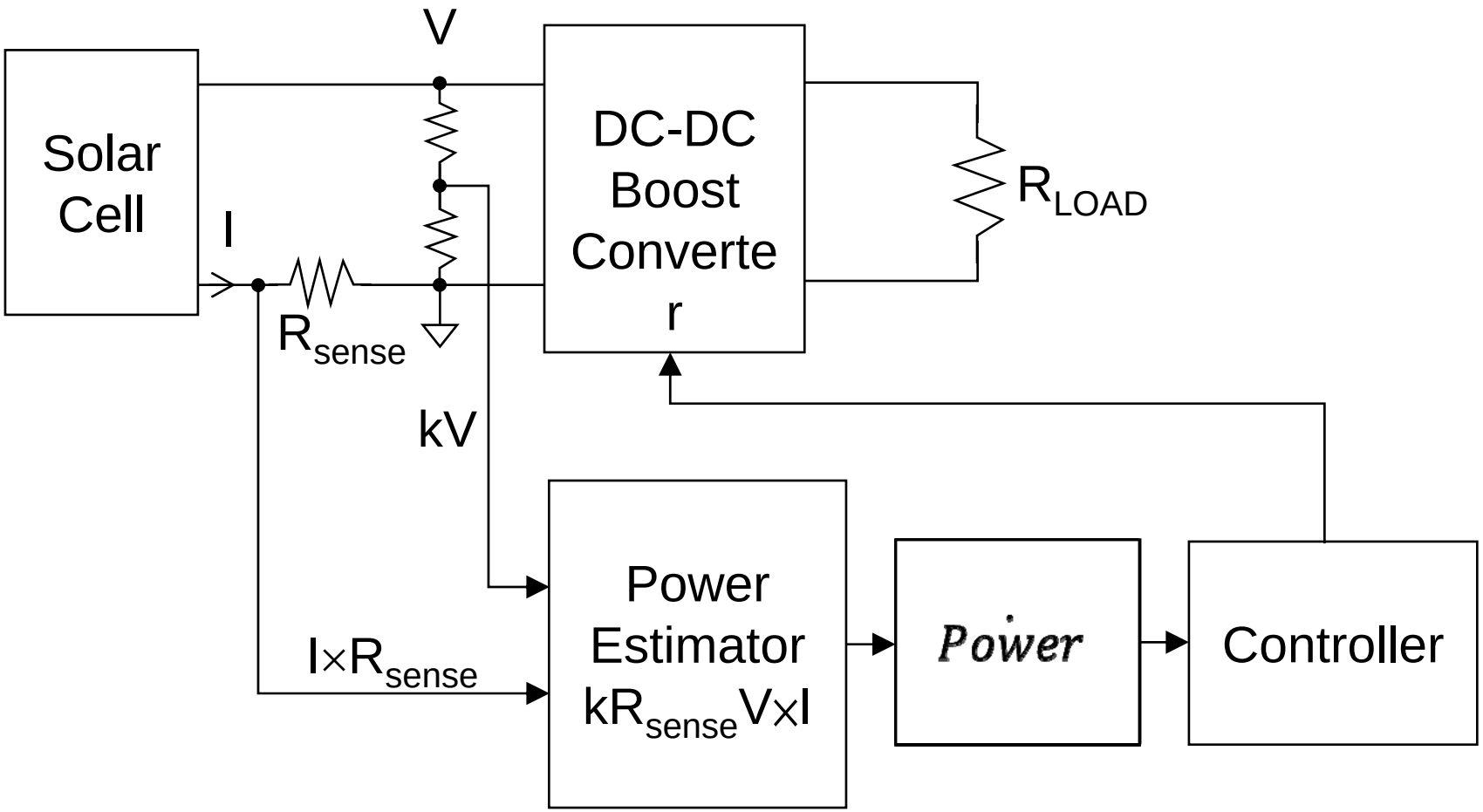


$$FF = \frac{V_{MP} I_{MP}}{V_{OC} I_{SC}}$$

MPPT

- **Maximum power tracking requires accurate tracking of solar cell output voltage to ensure it operates at (V_{MP}, I_{MP})**

MPPT


V
Solar Cell
I
DC-DC Boost Converte r
R_{LOAD}
R_{sense}
kV
Power Estimator $kR_{sense}V\times I$
$I\times R_{sense}$
Power
Controller