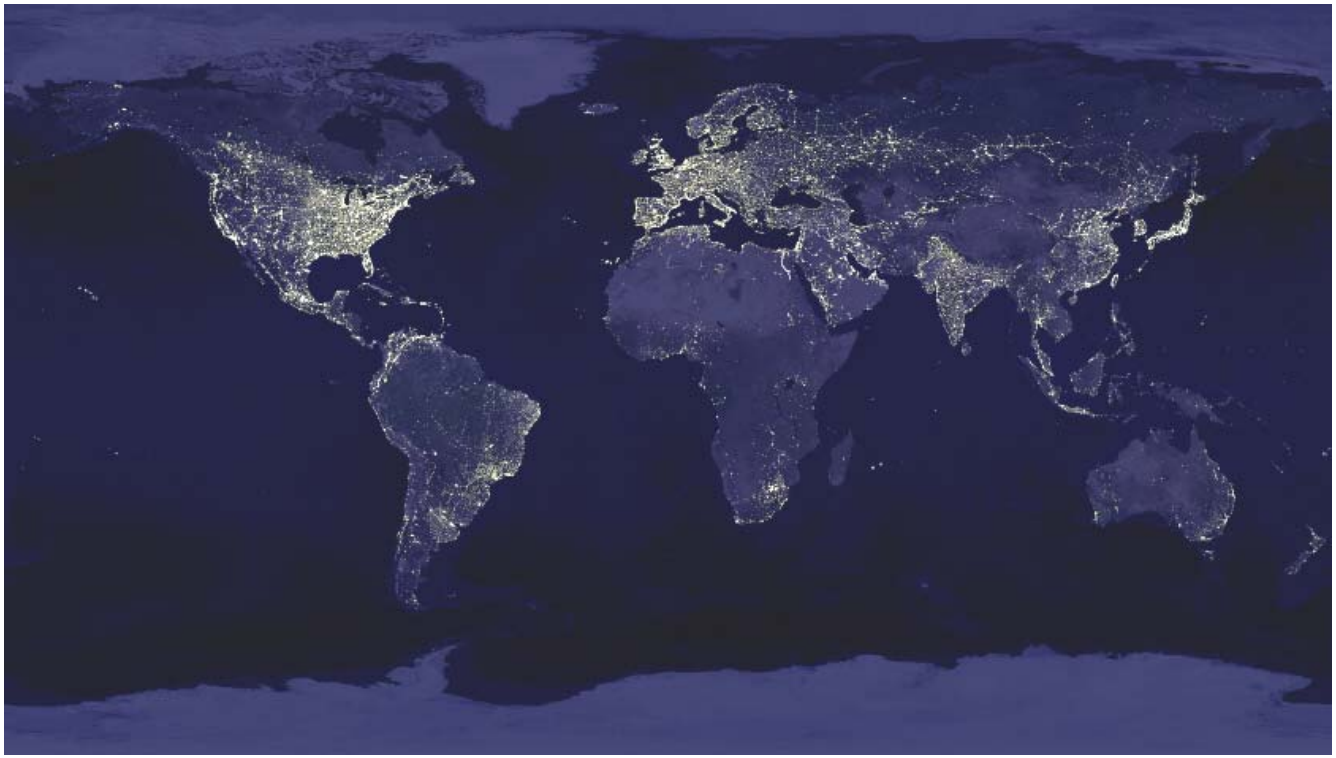
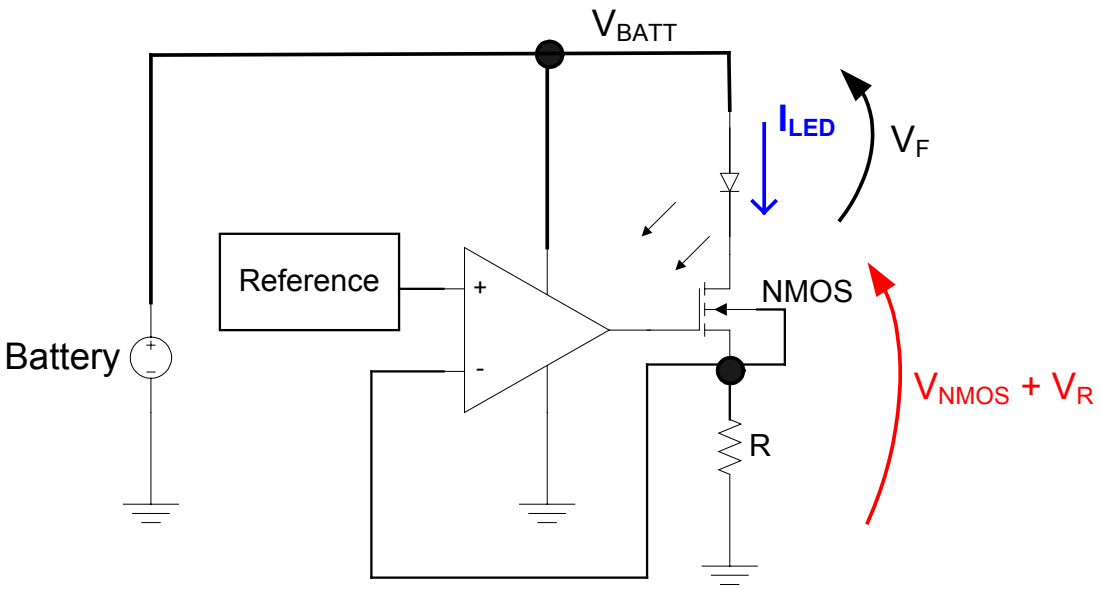
Custom Green Voltage Regulators for Portable Electronics



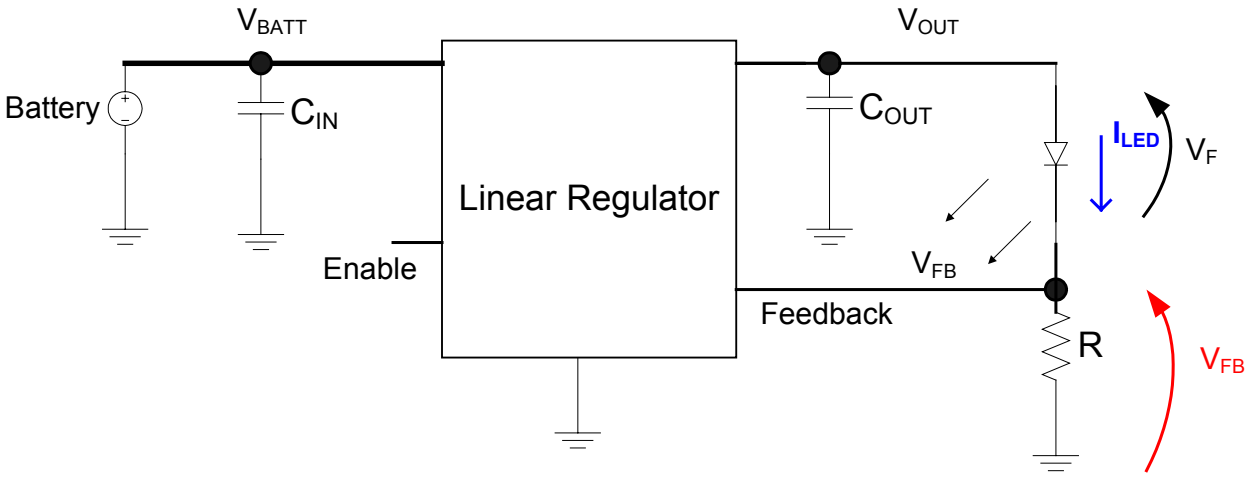
Old Fashioned LED Driver

- LED Forward Voltage V_F depends on the current
- Minimum Voltage of V_{BATT} is: $V_F + V_{NMOS} + V_R$
- Wasted Power is: $I_{LED}*(V_{NMOS} + V_R)$
  - Ignoring power loss in the Reference and Op Amp



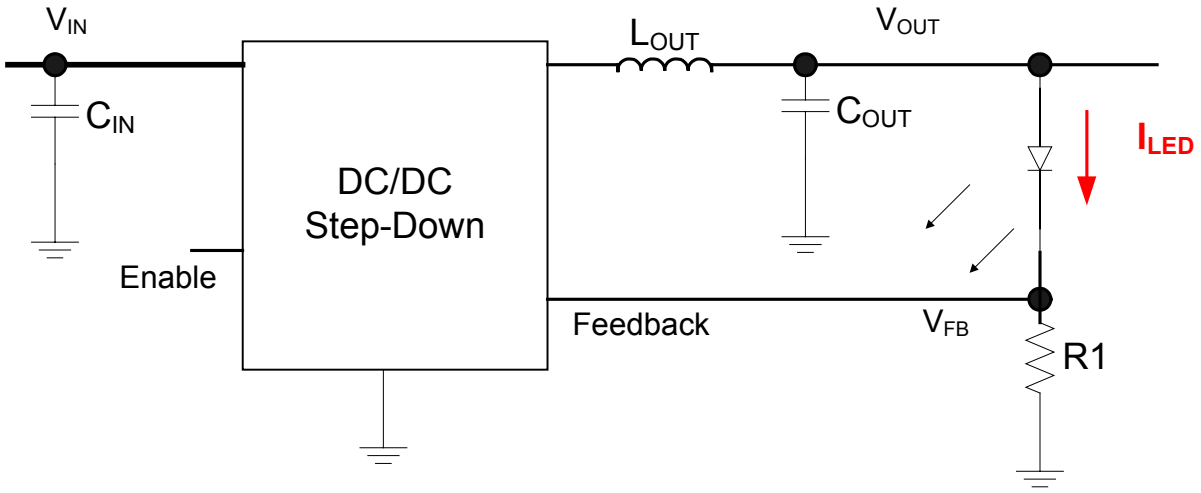
Linear (or LDO) LED Driver

- LED Forward Voltage V_F depends on the current
- Minimum Voltage of V_{BATT} is roughly $V_F + V_{FB}$
- Wasted Power is: $I_{LED}*[(V_{FB}) + (V_{BATT} - V_{OUT})]$
- Lowering the value of V_F
  - Will NOT save any power
  - Improves Operating Range



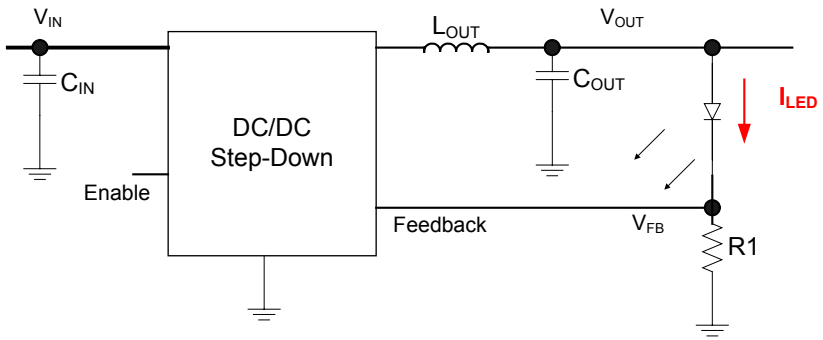
Using Step-Down (Buck) Regulator

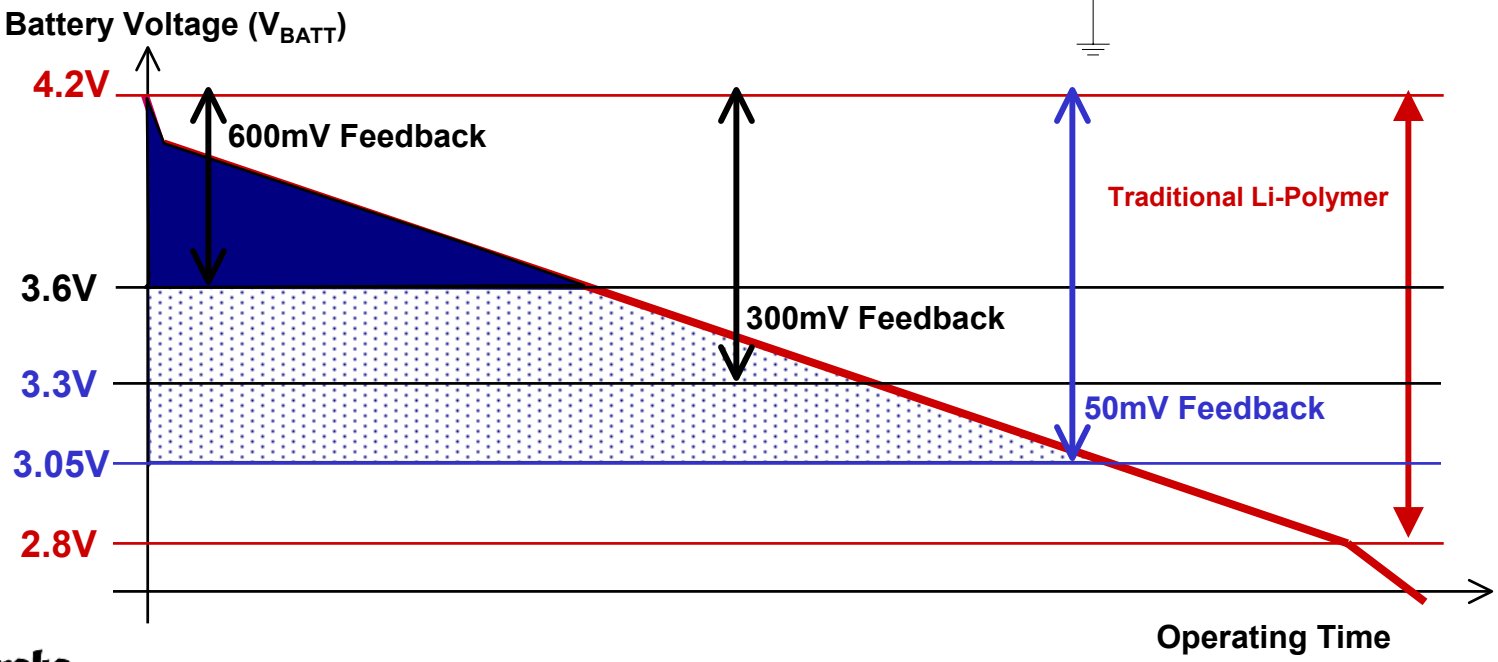
- Minimum Voltage of V_{BATT} is roughly $V_F + V_{FB}$
- Wasted Power is: $I_{LED*}(V_{FB}) + P_{DC/DC}$
- Lowering the value of V_F
  - WILL save power
  - Improves operating range



Li-Polymer Range vs. Feedback

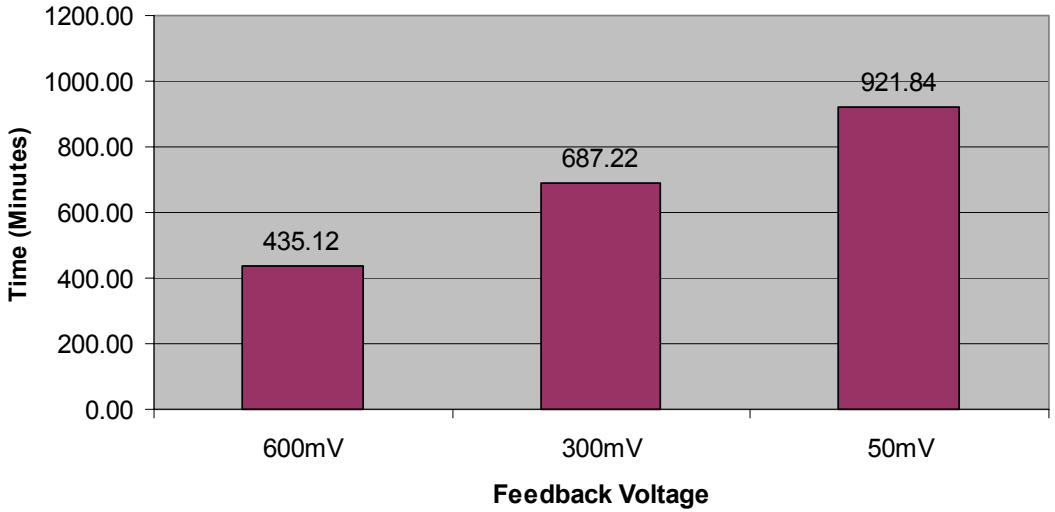
- Buck LED Driver With 100% Duty Cycle
  - LED @ 350mA with V_F = 3V
  - V_{FB} of 600mV, 300mV and 50mV

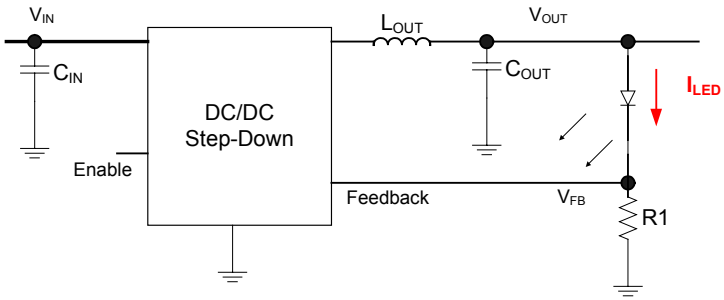




Operating Time Vs. Feedback Voltage

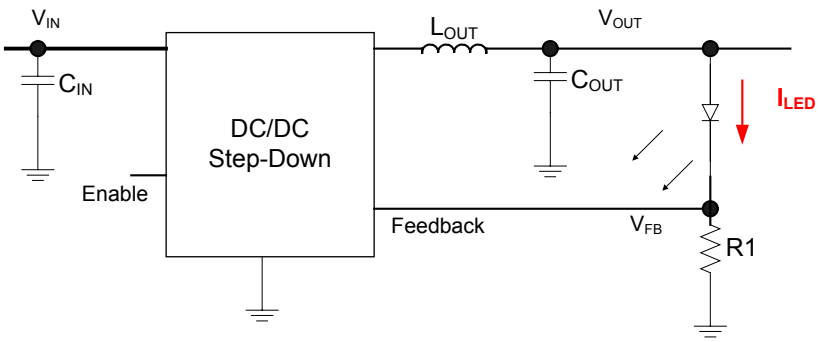
- Circuit Using A Step-Down DC/DC
  - Battery Is Assumed To Be 5000mAHr
  - 90% Efficiency For the DC/DC Regulator
  - Input Is Assumed To Be One Li-Polymer Battery (4.2V to 3V)
  - I_{LED}=350mA & Forward Voltage of 3V (1 Watt LED Power)
  - Feedback Voltages (V_{FB}) of 600mV, 300mV and 50mV

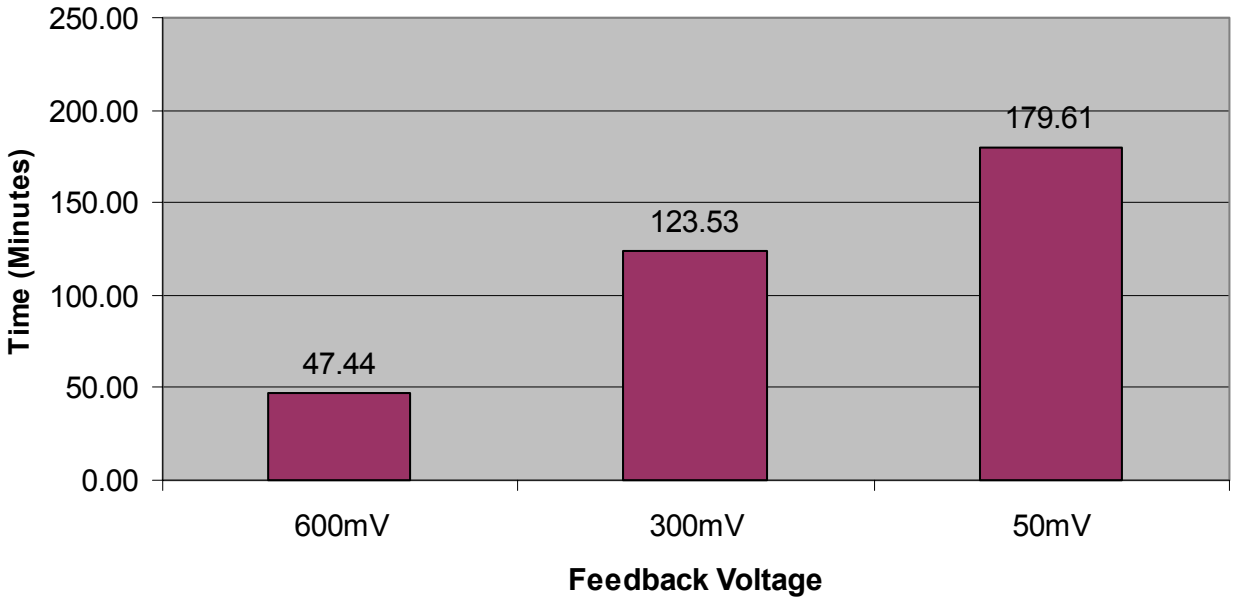




Operating Time Vs. Feedback Voltage

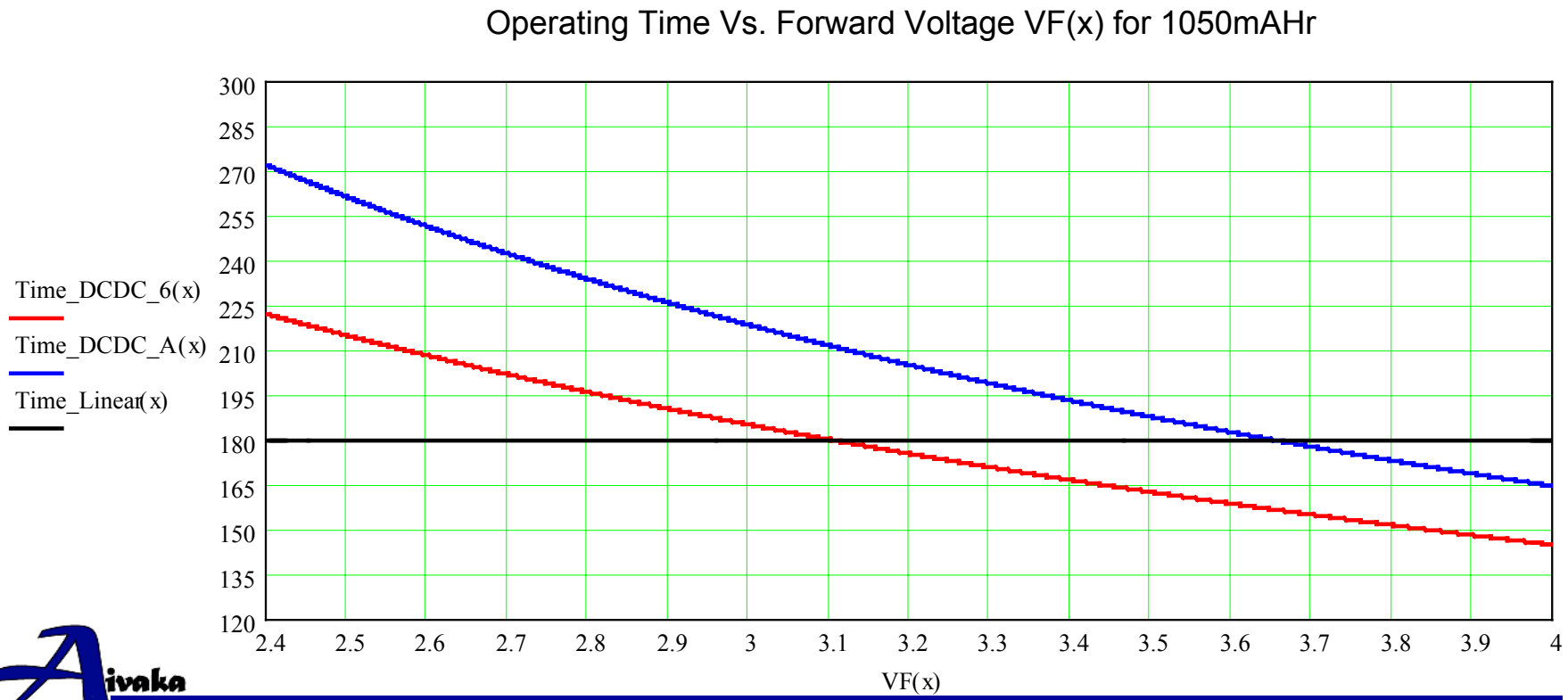
- Buck LED Driver
  - V_{FB} of 600mV, 300mV and 50mV
- One LED
  - 600mA @ VF = 3.4V
- One Li-Polymer (1600mAHr)
  - Cut-off @ 3.45V





Operating Time vs. LED Forward Voltage

- LED @ 350mA
  - Linear Solution vs. DC/DC
    - Black: Linear
    - Red: V_{FB} = 600mV
    - Blue: V_{FB} = 50mV




Saving The World One Battery
At A Time
Advanced Technology & Customer Service