

Resistor Calculations – V2

(All equations derived from Texas Instruments document SLUSAH0F, the application datasheet for the BQ25504 Energy Harvesting Boost Converter with Battery Charger)

MPPT set point target 80% of 2.76v = 2.208v

Set to 80% of solar cell open circuit.

Solar Cell open circuit voltage = 2.76v

2.76v x 80% = 2.208v (target VOC sample setpoint)

$VOC_SAM = Voc \times R_OC2 / (R_OC1 + R_OC2) = 2.76 \times 802k / (802k + 196k) = 2.217v$ (actual sample setpoint)

$R_OC1 = 196k$

$R_OC2 = 802k$

VBAT_UV set point target = 3.0v (From BQ25504 data sheet section 8.3.2, equation 2)

$$VBAT_{UV} = VBIAS \left(1 + \frac{R_{uv1}}{R_{uv2}} \right) = 1.25 * \left(1 + \frac{698k}{499k} \right) = 2.998v$$

$R_UV1 = 698k$

$R_UV2 = 499k$

VBAT_OV target (ideal) = 4.2v (From BQ25504 data sheet section 8.3.3, equation 3)

Due to the 2% tolerance, the target threshold has been reduced to 4.095 (see V2 strategy for setting thresholds)

$Vbias = 1.25v$

$$Vbat_{ov} = \frac{3}{2} Vbias \left(1 + \frac{R_{ov1}}{R_{ov2}} \right) = \frac{3}{2} * 1.25 * \left(1 + \frac{715k}{604k} \right) = 4.095v$$

$R_{ov1} = 715k$

$R_{ov2} = 604k$

VBAT_OK (settings for hysteresis thresholds) See included PDF document "Hysteresis.pdf"

(From BQ25504 data sheet section 8.3.4, equations 4 and 5)

Falling voltage target threshold 2.95v

$$Vbat_ok_falling = VBIAS \left(1 + \frac{Rok2}{Rok1} \right) = 1.25 \left(1 + \frac{715k}{523k} \right) = 2.959v$$

Rising voltage target threshold 3.10v

$$Vbat_ok_rising = VBIAS \left(1 + \frac{Rok2+Rok3}{Rok1} \right) = 1.25 \left(1 + \frac{715k+75k}{523k} \right) = 3.138v$$

Rok1 = 523k

Rok2 = 715k

Rok3 = 75k

V2 Strategy for setting thresholds

Based on the larger than expected variation in voltage thresholds (outside of the 0.1%v resistor tolerance), the battery upper charge threshold (the most critical threshold), has been reduced to a calculated threshold of 4.095 volts, which is 105mv below the battery max of 4.2v. In the circumstance that the chip variation is on the high side (+2%), the resulting threshold will be $1.02 \times 4.095 = 4.177v$, a safe threshold.

This considers the tolerance of the BQ25504 device. It has as much as 2% error, even when using 0.1% tolerance resistors.

SolarMD Electrical Characteristics

Symbol	Cell Parameter	Typical Ratings *)	Units
Voc	open circuit voltage	2.76	V
Isc	short circuit current	83.8	mA
Vmpp	voltage at max. power point	2.23	V
Impp	current at max. power point	78.7	mA
Pmpp	maximum peak power	175.6	mW
FF	fill factor	> 70	%
η	solar cell efficiency	25	%
$\Delta Voc/\Delta T$	open circuit voltage temp. coefficient	-6.96	mV/K
$\Delta Isc/\Delta T$	max power temp. coefficient	37.9	uA /K

*) All values measured at Standard Condition: 1 sun (= 1000 W/m²), Air Mass 1.5, 25°C

