Maximum efficiency of motor

\( I_o: \) no load current @ \( U_m \)

\( I_s: \) stall current = \( U_m / R_m \)

\[ \eta_{max} = \left(1 - \sqrt{\frac{I_o}{I_K}}\right)^2 \]

Measurement of \( R_m \)

Take a DC Power Supply with current limiter. Supply a current i.e. 3 amps between motor terminal a-b. Measure Voltage \( U \). \( R_m \) is \( U / I \). Repeat measurement on motor terminal a-c and motor terminal b-c. The results should be equal.

Measurement of \( I_o \)

Run the motor @ WOT without a prop. Measure \( I_o \) with a digital voltmeter, 10 A range, or a watt meter. Measure also \( U_m \) (on power leads of LiPo) @ \( I_o \).

Calculation of maximum efficiency of motor

With the measured \( I_o \) and \( R_m \) we can calculate the max motor efficiency. That is an easy way to estimate the max efficiency of a motor.

The max efficiency of a motor can normally not be reached using it in a plane, since shaft power at max efficiency is very low. But it is a way to compare motors with similar \( K_v \) and similar power rating.

Remark

The motor with the higher efficiency is not always the best one. Calculation of max efficiency does not predict i.e the quality of magnet material (temperature behavior). Also the thermal design of motors can differ. Rising motor temperature means a degradation of efficiency due to rising \( R_m \).

The efficiency of the motor is only one parameter of a good drive selection. Keep in mind the ESC, battery, weight of drive components and a prop selection that meet the needs of your model. Often people are using a motor with high \( K_v \) (high motor efficiency) but a small-sized prop. Result is a very bad propulsion efficiency.