

Power calculations

	Voltage (V)	Current (mA)	Power (W) when running	Power (W) when launching
SG90 servo (idle)	4.8	30	$9 \times 0.15 = 1.35$	$8 \times 0.15 = 1.2$
SG90 servo (launch)	4.8	200		0.96
TurtleBot (running autonav)			8.8	8.8
AMG8833 IR thermal camera	3.3	10	0.033	0.033
Total			10.18	11.00

The values we got for the servo were measured using an Analog Discovery 3 for the voltage and a benchtop multimeter for current. For the TurtleBot, we connected a Digital DC Power Supply as the power supply for the TurtleBot, and read the power shown. We took the highest value out of the three measurements. The AMG8833 power consumption is calculated based on the information in the datasheet.

Power when running: $P_{run} = 10.18W$

Power when launching: $P_{launch} = 11.00W$

From the SG90 servo data sheet, we know:

Servo speed (at 4,8 V): $\frac{0.12s}{60^\circ} = \frac{0.18s}{90^\circ}$

We assume that in each cycle, the robot will be running for 20 minutes, within which the servos will turn 9 times (corresponding to each of the 9 launches), and each turn is 90°.

Run time: $t_{run} = 20min = 0.33h$

Launch time: $t_{launch} = 9 \cdot 0.18s = 1.62s = 0.00045h$

Energy consumption: $P_{run} \cdot t_{run} + P_{launch} \cdot t_{launch} = 10.18 \cdot 0.33 + 11.00 \cdot 0.00045 = 3.36Wh$

Our battery specifications are: 1800 mAh, 11.1 V \ 19.98Wh

Dividing the two values we get: $\frac{19.98}{3.36} = 5.94$

Thus, our battery can last for 5 20-minute cycles until it dies.