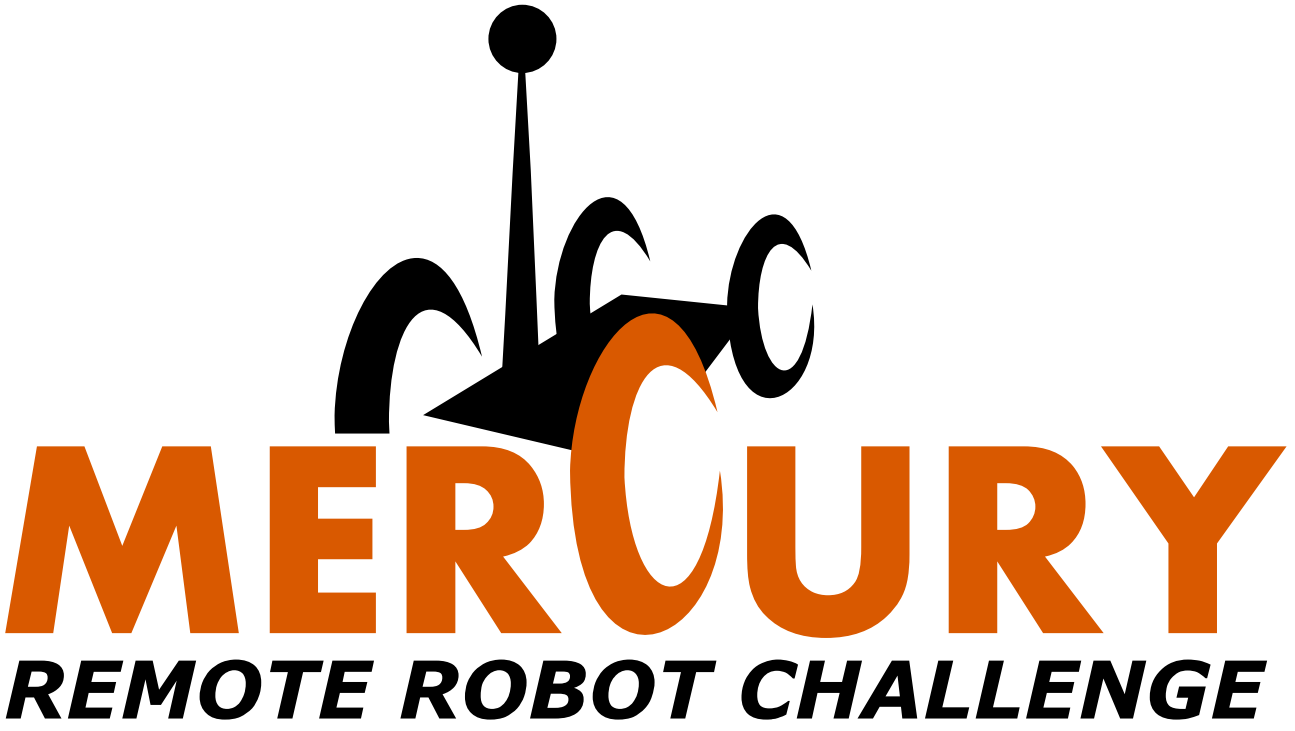

Powering A Mercury Bot

Batteries
The Energy Source of Champions!

- Fact: every Mercury bot has been powered by batteries
- Battery selection is of primary importance
  - Strongly influences (-ed by) motor selection in single battery bots
- Battery Selection Can Effect
  - Computing platform
  - Motor and servo performance
  - Sensor performance

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A Few Things to Consider

- Cost
- Voltage
- Required run time
- Charging complexity
- Capacity
- Weight
- The efficiency of electronics attached to the battery
- The worst case!

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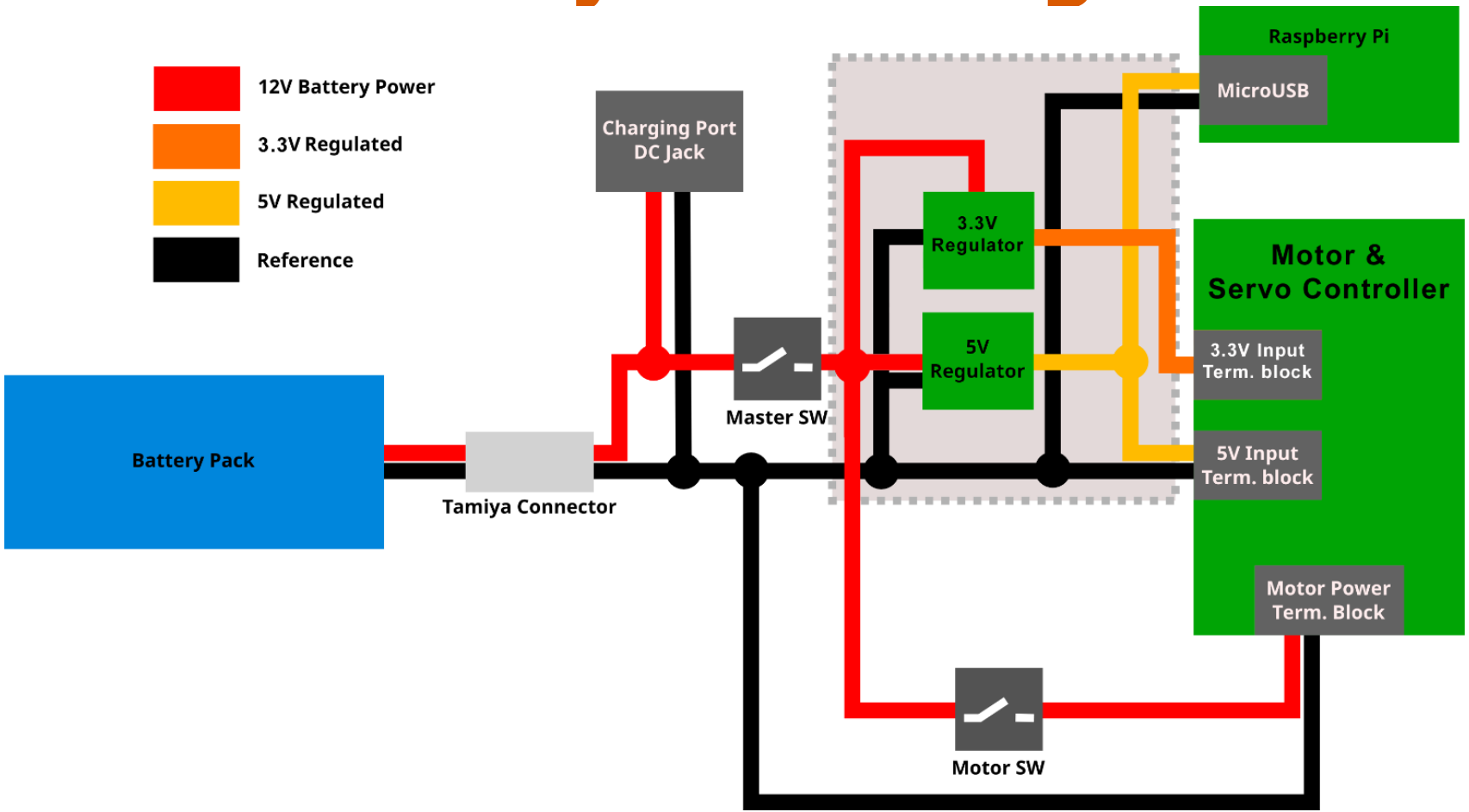
Power System Diagram



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Current Consumption: Electronics

Estimated Current Consumption	
Sharp Sensor Ityp	0.03
Hbridge Iq	0.06
PIC MCU Ityp	0.05
Pi Cam Ityp	0.25
Rpi Stress Ityp	0.75
Wifi Module Stress Ityp	0.245
Total Zeph 5V Sys Ityp	*1.505*

Current Consumption: Servos

- Not generally specified
- Analog servos usually require less current than digital when in motion
  - Correspondingly lower performance
- Rule of thumb: standard servo stall current ~1A
  - More likely to stall than motors during testing
- 2 servos = 2A

Current Consumption: Motors

- A Typical Mercury Bot
  - Weighs 15 lbs
  - Expected to climb a 30° incline @ 1m/s^2
  - Has four 2.78” dia. wheels
  - Moves at 1m/s
  - Operates around 30 min between charging
- BoE* per Motor Torque, Current @ 65% eff.
  - 80 oz-in, where stall torque 320 – 400 oz-in
  - 1.3 A

* https://www.robotshop.com/community/blog/show/drive-motor-sizing-tool

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Some Good Motors

Pololu
Robotics & Electronics

Rated Voltage	Motor Type	Stall Current @ Rated Voltage	No-Load Speed @ Rated Voltage	Approximate Stall Torque @ Rated Voltage	 With Encoder	 Without Encoder
12 V	high-power **(HP)**	5.6 A	10,200 RPM	5.5 oz-in	1:1 HP 12V w/encoder	
			2250 RPM	23 oz-in	4.4:1 HP 12V w/encoder	4.4:1 HP 12V
			1030 RPM	44 oz-in	9.7:1 HP 12V w/encoder	9.7:1 HP 12V
			500 RPM	85 oz-in	20.4:1 HP 12V w/encoder	20.4:1 HP 12V
			290 RPM	120 oz-in	34:1 HP 12V w/encoder	34:1 HP 12V
			210 RPM	165 oz-in	47:1 HP 12V w/encoder	47:1 HP 12V
			130 RPM	240 oz-in	75:1 HP 12V w/encoder	75:1 HP 12V
			100 RPM	300 oz-in	99:1 HP 12V w/encoder	99:1 HP 12V

*Don't forget to fuse properly!

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Total Current Consumption

$$I_{total} = I_{electronics} + I_{servos} + I_{motors}$$

$$I_{total} = 1.5 + 2 + 4(1.3)$$

$$I_{total} \triangleq 8.7\text{A}$$

Battery Capacity

- C Rate – Time to discharge cell to cut off voltage
  - Units are h^{-1}
    - 1hr = 1C
    - 0.5hr = 2C
    - 5hr = 0.2C
- Multiply by capacity to get amount of time a battery can supply a given current until discharged (around 1V for NiMH)
- Example: 1000 mAh at 2C (30 minute discharge time):

$$2A = 1000mAh * \frac{1}{0.5h}$$

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Battery Selection

BUILT-TO-ORDER ITEM

Order Now! Build Lead Time: 3-7 Business Days

PRODUCT HIGHLIGHTS

- Chemistry Ni-MH
- Nominal Voltage (V) 12
- Capacity (mAh) 4200
- Max Continuous Discharge Current 30A
- Weight 1.5lbs
- Dimension 223 x 48 x 25mm (LxWxT)
- Connector Standard Tamiya Connector

show Less

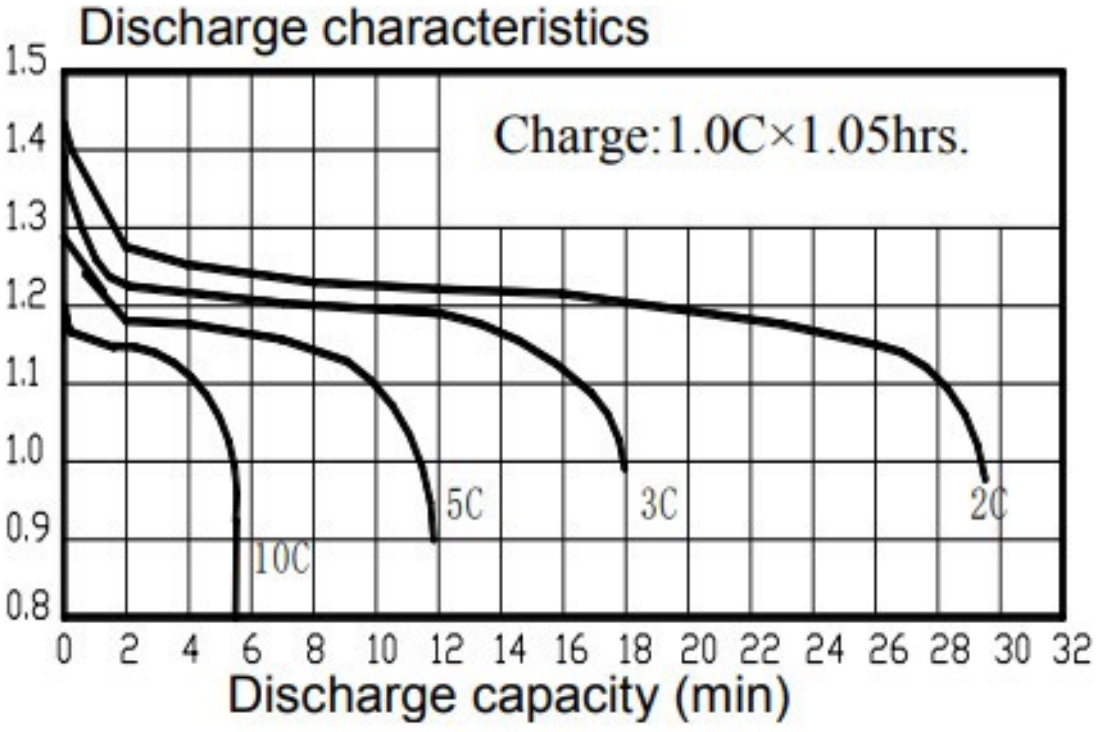
Battery Selection

Form1: Battery rated perfor

No	Description	Specification	
1	Nominal voltage	1.2 V	
2	Nominal capacity	5000mAh	
3	Minimum capacity	4600mAh	
4	Standard charge	460mA（0.1C） × 16 hrs	Ta=0～40℃
5	Rapid charge	0.5C×2.1hrs approx.	-△V= 5mV/cell
6	Trickle charge	0.05C-0.1C	Ta=0～40℃
7	Standard discharge	920mA（0.2C）	Ta=0～60℃
8	Discharge cut-off voltage	1.0V	
9	Maximum discharging current	30A（Cut-off voltage 0.9V）	Discharge time≥8.8min
10	Storage temperature	≤1 month -20℃～45℃	The best temperature range is 10℃-25℃
		≤3 months -20℃～40℃	
		≤1 year -20℃～30℃	
11	Typical weight(approximate)	69.0g	

Battery Capacity

- 2C for 4600 mAh battery
  - 9.2A > 8.7A
  - It’s good!



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