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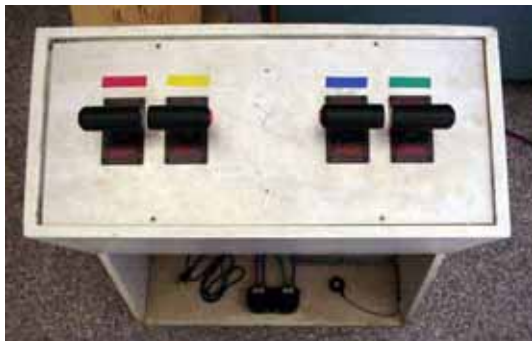
2.007 Design and Manufacturing I
Spring 2009

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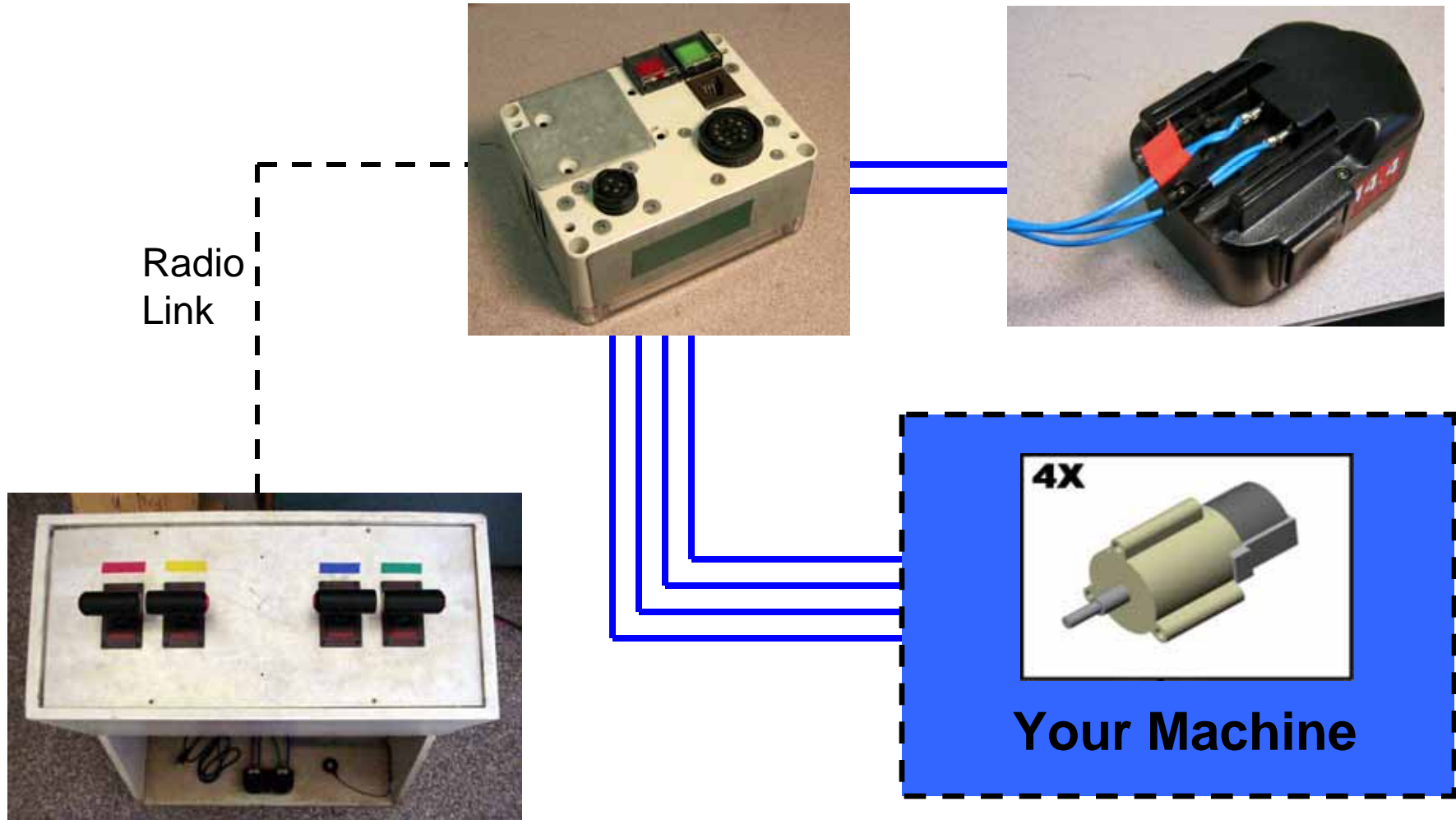


2.007 Control System Lecture

Spring 2005
Hong Ma



Control System Overview

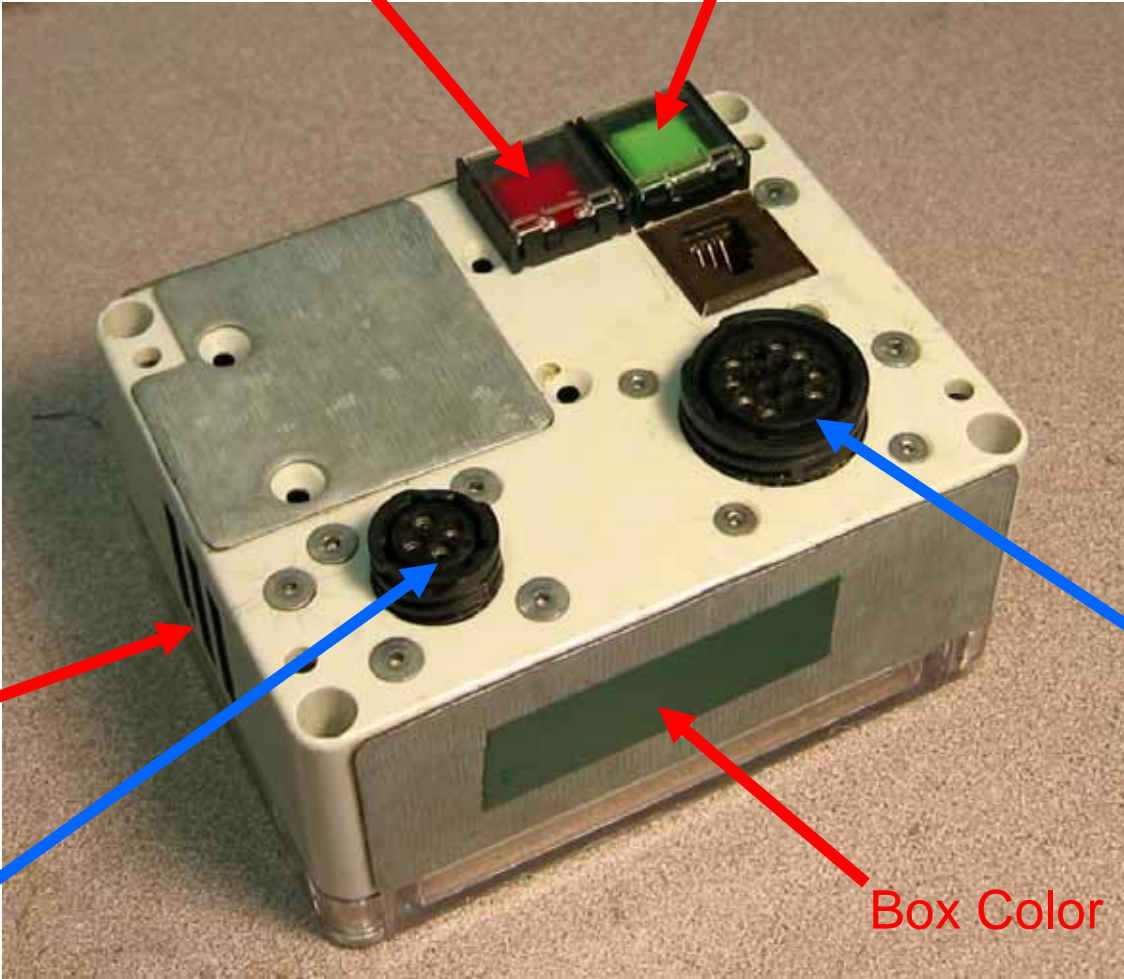


Control Box

Motor on/off Button

Calibration Button

Mass:
0.39 kg
(0.85 lbs.)



Vents

Motor Plug

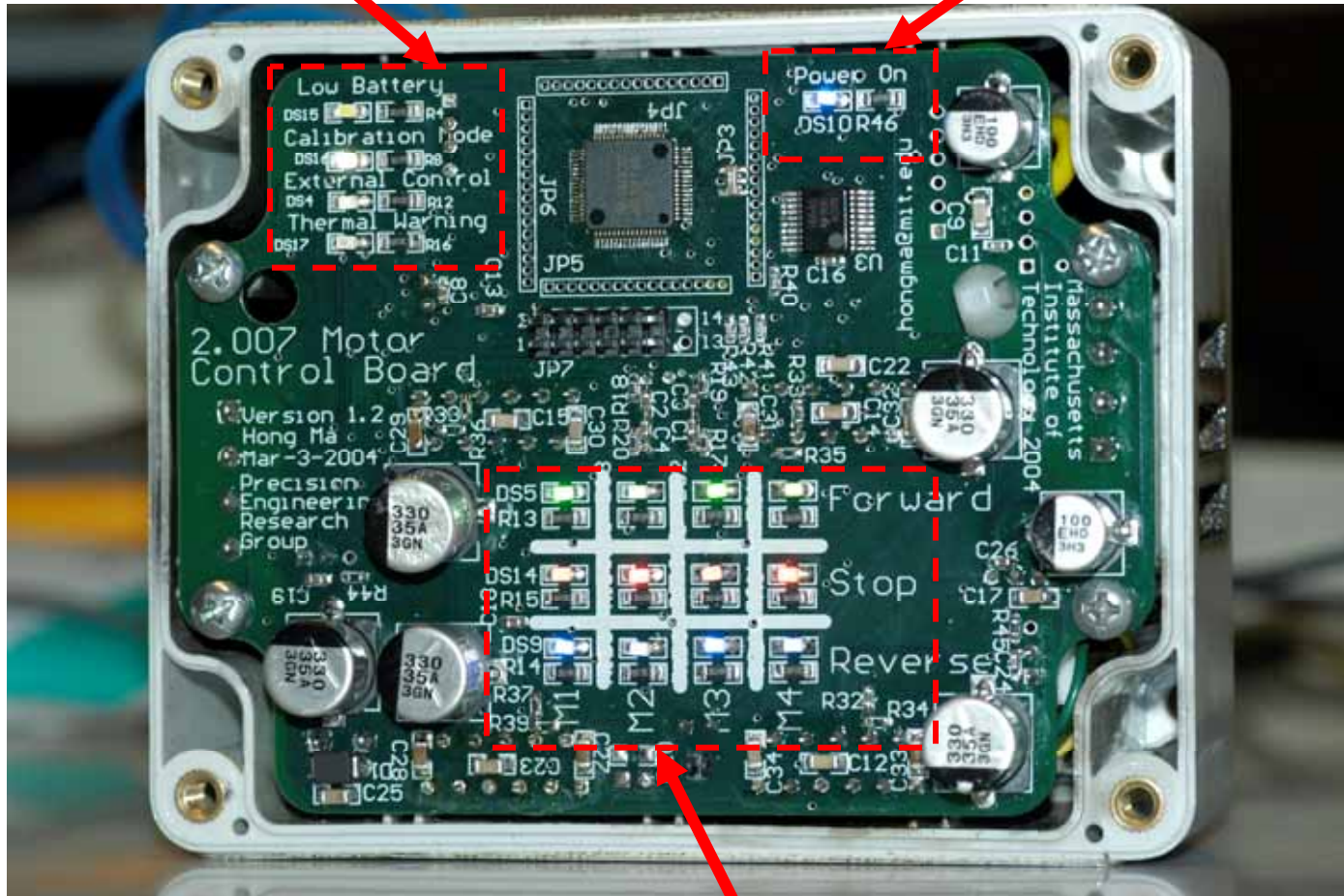
Power Plug

Box Color

Control Box Indicators

Status Indicators

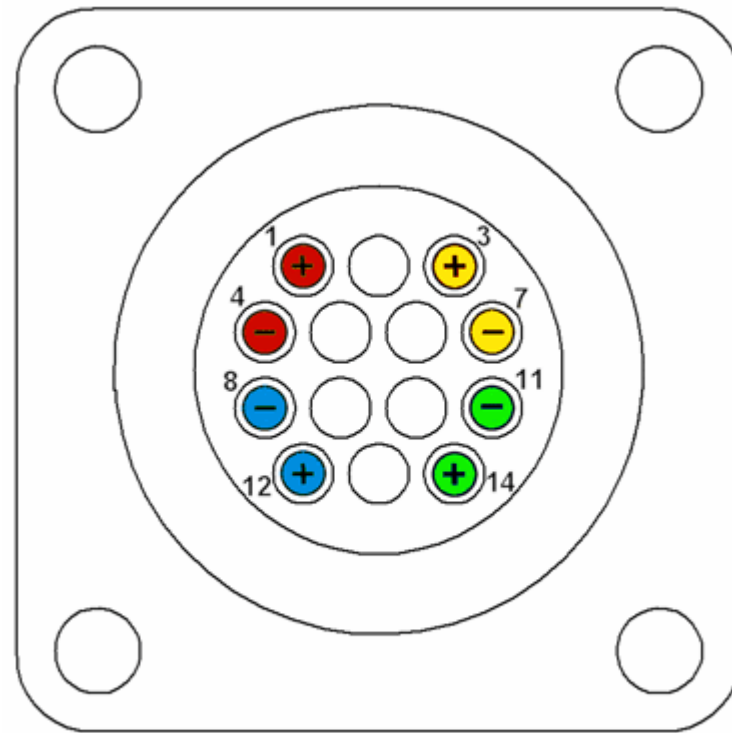
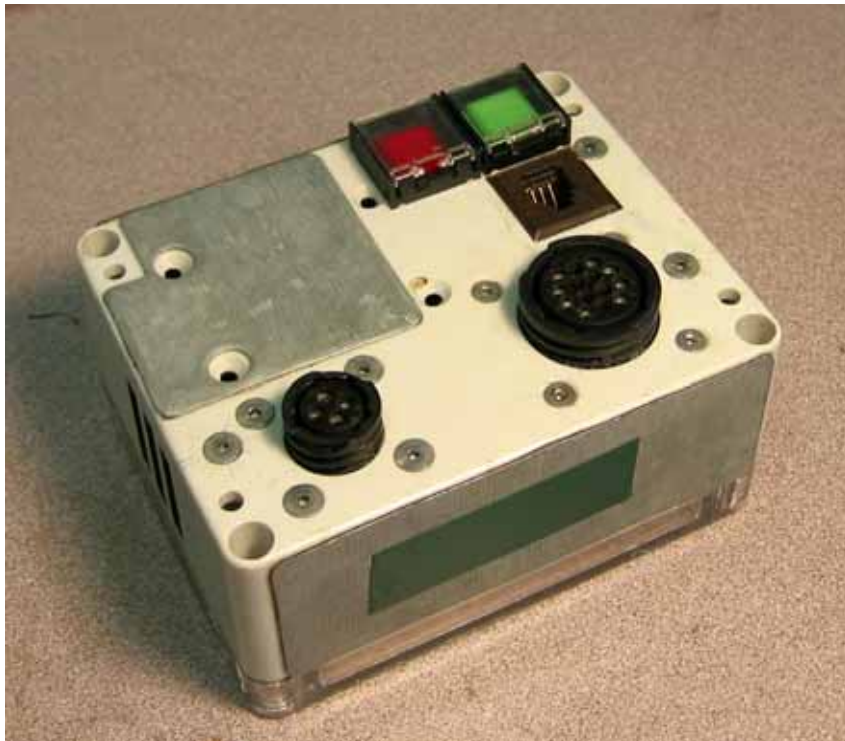
Power LED



Motor Status Indicators

Control Box – Electrical Characteristics

- 4 channel output
- Up to 3A maximum on each channel



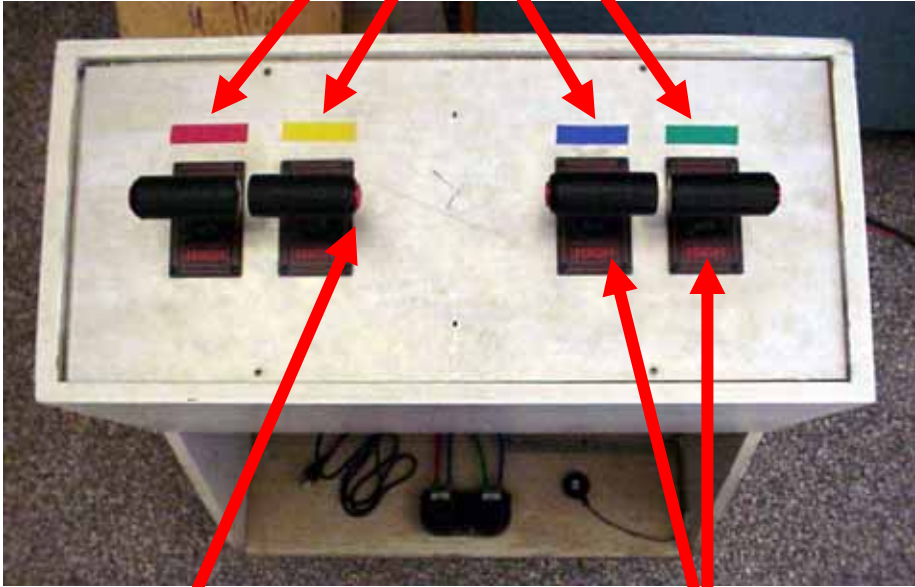
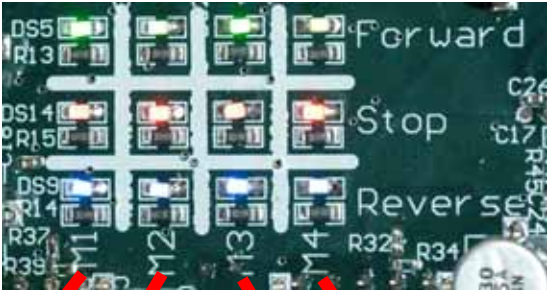
Motor Plug

Control Boxes

Green=Forward

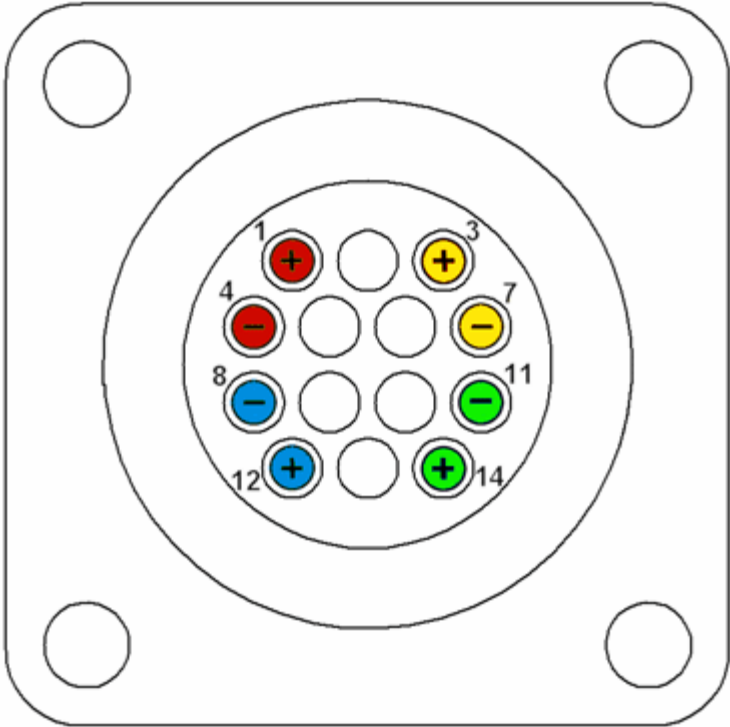
Red=Stop

Blue=Reverse



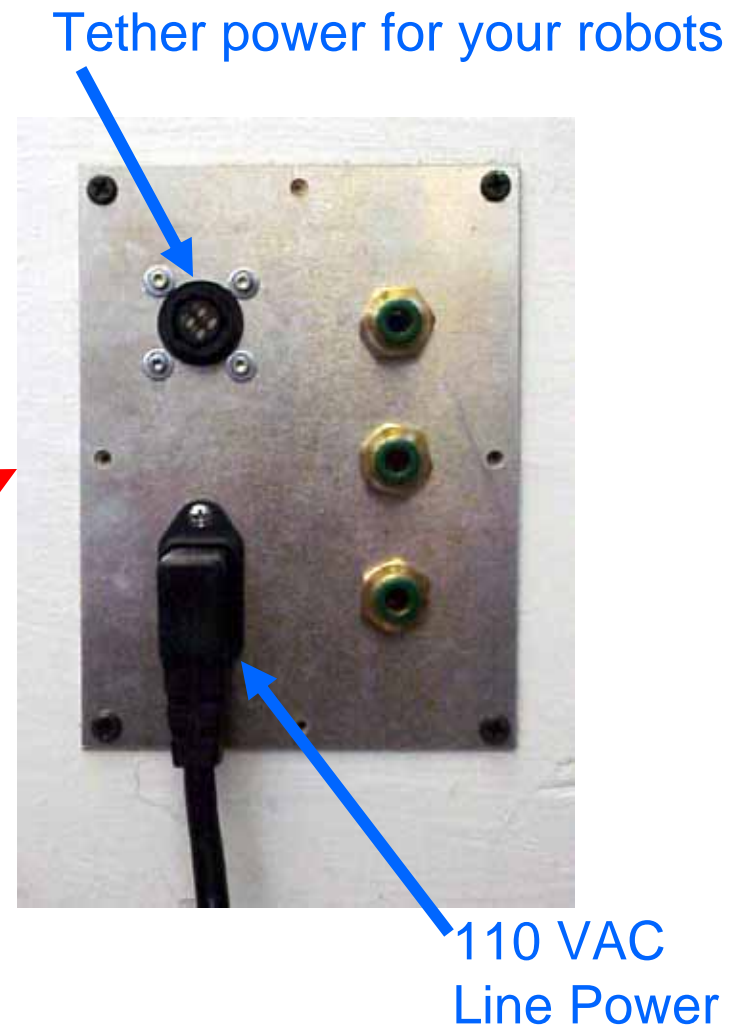
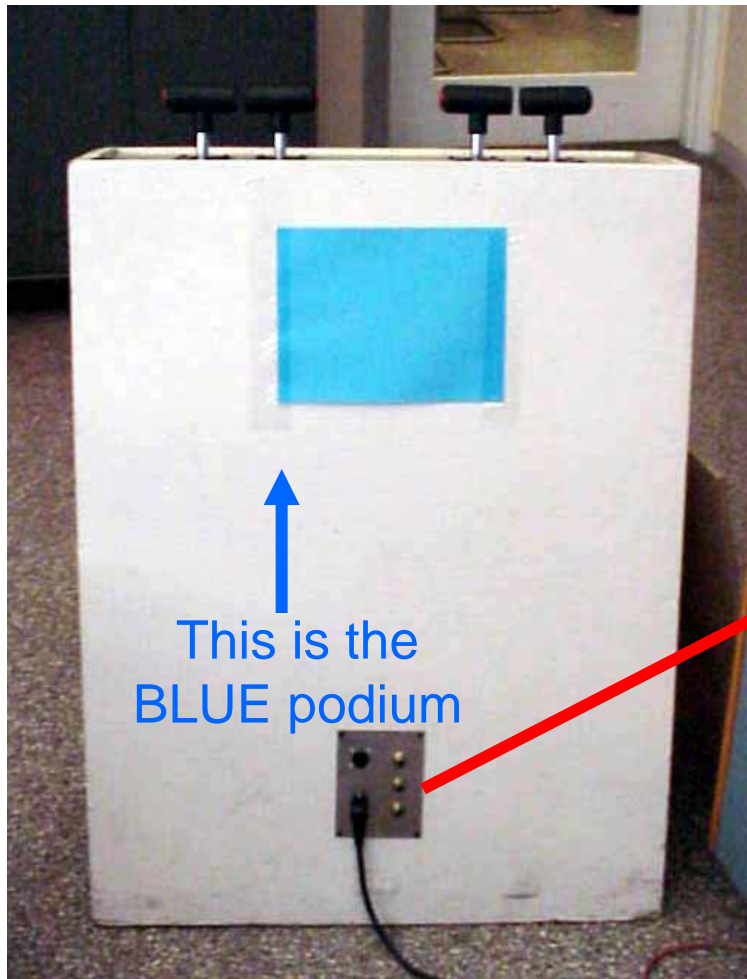
Inactive Button

Throttles

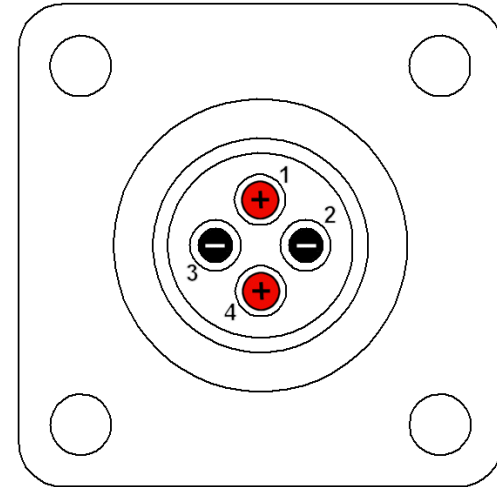


Motor Plug

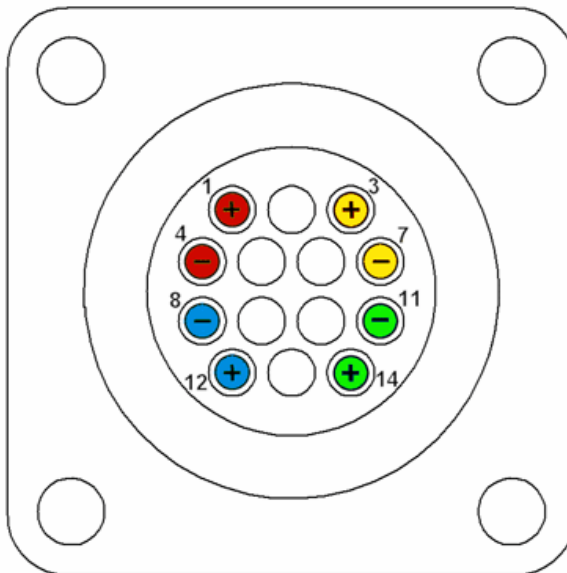
Control Podiums



Motor and Battery Wiring



Battery Plug

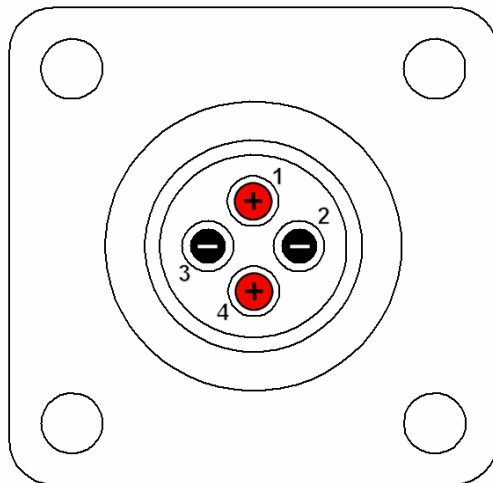
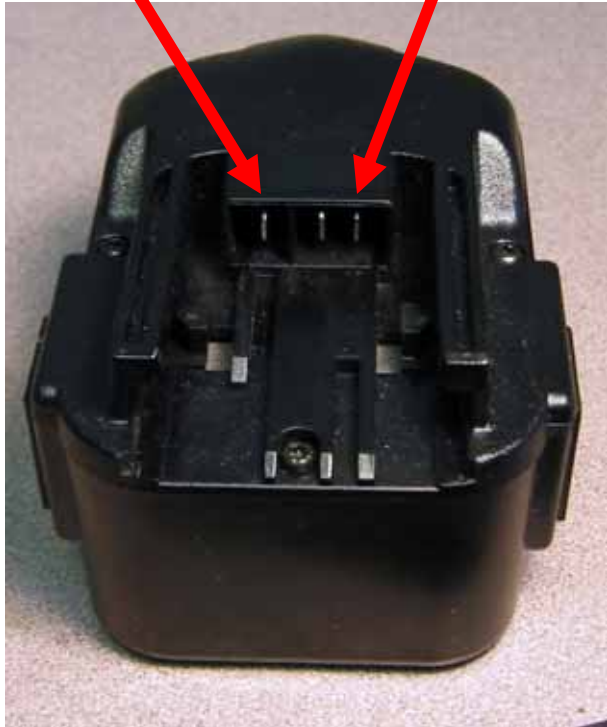


Motor Plug



Pin removal tool available in the tool crib.

Positive Negative



The Battery

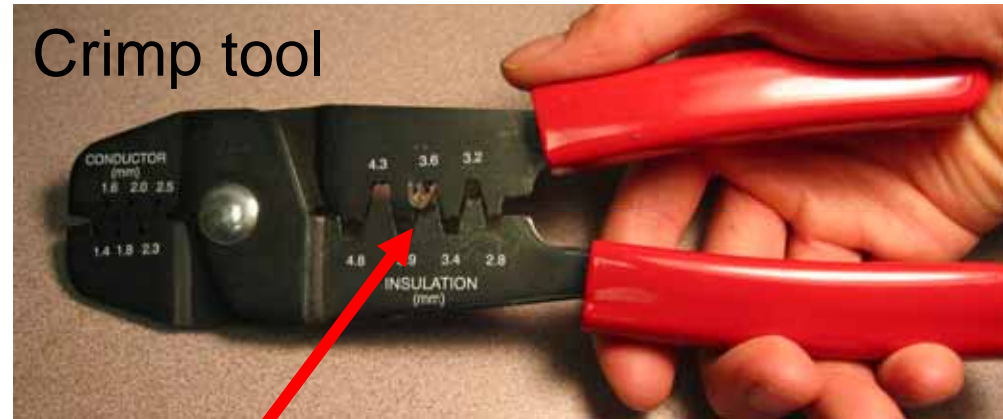
- Beasty NiCd battery
- 14.4V nominal, but actually 12-17V depending on charge



How to make a Battery Plug



1/4" Tab connectors

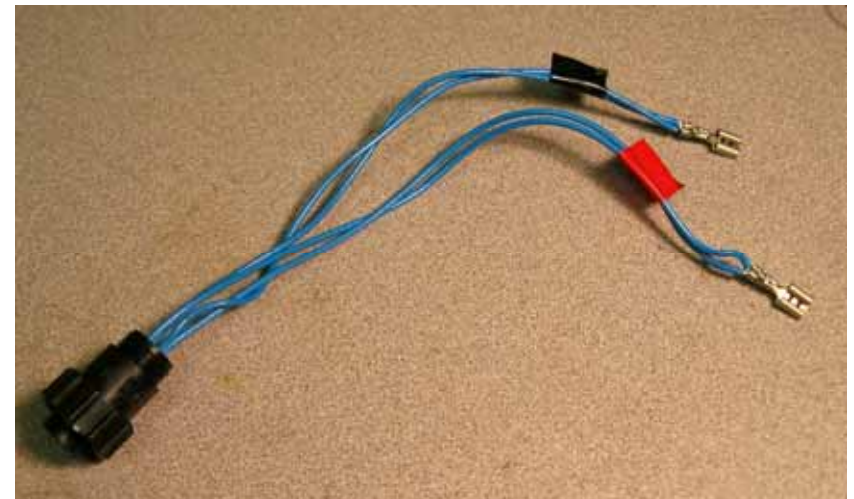


Crimp tool

Insert connector
and 2 pre-cut wires



Apply solder here



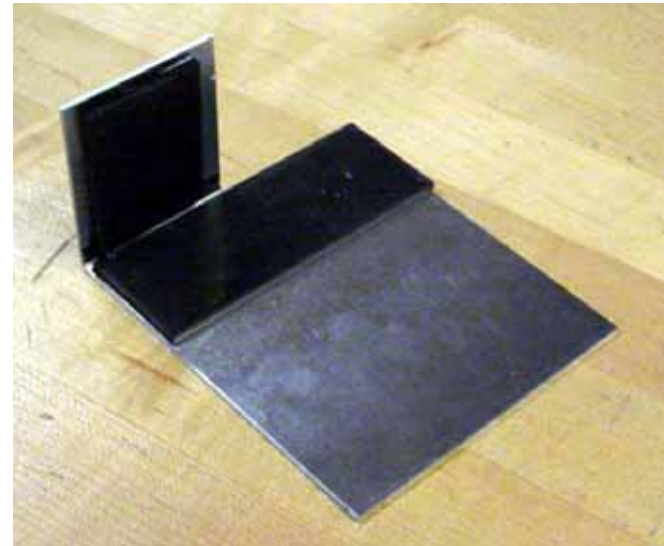
Label the terminals to avoid
plugging things backwards!!!

Mounting the battery and control box

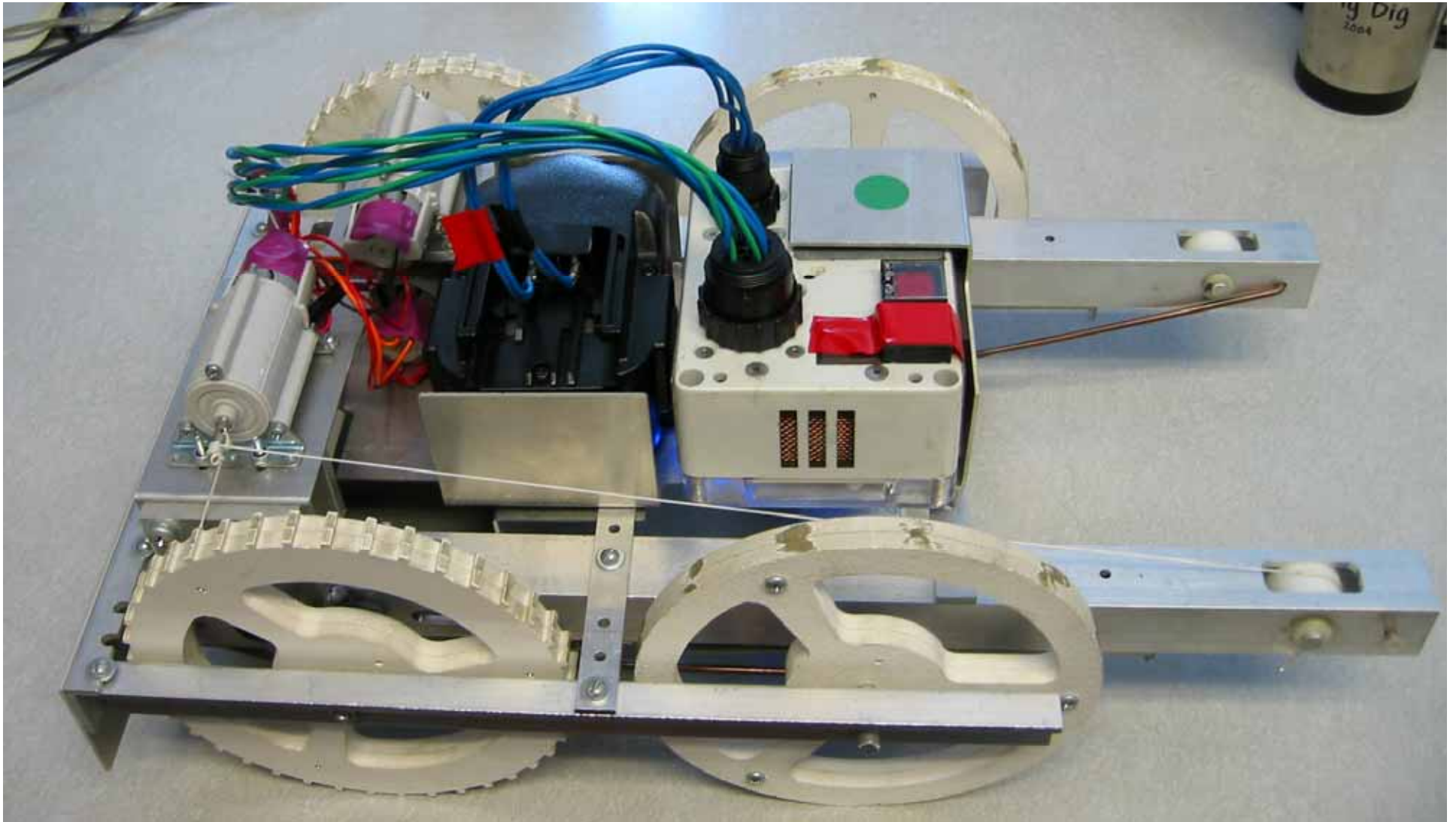
- Control box and battery is a large % of your total mass
- Need a robust mount for predictable robot performance

Mount design requirements:

- Buttons and plugs accessible by staff
- Fast and easy removal and replacement
- Should not fall off because of impact
- Do not block cooling vents
- Do not completely encase the control box in metal. This will kill the incoming radio signal



Battery and Control Box Mounting Example



Wiring Your Machine

NO EXPOSED CONTACTS

- Electrical Tape
- Heat Shrink Tubing

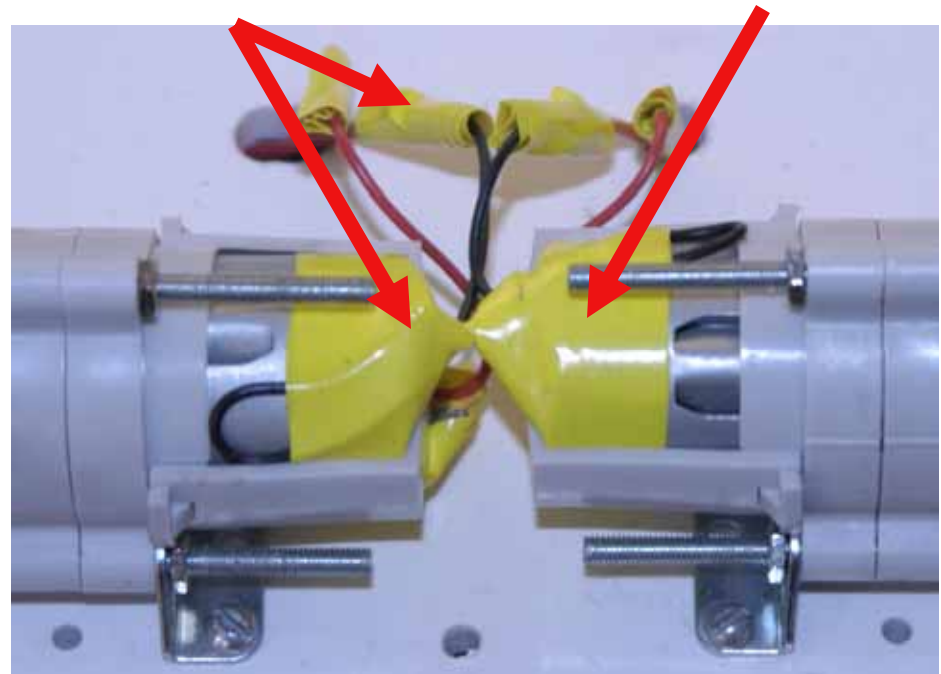
Can damage your machine and the control box.

Wiring will be checked on impound day.

BAD WIRING = YOU CANNOT COMPETE!!

Cover electrical contacts with tape

Make a loop with wire. Hold in place with electrical tape



Be careful not to block cooling vents!

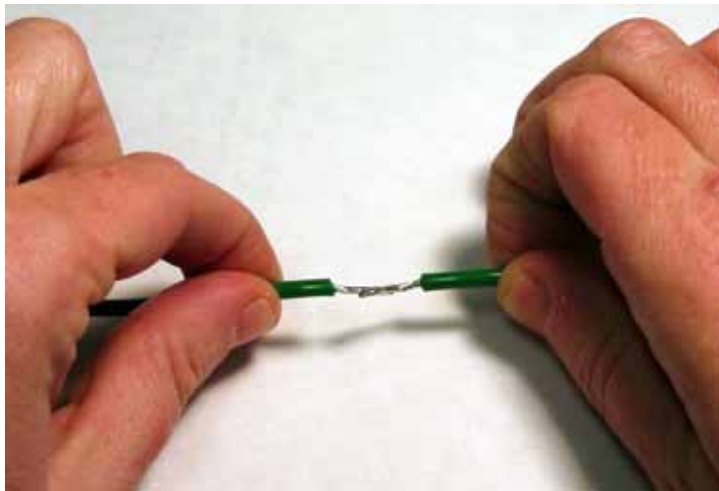
How to solder wires together

1. Strip insulation
2. Put on heat-shrink



3. Tin the exposed wire with solder (infuse the wire with solder)

4. Press the wires together with a soldering iron. Add more solder if necessary.



5. Give it the "pull test"
6. Shrink the Heat-shrink or cover with electrical tape.



More Wiring Tips

Do:

- Wrap all connections with electrical tape or cover them with shrink wrap
- Strain relieve all connections. Zip ties, etc. are in the cabinet
- Keep your wires as short as possible
- If you need longer wires, twist/braid them together

Don't:

- Make connections solely with electrical tape. Solder them or use a connector
- Wire your machine like a rat's nest
- Allow your motor leads to short against each other
- Use wires as string
- Wait until impounding day to wire your machine

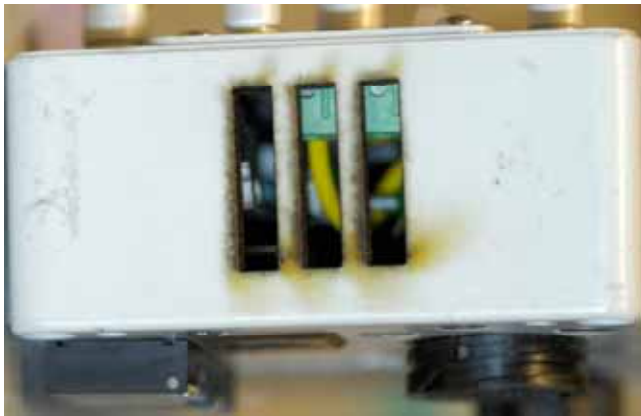
Control Box Feature: Battery Low-voltage Protection



- Red LED turns on when the battery is low.
- Motor controllers will turn off automatically soon after that

Control Box Feature:

Thermal Protection



- Amber Thermal Warning LED turns on when the internal temperature of the motor controller is too high.
- Thermal Warning usually means that your motor has been stalled for $>35s$. Beware of damage to your motor!
- Turn off motors, but leave the control box plugged in for cooling
- Continued heating will cause automatic shutoff.

Tips and FAQ

- Control box is on, but my motors doesn't work – Check the red button
- I can't get over obstacles – Rock back and forth, don't stall your motors!
- I get spurious radio signals when I'm driving – Your motor wires are causing interference. Shorten your wires, twist/braid the long wires, and don't encase your control box in metal