

MIT OpenCourseWare  
<http://ocw.mit.edu>

2.007 Design and Manufacturing I  
Spring 2009

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.

## 2.007 Procedures for Lithium Polymer Battery Use

Rev.0, 3/12/09

Beginning the week of March 15, a limited supply of 7.4V lithium polymer (LiPo) batteries will be available for robot testing. Unlike the 9V nickel-metal hydride (NiMH) batteries, the LiPo batteries are a shared resource. For that reason, please use them only for testing when necessary and return them immediately after use.

**YOU MUST READ AND ADHERE TO THE RULES BELOW TO USE THE LIPO BATTERIES, EVEN FOR TESTING. YOU WILL BE RESPONSIBLE FOR REPLACING DAMAGED COMPONENTS (BATTERIES, HOMEWORK BOARDS, RECIEVERS, SERVOS, ETC) RESULTING FROM FAILURE TO ADHERE TO THESE RULES.**

Here are some approximate specifications for the LiPo batteries:

Nominal Voltage	7.4V
Operating Voltage Range	6.0-8.4V
Capacity	730mAh
Energy Stored	19.5kJ
Continuous Discharge	14.6A
Peak Discharge	29.2A
Internal Resistance	< 0.1Ω
Peak Charge	0.73A

Because the LiPo batteries have a very high discharge rate, they can provide significantly more power than the NiMH batteries, even at a lower voltage. However, it is also easier to damage them or the components to which they supply power. So, adherence to the following rules of use is mandatory.

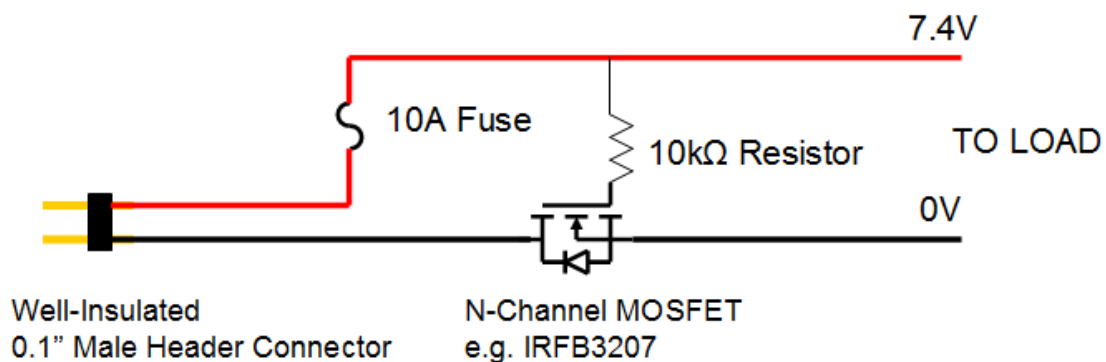
1. Energy stored in the LiPo battery counts toward the 20kJ limit. As a result, use of this battery may restrict the use of compressed air and virtually prohibits the use of additional batteries.
2. The Homework Board may be powered from the 7.4V line (as opposed to a 9V battery). The radio receiver(s) should be powered from a regulated 5V source, such as that provided by the Homework board. **DO NOT** supply 7.4V to the radio receiver(s).
3. Use of higher-than-specified voltages to drive servos or DC motors is at your own risk. The quarter-scale (large) servo and DC motor *should* be fine, but be aware that they may overheat more quickly.
4. Since the batteries are capable of putting out very high current, both **OVERCURRENT (>10A) AND REVERSE POLARITY PROTECTION MUST BE PRESENT ON YOUR ROBOT**. This rule is so important that I have explained it in detail on the next page. You are responsible for this and must demonstrate it **BEFORE** using the LiPo batteries.
5. The LiPo batteries have a 0.1" non-polarized female header connector. You must make a **WELL-INSULATED** (electrical tape, heat shrink, etc.) **0.1" MALE**

**HEADER CONNECTOR** for attaching to the battery. Headers, wire, and necessary tools will be available in the lab.

6. **DO NOT** charge the LiPo batteries. There are no adequate chargers available for use in the lab. They will be recharged as needed.
7. **DO NOT** over-discharge the LiPo batteries. If the voltage is allowed to fall past 6.0V, the battery may be permanently damaged. A battery voltage testing station will be set up next to the bins.
8. Take a battery from the CHARGED bin only. These will be between 7.2V and 8.4V.
9. Do not use a battery that is bulging, warm, or otherwise damaged. Put it somewhere away from flammable materials.
10. When finished, test the battery voltage. (A battery voltage testing station will be set up next to the bins.) If the voltage is:
  - a. greater than 7.2V, return it to the CHARGED bin.
  - b. less than 7.2V, but greater than 6.0V, return it to the UNCHARGED bin.
  - c. less than 6.0V, or if you are unsure, return it to the UNCERTAIN bin.
11. In competition, batteries will all start charged but it is infeasible for us to provide fully-charged batteries for every match. Starting battery voltages will vary from 7.2V to 8.4V for matches. This keeps the batteries at a minimum of 25% capacity, and keeps the discharge current high.

### OVERCURRENT AND REVERSE POLARITY PROTECTION

You are responsible for providing a method of interrupting the flow of current from the battery if it is greater than 10A. This may be a 10A slow fuse or circuit breaker, i.e. short bursts of more than that are okay. You are also responsible for providing an adequate method of reverse polarity protection that can handle 10A in the forward direction, but will eliminate reverse current flow. A large (10A-rated) diode is the bare minimum for this, but that will reduce your available voltage. A better way is shown below:



The MOSFET (a type of transistor) only turns on if the current passing through the resistor is positive. It needs to be a sizeable MOSFET, rated for much more than 10A. Some will be made available in lab.