



EECE 284

Electronics Laboratory

Dr. Jesús Calviño-Fraga, P.Eng.
Department of Electrical and Computer
Engineering, UBC
Office: KAIS 3024
E-mail: jesusc@ece.ubc.ca
Phone: (604)-827-5387

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Objectives

- Gain experience with electronics.
- Gain experience building and programming microcomputer systems.
- Integrate knowledge acquired in different courses into a working project: electromagnetics, network analysis, electronic circuits, and microcomputer systems.
- Develop teamwork skills.

Project

- For this course, you will design, build, program, and test a small rover. The rover must be battery operated and controlled using a microcontroller/microcomputer system. The rover must travel throughout a path in which a wire carrying an AC voltage is buried, in the shortest possible time.

Course evaluation

- Project : 90% of final mark
- Report: 10% of final mark

Project demonstration mark

Mark out of 100%	The rover:
84	Completed the track without any mistakes or help.
66-83	Mostly worked, not entirely, not the greatest design.
60-65	Didn't really work, ok design but didn't really come together.
50-59	Didn't work, not very good design.
0-49	Didn't work, poor design.

As you can see the maximum grade you can get after demonstrating your rover is 84%. The remaining 16% will be assigned based on the time your rover took to complete the track. Since there will be 16 teams in EECE284, the rover with the fastest time will get 16%, the rover with the second best time will get 15%, and so on.

Teams

- There must be 4 students per team.
- The teams will remain together for the rest of the term.
- Fill up and sign a team form. To buy the parts you'll need a team.

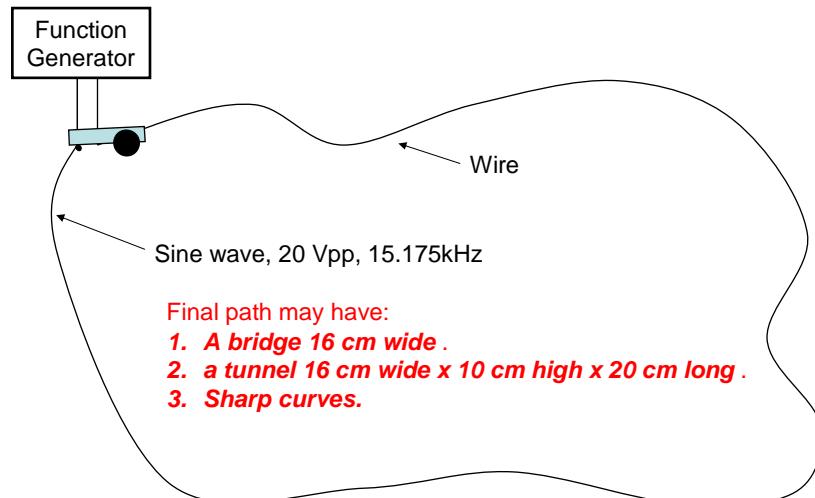
Requirements:

- P89LPC9351 Microcontroller System. The parts to build this board are included in the kit. You can use a different microcontroller provided that you acquire the processor and development tools!
- LCD to display running time and battery voltages.
- Battery operated. Do not use more than 6.0V to drive the motors. Batteries are not included.
- C programming. Embedded systems are programmed either in C or assembly (or both). Use C for this project!

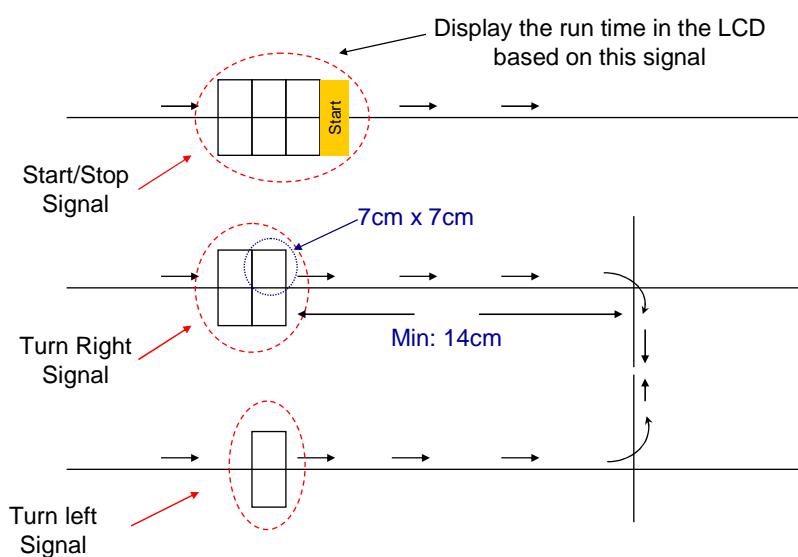
Requirements

- Rover construction. Build a nice, solid, and light chassis. Cardboard and tape are not good construction materials: the rover will fall apart!
- You must use:
 - Solarbotics GM4 Gear Motor 4 Clear Servo
 - Lynxmotion Servo Wheel 2.63" x 0.35" (pair)
- Optionally you can use:
 - Tamiya 70144 Ball Caster
 - Lumex LCM-S01602DTR/M LCD.

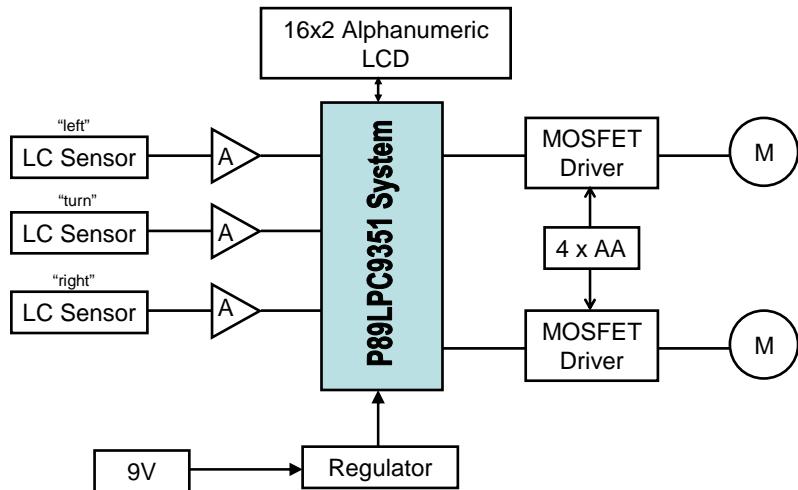
Simple Track



Path with Embedded Signals



Possible Rover Block Diagram



LC Sensor

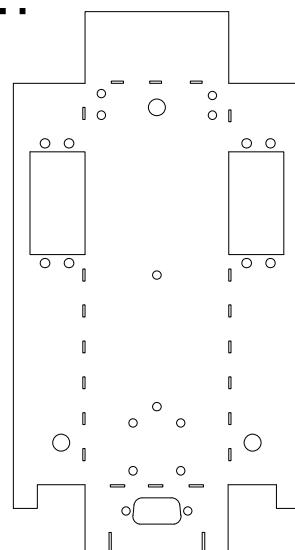
- Consists of an inductor in parallel with a capacitor.
- Choose the capacitor so the tank circuit resonates at around 15.175 kHz.
- The inductors provided are nominally 1 mH. Digi-Key part number M8275-ND.

LCD

- Lumex LCM-S01602DTR/M LCD. 16 x 2 characters.
- Uses the HD44780 from Hitachi.
- Your rover must display the track run time and battery voltages in the LCD.
- Mostly compatible with the NHD-0216BZ-FL-YBW display. This part has an excellent data sheet!

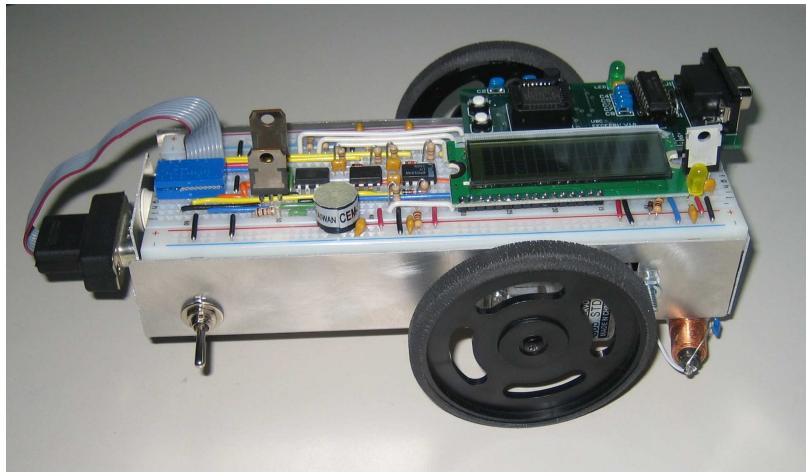
Chassis...

- Made with the Water Jet Cutter. Requires a DXF file from a graphic drafting program.
- Check 'chassis.vsd' (Microsoft Visio drawing) from the course web page.
- Included in parts kit.
- You'll need to fold the chassis before assembling the rover!



Newer version has fewer holes!

Rover prototype (from 2010)



Buying the project parts kit

- Procedure:
 1. Fill up the 'group form' and sign it.
 2. Get 40\$ (10\$ fro each group member) cash.
 3. Take the 40\$ to KAIS 5500 and paid for the kit. Get a receipt.
 4. Take the group form and the receipt to MCLD112B. Get the project kit for EECE 284.

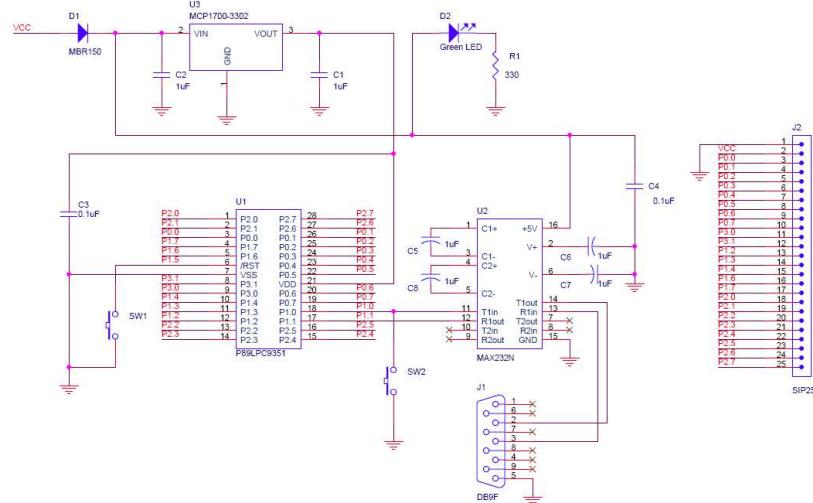
Parts Kit



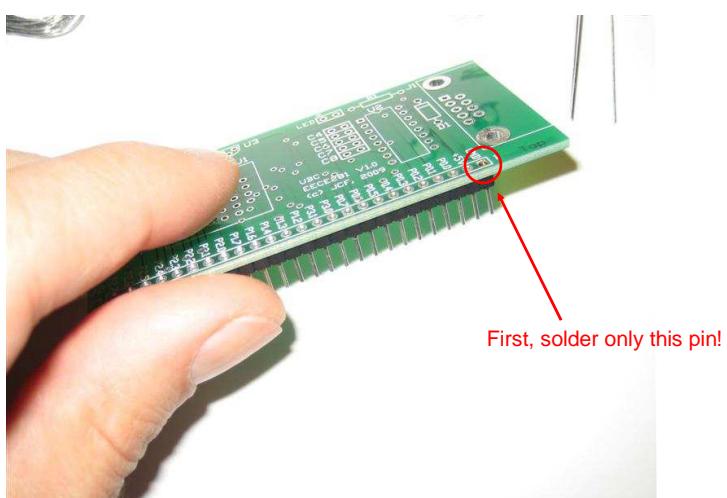
Parts Kit

- Resistor Kit
- Capacitor Kit
- USB to serial adapter (no cable)
- LED kit
- EECE281 board kit (with LCD)
- Discrete parts kit:
 - LM7805 Voltage regulator
 - LM324 Quad Op-amp
 - LTV827 Dual Opto isolator
 - 2 x P16NF06 NMOSFET
 - 4 x 1N4148 signal diode
 - 4 x pushbuttons
- Aluminum chassis.
- 3 x 1mH inductors
- DPDT switch
- 2 x Geared Motors
- 1 x Caster Wheel
- 2 x Wheel
- 1 x Female header (You could actually need two, other one provided in the lab)
- 1 x Prototype board
- 1 x 9-Volt battery clip
- 1 x 4-AA battery holder.

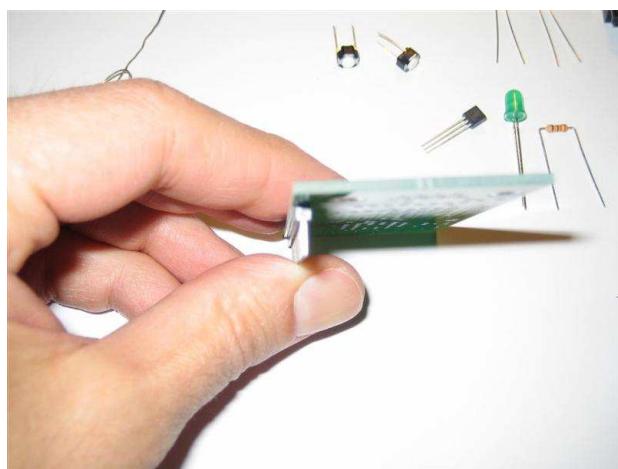
Microcontroller Board Diagram



Solder the Connector...

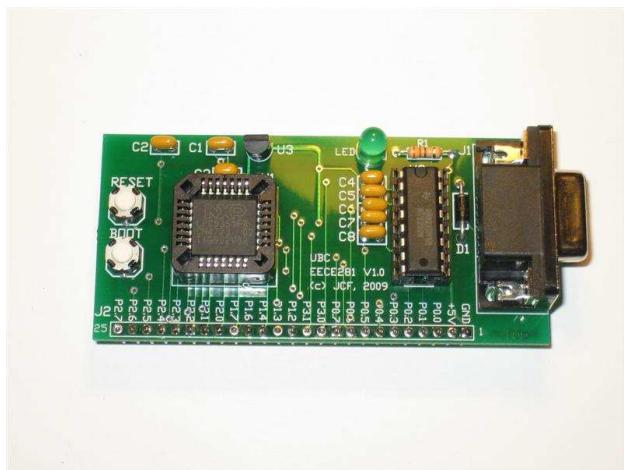


Make Sure the Connector is Straight.



Then, solder all the pins of the connector

Solder the Rest of the Components



Detailed instructions available in the course web page...

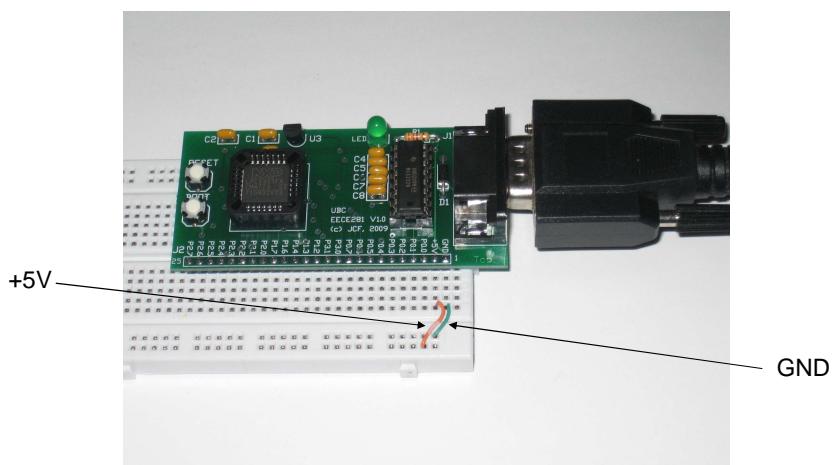
Other Things You May Need That Are Not Provided in the Kit

- A bread board.
- Tools: pliers, wire strippers, wire cutters, etc.
- You can buy these parts locally at:
 - The Source (<http://www.thesource.ca/>)
 - rp Electronics (<http://www.rpelectronics.com/>)
 - Lee Electronics (<http://www.leeselectronic.com/>)
 - Main Electronics (<http://www.mainelectronics.com/>)

Help!!!

- In the web page you'll find the guide "Soldering the EECE281 board". It shows how to:
 - Solder the components.
 - Download and Install the compiler.
 - Write and compile a C program.
 - Download ("Flash") the program to the microcontroller system.

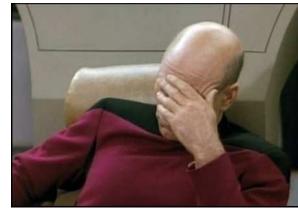
Apply 5V to the board



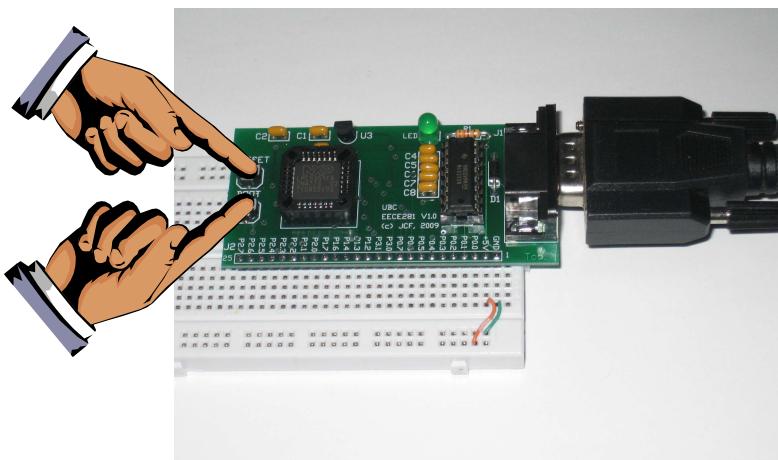
How to Enter Boot-Load Mode

- Press the BOOT button.
- Press and release the RESET button while pressing the BOOT button.
- Release the BOOT button.

A significant number of students get this wrong! So, here it is, again, in animated form (next slide):



Put the P89LPC9351 in ISP mode:



USB to Serial Adapter

USB to serial adapter included in kit.

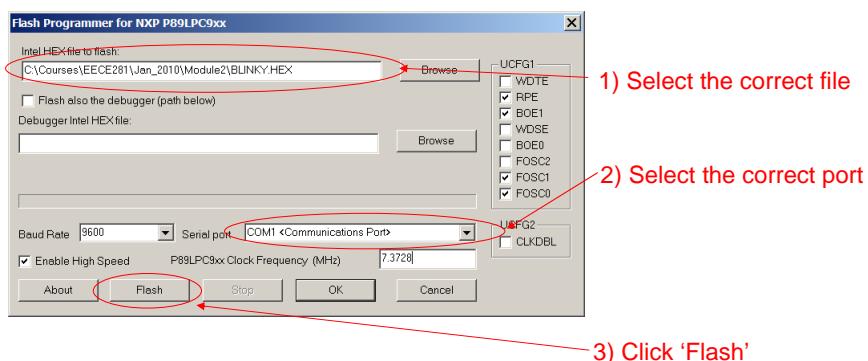
USB cable NOT included in kit.



Download drivers from <http://www.ftdichip.com/FTDrivers.htm>

Flashing...

- In CrossIDE click “fLash” followed by “NXP P89LPC9xx”:



Project Self Evaluation

- Team members determine mark distribution by indicating a “percentage of participation” in the project work.
- Disagreement resolved by:
 - Oral examination
 - Individual demonstrations

Example

Project Grade = 50% (function) + 14% (report) = **64%**

Student	% of participation.	Final Mark	
Liu Kang	27%	69.12	
Sonya Blade	28%	71.68	
Johnny Cage	30%	76.80	
Goro	15%	38.40	Failed!
TOTAL	100%	64 (mean)	

Project Due Dates

Function demo: March 31

Report: April 7

Course Web Page

Blackboard Connect.

Lab Location/Time

MCLD 112, Mondays 5:00pm to 5:50pm.