Spring 2011 Data Conversion
17.368
Course Project (30% of your course Grade)

Course Project guidelines …

Overall Guidelines … Design a fairly complex system that utilizes data conversion circuitry or create a circuit based on a data conversion process discussed in class. You can use components that were covered in class or other circuitry not discussed but related to the general topic. The design can be of your own choosing or select from one of the designs provided below. In addition to the design, you will construct a working prototype that will be demonstrated during the last class. A write-up will be submitted on the last day of class.

Your project does not have to be any more elaborate or sophisticated than one of the course labs.

The design needs to be your own, however, you can use an existing design as the basis of your project, but it needs to be sufficiently modified such that it performs different functions, routines, etc. ***It must be your own work!*** If your project is inspired or is a modification from some source, ***you must cite the source*** as well as provide a copy of the original schematic in your report.

1. **Prior to starting your Project, obtain my approval.** Submit an email outlining your system proposal ***NLT 11:59 PM EST Wednesday October 16, 2013***. Your proposal should simply state what the design application is intended on performing or problem you are solving. It needs to be no more than a few sentences. ***I am not looking for*** anything elaborate in your email, just an outline of your system proposal (a few lines should be sufficient). The details will be provided later when you submit your final report on the last day of class. Ten percent of your grade will come from the “Level of Difficulty” that your instructor determines your project to be. Low level will give you 1 out of 10 points. Medium is 5 out of 10, and high is 10 out of the total 10 points for this grading section. You may want to discuss with your instructor, prior to making your final project determination, your project details and what level of difficulty the project is initially assessed at. The “Level of Difficulty” may change as you add or decrease from you initial submittal.

2. **Project Suggestions**. Your project can either be one of the suggestions listed in Appendix A of these guidelines **or** one that you suggest.

3. **Draw a schematic of your system**

    a. Hand drawn is acceptable

    b. Include a parts list

4. **Construct a working prototype**

    a. Most parts should be available either from one of our labs or from the storeroom. If you need assistance in obtaining material, please give me as much advanced notice as possible. A list of suggested components is provided in Appendix B.

    b. Appendix C contains a 5 volt regulator schematic and Appendix D contains a 3.3 volt regulator schematic, both of which have been constructed during our labs. You can power the regulators with a 9 volt battery or a wall wart transformer. The output(s) will power your circuit.

    c. Appendix E contains a Switch Schematic, for your use if you desire

    d. The working prototype should be functional. If you encounter problems, get as much of the system functioning as possible. You will get partial credit. Recall that it is best to design your system in small sections and integrate the sections with one another.

5. **Progress Email --- submit as indicated below**

    a. Submit progress emails detailing your progress to date. Emails do not need to be elaborate, they will contain progress on:
        i. Parts procurement
        ii. Developing and constructing your circuit
        iii. Development of your code
        iv. Issues encountered

    b. Progress emails must be received NLT 11:59 PM on the following dates:

        i. Tuesday October 29th
        ii. Tuesday November 12th
        iii. Tuesday November 26th

6. **Submit a written report (Email submissions are preferred in PDF format, or Word if PDF is unavailable)** … **due December 12, 2013** (last day of class). Write a report describing your project in detail, using the “Guidelines on How to Write Memorandum Technical Reports” located on the Course Web Page. As a minimum, the report will contain the following:

a. State the purpose of your design
b. System identification
c. How did it perform (issues encountered during the development of your project)
d. Parts List
e. Schematic
f. Circuit operation … i.e. describe how the circuit works

See the instructor if you choose to create a Lab Procedure as your project as this will change your reporting requirements.

Use the following filename convention … ***lastname_course_project.pdf***

7. **Course Project demonstration** (**December 12, 2013**).

    a. Maximum length … 20 minutes

    b. At your lab workstation, make a presentation to the class. Describe what you developed, how it works, and issues you ran into during its development

    c. Demonstrate your prototype
        i. The demonstration needs to be long enough to present the above … there is no minimum; however, you cannot exceed 20 minutes

8. **Grading Policy**

a.	Proposal Submitted on time	05%
b.	Progress email submittals	10%
c.	Level of Difficulty	10%
d.	Prototype	35%
e.	Demonstration	20%
f.	Written Report	20%

Class #13 (December 5th) will be dedicated to your project development, prototype construction, testing, and troubleshooting. You must attend this class and work on your project.

Any question, please see me either in class, or contact me by email, or by phone.

APPENDIX A
PROJECT IDEAS

***NOTE*:** This list is for multiple courses; therefore, some ideas may not be directly applicable to this course. Some of these designs are elaborate and are beyond the scope of this course. In those instances it is acceptable to model various sensors by means of mechanical switches or other devices such as variable resistors. In addition, they may be reduced in scope. You may also submit your own idea/proposal.

1. Create a “Lab Procedure” utilizing a feature that may have been, or could have discussed during class of this class, such as a PIC or data conversion method, that was not created during a course lab

2. Resistor checker (could use analog to digital converter and or a comparator circuit that drives an output like LEDs).

3. Use a microcontroller to receive an analog input, then process the information and create an output that drives a Digital to Analog circuit that you construct (you ***cannot use*** a readymade circuit such as the DAC0800)

4. Interface the microcontroller with a computer

5. Create a compact code (most likely a header file) that interfaces the PIC with an LCD display. It cannot be the same code as used during the labs

6. Build and Analog to Digital which drives a Digital to Analog circuit. Again, the circuit ***cannot be a ready made circuit*** such as the DAC0800 or the ADC0804

7. Temperature to digital

8. Voice to digital then to a speaker

9. Strain gage to digital

10. Sensor to digital, store the digital information to memory utilizing a microprocessor. Then display the stored information

11. Thermometer

12. Voltmeter using ADC

13. Voltage indicator

14. Mileage and speedometer for bicycles

15. Clock

16. Binary clock

17. Christmas decorations with blinking lights and music

18. Digital Geiger counter

19. Toxic gas sensor

20. Ultrasonic Distance-Range Sensor

21. Intelligent garden lights

22. Weather indicator – displays temperature, wind speed and wind chill. Simulate temperature and wind speed, calculate wind chill

23. Design/Implement an Audio Record/Playback system.

24. Robot

25. Develop a detector which detects the mosquito ring tone also known as "Teen Buzz". Teen Buzz is a modulated 17 kHz sound that can be heard by teenagers or anyone younger. Those older cannot hear the sound (a normal loss of acute hearing that occurs with aging), thus teenagers use this sound as ring tones for their cell phones.

26. Create a rock-paper-scissors circuit: each player controls two switches. 00 = rock, 01 = paper, 10 = scissors, and 11 is the initial condition. Two LEDs are wired to indicate which player wins.

27. Using a state machine design, input two numbers from switches, add the two numbers and display the result on a seven segment display. A reset button restarts the state machine to the beginning. Incorporate a state machine that advances states based on a momentary push-button switch input.

28. Drive a bi-directional motor for 10 seconds in one direction, then brake for 10 seconds, then run the reverse direction for another 10 seconds, this sequence is started using a push button switch. When power is turned on motor must not run until start is initiated.

29. Design a digital clock (use a microcontroller for Microprocessors Course or Logic Gates for the Logic Design Course)

30. Reaction timer

31. Alarm system

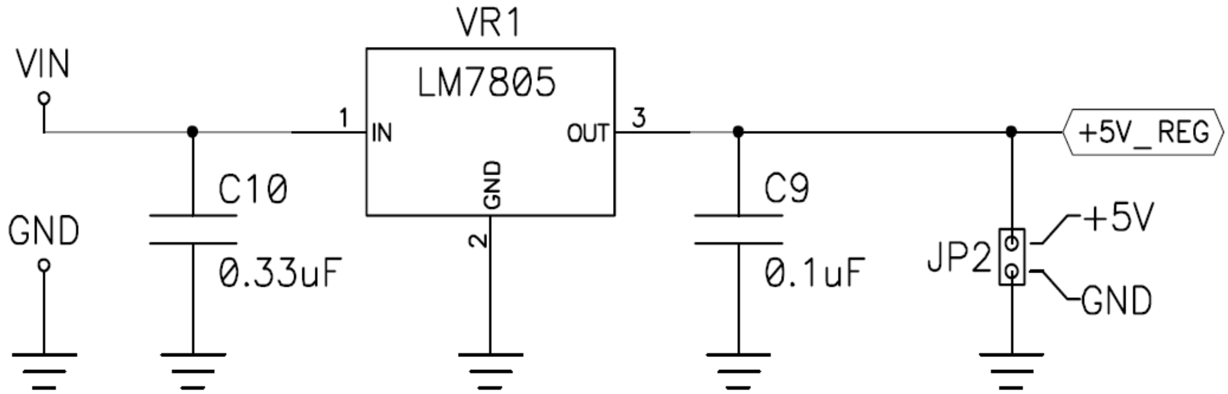
32. Temperature sensor (determines if too hot, too cold, or within a normal band)
33. Temperature controller
34. Traffic lights
35. Fan controller
36. Controlling AC appliances
37. Flashing LED train warning lights
38. TV IR remote control
39. Servomotors controller
40. Stepper motor controller
41. DC motor controller
42. Motor and steering control
43. IR Object-Ranging Sensor
44. Simple Elevator controller
45. Battery Charger/controller
46. Light Sensor
47. Mechatronics
48. Your own idea/proposal

APPENDIX B
Suggested Components

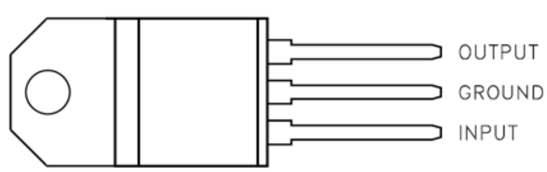
- ☐ 741 Linear IC
- ☐ LF398 Sample and Hold circuit
- ☐ National ADC0804 (8 bit μP Compatible Converter)
- ☐ DAC0800LCN (Digital to Analog Converter)
- ☐ XR-4151 (EXAR Voltage to Frequency Converter)
- ☐ PIC24HJ32GP202 – Microcontroller
- ☐ PIC24HJ128GP502 – Microcontroller
- ☐ PIC16F684 – Microcontroller
- ☐ PIC12F675 – Microcontroller
- ☐ LM60 Temperature sensor
- ☐ SN754410 motor driver
- ☐ MAX548A SPI DAC
- ☐ 7 segment LEDs
- ☐ LCD Display
- ☐ 9 volt battery clip (if using a 9 volt battery)
- ☐ LM7805 - Voltage Regulator
- ☐ 7400 – Two input NAND gate
- ☐ 7402 - Two input NOR gate
- ☐ 7404 - HEX Inverters
- ☐ 7408 - Quad 2-Input AND Gates
- ☐ 7420 - Dual 4-input NAND gate
- ☐ 7430 - 8-input NAND gate
- ☐ 7474 - Dual D-type flip-flop
- ☐ 7476 - Dual Master-Slave J-K Flip-Flops with Clear, Preset, and Complementary Outputs
- ☐ 7485 - 4-bit magnitude comparator
- ☐ 7486 - Quad 2-input exclusive-OR gate
- ☐ 7493 Synchronous 4-Bit Up/Down Counters
- ☐ 74153 - Dual 4-Line to 1-Line Data Selectors/Multiplexers
- ☐ 74155 - DUAL 2-LINE TO 4-LINE DECODERS/DEMULTIPLEXERS
- ☐ 74157 - Quad 2-input multiplexer
- ☐ 74163 - Synchronous Presettable Binary Counter
- ☐ 74170 - 4 X 4 REGISTER FILE
- ☐ 74174 - Hex D flip-flops
- ☐ 74194 - 4 BIT PIPO SHIFT REGISTER

- ☐ Other parts should be available … Breadboards, LEDs, resistors, capacitors, switches, etc.

APPENDIX C
Voltage Regulator Circuit (5 volts)

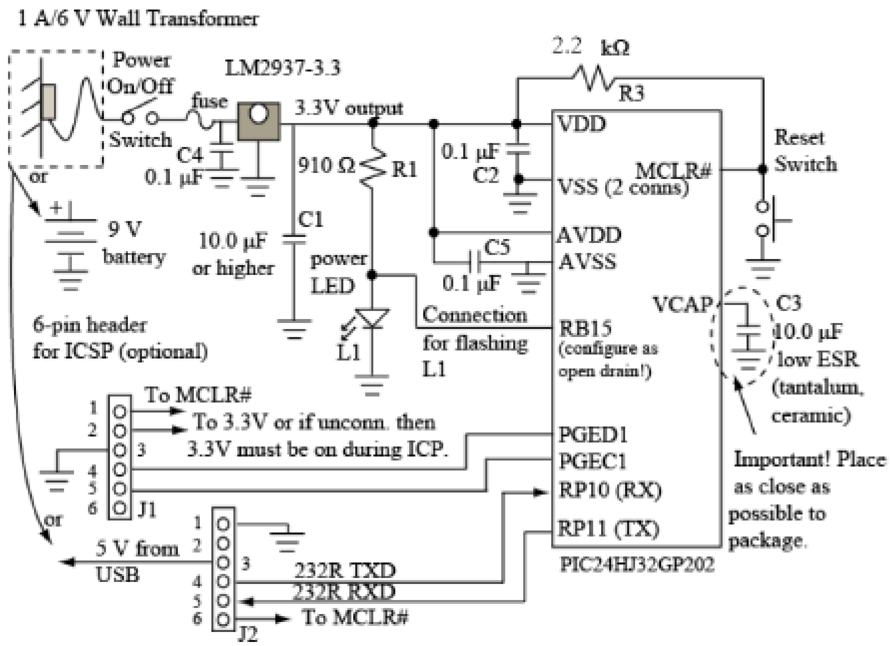


7805 Pin Connections - Top View



APPENDIX D

Voltage Regulator Circuit (3.3 volts)



6-pin header for FTDI TTL-232R-3.3V USB-to-TTL cable (PC serial communication link)

APPENDIX E
Switch Schematic