Lab 7 Design and Layout of an Embedded System

Dhruv Sandesara and Sean Tremblay

EKG with apple watch features

Deliverables (exact components of the lab report)

A) Objectives

1-page requirements document (Combined with Part C and attached below) To baicalyy learn about the entire design phase of making an embedded system from scratch.

B) Hardware Design

Regular circuit diagram (SCH file)(attached separately)

PCB layout and three printouts (top, bottom and combined) (attached separately)

C) Software Design

Include the requirements document (Preparation a) (Combined with Part A and attached below)

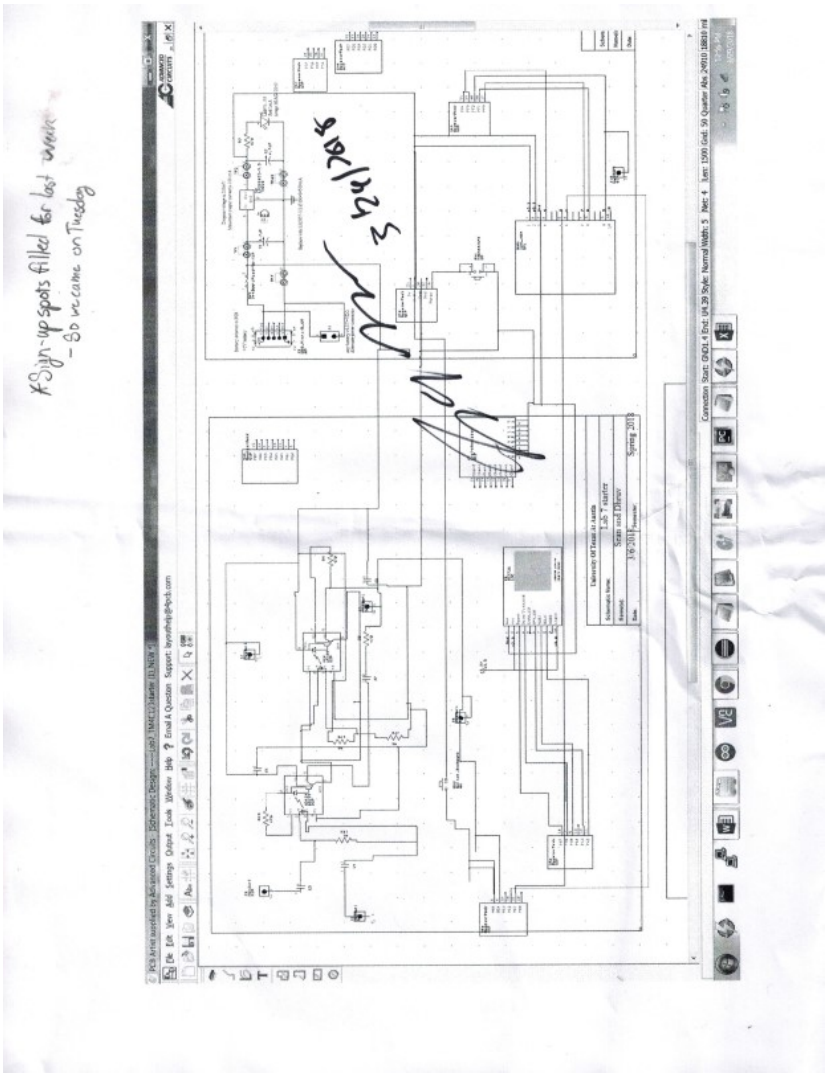
D) Measurement Data

Give the estimated current (Procedure d)~80 mA

Give the estimated cost (Procedure e)~$61.45 but most free roughly ends up at $20

E) Analysis and Discussion

Include a copy of the reviewed SCH/PCB and signed by your professor (Procedure c):



Report (30)

Requirements Document (10) - Due with Pre-Prep(done)

Schematic (10) - A significant amount of this grade will be on how you plan to debug your board(done)

Test points

Proper use of the logic analyzer

Professor's signature on the SCH file (10) - Due with Lab submission along with a copy of the above(done)

Lab 7 PrePrep

Dhruv Sandesara and Sean Tremblay

Requirements document

As always, feel free to adjust the syntax and format of your requirements document as you think appropriate. The goal of the document is to provide a clear an unambiguous description of what the project does.

1. Overview

1.1. Objectives: Why are we doing this project? What is the purpose?

The objectives of this project are to design, build and test an ECG as well as attempt to build an apple watch sort of device if possible. Educationally, students are basically trying to combine all that we have learned to create a real life embedded system. Our goal is to make an apple watch with a hear rate monitoring device inbuilt.

1.2. Process: How will the project be developed?

The project will be developed using the TM4C123 board. There will be two or three switches that the operator will use to control the watch. The system will be built on a solderless breadboard and run on the usual USB power. Also we plan to use the display Professor Valvono pointed out in class which has a touchscreen component to it so that we can use it for gesture control as a real apple watch. A hardware/software interface will be designed that allows software to control the watch and the ECG. There will be at least four hardware/software modules: switch input, Display input and output, the heart rate monitor, and the main driver. The process will be to design and test each module independently from the other modules. After each module is tested, the system will be built and tested.

1.3. Roles and Responsibilities: Who will do what? Who are the clients?

EE445L students are the engineers and the TA is the client. Students are expected to make minor modifications to this document in order to clarify exactly what they plan to build. Students are allowed to divide responsibilities of the project however they wish, but, at the time of demonstration, both students are expected to understand all aspects of the design. We primary are thinking that Sean will take care of the ecg monitor and to convert those signals and give Dhruv the status of the heart rate. Dhruv will look at the UI of the device and make sure that it is easy to cycle through the different display modes.

1.4. Interactions with Existing Systems: How will it fit in?

The system prototype will use the TM4C123 board, a solderless breadboard, switches, the touchscreen display, and the hert rate monitor. It will be powered using the USB cable. You may use a +5V power from the lab bench. When we have a working prototype, we will try to transfer this onto the PCB

1.5. Terminology: Define terms used in the document.

None used except ECG which is Electronic Cardiogram.

1.6. Security: How will intellectual property be managed?

The system may include software from StellarisWare and from the book. No software written for this project may be transmitted, viewed, or communicated with any other EE445L student past, present, or future (other than the lab partner of course). It is the responsibility of the team to keep its EE445L lab solutions secure.

Like this display
https://www.engadget.com/2016/03/02/business-card-ecg/

2.1. Functionality: The electrocardiogram (ECG or EKG) is a diagnostic tool that is routinely used to assess the electrical and muscular functions of the heart. The heart's electrical activity can be measured by electrodes placed on the skin. The electrocardiogram can measure the rate and rhythm of the heartbeat. An electrode lead, or patch, is placed on each arm and leg and six are placed across the chest wall. The signals received from each electrode are recorded. The printed view of these recordings is the electrocardiogram. An electrode lead, or patch, is placed on each arm and leg and six are placed across the chest wall. The signals received from each electrode are then recorded and displayed. We will also add other apple watch features to display it and show the step count miles floors etc.

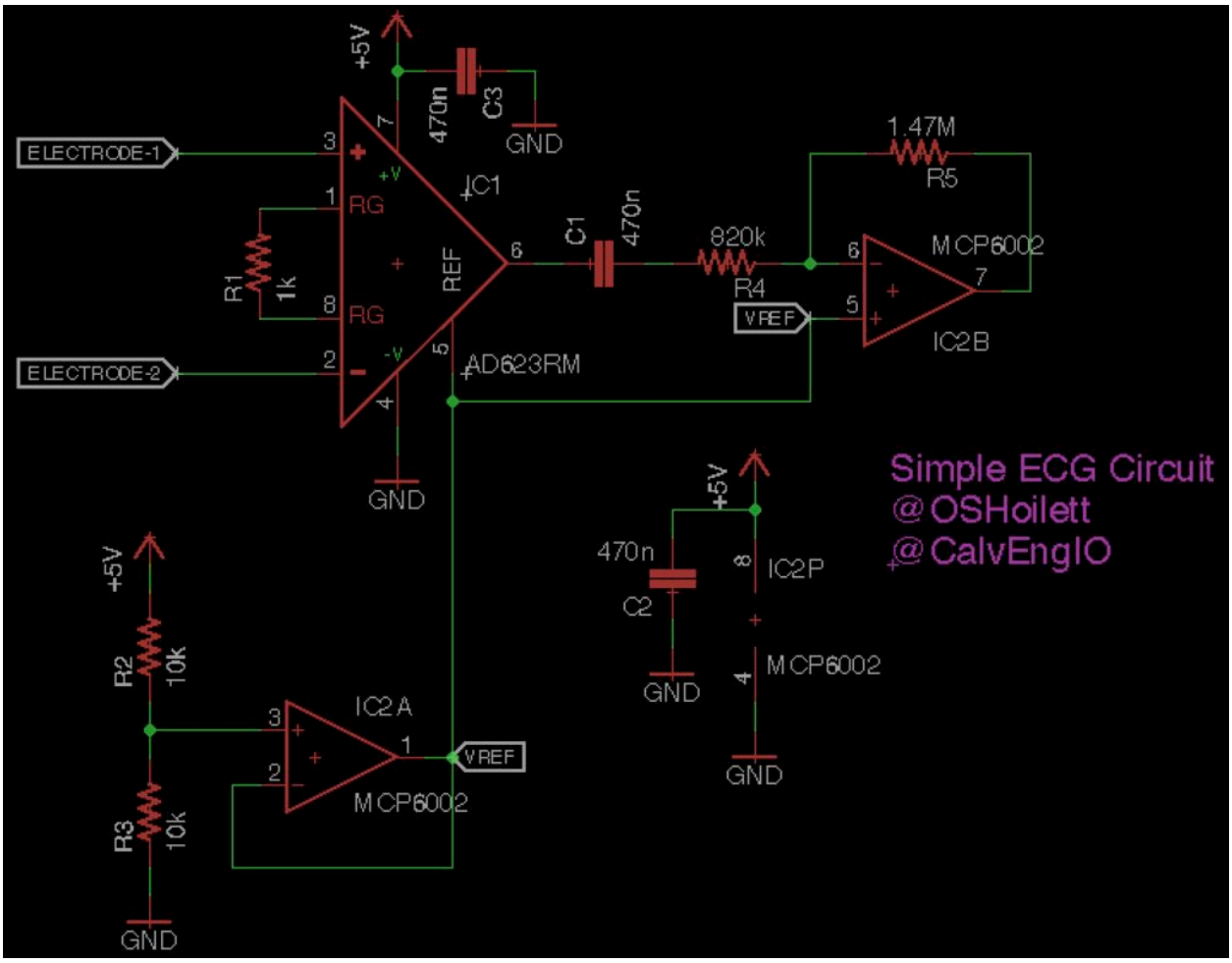


Figure 1

2.4. Performance: In general, components of the signal of interest will reside in the 0.67 to 40-Hz bandwidth for standard ECGs and up to 300 Hz to 1 kHz for pacemaker detection. We choose a AD623 instrumentation amplifier to amplify the ECG voltage from electrodes, which is in the range of several mV. This amplifier will amplify the signal voltage up to a 1000x multiplier. This ECG will be measured on our software where we will output a graph of the outputs, similar to an oscilloscope. For step counting we can just recognize patterns on a accelerometer.

2.5. Usability: We will interface an electrode lead to our TM4C123 through an op amp. The input will be determined after having applied a voltage gain to the signal with an MCP6002 operational amplifier. This will act as a highpass filter should our gain from the AD623 have caused unstable behavior. From here, our output, Vin, should be sampled by our ADC. The other circuit elements and their values can be seen in Figure.

3. Deliverables

3.1. Reports: How will the system be described?

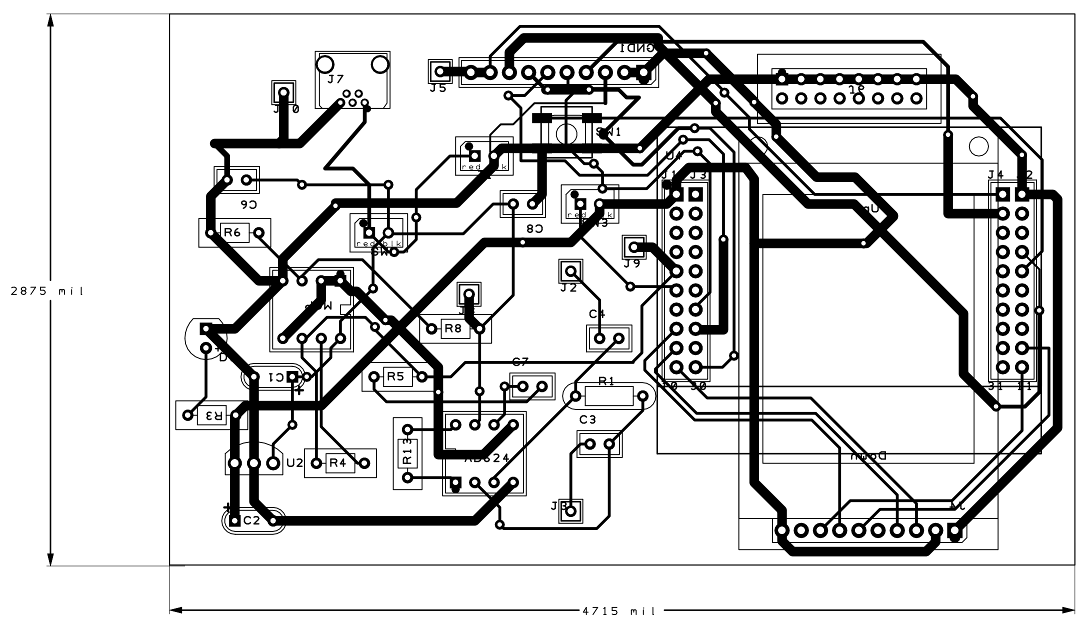
A lab report described below is due by the due date listed in the syllabus. This report includes the final requirements document.

3.2. Audits: How will the clients evaluate progress?

The preparation is due at the beginning of the lab period on the date listed in the syllabus. We will show that our device works on a solderless breadboard before the Lab is due.

3.3. Outcomes: What are the deliverables? How do we know when it is done?

There are 4 deliverables: pre-preparation, preparation, demonstration, and report.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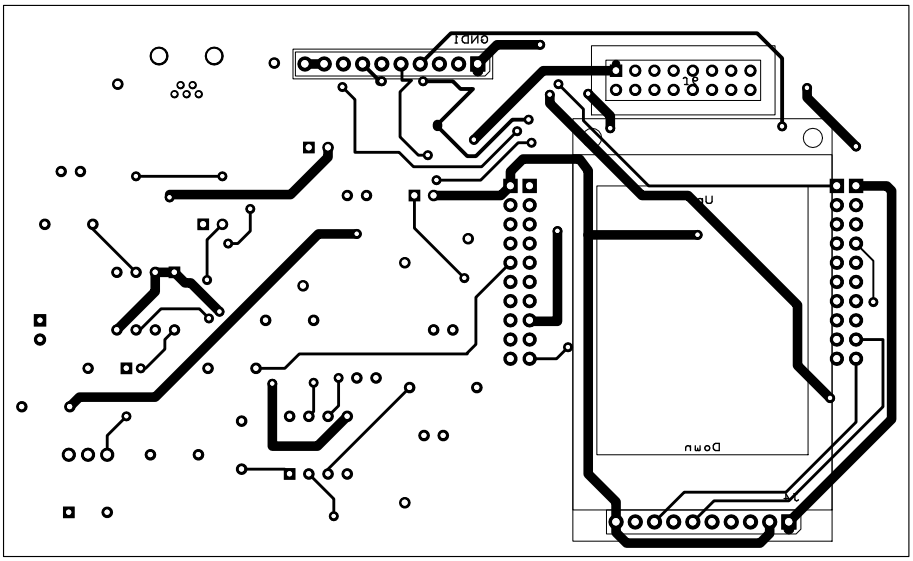

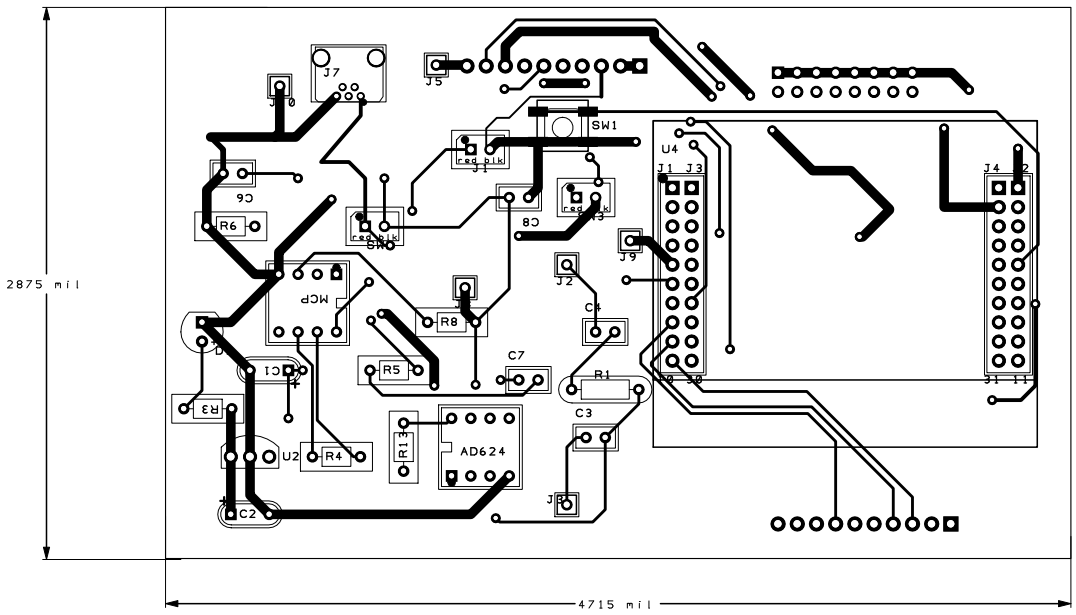
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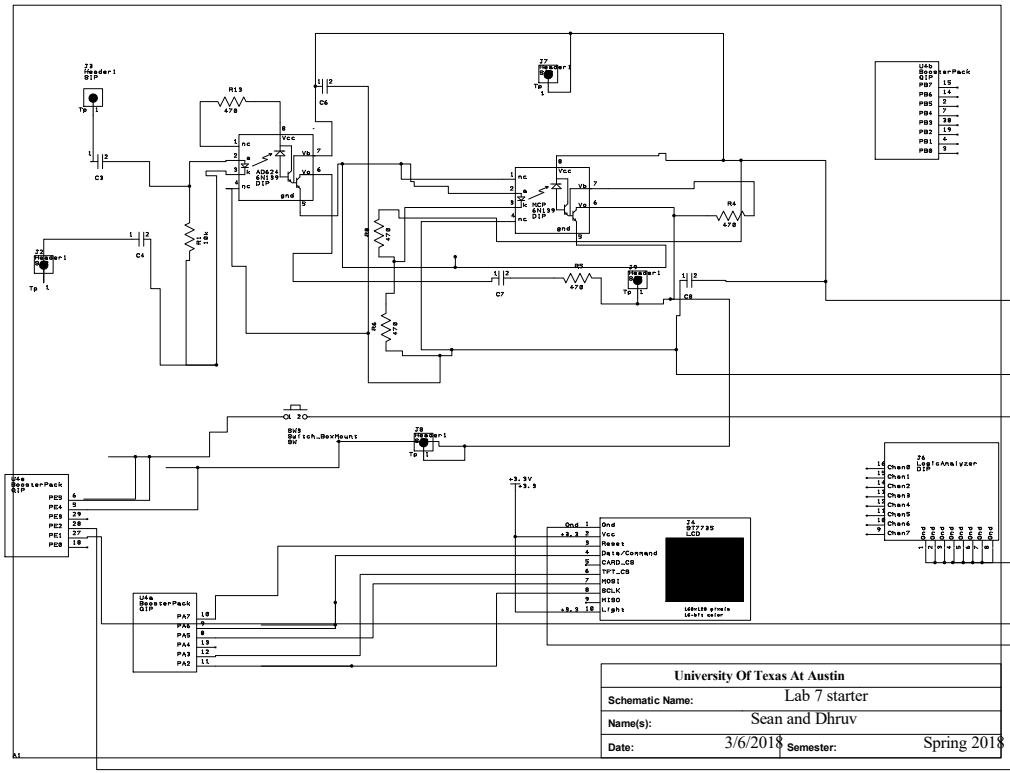
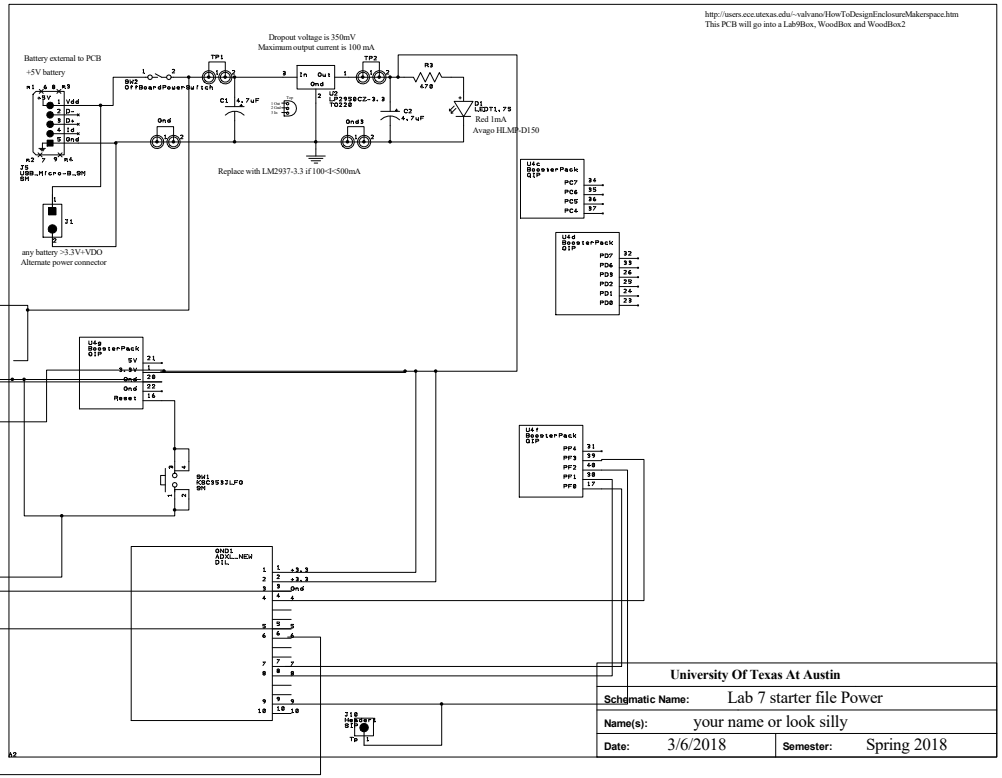
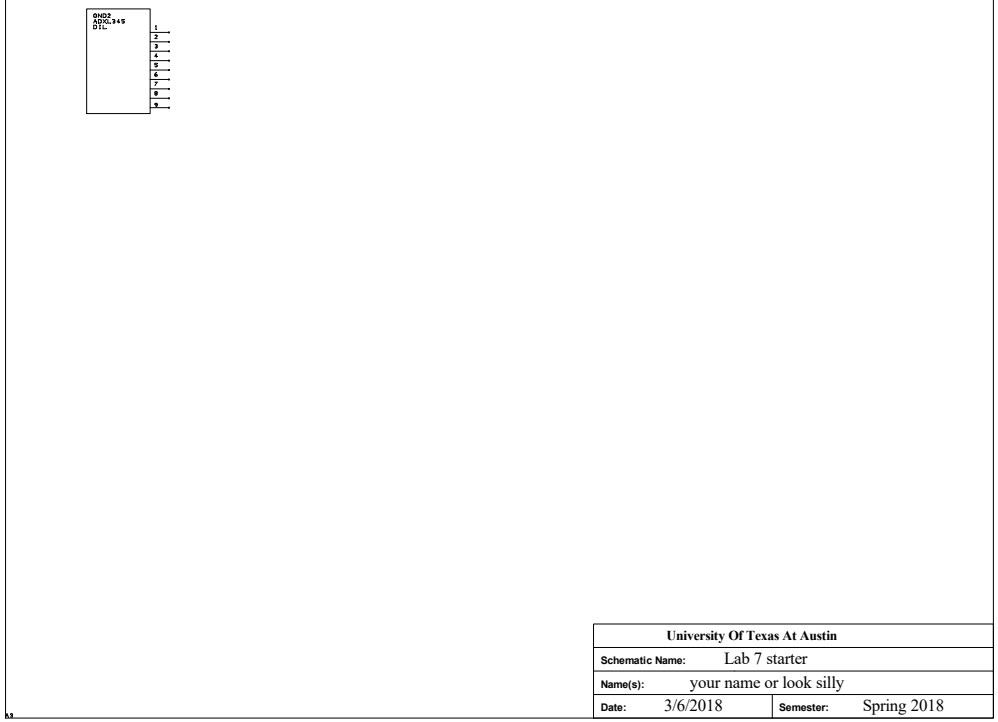


University Of Texas At Austin	
Schematic Name:	Lab 7 starter
Name(s):	Sean and Dhruv
Date: 3/6/2018	Semester: Spring 2018



University Of Texas At Austin	
Schematic Name:	Lab 7 starter file Power
Name(s):	your name or look silly
Date: 3/6/2018	Semester: Spring 2018



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