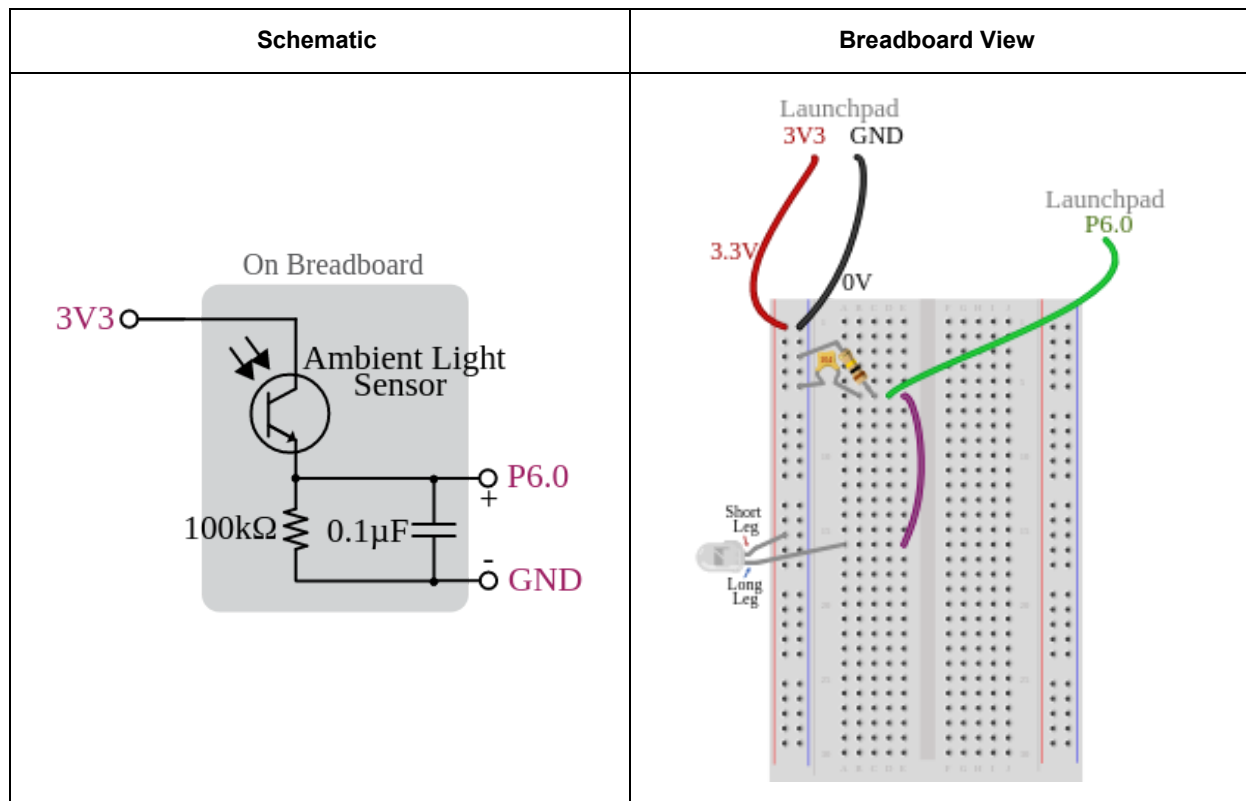


## Light Sensor Breadboard Circuit - Cory 140

Build the ambient light sensor circuit on a breadboard and hook it up to the Launchpad, as you did in Imaging Lab 1. This requires the following parts:

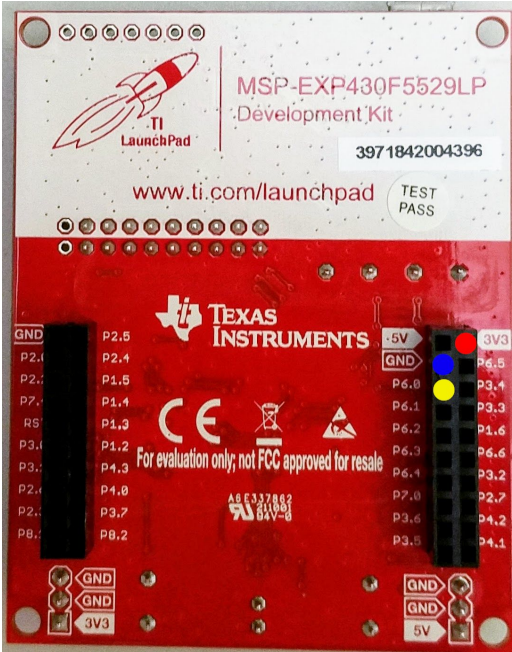
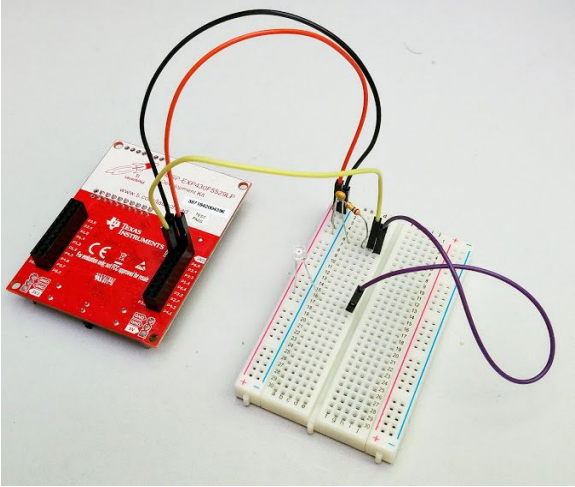
- 1x Breadboard
- 4x Male-to-Male Jumper Wires (Exposed metal connections on both ends)
- 1x Ambient Light Sensor a.k.a. Phototransistor
- 1x 0.1 $\mu$ F Capacitor (104)
- 1x 100k $\Omega$  Resistor (Brown-Black-Yellow-Gold)
- 1x TI Launchpad MSP430F5529LP
- 1x Micro-USB to USB-A Cable (Long, supplied for this lab)

The schematic that you will build is shown below. Labels in purple indicate connections to the Launchpad. Read through the following instructions to setup your single pixel imager.



## Setting up the Breadboard:

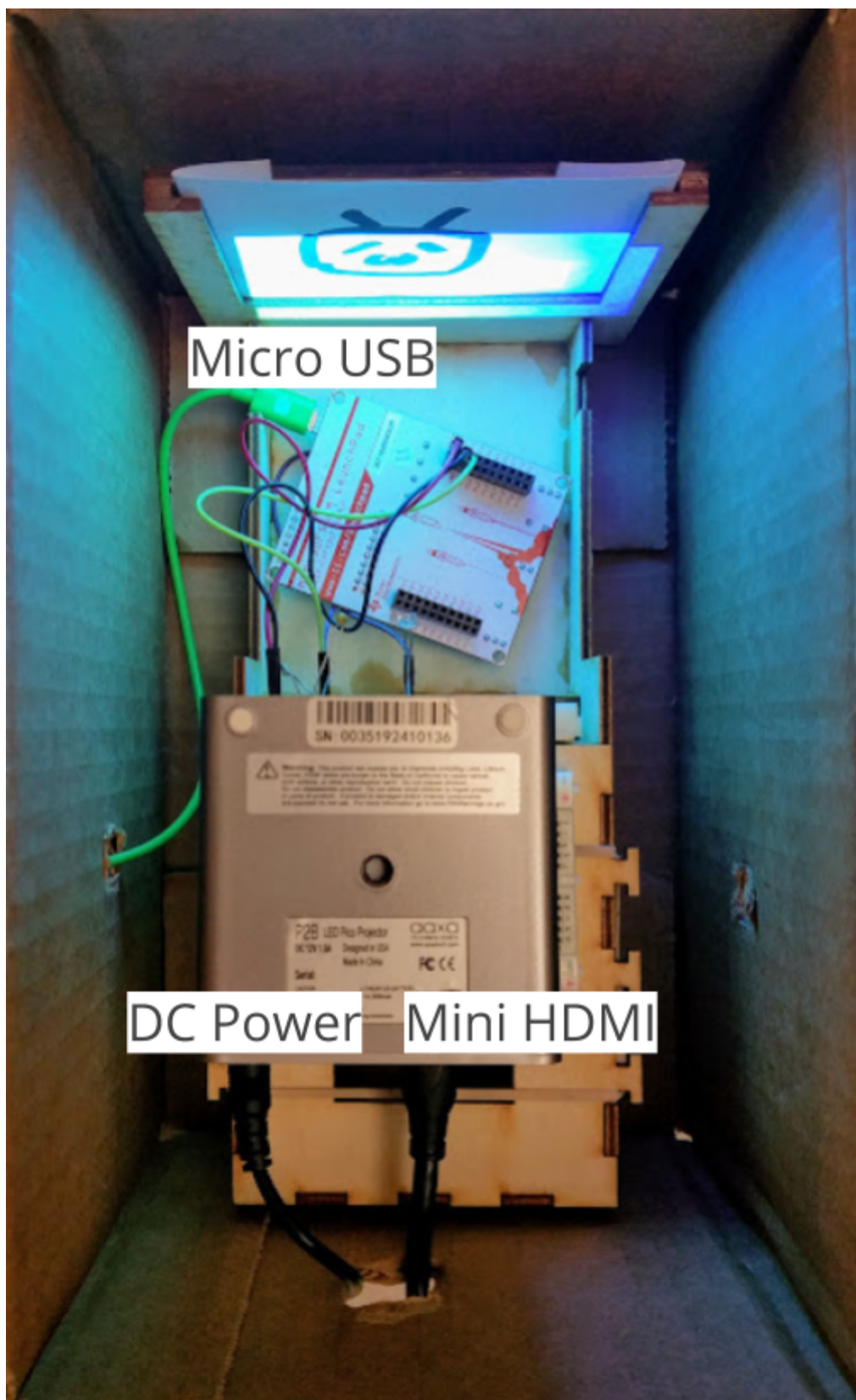
- Plug the **long leg of the ambient light sensor** into **Row 16, Column A** of the breadboard, as illustrated in the breadboard diagram above. The short leg should be plugged into the nearest hole in the **red (+) column** of the breadboard.
- Plug one leg of the **100k $\Omega$  resistor** into a hole in **Row 6** of the breadboard. Plug its other leg into a nearby hole in the **blue (-) column**.
- In a similar fashion, plug the **0.1 $\mu$ F capacitor** into a hole in **Row 6** of the breadboard. The other leg should also be plugged into the **blue (-) column**. *Warning: Make sure that none of the legs are touching each other to prevent shorting!*
- Use a **male-to-male jumper wire** to connect **Row 16, Column E** to **Row 6, Column E**.
- The Launchpad supplies 3.3V to our circuit. Use a **male-to-male jumper wire** to connect the right-most hole (~Row 1) in the **red (+) column** (3.3V supply) to **3V3 on the back of the Launchpad (red)**.
- Use a **male-to-male jumper wire** to connect the right-most hole in the **blue (-) column** (0V) to **GND on the back of the Launchpad (blue)**.
- Use a **male-to-male jumper wire** to connect **Row 6** (sensor circuit output) to **P6.0 on the back of the Launchpad (yellow)**. The Launchpad can read analog voltage values from our circuit, convert them into digital values, and then send them over to our computer.

MSP	Full Circuit
 <p>The image shows the MSP-EXP430F5529LP Development Kit, a red PCB with a white label at the top. The label includes the TI LaunchPad logo, the part number MSP-EXP430F5529LP, the text 'Development Kit', the number 3971842004396, the website www.ti.com/launchpad, and a 'TEST PASS' mark. The PCB features various pin headers labeled with pin numbers (e.g., P2.5, P2.4, P1.5, P1.4, P1.3, P1.2, P4.3, P4.0, P3.7, P8.2, P6.0, P6.1, P6.2, P6.3, P6.4, P7.0, P3.6, P3.5, P6.5, P3.4, P3.3, P1.6, P6.6, P3.2, P2.7, P4.2, P4.1) and power pins labeled GND, 3V3, and 5V. The Texas Instruments logo and 'For evaluation only; not FCC approved for resale' are also visible.</p>	 <p>The image shows the full circuit setup. A red MSP-EXP430F5529LP Launchpad is connected to a white breadboard. A black wire connects the 3V3 pin on the Launchpad to the red (+) column of the breadboard. A blue wire connects the GND pin on the Launchpad to the blue (-) column of the breadboard. A yellow wire connects the P6.0 pin on the Launchpad to the output of the sensor circuit on the breadboard. The breadboard circuit includes an ambient light sensor, a 100k<math>\Omega</math> resistor, and a 0.1<math>\mu</math>F capacitor, all connected as described in the instructions.</p>

## Stand Setup



- Take the wood stand (with projector) out of the cardboard box at your station (located at the top left next to some of the lab equipment. The number on the box does not matter).
- Place the breadboard into the vertical slot in front of the projector and the MSP in the flat area. You should be inserting the half of the breadboard without the components into the slot so you do not mess up the circuit.
- Place the setup into the box - **Pay close attention to where the holes are in the box.** The holes are cut out to make connecting the mini-HDMI and power cables easier. Align the holes to both the circular power connector and the mini-HDMI port on the back of the projector to the short side of the box that has a hole in it.
- Route the barrel jack power cable through the back with the DC connector and the mini-HDMI cable (should be at your lab station connected to your lab computer) through the other side and connect them both to the projector. Take the long USB cable and route it through either hole and connect it to the MSP.
- The power cable must be plugged into an outlet - there are outlets at each station under the platform where the lab computers stand, hidden in the back. Make sure the barrel connector is fully plugged into your projector - if the connection is loose during the scan you may have issues. **Observe a red light on your projector to indicate that it is charging.** Turn on the projector by pressing and holding the power button on the back. We will be placing the projector upside down, but not before confirming the projector settings in the next section.
- Plug the USB 2.0 end of the USB cable into the lab computer.
- Confirm your setup with the full set up below

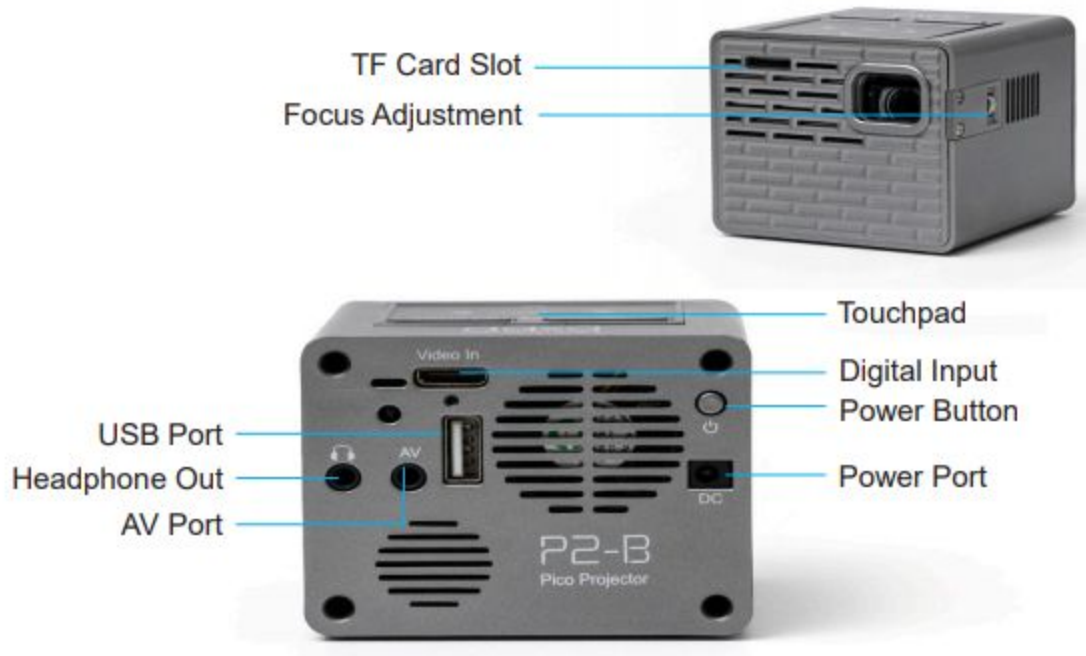


Micro USB

DC Power Mini HDMI

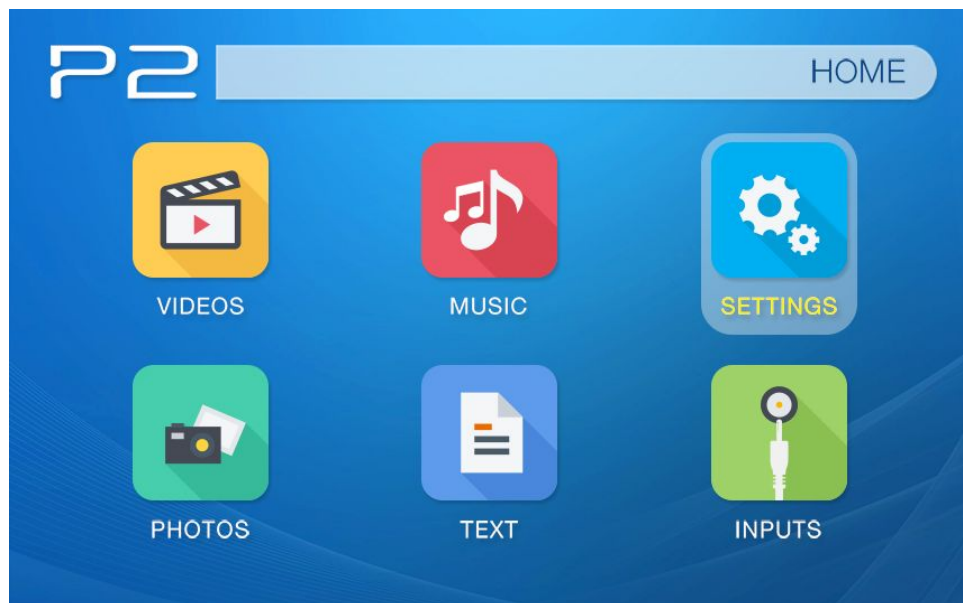


## Projector Setup

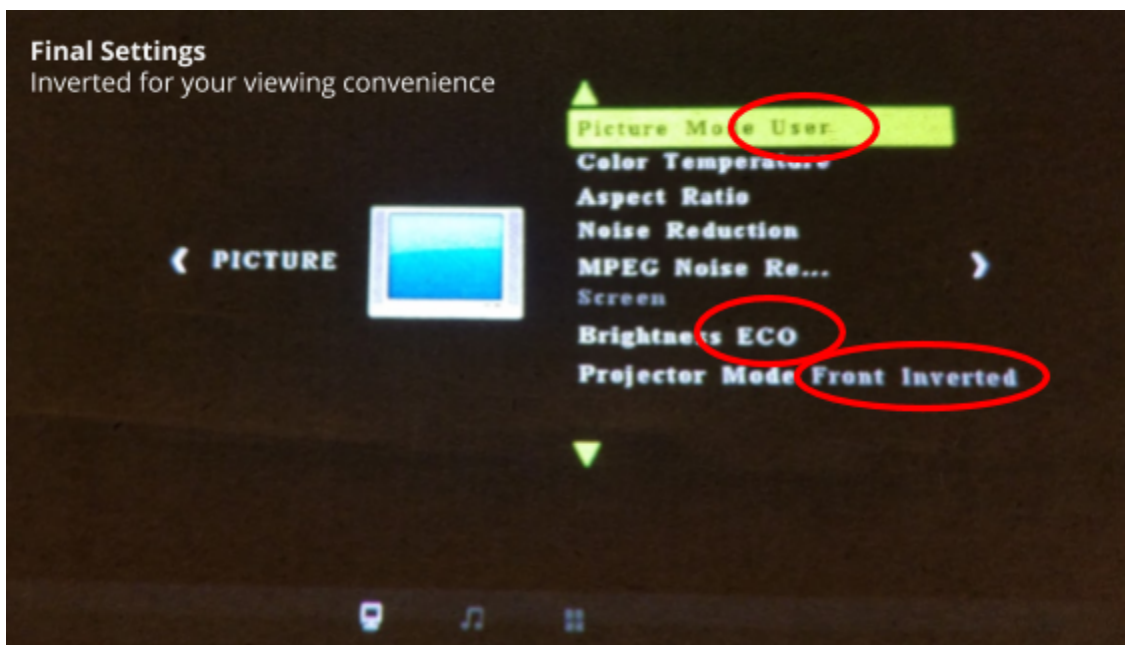


Setup the projector with the following steps:

- Turn on the projector by holding down the Power button (see the previous figure). You should see the
- Find the Focus Adjustment wheel on the side of the projector to adjust the focus of the projection onto the box. Focus it as close as possible.



- Using the left/right arrows on the Directional Pads, select **INPUTS** on the projector's main menu, then **DIGITAL**. After a few seconds, you should see the Windows 10 desktop.
- **If you see the Windows 10 taskbar at the bottom of the projected screen, take the following precautions:**
  - Hit the **Windows key** and type **Settings**.
  - Click on the **Personalization** icon.
  - Click on **Taskbar** on the left side.
  - Under the **Multiple Displays** section, turn **Show taskbar on all displays** off.
- Use the **Back button** on the projector to return to displaying the **main menu**.
- Use the left/right arrows to select the **Settings** option (gears icon).



- Select **Picture Mode** and change the **Picture Mode** from Standard to **User**.  
**IMPORTANT:** Use the down arrow to move the cursor down to **Contrast**. Then use the right arrow to adjust the contrast to **100**.
- **IMPORTANT:** Move the cursor down to **Brightness** and use the left arrow to adjust the brightness to **0**.
- To **Confirm the Selection**, hit OK and exit the menu with the **Back button**.
- Go back to **Settings** and cycle through **Brightness** on the main settings menu and find **ECO**
- Finally, go back to **Settings** and change the **Projector Mode** to **Front Inverted**. This will rotate the display 180°.
- Hit the button **SOURCE** and then **DIGITAL** and make sure that you see the Windows 10 desktop on your projector.
- Place the properly set up projector **upside down** on top of your **second breadboard** on the stand. If you do not have a second breadboard, proceed as usual, though you should note that you may not be able to take a full picture.

## Launchpad (MSP430) Setup

- Launch Energia (from Desktop)
- **Open the AnalogReadSerial program in Energia (File > Open). This is a different Launchpad code from last week, and can be found in the Imaging Lab 2 or 3 folder you downloaded. Select the right Serial Port (Tools > Port) by going to “Device Manager” and finding the MSP UART port. Upload the code by clicking on the Upload button (white circle with a right-pointing arrow, as shown below):**



- Hit the **RESET** button on your MSP (labeled **RST**).
- **To verify that the program is working, type a 6 into the serial monitor (accessed in Energia via Tools > Serial Monitor). You will need to set the Baud Rate to 115200. You should see a reading from the ambient light sensor appear.** If the numbers increase with light and decrease with less light your setup is good. **You must close this window before continuing.**

