A design for a printed circuit board to mount to a standard Arduino Uno microcontroller is provided here. This is often referred to as a "shield". The design files were created with Cadsoft Eagle 7.2, and be found in the online archive associated with this project, http://purl.stanford.edu/rb471wt3944 as the compressed archive "Tide_controller_circuit_board_files.tar". The Eagle files can be used to generate files that many online printed circuit board manufacturers can use to produce this board.

The shield is designed to interface with a CW230 stepper motor controller, two magnetic reed switches, and a real time clock. There are three different options available for real time clocks on the shield, depending on the user's desire and available parts. Two places for indicator LEDs are provided, along with buttons to reset the Arduino and a button to control the tide rack behavior (BUTTON1). The individual parts are indicated in the following sections.
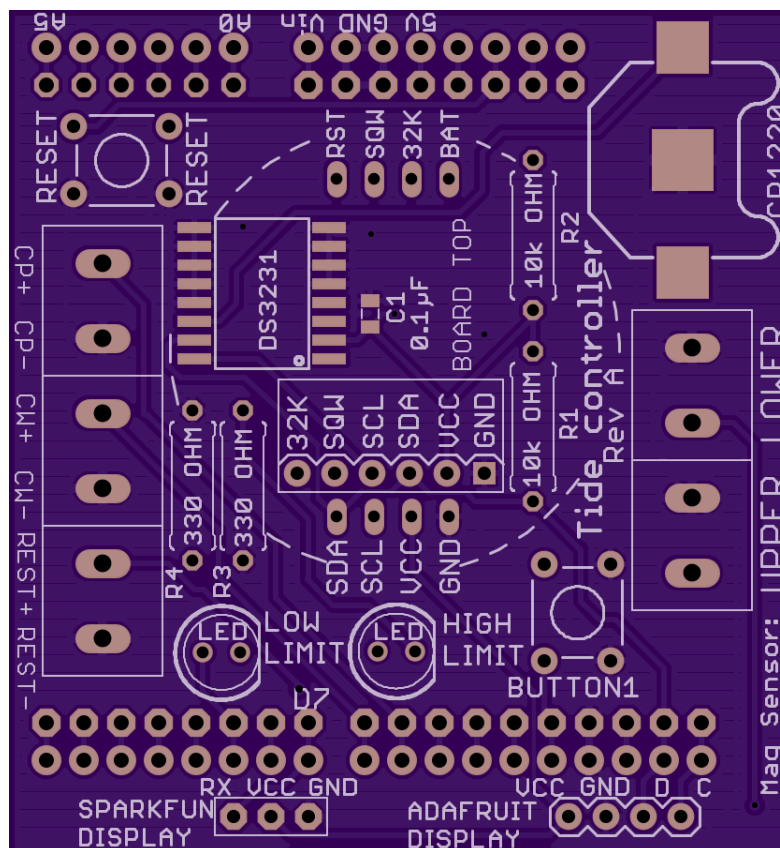

Figure 1. The top side of the tide controller shield.

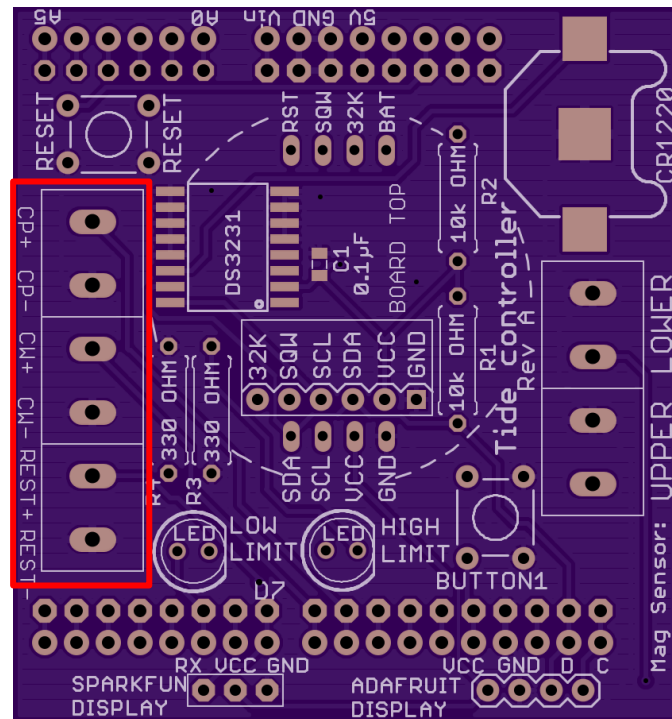# Connectors for CW230 stepper motor controller and magnetic reed switches

Figure 2. Positions for terminal blocks (highlighted in red) are provided to hook wires to the CW230 stepper motor controller. The labels here match the labels used on the CW230.
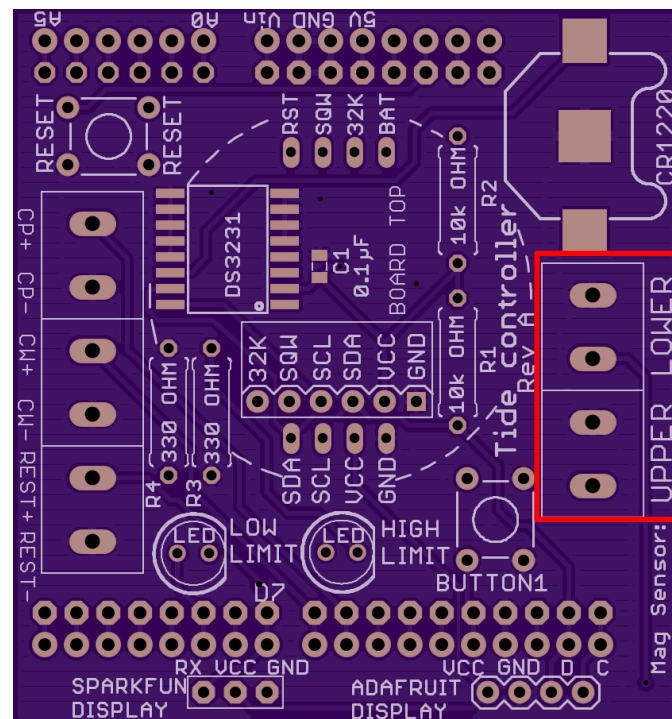

Figure 3. Positions for terminal blocks (highlighted in red) are provided to hook wires to two separate magnetic reed switches to be mounted on the frame of the tide rack. These set the upper and lower travel limits of the rack carriage,

and are actuated by a magnet attached to the rack carriage. The polarity of the wires on these terminals does not matter, they are simple open/closed switches.

Figure 4. Terminal blocks that will fit in the shield. These are available from several manufacturers. The pictured unit is from On Shore Technology Inc, part number EDZ250/2.
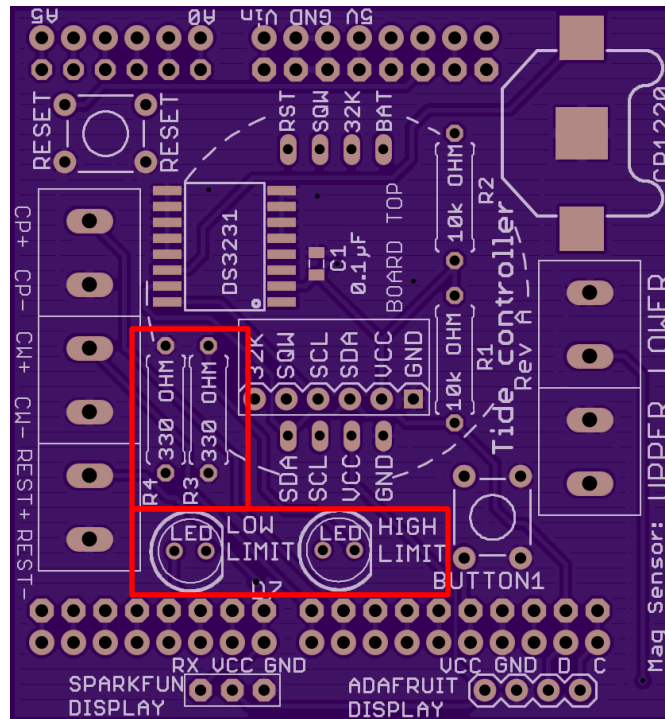
LED indicators

Figure 5. Positions for two LEDs, and their associated resistors are highlighted in red. A resistor value between 100ohm and 330ohm is sufficient. The LEDs fit standard 5mm (T 1-3/4) size LEDs. The low limit or high limit LED lights when the associated magnetic limit switch is activated. LED options from Lite-On include a red version LTL-307EE and a green version LTL-307GE. Resistors can be generic, such as Stackpole CF18JT330R 330 ohm 1/8Watt.
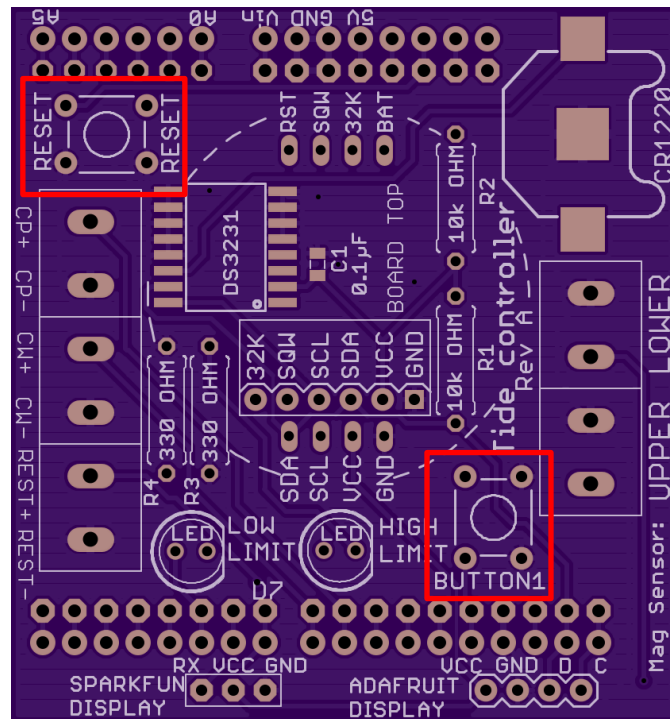
Buttons

Figure 6. Button (also referred to as a "tactile switch") mounting points are highlighted in red. The upper left position is a reset button for the Arduino, this duplicates the reset button found on Arduino boards and is not strictly necessary. The second button, labeled BUTTON1, along with the associated Arduino tide controller software, will cause the rack carriage to travel downwards until the user releases the button or the rack carriage activates the lower magnetic limit switch.

Figure 7. A standard tactile switch. These are available from many manufacturers. One common part is TE Connectivity part number 1825910-6.

Real time clock options

There are three potential methods for mounting a real time clock on the shield. All three involve the use of a DS3231S real time clock from Maxim.

Figure 8. The circled region indicates where a Chronodot real time clock can mount, with hole labels that match the labels on a Chronodot. Two positions for additional required 10,000 ohm resistors are indicated in the boxed region.

Figure 9. A Chronodot real time clock based on the DS3231S. Available from online vendors such as Macetech.com and Adafruit.com. The Chronodot also provides mounting positions for 10,000 ohm resistors, the user only needs to install resistors on the shield or on the Chronodot, but not both. If you use the Chronodot, you may also wish to install two 4-position female headers to make it removable, such as part number Sullins PPPC041LFBN-RC.
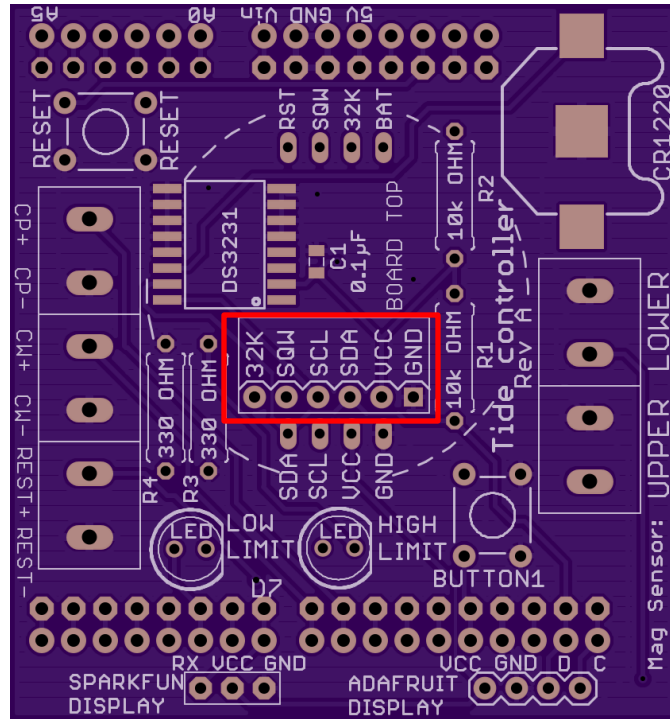
Figure 10. Mounting holes for a generic DS3231 + AT24C32 module. The hole labels match the labels on the module.
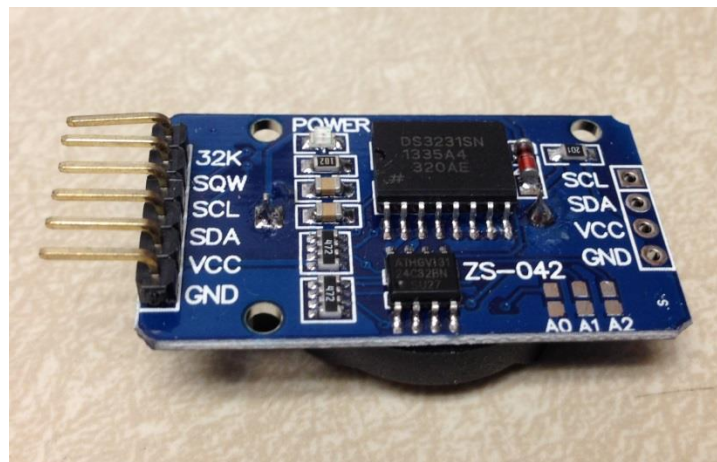

Figure 11. A DS3231 + AT24C32 module. These are a generic part available from a number of online vendors.
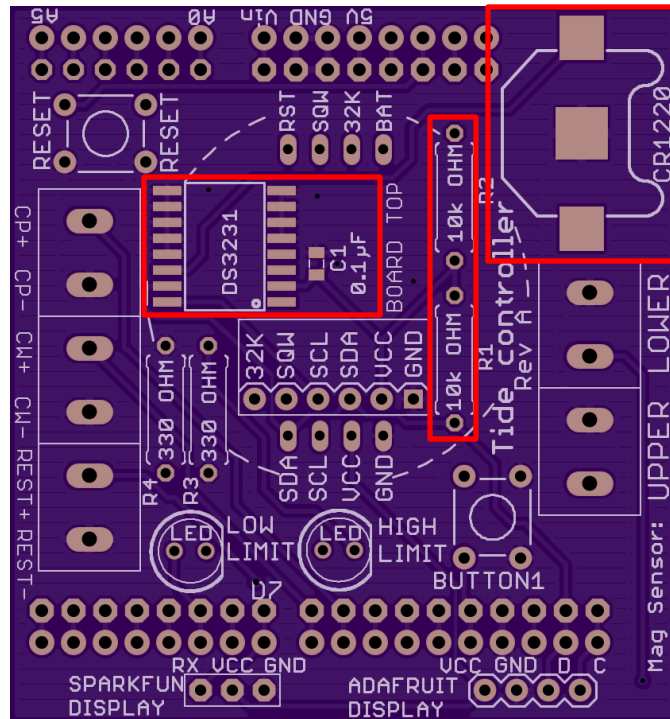
Figure 12. For users comfortable with surface mount soldering, a bare DS3231S chip (Maxim Integrated) may be mounted on the indicated footprint, along with a 0.1µF ceramic capacitor in a standard 0805 footprint (various vendors, for example part number 399-1168-1-ND from Digikey), and a CR1220 3V lithium battery holder (Keystone Electronics part number 3000). In this configuration, the user will also need to install the two 10,000 ohm resistors (for example, Stackpole CF18JT10K0).
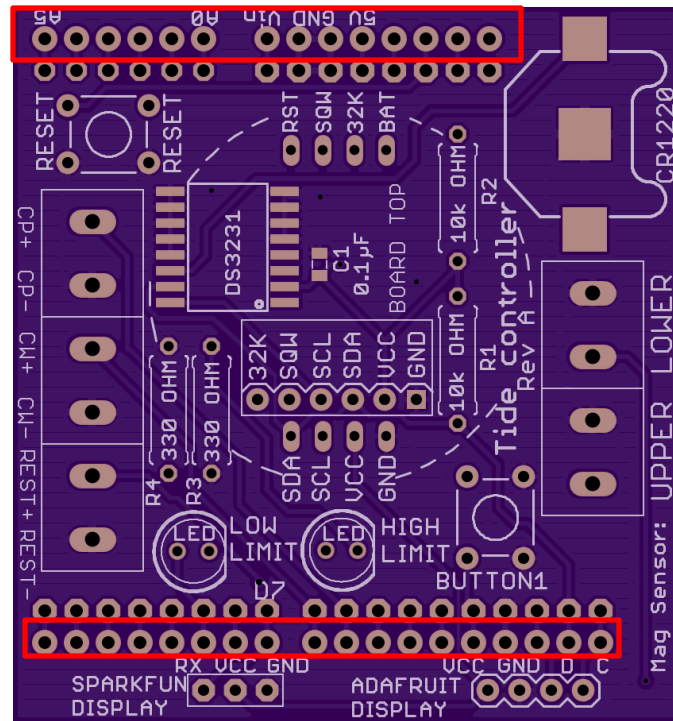
Mounting pins

Figure 13. To mount the shield to an Arduino board, install header pins on the bottom side of the board in the indicated rows of holes. These will match up with the female headers on the top of an Arduino board. The adjacent rows of pin holes to the inside of the indicate boxes are provided so the user can access the other Arduino pins if necessary. Example: TE Connectivity 4-103185-0, Digikey PN A26513-40-ND.