Motor Controller Board

How To Assembly Guide
0.1 Overview

- Parts
- Understanding the motor controller boards power
- Build and test the motor controller board
- The many uses of the motor controller board

0.2 Parts

<table>
<thead>
<tr>
<th>Qty Per Board</th>
<th>part ref</th>
<th>Name</th>
<th>Manufacturer</th>
<th>Manufacturer Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>N/A</td>
<td>0.100” Shunt - w/ Handle</td>
<td>TE Connectivity</td>
<td>881545-2</td>
<td>connector</td>
</tr>
<tr>
<td>2</td>
<td>J5, J21</td>
<td>1X4 0.1” Female Header</td>
<td>Samtec Corp</td>
<td>PPTC0411F80-RC</td>
<td>connector</td>
</tr>
<tr>
<td>2</td>
<td>J10, J11</td>
<td>1X2 0.3” Female Header</td>
<td>Samtec Corp</td>
<td>PPTC0211F80-RC</td>
<td>connector</td>
</tr>
<tr>
<td>2</td>
<td>J22, J23</td>
<td>1X12 0.1” Female Header</td>
<td>Samtec Corp</td>
<td>PPTC1211F80-RC</td>
<td>connector</td>
</tr>
<tr>
<td>1</td>
<td>J24</td>
<td>1X20 0.1” Female Header</td>
<td>Samtec Corp</td>
<td>PPTC0522F80-RC</td>
<td>connector</td>
</tr>
<tr>
<td>1.42 (55 pins)</td>
<td>J1, J2, J5, J6, J7, J8, J9, J10, J11, J12, J13, J15, J16, J17, J18, J19, J20, J22, J23, J24, J25</td>
<td>36 pin 0.1” Male Header</td>
<td>Jameco ValuePro</td>
<td>2012-2524-1X345G</td>
<td>connector</td>
</tr>
<tr>
<td>1</td>
<td>U1</td>
<td>QUADRUPEL HALF-H DRIVERS</td>
<td>Texas Instruments</td>
<td>293006NL</td>
<td>IC (Motor Driver)</td>
</tr>
<tr>
<td>1</td>
<td>U2</td>
<td>VOLTAGE REGULATOR</td>
<td>Texas Instruments</td>
<td>390261-4</td>
<td>IC socket (quick connect)</td>
</tr>
<tr>
<td>2</td>
<td>D1, D2</td>
<td>LED</td>
<td>Kingbright</td>
<td>WPS370YW</td>
<td>Diode (bi-directional)</td>
</tr>
<tr>
<td>3</td>
<td>R1, R2, R3</td>
<td>1K Ohm Resistor 1/8 Watt</td>
<td>Xicon</td>
<td>290-1K-RC</td>
<td>Resistor</td>
</tr>
<tr>
<td>1</td>
<td>D10</td>
<td>Grounding Clip</td>
<td>Keystone</td>
<td>5026</td>
<td>Test Point</td>
</tr>
<tr>
<td>1</td>
<td>D3</td>
<td>LED</td>
<td>Everlight</td>
<td>HLM-1700</td>
<td>Diodle</td>
</tr>
<tr>
<td>2</td>
<td>C1, C2</td>
<td>0.33 UF Ceramic Capacitor</td>
<td>Kemet</td>
<td>C320C334M533STA</td>
<td>Capacitor</td>
</tr>
<tr>
<td>1*</td>
<td>Teensy (not part of mtr_ctrl kit)</td>
<td>36 pin 0.1” Male Header</td>
<td>Jameco ValuePro</td>
<td>2012-2524-1X345G</td>
<td>connector</td>
</tr>
</tbody>
</table>

Figure 1: Parts List

![Parts List Image](image1.png)

Figure 2: Parts for motor controller board.

![Parts Image](image2.png)

Check your kit and make sure you have all the components from your parts list.
0.3 Understanding the motor controller boards power.

We recommend that all 3 external power input voltages to the board comes from a 9v battery or your TekBot charger board.

0.3.1 Input Voltage for Teensy

V+ (on J5) is the power for the Teensy breakout and logic. This input voltage can range from 5v to 15v and is regulated to 5v.

0.3.2 Input Voltage for Motor Channels 1,2

The other 2 input voltages can range from 4.5v to 15v for the motor controller: VCC1 (J7) for channel 1 and VCC2 (J8) for channel 2.

The motor controller input voltages VCC1 and VCC2 should not be supplied from the 5v regulated VCC pins on the board. The motors can draw peak 2A current and cause damage to your teensy and board.

0.4 Build and test the motor controller board

The steps to build the motor controller board and its parts:

- Voltage Regulator
- Breakouts
- Motor Controller

0.4.1 Schematic

Figure 3: Motor Controller board 3 schematic.
0.4.2 Voltage Regulator

![Voltage regulator schematic](image)

Components: J5,R3,D3,C1,C2,U2.

0.4.3 What do these parts do?

The female header (J5) brings in the power that will be used for the Teensy and its breakout pins. This power then splits going to the voltage regulator and the "power on" LED.

We use a capacitor (C2) before the voltage regulator (U2) as a filter incase there is any oscillation in the incoming voltage. The LP2950 is a voltage regulator IC. We use a capacitor (C1) after the IC to buffer the voltage to a more steady rate and reduce any spikes/drops in voltage.

We use a resistor (R3) to limit power loss through the "power on" LED (D3). The LED it a power on indicator, letting the user know that power is being supplied to the Teensy.

0.4.4 Assembly

![Motor controller PCB](image)

Figure 4: Voltage regulator schematic.

Figure 5: Motor controller PCB.
Begin assembling your motor controller board by soldering these components into your board.

The LED has polarity, and must be inserted into D3 with the positive lead (longer lead) on top (square hole) and the negative lead (short lead) on bottom (round hole). The LED is a diode and if not placed correctly it will not light up and may become damaged.

The voltage regulator must be placed into the board with the flat side facing the flat side of the decal (U2). The regulator will not output a regulated voltage if not placed correctly and may become damaged.

⚠️ Putting the LED and voltage regulator in the board incorrectly can damage your parts.

Plug ground and power into the board. Check to see if the LED is lighting up. Test the VCC using your digital multi-meter (DMM) from the test points GND(T3) and VCC(T2). You should get 5v.

0.4.5 Breakouts

![Teensy Breakout Diagram](image)

Figure 6: Teensy breakout.

components:(J1,J2,J3,J6,J7,J8,J9,J16,J17,J18,J19,J26,J25,J21,J22,J23,J24).
0.4.6 What do these parts do?

The breakout pins make it easy to connect components to your board. Using female-to-female jumpers you can connect components in seconds, with no soldering required. On top of the one-to-one ratio breakout pins for the Teensy and motor controller, there are extra VCC and GND breakout pins and a USART plug-in.

0.4.7 Assembly

![Breakout Pins](image)

Figure 7: Breakout Pins.

Begin by cutting your strips of male header into the sizes indicated in the parts list. Look for the component locations and cut a section of header to fit that location. Then solder all the male (J1, J2, J3, J6, J7, J8, J9, J16, J17, J18, J19, J26, J25) and female (J21, J22, J23, J24) headers into place.

Check to see if your Teensy fits on the Female headers (J22, J23, J24).
0.4.8 Motor Controller

The socket (U1) is a universal IC socket for any DIP packaged 16 pin IC. The L293DNE (U1) IC is a quadruple half-H driver IC. For our design we only use two of the drivers, and those are the connections that have breakout pins. The resistors (R1,R2) are to limit the current passing through the LED. The bi-directional LEDs (D1,D2) tells you whether the channel output clockwise or counter-clockwise. The ground clip (J20) is for easy ground access when testing with DMM, oscilloscope probes, and power supplies.
Begin by soldering in the socket (U1), ground pin (J20) and resistors (R1,R2). Place the L293 IC (U1) with the "half moon" facing into the socket as indicated by the U1 decal.

⚠️ Motor controller IC (U1) must be oriented as indicated by the decal.

Now solder in the LEDs (D1,D2) with the positive lead (longer lead) on top (square hole) and the negative lead (short lead) on bottom(round hole).

⚠️ Make sure both LEDs are put in correctly or your output may not be reflected by your LED.

Check to see if your LEDs both output the same color when given the same inputs (see truth table).
0.5 Uses of the motor controller board

0.5.1 Development board

Using the breakout pins for the Teensy this board offers quick access to functionality without the need to solder components to pins. The quick connection terminal to USART can be used as a plug-in terminal for a Bluetooth module.

0.5.2 Motor Controller

In ECE 111, this board is used to drive the servo motor used in the sustainability and renewable energy lab. The quick connections terminals for Channel 2 give access to pre-designated Teensy pins that will turn the solar panels.

In ECE 112, the board replaces previous versions of the motor controller board. This is possible using a Teensy to drive the logic. The functionality described on the truth table will tell you which connections need to be high and low in order to make the motors turn clockwise and counter-clockwise. Channels 1-2 on the board are connected to the left and right motors.
Demonstrate that the motor controller can rotate your motor clockwise and counter clockwise as indicated on the truth table.

![Figure 11: Truth Table.](image)

Demonstrate that the motor controller can rotate your motor clockwise and counter clockwise as indicated on the truth table.

TA Signature: __________________________

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