PiLC Information

Electronics At a Glance

Digital Output (Solid State Relay)	
Max Voltage	60v DC
Max Current	0.7 Amp
Digital Input	
Opto-isolator Forward Voltage (V_f)	1.2v
Absolute Max Foward Current (I_f)	50mA
GPIO Pullup	Pullup required
R calculation	$R \geq (V_{in} - 1.2v) / 50mA$
Analog Input	
Max Voltage at Pin	3.33v
Precision	10 bit (0 – 1023)
Communication	SPI
4mA – 20mA Setup	
Choosing R1 and R2	R1 = 0 Ohm R ≥ 167 Ohm (recommended higher in case failure causes higher than 20mA current)
DC Setup	
Solve the following equations:	
Eq 1	$3.33v \geq V_{in} * (R_1 / R_2)$
Choose R1 and R2 so that you keep the current fairly small	$i = V_{in} * (R_1 + R_2)$
Precaution	The analog inputs are not opto-isolated, so it is possible to damage your pi if you exceed 3.3v on the ADC input

Components List

Component	Description	System
LTV-814	Opto-isolator	Digital Input
CPC1002N	Solid State Relay	Digital Output
MCP3004	ADC	Analog Input
1x9 Pin Header	Expander header	Expander pins
2x20 Pin Header	Raspberry Pi header	Raspberry Pi header
1x2 Screw Terminal	Screw Terminal	Wire-to-board
1x3 Screw Terminal	Screw Terminal	Wire-to-board
1 uF Capacitor	0805 Capacitor	Analog Input
0 Ohm Resistor	0805 Resistor	Analog Input
100 ohm Resistor	0805 Resistor	Analog Input
1 kilo-ohm Resistor	0805 Resistor	Analog Input | Digital Input | Digital Output
6.65 kilo-ohm Resistor	0805 Resistor	Analog Input
10 kilo-ohm Resistor	0805 Resistor	Analog Input

Wiring

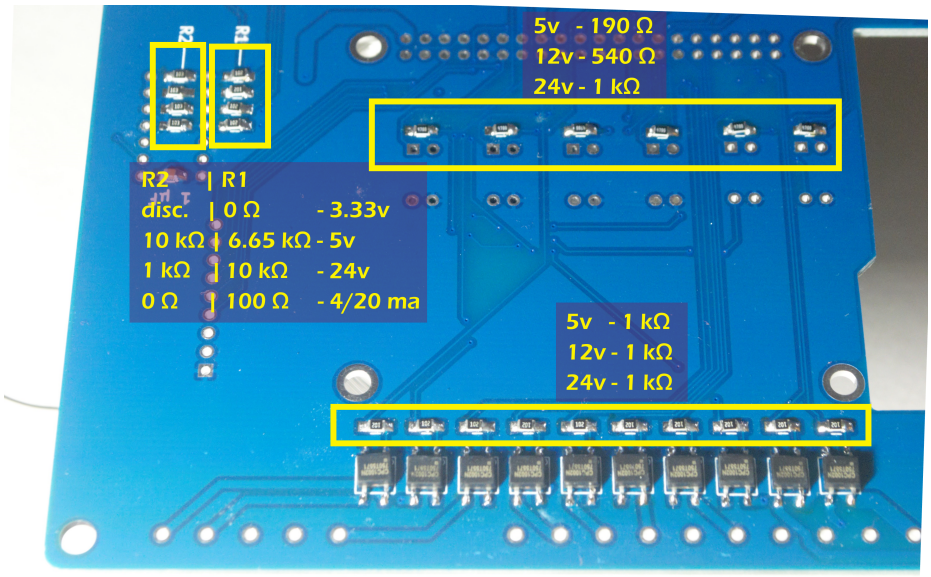
All of the inputs and outputs on PiLC are polarized, so make sure that you keep that in mind when hooking up voltage sources.

With the digital inputs and digital outputs, the worst thing that will can happen with reverse polarity or over-voltage (unless you are working with some kind of monstrous voltage source, like kilovolt or higher ranges) is that you will damage a solid state relay or an opto-isolator. If this happens, you can simply replace the damaged component with a new one and get right back to it.

On the other hand, because the Analog input has an electrical path back to your Raspberry Pi, applying over-voltages or reverse polarity may damage your GPIO pins, or zap your Pi completely.

Because of this risk, we recommend that you wire everything up *before* snapping your Raspberry Pi into the pin header. This gives you a chance to inspect your wiring before continuing.

Assembly and Soldering



If you purchased a kit version of PiLC, you'll need to solder your board together before you can use it.

Necessary Tools

- Soldering iron
- Solder
- Tweezers
- Flux (Recommended)

A note on soldering surface-mount components

PiLC uses surface-mount components. Remember,

DON'T PANIC

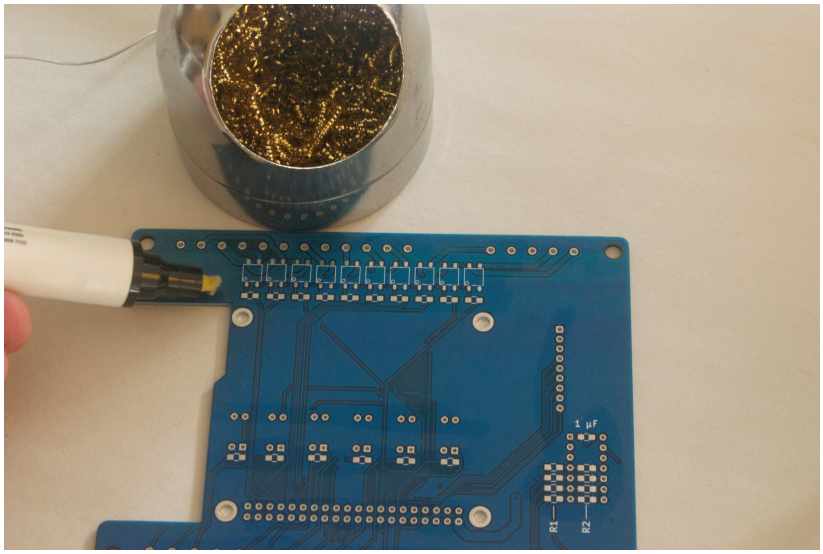
These are the biggest, friendliest, easiest-to-solder surface-mount components you can get. In fact,

a PiLC kit is the perfect intro to SMD soldering, and by the end of it, you will have a whole new class of boards you can tackle.

Step-by-step instructions with pictures

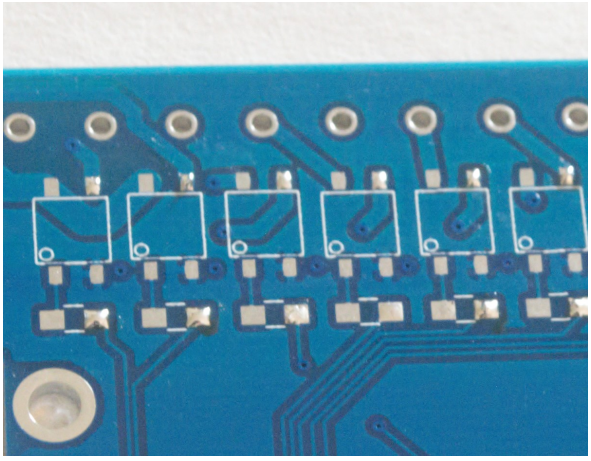
Typically, you'll want to move from smaller components to larger components, especially in terms of height.

Step 0 (Optional) – Apply Solder Flux



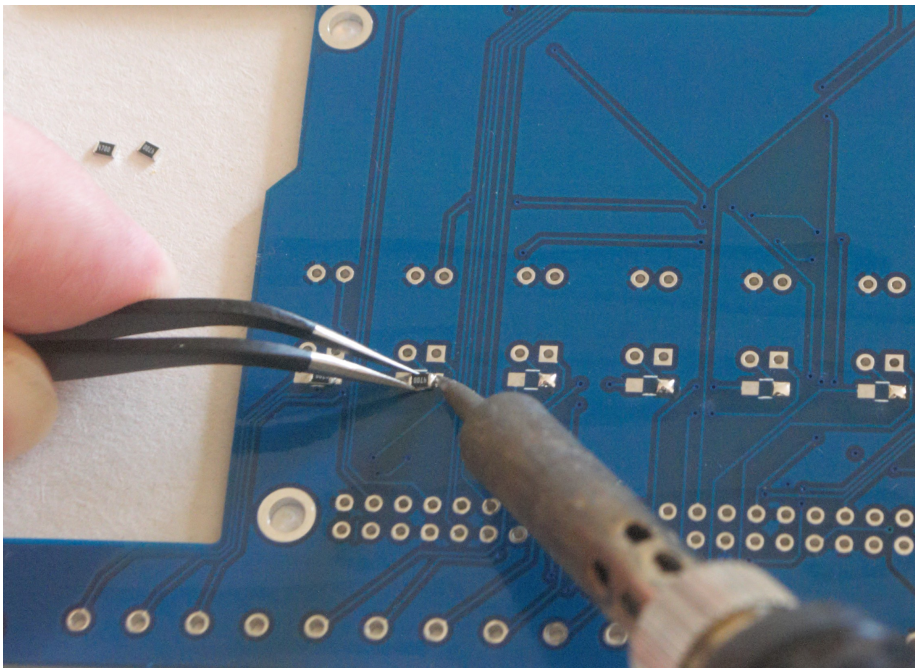
Apply flux to all solder pads to make soldering easier. Flux is your friend, and you can't really overdo it. Apply often, even between iron touches on the same pad if things aren't yet beautiful. Though, like some of your friends, flux does cause quite a mess. Nothing a little alcohol and an old toothbrush can't fix. To clean most fluxes, simply grab some Isopropyl Alcohol (rubbing alcohol), apply liberally, and brush it.

Step 1 – Apply Solder to Bottom Pads



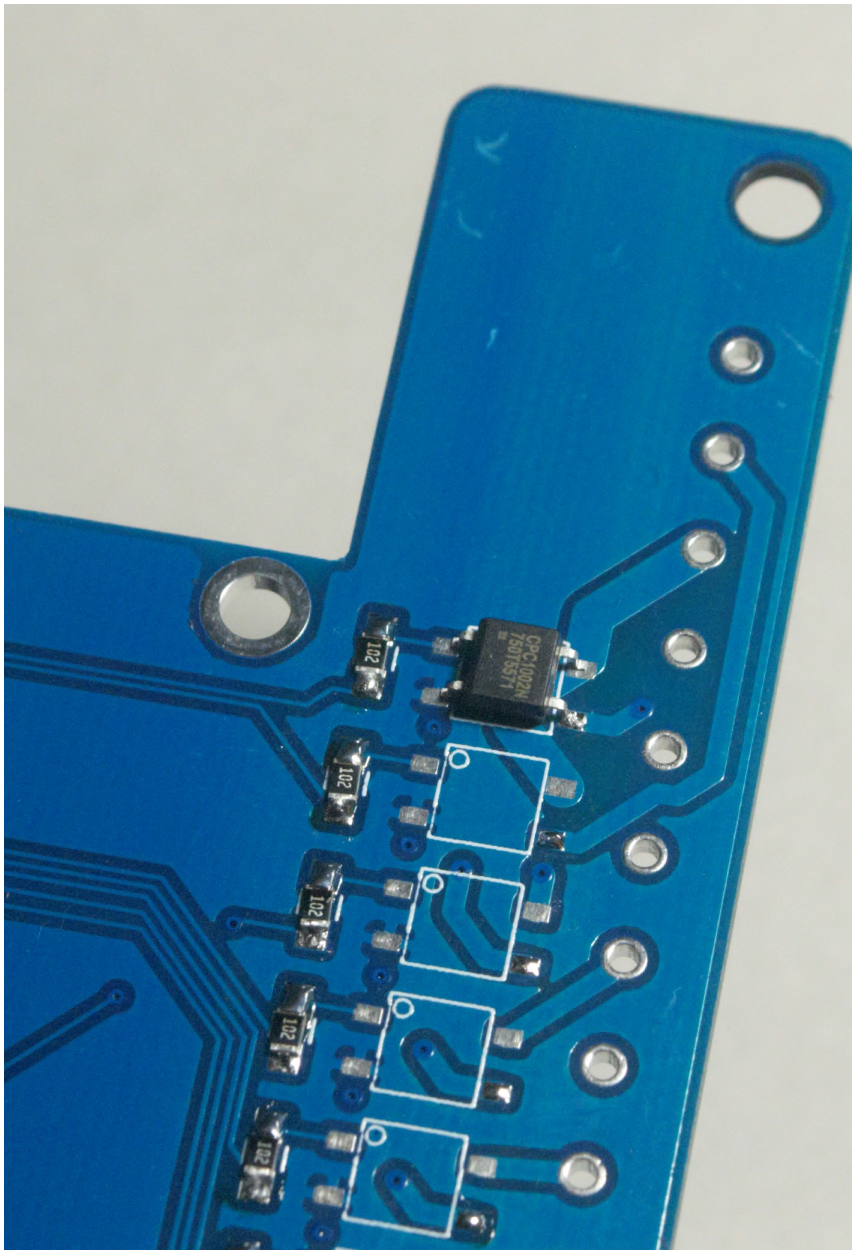
Starting on the bottom of the board, apply solder to one pad per component. It will make things easier for you later if you tin all of the pads toward one side of the board (for example, the side of the board with the cutout).

Step 2 – Resistors and Capacitor



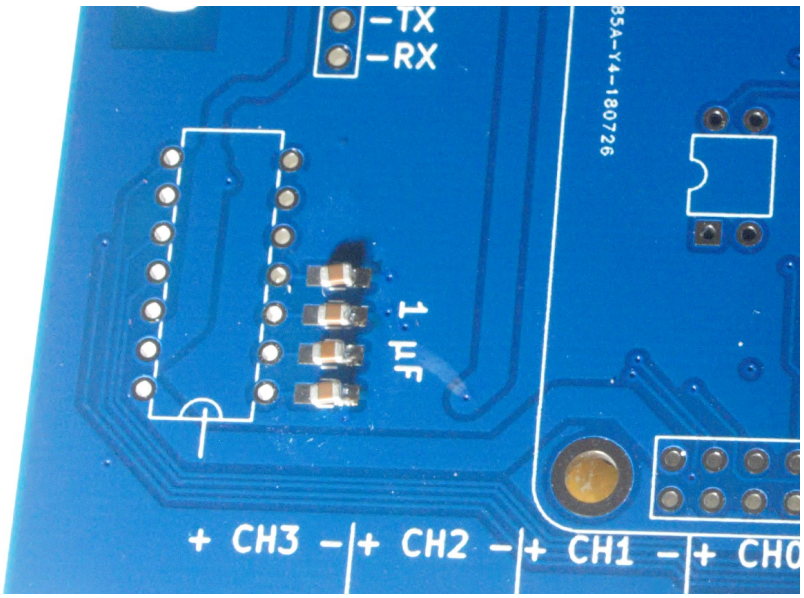
Using tweezers, hold the resistors to the board, lined up on the pads, and touch your iron to the pad with solder. This will secure the resistor in place. After the resistor is attached on one side, you may want to press down on the top of the resistor while re-melting the solder to get the resistor flat against the board. Follow the same to solder the 1uF capacitor.

Step 3 – Solid State Relays



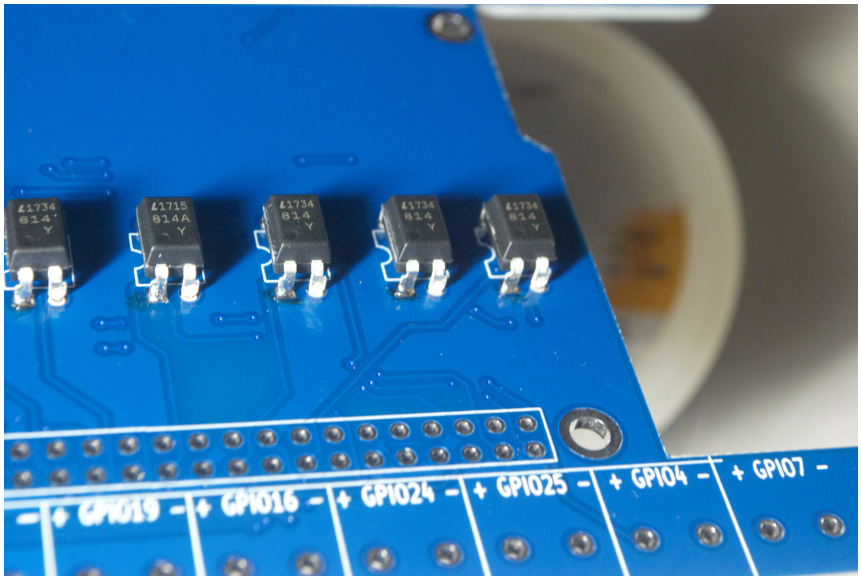
Line up the dots on the silk screen with the dots on the solid state relays. Then solder the one leg down corresponding to the pad you have already applied solder to. This will secure the chip as you apply solder to the rest of the legs.

Step 4 – Capacitors on the Front of the Board



Just like the resistors on the back of the board, start by securing each of the capacitors on one side. Then apply solder to the other side. You're now done with SMD components!

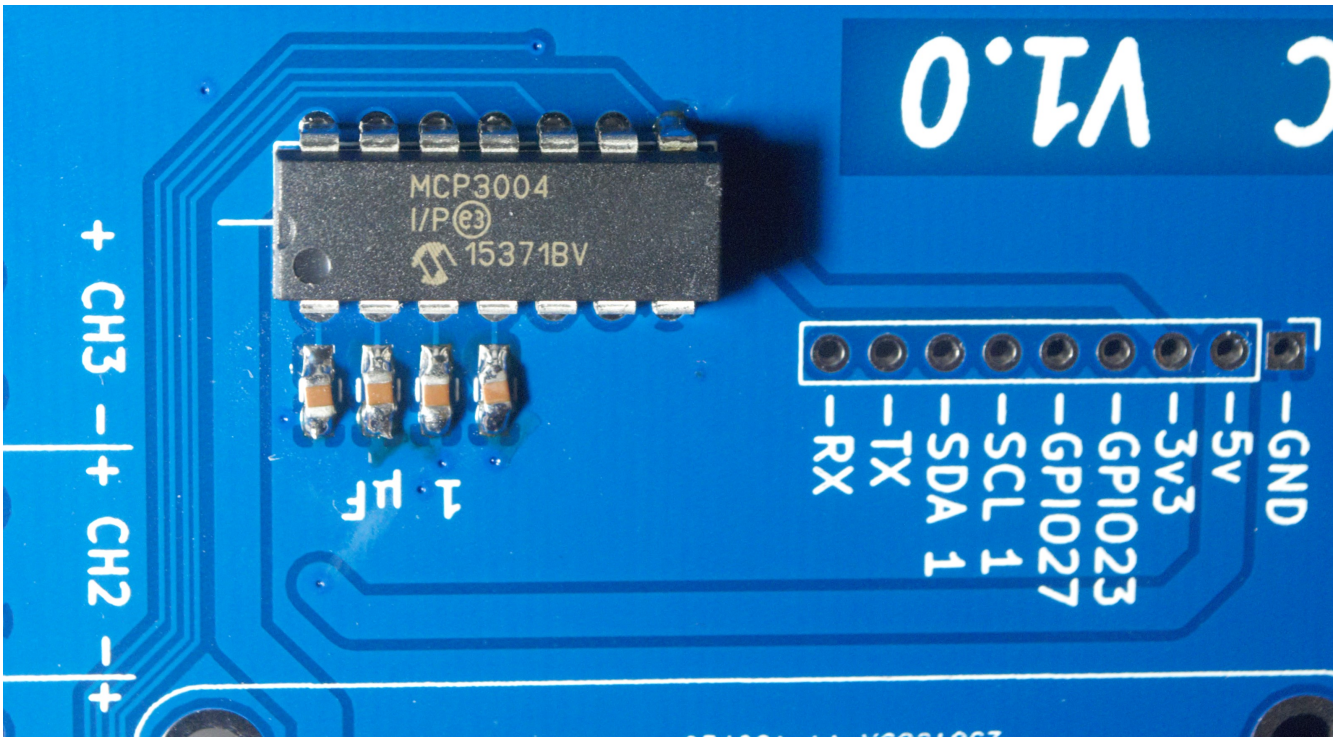
Step 5 – Opto-Isolators



Align the dot of the opto-isolators with the notch on the silk screen. You'll likely need to bend the legs slightly inward to achieve the right angles: right angles.

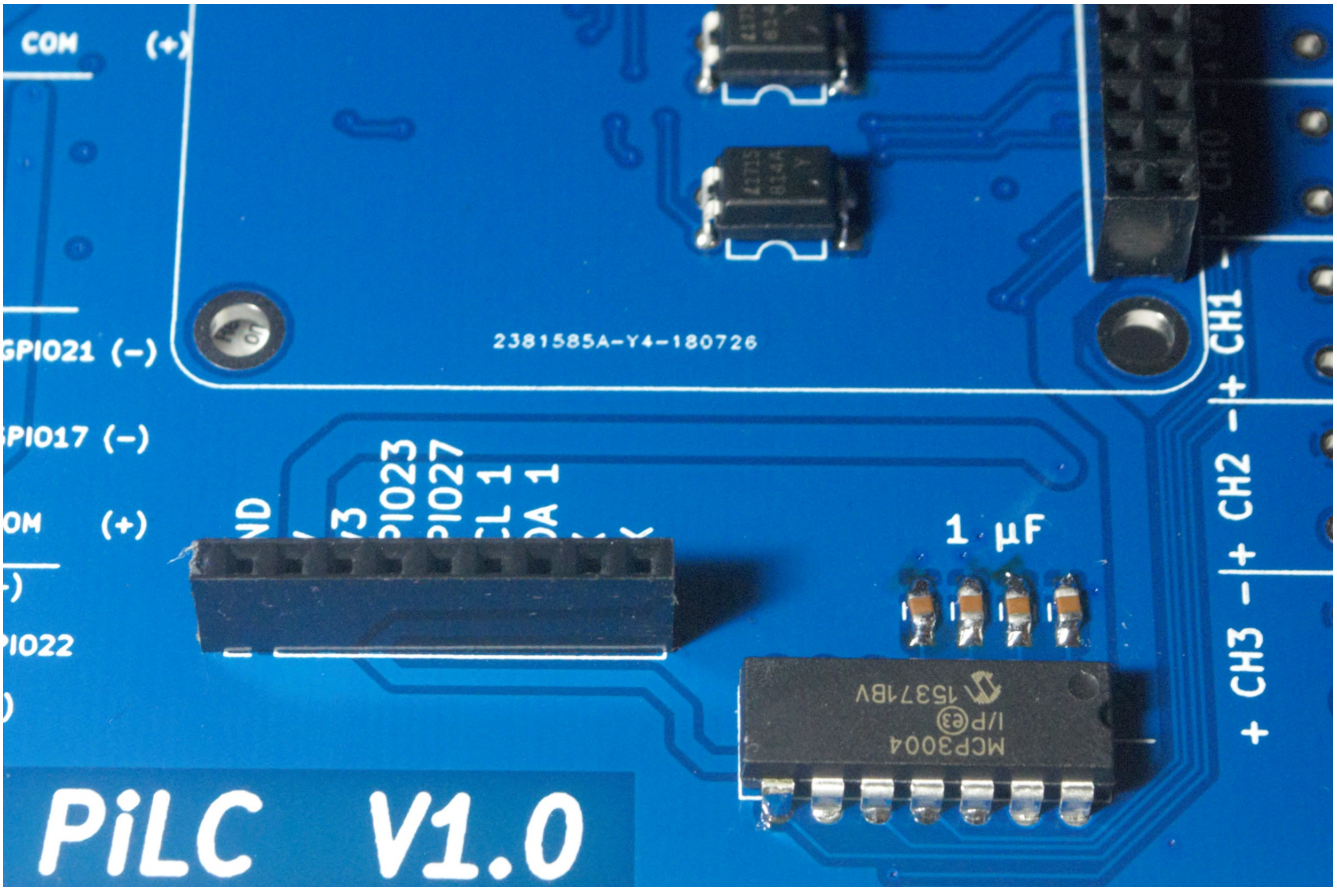
Once you have an opto-isolator placed, apply a small amount of solder to the top, so when you flip the board around, they remain secured. Then flip the board over, and finish soldering all of the legs.

Step 6 – MCP3004



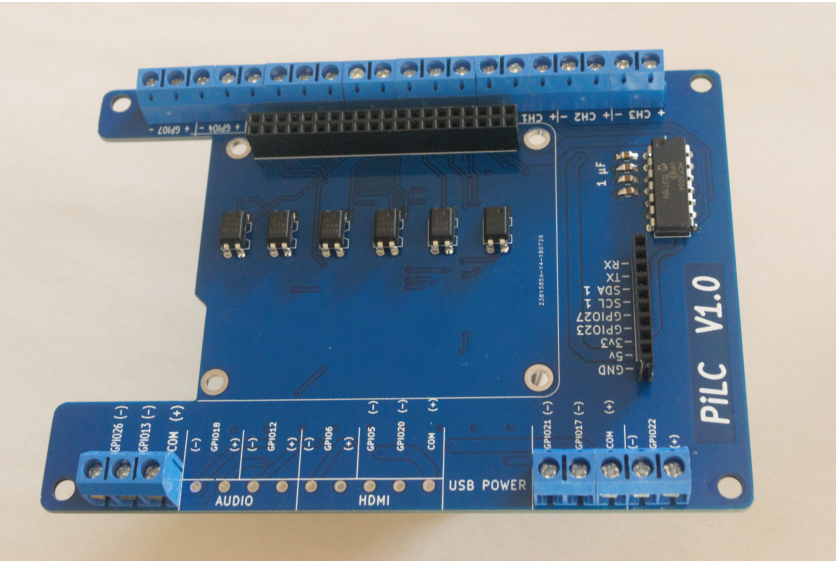
The MCP3004 is exactly like the opto-isolators. Start by bending the legs if needed, align the dot with the notch, and tack one leg down. Then flip the board over and solder the rest of the legs.

Step 7 – Pin Headers



Solder both the expander header, and the Raspberry Pi headers next.

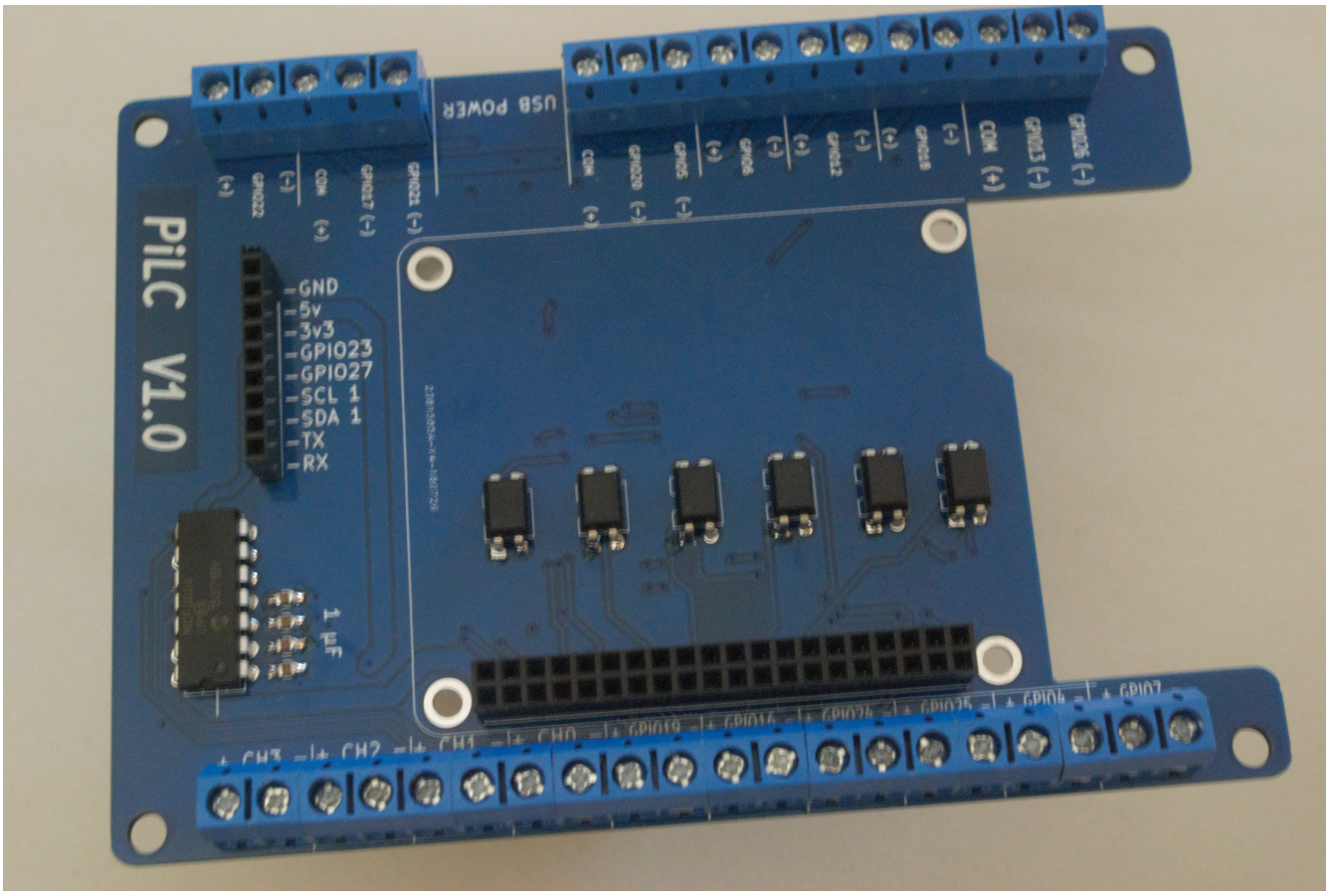
Step 8 (Multimedia Version) – Screw Terminals



For the multimedia version, place all of the screw terminals in like shown above, leaving the Audio and HDMI sections clear for your cables. The fit is nice and snug, so the screw terminals will likely

fit nice and snug while you flip the board over to solder the legs on the bottom.

Step 8 (Full version) – Screw Terminals



If you have the full version, place screw terminals in every spot.

The fit is nice and snug, so the screw terminals will likely fit nice and snug while you flip the board over to solder the legs on the bottom.

You're ready to rock and roll! Go hook up some bright lights and a button or something!