Pen15 v1.0 Assembly Instructions

The Pen15 board is a simple single-channel motor driver shield, with optional temperature sensing and over-current limiting. By default, the motor connection is broken out to a 2.5mm mono headphone jack, commonly found as the power supply for vibrators. Powered via the Arduino's main regulator, current needs to be limited to 500mA maximum.

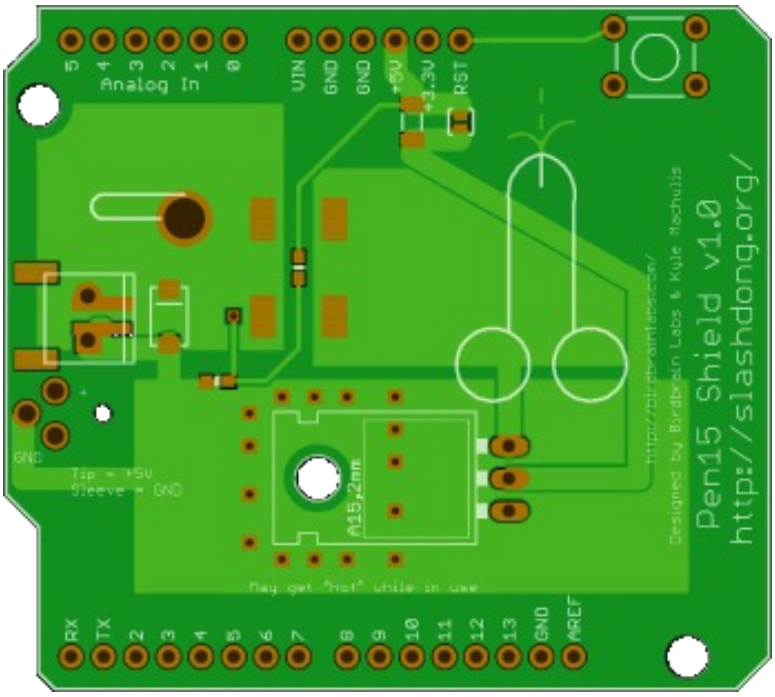
Current limiting is handled by two mechanisms: first, two 20Ω resistors are placed, in parallel, between the transistor and the motor. Assuming a maximum input voltage of 5V, these will limit the maximum current to 500mA.

$$\begin{array}{rcr} V & = & IR \\ 5 & = & I(10) \\ 5/10 & = & I \\ I & = & 500mA \end{array} \quad (1)$$

Additionally, a PTC resettable fuse is provided on the input power. This fuse will trip immediately (must trip) at 1A, and will not reset until the current has dropped below 500mA. A jumper is provided to bypass this fuse, if desired.

The transistor driving the motor is a TIP120, which has a maximum rating of 60V and 5A, and includes an integral flyback diode.

Additionally, a NTC resistor is provided to measure the board temperature near the 20Ω resistors. However, this is not required, and can be omitted if you are not comfortable soldering 0603 components.



The kit includes the following:

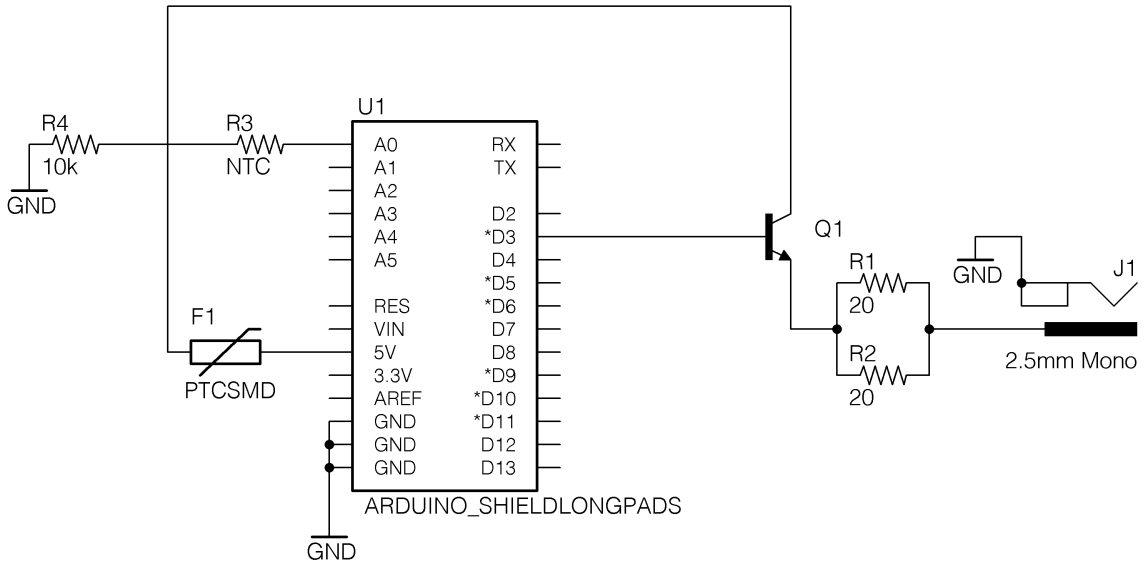
- Pen15 Board
- (2) 20Ω resistors, 2512 size, (labeled 200)
- (1) TIP120 Transistor
- (2) 8-pin Shield Sockets
- (2) 6-pin Shield Sockets
- (1) PTC Fuse (500mA), 1210 size (marked with F)
- (1) NTC Resistor 0603 (black, unmarked)
- (1) 10k Resistor, 0603 (marked 103)
- (1) 2.5mm mono jack

If you are missing any items, please contact us for a replacement. There are a few "extra" pads

on the board, for parts not included: top right, is the placement for a reset switch; middle left are dual pads for a 2mm JST connector, a 3.5mm screw terminal block, and an SMA sized diode. If you use a different transistor than provided, you may need this diode as flyback.

We recommend assembly in this order:

1. Solder the NTC resistor in place between the pads for the big power resistors.
2. Solder the 10k resistor in the other 0603 space below the power resistors.
3. Solder the PTC fuse in place, it's located between the +5V and +3.3V pins. There is a solder jumper you can jump to the right of this if you want to just skip the PTC fuse.
4. Solder the two 20Ω fuses in place. They bridge left to right when the board is oriented as shown in the image.
5. Solder the 2.5mm mono jack into place.
6. Solder the transistor in, and if desired flatten towards the board. The transistor should be oriented with the flat of the heat sink towards the left of the board. If you want to use the board as a heat sink for the transistor (not required at 500mA), bolt the transistor in place before you solder it.
7. Solder the Shield Sockets in place, possibly using another shield as a guide if you're having trouble getting them straight.



If you'd like to provide more power to your vibrator, there's a couple things you can do. First and easiest, you can replace one or both of the 20Ω resistors with a piece of wire. This will let the motor use its full available current, instead of being current limited. If your motor pulls more than 500mA, this may trip the PTC and/or cause the Arduino to go into continuous reset. If you need more power than is available, you can bend the 5V pin so it does not directly pull power from the Arduino, and provide your own power source (plugged into the 5V pin from the top, or soldered onto the bent pin). As long as your power source and the Arduino share ground, this should provide an external power source to the vibrator, without taxing your Arduino's regulator. Do note that the 2.5mm jack is only rated for 12V and 1A. Please switch to the 2mm JST connector (rated to 2A) or the 3.5mm screw terminals (rated for more than the board will take). You can also swap out the transistor for any TO-220 package you'd like, if you need to supply more than 5A. The board is designed around a 5A maximum current, but you may be able to run more current through it.