

DIYPad User Manual



[TODO: replace prototype picture with product]

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1) Overview

DIYPad is an expandable USB gamepad joystick kit that helps teach the basics of microcontrollers and provides some interesting inputs and outputs to experiment with building USB devices.

Features:

- Analog joystick, and an analog to digital converter IC to read it
- Button pad with RGB LEDs and an IC to drive them
- Vibration motor buzzer and driving circuit for force feedback
- Several expansion ports for adding new hardware
- Open source firmware for easy customization

2) Building your DIYPad

A) Soldering Tips

- Using your iron, always heat the leg of the part you are soldering and the copper pad on circuit board, *not* the solder itself. The heat coming from the heated part should melt the solder and create a very solid connection.
- When soldering, be sure to clean the tip of the iron often, using brass sponge in a can of some sort. A dirty tip will lead to messy results.
- After cleaning, put a small amount of solder on the tip. This will help heat transfer more easily to the copper on the printed circuit board and the metal leg of the part.
- If you accidentally use too much solder and create a bridge between some pins, solder wick (also sometimes called solder braid or copper braid) is a very handy way to remove it. Pull a bit of the wick from the packaging, make sure you're using a clean piece. Spread it out a little bit, place it over the top of the solder bridge. Heat the back side of the wick, and the excess solder should just get sucked right up.

B) Soldering The Parts

Solder all the resistors first. The correct resistor value is printed on the circuit board. Resistors are not polarized, so they can be inserted in either direction. It looks a bit neater though when they are all facing the same direction.

Next, solder the buzzer circuit – a transistor and a diode. The direction of these components is very important, so pay close attention to the markings on the circuit board to determine how to install them. There is a band near one side of the diode on the circuit board, and a similar band on the diode itself. Make sure they line up. The transistor has a semi-circle shape and there is an outline of that shape on the board. Make sure they match.

The analog to digital converter IC should come next. Careful not to bend the pins, and be mindful of the semi-circle indented into one end of the chip. There's a similar semi-circle on the circuit board showing the direction of this component.

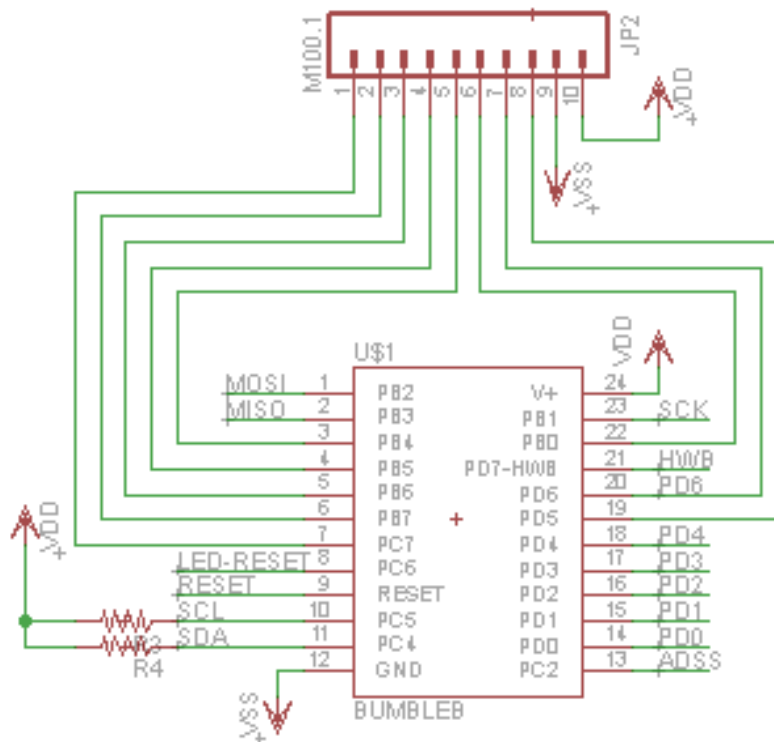
Solder the Bumble-B next. Solder the pins to the DIYPad PCB and then solder the Bumble-B to the pins. The USB connector should be facing out, as shown in the outline on the circuit board.

The joystick can be a bit tricky, there is a lot of little pins that can easily get bent up. Check that they are indeed positioned above the holes before pressing down. If the pins are not aligned on part of it, use an awl or a small screwdriver to gently pry the pins back into place. When it is all aligned, press down from the top.

Lastly, solder the force feedback vibration motor. The small wires can be connected in either direction, and you might want to trim some of the excess wire. Be careful though, the wires are very small and delicate, you don't want to accidentally pull it off the motor case. There is a piece of double-stick tape on the buzzer that you can use to stick it in place.

3) Schematics and Explanations

(A) Bumble-B



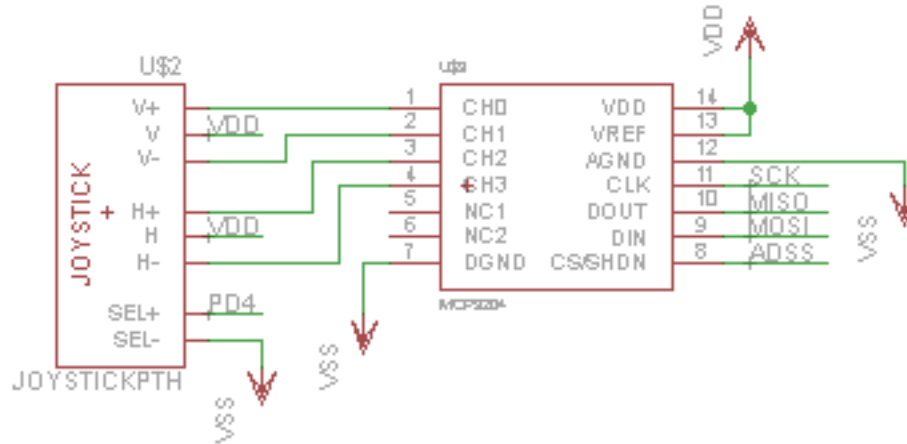
The Bumble-B is the heart of the DIYPad. It communicates to the host computer using USB, and coordinates the activity of the components on the circuit board. It is connected directly or indirectly to every component on the board.

The various named wires in the above picture are connected to various other components on the board, as described below.

Seven general purpose I/O pins are brought out directly to the expansion header near the bottom of the Bumble-B. PD6 is also brought out to this header, this is the line that goes high when force feedback buzzes and can be used to trigger something external. 5 volt supply (VDD) and ground (VSS) are also supplied on this expansion header.

The SCL and SDA lines of the I2C bus have 10k pull-up resistors.

(B) Joystick / Analog to Digital Converter

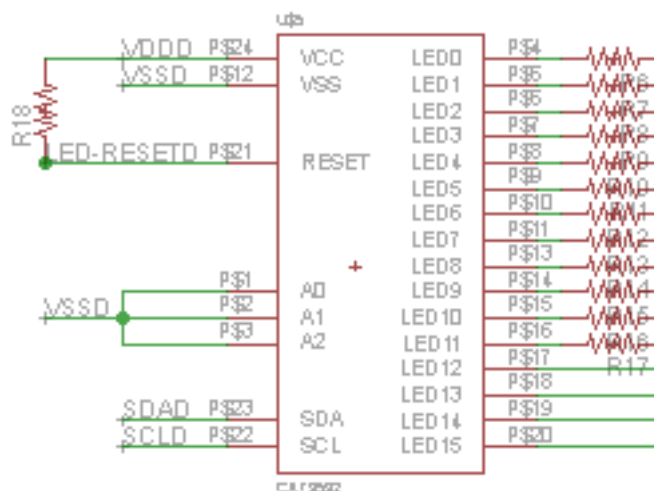


[TODO: Old picture, pre-voltage divider. Update.]

The joystick is an analog joystick sold at sparkfun.com. The analog to digital converter is an MCP3204, a widely available ADC from Microchip. This component is connected to the SPI bus (MOSI, MISO, SCK), and has a chip-select pin called ADSS that is independently connected to the Bumble-B.

The ADC is connected to the joystick through 4 voltage dividers. The joystick potentiometers form the top half of the voltage divider, and the resistors are the bottom half. This circuit gives a wider range of analog values than if the joystick were directly connected to CH0-CH4.

(C) LED Driver / RGB LEDs

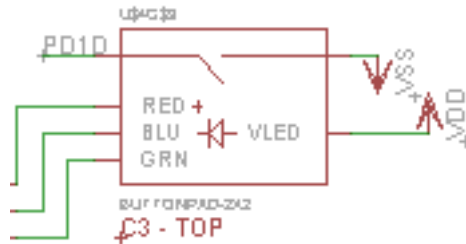


[TODO: Old picture, names slightly off, make more self-contained. Update.]

The grounds of the button pad LEDs are connected to LED0 to LED11 on the CAT9532 driver IC through series resistors. The values of the resistors are specific to each color R, G, or B. LED12 through LED15 are connected to an external expansion port for additional LEDs or additional general purpose IO pins.

LED_RESET has a 10k pull-up resistor, as specified by the CAT9532 datasheet. When the reset function in the firmware driver is invoked, this line is toggled.

The configurable I2C address pins A0,A1,A2 are all connected to ground, meaning the device has an I2C device address of 0xC0 (manufacturer address) + 0x00 (device address) = 0xC0.



[TODO: Old picture, names slightly off, make more self-contained. Update.]

Each of the four individual buttons on the pad has a physical button connection, and an RGB LED as shown here.

(D) Buzzer

(E) Expansion Ports

4) Firmware

[text]

5) Package Outline

[text]

6) Disclaimer and Warranty Statement

In order to keep costs low, Fletchtronics cannot offer a warranty for the Bumble-B device or be held liable for any damages caused to your Bumble-B board or computer system. Having said that, we will attempt to ensure the highest level of quality.