

Here we provide spaces for pull-up resistors on the I2C lines. A relatively large 10k would work well if they're not the only pull-up resistors on the bus.

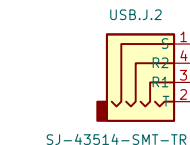
Series resistors and ferrite beads on the I2C lines provide some protection against shorts to 5V/GND as well as ESD/EMI.

Everyone recommends we add 10uF of capacitance to the 5V input of the USB port, so we'll do that.

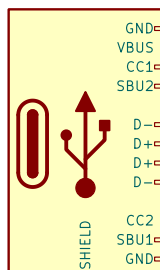
To properly identify this device when connecting to a fully functional USB3.0 upstream device, the CC pins must be pulled down with a "5.1k" resistor. Here, 5k will do to simplify the BoM.

The SBU pins in this application are unused, but perhaps in a future version they could be used to transport I2C from an upstream QMK keyboard? ;)

This neat device protects the mouse from ESD. It should be more than adequate for this relatively tame application.



USB.J.3
DX07S016JA1R1500



Since we hide the USB traces sandwiched between ground planes, it makes a lot of sense to make the ground planes of the PCB continuous with the cable shield.

USB.R.12
10k 1%

USB.R.13
10k 1%

USB.R.14
10k 1%

USB.R.15
10k 1%

USB.R.8
10k 1%

USB.R.9
10k 1%

USB.Z.1
IP4220CZ6

USB.R.10
100R 1%

USB.FB.4
ACML-0805-601-T Ferrite Bead 6000hm

USB.FB.5
ACML-0805-601-T

USB.R.11
100R 1%

USB.FB.1
ACML-0805-601-T

USB.C.19
10uF 25V

USB.FB.2
ACML-0805-601-T

USB.FB.3
ACML-0805-601-T

USB.R.6
22R 1%

USB.R.7
22R 1%

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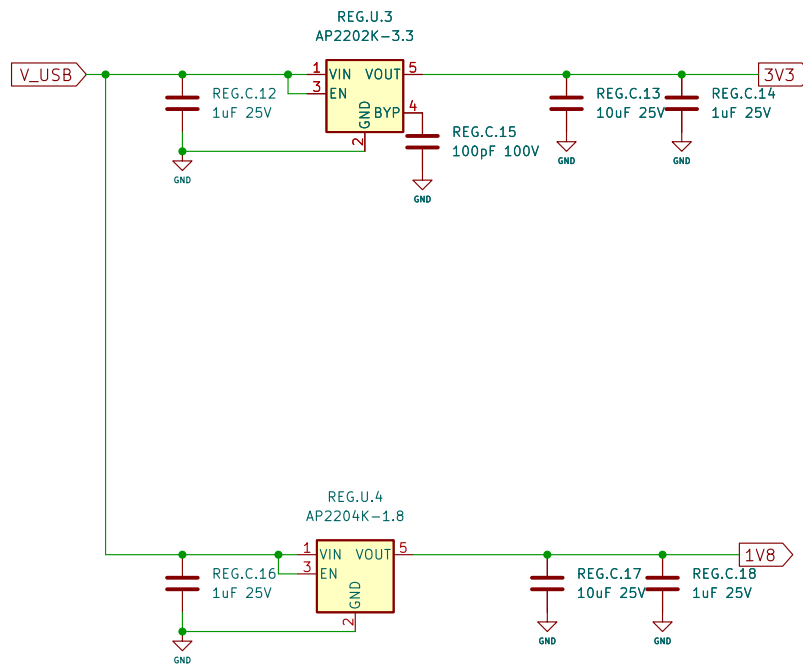
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Sheet: /USB/
File: Connectors-SchDoc.kicad_sch

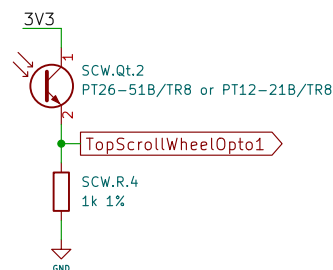
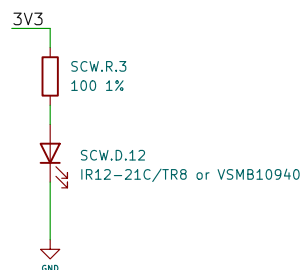
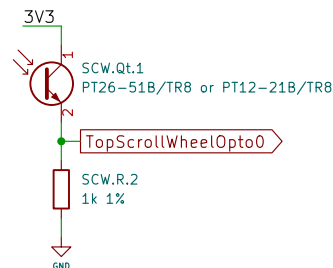
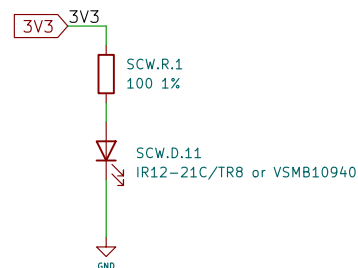
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Size: A4	Date: 17 01 2023	Rev: 2.001
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The scroll wheel mechanism is a 2-bit optical encoder. The light paths are spaced 1.5 periods over the encoder wheel holes, which should allow for the detection of the rotation direction as well as the rotation itself.

Two IR LEDs are used as light sources; the light from these is obstructed by the encoder wheel built into the scroll wheel mechanism. Two phototransistors are used to detect when the light is blocked/not blocked by the wheel.

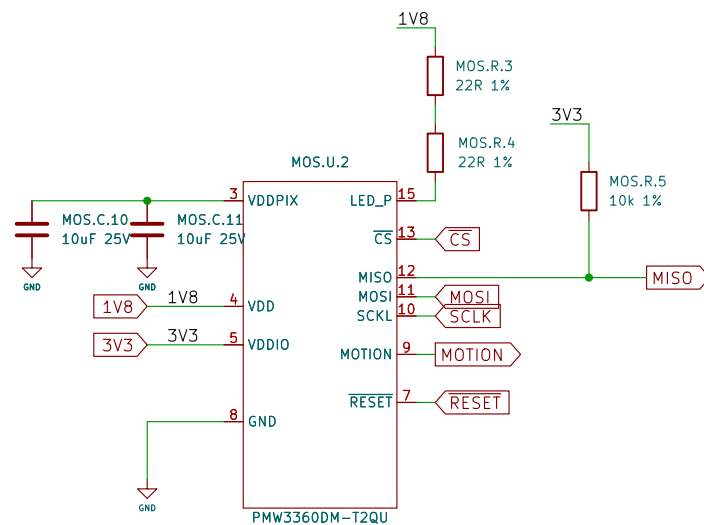
Typical LED forward voltage is 1.3V @20mA. To achieve this current level with a 3.3V supply, we'll use a 100R resistor, which is very convenient.

At this power level, the output should be approx 2.3mW/sr.

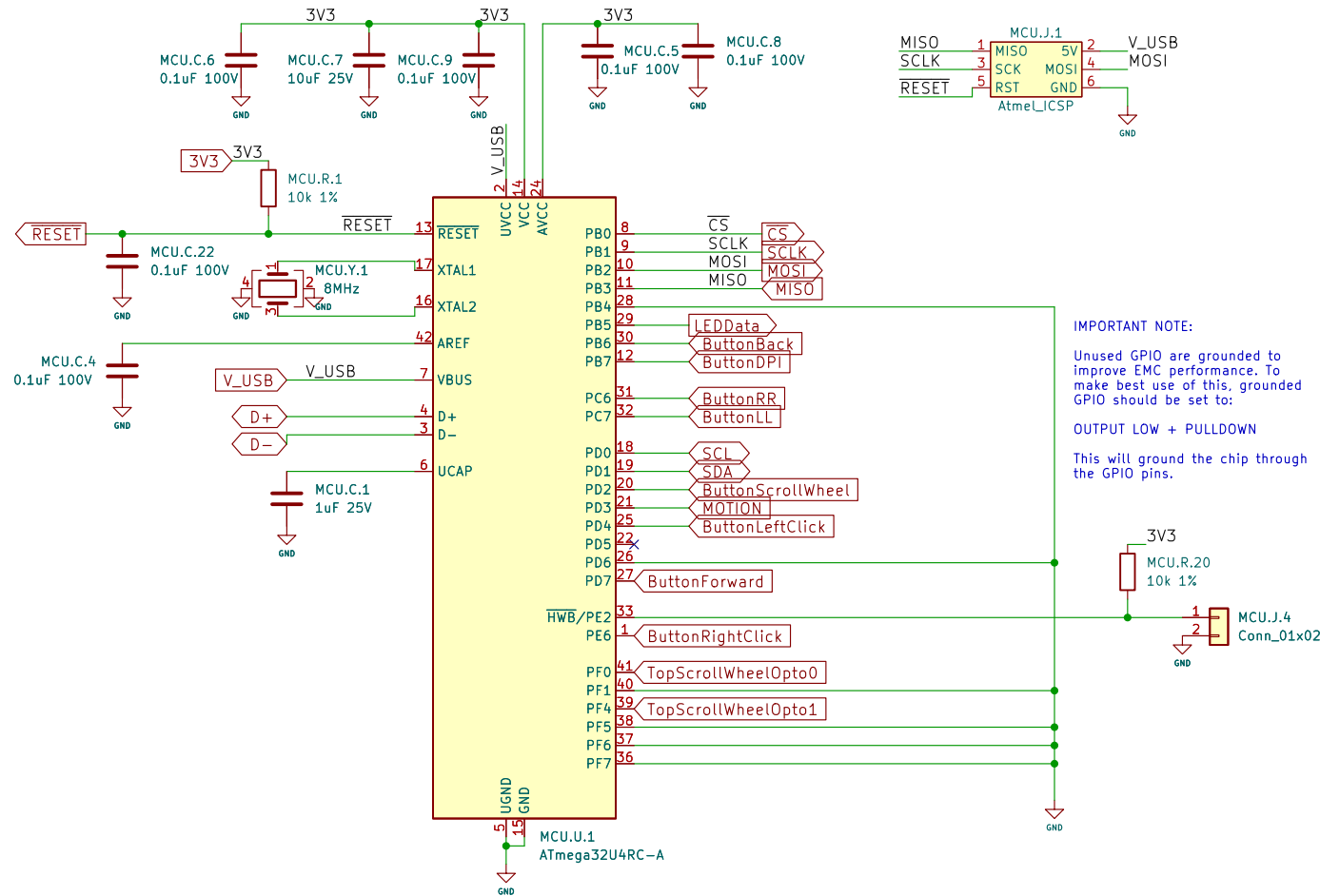
Since the light path distance is about 12mm, that works out to about 2mW/cm², though the actual delivered power will be lower due to the vagaries of the obstructions in the mechanism.

With this amount of light (and accounting for the fact that we'll probably lose a lot of it along the way), we are expecting 1-3mA out of the phototransistor (see figure 6 of the datasheet), so we size the biasing resistor accordingly to produce a useful signal.

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IMPORTANT NOTE:

Unused GPIO are grounded to improve EMC performance. To make best use of this, grounded GPIO should be set to:

OUTPUT LOW + PULLDOWN

This will ground the chip through the GPIO pins.

The RC variant only means that the internal 8MHz oscillator is enabled by default and that the divider is set so that it results in 1MHz system clock. This is important if we dont supply an external oscillator otherwise we can not programm it.

https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7766-8-bit-AVR-ATmega16U4-32U4_Datasheet.pdf#G4.1055626

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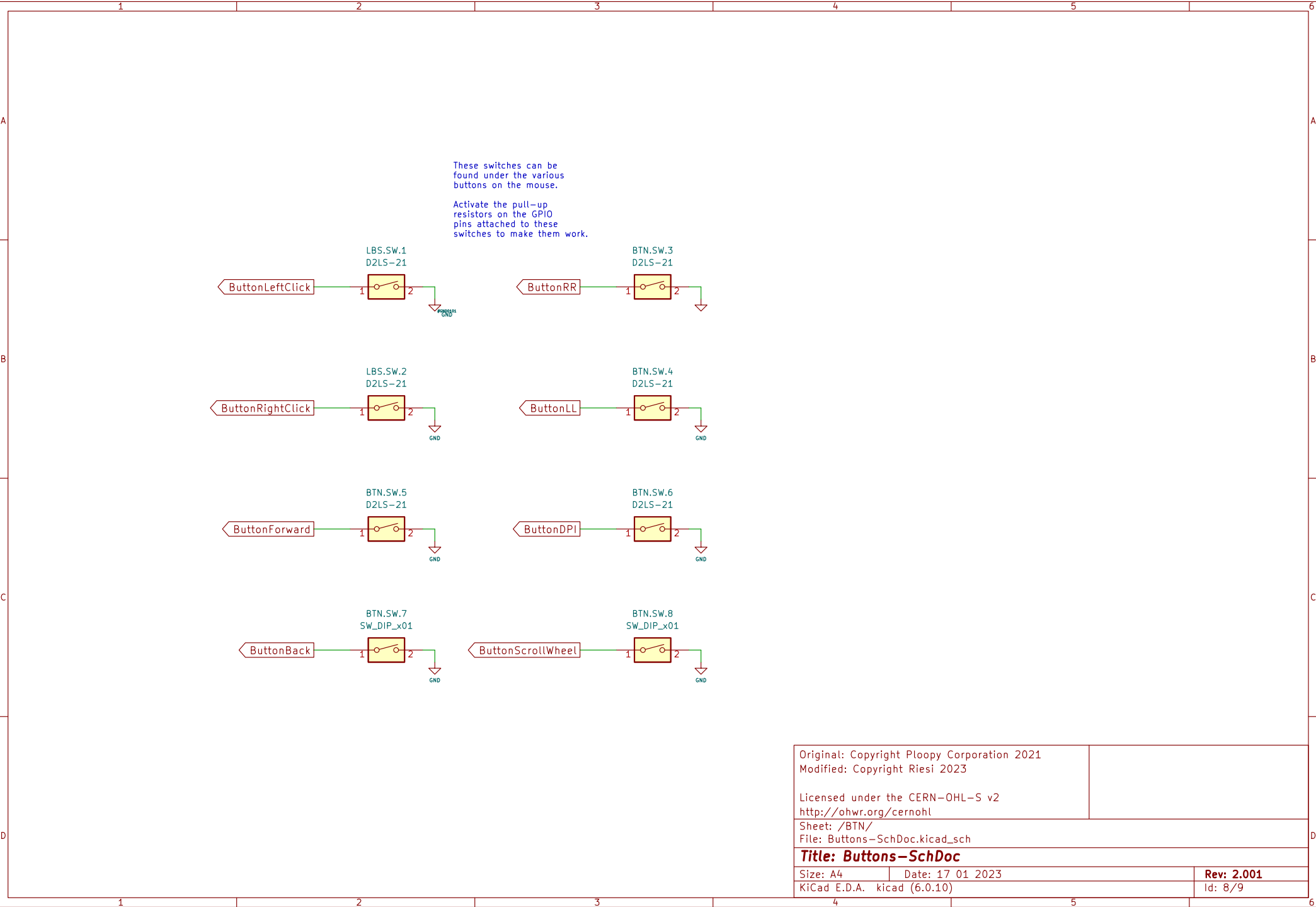
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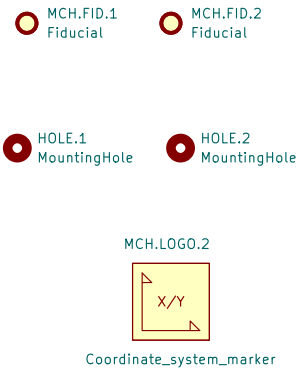
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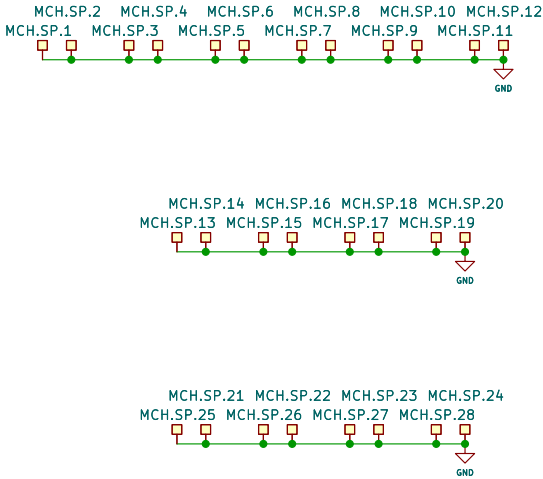
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Pick and Place Fiducials



Spark Gaps -- Case

Since the case has gaps in it, we expect ESD to worm its way in via creepage and perhaps other ways. To protect the board from this eventuality, we place spark gaps along the edges.



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