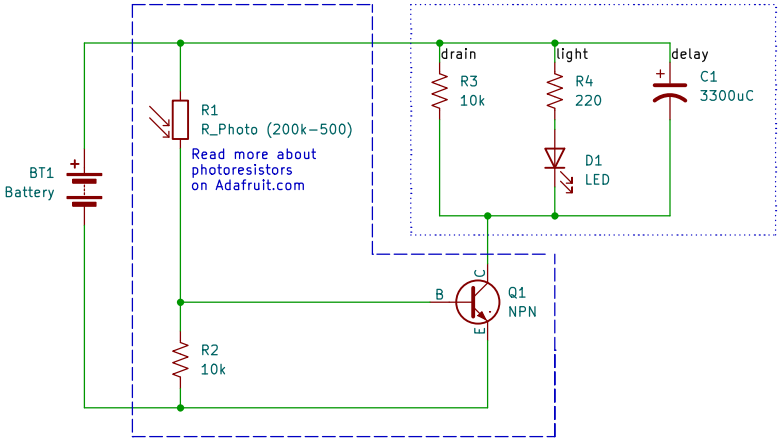

This voltage divider will turn on the transistor if there is enough light shining on the photo-resistor. If the transistor is ON, the other section of this circuit will be activated, since it can then be connected to the circuit's 'ground.'

The three parallel branches: "drain, "light", "delay" are the core of how this circuit works. They each provide a different resistance, and thus have different electric current supplied at the instant the transistor turns on. The interplay between these three branches is complex, and drives this analog circuit's operation.

Since this circuit is NOT consistent in its operation over time, let's consider what happens in order when the transistor is first turned on:

First, the 'delay' branch has no resistor, so it takes on the vast majority of the newly-supplied current. This starts to charge the capacitor: quickly at first, then slower.

Second, as the capacitor fills, it builds up a voltage across its two plates. When that voltage equals the 'forward voltage' of the LED, a critical change happens:

The LED (and whole light branch) can turn ON when there is enough built-up voltage on the capacitor. Although it is dim at first, it quickly brightens as the capacitor charges asymtotically to its max.

While this whole parallel subcircuit is active, the 'drain' branch has too high of a resistance (compared to the other two branches) to be more than a leakage current. In the active state, you can basically ignore the 'drain' branch since it carries so very little current.

When the circuit is no longer active (the transistor turns off), the 'drain' branch has its useful moment. This resistor provides a path for hte capacitor to slowly drain its built-up voltage, so that it can rreset itself automatically to be ready for the next time this sub-circuit is activated by the transistor.

2015 Mission Possible Ohio State Champions

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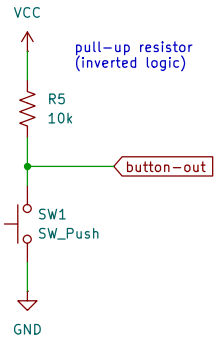
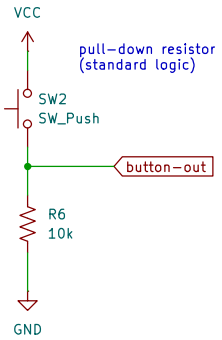
Sheet: /scioly-delayed-light/

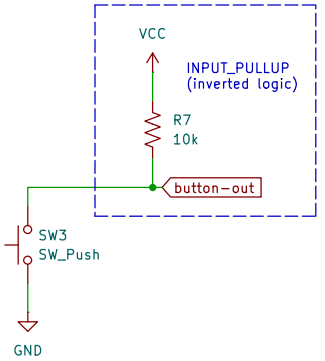
File: scioly-delayed-light.kicad_sch

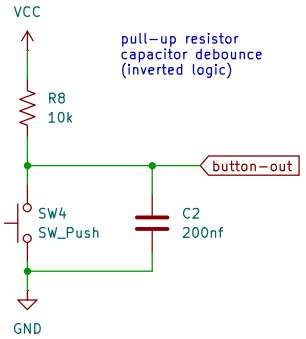
Title: Science Olympiad Real-Life RC Circuit

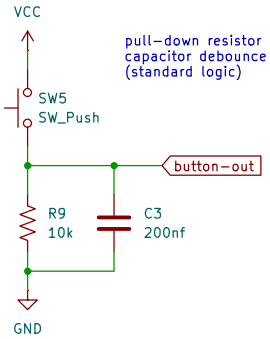
Size: USLetter	Date: 2025-03-20	**Rev: v1.0**
KiCad E.D.A. 8.0.6		Id: 2/9

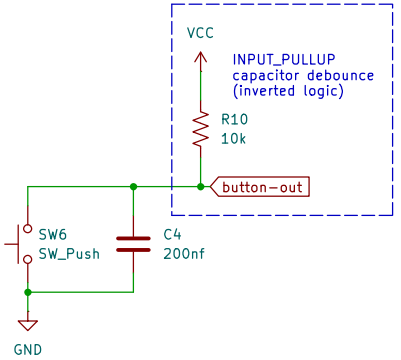












`Floating Pin` – without a pull-up or pull-down the value of the button can change erratically when the button is disconnected

`Standard Logic` – HIGH when pressed, LOW when un-pressed

`Inverted Logic` – LOW when pressed, HIGH when un-pressed

`Capacitor Debouce` – a capacitor will take time to charge, effectively applying a physical debounce: 100nF to 1µF common

6 common ways to use buttons with microcontrollers

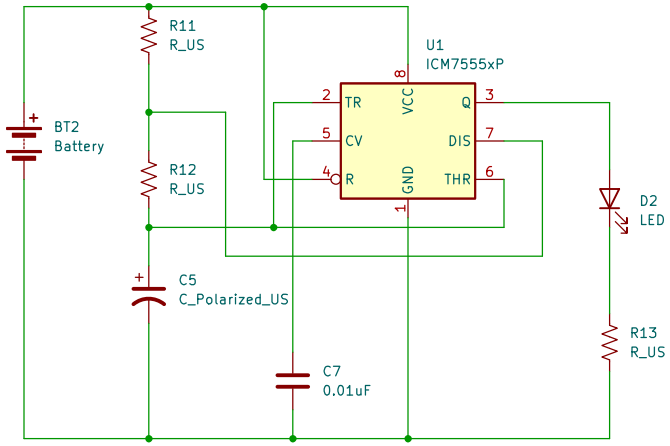
Mason High School Applied Technology

Sheet: /momentary-button/

File: momentary-button.kicad_sch

Title: Button Implementation Strategies

Size: USLetter	Date: 2025-03-20	**Rev: v1.0**
KiCad E.D.A. 8.0.6		Id: 3/9



A classic design that lets an LED turn on and off.

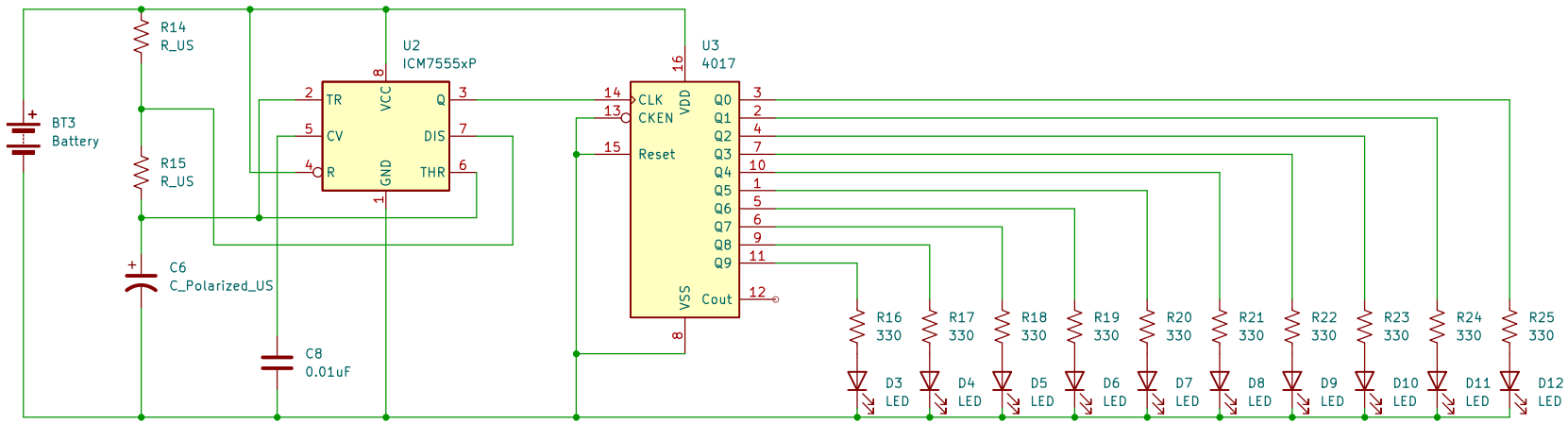
Mason High School Applied Technology

Sheet: /555-basic-blinker/

File: 555-basic-blinker_sch.kicad_sch

Title: 555 Basic Blinker

Size: USLetter	Date:	**Rev: v1.0**
KiCad E.D.A. 8.0.6		Id: 4/9



Video explainer: https://youtu.be/WdhzOjQjNrg
"Learn Electronics | LED chaser with 555 & 4017"
-- TheElectroBench, YouTube

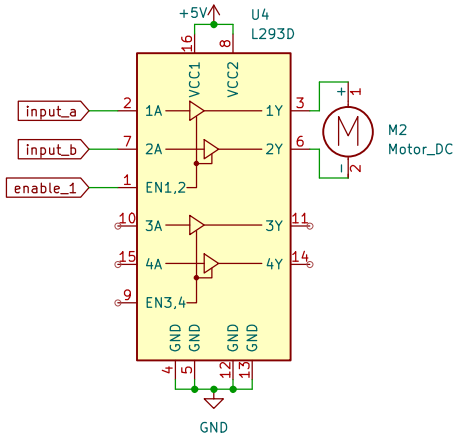
Using a decade counter to setup some chasing lights
Mason High School Applied Technology

Sheet: /night-rider/
File: night-rider.kicad_sch

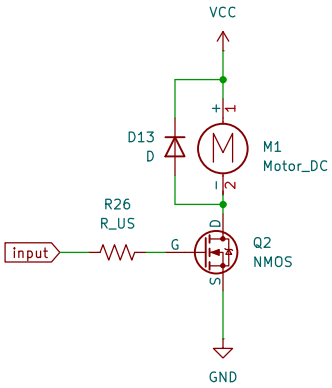
Title: Night Rider (LED Chaser)

Size: USLetter	Date:	**Rev: v1.0**
KiCad E.D.A. 8.0.6		Id: 5/9

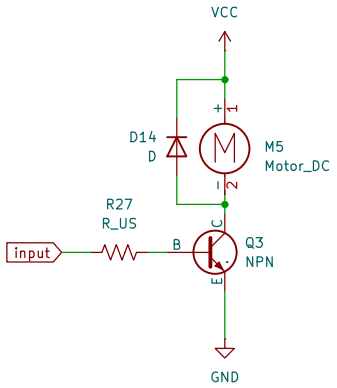
H-Bridge motor driver
"Forward" "Reverse" "Stop" "OFF"



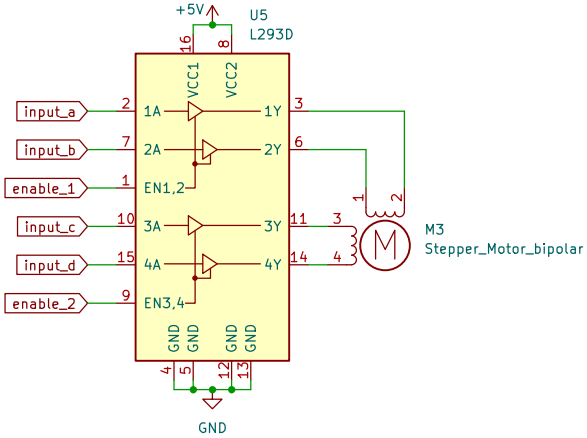
Single MOSFET control
DC brushed motor only
Only 'Forward' or OFF



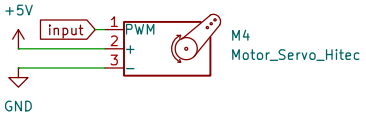
Single BJT Transistor control
DC brushed motor only
Only 'Forward' or OFF



Dual H-Bridge Motor Driver
For driving a stepper motor
"Forward" "Reverse" "Stop" "OFF"



Basic Servo Motor (5-6v)
with typical signal input



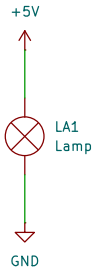
5 Ways to implement motors
1 simple servo motor
2x using common L293 motor driver
2x using simple transistor control
Mason High School Applied Technology

Sheet: /motors/
File: motors.kicad_sch

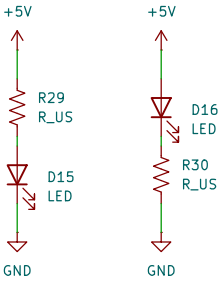
Title: Motors

Size: USLetter	Date: 2025-04-24	**Rev: v1.0**
KiCad E.D.A. 8.0.6		Id: 6/9

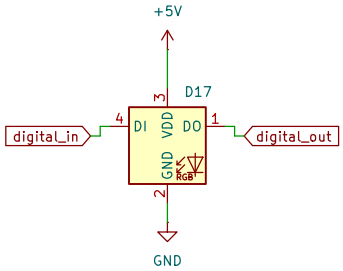
Incadescent Lamp
(old school lights)



Simple LED
Resistor above
& below configs

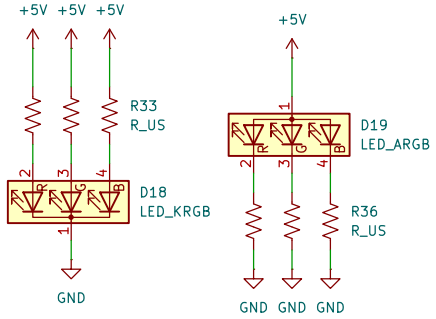


Single LED [3528 or 5050 type]
from an addressable LED strip
Digital In & Digital Out

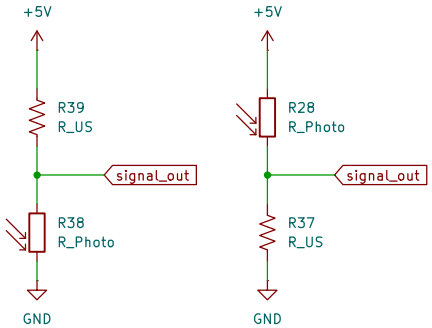


**Especially long or power
hungry LED strips will need
more elaborate setups: caps, etc.

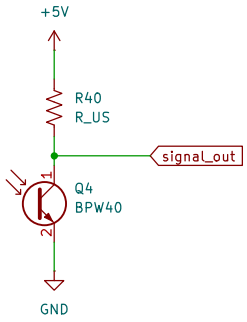
3-in-1 RGB LEDs
common cathode [KRGB] more common
common anode [ARGB]



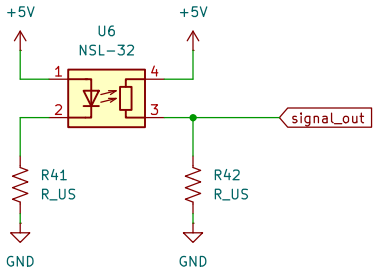
CdS Photoresistor
in voltage divider



Phototransistor
in voltage divider



Optocoupler
(link circuits without any
true electrical connection)



These examples are just the basics:
Learn about voltage dividers and/or
transistors-as-switches for added use

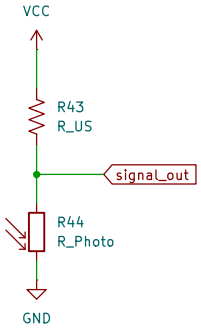
4x light outputs that are very common
3x light inputs (optocoupler is kind of both in/out)
Various ways to interact with light
Mason High School Applied Technology

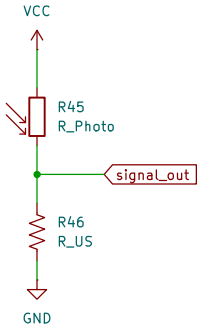
Sheet: /lights/
File: lights.kicad_sch

Title: Lights

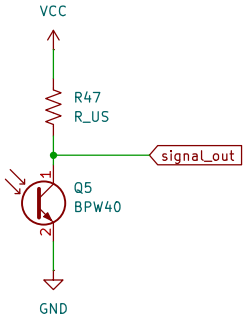
Size: USLetter	Date: 2025-04-24	**Rev: v1.0**
KiCad E.D.A. 8.0.6		Id: 7/9

CdS Photoresistor in voltage divider

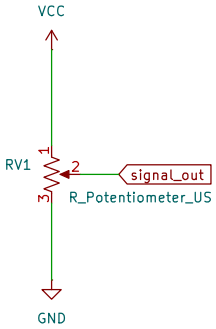




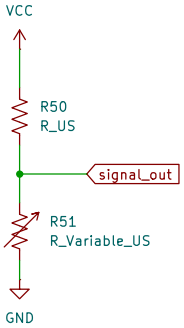
Phototransistor in voltage divider

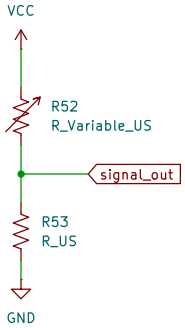


potentiometer in voltage divider

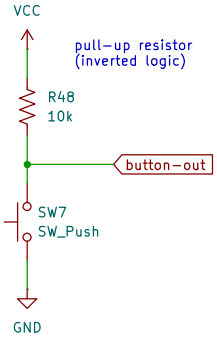


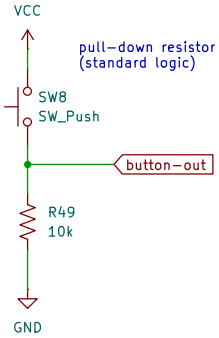
variable resistor in voltage divider

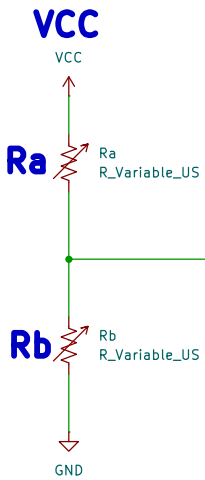




Simple Push-Button in voltage divider







$$V\text{-}OUT = VCC \frac{Rb}{Ra+Rb}$$

V-out is just a percentage of VCC (input).
Specifically, percent of Rb compared to Ra+Rb total.

This example shows two variable resistors, but most of the time only one of the two 'sides' of the divider will change resistance.

**note on buttons: they can be considered as resistors. Unpressed, their air-gap is very high resistance. Pressed, they are almost-zero reistance. (so very good binary voltage dividers)

Voltage dividers use different or changing resistance values and 'convert' them into changing voltages (for the V-OUT).

This is important, because many circuits, microcontrollers, etc. can be controlled based on changes in voltage supplied.

Analog inputs (ADCs) can read the V-OUT voltages, but you can also use some voltage dividers for basic digital signals (if the middle-voltages don't cause problems).

So the voltage divider can effectively convert quirkly electrical properties into useful signals and information...

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Sheet: /the-voltage-divider/		
File: voltage-divider.kicad_sch		
Title: The Voltage Divider		
Size: USLetter	Date: 2025-04-24	**Rev: v1.0**
KiCad E.D.A. 8.0.6		Id: 8/9