# GPIO interrupts

GPIO insterrupts

RP2040 has two GPIO banks that can trigger interrupts. Second GPIO bank is dedicated to external flash interface so user programs can use only GPIO bank 0. Each pin in the bank can be programmed to trigger an interrupt on HIGH/LOW level of rising or falling edge. It is possible to configure more than one trigger per pin but the most common case is to configure only one type of trigger.
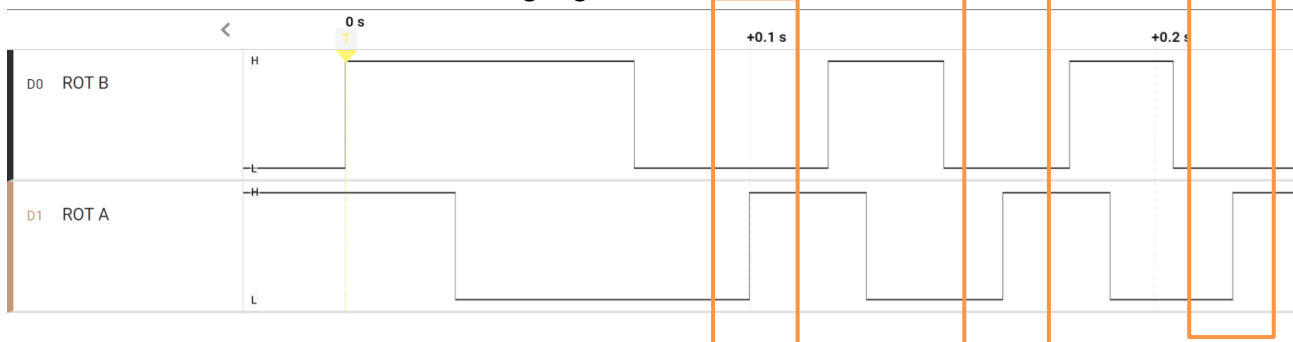
Study https://www.raspberrypi.com/documentation/pico-sdk/hardware.html#hardware_gpio. Pay attention to assigning callbacks to GPIO pins.

Rotary encoder has two outputs that change their state when the encoder is turned. The outputs are typically named A and B. The encoder is built so that only one of the outputs changes at a time when the shaft is turned. Depending on the rotation either A or B makes contact first. To decode direction of turn we can choose one of the signals as clock and monitor the change of the other on one edge of the clock.
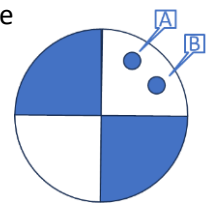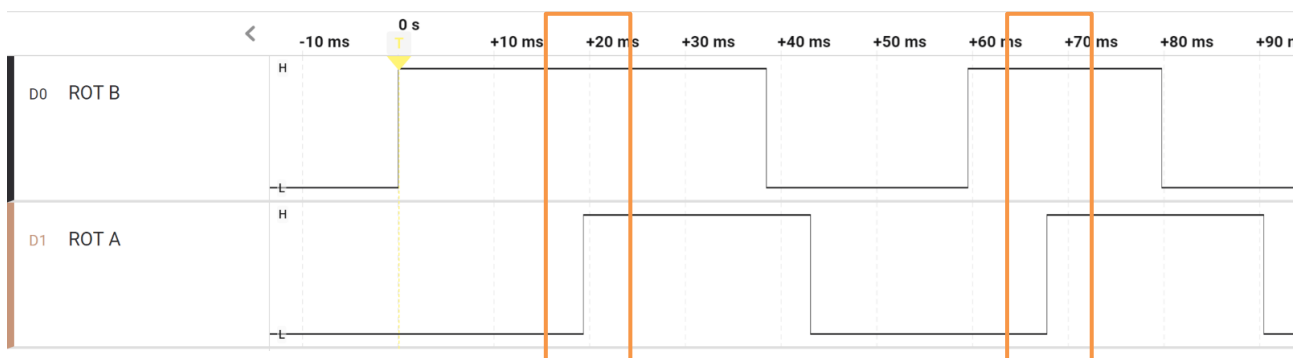

For example, if we choose A as the clock, we check the state of B on every rising edge of A. To ensure that we don't miss any of the edges we'll configure an interrupt on the rising edge of the pin A is wired to.
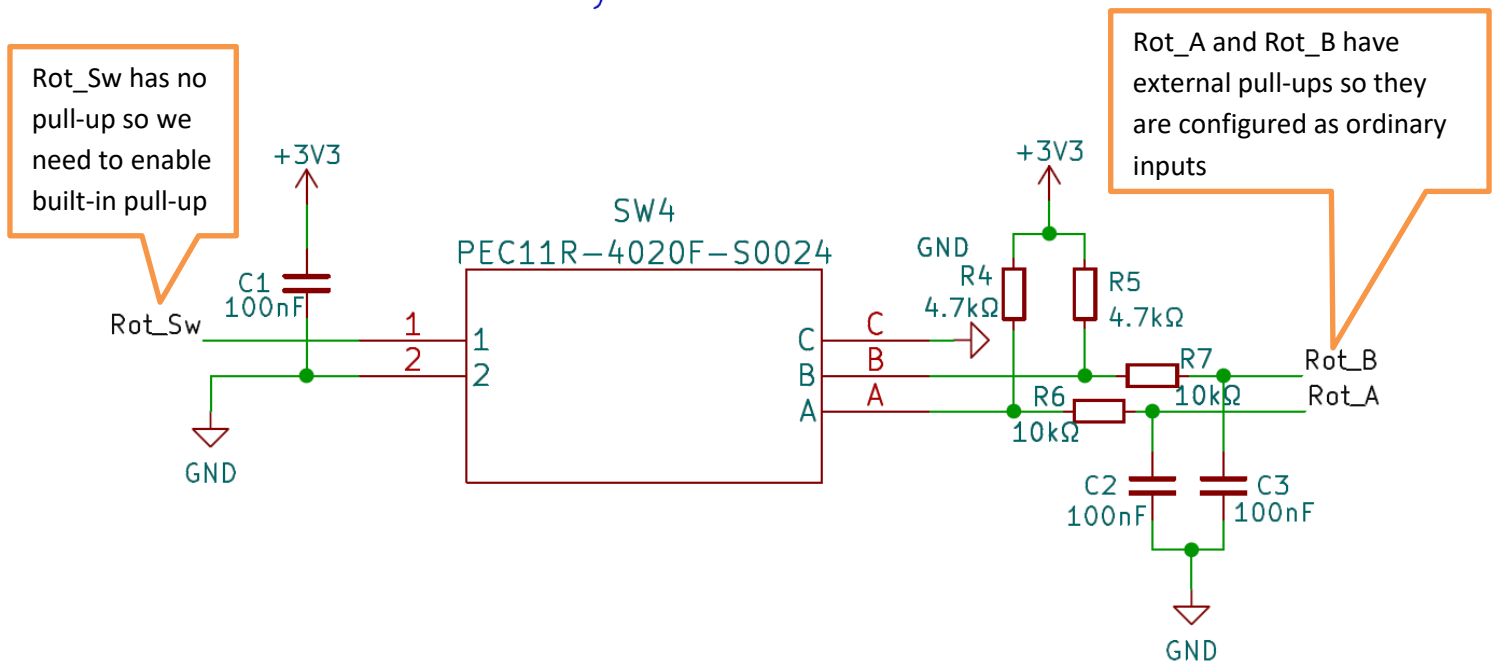
Shaft is turned clockwise→ B is low on rising edge of A

Shaft is turned counter-clockwise: B is high on rising edge of A

Rotary encoder

Rot_Sw has no pull-up so we need to enable built-in pull-up

Rot_A and Rot_B have external pull-ups so they are configured as ordinary inputs

+3V3

C1
100nF

Rot_Sw

GND

SW4
PEC11R-4020F-S0024

1
2

1
2

C
B
A

C
B
A

GND

+3V3

R4
4.7kΩ

R5
4.7kΩ

R6
10kΩ

R7
10kΩ

Rot_B
Rot_A

C2
100nF

C3
100nF

GND

The rotary encoder is connected to three GPIO pins:

- Rot_A to 10 – configure as an input **without** pull-up/pull-down
- Rot_B to 11 – configure as an input **without** pull-up/pull-down
- Rot_Sw to 12 – configure as an input **with** pull-up

Exercise 1 – Dimmer with a rotary encoder

Implement a program for switching LEDs on/off and dimming them. The program should work as follows:

- Rot_Sw, the push button on the rotary encoder shaft is the on/off button. When button is pressed the state of LEDs is toggled. Program must require the button to be released before the LEDs toggle again. Holding the button may not cause LEDs to toggle multiple times.
- Rotary encoder is used to control brightness of the LEDs. Turning the knob clockwise increases brightness and turning counter-clockwise reduces brightness. If LEDs are in OFF state turning the knob has no effect.
- When LED state is toggled to ON the program must use same brightness of the LEDs they were at when they were switched off. If LEDs were dimmed to 0% then toggling them on will set 50% brightness.
- PWM frequency divider must be configured to output 1 MHz frequency and PWM frequency must be 1 kHz.

You must use GPIO interrupts for detecting the encoder turns.