Switch (de)Bouncing

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What is switch bounce?

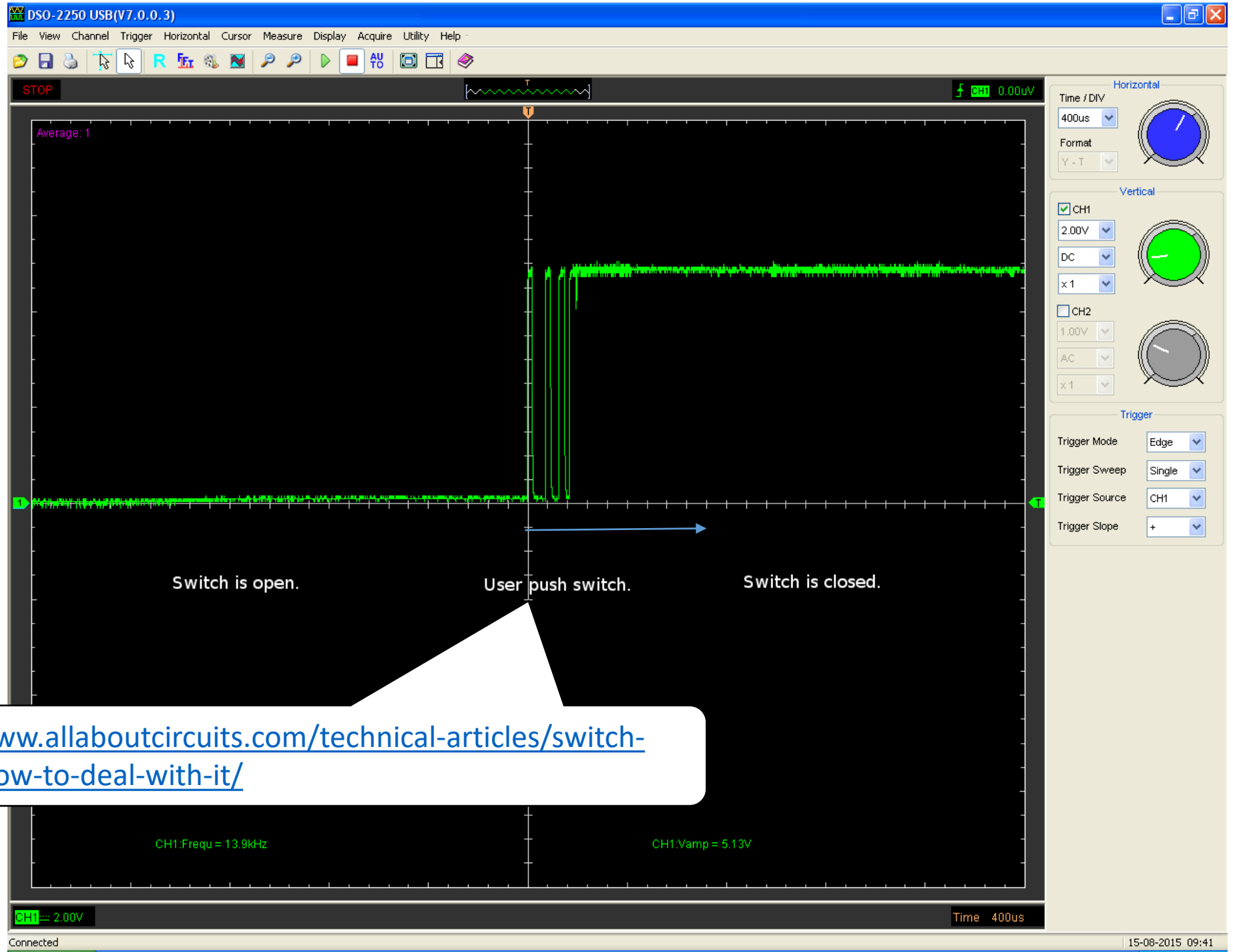
- When you push a button, press a micro switch or flip a toggle switch, two metal parts come together.
- For the user, it might seem that the contact is made instantly.
- That is not quite correct.

Why a switch bounces

- Inside the switch there are moving parts.
- When you push the switch, it initially makes contact with the other metal part, but just in a brief split of a microsecond.
- Then it makes contact a little longer, and then again a little longer.
- At the end the switch is fully closed.
- The switch is bouncing between in-contact, and not in-contact.

Bouncing measurement

- "When the switch is closed, the two contacts actually separate and reconnect, typically 10 to 100 times over a period of about 1ms." ["The Art of electronics", Horowitz & Hill, Second edition, pg 506.]
- Usually, the SoC works faster than the bouncing, which results in that the hardware thinks you are pressing the switch several times.



https://www.allaboutcircuits.com/technical-articles/switch-bounce-how-to-deal-with-it/

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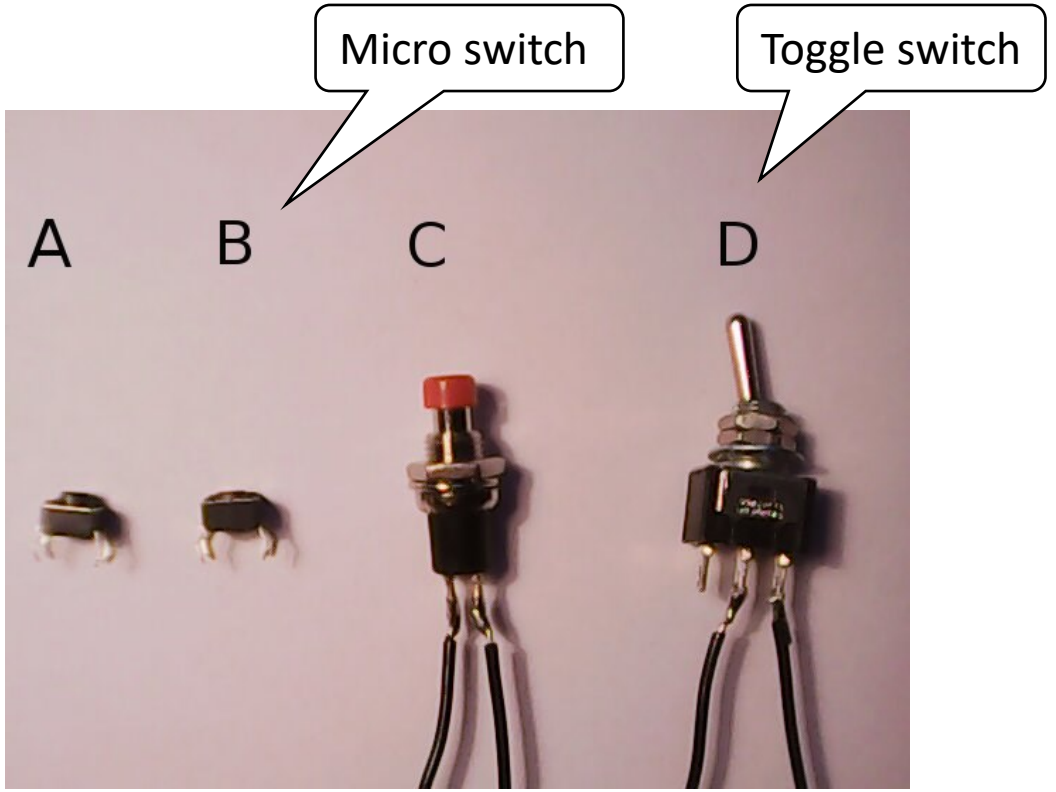
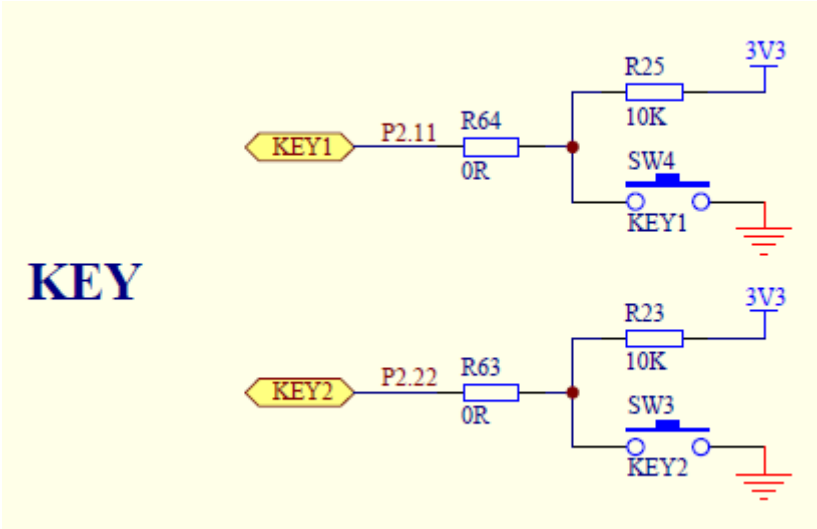
- A nice experiment about 4 switch components is shown at the above URL



Key behavior

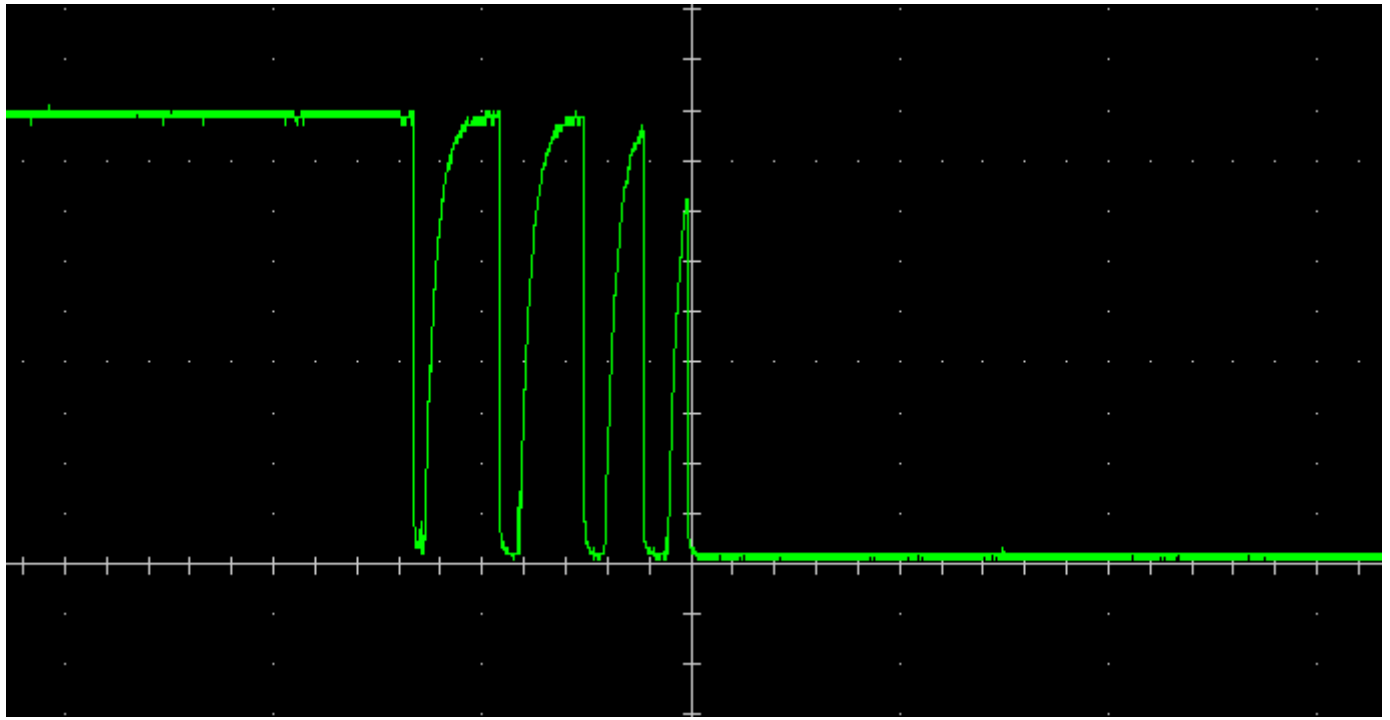


When pressed, the button drives the logic value to 0

When released, the button drives the logic value to 1

Button pulse-low pressure (our case)

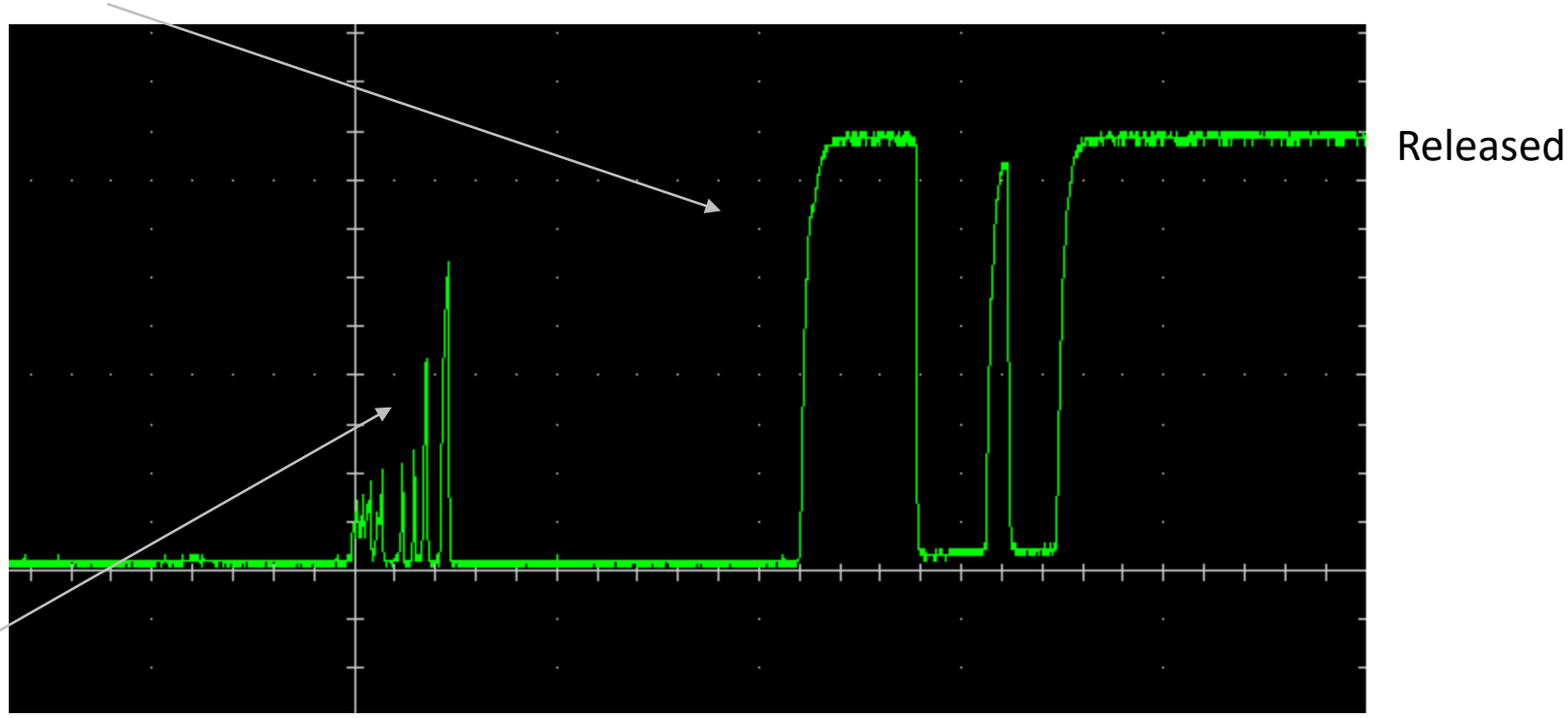
Released



Pressed

Button bouncing example

- Also the release of the button may produce bouncing



- Spikes may also show up (and be triggered during pressure of the button).

A first conclusion

- When working with microcontrollers, we can deal with switch bouncing in a different way that will save both hardware space and money.

SW implementation

- A common way to deal with switch bouncing is to re-read the value of the pin after 50ms delay from the first bounce.

Assumptions

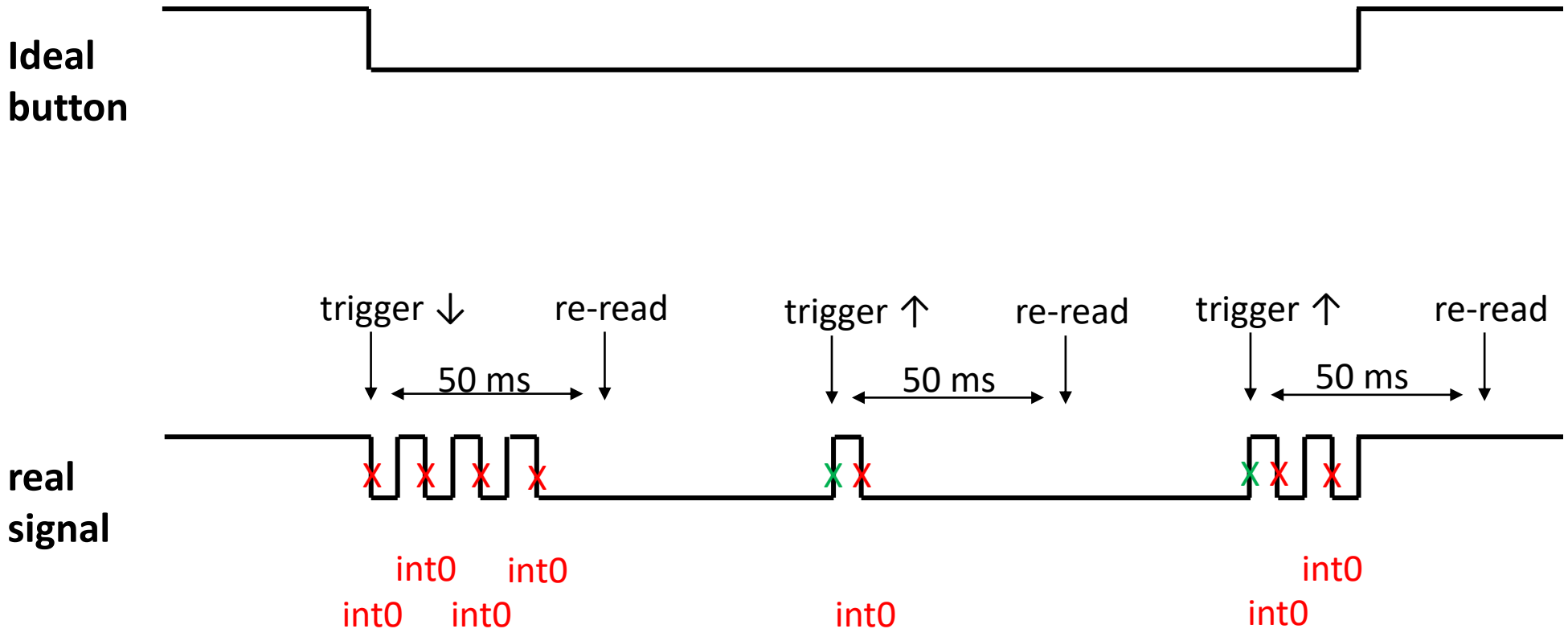
- We prefer using interrupt mode for buttons (this is power efficient as we can enter power down mode since the button is pressed)
- If interrupt is not available, “polling” the value of the button related pins is the solution
  - A timer can be used to wake up the system at regular time

- Blocking delay implementations are not desirable
  - SW delay by using “for/while/do-while” empty constructs is considered a very “dirty” technique and deprecated.

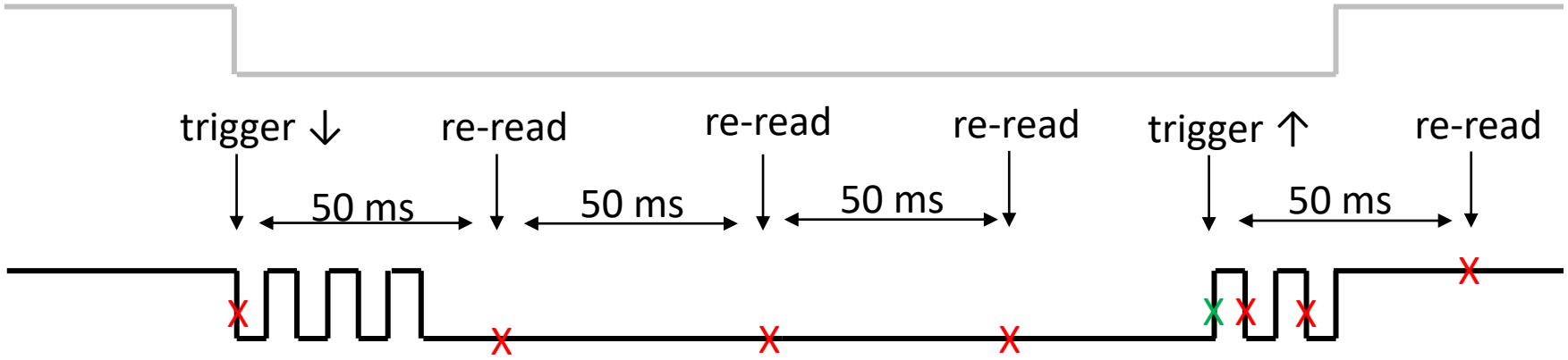
Complications

- If interrupt pin mode selection is selected, the pin may not be directly readable.
  - So, in order to read the button value, it is necessary to disable the interrupt functionality and accept to read an input value.

Visual solution



Visual solution - 2



Int0 enables a timer and disables the interrupt

Read the signal value If OK Perform the button action

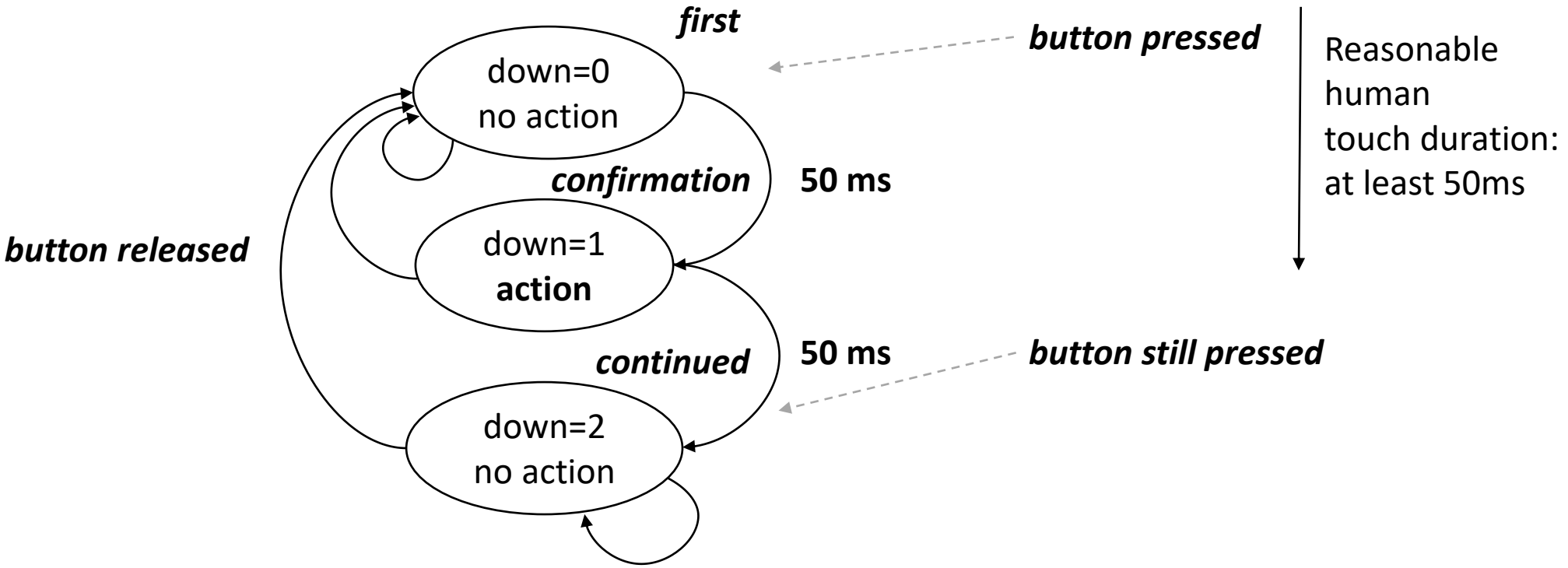
Read the signal value

Read the signal value

enables int0

our solution enables Int0 here!

Button de-bounce - finite state machine



Repetitive Interrupt Timer

- You may take advantage of the sample project

sample_BUTTON_DE-BOUNCING

- that includes the Repetitive Interrupt Timer library.

RIT

- Repetitive Interrupt Timer

The Repetitive Interrupt Timer provides a versatile means of generating interrupts at specified time intervals, without using a standard timer.

- Configured to interrupt every 50ms:

Table 41. PCLKSEL1

27:26	PCLK_RIT	Peripheral clock selection for Repetitive Interrupt Timer.	00

Table 42. Peripheral Clock Selection register bit values

PCLKSEL0 and PCLKSEL1 individual peripheral's clock select options	Function	Reset value
00	PCLK_peripheral = CCLK/4	00
01	PCLK_peripheral = CCLK	
10	PCLK_peripheral = CCLK/2	
11	PCLK_peripheral = CCLK/8, except for CAN1, CAN2, and CAN filtering when "11" selects = CCLK/6.	

lib_RIT.c

```
uint32_t init_RIT ( uint32_t RITInterval )
{
  LPC_SC->PCLKSEL1  &= ~(3<<26);
  LPC_SC->PCLKSEL1  |=  (1<<26); //RIT Clock = CCLK
…
```

RIT_cnt = 50ms * 100MHz
RIT_cnt = 5.000.000 = 0x4C4B40

Exercise

- Experiment switch bouncing with your board and try to mitigate Key bouncing: they must use the external interrupt functionalities

Advanced -> Joystick: implement a «timer controlled polling strategy» also able to mitigate debouncing

Quite Advanced -> can you manage the pressur of many buttons or the contemporary use of buttons and Joystick?

Super-Advanced -> implement button and joystick debouncing by using the RIT only.