# Diseño con microcontroladores

## Entradas y salidas digitales: Clase II

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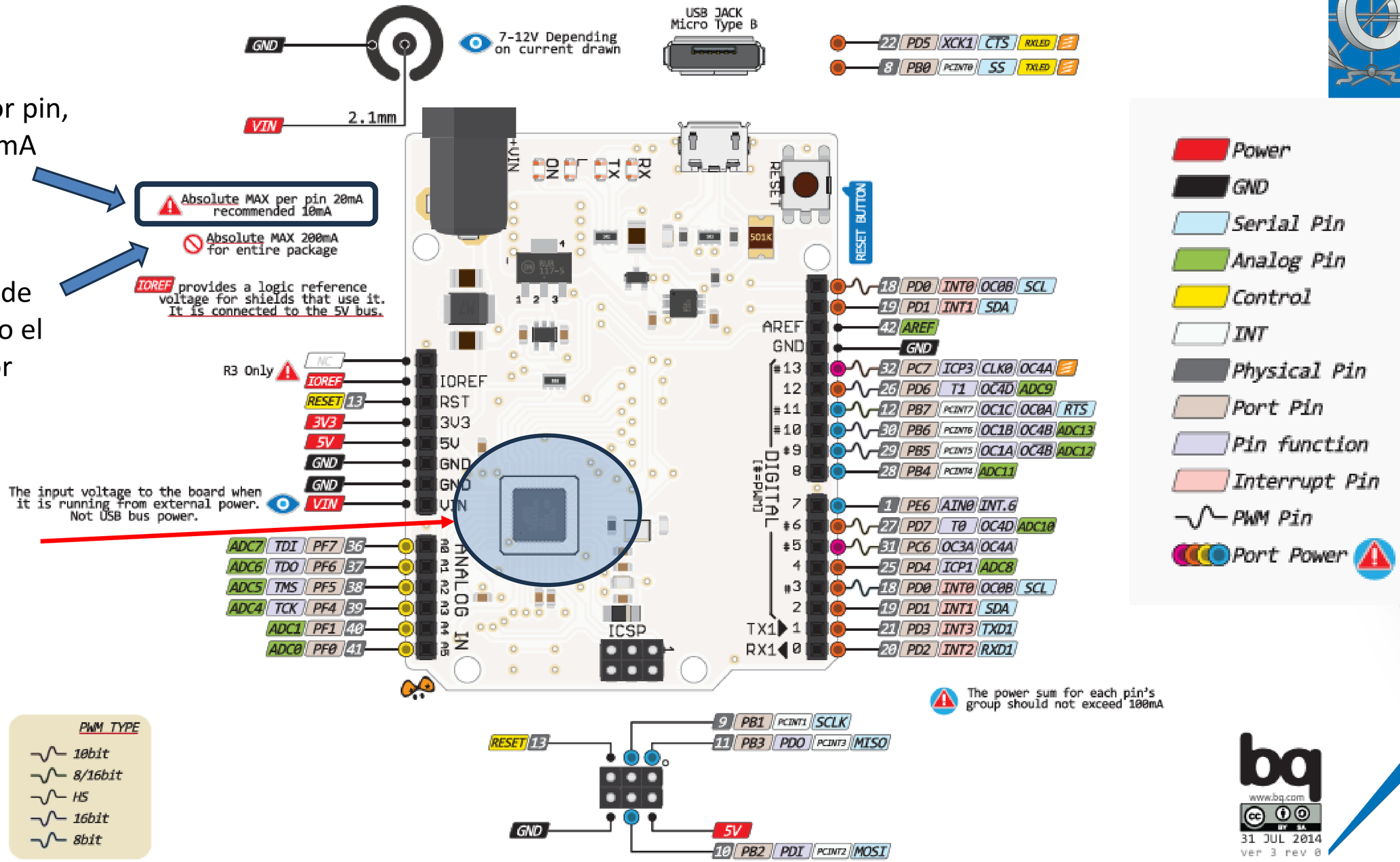
# LEONARDO PINOUT

Máximo 20mA por pin, recomendado 10mA

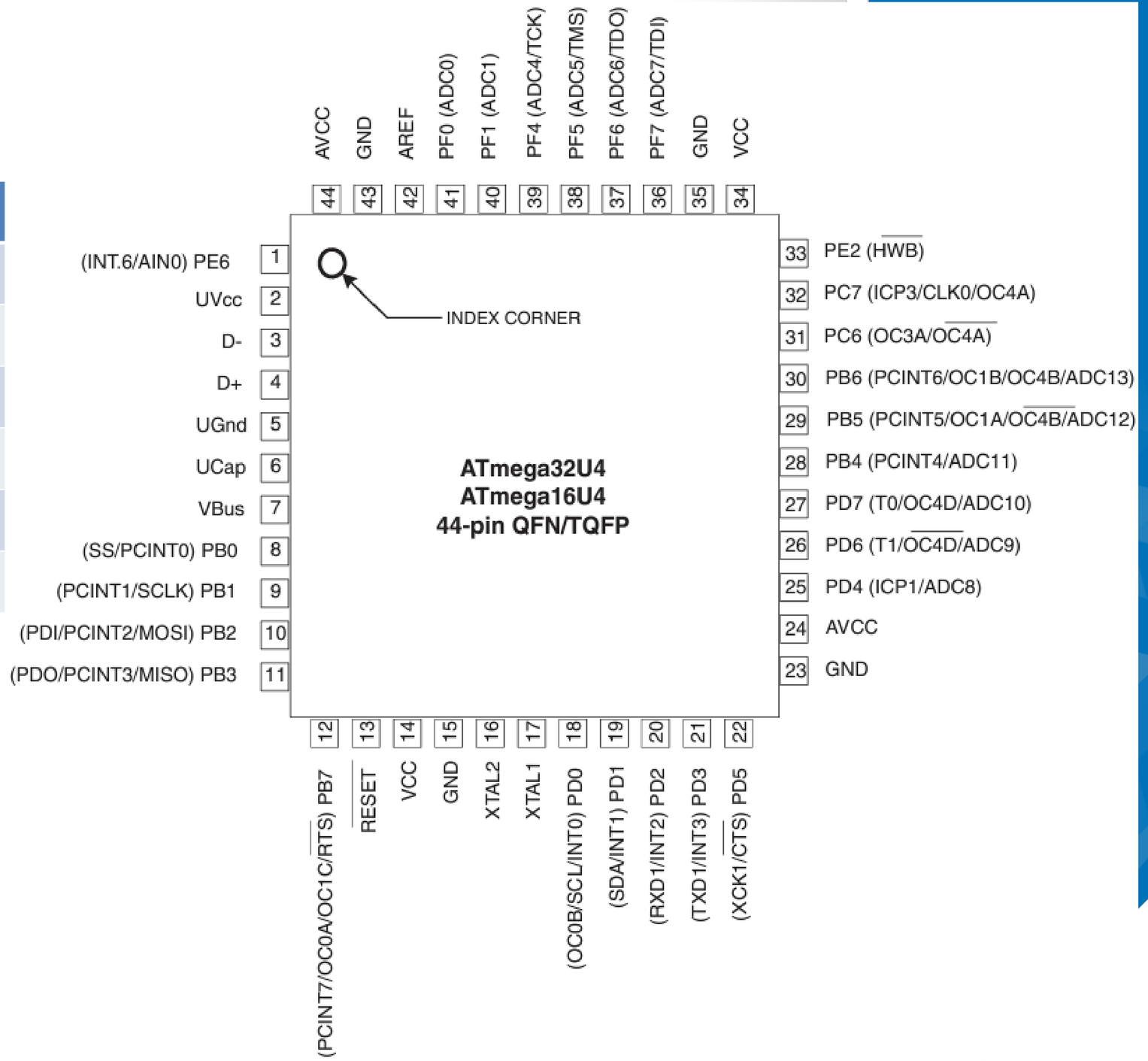
Máximo 200mA de consumo en todo el microcontrolador

Atmega 32U4

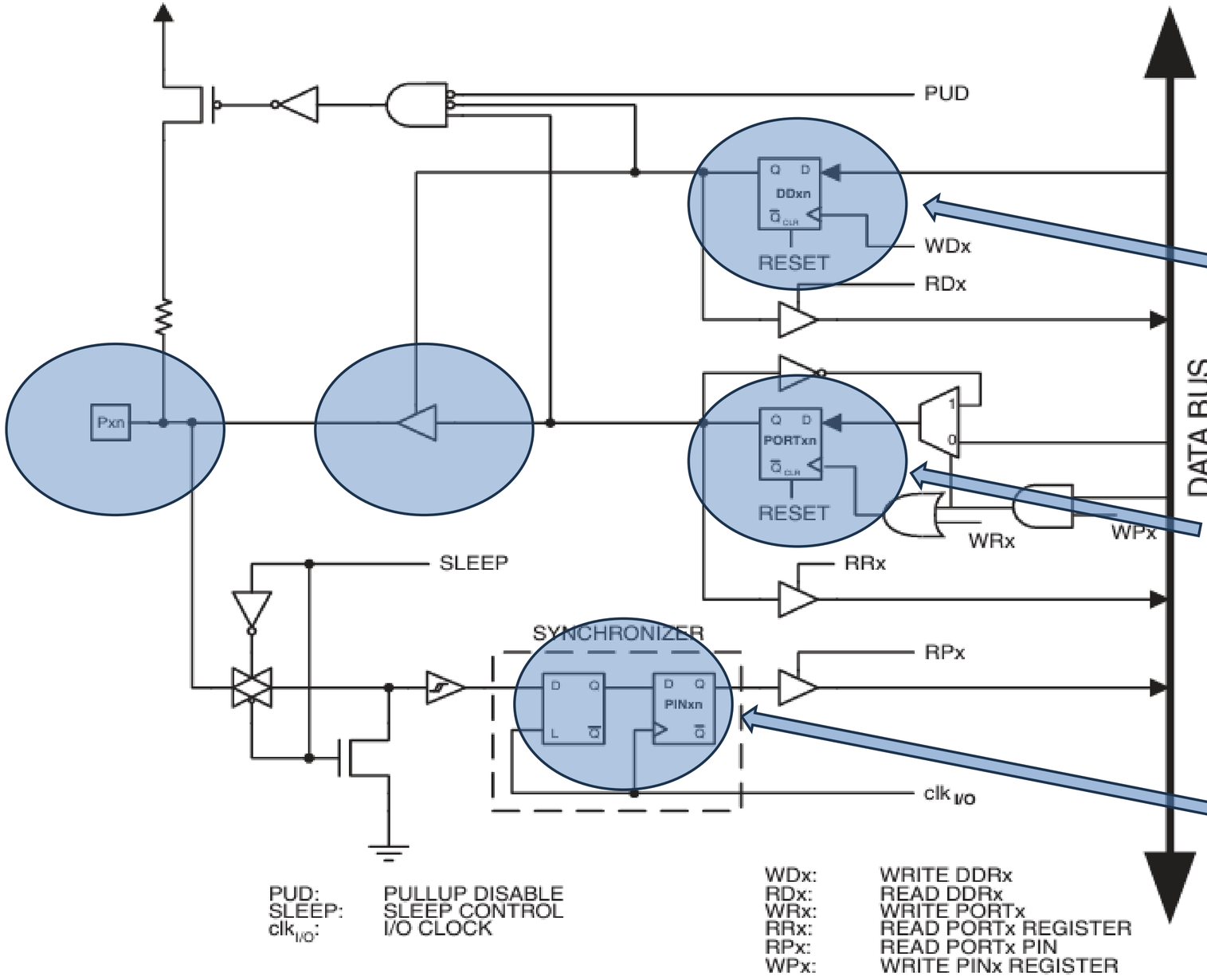


| Arduino | ATmega |
|---|---|
| D0 | PD2 |
| D1 | PD3 |
| D2 | PD1 |
| D3 | PD0 |
| D4 | PD4 |
| D5 | PC6 |
| D6 | PD7 |
| D7 | PE6 |
| D8 | PB4 |
| D9 | PB5 |
| D10 | PB6 |
| D11 | PB7 |
| D12 | PD6 |
| D13 | PC7 |

| Arduino | ATmega |
|---|---|
| A0 | PF7 |
| A1 | PF6 |
| A2 | PF5 |
| A3 | PF4 |
| A4 | PF1 |
| A5 | PF0 |



Salida física



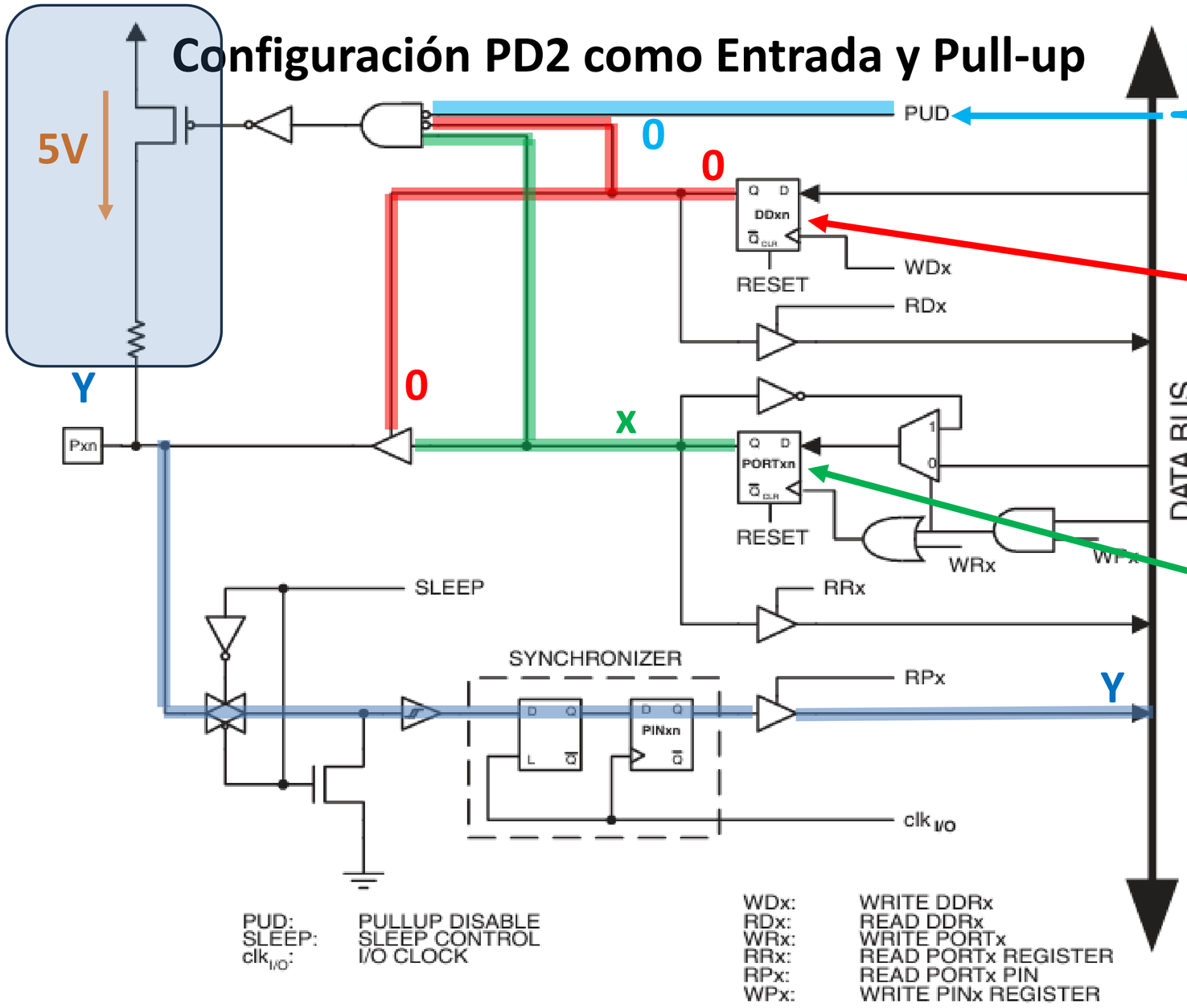

Registro DDRx (8bits)

Registro PORTx (8 bits)

Registro PINx (8 bits)

Note: 1. WRx, WPx, WDx, RRx, RPx, and RDx are common to all pins within the same port. $clk_{I/O}$, SLEEP, and PUD are common to all ports.

# Configuración PD2 como Entrada y Pull-up




MCU-Registro de control
MCUCR |=(1<<4) desactiva pull-up
MCUCR &=~(1<<4) activa pull-up

DDRD &=~(1<<2)

PORTD|=(1<<2) ⟹ Activa
PORTD &=~(1<<2) ⟹ Desactiva

Entrada Y=1 ⟹ 5V
Y=0 ⟹ 0V

PIND = 0b00000Y00

Note: 1. WRx, WPx, WDx, RRx, RPx, and RDx are common to all pins within the same port. $clk_{I/O}$, SLEEP, and PUD are common to all ports.

| bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| DDR(x) | DDx7 | DDx6 | DDx5 | DDx4 | DDx3 | DDx2 | DDx1 | DDx0 |
| PORT(x) | PORTx7 | PORTx6 | PORTx5 | PORTx4 | PORTx3 | PORTx2 | PORTx1 | PORTx0 |
| PIN(x) | PINx7 | PINx6 | PINx5 | PINx4 | PINx3 | PINx2 | PINx1 | PINx0 |

¿Cuál es la mejor?

**Arduino**

pinMode(pin, OUTPUT / INPUT / INPUT_PULLUP )

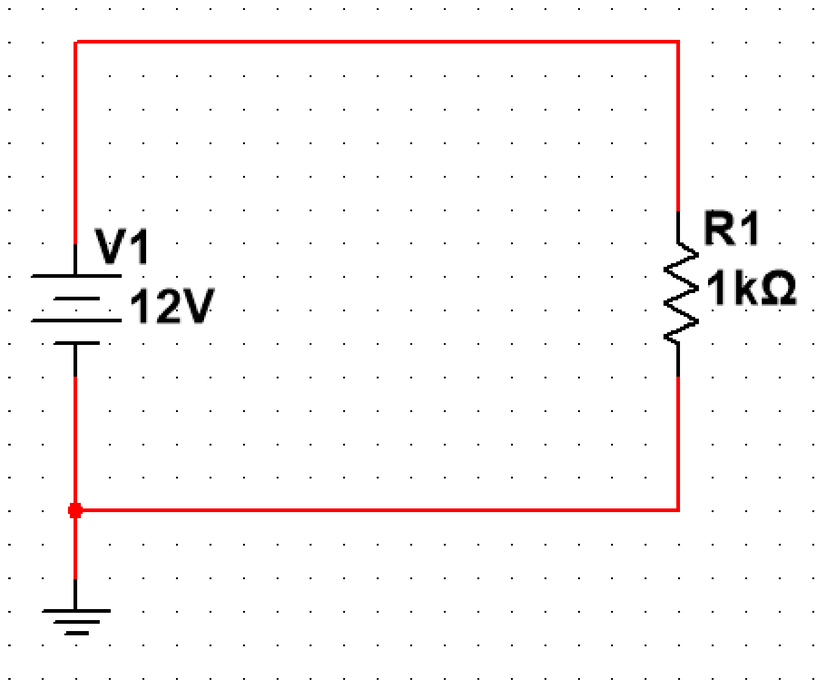
digitalWrite(pin, LOW / HIGH )

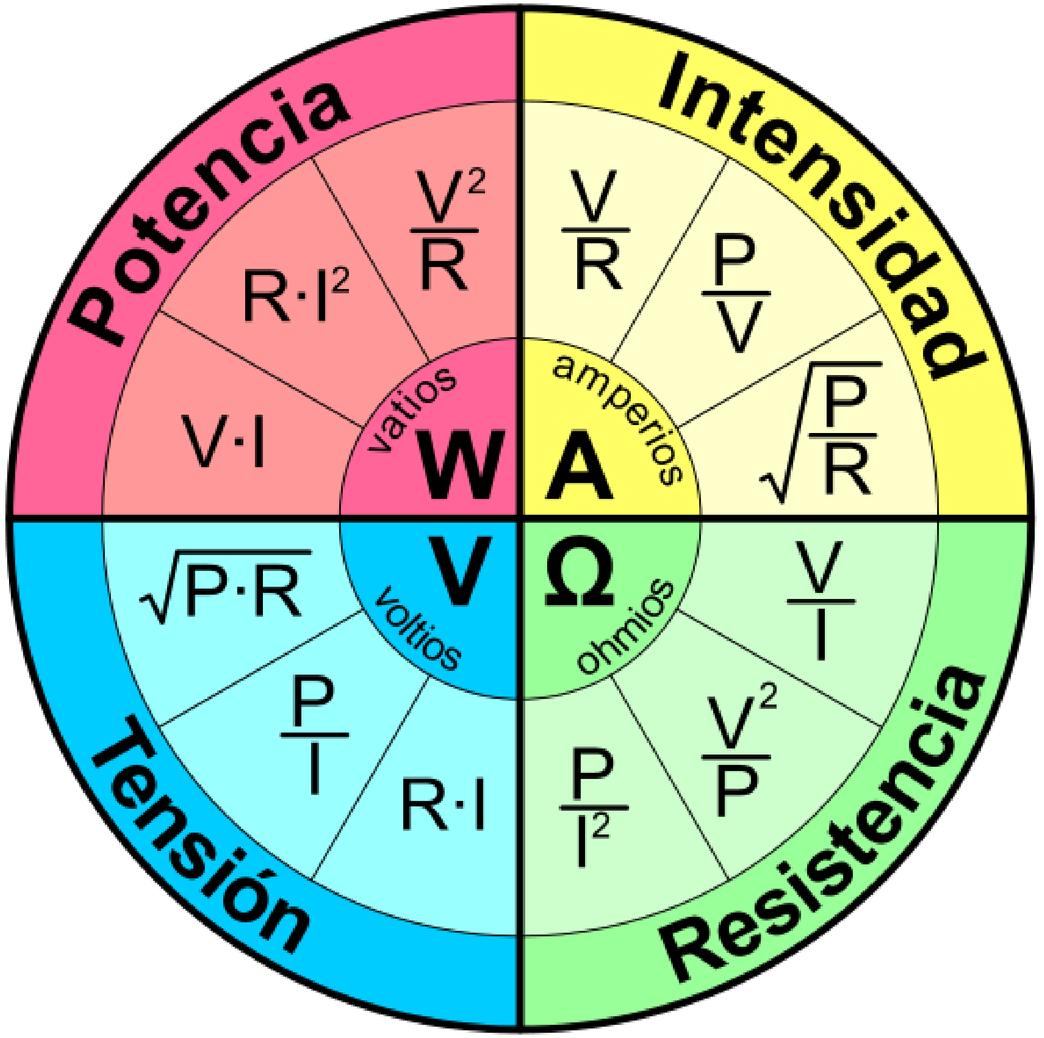
Val=digitalRead(pin)

**ATmega**

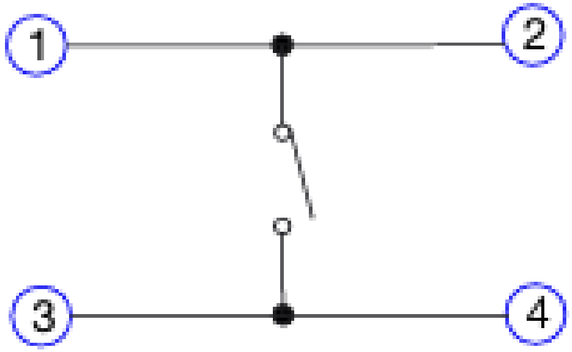
```
DDRB|=(1<<bit);
DDRB &=~(1<<bit);

PORTB|=(1<<bit);
PORTB &=~(1<<bit);

Val=PINB & (1<<pin)
```

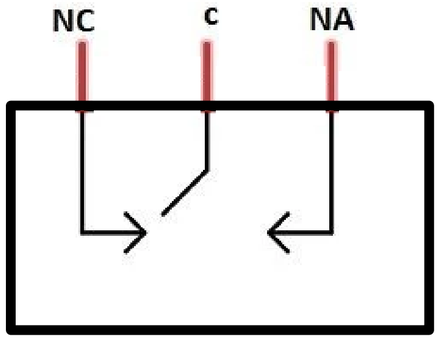
# LEY DE OHM


V1
12V
R1
1kΩ

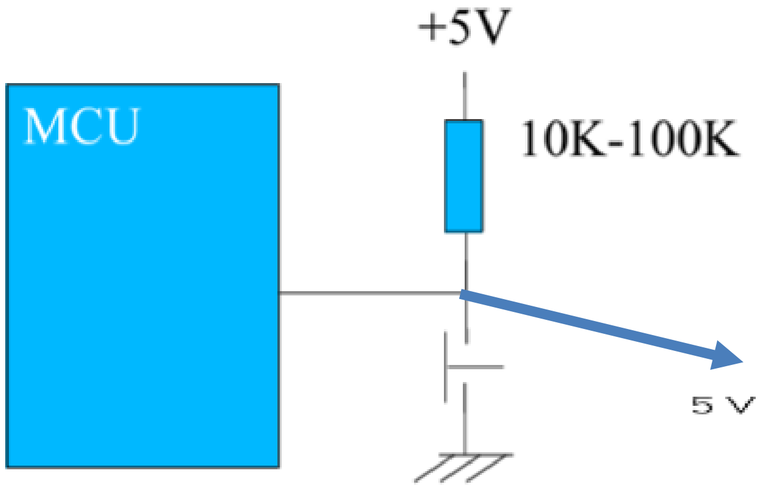

Potencia
Intensidad
Tensión
Resistencia
W
vatios
A
amperios
V
voltios
Ω
ohmios
V·I
R·I²
V²/R
V/R
P/V
√(P/R)
√(P·R)
P/I
R·I
V/I
P/I²
V²/P

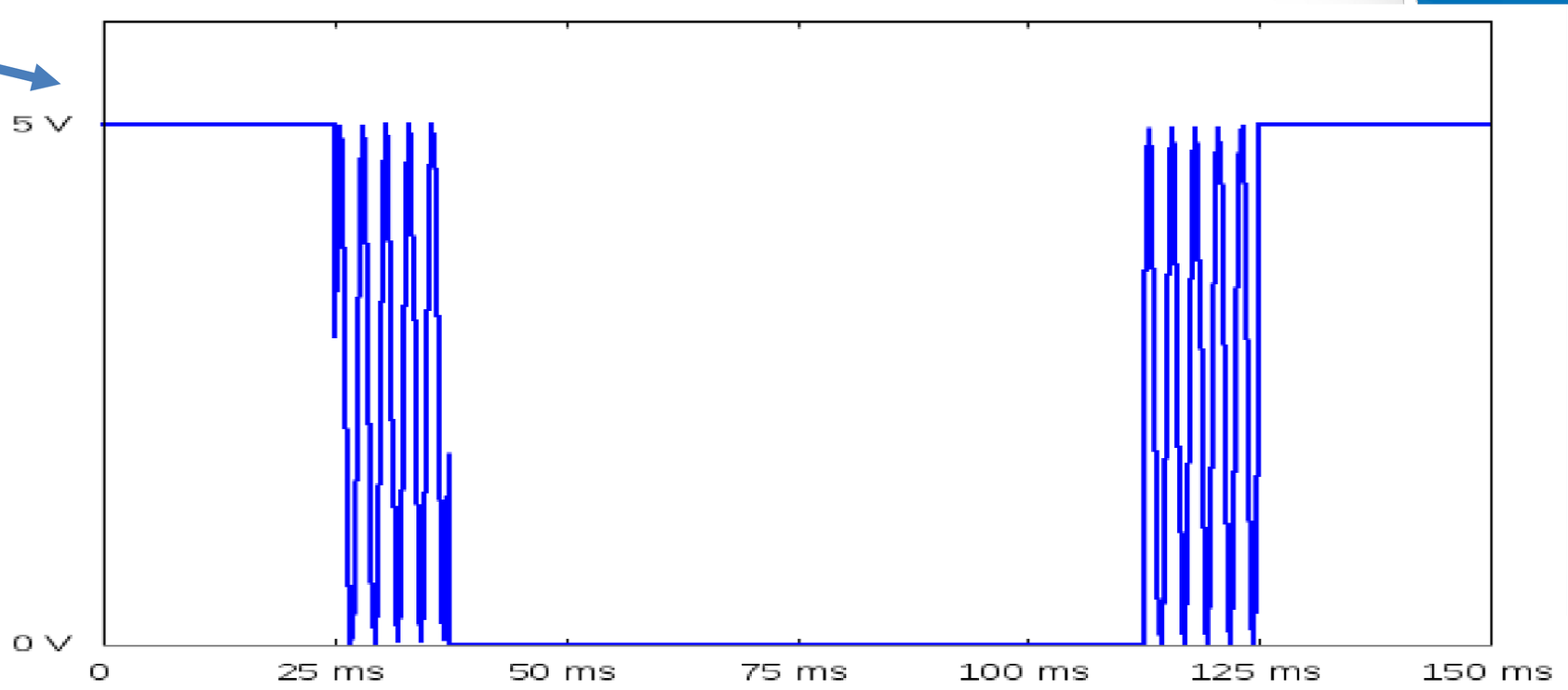
# Entrada pasiva: pulsador e interruptor



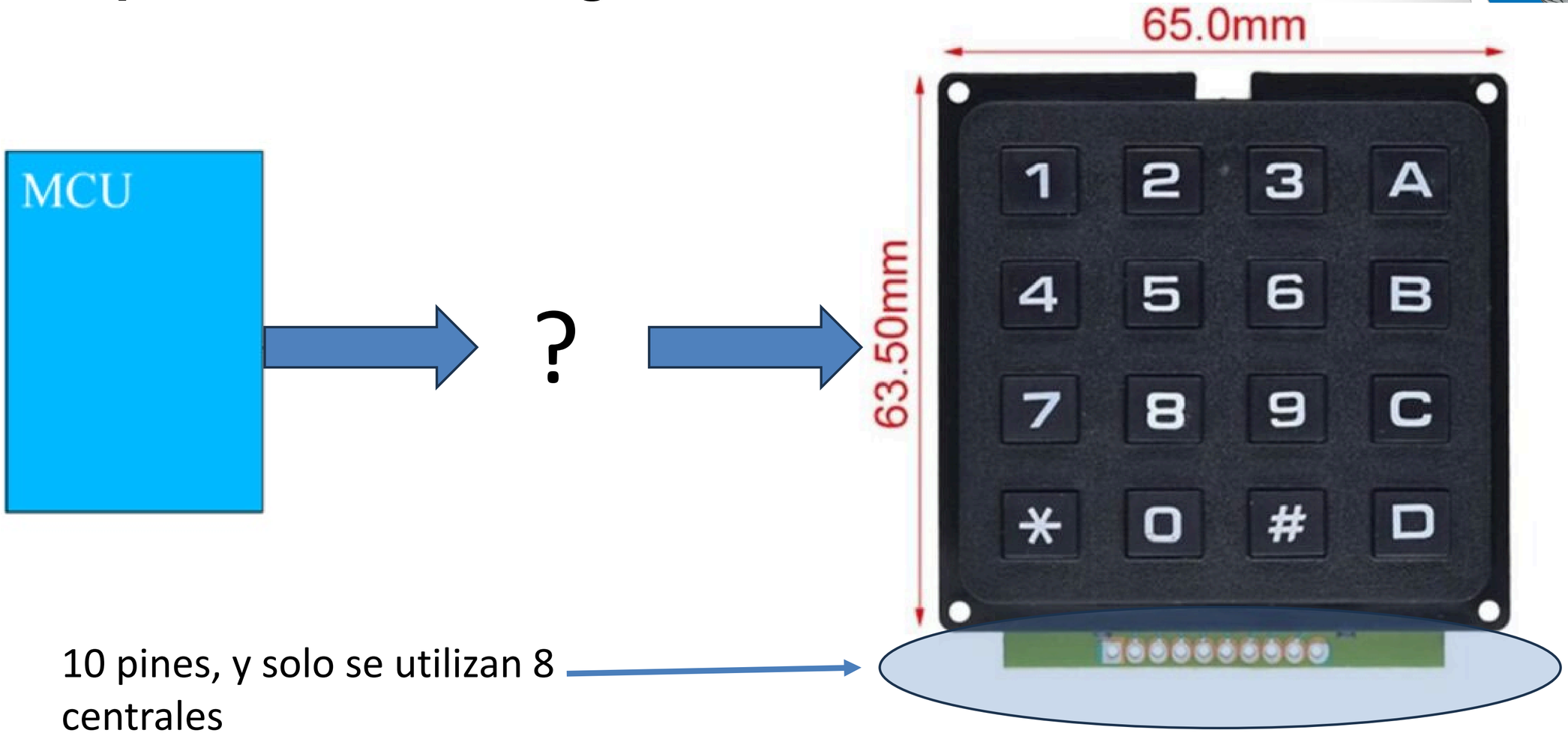



# Entrada pasiva: pulsador e interruptor



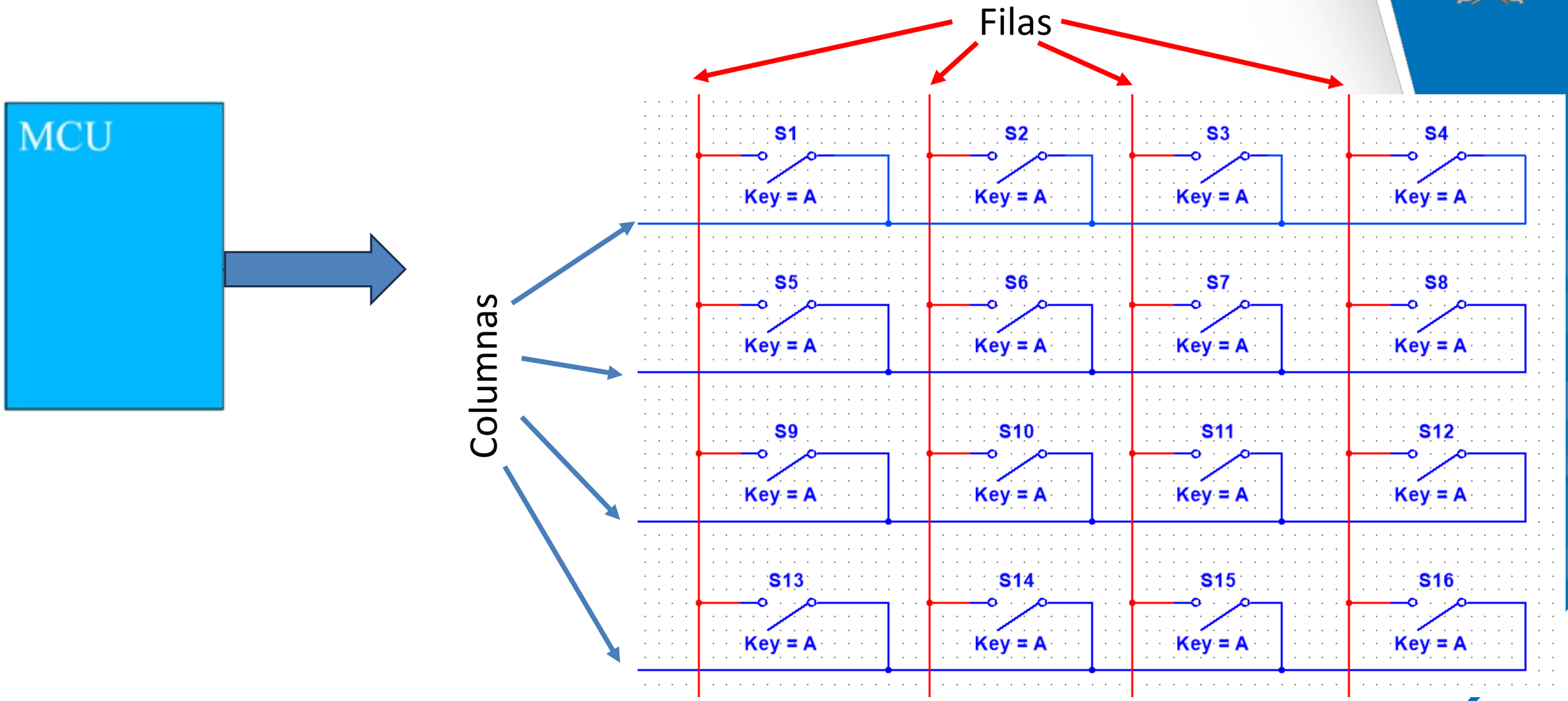



# Entrada pasiva: teclado digital

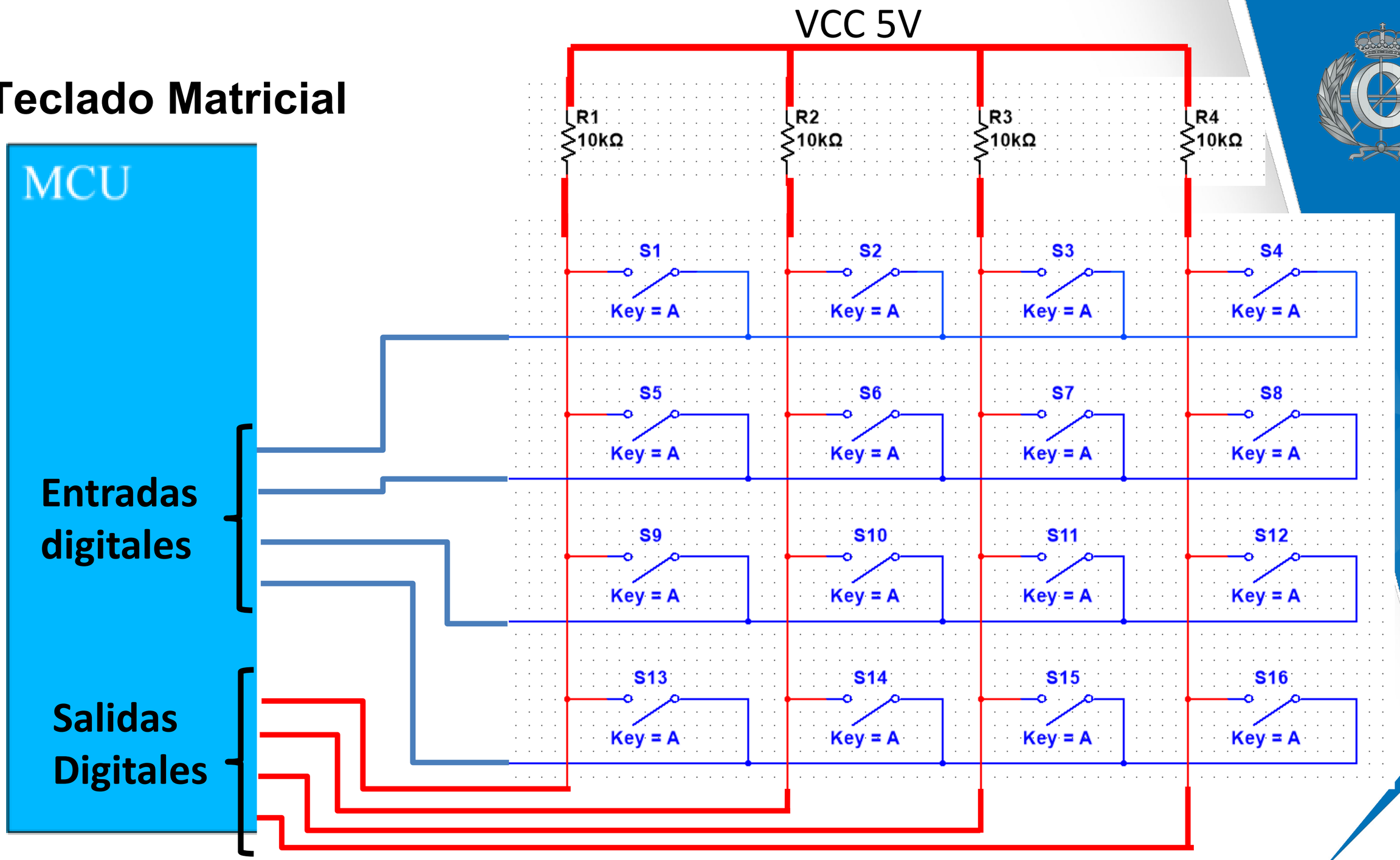



10 pines, y solo se utilizan 8 centrales

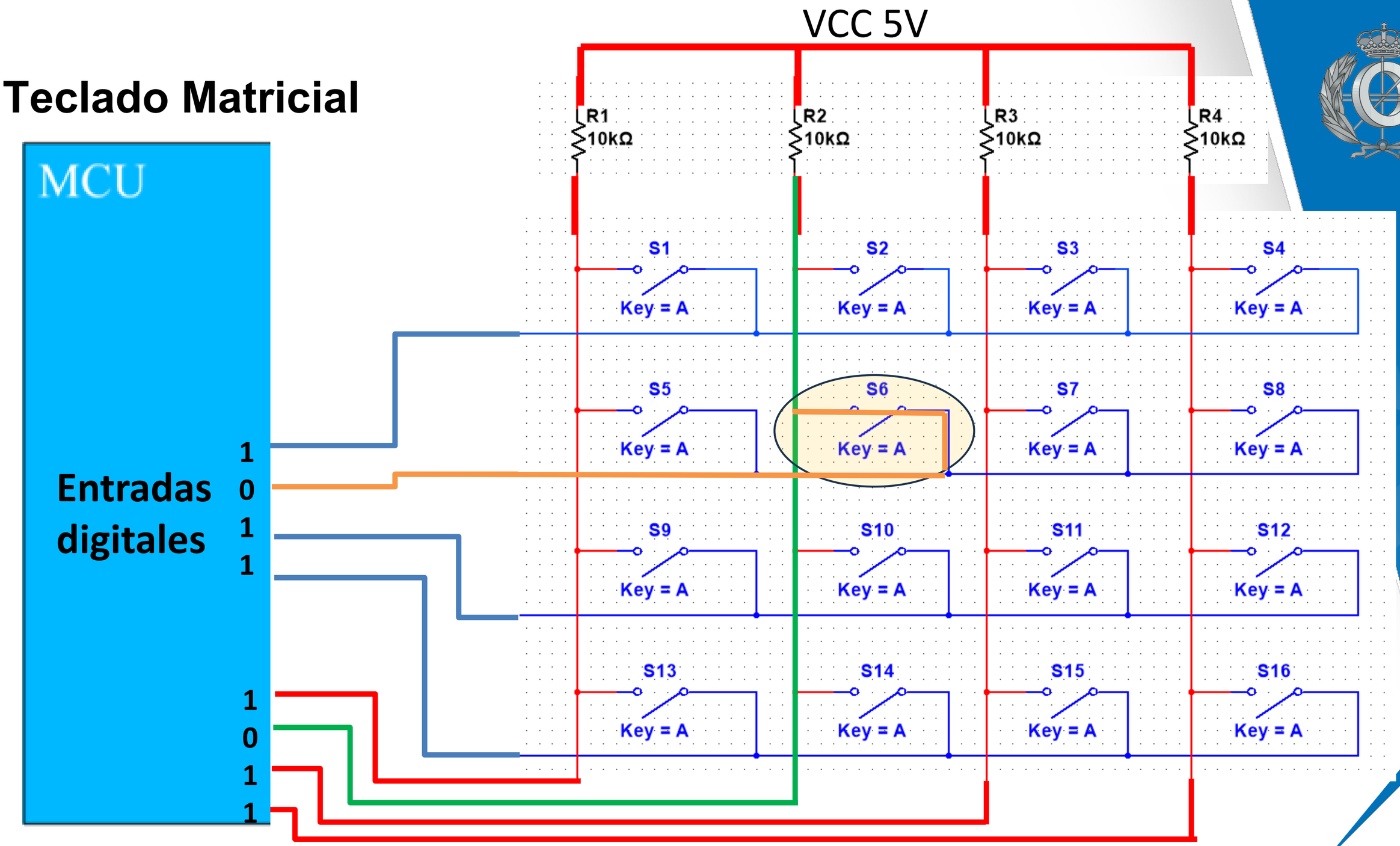
# Entrada pasiva: teclado digital o teclado matricial



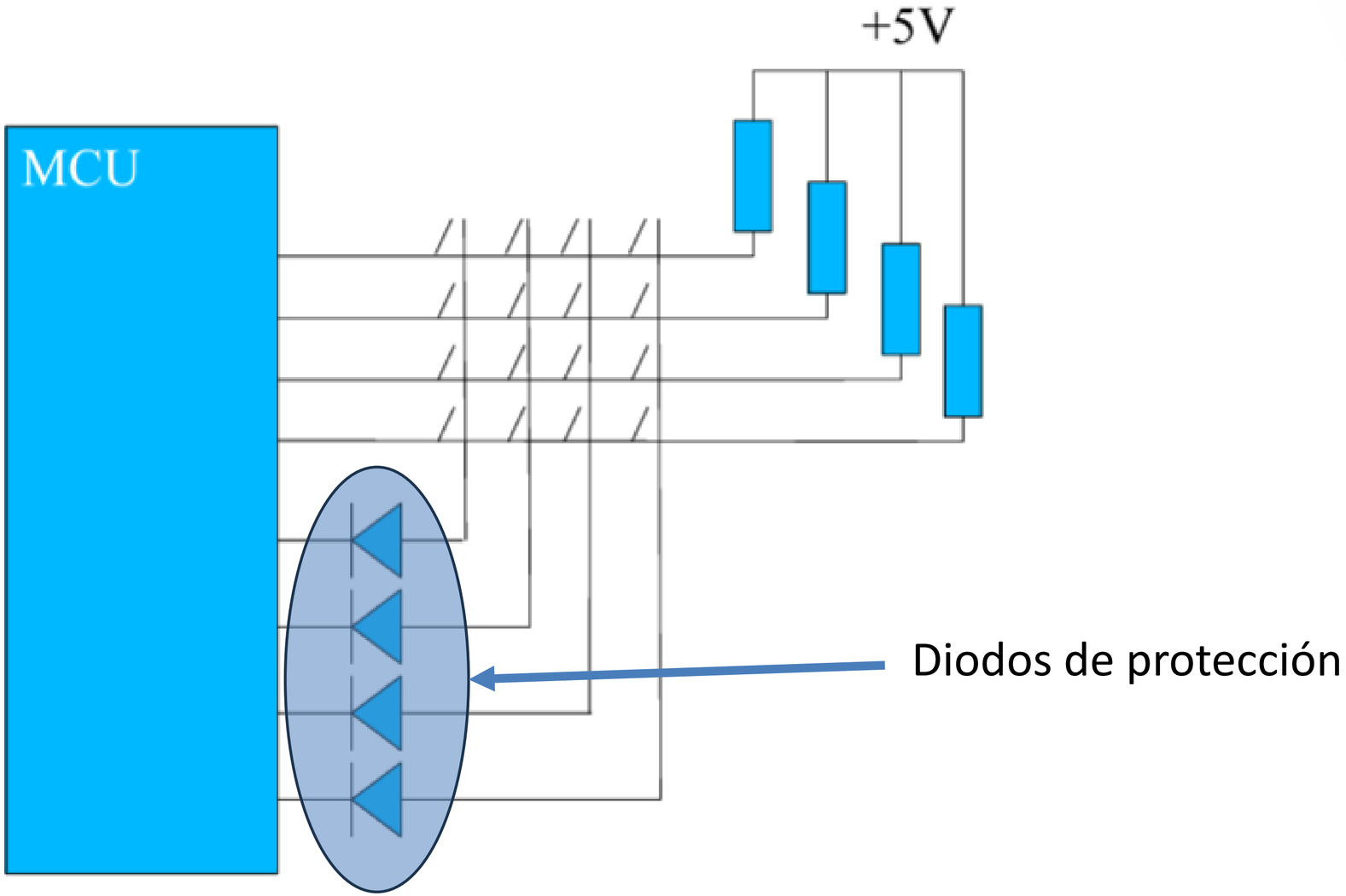
# Teclado Matricial



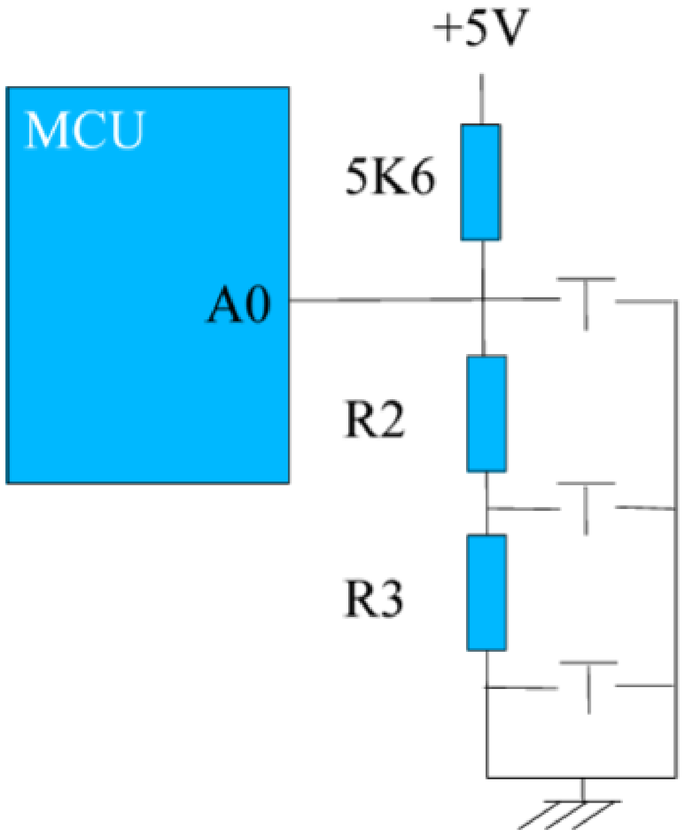
# Teclado Matricial



# Teclado matricial



# Entrada pasiva: teclado analógico




Convertidor analógico

0=======>5

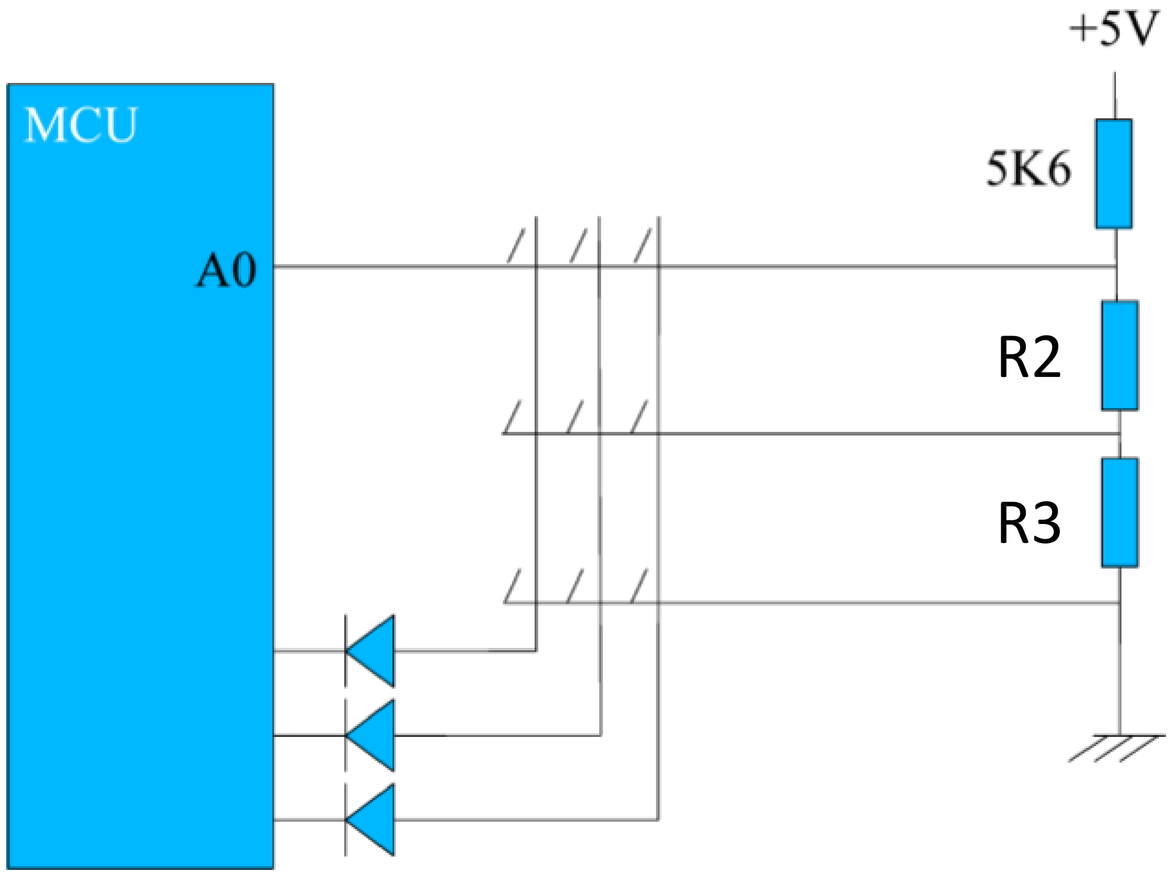
analogRead(pin)

0=======>1024

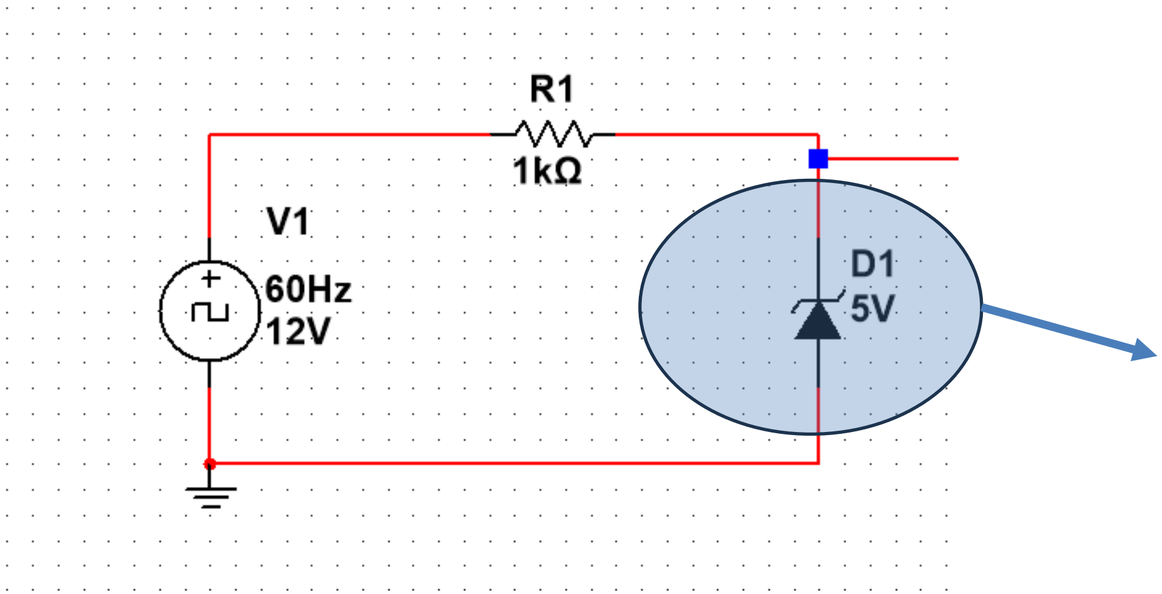
Divisor de tensión

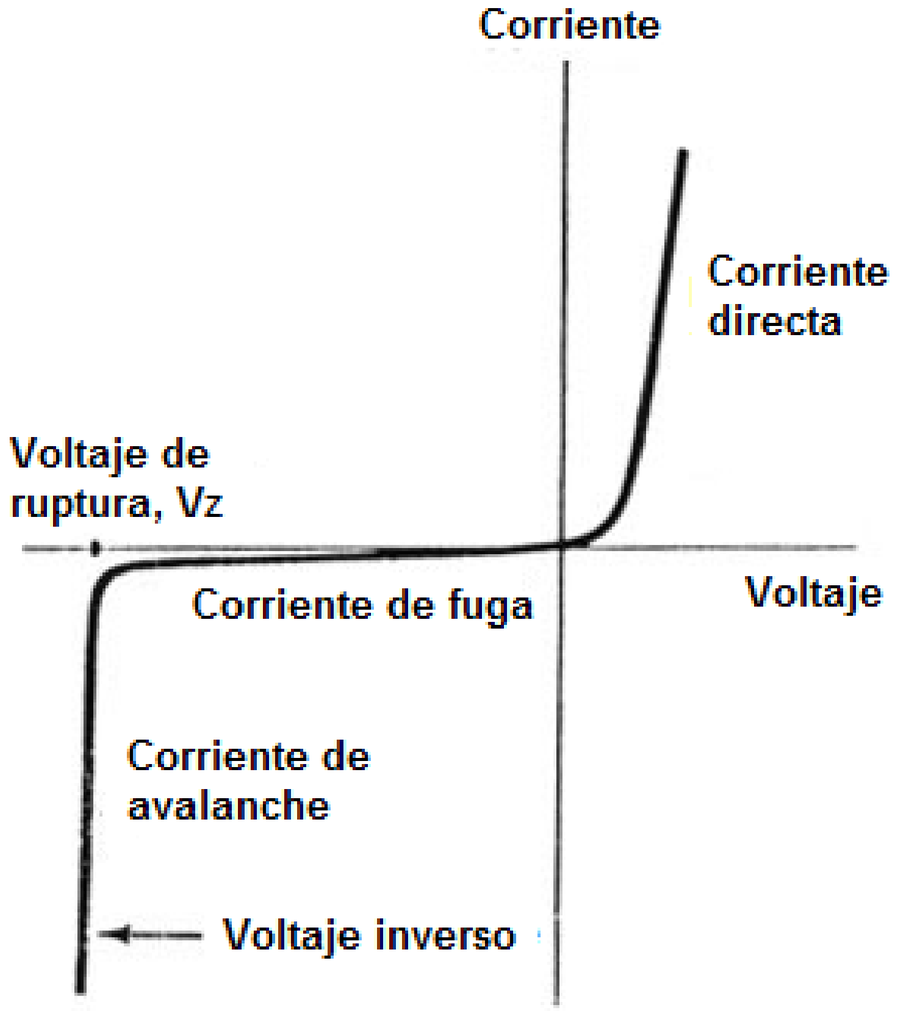
$$V_0 = V_{in}\left(\frac{R2}{R1 + R2}\right)$$

# Entrada pasiva: teclado matricial analógico

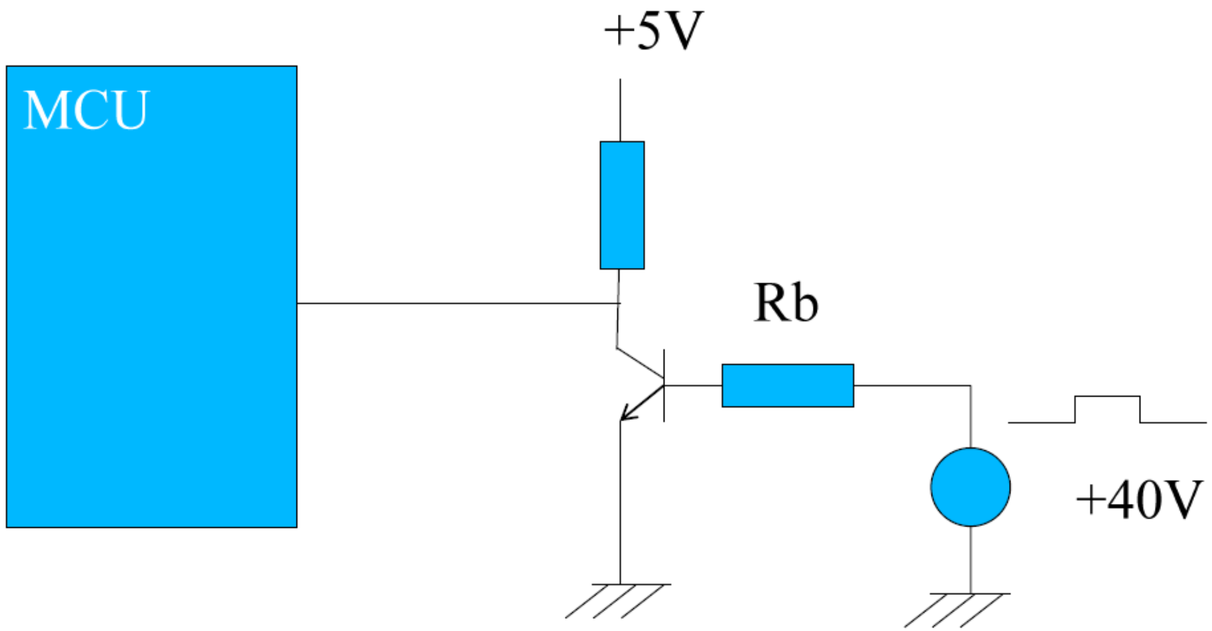


# Entrada Activa: con diodo Zener

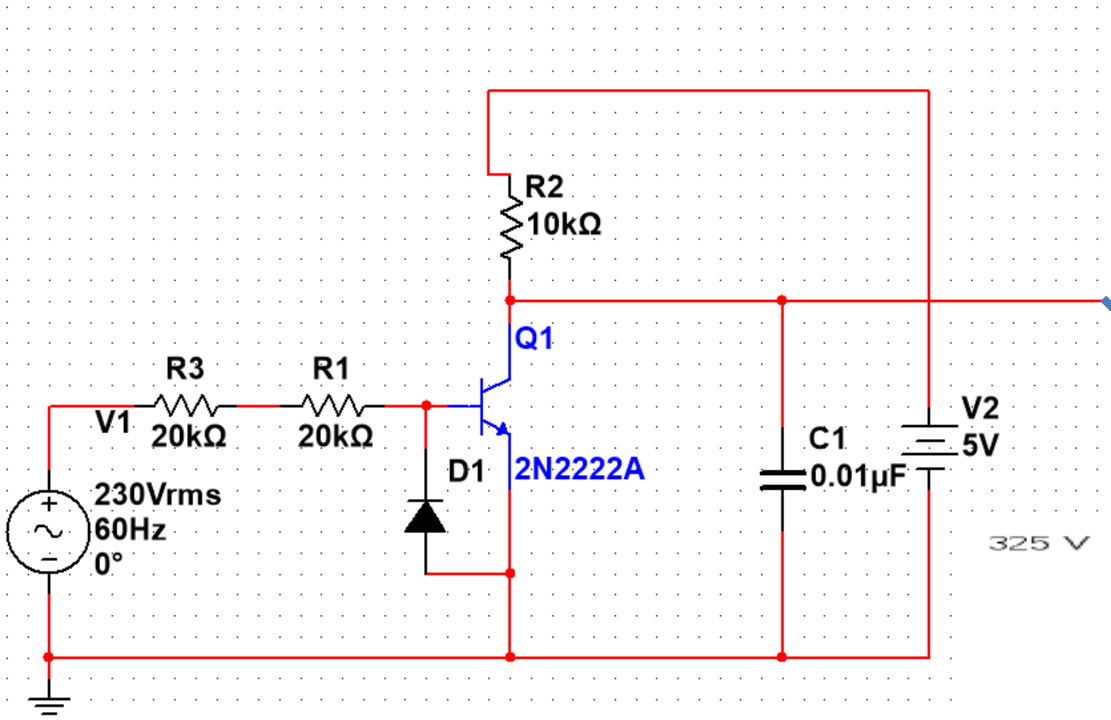


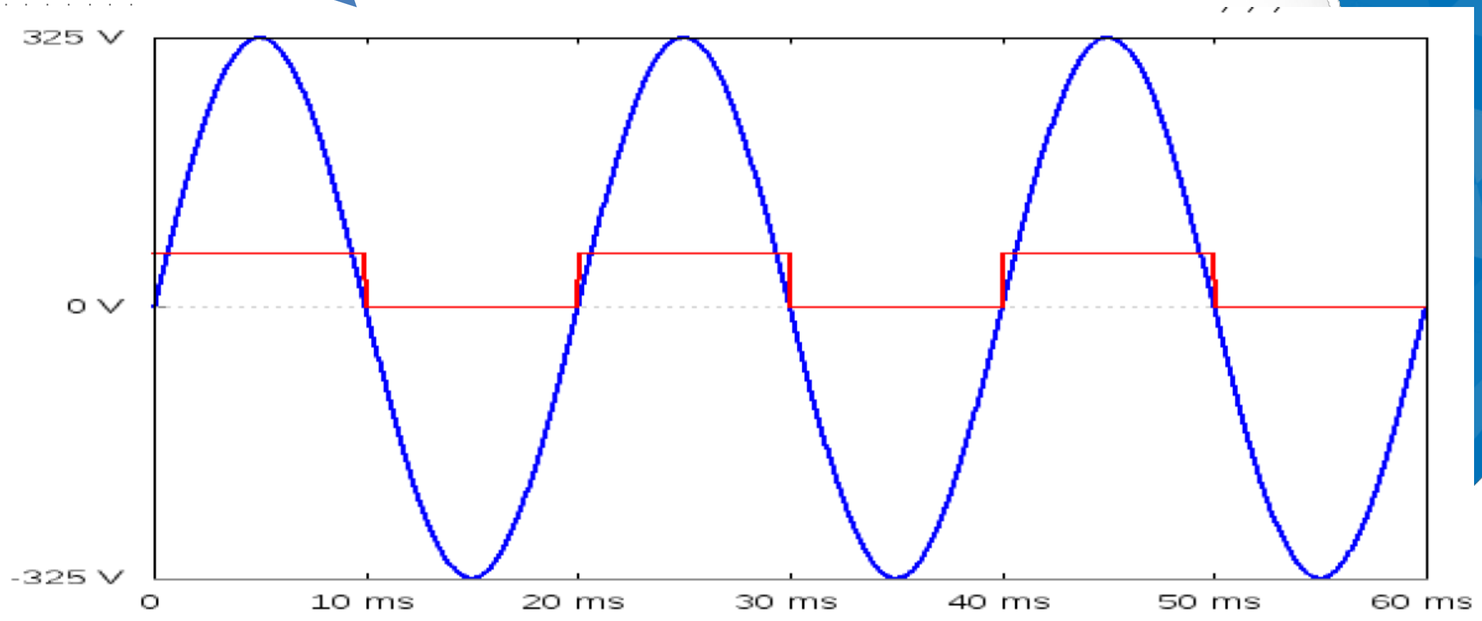



# Entrada Activa: con transistor

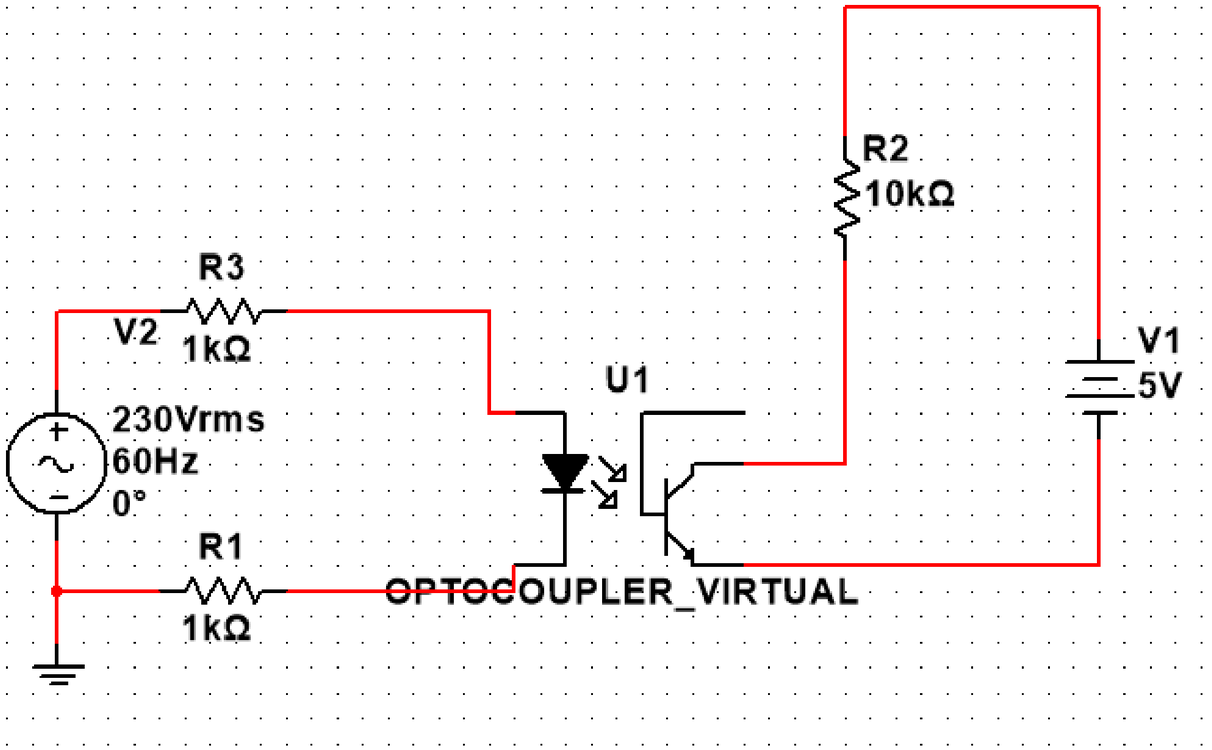


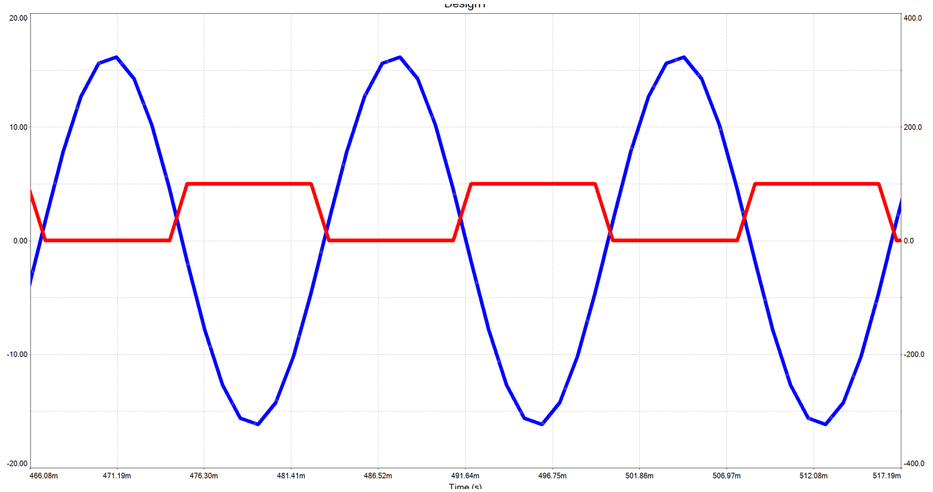
# Entrada Activa: con transistor



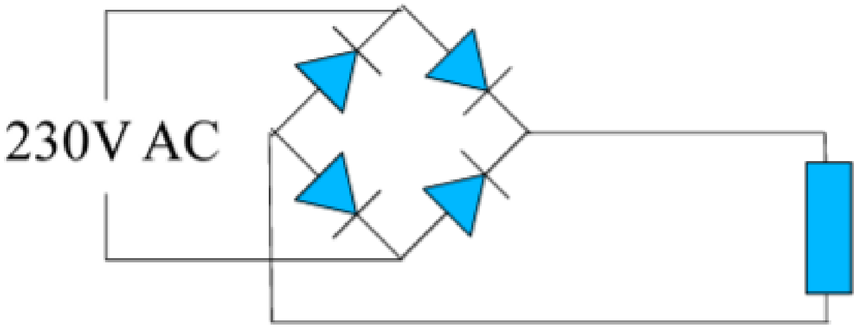



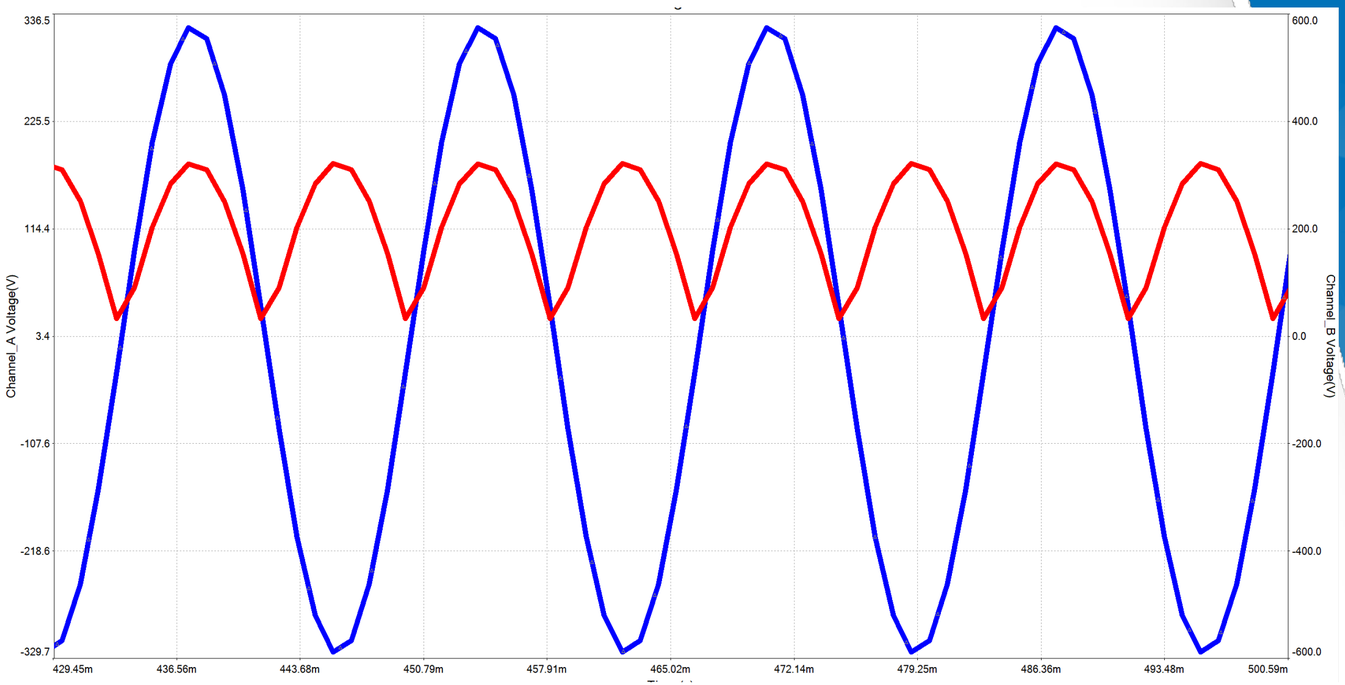
# Entrada activa: detección de red 230 V AC



# Detección de red 230 V AC: Puente de diodos



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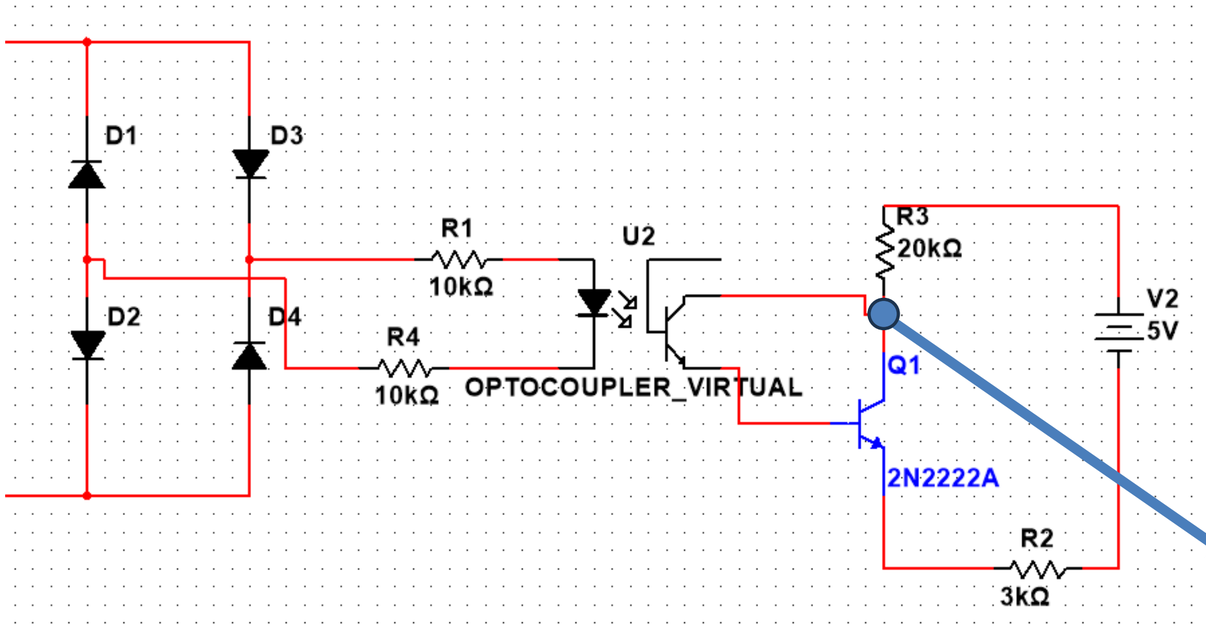


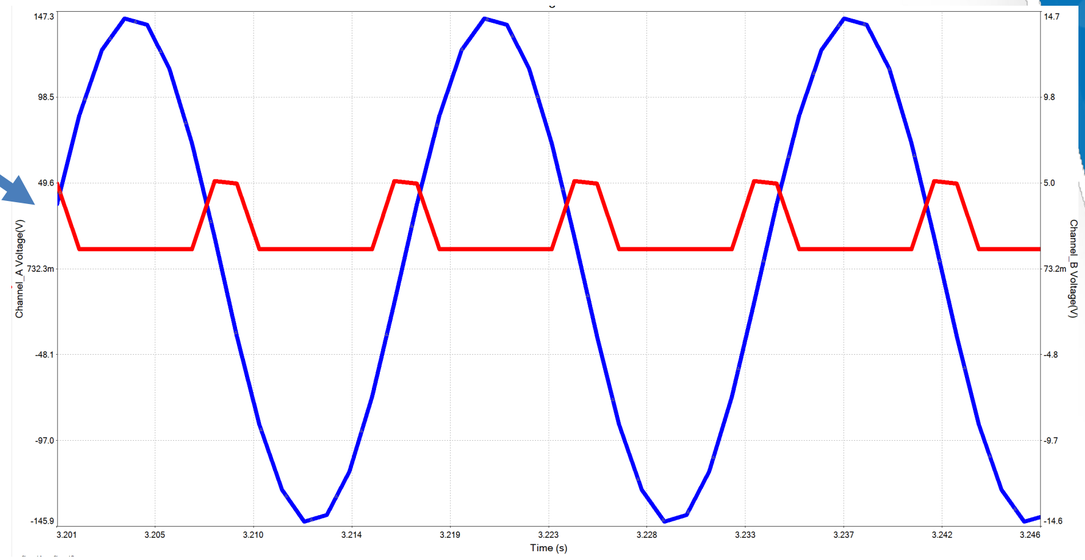

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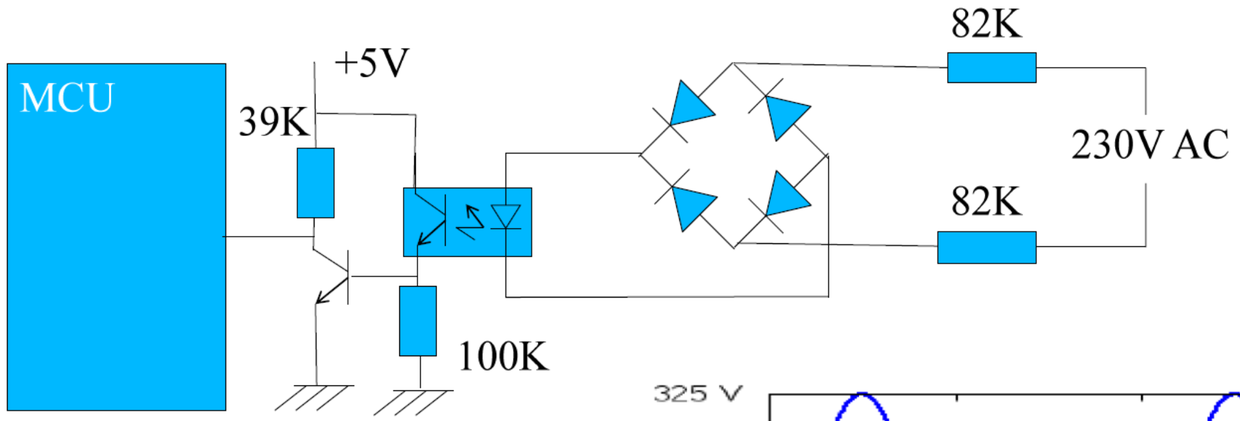


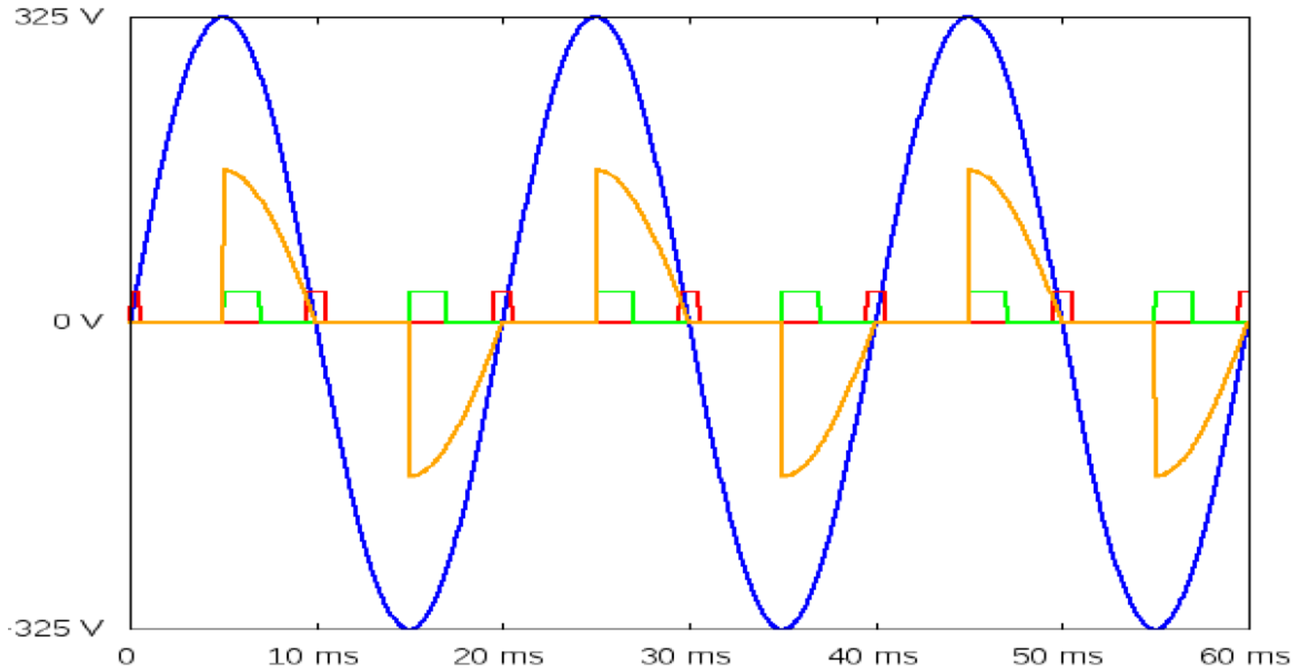

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