Diseño con microcontroladores

Entradas y salidas digitales: clase I

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Escuela Técnica Superior de
Ingenieros Informáticos

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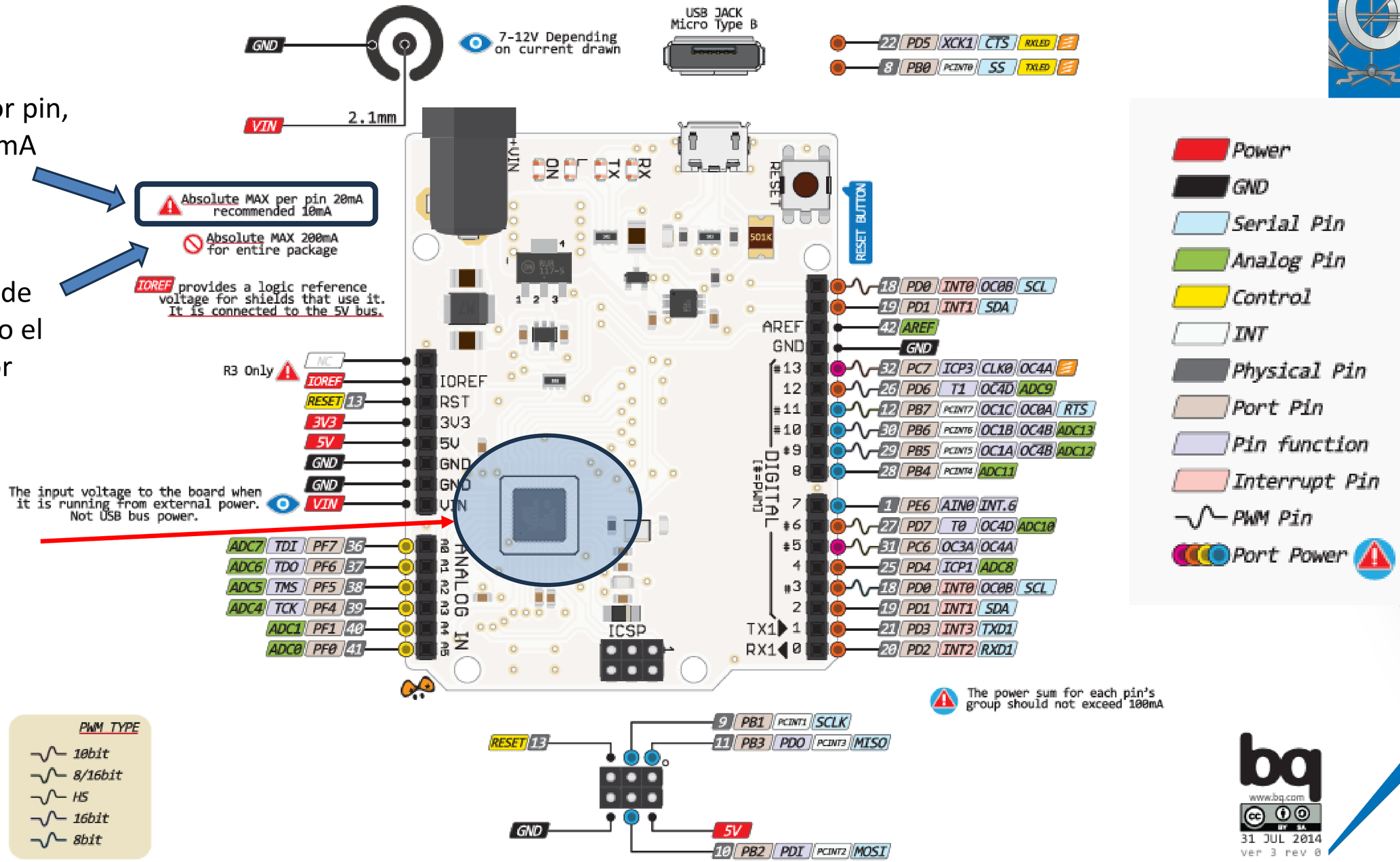
Máximo 20mA por pin, recomendado 10mA

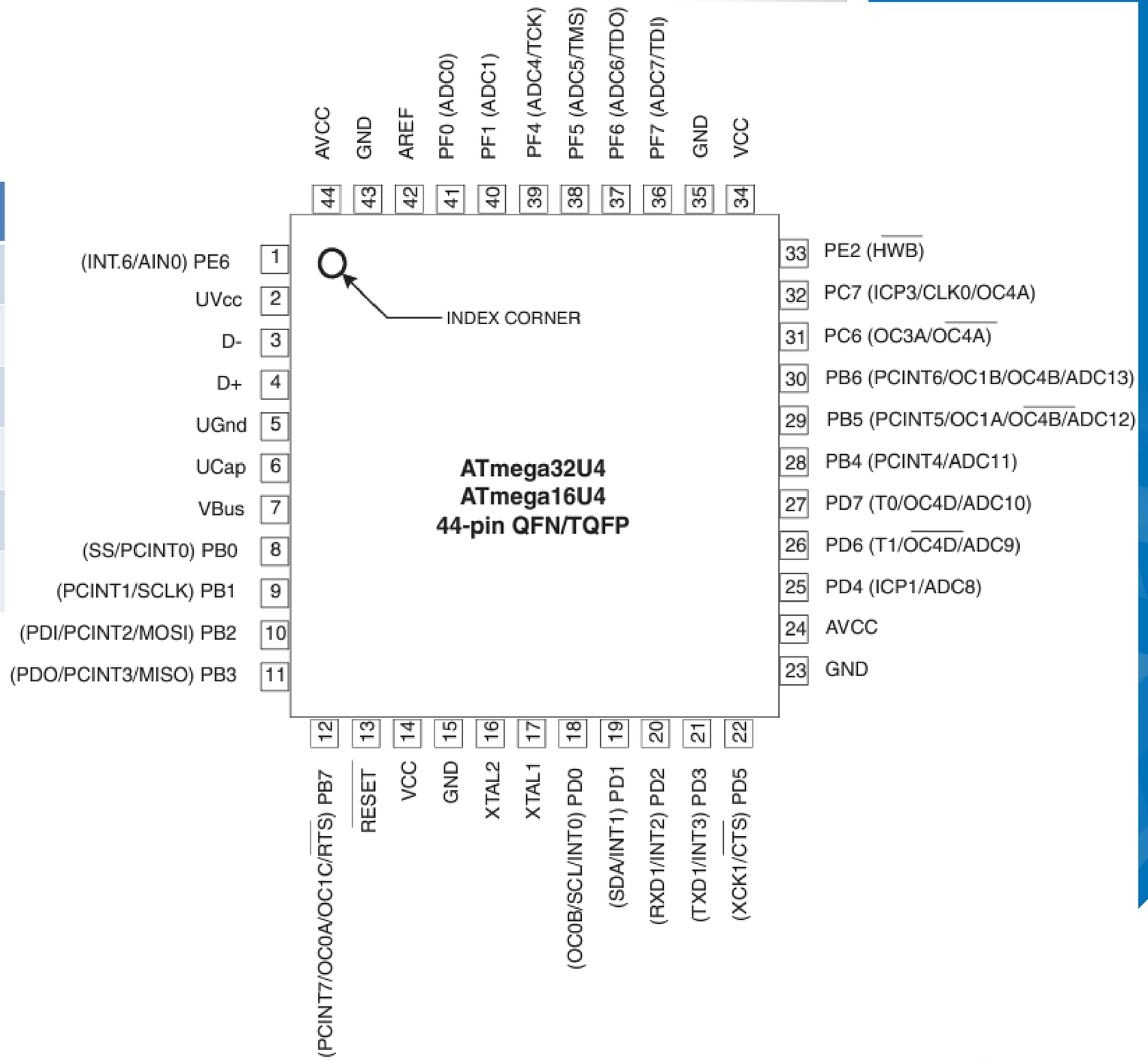
Máximo 200mA de consumo en todo el microcontrolador

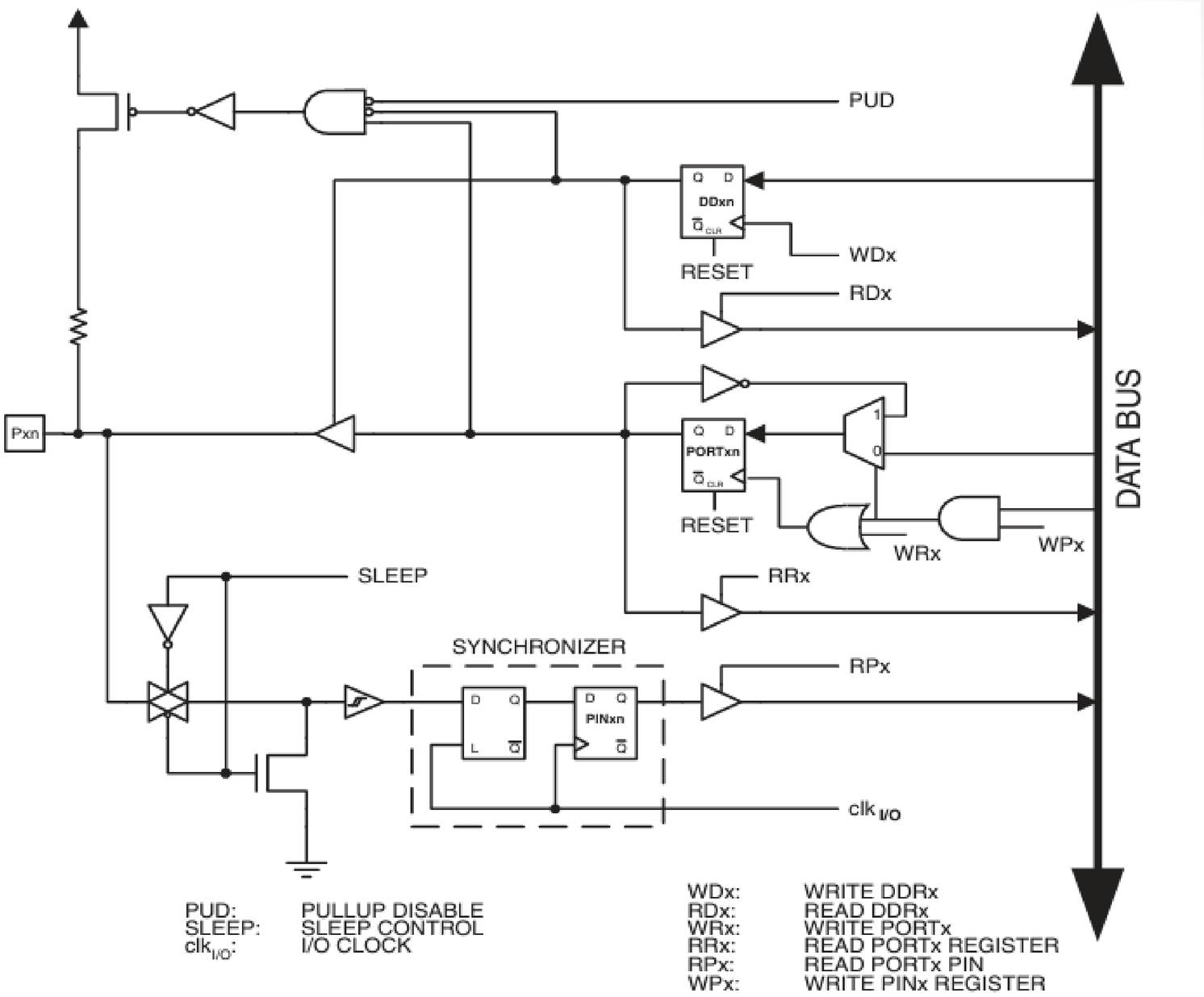
Atmega 32U4



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

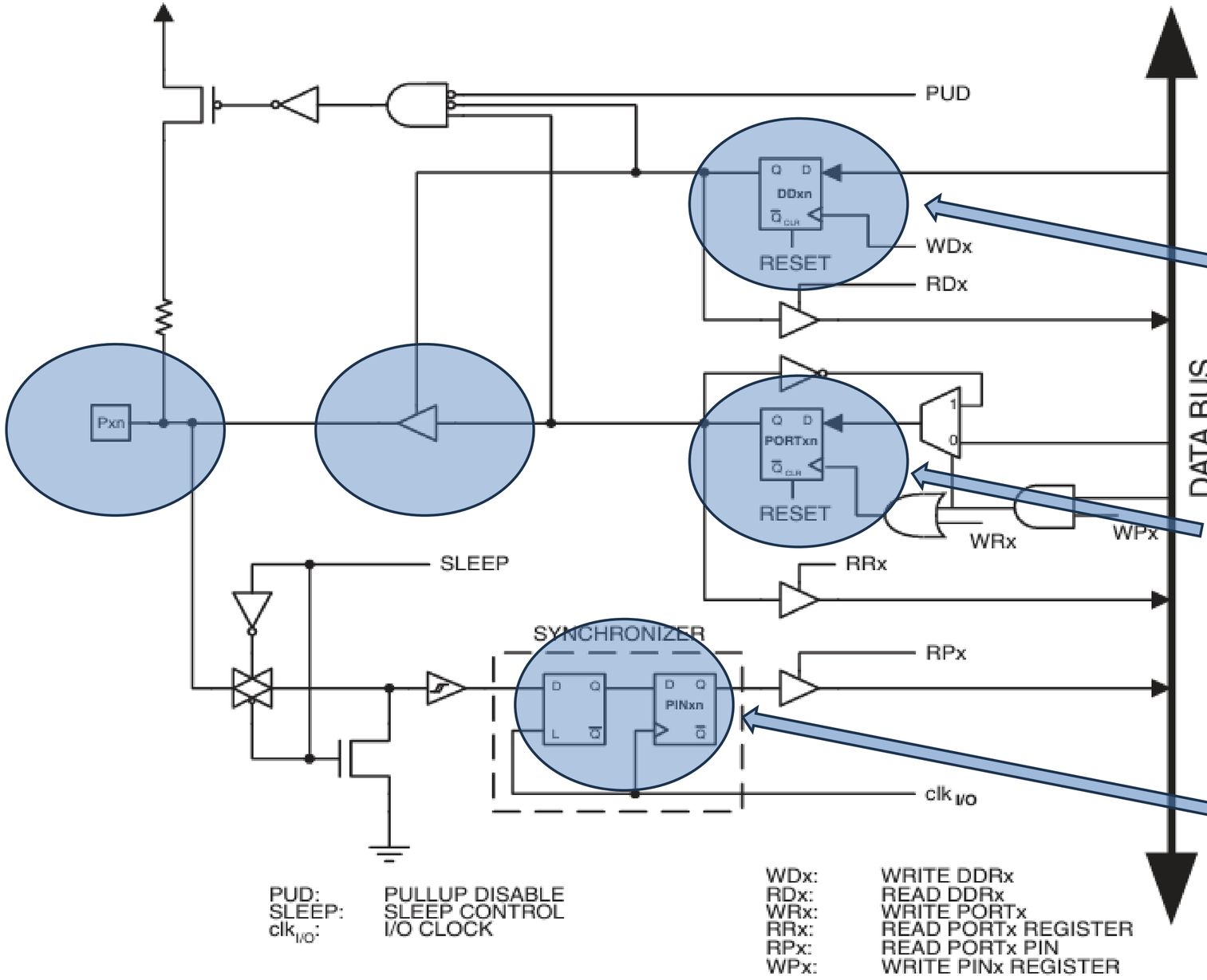
Arduino	ATmega
A0	PF7
A1	PF6
A2	PF5
A3	PF4
A4	PF1
A5	PF0





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.

Salida física



Registro DDRx
(8bits)

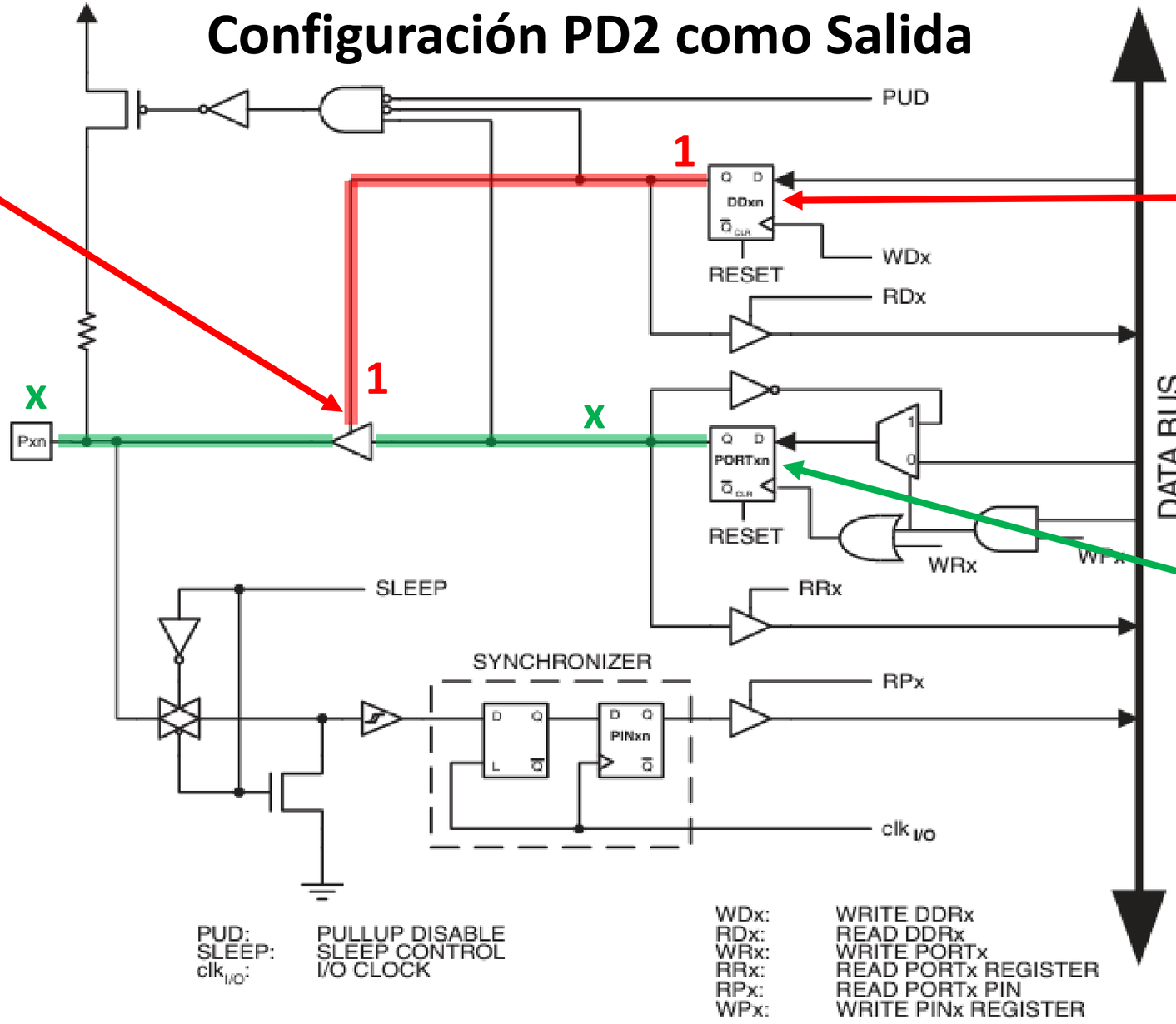
Registro PORTx
(8 bits)

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 Salida

Activamos el driver triestado



DDRD=0x04

PORTD|=(1<<2)

PORTD &=~(1<<2)

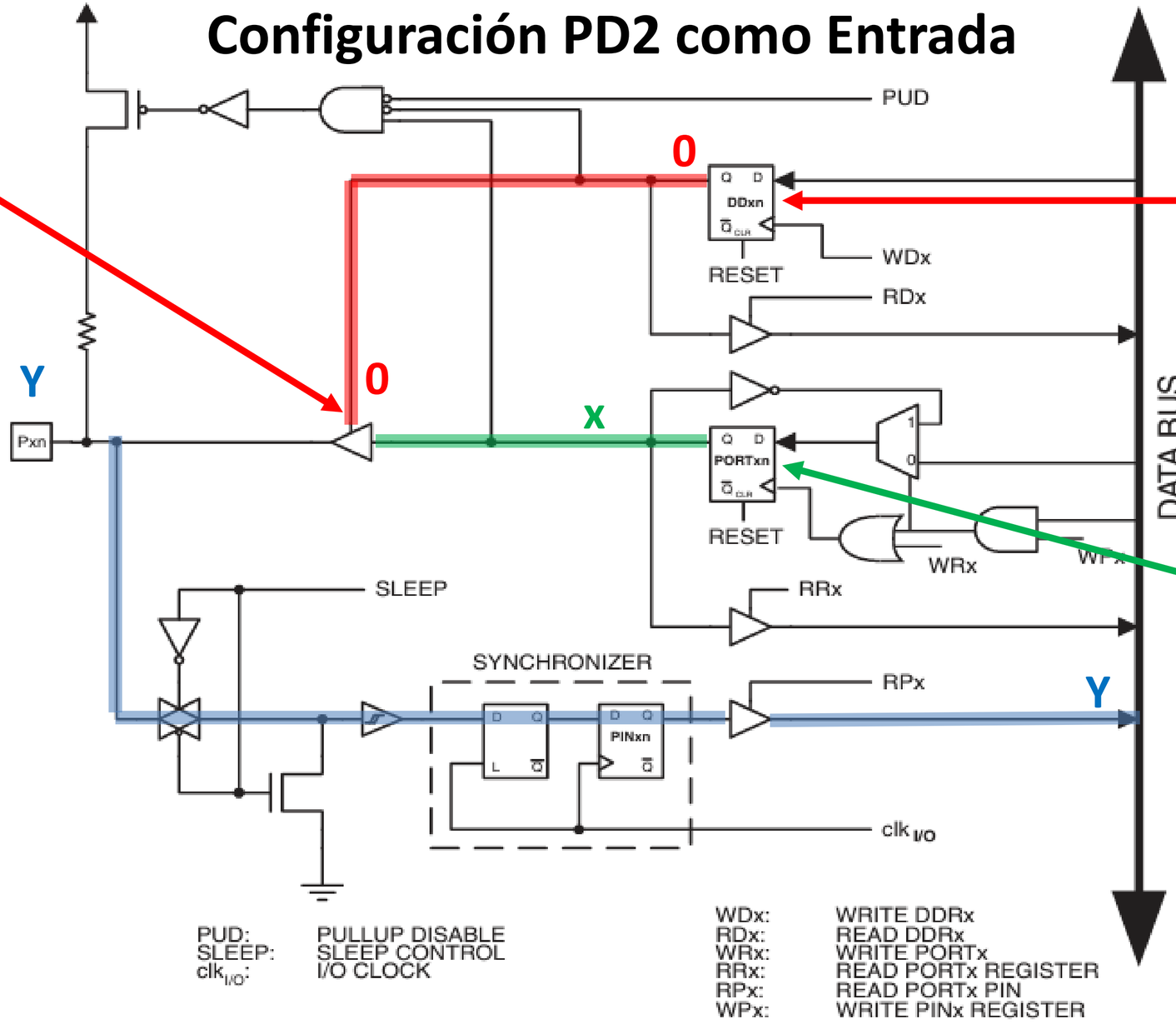
Salida X=1 ⟹ 5V

X=0 ⟹ 0V

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

Desactivamos el driver triestado



DDRD &=~(1<<2)

PORTD|=(1<<2)

PORTD &=~(1<<2)

Entrada Y=1 ⟹ 5V

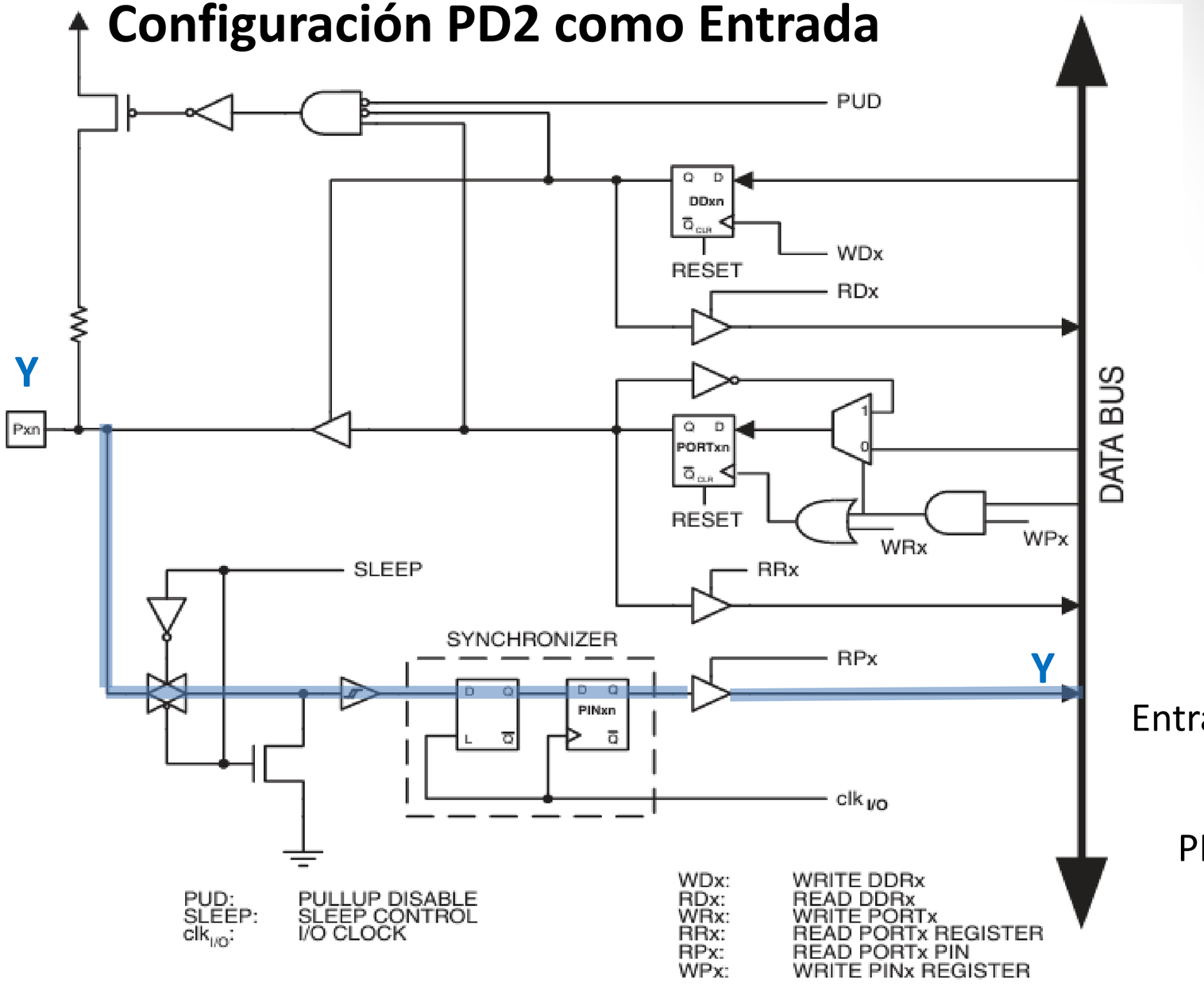
Y=0 ⟹ 0V

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.

Configuración PD2 como Entrada

¿Qué valor tomaría **Y**, si no está conectado a ningún circuito?



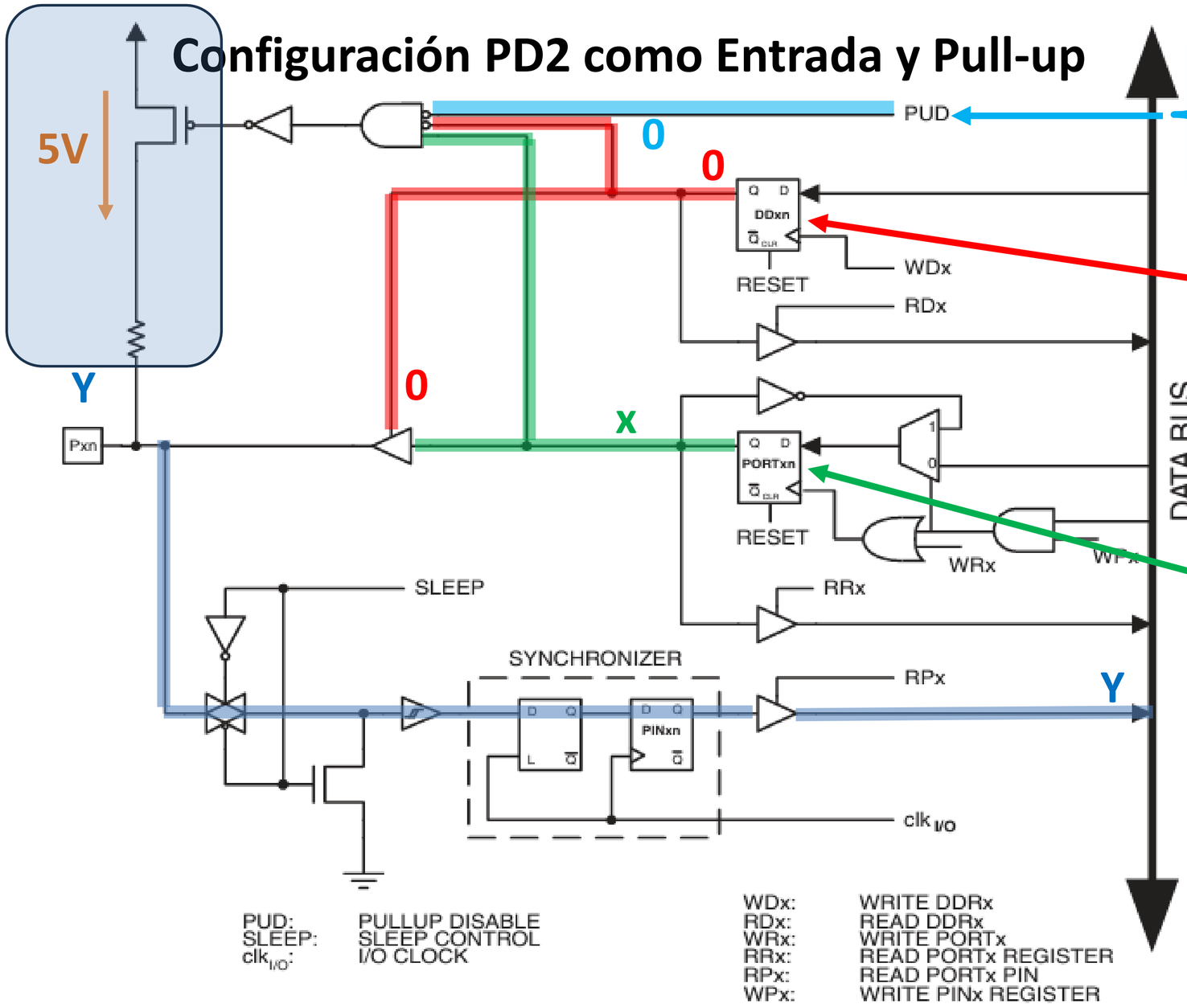
Entrada Y=1 ⟹ 5V

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.

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)

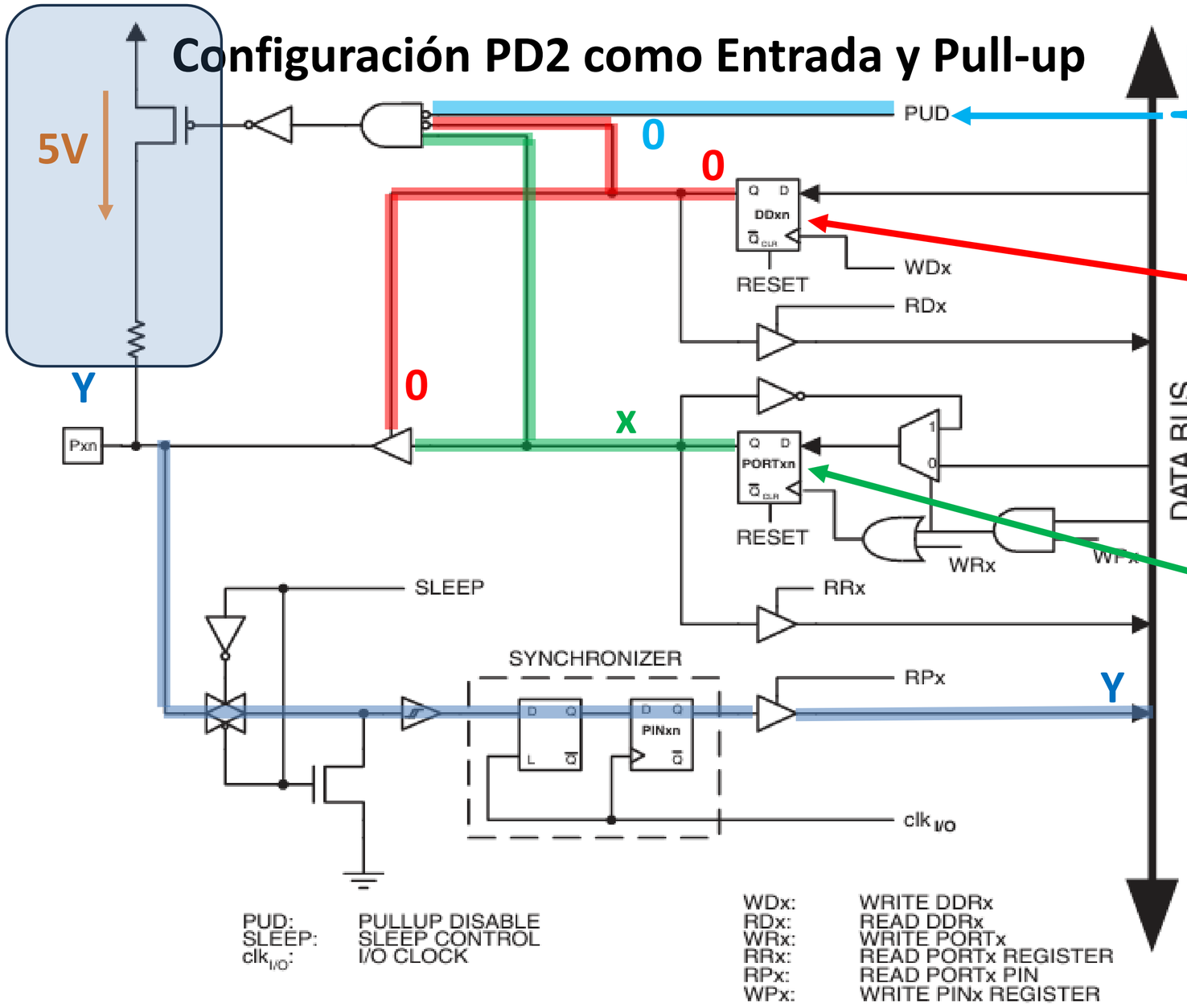
PORTD|=(1<<2) ⟹ ?
PORTD &=~(1<<2) ⟹ ?

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.

Configuración PD2 como Entrada y Pull-up



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

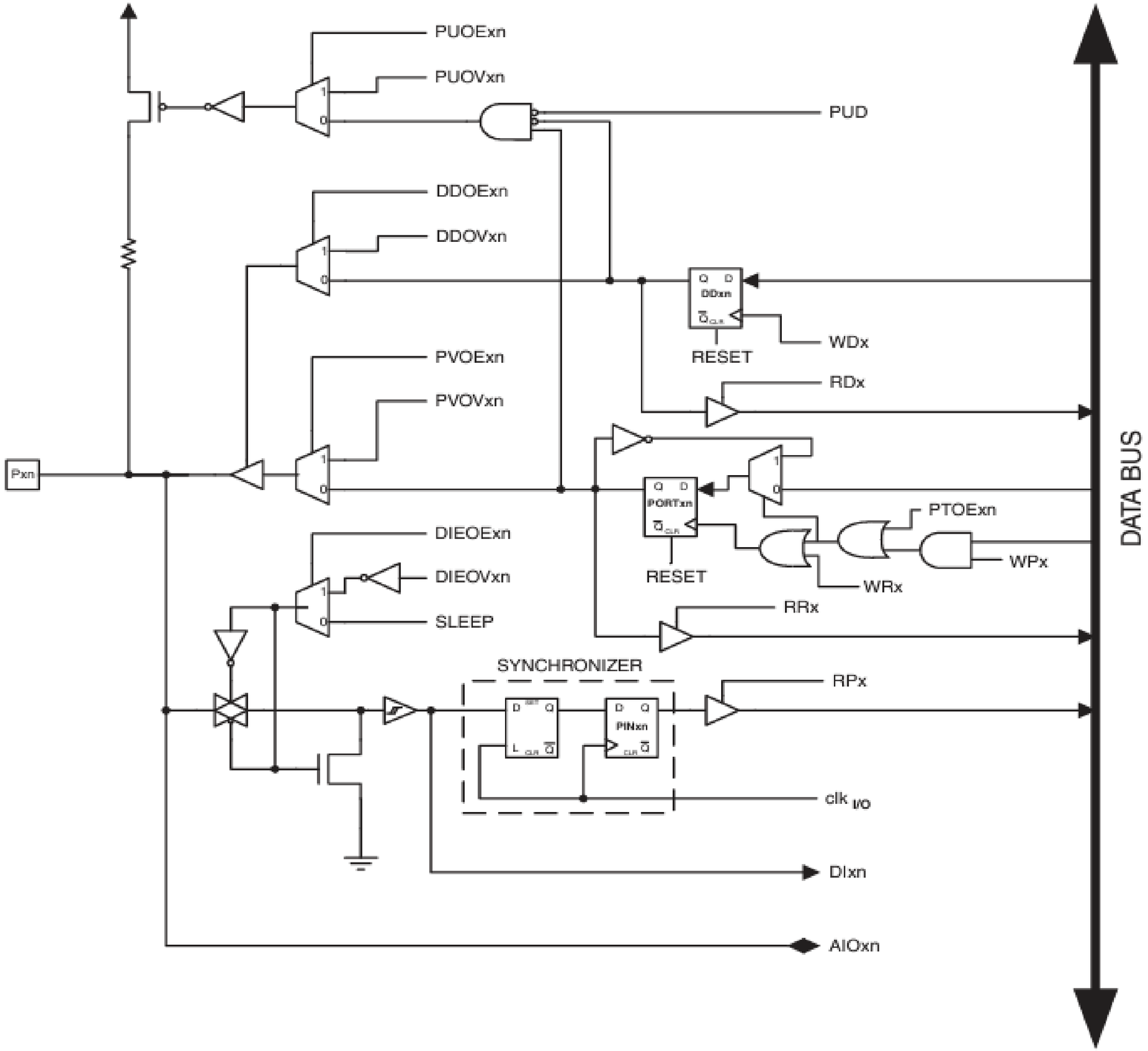
DDRD &=~(1<<2)

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.


PUOExn
PUOVxn
PUD
DDOExn
DDOVxn
DDxn
RESET
WDx
PVOExn
PVOVxn
RDx
Pxn
PORTxn
RESET
PTOExn
WPx
WRx
DIEOExn
DIEOVxn
SLEEP
RRx
SYNCHRONIZER
RPx
PINxn
clk I/O
DIxn
AIOxn
DATA BUS

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
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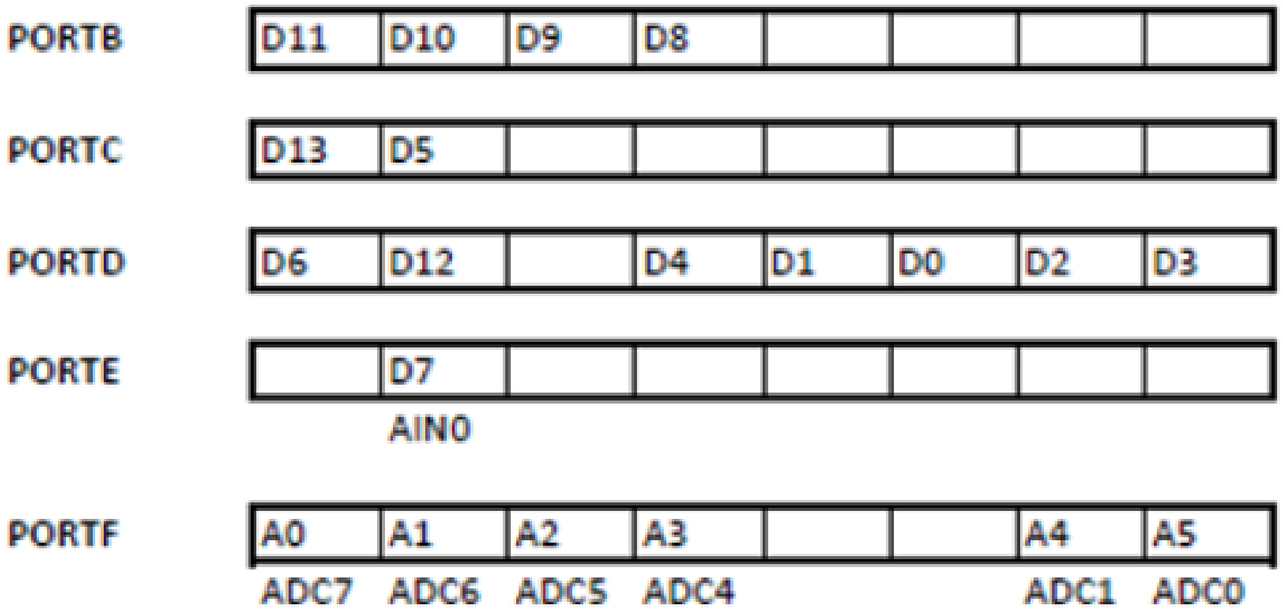

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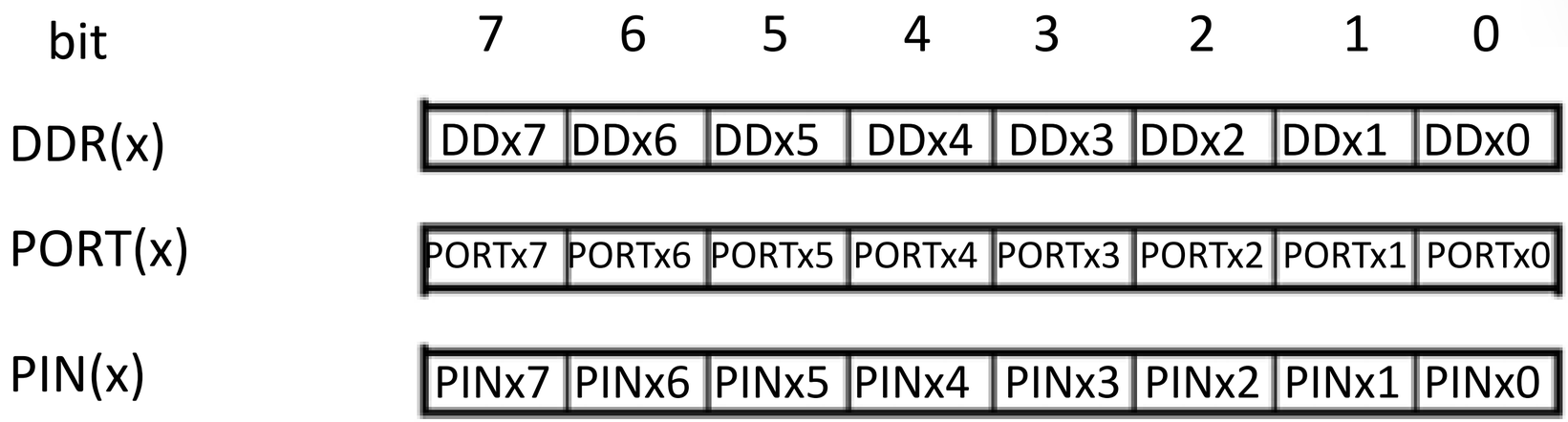
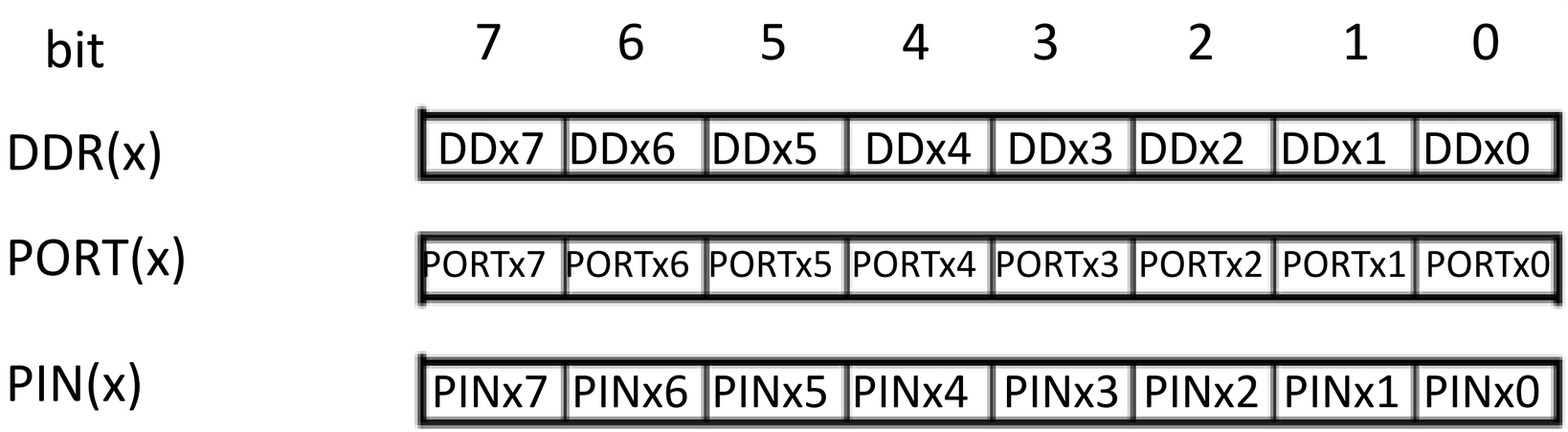




¿Cuál es la mejor?

Arduino

pinMode(pin, OUTPUT / INPUT / INPUT_PULLUP)

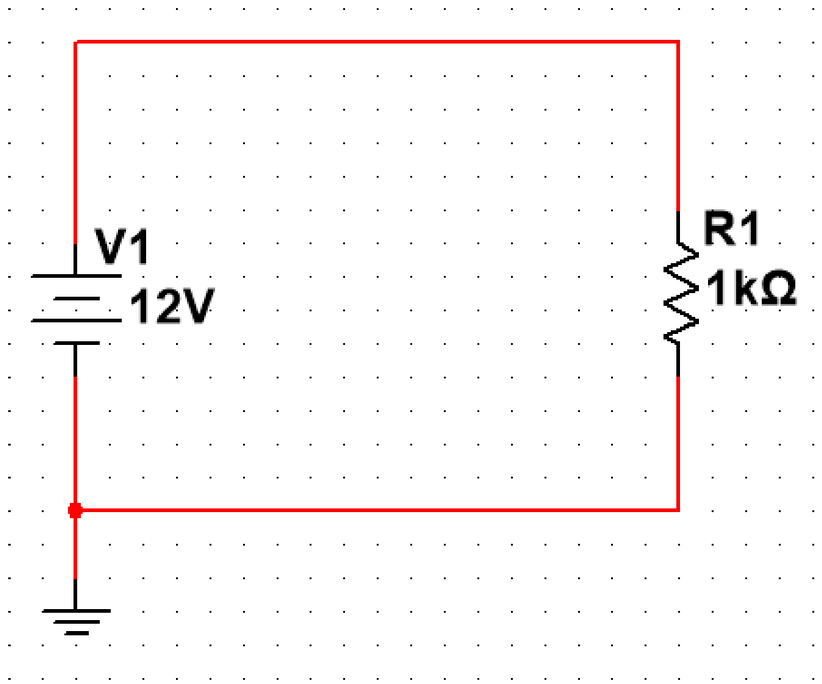
digitalWrite(pin, LOW / HIGH)

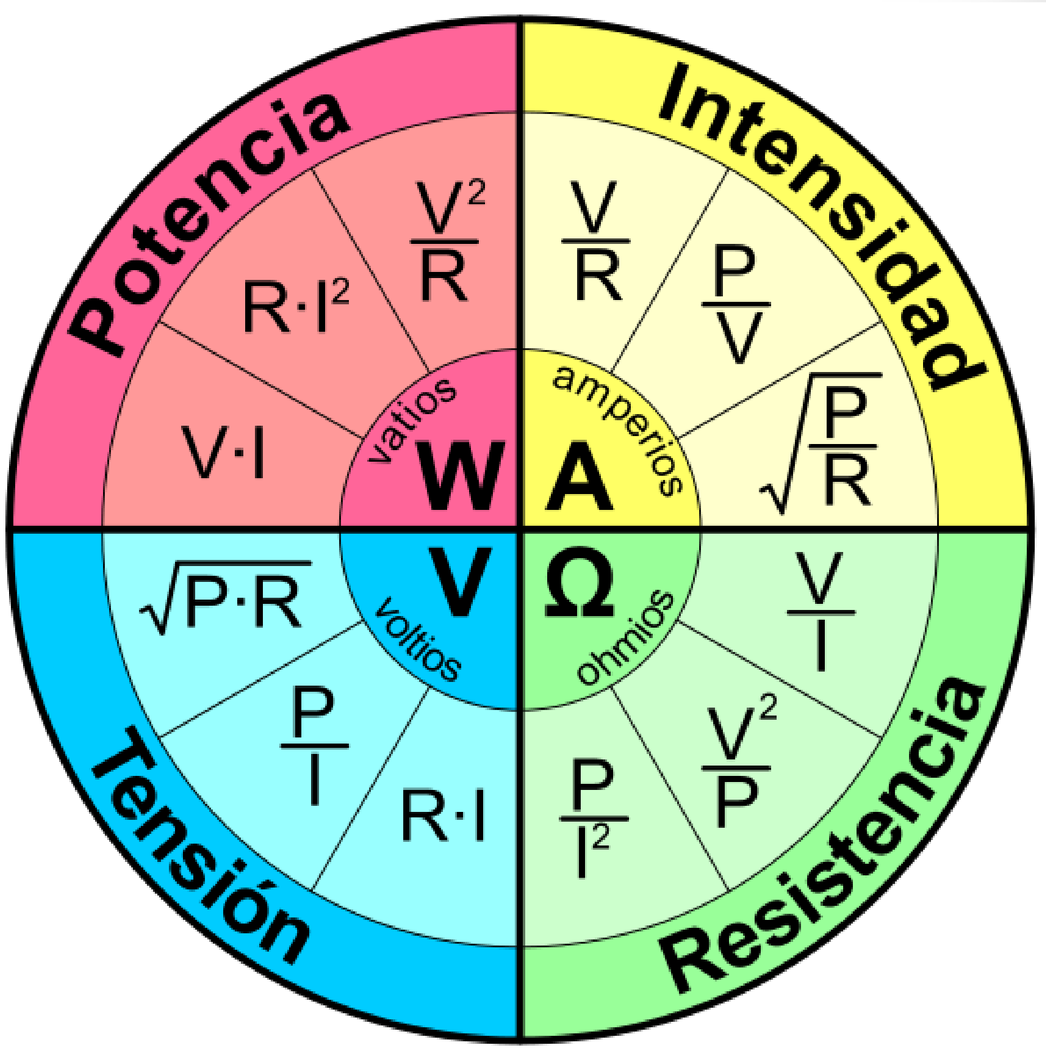
Val=digitalRead(pin)

ATmega

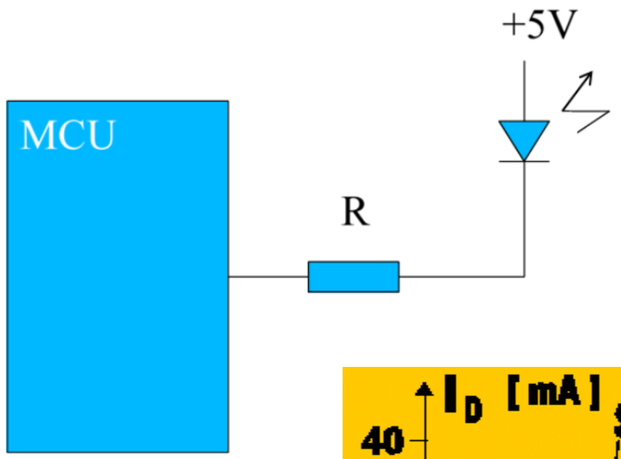
```
DDRB|=(1<<bit);
DDRB &=~(1<<bit);

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

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

LEY DE OHM

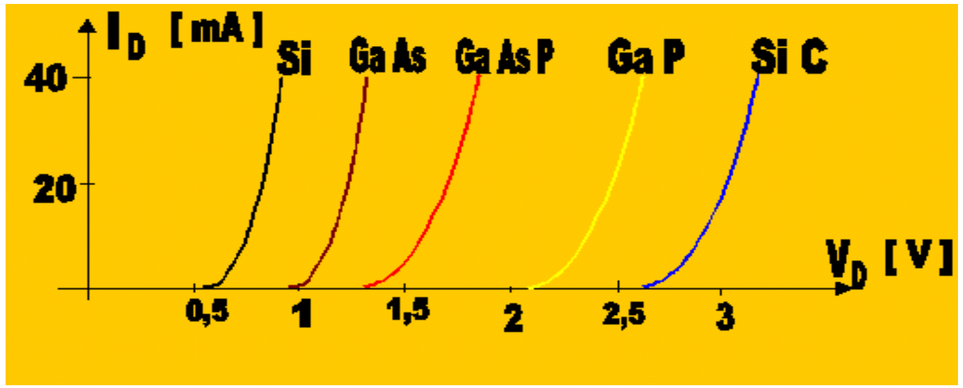

V1
12V
R1
1kΩ

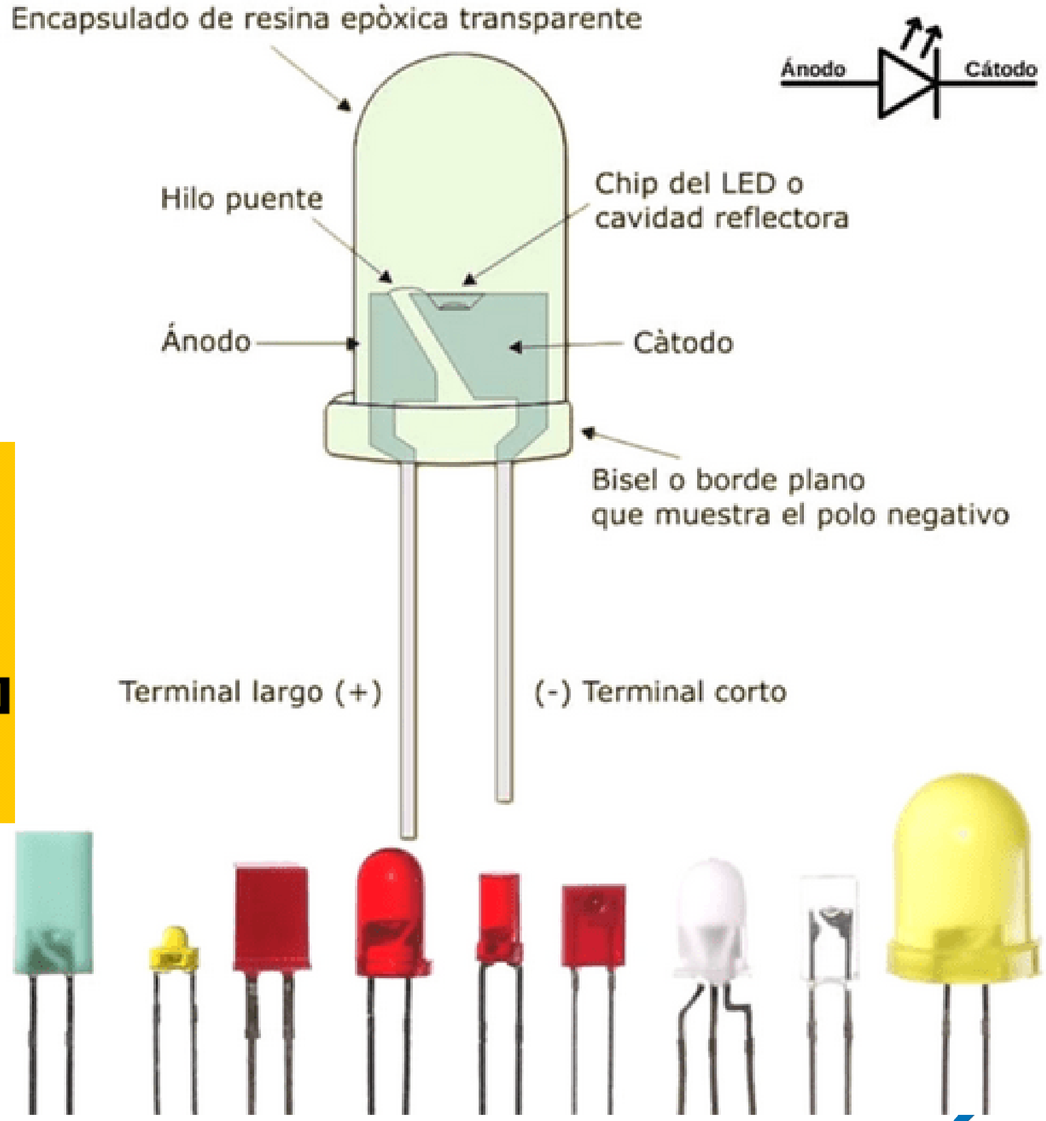

Potencia
Intensidad
Tensión
Resistencia
vatios
W
amperios
A
voltios
V
ohmios
Ω
V·I
R·I²
V²/R
V/R
P/V
√(P/R)
√(P·R)
P/I
R·I
V/I
P/I²
V²/P

I/O pin con DIODO



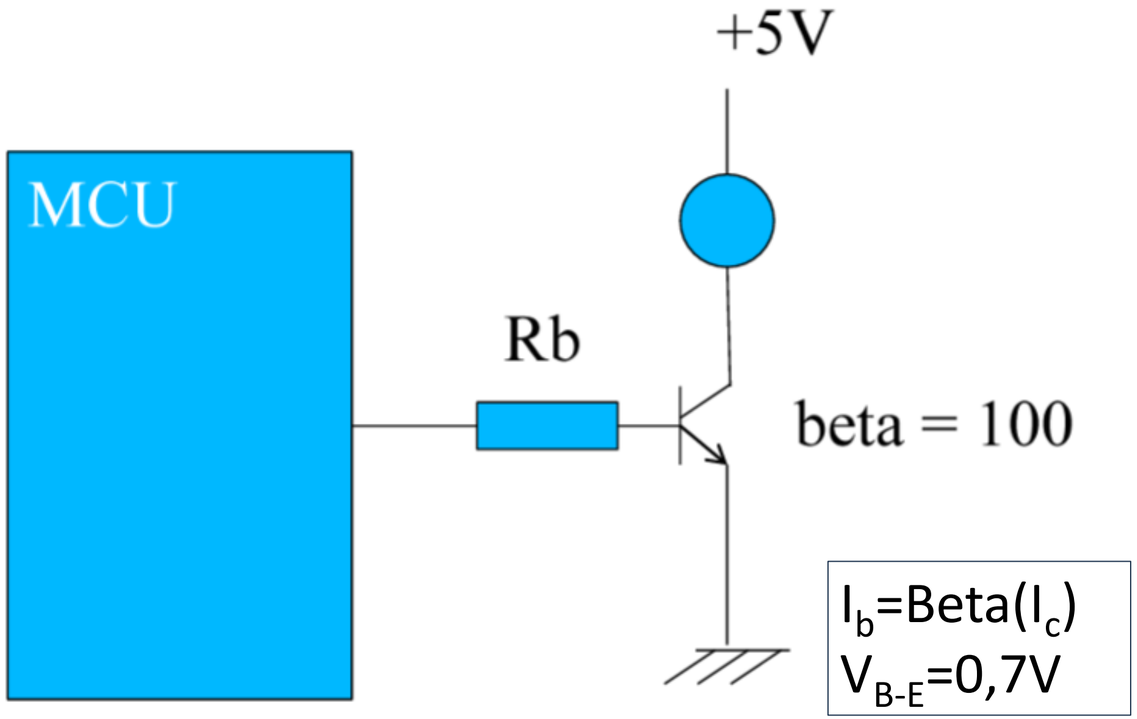
I = 10 mA
Vd = 1,5 V
¿R?



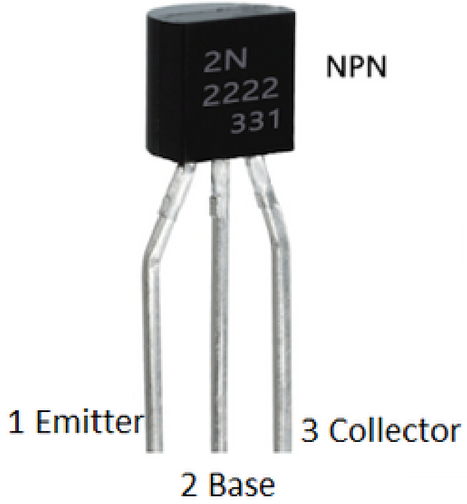


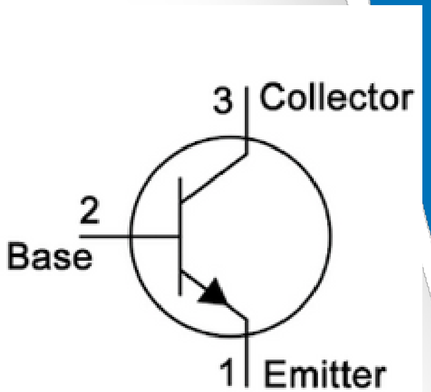
Corriente máxima por pin es 20 mA; recomendable 10mA y un total de consumo de todo el microcontrolador de 200mA

I/O pin con bombilla de 5v DC 0.75W



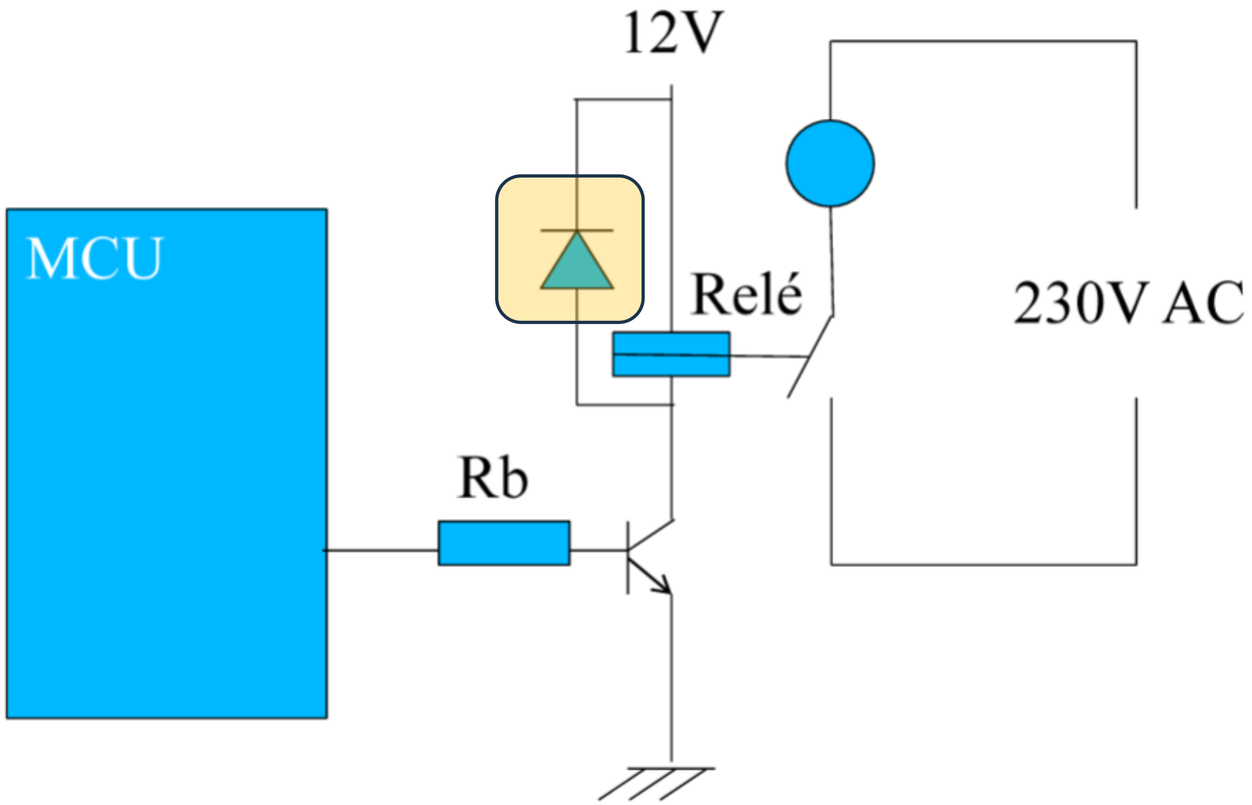
I_b=Beta(I_c)
V_{B-E}=0,7V

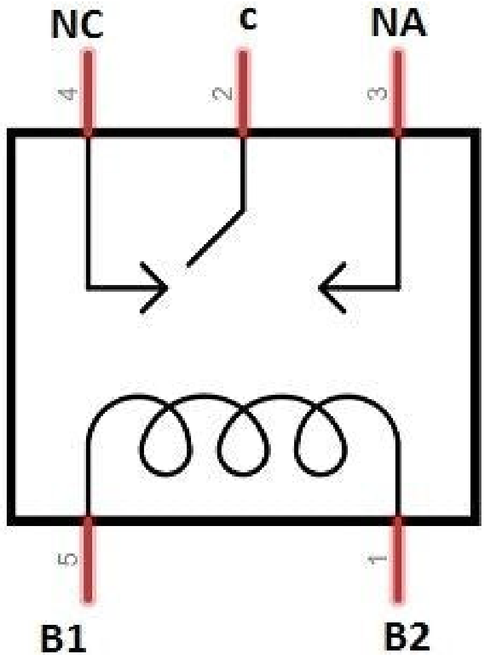




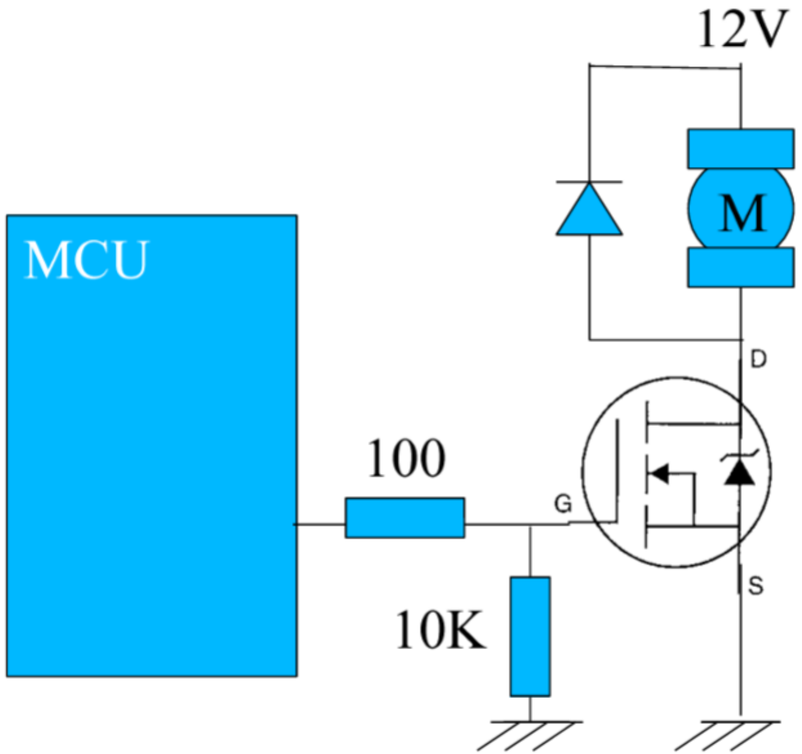
Beta =100
V_{B-E}=0,7V
I_b>1,5mA

I/O pin con bombilla 230V AC 100 W



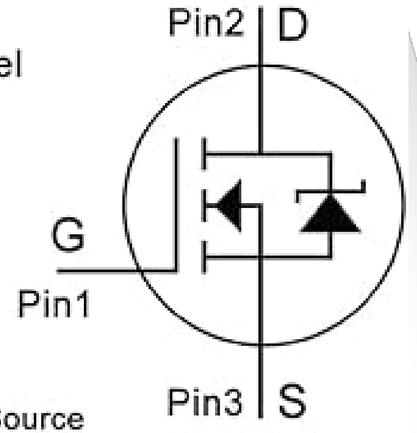


I/O pin con motor de 12V DC 50W



MOSFET

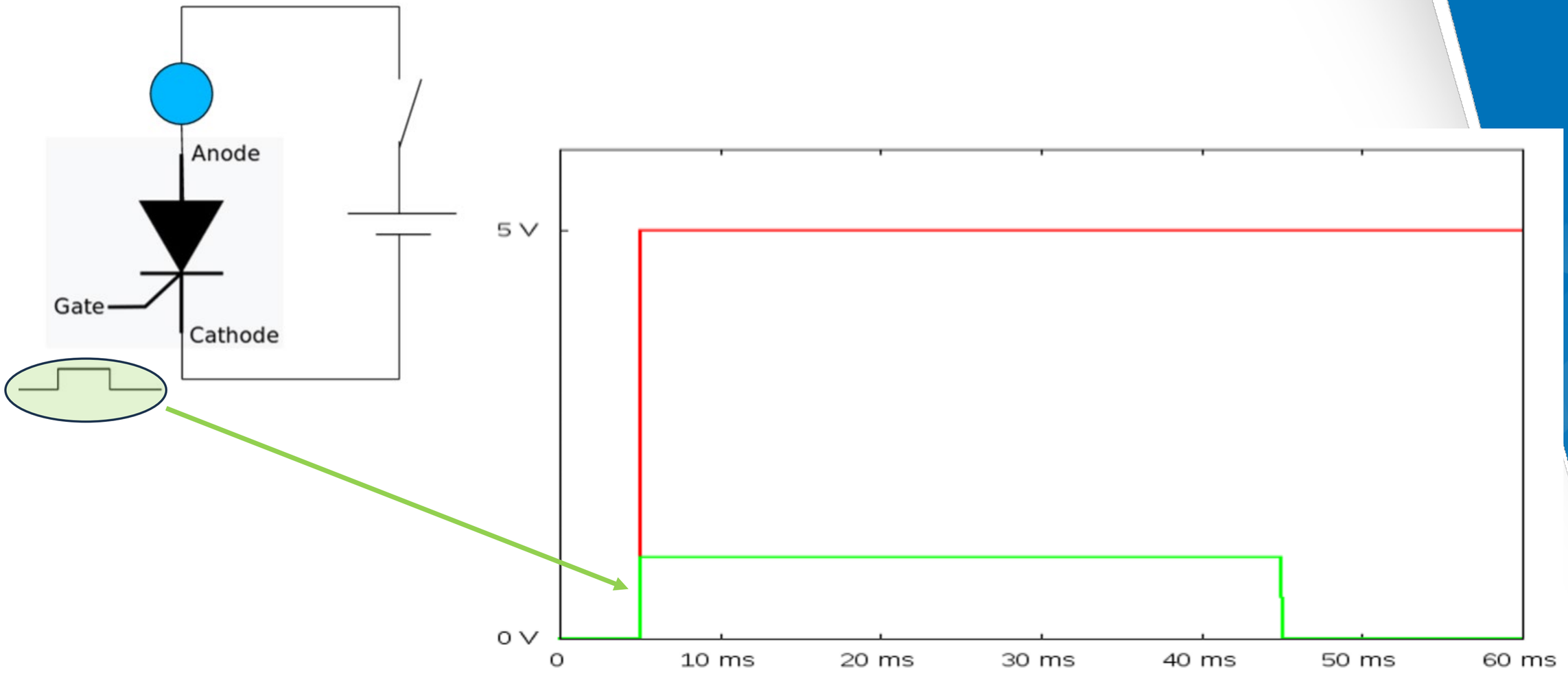
N Channel
Mosfet



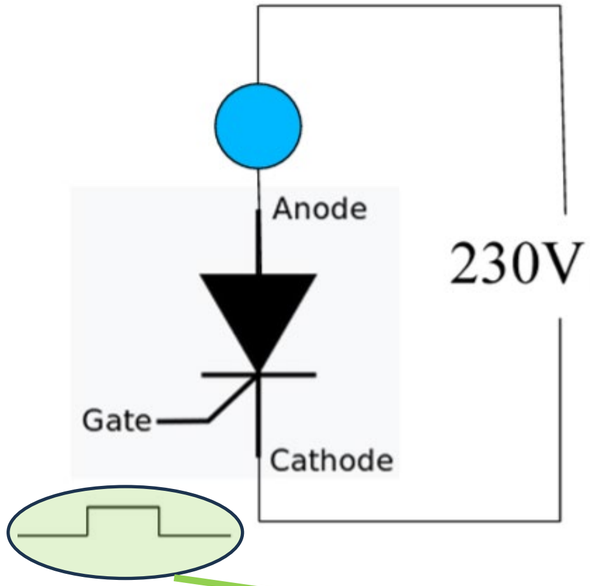
S = Source
G = Gate
D = Drain

V_{ds}=55 V
R_{ds}=17,5 mΩ
I_d=50 A

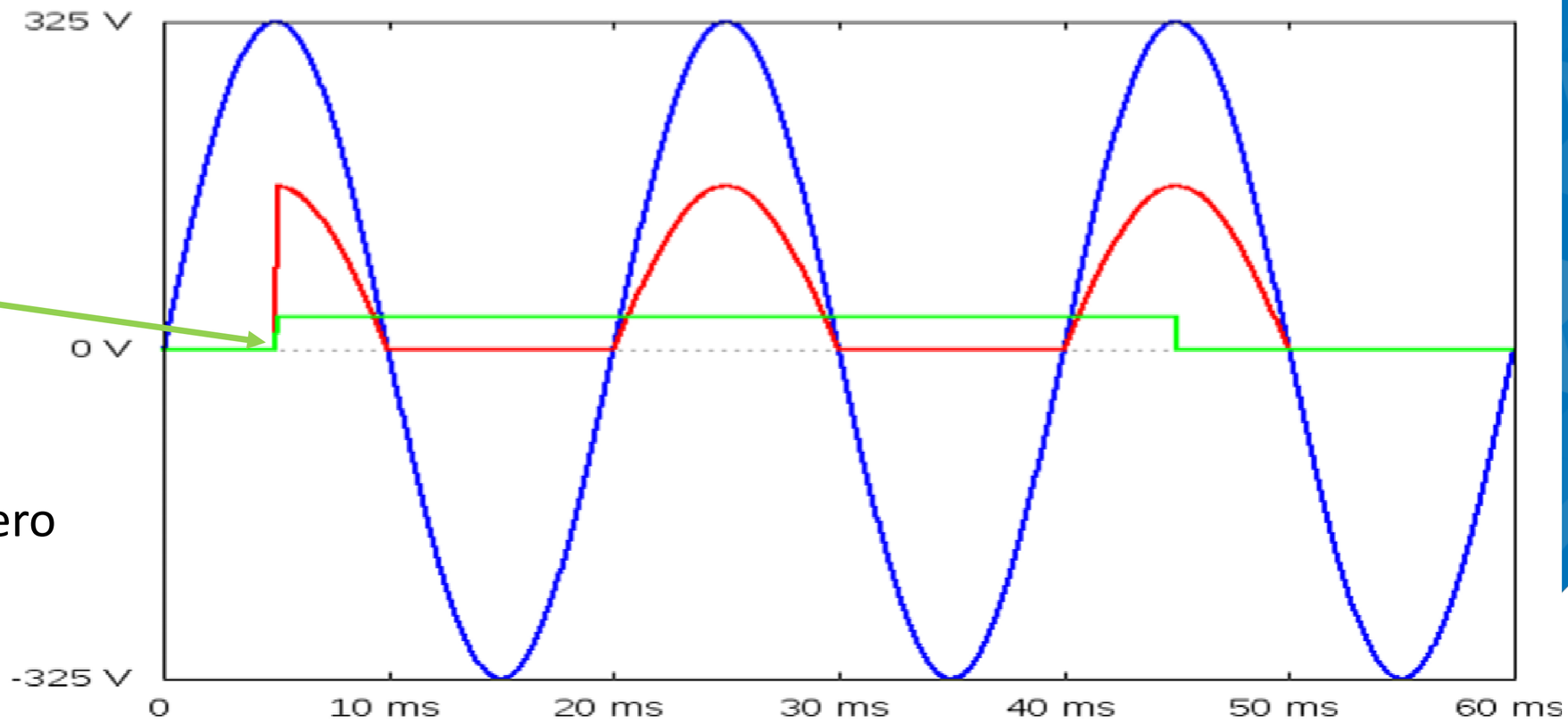
Control de potencia con el tiristor: tiristor en DC



Control de potencia con el tiristor: tiristor en AC

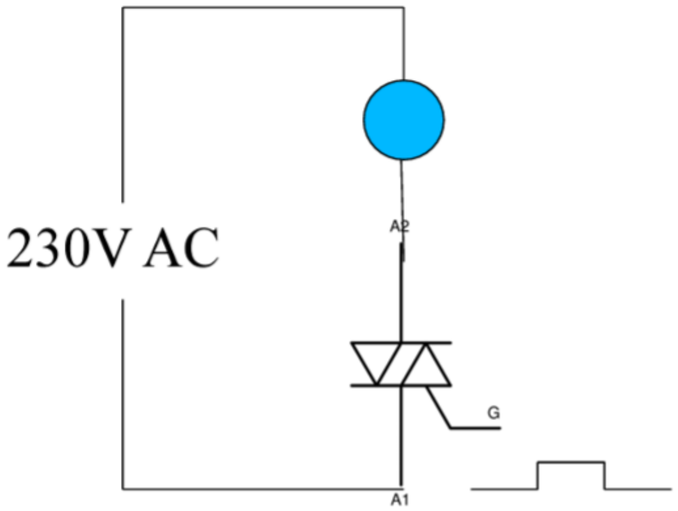


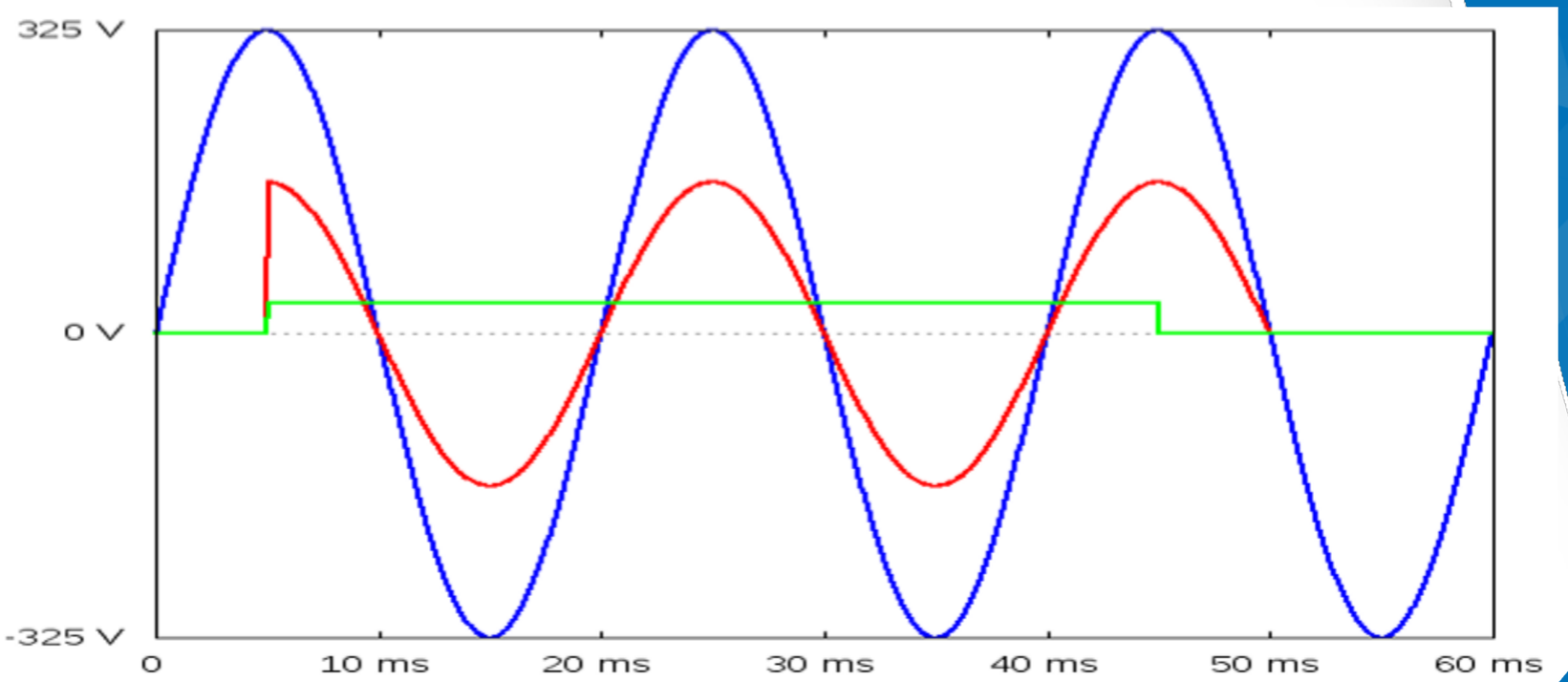
230V AC



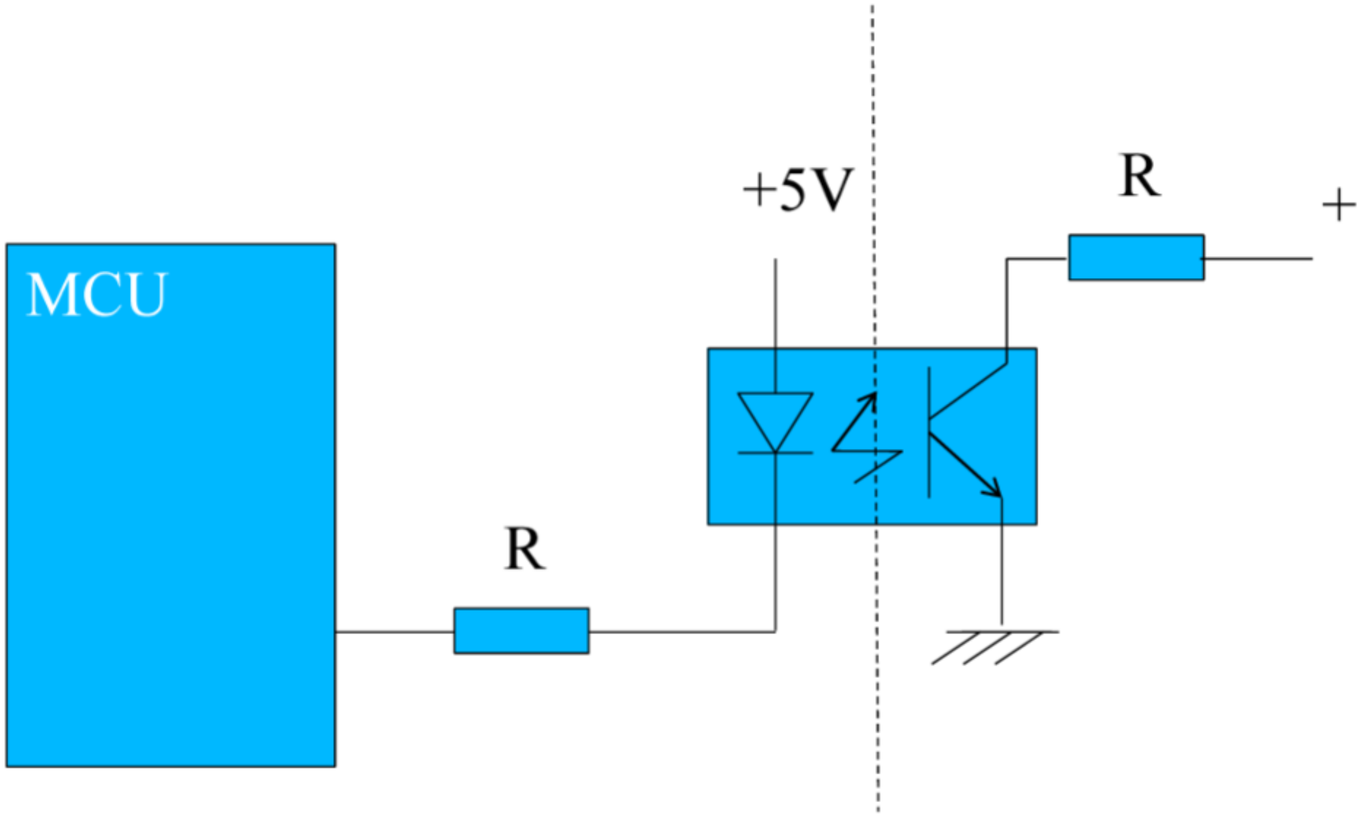
Conduce hasta cruce por cero

Control de potencia con TRIAC

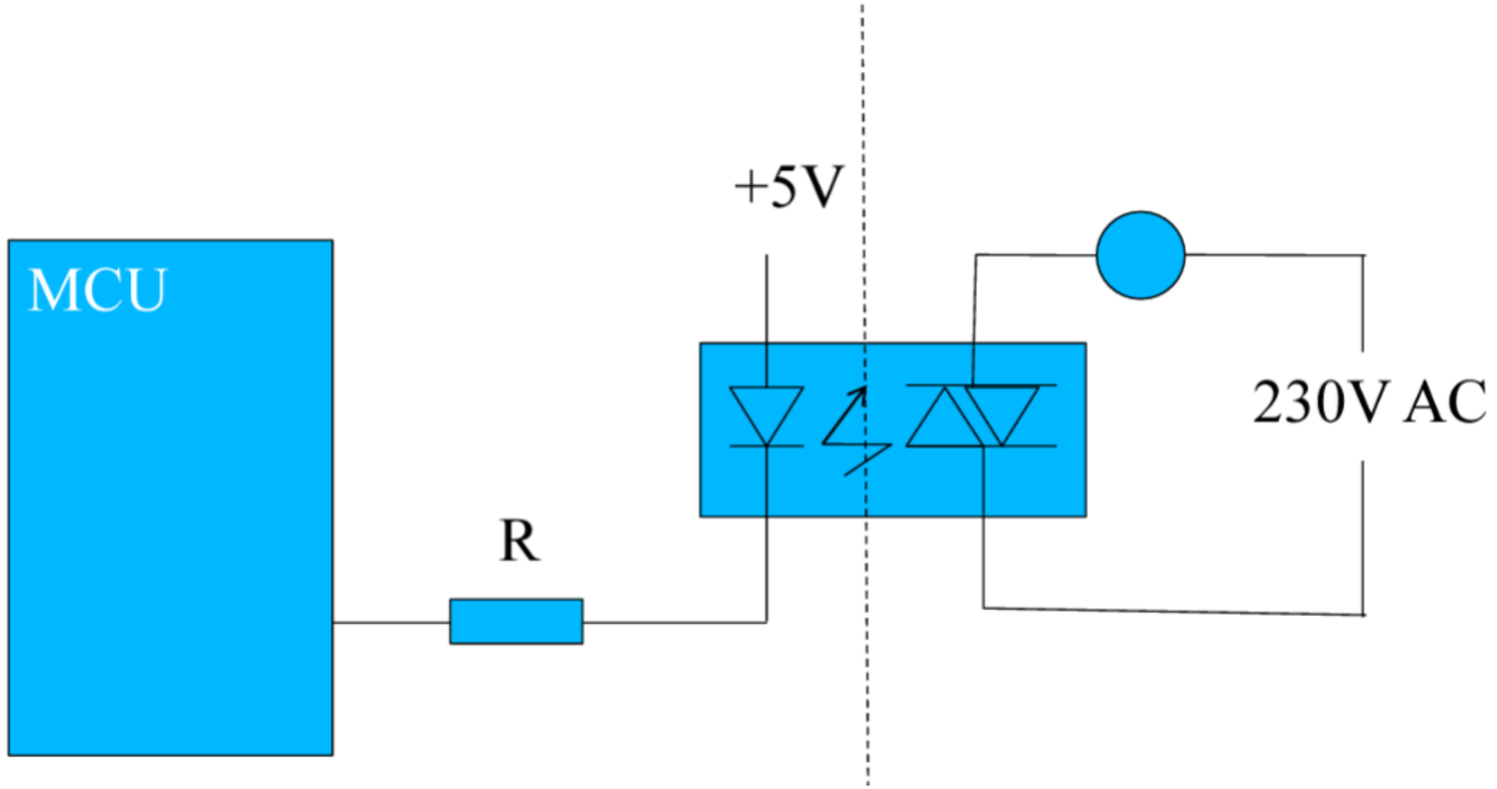




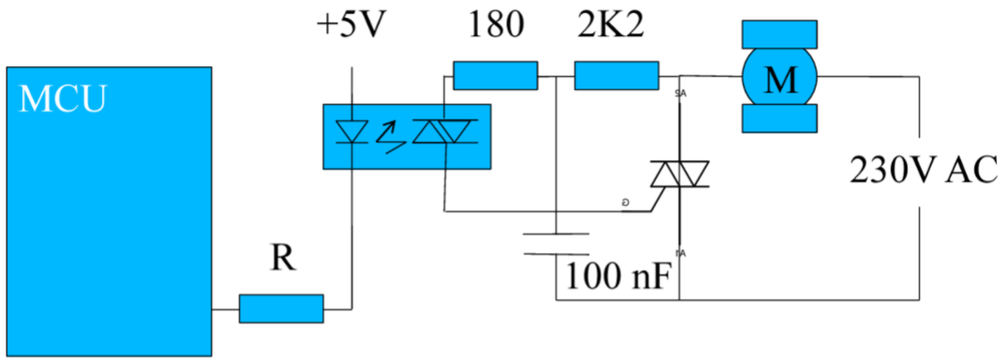
Aislamiento mediante optoacoplador



Aislamiento mediante Optotriac



Control de Potencia 230V AC con Optotriac y red SNUBBER



Circuito amortiguador de seguridad para el TRIAC, debido a una carga inductiva.