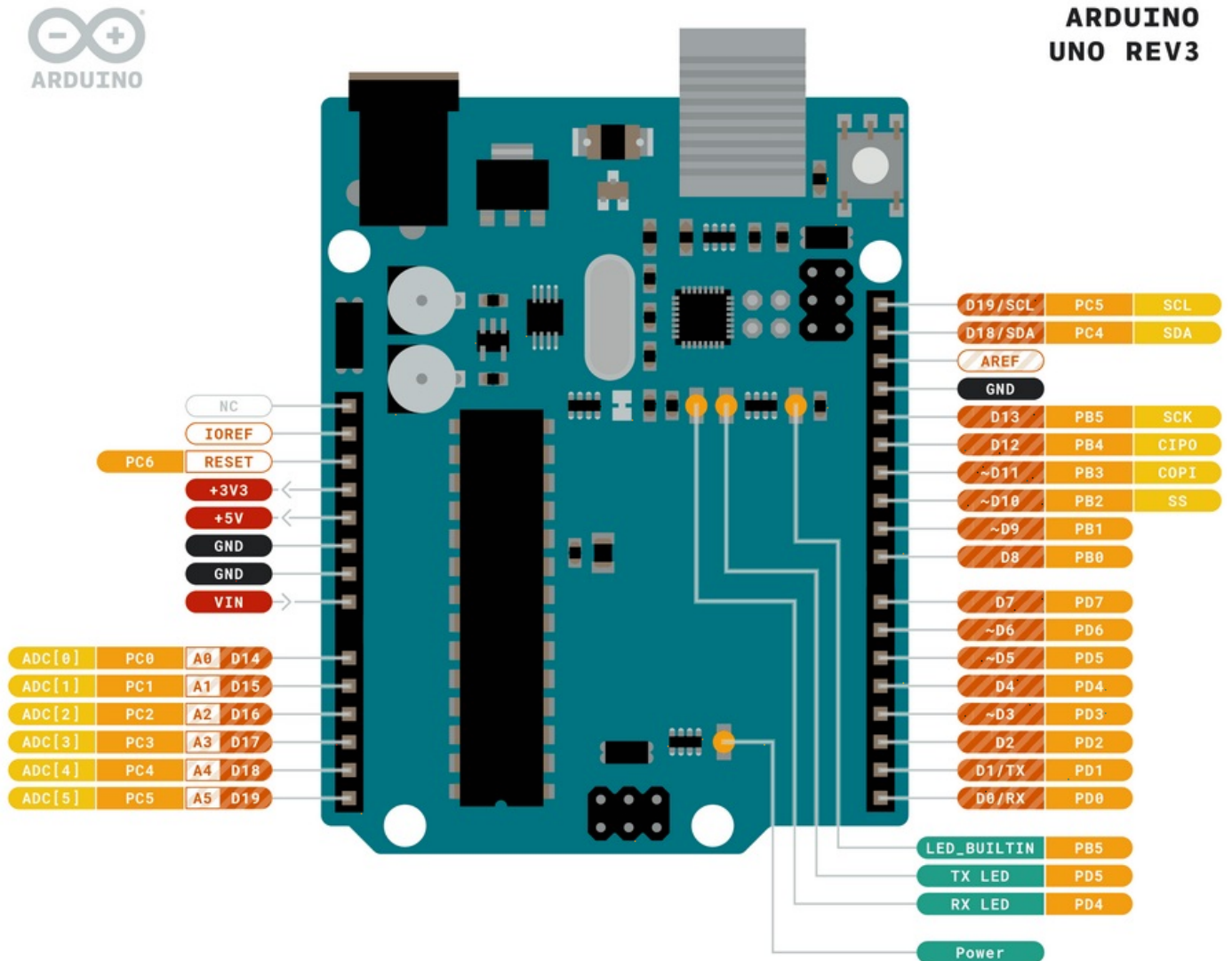


3. Input/Output (I/O) Programming

On the Arduino Uno (ATmega328P), digital I/O is controlled through **Port B, Port C, and Port D**. Each port is 8-bit, allowing control of up to 8 pins simultaneously.



Ground	Internal Pin	Digital Pin	Microcontroller's Port
Power	SWD Pin	Analog Pin	
LED	Other Pin	Default	

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A. Port to Arduino Pin Mapping

Port	Bits	Arduino Pin	Notes
Port B	PB0 - PB5	Digital Pin 8 - 13	PB6-PB7 are used for crystal oscillator
Port C	PC0 - PC5	Analog Pin A0 - A5	PC6 is the RESET pin
Port D	PD0 - PD7	Digital Pin 0 - 7	PD0 (RX) and PD1 (TX) for serial communication

B. Main I/O Registers

Three main registers control the behavior of each port:

Register	Full Name	Access	Function
DDRx	Data Direction Register	Read/Write	Configures pin direction. 0 = Input, 1 = Output
PORTx	Data Register	Read/Write	If Output: Sets logic High (1) or Low (0). If Input: Activates internal Pull-up resistor (1) or Tri-state (0)
PINx	Input Pins Address	Read Only	Reads the physical logic state of the pin (0 or 1)

(Replace 'x' with Port name, e.g., DDRB, PORTB, PINB)

C. Register Bit Configuration Details

DDRx - Data Direction Register

DDRx Bit Value	Pin Direction	Explanation
0	Input	Pin is configured as input (high impedance)
1	Output	Pin is configured as output (source/sink current)

PORTx - Data Register (Depends on DDRx Configuration)

DDRx	PORTx	Mode	Pin Condition
0 (Input)	0	Tri-state (Hi-Z)	Pin is floating, no pull-up
0 (Input)	1	Input Pull-up	Internal pull-up resistor active, pin defaults to HIGH
1 (Output)	0	Output Low	Pin outputs 0V (GND)
1 (Output)	1	Output High	Pin outputs 5V (VCC)

PINx - Input Pins Register

PINx Bit Value	Pin Status	Explanation
0	LOW	Pin voltage is below threshold (near 0V)
1	HIGH	Pin voltage is above threshold (near 5V)

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