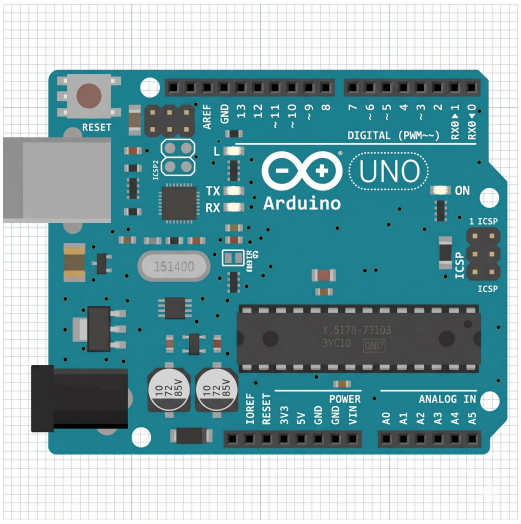
Arduino UNO R3

Microcontroller Development Board — Technical Datasheet



Overview

The Arduino UNO R3 is an open-source microcontroller board based on the Microchip ATmega328P. It is widely used for prototyping, education, and embedded development, offering 14 digital I/O pins, 6 analog inputs, a 16 MHz crystal oscillator, USB connection, and a DC power jack.

Key Features

- Microcontroller: ATmega328P @ 16 MHz
- Digital I/O: 14 pins (6 PWM-capable)
- Analog Inputs: 6 channels, 10-bit ADC
- Interfaces: UART, SPI, I2C
- Memory: 32KB Flash, 2KB SRAM, 1KB EEPROM
- Power: USB or 7–12V barrel jack
- Form Factor: 68.6 × 53.4 mm

At a Glance

MCU	Clock	Flash	SRAM	EEPROM	Digital I/O	Analog In	Operating Voltage
ATmega328P	16 MHz	32 KB	2 KB	1 KB	14	6	5V

Electrical Specifications

Absolute Maximum Ratings

Exceeding these values may permanently damage the device.

Parameter	Min	Typical	Max	Unit
Input Voltage (VIN)	6	7–12	20	V
Input Voltage (USB)	4.5	5.0	5.5	V
DC Current per I/O Pin	—	—	40	mA
DC Current for 3.3V Pin	—	—	50	mA
Operating Temperature	-40	25	85	°C
Flash Write Endurance	—	10,000	—	cycles
EEPROM Write Endurance	—	100,000	—	cycles

DC Characteristics (VCC = 5V, T = 25°C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage (USB)	VCC	4.5	5.0	5.5	V
Supply Voltage (VIN)	VIN	7.0	9.0	12.0	V
I/O High-Level Output	VOH	4.2	4.9	—	V
I/O Low-Level Output	VOL	—	0.05	0.7	V
I/O High-Level Input	VIH	3.0	—	5.5	V
I/O Low-Level Input	VIL	-0.5	—	1.5	V
Active Mode Current	ICC	—	12	20	mA
Power-Down Sleep Current	IDD	—	0.1	1	µA

Power Supply

Rail	Source	Max Current	Regulator	Notes
5V	USB or VIN	500 mA	NCP1117	Primary logic supply
3.3V	5V rail	50 mA	LP2985	For 3.3V peripherals
VIN	Barrel jack	—	—	Unregulated, 7–12V
IOREF	5V rail	Ref only	—	Shield voltage reference

Pin Reference & I/O

Digital I/O Pins (D0–D13)

All pins operate at 5V logic. 6 pins support PWM output. Internal pull-ups of 20–50 kΩ available on all pins.

Pin	Label	Alt Function	PWM	Notes
PD0	D0 / RX	UART RX	—	Serial receive
PD1	D1 / TX	UART TX	—	Serial transmit
PD2	D2	INT0	—	External interrupt 0
PD3	D3	INT1	Yes (~980 Hz)	External interrupt 1 + PWM
PD4	D4	T0	—	Timer 0 clock input
PD5	D5	T1	Yes (~490 Hz)	PWM output
PD6	D6	AIN0	Yes (~490 Hz)	Analog comparator + PWM
PD7	D7	AIN1	—	Analog comparator input
PB0	D8	ICP1	—	Timer 1 input capture
PB1	D9	OC1A	Yes (~490 Hz)	16-bit timer PWM
PB2	D10	SS / OC1B	Yes (~490 Hz)	SPI Slave Select + PWM
PB3	D11	MOSI / OC2A	Yes (~490 Hz)	SPI MOSI + PWM
PB4	D12	MISO	—	SPI Master In Slave Out
PB5	D13	SCK / LED	—	SPI clock + onboard LED

Analog Input Pins (A0–A5)

Pin	Label	ADC Channel	Digital Alt	Notes
PC0	A0	ADC0	D14	General analog input
PC1	A1	ADC1	D15	General analog input
PC2	A2	ADC2	D16	General analog input
PC3	A3	ADC3	D17	General analog input
PC4	A4	ADC4 / SDA	D18	Shared with I2C SDA
PC5	A5	ADC5 / SCL	D19	Shared with I2C SCL

Communication Interfaces

Interface	Pins	Max Speed	Library
UART	D0 (RX), D1 (TX)	2 Mbps	Serial
SPI	D10 (SS), D11 (MOSI), D12 (MISO), D13 (SCK)	8 Mbps	SPI
I2C	A4 (SDA), A5 (SCL)	400 kHz	Wire

Memory, Timers & Programming

Memory Map

Memory	Size	Address Range	Volatility	Notes
Flash (Program)	32 KB	0x0000–0x7FFF	Non-volatile	512B reserved for Optiboot bootloader
SRAM (Data)	2 KB	0x0100–0x08FF	Volatile	Stack grows down from 0x08FF
EEPROM	1 KB	0x000–0x3FF	Non-volatile	100,000 write cycle endurance
I/O Registers	64 B	0x0020–0x005F	Volatile	Direct peripheral control
Ext I/O Registers	160 B	0x0060–0x00FF	Volatile	Extended peripheral registers

Timer/Counter Modules

Timer	Bits	Prescaler Options	PWM Pins	Notes
Timer 0	8-bit	1, 8, 64, 256, 1024	D5, D6	Used by millis() / delay() — do not modify
Timer 1	16-bit	1, 8, 64, 256, 1024	D9, D10	Input Capture, Phase-correct PWM
Timer 2	8-bit	1, 8, 32, 64, 128, 256, 1024	D3, D11	Async mode with 32.768 kHz crystal

ADC Specifications

Parameter	Value	Notes
Resolution	10-bit	0–1023 output range
Conversion Time	13–260 µs	Depends on ADC clock prescaler
Reference Options	AVCC, AREF, 1.1V internal	Set via analogReference()
Accuracy (INL)	±2 LSB	Integral non-linearity max
Recommended Source Impedance	< 10 kΩ	Higher impedance reduces accuracy

Programming Methods

Method	Interface	Bootloader Required	Speed
USB (Standard)	USB-B → ATmega16U2 → UART	Yes (Optiboot)	115,200 baud
ICSP Header	6-pin ISP connector	No	Up to 1 MHz SCK
UART Direct	D0/D1 via USB-TTL adapter	Yes	115,200 baud

Mechanical & Reference

Physical Dimensions

Dimension	Value	Notes
PCB Length	68.6 mm (2.7 in)	Along connector edge
PCB Width	53.4 mm (2.1 in)	USB to power jack edge
PCB Thickness	1.6 mm	Standard FR4 substrate
Weight	~25 g	Bare board without cables
Mounting Hole Diameter	3.2 mm	4× holes, M3 compatible
Digital Header Pitch	2.54 mm (0.1 in)	14 pins D0–D13
Analog Header Pitch	2.54 mm (0.1 in)	6 pins A0–A5
USB Connector	Type-B (standard)	Host-side connection
DC Power Connector	5.5mm OD / 2.1mm ID barrel	Center positive

Board Components

Component	Part	Description
Main MCU	ATmega328P-PU	28-pin DIP, 8-bit AVR @ 16 MHz
USB-Serial Bridge	ATmega16U2	Full-speed USB 2.0, factory-programmed
5V Regulator	NCP1117	LDO, up to 800 mA
3.3V Regulator	LP2985	LDO, 50 mA max
Crystal	16 MHz	Main clock source
Reset Button	Tactile switch	Pulls RESET pin to GND
Onboard LED	Pin D13 (yellow)	Controlled via digitalWrite(13, ...)
ICSP Header	6-pin 2×3	For ISP programming of ATmega328P

Regulatory Compliance

Certification	Status	Region
CE Marking	Compliant	European Union
FCC Part 15	Class B Compliant	United States
RoHS	Compliant (Pb-free)	Worldwide
Open Source Hardware	OSHW Certified — CC-BY-SA	Global

References

• Arduino Official Docs: arduino.cc/en/Reference

• ATmega328P Datasheet: Microchip Technology DS40002061B

• Optiboot Bootloader: github.com/Optiboot/optiboot

• Arduino UNO Schematic: content.arduino.cc/assets/UNO-TH_Rev3e_sch.pdf

• voltX.dev: voltX.dev