Introduction to the Arduino Uno Board

Branded Arduino vs. clones

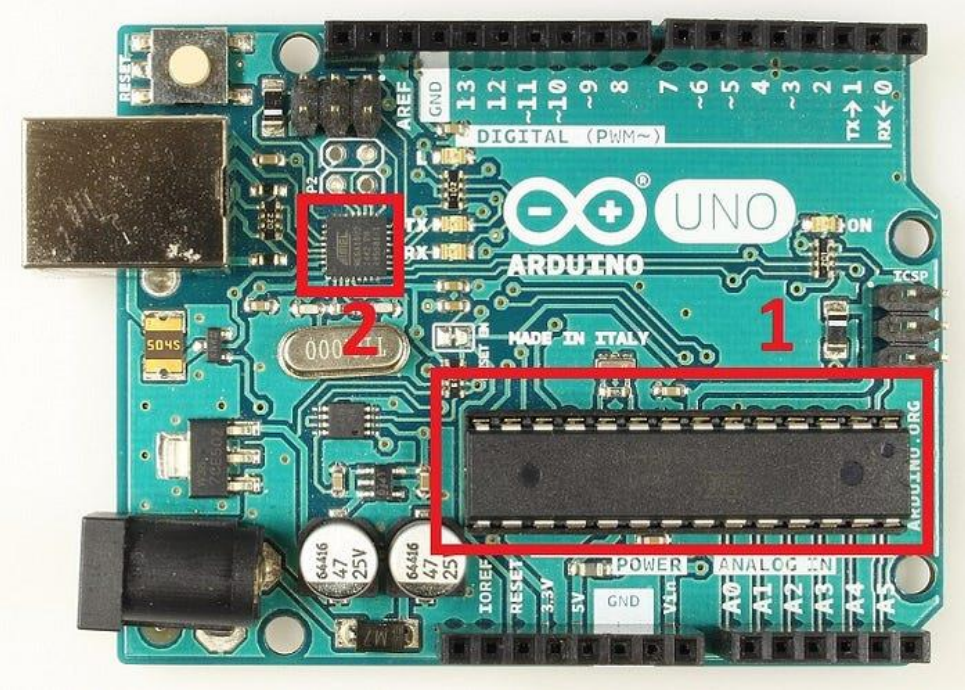
What does “Arduino” really mean?

- Arduino is the name of an Italian company who originally came up with the board design.
  - It is NOT the name of the chip. That is an ATMEL MEGA328P.
  - To be called an Arduino clone, the board will have the same pinout and same form factor.
  - There are many types of Arduino boards, but we will be working with the most common, the UNO.
  - The Arduino company continues to do research, improve the IDE and develop new boards and drivers.
- If your board does not say Arduino, it is probably a licensed clone. A licensed clone should not have any Arduino branding on it.
- All clones should work identically to a true Arduino board. They may differ in power consumption, but functionally they should be the same.
- The same software (IDE) is used regardless of the board source.
- The most common language to program an Arduino-type board is C++, using the official IDE.
- Typically the branded Arduino is 2-3 times more expensive than the clone ($25-30 vs $10-15)

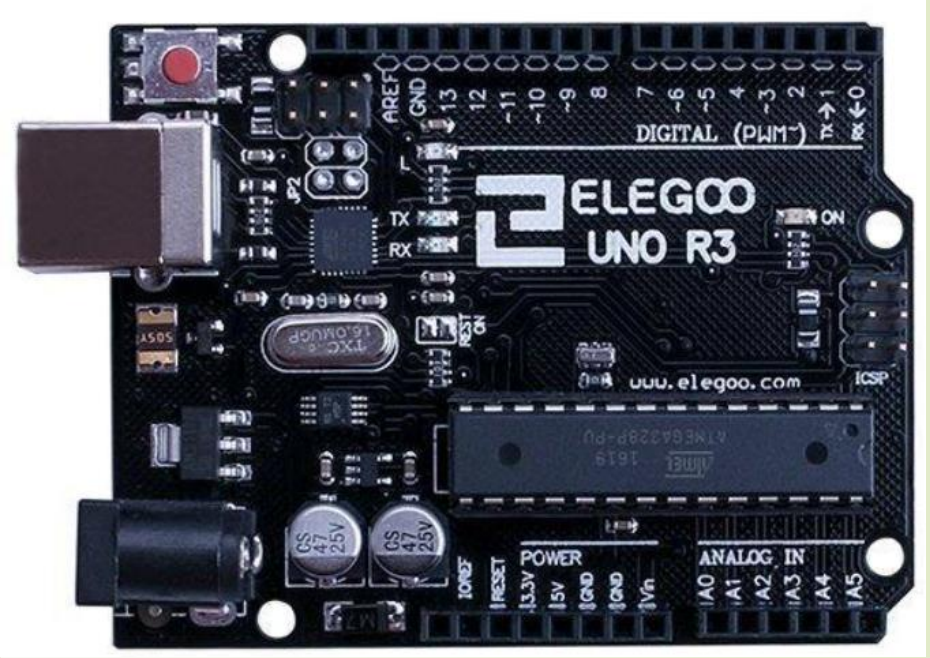
Clone or branded?

- Clones can be just as good of quality as a branded board, so why pay more?
  - Branded Arduino purchase also supports further R&D, advances in the IDE, and development of new drivers.
  - Branded Arduino uses a different chip (ATmega16U2) for USB to Serial communication, and does not require a separate driver to be installed.
- Are there advantages to clones?
  - Some clones may use less power because of their use of a simpler, lower-power USB to Serial chip (CH340G)
  - Other clones may use the exact same chip set but still cost less.
- One advantage to using the DIP (dual inline package) version of the Atmel 328P chip is that you can unplug it and plug in a new chip if it becomes unusable (burned out accidentally for example).
  - Of course, you can get an entire new board for about $15 so cost is not a big deal

Physical appearance

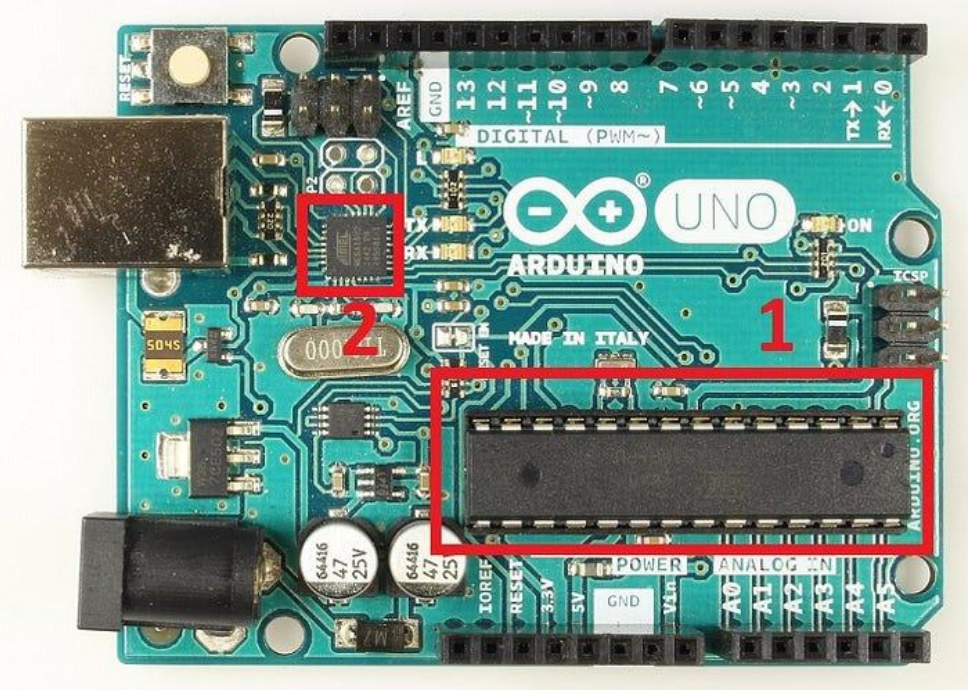


Branded Arduino Uno board
1=Atmel Mega 328P
2=ATmega16U2

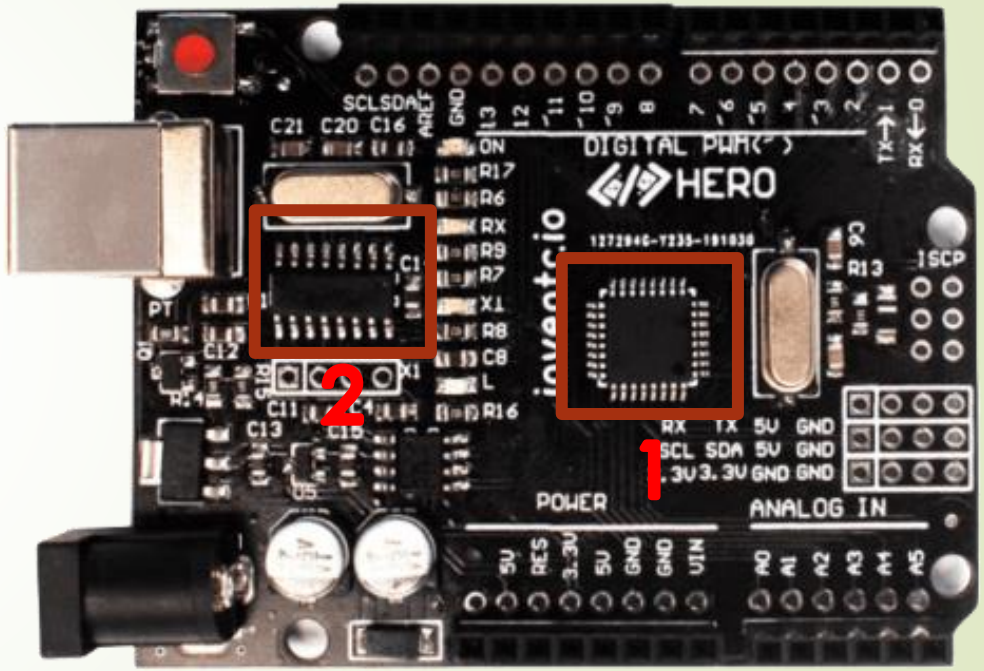


Licensed clone using same chipset
Note no Arduino logos are being illegally used.

Physical appearance (different chip set)



Branded Arduino Uno board
1=Atmel Mega 328P DIP package
2=ATmega16U2



Legal clone using different chips
1=Atmel Mega 328P surface mount
2=CH340G

Features of the Arduino Uno

- Digital I/O Pins: The UNO has 14 digital input/output pins, with 6 of them capable of providing pulse width modulation (PWM) output.
- Analog Input Pins: There are 6 analog input pins available, capable of sensing 0-5V.
- Resonator: The UNO features a 16 MHz ceramic resonator.
- Connectivity: It has a USB connection and an ICSP (for flashing firmware) header.
- Reset Button: The reset button is included on the board.
  - Note this does not clear code from memory, just starts the existing code from the beginning. To clear existing code from memory just upload a new sketch with an empty setup and loop.
- EEPROM: The ATmega328P microcontroller on the UNO also has 1 KB of non-volatile EEPROM memory.
- Programmable with C++ and the Arduino IDE
- Battery Connector: The UNO features a barrel plug connector compatible with a 9V battery (or 7-12 volt power supply), or can be powered by USB.

Types of pins (using board numbers)

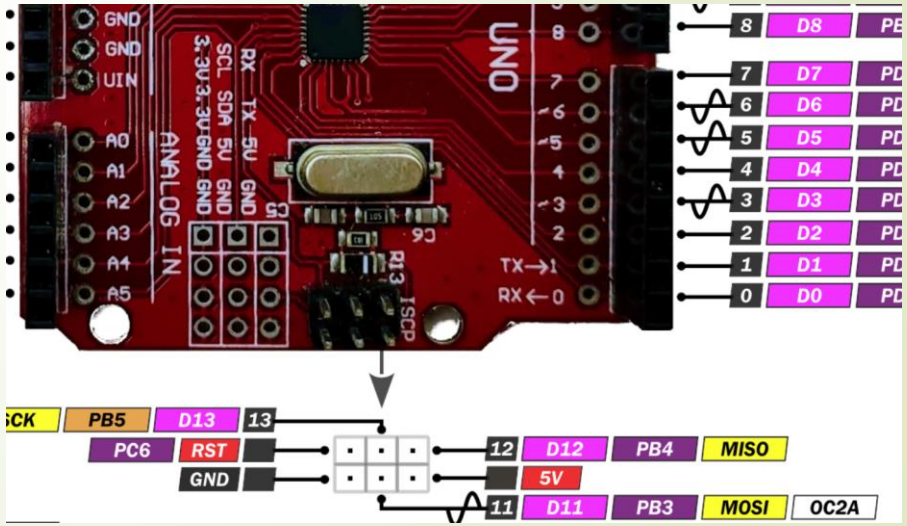
- 0-13: digital I/O. Use pinModes OUTPUT, INPUT, or INPUT_PULLUP
- 3,5,6,8,10,11: digital pins that support Pulse Width Modulation by hardware
- 0, 1: used for serial communication. Don't use these simultaneously for both serial and also something like LED control or switch reading.
- A0-A5: analog Input or digital I/O
  - Set up as digital IO with pinModes above, or
  - Use as analog input with analogRead() (0-1023 returned for 0-5V)
- A4, A5: used when a device needs to communicate with I2C protocol. Note these are also available on the header near the reset button. If not using I2C protocol, these can be used as normal analog pins.

The power block

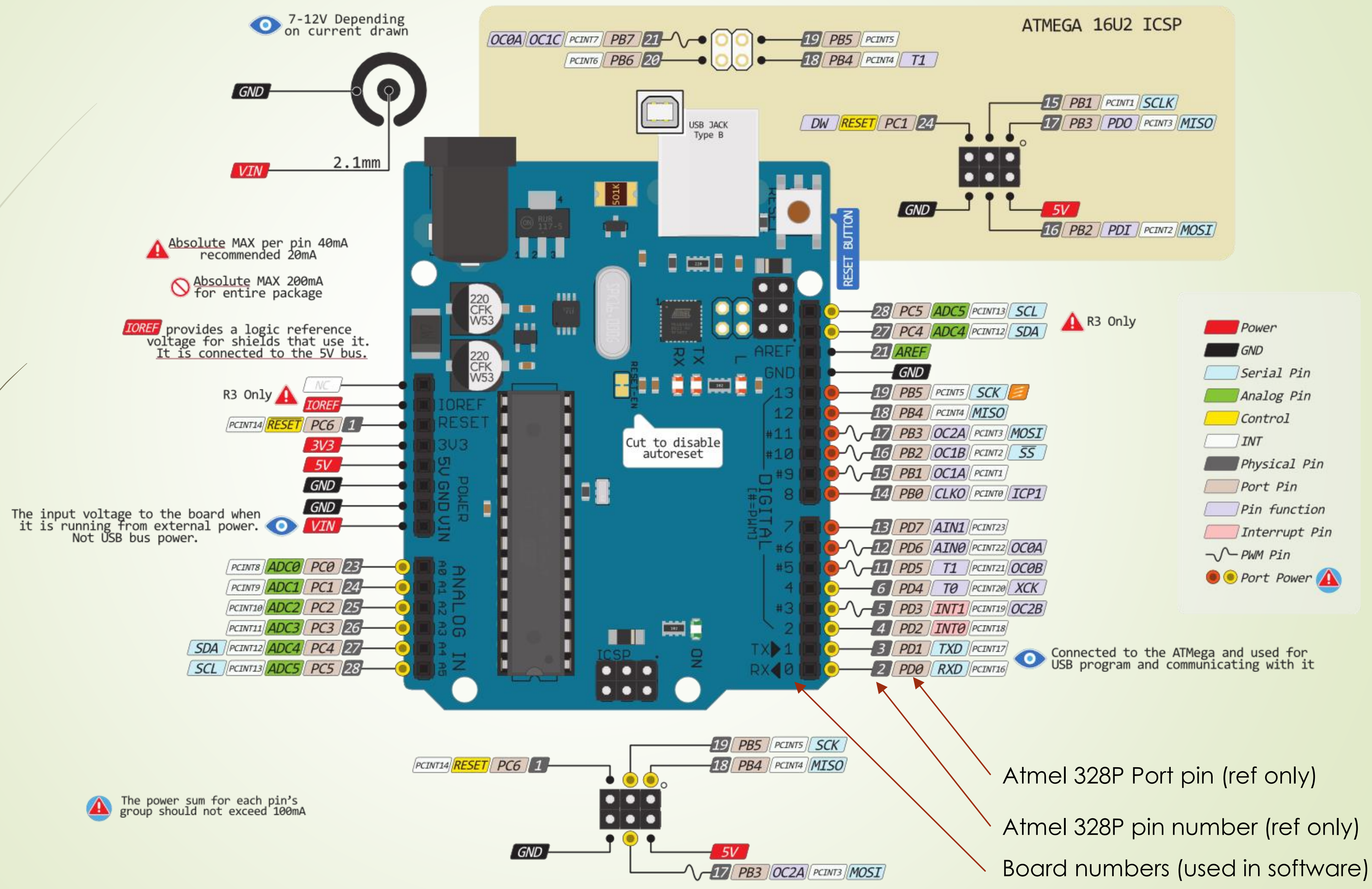
- Next to the analog pin block is the power block.
  - Vin – A dual purpose pin. When the barrel jack is used for power, this provides the approximate input voltage (for a 9V supply, I got a reading of 8.4V). When the barrel jack is NOT in use, this pin can be connected to the + side of a 7-12 V power supply. In other words, this is an alternate connection to provide power. This provides about 4.5 volts when USB is being used. Not usually used for powering things.
  - Gnd (3 pins)-- These two grounds, as well as the ground next to pin 13 are all connected together. These are the ground connections to use for your circuits.
  - 5V – This is a source of regulated 5V which can be used to power your circuits.
  - 3.3V – A lower voltage regulated power which is sometimes used for some devices.
  - Res(et) – Can be used to mimic the effect of the reset button by connecting directly to ground using a momentary button
  - IORef (or sometimes 5V) – Practically speaking this is another source of 5V since it is connected to the other 5V pin. Some shields read the voltage at this pin to adapt to the power being used on the board. (A shield is a board, typically with a single function, that plugs into the top side of the board, like a Wi-fi shield or a display shield)
- Note that while you can connect an external power supply at the barrel jack at the same time the USB is connected, internal circuitry will automatically only use the barrel jack power supply. When the barrel jack is no longer being used, power automatically switches back to the USB connector.

Miscellaneous pins and duplicates

- AREF – This pin allows an external reference voltage (0-5V) to be used when making analog conversions. This voltage defines the maximum range as 1023 counts and so can be used to control resolution. (Default is 5V, internal avail as 1.1V, or use this pin for an external voltage source).
- Male pin block near analog pin block end of board:
  - ICSP header (In-circuit serial programming). Only needed for custom flashing.
  - Holes next to male block are duplicates for:
    - Serial: RX and TX
    - I2C: SCL and SDA
- Also, there are holes next to the CH340G chip
  - These are for directly communicating with the CH340G, and will not be used in this course
- Holes next to headers can be used for soldered connections



UNO PINOUT



7-12V Depending on current drawn
GND
2.1mm
VIN
ATMEGA 16U2 ICSP
OC0A OC1C PCINT7 PB7 21
PCINT6 PB6 20
19 PB5 PCINT5
18 PB4 PCINT4 T1
USB JACK Type B
DW RESET PC1 24
15 PB1 PCINT1 SCLK
17 PB3 PDO PCINT3 MISO
GND
5V
16 PB2 PDI PCINT2 MOSI
RESET BUTTON
Absolute MAX per pin 40mA recommended 20mA
Absolute MAX 200mA for entire package
IOREF provides a logic reference voltage for shields that use it. It is connected to the 5V bus.
R3 Only
NC
IOREF
PCINT14 RESET PC6 1
3V3
5V
GND
GND
VIN
The input voltage to the board when it is running from external power. Not USB bus power.
PCINT8 ADC0 PC0 23
PCINT9 ADC1 PC1 24
PCINT10 ADC2 PC2 25
PCINT11 ADC3 PC3 26
SDA PCINT12 ADC4 PC4 27
SCL PCINT13 ADC5 PC5 28
Cut to disable autoreset
28 PC5 ADC5 PCINT13 SCL
27 PC4 ADC4 PCINT12 SDA
21 AREF
GND
19 PB5 PCINT5 SCK
18 PB4 PCINT4 MISO
17 PB3 OC2A PCINT3 MOSI
16 PB2 OC1B PCINT2 SS
15 PB1 OC1A PCINT1
14 PB0 CLKO PCINT0 ICP1
13 PD7 AIN1 PCINT23
12 PD6 AIN0 PCINT22 OC0A
11 PD5 T1 PCINT21 OC0B
6 PD4 T0 PCINT20 XCK
5 PD3 INT1 PCINT19 OC2B
4 PD2 INT0 PCINT18
3 PD1 TXD PCINT17
2 PD0 RXD PCINT16
Connected to the ATMega and used for USB program and communicating with it
Power
GND
Serial Pin
Analog Pin
Control
INT
Physical Pin
Port Pin
Pin function
Interrupt Pin
PWM Pin
Port Power
PCINT14 RESET PC6 1
19 PB5 PCINT5 SCK
18 PB4 PCINT4 MISO
GND
5V
17 PB3 OC2A PCINT3 MOSI
The power sum for each pin's group should not exceed 100mA
Atmel 328P Port pin (ref only)
Atmel 328P pin number (ref only)
Board numbers (used in software)

For More Information

- The official Arduino documentation site: Arduino Docs | Arduino Documentation
- Code examples: Built-in Examples | Arduino Documentation
- Language reference: Arduino Reference - Arduino Reference
- A deeper dive into pinout: The Full Arduino Uno Pinout Guide [including diagram] (circuito.io)
- The GITHUB page for inventor.io clone, the Hero board. The clone provided in your kit should be very similar to this: HERO/README.md at master · inventrkits/HERO · GitHub This link contains board artwork and schematics.