

Development Boards

Module Code: GEEN1064

Module Name: Engineering Design and Implementation

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What is (and isn't) a Microcontroller (μ C)

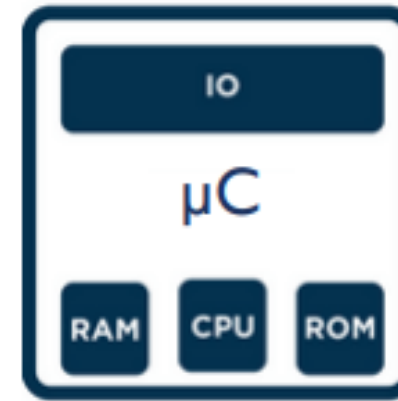
- A μ C is a small, self-contained computer that is housed on a single integrated circuit, or microchip.
- They differ from your desktop computer in that they are typically dedicated to a single function, and are most often embedded in other devices (e.g. mobile phones; household electronics).
- A μ C is an Integrated Circuit (IC) device used for controlling other portions of an electronic system
- These devices are optimized for embedded applications that require both processing functionality and agile, responsive interaction with digital, analogue, or electromechanical components.

What is (and isn't) a Microcontroller (μ C)

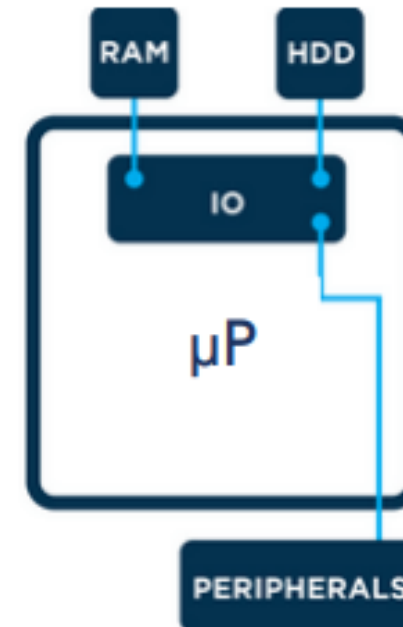
- μ C” is a well-chosen name because it emphasizes defining characteristics of this product category. The prefix “ μ ” implies smallness and the term "controller" here implies an enhanced ability to perform control functions.
- As stated above, this functionality is the result of combining a digital processor and digital memory with additional hardware that is specifically designed to help the μ C interact with other components.

Microcontroller vs a Microprocessor

- μP contain only a Central Processing Unit (CPU), and therefore require added peripherals to perform tasks.
- CPU is the brain of any computer and it is the part of a computer that performs calculations, actions, and runs programs.
 - Intel Core i series, AMD



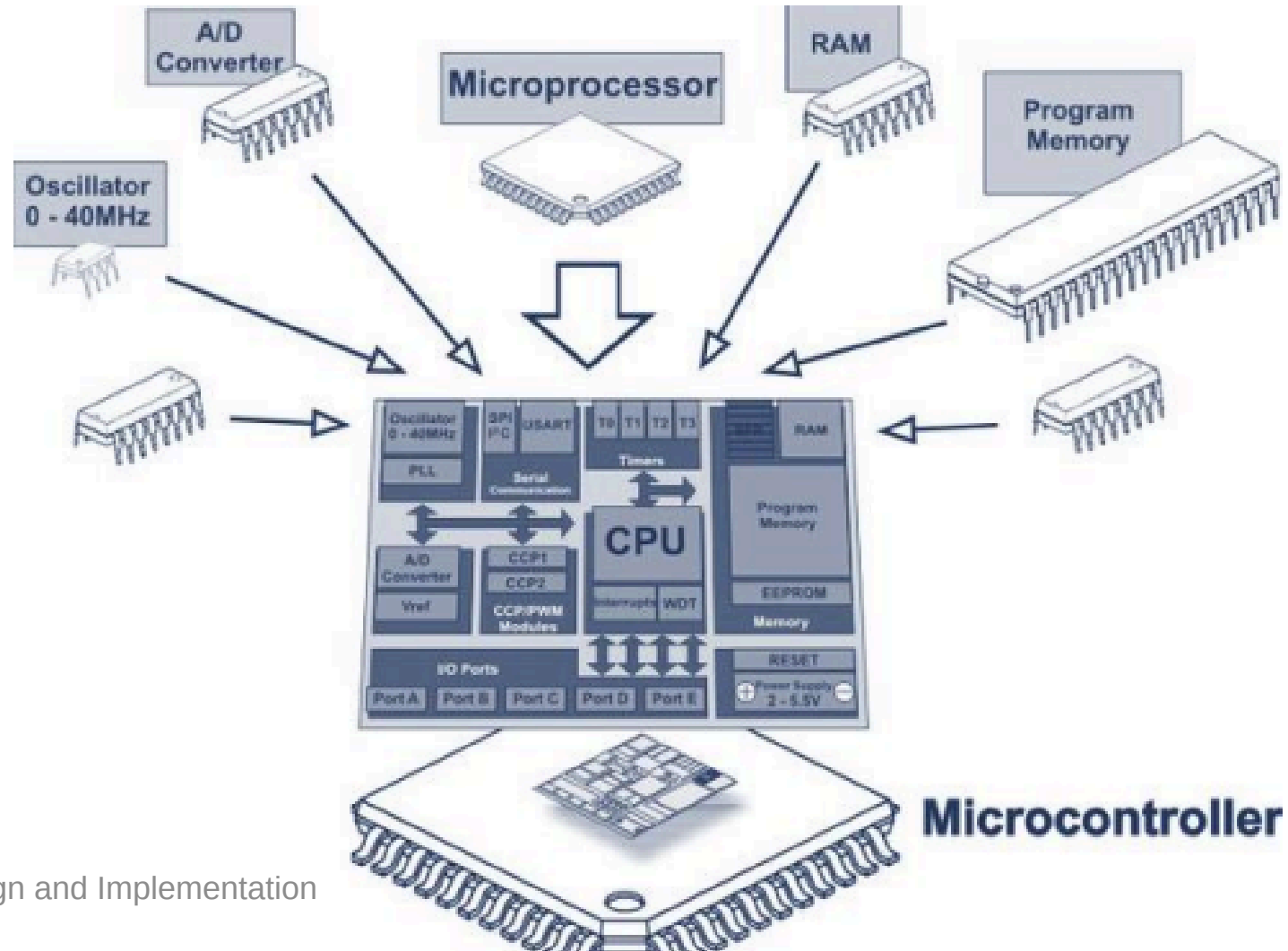
μC vs μP



RAM and ROM

- μ Cs, on the other hand, contain RAM, ROM, and similar peripherals, which allow them to perform (simple) tasks independently.
- Random-Access Memory (RAM)
 - everyday tasks, such as loading applications, browsing the internet, editing a spreadsheet, or experiencing the latest game
- Read-Only Memory (ROM)
 - computer memory chips containing permanent or semi-permanent data.
Unlike RAM, ROM is non-volatile; even after you turn off your computer, the contents of ROM will remain

Exploded View



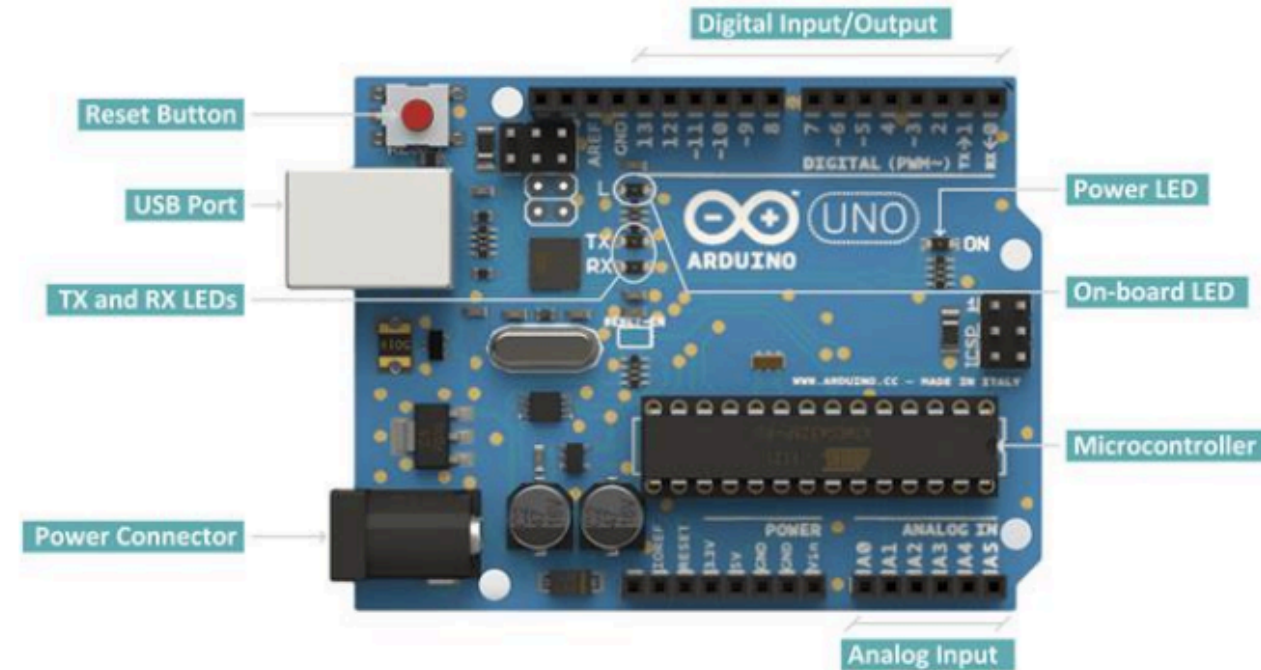
Deployment Platforms

- Prototyping platforms
 - Arduino family -> Uno, Mega, MKR series...
 - Single board computers -> Raspberry Pi, Orange Pi, Odroid, Jetson Nano....
- Used to build physical computing projects
 - Taking information from the world around us by using inputs such as sensors and switches and responding to that information with outputs like actuators, graphical indicators, lights etc.
- Open source hardware and software
- Open source projects emphasise the importance of documentation and sharing, making the community of users a great resource for learners.

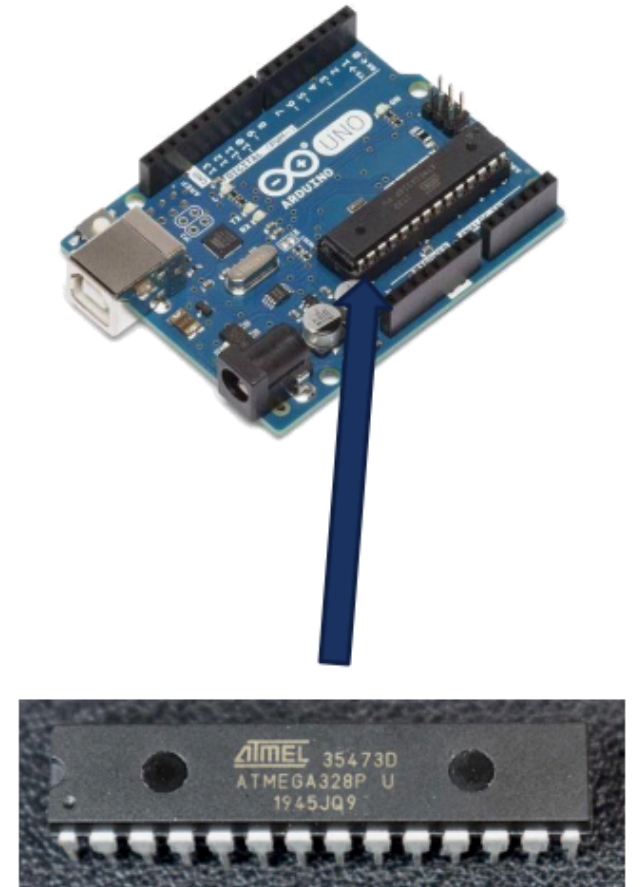
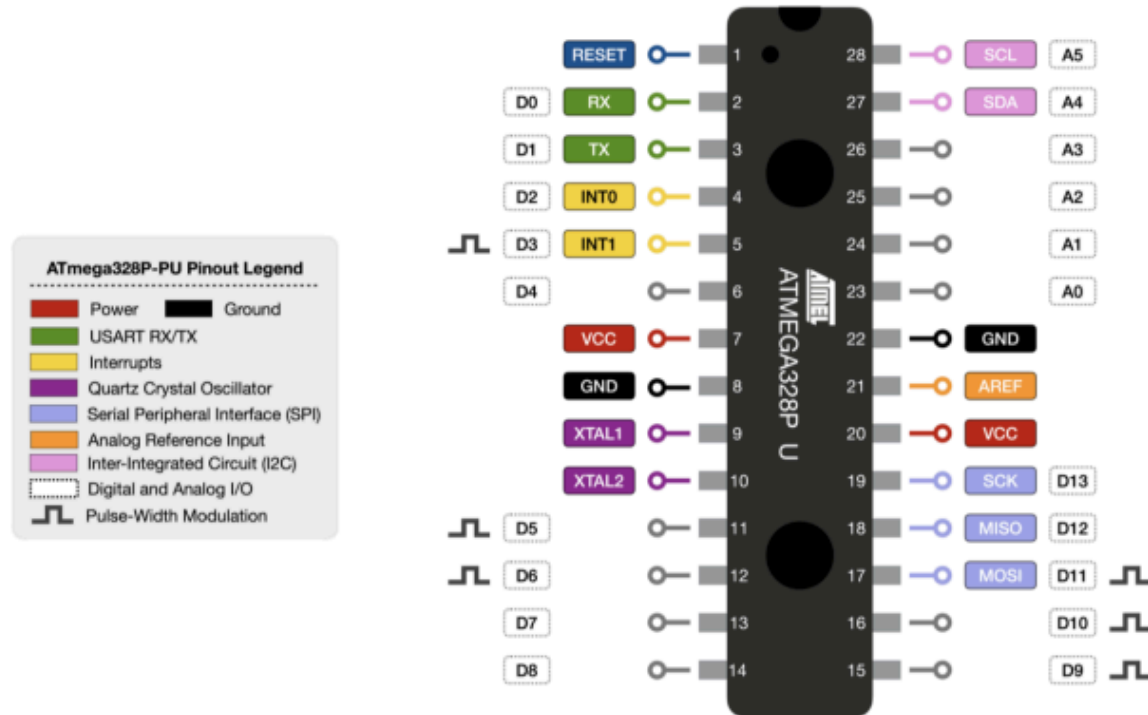
Arduino Uno

Prototype Board from Arduino

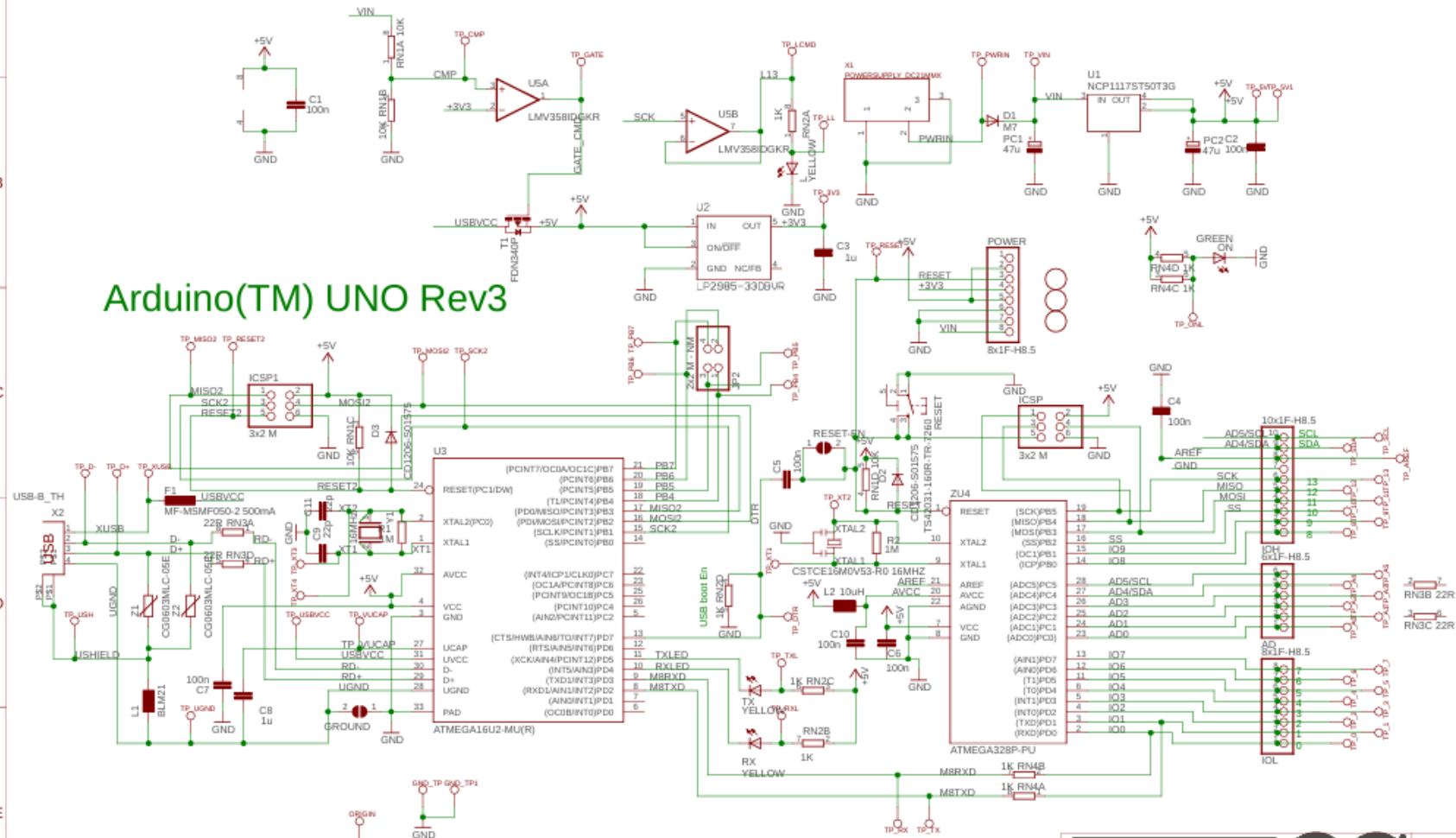
- The Uno is a μ C development board with an Atmega328P Chip
- 14 digital Input/Output (I/O) pins
- 6 Analogue Input pins (e.g. temperature sensors)
- 6 PWM Output pins (e.g. actuators)
- A 16 MHz quartz crystal



ATmega328P Chip



Arduino(TM) UNO Rev3

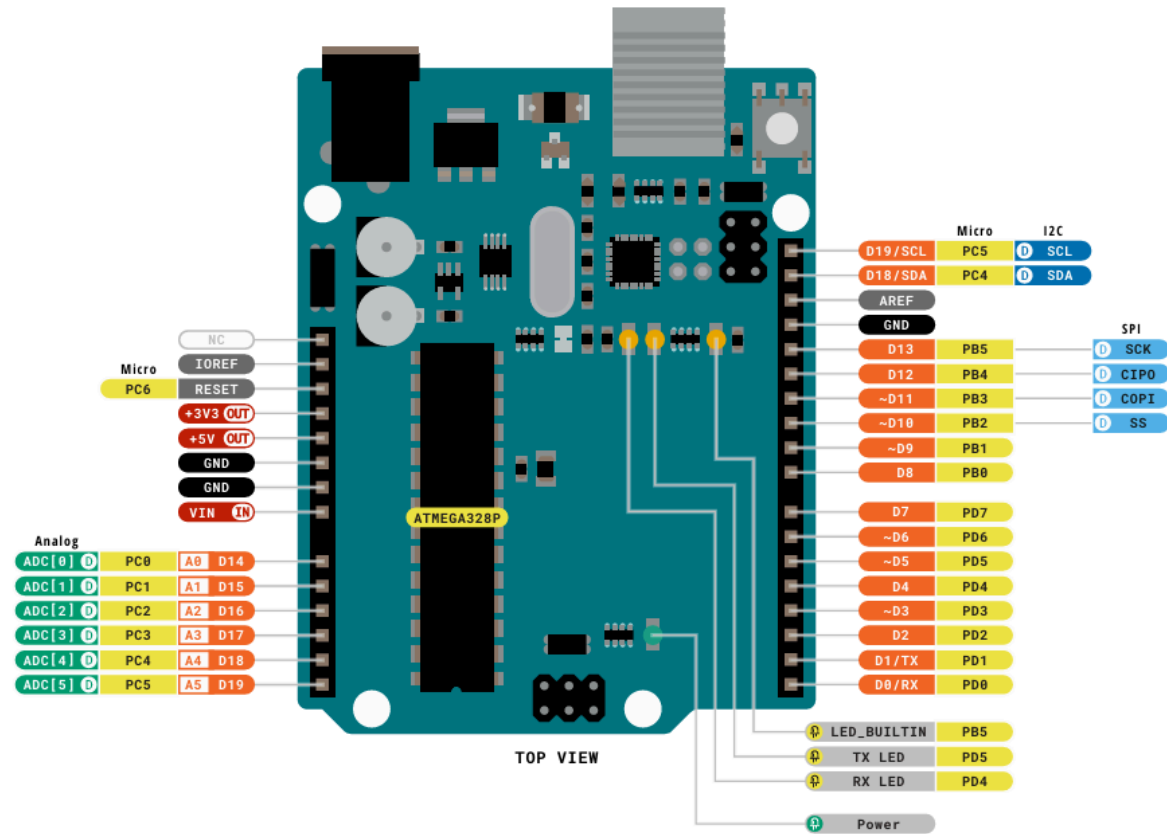


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UNO-TH_Rev3e
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Legend:

■ Power	IN Power Input	■ GPIO Digital External	■ I2C	Ⓢ Default	Ⓢ LED
■ Ground	OUT Power Output	■ Analog External	■ SPI	Ⓢ Default	Ⓢ RGB LED
		■ Main Part	■ UART/USART	Ⓢ Default	□ Other
		■ Secondary Part	■ Other SERIAL Communication	Ⓢ Default	
		■ Internal Component	■ Analog		
		■ Other Pins (Reset, System Control, Debugging)	■ PWM/Timer		

- ⚠ **MAXIMUM** current per I/O pin is 20mA
- ⚠ **MAXIMUM** current per +3.3V pin is 50mA
- ! VIN 6-20V input to the board
- ! CIP0/COP1 have previously been referred to as MISO/MOSI



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Last update: 6 Oct, 2022

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Base Code

```
int led = 12; // set a variable, in this case pin number 12

void setup(){
    // Should only run once
    pinMode(led, OUTPUT); // set pin to send signal out
    Serial.begin(9600); // set the speed at which data is transmitted to the serial monitor
}

void loop(){
    // This runs forever
    digitalWrite(led, HIGH); // Turn pin 12 on
    Serial.println("On");
    delay(500); // on for 0.5 secs
    digitalWrite(led, LOW); // turn pin 12 off
    Serial.println("Off");
    delay(500); // off for 0.5 secs
}
```

Basic Functions

```
pinMode(int, <OUTPUT/INPUT>); // pin, direction
digitalWrite(int, <HIGH/LOW>); // pin, state

analogRead(int); // pin
analogWrite(int, int); // pin, value (0-255)

Serial.begin(int); // speed (4800, 9600, 19200 ...)
Serial.print(Type); // will write to serial any data type, without a new line terminator "\n"
Serial.println(Type); // will write to serial any data type, with a new line terminator "\n"

delay(int); // a specified amount of time in ms the cpu will wait before continuing to the next line
```