Development Boards

Module Code: GEEN1064

Module Name: Engineering Design and Implementation

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What is (and isn't) a Microncontoller (μC)

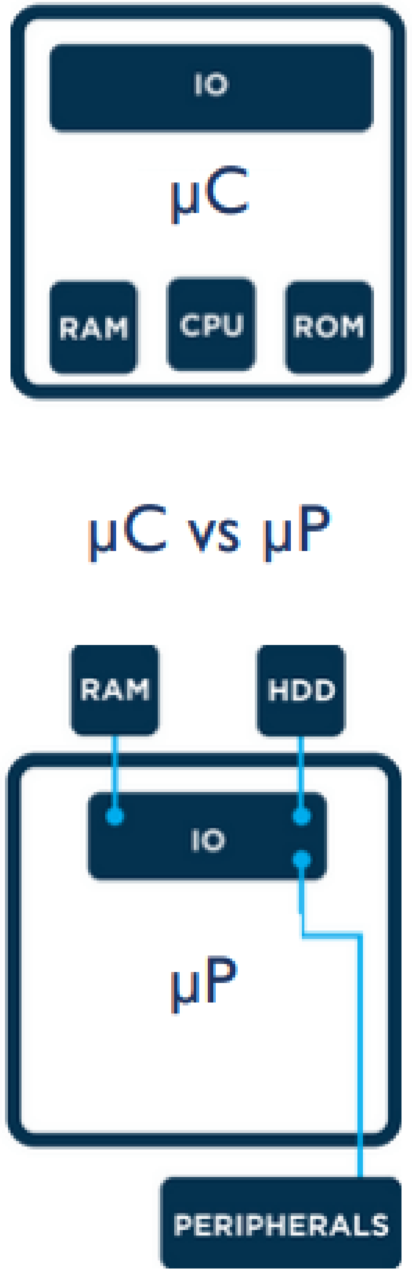
- A µC is a small, self-contained computer that is housed on a single integrated circuit, or microchip.
- They differ from your desktop computer in that they are typically dedicated to a single function, and are most often embedded in other devices (e.g. mobile phones; household electronics).
- A µC 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 Microncontoller (μC)

- µC” 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 µC interact with other components.

Microcontroller vs a Microprocessor

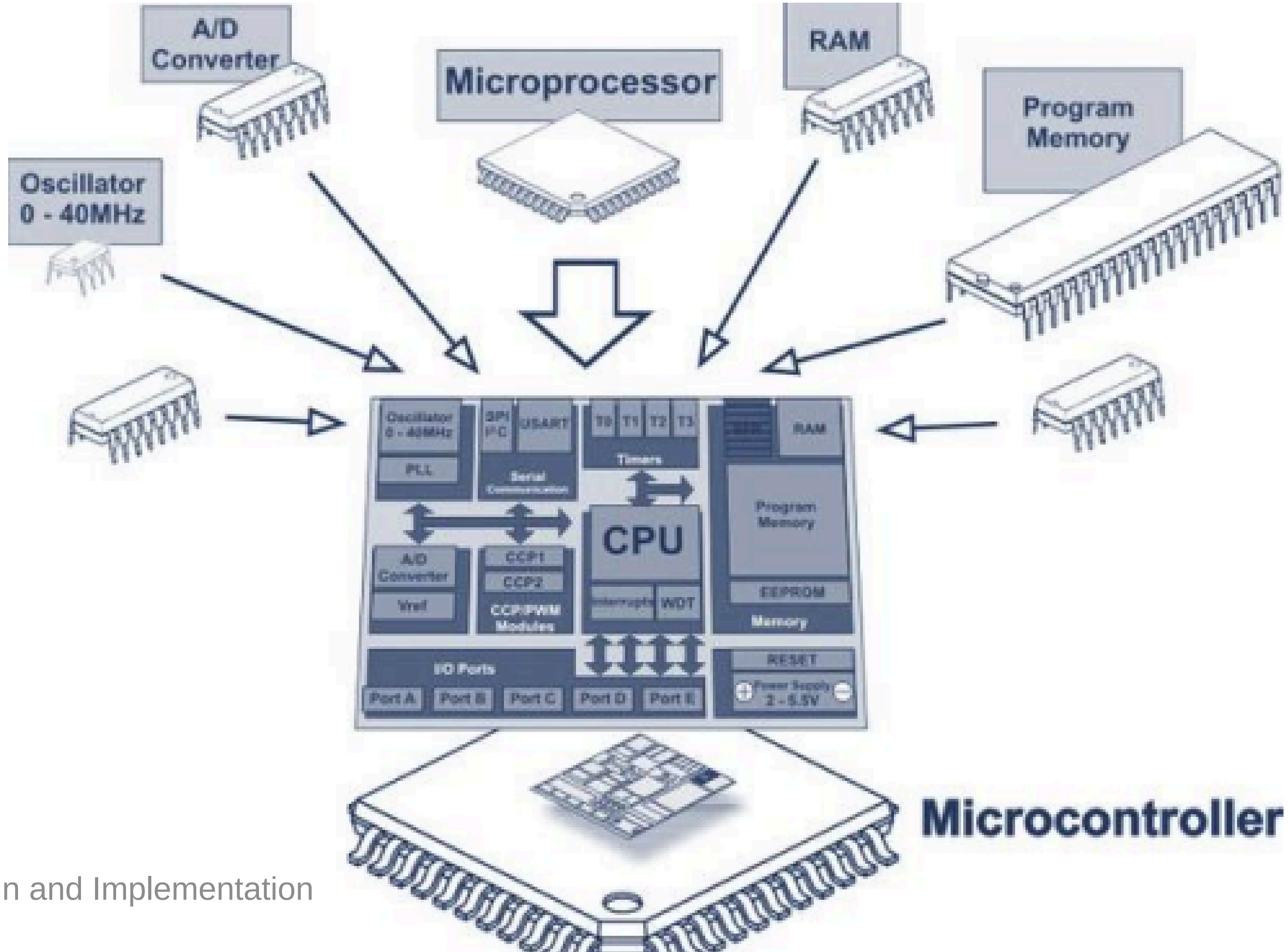
- μP contain only a Central Processing Unit (CPU), and therefore require added peripherals to perform tasks.
- CPU is the brain of any computer and it is the part of a computer that performs calculations, actions, and runs programs.
    - Intel Core i series, AMD



RAM and ROM

- µCs, 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



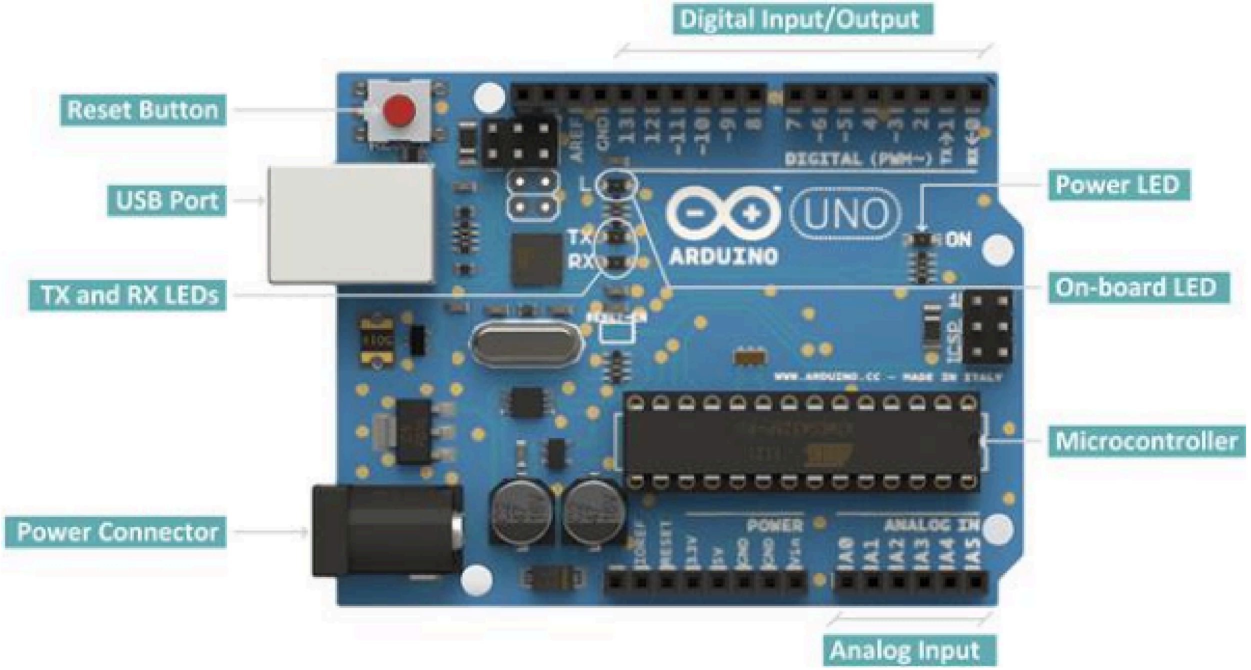
Deployment Platforms

- 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.

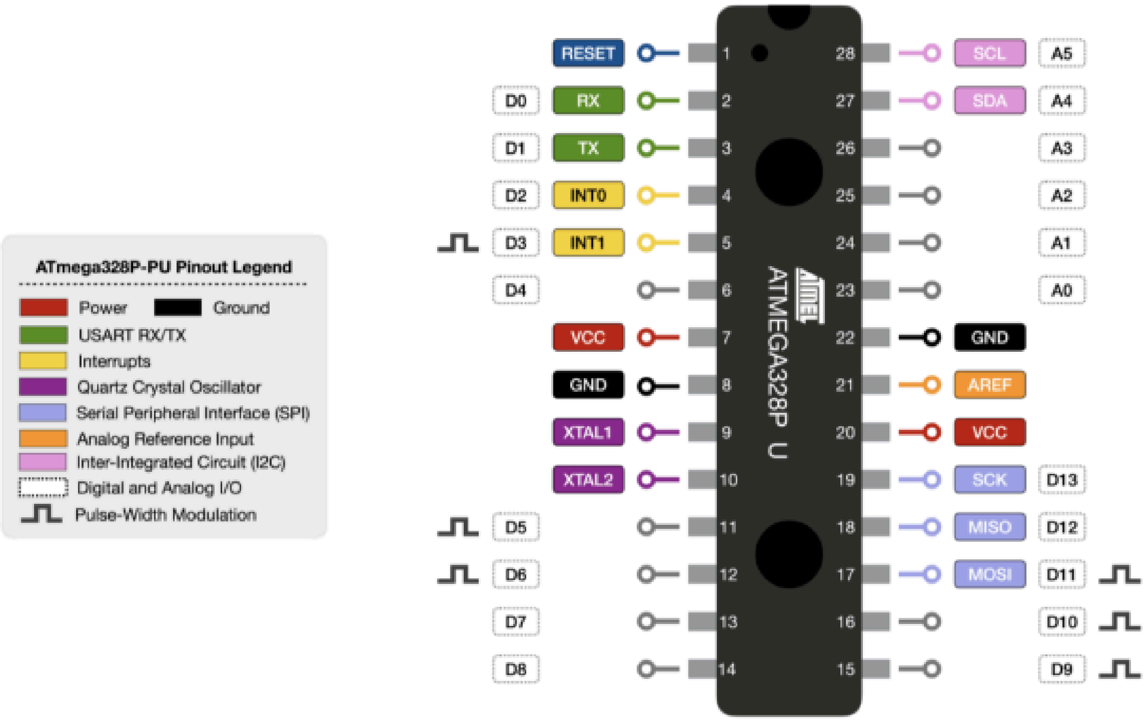
Arduino Uno

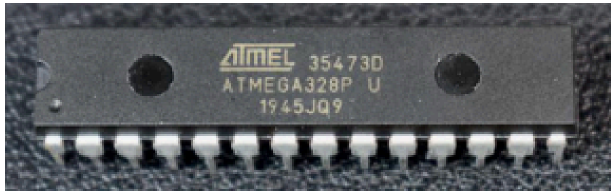
Prototype Board from Arduino

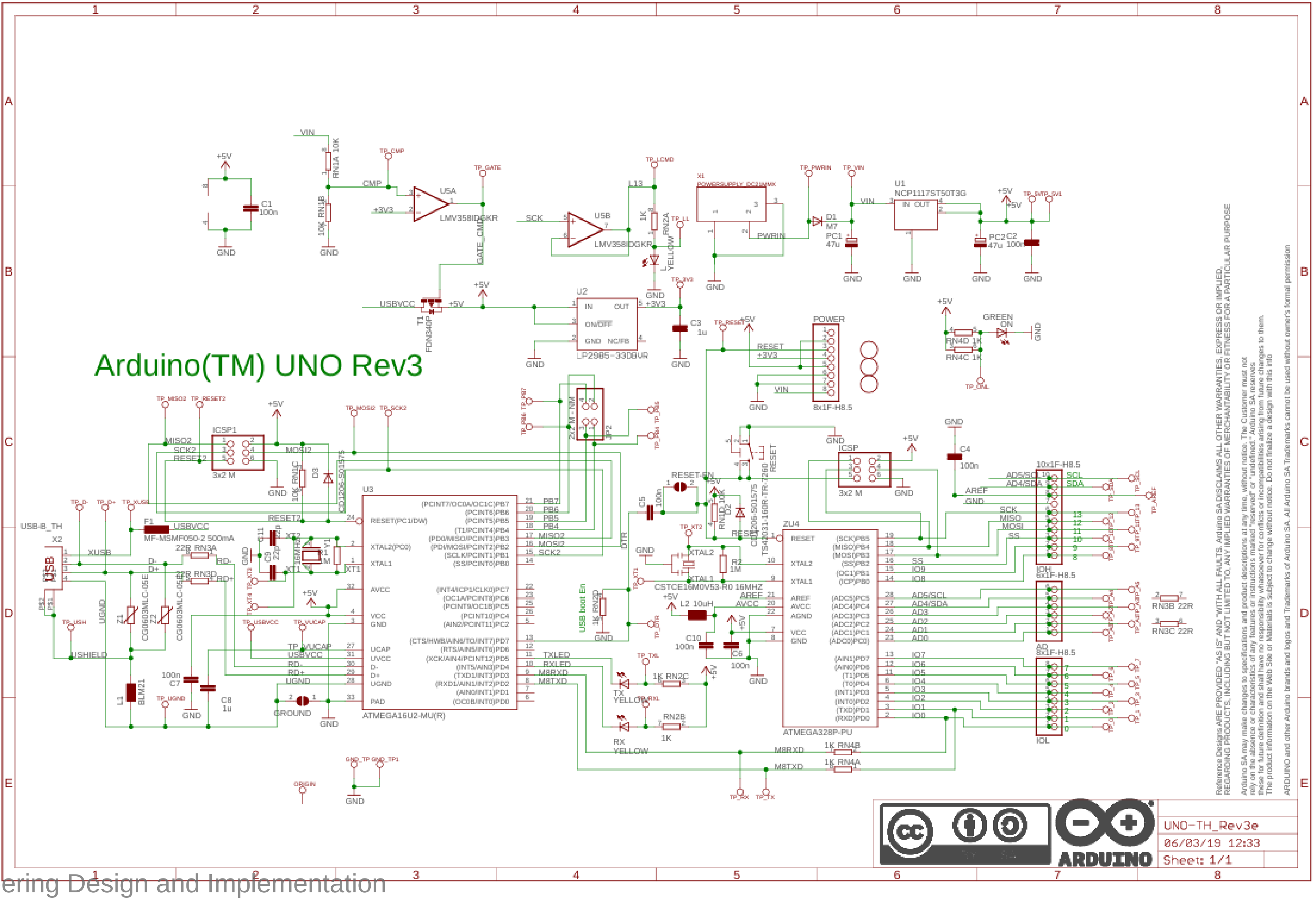
- The Uno is a µC development board with an Atmega328P Chip
- 14 digital Input/Output (I/O) pins
- 6 Analogue Input pins (e.g. temperature sensors)
- 6 PWM Output pins (e.g. actuators)
- A 16 MHz quartz crystal



ATMega-328P Chip






Arduino(TM) UNO Rev3
ATMEGA16U2-MU(R)
ATMEGA328P-PU
LMV358IDGKR
NCP1117ST50T3G
LP2985-33DBVR
FDN340P
POWERSUPPLY_DC21MMX
MF-MSMF050-2 500mA
CSTCE16M0V53-R0 16MHZ
USB-B_TH
ICSP1
ICSP
POWER
IOH
AD
IOL
USBVCC
VIN
+5V
+3V3
GND
RESET
AREF
SCL
SDA
TX YELLOW
RX YELLOW
GREEN ON
L YELLOW
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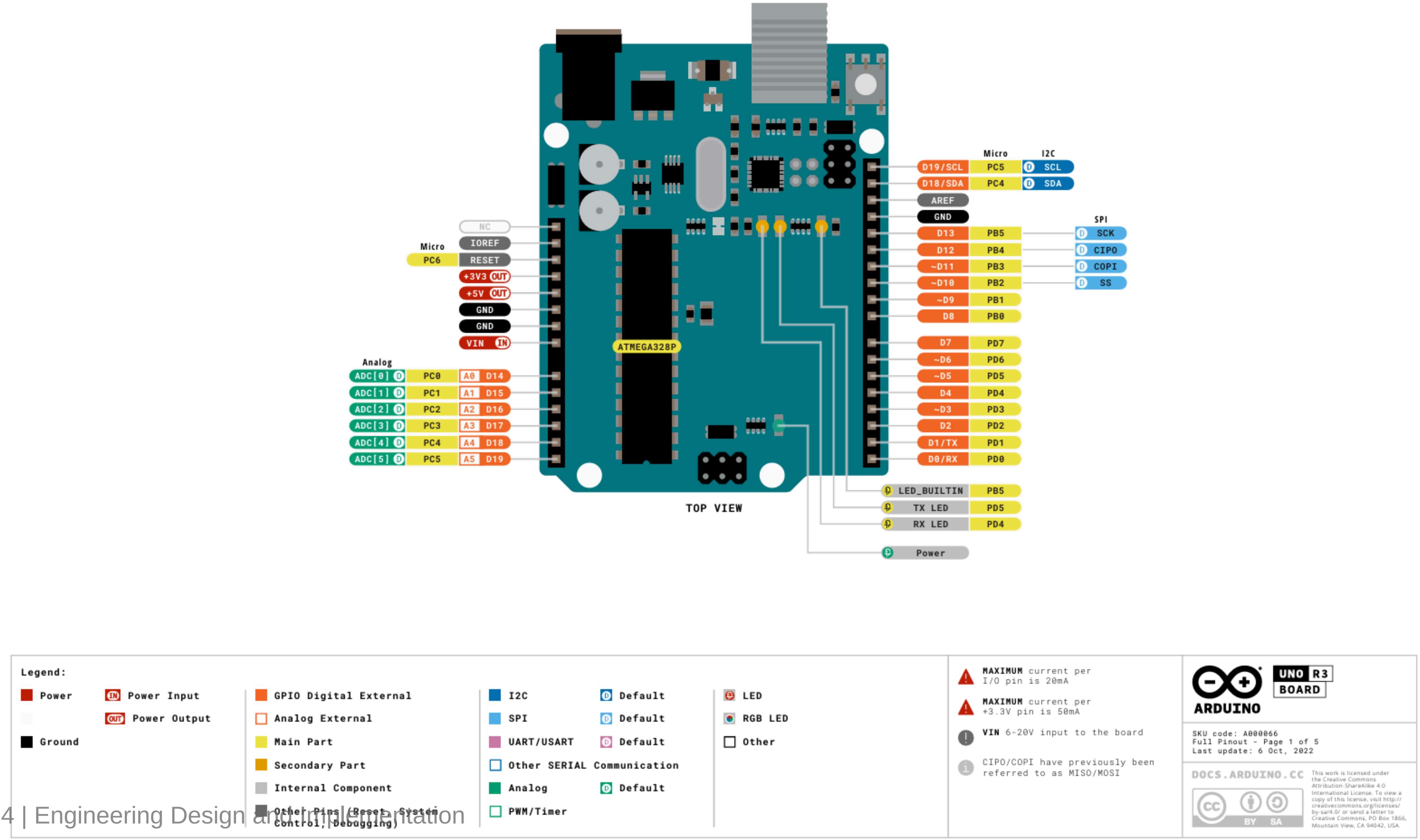
ARDUINO


Micro
I2C
D19/SCL PC5 SCL
D18/SDA PC4 SDA
AREF
GND
SPI
D13 PB5 SCK
D12 PB4 CIPO
~D11 PB3 COPI
~D10 PB2 SS
~D9 PB1
D8 PB0
D7 PD7
~D6 PD6
~D5 PD5
D4 PD4
~D3 PD3
D2 PD2
D1/TX PD1
D0/RX PD0
LED_BUILTIN PB5
TX LED PD5
RX LED PD4
Power
NC
IOREF
Micro
PC6 RESET
+3V3 OUT
+5V OUT
GND
GND
VIN IN
Analog
ADC[0] PC0 A0 D14
ADC[1] PC1 A1 D15
ADC[2] PC2 A2 D16
ADC[3] PC3 A3 D17
ADC[4] PC4 A4 D18
ADC[5] PC5 A5 D19
ATMEGA328P
TOP VIEW
Legend:
Power
Power Input
Power Output
Ground
GPIO Digital External
Analog External
Main Part
Secondary Part
Internal Component
Other Pins (Reset, System Control, Debugging)
I2C
SPI
UART/USART
Other SERIAL Communication
Analog
PWM/Timer
Default
Default
Default
Default
LED
RGB LED
Other
MAXIMUM current per I/O pin is 20mA
MAXIMUM current per +3.3V pin is 50mA
VIN 6-20V input to the board
CIPO/COPI have previously been referred to as MISO/MOSI
ARDUINO
UNO R3 BOARD
SKU code: A000066
Full Pinout - Page 1 of 5
Last update: 6 Oct, 2022
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BY SA

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
  digtialWrite(led, HIGH); // Turn pin 12 on
  Serial.println("On");
  delay(500); // on for 0.5 secs
  digtialWrite(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
```