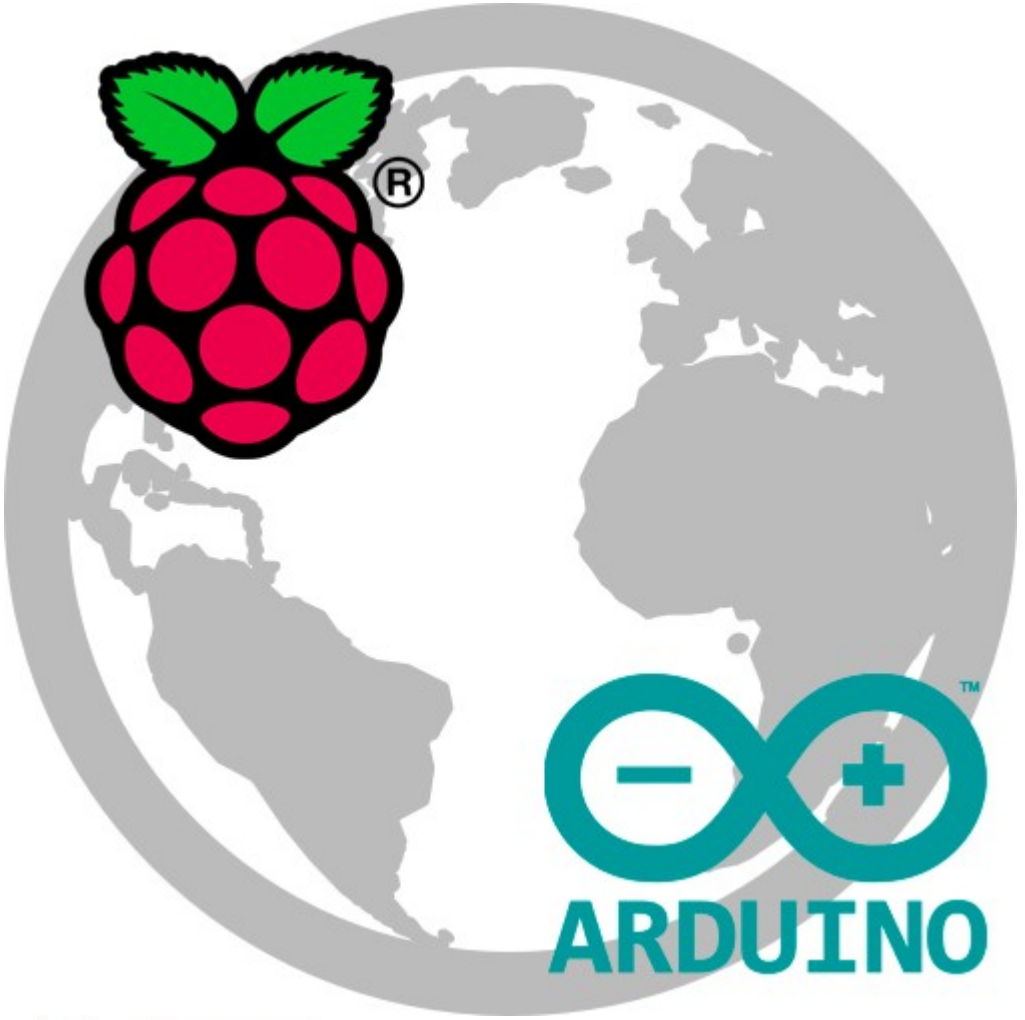
Arduino i Raspberry Pi



up date Formació EN ENGINYERIA

Enginyers Industrials de Catalunya

electronics.cat
OPEN SOURCE HARDWARE & TRAINING

11 d'octubre 2018

JESUÏTES El Clot
Escola del Clot

Arduino i Raspberry Pi

Part d'Arduino (matí)

1. El microcontrolador Arduino
2. Sensors i actuadors. Exemples pràctics
3. Maneres de programar un Arduino:
    * Per blocs
    * Des de l'IDE d'Arduino
4. Connexió de perifèrics a l'Arduino:
    entrades i sortides digitals, SPI, I2C, UART
5. Comunicació entre l'Arduino i l'ordinador
6. Bluetooth i RS485

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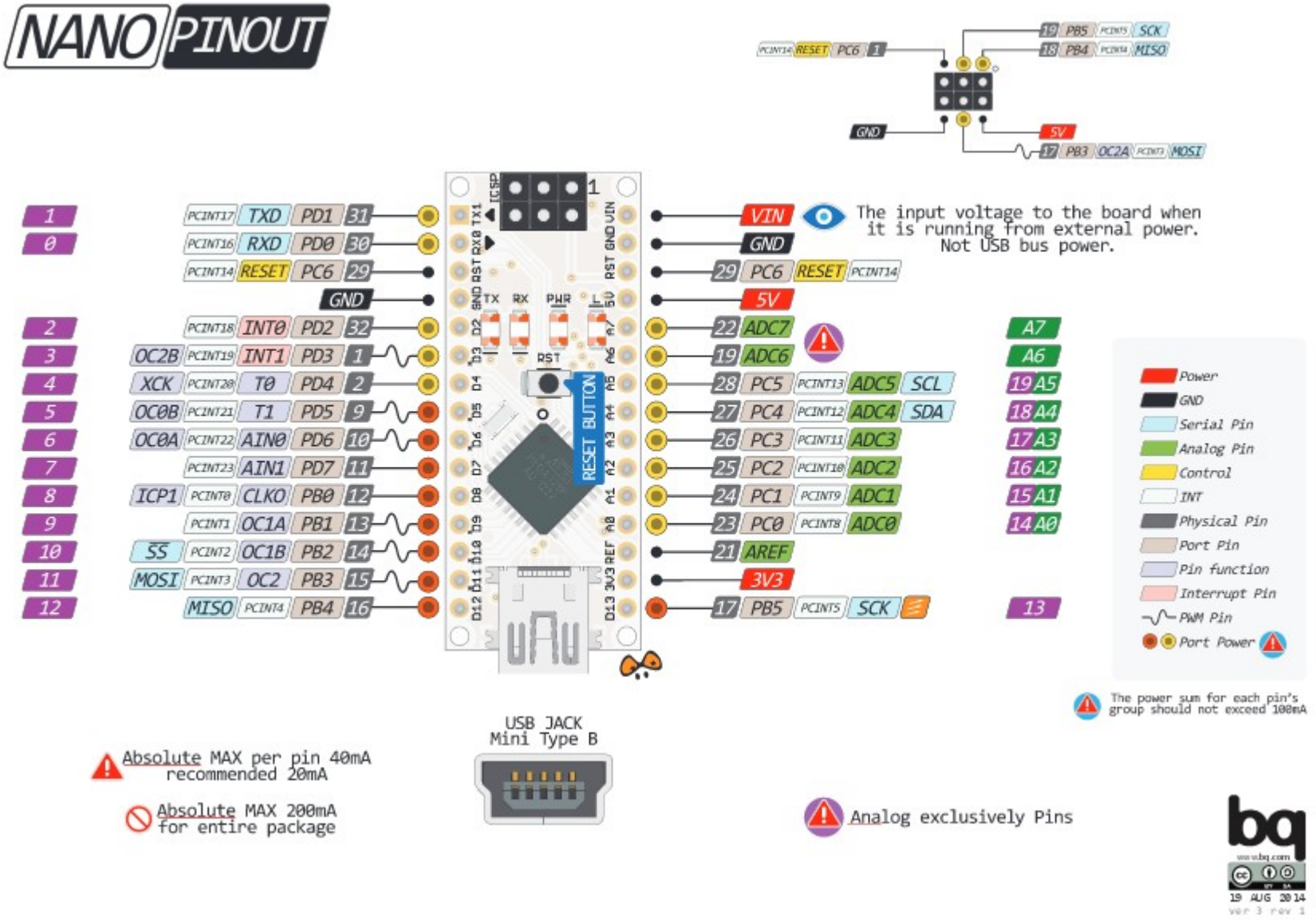
El microcontrolador Arduino

L'Arduino Nano



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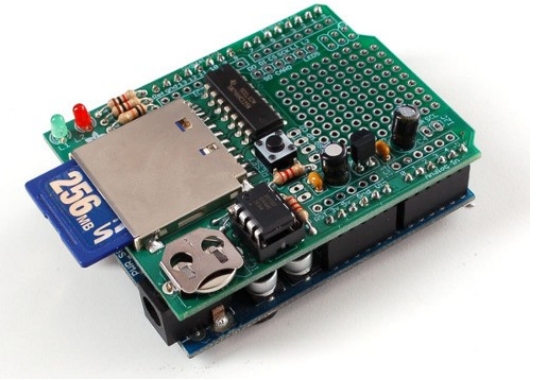
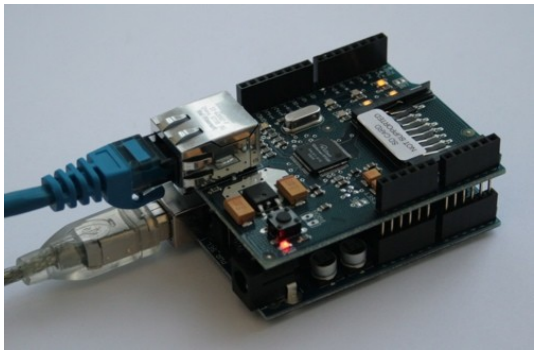
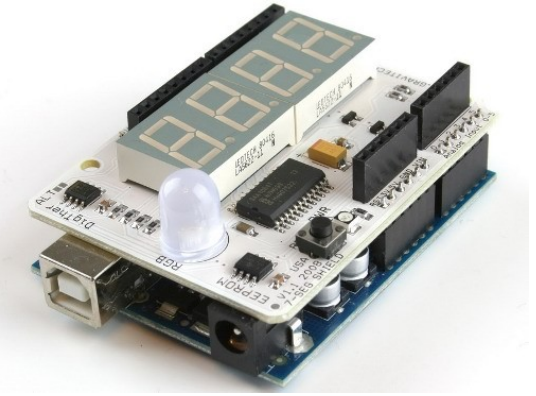
El microcontrolador Arduino

Plaques complementàries (shield / hat)







La majoria de plaques complementàries venen amb biblioteques i arxius de capçalera que acceleren el procés de funcionament.

http://arduino.cc/en/pmwiki.php?n=Main/ArduinoShields

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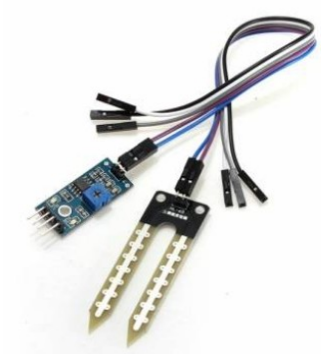
El microcontrolador Arduino

Interacció amb el món físic

Sensors



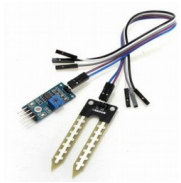
Lectura
d'informació

Actuadors

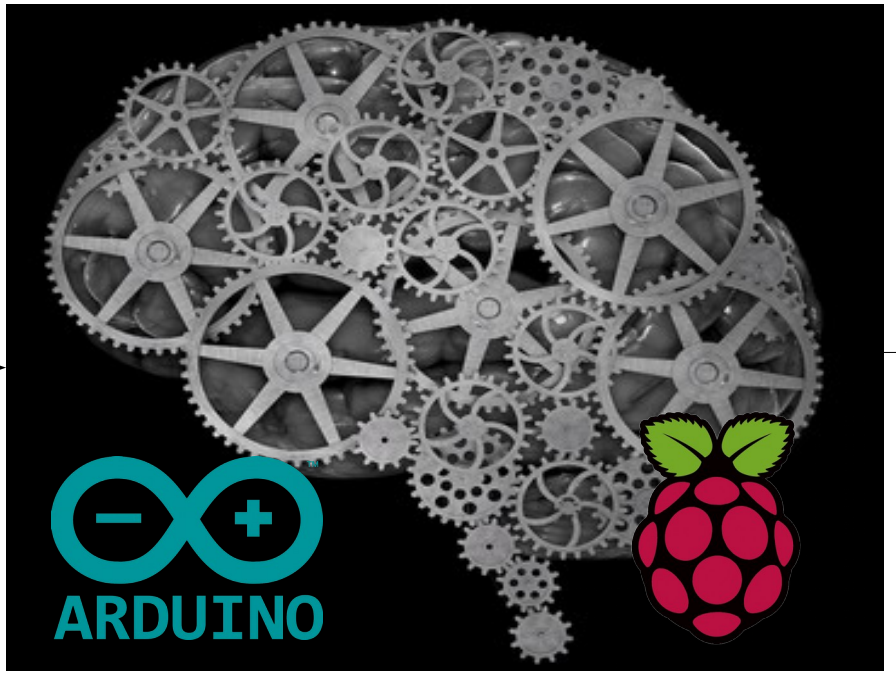
Escriptura
d'informació

El microcontrolador Arduino

Automatització del món físic



Sensors



Actuadors

Sortida de sensors Escriptura -->	**Entrada** d'informació --> Lectura	**Sortida** d'informació Escriptura -->	**Entrada** d'actuadors --> Lectura

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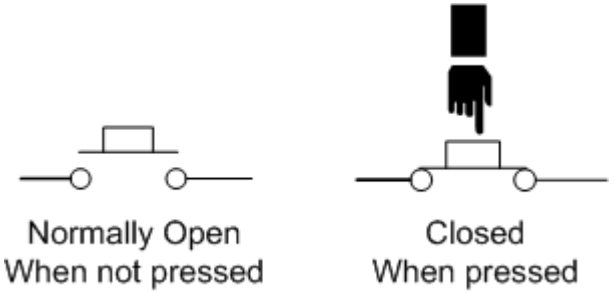
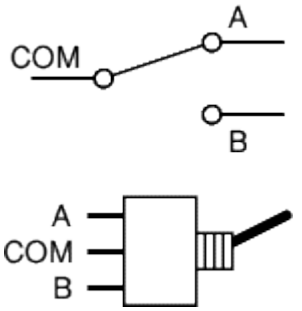
El microcontrolador Arduino

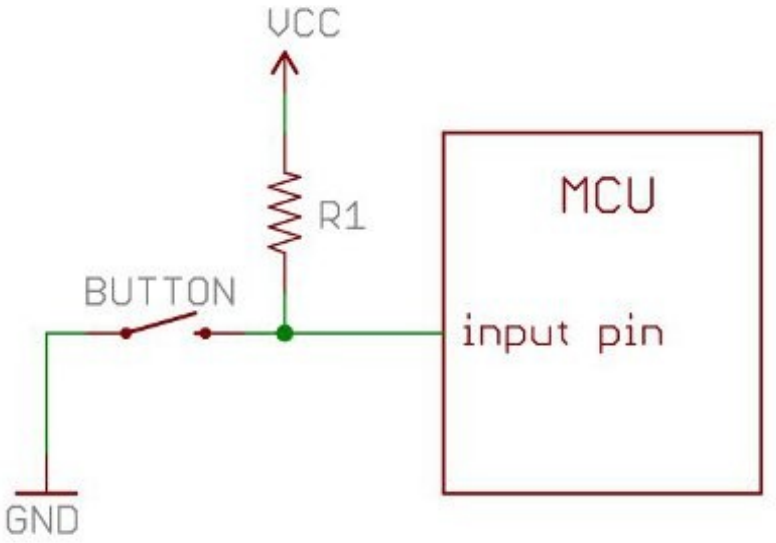
Lectura de l'estat d'un sensor digital





Cert : 1.8v, 3.3V,5V
Fals : 0v

True / False
High / Low



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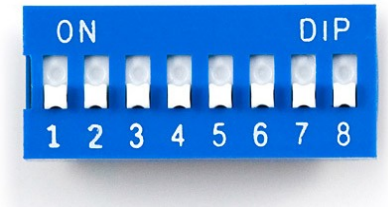
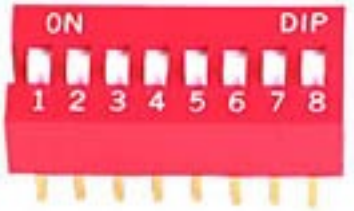
El microcontrolador Arduino

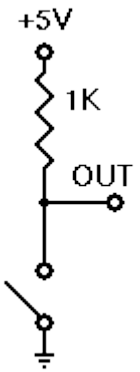
Lectura de l'estat d'un sensor digital

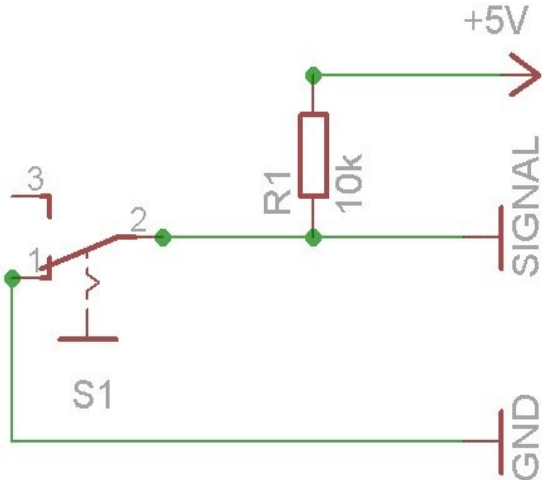
uSW : Microrruptor (dip-switch, microswitch)





Pull-up : Connexió d'un resistor a alimentació per assegurar un nivell lògic a una entrada digital





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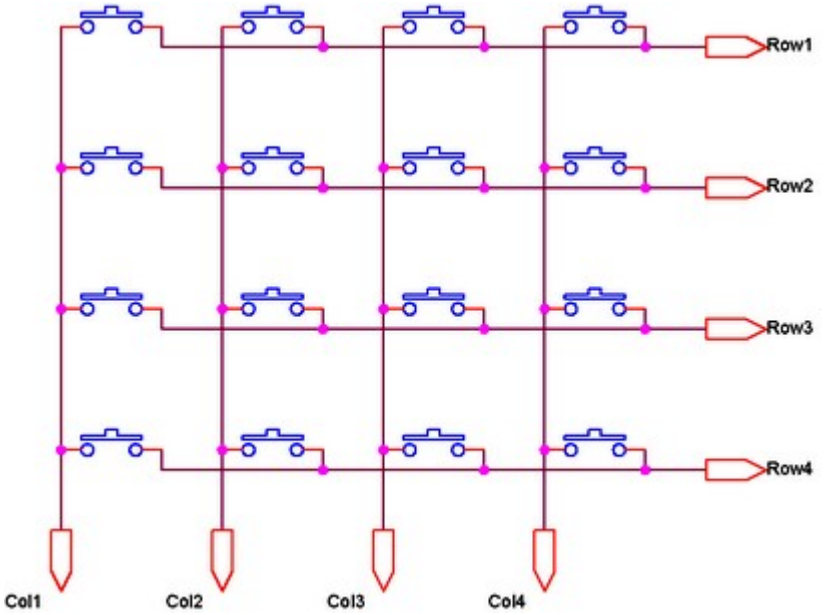
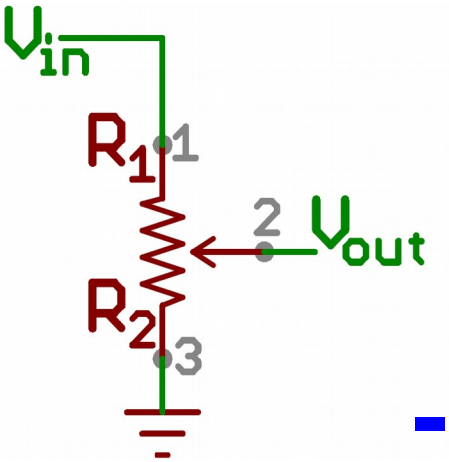
El microcontrolador Arduino

Lectura de la informació d'un teclat



El microcontrolador Arduino

Lectura d'informació analògica



0..3,3V
0..5V
0..10V
-10..10V

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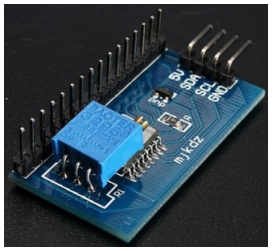
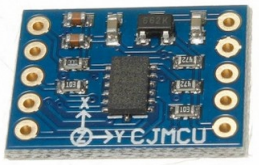
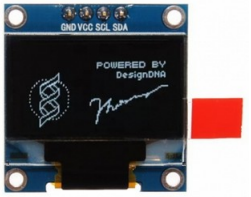
El microcontrolador Arduino

Protocols I2C (TWI), SPI i 1-Wire

I2C : Inter-Integrated Circuit

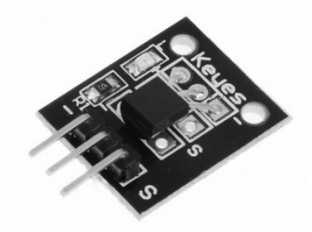


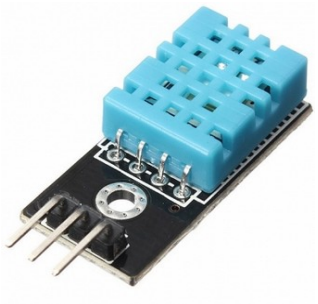




SPI : Serial Peripheral Interface Bus

1-Wire





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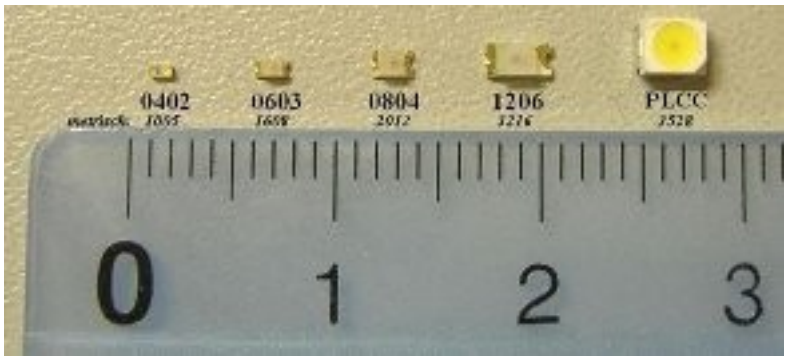
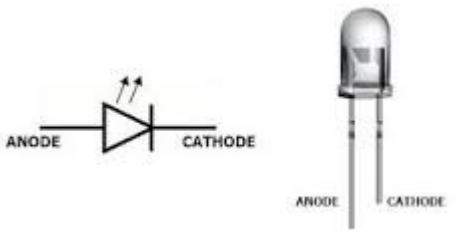
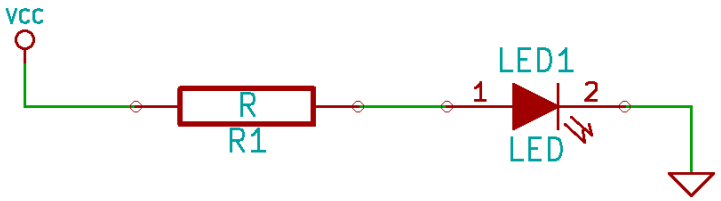
El microcontrolador Arduino

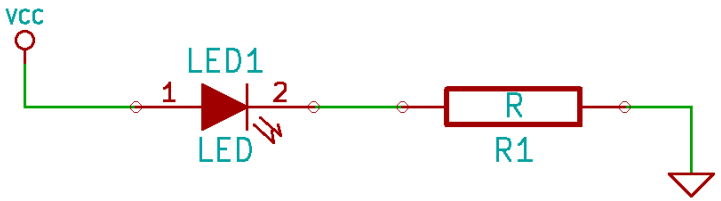
Escriptura d'estat a un actuador digital

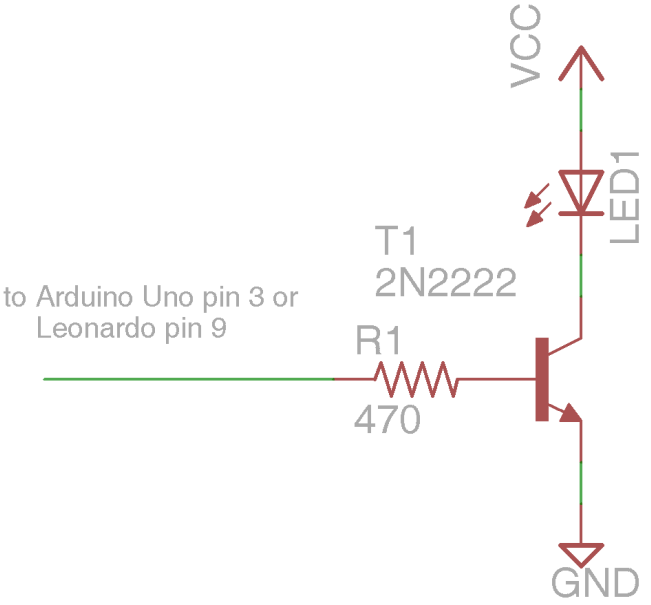
LED : Díode emissor de llum











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El microcontrolador Arduino

Escriptura d'estat a un actuador digital

Relé : Sistema electromecànic que modifica l'estat d'un commutador. Amb una tensió de control petita s'activa un electroimant podent controlar tensions molt superiors.

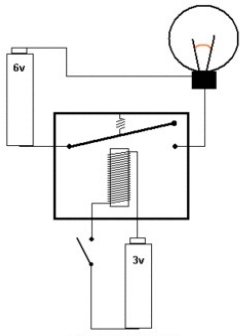


Figure 1: Relay off

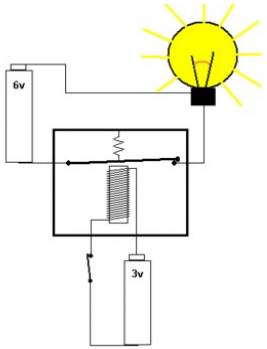
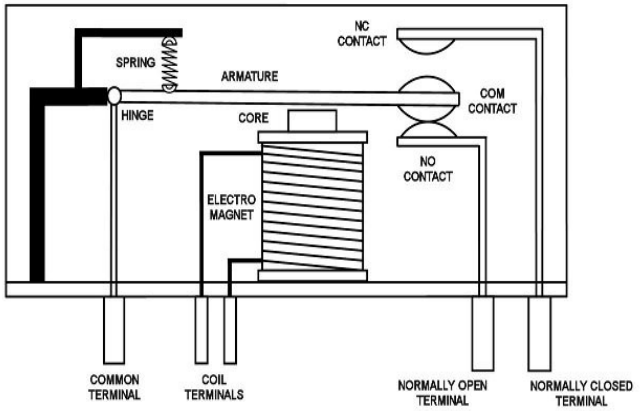
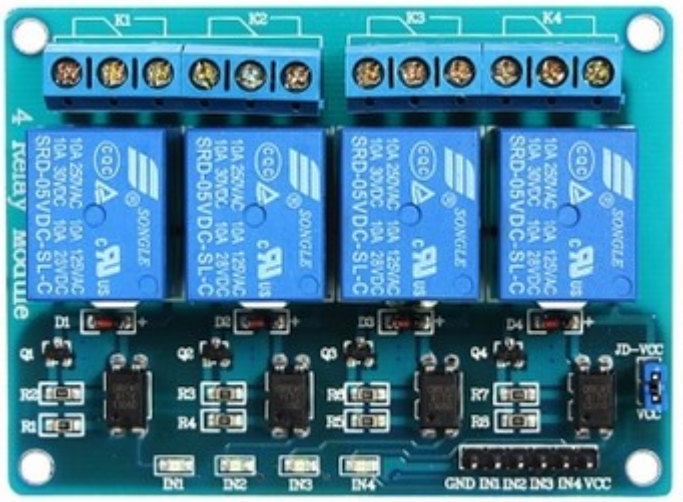
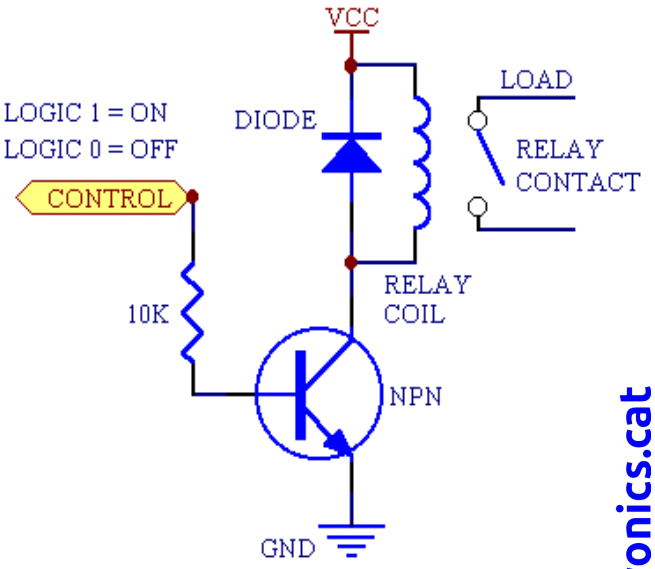


Figure 2: Relay on







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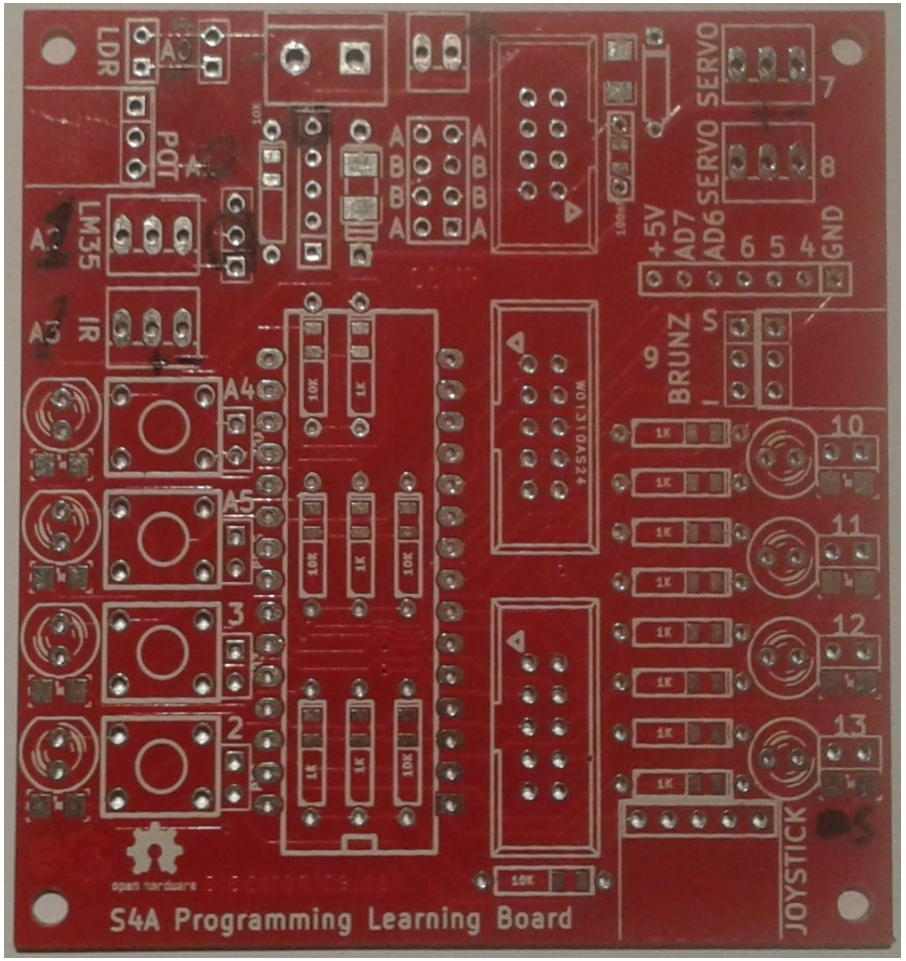
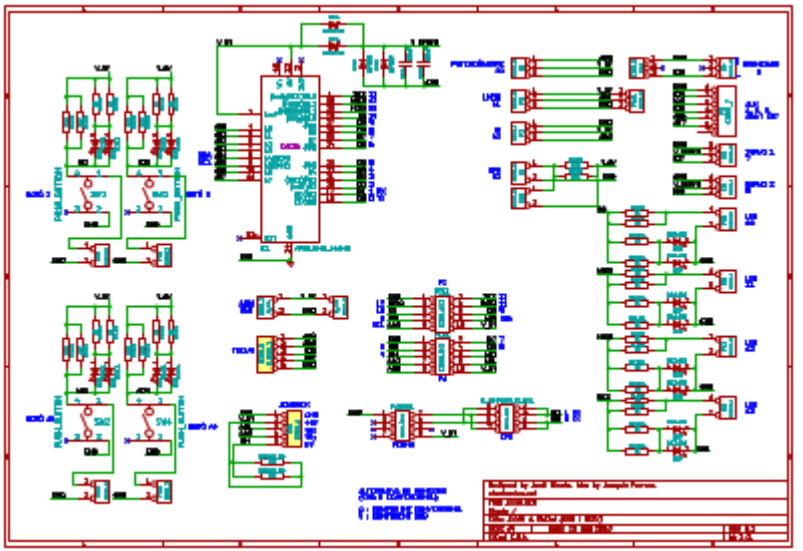
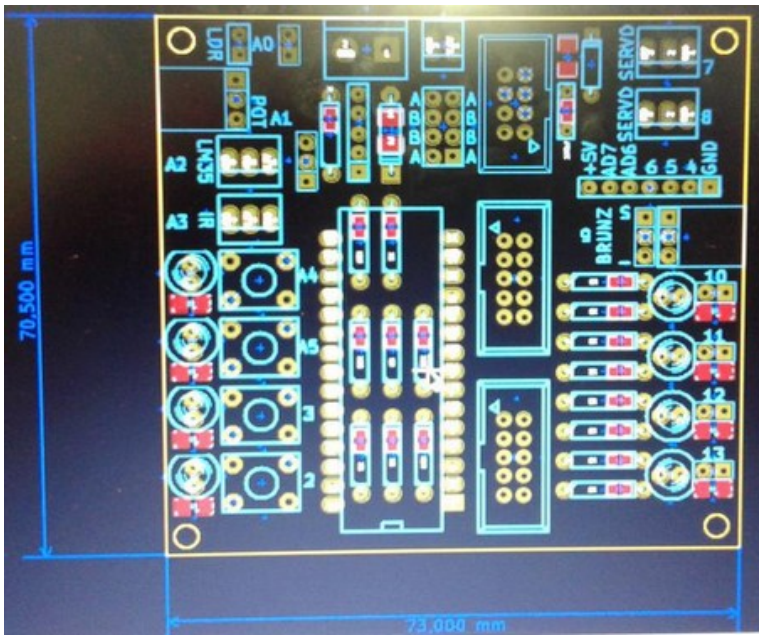
El microcontrolador Arduino

La placa S4A Programming Learning Board







Placa desenvolupada amb l'entorn de disseny integrat de programari lliure KiCad

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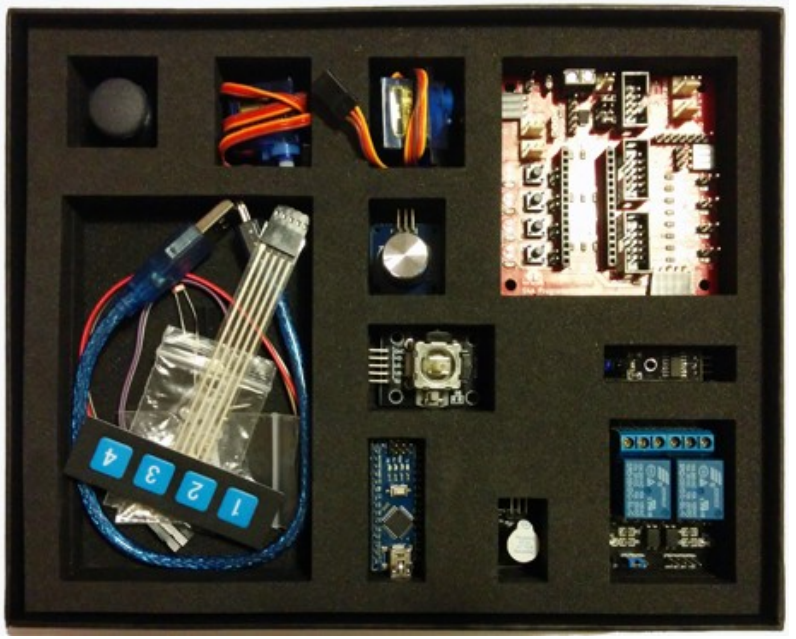
El microcontrolador Arduino

Make It!

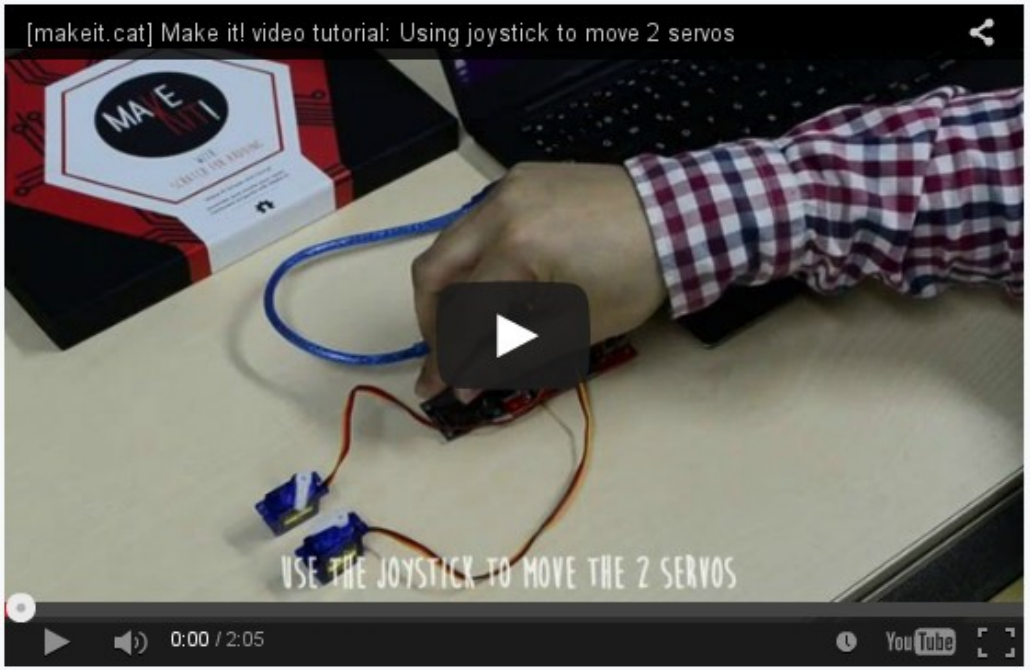


http://www.makeit.cat

electronics.cat

El microcontrolador Arduino

Make It!



Tutorial *Make it!*: Utilitzant un joystick per moure 2 servos

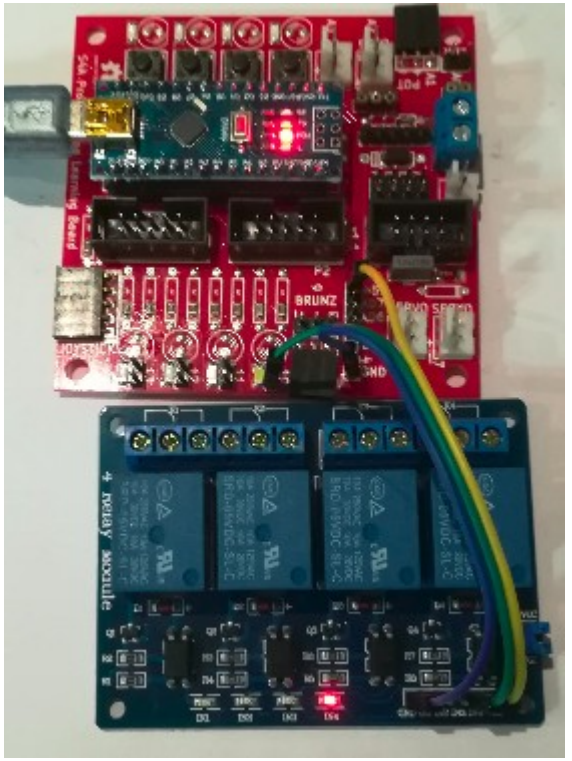
Com moure 2 servos utilitzant un joystick, el *Make it!* i el programa Scratch for Arduino.

http://makeit.cat/cat/

electronics.ca

El microcontrolador Arduino

Exemple d'ús amb relés



Placa de relés

https://binefa.cat/training/ceic/20181031/material/exemples/s4a_test/s4a_test.ino

electronics.cat

S4A Progamming Learning Board

Concepte de relé

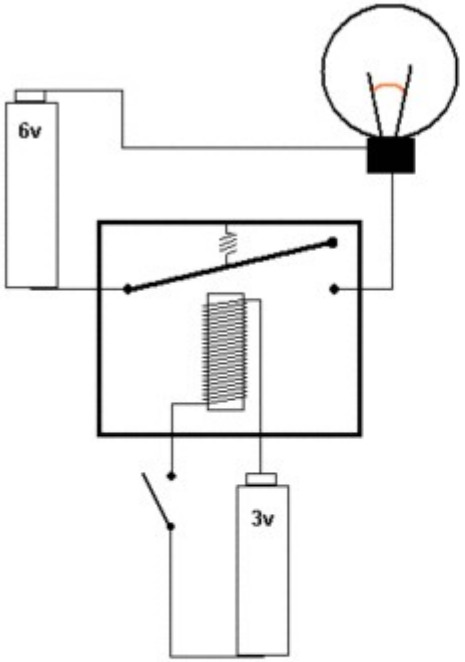


Figure 1: Relay off

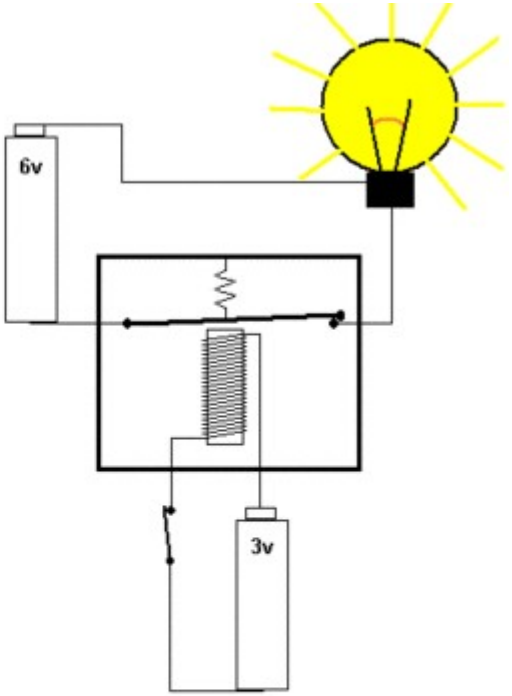


Figure 2: Relay on

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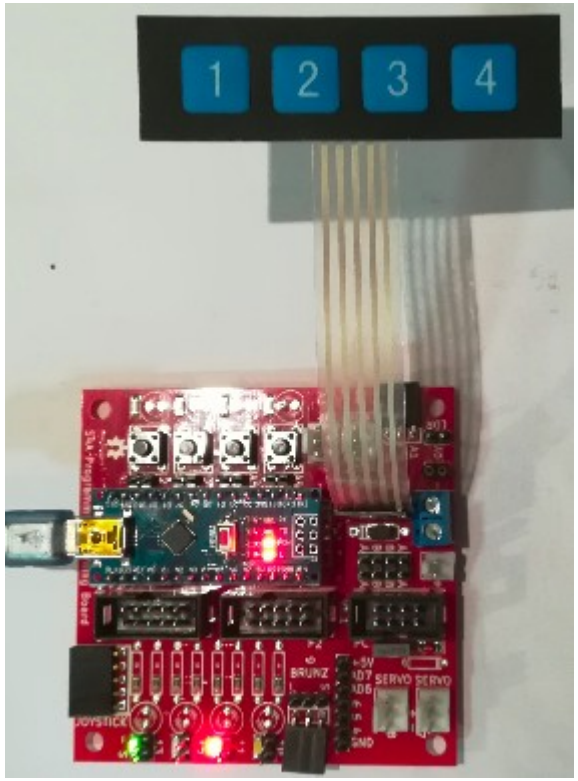
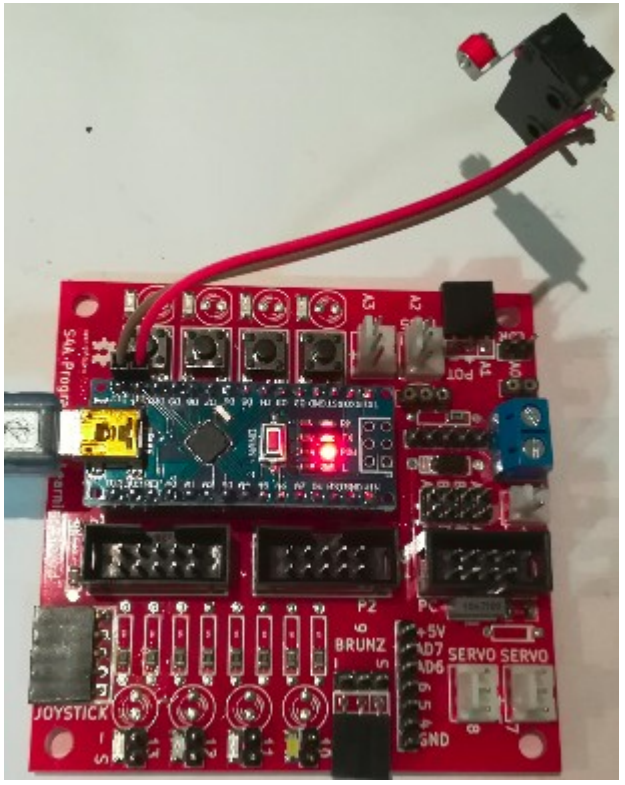
El microcontrolador Arduino

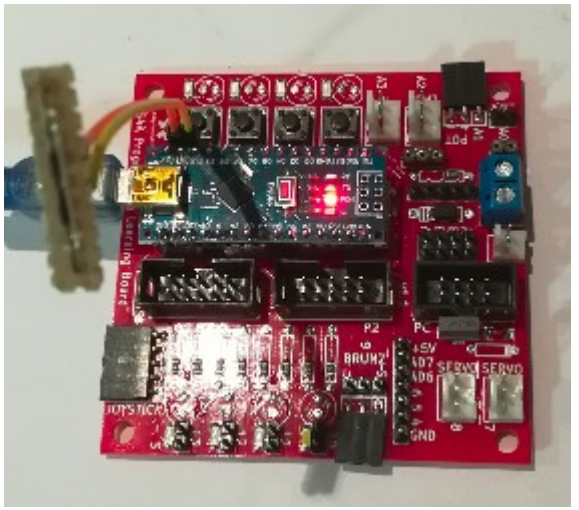
Exemple amb entrades de contacte obert



Teclat de membrana



Microrruptor



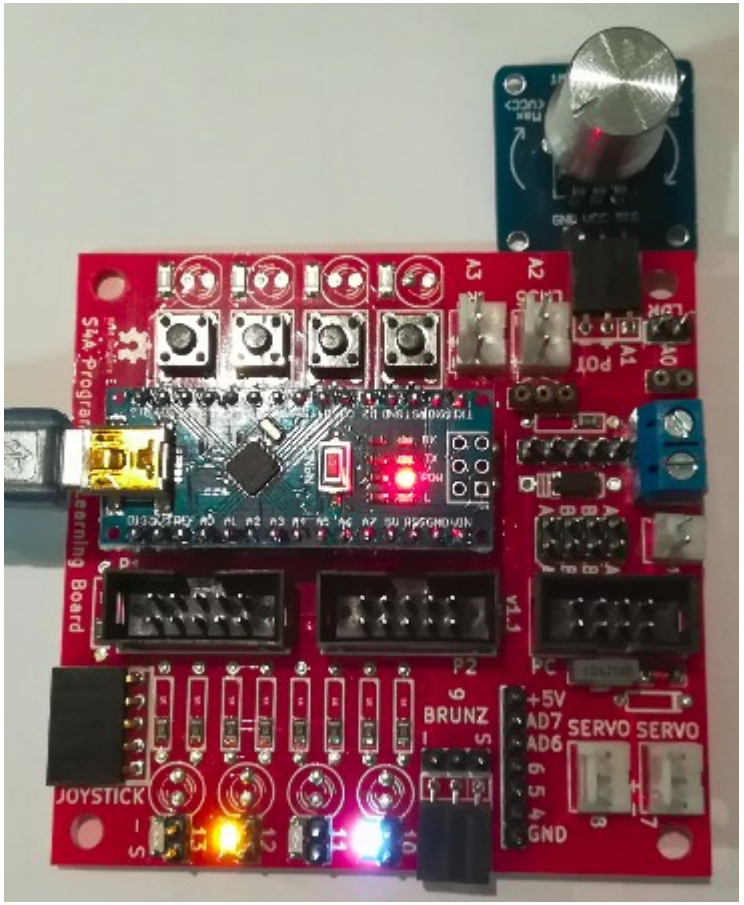
Relé Reed

https://binefa.cat/training/ceic/20181031/material/exemples/s4a_test/s4a_test.ino

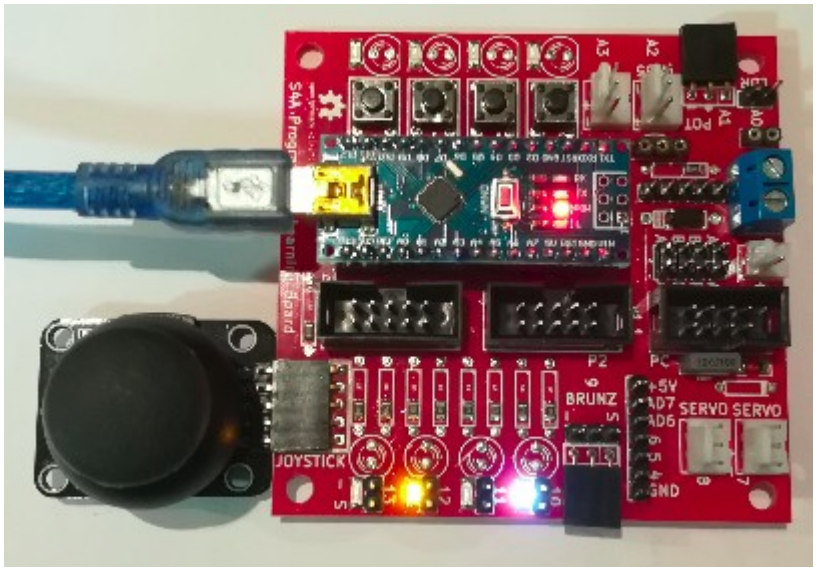
electronics.cat

El microcontrolador Arduino

Exemple amb entrades analògiques



Potenciòmetre



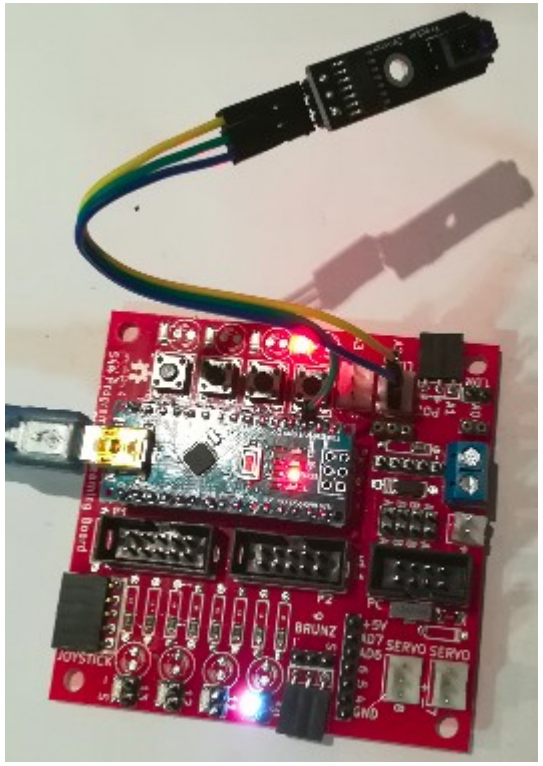
Joystick + SW

https://binefa.cat/training/ceic/20181031/material/exemples/s4a_test/s4a_test.ino

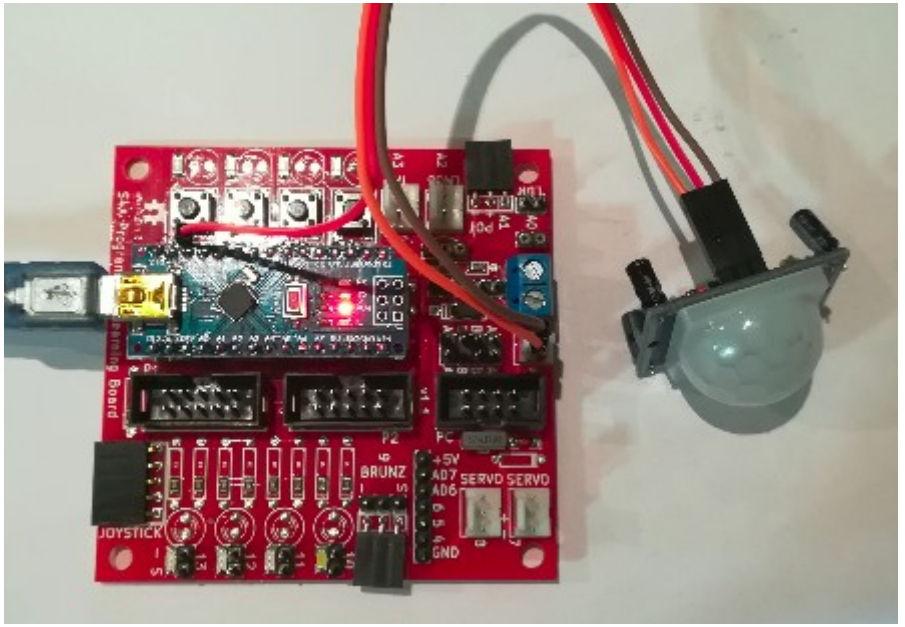
electronics.cat

El microcontrolador Arduino

Exemple amb entrades actives



IR



PIR

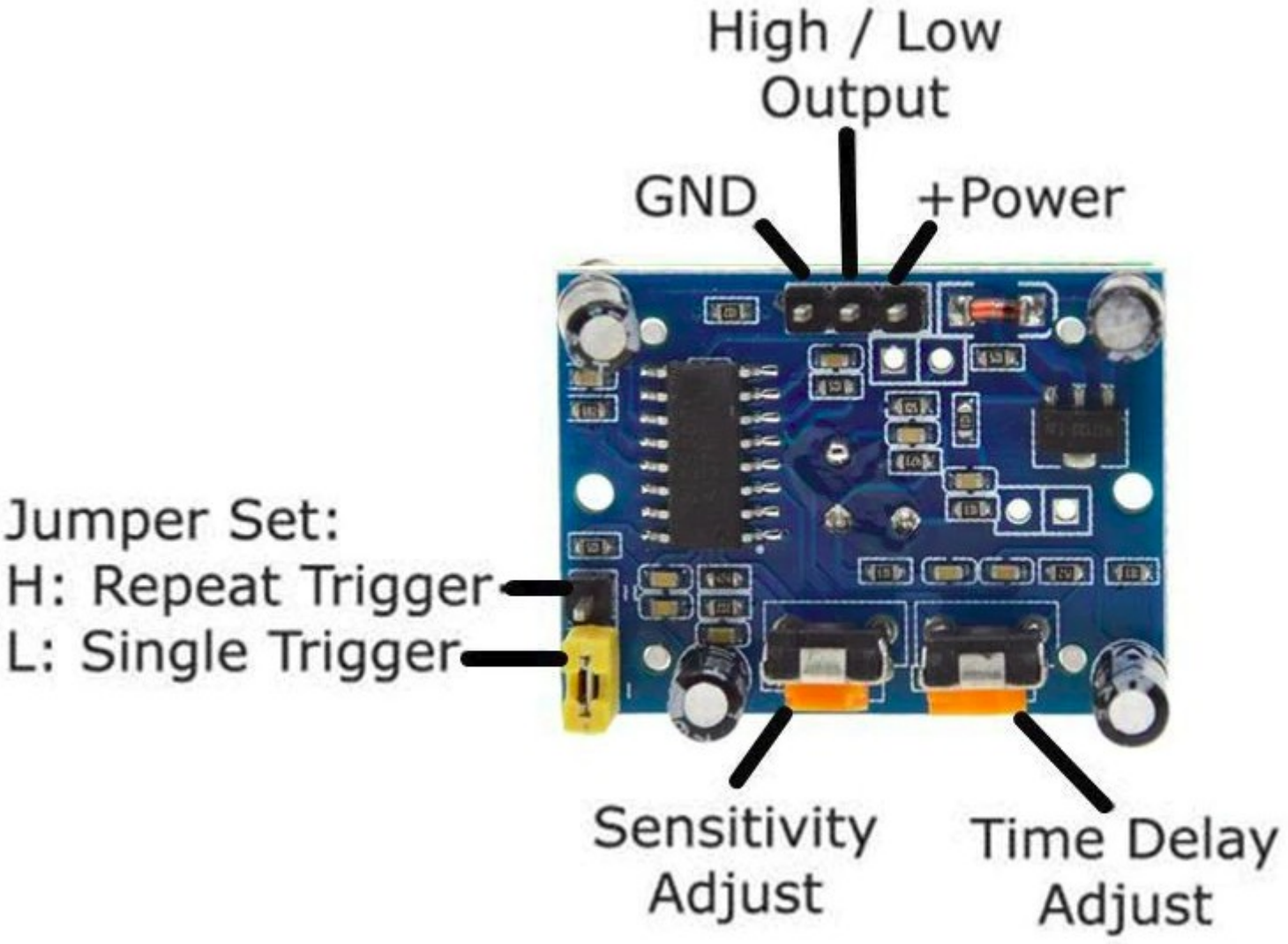
(patillatge a la següent diapositiva)

https://binefa.cat/training/ceic/20181031/material/exemples/s4a_test/s4a_test.ino

electronics.cat

El microcontrolador Arduino

Patillatge del PIR

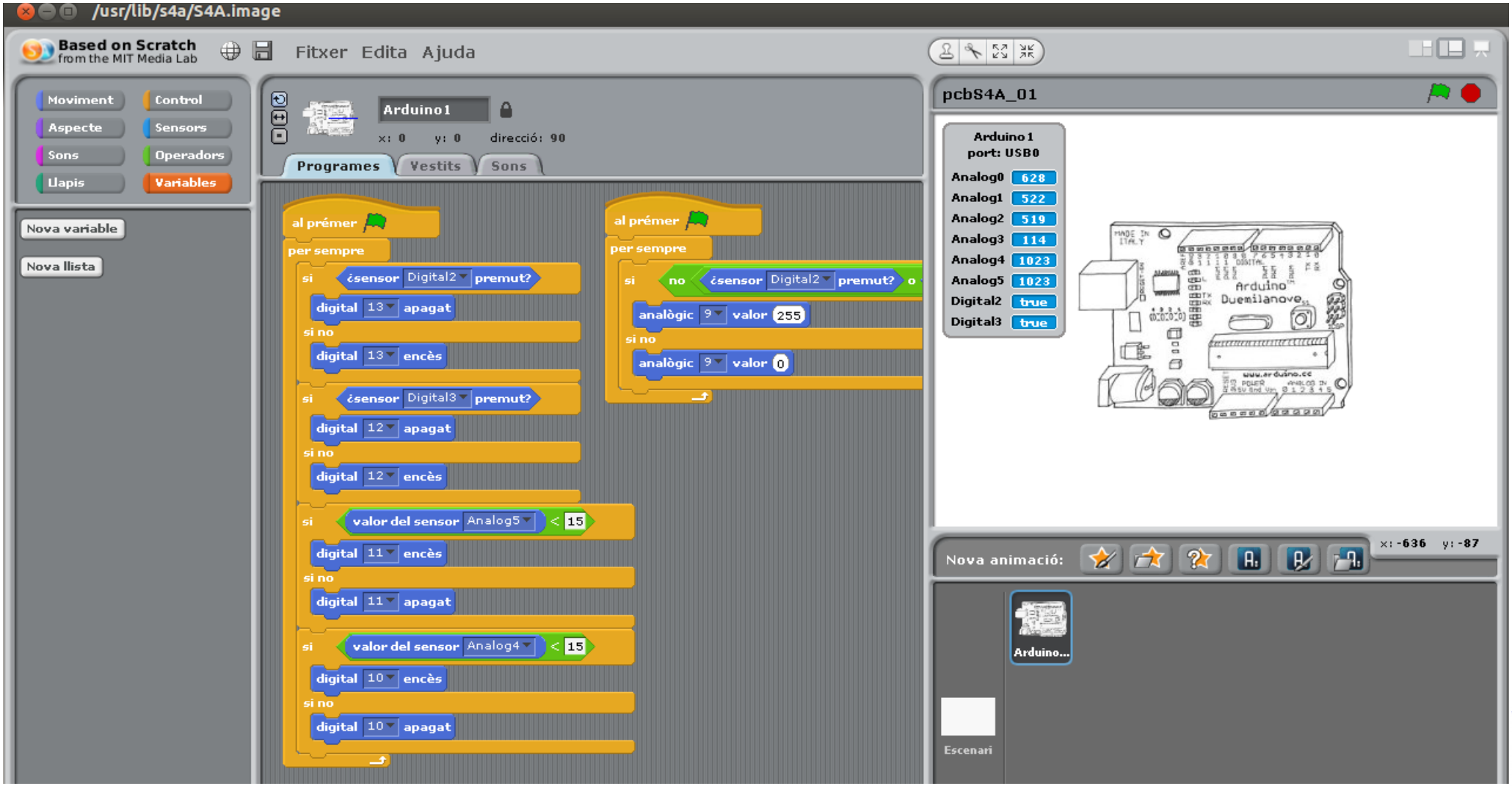


https://binefa.cat/training/ceic/20181031/material/exemples/s4a_test/s4a_test.ino

electronics.cat

El microcontrolador Arduino

Entorn de l'S4A



Codis d'exemple d'aquesta presentació per a l'S4A

www.s4a.cat

electronics.cat

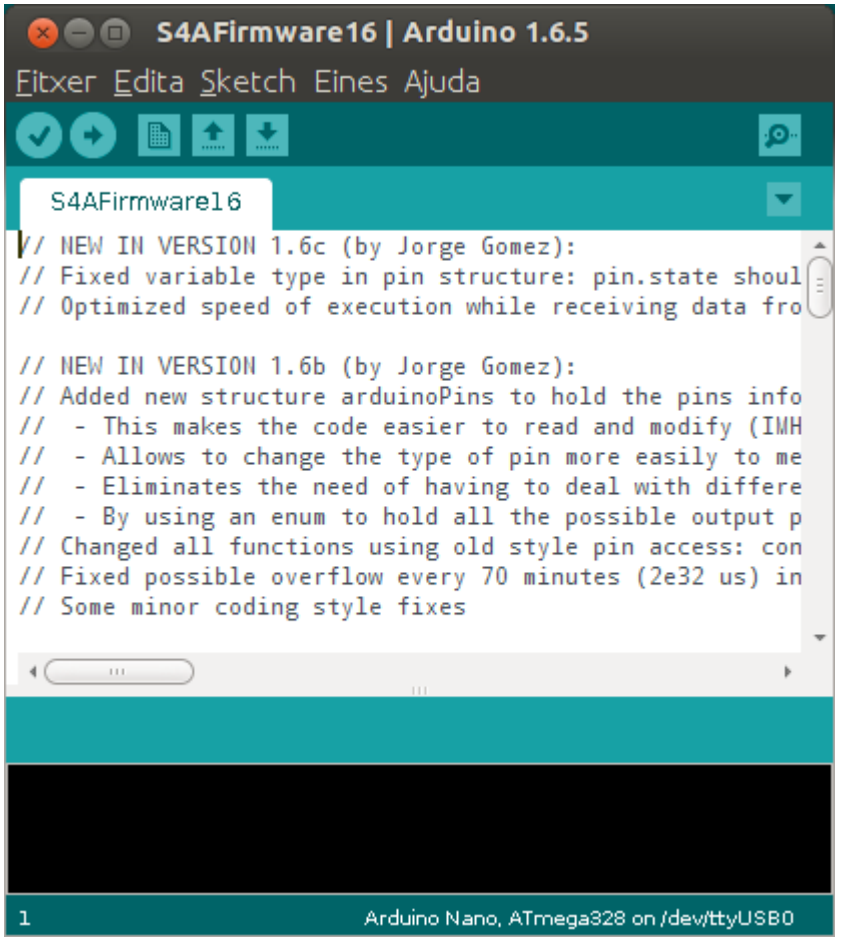
El microcontrolador Arduino

Microprogramari de l'S4A

El microprogramari és el programari del maquinari

Català	*Anglès*
Programari	**Software**
Maquinari	**Hardware**
Microprogramari	**Firmware**

Arduino Nano



Microprogramari per l'Arduino per funcionar amb l'S4A :
http://vps34736.ovh.net/S4A/S4AFirmware16.ino

electronics.cat

S4A Progamming Learning Board

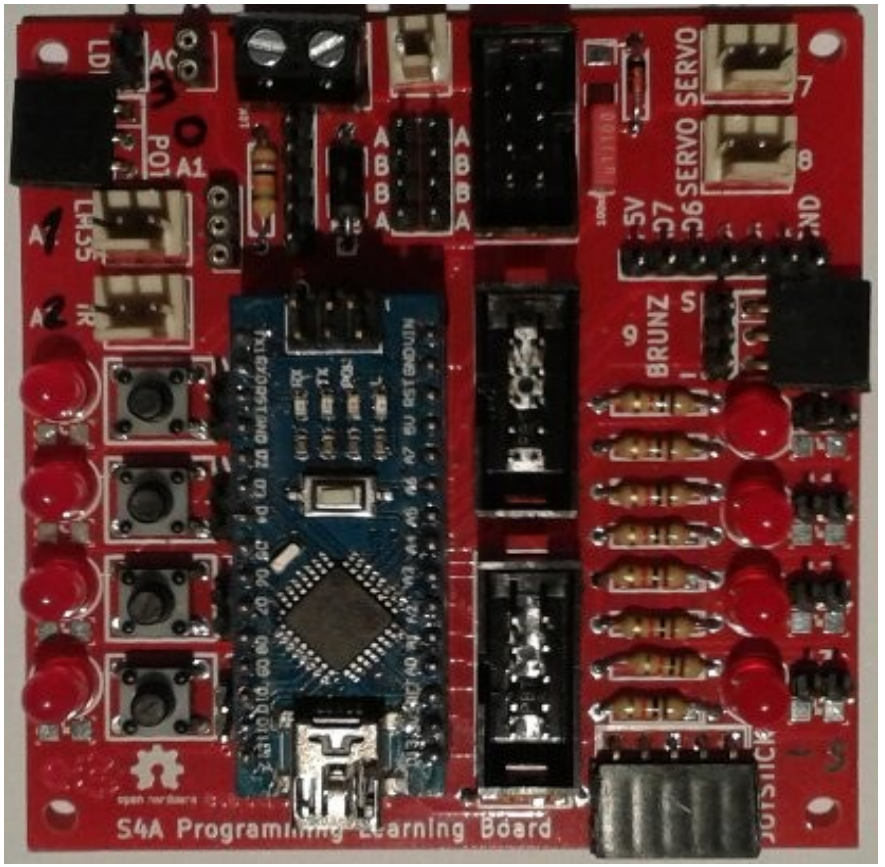
Botons i leds

A4 10

A5 11

3 12

2 13



Codis d'exemple d'aquesta presentació per a l'S4A

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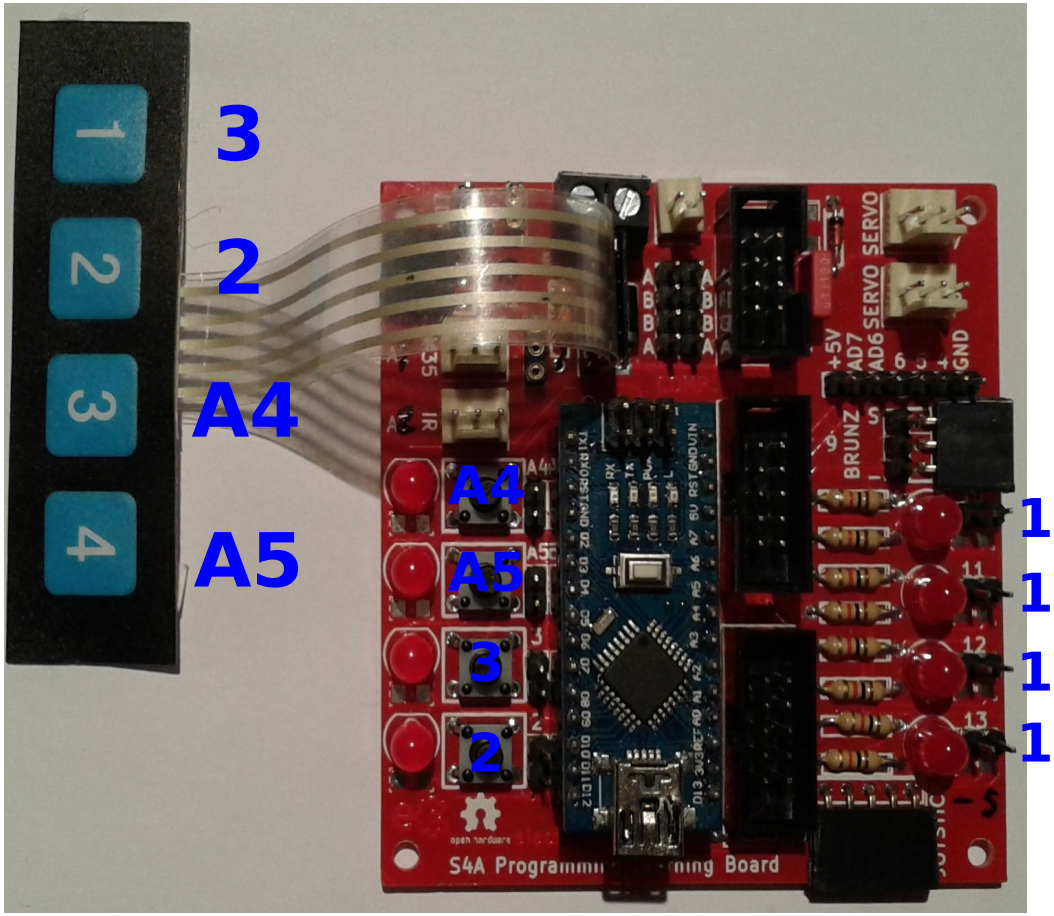
S4A Progamming Learning Board

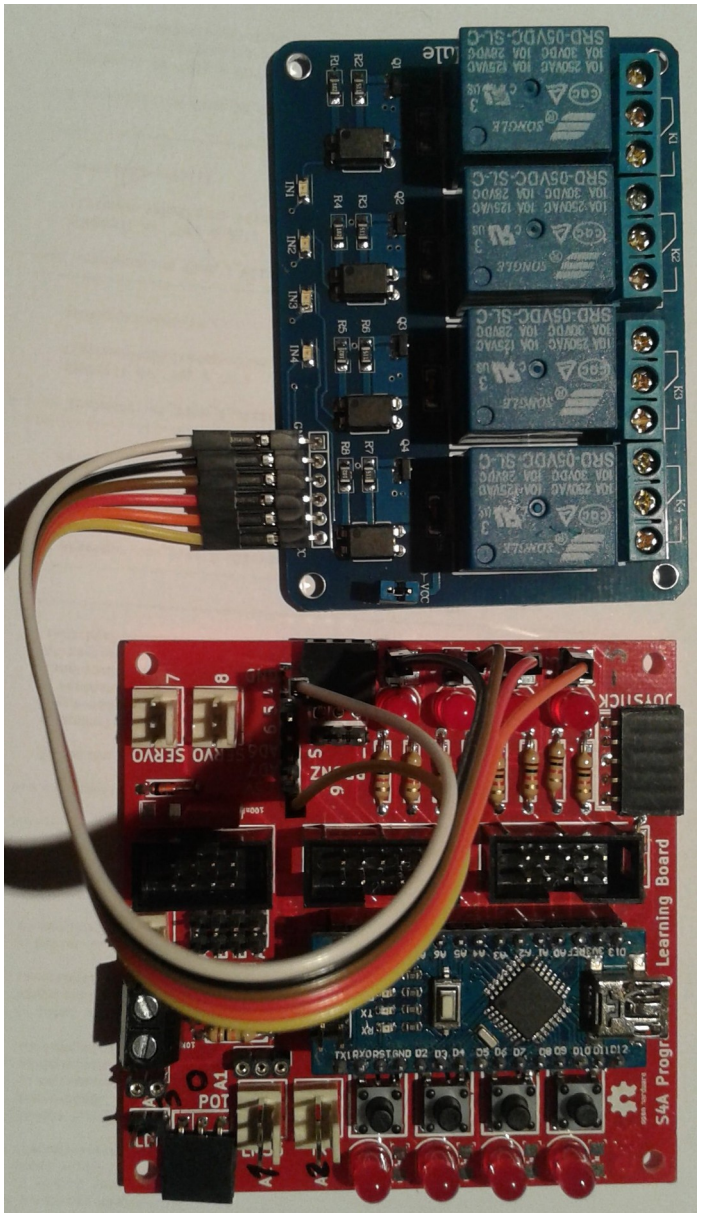
Teclat de membrana i leds



electronics.cat

S4A Progamming Learning Board

Botons, leds i relés



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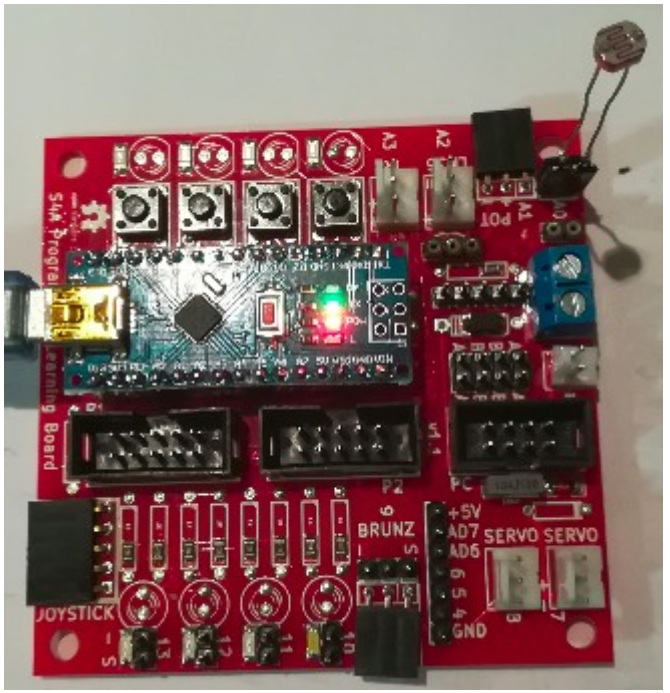
El microcontrolador Arduino

Exemple d'ús amb S4A

Brunzidor



LDR

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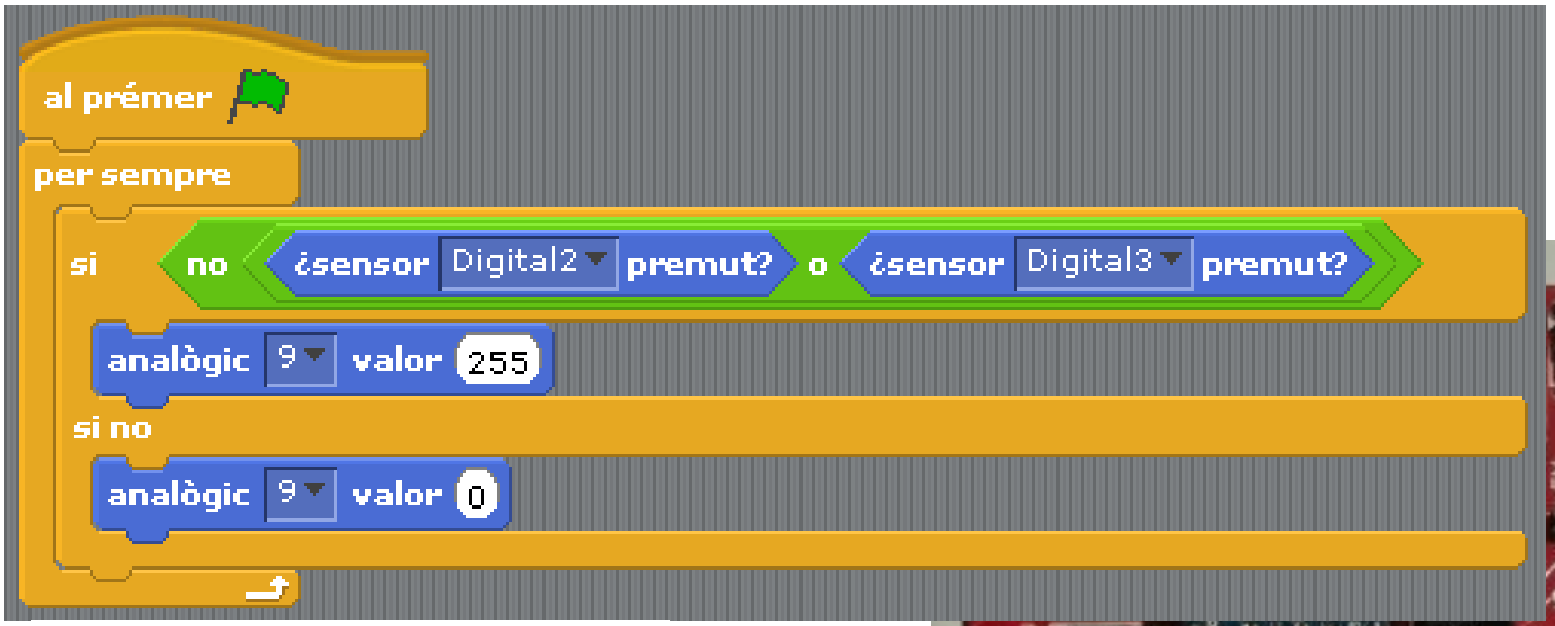
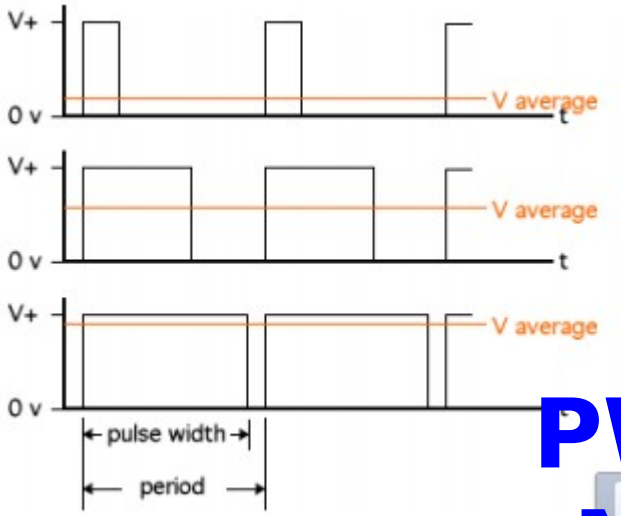
S4A Progamming Learning Board

Botons i brunzidor





A4

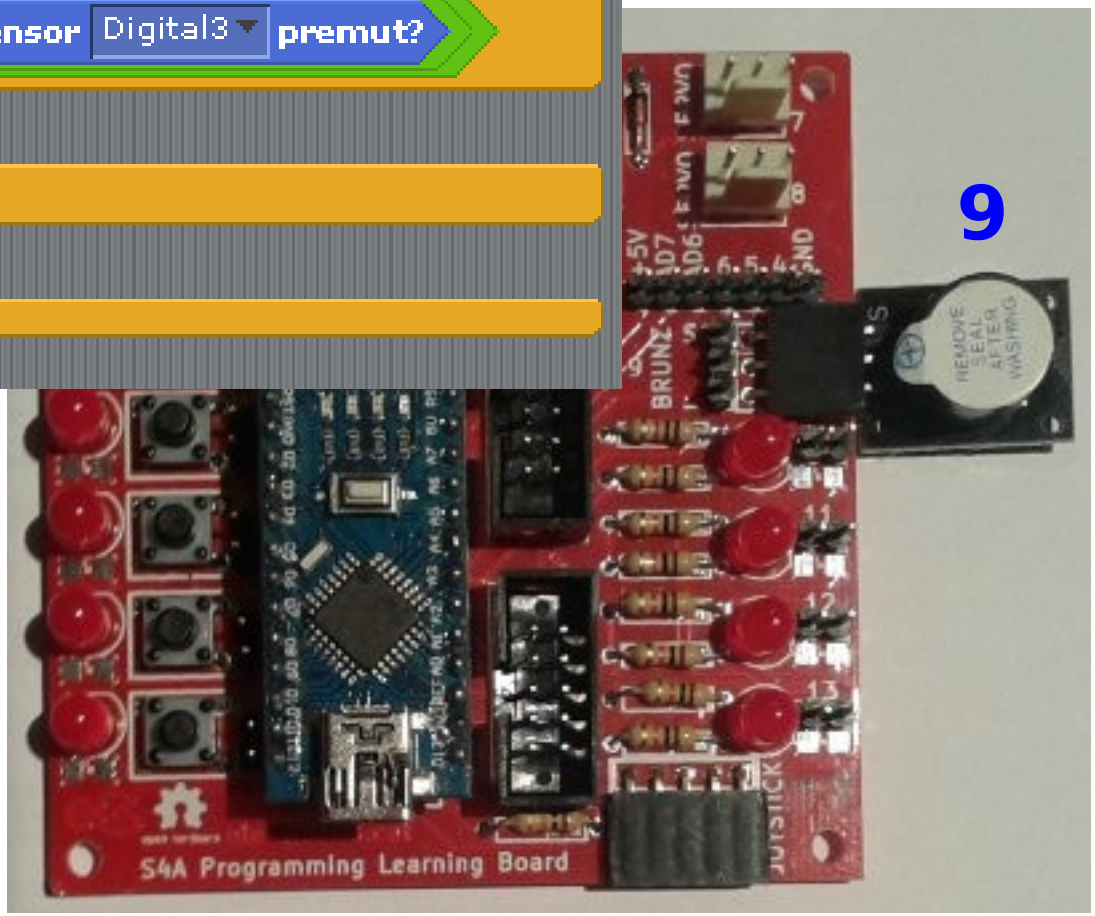
A5

3

2

PW

M



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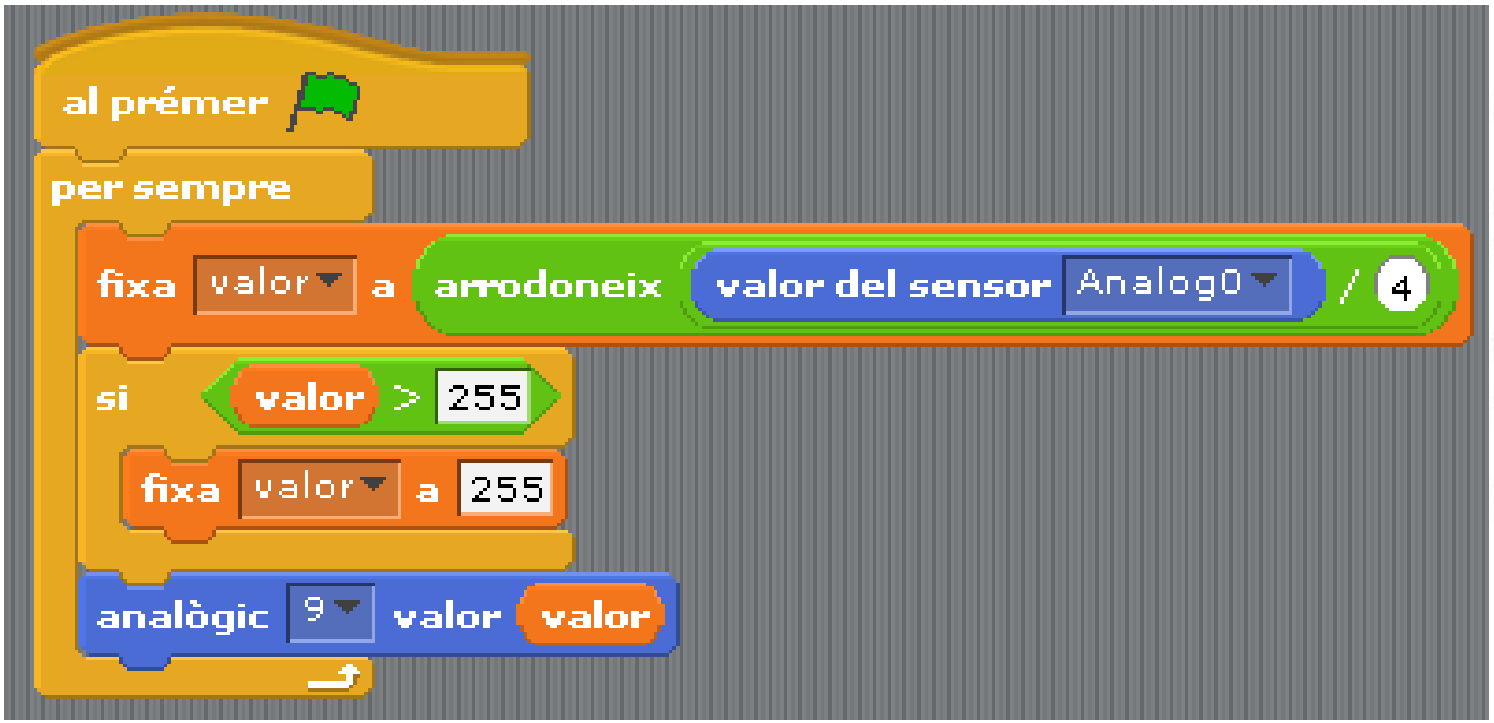
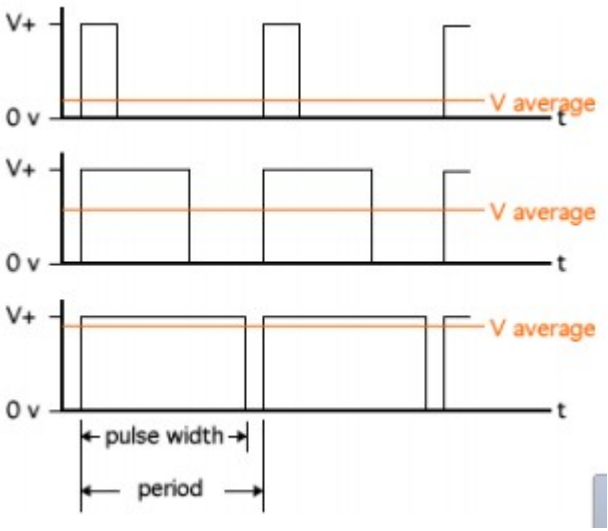
S4A Progamming Learning Board

Potenciòmetre i brunzidor





A0

9

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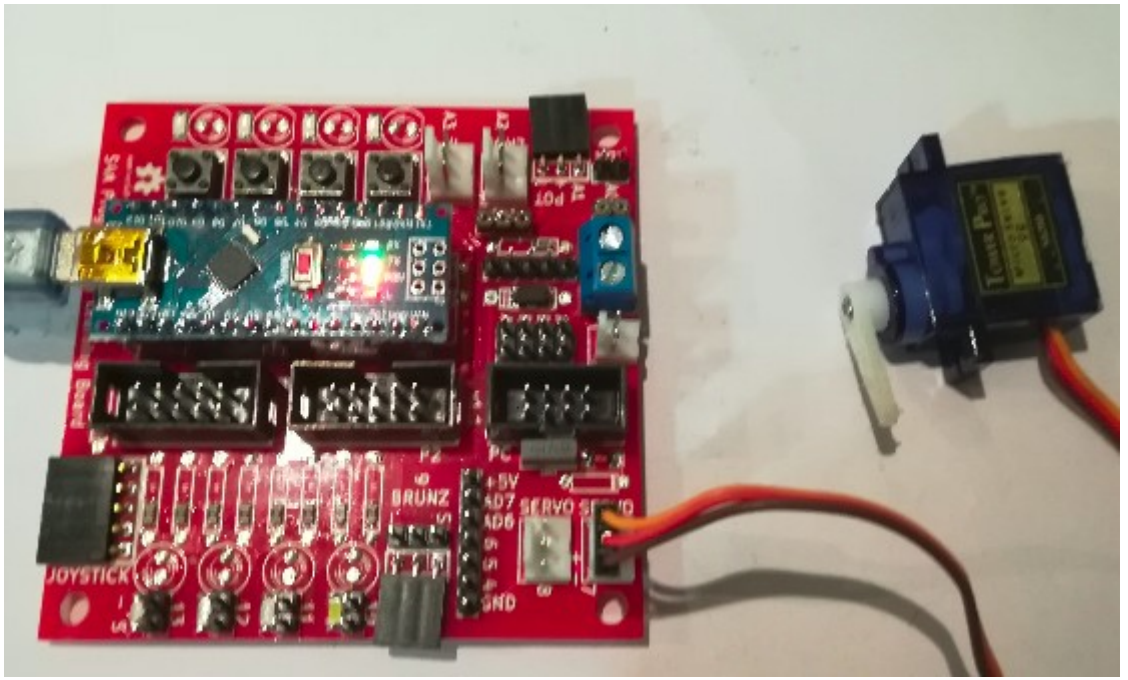
El microcontrolador Arduino

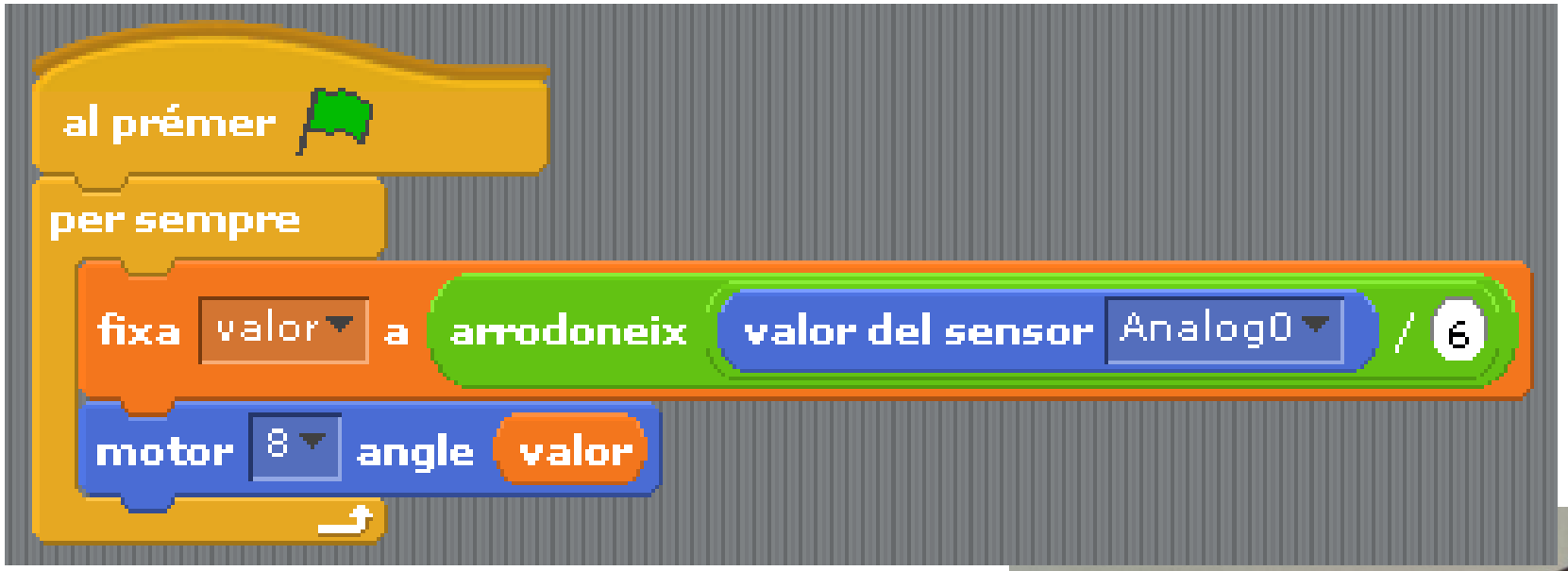
Exemple d'ús amb S4A



Servo

S4A Progamming Learning Board

Potenciòmetre i servomotor



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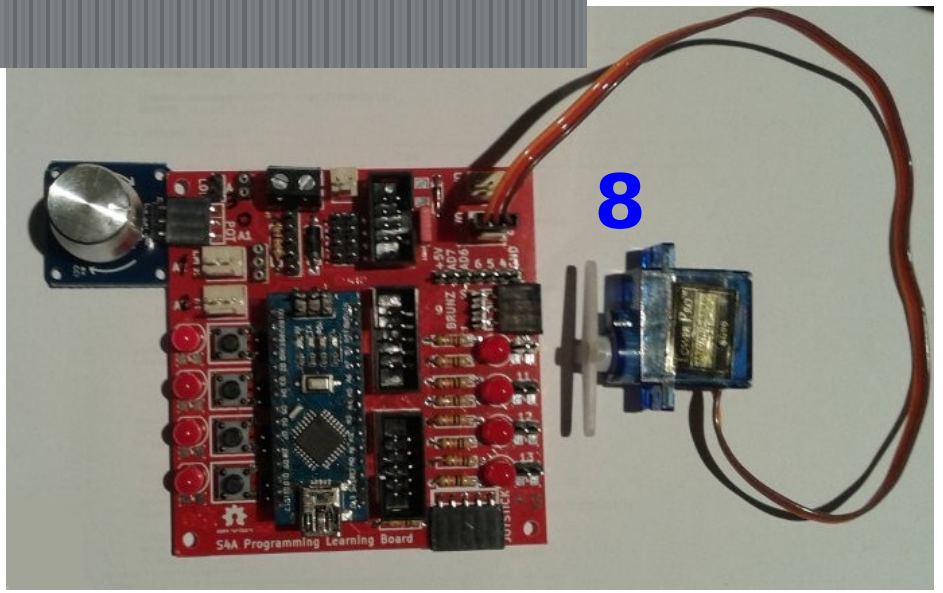

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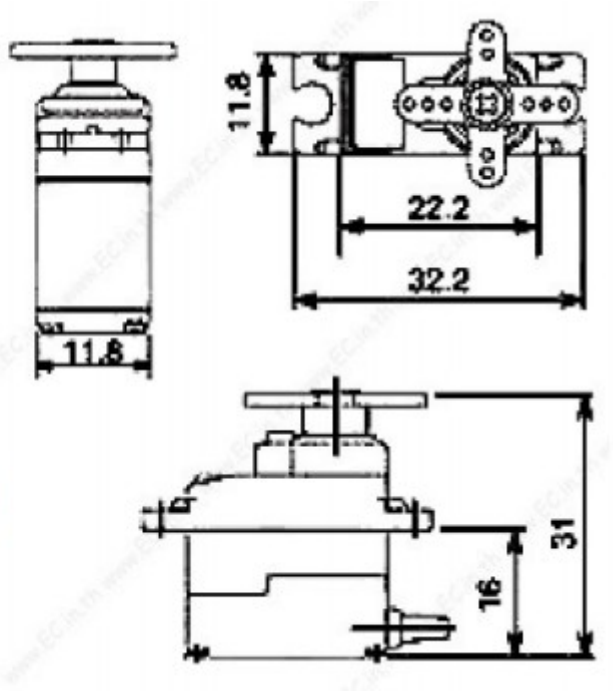
S4A Progamming Learning Board

Servo



Specifications

- Weight: 9 g
- Dimension: 22.2 x 11.8 x 31 mm approx.
- Stall torque: 1.8 kgf·cm
- Operating speed: 0.1 s/60 degree
- Operating voltage: 4.8 V (~5V)
- Dead band width: 10 µs
- Temperature range: 0 ºC – 55 ºC

http://datasheet.sparkgo.com.br/SG90Servo.pdf

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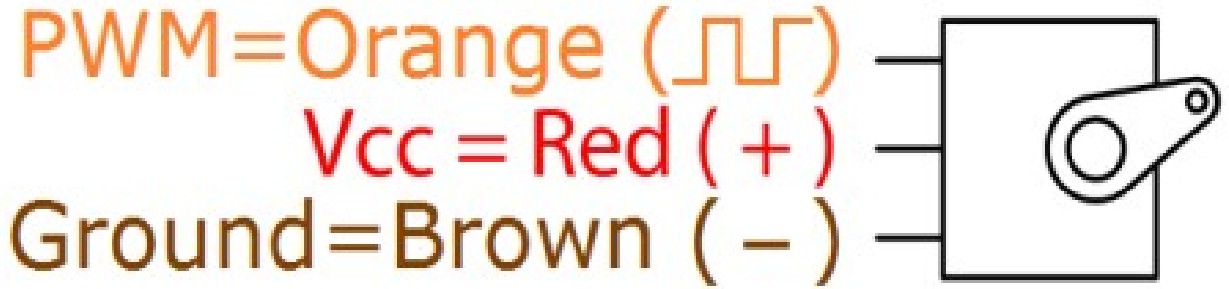
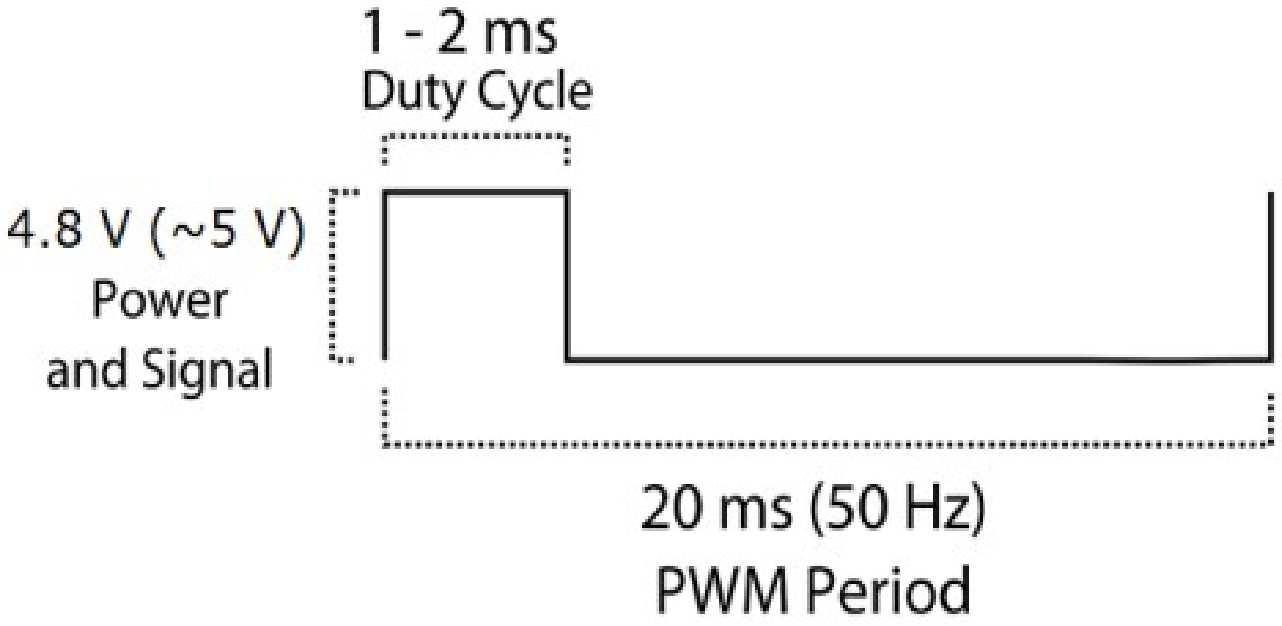
S4A Progamming Learning Board

Servo





Position "0" (1.5 ms pulse) is middle, "90" (~2 ms pulse) is all the way to the right, "-90" (~1 ms pulse) is all the way to the left.

http://datasheet.sparkgo.com.br/SG90Servo.pdf

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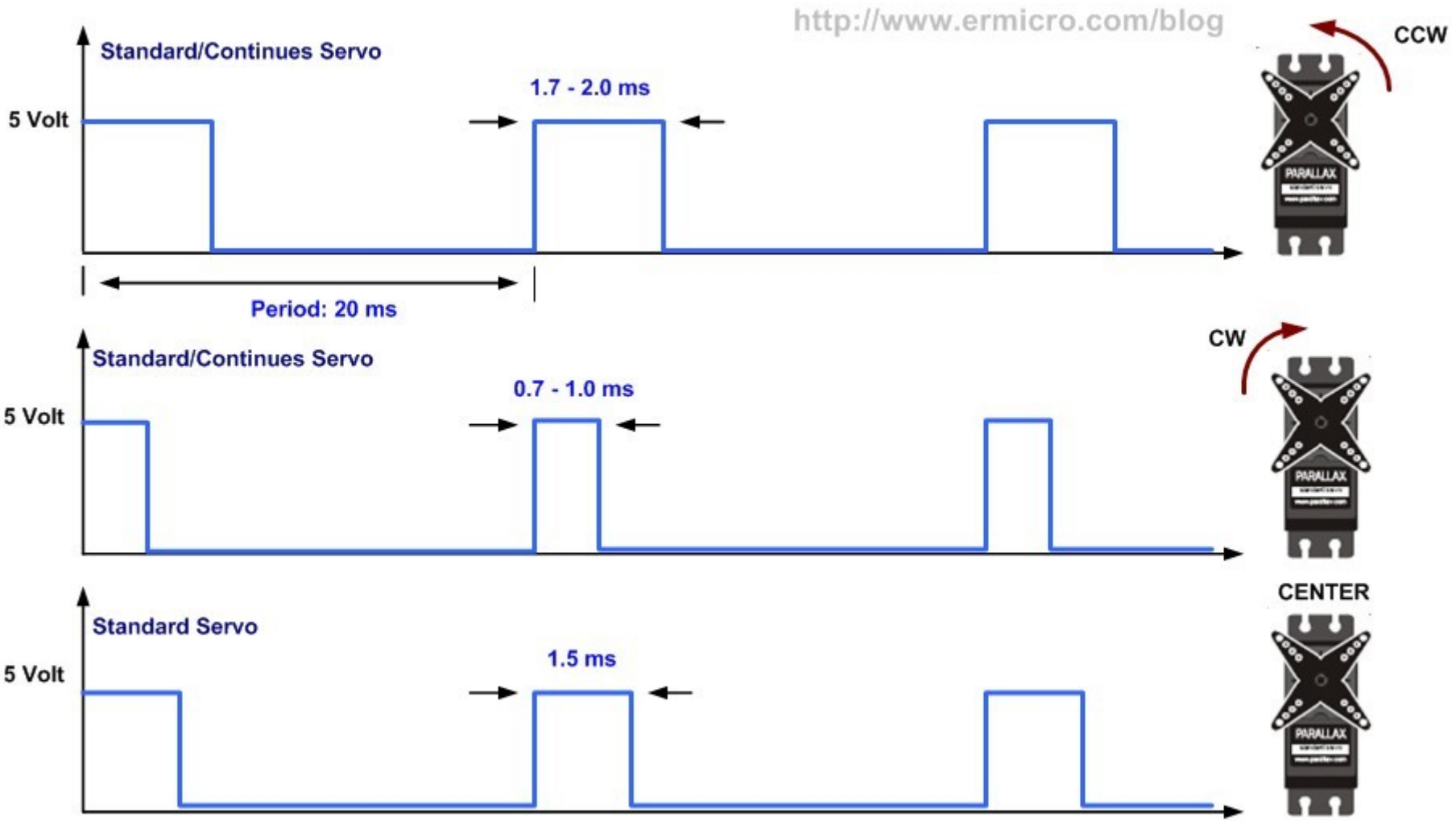
S4A Progamming Learning Board

Servo



Servo Motor PWM Timing Diagram

http://www.ermicro.com/blog/wp-content/uploads/2009/02/servo_01.jpg

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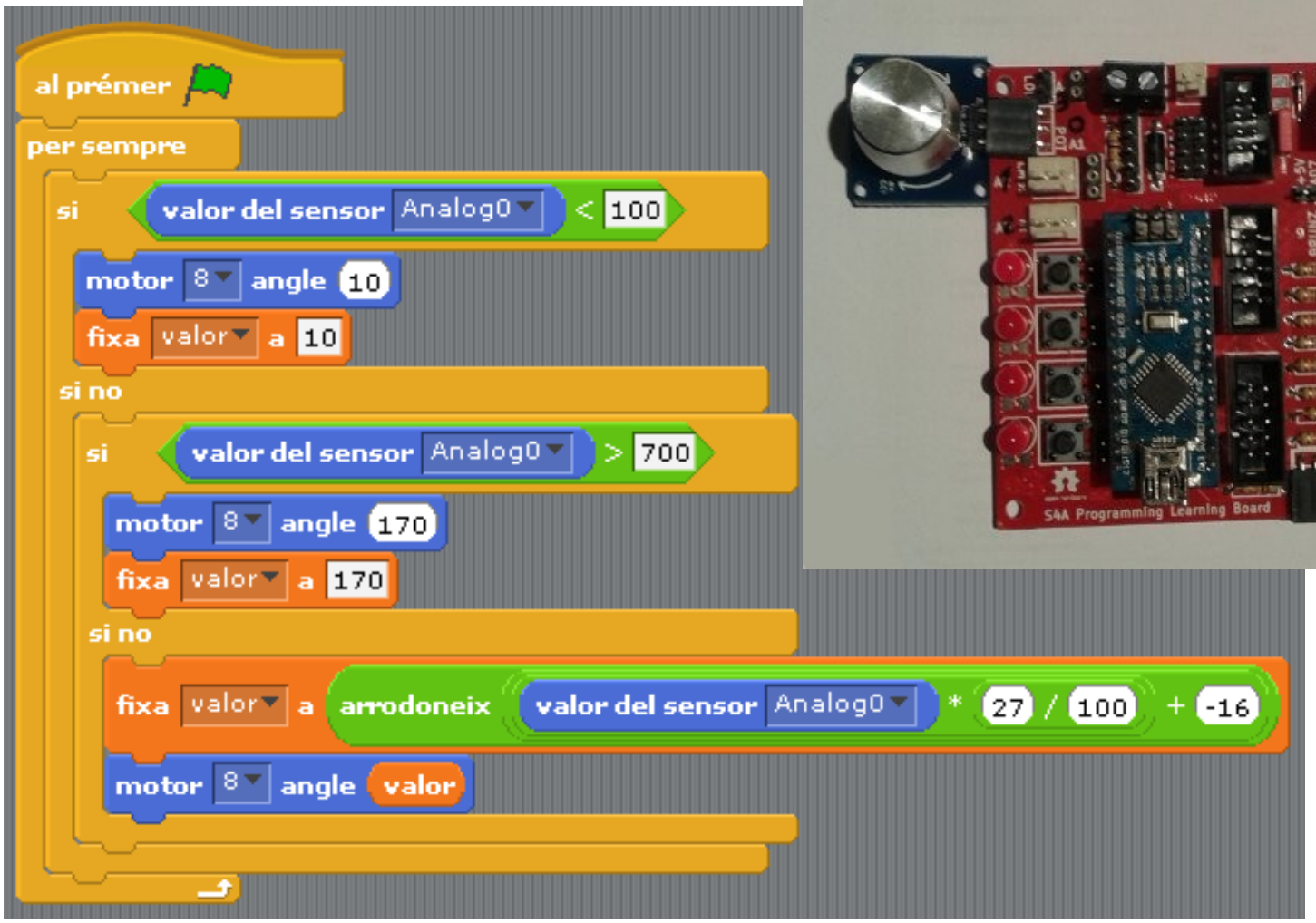
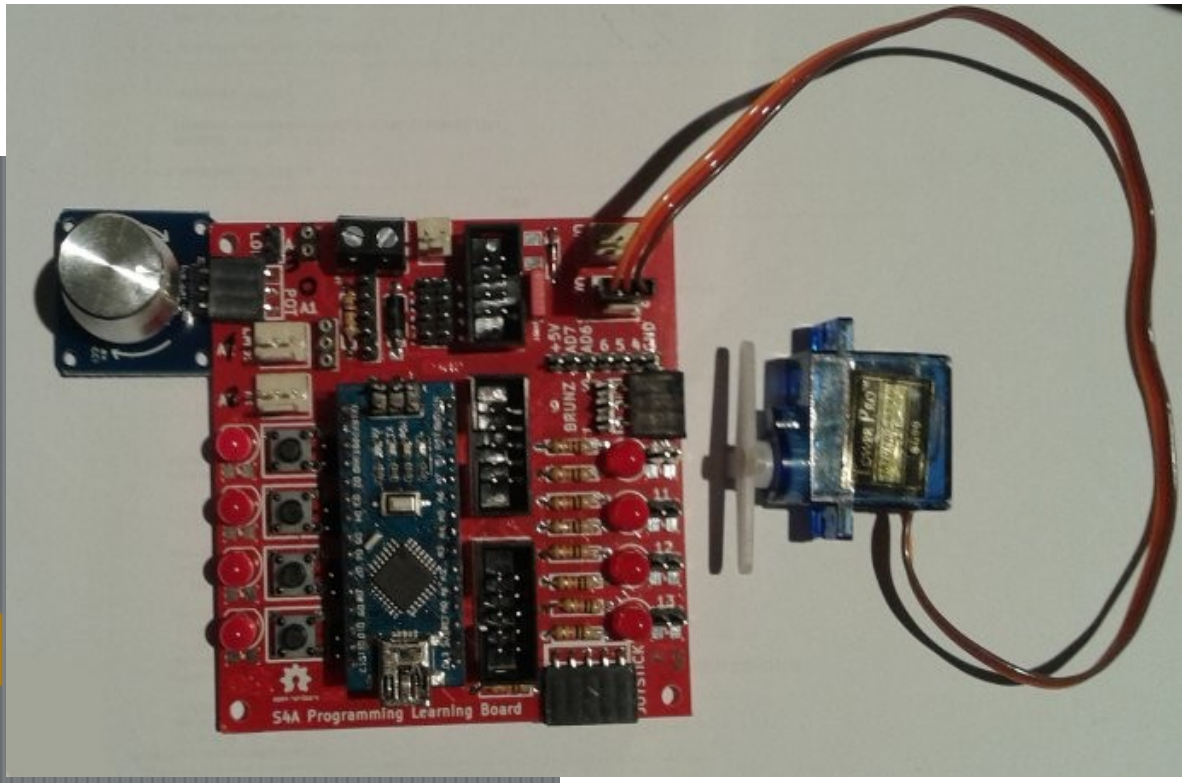
S4A Progamming Learning Board

Potenciòmetre i servomotor





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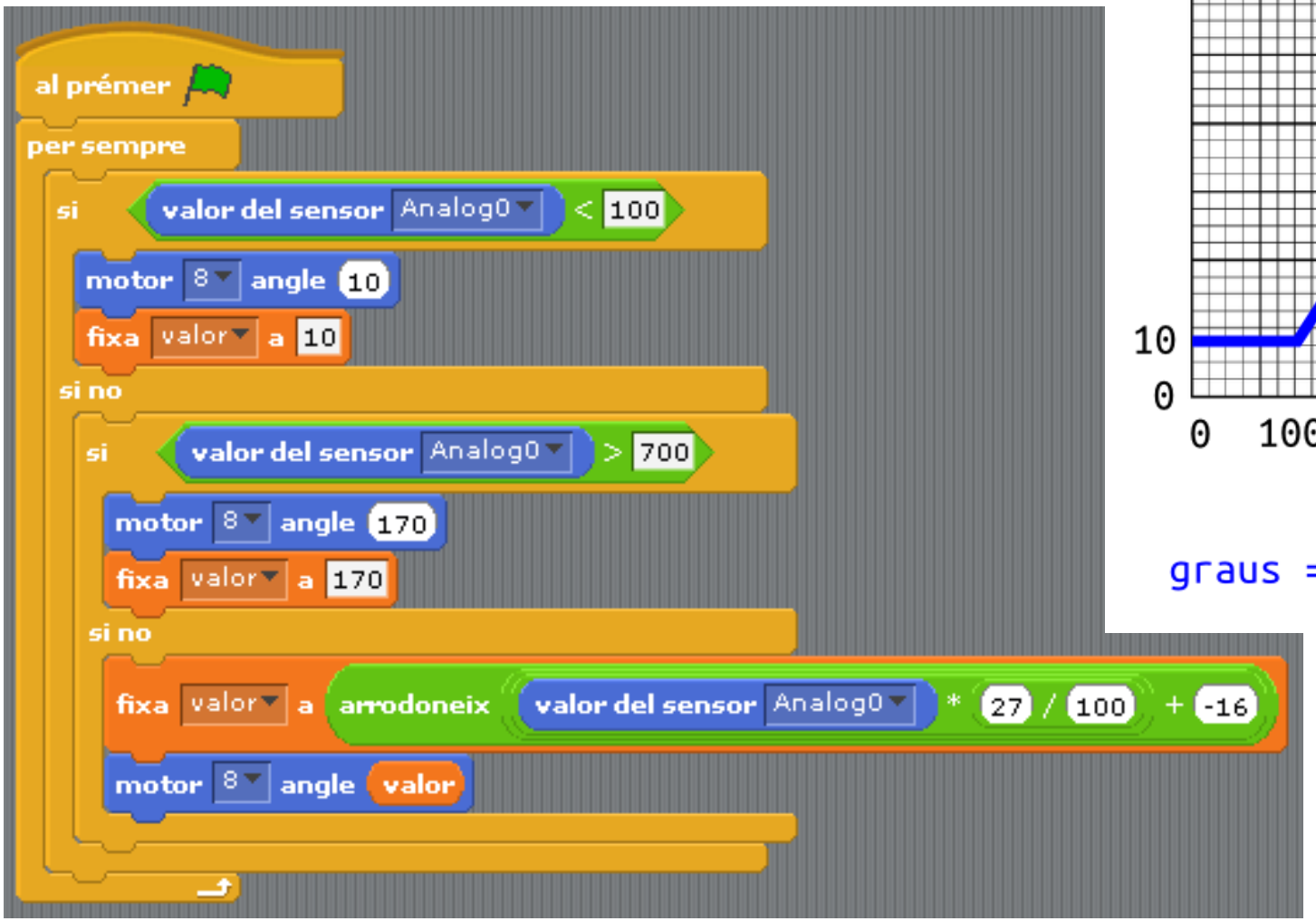
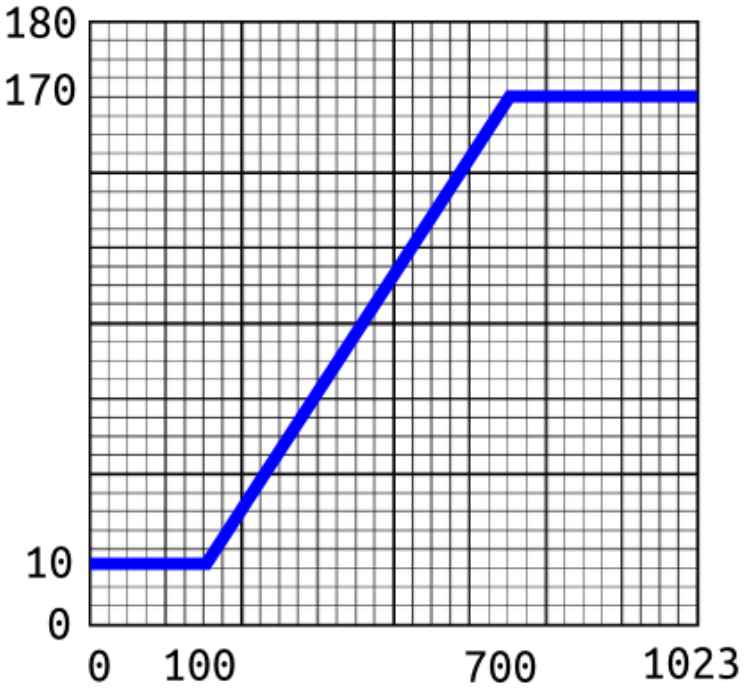
S4A Progamming Learning Board

Potenciòmetre i servomotor





$$graus = Analog0 \frac{27}{100} - 16$$

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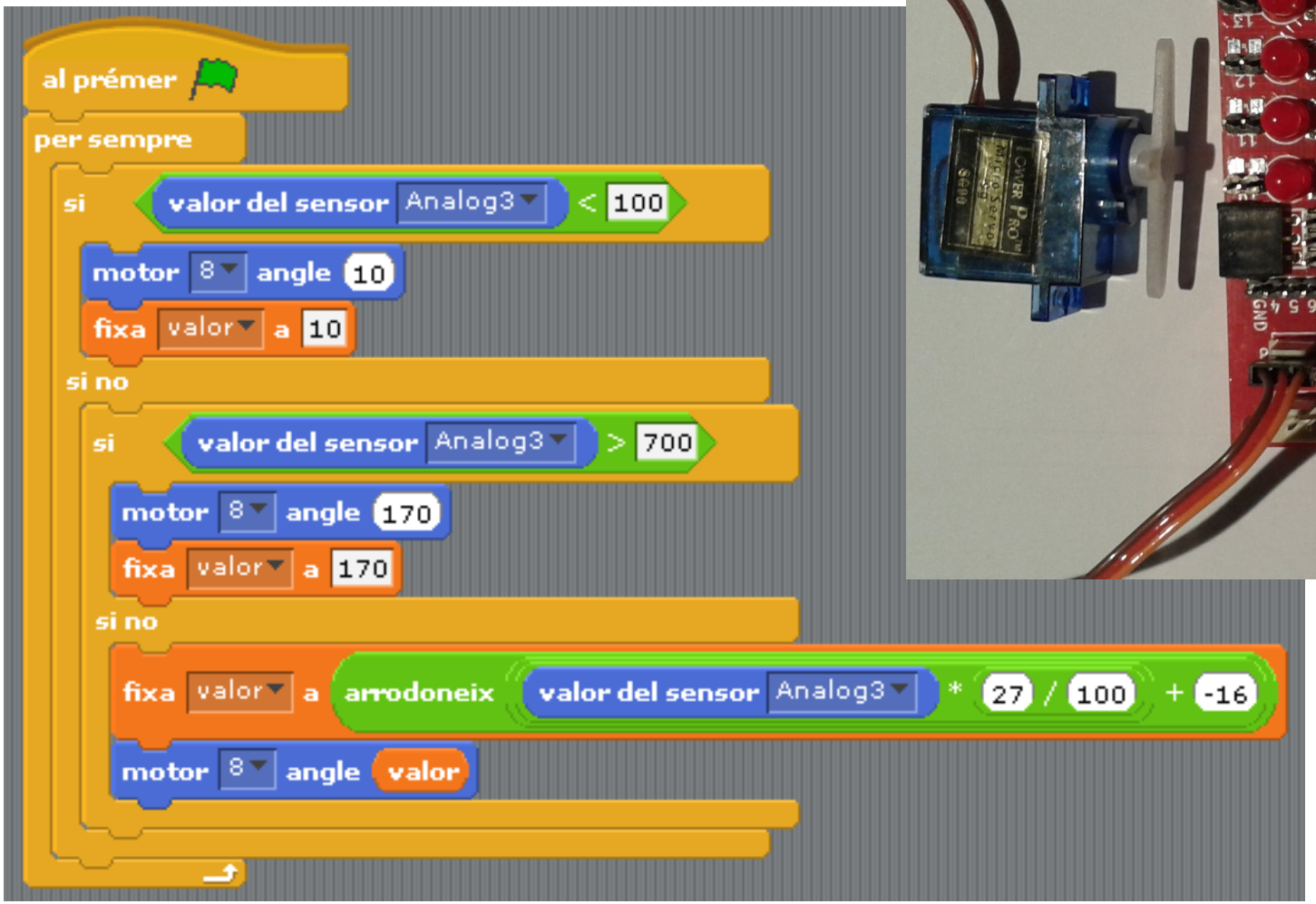
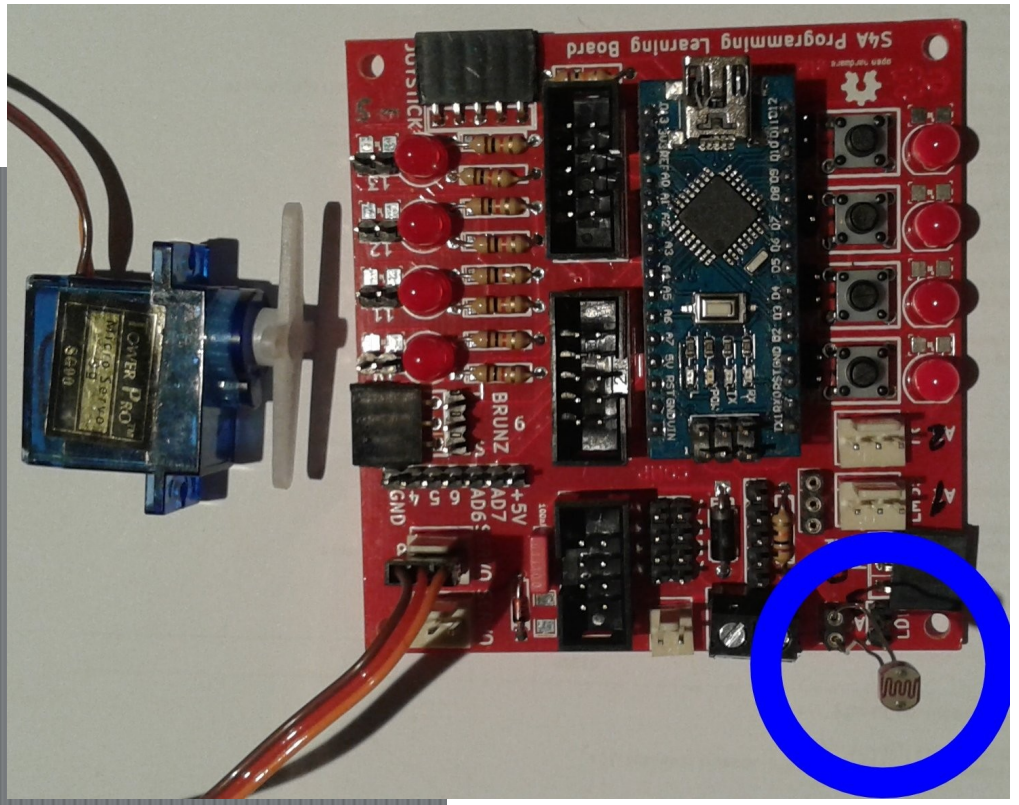
S4A Progamming Learning Board

LDR i servomotor





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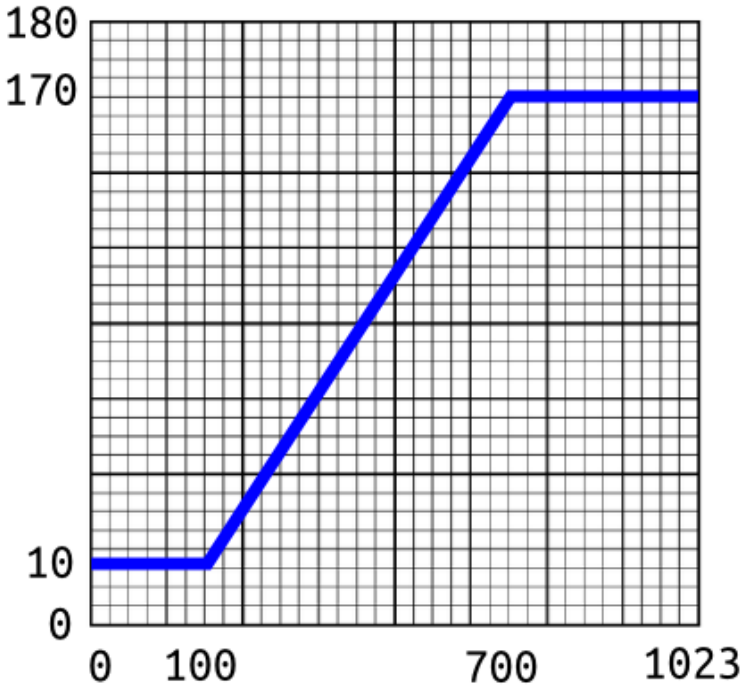
S4A Progamming Learning Board

LDR i servomotor



$$graus = Analog0 \frac{27}{100} - 16$$

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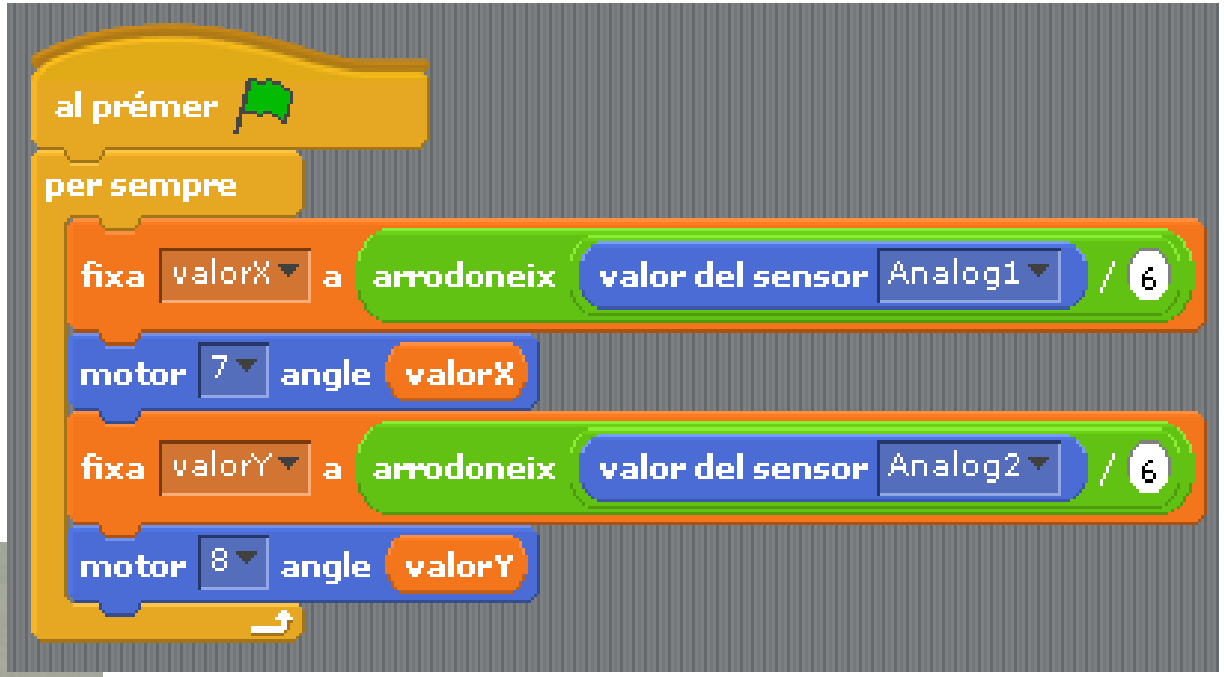
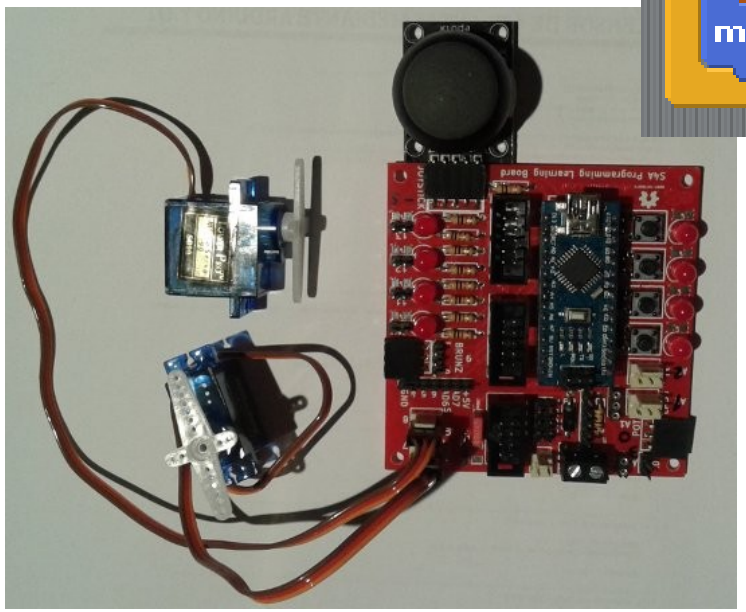
S4A Progamming Learning Board

Joystick i servomotors





Per a fer servir el joystick desconnecteu el sensor de temperatura i el sensor infraroig

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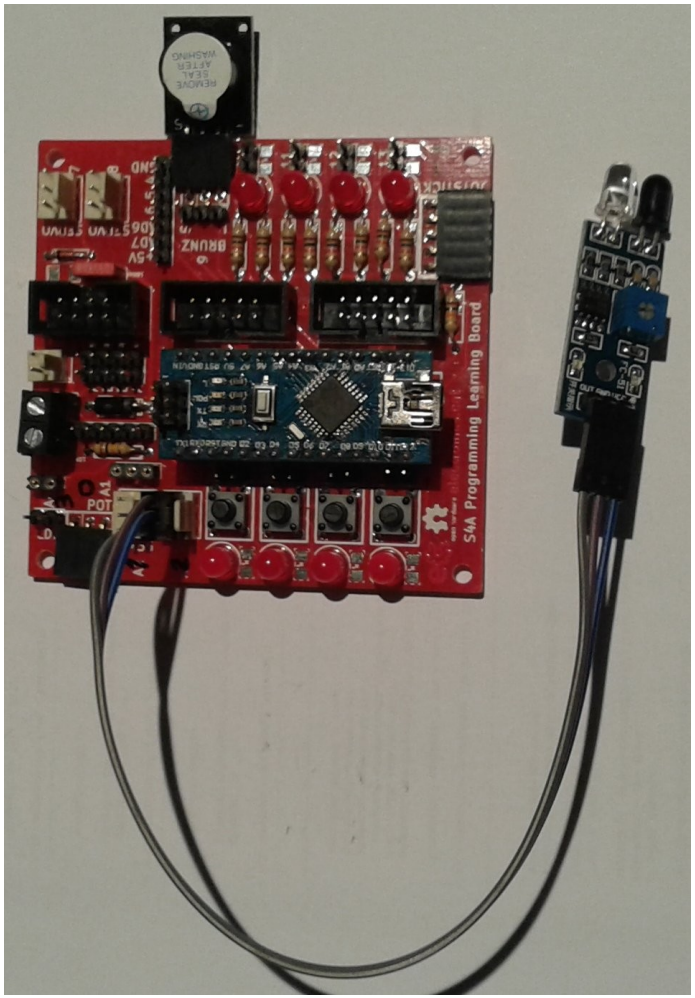
S4A Progamming Learning Board

Sensor d'infrarojos i brunzidor



Per a fer servir el sensor infraroig desconnecteu el joystick

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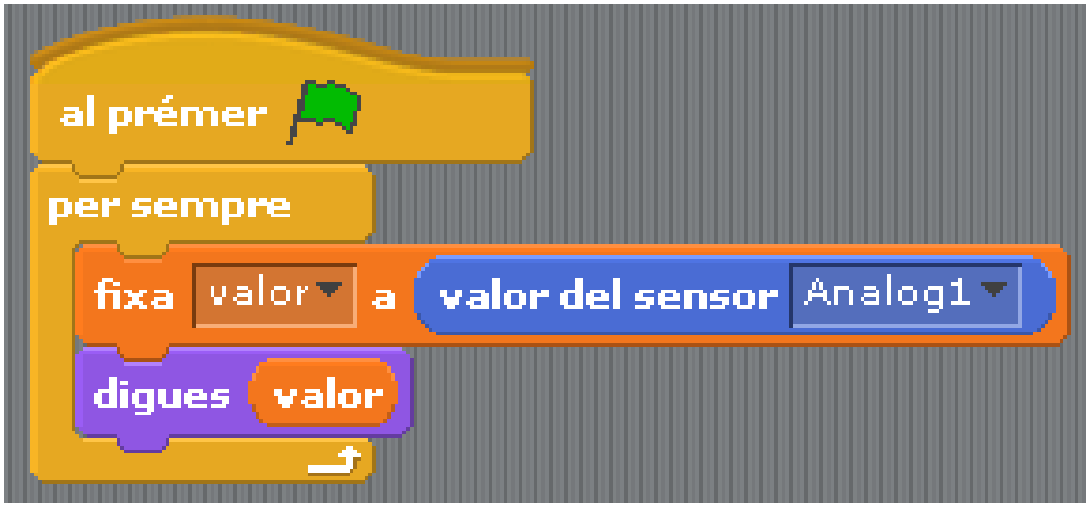
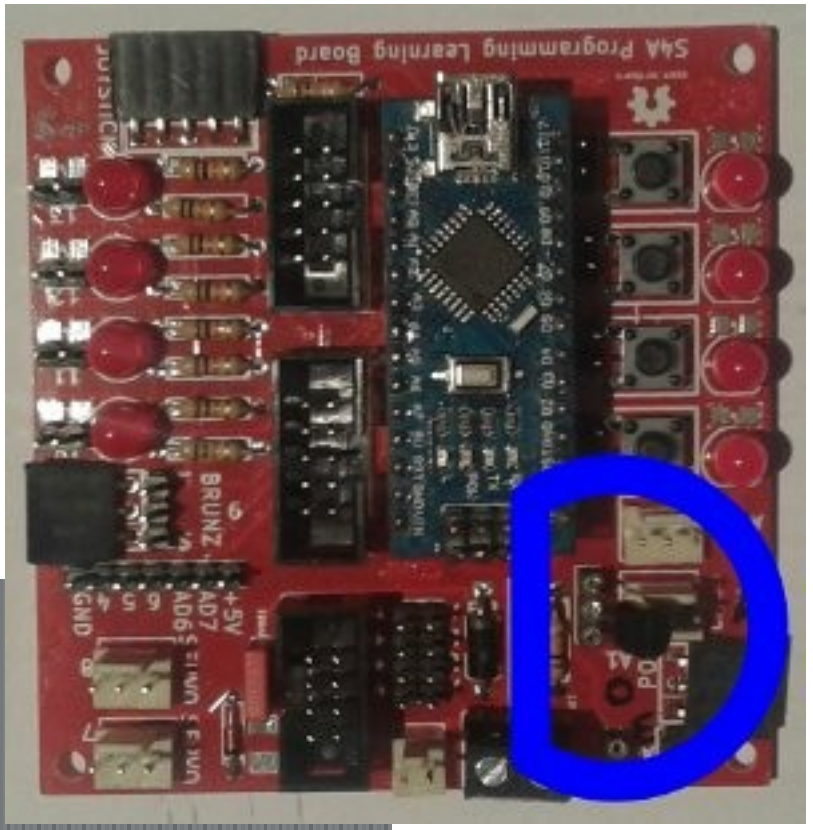
S4A Progamming Learning Board

Sensor de temperatura LM35





Per a fer servir el sensor de temperatura desconnecteu el joystick

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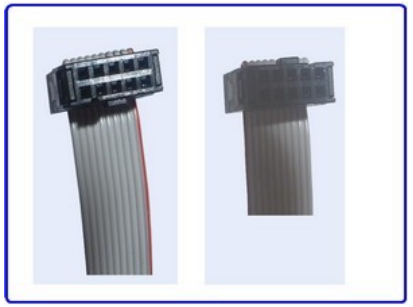
El microcontrolador Arduino

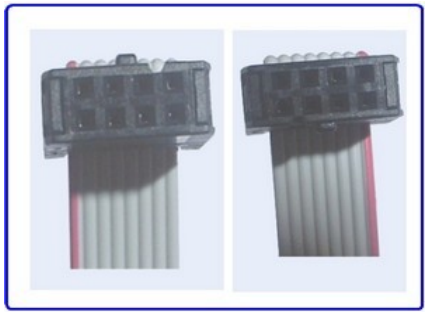
BUS : Sistema digital que transfereix dades entre dispositius electrònics

GND	b7
b6	b5
b4	b3
b2	b1
b0	+5V

	+5V o	CTS / RTS
CTS / RTS	o X	
TX / RX	o X	
RX / TX	o GND	

Cable pla
5x2 a 5x2
(0104A)





eCat System : Dues tipologies de BUS, dades (8 bits) i comunicacions

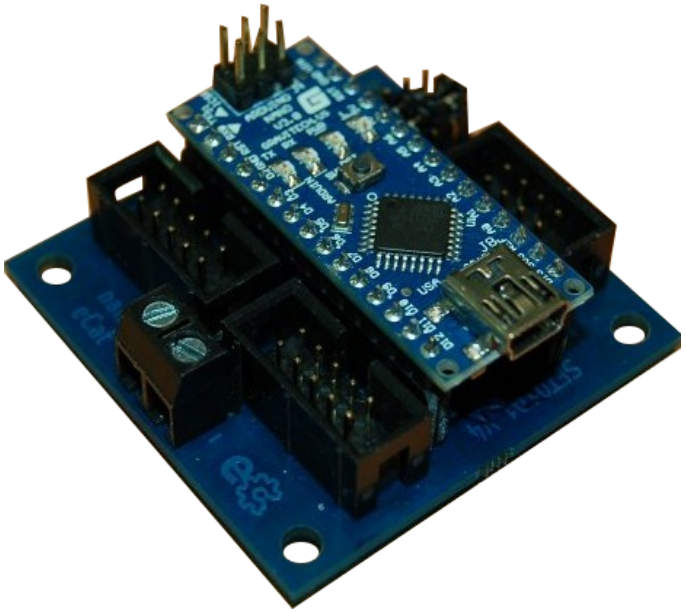
http://electronics.cat/php/common/index.php?lang=ca&page=044

electronics.cat

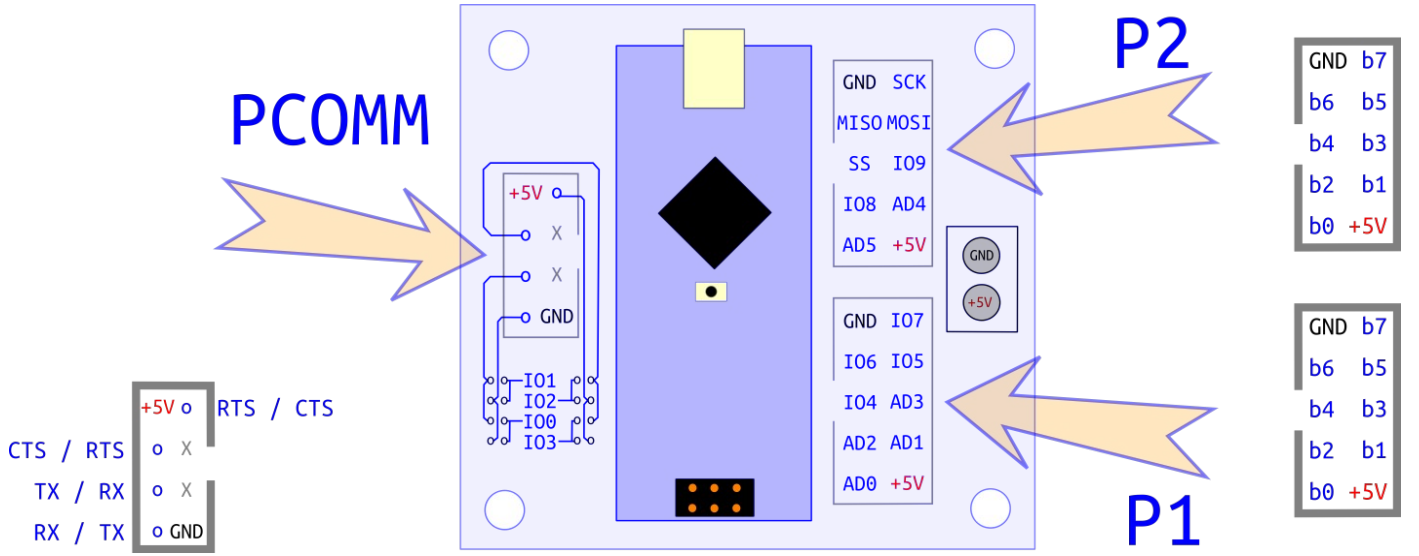
El microcontrolador Arduino

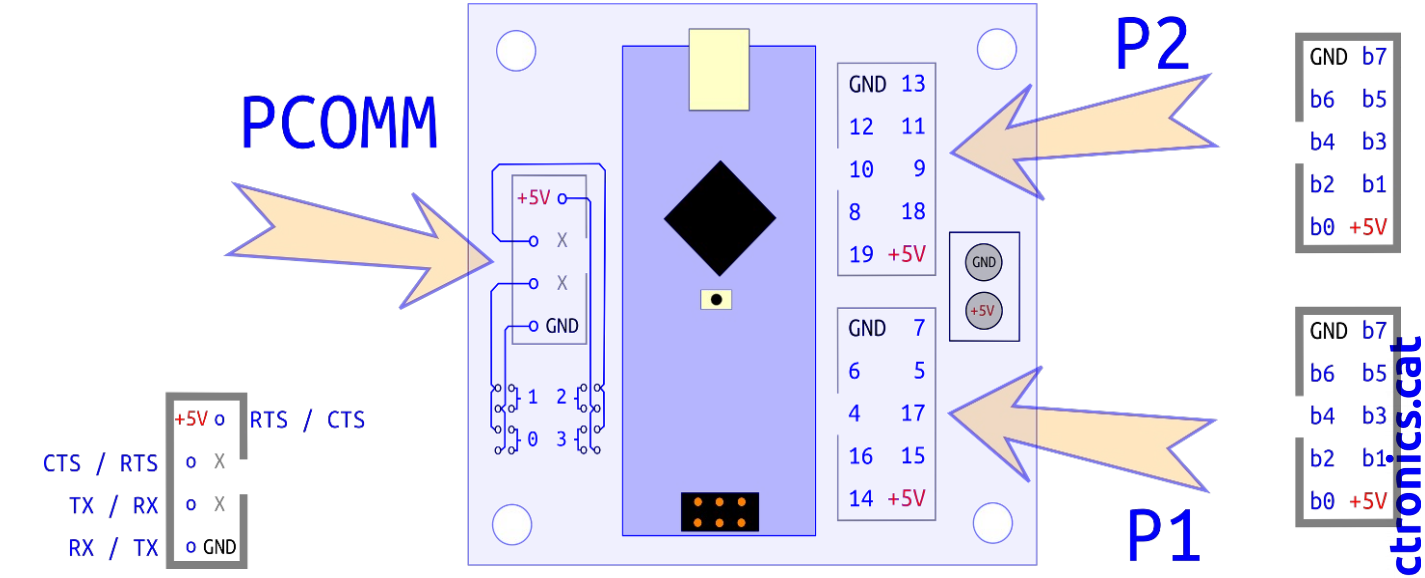
nano-eCat

Placa 0101 v4



Placa convertidora de l'Arduino Nano al sistema de bus lliure eCat System





http://electronics.cat/php/common/index.php?lang=ca&page=101

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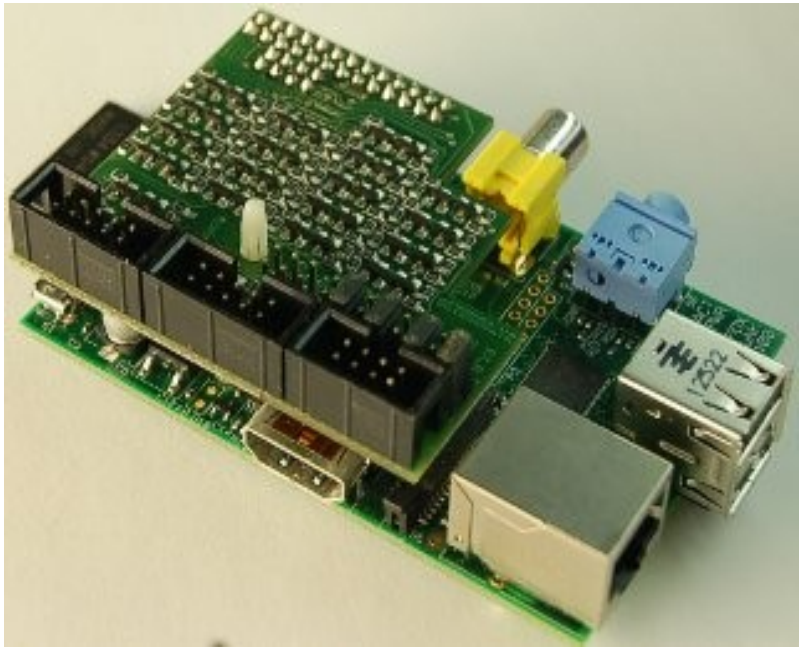
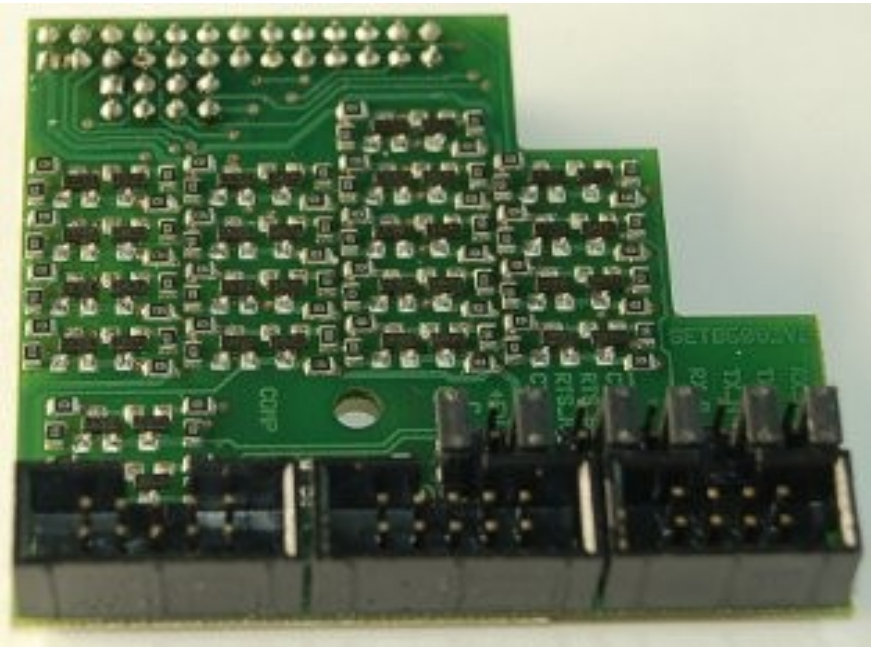
El microcontrolador Arduino

Nivells de tensió



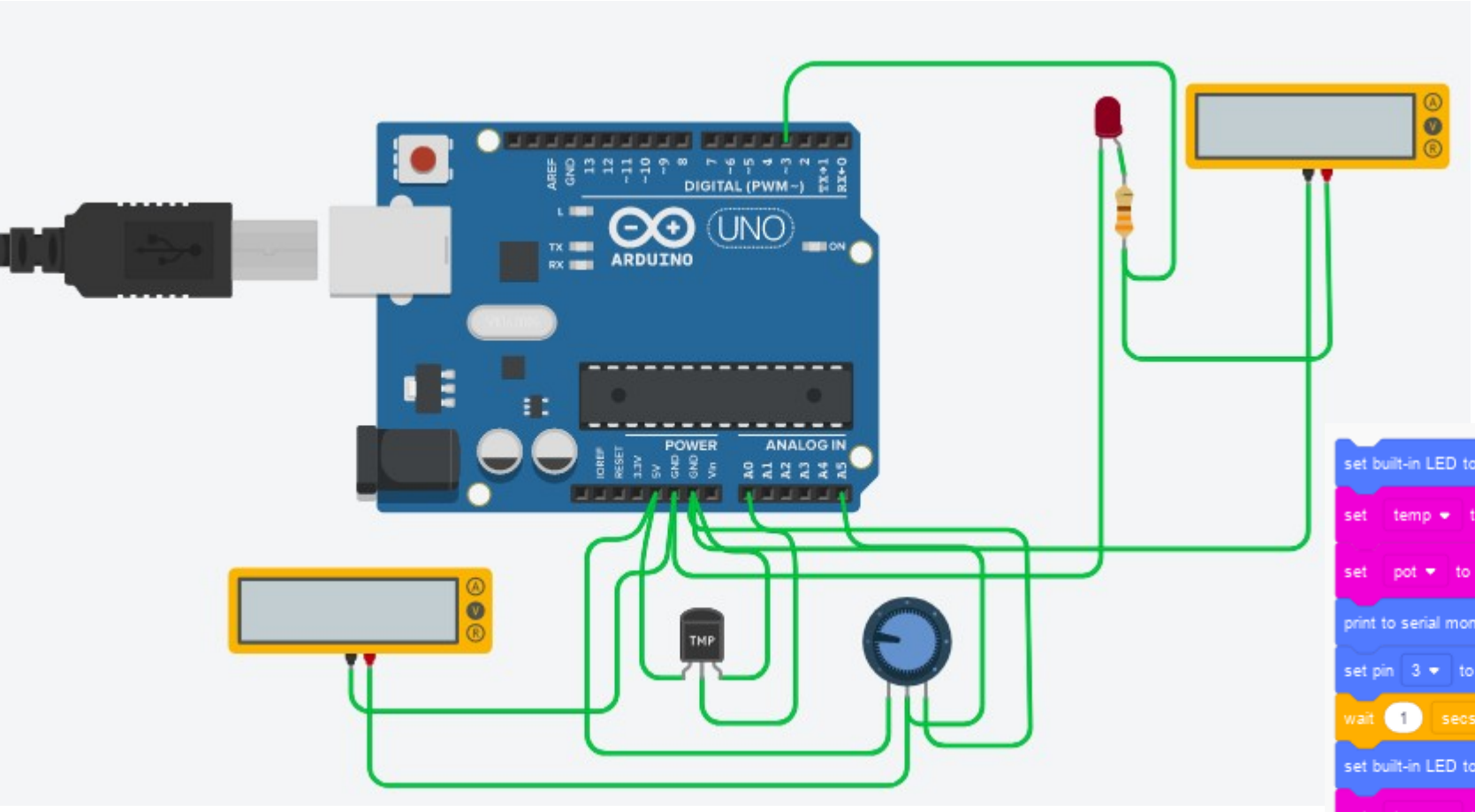


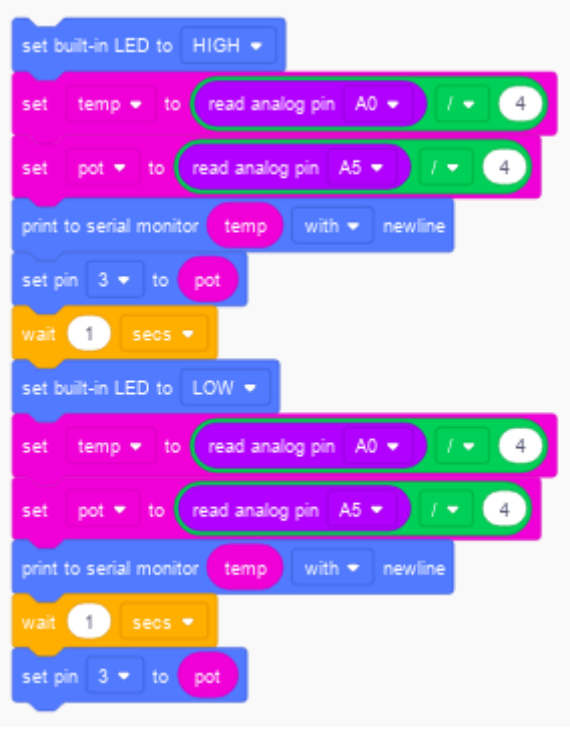
http://electronics.cat/php/common/index.php?lang=ca&page=508

electronics.cat

Maneres de programar un Arduino

Simulació per blocs a TinkerCad





https://www.tinkercad.com/

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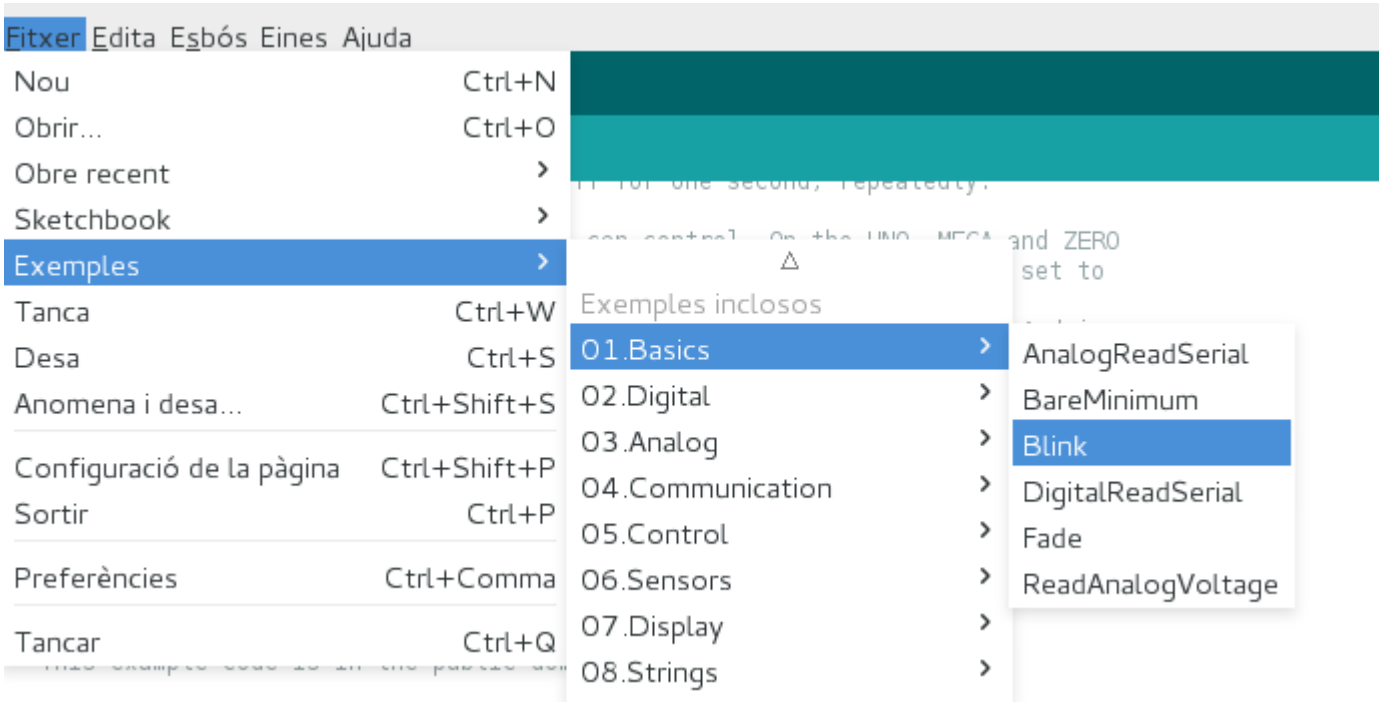
Maneres de programar un Arduino

Des de l'IDE d'Arduino



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Connexió de perifèrics a l'Arduino

Entrades i sortides digitals

```
// basic_05_flanc.ino
#define BOTO 2
#define TEMPS_REBOTS_EN_ms  20

void setup(){
        Serial.begin(9600);
        pinMode(BOTO,INPUT);
        Serial.println("Quants cops he premut ...");
}

void loop(){
        static bool bPrevi = HIGH;
        bool bAra = digitalRead(BOTO);
        static int nCmpt = 0;

        if(bAra != bPrevi){
                // Hi ha canvi
                delay(TEMPS_REBOTS_EN_ms);
                if(!bAra){ // if (bAra == LOW){
                        // Serial.println("Flanc de baixada detectat.");
                        Serial.print("He premut ");
                        nCmpt++;
                        Serial.print(nCmpt);
                        Serial.println(" cops");
                }
                bPrevi = bAra;
        }
}
```

Exemples d'entrades / sortides digital i flancs

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Connexió de perifèrics a l'Arduino

SPI, I2C, UART

SPI

Serial Peripheral Interface

I2C BUS

UART Bus

Universal asynchronous receiver-transmitter

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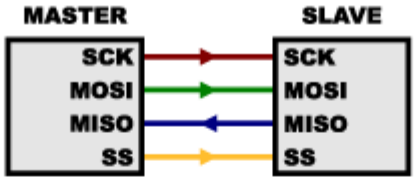
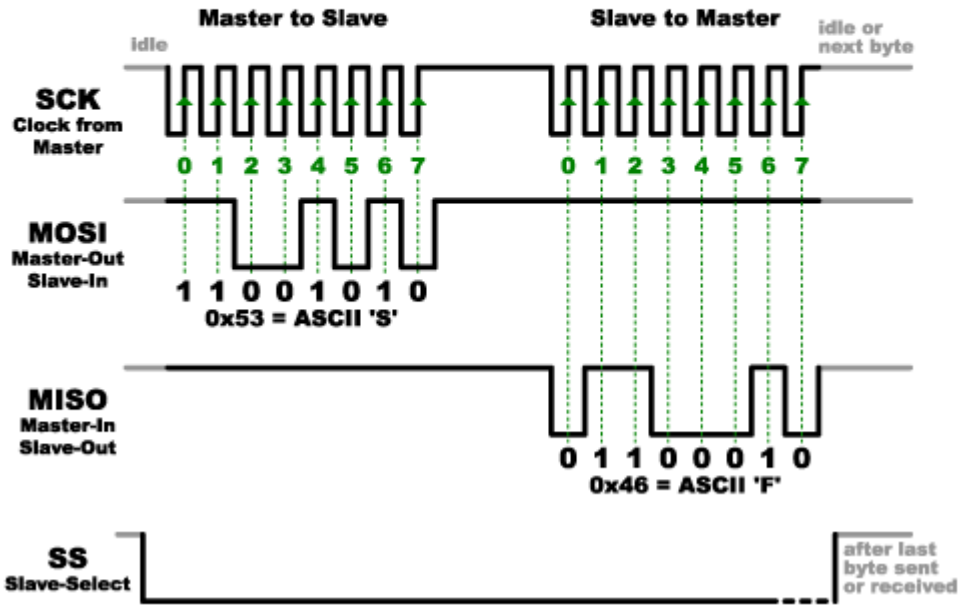
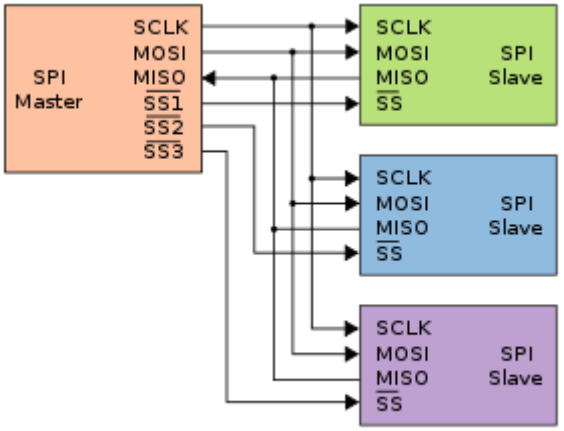
Connexió de perifèrics a l'Arduino

SPI







Explicació del bus SPI

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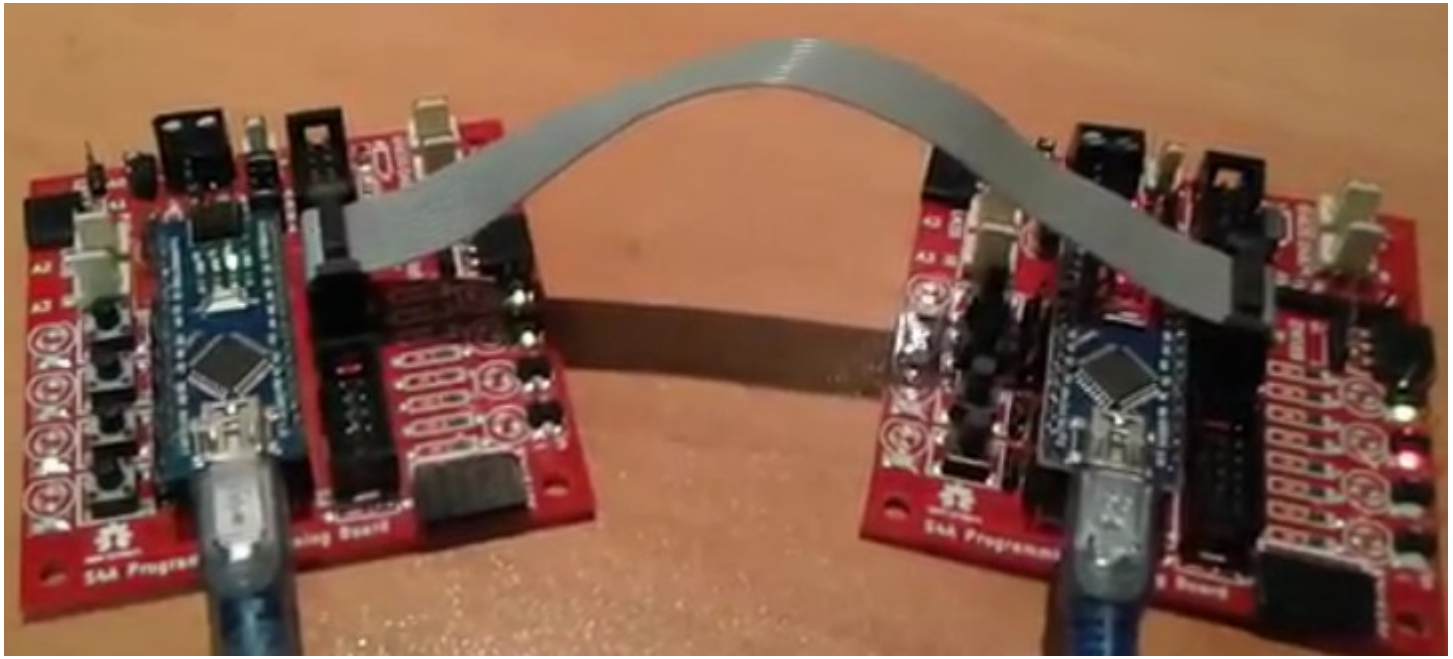
Connexió de perifèrics a l'Arduino

SPI



Codis d'Arduino per al mestre i l'esclau

Vídeo de funcionament

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Connexió de perifèrics a l'Arduino

SPI

```
  Serial.println("Master Initialized");
}
// The loop() function runs continuously after setu
void loop() {
  // Master button pressed?
  if (!digitalRead(btn)) {
    // Yes
    Serial.println("Master Button Pressed.");
    // Select and wait for slave.
    digitalWrite(SS, LOW);
    Serial.println("***Slave Selected.");
    delay(20);
    // Send cmdBtn
    SPI.transfer(cmdBtn);
    Serial.println("cmdBtn Sent.");
    // Wait for slave.
    delay(20);
    // Get slave response.
    byte rx = SPI.transfer(255);
    // Acknowledged?
    if (rx == cmdBtn) {
      // Yes.
      Serial.println("Slave acknowledged cmdBtn.");
    }
    // Command not recognized?
```

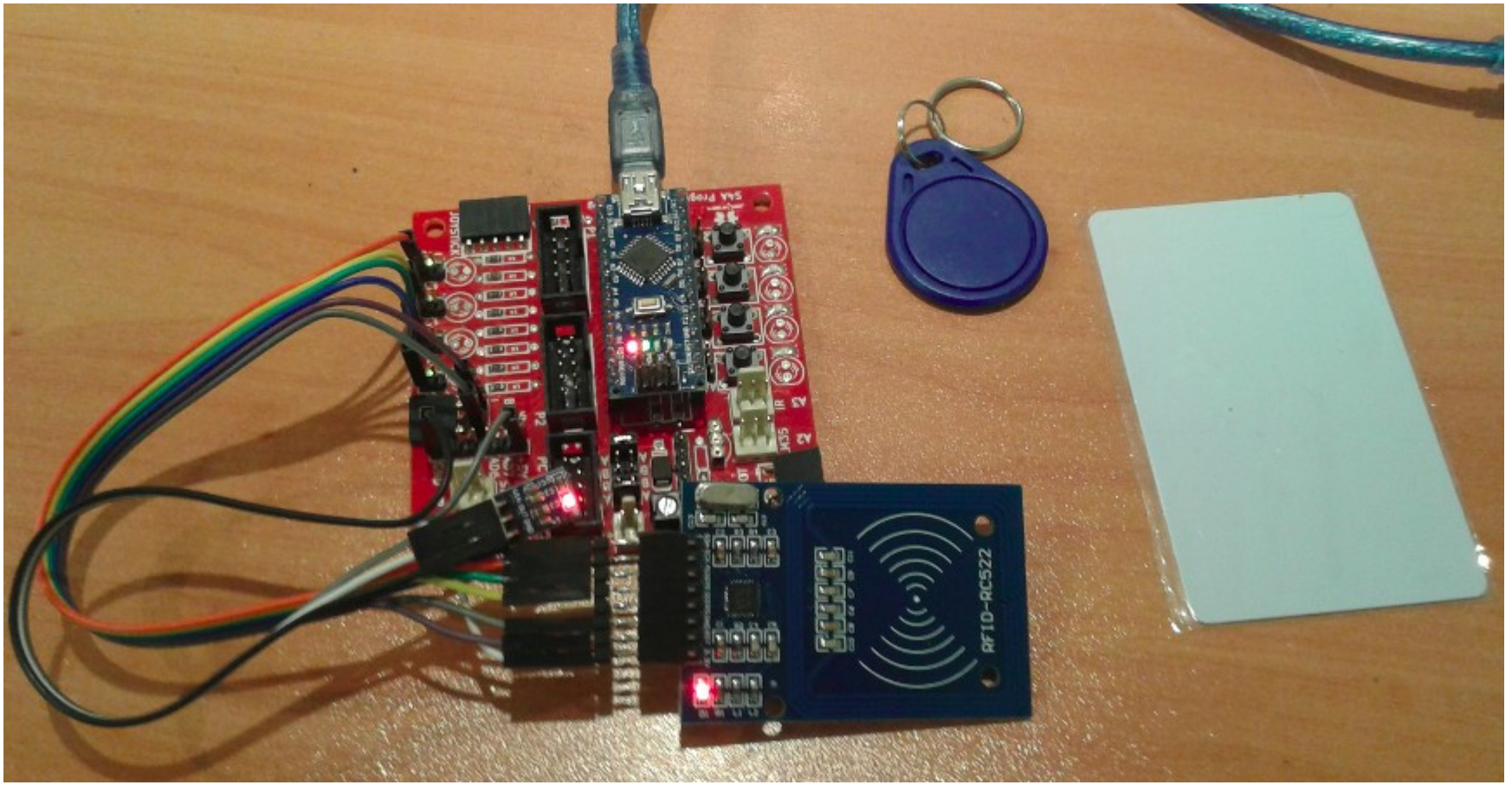
```
void loop() {
  // Slave Enabled?
  if (!digitalRead(SS)) {
    // Yes, first time?
    if (SSlast != LOW) {
      // Yes, take MISO pin.
      pinMode(MISO, OUTPUT);
      Serial.println("***Slave Enabled.");
      // Write -1 slave response code and receive master command c
      byte rx = SPItransfer(255);
      Serial.println("Initial -1 slave response code sent");
      Serial.println("rx:" + String(rx) + ".");
      // cmdBtn?
      if (rx == cmdBtn) {
        // Acknowledge cmdBtn.
        byte rx = SPItransfer(cmdBtn);
        Serial.println("cmdBtn Acknowledged.");
        Serial.println("rx:" + String(rx) + ".");
        // Toggle LED State
        ledState = !ledState;
        digitalWrite(led, ledState);
      }
      // cmdLEDState?
      else if (rx == cmdLEDState) {
        // Acknowledge cmdLEDState.
        byte rx = SPItransfer(cmdLEDState);
        Serial.println("cmdLEDState Acknowledged.");
        Serial.println("rx:" + String(rx) + ".");
        rx = SPItransfer(ledState);
        Serial.println("ledState:" + String(ledState) + " Sent.");
        Serial.println("rx:" + String(rx) + ".");
```

Codis d'Arduino per al mestre i l'esclau

Vídeo de funcionament

Connexió de perifèrics a l'Arduino

SPI



Com connectar el mòdul RFID-RC522 a Arduino

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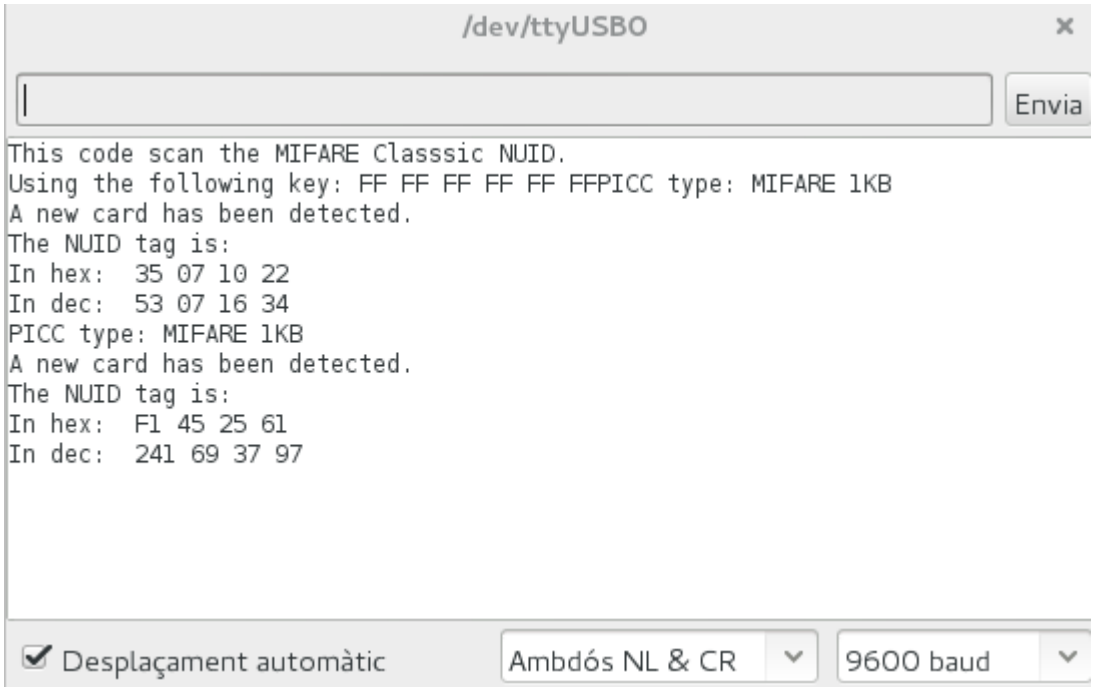
Connexió de perifèrics a l'Arduino

SPI



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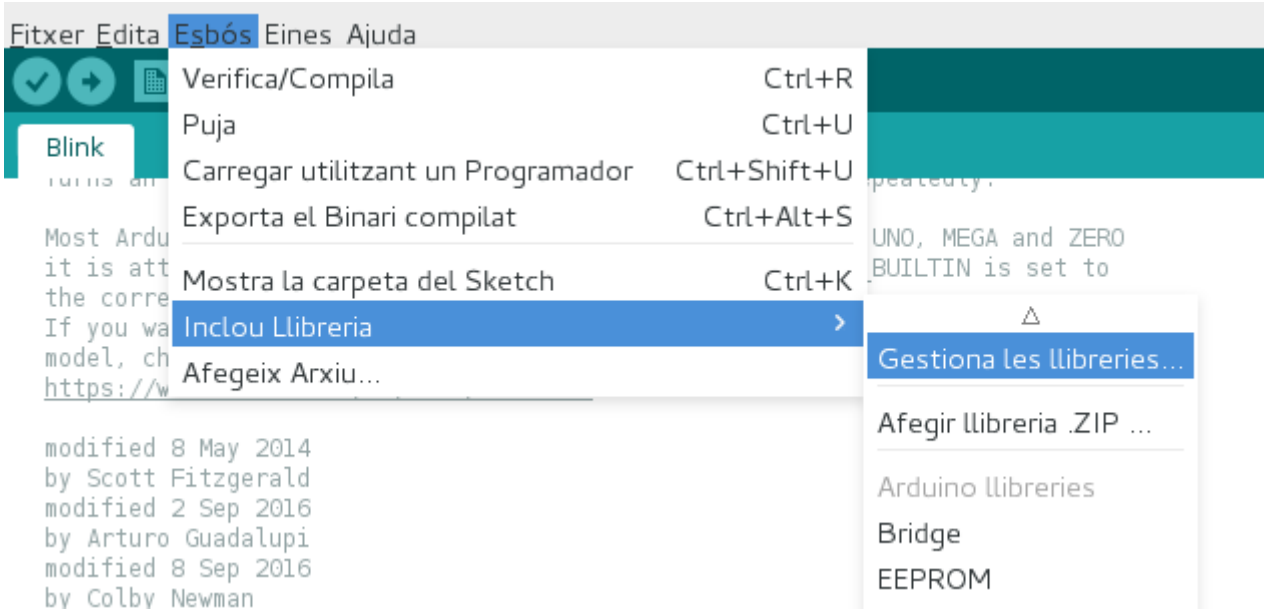
Connexió de perifèrics a l'Arduino

Afegint biblioteques a l'IDE d'Arduino



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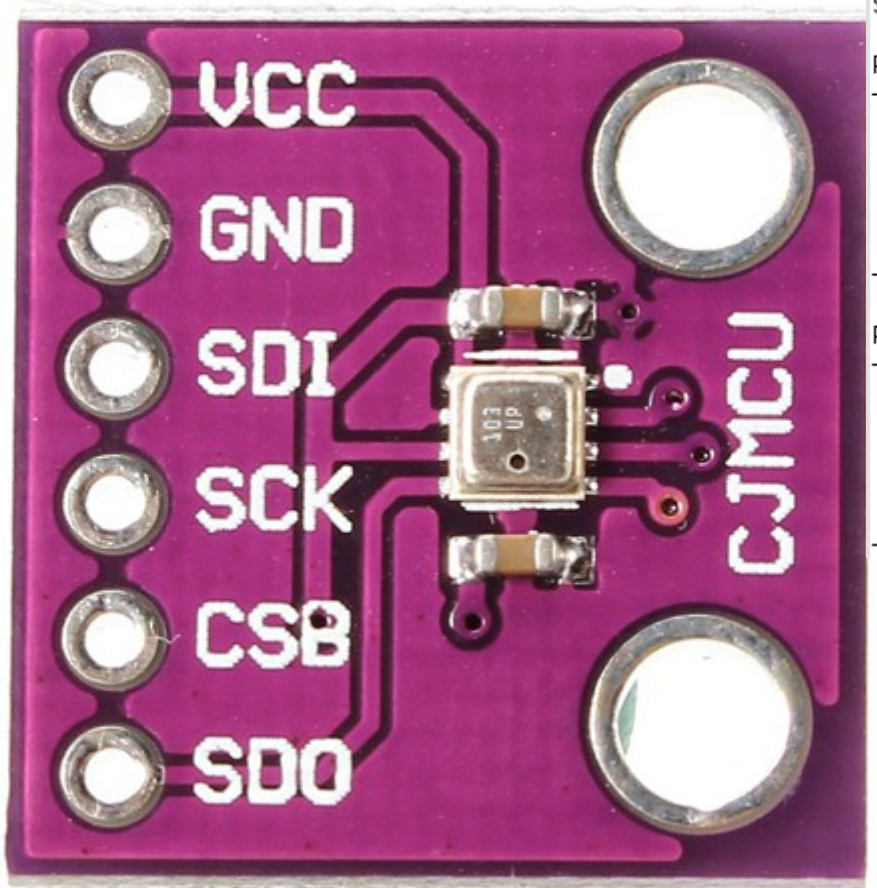
Connexió de perifèrics a l'Arduino

BME 280 funcionant amb SPI




```
Mode SPI:
bme280.parameter.communication = 2;

VCC VCC
GND GND
SCL SCK      (13)
SDA MOSI     (11)
CSB CS       (10) // bme280.parameter.SPI_cs = 2; <-- Canvieu el 2 per un 10
SDO MISO     (12)

P2
+----------+
| GND  SCK |
| MISO MOSI|
  CS   x   |
| x    A4  |
| A5   +5V |
+----------+

P2
+----------+
| GND  13  |
| 12   11  |
  10   9   |
| 8    18  |
| 19   +5V |
+----------+
```

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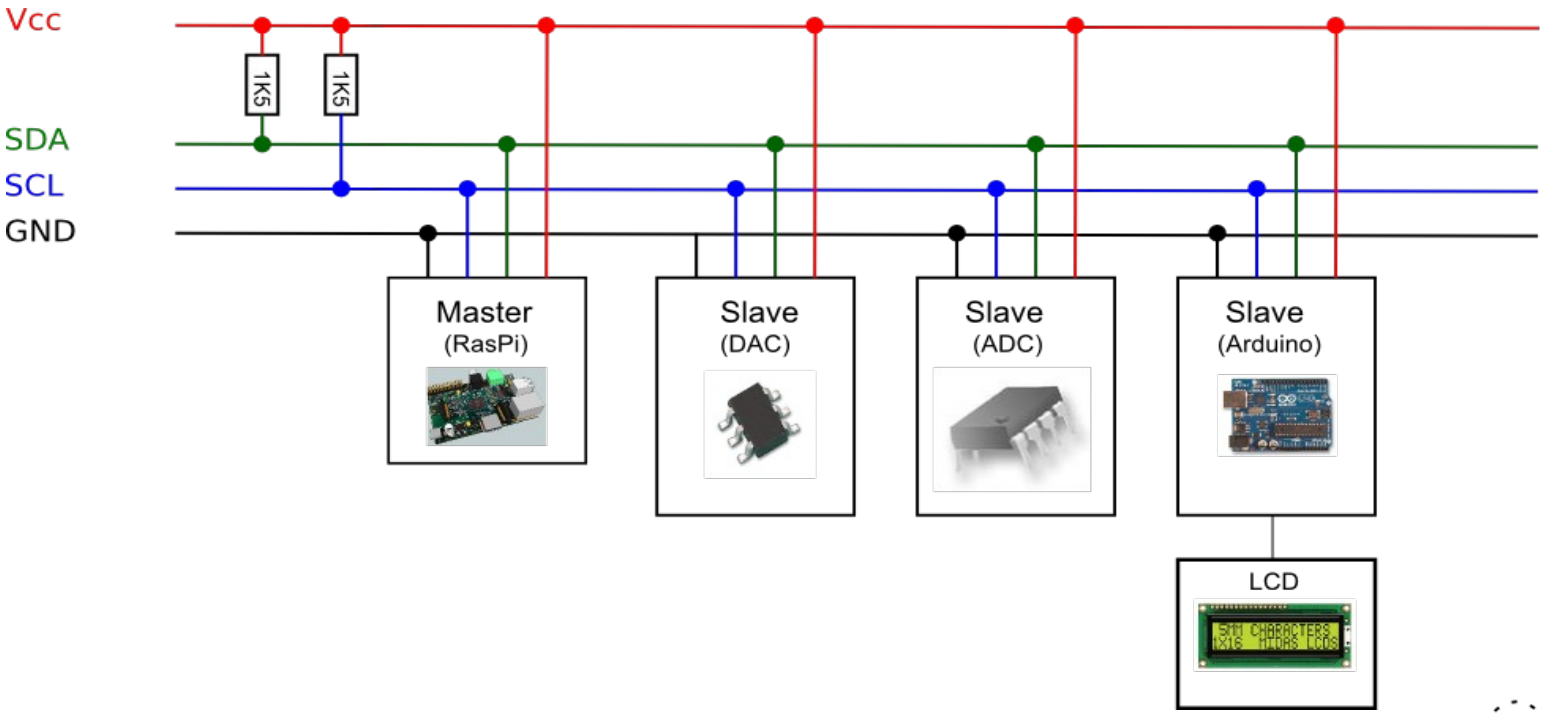
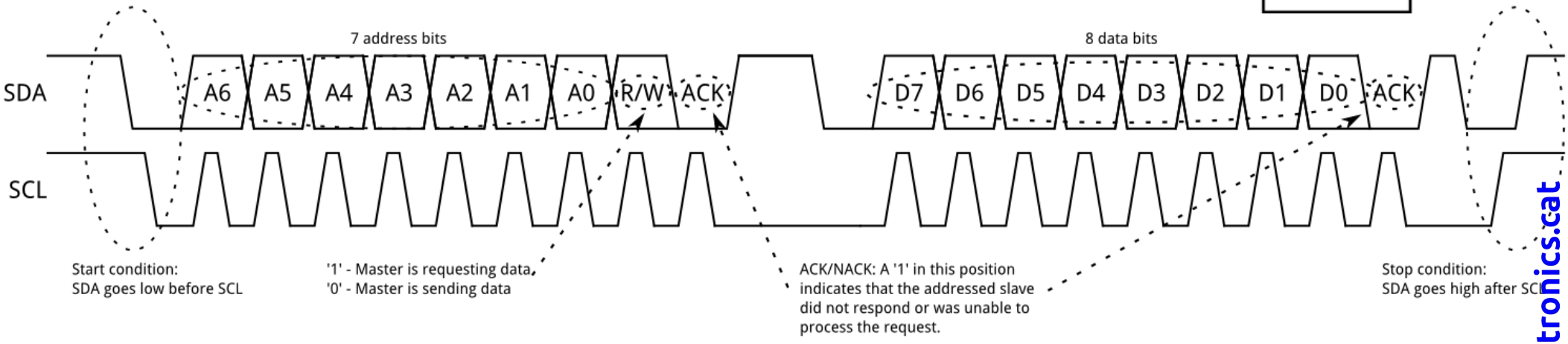
Connexió de perifèrics a l'Arduino

I2C





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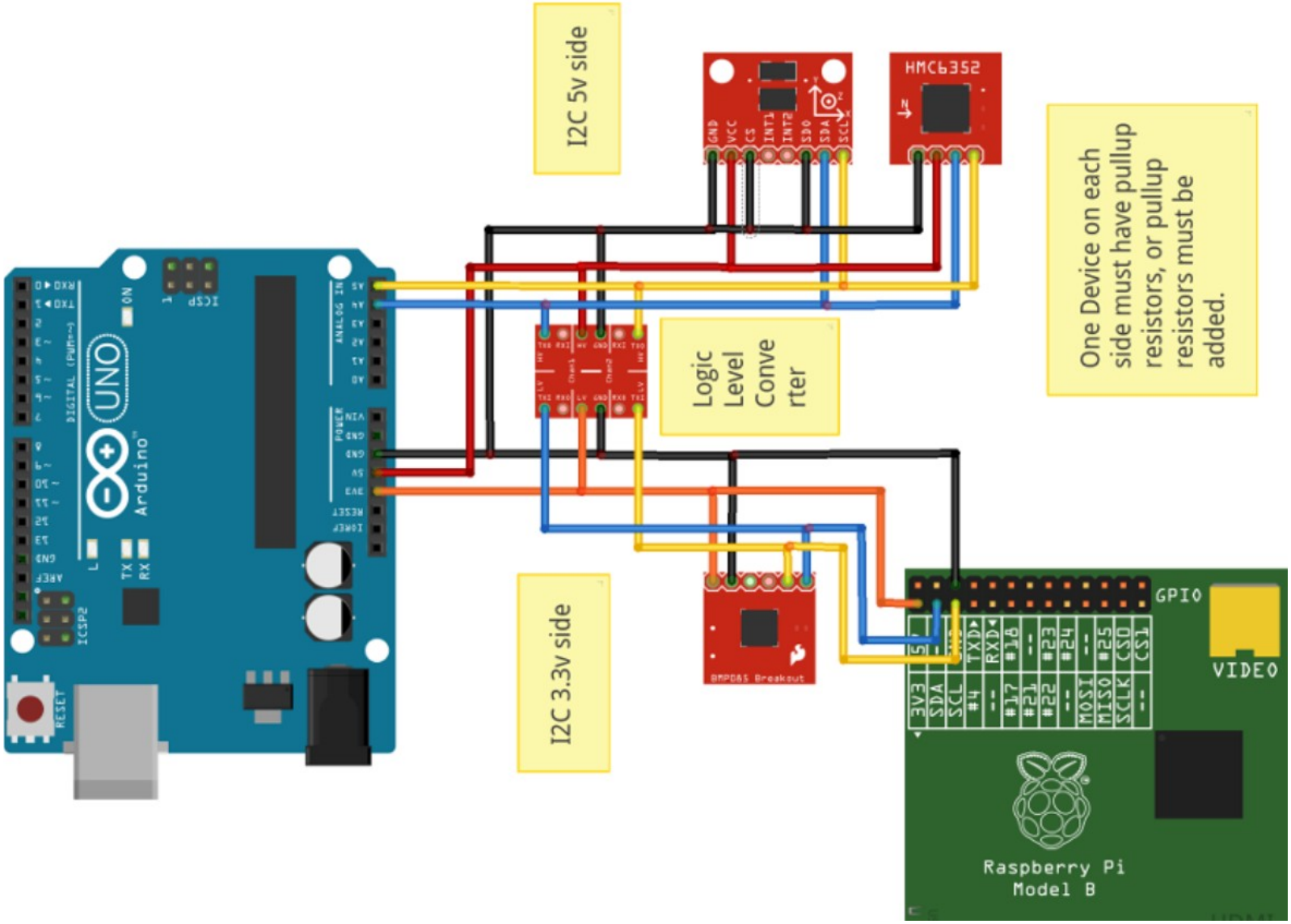
Connexió de perifèrics a l'Arduino

I2C



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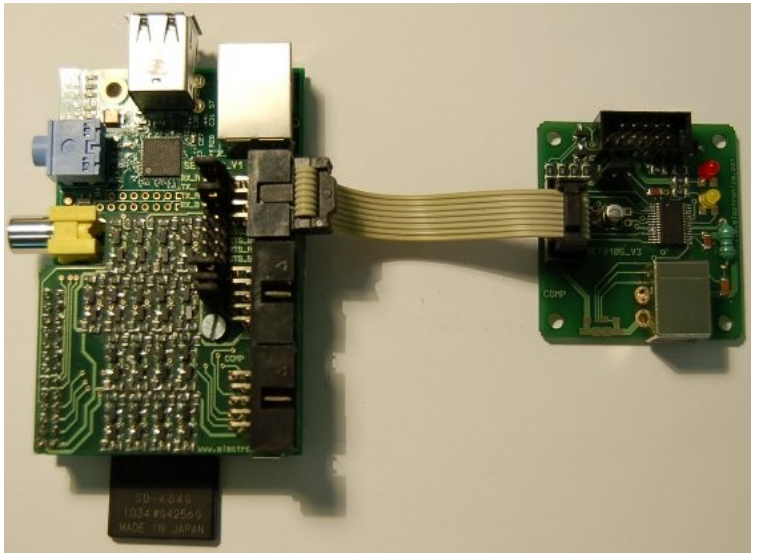
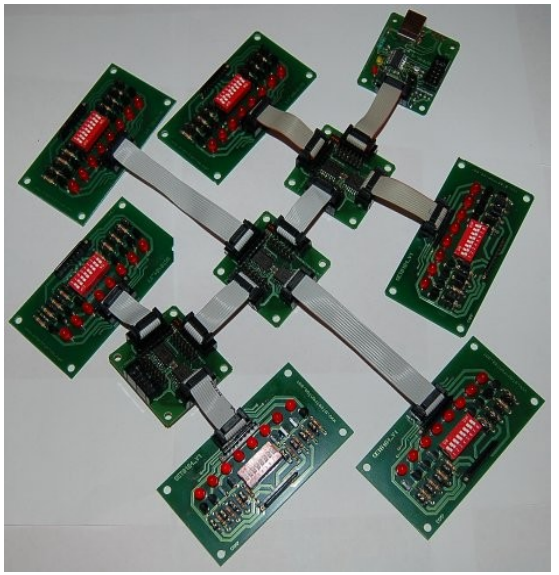
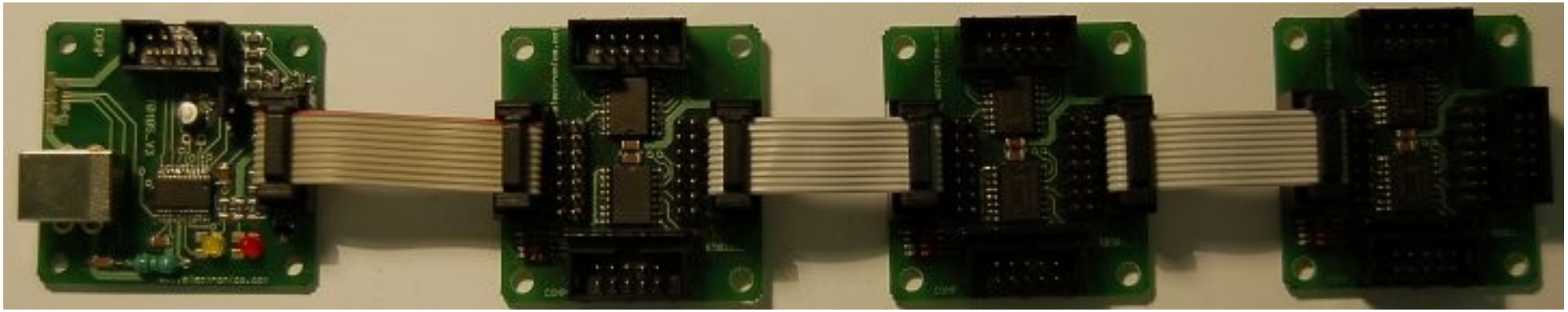
Connexió de perifèrics a l'Arduino

I2C





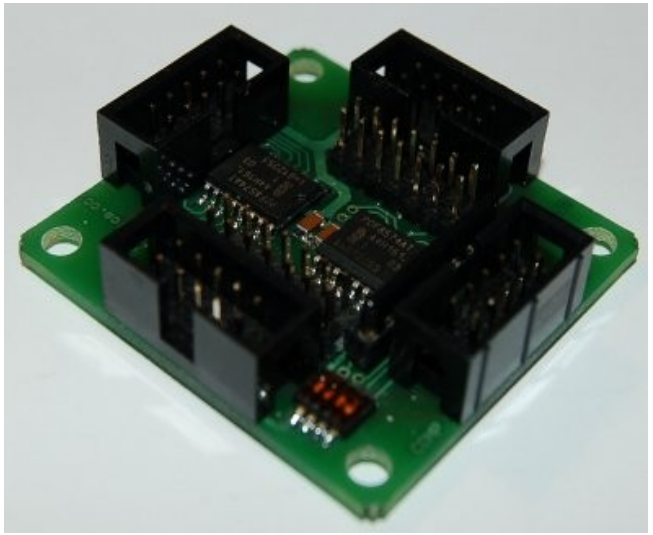


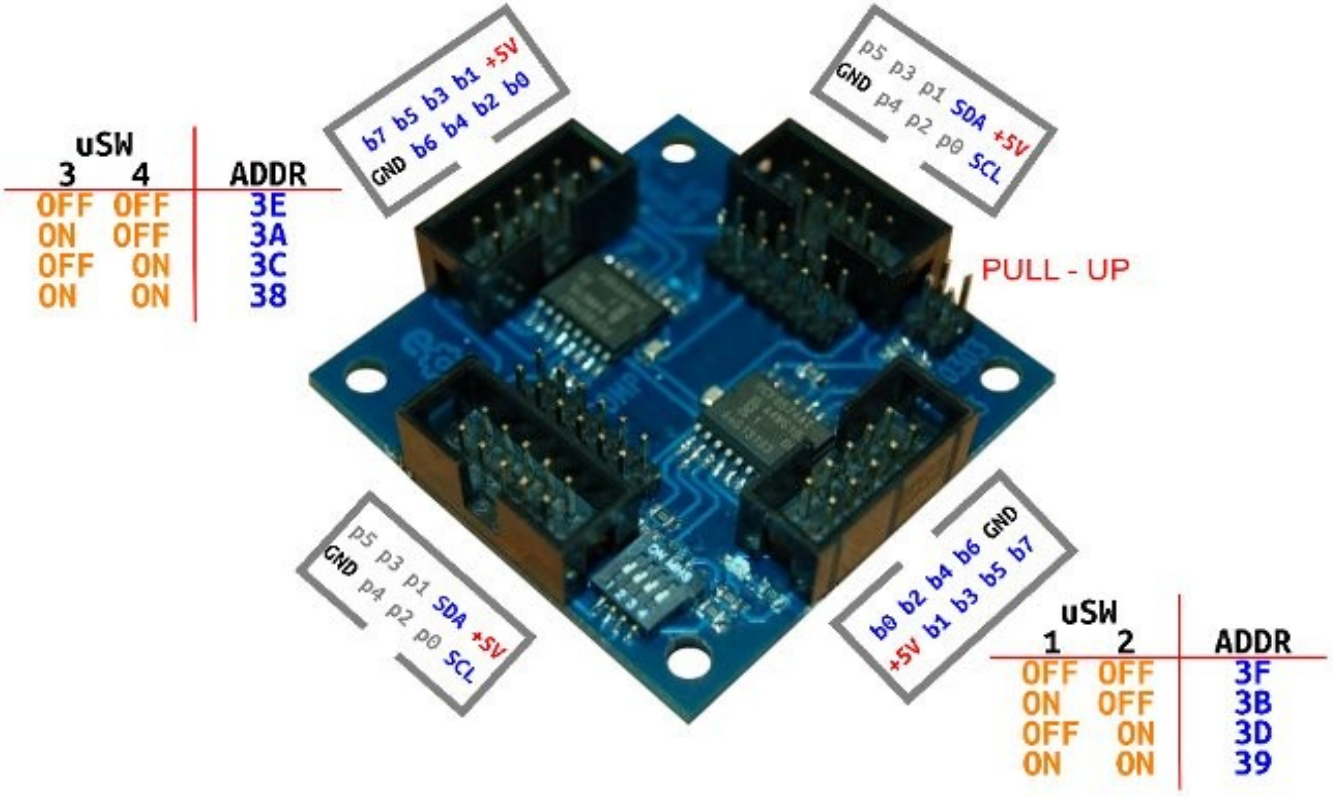
http://electronics.cat/php/common/index.php?lang=ca&page=105

electronics.cat

Connexió de perifèrics a l'Arduino

I2C



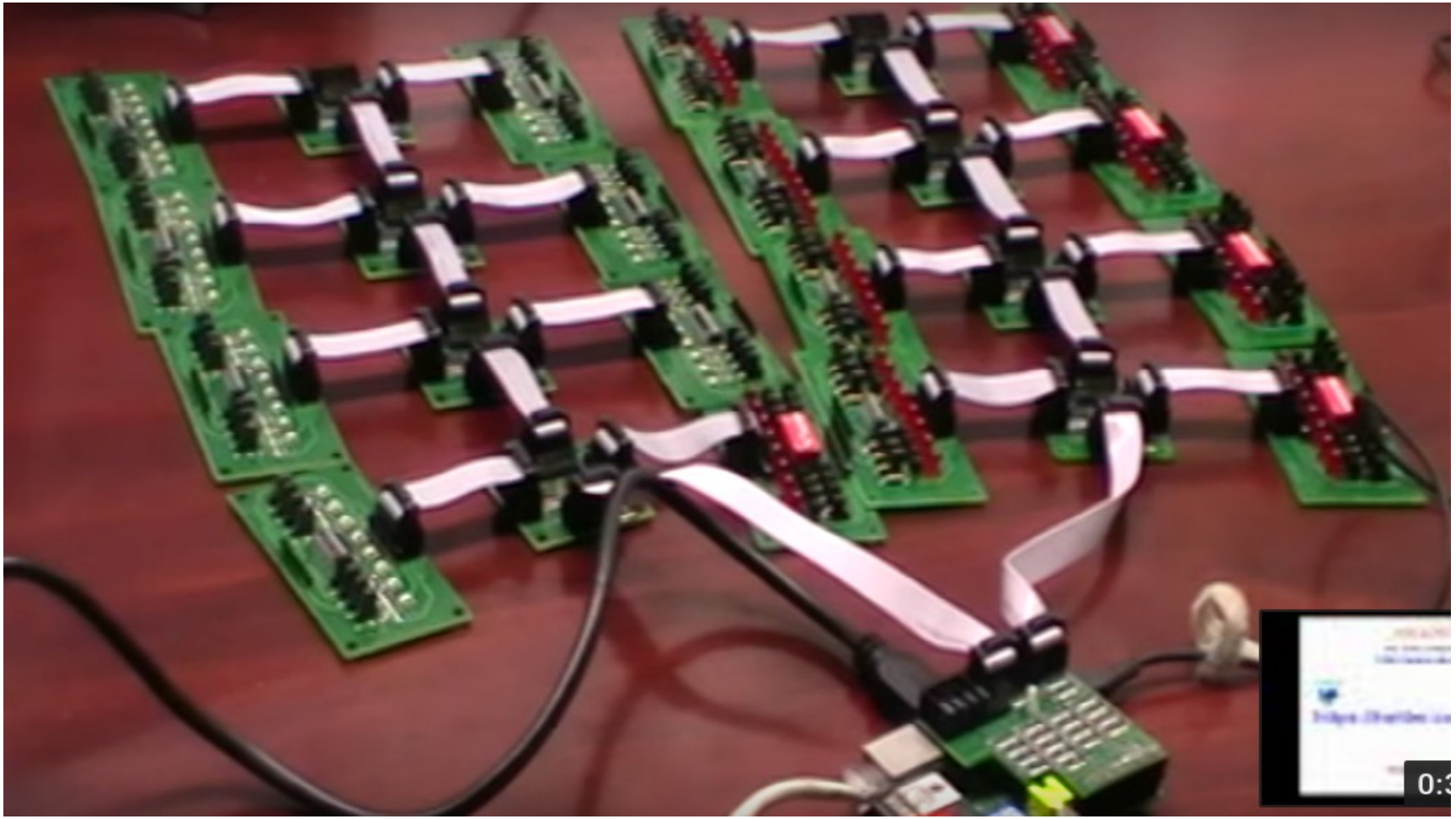


http://electronics.cat/php/common/index.php?lang=ca&page=303

electronics.cat

Connexió de perifèrics a l'Arduino

I2C

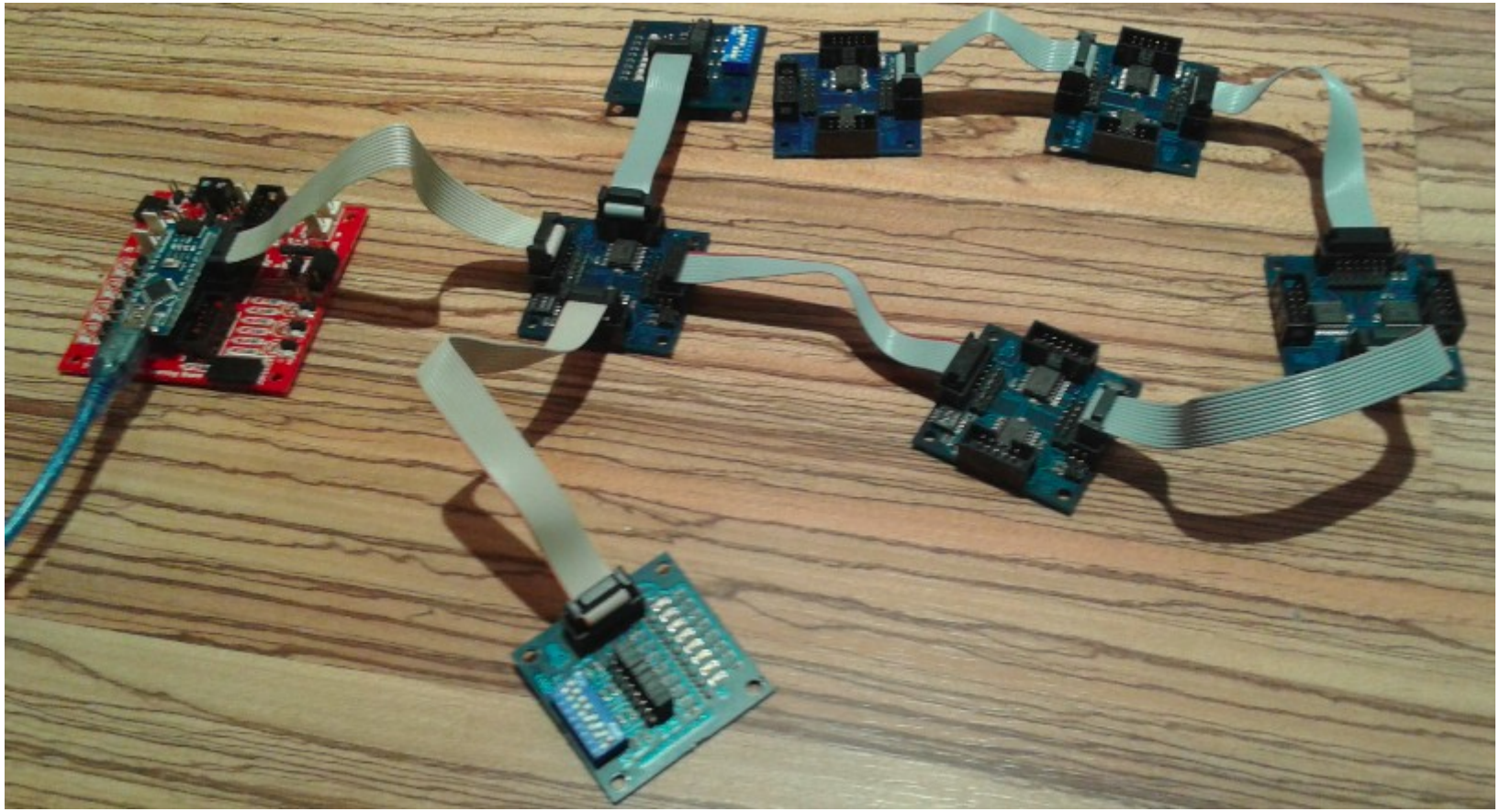


http://electronics.cat/php/common/index.php?lang=ca&page=508

electronics.cat

Connexió de perifèrics a l'Arduino

I2C



Codis I2C

electronics.cat

Connexió de perifèrics a l'Arduino

I2C

I2cScanner.ino

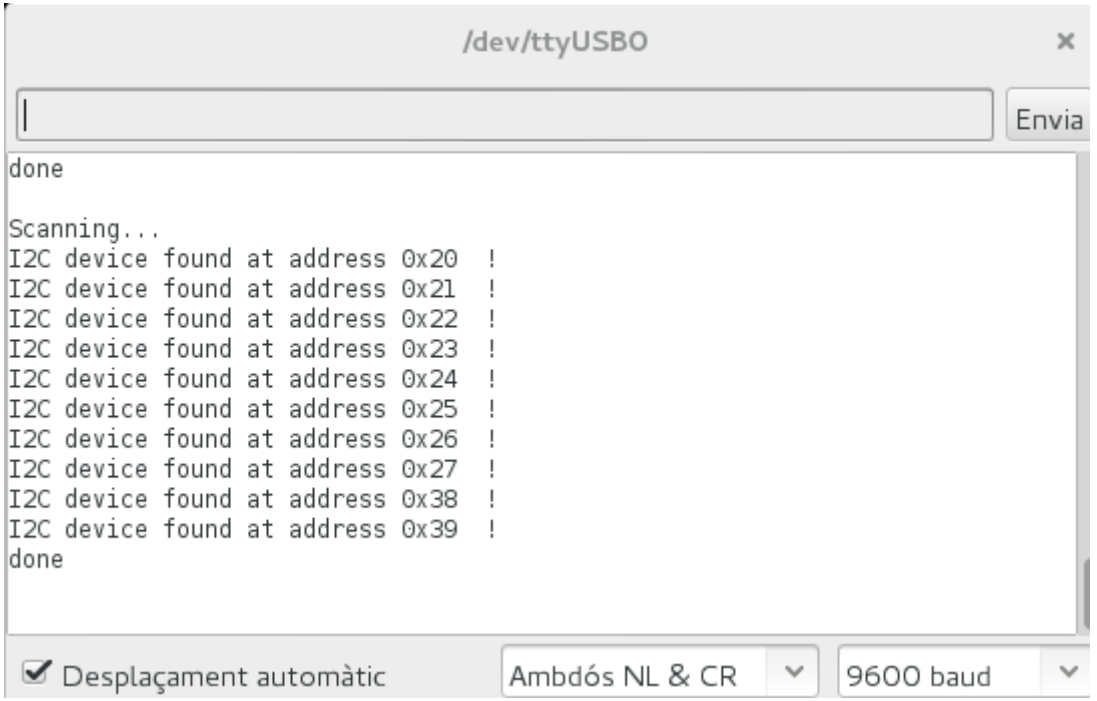
```
void loop()
{
  byte error, address;
  int nDevices;

  Serial.println("Scanning...");

  nDevices = 0;
  for(address = 1; address < 127; address++ )
  {
    // The i2c_scanner uses the return value of
    // the Write.endTransmisstion to see if
    // a device did acknowledge to the address.
    Wire.beginTransmission(address);
    error = Wire.endTransmission();

    if (error == 0)
    {
      Serial.print("I2C device found at address 0x");
      if (address<16)
        Serial.print("0");
      Serial.print(address,HEX);
      Serial.println("  !");

      nDevices++;
    }
```

electronics.cat

Connexió de perifèrics a l'Arduino

I2C

I2cScanner.ino



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Connexió de perifèrics a l'Arduino

I2C

```
// http://playground.arduino.cc/Code/I2CPortExpander8574

#include <Wire.h>
// 8574  Address range is 0x20-0x27
// 8574A Address range is 0x38-0x3F
// 9555  Address range is 0x20-0x27 (same as 8574, bummer)

#define INaddr 0x20
#define OUTaddr 0x21

void setup()
{
  pinMode(12, INPUT);  // to read /INT
  pinMode(13, OUTPUT); // to show we are working
  Wire.begin();
  expanderSetInput(INaddr, 0xFF);
}
```

```
byte expanderRead(int i2caddr) {
  int _data = -1;
  Wire.requestFrom(i2caddr, 1);
  if(Wire.available()) {
    _data = Wire.read();
  }
  return _data;
}

void expanderWrite(int i2caddr, byte data)
{
  Wire.beginTransmission(i2caddr);
  Wire.write(data);
  Wire.endTransmission();
}
```

```
void loop(){
  static byte data = 0x01;

  expanderWrite(OUTaddr, (byte)data);
  data <<= 1;
  if(!data)
    data = 0x01;
  delay(200);
}
```

```
void loop(){
  static byte data = 0x01;

  expanderWrite(OUTaddr, data);
  expanderWrite(INaddr, ~data);
  data <<= 1;
  if(!data)
    data = 0x01;
  delay(200);
}
```

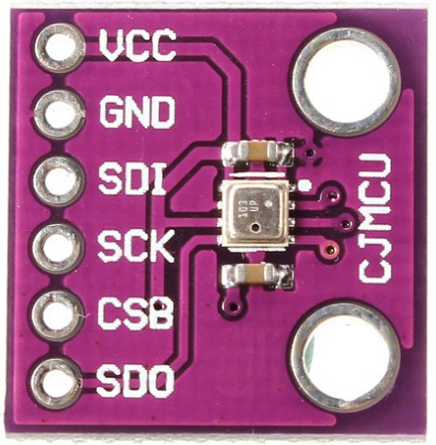
```
void loop(){
  byte data = expanderRead(INaddr);

  expanderWrite(OUTaddr, data);
}
```

Codis I2C

Connexió de perifèrics a l'Arduino

BME 280 funcionant amb I2C

```
P2
+----------+
| GND  SCK |
| MISO MOSI|
  CS   x   |
| x    A4  |
| A5   +5V |
+----------+

P2
+----------+
| GND  13  |
| 12   11  |
  10   9   |
| 8    18  |
| 19   +5V |
+----------+

Mode I2C:
bme280.parameter.communication = 0;

Recordeu de fer servir un scanner I2C per saber l'adreça (sovint és 0x76)

bme280.parameter.I2CAddress = 0x77; <-- Canvieu el 0x77 per 0x76 o l'adreça I2C trobada.

A l'Arduino Nano:
SDA: A4
SCL: A5
```



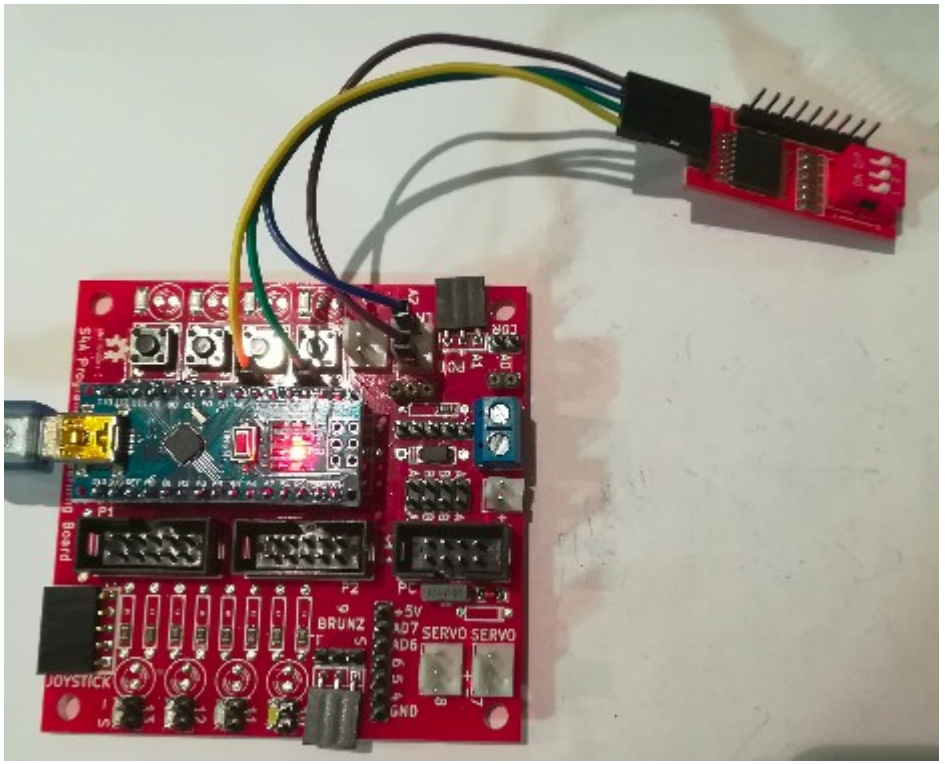
https://binefa.cat/training/s4a/i2c_scanner.zip

electronics.cat

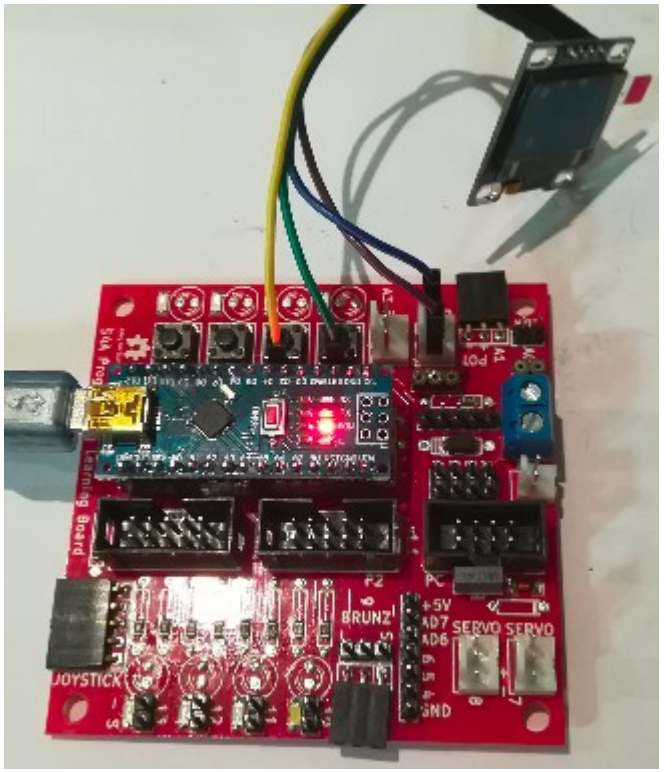
El microcontrolador Arduino

Exemple d'ús amb I2C

Cerca d'adreces I2C



PCF8574



OLED

https://binefa.cat/training/ceic/20181031/material/exemples/s4a_i2c_scanner/s4a_i2c_scanner.ino

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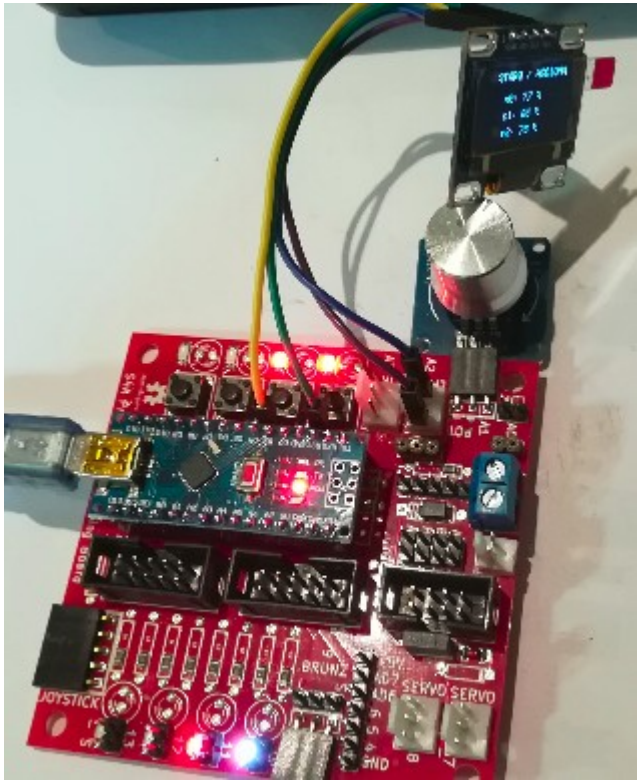
El microcontrolador Arduino

Exemple d'ús amb I2C i PWM



OLED visualitzant valors i controlant la brillantor d'un led emprant PWM.

https://binefa.cat/training/ceic/20181031/material/exemples/s4a_pwm_01/s4a_pwm_01.ino

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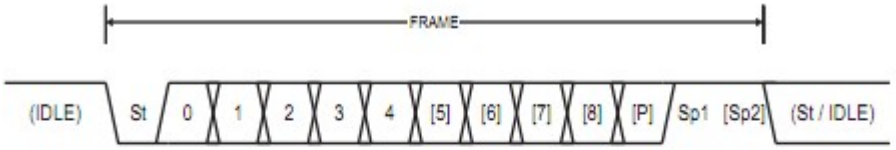
Connexió de perifèrics a l'Arduino

UART



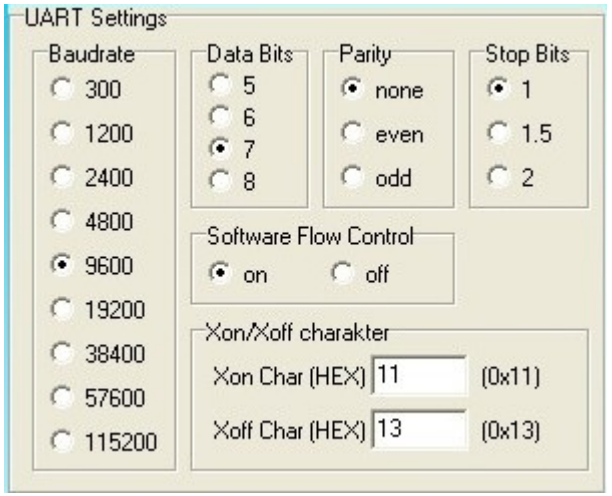
St Start bit, always low.

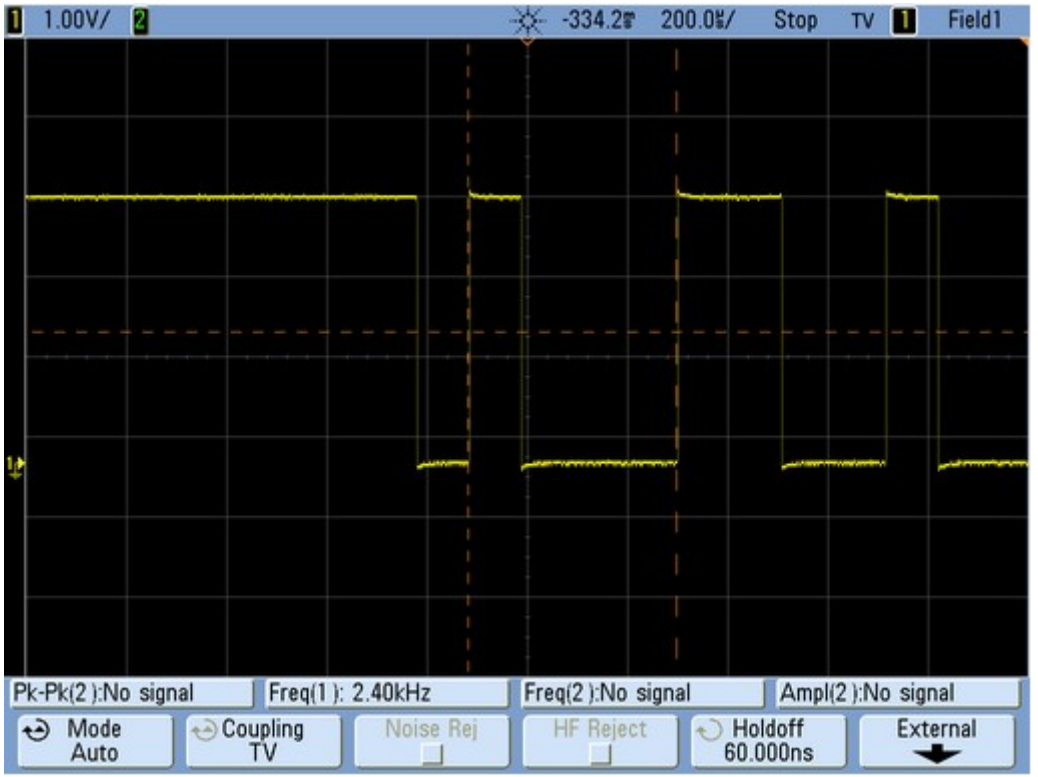
(n) Data bits (0 to 8).

P Parity bit. Can be odd or even.

Sp Stop bit, always high.

IDLE No transfers on the communication line (RxDn or TxDn). An IDLE line must be high.





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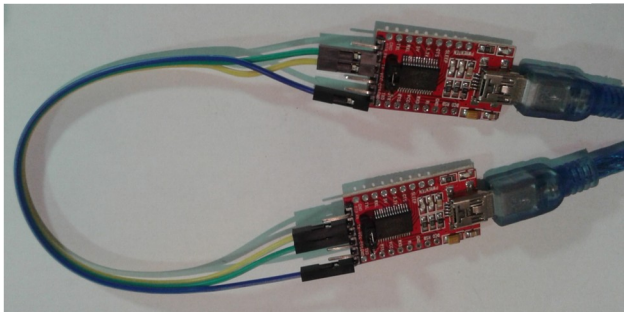
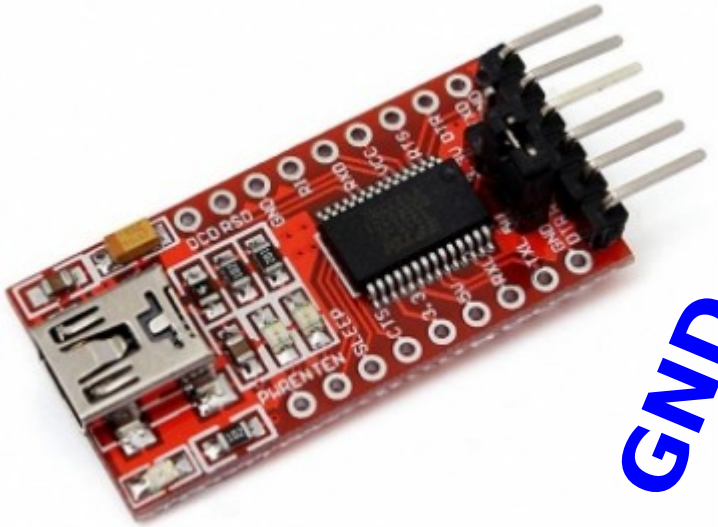
Connexió de perifèrics a l'Arduino

UART



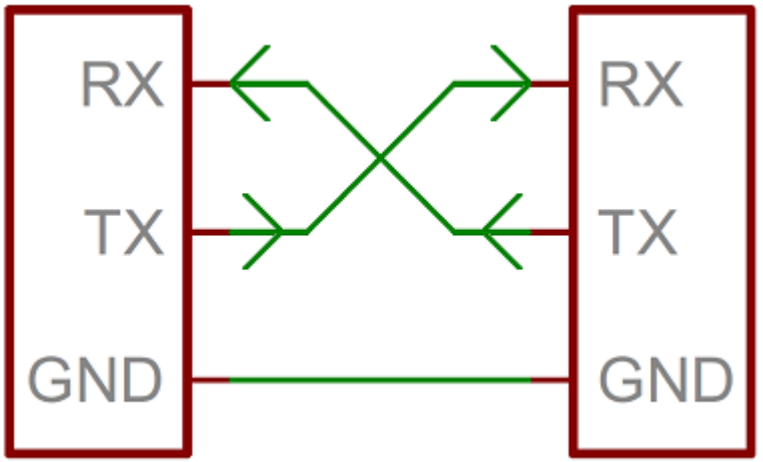


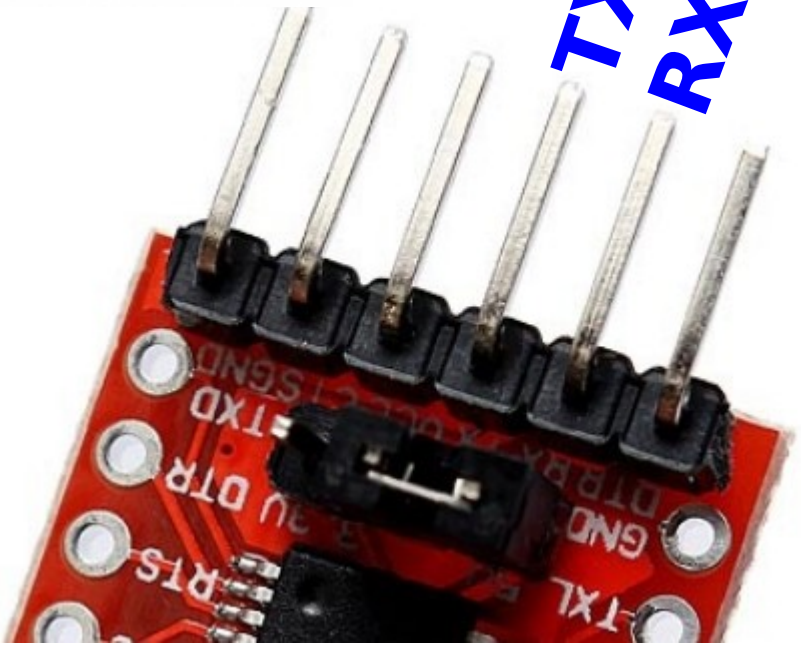
El pont pot estar a 3,3V o a 5V

GND

TX

RX





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Connexió de perifèrics a l'Arduino

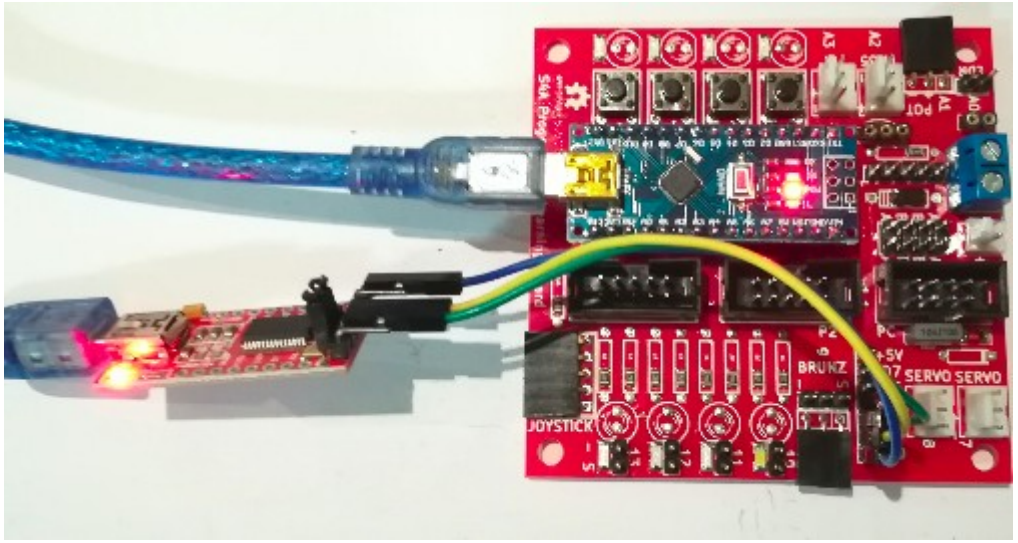
UART virtual / Biblioteca SoftwareSerial

```
#include <SoftwareSerial.h>

SoftwareSerial mySerial(4, 5); // RX, TX

void setup()
{
  // Open serial communications and wait for port to open:
  Serial.begin(115200);
  while (!Serial) {
    ; // wait for serial port to connect. Needed for Leonardo only
  }

  // set the data rate for the SoftwareSerial port
  mySerial.begin(9600);
}

void loop() // run over and over
{
  if (mySerial.available())
    Serial.write(mySerial.read());
  if (Serial.available())
    mySerial.write(Serial.read());
}
```

https://binefa.cat/training/s4a/virtualSerial/virtualSerial.ino

El microcontrolador Arduino

Exemple d'ús del SoftwareSerial



Connexió a una segona UART emprant SoftwareSerial

https://binefa.cat/training/ceic/20181031/material/exemples/s4a_softwareSerial/s4a_softwareSerial.ino

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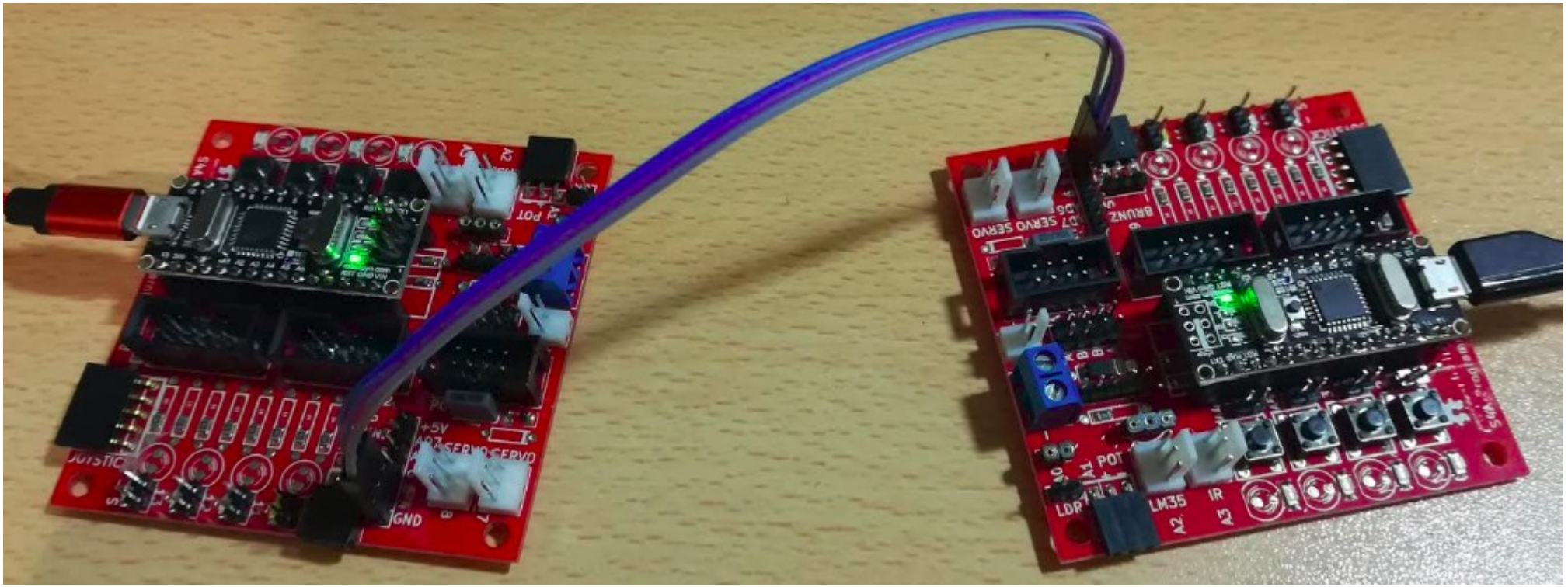
Connexió de perifèrics a l'Arduino

UART virtual / Biblioteca SoftwareSerial



https://binefa.cat/training/s4a/virtualSerial/virtualSerial.ino

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Connexió de perifèrics a l'Arduino

UART virtual / Biblioteca SoftwareSerial

https://binefa.cat/training/s4a/virtualSerial/virtualSerial.ino

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Comunicació entre l'Arduino i l'ordinador

Càrrega del protocol Firmata a l'Arduino

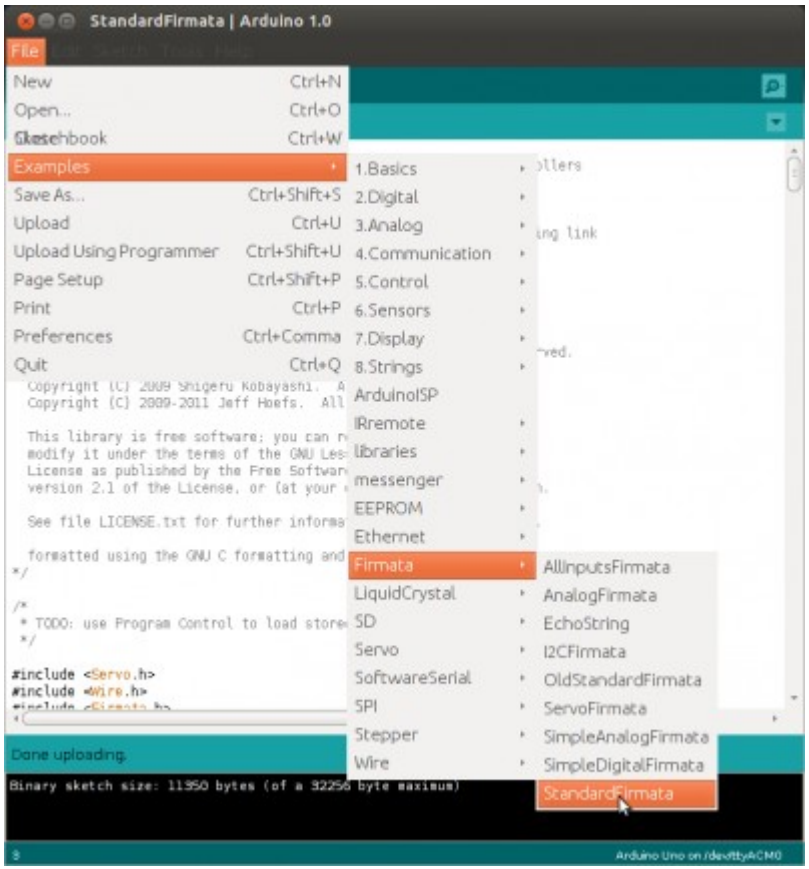
Connecteu la Raspberry Pi a la placa nano-eCat (la que conté l'Arduino Nano) mitjançant el cable USB-A a miniUSB.

A la Raspberry Pi aneu a Menú / Electrònica / Arduino IDE.

A l'Arduino IDE aneu a Fitxer / Exemples / Firmata / Standard Firmata.

Un cop l'Arduino IDE té carregat el programa Standard Firmata, premeu a la icona de la fletxa que apunta a la dreta (quan passeu el ratolí per sobre hi sortirà el text ”Puja” a la seva dreta).

Un cop hi surti el text ”Pujada enllestida” de color negre sobre fons verd a la part de sota de l'IDE, ja està preparat l'Arduino Nano per establir comunicacions seguint el protocol Firmata.



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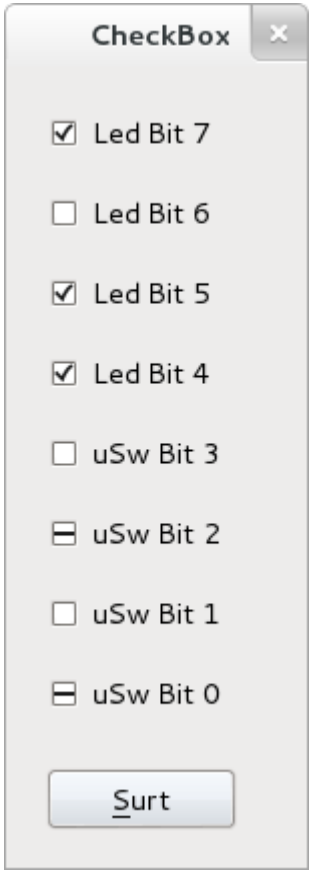
Comunicació entre l'Arduino i l'ordinador

Prova del protocol Firmata entre l'Arduino i la Raspberry Pi

A la Raspberry Pi aneu a Menú / Accessoris / LXTerminal i escriviu el següent :

```
pi@raspberrypi ~ $ cd Documents/codis/firmata/pyQt/
pi@raspberrypi ~/Documents/codis/firmata/pyQt $ ls -ls
total 24
8 -rwxr-xr-x 1 pi pi 4122 des  7 21:10 exFirmata03P1.py
4 -rwxr-xr-x 1 pi pi 3970 des  7 20:57 exFirmata03P2.py
4 -rw-r----- 1 pi pi 3255 abr  9 13:31 led_uSw.ui
4 -rw-r--r-- 1 pi pi 3954 des  5 16:25 ui_led_uSw.py
4 -rw-r--r-- 1 pi pi 3058 abr  9 13:33 ui_led_uSw.pyc
pi@raspberrypi ~/Documents/codis/firmata/pyQt $ ./exFirmata03P2.py
```



Us sortirà la finestra de la dreta amb diverses caselles de selecció. Seleccioneu i deseleccioneu la casella corresponent a Led Bit 7 i observeu com canvia d'estat (il·luminat / apagat) el led integrat a l'Arduino.

http://binefa.cat/blog/?p=109

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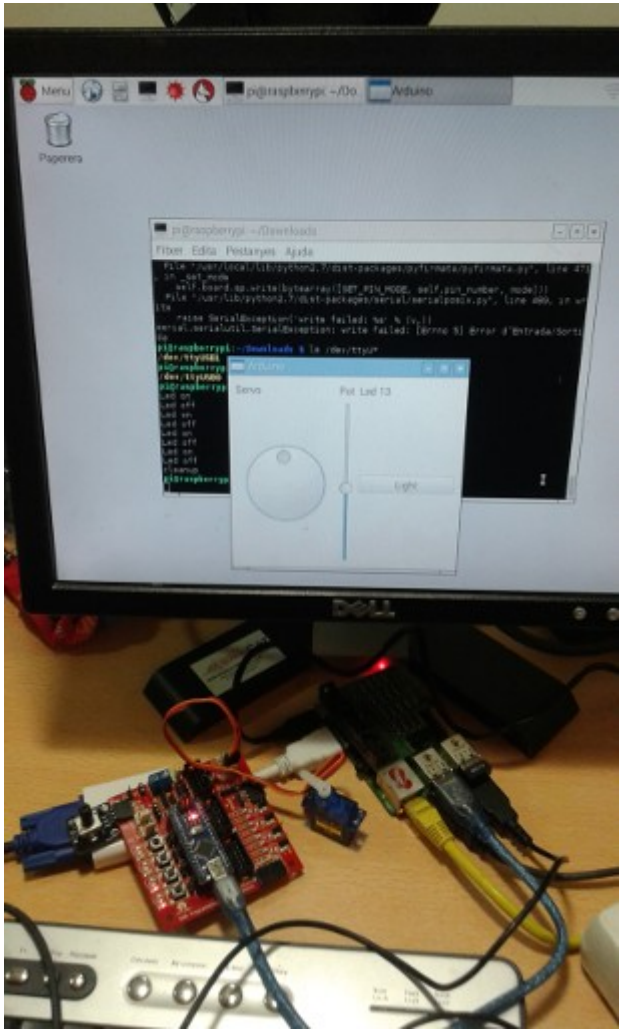
Comunicació entre l'Arduino i l'ordinador

Raspberry Pi amb pyfirmata i Arduino amb Firmata estàndard



Codi per a la Raspberry Pi (qtgui03.py)

Cal tenir instal·lada la biblioteca pyfirmata:

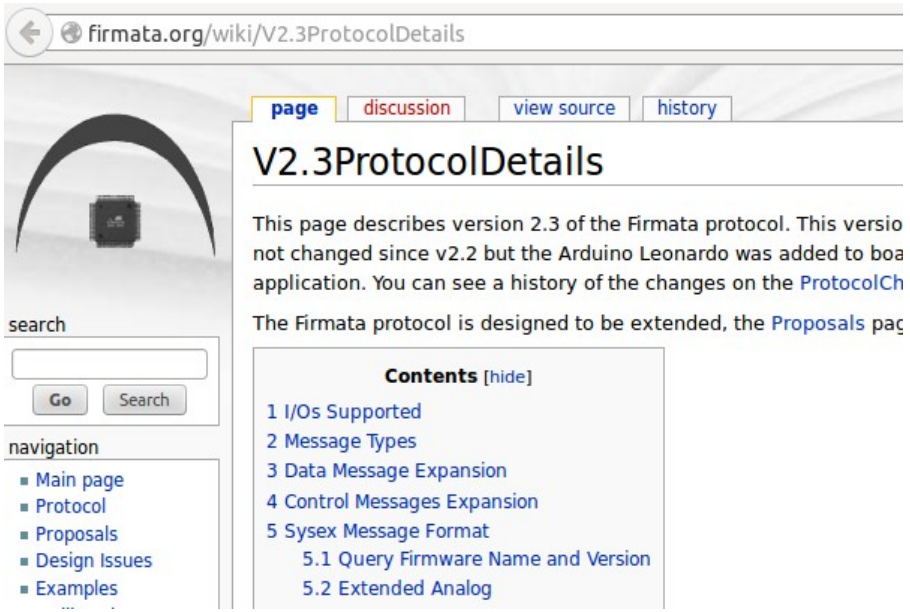
```
sudo pip install pyfirmata
```

Més informació : http://binefa.cat/blog/?p=102
Vídeo: https://youtu.be/2kSSPvfXqug

electronics.cat

Comunicació entre l'Arduino i l'ordinador

Protocol Firmata estàndard



http://firmata.org/wiki/V2.3ProtocolDetails

Vídeo de com funciona firmata : https://youtu.be/l4jFQIoY9ZY

Comunicació entre l'Arduino i l'ordinador

Ús de pyFirmata

Usage

Basic usage:

```
>>> from pyfirmata import Arduino, util
>>> board = Arduino('/dev/tty.usbserial-A6008rIF')
>>> board.digital[13].write(1)
```

To use analog ports, it is probably handy to start an iterator thread. Otherwise the board will keep sending data to your serial, until it overflows:

```
>>> it = util.Iterator(board)
>>> it.start()
>>> board.analog[0].enable_reporting()
>>> board.analog[0].read()
0.661440304938
```

`:` . Eg. `a:0:i` for analog 0 as input or `d:3:p` for digital pin 3 as pwm.:

```
>>> analog_0 = board.get_pin('a:0:i')
>>> analog_0.read()
0.661440304938
>>> pin3 = board.get_pin('d:3:p')
>>> pin3.write(0.6)
```

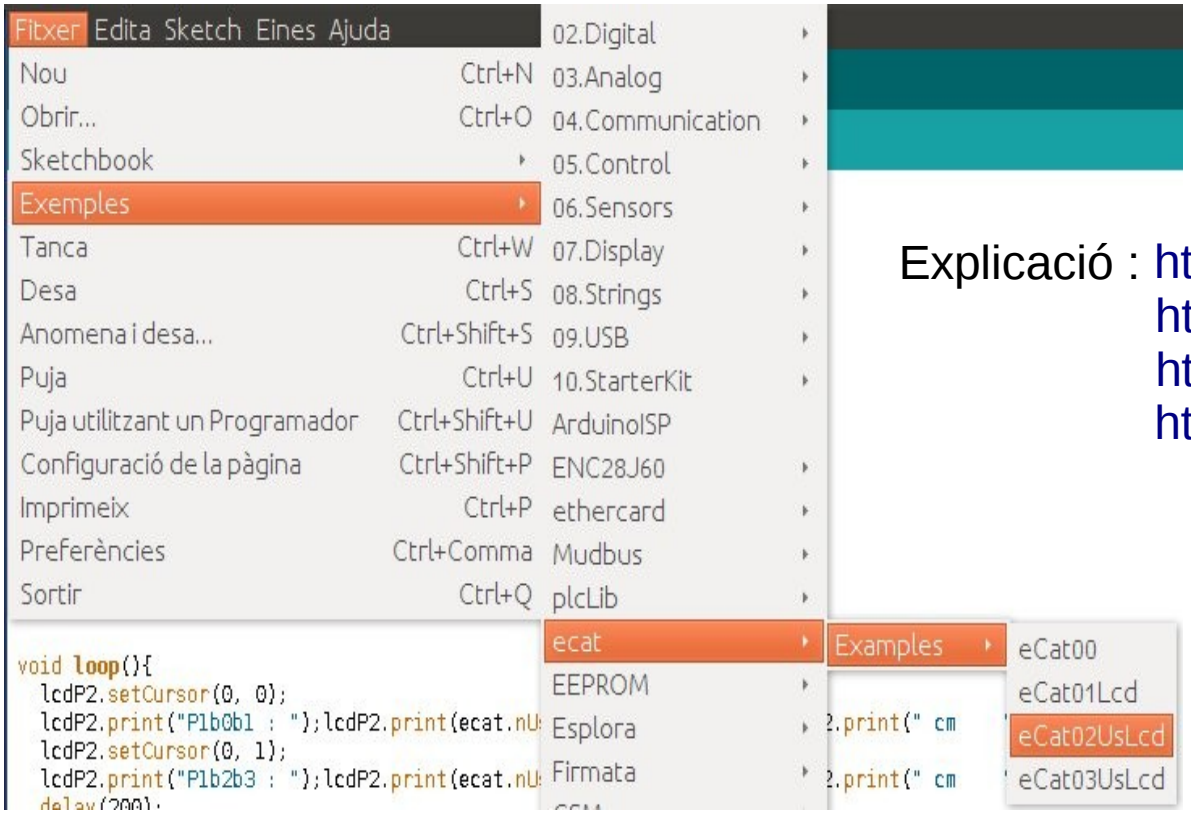
https://github.com/tino/pyFirmata

electronics.cat

Tecnologies creatives a l'aula

Biblioteca ecat.h per a l'IDE d'Arduino

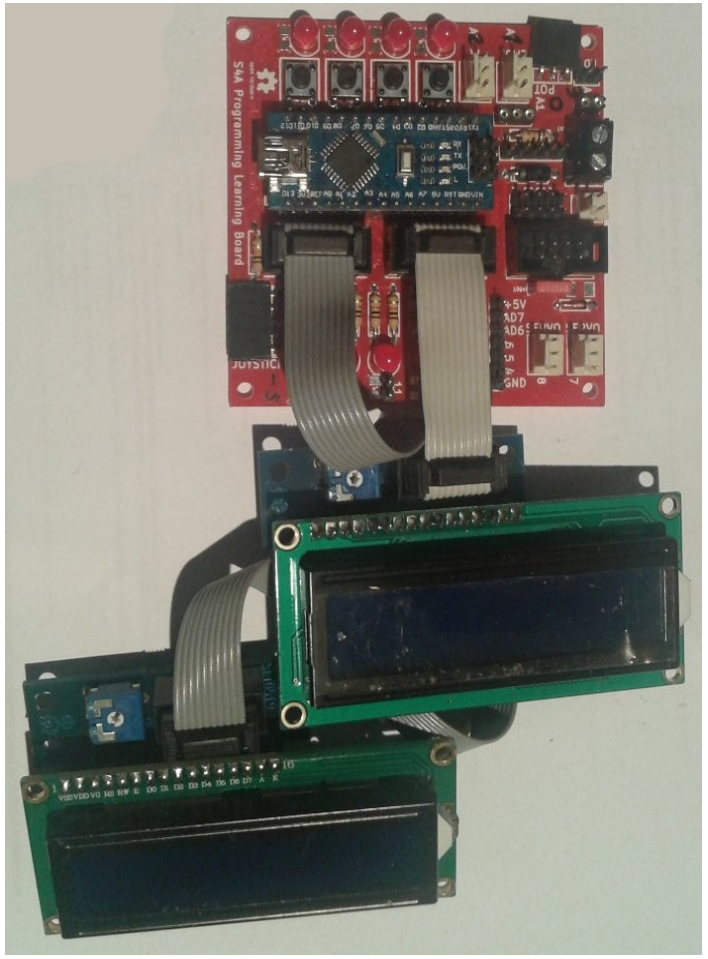
http://www.electronics.cat/doc/arduinoLib/ecat.zip

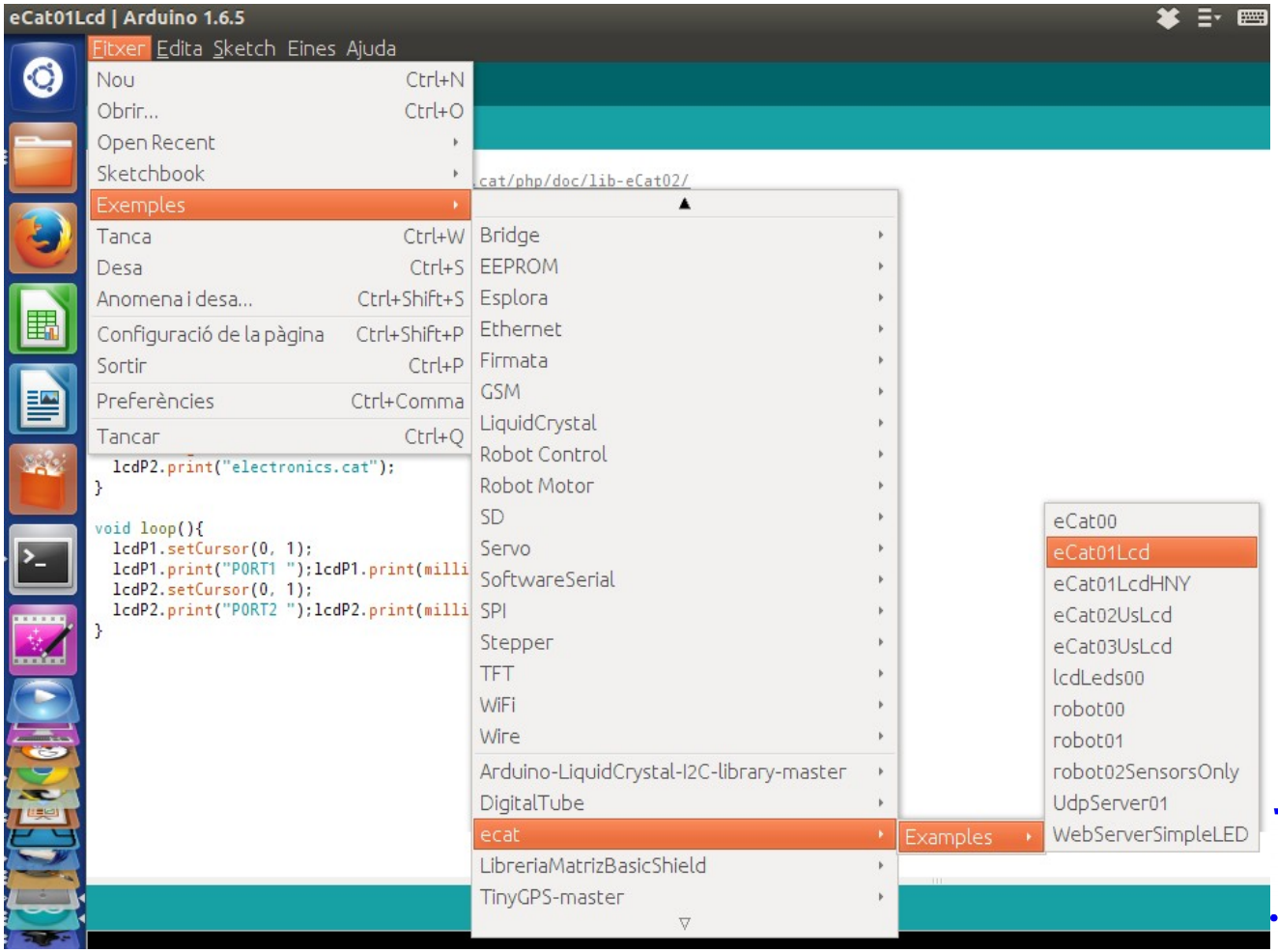


Explicació : http://www.binefa.cat/php/doc/lib-eCat01/
http://www.binefa.cat/php/doc/lib-eCat02/
http://www.binefa.cat/php/doc/lib-eCat03/
http://binefa.cat/blog/?p=140

S4A Progamming Learning Board

Ús de la biblioteca ecat.h





Tecnologies creatives a l'aula

Biblioteca ecat.h per a l'IDE d'Arduino

http://www.electronics.cat/doc/arduinoLib/ecat.zip

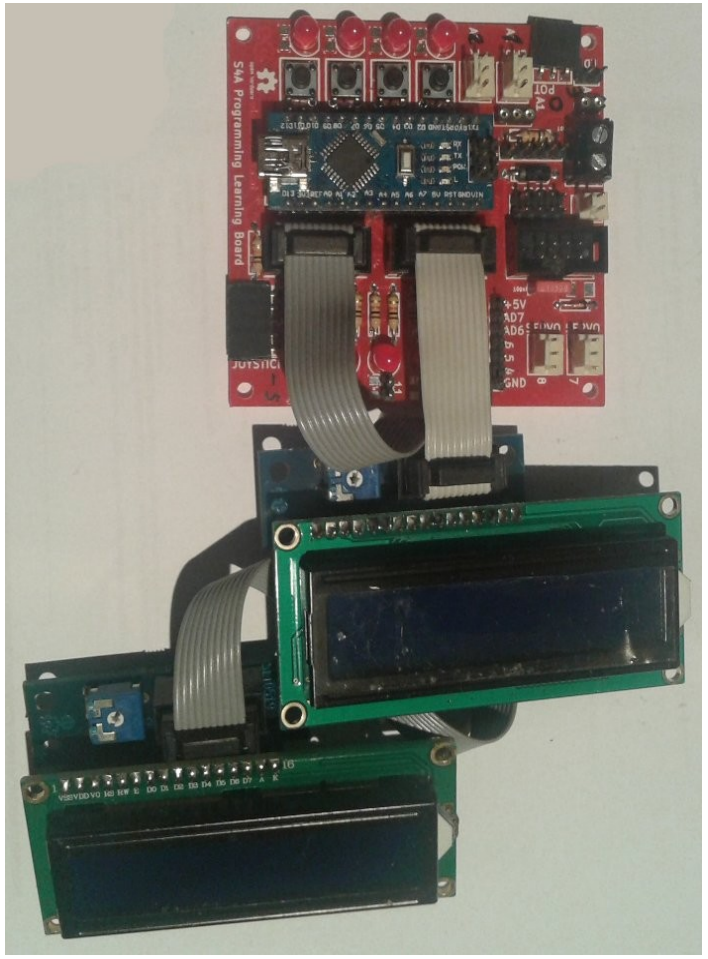
Explicació : http://www.binefa.cat/php/doc/lib-eCat01/
http://www.binefa.cat/php/doc/lib-eCat02/
http://www.binefa.cat/php/doc/lib-eCat03/
http://binefa.cat/blog/?p=140

```
#include <ecat.h>

#define ROBOT_ATURAT      0
#define ROBOT_ENDAVANT    1
#define ROBOT_ENDARRERA   2
#define ROBOT_DRETA       3
#define ROBOT_ESQUERRA    4

String szMissatge;
Ecat ecat;
boolean bConnectat;
int nG,nA,nB,nEstatActual;

void setup(){
  ecat.setupNibbleMode(NIBBLE_H_P1,OUTPUT);
  ecat.vUltrasonicSensorP1b0b1_init();
  pinMode(ecat.nPinP1B2,INPUT);
  pinMode(ecat.nPinP1B3,INPUT);
  pinMode(ecat.nPinP2B7,OUTPUT);
  pinMode(ecat.nPinP2B6,INPUT);
  pinMode(ecat.nPinP2B5,INPUT);
  pinMode(ecat.nPinP2B4,INPUT);
  ecat.setupNibbleMode(NIBBLE_L_P2,INPUT);
  Serial.begin(9600);
  nG = 150;
  nA = nB = 30;
  bConnectat = false;
  nEstatActual = ROBOT_ATURAT;
}

```

http://electronics.cat/downloads/code/robot08.ino

S4A Progamming Learning Board

Ús de la biblioteca ecat.h

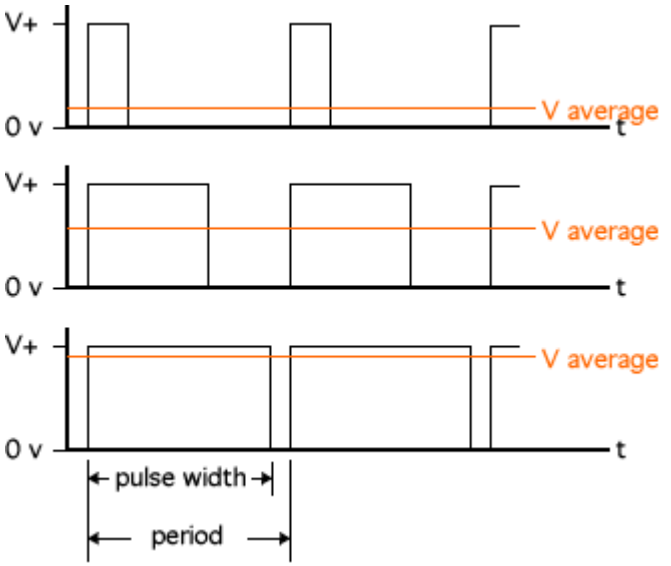


```
/*
Connection schematic at http://www.binefa.cat/php/doc/lib-eCat02/
*/

#include <ecat.h>
#include <LiquidCrystal.h>

Ecat ecat;
lcdP1_init();
lcdP2_init();

void setup(){
  lcdP1.begin(16, 2);
  lcdP1.print("ecat.h - v");lcdP1.print(ecat.fVersion());
  lcdP2.begin(16, 2);
  lcdP2.print("electronics.cat");
}

void loop(){
  lcdP1.setCursor(0, 1);
  lcdP1.print("PORT1 ");lcdP1.print(millis()/1000);lcdP1.print(" seconds");
  lcdP2.setCursor(0, 1);
  lcdP2.print("PORT2 ");lcdP2.print(millis()/1000);lcdP2.print(" seconds");
}
```

Tecnologies creatives a l'aula

Modulació per amplada de pols PWM

```
31  int nPwmA(){
32    int nAux = nG + nA;
33    if(nAux > 255)
34      nAux = 255;
35    return nAux;
36  }
37
38  int nPwmB(){
39    int nAux = nG + nB;
40    if(nAux > 255)
41      nAux = 255;
42    return nAux;
43  }
44
45  void vRobotAturat(){
46    nEstatActual = ROBOT_ATURAT;
47    ecat.vWriteHighNibbleP1(0x00);
48  }
49
50  void vRobotEndavant(){
51    //ecat.vWriteHighNibbleP1(B00000110);
52    nEstatActual = ROBOT_ENDAVANT;
53    digitalWrite(ecat.nPinP1B4,LOW);
54    analogWrite(ecat.nPinP1B5,nPwmA());
55    analogWrite(ecat.nPinP1B6,nPwmB());
56    digitalWrite(ecat.nPinP1B7,LOW);
57  }
```



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Tecnologies creatives a l'aula

Preparant la comunicació BlueTooth

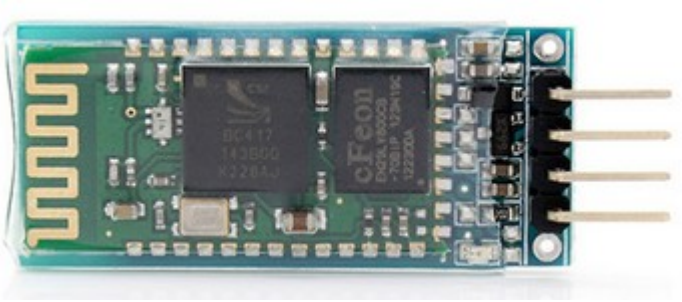
```
#include <ecat.h>

Ecat ecat;
boolean bP2B0;

void setup(){
  pinMode(ecat.nPinP2B7,OUTPUT);
  pinMode(ecat.nPinP2B0,INPUT);
  Serial.begin(9600);
  bP2B0 = digitalRead(ecat.nPinP2B0);
}

void loop(){
  String szMsg;

  while(Serial.available()){
    delay(3);
    char c = Serial.read();
    szMsg += c;
  }
  if(szMsg == "n"){
    digitalWrite(ecat.nPinP2B7,HIGH);
  }
  if(szMsg == "f"){
    digitalWrite(ecat.nPinP2B7,LOW);
  }
  if(bP2B0 != digitalRead(ecat.nPinP2B0)){
    bP2B0 = digitalRead(ecat.nPinP2B0);
    if(bP2B0){
      Serial.println("P2B0 HIGH");
    }else{
      Serial.println("P2B0 LOW");
    }
  }
  szMsg = "";
}
```



http://electronics.cat/doc/hc06/bluetooth04.ino

Tecnologies creatives a l'aula

Com trobar pel terminal el número ID del BlueTooth

```
$ hcitool scan
Scanning ...
  98:D3:31:30:2C:0D  HC-06
```

electronics.cat

Tecnologies creatives a l'aula

Preparant la comunicació BlueTooth

```
#include <ecat.h>

Ecat ecat;
boolean bP2B0;

void setup(){
  pinMode(ecat.nPinP2B7,OUTPUT);
  pinMode(ecat.nPinP2B0,INPUT);
  Serial.begin(9600);
  bP2B0 = digitalRead(ecat.nPinP2B0);
}
```

http://electronics.cat/doc/hc06/bluetooth04.ino

Tecnologies creatives a l'aula

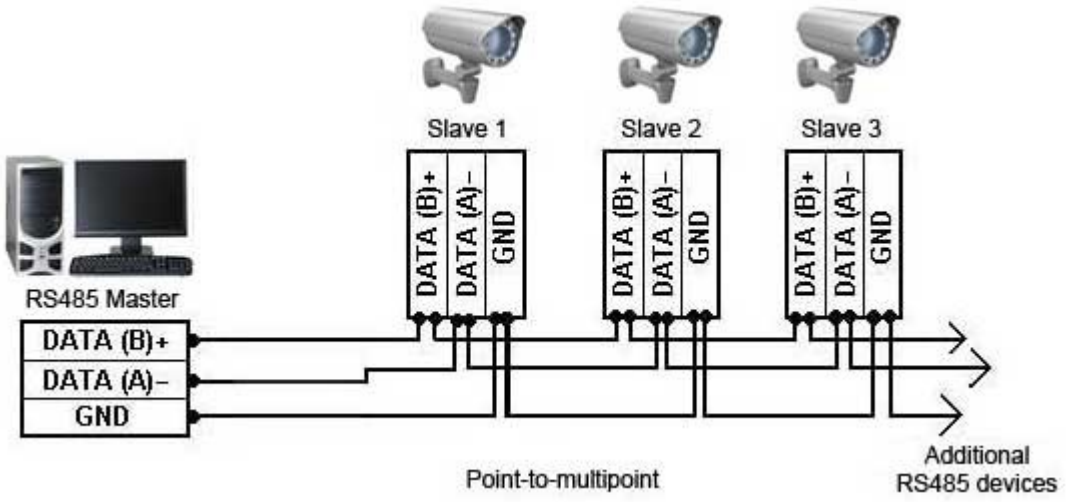
Preparant la comunicació BlueTooth

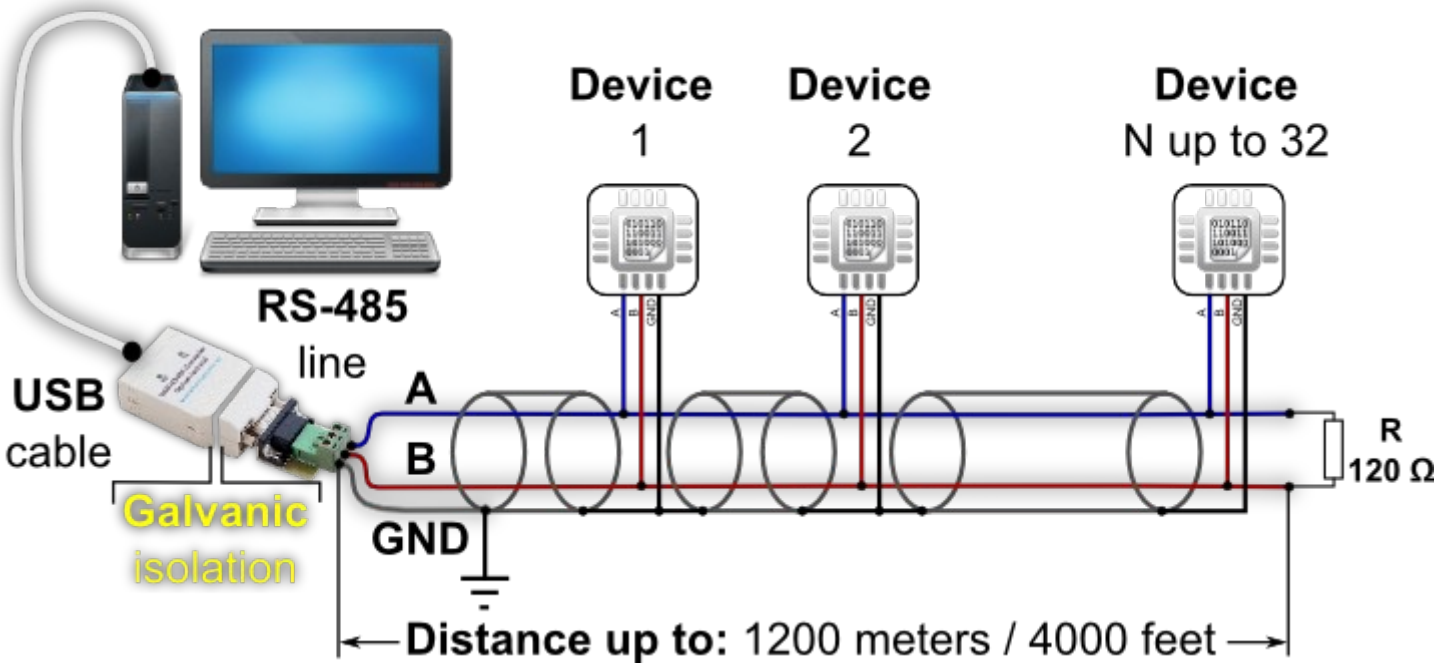
```
void loop(){
  String szMsg;

  while(Serial.available()){
    delay(3);
    char c = Serial.read();
    szMsg += c;
  }
  if(szMsg == "n"){
    digitalWrite(ecat.nPinP2B7,HIGH);
  }
  if(szMsg == "f"){
    digitalWrite(ecat.nPinP2B7,LOW);
  }
  if(bP2B0 != digitalRead(ecat.nPinP2B0)){
    bP2B0 = digitalRead(ecat.nPinP2B0);
    if(bP2B0){
      Serial.println("P2B0 HIGH");
    }else{
      Serial.println("P2B0 LOW");
    }
  }
  szMsg = "";
}
```

http://electronics.cat/doc/hc06/bluetooth04.ino

RS485





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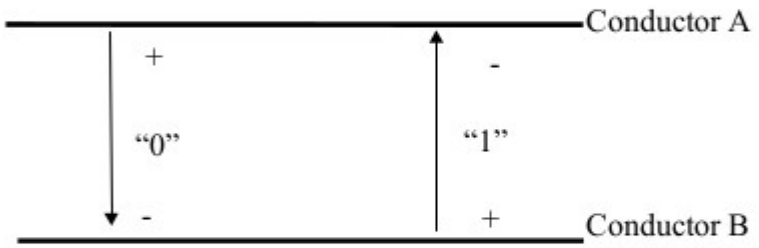
RS422

Comunicación Serie RS-422

Descripción

La RS-422 trabaja en forma diferencial con las líneas que transmite y recibe, el circuito tiene solo dos hilos sin que exista una línea de masa común. Los unos y ceros lógicos se establecen en función de la diferencia de tensión ambos conductores del circuito.

Especificaciones		RS422
Modo de Operación		DIFERENCIAL
Número de dispositivos		1 EMISOR 10 RECEPTORES
Máxima longitud del cable		1200 metros
Máxima velocidad de transmisión		10 Mb/s
Rango de trabajo		+/-10V
Rango de señal	Alto	+/-6V
	Bajo	+/-2V
Sensibilidad de entrada receptor		+/-200mV
Resistencia de entrada receptor		>=4K



"0" $1{,}5\ V < \Delta V_{AB} < 5V$

"1" $-1{,}5\ V > \Delta V_{AB} > -5V$

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RS485

Comunicación Serie RS-485 (I)

Descripción

La RS-485 es una leve modificación de la RS-422, redefiniendo características eléctricas para asegurar un nivel de tensión adecuado a la máxima carga, incrementándose él numero de dispositivos.

En una red de dispositivos sobre un una simple línea, es necesario direccionar uno en particular. Esto se puede realizar simplemente utilizando caracteres ASCII, constituyendo comandos de identificación del dispositivo y que este a su vez responde con los datos. Esto es un esquema básico de protocolo de comunicación denominado comúnmente maestro/esclavo (Master/Slave).

Especificaciones		RS485
Modo de Operación		DIFERENCIAL
Número de dispositivos		32 EMISORES 32 RECEPTORES
Máxima longitud del cable		1200 metros
Máxima velocidad de transmisión		10 Mb/s
Rango de trabajo		-7V a +12V
Rango de señal	Alto	+/-6V
	Bajo	+/-1,5V
Sensibilidad de entrada receptor		+/-200mV
Resistencia de entrada receptor		>=12K

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RS485

Comunicación Serie en Tensión – Comparativa

Especificaciones		RS232	RS423	RS422	RS485
Modo de Operación		NO DIFERENCIAL	NO DIFERENCIAL	DIFERENCIAL	DIFERENCIAL
Número de dispositivos		1 EMISOR 1 RECEPTOR	1 EMISOR 10 RECEPTORES	1 EMISOR 10 RECEPTORES	32 EMISORES 32 RECEPTORES
Máxima longitud del cable		15 metros	1200 metros	1200 metros	1200 metros
Máxima velocidad de transmisión		19,2 Kb/s	100 Kb/s	10 Mb/s	10 Mb/s
Rango de trabajo		+/-25V	+/-6V	+/-10V	-7V a +12V
Rango de señal	**Alto**	+/-15V	+/-6V	+/-6V	+/-6V
	Bajo	+/-3V	+/-3,6V	+/-2V	+/-1,5V
Sensibilidad de entrada receptor		+/-3V	+/-200mV	+/-200mV	+/-200mV
Resistencia de entrada receptor		7K	4K	>=4K	>=12K

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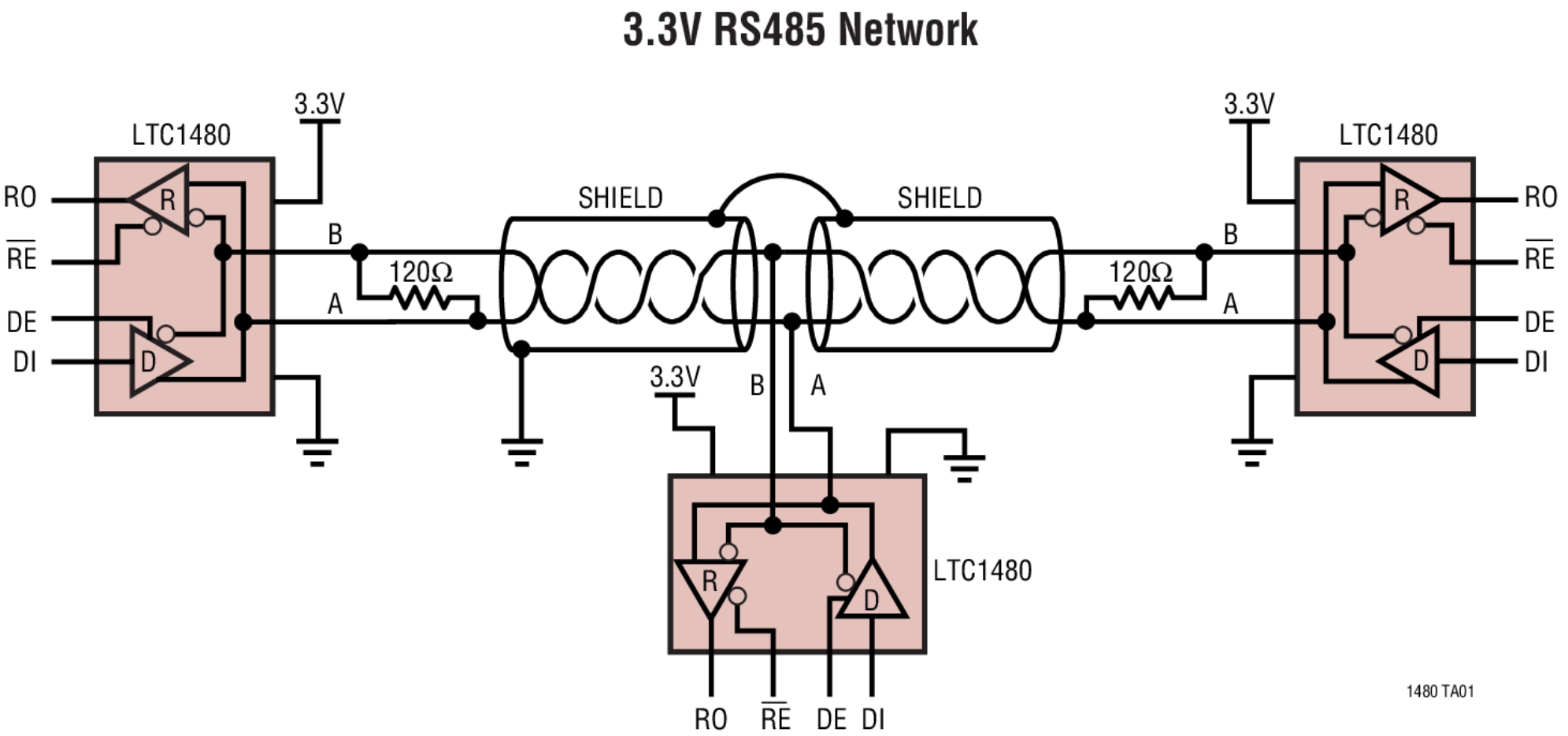
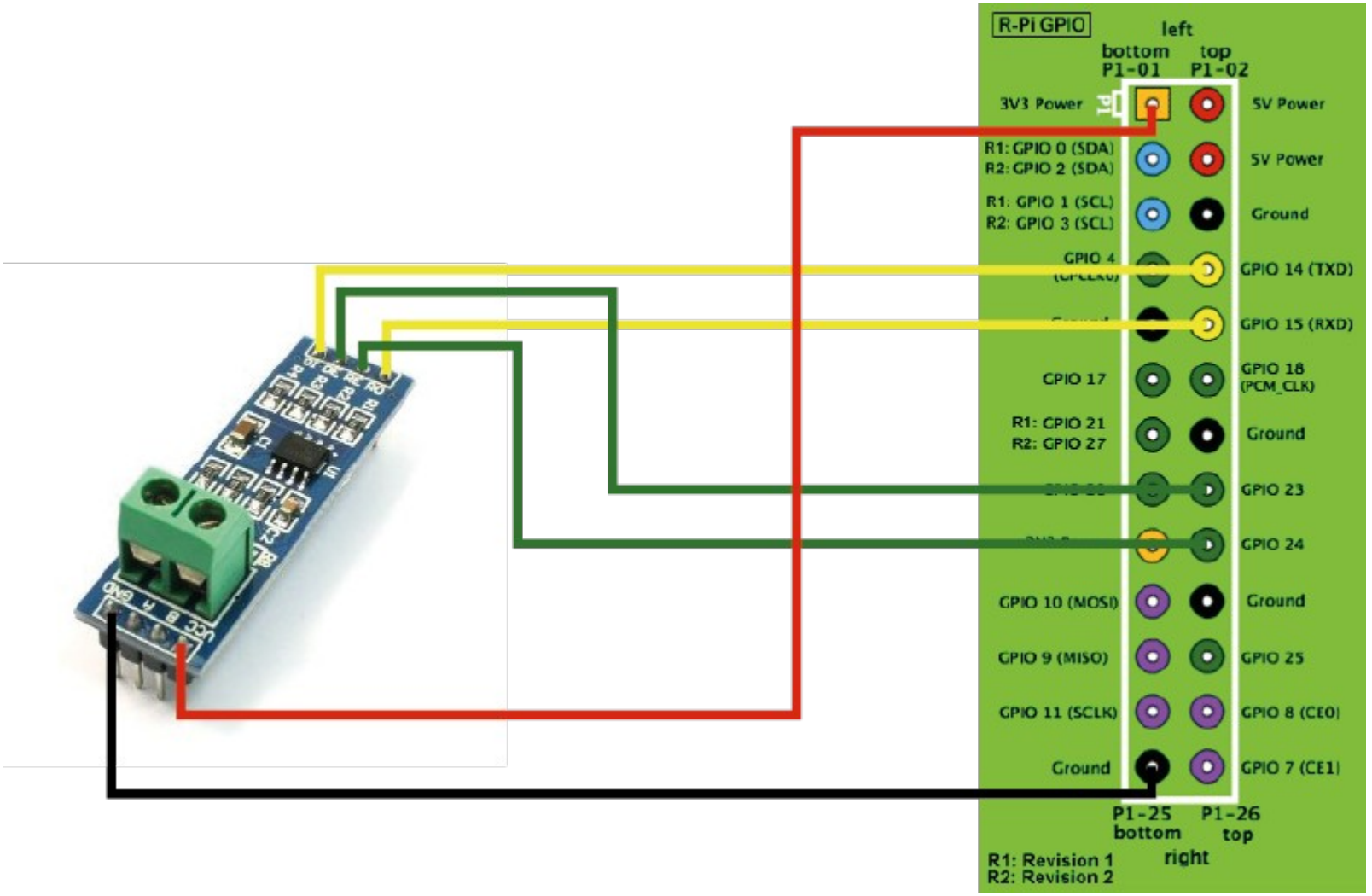
RS485


3.3V RS485 Network
LTC1480
3.3V
RO
RE
DE
DI
R
D
B
A
120Ω
SHIELD
SHIELD
LTC1480
3.3V
LTC1480
1480 TA01

RS485



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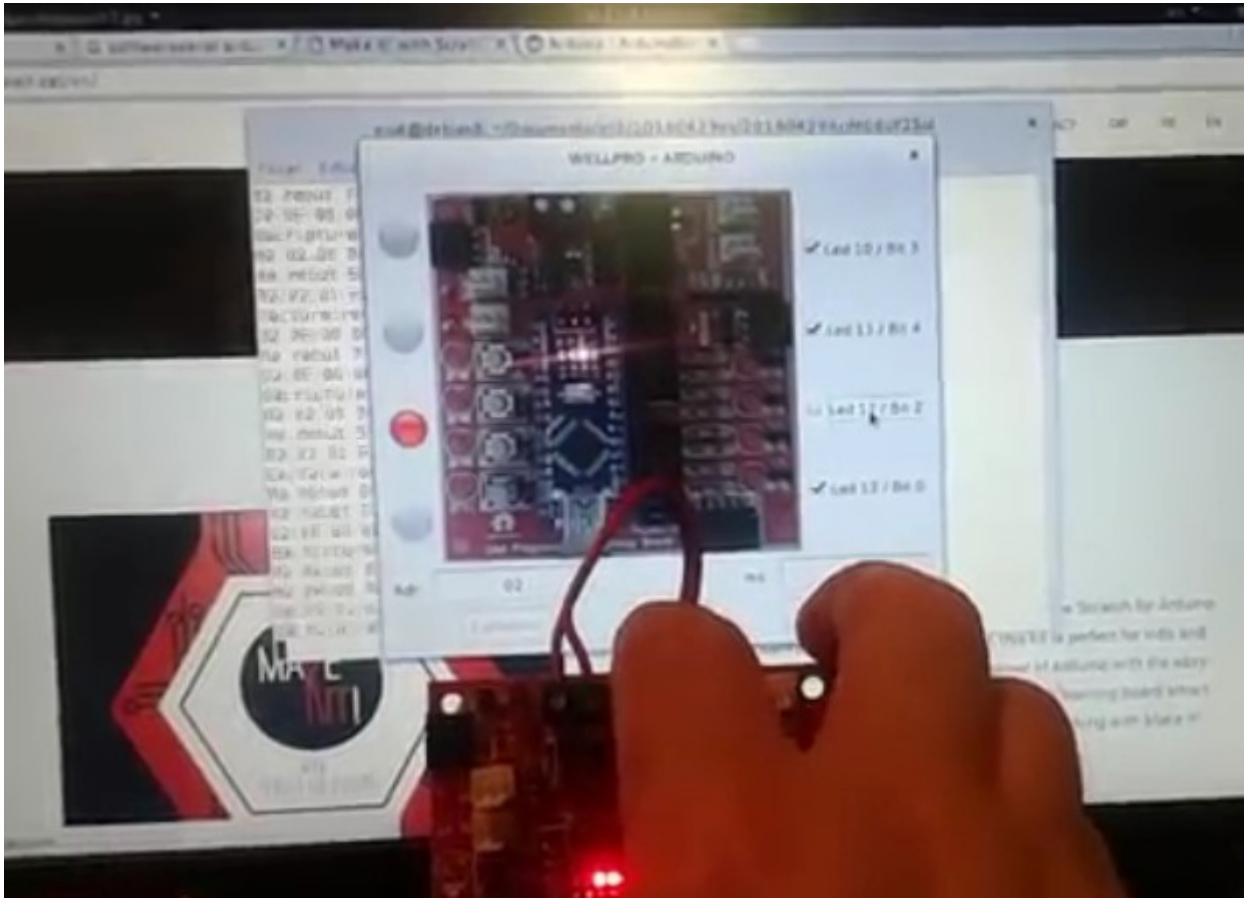
RS485
ModBus RTU



ModBus RTU sobre RS485 emprant Arduino i pyQt
Modbus dobre USB emprant Arduino i pyQt
Modbus RTU sobre un mòdul industrial

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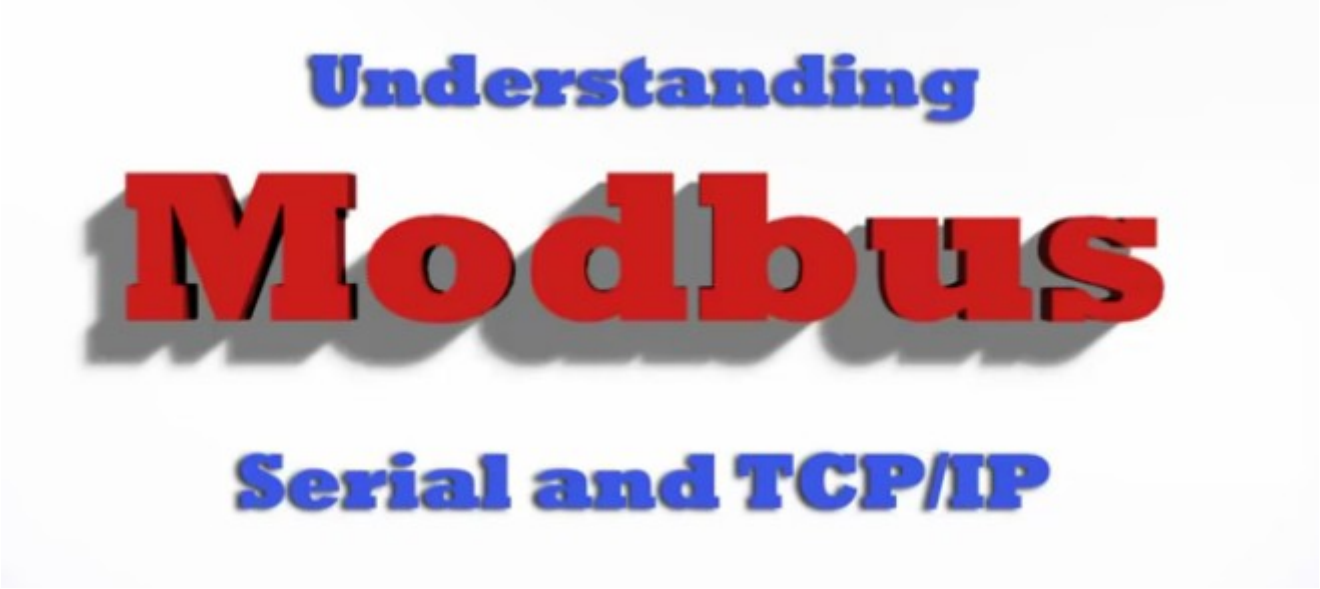
RS485
ModBus RTU



Vídeo explicatiu del ModBusRTU i el ModBusTCP

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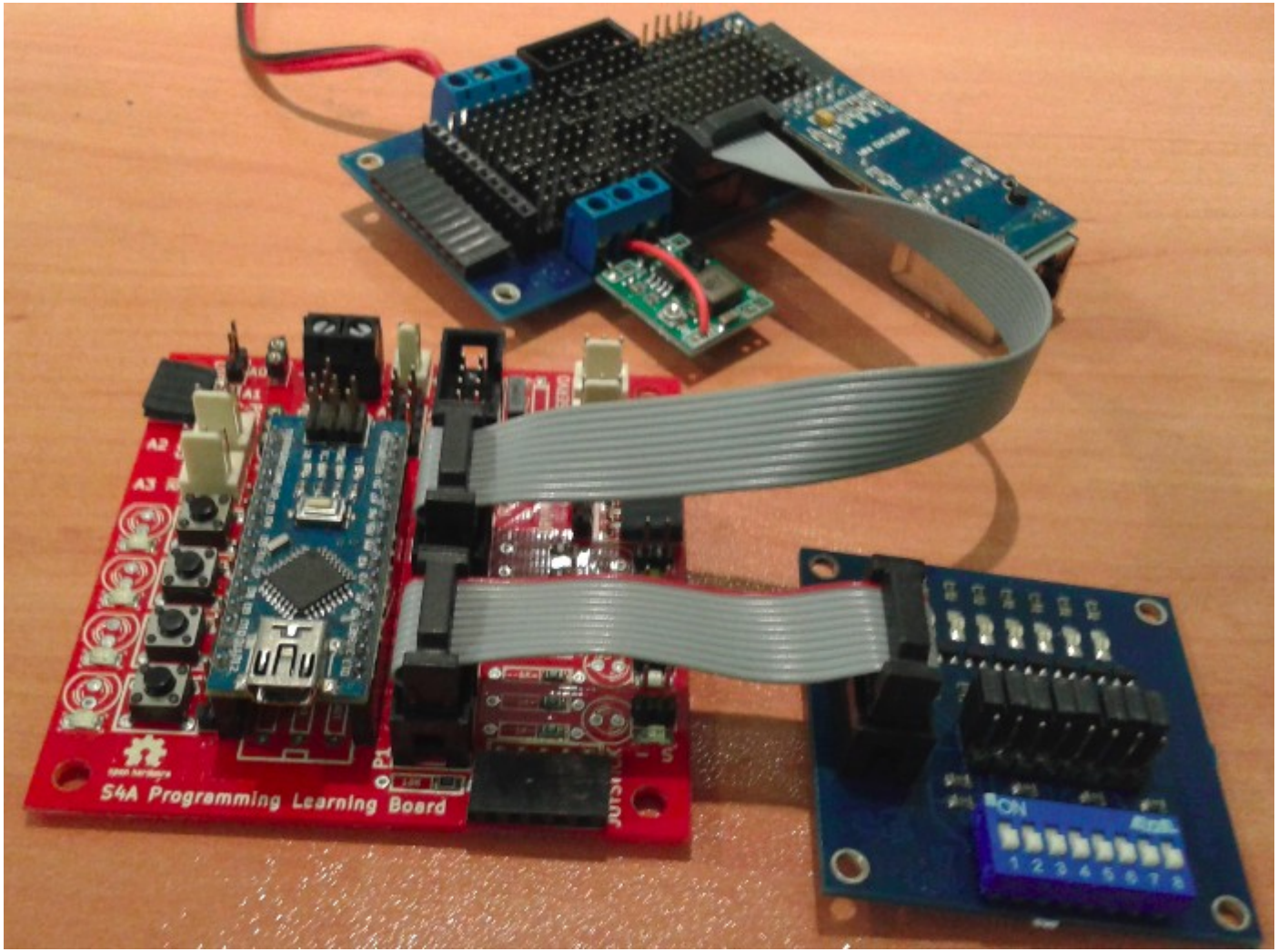
Ethernet

Ethernet – Mòdul ENC28J60

Un altre ús del bus SPI



Codi per a Arduino UdpServer01b

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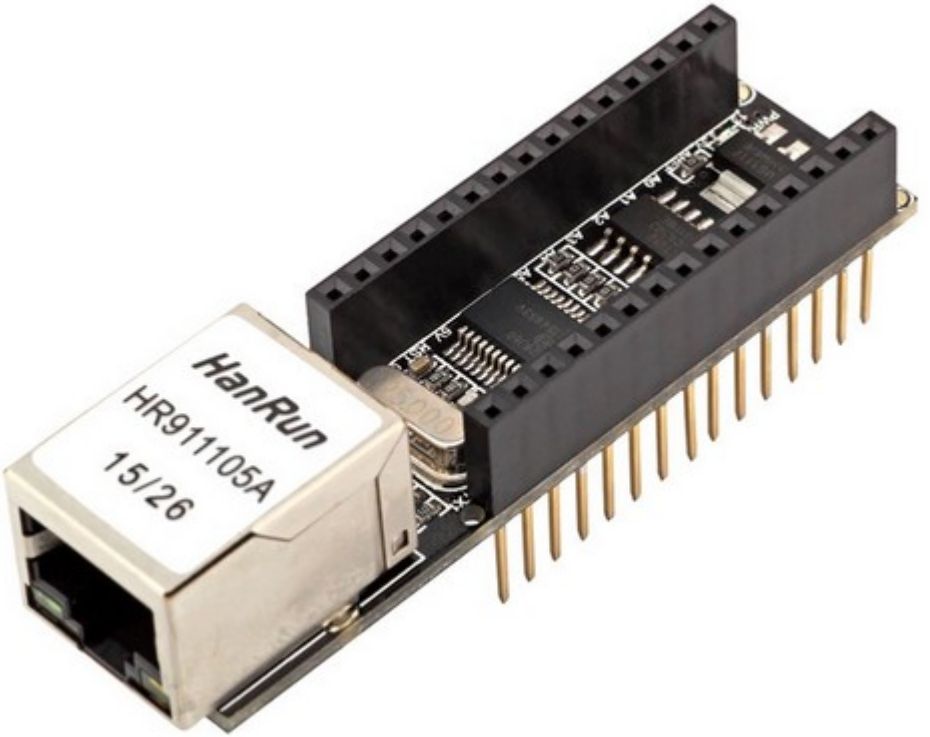
Ethernet

Ethernet – Mòdul ENC28J60



Biblioteca UIPEthernet per Arduino i ENC28J60

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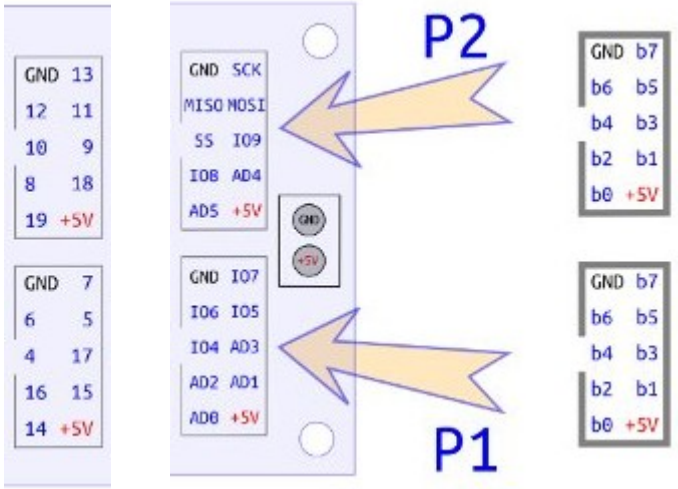
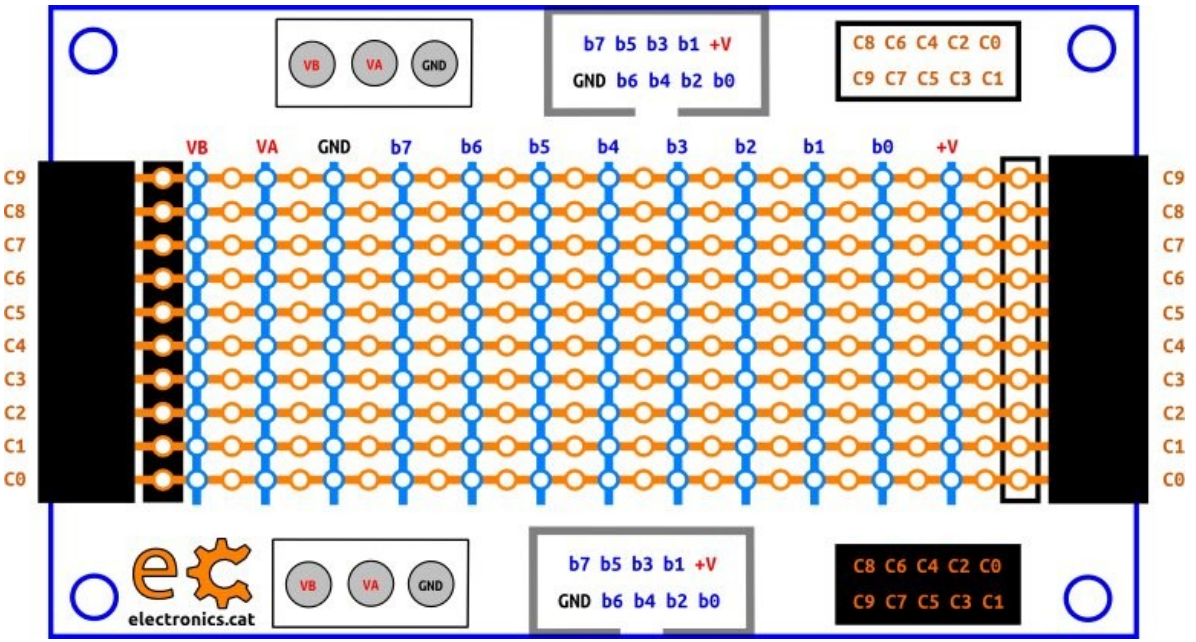
Ethernet

Ethernet – Mòdul ENC28J60

Connexió a la matriu inversa (pàgina 100 del pdf)				
C8	C6	c4	C2	C0
C9	C7	C5	C3	C1
Connexió de l'ENC28J60				
CLK	WOL	SI	CS	VCC
INT	SO	SCK	RST	GND
Connexió bus ecat				
N	NC	b5	b4	3V3
NC	b6	b7	+5V	GND



Per pota de connector ecat		
1	CK	NC
2	INT	NC
3	WOL	NC
4	SO	b6
5	SI	b5
6	SCK	b7
7	CS	b4
8	RST	+5V
9	VCC	3V3
10	GND	



http://electronics.cat/php/common/index.php?lang=ca&page=517

electronics.cat

Ethernet

Ethernet – Mòdul ENC28J60

Recepció de datagrames UDP

```
#include <UIPEthernet.h>
#include <ecat.h>

EthernetUDP udp;
Ecat ecat;

void setup() {

  Serial.begin(9600);

  uint8_t mac[6] = {0x00,0x01,0x02,0x03,0x04,0x05};

  Ethernet.begin(mac,IPAddress(192,168,1,108));
  //Ethernet.begin(mac,IPAddress(172,20,1,168));

  int success = udp.begin(5000);

  Serial.print("initialize: ");
  Serial.println(success ? "success" : "failed");
  ecat.setupHighNibbleP1(OUTPUT);

}
```

```
void loop() {

  //check for new udp-packet:
  int size = udp.parsePacket();
  if (size > 0) {
    do
      {
        char* msg = (char*)malloc(size+1);
        int len = udp.read(msg,size+1);
        msg[len]=0;
        Serial.print("received: '");
        Serial.print(msg);
        if(msg[0]=='0'){
          digitalWrite(ecat.nPinP1B7, LOW);
        }else{
          if(msg[0]=='1'){
            digitalWrite(ecat.nPinP1B7, HIGH);
          }
        }
        free(msg);
      }
    while ((size = udp.available())>0);
    //finish reading this packet:
    udp.flush();
    Serial.println("'");
```

Codi per a Arduino UdpServer01b

electronics.cat

Ethernet

Ethernet – Mòdul ENC28J60

Enviament de datagrames UDP

```
    int success;
    do
      {
        Serial.print("remote ip: ");
        Serial.println(udp.remoteIP());
        Serial.print("remote port: ");
        Serial.println(udp.remotePort());
        //send new packet back to ip/port of client. This also
        //configures the current connection to ignore packets from
        //other clients!
        success = udp.beginPacket(udp.remoteIP(),udp.remotePort());
        Serial.print("beginPacket: ");
        Serial.println(success ? "success" : "failed");
    //beginPacket fails if remote ethaddr is unknown. In this case an
    //arp-request is send out first and beginPacket succeeds as soon
    //the arp-response is received.
      }
    while (!success);

    success = udp.println("hello world from arduino");

    Serial.print("bytes written: ");
    Serial.println(success);

    success = udp.endPacket();

    Serial.print("endPacket: ");
    Serial.println(success ? "success" : "failed");

    udp.stop();
    //restart with new connection to receive packets from other clients
    Serial.print("restart connection: ");
    Serial.println (udp.begin(5000) ? "success" : "failed");
  }
}
```

Codi per a Arduino UdpServer01b

electronics.cat

Ethernet

Enviament de datagrames UDP en Python

```
$ ./udpOn.py 192.168.1.108
```

```python
#!/usr/bin/python

import socket
import sys

szServer = str(sys.argv[1])
nUdpPort = 5000

client_socket = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
client_socket.sendto("1", (szServer,nUdpPort))
client_socket.close()
```

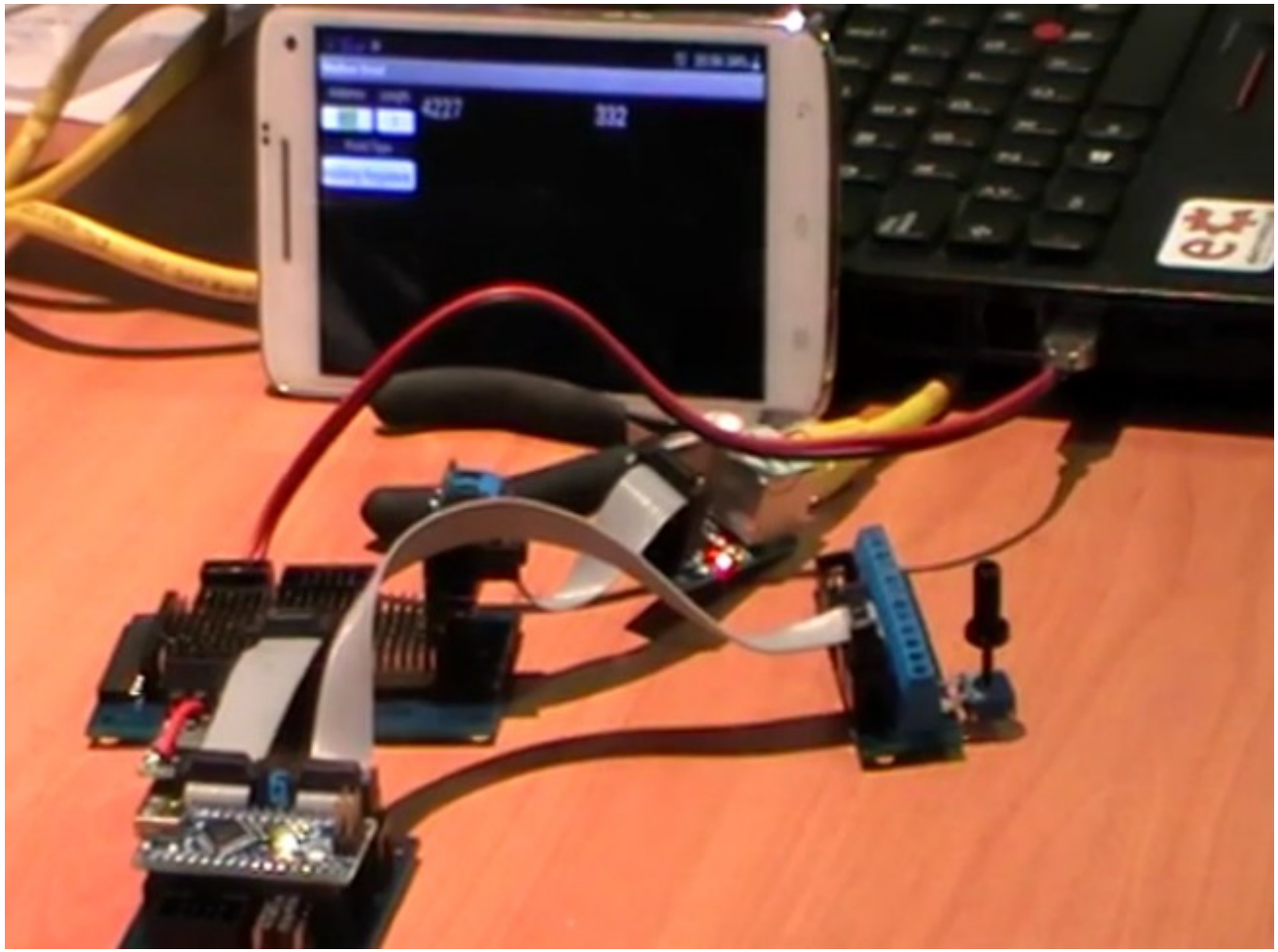
```
$ ./udpOff.py 192.168.1.108
```

```python
#!/usr/bin/python

import socket
import sys

szServer = str(sys.argv[1])
nUdpPort = 5000

client_socket = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
client_socket.sendto("0", (szServer,nUdpPort))
client_socket.close()
```

Codis font dels codis d'enviament de datagrames UDP en Python

electronics.cat

Ethernet
ModBus - TCP



http://www.binefa.cat/php/doc/modbus/

Vídeo: https://www.youtube.com/embed/j-1f-dV7ohQ

electronics.cat

LoRaMAC
Encriptació AES

/dev/ttyUSB0 @9600

String: SX1276 at Arduino

Hexadecimal: 535831323736206174204172647569 6E6F

CRC: 6791

Tx / Rx / Freq — Send — Without CRC / Add CRC / CRC at uC — Read bytes as characters / Encrypt AES at uC (Tx) / Decrypt AES at uC (Rx)

```
202020205278206D6F64650D0A ( Rx mode )
E0
202020205278206D6F64650D0A ( : 32) (Rx mode )
3632081153583132373620617420455350383236 36 (6: 17) (SX1276 at ESP8266)
0811535831323736206174204172647569 6E6F
0811535831323736206174204172647569 6E6F
0811535831323736206174204172647569 6E6F
0811535831323736206174204172647569 6E6F
0811535831323736206174204172647569 6E6F
C8
202020205278206D6F64650D0A ( : 32) (Rx mode )
3732081153583132373620617420455350383236 (7: 17) (SX1276 at ESP8266)
3832081153583132373620617420455350383236 (8: 17) (SX1276 at ESP8266)
0811535831323736206174204172647569 6E6F
0811535831323736206174204172647569 6E6F
0811535831323736206174204172647569 6E6F
```

ecat@debian8:~/Documents/lora/python/lora09$ ./lora09.py

/dev/ttyUSB1 @9600

String: SX1276 at ESP8266

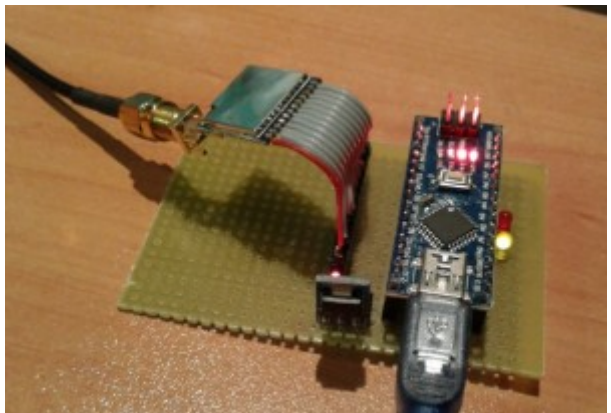
Hexadecimal: 535831323736206174204553503832 3636

CRC: 0861

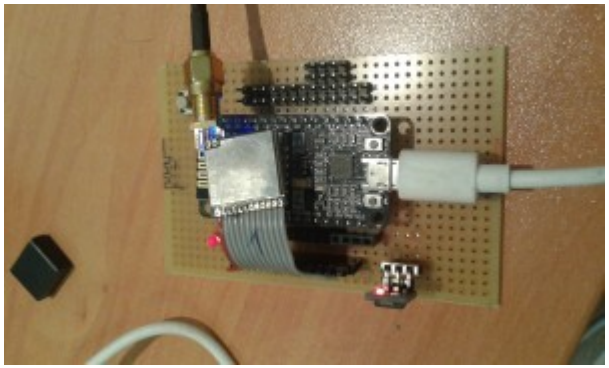
Tx / Rx / Freq — Send — Without CRC / Add CRC / CRC at uC — Read bytes as characters / Encrypt AES at uC (Tx) / Decrypt AES at uC (Rx)

```
E0
202020205278206D6F64650D0A ( Rx mode )
0811535831323736206174204553503832 3636
0811535831323736206174204553503832 3636
C8
202020205278206D6F64650D0A ( : 32) (Rx mode )
3132081153 (1: 17) (S)
583132373620617420417264756 96E6F (X: 55) (6 at Arduino)
333208115358313237 (3: 17) (SX127)
3620617420417264756 96E6F (6: 116) ( Arduino)
353208115358313237362061742041726475696E6F (5: 17) (SX1276 at Arduino)
0811535831323736206174204553503832 3636
0811535831323736206174204553503832 3636
C8
202020205278206D6F64650D0A ( : 32) (Rx mode )
3832081153583132373620617420417264756 96E6F (8: 17) (SX1276 at Arduino)
```

an8:~/Documents/lora/python/lora09$ ./lora09.py /dev/ttyUSB1



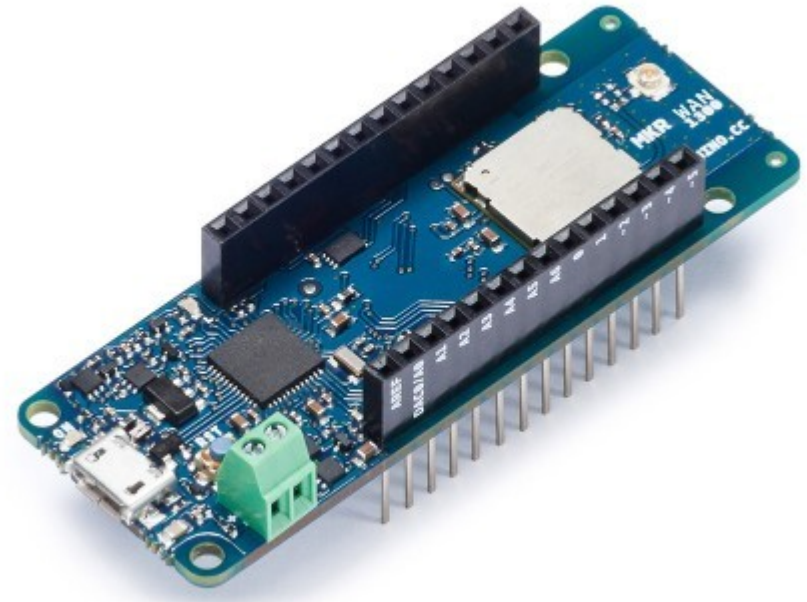
http://binefa.cat/blog/?p=327



electronics.cat

LoRaWAN

Arduino MKR WAN 1300



Ús i configuració: http://tinkerman.cat/arduino-mkr-wan-1300/

electronics.cat

Altres plaques programables des de l'IDE d'Arduino

Família d'Arduinos i Teensy

Arduino Uno

Arduino Leonardo

Arduino Due

Arduino Yún

Arduino Tre

Arduino Micro

Arduino Robot

Arduino Esplora

Arduino Mega ADK

Arduino Ethernet

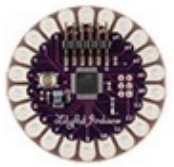
Arduino Mega 2560

Arduino Mini

LilyPad Arduino USB

LilyPad Arduino Simple

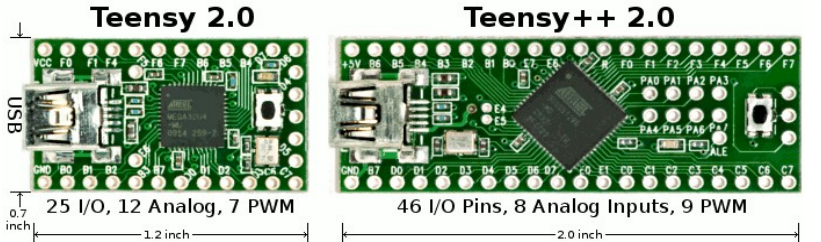
LilyPad Arduino SimpleSnap



LilyPad Arduino

Arduino Nano

Arduino Pro Mini



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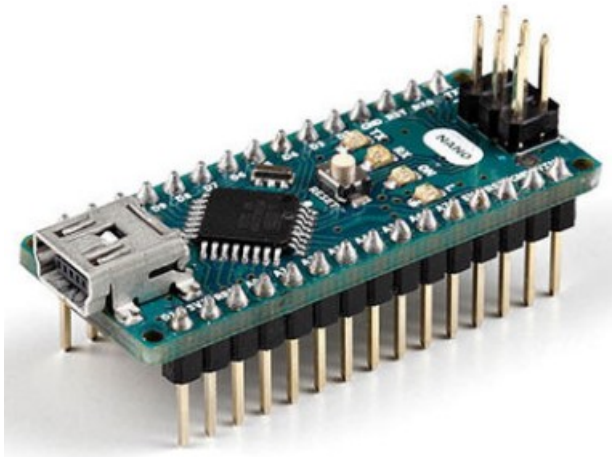
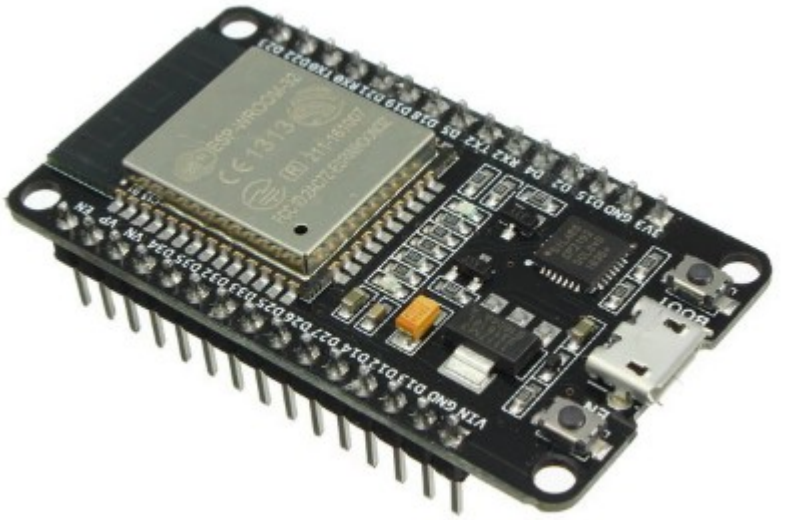
Altres plaques programables des de l'IDE d'Arduino

ESP8266 / ESP32 / STM32 / ...





https://binefa.cat/blog/?s=esp82

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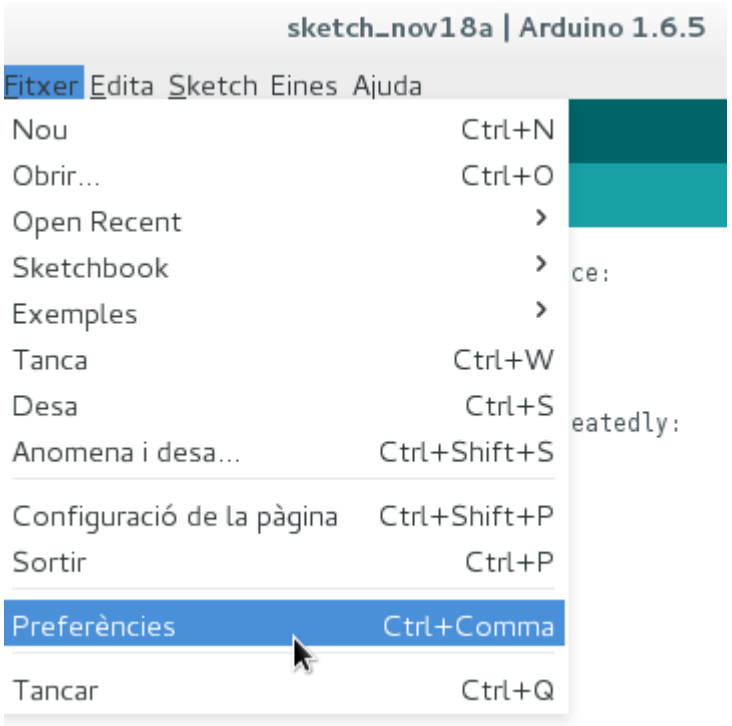
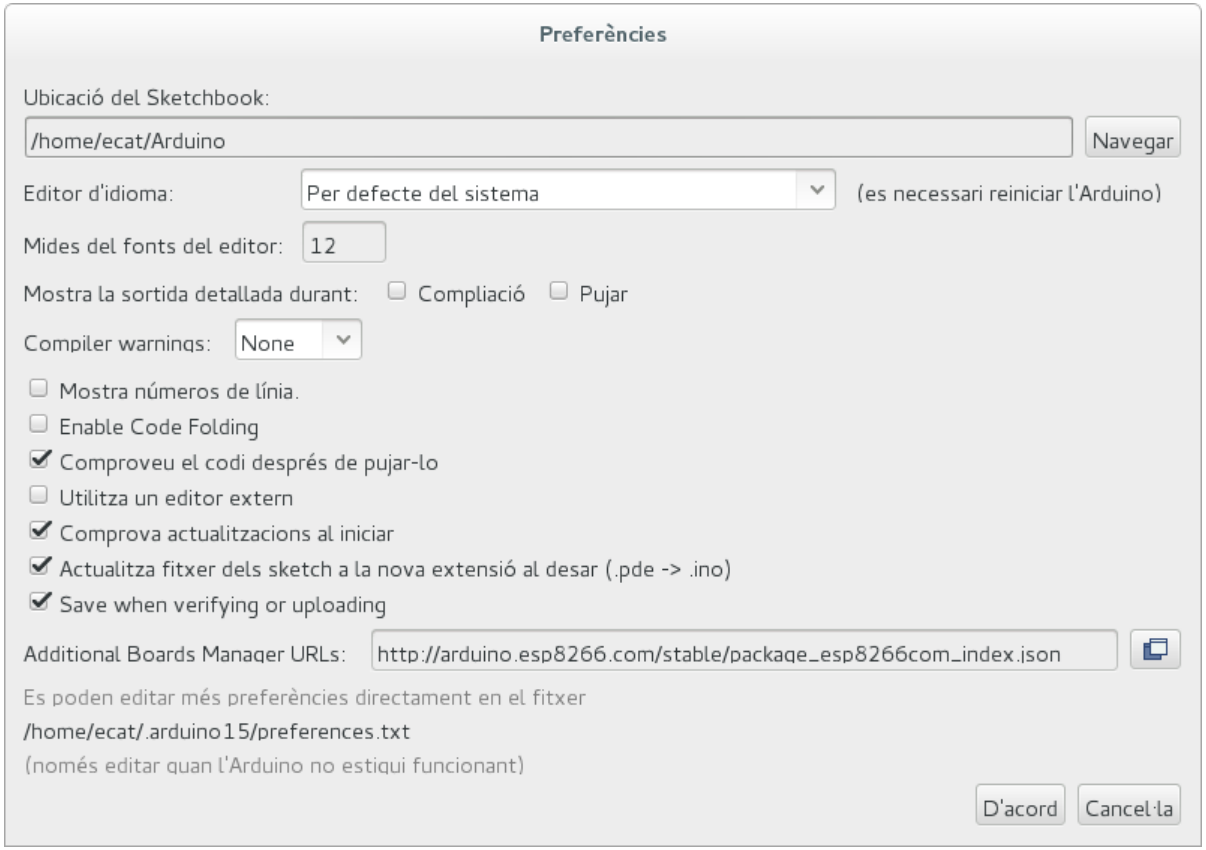
ESP8266





Entreu aquesta adreça a ”Additional Boards Manager URLs”:
http://arduino.esp8266.com/stable/package_esp8266com_index.json

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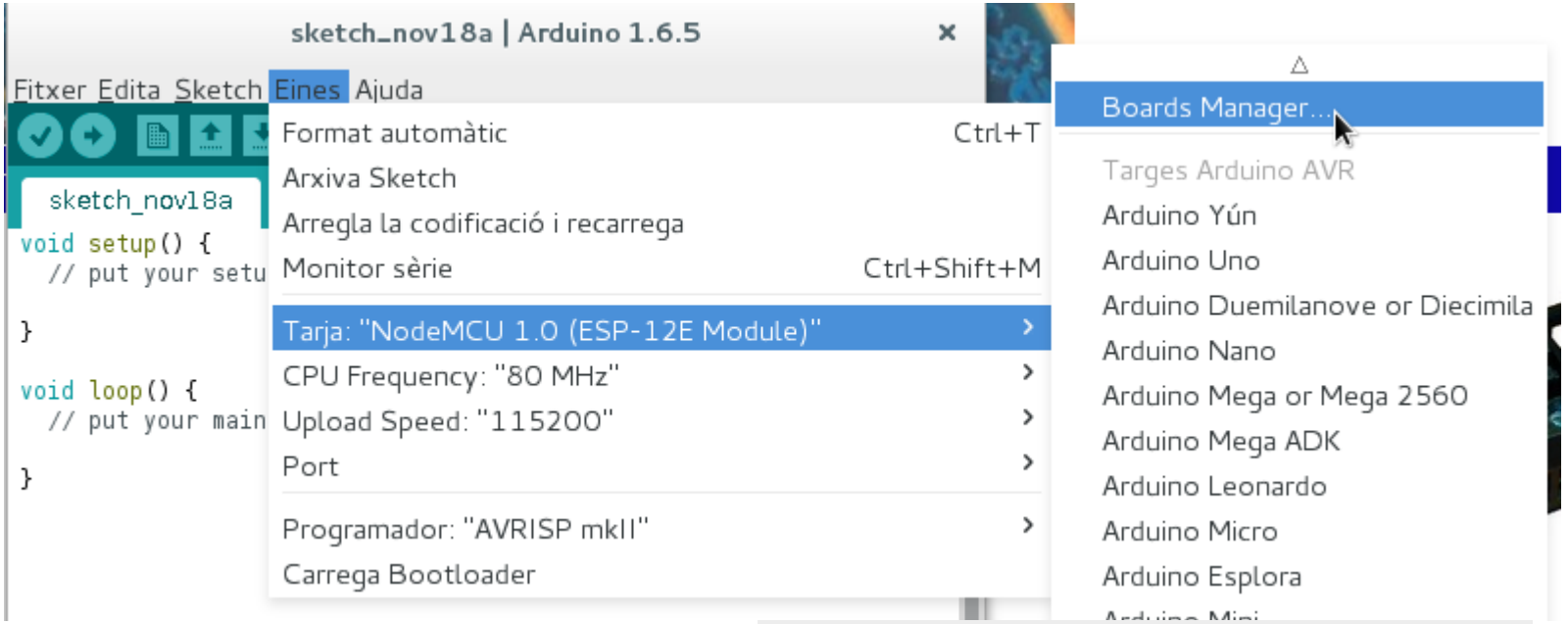
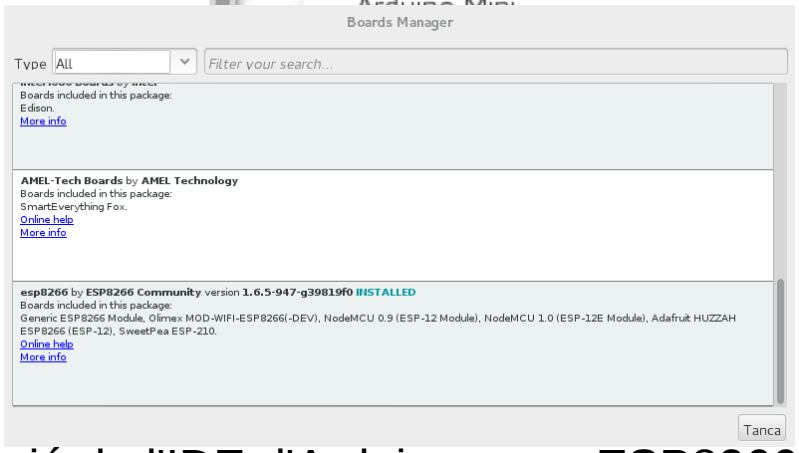
ESP8266

Tools → Board: “current” → Boards Manager ...





Click install ESP8266
(It is about 450 MB to download) :

Una altra manera de fer la instal·lació de l'IDE d'Arduino per a ESP8266:
https://libraries.io/github/adafruit/ESP8266-Arduino

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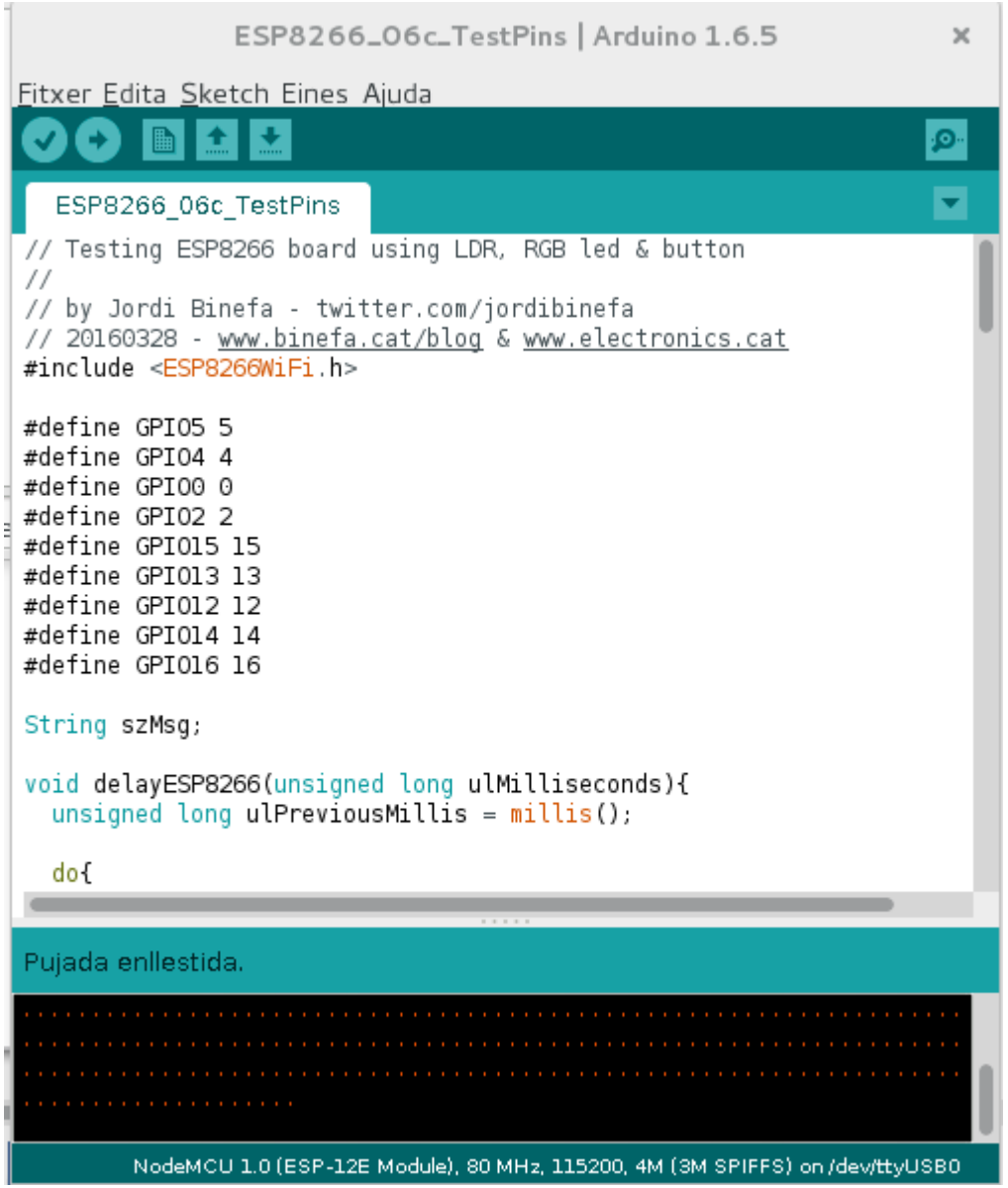
ESP8266
witty



Microprogramari de verificació

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ESP8266
witty

/dev/ttyUSB0

Envia

```
 sent to UDP server
00010) 5c:cf:7f:c0:84:07
 sent to UDP server
00011) 5c:cf:7f:c0:84:07
 sent to UDP server
00012) 5c:cf:7f:c0:84:07
 sent to UDP server
00013) 5c:cf:7f:c0:84:07
 sent to UDP server
00014) 5c:cf:7f:c0:84:07
 sent to UDP server
00015) 5c:cf:7f:c0:84:07
 sent to UDP server
00016) 5c:cf:7f:c0:84:07
 sent to UDP server
```

Desplaçament automàti

UDPClientMAC02 | Arduino 1.6.5

Fitxer Edita Sketch Eines Ajuda

UDPClientMAC02

```
Serial.println();
Serial.println();
Serial.print("Connecting to ");
Serial.println(ssid);

WiFi.begin(ssid, password);

while (WiFi.status() != WL_CONNECTED) {
  delay(500);
  Serial.print(".");
}

Serial.println("");
Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());

//  Udp.beginPacket("192.168.1.105", 888);
//  Udp.beginPacket("192.168.1.13", 6000);
//  Udp.beginPacket("192.168.1.52", 6000);
  Udp.beginPacket("192.168.1.12", 6000);

}
```

pyUdp
qt
qtPyU
s2a_fr
scratc
Scratc

UDPdlg

Text :

Tramet

IP servidor : 127.0 .0 .1

Port Tx : 45454 <-> Port Rx : 6000

```
00004) 5c:cf:7f:c0:84:07
00005) 5c:cf:7f:c0:84:07
00006) 5c:cf:7f:c0:84:07
00007) 5c:cf:7f:c0:84:07
00008) 5c:cf:7f:c0:84:07
00009) 5c:cf:7f:c0:84:07
00010) 5c:cf:7f:c0:84:07
00011) 5c:cf:7f:c0:84:07
00012) 5c:cf:7f:c0:84:07
00013) 5c:cf:7f:c0:84:07
00014) 5c:cf:7f:c0:84:07
00015) 5c:cf:7f:c0:84:07
00016) 5c:cf:7f:c0:84:07
```

Microprogramari client UDP

ESP8266

Trametent trames UDP amb l'ESP8266

UDPClientMAC02 | Arduino 1.6.5

Fitxer Edita Sketch Eines Ajuda

UDPClientMAC02

```
#include <ESP8266WiFi.h>
//#include <WiFiUDP.h>
#include <WiFiUdp.h>


#ifdef ESP8266
extern "C" {
#include "user_interface.h"
}
#endif

const char* ssid     = "IoT-eCat";
const char* password = "clotClot";

// A UDP instance to let us send and receive packets over UDP
WiFiUDP Udp;


void setup() {
  Serial.begin(115200);
  delay(10);

  // We start by connecting to a WiFi network
```

NodeMCU 1.0 (ESP-12E Module), 80 MHz, 115200 on /dev/ttyUSB0

```
void loop() {
//  char temp[20];      // buffer for for
  char temp[28];      // buffer for forma

  vGetMac(temp);

  Udp.write(temp);
  Udp.endPacket();

  Serial.print(temp);
  Serial.println(" sent to UDP server");

  delay(5000);
}
```

http://binefa.cat/php/esp8266/codis/arduinoIDE/UDPClientMAC02/UDPClientMAC02.ino

MQTT

MQTT és una forma de comunicar dispositius d'Internet de les Coses (IdC / IoT) entre si. És un protocol lleuger i molt versàtil que es pot fer servir des d'un Arduino, una Rasperry Pi, un PC multinucli fins als serveis d'Amazon Web Services.

https://www.baldengineer.com/mqtt-introduction.html
http://binefa.cat/php/dam/m09uf3/20170224/2017024_mqtt_00.pdf

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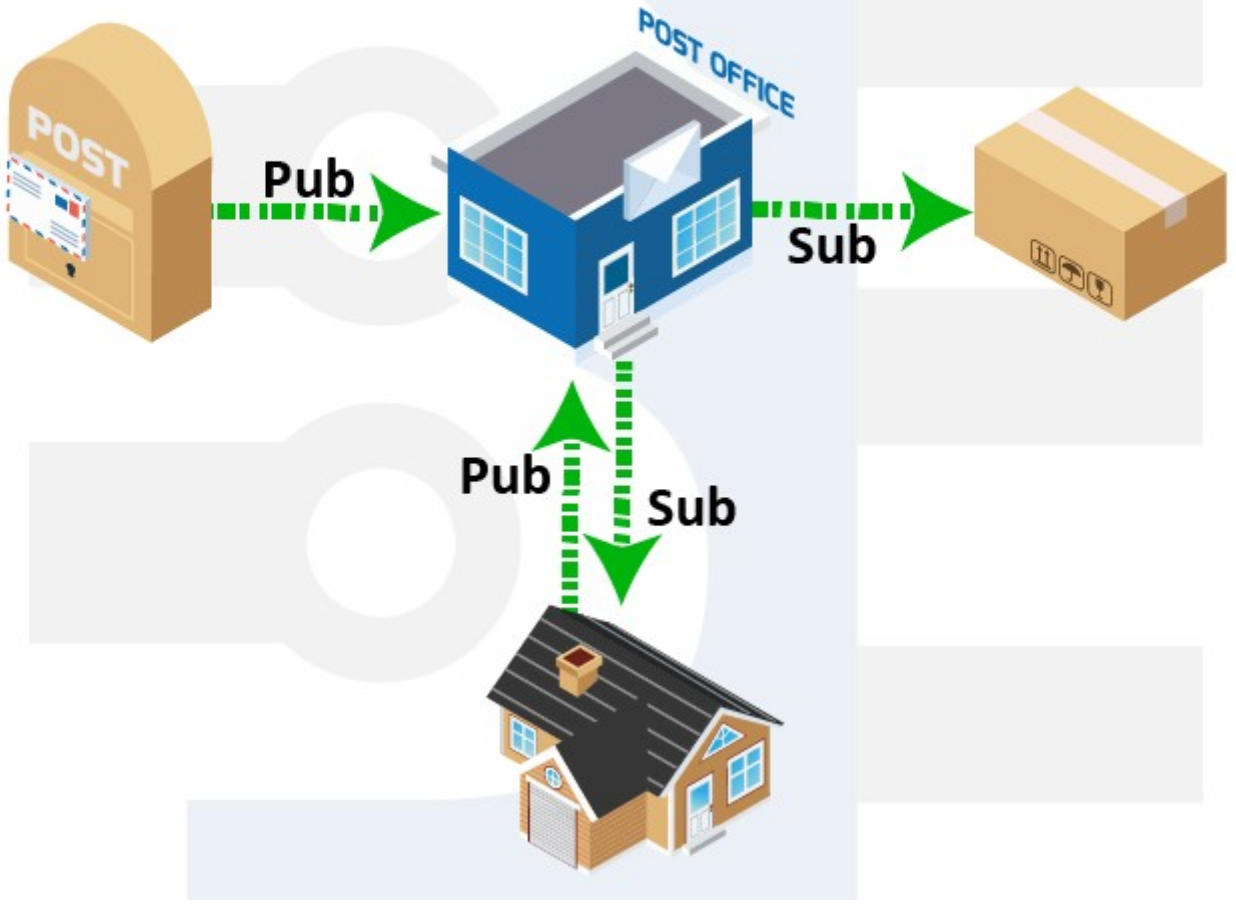
MQTT

Analogia amb el servei postal

mqtt://broker/topic/message



https://www.baldengineer.com/mqtt-introduction.html

MQTT

Perquè no fer servir HTTP (o REST)

HTTP requereix de múltiples accions POST per a distribuir un missatge a més d'un client. L'objectiu del sistema de missatgeria intermediària és que l'intermediari distribueixi el missatge, tan sols als clients interessats. La funcionalitat del MQTT és trametre d'un a molts.

https://www.baldengineer.com/mqtt-introduction.html

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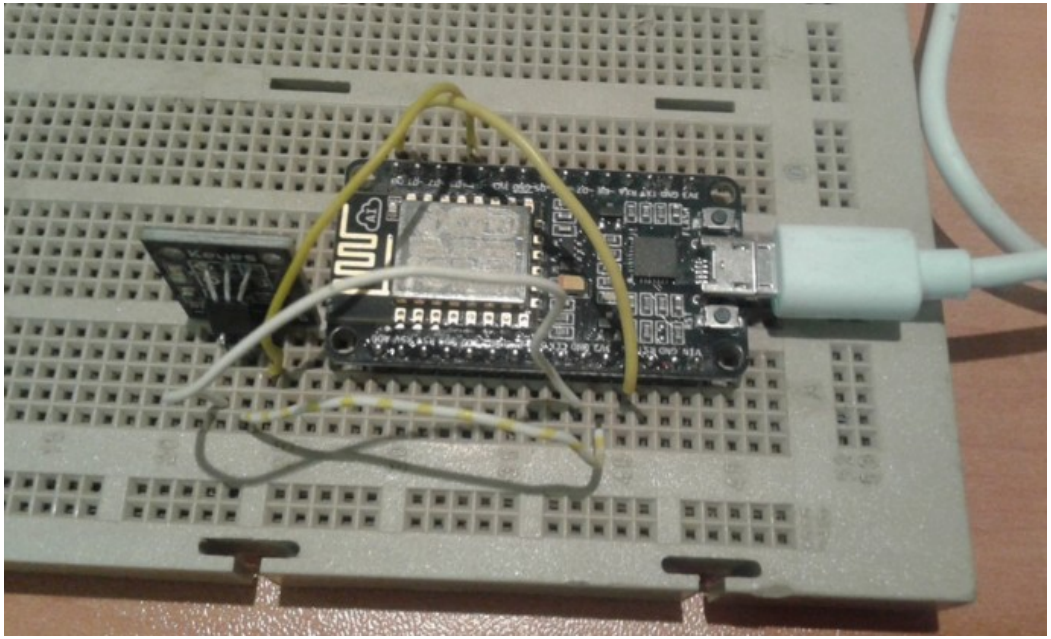
MQTT

ESP8266 sobre l'IDE d'Arduino - MQTT



```
Fitxer  Edita  Vi
Client mosqsub
Client mosqsub
24.94
Client mosqsub
25.00
Client mosqsub
24.94
Client mosqsub
25.00
Client mosqsub
Client mosqsub
Client mosqsub
25.00
Client mosqsub
25.06
°C
ecat@debian8:~$ mosquitto_sub -d -t sensors/test/temperature
Client mosqsub/15509-debian8 sending CONNECT
Client mosqsub/15509-debian8 received CONNACK
Client mosqsub/15509-debian8 sending SUBSCRIBE (Mid: 1, Topic:
Client mosqsub/15509-debian8 received SUBACK
Subscribed (mid: 1): 0
Client mosqsub/15509-debian8 received PUBLISH (d0, q0, r0, m0,
24.81
Client mosqsub/15509-debian8 received PUBLISH (d0, q0, r0, m0,
24.75
Client mosqsub/15509-debian8 received PUBLISH (d0, q0, r0, m0,
24.69
```

```
Entering deep sleep mode for 3 seconds...
rl  l@@|  @l@|◁   @ l@ b|@@◁@,@r@b@ b@@nn@lnn@@@ b☺p@@lrlrlp@n
Connecting to IoT-eCat
.............
WiFi connected
IP address:
192.168.1.12
Attempting MQTT connection...connected
Requesting DS18B20 temperature...
Sending temperature: 24.69
Closing MQTT connection...
Closing WiFi connection...
Entering deep sleep mode for 3 seconds...
rl  l@@|  @l@|◁   @ l@ b|@@◁@,@r@b@ b@@nn@lnn@@@ b☺p@@lrlrlp@n
Connecting to IoT-eCat
....
☑ Desplaçament automàtic
```

https://binefa.cat/telecos/ESP8266/esp8266_03.pdf

http://www.jerome-bernard.com/blog/2015/10/04/wifi-temperature-sensor-with-nodemcu-esp8266/

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Torn de preguntes ...

… i sessió pràctica.

Arduino i Raspberry Pi

Presentació descarregable a : **https://binefa.cat/blog/**

Correu electrònic de contacte : **jordibinefa@electronics.cat**

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https://twitter.com/JordiBinefa

https://twitter.com/electronicscat

LinkedIn **http://es.linkedin.com/pub/jordi-binefa/13/717/90b**

https://wiki.binefa.cat

http://www.electronics.cat

http://www.makeit.cat

Moltes gràcies per la vostra atenció