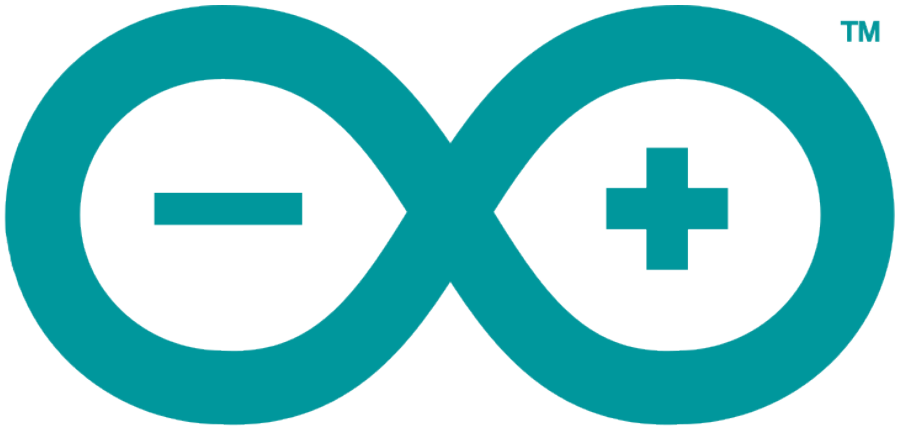


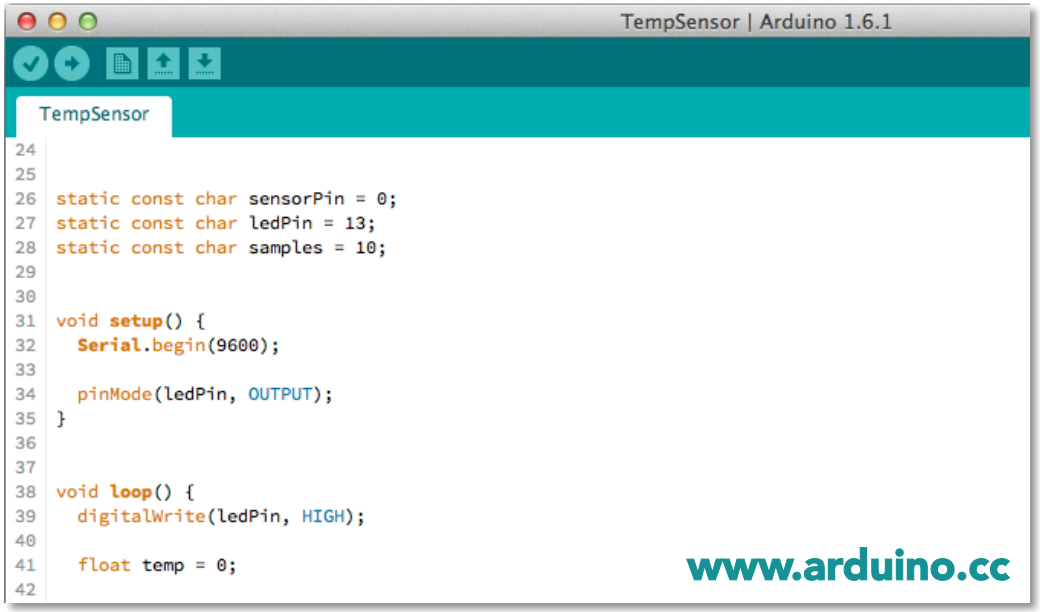
Electrónica Básica com o Arduino

…explicada por um informático

ARDUINO DAY 2015

Carlos Rodrigues – Março de 2015

A Plataforma Arduino



...10101010...

- Uma biblioteca de abstracção do *hardware*
- Um IDE simples em cima das ferramentas da GNU

- Circuitos de suporte ao microcontrolador
- Um *bootloader* para carregar programas

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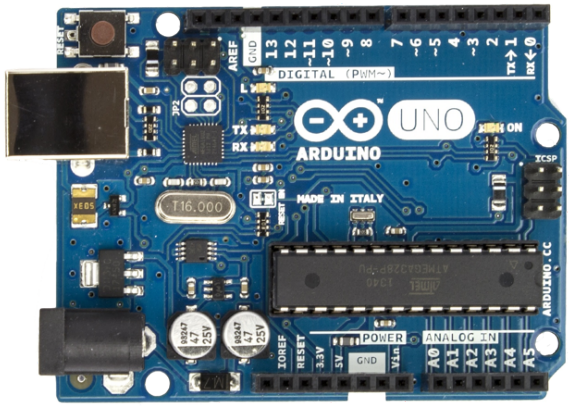
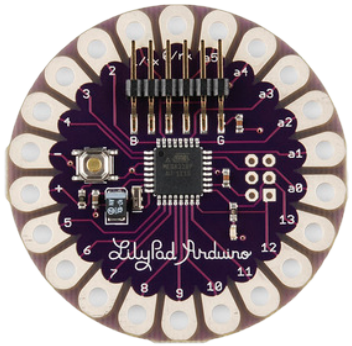
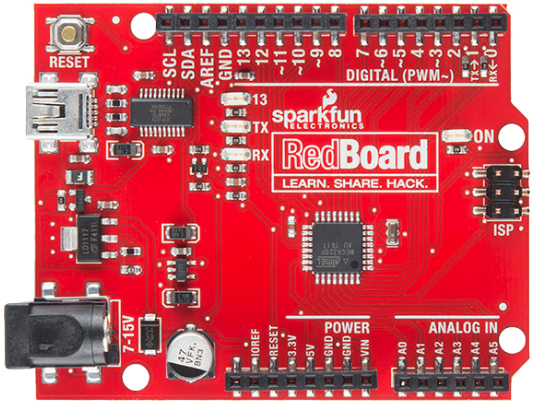
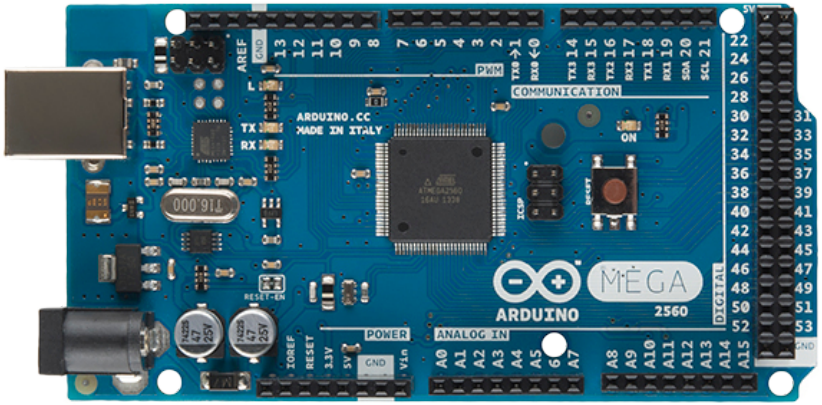
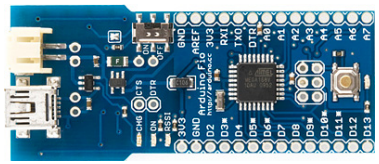
A Plataforma Arduino

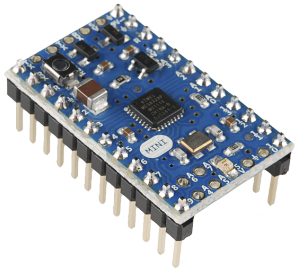












ATMEL AVR

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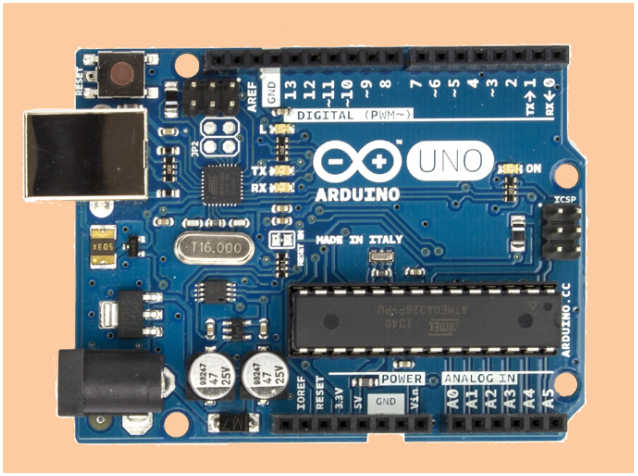
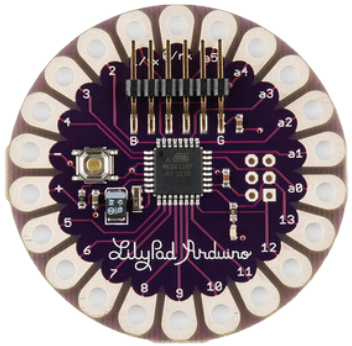
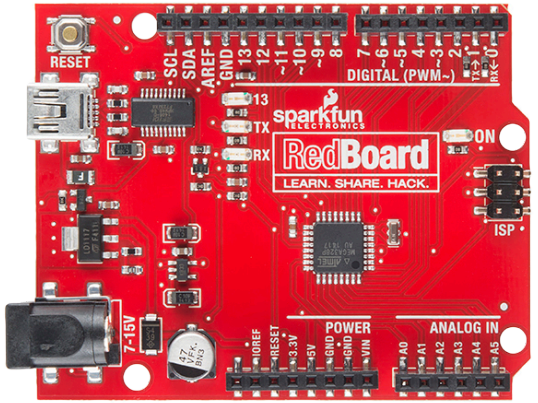
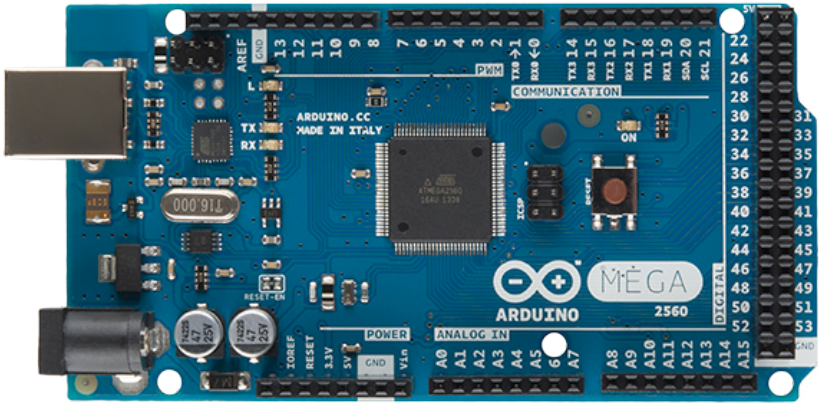
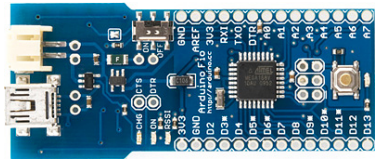
A Plataforma Arduino

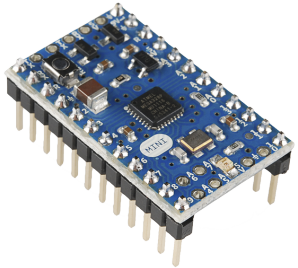












ATMEL AVR

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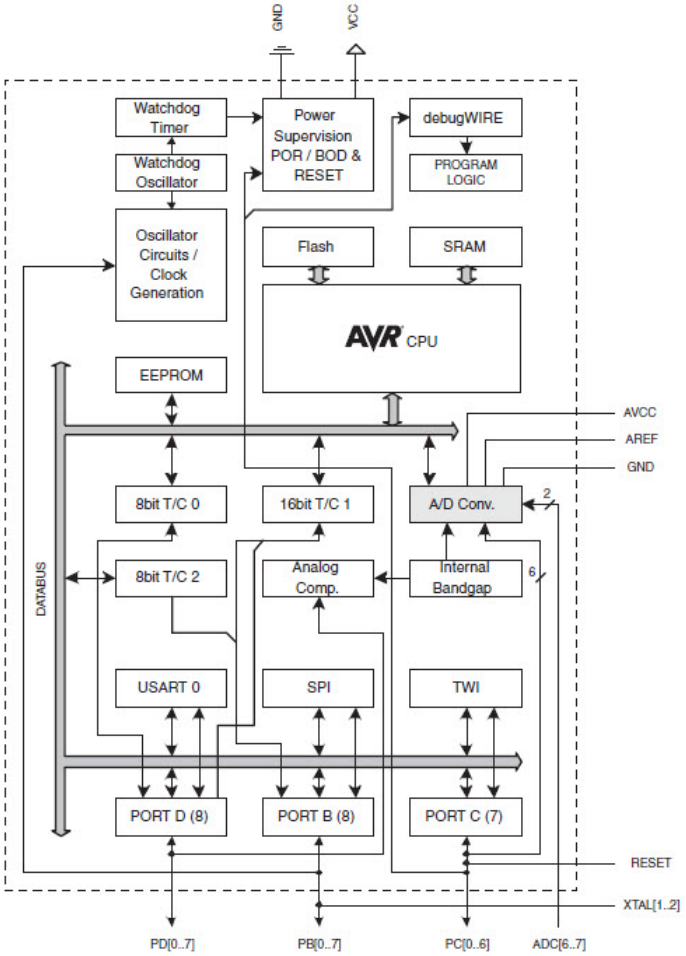
Especificações (do Arduino Uno)



- ATmega328p (8-bit) @ 16 MHz
- 2 KB de RAM
- 32 KB de memória Flash (programas)
  …mais 1 KB de EEPROM (estado persistente)
- 14 pinos de I/O digital
  …6 deles com PWM disponível (8-bit)
  …2 com suporte para *interrupts*
- 6 pinos de *input* analógico (10-bit)

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Especificações Eléctricas

- A placa funciona a **5 V**

- Fonte de alimentação entre **7** a **12 V**

  …que pode ir até 20 V, mas não se recomenda

- Cada pino de I/O aguenta **20 mA** (em segurança)

  …mas **evitem** mais de **100 mA** na soma de todos os pinos

  …e **nunca** lhes dêem mais de 5 V ou voltagens negativas

- O pino "5V" debita até cerca de **100 mA** (sem aquecer muito)

  …mas o pino V_{in} (voltagem de alimentação) aguenta até **1 A**

Arranjem um destes…

- Voltagem* (V_{dc} e V_{ac})
- Corrente (DC e AC)
- Resistência (Ω)
- Capacitância (F)
- Ganho de transístores (hFE)
- Teste de continuidade
- Temperatura (°C)

Qualquer marca serve, mas não sejam forretas…

*Mais correctamente: "Tensão Eléctrica"

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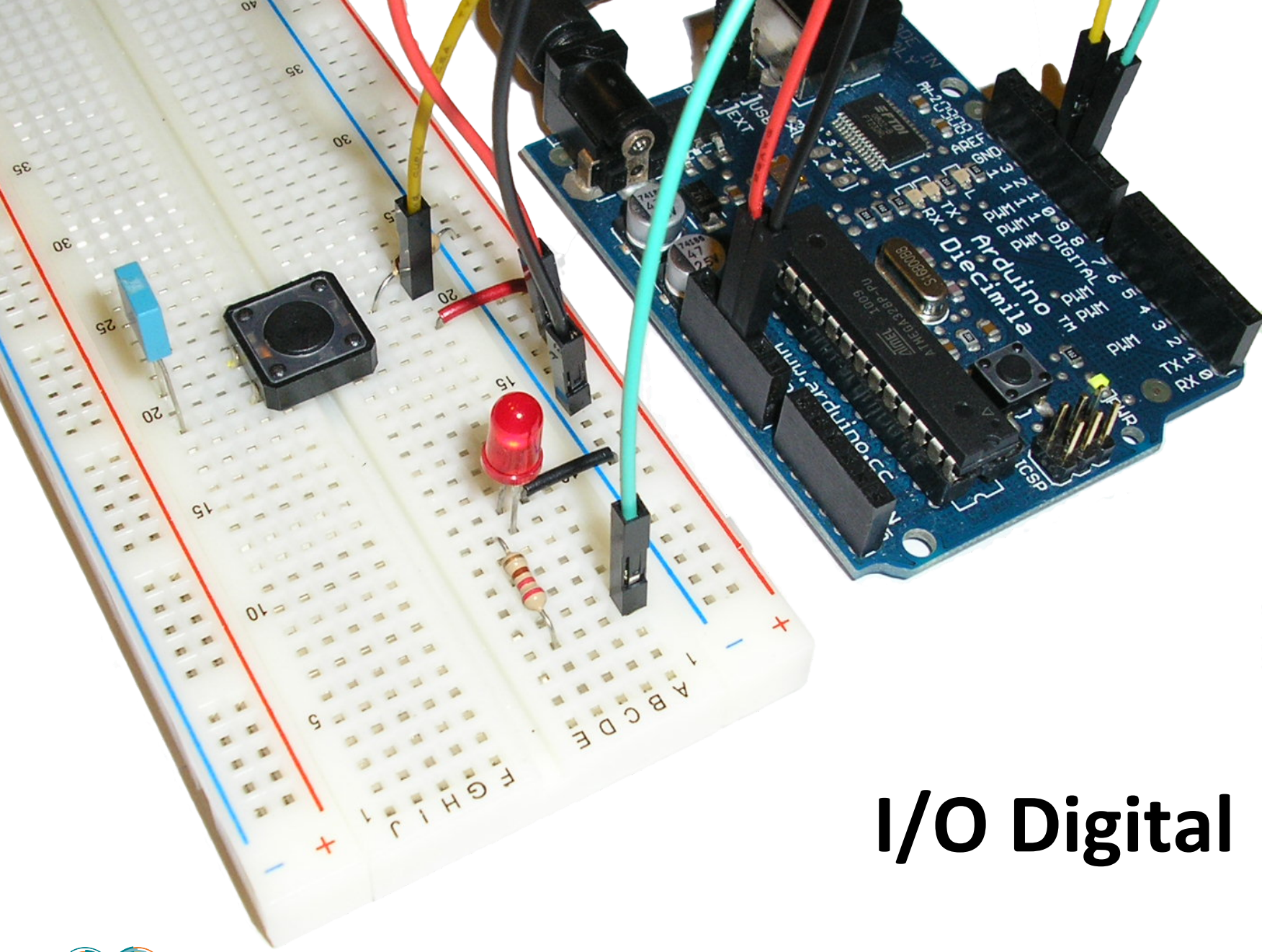

I/O Digital

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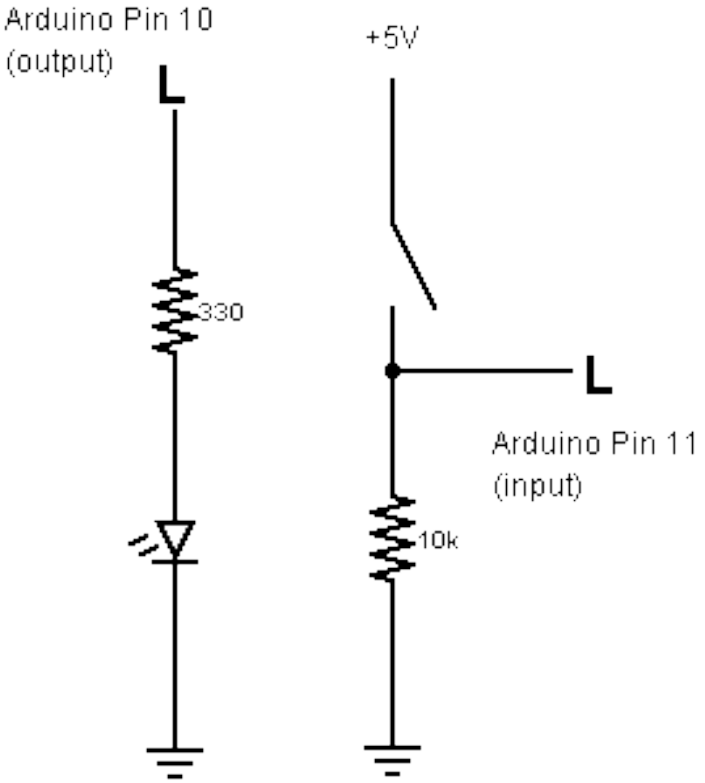
O Primeiro Circuito (I/O Digital)




```
// Alternar o estado de um LED pressionando um botão...

static const char led_pin = 10;
static const char button_pin = 11;

boolean led_state = LOW;
boolean last_button_state = LOW;

void setup() {
  pinMode(led_pin, OUTPUT);
  pinMode(button_pin, INPUT);
}

void loop() {
  boolean button_state = digitalRead(button_pin);

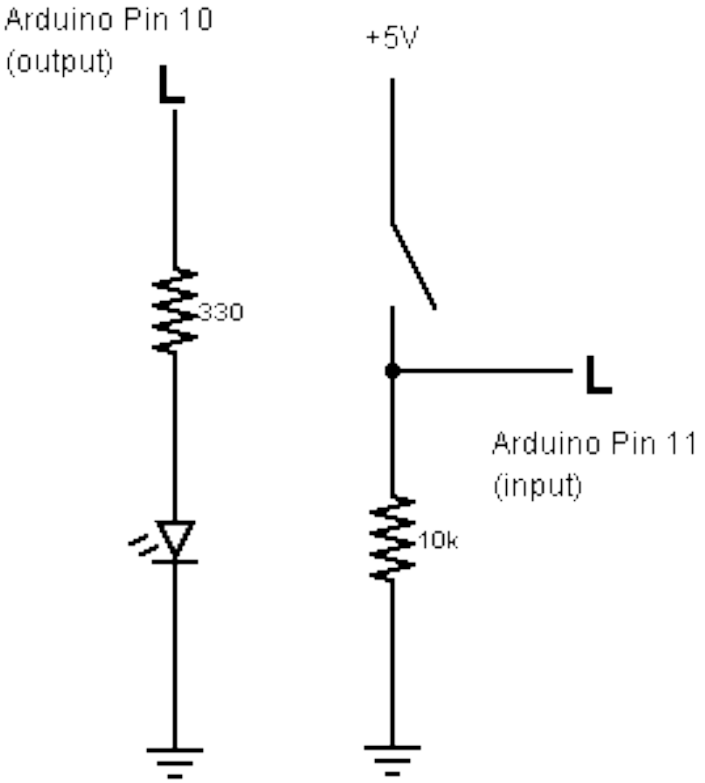
  if (button_state == HIGH && last_button_state == LOW) {
    led_state = !led_state;

    digitalWrite(led_pin, led_state);
  }

  last_button_state = button_state;
}
```

Binário: 988 bytes

O Primeiro Circuito (I/O Digital)

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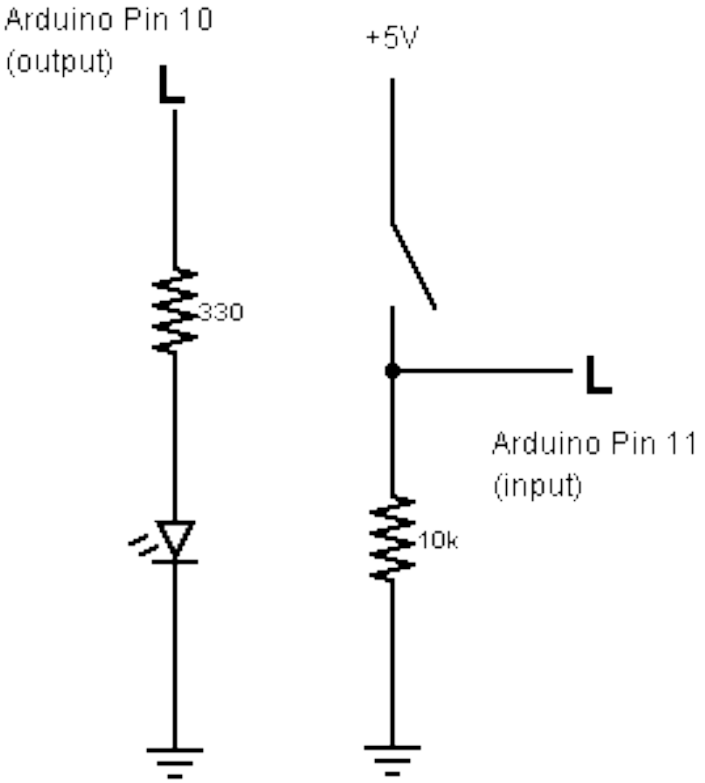


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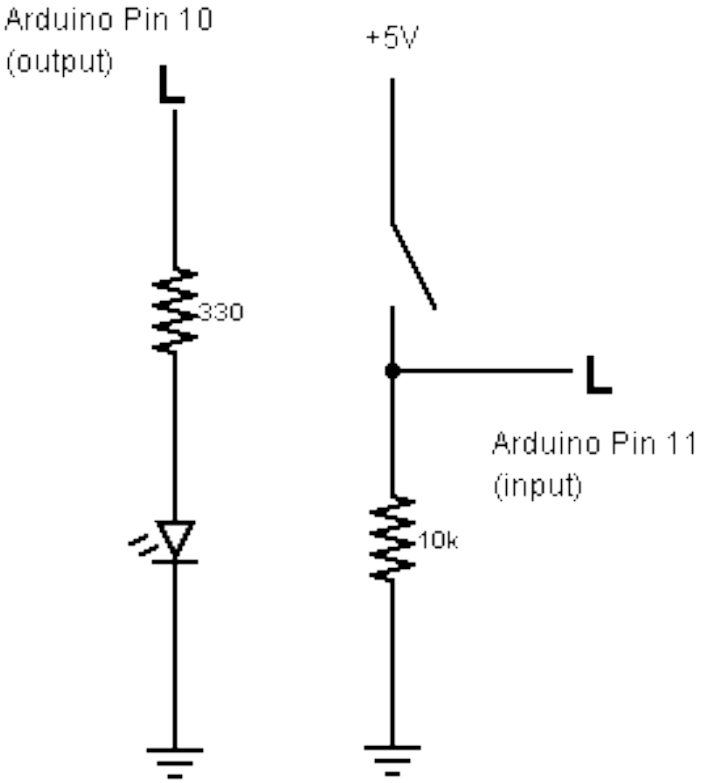


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  boolean button_state = digitalRead(button_pin);

  if (button_state == HIGH && last_button_state == LOW) {
    led_state = !led_state;

    digitalWrite(led_pin, led_state);
  }

  last_button_state = button_state;
}
```

Binário: 988 bytes

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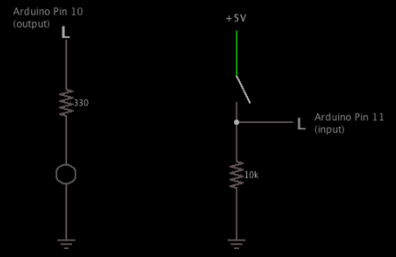
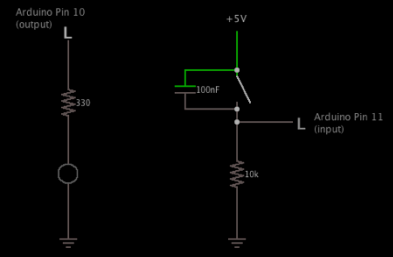
Simulação

Simple Digital Input and Output



Simple Digital Input and Output (debounced)



This works because Arduino digital pins have input hysteresis (Schmitt-Trigger).

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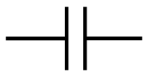
“Debouncing” com Condensadores

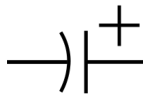
Poliéster

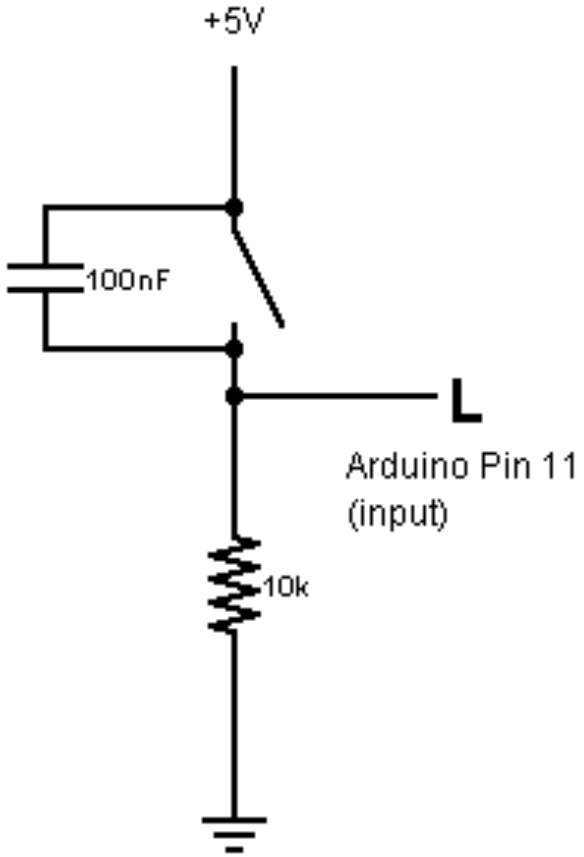
Tântalo

Cerâmicos

Electrolíticos







Isto funciona porque os pinos digitais do Arduino têm histerese (Schmitt-Trigger).

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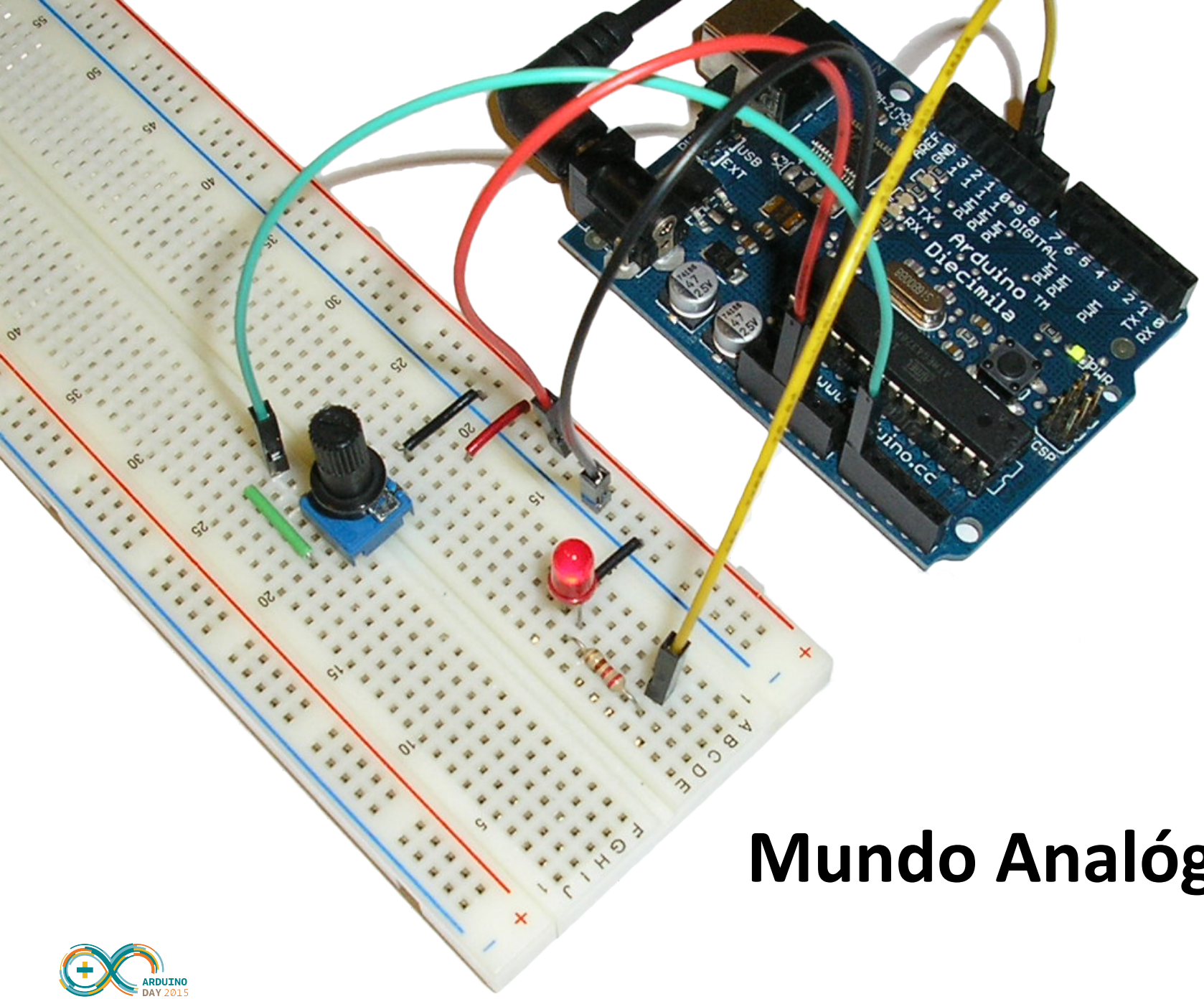

Mundo Analógico

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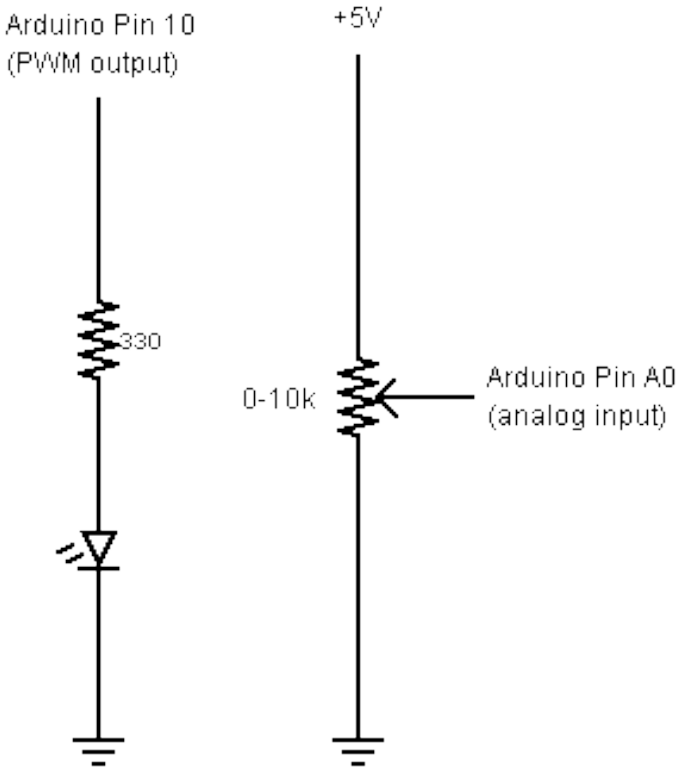
Input Analógico e Output PWM*




```
// Controlar o brilho de um LED com um potenciómetro...


static const char led_pin = 10;
static const char pot_pin = A0;


void setup() {
  pinMode(led_pin, OUTPUT);
}


void loop() {
  short pot_value = analogRead(pot_pin);
  short brightness = map(pot_value, 0, 1023, 0, 255);

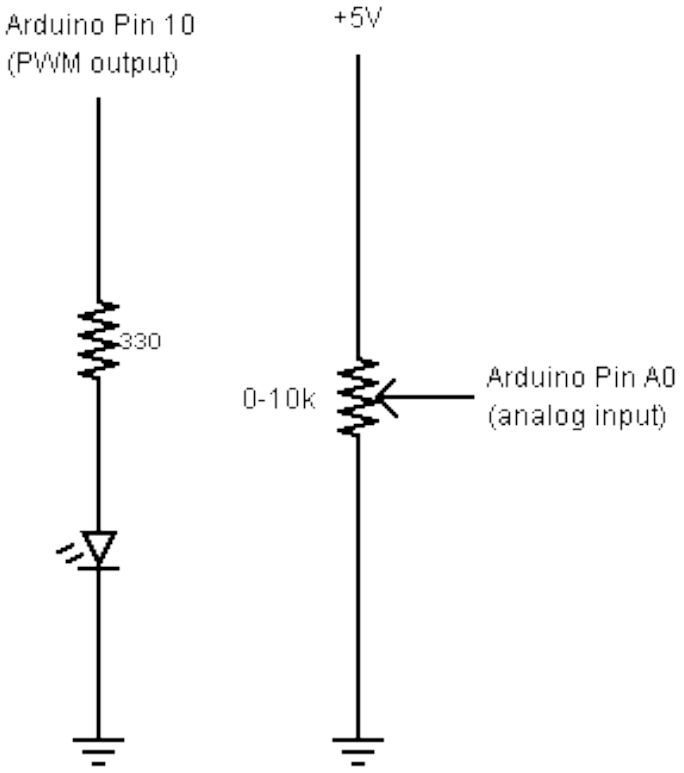
  analogWrite(led_pin, brightness);

  delay(10);
}
```

*Pulse-Width Modulation

Binário: 1734 bytes

Input Analógico e Output PWM*

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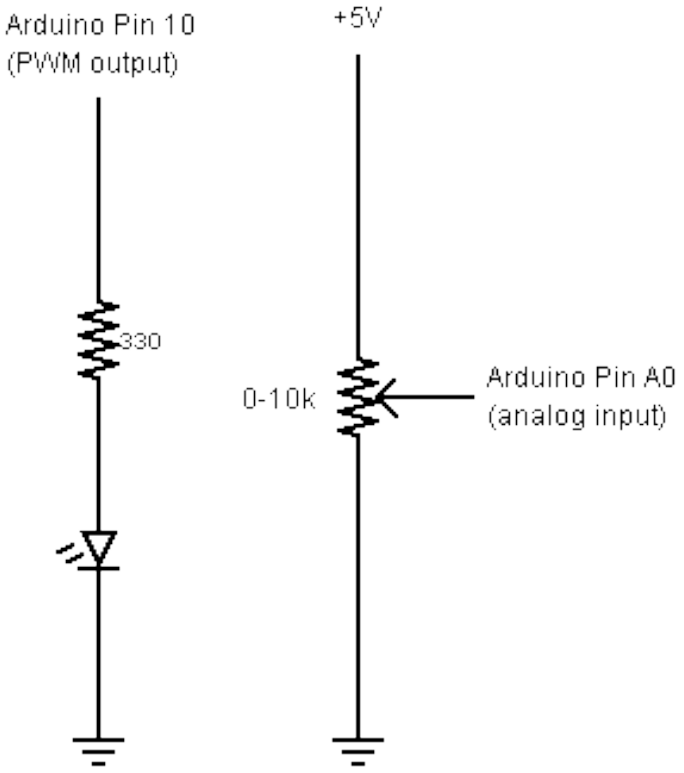
ARDUINO DAY 2015

Input Analógico e Output PWM*

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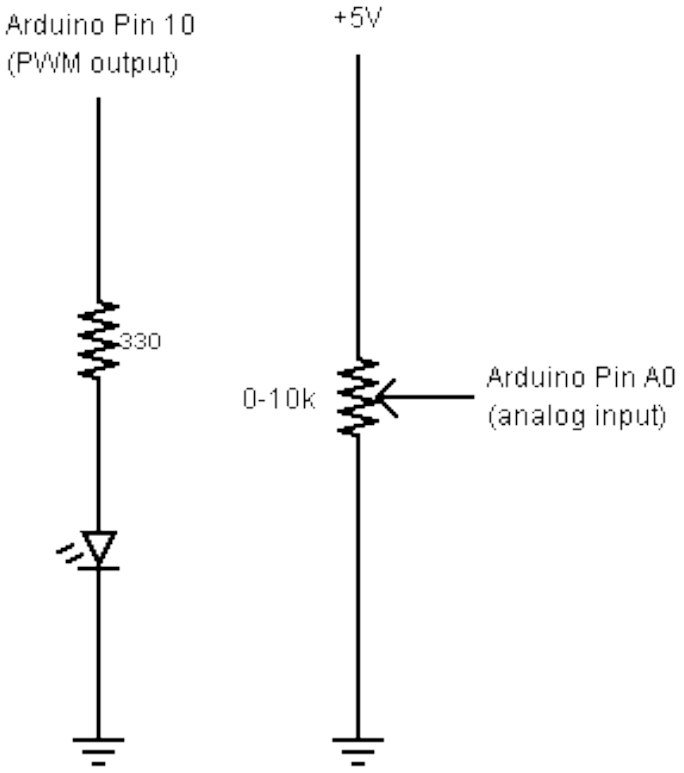
Input Analógico e Output PWM*

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*Pulse-Width Modulation

Binário: 1734 bytes

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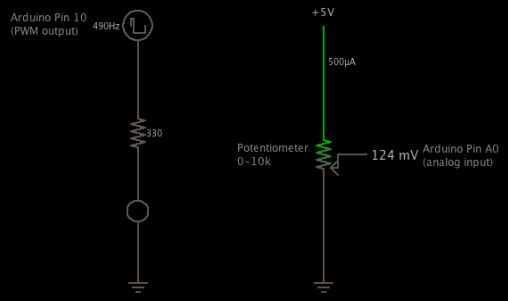
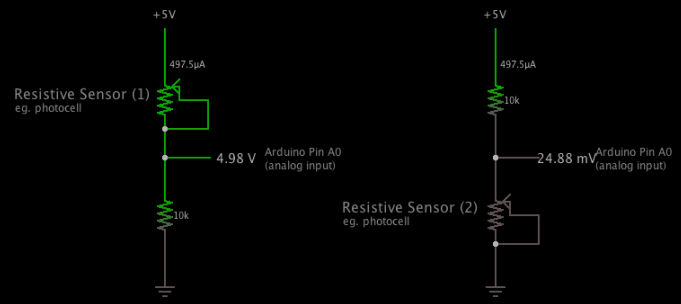
Simulação

Simple Analog Input and Output



Resistive Analog Input (Voltage Divider)



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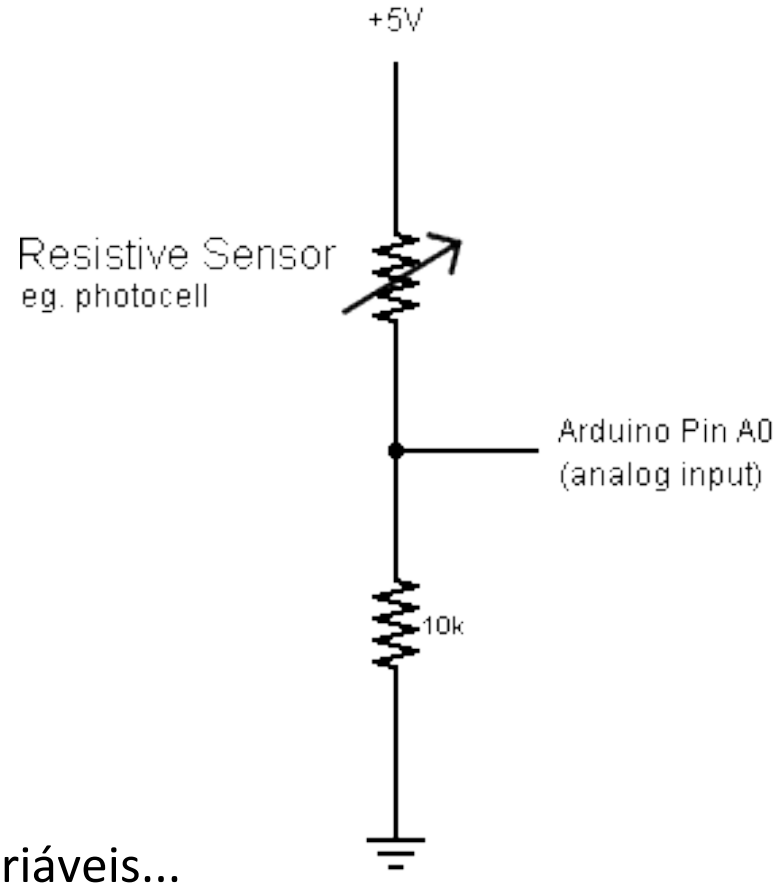
Input Analógico: Sensores Resistivos

Luz

Temperatura

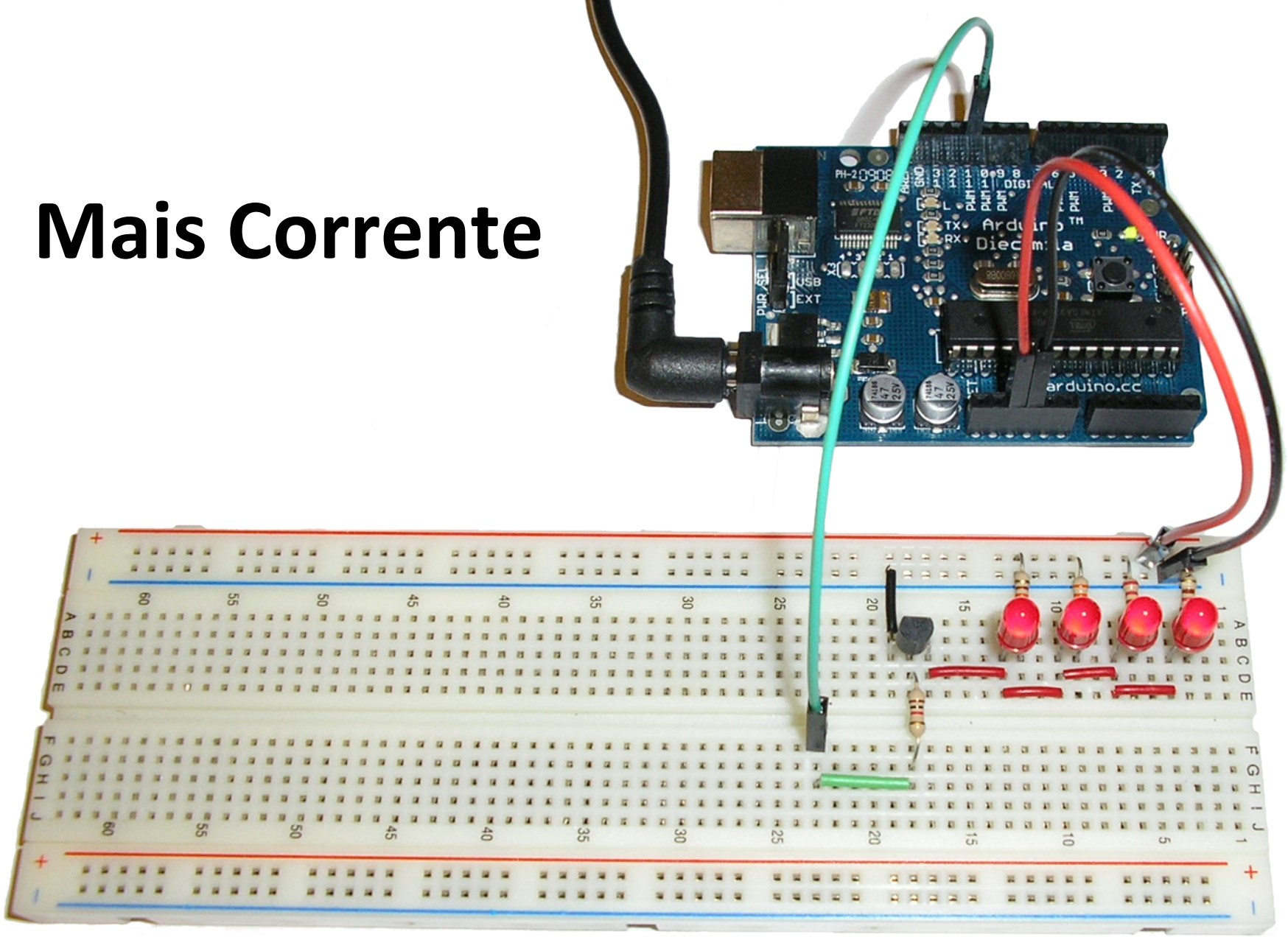
Força

Flexão

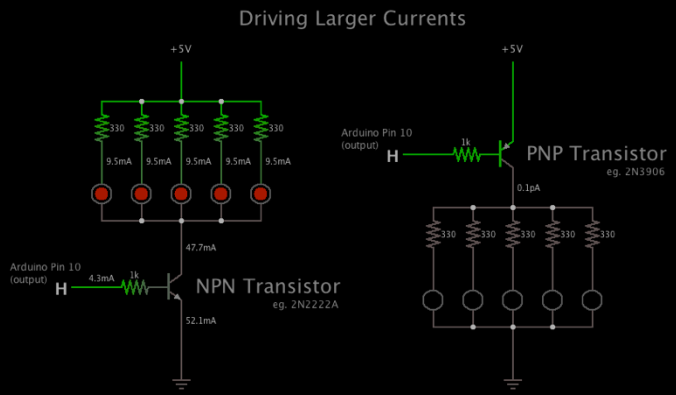


Muitos sensores são apenas resistências variáveis...

Mais Corrente



Simulação



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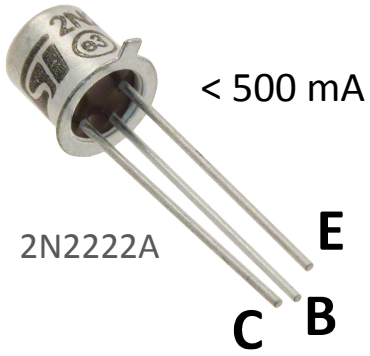
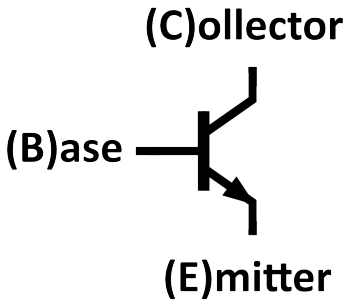
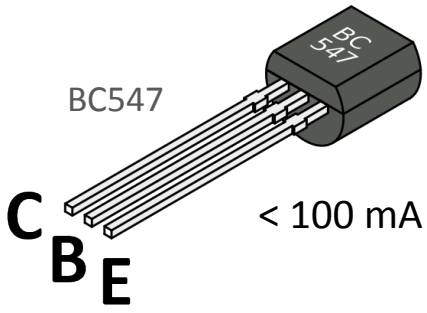
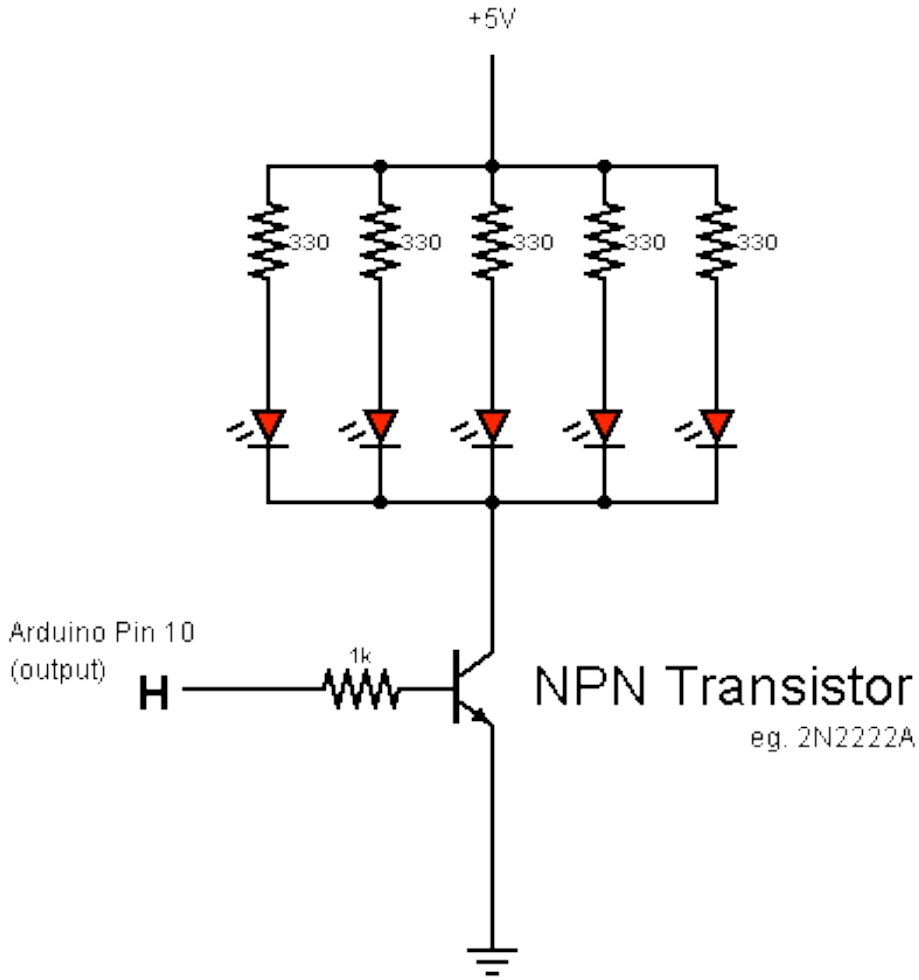
Controlar Mais Corrente: BJTs*









*Bipolar Junction Transistors (Transístores Bipolares)

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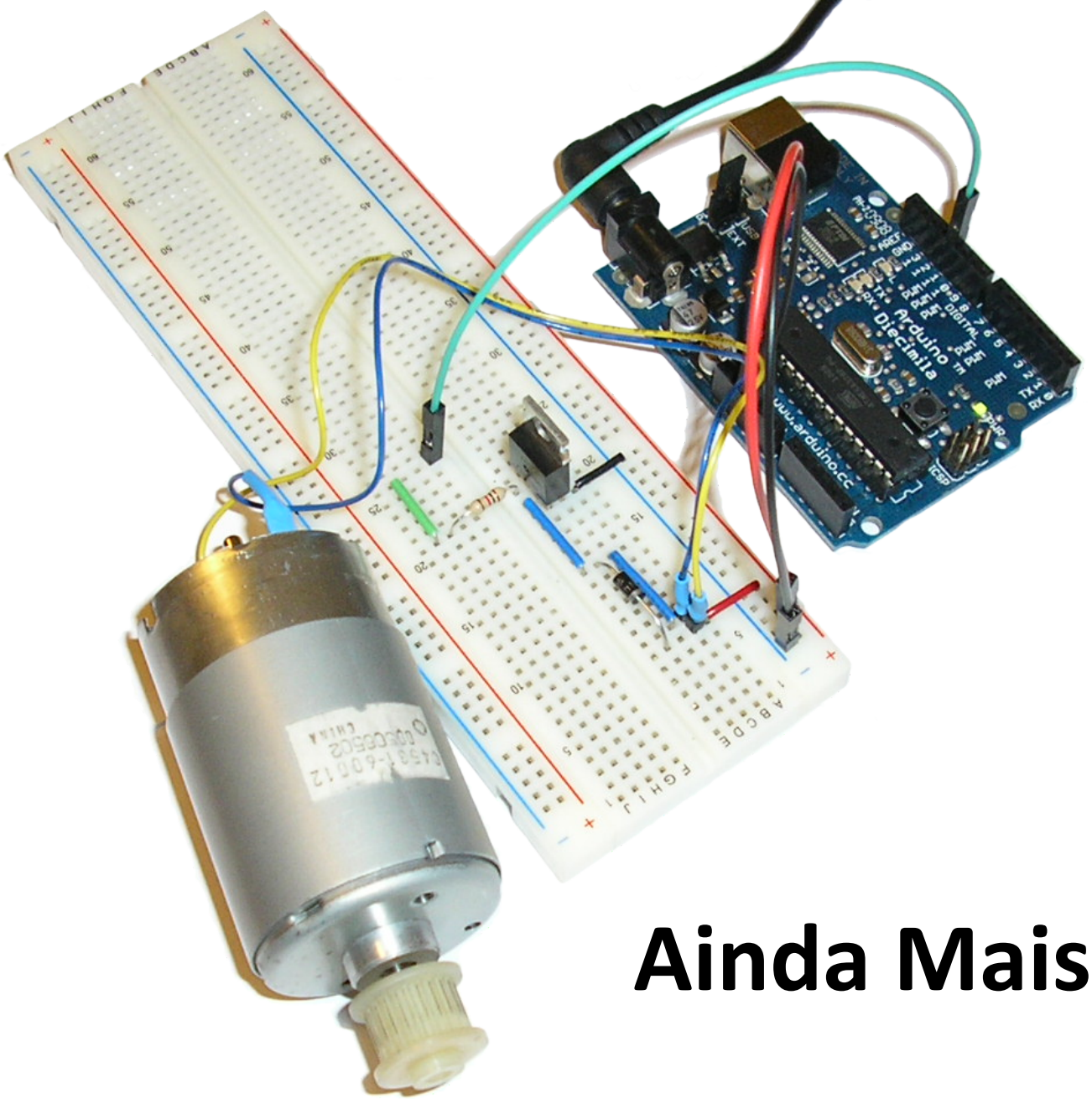

Ainda Mais Corrente

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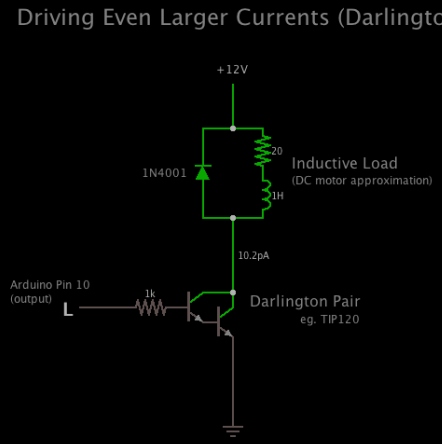
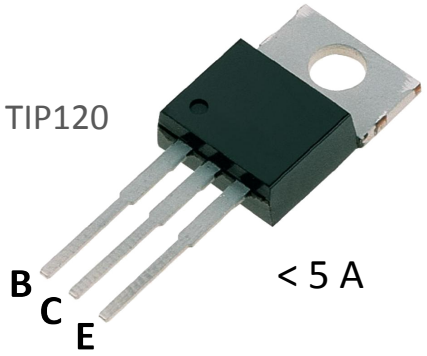
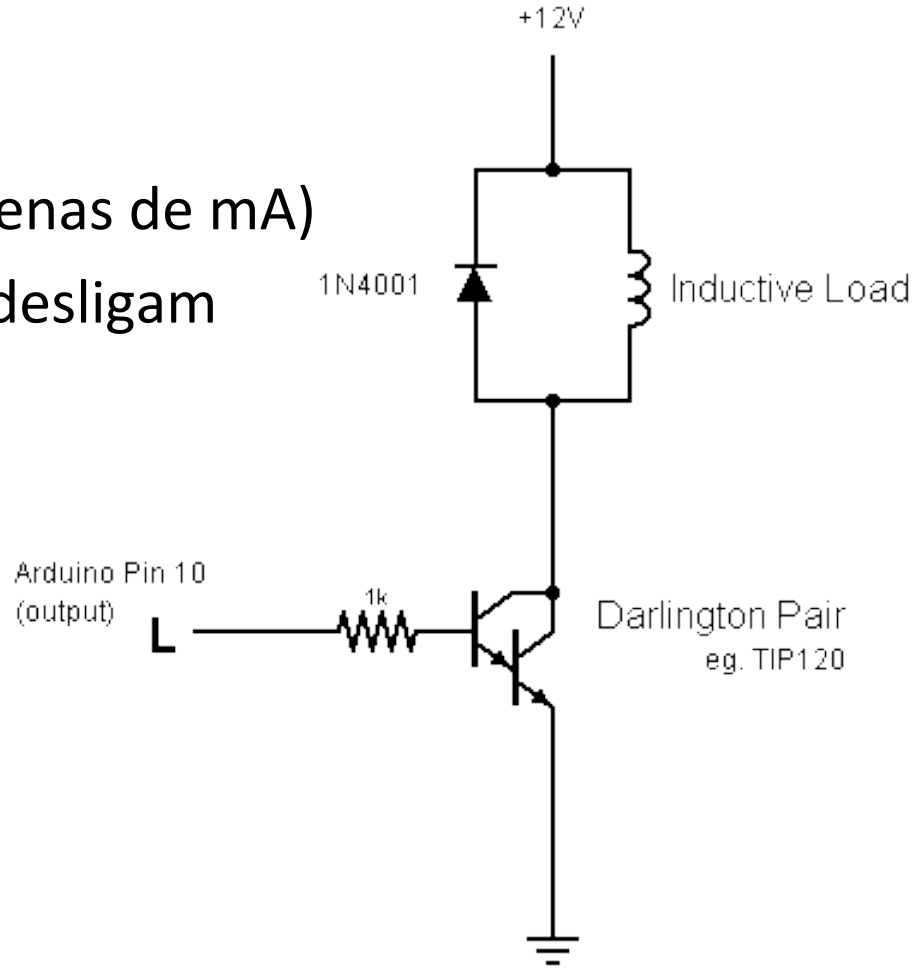
Simulação

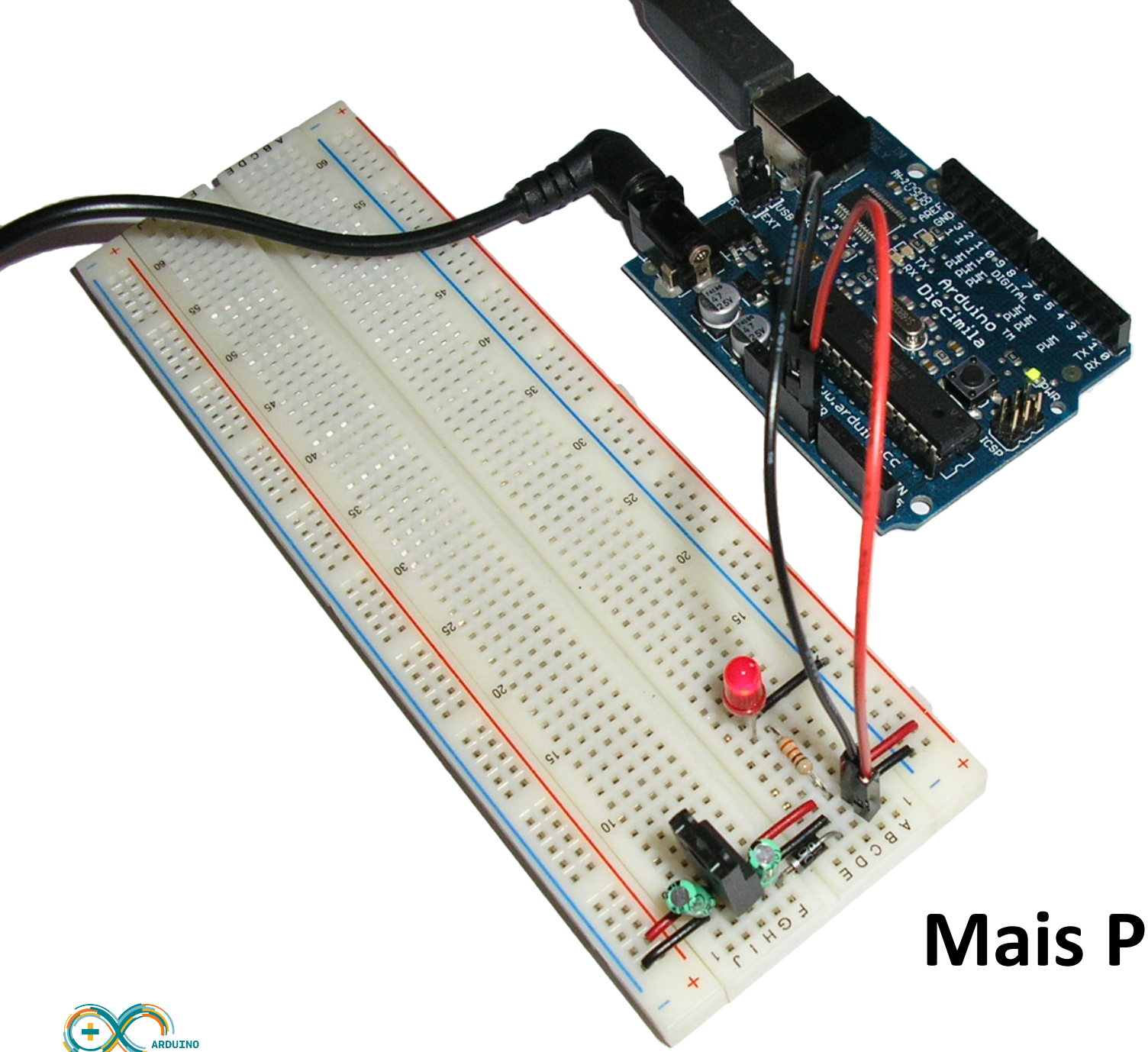


Cargas Indutivas

- Motores, solenóides, relés…
- Puxam muita corrente (centenas de mA)
- Causam “kickback” quando desligam







Mais Potência

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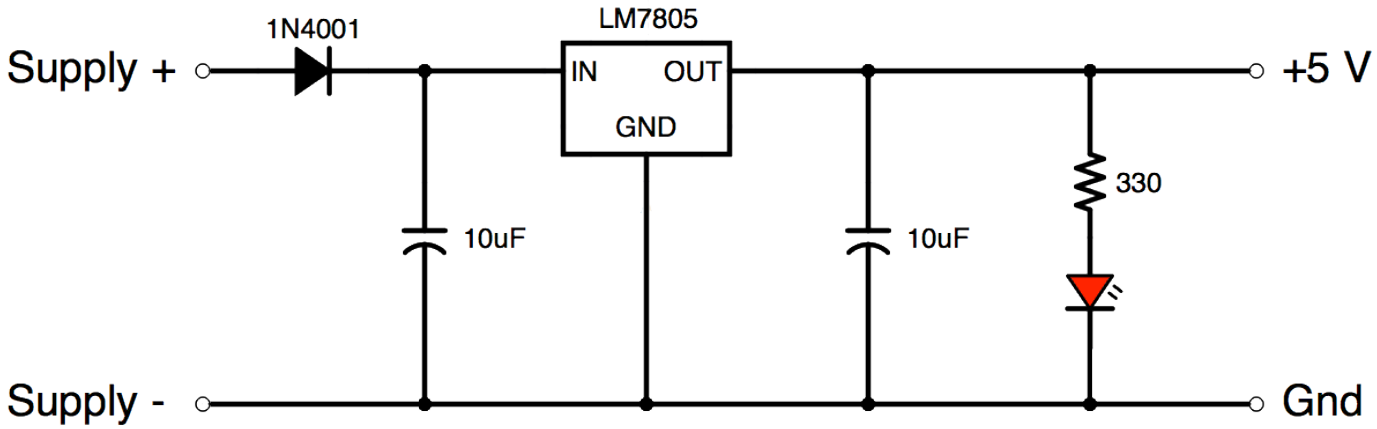
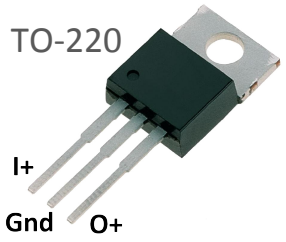
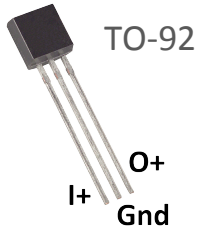
Alimentação Regulada







- 5 V (LM7805), 12 V (LM7812) e outras
- Voltagem de entrada até 35 V
- Máx. 100 mA (TO-92) ou **1 A** (TO-220)
- Condensadores **obrigatórios** para funcionar correctamente

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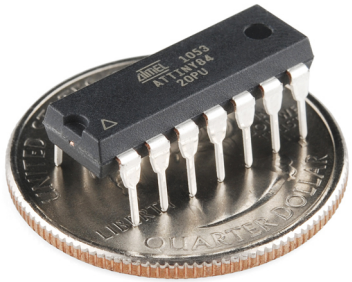
Microcontroladores Isolados

ATtiny85



ATtiny84

ATmega168
ATmega328p

Podem ser programados com o IDE do Arduino!

Precisam de um programador ISP, mas um Arduino a correr o *sketch* "ArduinoISP" é suficiente.

github.com/carlosefr/atmega – Configuração para microcontroladores ATmega sem componentes externos
highlowtech.org/?p=1695 – Configuração para microcontroladores ATtiny

Obrigado!

Questões?

PDF desta apresentação, simulações e código:
cloud.carlos-rodrigues.com/arduino-day/2015.zip

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