Arduino For Total Newbies
w/ TV-B-Gone as example project

Mitch Altman
Chief Scientist, **Cornfield Electronics**, San Francisco, CA
Inventor of **TV-B-Gone** universal remote controls
Co-founder of **3Ware** (successful Silicon Valley startup)
Pioneer of **VR** (in the mid-1980s)
Founding mentor at **HAX** (1st and biggest hardware accelerator)
Co-founder of **Noisebridge** (San Francisco hackerspace)

email: mitch@CornfieldElectronics.com
site: www.CornfieldElectronics.com
twitter: @maltman23
flickr: maltman23
WeChat: mitchaltman
Bring all of this home with you!

Stuff!

DO NOT open this bag yet!

U-Do-It-Duino kit

Parts Pack

USB-Serial cable
Syllabus

• Intro
• Everything You Need to Know About Electronics
• How to solder / make your own Arduino
• How to Set Up and Use the Arduino Software
• How to Hack Arduino Programs ("Sketches")
• How to Use Solderless Breadboards
• How to Read a Schematic
• Make a TV-B-Gone Remote Control with your Arduino Clone without soldering
Tools

(Don’t bring these home)
Tools

I have these Toolkits for sale
Intro
Everything You Need to Know About Electronics
Learn To Solder

SOLDERING IS EASY
HERE'S HOW TO DO IT

BY: MITCH ALTMAN
(SOLDERING WISDOM)

ANDIE NORDGREN
(COMICS ADAPTATION)

JEFF KEYZER
(LAYOUT AND EDITING)

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SOLDER C'EST FACILE
VOICI COMMENT FAIRE

DE: MITCH ALTMAN
(MAÎTRE SOUDEUR)

ANDIE NORDGREN
(ADAPTATION BD)

JEFF KEYZER
(ÉDITION, MISE EN PAGE)

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ET PARTAGEZ LA AVEC VOS AMIS !
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SOLDAR ES FÁCIL!
APRENDE CÓMO HACERLO

POR: MITCH ALTMAN
(SABIDURÍA EN SOLDADO)
ANDIE NORDGREN
(ADAPTACIÓN A COMIC)
JEFF KEYZER
(DISEÑO Y EDICIÓN)

DISTRIBUYE AMPLIAMENTE!

Download in the language of your choice for free at:
http://mightyohm.com/soldercomic
Solder Your Arduino Clone
How to Set Up and Use the Arduino Software

```cpp
void setup() {
  // put your setup code here, to run once:
}

void loop() {
  // put your main code here, to run repeatedly:
}
```
How to Hack Arduino Programs ("Sketches")

```cpp
// Blink

// Turns an LED on for one second, then off for one second, repeatedly.

Most Arduinos have an on-board LED you can control. On the UNO, MEGA and ZERO it is attached to digital pin 13, on MKR1000 on pin 6. LED_BUILTIN is set to the correct LED pin independent of which board is used.

If you want to know what pin the on-board LED is connected to on your Arduino model, check the Technical Specs of your board at:

https://www.arduino.cc/en/Main/Products

modified 8 May 2014
by Scott Fitzgerald
modified 2 Sep 2016
by Arturo Guadalupi
modified 8 Sep 2016
by Colby Newman

This example code is in the public domain.

https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink

// the setup function runs once when you press reset or power the board

void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever

void loop() {
  digitalWrite(LED_BUILTIN, HIGH);  // turn the LED on (HIGH is the voltage level)
  delay(1000); // wait for a second
  digitalWrite(LED_BUILTIN, LOW);   // turn the LED off by making the voltage LOW
  delay(1000); // wait for a second
}
```
How to Use Solderless Breadboards

Solderless Breadboard
How to Use Solderless Breadboards

Solderless Breadboard with LED and wires

- Short lead
- Long lead

- To D13 on Arduino
- To GND on Arduino
How to Read a Schematic

Arduino For Total Newbies

Mitch Altman (original TV-B-Gone hardware and firmware, modified TV-B-Gone Arduino design)
Limor Fried (firmware modifications, kit design)
Ken Shiriff (original modifications for Arduino)
Johannes Schneemann (documentation)

4.5V
red wire
power switch
battery pack with switch
(3 AA batteries)

4.5V
red wire
IR LED
10
2N3904

5V / Vcc
D3
(RED)
1K
D2
(PUR)
D5
(YEL)

visible LED
on Arduino board

Na / eu
select

EU: use 1K
NA: no resistor

activator switch

Arduino

Black wire

TO-92 package
2N3904

10 Ohm
brown
black
gold
brown
black
brown

47 Ohm
yellow
violet
black
gold
brown

Use either one of these two terminals for one side of the switch
Use either one of these two terminals for the other side of the switch
Make a TV-B-Gone Remote Control with your Arduino Clone without soldering

Solderless Breadboard with parts & wires for TV-B-Gone

- Short lead
- Long lead

- Vcc
  - To Vcc on Arduino

- D3
  - To D3 on Arduino

- D2
  - To D2 on Arduino

- GND
  - To GND on Arduino
Questions?
Intro
Intro

Arduino For Total Newbies Workshop at 30C3, Hamburg Germany
Intro to Arduino
Intro to Arduino: microcontrollers

A complete computer on a chip
Intro to Arduino: microcontrollers

A complete computer on a chip:
they control parts connected to their pins
Intro to Arduino: microcontrollers
Intro to Arduino: microcontrollers

-- one of Mitch’s projects --

ArduTouch
music
synthesizer
kit
Intro to Arduino: microcontrollers
Intro to Arduino: microcontrollers
Intro to Arduino: microcontrollers
Intro to Arduino:
microcontrollers
Intro to Arduino:
microcontrollers
-- one of Mitch’s projects --

TV-B-Gone
Intro to Arduino: microcontrollers
-- one of Mitch’s projects --

TV-B-Gone
Just a remote control, but only one button: OFF!
Intro to Arduino: microcontrollers
-- one of Mitch’s projects --

TV-B-Gone
Intro to Arduino: microcontrollers

A complete computer on a chip: they control parts connected to their pins
Intro to Arduino: microcontrollers

But,

How do you connect parts to its pins?

A complete computer on a chip:
they control parts connected to their pins

How do you create and upload a program to control the parts?
Intro to Arduino: microcontrollers

A complete computer on a chip: they control parts connected to their pins

How do you connect parts to its pins?

How do you create and upload a program to control the parts?

Answer: Be a geek, and learn how!
Intro to Arduino

Use an Arduino board
Intro to Arduino

Use an Arduino board

Super easy to connect parts to its microcontroller’s pins
Intro to Arduino

Super easy to connect parts to its microcontroller’s pins

Super easy to create and upload a program to control the parts

Use an Arduino board
Intro to Arduino

Arduino board

Designed for non-geeky artists
Intro to Arduino

Many Arduino boards to choose from
Intro to Arduino

Basic Boards  Enhanced Boards  IOT Boards

Open Source
Intro to Arduino

Open Source
Intro to Arduino

Arduino "Clones"
Intro to Arduino

hundreds of thousands of projects online!
Intro to Arduino

“Arduino-Compatible”

ArduTouch music synthesizer kit
Intro
Intro

Questions?
Everything You Need to Know About Electronics
Everything You Need to Know About Electronics

Electrons
Everything You Need to Know About Electronics

Circuit = Electrons going in complete circle = Magic!
Everything You Need to Know About Electronics

Power Supplies
Everything You Need to Know About Electronics

Voltage / Volts
Everything You Need to Know About Electronics

Speed of electrons is Current measured in Amps

Electrons pushed with 1.5V. So, they move!

Current / Amps
Everything You Need to Know About Electronics

Speed of electrons is Current measured in Amps

- 3 times more Volts
- 3 times more push
- 3 times faster electrons
- 3 times more current / Amps

Current / Amps
Everything You Need to Know About Electronics

Too much energy?

Lots of energy!

Current / Amps
Everything You Need to Know About Electronics

Speed of electrons is Current measured in Amps

Resistance in the electrons’ path slows them down, which means less current (less Amps).

Resistance / Ohms
Everything You Need to Know About Electronics

Resistance / Ohms

Same Circuit!
Everything You Need to Know About Electronics

Resistance / Ohms

Same Circuit!
Everything You Need to Know About Electronics

Same Circuit!

Resistance / Ohms

4.5V
Resistance / Ohms
Ohm’s Law

Volts -- *force* pushing electrons

Amps -- *speed* of electrons

Ohms -- *Resistance* to flow of electrons
Everything You Need to Know About Electronics

Ohm’s Law

Volts -- **force** pushing electrons

Amps -- **speed** of electrons

Ohms -- **Resistance** to flow of electrons

\[ \text{Volts} = \text{Amps} \times \text{R (Ohms)} \]
Everything You Need to Know About Electronics

**Ohm’s Law**

Volts -- *force* pushing electrons

Amps -- *speed* of electrons

Ohms -- *Resistance* to flow of electrons

\[ V = I \times R \]

Also commonly written: \[ E = I \times R \] (Ohms)
Everything You Need to Know About Electronics

The symbol for Resistance: \( \Omega \)

Resistor / Ohms
What You Need to Know About Electronics

10KΩ: Brown, Black, Orange

Resistor / Ohms
Everything You Need to Know About Electronics

Power Supply – it matters how you connect it!

What happens?

Polarity

Power Supply – it matters how you connect it!
Everything You Need to Know About Electronics

Power Supply – it matters how you connect it!

Black Wire = “−”

Red Wire = “+”

4.5V
Everything You Need to Know About Electronics

Red wire:
- Power,
- Plus, Positive,
- 4.5V, Vcc

Black wire:
- Minus, Negative,
- 0V, Ground (GND)

Power Supply – it matters how you connect it!
Resistors – it doesn’t matter which way

(electrons slowed down the same either way)
Minus / Negative side

Diodes – One-Way valve for electrons

Diodes – it matters which way!
Short wire is Minus / Negative

Special kind of Diode – it Emits Light!

LED – it matters which way!
Lots of different colored LEDs! (including IR)
Everything You Need to Know About Electronics

More current ➔ More brightness! (until...)

LED
More current $\rightarrow$ More brightness! (until...)
This is why we put a resistor in line with an LED (with a resistor so no magic smoke goes away)
This is why we put a resistor in line with an LED.

(the resistor can go on either side)
Everything You Need to Know About Electronics

Series = in line

Parallel = across
Everything You Need to Know About Electronics

Let’s make this light up!

LED
(add a power supply)

Let’s make this light up!

LED
Let’s make this light up!

LED
Everything You Need to Know About Electronics

Let's make this light up!

LED

Black wire: “−” (ground)

Red wire: “+” power
Everything You Need to Know About Electronics

Let's make this light up!

Black wire: “-” (ground)

Red wire: “+” power

short lead: “-”

long lead: “+”

LED
Let's make this light up!

Red wire: “+” (power)

Black wire: “-” (ground)

Short lead: “-”

Long lead: “+”

LED
Everything You Need to Know About Electronics

Let's make this light up!

Red wire: “+” (power)

Black wire: “-” (ground)

short lead: “-”

long lead: “+”

LED
It lights!

Red wire: “+” (power)

Black wire: “-” (ground)

On

long lead: “+”

short lead: “-”

LED
It’s off

LED
Everything You Need to Know About Electronics

LED & battery

Our first circuit
Everything You Need to Know About Electronics
Everything You Need to Know About Electronics
Everything You Need to Know About Electronics

IR LED
Everything You Need to Know About Electronics

IR LED
A “code” is IR light blinking on-off-on-off-on-off...

IR Remote Control
A “code” is IR light blinking on-off-on-off...

(we can’t do this, but microcontrollers can!)

IR Remote Control
Everything You Need to Know About Electronics

About 150 IR "OFF" codes (one per blink)

TV-B-Gone universal remote control
Little buckets for electrons

(either way is fine for small ones)

Short wire is Minus / Negative

Capacitor / Farads
Everything You Need to Know About Electronics

Little buckets for electrons

Capacitor / Farads

Short wire is Minus / Negative

(either way is fine for small ones)
Strips of metal connected together – or not

Switch
A complete computer on a chip

Microcontroller
It runs programs that control electronic parts connected to its pins.

Microcontroller
A complete computer on a chip

Microcontroller – it matters how you hook it up!
Everything You Need to Know About Electronics

A complete computer – running a program!

Microcontroller – turned on!
Your program controls electronics parts on these other pins.

- All other pins are **Input pins** or **Output pins**.

Microcontroller
Everything You Need to Know About Electronics

Analog Electronics:
Any voltage between Ground (0V) and Vcc

Digital Electronics:
Only 2 choices: Ground (0V) or Vcc

2 types of electronics
Everything You Need to Know About Electronics

Digital Electronics

<table>
<thead>
<tr>
<th>Ground (0V)</th>
<th>Power / Vcc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

(without Voltage / with Voltage)
(without current / with current)

Digital Electronics:
Only 2 choices: Ground (0V) or Vcc
To make a pin an *Output pin*, you tell it to become an Output pin with a statement in your program.

Let’s tell pin 13 to be an Output pin.

Microcontroller – Output pins
Only 2 choices: High or Low

Microcontroller – Output pins

- **Low**
  - Off (0V)

- **High**
  - On (Power supply voltage)
  - -- like the Red wire of our power supply
  - -- but controlled by our program!
A real world example

How to make an LED blink?

Hello World

Microcontroller
Hello World

Software
Type: Hello World
on your screen

Microcontrollers
make an LED blink

Hello World

Microcontroller
Turning an LED on and off

Without a microcontroller we can blink with our power supply

Turning an LED on and off

(Leading up to Hello World)
Everything You Need to Know About Electronics

Let’s replace the power supply

Turning an LED on and off

(Leading up to Hello World)
Turning an LED on and off

(Leading up to Hello World)
We can use an Output pin (and Ground) as our power supply.

Turning an LED on and off

(Leading up to Hello World)
Turning an LED on and off

Pin 13 is our Output pin (which can be On or Off)

Turning an LED on and off

(Leading up to Hello World)
Turning an LED on and off

(Leading up to Hello World)
What You Need to Know About Electronics

Turning an LED on and off

“Ground”

“+”

Output pin is High / On

Turning an LED on and off

(Leading up to Hello World)
What You Need to Know About Electronics

Turning an LED on and off

(Leading up to Hello World)
This is our **Hardware** for **Hello World**!

Turning an LED on and off

Hello World
Everything You Need to Know About Electronics

How about our program?

Turning an LED on and off

Hello World
Turning an LED on and off

Programs on microcontrollers are called “Firmware”

Hello World
What You Need to Know About Electronics

Programs on microcontrollers are called "Firmware"

A program for Arduino is called a "Sketch"

Turning an LED on and off

Hello World
Hello World

Everything You Need to Know About Electronics

Pin 13: Make it an Output pin

Hello World -- Firmware

Microcontroller
It lights up!!

**Pin 13:** Set it to High

Hello World -- Firmware

Microcontroller
Hello World -- Firmware

Pin 13: Set it to Low

Microcontroller

Everything You Need to Know About Electronics

(off)
Everything You Need to Know About Electronics

We now have

Hello World!

Microcontroller
Everything You Need to Know About Electronics

We now have Hello World!

Microcontroller

Except

We won’t see it 😞
We need a delay

Microcontrollers – they go really fast!
Hello World – for real now!

Microcontroller – Firmware

- pin 13 is Output pin
- set pin 13 High
- delay
- set pin 13 Low
Hello World – for real now!

What You Need to Know About Electronics

Hardware

Firmware

• pin 13 is Output pin
• set pin 13 High
• delay
• set pin 13 Low
• delay

Microcontroller – Firmware
A precision cut piece of quartz crystal

For precise timing

Crystal / Hertz
Frequency, measured in Hertz.

For precise timing (but less than a crystal).

Crystal / Hertz
A bunch of resistors and capacitors

For precise timing (but less than a crystal)

Ceramic Resonator / Hertz
Everything You Need to Know About Electronics

**Hardware**

- [Image of hardware setup]

**Firmware**

- pin 13 is Output pin
- set pin 13 High
- delay
- set pin 13 Low

---

Let’s hack **Hello World**!
Add an IR LED to another pin

IR “OFF” codes

Microcontroller
Add an IR LED to another pin (say, pin3)

IR “OFF” codes

Microcontroller
Add an IR LED to another pin (say, pin3) and a resistor so no magic smoke goes away.

IR “OFF” codes

Microcontroller
Everything You Need to Know About Electronics

But, *When*?

IR "OFF" codes

Microcontroller
Let’s add an Input pin!

and

We can add a Start button

Microcontroller
How do we make a pin an Input pin?

We tell it to be one – with our program.

*Any pin can be an Input pin (like, pin 2).*
Once we have an **Input pin** (like, pin 2):

only 2 choices – is the Input pin: **High** or **Low**?
To make the Input pin **Low**, connect it to the Black wire of our power supply (Ground).

Microcontroller – Input pins

**Low**
To make the Input pin High, connect it to the Red wire of our power supply (Vcc).

High

Microcontroller – Input pins
FYI: Wire color does not matter! (electrons don’t care)
To make the Input pin High, connect it to the Red wire of our power supply (Vcc).

OR:

just leave it blank
(built-in resistors on each pin)
Everything You Need to Know About Electronics

Microcontroller – Input pins

Reading the Input pin

If firmware looks at Pin 2 when it’s like this, it reports back:

Low

If firmware looks at Pin 2 when it’s like this, it reports back:

High

Microcontroller – Input pins
Everything You Need to Know About Electronics

Reading the Input pin, with Switch

Microcontroller – Input pins
Reading the Input pin, with Switch

If firmware looks at Pin 2 when switch NOT pushed, it reports back: **High**
If firmware looks at Pin 2 when switch pushed, it reports back: **Low**

**Reading the Input pin, with Switch**

**Microcontroller – Input pins**
If firmware looks at Pin 2 when switch NOT pushed, it reports back: **High**

Reading the Input pin, with Switch

**Microcontroller – Input pins**
Everything You Need to Know About Electronics

**Hardware**

![Image of hardware components]

**Firmware**

- Pin 13 Output – visible LED pin
- Pin 3 Output – IR LED pin
- Pin 2 Input – Push Button

- Wait for Switch to be Low

- Blink visible LED: High, Delay, Low

- Pulse IR LED for Sony “OFF” code: High, Delay, Low, Delay...

- Blink visible LED: High, Delay, Low

- Pulse IR LED for Panasonic “OFF” code: High, Delay, Low, Delay...

- Etc for all “OFF” codes

---

TV-B-Gone remote control

Microcontroller
Everything You Need to Know About Electronics

**Hardware**

**Firmware**

- Pin 13 Output – visible LED pin
- Pin 3 Output – IR LED pin
- Pin 2 Input – Push Button

- Wait for Switch to be Low

- Blink visible LED:
  - High, Delay, Low

- Pulse IR LED for Sony “OFF” code:
  - High, Delay, Low, Delay...

- Blink visible LED:
  - High, Delay, Low

- Pulse IR LED for Panasonic “OFF” code:
  - High, Delay, Low, Delay...

- Etc for all “OFF” codes

**TV-B-Gone remote control**

**Microcontroller**
More current → More brightness! (until...)
Output pin – only 2 choices:

- **Low**
- **High**
- **Off**
- **On**

((0V) (Power supply voltage -- controlled by our Firmware!))

Output pins *only* allow limited current

(built-in resistors on each pin)

Microcontroller – Output pins
Output pin – only 2 choices:

- **Low** (Off, 0V)
- **High** (On)

(Power supply voltage -- controlled by our Firmware!)

So, the IR LED can only light up dimly from the Output pin.

Output pin – only limited current

Microcontroller – Output pins
So,

let’s amplify
the current
from the Output pin

with

a

Current amplifier!
Everything You Need to Know About Electronics

Current at Output lead is the same as for the Input lead but MUCH BIGGER!

Transistor

Ground
Input
Output

Current amplifier
TV-B-Gone remote control – we’re done!
And, that is
And, that is

*Everything You Need to Know About*

*Electronics*
Questions?
SOLDERING IS EASY
HERE'S HOW TO DO IT

BY: MITCH ALTMAN
(SOLDERING WISDOM)

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Learn To Solder

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http://mightyohm.com/soldercomic
Parts to use

10 pins
8 pins
8 pins
6 pins
Unused parts

- 100 Ω Resistor (R1)
- 1kΩ Resistor (R2)
Our first part to solder: C1

Either one of these
C1: Look down at the shape of this part
Some parts, such as resistors, need their leads bent first.

If necessary, bend leads before inserting the part into the board.

Wires coming out from parts are called “leads” – they lead to the part.
This is how a resistor look *before* inserting it into the board
C1: No need to bend leads first
Insert leads into pads

the circles with holes in them are called "pads"

there is one "pad" per lead for each part
C1: leads inserted into their pads
C1: board upside down

Bend leads half way out (only half way) like a “V” so that the part won’t fall out while soldering it
How to hold a soldering iron

(Like a pencil – held from underneath)
The perfect kind of solder for electronics:

60/40 rosin core, 0.031” (0.7mm) diameter (or smaller)

Important:
Use solder WITH lead (Pb)!!
lead-free solder has very poisonous fumes!
3 Safety Tips...
Safety Tip #1:

Hot !!

(When you touch the tip, you will let go quickly -- every time!)
Safety Tip #2:

Lead (Pb) is toxic
But it easily washes off your hands with soap and water
Safety Tip #3:

(coming soon)
2 secrets to good soldering...
Secret #1: Clean the tip! (before every solder connection)
Bang (lightly) 3 times, Swipe, Rotate, Swipe (on the sponge):
Keep the tip shiny silver!
Lay clean tip across half of the pad, touching the pad and lead for 1 second.
Push solder in, over the pad, and under the tip

Make sure solder melts on the **underside** of the soldering iron tip (not the side or top of the soldering iron tip)!

Do this quickly (slowly doesn’t work well) – solder in & out in about 1 second
Do this quickly (slowly doesn’t work well) – solder in & out in about 1 second

Push in about 1 mm of solder

Make sure solder melts on the **underside** of the soldering iron tip (not the side or top of the soldering iron tip)!
Pull solder away, 

**But** keep holding soldering iron down for 1 more second
Secret #2:

Keep hot tip down for 1 second for solder to flow!!
Now

Lift soldering iron
If you can see any of the pad, or the hole, you need more solder – so, just do all the steps again to make it perfect.
The Rhythm!
and speed (about 1 second per step)
The Rhythm!
and speed (about 1 second per step)

Clean the tip
Tip Down

The Rhythm!
and speed (about 1 second per step)
The Rhythm!
and speed (about 1 second per step)

Solder In
The Rhythm!
and speed (about 1 second per step)

Solder Out
The Rhythm!
and speed (about 1 second per step)

WAIT!
The Rhythm!
and speed (about 1 second per step)

Lift Tip
The Rhythm!
and speed (about 1 second per step)
The Rhythm!
and speed (about 1 second per step)
Clean the tip
The Rhythm!
and speed (about 1 second per step)

Tip Down
The Rhythm!
and speed (about 1 second per step)

Solder In
The Rhythm!
and speed (about 1 second per step)

Solder Out
The Rhythm!
and speed (about 1 second per step)

WAIT!
The Rhythm!

and speed (about 1 second per step)

Lift Tip
Solder all of the leads of the part to the board

For this part, there are two leads
Here you can see two good solder connections
Now cut the leads short

Hold the lead while cutting it all the way down to the little bump of solder

Cutting with the tip of the wire cutter gives you more control
Safety Tip #3:

Hold or cover the lead!

(or it will fly into your eye!)

(They like doing that – so please hold or cover the lead when you cut.)
No wires sticking out

All done!
C1: All done!

No wires sticking out
One part at a time
Till all the parts are soldered
And it will look like this when you’re done.
Then test with battery pack,

Turn it on,

And it works!

(Or you start debugging.)
Let’s start!
Bend pins down on two opposite corners

- Solder all 28 pins.
- Only need to clean the tip after it gets dirty.
- No need to cut the pins short after soldering.
Solder on top of board if it falls out upside down
Headers
Headers
Headers
Use both thumbs to push chip into socket
We’re done!
First test:

Connect power with a battery pack...
First test:

... and it blinks!
Now we can connect parts to our Arduino, and program it!
USB-Serial Cable
USB-Serial Cable Driver

You may need to download and install a driver for your Operating System (Windows, MacOS, or Linux):

Helpful info on the Arduino for (4) Total Newbies workshop web-page:

Take control

At Cornfield Electronics we create devices that give people opportunities for effective choices in their lives. Each of us can decide whether to watch TV monitors, and when to watch. Each of us can decide when to get the rest we want, and how we dream. Everyone can learn to make cool things with our kits. Please explore our products, make your own choices, and see how your life can be enhanced.

Join our mailing list

Love it or hate it, TV screens are all around us. TV-R-Gone® universal remote control is the first fruit of our technical savvy, embodying our belief in empowerment, and sense of humor. This universal remote control fits in your pocket and allows you to discreetly turn TVs off whenever you go. TV-R-Gone fans around the world are using it for a variety of practical, philosophical, and humorous purposes. Imagine the possibilities...

Years in the making NeuroDreamer sleep mask is another of our personal empowerment inventions. We all need rest, but we don’t always get it in our busy lives. NeuroDreamer sleep mask kits use your own brainwaves to bring you the rest you need. And with the lucid dreaming model, you can take control of your dreams.

Want to learn electronics? We make way cool, fun, intriguing, educational kits that anyone can make! Our most POPULAR kits are: Auditory Music, Synthesizer kit, and TV-R-Gone kit.

We make truly useful technological solutions that put you in charge.

Welcome to our better world!

NOTE: As of 14-Feb-2023 Cornfield Electronics is a sole proprietorship of Mitch Atman.
DO-IT-YOURSELF PROJECTS
by Mitch Altman, and friends.
Last modified: 5-Oct-2022

You Can Make Cool Things With Electronics!
The projects on this page were all created for total beginners, with no experience, so everyone can complete them successfully at my workshops, or at home, or anywhere!

All you need is:
a desire, a handful of parts, a soldering iron (with stand and sponge), a wire-cutter, a wire-stripper, solder, and an afternoon.

Here is a really nice tutorial on how to solder -- for total beginners!
Soldering Tutorial for total beginners

Open Hardware!
Everything on this page (and everything I do) is free and open source!
(That's free as in freedom.)
(But everything here is free to download -- and that is free as in beer.)
If you have any questions on anything, please feel free to email me:
mitch AT CornfieldElectronics DOT com

Soldering is fun! And it is easy! Really, it is!
I have taught tens of thousands of people around the world how to solder. Everyone can do it! All ages, all skill levels.
People who have never even sewn a button can easily learn to solder. Even you!
Once you learn how to make one good solder connection, you can make anything on this page. And if you can make anything on this page, you can learn to make anything with electronics and microcontrollers.
Project: Make your own open source TV-B-Gone Kit (developed with Ledayoda)

The TV-B-Gone Kit was originally developed from a MinigoV3 hack (see below) (which, of course, I hacked from my original TV-B-Gone.)

For excellent assembly instructions, please go to the TV-B-Gone Kit page of the Adafruit.com website.

For questions about the TV-B-Gone Kit, please go to the TV-B-Gone Kit user forum.

To see the schematic, firmware, and board layout, please go to TV-B-Gone Kit downloads.

TV-B-Gone Kits are available for purchase from the TVB Gone.com website.

---

Project: Arduino For Total Newbies workshop
--- Learn Arduino, and make your own TV-B-Gone!

This workshop covers lots of ground -- all you need to learn how to play with Arduinos. As an example project, you can make your own TV-B-Gone using Arduino.

Many thanks to Ken Shiriff for the original TV-B-Gone for Arduino project!

For documentation on this workshop, please see the: Arduino For Total Newbies Workshop page.
Project: Make your own open source TV-B-Gone Kit (developed with Ladayada)

The TV-B-Gone Kit was originally developed from a MinPOV3 hack (see below) (which, of course, I hacked from my original TV-B-Gone.)

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Project: Arduino For Total Newbies workshop

--- Learn Arduino, and make your own TV-B-Gone!

This workshop covers lots of ground — all you need to learn how to play with Arduinos. As an example project, you can make your own TV-B-Gone using Arduino. Many thanks to Ken Shiff for the original TV-B-Gone for the Total Newbies project!

For more details on this workshop, please visit the:

Arduino For Total Newbies Workshop page.
Arduino For Total Newbies Workshop

last updated: 1-May-2023

Learn how to make your own way cool projects with Arduino, using TV-B-Gone as an example project to learn from.


Each time 10 to 50 people show up. (Folks seem to like it.)
Here is what is available for downloading for the Arduino For Total Newbies Workshop:

1) If you don't already have **Arduino software** you need to download it for your computer (Windows, Mac OS, or Linux):
   [Arduino download page](https://www.arduino.cc/en/main/software)

2) You need a **driver for your USB communications/programming cable**. Several different ones are available. Choose the driver for the cable you have and the operating system for your computer:
   - **Samurai Circuits board** (SiLabs CP210x USB-to-Serial TTL) drivers:
     [The latest drivers from SiLabs' website](https://www.silabs.com/resources/downloads/usb-drivers)
     The SiLabs driver is installed by default on most Linux systems.
   - **Adafruit FTDI Friend drivers**:
     [The latest drivers from FTDI's website](https://www.ftdichip.com/Drivers/D2XX.htm)
     The FTDI driver is installed by default on most Linux systems.
   - **FTDI Cable drivers**:
     [The latest drivers from FTDI's website](https://www.ftdichip.com/Drivers/D2XX.htm)
     The FTDI driver is installed by default on most Linux systems.

3) You also need the **TV-B-Gone Arduino Sketch** (download this, unzip it, and copy it to your computer in the "examples" folder inside your "arduino" folder that you downloaded):
   [TV-B-Gone Arduino sketch (22KB)](https://cornfieldelectronics.com/ftp/arduino/TVBgone_tvbg.zip)

4) **Schematic Diagram for Arduino TV-B-Gone remote control**:
   [Schematic Diagram (449KB)](https://cornfieldelectronics.com/ftp/arduino/TVBgone_tvbg_schematic.pdf)

Parts List for Arduino TV-B-Gone remote control:
- [Parts List (Open Office) (12KB)](https://cornfieldelectronics.com/ftp/arduino/TVBgone_tvbg_parts_openoffice.pdf)
- [Parts List (MS Office) (9KB)](https://cornfieldelectronics.com/ftp/arduino/TVBgone_tvbg_parts_msoffice.pdf)

Schematics for the U-Do-It-Duino Arduino clone kit:
- [U-Do-It-Duino schematic (110KB)](https://cornfieldelectronics.com/ftp/arduino/DoItDuino_tvbg_schematic.pdf)

Complete assembly instructions for the U-Do-It-Duino Arduino clone kit:
[U-Do-It-Duino complete assembly instructions](https://cornfieldelectronics.com/ftp/arduino/DoItDuino_tvbg_assembly.pdf)
The FTDI driver is installed by default on most Linux systems.

**Adafruit FTDI Friend drivers:**
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- [Schematic Diagram](#)

**Parts List for Arduino TV-B-Gone remote control:**
- [Parts List (OpenOffice)](#)
- [Parts List (MS Office)](#)

**Schematics for the U-Do-It-Duino Arduino clone kit:**
- [U-Do-It-Duino schematic](#)

**Complete assembly instructions for the U-Do-It-Duino Arduino clone kit:**
- [U-Do-It-Duino complete assembly instructions](#)

**Soldering Is Easy comic book:**
- [Solder Comic (English)](#)
- [Many other languages are available!](#)

**Here are links to the slides I use in the workshop:**
- [Arduino For Total Newbies workshop slides (with U-Do-It-Duino kit)](#)
  - [69.2MB](#)
- [Arduino For Total Newbies workshop slides (with Arduino Uno -- no soldering)](#)
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1) If you don't already have Arduinosoftware you need to download it for your computer (Windows, Mac OS, or Linux): Arduino download page

**ARDUINO WEB EDITOR**

Start coding online with the Arduino Web Editor, save your sketches in the cloud, and always have the most up-to-date version of the IDE, including all the contributed libraries and support for new Arduino boards.

Download the Arduino IDE
2) You need a driver for your USB communications/programming cable. Several different ones are available. Choose the driver for the cable you have and the operating system for your computer.

Samurai Circuits board (SiLabs CP210x USB-to-Serial TTL) drivers:
The latest drivers from SiLabs' website
The SiLabs driver is installed by default on most Linux systems.
3) You also need the **TV-B-Gone Arduino Sketch**
(download this, unzip it, and copy it to your computer in the "examples" folder inside your "arduino" folder that you downloaded):

[TV-B-Gone Arduino sketch](http://tiny.cc/A4TN)
4) Schematic Diagram for Arduino TV-B-Gone remote control:

Schematic Diagram (449KB)
USB-Serial Cable
To computer’s USB

- **GND**
- **RST**

**no twists**
Arduino

After you download and install the Arduino software start it, and you will see a screen that looks like this:
Arduino

How to Set Up and Use the Arduino Software

```cpp
void setup() {
  // put your setup code here, to run once:
}

void loop() {
  // put your main code here, to run repeatedly:
}
```
The **first time** you start your Arduino software you need to do **two things** to set things up:

(1) Choose “Uno” as the Board

*(Your U-Do-It-Duino acts just like an Arduino Uno board)*
The **first time** you start your Arduino software you need to do **two things** to set things up:

1. **Choose the Port** (this will be different depending on your Operating System)

   ![Arduino IDE Screen](image)

   - **First:** Tools → Port
   - **without USB cable plugged in**
   - In this example we see only: COM3 and COM4
The **first time** you start your Arduino software you need to do **two things** to set things up:

(2) Choose the Port (this will be different depending on your Operating System)

(After installing the driver for your USB-Serial cable and plugging it in your operating system will see a serial port and it appears here.)

Second: Tools → Port with USB cable plugged in

In this example we now also see: COM18
Arduino

Your Arduino software is now ready to program your U-Do-It-Duino!

```cpp
void setup() {
    // put your setup code here, to run once:
}

void loop() {
    // put your main code here, to run repeatedly:
}
```
Arduino

Designed for non-geeky artists

“Sketch”:

an Arduino program
Arduino

Designed for non-geeky artists

The Arduino language:

“Wiring”

(actually C/C++)
Arduino

Your Arduino software is now ready to program your U-Do-It-Duino!

Let’s make an LED blink! Hello World

```cpp
void setup() {
  // put your setup code here, to run once:
}

void loop() {
  // put your main code here, to run repeatedly:
}
```
Arduino

Your Arduino software is now ready to program your U-Do-It-Duino!

Let’s make an LED blink!  Hello World
Let's make an LED blink!  Hello World

Arduino

```cpp
// Blink

/*
 * Turns an LED on for one second, then off for one second, repeatedly.
 */

Most Arduinos have an on-board LED you can control. On the UNO, MEGA and ZERO it is attached to digital pin 13, on MKR1000 on pin 6. LED_BUILTIN is set to the correct LED pin independent of which board is used.

If you want to know what pin the on-board LED is connected to on your Arduino model, check the Technical Specs of your board at:
https://www.arduino.cc/en/Main/Products

modified 8 May 2014
by Scott Fitzgerald
modified 2 Sep 2016
by Arturo Guadalupi
modified 8 Sep 2016
by Colby Newman

This example code is in the public domain.

https://www.arduino.cc/en/Tutorial/BuiltinExamples/Blink
```
Let's make an LED blink!  Hello World

 Arduino

```c
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);  // turn the LED on (HIGH is the voltage level)
  delay(1000);  // wait for a second
  digitalWrite(LED_BUILTIN, LOW);   // turn the LED off by making the voltage LOW
  delay(1000);  // wait for a second
```

[scroll down]
How to Hack Arduino Programs (“Sketches”)

```cpp
by Arduino Team
modified 8 Sep 2016
by Colby Newman

This example code is in the public domain.

https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink

/*

// the setup function runs once when you press reset or power the board
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    delay(1000);  // wait for a second
}
```
How to Hack Arduino Programs (“Sketches”)

Many ways!

Here are just a few:

- Change blink rates
- External LED
- External motor
- External speaker
- External LED on Solderless breadboard
- More complex projects on Solderless breadboard
How to Hack Arduino Programs ("Sketches")
How to Use Solderless Breadboards

Solderless Breadboard
How to Use Solderless Breadboards

Solderless Breadboard with LED

Short lead

Long lead
How to Use Solderless Breadboards

Solderless Breadboard with LED and wires

Short lead

Long lead

To D13 on Arduino

To GND on Arduino
How to Use Solderless Breadboards

Solderless Breadboard with LED and Resistor and wires

- Short lead
- Long lead

- To D13 on Arduino
- To GND on Arduino
How to Read a Schematic
Arduino For Total Newbies

Mitch Altman (original TV-B-Gone hardware and firmware, modified TV-B-Gone Arduino design)
Limor Fried (firmware modifications, kit design)
Ken Shinif (original modifications for Arduino)
Johannes Schneemann (documentation)

How to Read a Schematic

Use either one of these two terminals for one side of the switch
Use either one of these two terminals for the other side of the switch
Parts Pack Contents
If you want to:

https://cornfieldelectronics.com/cfe/u_do_it_duino_complete.php
Please Remember:

to

Wash your hands
I have these Toolkits for sale
Arduino For Total Newbies
w/ TV-B-Gone as example project

Mitch Altman
Chief Scientist, Cornfield Electronics, San Francisco, CA
Inventor of TV-B-Gone universal remote controls
Co-founder of 3Ware (successful Silicon Valley startup)
Pioneer of VR (in the mid-1980s)
Founding mentor at HAX (1st and biggest hardware accelerator)
Co-founder of Noisebridge (San Francisco hackerspace)

email: mitch@CornfieldElectronics.com
site: www.CornfieldElectronics.com
twitter: @maltman23
flickr: maltman23
WeChat: mitchaltman