

✨ Claire's intro to (addressable) LED strips ✨ ✨ for artists and non-technical babes ✨

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LEDs. You want that skill, right? They are incredible. Shiny. Beautiful. So many applications. It is technology that has so sufficiently advanced it is indistinguishable from magic. Even if you give no f*cks for other technical or electrical information, you need **this** skill. I know that feeling. I got you.

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SOME DEEPER, PERSONAL CONTEXT: Who am I? I'm a curious 35-ish y/o woman with a decades-long obsession with LEDs. Specifically, shiny, pretty, rainbowy LED strips and sometimes individual pixels or matrixes. I've spent as much time being overwhelmed and baffled by them as I have feeling curious or confident. For me, LEDs were the gateway to electrical engineering that I never saw coming. Because of my interest in them I now work within the often murky cloud that is "technology", from a self-taught background. I pivoted from being a professional artist/crafter for over a decade to working in open source hardware a few years ago. I've jumped the [tech learned-helplessness](#) hurdle.

This is important for me to be loud about. I'm an easily overwhelmed person, I didn't grow up in a technical environment nor was encouraged to learn technical things, and my learned-helplessness barriers are quite strong. If I've learned anything over time, it's that I'm *not alone* in that. Particularly among marginalized folks, technology is almost always *not* a welcoming place. I think it's important to acknowledge "technical" skills from this perspective: They can be extremely overwhelming and full of gatekeeping barriers for a majority of people, *whether they are actually difficult or not*. If you feel this way you are not alone, and maybe we can do something about it together. I think LEDs in all their shiny pretty whimsy are a powerful tool to help, and that's why I wrote this guide.

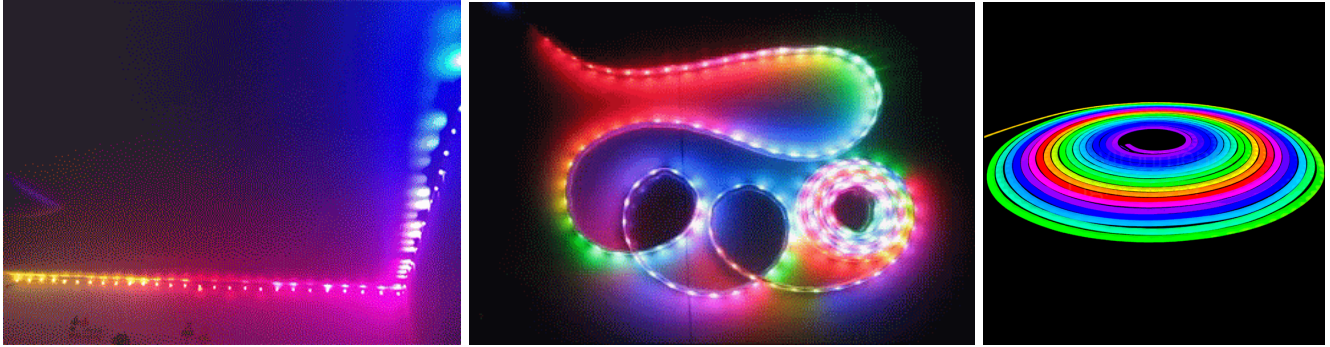
If you wish to support my work and the continuation of this documentation, you can follow and/or support me through [my Patreon](#). Everything I share there is also always open and free.

MORE CONTEXT FOR WHY THIS PARTICULAR DOCUMENT EXISTS: There are many, many LED tutorials out there that start by explaining how to power a simple, single LED*. And, there are many tutorials that dive into programming LEDs with systems like Arduino, right away. There are also listicles that give an extremely deep, wide range of applications for LEDs. This guide is not really like any of *those* tutorials. This guide is geared to help you get satisfyingly stunning rainbow **LED strips** up and running with little to no effort, then learn more if you want to, with lots of resources.

***Simple, single LED saying Hello World! It's kinda cool, but not our focus.**



***We're starting here!**



Why a Google Doc?

This is a format I have used to organize guides and workshops successfully in the past, and one I feel is accessible to a fairly non-technical audience. I think it's got an informal, shareable, live-editable feel. As this guide progresses, depending on audience and feedback, it may branch out into other formats, like Github. If that happens I will link to anything else I create here.

As time goes on links in this guide may break, disappear or not be the most current. If you notice that please let me know through my [contact info](#) at the bottom of this document.

Goals of this Doc:

I have tried to keep this tutorial **quite** simple (it is still a lot of information, so take your time as needed). And I have attempted to focus on these goals:

1. Give you the specific, useful info to confidently purchase supplies to make and control colorful (usually something like a rainbow) LED strips for decor, wearables, costumes, art, display etc. Often affordably, with no need for soldering or programming.
2. Show you that you do not need a deep, or even strong understanding of the materials, components and programming until you get curious or specific in what you are making and *choose* to dive deeper.

So. Those goals in mind, there is also this parallel one: I'm a resource dragon, I love good resources more than gold and hoard them accordingly.

There's a truly immense amount of lovely people making stellar tutorials that build off of what we are covering here. I encourage you to go look things up on your own once curiosity strikes! Also, I will maintain this document as my knowledge grows to clearly lay out and organize quite a lot of those resources for LED enthusiasts of any level to learn from.

Think of this guide as a rainbow runway. It should take you from knowing nothing (or feeling like you know nothing, which is probably not entirely true) to at least being able to make/acquire/use a shiny sparkly LED strip **and** be able to see where you want to go next, with resources to get you there.



Let's start with Plug and Play Kits/Strands

An opinion I hold dear to my heart is that “ease-of-use” or “easily-understood” does **not** mean less-good, or less-smart. This is very true for LEDs. A lot of people make it sound *so much* harder than it needs to be.

I have only gotten as far as I have with LEDs, in part, by buying all-in-one plug-and-play LED kits/strands and noticing the differences and similarities in them. If it saves you time and spoons, and you have the funds, that's a *brilliant* way to go! The only important question to sort out is: what kit to buy?

We are currently in a very accelerated (what I call a “limited golden age” because it is powerful but can't last) of LED technology (and electronics generally) where plug-and-play kits are increasingly high-quality, useful for a wide range of applications, and fairly affordable. Here's a list of kits and strips that I believe are very easy starting points:

Some plug-and-play kits, all a super easy way to check out addressable LEDs!

Yes, I'll explain *all about* addressable leds in this guide. But I'm serious about showing you that this is something that is *easy* to do. If you came here for something you can slap on a bike, up in your bedroom, or stick in a coat, and you just want something with a nice rainbow pattern or some other non-specific pattern, these will all do that. No stress, no mess, what I like to call *good e-heckin-nough*.

[Full 33' addressable LED strip kit from Amazon](#): Comes with everything you need. Good for house decor, maybe festival lighting. It will need to plug into a wall/AC outlet (normal house wall outlet).

[3.3 ft addressable strip with small USB controller](#) (great for wearables!)(depreciated but left as an example). With [this controller](#) and [this LED strip](#) you can plug into a portable USB battery or the wall through USB.

[LED strip + controller kit from Aliexpress](#): I suggest using this link once you review this guide, to know how to choose from the options they give you. This kit is good for wearables and portable lighting. You will need to buy a [USB battery pack](#) as well, or a [USB to wall plug converter](#). Depending on what length you get it will run you ~\$8-\$20, and since it's Aliexpress it'll probably be slower shipping.

[Rose lights \(AA battery powered string\)](#): the roses come in various colors and use three AA batteries to power a strand of single color lights. I really like these simple strands. The batteries last forever, the flowers are lovely and soft, and they are very aesthetically pleasing.

[Rainbow Curtain lights](#): These get power through USB, so you can plug them into the wall or a

[portable USB battery](#), your choice. They are a big rainbow curtain of little lights (a bit like small christmas lights in form factor). I LOVE these. I have two strands. They are *awesomely* simple for a *very* good effect.

If you are looking for more neat things you can simply buy (at various levels of technical difficulty), please go check out the section in the [FAQ](#) called [Where did you get...?](#).

A note about Amazon, Aliexpress and where we get our electronics:

To be fully transparent, I feel gross about promoting Amazon. HOWEVER. As I myself have been a maker with little money and often low energy and spoons, I believe it's currently an intractably valid platform for access to resources, especially when it comes to experimenting with electronics. It is nearly impossible to find most specialized electronics in-person, and everything about addressable LED strips (and most electronics) is specialized. So, I link to resources and kits on Amazon throughout this document. You can always do a search to find similar or identical supplies elsewhere, in particular from [Aliexpress](#), another resource I use often. Aliexpress works similarly to Amazon, but everything is coming directly from China, instead of being made in China then going through Amazon (which is just a middleman company, most of the vendors are actually the same). I prefer the Aliexpress structure because it's more direct and less wasteful overall, but Aliexpress is notorious for slow shipping to the USA (of course! It's coming from China!). They are getting faster overall, and you can check reviews to find faster vendors on there, but keep this in mind. As a last tip, I also highly suggest purchasing from [Adafruit](#) if you can afford to, once you understand what you want to build. They have some of the most beginner-friendly [LED tutorials](#) around, are woman-owned, and are located in NYC. Anytime I have funds to spare I buy from them.



Next - The Components, Seperated:

Now we'll be going over the different components that you need to make a very powerful, addressable LED...thingy of your choice. When you know enough about these components and can choose your own, you can get better/more powerful/more specific effects than a pre-packaged kit. The more you understand these components, the more you can dial in specific uses and optimization.

As I mentioned, we'll be focusing on LED strips as our light source. This is because they are stunning, easy-to-find, easy-to-use, versatile, and I believe that once you understand them you can branch out to other LED form-factors relatively easily.

NOTE! You do not really need to know everything about every component to start trying out or buying things. You can experiment, buy stuff for projects, try things before you feel like you understand everything. Just be ready to get a bit frustrated and sometimes fail, an important and inevitable side-effect of being brave and trying things. Over time, as you try things out, you will digest more and more information. My gentle advice, If you start feeling overwhelmed or like giving up, dial it back, take some time, digest one tiny thing at a time...and then keep going. You got this, and it's worth it.

The main components we'll be going over are:

1. **LEDs** (again, we'll focus on LED strips, but know that there are many form factors you might get into after understanding LED strips.)
2. **Controller/s**
3. **Power**

To a lesser extent we'll discuss:

- Connectors - the pros and cons of various connection types and what they are called
- Adhesion - because sticking your LEDs to things is surprisingly difficult sometimes
- Diffusion - because a soft diffuse glowing rainbow is as desirable as a sharp bright glowing rainbow
- Soldering - because some of you **do** want to learn, though you don't have to
- Programming - a whole galaxy to itself, the most important thing to know is that there are *pre-prepared* LED software libraries. Rarely will you ever want to code raw, and never *have* to.



THE LEDs THEMSELVES

Addressable Vs. Non-Addressable LEDs:

From here on I'll be using the term "addressable" a lot. What do I mean? Basically **addressable** means that each little LED light (pixel) on, say, an LED strip, can be **told what to do individually**. This is significant because there are, currently and historically, plenty of **non-addressable** LED lights (pixels) to choose from and (maybe accidentally) buy. The category I'm calling "Non-addressable LEDs" include single color LED strips (like an all-white, or blue, or red LED strip), or even RGB color-changing LED strips that are *not addressable*.

Non-addressable RGB LED strip (see how all the lights are changing color at the same time?):



Addressable RGB LED strip (look at each pixel DANCE!):



Addressable and non-addressable RGB LED strips look similar in a few ways, which is why I'm taking the time to explain. Non-addressable RGB strips can't do pretty patterns, so I don't focus on teaching you about them in this tutorial. That said! Single color and non-addressable LEDs *may* be something you want to use, depending on your project. They are cheaper and less complex to figure out.

NOTE! When you are buying your LED strips online, especially if you can only look at static images, it is common for listings for **non-addressable** RGB led strips to **look like** addressable RGB LED strips. [This listing](#) is a great example, and I have pulled the photos from it to explain below.

The first photo below shows an LED strip where it *looks* like you can control each individual light (pixel). Only an addressable LED strip would look like that in real life. However, when you look further through the listing (and reviews are handy), it becomes clear that this is a **non-addressable** RGB LED strip, because all the lights (pixels) change color at the same time. They are trying to convey that the LED strip changes color in the first photo, misleadingly. This is **extremely** common.



This is the main listing photo. It is misleading because it looks like you can control each pixel individually.



Scrolling through the listing photos, you can see that this is a non-addressable LED strip. This is a confusingly common ruse!

Next, we learn how to make sure we are buying **addressable** LEDs.



Pixel Types (a string of jargony letters and numbers we care about):

~DANGER~ HERE THERE BE JARGONS

So, LEDs, addressable and non-addressable, come in many [form factors](#), but, again, right now we'll be focusing mostly on addressable LED strips, which are: a lot of single LED pixels lined up on a flexible strip that links them together (that flexible strip most strips are made of is actually a PCB ([Printed Circuit Board](#))).

The only really important part to know is that **the pixels that make up an LED strip are how an LED strip gets its name**, and that name can be CONFUSING. Like, a string of letters and numbers gobbldy-gook. This is where a lot of people throw up their hands in confusion, but we'll get through this together! You **DO** want to know / be vaguely familiar with the names of these different pixel types when you are buying and researching LEDs. You can always reference this document as you go.

Here's some important starting points:

1. The differences between the different types of addressable LED strips/pixels are relatively minor, they are more alike than they are different. The differences **do** tend to come up eventually, so this *is* handy info to have, but you **don't need to memorize it all now**. Conserve brainpower! Learn over time!
2. In order to conserve brainpower, just know THIS: an excellent, popular LED type to start with (in strip form, and other forms!) is the **ws2812B**. If you take **one** thing away from this section, take that string of letters and numbers. You need to know it to search for and purchase LEDs that will treat you well in a wide range of applications. Sometimes the letters are capitalized, like WS2812B, sometimes they are lower case, like ws2812b, sometimes a mix. It doesn't matter.



3. LED pixel names come in (are developed in) *groups* or *classifications*. We'll be focusing on the 'ws28' classification, and to a lesser extent, the 'apa' and 'sk' classifications. Just know that LED pixels often belong to a line of similar pixels, that are developed and manufactured over time as **versions**, and that's part of their classification/name. Did that go over your head? That's fine!

4. Both RGB non-addressable and RGB addressable LEDs have **RGB** in their title. [RGB](#) is short for **Red Green Blue**. These are the primary colors that other colors can be created from. Basically each LED pixel has red, green and blue light emitting diodes. This can be true if they are addressable or not. This can be confusing when searching for LEDs to buy, because again, both non-addressable and addressable LEDs can have **RGB** in their title.

NOTE! There are also led strips/ pixels that have a **white** diode, and those are called RGB-W or RGB-WW. They are a bit more expensive, but, *if* you want to have white light AND RGB light you will want these, because mixing R, G and B to achieve white pulls a *lot* of power. I'll go over this more thoroughly later.



Back to the different types of addressable LED pixels....

A fairly handy chart:

Strip Type	Voltage	Compatible Libraries	Price (As Tested)	Pros	Cons
WS2811	12	FastLED, Neopixel, WS2812FX	\$15.83	- Inexpensive - Compatible with most libraries - Resistant to voltage drop	- Control groups of 3 LEDs instead of individual LEDs 12 volts means separate power will be required for your microcontroller
WS2812B	5	FastLED, Neopixel, WS2812FX	\$17.08	- Inexpensive - Compatible with most libraries 5 volts means your LEDs and microcontroller can share power	Power injection required every 5m to keep color accuracy
WS2812B Eco	5	FastLED, Neopixel, WS2812FX	\$13.15	- Least expensive - Lowest idle power consumption - Compatible with most libraries 5 volts means your LEDs and microcontroller can share power	Power injection required every 5m to keep color accuracy
WS2813	5	FastLED, Neopixel, WS2812FX	\$22.98	- Compatible with most libraries 5 volts means your LEDs and microcontroller can share power - Backup data channel to prevent strip outage	- Expensive - Power injection required every 2.5m to keep color accuracy
WS2815	12	FastLED, Neopixel, WS2812FX	\$23.86	- Compatible with most libraries - Backup data channel to prevent strip outage - Resistant to voltage drop	- Expensive 12 volts means separate power will be required for your microcontroller
SK9822	5	FastLED	\$28.45	- Clock pin allows for total control of frames per second and accurate animations. 5 volts means your LEDs and microcontroller can share power	- Expensive - Power injection required every 2.5m to keep color accuracy - Library must include a clock pin (FastLED)
SK6812	5	Neopixel	\$26	- Dedicated "white" LED channel allows for the most accurate white colors - Lowest power consumption when producing white light 5 volts means your LEDs can microcontroller can share power	- Expensive - Power injection required every 2.5m to keep color accuracy (only when using RGB for white). - Library must include a white channel (Neopixel)

You can view and expand this image [here](#), and if it's easier for you to take in video, you can watch a video overview of all these types [here](#).

Let's reiterate something I just said just before we got to this chart, because it's the main thing I want beginners to take away from this section:

See how there are several LED strip types that start with 'ws28-' on that chart? The one that is great to start with (if you need less than ~35' of LEDs for your project) is the **ws2812b**. If you take *one* thing away from this chart, take that string of letters and numbers.

The other **very** handy bit of this chart is how it illustrates that some 'ws28-' LED types take 12V power, and some take 5V. Just...know that. We'll go over power later, and you don't need to know anything about electricity to use those numbers effectively.

A Quick Sidebar about Adafruit (an Excellent Resource), and Further Naming Complications:

So this is a great time to introduce a company I adore called [Adafruit](#). Adafruit is an amazing place to learn about and purchase LEDs. That said, Adafruit does a (potentially confusing) thing where they call the ws2812b LED pixels and strips they sell “[Neopixels](#)”. It’s a brand name. I need you to know this because they have an [*awesome* LED guide](#) for, you guessed it, Neopixels. You *can* buy LEDs from them (they are a fantastic company to support), OR you can buy ws2812b LED strips (usually for much cheaper) on Aliexpress or even Amazon, and still use all of the information in their guides with them. **Ws2812b LEDs are Neopixels, Neopixels are ws2812b LEDs.** Now that you know that, you can start looking at [LED guides](#) on Adafruit. They are a glorious source of delightful learning and friendly community.

A Quick Note on APA102/SK6812/Dotstar LED strips:

Do you know what persistence of vision (POV) is? When you spin POV LEDs it looks like this:

POV LEDs can make pictures when they spin!:



In order to make pictures by spinning LEDs around you need LEDs with a super fast refresh rate, and the LEDs that can do that are in the ‘**APA**’ and ‘**SK**’ classifications of pixels. You can see a few ‘SK’ classifications in the handy yellow chart on the last page. Adafruit calls ‘APA’ and some ‘SK’ pixels “**Dotstar**” and they have a [lovely Dotstar guide](#). For most applications, certainly any I’m talking about in this guide, you don’t need to know more than that these classifications exist and the names come up sometimes. You might want APA/SK/Dotstar for POV Poi, POV bike wheel lights, light painting, etc. If you are interested in those things, again, I highly suggest the [Adafruit Dotstar guide](#). You *can* use these LEDs just like you would use ‘ws2812b’ LEDs, as they are all addressable, but the APA/SK/Dotstar LEDs are **much** pricier and unless you know *why* you are using them I don’t suggest them.

If you want to go deeper, [here’s](#) a dissection of the (minor) differences between APA102 and SK9822 LEDs and [here’s](#) a video showing the technical difference between Neopixels and Dotstars (AKA: ws2812b and SK9822).

a few LED pixel jargon gotchas:

Keep an eye out for these confusing bits out there on the internet:

1. LED pixels can sometimes be called “[diodes](#)” or “[SMD](#)” leds. They are all essentially the same thing for our purposes, and understanding the subtleties can come later, over time, or not at all.
2. Addressable LEDs can be called “digital”, non-addressable LEDs can be called “analog”. If you start doing your own research, or join any LED enthusiast groups, this may come up.

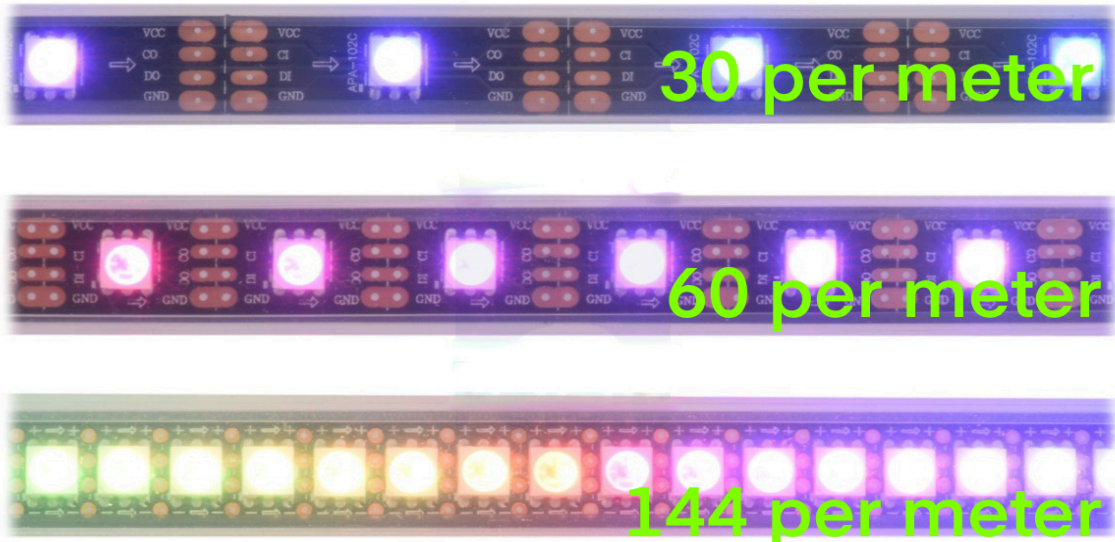
Next we’ll be learning about features we can choose from when purchasing LED strips:

Pixel Density (or, ‘Pitch’):

Pixels, on LED strips, can be packed onto the strip at different densities. This density is measured per meter of LED strip. This density affects the aesthetic and price somewhat significantly. In higher densities, it can also affect the amount of power you need.

The common LED strip densities are:

30 pixels per meter ([example](#)), 60 pixels per meter ([example](#)), 144 pixels per meter ([example](#))
...and recently, very dense 330ish-350ish pixels per meter ([these are intense](#)).



You don’t need to memorize all that, but it’ll come up when you are purchasing LED strips. **I HIGHLY recommend going with 60 pixels per meter.** It’s excellent aesthetically, it’s fairly affordable, and you can still cut the strip apart and solder it relatively easily if you need to.

a note on density

Density of LEDs only stays consistent for standard sized 5050 pixel LED strips, because density is measured per meter. I’ll go over pixel sizes in a bit, but know that these densities don’t directly apply to, say, [super tiny LED strips](#).

Also if, (or when!) you wander into using LED form factors outside of addressable strips, these rules on density kinda go out the window. You will often find some measurement for the space between the pixels, but it might be in millimeters, centimeters, or something completely new.

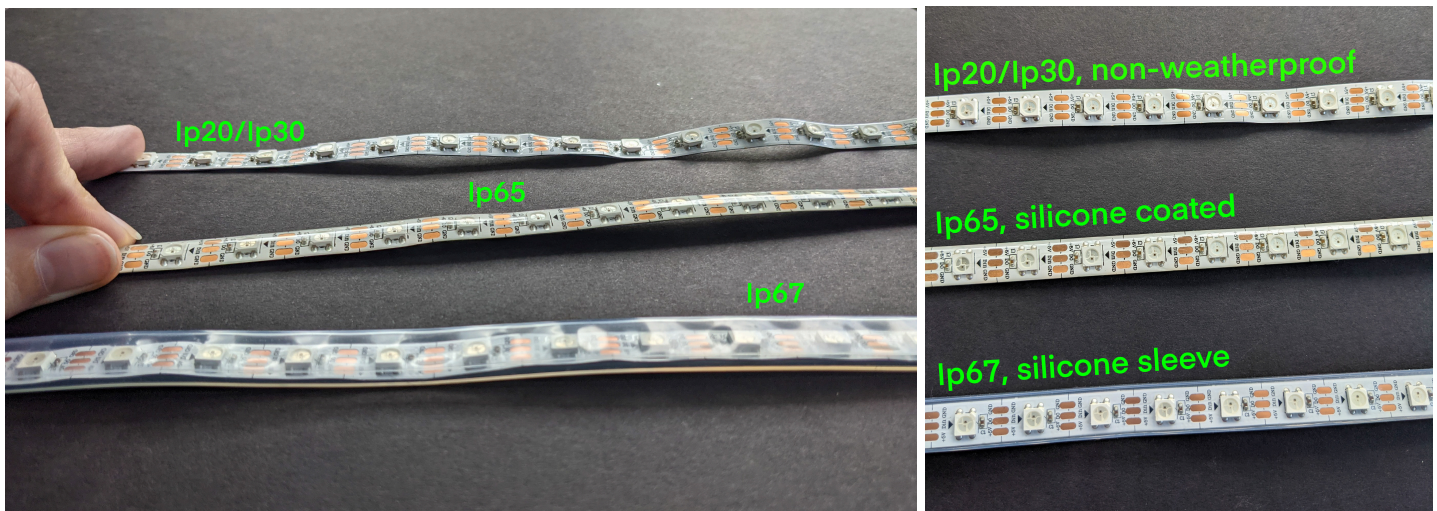
Weatherproofing (IP):

Again, talking specifically about LED strips, you will often run into jargon, called the “IP”, with a number next to it. The IP (or Ip, or ip) rating of an LED strip is referring to how weatherproof it is, and what kind of silicone casing/coating it has (or doesn’t have).

[IP is not a term specific to LEDs](#), from Wikipedia: “(IP) rates the degree of protection provided by mechanical casings and electrical enclosures against intrusion, dust, accidental contact, and water.”

The common LED strip weatherproofing IP choices are:

- **Ip 20/30** - this means the LED strip has no weatherproofing. Easy to cut and solder, cheap, very bright, and importantly, fairly easy to destroy.
- **Ip 65** - this means the LED strip has an adhered, flexible silicone coating bonded to the strip. It’s hard to cut and solder, but very durable. It diffuses the LEDs the tiniest bit and yellows a bit over time.
- **Ip 67** - this means the LED strip comes in a silicone sleeve, or tube, that it can be pulled out of. This is handy if you need the LEDs to be fairly weatherproof, but need to be able to get to them for cutting and soldering.

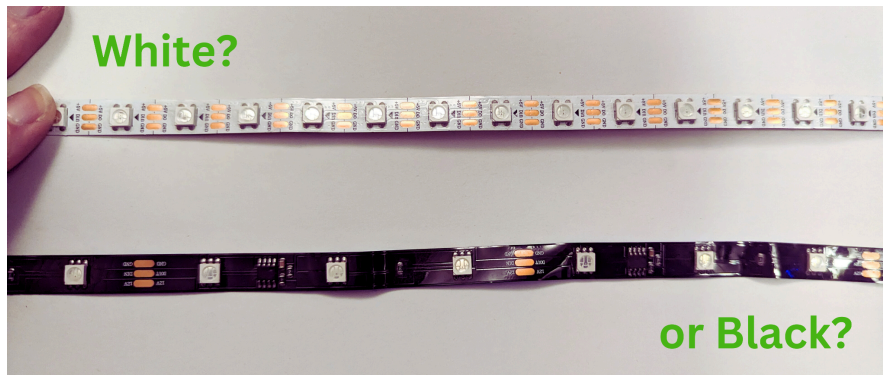


RGB vs. RGB-W or WW:

Remember how both non-addressable and addressable LEDs can be called RGB? RGB just refers to LEDs that have Red, Green and Blue diodes in each pixel. Well, you can also find/buy/stumble upon LED strips (both addressable and non-addressable) with pixels that **also** have a white diode. They are often called RGB-W or RGB-WW (which stands for warm white). This is a bit of an advanced feature, because to take advantage of both the RGB and W features, you will need a controller that can handle that. You can dive deeper with this [video](#). Also, my favorite controller, the [pixelblaze](#), can handle RGB-W.

PCB Color:

LED strips, as in the actual strip the lights sit on, can come in white or black. This isn't terribly important, but it can be confusing when looking at them. It only mildly affects your application aesthetically. If you get a choice when purchasing LEDs, I suggest white PCB, I think it shows off the light better.



Up to you!

✨ Quick intermission to say ✨



✨ Remember to take breaks and integrate all of this gently! ✨

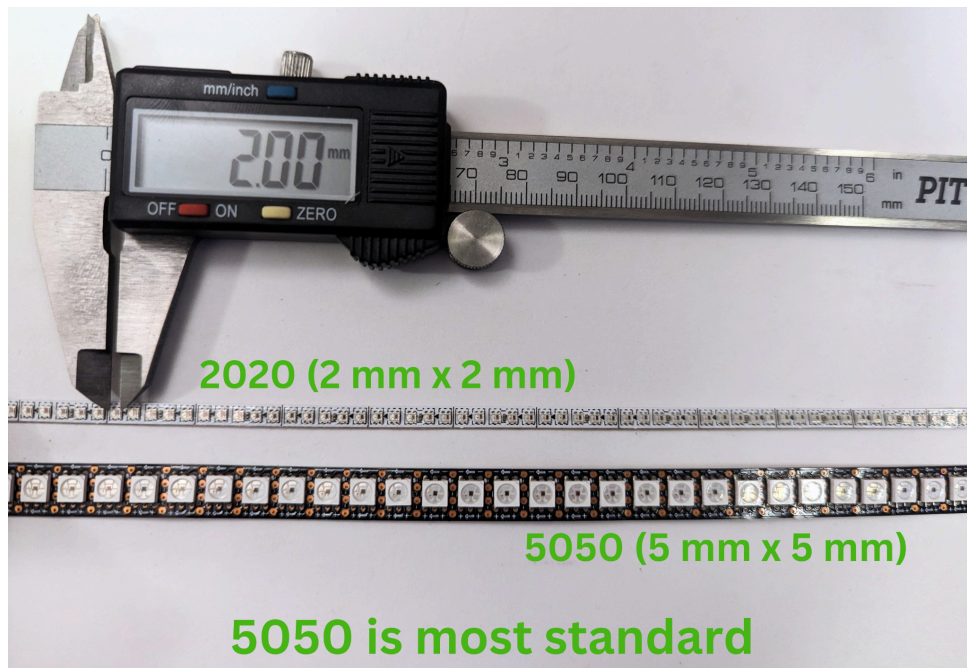
Pixel Size:

The majority of addressable LED strips have one pixel size, and it's called: **5050**. That number correlates to the physical dimensions of the chip in millimeters, so it really means **5 mm X 5 mm**. The numbers 5050, 3528 (3.5 mm X 2.8 mm), and 3020 (3 mm X 2 mm), etc. all correlate to the size of a pixel in millimeters.

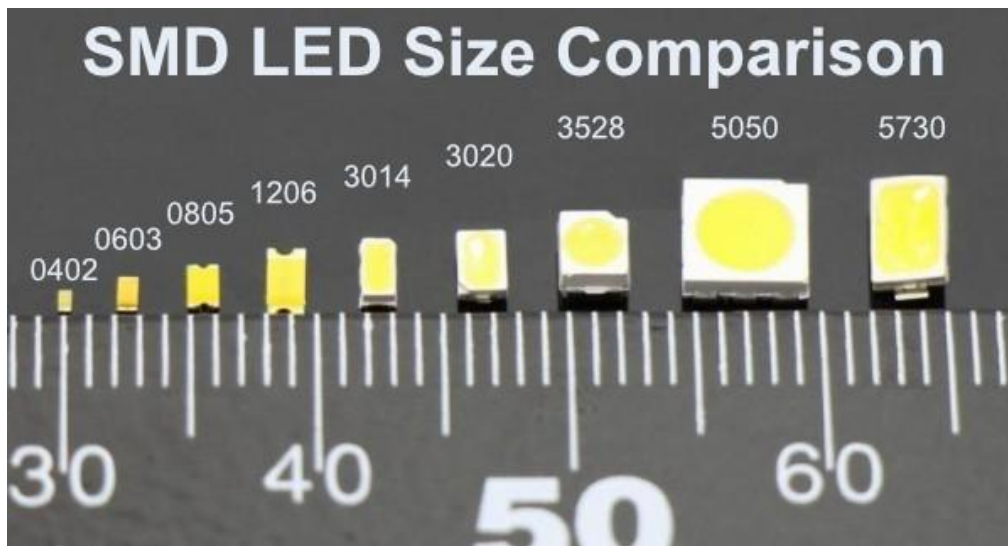
This is handy to know, because other pixel sizes occasionally come up while searching. You want to make sure you are getting 5050 RGB LEDs while learning because there are smaller form factors of RGB addressable LED strips, like 2020 and 1515 (1.5 mm X 1.5 mm!). The difference in size

between, say, a 5050 strip and a 2020 strip are [very hard to distinguish in photos](#) online. And while these tiny LED strips can be fun and pretty to play with, they can be frustrating for beginners.

See how teeny tiny they can get?



And example of what the individual pixels that get lined up on LED strips can look like



These examples are **non-addressable**, and come in a larger variety of sizes than addressable LEDs.

Common LED strip lengths:

LED strips are measured in meters, though you will often see that translated into feet. LED strips come in 1, 2, 3 or 4 meters, but a roll of LEDs is most commonly 5 meters (and they basically don't come in longer lengths). 1 meter is 3.3 feet, 2 meters is 6.6 feet, 5 meters is 16.4 ft.

Can I connect LED strips together to make them longer?

Yes. LED strips are basically always sold with [JST connectors](#) on either end, so you can connect lengths of LEDs together fairly easily. If you do this, I suggest you stick to linking 1 or 2 addressable LED strips at first, because if you want longer lengths you will have to learn how to deal with the power they will need. This is not as frightening as it sounds, but it is something to learn after you are comfortable with powering just one or two LED strips normally.

Core takeaways to remember about LED pixels and strips:

- Stick to strips that say **ws2812b** or **ws2812** at first, unless you know you want something else
- Stick to strips that say **RGB**, not RGB-W or RGB-WW
- I suggest a pixel density of **60 per meter**.
- I suggest an **IP rating** of, well, any of them, but know what you need for your application. I tend to use IP67 (with a silicone sheath), because they are repairable and long-lasting.
- Your pixel size should be **5050**, unless you know you want something else. Make sure the listing doesn't say 2020, or something else.

Now that you know all that, here's what a common good-quality addressable LED strip listing on Amazon looks like:



BTF-LIGHTING WS2812B RGB 5050SMD
Individual Addressable 16.4FT 60Pixels/m
300Pixels Flexible White PCB Full Color LED
Pixel Strip Dream Color IP30 Non-Waterproof
Making LED Screen LED Wall Only DC5V
[Visit the BTF-LIGHTING Store](#)
★★★★★ 2,208 ratings | 181 answered questions

Price: **\$30.88** & FREE Returns

Get \$50 off instantly: Pay \$0.00 ~~\$30.88~~ upon approval for the Amazon Rewards Visa Card. No annual fee.

Available at a lower price from [other sellers](#) that may not offer free Prime shipping.

Extra Savings Promotion Available. 10 Applicable Promotion(s)

Color: **White Pcb Ip30**

Size: **16.4FT 300LEDs**

3.2FT 60LEDs 3.2FT 100LEDs 3.2FT 144LEDs 16.4FT 150LEDs

16.4FT 300LEDs

That listing title is pretty intense, huh? But hey, we just learned all this! Or, at least, I wrote it down in this guide for you to reference when you need to. You can go look at this listing yourself [here](#), and if you scroll down just a bit we'll dissect every bit of that tricky title.

Here is the same **listing title** from the last photo, broken down:

Anatomy of a common LED strip listing

1. Company name/manufacturer
2. LED/pixel type
3. Red, green, blue diodes (no white)
4. Size of pixel & how it's attached
5. Addressable (known from #2)
6. Length of strip (aka 5 meters)

1. 2. 3. 4. 5.
BTF-LIGHTING WS2812B RGB 5050SMD Individual Addressable
6. 7. 16.4FT 60Pixels/m 300Pixels Flexible White PCB Full Color LED 8. 9.
Pixel Strip Dream Color IP30 Non-Waterproof Making LED
Screen LED Wall Only DC5V 11. 10.
Visit the BTF-LIGHTING Store

7. Pixel density/pitch & quantity of pixels
8. PCB (strip) color (black or white)
9. Seller added search terms (nothing technically new or important)
10. Weatherproof rating (IP)
11. Voltage needed (usually 5 or 12) (also known from #2)

Created by Claire Danielle Cassidy 2021

Some Other Form Factors:



Up until this moment I have been referring entirely to standard 5050 addressable LED strips. But you should know, and will probably be quickly curious about other form factors! I call all of the forms pictured above “strips”, or “strands”, but they do have names. Generally. Kinda.

When you get into new form factors always check your wiring carefully, and watch for any weird behavior. While they generally work the same as standard addressable LED strips, particularly ws2812 pixels, it is often harder to tell where your Power, Ground and Data wires are. They come in different voltages. And sometimes instead of Power, Data, Ground (in that standard order), they will come as Power, Ground, Data (for example). Always be on the lookout for something new that might be a bit different. That's just the world of LEDs!

From top to bottom (in the photo above):

- [15 mm density "pebble" LEDs](#). I'll be honest, these are the coolest, newest form factor. They come in different densities, are almost fully waterproof, and are wonderfully flexible and durable.
- [Addressable fairy light wire](#). These are fun! Addressable wire was not available for a long while, so it's nice that it's here now. Not very dense, and can't take a ton of abuse. But it holds its shape!
- [Pre-soldered pixel breakout boards](#). Not very durable as a strip, but real handy if you just want a few pixels on tiny, stable boards that are already soldered to wire. You can break them apart easily.
- ["Bullet" LEDs](#). Extremely popular for large-scale art, they even fit into mesh to make huge screens.
- [Standard ws2812 5050 LED strip](#). IP30, 60 pixels per meter.

Where I suggest buying LED strips from:

These are links to searches for ws2812b LED strips from the three places I buy from most often.

[Adafruit](#) - This is a USA-based, small, woman-owned business that consistently puts out world-class LED tutorials and are at the forefront of making electronics accessible to a wider range of people. They also design and manufacture excellent LED components, like tiny controller boards, in-house. They are on the pricier side of electronics, and their products are accordingly top-notch.

[Aliexpress](#) - If you haven't been here before, welcome to direct to manufacturer purchasing! It's extremely easy, basically the same as Amazon (though the shipping can widely vary), A very popular Aliexpress vendor of LEDs within the LED community online is [Ray Wu](#). Another well-reviewed vendor is [BTF-Lighting](#).

[Amazon](#) - There are simply a lot of specialty electrical components on Amazon, for relatively affordable prices, with quick shipping. This makes it a massive contender in the niche of LEDs. Keep in mind you can find everything here on Aliexpress, and much more actually, but with slower shipping.

***whew!* That section on LEDs was intense!**

If you are new to all this, please allow yourself patience and grace while you learn. It's a lot of different pieces of information to remember. I believe in you!

Next, we'll talk about **controllers** and **power**, the other two main components.



CONTROLLERS:

Ah, LED controllers. This is arguably where the magic is. The brains. The control. Addressable LEDs don't just work, they *must be told what to do*. Just hooking them up to power won't do anything. You must understand and own an LED controller of some kind to use addressable LEDs.

I truly believe that ready-to-go, generic controllers where you don't have to encounter any programming or code are best to start out with. Of course, you **can** learn how to program LEDs (you do **not** need to know how to code to learn this), but you don't have to, and you can still get good effects. Also, if you *do* start diving into programming LEDs, you don't have to know how to write or create your own code from scratch. There are several massive online communities devoted to creating basically all the LED code you could want.

Generic controllers I have used and suggest:

When I use the term "generic controller", what I mean is that manufacturers have been producing ready-to-go, easy-to-use controllers for addressable LEDs for years now. The huge pro to these controllers is this: you don't have to program them, at all. The downfall? In return...you only get the patterns they give you. These two controllers (and in my experience nearly **all** generic LED controllers) have essentially the **same** patterns, and only a few of these patterns are very good. (though they usually include rainbow chase! The best pattern!). For the low price and ease-of-use? I often find generic controllers very worth it for the rainbow chase pattern alone.

- [Small, remote controlled, 200 pattern USB 5v controller](#) (~\$10) I really like this controller. One side connects to your LEDs, one side connects to a [portable battery pack](#). That simple.

- [Slightly larger, bluetooth, 200 pattern controller](#) (~\$20) This controller has, essentially, the **same** patterns as the last controller, but you can control it via bluetooth through your phone instead of a remote, and it can control a larger range of LED strips, like ones that take 12 V instead of 5 V.

My favorite controller:

Moving into the realm of custom, non-generic controllers, but still comfortably sitting in easy-to-use no-programming-needed territory, the [Pixelblaze LED controller](#) is incomparable (I'm biased through years of use, but this is my honest opinion). The [startup guide](#) is beginner-friendly, and the controller is made by a maker local to Portland, OR (where I'm from) who I admire.

You'll set the Pixelblaze up nearly as easily as a generic controller, and you can immediately use the many LED patterns provided. The patterns provided are far superior to the generic controllers. Also, if

you want to dive into learning how to program the LEDs, you can! The Pixelblaze comes with several patterns specifically made to teach you how to program LEDs.

Price: \$39 for the Pixelblaze [Standard](#). \$29 for the [Pico](#).

NOTE! You might need to do a small amount of [soldering](#) to connect screw terminals to your Pixelblaze board for easier connection to your LED strip. You also might need to find a [JST cable](#), the most common LED strip cable type.

Yes, you can also learn how to program LEDs, whenever you are ready:

A very common method of controlling addressable LEDs is to purchase a cheap microcontroller and put your own code onto that board, which essentially creates your own custom LED controller. While this method has pros, because it's affordable and if you know how to optimize LED code you can do basically anything, it is also a very high bar for beginners. That's why I suggest starting with a generic controller, then moving to something like the [Pixelblaze](#), then exploring making your own controller.

When you do feel ready to dive into the code and hardware that can makes addressable LEDs run, here's a few places I suggest you start:

- [This video](#) from a cosplayer called Zibartas is a **great** place to start even if you are just curious, it covers a lot of what we have covered already, with a focus on applying simple code to your LED strip.

- [The FastLED library for Arduino](#) and the [WLED library for Arduino](#) are both very popular, for good reason. They are powerful, open source software libraries and have great communities. If you know how to wield it properly you can save some money buying (relatively) cheap Arduino compatible microcontrollers to put your own code, from these libraries, on. Essentially, you are making your own LED controller with your choice of microcontroller PCB board, and your own code, but with a lot of tutorials and help. You don't even really need to code anything, it's all there in the libraries for you!

- [Adafruit](#) will also teach you several ways of controlling Neopixels with your own code.



POWER: (Warning! This section is under construction)

What do tiny wearable LED projects and giant LED art installations have in common? Power. They both need it, and it can be challenging to get it right in those extreme cases. Power gets tricky when you need it to be very small, or very big. That said, there is a “regular” (ish) middle-ground range you can understand right away, and that's where we will be focusing.

A hill I will die on: To understand power for addressable LED strips you DO NOT need to understand electricity in-depth. You **will**, like with most things in this guide, benefit from flexibility and a willingness to keep trying when things go wrong. I'm going to give you a range of engagement levels, from simple plug-and-play, to starting to understand the basics of the underlying electrical jargon. If you just want to buy something that works now, scroll down to the section below titled "Easy Mode". Remember, we are focusing specifically on how to power 1-2 addressable LED strips, portably or plugged into a wall. Powering other electronics may work differently, though you will start to see a lot of similarities and direct parallels as you pick up these electrical concepts.

If you are wanting to power small individual LEDs, SMD (surface mounted) LEDs, LED matrices (grids), or want to power a lot (over 4) LED strips at once I will try to post enough links to get you in the direction you need to go, but I won't be covering those things in depth.

Voltage, or, the *type* of power you need:

Voltage is the same as Volt, and is usually shown as 'V', as in '5V' or '5 V'. Sometimes '5VDC' which stands for '5 Volt Direct Current'. For this guide it *does not matter* what Direct Current means. It might be too much information at first, and that's fine. You can certainly look it up if you are curious.

LED strips nearly always take either 5V or 12V power:

LEDs require power. No matter what. The addressable LED strips I have been suggesting to you, ws2812b addressable LEDs, take 5 Volts (5V) as the type of power they need to light up. Some other, similar addressable LED strips (like ws2815 addressables) take 12 Volts (12V) as the type of power they need to light up.

I'm mentioning all these details now because addressable LED strips **basically always** take either 5 Volts or 12 Volts of power, so the sooner you start hearing those two numbers the better. It's **really important** to know what voltage your LED strip takes so that you match the type of power you are putting in.

Label your LEDs with their voltages:

To complicate things a bit, it's **hard** to tell what voltage an LED strip takes just from looking at it, especially if you have separated it from its packaging. Why am I talking about this stuff first? Because the first time you order an addressable LED strip you will take it out of its packaging, and might lose that packaging. I certainly have! If you start trying out different types of strips, and start storing them together, pretty soon you just don't know what type of power your LEDs take. That's a problem!

You can prepare for this in a few ways. As you first get into addressable LEDs I suggest only playing around with ws2812b LED strips, which all take 5 Volt power and come in many different fun form-factors. Easy! Then you only own 5V LED strips and 5V power supplies. They match. No worries.

Once you do branch out into LED strips that take 12 Volt power, **label them** by wrapping a piece of

masking tape around the wire at the end of the LED strip and writing “12V”. Always assume you will separate the LED strip from it’s packaging, so writing on the packaging is unreliable.

Other reasons why remembering 5V and 12V is so important for LED strips:

Power supplies come in many voltage types other than 5V and 12V! Like 6.6 Volts or 8 Volts and so on. So if you are using a power supply you just found, or you want to start buying them from thrift stores, even if you are buying the power supply you need online, you need to know the voltage your LED strip takes (input) and the voltage your power supply gives (output).

Finally, remember how addressable LEDs require power AND a controller? Well, the controller *also needs power*. During the process of setting up your LEDs the controller usually *automatically* gets fed the power it needs when you power the LED strip, so you don’t often need to do anything special to give your controller power. But, it is good to know that this is happening. And it’s extra useful if you ever branch out into other electronics work, for possible debugging (figuring out why your shiz isn’t working how it should).

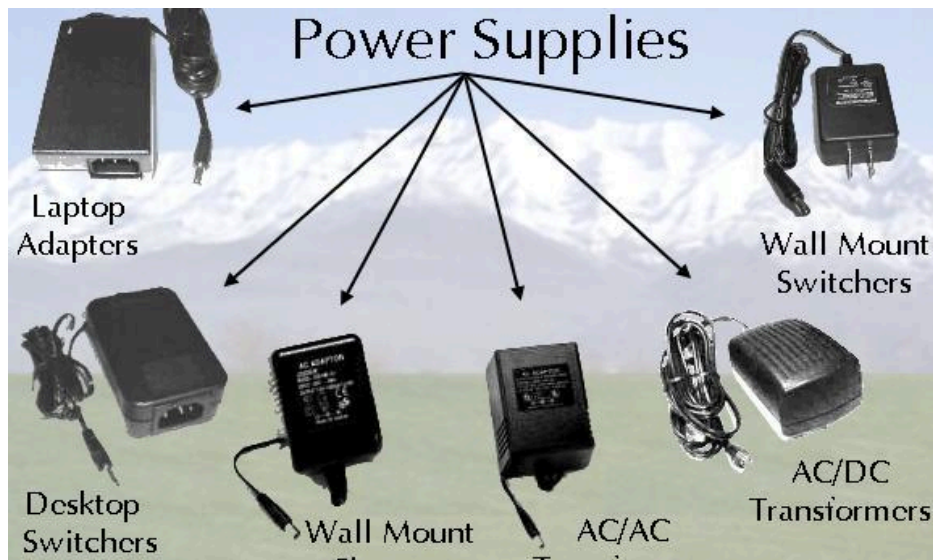
But Claire, what is a power supply?

Something that was confusing to me when I first started with LEDs is that the term “power supply” is thrown around a LOT. There is the [technical definition](#), (warning, dry. You do not need to grasp that dryness) and then there is the general cultural use which I find tends to be...*much looser*.

Running with the loose cultural use, power supplies come in a **wide range** of form factors. The term “power supply” broadly refers to **any of these and more**: portable USB battery packs (you may have one for charging your phone), coin-cell or AA battery holders, the cord and plug for your laptop, or the cord and plug that goes from an appliance to a wall. Generally, if it’s giving you power, it’s a power supply.

When you are connecting LEDs to a standard house wall outlet (p.s...house wall power is called AC power, which stands for Alternating Current), the cord you are using will often have some kind of...well, lump on it. That lump is managing the power it’s taking from the wall. Wall plug power supplies come in a range of form-factors:

A few examples of cords that plug into walls that have lumps:



(You can ignore the words, see how the images are kinda familiar? These are everywhere.)
 So here's a tricky bit: wall plug power supplies provide a wide variety of voltages, tailored to the thing they are trying to power. Fortunately, they all have to (basically always, basically) tell you in writing **on** the power supply what voltage they are providing. That's what all that teeny tiny (often confusing and intimidating) writing on the power supply is saying.

To read a power supply? Look for the word "Output". Next to it should be a number, with a V next to it. That's it, that's the voltage that power supply is delivering. I suggest you start inspecting anything that looks like the images above or below just to practice!

What 5V power can look like (and more!):



What 12V power can look like (and more!):



Part of my intent here is to show you *just how similar* these power supplies can look, even with different voltages. It took me a long time to understand that power comes in many form factors, so I hope this helps you get a head start I didn't have.

The magic of LEDs and USB:

In the world of LEDs I've found that the only immediately obvious indicator of what sort of power you are using is *whether that power is delivered by USB or not*. When I say USB, I mean this very common type, USB-A:



This type of USB connector dependably delivers 5 volts. No more, no less. You can count on it. And it's not the only USB type that delivers 5 volts as a standard. Micro USB also delivers 5 volts.

I have ended up using a TON of USB connections with my LED setups, because I know they are *always* 5 V and I don't have to worry or even think about it. They are also a stable connection that some LED controllers and many battery packs are set up to use.

A note on USB-C:

The biggest exception to the fact that USB connection (almost) always delivers 5 V is the new, popular type of USB connection, USB-C. Part of the usefulness and popularity of USB-C is that it can deliver *more voltage*, and therefore more power. It could theoretically deliver 12 V or more! This said, it's not the same as most other types of connectors. This is because USB-C is a **smart connection**. It is a rare example of a cable actively controlling your power flow, (most do not). USB-C can *read* and *change* the amount of voltage it accepts and delivers (most cables cannot). Inside the cable, USB-C checks what the object you are plugging into is asking for, power-wise. It needs permission and directions to give the right amount of power. This ("smart") little back-and-forth check between the USB-C cable and the thing you are plugging into is called a **handshake**. Unfortunately, this isn't super handy for LED strips because USB-C cables are *picky*. You need to know how to change their protocol to get them to work with anything you want, and that's challenging, and beyond the scope of this guide.

Next, Amperage, the AMOUNT, or how MUCH, power you need:

I've found, in my years of doing this, that there is a difference between the technically correct amount (Amperage) of power you should use for powering addressable LEDs...and what you can get away with. Unlike voltage, the amount (Amps) of power you need to run LEDs is **flexible**. It's not going to hurt your LEDs to underpower them. They will even let you know (most of the time).

SO, here's a dirty secret: I don't often give my LED strips the *technically correct* amount of power and *it often works out fine*. The more you play with LEDs the more of a feel for this you get.

The *technically correct* amount (Amperage) of power for an LED setup is assuming you will turn all your LEDs to full white (the highest power-drawing mix of RGB light), on full brightness, forever. The thing is, I don't think you want that. Or, well, I very rarely want that. And most LED patterns don't actually use white much, often not at all.

The technically correct amount of power that addressable LED strips want, on paper, is *a lot*. If you always use the technically correct amount you might start buying ridiculously large, expensive and obscure power supplies, which I did indeed do when I started. Leave that for when you are building large scale LED art or doing something with high stakes. For now, for a few addressable LED strips (two or three maximum), while we are learning, we can get away with a lot less power, which is a lot easier.

Remember your LEDs will let you know if you underpower them? Voila!:

Addressable LEDs and color cost! (Aka something slightly scary but harmless your LEDs might do aka TROUBLESHOOTING TIP):

When LEDs are underpowered they will simply start losing certain color tones. First color you lose is Blue, then Green fairly soon after. When you are underpowering your LEDs (for example, running out of battery power), they will end up fading to simply, Red. Because Red is the least power costly color. This can look visually different in different LED displays, but if your LEDs are showing some or all red, or even just warmer tones, you haven't broken them, they just aren't getting enough power (Amperage).

What does all of this have to do with knowing Amps? Well, once you find your 5V power supply, next to where it says 5V it's going to give you a number like ".5A" or "4A" or "10A" or even "10,000mAh". That's how they are telling you how many Amps that power supply is able to give you. [Amps](#) means (roughly, essentially) the *amount* of power you are getting, which translates to how well it can handle the load that is being asked of it. With batteries the amperage lets you know the amount of power that battery contains in one charge, and therefore how long you can power something for.

Long story short, for one 16.5" addressable LED strip running mostly rainbow patterns you can get away with anywhere from ~3 to 10 Amps with both 5V and 12V supplies. For portable USB battery packs, they are going to give you mAh (milliAmp hours) instead, and the range you want is anything above 5000. 10,000 mAh is going to last you a solid 8ish hours and is the type of USB battery pack I use the most.

If at this point you are like "but I would like to know how to figure out the technically correct amount of power please and thank you!" I deffo suggest following that curiosity, and there are plenty of resources! Again, Adafruit is a [great place to start](#) and I give a few more resources further down.

All of my advice around power is coming from a place where I am comfortable with manipulating power because I understand it, so I feel ok bending the 'rules'. For electronics I don't know so well, I take my time and look things up. I suggest you do the same. I have no formal training and have picked all this up here and there, mostly through working on electronics with my hands directly.

It is also handy to know that when working with "small" electronics, batteries and 5 or 12V, there is little danger of hurting yourself much. Always be careful with house wall sockets, but also know that small electronics are a categorically different (low) level of danger compared to large electrical projects.

Fun fact: the same things you are learning about electricity here apply to electricity anywhere. LEDs are a gateway to all electrical knowledge!

Injecting Power:

If you use a lot of LED strips in one project, you'll want to learn how to "inject" power. Why? Well, power is kinda like water. It'll rush through a pipe (the LED strip and connectors) fairly easily, but the "water" will lose strength if the strip (pipe) is very long, or if it's being squeezed through super thin wires. Fortunately, you can add more power into the strip at the point it starts losing power. This is a bit beyond the scope of this guide, but wLED has an [excellent guide on wiring](#) that goes over power injection. If you are struggling with power loss on a large project, check this out.

A few final notes on power:

Of all the sections in this guide, this one on power took the longest. After thinking about it for a while I don't think it's because the information is more difficult, it's that the cultural gatekeeping around electricity and power is huge, and I want to make sure I impart confidence and ease around this subject. As you start engaging with electronics, I hope you can carry some of that sense with you. The jargon and information out there can get very intense and complicated. That doesn't mean you don't, or can't, understand and use it safely. Of all of the information I hope to make accessible in this guide, understanding power and electricity is what I hope to instill confidence around most. It is literal power, and I want that power to belong to you.

A few resources to learn about electricity:

I will not give you standard recommendations here, that's why there's so few. But mine are *fun*!

- [The Manga Guide to Electricity](#)
- [Power Up](#) zine by Lee Borg

Just tell me what to get to make it all work!

Here's a few setups that I use all of the time that will make it all *just work*:

1. Say you are using [ws2812b LEDs](#) that are 5 meters (16.5") long, and [this generic USB controller](#). Use this [wall plug](#), OR (if you need to go portable) [this USB battery](#) and [this cord](#), will make them go go! A wall plug is best if you are installing them in a house or somewhere with a stable wall outlet.

2. If you want something portable and affordable that you can drape on a backpack or yourself, or even put in the lining of a coat, try this [LED strip and controller](#) kit with this 10,000mAh [USB battery pack](#).

3. If you want something a bit more expensive with *way cooler* light patterns, go with a [ws2812b LED strip](#) of any length and waterproofing you choose, a [Pixelblaze LED controller](#) (read the setup docs, you can do it! It is beginner friendly if you take your time.), and either a wall plug or USB battery pack like the ones listed above.

CONNECTIONS: (Warning! This section is unfinished and under construction)

Something that will start coming up as you get into LED strips, and electronics generally, is how everything is connected together. There are many connection types, with various benefits and uses.

A brief introduction to the concept of “connectors”:

So, when working with electricity you tend to use wires (cable, cord) to get power and data from place to place. Since you are possibly buying your LEDs, controller and power supply all separately, you might also need to make sure you have the correct cable connectors to make sure they all connect to each other. This takes a bit of know-how.

Here’s a core concept to understand about wire and connectors. *Most* of the time, *especially* when dealing with LEDs in the way this guide shows you, **the wire and connectors themselves are (almost always) not doing anything special. They are not “smart”**. They take and pass along any voltage or amperage. The only thing limiting the type or amount of power they take is the thickness of the cable itself. And for our purposes (LEDs), you don’t have to worry about that.

I say this because I found this confusing when I started, and I’ve noticed other people do too. For example, say you have a red wire. And you have another wire, a green wire. Can you connect those together? Will anything bad happen? Maybe, because of what’s on the other end of each of those wires, but it will ***not be because of the color of the wire***.

Another example. Connectors come in pairs, that’s how they connect right? Think USB plug and socket. Or a wall plug and socket. Or, (often for LEDs) a JST plug and socket (if that’s not familiar, you will learn in a minute!). So. You have a JST socket at the end of some wire on the end of your LED strip you just bought. What happens if you cut that end off, and swap in *the opposite type of JST* (pin side)? Does that change the flow of power? Does it change the flow of anything? Does it blow my stuff up!?

No, nope, not even a little. For all of the above, good news, you should not be concerned! Most connectors, and all wires, are doing one thing: simply connecting your shiz together. They are almost all “dumb” connections, they don’t control anything themselves, they are just drawing a line from A to B. Control over what those wires and connectors are doing is going to come from somewhere else in

your system, like your controller or your LEDs. (For more info and the rare exception of USB-C, check out the [Magic of LEDs and USB](#) section further up in this doc.)

Ok. So whew. One less thing to worry about right? Well...mostly.

It's true that you can connect a red wire and a green wire together and they will work as one wire. But **socially?** Sometimes annoyingly, often usefully, in the world of electronics we have what are called **standards**. *This* is why people will tell you to never connect red wires to green wires. It would be confusing to you, and anyone else that looks at your project, because red wires and green wires indicate different *standards*. Red means power, green usually means data, black or white usually means ground. There are some standards that are common sense, and many that are not. It takes a while (took me a long while, honestly!) to learn the difference between what is important *electrically* with connections, and what is just a common *standard*.

Power, Data and Ground wires in LEDs:

LED strips all have Power, Data and Ground in common. Going back to how I recommended you use WS2812 LED strips to start, all WS2812 strips will require Power, Data and Ground to work.

I mention this because there are LED strips, like the WS2815, SK9822 and others, that have an additional fourth wire connection, called Clock. Clock helps regulate subtle things about the LED strip lighting, like making something called the **Framerate** work more smoothly. In the beginning, you won't notice framerate, and don't need to worry about it.

Connecting wire

To connect wires together, you can absolutely do something you might assume should happen, or maybe have seen folks do: You can strip the wire (take the outer insulation off the wire), get down to the bare metal, connect the metal together and solder that connection to make a secure connection. That can be a good choice. It is, however, rather *permanent* and also fairly tricky to do at first. Also, it involves soldering, which you may or may not want or know how to do.

Common LED connectors:

In the sandbox of LEDs, here are the standard connectors that you'll encounter most often.

[Screw terminals](#): screw terminals are essentially a way to connect wires to a circuit board (like your controller board, whatever it is) by screwing and unscrewing little...screws. Ahem. Maybe some images will help. You might need to solder your screw terminal to your controller board. Don't panic!



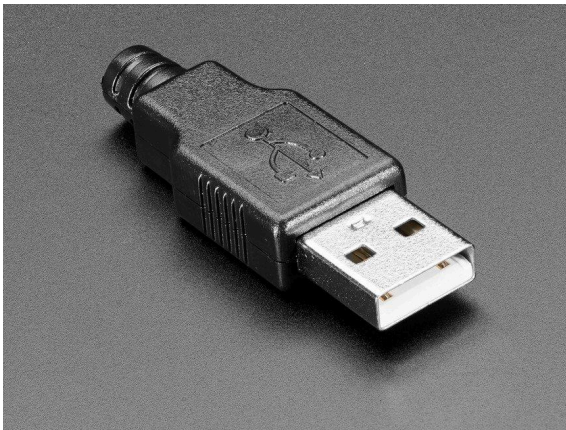
JST: JST connectors are incredibly common when you work with LED strips, particularly addressable LED strips. In fact, most addressable LED strips that you buy will come with a 3pin or 4pin (“pin” just means the number of wires coming out of it) JST connector already attached. You may need to purchase a [pack of JST connectors](#) to connect your LED strip to your controller. 3 pin JST is the type that will be used with the LED strips I keep mentioning, the ws2812b, because it only has 3 pads to connect wires to:



Barrel: Barrel connectors are used in all kinds of electronics. You may have seen them on laptop cords, other appliance cords, or on audio or video cables. They are versatile. The most common use of them on LED strips is to connect the LED strip to power. They come in different form factors, like ones with wires coming off of them, or ones with screw terminals you can connect wires to yourself.



[USB-A](#): Fun fact about USB-A: They can only deliver 5 Volts! I talk about it more [here](#). They are very common, you probably use them regularly. I like to use them to deliver power to 5 V LED strips.

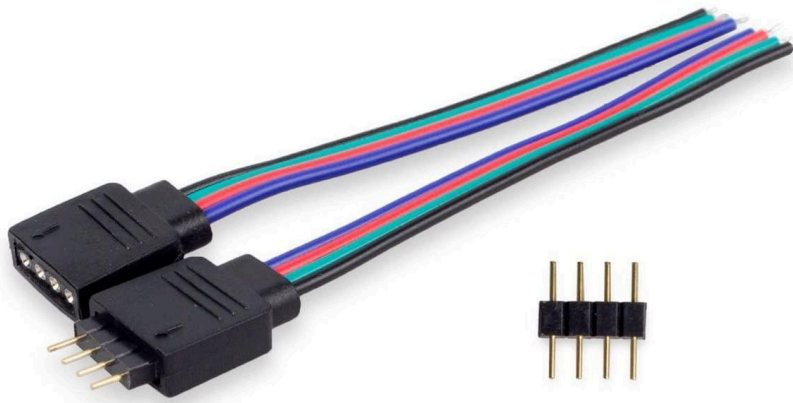


Other ways!

[Wire wrapped](#)

Warning! Do NOT buy these pin connectors if you can help it:

They just suck. And are common. They pull apart easily, and they break easily. They are unfortunately common in plug-and-play LED kits.



Soldering!

While I feel confident that you can get a lot of information you need from this guide, soldering is a stretch for me to teach through writing, and I want to emphasize that you can use 99% of this guide and get brilliant LED strips working *without soldering*. I spent years working with LEDs before soldering.

But if you want to learn, that's great! It's a neat skill. So, think of soldering like applying eyeliner, or painting nails. It's finicky, and it takes practice, and it's easiest to learn in person with your hands on a tool. **MOST** importantly, it's **not as hard as some people make it seem, and you can absolutely do it.**

I will not explain soldering step by step in this guide, but I will give you excellent resources to learn!

- Adafruit's [guide to excellent soldering](#)
- There are so many cute, fun, useful kits to learn soldering with. I enjoy [Learn to Solder kits](#), kits from [Alpenglow Industries](#), and if you are enjoying looking at and learning about indie electronics kits, check out [Tindie](#). It's the Etsy of electronics.
- In my experience, **your soldering iron REALLY MATTERS**. I use a [Pinecil](#) as my preferred soldering iron. It's friendly, portable, and heats up really fast! It's sometimes out of stock on the website, but you can also [get it on Amazon](#). You will need a USB-C to USB-C cord and/or power supply. If you want to connect it to a portable USB battery pack the battery pack must deliver 12 to 20 V. Try searching for "20 volt portable USB-C battery" on the platform of your choice. I recently bought [this one](#).

ADHESION:

There are endless ways of attaching your LEDs to things, but it might be harder than you expect! Since LED strips are relatively fragile, usually only bend in one direction, and are made of plastics, it can be hard to figure out how to attach them to things, especially complex things. Many LED strips come with an adhesive liner on the back, buuut I wouldn't trust it in most applications. It doesn't tend

to stick very well over time.

Easy:

- None (just drape 'em! I call it "The Zen Art of Draping an LED On It")
- Safety pins (I use these with wearable LEDs ALL THE TIME. Don't underestimate them.)
- Zip ties (similarly awesome to safety pins)
- Binder clips
- 3M double sided tape (the stuff that comes on the back of the strip is often 3M or similar)
- Magnets (fun fact, magnets do not negatively interact with LED strips!...unless you crush it)
- wire wrapping

Medium:

- Stick 'em in a tube and attach it. Tubes can be plastic, fabric, anything that's clear or translucent.
- Hot glue
- Mounting brackets and screws (brackets made specifically [for LED strips](#) exist.)
- Sewing them on (usually hand-sewing)

Hard:

- Any liquid glue (it's a mess! And often doesn't work!)
- [RTV Silicone](#) will adhere to the silicone sheath that comes on IP 67 LED strips, which can be very handy if you cut a strip and want to re-seal the end, or if you want to attach it to wood or whatever.
- Bury them in resin (basically impossible to fix mistakes)
- 3D print custom brackets or channels

Bad idea:

- Staples (I thought I was so clever when I first did this, but it turns out that when you connect metal to the copper pads on an LED strip, it can short and be very bad!)

DIFFUSION: (Warning! This section is unfinished and under construction)

Diffusion is when you want the bright points of light that LED pixels give off to visually blend together, until you can't visually distinguish where one pixel starts and ends. This is done by covering the LEDs in one way or another. YOU get to choose if you want to add diffusion to your LED project, it is not required, and your aesthetic taste is what you should shoot for. Here's some starting points:

- I highly suggest playing with white faux fur, it's an excellent diffusing material, or even paper or whatever somewhat transparent material you have around. Ping pong balls and pool noodles are quite popular to use as well!
- If you have access to a sewing machine, a lasercutter, a 3d printer or any other type of craft that might be able to work with a material that could diffuse the LEDs, maybe play around! You can use resin (try it with pigments and dyes), any fabric that might work, clay, hot glue and more. [Black LED diffusing acrylic](#) exists for lasercutting. And for 3D printing, translucent clear filament is good, but you can also play with white (stronger diffusion with less material), and even smokey gray translucent.

- [Adafruit's guide to diffusion](#)

- [13 ways to diffuse LEDs](#)

A few other options:

- You can buy ["Neon" LED strips](#) that come pre-diffused, inside of a silicone sheath. There are a few different versions of this style of LED strip. They do not use any actual neon fabrication processes, the term "neon" is only used because of the visual effect these have. "Addressable neon LED strip" is a good search term to find this kind of thing. These LED strips can only bend in one direction, just like standard LED strips.

- You can also buy [silicone sheaths](#) to add to the LED strips you already have. There is a learning and research curve here to figure out which sheaths are compatible with which LED strips, and it is notoriously challenging to get an LED strip to fit into a sheath. Therefore, I suggest you attempt this when you have a specific project in mind that requires this level of customization.

- Both of the silicone sheath options mentioned above are a different form factor than a type of LED strips referred to as COB leds. [Addressable COB leds](#) are diffused with a plastic, flexible coating and they are generally thinner, and smaller, than "Neon" LED strips. They come in both single colors, and addressable LED options.

Troubleshooting: (Warning! This section is unfinished and under construction)

- [troubleshoot LED strip problems](#)

What to check first when your LED setup isn't working:

- connections - power and ground - correct data direction - is your power on? You sure?

FAQ: (continuously updated)

Where did you get...?:

- **Where did you get your awesome soldering iron?:** I use a [Pinecil](#) as my preferred soldering iron. It's sometimes out of stock on the company's website, but you can also [get it on Amazon](#). You will need a USB-C to USB-C cord and/or power supply. If you want to connect it to a portable USB battery pack, that battery pack has to be able to deliver 9 to 20 V. Try searching for "20 volt portable USB-C battery" on the platform of your choice. I recently bought [this one](#).

- **Where did you get those cool LEDs?:** Here's a short list of links to my favorite LED form factors. These links are *only* for the LED "strips" (or wire, or matrixes, or other LED form factors) themselves, meaning they don't come with controllers, or a way to plug them in, or batteries. You will need to find, choose and buy those yourself.

- [Extremely dense LED pebbles](#). I am currently most excited about the 1.5 cm pitch, but anything up to 5 cm pitch is useful to me! (that's 15 mm and 50 mm respectively) **Warning:** the more dense this form factor is, the more it requires intermediate/advanced abilities in wire stripping and soldering. But they are cheap so you can practice lots! Does NOT come with a JST connector.

- [Extremely dense, tiny 2020 LED strips](#). (Not diffused) I get them from Aliexpress, but you can find them on [Adafruit](#)! Typically comes with a JST connector.

- [Small COB LED strip, 2020 5mm thickness](#) with diffusion (you might have seen this on my wizard hat or staff!). These are on Aliexpress. There is also a [2.7mm thickness](#) available. (Note: on the 2.7mm the power and ground pads are on one side of the strip, with the data pad on the *other side*. This is to fit solderable pads on such a tiny strip. Both come with a JST connector.

- [16 x 32 "transparent" LED matrix](#). Gorgeous. Between every pixel on this hard (not flexible) rectangular LED matrix is a hole. This makes a fully see-through screen effect, while having a beautiful LED matrix effect. 3 pin, works as WS2812. Comes with a JST connector.

- **Where did you get your LED mask?:** You can find them by searching for "LED mask" anywhere, but the original creator is [Chelsea Klukas of Lumen Couture](#) and I suggest you support her directly. She also designs a bunch of other rad, groundbreaking wearable LED fashions.

- **Where did you get your LED backpack?:** [Aliexpress](#). This is also something you can just search for anywhere with "LED Backpack" and find a lot of results.

Other things Claire's known for that you might be looking for:



I have created a tutorial to teach you how to make a [handheld light graffiti projector](#). Very useful at protests, or anywhere!

I have also started a document called [Claire's Cool Solar Resources](#). I am enthusiastic about off-grid solar power and want to get as many people into it as possible. And guess what? A huge part of how I came to understand solar came from understanding LEDs. The electrical concepts are the same!

[There U Glow Camp Swag Bag](#). A Google Drive I created to expand upon this document. Hella high-quality, open source, free files to make electronics/tech more accessible. Several soldering guides, and more. Take it all!

And finally, I am also a huge nerd about healing trauma and dealing with mental health struggles. For that, a few years ago I created my [Resources for Emotional Overwhelm](#). I hope it helps 💖

Generally helpful links: (This section is unfinished and under construction)

- [Adafruit's overview of LEDs](#) (broader in scope than just Neopixels or LED strips):
- [LED projects on Adafruit](#) (a ton are beginner and non-technical friendly):
- [Addressable LED Controllers, Drivers, and Related Products & Projects](#) (a community sourced document of all of those resources. Not a community I am in, but useful.)
- a lot about wearables: <http://www.wearabletutorials.com>

Contact Info:

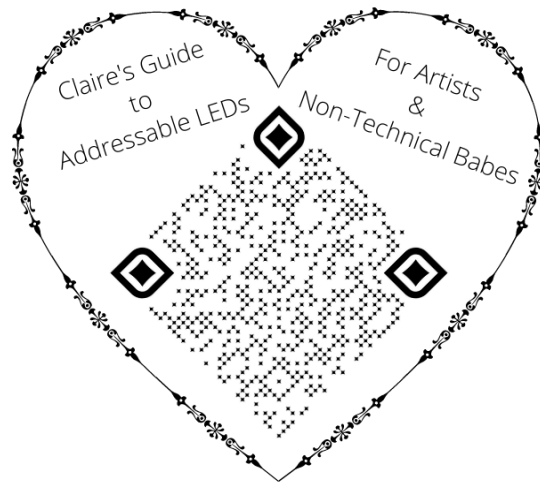
This is a living document that I will continue to update and add to over time.

If you wish to support my work and the continuation of this documentation, you can follow and/or support me through [my Patreon](#). Everything I share there is also always open and free.

If you have questions, suggestions or comments about this doc you can contact me at clacassidy@gmail.com, and I may get back to you (though I reserve the right not to). I rarely teach in person, and hold boundaries around how much emotional and unpaid labor that I do. As time goes on links in this guide may break, disappear or not be the most current. If you notice that please let me know.

You can find me on mastodon [@LaserMistress@mstdn.social](https://mstdn.social/@LaserMistress) and here is [my Linktree](#) if you would like the full list of my public offers.

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And remember, I am SO SO proud of you!!
Thank you for every second you take a chance on yourself by
learning technical stuff, no matter where you go with it 💖🌟