How to Connect Extra Power Directly to LED Strips

a guide from Visual Vibes

ViVi only works with 5V and will be **damaged if 12V is attached** to it or the LED strips it is controlling. There is a separate guide on how to safely use ViVi to control 12V LED strips, **this guide covers 5V only** setups.

Disclaimer

This is an informational guide, not step-by-step instructions on to how wire extra power connections. Every setup is slightly different, so the information in this guide is meant to be understood and then applied to your specific setup as needed. Electricity, even at 5 volts, can be extremely dangerous and cause fires if wired improperly; and the power supplies all take in full voltage of 120V or higher which can cause injury or death as well as fire.

If you do not clearly understand the information in this guide or are not confident in your ability to perform the custom wiring required then it is strongly recommended to **HIRE A LICENSED PROFESSIONAL ELECTRICIAN**.

This guide covers three examples of different extra power needs and has additional information on topics related to LED power distribution.

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Summary and Quick Calculations

ViVi can only pass-through a maximum of 5 amps of continuous current. If this is exceeded a protective circuit shutdown the controller and any lit LEDs should turn red and the animation will freeze. To reset unplug the power and wait 1 minute, then plug back in. If ViVi sets the LEDs red and freezes too quickly, remove some LED strips before restoring power. Follow the guidelines below for creating a setup that does not exceed the power limits.

LED POWER GUIDELINES (amps per 100 LEDs at 5V):
1A per 100 LEDs – Music reactive animations, 100% brightness
2A per 100 LEDs – Constant on, all LEDs, assorted colors, 100% brightness
3A per 100 LEDs – Constant on, all LEDs, white, 100% brightness
Power consumption drops in relation to brightness, power consumption decreases faster than brightness, so, for example, LEDs set to 70% brightness will use 60% of the power compared to LEDs at 100% brightness.

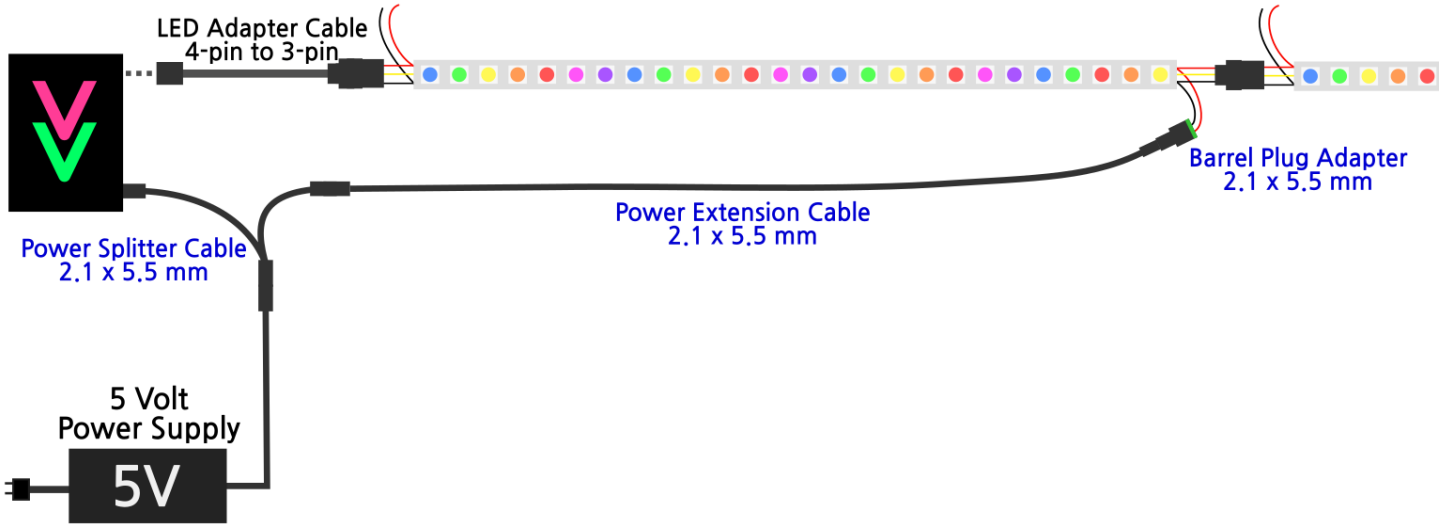
If your calculated power consumption exceeds the rating of your power supply (8A for the power supply included in ViVi kits) then you will need an additional power supply.

Example Setups with Extra Power

Two Strips in Series (strips connected end-to-end)
It's best to connect power in between the two strips rather than at the far end of the second strip, but you can connect it at the far end, or even at both the far end and the center.

Depending on the total number of LEDs the extra power may not be needed to avoid exceeding ViVi's power pass-through limits, but it is needed to correct the effects of voltage drop (voltage drop is explained in detail later in this guide).

Examples of the items labeled in BLUE can be found at the end of this guide.



Many Strips in Parallel (strips using a splitter)
It may be necessary to connect extra power to that start of the strips, where ViVi is connected. This is because electricity follows the path of least resistance, so even with extra power attached further down the strip there are enough LEDs closer to ViVi's connection that they will still draw too much current through ViVi and cause it to shutdown.

[pic]

Very High Power Demand (so many LEDs!)
If your setup is going to be used for constant-on high brightness lighting or use well over 1,000 LEDs with any settings then it may be necessary to completely isolate ViVi from supplying power to the LEDs. Even with extra power connected at the start of the LED strips it is possible for very high power setups to still draw enough power through ViVi to trip the protection

[pic]

How to Attach Power Plugs to LED Strips

Two options, solder pigtails to the existing extra power wires or use screw terminal clamp plugs.

[real images of each]

ViVi's Limits for Power and Total LEDs

These two limits are not directly related!

How many LEDs?
It can control 300 LEDs addresses per output, for 900 total. These data signals can be split to multiple strips so that they show the same thing, so you can control more than 900 LEDs with this method. It can power the LEDs directly as well, but if more than 600 LEDs are being used additional power connected directly to the LEDs will be required to prevent overheating the controller circuitry.

What length of LEDs?
Maximum length of LEDs depends on the density of the LED strips and installation configuration of the strips. The main limit is the number of LED addresses, which is 300 per channel. Using 30 LED/m strips that would be 32 feet. You can also use a splitter (or multiple) to send the same signal to more than one strip, so still a max of 300 unique LEDs, but you can have multiple strips displaying the same thing; The most common use it to start two strips at the same point and go in opposite directions, so you could have a span up to 64 feet that is mirrored from the center.

When using more than 600 LEDs total you need to run additional power directly to the LED strips to prevent tripping ViVi's overheating protection. When connecting strips end-to-end you need to run power directly to the LED strips as well because voltage drops over distance and affects the color and brightness of LEDs furthest from ViVi; lowering the brightness can reduce the effects of voltage drop as well.

Power Consumption of LEDs

LED POWER GUIDELINES (amps per 100 LEDs at 5V):
1A per 100 LEDs – Music reactive animations, 100% brightness
2A per 100 LEDs – Constant on, all LEDs, assorted colors, 100% brightness
3A per 100 LEDs – Constant on, all LEDs, white, 100% brightness
Power consumption drops in relation to brightness, power consumption decreases faster than brightness, so, for example, LEDs set to 70% brightness will use 60% of the power compared to LEDs at 100% brightness.

Voltage Drop Explained

As power travels down an LED strip and passes lit LEDs the voltage will decrease and the furthest LEDs begin to get dimmer and the color shifts to red (the red diode operates at the lowest voltage). At 150 LEDs it is barely noticeable, at 300 it's very noticeable, but you can turn down the brightness to help keep the strip more even. Attaching extra power further down the strip corrects voltage drop.

Setup Design Tips

What is a large setup?
A setup in which a single continuous strip is planned to be greater than 7 meters (23 feet).

Data Point: A single digital address that can have the RGB values adjusted. On 5V strips this is a single LED, on 12V strips this is a group of 3 LEDs that all change together.

12V stuff, ignore for now

Use less memory per meter of lights
ViVi has a memory limit of 500 data points per output (only 300 max for animations to keep a high frame rate), so this allows for more total LEDs in a continuous strip.

Note: If one output's signal is split to multiple strips, the additional strips are using the same data and not using additional memory.

Animations appear to move faster
Which is good for big displays that cover a large distance. When ViVi changes one LED from lit to off and lights up the next one to create the appearance of motion it does this at a fixed rate, so the further apart the LEDs are, the faster the "object" appears to be moving. Using 30 LED/m density and 12V strips makes the data points (group of 3 LEDs) the furthest apart for any strip type and provides the fastest perceived animation speed.

If using string lights you may be able to order custom distances between each LED or modify them yourself.

Animations actually move faster when less data points are used
We are working on a custom protocol that transmits data faster than the standard specifications and it will reduce the following effects and allow more data points with a higher frame rate, but it is not yet complete, so the following is still relevant:

Different from the perceived speed, the actual time required to display each frame is increased when there are more data points. The time to change frames (update all LEDs on the strip) is most significantly limited by the communication protocol for the LEDs, there are strict timing requirements and each data point requires 30 microseconds to send data for, so the more LEDs you have the more time is required to send the string of data to update the strip.

The data protocol has the largest effect, but the math to generate each frame also takes time, and as more data points are added the time to compute each frame also increases and adds more delay to the time between frames.

ViVi has a target frame rate and once a single output exceeds approximately 300 LEDs the timing limitations add up enough to have a noticeable effect slowing down the frame rate, and it gets worse as more data points are added. With three outputs the timing on one output can affect another, but because calculations for each output are done separately and the data for each is sent separately the total data points across all outputs has a lesser effect than the total on a single output.

5 Volt, 300 vs 150 LED reels (60 LED/m vs 30 LED/m)
300 is not necessarily better, it all depends on how big of a setup you're building and what your goal is.

ViVi can control a max of 300 LED addresses per output for animations (to maintain a high frame rate). So if you want more than 5 meters of continuous strip you would need to use a splitter instead of connecting strips end-to-end when you have a 300 LED strip.

ViVi can directly power 600 LEDs at 100% brightness running animations, at 50% brightness you can do about 1200; you can always connect extra power directly to the LED strips if more power is needed. Here is a chart for estimating power use, the estimates are a little high because this is for choosing a power supply, not necessarily the exact amount the LEDs will use:
LED POWER SUPPLY GUIDELINES (amps per 100 LEDs at 5V):
1A per 100 LEDs – Music reactive animations, 100% brightness
2A per 100 LEDs – Constant on, all LEDs, assorted colors, 100% brightness
3A per 100 LEDs – Constant on, all LEDs, white, 100% brightness

There is also **voltage drop** to consider, as power travels down an LED strip and passes lit LEDs the voltage will decrease and the furthest LEDs begin to get dimmer and the color shifts to red (the red diode operates at the lowest voltage). At 150 LEDs it is barely noticeable, at 300 it's very noticeable, but you can turn down the brightness to help keep the strip more even. Attaching extra power further down the strip corrects voltage drop.

One final thing is the perceived animation speed for any animations that have linear movement. Because the LEDs are twice as close together whenever a lit LED moves one position it only covers half the distance, so linear animations will appear to move at half the speed.

Product Examples and Suggestions

The following products can be used for adding extra power to LED strips. It is not required to get the exact products listed, they are all standard items available from various manufacturers and stores.

5V 10A power supply
https://smile.amazon.com/ALITOVE-Adapter-Converter-Charger-5-5x2-1mm/dp/B01M0KLECZ

5V 8A power supply
https://smile.amazon.com/gp/product/B078RZBL8X/

BIG power supply
---example here---

No-Solder barrel plugs for connecting power to strips, 2.1 x 5.5 mm, 10pk
https://www.amazon.com/5-5mm-2-1mm-Female-Connector-Camera/dp/B005CMP434/

Barrel Plug Pigtails 18awg (soldering required), 2.1 x 5.5 mm, 10pk
https://www.amazon.com/gp/product/B072BXB2Y8/

Power splitter and 5m extension, 2.1 x 5.5 mm
https://www.amazon.com/Eleidgs-Splitter-Female-Adapter-Extension/dp/B0718ZQVYN/

PORTABLE POWER

USB 2.0 Power Enhancer Y Cable, 1 Female to 2 Male
https://www.amazon.com/gp/product/B00NIGO4NM/

Anker PowerCore 20100mAh - Ultra High Capacity Power Bank with 4.8A Output
https://www.amazon.com/Portable-Charger-Anker-PowerCore-20100mAh/dp/B00X5RV14Y/