

How To Build an Inexpensive 365nm UV Exposure Unit

A practical step by step guide that details everything you need to know

Introduction

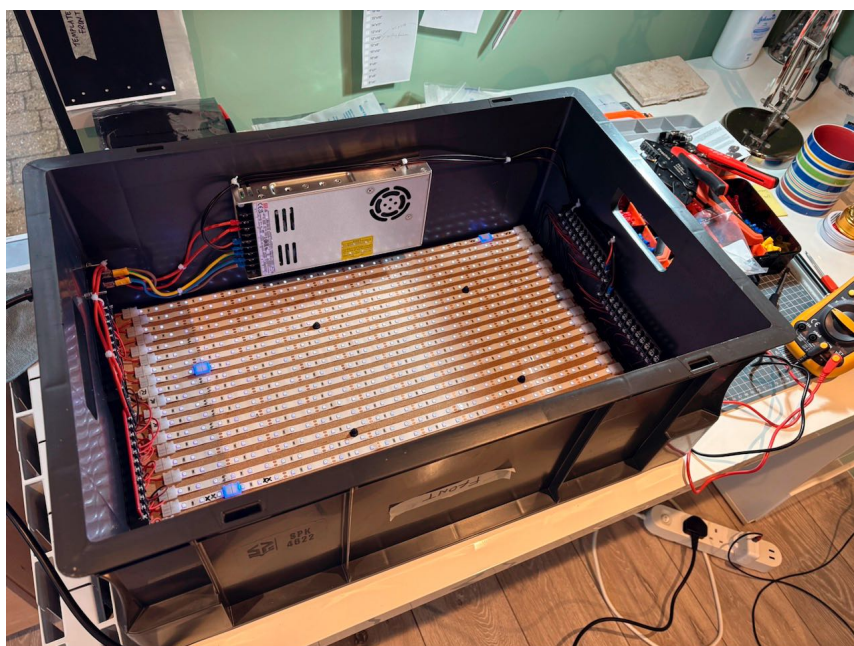
This guide describes how to build a simple, inexpensive 365nm LED exposure unit suitable for alternative photographic processes such as photopolymer etching (photogravure). It is based on a design developed for use in my own darkroom, as well as a second unit built for someone else, and focuses on a practical, no-frills approach using readily available components.

Commercial exposure units and kits can be expensive and often offer little advantage over a well-designed DIY alternative. The aim here is to produce a unit that is reliable, consistent, and straightforward to construct, without relying on specialist parts or complex electronics. The guide explains not only how to build the unit, but also the reasoning behind the key design decisions, so that the design can be adapted if required.

The approach assumes a basic level of confidence with component sourcing and electrical work, including low-voltage wiring and mains connections. Where appropriate, design choices and trade-offs are explained so that readers can adjust the build to suit their own requirements.

In use, the combination of 365nm LED strips and a relatively shallow enclosure allows for short and repeatable exposure times. For example, when exposing an aquatint screen for photopolymer gravure, exposures are typically under three minutes with consistent results across the plate.

This guide assumes basic competence with low-voltage wiring and mains electrical safety. If you are not comfortable working with mains power, seek assistance.



The design is driven by a set of practical goals that reflect cost, usability, and the requirements of alternative photographic processes. These goals inform the design choices described throughout the guide:

- Lower cost than commercial units and kits
- Built from readily available components
- Based on proven design principles and component choices
- Easily customisable to suit your needs
- Lightweight and portable
- Optimised for 365nm UV output
- Capable of exposing up to A3+
- Short, consistent exposure times
- Compatible with an external darkroom timer

This guide is organised into a series of stages, covering design, materials, construction, and wiring. Each section explains both the practical steps involved and the reasoning behind them.

Where options exist, they are noted explicitly so that the design can be adapted to suit different budgets, component availability, and working methods. You can choose to follow the guide exactly or use it as a basis for their own variations.

Design Choices and Options

This exposure unit is intentionally simple and adaptable. While the guide describes one specific implementation, many aspects of the design can be adjusted to suit different workflows, budgets, or space constraints. Where relevant, the implications of these choices are explained in the sections that follow.

Key design choices and optional variations include:

- **Enclosure size and depth**
The unit is built in a 40-litre Euro Container, which provides A3+ capacity and short exposure times. Taller enclosures can be used to increase exposure times if required.
- **LED density and total output**
The guide uses 365nm LED strips with either 60 or 120 LEDs per metre. Higher LED densities and longer total strip lengths reduce exposure times at increased cost but are not essential for effective operation.
- **Reflective lining**
Lining the enclosure or mounting board with aluminium foil or tape is optional. In practice, with the LED spacing and intensity used here, it is unlikely to make a meaningful difference.
- **Wiring approach**
All LED strips are wired individually in parallel to ensure uniform illumination. Other wiring arrangements are possible but are not recommended due to uneven brightness.
- **Timing and control**
The unit is designed to be switched by an external enlarger timer. A built-in digital timer can be added but offers no functional advantage for most darkroom workflows. Alternatively, an on/off switch could be incorporated to accommodate manual timing.
- **Cooling**
No cooling fans are included in this design, as exposure times are short and heat generation is modest. Fans can be added if longer exposures or higher output configurations are used.

These choices are discussed below and allow the design to be scaled or modified without changing the underlying principles of the build.

Step 1: Materials

The Box

This section explains the enclosure choice and how its dimensions affect exposure time and portability.

To meet the goals of portable and inexpensive, the UV unit is housed in a standard plastic *Euro Container*. These are widely available, come in all sorts of shapes and sizes, can be had secondhand if necessary, are heavy duty (thick plastic), and crucially are light and cheap.

For this A3+ unit, a 40 litre 400 x 600 x 200mm (*external* dimensions) box is recommended. Rationale is that for A3 plates (~300 x 420mm) this box gives ample headroom given that the *internal* dimensions are 350 x 550 x 190. The internal depth (190mm) is going to give short exposure times as the LED-to-plate distance is low. If you need longer exposure times, you can use the 80 litre version which has the same footprint but is 400mm tall.



Standard 400 x 600 x 200 Euro Containers

Box choice summary:

A 40L 400x600x200 Euro Container gives A3+ capacity, short exposure times, low cost, and good portability. Taller boxes increase exposure times.

The LEDs

This section covers LED wavelength, chip types, and strip specifications that directly affect exposure efficiency and uniformity.

LED strips on a roll come in many different forms and it's important to get the right ones. The most important factor is the wavelength of the UV light. Most alt-photographic processes, including photogravure, are optimised to use UV light at 365nm. UV light at other wavelengths will work but it needs to *include* 365nm, you'll just need longer exposure times (the Sun is a good example)

Another factor in LED selection is the *type* of LED chips. Some of the ones available are:

- SMD 5050
 - Three diodes of different colours per chip
- SMD 3528
 - Least bright
- SMD 2835
 - Newest, most efficient and longest life
 - These are the ones to get

The 2835 LEDs are less common but still readily available. They come in strips of either 60 or 120 LEDs per metre that primarily only differ on price. You will find some rated at 0.2W per LED and others at 0.5W. Again, price is a factor and the impact to the UV unit is, again, exposure time. Many LED suppliers don't state the wattage so assume 0.2W. You also want LEDs strips that are 12v (as opposed to 24v or USB power). Finally, you also want the LED strips to be 8mm wide (not 10 or 15mm) as this wastes real estate on the mounting board.

LED choice summary:

*When sourcing LEDs, search for **12v 2835 365nm** and either **60/m** or **120/m**. Expect to pay ~£120 for 15m of 60/m, and ~£200 (or significantly more) for 120/m. For the Euro Container box, 12m of LED strips fits well but given the modest additional cost, 15m is optimal.*



Important LED strip wiring polarity note

When the strips arrive, you will likely see that they have soldered wires at each end that are wired **RED** for **negative** and **BLACK** for **positive**, as reflected by the labelling on the strips themselves.

When wiring to the transformer, the **BLACK**, positive end of the strips is wired to the **NEGATIVE** (-ve) side of the transformer. And the **RED** end of the strips to the **POSITIVE** (+ve) side of the transformer. This will be at odds to what is printed on the LED strips.

This reversal is specific to how these strips are labelled internally and is common with some 365nm products.

You are encouraged to test this for yourselves – it will NOT damage the strips to wire them the wrong way round.

Mounting the LEDs in the box

For ease of construction, it's easier to mount the LED strips to a board that can then be attached to the bottom of the box than to mount them directly into the box. An MDF board is easy to source and is a sound substrate for the LED strips.

Lining the box with aluminium tape/foil is moot and is up to you. This design does not line either the box or mounting board. Given the intensity of the light and the spacing of the strips, it is unlikely to make a meaningful difference in practice.

To fit the 40 litre Euro Container a 350 x 540 x 18mm board is ideal.



8mm LED strips and 18mm MDF mounting board

12v Transformer and wiring

There are multiple ways of powering and wiring the strips and if you search YouTube for “DIY UV exposure unit” you’ll see quite a variety. The goal to keep in mind though is to have each strip having the same brightness. This is typically achieved by wiring and powering each strip *individually*. Individually, as in, each strip is individually wired back to the transformer. You *can* wire the strips into a single 15m chain with positive at one end and negative at the other (and other similar arrangements) *but* the brightness of the LEDs at the end of the chain will be significantly lower than the ones at the front. This will be unusable as an exposure unit as the light will not be uniform across the plate. NOT RECOMMENDED.

There is a bit more complexity in wiring each strip individually, and it requires a few more components, but is easily achievable – and far superior. And besides, it’s the *best* way of doing it if you want uniform brightness across the UV unit.

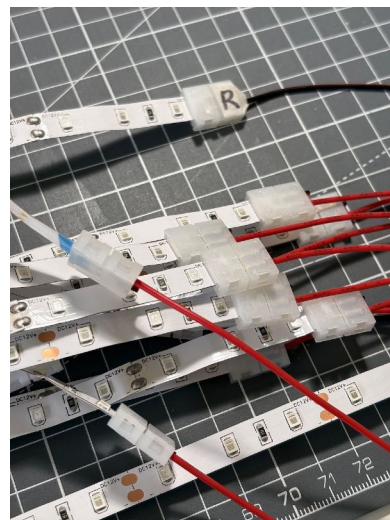
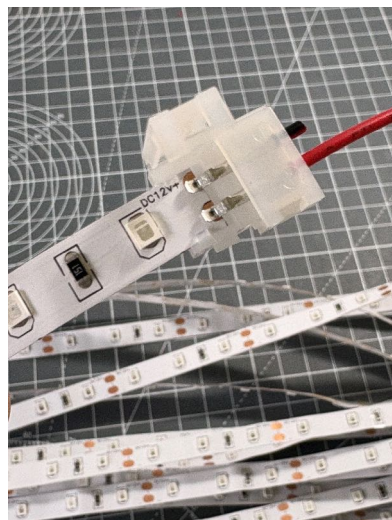
We’re using 12v LED strips so the heart of the power side of the unit is the 12v transformer. These are widely available and they convert the mains power to the 12v power required to power the LED strips (and the cooling fans and timer if you include these in your design). You need to choose a transformer that is sufficiently powerful to power all your strips. This is very important. You want a transformer that has more than enough power capacity for the number of LEDs you will be using.

The **Mean Well LRS-350 12v 350W** transformer is widely used and readily available from many sources. Note that it is a transformer designed to be enclosed so requires mounting *inside* the box as it has exposed terminals.



The Mean Well LRS-350 12v 350W transformer mounted inside the Euro Container

It is possible to solder wires onto the ends of each cut LED strip, but it's much easier and perhaps more reliable, to use connecting strips (pigtails). These are designed for 8mm LED strips and make wiring the strips quick and easy.



Inserting the strips into the pre-wired pigtails. Note that each pigtail has one wire removed.

Each pigtail has two wires but as the strips are being wired in parallel, only one wire at each end is used so you need to cut one of the wires off (and discard).

To wire everything together you'll also need the following as a minimum:

- Terminal blocks (12-position dual row)
 - To facilitate wiring each strip individually while keeping the wire runs as short as possible.

- 16 AWG wire (red and black)
 - To wire the terminal blocks to the transformer (12v side). Some of these runs are quite long (see construction photos) hence the heavier gauge.
- 3-Core mains wire (1m)
 - To wire the mains socket to the transformer (240v side)
- Socket for the mains lead
- Assorted machine screws, crimp connectors and cable ties

Wiring summary:

All LED strips are wired in parallel back to the transformer to ensure uniform brightness across the exposure area, using pre-wired pigtails rather than solder.

Timer and cooling fans

Instead of having a timer built into the unit, you might find it easier and more practical to use a darkroom enlarger timer that behaves as the on/off switch for it.



A simple enlarger timer capable of timing 0 to 999s

You can wire a digital timer into your unit but given the plastic Euro Container based design, implementing one might not be practical. Alternatively, an on/off switch can be incorporated into the design to facilitate manual timing. This would be wired between the incoming mains wire socket and the transformer.

While LED strips generate some heat, exposure times are short, so this design doesn't incorporate any cooling fans. They can easily be added however, and the Mean Well transformer has the capacity should they become necessary.

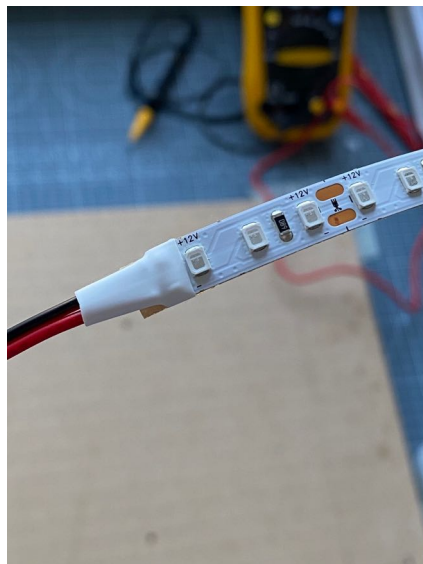
Step 2: Mounting the LEDs on the board

The first step is to cut the LED strips to length and for the size of MDF board described above, the strip length is ~500mm. In practice you need to cut the strips at one of the designated cutting points marked in the strips themselves.

With the strips cut and ready, the next step is to connect each one to a pigtail (having tinned, if necessary, the pigtail wires):



LED strip connected to a pigtail connector before the locking part is clicked into place



*This is how the strips arrive: Black to +ve and red to -ve.
Note that the red wire is not on the +ve side as you would expect.*

When the strips each have a pigtail attached, they can be stuck to the board. The strips are self-adhesive, so this is straightforward. You will need to calculate the strip gap to match the size of the board to the number of strips you have. The calculation is:

- LED strips are 8mm wide, and if the strips are ~5mm apart, each strip will use 13mm of the width of the board
- The board is 350mm wide, so $350\text{mm}/13\text{mm} = 27$ strips
 - But remember there is one less gap than there are strips (27 gaps in between 28 strips)
 - So, for 28 strips, and 27 gaps:
 - 28 strips is $28 \times 8\text{mm} = 224\text{mm}$
 - 350mm board – 224mm of strips is 126mm (for the gaps)
 - 126mm divided by 27 gaps = 4.6mm

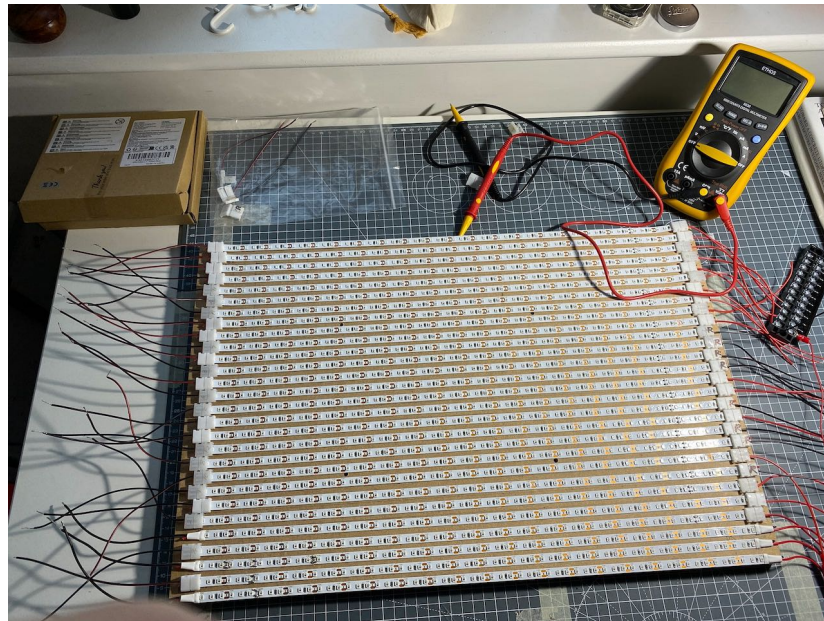
As each LED strip now has a pigtail attached at each end, one with a red wire and one with a black, it is a sensible precaution to test each one for electrical integrity. Most multimeters have a continuity tester and you are recommended to use it to test each strip. Replacing a faulty pigtail at this stage is easier than when the strips are stuck to the board and the board is screwed into the box.

While all the strips are the same length, it's sensible to offset every other strip to reduce the distance between diagonally adjacent LEDs. This will deliver more even illumination.



Strips offset against each other

Measuring the gap after sticking down a strip rather than measuring and marking all the lines in advance works well here and keeps the strips pretty much parallel.



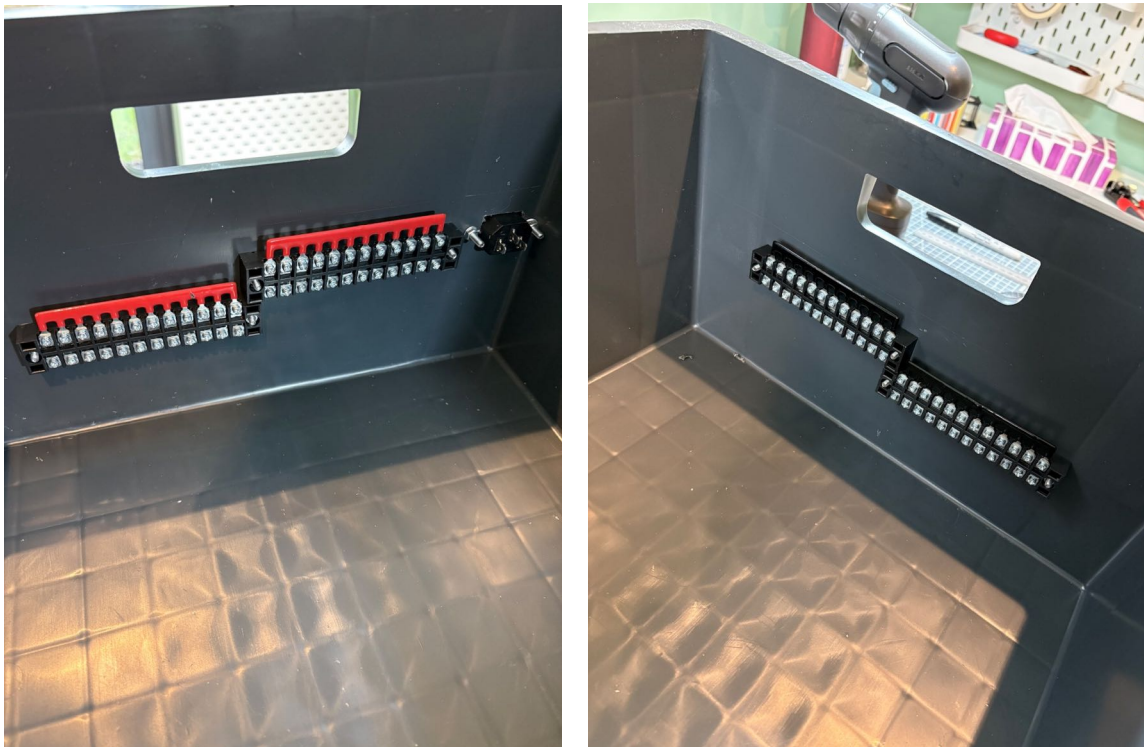
All the strips glued to the board

Step 3: Preparing the box

Now is a good time to prepare the box by deciding where the peripherals are going to be located. These include:

- Transformer
- Terminal blocks for both the positive and negative ends of the strips
- The mains socket
- On/off switch, if one is being used
- Fans, if they are being used

Place the board with the strips attached into the bottom of the box and work out where everything is going to go.



*Terminal blocks positioned at each end of the box
(they are offset so that the mounting screws miss the plastic ribs on the outside of the box)*

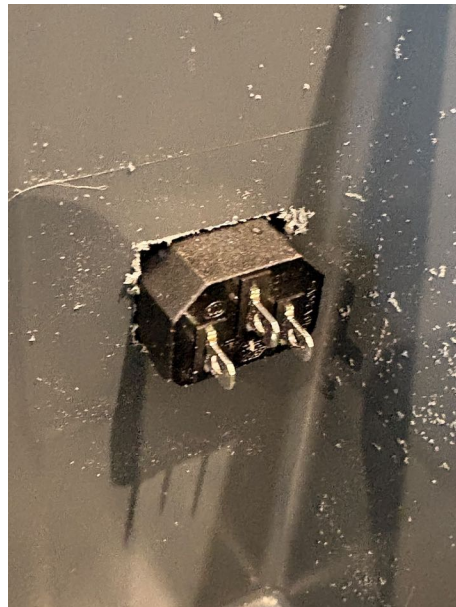


Transformer positioned on the side of the box

The position of the mains socket will partly depend on where the transformer is sited, and how you will use the box. It makes sense to position it in a corner.

When you know where everything will be, you can drill the mounting holes and bolt everything into place with M4 set screws. Now is also a good time to drill the holes that mount the MDF board into the base of the box. Drill carefully between the LED strips and use **nylon** M4 set screws to prevent any issues that might arise from current being conducted to the outside of the box through metal ones.

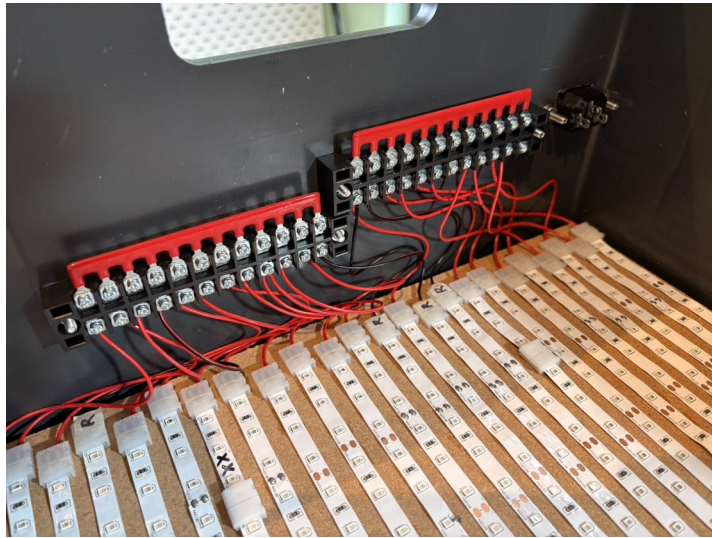
Cut a hole for the mains socket and bolt it into place.



Hole cut for the mains socket; and the socket in place (not yet bolted in)

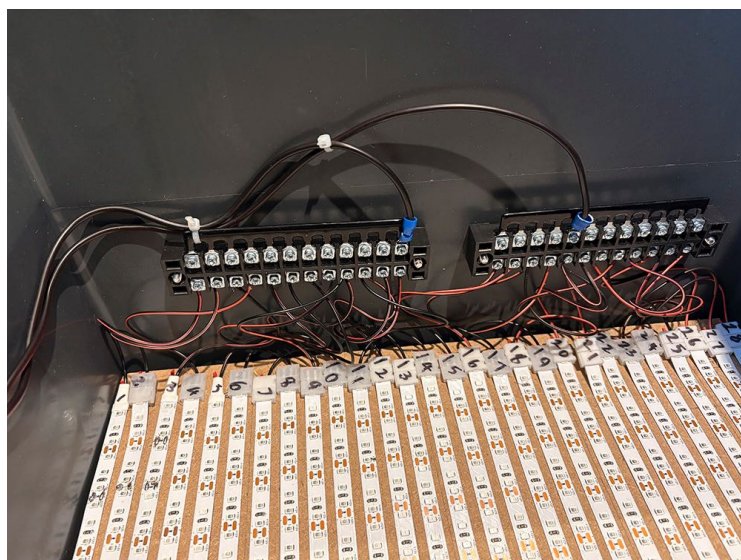
Step 4: Wiring the LED strips (12v side)

The pigtails on the ends of each LED strip are wired to the terminal blocks.



Pigtails on one end of the LED strips wired to terminal blocks

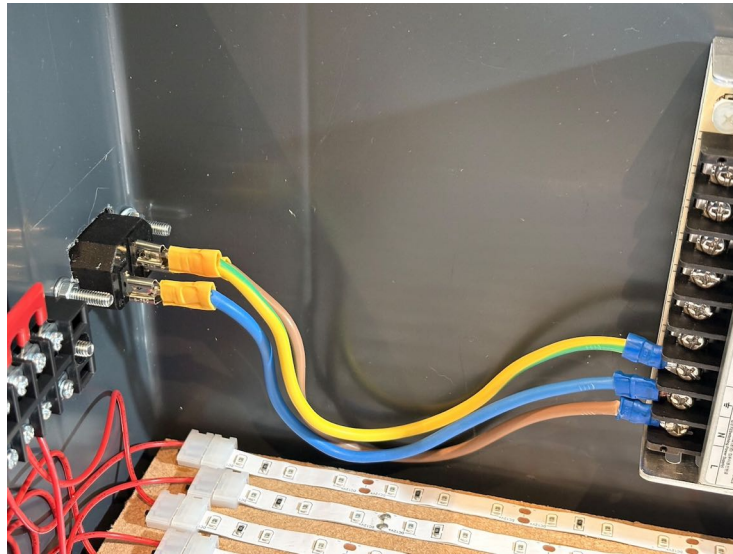
The terminal blocks at each end of the box are then wired back to the transformer with heavier gauge 16AWG wire to minimise voltage drop. In this way, as described previously, each strip is *individually wired* back to the transformer to ensure each one receives enough power (the *same* power) to deliver the *same* level of illumination.



Wiring the terminal blocks back to the transformer with heavier gauge wire

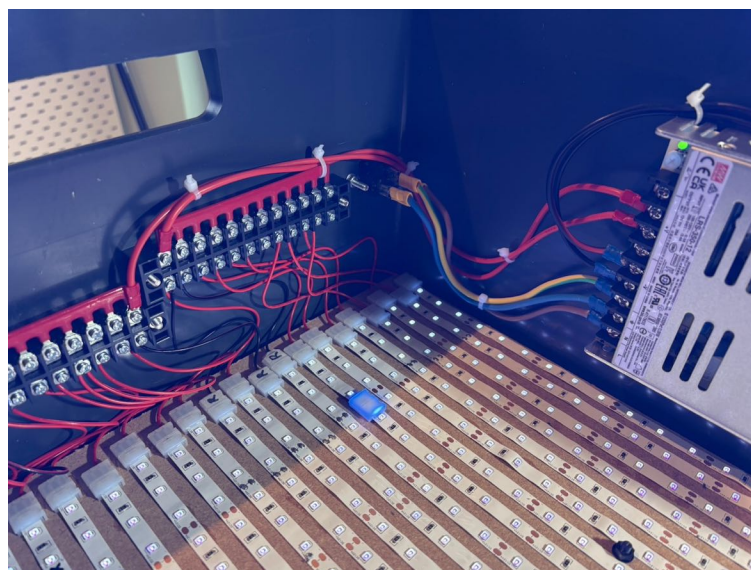
Step 5: Mains wiring and final assembly

Wire the socket to the transformer using appropriate heavy-gauge wire.

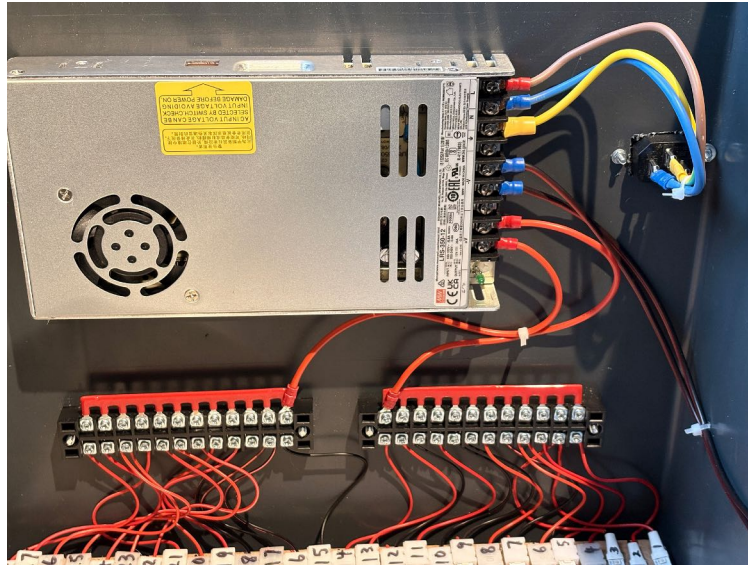


*Mains wiring inside the box.
The bare terminals at the socket end were later sleeved.*

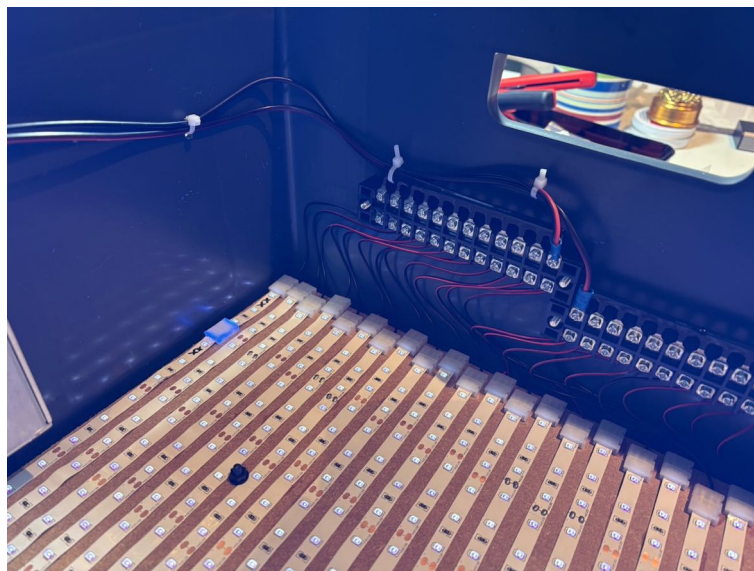
Finish wiring the terminal blocks to the transformer taking care to wire them with the correct polarity: the **BLACK**, positive end of the strips is wired to the **NEGATIVE** (-ve) side of the transformer. And the **RED** end of the strips to the **POSITIVE** (+ve) side of the transformer. [This will be at odds to what is printed on the LED strips.](#)



Terminal blocks wired back to the transformer



Terminal blocks wired back to the transformer in a unit of similar design but in a taller box that accommodated the transformer installing at the end rather than at the side



Wiring completed and the LEDs illuminated

Securely attach the wiring to the box and/or its peripherals to keep everything secure and not loose and not potentially casting a shadow.

Test the completed box with mains power and address any strips that do not light up – usually because of loose connections in the terminal blocks, or dud pigtails. If the cause is the latter, discard and replace rather than attempt to fix.



Completed box with all strips illuminated

Step 6: Practical considerations

Power up time delay

Whatever method of controlling the unit you use, you will likely see a short delay of around one second between turning the unit on, with an external timer for example, and the LEDs lighting up. This is normal and is a function of both the transformer and the nature of the LEDs. It is highly unlikely that this delay will have any practical impact on real world use.

Contact frame

In practice, the box is used 'upside down', as in, the LEDs point *downwards*. This means that rather than needing a complex and cumbersome vacuum frame, a simple contact frame can be used, either as a standalone frame, or using a simple (but heavy) sheet of glass.

I use a sheet of 8mm plate glass that is a bit smaller than the box so that when the box is placed (face down) over the glass, the glass fits *inside* the box. The sheet of glass I use (340 x 480mm) weighs 3.25Kg and provides ample weight to provide a high level of contact between plate and screen/image acetate. Alternatively, you could use a sheet of glass *larger* than the box and have the box sit on top of it thus providing more weight and therefore more pressure. Interestingly, a sheet of glass this big (say, 440 x 640) would weigh a whopping 5.5Kg.

Exposure calibration

There are many calibration tools you can use to determine aquatint screen and image acetate exposure times. With careful attention to detail and a bit of dedication, they will all deliver the same outcome. That said, some are easier to use than others and some require quite a bit more visual evaluation and judgement than others.

A good starting point is to use the [Lux Darkroom via their free online calculator](#). The beauty of it is in its simplicity in how it encapsulates a lot of measurement in single exposures of a Stouffer step wedge. Highly recommended to determine your ballpark aquatint screen exposure time with good accuracy. The process started me off with a 110s screen time and I ended up with 60s. Remember though that the process, through its use of the half a stop per wedge Stouffer, is only accurate to that half a stop level. I ended up with 60s screen time (one stop below 110s) but 90s was almost as good (half a stop below 110s).

Exposure times with 120 LEDs/m

*These times are what you might expect to see but they will depend on factors such as the nature of your aquatint screen. **See then as a starting point from which to experiment and fine tune.***

In a box containing 15m of 120 LEDs/m, the following exposure times are typical:

- Box height ~400mm
- Aquatint screen (Danish, from Henrik Bøegh) 60 seconds
- Image (Colourbyte image transfer film) 10-15 seconds

With the same number of LEDs but in a box that is only ~200mm tall, the exposure times are likely to be roughly a quarter of the above (using the inverse square law whereby halving the distance results in a reduction in radiation power to a quarter of the original):

- Box height ~200mm
- Aquatint screen (Danish, from Henrik Bøegh) 15 seconds
- Image (Colourbyte image transfer film) 3-5 seconds

Exposure times with 60 LEDs/m

These times are what you might expect to see but they will depend on factors such as the nature of your aquatint screen. See then as a starting point from which to experiment and fine tune.

Similar boxes to the above sizes, but with half the number of LEDs, will require exposure times that are roughly double:

- Box height ~400mm
 - Aquatint screen (Danish, from Henrik Bøegh) 120 seconds
 - Image (Colourbyte image transfer film) 20-30 seconds
-
- Box height ~200mm
 - Aquatint screen (Danish, from Henrik Bøegh) 30 seconds
 - Image (Colourbyte image transfer film) 5-8 seconds

This guide was written by Nik Stanbridge, an analogue photographer and printmaker living and working in Stratford-upon-Avon in the UK.

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Appendix: Materials

Some resources that you might find useful, especially if you are in the UK. These are where I obtained some of my materials.

- Euro Container
 - A good value UK supplier, with a wide range of sizes, is [3JC](#). Top tip is to use their eBay site as postage is cheaper.
- MDF board
 - [WoodSheets.com](#) is a good supplier in the UK
- 365nm LED strips
 - 60 LEDs per metre strips can be obtained from eBay
 - For 120/m, the **ST-1201208-2835-UVA** LEDs from [SunTech LED](#) are recommended as being very good quality and very good value (and the people at SunTech are very friendly!)
- LED pigtailed
 - [2 Pin 8mm LED Connector Kit](#)
- Terminal blocks
 - [Terminal Block 12 Position](#)
- Transformer
 - [Stepper Online](#) is a reliable source of the [Mean Well LRS-350 12v](#) that has fulfilment in a number of countries worldwide. Ensure you get the 12v version.



Pigtails



Terminal blocks