Adafruit Qualia High Res Displayport Desktop Monitor

Created by lady ada



https://learn.adafruit.com/qualia-high-res-displayport-desktop-monitor

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Overview



Add a glorious 2048x1536 retina-blasting, ultra-high pixel density, IPS display to any computer with a Thunderbolt/DisplayPort port. This product comes with a new 9.7" diagonal TFT display module (the same one used in the iPad 3 & 4), along with our custom made driver board, a stand-up monitor enclosure kit, 10' DisplayPort cable and 9V power adapter.



The driver board is a work of art (it was designed by resident engineer KTOWN) - and we use the really awesome LT3754 as a 12-channel constant current driver with

individual backlight string channel control (https://adafru.it/d8V). This gives the backlight perfect consistency over any usage or temperature range. A ATtiny85 handles the backlight dimming and soft on/off, so you can PWM the backlight over a range to get the look you want.



Comes with a display panel already attached, tested and ready to go. The plastic enclosure kit takes 20 minutes to put together using only a small screwdriver and will protect your display. Plug in the power and connect the DisplayPort cable. Ta-da display working immediately! No drivers, soldering, configuration or other converters required.



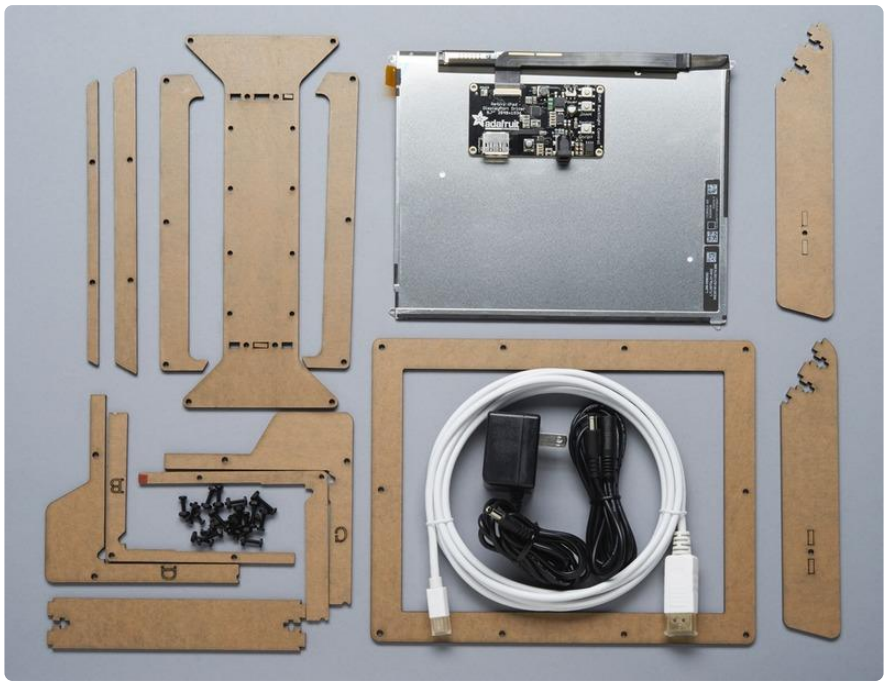
Use as a main screen or even better, as a secondary monitor. Great for photo or video editing - you can use a large main monitor for frame-by-frame editing and then preview on the smaller side frame. Or keep your email or dashboard notifications on the side. Heck, web-devs will want to use it to preview what their sites will look like on a "Retina" display. The 9.7" screen is small enough to keep out of the way.

Learn more!

This project is based on the awesome analysis done by Mike's Mods, check out his webpages for tons more details! (https://adafru.it/d8Y)



Assembly



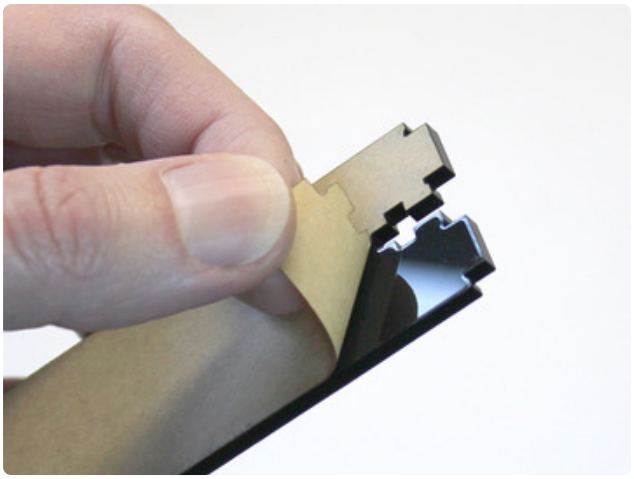
Before commencing assembly, confirm your kit contains all the following parts:

- **LCD panel** with **Driver board** attached
- **9V** switching power supply
- **DisplayPort cable**
- Thirteen (13) laser-cut pieces
- Twelve (12) #4-40 x 1/2" nylon screws w/nuts
- Four (4) #4-40 x 5/8" nylon screws w/nuts (a little longer than the 1/2" ones)
- Four (4) #2-56 x 1/4" screws w/nuts (these are much smaller and thinner)

Tools needed:

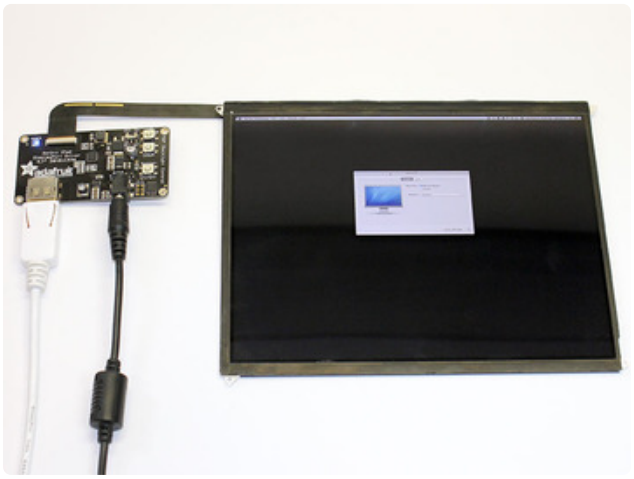
- Small screwdriver
- **Optional:** masking tape is very helpful for holding screws temporarily, but is not absolutely required.

The flexible cable that joins the LCD to the driver board is delicate. Some steps require bending it in one direction or another. Work slowly and methodically so as not to damage it.



Start by peeling the backing paper off both sides of all the laser-cut parts. It's easiest to start at a corner, catching the edge of the paper with a fingernail.

The laser-cutting process sometimes leaves a little paper soot at the edges. If you like, you can wash these off with soap and water, just be **absolutely certain** that all the parts are **completely dry** before proceeding!



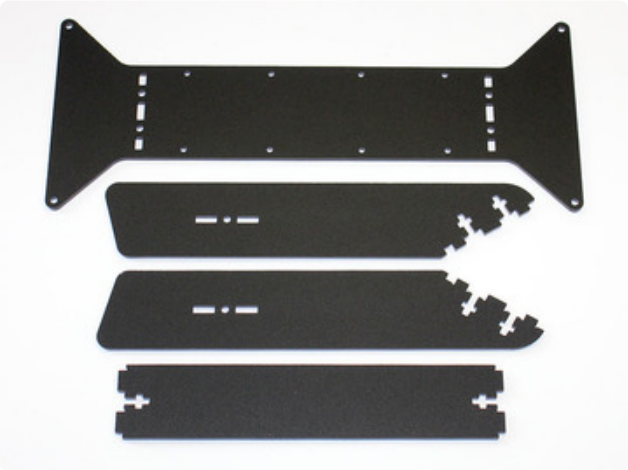
Optional: testing the LCD and driver board before assembly may avoid some troubleshooting later. Read ahead to the "How to Use" page for guidance.

Warning: this requires straightening the flex cable. Be extremely careful not to pull or strain this delicate part.

Rather than placing the driver board to the side, you can keep it behind the display, but place something like an index card or piece of paper between the two to prevent an electrical short.

You may want to remove the protective film at this time as well, pull on the yellow tab to carefully remove the film

Let’s build it!



Locate these four laser-cut parts. For the sake of later explanation, let’s refer to these (top-to-bottom) as the “bow tie,” “legs” and “cross brace.”

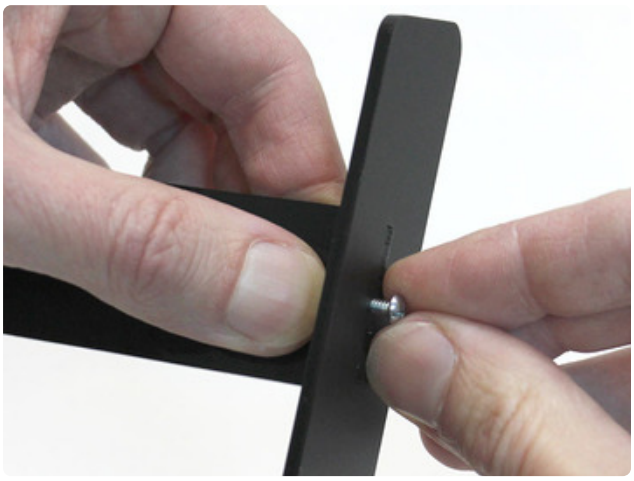
The bow tie and cross brace have no up or down, left or right; they can be installed any which way. The legs have a specific orientation, but there is no “right leg” or “left leg” — they’re interchangeable.

Start by picking up the cross brace...



This kit uses t-slot construction. Slide a nut into the cross part of the T at either end of the cross brace, then hold it in place between finger and thumb.

If you need an extra hand in the steps that follow, the nut can also be held in place temporarily with a bit of masking tape.

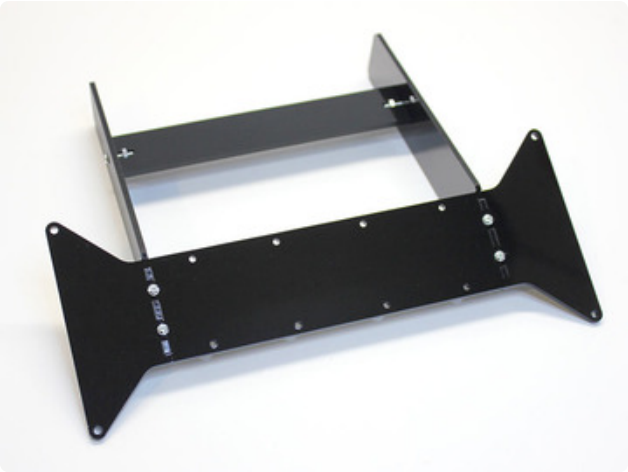


Slots in the leg pieces are “keyed” to fit into the tabs on the cross brace. Position a leg using these tabs and slots, then install a #4-40 1/2" screw through the middle, meeting up with the nut held in the cross brace.

You do not need to crank these screws down. Finger tight is fine for now.



Repeat with the second leg at the opposite end of the cross brace. Both legs should be oriented the same way, as seen here.



The “bow tie” now joins with the legs, using the same t-slot technique with four #4-40 1/2" screws and nuts.

The bow tie is symmetrical, so you can install it any which way.

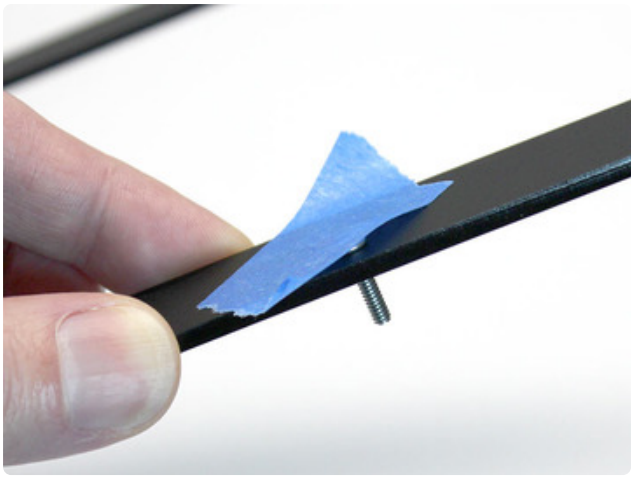
Use a screwdriver to gently tighten all the screws in place now. (You **do not** need to crank these down hard, or else you’ll crack the plastic!)

The rear stand is complete. Set it aside and we’ll return to it later.



Here’s the front bezel. Like the bow tie before, this piece is completely symmetrical; there is no front or back, left or right.

However, once assembled the display definitely takes on a top and bottom. Pick one of the longer edges (either one) and call it “top.” This is important for the placement of the four longer screws (5/8" instead of 1/2"). The long screw positions are indicated at left. All the other holes will receive 1/2" screws.



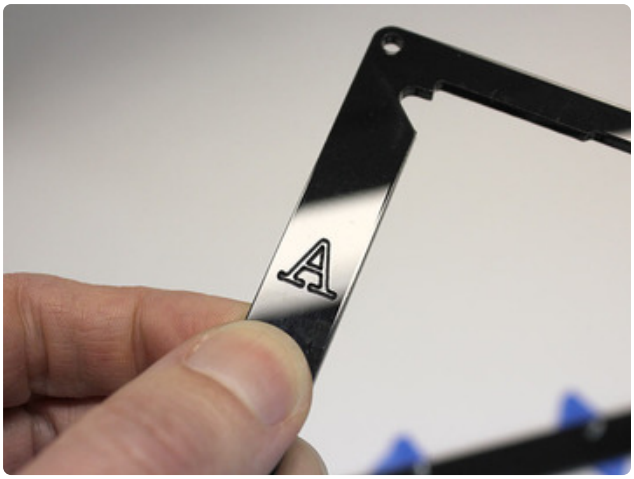


Insert a screw into each hole (1/2" or 5/8", as appropriate to the above diagram). The bezel will need to be flipped over later, so as you place each screw, secure it with a bit of tape, or you can use the nuts temporarily to keep the screws from sliding out (you'll need to remove these nuts later).

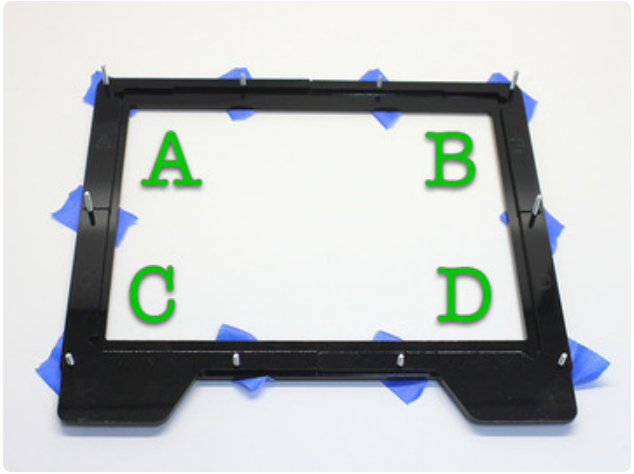


Once all the screws are placed, set the bezel face down on your work surface. Turn it so the "top" (with the longer screws) is at the...well...top.

If you used nuts instead of tape, you can remove these now (keeping the screws in place).

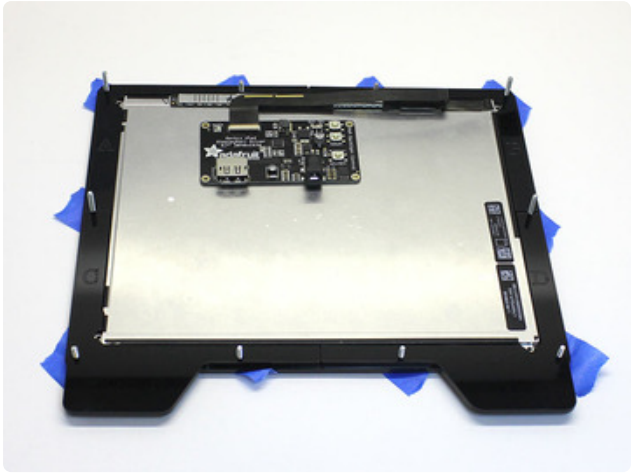


Unlike most of the other parts, the four L-shaped corner supports are all unique and have a very specific orientation. Each is etched with a letter: A, B, C and D.



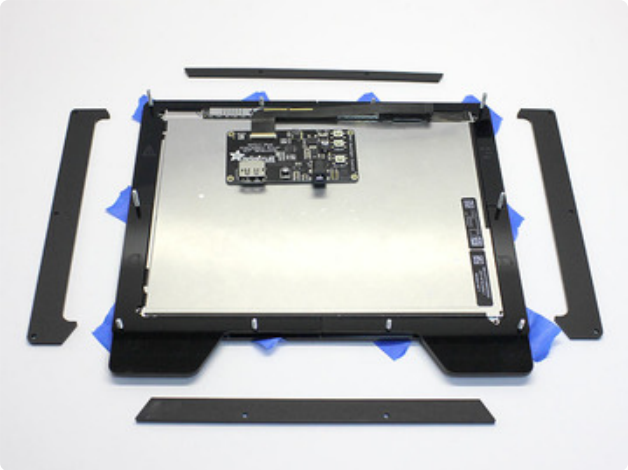
Slide each of the corner supports over the screws in the correct positions. The etched letter should be visible and in the correct orientation for reading. A at the top left, B at the top right, C at the bottom left, D at the bottom right.

The upper and lower supports each share “half a screw” in common. This is normal.

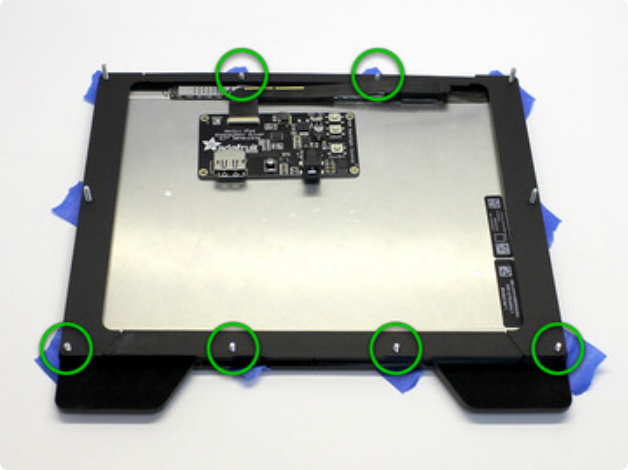


The LCD can now be placed **face-down** between the corner supports, and all the various protuberances should fit neatly into corresponding cutouts around the perimeter. It may need a little wiggle to make this happen.

If anything seems to require force, **stop!** Make sure all the pieces are installed in the correct positions and alignments.



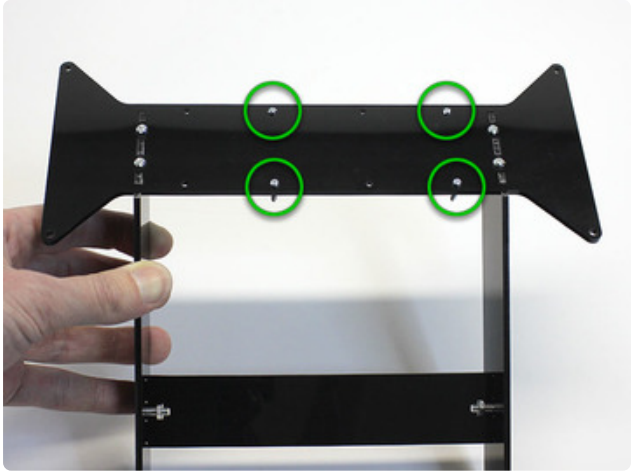
Another layer of edge pieces now fit over the screws and hold the screen from the back. These parts are symmetrical left to right and can go either way, but the top and bottom are unique. The wider edge should go at the bottom, and the right and left pieces should be flipped as needed to match.



With the edge pieces in place, six nuts can be installed over the shorter (1/2") screws, in the positions marked here. The four longer screws should not receive nuts yet!

You can leave these nuts just “finger tight” for now. We’ll make a pass later after everything’s assembled.

Now let’s go back to the rear stand that you assembled earlier...

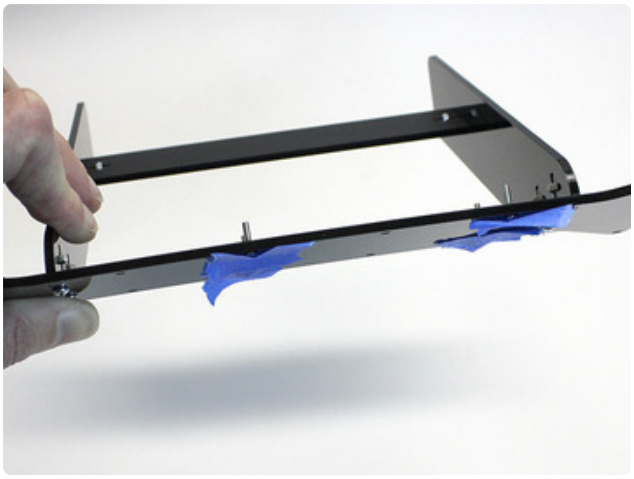


The “bow tie” has eight holes in it, but we’ll only be using **four**. Looking at the flat side (the legs should poke out the back, not forward), install the four tiny #2-56 screws in the positions indicated here.

The extra holes allow this piece to be flipped either way in the earlier assembly steps; less aggravating that way.

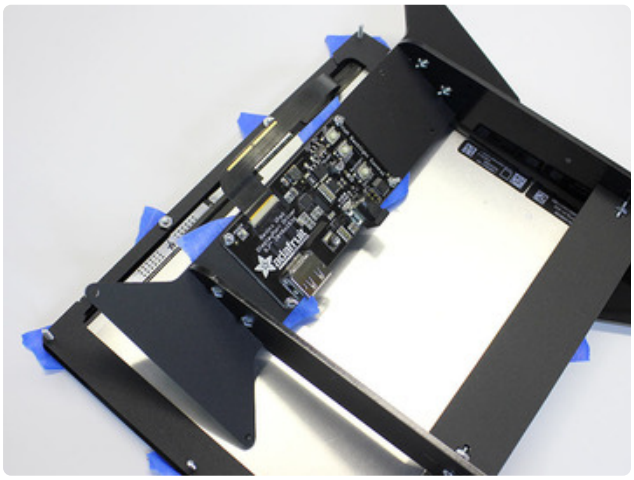


To reiterate a prior point: these screws should sit flush, pointing **back**, not forward. Getting this wrong will break the LCD!

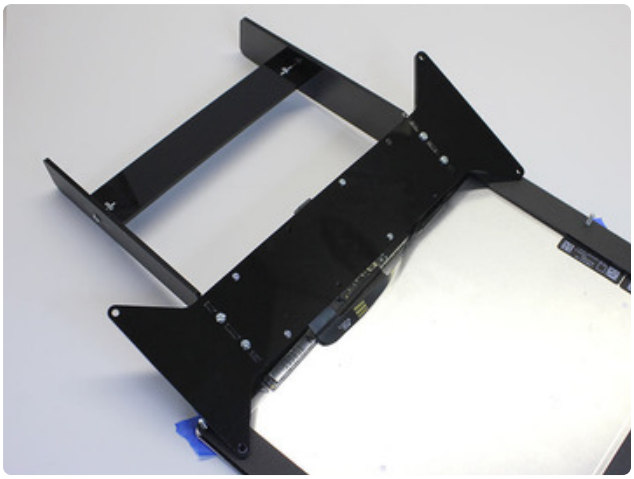


As with the main bezel, a little tape over the heads of these screws helps keep them in place.

This is the tricky part. Be careful with that flex cable!

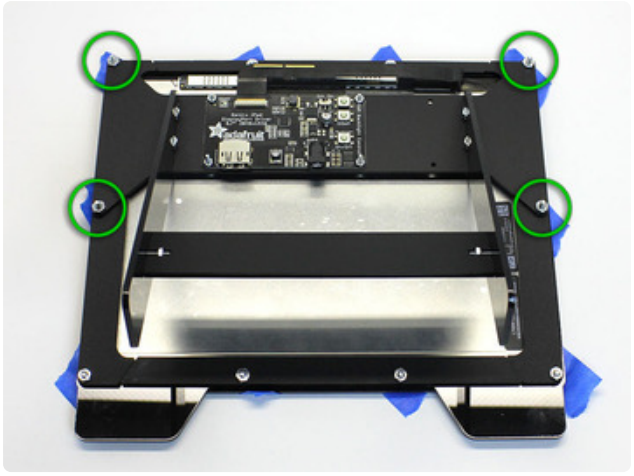


Set the “bow tie” carefully near the top of the screen. Pick up the driver board and... being very mindful of the flex cable, don’t tear or pull it out...lower it on to the four small screws on the bow tie. Then add a nut for each.



Now flip the bow tie / support over, remove the tape and tighten the four small screws.

You'll need to twist the flex cable a bit to do this. That's fine...work slowly and don't kink or jerk it.



Carefully turn the stand over and lower it onto the four 5/8" screws. Add a nut to each and finger tighten.



Stand the screen up and remove the tape pieces (if used) from the front bezel. Give it a very gentle tap on the desk to make sure everything's seated, then work around the perimeter tightening these screws. Just snug them down a little...don't go crazy or you'll crack the plastic.

You can connect the power and DisplayPort cables now if you like, routing them under the cross brace piece or out either side.



Now you're ready to fire it up! Read on. The resolution is intense!

How To Use



Using the Qualia display is super easy, similar to any other monitor you've used. You will need a 9 or 12V DC power supply that can provide at least 1000mA (1A) of current, a DisplayPort cable and a computer with a DisplayPort

Read the sections to learn all about your new miniature monitor!

- How to make a DisplayPort connection (https://adafru.it/d9w)
- How to power your monitor (https://adafru.it/d9x)
- How to control the Backlight (https://adafru.it/d9y)



DisplayPort Connection

This monitor is only for use with DisplayPort native computers. DisplayPort is not the same as HDMI or DVI!

If you don't have a DisplayPort on your computer or laptop, check out our HDMI/VGA display offerings (https://adafru.it/d8R)

Just about every single Apple computer and laptop has DisplayPort capability, often a Mini DisplayPort connector instead of the full size version. Many newer PCs do as well but make sure to verify before purchasing! DisplayPort connectors looks a lot like HDMI

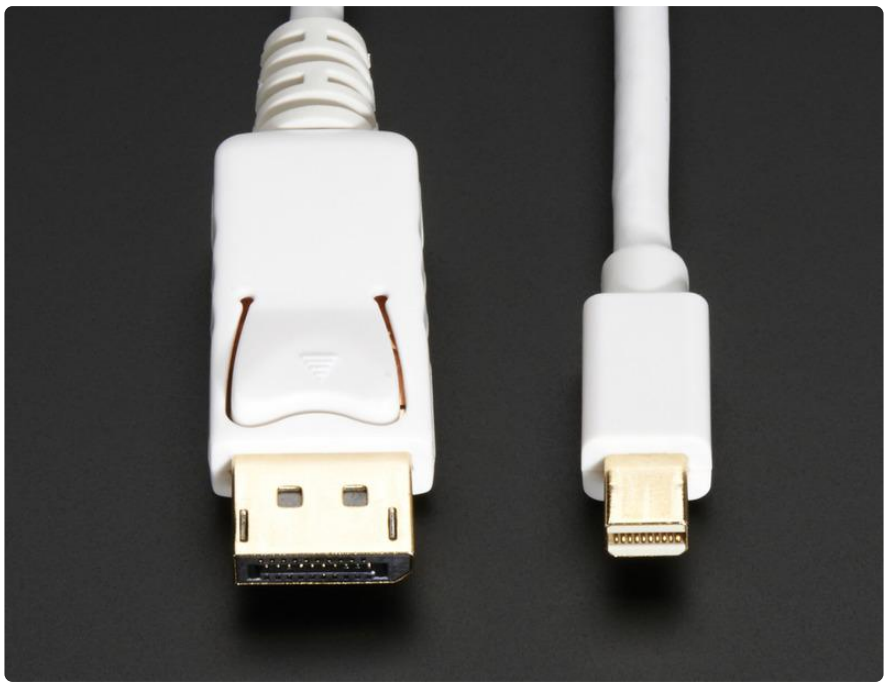


This is what a standard DisplayPort connector looks like, with the displayport logo above (thx wikipedia) (https://adafru.it/d8S)

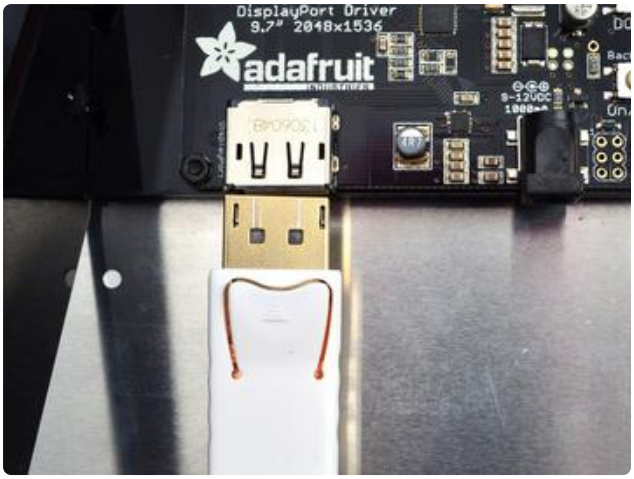


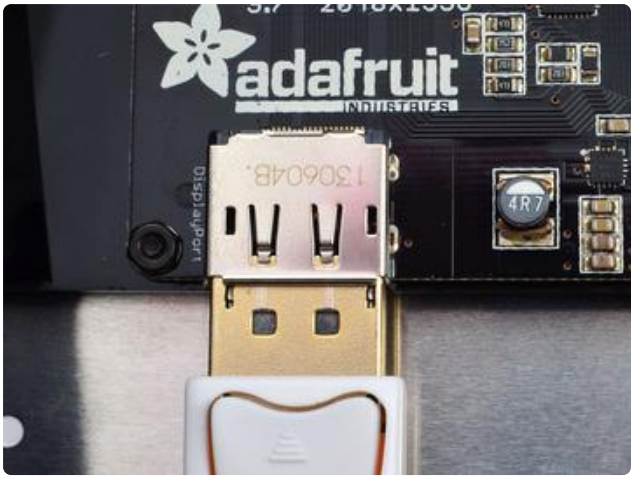
This is what a Mini DisplayPort connector looks like (thx wikipedia) (https://adafru.it/d8T)

Mini and Standard DP are the same, just require different cables. Since most computers have a mini DisplayPort, we ship with a Mini type cable



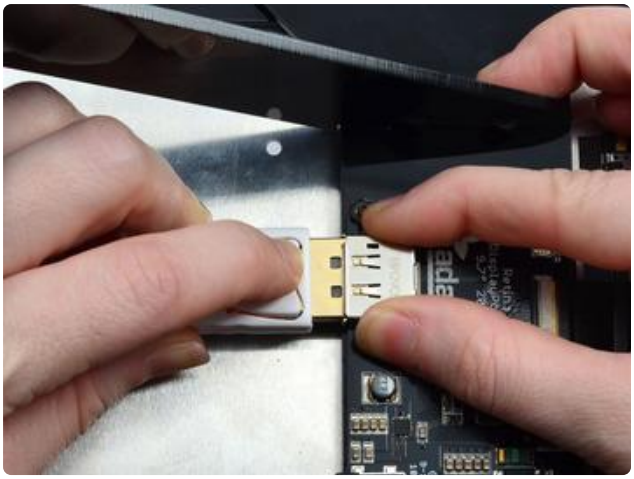
Our cable has classic DisplayPort on the left, and Mini DisplayPort on the right.





OK plug in your cable so that it snaps in nicely into the DP connector on the Qualia driver. It should snap in all the way





Removing a DisplayPort connector is a little more difficult because the connector is quite strong. You have to press down on the cable latch and wiggle-pull it out. Hold onto the connector with your other hand to make it easier!

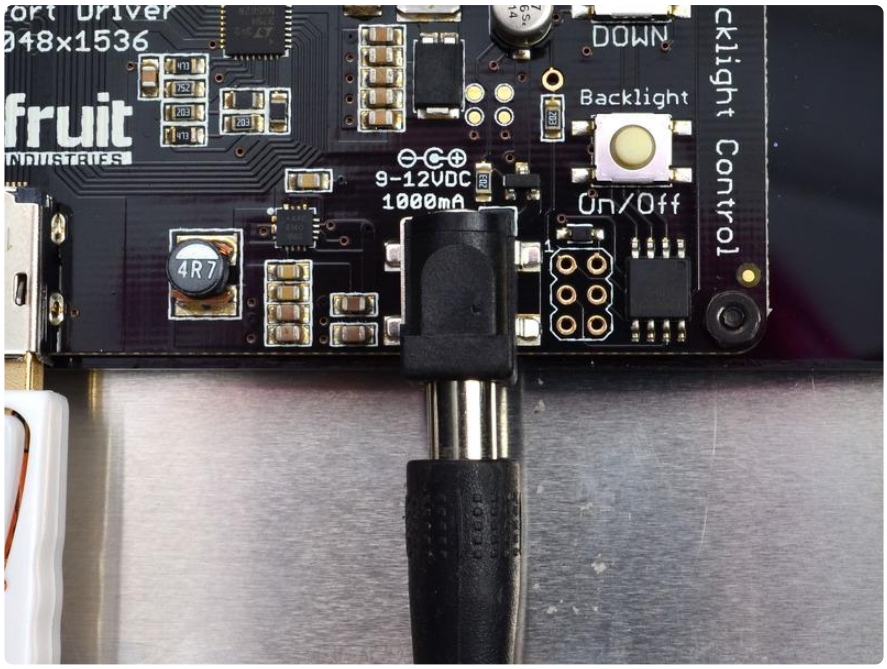
Power Connection

The Qualia monitor backlight is massive and bright, to drive all those LEDs requires an external power supply. You can use any 9V to 12V power supply with a 2.1mm/5.5mm sized barrel jack and center-positive power. The driver uses that voltage to create the 22V required to drive the backlight LED strings.

We include a 9V power supply that works very well so please use that if you can!



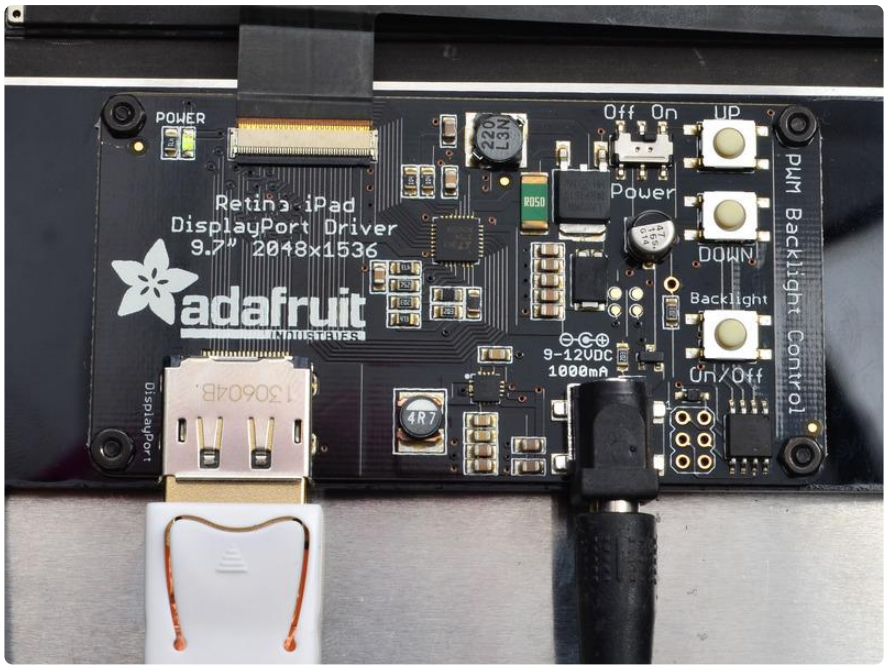
To power up, just plug into the 2.1mm power jack.



Once plugged in, check that the **POWER** switch is switched to **ON**. The power switch is in the upper right of this photo, next to the UP button

You should see the **POWER** LED light up when power to the board is working right. If its not lit, check that your power supply is correct and that the power switch is on.

If you never need to turn off the display completely, switch the power switch to Off and check that the LED is no longer lit

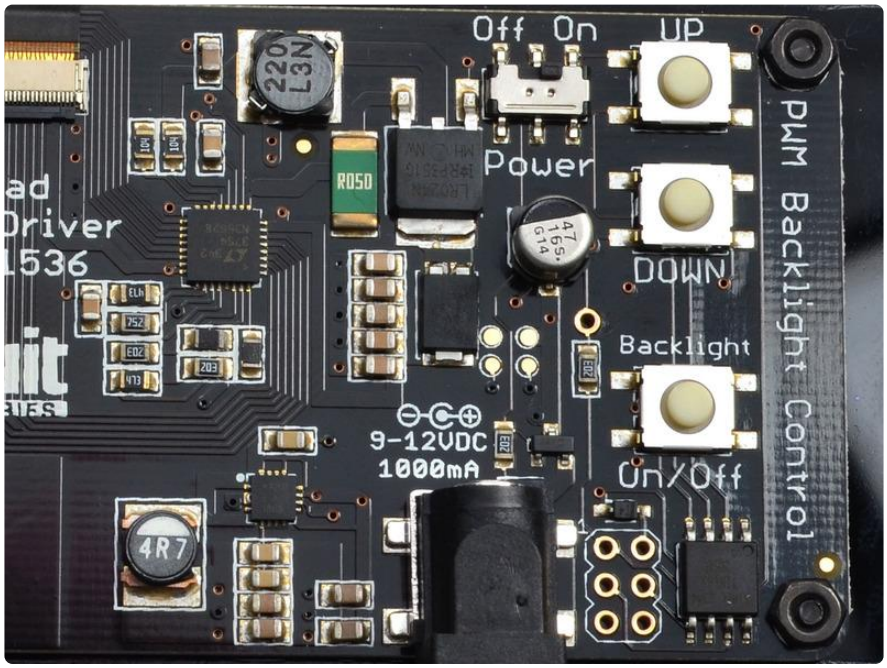


If you want to take your Qualia on the road, you may find yourself without a power plug nearby. Unfortunately, the backlight driver for the Qualia display can't run from 5VDC so its not possible to power it from a laptop USB port. However you can use a

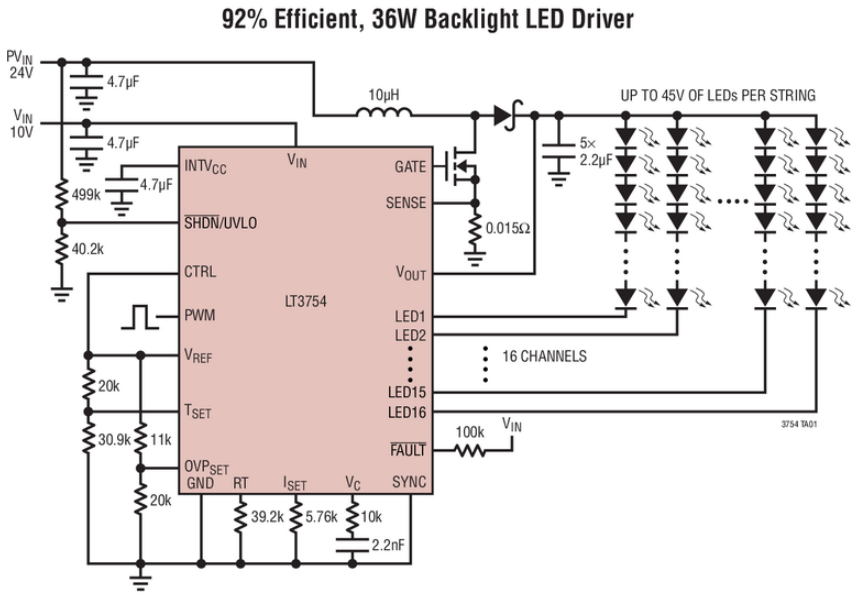
8xAA 'power brick' with either Alkaline or Rechargeable batteries.



Backlight Control



To control the backlight of the display, we use the awesome LT3754 LED driver from Linear Tech (https://adafru.it/d8V). The great thing about this driver is it is a cross between an efficient boost convert and a fully-matched constant-current LED driver. The boost converter half can take 9-12VDC and boost it up to ~22VDC and the LED driver half makes sure that each LED strand is driven with exactly 18.5mA for perfectly distributed light (which gives better color representation).



To control the backlight, we use a very tiny microcontroller (the ATtiny85 from AVR) which listens for button presses and then sends a 4KHz PWM signal to the LT3754 to tell it how much to dim the display.

How to control the backlight

The backlight is super easy to control. Press the **UP** or **DOWN** buttons until you reach the brightness level you like. If you want to turn off the backlight, press the **Backlight On/Off** button. The backlight On/Off is different than the switch. If you turn off just the backlight, the computer will still recognize a monitor is there, you just wont be able to see the graphics since there's no backlight. If you turn off the switch the entire monitor is off, and it wont be recognized by the computer!

When the backlight or monitor is turned off and an on, it will revert to the same brightness you had before.

Downloads

Datasheets

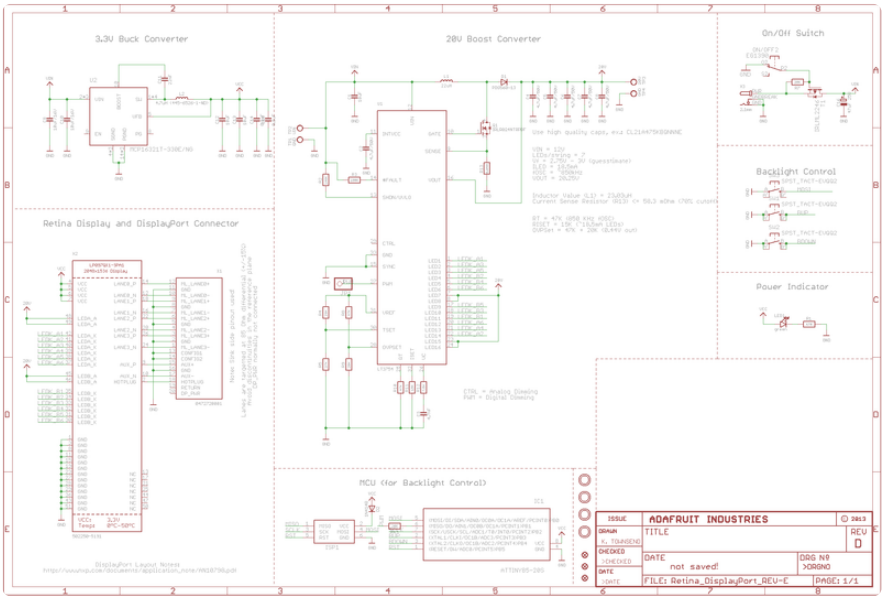
- LT3754 Datasheet (https://adafru.it/d8W) (LED backlight driver)
- LP097QX1-SPC1 Datasheet (https://adafru.it/d8X) (The raw display itself)

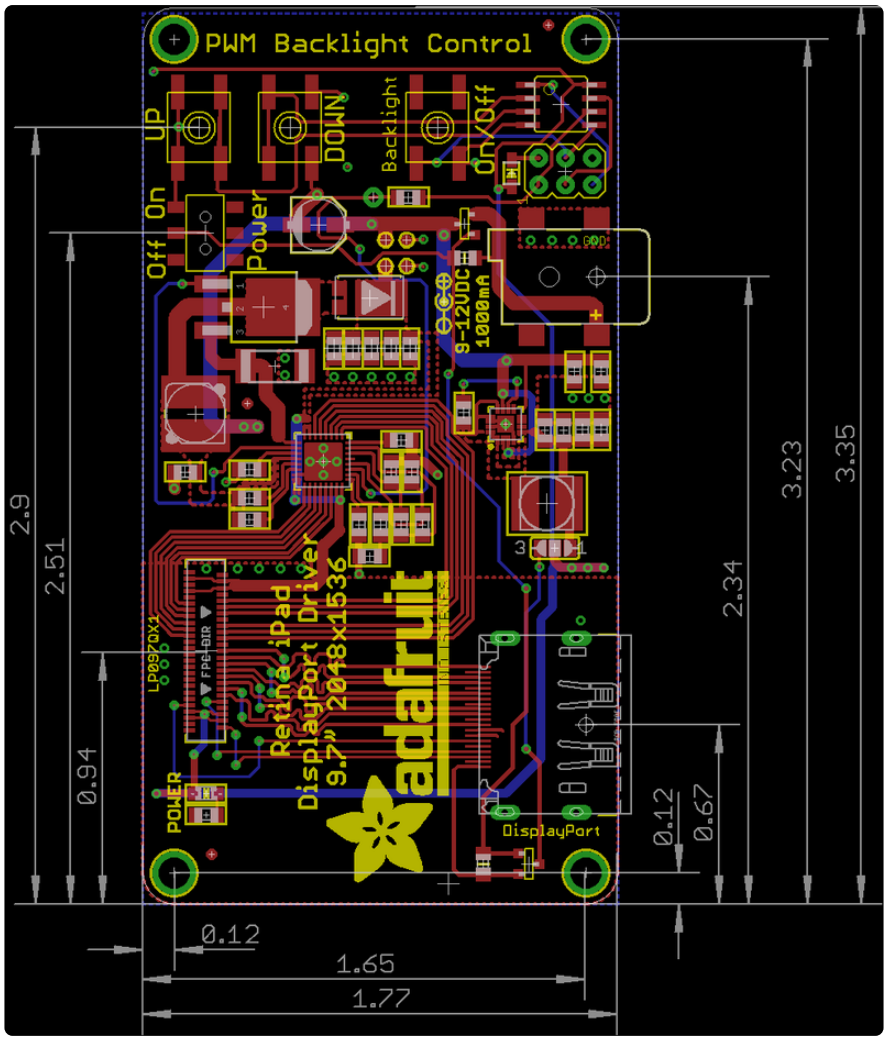
Design Files

- Frame design file (https://adafru.it/dVT)
- EagleCAD PCB files on GitHub (https://adafru.it/rDx)

Schematic

In case you're wondering how its made, here is the connections diagram!





Firmware

There's a tiny bit of firmware on the ATtiny85, you can grab it here:

```
/* Adafruit Qualia firmware for DisplayPort to LP097QX1 driver board
   Basically, a Trinket w/PWM output to the LT backlight driver. :)
   Recompile with Adafruit Trinket 8MHz supported Arduino IDE.
   Upload w/USBtinyISP
*/

#include "EEPROM.h"

#define led 1
#define upbutton 4
#define downbutton 3
#define onoffbutton 0

int16_t brightness;      // range from 0 to 255 (0 is off)

boolean on = true;       // whether the display is 'on' or not
boolean dirtee = false;  // is the EEPROM brightness wrong?

void setBrightness(uint8_t b) {
  OCR1A = b;
}
```

```
void setup() {
  digitalWrite(led, LOW);
  pinMode(led, OUTPUT);

  // way faster than analogWrite, 15.625Khz!
  OCR1C = 255;
  OCR1A = 0;
  TCCR1 = _BV(CS10) | _BV(CS11) | _BV(PWM1A) | _BV(COM1A1);

  // read the eeprom location 0!
  brightness = EEPROM.read(0);

  // slowly fade up!
  for (uint8_t i=0; i &lt; brightness; i++) {
    setBrightness(i);
    delay(10);
  }

  pinMode(upbutton, INPUT);
  digitalWrite(upbutton, HIGH);
  pinMode(downbutton, INPUT);
  digitalWrite(downbutton, HIGH);
  pinMode(onoffbutton, INPUT);
  digitalWrite(onoffbutton, HIGH);
}


void loop() {
  if (on) {
    while (! digitalRead(downbutton)) {

      // Don't let it get dimmer than 2/255
      if (brightness &gt; 2) {
        brightness --;
        setBrightness(brightness);
        dirtee = true;
      }
      delay(10);
    }
    while (! digitalRead(upbutton)) {
      if (brightness != 255) {
        brightness ++;
        setBrightness(brightness);
        dirtee = true;
      }
      delay(10);
    }
    // once they release the button, write the new brightness to EEPROM
    if (dirtee) {
      EEPROM.write(0, brightness);
      dirtee = false;
    }
  }

  if (! digitalRead(onoffbutton)) {
    delay(10);
    while (! digitalRead(onoffbutton));
    delay(10);
    if (on) {
      // quickly turn off
      setBrightness(0);
      delay(100);
      on = false;
    } else {
      // slowly fade up!
      for (uint8_t i=0; i &lt; brightness; i++) {
        setBrightness(i);
        delay(10);
      }
```

```
      // give me a break to avoid any bouncing
      delay(100);
      // we're on
      on = true;
    }
  }
}
```