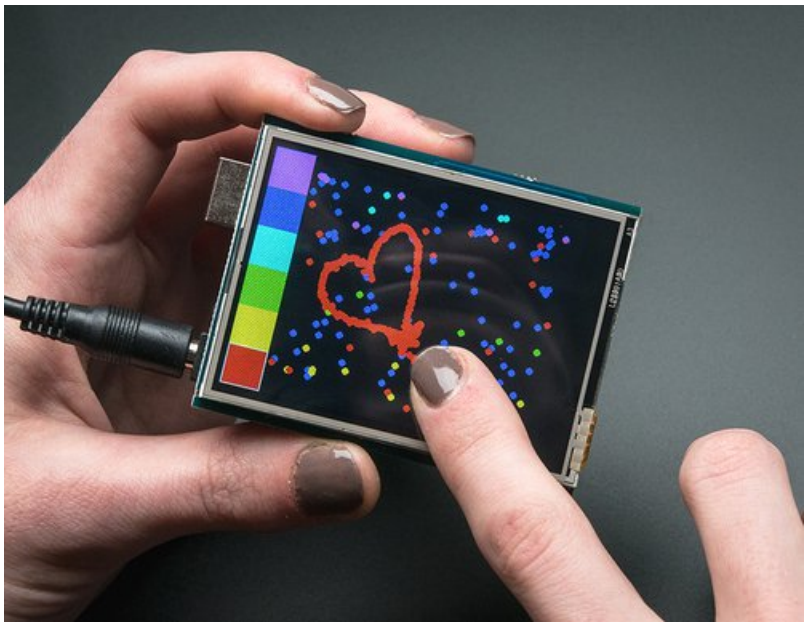
adafruit learning system

Adafruit 2.8" TFT Touch Shield v2 - Capacitive or Resistive

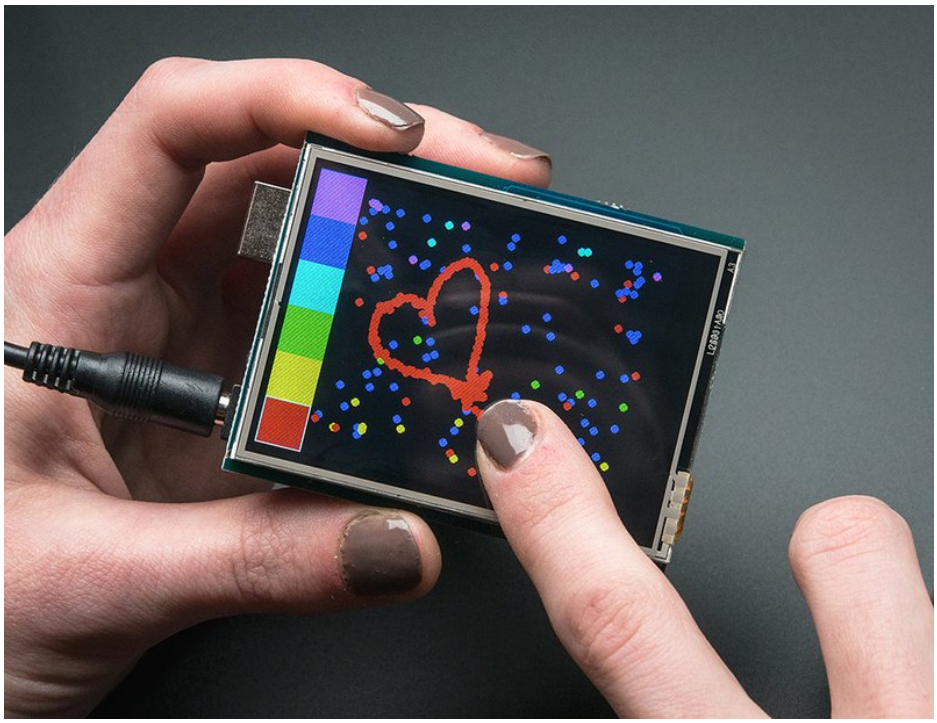
Created by lady ada



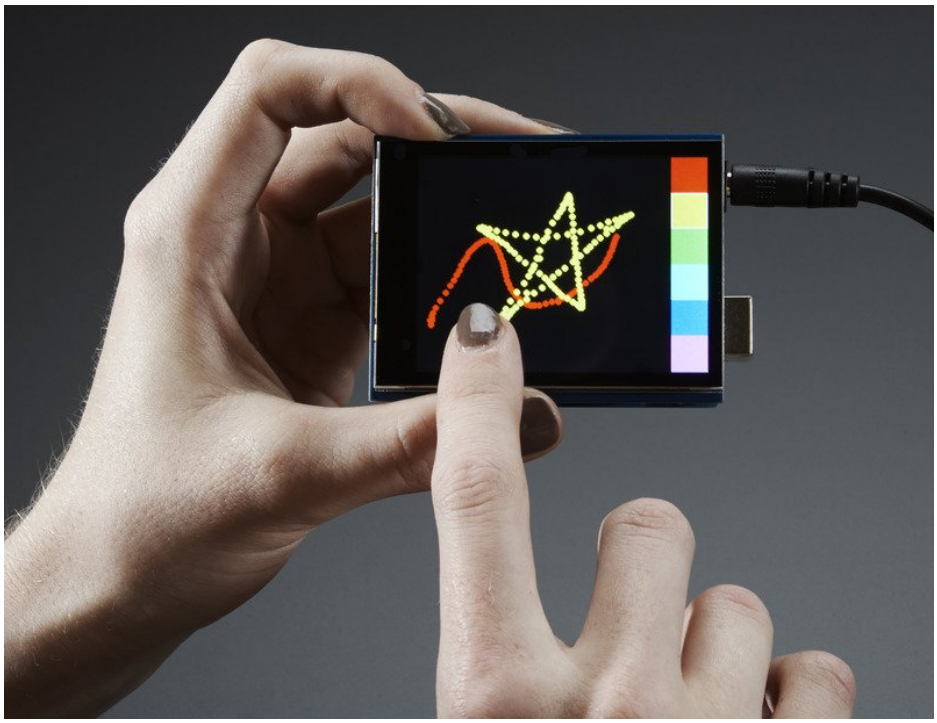
Last updated on 2018-12-22 01:42:43 AM UTC

Guide Contents

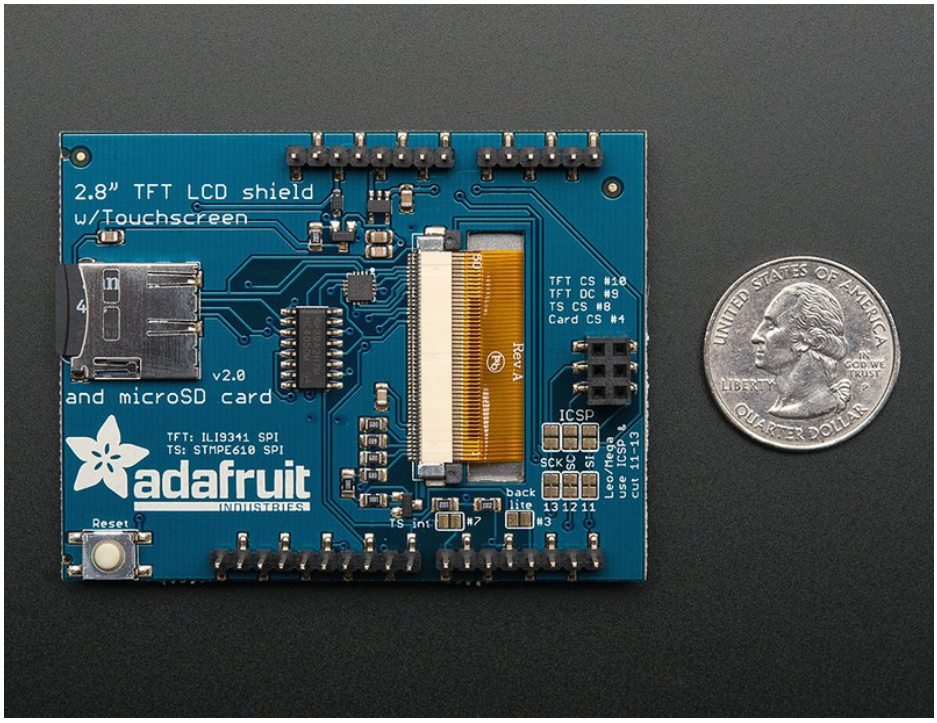
Overview



Spice up your Arduino project with a beautiful large touchscreen display shield with built in microSD card connection. This TFT display is big (2.8" diagonal) bright (4 white-LED backlight) and colorful (18-bit 262,000 different shades)! 240x320 pixels with individual pixel control. It has way more resolution than a black and white 128x64 display. As a bonus, this display comes with a **resistive or capacitive** touchscreen attached to it already, so you can detect finger presses anywhere on the screen.



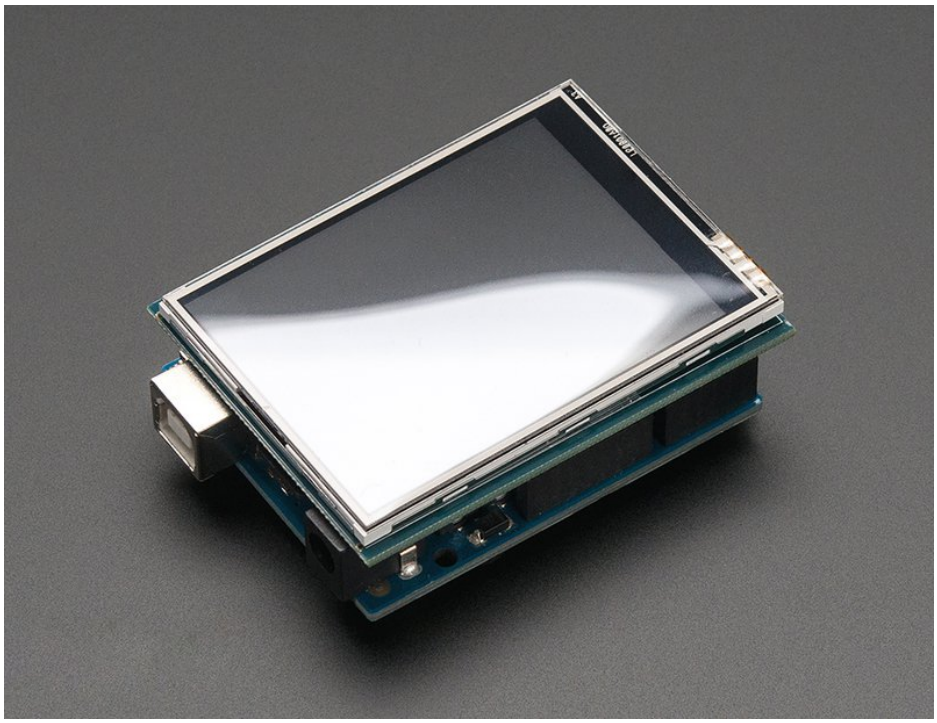
This shield uses a SPI display - its much easier to use with Mega & Leonardo than our v1 shield. We also include an SPI resistive touchscreen controller or a I2C capacitive touch screen controller so you only need one or two additional pins to add a high quality touchscreen controller. Even with all the extras, the price is lower thanks to our parts sourcing & engineering skillz!

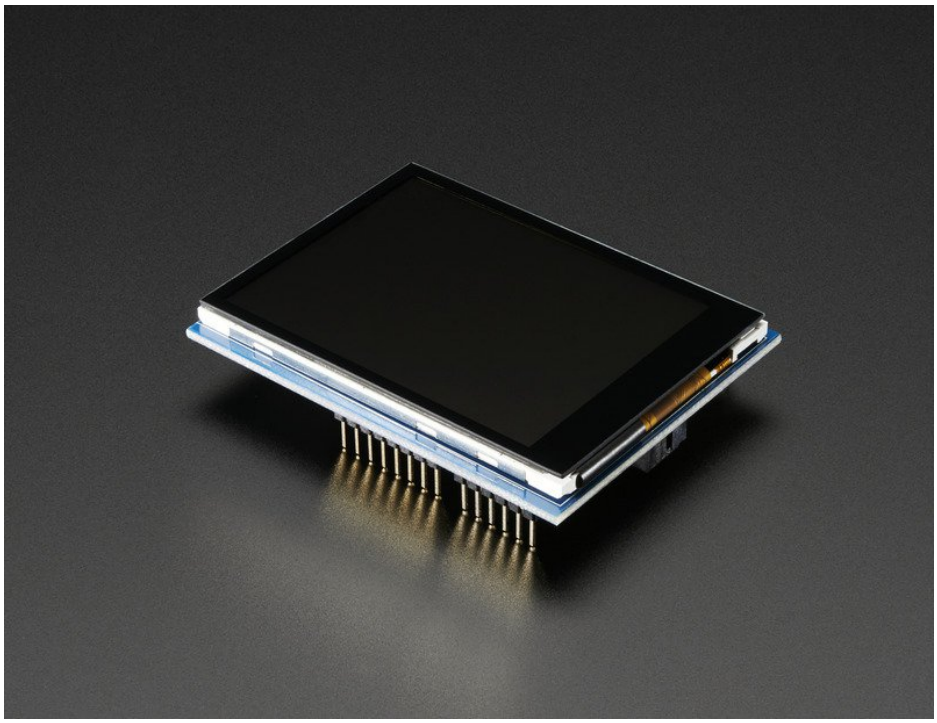


The shield is fully assembled, tested and ready to go. No wiring, no soldering! Simply plug it in and load up our library - you'll have it running in under 10 minutes! Works best with any classic Arduino (UNO/Duemilanove/Diecimila). Solder three jumpers and you can use it at full speed on a Leonardo or Mega as well.

This display shield has a controller built into it with RAM buffering, so that almost no work is done by the microcontroller. This shield needs fewer pins than our v1 shield, so you can connect more sensors, buttons and LEDs: 5 SPI pins for the display, another pin or two for the touchscreen controller and another pin for uSD card if you want to read images off of it.

Connecting





Pinouts

There's two versions of the shield. One has a resistive touch screen, one has a capacitive one. The *TFT display* and pinouts is the same for both. The microSD card is the same too. The differences come in on the touch screen controller

TFT Screen Pins

TFT Screen Pins

- **Digital #13 *or* ICSP SCLK** - This is the hardware SPI clock pin. By default its digital #13. By cutting a jumper and soldering another on the back, you can move this line from #13 to the ICSP clock pin. This pin is used for the TFT, microSD and resistive touch screen data clock
- **Digital #12 *or* ICSP MISO** - This is the hardware SPI master-in-slave-out pin. By default its digital #12. By cutting a jumper and soldering another on the back, you can move this line from #12 to the ICSP MISO pin. This pin is used for the TFT, microSD and resistive touch screen data
- **Digital #11 *or* ICSP MOSI** - This is the hardware SPI master-out-slave-in pin. By default its digital #11. By cutting a jumper and soldering another on the back, you can move this line from #11 to the ICSP MOSI pin. This pin is used for the TFT, microSD and resistive touch screen data
- **Digital #10** - This is the TFT CS (chip select pin). It's used by the Arduino to tell the TFT that it wants to send/receive data from the TFT only
- **Digital #9** - This is the TFT DC (data/command select) pin. It's used by the Arduino to tell the TFT whether it wants to send data or commands

Resistive Touch Controller Pins

- **Digital #13 *or* ICSP SCLK** - This is the hardware SPI clock pin. By default its digital #13. By cutting a jumper and soldering another on the back, you can move this line from #13 to the ICSP clock pin. This pin is used for the TFT, microSD and resistive touch screen data clock
- **Digital #12 *or* ICSP MISO** - This is the hardware SPI master-in-slave-out pin. By default its digital #12. By cutting a jumper and soldering another on the back, you can move this line from #12 to the ICSP MISO pin. This pin is used for the TFT, microSD and resistive touch screen data
- **Digital #11 *or* ICSP MOSI** - This is the hardware SPI master-out-slave-in pin. By default its digital #11. By cutting a jumper and soldering another on the back, you can move this line from #11 to the ICSP MOSI pin. This pin is used for the TFT, microSD and resistive touch screen data
- **Digital #8** - This is the STMPE610 Resistive Touch CS (chip select pin). It's used by the Arduino to tell the Resistive controller that it wants to send/receive data from the STMPE610 only

Capacitive Touch Pins

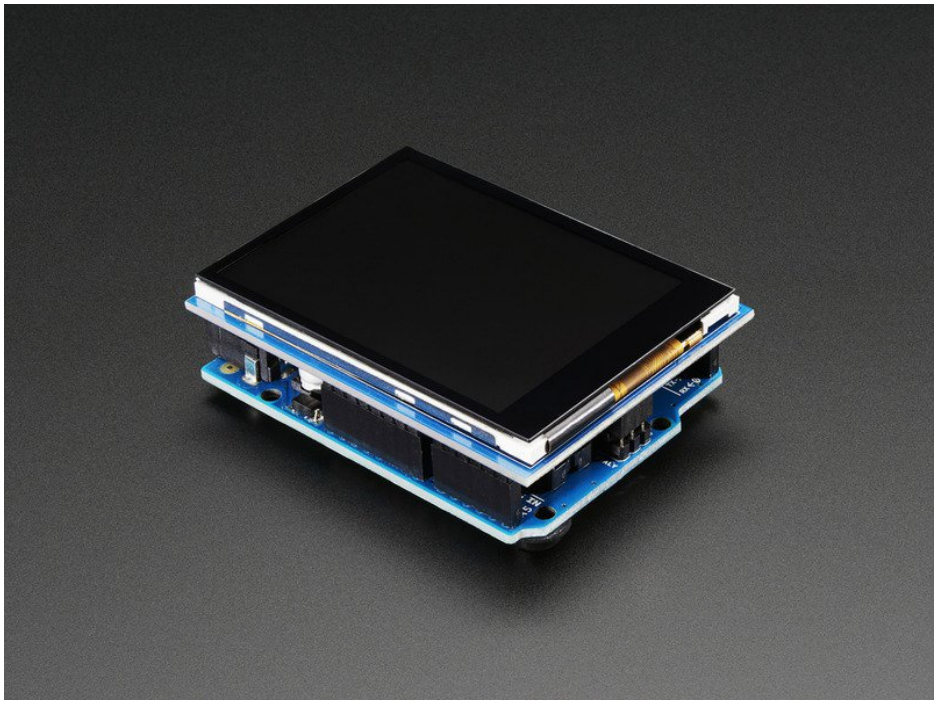
- **SDA** - This is the I2C data pin used by the FT6206 capacitive touch controller chip. It can be shared with other I2C devices. On UNO's this pin is also known as Analog 4.
- **SCL** - This is the I2C clock pin used by the FT6206 capacitive touch controller chip. It can be shared with other I2C devices. On UNO's this pin is also known as Analog 5.

MicroSD card Pins

- **Digital #13 *or* ICSP SCLK** - This is the hardware SPI clock pin. By default its digital #13. By cutting a jumper and soldering another on the back, you can move this line from #13 to the ICSP clock pin. This pin is used for the TFT, microSD and resistive touch screen data clock
- **Digital #12 *or* ICSP MISO** - This is the hardware SPI master-in-slave-out pin. By default its digital #12. By cutting a jumper and soldering another on the back, you can move this line from #12 to the ICSP MISO pin. This pin is used for the TFT, microSD and resistive touch screen data
- **Digital #11 *or* ICSP MOSI** - This is the hardware SPI master-out-slave-in pin. By default its digital #11. By cutting a jumper and soldering another on the back, you can move this line from #11 to the ICSP MOSI pin. This pin is used for the TFT, microSD and resistive touch screen data
- **Digital #4** - This is the uSD CS (chip select pin). It's used by the Arduino to tell the uSD that it wants to send/receive data from the uSD only

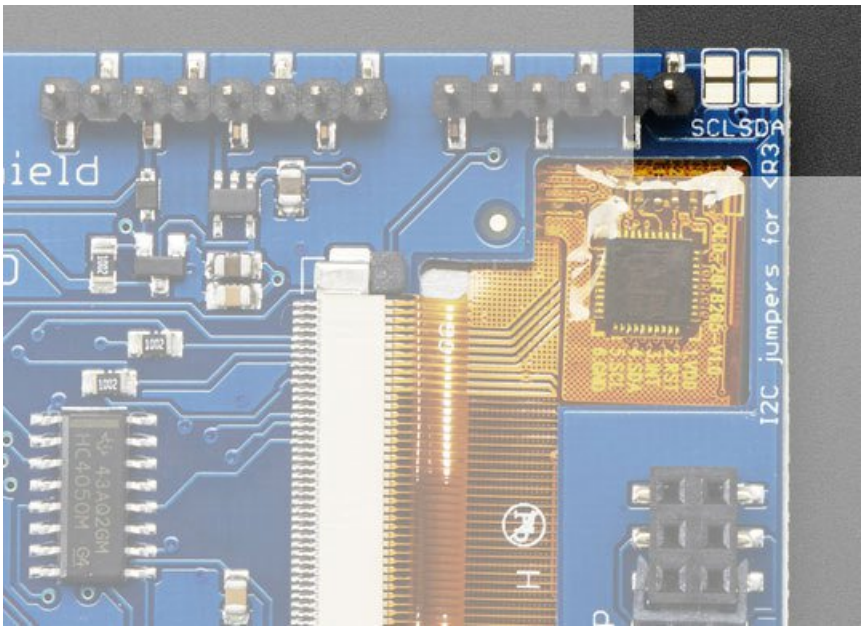
Using with an Uno R3

Because the TFT is about the same size as an Arduino, we pre-assemble the shield in the factory. To use, simply place it onto your Arduino Uno/Duemilanove/compatible. No wiring, no soldering! **Bam!**



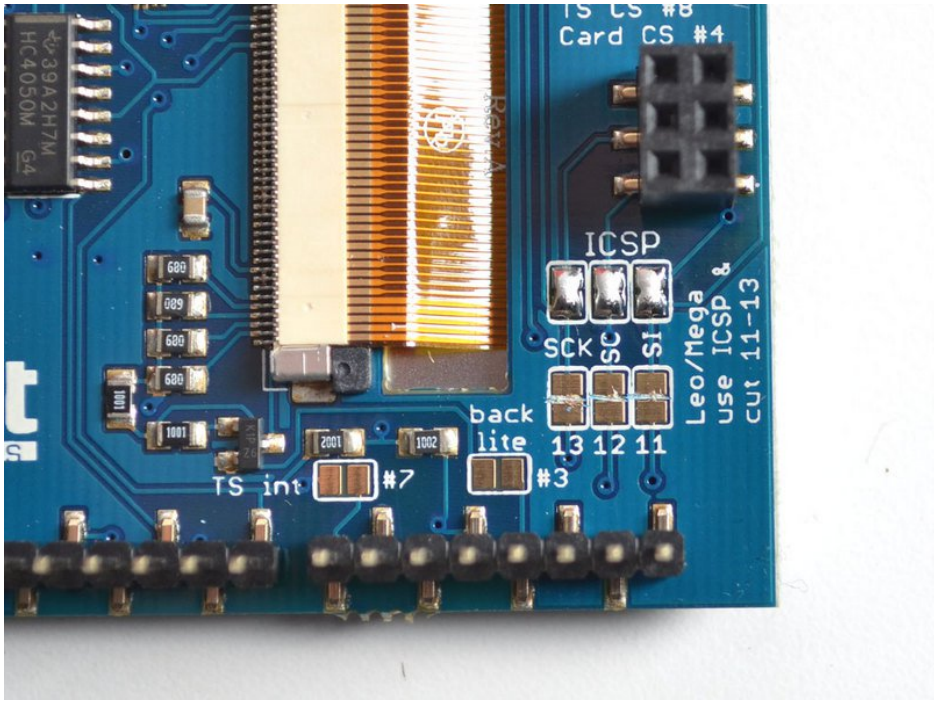
Using Capacitive Touch Version w/Older Arduino

If you have an old Arduino without the SCL/SDA pins brought out (pre UNO R3) use a soldering iron to short these two jumpers:



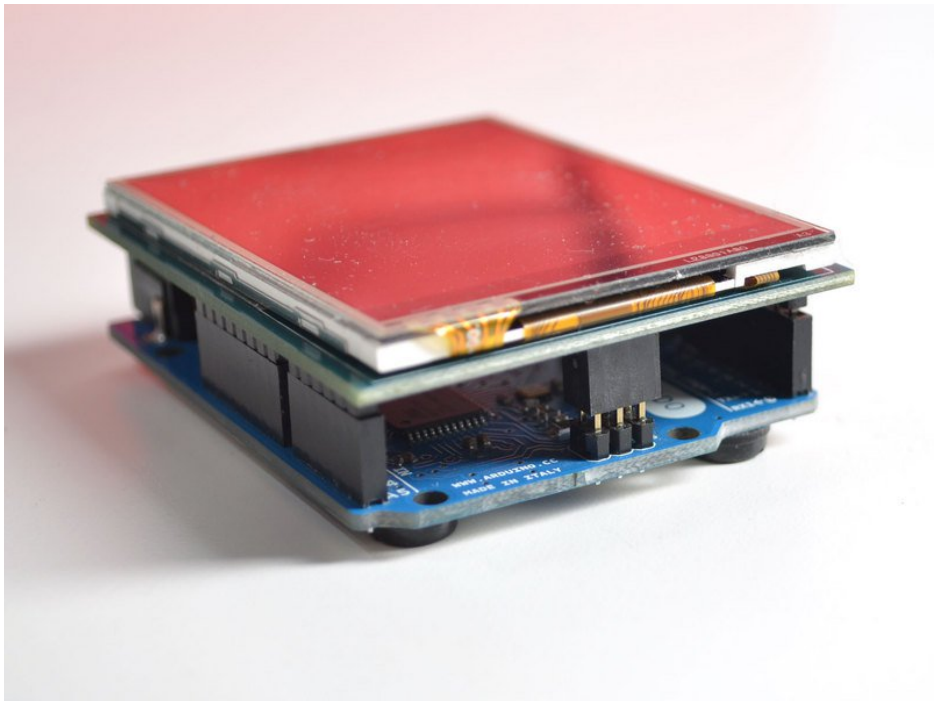
Using with a Mega/Leonardo

With just a little effort you can make this shield plug-n-play with the Mega/Leonardo. Look at the bottom of the shield and find the area with the 6 jumpers. Three of them are closed, and three are open. Solder close the three ICSP jumpers.



You can then cut the small line in between the #11, #12, #13 pads. This will free up digital #11, 12, and 13 for you to use on the Leo or Mega.

That's it! No software or firmware hacking other than that is required.



With this mod, the shield uses the ICSP header for data so make sure your duino (or stack of shields) has a ICSP plugged into the socket as above!

Graphics Test

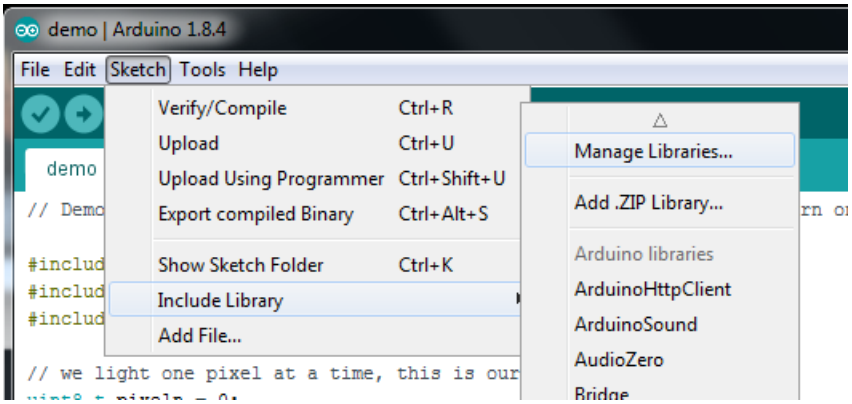
We have a library with example code ready to go for use with these TFTs. The library is not incredibly fast and optimized but its a good start and can easily be ported to other micrcontrollers. However, we'll assume you're using an Arduino.

Our github repository (https://adafru.it/d4d) contains all the code and examples you'll need for driving the TFT.

Install Libraries

You'll need a few libraries to use this display

From within the Arduino IDE, open up the **Library Manager...**

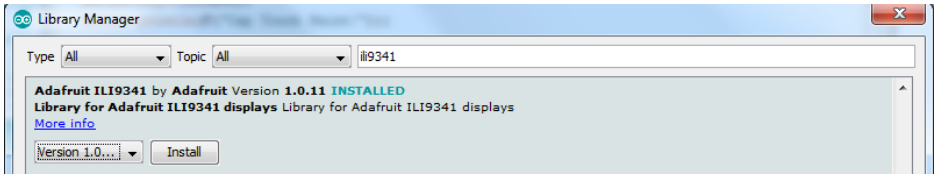


Install Adafruit ILI9341 TFT Library

We have example code ready to go for use with these TFTs.

Two libraries need to be downloaded and installed: first is the Adafruit ILI9341 library (https://adafru.it/d4d) (this contains the low-level code specific to this device), and second is the Adafruit GFX Library (https://adafru.it/aJa) (which handles graphics operations common to many displays we carry). If you have **Adafruit_GFX** already, make sure its the most recent version since we've made updates for better performance

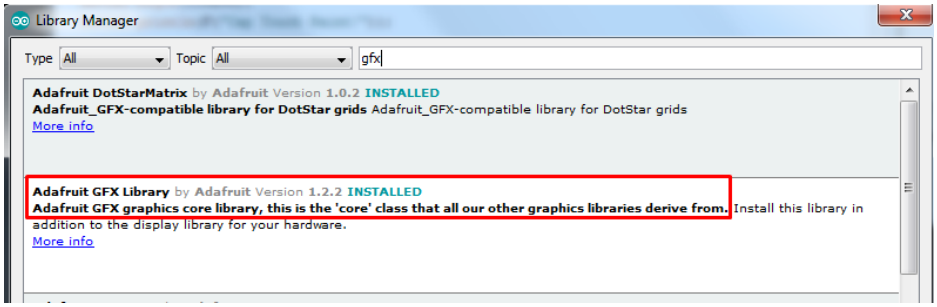
Search for **ILI9341** and install the **Adafruit ILI9341** library that pops up!



For more details, especially for first-time library installers, check out our great tutorial at http://learn.adafruit.com/adafruit-all-about-arduino-libraries-install-use (https://adafru.it/aYM)

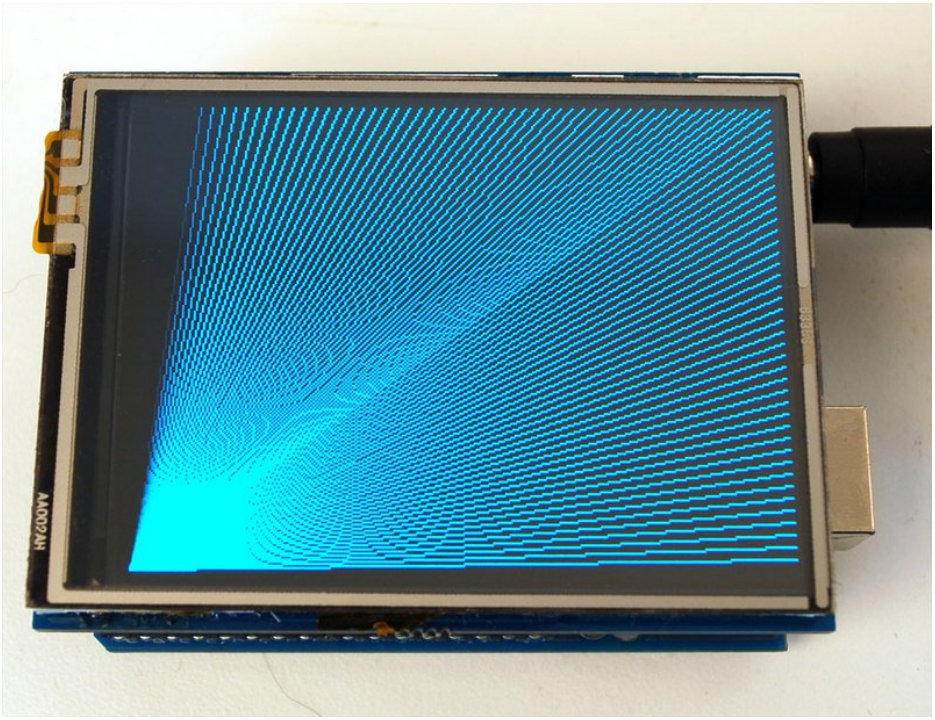
Next up, search for **Adafruit GFX** and locate the core library. A lot of libraries may pop up because we reference it in the description so just make sure you see **Adafruit GFX Library** in bold at the top.

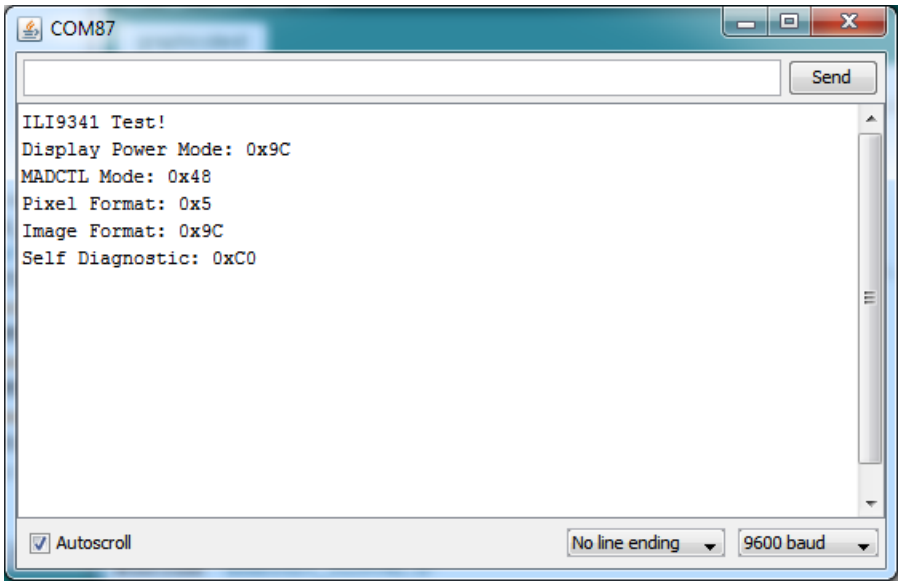
Install it!



Repeat this process one more time, looking for the **Adafruit_ZeroDMA** library. Install that one too.

Restart the Arduino software. You should see a new **example** folder called **Adafruit_ILI9341** and inside, an example called **graphicstest**. Upload that sketch to your Arduino! You should see a collection of graphical tests draw out on the TFT.




COM87
Send
ILI9341 Test!
Display Power Mode: 0x9C
MADCTL Mode: 0x48
Pixel Format: 0x5
Image Format: 0x9C
Self Diagnostic: 0xC0
Autoscroll
No line ending
9600 baud

Adafruit GFX library

The TFT LCD library is based off of the Adafruit GFX graphics core library. GFX has many ready to go functions that should help you start out with your project. Its not exhaustive and we'll try to update it if we find a really useful function. Right now it supports pixels, lines, rectangles, circles, round-rects, triangles and printing text as well as rotation.

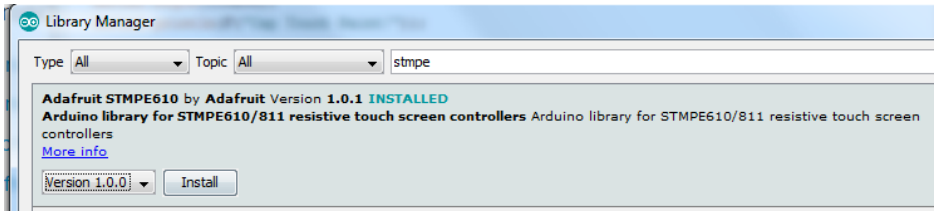
Check out the GFX tutorial for detailed information about what is supported and how to use it (https://adafru.it/aPx)!

Resistive Touchscreen Paint Demo

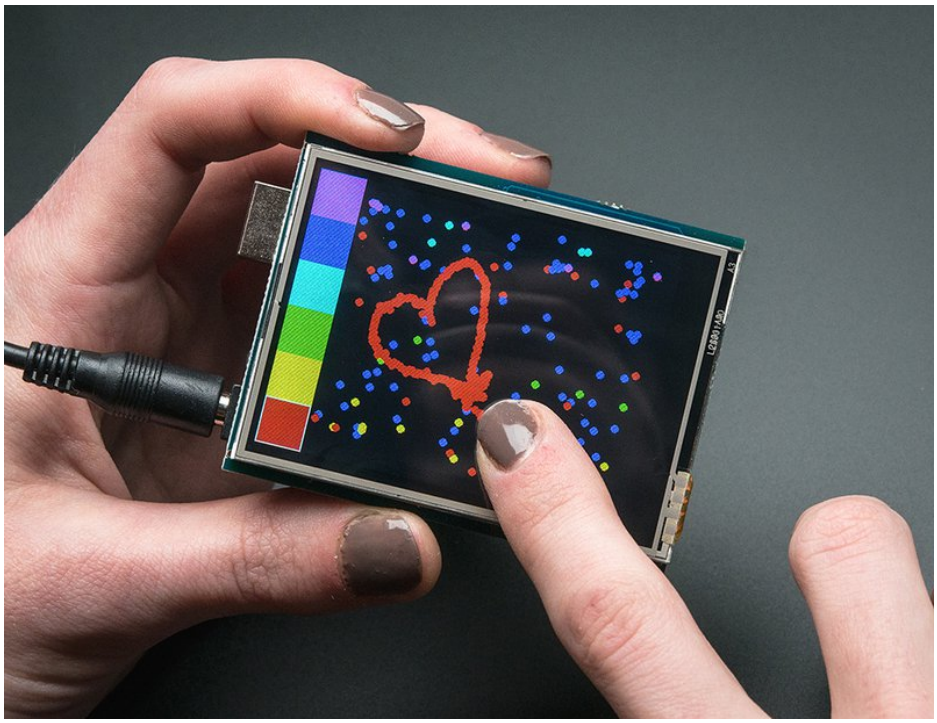
This page is for the Resistive Touch Screen version of the Shield!

The LCD has a 2.8" 4-wire resistive touch screen glued onto it. You can use this for detecting finger-presses, stylus', etc. Normally, you'll need 4 pins to talk to the touch panel **but** we decided to go all snazzy and put a dedicated touch screen driver onto the shield. The driver shares the SPI pins with the TFT and SD card, so only one extra pin is needed (digital #8) This allows you to query the controller when you're ready to read touchscreen data, and saves 3 pins.

To control the touchscreen you'll need one more library (https://adafru.it/d4f) - the STMPE610 controller library which does all the low level chatting with the STMPE610 driver chip.



Once you have the library installed, restart the IDE. Now from the **examples->Adafruit_ILI9341** menu select **touchpaint** and upload it to your Arduino.



The touch screen is made of a thin glass sheet, and its very fragile - a small crack or break will make the entire touch screen unusable. Don't drop or roughly handle the TFT and be especially careful of the corners and edges. When pressing on the touchscreen, sometimes people can use the tip of their fingers, or a fingernail. If you don't find the touchscreen responds well to your fingers, you can use a rounded stylus which will certainly work. Do not press harder and harder until the screen cracks!

Getting data from the touchscreen is fairly straight forward. Start by creating the touchscreen object with

```
Adafruit_STMPE610 ts = Adafruit_STMPE610(STMPE_CS);
```

We're using hardware SPI so the clock, mosi and miso pins are not defined here. For the shield, CS is #8 always. Then you can start the touchscreen with

```
ts.begin()
```

Check to make sure this returns a True value, which means the driver was found. If it wasn't, make sure you have the hardware SPI jumpers set up right: for Leonardo/Mega the ICSP jumpers get closed.

Now you can call

```
if (! ts.bufferEmpty())
```

to check if there's any data in the buffer. The touchscreen driver will store touchpoints at all times. When you're ready to get the data, just check if there's any data in the buffer. If there is, you can call

```
TS_Point p = ts.getPoint();
```

To get the oldest point from the buffer. TS_Point has **.x .y** and .**z** data points. The **x** and **y** points range from 0 to 4095. The STMPE610 does not store any calibration data in it and it doesn't know about rotation. **So if you want to rotate the screen you'll need to manually rotate the x/y points!** The z point is 'pressure' and ranges from 0 to 255, we don't use it here but you can experiment with it on your own, the harder you press, the lower the number.

Since data from the STMPE610 comes in 0-4095 but our screen is 320 pixels by 240 pixels, we can use **map** to convert 0-4095 to 0-320 or 0-240. Something like

```
p.x = map(p.x, 0, 4095, 0, tft.width());
p.y = map(p.y, 0, 4095, 0, tft.height());
```

However, the touchscreen is a bit bigger than the screen, so we actually need to ignore presses beyond the touchscreen itself. We found that these numbers reflected the true range that overlaps the screen

```
#define TS_MINX 150
#define TS_MINY 130
#define TS_MAXX 3800
#define TS_MAXY 4000
```

So we use

```
p.x = map(p.x, TS_MINX, TS_MAXX, 0, tft.width());
p.y = map(p.y, TS_MINY, TS_MAXY, 0, tft.height());
```

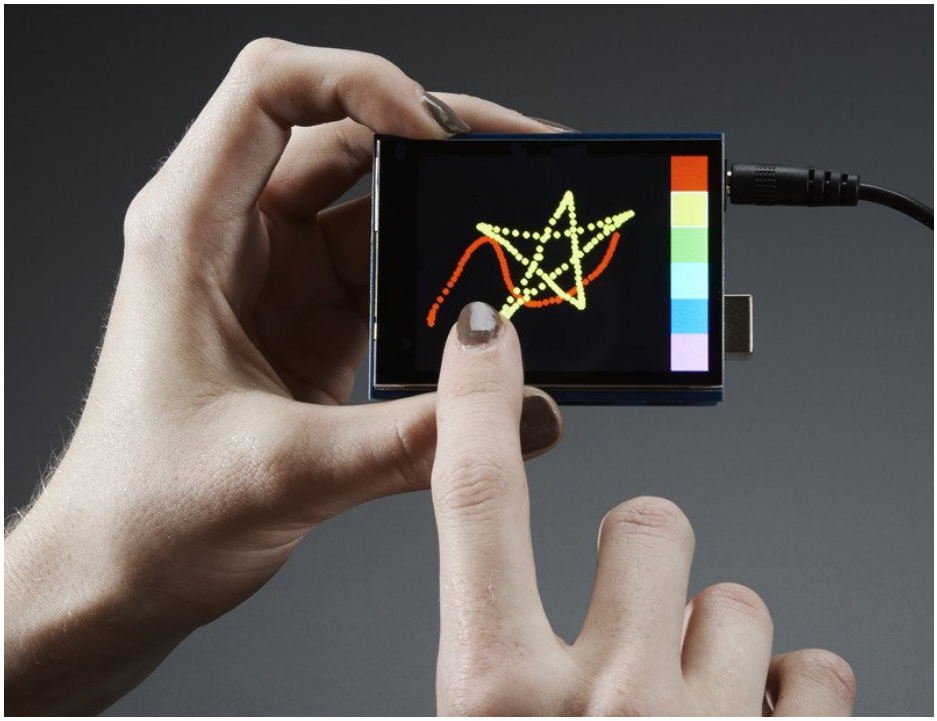
instead.

One last point (pun intended!) since the touchscreen driver stores points in a buffer, you may want to ask the driver "is the touchscreen being pressed RIGHT NOW?" You can do that with

```
if (ts.touched())
```

Capacitive Touchscreen Paint Demo

This page is for the Capacitive Touch Screen version of the Shield!

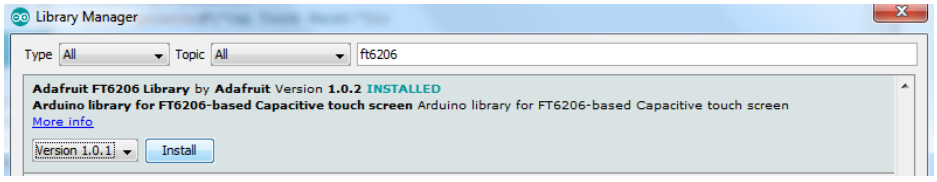


We now have a super-fancy capacitive touch screen version of this shield. Instead of a resistive controller that needs calibration and pressing down, the capacitive has a hard glass cover and can be used with a gentle fingertip. It is a single-touch capacitive screen only!

The capacitive touch screen controller communicates over I2C, which uses two hardwire pins. However, you can share these pins with other sensors and displays as long as they don't conflict with I2C address 0x38.

Download the FT6206 Library

To control the touchscreen you'll need one more library (https://adafru.it/dGG) - the FT6206 controller library which does all the low level chatting with the FT6206 driver chip. Use the library manager and search for **FT6206** and select the Adafruit FT6206 library:



Once you have the library installed, restart the IDE. Now from the **examples->Adafruit_FT6206** menu select **CapTouchPaint** and upload it to your Arduino.

The touch screen is made of a thin glass sheet, and its very fragile - a small crack or break will make the entire touch screen unusable. Don't drop or roughly handle the TFT and be especially careful of the corners

and edges. When pressing on the touchscreen, remember you cannot use a fingernail, it must be a fingerpad. Do not press harder and harder until the screen cracks!

FT6206 Library Reference

Getting data from the touchscreen is fairly straight forward. Start by creating the touchscreen object with

```
Adafruit_FT6206 ts = Adafruit_FT6206();
```

We're using hardware I2C which is fixed in hardware so no pins are defined.
Then you can start the touchscreen with

```
ts.begin()
```

Check to make sure this returns a True value, which means the driver was found. You can also call **begin(threshvalue)** wish a number from 0-255 to set the touch threshhold. The default works pretty well but if you're having too much sensitivity (or not enought) you can try tweaking it

Now you can call

```
if (ts.touched())
```

to check if the display is being touched, if so call:

```
TS_Point p = ts.getPoint();
```

To get the touch point from the controller. TS_Point has **.x** and **.y** data points. The **x** and **y** points range from 0 to 240 and 0 to 320 respectively. This corresponds to each pixel on the display. The FT6206 does not need to be 'calibrated' but it also doesn't know about rotation. **So if you want to rotate the screen you'll need to manually rotate the x/y points!**

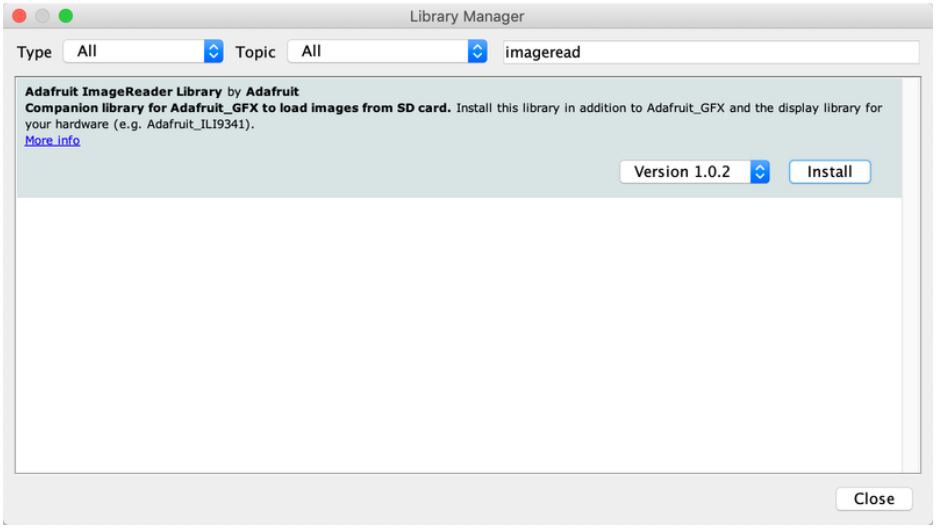
FT6206 Library Reference

FT6206 Library Reference (https://adafru.it/Atz)

Drawing Bitmaps

There is a built in microSD card slot into the shield, and we can use that to load bitmap images! You will need a microSD card formatted **FAT16 or FAT32** (they almost always are by default).

Its really easy to draw bitmaps. We have a library for it, Adafruit_ImageReader, which can be installed through the Arduino Library Manager (Sketch→Include Library→Manage Libraries...). Enter “imageread” in the search field and the library is easy to spot:



With the library installed, let’s proceed by downloading this image of pretty flowers (pix by johngineer):

Copy **purple.bmp** into the base directory of a microSD card and insert it into the microSD socket in the shield. Now upload the **File→Examples→Adafruit_ImageReader→ShieldILI9341** example sketch to your Arduino + shield. You will see the flowers appear!

To make new bitmaps, make sure they are less than 240 by 320 pixels and save them in **24-bit BMP format**! They must be in 24-bit format, even if they are not 24-bit color as that is the easiest format for the Arduino to decode. You can rotate images using the **setRotation()** procedure.

The ShieldILI9341 example sketch shows everything you need to work with BMP images. Here's just the vital bits broken out...

Several header files are included at the top of the sketch. All of these are required...they let us access the SD card and the display, and provide the image-reading functions:

```
#include <SPI.h>
#include <SD.h>
#include <Adafruit_GFX.h>         // Core graphics library
#include <Adafruit_ILI9341.h>     // Hardware-specific library
#include <Adafruit_ImageReader.h> // Image-reading functions
```

Several #defines relate to hardware pin numbers, all fixed values when using the shield.

Then we declare the tft screen object, and the image-reader object like so:

```
#define SD_CS   4 // SD card select pin
#define TFT_CS 10 // TFT select pin
#define TFT_DC  9 // TFT display/command pin

Adafruit_ILI9341     tft = Adafruit_ILI9341(TFT_CS, TFT_DC);
Adafruit_ImageReader reader; // Class w/image-reading functions
```

After the SD and TFT's `begin()` functions have been called (see the example sketch again, in the `setup()` function), you can then call `reader.drawBMP()` to load an image from the card to the screen:

```
ImageReturnCode stat;
stat = reader.drawBMP("/purple.bmp", tft, 0, 0);
```

You can draw as many images as you want — though remember the names must be less than 8 characters long. Call like so:

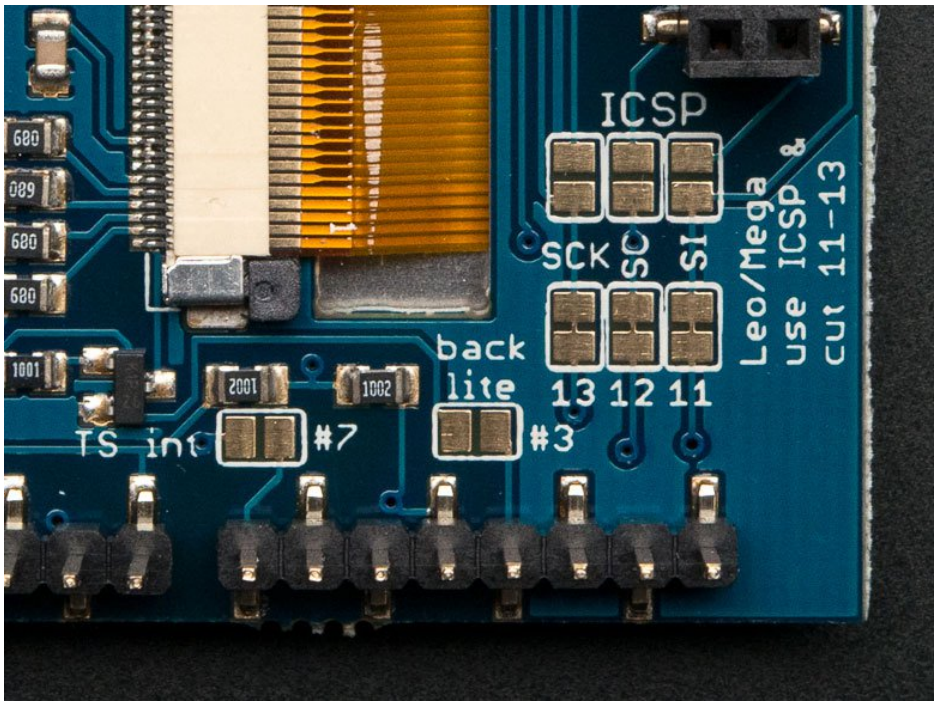
```
reader.drawBMP(filename, tft, x, y);
```

'x' and 'y' are pixel coordinates where top-left corner of the image will be placed. Images can be placed anywhere on screen...even partially off screen, the library will clip the section to load.

Image loading is explained in greater depth in the Adafruit_GFX library guide. (https://adafru.it/DpM)

Backlight & Touch IRQ

Both the resistive and capacitive versions of this shield have the ability to dim the backlight and get an interrupt from the resistive or capacitive touch controller chip on-board.



Controlling the Backlight

By default, we assume you'll want the backlight on all the time. However, you may want to PWM control or otherwise turn off the LED backlight to save power. You can do this with a simple hack. On the back, look for the **backlight** jumper.

On the resistive TFT touch shield
Solder the jumper labeled **Pin 3**. Then you can use Digital 3 to control the backlight.

On the capacitive TFT touch shield
Solder the jumper labeled **Pin 5**. Then you can use Digital 5 to control the backlight.

Touchscreen Interrupt pin

Advanced users may want to get an interrupt on a pin (or even, just test a pin rather than do a full SPI query) when the touchscreen is pressed. You can do that by jumpering the #7 solder jumper labeled **TS int**. We didn't want it to connect to #2 or #3 since those are the Leonardo I2C pins. You can use pin change interrupts to get an interrupt callback on #7. (https://adafru.it/d4h)Or, with a little blue wire, advanced users can connect a wire from the TS interrupt pad to any pin they choose. We find that querying/polling the chip is fast enough for most beginner Arduino projects!

Downloads

Datasheets & Files

- STMPE610 (https://adafru.it/d4k)
- ILI9341 (TFT controller) (https://adafru.it/d4l)
- Raw 2.8" Resistive TFT datasheet (https://adafru.it/sEt)
- Raw 2.8" Capacitive TFT datasheet (https://adafru.it/rwA)
- FT6206 Datasheet (https://adafru.it/sEu) & App note (https://adafru.it/dRn) (capacitive chip)
- PCB CAD files for both resistive and capacitive versions on GitHub (https://adafru.it/pQb)

Schematic

Schematic of the v2 Resistive touchshield

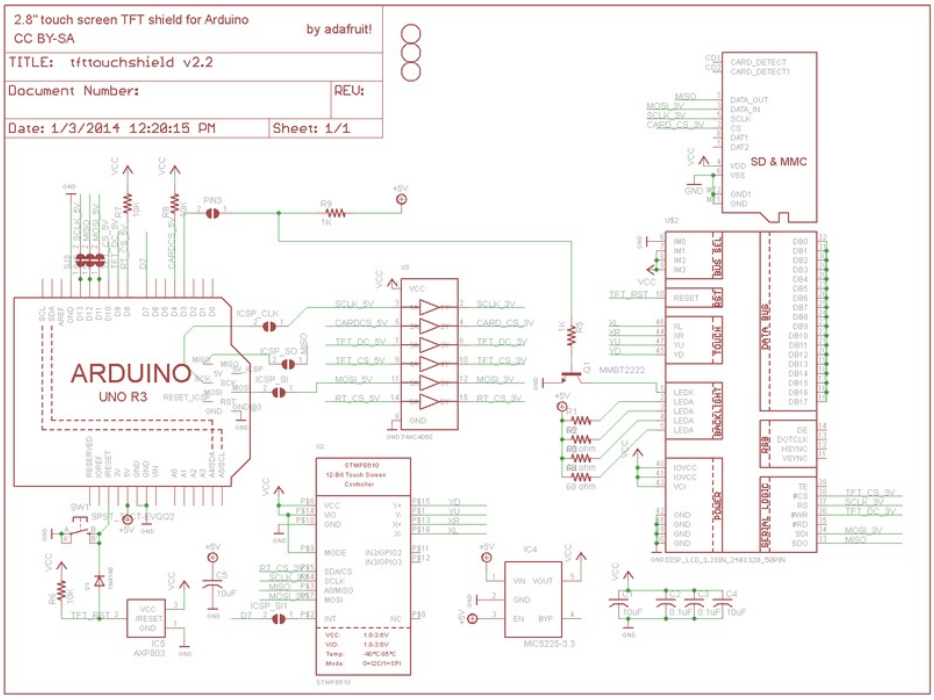
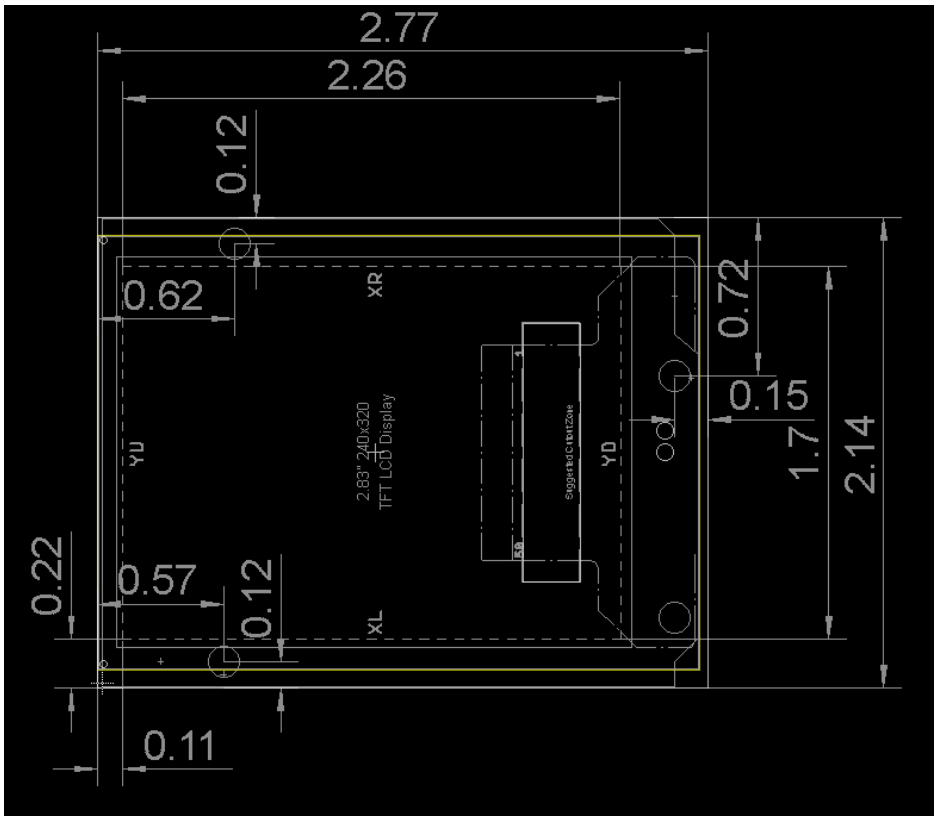


Diagram showing the TFT (yellow outline) underlying Arduino mounting holes (thin white line), PCP outline (rectangular thin white line) and 'visible portion' of the TFT (dashed inner line)



Schematic of the v2 Capacitive touchscreen