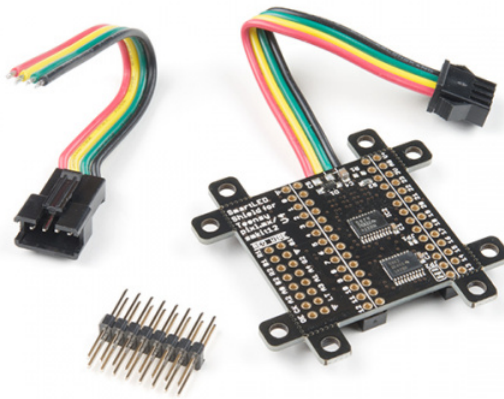


# Getting Started with the SmartLED Shield for Teensy

## Introduction

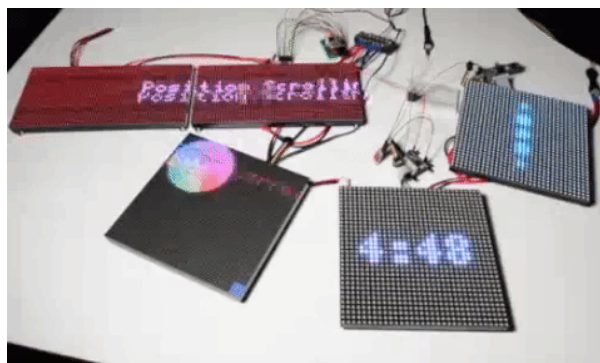
The PixelMatrix SmartLED shield for Teensy makes it easy to connect to RGB LED matrix panels! The shield makes it easy to connect to the 16 pins required to drive the display, connects an external 5V supply to power the display and Teensy, and brings out the Teensy's free signals to a convenient header.



## SmartLED Shield V4 for Teensy

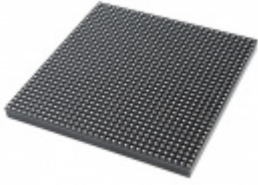
© DEV-15046

In this tutorial, we will explore a some of the examples provided with the SmartLED shield using different RGB LED matrix panel sizes.



## Required Materials

To follow along with this tutorial, you will need the following materials. You may not need everything though depending on what you have. Add it to your cart, read through the guide, and adjust the cart as necessary.



RGB LED Matrix Panel - 32x32

● COM-14646



RGB LED Matrix Panel - 32x64

● COM-14718



RGB LED Matrix Panel - 64x64

● COM-14824



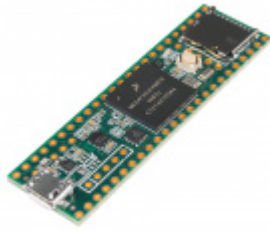
Teensy 3.2

● DEV-13736



Teensy 3.6 (Headers)

● DEV-14058



Teensy 3.5  
● DEV-14055



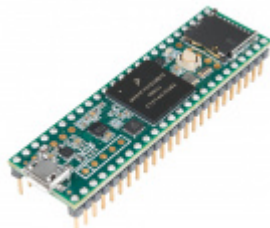
Break Away Headers - Straight  
● PRT-00116



microSD Card with Adapter - 16GB (Class 10)  
● COM-13833



USB micro-B Cable - 6 Foot  
● CAB-10215



Teensy 3.5 (Headers)  
● DEV-14056



microSD USB Reader  
● COM-13004

## Tools

Depending on your setup, you may need pliers, a soldering iron, solder, and general soldering accessories.



Solder Lead Free - 100-gram Spool  
● TOL-09325



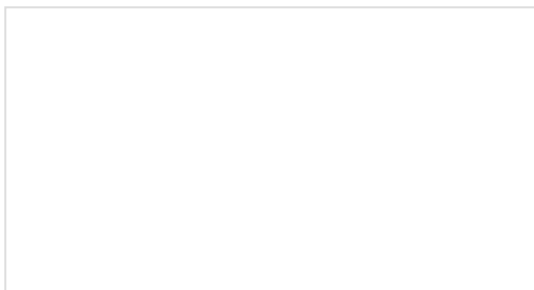
Weller WLC100 Soldering Station  
● TOL-14228



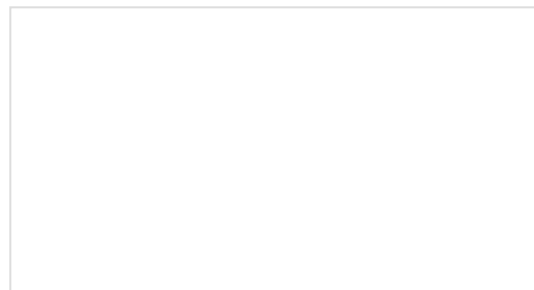
Needle Nose Pliers  
● TOL-08793

## Suggested Reading

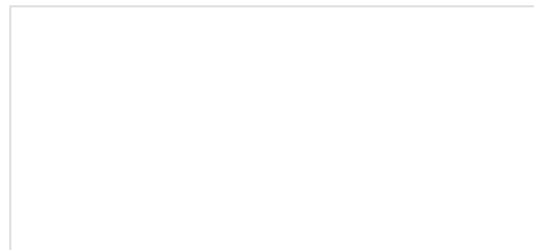
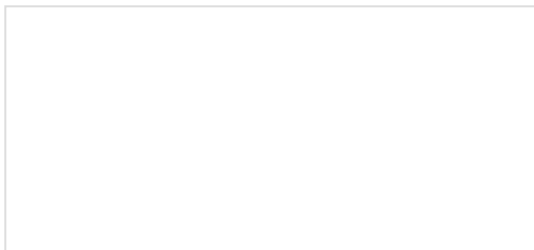
If you aren't familiar with the following concepts, we recommend checking out these tutorials before continuing.



**How to Power a Project**  
A tutorial to help figure out the power requirements of your project.



**What is an Arduino?**  
What is this 'Arduino' thing anyway?



## RGB Panel Hookup Guide

Make bright, colorful displays using the 32x16, 32x32, and 32x64 RGB LED matrix panels. This hookup guide shows how to hook up these panels and control them with an Arduino.

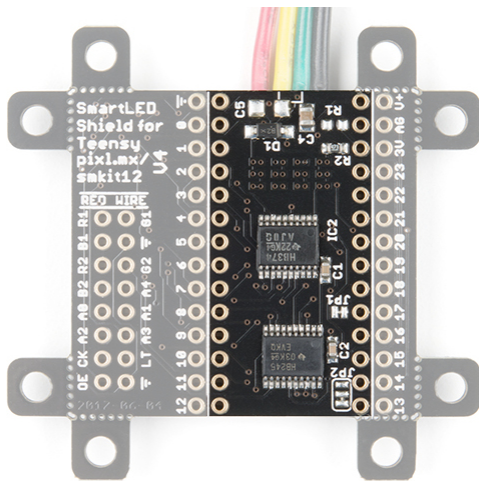
## Getting Started with the Teensy

Basic intro to the Teensy line of products, with soldering and programming suggestions.

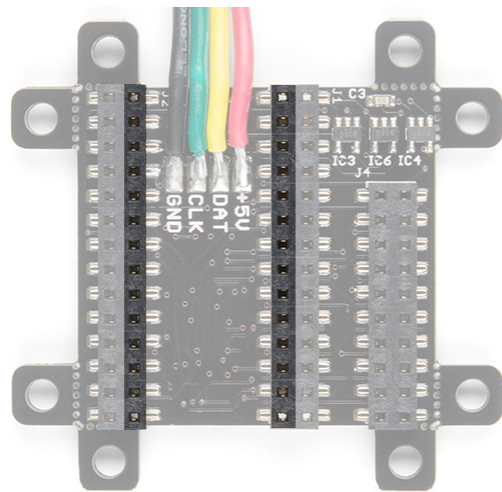
## Hardware Overview

### Teensy Footprint

The SmartLED shield makes it easy to connect to RGB LED matrix panels. As opposed to wiring to 16 pins on the RGB LED matrix panel, you simply sandwich the shield between a Teensy and the IDC connector! The top of the board is where you would insert the Teensy populated with straight headers. The bottom of the shield includes female headers to make a secure connection.

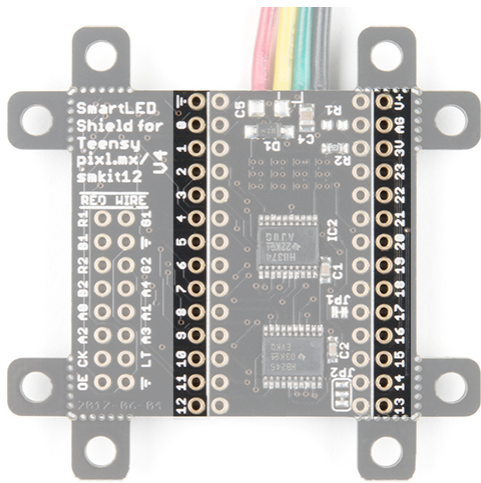


*Teensy Footprint (Top View)*

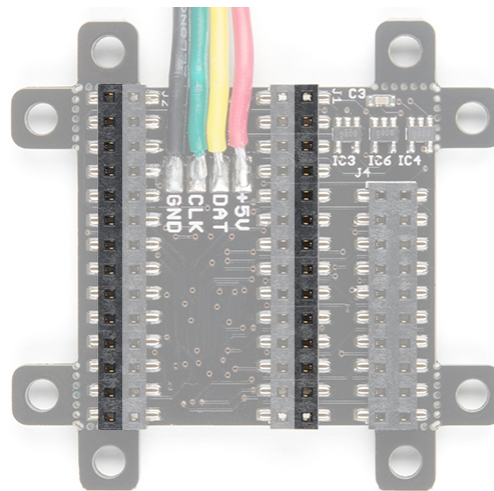


*Teensy Footprint (Bottom View)*

Adjacent to the Teensy footprint are additional pins that are broken out for easy access for prototyping or soldering wires directly to the shield.



Teensy Pins Broken Out (Top View)



Teensy Pins Broken Out (Bottom View)

For more information about the reserved pins on the SmartLED matrix shield, check out the image below for the pins that are used to drive the RGB LED matrix panel and APA102 LEDs.

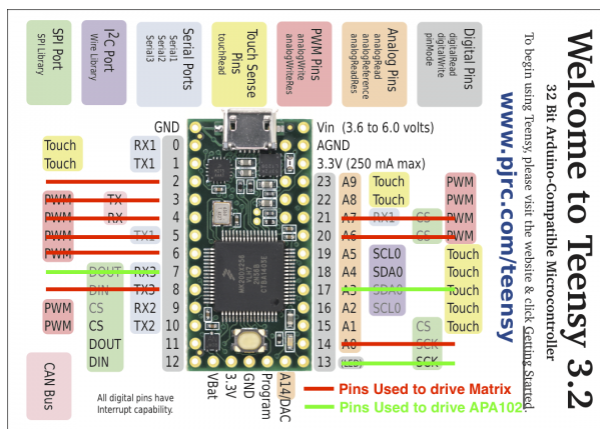


Image Courtesy of PJRC and PixelMatix

✦ **Tip:** If you are prototyping with the shield, try grabbing some square header pins, jumper wires, and a breadboard to connect. Make sure that the jumper wires are **square pins** for a secure connection with the female header populated on the bottom of the SmartLED shield.



Jumper Wires Premium 6" M/F Pack of 10  
 ● PRT-09140



Jumper Wires Premium 6" M/M Pack of 10  
 ● PRT-08431



Breadboard - Mini Modular (Red)

● PRT-12044

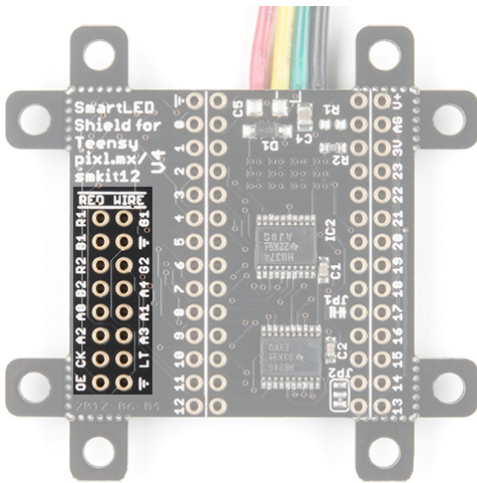


Break Away Headers - 40-pin Male (Long Centered, PTH, 0.1")

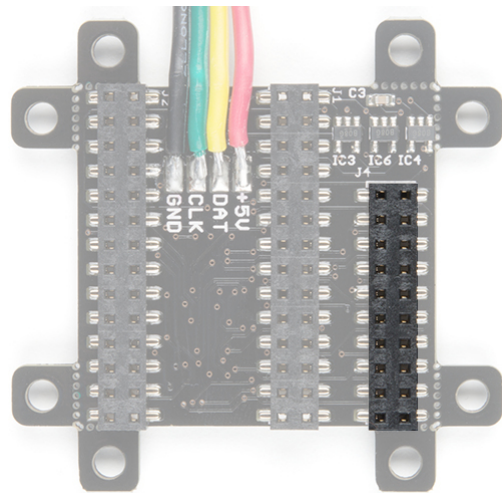
● PRT-12693

## IDC Connector

The shield breaks out the RGB LED matrix panel's IDC pins. Simply align the silkscreen with the panel's input and stack it on like a backpack. As an alternative, you can use an IDC cable and the included 2x8 long, centered header pins. Just make sure to align the cable's red wire with the silkscreen labeled **RED WIRE**.



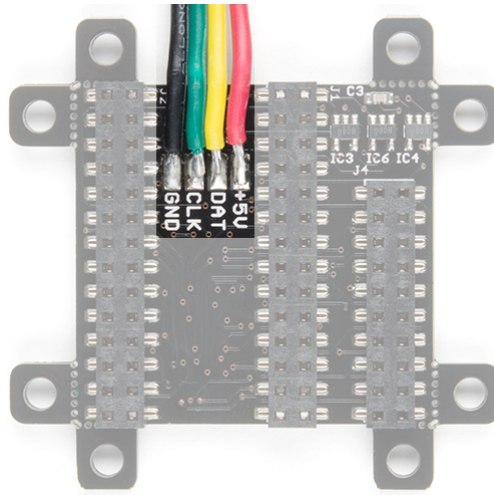
*IDC Connector (Top View)*



*IDC Connector (Bottom View)*

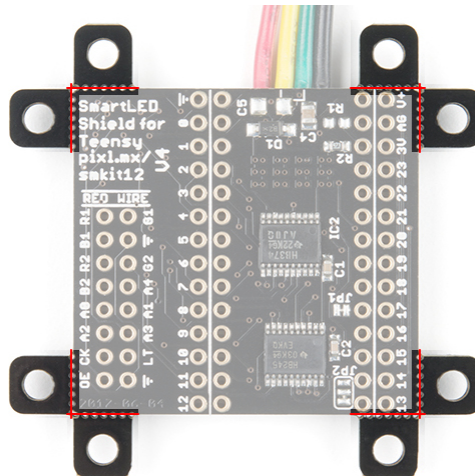
## APA102 LED

The shield includes additional 4-pin JST SM connector pair to connect a strip or matrix of APA102 LEDs from the SmartLED Shield.

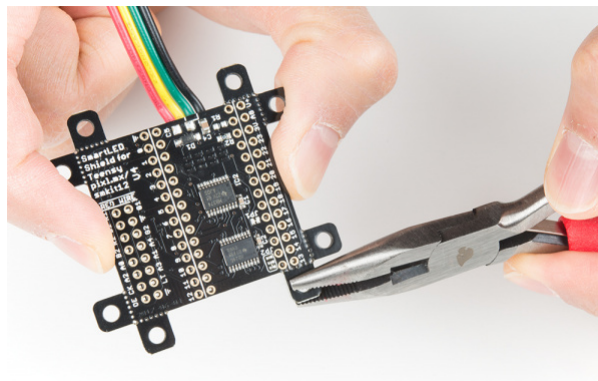


## Removable Mounting Holes

The shield includes mounting holes by each corner of the board. They can be used to mount the shield when using the IDC cable. They are held to the rest of the board with mouse bites. Each of the mounting holes can be removed using pliers. The image below shows highlights the mounting holes with red lines along the mousebites.



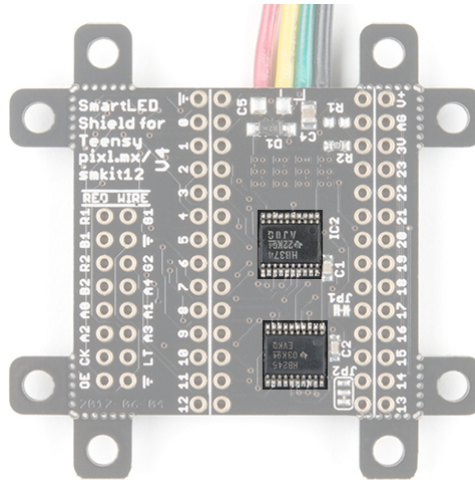
✦ **Tip:** If you are using a Teensy 3.5/3.6 with straight headers populated beyond the 1x14 pins along the side of a Teensy, you will need to snap off the mounting hole below pin 13.



## ADDX Pins and Logic Levels

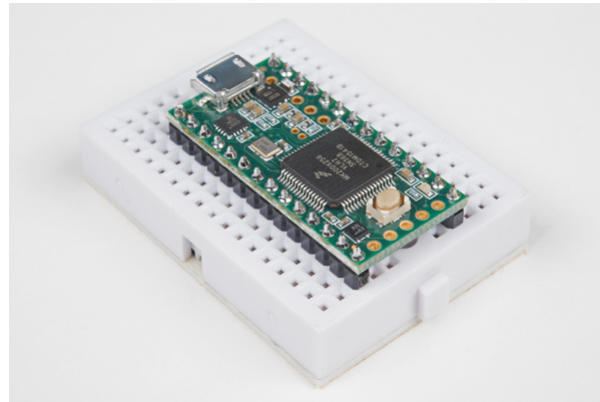


Certain panels may require **5V logic levels**, which may not be enough with the Teensy's output pins. While you can try to wire all 16 pins from the Teensy to the IDC cable, it is not the most reliable connection. The panel may flicker or fail to display properly. The SmartLED shield was designed to include level shifting buffers to safely and reliably control the RGB LED matrix panels.

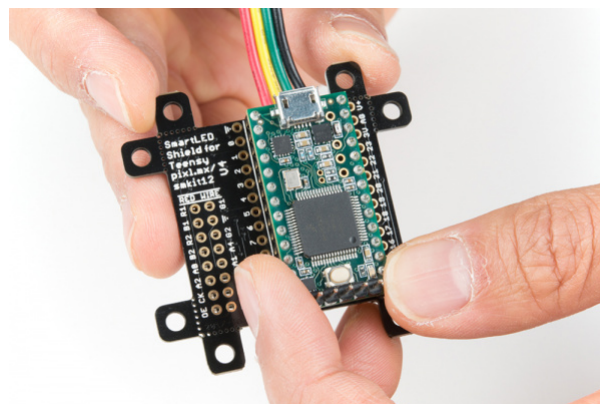


## Hardware Assembly

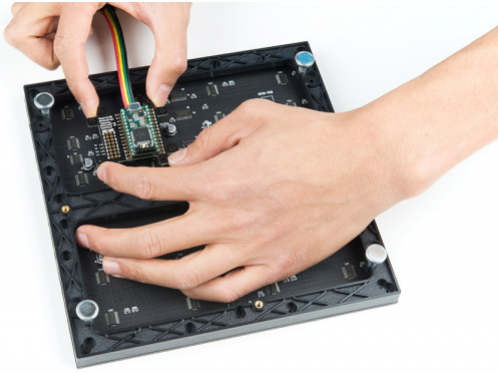
If you have not already, solder the male header pins on your Teensy before connecting. We will be using the 1x14 header pins on each side of a Teensy but you can also solder additional pins or wires depending on your setup.



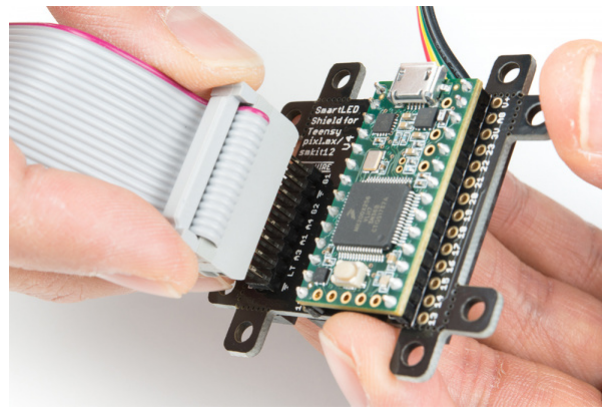
After soldering and removing the flux from a Teensy, stack the Teensy on the SmartLED shield. Make sure to face the USB connector in the same direction as the 4-pin JST SM connector.



Align the IDC connector breakout on the SmartLED shield with the IDC connector on your RGB LED Matrix Panel. The location of the IDC connector depends on the manufacturer of the panel but usually it will be located on the left side relative to the arrows pointing up and toward the right.



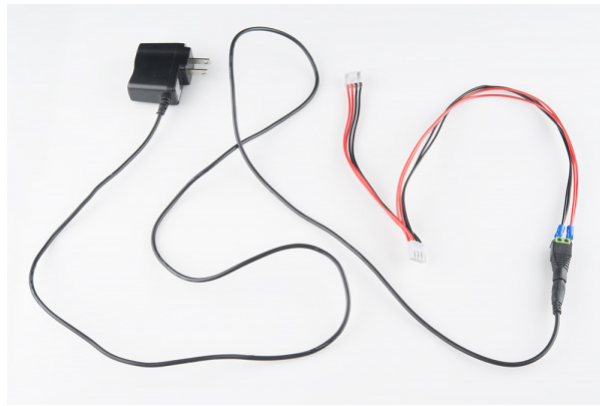
**Tip:** If you received a shield with the 2x8 header pins installed and decide to add the shield to the RGB LED matrix panel's IDC connector as a backpack, you can remove the headers from the shield. Otherwise, you can leave the 2x8 header pins inserted and connect using the IDC cable.



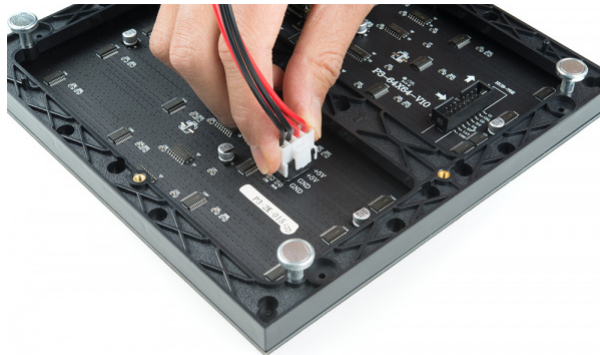
If you have not already, attach a 5V power supply to your RGB LED matrix panel's power cable by using the power supply in conjunction with a female barrel jack adapter and screwdriver to get a quick and dirty connection between the spade and barrel jack.



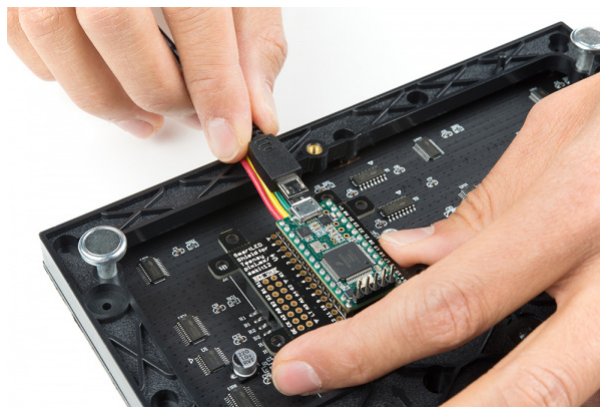
The connection should look like the image below.



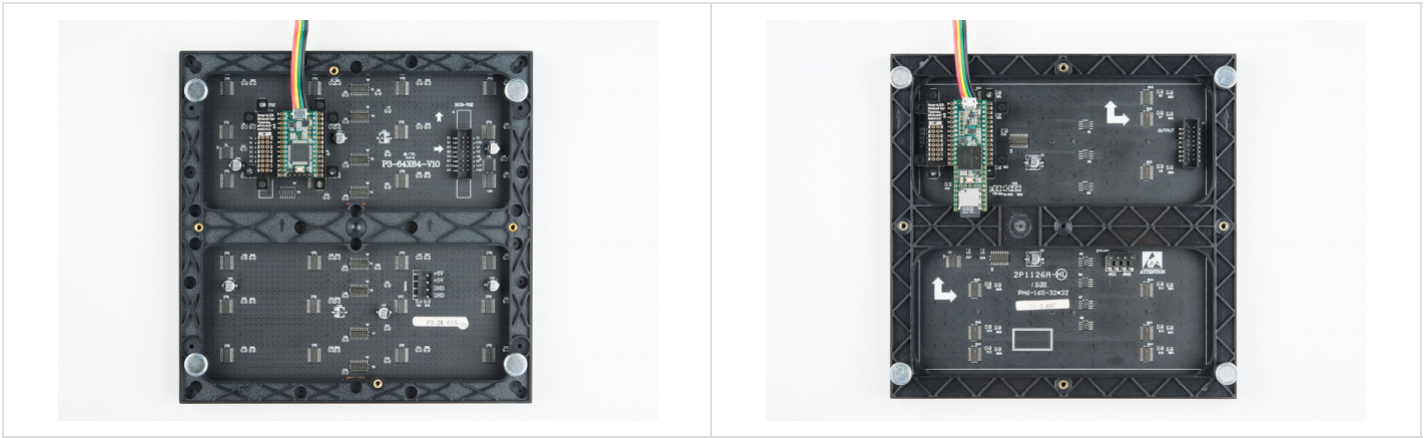
Then slide the polarized power cable for the RGB matrix panel into its respective mating connector. The red wires should be connected to the **5V** pins while the black wires should be connected to the **GND** pins.



For the scope of this tutorial, we will connect **5V USB power** directly to the Teensy's USB connector. This is separate from the power supply that is powering the RGB LED matrix panel. Depending on your setup, you can use the same power supply that the RGB LED matrix panel is using by connecting to either the Teensy's V+ and GND pins or the APA102 JST SM connector. Just make sure that the voltage is regulated at 5V.

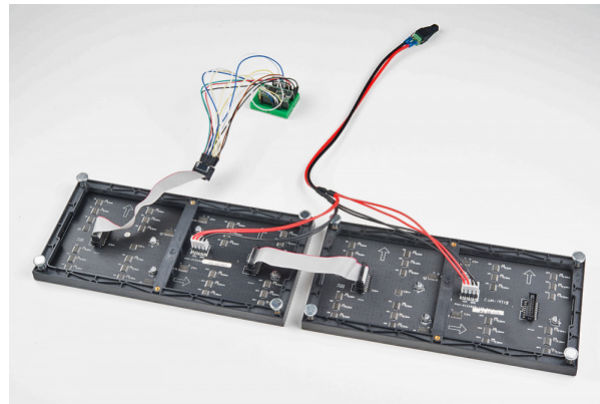


Once connected, the back of your RGB LED matrix panel should look similar to the images below. On the left, a Teensy 3.2 was connected to a 64x64 panel with 3mm pitched LEDs. On the right, a Teensy 3.6 was used for a 32x32 with 6mm pitched LEDs.



## Alternative Connections

There is an option to daisy chain the panels together if you are within the limits of the SmartLED library. Simply connect the output from the first panel to the input of the second panel. Make sure to provide power to each panel through the 4-pin polarized connector.



As explained earlier, you can try to wire all 16 pins from the Teensy to the panel's IDC cable. It is not the most reliable connection. There is a higher probability of wiring incorrectly or a connection becoming loose. For more information on trying the connection, check out the table below. This connection is not possible when wiring to a 64x64 panel due to the extra 5th addressing pin.

Panel Pin Label	Cable Connector Pin #	Teensy	Notes
R0	1	2	Red Data (columns 1-16)
G0	2	5	Green Data (columns 1-16)
B0	3	6	Blue Data (columns 1-16)
GND	4	GND	Ground
R1	5	21	Red Data (columns 17-32)

G1	6	8	Green Data (columns 17-32)
B1	7	20	Blue Data (columns 17-32)
GND	8	GND	Ground
A	9	15	Demux Input A0
B	10	22	Demux Input A1
C	11	23	Demux Input A2
D	12	9	Demux Input E1, E3 (32x32 panels only)
CLK	13	14	LED Drivers' Clock
STB	14	3, 8	LED Drivers' Latch
OE	15	4	LED Drivers' Output Enable
GND	16	GND	Ground

**Heads up!** When manually wiring the board to the panel, make sure that the latch pin is connected to both pins 3 and 8 on the Teensy! Doesn't the SmartLED shield sound good right about now?

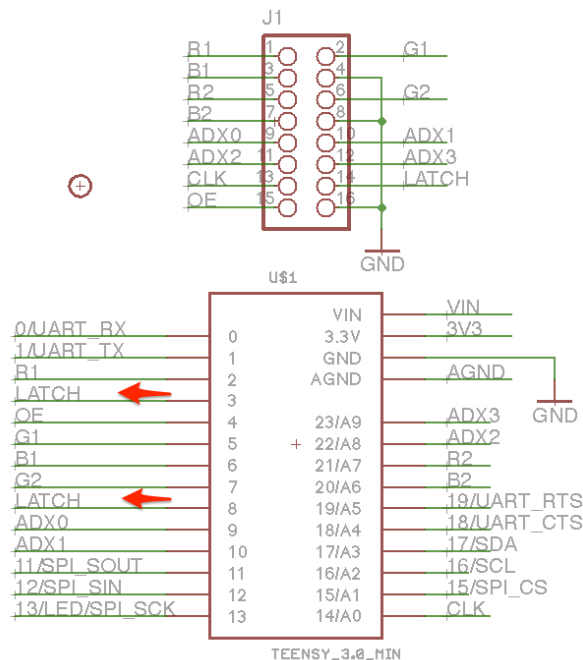


Image courtesy of PixelMatix: Manually Connecting Teensy and Panel

## Software Installation

**Note:** This example assumes you are using the latest version of the Arduino IDE on your desktop. If this is your first time using Arduino, please review our tutorial on installing the Arduino IDE. If you have not previously installed an Arduino library, please check out our installation guide.

## Teensyduino Add-On

If you haven't used Teensy before, you'll need to download and install the extension for the Arduino IDE called Teensyduino from PJRC. This will also install the drivers for the board. Follow the instructions on installing the add-on before continuing on.

[PJRC: TEENSYDUINO DOWNLOAD PAGE](#)

## Install Library

Louis Beaudoin has written an amazing library to control the RGB LED matrix panels. You can obtain these libraries through the Arduino Library Manager. Search for **SmartMatrix3** and you should be able to install the latest version. If you prefer downloading the libraries manually you can also grab them from the GitHub repository:

[GITHUB PIXELMATRIX - SMARTMATRIX \(ZIP\)](#)

## Library Overview

For an overview of the functions, check out documentation in the *MIGRATION.md* file from the GitHub repository.

[GITHUBPIXELMATRIX DOCS - SMARTMATRIX LIBRARY OVERVIEW](#)

## Example: Feature Demo!

There are a few examples from the SmartMatrix library for the SmartLED Shield. For the scope of the tutorial, we will be highlighting three of the examples.

### Feature Demo!

Let's start with the feature demo. After installing the library, click **File > Examples > SmartMatrix3 > FeatureDemo.ino** in the Arduino IDE. Once open, there are a minimum of 4 lines to modify to get the example working with your matrix panel:

- uncomment line “`#include <SmartLEDShieldV4.h>`” if you are using the shield
- adjust `kMatrixWidth` to the width of your panel
- adjust `kMatrixHeight` to the height of your panel
- adjust `kPanelType` based on the scan rate of your panel from line 34 in `SmartMatrix3.h`

The comments in the example code indicate that the known working *width* are: “32, 64, 96, 128”. As for the *height*, the known working sizes are: 16, 32, 48, 64. If you dig into the library, the known working scan rates are 1:8, 1:16, and 1:32.

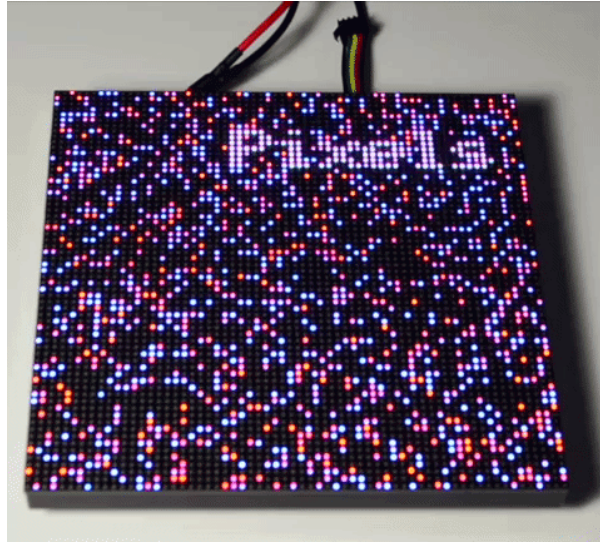
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### 64x64 Panel with 1/32 Scan Rate

Let's try modifying the example code to work with the 64x64 panel with a 1/32 scan rate. The SmartLED shield is required to address the extra 5th ADDX pin on the IDC connector. Simply:

- uncomment line “ #include <SmartLEDShieldV4.h> ” by removing the “ // ”
- adjust **kMatrixWidth** to the width of your panel by replacing 32 with 64
- adjust **kMatrixHeight** to the height of your panel by replacing 32 with 64
- adjust **kPanelType** by replacing SMARTMATRIX\_HUB75\_32ROW\_MOD16SCAN with SMARTMATRIX\_HUB75\_64ROW\_MOD32SCAN from line 34 in SmartMatrix3.h

When the changes are completed, select the Teensy board definition with the associated COM port and click upload. You should see the feature demo running. This includes scrolling text, animations, shapes being drawn, brightness changing, and refresh rate changing.

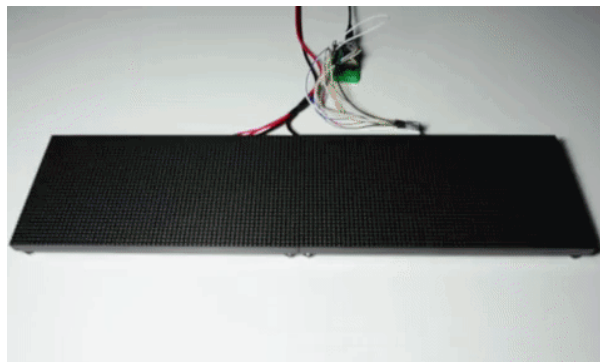


### Daisy Chained 32x64 with 1:16 Scan Rate

Let's try modifying the example code to work with two 32x64 panels with a 1:16 scan rate. In this example, we manually wire the connection to a Teensy 3.2. Modify the original code by:

- leaving the line “ #include <SmartLEDShieldV4.h> ” commented out by using the “ // ”
- adjusting **kMatrixWidth** to the width of your panel by replacing 32 with 128
- keeping **kMatrixHeight** the height of your panel by leaving 32 at 32
- keeping **kPanelType** by leaving SMARTMATRIX\_HUB75\_32ROW\_MOD16SCAN at SMARTMATRIX\_HUB75\_32ROW\_MOD16SCAN from line 34 in SmartMatrix3.h

When the changes are completed, select the Teensy board definition with the associated COM port and click upload. You should see the same demo running but for a matrix size of 32x128!



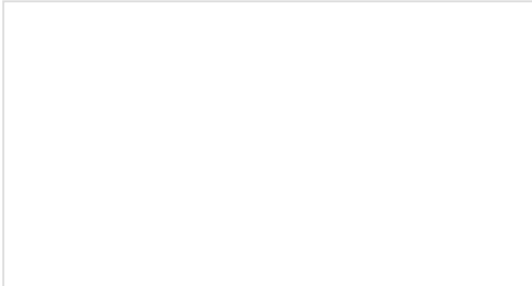
## Resources and Going Further

Now that you've successfully got your SmartLED shield for Teensy up and running, it's time to incorporate it into your own project!

For more information, check out the resources below:

- Pixelmatix
  - Hackster.io: SmartMatrix Projects
- TeensyDuino
- GitHub: PixelMatix
  - SmartMatrix Library

Need some inspiration for your next project? Check out some of these related tutorials:



### RGB Panel Jumbotron

This tutorial will show you how to combine a webcam, a 32x32 RGB LED panel, and a Teensy 3.1 to stream video from the webcam, pixelate it, and display it on the LED panel - LIVE.

Maybe try making a hover pong game with the 32x32 RGB LED Matrix using a gesture sensor and the SmartLED Shield. The example code can be found in the GitHub repo HoverPong.



Or check out the Aurora project.

- Instructables: SmartMatrix - Dynamic LED Art Display
- GitHub PixelMatix: Aurora Project