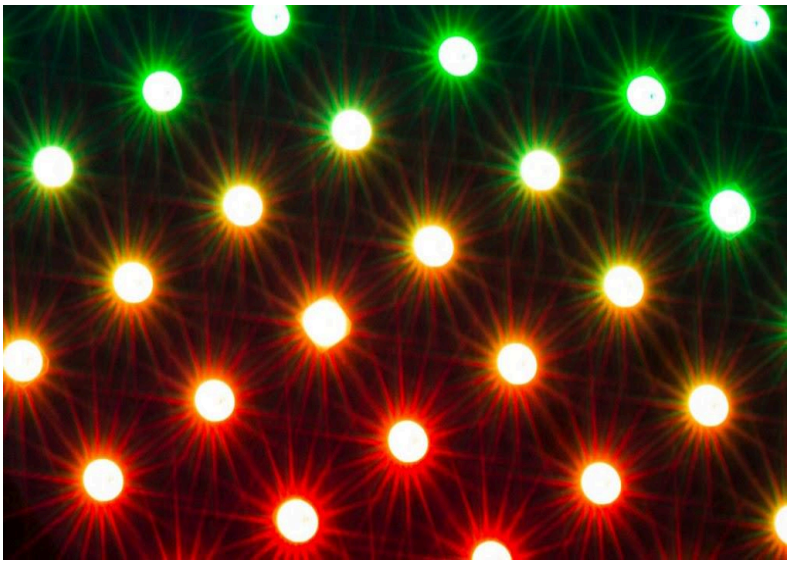
TiM (The intelligent Matrix) User Guide

revision 1



www.wyolum.com
info@wyolum.com

INDEX

INTRODUCTION

The WyoLum team have been working on a cool new project based on 5050-WS2811 RGB “smart” pixels. We just got the first boards back and they are amazing.

TiM (The intelligent Matrix) is an array of 8×16 individually addressable pixels. It is essentially 8 rows of 16 LED’s but with a very flexible control circuit that allows you to control the whole array (128 LEDs) with a single pin or up to 10 boards (1280 pixels) chained together using 8 input pins.

TiM boards can be linked together to create larger matrices. Stacking can be done in the vertical and horizontal orientations, and the pitch between individual LEDs is maintained when boards are stacked.

To control a single TiM board using a single microcontroller pin, we use the board in what we call “Serial” mode. The 8 rows of 16 LEDs each are chained together in a single long series. All the 128 LEDs can be individually controlled. Doing this requires soldering a set of eight bridges on the TiM. Several TiM boards can be chained together, being limited by the juice available from the power supply and the capability of the micro-controller. Each board received a single Data-In signal, and sends out a Data-Out (which goes to the Data-In of the next board).

Using 8 microcontroller pins allows larger matrices to be created. The TiM’s are used in what we refer as “Parallel” mode. Each row of 16 LEDs is individually addressed (Rows “A” thru’ “H”). The board receives 8 Data-In signals from the micro-controller, and outputs Data-Out which connect to the next board.

TiM boards are designed such that standard 0.1” pitch, right angle, header pins (male-female pair - see LINKS for details) can be used to interconnect the boards. These stacking connectors allow Data-Out from one board to connect to the Data-In of the next board easily. Power can also be transferred from one board to the other using similar headers, although for larger assemblies, each board may require its own individual power input.

FEATURES

- Super bright 24-bit RGB color (not multiplexed)
- Expandable -- make larger arrays by stacking multiple boards horizontally or vertically
- Control each board with 1 microcontroller pin (series mode, 128 RGB LEDs) OR
- Control each board with 8 microcontroller pins (1 byte, Parallel mode, 8 rows of 16 RGB LEDs each)
- Expand this configuration for larger matrices. A series matrix will still be controlled with 1 control signal, and a parallel matrix by 8 signals.
- Very low profile - lets you make a thin matrix
- Compatible with Adafruit Neo Pixel Library
- Drive up to 25 boards with 5V, 400W power supply

SPECIFICATIONS

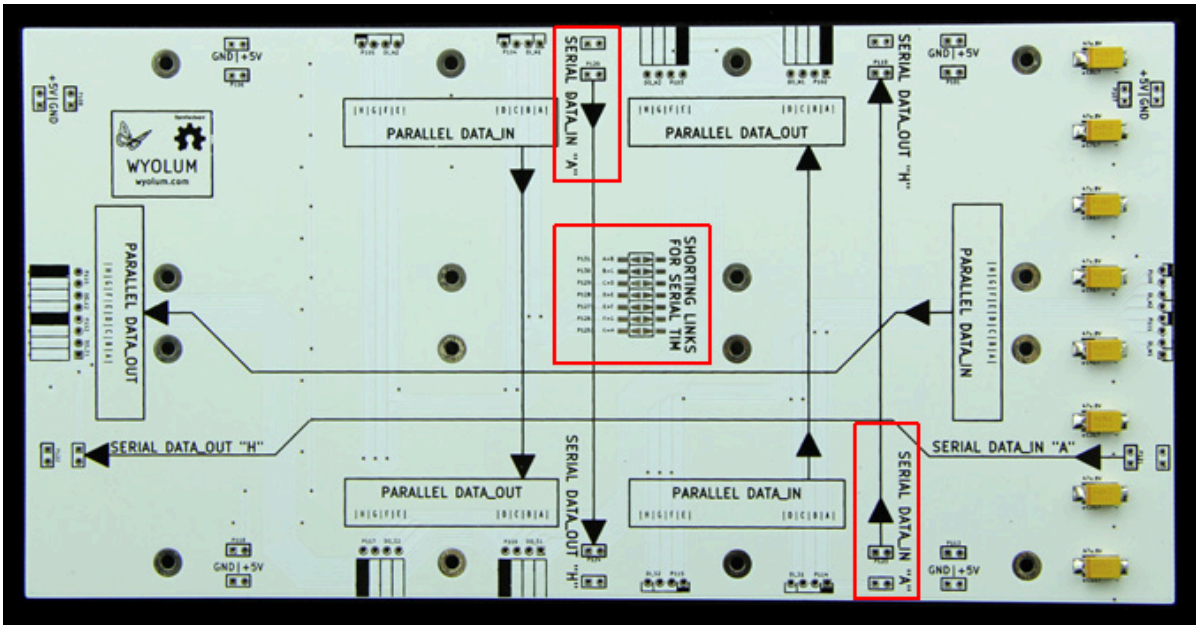
- 0.6” LED spacing - horizontal / vertical
- Input voltage : 3V3 ~ 5V0
- Max current 2.6 Amperes / board (measured at 100% duty cycle on R, G, and B at 5V)
- RGB WS2811 smart pixel LEDs
- Board size : 9.60” x 4.80” (1:2 aspect ratio)

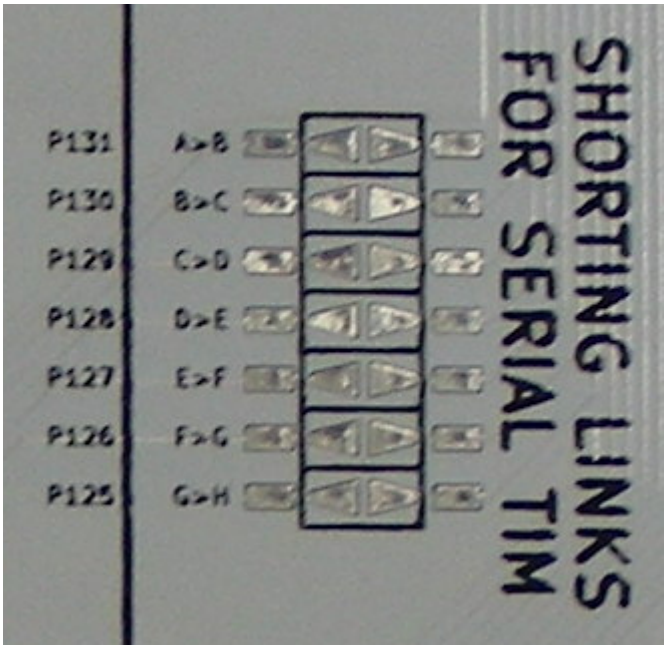
USES

- Large format displays
- Mood lighting
- Holiday lighting
- Super bright full color word clock

TiM - SINGLE BOARD, SERIAL MODE

To use this mode, you need to bridge “SHORTING LINKS FOR SERIAL TIM” on the back layer of the board. These are marked P125 thru P131.
A>B (P131) indicates that Data-Out of Row “A” connects to Data-In of Row “B” via the P131 shorting link. And so on, for all the other rows.



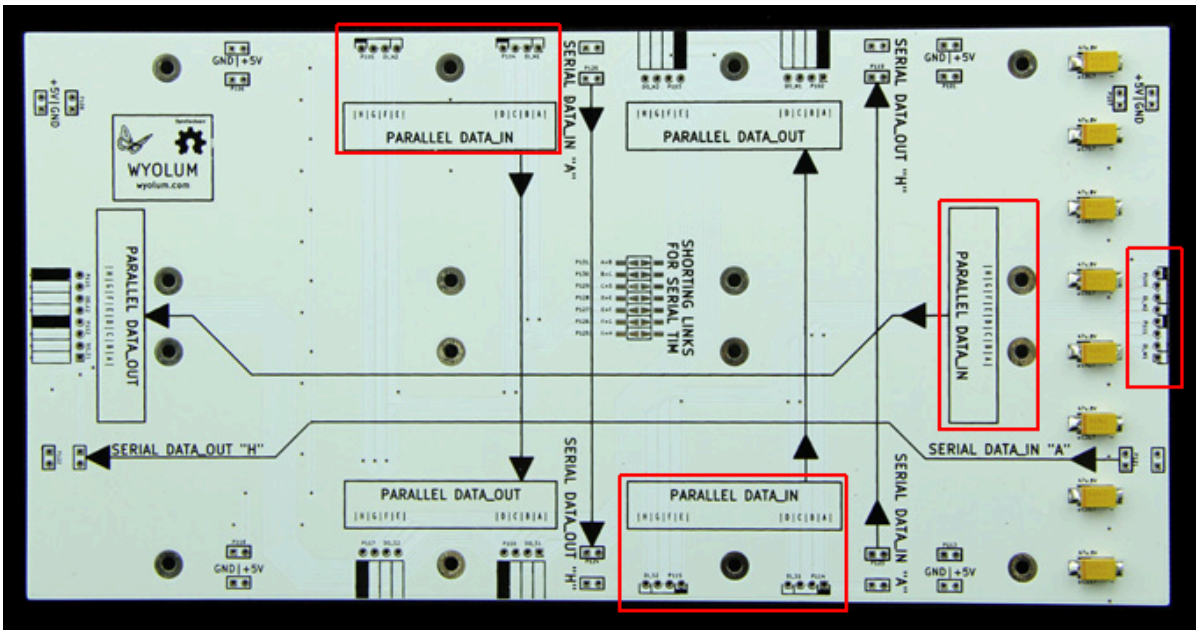


You can either permanently solder bridge the links using the trapezoid pads.
Or, mount 0.1” pitch, SMD, dual row header, using the rectangle pads and use jumper links across the header pins.
The single input signal from your microcontroller goes to “SERIAL DATA_IN “A” ” at one of two possible locations (see pic above). The 4 pads are linked together & you can use either straight or right angle, 2 pin, 0.1” pitch header, allowing for a better mechanical

anchoring.
Power input can be at any of the several locations around the board marked with +5V and GND. At each location, 4 pads are linked together & you can use either straight or right angle, 2 pin, 0.1” pitch header, allowing for a better mechanical anchoring.

TiM - SINGLE BOARD, PARALLEL MODE

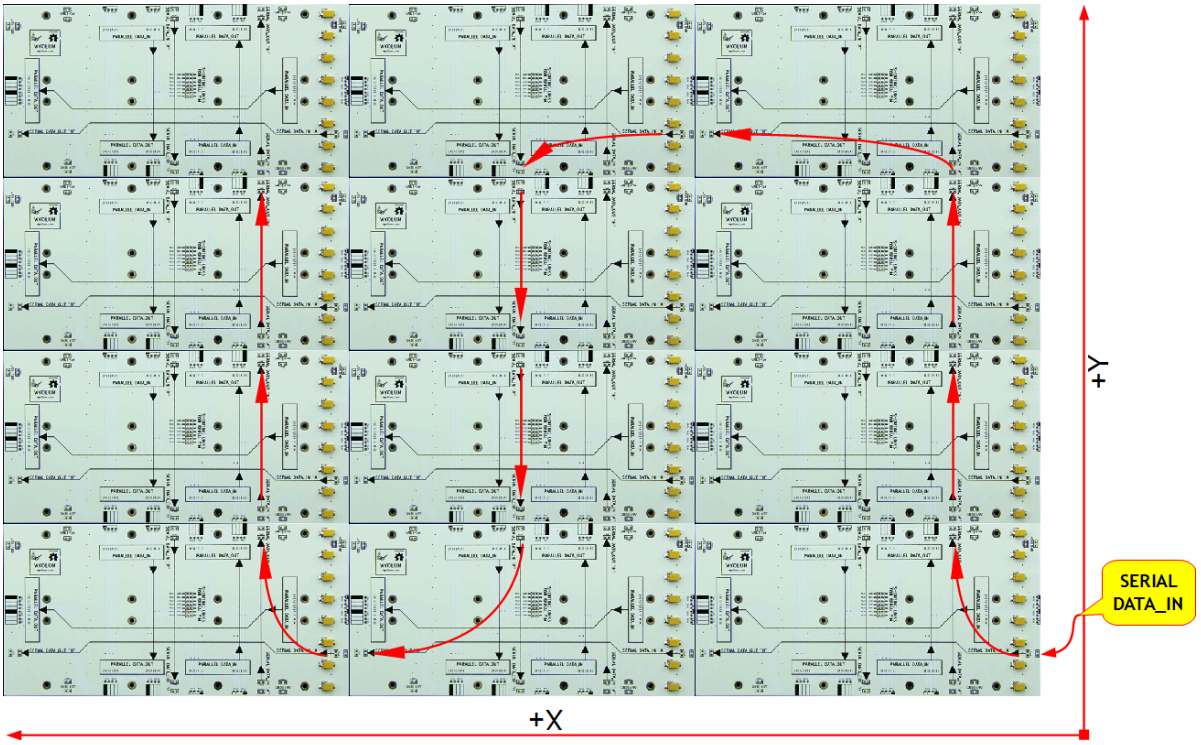
To use this mode, you need 8 microcontroller signals to drive rows “A” thru “H”.
These go to “PARALLEL DATA_IN” , at one of three possible locations. See the pic below.



Power input can be at any of the several locations around the board marked with +5V and GND. At each location, 4 pads are linked together & you can use either straight or right angle, 2 pin, 0.1” pitch header, allowing for a better mechanical anchoring.

TiM - MULTI BOARD MATRIX, SERIAL MODE

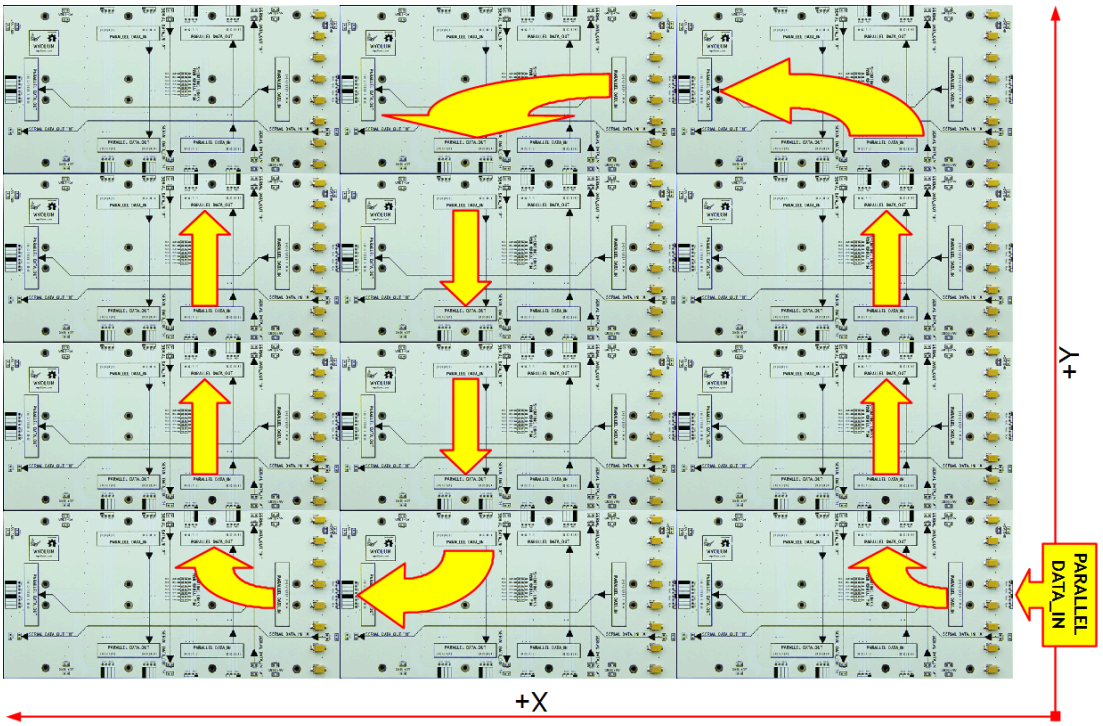
To create larger matrices by linking multiple boards in the serial mode, follow instructions for TiM - SINGLE BOARD, SERIAL MODE
The microcontroller signal goes to SERIAL DATA_IN of your first TiM board.
SERIAL DATA_OUT from the first board goes to SERIAL DATA_IN of your next TiM board. You will find that DATA_OUT header of the first board lines up with the DATA_IN header of the next board.
You can extend the matrix in both directions by “snaking” the Data signal from one board to the other.
Use 2 pin, male, right angle header for the DATA_IN ports, and 2 pin, female, right angle header for the DATA_OUT ports.
Power can be similarly transferred from one board to another.



The boards have power headers placed all around the 4 edges. These can be used to transfer power to all the other boards in the matrix. However, since each board requires about 2.6 Amps, it may be advisable to power each row or column separately.

TiM - MULTI BOARD MATRIX, PARALLEL MODE

To create larger matrices by linking multiple boards in the parallel mode, follow instructions for TiM - SINGLE BOARD, PARALLEL MODE
As in the serial mode, the microcontroller signals are connected to PARALLEL_DATA_IN on the first TiM. PARALLEL_DATA_OUT from the first TiM goes to PARALLEL_DATA_IN of the next TiM. Again, you “snake” the signals as you build the matrix, DATA_OUT of previous board going to DATA_IN of next.



The boards have power headers placed all around the 4 edges. These can be used to transfer power to all the other boards in the matrix. However, since each board requires about 2.6 Amps, it may be advisable to power each row or column separately.

SOFTWARE EXAMPLES (using AlaMode or Arduino)

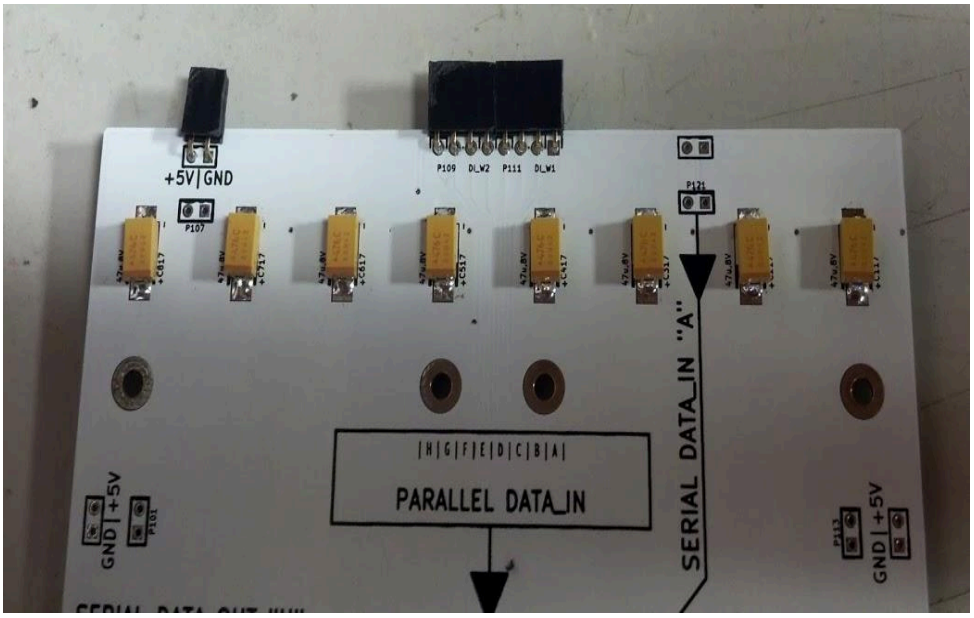
Many microcontrollers are available to drive TiM. We have used our own AlaMode in these examples, but you can use any ATMEGA328 based Arduino like Uno or Duemilanove .

Matrix Test

Build it

TiM has many options for stacking multiple boards. You have to decide how you would like to stack them before you solder any of the headers. Because you can stack more boards together in parallel mode, I will use that configuration here. To keep all of my boards as consistent as possible, I always use female header on the top and left sides of the board (looking from the front) and male headers inset from the right and bottom edges. To save time on re-configurations, only solder the headers you need when you need them.

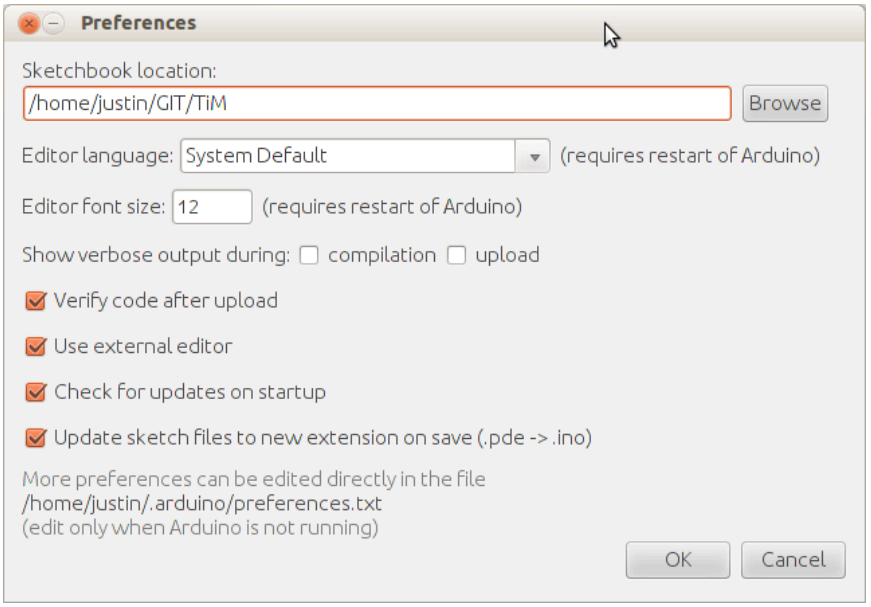
1. Solder 8 pin right angle female header on the “PARALLEL DATA_IN” port.
2. Solder 2 pin right angle female header on the top left power port (+5V | GND)



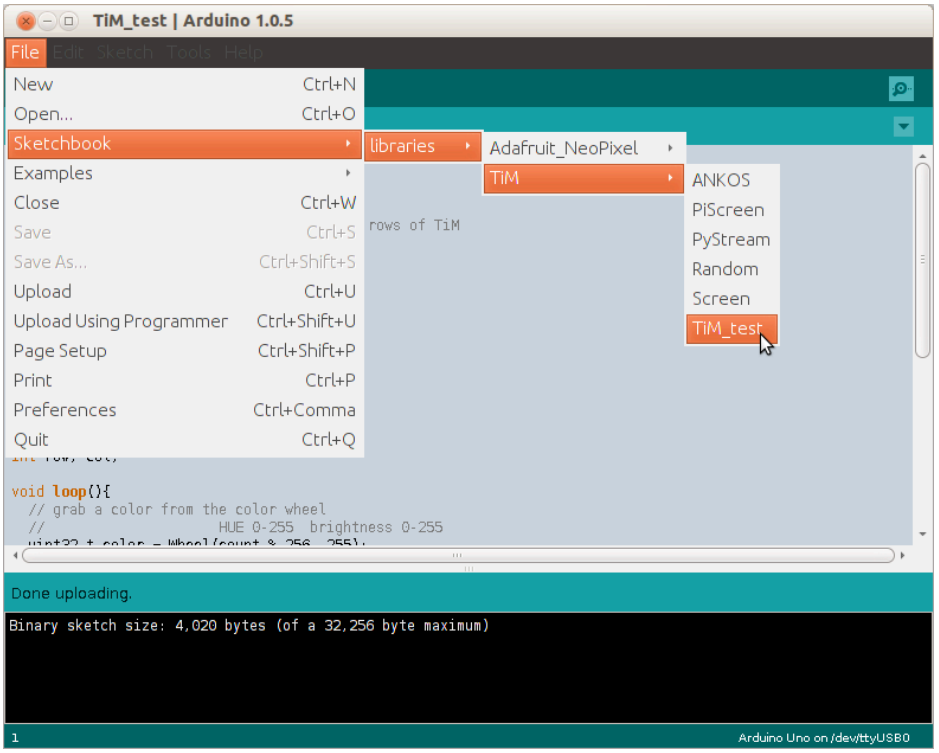
3. Add 2-pin male header to right power port (+5V | GND)
4. Connect AlaMode Digital Pins 2-9 to PARALLEL DATA_IN pins A-H
    - D2 → H
    - D3 → G
    - D4 → F
    - D5 → E
    - D6 → D
    - D7 → C
    - D8 → B
    - D9 → A
5. Connect AlaMode GND to left power port (GND)
6. Connect 5V 3A power supply to right (or left) power port (+5V | GND)

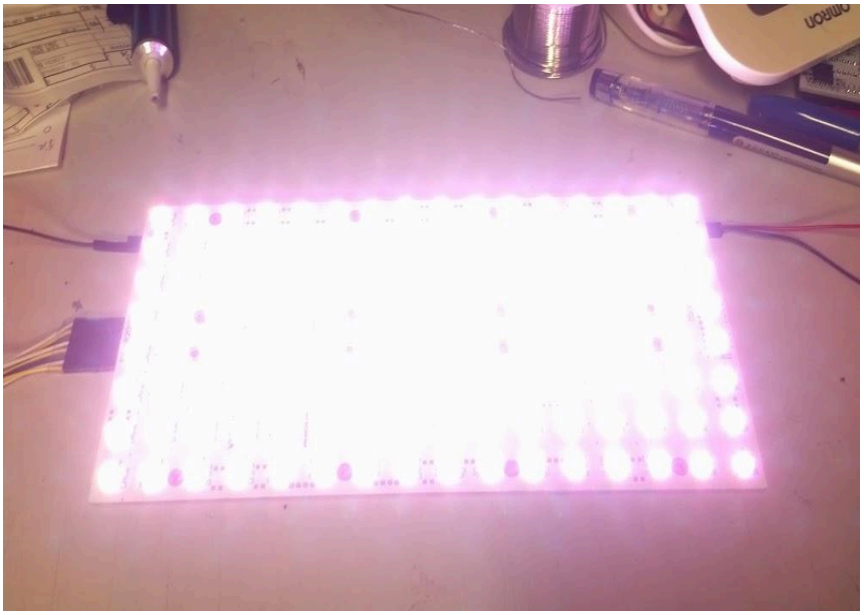
Run it

1. Download libraries and example code.
2. Unzip into known directory. I've started having a separate "sketchbook" for each project. This allows me to be sure I can share the minimal set of libraries to get a project working. I suggest unzipping the directory to "<USER>/GIT/TiM"
3. Point Arduino to TiM folder (open Arduino, File->Preferences, Sketchbook location)



4. Close *all* Arduino windows and restart Arduino.
5. Upload TiM_test from examples directory.





The display will light up all white for 1 second to show off its brilliance. Then it will run through red, green, and blue streaks.

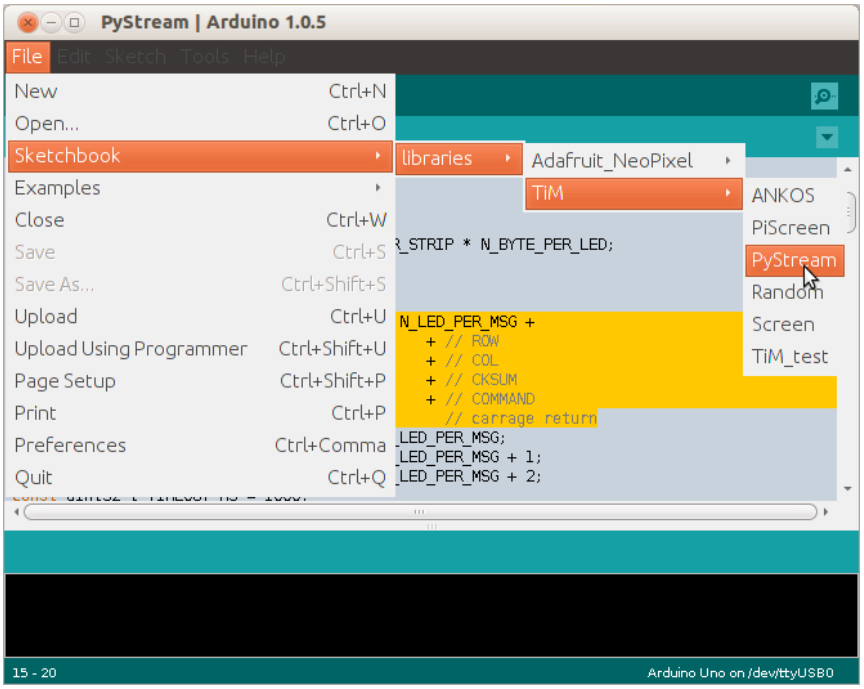
Stream Data

TiM can also stream data from the serial port.

Build it

Use the same setup as the test program.

Run it (upload PyStream)

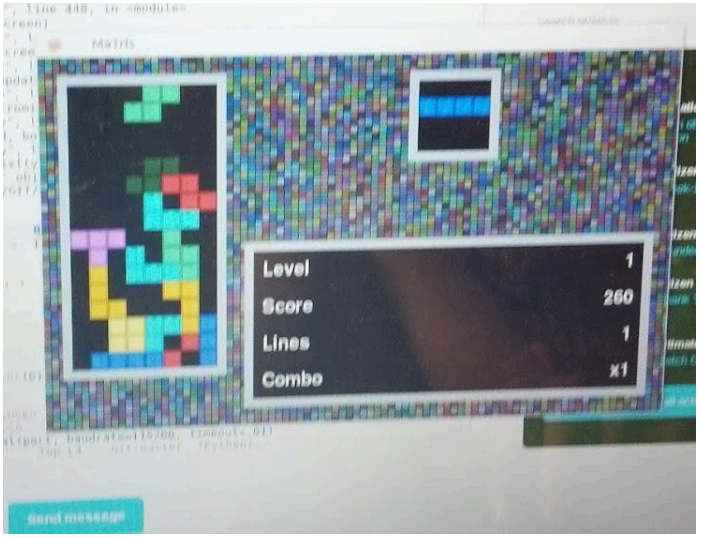


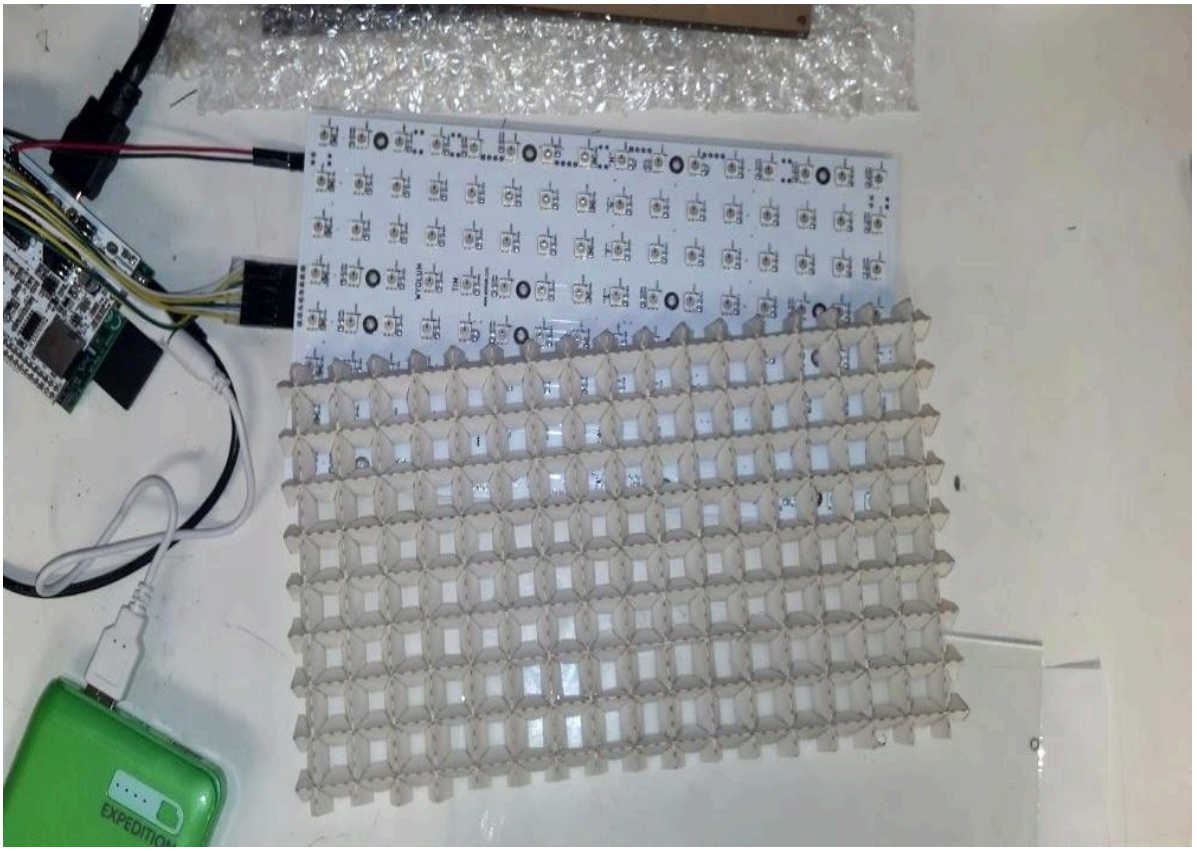
Protocol

The micro controller send an “R” for ready over the serial line which means it will accept the following message format to update 16 LEDs at a time.

BYTES	Description
0-47	RGB Stream for 16 LEDs
48	Row of first LED
49	Column of first LED
50	Command (not used)
51	End of message (carriage return)

Here are some photos of a Tetris clone driven by the Raspberry Pi.





SCHEMATIC, DIMENSIONS AND OTHER LINKS

Schematic
http://goo.gl/A2hmT

Dimensions
http://goo.gl/ntfw3y

Laser cut Paper Baffles
http://wyolum.com/paper-baffle-extension-with-inkscape/

Male Header Pins
http://www.digikey.com/product-search/en?x=-1184&y=-71&lang=en&site=us&KeyWords=SAM1043-50-ND

Female Header Sockets
http://www.digikey.com/product-search/en?x=-1184&y=-71&lang=en&site=us&KeyWords=SAM1009-50-ND