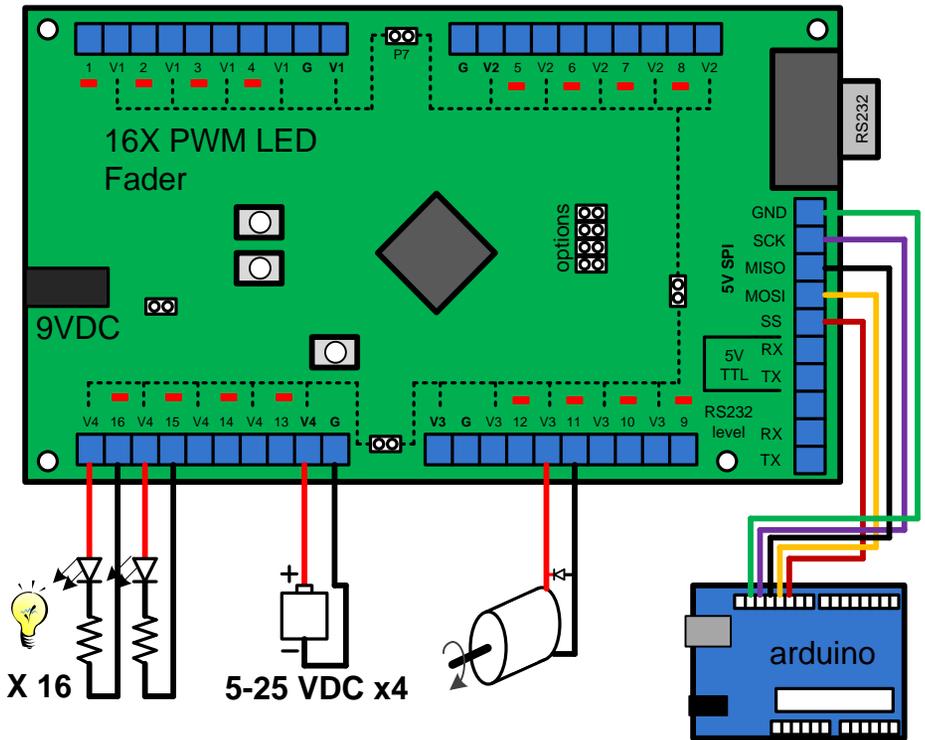# 16X PWM LED Fader v1.1 Specifications:

Available at CuriousInventor.com

Description:

The Fader provides 16bit control over 16 PWM channels for LED or motor control via RS232 serial, 5V TTL serial, or SPI.

Built-in commands make it easy to command groups of lights to blink, "glow / breathe", chase or fade.

Main Features:

- 16 channels, 4 different voltage banks. Mix different LEDs and motors.
- High resolution 16bit* control enables smooth fading, precise color mixing
- Control via RS232 serial, 5V TTL serial or high speed SPI from arduino or other uCs.
- Fast update / communication--with SPI, all 16 channels can be smoothly swept
- Easy Built-in commands: Group lights, Fade, Chase, Blink, Sunspot
- Up to 25V and 2A per channel (max power dependent on ambient temperature)

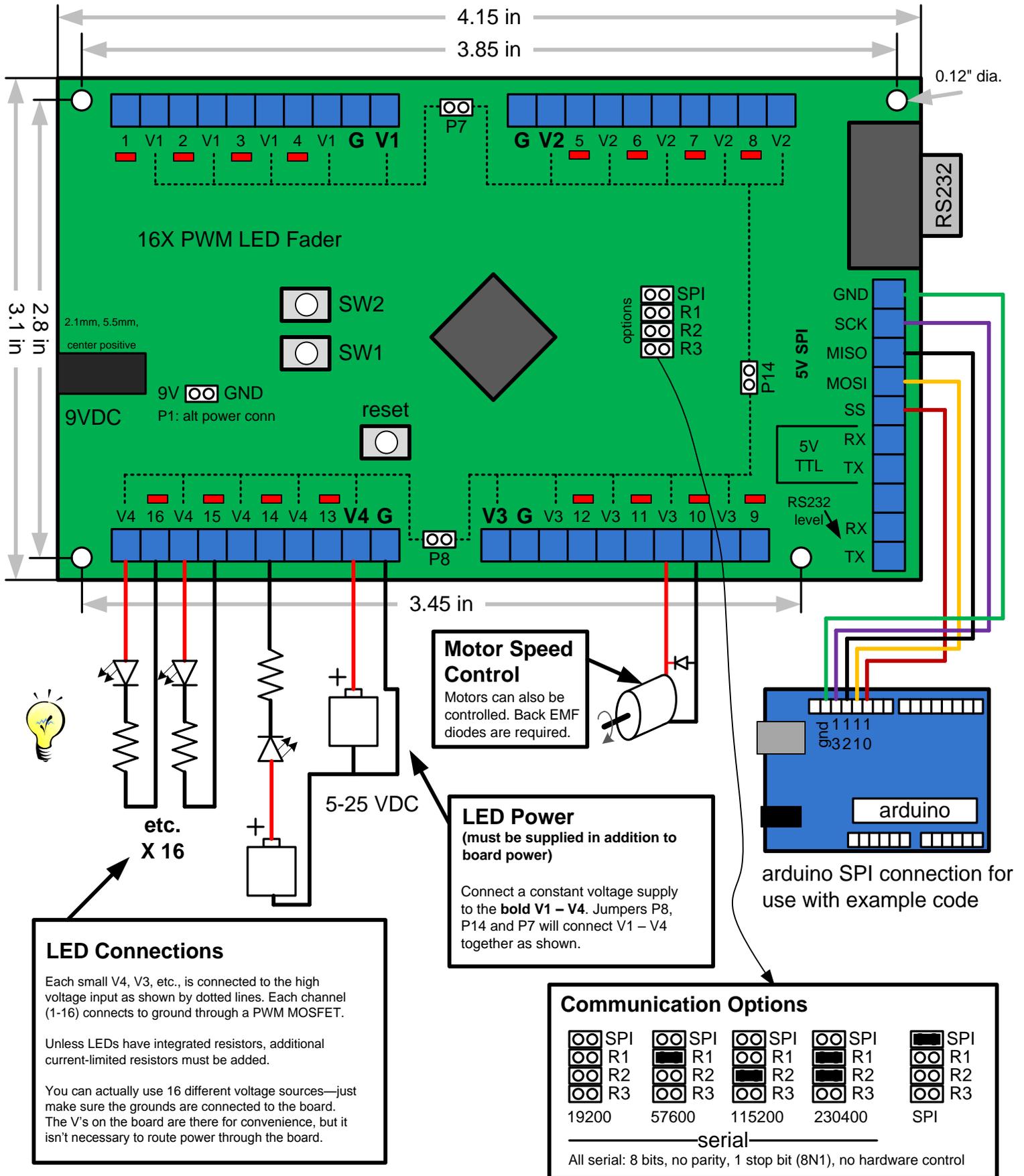## Examples using 16 Lights:
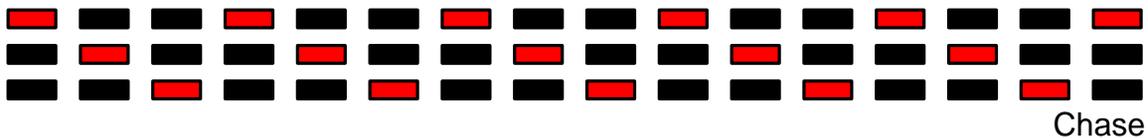
Chase

Fade / glow

Sunspot sweep

* Slight lower resolution at end points, full range is 8 – 65528 (8 to (2^{16}-8)).

16X PWM LED Fader v1.1
Electrical Connections and Hardware Dimensions

4.15 in

3.85 in

0.12" dia.

2.8 in

3.1 in

1 V1 2 V1 3 V1 4 V1 **G V1**   P7   **G V2** 5 V2 6 V2 7 V2 8 V2

RS232

16X PWM LED Fader

SW2

SW1

2.1mm, 5.5mm,
center positive

9V GND
P1: alt power conn

9VDC

reset

options   SPI R1 R2 R3

P14   **5V SPI**

GND
SCK
MISO
MOSI
SS

5V TTL   RX
TX

RS232 level   RX
TX

V4 16 V4 15 V4 14 V4 13 **V4 G**   P8   **V3 G** V3 12 V3 11 V3 10 V3 9

3.45 in

etc. X 16

Motor Speed Control

Motors can also be controlled. Back EMF diodes are required.

5-25 VDC

LED Power
(must be supplied in addition to board power)

Connect a constant voltage supply to the **bold V1 – V4**. Jumpers P8, P14 and P7 will connect V1 – V4 together as shown.

LED Connections

Each small V4, V3, etc., is connected to the high voltage input as shown by dotted lines. Each channel (1-16) connects to ground through a PWM MOSFET.

Unless LEDs have integrated resistors, additional current-limited resistors must be added.

You can actually use 16 different voltage sources—just make sure the grounds are connected to the board. The V's on the board are there for convenience, but it isn't necessary to route power through the board.

gnd 1111
3210

arduino

arduino SPI connection for use with example code

Communication Options

	SPI		SPI		SPI		SPI		SPI
	R1	■	R1		R1	■	R1		R1
	R2		R2	■	R2	■	R2		R2
	R3		R3	■	R3		R3		R3
19200		57600		115200		230400		SPI	

————serial————

All serial: 8 bits, no parity, 1 stop bit (8N1), no hardware control

Command Interface

Introduction

All commands are sent in ASCII text, even over SPI mode. The general format is:

```
Parameter;value;Command;Light/Group;
```

For instance, to set the brightness (PWM duty cycle) of light #3 to maximum:

```
b;65528;B;3;
```

To set the brightness to medium for lights 4, 5, and group g6:

```
b;32764;B;4;5;g6;
```

It's not necessary to type B; again.

To define group g3 as lights 10 and 11:

```
G;g3;10;11;
```

Typically, PARAMTER commands don't change anything, only ACTION commands apply the previously typed PARAMETERS.

Reference:

- **B: Brightness** – Immediately sets the brightness of a light or group
  uses: b: brightness (8 to 65528)
  example: Set the brightness of lights 2,12 and group g5 to ¼ duty cycle, or 16384.
  ```
  b;16384;B;2;12;g5;
  ```
- **G: Define Group** – Stores lights into one of 8 groups: g1 through g8
  Special Format: G;group_to_define;light1;light2;...
  example 1: Stores lights, 5,6,7, and 10 in group g5. Note, the order matters for commands like Chase.
  ```
  G;g5;6;7;10;5;
  ```
  example 2: Stores all lights into group g6. 0 is special and indicates all lights.
  ```
  G;g6;0;
  ```
- **M: Mute** – If the comm option jumpers are setup for a UART serial mode, toggle responses from the device. Useful if you're sending lots of commands and don't want your console cluttered.
  example: Turn off responses (or on if they were already off).
  ```
  M;
  ```

- **C: Chase** – Starts a chasing sequence in a group. Each light will fade on, hold for "blink on time", then fade off. The first light starts again after "sequence repeat time," so you can have multiple chases in a group going at once if the repeat time is faster than it takes to finish the whole sequence. To go in reverse, define a group with the reverse order.
  uses: b: brightness (8 to 65528)
  g: group (g1 to g8)
  t: chase step time (10 to 10000000) in ms (1000 = 1second). Sets the time between when each light starts to fade on. Note: the previous light does not have to finish before the next light will start.
  v: blink low brightness (8 to 65528). Sets the "off" level for lights.
  u: fade on time (0 to 10000000) in ms. If 0, lights will instantly turn on.
  y: fade off time (0 to 10000000) in ms. If 0, lights will instantly turn off.
  o: blink on time (0 to 10000000) in ms.
  x: sequence repeat time (10 to 10000000) in ms. The first light of the sequence starts fading on every period of this time.
  example 1: Start a simple sequence where lights just snap on/off, and only one lights is on at a time. The sequence repeats every 1s.
  `G;g1;1;2;3;4;`   (define a group of 4 lights)
  `b;65528;t;250;v;0;u;0;y;0;o;250;x;1000;` (setup the parameters)
  `C;g1;` (activate the chase on g1)
  example 2: Start a sequence where every 3rd light is chasing with fades:
  `G;g1;9;8;7;6;5;4;3;2;1;`   (define a group of 4 lights)
  `b;65528;t;111;v;0;u;150;y;150;o;100;x;333;` (setup the parameters)
  `C;g1;` (activate the chase on g1)

- **F: Fade to a new level** – Starts fading one or more lights to a new level over a given time.
  uses: b: brightness (8 to 65528)
  g: group (g1 to g8)
  u: fade on time (1 to 10000000) in ms. Note: the "fade on time" is used whether the lights will fade on or off, which depends on their current brightness. If the destination brightness (defined by b) is the same as the current brightness, no change will be seen.
  example 1: Fade lights 1 and 2 over 1s to max brightness and group g2 to brightness of 20000 over 2s.
  `G;g2;3;4;`   (define a group of 2 lights)
  `b;65528;u;1000;F;1;2;b;20000;u;2000;F;g2;`

- **N: Sunspot** – Creates a "hot spot" in a group. The lights fade from on to off away from the "center" of this hotspot over a "width". The total length of any group is 1000.
    - **uses:** b: brightness (8 to 65528)
        - c: sunspot center (0 to 1000)
        - w: sweep width (0 to 1000)
        - l: sweep first light position (0 to 1000). The first and last light positions are used so that you can position the center at 0, and not have any lights on.
        - r: sweep last light position (0 to 1000)
    - **example:** Center a sunspot in a group
        ```
        G;g1;0;  (store all lights into group g1)
        b;65528;c;500;w;300;l;150;r;150;
        N;g1;
        ```
    - **example 2:** Sequentially move a sun spot across the group. Note that when it starts, no lights are on because the first light is positioned at 150, which is half the width.
        ```
        G;g1;0;  (store all lights into group g1)
        b;65528;c;0;w;300;l;150;r;150;
        N;g1;
        c;100;N;g1;
        c;200;N;g1;
        c;300;N;g1;
        …
        c;900;N;g1;
        c;1000;N;g1;
        ```

- **R: Random Blink** – Starts a group of lights blinking in random order.
    - **uses:** b: brightness (8 to 65528)
        - g: group (g1 to g8)
        - t: chase step time (10 to 10000000) in ms (1000 = 1second). Sets the time between when each light starts to fade on. Note: the previous light does not have to finish before the next light will start.
        - v: blink low brightness (8 to 65528). Sets the "off" level for lights.
        - u: fade on time (0 to 10000000) in ms. If 0, lights will instantly turn on.
        - y: fade off time (0 to 10000000) in ms. If 0, lights will instantly turn off.
        - o: blink on time (0 to 10000000) in ms.

    - **example 1:** Start group g4 blinking randomly with slight fade
        ```
        G;g1;1;2;3;4;   (define a group of 4 lights)
        b;65528;t;400;v;0;u;100;y;100;o;300;(setup the parameters)
        R;g4;  (activate the chase on g4)
        ```

- **S: Sweep** – Smoothly sweeps a sunspot over a group, repeating / reversing according to the mode.
  - **uses:** b: brightness (8 to 65528)
    - w: sweep width (0 to 1000)
    - l: sweep first light position (0 to 1000). The first and last light positions are used so that you can position the center at 0, and not have any lights on.
    - r: sweep last light position (0 to 1000)
    - m: sequence mode (0 to 4).
      - 0: start the sweep again from the beginning after it finishes.
      - 1: start the sweep in the reverse direction after it finishes.
      - 2: start the sweep from the beginning after "sequence repeat time"
      - 3: start the sweep in reverse after "sequence repeat time"
      - 4: only sweep once
    - d: sweep direction (0 or 1)
      - 1: forward
      - 0: reverse
    - x: sequence repeat time (0 to 10000000) in ms.
    - s: sweep time (10 to 10000000) in ms. Time it takes to complete a sweep.

  - **example:** Create a cylon style sweep.
    - `G;g1;0;` (store all lights into group g1)
    - `b;65528;w;350;l;200;r;800;x;2200;s;2000;m;3;d;1;`
    - `S;g1;`
- **T: Trapezoidal Blink** – Starts a light or group blinking. Lights fade on, hold on for "blink on time", fade off, then hold off for "blink off time" before starting to fade on again.
  - **uses:** b: brightness (8 to 65528)
    - g: group (g1 to g8)
    - l: light (1 to 16). Either group or light can follow a T;
    - v: blink low brightness (8 to 65528). Sets the "off" level for lights.
    - u: fade on time (0 to 10000000) in ms. If 0, lights will instantly turn on.
    - y: fade off time (0 to 10000000) in ms. If 0, lights will instantly turn off.
    - o: blink on time (0 to 10000000) in ms.
    - f: blink off time (10 to 10000000) in ms.
  - **example 1:** Start one light blinking, on ⅓s, off 1/2s.
    - `b;65528;v;0;u;0;y;0;o;500;f;500;` (setup the parameters)
    - `T;1;` (activate the blink on light 1)
  - **example 2:** Start group g5 blinking with a triangle fade profile, only going half off.
    - `b;65528;v;32768;u;500;y;500;o;0;f;0;` (setup the parameters)
    - `T;g5;` (activate the chase on g1)