# PLS351 v1.0

Level shifter and power converter, 3.3V controller to single 5.0V output

Product data sheet, Rev 1, 10 August 2015

General Description

As most modern sensors and flash cards operate at 3.3V, but output devices such as Neopixels operate at 5V, a circuit designer has to manage the complexity of operating at two different voltages. The Cap'n Ajax PLS351 provides a simple solution for a 3.3V controller to drive 5V devices, so it can connect to any number of 3.3V devices without the need for bi-directional level shifters.

• Provides regulated 3.3V power to the controller and 5V power to an output device.
• Converts a 3.3V GPIO signal to 5V
• Handles up to 4000mA on the board, but can be adapted to handle any current load.
• Compact design, fits on a 27.9mm (1.1") × 20.3mm (0.8") circuitboard.
• All components, including the boards and solder are RoHS compliant and lead free.
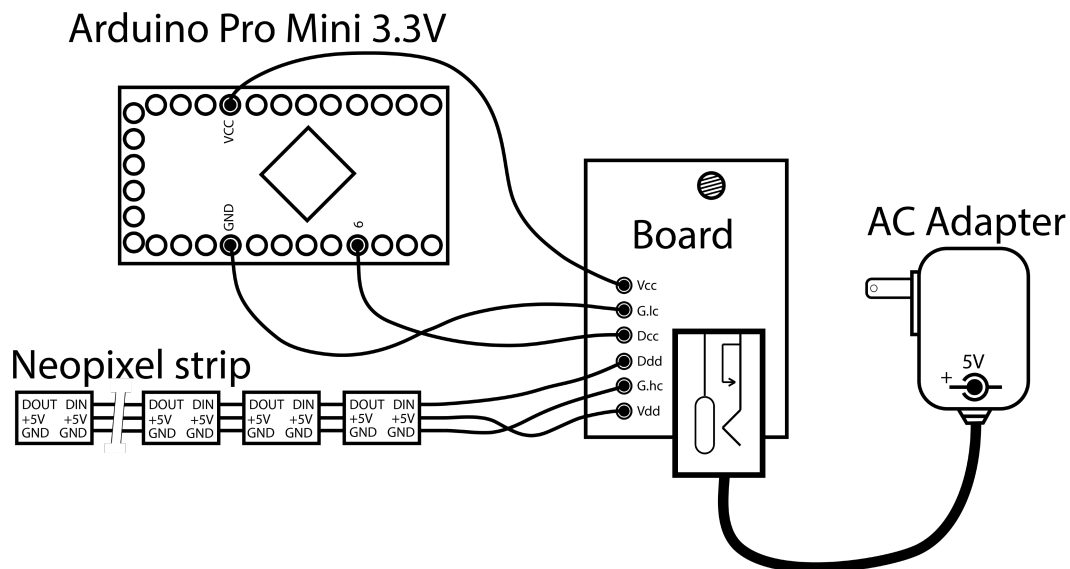
Terminology

Device - the 5V output device, such as a Neopixel strip.
Controller - the 3.3V logic board, such as a 3.3V Arduino Pro Mini, or a Punch Through Design LightBlue Bean.
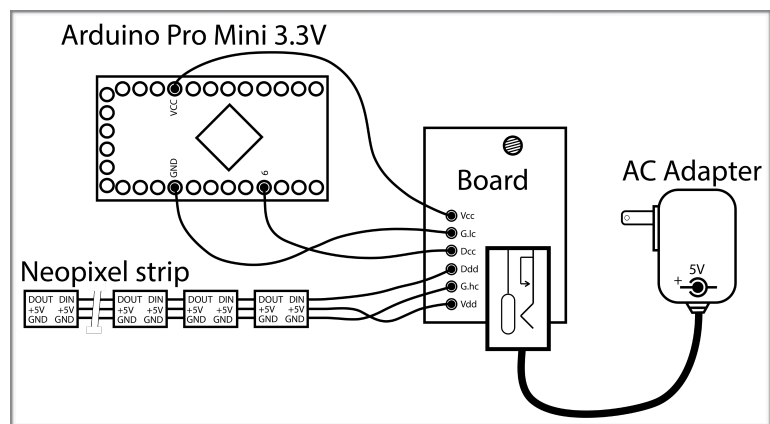**Board** - the Cap'n Ajax PLS351 level shifter and power convert board.
Jack - the DC barrel jack on this **board**.

Typical Usage

The typical scenario is as follows:

- Connect a Neopixel strip: +5V to Vdd, GND to G.hc, and DIN to Ddd.
- Connect a 3.3V Arduino (such as the Arduino Pro Mini): VCC to Vcc, GND to G.lc, and pin 6 to Dcc.
- Plug a 5V AC adapter into the jack.

A Neopixel strip requires 5V and a lot of power, but some Arduinos operate at 3.3V. This board provides the necessary power and converts the 3.3V signal from the controller to a 5V signal to the 5V.

The board can deliver 4A to Vcc+Vdd. Assuming the Arduino is providing negligible power to other outputs, 4A is enough to drive over 200 Neopixels in typical usage, or 65 at maximum output. Higher currents can be achieved by bypassing Vdd (See the section on "**Bypassing Vdd**").

Pinning and Device Connections
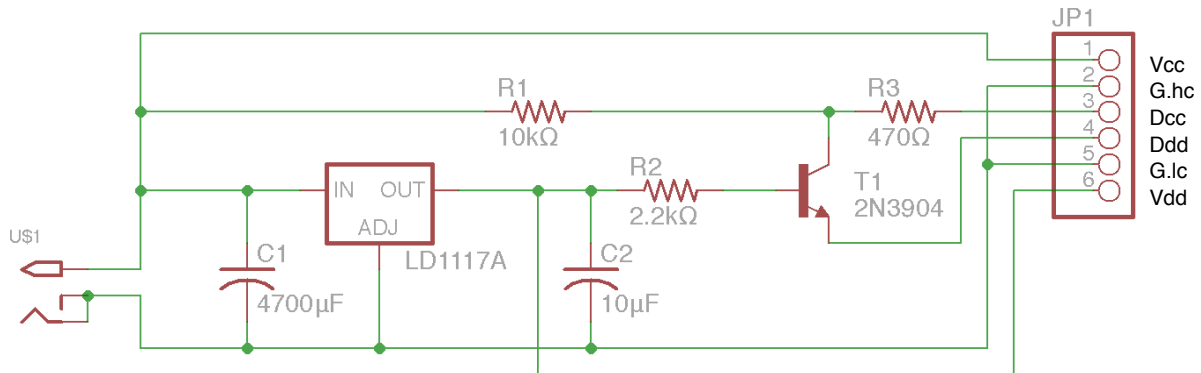
Pin	Description	Notes
Power Jack	5V Center-positive	
Vdd	5V directly from power jack for device	Current of Vcc+Vdd must not exceed 4A.
G.hc	High-current ground for device	Current of G.hc+G.lc must not exceed 4A.
Ddd	5V data signal to the device	
Dcc	3.3V data signal from the controller	
G.lc	Low-current ground for the controller	Do not exceed 800mA.
Vcc	3.3V power to the controller	Do not exceed 800mA.

Device

The PLS351 is designed with Neopixel strips in mind. It provides a single GPIO input, operating at 5V, plus a high-current Vcc and ground pin.

Controller

The PLS351 is designed to power any 3.3V controller and level-shift a single output from 3.3V to 5V. Supported boards include the 3.3V Arduino Pro Mini, the LightBlue Bean from Punch Through Design, the Teensy 3.0 and 3.1, and the 3.3V Trinket.

AC Adapter

The A/C adapter should provide enough current to run the controller and all connected devices. The current drawn by Neopixels depends on their usage. Neopixels draw up to 60mA each at maximum brightness. However, in typical usage, RGB Neopixels aren't running all three colours at maximum brightness. For example, in a Rainbow pattern, each light is only drawing 20mA.

Adapter Amp output	Lights @ 20mA each	Lights @ 60mA
500mA	25	8
1000mA	50	16
2000mA	100	33
4000mA	200	66

Use a 5V A/C adapter that exceeds the Amperage requirements for your Neopixel strip. This board provides a standard 2.1mm centre-positive barrel jack.

Bypassing Vdd

To allow higher currents than 4000mA the Vdd can easily be bypassed. This allows the driver to handle theoretically unlimited current, as long as the data pin's current is limited.

It is important to note that the Neopixel strips themselves can only carry limited current; larger pixel strips should by powered from several points according to the manufacturer's recommendations. Also note that the large 4700µF capacitor that normally stabilizes the power supply will be less effective, so if the strip itself doesn't provide its own caps, you will need to add appropriate capacitors to the circuit to stabilize it. Follow the manufacturers recommendations with regards to filter caps.

For currents up to 6500mA

The DC barrel jack is rated for up to 6500mA, and the pins on the underside of the board have holes for connecting wires to. Solder the Neopixel strips +V5 and GND ports directly to these holes. Connect the pin at the end of the barrel jack to +5V and the pin that extends from the center of the barrel jack to GND. The DIN pin connects to Ddd on the PLS351.

### For currents over 6500mA or where the jack is not wanted

The jack is not rated for currents over 6500mA and the circuit board is not rated for currents over 4000mA. In this case it's best to remove the barrel jack completely and route the power delivery directly to the device around the board. However, the rest of the board needs to be powered and connected to the circuit.

Desolder the barrel jack from the board and replace it with your external power supply. Connect the power leads of the device directly to the original power supply and the data lead of the device to the Ddd port on the board. The current to the device will not flow through the board, but the board can still provide power to the controller and convert its 3.3V signal up to 5V for use by the device.

Mounting the board

The board provides a single 100 mil (2.5mm) mounting hole, roughly inline with the jack for a sturdy mount. The other dimensions are as follows:

- The board is 27.9×20.3mm ($1.1" \times 0.8"$)
- The jack is 9.0mm (0.35") wide, 14.4mm (0.57") long and 11.0mm (0.43") high. The end of the jack extends 0.17" beyond the edge of the board. No other components extend beyond the edges of the board.
- The jack has 2.5mm (0.1") of clear space on either side at the edge of the board to accommodate mounting clips.
- The board is 1.6mm (0.063") thick and requires 27.5mm (1.1") clearance on top and 2 mm (0.08") underneath to accommodate all components.
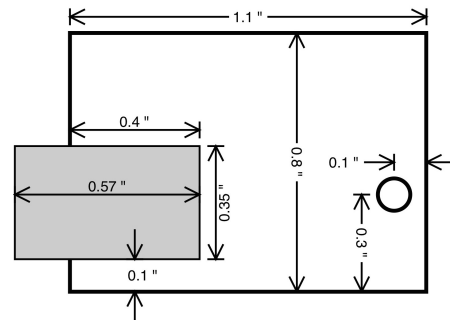
Note that due the manufacturing process, small variances in the placement of the components can occur.

Revision History

Date	Revision	Changes
10 August 2015	1	Initial release

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