WashU Race Car Brake Light PCB

Introduction:

I designed the following PCB to be a brake light for the WashU Racing car. There are specific rules regarding the brake light as outlined in the manual, which are worth mentioning. These rules are as follows:

T.3.4 Brake Light

1) T.3.4.1 The vehicle must have a Brake Light that is clearly visible from the rear in very bright sunlight.
2) T.3.4.2 The Brake Light must be:
    a) Red in color on a Black background
    b) Rectangular, triangular or near round shape with a minimum shining surface of 15 cm2
    c) Mounted between the wheel centerline and driver's shoulder level vertically and approximately on vehicle centerline laterally.
3) T.3.4.3 When LED lights are used without a diffuser, they must not be more than 20 mm apart.
4) T.3.4.4 If a single line of LEDs is used, the minimum length is 150 mm.

Schematic Justification:

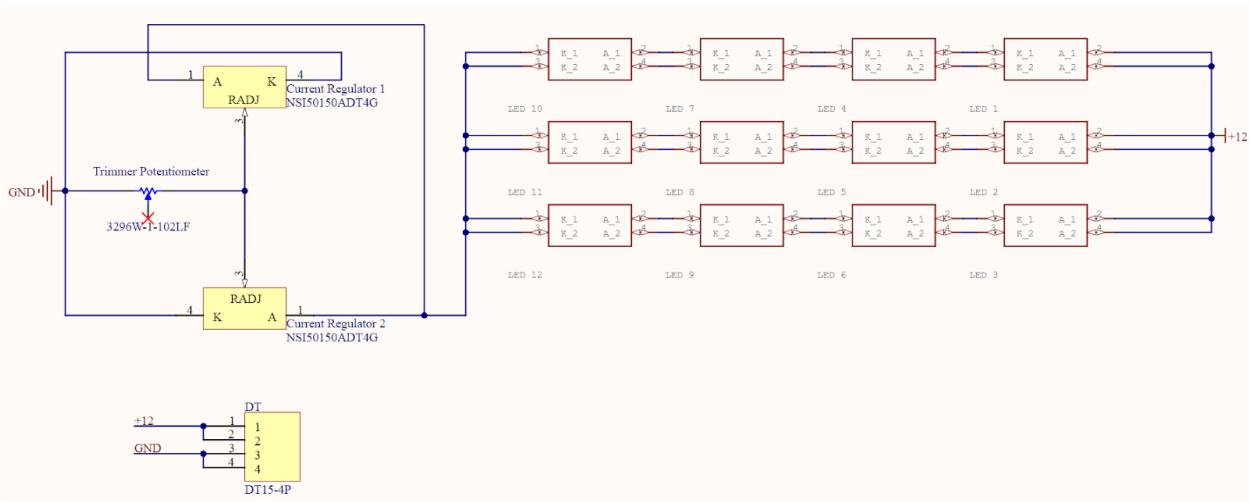

Figure 1: Brake Light Schematic

An industry standard automotive connector was used to interface with the brake light, providing lines for both power and ground. Red Kingbright WP7676CSEC/H high power LEDs were utilized for their high luminous intensity of 1800 millicandela in combination with their large viewing angle. NSI50150ADT4G Current Regulators in parallel with a Bourns 3296W-1-102LF trimmer potentiometer were used to dynamically tune the current flowing through the circuit, thus optimizing the brightness of the light.

Layout Justification:

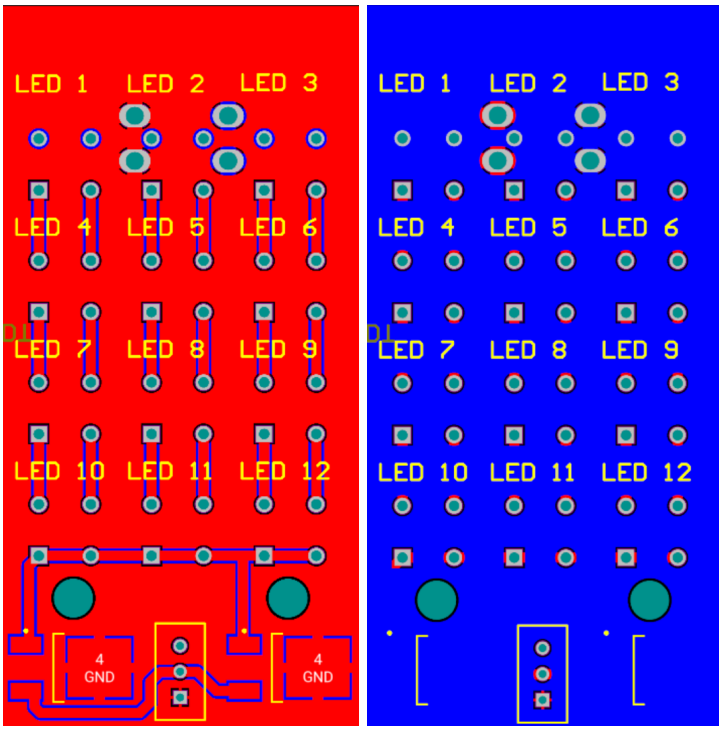

Figure 2: Layout Schematic

The final PCB measures 35.18mm by 71.37mm, approximately 25 square centimeters, with the LEDs occupying 15 square centimeters. The LEDs are aligned and evenly spaced to maximize their coverage area. Polygons were implemented to aid in heat dissipation for the brake light. All components, except for the Deutsch connector, were placed on the top layer of the board. The Deutsch connector was inserted through the bottom layer. Through-hole components were selected to expedite manufacturing and allow younger team members to practice their soldering skills.

Conclusion:

This brake light successfully passed all FSAE inspections at 2023 and 2024 competitions. It will be used for the third consecutive year by the team on WashU's 2025 Race Car, as its quality impressed an FSAE competition judge to the extent that they believed it was a store-bought product in 2022.