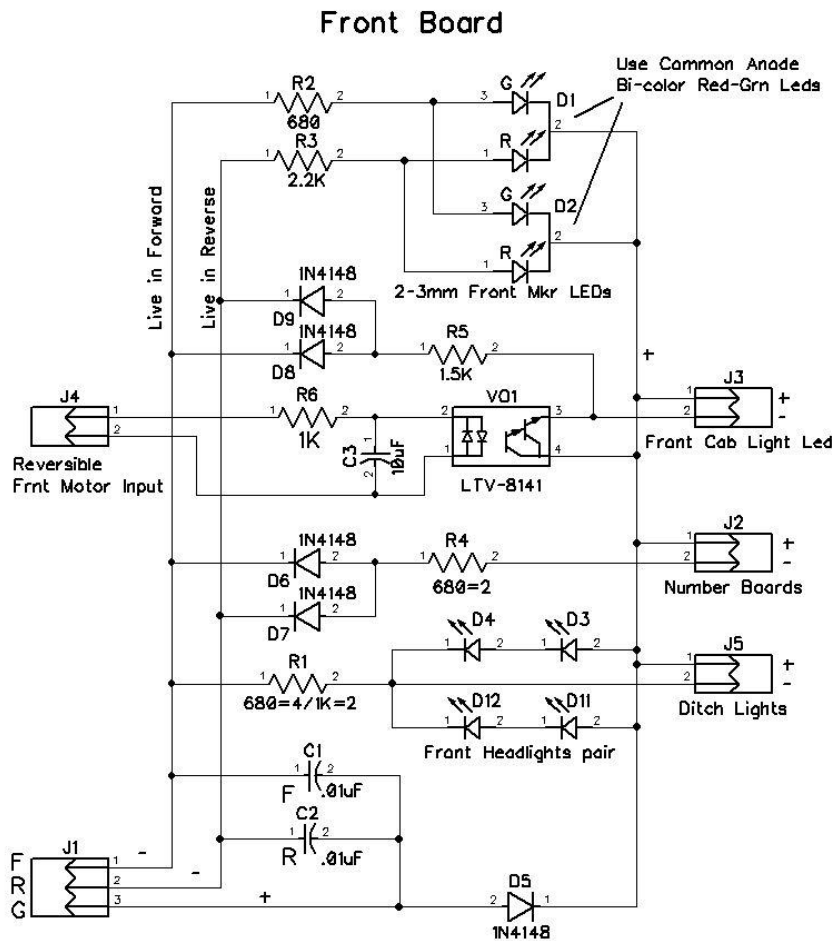


Discussion is based on this circuit diagram of the front board (the rear board is very similar):



The R2LC/R4LC “ground” output is actually +ve (up to 9V half wave DC) and the lighting triacs are current drains back to ground. So the overall current flow in this diagram is CCW and all leds/diodes are oriented anode to the G terminal, cathode to the triac F & R drains. Since the lighting triacs operate on an either/or basis, led operation is determined by which one is active at any given time.

(A word about the C1/C2 .01uF caps: Their purpose is to provide a small load to assure that the respective R2LC light triacs fire, because leds pose no load until their forward voltage threshold is reached. There is provision for both F and R caps on both boards. For only one front or rear board, both caps are needed. For a pair of boards, only a single F and a single R cap is needed on each.)

The off-board ditch, number board, and cab leds should always be a series pair of leds. No external load resistors are needed; this is all provided on the boards. The motor inputs to J4 for the cab light dimming are from the +/- motor power connections in the engine. In dual board installations normally the boards are inter-connected using a 3 wire #26-28 ribbon cable between the F-R-G terminals. Only one of the boards (either front or rear) is then connected to the Front, Rear and Ground mobo connections in the engine.

The following points describe the action when the Front triac is active. (The action in brackets is when the Rear triac is active)

1. Marker Leds: Current flows through the green junction of the onboard D1/D2 leds. (Conversely if the rear triac is active, it flows through the red junction) The front markers go green when the engine is in forward, (and red when the engine is in reverse) The values of R2/R3 are chosen to better balance the light output of the different colors. Note that **common anode bi-color** leds are the only type that will work in this application.
2. Headlights: Current flows through the series onboard leds D3/D4, or D11/D12, [not both] then R1. (Headlights and Ditch lights remain dark) The values of R1 shown are chosen depending on whether you have only headlights, or ditch lights as well. When using (2) ditch light leds, you must also use 2 headlight leds so as to balance the loads. Otherwise the set of 2 will not light.
3. Ditch Light Leds: Current flows through 2 off-board leds then back through R1. (Ditch lights remain dark)
4. Number Board Leds: Current flows through 2 off-board leds then back through R4 and diode D6. (Current flows the same way, but returns through diode D7, only if installed. Otherwise the leds remain dark in reverse)
5. Cab Light Leds: When the engine is still, current flows through 2 off-board leds then back through R5 and diode D8. (Current flows the same way, but returns through diode D9 only if installed. Otherwise the leds remain dark in reverse)  
When the engine is in motion motor current activates an led in the 8141 opto through R6. The opto turns on allowing current flow through pin 4 to 3 and through R5-D8 (D9). This effectively bypasses [or starves] the cab leds and they go dark. When engine motion stops the 8141 turns off and the cab leds turn on again. Polarity of motor current to J4 is unimportant.  
(D9 is used only to have the front cab leds light up when in reverse)  
Cap C3 provides bridging of motor commutator dead spots at low speed, to prevent cab led flicker.

Operation of the rear board is very similar, but all leds that light up in the front board remain dark in the rear board, and vice versa when in reverse. The rear markers go red when the engine is in forward, and green when the engine is in reverse; opposite of the front markers.

There is no provision to have the rear cab lights operational in forward.

Other options are detailed in the User Notes document.