Point Signal Box PCB

Build Instructions

Supplement to the MERG JOURNAL 2023
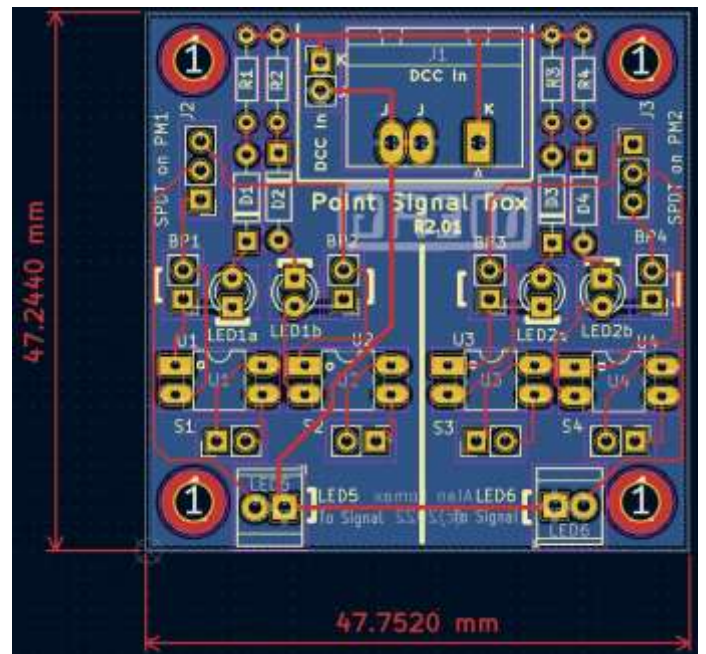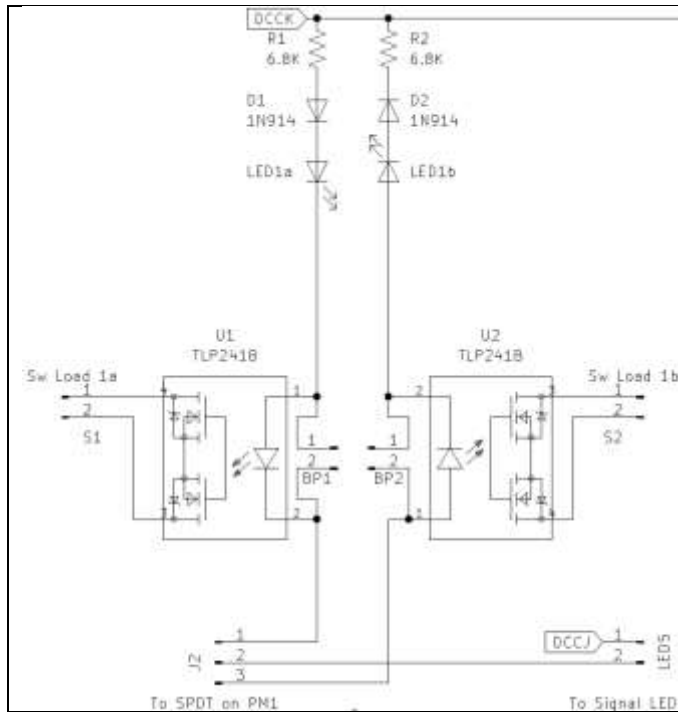
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Revision 1.1

Schematic and Parts List

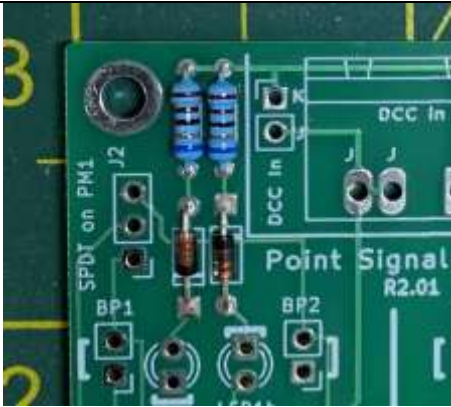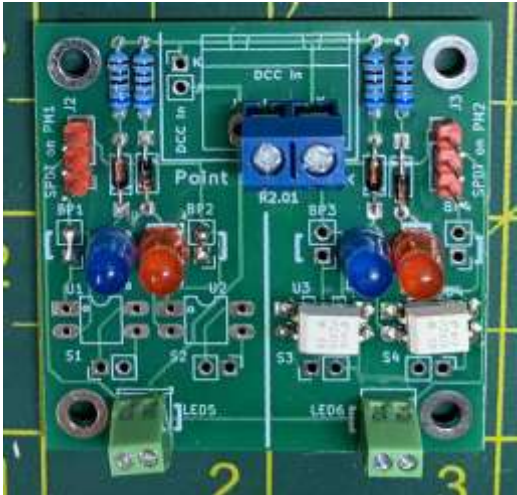Below left: This is showing ½ of the full schematic.
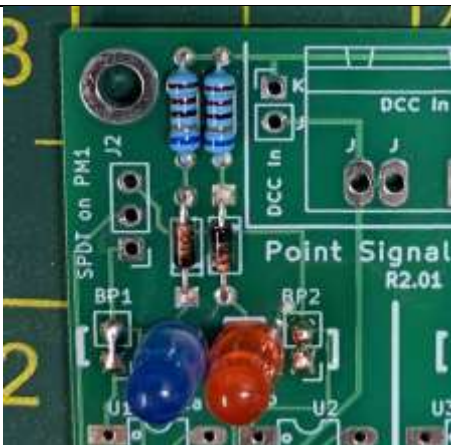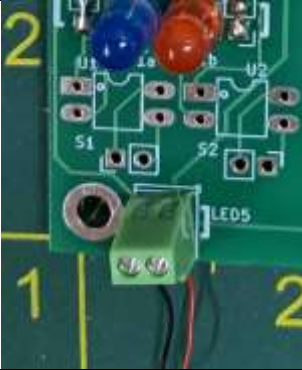Below right: This is the full PCB with two identical circuits as shown in the schematic. (With a common DCC input)
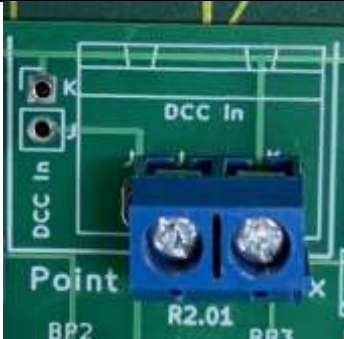

Parts list for ½ of the PCB				
Qty	Designation	Description	Part No	Source
2	R1, R2	6.8K ¼ watt TH Resistor		Widely available
2	D1, D2	1N914, (or 1N4148 or equivalent)		Widely available
2	LED1a, LED1b	5mm LED (two different colours)		Widely available
2	U1, U2 (optional)	TLP241(A or B) or TLP3554 Solid State photo-relay (MOSFET output)	Mouser: 757-TLP241AD4F or 757-TLP241BD4F	Mouser (Check on line) (I do not recommend AliExpress for TLP3554)
Varies	0.254mm (0.1 in) in line header pins	Quantity is optional depending on your build. Maximum would be 11 pins per half board.		Widely available
1	J1	DCC Input. Can use PCB mount screw terminals or solder wires direct to PCB. Multiple options of pin spacing are provided.		Widely available
1	Signal LED output connector	Small 0.254mm (0.1 in) pitch PCB mount screw terminals (recommended). You Could wire up direct also.		Widely available. (Prices vary widely)

Step by Step (For the left half):

Step	Instructions	Comments	
The steps below follow a general good practice by starting with the components closest to PCB first.			
1	D1, D2, R1, R2	Note D1 and D2 are oriented opposite each other. The white band on the PCB stencil indicates where the cathode end is. On glass diodes the cathode is actually indicated with a black band.	
The First Decision	Will you be installing the photo relays? (They are optional)	If you are only switching LED signals the photo relays are not needed. The relays can be used for switching other independent circuits (higher power).	
Step 2 (NO Photo Relays)	Install small wire jumpers in places marked BP1 and BP2.	BP1 and BP2 are bypasses (you've got to have bypasses!). I use short lengths of resistor or diode leads bent over into a staple shape. (Available from step 1 above)	Electrically the bypasses jump over where the photo-relay LED would be without ruining the PCB. Should you wish to retrofit the relays later just cut the jumper.
	Proceed to Step 3		
Step 2 (YES Photo Relays)	Install U1, U2 See comments about the optional 2 pin headers. (4 locations)	Note all of the photo-relays are oriented the same. On the relay itself pin 1 is usually marked with a 'dot' (I also show this on the PCB to be as clear as possible). Photo shows both halves half built up. Left half has no relays and bypasses. Right half is with relays installed and (no bypass jumpers of course) Additional 2 pin headers (S1 and S2) can be installed as connection points for the **photo-relay MOSFET outputs.** **Note:** To operate the signal LED's only this PCB does not use or need the MOSFET outputs – they are for controlling **your** external circuitry!	

Step 3	LED1a, LED1b	I recommend picking 2 different LED colours. I try to make one of the colours match the signal color. For example, here the red LED on the PCB will match a Red LED on the ground signal. Note the LEDs are oriented opposite each other. The Cathode (-ve) has a flat molded into the plastic and I have put a stenciled white line where the flat side is to go. (Readily visible in the Step 1 photo before the LEDs are fitted).	
Step 4	J2 = 3 pin header	Connection point for a SPDT switch (The auxiliary contact from a point motor for example.) It is your choice if you want to wire directly to the printed circuit board or mount a 3 terminal header as I have done.	
Step 5	PCB mount screw terminals for the output LED's	Small screw terminals are recommended. (This makes it easy to reverse the indication should that be necessary.) You could wire direct to the PCB with soldered connections.	
Step 6	PCB mount screw terminals for the DCC input (used to drive LED's only)	This one input provides the power to both halves of the PCB. (The second half may not even be populated.) There are multiple options for this connection to suit your preference. The only thing the DCC power does is drive one of the LEDs at a time via the 6.8K current limiting resistor. (And so power demand is very low).	
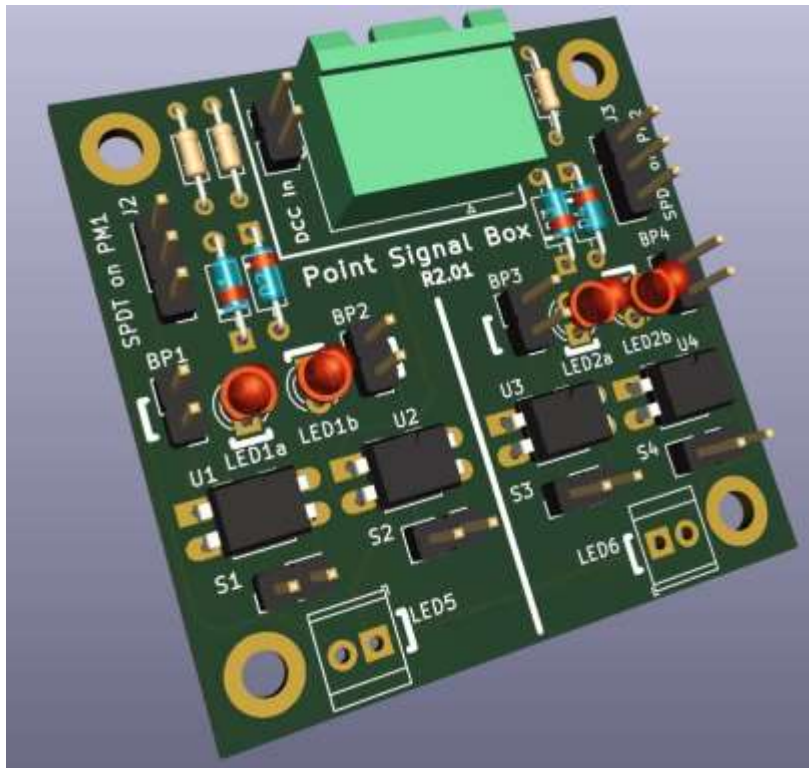
Final Comments on the Build Process

The second identical circuit on the right half is built up in the same way and can be used for completely separate SPDT input driving a completely separate LED signal. If you are only controlling one signal from one auxiliary switch you do not even need to build the second half.

If you find the colored signals are reverse to what you want flip the two wires going out to your signal.

How The Circuit Works

Referring to the figure below the SPDT switch simply selects either the left path or the right path.

The two paths differ in that the diodes are arranged in opposite directions ensuring that whichever path is selected the current will only flow in one direction for that given path.

The net effect is that the SPDT switch selects one branch and since current only flows in one direction only one of the two back-to-back LED's will light up.

The key thing to the operation is that the supply voltage is DCC which is actually an AC waveform where the current on the wire is flip back and forth (at several kHz frequency).

DCC K

Photo-Relay
Input Led
And Bypass

SPDT switch

Back to Back LEDs

DCC J

On PCB

Remote
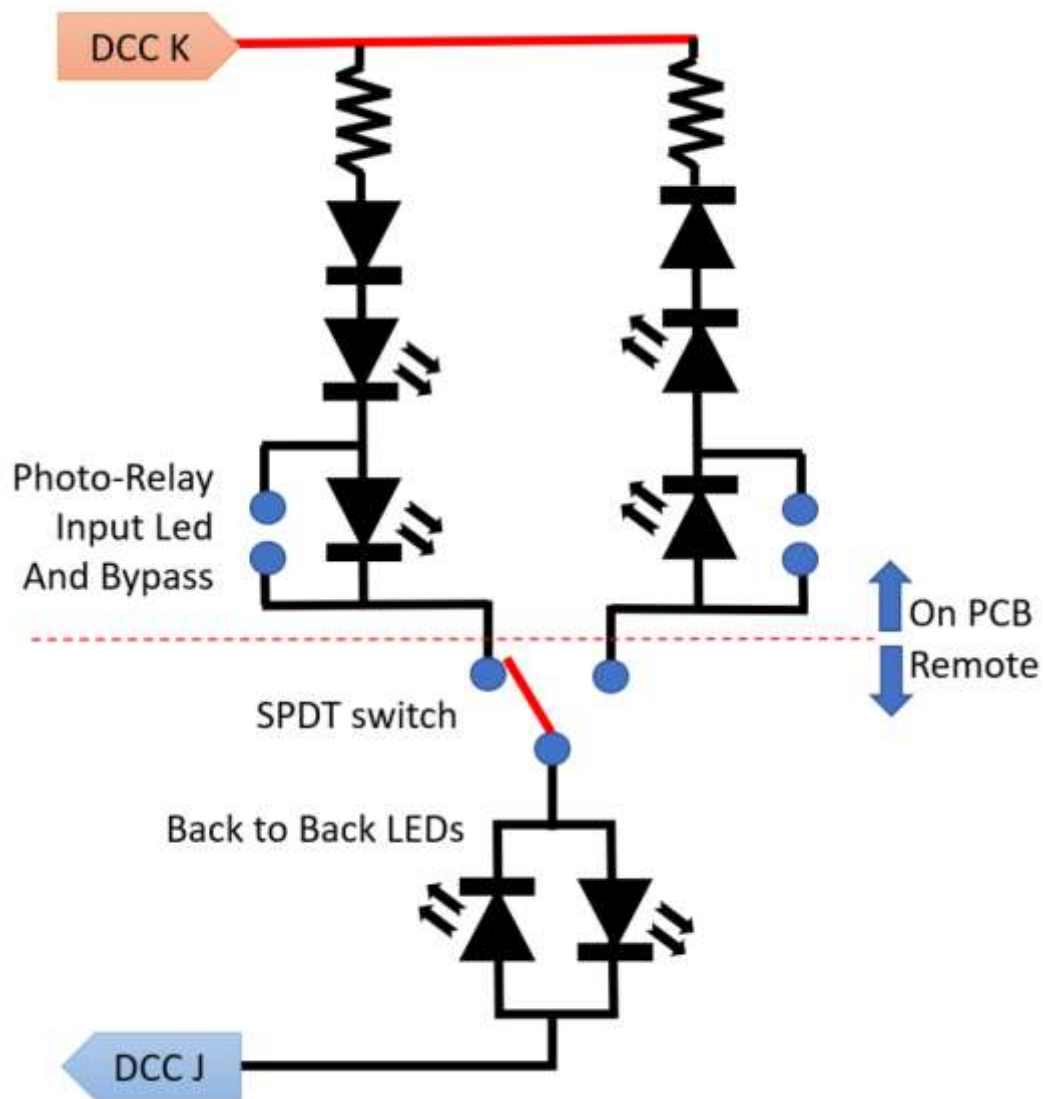
Below is as Installed on my under construction layout. The signal is indicating the status of point #509 which is hidden from view on the far side of the bridge.
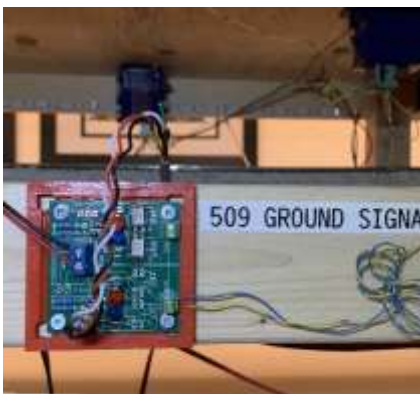
To the left is the module installed under the layout with point motor #509 visible in the background.

This point is not readily visible from the normal operating location.

With the LED's installed above now a quick glance at the layout indicates the point position.

PCB Change Log

Rev	What	Comment	Date	PCB's Ordered/Built
	Initial Design	This was the flawed H bridge design	Sept 2022	Yes / No
0	Revamp Design	4 circuits per PCB. (8 legs). No Photo Relays	Sept 2022	Yes / Yes
1	Add Photo Relays	4 circuits per PCB. Added photo relays. (Was never ordered)	Sept 2022	No / No
2	Reduced PCB size	2 circuits per PCB. With photo relays.	Oct 2022	Yes / Yes
2.01	Minor Improvements	**PCB:** SS Relays : pads made larger for use with SMD **Silkscreen:** fixed missing part references, - added LED polarity markers - added text	Oct 2022	Yes / Yes

Instructions Change Log

Rev	What	Comment	Date	By
1	Initial Version	First Draft of Build procedure	Sept 2022	Al
1.1	Updated Pictures	During editing of MERG article some images were clarified. This document now uses the cleaned up images.	Nov 2022	AL