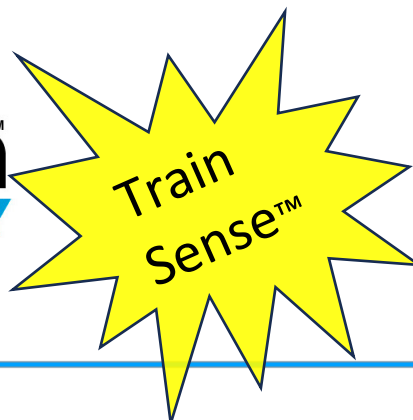




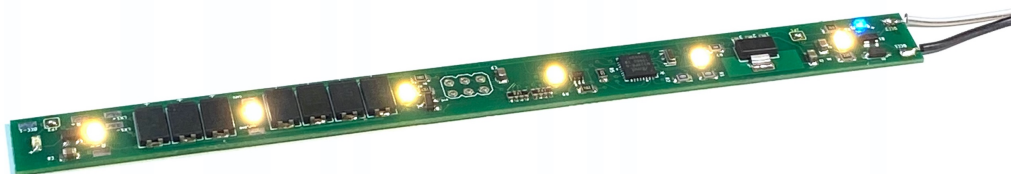
Model Train[™]
TECHNOLOGY



PASSENGER CAR LIGHTING with DCC DECODER and TRAIN SENSE™
OPERATIONS MANUAL

SERIES TS

Version 3.01a



Motion Sensing Light Activation Automatically!

OVERVIEW

In 2018 we invented an LED light board for use with N and HO scale passenger cars that included an onboard DCC decoder. That was the product that launched our business. The first boards used DCC to configure and control the lights. Since then, we have made continuous improvements to increase the “stay alive” capability using “SuperCaps” along with more reliability and more board options including varying lengths and easier installations.

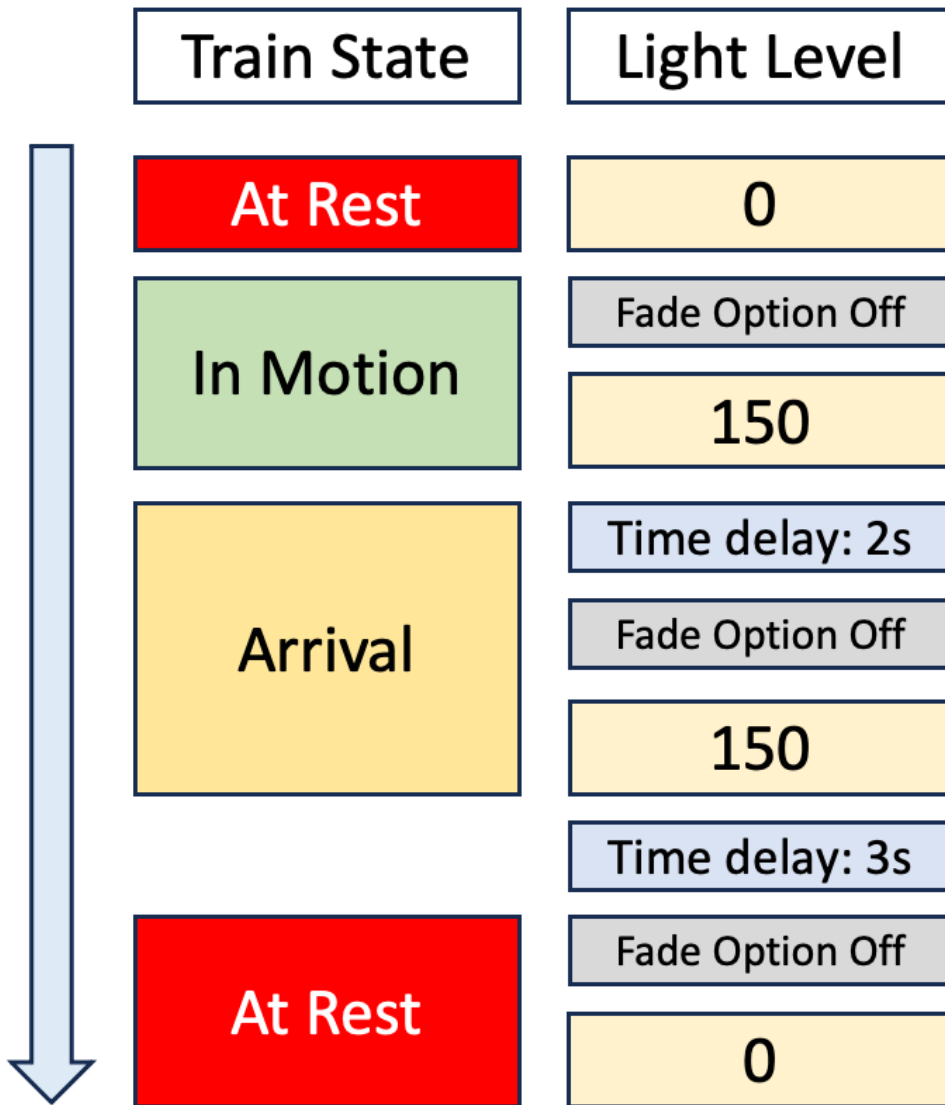
Now, after more than two years of development we have added solid-state motion sensing to all of our light boards! This new capability is called **Train Sense™**.

Train Sense™ senses the train movement and turns the lights on and off automatically. And there is a lot more! You can configure the light level at each of three stages: ***At Rest***, ***In Motion*** and at ***Arrival***. Further, you can set a timer to activate the ***Arrival*** light and then a second timer that subsequently turns off the lights after the timer expires. Of course, you can simply set the lights to go on when ***In Motion*** and off when ***At Rest***. There is a ***FADE*** option so the lights can fade through each stage rather than switch immediately on and off.

We kept all the DCC functions from the previous boards so you can still control the lights with your DCC controller.

The next page shows two of the five PRE-SET Behaviors examples of how the system works:

Pre-Set Behavior 1

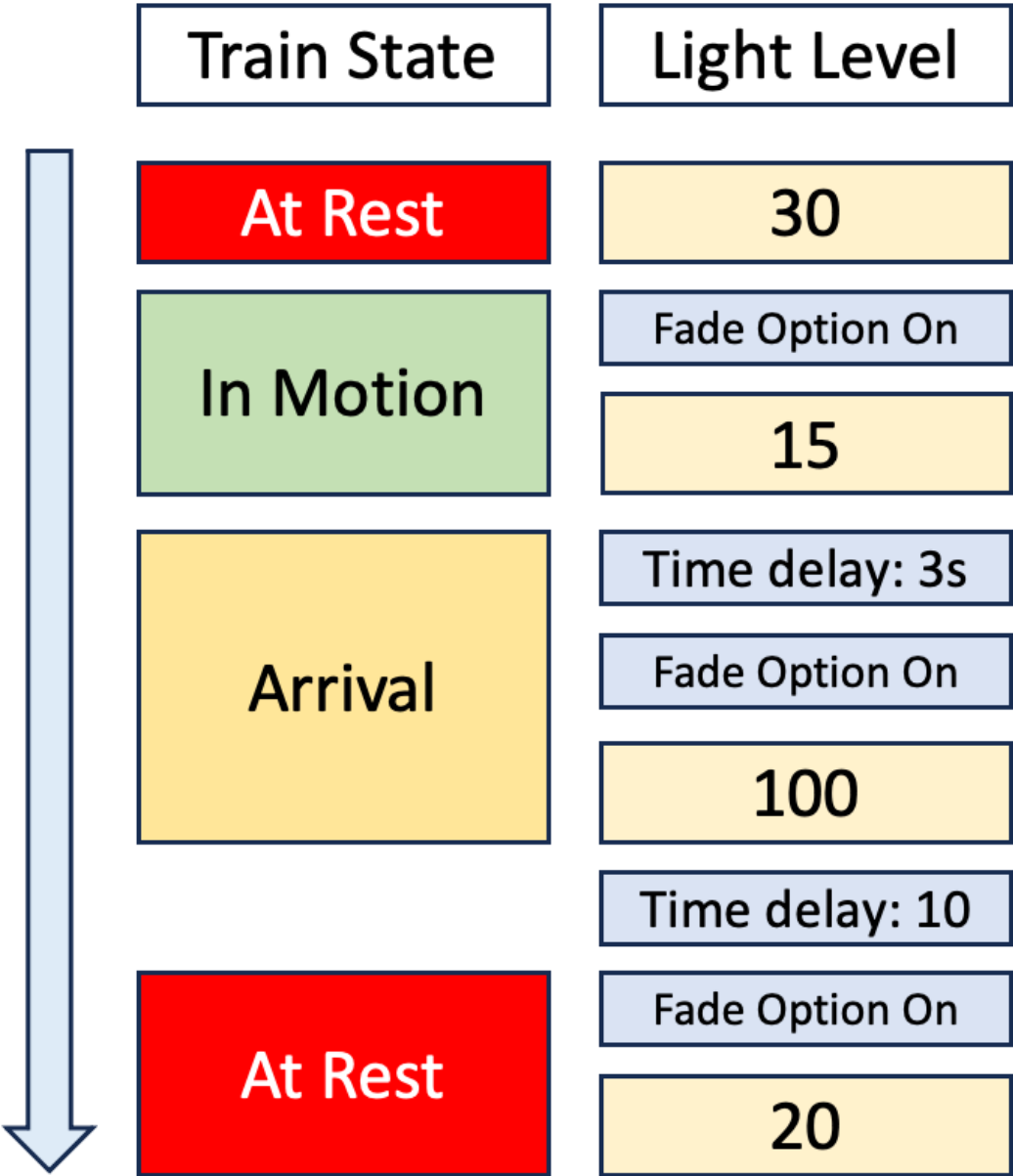


Note: light levels and time can be set from 0 to 255. 100% on is 255.

It is not necessary to set the lights to more than 200. Above that level our eyes cannot distinguish the brightness and it limits the power of the SuperCaps. For testing purposes and while you are learning about how the system works, we recommend that you leave the fade option OFF. This will make the light changes more obvious.

Here is another option that leaves the lights on a low setting while the cars are at rest, then dims the lights slightly as the train moves. When the train stops, the light come on full so passengers can safely disembark. Finally, after a few seconds the light dim back to the At Rest setting. You can change these setting to whatever you like.

Pre-Set Behavior 4



Here is a list of the five Pre Set Behaviors.



Pre-Set Train Sense® Behaviors

	1	2	3	4	5
Train Sense Start MODE	1	1	1	1	1
At Rest Light	0	0	20	30	100
In Motion Light	150	150	100	15	35
After Arrival Wait	2	2	3	3	1
Arrival Light	150	150	100	100	250
Wait before At Rest Light	3	5	10	10	10
Rear Red (On/Off)	1	0	0	0	0
Rear Mode Blinking	1	0	0	0	0
Fade Mode	0	1	1	0	1

There are two ways to activate one of these preset behaviors:

1. Set CV68 to a number between 1 and 5 as per the above chart. When you move the train to the main line, the configuration will be automatically loaded and saved. CV68 will revert back to zero once the preset is configured. Thereafter, you may modify any of the individual settings as per the chart on the next page.
2. Press the onboard pushbutton 1 to 5 times. The lights will flash to confirm the configuration is set.



TRAIN SENSE™ Motion Sensing Settings

		Range
Train Sense Startup (TS or DCC)	CV59	1,0
<i>At Rest</i> Light	CV60	0-255
<i>In Motion</i> Light	CV61	0-255
After <i>Arrival</i> Wait	CV62	0-255
<i>Arrival</i> Light	CV63	0-255
Wait before <i>At Rest</i> Light	CV64	0-255
Rear Red (On/Off)	CV65	1,0
Rear Mode Blinking	CV66	1,0
Fade Mode	CV67	1,0
Pre Set behaviors (0 = off)	CV68	0-5
Main LED brightness	CV47	0-255
Rear LED brightness	CV48	0-255
Digitrax/ All other DCC	CV46	1,0

F10 - Turns the Train Sense™ function on and off. If you change modes too fast you may not allow the Train Sense™ sensor to do its’ “thing”. If you have the fade option on, let the board complete its cycle back to ***At Rest*** before you try to change options. Configuration of the CV’s should be performed on a programming track (Digitrax™) or via the programming mode of your DCC Cab (such as with NCE™).

ORIGINAL FUNCTION DESCRIPTION

The N & HO Scale LED light boards (with DCC Decoder) have either 5, 6, 8, 11 or 22 built-in LEDs and pads (MAIN and (AUX) to connect two additional LEDs that are typically used for red end-of-car lighting. The Decoder has a Microprocessor (MCU) and the board behaves like an engine decoder (NMRA Multi-Function Decoder) using the function keys and speed control for brightness adjustments and address setting. Typical current draw @ 50% brightness (recommended) is 10-30ma. All LED light boards have *SuperCap™* capacitors and circuitry to reduce flicker and to help reduce problems with very brief moments of loss of power.

As per NMRA standards, the board default address is 3.

You can set it to anything that your DCC system supports (short and long addresses).

RESET

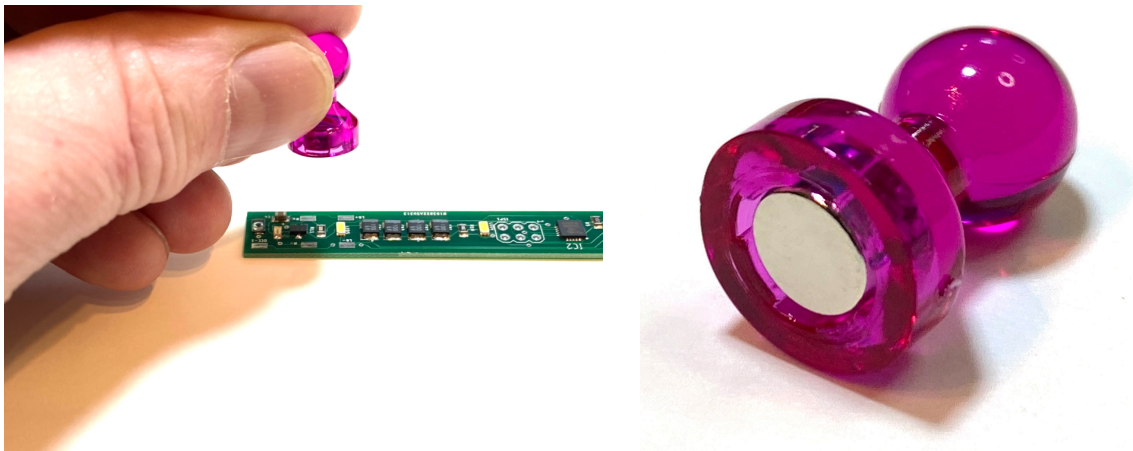
If you get lost, stuck, can't remember your board's address or just want to start over then follow these steps. You don't need to do this with a new board it's already ready to go:

1. Connect you board to you DCC main power supply. Make sure you are not connected to the programming lines. This works with the main track power.

As part of our ongoing inventive spirit we recently we began including a solid-state (non-mechanical) magnetic sensor on the board at the same end as the push button switch. This allows you to use a small magnet to trigger the reset from the OUTSIDE of the car once the board is installed. Now, you don't have to take the car apart in the rare case that you need to perform a reset.

And now you know what that funny looking refrigerator magnet is for! Simply hold the magnet above the board about 2" max for 5-8 seconds. Once the light blinks once, move the magnet away to let the board complete it's reset cycle (4 flashes confirm it is done).

Some boards do not have the magnet reset function. In which case, pressing the onboard button 8 times will activate reset.



OPERATIONS:

FUNCTION KEYS:

F0 Turn on the lights to the default brightness. If this is a new board, or you performed a RESET, the brightness will be 80%

- F2 This is the momentary push button (HORN) and is used for two operations:
- PUSH ONCE to SAVE the default brightness for the MAIN LEDs and AUX LEDs.
 - PRESS and HOLD for 10 seconds to set the DECODER BOARD ADDRESS while the car is on the main track. This is a cool feature we added that avoids having to move the car to a programming track! (see below)
- F3 Turns ON/OFF the AUX lights
- F4 ACTIVATE the speed throttle to adjust the brightness of the lights. If you move the speed control very fast there might be a slight delay in the LED response/adjustment. Fooling around you might spin up and down quickly for example. Once you stop though, the board will catch up.
- F5 Activates the Ramp Up/Down function for the main lights. Instead of instant on/off, the LEDs will dim up and down.
- F6 Activates the flashing mode of the Rear LEDs.
- F7 Activates the flickering (OR MARS) mode of the Rear LEDs. F6 has to be Off.

SAVING THE BRIGHTNESS LEVELS:

F2 works in conjunction with F4 (which activates the SPEED THROTTLE) to set the brightness of either or both the main LED's and the Read End lights.

The way it works: Press F2 ONCE to save the displayed LED brightness.

NOTE: NCE DCC – USE the HORN button instead of F2. The HORN button is configured as a momentary switch while the #2 button on the controller is a toggle – On and Off.

Further – NCE users should set CV46 = 0. This changes the internal counter so that the F2 button must be held down for the RESET. Otherwise, if you accidentally press the HORN without another function key ON, the board will immediately enter Address Programming mode. If this happens, just remove the track power for 10 seconds and the board will resume normal mode and all your settings are retained.

Step-by-step:

Set your DCC Throttle to match the address of the board just as you would to select an engine decoder. (remember, default is 3). Turn ON the light(s) you want to control/ adjust. You can set the MAIN lights and the AUX light bright separately OR together. If they are BOTH on when you press F2 (SAVE), the SAME brightness will be saved for both. If you want different light levels for the MAIN and AUX lights, then SAVE one first, and then turn it off, then turn on the other, adjust its brightness and then press F2 to save the setting for that light.

SET THE DECODER BOARD ADDRESS (without the programming track!)

Using this method, you can set the light board to an any address between 1 and 2048. (the range of switch addresses)

Turn OFF both F0 and F3 lights. The board will not enter programming mode if either is ON.

PRESS AND HOLD F2 for 10 seconds to put the board in ADDRESS PROGRAMMING MODE. (This can be done anywhere on the layout but the power to the track must be ON. This will NOT affect any Multi-Function Decoder (Engine) on the layout.

After roughly 10 seconds the board lights will flash about once a second. This tells you that the board is ready to accept a new address.

For this to work you must have the throttle set to the CURRENT board address and you are able to control the lights On/Off from the throttle. If not, either reset the board back to Address 3 or set your DCC throttle to the assigned board address.

Using the SWITCH function on your throttle, select the new address you want to program – then press either CLOSED or THROWN. The lights will go out indicating the new address has been saved. Using your throttle, EXIT switch mode and set the throttle (Loco) number of the new address you just programmed. Then use F0 and F3 to test for correct operations – the lights go on!

- This process has no effect on any engine decoder (Multifunction) on the layout.
- This will NOT reprogram any of your switches (UNLESS you simultaneously put your Accessory Decoder into programming mode – We’re not sure why anyone would do that?)
- If you use an address that is already assigned to a SWITCH – don't worry! When you press CLOSED/THROWN you will hear that switch operate but only for that one instance of programming this decoder. Thereafter the decoder knows it’s not a switch and will ignore any switch commands and likewise, your switch will ignore commands sent to this board. Pretty clever!

THE OLD FASHION WAY - DECODER ADDRESS PROGRAMMING

This LED Light Board can be programmed using any standard NMRA DCC compliant system. We can’t give you every combination of steps here because of the wide variety of manufacturers since each has its own specifications and limits. For example, NMRA extended addressing can go to 10,000+ but the Digitrax® throttle only allows up to 9983.

As you would with your engine decoder, hook up the light board (or put the car with it installed on the programming track) and program as you normally would.

When in “native” DCC programming mode this LED Light Board will both Short and Long addresses. Just bear in mind not to set it to an address that your DCC system and hand controller do not support.

From time to time we stumble across occasional strange behavior in mixed system environments. For the most reliable (and we think) simple operation, use the built-in in address programming mode (not programming tracks) and work your addressed to be organized within the 2044 address limit.

PERFORMANCE and INSTALLATION

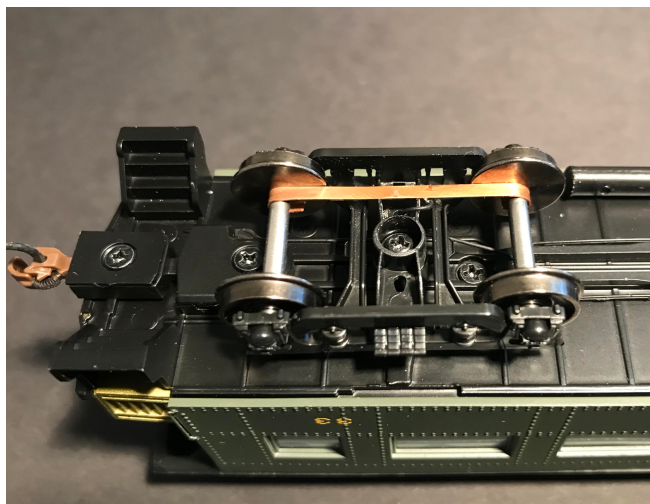
The N & HO Scale LED Light Boards are designed to operate visually best below 50% brightness. On my layout I run at about 25%. The circuit will still protect the LEDs if you operate at 100%. However, if you decide to build a really long train all with lighted cars the cumulative effect of the current drain will affect other action (engines) on the layout. For planning purposes, 10-30ma (milliamp) or less per car is about average. We design the board so you **could** run the lights brighter but for both appearance and current drain it's better to run at half or less rated capacity.

The N Scale board will safely operate at HO voltages at about 16V. It should NOT be operated at G scale voltages of 18-20v.

We have had the good results with KATO® passenger cars largely because they come with wheel pickups. One of the reasons we made these boards is that the rest of the KATO® lighting system is very “wimpy”. With KATO® we have found that the best hook up is to solder the wires to the very end of each of the two long copper strips that make contact with the wheel pickups. We tried to use a variation of the copper strip that slips inside and makes contact with the longer

metal strips – it “sort of” works. Depending on the version of the board you purchased, you may have as many as 8 capacitors that are designed to reduce the flicker effect that comes from the physical “noisy” pickup and the wheels.

For all other cars that are not pre-configured with electrical pickups, we recommend our “floating” brass strips. A single 1mm or 2mm piece of brass is wrapped around each axle of the truck at either end of the car. Then, a 36AWG stranded wire (supplied) is soldered to the brass and connects to the DCC1 and DCC2 on the board. The reason we call this “floating” is that it is NOT fastened to the wheel truck. This allows it to shift with the movement of the axle and doesn’t bind the wheel. ALL the other types we tried required you to fasten their metal contact to the truck with a screw or by glue. This tends to put extra pressure on the wheel or axle and causes it to pinch inside the truck wheel holder. It also adds friction that cause the car not to roll freely.



The width of the board is 11.5mm. In a few situations you may have a better fit at about 11mm. For example, this was the case for the Amtrak Skylight car. It’s perfectly ok to sand down the edge of the board up to a total of about 1mm. Use your good judgement on this. The

underside of the board is ground (GND), and you can see that it starts a little bit away from the edge of the board. I know it's hard to see but wiggle the board under a light to see the reflective difference. Consider up the edge of the GND a safe zone for filing and sanding. I use a piece of 220 grit paper on a flat surface and slide the edge of the board over it. The PCB material is fairly soft so don't go overboard!

These boards are NOT designed to be shortened lengthwise. We have two lengths available for N Scale; 124mm (4 7/8") and 144mm (5 5/8") and 192mm and 264mm for HO. If this doesn't fit your requirement, contact us to see if we can include a custom sized version in one of our manufacturing runs.



CONFIGURATION VARIABLES (CV) CHART

CV	Behavior	Comments
47	Saved Default Brightness for Main LEDS	Use F0 On, F4 On to activate "Speed" control and F2 to save. Valid value 1-127
48	Saved Default Brightness for REAR LEDS	Use F3 On, F4 On to activate "Speed" control and F2 to save. Valid value 1-127
49	Fade speed interval	Set via CV only
50	RESERVED	
51	F3-sync	Makes AUX pads follow MAINS only. Off=0, On = any non-zero number
54	Fade On/Off	Sets default
7	READ ONLY - Software Version	FYI - in case we need to know which board you have.

NCE and others do not send repeating signals by default. Therefore, you will need to press the Function keys – and possibly cycle on/off to get the board and the DCC controller in sync. You can change the NCE system to repeat Function keys via a Command Station option but the cycle time is about 1 second. ALSO – many DCC systems go into “idle” mode when there is an engine with no speed selected. Therefore, for the boards with lights, give those address some “speed”. 10 is fine. This does not affect the LED or anything else on the board. It just tell the DCC system not to let that address go to sleep.

The F2 function on the NCE controller is by default an On/Off toggle. Instead, please use the HORN button which is also “F2” but is a momentary pushbutton.

Further, the NCE sends a burst of F2 commands which causes the LED board to think that the user held the button for longer than they actually did. If you have no other function keys active and you hit F2, the LED board will immediately enter address programming mode and the lights will flash continuously. You don’t want that.

Instead, set CV46 =0 and then the NCE system will behave like other systems. Thus, you will have to press and hold F2 for 4-5 seconds before it enters the programming mode – which is the way it should behave. To change it to use Digitrax, change CV61=1.

Programming on the Main (DCC)

Almost all DCC systems have a way to send “write only” commands to decoders. This is called Ops Mode for Digitrax and Programming on the Main in NCE – speak. This provides a way to set the MTT Light board CV’s without moving the car to a programming track.

ANY TIME you write CV’s directly you will need to reboot the board so it can read the new settings. Simply rocking the car off its wheels for 5-10 seconds will do this. The time difference is based on which board you have and how many SuperCaps™ are installed. Turn the lights on and then rock the car (or remove it

from the track) and wait until all the LEDs are completely off, count to 3 and then replace the car on the track.

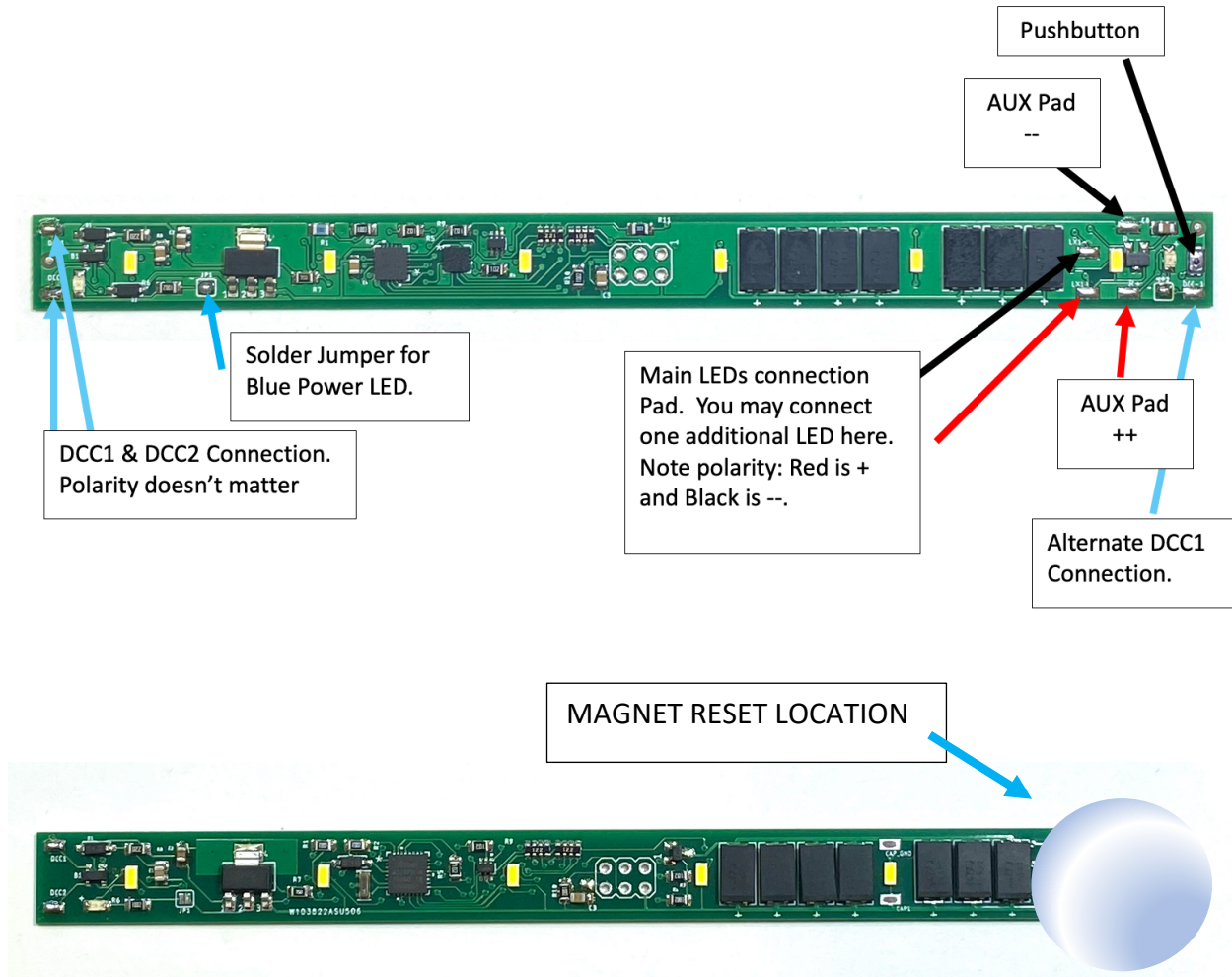
CV Direct Programming (programming track)

The MTT LED light boards can read and write CV's directly using your DCC programming track. To make this work properly you must do two things:

1. CV's 52,53, 55 and 56 must be set to zero. These are all "auto-on" features meant to override some aspects of DCC signaling – and thus they confuse the CV read/write function.
2. Have the car off the track for 20 seconds to allow the SuperCaps™ to completely discharge.

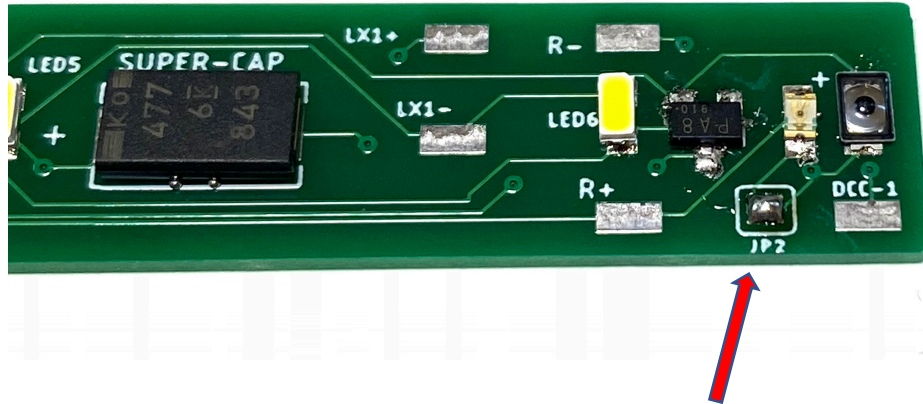
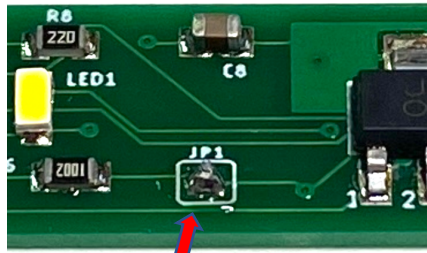
If on the first attempt to read a CV while on the programming mode/track, just try again. Once in a while there might a very small residual in the capacitors. The first read will usually clear this.

LED Light Board Installation Guide

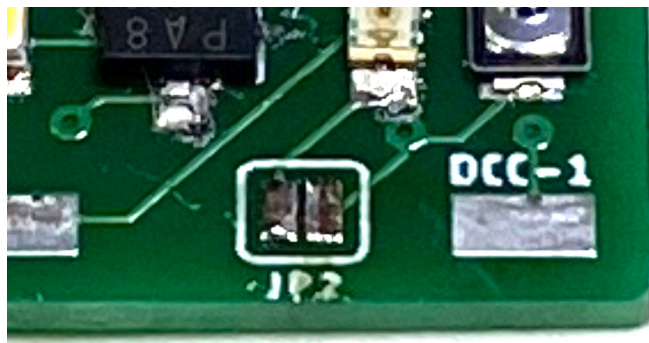


We've changed the board so that both the blue power LED and the red read LED each have a solder pad (JP1 and JP2) that we solder/connect during manufacturing and testing.

See the pictures below:



To disable either of the on-board LEDs simply remove the solder from the pad. This is actually quite easy because the shape of the pads (square) causes them to not “want” to be connected. If you apply a CLEAN solder tip to the solder bubble, more of the solder will want to attach to your iron than the pad and the connection will be “broken”. In some cases, you might have to repeat the procedure. You can always solder it back if you like. This way the board or LED never needs to be “destroyed” and you still have flexibility in your installation. Below is a picture of pad that was soldered and then UN soldered:



ELECTRONICS AND STATIC ELECTRICITY

Static electricity can cause component failure. Scuffing along a carpet and then touching one of the component connectors can cause a static spark. These components are rugged – some designed for the automotive industry. Just be mindful of the risk. The current on the board will not harm you if the board is powered as per the instructions.

Warranty

We warrant our products to be free from defects in workmanship and materials, under normal residential use and conditions, for a period of one (1) year from the original invoice date. Shipping and handling fees are to be paid for by the customer.

Warranty Repairs are subject to inspection of the product to determine the qualification for warranty service and appropriate steps to repair or replace at the sole discretion of the company.

Items must be returned in original packaging or similar packaging and condition as the original product was received. Customers are liable for damages as a result of accidental or improper use and inadequate packaging and shipping.

If an item is damaged either in shipping or accidental or abnormal use, customer will be provided a quote for repairs or replacement of the damaged product or parts. Components of a product that malfunctioned through normal use will be repaired under warranty.

LIMITATION OF LIABILITY

UNDER NO CIRCUMSTANCE SHALL COMPANY OR ITS AFFILIATES, PARTNERS, SUPPLIERS OR LICENSORS BE LIABLE FOR ANY INDIRECT, INCIDENTAL, CONSEQUENTIAL, SPECIAL OR EXEMPLARY DAMAGES ARISING OUT OF OR IN CONNECTION WITH YOUR USE, OR INABILITY TO USE THE PRODUCT, WHETHER OR NOT THE DAMAGES WERE FORESEEABLE AND WHETHER OR NOT COMPANY WAS ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, COMPANY'S AGGREGATE LIABILITY TO YOU SHALL NOT EXCEED THE AMOUNT OF THE PRODUCT. THE FOREGOING LIMITATION WILL APPLY EVEN IF THE ABOVE STATED REMEDY FAILS OF ITS ESSENTIAL PURPOSE.



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