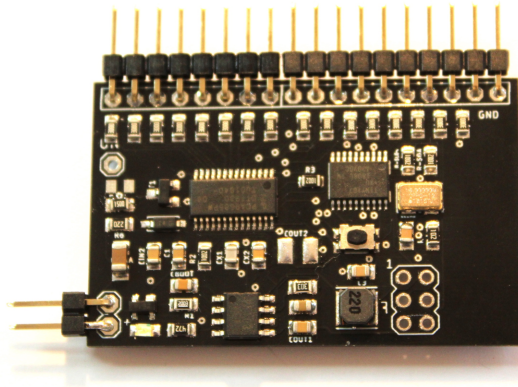




Model Train Technology™

16 Port DCC LED Scene Controller USER MANUAL



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There are 4 versions of the LED Scene Controller: with pads, holes, pins and terminal blocks. Pictured is the standard pin version. All boards operate the same.

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INTRODUCTION

If you are like me, I love to add LEDs to my layout. I put them everywhere because they make the railroad scene come alive regardless of which train I am running. But figuring out just what kind of LED to use and how to connect it can be difficult. There are many questions of voltage, amperage, forward voltage (what's that?), the color and what size "package" to use. And after you figure that out, you have to power the darn things without burning them out. You know you are supposed to put a current limiting resistor in series to the line – right? How bright should they be? What resistor to use, etc.

The Model Train LED controller solves these problems and it gives you a way to configure an array of "behaviors" that the 16 LEDs can perform. If you use the Plug Adapter Board for 12~18 VDC LEDs, all the behaviors will also apply to anything you plug into it. Those behaviors are:

- Adjust each LED for individual "brightness".
- Blinking with individual pin on/off speeds.
- Alternate 2-pin Flashing
- Fade all, one or groups of pins
- Random on/off with adjustable pace
- Step – each LED on/off in sequence
- TV Simulation (use 2,3 or 4 LEDs)

*** Some speed settings apply to all LEDs whereas blinking and brightness settings apply individually to each LED (they can be different). If you have multiple boards with the same DCC address but you program them separately, they will perform based on the board specific configuration.*

The LED Scene Controller can be operated and configured from your DCC hand controller. No programming is required.*

I designed and developed this board so that anyone who can run a DCC locomotive can easily, quickly and inexpensively add LED lighting effects to their layout. Yes, there are Arduino boards that make programming a circuit board “relatively” easy. That is how I built my first prototypes. But getting from that to a DCC controlled lighting system took over a year. Many people have wired their layout and run sophisticated software application that automate the running of the trains. However, most people are not about to start learning “C” and compiling software and building circuit boards. They want something that they can just hook up to run their LED lighting. That is what we built.

**All the settings are saved as CV's or configuration variables. They are saved even when the power goes out. If you like, you can customize the board by setting the configuration variables in Ops Mode via your DCC system. The CV's are listed at the end of this manual.*

The MTT LED Scene Controller is a customized, purpose-built Arduino-like circuit that has been pre-programmed, so you don't have to. It also has a ton more features than a typical Arduino solution has.

Overview of operations

Your board comes configured as address 3 per NMRA standards and it behaves similarly to an engine decoder otherwise known as a “multi-function” decoder. There are two ways to change the board address:

1. Connect the board to a programming track and set the Address CV (#2) to whatever address you like. Long and Short addresses work just as they do with locomotive decoders.

2. Connect the board to the main line DCC power and use the built-in programming mode to set an address that borrow fro the switch address. This is highly dependent upon the make and model of your DCC system For example, the Digitrax® DT400 goes to 999 but the DT500 can reach to 2044. Above that you will need to use the programming track and Ops Mode.

The board has four “modes” of operation:

1. Connected to a DCC line the board can operate in:

Operator Mode. In this mode each pin can be turned On or Off, Fade On and Off or Random to On and Random to Off. There is also an ALL on/off option.

Configuration Mode (F1). In this mode individual LED and board level setting can be configured and saved. (Note: all the settings can also be activated by setting CV's (configuration variables) using the programming track.

Animation Mode (F10). In this mode the simulation of Blinking, Flashing, Always On and Random On/OFF and TV Simulation on each pins of the board (based on your configuration) is activated.

2. Non DCC Powered Mode. (this is cool)

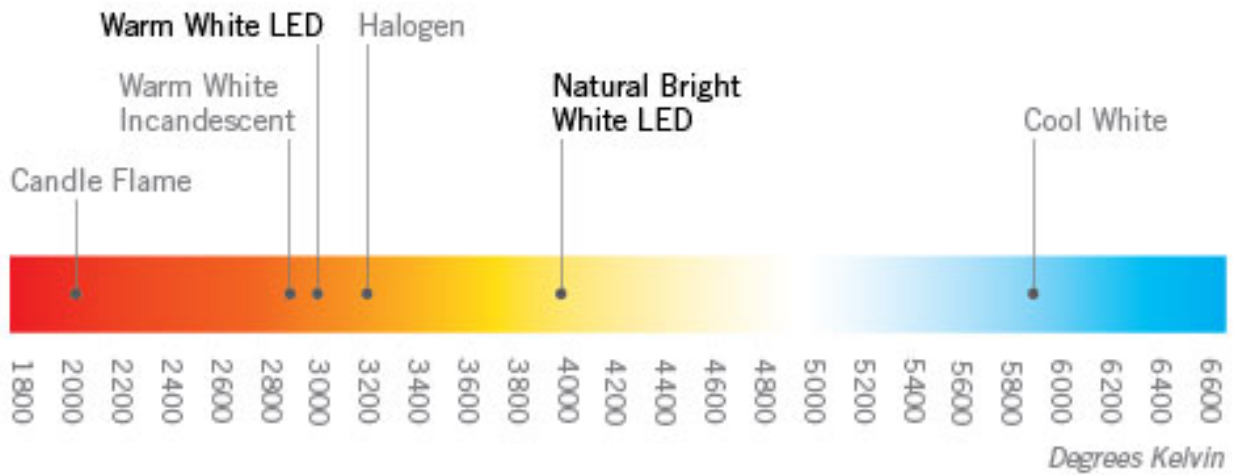
DCC Track power is precious, particularly if you have a big layout or are part of a club. To accommodate the requirement to have accessories run off non-DCC sources we have built that capability into the board.

Once you have decided what you want each of the 16 pins on the board to do and you have configured the board via your DCC hand controller or Ops mode, you can unplug it from the DCC line and plug in a standard 12-18V AC or DC 1A or more

power supply. After about 20 seconds the board will determine that it has power but no DCC signal. At that point it will automatically kick into Animation Mode just like F10 above.

The output voltage of the MTT LED Scene controller at each pin is designed for LOW voltage SMD (surface mount device) LEDs typically in the 1.8 to 3.3v range. We'll call these 5VDC LEDs. We supply LED "chips" that have the LEDs already soldered onto a convenient mounting board. These SMD LED chips are also available pre-wired from Amazon® and EBAY®. They are very inexpensive which is why we use them. We don't think many people are willing to pay ~\$4/LED – ours cost half that. We believe that if the LED's are inexpensive and can be connected in less than 10 minutes people will actually light their layout!

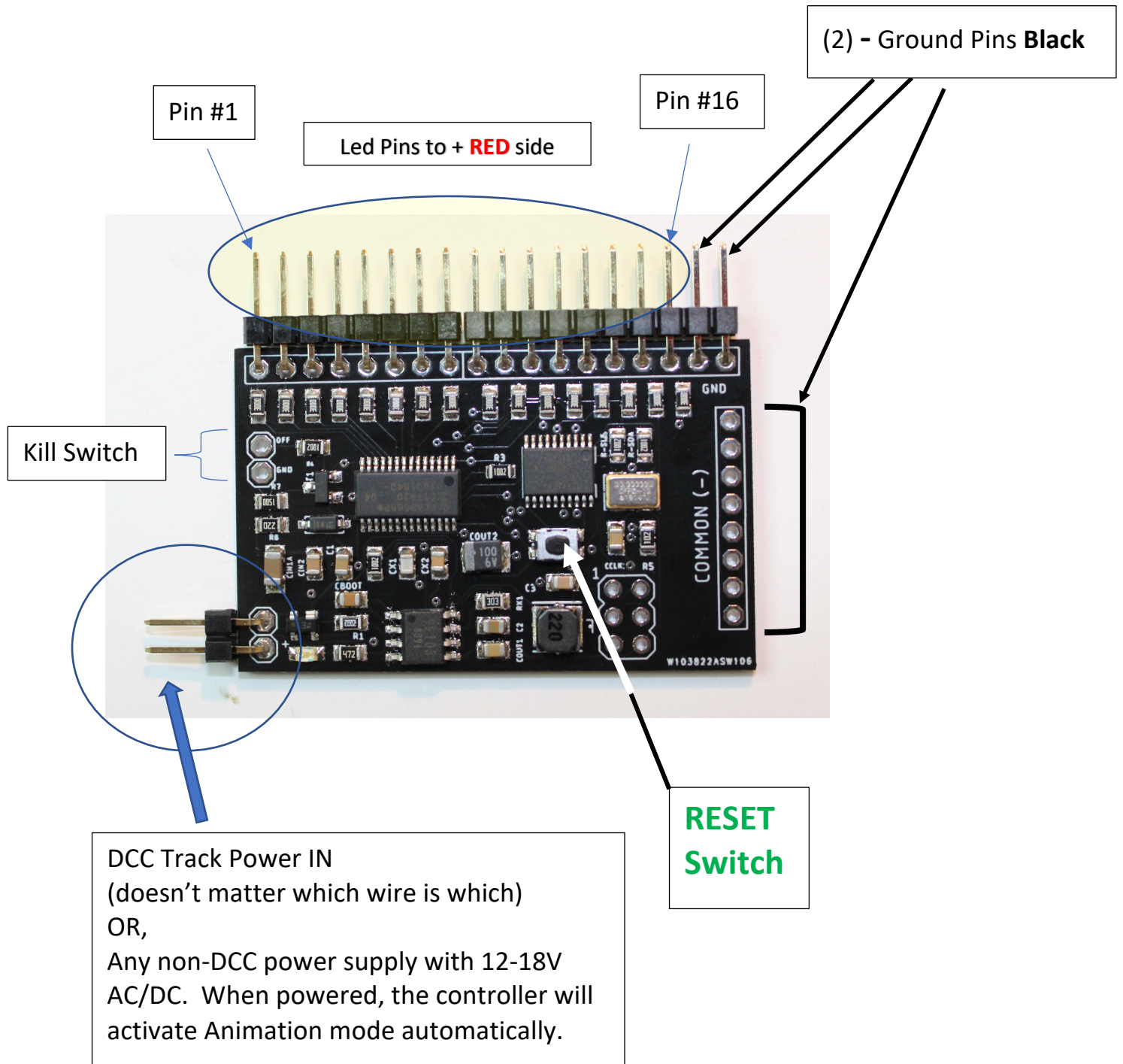
One thing to note about SMD LEDs, they are very sensitive to heat from say, a soldering iron. They melt very easily. That is why we solder the LEDs onto the "chip" board for you. You can buy these from us wired or un-wired and solder the wires onto the "chip" yourself. It's easy. We have 4 white "colors" available labeled with "K" (Kelvin) to indicate the "temperature" of the light. They don't actually get hot but light is measured by its temperature. For example, there is "warm" white and "cool" white. The lower the value the more yellow it will be, whereas a higher value will have a bluer color. We also have a TV Sim "chip" that has a blue and white LED and an RGB "chip" for a Color TV Sim – or anything else you can dream up. Below is a color chart for your reference:



Note: Everyone knows that the blue part of flame is hotter than the orange part. With that in mind I can see that the blue area of the above chart should be “hotter” and have a higher degree Kelvin associated with it. Then why is it called “cool” and the cooler part down near 3000k called warm? We found out that it is described by the way it **looks** that makes it “cool”, not the physics. Just thought you might like to know. Confusing, but we’re stuck with it.

There are other LEDs that are available online and from train scenery manufactures and suppliers that operate on 12~18VDC. The two are not compatible. Don’t worry, we solved that too! To operate the higher voltage LEDs you can connect this LED Scene Controller to our Plug Adapter Board. The board has connectors made by JST that are compatible with plug in LED products from other companies. Any LED product that has the JST plug will plug into the adapter and will have ALL the same features and controls as the LEDs you connect directly to our Controller. 12~18V prewired LEDs with mounting boards are available on Amazon and eBay in case you want to go that route.

Wiring your LED Scene Controller



This controller uses an AVR ATtiny167 MCU running at 16 or 20Mhz and a PCA9685 LED controller. The software is C and assembly. It uses a switching power supply that uses only the current that it needs when it needs it. As a result, it doesn't waste energy which you would notice in the form of heat. ... in case you are interested.

1. The LED Scene controller is designed to power LED's in the 1.8 to 5VDC range. It will not power LEDs that are made by another famous model train scenery company that are rated 12-18V. HOWEVER, you CAN control those other LEDs via our Plug Adapter Board which is powered by a 12-18VAC power adapter.
2. The LEDs "chips" that come with this kit and are available via our website ARE the right ones to use – and they are very Inexpensive. The + "plus" and the – "minus" are clearly marked. You wont damage the LED if you connect it backward accidentally – it just wont work.
3. Connect the DCC track power to the lower left (2) connectors (holes or solder pads). The orientation of the two wires does not matter.
4. Connect up to (2) "chip" LEDs (or LEDs of your own that are rated under 5VDC/20ma) to each of any of the pins as shown in the diagram. RED goes to the Pin as shown. BLACK is common and you can connect a few of the black wires (- side) together as you need.
5. Press F0 tests by turning all LED pins on.
6. Kill Switch – If you want to have the ability to "pause" the controller you can connect these two connections to a N/O (normally open) switch. If you close the circuit (connect the wires) the board will go into "standby" mode and all the LEDs will turn off. When you release the switch, the controller will resume what it was doing. The controller uses about 6-9ma (milliamps) when it is not powering LEDs.

A few things to keep in mind:

We will be using the function keys and the speed control of the DCC hand controller to set the configuration of the LED controller board. This causes a few weird behaviors in particular with the speed control switching from one mode to another. My advice is to go slow and follow the steps one by one. Additionally, there will be a few sequences where you might get stuck. In that case, turn off all the function keys and use F0 to turn All the LEDs on and off. This doesn't do anything more than confirm that the board is working and that you are back at the start.

PIN behavior description and options

Each pin is assigned a MODE. The default Mode is Random [6]. 6 is the value of the CV that you store for that pin to make it behave Randomly when in Operation, Animation or Non-DCC modes.

Each pin can be assigned only ONE behavior at a time. Of course, you can change that behavior anytime. In fact, one of the by-products of how we use the function keys and throttle of the DCC controller is that you can both control the board (the LED scene) AND configure the board via software such as Railroad Automation or jmri without disconnecting the board from the layout or using the programming "track".

To change the configuration of a pin you have to stop Animation mode (F10 OFF) and then make sure all other function keys are also off. This is explained further in this manual.

The pin behaviors and their CV values:

Value	Behavior	Notes:	Animation
0	disabled	No output on this pin during animation.	No
1	Always on	On during animation; ignore Random	Yes
2	nothing.	So as not to confuse with F2 which is SAVE	No
3	Blink	Blink speed On/Off configured for each pin	Yes
4	Nothing.		Yes
5	Fade	When selected by a function key, fade pin	No
6	Random	Default mode	Yes
7	Step	Sequentially turn LEDs On/Off with F0	No
8	Flashing	Use to create alternate pin Flashing	Yes
9	TV Sim	Simulate a TV (using Blue & White LEDs)	N/A
10	Nothing.		
11	Mimic F11	Operator Controlled - Mimics F11	No
12	Mimic F12	Operator Controlled - Mimics F12	No

The Mode CV addresses are [112- 127]. Pin #1 is 112, Pin#2 is 113, etc.

Operator Mode versus Animation Mode

There are two operating modes that the controller can execute. **Operator Mode** allows you to turn on and off any LED pin by pressing its corresponding Function key +10. That means that hitting F11 will turn pin #1 on and off. F12 will turn pin #2 on and off, and so forth. Nothing happens unless you tell it to do something by selecting a function key. This is different from Animation mode whereby your configuration of the pins will cause them to behave accordingly just by pressing F10 On.

If you use software to control your layout and if it supports controlling Function keys then you can control the LED Scene Control board using software – which is how all the animation on my layout operates.

There are also a few animations that are possible to activate in Operator mode. See the chart below:

The available Functions in Operator Mode (F1 OFF) are:

Function Key	Behavior	Comments
F0	All Pins On/Off	Also used to check everything works.
F4	Adjust all Pin Bright level	Forces all pins to same Dim level; use F2 to save
F5	All Pins Fade	Works with F0
F6	Random	On pins where mode = 6
F7	Pins On or Off in Sequence	Use in conjunction with F0
F8	Alternate pin Flashing	Overrides individual mode setting; all pins
F11-F26	Turn on Pin**	For pin 1, add 10 = F11. Pin 16 = F26

** if Mode =5 for any pin, the pin will Fade On and Off when the function key is turned on and off.

Fade cannot be automatically triggered by activating Animation mode. You have to turn an individual pin on or off and it has to be set to Fade (5) in the mode settings. The Random animation will ignore a pin that is set to Fade and is On. If the pin is Off, Random will include it in its set of pins to turn on and off.

Step is only available in Operator Mode and ignores the Mode setting. Therefore, when the board is switched to Animation Mode, the Mode setting for each pin will then be used.

Use of Function Keys

Function Keys are used to both configure the board and to control its operation. Therefore, keeping track of which functions are on and off is important to keep things running smoothly. The F1 key is used to switch into Configuration mode. When F1 is On, the other function keys will behave differently than when it's Off. The chart below will help but we also have some examples.

F2 has a special role and since it is configured 99.9% of the time as a momentary Horn, we will use it to the SAVE configuration options. You press the F2 key when you want to save something

and then the LEDs will flash to tell you it worked. If the LED's don't flash, something is not right.

F2 is also used to send the board into Address Configuration mode. This is a little trick we designed into our LED light boards for passenger cars and we implemented it here as well. I was never a fan of having to move my trains to a programming track to change their configuration. Instead, with some minor limitation we invented a way to change the address of a board while it is connected to the live DCC track – without impacting or changing any other decoder on the layout. Check out the Address Programming section but for now, just note that F2 is “special”.

The LED Scene Controller uses Function F0 through F12 to configure and control the pins on the board. Every hand controller has at least these 12. The current NMRA® specification calls for support of function keys to 29 – which all controllers don't have on the primary panel. How you get to functions above 12 depends on the controller. Digitrax DT400 and below cannot access above F12. DT402 and above do have a way by using a combination of the FUNC key with either a 1 or a 2. With software application running the show this isn't a problem.

Since we make use of F0-F12 for control of the board we had to put the individual pin control for on and off starting at F11. Just add 10 to the pin you want to control. Pin 1 is F11 (1 +10). Pin 16 is F26 (20+6) using the extended function commands. After I got the LED Scene Controller prototype board working and configured, I discovered that I never needed to control above F12 – but I did add a way to do it from the primary keyboard even if your controller can't access above Function 12. Look up the Mimic option in the chart for an explanation.

Use of the Speed Control

We primarily use the Digitrax® system so there will be some variation with your system when it comes to how the speed controller behaves. And while we have been testing the controller with as many different systems as we could, we are sure there will be a few hardware configurations we haven't seen yet. If you have an issue like this, please contact us so we can update the design to support you.

If there is anything that will confuse you as you configure the controller it will be the behavior of the speed control. After a LOT of consideration, we decided that putting more functionality and flexibility into the controller was more important than super simple. Here is why you might get confused as we did the first time.

We give you the option to configure each pin individually. The way you select a pin to configure is with the speed controller. Press F1 and then turn the **speed** dial to any value between 1 and 16. As long as no other function keys are on, the LEDs connected to each pin will light. If you select 8 on the speed control, pin 8 will light. (consider our LED test board to simplify setup)

Note: you will notice a slight idiosyncrasy when you turn the speed controller. Occasionally you may feel two "clicks" of the dial when the LED only moved by one. This is because the range of speed is 0-127 (128 speed steps) but the dial is two digits to represent 0-100%, not the actual internal speed step. Actually, it only goes to 99 on the Digitrax system. That means each click is 1.27 not an even 1. So, we have to do some math to make sure that when the dial says "5" – it really is 5 on the inside.

That part is simple. If you dial a value above 16 no LEDs will light. Likewise, if you choose zero. Now that you have pin 8

dialed in, press F4. This is the key to activate adjusting the brightness. The moment you press F4, the LED on that pin will light to a value of 8 – since that is where the speed dial was when you selected pin 8. It will be fairly dim. Now adjust the speed control to brighten the LED. You can go all the way to 99! Is that the brightness you want for that pin? Ok, then press F2 – SAVE. The LED on pin 8 will flash a few times letting you know that it saved your brightness setting. Done. Right? Ok, now turn F4 OFF – this deactivates the brightness adjustment mode. What happened – no LED's are lit and pin 8 LED went off! Yep, because the SPEED control is still set at 99 or whatever your last setting was if it is above 16.

If you now dial the speed control back to 8, the LED will go back on and you will see the new, adjusted and probably a brighter setting for pin 8. Now you can use the speed dial to pick another pin and adjust its brightness and other configurations and so on.

If you followed that then you are all set! You can only pick a pin from 1-16 but you will use speed controller to adjust for **Values** that are usually above that. This will occur for each instance where you want to set the Mode, adjust the Brightness setting or change the speed of Blinking for individual pins. This will not happen when you set the speed for Flashing, Fade, Random or Step since those are board-specific and affect all pins identically.

Setting the LED Scene Controller Address

The LED Scene Controller default address is 3. If your board is acting flaky or you can't remember the board address, you might need to resort to a RESET. There are two methods. The first is to set CV8 to 1 via the programming track – if you have to resort to that. By the way, this method does NOT reset your

configurations of the pins. If you need to flush the pin settings use the next method.

The other way is as follows:

RESET – press and hold the reset button on the controller board for approximately 5 seconds until the LED light – Then **RELEASE** the button. After 5 seconds ALL the LEDs that are connected to pins will flash a few times. When the LEDs go out your board is back to factory defaults. We recommend that you power down the board for 5 seconds (just unplug the power) and then restart it. Everything should be back to normal and the address for the boards is back to 3.

As mentioned, you can always use the programming track methods, otherwise known as DCC Ops mode - to program the address. In that case, the pin configurations will not be set back to defaults.

Setting the Scene Controller board Address with F2

1. Connect the board to a DCC layout and turn the power on.
2. Turn OFF all function keys.
3. Press and hold F2 for ~ 5 seconds.
4. Wait for ALL the LED's connected to the board to flash
5. The board is now waiting for a SWITCH address.
6. Press the SWITCH key on your controller.
7. Select a switch number (1-2044 based on your system)
8. Press either Close or Thrown. The LEDs will stop blinking.
9. Press EXIT to exit the switch mode and return to normal operations.

That's it. Now select the "Loco" for the address you just programmed into the board. Press F0 to test that it works by lighting all the LEDs.

If you chose an address for your board that is ALSO the address of a switch on your layout – don't panic! Although the switch was thrown or closed when you hit C or T on your hand controller – it did nothing else on your layout nor did it change the switch control address. (That is unless you somehow put your switch controller into to "address setting" mode at the same time. That is not easy to do so we don't' expect it to occur too often.)

For convenience, I use addresses for my LED Scene Controller that start at 1,000. That way I won't confuse myself with the layout switches. With 2044 possible addresses, why would anyone need to do anything else with the programming track?

CONFIGURATION

Configuration Activation Function Keys:

Function Key	Behavior	Comments
Speed Dial	Select Pin 1-16 and enter Values 1-99	When NO other function keys are on, the selected LED for that pin will light.
F1	Enter Configuration Mode	
F2	Save Configuration	If the value is valid, the pin(s) will flash
F3	Adjust Pin Blinking Rate	Use F0 to switch between the On time and OFF time.
F4	Adjust Pin Dim level	Adjust selected Pin brightness level with speed dial.
F5	Fade Speed (all pins)	Use the speed dial to adjust these settings. Since these apply to all pins, no pin will be lit. A successful save will cause all the pins to flash.
F6	Random (all pins)	
F7	Step speed (all pins)	
F8	Flashing speed (all pins)	
F9	Switch to MODE select	See chart for MODE options

Pin MODE Configuration values*:

Value	Behavior	Notes:	Animation
0	disabled	No output on this pin during animation.	Yes
1	Always on	On during animation; ignore Random	Yes
2	nothing.	So as not to confuse with F2 which is SAVE	
3	Blink	Blink speed On/Off configured for each pin	Yes
4	Nothing.		
5	Fade	When selected by a function key, fade pin	No
6	Random	Default mode	Yes
7	Step	Sequentially turn LEDs On/Off with F0	No
8	Flashing	Use to create alternate pin Flashing	Yes
9	TV Sim	Simulate a TV (2-4 pins required)	Yes
10	Nothing.		
11	Mimic F11	Operator Controlled - Mimics F11	No
12	Mimic F12	Operator Controlled - Mimics F12	No

*Repeated for convenience

1.0 Overview of the behavior “MODE” of a pin for Animation

Each of the 16 pins on the LED Scene Controller can be set to behave differently for the purpose of Animation Mode F10. When F10 is activated, the Mode setting of that pin directs its behavior with a few the exceptions that will be mentioned. The Mode can be set via the configuration mode F1 and F9 explained in the next section. There are 6 modes that will activate for the animation:

	Mode Value
• Always off	0
• Always on	1
• Blink	3
• Random	6
• Flashing	8
• TV Simulation	9

The speed of Blink, Random and Flashing for each pin can adjusted separately.

Blink - a single LED pin at its configured speed On/Off.

Random – turns LED pins on and off randomly. When in Operations mode – F10 - the F6 controls whether the lights sequence “spools” up or down. In other words, the sequence will randomly turn the lights On/Off to about 80% (default) of the pins being On at any one time when F6 is on. After the lights have been randomly on, turning F6 OFF will randomly shut off the lights until they (the pins with Random set = 6) are all off. The other Modes will continue to operate.

Flashing – alternate flashes Odd/ Even pins.

TV Simulation – randomly turns one or more LED pins on at varying light levels to simulate the changing scenes on a TV. A RGB LED “chip” is available to simulate a color TV. This requires four (4) LED pins – three for the RGB LEDs and one for a white (6500k) LED chip. For black and white TV simulation a single Blue and White TV “chip” is recommended. To make this work best you will want to adjust the bright level of each of the pins so that one color doesn’t overwhelm the other.

STEPS TO CONFIGURE THE CONTROLLER

1.1 Setting the Pin MODE [F1] [F9]

- a) All Functions Keys OFF
- b) F1 [On] - enter configuration mode
- c) Select LED pin by using the speed dial (1-16) – Pin will light.
- d) F9 [On] - disables pin select mode; now select the MODE (0-12) with the speed control.
- e) F2 [Press Once] – selected pin LEDs will flash to confirm SAVE of new bright level for pin.
- f) F9 [Off] – Exit Mode Select adjustment; now in pin select mode.

This is where I mentioned you might get confused if the LED is not lit. Check the speed dial – is it between 1 and 16?

- g) Use the speed dial to select another pin to adjust OR,
- h) F1 [Off] Exit pin configuration mode.

1.2 Configure ALL LEDs Bright Level [F4]

- a) All Function keys OFF
- b) F0 [On] – all LEDs should be lit
- c) F4 [On] - LEDs will dim to the setting on the speed dial.
- d) Adjust the speed dial 0-100% to your liking.
- e) F2 [Press Once] – all LEDs will flash to confirm SAVE.
- f) F4 [Off]

Note: This is the only configuration that can be made without using F1.

1.1 Configure a single LED pin Bright Level [F1] [F4]

- i) All Functions Keys OFF
- j) F1 [On] - enter configuration mode
- k) Select LED pin by using the speed dial (1-16) – Pin will light.
- l) F4 [On] - disables pin select mode; now adjust the brightness with the speed control.
- m) F2 [Press Once] – selected pin LEDs will flash to confirm SAVE of new bright level for pin.
- n) F4 [Off] – Exit brightness adjustment; now in pin select mode.

This is where I mentioned you might get confused if the LED is not lit. Check the speed dial – is it between 1 and 16?

- o) Use the speed dial to select another pin to adjust OR,
- p) F1 [Off] Exit pin configuration mode.
- q) Test the selected pin by pressing the function key for that pin:
F11 = pin 1, F12 = pin 2, F13 = pin 3, etc.
- r) OR, F0 will turn on all pins and you can evaluate the pin that you configured.

1.2 Adjust Individual Pin Blink Speed [F1] [F3]

Each of the 16 pins can be set to blink, and each can blink on and off a different rate. When you use F3 below to activate the adjustment of the blink rate, the MODE setting for the pin may or may not be set to Blink. In fact, the default for all pins is Random(6). However, when you press F2 to SAVE any adjusted blink rate, the controller will also set that pin's MODE setting to Blink (3). It assumes that is what you want to do so that when you activate Animation with F10 – the pin will, in fact, blink.

If you don't save the Blink settings with F2, the controller will abandon your adjustments and use whatever the set MODE setting is – which may not be Blink(3)

- a) All Functions Keys OFF
- b) F1 [On] - enter configuration mode.
- c) Select LED pin by using the speed dial (1-16) – Pin will light.
- d) F3 [On] – Pin will start blinking at the existing saved setting which could be the system default. Since F0 is Off, the blink rate you will adjust first is the OFF time. Use the speed dial to increase the time the LED is off.
- e) F0 [On] – Adjust the time for the LED to be on.
- f) Use the speed dial to adjust the time the LED is on.
- g) F2 – Press once to save the settings. All the LEDs will flash to confirm the setting was saved.
- h) F3 [Off] – turn off adjusting the LED blink timing. If you still have F1 on, you will need to adjust the speed dial to get back in range 1-16 for any of the LEDs to light.

Note: if you turn F3 Off before you save the new settings, the pin will revert back to the system stored settings.

A good way to test this new setting is to simply press F3 On. Turn F3 Off to leave the existing settings.

1.4 Adjust the Fade Speed – All Pins – [F1] [F5]

You can adjust a controller variable that “paces” the rate of the fade behavior from about ½ second to 5 seconds depending on how bright the led has been set. It is not an exact time.

Experimentation is the best way to pick a value that works for you.

A characteristic of the fade behavior is that the number of “steps” that the fade will execute is directly related to the brightness – which can be pin individually for each pin. That means that the pins will fade up and down at different apparent rates based on how many “steps” it has to take to get to or from the bright level. A pin set at bright level 25 will finish sooner than a pin set at 50 or 99.

Finally, the amount of light that the LED emits at 25%, 50% and 99% is not linear. It follows a curve which has the effect of making the fade more apparent between a bright setting of 10% and 20% than between 50% and 99%. It’s just the way the LEDs work and how our eye perceive it.

- a) All Functions Keys OFF
- b) F1 [On] - enter configuration mode.
- c) F5 [On] – activate Fade Speed control – nothing visible will happen.
- d) Adjust the speed control to increase or decrease the rate of the fade for all pins. 25 is the default and 1 is the minimum. If you try to set it to 0 pressing F2 will not flash – meaning that it did not save the value.
- e) F2 – Press once to save the settings. All the LEDs will flash to confirm the setting was saved.
- f) F5 [Off] – Exit setting Fade speed
- g) F1 [Off] – Exit Configuration mode.

1.5 Adjust the Random Delay – All Pins - [F1] [F6]

The Random behavior affects any pin where Mode = 6. However, pins that have been individually turned on by a function key [F11-26] will stay lit and will be skipped until they are “manually” turned off via the function keys. If you want your animation to

turn on certain LEDs and keep them On, set their MODE to 1 (always on). Mode 1 only activates during F10 – animation.

You can activate Random while NOT in Animation Mode by turn F6 on. In this way the other animations such as always on, blink, flashing and TV will not activate. Only LED pins set to Random will activate.

In Animation Mode, once you turn F6 on and at least one LED has come on, the controller knows this. Then what happens when you turn F6 Off, the controller will keep behaving randomly but it will turn the LED's off until eventually they are all extinguished.

The Random delay setting has the effect of stretching out the pace of the "randomness". Since the whole behavior is random including the timing, we can't tell you exactly by "how much". The default setting is 5 so if you change that to 50, for example, it will really stretch the timing – which is what you might want. 5 is setting where it changes enough to keep the scene interesting.

During Animation mode the roughly 85% of the LEDs will be on. You can change this by setting CV 116 to a number lower than 60 (default) so that for example, only 20% of the LEDs are on at a time.

- a) All Functions Keys OFF
- b) F1 [On] - enter configuration mode.
- c) F6 [On] – activate Random delay control – nothing visible will happen.
- d) Adjust the speed control to increase or decrease the value of the delay setting for all pins. 5 is the default and 1 is the minimum. If you try to set it to 0 pressing F2 will not flash – meaning that it did not save the value.
- e) F2 – Press once to save the settings. All the LEDs will flash to confirm the setting was saved.

- f) F6 [Off] – Exit setting Random delay
- g) F1 [Off] – Exit Configuration mode.

1.6 Adjust the Step Speed – All Pins - [F1] [F7]

The Step mode is not obvious – until I explain it. Imaging a night watchman inside a building going room by room to turn the lights on or off. How many steps does he take between each action of hitting the switch? Thus, was born Step mode. What happened though is that I set the Step speed very low to test the prototype controllers and ended up with a chase sequence – very fast. Use it however you like. Step is a behavior that affects all pins simultaneously, it overrides any individual pin setting and is only available in Operator mode. F7 does not function without F0. Since F0 overrides F10 animation you can't mix the F7 behavior with other effects.

- a) All Functions Keys OFF
- b) F1 [On] - enter configuration mode.
- c) F7 [On] – activate Step speed control – nothing visible will happen.
- d) Adjust the speed control to increase or decrease the value of the step speed setting for all pins. 10 is the default and 1 is the minimum. If you try to set it to 0 pressing F2 will not flash – meaning that it did not save the value.
- e) F2 – Press once to save the settings. All the LEDs will flash to confirm the setting was saved.
- f) F7 [Off] – Exit setting Step speed
- g) F1 [Off] – Exit Configuration mode.

1.7 Adjust the Flashing Speed – ALL – [F1] [F8]

Flashing mode blinks alternate Pins on and off so that you can use any combination of odd/even pins, not necessarily adjacent to each other, to create an alternate flashing mode. You could also use only odd or even pins to give a group of LEDs a synchronized blink. Use this Flashing speed adjustment to set the speed. Flashing uses evenly spaced timing of On/Off which is different than using Blink where the On and Off times can be different.

- h) All Functions Keys OFF
- i) F1 [On] - enter configuration mode.
- j) F8 [On] – activate Step speed control – nothing visible will happen.
- k) Adjust the speed control to increase or decrease the value of the step speed setting for all pins. 10 is the default and 5 is the minimum. If you try to set it to below 5, pressing F2 will not flash – meaning that it did not save the value.
- l) F2 – Press once to save the settings. All the LEDs will flash to confirm the setting was saved.
- m) F8 [Off] – Exit setting Step speed
- n) F1 [Off] – Exit Configuration mode.

Configure Mimic Mode - F11 & F12 MODE [F1] [F9]

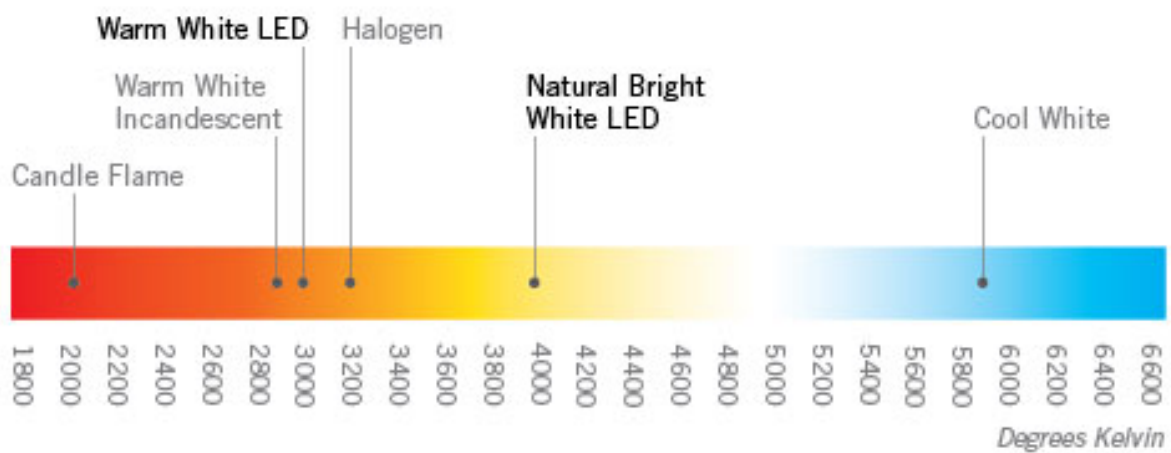
Mimic mode was born out of a sudden discovery at a local HO club that the Digitrax DT400 and other older DCC systems did not have a way to access the extended

function keys above 12. Yikes! I had been using the DT500 which handles this nicely. Further researched showed that all controllers have at least the ability to activate functions F0 to F12.

Therefore, for use when in Operator mode only, Mimic mode allows you to configure LED pins 3-16 to "mimic" either F11 or F12, LED pins 1 and 2 respectively. The mimic function will only perform two behaviors: On/Off and Fade. When you turn on F11, any pin configured to mimic it will turn on or off. If LED pin 1 or 2 is configured to Fade (5), then the pins set to mimic will also fade on and off. LED pins set to mimic WILL respond to the Random behavior in Animation mode. That is UNLESS they are Fade to ON. On by a function key overrides the Random behavior. The LED will stay on, mimicking the function key F11 or F12. When either of these is Off or Fade to OFF, the Random behavior will pick up these pins again and they will join the animation. I know that might sound complicated, but it should make it easier for folks with older DCC controllers to control their LED Scene Controller.

LED "chips" are available in the following colors:

- 2000K
- 3000K
- 5000K
- 6500K
- TV Sim (Blue & White)
- TV Sim (RGB)



OPERATOR MODE FUNCTION KEYS

Function Key	Behavior	Comments
F0	All pins On/Off	Overrides all functions, except when F1 is on.
F4	Adjust All Pin Brightness	Forces all pins to the same bright level, use F2 to save
F5	All pins Fade On/Off	Use to F0 to activate; Speed of fade is related to brightness.
F6	Random	For pins where Mode = 6 or Mimic. Does not shut off when F6 is turned off which is a different behavior than Animation.
F7	Step mode	Pins On/Off in sequence. Use with F0 to activate
F8	Alternate Flashing	All pins flash alternately odd/ even.
F11-26	Turn on individual pin	Add 10 to Function key number : pin 1 is F11, Pin 16 is F26

CONFIGURATION MODE FUNCTIONS & SPEED CONTROL

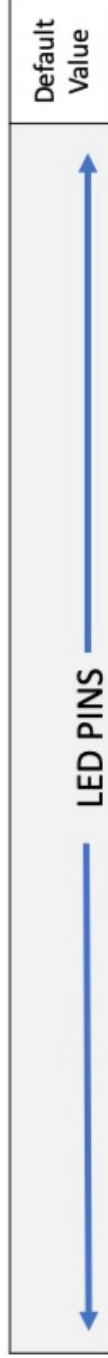
Function Key	Use & Behavior	Comments	Default
F0	Switch On/Off time for Flashing	Used with F3 Blink speed setting to switch from On time to Off time	
F1	Enter Configuration Mode	Use F1 to activate Configuration mode, Animation will stop.	
F2	Save Settings	Push once to save. LEDs will blink to confirm a valid settings was saved.	
F3	Adjust pin Blink time On & Off	Use F0 to choose On or Off Time. If FO is OFF, then OFF time for LED.	
F4	Adjust pin Brightness level	Use the speed dial to adjust thses settings. Since these apply to all pins, no pins will be lit. A succesful save will be indicated by all the pins flashing when you press F2.	20
F5	Adjust Fade speed		2
F6	Random speed		10
F7	Step speed		5
F8	Alternate Flashing Speed		3
F9	Switch to MODE select	With F9 On, use the speed control to select a pin MODE number.	

MODE CONFIGURATION VALUES [F9]

Value	Behavior	Notes:	Animation
0	Pin disabled	No output on this pin during Animation.	
1	Always On	Pin will turn On during animation & ignore Random	
2		Not used to avoid confusion with Save.	
3	Blink	The pin will blink On and Off at the configured speed for each pin	
4		Not used to avoid confusio with brightness control.	
5	Fade	Operator Mode only. Use the pins function key to activate	
6	Random	Default mode	
7	Step	Sequentially turn LEDs on/Off. Activate with F0	
8	Flashing	Alternate equal time On/Off Flashing.	
9	TV Simulator	Simulate B&W or Color TV. 2 pins for B&W, 4 for color	
10		not used to avoid confusion with activation of Animation F10	
11	Mimic F11 (Pin 1)	Operator control only - any number of pins can be set to mimic	
12	Mimic F12 (Pin 2)	Operator control only - any number of pins can be set to mimic	



CV - CONFIGURATION VARIABLES



CV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Default Value
Bright Level %	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	30
Pin Mode Behavior	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	6
Blink Time ON	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	5
Blink Time OFF	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	10

Fade Speed	112	25
Random Delay	113	25
Step Speed	114	1
Flashing Speed	115	10
Random Ratio ON**	116	60

** this is only configurable by setting the CV.



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