Embedded Design Works, Inc.

Model Lighting Board

Take the helm of your model!

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Introduction

Thank you for purchasing the Model Lighting Board. Even though the board has been designed to work with the Polar Lights 1/350 Enterprise model kit, it can be used with other models. However, any modification to the board will be done at the ***user's/hobbyist's own risk***. The board can be controlled in one of 3 ways:

1. 16 Key keypad (supplied)
2. USB port on your computer (USB cable supplied)
3. 9 pin serial port (If your computer has one) (Cable not supplied)
   Software can be downloaded here:
   http://www.embeddeddesignworks.com/ModelLightingBoard.htm

Features

The board has the following features:

- Super bright LED's included (72 count). Can be purchased with the board or separately.
- 16 Button keypad used to control individual sections of lighting.
- 12VDC power supply.
- On power up the board goes through a lighting sequence turning on the individual sections of the ship (or any other model). (Sequence matches very closely to the movies)
- Computer control software available via download. USB or the 9 pin serial port can be used. Data is transmitted back to the computer through the USB port. Data shows which lights are on (May be available through the 9 pin serial port at a future date).
- Free Firmware upgrades available via download. (only available through the USB port)
- Custom chip programming available at additional cost. (only available through the USB port, please go to http://www.embeddeddesignworks.com/hobby.html)
- Possible Add on cards in the future.

Please read Appendix B and Appendix C to understand LED basics before continuing. Also, please reference the included schematics of the LED lighting: Model Lighting Board. These are pdf files available in the install directory.

Software Installation

You can download the free software by going to the following link:
http://www.embeddeddesignworks.com/ModelLightingBoard.htm

1. Unzip the downloaded file.
2. Double click on the setup.exe file and follow the instructions from the installer.

Driver Installation (Windows 7/Vista)

1. Make sure you downloaded and installed the free software from the previous section in this manual.
2. Connect the supplied USB cable to the USB port of your computer.
3. After connecting the cable you will get a message that the USB drive did not install correctly. This is normal.

4. Go to the start menu and select control panel as shown in Figure 1. The control panel will open.

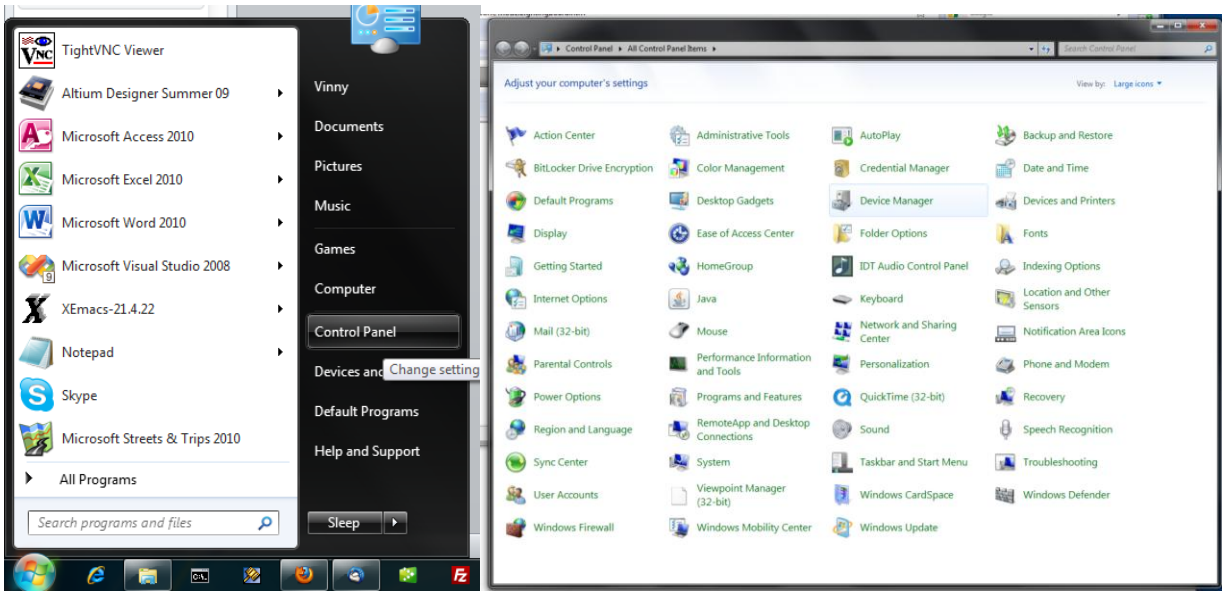


Figure 1: Control Panel

5. Select "Device Manager" from within the control. The device manager will pop up and you will see a device that has a driver problem with the name "Model Lighting Board" as seen in Figure 2. Right click on "Model Lighting Board" and select "Update Driver Software…"

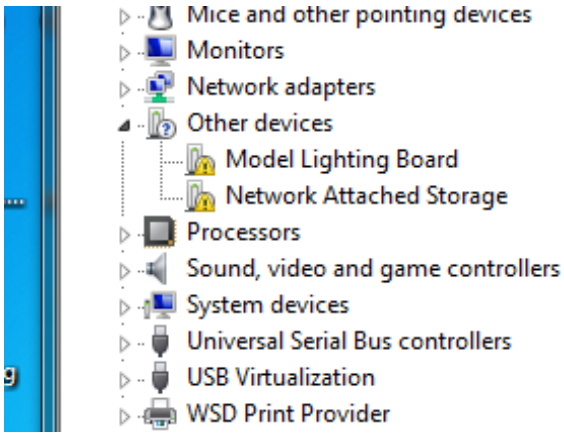


Figure 2: Device Manager - Model Lighting Board

6. A window will pop up asking how you want to search for the drive. Select “Browse my computer for the driver software” as shown in Figure 3.

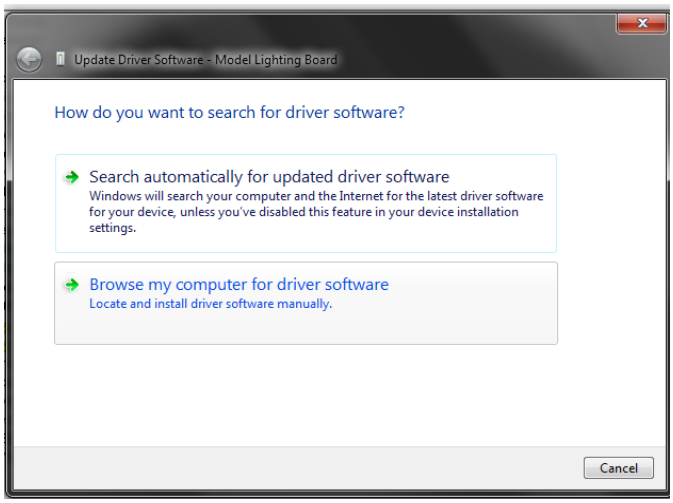


Figure 3: "Browse my computer for driver software"

7. Next, as shown in Figure 5 click on the browse button and navigate to the install directory for the USB driver that is located here:
C:\Program Files (x86)\Embedded Design Works\Model Lighting Board\USB Driver

   Then click next.

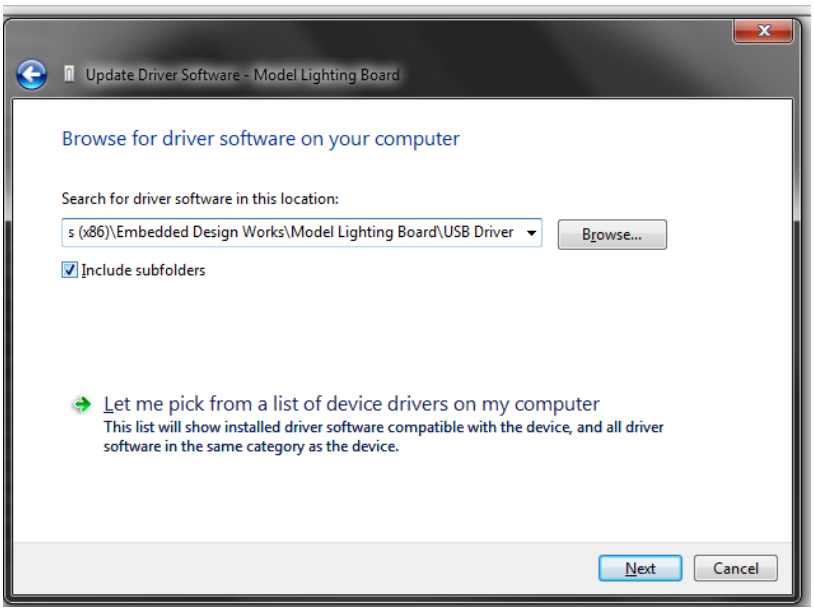


Figure 4: "Browse for driver software on your computer"

8. A warning will pop up as shown in Figure 5, please select “Install this driver software anyway”.

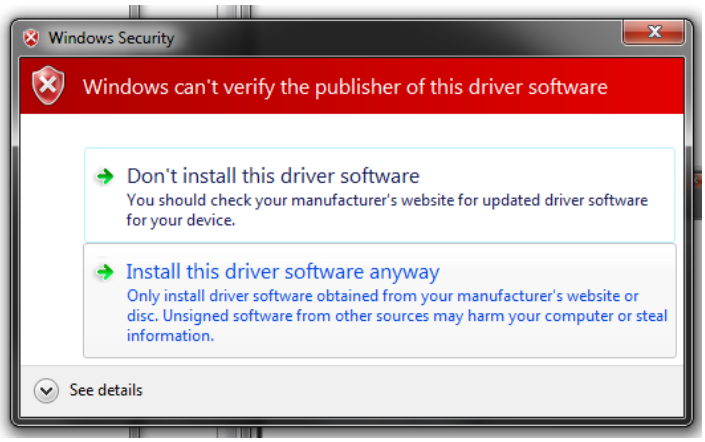


Figure 5: "Windows can't verify the publisher of this driver software"

9. The next window shown in Figure 6 will show a successful install of the driver software.

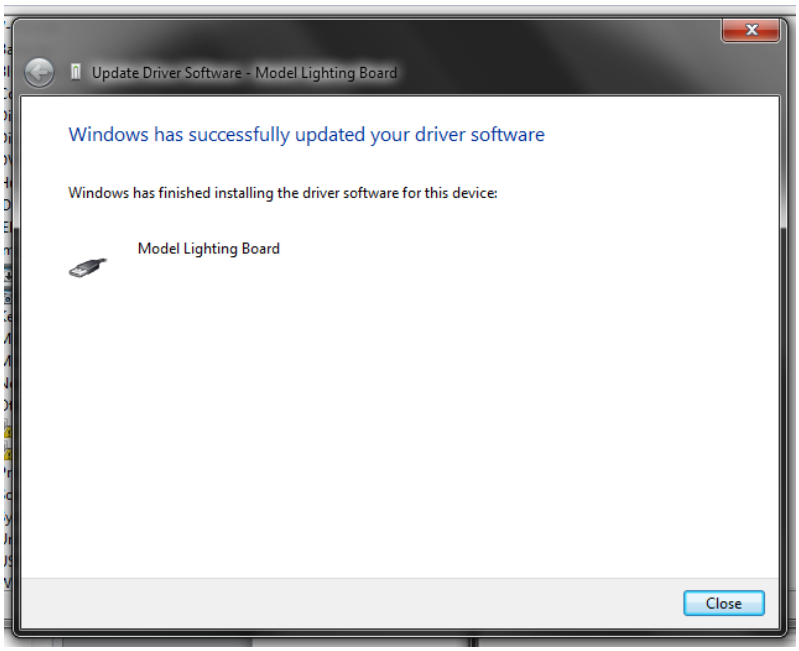


Figure 6: "Windows has successfully updated your driver software"

10. After a successufl install you wil see the “Model Lighting Board” listed under “Custom USB Devices” as shown in Figure 7.

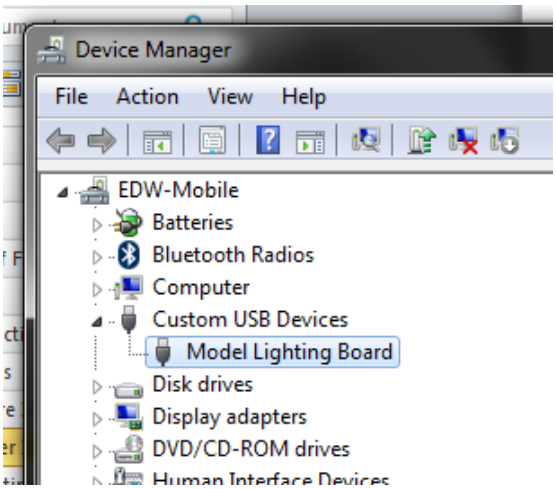


Figure 7: Custom USB Devices

11. If you choose to uninstall the driver all you have to do is right click on the device shown in Figure 7 and click “Uninstall”. Note that uninstalling the software program will not uninstall the USB driver.

Connecting LED's

The user/hobbyist must proceed at their own risk; it is highly recommended that the user/hobbyist read Appendix B: LED Basics before continuing. When soldering or wire wrapping the LED's to the board please observe the proper polarity. The positive end of the LED is called the Anode (long lead) and is connected to the square pin/pad as seen in Figure 8. The negative end of the LED called the Cathode (short lead) is connected circular pin/pad as seen in Figure 8. The board is configured to work with the supplied LED's. If you intend to use your own LED's then you must check to see which resistors need to be replaced. If you are using LED's that already have resistors in your model then you must replace the resistor(s) with a wire soldered in place of the resistor. Appendix B: LED Basics shows sample calculation on how to determine the correct value resistor.

Figure 8: LED Connection

Fan Setup

Before you power up the Model loading board, please be sure to attach the supplied fan. The fan connector can only go in one way. If the fan is not attached please do so now before plugging in the board. The connector is labeled J_FAN and is located to the right of the 9 pin serial port on the board as shown in Figure 9. Once the fan is connected have the fan blowing in the direction of two voltage regulators labeled U4 and U3 (Figure 10) and no more than 3 inches away from the regulators. This will prevent the board from overheating.

Figure 9: Fan Jumper

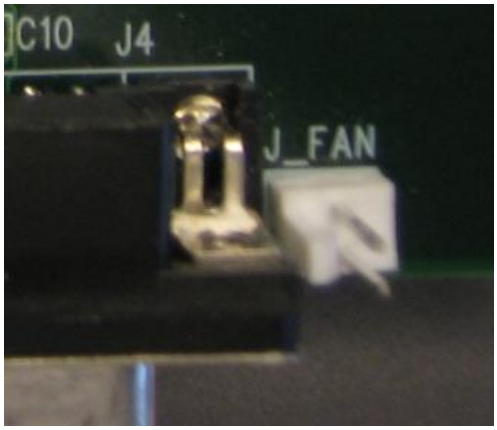
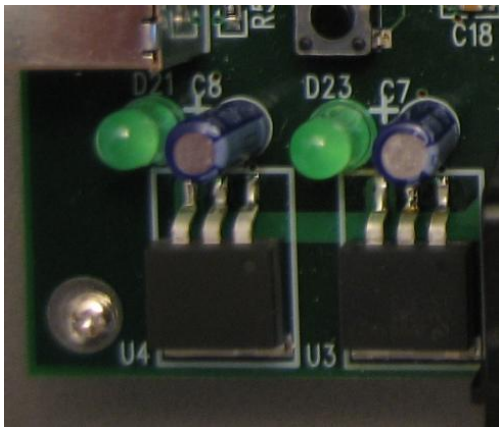


Figure 10: Voltage Regulators



Keypad Setup/Use

If the Keypad is not connected please do so at this time. Use the supplied ribbon cable and connectors and connect one end of the ribbon cable to the keypad as shown in Figure 11. Connect the other end of the ribbon cable to the board as shown in Figure 12. Please observe proper orientation as shown with the single red stripe that runs the length of the ribbon cable. If the orientation is not followed correctly you will get undesired operation.

Figure 11: Keypad Back Panel

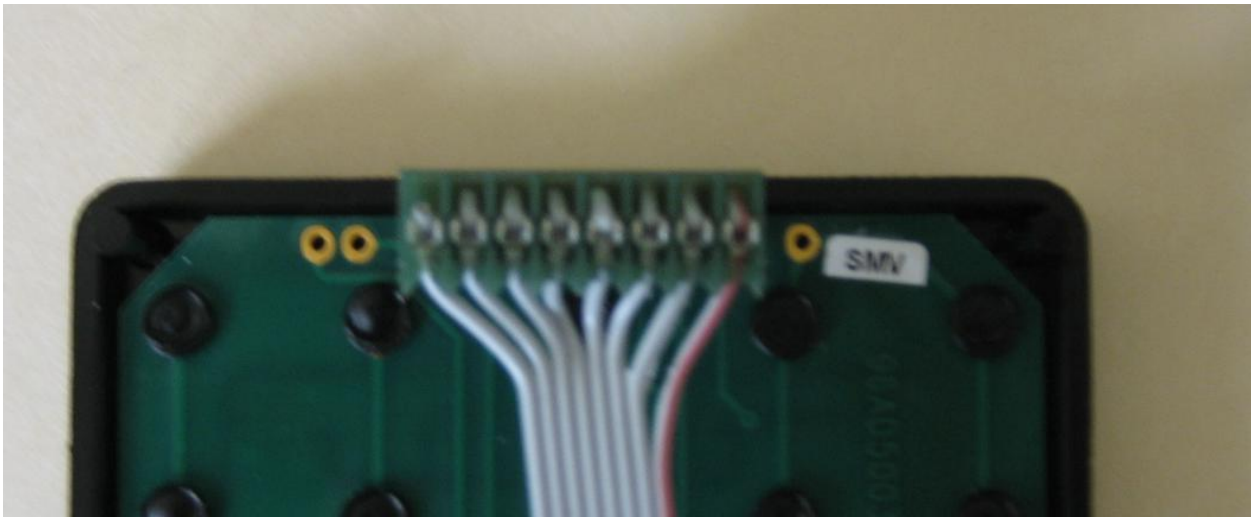
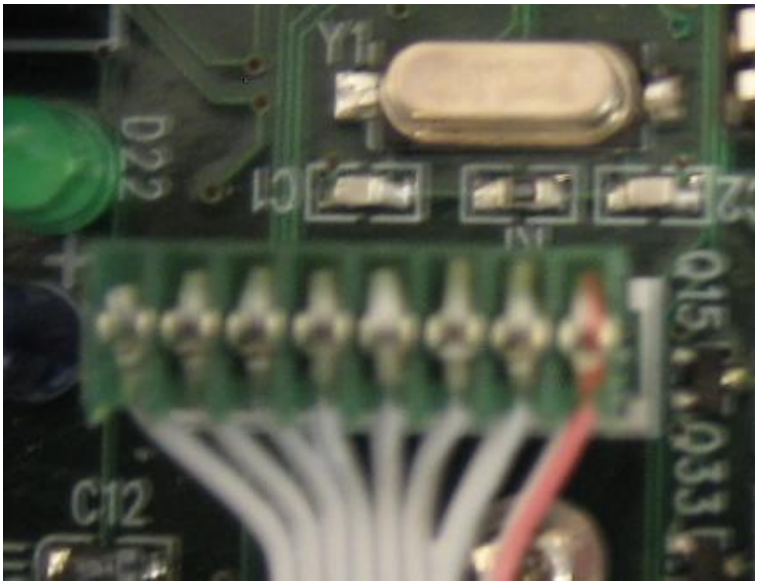


Figure 12: Keypad Connection To Board



To control the board using the keypad all you have to do is press the corresponding button according to the command table listed on Table 1 in Appendix A.

For example to toggle the Engineering lights you would simply press the number 1. You can also put in the following key sequence to toggle the engineering lights:

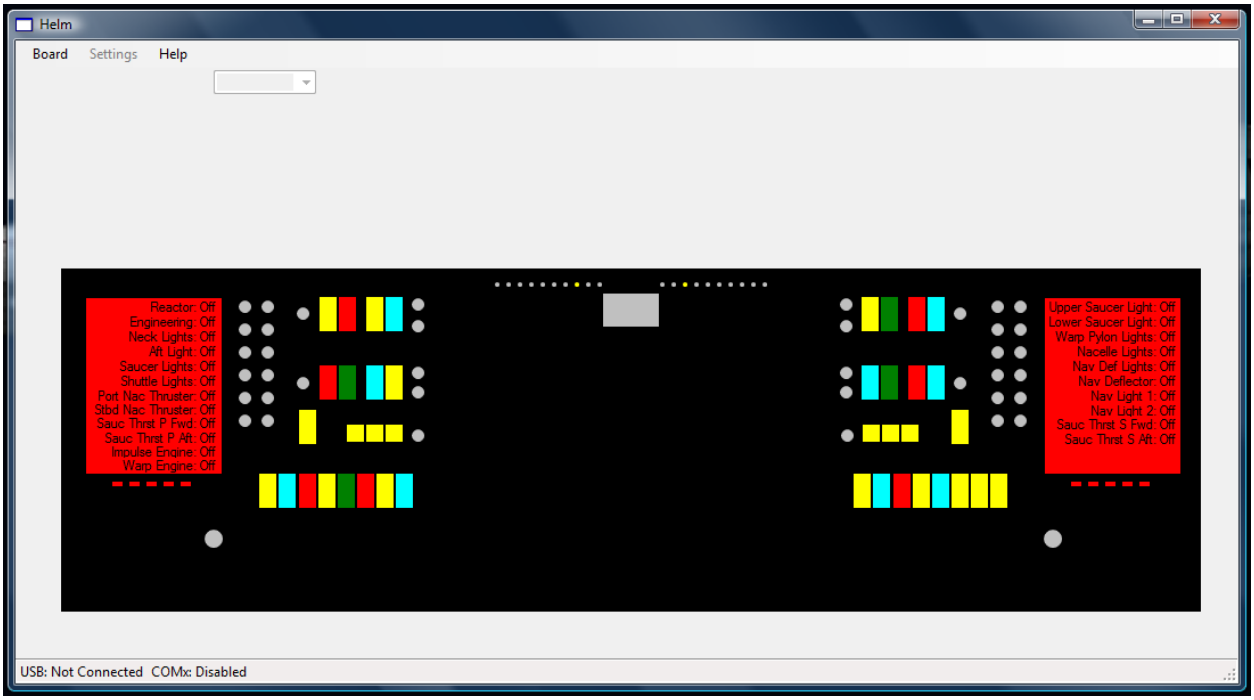
0 0 1

Note: Any time you press the "#" button you must press 3 buttons after to complete the sequence.

Computer Control

The board can be controlled by computer in 1 of 2 ways. Either through the USB port (recommended) or by the 9 pin serial port (if available). In either case the computer software control is the same. A view of the computer program can be seen in Figure 13. Through the USB control you can see real time updates of what lights are on using the software user interface. Real time updates are not available through the serial port.

Figure 13: Helm Control



From the software program you can control all lighting on the board. You can toggle the lighting of the individual sections of the ship simply be pressing the corresponding button. Hover your mouse over any one of the colored buttons and a tool tip will pop up telling you what the button controls are. If a tool tip does not pop up then that means that particular button has not been assigned to any control.

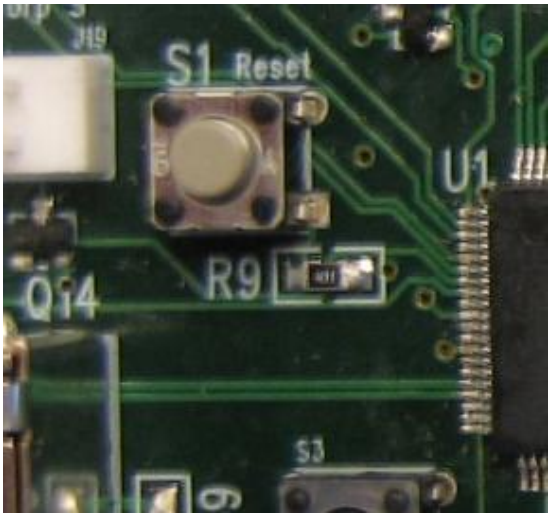
You can also reset the board from the user interface and restart the light up sequence that starts on power up.

Board->Reset Board

Board->Startup Sequence

Keep in mind that if you reset the board that you will need to wait approximately 6 seconds before the light up sequence starts. You can also reset the board by pressing the reset switch on the board labeled "S1 Reset" as shown in Figure 14. Also, you can see the board's serial number (only with USB) by selecting Help->About. Here you can also see the current software version and the boards' firmware version.

Figure 14: Reset Switch



Appendix A: Keypad Commands

Table 1 : Keypad Command Table

Command	3 Digit Input	Button
Impulse Engines	#000	Button 0
Engineering Lights	#001	Button 1
Neck Lights	#002	Button 2
Reactor	#003	Button 3
Main Saucer Lights	#004	Button 4
Warp Pylon Lights	#005	Button 5
Nacelle Main Lights	#006	Button 6
Lower Saucer Lights	#007	Button 7
Upper Saucer Lights	#008	Button 8
Red Shuttle Lights	#009	Button 9
Aft Light (Uner Shuttle Bay)	#010	
Stbd Nacelle Thrust	#011	
Port Nacelle Thrust	#012	
Nav Deflector Light	#013	
Nav Deflector	#014	Button D
Nav Lights 1	#015	
Nav Lights 2	#016	
Engineering Lights	#017	Button 1
Neck Lights	#018	Button 2
Prt Sauc Thrust Fwd	#019	
Reactor	#020	Button 3
Prt Sauc Thrust Aft	#021	
St Sauc Thrust Fwd	#022	
St Sauc Thrust Aft	#023	
Port Torpedo	#024	Button A
Turn On All Lights	#025	
Turn Off All Lights	#026	
Restart Startup Sequence	#027	
	#028	
	#029	
	#030	
	#031	
	#032	
Main Saucer Lights	#033	Button 4
Warp Pylon Lights	#034	Button 5
	#035	
Nacelle Main Lights	#036	Button 6
	#037	
	#038	
	#039	
Starbard Torpedo	#040	Button B

Appendix B: LED Basics

Figure 15 shows the schematic symbol for an LED where A is the Anode(+) and C is the Cathode(-). Figure 16 shows a typical LED, where the longer lead represents the Anode and the shorter lead represents the Cathode.

Figure 15: LED schematic symbol

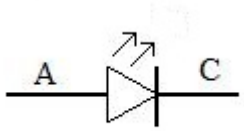
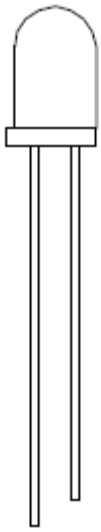


Figure 16: Typical LED



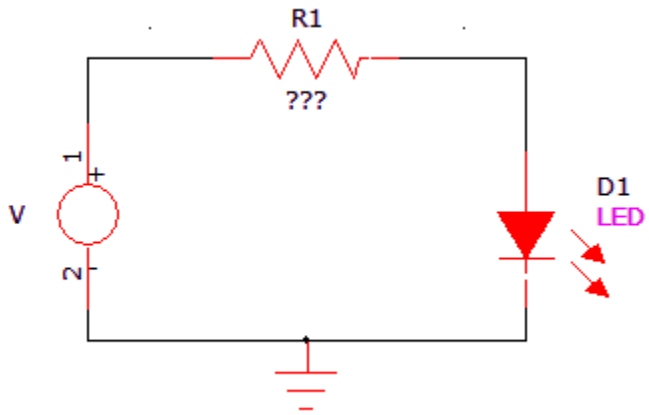
To correctly light an LED you need to know 4 things, voltage source (V), forward voltage (Vf), forward current (If) and current limiting resistor value. The voltage source is the voltage that is connected across the resistor and LED shown in Figure 17, Vf is the turn on voltage for the LED and If is the turn on current for the LED, and R1 is the calculated resistance to limit the current going through the LED. If the resistance is too low then the LED could burn out from excess current, if the resistor is too high the LED may not light. For example if we have a voltage source of 5V, Vf=3.4V, and If=.02A, then we would calculate R1 as shown in Equation 1. The result is an 80 Ohm resistor, however a value of 80Ohms does not exist, therefore we need to go up to the next standard value resistor which is 82Ohms.

Please note that my explanation is very basic, if you wish to learn more please go to your local bookstore and pick up a book on basic electronics.

Equation 1: Single LED equation

$$R1 = \frac{V - Vf}{If} = \frac{5 - 3.4}{.02} = \frac{1.6}{.02} = 80Ohms$$

Figure 17: Single LED circuit



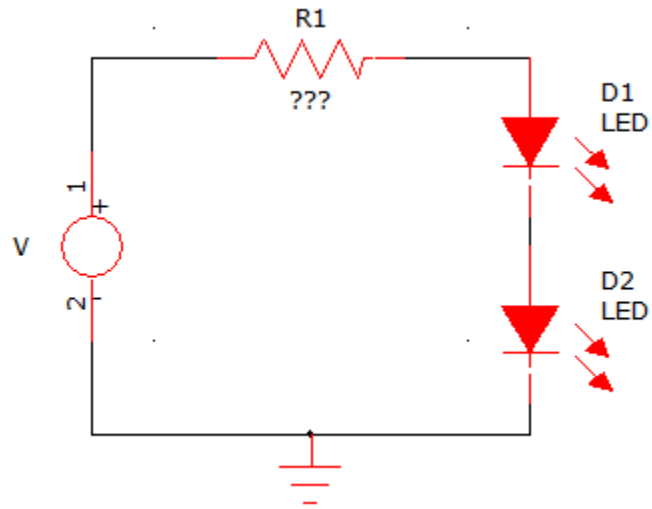
Equation 2: Two LED's

When you have two or more LED's connected in series as shown in Figure 18 then you must add up the Vf's of each LED and increase your voltage source because 3.4V+3.4V= 6.8V and exceeds the previous voltage source of 5V. The Model Lighting Board has both 5V and 12V voltage sources to power the supplied LED's.

Equation 3: Two LED equation

$$R1 = \frac{V - Vf}{If} = \frac{12 - (3.4 + 3.4)}{.02} = \frac{5.2}{.02} = 260Ohms \rightarrow 270Ohms$$

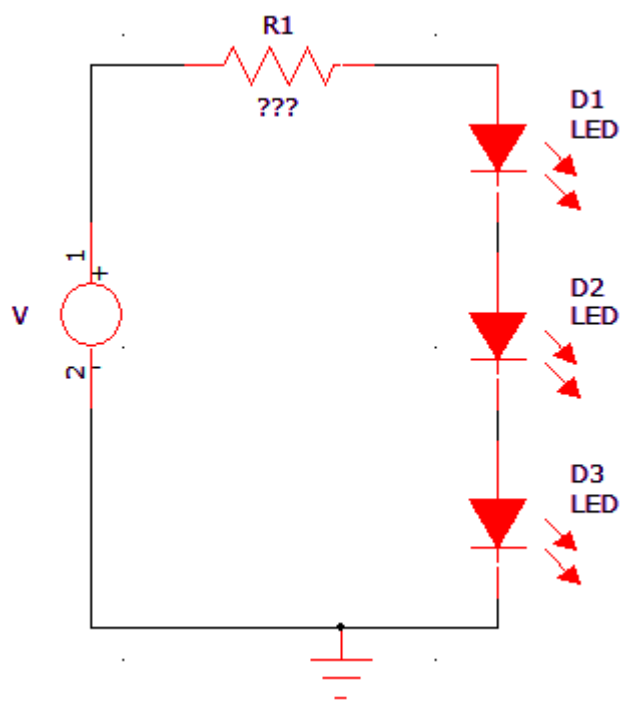
Figure 18: Two LED circuit



Equation 4: Three LED equation

$$R1 = \frac{V - Vf}{If} = \frac{12 - (3.4 + 3.4 + 3.4)}{.02} = \frac{1.8}{.02} = 90Ohms \rightarrow 91Ohms$$

Figure 19: Three LED circuit

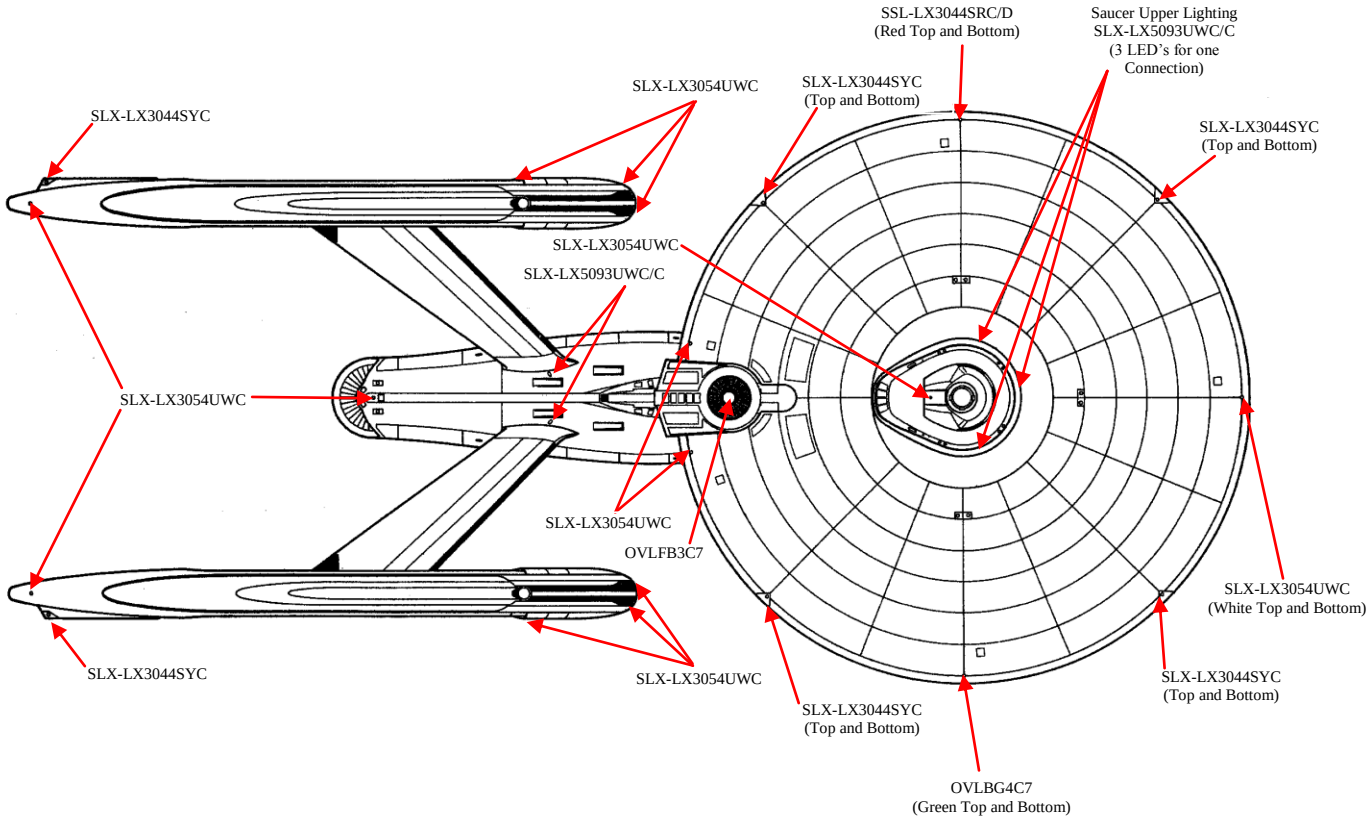


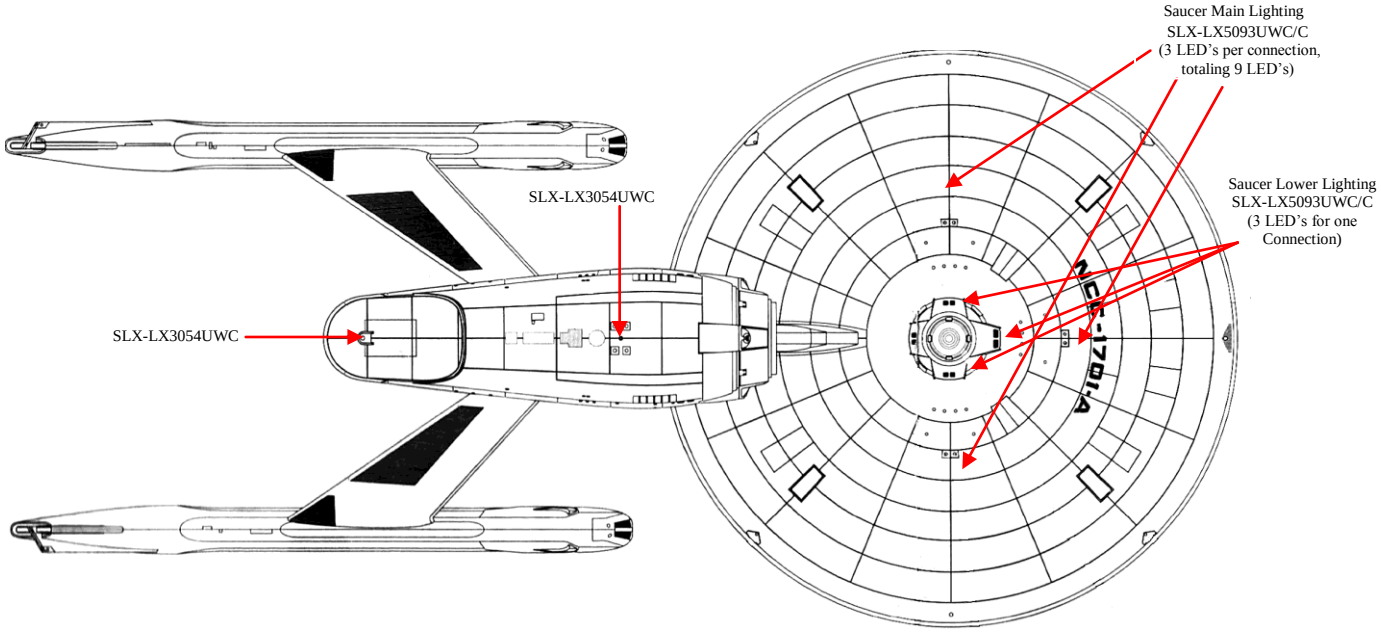
Appendix C: LED Placement

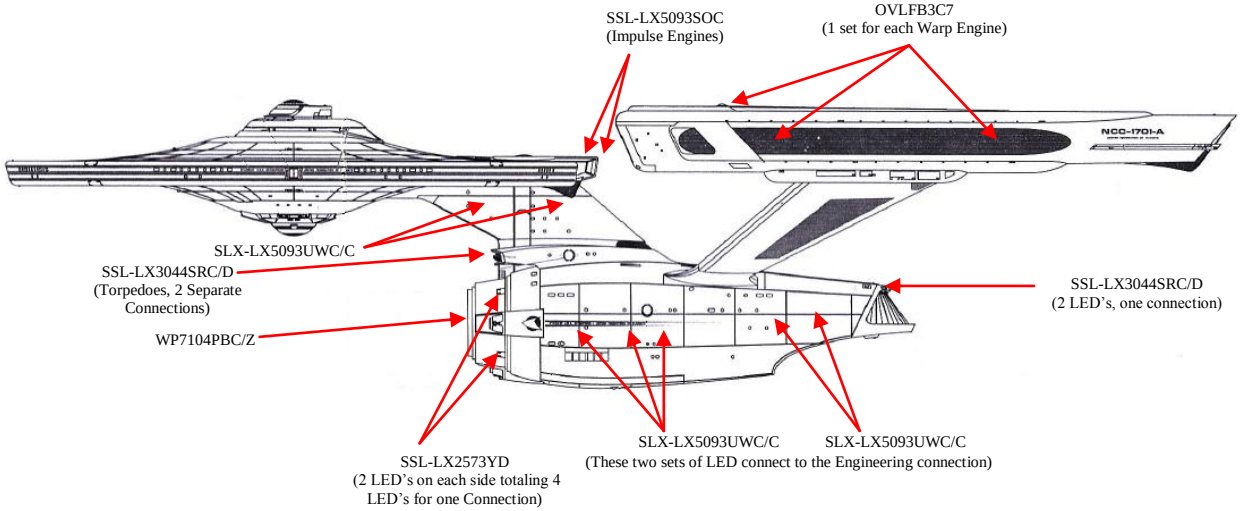
This is an example place of LED's. Please feel free to place LED's wherever you think is the best place for your mode.

Table 2: LED's Used

Part Numer	Color	Vf	If
SSL-LX3044SRC/D	Red	1.8V	.02A
OVLBG4C7	Green	3.4V	.018A
SLX-LX3054UWC	White	3.5V	.02A
WP7104PBC/Z	Blue	3.2V	.024A
SSL-LX2573YD	Yellow	2.1V	.024A
SLX-LX5093UWC/C	White	3.4V	.02A
OVLFB3C7	Blue	3.4V	.018A
SSL-LX3044SYC	Yellow	2.1V	.02A
SSL-LX5093SOC	Orange	2V	.025A




Saucer Main Lighting
SLX-LX5093UWC/C
(3 LED's per connection,
totaling 9 LED's)
SLX-LX3054UWC
Saucer Lower Lighting
SLX-LX5093UWC/C
(3 LED's for one
Connection)
SLX-LX3054UWC
NCC-1701-A


SSL-LX5093SOC
(Impulse Engines)
OVLFB3C7
(1 set for each Warp Engine)
NCC-1701-A
SLX-LX5093UWC/C
SSL-LX3044SRC/D
(Torpedoes, 2 Separate
Connections)
WP7104PBC/Z
SSL-LX3044SRC/D
(2 LED's, one connection)
SSL-LX2573YD
(2 LED's on each side totaling 4
LED's for one Connection)
SLX-LX5093UWC/C
(These two sets of LED connect to the Engineering connection)
SLX-LX5093UWC/C