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How Illuminated Switches Work



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NKK
SWITCHES

Introduction

Purpose:

- This product presentation training will help you understand the various aspects of selecting and using NKK's illuminated switches.

Objective:

- Introduce the various types of illumination
- Describe how isolated lamp terminals offer more flexibility
- Explain how resistors are used with illuminated switches
- Present the various types of illuminated actuations
- NKK Switches illuminated product offering & value added capabilities
- Summary




Note: Please check the presentation speaker notes for additional slide information.

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Illumination Options

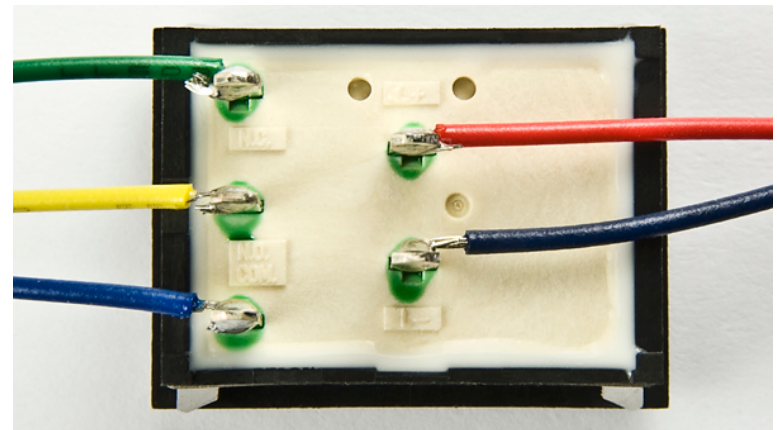
Illumination Type	Benefits	Disadvantages
 LCD	<ul style="list-style-type: none"> • Long Life • Low Current & DC Voltage Levels • Not easily damaged by shock • Variety of colors • Bright & Super Bright options • Bicolor & RGB available in some lines 	<ul style="list-style-type: none"> • High initial costs • Ballast resistor required
 Incandescent	<ul style="list-style-type: none"> • Lower initial costs • Brightness 	<ul style="list-style-type: none"> • Short life • Sensitive to shock & vibration • High heat dissipation
 Neon	<ul style="list-style-type: none"> • Not long life • Not easily damaged by shock or vibration 	<ul style="list-style-type: none"> • Low intensity • Resistor required

Isolated Circuits from an External Source

In this picture, the lamp terminals are wired to an external source.

The red and dark blue wires are soldered to the external source that will send the current to illuminate the lamp.

Note: The source current will depend upon the lamp specifications.



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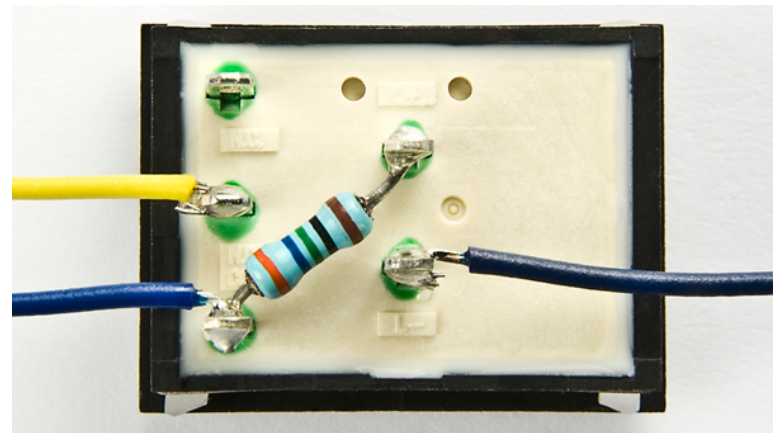


Isolated Circuit Wired In-Line with Switch Actuation

In this picture, a resistor is wired to the positive lamp terminal from the “Normally Open” switch terminal.

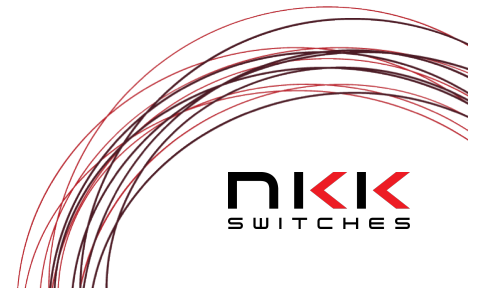
Here a resistor is required to properly power the lamp.

When the switch is actuated from the “Normally Closed” terminal to the “Normally Open” terminal, the lamp will illuminate.



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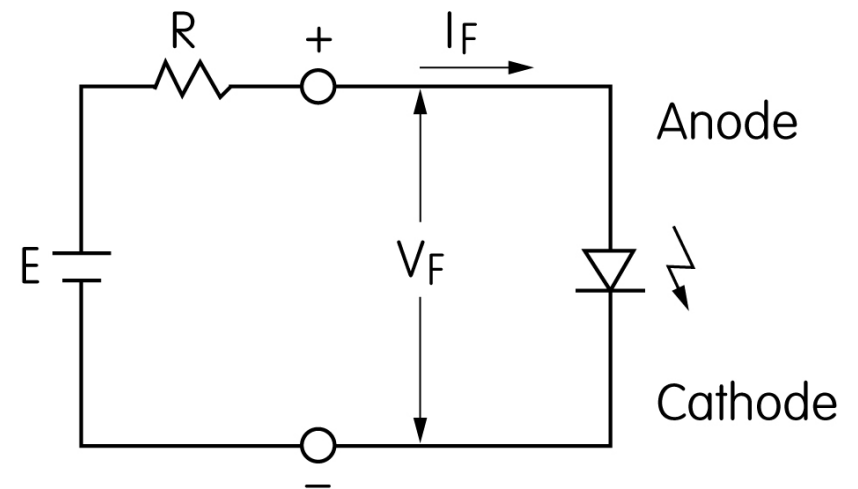


LED Circuit

The LED illumination is created using properties of a diode (Anode “+” and Cathode “-”).

The LED illuminates once the Forward Voltage (V_F) and Current (I_F) is achieved.

The ballast resistor (R) creates the proper voltage and current through the circuit.



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Ballast Resistor Calculation

Example:

- Source Voltage = 5.0V
- Forward Voltage = 1.9V (set by LED)
- Forward Current = 20mA (set by LED)
- The resultant ballast resistor = 155Ω

The power rating of this ballast resistor must also be considered:

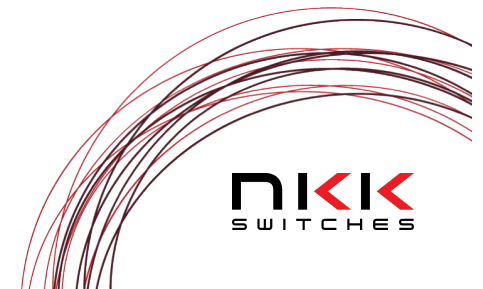
- With a forward current of 20mA and the voltage across the ballast resistor (5.0V – 1.9V) = 3.1V
- Power across is then calculated: 3.1V x 20mA = 0.062W
- For safety purposes, a typical power rating of 2x the calculated value is selected
- Power Rating Result = 0.125W (1/4W resistor)

$$R = \frac{E - V_F}{I_F}$$

Where: R = Resistor Value (Ohms)
E = Source Voltage (V)
V_F = Forward Voltage (V)
I_F = Forward Current (A)

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Ballast Resistor Calculation for LED

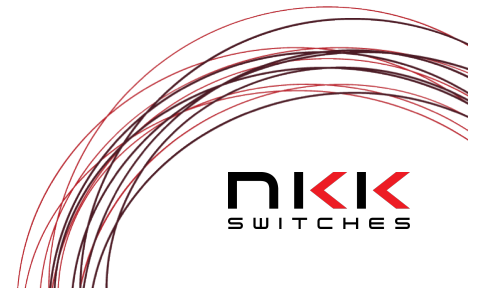
Forward voltages of the LED are different for each LED and color.

To properly maintain the light emitting from the LED, the operating temperature in which the lamp will be functioning must be considered when calculating resistor values

AT635 LED Specifications				
Colors		Red	Amber	Green
Forward Peak Current	I_{FM}	30mA	30mA	30mA
Continuous Forward Current	I_F	20mA	20mA	20mA
Forward Voltage	V_F	1.9V	2.0V	2.1V
Reverse Peak Voltage	V_{RM}	5V	5V	5V
Current Reduction Rate Above 25°C	ΔI_F	0.42mA/°C		
Ambient Temperature Range		-25° ~ +50°C		

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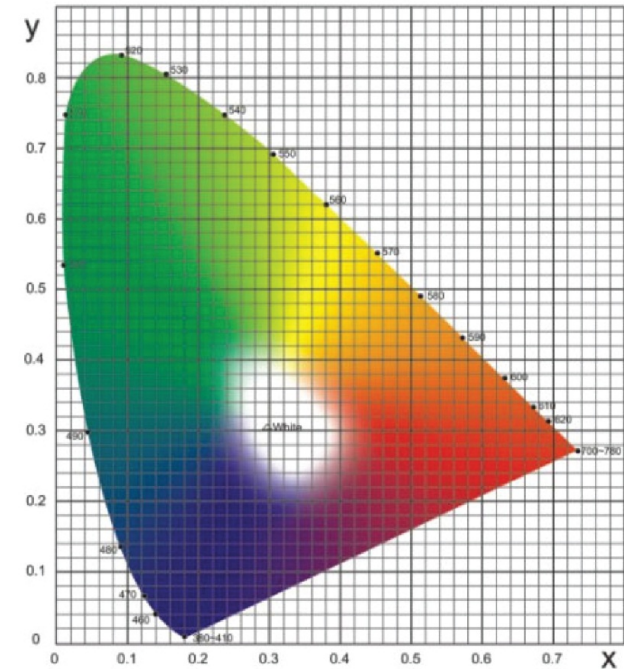
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LED Colors & Chromaticity

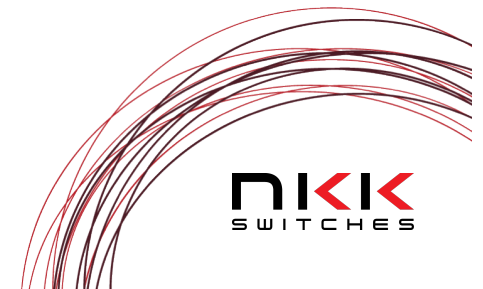
LED Illuminated switches are available in:

- Single Color: Red, Green, Amber, Blue, White (see “White” note below)
- Bicolor: Red/Green (produces Amber when both are illuminated)
- RGB: Red/Green/Blue; theoretically, all colors can be created by combining these, except for Black
- White: Blue LED with Yellow fluorescent (analog White)
 - Generated by RGB (digital White)



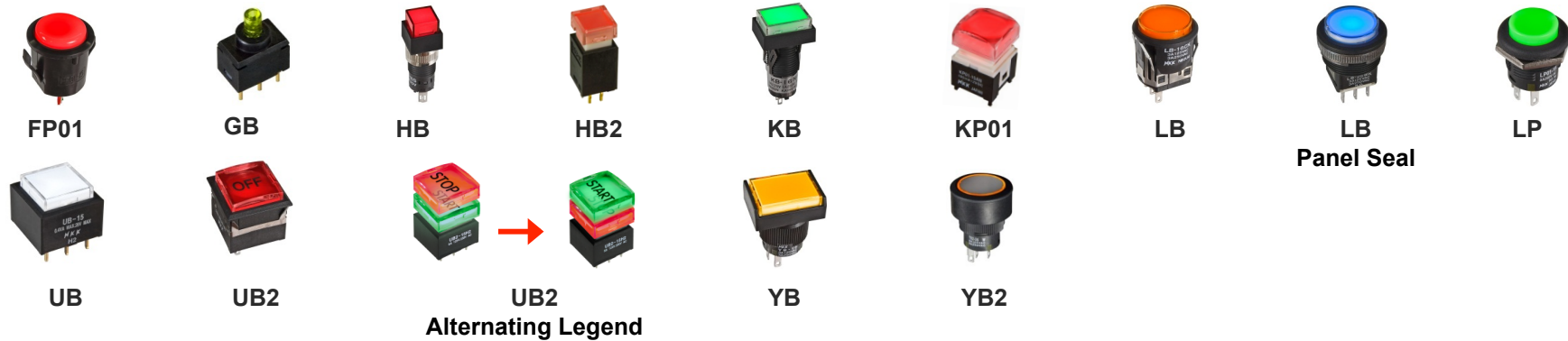
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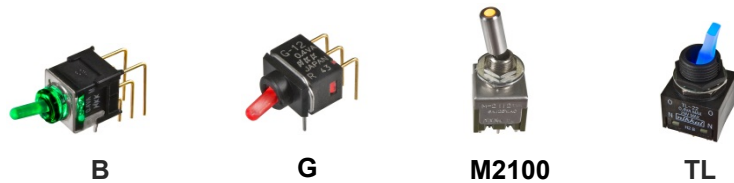


NKK's Illuminated Product Offering by Series

Pushbuttons:



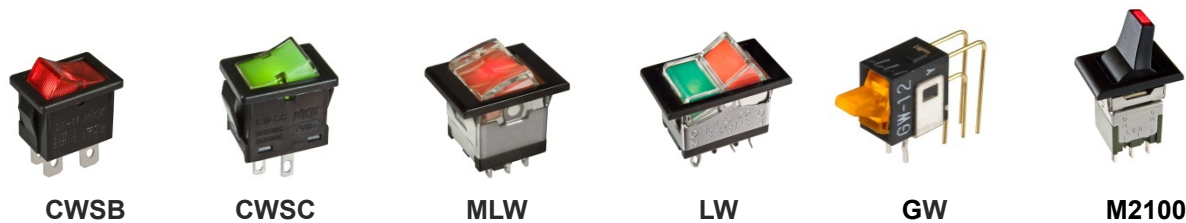
Toggles:



Tactiles:



Rockers & Paddles:



Custom Switch & Value Added Capabilities

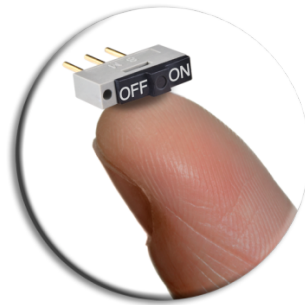
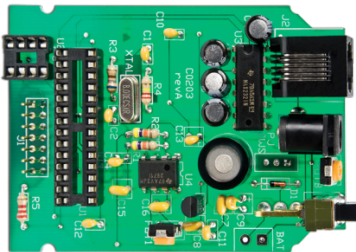
Methods for All Applications

Custom Switch Solutions:

NKK Switches has the flexibility, expertise and skills to help Engineers design custom switch solutions for today's most innovation applications.

Custom Printing:

- Laser Etching
- Screen Printing
- Pad Printing



Custom Assembly:

- Cables & Harnesses
- Electronic
- Electro-Mechanical
- Mechanical



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Thank you!

Have questions? Contact NKK Switches at
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