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LED Testing Problems

LED Testing Problems

1. Problem: LED circuits fail during final testing with a membrane switch tester.

LED testing should ideally be performed with a constant current source, typically at 20 milliamps. Final test units for membrane switches frequently use either constant power sources or constant current sources that are limited to well below 20 milliamps. So, as the resistance of the circuit being tested increases, the current decreases or the current is limited to a very low level by the tester. As the current decreases, the measured voltage will decrease, which can cause a false failure if the voltage falls below the allowable minimum voltage set by the user.

Additionally, as LEDs, are non-ohmic devices, their internal resistance changes with current. At low voltage/low current levels, the internal resistance of an LED can be very high, resulting in a false failure shown as an open circuit.

These types of testers are valuable devices that can identify incorrectly placed LEDs, open circuits, and shorts, but they should not be used to evaluate an LED to determine if it is with the specified voltage limits at a specific current level. They can also give false failures as a result of the issues identified above depending on the overall switch design. All failures should be evaluated to determine the root cause and insure that is not a false failure for the above reasons.

2. Problem: Some or all of the Blue LEDs fail while other LEDs on the circuit all work properly.

This is likely due, once again to the tester and the reasons shown above in Problem number 1. The Blue LEDs require a higher voltage to illuminate properly, because they have a higher internal resistance. For this reason, the problems described above are more likely to occur and depending on the overall circuit resistance of each trace may only be exhibited on the higher voltage LEDs.

3. Problem: Some LEDs initially do not illuminate during test, but when they are re-tested on the same set-up after attempting to troubleshoot the problem they work fine.

The final test device is testing the LED at very low current levels. LEDs, non-ohmic devices, initially have very high and inconsistent resistances at low current levels, so some of the LEDs may be seen as open circuits, while some may pass.

When a separate power source, or even a good multi-meter is used to illuminate the LED during troubleshooting, the LED can be 'burned in'. This generally reduces the resistance of the LED and makes the resistance from LED to LED more consistent at the low current levels used by the final tester for testing, so the LED illuminates and passes when re-tested.

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4. Problem: Some LEDs have a higher resistance then others. No other differences are identified.

LEDs are non-ohmic devices, which means that their resistance changes with current. At very low current levels, an LEDs can have a very high and inconsistent resistances. Most multi-meters on a standard setting take their measurements of resistance at very low current levels to conserve battery power and because for an ohmic device, such as a resistor, it does not matter what current is used to measure the resistance.

Many multi-meters also have a setting for measuring resistance at higher current levels. If this setting is used, the resistance readings will be more consistent from LED to LED. However, due to the nature of an LED, resistance is a relatively meaningless measurement and should not be used to learn anything about the LED or to accept or reject an LED. LEDs should be measured with a constant current source to determine if they meet their specifications when required.

5. Problem: LEDs have a different Brightness in different parts of the switch

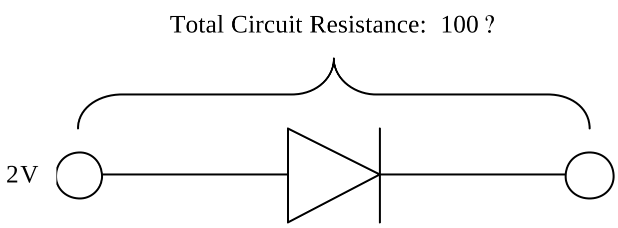
LEDs are sorted by the manufacturer by brightness to insure that LEDs from the same Lot code AND Bin Code will have very similar brightness levels when powered with the same current level. (Different batches of LEDs should not be combined on the same switch.)

However, most applications utilize a constant voltage or contacts power source, so when the circuit resistance differs from one LED to another there will be a different current level thru each trace, resulting in different brightness levels. Additionally, each LED may have a different internal resistance as well, which causes the same problem. For this reason, every application should include trimming resistors to minimize the differences in current levels and therefore brightness levels within a switch. The resistance value of the trimming resistors is specific to each application and is dependent on the source voltage, the circuit resistance, and the voltage required by the LED. Different colors may require different resistor values. These resistors can be embedded on the membrane switch with the LEDs or applied to the controller board.

Below is an example of the effect of a trimming resistors;

Design One. No Trimming Resistor – 2V applied direct to all LEDs

Circuit 1 – Short Trace



Result – 20 milliamps of current

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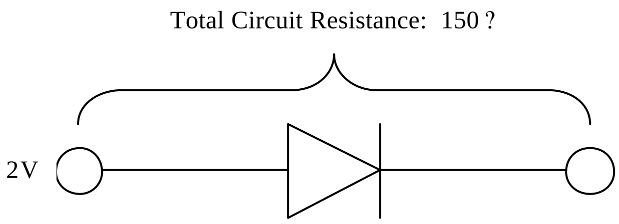
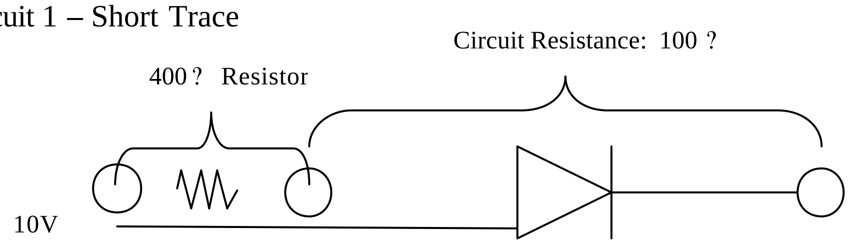
Circuit 2 – Long Trace



Result – 13 milliamps of current

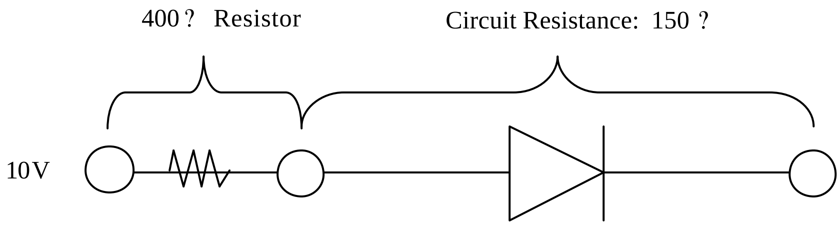
Design Two: With Trimming Resistor – 10V applied to circuit, Resistors are sized to apply a nominal 2V to LED.

Circuit 1 – Short Trace



Result – 20 milliamps of current

Circuit 2 – Long Trace



Result – 18 milliamps of current

6. Problem: When I test the LEDs, I hear a snap, crackle or pop and may even see smoke coming from the LED. The LED may even change color or stop working.

This indicates that you are probably applying too much voltage and have exceeded the maximum allowable voltage of the LED. Never use an unregulated power supply to apply voltage to an LED or a circuit that contains an LED as you may damage the LED.