From the Help Desk – June 2026

Note – this is part of an ongoing series of related articles that will each take a look at some facet of radio selection, installation, or operation as suggested by actual questions received from Club members or other amateur operators.

Q: How can the two leads of a typical through-hole LED be identified as to which is the anode and which is the cathode, and why does it matter?

A: Let's start by answering the last question first, and then move on to the more difficult one. All LED's are polarized devices. At its heart, an LED is, after all, just another diode, and as such it must be connected into the circuit with the correct polarity in order for it to do what we want it to do… which is usually to produce a light output.

In order to produce its light output, an LED must be biased in the forward direction, which means that its anode must be at a voltage that is sufficiently more positive than its cathode to meet that LED's forward bias requirements. Notice that I did not say that one terminal must be positive and the other negative. That is because they can, in reality, both be either positive or negative, *so long as the difference in voltage between the two terminals is great enough to satisfy the forward voltage bias requirement for operation of that LED.* For example, if the forward voltage of a given LED is 2.1VDC, that LED will illuminate just as well with the anode at +5.6VDC and the cathode at +3.5VDC as it will with the anode at +1.5VDC while the cathode is at -0.6VDC, or with the anode held at -1.0VDC while the cathode is at -3.1VDC. It is the *voltage difference* that is important here, *not* the actual voltages.

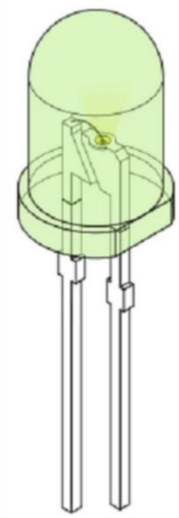

Figure 1 - LED cutaway

So… if it is the difference in voltage that matters, and if it is the polarity of that voltage that matters, then it is equally important that we know which lead, or in other words which terminal, is which. That brings us to the first question, which deals with how to identify which terminal is which. There are three common methods of identifying the terminal assignments, two of which *may* be inconclusive, leaving one method that *should* work every time… but which may also be the most difficult to discern.

Refer to the LED cutaway view shown in Figure 1. Look carefully and it will become apparent that one of the two structures inside the LED is somewhat larger than is the other. The manner in which many LED's are assembled has the semiconductor die mounted to a supporting structure to which the body of the N-type material is attached. A wire "whisker" is then bridged from the P-type material, which is deposited on top of the N-type body, over to the smaller internal structure. These internal structures are integral to the LED terminal leads. Thus, when viewed through the body or envelope of the LED, the lead which is common to the larger internal structure will be the negative or *cathode* lead. This leaves the lead that is common to the smaller internal structure as the positive or *anode* lead. This method of terminal lead identification is always reliable… when a) the envelope of the LED is transparent or is at least translucent enough to permit the internal structure to be seen, and b) when there is a difference in size between the internal structures, which is not always the case. That brings us to method number two.

In this method, we attempt to determine the terminal lead identity by the length of the individual leads. More often than not, the *anode* is the longer of the two leads, while the *cathode* is the shorter lead. As I said, however, this is *usually,* but by no means *always* a reliable method of identification. In order to know for sure, it would be necessary to either combine this method with another one of the three methods, or to have a datasheet available for the LED at hand. The problem is that LED's are available with so-called *"long cathodes".* In some cases, that is the standard lead scheme used by a given manufacturer. In other situations, the "long cathode" is an optional or even a by-request configuration. Occasionally, LED's will be encountered with both terminal leads having the same length. So much for method two; now it is time to move on to method three.

This method is, to the best of my knowledge and experience, universal and is therefore always reliable. However, it is also often very difficult to see and identify, especially in smaller LED's like the ø3mm or T1 size devices. The key to using this method is to identify the flatted side of the LED envelope. Refer again to the Figure 1 drawing, and this time notice the flat on one side of the base of the LED envelope. This flat will always be positioned in alignment with the cathode terminal lead of the LED. When a given LED has a flanged lower edge, the flat can be more easily identified than what is possible when the LED has no flange. A magnifying glass can help, as can running a fingernail around the base of the LED envelope to feel the "points" where the shape of the LED changes from round to flatted and back again. The good part is that when the flat can be found, it is absolutely diagnostic and reliable.

I hope that this explanation helps to improve your understanding of LED terminal lead identification. Hopefully, it will also broaden your overall knowledge of the design and structure of discrete LED's. Taken in its entirety, this information should help to make your electronics project and kit assembly tasks just a bit easier.