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## SPRING-LOADED SELF-ALIGNING LIGHTPIPE

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## SPRING-LOADED SELF-ALIGNING LIGHTPIPE

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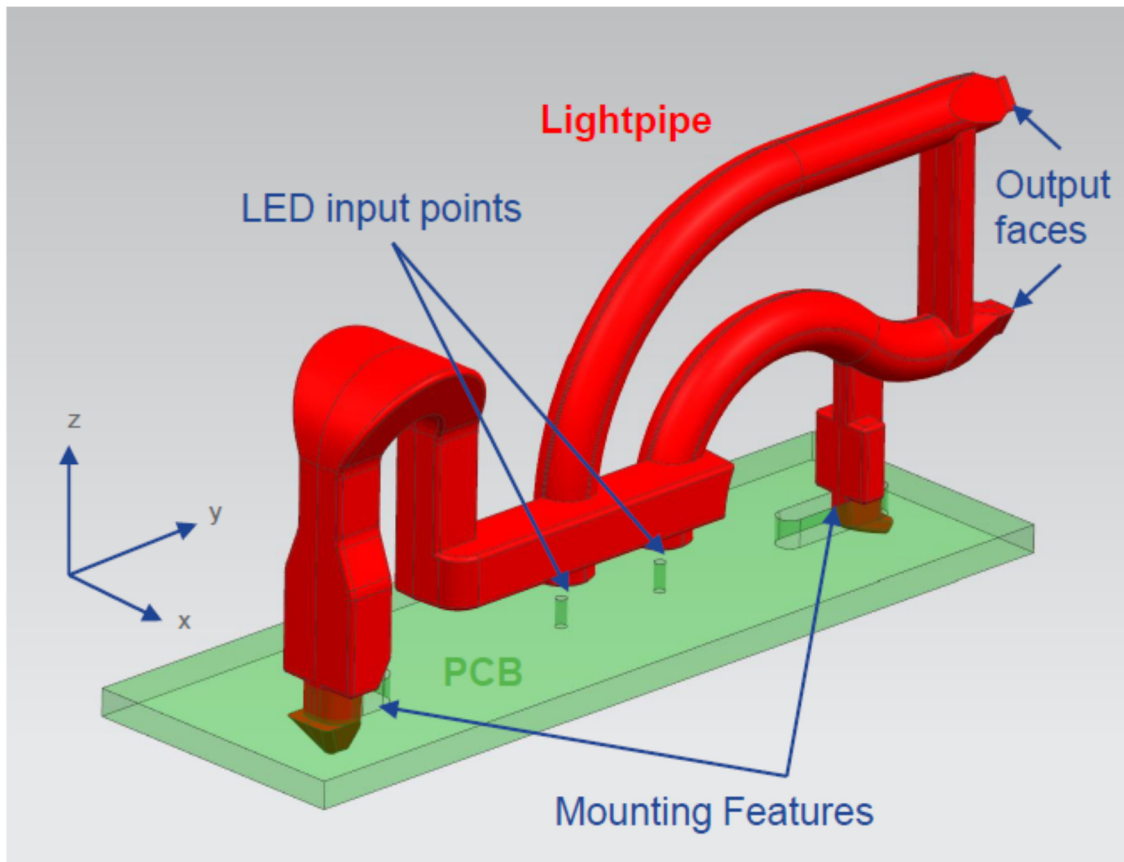
### ABSTRACT

Presented herein is a low-cost, assembly-order-versatile, self-aligned lightpipe that is designed for constrained environments.

### DETAILED DESCRIPTION

Light Emitting Diodes (LEDs) are often used as indicators for different functions throughout different systems. Due to the volume and footprint of PCBs, it is often impractical to mount LEDs to the external casing of the system, where the user is able to more clearly see whether or not the LED is lit. As such, lightpipes are used to redirect light from an internal LED to the outside of the unit and the input for the pipe must be very accurately controlled to ensure the reception of light from the LED into the lightpipe. However, output is typically inaccurate, given standard tolerances and inability to control the location of output faces. The mounting of the lightpipe is yet another constraint to, not only the overall board real estate, but also from a “design for assembly” perspective. Most lightpipes are either screw mounted, press fitted onto the PCB, snap fitted, or heat staked to the bezel.

Presented herein is a new lightpipe design, referred to herein as a spring-loaded self-aligning lightpipe. The spring-loaded self-aligning lightpipe is enhanced with several unique features which make the lightpipe: (1) tool-less, (2) self-aligning, (3) self-locking, and (4) forward pressing to ensure that the lightpipe is constantly biased to the front end of plastic bezel. Figure 1, below, is a perspective view of a spring-loaded self-aligning lightpipe in accordance with embodiments presented herein.

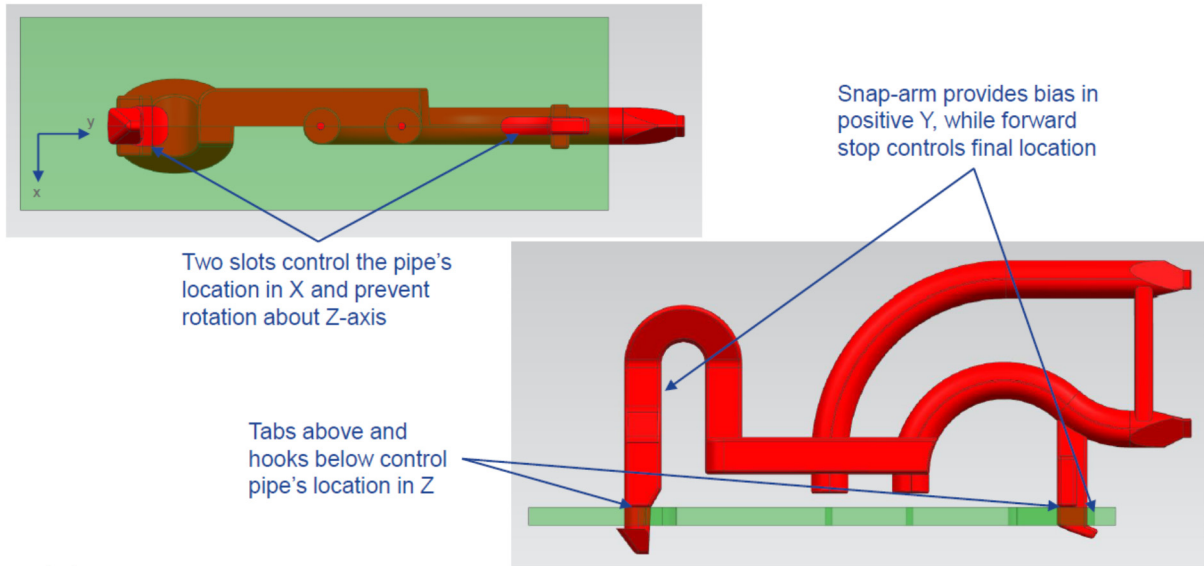


**Figure 1**

As shown in Figure 1, the spring-loaded self-aligning lightpipe has strong control in all directions, including:

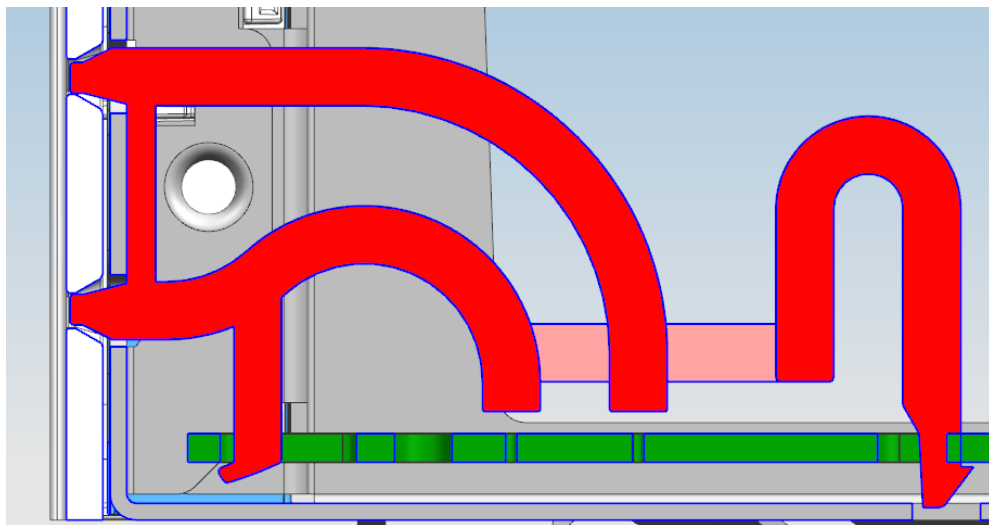
- X direction: Thin slots on PCB
- Y direction: Spring arm at the back of pipe biases pipe forward
- Z direction: Top faces of snap, bottom faces of supports

In addition, the spring-loaded self-aligning lightpipe has forward bias and funneled lead-in controls location of output. Figure 2, illustrates two additional views of the spring-loaded self-aligning lightpipe of Figure 1.

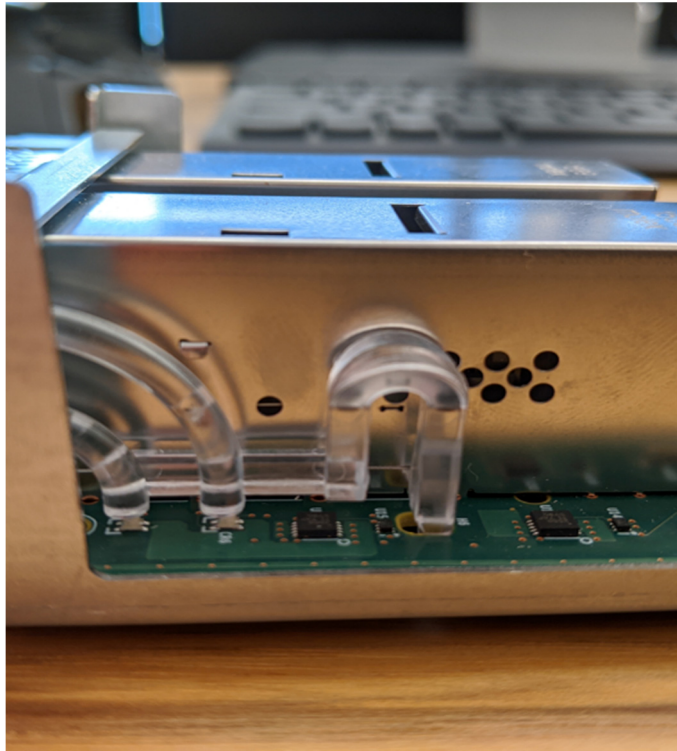


**Figure 2**

The spring-loaded self-aligning lightpipe has tight control present in all directions. For example, a snap-arm provides bias in positive Y direction, while forward stop controls the final location. For example, as shown in Figures 3 and 4, below, the plastic spring on the back of the lightpipe pushes it forward until it locates against the sheetmetal / bezel, thereby ensuring that the end of the pipe is located tightly with regards to the output. This solves the challenge of Y-positioning the lightpipe that may potentially cause cosmetic/viewing defects due to a recessed lightpipe (reduce viewing angle) from the tolerance stack up of multiple components.

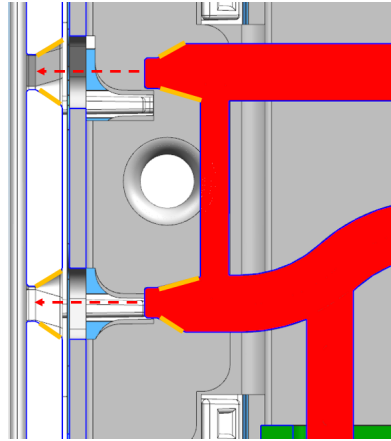


**Figure 3**



**Figure 4**

The two slots control the pipe's location in the X direction and prevent rotation about the Z-axis. The tabs (above) and hooks (below) the mounting surface control the lightpipe's location in the Z direction. As shown in Figures 5 and 6, below, the key way slot on the PCB and the lightpipe feature dictates coarse X-Z planar position, while forward bias fixes the Y location. As shown in Figure 7, below, this allows the lightpipe to be installed onto the PCB first and then assembled into the main assembly or, alternatively, the PCBA can be installed on the tray with faceplate, and then the lightpipe is installed last (without the need of bezel removal). Upon contact with outside faces, the lightpipe loses contact with the PCB and is datumed against the outside wall.

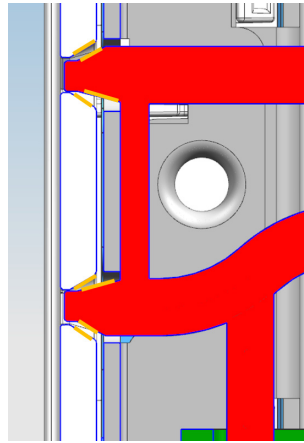


-Orange surfaces provide precise lead-in for +y motion

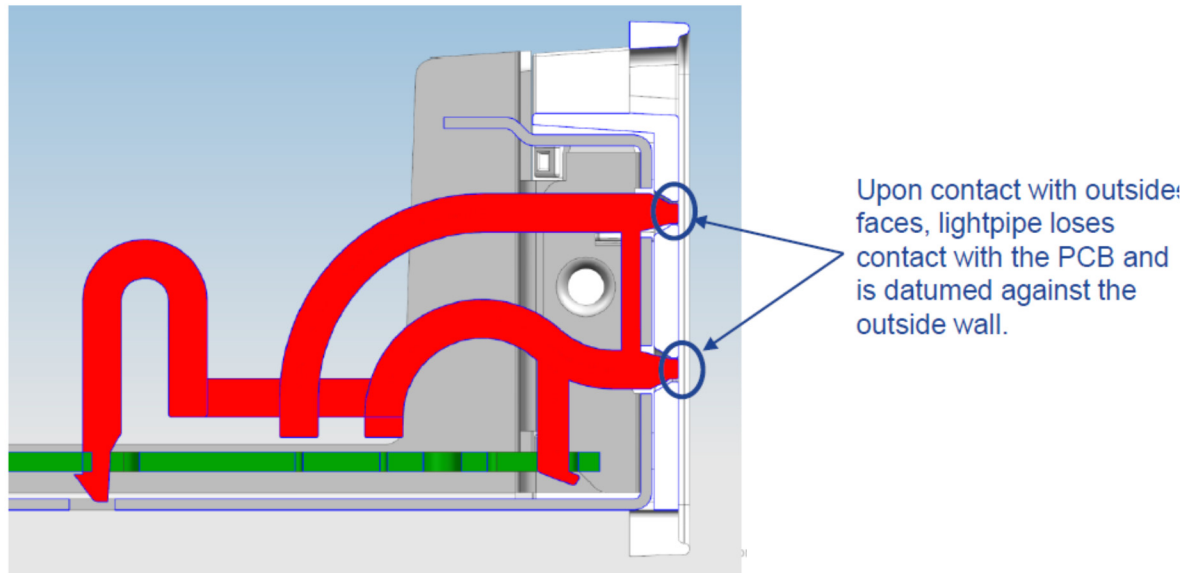
-Spring biases the pipe into the cone-shaped form in bezel

-Sloped surfaces control output in x, y, and z

**Figure 5**



**Figure 6**



**Figure 7**

The spring-loaded self-aligning lightpipe is unique in that no mounting hardware (e.g., screws, springs or other hardware) is required and the lightpipe can be installed and un-installed without needing to remove any other components. The spring-loaded self-aligning lightpipe is also self-aligning. That is, the spring-loaded self-aligning lightpipe includes biasing features and lead-in components ensure that the lightpipe's final location is consistently predictable and flush on the bezel front which provide optimum ID look. This eliminates the need of an overlay to achieve the clean, high end look.

In summary, the proposed spring-loaded self-aligning lightpipe provides a robust and tool-less solution to convey light from an LED to an output. The spring-loaded self-aligning lightpipe achieves self-alignment and positioning without the need of hardware, and eliminates the need of an overlay to achieve the high quality look and feel with lightpipe constantly bias to flush against the plastic bezel. The spring-loaded self-aligning lightpipe also eliminates the need for additional dis-assembly, preventing extra rework and potential mis-assembly. The lightpipe is designed for flexibility, where the part can be installed before or after the complete assembly, thereby making it manufacturing-friendly. The spring-loaded self-aligning lightpipe retains all the original functionality of accurate input/output location, while introducing major cost-reductions and removing the need for hardware and overlays, while retaining the functional and ID look.