A COMPREHENSIVE GUIDE TO EVALUATING HAPTIC TRACKPAD

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HAPTIC TRACKPADS: MORE THAN A TREND

Haptic technology has come a long way since it was first implemented in consumer devices in the 1970s, but the past decade has seen some particularly enormous strides. Now, projections estimate the haptic market will reach $4.6 billion by 2026. But this innovation hasn't always been looked upon with such promise.

In the early 2010s, when major manufacturers began implementing haptic features into their electronic devices, many quickly labeled it a fad. However, as major companies began featuring the tech in their most popular products — such as Apple's MacBook in 2015 and Microsoft's new lineup at CES 2022 — it has become clear that the technology is a feature widely sought out by consumers. As tech companies strive to take user experience to new heights, haptics remains a core methodology for creating responsive, accurate, and interactive devices. Whether it's smartphone touch screens or electric vehicle controls, haptic elements exist in many devices that are part of everyday life. One area in which haptics are now extremely common is computer trackpads.

It's clear that haptic technology is here to stay. Now that haptic trackpads have become more ingrained in tech products, it's essential to understand how to evaluate and compare trackpad options effectively. But this is easier said than done, as all haptic trackpads claim to have outstanding feedback. Such claims make determining differences between haptic trackpads a struggle for reviewers, and many find it hard to research, analyze, and communicate performance details. The reason is that reviewers don't understand key attributes or have a list of tests that effectively determine the various factors of trackpad quality.

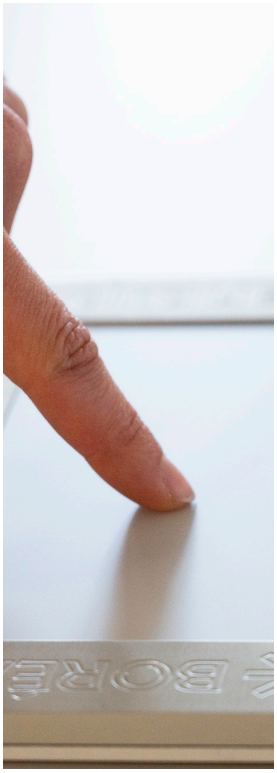
To guide you through this process, we've created a comprehensive guide to haptic trackpads below. This guide breaks down the essential factors to consider when assessing haptic trackpads, focusing on three main aspects:

- Architecture
- Performance
- UX design

Then, we'll review some of the core benefits of haptic feedback regarding user interface, product design, and more.

Following these steps for evaluation, you'll garner expertise in distinguishing various forms of haptic trackpads. With this knowledge, when people ask you, "What is haptic feedback?" you'll have the ability to provide more value by delivering expert and nuanced reviews for your audience.

WHY IS HAPTIC FEEDBACK IMPORTANT?



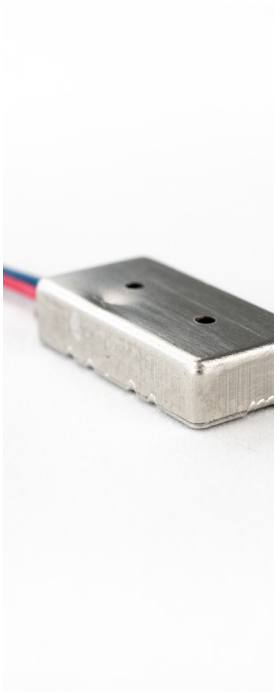
At this point, you're probably vaguely familiar with haptic feedback. However, the question remains for many: How does haptic feedback work?

In a nutshell, haptic technology uses motors, vibrations, and sensors to simulate touch and a sense of presence. For example, where once a computer used a mechanical device to use a physical force to trigger a sense, haptics only emulates the sense of touch.

There are different types of haptic feedback depending on the type of device and what command is being performed. This is the effect, but why is haptic feedback important? Overall, the sense of active touch supplied by haptic features offers a range of benefits concerning user experience, performance, and personalized control methods.

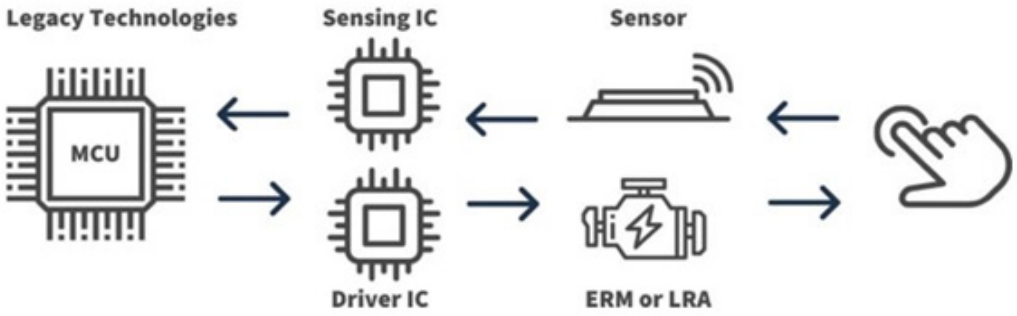
Is haptic feedback good for users? The answer is yes. However, as you'll see below, various haptic interface designs do not yield the same results. Next, we'll run through how to distinguish between haptic trackpads.

ARCHITECTURE



The first fundamental thing to know about trackpads is that they come in different designs. Haptic trackpads come in two dominant architectures: LRA and piezo.

The LRA (linear resonant actuator) architecture is the older technology. It uses a small motor, which creates a vibration to simulate a click. In contrast, the piezo architecture uses a solid-state component that generates vibrations when voltage is applied, creating a haptic sensation.

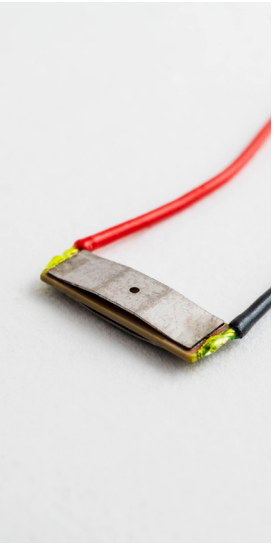


LRA Design

THE LRA COMMUNICATION SCHEMA CAN INTRODUCE LATENCY ISSUES DUE TO THE TIME REQUIRED FOR THE VARIOUS COMPONENTS TO COMMUNICATE

With LRA architecture, the sensing element detects pressure from the user's fingers. Then, the sensor communicates with the sensing IC, which converts the mechanical motion into an electrical signal. The sensing IC sends the signal to the MCU (microcontroller unit), which processes the signal, sending a request to the driver IC to generate an electric current that drives the LRA (linear resonant actuator). The driver IC controls the LRA's voltage and current, generating an oscillating electric signal at the resonant frequency of the LRA, which produces the click sensation.

The LRA communication schema can introduce latency issues due to the time required for the various components to communicate before the click sensation aligns with the command to the operating system. Also, the LRA's design sometimes leads to a "spongy" click sensation, and many users prefer a more crisp and snappy click sensation.



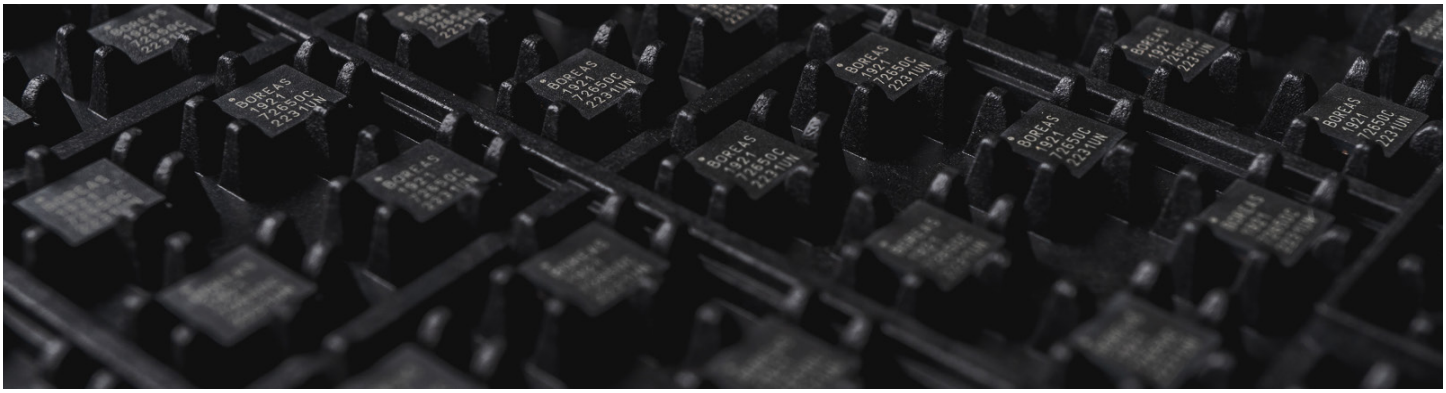
Piezo Design

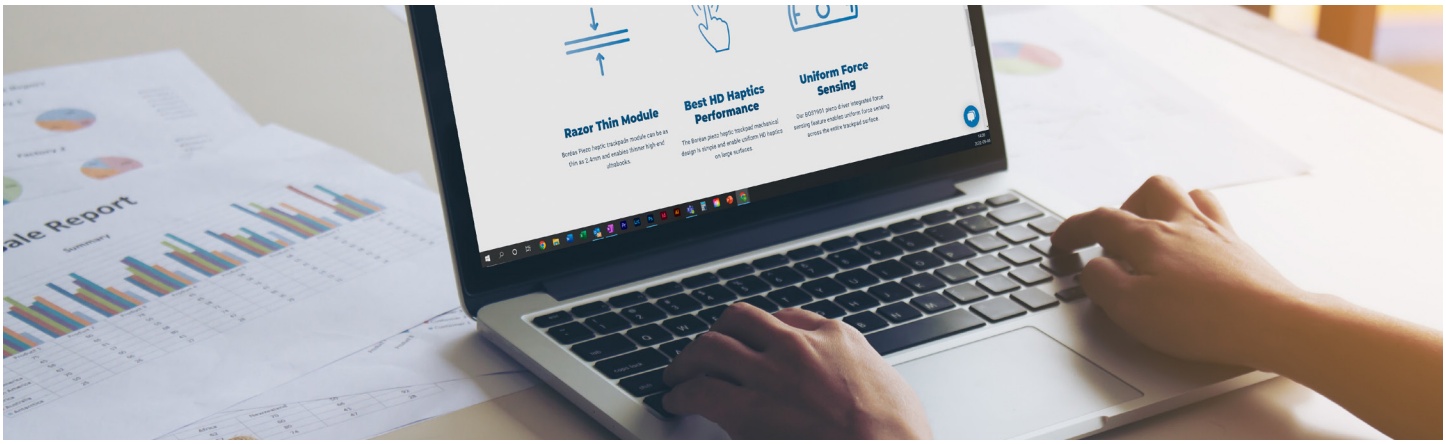
On the other hand, piezo-power designs solve many of the flaws inherent in LRA models. For example, the piezo trackpad solution from Boreas performs sensing directly in the piezo actuator. With our chip handling both sensing and driving, the communication pathway becomes much shorter, reducing latency.

THIS DIRECT AND SIMULTANEOUS SENSING AND DRIVING ARCHITECTURE REDUCES LATENCY, PROVIDING USERS WITH AN IMMEDIATE AND CRISP RESPONSE TO THEIR INPUT.

When a user clicks on the trackpad, the piezo actuator directly senses this action. It communicates with the Boreas IC, which sends the command to the MCU for the host click event and activates the piezo actuator for haptic feedback at the same time.

This direct and simultaneous sensing and driving architecture reduces latency, providing users with an immediate and crisp response to their input. The result is a heightened UX that allows users to click and receive a response as fast as they want. Additionally, because the piezo design uses fewer parts, the thickness of the trackpad is reduced considerably, allowing for a more streamlined and sleek design. Furthermore, the piezo-based click is customizable to user preference. Users can program their devices to adjust the intensity of the feedback. Also, users can set up personalized shortcuts and functions based on differentiating pressure levels.





PERFORMANCE

When evaluating a trackpad, the second thing to consider is its performance. There are a handful of qualities to check, including uniformity, sharpness, delays, and speed.

Click Uniformity

A critical metric to test when evaluating a trackpad is the uniformity of the click. To test for uniformity, apply the same force throughout the entire surface in an attempt to trigger the click. As you try every spot, ensure the sensation of the click remains the same. Look for consistency throughout the trackpad, and remember to test the four corners.

Whether you are using your trackpad as a game controller or for graphic design, inconsistencies in click sensation or force requirements can result in inaccurate inputs. Therefore, it's crucial to identify any variations in the trackpad's uniformity and communicate them in your review. Inconsistencies can include differences in click sensation or varying force requirements in different trackpad areas. Or, in worst-case scenarios, dead spots.

Click Sharpness

In addition to uniformity, it's essential to evaluate the click sharpness. To test this, press down on various parts of the trackpad and pay close attention to the response. A "crisp" click feels immediate and precise, while a "spongy" click feels springy. You can likely tell the trackpad's design style if you notice a difference. Spongy clicks often indicate an LRA architecture, while piezo-based trackpads usually have crisper clicks.

The most highly recommended evaluation method is conducting a side-by-side comparison of an LRA and piezo design. For example, one of the best LRA trackpads comes with Microsoft's Surface Pro lineup, which you can compare to a piezo-powered unit.

Delayed Response

PIEZO-BASED TRACKPADS SHOULD PROVIDE AN INSTANTANEOUS RESPONSE TO CLICKS, WHILE LRA-BASED TRACKPADS MIGHT BE DELAYED

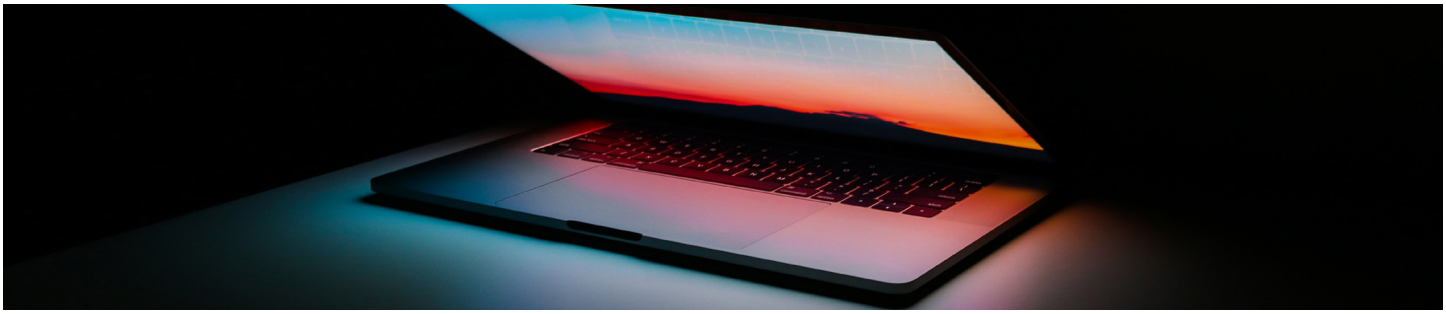
Another essential test is for latency in the trackpad's response time. To evaluate the latency, perform a "drag and drop" test. Click and hold an item, such as a file, and move it around the screen. As you select the item, the trackpad should vibrate. Then, when you release the item, you should receive distinct feedback indicating the release. If there is no release feedback, or any delays, that indicates a latency issue.

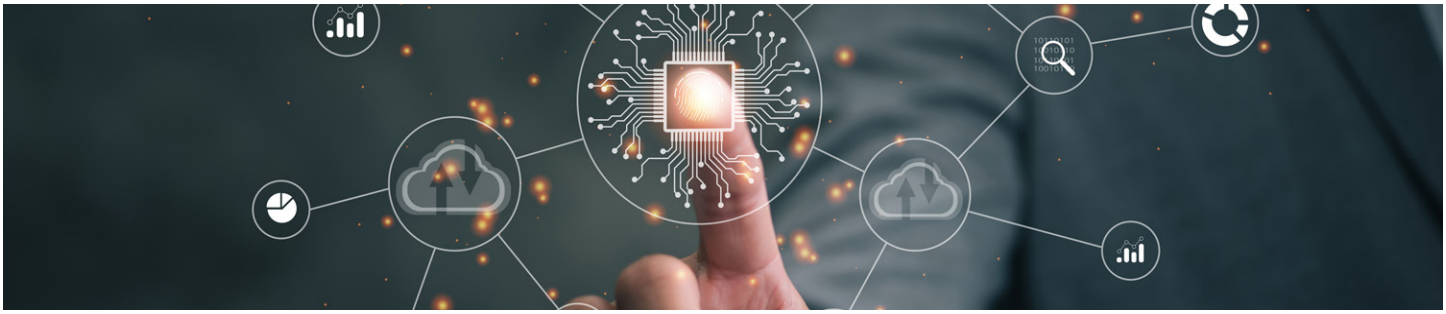
A delayed response is problematic for many use cases, especially in high-pressure scenarios such as video editing. As with sharpness, response quality depends on the architecture. Piezo-based trackpads should provide an instantaneous response to clicks, while LRA-based trackpads might be delayed due to the need to communicate with an external sensor.

Rapid Clicking

The last test to perform is to determine how fast your trackpad senses commands. To test the trackpad's rapid clicking ability, use a website like "Click Test" to count the number of clicks per second the trackpad can register accurately.

LRA-based trackpads typically have a lower maximum click rate due to the inherent latency issue, and piezo designs are much more responsive given their sleeker architecture. Ultimately, comparing click counts helps you understand how well the trackpad performs under high-intensity situations, whether it be high-speed video games, graphic design, or video editing.





UX DESIGN

The third factor in trackpad evaluation is the UX design. This step is more subjective than the previous two and depends on things such as hand size, but you can use a list of QA tests to evaluate the trackpad's functionality. Below is a series of tests you can perform:

- **PALM RESTING:** Rest your palm on the trackpad and try a click with your other hand. As you click, check to see if the trackpad still clicks.

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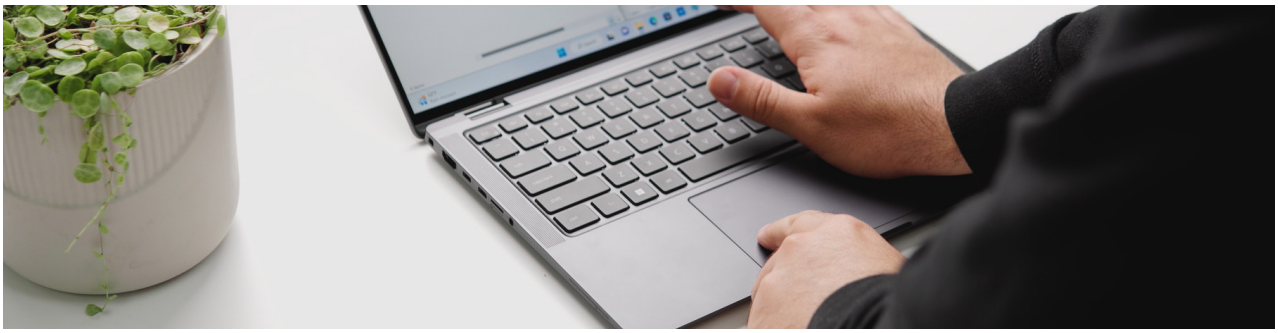

- **PALM-CLICKING INHIBITION:** Place your palm on the trackpad and apply pressure to simulate a clicking action. Observe whether the trackpad registers this as a click and produces haptic feedback.

2

- **THUMB RESTING:** Place one thumb on the trackpad and try to click with the other finger. Does the trackpad register a click or provide sensory feedback?

3

- **DRAG AND DROP:** Click on a file or item and drag it to the desired location on the screen without releasing the click. As you do this, check for any delay in the object's movement or slow responses as you press and release.

4

- **TWO-FINGER SCROLL:** Place two fingers on the trackpad and move them vertically and horizontally, known as stroke touch mode. Ideally, the screen should scroll up, down, left, and right without any latency or delay.

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- **ZOOM IN AND OUT:** Place two fingers on the trackpad and move them closer together to zoom in or farther apart to zoom out. The trackpad should move directly in line with your fingers, and there should be no detectable delay.

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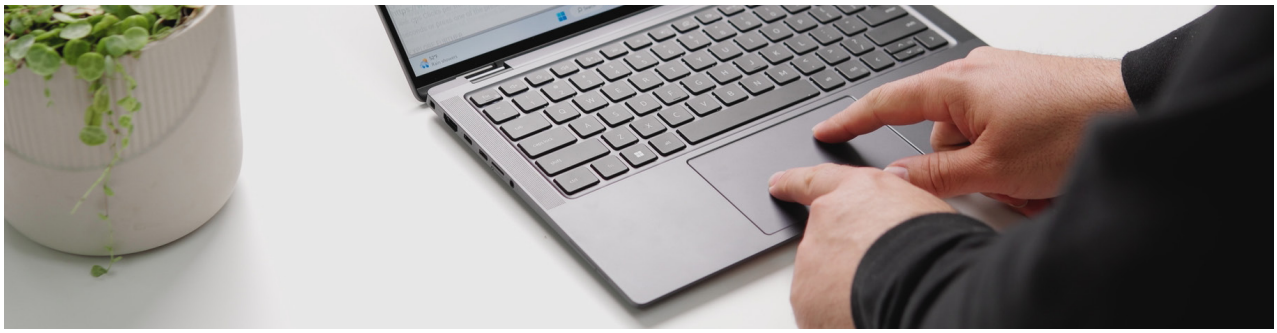

- **TWO-FINGER, THREE-FINGER, AND MULTIPLE-FINGER CLICKING:** Test the trackpad's ability to recognize and respond to different types of finger input. Try performing various multi-finger clicks, such as with two or three fingers. As you test the trackpad's ability to distinguish between clicks, you can enter your trackpad's personalization settings to change the function of each command.

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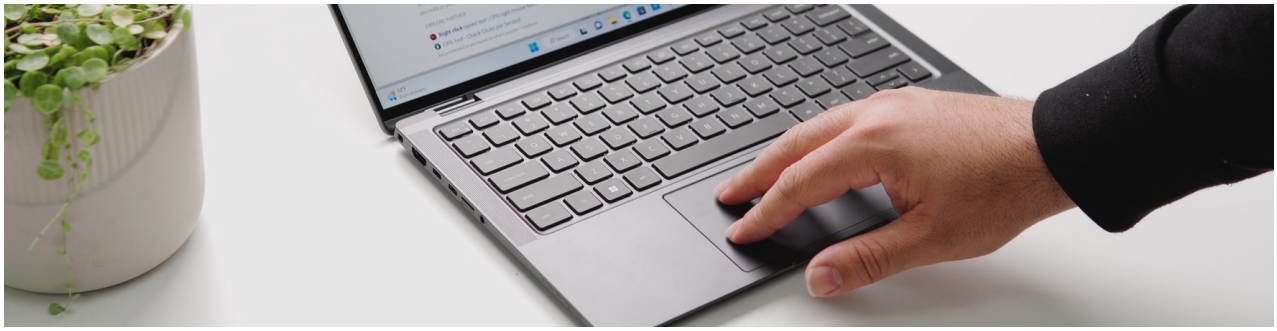

- **NO-CLICK SCROLLING:** Scroll up, down, and across the page and ensure the trackpad does not produce accidental clicks.

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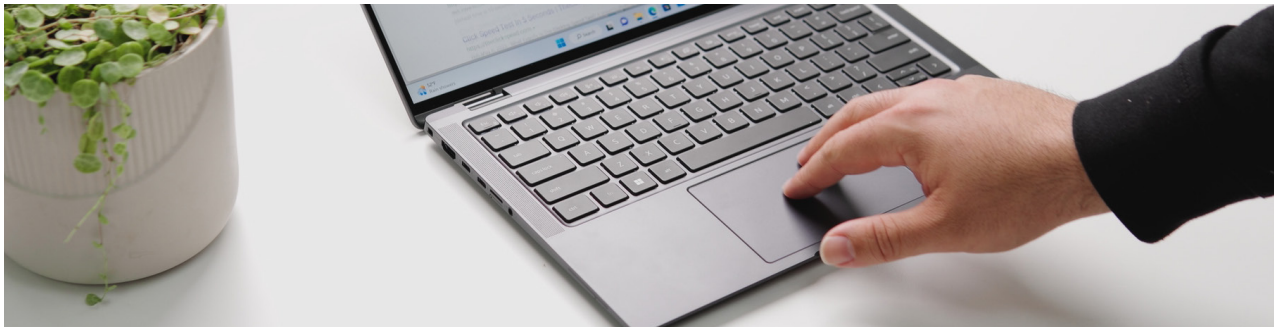

For any questions on how to conduct these tests, please refer to our explanatory video that provides a step-by-step guide for each. The video ensures that you properly execute each test and obtain accurate results. Additionally, if you encounter any issues or inconsistencies during the testing process, we recommend repeating them multiple times to secure consistent results. By following these guidelines, you can thoroughly evaluate the performance of the trackpad and accurately assess its quality.

Ultimately, conducting these basic tests helps you better understand how to compare and evaluate haptic trackpads. When reviewing haptic technology, always consider the trackpad's architecture, performance, and UX design for a well-rounded evaluation.

BENEFITS OF PIEZOELECTRIC POWERED TRACKPADS

At this point, we hope to have explained why haptic feedback is important and why there's a growing push among the world's top tech companies to incorporate the best haptic technology into their devices. Whether to make gaming more immersive, such as haptic gloves, or to enhance the mobile experience through dynamic touchscreen controls, haptics is revolutionizing many of our daily experiences. However, as explained above, not all haptic designs are created equal.

Technological innovation moves at a relentless speed, meaning manufacturers are always looking for the most cutting-edge features. In terms of haptics, piezo is the best there is.

Piezo trackpads have a simpler, sleeker, more efficient design. The simplified design allows it to perform faster, more accurately and increases the usable trackpad surface. Piezo also allows users to input custom commands, which can help in terms of productivity, creativity, and performance.

PIEZO ACTUATORS SAVE USERS SIGNIFICANT BATTERY LIFE, IN MANY CASES UP TO 10 TIMES THE AMOUNT AS OTHER MODELS.

From a functional standpoint, piezo's smaller design enables manufacturers to produce lighter, slimmer computer models, something that's imperative concerning consumer expectations. Lastly, compared to other haptic designs, piezo actuators save users significant battery life, in many cases up to 10 times the amount as other models.

Understanding how these different forms of haptic designs impact the user interface and, ultimately, the overall experience is crucial. If you're interested in experimenting with the best-in-class piezo trackpads, visit Boreas Technologies' product page to learn more about how our actuator solutions stand at the forefront of haptic technology. Schedule a demo or visit our blog to learn more.

Contact Us For More Information About Haptic Trackpad

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