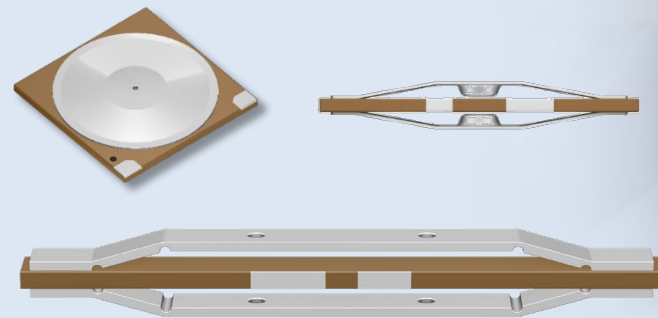


Attracting Tomorrow



# PowerHap Piezoelectric Actuators


























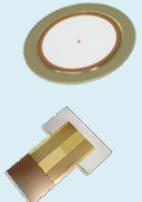









for Active Haptic Solutions



**TDK Electronics AG**  
Piezo & Protection Devices Business Group  
Munich, Germany  
January 2025

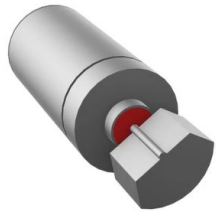


# Comprehensive Piezo-Based Actuators Overview

Best suitable technology for each application		Automotive		ICT		Virtual reality		General industry	Texture feeling	
										
Vibrotactile (< 1000 Hz)	PowerHap									<b>PowerHap</b> <b>High-definition haptic experience</b> <ul style="list-style-type: none"> <li>Powerful for heavy loads</li> <li>Fast accelerations</li> <li>High bandwidth</li> <li>Compact design</li> </ul> 
	PiezoHapt S/L									<b>PiezoHapt S/L</b> Ultra-thin and cost-effective 
Surface friction (> 20 kHz)	Booster									<b>Customized piezo boosters</b> For surface haptic applications (Hap2U) 

# Why Piezo as Actuator?

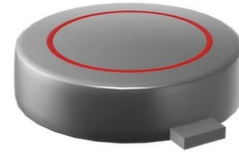
## ERM = Eccentric Rotating Mass



### Basic haptics

Just notifying through vibration

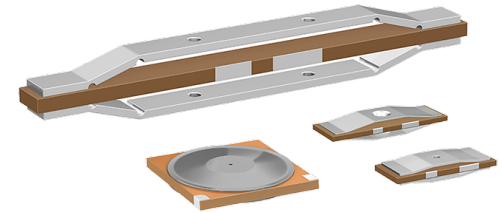
## LRA = Linear Resonant Actuator



### Standard haptics

- More flexible than ERM
- Basic click-type feedback possible
- Small bandwidth

## Piezoelectric actuators PowerHap

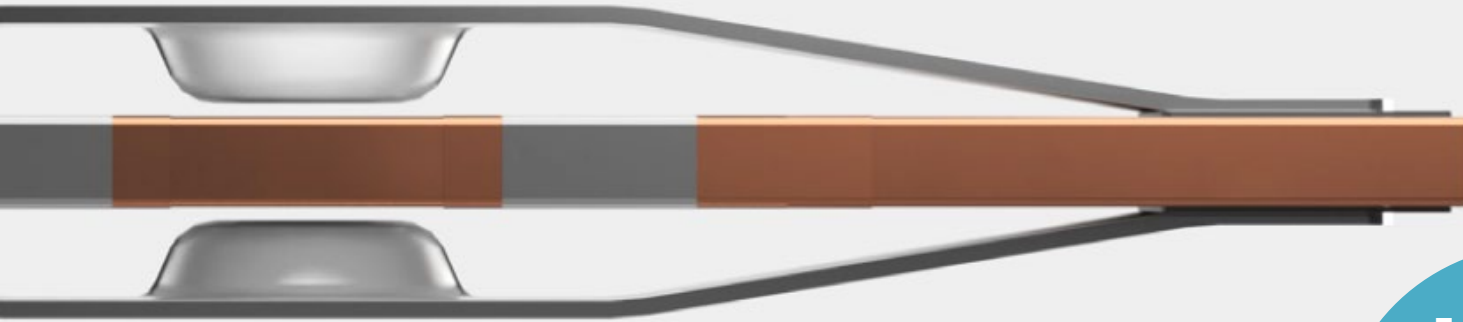


### High-definition haptics

- Crisp and fast responses
- High bandwidth
- Low power consumption

# PowerHap How It Works

Stainless steel bows (or cymbals) on both sides of the actuator work as a displacement amplifier



Its **high bandwidth** enables endless effects by adjusting the frequency, the signal and the amplitude



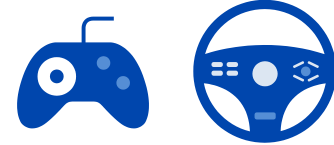



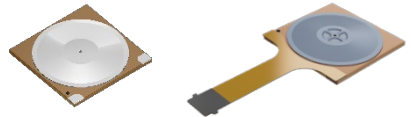
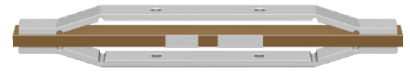
**Force sensing capability** – when applying pressure on the bows an electric charge is generated

The multilayer piezo-ceramic element delivers outstanding **fast and precise displacements**

When voltage is applied (0 to 120 V), the piezo-ceramic will shrink/contract accordingly

# PowerHap for Haptic Applications

# PowerHap in a Nutshell

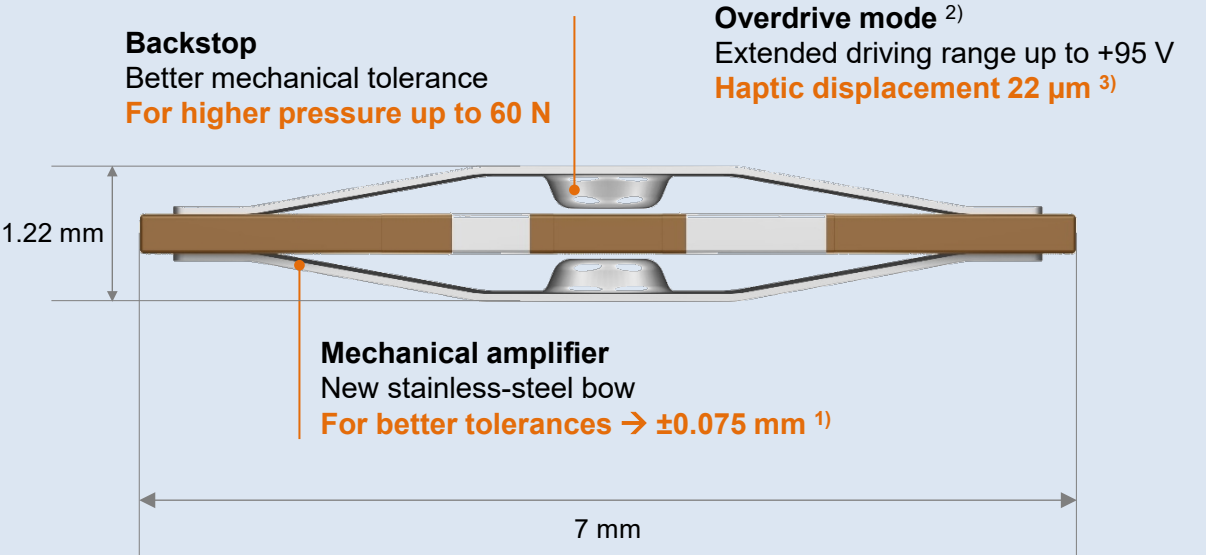
Applications	Stylus pens	Wearables, mobile, VR	Buttons / modules / Small to medium displays	Large / heavy displays	
					
Max. driving specs.	Capacitance [μF, 1 V, 1 kHz]	0.26	0.50	0.9 / 2.5	3.2
	Voltage range [V]	0 ... +60, +95*	0 ... +60, +95*	0 ... +120	0 ... +120
	Displacement [μm]	15 / 23*	27 / 43*	65 / > 110	120
	Acceleration** [g]	2.3 / 3.0*	3.3 / 4.8*	7 / 18	14
PowerHap	True writing feeling for stylus pens	Compact and powerful	Button-like feedback for switches and touchpads	A single actuator can move displays up to 2 kg!	
					
	Dimensions [mm] Series/type	7 x 3.75 x 1.22 <b>0704H013V060</b>	12 x 4 x 1.74 <b>1204H018V060</b>	12.7 x 12.7 x 1.8 / 19.3 x 19.3 x 2.2 <b>1313H018V120 / 1919H022V120</b>	60 x 5 x 8 <b>6005H080V120</b>

\*Overdrive mode @ +95 V – up to two consecutive cycles with a minimum time interval of 100 ms.

\*\*Acceleration load mass 100 g @ single pulse, sine wave 200 Hz (g peak)

# PowerHap 0704 enables a true writing feeling by moving the tip of a stylus pen

PowerHap 0704H013V060 Specs



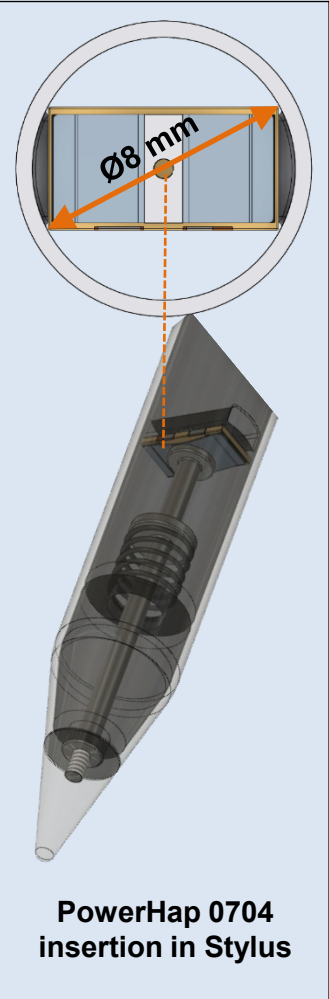
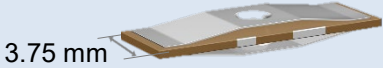
**Capacitance**  
0.21  $\mu\text{F}$  @ 1 V, 1 kHz

**Voltage range**  
0 ... +60 / +95 V <sup>2)</sup>

**Displacement**  
14 / 22  $\mu\text{m}$  <sup>3)</sup>

**Acceleration**  
3.8 g, (PtP), 100 g

**Stiffness**  
160 N/mm\*



PowerHap 0704 insertion in Stylus

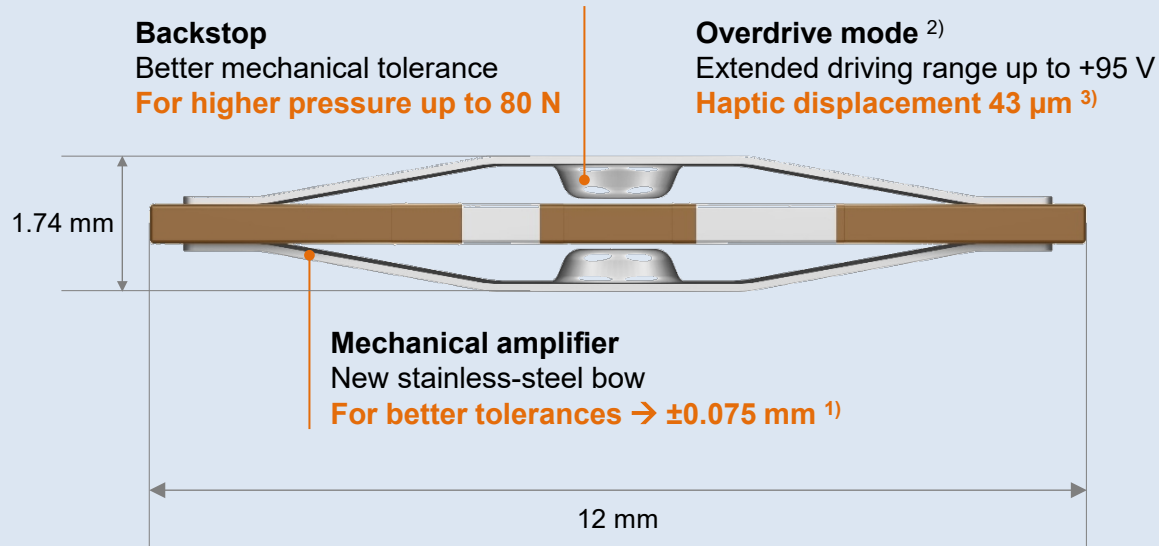


1) All PowerHaps are measured at the end of the line. The tolerance target is  $\pm 0.05$  mm.  
 2) Extended voltage range for up to two consecutive cycles with a minimum time interval of 100 ms, getting approx. ~ 50% in displacement -> a much better experience  
 3) Driven at overdrive mode +95 V

# PowerHap 1204 is powerful for a crisp haptic feedback

## A compact design ideal for VR/AR gloves

PowerHap 1204H013V060 – Adjustable haptic feedback and force sensing



**Capacitance**  
0.45  $\mu\text{F}$  @ 1 V, 1 kHz

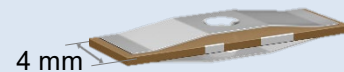
**Voltage range**  
0 ... +60 / +95 V <sup>2)</sup>

**Displacement**  
27 / 43  $\mu\text{m}$  <sup>3)</sup>

**Acceleration**  
6.9 g, (PtP), 100 g

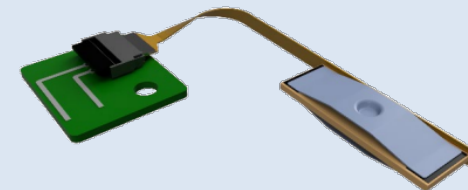
**Stiffness**  
160 N/mm\*

**Frequency**  
700 Hz



Insertion height as low as 1.74 mm is ideal for wearable and mobile devices

Flexible Printed Circuit (FPC) with a ZIF connector, ideal for slim designs

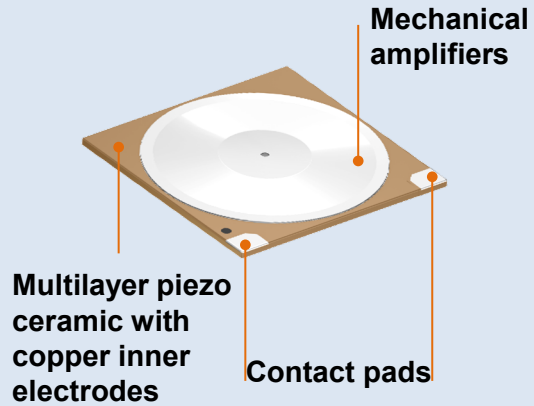




# PowerHap 1313 & 1919

## Button-like Feedback for Switches and Touchpads

### PowerHap 1313H018V120



Dimensions (W x D x H): 12.7 x 12.7 x 1.81 mm

**Capacitance**  
0.9  $\mu$ F @ 1 V, 1 kHz

**Voltage range**  
0...+120 V

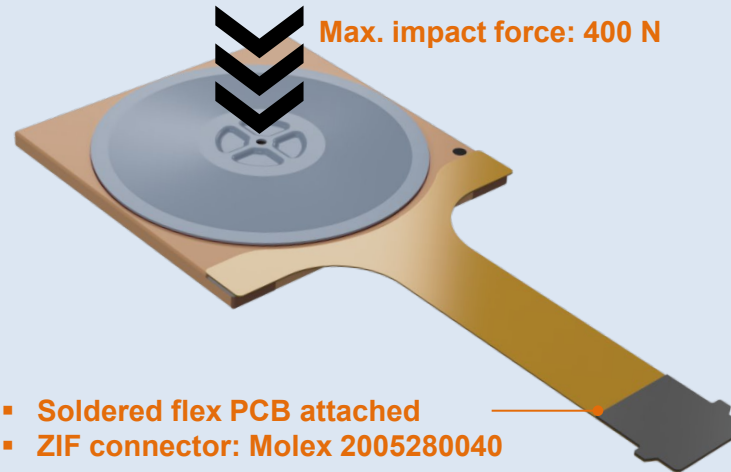
**Displacement**  
65  $\mu$ m

**Acceleration**  
13 g, (PtP), 100 g

**Stiffness**  
130 N/mm

**Frequency**  
up to 700 Hz

### PowerHap 1919H022V120



Dimensions (W x D x H): 19.3 x 19.3 x 2.2 mm

**Capacitance**  
2.5  $\mu$ F @ 1 V, 1 kHz

**Voltage range**  
0 ... +120 V

**Displacement**  
> 110  $\mu$ m

**Acceleration**  
35 g, (PtP), 100 g

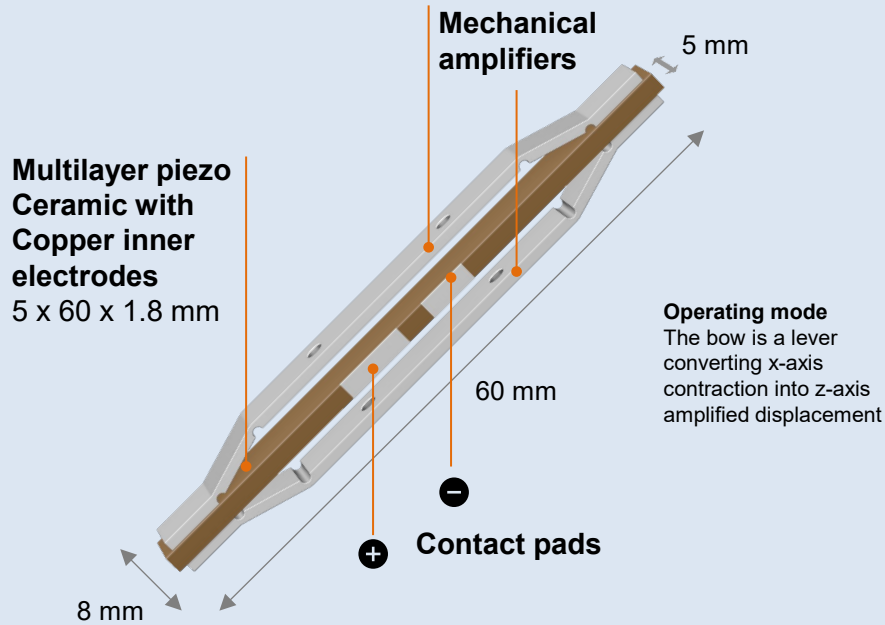
**Stiffness**  
160 N/mm

**Frequency**  
up to 700 Hz



# Homogeneous and crisp feedback across the display with a single actuator in lateral setup

## PowerHap 6005H080V120



**Capacitance**  
3.2  $\mu\text{F}$  @1 V, 1kHz

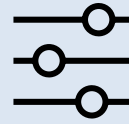
**Voltage range**  
0 ... +120 V

**Displacement**  
120  $\mu\text{m}^*$

**Acceleration**  
8.7 g, (PtP), 1000 g

**Stiffness**  
340 N/mm $^*$

## Why PowerHap 6005H080V120 for displays?



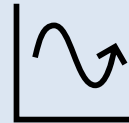
**Fully configurable** – A high bandwidth enables reproducing gesture, surface, and rendering effects



**Powerful** – A single actuator can move displays up to 2 kg!



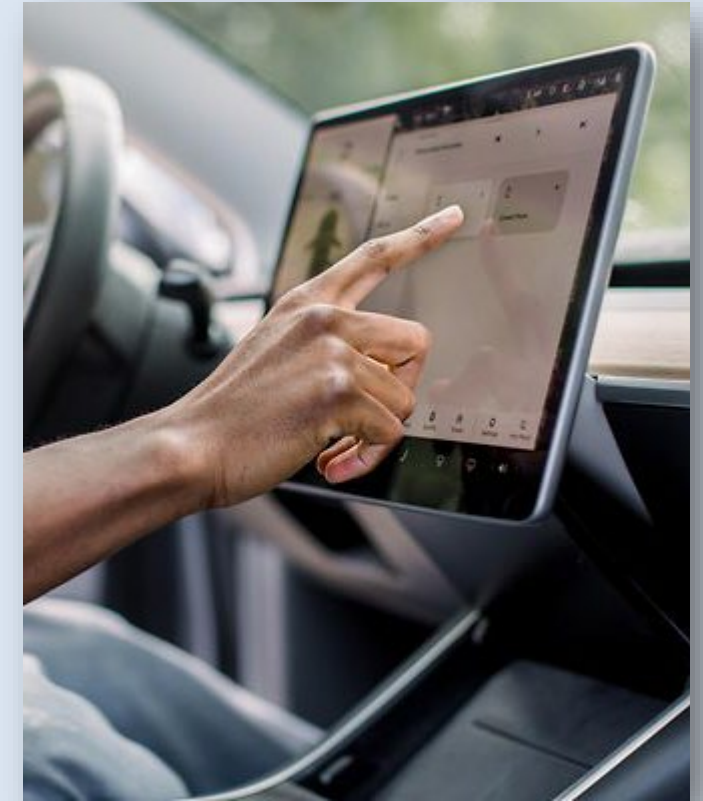
**Silent** – Having the actuator in a lateral configuration the system becomes very quiet



**Damping** – The same actuator damps the tail signals



**Cost-effective** – Reduce significantly the cost of integration and electronics



# PowerHap Starter Kit

Experience & speed up your haptic design

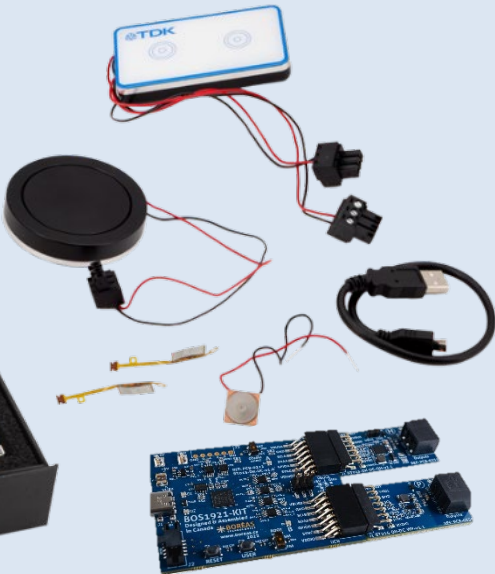
# PowerHap Starter Kit

## Haptics Experience Out-of-the-box!



PowerHap's development Starter Kit for fast haptics prototyping gives mechanical designers and engineers first impressions of the haptic feedback. The kit demonstrates how the mechanical integration works and provides a reference design that can be adapted to various applications.

PowerHap piezo actuators offer an unprecedented quality of haptic feedback based on their unrivaled acceleration, force, and response time performance.



**Play and build your own haptic configuration**  
Exchangeable actuators between buttons

**Speed up your design**  
Use the reference designs provided for a fast and easy integration

**Fully configurable**  
Adjust amplitude, frequency and waveform to fit your desired haptic effect

Seamless button



PowerHap 1204



Round button



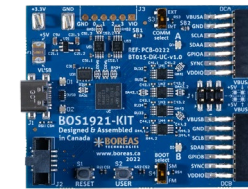
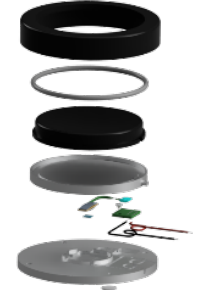
PowerHap 1313



Seamless button



Round button



**Boréas DevKit – Driver & Software**



[www.tdk-electronics.tdk.com](http://www.tdk-electronics.tdk.com)