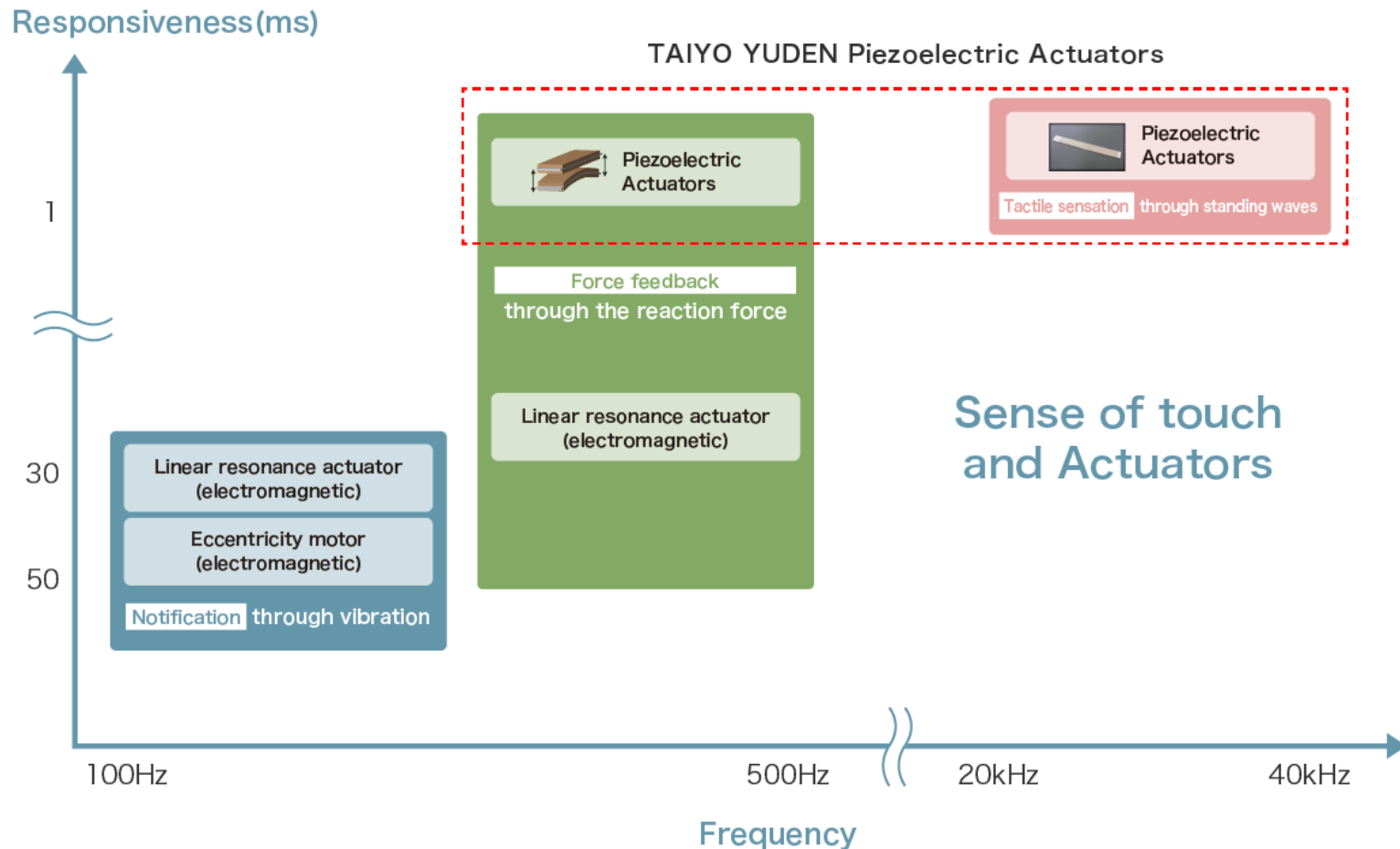


Various actuators are used for tactile functions. "Notification" uses eccentricity motors, linear resonance actuators, and other electromagnetic actuators, while "force feedback" utilizes piezoelectric actuators in addition to such electromagnetic actuators. The subsequent "tactile sensation" requires piezoelectric actuators with a broad drive frequency band and a quick response speed.



This section introduces the advantages of "Piezoelectric Actuators" which optimize the lamination technology cultivated in our Multilayer Ceramic Capacitors and Multilayer Ceramic Inductors.



Broad drive frequency band and a quick responsiveness

Technologies

- Material
- Optimal design



Expresses a delicate and high-quality tactile sensation

Technologies

- Material
- Lamination
- Latest design



Low power consumption

Technologies

- Material
- Lamination



Low power consumption

Characteristics	Piezo	LRA (rectangular-type)	Eccentricity motor
Actuator-type	Piezo	Inertia (horizontal)	Inertia
Force feedback	Possible	Possible	Possible
Tactile feedback	Superior	Possible	Not possible
Frequency	1 to 500Hz (all bands)	175 to 250Hz	1 to 300Hz
Waveform	Sine wave	Sine wave	Sine wave
Response time	Less than 1ms	20~30ms	40~80ms
Phonation	Possible	Not possible	Not possible
Size	53×8mm, t0.3mm	20×7mm, t3mm	12×3.5mm, t2.7mm
Low power consumption	<i>Excellent</i>	<i>Good</i>	<i>Average</i>
Advantages	<ul style="list-style-type: none"> •Fast response speed •High frequency band support 	<ul style="list-style-type: none"> •Small circuit component area •Widespread adoption 	<ul style="list-style-type: none"> •Inexpensive •Vibrations transmitted in all device directions
Disadvantages	<ul style="list-style-type: none"> •Must be affixed to the panel •High cost 	<ul style="list-style-type: none"> •Slow response speed •Single frequency •Thick 	<ul style="list-style-type: none"> •Extremely slow response speed •Single frequency •High power consumption

The replacement of interior switches with flat panels and touch sensors is advancing in automobile-related fields. Due to the need to emphasize safety inside automobiles, it is believed that providing feedback during switch operation is absolutely required.

Automotive application examples



- ① Door mirror (camera support) panel switches
- ② Steering panel switches
- ③ Center console panel switches
- ④ Touchpad

Automotive: futuristic interiors and cockpits Advantages of Piezoelectric Actuators

- Low power consumption
- High frequency band support
- Faster response speed than electromagnetic actuators
- Thinner than electromagnetic actuators
- Can be used together with sound

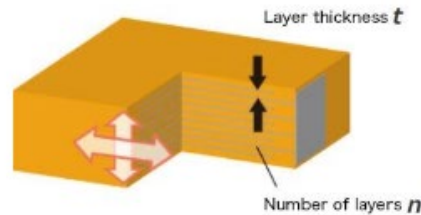
Appliance application examples



Other application examples

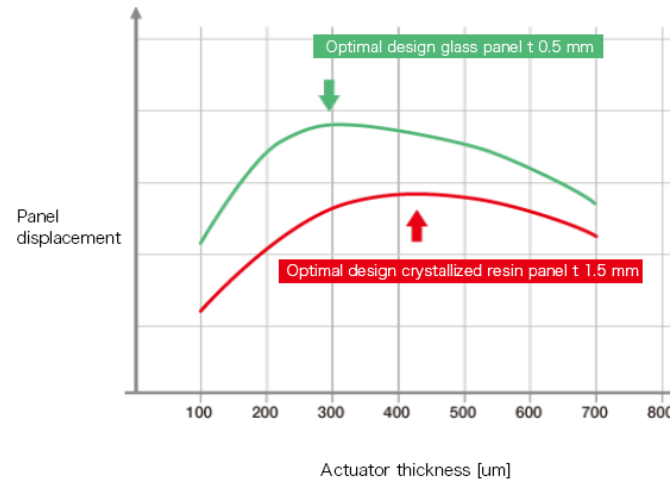
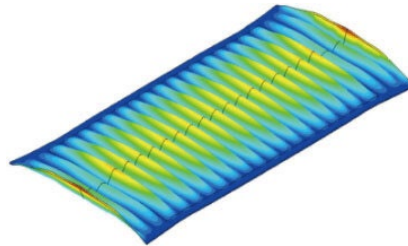
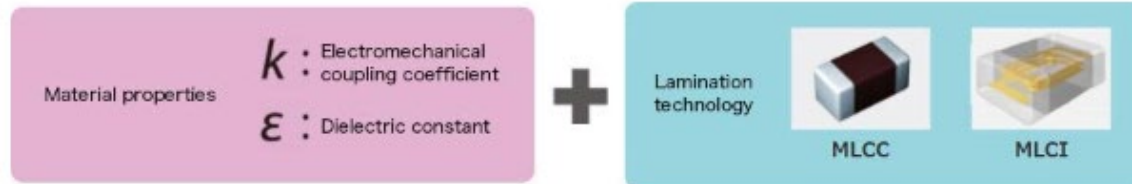


We optimized material properties such as the low dielectric constant and high electromechanical coupling as well as the laminate structure to realize a high displacement and low power consumption actuator.



$$\text{"Performance"} \propto k^2 \epsilon \frac{n}{t}$$

Combines high k , low ϵ and an optimized laminate structure.



Enables simulation according to the panel shape, material, and plate thickness.
We offer the optimal actuator structure based on the customer's intended application.