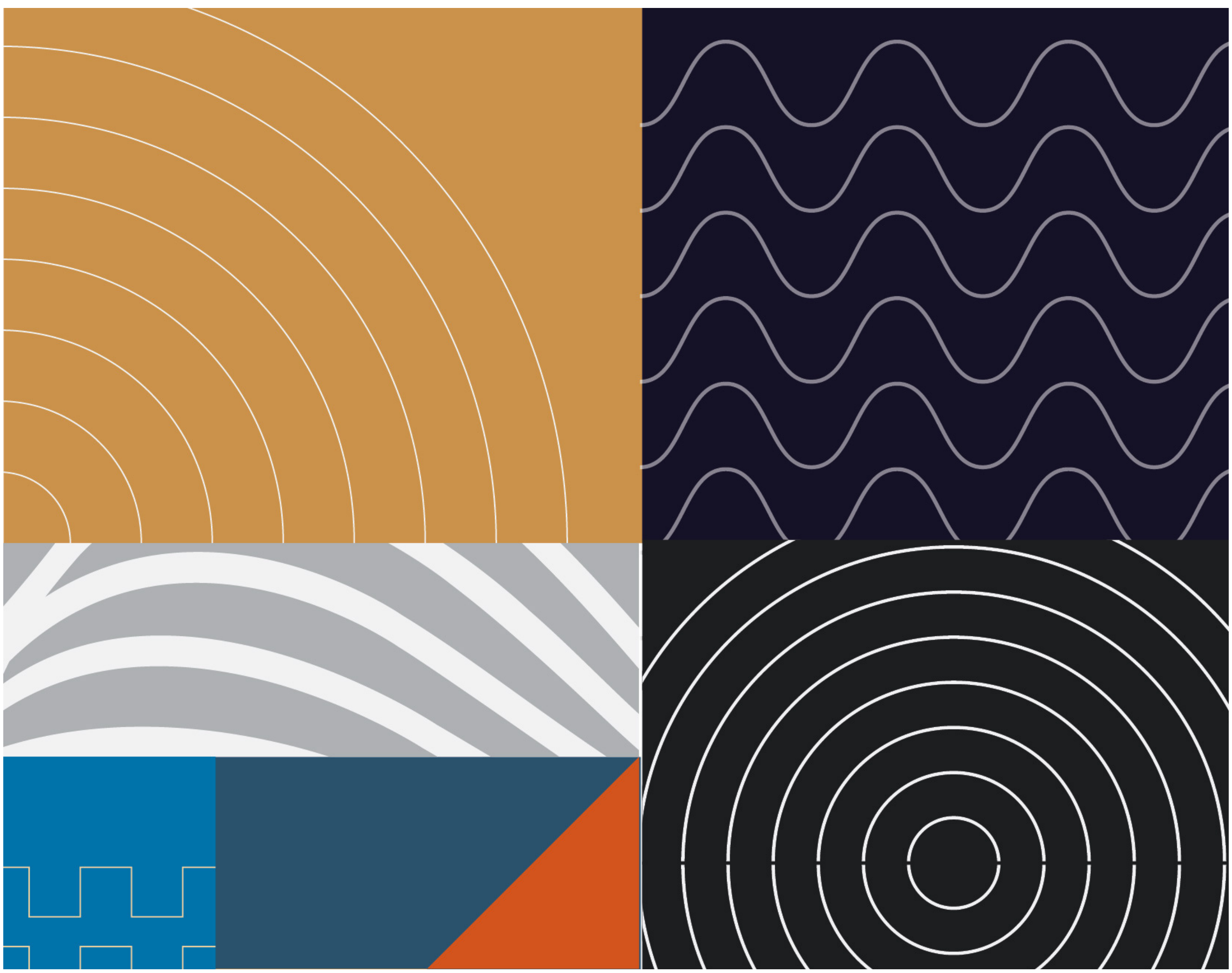
NEW PRODUCT INTRODUCTION
DEC 2023

Haptics LRA Expansion



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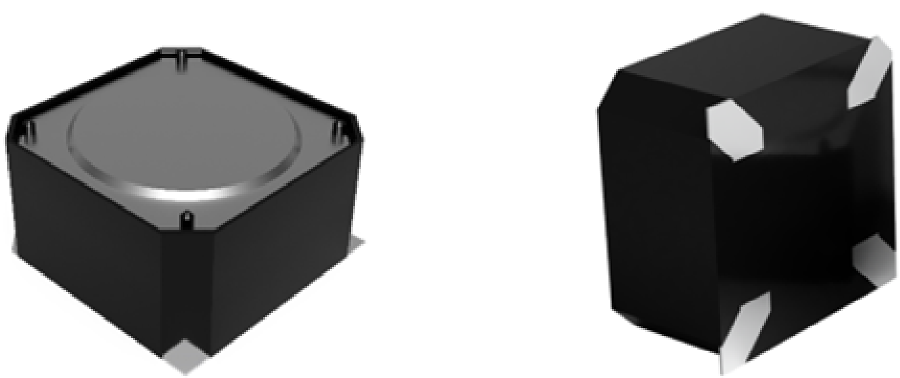
Announcement

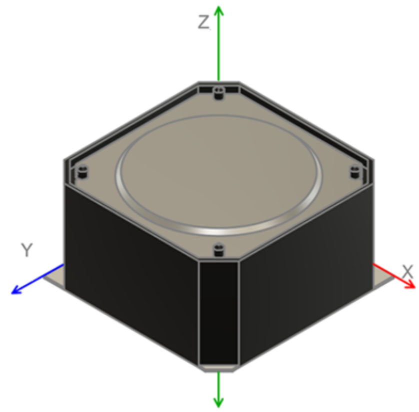
PUI Audio introduced Haptics in 2022, ensuring that when a tactile response or alert is necessary it can be felt clearly. Our commitment to innovation continues as we expand our haptics portfolio with new products tailored for diverse applications.

PUI Audio is excited to unveil the addition of a surface mount Linear Resonant Actuator (LRA) featuring patent-pending design, making it reflowable and washable through seamless automatic pick and place operations.

HD-LA1307-SM measures just 13mm x 13mm and delivers 1.8G maximum acceleration in a linear direction at a resonant frequency of 154 Hz to provide immediate, high-resolution tactile feedback. Our new waterproof IP rated surface mount product facilitates seamless integration into various end applications, such as virtual reality environments, gaming consoles, medical simulators, handheld devices, and consumer and industrial control interfaces.



Key Advantages of Linear Resonant Actuators



Linear Resonant Actuators (LRA) Haptic devices are AC-driven parts and produce a vibration in two directions along one axis. In default orientation, this is in the Z-axis (but can be adjusted using different mounting directions). A change in the frequency or amplitude of the driving signal will directly correspond to changes in vibration produced by the actuator.

A key benefit of using an LRA is the linear response- there is no ramping time for the device to reach a threshold for proper actuation like an ERM. The user will feel a vibration as soon as the coil is excited, and the mass moves up or down.

LRA devices fit into some of the smallest form factors available for haptic actuators. They are incredibly power efficient, making them the most popular choice in products such as wearables and smartphones.
Designers using LRA devices in their products can take advantage of high-resolution, responsive vibration patterns to deliver information to the user. These vibrations are often supplementary to another stimulus, like audio effects or information on the devices' screen, but also may be used as an independent source of information for a user. The rapid linear response of LRA devices allows product designers to design custom vibration patterns to fit the needs of any situation.

Drive Circuit for LRA

A haptic device can be implemented in the end application as shown below:

1) Pair a microcontroller with a drive circuit constructed with discrete components. The most common configurations involve PWM outputs from the microcontroller controlling a MOSFET drive circuit, for example an H-Bridge circuit.

2) An integrated drive system. With the latest advancement in technology, it is best to accommodate a haptic driver chip. A small variation in frequency arising from manufacturing tolerances, component aging, temperature fluctuations, or mounting conditions can impact vibrations significantly. Often, these chips have integrated digital libraries with pre-programmed vibration patterns- just send a digital command from the microprocessor to the chip, which manages the rest. Complex amplifiers and boost circuitry are typically included in these packages, and extended capabilities include auto-resonance detection, audio-to-vibration, and much more.

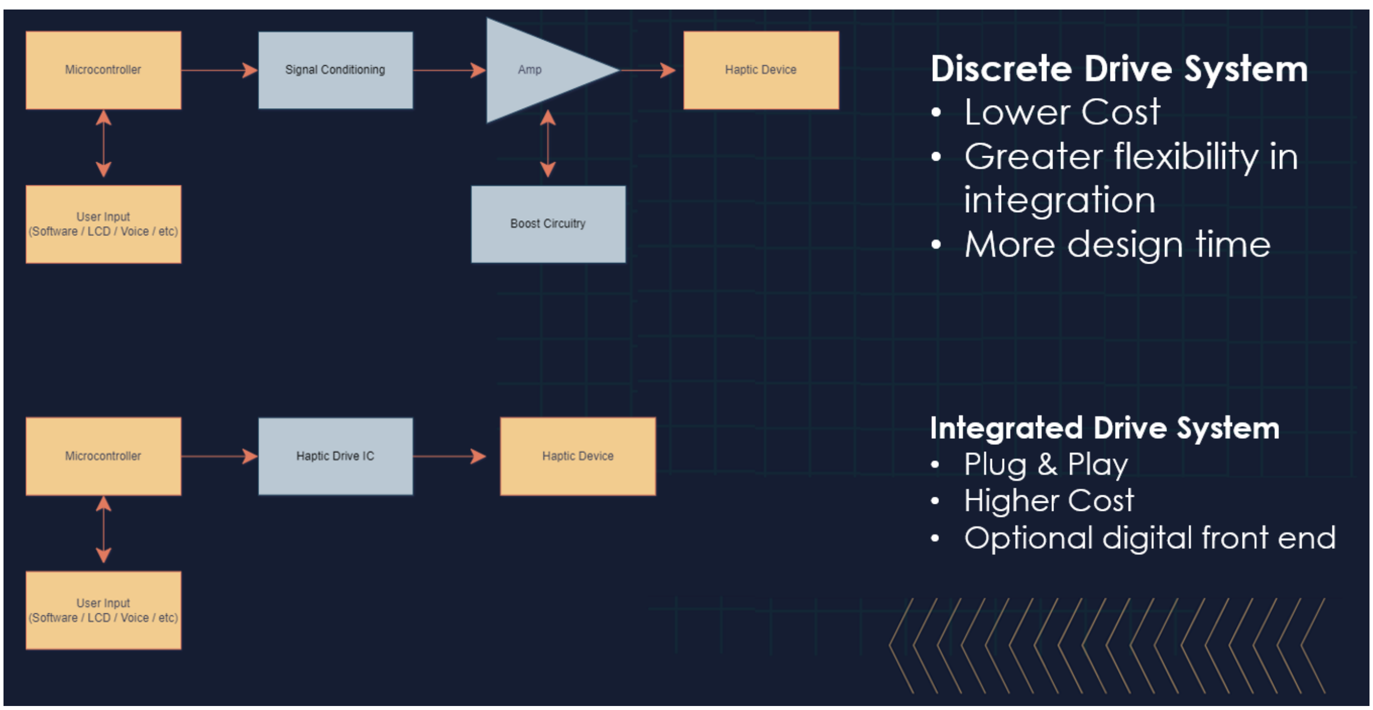


Figure 1

Frequently Asked Questions

How can you maximize the vibration of an LRA?

- When LRAs are operated at their specified voltage, the highest level of vibration intensity occurs at the resonant frequency of the actuator. Controlling the vibration can be achieved by modifying the amplitude of the driving signal (while keeping resonance constant), tuning the frequency within a narrow range around the resonant point (while keeping the drive voltage constant), or employing a combination of both approaches. This capability enables more precise control and higher resolution in vibrations compared to eccentric rotating mass (ERM) devices.

How do you apply Haptic device in the end application?

- To control Haptic device, you can design a custom drive circuit specifically for your needs or use an IC for simplicity (see Texas Instrument's DRV2605L) noted in Figure 1 above. Off-the shelve driver ICs incorporated many features like auto-resonance optimizing the efficiency of LRA. If you need any support for calibration routine, please reach out to PUI Audio Application engineering and we would be happy to provide detailed instructions. See the table below for a limited list of recommendations by PUI Audio- other available options may match your application's requirements.

Manufacturer No.	Manufacturer	Resources
DRV-2605L	Texas Instruments	https://www.ti.com/product/DRV2605L
MAX1749	Analog Device / Maxim	https://www.analog.com/media/en/technical-documentation/data-sheets/MAX1749.pdf
DA7280	Dialog Semiconductor / Renesas	https://www.renesas.com/tw/en/products/interface-connectivity/haptic-drivers/da7280-low-power-high-definition-haptic-driver-next-generation-human-machine-interfaces
LC898301XA	onsemi	https://www.onsemi.com/download/data-sheet/pdf/lc898301xa-d.pdf

Do you know of any good driver ICs that communicate with SPI protocol instead of I2C?

- Most ERM/LRA drivers use I2C, like DRV2605 which also accepts PWM via another pin post I2C setup. The datasheet for the IC contains detailed information on the different methods of control. For SPI-like control without I2C, consider ICs like TI's DRV8601, which operate with just PWM- https://www.ti.com/product/DRV8601

What are the pros/cons of using LRA vs ERM?

- Very application dependent. Typically, ERM will provide a lower frequency, "rumble" sensation, while an LRA will provide a higher-resolution "effects" sensation. You could equate this to the difference in vibration between a pager (ERM) and modern smartphone (LRA).
- ERMs are DC Driven, LRAs are AC Driven. Current draw varies between parts and usage.
- Rise/fall time of LRA is significantly faster than ERMs, allowing for high-resolution vibration effects.

Is there currently LRA part that is same or similar size to the ERM?

- Typically, yes. We have identical sized ERM/LRAs in 8mm diameter, and we can create a custom sized part if needed.

If using LRAs and only occasionally being used, is there a concern of the motor seizing up over time?

- LRAs will typically have a longer lifespan (compared to an ERM, there's less wear on the mechanical parts when being used). However, brushless ERM technology can also offer longer life span.

What's the best testing method to measure acceleration?

- For acceleration, we recommend using an off-the-shelf accelerometer system like from Texas Instruments that is specially designed for haptics. The accelerometer will output analog voltages that correspond to changes in acceleration, which are viewed on an oscilloscope.
  Customers can purchase one of these accelerometers for their testing purposes, or a similar one. They will need to mount the haptic device they are testing onto a standard mass that will be moved by the actuator, acceleration of a mass will cause vibration. For e.g.- To measure the acceleration of an actuator for use inside a smartphone, place the actuator on a 100 g block that has a similar size and shape as the phone. Next, place the block on a piece of packing or ESD foam to represent a hand, which is where a phone is normally held. Finally, measure the acceleration of the block on the foam and compare it to when a person holds it in their hand.