

As hearables gain in popularity, balanced armature driver technology stands ready to improve the user experience

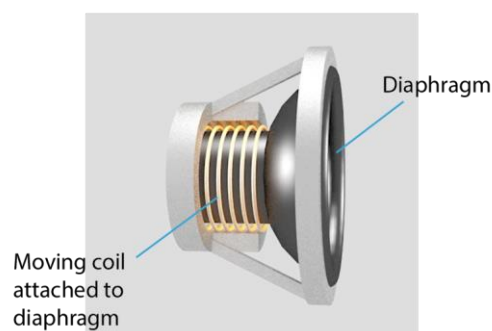
Consumer adoption of true wireless earphones and intelligent hearables is accelerating as models move beyond playing music to incorporating features such as fitness tracking, hearing enhancement, and hands-free voice assistant access. This is driving people to wear their hearables for longer and longer periods of time. In turn, users demand greater comfort, longer battery life, and better sound. Knowles balanced armature drivers are uniquely positioned to improve all three.

The Convergence of Hearing Aids and Hearables

Knowles originally developed balanced armature drivers more than 60 years ago for use in hearing health devices. This advancement enabled the design of compact, comfortable, high quality hearing aids that could be ear-worn and operate all day on a small battery—the same demands now placed on hearable devices. Just as hearing aids universally rely on the small size, low power consumption, and faithful sound reproduction of balanced armature drivers, more and more designers of hearables are making the same choice.

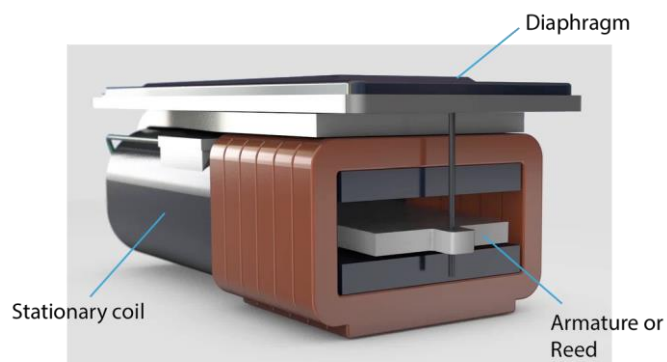
The coil of an ordinary dynamic speaker is attached to the moving diaphragm. In smaller sizes, the total mass of the moving components can become a problem. If the moving mass is too high, the sound cannot be accurately reproduced. This is a particular issue in the

smaller speakers used in hearables. To avoid this, the number of turns of wire in the coil is limited. This reduces the speaker's efficiency, driving power consumption up.



Dynamic speaker diagram showing moving coil

In a balanced armature driver the moving mass is comprised of only a thin reed (or armature), the diaphragm itself, and a very small drive rod which joins the two. The coil itself is stationary, allowing many more turns of wire to be used. This creates a stronger magnetic field, higher



Balanced armature diagram showing stationary coil

efficiency, and lower power consumption in a very small size. The construction of a balanced armature driver also allows considerable freedom to customize the device for particular needs. This freedom, critical to supporting a wide range of hearing aid designs, is increasingly important in hearables too.

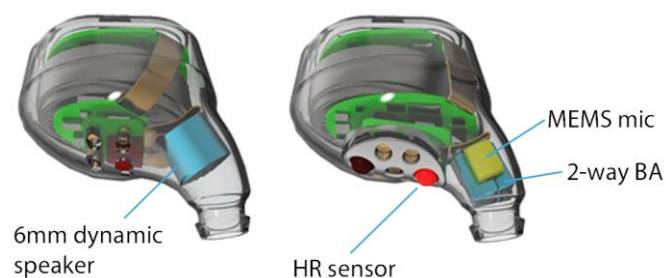
Small Size, Design Flexibility

The smallest commonly available dynamic speaker that provides acceptable sound is 6mm in diameter. Designers of hearables often choose this size in an effort to minimize the speaker volume required. However, there is a far smaller option that is increasing in popularity. Knowles balanced armature model RAB consumes only 1/3 the volume of a 6mm dynamic speaker, yet has excellent sound quality. RAB is the ideal choice when size is valued above all else. There are other options including a 2-way driver offering premium sound for hearables using higher resolution CODECs such as aptX, LHDC or LDAC.



By taking advantage of the small size of balanced armature drivers, designers have the choice of making their hearable smaller, adding features, increasing battery size, or a combination of all three.

Balanced armature drivers also outperform the typical 6 mm dynamic speaker when it comes to mechanical versatility. The balanced armature's sound port can be placed on its end, face or sides. This can help with the integration of a microphone, circuit, or other components based on packaging design constraints. Moreover, the rectangular shape of a balanced armature driver

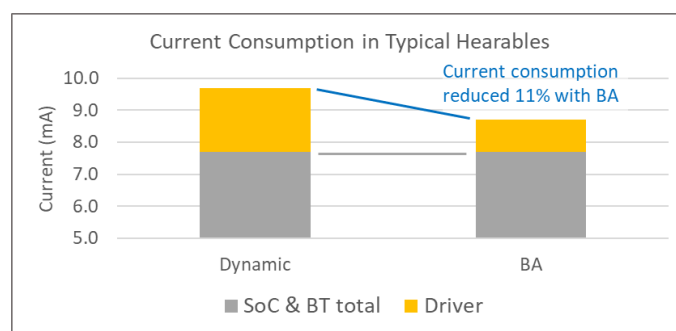


Example hearable showing added features made possible in the same volume through the use of BA

maximizes volume utilization because other components are more easily packed tightly around it.

Give Customers What They Want – Longer Battery Life

It used to be that the DSPs used in hearables consumed so much power that the speaker power was negligible. No more. Just as the speaker consumes a large fraction of total power in hearing aids due to the extremely low power consumption of their DSPs, the same is becoming true in hearables. The battery life of a modern device can be significantly improved by the use of balanced armatures. As future DSP power consumption further declines, the percentage increase in battery life with balanced armatures will go up correspondingly.



When the dynamic speaker is swapped in favor of a balanced armature, the estimated current consumption is reduced by approximately 11%.

Of most concern is how this translates into longer battery life. To confirm the power savings potential of balanced armatures, Knowles



measured the run time of a wireless earphone with either a 6mm dynamic or balanced armature model RAB installed. To eliminate changes in power consumption resulting from varying audio sources, the same song was streamed continuously. Both a Western and Asian pop song were used, with similar results. The run time increased 20% with balanced armature, or **more than an hour**.

	Asian song		Western song	
	Dynamic speaker	Balanced armature	Dynamic speaker	Balanced armature
Speaker power consumption	5.4 mW	2.1 mW	5.8 mW	2.5 mW
Play time	5.7 hours	6.8 hours	5.6 hours	6.7 hours
BA play time incr.		1.1h / 19%		1.1h / 20%

60mAh battery, 105db into 711 coupler

These results are also confirmed in an actual product. Shanling, a manufacturer of premium music devices and earphones, released two versions of its TWS model MTW100. One uses a 6mm dynamic and the other, a Knowles balanced armature. Shanling published the speakers used and corresponding run times: 6 hours for the dynamic version and 7 hours with Knowles balanced armature – **a 17% increase**.

Poised to Serve a Growing Market

True wireless earphones are rapidly evolving from music playing devices to intelligent hearables, incorporating biometrics, hands-free voice wake, dynamic hearing enhancement, and more. This added utility is driving ever-increasing demand. End-users expect to wear the next generation of hearables for longer and longer periods of time. As a consequence, customers are choosing hearables that offer

longer run times, premium sound quality, and a high level of comfort.

Knowles balanced armature drivers, which, for many decades, have enabled hearing-aid advances, now elevate the hearable experience in four very important and specific ways:

- Customization: Knowles can fine-tune its balanced armature drivers to provide exceptional clarity and pleasing audio for virtually any use case.
- Consistent performance: Knowles individually calibrates the output level of every balanced armature driver. Knowles drivers are tested to meet stringent requirements and rigorous environmental testing is performed on each new design.
- Smaller size: Allows the designer more freedom to shrink the device, increase the battery size, or add features while maintaining comfort and sound quality.
- Power savings: Knowles balanced armature drivers are ideally suited for hearables due to their low power consumption compared to dynamic drivers.

In conclusion, balanced armature drivers have proven to be a significantly better alternative to dynamic speakers from a design, size, and power efficiency perspective. Users of hearables that feature balanced armature drivers will experience greater comfort, premium sound, and longer battery life.

More information on Knowles balanced armature drivers for hearables & music earphones can be found at www.KnowlesPremiumSound.com

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