

## RIC REVOLUTION - STARKEY'S COMPREHENSIVE RIC FAMILY

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The year was 1997; scientists had cloned Dolly the sheep, and the spacecraft Pathfinder had landed on Mars. In the hearing aid industry, digital hearing aids were arriving in the market with much-anticipated hype; yet, one other groundbreaking technology was quietly setting the stage for a future revolution.

The intent of the original receiver-in-canal (RIC) design was to address problems for those losses requiring a high-gain hearing instrument — namely occlusion and feedback. By placing the receiver deep into the bony portion of the ear canal, self-generated, bone-conducted sounds would be reduced, therefore minimizing occlusion. Furthermore, Reiter et al. (1997) surmised that feedback could be eliminated by mechanical separation of the microphone and receiver along with the deep placement of the receiver into the ear canal.

Based on the original idea, the first modern RIC hearing instrument was released in the fall of 2003. This hearing instrument used a newly created modular design and consisted of a sound processor, a replaceable receiver assembly and a silicone-based soft tip.

Between 2003 and 2008, practitioners and hearing aid manufacturers began to realize the potential benefits of RIC technology. Removing the receiver from the behind-the-ear (BTE) case allowed for aesthetically improved design, and state-of-the-art feedback cancellation expanded the opportunities

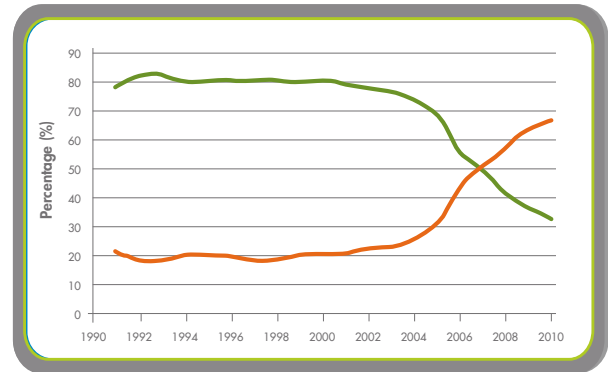


Figure 1: Market penetration for custom products (green curve) versus standard products (orange curve) from 1991 to 2010. Trends are extrapolated from Hearing Industries Association (HIA) data.

for open-canal fittings. As RIC devices of all shapes and sizes started flooding the market, a large growth trend in the behind-the-ear market was starting to take shape.

In the United States between the early 1990s and 2003, BTE hearing instruments maintained a relatively flat market share (Strom, 2010). With the introduction of the first RIC device in 2003, the market started an upward trend that has now resulted in the sales of standard devices exceeding the sales of custom devices (Figure 1).

### RIC options

As part of this revolution in hearing aid design, focus groups conducted by Starkey showed that professionals and patients alike were looking for stylish options that were comfortable when fit to the ear — something that could be attained by mimicking the ear's natural curves in case design. Other in-demand features included user controls, moisture protection, effective feedback cancellation and directionality (Galster, Yanz, & Freeman, 2008).



In the spring of 2008, Starkey released a sleek and contemporary RIC product with a painted finish, chrome microphone cover and accent-molded user control. This product did more than look good in the hand; clinical and laboratory testing showed that this device outperformed three top competitive devices in both directional microphone performance and added stable gain (Galster, Yanz, & Freeman, 2008).

With the addition of HydraShield®, a suite of moisture barriers that protects the outside as well as the inside of the device (Figure 2a and 2b), negative effects to electroacoustic performance were mitigated and all patient requirements for moisture protection had been met.

Over the next couple of years, Starkey's new products, including Zōn™ and S Series™, improved on the original design. Enhancements included the addition of a telecoil, the extension of available



Figure 3: RIC Absolute Power.

receiver gains up to 70dB with the Absolute Power custom shell (Figure 3), as well as platform and algorithm enhancements.

In January 2011, IRIS™ Technology, Starkey's wireless platform, was added to this proven, award-winning case design. This dramatic hardware upgrade introduced Starkey's Wi Series™, a platform that remains the first and only wireless hearing aid to provide ear-to-ear signal processing, direct-to-hearing aid wireless programming and far-field wireless streaming without a relay device (Galster & Burk, 2011).

Current market research shows that RICs represent approximately 37.8 percent (Strom, 2010) of all BTEs dispensed in the U.S. Moira (2011) mentions that potential hearing aid users expect discreet devices that provide an instant fit and easy replacement. With these findings in mind, it's no surprise that most RIC products are sold with size 312 or 10A batteries. As an interesting counterpoint, Kochkin (2009) notes that battery life had the highest negative rating in a survey of satisfaction. The combination of these observations suggests that a RIC product that offers a size 13 battery while maintaining a discreet form factor is a highly desirable option for prospective hearing aid users.

The lessons learned from market research, in conjunction with market demand, provided input into the requirements that fed development and clinical validation of Starkey's comprehensive RIC family: the Wi Series and X Series™ RIC 13,



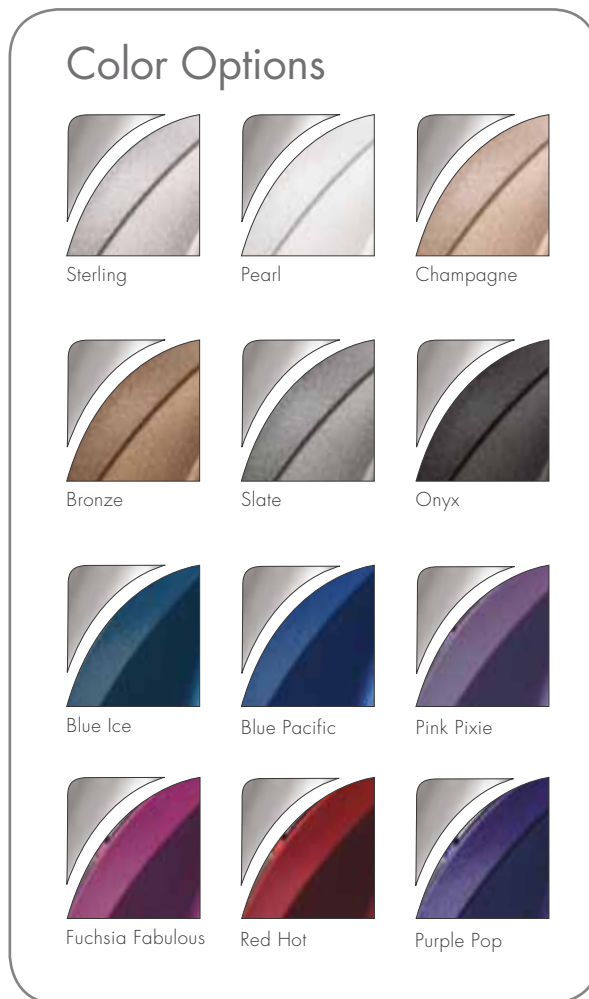
Figure 4: Wi Series and X Series RIC 312, Wi Series and X Series RIC 13, and X Series Xino™ RIC 10.

|                | General |                                |          |                           | Mechanical |                   |         |     |  |                          |                          | Algorithms     |                    |                  |                     | Wireless Features            |                     |                  |             | Accessories |                 | Other           |               |              |
|----------------|---------|--------------------------------|----------|---------------------------|------------|-------------------|---------|-----|--|--------------------------|--------------------------|----------------|--------------------|------------------|---------------------|------------------------------|---------------------|------------------|-------------|-------------|-----------------|-----------------|---------------|--------------|
|                | Colors  | Matrices                       | Memories | Adjustable Channels/Bands | Switches   | Battery Door Lock | User VC | DAI | Automatic Telecoil/Automatic Telephone | Water Resistance         | HydraShield <sup>2</sup> | Directionality | Frequency Lowering | Noise Management | Feedback Management | Environmental Classification | Binaural Processing | E2E Feature Sync | Programming | Streaming   | SurfLink™ Media | SurfLink Remote | Self Learning | Data Logging |
| <b>RIC 10</b>  | 12      | 110/40, 115/50, 128/60, 130/70 | 4        | 16, 12, 8, 6, 4           | ✓          | ✓                 | ✓       | ✗   | ✓                                      | HydraShield <sup>2</sup> | Dynamic                  | ✓              | ✓                  | ✓                | ✓                   | ✗                            | ✗                   | ✗                | ✗           | ✗           | ✗               | ✗               | ✓             | ✓            |
| <b>RIC 312</b> | 12      | 110/40, 115/50, 128/60, 130/70 | 4        | 16, 12, 8, 6, 4           | ✓          | ✓                 | ✓       | ✗   | ✓                                      | HydraShield <sup>2</sup> | Dynamic                  | ✓              | ✓                  | ✓                | ✓                   | ✓                            | ✓                   | ✓                | ✓           | ✓           | ✓               | ✓               | ✓             | ✓            |
| <b>RIC 13</b>  | 12      | 110/40, 115/50, 128/60, 130/70 | 4        | 16, 12, 8, 6, 4           | ✓          | ✓                 | ✓       | ✓   | ✓                                      | HydraShield <sup>2</sup> | Dynamic                  | ✓              | ✓                  | ✓                | ✓                   | ✓                            | ✓                   | ✓                | ✓           | ✓           | ✓               | ✓               | ✓             | ✓            |

Figure 5: Feature sets available on the Wi Series and X Series RIC 312, Wi Series and X Series RIC 13, and X Series Xino RIC 10.

Wi Series and X Series RIC 312, and the X Series Xino RIC 10 (Figure 4). Each RIC contains Starkey's leading features including Voice iQ<sup>2</sup>, the noise reduction and speech preservation system that nearly doubles noise reduction capability while still maintaining speech; Spectral iQ, Starkey's new frequency lowering technology designed to enhance real-time audibility by intelligently identifying high-frequency speech cues, then replicating them in lower frequencies; HydraShield<sup>2</sup>, adding advanced oleophobic properties to the nano-coating to better protect the hearing aids from earwax and other oily substances; and much more. An overview of the color guide and feature set are provided in Figures 5 and 6 of this article. With this family of RIC products, there is a solution for nearly every patient regardless of their cosmetic needs or hearing loss. Whether a wired or wireless RIC is required, battery life is a concern, or a telecoil or DAI is needed, Starkey's complete family of RIC products has something for everyone.

Figure 6: Standard and Bright Colors offered in the Wi Series and X Series RIC 312, Wi Series and X Series RIC 13, and X Series Xino RIC 10.



## Conclusion

Today, the advantages envisioned by the original designers of the RIC extend far beyond those listed in the original patent; these advantages have driven market trends over the last eight years and have revolutionized the hearing industry.

We have seen, whether by design or chance, the impact on the market of an instrument that meets professional and user needs. Starkey has responded to the market with a complete line of evidence-based, fully featured, small, wired and wireless RIC devices that meet both professional and patient expectations.

The year is 2011. The number of Internet users worldwide reaches two billion and scientists have grown a human heart in the laboratory from stem cells. In the hearing aid industry, wireless devices are the latest advancement, but what groundbreaking hearing instrument technology is quietly setting the stage for the next revolution?



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