Next generation RIC connector for hearing aids

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Project Leader
Sonion A/S

ATV Seminar
COTECH-DTU
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Agenda

1. Introduction to Sonion
2. RIC hearing aids & connectors
3. Future RIC connectors
   - 4 Pin System
   - 8 Pin System
Company Overview

- Founded in Denmark in 1974
- Facilities in Roskilde, the Netherlands, Poland, Vietnam, the US, and China
- ~1,900 employees
- Owned by Altor Equity Partners since June 2009
- Net revenue in 2010 ~ 677mDKK

Support the customer
Open minds
Non-compromising ethics
Innovation makes the difference
Open communication
N-joy teamwork
What We Do

<table>
<thead>
<tr>
<th>Electromechanicals</th>
</tr>
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<tbody>
<tr>
<td>User Interface</td>
</tr>
<tr>
<td>Dispenser Interface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transducers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balanced Armature Receivers</td>
</tr>
<tr>
<td>High Performance Electret Microphones</td>
</tr>
<tr>
<td>Telecoils</td>
</tr>
</tbody>
</table>

| Modules                            |

Hearing Instruments

Medical Devices

High-end Earphones and Communication Devices
## Transducers Product Range

<table>
<thead>
<tr>
<th>Series</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4400 Series</strong></td>
<td>Smallest dual receiver in the world. Ideal for CIC and RIC applications due to reduced mechanical vibration</td>
</tr>
<tr>
<td><strong>2600 Series</strong></td>
<td>Great for ITC and CIC applications. Maximum size to volume output</td>
</tr>
<tr>
<td><strong>2800 Series</strong></td>
<td>Excellent for high power ITE applications. Reduced vibration</td>
</tr>
<tr>
<td><strong>2300 Series</strong></td>
<td>Great for ITC, ITE and small BTE applications. Optimized shock protection</td>
</tr>
<tr>
<td><strong>3100 Series</strong></td>
<td>Similar performance as larger receivers in ½ the size of a 3300 and 1900. Broadband Frequency Response</td>
</tr>
<tr>
<td><strong>1900 Series</strong></td>
<td>Great for BTE applications. Wide variety of spout locations</td>
</tr>
<tr>
<td><strong>3300 Series</strong></td>
<td>Tandem twin-motor performance. 3-4dB more SPL output than other receivers. Significantly reduced mechanical vibration</td>
</tr>
<tr>
<td><strong>2000 Series</strong></td>
<td>Multiple spout- and solder pads locations. World’s highest Balanced Armature Receiver-output</td>
</tr>
<tr>
<td><strong>6000 Series</strong></td>
<td>The thinnest profile microphone model. IC design provides excellent ESD protection</td>
</tr>
<tr>
<td><strong>8000 Series</strong></td>
<td>The best EMI suppression available. Optimized for high humidity environments</td>
</tr>
<tr>
<td><strong>9000 Series</strong></td>
<td>Variety of different performance specifications. Excellent EMI and ESD protection</td>
</tr>
<tr>
<td><strong>100 Series</strong></td>
<td>Ideal for high gain ITE and BTE hearing applications. Variety of spout configurations available</td>
</tr>
<tr>
<td><strong>6900 Series</strong></td>
<td>No tubing required. Highest directivity index performance</td>
</tr>
<tr>
<td><strong>Powder-Coated Telecoil</strong></td>
<td>Most robust telecoil on the market</td>
</tr>
<tr>
<td><strong>Amplified Telecoil</strong></td>
<td>The best EMI suppression in the market. Improved frequency response with extra hum suppression</td>
</tr>
</tbody>
</table>
# Electromechanicals Product Range

**PB 100**
- Momentary push button
- 1.9 mm Ø [0.075”]
- With or without flange
- User-friendly knob

**MT 90**
- Momentary toggle switch
- 2.54 mm Ø [0.1”]
- With or without flange
- Electronic volume control

**SW 96/97**
- 2-position toggle switch
- 2.54 mm Ø [0.1”]
- With or without flange
- SW 97: without flange

**SW 511**
- 3-position toggle switch
- 3.8 mm Ø [0.15”]
- With or without flange
- SW 97: without flange

**SA 13**
- 3-position toggle switch
- 7.0 mm Ø [0.276”]
- Separate on/off switch
- Break-Before-Make

**SA 18**
- 4-position toggle switch
- 5.4mm Ø [0.213”]
- Separate on/off switch
- Break-Before-Make

**PJ 11-27**
- 2.54 mm Ø [0.1”]
- Large housing and knob style selection
- Large color selection
- Custom tapers

**PJ 62/63**
- 1.9 mm Ø [0.075”]
- Large knob style selection
- Large color selection
- Custom tapers

**DCU Scroller**
- Digital ITE/BTE
- 3.8 mm Ø [0.15”]
- 10 pulses per rotation
- Continuous rotation

**DCU 193**
- Digital ITE/BTE
- 4.0/3.8 mm Ø [0.157/0.15”]
- 5, 7, 10 or 15 pulses per rotation

**DCU 254**
- Digital BTE/ITE
- 2.54 mm Ø [0.1”]
- 10 pulses per rotation
- Continuous rotation

**PJ 185**
- Analog ITE
- 2.54 mm Ø [0.1”]
- Built-in on/off switch
- Snap-on knob

**PJ 88**
- Analog ITE
- 3.8 mm Ø [0.15”]
- Built-in on/off switch
- Snap-on knob

**PJ 77/78**
- Analog BTE
- 5.0 mm Ø [0.197”]
- Large knob and print selection
- PJ 78: Built-in on/off switch
- Break-Before-Make

**Connector Systems**
- CS 43/44/45 socket and plug
- CS 53/54 flex adaptor
- CS 73/74 snap-in module
- HI-Pro and NOAHLink Cable assemblies

**Wax Protection**
- Designed to protect the sound outlet of an acoustic transducer
- Increases the life expectancy of a hearing instrument by keeping out foreign material

For a complete product range visit [www.sonion.com](http://www.sonion.com)
Agenda

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3. Future RIC connectors
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   - 8 Pin System
Hearing aids

- **BTE** (Behind The Ear)
- **ITE** (In The Ear)
- **ITC** (In The Canal)
- **RIC** (Receiver In Canal)
- **CIC** (Complete In Canal)

RIC hearing aid
Ric Connector

- Connect the hearing aid receiver with hearing aid processor

- Mainly 2 parts
  - RIC Plug
  - RIC Socket

- Advantage/disadvantage of RIC system

RIC

BTE

www.oticon.com
Problem with current RIC socket

-Sealing problem and loss of connection
Current RIC Socket
New design of RIC Socket
Improved design - RIC Socket

-2k moulding
-Sealing ring design modification
-Overall size is smaller
## Material Selection

1. Victrex PEEK 150GL30 – from Victrex

2. Ultramid PA66 A3EG10 – from BASF

<table>
<thead>
<tr>
<th>4 TPE-S</th>
<th>Thermolast K (Kraiburg TPE, Germany)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lifoflex (Müller Kunststoffe, Germany)</td>
</tr>
<tr>
<td></td>
<td>Dryflex (Elasto, Sweden)</td>
</tr>
<tr>
<td></td>
<td>Thermoflex (PTS, Germany)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 TPE-V</th>
<th>Santoprene (ExxonMobil Chemicals, USA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uniprene (PTS, Germany)</td>
</tr>
</tbody>
</table>
2k Moulding Machine

- FormicaPlast 2K
- Manufacturer: Klöckner DESMA (Bremen, Germany)
- 2K micro injection molding machine
Machine - Structure

- Screw-less, 2 independent injection units
- Piston diameter smaller than available screws
- Fine dosing (10-400 mg part weight)
Machine - Mold Transfer

- Rotary arm
- Containing 2 mold inserts
- Shifting the inserts in 0.2 s
2K Moulding - Problems

- Poor bonding - Need Mechanical locking
- Flash problem
2k moulded Socket house

BASF Ultramid A3EG10 & Elasto Dryflex A1 602602

BASF Ultramid A3EG10 and Kraiburg TPE Thermolast K TC5PCZ
2k Moulding - Sealing ring

TPE Thermolast K TC5PCZ

TPE Elasto Dryflex A1 602602
## 2k Molding summary

<table>
<thead>
<tr>
<th>Hard</th>
<th>Soft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victrex PEEK 150GL30 - from Victrex</td>
<td>Difficult to process with DESMA</td>
</tr>
<tr>
<td>Ultramid PA66 A3EG10 - from BASF</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lifoflex</td>
</tr>
<tr>
<td></td>
<td>Thermoflex</td>
</tr>
</tbody>
</table>
Adhesion Test

- Ultramid (PA66) + Thermolast TPE
- 2k Dogbones
- 2K mold with shutter
Adhesion Test

- Open gate - better bonding for sufficient melting of two materials
- Close gate - still acceptable
Sealing test setup

- Manometer
- Guiding
- Top plate
- Water connection
- Guiding pillar
- Bottom plate
- Standard o-ring
- Core
Sealing Test

- 5 parts tested-randomly taken (PA-Thermolast)
- Resist more than 1 bar gauge pressure
- Slight problems with leakage at manometer and screws
Summary

- RIC socket integrated with sealing ring was moulded by 2k moulding
- Ultramid PA-TPE Thermolast K was selected as suitable material combination for the 2k Socket
- Tensile tests: Good adhesion
- Sealing tests: Passed
Future RIC Socket- 8 Pin System
Locking mechanism

- Drop in specific orientation
- $30^\circ$ Rotation
Advantage of 8 Pin RIC connector

- Combine the function of RIC socket and Programming socket
- Integrated sealing ring, Innovative and simple lock/unlock mechanism
- Extra terminal for additional components
- Enable simultaneous programming with feedback from user
Sonion’s COTECH demonstrators

- Ric Socket by Sonion
- Flash lense by Heptagon
- Dental bracket by EO
- LED based lamp by CRP
- Micro fluidic by GBO
- Micro cooler by Atherm
- Substrate by Gema
- aIOL by BI
Next generation of RIC Socket-Sonion

- Design is finalized
- Production phase has started

House

Lock sphere

Connection pins
# Materials for Socket

## 8 Pin Ric Socket by Sonion

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socket house</td>
<td><em>PEEK, PA or LCP</em></td>
</tr>
<tr>
<td>Contact pin</td>
<td><em>Stainless steel</em></td>
</tr>
<tr>
<td>Snap ball</td>
<td><em>Hardened tool steel</em></td>
</tr>
</tbody>
</table>

![Diagram of 8 Pin Ric Socket by Sonion](image)
Manual vs. Automated production

Manual Production ↔ Automated Production
Current production

![Image of a production component]

1mm

[Images of various production processes labeled a to f]

SONION
Rapid prototyping of 8PRC

-Machined components
Snap head

- Tite tolerance to obtain the same lock force
- Use standard ball with spot welding
- 0.7 mm ball with spot welding resist 2kg without failure
Snap head production

-0.7mm standard ball
-Spot welded
-Withstand 8 Kg
Rapid prototyping-8PRC
Rapid prototyping-8PRC

Connected Plug-Socket
COTECH plan for 8 Pin Socket

- Machining of mould components and cavities
- Moulded parts available by Oct 2011
Summary and Conclusion

- RIC hearing aid is a recent alternative to traditional BTE hearing aids, which provide superior performances and visually attractive features.

- Many of the problems associated with the current RIC hearing aids can be eliminated by the new design of RIC connector.

- Future RIC connectors will provide BTE hearing aids with more integrated functionalities, space-saving design to make hearing aids even more robust and aesthetically pleasing.
Thank you very much for your kind attention

Acknowledgement:

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