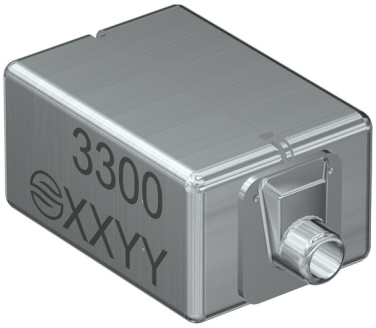
# Technical Bulletin


# 3100/3300 Receivers

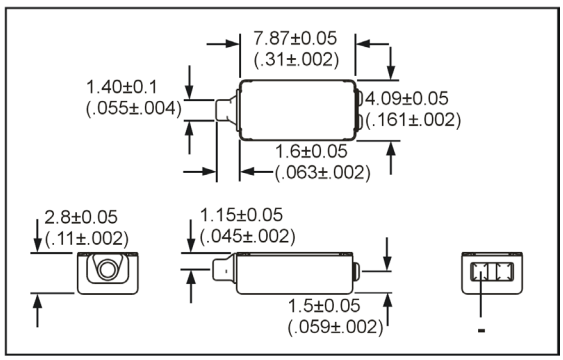
## 1. Introduction

The 3000 series receiver is ideal for applications where wide band frequency response, small size and high output are required. The 3000 series consists of two models:

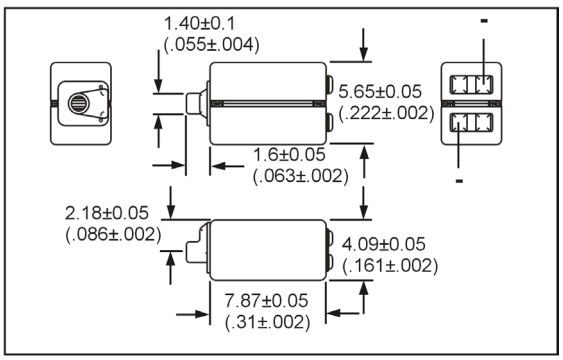
- 3100 series, featuring wide band response and output at half the size of comparable products.
- 3300 series, a dual receiver construction at the size of a single comparable product, featuring wide band response, high output and greatly reduced vibration level.

The 3100 series was designed for small BTE hearing instruments offering the same bandwidth and output as a receiver with twice its size. It is also suited for ITE instruments were high output is a requirement. The 3300 is based on a dual 3100 and in size it is equivalent to the 1900 receiver. The 3300 offers state of the art output, frequency response and vibration cancellation.

### 3100 Receiver




### 3300 Receiver



## 2. Design basics

The 3000 series is based on a completely new motor and diaphragm design. A well-balanced choice of armature and diaphragm properties made it possible to design a receiver with high output capability and large bandwidth.

The E-shape armature provides high saturation level and excellent vibration properties. The symmetric motor design limits the force output along the armature to a very low level as shown in the 'detailed performance information' section. This results in ease of use with respect to suspending the receiver in an application. Especially in the dual configuration of the 3300 the vibration force is minimized by principle of cancellation. The two identical receiver halves will cancel out each other's vibration force, greatly reducing mechanical feedback by 30 dB. The excellent vibration properties and high output capability will allow the designer to develop higher gain instruments.

The motor is provided with shock limiters in order to protect the armature for mechanical shock up to a survival rate of 90% at 15000 g. A 3000 series receiver built into a BTE style instrument will be sufficiently protected against drops up to 2.0 m (6.56') in height.
The wide band response is accomplished by a new diaphragm, designed to extend the frequency response curve up to 7.5 kHz. This feature makes the 3000 series receiver especially suitable for all modern DSP based instruments.

The 3000 series receiver is designed to be used with low output impedance amplifiers such as class D. Specific needs for class A and class B are not supported.

## 3. Models and type numbers

The 3100 and 3300 receiver is available as a standard response receiver with 12s port location. The impedance range is reflected in the type number. The table below shows available types. Please contact your local Sonion representative for other configurations.

| **3100 Series** | | | | | |
|---|---|---|---|---|---|
| **Type number** | **Nom. power level [mVA]** | **Rdc [ohm]** | **Imp 500 Hz [ohm]** | **Imp 1000 Hz [ohm]** | **U nom [V]** |
| 31A007 | 0.35 | 24 | 36 | 70 | 0.11 |
| 31A015 | 0.35 | 43 | 68 | 155 | 0.15 |
| 31A029 | 0.35 | 82 | 124 | 291 | 0.21 |
| 31A042 | 0.35 | 120 | 182 | 426 | 0.25 |
| 31A062 | 0.35 | 180 | 290 | 620 | 0.30 |

| 3300 Series, parallel configuration | | | | | |
|---|---|---|---|---|---|
| **Type number** | **Nom. power level [mVA]** | **Rdc [ohm]** | **Imp 500 Hz [ohm]** | **Imp 1000 Hz [ohm]** | **U nom [V]** |
| 33AP007 | 0.7 | 12 | 18 | 21 | 0.11 |
| 33AP015 | 0.7 | 22 | 34 | 42 | 0.15 |
| 33AP029 | 0.7 | 41 | 62 | 79 | 0.21 |
| 33AP042 | 0.7 | 60 | 91 | 121 | 0.25 |
| 33AP062 | 0.7 | 90 | 145 | 171 | 0.30 |
| **3300 Series, series configuration** | | | | | |
| **Type number** | **Nom. power level [mVA]** | **Rdc [ohm]** | **Imp 500 Hz [ohm]** | **Imp 1000 Hz [ohm]** | **U nom [V]** |
| 33AS007 | 0.7 | 48 | 72 | 84 | 0.22 |
| 33AS015 | 0.7 | 83 | 136 | 168 | 0.30 |
| 33AS029 | 0.7 | 162 | 248 | 316 | 0.42 |
| 33AS042 | 0.7 | 240 | 364 | 484 | 0.50 |
| 33AS062 | 0.7 | 360 | 580 | 684 | 0.60 |

### 3300 wire options

The 3300 receiver consists of two identical receivers therefore there are two options to wire the total receiver. Both receiver halves can be used in parallel or in series. Using the parallel circuit, the impedance and resistance will be half of the single receiver. Using a series circuit, the impedance and resistance will be twice of the single receiver. In this respect the design engineer has two impedance choices from one 3300 receiver. The pictures below show correct wiring configuration. The 3300 will also be available in a pre-prepped version, please contact your local Sonion representative for more information.

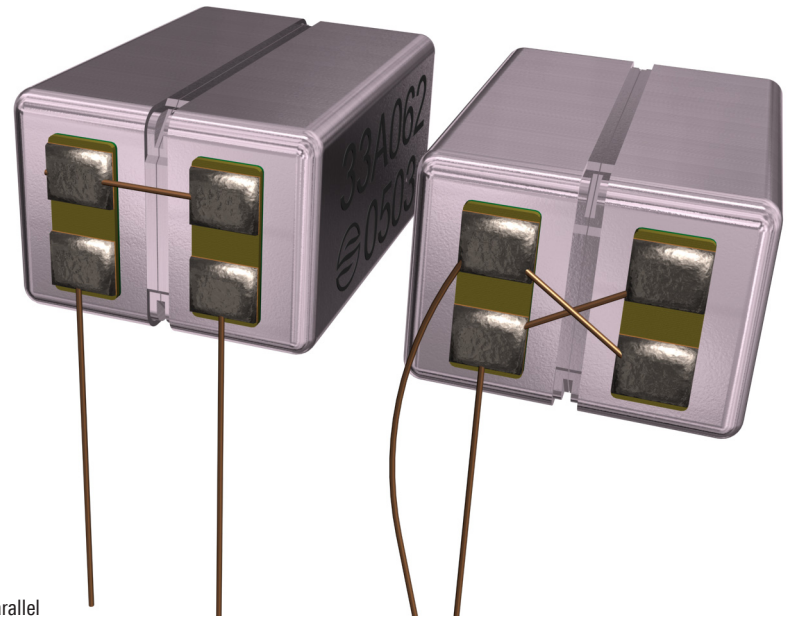


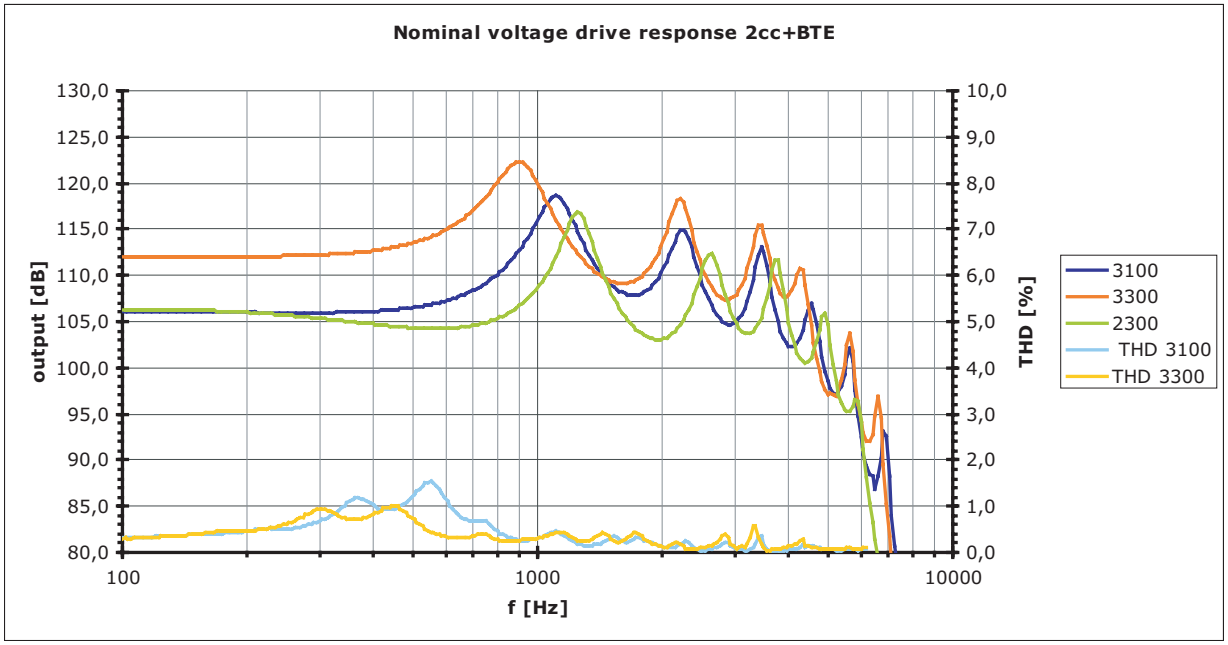

Fig1: Wiring 3300 receiver in series and parallel

## 4. Detailed performance information

### Nominal frequency response

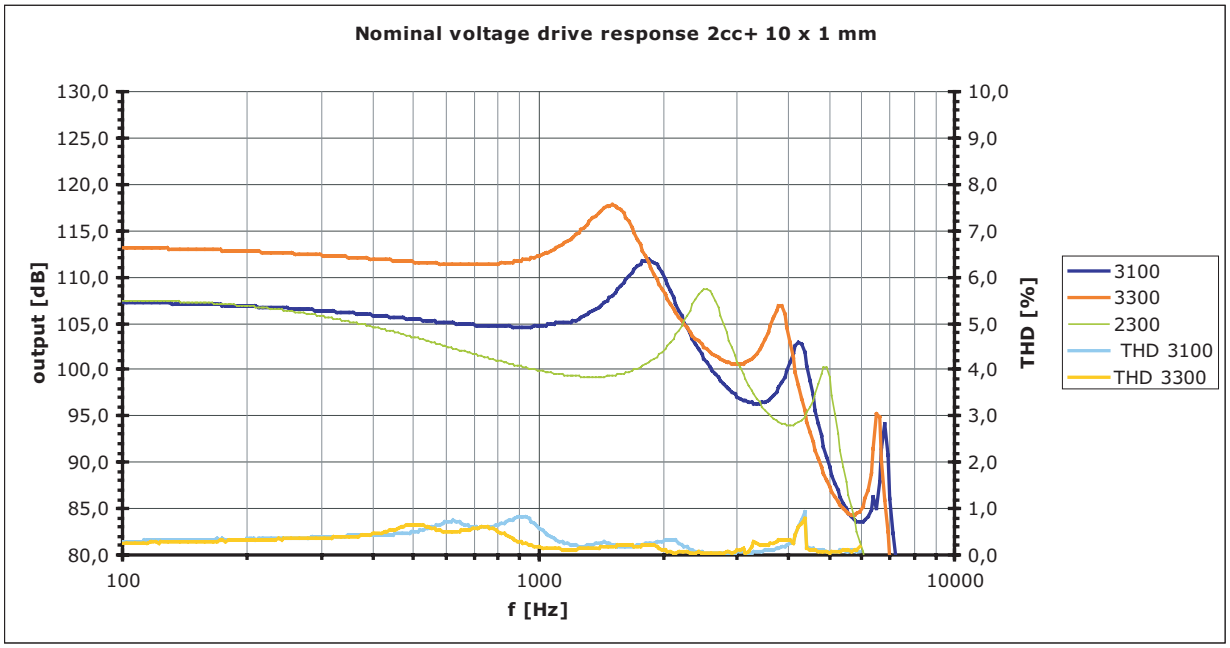
The following figures show the performance of the 3100 and 3300 receiver. For reference also 2300 receiver response is shown. The graphs normalized at the nominal dissipation level and therefore valid for all standard response receivers within the 3100 and 3300 family. For the 3100 receiver the nominal input power is equal to 0.35 mVA into the impedance at 500 Hz. For the 3300 series the nominal input power is equal to 0.70 mVA into the impedance at 500 Hz. The actual drive voltage however, depends on the impedance of the particular model.

In Graph 1 the acoustic load consists of a BTE tube (8 mm x 1 mm ID + 28 mm x 1.5 mm ID + 25 mm x 2 mm ID + 18 mm x 3 mm ID) into a 2 cc coupler. Both response and harmonic distortion are shown.




Graph 1: Nominal voltage drive and distortion for 3100 and 3300 loaded with a 2cc coupler with BTE tubing

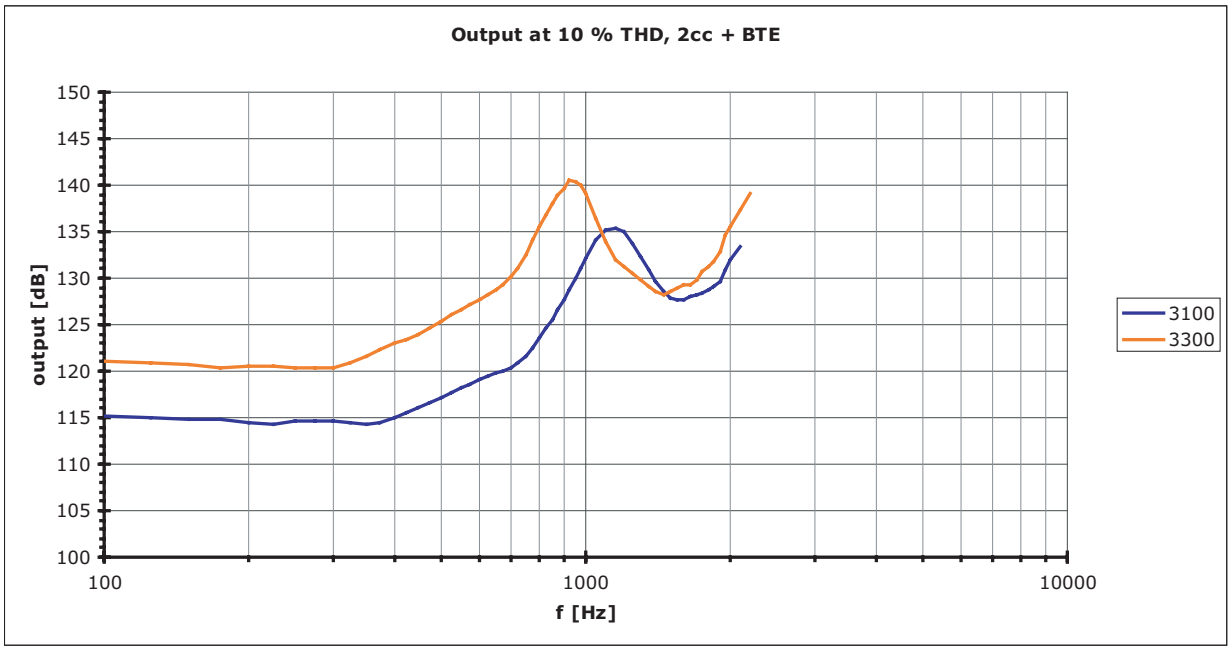
In graph 2 the acoustic load consists of ITE tubing 10 x 1 mm and a 2cc volume. Effects on frequency response using an ear simulator according to IEC-711 will be shown and discussed in graph 6 and 7. The dual construction of the 3300 shows 6 dB more low frequency output. The special diaphragm construction shows an increase of bandwidth within the 4-6 kHz area.




Graph 2: Nominal voltage drive response and distortion for 3100 and 3300 loaded with a 2cc coupler with ITE tubing

## Maximum output

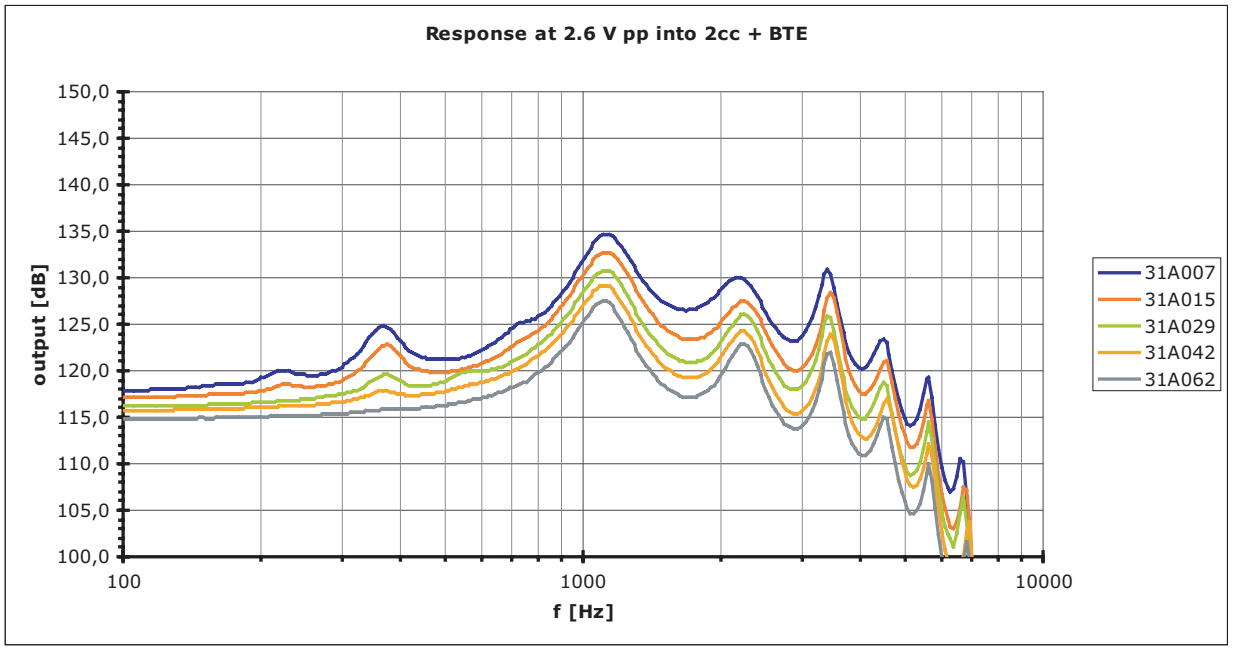
Maximum output is shown as the level before 10% distortion is reached. This is the saturation level of the receiver determined by the properties of the motor. The level is related to the dissipation and therefore similar for each model within 3100 series and also similar for each model within the 3300 series. The graph for the 3300 shows the remarkable high output capability of this receiver for its size.



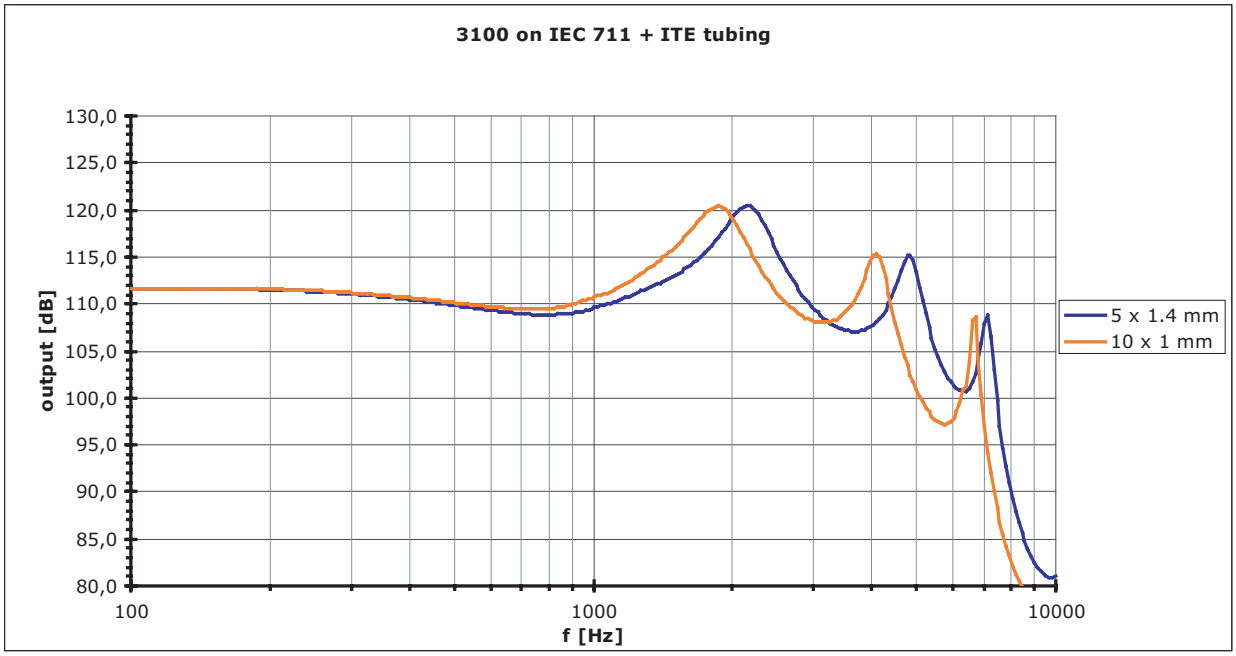

Graph 3: Output at 10% distortion for 3100 and 3300 loaded with a 2cc coupler with BTE tubing

**Maximum output applied versus impedance**

In a hearing aid application the maximum output will depend on the maximum undistorted output voltage of the amplifier that restricts the power fed into the receiver. This is associated with the receiver impedance. In practice applications with low impedance (ex. 70Ω) receivers will have maximum output determined by the saturation of the receiver. For middle or high impedance receivers, the amplifier and especially its supply voltage will determine the maximum output conditions. Graph 4 and 5 show output of 3100 and 3300 receivers for variety of impedances at 2.6 Vpp input. The 2.6Vpp figure is the maximum voltage swing of a battery driven H-bridge output stage. (Note: the graph is based on a RMS measurement) At saturation level of the receiver the high distortion contributes and can be seen in the measured frequency response. In the graph below, this high distortion can be seen as an extra peak at a third of the peak frequency. (Note: The differences in low frequency output look very small due to saturation). When operated from a lower input level the output difference between other impedance models varies from 1.6 dB (31A062-31A042) to 3 dB (31A007-31A015).




Graph 4: Response 3100 series for available impedances at 2.6Vpp sine into a 2cc coupler with BTE tubing




Graph 5: Response 3300 series for available impedances at 2.6 Vpp sine into a 2cc coupler with BTE tubing

### Amplifier considerations

The 3000 series receiver is designed to be used in combination with class D amplifiers. In the application the power consumption will greatly depend on the following: The clock frequency of the class D; the impedance of the receiver and its harmonics at this clock frequency. The low impedance 3000 versions, especially the 3300 used in parallel configuration, are best powered from a high clock frequency device (PDM) with low output impedance H-bridge. The high clock frequency will reduce the quiescent current and a low impedance H-bridge will make it possible to get all the output from a 3000 series receiver.

The table below shows possible values for the HF impedance of the receiver. The resonance frequency due to the induction of the receiver coil and parasitic capacitance of the receiver coil is also shown. Impedance will decrease for frequencies above the resonance frequency. Since the induction and impedance are related, the HF resonance frequency is inversely proportional with the nominal impedance. To show the effects of the HF impedance some measured values are shown of 3000 series receiver connected to a commercially available class D amplifier (PWM type with low 140 kHz clock frequency, Q-current 0.11 mA). The amplifier generates some electric noise that is converted into acoustic noise by the receiver. The lower the impedance of the receiver, the higher the noise level. This noise level is also shown in the table for the same circuit, measured using 2cc + BTE tubing.

| 3100 Series | | | | | | |
|---|---|---|---|---|---|---|
| **Type number** | **Z @ 100 kHz [kΩ]** | **Z @ 1 MHz [KΩ]** | **FresHF [kHz]** | **Fat HF res [kΩ]** | **A-weighted noise [dBA SPL]** | **Q current [mA]** |
| 31A007 | 1.1 | 3.9 | 3000 | 9.8 | 47.9 | 0.67 |
| 31A015 | 2.1 | 9.1 | 1600 | 13.8 | 46.9 | 0.39 |
| 31A029 | 3.7 | 18.0 | 1200 | 21.9 | 45.7 | 0.27 |
| 31A042 | 5.5 | 27.9 | 900 | 26.8 | 45.2 | 0.23 |
| 31A062 | 8.8 | 39.0 | 750 | 39.3 | 44.1 | 0.18 |

| 3300 Series, parallel configuration | | | | | | |
|---|---|---|---|---|---|---|
| **Type number** | **Z @ 100 kHz [KΩ]** | **Z @ 1 MHz [KΩ]** | **FresHF [kHz]** | **Fat HF res [kΩ]** | **A-weighted noise [dBA SPL]** | **Q current [mA]** |
| 33A007 | 0.5 | 1.9 | 3200 | 5.1 | 49.5 | 1.25 |
| 33A015 | 1.1 | 4.7 | 1650 | 7.5 | 50.1 | 0.66 |
| 33A029 | 1.8 | 9.1 | 1100 | 9.7 | 50.0 | 0.45 |
| 33A042 | 2.7 | 13.6 | 890 | 12.6 | 48.0 | 0.44 |
| 33A062 | 4.3 | 14.2 | 640 | 16.5 | 47.6 | 0.27 |

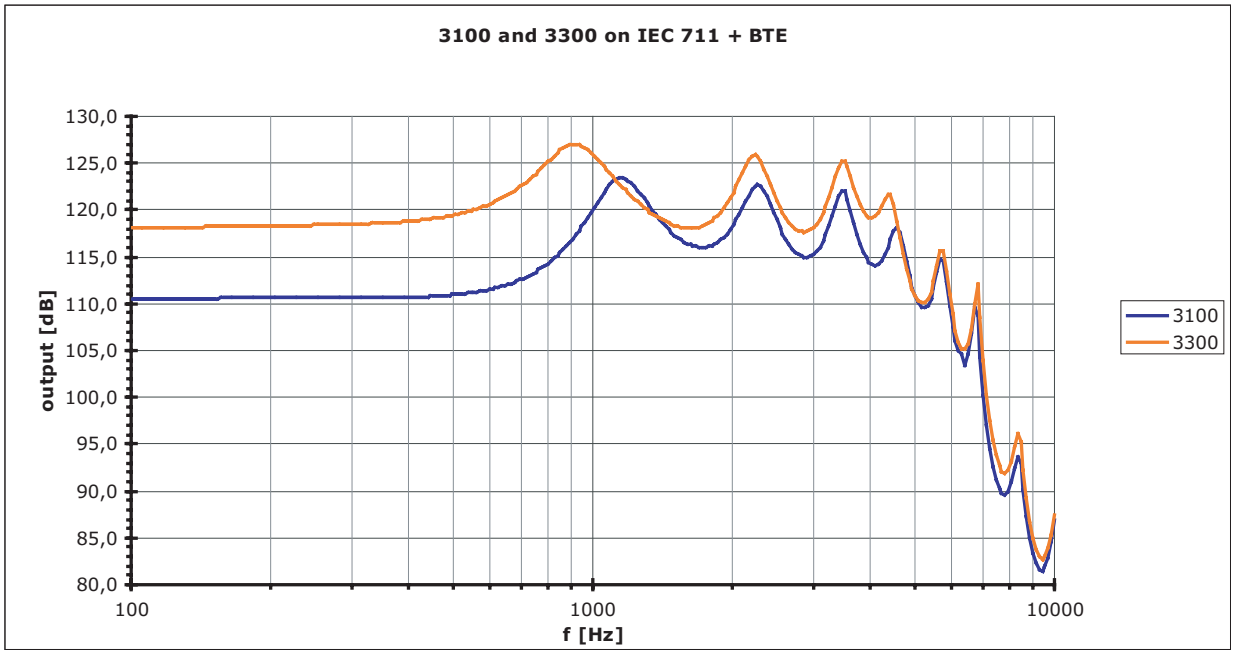
**Acoustic load and impact on response curve**

Receivers are usually specified on a 2cc coupler with BTE tubing or ITE tubing. Today there are better representations of the human ear such as the B&K 4157 (IEC-711). In practice the tubing may also be different. For example, in an ITE configuration the tube may be shorter and wider than the 10 x 1 mm used for specifications.

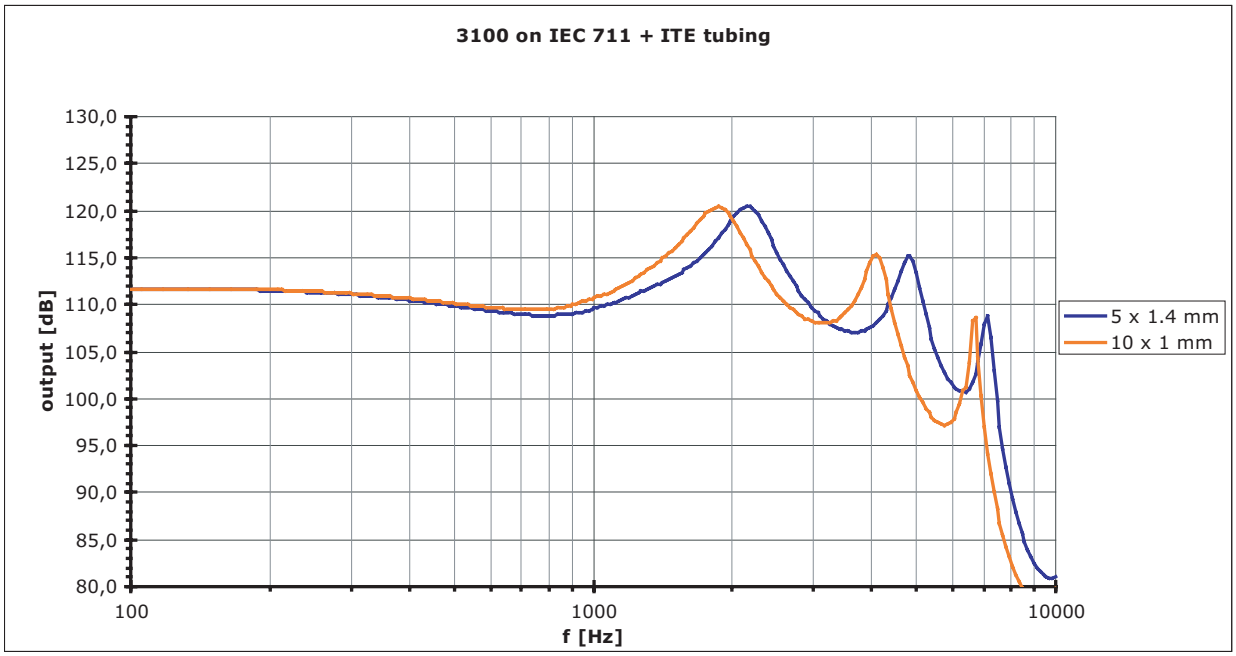
The 3000 series response on IEC-711 with BTE tubing is shown in Graph 6. The BTE tubing is similar as used with the standard 2cc coupler and consists of 8 mm x 1 mm ID + 28 mm x 1.5 mm ID + 25 mm x 2 mm ID + 18 mm x 3 mm ID.

The 3100 series response on IEC-711 with ITE tubing is shown in Graph 7. Responses are shown both with the 'standard' 10 x 1 mm and the 5 x 1.4 mm tube that better represents practical applications.

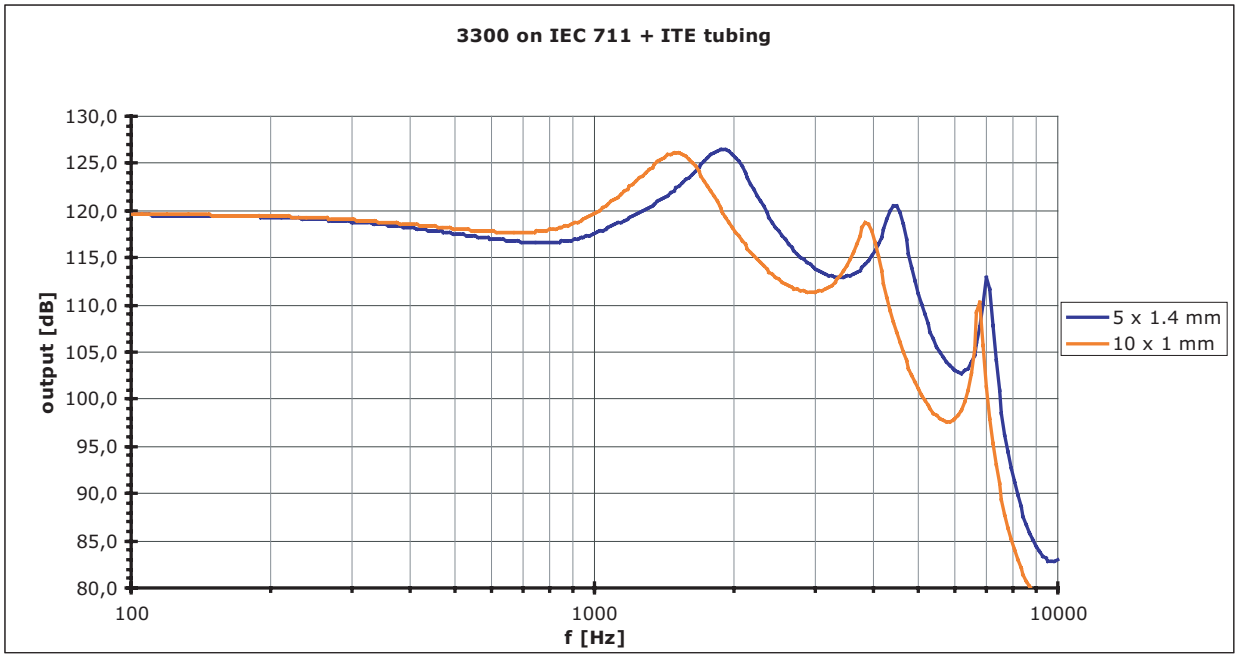
In Graph 8 the 3300 series response is shown with ITE tubing as described above.




Graph 6: Response 3100 and 3300 series on an IEC 711 coupler with BTE tubing



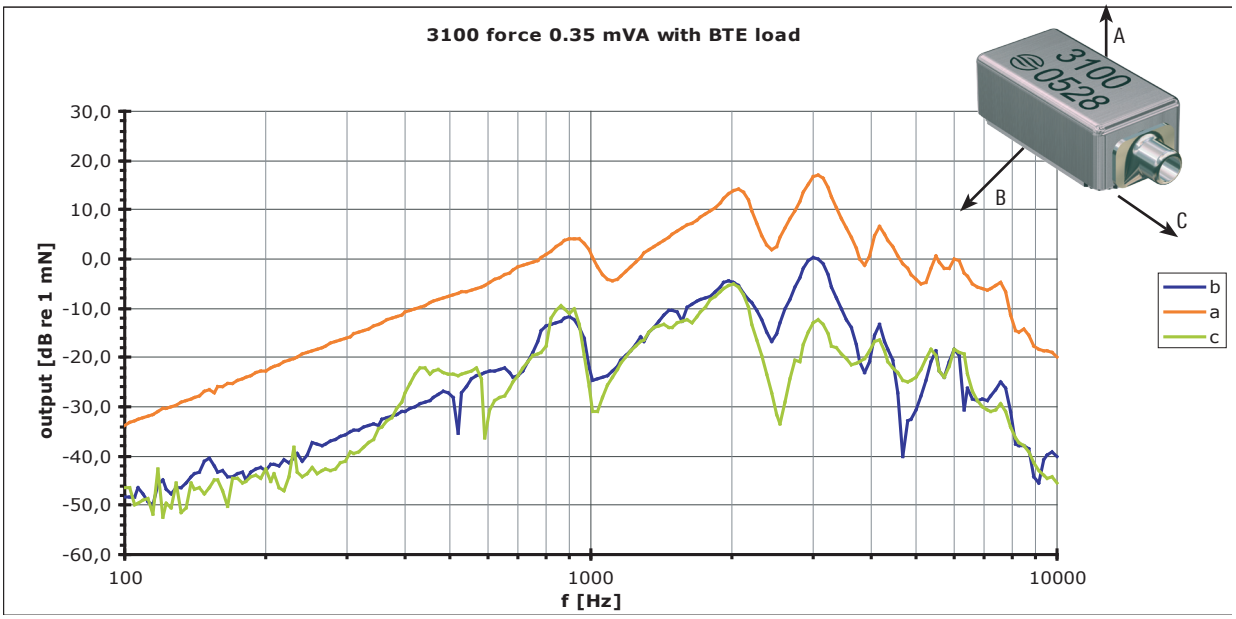

Graph 7: Response 3100 on an IEC 711 coupler with different ITE tubing



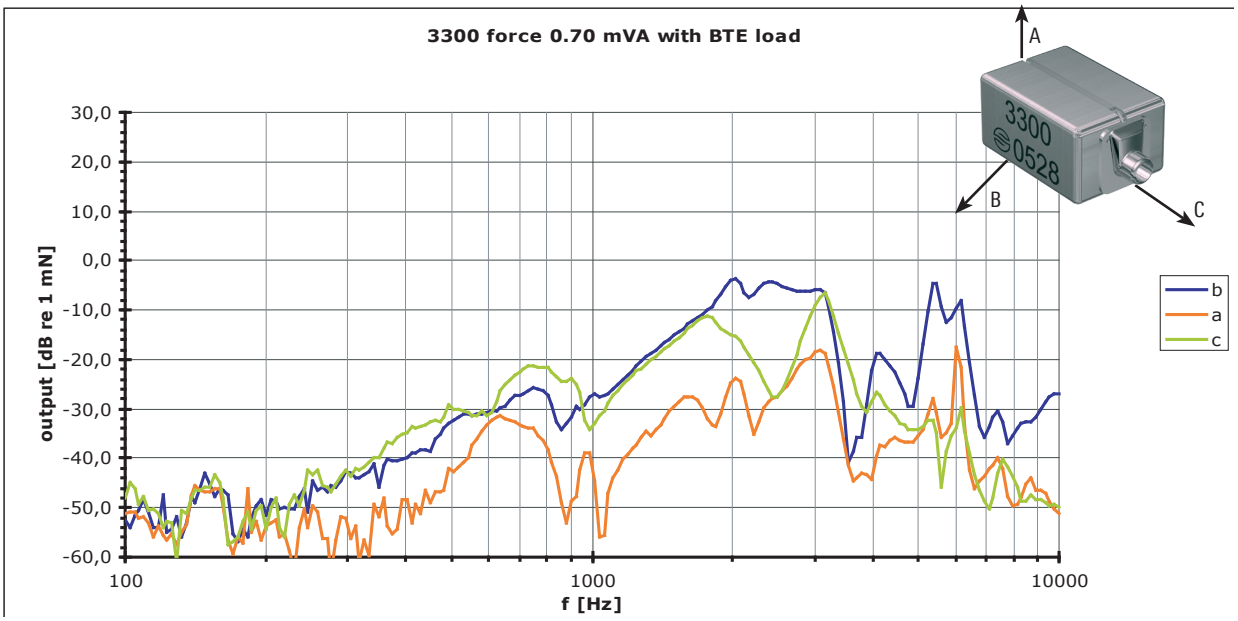

Graph 8: Response 3300 on an IEC 711 coupler with different ITE tubing

### Vibration properties

The benefits of vibration cancelling due to the dual construction of the 3300 are shown using an artificial mastoid measurement. The output is a force figure that represents the force induced by the moving parts of the receiver. Distribution figures are not a result of this test, but strongest motion will be found near the sound outlet of the receiver. This is due to the construction of the receiver, in particular the orientation of the motor with the free end of the armature located near the sound outlet. The receivers are tested using constant voltage of 0.35 mVA into impedance at 500 Hz. During the measurement the receivers are loaded with a 2 cc coupler and BTE tubing.



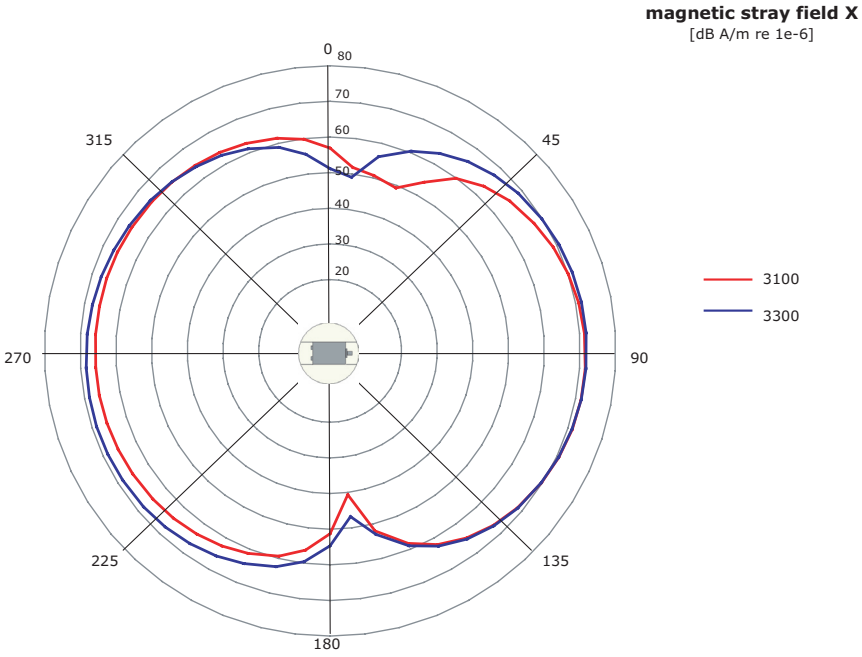

Graph 9: Force response 3100 receiver loaded with 2cc +BTE tubing



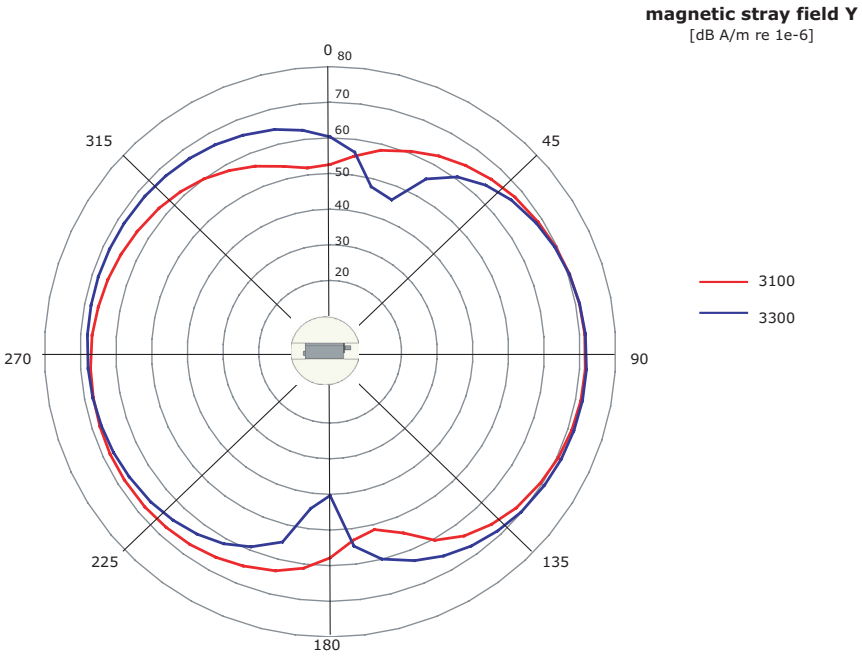

Graph 10: Force response 3300 receiver loaded with 2cc +BTE tubing

## Magnetic radiation

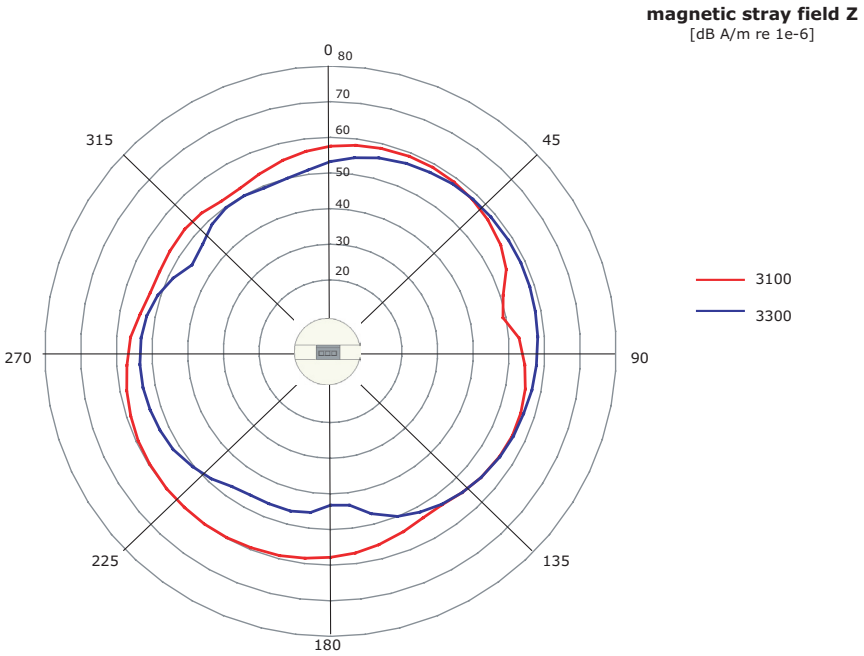
For the 3000 series design, extra attention has been paid to minimize the magnetic stray field as best as possible. This results in very low values as is shown in Graphs 11-13. (perpendicular)




Graph 11: Magnetic Stray field X




Graph 12: Magnetic Stray field Y




Graph 13: Magnetic Stray field Z

### Test set-up

All response and distortion graphs shown in this report are measured using a Rohde & Schwarz UPL analyzer. An NAD audio amplifier has been used to drive the receivers. A ½ inch B&K measuring microphone type 4134 was used in combination with a BK type 2610 measuring amplifier.