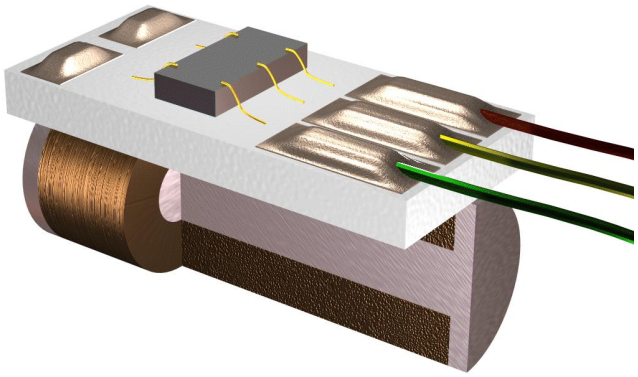

Active Telecoils

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NL: +31 20 6068 100

Introduction

For the reception of magnetic signals from telephones, loop systems or other sources, a hearing instrument can be equipped with a telecoil. Such a coil consists of a magnetically conductive core with (usually) several thousands of windings of copper wire. The sensitivity of a coil is determined by size and form of the core (e.g. adding flanges to the core increases the sensitivity with several dB's), as well as the number of windings.

Figures 1, 2 and 3 show the increasing magnetic field in a coil without core, a magnetic core and a core with flanges.

Figure 1. Magnetic field lines thru the coil.

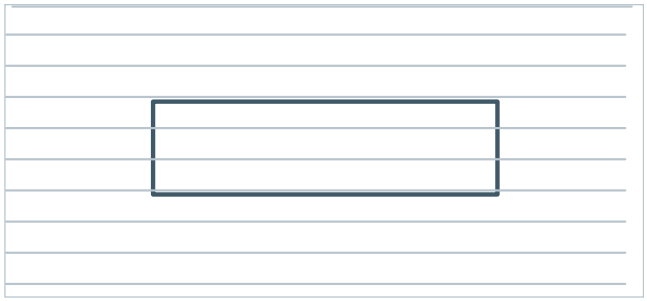


Figure 2. Magnetic field lines thru the coil with bobbin.

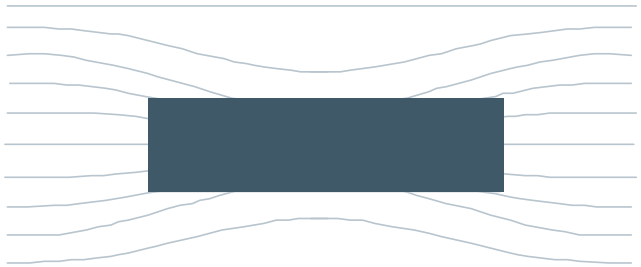
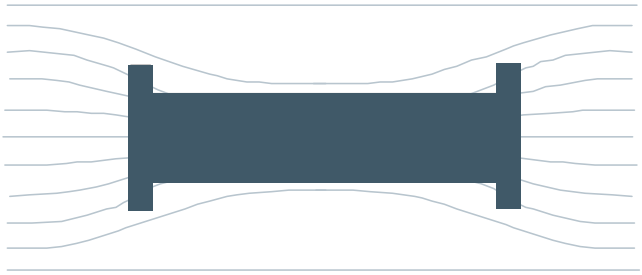


Figure 3. Magnetic field lines thru the coil with bobbin and flanges.



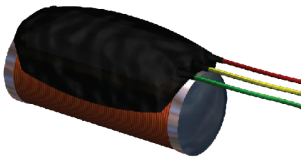
To connect a telecoil to the outside world, the very thin winding wires are connected to thicker lead wires on solderpads. Finally the coil gets a protective coating, which coating will protect the coil from environmental influences and physical damage.
Adding a specially designed amplifier/ASIC, turning the so-called passive coil into an active telecoil, can increase the sensitivity of a telecoil.
Such an amplifier is mounted on a hybrid together with some passive components. Apart from increasing the sensitivity, the amplifier circuit can also change the frequency response shape of the telecoil. This makes it easier to match the telecoil response to the microphone response (as required in the Nordic Standard 5th edition). Also certain frequencies can be suppressed (e.g. hum suppression).

Electrical Parameters

The electrical interesting parameters differ between a passive and an active telecoil.
• Passive coils: resistance, inductance, sensitivity
• Active coils: sensitivity, response curve, output impedance

Figure 4. Passive flanged telecoil

Figure 5. Active telecoil



Telecoil Part Number (PN) System

The telecoils designed by Sonion have a numbering system, which shows the different characteristics of the telecoil, for example telecoil number: TA20AE01 This telecoil consists of the following elements
:
'Type'+'Design no.'+'Serial no.'+'Assembly'
The elements are explained below:

Element	Example	Explanation
Type	T	Standard, non amplified telecoil
	TA	Amplified telecoil
Design no.	20	Designates the basic (bobbin) shape
Serial no.	AE	Variations in the coil (sensitivity, number of turns)
Assembly	01	Variations in assembly (coating, leads etc.)

Assembly

All Active Telecoils are available with variations in coating and used lead wires. The coatings vary in thickness and strength.

Cellular Phone Protection

All Active Telecoils have excellent EMI performance.
In the TA 20 series of telecoils there are two different levels of EMI suppression available.

The TA20AD01 has a superior EMI suppression above 1700MHz. This is accomplished by using a hybrid with capacitors. These capacitors are selected to have minimum impedance at the interference frequencies.

The figures 4 and 5 below show the performance of equivalent EMI noise using a Far Field Measurement.

Figure 4. Equivalent EMI performance in the range 800MHz – 1000MHz

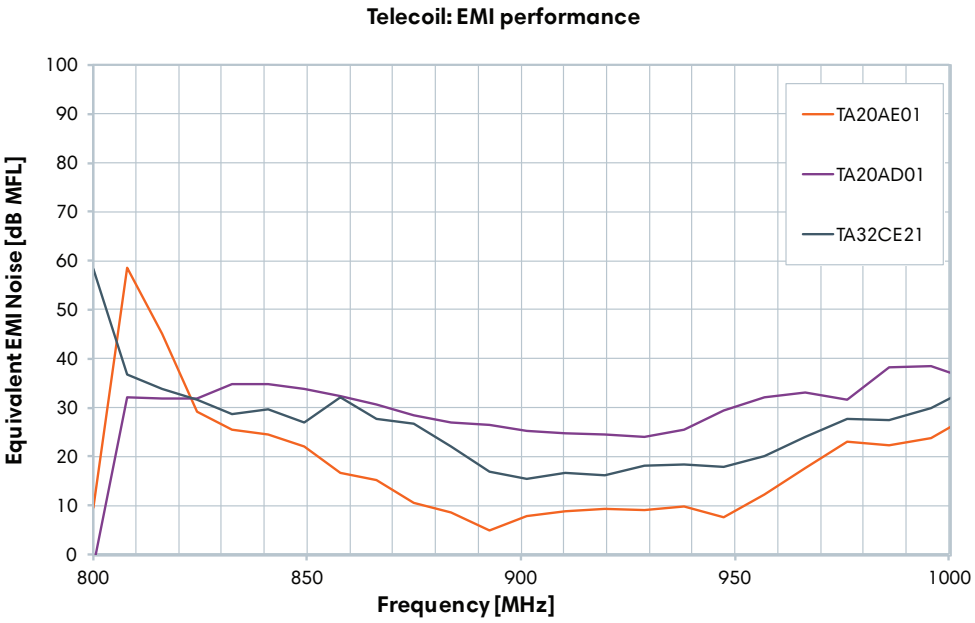
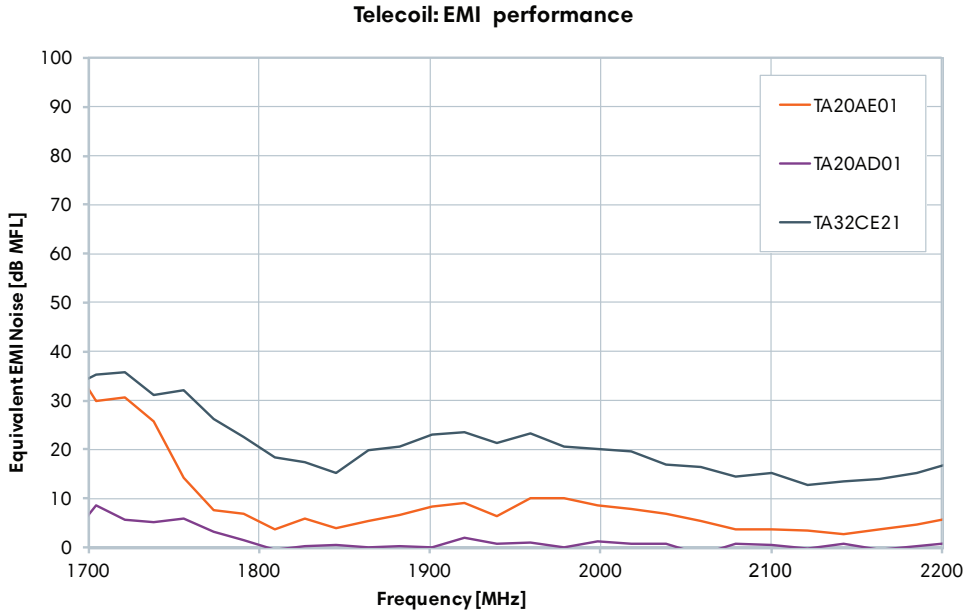


Figure 5. Equivalent EMI performance in the range 1700MHz – 2200MHz



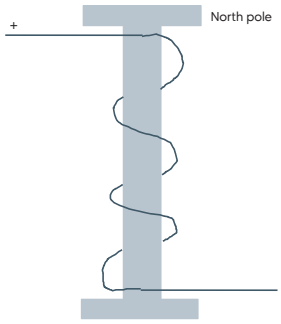
Winding Direction

The standard winding direction is 'North Positive". Refer to figure 6. This means that applying a positive Voltage at the start end of the coil creates a north magnetic pole (flux exiting) at that end.
The TA 20 and TA 32 series telecoil features the latest ASIC design for superior performance on EMI suppression and a special frequency response which combines an improved match to microphone responses with a reduced interference from disturbances in the audio frequency range.

The benefits of the design are:

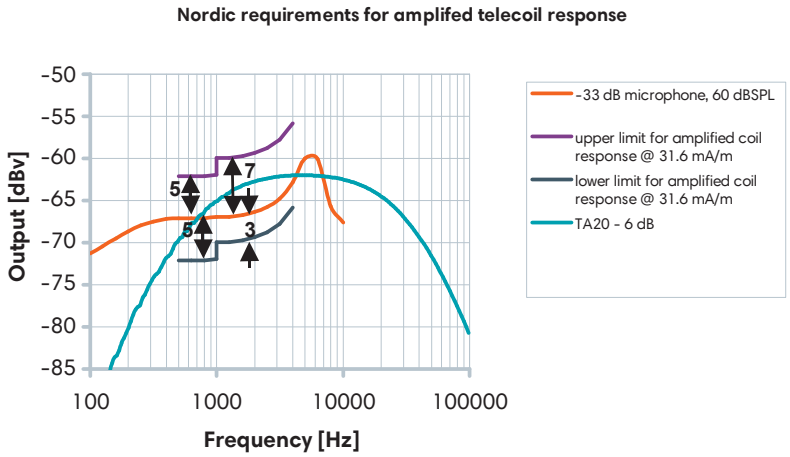
- Integrated cellular phone protection (superior EMI suppression)
- Improved frequency response
- New hum suppression filter
- Complies with the Nordic standards
- Highly durable coating for increased reliability

Figure 6. Standard winding direction of a telecoil: North Positive.



The improved frequency response results in a behavior comparable to the microphones in such a way that the Nordic standards are fulfilled. Please refer to figure 7.

Figure 7. The frequency response and the Nordic Standard requirements.



Application Information

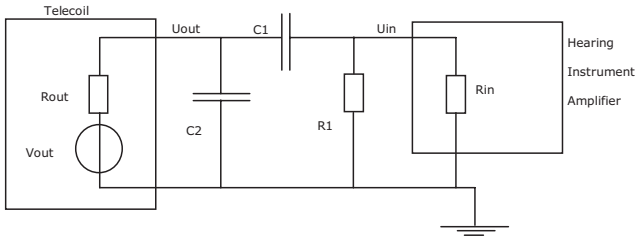
Connecting the Telecoil

In order to obtain the best EMI frequencies suppression, the wires from the telecoil to the hearing instrument amplifier have to be twisted, as short as possible and shielded if possible.

Refer to figure 8:

For a reduction of the output signal of a factor 2 the resistor R1 equals 3kΩ. C1 is required, C2 and R1 are not required.

Figure 8. Connection of the telecoil to the hearing instrument amplifier.



Please refer to figure 8. The output of the telecoil consists of an AC and DC signal. For that reason it is required to position a capacitor C1 in series with the telecoil output signal. The output impedance Rout is 3kΩ, if the input impedance of the hearing instrument amplifier Rin is 200kΩ. The required capacitor C1 value equals 10nF to obtain a high pass filter with a cut-off frequency of F1 = 80Hz.

The used formula for calculating the capacitor is:

$$C1 \cong \frac{1}{2\pi F1(Rout+Rin)}$$

In order to have extra suppression of high frequencies, capacitor C2 can be added. C2 can be calculated by:

$$C2 \cong \frac{Rout+Rin}{2\pi F2RoutRin}$$

Where F2 is the required cut-off frequency. For example an extra suppression for frequencies above 10kHz can be obtained by using C2 = 3.9nF.

The resistor R1 can be added if the sensitivity of the telecoil is too high in the application. This resistor will decrease the output signal.

$$R1 \cong \frac{UinRout}{Uout-Uin}$$

Optimal Placement of Coil in Hearing Instrument. Optimal placement of coil for minimal magnetic feedback from receiver.

Figure 9

Shows an example of the optimal placement of the telecoil for the least influence of the magnetic radiation of the receiver. This is achieved by placing the coil anti-parallel to the field lines. In the figure, the level of the magnetic field can be observed. This is an example