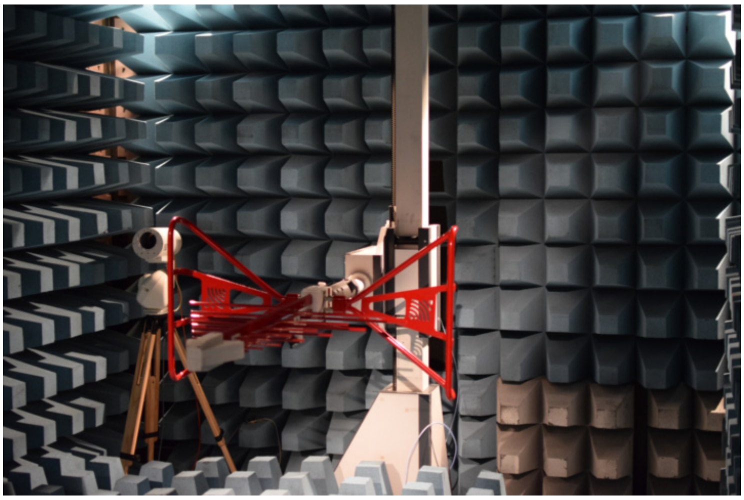
Measurement of the radiated power of 1 455 MHz body-worn PMSE

1. Purpose of measurement

a. Expanding on previous measurement at 800 and 1800 MHz body loss by DKE in 2012[1].
b. Additional information on frequency dependant effect of body absorption.
c. Suggested information for contribution, e.g. to CEPT and ITU-R.

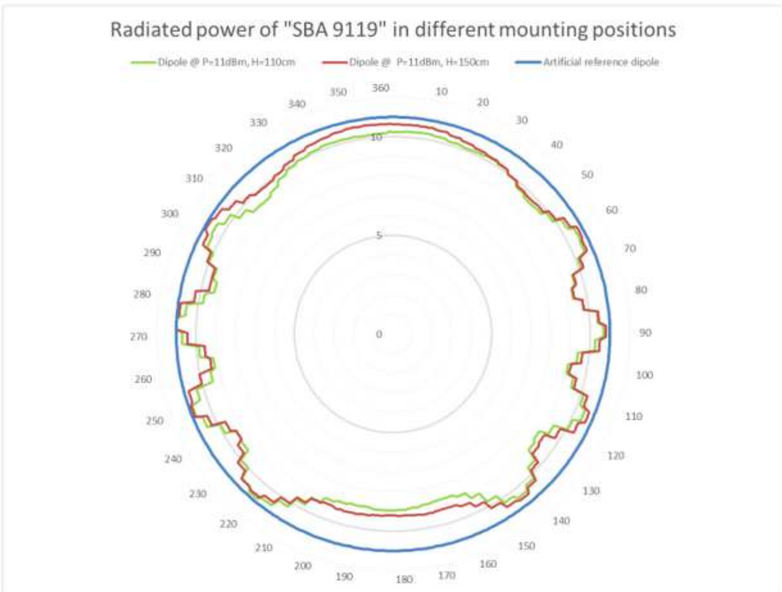
2. Measurement setup

The lab test was carried out in the EMC test chamber of Sennheiser Electronic at Wedemark (D):



3. Reference Dipole measurement

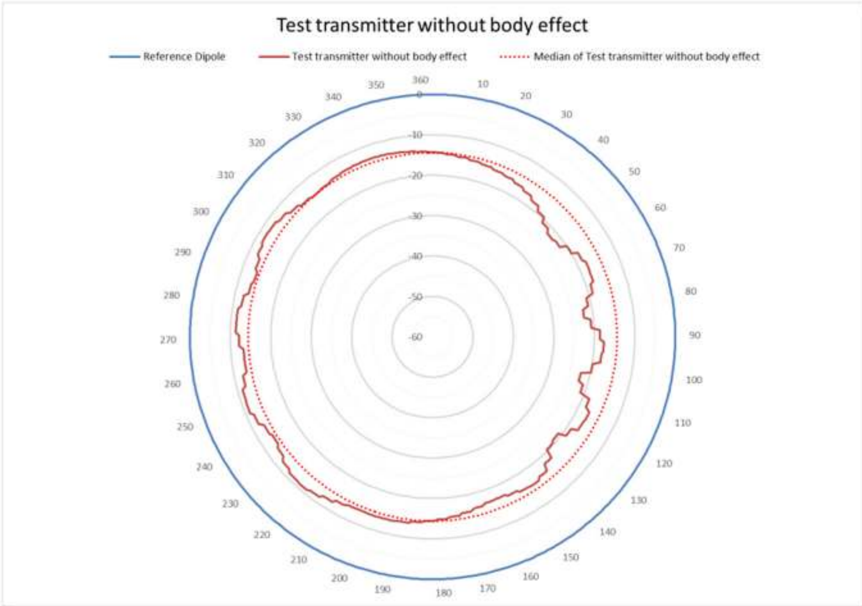
A typical wide-band dipole (SBA 9119) was mounted in the non-anechoic test chamber, placed on a wooden rotating test platform. Radiated RF power was measured at different antenna heights of 1.1 m and 1.5 m and show a significant effect of mounting position:



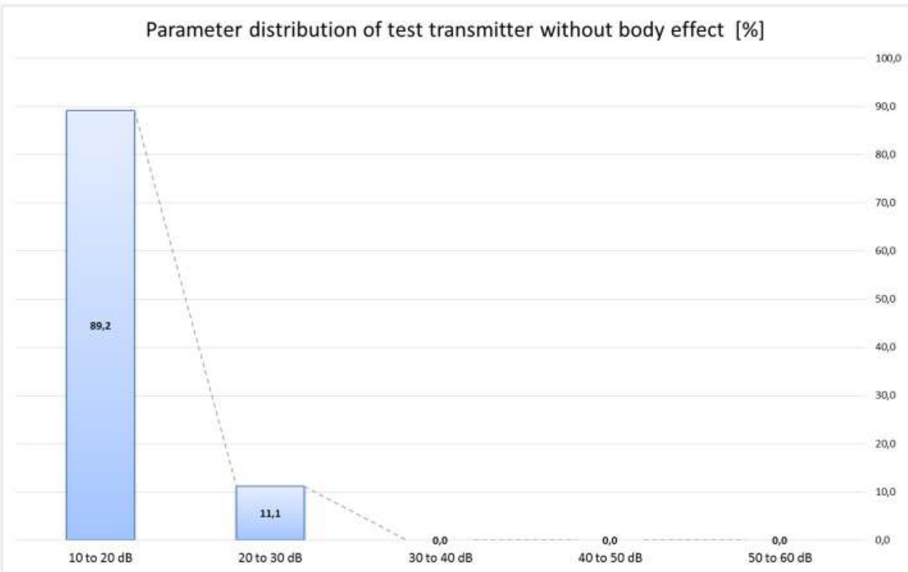
[1] http://www.apwpt.org/downloads/dke_pmse_822mhz_1800mhz.pdf

4. Body-worn transmitter in free space

Body-word PMSE are optimized for maximum radiated power when close to the human body. Without the body effect and due to the incorrectly matched antenna the 10 mW test transmitter radiates a significantly lower RF field:



The well-known vertical antenna characteristic is almost round. The real scenario differs from it, also in this test. This can be seen above in the graph of RF attenuation distribution and compares with the reference dipole measurement. The diagram unbalance mainly arise from the test transceiver design and the laboratory fastening.

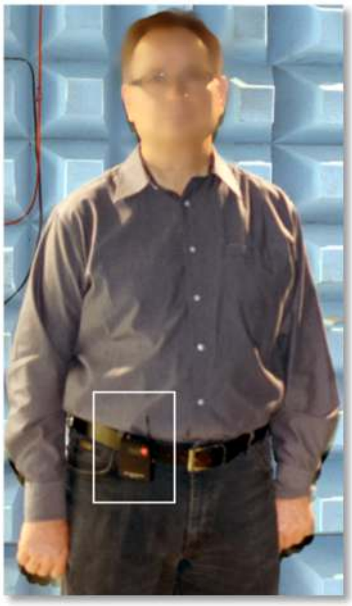


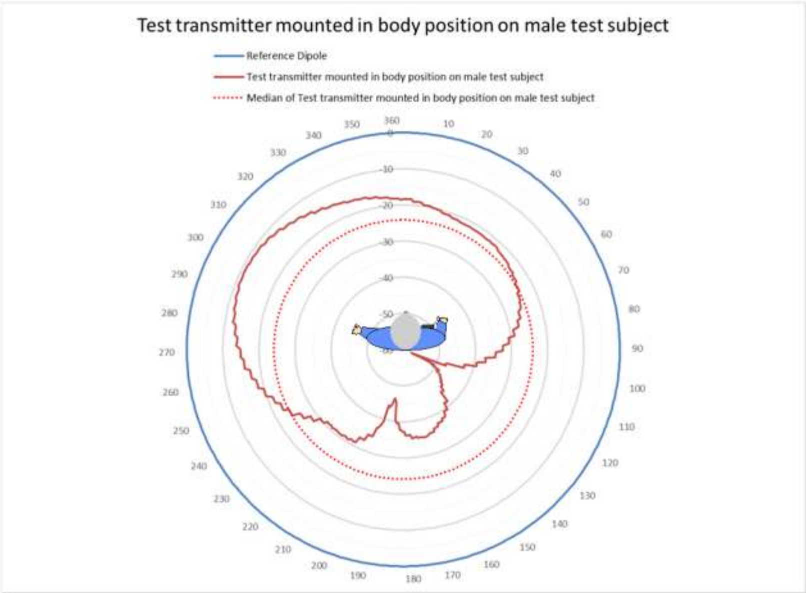
5. Body-worn transmitter

The test transmitter was mounted on a male and female test subject in two positions: on the front and then on the back.

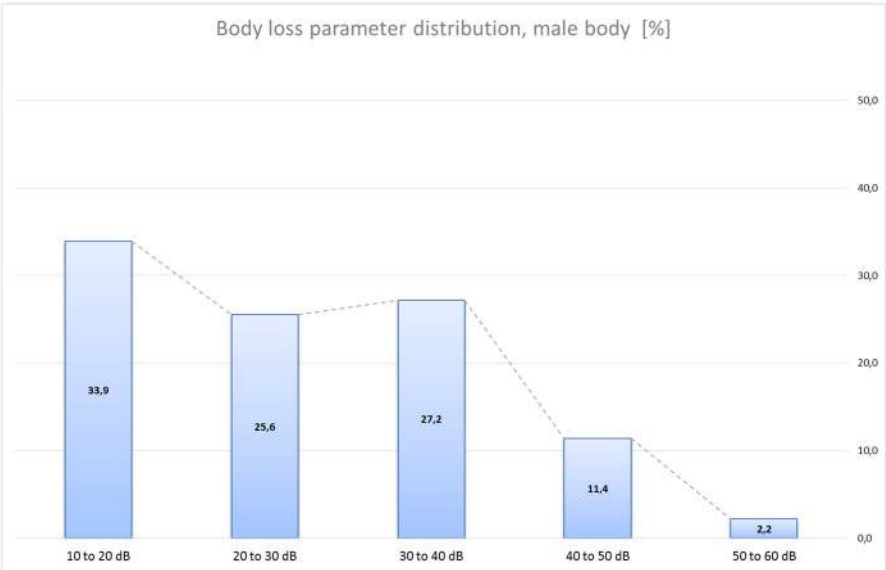
5.1 Test transceiver mounted in body position on male test subject

PMSE can be fixed on different position on the human body. In this scenario a typical body position was choose. Section 6 discusses the body effect in a symmetrical mounting position.





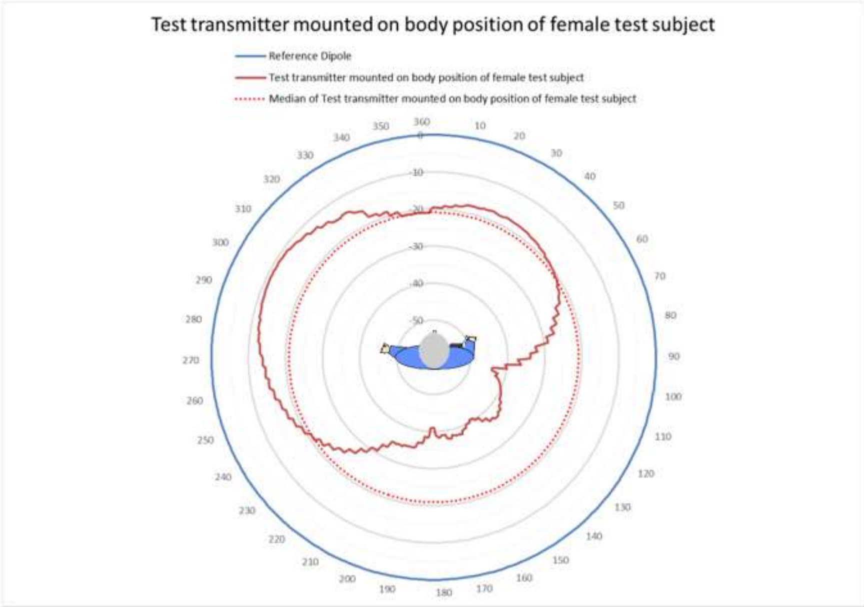
The body absorption has a significant effect on the antenna polar diagram. This is also clearly shown in the graph of body loss parameter distribution:



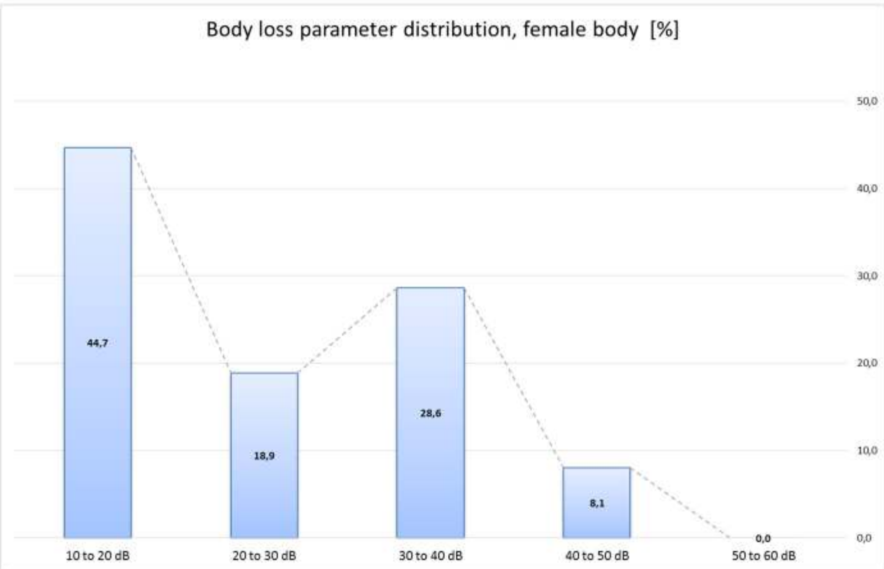
Summary of variance of measured body attenuation
Min= 11 dB / Max= 58 dB / Delta= 47 dB / Median= 24 dB / Mean= 27 dB
Note: All results were rounded on integer numbers.

5.2 Test transceiver mounted on body position of female test subject

PMSE can be fixed on different position at human body. In this scenario typical body position was choose. Section 6 discusses the body effect/absorption in a symmetrical mounting position.



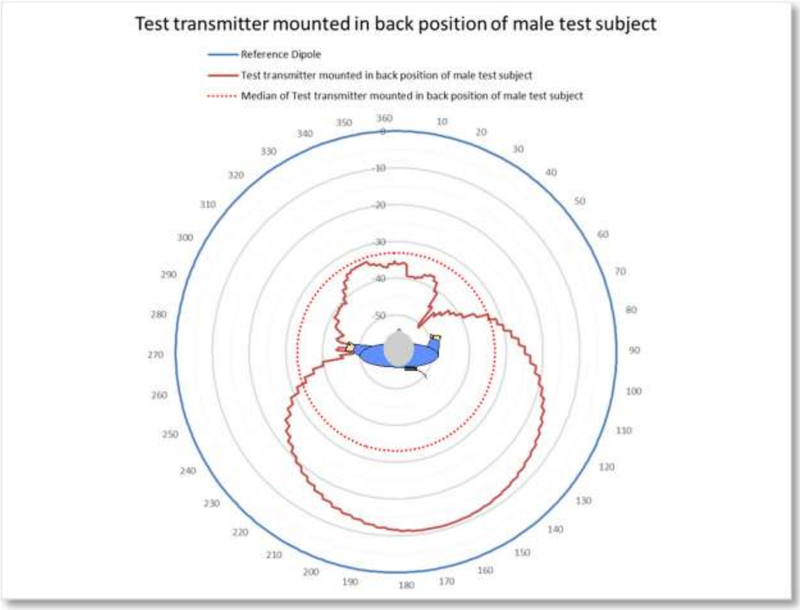
The body absorption has a significant effect on the antenna polar diagram. This is also clearly shown in the graph of body absorption parameter distribution:



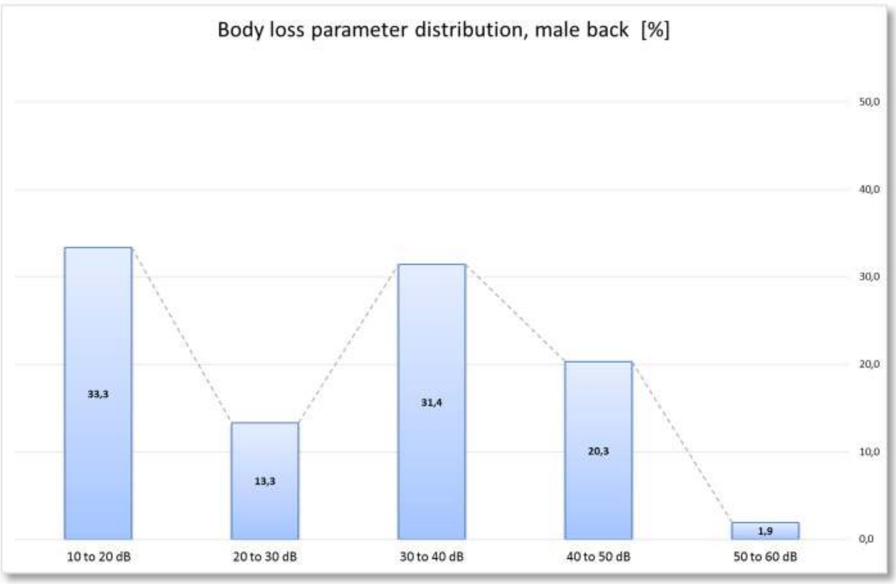
Summary of variance of measured body attenuation
Min= 11 dB / Max= 44 dB / Delta= 33 dB / Median= 21 dB / Mean= 25 dB
Note: All results were rounded on integer numbers.

5.3 Test transceiver mounted in back position of male test subject

In general a PMSE can be fixed on different position at human body. In this scenario typical back position was choose. Section 6 discusses the body effect in a symmetrical mounting position.



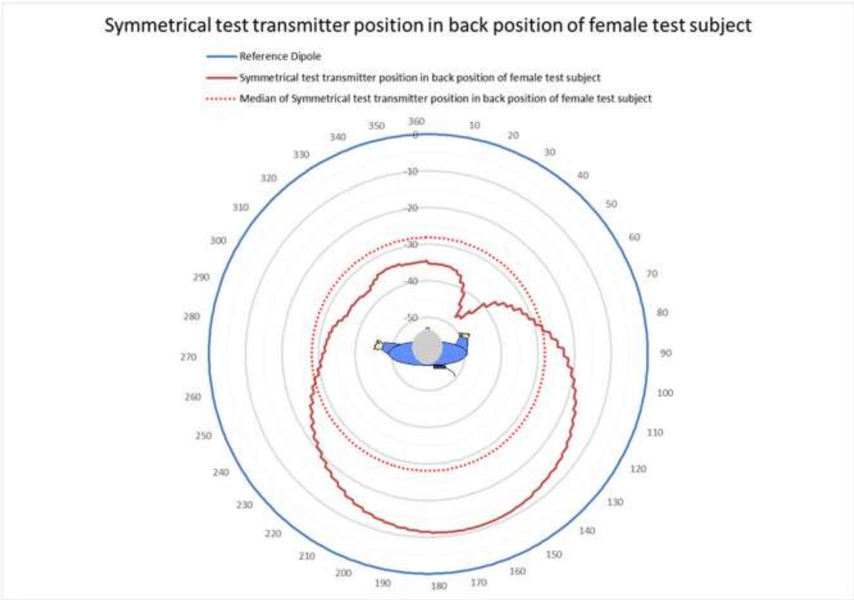
The body absorption has a significant effect on the antenna polar diagram. This is also clearly shown in the graph of body loss parameter distribution:



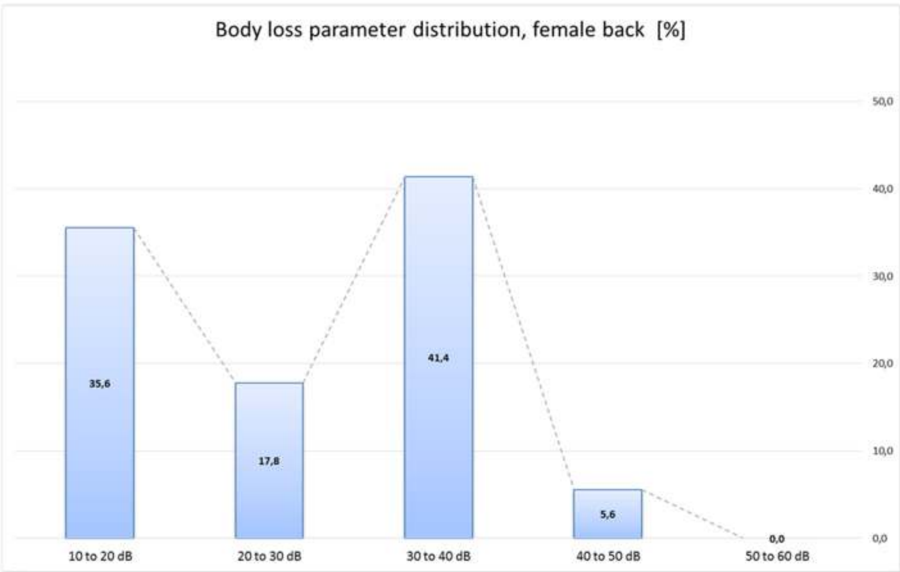
Summary of variance of measured body attenuation
Min= 11 dB / Max= 52 dB / Delta= 41 dB / Median= 33 dB / Mean= 29 dB
Note: All results were rounded on integer numbers.

5.4 Test transceiver mounted in back position of female test subject

In general a PMSE can be fixed on different position at human body. In this scenario typical back position was choose. Section 6 discusses the body effect in a symmetrical mounting position.



The body absorption has a significant effect on the antenna   polar diagram. This is also clearly shown in the graph of body loss parameter distribution:



Summary of variance of measured body attenuation
Min= 11 dB / Max= 47 dB / Delta= 36 dB / Median= 28 dB / Mean= 26 dB
Note: All results were rounded on integer numbers.

5.5 Summary table of all measured body absorption values

In practice the measured body loss absorption is used for different purposes:

- Maximum values are used for compatibility assessments.
- Median and maximum body absorption values are used to estimate the safe frequency and physical separation for the required production quality.

Note: the median and mean values are used in a number of study groups, e.g. for CEPT SEAMCAT calculations.

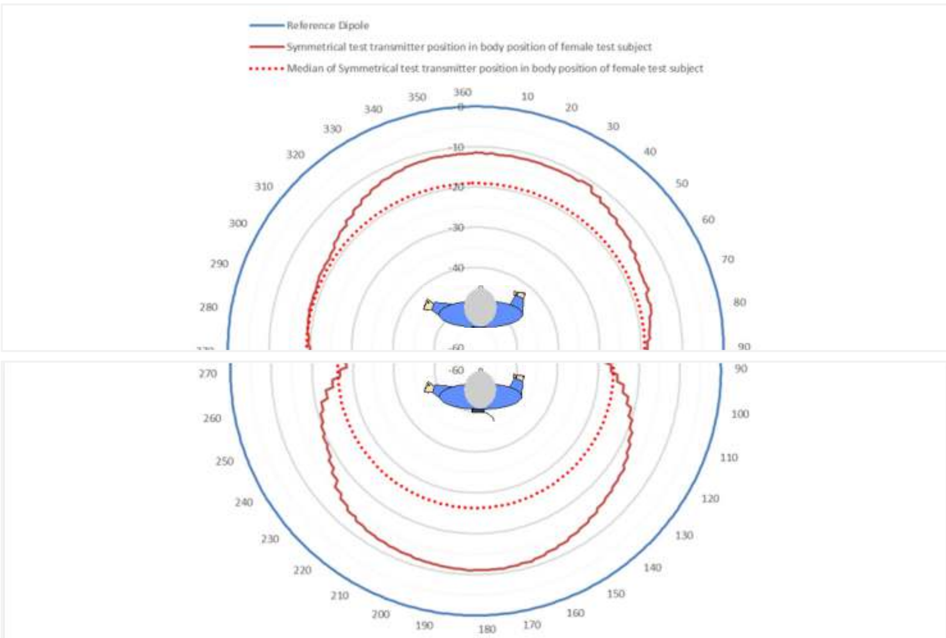
Table1: summary of measured data

Test case	Section	Min [dB]	Max [dB]	Delta [dB]	Median [dB]	Mean [dB]
Male test subject - body	5.1	11	58	47	24	27
Female test subject - body	5.2	11	44	33	21	25
Male test subject - back	5.3	11	52	41	33	29
Female test subject - back	5.4	11	47	36	28	26
Amplitude of variation	--	about 11	44 to 58	33 to 47	21 to 33	25 to 29

Note: all results were rounded on integer numbers.

6. Discussion of asymmetries in the radiated power

In section 4 and 5 we noted an unsymmetrical radiation characteristics. For clarification additional tests were carried out with a test transceiver position in the centre on human body:



7. Conclusion

The results of this lab test show significant body effect on body-worn audio PMSE, the scenarios are presented in sections 4 to 6. In every scenario the minimum body absorption exceeds 11 dB @ 1 455 MHz (see the “Min” raw in table 1). The test results distribution shows that in 43 to 66 % of all directions the body absorption exceeds 20 dB.

The median body absorption was measured was typically 26 dB (see the “Median” raw in table 1). The maximum measured body absorption, up to 58 dB, represents in worst-case a very high body effect in this frequency band.