



**Speech and multimedia Transmission Quality (STQ);
Frequency responses of Headphones and Earphones using
measurement methods and limits of STQ TS 102 924**

Reference

DTR/STQ-215

Keywords

acoustic, conformance, performance, quality**ETSI**

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

1 Scope

The present document presents measurement results of various headphones and earphones using the measurement method defined by ETSI TC STQ in TS 102 924 [i.3].

These measurement results are presented for information.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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2.1 Normative references

The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] Recommendation ITU-T P.58: "Head and torso simulator for telephonometry".
- [i.2] Recommendation ITU-T P.57: "Artificial ears".
- [i.3] ETSI TS 102 924: "Speech and multimedia Transmission Quality (STQ); Transmission requirements for Superwideband/Fullband headset terminals from a QoS perspective as perceived by the user".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

dB	decibel
dB(A)	decibel with A-weighting
FFT	Fast Fourier Transform
HATS	Head and Torso Simulator
Hz	Hertz

4 Measurement method

4.1 Test procedure

The measurement system used to measure the response curve of headphones and earphones is illustrated in figure 1.

NOTE 1: This figure refers for an earphone, but applies also to a headphone.

NOTE 2: Measurements are realized in an acoustically treated room with a noise floor less than 30 dB(A).

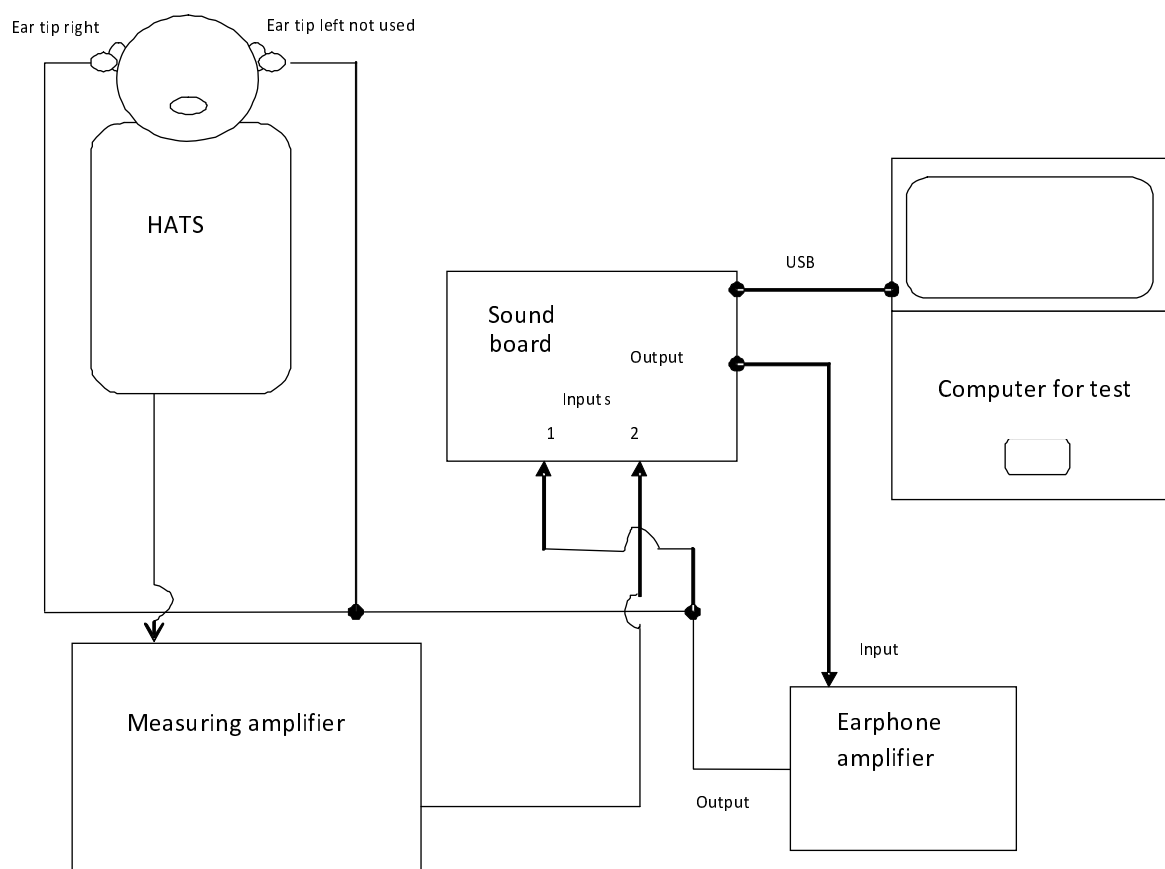


Figure 1: Test system used for headphones and earphones

The output of sound board is connected to an earphone amplifier and the output of this amplifier is connected to the device to be tested.

The device is positioned on the HATS [i.1] where Type 3.3 artificial ear [i.2] is used and the measurement is done monaurally, with the right ear.

The output of the microphone inside the artificial ear is connected to the preamp input of a measuring amplifier. The output of this measuring amplifier is connected to input 2 of the sound board.

The test signal is a full band pink noise signal that is played back by the computer. The obtained level is adjusted to reach 90 dB(A) with the full band pink noise.

The output of the measuring amplifier and electrical input (output of earphone amplifier) are recorded through the computer. Files are 48 kHz 16 bits .wav.

1/3rd and 1/12th octave analysis are provided using FFT software. Number of points for FFT calculation is 8 192. Each calculated response curve results of a difference between electrical input (input 1 of sound board) corresponding to a signal applied to earphone, and output of a measuring amplifier representative of the acoustic level on eardrum of HATS (input 2 of sound board).

NOTE 3: Each response curve results of an average over 5 measurements with a new placement of headphone or earphone each time.

4.2 Correction factor

Each response curve, obtained in both 1/3rd and 1/12th octave, is then corrected by the diffuse-field correction factor given in Recommendation ITU-T P.58 [i.1].

4.2.1 1/3rd octave correction

Freq. Hz	Corr. dB	Freq. Hz	Corr. dB	Freq. Hz	Corr. dB	Freq. Hz	Corr. dB
16	0,0	100	0,0	630	2,0	4 000	11,5
20	0,0	125	0,0	800	4,0	5 000	11,0
25	0,0	160	0,0	1 000	5,0	6 300	8,0
31	0,0	200	0,0	1 250	6,5	8 000	6,5
40	0,0	250	0,5	1 600	8,0	10 000	10,5
50	0,0	315	0,5	2 000	10,5	12 500	4,0
63	0,0	400	1,0	2 500	14,0	16 000	1,0
80	0,0	500	1,5	3 150	12,0	20 000	-3,0

4.2.2 1/12th octave correction

Freq. Hz	Corr. dB	Freq. Hz	Corr. dB	Freq. Hz	Corr. dB	Freq. Hz	Corr. dB	Freq. Hz	Corr. dB	Freq. Hz	Corr. dB
19	0,0	64,9	0,0	218	0,2	729	3,2	2 441	13,6	8 175	6,9
20,5	0,0	68,8	0,0	230	0,3	772	3,7	2 585	13,7	8 660	7,8
21,8	0,0	72,9	0,0	244	0,4	818	4,1	2 738	13,3	9 173	8,8
23	0,0	77,2	0,0	259	0,5	866	4,3	2 901	12,8	9 716	9,9
24,4	0,0	81,8	0,0	274	0,5	917	4,6	3 073	12,2	10 292	9,7
25,9	0,0	86,6	0,0	290	0,5	972	4,9	3 255	11,9	10 902	8,2
27,4	0,0	92	0,0	307	0,5	1 029	5,2	3 447	11,8	11 548	6,5
29	0,0	97	0,0	325	0,6	1 090	5,5	3 652	11,7	12 232	4,7
30,7	0,0	103	0,0	345	0,7	1 155	5,9	3 868	11,6	12 957	3,6
32,5	0,0	109	0,0	365	0,8	1 223	6,3	4 097	11,5	13 725	3,0
34,5	0,0	115	0,0	387	0,9	1 296	6,7	4 340	11,3	14 538	2,3
36,5	0,0	122	0,0	410	1,1	1 372	7,0	4 597	11,2	15 399	1,5
38,7	0,0	130	0,0	434	1,2	1 454	7,4	4 870	11,1	16 312	0,7
41	0,0	137	0,0	460	1,3	1 540	7,7	5 158	10,6	17 278	-0,1
43,4	0,0	145	0,0	487	1,4	1 631	8,2	5 464	9,9	18 302	-1,0
46	0,0	154	0,0	516	1,6	1 728	8,8	5 788	9,2	19 387	-1,9
48,7	0,0	163	0,0	546	1,7	1 830	9,4	6 131	8,4	20 535	-2,9
51,6	0,0	173	0,0	579	1,8	1 939	10,1	6 494	7,8	21 752	-3,9
54,6	0,0	183	0,0	613	1,9	2 054	10,9	6 879	7,5		
57,9	0,0	194	0,0	649	2,2	2 175	11,7	7 286	7,1		
61,3	0,0	205	0,1	688	2,7	2 304	12,6	7 718	6,7		

5 Response curves and standard deviation

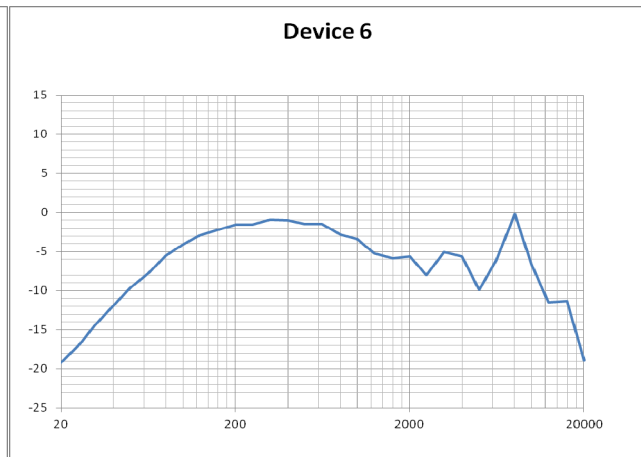
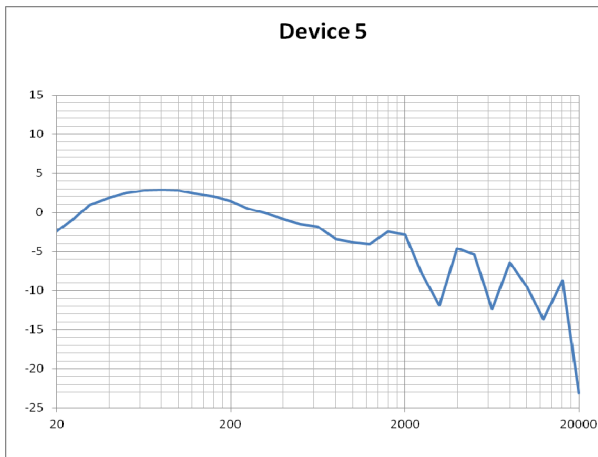
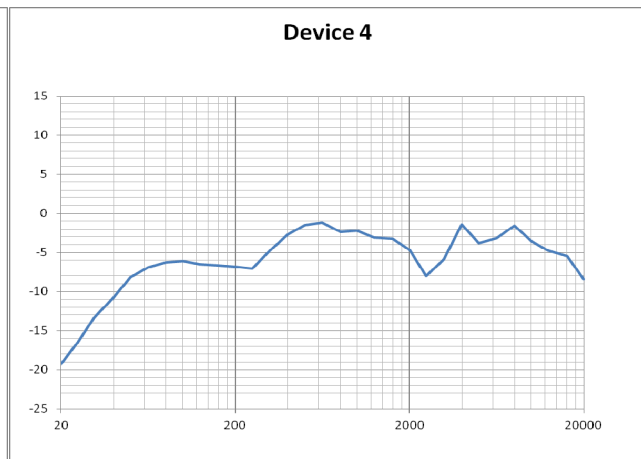
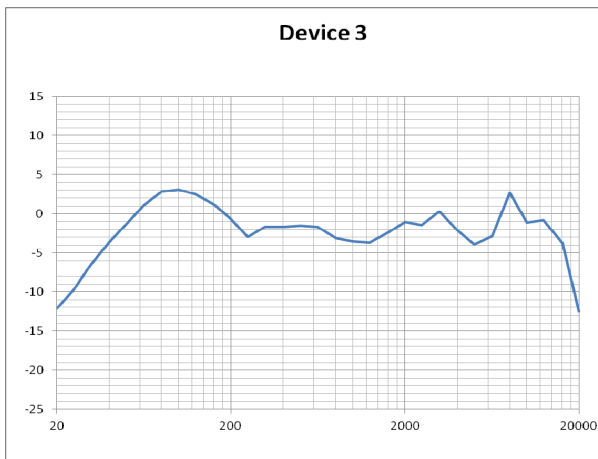
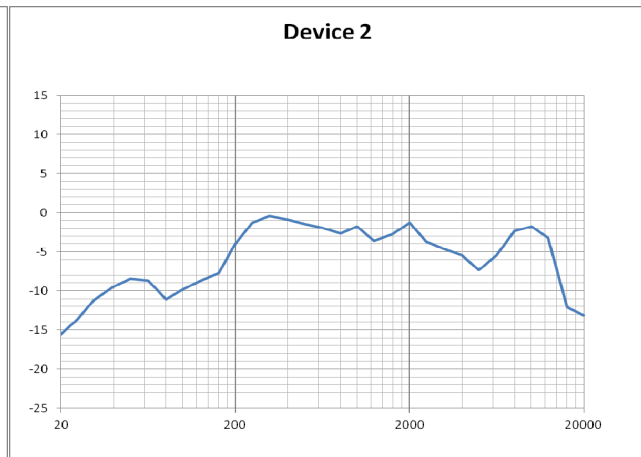
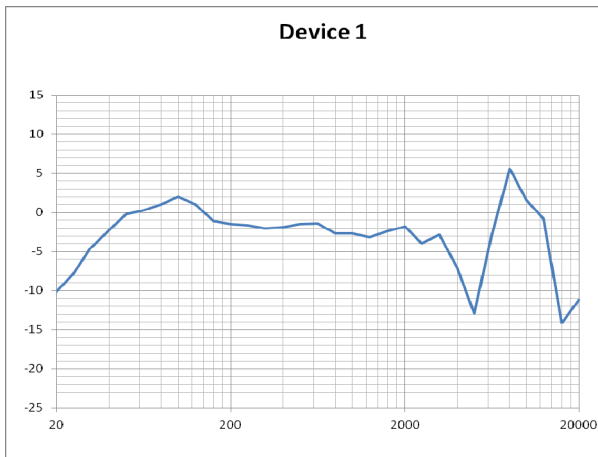
16 headphones and earphones have been measured in Orange laboratory at Lannion and in Lacroix Electronics Solutions laboratory at Quimper.

5.1 List of headphones and earphones

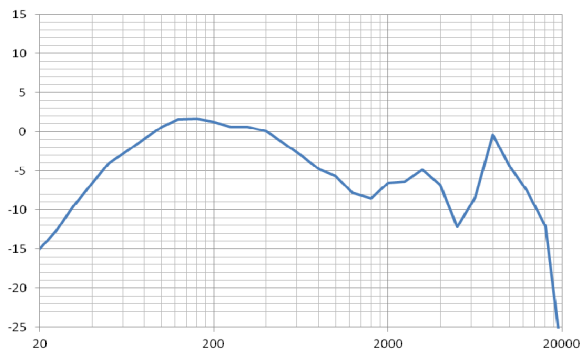
- Device 1: supra aural closed back; good quality headphone
- Device 2: circum aural closed back; good quality headphone
- Device 3: circum aural closed back; good quality headphone
- Device 4: circum aural closed back; good quality headphone
- Device 5: supra aural open back; average quality headphone
- Device 6: circum aural open back; good quality headphone
- Device 7: circum aural open back; good quality headphone
- Device 8: circum aural open back; good quality headphone
- Device 9: circum aural open back; high quality headphone
- Device 10: circum aural open back; high quality headphone
- Device 11: no name, supra aural open back; low quality headphone
- Device 12: intra auricular; good quality earphone
- Device 13: intra auricular; good quality earphone (same as Device 12 with a different tip)
- Device 14: intra aural; average quality earphone
- Device 15: handsfree kit for smartphone, intra aural; average quality earphone
- Device 16: intra concha ("button" type); average quality earphone

NOTE: Criteria about quality given here refer to cost and reputation of the product, and subjective audio test.

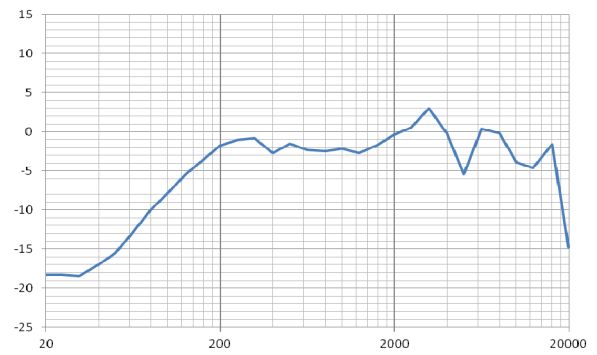
5.2 1/3rd octave frequency response curves



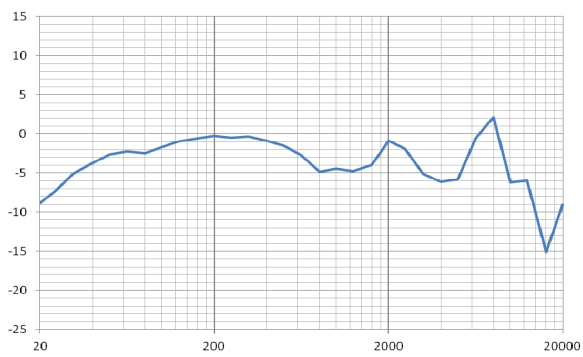
Device 7



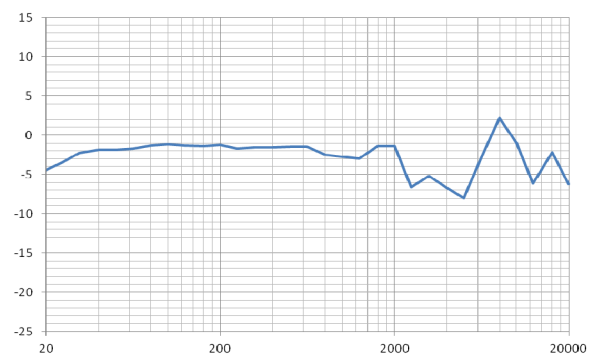
Device 8



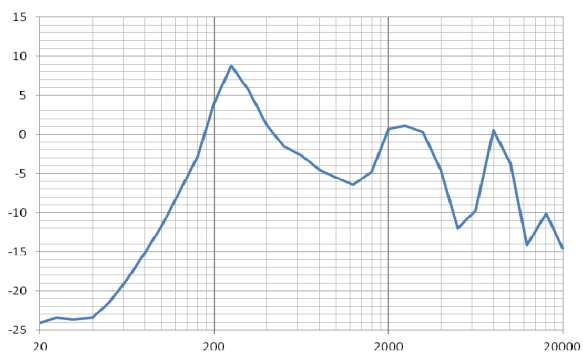
Device 9



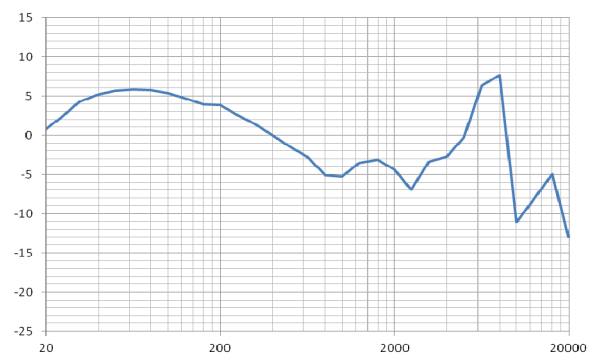
Device 10

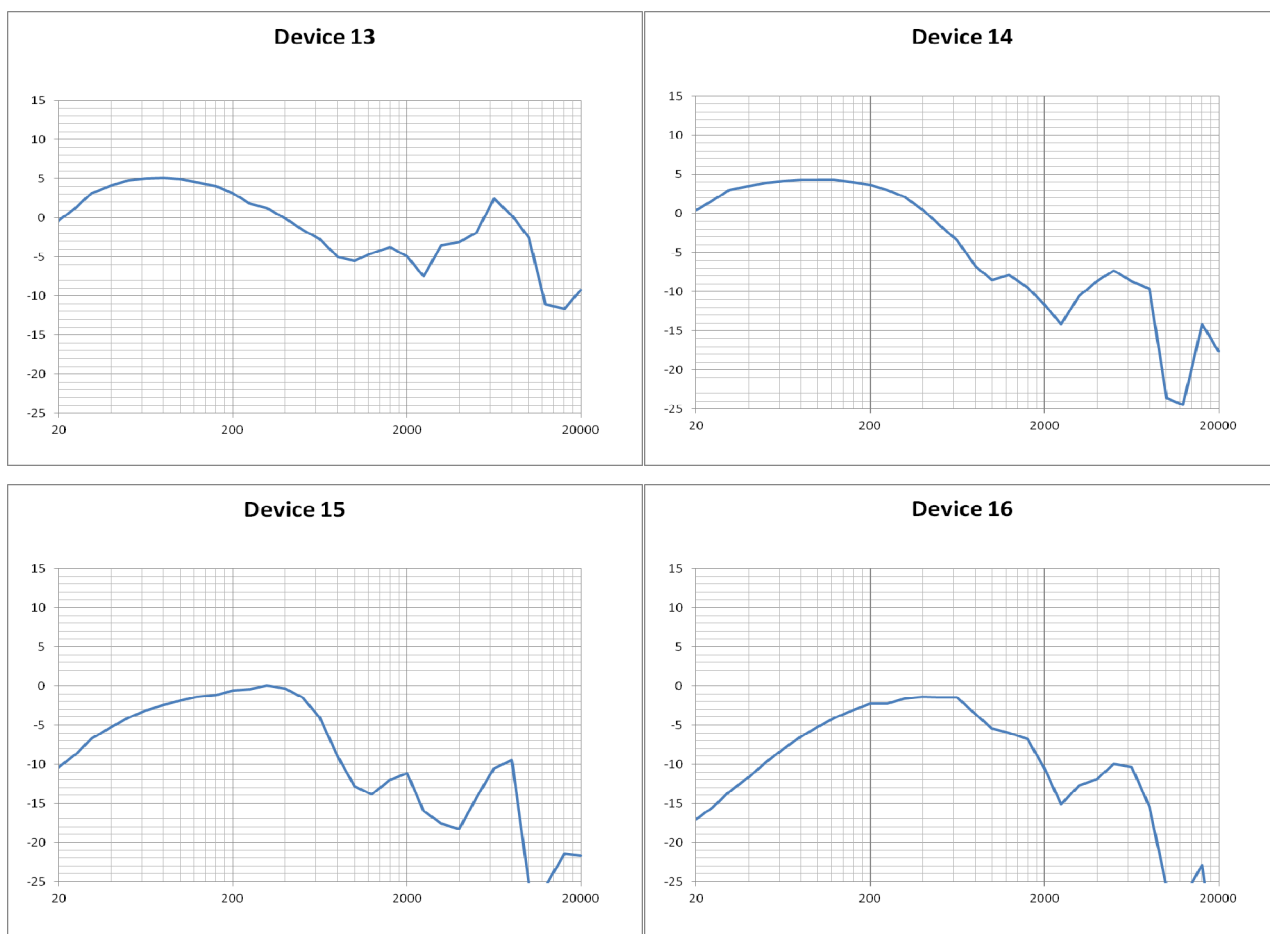


Device 11

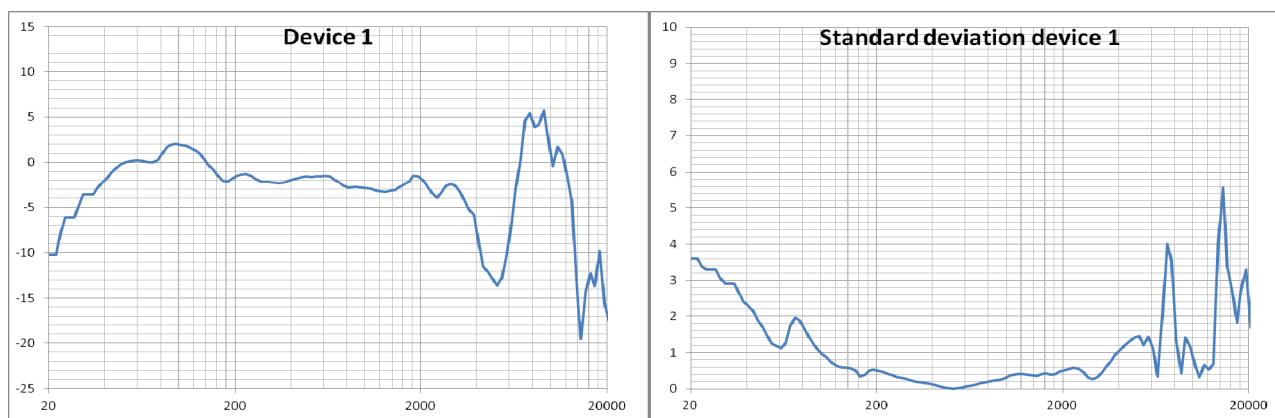


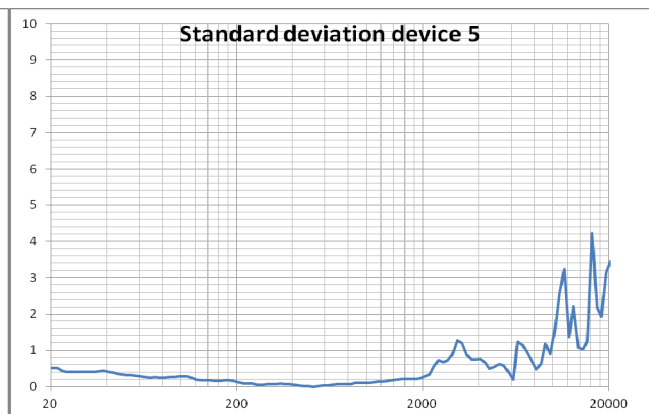
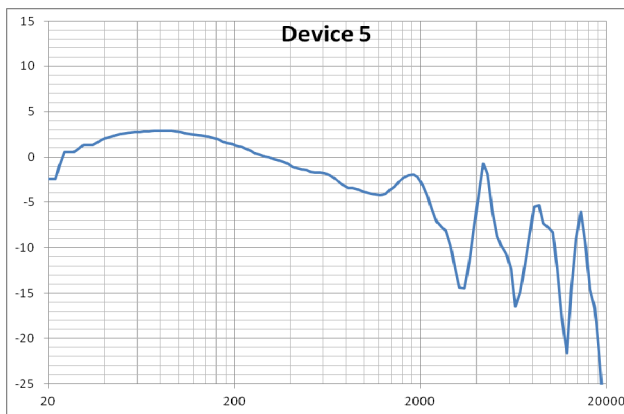
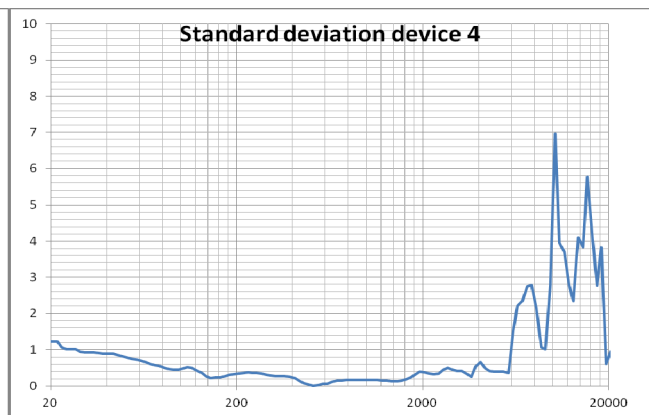
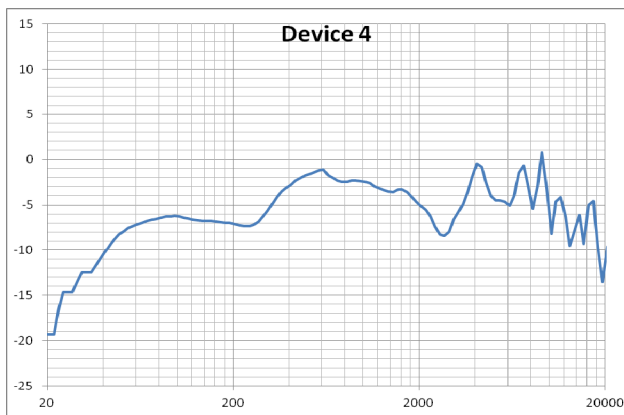
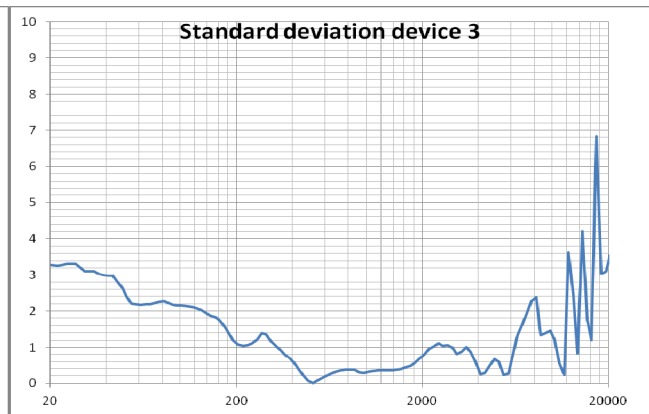
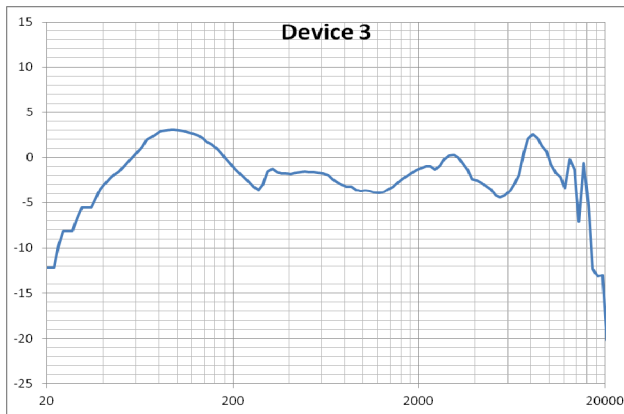
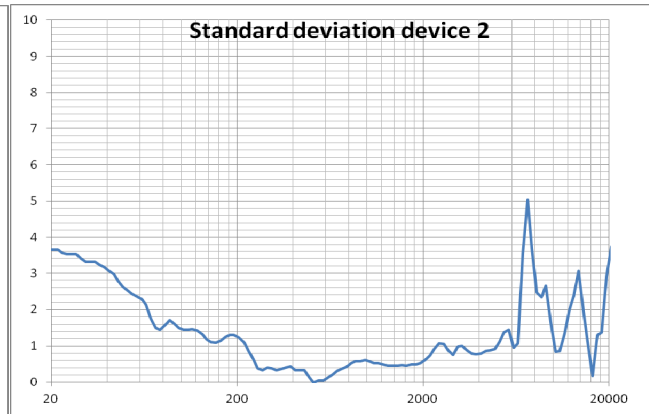
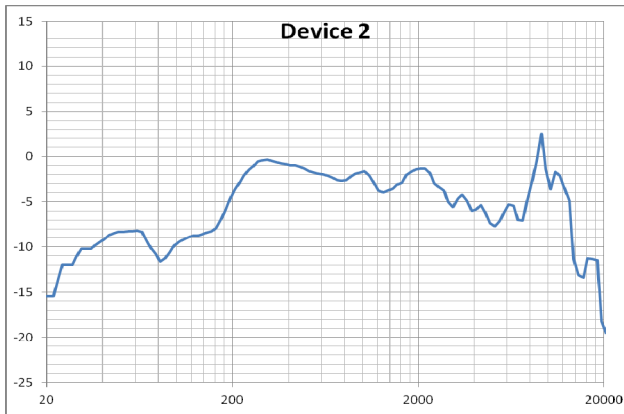
Device 12

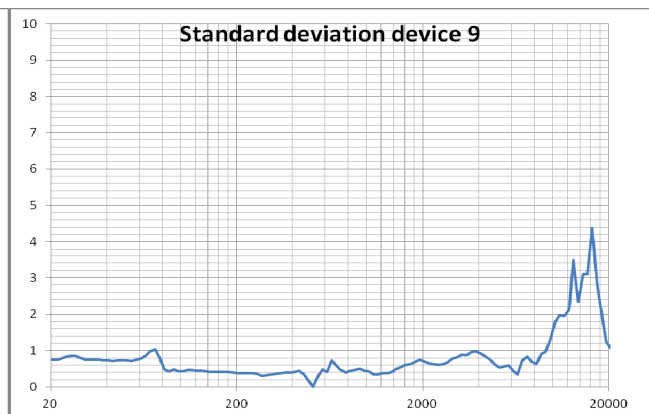
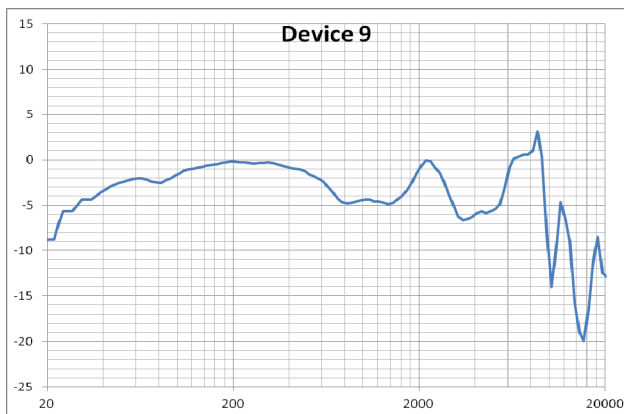
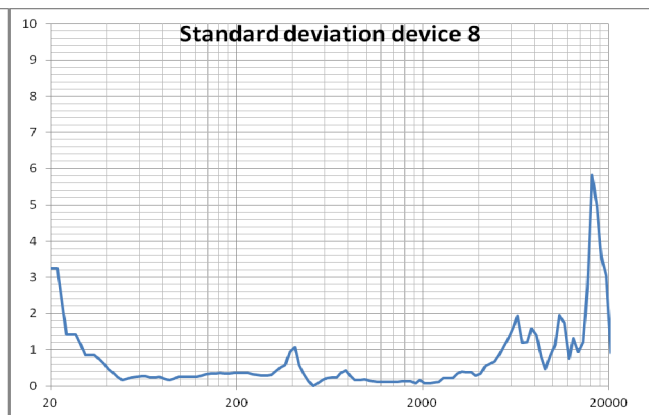
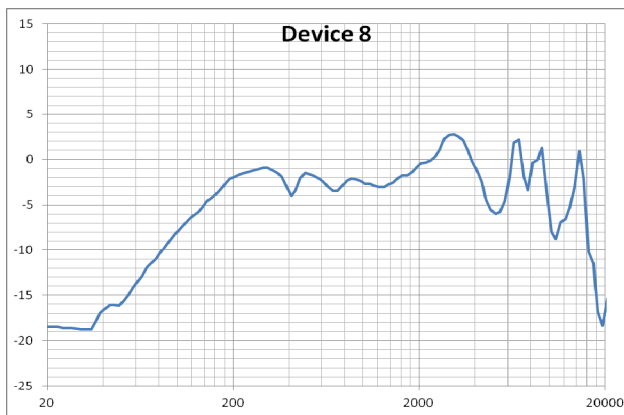
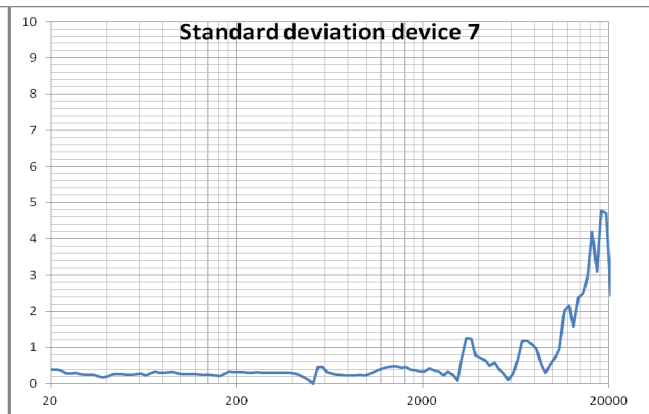
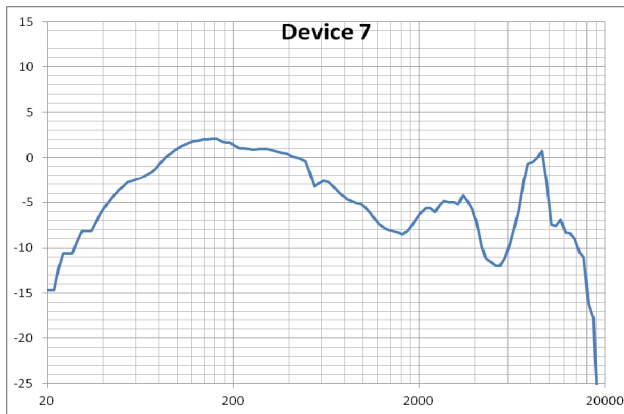
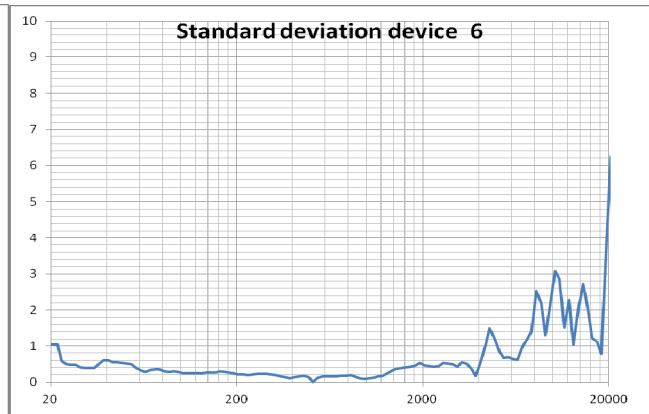
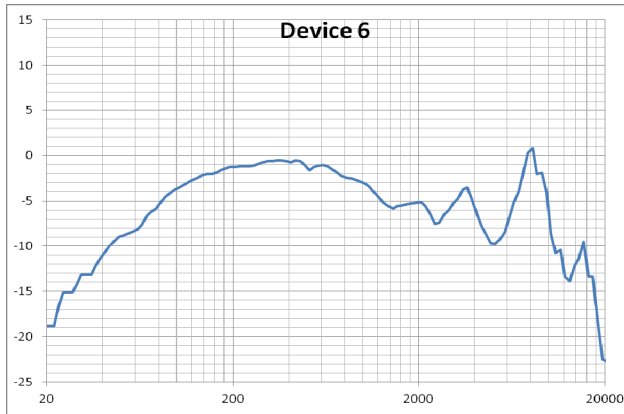


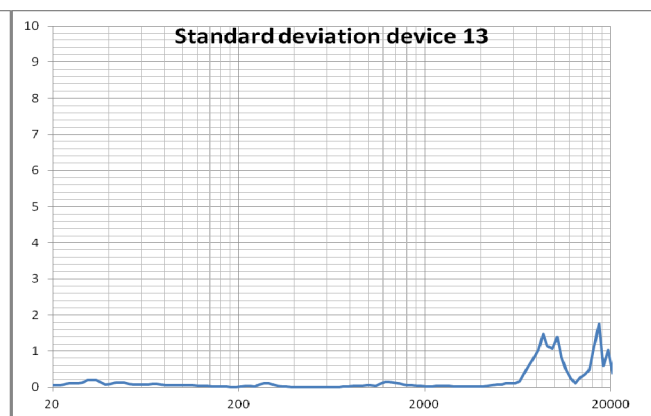
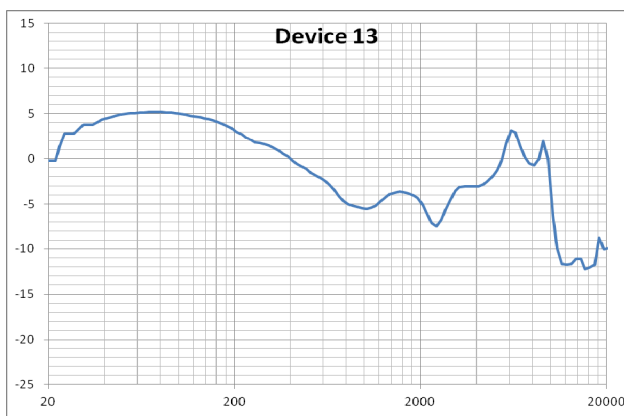
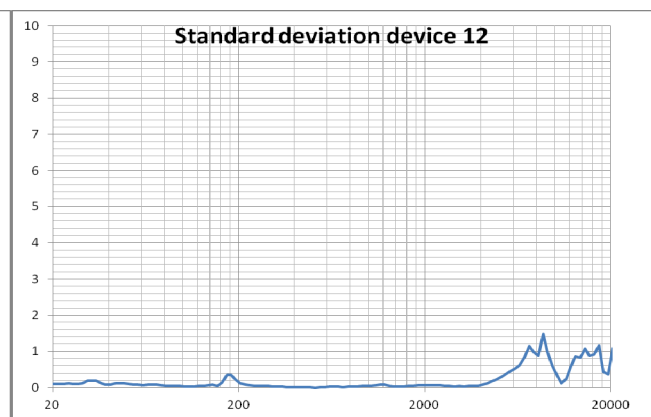
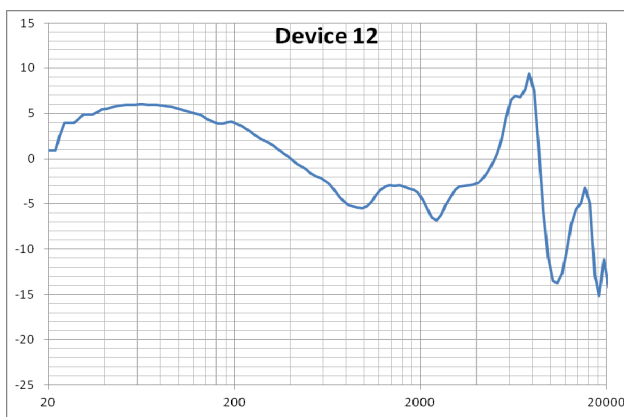
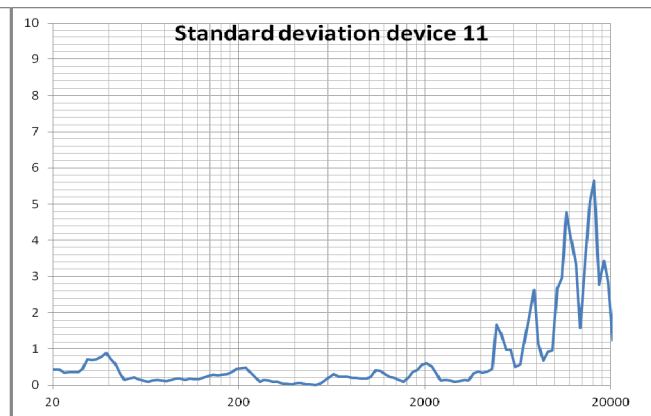
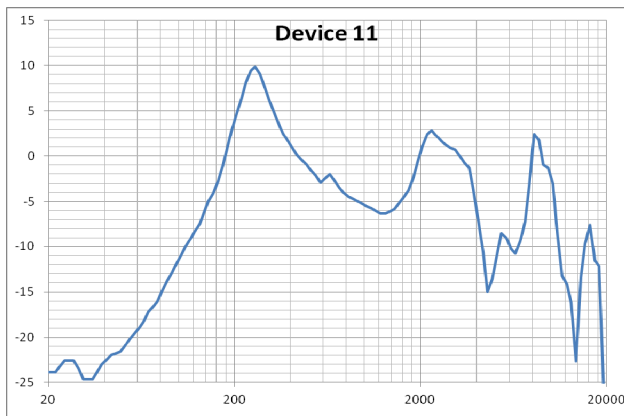
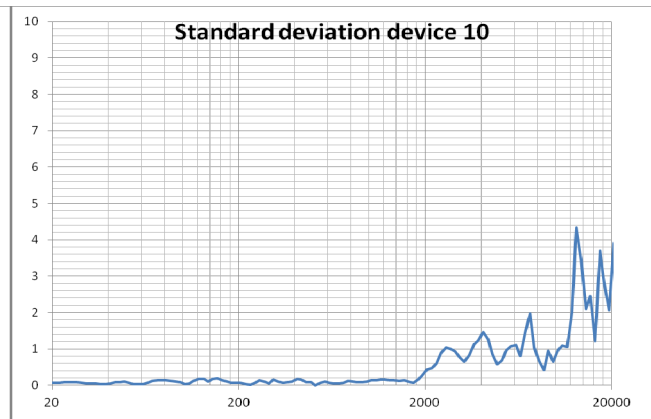
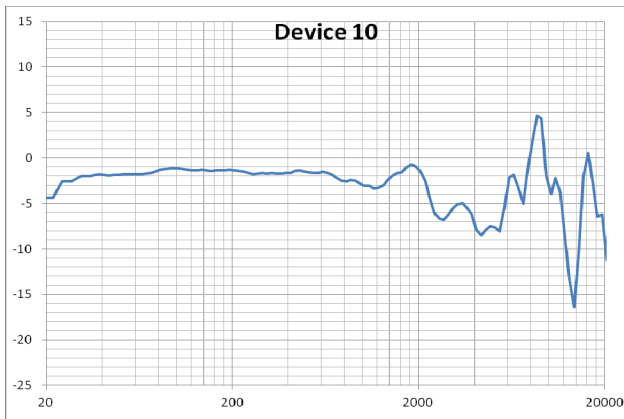


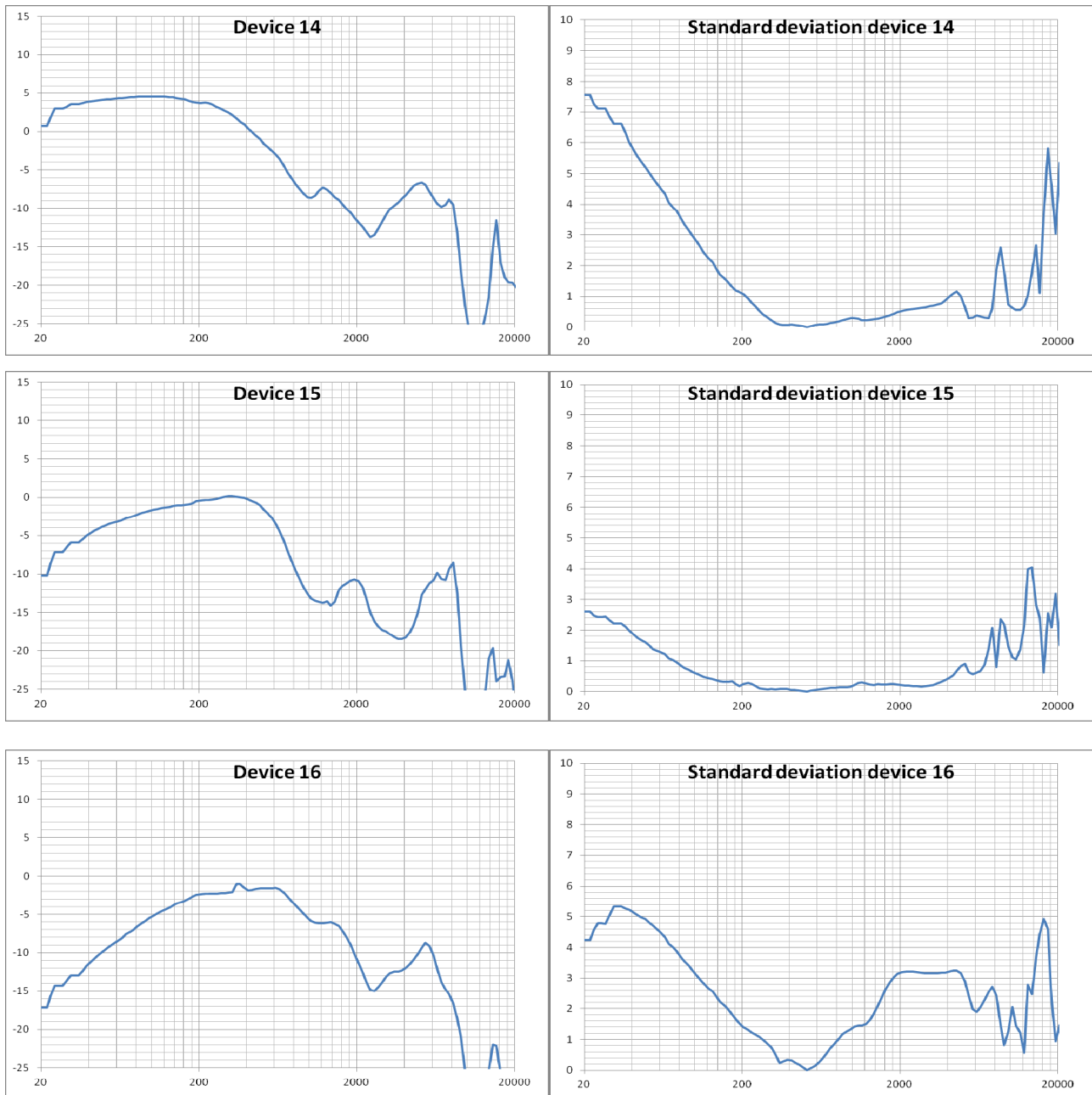
5.3 $1/12^{\text{th}}$ octave frequency response curves and associated standard deviations







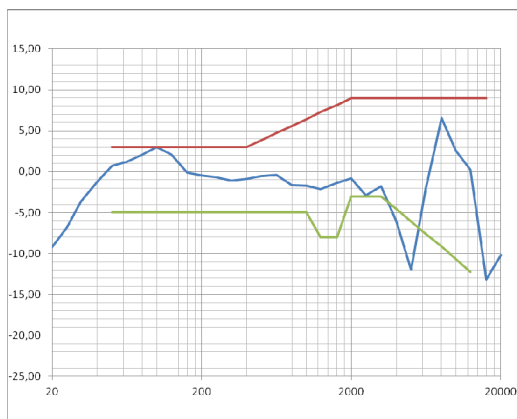




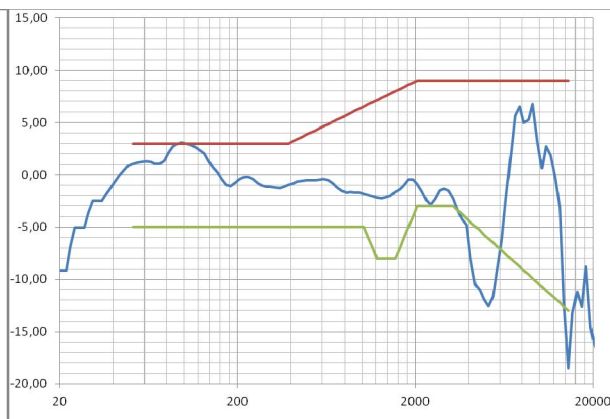
6 Application of limits to headphones and earphones

The limits given in TS 102 924 [i.3] for receive have been applied to each device response curve for both 1/3rd and 1/12th octave. The results obtained for the 16 devices are shown below.

6.1 Device 1

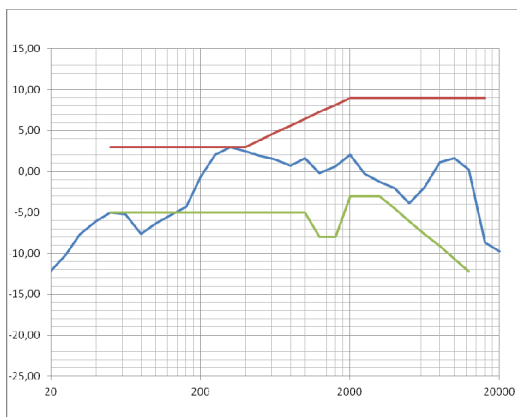


1/3rd octave response curve with TS 102 924 limit

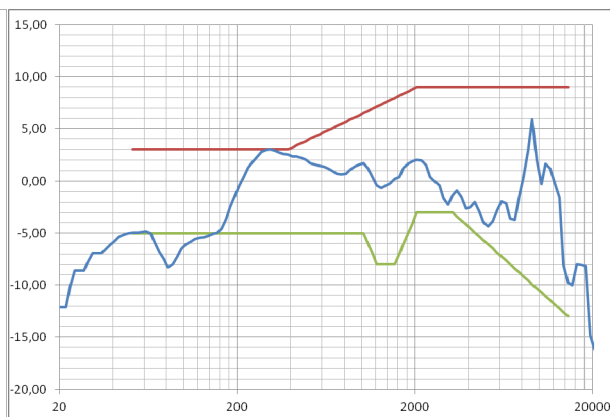


1/12th octave response curve with TS 102 924 limit

6.2 Device 2

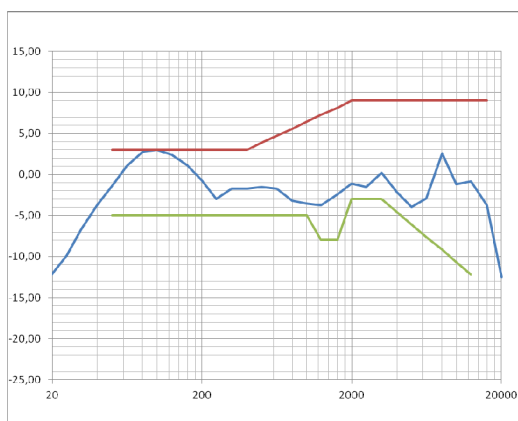


1/3rd octave response curve with TS 102 924 limit

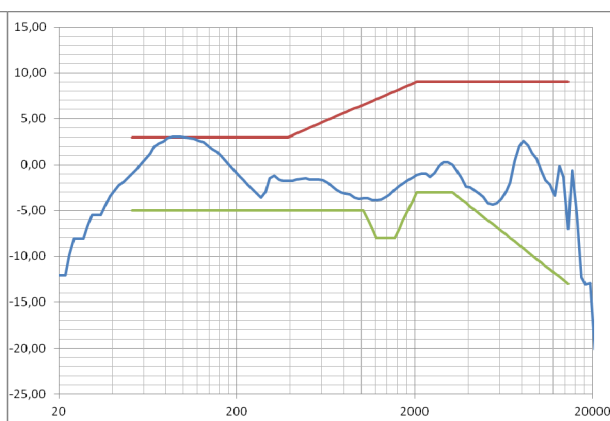


1/12th octave response curve with TS 102 924 limit

6.3 Device 3

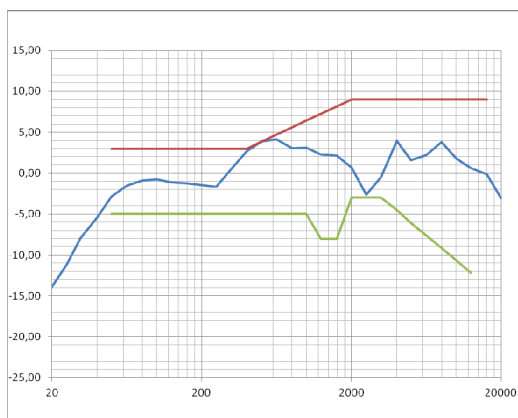


1/3rd octave response curve with TS 102 924 limit

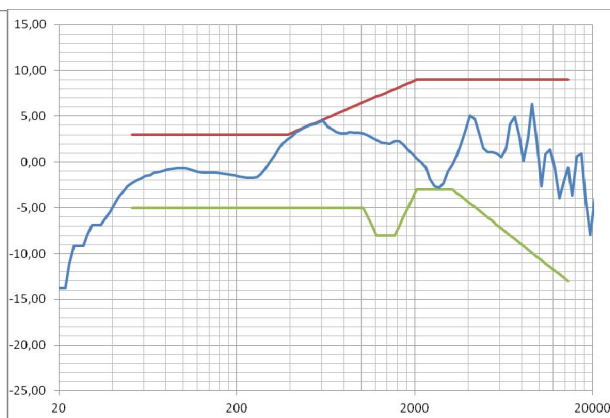


1/12th octave response curve with TS 102 924 limit

6.4 Device 4

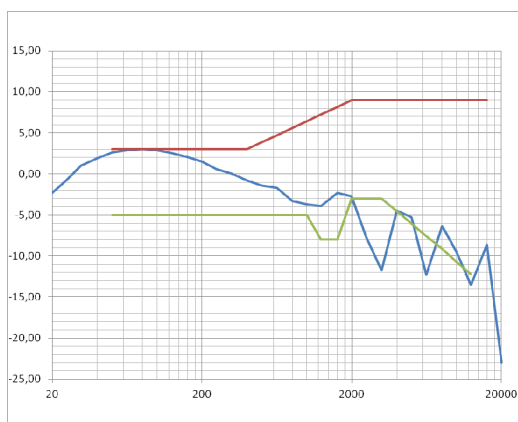


1/3rd octave response curve with TS 102 924 limit

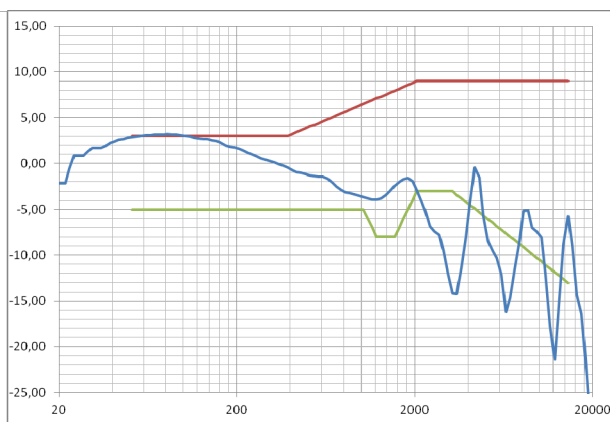


1/12th octave response curve with TS 102 924 limit

6.5 Device 5

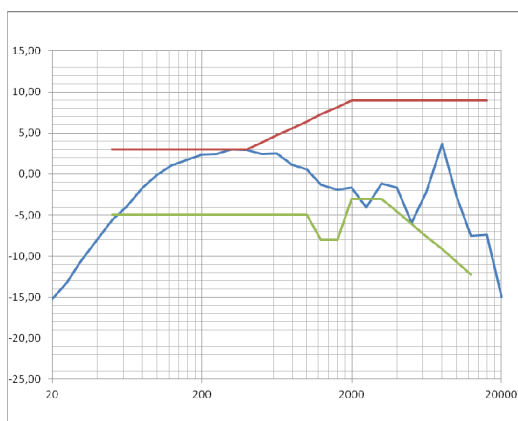


1/3rd octave response curve with TS 102 924 limit

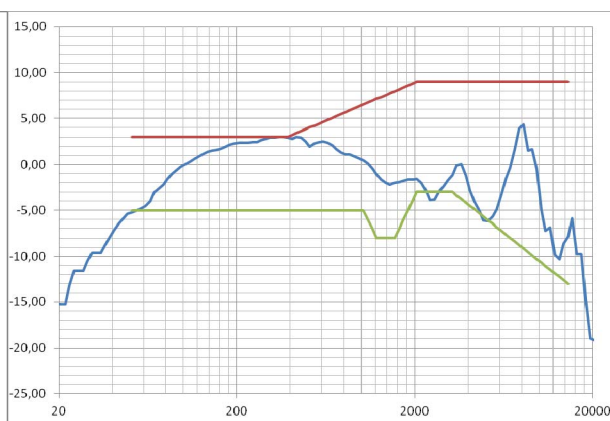


1/12th octave response curve with TS 102 924 limit

6.6 Device 6



1/3rd octave response curve with TS 102 924 limit

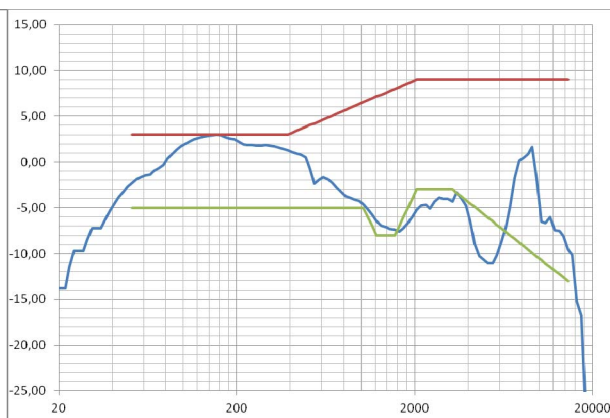


1/12th octave response curve with TS 102 924 limit

6.7 Device 7

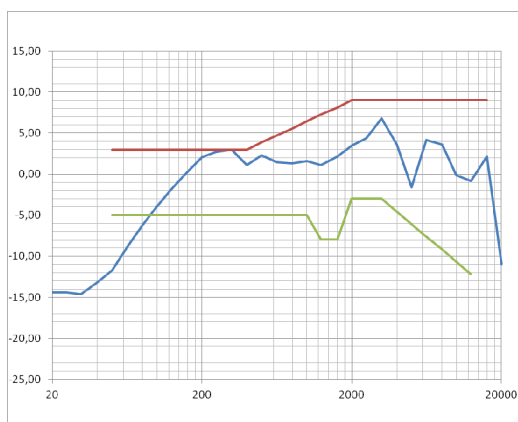


1/3rd octave response curve with TS 102 924 limit

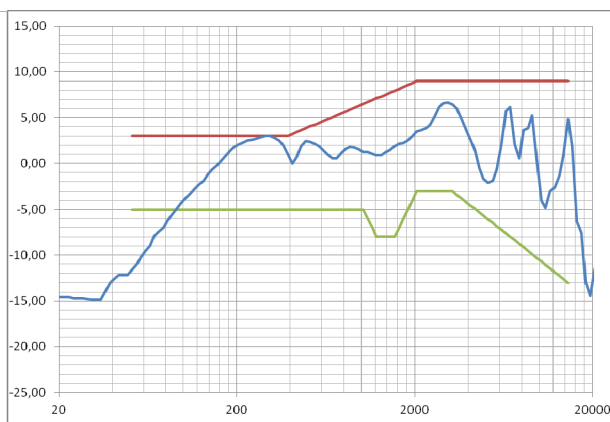


1/12th octave response curve with TS 102 924 limit

6.8 Device 8



1/3rd octave response curve with TS 102 924 limit

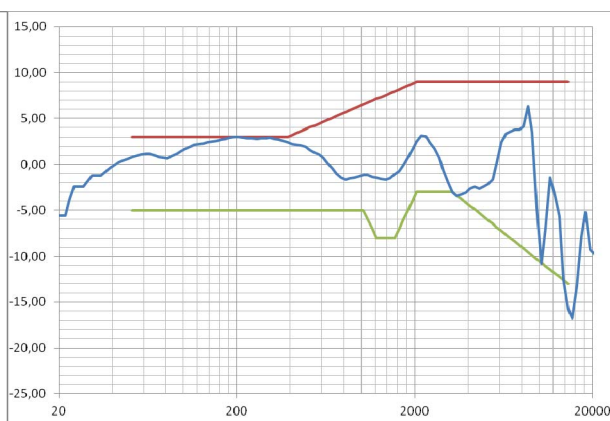


1/12th octave response curve with TS 102 924 limit

6.9 Device 9

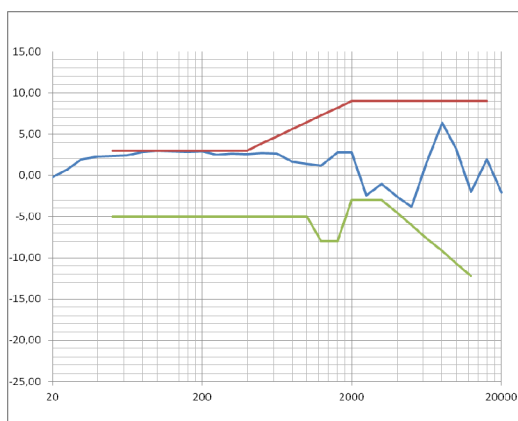


1/3rd octave response curve with TS 102 924 limit

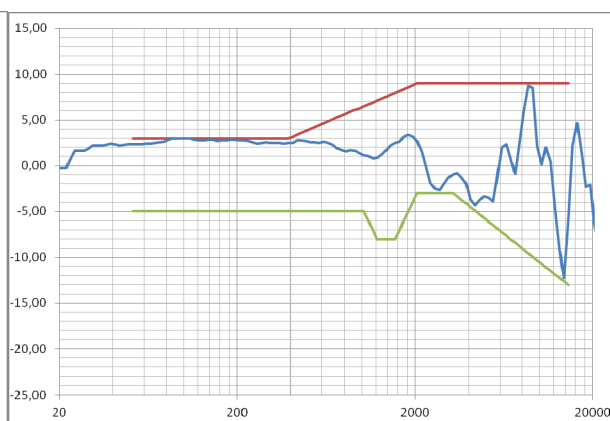


1/12th octave response curve with TS 102 924 limit

6.10 Device 10

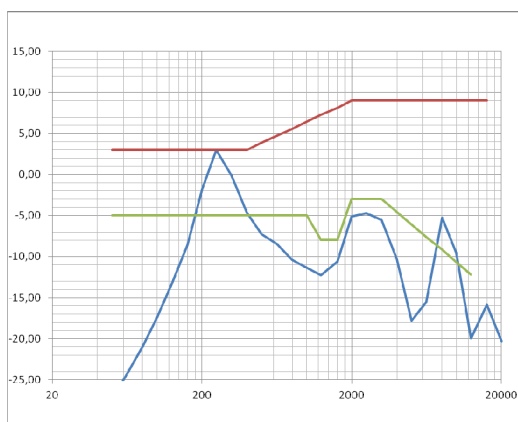


1/3rd octave response curve with TS 102 924 limit

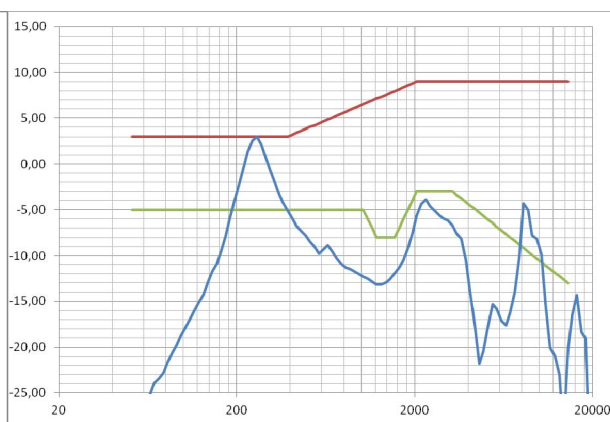


1/12th octave response curve with TS 102 924 limit

6.11 Device 11

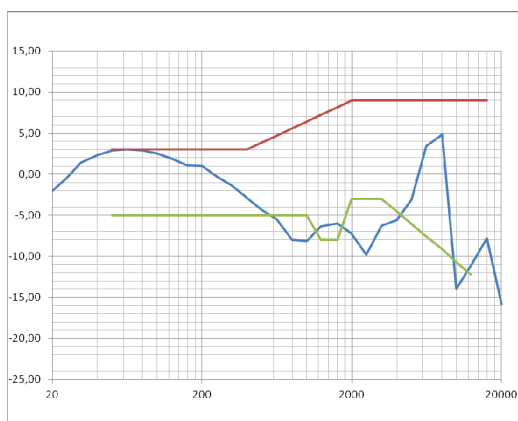


1/3rd octave response curve with TS 102 924 limit

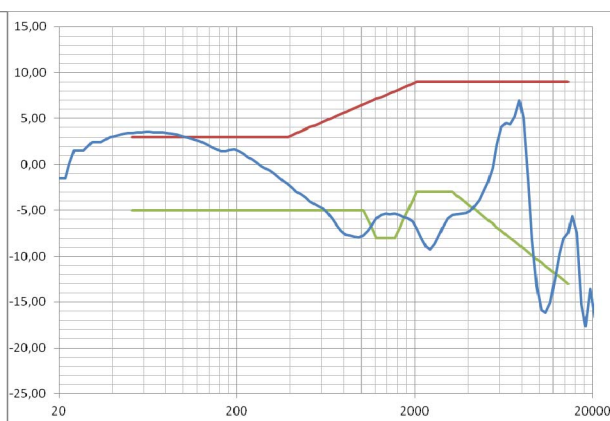


1/12th octave response curve with TS 102 924 limit

6.12 Device 12

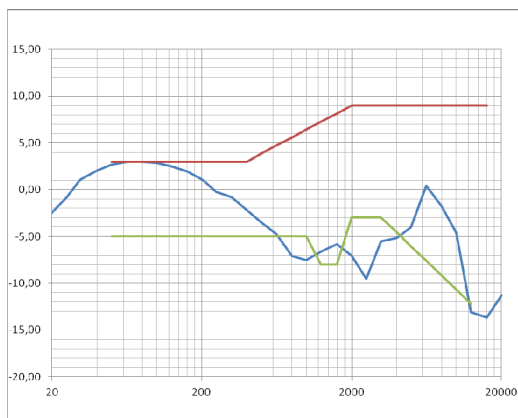


1/3rd octave response curve with TS 102 924 limit

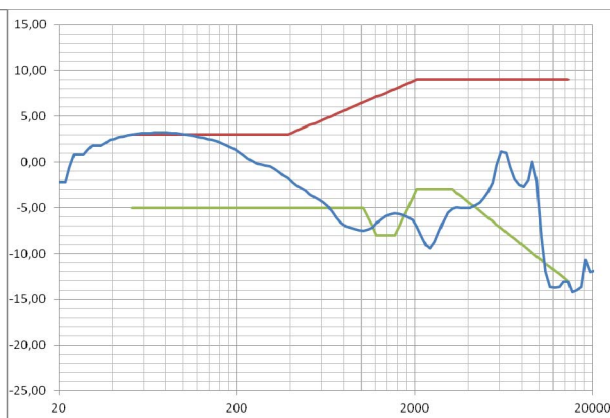


1/12th octave response curve with TS 102 924 limit

6.13 Device 13

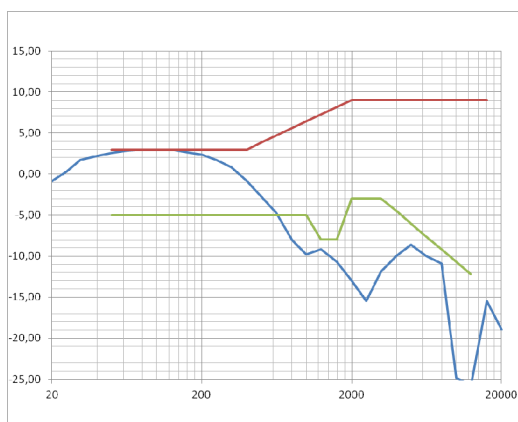


1/3rd octave response curve with TS 102 924 limit

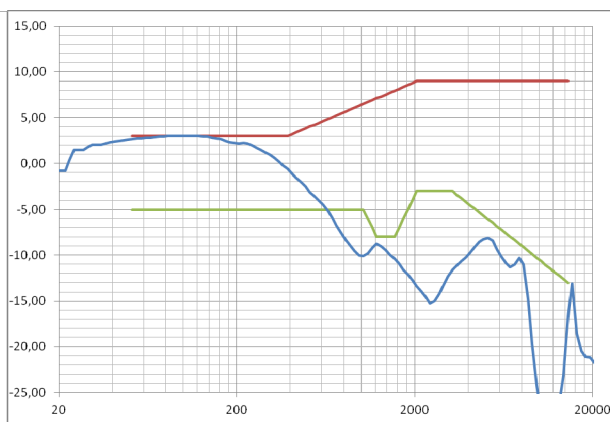


1/12th octave response curve with TS 102 924 limit

6.14 Device 14

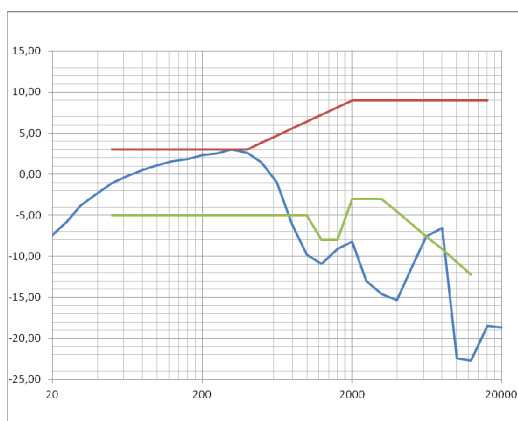


1/3rd octave response curve with TS 102 924 limit

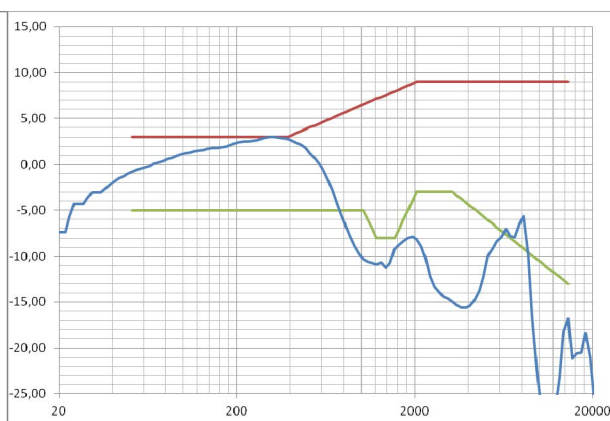


1/12th octave response curve with TS 102 924 limit

6.15 Device 15

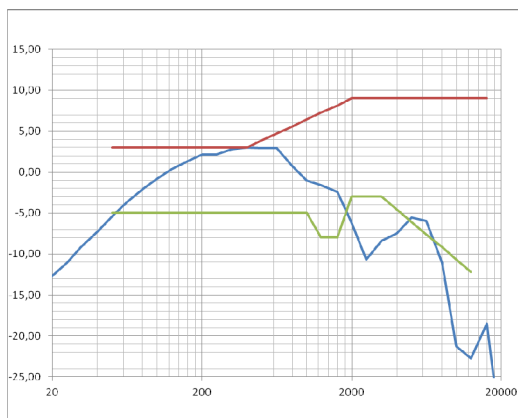


1/3rd octave response curve with TS 102 924 limit

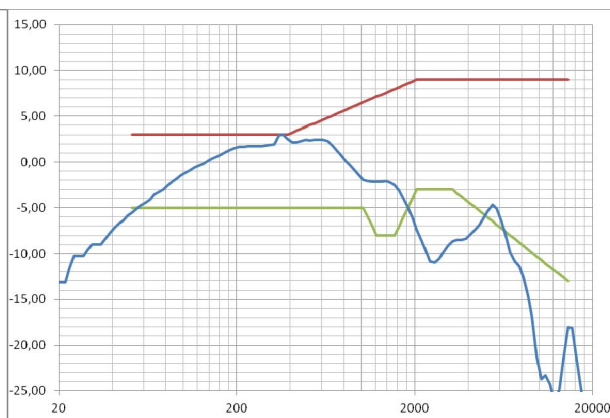


1/12th octave response curve with TS 102 924 limit

6.16 Device 16



1/3rd octave response curve with TS 102 924 limit



1/12th octave response curve with TS 102 924 limit

History

Document history		
V1.1.1	October 2013	Publication