Test Method for Effective Frequency Range of Loudspeakers

Technologies Application Notes-041-V1.0

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1. Introduction

This article aims to share some test methods for the "Effective Frequency Range" metric of loudspeakers. This metric appears in Part 5 of the GB/T 12060 series standards: "Methods of measurement for the main characteristics of loudspeakers". It is also frequently mentioned in testing standards for various other audio-related products. If you have questions about testing this metric, we hope this article provides some helpful insights.

2. Metric Interpretation

2.1 Metric Description

Figure 1 shows the relevant description of the effective frequency range metric from GB/T 12060.5. While descriptions in other standards containing this metric may vary slightly, the test methods are generally similar.

21.2 有效频率范围

21.2.1 特性解释

由规定上下限频率所限定的频率范围。按 21.1.2 规定，馈以正弦信号并在参考轴上测得的扬声器频率响应上，在最高灵敏度区域一个倍频程的带宽（或由制造商规定的更宽的频带）内的平均声压级之下、10 dB 以内的上限频率和下限频率。在该确定频限内，应忽略频响曲线上，与低于平均声压级 10 dB 的水平线相交处，窄于 1/9 oct 宽度的尖谷。

21.2.2 测量方法

有效频率范围可以由 21.1.1 所述、仅用正弦信号测得的频率响应上得到。

Figure 1

2.2 Test Method

First, the frequency response curve of the device under test (DUT) needs to be measured. Taking a megaphone as an example, the test setup connection is shown in Figure 2, and a sample frequency response test result is shown in Figure 3.

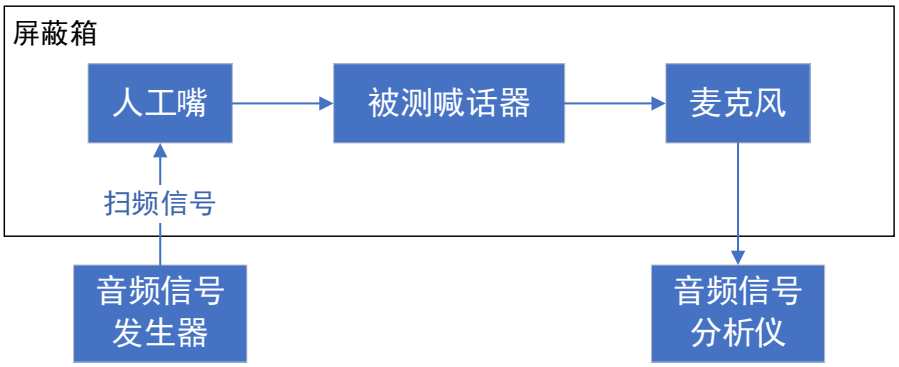

Figure 2

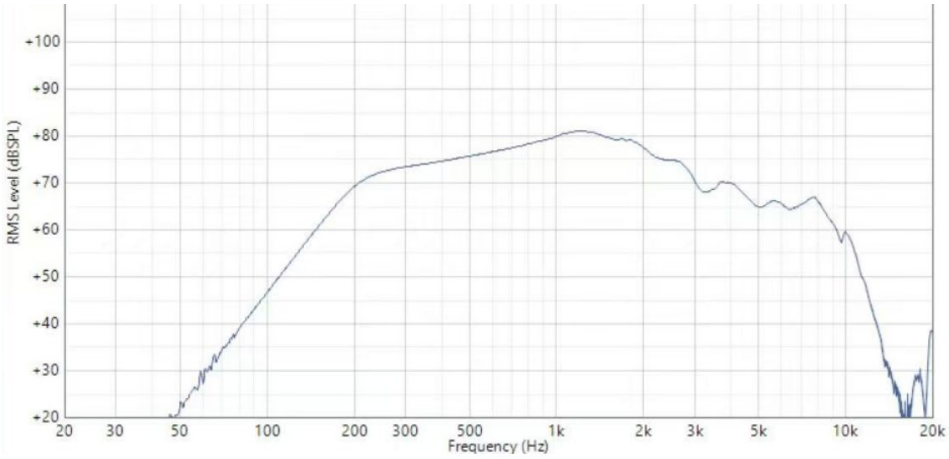

Figure 3 (This figure is for illustrative purposes only and may differ from actual test results)

Identify the frequency corresponding to the point of highest sensitivity on the frequency response curve. Using the curve in Figure 3 as an example, the highest sensitivity occurs around 1.5 kHz.

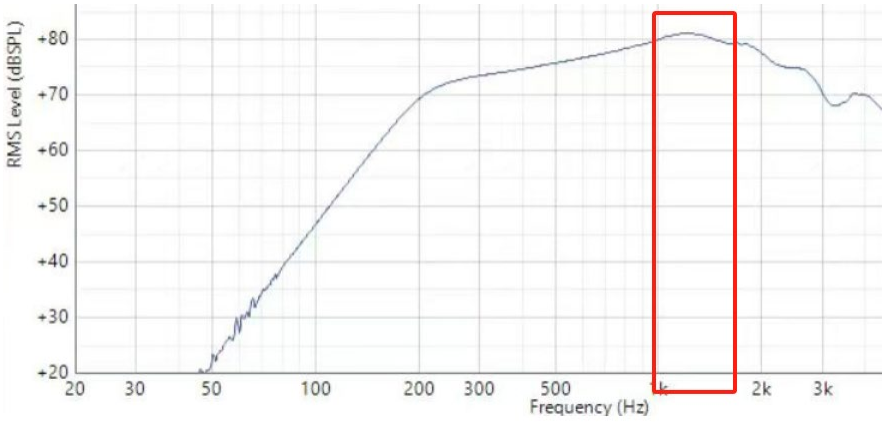

Figure 4

Refer to the octave band table in Figure 5 to determine which bandwidth the identified frequency belongs to. This bandwidth is used to calculate the average power of the signal within that one-octave bandwidth. Following Figures 3 and 4, 1.5 kHz falls within the 1400 Hz - 2800 Hz range. Therefore, we calculate the average sound pressure level of the signal within the 1400 Hz - 2800 Hz frequency range as P_0.

1/1/倍频程		1/3 倍频程		1/1/倍频程		1/3 倍频程	
中心频率	带宽	中心频率	带宽	中心频率	带宽	中心频率	带宽
16	11.2-22.4	12.5	11.2-14.1	1000	710-1400	800	710-900
		16	14.1-17.8			1000	900-1120
		20	17.8-22.4			1250	1120-1400
31.5	22.4-45	25	22.4-28	2000	1400-2800	1600	1400-1800
		31.5	28-35.5			2000	1800-2240
		40	35.5-45			2500	2240-2800
63	45-90	50	45-56	4000	2800-5600	3150	2800-3550
		63	56-71			4000	3550-4500
		80	71-90			5000	4500-5600
125	90-180	100	90-112	8000	5600-11200	6300	5600-7100
		125	112-140			8000	7100-9000
		160	140-180			10000	9000-11200
250	180-355	200	180-224	16000	11200-22400	12500	11200-14100
		250	224-280			16000	14100-17800
		315	180-355			20000	17800-22400
500	355-710	400	255-450				
		500	450-560				
		630	560-710				

Figure 5

Decrease P_0 by 10 dB to obtain sound pressure level P_1. Draw a horizontal line on the graph at the level of P_1. This line will intersect the frequency response curve at several points. Neglect any intersection points spaced less than 1/9 octave apart. The frequency range defined by the remaining intersection points represents the effective frequency range of the DUT, as illustrated in Figure 6.

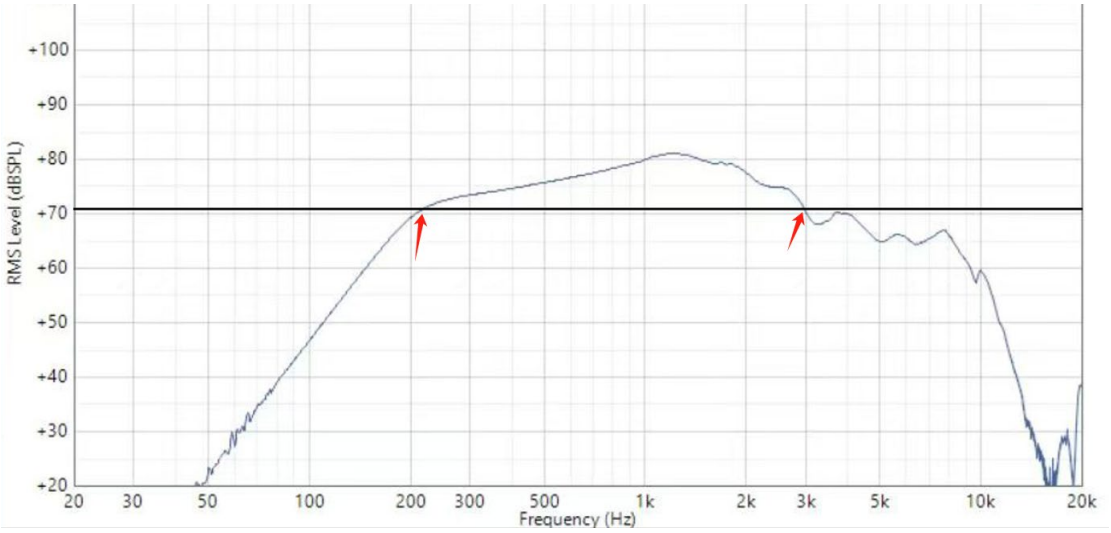

Figure 6

The above describes the test method for the effective frequency range of loudspeakers. Our company's professional Audio Analyzer is well-suited for accurately measuring this metric. Key parameters of the audio analyzer are listed below.

Audio Analyzer A10

- Standard support for SPDIF/TOSLINK/AES/EBU digital interfaces;
- Supports various digital interface expansions (BT/HDMI/I²S/PDM, etc.);
- Comprehensive and powerful electroacoustic analyzer functions;
- Codeless automation and full API interface;
- Support for LabVIEW, VB.NET, C#.NET;
- Automatic generation of test reports in various formats;
- Over 60 test functions, including Oscilloscope, Spectrum Analyzer, Continuous Fast Sweep, etc.

Furthermore, if you are interested in other audio-related testing, our company offers a wide range of audio test equipment, test accessories, and testing services. We also welcome any questions or feedback regarding the test method described above.