UHD World Association
世界超高清视频产业联盟

3D Audio Technology Specification Part 3-3: Technical Requirements and Test Methods - UHD STB

（V1.0）

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Contents

Technical specifications for three-dimensional sound Part 3-3: Technical requirements and testing methods for ultra high definition set-top boxes

1 Scope

This document specifies the technical requirements and testing methods for using the 3D sound technology ultra high definition set-top box specified in T/UWA 009.1.

This document is applicable to the design, production, and inspection of ultra-high definition set-top boxes using 3D sound technology as specified in T/UWA 009.1. Other set-top boxes using 3D sound technology specified in T/UWA 009.1 can be used as a reference.

2 Normative References

The contents of the following documents constitute essential clauses of this document through normative references in the text. Among them, for referenced documents with dates, only the version corresponding to that date is applicable to this document; The latest version (including all modifications) of the referenced document without a date is applicable to this document.

GB/T 9002-2017 Vocabulary for Audio, Video, Audiovisual Equipment and Systems

GB/T 17975.1-2010 Information Technology - Generic Coding of Moving Images and Associated Audio Information - Part 1: System

GB/T 17975.2-2000 Information Technology - Generic Coding of Moving Images and Associated Sound Signals - Part 2: Video

GB/T 17975.3-2002 Information Technology - Generic Coding of Moving Images and Associated Sound Signals - Part 3: Audio

GB/T 33475.3-2018 Information technology - Efficient multimedia coding - Part 3: Audio

GY/T 377-2023 Standard for Broadcasting, Television and Network Audiovisual Industry of the People's Republic of China: Technical Requirements and Measurement Methods for Audio Loudness of Network Audiovisual Programs SJ/T 11324-2006 Terminology for Digital Television Receiving Equipment

T/UWA 009.1 3D Sound Technical Specification Part 1: Encoding Distribution and Presentation

T/UWA 009.3-1 Technical Specification for 3D Sound Part 3-1: Technical Requirements and Testing Methods for Home Audio Video Playback Equipment

ITU-R BS.1770-5 (11/2023) Algorithm for Measuring Loudness and True Peak Audio Level of Audio Programs

ITU-T H.265 (09/2023) High Efficiency Video Coding

3 Terms, Definitions, and Abbreviations

3.1 Terms and Definitions

The terms and definitions defined in GB/T 9002-2017, SJ/T 11324-2006, and T/UWA 009.1, as well as the following terms and definitions, are applicable to this document.

3.1.1 Ultra HD Set-Top box

A television signal receiving device used for receiving and decoding ultra high definition audio and video signals.

Note: Ultra high definition set-top boxes transmit ultra high definition audio and video content to televisions or amplifiers by receiving wired or wireless signals, providing an immersive sound experience and clearer and more realistic image color representation.

3.1.2 Audio Vivid

The audio encoding and decoding technical specifications specified in T/UWA 009.1, as well as the corresponding derivative technologies.

3.2 Abbreviations

The following abbreviations apply to this document.

AV Audio and Video
C center channel (Front Center)
DBFS Decibel Full Scale
FFT Fast Fourier Transform
L Left Channel
LFE Low Frequency Enhancement
Loudness, K-weighted, relative to nominal full scale under LKFS K-weighting
Lrs Left Rear Surround
Ls Left Surround
Lss Left Side Surround
Ltb Left Top Back
Ltf Left Top Front
LU Loudness Unit
Moving Picture Experts Group (MPEG)
PMT Program Map Table
R Right Channel
Rs Right Surround
Rrs Right Rear Surround
Rss Right Side Surround
Rtb Right Top Back
Rtf Right Top Front
THD total harmonic distortion
THD+N total harmonic distortion plus noise

4 Technical Requirements

4.1 Requirements for Mixed Dual Channel Function in Audio Vivid Decoding

The mixed dual channel function under Audio Vivid decoding should comply with the specifications in Table 1.

Table 1 Requirements for Mixed Dual Channel Function in Audio Vivid Decoding

No.	project		Functional requirements
1	Audio Vivid Audio Recognition		It should have the ability to decode Audio Vivid audio streams, correctly decode Audio Vivid from multiple audio streams (Audio Vivid, MPEG-1 Layer II audio) multiplexed in a program, and devices with UI should correctly identify Audio Vivid audio streams and not label non Audio Vivid audio streams as Audio Vivid.
2	Soundbed decoding	Channel mapping	It should be able to correctly map all channels of Audio Vivid audio, including dual channel stereo, 5.1.4 multi-channel, etc., and all normal channel signals can be reproduced correctly.
3		Input sampling frequency	It should be able to decode Audio Vivid audio with sampling frequencies of 32 kHz, 44.1 kHz, and 48 kHz, and should be able to decode Audio Vivid audio with a sampling frequency of 96 kHz.
4		Bit rate	Should be able to decode Audio Vivid audio with bitrates ranging from 64 kbps to 832 kbps
5		Sampling accuracy	Supports 16 bits, lossless audio decoding should support 24 bit sampling accuracy
6	Lossless audio decoding		Should support lossless audio decoding
7	HOA decoding		It is advisable to be able to accurately restore the third-order HOA signal and accurately restore all directions.
8	Object audio decoding and rendering		Should support object audio restoration, with accurate restoration in all directions.
9	Output sampling frequency		Devices with digital audio output should support 48 kHz sampling frequency output and should support 96 kHz.

4.2 Performance Requirements for mixed binaural decoding in Audio Vivid

The performance of the audio Vivid decoding mixed dual channel output should comply with the specifications in Table 2.

Table 2 Performance requirements for mixed dual channel output in audio Vivid decoding

No.	project	Company	performance requirement
1	Reference signal output amplitude test	dBFS	-20±0.5
2	Audio signal-to-noise ratio	dB	≥90
3	cross talk	dB	≤-60
4	Frequency response characteristics	dB	≤ 1 (unevenness of peaks and valleys within the range of 500 Hz~8000 Hz) Excluding levels with peak and valley widths less than 1/6 oct;
5	Total harmonic distortion+noise (THD+N) at rated input	%	≤5（500 Hz~8000 Hz）
6	Average loudness consistency	LU	The average loudness of the device should be consistent, with a tolerance range of no more than ± 1 LU.

4.3 Audio-Video Synchronization

The time difference range of the decoded audio and video signal should be between -40ms and 20ms.

Note: A time difference of -40 ms between audio and video signals indicates that the decoded audio signal from the receiving terminal lags behind the video signal by 40 ms;

A time difference of 20 ms between audio and video signals indicates that the decoded audio signal from the receiving terminal leads the video signal by 20 ms.

4.4 Digital Media Interface Output

It should support decoding down mixed dual channel audio output through PCM.

It is advisable to support audio and metadata output through transparent transmission.

4.5 Metadata Processing Performance

The metadata processing performance should comply with the provisions of Table 3.

Table 3 Metadata processing performance

No.	project	Functional requirements
1	gain control	It should be able to correctly parse the gain metadata and control the gain correctly. The amplitude change trend of the played audio should be consistent with the preset in the test audio stream, and the deviation should not exceed ± 2 dB.
2	White gain control	It should be able to correctly parse the metadata of dialogue gain and control the dialogue gain correctly. The amplitude change trend of the played audio should be consistent with the preset in the test audio stream, and the deviation should not exceed ± 2 dB.
3	UI dynamic settings	It should support object volume setting. When the object volume of the UI is set to 0, it is required to output as mute; When set to 100%, the output should be the maximum value. During the process of increasing from 0 to 100%, the output follows an increasing trend without any overload phenomenon.
		Should support dynamic setting of sound direction for objects.
		Should support switching between mutually exclusive objects.

5 General Measurement Conditions

5.1 Environmental Conditions

Measurements should be taken within the following temperature, humidity, and pressure ranges:

——Environmental temperature: 15 ℃~35 ℃

——Relative humidity: 25%~ 75%

——Air pressure: 86 kPa ~ 106 kPa

5.2 Power Supply

The measurement should be carried out under rated power supply voltage conditions, and the change in power supply voltage during measurement should not exceed ± 2%.

When using AC power grid for power supply, the fluctuation of power frequency does not exceed ± 2%, and the harmonic component does not exceed 5%.

5.3 Adjustment of Rated Working State

5.3.1 Sound Settings

All sound effects settings should be turned off during performance testing.

5.3.2 Other Settings

Except for the requirements of 5.3.1, all other settings are the factory settings of the device.

5.4 Stabilization Time

Before testing, the tested equipment should be operated under rated measurement conditions for 15 minutes to ensure stable performance.

5.5 Measurement Interface

The measurement input interface adopts one type, and the recommended order is: USB, IP, and others.

5.6 Primary Measuring Instruments

The main measuring instruments should meet the requirements of Table 4.

Table 4 Main measuring instrument requirements

No.	Equipment name	requirement
1	Audio analyzer	a) Capable of FFT spectrum analysis function [a]; b) Equipped with waveform monitoring function; c) Capable of digital audio input function .
2	Digital one to two splitter	Support dividing one digital signal a into two consistent and synchronized digital signal outputs
[a] If FFT spectrum analysis function is not available, spectrum analyzer in the frequency range of 20 Hz to 20 kHz can be used.		

6 Test Signals

6.1 Packaging Form

The test signals in this document are encapsulated in MP4 files or transport stream files that comply with the provisions of GB/T 17975.1-2010; The pure audio test signal is packaged in MP4 files.

6.2 Video Basic Stream

The digital video basic stream in this document shall comply with the provisions of ITU-T H.265.

6.3 Audio Basic Stream

The test audio basic stream includes audio and video streams and independent audio streams. The digital audio basic stream in this document should comply with the following regulations.

a) The audio Vivid basic stream complies with the regulations of T/UWA 009.1.
b) The MPEG-1 layer II audio basic stream complies with the provisions of GB/T 17975.3-2002.

6.4 Requirements for Audio Basic Stream

6.4.1 Audio Recognition Testing of Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 5.

Table 5 Audio recognition testing of audio basic stream characteristics

Test file	characteristic
Multi_Audio_4object_714_AVivid Multi_Audio_6object_514_AVivid	Vivid Audio
Audio_ MPEG	MPEG-1 Layer II Audio

6.4.2 Channel Mapping Test Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 6.

Table 6 Channel mapping test audio basic stream characteristics

Transport Stream	characteristic		
	Audio encoding	Encoding mode	channel routing
Channel_ID_voice_714_AVivid	Audio Vivid	7.1.4	L， R，C，LFE，Lss，Rss，Lrs，Rrs，Ltf，Rtf，Ltb，Rtb
Channel_ID_voice_514_AVivid	Audio Vivid	5.1.4	L，R，C，LFE，Ls，Rs，Ltf，Rtf，Ltb，Rtb
Channel_ID_voice_51_AVivid	Audio Vivid	5.1	L，R，C，LFE，Ls，Rs
Channel_ID_voice_20_AVivid	Audio Vivid	2.0	L，R

6.4.3 Input Sampling Frequency Test Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 7.

Table 7 Sampling frequency testing of audio basic stream characteristics

Transport Stream	characteristic		
	Audio encoding	Encoding mode	sampling frequency
Samplerate_514_32k_AVivid	Audio Vivid	5.1.4	32 kHz
Samplerate_514_44.1k_AVivid	Audio Vivid	5.1.4	44.1 kHz
Samplerate_514_48k_AVivid	Audio Vivid	5.1.4	48 kHz
Samplerate_514_96k_AVivid	Audio Vivid	5.1.4	96 kHz

6.4.4 Sampling Accuracy Testing of Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 8.

Table 8 Sampling accuracy testing of audio basic stream characteristics

Transport Stream	characteristic		
	Audio encoding	Encoding mode	Sampling accuracy
Bitdepth_16_AVivid	Audio Vivid	5.1.4	16 bits
Bitdepth_24_AVivid	Audio Vivid (Lossless encoding)	5.1.4	24 bits

6.4.5 Bit Rate Support for Testing Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 9.

Table 9 Bit rate support for testing audio basic stream characteristics

Transport Stream	characteristic		
	Audio encoding	Encoding mode	Bit rate
Data_rate_20_32_AVivid	Audio Vivid	2.0	32 kbps
Data_rate_20_320_AVivid	Audio Vivid	2.0	320 kbps
Data_rate_51_96_AVivid	Audio Vivid	5.1	96 kbps
Data_rate_51_720_AVivid	Audio Vivid	5.1	720 kbps
Data_rate_514_176_AVivid	Audio Vivid	5.1.4	176 kbps
Data_rate_514_704_AVivid	Audio Vivid	5.1.4	704 kbps
Data_rate_714_240_AVivid	Audio Vivid	7.1.4	240 kbps
Data_rate_714_832_AVivid	Audio Vivid	7.1.4	832 kbps

6.4.6 HOA Testing Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 10.

Table 10 HOA testing audio basic stream characteristics

Transport Stream	characteristic		
	Audio encoding	Encoding mode	Order number
HOA_3order_AVivid	Audio Vivid	HOA	3

6.4.7 Object Audio Test Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 11.

Table 11 Object Audio Test Audio Basic Stream Characteristics

Transport Stream		characteristic	
		Audio encoding	Encoding mode
Object_4_AVivid	Sound Bed	Audio Vivid	5.1.4
	object	Audio Vivid	object

Explanation: The number of objects is 4, divided into three groups, and the characteristics of each object should comply with the provisions of Table 12

Table 12 Object characteristics

Object Number	type	content
1	0 (point sound source)	Speaking of books
2	0 (point sound source)	Female singing voice
3	1 (Surface sound source)	Male singing voice
4	2 (Diffuse sound source)	Footsteps sound

6.4.8 Audio Reference Signal Output Amplitude Test Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 13.

Table 13 Audio Reference Signal Output Amplitude Test Audio Basic Stream Characteristics

Transport Stream	characteristic			
	Audio encoding	Encoding mode	Signal Description	
			frequency	range
Reference_20_997_-20dB_AVivid	Audio Vivid	2.0	997 Hz	-20 dBFS

6.4.9 Audio Signal-to-Noise Ratio Testing of Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 14.

Table 14 Audio signal-to-noise ratio testing of audio basic stream characteristics

Transport Stream	characteristic				
	Audio encoding	Encoding mode	Signal Description		
			Vocal tract	frequency	range
514_997_0dB_AVivid	Audio Vivid	5.1.4	All channels (LFE silent)	997 Hz	0 dBFS
514_Silence_AVivid	Audio Vivid	5.1.4	All channels	Numbers are silent	

6.4.10 Crosstalk Testing of Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 15.

Table 15 Crosstalk testing of audio basic stream characteristics

Transport Stream	characteristic				
	Audio encoding	Encoding mode	Signal Description		
			Vocal tract	frequency	range
514_997L_0dB_AVivid	Audio Vivid	5.1.4	Left channel	997 Hz	0 dBFS
			Right channel	Numbers are silent	
514_997R_0dB_AVivid	Audio Vivid	5.1.4	Left channel	Numbers are silent	
			Right channel	997 Hz	0 dBFS

6.4.11 Amplitude Frequency Response Testing of Audio Basic Stream Characteristics

The basic stream characteristics of the test audio should comply with the provisions of Table 16.

Table 16 Amplitude frequency response testing of audio basic stream characteristics

Transport Stream	characteristic				
	Audio encoding	Encoding mode	Signal Description		
			Vocal tract	frequency	range
2_fstplr12oct_L-12dB_AVivid	Audio Vivid	2.0	Left channel	20 Hz~20 kHz（1/12 oct）	-12 dBFS
			Right	Numbers are silent	
2_fstplr12oct_R-12dB_AVivid	Audio Vivid	2.0	Left channel	Numbers are silent	
			Right	20 Hz~20 kHz（1/12 oct）	-12 dBFS

6.4.12 LoudnessTest Audio Basic Flow Characteristics

The basic flow characteristics of the loudness test audio should comply with the provisions of Table 17.

Table 17 Loudness test audio basic flow characteristics

Transport Stream	characteristic				
	Audio encoding	Encoding mode	Signal Description		
			Vocal tract	frequency	range
Loudless_714_-24LU_pink_Avivid	Audio Vivid	7.1.4	All channels (LFE silent)	20 Hz~20 kHz pink noise	-24 LKFS
Loudless_714_-15LU_pink_Avivid	Audio Vivid	7.1.4	All channels (LFE silent)	20 Hz~20 kHz pink noise	-15 LKFS

6.4.13 Basic Stream Characteristics of Audio and Video Synchronization

The basic stream characteristics of the test audio should comply with the provisions of Table 18.

Table 18 Audio and video synchronization testing of audio basic stream characteristics

Transport Stream		characteristic				
		code	Encoding mode	Signal Description		
				Vocal tract	frequency	range
AV-Sync_4object_714_AVivid_MP4_h265_25fps	Sound Bed	Audio Vivid	7.1.4	All channels	Every three seconds, a 3kHz audio signal with a duration of 40ms	-10 dBFS
	object	Audio Vivid	object	—	Numbers are silent	
	video	H.265	4K@25Hz	—	The video consists of black and white frames, with white frames appearing every three seconds	
AV-Sync_20_AVivid_MP4_h265_25fps	Sound Bed	Audio Vivid	2.0	All channels	Every three seconds, a 3kHz audio signal with a duration of 40ms	-10 dBFS
	video	H.265	4K@25Hz	—	The video consists of black and white frames, with white frames appearing every three seconds	

6.4.14 Gain Control Test Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 19.

Table 19 Gain control test audio basic stream characteristics

Transport Stream	characteristic					
	Audio encoding	Encoding mode	Signal Description			gain (Static metadata)
			Vocal tract	frequency	range	
Loudless_0_AVivid	Audio Vivid	2.0	All channels	997 Hz	-20 dBFS	0 dB
Loudless_10_AVivid	Audio Vivid	2.0	All channels	997 Hz	-20 dBFS	10 dB
Loudless_-10_AVivid	Audio Vivid	2.0	All channels	997 Hz	-20 dBFS	-10 dB

6.4.15 White Gain Control Test Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 20.

Table 20 White gain control test audio basic stream characteristics

Transport Stream		characteristic					
		Audio encoding	Encoding mode	Signal Description			
				Vocal tract	frequency	range	duration
Dialog_AVivid	Sound Bed	Audio Vivid	2.0	All channels	Numbers are silent		30 s
	Dialogue Object	Audio Vivid	object	—	997 Hz	-20 dBFS	30 s

The metadata control for white gain control should comply with the provisions of Table 21 as it changes over time.

Table 21 White gain control metadata change characteristics

time	Gain (dynamic metadata)
0~10 s	0 dB
10~20 s	10 dB
20~30 s	-10 dB

6.4.16 UI Dynamic Setting Metadata Testing Audio Basic Stream Characteristics

The basic audio stream characteristics should comply with the provisions of Table 22.

Table 22 UI dynamic setting metadata testing audio basic stream characteristics

Transport Stream		characteristic			
		Audio encoding	Encoding mode	Signal Description	
				Vocal tract	duration
UI_1object_AVivid UI_4object_Avivid	Sound Bed	Audio Vivid	7.1.4	All channels (digital silent)	3 min
	object	Audio Vivid	object	—	3 min

The initial value of the interaction test object metadata for UI_1objectid_Vivid should comply with the specifications in Table 23.

Table 23 Interactive testing object metadata characteristics

Object Number	type	content	range	Up and down coordinates note 1	Left and right coordinates note 1	Front and rear coordinates note 1	Default gain note 2	Support interaction
1	Ordinary object	997 Hz sine wave injection	0 dBFS	0	0	0	5	yes

The initial value of UI4objectid_Vivid object metadata should comply with the provisions of Table 24.

Table 24 UI dynamically sets object metadata properties

Object Number	type	content	Up and down coordinates note 1	Left and right coordinates note 1	Front and rear coordinates note 1	Default gain note 2	Support interaction
1	Mutually exclusive object	English commentary	0	0	0	5	yes
2	Mutually exclusive object	Chinese commentary	0	0	0	5	yes
3	Ordinary object	Instrument sound	0	0	0	5	yes
4	Ordinary object	singing	0	0	0	5	no

Note 1: The top and bottom correspond to the positive and negative values of the Z-axis in the Cartesian coordinate system, the left and right correspond to the negative and positive values of the X-axis in the Cartesian coordinate system, and the front and back correspond to the positive and negative values of the Y-axis in the Cartesian coordinate system, respectively. The range refers to Table 88 metadata definition table in T/UWA 009.1 (continued).

Note 2: The unit is linear, and the corresponding actual volume value should refer to Table 35 in Appendix A for the reference table of object volume corresponding to actual volume.

7 Test Methods

7.1 Audio Vivid Decoding Mixed Dual Channel Function Test

7.1.1 Summary

Verify the Audio Vivid decoding function of the tested device by testing the mixed dual channel function under Audio Vivid decoding. The decoding function test includes: Audio Vivid audio recognition test, soundbed decoding test, HOA decoding test, and object audio decoding test.

7.1.2 Test Connection Diagram

The test connection diagram is shown in Figure 1.

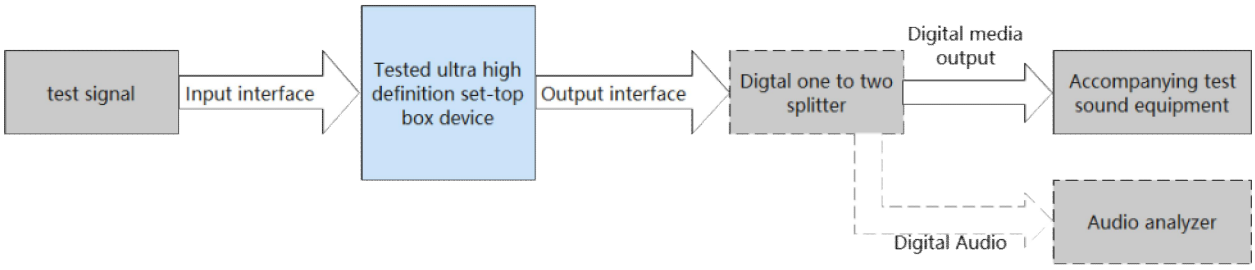

Figure 1 Decoding function test connection diagram

Ultra high definition set-top box devices do not have their own sound unit, and can be tested using accompanying sound units (such as televisions or speakers) or audio analyzers. The accompanying sound unit can independently restore at least 2 channels. The audio analyzer is used to output sampling frequency test items.

7.1.3 Audio Vivid Audio Recognition

7.1.3.1 Feature Description

This section verifies whether the tested device has the Audio Vivid audio recognition function listed in Table 1.

The functional requirements should comply with the provisions of Table 25.

Table 25 Criteria for determining the audio Vivid recognition testing function

test signal	Functional requirements
Multi_Audio_4object_714_AVivid Multi_Audio_6object_514_AVivid	Should be able to correctly decode Audio Vivid audio
	It should be labeled as Audio Vivid audio and a prompt should be given on the UI interface
Audio_ MPEG	Cannot be identified as Audio Vivid

7.1.3.2 Measuring Method

The test shall be conducted according to the following steps:

a) Connect the tested device according to Figure 1;

b) Play the test streams in Table 5 in sequence to verify whether the tested device meets the functional requirements in Table 25.

7.1.3.3 Result Expression

The result is expressed as either conforming or non-conforming.

7.1.4 Channel Mapping Test

7.1.4.1 Feature Description

This section verifies whether the tested device has the channel mapping function listed in Table 1.
The functional requirements should comply with the provisions of Table 26.

Table 26 Judgment criteria for channel mapping test

Test signal	Functional requirements
Channel_ID_voice_714_AVivid	All channels are correctly mapped/reproduced as [a], with no confusion in orientation
Channel_ID_voice_514_AVivid	All channels are correctly mapped/reproduced as [a], with no confusion in orientation
Channel_ID_voice_51_AVivid	All channels are correctly mapped/reproduced as [a], with no confusion in orientation
Channel_ID_voice_20_AVivid	All channels are correctly mapped/reproduced as [a], with no confusion in orientation
All channels are correctly mapped/reproduced: that is, the left and right channels are mapped correctly, and there is no problem of losing one or several channels, among which the LFE channel does not produce sound.	

7.1.4.2 Measuring Method

The test shall be conducted according to the following steps:

a) Connect the tested device according to Figure 1;
b) Play the test streams in Table 6 in sequence to verify whether the tested device meets the functional requirements in Table 26. During the testing process, after switching between different test signals, the tested device should be able to automatically recognize and play.

7.1.4.3 Result Expression

The result is expressed as either conforming or non-conforming.

7.1.5 Input Sampling Frequency Test

7.1.5.1 Feature Description

This section verifies whether the tested device meets the sampling frequency requirements in Table 1.
The functional requirements should comply with the provisions of Table 27.

Table 27 Basis for determining sampling frequency testing

test signal	Functional requirements
Samplerate_514_32k_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Samplerate_514_44.1k_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Samplerate_514_48k_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Samplerate_514_96k_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects

7.1.5.2 Measuring Method

The test shall be conducted according to the following steps:

a) Connect the tested device according to Figure 1;
b) Play the test stream files of the test signals in Table 7 in sequence to verify whether the tested device meets the functional requirements in Table 27. During the testing process, after switching between different test signals, the tested device should be able to automatically recognize and play.

7.1.5.3 Result Expression

The result is expressed as either conforming or non-conforming.

7.1.6 Rate Support Testing

7.1.6.1 Feature Description

This section verifies whether the tested device meets the bitrate requirements in Table 1.
The functional requirements should comply with the provisions of Table 28.

Table 28 Rate support testing criteria

test signal	Functional requirements
Data_rate_20_32_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Data_rate_20_320_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Data_rate_51_96_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Data_rate_51_720_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Data_rate_514_176_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Data_rate_514_704_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Data_rate_714_240_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Data_rate_714_832_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects

7.1.6.2 Measuring Method

The test shall be conducted according to the following steps:

a) Connect the tested device according to Figure 1;
b) Play the test stream files in Table 9 in sequence to verify whether the tested device meets the functional requirements in Table 28. During the testing process, after switching between different test signals, the tested device should be able to automatically recognize and play.

7.1.6.3 Result Expression

The result is expressed as either conforming or non-conforming.

7.1.7 Sampling Accuracy Test

7.1.7.1 Feature Description

This section verifies whether the tested equipment meets the sampling accuracy requirements in Table 1.
The functional requirements should comply with the provisions of Table 29.

Table 29 Basis for determining sampling accuracy testing

test signal	Functional requirements
Bitdepth_16_AVivid	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects
Bitdepth24_Sevid (lossless audio)	Should be able to correctly decode Audio Vivid audio without cracking, clicking, or defects

7.1.7.2 Measuring Method

The test shall be conducted according to the following steps:

a) Connect the tested device according to Figure 1;
b) Play the test stream files of the test signals in Table 8 in sequence to verify whether the tested device meets the functional requirements in Table 29. During the testing process, after switching between different test signals, the tested device should be able to automatically recognize and play.

7.1.7.3 Result Expression

The result is expressed as either conforming or non-conforming.

7.1.8 HOA Decoding Test

7.1.8.1 Feature Description

This section verifies whether the tested device has HOA decoding capability.

7.1.8.2 Measuring Method

The test shall be conducted according to the following steps:

a) Connect the tested device according to Figure 1;
b) Play the test stream file HOA_3order_Sevid from Table 10 and verify that all channels of the tested device are correctly reproduced without any cracking, clicking, or defects.

7.1.8.3 Result Expression

The result is expressed as either conforming or non-conforming.

7.1.9 Object Audio Decoding Test

7.1.9.1 Feature Description

This section verifies whether the tested device supports object audio decoding capability.
The functional requirements should comply with the provisions of Table 30.

Table 30 Judgment criteria for object audio decoding test

Test signal		Functional requirements
Object_4_AVivid	Sound Bed	All channels are correctly mapped/reproduced without any popping, clicking, or defects
	Object 1	The storytelling sound is correctly mapped/reproduced without any cracking, clicking, or defects
	Object 2	The female singing voice is correctly mapped/reproduced without any cracking, clicking, or flaws
	Object 3	The male singing voice is correctly mapped/reproduced without any cracking, clicking, or flaws
	Object 4	The sound of footsteps is correctly mapped/reproduced, without any cracking, clicking, or defects

7.1.9.2 Measuring Method

The test shall be conducted according to the following steps:

a) Connect the tested device according to Figure 1;
b) Play the test stream file in Table 11 to verify whether the tested device meets the functional requirements in Table 30.

7.1.9.3 Result Expression

The result is expressed as either conforming or non-conforming.

7.1.10 Output Sampling Frequency Test

7.1.10.1 Feature Description

This section verifies the sampling frequency of the digital audio output from the tested device.

7.1.10.2 Measuring Method

The test shall be conducted according to the following steps:

a) Connect the tested device according to Figure 1;
b) Play the Samplerate_514_44.1k_Sevid test stream file from playlist 7,
c) Use an audio analyzer to analyze the output sampling frequency of the tested device, and the results are expressed in kHz.

7.1.10.3 Result Expression

Expected result: The audio output frequency should meet the requirements of the output sampling frequency item in Table 1. If it meets the requirements, it is considered compliant; otherwise, the result is not compliant.

7.2 Performance Test of Mixed Dual Channel under Audio Vivid Decoding

7.2.1 Summary

This test verifies the electrical performance of audio output when mixed into two channels under Audio Vivid decoding of the tested device. The tests include: audio signal-to-noise ratio test, channel crosstalk test, noise floor test, frequency response characteristic test, maximum amplitude test at rated input, total harmonic distortion+noise test at rated input, etc. Select an existing digital media interface and test it by connecting it to an audio analyzer.

7.2.2 Test Connection Diagram

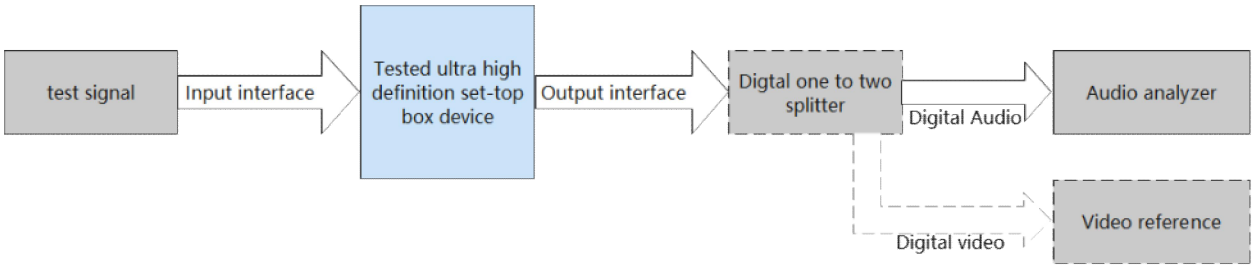

Figure 2 Connection diagram for mixed dual channel performance testing under digital audio

Among them, the "digital one to two splitter to video reference" can be replaced with other devices with video display effects.

7.2.3 Reference Signal Output Amplitude

7.2.3.1 Feature Description

This measurement measures whether the output amplitude of the tested equipment meets the requirements under the reference signal.

7.2.3.2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the tested device according to Figure 2;
b) Play the reference_20_997_ -20dB_Sevid test signal file;
c) Measure the audio output amplitude of the tested device using an audio analyzer, continuously adjust the set volume of the tested device to ensure that the output amplitude of the left and right channels of the tested device is within -20 ± 0.5 dBFS, and record the set volume value and left and right channel output amplitude values of the tested device at this time. The set volume value of the tested device at this time is the reference set volume value, and all subsequent performance test items are configured with this set volume value.

7.2.3.3 Result Expression

Expected result: The output amplitude of the left and right audio channels should meet the requirements of Table 2-20 dBFS, with an allowable error of no more than ± 0.5 dB. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7.2.4 Audio Signal-to-Noise Ratio

7.2.4.1 Feature Description

This measure measures the signal-to-noise ratio of the audio output terminal of the tested device.

7.2.4.2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the tested device according to Figure 2;
b) Play the 514_997_0dB_AVivid test signal file;
c) Set the volume of the tested device to the reference volume value in 7.2.3.2;
d) Read the output of the audio output terminal using an audio analyzer, denoted as $_{DS}$;
e) Play the 514_Silence_Sevid test signal file;

f) Read the output of the audio output terminal using an audio analyzer, denoted as $_{DN}$;

g) Repeat steps b) to f) and measure the signal-to-noise ratio of each channel separately (results in decibels (dB)).

The audio signal-to-noise ratio is:

$$SNR = | _{DS} - _{DN} |$$

In the formula:

SNR - Signal to Noise Ratio;

$_{DS}$ - Signal amplitude;

$_{DN}$ - Noise amplitude.

7. 2. 4. 3 Result Expression

Expected result: The signal-to-noise ratio of each channel at the audio output end should meet the requirements of Table 2: ≥ 90 dB. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7. 2. 5 Crosstalk

7. 2. 5. 1 Feature Description

This measure measures the ratio of the amplitude of the signal from one channel of the audio output terminal of the tested device to the amplitude of the signal that is concatenated to another channel.

7. 2. 5. 2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the tested device according to Figure 2;

b) Set the volume of the tested device to the reference volume value in 7.2.3.2;

c) Play the 514_997L_0dB-AVivid test signal file;

d) Measure the left channel to right channel crosstalk of each channel pair of the tested device using an audio analyzer, and record the test results in decibels (dB);

e) Play the 514_997R_0dB-AVivid test signal file;

f) Measure the right channel to left channel crosstalk of each channel pair of the tested device using an audio analyzer, and record the test results in decibels (dB).

7. 2. 5. 3 Result Expression

Expected result: The crosstalk between the left and right channels should meet the requirement of ≤ -60 dB in Table 2. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7. 2. 6 Frequency Response Characteristic Test

7. 2. 6. 1 Feature Description

Measure the frequency response performance of the tested equipment within the range of 500 Hz to 8000 Hz.

7. 2. 6. 2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the testing system according to Figure 2

b) Set the volume of the tested device to the reference volume value in 7.2.3.2;

c) Play the audio analyzer and measure the frequency response characteristic curve of the left channel by

playing the 2-fstplr12oct_L-12dB_AVivid;

d) Calculate the difference (dB) between the maximum and minimum amplitude values in the frequency response curve within the frequency range of 500 Hz to 8000 Hz, excluding levels with peak and valley widths less than 1/6 oct;

e) Repeat steps c) to d), change the playback file to _2fstpl12oct_r-12dB_AVivid, and measure the frequency response characteristic curve of the right channel sound.

7. 2. 6. 3 Result Expression

Expected result: The difference between the maximum and minimum amplitude values in the frequency response characteristic curves of the left and right channels should meet the requirements of Table 2, which is ≤ 1 dB (500 Hz~8000 Hz). If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7. 2. 7 Total Harmonic Distortion + Noise Test at Rated Input

7. 2. 7. 1 Feature Description

Measure the total harmonic distortion+ground noise (THD+N) of the tested equipment within the rated input range of 500 Hz to 8000 Hz.

7. 2. 7. 2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the testing system according to Figure 2

b) Set the volume of the tested device to the reference volume value in 7.2.3.2;

c) Play the 2-fstplr12oct_L-12dB_AVivid and use an audio analyzer to measure the variation curve of total harmonic distortion and background noise with frequency;

d) Record the maximum value of total harmonic distortion and background noise within the range of 500 Hz to 8000 Hz as the left channel total harmonic distortion and background noise result;

e) Repeat steps c) to d), change the playback file to 2.fstplr12oct_r-12dB_AVivid, and measure the total harmonic distortion and background noise of the right channel.

7. 2. 7. 3 Result Expression

Expected result: The total harmonic distortion and background noise of the left and right channels should meet the requirements of Table 2, which is ≤ 5% (500 Hz~8000 Hz). If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7. 2. 8 Audio Loudness

7. 2. 8. 1 Feature Description

Check if the audio volume control of the tested device meets the requirements for TV playback.

Table 31 Basis for determining audio loudness test

test signal	Functional requirements
Loudless_714_-24LU_pink_Avivid	-24LUFS
Loudless_714_-15LU_pink_Avivid	-15LUFS

7. 2. 8. 2 Measuring Method

The audio loudness testing method is as follows:

a) Connect the testing system according to Figure 2;
b) Set the volume of the tested device to the reference volume value in 7.2.3.2;
c) Play the test file Loudless_714_ -24LU_pink_ Vivid;
d) Use an audio analyzer to save the signal output by the tested device as a WAV file;
e) Using audio signal analysis software to calculate the average loudness of WAV files;
f) Play the test file Loudless_714_ -15LU_pink_ Vivid;
g) Use an audio analyzer to save the signal output by the tested device as a WAV file;
h) Use audio signal analysis software to calculate the average loudness of WAV files.

7. 2. 8. 3 Result Expression

Expected result: The average loudness result should meet the requirements of Table 31, with an error not exceeding ± 1 LU. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7. 3 Audio and Video Synchronization

7. 3. 1 Feature Description

Check the audio and video synchronization time difference of the tested device, in milliseconds (ms).

7. 3. 2 Test Block Diagram

The connection diagram for audio and video synchronization testing is shown in Figure 3.

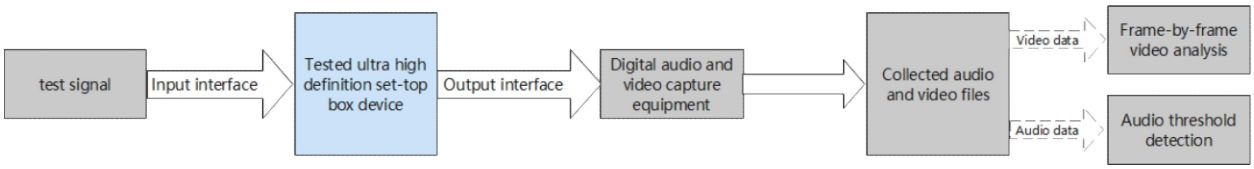

Figure 3 Block diagram of audio and video synchronization testing

7. 3. 3 Measuring Method

The method for testing audio and video synchronization is as follows:

a) Connect the testing system according to Figure 3;
b) Set the volume of the tested device to the reference volume value in 7.2.3.2;
c) Play the test file AV-Sync_4object_714_AVivid_MP4_2265_25fps.mp4;
d) Use digital audio and video capture devices to collect playback signals and save them as local video files;
e) Decompose the collected video files frame by frame, and use image comparison algorithms to detect the position of the nth frame where a completely white image appears. The time t1 at which the completely white image appears is 1000 * (n-1)/frame rate, measured in milliseconds; Using audio signal analysis software, record the time t2 in milliseconds when the audio of the recorded video file appears to be greater than -10 dB (threshold adjustable); The result of audio and video synchronization is (t1-t2);
f) Play the test file AV-Sync_20-AVivid_MP4_0265_25fps.mp4;
g) Repeat steps d) - e) to calculate the time difference of the audio and video signals and record it.

7.3.4 Result Expression

Expected result: The audio and video synchronization test results should be within -40 ms~20 ms, and the test results should be expressed in milliseconds (ms). If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7.4 Digital Media Interface Output

Refer to sections 7.1, 7.2, and 7.3 for the testing method of decoding mixed dual channel audio output through PCM.
The method of testing audio and metadata output through transparent transmission is yet to be determined.

7.5 Metadata Support

7.5.1 Gain Control Test

7.5.1.1 Feature Description

Test whether the tested device can correctly parse and apply metadata related to gain control.

Table 32 Basis for determining gain control testing

test signal	Functional requirements
Loudless_0_AVivid	-20 dBFS
Loudless_10_AVivid	-10 dBFS
Loudless_-10_AVivid	-30 dBFS

7.5.1.2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the tested device according to Figure 2;
b) Set the volume of the tested device to the reference volume value in 7.2.3.2;
c) Play the gain control test audio files in Table 19 in sequence;
d) Use an audio analyzer to test the audio amplitude at the output of the tested device, and the results are expressed in dBFS.

7.5.1.3 Result Expression

Expected result: The synchronous test results of gain control should meet the requirements of Table 32, with a deviation not exceeding ± 2 dB. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7.5.2 White Gain Control Test

7.5.2.1 Feature Description

Test whether the tested device can correctly parse and apply metadata related to white gain control.

Table 33 Basis for determining white gain control test

Test signal time	Functional requirements
0~10 s	0 dB
10~20 s	10 dB
20~30 s	-10 dB

7. 5. 2. 2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the tested device according to Figure 2;
b) Set the volume of the tested device to the reference volume value in 7.2.3.2;
c) Play the test audio file Dialog_AVivid for white gain control in playlist 20;
d) Use an audio analyzer to test the audio output amplitude of the signal in three time periods of 0-10s, 10-20 s, and 20-30 s, and the results are expressed in dBFS. Calculate the difference between the audio output amplitude of 10-20 s and 20-30 s, and the audio output amplitude of 0-10 s, respectively, and express the result in dB.

7. 5. 2. 3 Result Expression

Expected result: The difference between the audio output amplitude of 10-20 s and 20-30 s, and the audio output amplitude of 0-10 s should meet the requirements of Table 33, with a deviation of no more than ± 2 dB. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7. 5. 3 UI dynamic setting object volume test

7. 5. 3. 1 Feature Description

Test whether the tested device can correctly display and modify metadata related to object volume.

7. 5. 3. 2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the tested device according to Figure 2;
b) Set the volume of the tested device to the reference volume value in 7.2.3.2;
c) Play the UI_1objectid_Vivid audio file;
d) Check if the default gain initial value displayed on the UI matches the description in Table 23 and if the volume supports adjustment;
e) Set different values for UI object volume, gradually increasing from 0 to maximum, and use an audio analyzer to record the trend of signal amplitude changes;
f) When setting the volume of the UI object to maximum, observe whether there is an overload phenomenon in the signal amplitude of the audio analyzer.

7. 5. 3. 3 Result Expression

Expected results: The UI displays a default gain of 5 and supports volume adjustment. When the object volume is set to 0 in the UI, it is required to output mute; When set to maximum, the output should be the maximum value; And during the process of increasing from 0 to the maximum, the output follows an increasing trend

without any overload phenomenon. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

7. 5. 4 Dynamic Setting Object Sound Direction Test

7. 5. 4. 1 Feature Description

Test whether the tested device can correctly display and modify metadata related to the sound direction of the object.

7. 5. 4. 2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the tested device according to Figure 2;
b) Set the volume of the tested device to the reference volume value in 7.2.3.2;
c) Play the UI_1objectid_Vivid audio file;
d) Check whether the initial value of the object sound direction displayed on the UI conforms to the description in Table 23, and whether the object sound direction in the three dimensions of left and right, front and back, and top and bottom supports quantization value settings;
e) Set the coordinate values of the left and right, front and back, and top and bottom dimensions to the initial value of 0. Set the sound direction values of the object to change from left to right, that is, adjust the corresponding quantization value from minimum to maximum. Use an audio analyzer to record the amplitude change trend of the dual channel output signal;
f) Set the coordinates of the left and right, front and back, and top and bottom dimensions to the initial value of 0. Set the sound direction values of the object to change from back to front, that is, adjust the corresponding quantization value from minimum to maximum. Use an audio analyzer to record the amplitude change trend of the dual channel output signal;
g) Set the coordinate values of the left and right, front and back, and top and bottom dimensions to the initial value of 0. Set the sound direction values of the object to change from bottom to top, that is, adjust the corresponding quantization value from minimum to maximum. Use an audio analyzer to record the amplitude change trend of the dual channel output signal.

7. 5. 4. 3 Result Expression

Expected results:
The initial value of the sound direction of the object displayed in the UI is required to be 0. The object sound direction in the three dimensions of left, right, front, back, and up and down supports quantization value settings. When the sound direction of the object changes from left to right, the amplitude of the left channel output signal is maximum when the sound direction value of the object is the smallest, and the amplitude of the right channel output signal is maximum when the sound direction value of the object is the largest; And during the process of the left and right sound direction values changing from the minimum to the maximum, the amplitude output of the left channel output signal follows a decreasing trend, and the amplitude output of the right channel output signal follows an increasing trend, without overload phenomenon. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

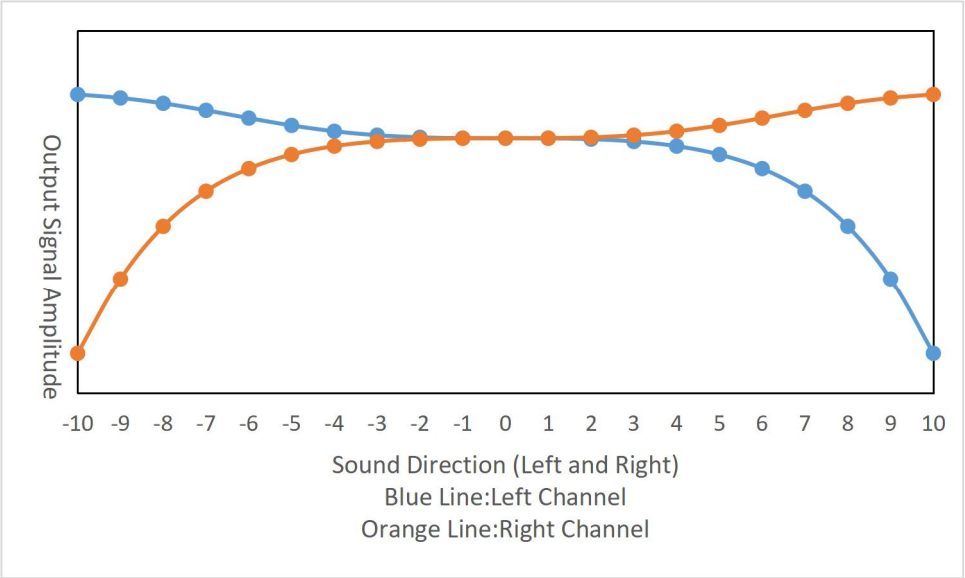

Figure 4 Trend chart of amplitude variation of dual channel output signal when the direction of sound changes from left to right of the object

When the sound direction of the object changes from back to front, the amplitude of the dual channel output signal reaches its maximum when the sound direction value of the object is at its maximum; And during the process of the direction value of the front and rear sound changing from the minimum to the maximum, the amplitude of the dual channel output signal follows an increasing trend without any overload phenomenon. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

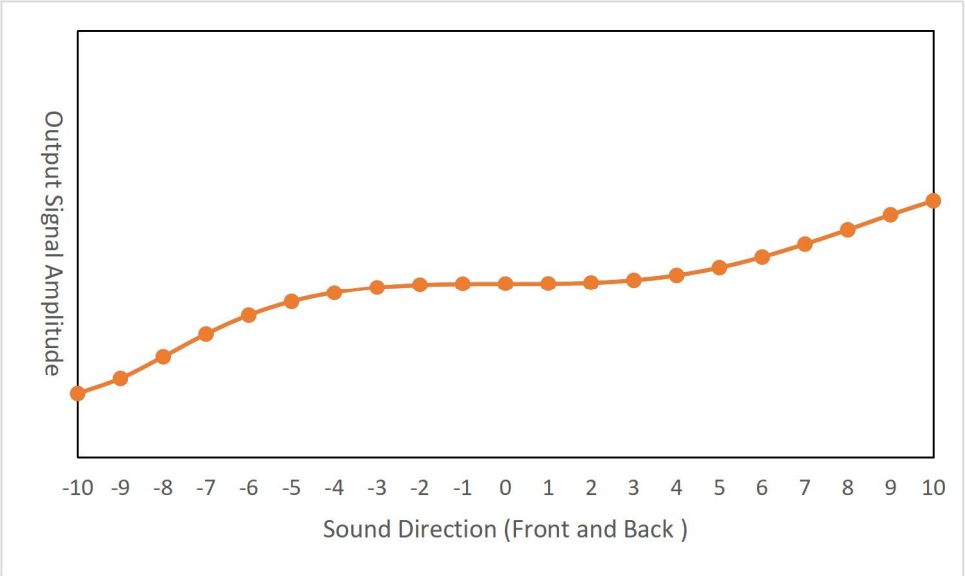

Figure 5 Trend chart of amplitude change of dual channel output signal when the direction of sound behind the object changes

When the sound direction of the object changes from bottom to top, the amplitude of the dual channel output signal reaches its maximum when the sound direction of the object is at its minimum; And during the process of the up and down sound direction values changing from the minimum to the maximum, the amplitude of the dual channel output signal follows a decreasing trend without any overload phenomenon. If the above conditions are met, it is considered compliant; otherwise, the result is not compliant.

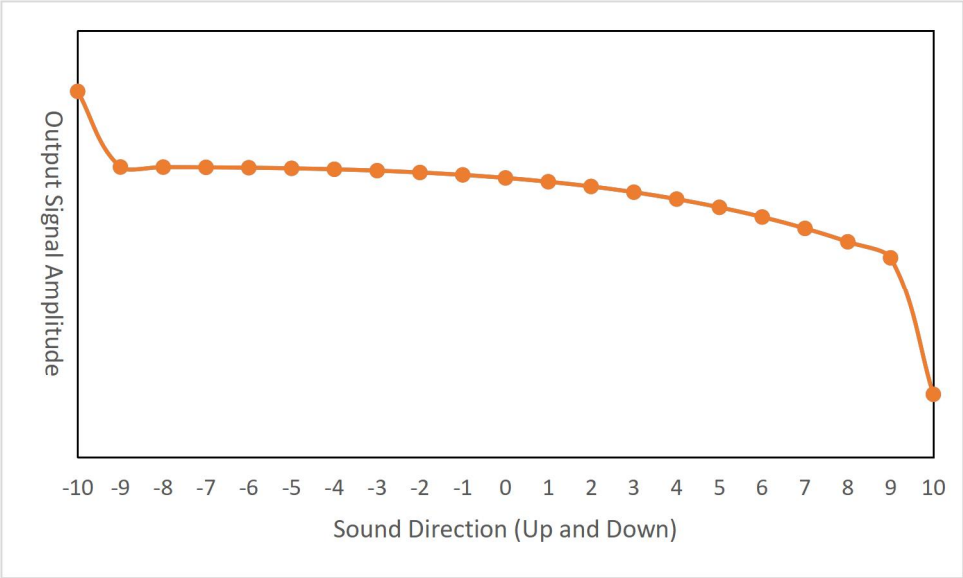

Figure 6 Trend chart of amplitude variation of dual channel output signal when the direction of sound changes below and above the object

7.5.5 UI Switching Mutex Object Testing

7.5.5.1 Feature Description

Test whether the tested device can correctly display and switch mutex objects.

Table 34 UI switching mutual exclusion object judgment criteria

Object Number	content	Functional requirements
1	English commentary	The object information is displayed correctly, supports interaction, and is mutually exclusive with Chinese explanatory objects
2	Chinese commentary	The object information is displayed correctly, supports interaction, and is mutually exclusive with the English explanation object
3	Instrument sound	The object information is displayed correctly, supports interaction, and is not mutually exclusive with other objects
4	singing	The object information is displayed correctly, does not support interaction, and is not mutually exclusive with other objects

7.5.5.2 Measuring Method

The measurement method is carried out according to the following steps:

a) Connect the tested device according to Figure 1;
b) Play the UI4objectid_Vivid audio file;
c) Observe whether the object information displayed on the UI conforms to the corresponding description in Table 24;
d) Test whether each object supports interactive settings through the UI interface and check if it meets the corresponding description in Table 24;
e) Test whether there is a mutually exclusive relationship between two objects that support interaction, and whether it conforms to the corresponding description in Table 24.

7. 5. 5. 3　Result Expression

Expected result: If the test result meets the requirements in Table 34, it is considered compliant; otherwise, the result is not compliant.

Appendix A (Informative).
Reference Table for Actual Volume Corresponding to Object Volume

The reference value of the object volume (linear) corresponding to the actual volume value dB is shown in Table A.1.

Table A.1 Reference Table for Actual Volume Corresponding to Object Volume

Object volume in UI (linear)	Actual volume value dB
0	Mute
1	-20
2	-13.979
3	-10.458
4	-7.959
5	-6.021
6	-4.437
7	-3.098
8	-1.938
9	-0.915
10	0
11	0.828
12	1.584
13	2.279
14	2.923
15	3.522
16	4.082