



# ZIRENE® SOUND

## Audio Enhancement

### OVERVIEW

ZIRENE® SOUND is a HD quality audio enhancement solution. It significantly improves the output sound quality of audio playback devices such as smartphones, tablets, TVs, soundbars, Head Mounted Displays, headphones and other kinds of devices in which audio is an essential part of the user experience. The solution is purely software-based and easily integrated into a device.

The demand for small, slim and portable audio devices means that audio playback capabilities often differ significantly from those intended by the creators of the original media content. For example, stereo music and multi-channel audio are produced with specific loudspeaker arrangements in mind. These are not directly achievable with small devices or headphones. Other limitations may be caused by low acoustic output power or reduced bandwidth capability.

To overcome the inherent performance limitations of audio devices, ZIRENE® SOUND offers state-of-the-art audio enhancement technologies to optimise the audio playback capabilities. ZIRENE® SOUND significantly increases the sound quality by post-processing the audio signal in the device. ZIRENE® SOUND includes high-quality features to:

- Create surround sound virtually for headphones and stereo loudspeakers
- Enhance audio content by boosting voice dialog and equalise loudness differences
- Enhance playback capabilities by equalising and boosting bass, treble and level

In addition to the ZIRENE® SOUND software solution, AM3D offers tuning tools for quick and easy adaption to each device model.

### FEATURES

ZIRENE® SOUND consists of audio processing modules for micro-speakers, loudspeakers and headphones. The features can be used separately or in combination:

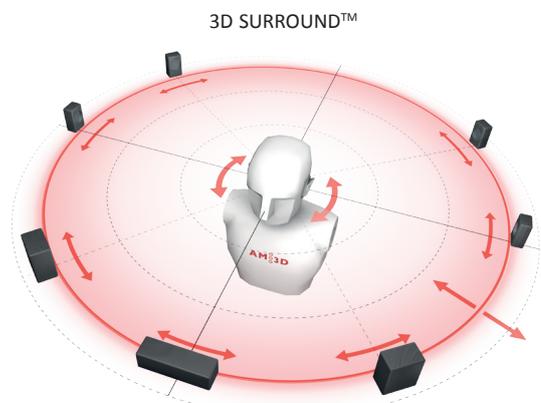
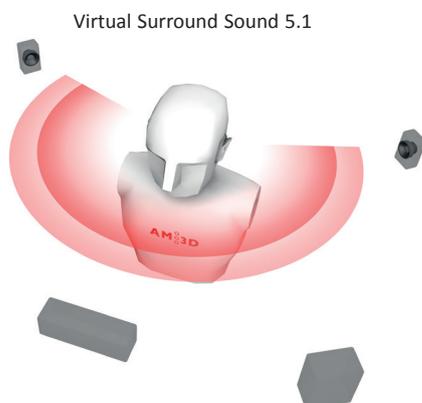
- 3D SURROUND™
- Virtual Surround Sound (mono, stereo, 5.1, 7.1)
- Voice enhancement
- Level alignment
- Standard equalisers
- Transducer equalisation
- Bass and treble enhancement
- High-pass filter
- Dynamic range compressor
- Output limiter

Please find more details on the other side of this hand-out.

### INTEGRATION

ZIRENE® SOUND is based on digital signal processing algorithms implemented in software. AM3D's patented software is easily integrated to operating systems, apps or chipset-platforms.

ZIRENE® SOUND software is generic, module-based and configurable. The solution is not dependent on any external libraries, e.g. open source code, and is developed in ANSI C using assembly-optimised coding for the resource-intense parts targeted at various platforms. An ANSI C reference is available for fast prototyping on customer devices. Optimised software is already available for a number of platforms (e.g. ARM, Tensilica HiFi and CSR chipsets) and can within short time be optimised for, or ported to other dedicated platforms.



### ABOUT AM3D

AM3D provides world-class audio technology. The company delivers software solutions for the consumer electronics industry such as smartphones, tablets, TVs, Bluetooth devices and automotive systems. AM3D holds several patents on audio enhancement and 3D audio technologies.

AM3D has offices in Denmark, Japan and South Korea. AM3D A/S was established in 1997 as a commercial offspring of research activities at Aalborg University in Denmark and is owned by Dynaudio, which is part of GoerTek Inc.

## FEATURES IN DETAIL

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**3D SURROUND™** is a real 3D object oriented Virtual Surround Sound for headphone playback. It incorporates a full binaural synthesis based on AM3D's state-of-art HRTFs for true life-like perception. Natural listening environments are synthesized using a high-density reverberation algorithm. Immersive sound is achieved regardless of the number of input channels. HD audio quality surround is obtained for mono, stereo, 5.1 and 7.1 input content.

3D SURROUND™ offers a number of real-time changeable settings for optimising the listening experience. The end-user is able to change the position of each virtual loudspeaker in 360° as well as the distance between the listener and the virtual loudspeakers. The characteristics of the listening environment can be altered by using 10 different pre-sets.

3D SURROUND™ eliminates known problems with headphone listening such as occlusion and "vocal-in-head" effects, which results in an "out-of-head" sound experience. The listener clearly perceives the virtual center, front, side and rear loudspeakers in the correct positions hereby enhancing playback of multi-channel content.

**Virtual Surround Sound** Multi-channel and stereo contents are not intended for playback on small devices. Virtual Surround Sound overcomes this problem by using binaural technology to create virtual sound sources, which simulates the intended loudspeaker set-ups needed for optimum playback.

With a 2.0 channel input (stereo or multi-channel down-mix) the signal is enhanced to produce a multi-channel alike surround sound signal. When played back, it produces a profound surround sound perception and an enhanced center optimum for movie as well as music playback.

With a 5.1 or 7.1 multi-channel surround sound input an enhanced stereo signal is produced. When played back, it reproduces a virtual 5.1 or 7.1 multi-channel loudspeaker set-up for perfect surround sound perception. The produced sound image extends beyond the physical loudspeakers.

**Voice Enhancement** Voice enhancement operates on mono, stereo and multi-channel input by detecting voice in movie and TV audio content. Once detected, a compressor is activated to boost the voice and a significant improved user experience is achieved when watching video content on tablets, smartphones and TVs. Combining voice enhancement with level alignment results in a clear voice dialog on movie content played back on micro speakers with low output capabilities. Thereby, inaudible voice becomes audible.

**Level Alignment** Level alignment adjusts the level of different audio signals to compensate for differences in loudness. This is useful e.g. when two consecutive music pieces have very different loudness. This is the case when the level of advertisements on the radio is much louder than the music being played. In such cases, level alignment effectively aligns the signal loudness to minimise the difference. With movie content the silent parts are increased in level, while loud action scenes are left unchanged.

**Standard Equalisers** A 6-sections parametric equaliser, a 3 band tone control and a 5-band graphics equaliser can be used to control the timbre of the audio to a preferred sound.

**Transducer Equalisation** Often speakers in small devices and headphones do not have an ideal frequency response, e.g. some frequencies are reproduced louder than intended due to resonances of the acoustic system. Transducer equalisation compensates for this by equalising the response to achieve a specific target. The Transducer equalisation is a vital component to optimise the speaker playback, and the overall perceived sound quality is improved significantly.

**Bass Enhancement** Loudspeakers which reproduce sound in the mid and high-frequency range are generally poor at reproducing low-frequency sounds. Bass content is vital to movie effects and music to achieve a perceived high sound quality. Bass enhancement boosts the low frequency part of the signal and leaves the remaining part of the frequency range unchanged in terms of loudness and timbre. This gives the possibility to create extreme bass enhancement.

AM3D offers three dedicated bass enhancement solutions: A generic solution optimised for mid-range loudspeakers and headphones, one optimised specifically for micro-speakers used in e.g. mobile phones, and a bass harmonics solution.

**Treble Enhancement** Loudspeakers which reproduce sound in the low to mid-frequency range are generally poor at reproducing high frequency sounds. A common approach in playback systems is to use a second loudspeaker (tweeter) for reproducing the high frequencies. Treble enhancement approaches this problem differently by boosting the high frequency content of an audio signal. As a result, treble enhancement provides a clear and crisp treble which emphasises details that are usually lost during playback.

**High-pass Filter** Input signals with high level of low frequency content can cause large displacements of the loudspeaker membrane, while producing little or no audible sound. This can also cause high distortion levels or even damage the loudspeaker. The high-pass filter removes the lowest frequencies of the input signal, which cannot be reproduced. As a result, the risk of distortion and damage to the loudspeaker is significantly reduced.

**Dynamic Range Compressor** Small loudspeakers are typically not able to produce enough loudness level causing the sound to be inaudible. This is normally experienced for input signals with a high dynamic level range e.g. movie content. The dynamic range compressor boosts the level of low input signals, while leaving high input signals unchanged. As a result, the output loudness can be significantly increased.

**Output Limiter** The output can be limited with respect to peak and power for avoiding overdriving the hardware and loudspeaker. This can protect the loudspeaker from damage.