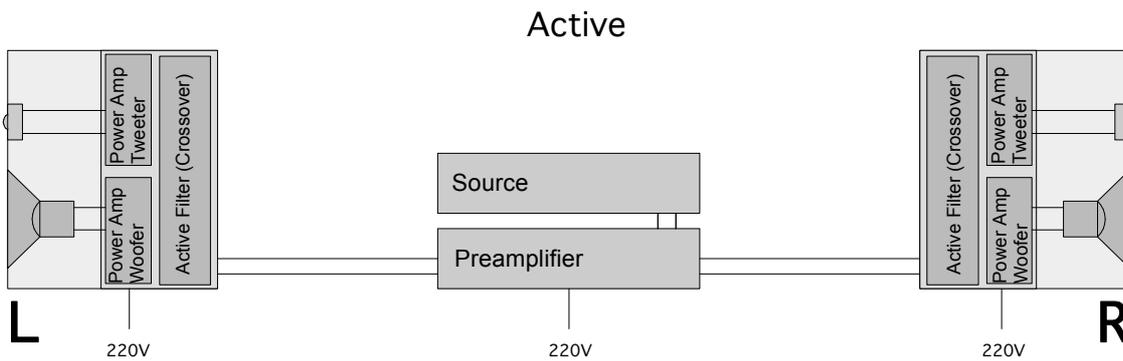


ACTIVE TECHNOLOGY

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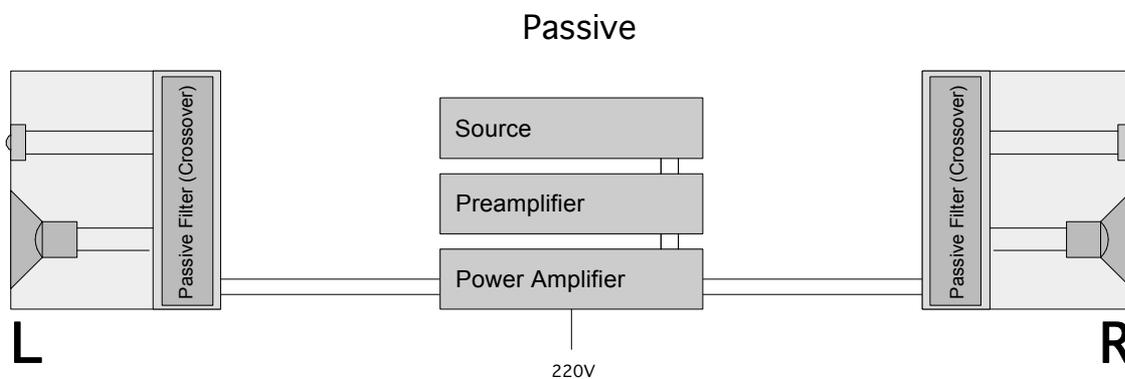
Active versus Passive Technology



An active loudspeaker has its own amplifier which is optimized for it and is typically integrated in the cabinet to keep the cables to the drivers as short as possible. Each frequency range / driver has its own power amplifier and the incoming signal is divided before the amplification. The division is done with an active filter which works more precisely because the components are much smaller, with tighter tolerances and lower distortions. Furthermore the signal can be treated with special technologies like CPR to optimize performance.

The power amplifiers corresponding to each section of drivers can be designed according to the specs of the drivers and special technologies like AOI can be implemented. Also the influence of the speaker cable can be integrated precisely.

Active Designs have become very popular in Professional Audio. The advantages in accuracy, reliability, overload protection are more evident than in HiFi, where subjective listening is more demanded.



The traditional passive HiFi-loudspeaker is driven by an external power amplifier and the signal is divided in different frequency ranges after the amplification. This is done with big, rather costly components: coils, capacitors, resistors. They suffer from big tolerances, distortions and degrade signal quality in many ways. The power amplifier then doesn't "see" the drivers directly, because the passive filter is in between. So the control over the movement of the membranes is not directly possible, the drivers interfere with each other and the passive filter introduces distortions in phase and degrades impulse response.

The combination of loudspeaker and amplifier becomes a game of trial and error, but leaves space to personal choices and a more subjective approach.

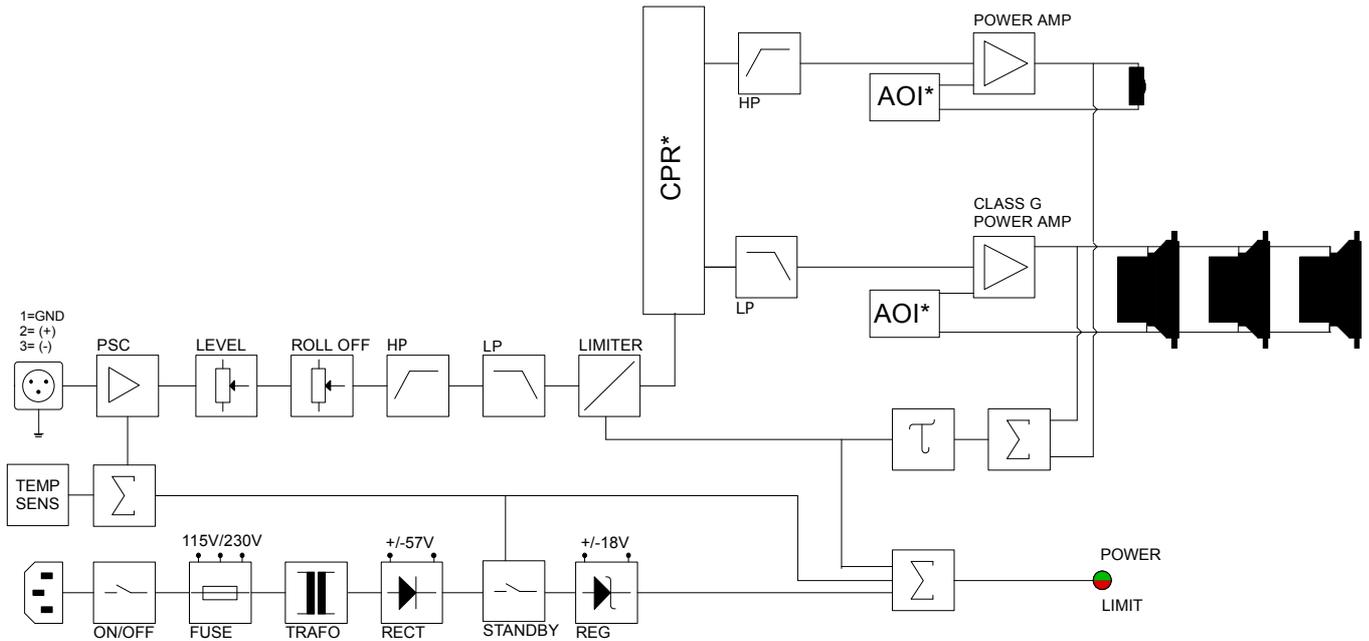
Klangwerk also manufactures passive loudspeakers. With careful design and as few components as possible in the passive filter, very good performances can be realized. Passive designs are cost effective and easier to integrate in existing systems. And the choice of amplifiers or nice all-in-one systems is much bigger than with active designs. But when it comes to ultimate performance the errors introduced with passive designs become an issue.

Active Electronics by Relec SA, Yverdon - Switzerland

The active electronics of the Klangwerk speakers has been developed and is manufactured from the Swiss company Relec SA in Yverdon. They are specialized in the manufacturing of Studio Monitors under their brand name PSI-Audio. Their purely analog active solutions are unique to optimize the electroacoustic behavior of loudspeakers.

Active Electronics of ELLA

*AOI und *CPR / © by Relec SA, Yverdon, Switzerland



Efficient use of Power

In a consequent active system, the power amps are working directly behind each section of drivers. The division of frequency ranges where the power amps are working reduces the necessary total power. If for example a high and low frequency signal of identical volume have to be amplified simultaneously, each amplifier has to deliver a power which is only a quarter of the power compared to an amplifier which would amplify both signals in common.

Dynamic Limiter

A dynamic limiter smoothes peaks which could damage the drivers. The whole frequency range then is reduced in level to keep the tonal balance of the program material.

Compared to this, a passive system loses the tonal balance at high levels due to compression in certain frequency ranges. The ranges which are not compressed play louder than the compressed ranges (typically the bass) and the sound gets harsh. The dynamic limiter solves this problem.

CPR (Compensated Phase Response) System*

In a multi-way speaker system, the crossover filters, as well as the transducers, introduce distortion of phase and by consequence of the variations of group delays.

The group delays in low frequencies are more important than in high frequencies. They provoke a time related separation of the low and high frequencies which then is responsible for the hollow sound of multi-way speaker systems.

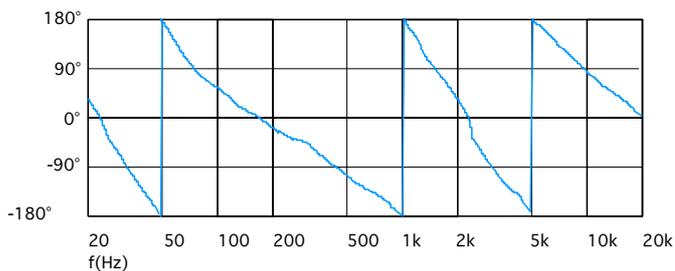
In a limited frequency range, an all pass filter allows to intervene on the phase without influencing the amplitude. The CPR system consists of several all pass filters who each act in a specific range of frequency in order to obtain a wide area of Compensated Phase Response. This then provides a constant group delay. Thanks to the CPR system the placement of sound sources in the actual sound space is highly accurate.

The human ear is sensitive to group delays or phase irregularities of sounds. The human brain detects such irregularities easily and processes them into space related information's like the positioning of a sound source. All traditionally designed speaker systems suffer to a certain degree of such irregularities. These irregularities are the reason why some speakers produce a wider and deeper room perception which is often misunderstood as a quality.

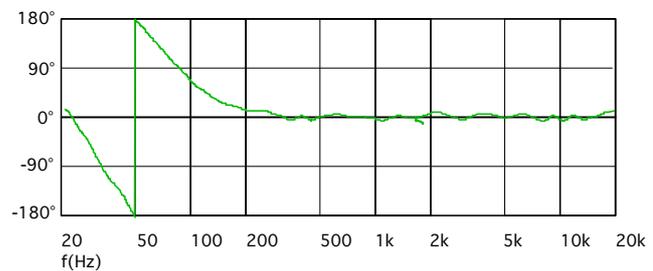
Phase irregularities are desirable on creative tools like equalizers, compressors, reverbs and delay units when creating a certain desired sound, whilst being an important part of the creative process of sound engineering. But if the speaker system should represent the result of the sound engineer's work, these irregularities are a disturbing factor and the sound reproduction can't be accurate.

Phase accuracy is the basis of an accurate reproduction of stereophonic sound.

Acoustic Phase response:
Multiway speaker without CPR



Acoustic Phase response:
Multiway speaker with CPR and AOI



*AOI und *CPR / © by Relec SA, Yverdon, Switzerland

AOI (Adaptive Output Impedance) System*

In low frequencies a loudspeaker behaves like a high-pass filter; therefore the damping depends on its mass, on compliances (mechanical and acoustical suspension) and of the source resistance.

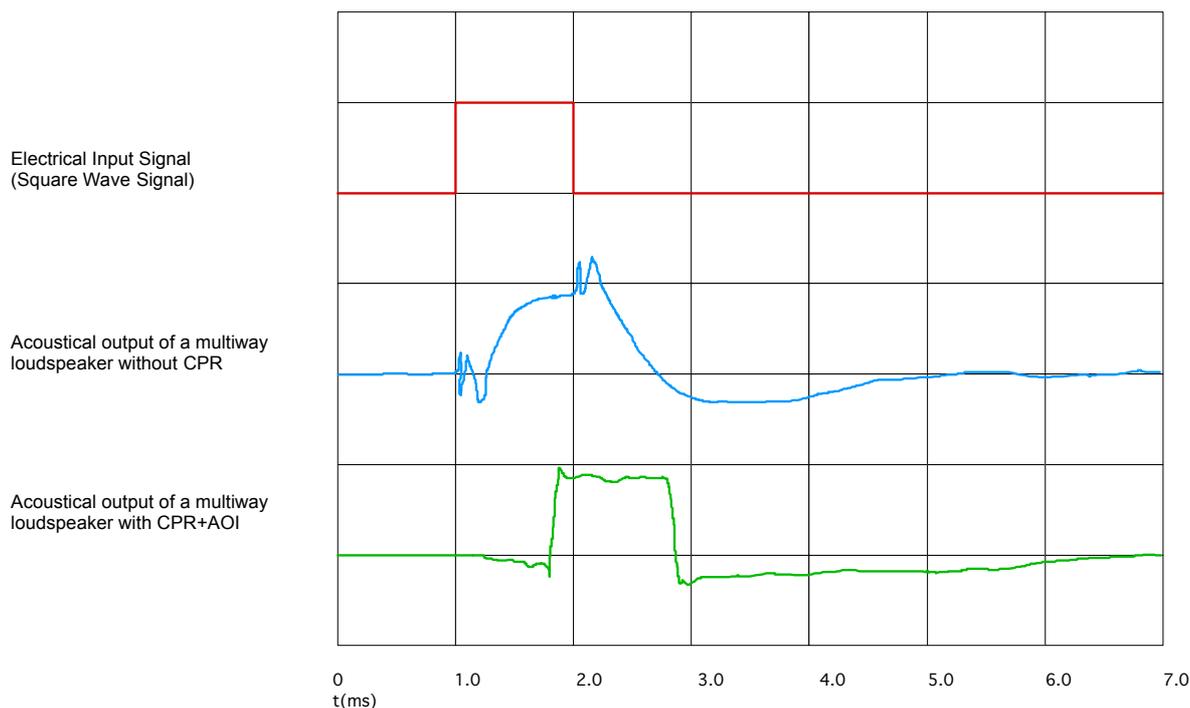
In high frequencies, the resonances correspond to the deformations of the membranes. The masses in movement are parts of the mobile mass. Compliances depend on the elasticity of the material. The resistances are the internal damping and the source resistance.

For an ideal damping in a wide area of frequency, the source impedance must be adapted to every range of frequency for every transducer. The AOI system is constituted by a detection of the movement of the membrane and the moving coil, as well as by a counter reaction filtering. Therefore the damping rate is continuously ideally adjusted according to the frequency. The AOI system allows the reproduction of sound without transducer coloring over the whole frequency range.

Speakers featuring the AOI system have superior impulse behavior to traditional amplifier designs. Whilst the transducer travels to its intended position the AOI circuitry seamlessly adapts the amplifiers output impedance to ensure ideal acceleration of the membrane to reproduce the desired impulse. Once the transducer reaches the end of the impulse, the AOI circuitry provides a break, in order to act against an overshooting of the transducer.

The AOI circuitry is almost capable of reproducing a square wave and therefore increases accuracy by marrying the transducer and the amplifier into a perfect couple.

Impulse Response of Loudspeakers



Today more importance is given to the low end reproduction of sounds, especially when using subwoofer technology in surround sound systems. Then the importance of a system that has an accurate and not a flattering reproduction becomes essential.

The result of the AOI featured speakers is a highly accurate impulse behavior with a minimum of transducer coloration.

Another benefit is that cabinet size can be halved compared to a traditional passive design. The alignment of driver, port and volume of the air will be calculated differently. The benefit is optical (smaller speakers are always preferred) but also acoustical: A smaller cabinet is stiffer than a bigger one, given the same construction. Also is a smaller speaker easier to integrate in an interior design and can be better positioned in rooms to optimize performance. Furthermore, the amplifier module features a Roll Off knob to adapt bass response according to the distance from the speakers to the wall.

A nice side effect of the AOI system is that the membranes do not produce parasite sounds when other speaker systems in the room are in use. When air pressure is produced by other sources, the AOI will detect this and tighten the damping of its transducers in order not to produce parasite sounds not originating by the speaker system in use.

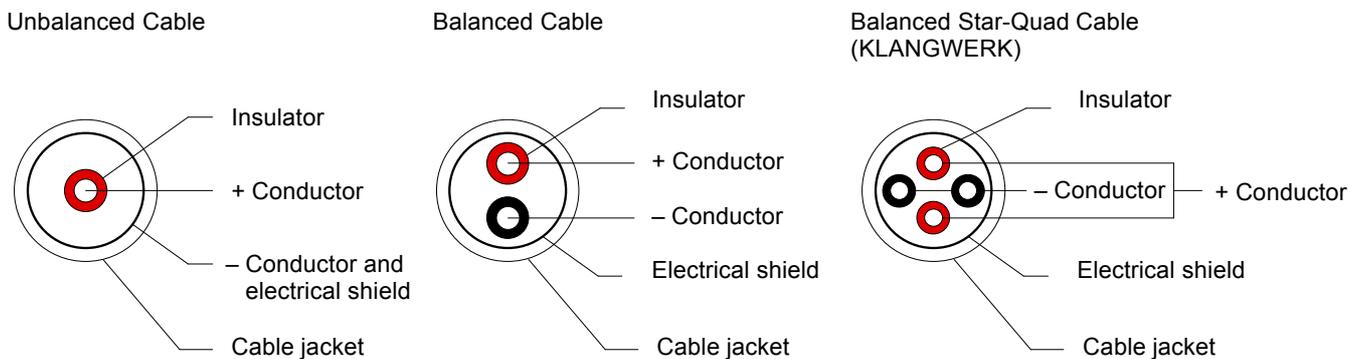
*AOI und *CPR / © by Relec SA, Yverdon, Switzerland

Balanced Signal Transmission

As in active loudspeakers the amplifiers are near the drivers, the critical loudspeaker cables can be kept short. Also contacts don't suffer from mechanical manipulations and the loudspeaker cables can be fixed and soldered. On the other side the signal cable from the preamplifier to the active loudspeaker is typically rather long. Therefore the well established balanced signal transmission, used in the professional domain should be used. The signal can be transported over long distances without a loss in quality or induction of interferences and noises.

The balanced cable has a protection over the + and the – conductor. The unbalanced cable, which is common in HiFi-Systems, uses the protection also for the - conductor, what makes it more sensible to interferences. The balanced cable allows to subtract the interferences in the receiving device by comparing +/- conductors. Special arrangement of the conductors allow to optimize the cable.

Balanced cables use XLR-connectors which are robust and give good contact.



The balanced signal transmission can be maintained inside amplifiers or source components with the same benefits of higher immunity to interferences or noises.

Sound character with AOI and CPR

Carefully designed active systems tend to sound clearer, preciser and more dynamic. Music sounds more natural, livelike and effortless.

The special technologies AOI and CPR help that music is reproduced uncolored and homogenic. The spatial information of a recording becomes very realistic and music can sound holografic. Especially well recorded music benefits from this effect. Complex music like orchestral works sounds natural, open and transparent, even when played at very high volumes and doesn't tend to sound harsh or uneven. The difference between mediocre and good recordings becomes more evident.