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COMPACT PA
SE Audiotechnik I-Line

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With the I-Line, the Solingen-based manufacturer SE Audiotechnik presents a series of compact loudspeakers with sets consisting of two tops in column design, two DSP amplifiers and an active 12" subwoofer. How will this combination perform in fixed installations?

Copy and measurements: Anselm Goertz | Images: Anselm Goertz





SE Audiotechnik IC32 / IC34 two or four full-range chassis working on a bass reflex cabinet

For a long time, column loudspeakers with full-range drivers had an outmoded image with their use being limited to undemanding PA applications. Modern drivers with powerful neodymium drives and special diaphragm materials have however changed the image of the full-range driver and thus also of the column speaker. Today, full-range drivers of various sizes enjoy an excellent reputation – even in high-end circles: the entire frequency spectrum is dispersed from a single source and phase rotations occur to a lesser extent in a full-range driver than they do in multi-way systems. What remains is a certain weakness in the reproduction of low frequencies – a circumstance that can be eliminated by relying on a supplementary subwoofer without at the same time diminishing the advantages of the full-range driver too much. Even when adding a subwoofer for the respective frequency range, the dispersion from only one source and the favourable phase response persist.

Solingen-based manufacturer SE Audiotechnik's I-Line also relies on the concept of full-range drivers combined with an optional subwoofer. To increase the performance and to adjust the dispersion angle, the full-range drivers in the I-Line tops are arranged as short columns with two or four drivers in a line one above the other. While the vertical dispersion is somewhat narrowed as a result, the horizontal dispersion angle of a single speaker remains unchanged. This results in a number of advantages, especially in an acoustically difficult environment. This characteristic, the column loudspeaker's wide horizontal and a narrow



Slightly rotated design of the drivers to extend the horizontal beam angle



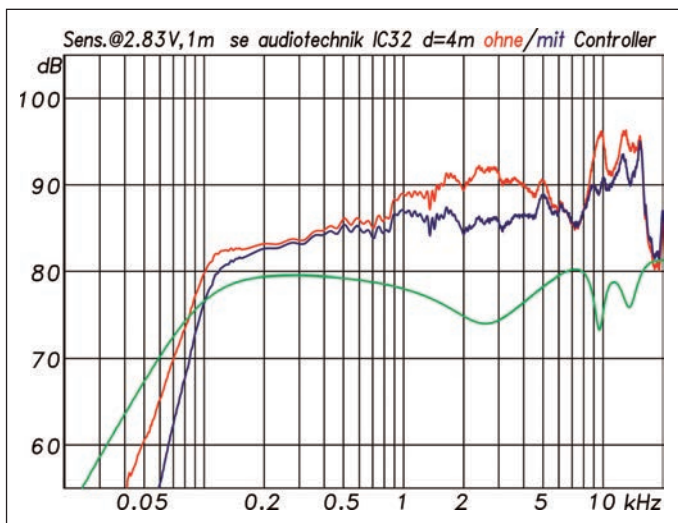
4-pole Phoenix connectors at the top and bottom; users can select via slide switch whether to use signal connections 1± or 2±

vertical dispersion, has been the basis and motivation for numerous loudspeaker concepts – from classic loudspeakers installed in churches to today's line arrays and DSP-controlled speakers.

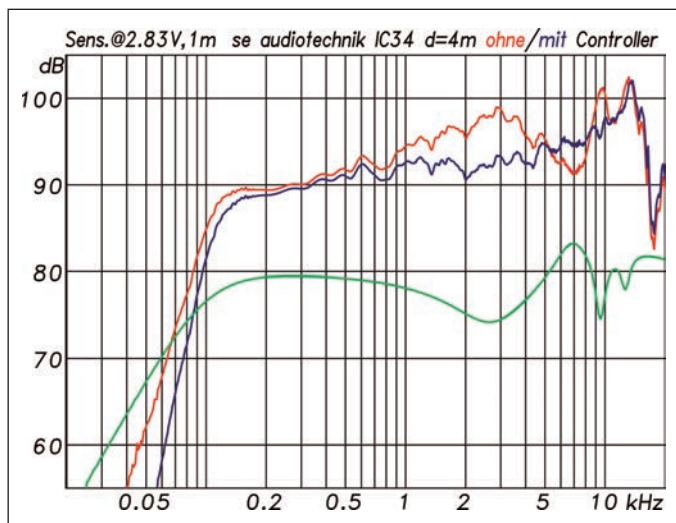
I-Line: controlling, mounting, connecting

In the I-Line's info sheet, SE Audiotechnik lists meeting and conference rooms as well as bars and restaurants as typical applications. The list could be extended to also include boutiques, stores of all kinds, small venues and many more – all small and medium-sized applications, which are acoustically more or less easy and which require the installation of a simple, good quality sound reinforcement without a lot of effort. To ensure that this succeeds, the I-Line's small column speakers are available with matching amplifiers featuring integrated DSP. When selecting the speaker type on the display, one will see that all settings for the respective speaker are already loaded. In addition, gain, delay, limiter and user EQs can be configured for further adaptation to the specific application.

Both column loudspeakers, the IC 32 and the IC 34, feature an aluminium profile with a width of 116 mm and a depth of 150 mm. The enclosures are 247 mm and 462 mm high, respectively. On the front, the speakers are protected by a very solid and elegantly designed grille – backed with



Frequency response and sensitivity IC 32 The red curve shows solely the IC 32, the blue curve shows it together with the filter function (green) from the IA 202D amplifier with DSP (Fig. 1)



Frequency response and sensitivity IC 34 The red curve shows solely the IC 34, the blue curve shows it together with the filter function (green) from the IA 402D amplifier with DSP (Fig. 2)

opaque foam. If one loosens the screws from the column loudspeaker's cover or base plate, the grille can be easily removed. Behind the grille, depending on the model, two or four 3.5" drivers are revealed, which are installed slightly

twisted against each other to slightly expand the horizontal dispersion angle. On the enclosure's rear, one can find four-pin Phoenix sockets at the top and bottom, which are internally wired in parallel. A slide switch allows users to

select whether the speaker receives its signal from pins 1± or 2±: if there are two signal strands on a four-wire line, one can simply switch without having to modify the connectors. Small, useful details such as these can make an installation a lot easier.

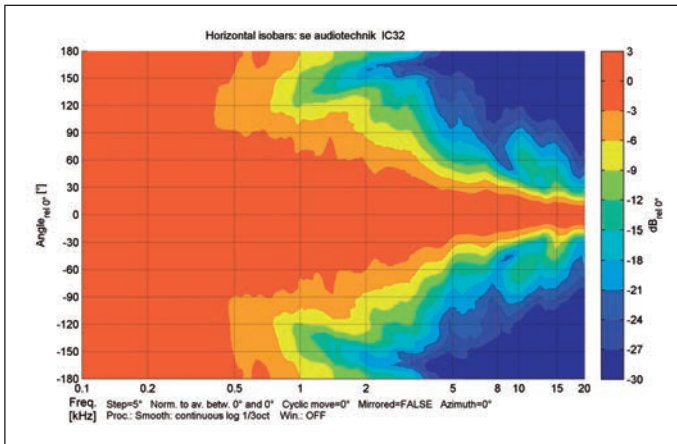
Equally very practical and solid is the mechanical mount. The included smart mounting bracket can be used for wall or ceiling mounting and can be attached to the enclosure's rear with two screws to secure it in an upright or horizontal position. The angles of the bracket's rotation axes can be precisely adjusted and set in 10-degree increments. A safety rope is also included and can be attached to the panel for wall mounting. Thus, nothing is missing and the high-quality accessories and the speaker itself make a very good impression.

IC 32 and IC 34

In the next step, we will have a look at the measurement results. The IC 32 is a nominal 16-Ω loudspeaker with an impedance minimum of 15.6 Ω, while the IC 34 is a nominal 8-Ω system with a minimum of 8.2 Ω (see Fig. 8). Both speakers are designed as bass reflex systems with a tuning frequency of approximately

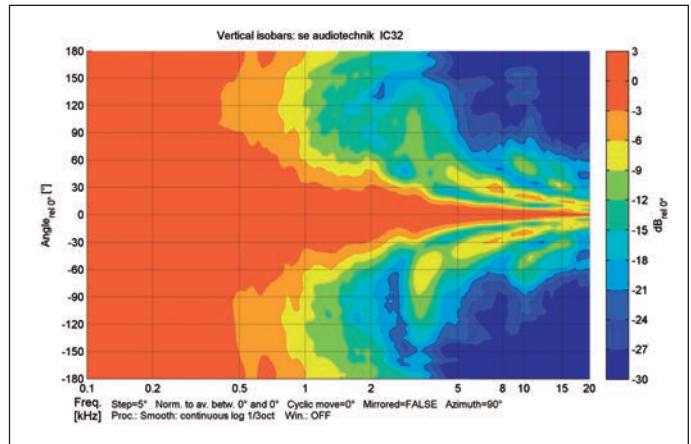


Wall bracket adjustable in all directions and cleanly latching, the tops can be mounted on the wall well



Horizontal isobars of the IC 32 with a continuous constriction towards the high frequencies, as is typical for full-range drivers (Fig. 3)

110 Hz. This results in frequency responses as shown in Fig. 1 and Fig. 2. The red curves show the pure loudspeaker with a sensitivity of 2.83 V/1 m. With 16 Ω nominal impedance, the common value of 1 W/1 m is then 3 dB higher for the IC 32. The green curves show the associated amplifiers' filter functions in the DSP. The blue curves show the loudspeakers with filters. Despite the filtering, the curve has a tendency to rise slightly, which of course could have been easily compensated for. Presumably, however, this was done deliberately, as it allows enough high frequencies to be achieved outside the mid-axis, given that these systems bundle high frequencies. A further reason could be that as the dispersion becomes increasingly wider at lower frequencies, the diffuse field in the room leads to a level

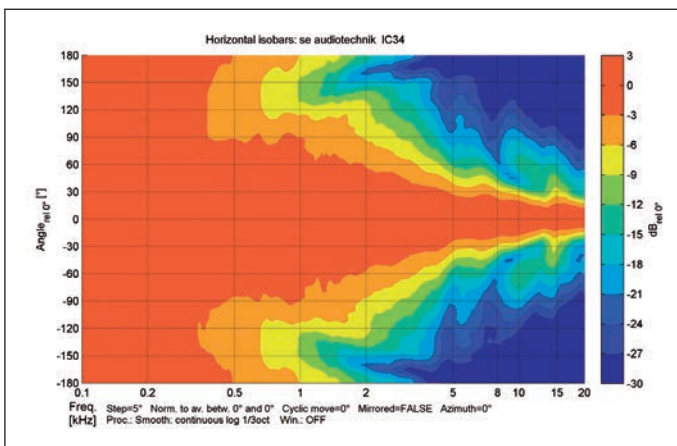


Vertical isobars of the IC 32 with increased bundling and small secondary maxima from 3 kHz onwards due to the two drivers arranged one above the other (Fig. 4)

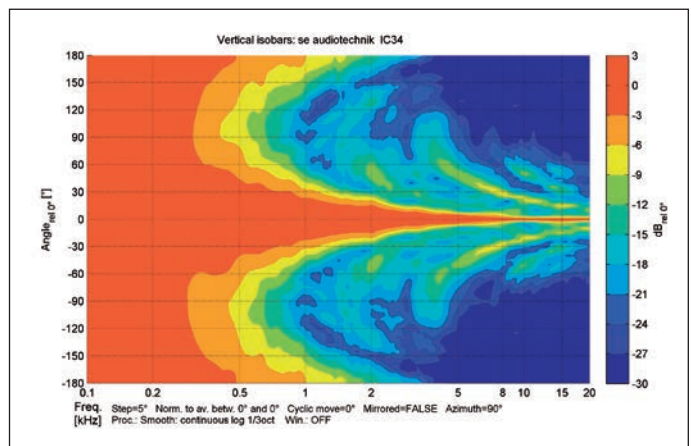
increase, which is thus compensated for to some extent in advance. The IC 32 and IC 34's filter tuning is designed in such a way that both speakers achieve a largely identical frequency response and thus match each other sonically. The high-pass filter at the lower end of the transmission range protects the speaker from signal components below the tuning frequency.

Isobars: versions for modifications

In the horizontal plane, the isobar curves for the IC 32 (Fig. 3 and Fig. 4) and for the IC 34 (Fig. 5 and Fig. 6) show a full-range driver's typical behaviour with a continuous increase in directivity towards higher frequencies, which is determined by the size of the diaphragm. In the vertical



Horizontal isobars of the IC 34 with behaviour comparable to the IC 32 (Fig. 5)



Vertical isobars of the IC 34 with strongly pronounced bundling at the high frequencies due to the length of the column speaker (Fig. 6)



■ IA 402D and IA 202D amplifiers for the I-Line

plane, we can find a second, overlapping effect: the two or four sources arranged one above the other act as one large source at low frequencies and therefore bundle more than the single driver. The isobars in Fig. 4 and Fig. 6 show the difference between the small IC 32 and the IC 34, where pronounced bundling starts at 1 kHz and at 500 Hz respectively. As soon as one approaches the frequency range in which half a wavelength becomes smaller or equal to the distance between the individual sources, lateral secondary maxima occur in addition to the maximum on the central axis. These secondary maxima advance towards the central axis as the frequency continues to increase. For the IC 34, this effect can be seen from 1.5 kHz and somewhat more clearly from 3 kHz onwards. However, the secondary maxima are only weak as the assumed dispersion of the four point sources arranged on top of each other still overlaps

with that of the single driver, which also already bundles strongly at 3 kHz.

With the IC 32 and IC 34, users therefore have the possibility to adapt to the given environment and requirements:

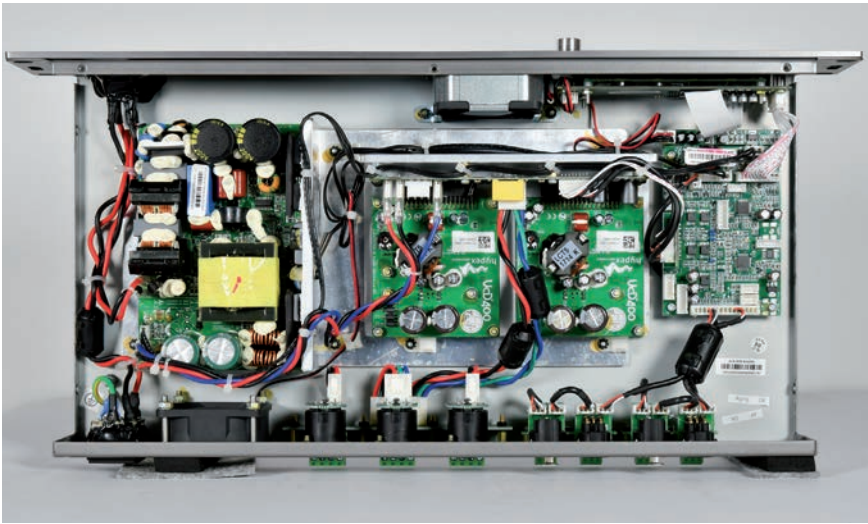
- The IC 32 is well suited for shorter distances and rooms with low reverberation time.
- With its stronger bundling and four drivers, the IC 34 can achieve greater ranges and is better at handling difficult room acoustics.

DSP amplifiers IA 402D and IA 202D

The I-Line also includes two amplifiers, which SE Audio-technik developed and produces in-house. Both amplifiers have two channels and deliver a maximum of 2×400 W and 2×250 W respectively. The IA 202D provides a maximum power of 250 W per channel at 8 Ω and, according to



■ **Dual design** in addition to the Speakon and XLR sockets, the amps also feature a Phoenix socket for each input and output



IA 402D with two Hypex UcD400 amplifiers The power supply and the DSP section are proprietary developments of SE Audiotechnik

the data sheet, is not suitable for 4-Ω operation. The IA 402D is specified with 200 W at 8 Ω and 400 W at 4 Ω per channel. A single IC 34 (200 W/8 Ω) or two IC 32s (100W/16 Ω) operated in parallel would therefore be combined with one IA 202D. If two IC 34s or four IC 32s operated in parallel per channel result in a total impedance of 4 Ω, then the IA 402D would be the right choice. While the IA 202D is a complete in-house development, the IA 402D features two Hypex UcD400 amplifier modules. The power supply and the DSP element, however, are also the result of SE Audiotechnik's in-house development. For the I-Line speakers, ready-made factory pre-sets inclu-

ding all settings are already included in the DSP system. Based on these, users can create their own modified setups. The specific filter and limiter settings for the selected loudspeaker are always retained. Both amplifiers operate with quiet, active cooling from two fans. A look at the rear panel reveals a complete set of XLR and Speakon jacks as well as the Phoenix connectors which are common in fixed installations. In both versions, the inputs are equipped with link sockets. The outputs are available for A and B in single assignment and with a combined connection A+B. All Speakon and XLR sockets are genuine Neutrik. The undeniable ambition that the developers are pursuing here continues on the device's inside.

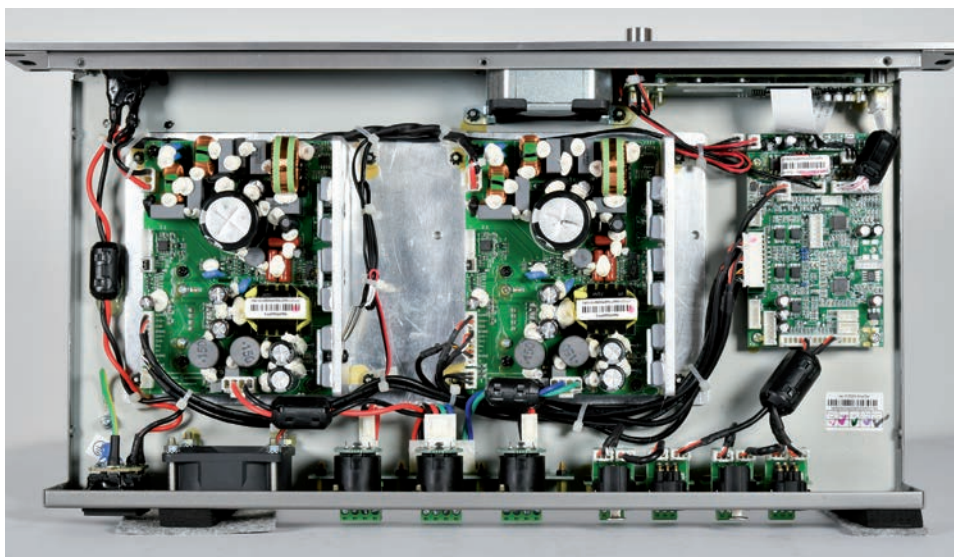
The cabling is neatly executed and secured several times. All connections leading to the outside are equipped with ferrite cores as sheath wave filters against HF interference.

Active subwoofer S 112i

The active S 112i is SE Audiotechnik's subwoofer for the I-Line. As its name suggests, this is a 12" system. The driver with a nominal impedance of 4 Ω (also see Fig. 8) operates on a bass reflex cabinet with a tuning frequency of 46 Hz, making a compact design possible. Its dimensions are 355 × 506 × 496 mm (W × H × D), with a weight of 22 kg. With the two recessed handles on the sides, the S 112i can

still be handled well by one person, while a tripod socket can be found on the enclosure's top side. As is the case with the tops, the subwoofer's front is covered by a solid, opaque grille. The associated electronics with amplifier and controller are located on the rear and can be removed as one unit. Two details should not go unmentioned here:

On the one hand, the electronics are located in their own internal housing and are thus well protected against vibrations caused by the woofer – a lot of electronics that were at the mercy of these vibra-



Smaller IA 202D Two in-house amplifier modules with integrated power supply



■ **Subwoofer S 112i**

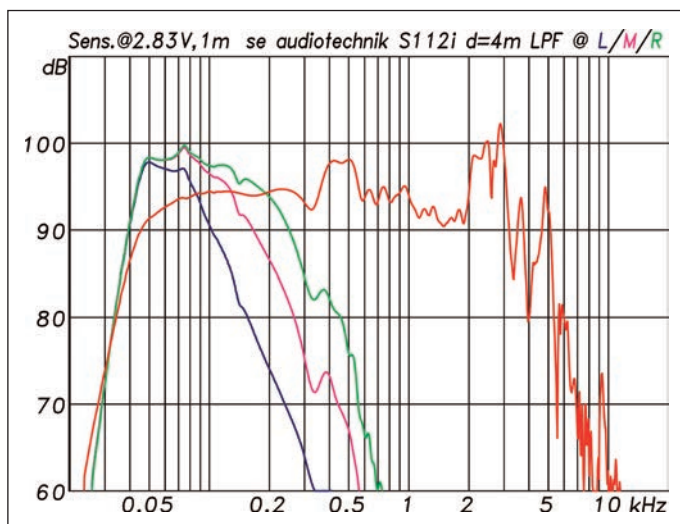


■ **12" driver produced in-house** in a bass reflex cabinet tuned to 46 Hz

tions have been destroyed in the past. Viewed from the outside, the electronics module is recessed and secured by a rim, which protects it from damage, especially during transport and when placed on the floor. A look at the elec-

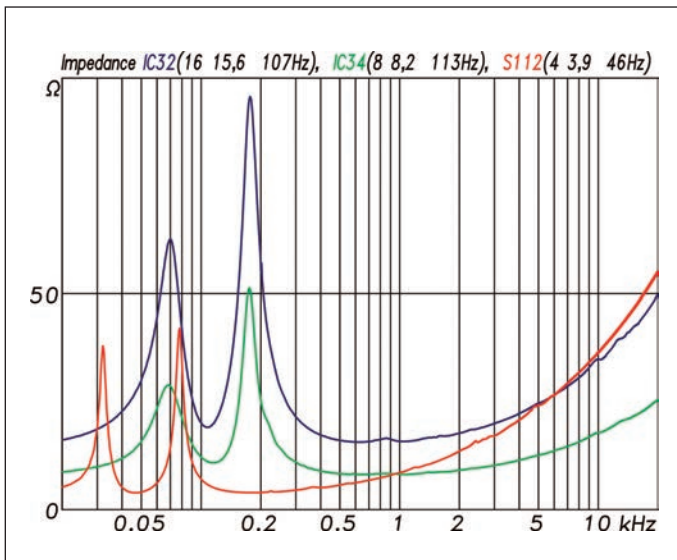
tronics shows a powerful power supply and the UcD400 Hypex module already known from the IA 402D. One will find one potentiometer each for level and for the crossover frequency of the low-pass filter, which can be set between 80 and 250 Hz. Additionally, a "phase inverse" can be activated via a switch. The appropriate crossover frequency setting for a combination with an IC 32 or IC 34 is between the 4th and 5th line on the scale (10:30 on a clock) together with the setting phase = 0°. The symmetric input with link as well as the power connection with PowerCon In and Out are also genuine Neutrik sockets. Here, too, it is worth taking a look at the details: all screws are double-locked, the mains switch and fuse holder are firmly cast and all cables are neatly fixed. The module does not require active cooling, as the waste heat can be dissipated via the solid aluminium plate as well as via ventilation slots located at the top and bottom.

Fig. 7 shows how the S 112i performs during the measurement. The red curve was initially measured without the built-in electronics, allowing the sensitivity to also be recorded. Below 250 Hz, the average is 94 dB for 2.83 V/1 m. For the 1 W/1 m value, 3 dB have to be subtracted, as the S 112i is a 4-Ω driver. The other three



Frequency response and filter functions of the S 112i

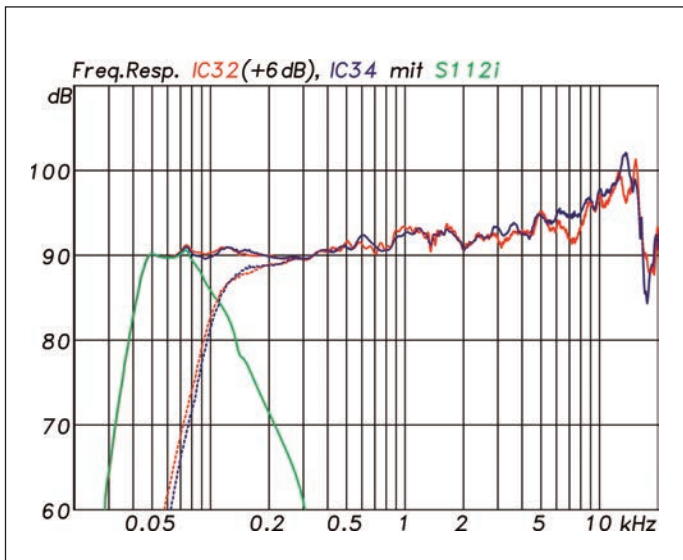
The red curve shows the subwoofer without the built-in electronics. The other three curves measured with electronics for settings of the low-pass filter to 80 Hz (blue), 250 Hz (green) and in central position (magenta) (Fig. 7)



Impedance curves of the two IC 32 and IC 34 tops

(blue and green) as well as the S112i subwoofer (red).

The nominal impedances are 16 Ω for the IC 32, 8 Ω for the IC 34 and 4 Ω for the S 112i (Fig. 8)



Frequency responses of the combinations of IC 32

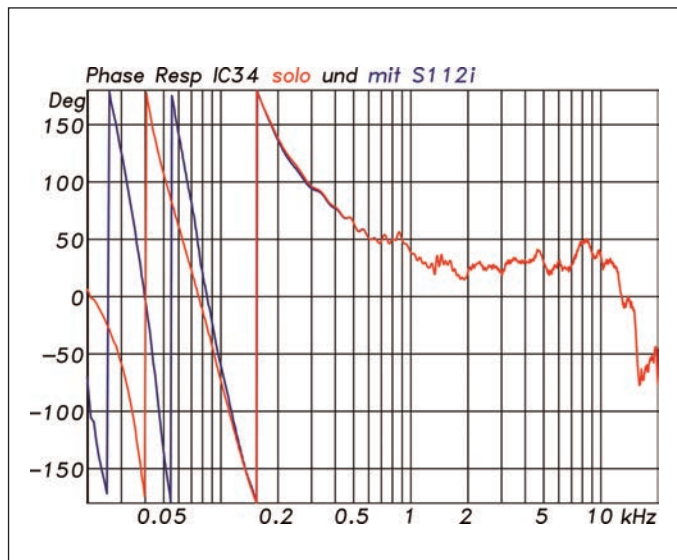
(red) and IC 34 (blue) with the S 112i subwoofer (green), the adjustment is perfect (Fig. 9)

curves show measurements conducted with electronics for settings of the crossover frequency at minimum, maximum and in central position.

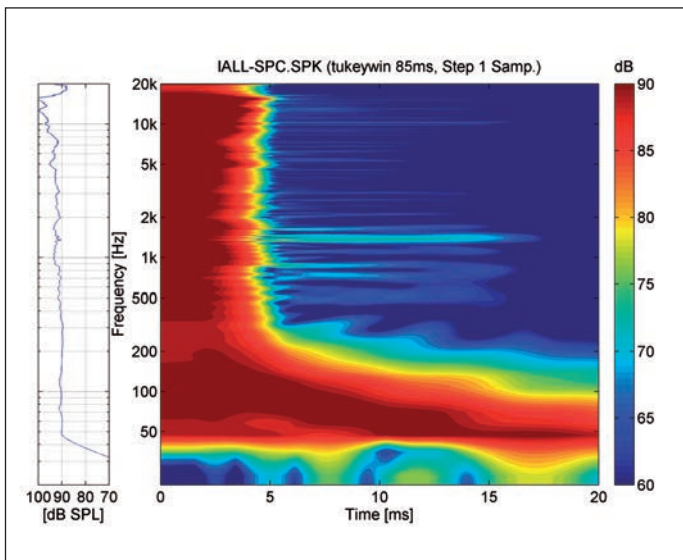
Combinations

The I-Line brochure lists some possible combinations of IC 32s and IC 34s with the two amplifiers and the subwoofer. The choice of amplifier can be made on the basis of

the impedance. The IA 202D can be deployed for 8 Ω or 16 Ω per channel, while the IA 402D is intended for 4 Ω. The IC 32 and IC 34 offer no different pre-sets for full-range and subwoofer operation, as the 3.5" full-range drivers also reach their natural limit at 100 Hz at the latest. For the frequency range below 100 Hz, the subwoofer is added if required. Fig. 9 shows how well this works. Both tops and the subwoofer complement each



Phase responses of the sole IC 34 (red) with controller and in combination with the S 112i subwoofer (blue) (Fig. 10)



Spectrogram of the combination of the IC 34 and S 112i, only at 1,355 Hz does a small resonance stand out (Fig. 11)

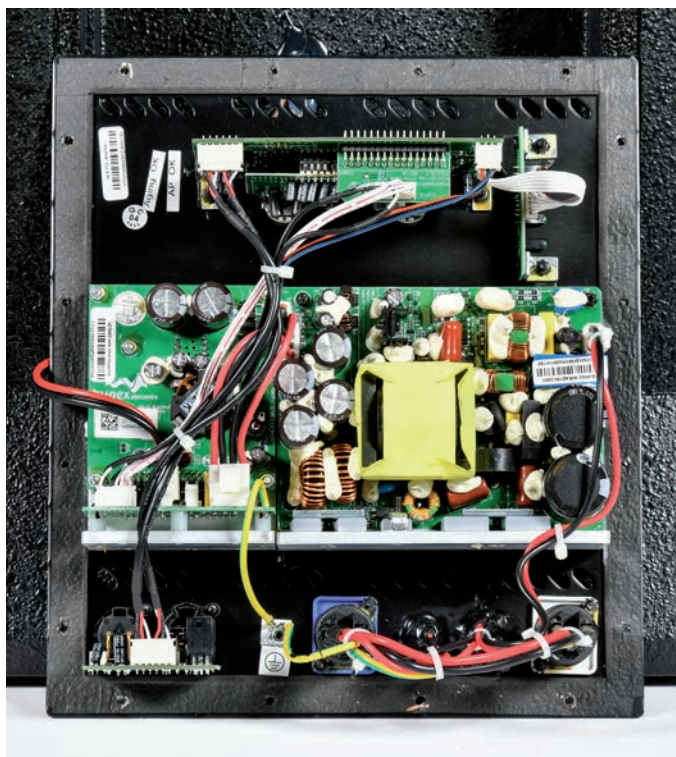


Subwoofer electronics module Level, crossover frequency of the low-pass filter (80-250 Hz) and phase reverse can be set

other perfectly. Depending on positioning and distance from each other, the delay is the only thing that needs to be adjusted. Together with the subwoofer, the frequency response reaches down to approximately 40 Hz, so that the system is also well suited for music reproduction in bars and small clubs that can sometimes get a little louder. Without a subwoofer, the lower cut-off frequency is around 100 Hz, which also makes the system well-positioned for speech transmission, vocals and light background music.

The phase responses from Fig. 10 show further measurements with and without a subwoofer. The typical behaviour of a full-range driver is clearly visible here. In the mid- and high-frequency range, the reproduction is linear-phase. The bass reflex cabinet's high-pass behaviour as a 4th order acoustic high-pass filter and the additional high-pass filter in the DSP create a phase rotation of $2 \times 360^\circ$ only towards the lower frequencies. Together with the subwoofer (blue curve), another 360° are added.

The spectrogram (Fig. 11) of the combination of IC 34 and S 112i shows no problems. Only at 1,355 Hz can one detect a noticeable resonance, presumably caused by an enclosure mode that couples to the outside via the



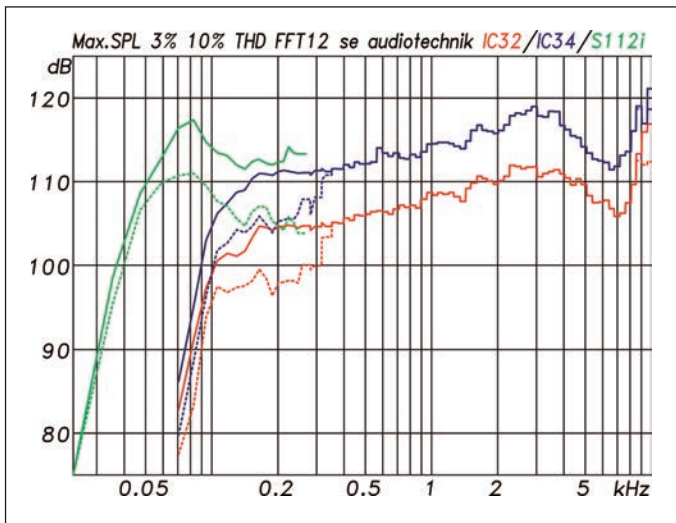
Electronics of the S 112i with a Hypex UcD400 in its own separate volume

bass reflex ports. Despite their large diaphragm for high frequencies, the drivers are flawless. Partial vibrations of the diaphragms are not visible in the spectrogram.

Maximum level

Small and elegant loudspeakers such as the IC 32 or IC 34 are easy to like. However, especially when it comes to applications in event catering, for example, the question always arises: what are these small loudspeakers capable of – and can a DJ also perform with them? The data sheet specifies a maximum level of 111 dB for the IC 32 and 117 dB for the IC 34. For the S 112i subwoofer, the maximum level is 121 dB under half-room conditions, which means that the loudspeaker is positioned on a sound-reflecting boundary surface, in this case the floor. Compared to the value under full-room conditions, the half-room value is 6 dB higher. For subwoofers, this type of indication is legitimate, as subwoofers are usually operated when positioned on the floor.

For the I-Line systems' maximum level measurements, the two common methods with sine bursts and with a multitone signal were used. The sine burst measurement determines what level is possible as a function of frequency



Maximum level at a maximum of 3% (dashed) and a maximum of 10% (solid) distortion for the IC 32 (red), the IC 34 (blue) and the S 112i subwoofer (green). The sound pressure levels refer to full room conditions (Fig. 12)

at a defined maximum distortion value. Measurements are taken at one frequency at which the level for the 185 ms burst is increased until a predefined distortion limit is reached. The level increase takes place in steps of 1 dB, while the frequency steps are 1/12 octave. Fig. 12 shows the results for the two IC 32 (red) and IC 34 (blue) tops as well as for the S 112i subwoofer (green). The dashed curves are measured for a distortion limit of 3% and the solid ones for 10%. Where both curves coincide, the 10% value was not reached as a limiter intervened beforehand. With the IC 32 and IC 34, this is the case from 300 Hz upwards, where the amplifiers' clip limiter intervenes. Below 300 Hz, the 3% and 10% curves separate, where – as is the case for the subwoofer – the driver's distortions begin to play a role when large diaphragm excursions occur. None of the measurements show serious dips that would be an indication of weaknesses.

More meaningful in practice is a second type of maximum level measurement, the multitone measurement, which uses a test signal with a spectrum that corresponds to that of an average music signal. At 12 dB, the test signal's crest factor (ratio of peak value to effective value) comes quite close to a music signal that is not too heavily compressed, so that the distortion-free reproduction of signal peaks is primarily evaluated here. The multitone signal is composed of 60 sine signals with random phase and a frequency interval of 1/6 octave. The evaluation is

Pro audio from SE Audiotechnik

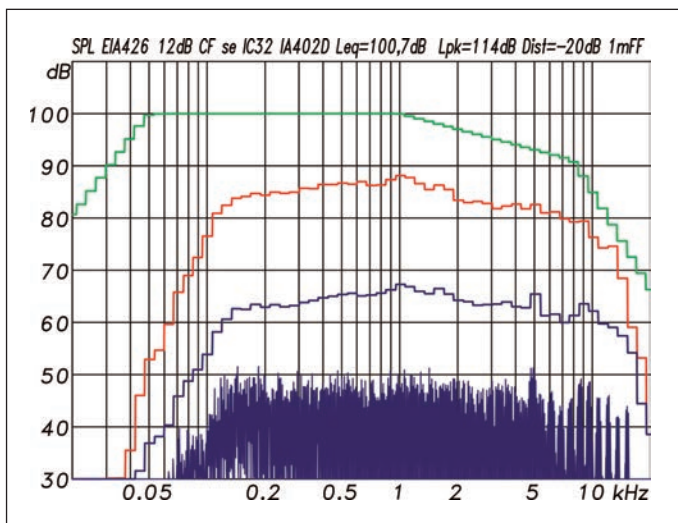
The roots of SE Audiotechnik stem from the hi-fi scene. Even today, one can find sales hits with long-established names on online portals, a circumstance that is currently generating helpful economic background noise for the company. Another, almost forgotten mainstay is car hi-fi: from 2020 onwards, many a car fan has probably rediscovered his or her love of the rave on four wheels and started tinkering again. This also helps SE Audiotechnik to get through the crisis. But the focus in Solingen has long been on pro audio.

The company is broadly positioned, from development and production to its portfolio. This ranges from the original hi-fi products to PA from SE Audiotechnik to the premium VUE Audiotechnik brand from the United States. The latter was founded as a German-American cooperation and is now run completely under its own management in the sole ownership of Michael von Keitz. In addition, there is a respectable OEM business in which audio products are developed and manufactured for other manufacturers. When it comes to R&D and manufacturing, the company is positioned internationally.

As early as 1997, 17 years after the company was founded, Michael von Keitz opened his own loudspeaker manufacturing facility near Shanghai, as a wholly owned subsidiary without Chinese involvement. Since then, development and production have been carried out in Solingen and in Shanghai. The factory has 600 employees, 10% of whom work in development. SE Audiotechnik's most important flagship product is the M-F3A PRO (review available online), a fully active module weighing only eight kilograms. By 2020, there should be well over 30,000 units on the international market.

simple if one uses an FFT measuring system with synchronous measurement: all components that are not part of the excitation signal – and are therefore distortions – are set in relation to the total signal. Both total harmonic distortions (THD) and intermodulation distortions (IMD) are recorded. Together, they are also called total distortions (TD). The distortion limit for this type of measurement was also defined as 10%.

The multi-tone measurement was only applied to the two tops, whose behaviour does not change with or



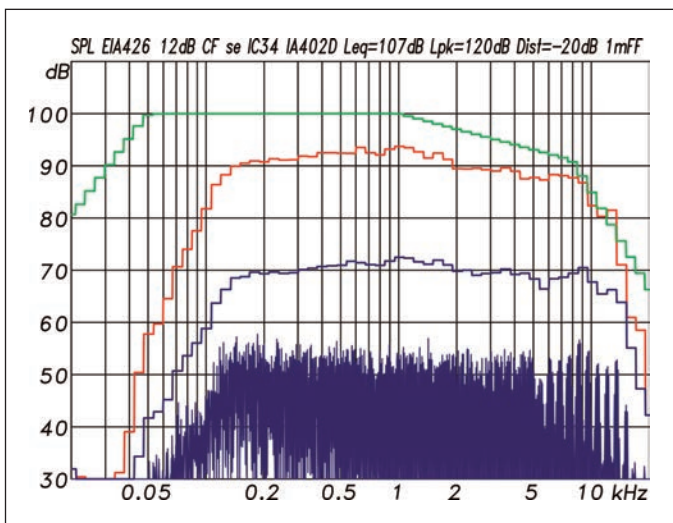
Measurement the IC 32 with a multitone signal with an EIA-426B spectrum and a 12 dB crest factor. At 10% total distortion, it achieves an average level L_{eq} of 100.7 dB and a peak level L_{pk} of 114 dB (Fig. 13)

without subwoofer, as the same filter setting is used in both cases. The level values achieved with a medium music spectrum were, as L_{eq} average level, 101 dB for the IC 32 and 107 dB for the IC 34. In both cases, the achievable peak level was 13 dB higher. What this means is that an IC 34 can achieve an impressive peak level of 120 dB at a distance of 1 m. If we now look at the subwoofer's measurements from Fig. 12 again, below 100 Hz, we see values of approximately 115 dB for the full room and therefore 121 dB for the half room. Measured with sine signals, this means that the achievable peak level is at least 3 dB higher, which means it fits well as a supplement to two IC 34s or four IC 32s. Both combinations are also shown as application examples in the I-Line's brochure.

[...]

Summary

With the I-Line, SE Audiotechnik has a series of small but extremely fine installation speakers in its range: two short, full-range columns, matching DSP amplifiers and a com-



Multitone measurement of the IC 34 at 10% total distortion, the IC 34 achieves an average level L_{eq} of 107 dB and a peak level L_{pk} of 120 dB (Fig. 14)

pact subwoofer can be combined as needed to create small PA systems for conference rooms, shops, event catering and much more. At the same time, the system is both well thought out and well developed: all components work together very favourably, all lab measurements delivered good results without exception, all data sheet specifications are spot on and the workmanship of the speakers and amplifiers is at the highest level. Thanks to its own driver development and production, SE Audiotechnik can rely on customised components, especially the 3.5" full-range driver is a major success. The prices are also pleasantly surprising: the price/performance ratio offered with the I-Line series is extremely good and, thanks to their excellent workmanship and audio quality, the products are a pleasure to use.

Shortly before this test report was finalised, SE Audiotechnik presented a further column loudspeaker from the I-Line, the IC 38X: the 82 cm high speaker, equipped with eight drivers, is predestined for use in difficult room acoustic applications. In contrast to the previous concept, the two centrally positioned drivers are designed as a small coax and feature an additional 0.5" compression driver, which is mounted on the rear of the full range driver and disperses the frequency range from 3 kHz upwards through the pole core via a small horn. With 4 Ω nominal impedance and 400 W power, the IC 38X is optimally driven by an IA 402D amplifier. ■

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