



EXPECT GREAT SOUND



## Signature E Series

American Audio Engineering, European Sound  
White Paper

[www.polkaudio.com](http://www.polkaudio.com)



# Signature E Series

WHITE PAPER

## Table Of Contents

- Polk Signature E Series Product Goals / 03
- Dynamic Balance® technology / 03
- Transducer Motor Optimisation – Klippel Distortion Analyser / 04
- Patented Power Port® technology / 04
- 1" Terylene High Resolution Tweeter technology / 05
- Mica/Polymer mid/bass driver technology / 06
- Crossover Design / 08
- Enclosure Design / 09
- Cabinet optimisation / 10
- Centre Channel And Surround Systems / 11
- Fink Audio Consulting – partnering with Polk / 11
- Recommended System Configurations / 12
- About Polk / 13
- Tech Specs / 14





## Signature E Series

WHITE PAPER

### Product Goals

The Signature E Series represents a new standard of sonic performance and design for any audio enthusiast looking to put together a true high-resolution audio system without breaking the bank. Working with our European partners, we developed the Signature E Series to offer superb performance and value for money.

Polk Audio established its worldwide reputation for excellence by combining excellent performance and competitively pricing; from the original Monitor 7 introduced in 1972, Polk loudspeakers have been built to transport you into immersive and exciting music and cinema experiences. With three new towers and two new bookshelf models, along with matching centre channel and surround speakers, the new Signature E Series has been developed in association with acclaimed European partners to incorporate new design and engineering advancements, delivering the ability to impress and captivate every time you listen.

### Dynamic Balance® Design Technology

Advanced analysis of a speaker's entire electroacoustic and mechanical system helps Polk's engineers select better materials and create more efficient driver geometry. With deep analysis, and – for the Signature E range – close co-operation with industry-leading speaker design consultants, we can pinpoint and eradicate elements that reduce performance, and enhance the positive aspects of a design, helping us build more realistic-sounding loudspeakers.

It all begins with the materials used, and the performance-limiting resonances that develop on and within them. As an example, modal resonances – distortions caused by unwanted vibrations in speaker cones – are a major cause of frequency response aberrations. By combining unique materials in new ways, along with new geometry and state-of-the-art construction techniques, we were able to tune out almost all the destructive modal resonances on speaker cones, while additional research and development by Germany's Fink Audio Consulting, the 'driving force' behind some of the world's most successful speaker designs, further refined the loudspeakers.

The result is an exceedingly smooth, yet dynamic and detailed sound, free from resonant aberrations, and a speaker range designed for wide dispersion, giving a big, open soundstage.





## Signature E Series

WHITE PAPER

### Transducer motor optimisation using the Klippel distortion analyser

At the heart of any loudspeaker drive unit is its 'motor' – the electromagnetic system moving the diaphragm in response to an incoming electrical input, thus creating sound. Optimising the combination of motor and diaphragm to reduce distortions and maximise detail used to be a matter of trial and error, using prototype cones with various combinations of magnet, voice coil, suspensions and speaker baskets to achieve the desired result. The Klippel system has changed all that.



Bringing together state of the art loudspeaker measurement tools for precise analysis, Klippel creates an innovative research and development environment, accelerating the design and testing of both speakers and audio electronics. It departs from old measurement techniques by using both high and low amplitude test signals, more closely replicating real world performance, and uses a laser to measure the excursion of a drive unit to identify the root causes of non-linear

distortion. Our European partner, Fink Audio Consulting, is one of the most experienced users of Klippel tools in the analysis, development and design of loudspeaker drive units and systems, and its extensive knowledge has helped refine the Signature E speaker range.

### Power Port® technology

US Patents # 5517573 & 5809154

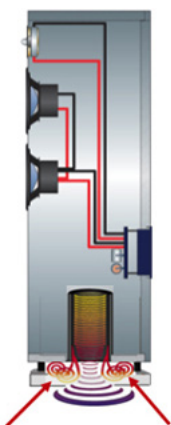
Ported loudspeakers use vents to tune, enhance and control the performance of a bass drive unit. The port allows additional bass output from the rear of the driver to enhance low frequency reproduction, but in a typical ported design this moving air creates turbulence at higher volume levels: this can result in unwanted 'chuffing' sounds, which muddies bass detail, definition, extension and overall output.



Polk's Power Port® overcomes this limitation using carefully calculated funnel shaped components at the mouth of the port: these channel and slow the moving air as it exits the port, promoting laminar airflow. The ingeniously compact design mimics the properties of what would otherwise be a very long flared port opening, reducing air turbulence to give 50% greater sound pressure level (SPL) at the low frequency tuning point.

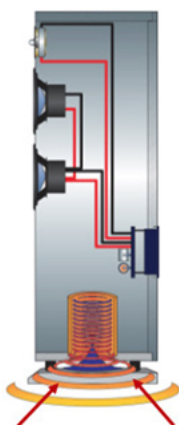
As well as making more efficient use of amplifier power, Power Port allows Polk speakers to deliver deeper, more powerful bass with greater detail, the high order of 2nd, 3rd 4th and 5th harmonic output above 150Hz of normal ported systems, due to turbulence, is all but absent when using Power Port.

Regular Port



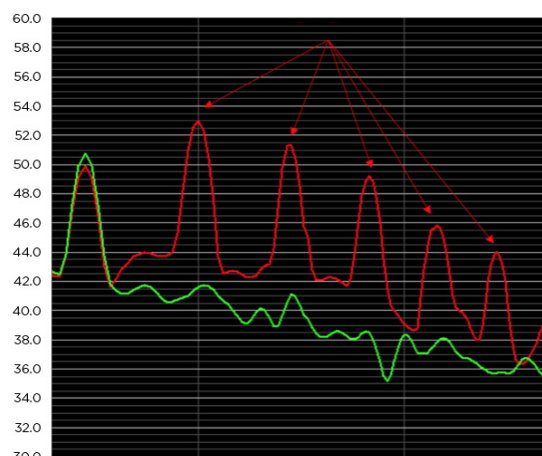
Airflow becomes turbulent and unwanted chuffing is heard. A loss of up to 3dB.

PowerPort



Airflow is controlled, eliminating chuffing with a 3dB increase in output. Better bass, lower distortion.

Turbulence



Normal Port — Power Port —



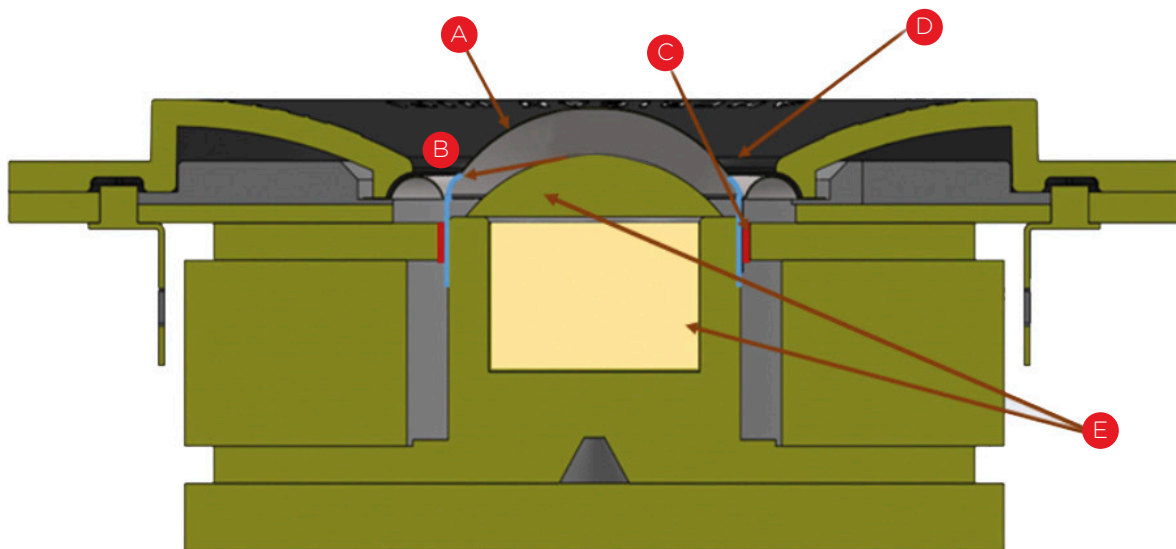
## Signature E Series

WHITE PAPER

### 1" Terylene High Resolution Tweeter Technology

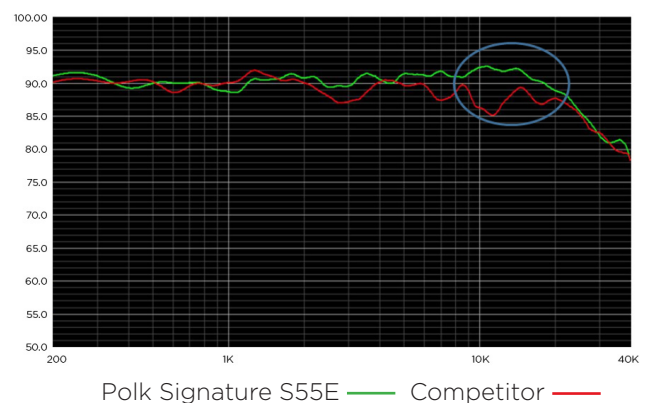
High Resolution audio reveals those subtle details and nuances previously only heard in the recording studio, so one of the key challenges for the Signature E Series was the development of a new tweeter capable of output up to 40 KHz in order to take full advantage of this extended frequency range.

However, merely meeting this 40 KHz requirement wasn't enough: the response to that point had to be smooth and even in output, whereas other high-resolution tweeter designs achieving this output tend to be jagged in their high-frequency frequency response, as shown below.



The key elements used to achieve our objective are:

- A** The 1" (25mm) dome is made of polyethylene terephthalate or Terylene – a thermoplastic polymer woven, treated and dyed to create a soft and light material. This gives it good output sensitivity and internal damping to suppress unwanted resonances (in accord with our concept of Dynamic Balance).
- B** Curvilinear former to dramatically increase dome stiffness and heat dissipation: this is critical for output to 40 KHz, typically approaching twice the frequency extension of a normal tweeter
- C** Ferromagnetic, colloidal liquid cooling is also employed for increased power handling and superior damping.
- D** The dome is mated to a faceplate carefully designed to balance and enhance high frequency dispersion and extension, midrange/tweeter integration and output sensitivity, creating a wide and open soundstage.
- E** Tuned/damped rear chamber with foam damper to reduce primary resonance and reduce back wave interference, which reduces distortion and removes the unwanted reflections from pole piece, while again improving integration with the midrange driver.





## Signature E Series

WHITE PAPER

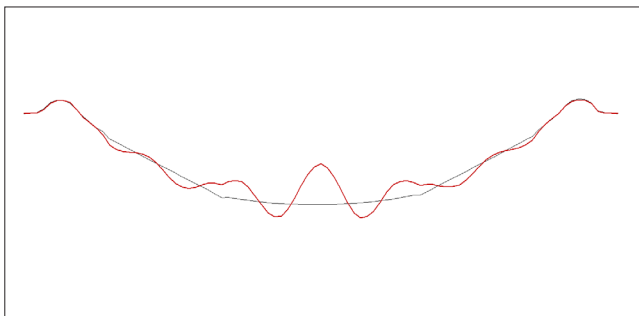
### Mica/Polymer mid/bass driver technology

The heart of any fine loudspeaker is the mid bass driver, as the midrange (200Hz – 2 kHz) is critical for our perception of a speaker as sounding 'natural'. After all, on this frequency band are centred most voices and instruments, and our most obvious term of reference when assessing a loudspeaker or an entire audio system is how 'real' those voice and instruments sound, when referenced again our experience of hearing music played live.

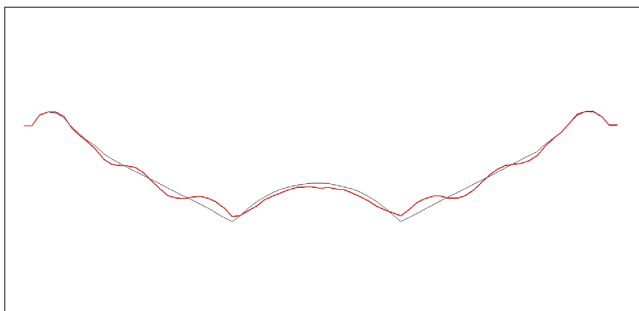
Smooth and flat frequency response is the key, so – working with our European consultants – we have lowered the distortion of the Signature E mid/bass driver, and optimised its upper frequency roll-off to the 1in tweeter, thus enabling the crossover circuitry to be simplified for a cleaner signal path.

The Mica/Polymer material used for the driver cone is a very good compromise between stiffness, weight and internal damping, but it's the shaping of the cone that ensures a smooth roll-off characteristics at the driver's frequency extremes.

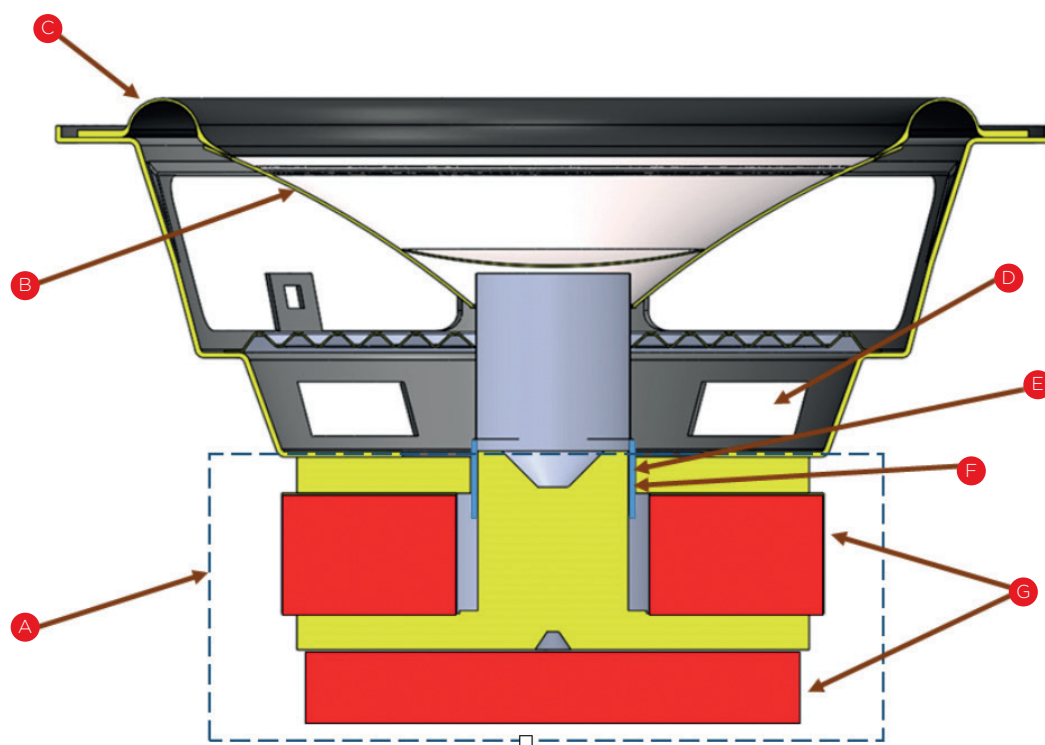
So for the Signature E Series, we further optimised the driver. The previous version showed a peak at 6.5kHz – way beyond the crossover frequency, but still requiring compensation in the crossover. A laser scan showed that the dustcap was generating this peak; a new dustcap was developed to smooth it out.



Laser scanning of the original drive unit shows a significant deviation from the optimal pistonic motion of the cone, resulting in a peak at 6.5kHz – beyond the crossover frequency, but requiring attention from the crossover network.



By redesigning the dustcap on the front of the voicecoil at the centre of the driver, a smoother motion of the cone was created right across its surface, cancelling this peak and thus enabling a much simpler crossover design to be used.



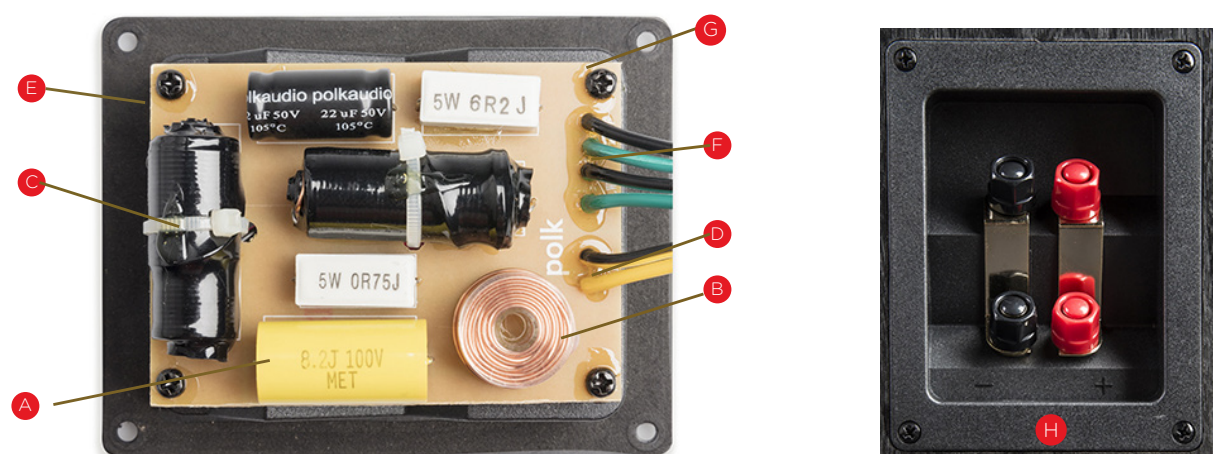
Here are the key elements in the Signature E driver mid/bass driver:

- A** Klippel computer optimised ceramic vmotor structures.
- B** Injection moulded mica reinforced polymer cone and improved dust-cap for lower distortion in the Signature E range: driver combines lightness, high internal damping and stiffness, plus enhanced upper frequency roll-off to allow simpler crossover design.
- C** High quality butyl rubber surround for increased long term reliability and superior damping of unwanted cone resonances.
- D** Vented baskets maintain voice coil stability at extreme operating levels by improving heat dispersion.
- E** 1" voice coil structures for correct ratio of power handling and frequency response to weight.
- F** Bifilar voice coils (in S60e) maintain motor strength but reduce inductances – to cascade the twin driver array frequency response for improved overall system integration.
- G** Dual magnet structures for increased motor strength, resulting in greater dynamic range.

## Crossover Design

A theoretically perfect loudspeaker would be a single 'point source' driver – the smaller the better for a focused sound – capable of reproducing all frequencies to concert levels, and with perfect hemispheric dispersion. Because that's beyond current driver technology – though we keep working on it! – we need drive units of different sizes to achieve proper sonic reproduction: small, light, fast tweeters for high frequencies, larger drivers to 'shift the air' for the midrange and bass.

That covers the frequency range, but these drivers still need to be integrated together to create a unified sound, getting as close as we can to that ideal of a 'point source' effect: that's done with the crossover, which divides the incoming signal between the drivers used in a speaker, and also 'knits together' the drive units into a sonic whole.



Here are the key design elements in the Signature E crossovers

- A** Mylar® capacitors reduce losses in the high frequencies compared to electrolytic types, for a more detailed response.
- B** Air core inductors are used on all tweeter circuits, removing saturation distortion even at high levels.
- C** Steel laminate core inductors on mid-woofer circuits reduce DC resistance, providing more power to the woofers, and demonstrating no audible saturation distortion within operating limits.
- D** 2nd order high pass on tweeter circuits give improved protection and better integration with mid/bass drivers.
- E** Damped 2nd order low-pass filtering is used in smaller Signature E models using single mid/bass drivers. This, combined with the upper roll-off tuning of the Signature E woofer, improves integration between the drivers while reducing out-of-band resonances.
- F** Hybrid 2nd/3rd order cascaded arrays are used on units with multiple mid/bass and bass drivers (S50E, S55E, S60E and S35E Centre), making the dispersion of the speaker seem more like that of the ideal 'point source' array with regard to dispersion. The Slim centre speaker features inner, middle and outer woofers, to maintain symmetrical dispersion.
- G** Signature E crossover boards are carefully designed to avoid interaction between components, for example avoiding parallel positioning of the inductors, which would create electromagnetic interference between them, changing their performance.
- H** Dual sets of gold-plated binding posts are provided, for either biamplication or biwiring connections.



# Signature E Series

WHITE PAPER

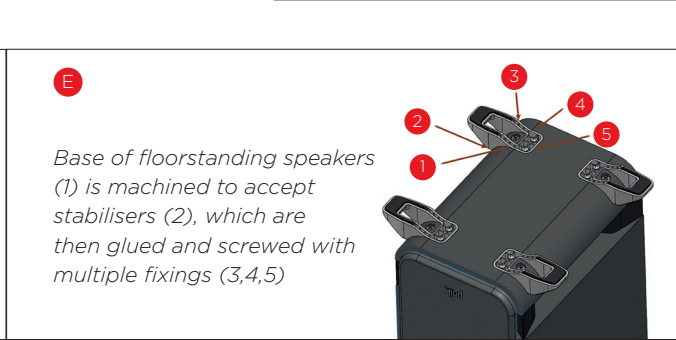
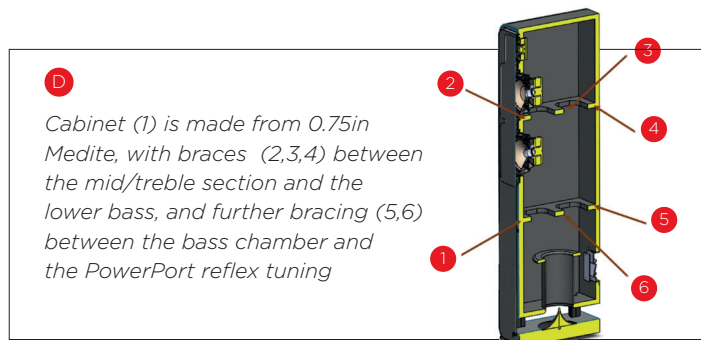
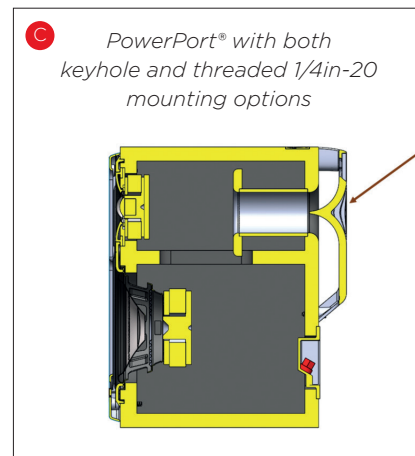
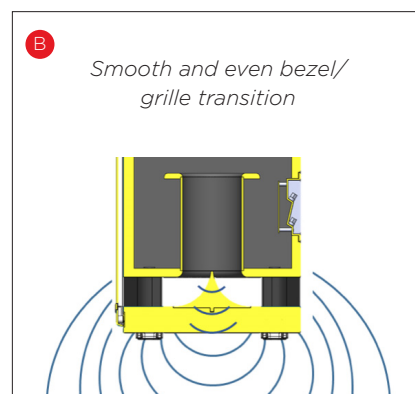
## Enclosure Design

The design of a loudspeaker's enclosure, or cabinet, is critical to its overall performance. Ideally, the enclosure should neither add anything to the sound of the drive units, nor take anything away, and designs with thin walls, insufficient damping or poor bracing will resonate or "sing along" with the drivers.

While this is great for musical instruments such as guitars, it's not what you want in a loudspeaker – a silent cabinet is the ideal, doing no more than housing the drivers and positioning them properly for bass response and proper imaging.

Fink Audio Consulting has extensive experience of the measurement of cabinets and their influence on the overall sound of a loudspeaker, using advanced tools to create images such as this mesh view of the S15E (right). As a result, it was possible to enhance the performance of the Signature E loudspeakers, while also improving their aesthetic appeal with a smoother, more room-friendly look. Elements of the cabinet design include:

- A** Low diffraction grilles to maintain even frequency response and three-dimensional imaging. Note the complete absence of cross bracing or lattice, which can create diffraction and uneven frequency response, particularly at high frequencies. The transition from grille to bezel is smooth and even to promote non-interference between the two.
- B** Polk patented Power Port®. The downward firing Power Port uses the weight of the cabinet to reduce vibration due to the acceleration of the air mass in the port. Floor coupling increases low frequency efficiency by increasing the effective radiating area of the diffuser, and bass response is not adversely affected by room placement
- C** 0.75" (19mm) Medite (MDF) cabinets use carefully placed bracing to reduce cabinet wall vibrations, removing coloration – particularly in the critical midrange. S15E speaker also uses critically placed point-to-point damping, while extra top-plate damping is created in the Signature E series using the 'waste' material created by the cut-out in the baffle for the mid/bass driver.
- D** Coupling a floorstanding loudspeaker to the floor reduces its tendency to move at high volume levels – any slight shift of the speaker baffle will smear midrange detail and definition. Some floorstanding speakers attach stabiliser feet with either glue or screws, giving only one contact point, but Polk embeds a stabiliser into the base of the Signature E, with five points of contact. The 2" thick Medite base is machined to accept the glass reinforced ABS stabiliser, which is pressed in place and screwed down, for superior coupling.
- E** Bookshelf, centre and surround Signature E Series speakers use rear-mounted Power Port® tuning, which doubles as a wall-mount with both with both keyhole and 1/4in threaded attachment options.

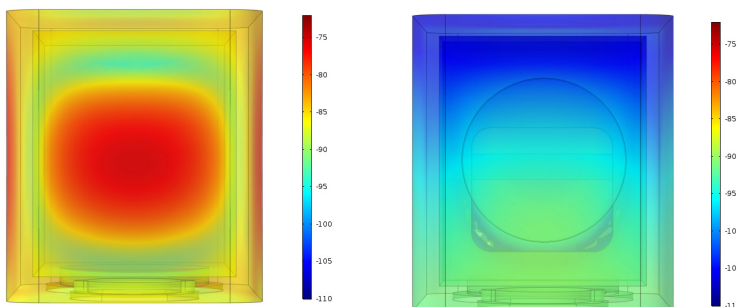


## Cabinet optimisation

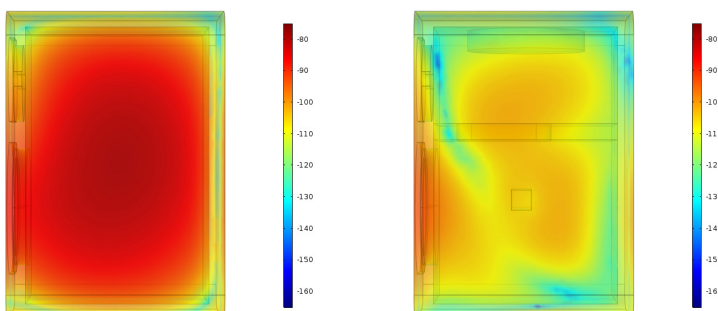
Just as the ideal loudspeaker cabinet should be silent, contributing nothing to the sound of the drive units, so the way to find out what a cabinet is doing is to find a way of 'listening' to it without hearing the sound of the drivers. In order to do that, the same kind of laser-scanning technology used to optimize drive units is also used to measure the vibration in the walls of the enclosure, thus allowing one to see 'hotspots' of vibration, which will affect the sound as resonances. It's then possible to tackle these 'hotspots' with the application of damping or bracing, either across an entire panel in the cabinet construction – the sidewalls, for example, or the top-plate – or with bracing within the cabinet at critical points, allowing even finer tuning of the cabinet effect. The use of this kind of laser scanner is a major tool within Fink Audio Consulting" with the drivers, which has developed expertise in interpreting the results it delivers, and the best methods to correct the problems it finds.



## Laser measurements from the Signature E development process – before and after



Scanning the top of the cabinet revealed it to be a major resonance hotspot (left): using the material cut out of the front baffle to accommodate the mid/bass driver added an extra layer to the top panel, thus damping out most of this vibration



The laser scan of the side panels of the speaker enclosure showed that they, too, were radiating sound in sympathy with the action of the mid/bass driver (left): the use of critical bracing, seen as the shadow lines in the picture on the right, helped damp this down.



## Signature E Series

WHITE PAPER

### Centre Channel and Surround Speakers

In a multichannel system, the centre channel is key to the cinema experience, so the centre channel speaker needs two important qualities:

- 1 It must be capable of matching the sound pressure level of the other channels in the system, and
- 2 It must match the timbre of the rest of the speakers, with even response both on and off axis, to accommodate various positions in the listening environment.

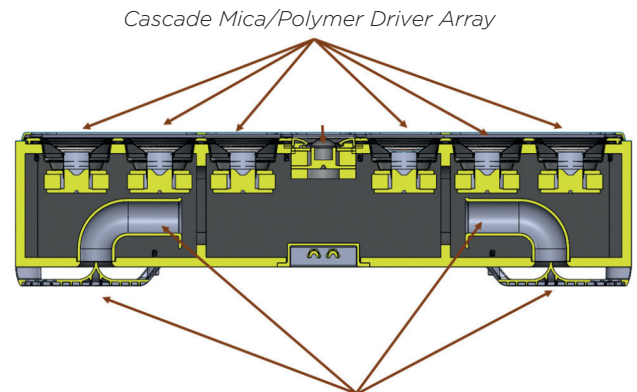
The Signature S10E is a dedicated unipolar surround speaker to complement any combination of Signature E floorstanding speakers and centre channel. Though compact in design, it is both timbre-matched to the rest of the Signature E range and capable of high output.



### Cascade Mica/Polymer Driver Array

All Signature E Series centre channels and surrounds use the same tweeter and mid/bass driver design as the rest of the range, to ensure that power-handling and timbre-matching. The centre channels are optimised to ensure

off-axis tonal balance, thus ensuring they anchor the viewer's attention to the screen. Shown below is a cross section of the Signature S35E slim centre channel loudspeaker, using cascaded mid/bass units to achieve this effect.



*Twin PowerPorts® with both keyhole and threaded 1/4in -20 mounting options.*

### Fink Audio Consulting

Based in Essen, Germany, and led by Karl-Heinz Fink, Fink Audio Consulting – Polk's partner in the tuning of the Signature E Series – is one of the world's most respected audio design consultancies.

With a wide range of famous clients from the home theatre, hi-fi and automotive sectors, FAC offers unparalleled expertise in the research and development of loudspeakers. It has facilities for measurement, computer modelling, prototyping and small-scale manufacturing, and works with production partners around the world.





## Signature E Series

WHITE PAPER

### Some Recommended Home Theatre Systems using the Signature E Series

#### Good

S50E x 2  
S30E  
S10E x 2  
HTS10



#### BETTER

S55E x 2  
S35E  
S15E x 2  
HTS10



#### BEST

S60E x 2  
S55E x 2  
S35E  
HTS12





## Signature E Series

WHITE PAPER

### About Polk

Polk ([www.polkaudio.com](http://www.polkaudio.com)) is an award-winning designer of high-performance audio products and the largest audio brand of Sound United. Founded in 1972, Polk is the market share leader in premium home theatre speakers in North America, and a leading manufacturer of sound bars, headphones, wireless speakers, mobile and marine speakers and amplifiers, and other high-performance audio products. For more information on Sound United and its brands, visit [www.soundunited.com](http://www.soundunited.com). All trademarks are the property of their respective owners.



## Tech Specs

	S60e	S55e	S50e
	Full Range Passive floorstanding Loudspeaker	Full Range Passive floorstanding Loudspeaker	Full Range Passive floorstanding Loudspeaker
<b>TRANSDUCERS</b>			
Tweeter	2.54cm Terylene High-Res Dome Tweeter	2.54cm Terylene High-Res Dome Tweeter	2.54cm Terylene High-Res Dome Tweeter
Mid-bass	16.5cm low distortion mica-reinforced polypropylene drivers	16.5cm low distortion mica-reinforced polypropylene drivers	13.34cm low distortion mica-reinforced polypropylene drivers
Crossover Frequency	2.5 kHz2	.5 kHz	2.5 kHz
<b>GENERAL</b>			
Recommended Amplification (wpc)	20-300	20-200	20-150
Impedance	Compatible with 8 ohm outputs	Compatible with 8 ohm outputs	Compatible with 8 ohm outputs
Overall Frequency Response	36Hz-40 kHz	40Hz-40 kHz4	2Hz-40 kHz
Sensitivity	90dB	90dB	89dB
Electrical Inputs	Dual gold-plated 5-way binding posts	Dual gold-plated 5-way binding posts	Dual gold-plated 5-way binding posts
<b>WEIGHTS AND DIMENSIONS</b>			
Height (cm)	113.03	105.41	95
Width (cm)	21.59	21.59	19.05
Depth (cm)	39.88	31.75	27.69
Width including feet (cm)	29.72	29.72	26.16
Weight	23.59 kg	19.96 kg	14.51 kg
<b>MATERIAL CODE / EAN</b>			
Black	SIGS60EBK / 0747192131036	SIGS55EBK / 0747192131029	SIGS50EBK / 0747192131012
White	SIGS60EWT / 0747192130954	SIGS55EWT / 0747192130947	SIGS50EWT / 0747192130930

	S35e	S30e	S20e	S15e	S10e
	Left/Centre/Right (L/C/R) Loudspeaker	Dedicated Centre Center Loudspeaker	Full Range Passive Bookshelf Loudspeaker	Full Range Passive Bookshelf Loudspeaker	Uni-Pole Surround Loudspeaker
<b>TRANSDUCERS</b>					
Tweeter	2.54cm Terylene High-Res Dome Tweeter	2.54cm Terylene High-Res Dome Tweeter	2.54cm Terylene High-Res Dome Tweeter	2.54cm Terylene High-Res Dome Tweeter	2.54cm Terylene High-Res Dome Tweeter
Mid-bass	7.62cm Low Distortion Mica Reinforced Polypropylene Drivers	13.34cm Low Distortion Mica Reinforced Polypropylene Drivers	16.5cm Low Distortion Mica Reinforced Polypropylene Drivers	13.34cm Low Distortion Mica Reinforced Polypropylene Drivers	10.16cm Low Distortion Mica Reinforced Polypropylene Drivers
Crossover Frequency	2.5 kHz	2.5 kHz	2.5 kHz	2.5 kHz	2.5 kHz
Wall Mounting Option —Key Hole slot	Yes	No	No	Yes	Yes
Wall Mounting Option —1/4"-20 Threaded Insert	No	No	No	No	Yes
<b>GENERAL</b>					
Recommended Amplification (wpc)	20-150	20-125	20-125	20-100	20-100
Impedance	Compatible with 8 ohm outputs	Compatible with 8 ohm outputs	Compatible with 8 ohm outputs	Compatible with 8 ohm outputs	Compatible with 8 ohm outputs
Overall Frequency Response	70Hz-40 kHz	55Hz-40 kHz	44Hz-40 kHz	48Hz-40 kHz	75Hz-40 kHz
Sensitivity	88dB	89dB	88dB	88dB	87dB
Electrical Inputs	Single gold-plated 5-way binding posts	Single gold-plated 5-way binding posts	Single gold-plated 5-way binding posts	Single gold-plated 5-way binding posts	Single gold-plated 5-way binding posts
<b>WEIGHTS AND DIMENSIONS</b>					
Height (cm)	10.41	19.05	37.59	30.48	21.33
Width (cm)	61.97	50.8	21.59	19.05	13.71
Depth (cm)	15.49	26.92	35.05	25.9	15.49
Weight	6.35 kg	8.61 kg	7.71 kg	5.89 kg	2.72 kg
<b>MATERIAL CODE / EAN</b>					
Black	SIGS35CEBK / 0747192131067	SIGS30CEBK / 0747192131074	SIGS20EBK / 0747192131050	SIGS15EBK / 0747192131043	SIGS10EBK / 0747192131081
White	SIGS35CEWT / 0747192130985	SIGS30CEWT / 0747192130992	SIGS20EWT / 0747192130978	SIGS15EWT / 0747192130961	SIGS10EWT / 0747192131005