



# Tempo

## The Tempo – Time aligned two-way floorstander



One thing missing on the Humble Homemade Hifi site up to now: a standard 2-way floorstander. This configuration uses a Vifa 7-inch mid-woofer and a Seas 1-inch soft dome tweeter in a reflex loaded floor standing cabinet. Furthermore the drivers are physically time aligned.

### Is it clone or isn't it?

One of my favourite looking commercial speakers is the Audio Physics Tempo. The Series-II, where I had found my inspiration, has now been discontinued so I thought this should give no problems getting my inspiration from them. A nice simple form-follows-function design, straightforward cabinetry without the exotic design gimmicks found on many speakers today. Ideal for a standard 2-way floorstander. Here is a quote from the original Audio Physics Tempo-II sales literature:

*" In 1985 the climax of gigantic loudspeakers and enormously expensive active systems, a compact two way loudspeaker appears on the market, which was to write a small chapter of audiophile history: the original Tempo by Audio Physic. Affordable and of modest dimensions, yet exceptionally musical, this loudspeaker created quite a sensation with discriminating listeners after a splendid test in the legendary magazine "Das Ohr". We developed the new model with the same intentions. At a fair price, you can purchase an aesthetically convincing loudspeaker of a sound quality you wouldn't expect in this class."*

Exactly what I was looking for! Further quotes from the same brochure:

*" The bass midrange drivers cone is made of selected hand coated paper which is very low in coburation. Its extremely linear driving system combined with a low loss suspension, provides for high dynamics and excellent resolution of detail."*

Sounds and looks like a Vifa PL18W0-09-08!

*" As the drivers are extremely linear by virtue of their construction, the crossover consists of only three selected parts. The baffle is slanted by 7 degrees and together with the acoustical features of the drivers this results in a nearly phase - linear pattern of radiation. "*

Okay, I use a totally different crossover configuration, a series one of course!

*" The bass-midrange works into a gradually damped three-chamber system. This system needs very little damping material and functions nearly resonance free. The result is an open reproduction without any effects of compression. "*

Two-chamber medium damped.

*" The tweeter is mounted in a chamber which is decoupled from the varying pressure inside the cabinet and which at the same time serves as extra bracing for the baffle."*

Exactly!

*" The solid stand is fitted with spikes to deter resonance's. The high-grade terminals are highly accessible for optimal wiring as they are mounted near the bottom of the cabinet. "*

Yeah, and the front door of my house is highly accessible for entering the building as it is mounted at ground level!

*" Width 190 mm; Depth 400 mm; Height 1120 mm; Weight 28,5 Kg "*

“ Width 191 mm; Depth 350 mm; Height 1084 mm; Weight 20 Kg ”



*The result of all these findings.*

### The tweeter



The [Seas 27TFF-H831](#). One of the main differences with the Audio Physics Tempo-II (the original uses a Seas metal dome tweeter). It is a 27mm dome tweeter with glass fibre reinforced plastic chassis. The diaphragm is formed from a pre-coated lightweight fabric. The technology gives an improvement in consistency compared with other coating methods. These tweeters don't come in matched pairs but I had a box containing several of them and they all measured exactly the same Rdc. Careful matching of fabric and coating results in a very smooth frequency response throughout the audible frequency range and gives a very high degree of stability against changes in air temperature and humidity according to Seas. The voice coil is wound on an aluminium voice coil former with ventilating holes that reduce problems connected with resonances in the internal cavities. The voice coil is immersed in low viscosity magnetic fluid, allowing high power handling capacity and simplified crossover design. Increased volume under the diaphragm by means of well in the pole piece, lowers the resonance frequency. This unit is also sold by Intertechnik under the name Seas KT27F.

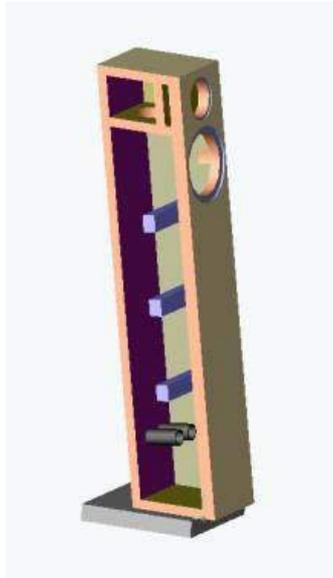
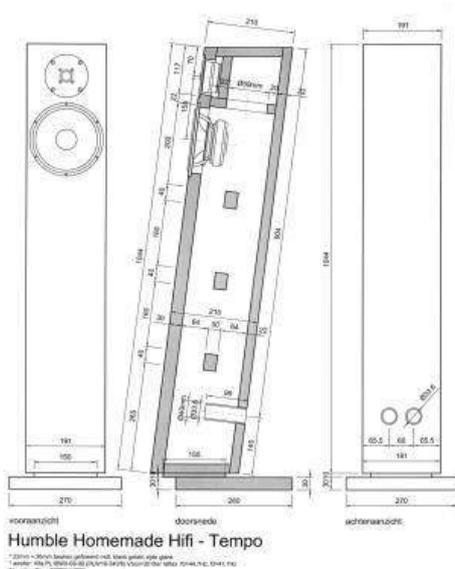
### The mid-woofer



The Vifa PL18W0-09-08. It is the same woofer as used in the original Tempo-II. A 7-inch midwoofer with a robust magnesium low reflection chassis, stiffened treated paper so called NRSC cone, 40mm voice coil wound on an aluminium former, gold plated terminals, long throw magnet system and rubber surround. I selected the Vifa PL18 woofer because I had heard it produced exceptional, highly regarded midrange clarity and has the deep, highly resolved bass of the Scan Speak 18W8545K (without the high price tag of the Scan Speak woofer) and its very smooth frequency response. It has a medium weight paper cone coated only on the front; the moving mass is 17,5 grams. The magnet is reasonably large and in combination with the bumped back plate cone it should give high excursion possibilities. The basket has six mounting holes to give good mounting contact between the driver and the cabinet. This unit is also sold in Germany under the name Vifa PLW18 340/8.

### The cabinet

All the panels are made of 22mm MDF except the front panel and base, which are made of 30mm MDF.



A higher resolution drawing is available on request.

3D rendering by Ulf Carlsson from Sweden.

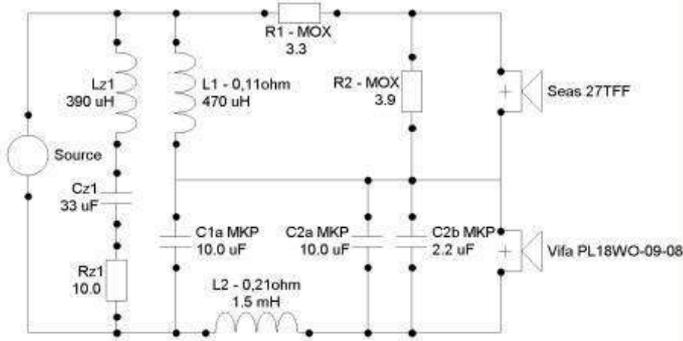
The cabinet is reasonably straight forward, the only difficulty being the 7-degree angle. Between the woofer and the tweeter there is a horizontal brace with a circular cutout and a vertical partition forming a separate sub-enclosure for the tweeter to stop unwanted vibrations in the box reaching the rear of this unit. A piece of foam rubber is pressed between the back of the tweeter and the rear of the sub-enclosure to stop any vibrations in the tweeters rear cover. Furthermore the cabinet is internally strengthened with three 30x40x147mm cross-joints. These together with the internal bracing form a very rigid cabinet. For a single walled box the vibrations that can be felt on the outside, when playing them loudly, are minimal. The total weight of each cabinet is about 20 kg. The reflex ports are placed near the bottom of the rear panel for esthetical reasons and also to give maximum boundary reinforcement to the bass energy coming from the ports near the floor. All internal walls except near the ports are covered with wedge-moulded foam to minimise standing waves. Bonded acetate fibre damping material is rolled up and placed directly behind the woofer and in the middle of the cabinet. The area near the ports is kept free of BAF. Depending on the positioning of the speakers in the room and personal taste this fibre can be rolled up densely or loosely to give a tighter and dryer or a fuller and warmer sounding bass. I used Monacor MDM-3 damping pads that consist of 2/3 sheep's wool and 1/3 polyester fibre and found that one bag per speaker was okay. If you have a small listening room or your speakers have to stand close to a wall then maybe some extra fibre placed throughout the cabinet will be necessary. The internal volume is about 20 litres net and the bass-reflex ports are tuned to about 45Hz.



Reflex ports, binding posts and base.

### The crossover network

The Vifa PL18W0-09-08 and the Seas 27TFF are wired together using an a-symmetrical order series-filter combining 1<sup>st</sup> and 3<sup>rd</sup> order slopes. I haven't come across any other designs yet that do this but it seems to give the best result in this configuration. The tweeter runs flat down to about 1500Hz (less than 1 octave below  $f_x$ ) and then drops with about 12dB/octave; the woofer runs up to 6kHz (nearly 3 octaves above more than  $f_x$ ). The crossover point is at 2400Hz, so that means the woofer will need a steeper electrical cut-off than the tweeter to result in symmetrical acoustic slopes at  $f_x$ . There is no parallel RC-network to compensate for the rising impedance due to the voice-coil inductance of the woofer as the higher the order of the crossover the less effect it has. To simplify things I left it out completely. Or you could look at it from a different angle: the capacitors directly parallel to the woofer could be a Zobel network with a resistor of zero ohms! When does it become a 2<sup>nd</sup> order network with Zobel and when does it become a 3<sup>rd</sup> order network without a Zobel? If they had a resistor of 1,5 ohms in series with them, would it be a Zobel or not? The inductors are air-core type using thick wire for low  $R_{dc}$  and no saturation and are matched in pairs using a LCR meter. The capacitors use metallised polyester foil (MKP) in the critical stages. The resistors use metal film with 1-% tolerance matched in pairs using a LCR meter. Depending on your equipment and taste the parallel tweeter resistor can vary between 3,3 ohms to 3,9 ohms. I had the best results with 3,9 ohms. The crossovers are mounted against the rear wall accessible via the woofer cutout, a bit of a fiddle to get the whole crossover with its large inductors in but it is possible. You could always add a second pair of binding posts on the rear of the cabinet and make an external crossover.



*The Tempo crossover schematic.*

**Filter components with a good price/quality ratio:**

L1 = 0,47 mH air-core inductor 2,0 mm wire, R = 0,11 ohms

L2 = 1,50 mH air-core inductor 2,0 mm wire, R = 0,21 ohms – if you can lower the Rdc by using 3,0 or 4,0mm wire then do so!

Lz1 = 0,39 mH air-core inductor 0,71 mm wire, R = 0,53 ohms

C1 = 10uF MKP polypropylene foil capacitor or better – preferably Audyn Cap Plus or Mundorf Supreme

C2a = 10uF MKP polypropylene foil capacitor

C2b = 2,2uF MKP polypropylene foil capacitor

Cz1 = 33uF MKT capacitor

R1 = 3,3 ohms, 10 watts metal film resistor

R2 = 3,9 ohms, 10 watts metal film resistor – 3,3 ohms will give a slightly more “rounded-off” top end

Rz1 = 10 ohms, 10 watts cemented resistor

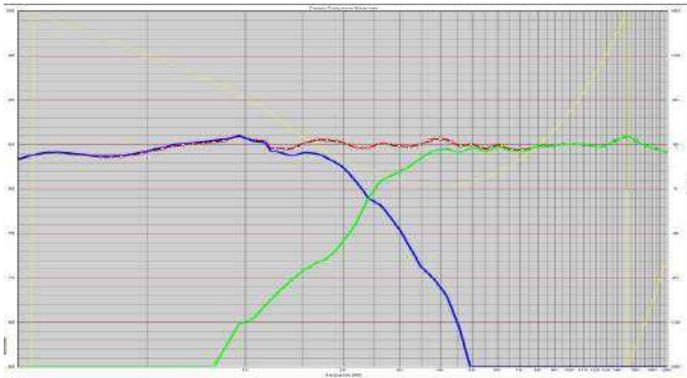


*An Intertechnik air-core inductor with Ø2,0mm wire.*

**Listening impressions**

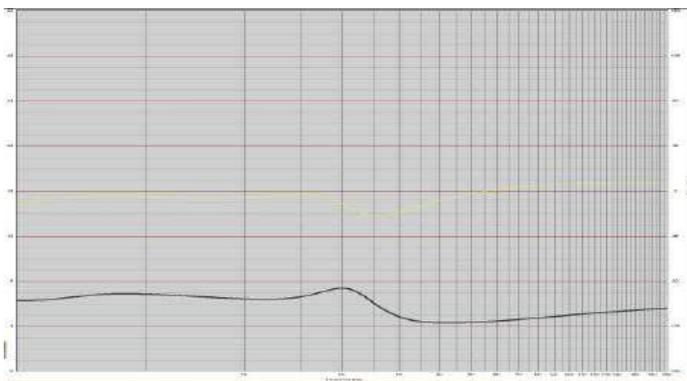
First of all the deep bass with good low-end extension and excellent transient capabilities impressed me, quite surprising considering only a single 7” woofer is used. Furthermore the superior mid-range clarity is a positive characteristic of these speakers; no detail is hidden or covered by any form of “blanket”. This gives my Tempo an astonishing ability to present both ambience and depth in the sound stage. If you listen to a lot to jazz trio’s and classical quartets you will be amazed by the amount of detail. It is not at all bright just very revealing. Very important is that the inductors must have the lowest Rdc possible, the crossover schematic states the maximum values, otherwise the speaker will lose its lovely midrange clarity. The only downside of such clarity is that bad recordings sound bad, this speaker doesn’t make things sound better (or worse) than they are!

**Graphs**



*The individual driver and total summed output levels.*

Efficiency is not very high (but that is normal for most 2-way speakers) at about 85dB's for 2,83V/m so your amp must be able to deliver a bit of power to get them going, I would advise a minimum of 2x 40watts solid state. I have left out the response curve below 200Hz so that room influences don't mess things up in the bass. The horizontal scale is 5dB's with sub divisions of 1dB ranging from 60 to 100dB. A very flat response with +/-1dB over the whole range. This is taken with a 3,9ohm resistor in parallel to the tweeter. The crossover point is clear at 2400Hz with a nice symmetrical -6dB point of both drivers summing to a flat response at the crossover point.



*System impedance.*

The horizontal scale is 4ohms with sub divisions of 1ohm ranging from 0 to 32ohms. The impedance curve corresponds with the output curve so doesn't show anything below 200Hz, there it will only show the two impedance peaks of the reflex loading with its tuning frequency centred at 45Hz. The impedance varies between 7,5 and 4,2 ohms and is reasonably constant making the load easy for most amplifiers, electrical phase is therefore also very smooth staying between about +10 to -25 degrees.

NOTE: This design is strictly for the home DIY enthusiast and not to be used professionally without my permission!

Tony Gee, The Netherlands

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