Suggestions for cabinet size and tuning for your Scan-Speak drivers

On the 2020 Scan-Speak datasheets you'll find suggestions for cabinet sizes for closed and vented systems respectively. The intention is to provide our customers with a simple and quick comparison between drivers for one and the same type of alignment.

We know, of course, that there are many methods to achieve a system alignment ranging from the classical alignments based on Neville Thiele's work and Richard Small's parameters (see references below) to the higher order systems assisted with different filter technologies. So, in order to provide our datasheets with valid information we sought to find a simple and reproducible way that would provide any not so experienced customer a starting point for a system design. As you may know, our website already contains an Excel® spreadsheet that allows you to take the T/S parameters from the datasheets and find a suitable alignment, closed or vented. With the basic suggestions on the datasheets we have given a valid starting point for fine-tuning a system.

Classical approach

We decided to go back to the classical alignments for vented boxes as we believe that most loudspeaker systems are based on those anyways.

Approaches may differ, but still we basically considered three different alignments for vented systems.

1. *The "3. Order Quasi Butterworth alignment"*
2. *The "4. Order sub-Chebychev"*
3. The "Maximally flat amplitude response" actually a Butterworth response with a Q of 0,707.

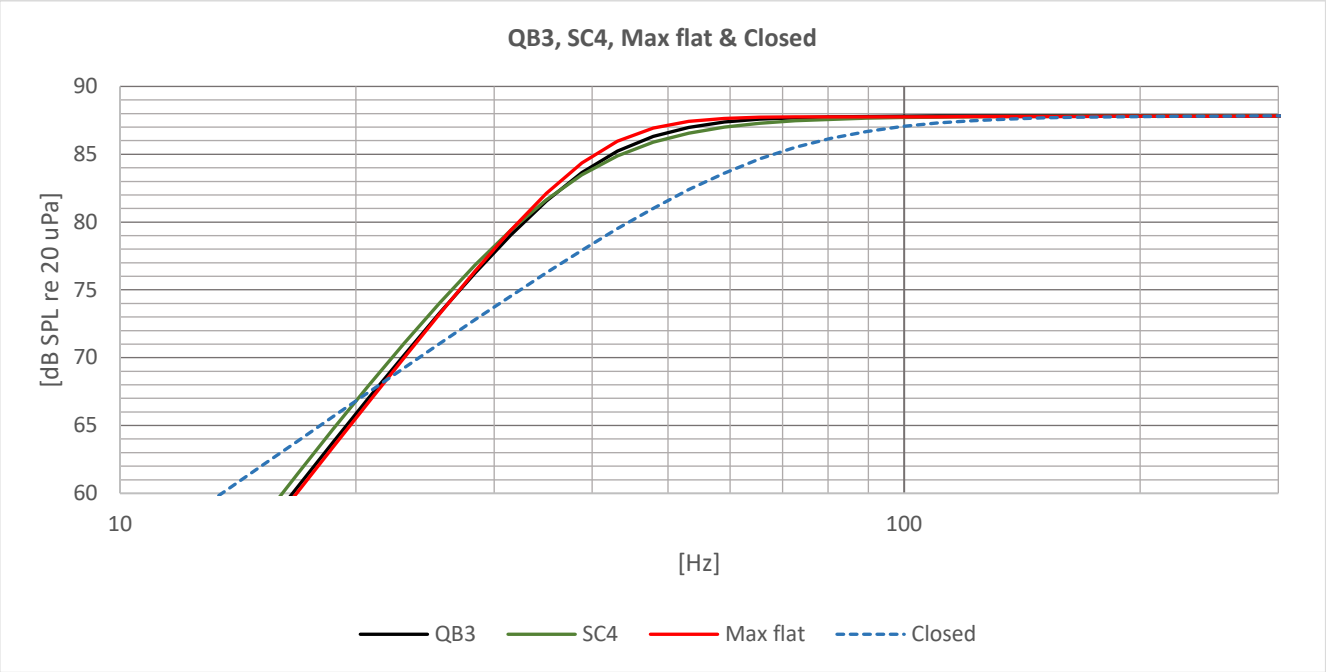
We did not consider any so called "assisted" alignments with various filter techniques applied to shape the low frequency roll off. Neither did we consider bandpass or similar systems of any kind. There are numerous articles and papers on these subjects in the AES library and elsewhere.

An example:

We have a driver with T/S parameters in the table below and the columns to the right of the grey column show the calculated alignment data. There are useful tools for such calculations online should you not already know. Please note that in addition to the DC resistance "Re" a serial resistance of 0.3 Ohm is added to the calculation representing resistance in cables, etc.

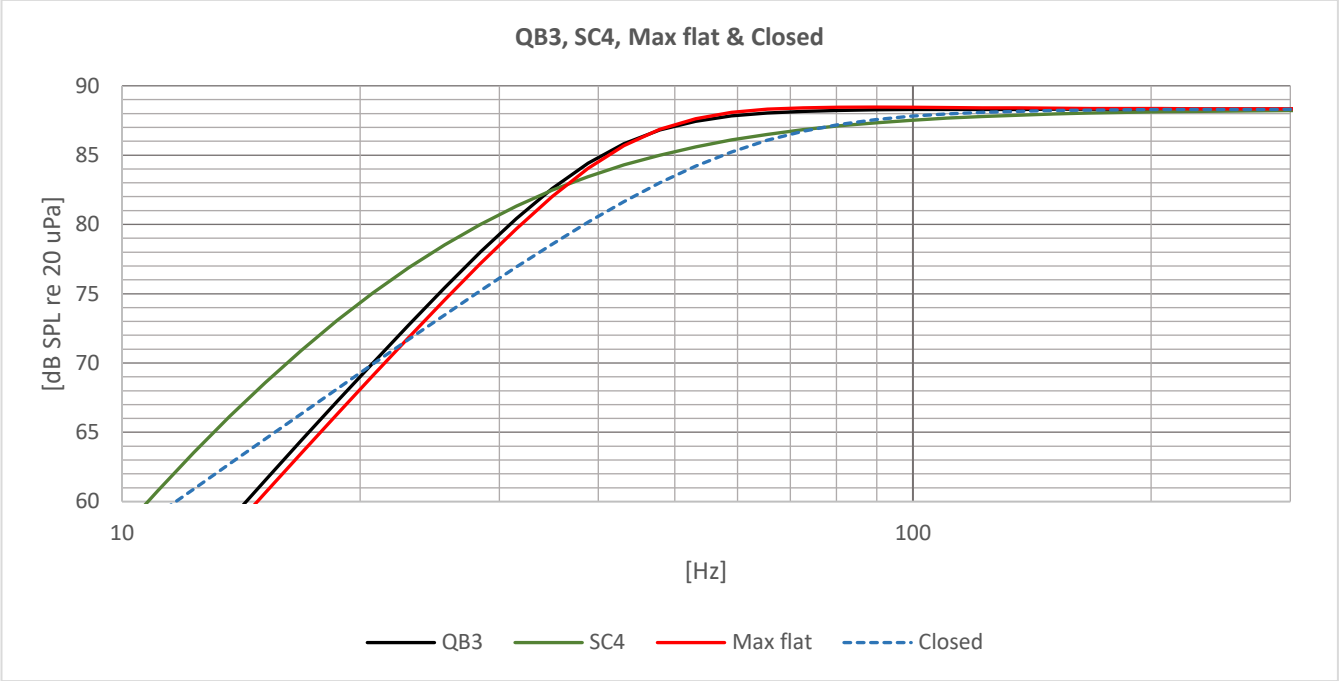
Driver T/S				Alignment parameters		QB3	SC4	Max flat	
Fs	33	Hz		**Vb**	box size	23,5	22,9	26,3	liters
Re	3,4	Ohm		**Fb**	box tuning frequency	37,6	36	38,2	Hz
Mmd	17,5	g		**F3**	low 3 dB roll off frequency	41,9	42,8	39,7	Hz
Sd	150	cm^2		**Dp**	Minimum port diameter	6	6	6	cm
Le	0,3	mH		**Lp**	Port length	21,7	24,1	17,8	cm
Rms	0,7	Ns/m		**Ql**	Box leakage (default value, but can be changed if you know your leakage factors better	7	7	7	
Bl	5,7	Tm		**Rs**	Serial resistance = 0,3 Ohm				
Cms	1,33	mm/N							
Qm	5,18				Closed box 13,63 l for Q = 0,707				
Qe	0,38								
Qt	0,35								
Vas	42,00	liter							

The alignment responses are very similar. That is due to the almost “perfect” driver parameters for a vented system. It shouldn´t come as a surprise that the QB3 and the “Max flat” are quite similar as they come from the same family. It should be noted, however, that there may easily be bigger differences between the step responses of the alignments that in the end will determine which alignment to use. For comparison, the closed box response is included in the plot. Here a Q of 0,707 is obtained by a cabinet volume of 13,6 liters.



If we change to a different set of parameters we get more variation between the alignments. The QB3 and the Max flat are still quite close to each other though. For the closed box a Q of 0,707 is obtained in a cabinet volume of approximately 17.8 liters.

Driver T/S				Alignment parameters		QB3	SC4	Max flat	
Fs	21	Hz		**Vb**	box size	27,2	32	25,7	liters
Re	6,2	Ohm		**Fb**	box tuning frequency	32,8	21,7	34,3	Hz
Mmd	31	g		**F3**	low 3 dB roll off frequency	41,3	50,3	40,4	Hz
Sd	220	cm^2		**Dp**	Minimum port diameter	6	6	6	cm
Le	0,35	mH		**Lp**	Port length	24,6	51,9	23,8	cm
Rms	0,8	Ns/m		**Ql**	Box leakage (default value, but can be changed if you know your leakage factors better	7	7	7	
Bl	9,9	Tm		**Rs**	Serial resistance = 0,3 Ohm				
Cms	1,85	mm/N							
Qm	5,11				Closed box 17,79 l for Q = 0,707				
Qe	0,26								
Qt	0,25								
Vas	124,50	liter							



The datasheet entries

We decided to use the *Butterworth/Max flat alignment* for the datasheets as this way we seek the same Q value of the low frequency roll off for both closed and vented systems for a specific driver.

You can use our basic suggestion as a starting point for fine-tuning your system with the Excel® spreadsheet on the Scan-Speak website. Here, other parameters can be adjusted such as box damping, port size etc. some of which are not part of the "quick and dirty" classical alignment method.

You may, of course, choose a different approach to the above and find other parameters of value for your systems and that is perfectly OK, but, now you know where our cabinet suggestions come from.

References:

1. Neville Thiele
   - Loudspeakers in Vented Boxes: Part 1, JAES Volume 19 Issue 5 pp. 382-392; May 1971
   - Loudspeakers in Vented Boxes: Part 2, JAES Volume 19 Issue 6 pp. 471-483; June 1971
2. Richard H. Small
   - Direct Radiator Loudspeaker Analysis, JAES Volume 20 Issue 5 pp. 383-395; June 1972
3. S. Butterworth
   - On the Theory of Filter Amplifiers", *Experimental Wireless and the Wireless Engineer*, vol. 7, 1930, pp. 536–541.
4. A useful online toolbox
   - http://www.mh-audio.nl/Calculator.html
5. Toolbox on Scan-Speak web
   - https://www.scan-speak.dk/toolbox/