JS-SPEAKER
HCS -LTB
Home Cinema Speaker

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Idea and Requirements

Specifications:

a) Construction of a home cinema loudspeaker for both the front and surround channels, which can meet the requirements in terms of level stability, speech intelligibility, constant horizontal radiation behavior, shallow housing depth and at an acceptable monetary cost (current price per unit is around EUR 560)
b) High efficiency (approx. 92db)
c) Installation in a baffle wall as well as operation as a free-standing speaker possible
d) Separation at max. 80hz. With Roomgain (construction close to the wall) can be operated up to 60hz without any problems
e) Variable inclinable mid/tweeter housing
f) Passive crossover, where the focus is on the costs and thus small increases in the amplitude are deliberately tolerated
g) Can be operated with a powerful AV receiver (approx. 100 watts at 8 ohms).

Driver selection

When selecting the drivers, the focus was clearly on price and performance. Three ways were important to me in order to be able to use a dedicated midrange driver for the very important midrange.

The following drivers were selected:

1) Lavoce DF 10.142 LK
   http://www.lavocespeakers.com/single-product/?id=144
   - Measures well in the waveguide
   - Low distortion
   - Very high efficiency
   - Surprisingly good value for money
   - Unfortunately, only useful from about 2000 Hz

2) Beyma 6 MI100
   https://www.beyma.com/en/products/c/low-mid-frequency/106MI108/altavoz-6mi100-8-oh/

   - Pure mid-range driver with a high efficiency of 94db, high resilience and can be used without any problems up to 300hz-400hz
   - Very good value for money
   - Unfortunately, a bit “bitchy” in the frequency response in some places

3) The box Speaker 12-280/8-W
   https://www.thomann.de/de/the_box_speaker_12_280_8_w.htm

   - Very powerful kick bass
   - Good efficiency of 95db
   - Very good value for money
   - Good workmanship
   - Unfortunately, a bit “bitchy” in the frequency response in some places

Tools and Materials

Werkzeug

Jigsaw with fine blade
Router
Milling circle
Screw clamps
Screwdriver
Table Milling machine (optinal)
Soldering Iron
Hot glue gun

Material

Wood glue
Warnex paint
Cable ties
Cylinder head screws black M4 woofer 30mm
Cylinder head screws black M5 20mm for Beyma Mid
Countersunk thread screws M5 20mm (Waveguide)

Countersunk thread screws M5 20mm (Tweeter)
Countersunk thread screws black for speakon sockets
Trimming cutter/router
Grooving cutter for Milling circle (recommended extra-long)
Wago terminals 3-pin and 5-pin for points
LS cable for crossover (included in shopping cart)

Case Dimension and Wood List

According to the blueprint, the housing measures (approx.) 120cm high, 37cm wide and 19cm deep. If you don't want to adjust the headboard variably, you can also connect it to the bass section or build 1 complete box.

Wood parts list in mm per "HCS-LTB"

Enclosure Top

					Gross Volume		
Dimension	420	340	160	1	22,85		
	Length	Width	Material	Number	Volume	m^2	Material
Front	405	340	6,5	1	0,90	0,14	MPX
Double Up	385	320	10	1	1,23	0,12	MDF
Backside	405	340	10	1	1,38	0,14	MDF
Side	143,5	385	10	2	1,10	0,11	MDF
Lid	340	143,5	10	1	0,49	0,05	MDF
Bottom	340	143,5	10	1	0,49	0,05	MDF
Bracing	40	143,5	10	4	0,23	0,02	MDF
					6,13		
Driver Displacement					4,00		
					Net Volume		
					12,71		

Enclosure Woofer

					Gross Volume		
Abmessung	760	370	190	1	53,43		
	Length	Width	Material	Number	Volume	m^2	Material
Front	760	370	16	1	4,50	0,28	MDF
Double Up	760	370	10	1	2,81	0,28	MDF
Backside	760	370	16	1	4,50	0,28	MDF
Side	728	148	16	2	3,45	0,22	MDF
Lid	370	148	16	1	0,88	0,05	MDF
Bottom	370	148	16	1	0,88	0,05	MDF

Bracing 1	100	148	16	2	0,47	0,03	MDF
Bracing 2	101	100	16	1	0,16	0,01	MDF
Bracing 3	45	338	16	1	0,24	0,02	MDF
Port 1	113	338	12	1	0,46	0,04	MDF
Port 2	238	338	12	1	0,97	0,08	MDF
					19,31		
Driver Displacement					3,50		
					Net Volume 30,62		

Adapter for MID*	190	185	6,5	1		0,04	MPX
Adapter for MID*	190	185	3	1		0,04	MDF/HDF

Attachment 1

*There is the possibility to ask Mr. Limmer from Limmer Horns to get the Beyma Adapter directly

Shopping list and prices

Shopping Cart for a PAIR of speakers (without shipping)

Article	Number	Price	Total	Dealer
the Box Speaker 12-280/8-W	2	59,00	118,00	Thomann
the sssnake SSK 225 BK	5	1,39	6,95	Thomann
Lavoce DF 10.142 LK	2	40,89	81,78	TLHP
Beyma 6MI100	2	60,10	120,20	TLHP
TLHP Damping 15	1	11,39	11,39	TLHP
Neutrik NL4MPR	4	3,31	13,24	TLHP
Visaton synthetic Damping	2	3,89	7,78	TLHP
Screws, Warnex, Glue, ...	2	12,50	25,00	Diverse
Limmer Horns 630 BC1	2	145,00	290,00	Limmer Horns
			674,34	

Costs for Wood for 2 speakers --> estimation due to high volatility in prices

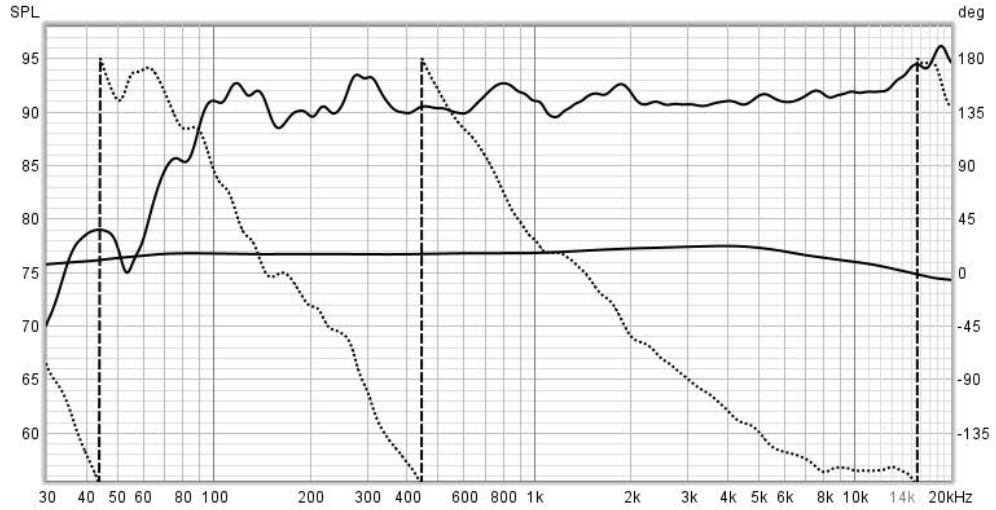
	m^2	Price	Total
16mm MDF	1,93	28,00	54,11
12mm MDF	0,27	23,00	6,16
10mm MDF	1,67	25,00	41,86
6,5 mm MPX	0,35	35,00	12,10
3mm HDF	0,07	25,00	1,76
			115,98

Switch components depending on quality and dealer (my price was)		330
	TOTAL	1.120,32

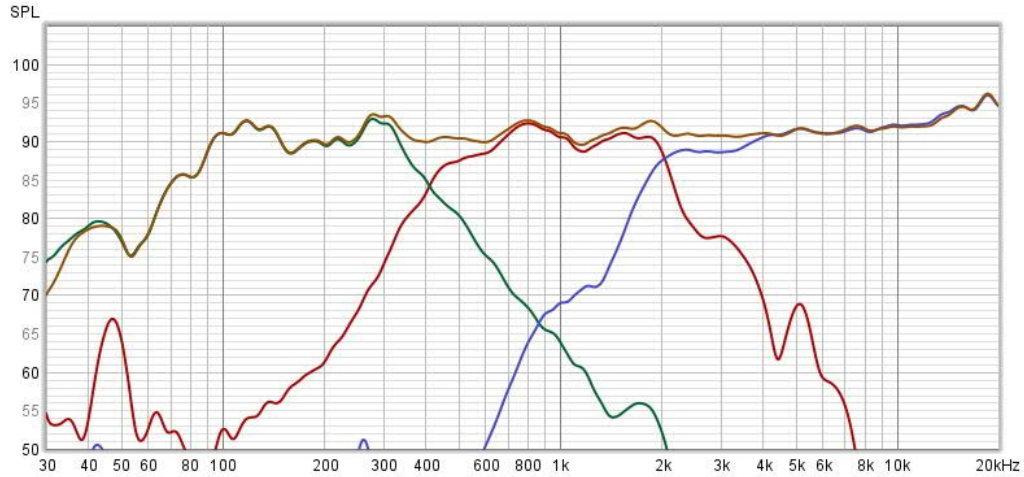
Price per speaker	560,16

Measuremenets

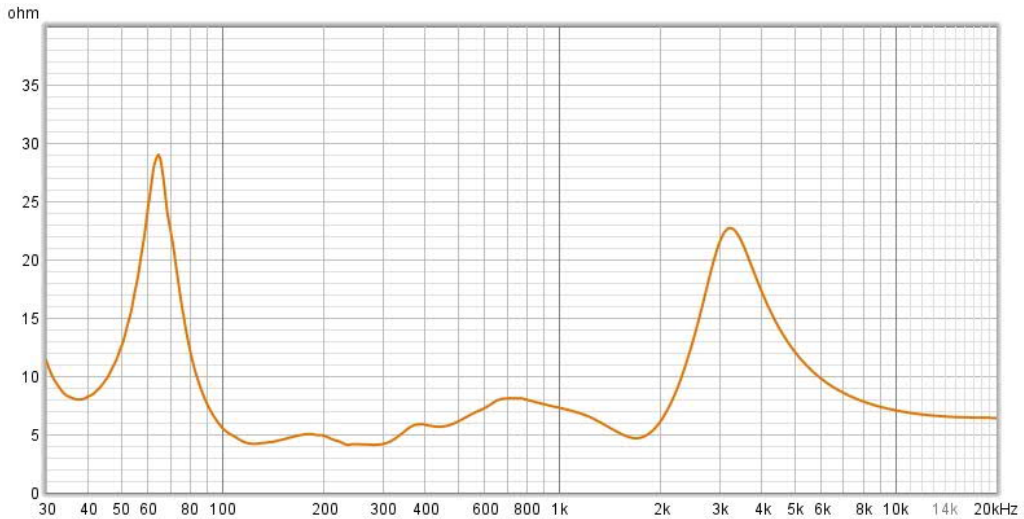
Amplitude und Phase



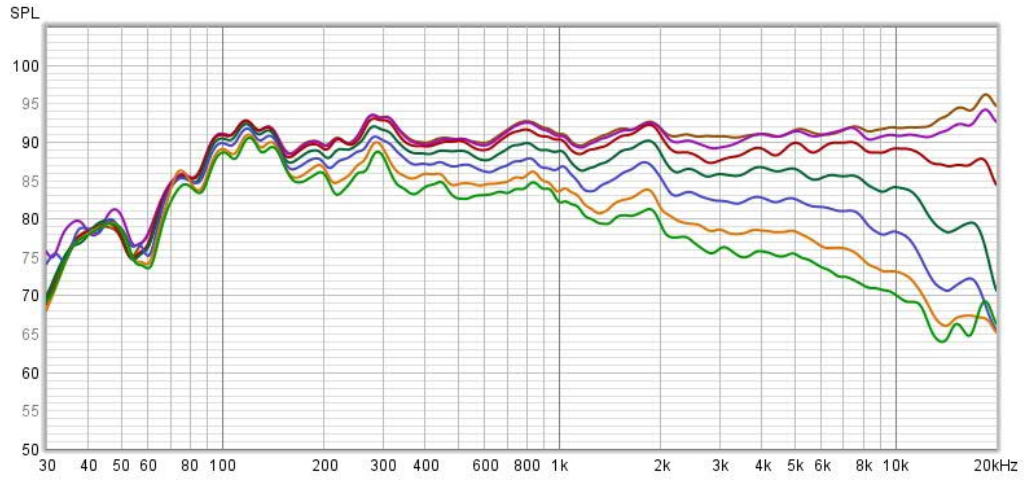
Drivers and Total Amplitude



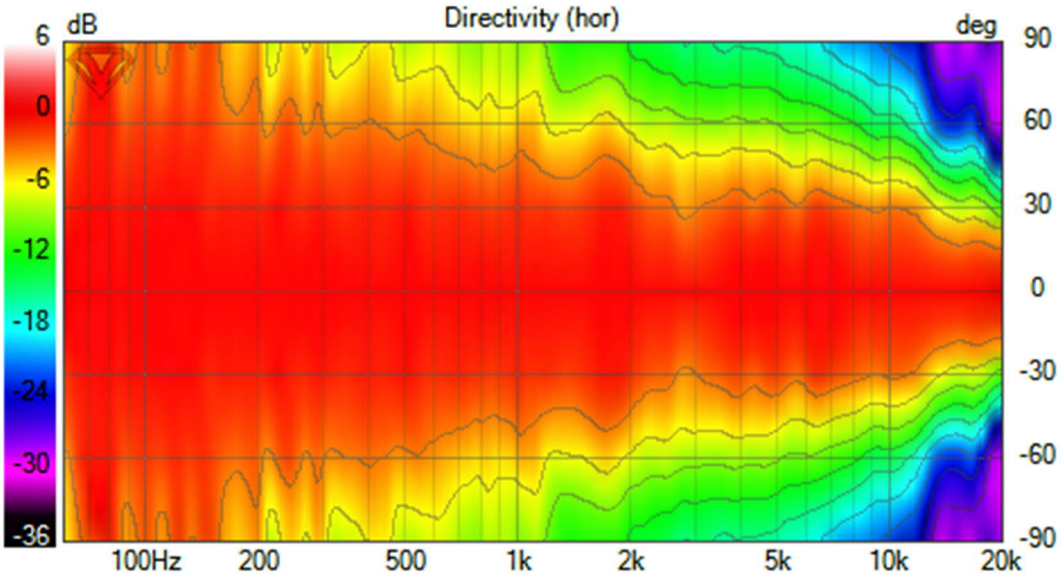
Impedance



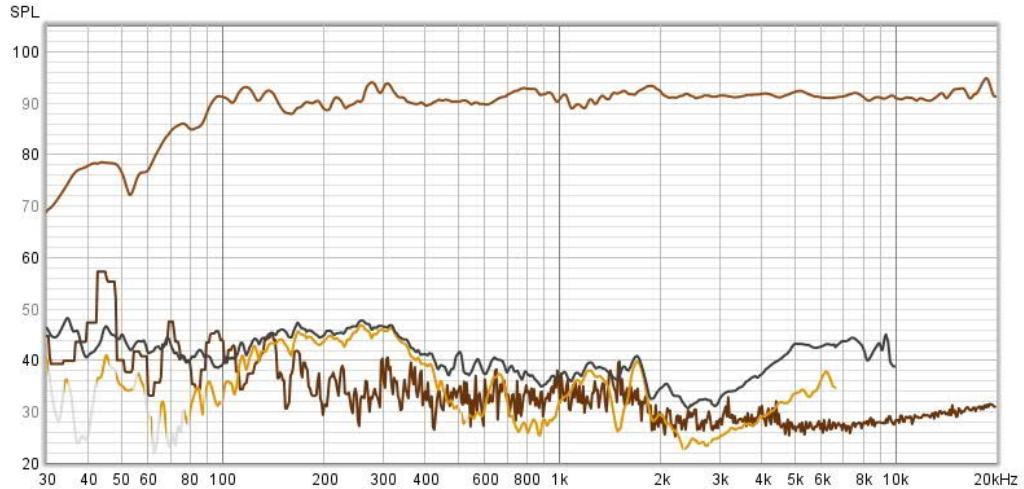
Angle measurements (0, 15, 30, 45, 60, 75, 90 degree)

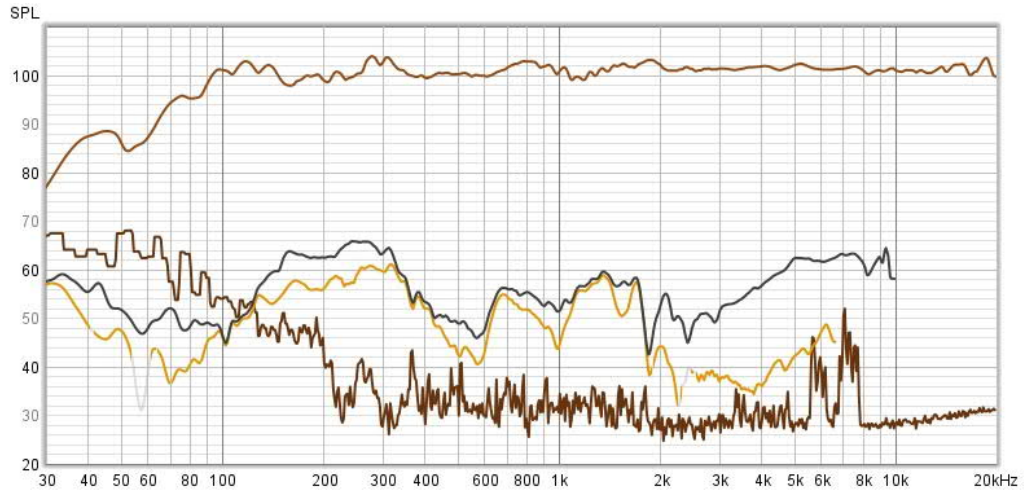


Horizontal isobaric diagram



Distortion

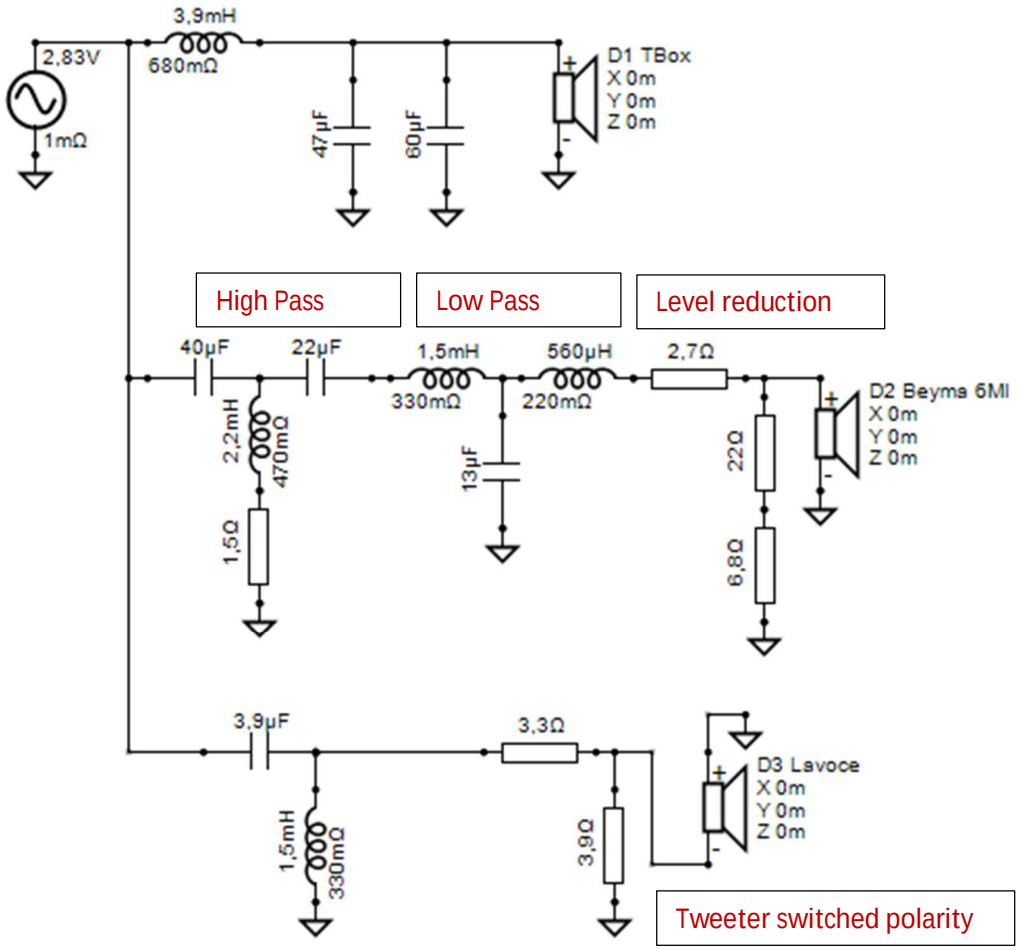




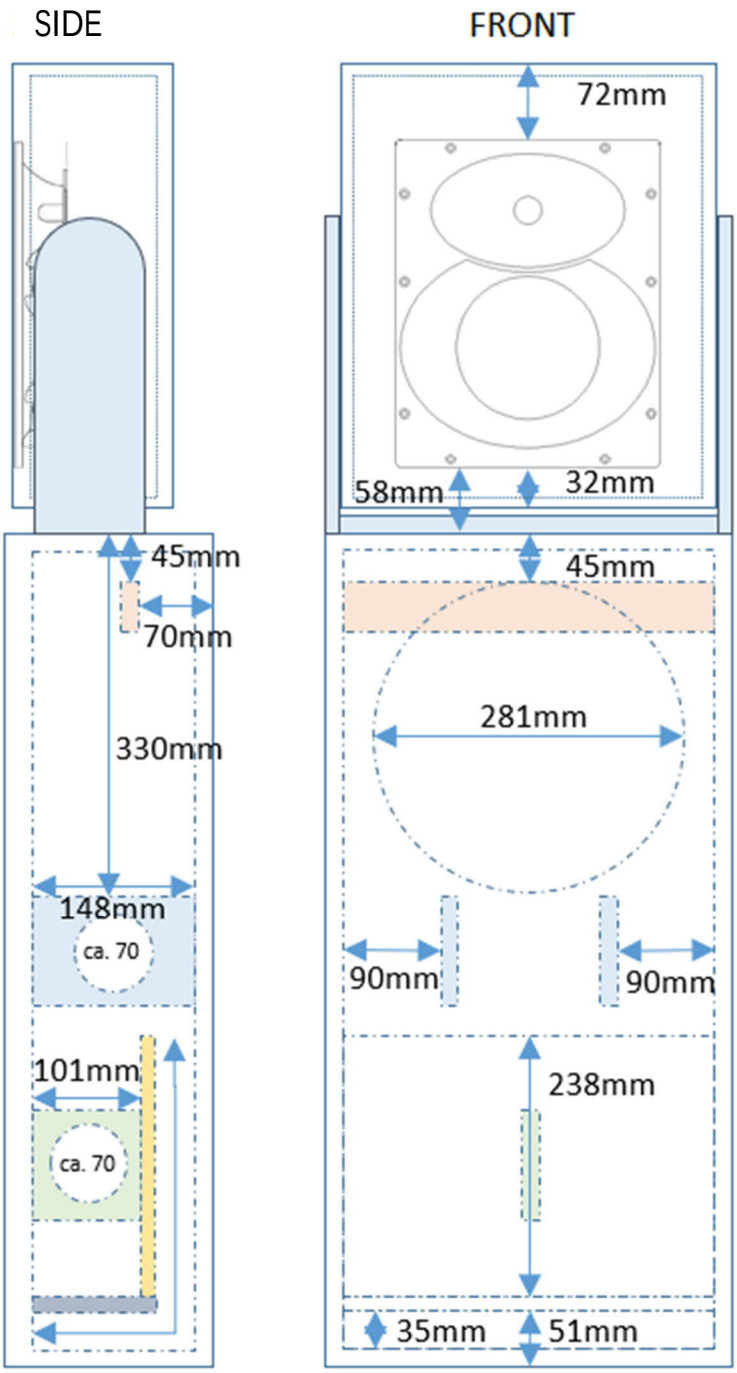
switch circuit

I build the switch on a wooden board (as thin as possible to use as little volume as necessary). I then either place these next to the speaker or attach them to the appropriate part of the box.

For this I recommend placing the MID/HIGH section in the head part (MID/HIGH housing) and the und die Woofer section in the woofer housing.
Theoretically, you can operate the speaker in bi-amping but is not necessary

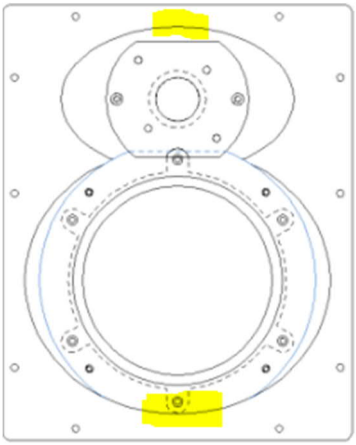


Blueprint and Instructions



1) MID/HIGH Enclosure

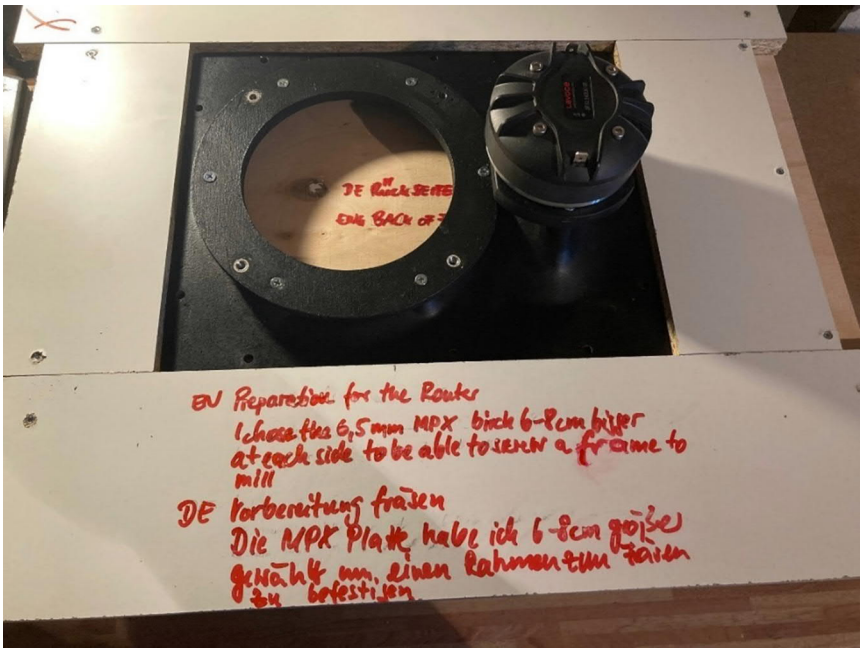
With the mid-range enclosure, you start with the front panel/doubling of the loudspeaker. For this I draw the waveguide on the board according to the blueprint.
The waveguide has a thickness of approx. 6.5mm and a radius at the corners of approx. 6mm.
Since the waveguide has 2 slight bulges on the back through the waveguide, these should be taken into account during construction.



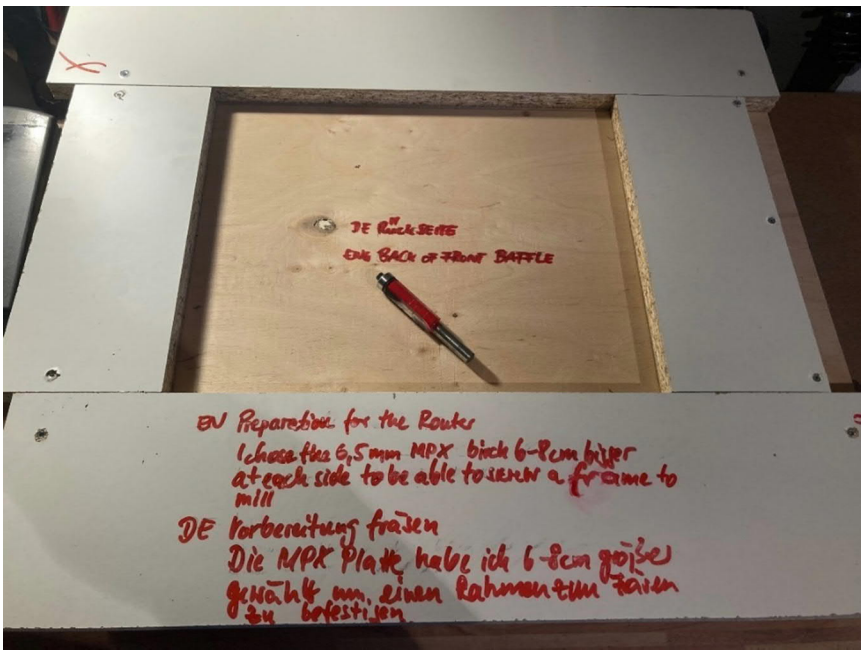
https://www.limmerhorns.de/630-bc1/
It is recommended to mill the waveguide flush into the baffle (the softness was measured this way).

Solution with trimming cutter and milling table:

To do this, place the waveguide backwards on the board from which it is to be milled. Now the auxiliary boards are screwed to the waveguide all around.

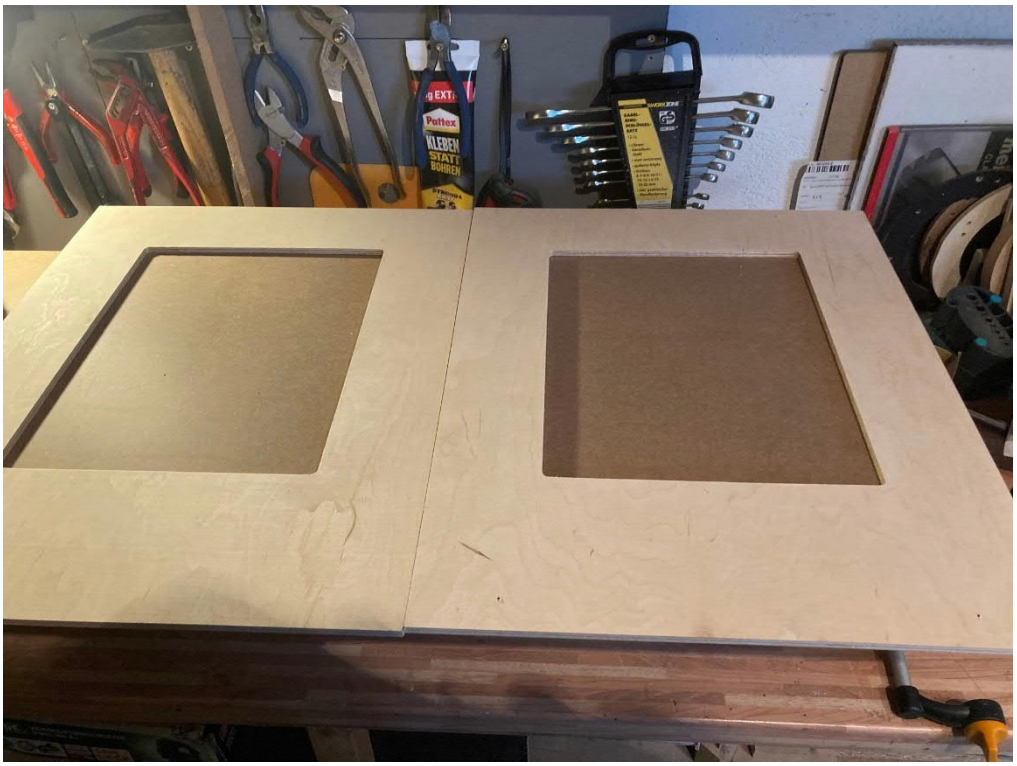


Then you remove the waveguide again, take a trimming cutter and mill out the hole for the waveguide.



Alternatively, this can also be done using a guide sleeve and a milling cutter. You can also use boards or milling aids for this.
However, please note the outer diameter of the guide sleeve and the diameter of the cutter.
For example, you need a larger distance of (17mm-10mm) /2 = 3.5mm to mill the opening. But please think about a tolerance of about 1mm.

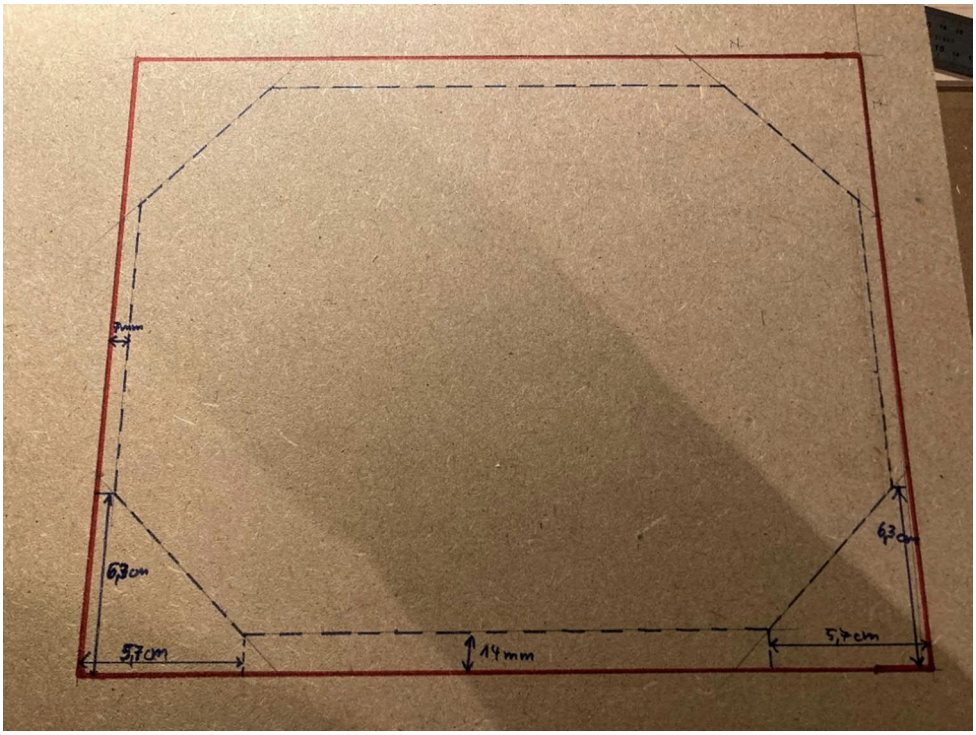
After that, the two boards should look like this

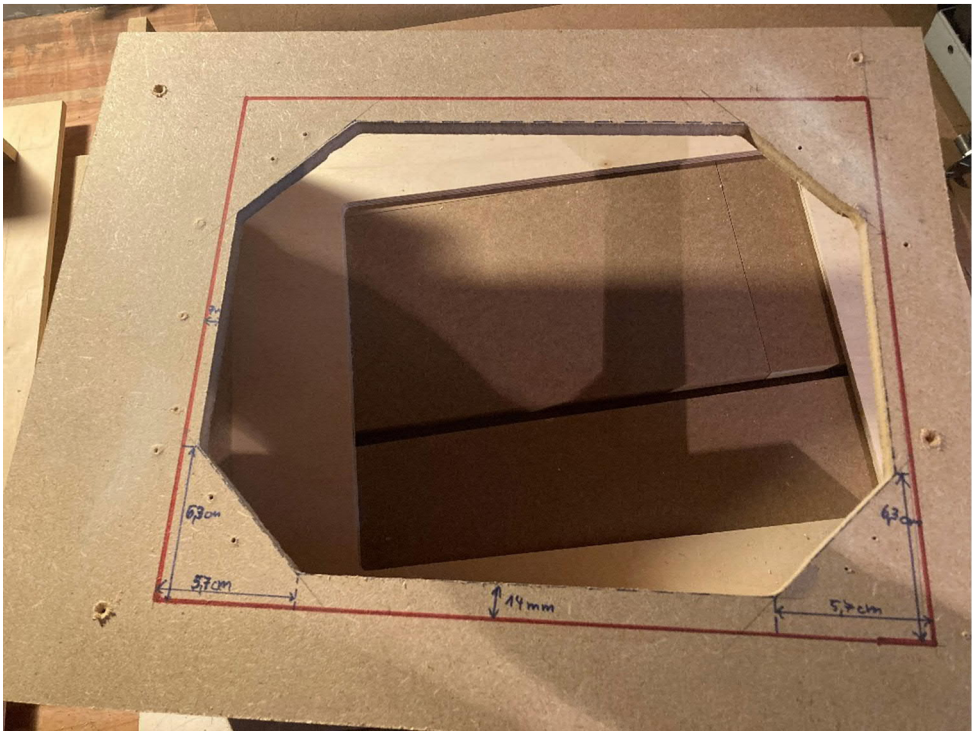


Now the recess for the waveguide is then cut out of the doubling. This can be milled or sawn out with a jigsaw and a steady hand. I recommend you to paint

this on the plate and then edit it.

Please work very carefully!

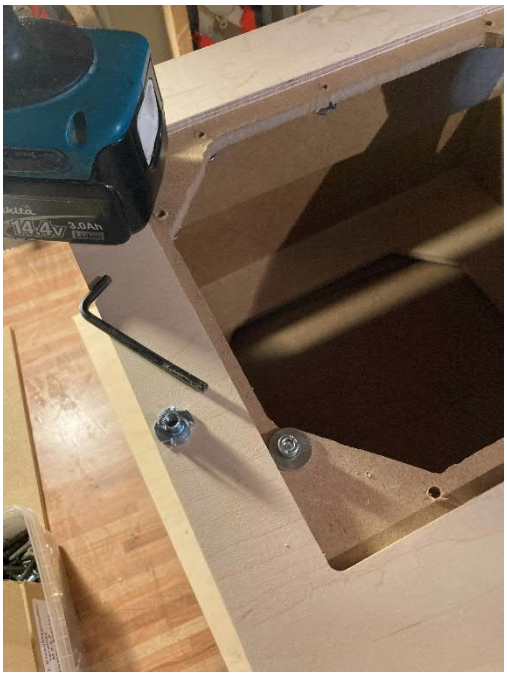




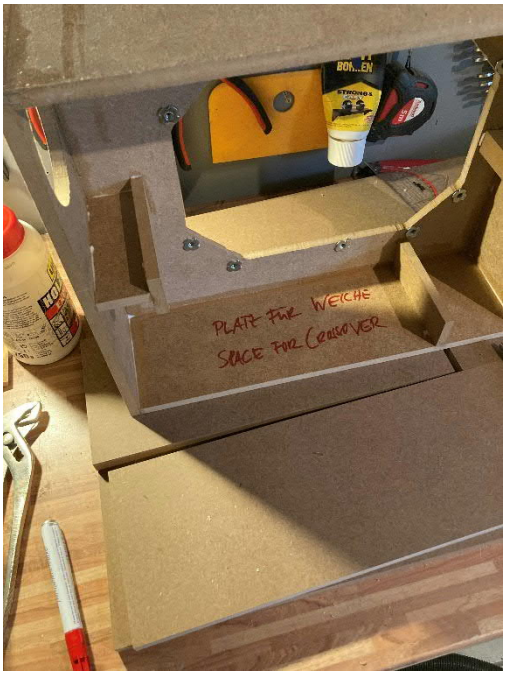
Then you can glue both boards (front and doubling) together.

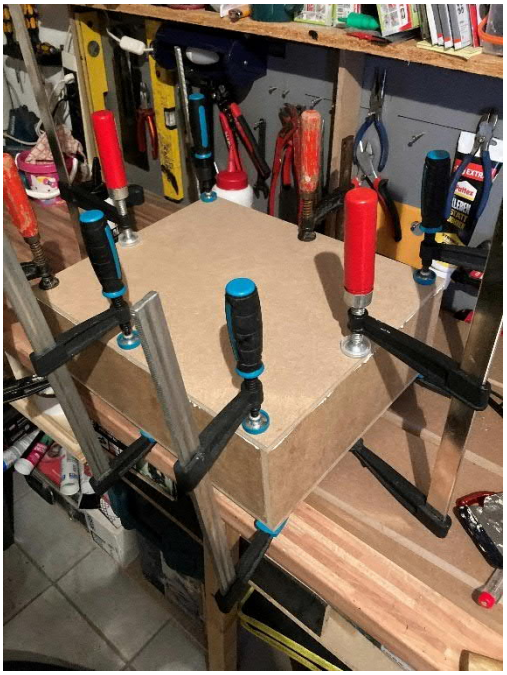
Now the drive-in nuts come into the front wall.

To do this, I put the waveguide on and drill the holes in the right places. Then I attach the drive-in nuts with a screw and washer. If you want, you can also use small safety screws for the nuts (please note the board thickness).



Then I glue the rest, i.e. side walls, struts, rear wall.





The housing is only insulated with half a pack of Visaton insulation, which is loosely placed in the housing.

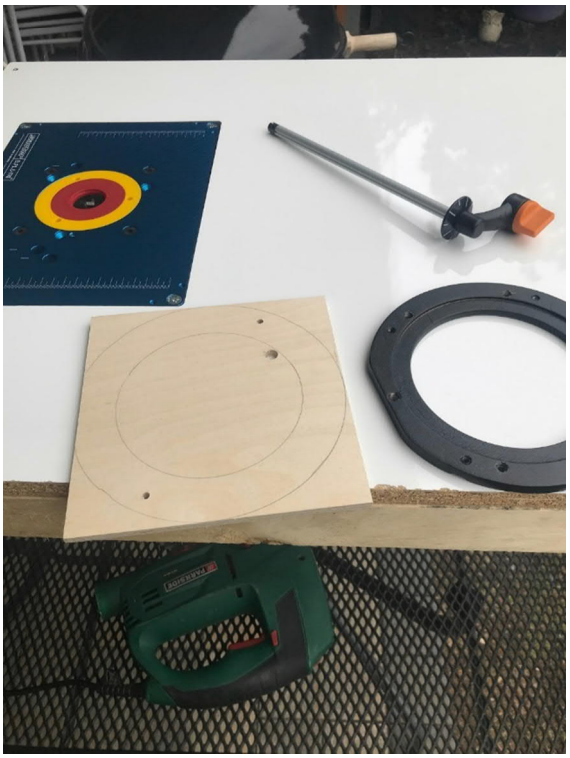
2) WAVEGUIDE UND ADAPTER RING:

Attachment 1

Please ask before doing this step Mr. Limmer if he can deliver the right adapter directly (for Beyma). If not the following has to be done.

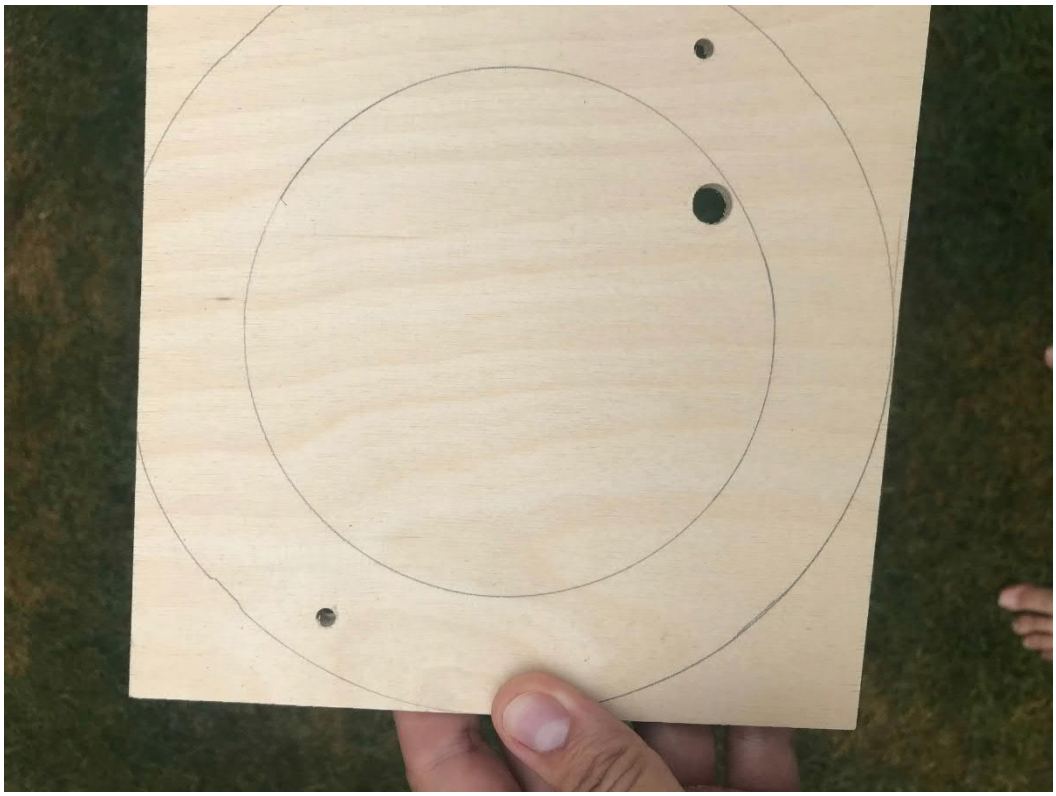
The waveguide used in the JS-HC is the LH 630 BC1.
Unfortunately, the adapter ring that is included is not suitable for the Beyma midrange driver, which is why you have to build your own.
The production using a milling table and copy milling cutter is described here, but it also works with a milling circle and normal router.

Step 1)
Draw the contour of the supplied adapter ring on the board 18.5*19*6.5.
Drill out two of the holes in the actual adapter ring (the ones used for attachment to the waveguide) and attach the adapter ring to the board. To do this, countersunk screws with nuts are used.



Drill a hole in the middle ring near the ring to be routed to pre-cut with a jigsaw close to the edge.

Caution: It is advisable to place a board underneath for all drilling, since multiplex splinteres easily and the holes are less likely to fray.

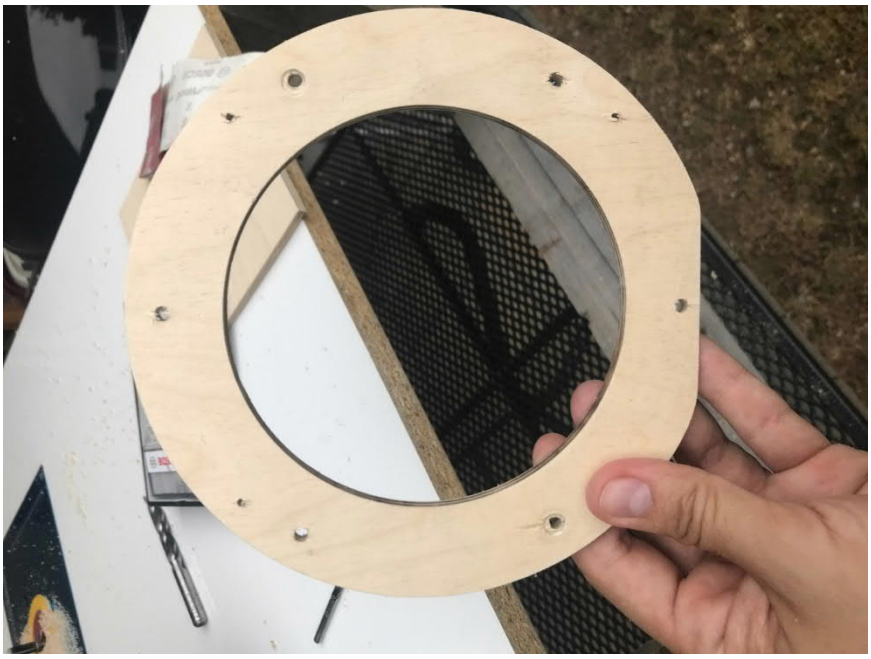


For the jigsaw, please also use a very fine blade that is suitable for cutting curves. Saw blades from Bosch "T101 AO clean wood" were used here.

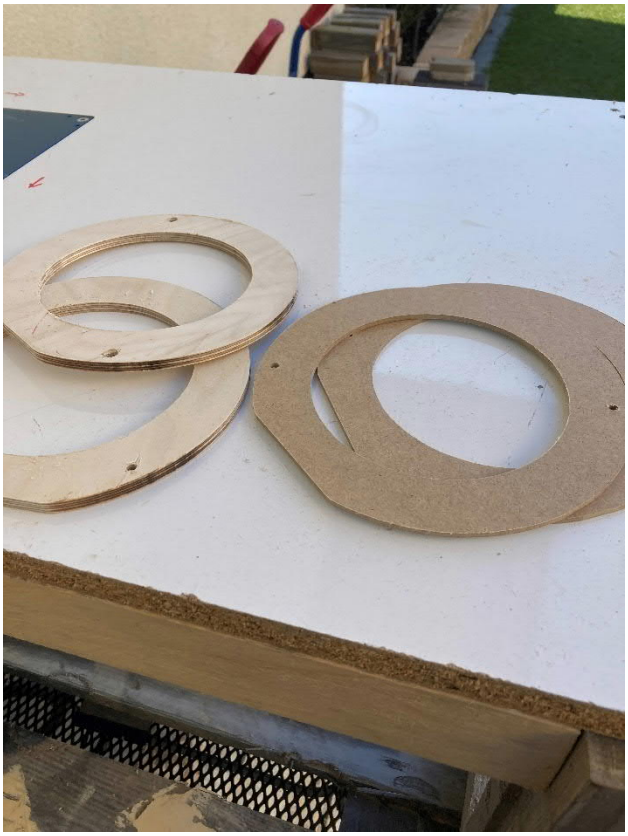
The result is now as follows

The supplied adapter ring is now attached

When milling, please act carefully and pay attention to the direction of the milling cutter. After milling, you can drill through the holes of the supplied adapter ring (5 mm drill bit is required)
The result is as follows.



You then do the same with the 3mm MDF/HDF board. (see right)



Place the Beyma MT on the 6.5mm MPX plate and drill the mounting holes from behind. The 3mm MDF/HDF plate is placed on the MPX plate and the holes are marked with a felt pen.
Now you drill through the 3mm plate at the markings with a Forstner drill that is larger than a drive-in nut (M5). Now both plates are glued together and the drive-in nuts are screwed in (so that they are countersunk see picture). Please make sure - it goes without saying that the mounting holes of the adapter for the Beyma do not collide with the mounting holes of the adapter with the waveguide.

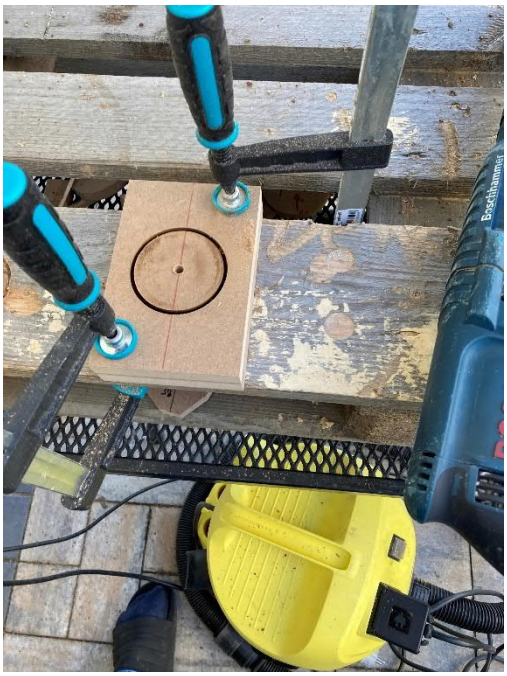
3) Woofer Enclosure:

When it comes to the woofer cabinet, the best place to start is with the baffle.

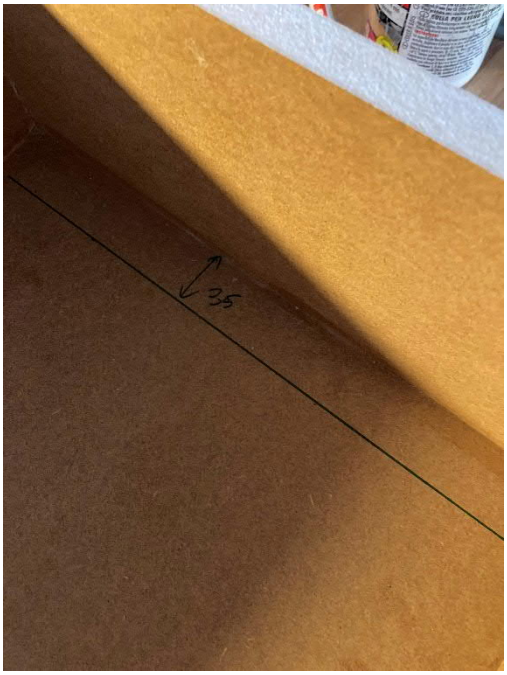
Here it is best to mill out the woofer in the 1st step (using a milling compass). You can do this first or glue the sides first and then mill them out.

I glued the doubling onto the housing afterwards. For this I sawed it a little bigger and adjusted it to the housing with a trimming cutter so that it fits 100%. The doubling corresponds exactly to the basket edge height of the woofer and is 1cm.

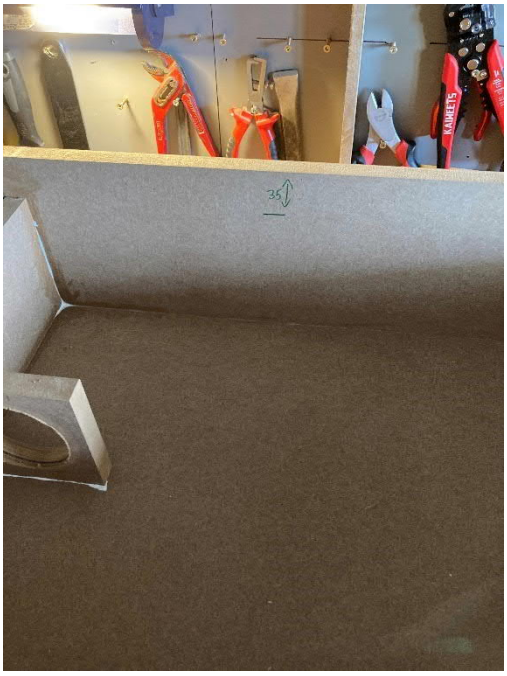
Next, I worked on the struts with a hole circle drill as they serve to stabilize the Bas Reflex channel.



Now draw a line inside the case where the shorter BR board goes and glue the BR board into it.



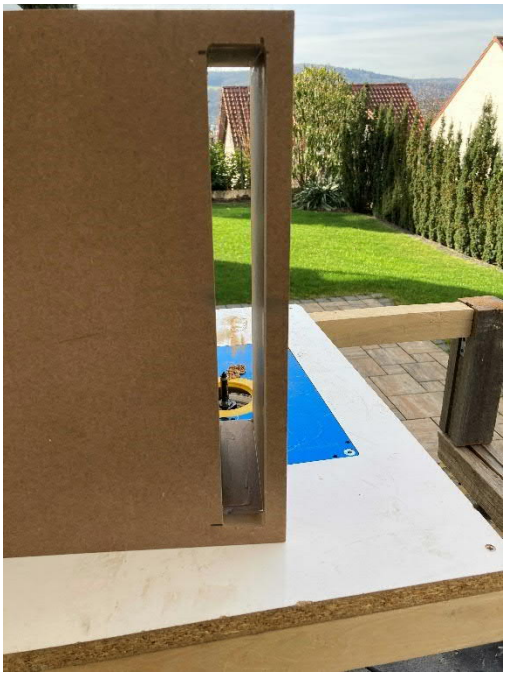
Glue the stabilization that you have processed with the circular hole saw to the edge in the middle and draw a line on the inside of the side walls again with a distance of 35mm.



Now you glue in the 2nd BR channel board and the remaining struts

The opening of the BR channel on the font is pre-cut with a jigsaw and the rest is milled with a

flush cutter so that you have a nice edge.



Then add the back wall and the doubling and you're done for the time being.

4) Bracket for Mid/High Enclosure:

This is relatively easy to do. For this I glued 3 boards together with the help of wooden dowels. You can also glue and screw them together.

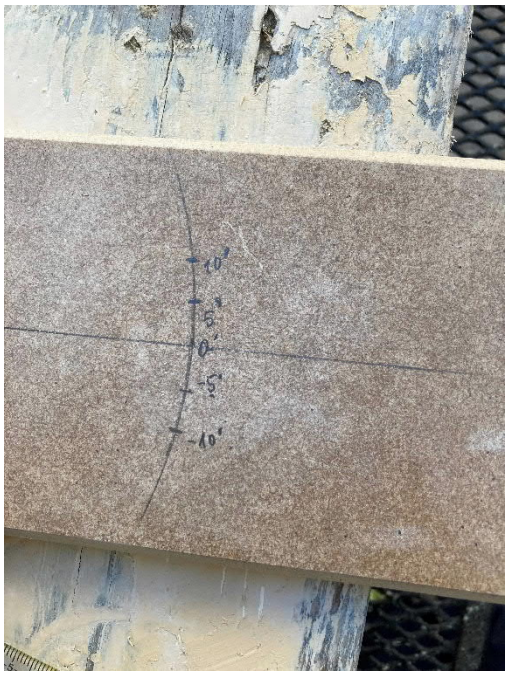
The idea with the bracket is that the MT/HT part (head part) can be tilted, i.e. if you place the speaker higher you can still point the head part towards the seat. So you have some flexibility.

However, the bracket is NOT absolutely necessary!

Here are the pictures for the side part of the bracket. The angles are freely selectable.

So that the headboard is stored floating, I put a board on the holder (floor) to lock it, then put the headboard on it and drilled the necessary holes. You need one hole in the header where it pivots (top of bracket) and one at the bottom (NOT one per angle!!!). Drive-in nuts have been used inside the head part for this purpose.

I used furniture glides as spacers between the headboard and the bracket.



5) Enclosure Damping

As already described above, the MT/HT housing is only designed with half a mat of Visaton insulation.

Two materials are used for the woofer housing. The Damping 15 and the other half mat of Visaton insulation.

I made the following cuts for it, which were attached as follows:

6) Speakon connector

I like to sink the Speakon sockets flush in the housing. Please think about where you want to place them beforehand. The same applies to the crossover. Here you should reserve a place in the housing in advance.

To countersink the Speakon plug I use a milling compass, with which I countersink the edge.

Then I drill the hole with a forstner bit. For this I make myself a drilling aid using a leftover piece of wood.

The headboard looks like this. Since it is quite thin for sinking with a wall thickness of 1cm, I glue an auxiliary board from leftovers in from the back.