



# Bass Rig

## Bass Rig – A high quality speaker system for my bass-guitar and double-bass

This speaker system is designed to be flexible in use, light-weight and have high sound quality as it is to amplify the acoustic upright bass. I have gigs in many different locations varying from receptions in small places where only back-ground music is required, to larger outdoor live performances at jazz festivals so the set-up must be flexible enough that I don't have to transport a large system when I will only be playing background but it still must have enough power and throw when being used at larger venues. These criteria lead to a two piece system consisting of a 15" woofer with tweeter that can be used as a full-range stand-alone and a second cabinet containing a single 18" woofer that can be added for more power and even stronger bass. In the past I have had many bass-systems ranging from multiple smaller woofers, separate midrange drivers, to single large woofers. I have found that for me the only way to get realistic bass, especially amplified acoustic bass, is to have at least a 15" woofer. As in hi-fi there is no substitute for a single large driver instead of multiple smaller ones. Playing techniques like "slapping" can call for multiple small sized woofers, but they still will need an accompanying large woofer to produce true life-like deep notes. I choose a 15" midwoofer with a relatively light-weight cone and strong motor to ensure articulate midrange. The combination with a tweeter gives crystal clear treble all the way to 16 kHz giving the bass-notes a well defined edge and also lets you hear the true character of a bass. Also both woofers use a neodymium magnet that makes them very light-weight compared to standard ferrite magnets – I don't want to get back problems!



Let's get funky!

### The tweeter

The [Celestion HF-50](#) is a compact bullet tweeter with a 60 degree conical radiation pattern. It has a high efficiency of 103dB's and can be crossed from 3kHz upwards if a 3<sup>rd</sup> order network is used. It has a sturdy thick plastic face-plate and can found in some EBS bass-rigs. I used it for its relatively large bandwidth, very compact size and low price.

### The midwoofer

The [Ciare 15.00Ndw1](#) is a 15 inch / 39cm paper cone woofer with a usable frequency range up to about 1 kHz officially but when used without a crossover it can be stretched up to 3 kHz which is the crossover point to the tweeter. It has a strong aluminium and magnesium basket with a small but very strong neodymium magnet producing a B1 of more than 25Tm. This makes a very light weight system; the whole driver only weighs 6,3kg's. Other positive parameters are the very high Qms of 14,47 leading to a very low Rms of 2,2kg/s. Finally with an Xmax of 7mm; an SPL of 97dB and 500watts of power handling this driver can play loud.

### The woofer

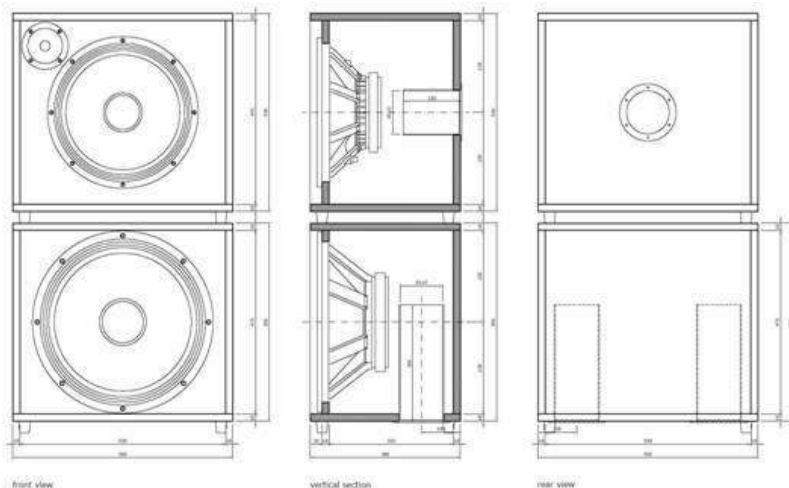
The Ciarc 18.00Ndw is an 18 inch / 46cm paper cone woofer with a usable frequency range up to about 1500Hz. It has a strong aluminium and magnesium basket with a small but very strong neodymium magnet producing a Bl of more than 28Tm. This makes a very light weight system; the whole driver only weighs 6,6kg's. Other positive parameters are the very high Qms of 10,5 leading to a low Rms of 3,6kg/s (Rms is proportional to the cone area). Finally with an Xmax of 5mm; an SPL of 100dB and 800watts of power handling this driver can play very loud. Both woofers use Kapton voice-coil formers with 4-inch / 100mm diameter.



*The drivers.*

### The cabinet inside and out

Both boxes are made from 18mm thick Baltic Birch plywood and are identical except for the driver cut-outs and de reflex port tuning and position. Both cabinets measure 566x506x386mm with an internal net volume of 70 litres. The 15.00Ndw1 cabinet uses one Monacor MBR-110 reflex port with an internal diameter of 110mm and a length of 50mm giving a tuning frequency of about 54Hz – this results in a more full-bodied bass character compared to a lower tuning frequency. This port is placed in the centre of the rear wall for maximum efficiency. The 18.00Ndw cabinet uses two Monacor MBR-110 reflex ports with an internal diameter of 110mm and a length of 300mm giving a low tuning frequency of 45Hz. These ports are placed in the bottom panel and radiate their energy towards the floor. The cabinet stands on 30mm high rubber feet creating a cavity to let the down-firing ports radiate. The coupling of the air-mass under the woofer cabinet lowers the tuning frequency more towards 40Hz so that together with the low-pass crossover on the 18.00Ndw it works like a subwoofer adding more weight, especially when using a 5 or 6-string bass. Also an acoustic double-bass benefits from this subwoofer set-up in making the instrument sound larger compared to the top cabinet on its own. The cabinets are strengthened with 40x40mm wood on all internal edges and across the top and bottom panels to give more strength. The large circular woofer cut-outs are glued to the inside of the rear panels to give these panels more strength and minimize vibrations. All external comers are fitted with stackable protective plastic corners and each cabinet has a large pair of sturdy metal recessed handles. The finish is black semi-gloss paint with black protective grilles. All the hard-ware is attached with matching black cross-head screws. Internal damping consists of Pritex wedge moulded foam on all internal walls except for the inside of the front baffle. Internal wiring is 4mm<sup>2</sup> OFC copper wire. On the rear panel I have used professional Neutrik Speakon connectors for durable contact.



front view  
Humble Homemade Hifi - Bass Rig  
© 2018 hifi, hifi, hifi

*A higher resolution drawing is available on request.*



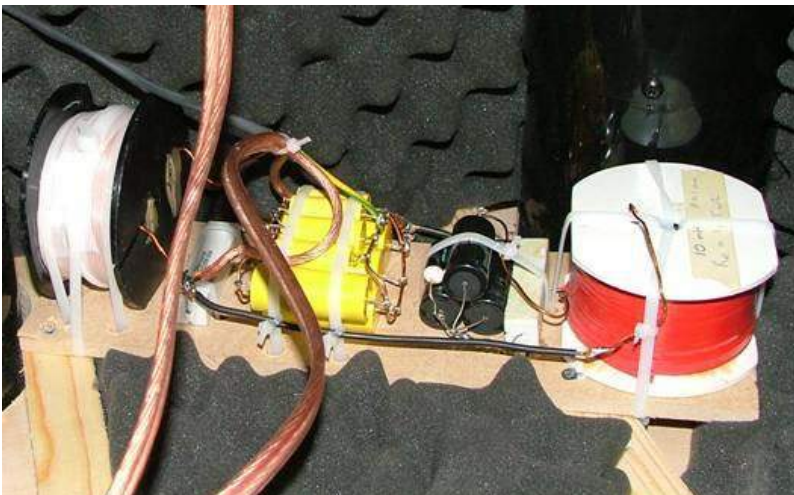
*The top cabinet without damping material.*

### Crossover and listening

This bass-rig is designed with flexibility in mind. For small gigs I use only the top cabinet in which the 15-inch is connected directly to the amplifier without any form of crossover. Irregularities in the frequency curve are corrected by the 11-band equalizer on my Trace-Elliott amp-head. The tweeter has a 3<sup>rd</sup> order crossover in its signal path consisting of two high quality polypropylene capacitors and an air-core inductor in a T-configuration. No damping resistors are used to maintain the maximum output level that again can be damped or boosted by the equalizer. The use of an equalizer is a must when playing in all types of venues because the room acoustics can be so extremely different each time and you need to adjust the tonal balance to match the situation of the moment. Also electric bass-guitar needs a slightly different setting compared to my double-bass and different playing techniques can call for different EQ-settings.

For larger gigs I add the 18" subwoofer cabinet that can be connected directly for maximum output level, but most of the time it is connected with a first-order low-pass crossover. Two correction networks run parallel to the woofer: the LCR-network flattens the upper of the two typical bass-reflex impedance peaks so that the low-pass inductor can do what its meant to do at lower frequencies. Furthermore there is an RC-network to compensate the inductive rise of the voice-coil so that the low-pass inductor can do what its meant to do at higher frequencies. On the photo the yellow capacitors make up the 68uF needed, I happened to have these capacitors from a previous project – you can also use a single capacitor of the correct value for the same result.

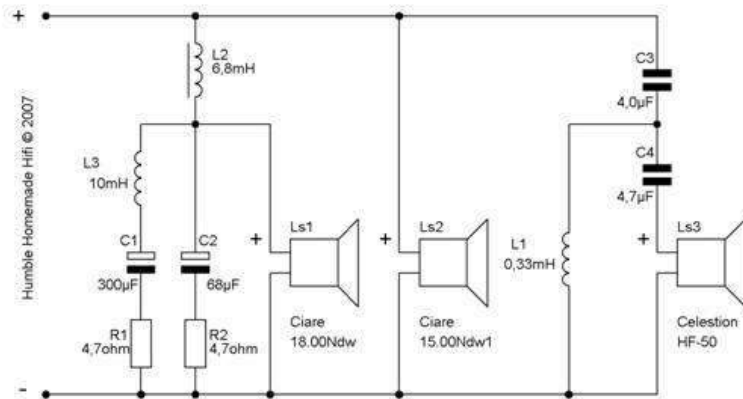
Now down to being "on the road". First of all the having two separate relatively compact enclosures makes transport and set-up very flexible and easy. Lifting them in and out of a car doesn't break your back and at home they stack nicely in a corner behind the bedroom cupboard – they have to be carried up and down the stairs! Also they fit perfectly on my three-wheeled transport bicycle. Sound quality is very realistic re-producing the character's of the different instruments – a Jazz Bass sounds like a Jazz Bass, a Musicman Stingray sounds like a Musicman Stingray. Acoustic bass is produced "acoustically" with a natural low-end and midrange. The top-end clarity makes the overall sound nicely articulate. Other qualities are the immense reserve of power, giving plenty of dynamic head-room. Things never get congested or compressed; I hardly ever have the volume knob of my 150watt amplifier past setting 3 on a scale of 1 to 10. Any further just gets too loud. The 15"/tweeter top cabinet on its own produces a well balanced sound that satisfies for most occasions and would be a very good bass-speaker on its own. But with the addition of the 18" woofer the bottom-end becomes powerful and strong and the overall system efficiency rises. My double-bass sounds like a double-bass and not like an electric upright.



*The subwoofer low-pass crossover.*



### Bass Rig crossover



*The crossover schematic.*

#### Crossover components:

L1 = 0,33 mH air-core inductor, 1mm wire, R = 0,35 ohms

L2 = 6,8 mH high-power iron-core or steel-laminated inductor, R = 0,50 ohms

L3 = 10 mH air-core inductor, 1mm wire, R = 1,55 ohms (the high resistance here is important)

C1 = 300uF bi-polar (3x 100uF parallel bypassed by 1,5uF MKP)

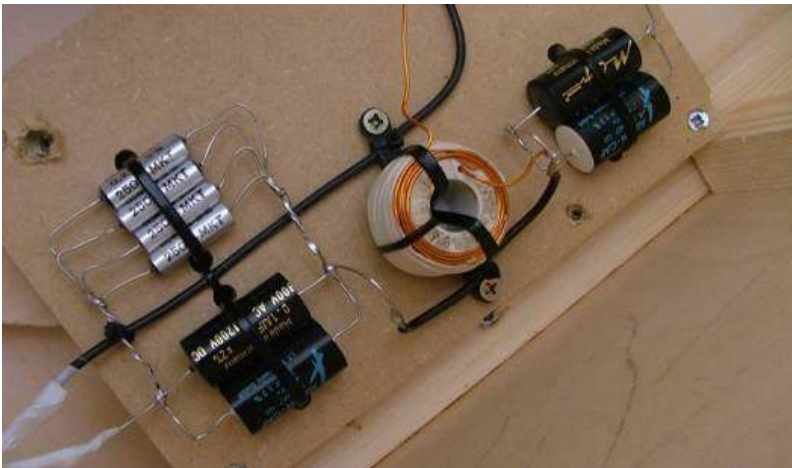
C2 = 68uF MKT or standard MKP

C3 = 4,0uF MKP (3,9uF standard MKP bypassed with a 0,10uF Mundorf M-Cap Supreme)

C4 = 4,7uF MKP (3,9uF standard MKP bypassed with a 0,82uF Mundorf M-Cap Supreme)

R1 = 4,7 ohms / 20 watts cement resistor

R2 = 4,7 ohms / 20 watts cement resistor



*The tweeter high-pass crossover in the top-cabinet.*



*Hardware.*

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

Tony Gee, The Netherlands

August 2006, updated April 2007