Description of the mbl 111B Hybrid Loudspeaker

The following document describes some of the technical features of the **mbl** 111B hybrid loudspeaker.

Omnidirectional Radiator (4 π Omni)

This system design does not rely solely on two bending segments systems (the isotropic transducers), but also on two conventional loudspeakers. The mbl 111B is a full range omnidirectional radiator (4 π Omni).

The woofer is an omnidirectional radiator because, at the cross-over frequency of 130 Hz, it has a wavelength of approx. 2.65 m, which is very large in comparison to the cabinet dimensions.

The mid-range/low loudspeaker possesses an effective diameter of 104 mm and radiates relatively unfocussed sound signals up to 1.05 kHz without a radiation diffuser and, at this maximum piston radiation frequency, the test values measured in a 90° measurement are only by 3 dB lower than the test values from the measurement against axis. Since this loudspeaker only operates up to 670 Hz, the radiation diffuser is used to adapt the mid-range magnet, rather than for better radiation of the mid-range/low loudspeaker.

The mid-range loudspeaker and the tweeter are omnidirectional loudspeakers due to their design structure.

Bandpass Filter Concept

The woofer is a bandpass system.

The bandpass filter is equipped with a second order highpass filter based on a slope of 12 dB. Therefore, it exhibits the same favorable oscillation on/off performance as a closed box. The system also has a very low cutoff frequency, thus allowing for a very full bass sound.

This combination of a deep and a dry bass sound is unique and worth hearing.

The speaker always works back to back with a closed system and is therefore protected against subsonic interference. Thus, the woofer always operates in a linear region of the magnetic field and it is almost impossible to destroy it.

An acoustic second order lowpass filter built into the bandpass system provides for filtering out the harmonic waves. A fourth order Linkwitz-Riley filter is achieved by adding another second order filter.

By using only one woofer, such a bandpass system design choice allows the loudspeaker to cover a large frequency range, and to achieve a **high dynamic** and **volume level** with consequent **low excursions** of the woofer and with **minimum distortions**.

Some Details

Impedance

The typical **impedance** is **4 Ω**.

At no point is the impedance of the loudspeaker lower than 4 Ω. At the two peak points of 25 Hz and at 700 Hz, this impedance is below 18 Ω.

Power

The cross-over network was designed for a **continuous power** of **320 W**.

The two mid-range loudspeakers establish the system load limit. The tweeter and woofer can bear much more power.

The **music power** is **500 W**.

Efficiency (SPL)

Within a **room**, the sound pressure is **81 dB/W/m**. This corresponds to a 2 π half-space (measuring conditions specified for dipole arrays).

Maximum Sound Pressure Level

The **maximum linear sound pressure level** of the system within a 2 π half-space is **106 dB/m**. In order to achieve this, an input power of approx. 500 W is required.

The mechanical peak level (up to the mechanical limit of the speaker) is 111 dB/m for pulses, and this requires a peak power of 2200 W.

Cross-Over Network

The loudspeaker is a **4-way system**.

The **cross-over frequencies** are **105 Hz, 600 Hz and 3500 Hz**.

The cross-over network is always a Linkwitz-Riley filter of fourth order, i.e., it has an acoustic slope of 24 dB per octave. All speakers are connected in phase and radiate at each frequency in phase.

Mechanical design of the cross-over network:
The excellent and manually selected components lay on a flat square tube to avoid mutual influencing, i.e., the magnetic axes of the coils are rotated by 90° relative to each other. The cross-over network is housed in a separate part of the cabinet filled with silica sand. This very costly design allows for the

avoidance of all negative effects resulting from sound pressure or vibrations impacting the cross-over network.

Reference Level

During development, the upper edge of the tweeter magnet's pole flange was used as reference.

The acoustic center is 109 cm (43 inches) above the installation area. The recommended seating height (distance between the ear and the installation area when seated) is 104 to 114 cm (41” to 45”).

Speakers

Woofer

The diameter of the woofer is 30 cm and that of the connected moving coil is 10 cm. The moving coil is composed of an aluminum/magnesium alloy with a very low thermal resistance (black anodized), thus allowing for the high level resistance of the system. Using a heat resistant glue, the moving coil is glued to its support. Consequently, temperatures up to 360° C can be withstood without possibility of damage.

The end result is a loudspeaker that is extremely difficult to destroy. The air gap is 10 mm high and the moving coil has a winding width of 24 mm. Thus, the loudspeaker has an extremely high linear throw of 14 mm. The maximum mechanical throw is two times larger-- 28 mm.

Mid-Range Low Loudspeaker

For supporting the fundamental sound range, a 13 cm speaker transducer produced by mbl was built in the mid-range/low cabinet that carries the mid-range/low loudspeaker top. The speaker radiates vertical to a cone. The frequency range of this speaker is selected in such a way that the radiated fundamental sound frequencies are perfectly distributed omnidirectionally. The cone above the speaker only serves for adapting the obstacle above (mid-range/high speaker) in order to avoid edge defraction.

Mid-Range Loudspeaker and Tweeter

System

Like the complete system, the tweeter is an omnidirectionally radiating 360° speaker (isotropic). The drivers used in mbl 101 are used in the mid-range and tweeter speakers of the 111. They are composed of a bending segments system. The tweeter is made of 24 segments arranged around a center axis. At the top, they are fixed to a rigid support, and at the bottom, they are connected to a moving coil. When

the coil moves upwards, the segments bend outward and vice versa, i.e., when the coil moves downwards, the segments flex inward. The spacing between the individual segments is filled with silicon to seal the surface.

Material

The tweeter segment is made of a unidirectional carbon fiber composite. This material has a high rigidity and a low specific weight. Due to this feature, and the fact that the internal loss of the carbon fiber composite is 10 times larger than that of other metals, the segments can perfectly follow the connected electrical signal.

Mechanical Design

The segment, the support and the center rod that holds the support are manufactured with the same material to avoid material reflections. In addition to this, mbl does not use a spider for the mid-range or the tweeter loudspeaker to hold the moving coil in the center of the air gap. The resulting reduction of mass and restoring forces allows for the incredibly fast signal processing capacity of these speakers.

Cabinet

The cabinet is made of 30mm thick MDF (medium density fiber) boards. which provides excellent rigidity as well as an optimum damping coefficient. In addition to this, **mbl** uses internal braces to stabilize the cabinet. The specific inclination of the cabinet walls serves to avoid standing waves.

Spike

A unique feature of this loudspeaker is the spike (color: gold or champagne) that is located above the tweeter. This spike reflects that part of the high frequencies that is radiated upwards. Thus, delay differences due to different room heights are avoided. The result is that, due to the use of this spike, the reproduction accuracy of the loudspeaker does not depend on the room height.

The spike is supported by four black anodized AlMg3 tubes filled with lead shot. This measure serves to absorb resonances of the mid-range cabinet as much as possible.

This concept is a perfect combination of modern design and functionality.

Resonance Suppression

There is an acoustic interaction between the cabinet and the loudspeaker magnet. The masses, i.e., the cabinet and the magnet of the speaker, form a mechanical resonant circuit that oscillates at a frequency of approximately 300 Hz. If the cabinet is reinforced, the resonance frequency will be in a narrow band, but the interfering amplitude increases greatly (this phenomenon can be seen in almost every publication that performs loudspeaker tests). mbl makes great efforts to eliminate this default situation. Therefore, the woofer and the mid-range/low magnet are equipped with a separate **resonance damping system using a frequency absorber**. In order to suppress the resonance energy, it is passed through a high-end cabinet construction to the frequency absorber.

Specifications

System		4-way
Frequency range		20 Hz to 40,000 Hz
Impedance		4 Ω
Sound Pressure Level		81 dB/W/1m (2,83V/ 2 π)
	linear max.	106 dB
Cross-over frequencies		105 Hz, 600 Hz, 3500 Hz Linkwitz-Riley, 4th order
Acoustic center		109 cm, 44 inch
Power	continuous	320 W / 500 W
	peak power	2200 W
Woofer system		300 mm, 12-inch cone driver (mbl)
Mid-range low		Double push-push configuration 2 X 140 mm (6.5 inch) Alu
Mid-range high		Radial MT50, cross-directional CFK (mbl)
Tweeter		Radial HT37, unidirectional CFK (mbl)
Finish		**Satin:** standard black, silver, beech veneer **Piano:** on request black and Diamond arctic silver
Dimensions		400 x 400 x 1160 mm, (H 1300mm with cover) 16 x 16 x 47 inches (W x D x H) (H 53 inch with cover)
Weight		60 kg, 132 lbs. (each)