HARMAN

# JBL 4367 STUDIO MONITOR WHITE PAPER

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# INTRODUCTION

JBL loudspeakers have been the choice of music and movie professionals for more than 60 years; they are behind the screens of more than 50 percent of all movie theaters and hang in concert venues everywhere. In fact, the line of JBL Studio Monitors dates to almost 50 years ago; yet the spirit behind their design began with James B. Lansing himself.

This spirit has always been to use the best technology to deliver the best performance. To the Studio Monitor legacy, this has resulted in increasingly louder speakers of steadily greater dynamic capability, increasing accuracy of reproduction, all with JBL's unique "bullet-proof" approach to design and assembly.

The flagship JBL 4365 Studio Monitor was first produced in 2010, setting new levels of performance by employing the 1501FE-8 15" woofer, a 476Mg high-frequency compression driver and horn, and an 045Ti -1 ultra-high-frequency compression driver and horn.

Now, the award-winning 4365 has been eclipsed by the new JBL 4367 Studio Monitor. The 4367, a result of further refinement of the design, uses a new version of the 2216Nd woofer as well as the patented dual-diaphragm D2430K driver coupled to a new patented High-Definition Imaging (HDI™) waveguide horn. The new 2216Nd-1 has been refined for a more articulate and defined low end, while the two high-frequency drivers of the 4365 have been replaced by the new, patented D2430K dual-diaphragm driver and HDI™ waveguide horn for increased output capability and to match the low frequency power compression in the high frequencies. The D2430K also now lets the 4367 produce high- and ultra-high-frequencies from a single coincident source, improving the imaging capabilities of the system.

Although this may sound like the JBL 4367 is solely a professional monitor, but its accuracy, lack of power compression, and enhanced imaging make the 4367 a perfect choice for critical listening in 2-channel audio systems or for the LCR speaker system in a high-performance multi-channel home theater installation. Enhanced components used in the crossover for frequency division as well as for making connections help ensure audiophile levels of performance, while the attractive walnut and black walnut wood veneer enclosures allow the 4367 to blend in at home.

# SYSTEM OVERVIEW

In the 1950's and 1960's, JBL built mainly 2-way systems with a 12" or 15" woofer crossed over to a large-format compression driver/horn combination. The 4367 is a return to that tradition. Similar to those highly acclaimed speaker systems, the 4367 has a crossover at a single frequency, away from the most sensitive frequency band of human hearing.

Although this seems a very simple system, it is in fact simplicity at its best – the compact, symmetrical system with a single crossover is characterized by a compact acoustic focus point with exemplary control of its off-axis energy.

Fig. 1: JBL 4367 See-through front view

The acoustic components are housed in a traditional JBL Studio Monitor series-style of cabinet with a clean, professional design. The heaviest component of the design, the cabinet has 1" thick MDF walls and an additional 5/8" thick surface baffle below the horn for a total 1-5/8" thick massive and unmoving support for the woofer. Rigidity is further enhanced by the use of two varying braces connecting all of the vertical panels. The cabinet, with beveled front edges is available in a furniture-grade walnut finish wood veneer or black walnut wood veneer.

Although the 4367 is a two-way speaker, the innovative crossover provides front-mounted controls for both high-frequency and ultra-high-frequency ranges. Rear gold-plated connections are provided for bi-amplification or bi-wiring through the separate networks, but heavy-duty jumper wires are provided for single-amplifier usage as well. The natural roll-off of the woofer is extended by two 4" diameter, dual-flared ports, front-mounted for more impact.

The grille, designed to be very open and have minimal effect to the 4367's acoustic response, is bowed for more rigidity, resulting in a very light and easily removed grille. The 4367 has four low-profile feet made of three solid pieces of black-chrome-plated brass: a glide, a point that threads into the glide, and a cup to protect fine flooring.

Fig. 2: JBL 4367 See-through rear view

But without transducers, the cabinet and all attached can make no sound.

# Transducers

## The Woofer

The woofer used in the JBL 4367 is JBL's latest version of one our most advanced woofers, the 2216Nd-1. The 2216Nd-1 is a 15" (380mm) cast-frame woofer with Aquaplas-treated Pure Pulp cone that uses the latest Differential Drive® motor system.

The Differential Drive® motor system is a powerful dual-voice-coil, dual gap system for high efficiency and better control of the moving parts, resulting in lower distortion than common woofers. This motor also employs shorting rings, a flux-stabilizing ring, saturation tips, and a heat-conducting ring for one of the most linear motors with high power handling that JBL makes.

The dual 3-inch voice coils are made using a patented wire application resulting in a very low thermal response of the voice coils to applied power. This results in much less of the output-robbing power compression of conventional speakers.

To keep the assembly small and light, the 2216Nd-1 uses a neodymium magnet system. The 2216Nd-1 also sports a lowered resonant frequency compared to the 2216Nd, to take more advantage of the JBL 4367 cabinet volume and tuning to produce a more articulate and defined bass region. This adjustment to the edge treat also reduces break-in period.

The woofer is covered by U.S. patent nos. 5664023, 5748760, 6768806, 6847726, and 6774510.

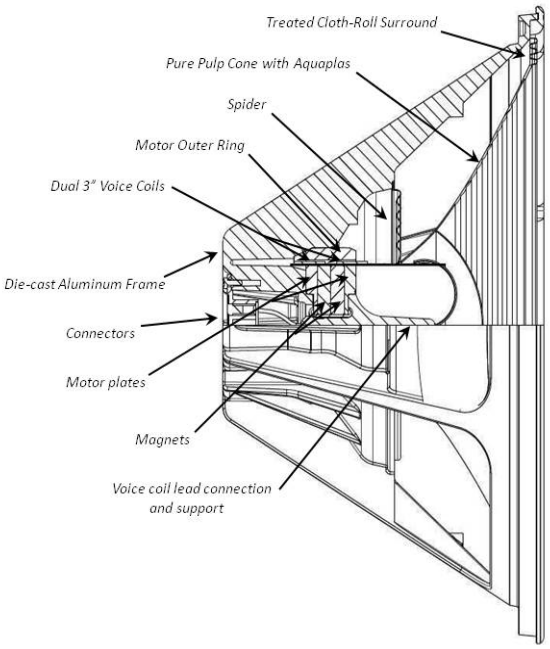



Fig. 3: JBL 2216Nd-1 Section View

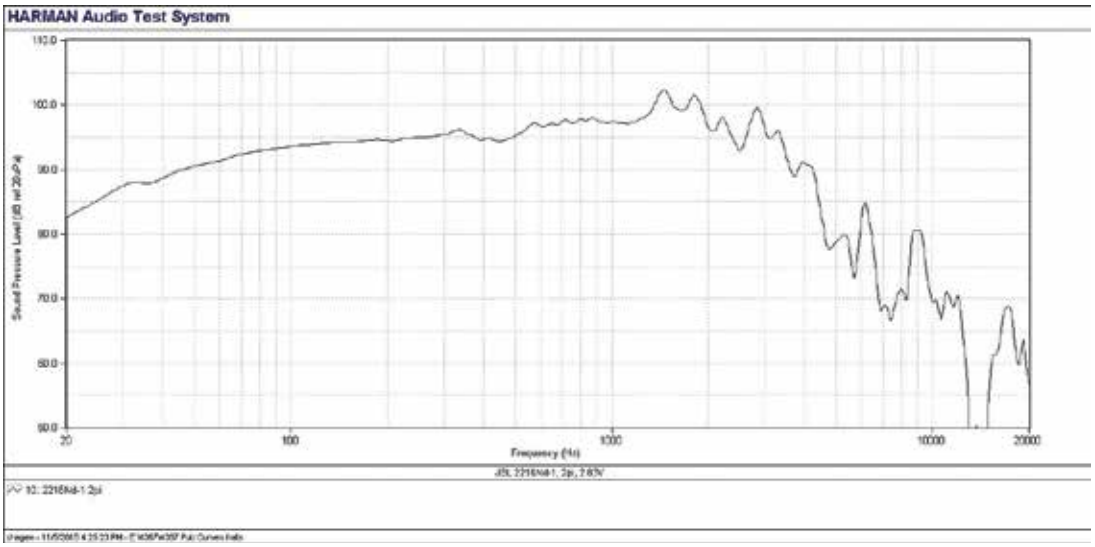



Fig. 4: 2216Nd-1 2pi curve

| 2216Nd-1 parameters | |
|---|---|
| Flux density | – 0.934 Tesla for each of the two gaps |
| Bl product | – 18.9 T-m |
| Voice coil resistance | – 5.2 Ohm |
| Voice coil winding length | – 0.8 inch for each of the two coils |
| Free air resonance | – 28 Hz |
| Peak-to-peak linear excursion | – ~20 mm |
| Magnet structure weight | – 1520 gm, High-Efficiency, Lightweight Neodymium motor |
| Sensitivity | – 94 dB, 150 – 250 Hz |

## The HF driver and Horn

The high frequency driver of the JBL 4367 Studio Monitor is the D2430K Select. This is a relatively new high output compression driver that has two very light annular polymer diaphragms, instead of the single diaphragm of most compression drivers. The two diaphragms have the same radiating area of a single-diaphragm 3" compression driver but have a much lower mass-to-motor force ratio. The reason it is designed this way is to optimize the two diaphragms to allow the 3" driver to produce more high frequency output than a typical 3" compression driver. Using two diaphragms also helps to smooth and extend the response as well.

Each diaphragm has its own associated voice coil and neodymium magnet structure. Having dual motor systems brings more benefit to the D2430K – more than double the normal power handling, higher efficiency, higher maximum output, and lower distortion. The higher maximum output translates into increased dynamic headroom, while having the two motors to dissipate power as heat quickly reduces power compression.

The novel D2430K is covered by U.S. patent no. 8280091.

To properly control its dispersion, the D2430K is attached to JBL's newest High-Definition Imaging (HDI™) waveguide horn (U.S. patents pending). This horn is of a revolutionary design that properly controls the frequency response both on- and off-axis for a balanced and neutral sonic reproduction, resulting in not only realistic character of musical instruments and human voice, but a three-dimensional sonic image as well. The size of the horn is such that these characteristics apply all the way down to the 700 Hz crossover to the woofer section.

The low-profile HDI™ waveguide horn is exposed proudly above a removable grille that covers the woofer on an iconic JBL Studio Monitor series blue baffle. The horn is made of BMC, or bulk molding compound, an extremely dense and acoustically inert composite.

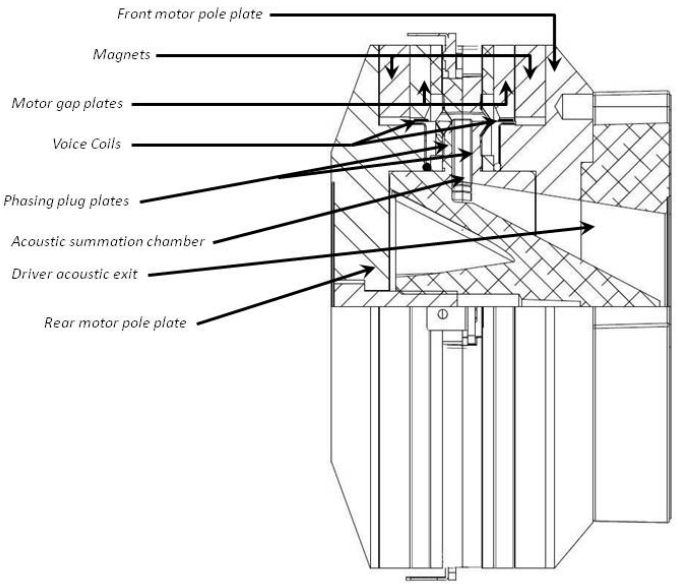



Fig. 5: JBL D2430K Section View

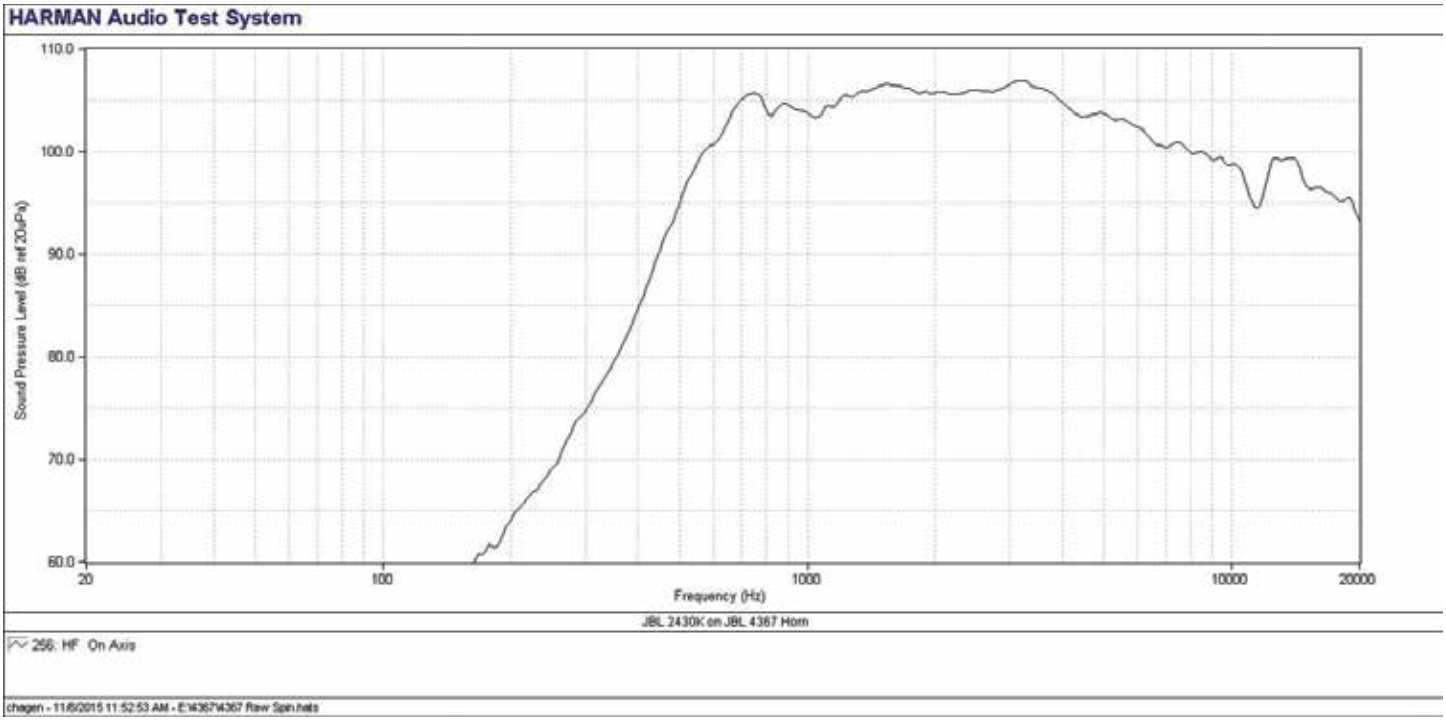



Fig. 6: D2430K driver frequency response on 4367 horn

| **D2430K parameters** | |
|---|---|
| Voice coil resistance | – 16 Ohm total |
| Voice coil winding length | – 0.125 inch for each voice coil |
| Mass of moving system | – 0.95 gm total |
| Impedance | – 16 Ohm |
| Bl product | – 10.0 T-m |
| Sensitivity (2.83V @ 1m) | – 104 dB, measured on the 4367 horn |
| Weight | – 5.1 lb. (2.3kg) |

# System Integration

Even having exemplary transducers does not make a fine speaker system – a properly designed crossover to integrate them is needed for proper blend and operation.

The 4367 Studio Monitor crossover, combined with the acoustic behavior of the 2216Nd-1 woofer in the cabinet and D2430K driver with the HDI™ waveguide horn, gradually and smoothly blends the two sections of the speaker. Along with creating the crossover at 700 Hz, the passive network also performs minor acoustic shaping as well as provides the HF and UHF adjustments for the D2430K compression driver.

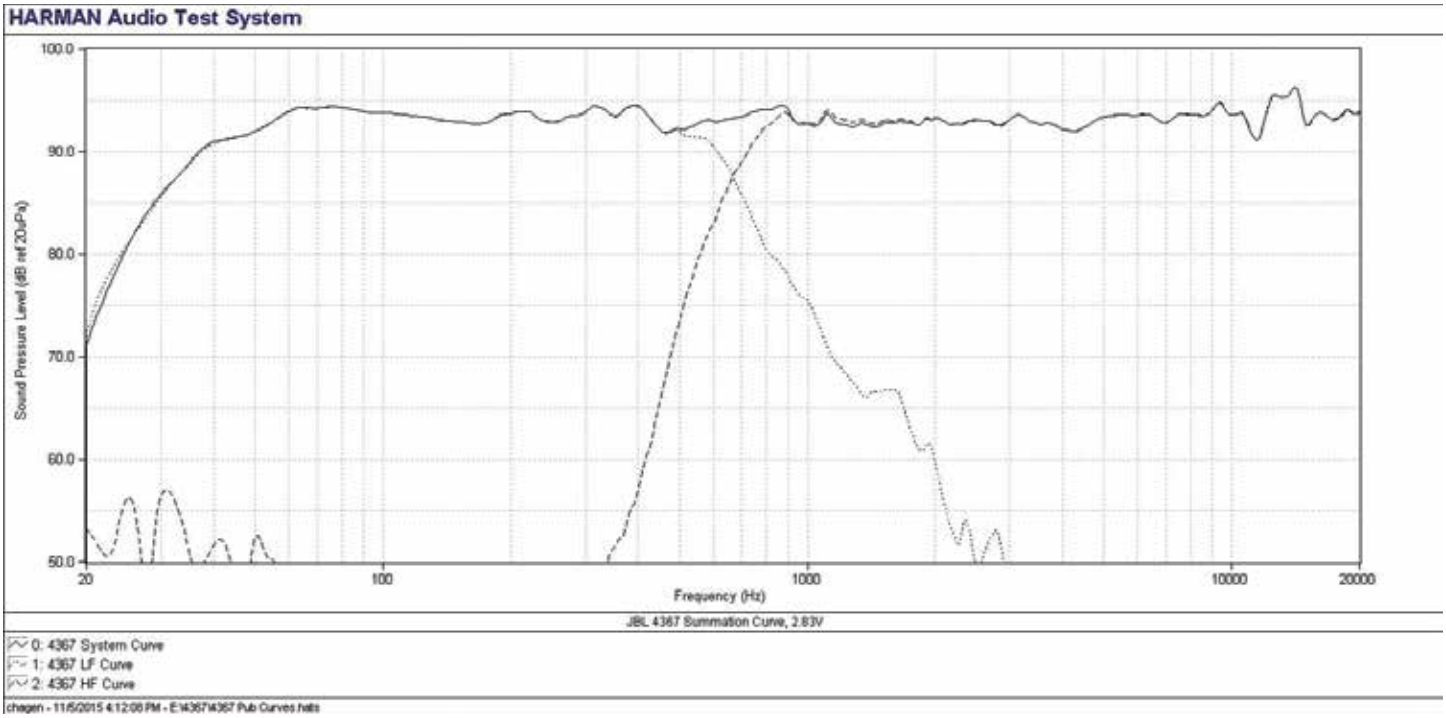



Fig. 7: JBL 4367 Acoustic Summation

The HF control provides adjustment from -1 dB to +1 dB in 0.5 dB increments from 600 Hz to 9 kHz:

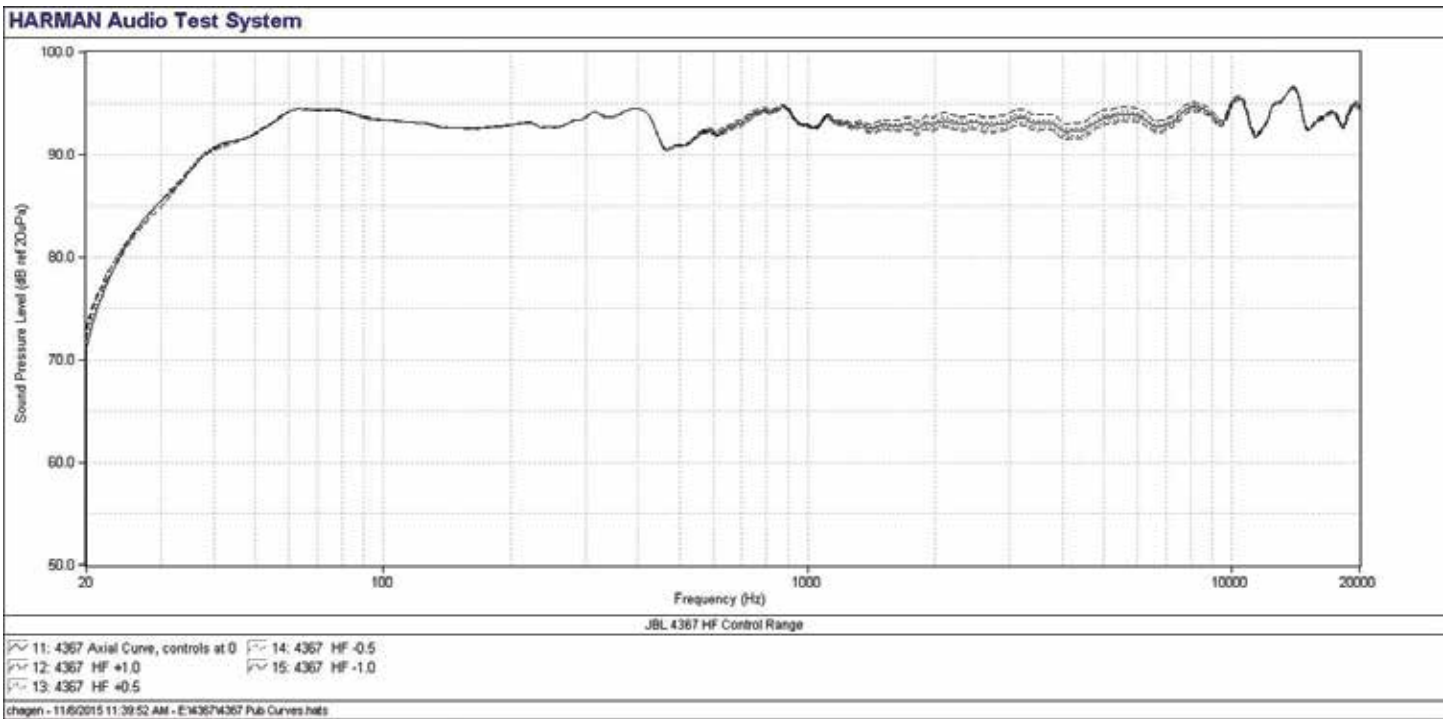



Fig. 8: JBL 4367 HF Control Range

The UHF control provides similar adjustment from 4 kHz to beyond 20 kHz:

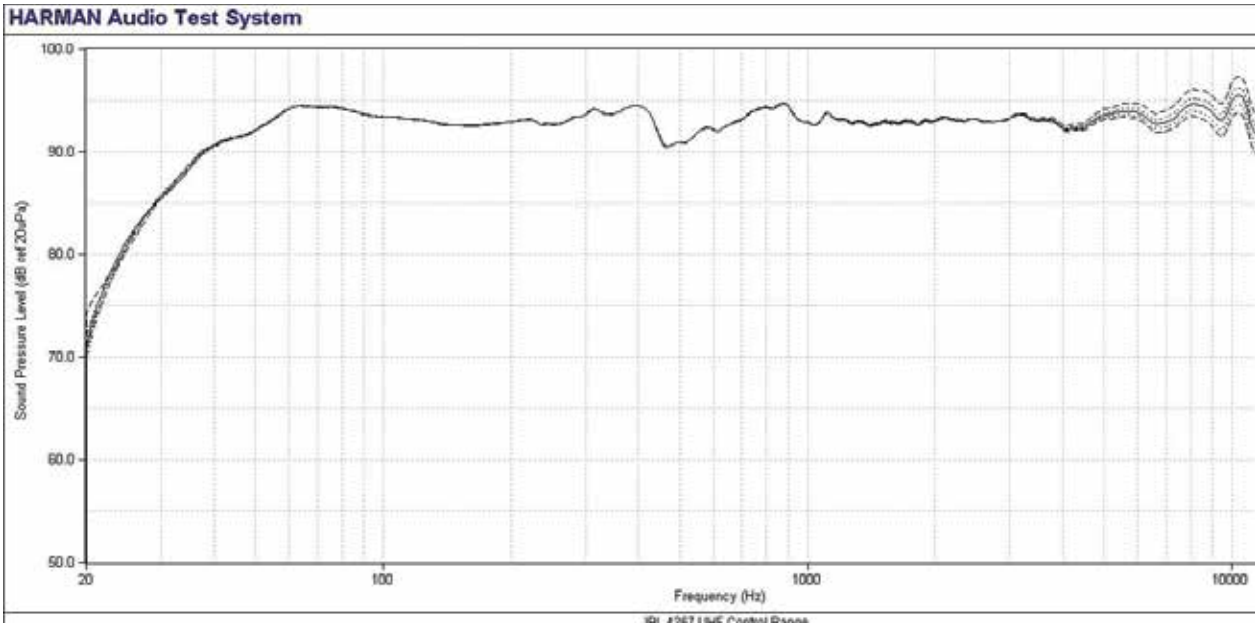



Fig. 9: JBL 4367 UHF Control Range

The crossover network is comprised of 2 individual boards – one for each transducer. They are optimized for each transducer and associated frequency range and separated within the enclosure to minimize any potential cross talk. Each crossover board has been designed for maximum headroom and to operate in an extremely linear behavior. All of the electrical components are of the highest quality and lowest internal loss. The inductors used are air core so as to not introduce nonlinear hysteresis effects. Capacitors are constructed using polypropylene foil, which is known for having minimal distortion caused by dielectric absorption non-linearities. All resistors carrying applied audio are selected for their superior sonic characteristics and are of wire-wound construction; they are also elevated on metal legs to permit significant airflow to minimize negative effects at high power.

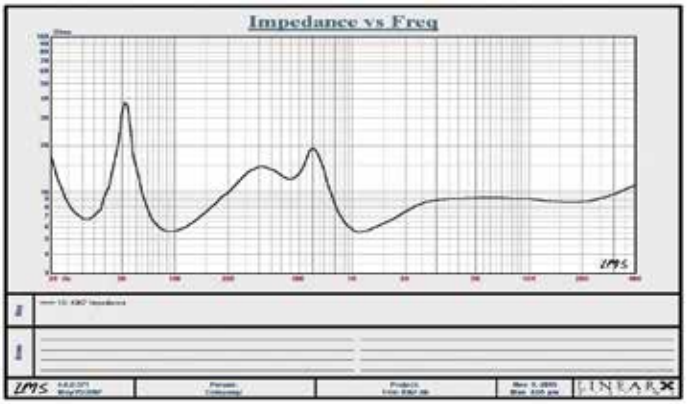



Fig. 10: JBL 4367 System Impedance

The networks also employ DC voltage bias to operate the capacitors effectively in a Class A mode. DC Bias for the 4367 Studio Monitor is accomplished using a diode charging circuit internal to the crossover network and driven by the applied signal, so no additional external power is needed for this feature.

The biasing of the capacitors is done through a diode that creates DC voltage from the input signal, and a large value resistor to isolate the diode from the input and limit the current drawn. This keeps the charging circuitry from affecting the audio signal in any way.

Each capacitor position is actually made up of two capacitors connected in series. The voltage generated from the resistor and diode combination is applied to the center connection of the two capacitors. This produces a voltage potential between the two plates within the capacitor. When the two parts are taken as a whole, there is no DC voltage that appears across them, but individually they are each biased. The sonic result of the biasing yields an increase in detail, increased smoothness and considerably more natural decay of sounds within the music.

The terminal cup carries two red and two black 5-way gold-plated binding posts for input to each of the crossover boards. The 4367 is shipped with large effective gauge jumper wires; one between the two red terminals and one between the two black terminals. In this configuration, the 4367 can be driven by a single amplifier channel. However, should it be desired, these jumpers can be removed and wires can be run to each input from a single amplifier channel (bi-wire operation) or wires can be run to each from two separate amplifier channels (bi-amp operation) can be employed. Since each crossover carries its own capacitor DC bias circuitry, use of the 4367 in either bi-wire or bi-amp operation modes does not defeat the capacitor DC bias feature. The bi-amp and bi-wire operations work with the applied amplifier(s) powering the drivers through the crossover boards.

## Conclusion

From all of this, we can see that the JBL 4367 Studio Monitor is a very well and carefully thought out speaker system. Quite a bit of thought has been applied to every component of the model, whether you consider the bi-amp/bi-wire-capable terminal cup, the highly braced and solid cabinet, the high quality advanced crossover network, the cutting-edge-technology woofer and compression driver, or the patent-pending horn design.

This level of quality is seen directly in the power compression curve. Power compression is the phenomenon of a speaker system not playing as loudly as one would calculate from the applied power. It translates to a frequency response that varies with level. One can see from the power compression curve that the 4367 is exemplary in this regard, with frequency response staying the same at levels up to 110 dB at 2 meters.

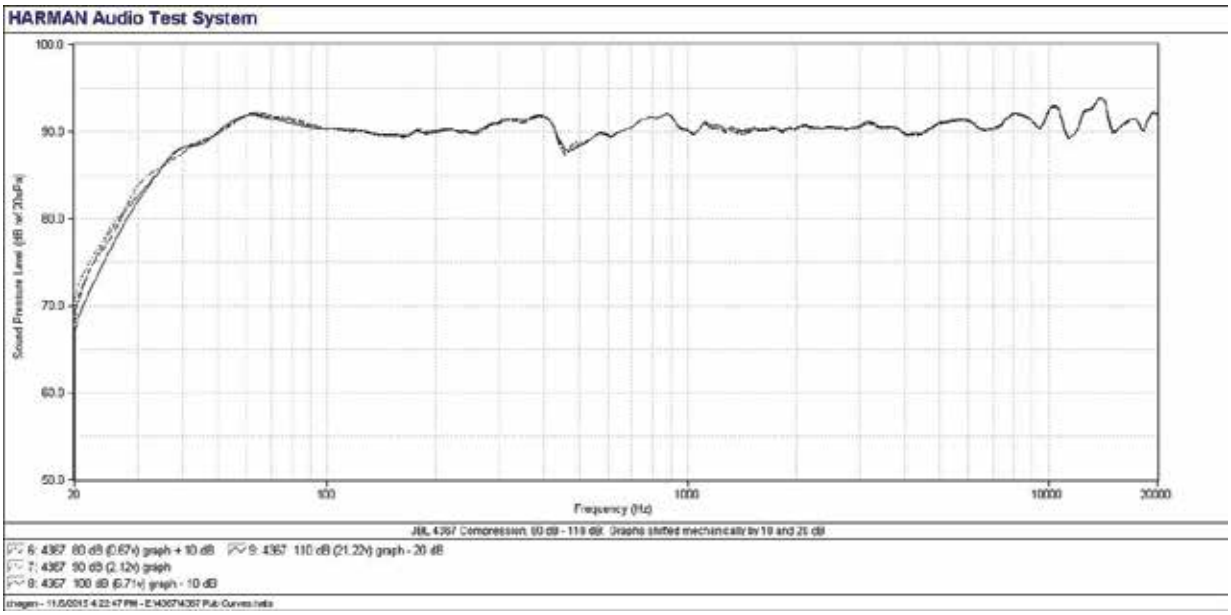



Fig. 11: JBL 4367 Compression – ~90 dB-normalized 80, 90, 100, and 110 dB, 2m curves

As we can see, capable of tremendous acoustic output, the design intent of the JBL 4367 Studio Monitor is to be completely linear in every way up to their maximum level. Within this operating range there are no appreciable changes in any measured parameter of the system. This enables the system to sound the same regardless of playback level.

Further, the distortion is very low, as the 2216Nd-1 woofer and D2430K compression driver are both designed to be absolute minimum distortion drive units. This trait translates directly into a very low distortion system, see Fig. 12.

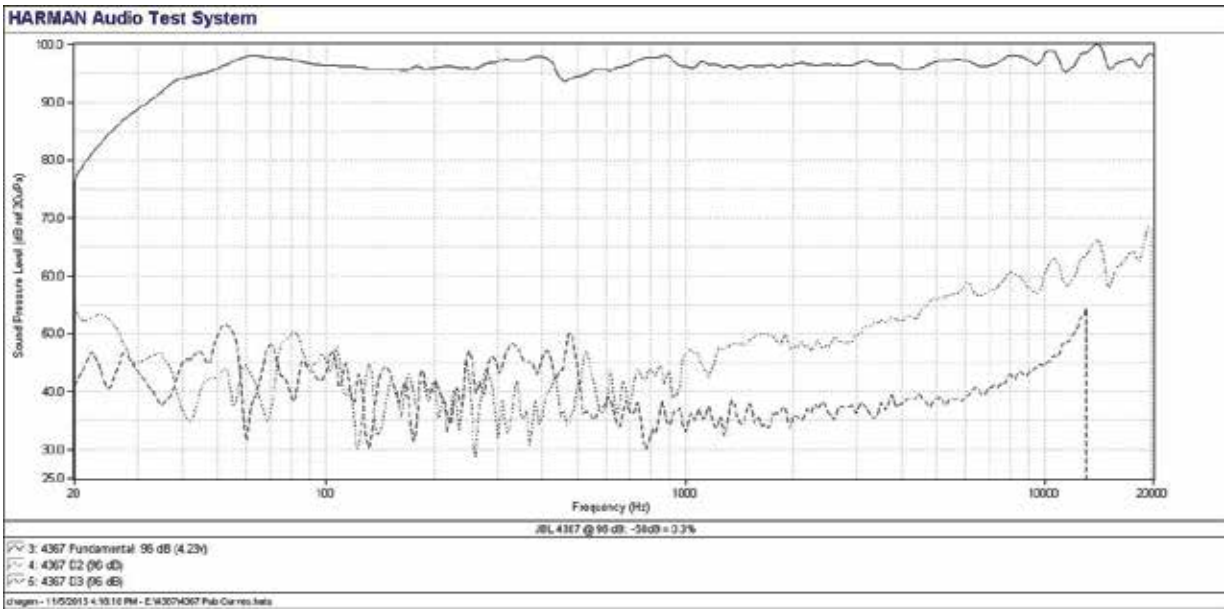



Fig. 12: JBL 4367 Distortion measurement at 96 dB

From these system measurements, it can be seen that the design target for the JBL 4367 Studio Monitor was achieved: producing a high output, low distortion speaker system with very little power compression. The 4367 is definitely a model that is engineered to deliver accurate sound and show with their performance why they are the top of the line of the Studio Monitor series.

## System spec list

Speaker type: 2-way Floorstanding Loudspeaker

Alignment type: Bass-reflex via dual front-firing ports

Maximum recommended amplifier power: 300 watts

Frequency response (-6 dB): 30Hz – 40kHz

Bass response (-10 dB): 26 Hz

Nominal Impedance: 6 Ohm

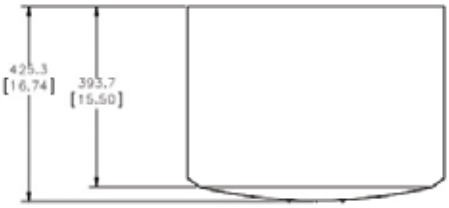
Sensitivity (2.83V@1m): 94 dB

Crossover frequency: 700Hz

Inputs: Dual gold-plated five-way binding posts for biamp and bi-wire capability

Dimensions (H x W x D): 37-1/16" x 22-1/16" x 16-3/4" (941mm x 560mm x 425mm)

Weight: 135 lb (61.2kg)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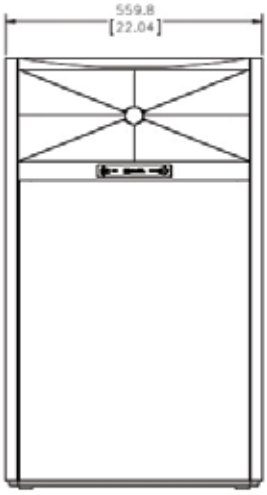
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