

The Ultimate Automobile Audio System

Using rigid, floating enclosures and adjusting the 'aim' of the speakers makes this audio system totally unique from anything available from a car manufacturer.

Jon Whitlege's primary goal when designing and fabricating the audio system was to achieve the finest possible musical playback quality within the automotive environment, preferably comparable in performance to the finest home audio systems; in fact, achieving sonic performance that approaches that of live music. The system was installed in a Dodge Sprinter van, which would accommodate what Jon figured would be one of the largest and heaviest systems designed for an automobile. Jon believed loudspeaker placement and aim were among the most important factors necessary to achieve these acoustic performance goals. Jon also believed that using the fewest number of transducers, thereby minimizing the number of crossover regions, would sound best.

These design goals resulted in the use of two sealed loudspeaker enclosures, one on each side of the dash, each containing two transducers. In order to dramatically reduce sympathetic vibrations, Jon isolated the enclosures from the dash and windshield so that they would "float" above the dash and avoid contact with the windshield. He used a variety of materials to maximize rigidity.

Considerable effort was expended to optimally aim the loudspeakers. With the transducers mounted on multi-way adjustable plates, a 17 run Box-Behnken experimental design was performed, which examined several key factors. The acoustical responses were measured and optimized both objectively and subjectively. This work, combined with further subjective listening and final adjustments, took over 300 hours. "The A-pillar mounted loudspeaker enclosures

provide for a very high and stable sound stage," Jon commented, "and the use of Dynaudio's tweeters and midranges beautifully anchored the front sound stage with astonishing clarity, detail, and imaging."

In typical automotive installations, large woofers and subwoofers are placed in the rear of the vehicle due to space limitations. Consequently, the front soundstage performance is compromised. Jon designed the front soundstage with the lowest possible frequency response. In order to accomplish this goal, and properly integrate the midbass and bass frequencies, sealed enclosures were designed for each door. Each enclosure contained a powerful, Dynaudio woofer, optimally positioned relative to the tweeters and midranges. The enclosures were mounted to the door using rubber isolators.

"The door-mounted loudspeaker enclosures virtually "disappear" into the sound stage and creates the illusion that instruments, such as the kick drum and upright bass, originate from a point in space well beyond the windshield," Jon said. "The Dynaudio woofers provided impressively tight, powerful, and well-controlled bass, adding a beauty and richness that integrated seamlessly with the midranges and tweeters."

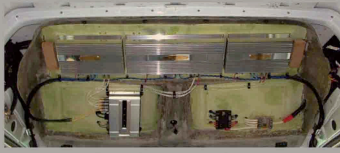
System layout was very important. The use of an overhead console for the electronics offered many advantages. First, the digital signal processor was mounted in close proximity to the amplifiers, reducing the length of the interconnects. Second, the amplifiers were mounted close to the loudspeakers, reducing the length of the loudspeakers' cables. Third, the components were arranged on the console to allow for easy access to fuses through access holes in the headliner. To minimize



View of the partially completed loudspeaker enclosures.



View of partially completed door enclosures.



View of partially completed overhead electronics console.

electromagnetic interference, the high-current carrying power wires were routed on the backside of the console. In order to accommodate the height (thickness) of the overhead electronics console, a completely new headliner was fabricated.

Component selection

Jon considered system design and component selection to be vitally important. With regard to system design, a fully active system with all signal processing performed in the digital domain would provide superior results in the automobile environment. Jon prefers playback systems based on two-channel stereo rather than other formats, so he selected each component in the audio system according to stringent performance and quality requirements. He chose the head unit and the digital signal processor from Alpine's prestigious F#1 Status product family. Alpine's DVI-9990 head unit, capable of playing DVD-Audio, DVD-Video, CD, WMA, and MP3, was connected to Alpine's



View of the completed headliner.

PXI-H990 digital signal processor using the factory supplied FireWire™ (IEEE-1394) cable. Jon stated, "The Alpine head unit and processor are extraordinarily designed and offer unparalleled tuning capabilities. The PXI-H990 processor allowed for the creation of a truly state-of-the-art two-channel, four-way audio system with total and independent control over each transducer

in the digital domain. The user-interface provided by the DVI-9990 head unit made programming the PXI-H990 simple and effective."

For audio signal amplification, Jon chose Genesis amplifiers, specifically the Dual Mono and Dual Mono Xtreme models. The amplifier architecture consists of two single channel amplifiers ("monoblocks") housed in one chassis. Each channel of the amplifier is dedicated to a specific transducer. Therefore, the front sound stage is comprised of six transducers, each driven by an amplifier channel and each controlled by a digital signal processor channel. "I chose Genesis amplifiers for my fully active audio system because of their dual mono architecture, superb design and build quality, and stunning sonic performance," Jon said.

For audio signal transmission, he chose interconnects and loudspeaker cables manufactured by Kimber Kable, and various signal connections (spade plugs, banana plugs, RCA connectors, and binding posts) manufactured by WBT. According to Jon, "Kimber Kable's products have an outstanding reputation in the audio industry, particularly their KCAG interconnects, which use pure silver conductors." For 12-volt power transmission cables, Jon chose Radix Wire's Sil-A-Blend™ power cable, which is insulated with layers of silicone and fiberglass and rated for continuous usage at 200 °C.

Competitive specifications

The audio system includes a subwoofer system for two reasons. First, competitive organizations require frequency response down to 20 Hz, and second, they impose a minimum loudness requirement of 135 dB. Failure to meet these criteria results in reduced scores. Although generally opposed to the use of a subwoofer in a high-fidelity audio system, Jon set out to design and build a unique subwoofer system, capable of "filling in" the bottom octave and appropriately integrating with the front sound stage. He used the remaining two channels of the PXI-H990 to feed the audio signal to a Genesis Dual Mono Xtreme amplifier. The left and right channels were internally summed and amplified in mono, which allowed the Genesis amplifier to deliver 1000 W (Watts) to a loudspeaker impedance of 2.67 Ohms. A minimum of three Dynaudio MW190 subwoofers were used to achieve a loudness of 135 dB.

The isobaric configuration was implemented by placing a pair of subwoofers face-to-face, and wiring one of them out of phase. The benefit was a 50% reduction in the required enclosure volume and improved performance with no loss in efficiency. The subwoofer system remains to be completed, "...but the use of the isobaric configuration should result in excellent sonic performance," Jon said. The Alpine PXI-H990 will allow him to program into memory two different tuning parameters, one set of parameters for sound quality and a second set for maximum loudness.

Jon believed the overall sonic performance of the



View of the partially completed subwoofer

system would be greatly enhanced by using sonic treatments and damping materials. He measured and analyzed the acoustic properties of the van and implemented appropriate treatments to reduce road noise and improve interior acoustics. Products were chosen exclusively from Cascade Audio Engineering, a premier manufacturer of damping materials and acoustical treatments. The interior metal panels were treated with V-Max, while the inner metal door skins were treated with VB-2. During the process of fabricating the fiberglass loudspeaker enclosures and headliner, VB-FD was incorporated to provide internal damping. The loudspeaker enclosures will be internally coated with VB-IX, and treated with Deflex Power Pads. Jon commented, "Cascade Audio manufactures innovative, high-quality, easy-to-use products, which substantially reduce road noise and improves the performance of my audio system."

To further reduce road noise, improve thermal insulation, and improve interior acoustics, the interior cargo area of the van was entirely treated with Echo Eliminator Composite™ panels manufactured by Acoustical Surfaces, Incorporated. The interior walls of the cargo area will be treated with Sound Silencer™ wall panels. Jon said, "Acoustical Surfaces' wall panels use intrinsically safe materials such as cotton or polypropylene in innovative ways to achieve excellent sonic performance, and were the perfect compliment to Cascade Audio's products."

For More Information:

Whitledge Designs Home:

<http://www.whitledge.com>

Dynaudio's Home: <http://www.dynaudiousa.com>

Alpine's Home: <http://www.alpineusa.com>

Genesis' USA Distributor's Home:

<http://www.theautophile.com>

Kimber Kable's Home: <http://www.kimber.com>

Radix Wire's Home: <http://www.radix-wire.com>

Cascade Audio's Home:

<http://www.cascadeaudio.com>

Acoustical Surfaces' Home:

<http://www.acousticalsurfaces.com>