Installation and Tuning guide.
USD Audio WaveGuide™
A & BC Series RotoMounts™

Congratulations! You have just purchased the most award winning and realistic sounding Loudspeaker system for the automobile environment.

The information included in this guide has been designed to help you get the most enjoyment and listening pleasure possible out of your new USD Audio WaveGuide™ loudspeaker system. It is important to us at USD Audio™ that you have the best experience with our product and service. Should you have a need concerning the installation and use of this product do not hesitate to call USD Audio at 714-997-2475. We will give you prompt, courteous information and help.

We are always interested in improving our products, so please share with us any ideas and experience that you have while installing and listening. We enjoy sharing your pride and fun in car audio.

Safety disclaimer and other legal mumbo-jumbo:

The USD Audio WaveGuide is designed for underdash installation in most vehicles. Make sure your installer has car audio installation training and experience. If you are going to install them yourself, make sure and take advantage of our technical services if you have any questions or trouble. The installer must understand safety associated with car audio installation. Under no circumstance should the WaveGuides be installed so that they could interfere with the safe operation of the vehicle's brakes, clutch or accelerator. Do not allow an installer to remove or disable ANY safety device or the emergency brake. Your safety and the safety of the people and property around you is important to USD Audio. USD Audio accepts no responsibility for installation quality or safety.

Assembly:

The RotoMount™ series WaveGuides are easy and fun to assemble. The kit comes with 2 large Guide "Bodies", 2 "Heads", 2 motor mounts, 2 Clamps, 2 compression drivers (the big heavy metal things, also called 'motors' or 'drivers') and a hardware packet. Install the Heads onto the 'Neck' of the WaveGuide Bodies. The slip-joint will be tight fitting. To help make it easier, check that the edges of the neck and the base of the head where the neck fits into it are free of any debris and flashing. Once you have fit the head to the body, slip the clamp over the neck joint, so that the bolt holes in the clamp line up with the bolt holes in the head. Now for the fun part. Go ahead and do it. Everybody does. Put the WaveGuides up to your ears and listen to the noises that surround you. You will hear details that up to that point have escaped your normal listening. This will also allow you to get a feeling for the dispersion pattern of the WaveGuide. The loudest sounds will be within a 120 degrees area in front of the mouth of the WaveGuide. Ok, now that you have had fun with that, you can talk through the Guide now and in general make as much noise and silliness as you like.

Mount the motor onto the head of the WaveGuide with the hardware from the hardware packet. We are now ready to start the installation.

Note #1: Once the WG bodies are installed, and you have decided on the position that the head will remain in, you will need to trim a small area of the locking ring on the body. You will notice that the ring stands above the mounting deck of the head. You can use clippers or sand off the extra height to make the ring flush to the mounting deck height. If you do not do this, the Motor will not seal onto the WG properly and you could damage the Diaphragm. This type of damage is not warranty.

Note #2: Removing the motor from the body during most of the mounting process will make handling the Guide easier.

Orientation:

With RotoMount, WaveGuides provide maximum flexibility and ease of installation. The RotoMount allows the compression driver of the WaveGuide to be angled in any position in a 360-degree radius, without any affect on sound reproduction. Always check for foot and peddle clearance when you select the mounting position.

The USD Audio WaveGuide is designed for underdash installation in most vehicles. The neck and head of the Guide goes along the kickpanel, with the Mouth of the Guide facing out from under the dash, toward the listener. In most cases, the guides should be positioned as far outboard as possible, without interfering with the safe operation of the vehicle (remember SAFETY FIRST).

Important: Keep the Motor and throat of the Guides clean and clear of debris. The magnetic structure of the A & BC motors are very powerful and they will suck all kinds of metal filings into the motor assembly, damaging the voice coil. This type of damage is not covered under warranty. Also, protrusions inside of the Guides throat and mouth can affect performance.

Installing the WaveGuides symmetrically is not mandatory. This is good, because many vehicle dashes are not the same height, depth or shape on the left and right. Excellent results are achieved with the left and right WaveGuides in slightly different mounting positions.

Mounting:

The Guides must be mounted solidly. Some professional installers will build a shelf or frame attached to the dash to support the mouth. One of the easiest and most effective methods of mounting the Guide is to attach them to the underside of the dash from three mounting brackets. Two brackets, one on each

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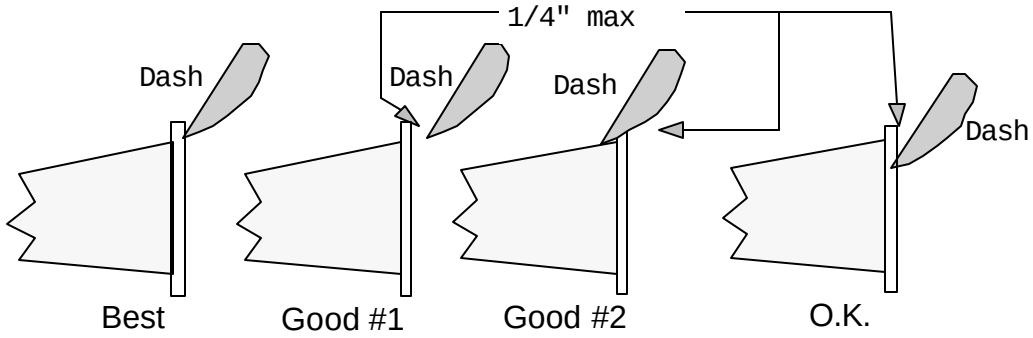
WaveGuide to Dash Relationship.



side of the mouth of the Guide and one bracket to support and mount the weight of the motor assembly.

Make the brackets out of strips of either aluminum, tin, back strap material, light steel or even plumbers tape.

Flange: The flange around the mouth of the Guide should be used for improved mounting ease. The brackets can be attached via pop rivets or flat head screws to the flanges around the mouth of the Guide, the rear mounting boss or body of the Guide.

Important Note: If you need to mount the brackets to the 'body' part of the Guide, it is important to attach them with the flat or smooth head of the fastener on the inside of the Guide. Remember to keep the inside of the Guide smooth.

Find suitable mounting locations under the dash for you to screw the brackets onto. Many times you can mount them to the kick-panel and the console. Be very careful to select locations to drill that will not damage wiring or other vehicle devices behind the dash. Once you have found the best locations for attaching the brackets, bend the brackets to fit. Trim off excess of strips and mount.

The installer should trim the flange to contour it to fit the bottom of the dash (see illustration. above). This maximizes the Guides' acoustic coupling to the lower dash surface, thereby giving a lower cut-off frequency and the best possible vertical dispersion. Improving image height and staging width. Gaps and protrusions larger than 1/4" can affect performance. To help improve the junction, you may want to use a weather strip material to seal the mouth of the Guide to the dash.

Always maximize foot room clearance! If the WG seem to be **"Too Low,"** you may want to trim off the top and bottom flanges around the mouth of the WG.

In some cars, you can simply raise the WG behind the dash so that the mouth flows onto the the bottom of the dash, and in the **"Best"** illustration above. By raising the WG, you will gain about .75 inches, which does not sound like a lot, but it can make all the difference. If you cannot get the WG behind the dash board, you should trim the top flange like in the **"Good #2"** illustration. If the WG still seems "too low," trim off the bottom flange. This will give you another .5 to .75 inches of clearance. I have not seen a car that this has not been enough to fit and have excellent foot room.

The best and easiest way that we have found to trim the flanges, is to use a table saw with a fence. If you do not have a table saw, you can cut off the flange with a hand saw, or if you take a Scratch Awl or a sharp blade, you can "score" the back of the flange and snap off the flange. Make sure that you measure twice before you cut!

Console: In some vehicles that have center consoles, the mouth of the WG may appear to be too wide. Never fear, you can fit the WG's in a number of ways. Sometimes it is possible to put the tip of the WG mouth behind the console. If this will not work you can Cut up to 2 inches off of the tip of the WG mouth.

Mounting the Motor: You MUST support the motor with it's own bracket(s). Use the third bracket to support it. Drill slotted mounting holes into the rear mounting bracket. This way you can adjust the angle, and the relationship of the Guide to the lower part of the dash. Bend to fit and mount to the firewall, dash support or anything solid.

Aiming: The mounting angle of the Guide will be determined by the amount of foot clearance available. Remember to always allow more than adequate foot room clearance.

It is OK to point or aim the WaveGuides. They can be angled up or straight and/or left or right. To determine the best positioning, you will need to do some listening tests. Don't be afraid to experiment in this department. A lot of people do not maximize the performance of their Guides because they do not spend time on this.

A good starting point is to move the Guides as far out to the kick panels as possible. The wider out you can install them, the closer you will be to center stage. Angling them will not necessarily raise the height of the sound stage. Experiment with the angle up and the pointing in toward the center. Most vehicles will perform best with the mouth aligned with the under dash and the motor mounted slightly lower, pointing the Guides upward. The only way not to mount the Guide is pointing downward.

Making Grills:

Here are a few of the easiest ways to make grills for the WGs.

Method 1. Once you have fit the WGs to the vehicle, simply wrap the mouth area in a grill cloth using spray adhesive. This is the fastest and easiest, but not the prettiest.

Method 2. Use the "L" shaped Perforated Metal supplied with

the WG. Place the short 'L' part of the Perf metal on the top of the WG, and then bend the bottom under the WG to have it "clamp" onto the the mouth of the WG. Wrap in grill cloth and snap back on. You can use double sided tape to make that more secure too.

Method 3. Start the same as with Method 2, but instead of bending the bottom under the WG, take a marking pen and draw a line along the bottom of the WG. Remove the Perf metal and cut along the line. Now the Perf metal grill should be the same height as the mouth of the WG. Wrap the grill in cloth an use double side sticky tape attach it to the front of the WG.

Method 4. Go custom. For a complete set directions on doing this, call us at 714-997-2475 and we will mail it out to you!

Important Note:

You MUST use acoustically transparent grill material...not just visually transparent. Remember, just because you can see through it does not mean that it passes sound.

Crossover for the WaveGuide.

The minimum recommended crossover frequency for any power condition is around 800Hz. Below this frequency the WaveGuide / dash combo may not provide proper loading of the driver and will damage the driver. This type of damage is not warranty.

Minimum recommended x-over slope is 12 dB per octave. Higher order x-overs are recommended to minimize interaction between the midbass and Guide, improving clarity, phase cohesion and reliability.

We Recommend crossing the WaveGuides at 800 Hz. We do not recommend crossing these drivers any lower.

We also offer a Passive X-over system called the PX-BC. The PX-BC is a 2-way passive x-over with a center frequency of 775Hz. The PX-BC has built-in Equalization, Impedance compensation and Attenuation for the WaveGuide to improve the frequency response and sound. The PX-BC is available separately or in our WaveGuide component systems, the USD B-62 and the USD B-82. The PX-BC allows you to hook up a 5, 6 or 8 inch woofer to the WaveGuides and create an incredible 2-way speaker system.

If you are using all active X-overs for your system, you will want to add the USD Audio WaveNet to the signal path. The WaveNet is a Low level WaveGuide normalization network. It is not a Crossover. The WaveNet helps to smooth the frequency response of the A and BC model WGs.

Tuning tips by Eric Holdaway.

Make sure that all of the speaker in the system are working.

Setting Crossover Frequency: In systems using Active x-overs, you need to accurately set the x-over frequency. Meaning, just because the Knob or the X-o chip says "800 Hz" that does not always mean that it is really working at 800 Hz. By following this test, you can know, absolutely, what frequency you are crossing over at.

The best way to do this is with a Real Time Analyzer (RTA) and pink noise. This method will work on all of your speaker systems for dialing in the exact freq. that you want.

Note: Do NOT change the volume of the signal once you have started this test.

Using pink noise and the RTA, play only the WG's at a low volume, full range or at least down to 400 HZ.

Important Note: Do not play the WG's above 80dB during this test!!! You may damage them from over excursion and this type of damage is NOT warranty.

Measure the freq. response of the WG on the RTA. You need to record the SPL level at 800 Hz. For this example, let's say that at 800Hz the SPL measures 90 dB. Start raising the x-over freq. The object is to raise the x-over freq. until you get a 3 dB reduction at 800Hz. When the SPL reading for 800Hz goes down to 87dB, you have set the x-over freq. for the high pass to the WG at 800 Hz. You should do this for all of the speaker in the system to make sure that you are accurate on all of the x-over Frequencies in the system.

Once you have all of the X-over frequency selected, adjustment the gains on the x-over and amps to achieve the flattest frequency response possible.

Phase relationship: Next, check to insure the proper phase relationships between the drives, ie. WG to midbass / midbass to subwoofer. You do this by playing the entire speaker system and looking at the x-over frequencies on a RTA and see if there is a dip in the response curve at the x-over frequencies.

Example: Let's say that you have selected 100 Hz and 800 Hz as your crossover points. When you measure the curve on the RTA, you have a dip at 800 Hz, but not at 100 Hz. In this example the WaveGuides maybe "out of phase" with the midwoofers.

To test this and correct the dip you want to do the following. Do not change the volume level of the system. Note how loud the 800 Hz level is on the RTA reading. Reverse the polarity of **both** Guides and remeasure the loudness of 800 Hz. If the 800 Hz level is now louder than the previous measurement, then you have improved the relative phase between the two pairs of drivers. If 800 Hz is less loud, then the relative phase is worse and you should return to the original wiring. This test is valid for all speakers.

Equalization: Any equalizer is usable with the WaveGuides. Even a 7 band in-dash will yield surprising performance. Especially when you are using the PX-BC or the WaveNet.

The more bands of equalization that you have, the more you can control the response curve. For show cars and competition, I recommend the use of a third octave equalizer, with separate left and right equalization controls, but any equalizer is useable.

When using an equalizer, be moderate on boosting frequencies. It is possible to over boost a frequency and add distortion. Always start by cutting the peaks first. Then boost a little to fill in the valleys. Always look for a smooth, and even slope. Now, if you are seeing a dip/hole at 500Hz, 630Hz and/or 800Hz, do not be tempted to boost those levels more than a

couple of dB at the most. First, try moving your microphone around. In most cases you will see these frequencies fill in. These dips are usually not really there, but are artifacts of a one microphone measurement.

If you do boost theses frequencies, in most cases you will degrade the sound quality, imaging and run the risk of damaging the Guides voice coils. So, before you add into any of these frequencies, listen to the sound, then change them and relisten.

Once you have a nice curve on the RTA, I just about turn the RTA off. The sound is more important than the shape of the curve. You need to start listening and start "peek'n & tweek'n."

This is where having left and right eq's really gets useful. By adjusting the eqs, you can improve the center image, and correct for differences in channel balance on a frequency by frequency basis.

Remember, tuning can be a time consuming, aggravating, and frustrating task. Take your time. Keep your adjustment small and only adjust one thing at a time. Use music that you are familiar with. I like to use a female vocal with open-clear instrumentation as my main musical format. You will achieve excellent result through experience -

I promise. EH.

Midbass locations.

Experimentation has shown that the best installation location for the midbass is in the front of the listening compartment. It is very important for the performance of the midbass to have an adequate enclosure and a large enough air volume to allow the midbass to work. If the enclosure is to small or to resonate, you will have very poor midbass clarity and definition. Several possibilities exists in the front of all vehicles.

The Doors are the easiest in most vehicles. You want to angle the midbass in the door up toward the center of the roof line as much as possible. Aiming the midbass can have a profound impact on the imaging and staging. If you are using large midbass drivers, you will want damp the doors well.

The kickpanel/firewall area, aiming toward the upper middle part of the roof. Try to "crossfire" the midbass as much as possible. For the most part, I have found that you do not want the midbass facing directly on axis for the best imaging.

One of the best locations for the midbass, is directly in front of the seat, on the floor, angled up toward the windshield. Yes, that would be under your legs. But, I have heard this location do a great job for sound. To get enough enclosure volume, you may need to build part of the enclosure under the floor of the vehicle.

If the midbass cannot fit into the Frontal area of the vehicle, then we recommend the rear side panels of the vehicle. The third choose for locating the midbass is the rear deck area.

Protection Circuit:

Below is a schematic of the WaveGuide protection circuit. It is a must to use these circuits in the speaker leads. The protection circuit is designed to AC couple the amplifier to the Guide and thereby eliminate any DC offset that the amplifier has (all amps have some DC offset.) These parts are available at most Radio Shacks or electronic supply store. The small 0.47mfd Polypropolyne cap is used as a By-pass cap. It will improve the performance of the larger cap. The Poly cap can be almost any

value. You could even just use a 50 mfd Polypropolyne cap if you could find one. If you do find a 50 mfd Polypropolyne, then you would **not** use the other 50 mfd cap.

These circuits are to help keep you from blowing the Guides up. They will not prevent you from blowing them up. That's in your control - it's called the Volume.

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