HYBRID AUDIO TECHNOLOGIES

Mirus-Series Coaxial Systems

Installation & Reference Manual

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Congratulations on your Mirus Coaxial System purchase, and welcome to the world of Hybrid Audio Technologies!

Welcome and Introduction
by Scott Buwalda - Founder

We realize that you have a choice in loudspeakers, and are thrilled that you have chosen the Mirus-series coaxial systems. For more information about Hybrid Audio Technologies, our philosophies regarding high-end mobile audio, to learn more about our lifetime guaranteed value program, and for information about our other products, please visit us at: hybrid-audio.com

Speaker development is our passion! When installed and set-up properly, the Mirus Coaxial System you have purchased will make a remarkable improvement in the sound quality of virtually any mobile audio sound system and give years of superior performance.

With the publication of this manual, it is our goal to assist the "do it yourself" enthusiast and professional installer alike in getting the highest level of performance out of Mirus Coaxial Systems using straight-forward installation advice.

Thank you, and happy listening!

Mirus Coaxial Systems

Your Mirus system contains speaker drivers and a tweeter passive crossover network that were developed and assembled with a significant effort in research and development, materials science engineering, an exhaustive level of sampling and prototyping, real-world testing, and obsessive attention to detail. The specifications and parameters of your Mirus coaxial system is detailed on these pages.

Midbass Attributes

Mirus M4, M5, M6, M57, & M69

Frame

Stamped and powder-coated steel. The basket is a high-quality stamped steel design, which plays a critical role in aligning the voice coil in the magnetic circuit. The frames are proprietarily tooled by Hybrid Audio to allow for the inverted mounting of the surround, discussed in detail below. The stamped steel frame provides adequate clamping force in relation to its mass, and ensures that the voice coil remains centered in the former.

Cone

Pressed paper with water proof treatment. It is widely acknowledged that pressed paper cones are the best marriage of lightness, stiffness, and ability of the cone to damp unwanted cone and edge modes and resonances (read: distortion). The paper cone, known for its excellent sonic attributes, is water proof, thanks to a polymer developed exclusive and proprietarily by Hybrid Audio Technologies. The treatment does not change the look and parameters of the driver like old-fashioned "glossy" polymers which added an appreciable amount of moving mass and significantly colored the sound. No, the Mirus cones look like any "normal" paper cone, but in reality are likely the only high-performance water proof paper cone car audio speaker systems on the market. The treatment protects the cone from periodic drips (such as inside a door panel), as well as accidental splashes to the front of the cone. On the hybrid-audio.com website, we have hosted a video of an actual water-proof demonstration where we pour two liters of water over an Imagine coaxial (sibling to the Mirus coaxial that uses the same cone topology), and then connect it to a musical source. That video may be viewed at: http://hybrid-audio.com/imagine/

Tweeter Pole Piece

Cast ABS plastic. The tweeter pole piece is ABS and effectively places the tweeter forward of the cone, centered, for optimal operation. The pole piece contains a unique swiveling feature to allow for aiming of the tweeter.

Surround

Inverted high-loss rubber surround. The inverted high-loss rubber surround (in concert with the spider, detailed below), helps to provide the compliance and "restorative force" needed for the Mirus drivers to play effectively into the lower coaxials, and perhaps even upper subbass frequencies (depending on in-car cabin gain and other factors). You'll also know a Hybrid Audio midrange and coaxials design by its inverted surround; this design feature allows for the use of a smaller height grille, better clearance with OEM panels, and more flexibility in mounting options. The inverted surround is a Hybrid Audio exclusive in automobile loudspeakers.

Spider

Phenolic fabric and tinned tinsel leads. The spider is the brownish/yellow corrugated (rippled) fabric that attaches the cone and voice coil. The spider for the Mirus designs was the subject of a considerable amount of our research and development. The spider is a phenolic symmetrically-rolled fabric which provides excellent restorative force during excursion. The tinsel leads are connected to real epoxy PCB, not flimsy cardboard, unheard of in the price range of Mirus.

Voice Coil and Motor System

The voice coil used in the Mirus coaxials is a 2-layer aluminized copper wire coils on a round former. An "overhung" voice coil was selected to improve sensitivity while still keeping distortion to a minimum.

Continued on following page...

Mirus Coaxial Systems

Your Mirus system contains speaker drivers and a tweeter passive crossover network that were developed and assembled with a significant effort in research and development, materials science engineering, an exhaustive level of sampling and prototyping, real-world testing, and obsessive attention to detail. The specifications and parameters of your Mirus coaxial system is detailed on these pages.

Tweeter Attributes

Mirus M1

Dome

Small diameter impregnated silk textile dome with high-loss rubber suspension. The M1 has an impregnated fine cloth silk dome diaphragm for a linear, smooth sound, with a high-loss rubber suspension to damp edge modes and resonances. The dome is of extremely low mass and is much less susceptible to mechanical deformation than other designs, and yet yields a smooth response over the extent of its range. At Hybrid Audio Technologies, we feel larger diaphragm tweeters sound heavy and unremarkable, lack detail in the upper treble frequencies, have undesirable polar response, and are difficult to install. Additionally, we find metal dome tweeters to be harsh, brittle, and sound unrealistic. As a small diameter, soft-dome tweeter, the M1 is the antithesis of large diaphragm and metal-dome tweeters, for the effective and convincing reproduction of treble frequencies.

Voice Coil and Motor System

20mm complimentary design. The motor assembly is "conventional dynamic", with a compact neodymium magnet structure to ensure a small footprint size and shallow depth. A perforated grille protects the dome. The voice coil is ferrofluid cooled and damped.

Tweeter Passive Crossover

Low-Tolerance Mylar Capacitor. The tweeter's protection circuit and crossover filter is a very high-quality, low-tolerance Mylar capacitor that has been affixed to the coaxials frame. An outboard crossover "box" is not included for empirical reasons, explained in this portable document format download provided for the Imagine series, a similar crossover topology.

http://hybrid-audio.com/downloads/white-papers-technical-bulletins/White%20Paper%20-Imagine-Series%20Crossovers.pdf

Thiele/Small Parameter Discussion for Mirus Midbass Speakers

The mechanical and electrical parameters of the Mirus coaxials are amenable to a variety of different installations and speaker locations. The high Qms (Q factor of mechanical system) and Qts (Q factor of total system), coupled with the driver's Fs (resonance frequency) allow it to be used in an "infinite baffle" configuration. In more practical terms, install the Mirus coaxials such that the front and back waves don't "meet" (as detailed in later in the Basic System Installation), including in a door or kick panel, or in the case of a motorcycle, in the fairing (using only the airspace behind the speaker as a pseudo enclosure), with no need for a real enclosure or "box."

Mirus Coaxial Systems
Specifications

† Typically, in-car response including vehicular "cabin gain", or the gain expected with midbass coaxials installed in the vehicle, will result in an extended midbass and upper subbass response. This is a result of these frequencies being below the lowest resonance in the vehicle (typically around 50-125 Hz in most vehicles). In more practical terms, install the Mirus coaxials into your vehicle and you will see a dramatic improvement in midbass and upper subbass output, much more so than just simply listening to the Mirus in a large room, or worse yet, "free air" (we don't recommend even trying the Mirus speakers in "free air" without some form of enclosure or infinite baffle for the coaxials).

	M41-2	M51-2	M61-2	M57-2	M69-2
Overall Diameter	Φ117 mm	Φ150 mm	Φ165.5 mm	See drawing	See drawing
Mounting Depth	52.5 mm	57 mm	63 mm	67 mm	88 mm
Bolt Circle Diameter	Φ109.5 mm	Φ138 mm	Φ155.7 mm	See drawing	See drawing
Mounting Hole	Φ93 mm	Φ114.2 mm	Φ142 mm	See drawing	See drawing
Recommended Minimum Highpass Crossover Frequency (fourth order)	100 Hz	70 Hz	65 Hz	65 Hz	60 Hz
Continuous Power Handling	50 watts	70 watts	80 watts	80 watts	80 watts
Peak Power Handling	100 watts	140 watts	150 watts	150 watts	150 watts
Recommended Power Range	10-75 watts	10-100 watts	10-100 watts	10-100 watts	10-100 watts
Frequency Response (+/- 3dB)	90 Hz - 22 kHz	60 Hz - 22 kHz	55 Hz - 22 kHz	55 Hz - 22 kHz	50 Hz - 22 kHz
Efficiency 2.83V/1 meter	89.2 dB	90.8 dB	92.6 dB	92.6 dB	93.4 dB
Nominal Impedance	4 Ω	4 Ω	4 Ω	4 Ω	4 Ω

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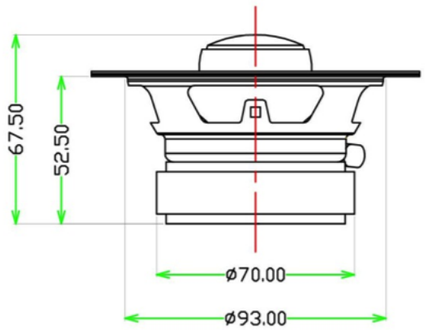
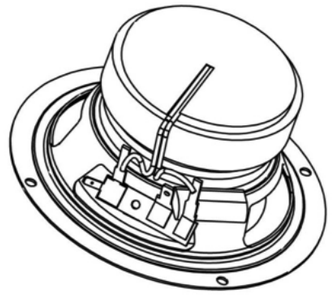
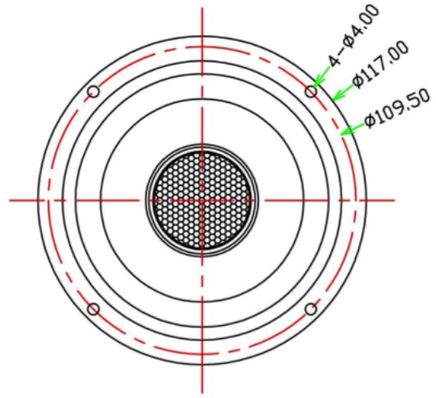
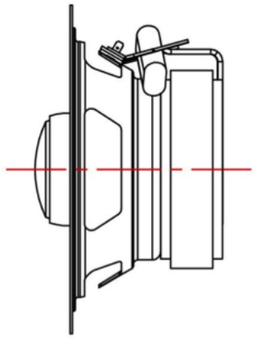
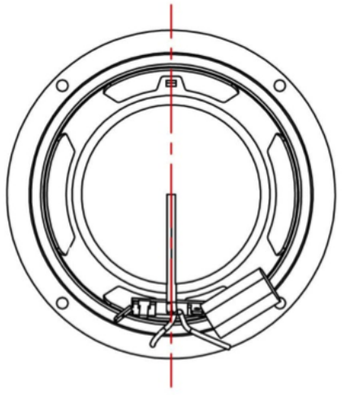
Mirus M41-2
Mechanical Drawing

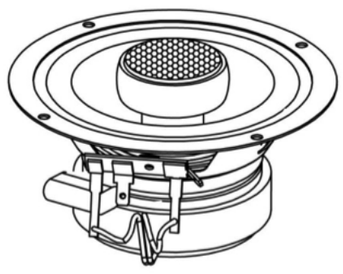




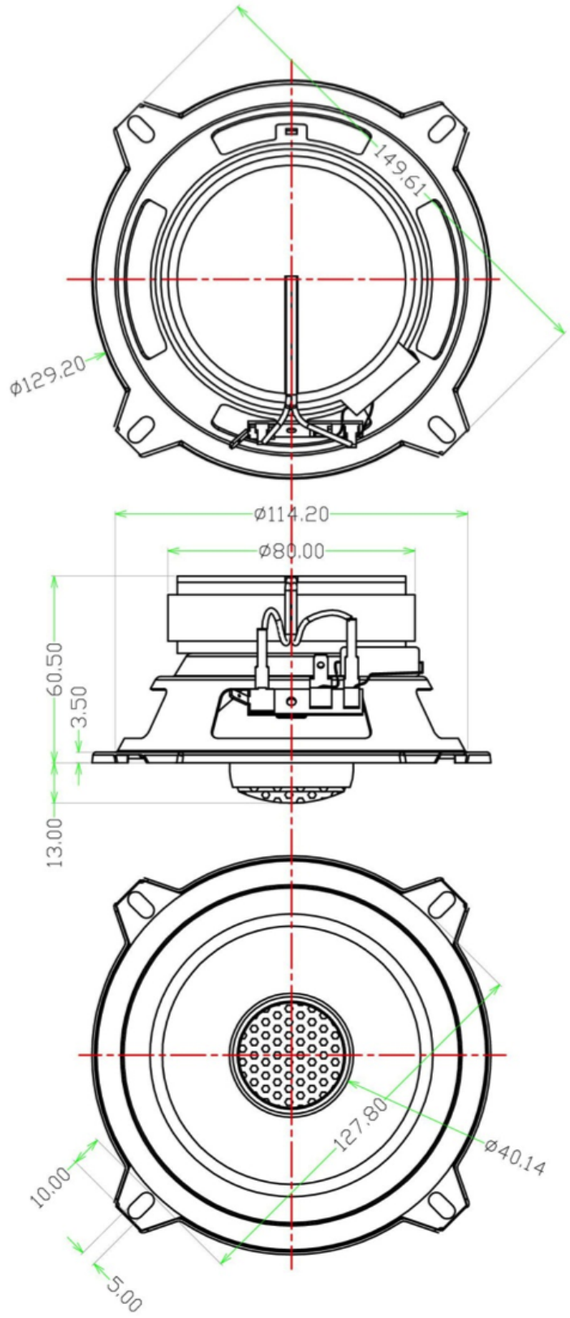


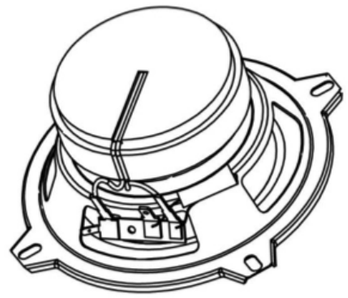


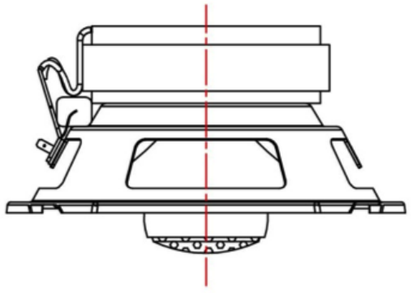


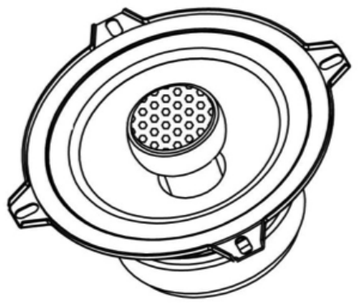


Mirus M51-2
Mechanical Drawing

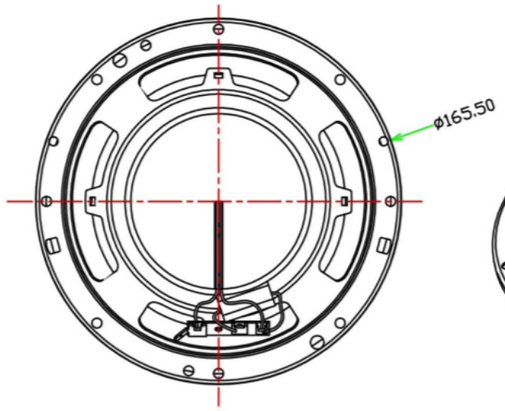


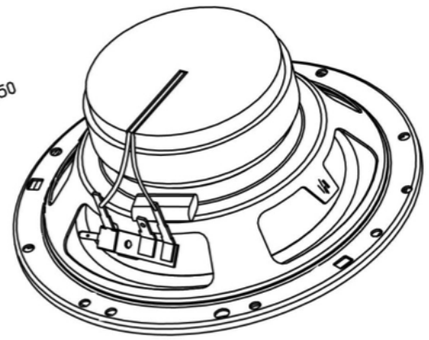


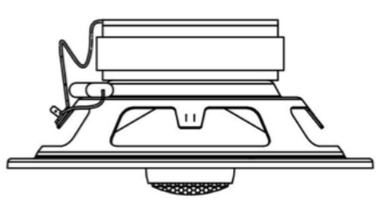


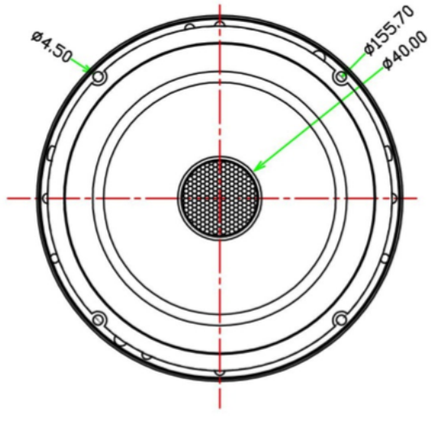


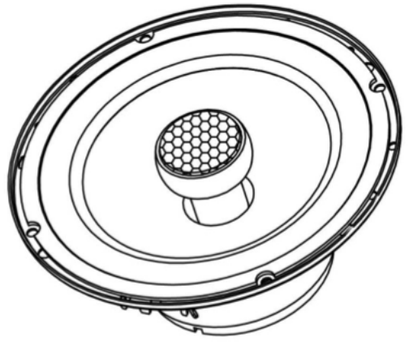
Mirus M61-2
Mechanical Drawing



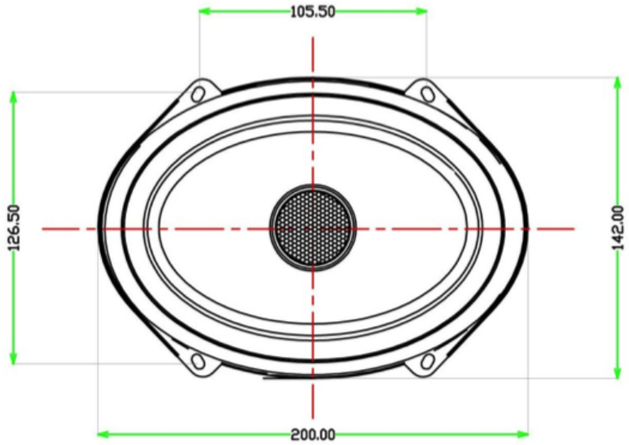


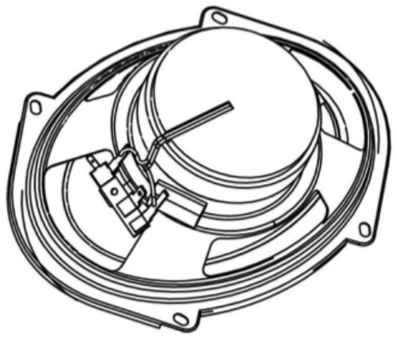


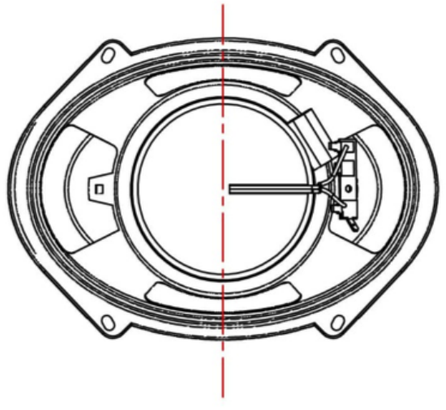


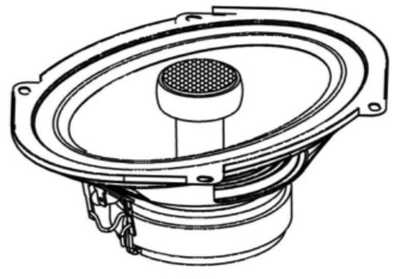


Mirus M57-2
Mechanical Drawing

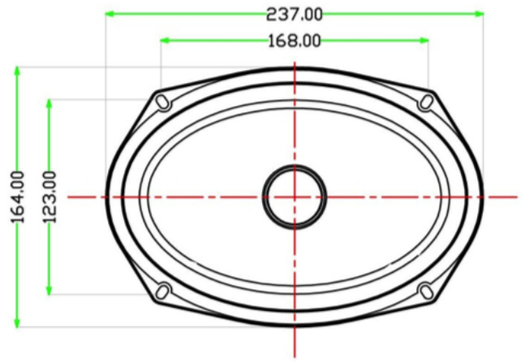


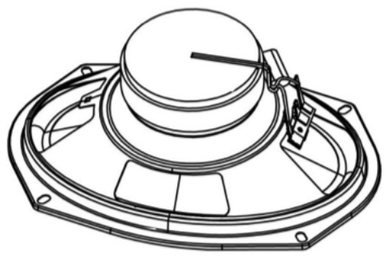


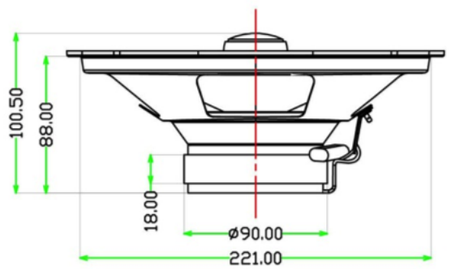


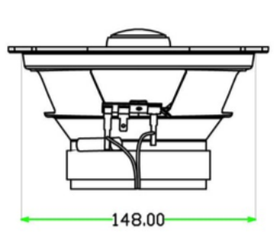


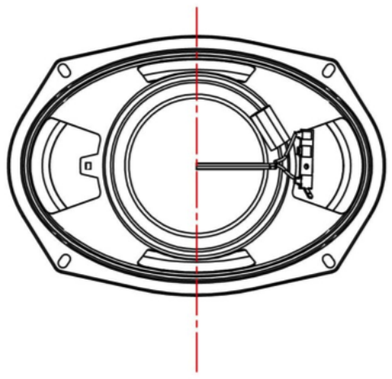
Mirus M69-2
Mechanical Drawing

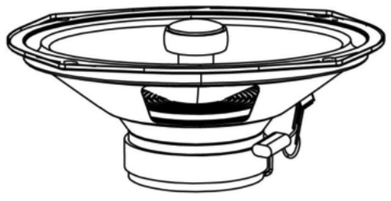












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Mirus Coaxial Systems

Using this Manual

This manual focuses on a typical, basic installation of the Mirus product, and follows in general what you'd expect from a mobile audio coaxial system owner's manual. Should the end-user wish to delve deeper into advanced acoustic principals, or perhaps to incorporate ways to get more performance out of their car audio systems and installations, we'd invite the reader to investigate any of the other product lines we carry, and their respective user's manuals and car audio reference guides, located at: http://hybrid-audio.com/downloads/

Unpacking/Inventory

Carefully unpack the Mirus carton, and verify that the following parts are included in the box (CAUTION: use care to remove the speakers with two hands, and avoid pressing your thumb or fingers against the cone of the midbass – never test the speaker's excursion manually with your fingers by pressing the cone):

- Two Mirus coaxial midbass speakers with integrated tweeter crossover; and
- Two Mirus M1 20mm tweeter speakers assembled coaxially above the midbass.

NOTE: grilles with anodized aluminum Hybrid Audio Technologies nameplates and ABS grille mounting flanges are available for most models and are sold separately.

Should you be missing parts, please contact your authorized Hybrid Audio Technologies dealer for replacement parts, or contact us directly at: support@hybrid-audio.com

Section I • Getting Started

Basic System Installation

Now that you have unpacked the Mirus box and have verified that all of the parts are included, it is time to evaluate the vehicle for the impending installation. If you feel the least bit uncomfortable about the installation, have the Mirus speakers installed by an authorized Hybrid Audio Technologies dealer. The Mirus speakers are an incredible high-end speaker system, but will only be as good as the installation; a poor installation can negatively affect the performance of the Mirus speakers. We can only build great speakers, but can't control or account for poor or inadequate installations.

Should you decide that you can handle the installation yourself and feel confident that the end result will be adequate to reap the performance benefits of the Mirus coaxial system, you will need to have certain hand tools available to you for the installation. These include, but may not be limited to:

- Cordless drill/driver with a 1/8" drill bit and a Phillips head and a few assorted driver bits (commonly including Torx driver bits) with an attachment (a hand-operated screw driver and/or Torx driver will also likely work);
- Certain vehicles may require an assortment of hex-key wrenches to remove the old speakers and/or panel screws;
- A panel-popping tool (retaining clip removal tool) to remove panels in the vehicle (such as door panels). In a pinch, a large flat-head screwdriver does work, but damage to panels or retaining clips can result;
- A wire cutter and wire stripper;
- Electrical tape; and
- If you plan to use the vehicle's existing speaker wire, you will need to know which wire is positive and which is negative at each proposed speaker location. If you're unsure, we highly recommend the use of Installation Excellence, an on-line resource for wire colors, wire locations, fit guides, and technical support.

Continued on following pages...

In a basic system, the Mirus speakers were designed to be installed in the original factory speaker locations, most often in the vehicle's doors, b-pillars, or rear parcel shelf, or in the event of motorcycle or ATV installation, in the fairing. The Mirus coaxials drivers are infinite baffle-capable speakers, and must be mounted in a "large enclosure", or as close to it as possible, with unrestricted access to airspace to ensure the speaker's ability to effectively reproduce its wide frequency bandwidth. The reason why the speaker was designed in this way is highly empirical. When a speaker is mounted in a small closed box, it radiates as much energy forward of the cone as it does rearward of the cone. All speaker cones (diaphragms) are a weak sound barrier at best, and the result of the high amount of energy being "pushed" into a small enclosure is the energy transmitting through to the outside of the cone (an additive phenomenon to the incidental wave). Consequently, Hybrid Audio has designed the Mirus coaxials to work well without an enclosure, and as such, should not be significantly prone to enclosure back-pressure and sound coloration when placed infinitely baffled. The "infinitely large" enclosure, such as one might find in a door panel or motorcycle fairing, improves spectral response and power response variation between high and low frequencies.

Hybrid Audio Technologies designed the Mirus-series to be used as a permanent coaxial. Do not attempt to remove and remotely-mount the tweeter from the midbass driver, as this will damage the driver and will void your warranty. If you are interested in a convertible coaxial system that offers the option of remotely mounting the tweeter, please inquire with your Hybrid Audio Technologies dealer about the Imagine-series convertible coaxial systems, or any one of our various component set options form the Unity, Clarus, Legatia, or Legatia SE series.

Once you have determined the mounting locations for the Mirus coaxials, and have evaluated the circumstances by which the Mirus speakers will need to be installed, it is time to dismantle the vehicle to access the old speakers. Most dashboard-mounted speakers are easily accessed by removing their grilles, which are usually attached to the dashboard with screws or retaining clips. A-pillars are usually accessed by pulling firmly at a right angle to the panel. Door speakers are usually easy to access as well, either from the front by prying off the OEM grille, or by physically removing the entire door panel.

Section I • Getting Started
Basic System Installation (Continued)

In all cases, it may be prudent to reference your vehicle's factory service manual. If you don't have a factory service manual, you can go to the Installation Excellence website for downloadable resources with respect to not only wiring but disassembly of your vehicle, and the procedures to access your OEM speakers.

With the OEM speakers removed, we HIGHLY recommend the use of a self-adhesive damping product, such as brand names Dynamat®, B-Quiet®, RAAMmat®, and others. The reason for the use of damping material is to quiet buzzes and rattles that will be exposed by the high-performance Mirus speakers, but more importantly to seal up door accesses and cavities, thereby creating a pseudo "enclosure" for the Mirus coaxials. If the Mirus speakers are installed immediately adjacent to a large access hole or opening in the door metal, there will be an acoustic "short circuit" where the front and back waves of the speaker meet, and cancellation will occur, seriously affecting midbass output. The use of a good damping product is the single-biggest installation-related improvement you can do to enhance the performance of your Mirus audio system. And since the Mirus coaxials require an "infinite baffle", it is intuitive to seal up the mounting area as best as possible, such as in the door, allowing the speaker to "see" a large enclosure in the door cavity, kick panel, dashboard, or wherever you decide to mount the Mirus coaxials.

If you plan to use the OEM speaker wiring, you will likely need to cut off the OEM speaker plug, and strip back approximately 3/8" (10mm) of insulation to expose the bare wire. It is recommended that you then install slide-style terminals on the wire, for easy connection to the Mirus coaxials.

In a basic installation, the Mirus coaxials were designed to install directly into the factory-supplied speaker baffles or speaker openings. The speaker should fit snug to the baffle without air gaps; do not force the speaker into a baffle that is too small, as this will damage the speakers. If the factory-supplied mounting baffle is too small, you will need to build or purchase an adapter plate/baffle (available at many places on-line or via your local Hybrid Audio dealer). When tightening your speakers to the baffle, alternate the tightening of the screws, just as if you were changing a tire on your vehicle, by alternating in a pattern around the speaker until all screws are hand-tight. DO NOT INSTALL THE SPEAKERS WITH A DRILL OR DRILL-DRIVER, as the drill-drive will put considerably more torque on the speaker basket than what is required, and can easily damage the frame of the speaker.

Section I • Getting Started
Basic System Installation (Continued)

Once all speakers are installed, you will need to do a brief listening test with CD-quality music that you are intimately familiar with to determine if the tweeter seems to be linear in amplitude with the coaxials, or seems to be too muted. If the tweeter seems too muted, or if you prefer a louder tweeter sound, simply reverse the black and red wires on the tweeter terminals located on the frame of the coaxials. You will be changing the polarity of the tweeter, and will be increasing the loudness of frequencies between approximately 6,000 – 10,000 Hz by doing this.

Crop your sound damping and re-install all interior panels, making sure all wiring is neatly wire-tied away from heat and noise sources, or from abrasion and areas where the wires may be accidentally sliced or cut, and sit back and enjoy the music.

We encourage the end-user to experiment with placement and angling of the Mirus coaxials, and further encourage learning of timeless acoustical principals detailed in all of our other user's manuals, such as the Imagine User's Manual and Car Audio Reference guide.

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Mirus Coaxial Systems
Warranty

Hybrid Audio Technologies extends a limited one year warranty to the original purchaser when self-installed, and lifetime warranty when installed by a certified Hybrid Audio Technologies dealer (United States only), and hereby certifies that this product will be free from defects in materials and workmanship under normal and proper use for one year from the date of purchase.

Hybrid Audio Technologies' responsibility under this warranty is limited to replacing or repairing, at Hybrid Audio Technologies' option, products or parts determined by Hybrid Audio Technologies to be defective either in materials, or workmanship. To attain warranty service, the customer must deliver the product or the defective part(s), appropriately packed with proof of purchase date, to an authorized Hybrid Audio Technologies dealer. In the event that a direct return from a consumer is required, the consumer must obtain from Hybrid Audio Technologies a return authorization number, and ship the defective product directly to Hybrid Audio Technologies. All shipping expenses are the customer's responsibility. If the product has been updated or superseded, a replacement will be made with a current model of the same quality and function. Warranty of the replacement parts is limited to 90 days or the unexpired portion of the warranty period of the product on which the parts are being used, whichever is longer.

This warranty does not cover any defects or costs caused by: (1) modification, alteration, repair or service of this product by any persons or company other than Hybrid Audio Technologies; (2) physical abuse to, overload of, or misuse of, the product or operation thereof in a manner inconsistent with the use indicated in the instructions; (3) any use of the product other than that for which it was intended; or (4) shipment of the product to Hybrid Audio Technologies for service. This warranty does not cover labor costs.

Hybrid Audio Technologies is not liable for any special incidental or consequential damages, including, but not limited to, personal injury, property damage, damage to or loss of equipment, loss of profits or revenue, costs of renting or buying replacements and/or any other additional expenses, even if Hybrid Audio Technologies has been informed of the prospect of such damages. Any express warranty not provided herein, and any remedy which other than the warranty contained herein might arise by inference or operation of law, is hereby excluded and disclaimed including the implied warranties of merchantability and of the fitness for a particular purpose.

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Thank You!

Hybrid Audio Technologies is delighted that you have chosen a Mirus Coaxial System for your high-end mobile audio sound system. We are convinced that a great product offering, backed up with unsurpassed customer service and technical support will advance the Hybrid Audio Technologies namesake in the coming years. We are pleased that you have joined us in our "new generation of in-car audio."

If there is anything we can do to help you get the most out of your Mirus installation, please do not hesitate to email us: support@hybrid-audio.com, by phone: 770.888.8200, or by visiting us at: **hybrid-audio.com**

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