Back to Basics – Car Audio 101

By Mike Stiers

So you've decided to upgrade your car stereo system? A great deal of research and planning should go into this purchase since there is a lot to consider. Do you desire a nice upgrade of your factory speakers, are you looking for a Sound Quality overall of speakers, subwoofers and amplifiers, or are you designing a vision-blurring SPL machine? It is important to make a list of exactly what you are looking to replace or add to your audio system so that you can prepare your electrical system for the investment to come.

Many people do not realize that their vehicles' factory electrical system was not designed for aftermarket audio equipment. In fact, most factory electrical systems can only handle an audio system of 600 to 1200 watts. The lower end of the scale being the smaller vehicles and most foreign rides, and the upper end being large trucks and sport utility vehicles. As you increase demand, you need to look at upgrading your battery, alternator and most importantly your "Big 3."

THE "BIG 3"

The "Big 3" consists of upgrading three wires under the hood of your vehicle. You can completely replace the three wires detailed below, or simply add additional wires to existing factory wires, the choice is yours. The existing factory wires are generally 8 gauge or smaller and are not designed for the high current demands of an aftermarket audio system. It is recommended that you use a nice insulated 0 gauge wire so that you only have to do this series of upgraded once.

The first of the "Big 3" is the positive charging wire from your alternator to your battery positive. This wire must be fused within 12" of the positive battery terminal connection. The fuse value should be equivalent to the maximum amperage output of your alternator. If you have an upgraded, high output, alternator you will remove your factory alternator charge wire altogether and use the replacement described above.

The second upgrade for the "Big 3" is the ground wire from battery negative to chassis. If you do not have access to the frame of the vehicle, don't settle for a piece of sheet metal under the hood, but rather locate the strut tower, remove a nut from the thread, sand all paint and debris, connect the 0 gauge ground using a ring terminal on the thread and tighten the nut down. This strut thread has direct access to the vehicle frame and will provide far less resistance than using sheet metal and relying on spot welds. Leave the factory ground in place and clean any dirt, rust or debris from this connection using sandpaper or a stiff wire brush.

The final upgrade for the "Big 3" is the engine ground to chassis. This is extremely important because this ground is also what ties the alternator ground, through the engine block, to the vehicle chassis. For this step, you want to add your 0 gauge ground to the existing ground. Just clean the area thoroughly and secure the two grounds

using the same bolts and locations if possible. Through these three steps, you have successfully made huge progress in improving the electrical systems' performance, decreased resistance, and enhanced the ability to supply power to your aftermarket audio system.

The alternator and battery pretty much go hand in hand, but I will do my best to key in on each individually.

ALTERNATORS

The alternator powers the vehicle, all components and recharges the battery. A standard factory alternator ranges from 40 amps to 120 amps depending on vehicle. When the alternator is under high demand or the demand exceeds the alternators' capability, your voltage will begin to fall and rely on the reserve of the battery. Let's use a 65 amp alternator for example in determining what aftermarket audio equipment the alternator can sufficiently power. In perfect condition, your 65 amp factory alternator is charging at 14.4 volts and is capable of supplying 936 watts. (65A x 14.4V = 936 watts) Your vehicle requires 30%-50% of this to run and operate standard vehicle components. If we use the middle, 40%, you are left with approximately 561 watts for your aftermarket audio equipment. (936W x (100% - 40%) = 561W) This 561watts is based on a 100% efficient amplifier which we know is not realistic. Lets assume you choose an 80% efficient amplifier, which is very efficient. If this amplifier uses 561watts and is 80% efficient, it will produce 448.8 watts for your speakers or subwoofers. (561W x (.8) = 448.8 watts) Going beyond this point and you begin to tap into the reserve of the battery. The result is a decrease in amplifier efficiency and an increase in heat due to decreases in voltage and increases in amperage. This is very hard on the alternator and amplifiers in the system. By now I'm sure you see why an upgraded alternator is vital when upgrading your audio system.

BATTERY

The battery provides reserve to the engine during starting, discharges current to accessories, acts as a buffer between the alternator and all accessories and after market audio equipment, as well as powers everything active in your vehicle when the vehicle is off but in the Accessory (ACC) position on the ignition. Your battery or batteries are extremely important in determining what aftermarket audio equipment can be added and survive in your application. As the demand becomes too great for the alternator and the voltage begins to drop, the battery is relied on for its' reserve power until the demand is reduced and the alternator can recover. This is why batteries are commonly rated in several ways. The most common rating is Amp Hour (AH) rating. This is a unit of measurement for battery capacity, obtained by multiplying a current flow in amperes by the time in hours of discharge. (Example: A battery which delivers 5 amperes for 20 hours delivers 5 amperes times 20 hours, or 100 ampere-hours. So, this 100AH battery can supply 5 amps per hour for 20 hours before dropping to 10.5volts. At 10.5volts, the battery is fully discharged.) Since manufacturers use different discharge periods to establish their own AH rating, Reserve Capacity is relied on heavily in the industry to

simplify battery selection. Reserve Capacity is the number of minutes a battery can maintain a useful voltage under a 25 ampere discharge. The higher the minute rating, the greater the battery's ability to run all of your electronics for a longer period before recharging is necessary. Deep Cycle batteries are different than starting batteries because they have been specially designed for multiple complete discharges without losing reserve capacity, but Cranking batteries will lose reserve capacity quickly with repeated hard discharges. This is why Deep Cycle batteries are ideal for the high demand of aftermarket car audio amplifiers. Once you have determined the audio equipment you are interested in for your purchase, you should contact a reputable battery manufacturer for their recommended battery based on total wattage in the aftermarket audio system. This could mean a simple replacement of your factory battery or adding additional batteries depending on what you have planned for your amplifiers.

VOLTAGE

Now that you have upgraded your “Big 3”, upgraded your alternator (if needed) and upgraded your battery (if needed), you need to turn your focus on delivering the power to the amplifiers. Bigger is always better in this situation. If the Power and Ground wire are too small, you will have increased resistance from battery to amp which can result in a large voltage drop. This voltage drop is bad because it will cause your amplifier to stress while making power which will create harmful distortion and possibly damage the amplifier or subwoofers. If you choose a 2000 watt amplifier for example, your amplifier requires 138.8 amps of current at 14.4 volts (2000W / 14.4V = 138.8A). Now, if your voltage drops one volt to 13.4V, your amplifier now requires 149.3 amps of current to produce that same 2000 watts (2000W / 13.4V = 149.3A). Now, if the extra current isn’t available in the system then the amplifier is reduced to a potential output of 1860 watts (138.8A x 13.4V = 1860W). This should help you see the importance of Voltage and delivery in your system. As voltage drops, so does efficiency in the amplifier which creates heat and heat leads to damaged components when it is too excessive. An amplifier may not reach the manufacturers rated potential if your electrical system does not meet the demanded requirements of the amplifier you have chosen.

I have included some helpful formulas that were used in this article and hopefully they can help you in planning and designing the ultimate sound system. Keep in mind that if you are ever in question on something, it is always best to contact a professional installer or even the manufacturer for further assistance. Never guess as this can often times result in a costly mistake.

Determining Potential of Current Alternator:

Step 1:
Alternator Amperage Rating x 14.4V = Potential Wattage
A x 14.4V = W

Step 2:
Potential Wattage x (Maximum Potential – Percentage Used to Run Vehicle) = Watts Available for Aftermarket Audio System
Answer from Step 1 x (100% - 40%) = Watts for Aftermarket Amplifier(s)

Step 3:
Answer from Step 2 (100% Efficient Amp) x (Actual Efficiency of Amplifier) = Watts that can be produced in current application

Determining Battery Capacity:

Amp Hour Rating of Battery / Current Draw = Hours until battery is dead (10.5V)
AH / A = Hrs

(Reserve Capacity of Battery / 2) + 16 = Amp Hours
(RC / 2) + 16 = AH

Reserve Capacity x 5 = Cold Cranking Amps (approximate)
RC x 5 = CCA

Cold Cranking Amps / 5 = Reserve Capacity (approximate)
CCA / 5 = RC

Amplifiers:

Amplifier Rated Wattage / Battery Voltage = Current Draw (Amperage)
W / DC V = A (Also helpful in determining fuse value at the front battery)

Current draw can theoretically be double the fuse rating for a short period of time before the fuse will pop