THE INSTALL DOCTOR™

Parallel vs. Series Speaker Wiring
(How To Wire And Find The Resistance Of Each)

Document# 999016

Series Speaker Wiring

Series speaker wiring links all speakers together in a chain. The amplifier will send an audio signal out through the (+) speaker output into the first speaker; but for the audio signal to return to the amp to complete the electrical circuit, the audio signal must travel down the chain, through each speaker, and out the last speaker to the (-) negative speaker output on the amp.

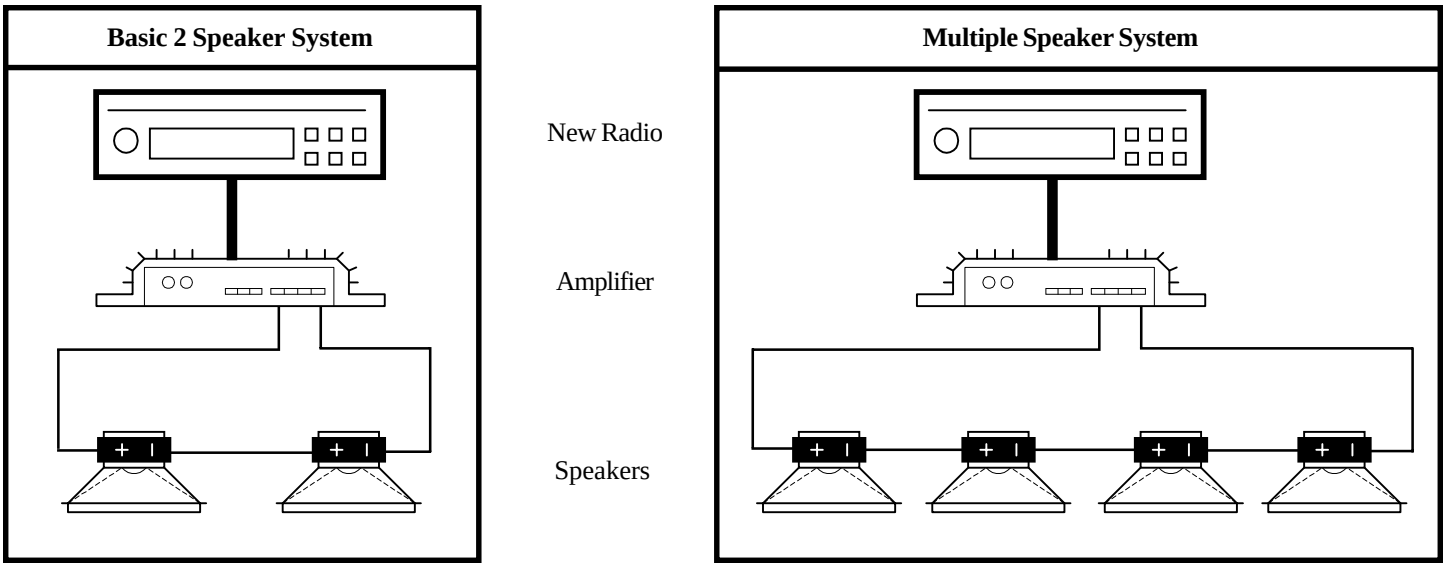
Electrical Basics Of Series Wiring:
Since the speakers are joined as a chain, the resistances of all the speakers are ***added*** together.
LAWS OF PHYSICS: Series circuits are "voltage dividers". Each resistance, or in our case a speaker, that is added gets a percentage of the overall voltage. Although the voltage of the entire circuit stays the same, every time a speaker is added, each speaker gets a percentage of the overall voltage. (This voltage is the amplified audio signal from the amp).

Pros and Cons of Series wiring:
Because the resistances of the speakers are added together, the **"pro"** to series wiring is that you can connect more speakers to an amplifier safely. For advanced installs with multiple speakers, series speaker wiring can be used to increase the resistance of the "equivalent" or "overall" resistance that the amplifier sees. This allows the amplifier to run cooler and more efficiently. This becomes a critical issue when trying to "bridge" an amplifier to get the amplifiers highest power output.

On the flip side, series wiring does increase the resistance that the amplifier sees. Because series circuits are "voltage dividers", this results in a decrease in amplified voltage audio signal to each speaker. Some people make the mistake and claim that there is a "decrease in power output from the amp". This is very wrong. What is really happening revolves around basic electrical principals. These basic principals of electrical circuits are based upon Ohms Law. Since series circuits are "voltage dividers" and cause each speaker to see a percentage of amplified audio output from the amp, it is common to assume the amp is producing less output voltage or power. The amplifier still produces the same output, but because each speaker gets a percentage of the overall power, it appears that the overall power output from the amp has decreased.

Automotive audio systems are designed operate with speakers that have 4 ohms of resistance (unlike home audio systems that are designed to operate with speakers at 8 ohms of resistance). Keeping the "overall" or "equivalent" resistance on the amplifier at or near 4 ohms is the standard installation procedure. However, increasing the resistance to more than 4 ohms of speaker resistance by adding speakers in series will split the amplified audio output from the amp across all the speaker in the circuit.

Basic Diagram of Series Wiring:



In the diagrams above, there are only two speaker wires connected to the amplifier. One speaker wire is connected to the amplifiers (+) positive output terminal then onto the (+) positive input of the first speaker in the chain. The second speaker wire is connected to the amplifiers (-) negative speaker terminal then onto the (-) negative speaker terminal of the last speaker in the chain. Then the speakers are chained together by running a speaker wire between the speakers by connecting one end of this speaker wire to the (-) negative speaker terminal of the previous speaker onto the (+) positive speaker terminal of the following speaker in the chain.

Parallel Speaker Wiring

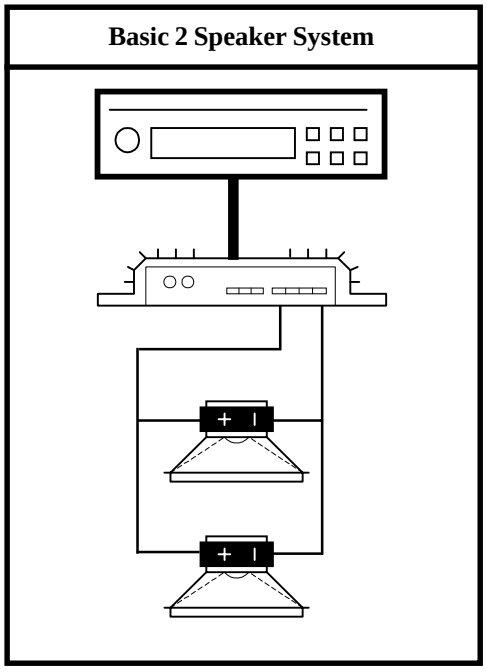
Parallel speaker wiring combines all speakers (+) positive speaker leads together, and all (-) negative speaker leads together. The diagram of this would look like a ladder. . Parallel circuits are the simplest of electrical circuits to wire because adding a speaker is as easy as connecting the new speakers (+) positive lead to the positive speaker wires of the other speakers and the (-) negative lead to the negative of the other speakers in a system.

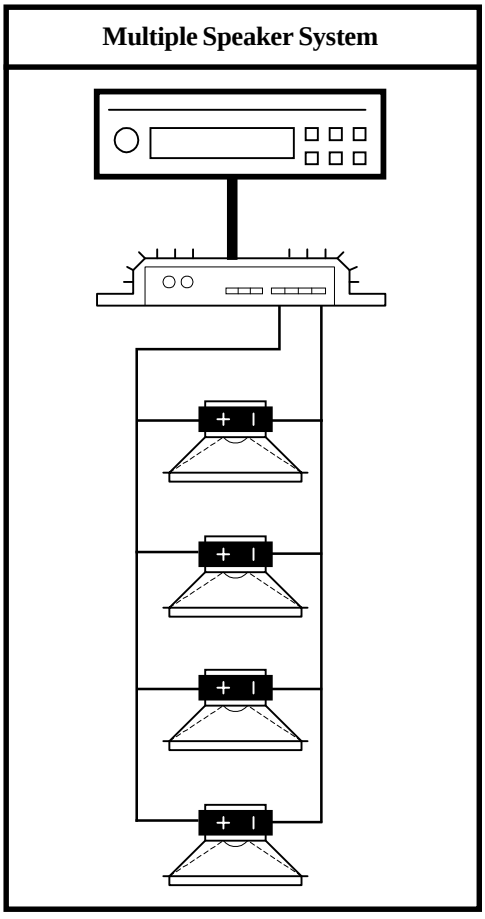
Electrical Basics Of Series Wiring:
Adding speakers in series ***reduces*** the overall resistance of the circuit.
LAWS OF PHYSICS: Parallel circuits are "current dividers" and overall resistance reducers, but each speaker receives the same audio output voltage power from the amplifier.

Pros and Cons of Parallel wiring:
Parallel circuits are the simplest electrical circuit to wire. As can be seen in the diagrams below, adding additional speakers is as easy as connecting all the speakers (+) positive leads to the (+) positive speaker output from the amp, and the (-) negative leads the (-) negative speaker output from the amp.

However, adding speakers in parallel causes the overall resistance of the circuit to drop, an drop very fast. This is VERY critical to understand. Automotive audio systems are designed around speakers with a 4 ohm resistance. But, many amplifiers are only designed to operate while powering resistance loads of 4 ohms. Some amps are able to handle resistance loads down to 2 ohms, but these amps must be designed to handle the increase in current draw of a speaker circuit at 2 ohms. Why is this so important to understand? Adding speakers causes the overall resistance to drop. As resistance drops, the current must increase according to Ohms Law. So, each time a speaker with the same resistance is added to the parallel circuit, the current draw on the amp increases. The circuitry of the amp must be able to handle this increase in current at the reduced resistance. This increase in current draw is also felt by the electrical system of the vehicle. The alternator may not be able to produce the additional current required by the amp. This can be seen by headlights and dash lights that dim as peak current draw is required by the amp.

Basic Diagram of Series Wiring:





In the diagrams above, all speakers are connected as a ladder. That is, each speakers (+) positive terminal is connected to all others speakers (+) positive terminal. And the same with the negative terminals. Each time a speaker is added with the same resistance as the other speakers, the overall resistance of the circuit drops. This drop in resistance also increases the current draw from the amp, causing the amp to get hotter and places additional current draw by the amp on the vehicles electrical system.

The Basics Of Ohms Law

Ohms Law lets us calculate Voltage, Resistance, and Current in simple circuits.

Ohms Law

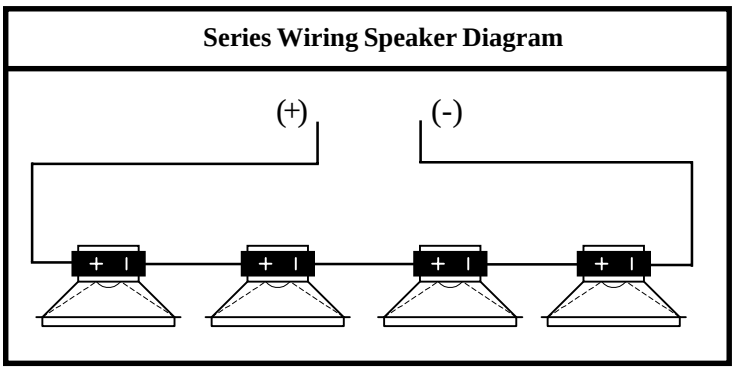
V = voltage
I = current
R = resistance

To determine V, or I, or R: cover the letter of the one you want to calculate.

V= I multiplied by R
I= V divided by R
R= V divided by I

How To Calculate The Resistance Of Series Circuits

Series Wiring Speaker Diagram

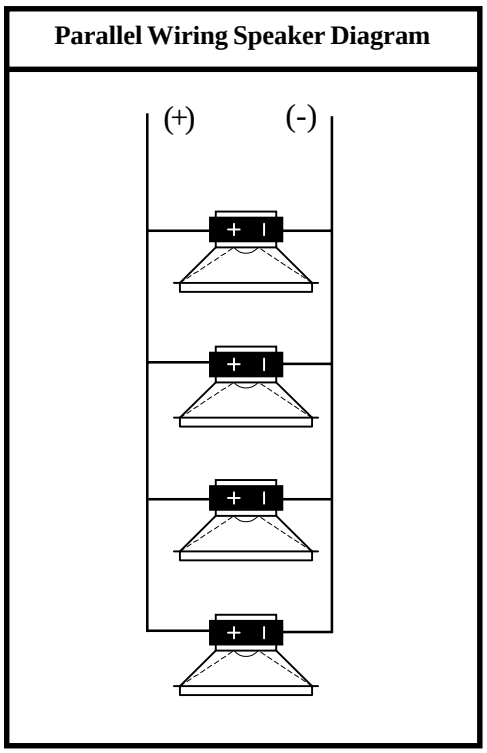


To Calculate The Total Resistance Of A Series Circuit:

$$\text{Total Resistance} = R1 + R2 + R3 + R4 \ldots\ldots$$

How To Calculate The Resistance Of Parallel Circuits

Parallel Wiring Speaker Diagram



To Calculate The Total Resistance Of A Parallel Circuit:

$$\text{Total Resistance} = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \frac{1}{R4} \ldots\ldots}$$

R1 = Resistance of speaker 1
R2 = Resistance of speaker 2
R3 = Resistance of speaker 3
R4 = Resistance of speaker 4