Speakers and your NSM Icon Jukebox

Here's a little about how speakers are rated. Understanding this will help you make an intelligent choice when shopping for them and connecting them to an NSM Jukebox:

Speakers have four important ratings: **Efficiency, Impedance, Max Power Handling and Frequency Response.**

Efficiency rating > the speakers' standardized sound pressure level (SPL) or ***how loud it can go***. Some speaker manufacturers call this Sensitivity. The rating is in Decibels (dB) and measured at a specific distance from the speaker with a standard amount of power. Generally, you'll see ratings from 86 to 104dB. (As a reference, Firecrackers or a Garbage Truck generate approx 90dB of sound.)

- The human ear *hears* a 10dB increase as twice as loud. A 96dB speaker will sound twice as loud as an 86dB speaker at the same volume setting.
- For every 3dB difference, twice the power is needed to generate the same SPL.
- NSM recommends using speakers with an efficiency rating of 89dB or higher.

Impedance > is the "Ohms" rating of the speaker. You need to know the Impedance in order to calculate and match the total Impedance. Matching the total Impedance to the amplifiers load rating will ensure maximum power delivery while not overloading the amplifier. By the way, many speakers that advertise an 8-Ohm rating in reality are 4 or 6-Ohms (More on calculating Impedance later.) If you're not sure of your speakers Impedance, simply measure it with an ohmmeter. Granted, measuring with an ohmmeter is not totally accurate, but it's close enough.

Max Power Handling > how many Watts a speaker can absorb without being damaged. Most are rated in true RMS power per speaker, however some manufacturers use Total Power or Music Power instead. To calculate RMS, divide Total Power by 2 then multiply by .707. For example, a speaker rated at 200 Watts Total Power is 70.7 Watts RMS. (200 / 2 X .707 = 70.7)

- *The max power rating does not indicate how loud a speaker can go; it simply indicates how many Watts the speaker can handle before it blows up.*
- A speaker's **Nominal Power** rating, the power level at which the speaker works best, is usually ½ of the max power rating. For best performance, you need to match the Nominal Power to the amount of power delivered by the amplifier. (More on Power Distribution later.)

Frequency Response > This is the ability of a speaker to reproduce audio frequencies. Generally the wider the response, the better a speaker will sound. A speaker with a frequency response of 50Hz to 22,000Hz (22kHz) will sound much better than a speaker with a range of 90Hz to 15,000Hz (15kHz).

Speaker Wire > Beside using the right speakers for the job, you need to use the correct gauge speaker wire. Speakers draw current the same as any other electrical appliance. A 4-Ohm load will draw close to 8 Amps. You cannot get that amount of current to flow efficiently with 18ga or 16ga "zip cord." The lack of current flow (resistance) will cause a loss of volume and amplifier overheating. **14ga or better, high quality speaker wire must be used.**

When choosing loudspeakers, you want to get the highest Efficiency and widest Frequency Response possible… while matching the nominal power rating to the power delivered by your amplifier.

NSM Icon Jukebox Amplifier Rating and Impedance Requirements

NSM's Icon Wall jukebox is equipped with two stereo amplifiers yielding 4 channels of output; each channel rated 300 Watts RMS into a 4-Ohm load. These amplifiers are designed to operate most efficiently with a speaker load of 4 to 8 Ohms. Below is the power distribution chart for a single channel. *Normally, power is divided equally to each speaker connected to an individual channel.*

1-Ohm	2-Ohms	4-Ohms	8-Ohms	16-Ohms	32-Ohms
Overload	Overload	300 Wrms	220 Wrms	105 Wrms	45Wrms

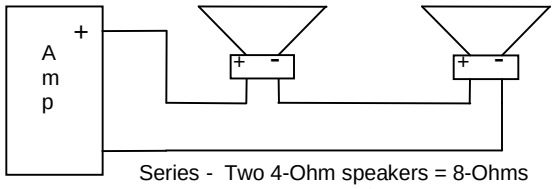
In order to deliver its full rated power; the amplifier should "see" a speaker load of 4 to 8-Ohms. If the load is less than 4-Ohms, the amplifier will overload, cut out and may be damaged. If the load is greater than 8-Ohms, the amplifier will not put out its full power.

That having been said, when designing a sound system, keep in mind; the key to creating a great system is to match your speakers to the power generated by the amplifier without overloading it. If the speaker load turns out to be greater than 8-Ohms, so be it as long as the speakers you use match the power put out by the amp.

Connecting Speakers, Calculating Impedance and Power Output.

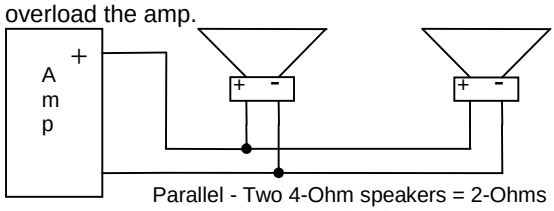
When connecting multiple speakers per channel, they will be connected in one of three ways; **Series, Parallel or Series/Parallel.** Let's define and analyze each. *Even though most speakers are rated 8-Ohms, very few actually perform at that level so we're going to use the more realistic 4-Ohms as our base figure.*

Series; Speakers are connected from amp pos to first speaker pos. First speaker neg connected to second speaker pos, second speaker neg connected to third speaker pos, etc. The last speaker neg is connected to the amp neg. To calculate the load, **add together the value of each speaker**. In this case the total impedance is 8-Ohms.



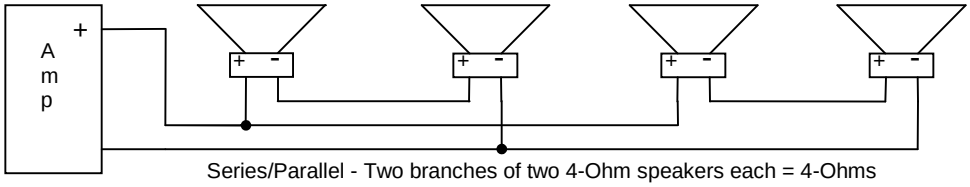
Series - Two 4-Ohm speakers = 8-Ohms
4 + 4 = 8
Power = 110 Wrms per speaker
220 ÷ 2 = 110

Parallel; Speakers are connected to the amp and each other pos to pos, neg to neg. To calculate the impedance, assuming equal loads, **divide the number of loads into the value of one load**. In this case, the total impedance is 2-Ohms. This connection scheme will overload the amp.



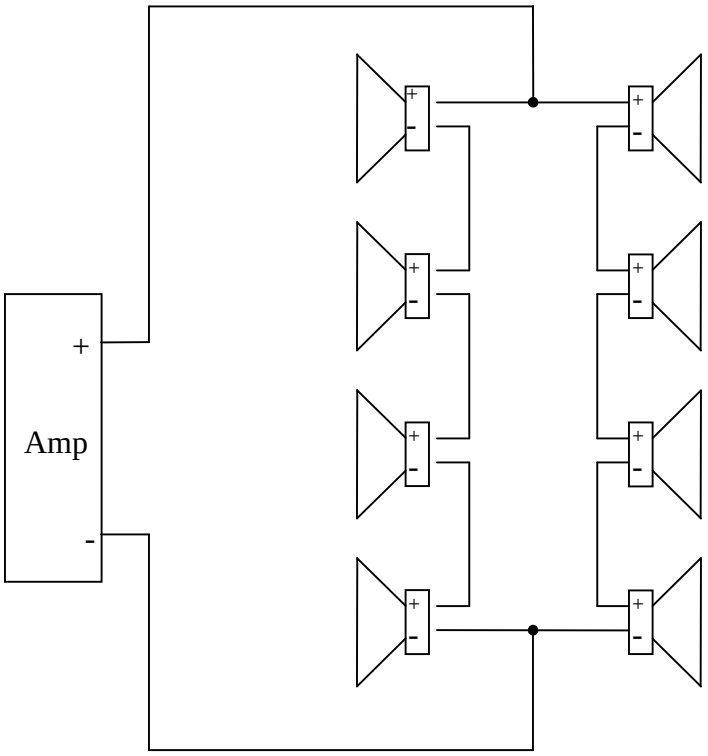
Parallel - Two 4-Ohm speakers = 2-Ohms
4 ÷ 2 = 2
Power = Overload – Less than 4-Ohms

Series/Parallel; Speakers are connected in series branches then each branch is connected to each other and the amp. To calculate the load, **assuming equal branches, add the value of one branch then divide by the number of branches**. In this case, the total impedance is 4-Ohms.



Series/Parallel - Two branches of two 4-Ohm speakers each = 4-Ohms
Each branch = 8-Ohms
8 ÷ 2 = 4
Power = 75 Wrms per speaker
300 ÷ 4 = 75

Need more speakers? Try this one out. Sure it's 27.5 Watts per speaker, but if you're using the right speakers, (such as Polk Atrium 45's) it's more than enough power.



This installation consists of two series branches of four 4-Ohm speakers yielding a total impedance of 8-Ohms. For those who like to see the math, here it is;
Imp = (4+4+4+4) ÷ 2
Imp = 16 ÷ 2
Imp = 8

An impedance of 8-Ohms, according to the power chart on page 2, creates a 220 Watt total draw from the amp. Divide the total power by the number of speakers to get 27.5 Watts per speaker.
220 ÷ 8 = 27.5

Using an Audio Transformer*

Some of you may have an earlier NSM downloader such as a Chameleon, Nostalgia or Evolution. Those models are equipped with a 240W per channel amplifier and an Audio Transformer for connecting speakers. All impedance and power distribution rules apply with the exception that the Audio Transformer allows you to easily match loads as low as 1/2-Ohm. For instance, if your system impedance is 1-Ohm, (four 4-Ohm speakers in parallel) connect the wires E-1 to E-5. Each speaker will get up to 60 Watts. (240 Watts divided by 4 speakers equals 60 Watts per speaker.)

Following is its power distribution chart.

Total System Impedance and Output Power per Channel

Sys Imp→	½-Ohm	1-Ohm	2- Ohms	4-Ohms	8-Ohms	16-Ohms
Tap E1 – E7	Overload	Overload	Overload	240	120	60
Tap E1 – E6	Overload	Overload	240	120	60	30
Tap E1 – E5	Overload	240	120	60	30	15
Tap E1 – E4	240	120	60	30	15	8
Tap E1 – E3	120	60	30	15	8	4
Tap E1 – E2	60	30	15	8	4	2

*The use of an Audio Transformer with an Icon Wall Jukebox is not recommended because the transformer, under certain conditions, may be damaged due to the amplifiers higher output level.

The final words
In conclusion, when connecting external speakers to an NSM Jukebox it's best to keep the impedance for each channel between 4 and 8-Ohms. Also be sure to use speakers with power ratings that match the amount of power delivered in your installation scheme. Doing so will ensure maximum audio performance without the danger of damaging your speakers or amplifier.