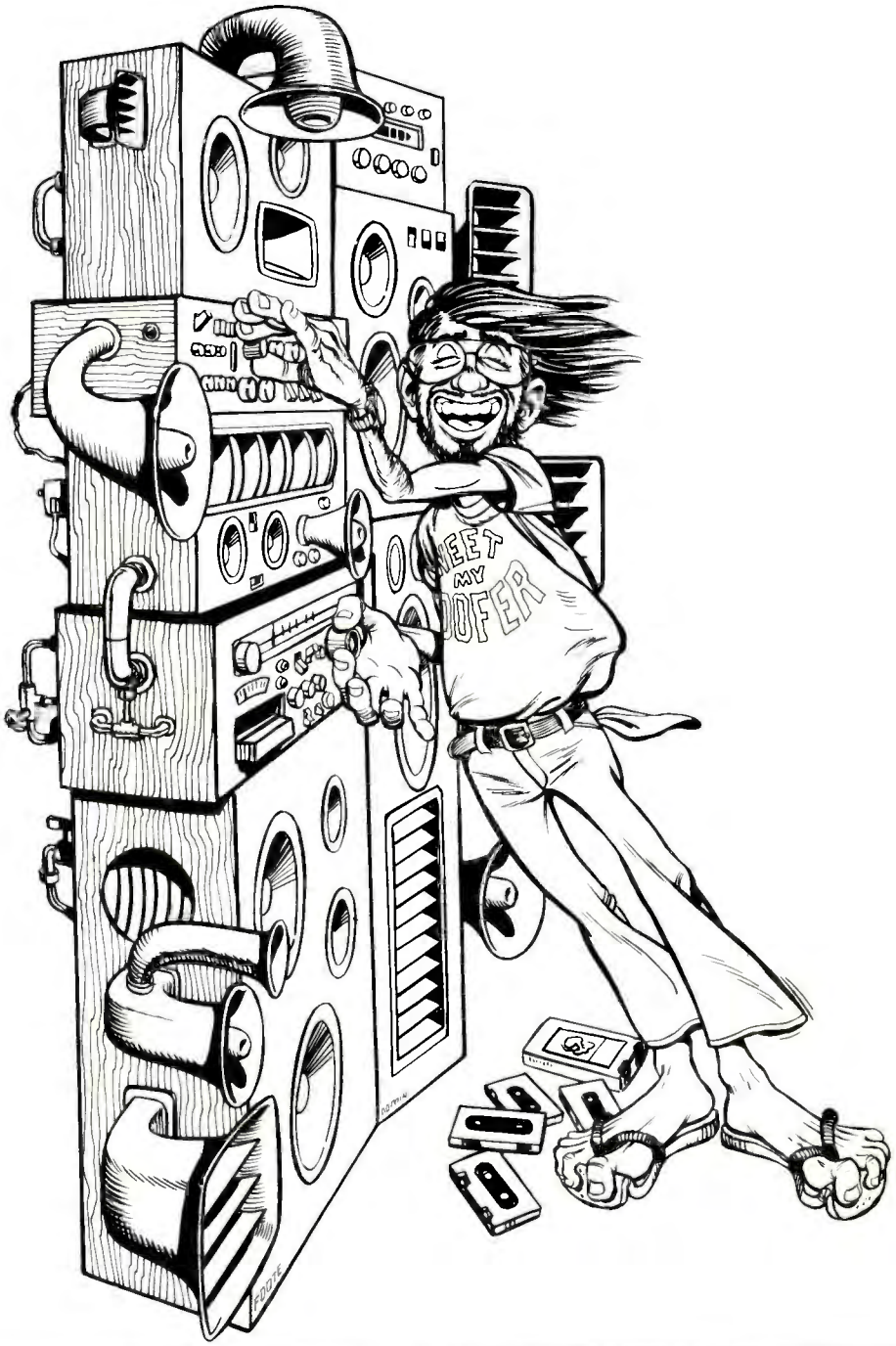
# Adding Extension Speakers To A Stereo System

***Practical installation methods to obtain better sound reproduction and additional listening areas with extra speaker systems.***

**By Norman Eisenberg**




Everyone knows that the normal complement of speaker systems for stereo reproduction is a pair—one for each channel. Furthermore, many stereo system owners have discovered that using additional ("extension") speakers can prove to be both useful and enjoyable. There are, of course, two basic reasons for adding extra speaker systems to a stereo setup. One is to enhance the sound in the same room in which the main speakers are located. The other is to supply stereo sound to another room. The two aims aren't mutually exclusive; you can do both —*if* you go about it properly.

Most of today's stereo receivers and integrated amplifiers have provisions for connecting extra speaker systems and then selecting them or the main pair or both pairs with a front-panel switch. Owners' manuals usually refer to this feature, but just as often provide little or no information on some important conditions involved when extra pairs of speaker systems are added. These considerations include speaker impedances, available power from the amplifier, relative volume, and the gauge and length of the cables used to interconnect speaker systems and amplifier or receiver with which they are used.

## *The Parameters*

For most consumer-grade audio equipment, the standard amplifier output load is 8 ohms. This is the im-

pedance for which the amplifier's output power is stated in the list of technical specifications. It also happens to be the nominal impedance of the vast majority of speaker systems.

Because they're constant-voltage devices, most receivers and amplifiers can supply more than their rated power into loads whose impedances are less than 8 ohms. How much power they can deliver, however, and with how much distortion and into how low impedance the load before the danger point is reached varies considerably from one amplifier to another. Unfortunately, even though this information is frequently of critical importance, rarely do manufacturers include it along with the other technical specifications.

With some professional-grade, heavy-duty amplifiers, you'll see a specification for 4-ohm loads. You might also see a statement to the effect it's safe for the impedance to go as low as 2 ohms. Supplementary information might even give you legitimate power data at these low-impedance speaker loads.

Most user's manuals for typical home stereo amplifiers and receivers are rather vague on this subject. The best I have come across in recent years promises 62.5 watts per channel into 8 ohms and 90 watts per channel into 4 ohms. This manual also cautions the user to connect only 8-ohm or greater speaker systems to the amplifier when using remote speakers. The cautionary note takes pains to specify that both remote *and* main speaker systems must have a minimum of 8-ohms impedance.

More typical, unfortunately, is the manual for many recent receivers and amplifiers that simply states remote speaker systems can be hooked up and selected with a front-panel switch. This is a very idealistic (and unrealistic) view. Things just aren't that simple. If you were to take a statement like this on face value, you could blithely blow your amplifier or speakers or both!

In the real world, very few—if any—things are perfect in design. Speaker systems, particularly, aren't. When a manufacturer specifies his speaker system to have an 8-ohm impedance, this is a *nominal* figure. The speaker system may, indeed, have an 8-ohm impedance—but only at selected frequencies. In fact, the impedance may quite readily drop to 7 or 6 ohms at certain frequencies. This would present no problems for the driving amplifier if only one pair (stereo) were connected to it, since even the most skimpily designed receiver can usually cope with a 4-ohm load. When you connect *two* such pairs of speaker systems in parallel to each of the receiver's outputs, the amplifier section could be in very real trouble. As for using three pairs of speaker systems, forget it!

## Estimating Total Impedance

The following equations can be used to determine *nominal* total impedances ($Z_t$), but don't assume you can blithely combine any number of speaker systems in series-parallel arrangements and hit the mark. In these equations, $Z_1$, $Z_2$, . . . $Z_n$ represent the nominal impedances of the individual speaker systems.

For any number of speaker systems:

$$Z_t = \frac{1}{\frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} + \cdots \frac{1}{Z_n}}$$

For two speaker systems in parallel:

$$Z_t = \frac{Z_1 \times Z_2}{Z_1 + Z_2}$$

For speaker systems in series:

$$Z_t = Z_1 + Z_2 + Z_3 + \cdots Z_n$$

*Fig. 1. Equations for estimating the total speaker impedance presented to the outputs of an amplifier.*

## *Estimating Impedances*

To estimate the total impedance presented to an amplifier (including the amplifier section of a receiver), note the equations in Fig. 1. Bear in mind that these equations represent "best-case" approximations when it comes to speaker systems, since actual impedance when a speaker reproduces music will vary across the audio range, often dipping below the rated nominal value.

If your owner's manual isn't explicit on the safe lower limit of impedance you can apply to the outputs of your amplifier or receiver, try to get the information from the manufacturer. Failing this, play it safe and assume that no impedance of less than 4 ohms total should be used with the amplifier as-is.

Similarly, consider the power available to drive the combination of main and extension speaker systems. You can't assume, for example, that a receiver rated for, say, 80 watts per channel when driving one pair of speaker systems (one per channel) will obligingly pump out double that power so that each of two speaker systems on each channel will be getting 80 watts of power. Things just don't work that way. Except for the most rigorously designed, heavy-duty professional-grade amplifiers, chances are that there will be a drop of at least 3 dB for each added speaker system per channel. Hence, the 80 watts per channel delivered by the amplifier becomes more like 40 watts per channel with respect to each of two speaker systems connected to a given channel.

Keep in mind that the more speaker systems you try to run off the same output channel, the closer you come—in terms of reduced load impedance and increased demand on available power reserves—to the safe operating limit of a given amplifier or receiver. When that limit is reached or exceeded, the amplifier will shut itself down, if you're lucky, or self-destruct, perhaps taking the speaker system with it if no safeguards are built in.

While it's generally safe to make use of the extra speaker outputs on today's receivers and amplifiers, the watchword (unless you can get specific advice to the contrary from the manufacturer) is to use no more than

one extra pair of speaker systems. Like the main pair, the added pair should have an impedance of 8 ohms.

## Going Beyond Two Pair

If you wish to use more than one extra pair of speaker systems, or if your equipment doesn't have a built-in speaker-pair selector, you'll need a separate switching setup. You can make your own speaker switch (see Fig. 2) or buy one already made up from most hi-fi equipment dealers.

Typical of the ready-made speaker-switching accessories on the market today are the Model 30-5006 that handles up to three pairs of stereo speaker systems and Model 30-5002 that handles up to five pairs, both from Audiotex. If you have a separate power amplifier, you can use Adcom's Model GFS-1 switcher (Fig. 3), which handles up to three speaker systems.

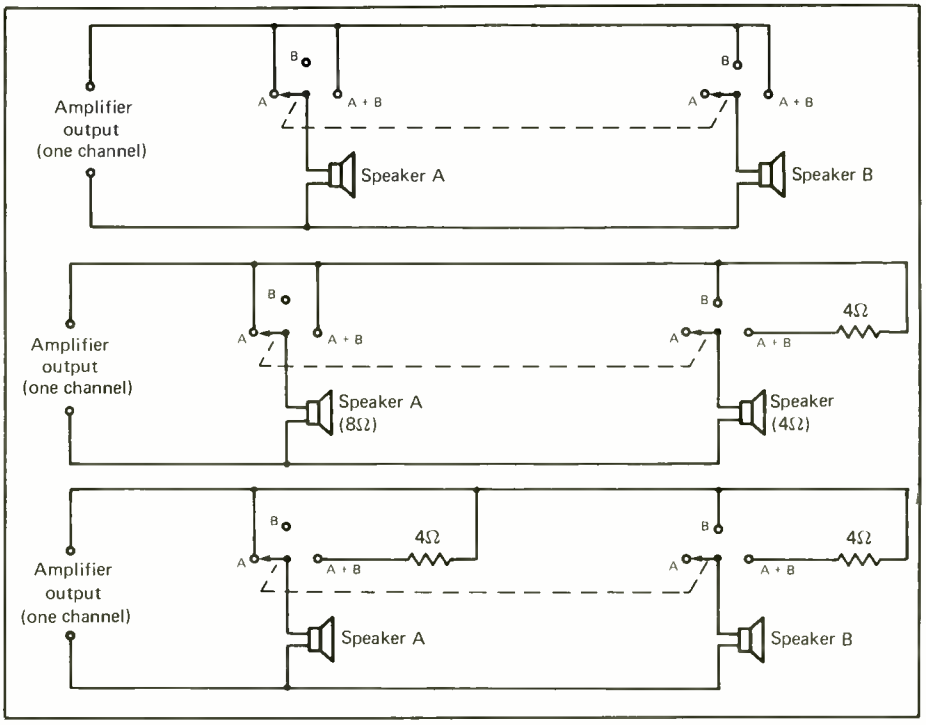



*Fig. 2. You can build your own switching arrangement for selecting either or both speakers connected to the output of an amplifier—for 8-ohm-only systems (top), for mixed 8/4-ohm systems (center), and for 4-ohm-only systems (bottom).*

## Beyond Switching

Using a speaker switching device will effectively handle impedance relationships, but it can't solve the power-drain problem. With regard to power, you must exercise some common sense. For instance, assume you're running three speaker systems from one side of an amplifier and the amplifier itself is rated to deliver 60 watts of power per channel. When all three speaker systems are being used simultaneously, each can get no more than 20 watts. This may be enough to drive the speaker systems adequately for your purposes, but don't expect to hear consistently loud and clear crescendos from all three, or even just one of the three.

With any switching arrangement in which several speaker systems are driven from the same amplifier, you have the additional problem of having to adjust the relative volumes from each speaker. For example, suppose you have set up the added speaker systems to provide a wider stereo spread in the same room in which your main speakers are located. Depending on program material, room acoustics, and the positions of all four speaker systems, it may be necessary to play one or even a pair of the speaker systems louder than the others. The volume control on your receiver or amplifier may be able to serve as a master level control, but it can't be used to adjust the volume of sound emanating from any *one* of the speaker systems.

The solution, of course, is to use an "L pad" (Fig. 4). This is a dual-sectioned volume control that maintains correct impedance match while adjusting the volume of an individual speaker system. L pads are sold by many hi-fi equipment dealers. When you buy one, get the best you can afford, and make sure its impedance is the same as that of the speaker system whose volume it will control. Wiring an L pad into your hi-fi setup is a simple enough procedure. Logically, it should be located fairly close to the speaker system it's to control.

An L pad, of course, can't increase the volume beyond the level set by the master volume control in the amplifier. So it may take some juggling between the settings of the two controls before you can get the balance you want. Remember, too, that when you turn down the L pad to silence an extension speaker system, the control will still be taking power from the line. Hence, even though the one speaker system is muted, the other speakers in the system won't be getting full power.

## Another Approach

The whole switching setup can be avoided if you're willing to use a fancier and costlier type of setup—an additional power amplifier for each pair of added speaker systems. The easiest, though most complex and costly, way to go is with a separate preamplifier and separate power amplifier for the main speaker systems. You can then use the preamp to drive whatever other individual power amp(s) you add to the setup.

If the added power amps have their own input level controls, so much the better. If they don't, you can still use


*Fig. 3. If you prefer a ready-to-install speaker switching box, you can use the Adcom Model GFS-1 shown here or a similar product from another manufacturer.*

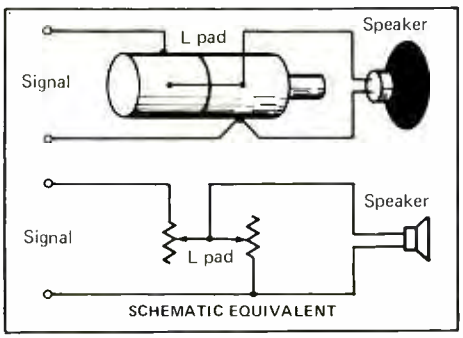



*Fig. 4. To control the volume from extension speakers, you will need an L pad for each speaker you add.*

L pads in the lines that go to the speaker systems connected to them.

Instead of using power amps for the extra speaker systems, you can use integrated amplifiers that *do* have volume controls. This choice offers redundancy that can prove to be a boon in terms of flexibility for elaborate extra speaker system arrangements.

Added amplifiers can be run from a receiver as well as from an integrated amplifier (see Fig. 5). An unused tape monitor jack, or the circuit-interrupt option, can be adapted for feeding signals from the main system into an added amplifier that's driving the extension speakers. The disadvantages of going this route include added equipment complexity and installation space, as well as cost. On the plus side is the fact that this type of setup gives you full control over each speaker system, independently of the others and with optimum relationships of impedance, power, and damping for *all* the speaker systems.

## *Where They're Used*

One of the most popular uses for extension speaker systems is in supplying stereo sound to one or more rooms other than the main listening room. If only one such "remote" setup is planned, the simple use of the existing speakers B outputs on your receiver or amplifier will suffice. Of course, the cautions regarding speaker impedances explained above still apply, and you'll have to insert L pads in the lines feeding the remote speaker systems to be able to control the volume without having to use the control on the amplifier.

If your hi-fi equipment doesn't have provisions for connecting an extra pair of speaker systems to it, you'll have to use one of the switching arrangements described above.

When more than one remote setup is planned, a more elaborate switching arrangement is needed. Probably your best best would be to buy a multiple-speaker switch after discussing your needs with your local audio equipment dealer. It would be better but more costly to introduce an additional amplifier into the system. Under no circumstances should you try to add several remote speaker systems directly to the outputs of a power amplifier by coming up with a series-parallel arrangement that *seems* to present the correct impedance on the basis of arithmetic computation. Many a well-intentioned hi-fi buff has done just this only to have caused very expensive damage to his hi-fi system.

Within the main listening room itself, there are two good reasons for

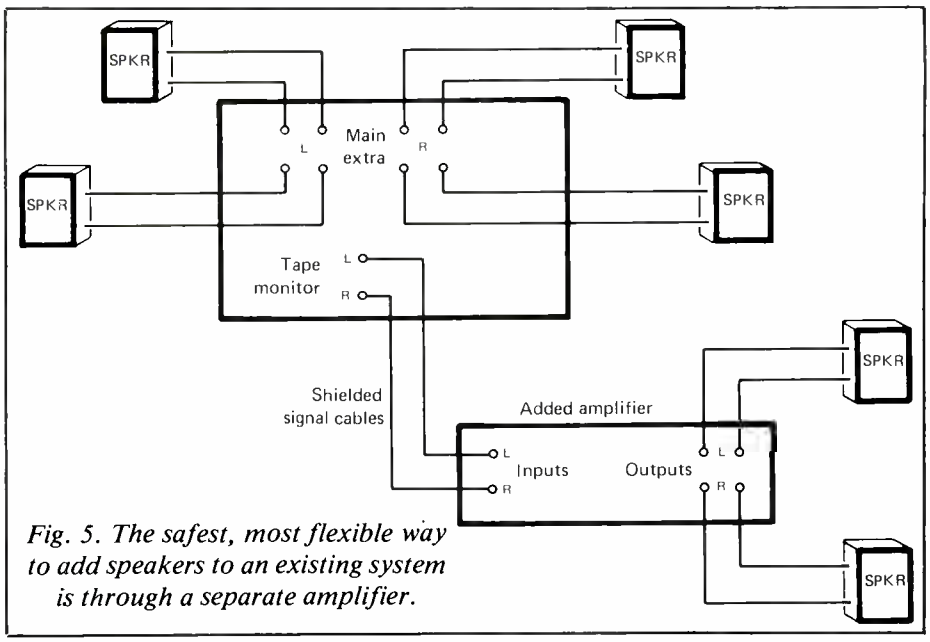



*Fig. 5. The safest, most flexible way to add speakers to an existing system is through a separate amplifier.*

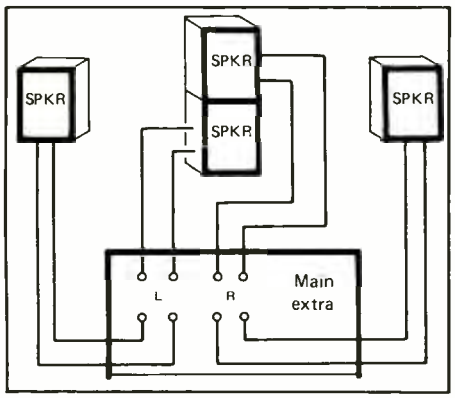



*Fig. 6. To obtain center-channel fill, stack speakers systems as shown here.*

*Fig. 7. In this wire-gauge table, the cable run range in feet is shown between the two lines.*

| Speaker Impedance in ohms | Cable Gauge for cable run in feet | | | |
|---|---|---|---|---|
| | 0-30 ft. | 31-40 | 41-70 | 71-100 |
| 4 | 18 | 16 | 14 | 12 |
| 8 | 18 | 16 | 14 | 14 |
| 16 | 20 | 18 | 16 | 14 |

using additional speaker systems. One is to enhance the stereo effect by using extension speaker systems as "flankers." Positioned along the side walls and flanking the two main speaker systems, the extension speakers can lend a dramatic highlight to large-scale musical works. They create a "big stage" effect that adds a rich ambience to the sound while washing out a lot of system response problems resulting from deficiencies in room acoustics.

Should center filling be the only application you plan for your extension speaker systems, you can probably achieve your goal by using the extra speaker outputs on your present equipment. You'll need L pads to obtain the kind of balance you want, of course. If you want flanking in your main listening room *and* remote listening in another room, you'll have to plan on using an accessory speaker switcher or get an additional driving amplifier.

A need for speaker flankers is indicated, in most instances, for installations in which the main speaker systems are relatively close together or are fairly directional in their dispersion pattern. At the opposite extreme is the situation where the main speaker systems are too far apart and don't provide a consistently solid center image or aural focus. What results from a situation like this is a "hole" in the middle of the stereo spread.

The hole-in-the-middle problem can be effectively dealt with by using a center-fill speaker system that provides A-plus-B (left-plus-right) channel signal. Center filling makes the stereo presentation more substantial or solid by providing a "wall of sound" effect. Again, musical perception is improved, and many problems of otherwise poor room acoustics are solved.

The concept of a center-fill speaker that handles an A-plus-B (monophonic) signal suggests the use of just one speaker system to do the job. Don't become a victim of this logic! Hanging a single speaker system onto the outputs of a solid-state amplifier can be tricky at best and downright dangerous at worst. Because a common ground may be involved in the two channels in solid-state amplifiers, manufacturers do not recommend bridging the channels with a speaker system.

Ruling out a single speaker system, you can obtain a perfectly workable A-plus-B fill by using two speaker systems. Simply stack one atop the other and plant the pair in the same location in which you'd put a single speaker system (see Fig. 6). Each speaker system in the stacked pair gets its own left or right channel signal from the left and right outputs of the amplifier or receiver. But since the two signals are so closely coupled physically, they form an acoustic mix that is perceived as a monophonic source containing the signal in channel A plus that in channel B.

As with all the other varieties of added speaker system hookups, the center-fill arrangement can be driven directly from the extra speaker outputs on your present stereo equipment. Alternatively, the speaker systems can be driven by their own separate amplifier driven from the tape-monitor or preamp output on the main amplifier. Again, use L pads for controlling the volume of the added speaker systems.

## A Final Consideration

When adding extension speaker systems, you must consider the thickness (gauge) of the cables delivering power to them from your amplifier. This is particularly important for installations where the add-on systems are far removed from the driving amplifier. Cables that aren't thick enough can reduce total power delivered to the speaker systems, resulting in a loss in listening volume.

In figuring the gauge to use for your cables, it's important that you take into account the *actual* cable lengths you'll be using. This is the actual length in feet, measured from the amplifier's output, routed along baseboards and doorways, and dressed around cabinets, etc., to the speaker systems. As a general rule of thumb, the longer the cable runs, the larger the thickness of cable needed.

Specific lengths of cable runs vary somewhat from one speaker manufacturer to another. The best advice is to follow the recommendations supplied with the speaker systems you purchase. If none are given, and you can't obtain them from the manufacturer, use the table in Fig. 7 to determine what you should use. This table errs slightly on the side of caution, but you won't go wrong by using a thicker (lower gauge number) cable than might nominally be required. **ME**