

FUSING AR SPEAKER SYSTEMS

All AR speaker systems can handle easily the output power of any amplifier while playing music in a normal home listening situation and within the limits specified in the chart at the end of this sheet. There are abnormal conditions, however, under which your speakers may receive far more average power than they can tolerate. A few such situations may occur:

1. When an amplifier of greater output capability than the maximum stated for your particular speaker is used.
2. When the system is subjected to frequency response testing.
3. If your amplifier develops a defect.
4. If your tape deck or recorder generates large amounts of ultrasonic power when in the fast forward or rewind modes.
5. When you exceed the output power capability of the amplifier so that it clips and distorts excessively.
6. When the loudspeakers are used in a discotheque application in which the demands for overall volume levels far exceed normal home listening.
7. When you feed the loudspeakers waveforms from a synthesizer at very high levels, or any other waveform whose average level is much greater than that of music waveforms.

If you wish to protect your speakers from thermal overload due to most abnormal inputs, the fuses we recommend are Buss Fusetron Dual Element type:

FNM-2 for the AR-11 and LST
FNM- $\frac{6}{10}$ for the AR-10π, AR-12 and LST-2
FNM- $\frac{1}{4}$ for the AR-14, AR-15, AR-16, AR-17, AR-18, AR-3a and AR-3a Imp.
FNM- $\frac{8}{10}$ for the AR-1x, AR-3 and AR-5
FNM- $\frac{6}{10}$ for the AR-2x, AR-2a, AR-2ax, AR-4, AR-4x, AR-4xa, AR-6, AR-7 and AR-8

These fuses will permit the following power levels to be fed into the speakers without blowing of the fuse.

FNM-2 (calculated on the basis of a 4-ohm nominal speaker impedance):
25 watts long-term average
64 watts for 30 seconds
180 watts for 10 seconds

FNM- $\frac{6}{10}$ (calculated on the basis of an 8-ohm nominal speaker impedance):
33.5 watts long-term average
72 watts for 30 seconds
185 watts for 10 seconds

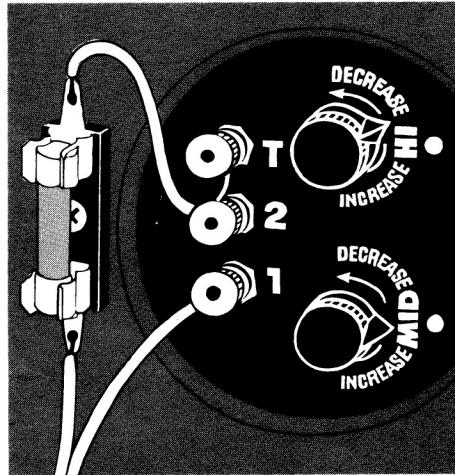
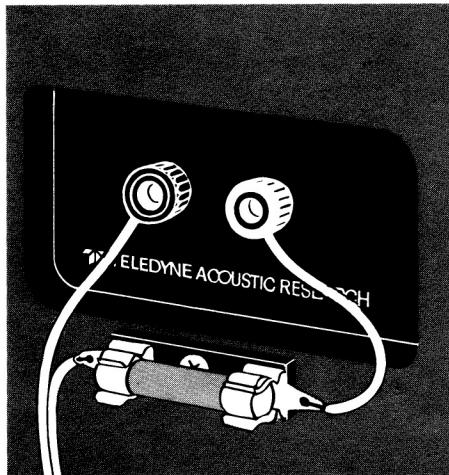
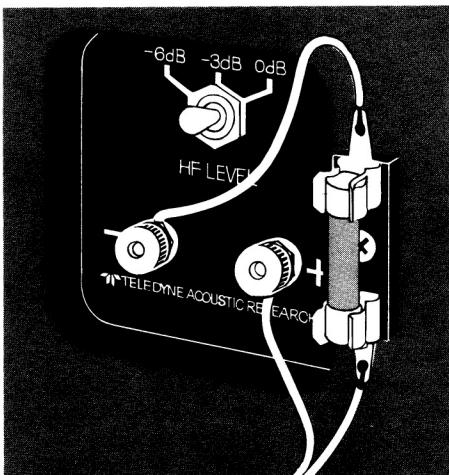
FNM- $\frac{1}{4}$ (calculated on the basis of an 8-ohm nominal speaker impedance):
19 watts long-term average
46 watts for 30 seconds
128 watts for 10 seconds
(calculated on the basis of a 4-ohm nominal speaker impedance):

10 watts long-term average
23 watts for 30 seconds
67 watts for 10 seconds

FNM- $\frac{8}{10}$ (calculated on the basis of an 8-ohm nominal speaker impedance):
9 watts long-term average
20 watts for 30 seconds
55 watts for 10 seconds
(calculated on the basis of a 4-ohm nominal speaker impedance):
4.5 watts long-term average
10 watts for 30 seconds
27 watts for 10 seconds

FNM- $\frac{6}{10}$ (calculated on the basis of an 8-ohm nominal impedance):
5.5 watts long-term average
12.5 watts for 30 seconds
29 watts for 10 seconds

NOTE: Although when using some of the recommended fuses with certain speakers it appears that the long-term average power able to be delivered to the speaker is rather limited, it should be borne in mind that power peaks during music reproduction, fed to loudspeaker through the fuse, last only a very short period of time—considerably less than a second. During playback of a good recording and when the amplifier is not "clipping", for example, the AR-7 with the recommended FNM- $\frac{6}{10}$ fuse can be fed peaks greater than 1500 watts and which have a duration of only $\frac{1}{10}$ second.



To operate properly these types of fuses must be mounted in an open fuse holder, not a cartridge-type fuse holder. Specifically, we recommend the Buss Fusetron type number 4421 which should be connected in series with one of the leads from the amplifier (see sketches for a typical hookup). The fuse holder may be attached permanently to the rear panel of the loudspeaker enclosure with a $\frac{3}{4}$ inch, flat-head, #8 wood screw. It is advisable to drill a pilot hole for the screw before mounting or at least make a screw-starting hole with an awl or heavy nail.

NOTE: The LST, LST-2 and early versions of the AR-10 π and AR-11 were supplied with a fuse holder permanently mounted on their input terminal plates. These fuse holders, and their fuses (listed above) were an integral part of the crossover design and are sufficient to afford those loudspeakers all the protection possible. Therefore, no additional fuse holder and fuse is required, recommended or is to be connected in series with the speaker input terminals.

If you do not wish to mar any of the surfaces on the speaker (particularly the finished-veneer rear panel of the 10 π), or if placement of the speaker on a shelf or against the wall makes it impractical or impossible to mount the fuse holder on the speaker back panel, you may mount it on the shelf or surface directly behind the amplifier or receiver. Make sure, if you decide to mount the fuse holder behind the amplifier, that it is screwed down to prevent accidental shorting of the fuse holder's terminals to the

amplifier or receiver chassis. Don't let the fuse holders lie loose behind the amplifier or receiver where, at some time, they may short to each other or to a metal part of the amplifier or receiver. Any such short, depending on the specific connections made to the fuse holder, can cause an amplifier malfunction and/or permanent damage to its output stages.

NOTE: Under no circumstances make an attempt to mount the fuse holder with a screw or other device on the input terminal plate recessed into the rear panel of the speaker enclosure. There are crossover components mounted on the inside of the input terminal plate which may be punctured by a screw tip or similar device. In addition, the material from which the input terminal plate is manufactured will not hold firmly a screw or fuse holder. The result, in such case, will be that the seal of the enclosure will be compromised.

Should any of the fuses recommended above blow frequently, interrupting operation of one or both speakers, the indication would generally be that the power output capability of the amplifier is being exceeded or that one or more parts of the system is not operating properly.

Please note that there is no fuse which can safeguard a loudspeaker from every type of overload. Even the specialized fuses recommended will not protect the speakers from short-term, very-high-peak-power inputs. It will not protect the woofer, for example, if the system is plugged into an AC wall outlet. Nor will it prevent speaker damage if your amplifier feeds a large

amplitude "thump" to the speaker during turn on or turn off. Also, it will not safeguard the speaker from damage if you drop the stylus onto a record with the volume control advanced substantially when you are using a very-high-power amplifier.

NOTE: It should be pointed out here that cumulative damage may be caused to a speaker if very frequent and continual blowing of the recommended fuses is experienced. This would be the case if the amplifier were clipping excessively and causing the fuses to blow. When demands for higher levels than an amplifier is capable are made, the amplifier saturates or "clips"—a condition which causes the generation in the amplifier of a large number of harmonics not related to, nor present in, the original music material. The harmonics, depending on the frequency at which clipping occurs, cause the amplifier to deliver most of its output in the midrange and treble. Since the design of good midrange and highrange drivers requires a light voice coil and small diaphragm, these drivers are unable to dissipate the large amounts of power fed to them under these conditions and will eventually fail. Damage can be caused even by a modest-power-output amplifier since all or most of its power will be delivered into the mid- and highrange under these circumstances. In fact, more-modest-power amplifiers are the most likely to cause this type of damage since they are most likely to clip or distort during high-level music passages.

Since the speaker fuses and fuse holders we recommend may not be available locally, you may purchase them directly from AR at nominal cost. For your convenience we are listing all fuse sets and fuse holder/fuse sets available through the AR Customer Service Department and their costs. Please note these prices are over-the-counter prices at the AR Customer Service Department in Norwood, Massachusetts and do not include shipping costs. Because of recent increases in packing material and shipping expenses, Acoustic Research is forced to charge **\$2.50 per parts order** in addition to the cost

of the fuse sets ordered.

Please order fuse holder/fuse sets and fuse sets using the correct letter code and include prepayment with your order for both the fuse holder/fuse set, or fuse set, and the packing and shipping charge. For your convenience and in order to expedite processing of your order please fill out the attached Parts Order Form with your name, address and zip code, the quantity of sets you require, the description (fuse set or fuse holder/fuse set), the Part Number (Set A, Set B, etc.) and the cost of the parts. Be sure to include the \$2.50 packing material and shipping charge.

Amplifier clipping is a highly undesirable condition since not only does it distort the signal (from slight, barely audible distortion to great, depending on the amplifier and its recovery characteristics) but it feeds almost all its power into the midrange and high-range of the speaker. This situation is radically different from that encountered while playing music material in which most of the amplifier power is directed into the woofer and lower midrange.

When using very-high-powered amplifiers and especially when bass boost or the "loudness" control is used, it is imperative that your record player's rumble be minimal and that its suspension isolate it well from its environment, particularly the surface on which it rests. Low frequency noise (turntable rumble or "thumps" resulting from tonearm oscillation and caused by record warps, eccentricity or walking near the turntable) and/or acoustic feedback, even when subsonic, must be kept to a minimum. Otherwise, the woofer cone will tend to make excessively large excursions in its magnetic gap. As a result, the response at low frequencies will become intermittently nonlinear, causing muddy or ill-defined music reproduction, and distortion may be audible during high level passages if they also include low frequency components. In severe instances, when excessive rumble and thumps are over-emphasized by large bass boosts, "bottoming" of the woofer cone, identifiable by a sharp "crack" from the speaker, may be experienced with subsequent rubbing of the voice coil in the gap. Please note that such damage is **not** covered by the Warranty.

Whenever any form of distortion is heard, generally one or more of the system components is being operated well beyond its capability and the overall demand for sound level should be reduced if damage to some part of the system is to be avoided.

With these factors as reference, estimates of power requirements for your individual application can be easily determined if you consider that power requirements rise and fall with the desired ultimate acoustic pressure levels, with the volume of the room, and with the amount of acoustically absorbent material in the room. For

Set A:	Two fuse holders (4421) and four FNM-6/10 fuses (two spares)	\$6.50
Set B:	Two fuse holders (4421) and four FNM-8/10 fuses (two spares)	\$6.50
Set C:	Four FNM-6/10 fuses (two spares)	\$5.00
Set D:	Four FNM-8/10 fuses (two spares)	\$5.00
Set E:	Two fuse holders (4421) and four FNM-1 1/4 fuses (two spares)	\$6.50
Set F:	Four FNM-1 1/4 fuses (two spares)	\$5.00
Set G:	Four FNM-2 fuses (two spares)	\$5.50
Set H:	Two fuse holders (4421) and four FNM-2 fuses (two spares)	\$7.50
Set J:	Two fuse holders (4421) and four FNM-1 6/10 fuses (two spares)	\$7.50
Set K:	Four FNM-1 6/10 fuses (two spares)	\$5.50

AMPLIFIER RECOMMENDATIONS AND POWER HANDLING

It should be stated clearly, that it is impossible for anyone to make a simple yet accurate statement of the power handling capability of any loudspeaker unless the conditions (as is the case with the DIN spec) are accurately defined and verifiable. No accurate power handling specification can be made unless the spectrum and its density are known and the phase angle of the voltage and current as well as impedance versus frequency are carefully monitored and stated. Such measurements are generally well beyond the capability of most service labs' equipment. As a result, only very general statements can be made concerning speaker power handling since the musical material played through loudspeakers and their spectral densities vary in almost astronomic numbers.

All the AR loudspeaker brochures have traditionally stated minimum

power requirements. While all such data given are the minimum recommendations for average program material in a normal home environment, there are certain other situations and types of program material which will require much greater amplifier output capability. (Since present day recordings can have a dynamic range or peak levels approximately 10 to 15 times that of the average power being delivered to the speakers, a suitable amplifier with adequate reserve power should be selected if uncomplicated reproduction of dynamics is desired and frequent amplifier clipping is to be avoided.)

Amplifier clipping, or saturation, is a phenomenon which occurs when an amplifier is called upon to deliver more power to the loudspeakers than its output circuit or power supply can deliver. When viewed on an oscilloscope, the waveform peaks look as if clipped by scissors, hence the name.

each 3 dB increase in required acoustic pressure level, the amplifier power must be doubled. Also, a corresponding doubling of amplifier power is required if room volume is doubled and a 3 dB decrease in listening level is to be avoided. The quantitative effect of absorbent materials cannot be defined as easily. Because their effect is frequency selective and because most absorbent materials are effective mainly in the upper regions of the audio spectrum in which music power density is not at maximum, the presence of such materials may require careful setting of tone controls and speaker controls but, in general, will not require an increase in amplifier power.

All AR loudspeakers are designed to operate optimally with an amplifier or receiver having a damping factor (DF) of 10 or higher. All other things being equal, very high damping factors will not in any way affect the low frequency performance of the speaker system.

Acoustic Research speakers are designed to reproduce all types of music. However, they cannot generate constant deafening volume levels associated with discotheques without damage being sustained eventually by some component in the system. Damage caused by such demands is **not**

covered by warranties and if these very-high-playback levels are desired or required, it is suggested that multiple speakers be used on each channel via parallel or series-parallel configurations.

The preceding incidentally is true of any wide-range, low-distortion high-fidelity loudspeaker made for home use. Interestingly, such volume levels can be achieved in the home only by driving home-type receivers and amplifiers into clipping and overload almost constantly and exceeding their proper operation points. It should be pointed out that speakers used during rock concerts and in discotheques are custom designed, highly specialized speakers used specifically for sound reinforcement only and almost always used in large multiples.

NOTE: *As is the case with loudspeakers designed for home music reproduction, AR loudspeakers should not be fed sine waves, or other test waveforms from a generator, test record or other sources at high level or for prolonged periods of time. Test signal inputs should never exceed 6 volts RMS (a very moderate listening level) or a duration of three minutes. To exceed this recommendation will result in thermal overload of the voice coils which can cause damage to the speaker **not** covered by the Warranty.*

The power-handling capability of all AR loudspeakers are as follows:

The AR-1x, AR-2x, AR-2a, AR-2ax, AR-3, AR-3a, AR-3a Imp., AR-4, AR-4x, AR-4xa, AR-5, AR-6 and AR-7 may be used with amplifiers capable of delivering up to 100 watts continuous power per channel being driven to clipping **less** than 10% of the time, on normal music source material.

The AR-14, AR-15, AR-16, AR-17, and AR-18 may be used with amplifiers capable of delivering up to 100 watts continuous power per channel being driven to clipping 10% of the time, on normal music source material.

The AR-10 π , AR-11, AR-12, LST and LST-2 may be used with amplifiers capable of delivering up to 150 continuous watts per channel being driven to clipping 10% of the time, on normal music source material.

NOTE: *It is permissible to deliver to all the speakers above peaks equivalent to double the maximum power stated so long as their duration does not exceed 2 milliseconds and are not the result of amplifier clipping.*



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